AKD™

User Guide

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Valid for Hardware Revision C

Patents Pending

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RoHS conform 2002/95/EC

Keep all manuals as a product component during the life span of the product.
Pass all manuals to future users/owners of the product.

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Record of Document Revisions:

Revision	Remarks
6/2010	Combined User Guide and Parameter and Command Reference Guide (released in Work-Bench only).
9/2010	Combined User Guide, CANopen, and EtherCAT manuals. Updated for Release 1.3.
11/2010, Rev A	Usability improvements, minor topic edits.
12/2010, Rev B	Document part number update.
05/2011, Rev C	Updated for release 1.4. Added Modbus, modulo, new homing modes, registration moves, W&S improved, new parameters, PLS enhanced, velocity unit changes, motion tasking revisions, switch bounce conditioning (DINx.FILTER), linear motor parameters.
10/2011, Rev D	Updated for release 1.5. Added Configuring with Linear Motors section. New parameters for EIP, DRV, MODBUS, VM, DIO, IP, FB3, IL, FB2, AIN. Improved description of rotary switch use, modbus scaling, homing.

Hardware Revision (HR)

Hardware Revision	Recommended Firmware	Minimum Firmware	Recommended Workbench	Minimum Workbench	Remarks
A	M_01-05-00-000	M_01-01-00-001	1.5.0.xxxxx	1.1.0.xxxxx	Initial Revision
C	M_01-05-00-000	M_01-03-00-011	1.5.0.xxxxx	1.3.0.xxxxx	STO certified

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Current patents:

US Patent 5,646,496 (used in control card R/D and 1 Vp-p feedback interface)

US Patent 5,162,798 (used in control card R/D)

US Patent 6,118,241 (used in control card simple dynamic braking)

Technical changes which improve the performance of the device may be made without prior notice.

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Table of Contents

1 About the AKD User Guide

1.1 About this User Guide

This guide describes the operation and use of the AKD drive. Each section details a specific topic related to the use of the product in basic terms which will help you get the most from the product. Each section include examples to help guide you in setting up and use the various features available in the drive.

This guide is for users who have installed and tested the drive according to the *AKD Installation Manual*. The *AKD Installation Manual* is included on the product CD and contains critical safety information.

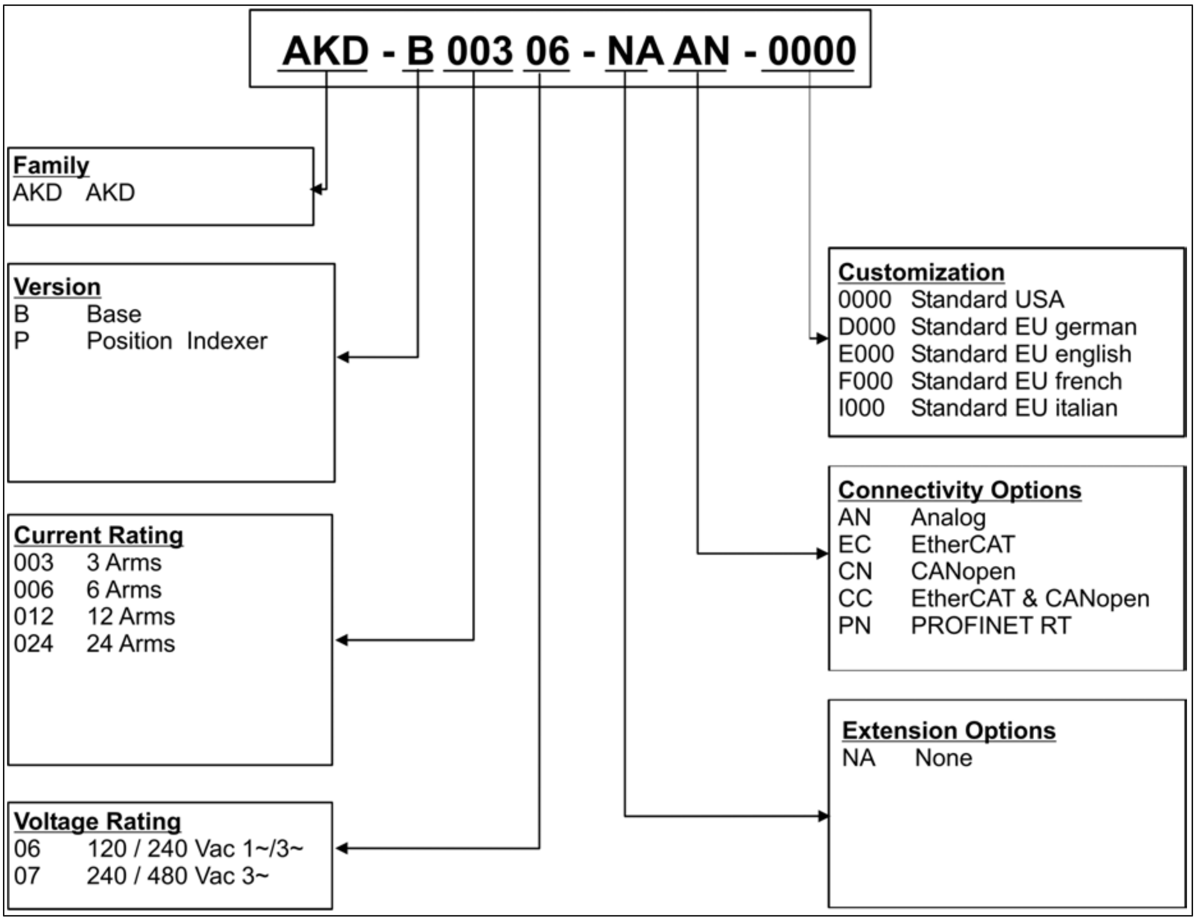
1.2 Abbreviations

Abbreviation	Meaning
AGND	Analog ground
CE	Communité Européenne
COM	Serial interface for a personal computer
DCOMx	Communication line for digital inputs (with x=7 or 8)
Disk	Magnetic storage (diskette, hard disk)
EEPROM	Electrically erasable programmable memory
EMC	Electromagnetic compatibility
F-SMA	Fiber optic cable connector according to IEC 60874-2
LED	Light-emitting diode
LSB	Low significant byte (or bit)
MSB	Main significant byte (or bit)
NI	Zero pulse
PC	Personal computer
PE	Protective earth
PLC	Programmable logic control
PLL	Phase locked loop
PLS	Programmable limit switch
PWM	Pulse-width modulation
RAM	Random access memory (volatile memory)
R_{Brake}/R_B	regen resistor (also called a regen resistor)
RBext	External regen resistor
RBint	Internal regen resistor
RCD	Residual current device
RES	Resolver
ROD	Incremental encoder (A quad B)
S1	Continuous operation
STO	Safe torque off
Vac	Volts, alternating current
Vdc	Volts, direct current

2 AKD Models

AKD drive models are available in a variety of combinations of features. The part number identifies the features included in your model.

The figure below shows part number identification for drive features:



The customization code includes language version of printed material for European countries:

- D000 for German
- E000 for English
- F000 for French
- I000 for Italian

2.1 CC Drive Models

CC drive models allow you to select between EtherCAT, CANopen, or analog operation. This drive model is identified with a new model number of the form AKD-Pxxxxx-NACC-0000 (the CC is the unique identifier).

The CC drive model is fitted with both the EtherCAT (X5 and X6) and CANopen (X12 and X13) fieldbus connectors and a new software parameter (DRV.TYPE) allows you to select which features the drive supports; you cannot use EtherCAT and CANopen at the same time.

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3 Basic Drive Setup

3.1 Basic Drive Setup

The AKD Quick Start Guide provides details for basic drive setup. Basic drive setup consists of the following general steps:

Hardware Installation:

1. Install the drive in on your conductive panel and connect the Protective Earth ground.
2. Connect the logic power you will need to operate all of the control logic to X1.
3. Connect the motor power to X2.
4. Connect the feedback to X10.
5. Connect the inputs and outputs you will be using on X7 and X8.
6. Bring AC power to the unit and connect AC power to X3 or X4.
7. Connect drive communications to X11.
8. Confirm that you can communicate with the drive and that your PC is linked to the AKD.

Software Installation and Drive Communication Setup:

1. Install and start the interface software (WorkBench).
2. Set the drive IP address using the S1 and S2 switches.
3. Configure the drive using the **Setup Wizard**.

WorkBench System Requirements

Required Components: Microsoft .NET Framework 2.0

Supported Operating Systems:

- Windows XP
- Windows Vista
- Windows 7

3.2 Display Codes

During drive operation, the drive display shows the following codes, depending on the drive status.

Display Code	Status
o0	Normal operation, current mode, no faults
o1	Normal operation, velocity mode, no faults
o2	Normal operation, position mode, no faults
F [3 digit code, flashing]	Fault (see Fault and Warning Messages)
n [3 digit code, flashing]	Warning (see Fault and Warning Messages)
I,P [IP address]	Displaying drive IP address
[.]	Drive enabled
[.] (flashing)	Drive in an internal dynamic brake mode (36.2 DRV.ACTIVE = 3).
d2	Firmware download: corrupted operational FPGA; resident FPGA is functional.
d3	Firmware download: HW download (HW switch was pressed - Rev 3 and higher).
d4	Firmware download: Corrupted operational FW.
d5	Firmware download: SW download (download command was issued from the operational FW).
dL	Loading image process is running.
dF (flashing)	Failure during firmware download.
Sb	Special mode: Burn-in

3.3 AKD Setup Wizard

The Setup Wizard contains step by step instructions for configuring a drive for the first time and generating a simple test motion. You can access the Setup Wizard from the AKD Overview screen or by right clicking on the drive name.

The Setup Wizard is useful when you first set up your system. The wizard confirms your connection with the drive and then leads you through a series of steps to quickly get your drive up and running. With plug and play feedback devices, several steps are skipped (feedback, brake) because the drive automatically configures these settings. For all systems, you can select the units you want to use, configure your operation mode, tune the system, and perform some simple jog moves within the wizard. After you are comfortable with the basic system setup, you can save your settings to the drive and exit the wizard.

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4 Connecting the Drive

4.1 Connected and Disconnected States

WorkBench always starts disconnected from any drives. The **Disconnected** view opens when you start WorkBench and offers two choices:

- **Connect**: Opens the **Connect to a Drive** view.
- **Delete**: Opens a list of available drives and allows you to delete a drive from WorkBench.

While WorkBench is trying to establish communications with the drive, WorkBench is in the connecting state. Normally, WorkBench will be in the connecting state for a few moments before the connection is established. If WorkBench cannot establish communications correctly, then a five second timeout occurs and WorkBench returns to the disconnected state.

4.2 Disconnected

When WorkBench is disconnected from a drive, no communication exists between your PC and the drive.

The drive becomes disconnected because of one of the following conditions:

- When WorkBench starts it remembers which drives you were using previously but it does not initially connect to these drives.
- If WorkBench detects that it can no longer communicate with the drive, it will automatically go to this disconnected state. Common causes include a network cable being disconnected or the drive being turned off.
- You pressed the disconnect command.

To restore communication:

1. Clicking Connect will start communication with the drive. If WorkBench cannot find the drive, it will immediately return to the disconnected state.
2. Pressing select will show a window where you can select a different drive you would like to use.
3. Pressing delete will remove this drive from the navigation tree on the left hand side of the main window.

4.3 Setting the IP Address

4.3.1 Setting the IP Address with Rotary Switches

You can use the rotary switches to set the IP address of the AKD. For CANopen and some other fieldbuses, the rotary switches also set the node address of the drive for that specific network.

Rotary Switch Setting	Drive IP Address
00	DHCP/AutoIP address. The IP address of the drive is obtained from the DHCP server on your network. If no DHCP server is found the IP addresses is an AutoIP address (it is internally generated following the AutoIP protocol and will be of the form 169.254.xx.xx).
01 to 99	Static IP Address. The IP address is 192.168.0.nn, where nn is the number from the rotary switch. This setting generates addresses in a range from 192.168.0.**2** to 192.168.0.**99**. Example:if S1 is set to 0 and S2 is set to 5 – the IP address is 192.168.0.5
NOTE	**The PC subnet mask must be set to 255.255.255.0 or 255.255.255.128**
NOTE	When connecting the AKD directly to a PC, use static IP addressing (not 00).

Dynamic IP addressing (DHCP and Auto-IP)

With S1 and S2 both set to 0, the drive is in DHCP mode. The drive will acquire its IP address from an external DHCP server if present in the network. If a DHCP server is not present, the drive will assume an Automatic Private IP Address of the form 169.254.x.x.

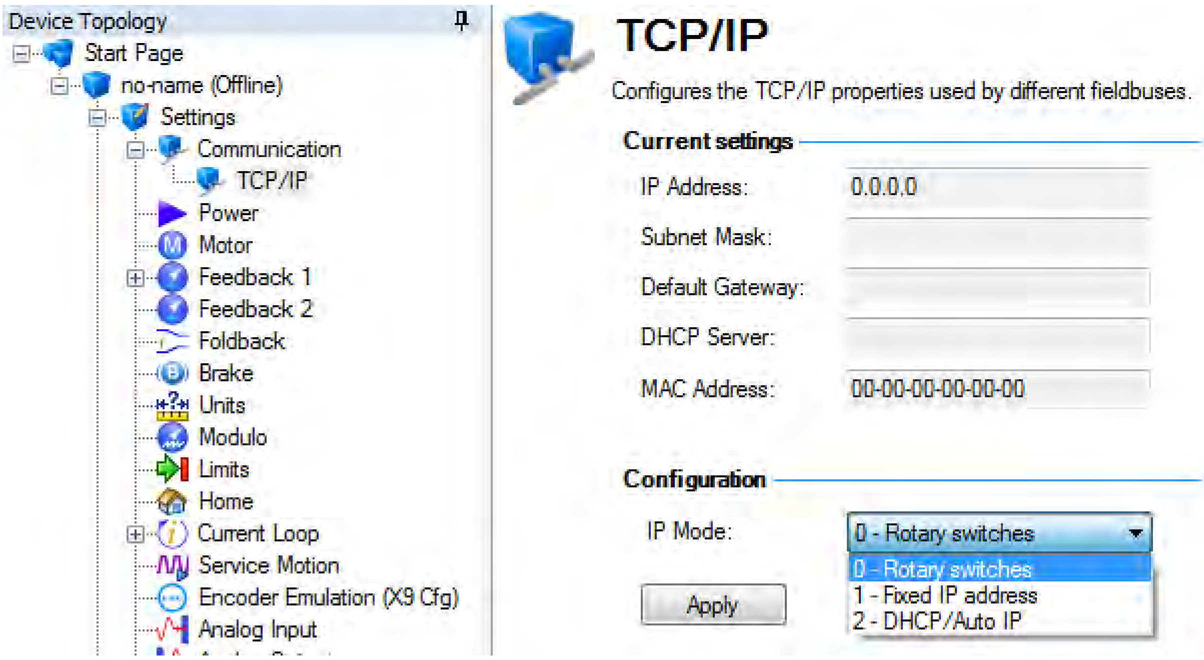
If your PC is directly connected to the drive, and set to obtain an IP address automatically in the TCP/IP settings, a connection will be established with both devices using compatible automatic generated addresses. It can take up to 57 seconds for a PC to configure an Automatic Private IP Address (169.254.x.x).

Changing the IP address

If the switches are altered while 24 V Logic power is supplied to the drive, you must unplug the network cable from the drive for 3 seconds or more. This action will reset the address.

4.3.2 Setting IP address with Software

In WorkBench, under Settings > Communication > TCP/IP, the configuration of the IP address can be changed for greater network and fieldbus flexibility. By default, the rotary switch method described above is recommended for simplicity.



There are three modes under IP Mode on the TCP/IP screen by which the IP address can be set.

Mode 0

Rotary Switches (default)

Mode 1

Fixed IP address (insert fixed TCPIP). Use this mode to set a fixed IP address for the drive which is independent of the rotary switches. This is common with Modbus TCP or Ethernet/IP applications.

Mode 2

DHCP/IP independent of the rotary switches. This is the same behavior as switch setting "00" in Mode 0, however it allows the user to still use the rotary switch settings. For example, CANopen node address is dependant on these switch settings, but the user can now use DHCP/AUtoIP for the IP address setting.

4.3.3 Recoverying Communications with a Drive on an Un-Reachable IP Address

Sometimes a drive may be configured for an IP Address, and the drive needs to be taken off-line, and bench tested, or otherwise used outside of its saved IP Settings.

If IP.MODE has been set to 1 (using software defined static IP) the drive will boot up on an IP Address that may be unreachable with the host computer's settings.

If the IP address prevents communication the IP settings can be reset to default by the following procedure:

1. Set both rotary switches to 0
2. Hold down button B1 (top-side of drive) for 5 seconds.

The display will flash 0.0.0.0 and then attempt to discover an address by DHCP.

Without removing logic power from the drive, use Workbench to connect to the drive, reconfigure the IP address settings as desired, and store the values to non-volatile memory.

4.4 Device Not Shown

If your specific drive is not shown in the list, then WorkBench has not been able to find the drive.

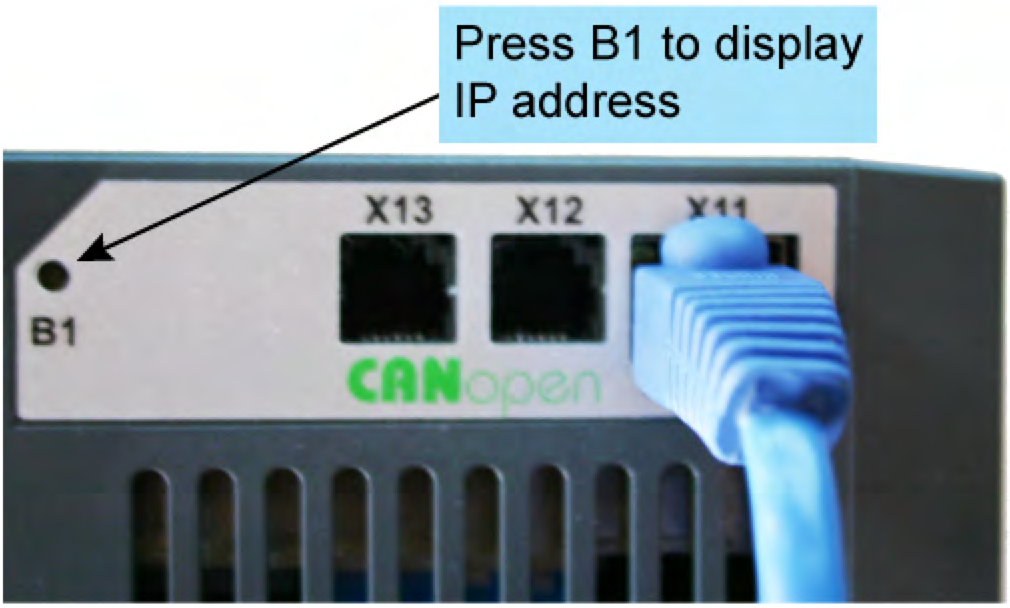
Common reasons why your drive is not shown in the list include the following:

- The drive is not powered on.
- One of the network cables between your PC and the drive are not connected correctly. You can check if the cable is connected to the drive by checking that the link LED on the Ethernet connector is on continuously. If your PC has a link LED, then you should check that this LED is also continuously lit (usually, this LED is next the RJ45 socket on your PC).
- A router on the network between your PC and the drive is blocking the drive discovery messages. Make sure that port 5002 is not blocked by any routers or firewalls. You can enter the IP address of your drive directly into WorkBench if a router or firewall is blocking port 5002. Often, firewalls are the cause of a blocked connection.
- Your PC and the drive are on different subnets. Networks, especially those with many devices on them, are split up into multiple subnets. The discovery protocol used to find drives will only work if your PC and the drive are both on the same subnet .You can enter the IP address of the drive directly into WorkBench if this is the case.
- The network mask defines more than 512 possible addresses. In this case, WorkBench will not ping all of these addresses, so you must unblock discover ports or specify directly the IP address of your drive. When an adapter has such a network mask, its background will be shown as yellow to warn that this network will not be discovered with all discover protocols.

4.5 Find and Enter IP Address

You can view the drive IP address on the drive display by pressing the button shown below. The display shows the digits of the IP address in sequence, with dots separating the numbers. You should see four numbers separated by three dots, for example, 192.168.1.5.

You can enter the IP address if you press **More** and check the **Specify Address** box.



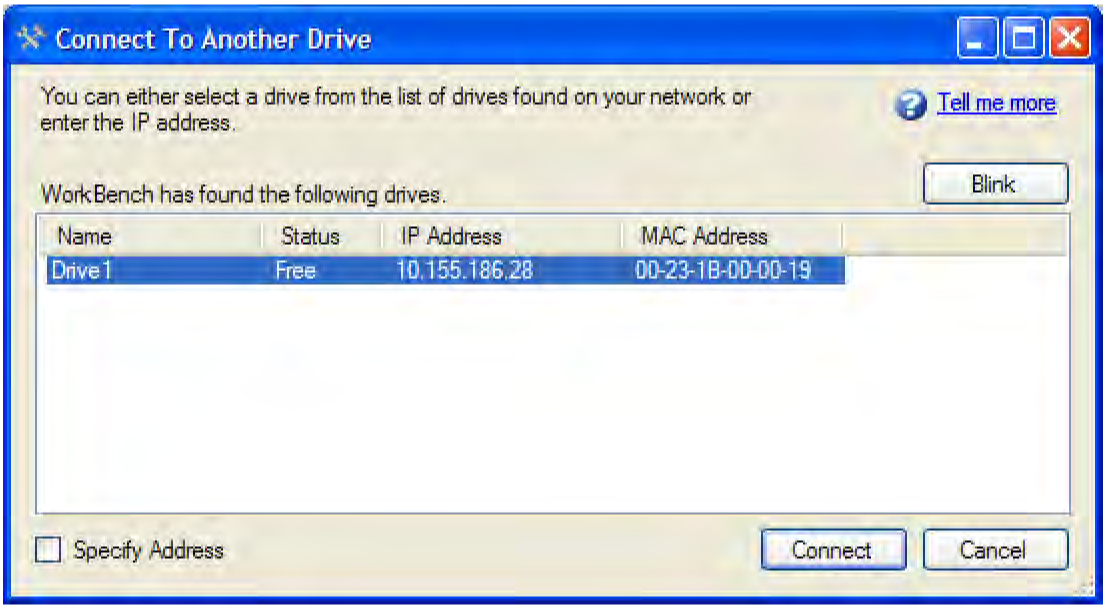
4.6 Check Communications

If you have more than one drive connected to your network, then you can confirm that the new drive is connected to the correct network as follows:

1. A two-digit, seven-segment LED display is located on the front of the drive near the top. If you can see the display, then press the **Blink Display** button on the drive and drive will flash the seven-segment display on and off.
2. If it is difficult to see the display, then you can check the MAC address in the WorkBench list against the MAC address on the label of the drive. The drive is connected if the numbers displayed in WorkBench match the numbers printed on the label on the side of the drive.

4.7 Connect To Another Drive

This window allows you to change the drive that you are using.



Button or Dialog Box	Description
Name	Displays the drive name. By default the name is "No_Name". You can change the name by connecting to the drive and navigating to the top item in the navigation tree.
Status	Only one user at a time can connect to a drive. If someone else is connected to the drive, it is **Busy**. If **Free** is displayed, then you can connect.
Blink	Clicking **Blink** forces the display on the selected drive to alternate between the whole display being on and the whole display being off for 20 seconds.
MAC Address	Displays the MAC address of the drive. The MAC address is unique and is also printed on the label on the side of the drive.
IP Address	Displays the IP address of the drive. You can enter a raw IP address (1.2.3.4) or a DNS name. You can also specify a port number different from the default (port 23) by appending the IP address (for example, 1.2.3.4:1000).

Button or Dialog Box	Description
Specify Address	If your drive does not appear in the list, you can enter its IP address (for example, 1.2.3.4) or a DNS name. You can also specify a port number different from the default (port 23) by appending the IP address (for example, 1.2.3.4:1000).

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5 Communicating with the Drive

5.0.1 Overview

In order to use the drive, you must be able to communicate with the drive using WorkBench and an Ethernet connection. With some basic network knowledge, you can quickly establish communication with your drive. The drive uses TCP/IP (a worldwide standard for high-speed communication); both the AKD and your PC need to understand each other through this standard in order to communicate. This section explains how to establish a TCP/IP link between your PC and a drive.

5.0.2 Identifying the Drive IP Address

The first step in establishing communication with the drive is to identify the drive IP address. WorkBench and the drive find each other using this IP address, which tells your PC where to look for the drive in order to make the communication connection. You can establish communication through the IP address with two types of connections:

- **Automatic:** Allow the drive and PC to link automatically.
- **Direct:** Connect to a drive directly based on a known IP address.

NOTE The current IP Address can be found at any time by briefly pressing button B1. The address will flash sequentially on the front display.

5.0.2.1 Automatic (Dynamic) IP Addressing

Automatic (also called "dynamic") addressing is performed using the Dynamic Host Configuration Protocol (DHCP). This protocol makes it easy for a device to attach to a network. The drive is set in automatic IP mode by setting the two rotary switches to zero (S1 and S2, located on the front of the drive). Your PC is set in automatic mode by configuring the TCP/IP screen to "Obtain an IP address automatically"

When first communicating with the drive, conflicts might exist with other programs or devices connected to your computer that are competing for IP addresses. If you have a problem recognizing a drive, then try turning off other devices (especially a wireless device or remote network connection). If you still have problems connecting with the drive, check in the troubleshooting area of this manual.

5.0.2.2 Static IP Addressing — Rotary Switches

Another option in connecting to the drive is via a static IP connection. In this case you are assigning a specific IP address to the drive and you are modifying your pc network configuration to be able to recognize the static address. The drive IP address can be set using the two rotary switches on the front of the drive.

The address will then be set as 192.168.0.S1S2, with S1 representing the 10's digit and S2 the 1's digit. As you turn the switches, the drive displays the S1 and S2 values.

Example:

S1 is set to 3, S2 is set to 5, the address now is set to: 192.168.0.35.

In order for the drive to connect to the PC, the PC network configuration must find this address. First, identify which network port you are using to communicate with the drive. Once you have identified the port, you can access the properties area of the network connection (on your PC) and set up the proper masking to allow the two devices to communicate. The configuration is set up in the "Use the following IP address:". Set the IP address to 192.168.0.100 and the Subnet mask to 255.255.255.0. This allows the two devices to recognize each other and connect point to point (note that S1 = 0 and S2 = 0 is automatic (dynamic) IP adressing).

Rotary Switch Functions

The following rotary switch settings are used to perform specific functions.

S1	S2	Function
0	0	Resets IP address
8	9	Switches DRV.TYPE between EtherCAT and CAN (See CANbus activation with -CC models).
9	0	Sets baudrate to auto (See Baudrate for CANbus).
9	1	Sets baudrate to 125 (See Baudrate for CANbus).
9	2	Sets baudrate to 250 (See Baudrate for CANbus).
9	3	Sets baudrate to 500 (See Baudrate for CANbus).
9	4	Sets baudrate to 1000 (See Baudrate for CANbus).

5.0.2.3 Static IP Addressing — Software Assigned

Full IP Addressing can be accomplished using three keywords accessible using terminal commands:

- IP.ADDRESS – specifies the address of the drive
- IP.SUBNET – specifies the subnet mask that the drive can communicate with
- IP.GATEWAY – specifies the gateway IP address if the drive needs to communicate outside of its specified subnet

Once the IP address has been properly configured using those three keywords, the IP.RESET command must be issued from the terminal. This will immediately implement the settings that have been configured. These settings must be saved to the drive (DRV.NVSAVE) to remain in effect after power has been removed and restored.

Notes:

- The software assigned static IP address will take precedence over the rotary switches and DHCP.
- To revert back to DHCP settings, or to use the rotary switches to aset the address, set IP.ADDRESS, IP.SUBNET, and IP.GATEWAY to 0.0.0.0, and issue the IP.RESET command.

5.0.2.4 Recovering communications with a drive on an un-reachable IP address

Sometimes a drive may be configured for an IP Address, and the drive needs to be taken off-line, and bench tested, or otherwise used outside of its saved IP Settings. If IP.MODE has been set to 1 (using software defined static IP) the drive will boot up on an IP Address that may be unreachable with the host computer's settings.

If the IP address prevents communication the IP settings can be reset to default by the following procedure:

1. Set both rotary switches to 0
2. Hold down button B1 (top-side of drive) for 5 seconds.

The display will flash 0.0.0.0 and then attempt to discover an address by DHCP. Without removing logic power from the drive, use Workbench to connect to the drive, reconfigure the IP address settings as desired, and store the values to non-volatile memory.

5.1 Check Communications

If you have more than one drive connected to your network, then you can confirm that the new drive is connected to the correct network as follows:

1. A two-digit, seven-segment LED display is located on the front of the drive near the top. If you can see the display, then press the **Blink Display** button on the drive and drive will flash the seven-segment display on and off.
2. If it is difficult to see the display, then you can check the MAC address in the WorkBench list against the MAC address on the label of the drive. The drive is connected if the numbers displayed in WorkBench match the numbers printed on the label on the side of the drive.

5.2 Troubleshooting Connection and Communication Problems

5.2.1 No Drives are Shown

If no drives are shown in the list , then WorkBench has not found any drives.

Common reasons why your drive is not shown in the list include the following:

- The drive is not powered on.
- One of the network cables between your PC and the drive is not connected correctly. If the cable is connected correctly, then the LINK LED on the Ethernet connector is lit continuously. If your PC has a LINK LED you should check that this is also continuously lit (normally this LED is next the RJ45 socket on your PC).
- A router on the network between your PC and the drive is blocking the drive discovery messages. You can enter the IP address directly into WorkBench if this is the case.
-

5.2.2 Device Not Shown

If your specific drive is not shown in the list, then WorkBench has not been able to find the drive.

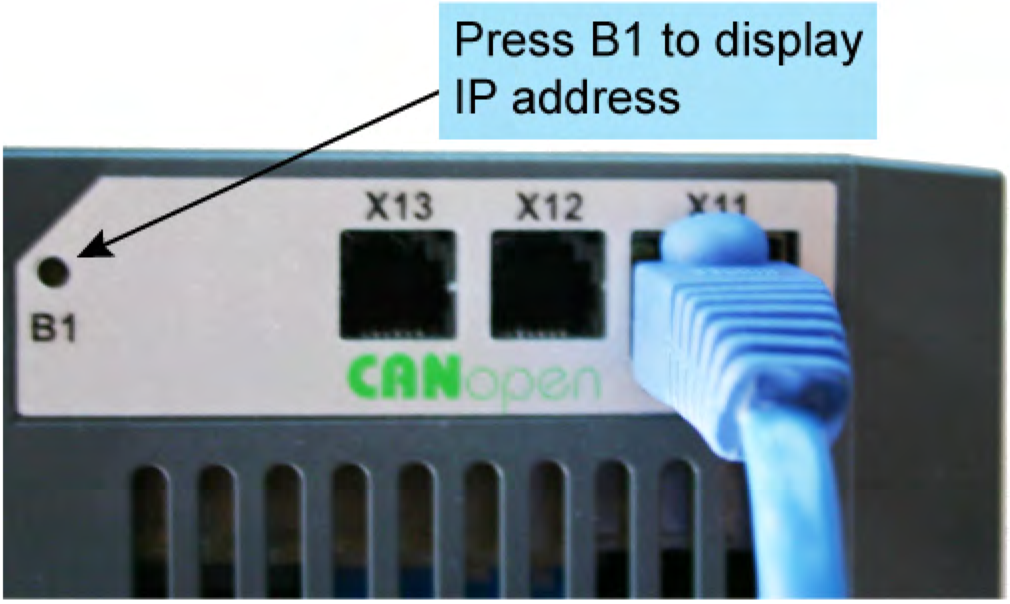
Common reasons why your drive is not shown in the list include the following:

- The drive is not powered on.
- One of the network cables between your PC and the drive are not connected correctly. You can check if the cable is connected to the drive by checking that the link LED on the Ethernet connector is on continuously. If your PC has a link LED, then you should check that this LED is also continuously lit (usually, this LED is next the RJ45 socket on your PC).
- A router on the network between your PC and the drive is blocking the drive discovery messages. Make sure that port 5002 is not blocked by any routers or firewalls. You can enter the IP address of your drive directly into WorkBench if a router or firewall is blocking port 5002. Often, firewalls are the cause of a blocked connection.
- Your PC and the drive are on different subnets. Networks, especially those with many devices on them, are split up into multiple subnets. The discovery protocol used to find drives will only work if your PC and the drive are both on the same subnet .You can enter the IP address of the drive directly into WorkBench if this is the case.
- The network mask defines more than 512 possible addresses. In this case, WorkBench will not ping all of these addresses, so you must unblock discover ports or specify directly the IP address of your drive. When an adapter has such a network mask, its background will be shown as yellow to warn that this network will not be discovered with all discover protocols.

5.2.3 Find and Enter IP Address

You can get the drive to display its IP address on the 7 segment display by pressing the button shown in the following picture. The display then shows the digits of the IP address in sequence with the dots. The display will show four numbers separated by three dots (for example, 192.168.1.5).

You can enter the IP address if you click More and select the Specify Address check box.


Press B1 to display IP address
X13
X12
B1
CANopen

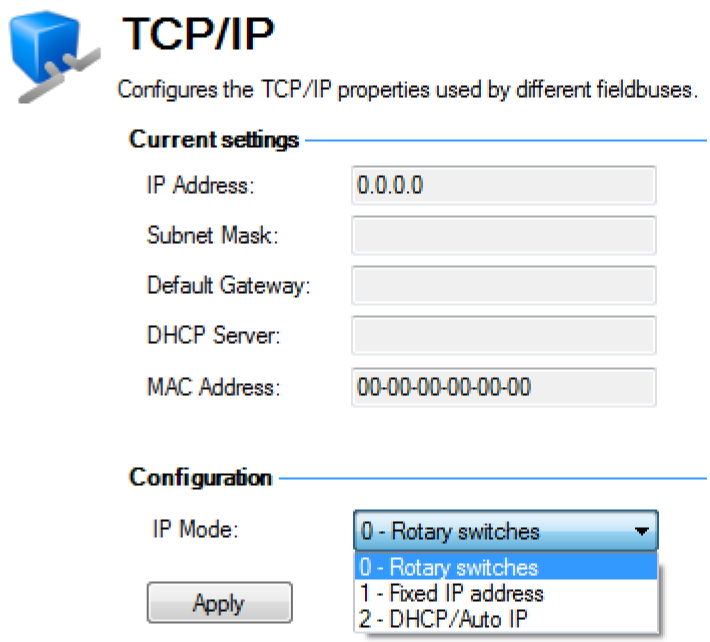
5.3 Communication View

5.3.1 Communication View

Once the drive is connected the Communication View will display the drive type as seen below.

5.3.2 TCP/IP View

This view allows the configuration of TCP/IP properties by selecting the IP Mode from the drop-down menu:



TCP/IP Communication Protocols

5.4 IP Address

The IP address of a drive uniquely defines the drive on the network. Ethernet requires that every device on a network segment must have a unique IP address.

5.4.1 MAC Address

Ethernet also requires that every device must have a globally unique identifier called the MAC address. The MAC address is a 48 bit number normally shown as a series of six hexadecimal numbers (for example, 00:AA:11:BB:22:CC).

Every AKD drive is given a unique MAC address when it is manufactured and this MAC address cannot be changed. The MAC address of every drive is printed on the sticker on the side of the drive.

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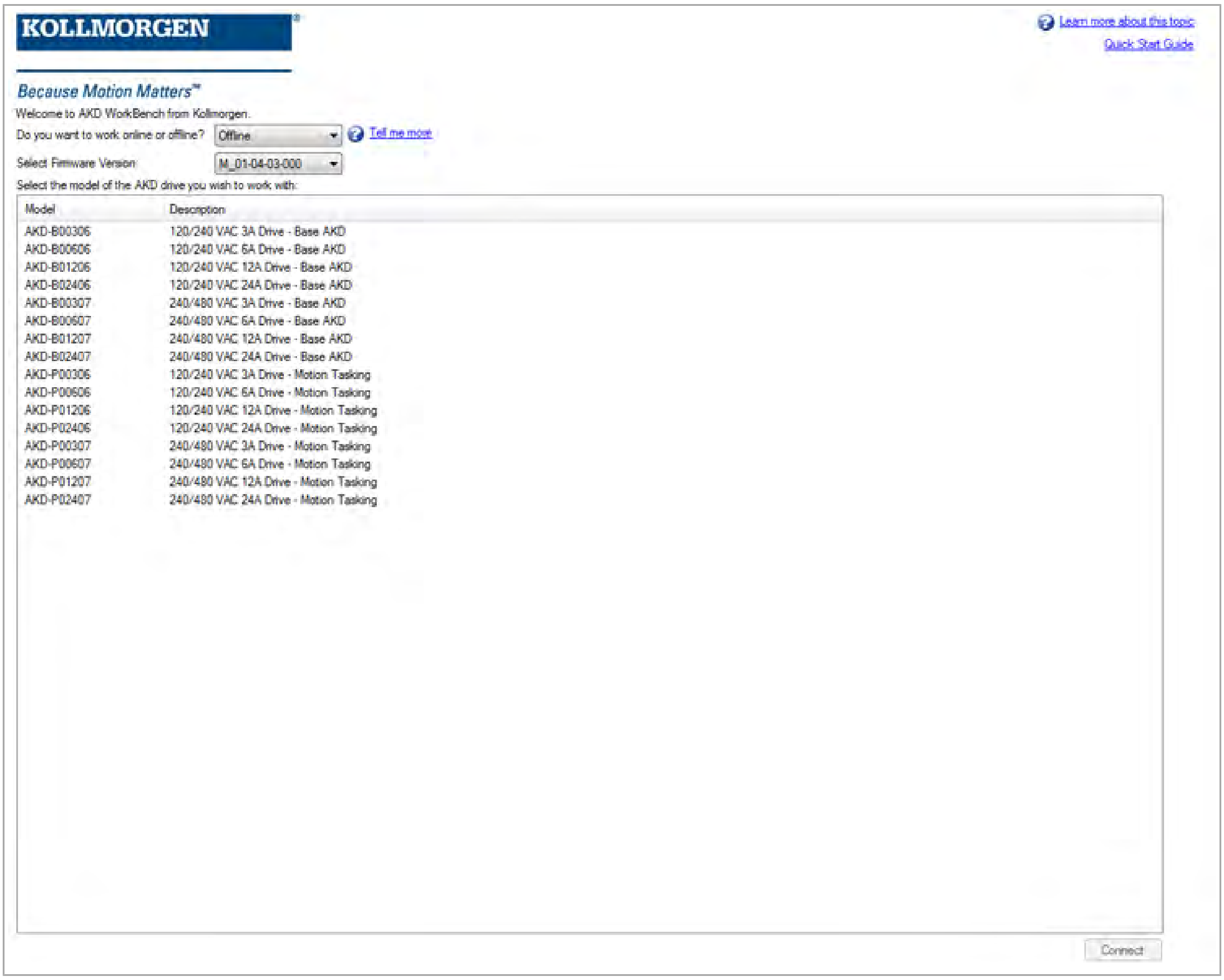
6 Using WorkBench

6.1 Welcome Screen

This view lets you select which AKD drive you wish to work with. You can work with a physical drive via the Ethernet port of your PC (online) or with a drive simulation (offline).



6.2 Online

Select **Online** to display a list of the AKD drives that WorkBench has found on your local network. You can select one of these drives from the list and click **Next** to continue. This will connect you to the drive and you will be given the option to use a wizard to setup the drive.

Button or Dialog Box	Description
Name	The name that someone has given the drive. By default, the name is "No_Name". You can change the name by connecting to the drive and navigating to the top item in the navigation tree.

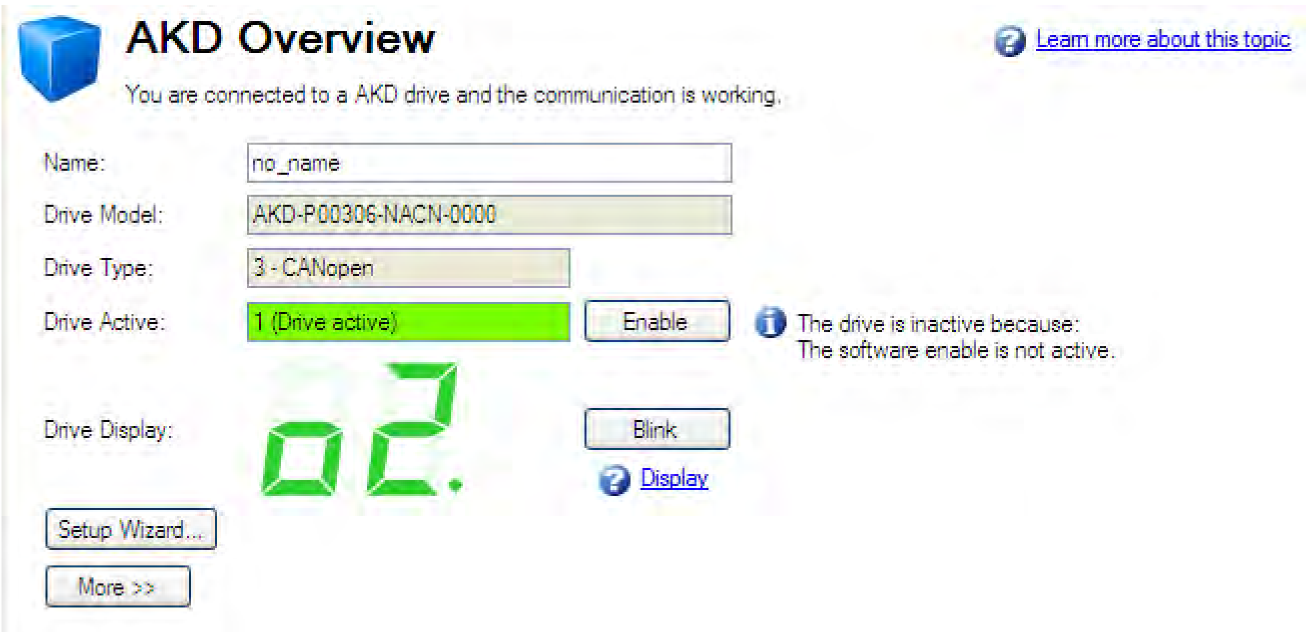
Button or Dialog Box	Description
Status	Only one user can connect to an AKD at a time. If someone else is connected to the drive, then the status is **Busy**. If no one is connected to the drive, then the status is **Free** and you will be able to connect.
Blink	Clicking **Blink** will force the display on the selected drive to to repeatadely flash the display LEDs.
MAC Address	This is the MAC address of the drive. The MAC address is unique and is also printed on the label on the side of the drive.
IP Address	This is the IP address of the drive.
Specify Address	If your drive does not appear in the list, you can enter its IP address (e.g. 1.2.3.4) or a DNS name. You can optionally specify a different port number than the default port 23) by appending it (for example, 1.2.3.4:1000 would be port 1,000).

6.3 Offline

Select **Offline** to display a list of the different models that WorkBench can simulate. Once you have made your selection, click **Next** and the **Overview** screen for the Offline drive opens.

6.4 AKD Overview

Once your drive is connected, the **AKD Overview** shows a summary of the drive that you are using.



You can view or edit the following information from the Overview window.

Button or Dialog Box	Description	Parameter
Name	Names each drive in use with a unique identifier.	DRV.NAME
Drive Model	Displays the model number of this drive. The model number is also on the label on the side of the drive. If you are offline, then you can change the type of drive that you are simulating.	DRV.INFO

Button or Dialog Box	Description	Parameter
Drive Type	Selects the operational fieldbus for your drive.	DRV.TYPE
Drive Active	The drive is active when it is enabled and also supplies voltage to the motor.	DRV.ACTIVE
Enable	Click **Enable** to turn on the power stage in the drive and apply voltage to the motor. This command may fail for many reasons; see "DRV.EN" (=> p. 170) for further details.	DRV.EN
Disable	Click Disable to turn off the power stage and remove the voltage applied to the motor.	DRV.DIS
Drive Display	This graphic replicates the two-digit seven-segment display located on the front face of the drive. The seven-segment display shows a code that indicates the state of the drive and any faults that may be present. WorkBench shows a copy of what the drive display currently shows. A key to the display is here.	
Blink	Click Blink to force the display to alternate between the whole display being on and the whole display being off for 20 seconds. You can use this button to confirm that you are communicating with the correct drive hardware.	DRV.BLINKDISPLAY
Setup Wizard	The Setup wizard takes you through the essential configuration steps so that you can control the motor movement.	
More	Click **More** to display **Serial Number**, **Firmware Version**, **Cumulative On Time**, and **Update Firmware**.	
Serial Number	This text box displays the unique serial number of the drive you are communicating with. The serial number is also shown on the label on the side of the drive.	DRV.INFO
Firmware Version	This text box displays the version of the firmware code running inside the drive.	DRV.VER
Download	Click **Download** to retrieve the latest AKD firmware from Kollmorgen. See 20.1 Downloading Firmware	
Cumulative On Time	This text box displays the cumulative time this drive has been powered on. When the drive is powered on, this value continues counting from the value it had when the drive was last turned off.	DRV.RUNTIME
Update Firmware	Use this box to select the firmware version you want your drive to run.	

6.5 Online and Offline

WorkBench allows you to work online (working with a real drive) or offline (working without any drive hardware).

6.5.1 Online Drive

An "online drive" means that WorkBench is working with a specific physical drive on your network.

Each online drive can either be connected to WorkBench (WorkBench has an active connection with the drive and data is being passed between WorkBench and the drive) or it can be disconnected (there is no communication between WorkBench and the drive). If communications are lost (for example a network cable is disconnected) with a drive then WorkBench will switch the drive to the disconnected state.

Only one PC can be connected to a drive at a time.

6.5.2 Offline Drive

An offline drive allows you to use WorkBench without having any drive hardware. The parameters of a drive are simulated within WorkBench. An offline drive allows you to create a drive configuration as well as exploring the different screens within WorkBench. Because this is a simulation there are a number of operations that are not possible (for example commanding motion).

6.5.3 Switching Between Online and Offline

WorkBench does not allow you to change an instance drive between offline or online. If you wish to move a configuration between two devices that you can save the parameters to a file and then import this parameter file into a new drive you have created.

6.6 Watch

This window allows you to view the current value of selected information from the drive. You can toggle the window on/off by clicking the glasses on the tool bar.

By default, the watch window shows position, velocity, and current for the selected drive. The list can be customized as shown below.

Button or Dialog Box	Description
Add	Adds a new parameter to the watch list.
Edit	Allows you to modify the selected item.
Delete	Removes the selected items from the list.
Move Up	Moves the selected items up one place in the list.
Move Down	Moves the selected items down one place in the list.

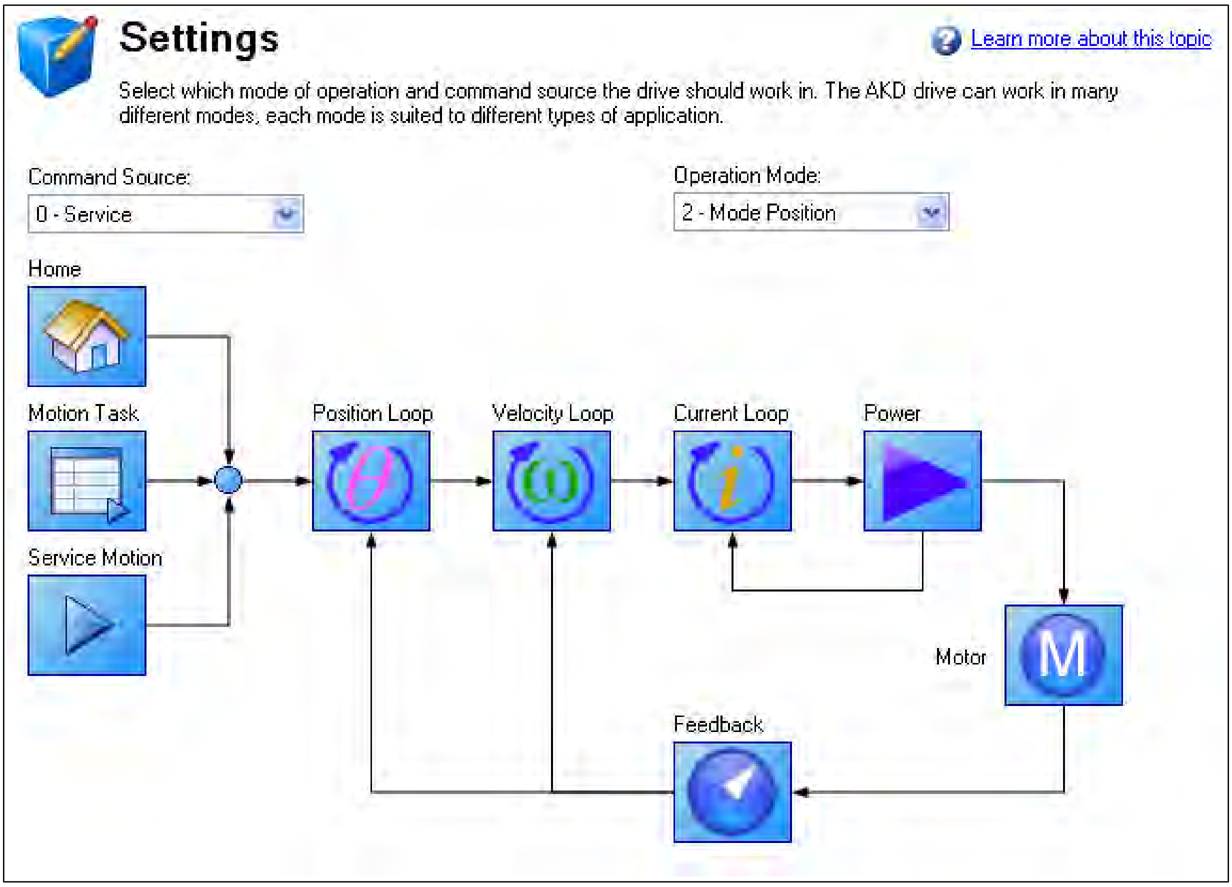
6.7 Settings

6.7.1 Navigation Tree

The Settings view allows you to configure the drive to fit your specific application. When you click Settings in the navigation pane located to the left of the WorkBench screen, additional views for configuring your drive appear. By default, only settings applicable to your current drive operation mode and command source will appear in this tree. To show all settings available for the AKD (even if the these settings are not used with the current operation mode and command source), right click on **Settings** and select **Show all Settings**.

6.7.2 Settings View

From the main Settings view, you can configure the following drive settings:



Button or Dialog Box	Description
Command Source	Selects where the command is being provided: 0-Service: You communicate with the drive using the TCP/IP service channel. 1-Fieldbus: The drive is being controlled by commands coming over the fieldbus. 2-Gearing: The position is proportional to the secondary feedback. 3-Analog: The analog input provides a current, velocity, or position command.
Operation Mode	Selects the control loop being commanded from the source: 0-Torque Mode: Drive controls are based on the current passing through the motor. For a rotary motor, this value is proportional to the torque of the motor; for linear motors, this value is proportional to the force the motor generates. 1-Velocity Mode: Drive controls are based on the velocity of the motor. 2-Position Mode: Drive controls are based on the position of the motor.
Motion and Control Loop Graphics	Allows you to select the details related to each specific loop from a graphical interface.

Related Topics

Using Command Source and Operating Modes for details on configuring the drive for your application.

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7 Configuring Drive Power

7.1 Power

7.1.1 Drive Setup for Power and Bus

The **Power** screen allows you to confirm Power Bus settings and accommodate external regeneration needs if required. Nothing is required for this screen if you have no regeneration requirements. Review the data on the screen to be certain the bus voltage is at the appropriate levels you expect (approximate input line AC voltage * 1.4). The other values are the appropriate limits for over voltage and under voltage for the particular drive. You can select the undervoltage fault mode to trigger either only when the drive is enabled or always.

From the **Power** screen, you can view and configure the drive power settings as follows:

Button or Dialog Box	Description	Parameter
Measured Bus Voltage	Reads the current DC bus voltage.	VBUS.VALUE
Over Voltage Fault Level	Reads the over voltage fault level.	VBUS.OVFTHRESH
Under Voltage Fault Level	Reads the under voltage fault level.	VBUS.UVFTHRESH
Under Voltage Fault Mode	Sets under voltage mode.	VBUS.UVMODE
Operating Voltage	Sets the operating voltage.	VBUS.HALFVOLT
Regen Resistor Type	Sets the regen resistor type to either -**1-External Regen** or **0-Internal Regen (if available)**.	REGEN.TYPE
Regen Power	Reads the regen power (only visible for external regen).	REGEN.POWER REGEN.POWER
External Regen Resistance	Sets the external, user-defined regen resistor resistance (only visible for external regen).	REGEN.REXT
External Regen Heat Up Time	Sets the external regen resistor thermal protection time constant (only visible for external regen).	REGEN.TEXT
External Regen Power	Sets the regen resistor's power fault level for an external regen resistor (only visible for external regen).	REGEN.WATTEXT

See Regeneration for more information about regen resistors and sizing regen resistors.

7.1.1.1 Operating Voltage

Operating voltage can be selected by the user to allow AKD-xxx07 (480Vac) drives to work on 240Vac input supplies.

The VBUS.HALFVOLT parameter has an effect on the following voltage-thresholds:

1. DC-bus over-voltage threshold (see VBUS.OVFTHRESH).
2. The regen-resistor enable/disable voltage thresholds.
3. The inrush-relay enable/disable voltage thresholds.

A power-cycle is needed after changing the value and saving the parameter on the NV memory of the Drive, since the voltage thresholds mentioned above are read during the boot-sequence of the Drive.

7.1.1.2 Direct DC Mains Operation

Direct DC input is available on all standard AKD models. The DC input should be run into the AC input connection. Positive and negative DC lines should use L1 and L2 connections (polarity is not critical). L1 and L2 connections are found on either the X3 connector or the X4 connector depending on the model.

(see 21.8 Mains Supply Connection (X3, X4) for more information on this connection).

The nominal level of DC voltage applied must be compatible with the voltage fault levels in the drive. You must also consider voltage variations in the DC power supply above and below the nominal value so that nuisance faults are avoided.

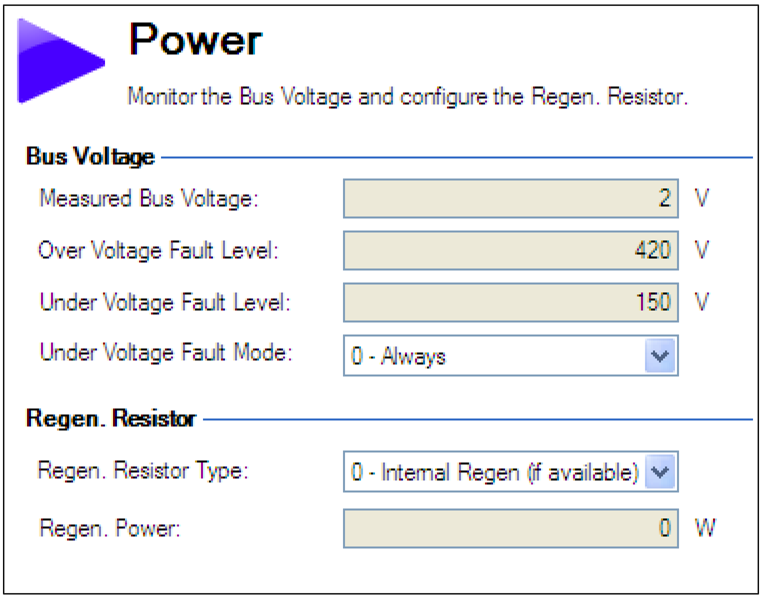
When you determine the maximum nominal DC voltage applied to the drive you should also consider the regeneration circuit, in addition to the over voltage level. Running the drive slightly below the over voltage level is not possible because the drive does not have the capability to dissipate regenerated energy. This practice can also be harmful to the regen circuit. A good practice is not to exceed the nominal DC voltage produced by a standard AC installation. For the AKD-zzzzz06, 340 Vdc is the equivalent DC voltage for an 240 Vac supply and for the AKD-xxxxx07, 680 Vdc is the equivalent DC voltage for a 480 Vac supply.

The voltage fault levels are also shown in the **Power** screen and depend on the voltage level of drive used.

Voltage ranges are as follows:

Model	Under Voltage Level	Over Voltage Level
AKD-zzzz06	90 Vdc	420 Vdc
AKD-zzzz07	380 Vdc	840 Vdc

You can view bus voltage values in the **Power** screen as shown below:



7.2 Regeneration

7.2.1 Overview

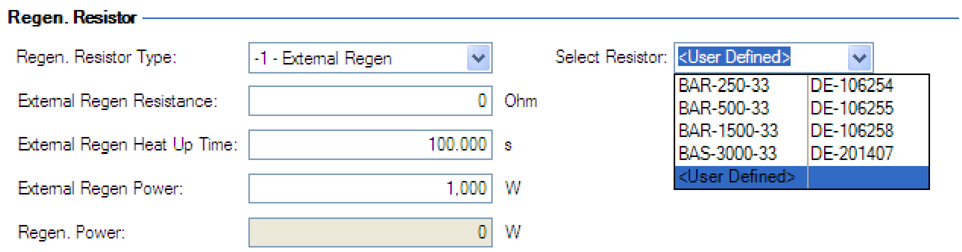
Regeneration, or "shunting", dissipates energy from the DC bus during deceleration of the motor load. During deceleration, the motor acts as a generator that pumps energy back into the system. If this energy is not dissipated, then the bus energy level can exceed acceptable levels (VBUS.OVFTHRESH). If the system exceeds the maximum bus voltage, then the drive generates an over voltage fault (FF501 and shuts down. A regeneration resistor, or regen resistor, is an external device that dissipates excess energy and allows the drive to function normally during deceleration.

Follow these steps to determine the regen needs for your system and to configure the drive for regen:

1. Calculate motor peak and continuous regenerative energy and use this value to size the regen resistor.
2. Select a compatible regen resistor.
3. Configure regen parameter values in WorkBench.

7.2.2 Regen Resistor Options

In the **Power** screen, you can select from a variety of pre-sized regen resistors using the **Regen Resistor Type** box.



When you select -1-External Regen, the **Select resistor** box appears and contains the pre-sized resistors for your drive. Select the model regen resistor that you are using and the drive will populate the remainder of the fields. If you are using a nonstandard resistor, then choose **<User defined>** and fill in the appropriate values for your resistor.

NOTE If you use a nonstandard resistor, contact Kollmorgen technical support to confirm that the nonstandard resistor will work correctly with your system.

7.2.3 Calculating Motor Peak Energy and Regen Resistor Size

In order to determine whether or not your system requires a regen resistor, you must calculate the peak kinetic energy that the motor generates during deceleration and the continuous regeneration energy created by the motor. If this energy exceeds the drive capacity, then you need a regen resistor. In many cases, peak or continuous regenerated energy does not exceed the drive capacity and no regen resistor is needed.

The calculation for peak kinetic energy requires values for several factors that affect the generation of energy in a motion system:

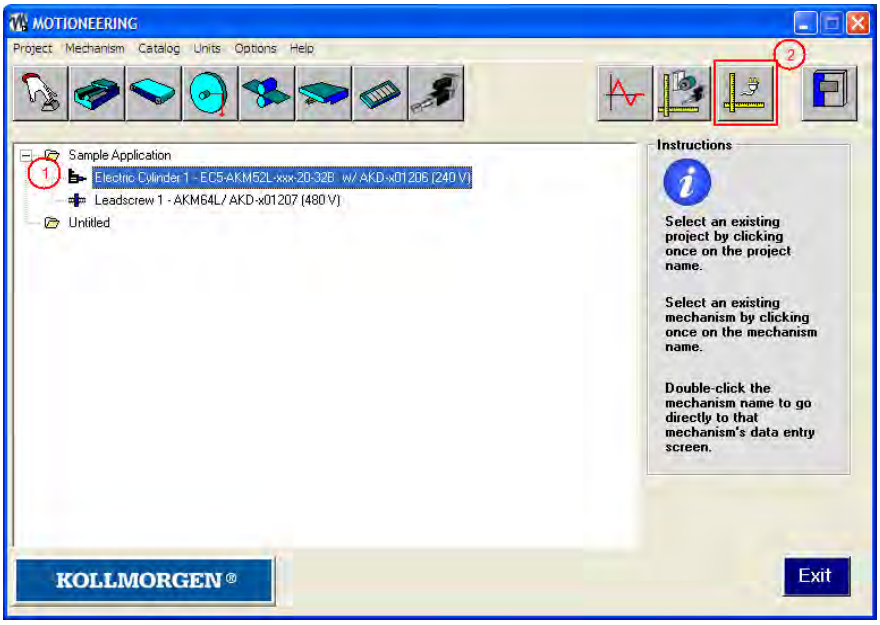
- Load inertia
- Motor inertia

- Motor speed from which deceleration occurs
- Time required to decelerate

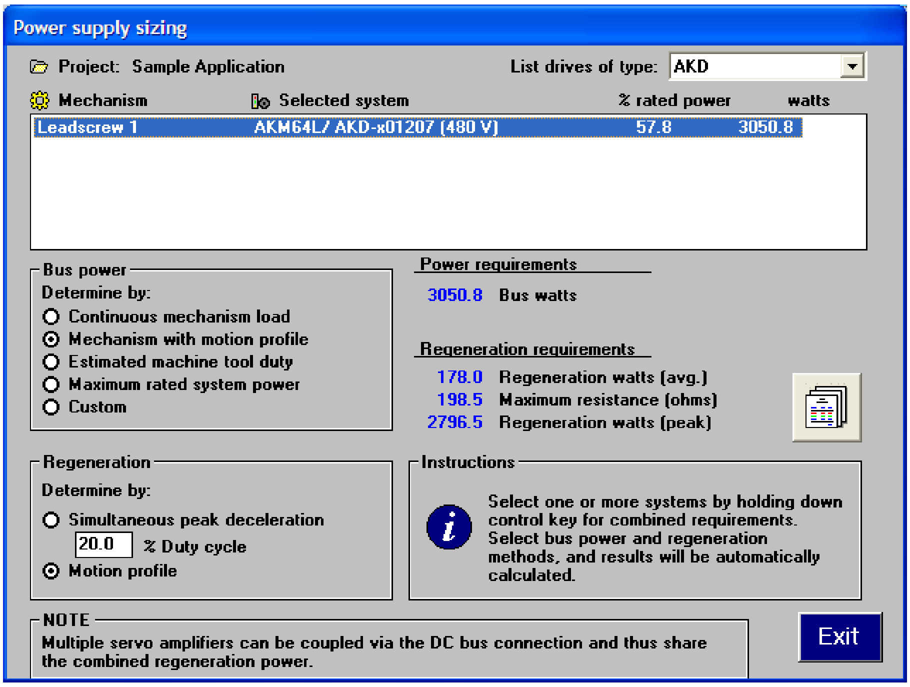
Regen resistor sizing information for your particular application can be calculated using the Motioneering® Application Engine. You can download this program here:

http://www.kollmorgen.com/website/com/eng/support/design_tools/motioneering.php

After you install and set up this program, highlight your application (1) and then click on the Power Supply Sizing icon (2).



The application then displays the regen sizing tool; see the application help for further sizing assistance.



7.2.4 Selecting a Compatible Regen Resistor

After you calculate the appropriate resistor size, compare the results with the capabilities of the drive and, if necessary, select an external regeneration resistor which matches these capabilities from the chart below. The resistors shown below are included in the WorkBench setup. If you do not find a match for your application, please contact the Kollmorgen customer support team for further assistance.

NA Part Number	EU Part Number	Resistor Type	AKD-x-00306	AKD-x-00606	AKD-x-01206	AKD-x-02406	AKD-x-00307	AKD-x-00607	AKD-x-01207	AKD-x-02407
BAFP-100-33	DE-201437	External Resistor, 100 W, 33 ohms	x	x	x					
BAFP-200-33	DE-201438	External Resistor, 200 W, 33 ohms	x	x	x					
BAR-250-33	DE-106254	External Resistor, 250 W, 33 ohms	x	x	x		x	x	x	
BAR-500-33	DE-106255	External Resistor, 500 W, 33 ohms	x	x	x		x	x	x	
BAR-1500-33	DE-106258	External Resistor, 1500 W, 33 ohms	x	x	x		x	x	x	
BAS-3000-33	DE-201407	External Resistor, 3000 W, 33 ohms	x	x	x		x	x	x	
BAR-600-23	DE-200613	External Resistor, 600 W, 23 ohms								x
BAR-1000-23	DE-200614	External Resistor, 1000 W, 23 ohms								x
BAS-2000-23	DE-200615	External Resistor, 2000 W, 23 ohms								x
BAS-3000-23	DE-200616	External Resistor, 3000 W, 23 ohms								x
BAS-4000-23	DE-200617	External Resistor, 4000 W, 23 ohms								x
BAR-500-15	DE-201439	External Resistor, 500 W, 15 ohms				x				
BAR-1000-15	DE-201440	External Resistor, 1000 W, 15 ohms				x				
BAS-2000-15	DE-103871	External Resistor, 2000 W, 15 ohms				x				
BAS-3000-15	DE-103872	External Resistor, 3000 W, 15 ohms				x				
BAS-6000-15	DE-103873	External Resistor, 6000 W, 15 ohms				x				

7.2.5 Configuring Regen Parameter Values

If you use an external regen resistor, then you must also include additional information about the regen resistor in the**Power**view. These values are automatically inserted in WorkBench. The chart below summarizes these three additional values:

- **External Regen Resistance** (REGEN.REXT, ohms)
- **External Regen Heat Up Time** (REGEN.TEXT, seconds)
- **External Regen Power** (REGEN.WATTEXT, watts)

These parameters allow the regen resistor to function properly and dissipate power appropriately for your system.

NA Part Number	EU Part Number	Resistor Type (all resistors UL recognized)	Resistance ohms (REGEN.REXT)	Heat Up Time s (REGEN.TEXT)	Power Rating W (REGEN.WATTEXT)
BAFP-100-33	DE-201437	External Resistor, 100 W, 33 ohms	33	16.5	100
BAFP-200-33	DE-201438	External Resistor, 200 W, 33 ohms	33	27.5	200
BAR-250-33	DE-106254	External Resistor, 250 W, 33 ohms	33	22.0	250
BAR-500-33	DE-106255	External Resistor, 500 W, 33 ohms	33	33.0	500
BAR-1500-33	DE-106258	External Resistor, 1500 W, 33 ohms	33	25.7	1,500
BAS-3000-33	DE-201407	External Resistor, 3000 W, 33 ohms	33	77.0	3,000
BAR-600-23	DE-200613	External Resistor, 600 W, 23 ohms	23	27.5	600
BAR-1000-23	DE-200614	External Resistor, 1000 W, 23 ohms	23	27.5	1,000
BAS-2000-23	DE-200615	External Resistor, 2000 W, 23 ohms	23	77.0	2,000
BAS-3000-23	DE-200616	External Resistor, 3000 W, 23 ohms	23	84.3	3,000
BAS-4000-23	DE-200617	External Resistor, 4000 W, 23 ohms	23	77.0	4,000
BAR-500-15	DE-201439	External Resistor, 500 W, 15 ohms	15	33.0	500
BAR-1000-15	DE-201440	External Resistor, 1000 W, 15 ohms	15	27.5	1,000
BAS-2000-15	DE-103871	External Resistor, 2000 W, 15 ohms	15	77.0	2,000
BAS-3000-15	DE-103872	External Resistor, 3000 W, 15 ohms	15	84.3	3,000
BAS-6000-15	DE-103873	External Resistor, 6000 W, 15 ohms	15	91.7	6,000

Related Parameters

REGEN Parameters

VBUS.OVWTHRESH

VBUS.VALUE

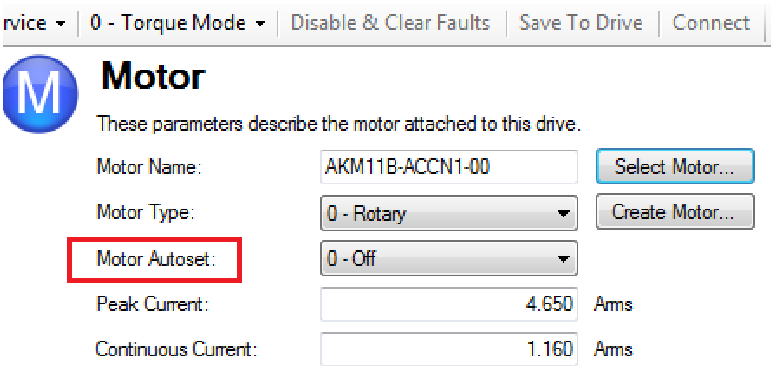
8 Configuring Motor Settings

8.1 Motor

8.1.1 Overview

The **Motor** screen is used to set up or confirm the parameters of the motor that is connected to the drive. In certain cases, based on the feedback type, the motor parameters will automatically be set. The drive will auto-detect feedback devices that are preset with the appropriate feedback and motor parameters when MOTOR.AUTOSET is set to 1 (default). The values the drive uses for commutation and current and velocity loop gains will be populated automatically.

If your motor does not have a plug and play feedback device, then you must turn off the motor autoset feature as shown in the screenshot below (MOTOR.AUTOSET = 0) and select the appropriate motor from the motor parameter database.



All of the appropriate Kollmorgen motors compatible with the AKD drive are contained in the motor database. For motors that are not listed, click **Select Motor** to open a custom motor view in which you can input the appropriate motor parameters.

8.1.2 Motor Setup

For SFD, Endat, and BiSS feedback devices, the drive will automatically be detected and the correct motor parameters will be automatically set in the AKD drive. If your motor is detected automatically, the parameters in the **Motor** view are shaded and not accessible. If you have a non-plug and play standard device (such as an incremental encoder or resolver), you can use this screen to enter the standard AKM, Cartridge motor, DDR, or DDL motor. Other motors can be entered using the **Custom Motor** selection and setting up the parameters (see section on non memory motors). Select the standard motor from the drop down list and select ok. The AKD drive will now show all of the appropriate parameters needed for the motor to operate properly.

8.1.3 Using the Motor View

The **Motor** view displays parameters related to the specific motor attached to the drive as follows:

- Motor Name: The motor part number read from the autoset device, or the name from the motor database. When entering a custom motor name, the motor name should not contain any spaces.
- Motor Type: This field allows you to select the proper parameters for a rotary motor or a linear motor (linear motors are a future feature).
- Motor Autoset: This setting to allows the drive to automatically set up a plug and play motor

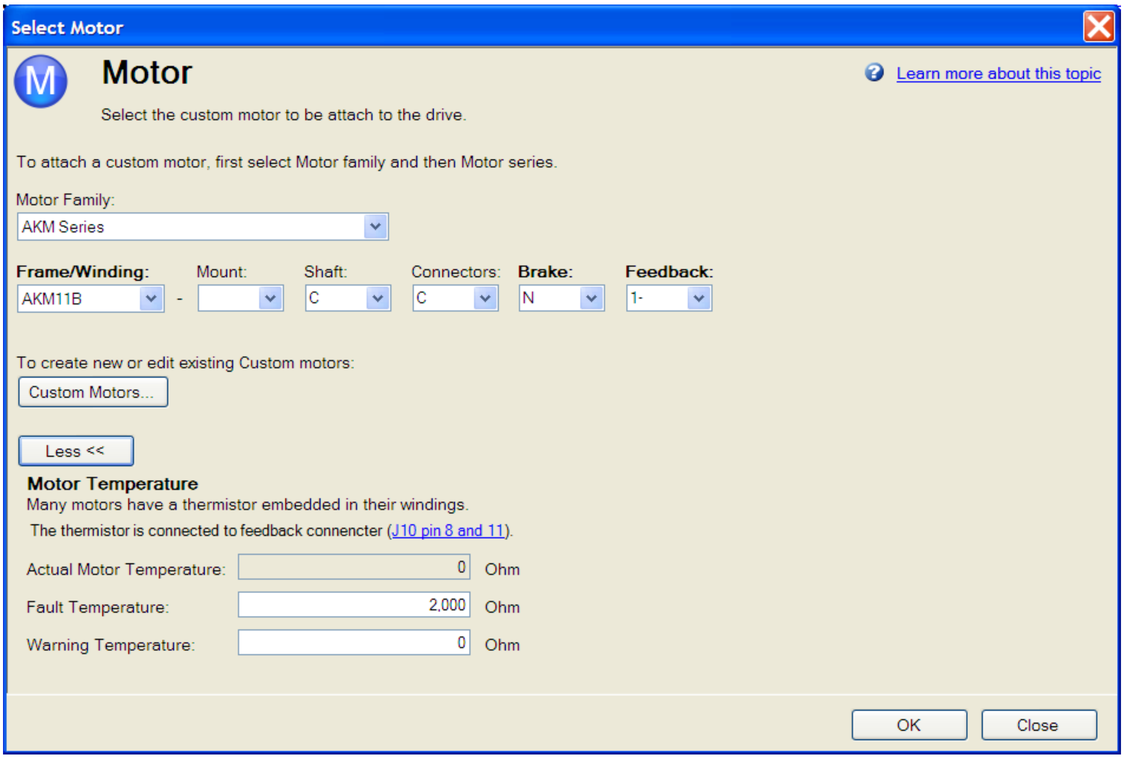
(MOTOR.AUTOSET = 1). With **Motor Autoset** turned off (MOTOR.AUTOSET = 0), you can access the motor database to select a catalog or custom motor.

The next set of parameters displayed are specific to the electrical and mechanical characteristics of the motor connected to the AKD drive.

- Peak Current: Motor peak current rating in Amps rms.
- Continuous Current: Motor continuous current rating in Amps rms.
- Inertia: Motor rotor inertia in Kg-cm^2.
- Torque Constant: Motor torque contant in Nm/Arms.
- Inductance: Motor rated inductance in milliHenries
- Motor Poles: Number of motor poles.
- Maximum Speed: Motor maximum rated speed
- Motor Resistance: Motor winding resistance in Ohms.
- Maximum Voltage:Motor maximum rated voltage in Volts rms.
- Motor Phase: Motor phase offset (used to set motor commutation as required - for most devices this is set to 0).
- Coil Thermal Constant: Motor coil thermal time constant in mHz.

8.1.4 Selecting a Motor

The **Select Motor** button opens a screen in which you can configure a non-plug and play motor or custom motor.



When this screen is opened, WorkBench displays by default the motor matched to the current motor name attached to the drive. WorkBench searches matching motor as follows:

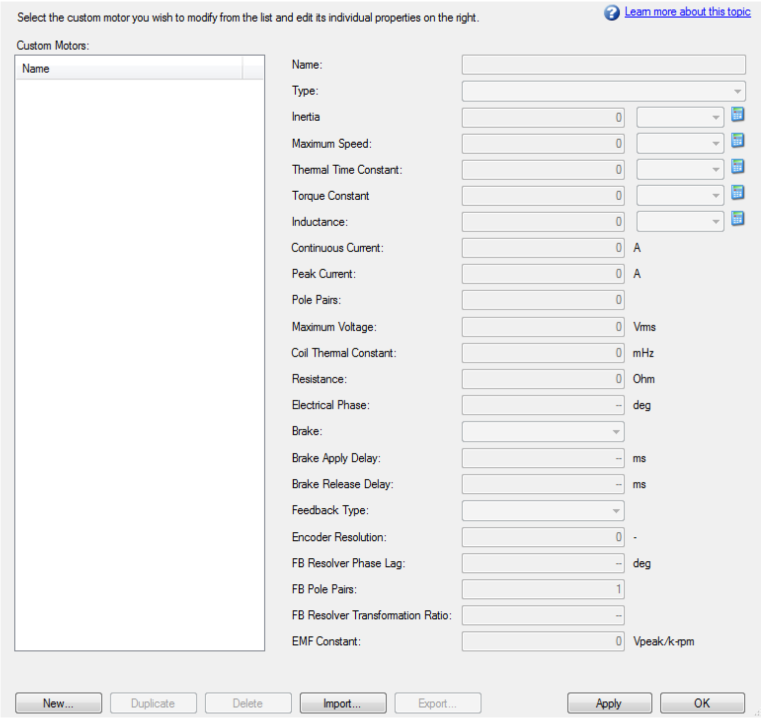
1. WorkBench first checks the motor name with custom motors for a match.
2. If a match is not found, then WorkBench checks the name with the standard motors database for a match.
3. If a match is not found, then an AKM motor is selected.

For non-plug and play motors, a database of catalog motors is available based on the different Kollmorgen motor families. When you select a motor family, a part number is displayed according to the selected motor family. You can change the part number as needed, and the complete motor name will be displayed according to your selection. This complete motor name is sent to drive. The portions of the part number labeled in bold are required values.

The **More/Less** button displays and hides motor temperature settings.

8.1.4.1 Configuring Custom Motors

Click on **Custom Motor** to create and edit custom motors in the following screen:



In this view, you can import or export a motor parameter file, or create a custom motor of your choice. The appropriate parameters must be chosen as listed. Several of the parameters allow you to select an alternate unit of measure. When building a custom motor file, do not use blank spaces in the name you choose. Once you have configured one or more custom motors, if you select a custom motor from the list and click **OK**, then the selected custom motor will be displayed in the **Select Motor** screen.

The actions available in the custom motor screen include:

- **New**. Allows you to start a new custom motor (with default values) or load a catalog motor you may want to modify.
- **Duplicate**. Makes a copy of the highlighted motor in the custom motor list.
- **Delete**. Deletes the highlighted motor in the customer motor list.
- **Import**. Allows you to import a motor file (*.motor) from another location
- **Export**. Allows you to save teh highlighted motor file (*.motor) to another location
- **Apply**. Accepts the values you have entered for the specific motor files you are entering.
- **OK**. Returns you to the **Motor Selection** screen.

When entering any of the motor data, be certain the units are correct. The AKD drive uses the motor parameters to set up the various feedback loops and limits associated with the motor selected.

Note that if you select a custom motor from the list and click Ok button then that selected custom motor will be displayed in the Select Motor screen.

8.1.4.2 Validating Motor Parameters

When you click **OK** in the **Select Motor** screen, WorkBench validates the range with the drive. If any error is found, an error screen is displayed. Click **Continue** to set the motor parameters in the drive. Click **Cancel** to close this screen.

If errors occur while setting the motor parameters, an error screen indicates which parameters require additional attention.

Related Parameters

MOTOR Parameters

8.2 Feedback 1

The Feedback view allows you to configure the primary position feedback device fitted to your motor.

When you select your feedback device from the Feedback Selection list, the appropriate feedback configuration choices appear below the dial.

8.2.1 Overview

The AKD offers a variety of feedback solutions, which allows you to optimize your system based on your specific machine needs. The available feedback options include resolver, SFD, sine-cosine encoder (Endat 2.1, BiSS, Hiperface), incremental encoder, as well as line-count, single, and absolute variations. Your motor model number will indicate the type of feedback that you have. With some incremental encoders, parameters are set up in the encoder itself, and the AKD drive recognizes the feedback automatically and sets up the drive accordingly. This automatic recognition is called "plug and play". Currently, SFD and Endat are plug and play encoders. Other feedback types require that you enter parameters manually.

The following table lists current support for primary and secondary feedback:

		Primary	Secondary
Resolver	Std & Multi pole	Yes	No
SFD		Yes	No
Incremental (Digital) Encoder	With Halls and Index	Yes	No
	No Halls with Index	Yes	Yes
	No Halls with No Index	Yes	Yes
Analog Sin/Cos Encoder	With Digital Halls	Yes	No
	With Digital Halls and Analog Index	No	No
	No Halls and No Index	Yes	No
EnDAT 2.1	Single & Multi Turn	Yes	No
EnDAT 2.2	Analog / Digital	Yes	No
	All Digital	Yes	Yes
BiSS	Analog / Digital	Yes	No
	All Digital (Mode C)	Yes	No
Hiperface	Analog / Digital; Single & Multi Turn	Yes	No
	All Digital	No	No
Halls Sensor Only (Digital)		No (expected 2012)	No

8.3 Using Feedback Options

Use the **Feedback** screen to set up your system to match the proper feedback device. By default, the drive uses the **Auto** setting to detect feedback devices. This setting allows the drive to interrogate the feedback device to see if it is a recognized plug and play device. If the drive recognizes the device, then all the parameters for that device and motor are loaded into the drive. Both the feedback and the motor information are now present in the drive and the system is operable.

If the feedback is a non- plug and play device, then you can choose from the list of supported devices in **Feedback Selection** list and then enter the line count manually. The following sections describe each supported device available in the **Feedback Selection** list and the input information required to configure each device.

8.3.1 Auto

This is the default setting and is used to determine if a plug and play device is available. If a plug and play device is available, the **Auto** mode is replaced by the feedback device detected, along with the appropriate resolution settings.

8.3.2 Incremental Encoder

The incremental encoder is a non-plug and play device. Incremental encoders are available in a variety of line counts. If you select an incremental encoder option, the encoder resolution must be entered into the **Rotary Encoder Resolution** box. The units for this field are in counts per revolution, which is post-quadrature (multiplies the lines per revolution by 4).

8.3.3 Sine Encoder

Sine encoders are offered with different data communication protocols. These include Endat, BiSS, Hiperface, and others. A standard sine-cosine encoder with simple analog communication is not a plug and play device. As with the incremental encoder, the line count is entered in the **Rotary Encoder Resolution** box.

8.3.4 Endat 2.1, Endat 2.2

Endat-based sine encoders are plug and play compatible, and the system will properly recognize these encoders. With the AKD set in **Auto**, this encoder type is detected and the feedback and motor parameters are loaded automatically.

8.3.5 BiSS

BiSS will be plug and play in a future release. Currently, the device is programmed with the motor and feedback information and once selected will sets up the feedback and motor parameters in the AKD.

8.3.6 Hiperface

Hiperface is a plug and play device that will be supported in a future release.

8.3.7 Resolver

The resolver feedback option is not plug and play. When selecting the resolver option, three specific parameters are set by default for the standard AKM resolver: phase lag, transformation ratio, and feedback poles. Currently,the AKD does not support non-Kollmorgen standard resolver options.

8.3.8 SFD

Smart Feedback Device (SFD) is Kollmorgen's most popular plug and play device. SFD allows for quick and easy setup from the **Auto** mode, which automatically configures the drive with the motor and feedback parameters.

8.3.9 Using Wake and Shake (WS)

8.3.9.1 Overview

Wake and shake (WS) is used to establish commutation in drives with the following types of feedback:

- Incremental encoders without Halls or commutation channels.
- Sine encoders without Halls or commutation channels.

When controlling a brushless DC (BLDC) motor, you must know the electrical position of the motor shaft. Without absolute position data, it is impossible for the drive to know which sequence of coils to energize to produce motion. Absolute feedback devices, such as resolvers and absolute encoders, can detect position directly. Incremental devices, such as incremental encoders and sine encoders without a commutation channel, must determine electrical position indirectly at start up. The drive uses the WS feature to determine electrical position by sending the motor short bursts of current and measuring the resulting incremental motion. The drive uses this measurement to estimate electrical position accurately enough to control the motor.

8.3.9.2 Configuring WS

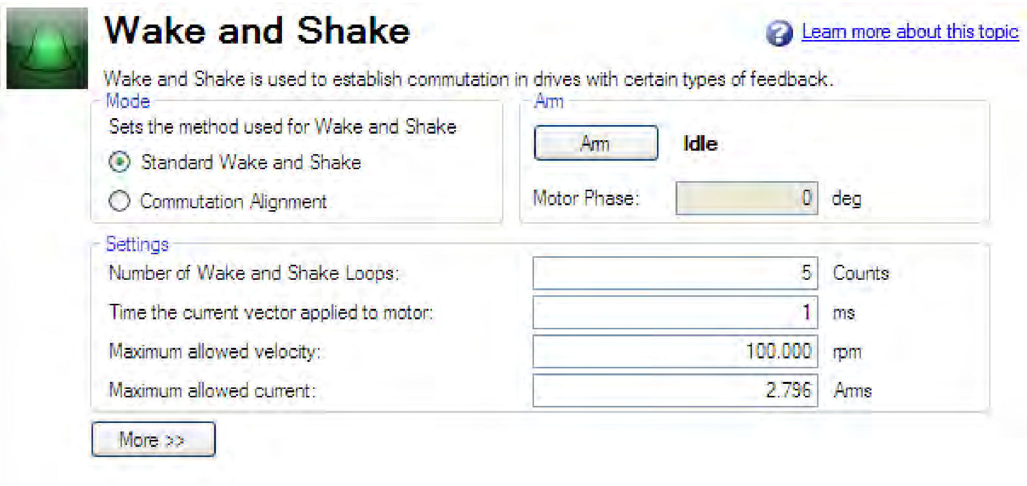
You can configure WS after your motor has been connected to the AKD according to the *AKD Installation Manual*. The WS procedure is initiated automatically when both the hardware and software enable signals become logic high.

Before attempting to enable the drive, the drive must be compensated for the motor and the AKD servo loops must be stable.

Compensation values for many rotary motors are included in a database already loaded into the drive.

NOTE An unstable system will not function properly during or after the WS process.

Use the default **Wake and Shake** view to configure your system:



Mode

The information in this help section primarily applies to **Standard Wake and Shake** (Mode 0), which is the default mode for Wake and Shake. **Commutation Alignment** (Mode 1) is a simple Wake and Shake mode which only uses the WS.IMAX parameter. In Mode 1, The windings are energized at for 1 second at WS.IMAX and the resulting position is used to calculate MOTOR.PHASE. The motion during **Commutation Alignment** is generally large (up to 180 electrical degrees). Select the mode (WS.MODE) according to your application needs.

Arm

Click **Arm** to set WS to start at the next drive enable (WS.ARMWS.ARM). This area also shows the current status of the wake and shake process. See WS.STATE for a detailed explanation of the possible states.

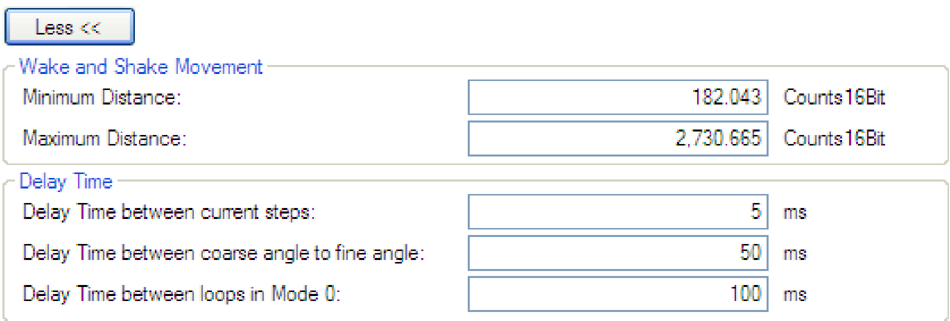
WS.ARM is not restricted to any feedback type.

Settings

- **Number of Wake and Shake Loops**. The WS feature uses the mean of all wake and shake repetitions, called "loops", to establish commutation (WS.NUMLOOPS; see Using WS: Advanced for a discussion of loops). If fewer than five loops are used, commutation may be incorrect, possibly causing poor performance or stability.
- **Time the current vector applied to motor.** This box specifies specifies the duration of the current pulse used for commutation. Increasing this value (WS.T) increases the movement of the system.
- **Maximum allowed velocity**. If a velocity (VL.FB) higher than this value (WS.VTHRESH) is detected while WS is running, then a fault will be generated.
- **Maximum allowed current**. This value (WS.IMAX) is directly proportional to the movement. A value that is too low may fail to cause movement; a value that is too high value may cause an over speed fault.
- **Maximum allowed movement** (WS.DISTMAX). If the total motion from the starting position (the position at the time the drive is enabled after a WS.ARM command) exceeds WS.DISTMAX a fault will occur. Setting WS.DISTMAX to zero disables this feature.
- **Minimum allowed movement** (WS.DISTMIN). If the total motion from the starting position is less than WS.DISTMIN a fault will occur. This will prevent poor initialization from broken wires, incorrect current settings, very high friction, etc. Setting WS.DISTMIN to zero disables this feature.

8.3.9.3 Wake and Shake, More View

To configure additional WS settings, click **More** at the bottom of the default view to display the following options:



Wake and Shake Movement

Use these boxes to set values for the maximum (WS.DISTMAXand minimumWS.DISTMINmovement required for finding commutation.

Delay Times

Delay time is the time that elapses when switching different current vectors. Use these boxes to set specific time delays for current steps WS.TDELAY1, coarse to fine angle (WS.TDELAY2) and time between loops in mode 0 (WS.TDELAY3).

8.3.9.4 Special Cases for WS

Operation with Motor Brake

An amplifier with a motor brake operates the WS procedure similar to an amplifier without a brake. All precautions and behavioral descriptions above also apply in this case. It is important to note that the brake is automatically applied (motor brake, not holding brake) after the WS process is complete. The brake may cause unexpected movement if the DRV.OPMODE used prior to WS does not retain position. If a force component is present parallel to the track on a linear motor (gravity, load, etc.), or tangential on a rotary motor, the motor may move from the startup position after WS completes and the brake is applied.

If the application requires that the startup position be retained, have the controller system ready to take control immediately after WS is complete. One way to set this control is to have the drive in DRV.OPMODE 1 (digital velocity) or DRV.OPMODE 2 (position mode) on power-up. This precaution keeps the motor stationary after enable.

End of Travel Limits

If anything restricts the motion of the motor, a commutation fault can occur. Examples of situations that may result in faults include the following:

1. If the motor is resting against a rigid endstop, the movement of the motor may be impeded below the minimum threshold set by WS.DISTMIN. This lack of movement causes a fault.
2. If the motor is actuating a limit sensor/switch, the system (PLC, SWLS.LIMIT0 and SWLS.LIMIT1) may be preventing the AKD from producing motion. If descriptive motion is not achieved, the system faults.

Large Load Inertia or High Friction System

Systems with a large load mismatch may need more current than the default setting for correct commutation. Begin with the default value for WS.IMAX and gradually increase or decrease as needed. If adjusting WS.IMAX does not result in a successful commutation, the width of the search pulse can be increased by increasing WS.T.

8.3.9.5 Using WS: Advanced

WS is performed upon enable in order to establish a valid value for MOTOR.PHASE at startup. MOTOR.PHASE is used to calculate electrical phase. With absolute feedback devices, MOTOR.PHASE is a fixed offset between absolute mechanical position and the electrical position. With incremental devices, position is accumulated relative to an initial MOTOR.PHASE. However, at startup, MOTOR.PHASE is invalid since the initial position is random, thus the requirement for the WS process.

WS is a two-step process:

1. Coarse Phase. The drive sequentially pulses a user-specified current, WS.IMAX, at each electrical quadrant (0°, 90°, 180°, 270°). Based on the resulting observed movement, an approximate location is calculated.
2. Fine Phase. The drive makes small adjustments to the coarse phase while monitoring movement during velocity mode (command velocity = 0) to find a precise position.

The amplitude of the current pulses in this process equals WS.IMAX. The drive repeats these two steps for a user-specified number of times (WS.NUMLOOPS) to produce a more accurate estimate of the electrical phase.

The drive normally indicates warning F478 before WS is initiated and successful. If WS fails, the commutation is not valid and the drive indicates one of the following faults:

- F473: Insufficient movement. The maximum movement during WS was less than WS.DISTMIN.
- F475: Excessive movement. The movement during WS exceeded WS.DISTMAX.

- F476: Fine-Coarse deltat too large. The phase calculated during the fine phase and coarse phase differed by more than 10 degrees.
- F478: Overspeed. The feedback velocity (VL.FB) exceeded WS.VTHRESH during WS.
- F479: Loop angle delta too large. The difference between the phase determined in different cycles (loops) exceeded 30 degrees.
- F482: Commutation not initialized. WS is required (feedback is one of the types listed in the Overview) but WS has not been successfully performed.
- F483 to F485: U, V, or W phase missing . Intermittent or broken motor connection.

Maximizing WS Reliability

The following suggestions will help you achieve successful commutation:

- Incorrect determination of MOTOR.PHASE may cause a system runaway. Since the typical movement during correct operation of WS is very small, you can use the velocity overspeed parameters (WS.VTHRESH and DRV.VTHRESH) to prevent a runaway. Prior to enabling the drive, set DRV.VTHRESH 100 mm/s for linear motors or 200 rpm for rotary motors. After a successful enable, DRV.VTHRESH can be returned to the normal operating value.
- Set WS.IMAX to its default value, WS.IMAX=0.5*min(MOTOR.IPEAK, DRV.IPEAK).
- Set WS.NUMLOOPS 20 for best results in many applications.
- WS.T specifies the duration for which the search current is applied. With a stable velocity loop, most applications work well with the default value of WS.T. The default value causes the software to calculate the width of the search pulse based on the velocity loop proportional gain, VL.KP. Increasing WS.T effectively increases the movement of the motor during WS, which may be necessary for systems with a low-resolution feedback or high load inertia.
- WS.IMAX specifies the amplitude of the current pulse used during the initial/rough commutation. A WS.IMAX value that is too low may result in a fault by failing to cause enough movement for commutation. If the value is too high, the preset movement threshold could be exceeded, also resulting in a fault. If the default value is producing faults for too little movement, gradually adjust this parameter to overcome excessive friction and/or load on the system. WS.IMAX also specifies the maximum current used in the second stage of commutation. The initial current is 25% of WS.IMAX, then steps up to 100% of WS.IMAX.
- FB1.SELECT selects the type of feedback used by the amplifier. The WS feature is used only for FB1.SELECT = 11, 21. The feedback must be configured prior to initiating the WS procedure.
- MOTOR.BRAKE If your amplifier has a motor brake, set MOTOR.BRAKE = 1. For motors without a brake, set MOTOR.BRAKE = 0.

⚠ CAUTION

- Adjust WS.T with extreme caution. Increasing WS.T increases the movement of the system. Applying an incorrect value of WS.T may cause erratic drive behavior.
- When initiating WS, the motor may experience a runaway. Stay clear of all moving parts. Ensure there are properly operating safety devices such as hardware limit switches and suitable end-of-travel limits.
- If WS.NUMLOOPS is less than 5, commutation may be incorrect. This condition may cause faults and/or adversely affect performance or stability. Set WS.NUMLOOPS = 20.

8.3.9.6 Troubleshooting WS

Problem	Possible Cause	Remedy
Excessive Movement	• Brake slips on vertical system. • External forces on motor too great.	• Check brake. • Remove forces acting on motor. • Lower WS.IMAX.
Insufficient Movement	• Motor brake too rigid. • Motor resting on rigid end-stop. • Too much friction on motor track. • Foreign objects impeding movement of motor. • Motor load very large, and impedes sufficient movement. • WS.DISTMIN manually set too high • WS.IMAX too low	a. Check brake b. Check physical location of motor c. Check friction and cleanliness of motor track d. Increase WS.IMAX value
Excessive Movement	• Brake slips on vertical system. • External forces on motor too great.	• Check brake. • Remove forces acting on motor. • Lower WS.IMAX.
Insufficient Movement	• Motor brake too rigid. • Motor resting on rigid end-stop. • Too much friction on motor track. • Foreign objects impeding movement of motor. • Motor load very large, and impedes sufficient movement. WS.DISTMIN manually set too high WS.IMAX too low	• Check brake. • Check physical location of motor. • Check friction and cleanliness of motor track Increase WS.IMAX value
U, V, or W Phase Missing Fault	Intermittent or broken motor connection.	Check connections to motor phases.
Commutation Not Initialized Fault	Wake and Shake is required but WS procedure has previously been canceled (WS.DISARM) or has failed.	Correct errors and rerun WS procedure.
Other	• Drive not configured correctly.	• Check drive compensation • Verify amplifier feedback

Related Parameters

WS Parameters

DRV.IPEAK

FB1.SELECT

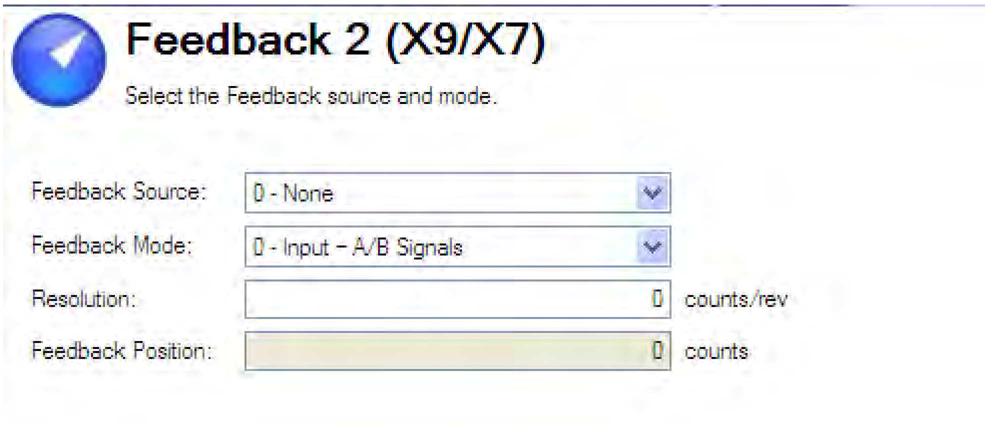
MOTOR.BRAKE

MOTOR.PHASE

MOTOR.IPEAK

8.4 Feedback 2

The Feedback 2 screen helps configure how you will be using either connector X9 or X7. The screen uses the term feedback in the labels, but you can also think of this as the “signal” source depending on how you use these connection points.



The **Feedback source** box allows you to choose from three feedback sources:

Source 0 – This simple indicates you are not using either connector as a feedback source.

Source 1 – This is tied to use of connector X9 (consider for emulated encoder connection).

Source 2 – This is tied to use of connector X7 (consider for the high speed opto inputs on the I/O Connector).

Feedback Mode offers three selections as well, depending how you are using the connection source above.

Mode 0 – The input is configured as A/B signals.

Mode 1 – The input is configured as Step and Direction signals.

Mode 2 – The input is configured as Up-down signals.

The **Resolution** box sets the resolution of the device you have indicated as your input of signal source.

Encoder Emulation Output

The drive offers the flexibility to use connector X9 for an encoder emulation output. This output can be set up using the Encoder Emulation view (see 8.4.1 Encoder Emulation .

The **Emulation Mode**box offers three settings for Encoder Emulation mode:

Mode 0 – The connector is free to use as an input

Mode 1 – The X9 connector is now set up as an encoder emulation with a once per rev index pulse (resolution is set in the next parameter (Emulation Resolution).

Mode 2 – The X9 connector is now set up as an absolute index pulse

Emulation Resolution sets the resolution desired for the output of the emulated encoder.

The **Index or Absolute offset** is dependent on which emulation mode is selected, allowing you to set an offset for either the index pulse or absolute pulse.

A check box allows you to consider the motor direction based on the encoder output.

8.4.1 Encoder Emulation

8.4.1.1 Overview

The encoder emulation (EEO) connector (X9) can be used as an either an output or an input. As an output, you can use this connector for position feedback to an analog controller and for configuring the drive as the master in a master/slave system. You can also use X9 connector as an input for controlling the drive through an A/B, pulse and direction, or up/down command. Common applications for this input include using the drive with a stepper controller and configuring the drive as the slave in a master/slave system.

8.4.1.2 Using Encoder Emulation

You can configure the X9 connector from the **Encoder Emulation** screen by setting the connector function, resolution, and (where applicable) input position. The **Electronic Gearing** screen also has provisions for setting the function of the X9 connector.

8.4.1.3 Function Settings

Function settings for the X9 connector are assigned through the 36.18 DRV.EMUEMODE parameter.

Emulation Mode

0-Input (No EEO Output). While in Emulation Mode, the EEO connector (X9) is configured as an input. This is the recommended setting and should be used in coordination with FB2.MODE to select the type of inputs the secondary feedback will accept. See Feedback 2 (FB2 Parameters) for definitions for the EEO Connector (X9). Note that this mode is also deprecated and will behave as it did with firmware versions prior to M_01-03-00-000.

In earlier firmware versions, this mode indicates that the EEO connector is not operative.

8.4.1.4 Output Modes 1 and 2

The drive generates ouput pulses based on the motor position. Pulse outputs on the SubD connector X9 are three signals: A, B and index, with 90° phase difference (i.e. in quadrature, hence the alternative term “A quad B” output), with a zero pulse.

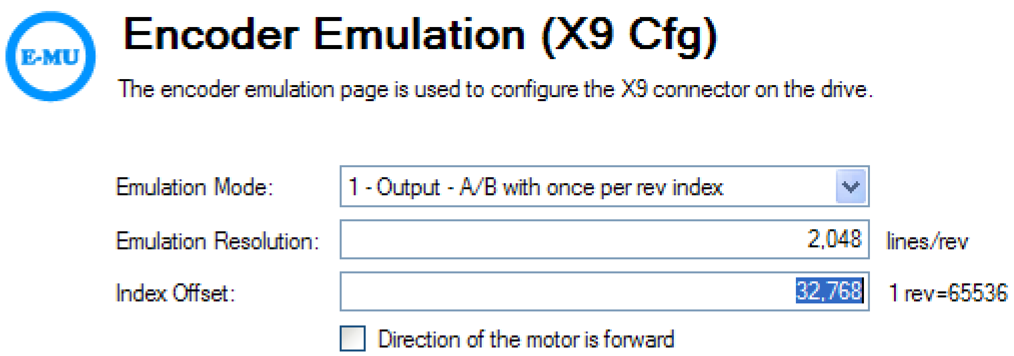
If you are using the AKD as a master, the slave drives use the master's encoder output signals as command input and follows these commands (velocity and direction). The drives operate from an internal supply voltage.

Mode 1– A quad B with once per rev index pulse

Output Mode 1 - A quad B with Once per Rev Index Pulse Connection Diagram

This output mode simulates an encoder signal from the X9 port to another AKD or external controller. EEO resolution (36.21 DRV.EMUERES) defines how many counts are outputted for one revolution of the primary feedback.

Index offset (36.22 DRV.EMUEZOFFSET) determines the point during the revolution of the primary feedback when the index pulse (X9 pins 7&8) is output through the X9 port. The pulse will occur once every revolution of the primary feedback at the positive value of the offset. Notice that the offset's resolution is set based on 1rev = 65536, or a 16-bit scale. This is fixed and independent of the Resolution setting of the A and B channel above.



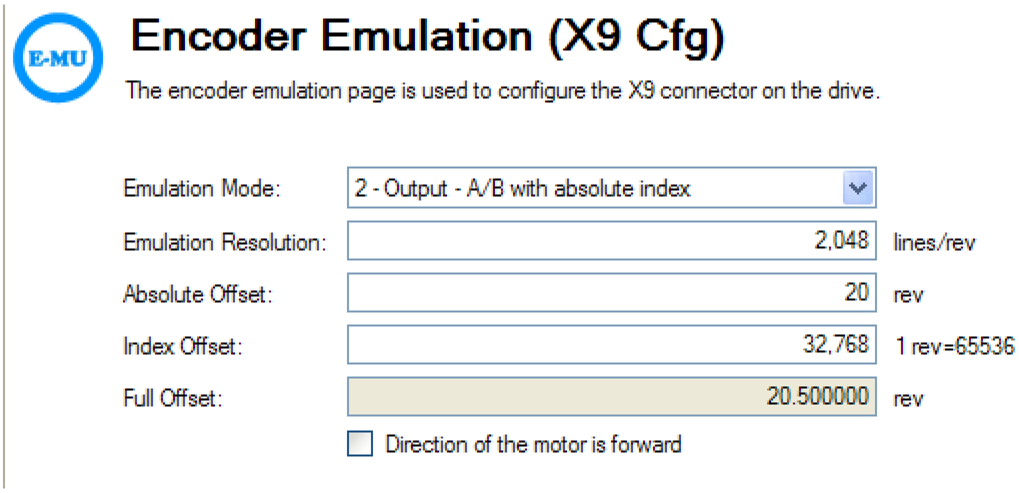
In this case, the Index is offset 180 degrees, or halfway through the revolution of the primary feedback.

Mode 2– A quad B with absolute index pulse

Output Mode 2 - A quad B with Absolute Index Pulse Connection Diagram

When mode 2 is chosen, a box will appear for an absolute index point to be entered (36.19 DRV.EMUEMTURN). The absolute index pulse will be output when the motor position reaches the full offset. The sum of the Absolute Offset (the revolutions) and the Index Offset (a fraction of a revolution) make up the "Full Offset". The index offset is fixed as 1rev = 65536, which is a 16-bit scale.

The "Full Offset" is a read-only calculation provided for easier understanding of the placement of the index pulse. In the example below, the pulse will occur at 20.5 positive revolutions of the motor.



8.4.1.5 Input Modes 3, 4, and 5 (deprecated)

The X9 connector is also capable of input modes. These input modes correspond to the signal types described below. The 11.7 Electronic Gearing screen also includes provisions for setting the function of the X9 connector for input modes. Because these settings are deprecated it is recommended to set DRV.EMUEMODE to 0 and use FB2.MODE to select the type of inputs the secondary feedback will accept.

Mode 3-A quad B signals

Input Mode 3 - A quad B Signals Connection Diagram

Input mode 3 allows an A quad B encoder or the encoder emulation output of another drive to be connected and used as a commander encoder, dual loop feedback, gearing, or camming input.

Mode 4-Pulse/direction signals

Input Mode 4 - Pulse/direction Signals Connection Diagram

Input mode 4 allows the drive to be connected to a third-party stepper-motor controller. The number of steps can be adjusted so that the drive can be adapted to match the step-direction signals of any stepper controller.

Mode 5-Up/down signals

Input Mode 5 - Up/down Signals Connection Diagram

The drive can be connected to a third-party controller which delivers up-down signals.

8.4.1.6 Resolution

The resolution setting defines how many counts are output for one revolution of the primary feedback (when X9 is configured as an output), or how many counts will be considered a full revolution of the input signal from an external controller (when X9 is configured as an input). The resolution value is post-quadrature; for example, a 1,000 count encoder has a resolution of 4,000 counts.

Note: If the resolution value is set to 0, then the X9 connector will not produce a command.

8.4.1.7 Related Parameters and Commands

The DRV.EMUEMODE parameter sets the EEO output and input modes. The resolution (before multiplication) is set by the DRV.EMUERES function. The DRV.EMUEZOFFSET parameter adjusts and saves the zero pulse position within one mechanical turn. DRV.EMUEMTURN sets the absolute index point in mode 2 and DRV.HANDWHEEL sets the position at which the index pulse is output in output mode 2.

DRV.EMUEDIR

DRV.EMUEMODE

DRV.EMUEMTURN

DRV.EMUERES

DRV.EMUEZOFFSET

8.5 Non-Plug and Play Feedback Devices

To set up an AKD drive with a non-plug and play feedback device (for example a resolver or an encoder), you must select a motor from the list of standard or custom motors or enter the motor parameters manually. Once the motor data is entered into WorkBench, an initial set of parameters can be calculated and downloaded to the drive.

8.5.1 Parameters

The following parameters can be initialized to their default values or calculated from user-supplied motor data:

IL.KP	IL.LIMITN	VL.KP	PL.KI = 0 (Default Value)
IL.KFFACC	IL.LIMITP	VL.KI	PL.INTINMAX = 0.419 (Default Value)
IL.KBUSFF	IL.PWMFREQ	VL.LIMITN	PL.INTOUTMAX = 0.419 (Default Value)
IL.FRICTION	IL.KVFF	VL.LIMITP	MOTOR.IPEAK
IL.OFFSET	IL.FOLDFTHRESHU	VL.THRESH	MOTOR.ICONT
IL.INTEN	IL.FOLDWTHRESH	VL.KVFF	MOTOR.PITCH
IL.IVFB	IL.MFOLDD	PL.KP	MOTOR.POLES
IL.KPDRATIO	IL.MFOLDT	PL.KD = 0 (Default Value)	MOTOR.TYPE

8.5.2 Calculations

WorkBench uses the following equations to calculate parameter values.

8.5.2.1 Current Loop

The current loop proportional gain (IL.KP) must be such that the current loop closed loop crossover frequency/bandwidth (BW) nominal is the lesser of 2000 Hz or (PWM Frequency/4).

Then, with this frequency:

IL.KP = 2*π*(desired bandwidth in Hz)*(motor L line-line in H)

Setting the D and Q components

8.5.2.2 Velocity Loop

VL.KP = (2*π*75)*(2*Jm/Kt) = 300*PI*Jm/Kt

VL.KI = 5

8.5.2.3 Position Loop

PL.KP = ??

8.5.2.4 Slider Tuning

The slider tuning algorithm in WorkBench currently uses the following algorithm.

8.5.2.5 Input - Motor Data

The values for inertia, Jm (Kg / cm2), and torque constant, Kt (Nm/A), are obtained from either the SFD or the motor model number that you select.

8.5.2.6 Constants

Velocity Loop Bandwidth – BW = The default value is 75Hz.

Input - Inertia Ratio – Q = The default is 1.

8.5.2.7 Output - Control Loop Gains

VL.KP = 2 * π * BW * Jm * (1+Q) * 0.0001/Kt

VL.KPI = BW*0.08 -1 (minimum of 1)

PL.KP = BW/5

8.6 Foldback

The foldback feature in the AKD protects both the motor and the drive from overheating. Two current foldback algorithms run in parallel in the drive: the drive foldback algorithm and the motor foldback algorithm. Each algorithm uses different sets of parameters. Each algorithm has its own foldback current limit, IL.DIFOLD (drive foldback) and IL.MIFOLD (motor foldback). The overall foldback current limit is the minimum of the two at any given moment.

IL.IFOLD = min (IL.DIFOLD, IL.MIFOLD).

Foldback is not the same as current limits. Instantaneous current limits for the drive are set by the positive peak current (IL.LIMITP) and negative peak current (IL.LIMITN) in the Limits view in WorkBench. The foldback algorithms may reduce the current output to the motor in spite of the current limit settings.

8.6.1 Drive Foldback

The drive foldback algorithm monitors current feedback; since this is a monitoring function, the drive foldback parameters are not user configurable. If the current feedback exceeds the continuous current rating of the drive (DRV.ICONT), then the algorithm decreases the current to the DRV.ICONT level. For example, under a step command input condition, the foldback algorithm allows maximum peak current (DRV.IPEAK) output from the drive for a short period of time (up to IL.DFOLDD time), after which the drive begins an exponential foldback (with time constant of IL.DFOLDT) of the current to the drive's continuous current.

It takes a few seconds for the exponential decay to drop from the drive's peak current to its continuous level. A recovery time, where the feedback current is below DRV.ICONT level, is required to allow current above DRV.ICONT level again. A recovery time of IL.DFOLDR with 0 current allows the drive to apply DRV.IPEAK current for IL.DFOLDD time.

8.6.2 Setting up motor foldback

Motor foldback is set up automatically when using a plug and play motor or when a particular motor is selected from the WorkBench database.

If you are using a custom motor, use the Motor view in WorkBench to set custom values needed for foldback configuration.The parameter entries required for the drive to apply motor foldback protection properly are coil thermal constant (MOTOR.CTFO), peak current of the motor (MOTOR.IPEAK), and continuous current of the motor (MOTOR.ICONT). These values are used to setup the algorithm for motor foldback.

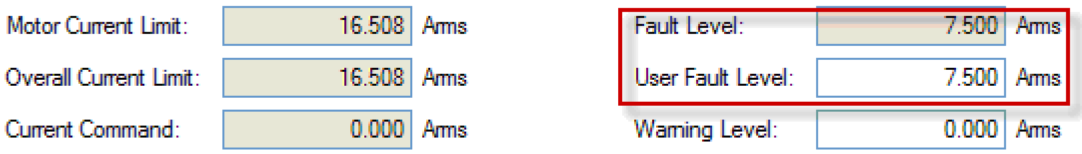
8.6.3 Setting Fault and Warning Levels

The **Motor Current Limit** and **Overall Current Limit** boxes show status variables that are constantly updated by the foldback algorithm. As current is applied above the drive or motor continuous rating, the capacity for the application of peak current starts to decrease. The motor current limit and overall current limit are actively decreased. If the move profile requires less than continuous current rating for a period of time, the Motor Current Limit and Overall Current Limit begin to increase until they reach maximum foldback capacity once again.

When Motor Current Limit or Overall Current Limit < Warning Level, an n524 status warning is triggered. When Motor Current Limit or Overall Current Limit < Fault Level, an F524 fault is triggered and the drive power stage is disabled. The load then coasts to a stop.

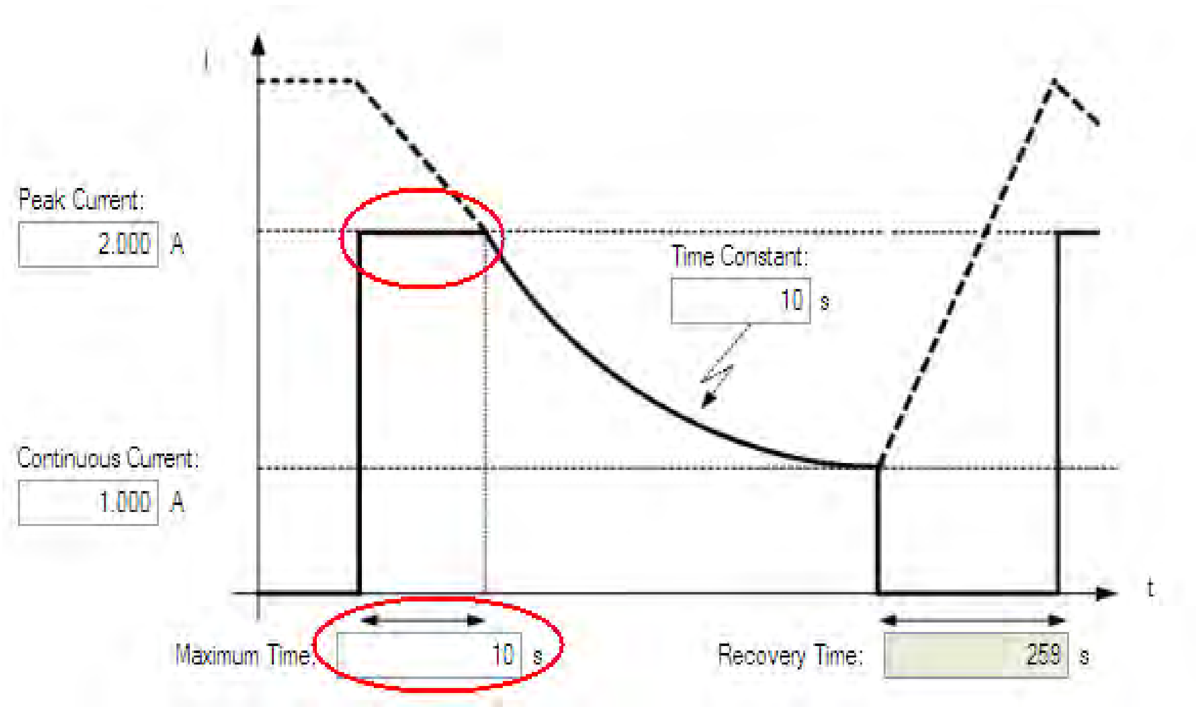
In the **Foldback** screen, setting the Warning Level to 0 turns off the warning feature. Otherwise, the Warning Level must be set above the Fault Level, but below the Motor Current Limit and Overall Current Limit to trigger a warning.

If User Fault Level is set above Fault Level, the User Fault Level will be ignored. The User Fault Level is used to increase the time the drive is operated in foldback mode without faulting. For instance if the default Fault Level is 9.000 Arms and a User Fault Level is set to 7.5 Arms, the Fault Level is changed to 7.5 Arms. This configuration effectively increases the time that foldback will be applied to the drive before faulting.



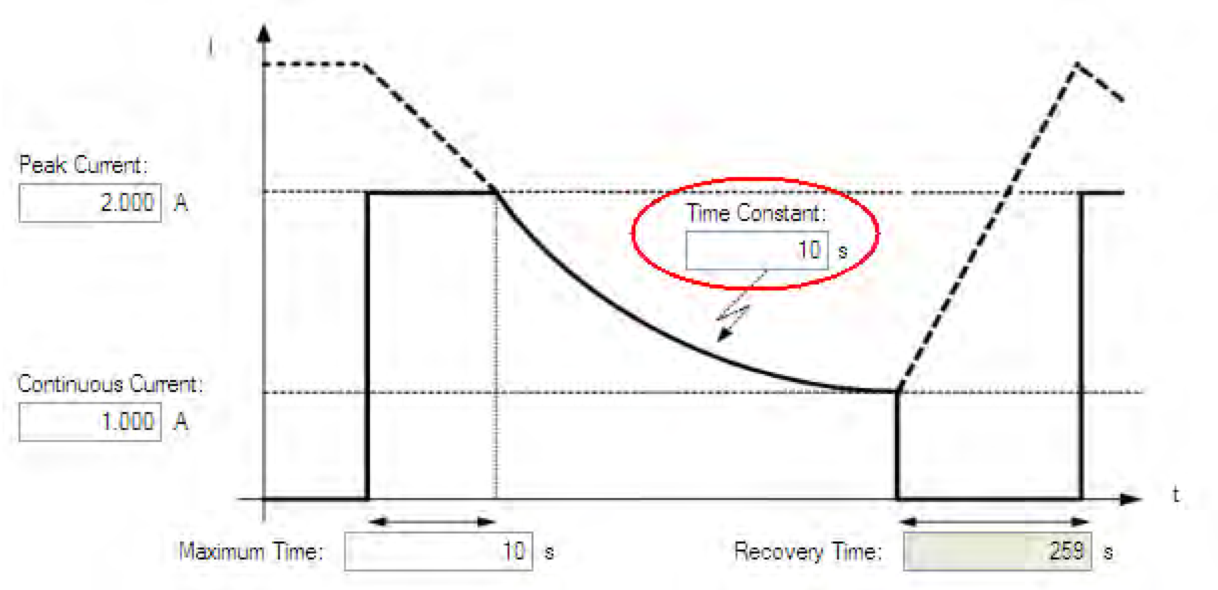
8.6.4 Motor Peak Current Time

Peak current (MOTOR.IPEAK) along with coil thermal constant (MOTOR.CTFO) are used to determine the maximum time the motor can sustain peak current. The maximum time (IL.MFOLDD) is displayed in the **Foldback** screen as shown below:



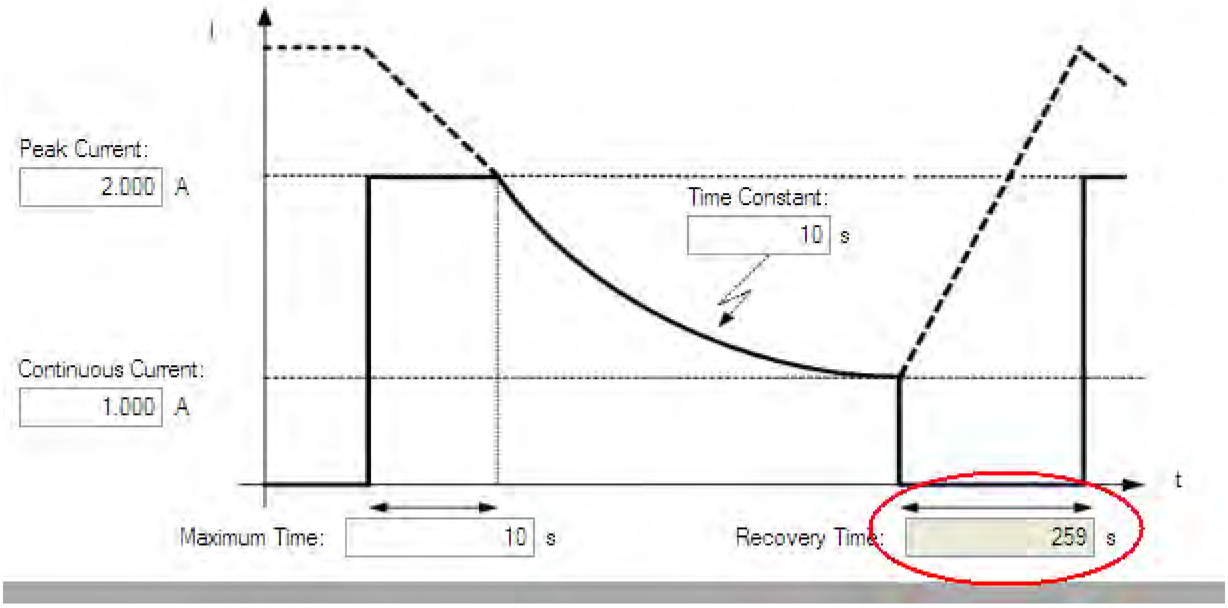
8.6.5 Motor Foldback Ramp

Once the maximum time for motor peak current has elapsed, if the move profile still demands peak current from AKD, the drive will exponentially lower the current applied to the motor. The Time Constant (IL.MFOLDT) dictates the profile. A smaller time constant represents a steeper decline in current applied to the motor.



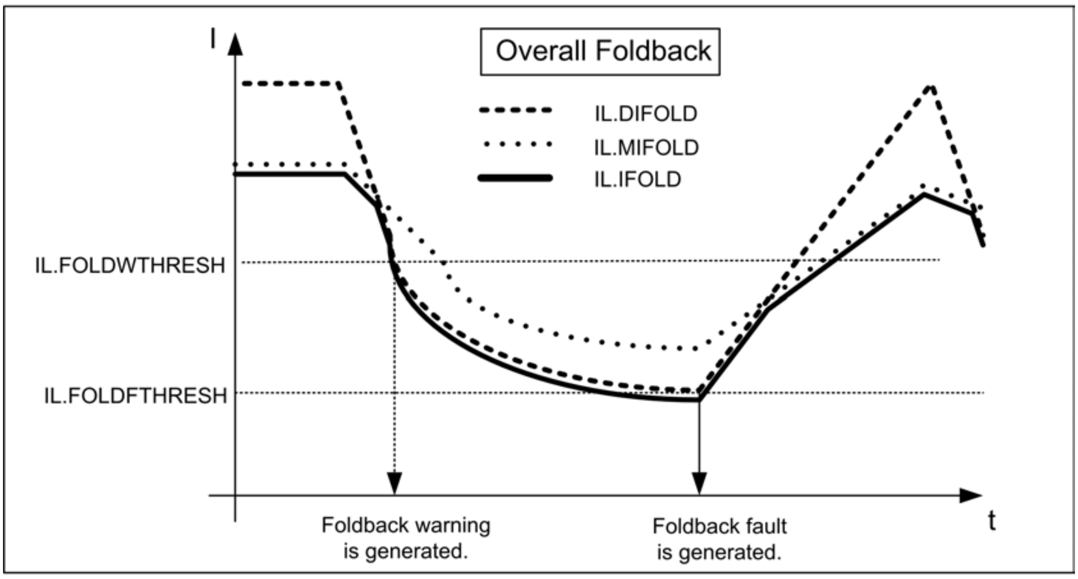
8.6.6 Motor Recovery

Once the peak motor current available has reached the continuous current of the motor, the motor needs Recovery Time (IL.MFOLDR) to cool down. Full Recovery Time (IL.MFOLDR) at 0 current is required for the motor to reach full maximum capacity in the shortest amount of time. The drive can command a current less than continuous current to continue driving the load, but the recovery time for full maximum capacity is increased.



8.7 Overall Foldback

The overall limit is the momentary minimum value between the drive foldback and the motor foldback. The overall foldback is shown in the diagram below. You can set the warning and the fault levels as shown in the diagram.



8.8 Brake

The brake output on connector X2 controls a mechanical brake that optionally may be fitted to a motor. The brake is applied and released relative to the **Drive Active** state of the drive. You can modify the release and apply delays using the parameters shown below.

Button or Dialog Box	Description	Parameter
Brake Control	Does this motor have a brake?	MOTOR.BRAKE
Brake Release Delay	The time between the drive being active and the brake being released.	MOTOR.TBRAKERLS

Button or Dialog Box	Description	Parameter
Brake Apply Delay	The time between the brake being applied and the drive not being active.	MOTOR.TBRAKEAPP

8.9 Using Position Capture

8.9.1 Overview

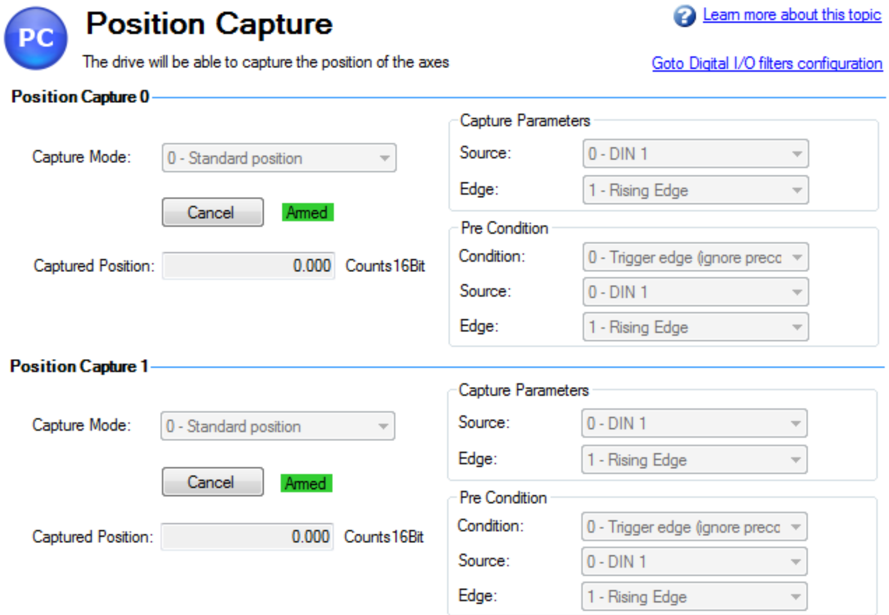
Position capture allows you to precisely determine what the motor position (or drive clock time) was when a specific event triggers. The AKD drive uses two independent captures, which operate similarly. The descriptions provided in this user guide refer to Capture 0, but also apply to Capture 1.

Position capture is used in precision environments, where the motor may be moving at very high velocities, an IO is triggered, and you must know exactly where the motor was when the event occurred. Homing algorithms often use position capture.

Position capture will capture the motor position (or drive clock time) when the capture trigger is activated. The capture engine operates on a faster clock than the 16 kHz clock used in the scope and recorder. This faster clock allows the position capture to obtain more accurate results than those obtained using the scope or recorder clock.

8.9.2 Configuring Position Capture

To configure the position capture, select **Position Capture** from the **Settings** group:



8.9.2.1 Setting the Capture Source (CAP0.TRIGGER)

The capture source determines which input on the drive causes the position capture to trigger.

Capture Source Options:

0 - 6: These options trigger on the Digital Input 1 pin through Digital Input 7 pin, respectively.

7- 9: These options trigger on the X9 connector RS485 Input 1 pin through RS485 Input 3 pin, respectively.

10: This option triggers on the primary encoder index.

8.9.2.2 Setting the Capture Mode (CAP0.MODE)

The capture mode determines what information is saved on the drive when the capture triggers.

Capture mode options:

0 – Standard Position. Captures the motor position in drive units

1 – Drive Internal Time. Captures the time of the trigger in ns

2 – Distributed Clock Time. Captures the network (Ethercat) distributed clock time

3 – Primary Encoder Signal. Captures the motor postion triggering on primary encoder index. This mode automatically rearms after each trigger.

If either **0 - Standard Position** or **3 - Primary Encoder Signal** is selected, delays may occur and are associated with feedback devices that are digital or interpolated .

8.9.2.3 Arming and Retrieving the Capture Value (CAP0.EN and CAP0.T)

CAP0.EN arms the capture and CAP0.T retrieves the capture value. Once you have configured the capture, you must arm it before it will trigger. Click **Arm** (1) to arm the capture.

Once the capture is armed, when it triggers, the captured value will be displayed below the Arm button (2).

8.9.2.4 Setting the Capture Edge (CAP0.EDGE)

The capture edge determines which input state change triggers the capture.

Capture Edge Options:

1 – Rising Edge. Captures when the input signal goes high, from a low state.

2 – Falling Edge. Captures when the input signal goes low, from a high state.

3 – Both Edges. Captures any time the input signal changes state.

8.9.2.5 Setting the Pre-Condition Event: (CAP0.EVENT)

The Capture Pre-Condition Event gives the user more flexibility in setting what conditions must be present for the Capture to trigger.

Event Options:

0 – No precondition. Capture triggers as soon as the capture edge occurs.

1 – Trigger Edge after precondition. Captures triggers only when the precondition occurs before the capture edge occurs.

2 – Trigger Edge while precondition = 1. Captures triggers only while the precondition is evaluated and is true while the capture edge occurs.

3 – Trigger Edge while precondition = 0. Captures triggers only while the precondition is evaluated and is false while the capture edge occurs

8.9.2.6 Setting up a Pre-Condition for complex capture

Setting the Precondition Edge: (Terminal Command: CAP0.PREEDGE)

The pre-edge determines what input state change triggers the precondition. This feature operates the same as the capture edge described above.

Setting the Pre-Condition Select: (Terminal Command: CAP0.PRESELECT)

The preselect chooses what input source will trigger the precondition (based on the preedge setting, and the prefilter setting). This feature operates the same as the capture source described above.

Related Parameters

31 CAP Parameters

9 Configuring with Linear Motors

9.1 Connecting a DDL Motor to an AKD Drive

Before Connecting a DDL motor to an AKD Drive, the following tasks must be accomplished:

1. Integrate motor coil and magnet way onto a bearing structure so that the motor moves freely. (Rubber stops at the end of travel are recommended, especially during commissioning)
2. Linear scale is integrated to the assembly and set up with the correct alignment and airgap to provide an appropriate sinusoidal or digital feedback signal.
3. Determine the resolution of the Linear Scale in micrometers (microns) per cycle (this will be listed in the documentation of the linear scale).

Connect Hall sensor, Linear Scale, and motor temperature cables through the ACI-AKD cable assembly to the AKD Drive X10 Feedback Connector.

Connect the motor power leads to the AKD motor power connector X2 with the following connections:

Red -> U

White -> V

Black -> W

Yellow / Green -> PE

Apply 24 volt logic power to the AKD and launch Workbench from a computer to interface with the AKD drive. From the main tree, under “Settings”, select “Motor” and click on “Select Motor”. Note: if “Select Motor” is grayed out, “Motor Autoset” may need to be set to “0 –Off” to enable the “Select Motor” option. On the Select Motor screen, for “Motor Family” select either “IC and ICD Series Ironcore DDL” or “IL Series Ironless DDL”. On the Select Motor screen for “Name” select the appropriate motor part number.

Click OK.

From the main tree, under “Settings”, select “Feedback 1”

Under “Feedback Selection”, select either “10 – Incremental Encoder with Halls”, or “20 – Sine Encoder with Halls” to correspond to the Linear Scale that is integrated with the motor.

Using the resolution of the Linear Scale in Microns per cycle, the Sine Cycles/Magnet Pitch is determined. Use the following:

1. Take the reciprocal of resolution to get cycles per micron
2. Multiply by 1000 to get cycles per millimeter
3. Multiply by 32 millimeters per Magnet Pitch to get Sine Cycles/Magnet Pitch

For example, if the resolution of the Linear Scale is 40 microns per cycle, then the Sine Cycles/Magnet Pitch would be 800.

The Linear Scale phase direction must be verified. Observe the “Feedback 1” screen in Workbench. When the coil assembly is moved in the direction of the cable exit (think of pulling the coil by the cable) the Position Feedback should increase positively in value and in the motor graphic, the gray block should move to the right. If the direction is opposite, then the A+ and A- signals on the Linear Scale must be swapped to correct the phase direction.

The motor is now ready for velocity loop and position loop compensation.

10 Selecting Units for Your Application

10.1 Selecting and Saving Units

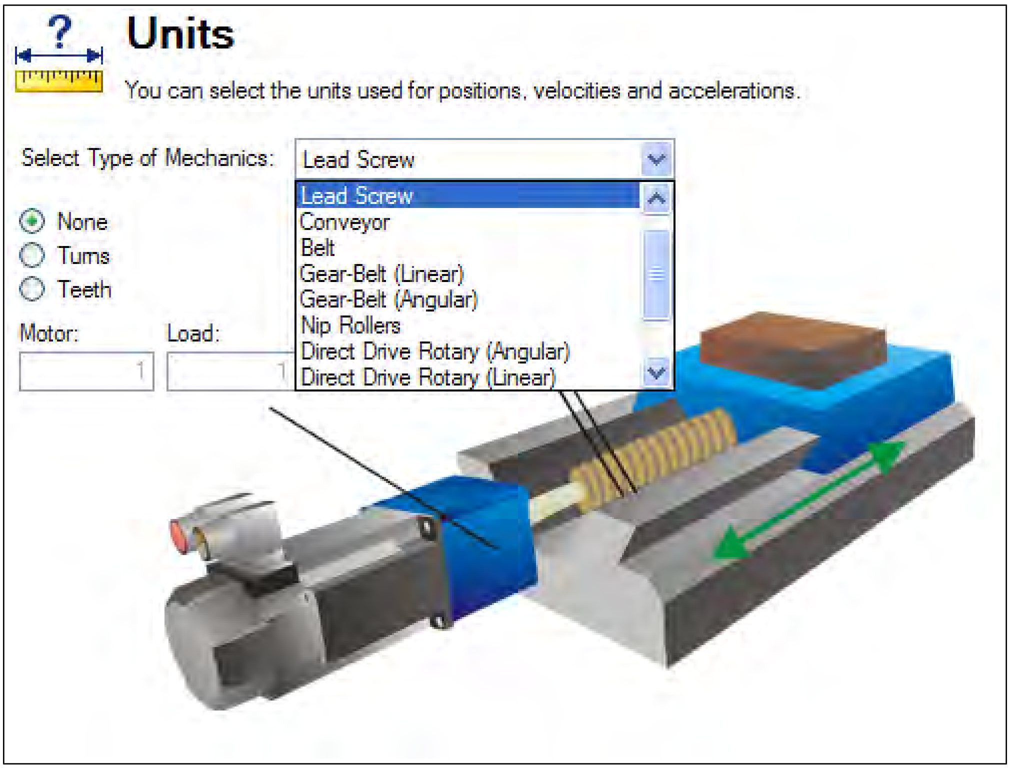
The drive uses three primary measures of motion: position, velocity, and acceleration. You must first choose units of measurement for each of these, and then enter the details of the mechanics in order to scale the chosen units appropriately.

The settings for units are automatically applied. The unit settings in the drive will reflect last settings made in the units screen before exiting. To save settings into the nonvolatile memory of the drive, click the **Save to Drive** button in the toolbar.

10.2 Units Example

1. Select type of mechanics

To set the units in the drive for a particular application, first select the type of mechanics present.



2. Select Position Units

By default, position is measured in counts. Counts are the smallest unit of position that can be represented in the drive. This unit of measure equates to 4,294,967,296 counts/revolution of the motor. You can use the units screen to change this measurement into a meaningful scale relating to the units of the application.

For position units, five selections are available:

0 –Counts (4,294,967,296/rev)

1 –Radians (2*π /rev)

2 –Degree (360/rev)

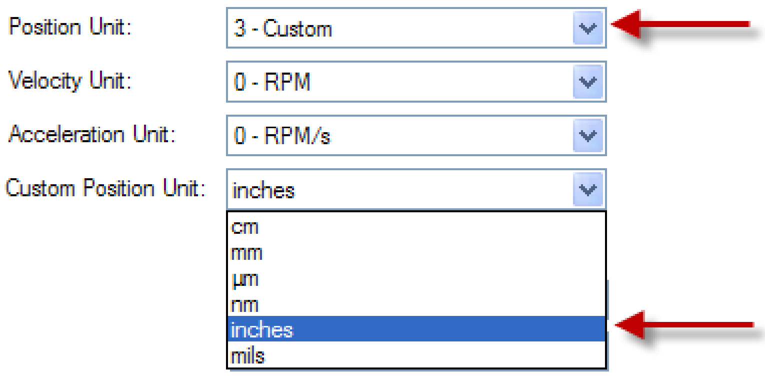
3 –Custom (set by user according to mechanics of machine)

4 –Counts (16-bit) (65,536 /rev)

Custom Units

The drive uses full 32-bit quantization for internal calculations regardless of unit settings. User units settings will not affect performance, resolution, or accuracy of the servo system.

Choose “3-Custom”, and then select your desired position units, for example, millimeters.



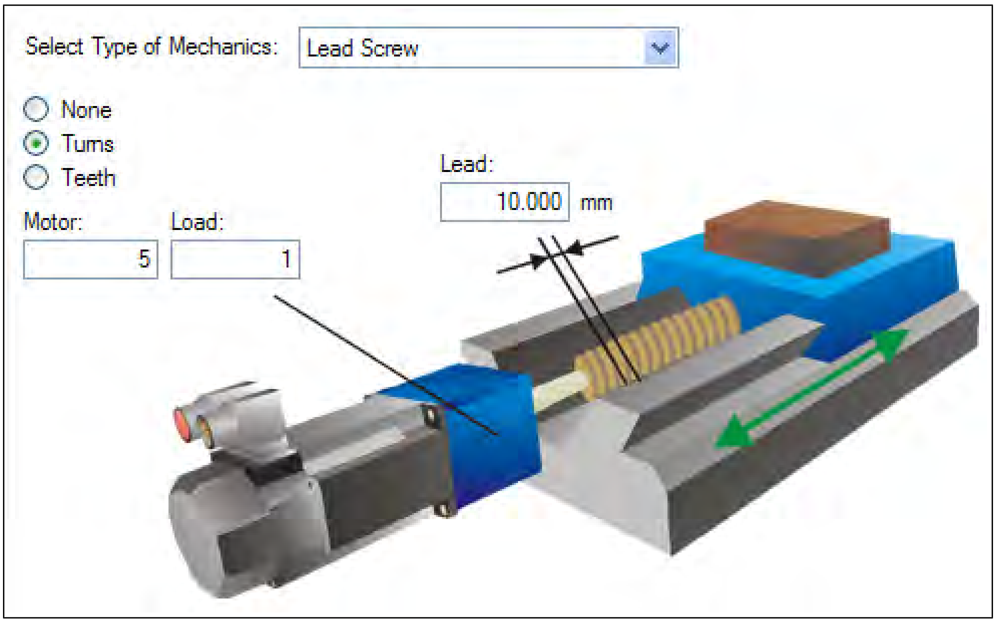
3. Select Velocity Units

For velocity, select **Custom/s** to set the measurement to mm/sec.

4. Select Acceleration Units

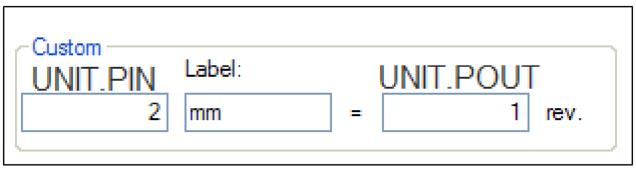
For acceleration, select **Custom/s^2** to set the measurement to mm/sec^2.

Once the chosen units of measurement are established, the details of the mechanics need to be entered to establish the scaling of the chosen units.



In this example, a lead screw with a 10 mm lead and a 5:1 gearbox has been selected. A 10 mm lead means the load will traverse 10 mm for every turn of the screw. A scale factor is applied based on the values entered for the chosen mechanics. This scaling is done through UNIT.PIN and UNIT.POUT parameters in the AKD, which are automatically adjusted when the mechanics values are entered.

In this example, scaling is adjusted as follows:



UNIT.PIN is calculated as follows:

10 mm/screw turn * 1 screw turn/5 motor turns = 2 mm/motor turn

UNIT.PIN and UNIT.POUT can be directly entered using the **Motor Only** selection from the **Select Type of Mechanics** box.

Related Parameters

59 UNIT Parameters

DRV.NVSAVE

MOTOR.TYPE

11 Configuring General Drive Settings

11.1 Digital Inputs and Outputs

11.1.1 Overview

The drive has programmable digital inputs and outputs that you can use to initiate motion, control auxiliary devices, or trigger other actions. The inputs and outputs should be wired according to the instructions in the drive Installation Manual. Note that the input on pin 4 of the X8 connector is dedicated as an enable input.

11.1.2 Using Digital I/O

Once wired correctly, digital inputs and outputs can be used for a variety of functions such as to trigger auxiliary devices, initiate homing moves or other motion tasks, or set travel limits. This section describes the specific functionality of the programmable I/O.

I/O Tip: When using I/O devices, you must carefully consider the type of device you use for switches. An unsuitable switch can cause switch bounce, which in turn can cause erroneous triggers to occur. For example a low cost xx switch, as it is toggled, will bounce a few times before it turns on or off. A device that is monitoring these inputs frequently may interpret the bounce as multiple triggers of that I/O. The drive has the ability to reduce this type of error using some debounce techniques to ignore sudden state changes caused by bounces.

11.1.3 Digital Inputs

Digital inputs can be set in different modes based on the desired function. These functions are outlined below:

Mode 0: Off

This mode is the non-use state and is the default setting for the drive. This mode is valid for all opmodes and command source combinations.

Mode 1: Fault Reset

When an input configured with this mode becomes active, the drive will try to clear all active faults. This mode is edge triggered, so the action occurs only once. If the condition that triggered the fault is still present, the fault condition will remain. See 18.1 Fault and Warning Messages for details regarding the behavior of individual faults.

This mode is valid for all opmodes and command source combinations.

Mode 2: Start Motion Task

This mode is used to start motion task number x, where x = the value of the associated input parameter. This input will trigger a motion task number as defined in the extra parameter field for this input.

This mode is valid for opmode 2 (position) and command source 0 (service) only.

Once started, the motion task will run until completed. Changes on the input that started the task will be ignored until the motion task is complete. If multiple inputs are configured to start a task, all of these inputs will be gnored until the task is complete. If a motion task is already active in the drive, changes on this input will be ignored.

Example:

-->`DIN1.MODE 2` - sets the input mode to be Start Motion Task

-->`DIN1.PARAM 1` - sets the Motion Task start to 1.

-->`MT.LIST` - confirms that Motion Task 1 exists.

-->`10.000 [counts] 1000.000 [rpm] 0 1001.358 [rpm/s] 1001.358 [rpm/s] 0 0 0 [ms]`

<Create a rising edge of the input>

<Motion Task 1 executed>

Mode 3: Motion Task Select Bit

This mode is used to select the motion tasks that are stored in the drive (numbers 1 to 127) or the reference traverse/homing (0). The motion task number is presented externally at the digital inputs. The motion task set by this mode will be executed when digital input assigned to mode 4 (motion task start selected) gets a rising edge.

This mode is valid for opmode 2 (position) and command source 0 (service) only.

> **Example**
>
> Assume:
>
> DIN1.MODE = DIN2.MODE=DIN3.MODE =3
>
> The state of input 1 and 3 is 1.
>
> The state of input 2 is 0.
>
> Motion task 5 ($5 = 2^0+2^2$) will be executed.

Mode 4: Motion Task Start Selected

This mode is used to start the motion task that is stored in the drive by giving the motion task number. This input uses a secondary variable for the motion task number to be started with the Input trigger. The secondary variable is set by mode 3 (Motion task select bit).

Motion task number “0” initiates homing/reference traverse. A rising edge starts the motion task and a falling edge cancels the motion task.

This mode is valid for opmode 2 (position) and command source 0 (service) only.

Mode 5: Start Home

This mode is used to start the homing motion task on the rising edge. The falling edge has no effect on this input mode of operation.

This mode is valid for opmode 2 (position) and command source 0 (service) only.

Mode 6: Start Jog

This mode is used to start a jog move. This input mode utilizes a secondary variable for the jog’s velocity. The jog will start upon a rising edge. A falling edge stops the jog.

This mode is valid for opmodes 1 (velocity) and 2 (position) and command source 0 (service).

Mode 7: Reserved

Mode 8: Zero Latch

This mode is used to define the current drive position as the zero pulse for the drive EEO and sets the incremental encoder zero pulse offset. The current position, depending on the incremental encoder resolution that is set, is calculated at the rising edge and stored as an offset. An automatic save is then generated. This function is used to perform an automatic setting of the zero pulse in one turn of the motor.

This mode is valid for all opmodes and command source combinations.

Mode 9: Command Buffer

This mode is used to execute four different sets of command buffers. Each set contains two buffers: low and high, for a total of eight buffers. DINx.PARAM for this mode can be 1 to 4, and determines which set of buffers to use.

To set the high and low values of the eight buffers from the terminal screen, use the commands DIN.HCMDx and DIN.LCMDx (1<=x<=4). Use ";" to separate the two buffer commands. Each buffer contains up to 128 characters.

> **Example**
>
> -->`DIN1.MODE 9` (sets command buffer mode to digital input 1)

-->`DIN1.PARAM 1` (sets the first set of buffers to digital input 1)

-->`DIN.HCMD1 DRV.OPMOE 1;` (sets high command buffer)

-->`DIN.LCMD1 DRV.OPMOE 0;` (sets low command buffer)

Under this configuration, a rising edge in digital input 1 will set DRV.OPMODE to 1 and a falling edge will set DRV.OPMODE to 0.

You can also set the command buffers from the **Digital I/O** view in WorkBench; see 11.2 Command Buffer

This mode is valid for all opmodes and command source combinations.

Mode 10: Control Fault Relay

This mode is used to create an external fault.

Input state is 0 – drive regular behavior

Input state is 1 – "Fault 245 – external fault" is issued.

This mode is valid for all opmodes and command source combinations.

Mode 11: Home reference

This mode is used to receive a physical home reference switch located on the machine to use for the different Home Types.

This mode is valid for opmode 2 (position) and command source 0 (service) only.

Mode 12: Reserved

Mode 13: Controlled Stop

This mode is used to stop the motor using the deceleration variable ramp. If zero velocity is reached, the power stage is then disabled. Also see controlled stop (CS) parameters and commands and Controlled Stop.

This mode is valid for all opmodes and command sources.

Mode 14: Reserved

Mode 15: Quick Stop

This mode is used to stop the motor. It is equivalent to issuing a DRV.STOP command.

This mode is valid for all opmodes and command sources 0 (service) and 2 (electronic gearing).

Mode 16: Activate Electronic Gearing

This mode starts/activates an electronic gearing procedure upon a rising edge.

This mode is valid for opmode 2 (position) and command source 2 (electronic gearing).

Mode 17: Activate Electronic Gear Position Shift

This mode is used to add a position shift to the gearing upon a rising edge. The distance of the position shift is set by the secondary variable. The secondary variable is set by DINx.PARAM. The parameter is in position units and is used to incorporate a phase shift while operating in electronic gearing mode.

This mode is valid for opmode 2 (position) and command source 2 (electronic gearing).

Example

An input is set to add a 180 degree "phase shift" when triggered. As the drive is following the electronic gearing input, the input is triggered and the motor will follow the drive acceleration and deceleration rates to shift 180 degrees while maintaining the gearing synchronization.

Mode 18: Positive Limit Switch

This mode will cause the input to operate as the positive limit switch. If the positive limit switch input is triggered (goes low), the positive direction motion will then be stopped.

This mode is valid for all opmodes and command source combinations.

⚠ CAUTION	**When setting up the hardware limit switches, you must be certain that the switch remains in the triggered state until you move off of the switch. A very low deceleration rate combined with a high approach velocity may overshoot the switch. This action will caue the position limit warning to be canceled. The warning is not latched, therefore if the switch is overshot, additional movement in the same direction (if commanded) will be possible. This movement can cause machine damage.**

Mode 19: Negative Limit Switch

This mode will cause the input to operate as the negative limit switch. If the negative limit switch input is triggered (goes low), the negative direction motion will then be stopped.

This mode is valid for all opmodes and command source combinations.

⚠ CAUTION	**When setting up the hardware limit switches, you must be certain that the switch remains in the triggered state until you move off of the switch. A very low deceleration rate combined with a high approach velocity may overshoot the switch. This action cancels the position limit warning. The warning is not latched, therefore if the switch is overshot, additional movement in the same direction (if commanded) will be possible. This movement can cause machine damage.**

Mode 20: Brake Release

This mode is used to apply or release the brake when the drive is not active.

Input = 0: the drive controls the brake (regular drive behavior)

Input = 1: the user controls the brake (apply or release using commands)

This mode is valid for all opmodes and command source combinations.

Mode 21: Current Limit

This mode is used to limit the drive current. The current limit is set by a secondary variable; use DINx.PARAM to set the secondary variable.

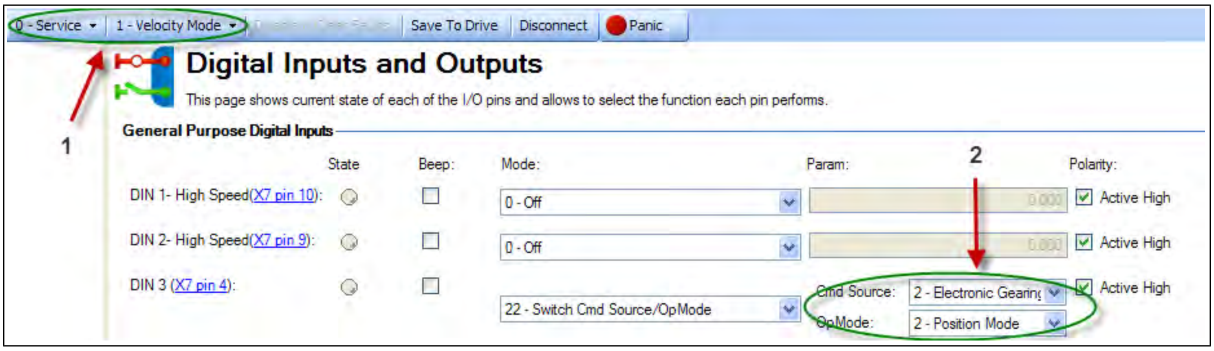
This mode is valid for all opmodes and command source combinations.

Mode 22: Switch Command Source and Opmode

This mode is used to switch between the present command source/opmode and another command source/opmode setting predetermined by the user upon the level change of a digital input. This mode is valid for all opmodes and command source combinations. Arrow 1 in the screen shot below indicates the present command source/opmode that the drive is set for. This is the mode the drive is in when the digital input is not high. This low state is determined by the original settings for DRV.CMDSOURCE and DRV.OPMODE.

The drive will switch into the command source/opmode setting shown in arrow 2 when the digital input level changes to high. This setting is stored by DINx.PARAM and is edited with the drop down boxes at arrow 2.

NOTE	When the digital input is switched high, DRV.CMDSOURCE and DRV.OPMODE will take the values defined by DINx.PARAM. Do not perform a “drive save” in this state, or the low state and high state settings will become the same.



DINX.PARAM	Command Source	Opmode
0	0-service	0-torque
1	0-service	1-velocity
2	0-service	2-position
10	1-fieldbus	0-torque
11	1-fieldbus	1-velocity
12	1-fieldbus	2-position
N/A	2-electronic gearing	0-torque
N/A	2-electronic gearing	1-velocity
22	2-electronic gearing	2-position
30	3-analog	0-torque
31	3-analog	1-velocity
32	3-analog	2-position

If more than one digital input is configured to this mode, and one of them is active, then the command source/opmode combination configured for that input will be active. If additional inputs become active, the command source/opmode combination configured for the lowest numbered will be the active one.

Example

Assume:

Input 1 is configured for electronic gearing/position.

Input 2 is configured for service/velocity.

Input 3 is configured for fieldbus/position.

The system is in service/torque.

Result:

With no inputs active, the system remains in service/torque.

If input 3 goes active first, then the system will go to fieldbus/position

If input 1 then goes active, then the lowest active input is now 1 so the system will go to electronic gearing/position

If input 2 then goes active, then the lowest active input is still 1 so there is no change.

If input 3 then goes inactive, then the lowest active input is still 1 so there is no change,

If input 1 then goes inactive, then the lowest active input is 2 so the system will go to service/velocity

If input 2 then goes inactive, then there are no active inputs and the system returns to service/torque.

Mode 23: Change algebraic sign of the measured analog input voltage

This mode can either change the algebraic sign of the measured analog input voltage, or zero the value using a digital input. Since the analog input voltage is used to generate command values in DRV.CMDSOURCE=3 (analog command source), Mode 23 can also be used to change the direction of movement or stop motion using a digital input in DRV.CMDSOURCE=3.

This mode is valid for all opmodes and command source 3 (analog).

The value of DINx.PARAM defines the value of a multiplication factor for the measured analog voltage. The low-byte of the DINx.PARAM value determines the value of this factor, which is multiplied by the measured analog input voltage upon a rising edge on the associated digital input. The high-byte determines the factor upon a falling edge as follows:

DINx.PARAM = 0xFFRR (F=Falling edge; R = Rising edge)

The following values are used in this mode:

Value	Description
0x00	Zero the measured analog voltage.
0x01	Multiply the analog voltage with 1.
0x02	Multiply the analog voltage with -1.
0x03	Zero the measured analog voltage plus trigger in addition a software enable command.
0x04	Multiply the analog voltage with 1 plus trigger in addition a software enable command.
0x05	Multiply the analog voltage with -1 plus trigger in addition a software enable command.
0x06	Zero the measured analog voltage plus trigger in addition a software disable command.
0x07	Multiply the analog voltage with 1 plus trigger in addition a software disable command.
0x08	Multiply the analog voltage with -1 plus trigger in addition a software disable command.

Example 1

DINx.PARAM = 513 = 0x0201

The measured analog input voltage is multiplied with a factor of 1 upon a rising edge on the associated digital input.

The measured analog input voltage is multiplied with a factor of -1 upon a falling edge on the associated digital input.

Example 2

DINx.PARAM = 256 = 0x0100

The measured analog input voltage is multiplied with a factor of 0 upon a rising edge on the associated digital input.

The measured analog input voltage is multiplied with a factor of 1 upon a falling edge on the associated digital input.

Example 3

DINx.PARAM = 1540 = 0x0604

The measured analog input voltage is multiplied with a factor of 1 upon a rising edge on the associated digital input. Additionally, the rising edge on the associated input triggers a software enable command, similar to the DRV.EN command.

The measured analog input voltage is multiplied with a factor of 0 upon a falling edge on the associated digital input. Additionally, the falling edge on the associated input triggers a software disable command, similar to the DRV.DIS command.

11.1.4 Digital Outputs

Digital inputs can be set in different modes based on the desired function. These functions are outlined below.

NOTE If an output is overloaded (> 100 mA), then the output will turn off (with no indication in WorkBench) and remain off until one of the following occurs:

- The power supply driving the output is removed.
- The output is turned off from the firmware.
- The 24V supply to the AKD is power cycled.

If the overload condition still exists, the output will not turn on.

Mode 0-User (Default = 0):The output state is decided by the user or fieldbus. This mode is valid for all opmodes and command source combinations.

Mode 1-Mains Ready: The output mode produces a high signal if the drive DC bus voltage is higher than the under voltage error level and lower than the over voltage error level. This mode is valid for all opmodes and command source combinations.

Mode 2-Software Limit: This output turns on when the software limit positions are reached. This output procudes a high signal if a software limit is reached by traveling in the direction of that software limit. Software limits are set in the **Limits** view. In the **Limits** view, Position 0 is the position limit for negative travel, while Position 1 is the limit for positive travel.

This mode is valid for all opmodes and command source combinations.

Mode 3-Move Complete: When a motion task has completed its move and the trajectory reaches zero and no following tasks are present, the move is considered complete and the output will activate when the actual position is within target_position_area, where target_position_area is as below.

```
target_position_area = motion_task_target_position +/- MT.TPOSWND
```

Mode 3 and Mode 17 - MT in Position are almost identical. Mode 17 will trigger as soon as the load is in the position window, whereas Mode 3 will wait until the trajectory is complete before monitoring the window. Mode 17 may signal faster because of this, and can also potentially bounce out of the window temporarily.

Mode 4 - Position Error Monitor: This output mode produces a high signal when the absolute value of the position error is less than the parameter entered in the extra parameter field and the drive is enabled.

-DOUx.PARAM < PL.ERR < DOUTx.PARAM

Mode 5-Position Greater than X: When the position is greater than the parameter entered in the extra parameter field, the output will activate.

This mode is valid for all opmodes and command source combinations.

Mode 6-Position Less than X: When the position is less than the parameter entered in the extra parameter field, the output will activate.

This mode is valid for all opmodes and command source combinations.

Mode 7-Warning: This output will activate when the drive experiences a warning, such as positive or negative limit switch input triggered.

This mode is valid for all opmodes and command source combinations.

Mode 8-Enable: If you need an output to indicate that the drive is enabled, use this output mode.

This mode is valid for all opmodes and command source combinations.

Mode 9: Reserved.

Mode 10-Motor Brake: The output mode produces a high signal if a brake is released (this is when the power is applied to the brake and the motor is free to spin). The output mode produces a low if a brake is applied (this is when power is removed from the brake and the brake is set).

This mode is valid for all opmodes and command source combinations.

Mode 11-Drive Faults: The output mode produces a high signal if the drive has a fault.

This mode is valid for all opmodes and command source combinations.

Mode 12-Absolute velocity greater than x: The output mode produces a high signal when the absolute value of the velocity is greater than a variable x. Use DOUTx.PARAM to set x.

This mode is valid for all opmodes and command source combinations.

Mode 13-Absolute velocity less than x: The output mode produces a high signal when the absolute value of the velocity is less than a variable x.

Use DOUTx.PARAM to set x.

This mode is valid for all opmodes and command source combinations.

Mode 14-Homing complete: The output mode produces a high signal when the homing process is completed.

This mode is valid for opmode 2 (position) and command source 0 (service) only.

Mode 15 - PLS.STATE bits OR connected: The output mode produces a high signal if at least one of the PLS.STATE bits is high (the PLS is active) and if the corresponding bit in the DOUTx.PARAM parameter also has been set to high. The DOUTx.PARAM command connects the PLS.STATE bits to the digital output itself and thus acts as an enable mask.

This mode is valid for all opmodes and command source combinations.

Example

```
|<- Bit 7 to 0 ->|
DOUT1.PARAM = 23 = 0b 0 0 0 1 0 1 1 1 (Binary code)
```

The digital output 1 is active when bit 0 or bit 1 or bit 2 or bit 4 of PLS.STATE is high. All other bits within PLS.STATE are not considered by the digital output mode due to the DOUT1.PARAM setting. Do not use decimal places for the DOUTx.PARAM parameter for this particular digital output mode.

Mode 16 - Command Buffer Active: The output mode produces a high signal when the commands in a digital input Command Buffer are being executed.

Mode 17 - MT In Position: This output turns on when the position value reaches a window around target position of the active motion task, which doesn't have any further following motion tasks. The motion task target position window size can be assigned using MT.TPOSWND parameter.

```
target_position_area = motion_task_taget_position +/- MT.TPOSWND
```

Mode 3 - Move Complete and Mode 17 - MT in Position are almost identical. Mode 17 will trigger as soon as the load is in the position window, whereas Mode 3 will wait until the trajectory is complete before monitoring the window. Mode 17 may signal faster because of this, and can also potentially bounce out of the window temporarily.

Summary of Opmode and Command Source Dependencies

DINx.MODE	Mode Description	Opmode	Command Source
0	Off	all	all
1	Fault Reset	all	all
2	Start Motion Task	2-Position	0-Service
3	Motion Task Select Bit	2-Position	0-Service

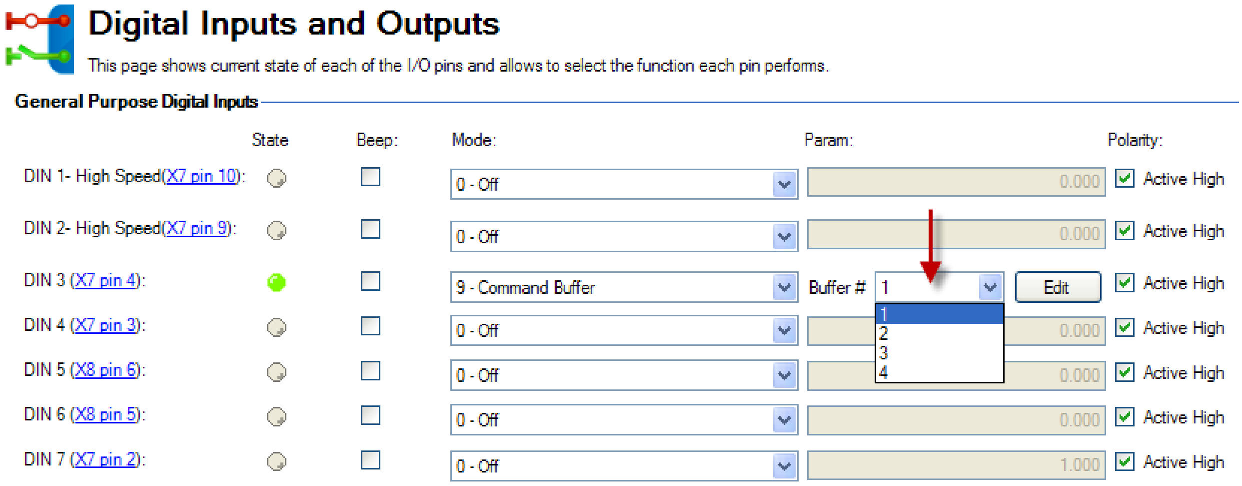
DINx.MODE	Mode Description	Opmode	Command Source
4	Motion Task Start Selected	2-Position	0-Service
5	Start Home	2-Position	0-Service
6	Start Jog	1 2-Position	0-Service
8	Zero Latch	all	all
9	Command Buffer	all	all
10	Control Fault Relay	all	all
11	Home Reference	2-Position	0-Service
13	Controlled Stop	all	all
15	Quick Stop	all	0-Service
16	Activate Electronic Gear-ing	2-Position	2-Electronic Gearing
17	Electronic Gear Position Shift	2-Position	2-Electronic Gearing
18	Positive Limit Switch	all	all
19	Negative Limit Switch	all	all
20	Brake Release	all	all
21	Current Limitation	all	all
22	Switch CmdSource/Op-mode	all	all
23	Analog In Sign Control	all	3-Analog
DOUTx.MODE	**Mode Description**	**Opmode**	**Command Source**
0	User- (Default=0)	all	all
1	Mains Ready	all	all
2	Software Limit	all	all
3	Move Complete	2-Position	0-Service
4	Inposition	2-Position	all
5	Position > x	all	all
6	Position < x	all	all
7	Warning	all	all
8	Enable	all	all
10	Motor Brake	all	all
11	Drive Fault	all	all
12	Absolute Velocity > x	all	all
13	Absolute Velocity < x	all	all
14	Homing Complete	2-Position	0-Service
15	Programmable Limit Switch	all	all
17	Mt in position		

11.2 Command Buffer

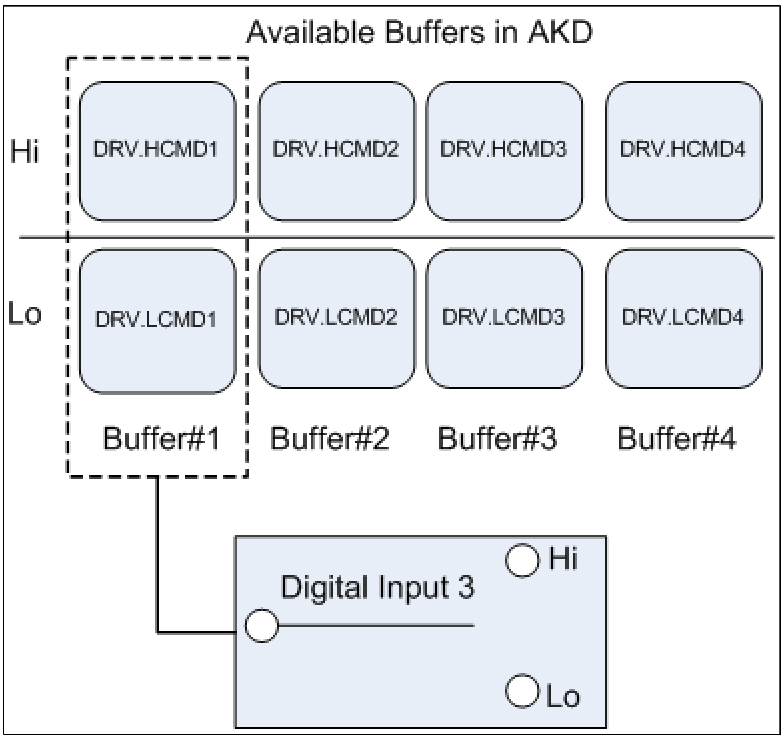
11.2.1 Overview

The Command Buffer input mode (11.1 Digital Inputs and Outputs) allows you to change values for parameters using a digital input.

The drive has four available buffers. A digital input configured for command buffer mode is linked to one command buffer set. This is determined by the user (see arrow 1). In this case, command buffer 1 is used.



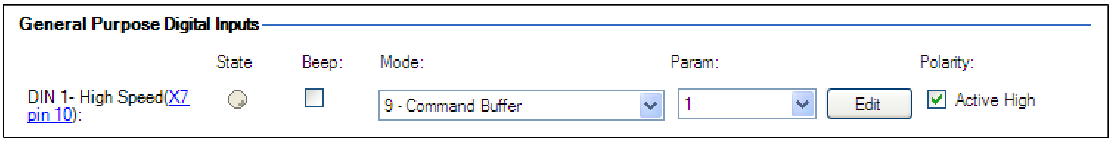
The graphic below explains the architecture of the buffers.



11.2.2 Editing the Command Buffers

By default, the buffers are empty. Each side of the buffer can contain 128 characters maximum (parameter and value included). You can use the **Command Buffer Editor** to enter the sequence of commands to the digital input buffer. You can enter the sequence of commands into Low command buffer (DIN.LCMDx) or High command buffer (DIN.HCMDx) and save these settings to the drive.

To edit the command buffers, open the **Digital I/O** view and select **Digital input mode** as **9 – Command Buffer**.



The **Param** box lists the available command buffers. Select desired command buffer number for the DIN. This number sets to the DINx.PARAM keyword. When you mouse over the **Param** box, the Tooltip displays the current content of the High command buffer and Low command buffer in the drive.

To edit the selected command buffer, click **Edit** to display the command buffer editor screen.

The command buffer editor screen has following properties:

Button or Dialog Box	Description
Command Buffer Number	The identification number of the command buffer (1, 2, 3, 4).
High Command Buffer	Adds sequence of commands to the High command buffer parameter. Contents are saved to the keyword DIN.HCMDx. A maximum of 128 characters can be set to drive along with the separator ";". Commands must be entered line by line and when saving to the drive each commands will be formed into single line separated by ";".
Low Command Buffer	Adds sequence of commands to the Low command buffer parameter. Contents are saved to the keyword DIN.LCMDx. A maximum of 128 characters can be set to drive along with the separator ";". Commands must be entered line by line and when saving to the drive each commands will be formed into single line separated by ";".
Ok	Saves the sequence of commands to the drive.

Button or Dialog Box	Description
Close	Closes the screen and returns to Digital I/O view. If contents are not saved to drive before closing the screen, confirmation message “The commands have been modified and not save to drive. Do you want close without saving?” is displayed.

Commands and parameters are entered on separate lines with a space between the parameter and the value.

A semicolon separator is not necessary in the editor, but it is required if the buffers are edited inside the terminal window.

11.2.3 Behavior of the Command Buffer

Digital inputs have either a high or a low state. The contents of the buffer are executed at the rising edge of the state change. The contents of the buffer are also loaded at drive power up according to the starting state of the digital input. When the command buffer is initially configured, the buffer is not executed until the first digital input state change is detected.

Tip: Once you have the buffer configured and tested, put the digital input in the most common state that it will be in at start up. Save the parameters to the drive. This will synchronize the NVRAM with the buffer, so at start up, values will not have to be changed.

11.2.4 Delays for the Buffer

There is a delay command that can be used to delay the execution of a command or parameter change (DRV.CMDDELAY). The value can be from 0 ms to 5000 ms.

The following commands may require a delay before the next command in the buffer can be executed:

DRV.EN (100 ms min)

DRV.DIS (50 ms min)

Example:

```
DRV.EN
DRV.CMDDELAY 100
MT.MOVE
```

The command buffer does not send back warnings when a parameter is invalid or out of range, so make sure the syntax is correct and that the digital input changes during legal drive states for the commands given.

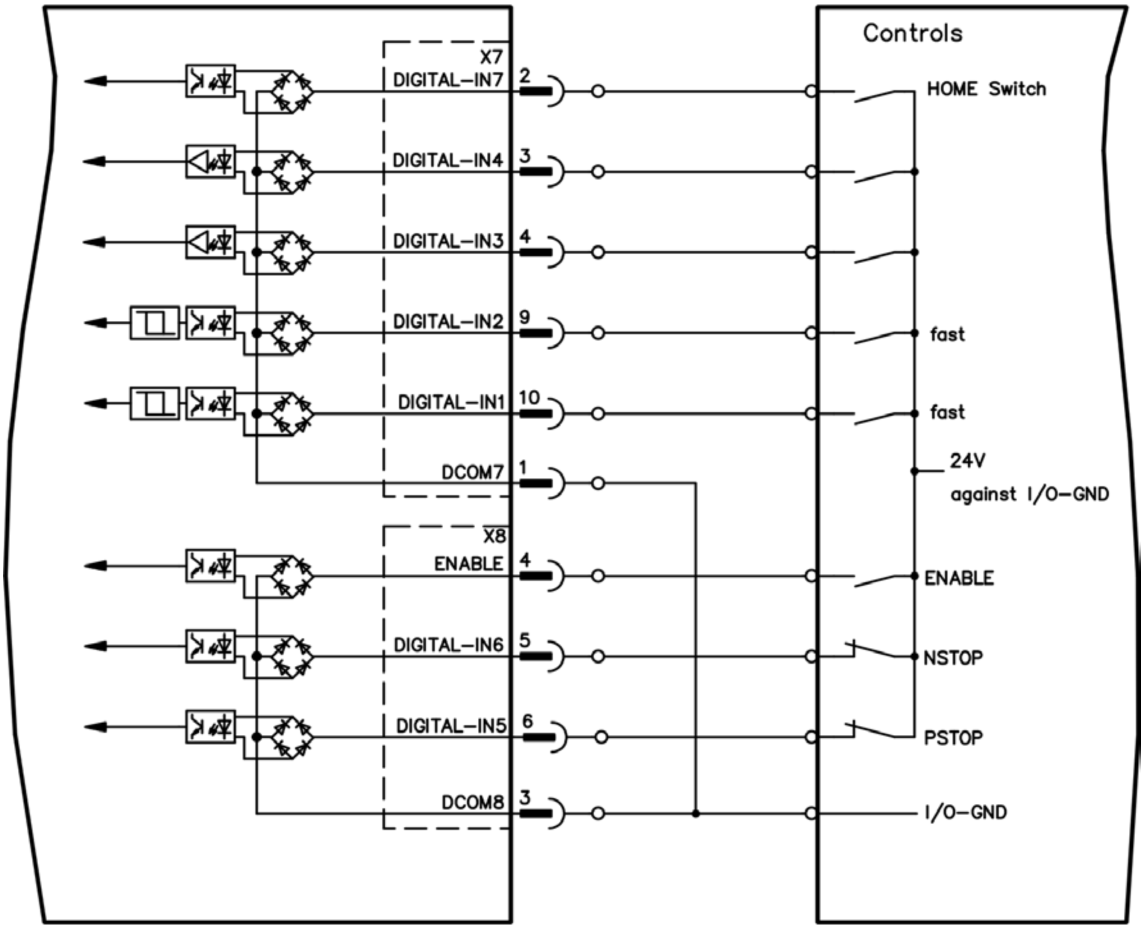
11.3 Digital Inputs (X7/X8)

The drive provides 8 digital inputs (=> p. 288). These can be used to initiate pre-programmed functions that are stored in the drive. A list of these pre-programmed functions is included in the WorkBench. Digital Input 8 is not programmable but is fixed to the ENABLE function.
If an input is programmed, it must be saved to the drive.

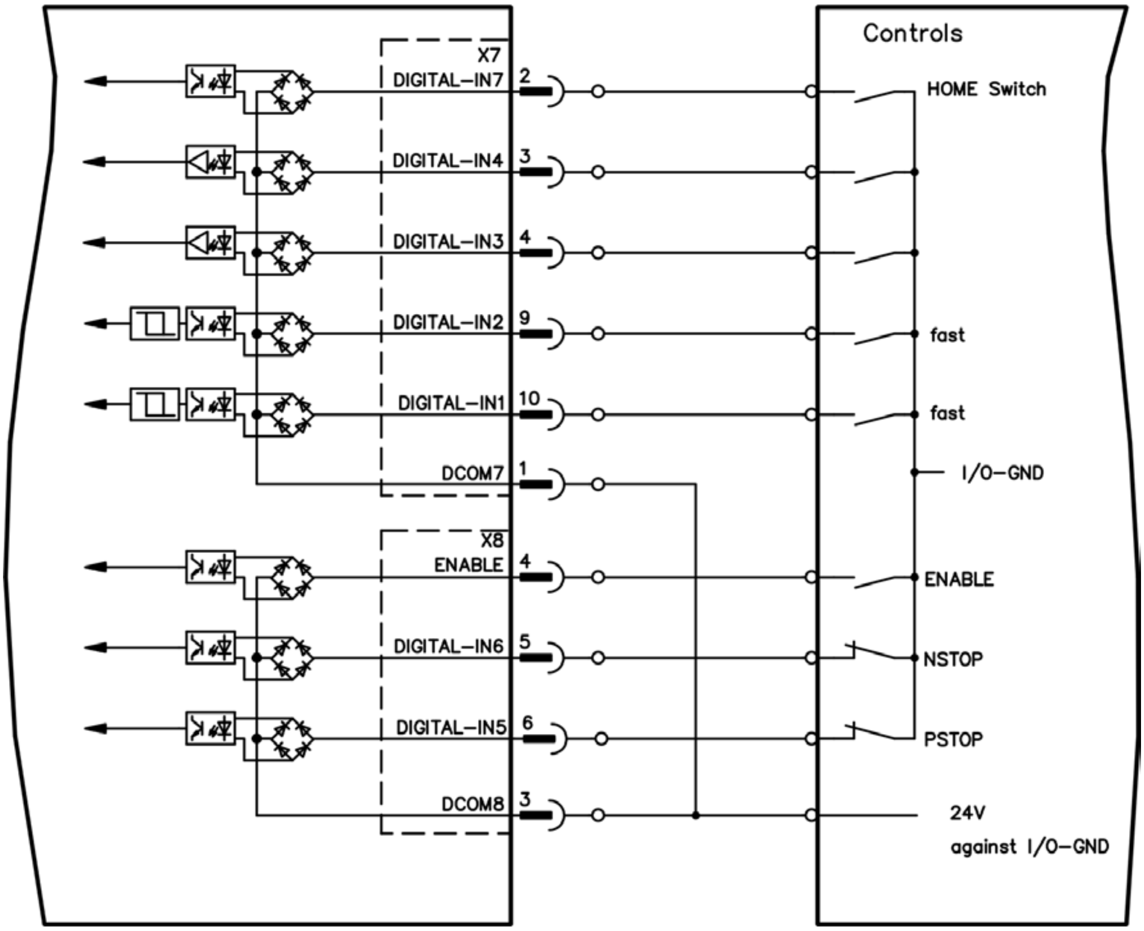
NOTE	**Depending on the selected function the inputs are high or low active.**

The inputs can be used with switched +24 V (source type) or switched GND (sink type). See diagrams below for typical examples of digital input wiring.

Digital Input Wiring Diagram (Source type connection, example)


X7
DIGITAL–IN7
2
DIGITAL–IN4
3
DIGITAL–IN3
4
DIGITAL–IN2
9
DIGITAL–IN1
10
DCOM7
1
X8
ENABLE
4
DIGITAL–IN6
5
DIGITAL–IN5
6
DCOM8
3
Controls
HOME Switch
fast
fast
24V
against I/O–GND
ENABLE
NSTOP
PSTOP
I/O–GND

Digital Input Wiring Diagram (Sink type connection, example)



11.3.1 Digital Inputs 1 and 2

These inputs (X7/9 and X7/10) are particularly fast and are therefore suitable for latch functions, for example. They can also be used as 24 V inputs for electronic gearing (=> p. 1)

Technical characteristics

- Floating, reference common line is DCOM7
- Sink or Source type sensors possible
- High: 3.5 to 30 V/2 to 15 mA , Low: -2 to +2 V/<15 mA
- Update rate: Hardware 2 µs

11.3.2 Digital Inputs 3 to 7

These inputs are programmable with the setup software. By default,all inputs are not programmed (off).

For more information refer to the setup software.

Technical characteristics

Choose the function you require in WorkBench.

- Floating, reference common line is DCOM7 or DCOM8
- Sink or Source type sensors possible
- High: 3.5 to 30 V/2 to 15 mA , Low: -2 to +2 V/<15 mA
- Update rate: Software 250 µs

11.3.3 Digital Input 8 (ENABLE)

Digital Input 8 (terminal X8/4) is set to Enable function.

- Floating, reference common line is DCOM8
- Sink or Source type wiring is possible
- High: 15 to 30 V/2 to 15 mA , Low: -3 to 5 V/<15 mA
- Update rate: direct connection to hardware (FPGA)

The output stage of the drive is enabled by applying the ENABLE signal (Terminal X8/4, active high). Enable is possible only if input STO has a 24 V signal (see page 1). In the disabled state (low signal) the connected motor has no torque.

A software enable by means of the setup software is also required (AND link), although this can also be permanently enabled with WorkBench.

11.4 Analog Input

11.4.1 Analog Input

If the drive command source is set to analog, then the analog input to the drive supplies the current or velocity command to the control loops of the drive.The default analog input screen displays a summary block diagram of the analog input. You can adjust the analog input settings from this view as follows:

Button or Dialog Box	Description	Parameter
Offset	The offset adds a bias to the analog input command. This offset is commonly used to remove any biases that may be present on the analog input signal.	AIN.OFFSET
Input Voltage	The value of the analog input after the offset, deadband, and low pass filters.	AIN.VALUE
Scale	If the opmode is current mode, then this value is the amount of current that will be commanded for each volt on the analog input. If the opmode is velocity mode, then this value is the velocity that will be commanded for each volt on the analog input.	AIN.ISCALE 27.9 AIN.VSCALE, or AIN.PSCALE
Torque Command	The current or velocity command that is sent to the control loops.	IL.CMD PL.CMDor VL.CMD

Click the **More** button to access a detailed view of the analog input. You can adjust additional analog input settings from this view as follows:

Button or Dialog Box	Description	Parameter
Low Pass Filter	The break point frequency for the low pass filter.	AIN.CUTOFF
Deadband	The threshold for the deadband. This parameter is commonly used to reduce noise while the drive is stationary.	AIN.DEADBAND

Both analog input views provide a link to the encoder emulation output setup; see 8.4.1 Encoder Emulation for more details on this feature.

Related Parameters

AIN Parameters

11.5 Analog Output

The drive has one analog output. You can either directly control the voltage output or select a different mode to output different signals. Analog output is configured through the X8 connector; for detailed information this connector, see Connection Diagrams, Analog Output.

Button or Dialog Box	Description	Parameter
Analog Output Mode	Select which internal signal is output by the analog output.	AOUT.MODE
Analog Output Value (user)	Enter the analog output value (when AOUT.MODE = 0, analog output signal is determined by the user)	AOUT.VALUEU
Analog Output Value	Displays the voltage that this analog output generates.	AOUT.VALUE
Analog Velocity Scale Factor	Scales the analog output (AOUT.VALUE) for AOUT.MODE = 1, 2, or 3.	AOUT.VSCALE
Low Pass Filter	Enables a software-based low pass filter of the analog output value. 0 Hz is a pass-through or "disable" of this feature.	AOUT.CUTOFF

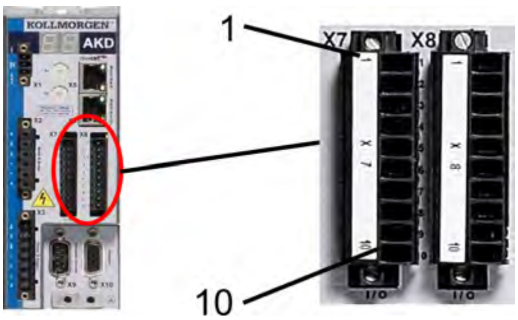
The analog output modes consist of the following:

AOUT.MODE	Description
0	User variable. The analog output signal is determined by the user (using AOUT.VALUEU).
1	Actual velocity. The analog signal describes the current velocity value (VL.FB).
2	Velocity error. The analog signal describes the velocity error value.
3	Velocity command. The analog signal describes the velocity command value.
4	Actual current. The analog signal describes the actual current value.
5	Current command. The analog signal describes the current command value.
6	Actual position. The analog signal describes the current position value.
7	Position error. The analog signal describes the position error value.
8	Triangle wave. The analog signal is a triangle wave (sawtooth pattern).
9	Debug mode. In this mode the user can define a drive variable to monitor via the analog output (AOUT.VALUEU).
10	Unfiltered Velocity (VL.FBUNFILTERED)
11	Filtered Velocity - 10Hz Lowpass (VL.FBFILTER)

Analog output return

11.6 I/O Connection

All standard digital and analog I/O signals are connected to X7 and X8.



11.6.1 I/O Connectors (X7 and X8)

Conn.	Pin	Signal	Abbreviation	Function	Specials
X7	1	Digital Common X7	DCOM7	Common line for X7 pins 2, 3, 4, 9, 10	-
X7	2	Digital Input 7	DIGITAL-IN 7	Programmable	-
X7	3	Digital Input 4	DIGITAL-IN 4	Programmable	-
X7	4	Digital Input 3	DIGITAL-IN 3	Programmable	-
X7	5	Digital Output 2-	DIGITAL-OUT2-	Programmable	-
X7	6	Digital Output 2+	DIGITAL-OUT2+	Programmable	-
X7	7	Digital Output 1-	DIGITAL-OUT1-	Programmable	-
X7	8	Digital Output 1+	DIGITAL-OUT1+	Programmable	-
X7	9	Digital Input 2	DIGITAL-IN 2	Programmable	high speed
X7	10	Digital Input 1	DIGITAL-IN 1	Programmable	high speed
X8	1	Fault Relay Output	Fault Relay Output	Fault Relay Output	-
X8	2	Fault Relay Output	Fault Relay Output	Fault Relay Output	-
X8	3	Digital Common X8	DCOM8	Common line for X8 pins 4, 5, 6	-
X8	4	Digital Input 8	DIGITAL-IN 8	Output stage enable	not programmable
X8	5	Digital Input 6	DIGITAL-IN 6	Programmable	-
X8	6	Digital Input 5	DIGITAL-IN 5	Programmable	-
X8	7	Analog Ground	AGND	Analog GND	-
X8	8	Analog Output +	Analog-Out	Actual velocity voltage	-
X8	9	Analog Input -	Analog-In-	Velocity set point	-
X8	10	Analog Input +	Analog-In+		-

Digital common lines for X7 and X8 are not common to each other.
The DCOMx line should be connected to the 0V of the I/O supply when using sensors of type "Source" with digital inputs.
The DCOMx line should be connected to the 24V of the I/O supply when using sensors of type "Sink" with digital inputs.

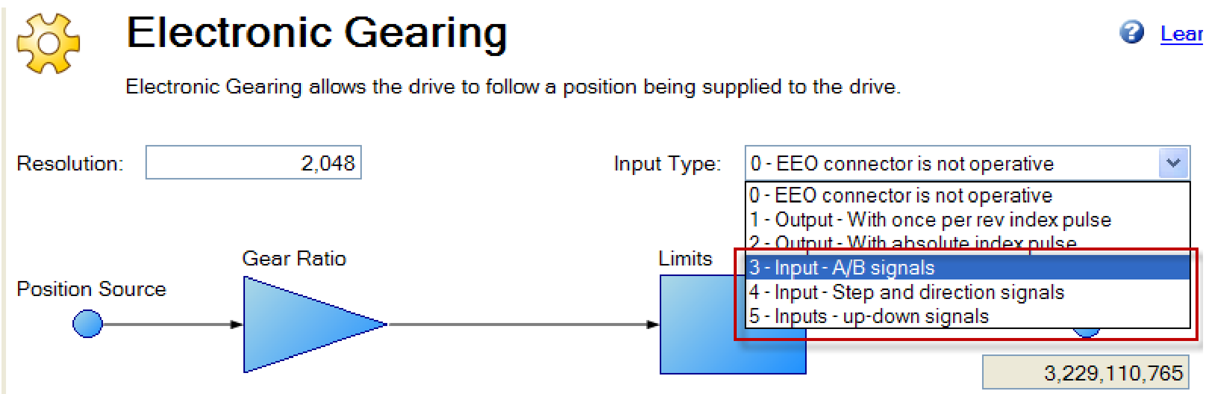
11.7 Electronic Gearing

11.7.1 Overview

Electronic gearing is the act of sending a digital pulse position command to the AKD drive. The X9 connector is used for controlling the drive through an A/B type signal, pulse and direction (also called step and direction), or up/down command. A common application for electronic gearing is using servos with a stepper controller or daisy chaining multiple AKD drives from one master drive as slave drives.

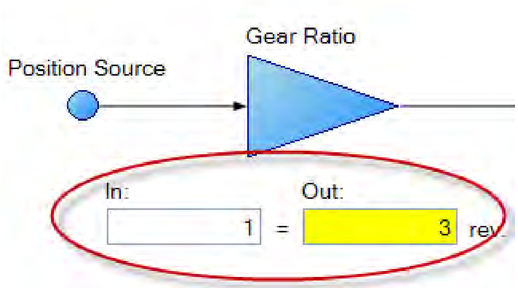
In order to command an AKD using electronic gearing, the command source (DRV.CMDSOURCE) must be set to **2-Electronic Gearing** and the opmode (DRV.OPMODE) must be set to **2-Position Mode**.

The input modes of the X9 connector are used to set up the AKD for electronic gearing.



Only input modes 3,4, and 5 pertain to electronic gearing input.

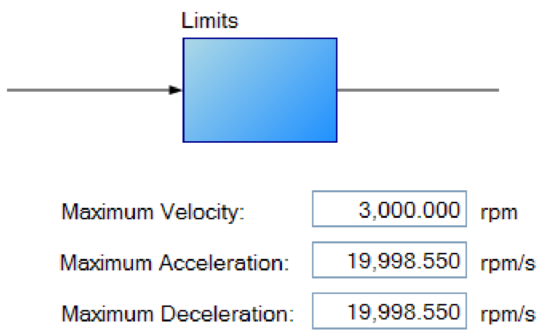
Resolution is the post-quadrature value of the counts/revolution of the input. Additionally, a gear ratio can be applied to affect the output ratio of the motor.



The position command (DRV.HANDWHEEL) reads the EEO value, where 4,294,967,296 is a full revolution of the input, then the value rolls over. Gear ratio does not affect the EEO value. If the output is set to 3 output revs per input rev, there will be 4,294,967,296 counts per 3 revolutions of the motor.

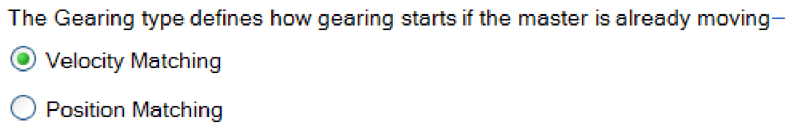
11.7.2 Limits

Electronic Gearing has independent limits, as shown below:



These limits (GEAR.ACCMAX, GEAR.DECMAX, GEAR.VELMAX) are applied only during gearing mode and the units are consistent with speed and acceleration of the output motor. All other limits in the drive are active along with gearing limits.

If the master is already moving when entering electronic gearing mode, velocity or position can be matched (GEAR.MODE):



In **Velocity Matching**, the motor will ramp up to the same velocity with no concern over lost steps during the acceleration period.

In **Position Matching**, the motor will match the position command from the switchover point by speeding up to recover the lost steps during the acceleration period.

More information on each type of input mode is found here:

3 – AquadB (see Command encoder signal connection)

4 – Pulse/Direction input (see Pulse / Direction signal connection)

5- Up/Down input (see Up / Down signal connection)

11.7.3 Determining Maximum Cable Length

When you use an external incremental encoder as an input to X9, you must determine the maximum allowable cable length.

NOTE	**This information is only applicable when using an external encoder as either a secondary feedback input or a gearing command (DRV.EMUEMODE3). Not applicable for any other X9 mode or when using two AKDs in a master/slave system.**

The X9 port has a 5V output used to supply power to an external incremental encoder.

The maximum cable length depends on the current draw of the external encoder and the cable type connecting the X9 port. The following example can be used as a guide to calculate the maximum cable length for your application.

X9 port characteristics:

Nominal Supply Voltage:5 V

Tolerance: 5%

Minimum Supply Voltage: 4.75 V

Maximum current: 0.25 A

Permitted wire gauge: 20-28 AWB (Typical for D9 connector)

Sample Application Hardware:

Example external encoder: Hengstler RI-36H (RS-422 encoder) used with X9 port.

Encoder Nominal Supply Voltage: 5V (+/- 10%)

Minimum Supply Voltage: 4.5 V calculated based on tolerance above

Maximum required encoder supply current: 50 mA

Example cable:

Lapp Li2YCY - 24AWG (0.22 mm^2)

Loop resistance: 0.186 Ohms/m

Sample Calculations:

Maximum Permissible voltage cable drop = 0.25 V

= (Minimum Supply Voltage from AKD) 4.75 V – (Minimum supply voltage of RI-36H encoder) 4.5V

Maximum permissible resistance of cable run to X9 = 5 Ohms

= (Max voltage cable drop) 0.25V ÷ (Maximum encoder current) 0.05A

Maximum permissible cable length for example application = 26.9 m

= (Max cable resistance) 5 Ohms ÷ 0.186 Ohms/m

Related Parameters

GEAR Parameters

DRV.CMDSOURCE

DRV.EMUEMODE

DRV.EMUERES

DRV.HANDWHEEL

DRV.OPMODE

11.8 Limits

This screen allows you view and modify the various drive limits.

Button or Dialog Box	Description	Parameter
Current Limits		
Positive Peak Current	The maximum positive current allowed.	IL.DLIMITP
Negative Peak Current	The maximum negative current allowed.	IL.DLIMITN
Velocity Limits		
Positive Speed Limit	The maximum speed allowed in the positive direction.	VL.LIMITP
Negative Speed Limit	The maximum speed allowed in the negative direction.	VL.LIMITN
Over Speed Limit	The threshold velocity for an over speed fault.	VL.THRESH
Position Limits		
Maximum Following Error	The maximum position error. If the position error PL.ERR is larger than PL.ERRFTHRESH, then the drive generates a fault	PL.ERRFTHRESH
Position Limit 0	The minimum position the drive can reach before generating a negative software position fault.	SWLS.LIMIT0
Position Limit 1	The maximum position the drive can reach before generating a positive software position fault.	SWLS.LIMIT1

Button or Dialog Box	Description	Parameter
Acceleration Limits		
Acceleration	The acceleration ramp used to profile some types of motion.	DRV.ACC
Deceleration	The deceleration ramp used to profile some types of motion.	DRV.DEC
Motor Limits	Motor limits are set through the Motor Foldback Screen (see 8.6 Foldback	

11.8.1 Limits

The limits screen covers most of the basic system limits, including current, velocity, and position.

- **Current Limits:** The current limits are set based on the drive ratings. You can change these limits to be lower then the default values for the drive, however, this may effect the expected performance of your application.
- **Velocity Limits:** The velocity limits are set based on the motor ratings. You can modify these settings above the ratings of the motor if the application requires some overhead, but be aware the motor has mechanical limitations and may be damaged if run above those limits. It is best to leave these at the default ratings for the motor selected.
- **Position Limits:** The position limits can be set based on your specific machine application requirements. The Maximum Position Error can be set to cause a fault when the position error exceeds the value you insert here. Position Limit 0 is tied to the clockwise (positive) motor direction. As the motor reaches the position entered, the motor will stop and display a warning n107. Position Limit 1 is tied to the counterclockwise (negative) motor direction. As the motor reaches the position entered, the motor will stop and display a warning n108.
- **Acceleration Limits:** This field allows you to raise accelerations to give the system crisp moves. These limits default to a low value, so you may wish to change these after the mechanics and other sections of your system are defined.

11.9 Programmable Limit Switch

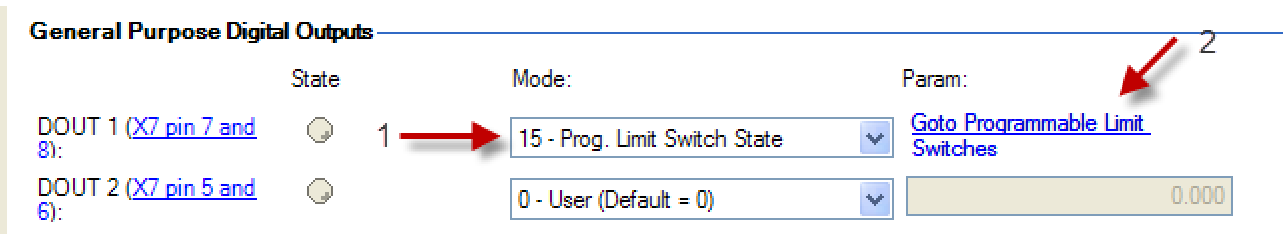
11.9.1 Overview

Programmable Limit Switches (PLSs) are used to turn on and off drive digital outputs based on the drive's position. Multiple positions can be combined to affect the state of an output when PLSs are combined.

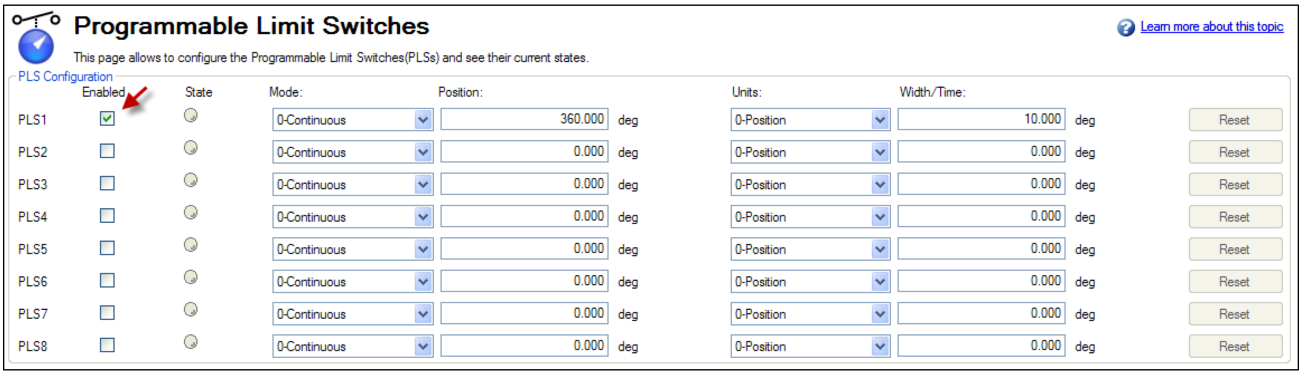
11.9.2 Using Programmable Limit Switches

To use PLSs, you must first configure a digital output as follows:

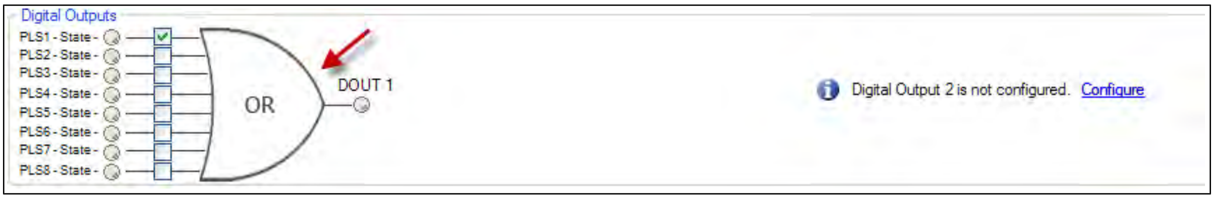
1. Click on the Digital I/O icon in the the tree view.
2. Set the output of your choice to mode fifteen (see 1 below). In this example, digital output 1 is used.
3. Now that the digital output mode is set for PLS, you can click on the **Goto Programmable Limit Switch** link (see 2 below) to open the PLS screen (this screen is also shown in the WorkBench tree view).



The PLS screen is used to establish the positions for the output(s) to turn on.

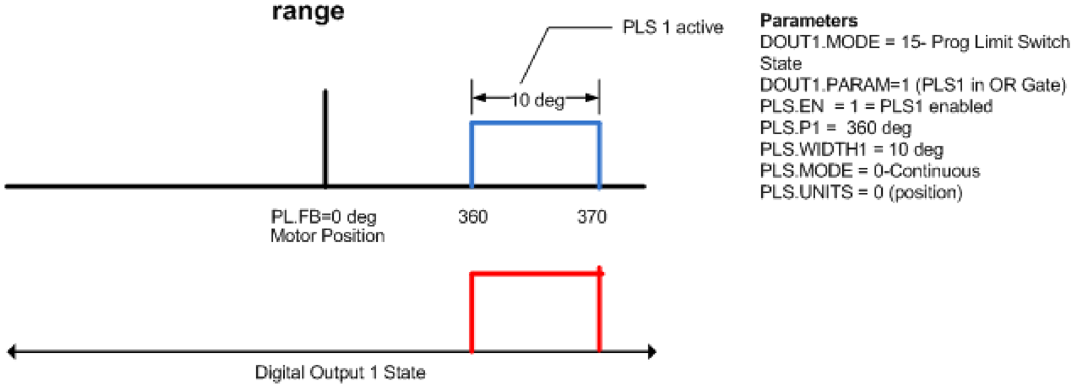


The PLS configuration section of the screen sets the mode and limits of each of the eight PLSs. The PLS is ignored unless it is enabled (see arrow). In the screen example, PLS1 is set for continuous operation in position mode. Every time the 360 degree position (PL.FB) is crossed in either direction, the output will turn on for 10 degrees of motor movement.

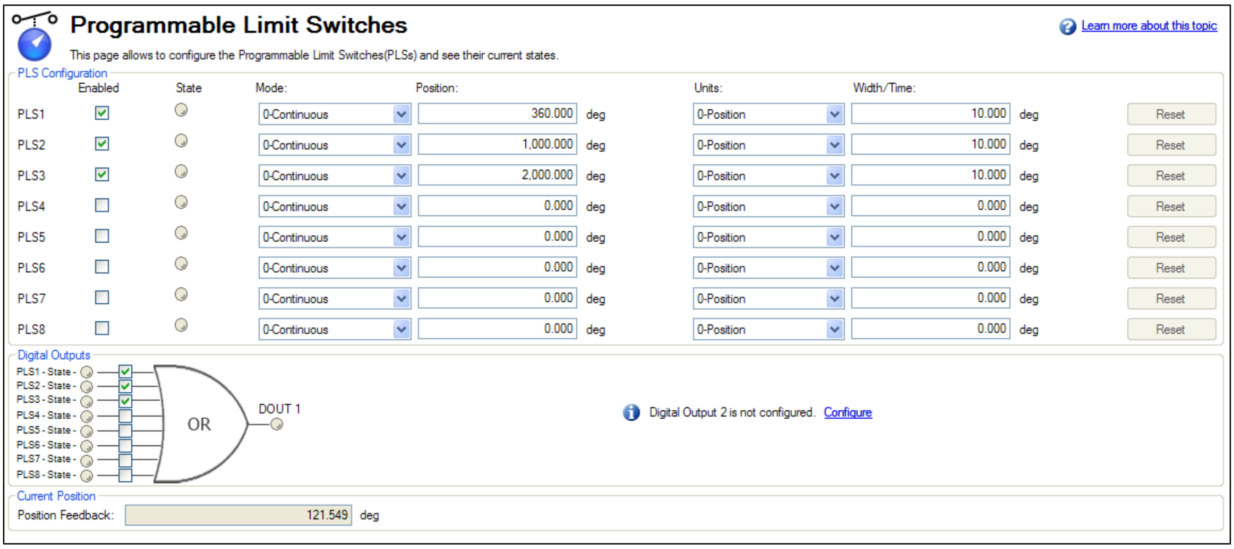


The final step is to configure the OR gate for the PLSs on which output is triggered. The gate appears for setup in the screen when a digital output is configured in Mode 15 – Prog Limit Switch State. Since only PLS1 is configured, select PLS 1 (see arrow above)

PLS Example 1 – Turning on a digital output for a position range

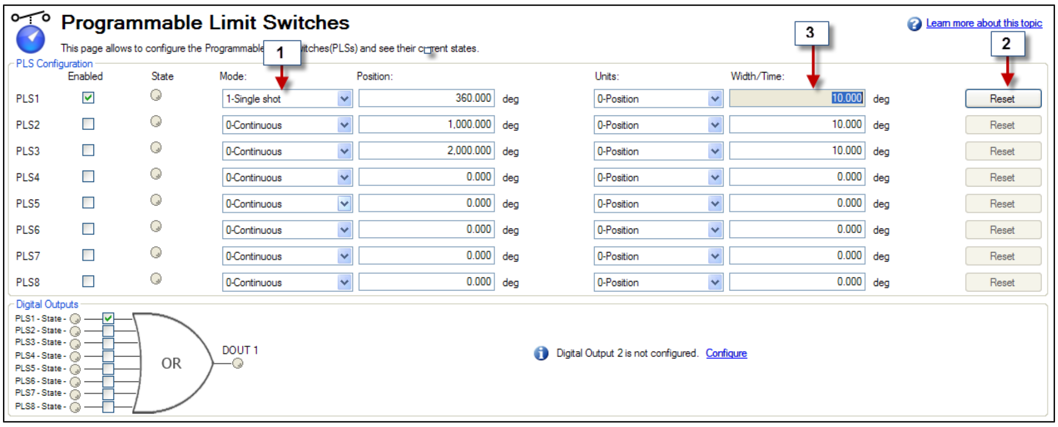


To setup an output with multiple turn-on points, configure and enable more PLS's and include them in the OR Gate.

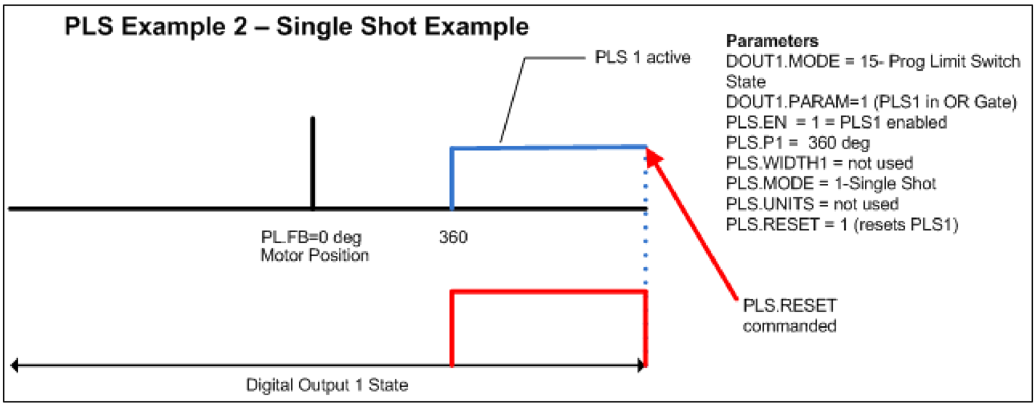


11.9.3 Single Shot Mode

Single shot mode is a special mode of PLS. Single shot mode (see 1 below) turns on the output until it is reset (see 2 below). Normal operation of this mode usually depends on a machine controller to reset the PLS using the fieldbus object for PLS.RESET.



Single Shot Example:



Related Parameters

53 PLS Parameters

11.1 Digital Inputs and Outputs

11.10 Enable/Disable

11.10.1 Enable Modes

The AKD offers several options for hardware and software enables, as well as safe torque off (STO) to cover a variety of conditions.

11.10.1.1 Hardware Enable Mode

The AKD has two methods hardware enable methods. These methods are controlled by DRV.HWENMODE. Mode 0 allows for the drive to enable and clear faults on the rising edge of the hardware enable input. Mode 1 will NOT clear any faults on the rising edge of the hardware enable input, allowing you to review any current faults and manually clearing.

11.10.1.2 Software Enable Default

In addition, the Software Enable has two methods for enabling the AKD. These are controlled by DRV.ENDEFAULT. Default 0 leaves the software in the disabled state upon start-up. Default 1 enables the software upon start-up.

11.10.2 Disable Modes

Use DRV.DISMODE to select the method for stopping the drive.

Mode 0: Immediately disable drive.

With this condition, the drive will immediately disable the power stages and the driven motor will either coast to a stop or in the case of a vertical or overhung load axis, will fall abruptly. If a brake is present, the brake will be applied according to MOTOR.TBRAKEAPP. Using Digital Input mode 13, you can achieve a controlled stop as described in Mode 2.

Mode 1: Dynamic Brake to a stop.

In this situation, the drive will use the dynamic brake feature and stop motion quickly, then disable the power stage. In most cases, the driven motor will stop quickly (pending the joules available and load circumstances). In the case of an overhung or vertical load, the driven motor will attempt to stop, but then will continue to allow the load to fall if no measures have been taken to secure the load.

Note: for Modes 2 and 3, you can access the Controlled stop section to set the values of the controlled stop deceleration rate, the velocity threshold, and time in velocity threshold to deactivate the drive.

Mode 2: Controlled stop, then disable.

In this mode, a controlled stop will take place based on a variety of parameters that you set. First, the driven motor will decelerate at a controlled rate (CS.DEC) until one of two things happens. 1) The motor reaches the velocity limit set (CS.VTHRESH) for a period of time (CS.TO), or 2) The drive emergency time out is reached (DRV.DSTO). Once either of these cases is reached, the power stage will be disabled (and brake applied if present)

Mode 3: Controlled stop, then dynamic brake.

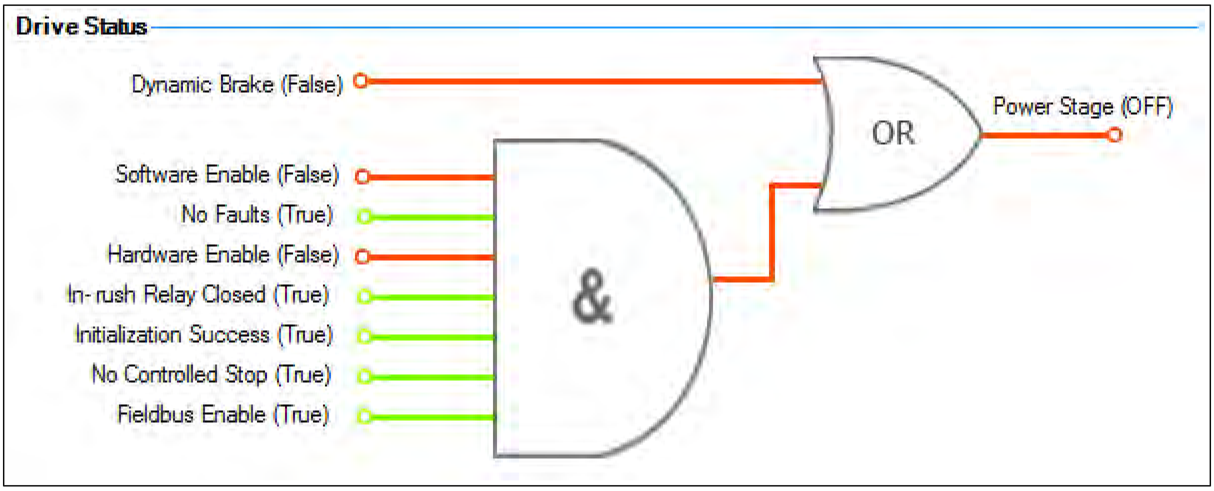
Similar to Mode 2, the motor will decelerate at a controlled rate (CS.DEC) until CS.VTHRESH is reached for a period of time (CS.TO). The drive will then dynamically brake and disable under the same conditions as described in Mode 2.

The Disable Timeout Setting determines the amount of time the drive will follow the disable mode before it deactivates the drive regardless of method chosen and alerts with an Emergency Timeout Fault.

All disable modes operate based on the type of disable command received. Any critical faults, hardware disable, or STO disable immediately turn off the power stage, and the motor will coast or free fall, depending on how the motor is secured.

11.10.3 Drive Status

The **Drive Status** area is displayed below the settings area and includes a graphical representation of drive active status with different sets of inputs. If the input or output is enabled, then it is shown in green; if the input or output is disabled, then it is shown in red. The inputs to the OR and & (AND) gates identify which conditions are true (green) or false (red) and follow the normal logic for & (AND) and OR gates. This diagram is useful in finding which input may be preventing the drive from being enabled. Click **More** to see the details of how the control stop is executed displayed both logically and graphically.



11.10.4 Controlled Stop

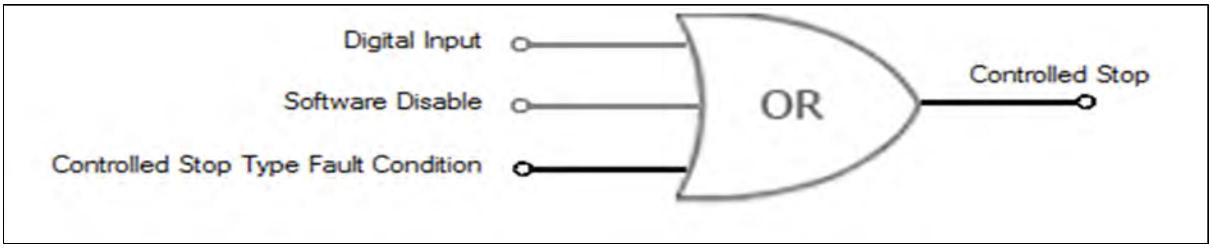
The Controlled Stop area displays values for parameters associated with controlled stop.

Button or Dialog Box	Description	Parameter
Velocity Threshold	Sets the velocity threshold for controlled stop process.	CS.VTHRESH
Velocity Threshold Timeout	Sets the velocity threshold, which is the time value for the drive velocity to be within CS.VTHRESH before the drive disables	CS.TO
Deceleration	Sets the deceleration value for the controlled stop process.	CS.DEC
Control stop Input	Displays the list of digital inputs configured to controlled stop mode separated by ','. When no controlled stop mode is configured, this box displays the message: **No CS Input Configured**. **Configure Input** link will opens the Digital I/O screen where you can configure the controlled stop mode.	

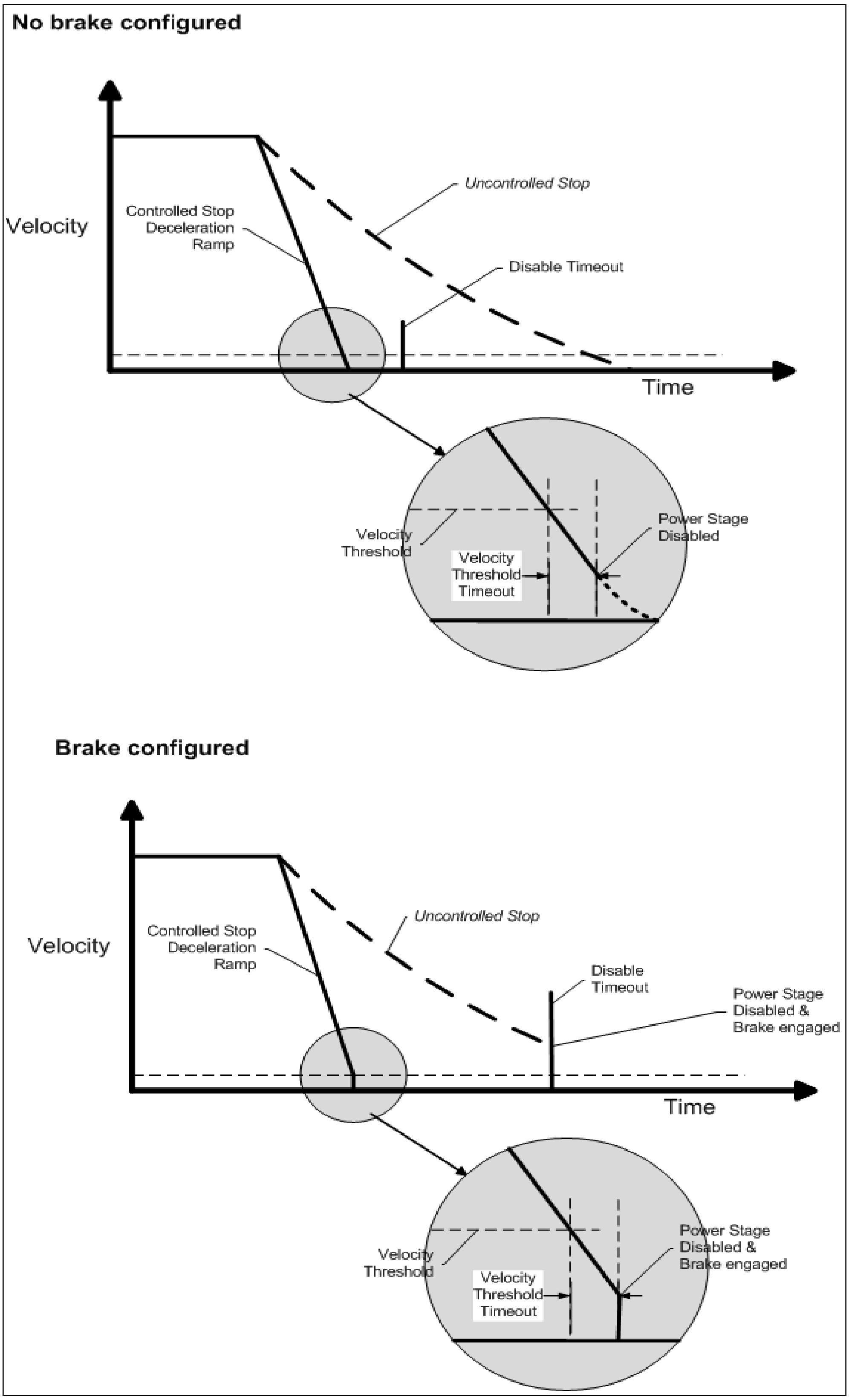
11.10.5 More/Less Button

The **More** button reveals the status diagram for the controlled stop configuration. It also displays the block diagram for the control stop. Two block diagrams available: one for a brake fitted and another for no brake.

Control stop status diagram



Controlled Stop Block Diagram


No brake configured
Velocity
Controlled Stop Deceleration Ramp
Uncontrolled Stop
Disable Timeout
Time
Velocity Threshold
Velocity Threshold Timeout
Power Stage Disabled
Brake configured
Velocity
Controlled Stop Deceleration Ramp
Uncontrolled Stop
Disable Timeout
Power Stage Disabled & Brake engaged
Time
Velocity Threshold
Velocity Threshold Timeout
Power Stage Disabled & Brake engaged

11.11 Controlled Stop

In a controlled stop, drive motion is brought to a standstill in a controlled manner. The drive commands a zero velocity from the motor. The motor decelerates at the prescribed deceleration value (CS.DEC).

A controlled stop can occur in four ways:

- The user configures a programmable digital input to mode 13 using DINx.MODE. For example, if DIN1.MODE 13 is applied, digital input 1 is set to controlled stop.
- Either a controller or the user (through the WorkBench terminal window) initiates a software disable (DRV.DIS) command .
- CANopen PDO is set to 3442.

CANopen Property	Value
Index/Subindex	3442/0
Data Type	Unsigned 8
Access	W/O
PDO mappable	N/A
Description	Controlled stop
ASCII Object	

- A fault initiates a controlled stop from the drive. See 18.1 Fault and Warning Messages for the faults which initiate a controlled stop.

The controlled stop mechanism is activated in the following cases:

1. DRV.DISMODE = 2 and user executes DRV.DIS from the terminal or WorkBench disable buttons.

NOTE	You must disable the drive in order to set DRV.DISMODE.

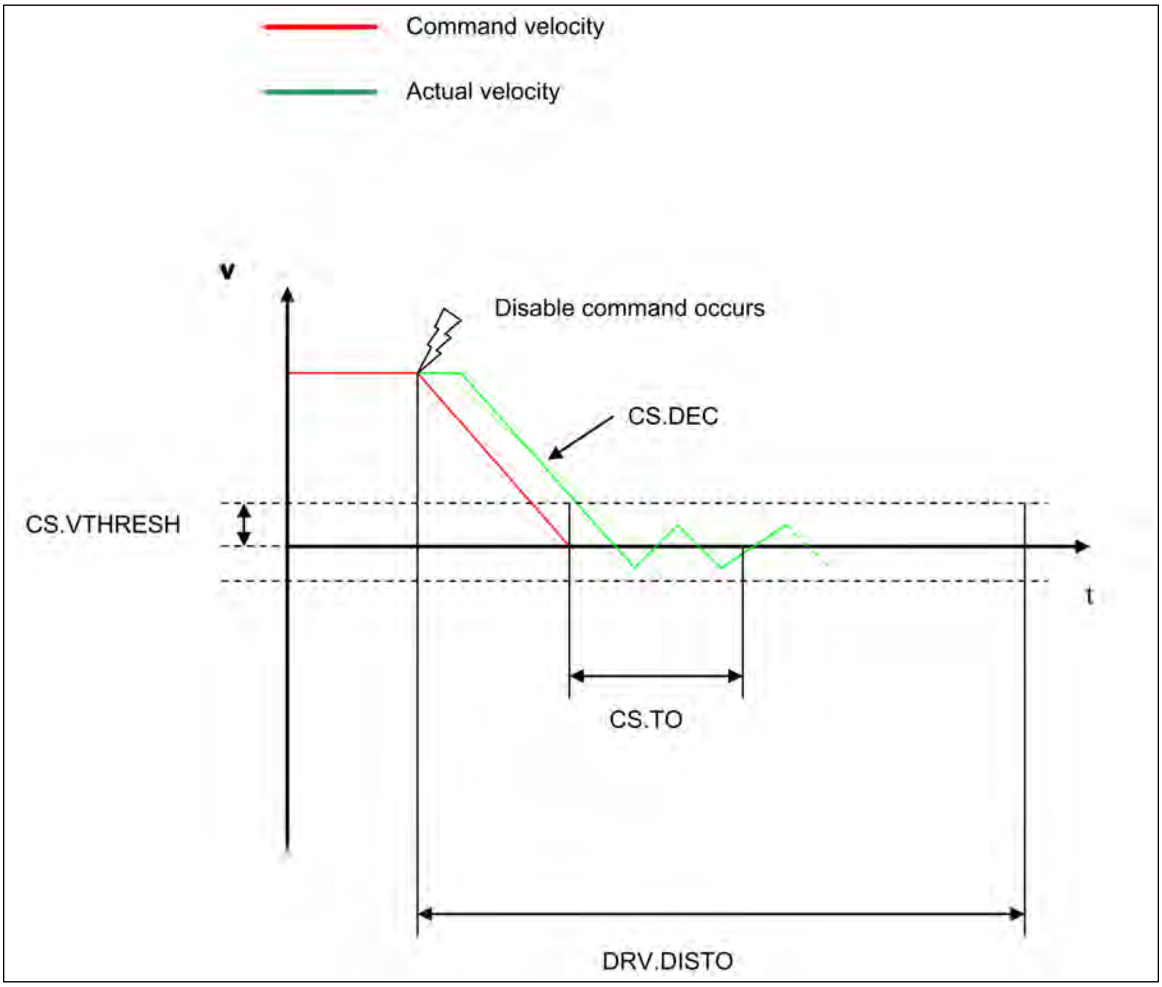
2. DRV.DISMODE = 2 and user executes DRV.DIS from a fieldbus connected to the drive.
3. A fault happens for which the reaction evolves controlled stop (CS). After the CS is executed, the drive disables.
4. A digital input mode (DINx.MODE) is set to 13. If the digital input state changes (active high or low according to DINx.INV) the CS is executed, then the drive disables.
5. HW limit switch: A digital input is defined as a positive (negative) limit switch (DINx.MODE 18 or 19). When the limit switch is met, the CS mechanism starts running. In this case, the parameter DRV.DISTO is not active.
6. SW limit switch: SWLS defines an active SW limit. When the limit is met, the CS mechanism starts running. In this case, the parameter DRV.DISTO is not active.

Use the drive CS parameters to configure a controlled stop as follows:

1. CS.DEC: Deceleration ramp that is used for disable.
2. CS.VTHRESH: Velocity 0 threshold. The motor shaft is considered as stopped as soon as the actual velocity (filtered through a 10 Hz filter, such as VL.FBFILTER) is within ± CS.VTHRESH.
3. CS.TO: Velocity 0 time. The actual velocity must be consecutively within 0 ± CS.VTHRESH for the time CS.TO, before the drive completes the CS process. This value is used since the motor can overshoot out of the VEL0 window depending on the gains, deceleration ramp, motor inertia and so on.
4. DRV.DISTO: Disable time out. This parameter sets an overall and independent running check as to whether or not the drive can achieve the disable state. If the VEL0 window set in step 3 is too small, it is possible that the drive may never reach the end of the CS process. The DRV.DISTO

parameter and functionality addresses this issue by disabling the drive after the DRV.DISTO time elapses, even if the CS process did not end.

Controlled Stop Diagram



When configuring the controlled stop feature, please note the following:

- If the HW limit switch is active and any of the other CS activated, the only difference will be that in this case the DRV.DISTO will limit the time before disabling the drive.
- If the value of DRV.OPMODE of the drive is current mode, the drive will not execute the CS but instead stop immediately.
- Set DRV.DISTO to an appropriate value that will allow the motor to decelerate from any velocity to 0 with DRV.DEC. This value must also allow the motor to afterwards remain within VL.FB for CS.TO consecutively within 0 ± CS.VTHRESH.

The drive issues a fault F703 in case that the DRV.DISTO counter expires during a controlled stop procedure.

Related Parameters and Commands

CS Parameters

CS.STATE: Reads the current state of controlled stop process (0 = controlled stop is not occurring. 1 = controlled stop is occurring).

DIN1.MODE TO DIN7.MODE

DRV.DIS

DRV.DISTO

DRV.DISMODE

Related topics:

11.13 Emergency Stop

11.1 Digital Inputs and Outputs

18.1 Fault and Warning Messages

11.12 Dynamic Braking

Dynamic braking is a method to slow a servo system by dissipating the mechanical energy in a resistor driven by the motor back EMF. The drive has a built in advanced (patent pending) dynamic braking mode which operates fully in hardware. When activated, the drive shorts the motor terminals in phase with the back EMF (q axis) but continues to operate the non-force producing current loop (d-axis) with 0 current. This action forces all of the dynamic braking current toward stopping the motor current and insures the fastest stopping/amp of motor terminal current.

The drive hardware also limits the maximum dynamic braking motor terminal current via the DRV.DBILIMIT parameter to prevent the drive, motor, and customer load from encountering excessive currents/forces. When the current is not being limited, the mechanical energy is dissipated in the motor terminal resistance. When the current is being limited, energy is returned to the drive bus capacitors. When the amount of returned energy raises the bus capacitor voltage enough, the drive activates the regeneration control to start transferring the returned energy to the regen resistor. This resistor could be internal or external to the drive depending on drive model and drive wiring.

Whether and how the drive uses dynamic braking mode depends on the drive disable mode (DRV.DISMODE) setting.

11.12.1 Drive Regeneration

When the servo motor is slowing down at a rate faster than friction and motor losses would slow the motor, then mechanical energy can be returned to the drive. This returned energy initially drives the internal bus voltage upwards. When the returned energy is high enough, the regeneration control transfers the excess returned energy into the regeneration power resistor. If the regeneration control cannot fully handle the power returned (for example, because there is not a regen resistor present or its resistance value is too high), then the bus voltage will continue to rise and a bus over voltage fault will happen and disable the drive completely, which allows the motor to freewheel.

11.12.1.1 AKD-x00306 to AKD-x00606

These units do not have an internal regeneration resistor. In many applications machine friction, motor losses, and the limited bus capacitor energy absorption handles the application. But, depending on the exact application requirements, an external resistor can be connected.

11.12.1.2 AKD-x01206 to AKD-x02406 and AKD-xzzz07

These units have an internal regeneration resistor plus the capability to connect an external resistor if higher power levels are needed.

Related Topics

See section *6.14 Dynamic Braking* in the *AKD Installation Manual* for detailed information on dynamic braking.

36.14 DRV.DISMODE

36.9 DRV.DBILIMIT

11.13 Emergency Stop

11.14 Safe Torque Off (STO)

Safe torque off (STO) is a restart lock safety feature that prevents a system restart. The STO input provides direct electrical control of the power stage of the AKD drive; it bypasses the processor and will disable the power stage irrespective of software or other hardware signals.

STO is controlled by a digital input on the X1 connector (pin 3) that must have 24V applied to it; otherwise, the drive will not enable.If the STO digital input does not have 24V applied to it and you attempt to enable the drive (using the hardware and software enables) the drive will generate a 602 “Safe Torque Off” fault. If you see this fault you need to apply 24V to the STO input and then clear the fault (DRV.CLRFAULTS) before you can enable the drive. The STO will not generate a fault until you try to enable the drive. You can read the current faults using DRV.FAULTS.

```
-->DRV.FAULTS
602: Safe torque off.
-->
```

The current state of the STO can be read using the STO.STATE parameter (this returns 1 if 24V is being applied to this input). WorkBench also shows you the state of the STO input in the status bar at the bottom of the window.

11.15 Under Voltage Fault Behavior

You can adjust the conditions for an under voltage fault using VBUS.UVMODE in the WorkBench terminal screen:

VBUS.UVMODE = 1 (default)

The drive will not report an under voltage fault unless the drive is enabled and VBUS.VALUE falls below VBUS.UVFTHRESH

VBUS.UVMODE = 0

The drive will report an under voltage condition any time VBUS.VALUE falls below VBUS.UVFTHRESH.

When an under voltage fault occurs, the drive is disabled and issues the following alerts:

- WorkBench alert: 502 Bus Under Voltage
- Drive LED alert: Left LED displays [F], right LED displays [u-V].

- Fault relay output turns on.

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12 Using Command Source and Operating Modes

12.1 Overview

Operation modes (opmodes) allow you to set up your drive to communicate directly over the Ethernet input, a specific fieldbus, or an analog or digital control.

There are two basic components to how you will command the drive and how it will behave. The “Service mode” indicates how the drive will be communicated to. The drive has communication options via Ethernet, a variety of fieldbuses, through an analog input, and through electronic gearing, or digital inputs. The second component ties to which loop you will be controlling (torque, velocity, or position).

12.2 Using Command Source and Operation Modes

There are two methods to access these two parameters within WorkBench. The first is by selecting the **Settings** screen from the left hand tree. By clicking on the top level of the **Settings** folder, you access the graphical representation of both the Command source and Operation Mode. The drop down box then allows you to select the desired command type and control loop you wish to activate. Please note that some Command Sources can only be used with certain control loops (as an example, Electronic Gearing can only be used in position loop Operation Mode).

12.2.1 Command Source

The command source sets how you communicate with the drive. Initially, you might be communicating via your PC using the Ethernet connection. Each Command Source is listed below:

12.2.1.1 Service

This is the most common source used when establishing initial communications with the drive to set the system up, and when you may need to “service” the drive. The Service source communicates with your PC via the Ethernet port located on the top of the drive at connector X11.

12.2.1.2 Fieldbus

When using a fieldbus, such as CANOpen or EtherCAT, the drive is set with this command source. For CANOpen, use the connectors X12 and X13 located on the top of the drive. For EtherCAT, Connectors X5 and X6 located on the front of the drive are used.

12.2.1.3 Electronic Gearing

If the drive will be used to follow the output of an external encoder, following motion using an electronic gear ratio, then you should use this command source. When using Electronic Gearing, the Operation mode must be set in the Position Loop mode. This is also the mode used for step and direction inputs as well.

12.2.1.4 Analog

This command source allows the drive to be controlled from an analog source. Typically a +/- 10 Vdc signal is attached to connector X8 pins 9 and 10. Varying the analog input will then vary torque, velocity, or position based on the Operation mode selected.

12.2.1.5 Operation Mode

The operation mode identifies which servo loop you will be controlling. The drive offers torque, velocity, or position control. From the setting screen page, a graphical representation of the loop is displayed. By clicking these graphical representations, you can access additional loop information such as gains, filters, and other settings.

Related Parameters

DRV.CMDSOURCE

DRV.OPMODEDRV.OPMODE

12.3 Current Loop

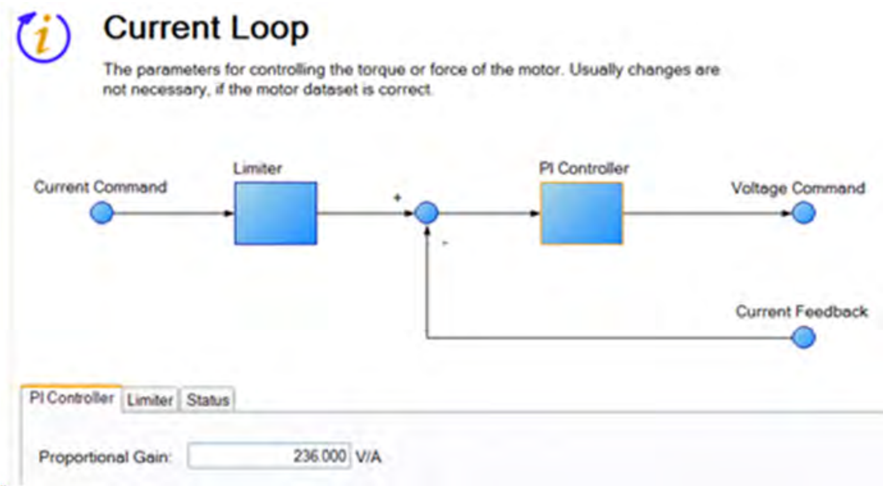
12.3.1 Overview

The current loop is active when the drive operates in current torque (current) mode (DRV.OPMODE = 0). The parameters that govern the current loop are shown in the Current Loop view. The various types of tuning for the drive adjust these parameters automatically, so you normally do not need to adjust the current loop parameters in the current loop screen. The Current Loop view includes an active block diagram. If you click on a block in the diagram, the appropriate tab opens below.

A more detailed block diagram for the current loop is included in 22 Block Diagrams

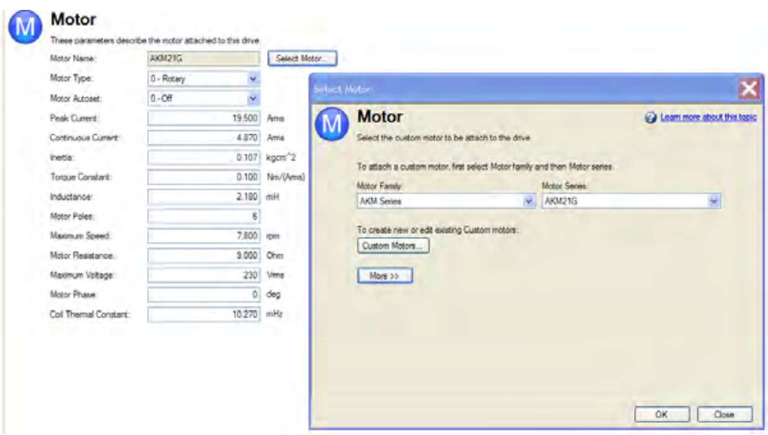
12.3.2 Current Loop Gain

The current loop is tuned based on the inductance of the motor used with the drive. The current loop gain is automatically set so that the idealized current loop crossover frequency is IL.KP/L in rad/sec where L is the motor line-line inductance.



Current loop gain is set automatically by the drive using the following methods:

- **Option A**. When a feedback device is automatically identified by the drive and the motor data is automatically populated (Motor Autoset = 1-On) the proportional gain of the current loop (il.kp) is set based on the motor data and is shown as a read-only parameter in the current loop screen.
- **Option B**.When the motor is selected using the motor database or using the custom motor tool, the imported inductance value is used to set the current loop proportional gain.



NOTE	**Manual adjustments to the current loop proportional gain parameter are not normally required during the motor tuning procedure. If manual adjustments are made to the current loop proportional gain parameter, repeating the motor setup procedure will overwrite the changes and restore the value to the Kollmorgen calculated value.**

Related Parameters

IL Parameters

DRV.OPMODE

12.3.3 Current Loop Gain Scheduling

This feature is needed when the motor inductance is saturated during normal operation. Because the current loop gain is calculated using the motor inductance, if the inductance changes, the current loop is at risk of becoming unstable.

If a motor is being used under high loads, the inductance is probably saturating if one or more of the following occurs:

- Audible chirping occurs.
- Chirping gets louder with higher commanded current.
- Instability occurs under high current loads (at or near MOTOR.IPEAK)

To rectify this problem, you can use gain scheduling to change the current loop gain as a function of the current command (IL.CMD).

12.3.4 Using the Gain Scheduling View in WorkBench

To use this feature effectively, you should have either an inductance chart of motor inductance as a function of current, or you must have an idea of how the current loop is performing.

If a chart of motor inductance versus current command is available, it is possible to calculate the required current loop gain values over the range of motor currents.

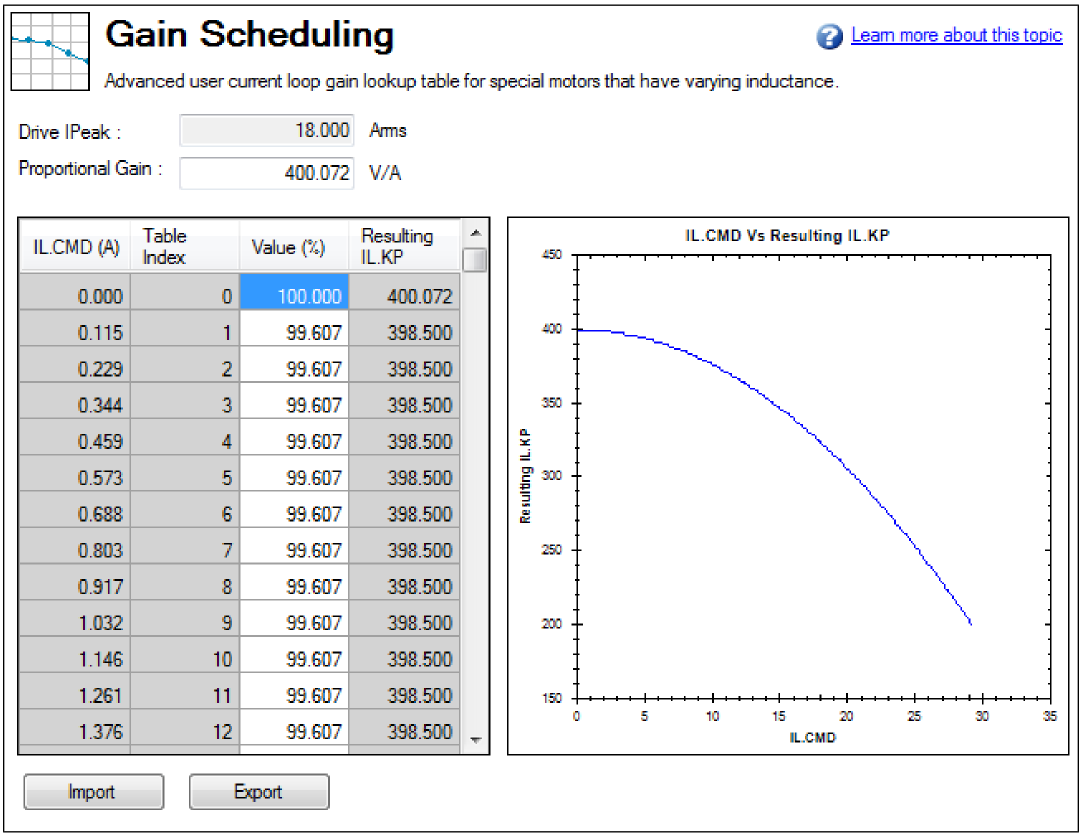
Current Loop Gain = 2000 * 2π* Motor Inductance (H)

Example

Motor Inductance is 3.19 mH, current loop gain would be 40.01

Current Loop Gain = 2000 * 2 π * 0.00319 = 40.01

Once suitable values have been identified, you can enter these values into WorkBench in the **Gain Scheduling** view. The **Import** and **Export** buttons at the bottom of the view allow you to import and export data as .csv files.



By default, the current loop value will be what is defined in IL.KP across the whole range of currents. To change the value of IL.KP over a range of values, simply enter a scaling term: 0 - 100% of the current value.

Example

If the current loop gain entered on IL.KP was 40.124 (shown above) and a current loop gain of 36 was desired, a scaling term of 90% should be entered for the desired current ranges.

40.124 * 0.90 = 36.112

12.3.4.1 Using the Terminal View for Gains Scheduling

You can also use the Terminal to set up the Gains Scheduling Table. If you use the Terminal, then two parameters are required for each lookup table point: IL.KPLOOKUPINDEX and IL.KPLOOKUPVALUE. IL.KPLOOKUPINDEX specifies the lookup table index (0 – 255), and IL.KPLOOKUPVALUE specifies the scaling term (0 – 100%) to scale IL.KP.

The current to which a lookup index refers can be calculated as follows:

IL.CMD Range = DRV.IPEAK/157 * IL.KPLOOKUPINDEX

A full list of table values can also be retrieved using IL.KPLOOKUPVALUES, which returns a comma delimited table as follows:

```
-->IL.KPLOOKUPVALUES
Index Value
0, 100.000
1, 100.000
2, 100.000
3, 100.000
4, 100.000
5, 100.000
6, 100.000
7, 100.000
```

```
8, 100.000
9, 100.000
10, 100.000
```

12.4 Velocity Loop

12.4.1 Overview

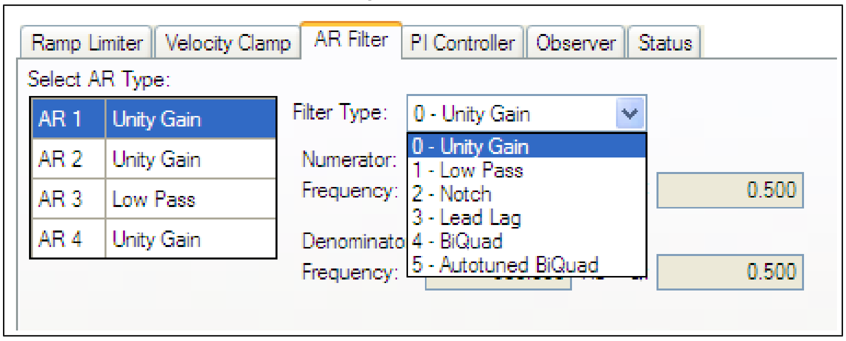
The velocity loop is active when the drive operates in velocity mode (DRV.OPMODE = 1) or position mode (DRV.OPMODE = 2). The parameters that govern the velocity loop are shown in the Velocity Loop view. The various types of tuning for the drive adjust these parameters automatically, so you normally do not need to adjust the velocity loop parameters in the velocity loop screen.

A detailed block diagram for the velocity loop is included in 22 Block Diagrams.

12.4.2 Tabs in the Velocity Loop View

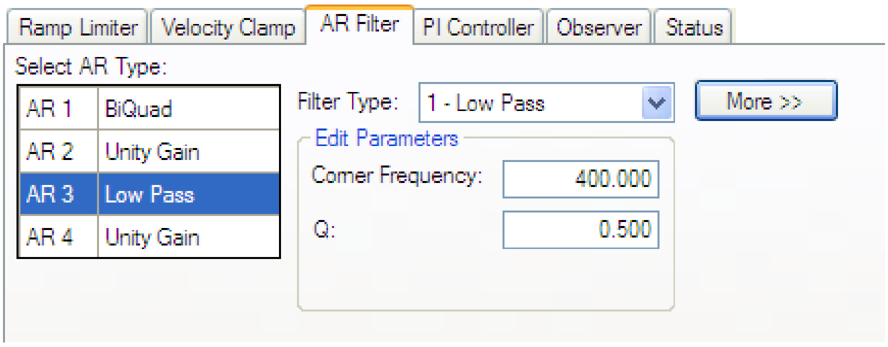
The velocity view includes an active block diagram. If you click on a block in the diagram, the appropriate tab opens below.

- **Ramp limiter** . The ramp limiter consists of the acceleration limits of the drive. These acceleration limits override both motion task and electronic gearing acceleration limits, so they must be set higher than the highest required motion task acceleration or gearing acceleration value. These acceleration and deceleration limits are also shown in the Service Motion view and the Limits view (DRV.ACC and DRV.DEC).
- **Velocity clamp**. The velocity clamp affects the maximum speed of the drive when the command source is service (DRV.CMDSOURCE = 0). This speed limit affects motion commanded in service motion and in motion tasks. These limits are also found in the limit screen on WorkBench. (VL.LIMITP and VL.LIMITN)
- **AR1, AR2, AR3, AR4**: These values are the independent bilinear quadratic (bi-quad) filters inside the drive. AR1 and AR2 are in the forward path and AR3 and AR4 are in the feedback path. These bi-quad filters can each be configured in five different modes.



0–Unity Gain. The filter is off, and it will not affect the loop.

1–Low Pass. In modes 1, 2, and 3, the bi-quad filter is configured for each respective type of filtering. The Edit Parameters field is used to set up the filter. The actual bi-quad filter values are shown to the left:



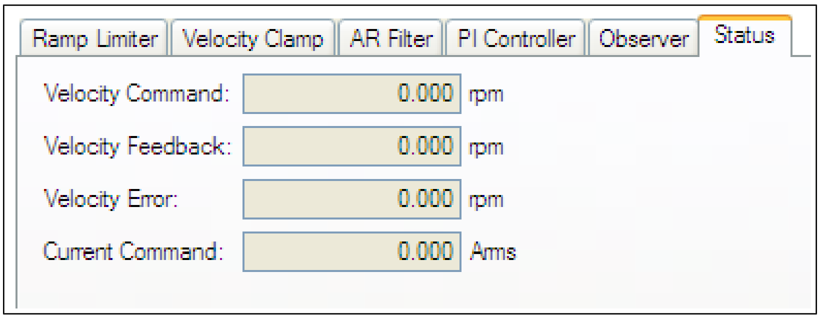
2–Notch

3–Lead Lag

4–Bi-quad . A manually configured Bi-quad filter. This is an advanced tuning function.

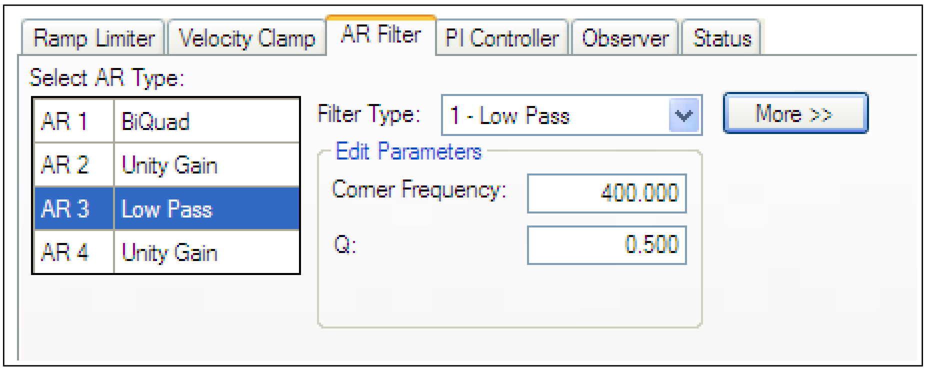
5–Autotuned Biquad . When the PST sets a filter after the PST process is complete, the values are input into the Bi-Quad filter and are shown as a read only values.

- **Status**. The status tab shows parameters that are relevant to the velocity loop performance.



12.4.3 Velocity Loop Default Settings and Changes

By default, a PI loop with a low-pass filter (AR3) is set in the drive.



The default value for the low-pass filter is 400 Hz. The low-pass filter is important for disturbance rejection, and it also reduces the audible noise of the system.

12.4.3.1 Velocity Loop Changes Based on Slider Tuning

Slider tuning (see 15.2 Slider Tuning) uses the slider control to adjust the proportional gain and integral gain values of the velocity loop based on the desired bandwidth. If you adjust the bandwidth using the slider tuner and then return to the velocity loop screen, you will see different values inside the proportional gain and integral gain fields. No adjustment is made to the filters automatically by using the slider tuner. Only the proportional and integral terms are adjusted.

12.4.3.2 Velocity Loop Changes Based on PST

When the PST (see 15.3 Using the Performance Servo Tuner) is used, changes are made to the proportional gain, integral gain, filters, and other parameters not related to the velocity loop screen directly. The values adjusted are dependent on the drive, motor, load, and the PST settings. The filters that are adjusted by the PST are automatically put into mode **5-Autotuned Bi-quad**.

No adjustments can be made to mode **5- Autotuned BiQuad** filters that are set by the PST. If adjustment to the tuning of the system is desired after the PST process is completed, then these adjustments should be made in the settings of the PST. The PST process can then be repeated.

Related Parameters

VL Parameters

DRV.ACC

DRV.CMDSOURCE

DRV.DEC

DRV.OPMODE

Related Topics

11.8 Limits

13.2 Motion Tasks

13.4 Service Motion

11.7 Electronic Gearing

15 Tuning Your System

12.5 Position Loop

12.5.1 Overview

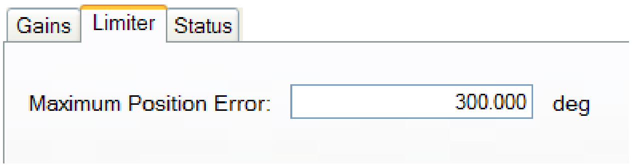
The position loop is active when the drive operates in position mode (DRV.OPMODE = 2). The parameters that govern the position loop are shown in the Position Loop view. The various types of tuning inside AKD adjust these parameters, so you normally do not need to adjust the position loop parameters in the position loop screen.

A detailed block diagram for the position loop is included in 22 Block Diagrams.

12.5.2 Tabs in the Position Loop View

The position loop view includes an active block diagram. If you click on a block in the diagram, the appropriate tab opens below.

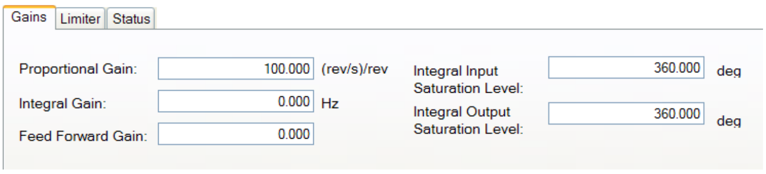
- **Gains**. This tab shows the gains for the position loop.
- **Limiter**. The value in the **Maximum Position Error** box (PL.ERRFTHRESH) limits the position error (PL.ERR) that can be present. When the maximum position error is exceeded, the drive generates fault F439, Following Error. If the maximum position error is set to 0 (default) then the maximum position error is ignored.



- **Status**. This tab shows the present value of commanded position (PL.CMD), position feedback (PL.FB), position error (PL.ERR), and velocity command (VL.CMD).

12.5.3 Position Loop Default Behavior and Changes

By default, only a proportional gain (PL.KP) is applied in the position loop.



12.5.3.1 Position Loop Changes Based on Slider Tuning

Slider Tuning (see 15.2 Slider Tuning) adjusts the proportional gain of the position loop (along with velocity loop view parameters; see 12.4 Velocity Loop). If you adjust the bandwidth using the slider tuner, then when you return to the position loop screen, you will see a change to the proportional gain only. No adjustment is made to the integral gain or feedforward gain through the slider tuner. The integral saturation levels are not applicable when the integral gain is set to 0. In the **Gains** tab, the boxes for these values may be populated with default values whether or not the integral gain is set to 0.

12.5.3.2 Position Loop Changes Based on PST

When the Performance Servo Tuner (PST, see 15.3 Using the Performance Servo Tuner) is used, changes are made to the position loop proportional gain, integral gain, feedforward gain and other parameters not related to the Position Loop view directly. The values adjusted are dependent on the drive, motor, load, and the PST settings.

Related Parameters

PL Parameters

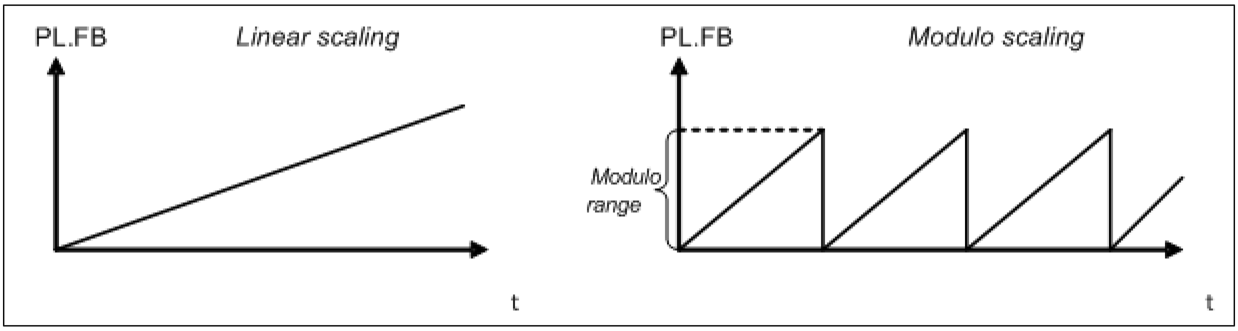
DRV.OPMODE

VL.CMD

12.5.4 Modulo Position

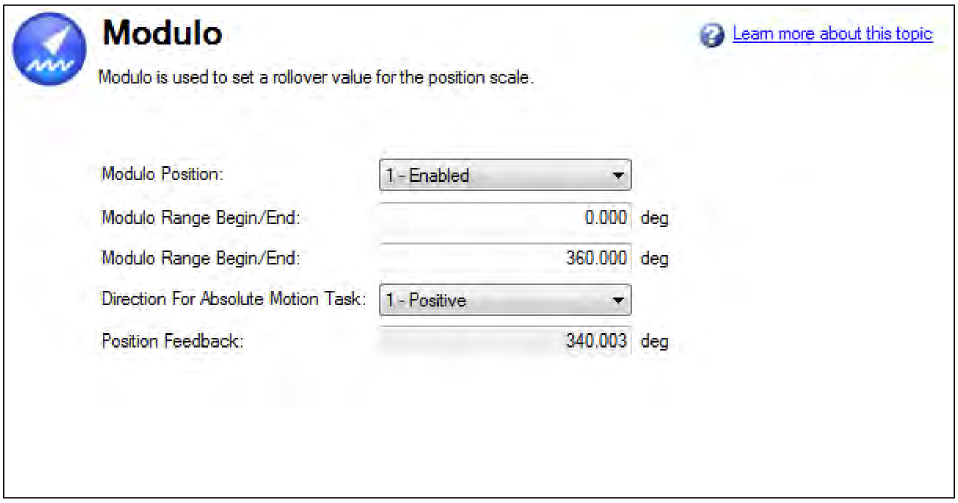
Modulo position is a function that simplifies rotational applications such as unidirectional rotating assembly tables. When enabled, the modulo axis feature converts several position-based parameters to fit in a defined modulo range. Once this range is defined, a given position value will roll over at the end of the modulo range and return to the beginning of the modulo range. This behavior affects some drive functions, which work with modulo-scaled position variables when the modulo-feature is enabled.

The following figure describes the progress of the actual position value (PL.FB) for linear scaling and modulo scaling when the motor moves continuously in a positive direction:



12.5.4.1 Setting up the modulo axis in WorkBench

You can set up the modulo axis from the **Modulo** view in WorkBench.



Button or Box	Description
Modulo Position	Enables or disables modulo (PL.MODPEN
Modulo Range Begin/End	Sets the beginning and end of the modulo range (PL.MODP1, PL.MODP2)
Direction for Absolute Motion Task	Sets the direction of an Absolute Motion task when Modulo is enabled. The direction can be set to always positive, or always move negative. The "Shortest Distance" mode will determine the shortest distance to the target and move in that direction. The "inside range" mode will move in the direction that allows the motor to stay in between the defined scale and therefore not to wrap around. Shortest Distance is more commonly used than Inside Range mode. (PL.MODPDIR)
Position Feedback	Reads and displays the position feedback (PL.FB)

12.5.4.2 Setting up the modulo axis from the Terminal

You can use the following parameters to configure the modulo-axis feature:

- PL.MODPEN: Enables or disables the modulo-axis feature.
- PL.MODP1: Defines either the beginning or the end of the modulo range, depending on the PL.MODP2 setting.
- PL.MODP2: Defines either the beginning or the end of the modulo range, depending on the PL.MODP1 setting.

12.5.4.3 Parameters affected by the modulo axis

The following parameters are converted into modulo format when the values of these parameters are queried by a user, a fieldbus, or the software oscilloscope.

- PL.FB: The actual position of the drive is converted into modulo scaling.
- PL.CMD: The command position of the drive is converted into modulo scaling.
- CAP0.PLFB: The actual position of the drive, which has been captured by the capture
- engine 0, is converted into modulo scaling.
- CAP1.PLFB: The actual position of the drive, which has been captured by the capture-engine 1, is converted into modulo scaling.

12.5.4.4 Drive functions affected by modulo axis

Software limit switch

The software limit switches in the drive compare the actual position (PL.FB) with threshold values. Motion is stopped when the actual position exceeds the software limits. Since PL.FB is affected by the modulo-axis feature, the software limit switches monitor the modulo-converted PL.FB value. Software limit switches with thresholds outside of the modulo range never limit motion.

Programmable limit switch

The programmable limit switches compare the actual position (PL.FB) with selectable thresholds and then status flags are set to "true" when the actual position is currently within these position limits. The programmable limit switches monitor the modulo-converted PL.FB value. Programmable limit switches that are set outside the modulo-range never become active.

Digital output Modes 5 and 6

The digital output modes 5 and 6 (position greater than x, position less than x) compare the actual position of the drive with thresholds and activate the associated outputs when PL.FB is lower or higher than the threshold. The digital output mode functionality monitors the modulo-converted PL.FB value. Position thresholds that are set outside the modulo range continuously activate or deactivate the digital output.

Motion tasking to absolute target positions

When modulo is enabled, absolute motion tasks assume that the command is modulo converted. Absolute motion tasks to target positions outside of the modulo range generate a warning, n18.1 Fault and Warning Messages (Motion task target position is out of modulo range).

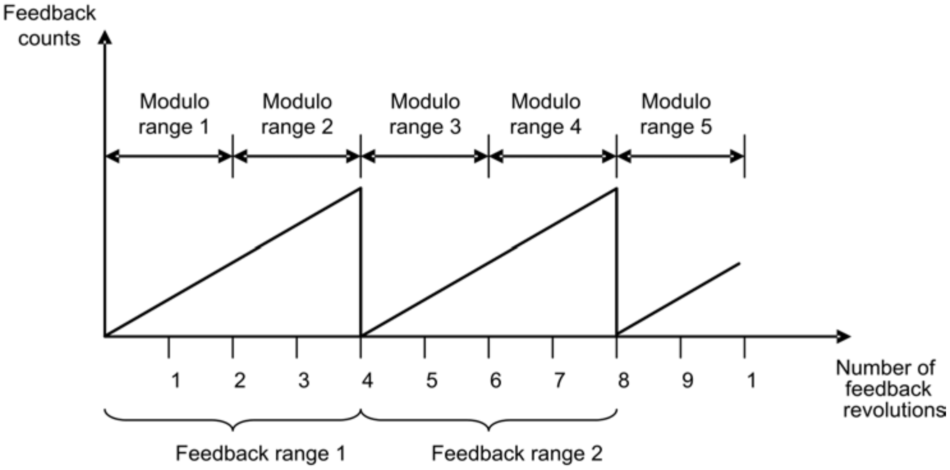
12.5.4.5 Using the modulo position feature with multiturn encoders

A special case exists for the following combinations of events:

- The drive is connected to a multiturn feedback device.
- The modulo axis feature is enabled.
- The selected modulo range does not fit as an integer in the range of the multiturn feedback.
- The application moves further than the total amount of multiturn feedback revolutions. In this case, problems occur because the multiturn feedback position overrun and a modulo range position roll-over points do not occur at exactly the same position.

After powerup of the drive, the actual position (PL.FB) will be read from the multiturn feedback device. This position can be considered as a position within the feedback range as described in the figures below.

The following figure illustrates drive behavior when the selected modulo range fits as an integer within the multiturn feedback range. For simplicity, assume that one multiturn feedback range describes four feedback revolutions and the selected modulo range is set to two feedback revolutions.

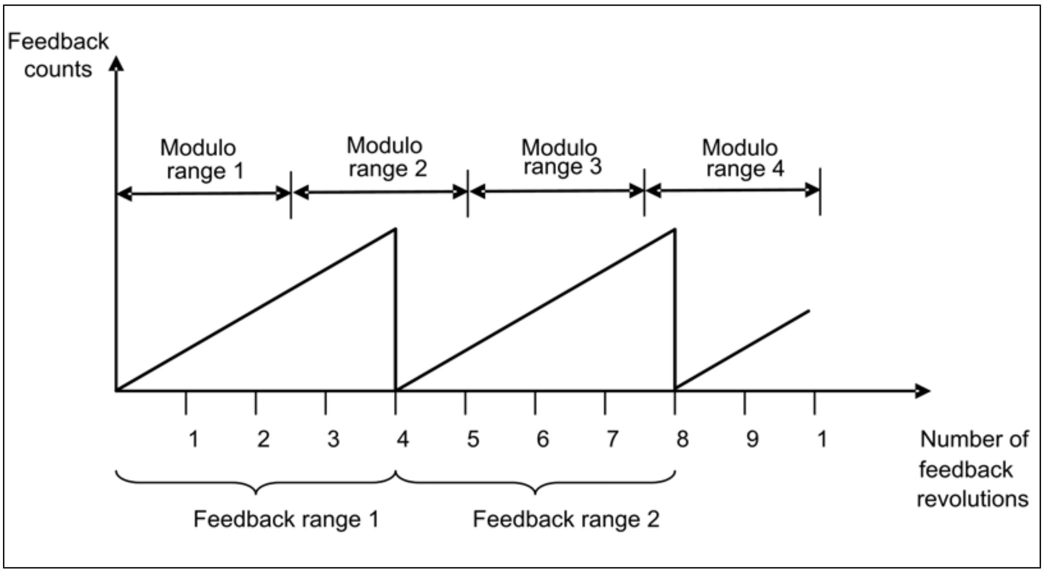


As described in the figure above, the selected modulo range of the drive is repeated exactly at the point where the connected multiturn feedback rolls over (Modulo range 1, 3, 5…). The application can move for several multiturn feedback ranges and the drive can recalculate the modulo position correctly after a power cycle. The positions within the modulo ranges represent the same value in modulo format for each feedback range.

Example

The modulo-converted position, which represents 5 or 9 feedback revolutions, corresponds to the modulo position, which represents 1 feedback revolution.

The next figure illustrates the drive behavior when the selected modulo range does not fit as an integer within the multiturn feedback range. For simplicity, assume that one multiturn feedback range describes four feedback revolutions and the selected modulo range is set to 2.5 feedback revolutions.



As described in the figure above, the selected modulo range is not repeated exactly at the place where the connected multiturn feedback rolls over. The application can move for several multiturn feedback ranges, but the drive cannot calculate the modulo position correctly after a power cycle.

Example

The modulo-converted position, which represents five feedback revolutions, does not correspond to the modulo-position, which represents one feedback revolution.

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13 Creating Motion

13.1 Homing

13.1.1 Overview

Homing is used to mechanically move a motor (connected to a mechanism) to a specific location on the machine, referred to as “home”. Motion tasks then use this home as a reference point for movements that must base a known position on this reference point. Motor movement is usually controlled by a variety of limit switches (end of travel) and a home reference switch. Using these reference points with the logic of the drive allows the machine to find and set the home reference point.

13.1.2 Using Homing

The AKD includes a variety of homing methods (set with HOME.MODE) to accommodate your machine needs:

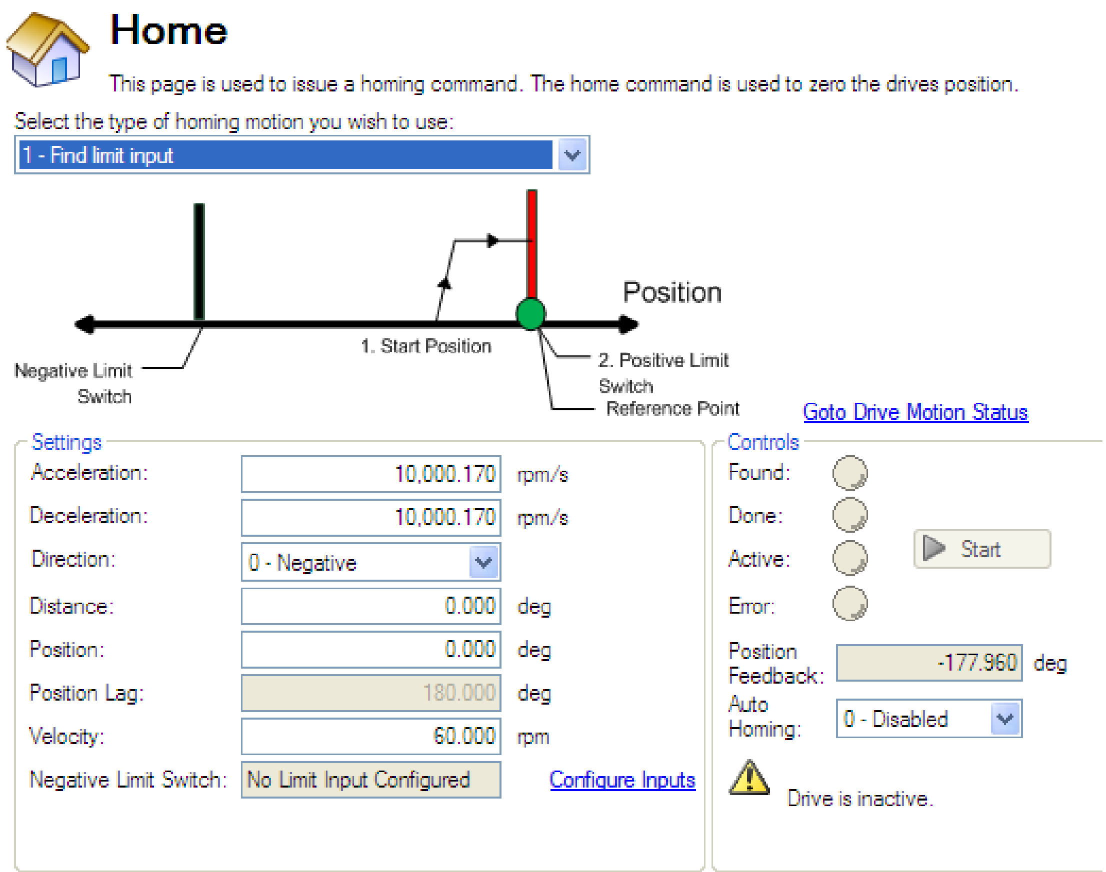
- Home using current position (HOME.MODE 0)
- Find limit input (HOME.MODE 1)
- Find input limit then find zero angle (HOME.MODE 2)
- Find input limit then find index (HOME.MODE 3)
- Find home input (HOME.MODE 4)
- Find home input then find zero angle (HOME.MODE 5)
- Find home input then find index (HOME.MODE 6)
- Find zero angle (HOME.MODE 7)
- Move until position error exceeded (HOME.MODE 8)
- Move until position error exceeded, then find zero angle (HOME.MODE 9)

Each of these homing methods offers a different way to achieve a home reference point based on your particular system mechanics. All homing methods provide the options of adjusting the acceleration, deceleration, and speed for homing moves. In addition, once the homing move is completed, you can either set an offset position or make an offset move as required. Homing modes, guidance for mode selection, and homing examples are included in 13.1.3 Selecting and Using Homing Modes

Note: When using any of the methods that use homing switches and limits, please refer to the Input/Output section for proper wiring techniques.

13.1.2.1 Home Default Window

The Home window provides a means to select your homing method and configure the homing settings. This window also provides a simple controls to start homing and confirm homing success.



13.1.2.2 Mode Selection:

Use this box to select the appropriate homing mode. Homing modes are described below in Selecting and Using Homing Modes. The active options in the **Settings** area change depending on the homing mode selected.

13.1.2.3 Settings:

- **Acceleration**: Sets the acceleration ramp used during the homing procedure.
- **Deceleration**: Sets the deceleration ramp used during the homing procedure.
- **Direction**: Sets the start direction for homing movement.
- **Distance**: Sets a prescribed distance you want the motor to move once the home reference point is found. A zero value (default) corresponds to the axis actively returning to the defined position found during the homing process.
- **Position**: Sets the current position to a precribed value once the home reference point is found.
- **Position Lag**: Sets the position error threshold, which is used for indicating home reference when using using the hardstop modes 8 and 9.
- **Velocity**: Sets the initial velocity used for homing moves.
- **Velocity Factor**: In modes where a limit is reached, and direction is reversed, the valocity factor allows you to reduce the velocity as a precentage of the homing velocity.
- **Positive/Negative Limit Switch/Home Reference/Peak Current**: These fields appear based on the mode selected. For homing to limits and home reference, this field will indicate how the digital inputs are configured as well as providing a link to the digital input page. For Homing to a hard stop, the Peak Current field allows you to set the peak current limit desired during homing.

13.1.2.4 Controls:

- **Found**: When the home reference is found, then this indicator is green.
- **Done**: When the home move ic complete, this indicator is green.
- **Active:** This indicator will be green while the Home move is taking place.
- **Error**:This indicator will be red if something in the homing sequence failed.
- **Position Feedback**: This window reports the current value for PL.PFB.
- **Auto Homing**: Allows the system to auto-home on power up.
- **Start/Stop**: Click this button to start or stop the selected homing method.

13.1.3 Selecting and Using Homing Modes

13.1.3.1 Homing Mode 0: Home Using Current Position

Using the current position is the most basic homing method. This method simply uses the current position of the motor as the home point reference. Two values allow you to further define homing with this method:

- Distance: A value other then zero will cause a movement of the motor the distance entered in counts (or other units based on your units settings). You can use this to establish a home point at some prescribed distance from the initial starting position of the motor. This home will be at the offset distance entered from zero.
- Position: You can use this parameter to set the value of the home position other then zero. This allows you to offset your home reference away from zero. PL.FB will be set to the value you enter when the motor reaches the home reference point (based on the method selected).

The distance and position offsets are available and behave similarly on all of the homing types. Either the motor will move an additional distance (distance value) after it finishes the homing method, or will set the position to the amount entered in the position value.

Homing Mode 0 Example

Use the current position as home and have the motor end motion 180 degrees from home:

1. Select Mode 0 from the drop down box.
2. Enter 180 into the **Distance** box.
3. Click **Start**,
4. The motor will move 180 degrees from the start position. The **Position Feedback** box (PL.FB) will show 180 (the motor is now sitting 180 degrees from home).

13.1.3.2 Homing Mode 1: Find Limit Input

The find limit input mode creates a move to a limit input. This method can be used if you have a positive or negative limit switch available that you want to establish as a home reference point. **NOTE: Limit switches should be set to Active Low (when switch power is lost, no current is flowing, thus drive homes at the point of the loss in power of the limit switch).**

The sequence of this homing mode is as follows:

1. The motor starts to move in the positive or negative direction, depending on the value you set in the **Home** screen (in the **Settings** section, **Direction** box).
2. The motor stops as soon as the hardware limit switch has been detected and then reverses direction.
3. The home position is set when the limit switch is no longer active. The actual and command position of the drive is immediately set to the home position value (HOME.P) and the motor ramps down to zero velocity. The axis is then moved to the position (HOME.P) + distance offset (HOME.DIST).

The values for distance and position can be used as described in homing mode 0.

⚠ CAUTION	**When homing to a limit switch, the limit switch must remain in the triggered state while the motor decelerates to zero and begins to reverse. A very low acceleration rate combined with a high approach velocity may overshoot the switch and cause it to become active. This action will cause a homing error fault.**

Homing Mode 1 Example

Use the positive end of travel limit as home reference, and then set this position to be -20 degrees.

1. Select Mode 1 from the drop down box and enter 20 into the Position box.

2. Set the direction to positive. When Start is selected, the motor will move until it encounters the positive end of travel switch.

3. As soon as the switch is triggered, the motor will reverse direction until the switch is no longer active.

4. As soon as the switch is no longer active, the position will be set to -20 degrees and the motor will ramp to 0. Depending on the velocity you are homing with, and the settings of the acceleration/deceleration ramps, the position feedback will be close to the position you entered.

13.1.3.3 Homing Mode 2: Find Input Limit then Find Zero Angle

Similar to the Find Input Limit method, the find input limit then find zero angle[1] mode follows the same steps, but upon completion of the move, it continues to move to find the zero angle reference of the motor.

NOTE: Limit switches should be set to Active Low (when switch power is lost, no current is flowing, thus drive homes at the point of the loss in power of the limit switch).

The specific steps are as follows:

1. The motor starts to move according to the direction (HOME.DIR) setting.
2. The motor stops as soon as the hardware limit switch has been detected and changes direction of movement.
3. The home position has been found as soon as the hardware limit switch is no longer active. The actual and the command position of the drive will immediately be set to the HOME.P value plus distance to the mechanical zero angle of the feedback device according to the current direction.
4. The motor moves to the home position (HOME.P) plus the distance move offset is applied (if present), which is located at the mechanical zero-angle of the feedback.

The values for distance and position can be used as described in home mode 0.

⚠ CAUTION	**When homing to a limit switch, the limit switch must remain in the triggered state while the motor decelerates to zero and begins to reverse. A very low acceleration rate combined with a high approach velocity may overshoot the switch and cause it to become active. This action will cause a homing error fault.**

Homing Mode 2 Example

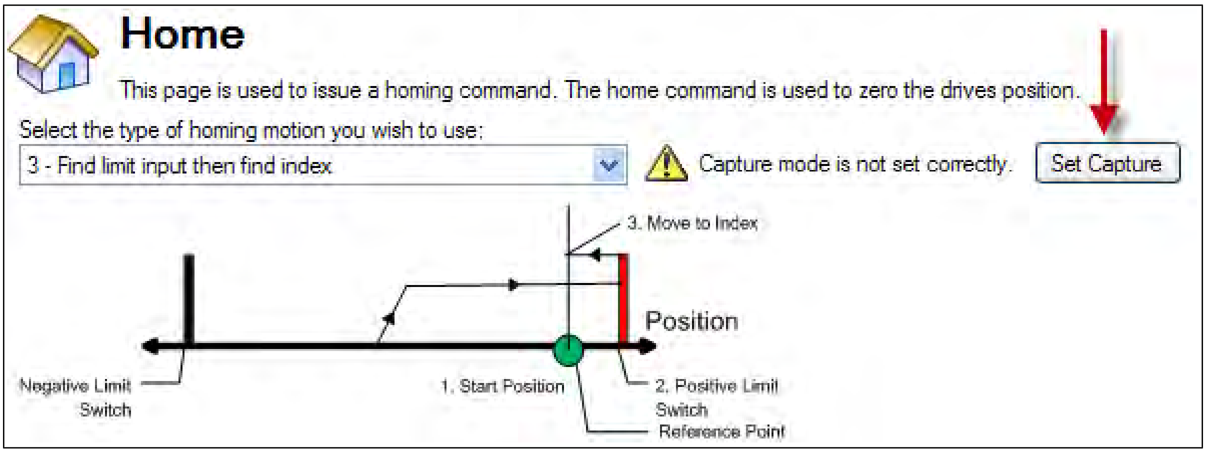
Use the positive end of travel limit as home reference and then move to the zero angle of the motor

[1] Mechanical zero angle of the feedback = 0 degree.

1. Use the positive end of travel limit as home reference and then move to the zero angle of the motor.
2. Select Mode 2 from the drop down box.
3. Set the Direction to Positive.
4. When Start is selected, the motor will move until it encounters the positive end of travel switch.
5. As soon as the switch is triggered, the motor will reverse direction and move to the zero angle of the motor.

13.1.3.4 Homing Mode 3: Find Input Limit then Find Index

Similar to the Find Input Limit method, this follows the same steps, but upon completion of the move, it continues to move to find the index pulse of the motor. This method can only be used with feedback devices that have an index pulse such as incremental encoders and analog sine encoders with an index channel (Feedback selection 10, 11, 20, 21). This method requires that Capture Mode is turned on in the home screen. With Mode 3 selected, a **Set Capture** button appears (see arrow below). Click **Set Capture** to set the Position Capture mechanism correctly for proper homing with an index pulse.



Once homing is triggered, the homing routine is performed as follows:

1. The motor starts to move according to the HOME.DIR setting.
2. The motor stops as soon as the hardware limit switch has been detected and changes direction of movement.
3. The motor ramps down to a reduced velocity as soon as the hardware limit switch is no longer active (please refer also to HOME.FEEDRATE). The drive is searching for the index-signal during this time. The home-position has been found as soon as the index-signal has been detected by the drive.
4. The actual and the command position of the drive will be set to the HOME.P value as soon as the index pulse is found. The drive then ramps down to velocity 0. The axis is then moved to the position (home.p) + distance offset (home.dist).

⚠ CAUTION	**When homing to a limit switch, the limit switch must remain in the triggered state while the motor decelerates to zero and begins to reverse. A very low acceleration rate combined with a high approach velocity may overshoot the switch and cause it to become active. This action will cause a homing error fault.**

Homing Mode 3 Example

Use the positive end of travel limit as home reference, and then move to the index reference of the motor feedback device at 50% of the original home velocity.

1. Select Mode 3 from the drop down box.
2. Set the Direction to Positive.
3. In the **Home** screen click **Set Capture**.
4. Set the velocity factor to 50%.
5. When Start is selected, the motor will move until it encounters the positive end of travel switch. As soon as the switch is triggered, the motor will reverse direction, decelerate to a reduced velocity based on the Velocity Factor value, and move until the motor encounters the index pules of the feedback device.

13.1.3.5 Homing Mode 4: Find Home Input

Homing Mode 4 establishes the home reference based on an external home switch connected to a drive digital input (DINx.MODE - 11 Home Reference).

The sequence of this homing mode is as follows:

1. The motor starts to move according to the direction (HOME.DIR) setting.
2. The home position has been found as soon as the home-switch becomes active while traveling in the selected direction of motion (HOME.DIR). The actual and command position of the drive will immediately be set to the position (HOME.P) value and the motor ramps down to velocity 0. The axis is then moved to the position (home.p) + distance offset (home.dist).

If the Home Reference Input is active when told to home, the drive does a reset and then the home sequence. The sequence of the reset:

1. The motor moves in the opposite direction of HOME.DIR
2. When the home switch is not active, the motor ramps down to zero, and subsequently follows the sequence of the homing mode.

The hardware limit switches are monitored during the homing procedure. The drive behaves as follows in case that a hardware limit switch is active before the home-switch has been activated:

a. The motor changes the direction until the home switch is crossed.
b. The motor ramps down to zero velocity and reverses direction again after crossing the home-switch.
c. The home-switch will now be activated according to the direction (HOME.DIR) setting and when the home-position has been found. The actual and the command position of the drive will immediately be set to the position (HOME.P) value and the motor ramps down to zero velocity. The axis is then moved to the position (home.p) + distance offset (home.dist).

Homing Mode 4 Example

Move in the negative direction towards the home reference point and then move 180 degrees from the reference point

1. Select Mode 4 from the drop down box.
2. Set the **Direction** to **Negative** and enter 180 for distance.
3. Click Start.
4. The motor moves until it encounters the home reference switch. As soon as the switch is triggered, the motor moves an increment of 180 degrees as desired.

13.1.3.6 Homing Mode 5: Find Home Input then Find Zero Angle

The sequence of this homing mode is as follows:

1. The motor starts to move according to the Direction (HOME.DIR) setting.
2. The home position has been found as soon as the home-switch becomes active while traveling in the selected direction of motion (HOME.DIR) and the zero angle of the resolver has been found.. The actual and the command position of the drive will immediately be set to the Position (HOME.P) value plus the distance to the mechanical zero angle of the feedback device according to the current direction.
3. The motor moves to the home Position (HOME.P) value plus the distance move offset is applied (if present), which is located at the mechanical zero-angle of the feedback.

If the Home Reference Input is active when told to home, the drive does a reset and then the home sequence. The sequence of the reset:

1. The motor moves in the opposite direction of HOME.DIR
2. When the home switch is not active, the motor ramps down to zero, and subsequently follows the sequence of the homing mode.

The hardware limit switches are monitored during the homing procedure. The drive behaves as follows in case that a hardware limit switch is active before the home-switch has been activated:

a. The motor changes the direction until the home switch is crossed.
b. The motor ramps down to zero velocity and changes afterwards the direction again after crossing the home-switch.
c. The home-switch will now be activated according to the HOME.DIR setting and when the home-position has been found. The actual and the command position of the drive will immediately be set to the position (HOME.P) value plus distance to the mechanical zero angle of the feedback device according to the current direction.
d. The motor moves to the home Position (HOME.P) value plus the distance move offset is applied (if present), which is located at the mechanical zero-angle of the motor feedback.

Homing Mode 5 Example

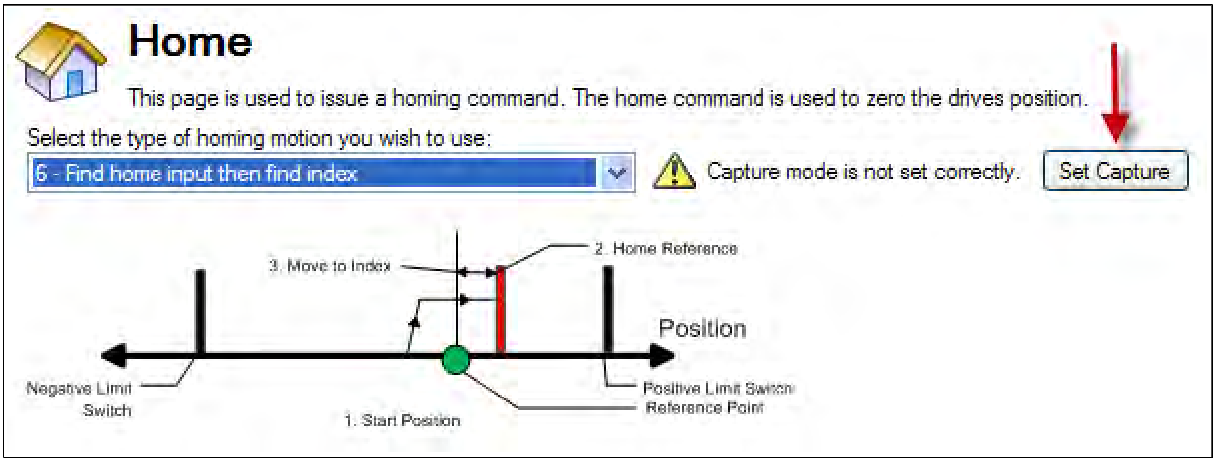
Move in the positive direction towards the home reference point and then move 60 degrees from the zero angle location.

1. Select Mode 5 from the drop down box.
2. Set the Direction to Positive and enter 60 for distance.
3. When Start is selected, the motor will move until it encounters the Home reference switch. As soon as the switch is triggered, the motor will move to the zero angle location plus an additional 60 degrees as desired.

13.1.3.7 Homing Mode 6: Find Home Input then Find Index

Similar to the Home input method, this follows the same logic as the other homing methods, first completing the home to input method, and finding the index pulse of the motor feedback.

This homing mode starts motion until a digital input, which is assigned to act as a home-switch, has been activated. The motor moves afterwards with a reduced velocity (HOME.FEEDRATE) until the index signal has been detected by the drive. **NOTE: This method requires that Capture Mode is turned on. This is done in the home screen. With Mode 6 selected, a “Set Capture” button will appear (see arrow below). Pressing the button sets the Position Capture mechanism correctly for proper homing with an index pulse..**



The home-switch must be activated according to the setting of the HOME.DIR setting.

The sequence of this homing mode is as follows:

1. The motor starts to move according to the HOME.DIR command.
2. The motor decelerates to a reduced velocity according to the HOME.FEEDRATE setting as soon as the home-switch becomes active during a motion in direction of the HOME.DIR setting.
3. The actual- and the command position of the drive will immediately be set to the HOME.P value as soon as the index-signal has been detected. The motor decelerates until velocity 0 has been reached.

If the Home Reference Input is active when told to home, the drive does a reset and then the home sequence. The sequence of the reset:

1. The motor moves in the opposite direction of HOME.DIR
2. When the home switch is not active, the motor ramps down to zero, and subsequently follows the sequence of the homing mode.

The hardware limit switches are monitored during the whole homing procedure. The drive behaves as follows in case that a hardware limit switch is active before the home-switch has been activated:

a. The motor changes the direction until the home-switch is crossed.
b. The motor ramps down to zero velocity and changes direction again after crossing the home-switch.
c. The home-switch will now be activated according to the HOME.DIR command. The motor decelerates to a reduced velocity according to the HOME.FEEDRATE setting as soon as the home-switch becomes active.
d. The actual and the command position of the Drive will immediately be set to the HOME.P value as soon as the index-signal has been detected. The motor decelerates until zero velocity has been reached. The axis is then moved to the position (HOME.P) + distance offset (HOME.DIST).

13.1.3.8 Homing Mode 7: Find Zero Angle

The sequence of this homing mode is as follows:

1. The home value is immediately found by the drive and the actual and the command position of the drive will immediately be set to the Position (HOME.P) value plus the distance to the mechanical zero angle of the feedback device according to the current direction.
2. The motor moves to the home Position (HOME.P) value, which is located at the mechanical zero-angle of the feedback.

Homing Mode 7 Example

Move in the positive direction towards the zero angle location.

1. Select Mode 7 from the drop down box.
2. Set the direction to Positive.
3. When Start is selected, the motor will move to the zero angle location.

13.1.3.9 Homing mode 8: Move Until Position Error Exceeded

This method is also referred to as move to hard or mechanical stop. The AKD has several options related to this method as well. For this basic method, the motor will move until it encounters a hard stop, causing the position error to exceed a specific threshold you set. Once the threshold is exceeded, the motion stops and home reference is established. You can use the Distance or Position as described initially in this section. One caution; make sure you choose the direction appropriately to move off of the stop if you use the distance offset.

The sequence in this homing mode is as follows:

1. As this home move is initiated, the moptor will move according to the Direction (HOME.DIR) value until the positon error exceeds the Position Lag (HOME.PERRTHRESH) value.
2. The motor is now at home position (HOME.P) value.

Homing Mode 8 Example

Move in the positive direction towards a hard stop and limit the current to 1 amp. Allow 30 degrees of error before considered at the hard stop.

1. Select Mode 8 from the drop down box.
2. Set the Direction to Positive, Position Lag to 30 degrees and Peak Current to 1.
3. When Start is selected, the motor will move to the hard stop with a peak current of 1 amp.
4. As the position error exceeds the 30 degrees, the home Position (HOME.P) is set.

13.1.3.10 Homing Mode 9: Move Until Position Error Exceeded then Find Zero Angle

The sequence in this homing mode is as follows:

1. As this home move is initiated, the motor will move according to the Direction (HOME.DIR) value until the positon error exceeds the Position Lag (HOME.PERRTHRESH) value.
2. The home value is immeadiately found by the drive and the actual and the command position of the drive will be set to the Position (HOME.P) value plus the distance to the mechanical zero angle of the feedback device according to the current direction.
3. The motor moves to the home Position (HOME.P) plus the distance move offset is applied (if present) value, which is located at the mechanical zero-angle of the feedback.

Homing Mode 9 Example

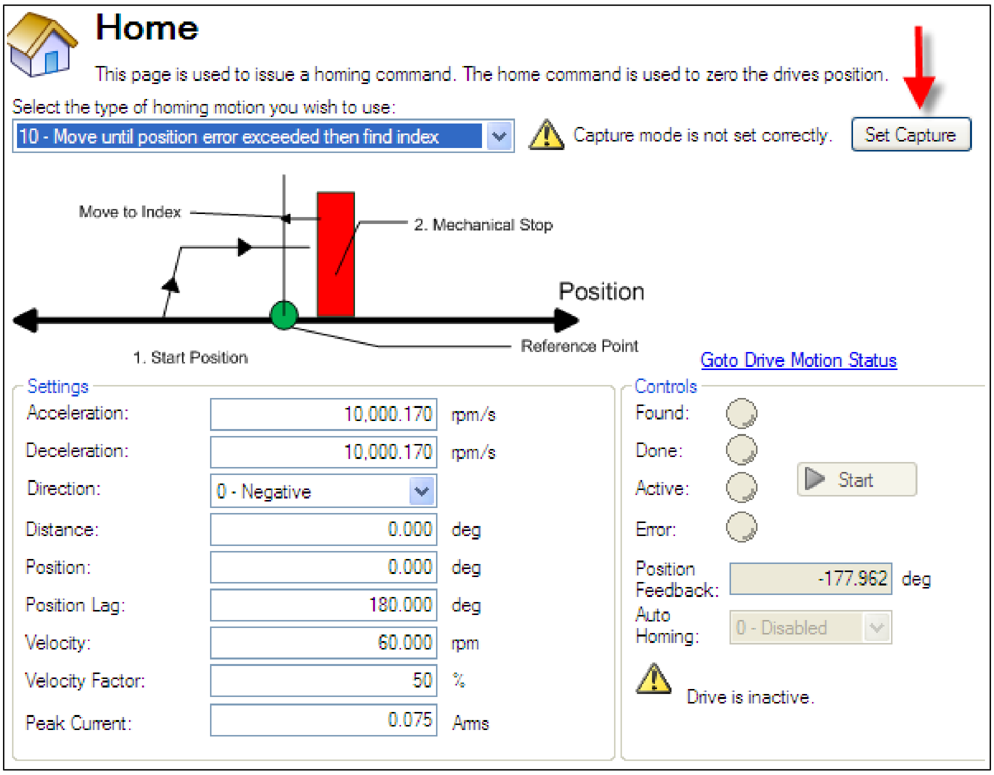
Move in the positive direction towards a hard stop and limit the current to 1 amp. Allow 30 degrees of error before considered at the hard stop. Then move to the zero angle of the motor and designate this as the 180 point.

1. Select Mode 9 from the drop down box.
2. Set the Direction to Positive, Position to 180, Position Lag to 30 degrees and Peak Current to 1.
3. When Start is selected, the motor will move to the hard stop with a peak current of 1 amp. As the position error exceeds the 30 degrees, the home Position (HOME.P) is set and the Position will be set to 180.

13.1.4 Homing Mode 10: Move Until Position Error Exceeded then Find Index

This method is similar to HOME.MODE 8, but looks for the index pulse after it encounters the hard stop. For this method, the motor will move until it encounters a hard stop, causing the position error to exceed a specific threshold that you set. Once the threshold is exceeded, the motion will reverse and look for an index pulse.

This method can only be used with feedback devices that have an index pulse such as incremental encoders and analog sine encoders with an Index channel (Feedback selection 10, 11, 20, 21). This method requires that Capture Mode is turned on in the home screen. With Mode 10 selected, a **Set Capture** button appears (see arrow below). Click **Set Capture** to set the position capture mechanism correctly for proper homing with an index pulse.



1. Motor advances into the mechanical stop and then reverses direction.
2. The motor is searching for the index pulse during this time.
3. If the motor finds the Index pulse, then the Home-position is found.
4. The actual and the command position of the drive will be set to the HOME.P value as soon as the index signal is found. The drive then ramps down to velocity 0.
5. If another mechanical stop is found before the Index signal, then the homing sequence will fail and the system needs to be reviewed for proper wiring.

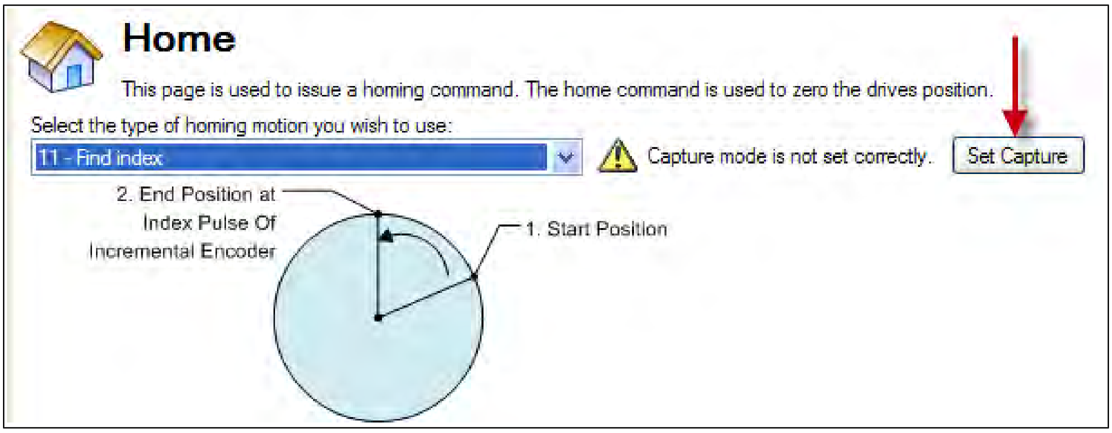
Homing Mode 10 Example: Move Until Position Error Exceeded then Find Index.

1. Select mode 10 from the drop down box.
2. Set the direction to positive.
3. In the home screen click **Set Capture**.
4. Set position lag and peak current values based on your application requirements.
5. When start is selected, the motor moves in the positive direction until a hard stop is encountered.
6. The motor reverses and moves until it encounters the index reference and then it stops.
7. If another hard stop is encountered before the index reference, home fails.

Unlike Homing Mode 3, the Home position is set as soon as the index pulse is found, irrespective of the direction of motion.

13.1.4.1 Homing Mode 11: Find Index Signal

This method can only be used with feedback devices that have an index pulse such as incremental encoders and analog sine encoders with an Index channel (Feedback selection 10, 11, 20, 21). This method requires that Capture Mode is turned on in the home screen. With Mode 11 selected, a **Set Capture** button appears (see arrow below). Click **Set Capture** to set the position capture mechanism correctly for proper homing with an index pulse.



Once homing is triggered, the homing routine is performed as follows:

1. The motor starts to move according to the HOME.DIR setting.
2. The Motor is searching for the index pulse during this time.
3. If the Motor finds the Index pulse, then the Home-position is found.
4. The actual and the command position of the Drive will be set to the HOME.P value as soon as the index-signal is found. The Drive then ramps down to velocity 0.
5. If the Limit switch is active before Index signal, then the Motor changes the direction and then repeats steps 3 and 4.

Homing Mode 11 Example: Find Index Signal.

1. Select Mode 11 from the drop down box.
2. Set the Direction to Positive.
3. In the home screen press the “set capture” button.
4. When Start is selected, the motor will move until it encounters the index reference and then it stops.
5. If Limit switch is encountered before Index reference, the Motor changes direction and searches for Index signal in the opposite direction.

Unlike Homing Mode 3, the Home position is set as soon as the index pulse is found, irrespective of the direction of motion.

Homing Mode 12: Homing to a home-switch, including mechanical stop detection

This homing mode starts a motion until a digital input, which is assigned to act as a home switch, has been activated. The home switch must be activated according to the setting of the HOME.DIR setting. The home position is found as soon as the home-switch was activated during a motion in direction of the HOME.DIR setting.

The sequence of this homing mode is as follows:

1. The motor starts to move according to the HOME.DIR setting.
2. The home position has been found as soon as the home-switch becomes active during a motion in direction of the HOME.DIR setting. The actual- and the command position of the Drive will immediately be set to the HOME.P value and the motor ramps down to velocity 0.

This homing mode is similar to the homing mode 4, but checks if the motor hits a mechanical stop instead of the hardware limit switches. A mechanical stop is detected as soon as the absolute value of the position error (PL.ERR) is larger than the position error threshold (HOME.PERRTHRESH) setting. The current command value is limited to the HOME.IPEAK value during the homing process. The motor behaves as follows when a mechanical stop has been detected before the home switch was found:

1. The motor changes the direction until the home switch is crossed.
2. The motor ramps down to velocity 0 and changes afterwards the direction again after crossing the home switch.
3. The home-switch will now be activated according to the HOME.DIR setting and the home-position has been found. The actual and the command position of the drive is immediately set to the HOME.P value and the motor ramps down to velocity 0.

If the Home Reference Input is active when told to home, the drive does a reset and then the home sequence. The sequence of the reset:

1. The motor moves in the opposite direction of HOME.DIR
2. When the home switch is not active, the motor ramps down to zero, and subsequently follows the sequence of the homing mode.

Homing Mode 13: Absolute Mode - Use Feedback Position

This mode should be selected when using a multi-turn feedback device with AKD. Since the feedback keeps track of its value at all times, the drive takes the value of the feedback at power up. The homing flag is also set. Use auto-home with this mode (HOME.AUTOMOVE). The multi-turn device is initially referenced using FB1.OFFSET. This value is set in the drive using the terminal screen and will need to be saved to the drive. Single-turn absolute devices can also utilize this mode if they are used in applications like a rotary index table where the entire range is within 360 degrees.

13.1.5 Using Homing: Advanced

The various homing methods in the AKD offer several options for setting up your home reference. When using any of the methods that use homing switches and limits, please refer to the Input/Output section for proper wiring techniques.

Related Parameters and Commands

HOME Parameters

PL.FB

CAP0.MODE, CAP1.MODE: Sets index capture method

Related Topics

11.1 Digital Inputs and Outputs

33 DIN Parameters

35 DOUT Parameters

13.2 Motion Tasks

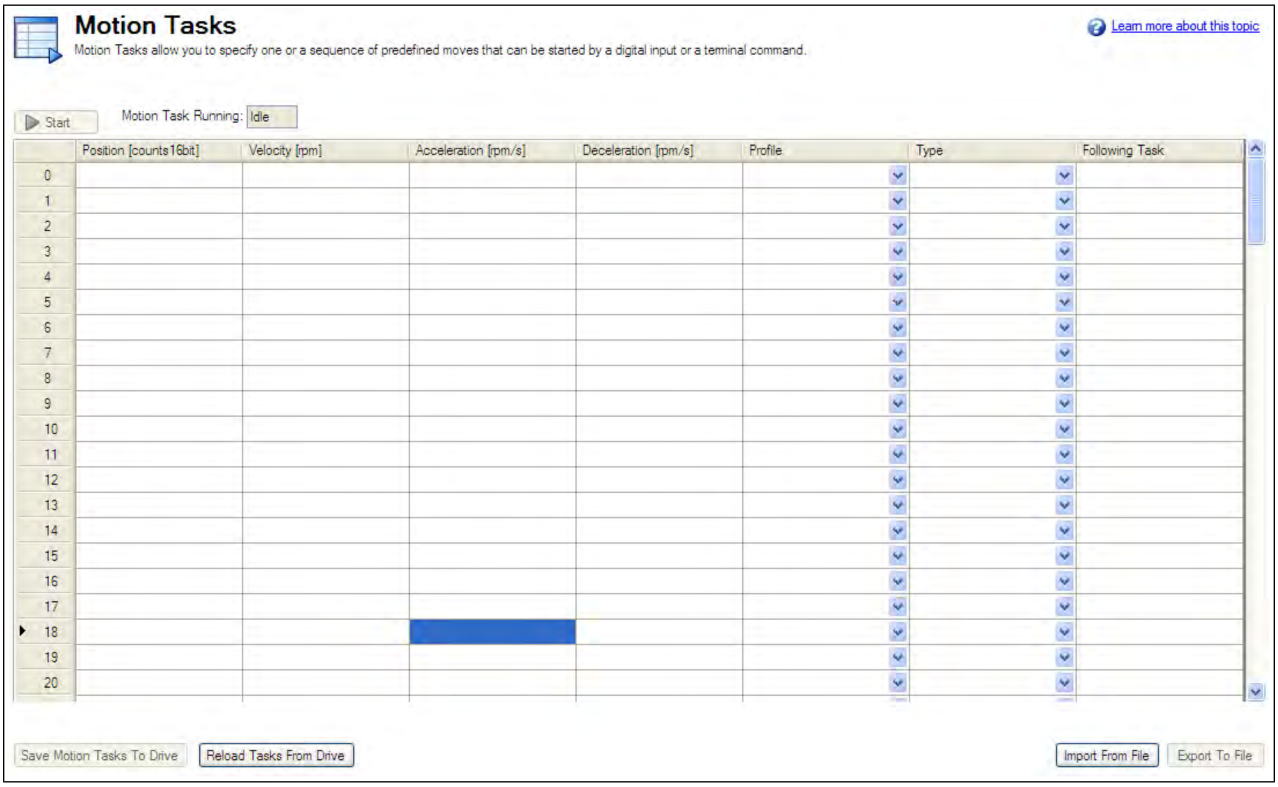
13.2.1 Overview

The AKD offers several options for executing moves, which are called "motion tasks" in WorkBench. You can directly link an input to a single motion task, assign inputs as a BCD pointer and execute, command over the Ethernet connection, or automatically execute a motion task as the result of the completion of another move event. Using WorkBench, you can also set up a single motion task or a sequence of motion tasks through the Motion Task screen, which is accessed from the Settings view. The Motion Task view allows you to modify a variety of parameters for a given move, including move profile, move type, velocity, distance, and acceleration limits.

NOTE Motion Tasking is not supported by AKD SynqNet.

13.2.2 Motion Task Input Table

Motion tasks can be easily entered and manipulated using the Motion Task Table. With this table, you can enter specific motion tasks and edit tasks, as well as insert and delete tasks, much like an Excel spreadsheet. The data table you build remains in WorkBench until you load the tasks into the drive. Once the tasks are loaded, you have access to the graphical representation of the moves (as in previous versions of WorkBench).

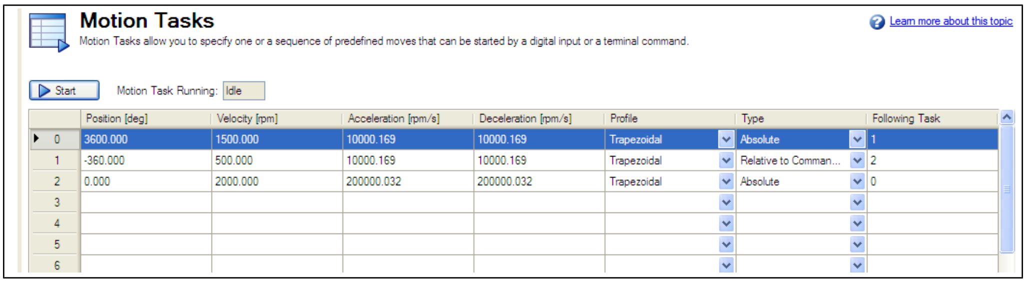


Enter values in each column for each task that you require. Once you enter an item, that field will change color indicating it has been edited but not yet loaded to the drive. Continue entering your tasks row by row. If you find that you skipped a task, you can easily insert it before or after a row that you highlight, and right-click to open the menu options. You can also select a task and using the right click access the copy and paste commands.

For delays and motion blends, double click on the line you want to edit and the delay and blend options will be available to adjust. You must load any changes or modifications to the drive before they will be available for use.

13.2.3 Using Motion Tasks

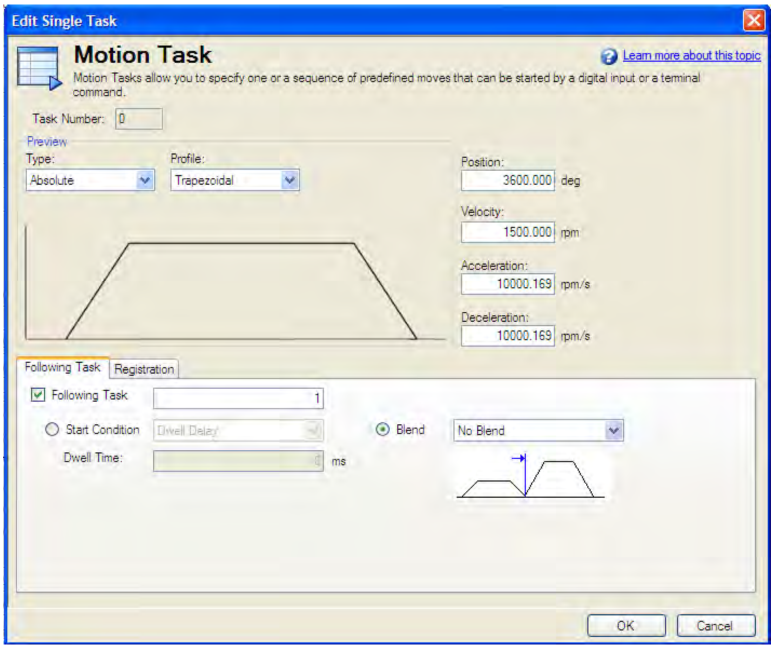
Use the Motion Task view to create and execute new motion tasks within WorkBench. As you add motion tasks, the new tasks appear as branches. You can use the root Motion Task view to view all tasks at once and execute individual tasks. When you select the Motion Task view, the Motion Task table is opened, as shown below.



From this view, you can perform the following actions:

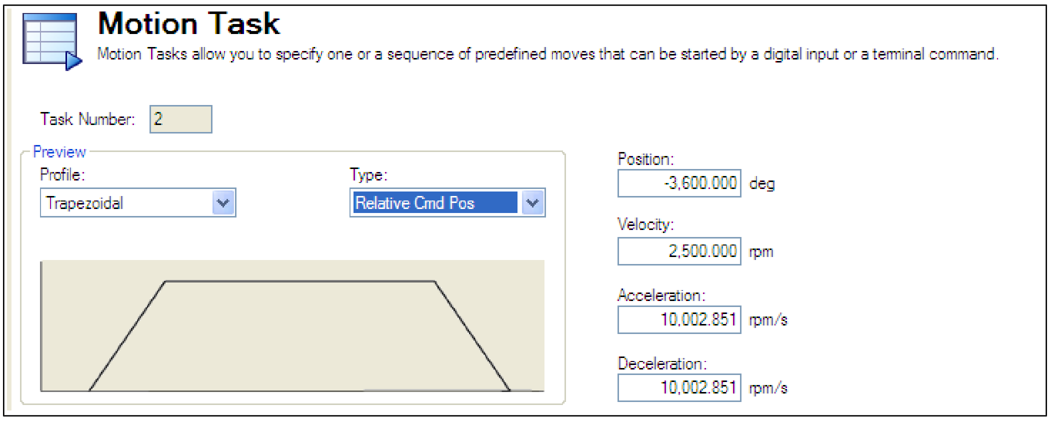
Button or Dialog Box	Description
Start	By highlighting an existing motion task, you can use this button to initiate that task (and subsequesnt tasks it may be linked to). In order to start any Motion Task, the motor must have been homed.
More/Less	This expands the Task table to include additional information regarding each task.
Save Motion Tasks To Drive	Saves the motion tasks in the table to the drive. This field is highlighted in pink if any values in the table have changed and have not been saved to the drive
Reload Tasks From Drive	Uploads motion tasks table with current values from the drive. This action deletes any values listed in the table.
Import From file	Allows import of a .xml file to the task table.
Export To File	Exports to a .xml file the current list of tasks in the table.

All of the task parameters can be added to the Motion Tasks Table when **More** is selected. You can also view individual tasks in the Motion Task (Edit Single Task) screen by double-clicking on the task row.



Once in the edit screen, you can adjust move type, position command, velocity and accelerations as well as sequencing options. The editable fields include:

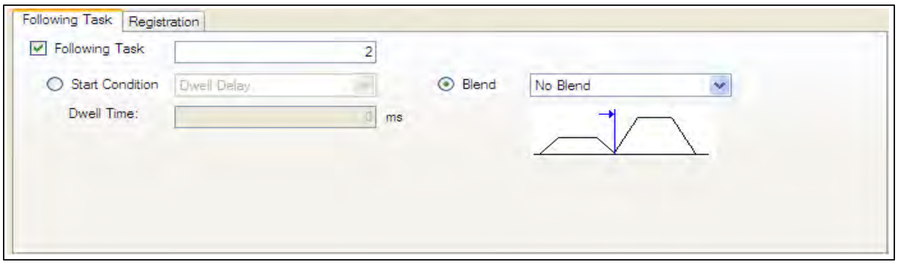
- **Type**: Sets the type of move, absolute or incremental type moves.



- **Profile** : This area sets the basic shape of the move. The basic move is trapezoidal, but S-curve (1:1) and custom profiles are also available using a "Profile Table".
- **Position**: This is the command position (PL.CMD), based on the type of move selected.
- **Velocity**: Sets the peak or traverse velocity depending on the move parameters
- **Acceleration**: Sets the profile acceleration ramp (this cannot be set higher then the drive acceleration limit setting - DRV.ACC)
- **Deceleration**: Sets the profile deceleration ramp (this cannot be set higher then the drive deceleration limit setting - DRV.DEC)

In addition to these profile settings, you can set additional parameters on how your next move will be executed. These parameters include:

- **Following Task**: By checking this box, you can indicate which task you want to follow the task that you are editing.



- **Start Condition**: This box allows for different start conditions to initiate the following task. Currently, the only option is a dwell delay. The dwell delay time can be entered in the dwell time box.
- **Blend**: It is possible to blend moves together by using the blend option. This option allows either a blend to velocity, or blend to acceleration.

Once you have entered the data, you can click on the Motion Task root directory to bring the table up to execute your moves. For more advanced motion tasks, specific constraints can be added. Currently, you can have a task that is either an interrupt task, or non-interruptible.

Advanced: Constraints

- **Interrupt**: This constraint can be used to interrupt a task that has not been finished. In other words, this constraint only will initiate the interrupt task motion if another task with no constraints is underway. This selection is a good option for registration tasks when you only want the move to happen if the current task has not finished.
- **Non-Interruptible**: When this constraint is selected, then the task can not be interrupted by another motion task or task call from inputs.

13.2.4 Motion Profiles

Trapezoidal moves include a fixed ramped acceleration (set by MT.ACC), a traverse period at velocity (set by MT.VEL), and a fixed ramped deceleration (set by MT.DEC). The distance traveled during the move is determined by the type of move (absolute or incremental). Position is set using MT.P. Note that for short moves, the traverse velocity may not ever be reached.

13.2.5 Motion Types

Motion tasks can use the following motion types:

- Absolute
- Relative to command position (PL.CMD)
- Relative to previous target position
- Relative to feedback position

Motion types define how the target position will be calculated. These can be either incremental (relative) or absolute. An incremental move is a move that increments a specific distance. The AKD allows the user to increment based on two different beginning positions as described below. Absolute moves move to a specific position based the actual position form an established zero or home point.

13.2.5.1 Absolute motion task

An absolute move type will move to the actual position indicated by MT.P. A home move would have been established to provide the reference for actual positions on the machine. In this case, the target position = PL.CMD=MT.P

Example:

You want to move to a position that is 68 degrees from home reference.

On the Motion Task edit page, Select the Absolute move type, and then enter 68 into the position block (units should be set in degrees). Enter the traverse speed and adjust the acceleration and deceleration parameters as needed. Once you move off the edit screen you can select this task and initiate a start. Regardless of your current position, the motor will now rotate to the absolute position of 68 degrees as referenced from the home position.

13.2.5.2 Motion task relative to command position (PL.CMD)

This type is simply an incremental move. The target position is based on the current position represented by PL.CMD plus the increment you want to move. Specifically, Target Position = PL.CMD + MT.P.

Example:

Your current motor position at the time you activate the motion task is 38 degrees. You want to move an increment of 30 degrees.

On the Motion Task edit page, select the **Relative to Command Position** move type, and then enter 30 into the position block (units should be set in degrees). Enter the traverse speed and adjust the acceleration and deceleration parameters as needed. Once you move off the edit screen you can select this task and initiate a start. The motor will move 30 degrees form the current position. After the motion task, the motor will now be at 68 degrees (38 + 30 = 68).

13.2.5.3 Motion task relative to previous target position

Using the last target position as the start point, this profile will move the increment chosen from that old position. This motion type is recommended in situations where a previous task may have been interrupted, or you want to eliminate any accumulated error. The target position will look at the previous target position and then add the increment you enter for this task. Specifically, Target Position = Previous Target Position + MT.P.

Example:

You initiated a motion task to increment 360 degrees, but that task was interrupted and the motor was stopped at 175 degrees. You use this method and increment another 360 degrees, the motor will complete the motion at 720 degrees (basically, it finished the first move to 360, and then made the additional distance requested of 360 degrees).

The task would be set up similar to the Relative command position example above. To view this in action, set up 2 tasks, once Relative Command Position and the second, Relative Old Target Position. Use low velocities so you can stop motion before the move is completed. Start the first move and then stop before it finishes. Then select the second move. The motor will stop at the desired end position if the stop had not occured. Try this again, but do not use the Relative Old Target Position and you will see the difference.

13.2.6 Using Motion Tasks: Advanced

13.2.6.1 Joining multiple tasks

Tasks can be joined in sequence using the task setup screen. Dwells can be added to allow the following tasks to wait a specific amount of time before starting. Tasks can also be blended to provide for smoother transitions between multiple moves. AKD allows blending with either acceleration or velocity.

13.2.6.2 Start Conditions

AKD currently provides only one alternatives to start a following task at this time (more are planned):

- **Dwell Delay**. Starts the following task after the dwell time entered (MT.FTIME)

13.2.6.3 Blending

As an alternative to dwells, the AKD can blend motion tasks to provide smooth transitions between multiple tasks. This feature extends the life of your machine life by minimizing mechanical wear due to hard move transitions (jerks).

- **No blend**. No blend, move starts upon completion of the previous task
- **Blend into Acceleration**. Blends the acceleration of the current task into the following task. As the target position of the first task is reached, the acceleration blends into the second task. This prevents the motor from decelerating to zero before starting the second move. This only works where both accelerations are driving the motor in the same direction.
- **Blend into Velocity**. Blends the velocity of the current task into the following task. In this method, the target position is reached as the velocity of the second move is reached. The belnding begins prior to reaching the target position, and is completed at the target position of the first move, and the traverse velocity of the second move. This only works when both velocitys are in the same direction.

Related Parameters and Commands

MT Parameters and Commands

DRV.MOTIONSTAT: Bit 0 monitors if motion tasking is active.

AIN Parameters

AOUT Parameters

DIN Parameters

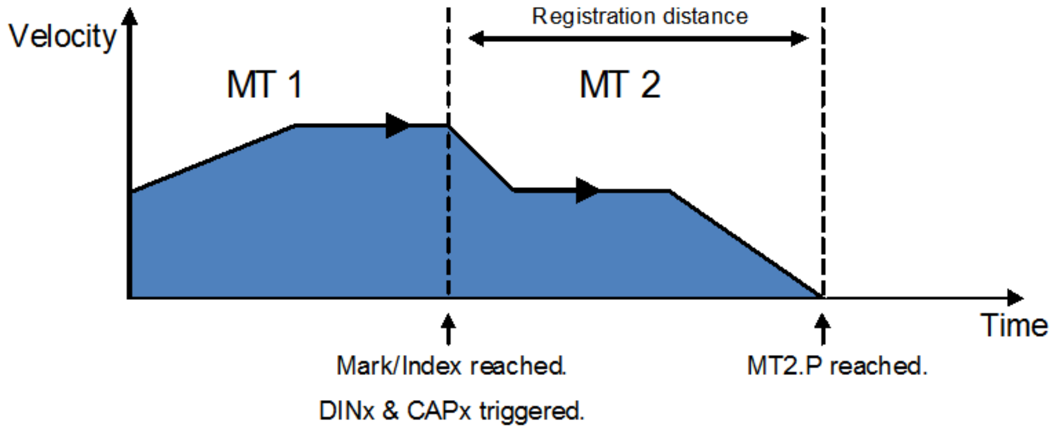
DOUT Parameters

HOME Parameters

13.3 Registration Moves

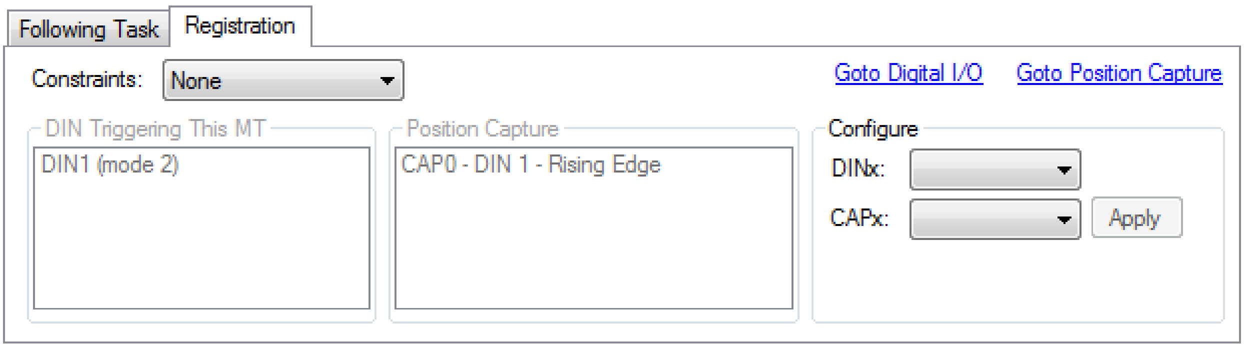
Registration moves are also known as "indexing on the fly." In a registration move, a digital input interrupts a running motion task and starts a new one. The start position of the new motion task is latched at the time the digitial input is activated. The target position of the new motion task is calculated based on the latched position value, for a very accurate target position.

Typical applications for using the registration move are feed-to-length applications, which must guarantee proper positioning with respect to special mark or index. If this mark is reached, an external trigger signal aborts the current move and starts the registration move.



13.3.1 Configuring Registration Moves in WorkBench

You can configure registration moves from the Motion Task editor:



Box	Description
Constraints	Configures bits 13 and 14 from the MT.CNTL keyword. For registration "none" or "interruptable" should be used. "Non-interruptable" will not function properly. See Using Motion TasksMotion Tasksfor information on constraints.
DIN Triggering (read-only)	Displays the list of all digital inputs that are configured to start motion tasks. These are potentially all digital inputs that can trigger this motion task. This field is read-only, indicating current configuration.
Position Capture (read-only)	Displays the list of capture engine that are configured with the proper Capture Mode (4-auto-armed position) in order to execute a registration move. These are potentially all registered position that can be used for this MT.
Configure (write-only)	Configures a digital input and the capture engine to be use as registration source for this MT.

13.3.2 Configuring Registration Moves from the Terminal View

You can also configure registration moves from the terminal view using drive parameters. To configure a registration move, you must configure three sets of parameters.

DINx
MODE = 2 or 4
PARAM = z

CAPy
MODE = 4
TRIGGER = x-1

MT (NUM = z)
CNTL = 5*
ACC = user def.
V = user def.
P = user def.
...

*other options are possible (Bit 13 & 14); see 13.3 Registration Moves and the MT.CNTL parameter description.

- Digital input (DINx) : Configure DINx to mode 2 or 4 so that input x will trigger the registration move.
- Capture (CAPy): Either capture engine 0 or 1 may be used to trigger a registration move. Set CAPy.MODE to 4, where "x" indicates the capture engine to be used. CAPy.TRIGGER must be set to x-1, where x is the DIN used above. All other capture parameters can be set as desired (see capture parameter descriptions).
- Motion tasking (MT): A registration move requires the standard motion task parameters (ACC, DEC, V, P). It also requires that the motion control word be set as follows:

  0x0005 - standard registration move (this move can be interrupted and can start regardless of previous velocity)

  0x2005 - non-interruptible registration move (move must complete before any other motion task can start)

  0x4005 - interruptible registration move but will not start if velocity is 0

  0x6005 - non-interrutible registration move that will not start if velocity is 0

  After the motion task is configured MT.SET can be used to complete the setup of the motion task.

Example

Mark triggers digital input 2.

Capture machine 0 is used.

Motion task 3 is the registration move.

Motion task 3 is only activated if a preceeding motion task is active.

Motion task 3 is configured with 1,000 rpm/s^2 acceleration and deceleration , target velocity of 10 rpm and a relative position of 50,000 counts.

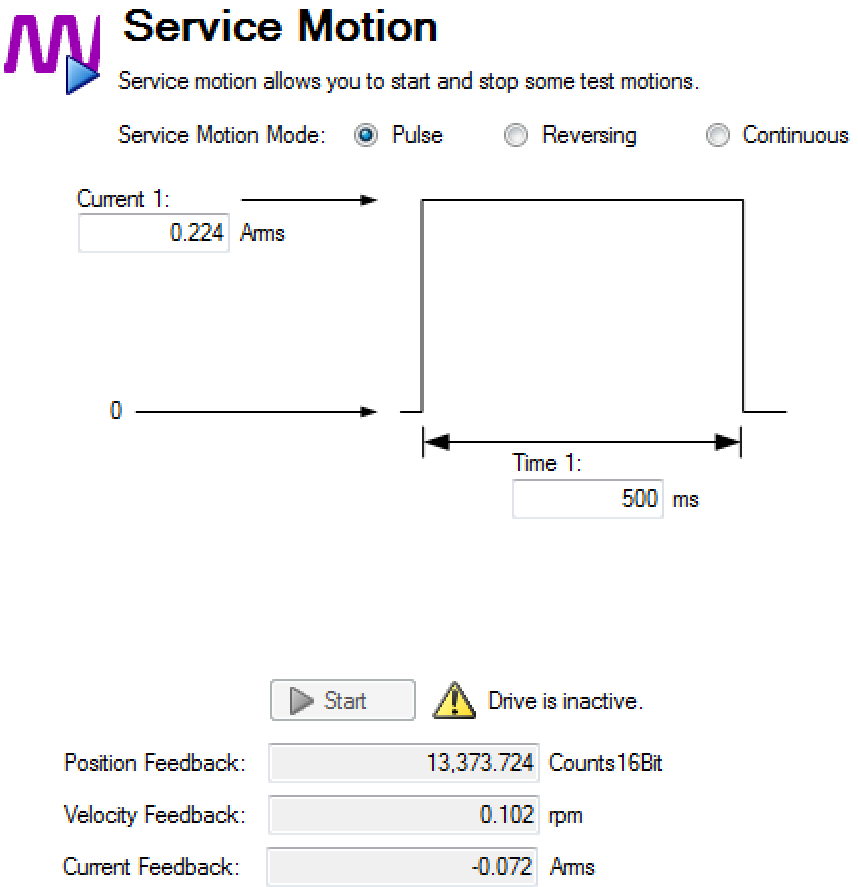
Commands:

```
DIN2.MODE 2
DIN2.PARAM 3
CAP0.MODE 4
CAP0.TRIGGER 1
MT.NUM 3
MT.CNTL 16389
MT.P 50000
MT.ACC 1000
MT.DEC 1000
MT.V 10
MT.SET
```

The registration move is now active.

13.4 Service Motion

Service Motion allows you to set up simple motion. It is typically used during initial set up to exercise the system. It can be used to help troubleshoot the system, execute tuning, make repetative moves for verification of mechanical set up, or for other general simple motion needs. There are multiple ways to set up motion depending on the desired result in torque, velocity or position modes. In all modes, you can run a momentary pulse, set up reversing motion, or initiate continuous motion.



The chart below identifies the commands available on the **Service Motion** view:

Button or Dialog Box	Description
Pulse	Alternates between the commanded current or velocity and zero velocity. You can specify the time period between the commanded value and the return to zero. Setting a time to zero will generate a continuous command.
Reversing	Alternates between the two commanded values. You can specify the time the command will be held in each state.
Continuous	Runs the commanded current or velocity continuously.
Current 1/Current 2	Sets the two different currents.
Time 1/Time 2	Sets the time for which the different commands are generated. Setting a time to zero generates a continuous command.
Start/Stop	Starts and stops the motion.
Position Feedback	Displays the present position of the motor.
Velocity Feedback	Displays the present velocity of the motor.
Current Feedback	Displays the present current of the motor.

The **Drive Motion Status** view indicates when the drive is performing service motion.

Related Topics

Drive Motion Status

Related Parameters

SM.I1

SM.I2

SM.I2

SM.MOVE

SM.T1

SM.T2

SM.V1

SM.V2

13.5 Jog Move

This screen verifies that the servo system is able to command motion. Verify the settings for velocity, acceleration, and deceleration. Adjust these settings if necessary. Click **Jog** and continuous motion will occur until you click **Stop**. If motion does not occur, check for warnings, faults, or prompts from WorkBench.

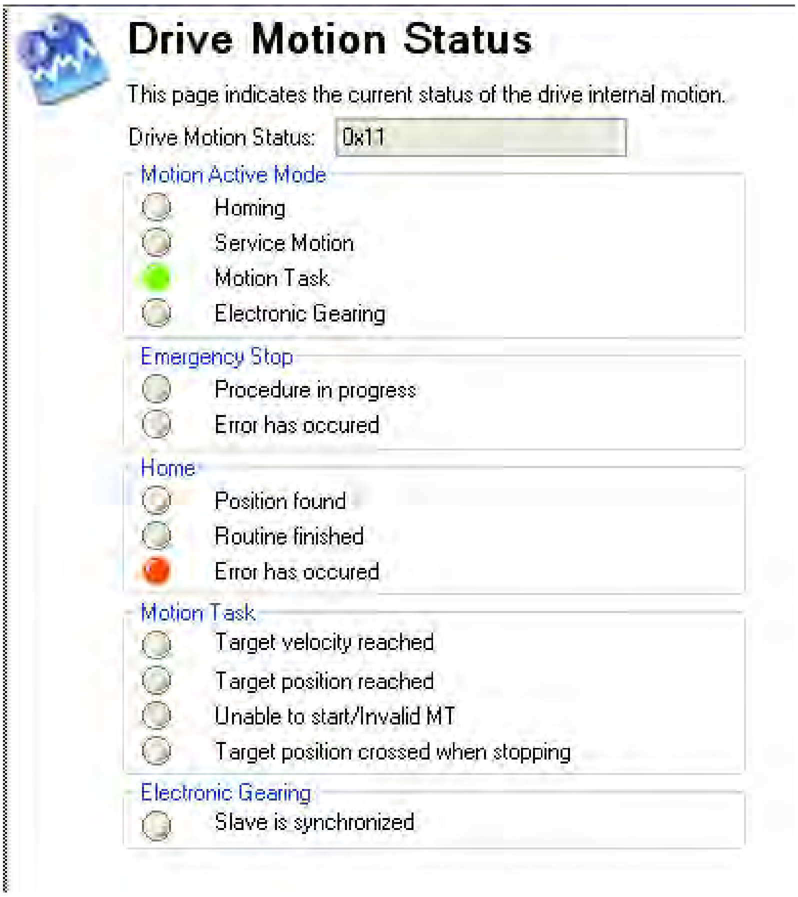
If erratic motion and or vibration occur when motion is commanded, open the wizard **Tuning** screen and reduce the desired bandwidth significantly. If erratic motion continues, exit the **Setup Wizard** and use the **Performance Servo Tuner** and **Service Motion** screens in the settings tree for more advanced setup of the servo system.

NOTE	**In order to tune the system the drive must be in service-type command source and either velocity or position opmode. If the drive is in torque opmode, then a popup screen will allow you to switch into velocity mode.**

13.6 Drive Motion Status

Drive Motion Status allows you to view the current status of the drive internal motion. An LED indicates the status of various possible motion states (as read by the DRV.MOTIONSTAT parameter).

The **Drive Motion Status** box displays the DRV.MOTIONSTAT output in hexadecimal form. The boxes below **Drive Motion Status** indicate the drive state. When drive motion is activated, a green LED is shown. When error occurs, a red LED is shown as indicated below:



Related Topics

Homing

Service Motion

Motion Tasks

Electronic Gearing

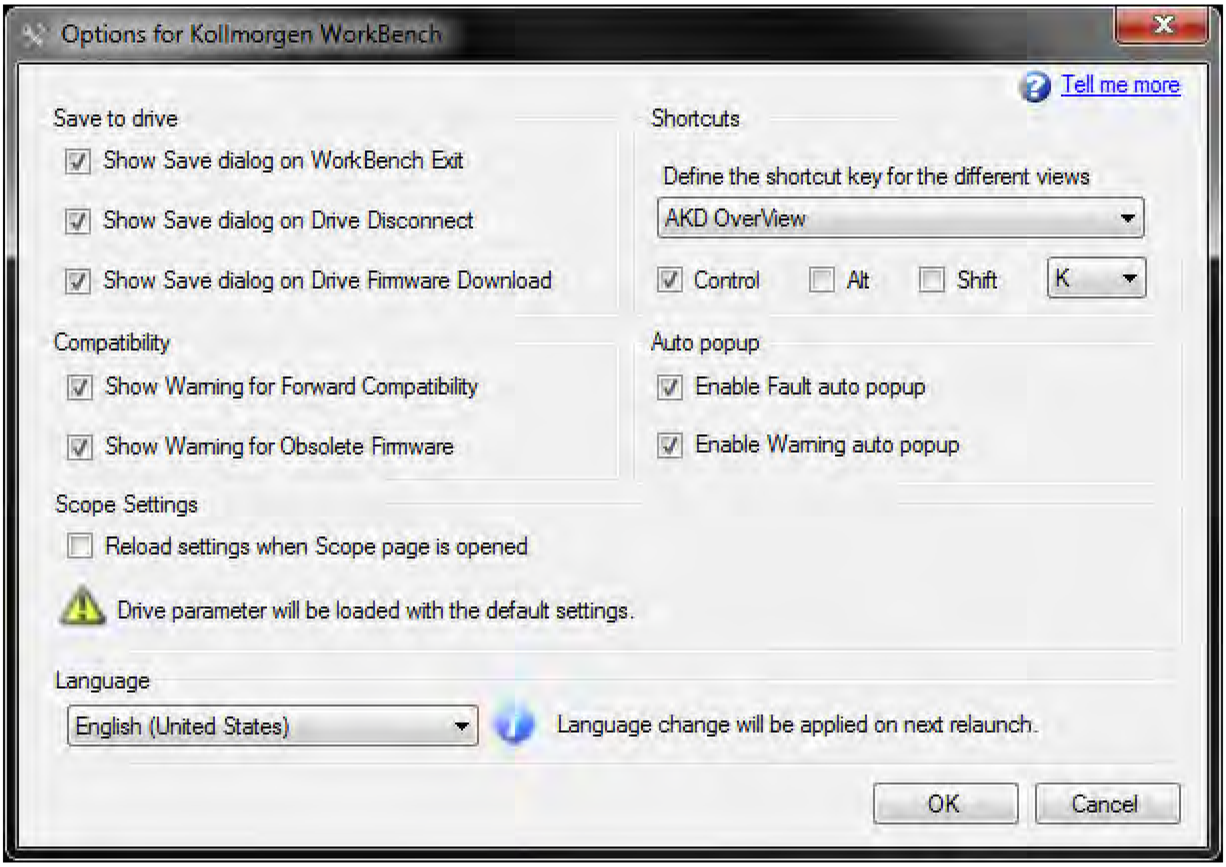
Emergency Stop

DRV.MOTIONSTAT

14 Saving Your Drive Configuration

14.1 Save Options

WorkBench offers several options for saving your drive configuration. From the WorkBench menu, if you select **Tools** and then **Options**, the following window appears:



The **Save** options are applied as follows:

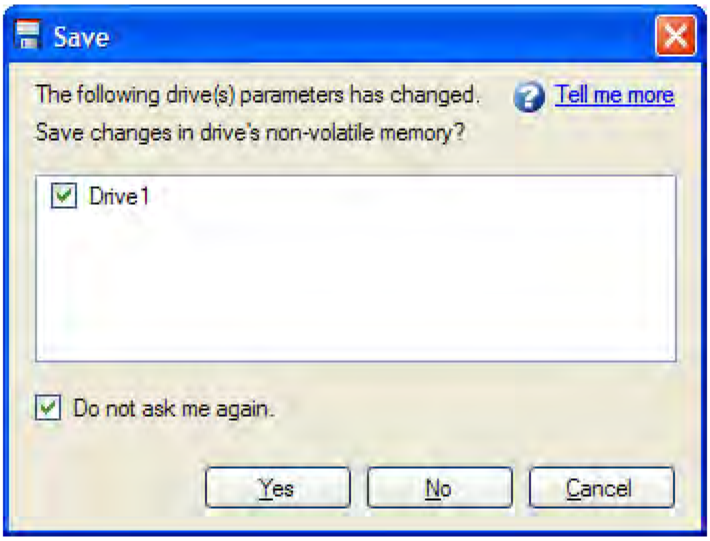
Button or Dialog Box	Description
Show Save dialog on WorkBench exit	If this box is checked, then every time you exit WorkBench a dialog will ask you if you wish to save the drive parameters to nonvolatile memory. If this box is not checked, the dialog will not be shown.
Show Save dialog on Drive Disconnect	If this box is checked, then every time you disconnect from a drive a dialog will ask you if you wish to save the drive's parameters to nonvolatile memory. If this box is not checked the dialog will not be shown.
Show Save dialog on Drive Firmware Download	If this box is checked and any parameter is changed, then every time you download a firmware to a drive, a dialog will ask you if you wish to save the drive's parameters to nonvolatile memory. If this box is not checked the dialog will not be shown

When the **Scope Settings** box is checked the default drive settings will be overwritten with selected Scope setting parameters each time the Scope page is opened. Otherwise, the drive will with default drive settings.

WorkBench is available in German and English. After making a selection from the **Language** drop down menu, click OK, and exit WorkBench. The next time WorkBench is started it will load with the selected language.

14.2 Save On Exit

When you exit WorkBench while you are connected to a drive, you may see this dialog box:



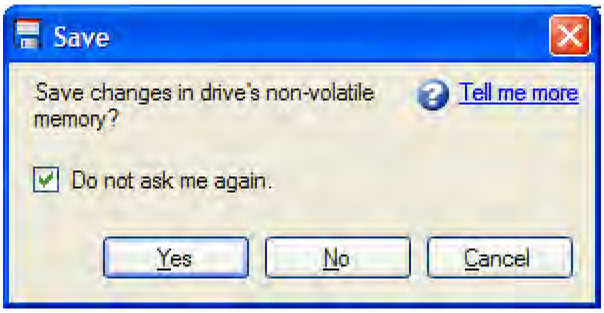
As you are working with a drive all the changes you make are stored in the volatile memory within the drive. If you power cycle the drive or loose power to the drive then any changes you have made to the drive would be lost. You can save the drive parameters to nonvolatile memory at any time and these saved parameters will be restored when the drive next powers up.

While you are connected to the drive WorkBench monitors all the changes you make to the drives parameters. An asterisk in the navigation tree shows if a parameter has been changed. If you do not change any drive parameters this dialog will not be shown.

Button or Dialog Box	Description
Yes	Saves the parameters to the nonvolatile memory within the selected drives and then exits WorkBench.
No	WorkBench will exit. No drive parameters will not be saved to nonvolatile memory.
Cancel	This will stop the exit command and WorkBench will remain open.
Do not ask me again	If you check this WorkBench will not show this dialog again. There is an option in the Options dialogue to restore this setting.

14.3 Save On Disconnect

When you disconnect from the drive, you may see this dialog box:



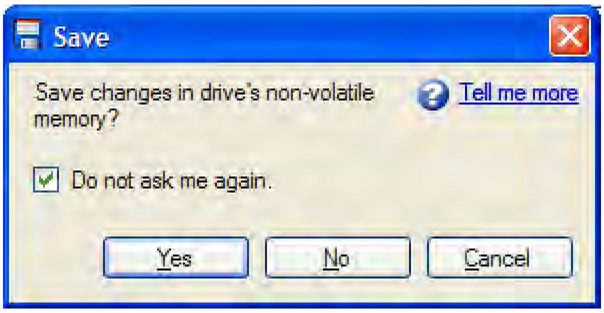
As you work with a drive, all the changes you make are stored in the volatile memory within the drive. If you restart the drive or lose power to the drive, then any changes you made to the drive would be lost. You can save the drive parameters to nonvolatile memory at any time, and these saved parameters will be restored when the drive next powers up.

While you are connected to the drive, WorkBench monitors all the changes you make to the drive parameters. An asterisk in the navigation tree shows if a parameter has been changed. If you do not change any drive parameters, this dialog box will not be shown.

Button or Dialog Box	Description
Yes	Saves the parameters to the nonvolatile memory within the drive and then finish disconnecting.
No	Disconnects the drive. The drive parameters are not saved to nonvolatile memory.
Cancel	Stops the disconnect command. You remain connected to the drive.
Do not ask me again	Does not diplay this dialog box again. If you check this box, WorkBench does not show this dialog again. The **Options** dialog includes a command to restore this setting.

14.4 Save On Firmware Download

When you download firmware to the drive, you may see this dialog box:



As you work with a drive, all the changes you make are stored in the volatile memory within the drive. If you restart the drive or lose power to the drive, then any changes you made to the drive are lost. To save these changes, you can save the drive parameters to nonvolatile memory at any time. If you save the changes to the nonvolatile memory, these saved changes will be restored when the drive next powers up.

While you are connected to the drive, WorkBench monitors all of the changes that you make to the drive parameters. An asterisk in the navigation tree indicates that a parameter has been changed. If you do not change any drive parameters, this dialog box will not be shown.

Button or Dialog Box	Description
Yes	Saves the parameters to the nonvolatile memory within the drive and then opens dialog box for the user to select the firmware file for downloading.
No	The drive parameters are not saved to nonvolatile memory. It opens dialog box for the user to select the firmware file for downloading.
Cancel	Stops the download command.
Do not ask me again	Does not display this dialog box again. If you check this box, WorkBench does not show this dialog again. The Options dialog includes a command to restore this setting.

15 Tuning Your System

15.1 Introduction

Most servo systems require some level of tuning (setting up the desired response of the system usually with the load attached). This can be done through several methods available within AKD WorkBench.

Slider Tuning - Slider tuning offers a very simplistic approach to tuning and can get you underway quickly. With this method, just the proportional and integral gains are adjusted based on the desired band-width you wish to achieve. You can take into account your load inertia if it is known. None of the Bi-quad filters are impacted by the slider tuning.

Performance Servo Tuner - This is an easy way to get a more sophisticated tuning accomplished. The details of how the PST works are included in the advanced section of this subject. However, the PST approach is a simple one-button solution that lets the system configure all of the tuning parameters for you. The PST is a robust solution to get your sytem tuned and ready to operate in a wide variety of mechanical configurations and loads.

Manual Tuning - Certain applications may require manual tuning where you set the gains and filters based on the specific performance you are looking for. You may also need to "tweak" the tuning that was set up in either the slider or the PST section to optimize your application performance.

15.2 Slider Tuning

This view allows you to vary the tuning of your drive using the slider.

15.2.1 Gentle, Medium, and Stiff

These buttons select three of the most common bandwidths:

- Gentle works in all but the most challenging situations.
- Medium is the default and works in most situations.
- Stiff works for unloaded motors.

15.2.2 The Slider

As you drag the slider to the right, the stiffness increases. In many situations, you cannot drag the slider fully to the right side because the system will become unstable.

15.2.3 Inertia Ratio

If you know the inertia ratio of your load, then entering it can improve the performance of your system. If you do not know the inertia of your load then WorkBench will assume a ratio of 1:1, which will give good performance in many configurations. The inertia ratio is the ratio of your load with respect to the inertia of your motor.

15.3 Using the Performance Servo Tuner

15.3.1 Overview

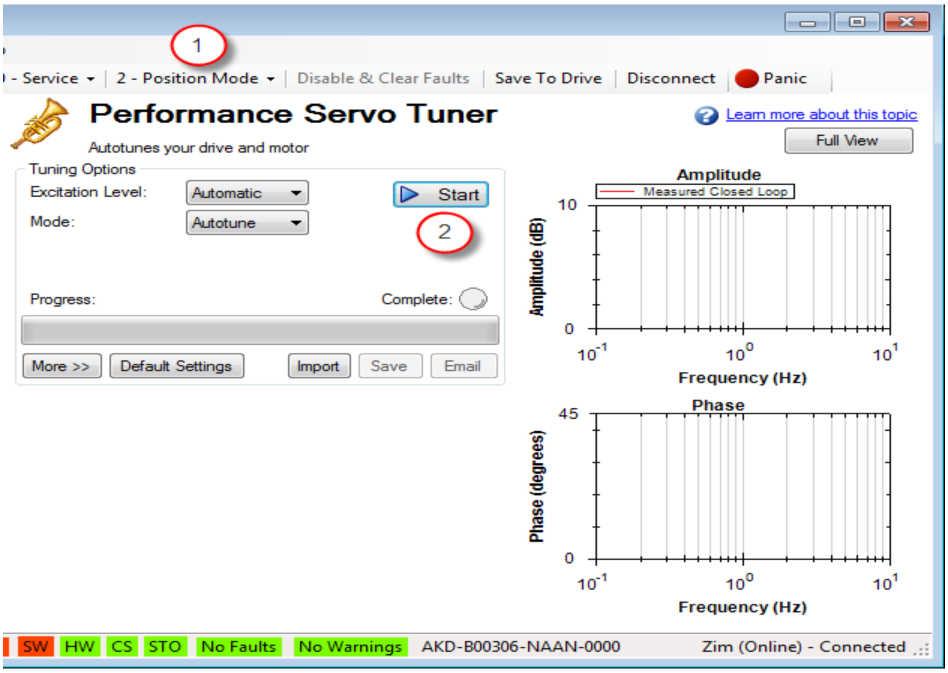
The Performance Servo Tuner (PST) tunes your system quickly and easily. The advanced technology in the PST achieves high performance and stability for both simple and complicated loads. The PST can work in a “one button” mode that requires no decisions from the user. It can also be set up in specific modes to control how the PST operates for specific requirements. Finally, the PST collects frequency response data (a Bode plot) that can be used for advanced analysis.

NOTE	**The PST will not work reliably on a vertical axis since the motor may rest against an end stop; in this case, the inertia will not always be correctly identified.**

15.3.2 Using the PST

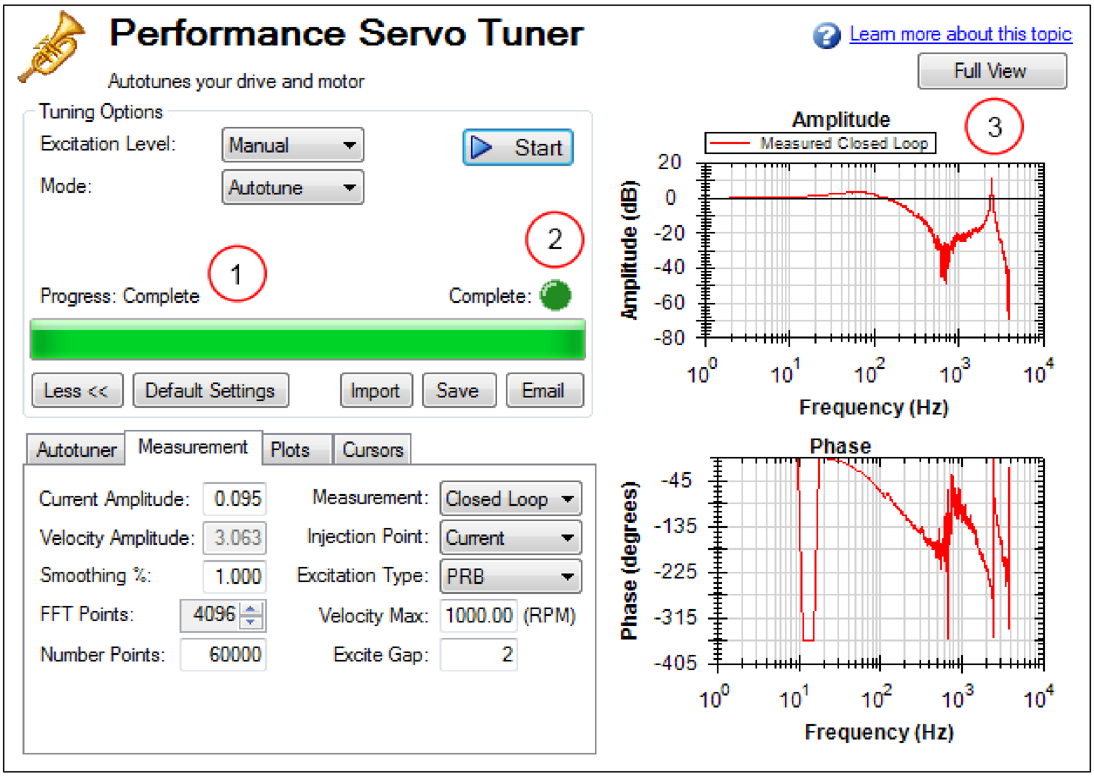
The PST defaults to a “one button” mode, in which the PST is completely automatic after pushing the start button. In the **Settings** select your desired operation mode,navigate to the **Performance Servo Tuner**view, and then tune your system as follows:

1. Select whether you would like the drive to be tuned in **1-Velocity** or **2-Position** Mode. If the drive is in torque mode, the PST will tune in position mode by default. This is set by using the tool bar and changing the mode to either velocity or position. The drive must be disabled in order to change the operation mode.
2. Click **Start**.



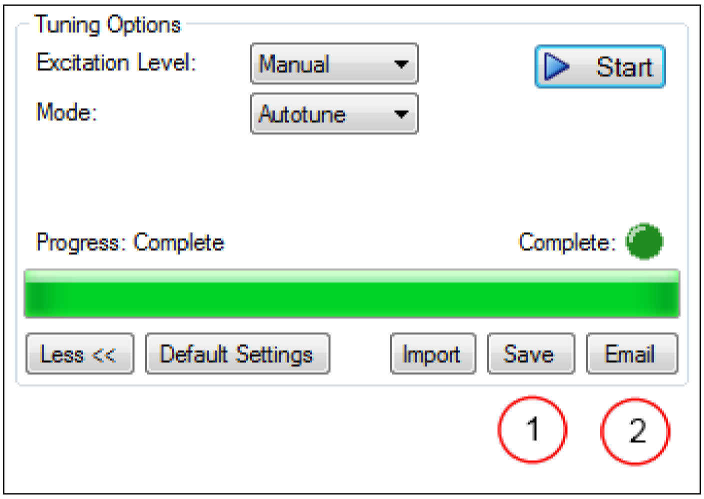
.

The PST will then perform several tests and display results as shown below. The progress bar (1) shows the relative progress of the PST, so you can estimate when the tuning will be finished. When the tuning is complete, the green **Complete** LED (2) illuminates, and a Bode plot (3) is displayed showing the frequency response of the tuned system.

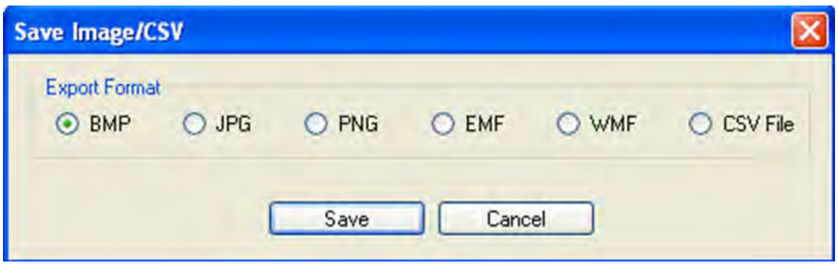


15.3.2.1 Saving and Emailing Bode Plots

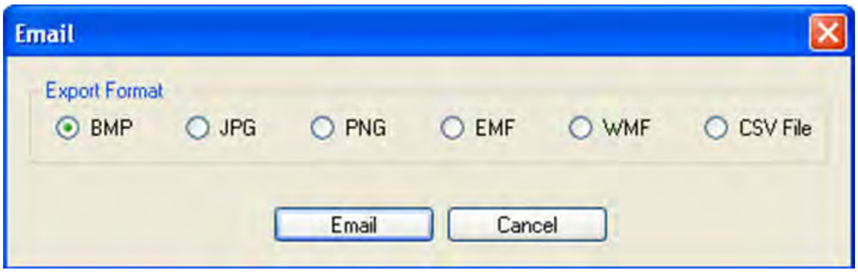
To save screenshots and raw data of a Bode plot, click on either **Save** (1), or **Email** (2).



Clicking **Save** opens a prompt to select how to save the screenshot or data. Selecting BMP, JPG, PNG, EMF, or WMF saves the Bode plot as an image. Choosing CSV saves the raw data that is currently plotted as a comma delimited file. Click **Save** to save the file to your hard drive in the desired format.



Clicking **Email** opens a similar prompt. Select the file format in which you wish to save the image or raw data, and an email will be created for you with the file automatically attached for your convenience. Click **Email** to create the email with the selected file attachment.



15.3.2.2 Importing a Frequency Response

If you have previously saved a frequency response measurement into a CSV file, it can be imported for later viewing. Click the **Import** button, and browse to your saved CSV file. You can import while in offline mode for convenience. Importing a frequency response is useful for developers off-site to analyze a machine tool.

15.3.3 Measurement Options

By default, the PST determines the excitation level automatically and autotunes the drive and motor.

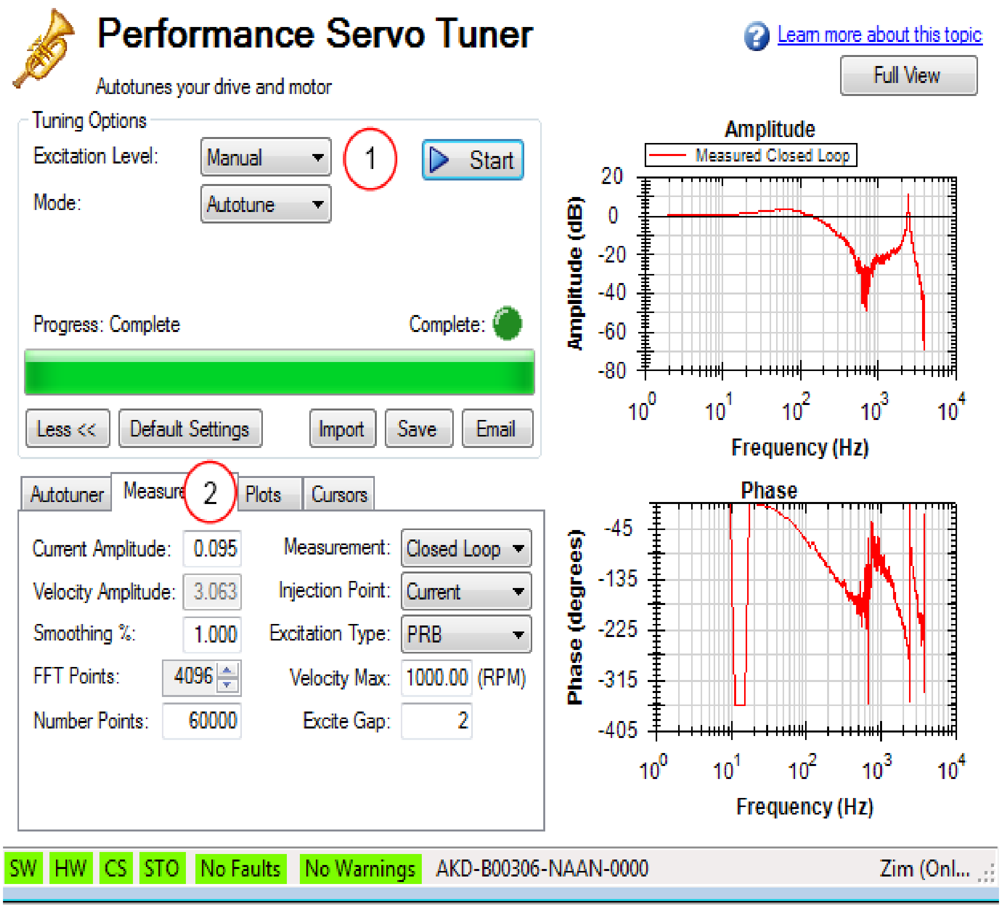
The PST also allows you to enter a manual excitation level or to take only Bode measurements (without autotuning the system).

15.3.3.1 Using Manual Excitation Levels

By default, the PST is set to use the automatic excitation level. To obtain the automatic excitation level, the PST runs a friction test at the beginning to determine how much excitation is needed to break friction and get an accurate measurement.

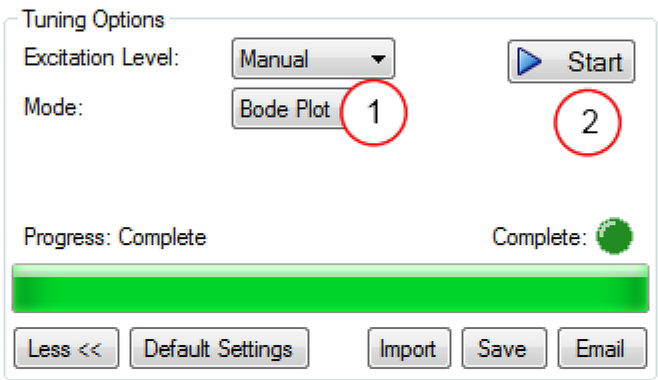
To change this excitation level, click on the **Excitation Level** drop down box (1), and select **Manual**. Then enter a new **Current Amplitude** (2) in amps.

Note: If the **Injection Point** is set to **Current**, then the **Current Amplitude** box will be enabled to enter an excitation level; if the **Injection Point** is set to **Velocity**, the **Velocity Amplitude** box will be enabled to enter an excitation level.



15.3.4 Taking a Bode Measurement without the PST

You may wish to take only the frequency response of a system, rather than using the PST. To take a frequency response measurement without the PST, click on the **Mode** drop down box (1) and select **Bode Plot**, then click **Start** (2).



15.3.5 Using the Performance Servo Tuner: Advanced

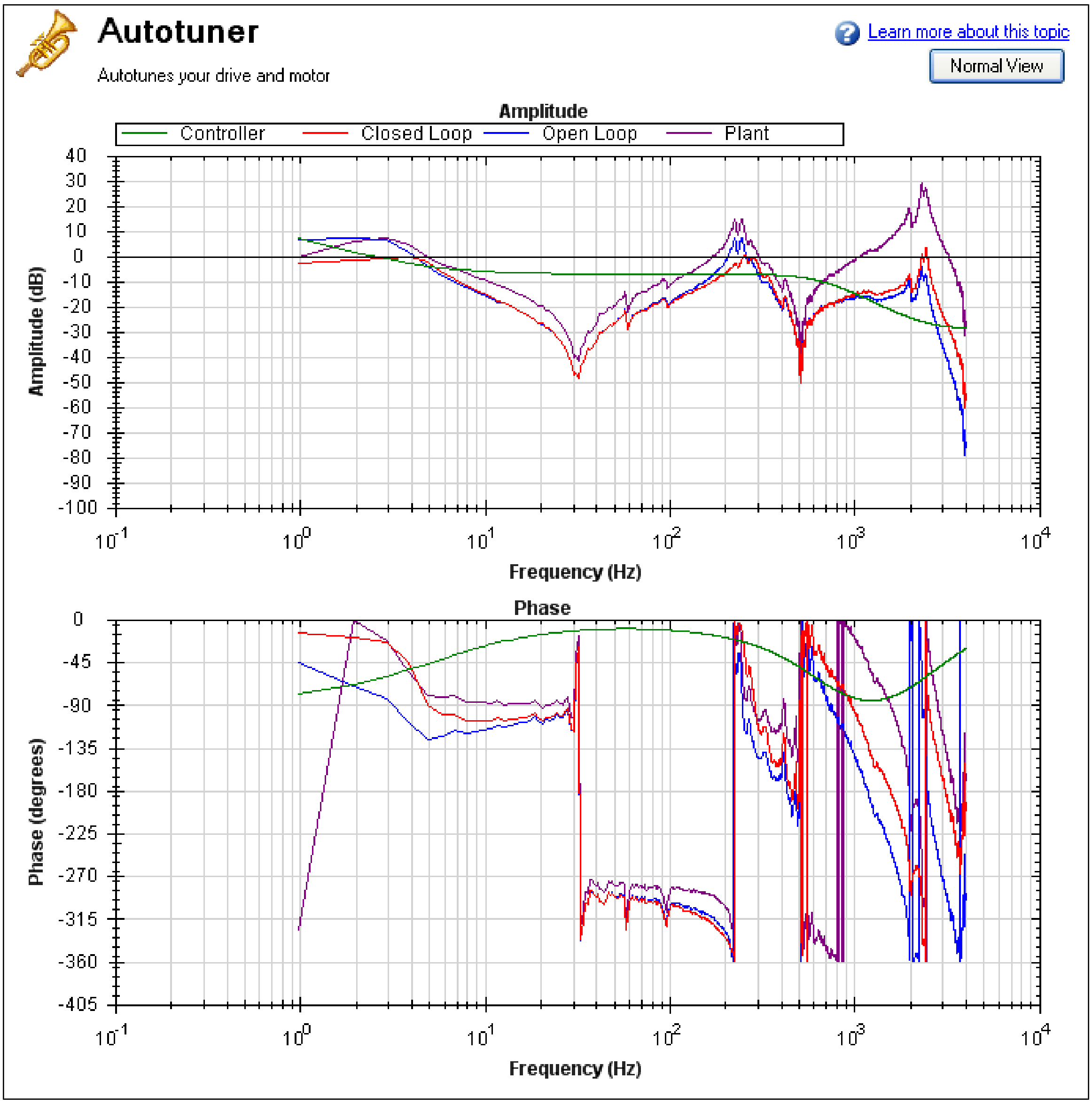
The Performance Servo Tuner (PST) can be set up to use specific modes or limits in tuning to provide tuning in ways you can control, while still taking advantage of the PST's ability to make decisions quickly and effectively for you.

To use the advanced modes of the PST, click the **More** button to display the additional features for advanced autotuning:

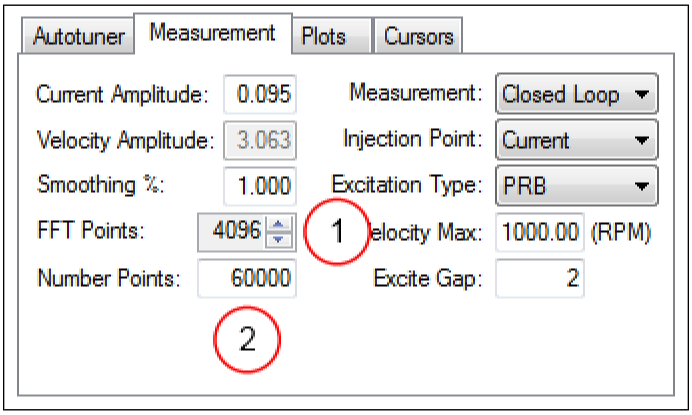
15.3.5.1 Typical Cases for Advanced PST Use

Tuning Systems with Low-Frequency Resonances

Systems with low-frequency resonances are challenging because low frequency data is difficult to measure. While the PST can tune these systems, you can expect lower system performance. If your system has a first anti-resonance of 30 Hz (pictured below), you can expect approximately 15 Hz (half the frequency of the first anti-resonance) of closed loop bandwidth.

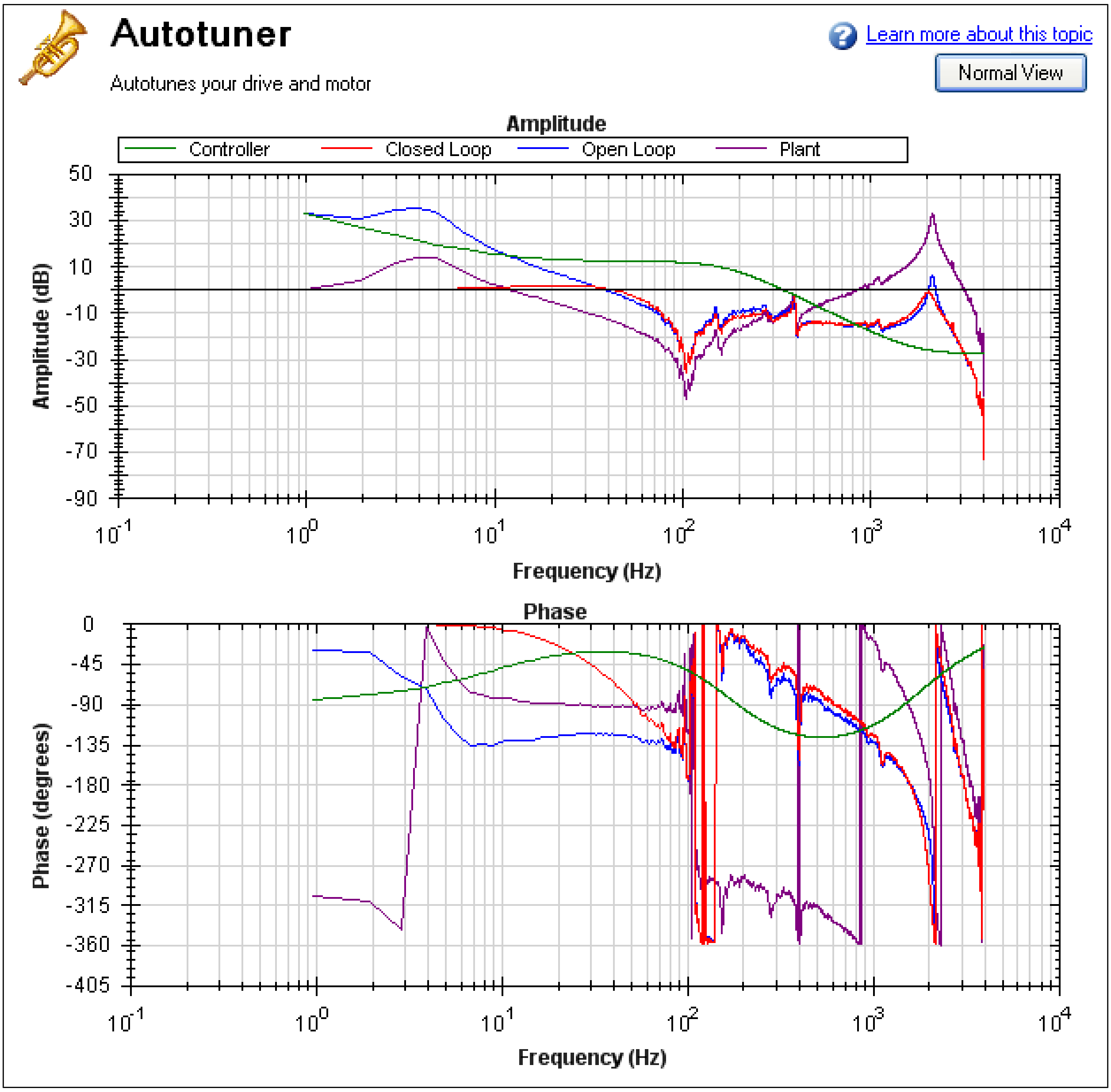


In addition, in order to accurately measure the low frequency resonances, the fast Fourier transform (FFT) resolution must be sufficiently fine to accurately measure the low-frequency resonance. A good place to start is to have an FFT resolution of 1/10 of the frequency of the lowest anti-node. In the case shown above, an anti-resonance of 30 Hz is present, so the resolution should be approximately 3 Hz FFT resolution. The PST can function with the resonance if it is accurately measured, as shown below. To adjust the FFT resolution, adjust **FFT Points** in the **Recording Options** tab as needed.

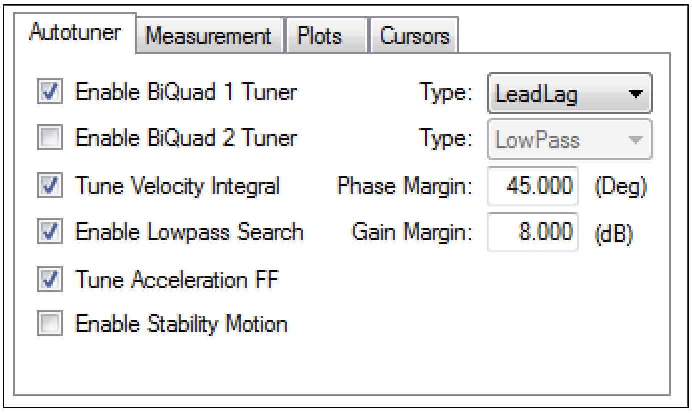


Tuning Systems with High-Frequency Resonances

Some systems have resonances at very high frequencies (greater than 1 kHz). When the resonance is this large, it can prove a challenge in tuning, because these systems generate high noise levels that are often audible. An example of a large resonance is shown below. This example is from a steel flywheel mounted to an AKM 22E motor. The source of the resonance is the spring mass relationship between the motor rotor, shaft, and flywheel.

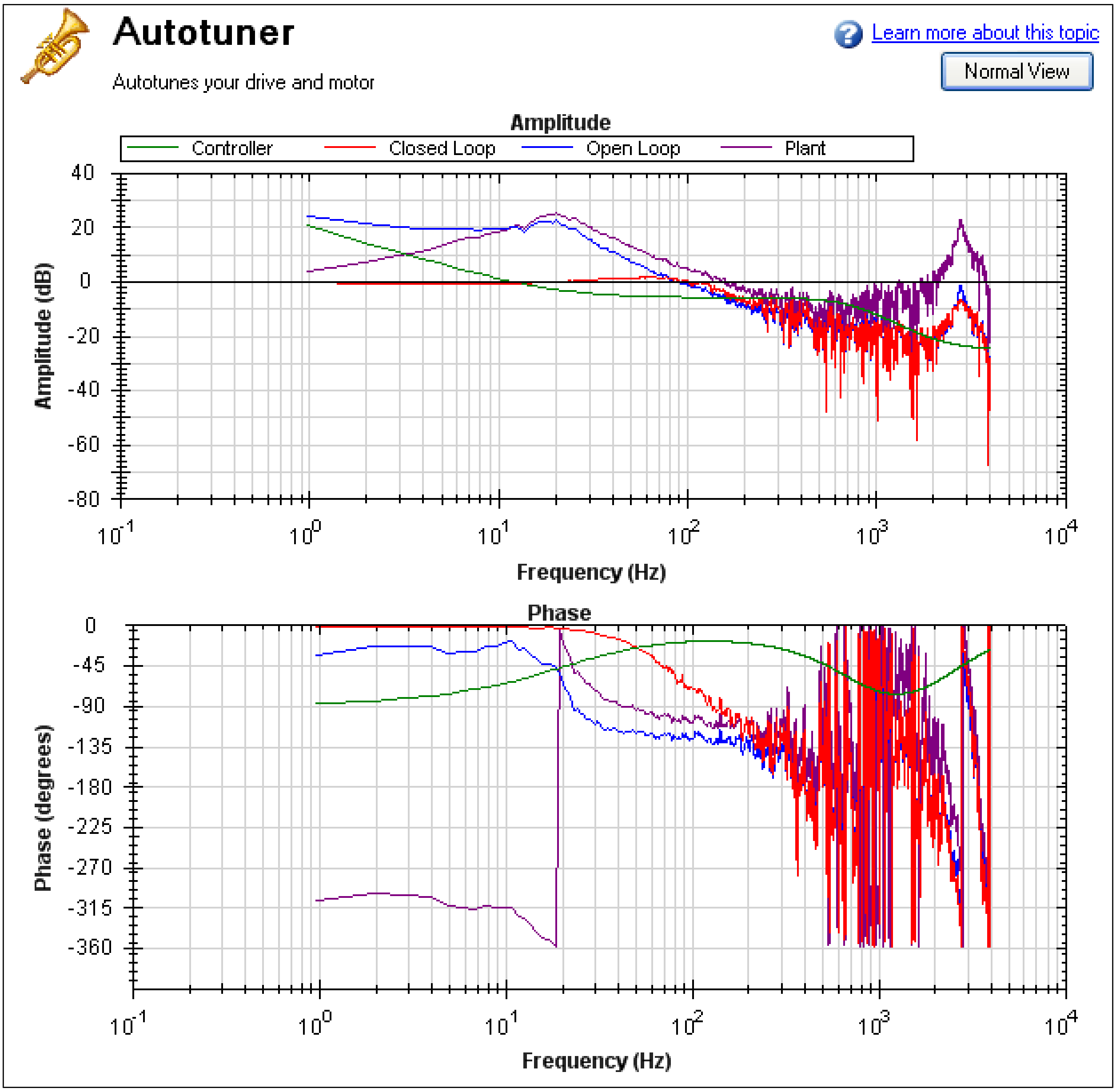


One way to resolve this problem is to use a low-pass filter in the feedback path. To use this filter, simply check the **Enable Lowpass Search** in the PST, which is the default behavior.

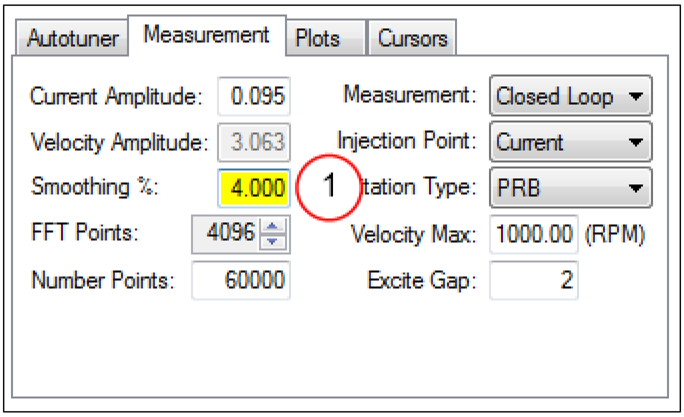


Tuning systems with noisy frequency responses

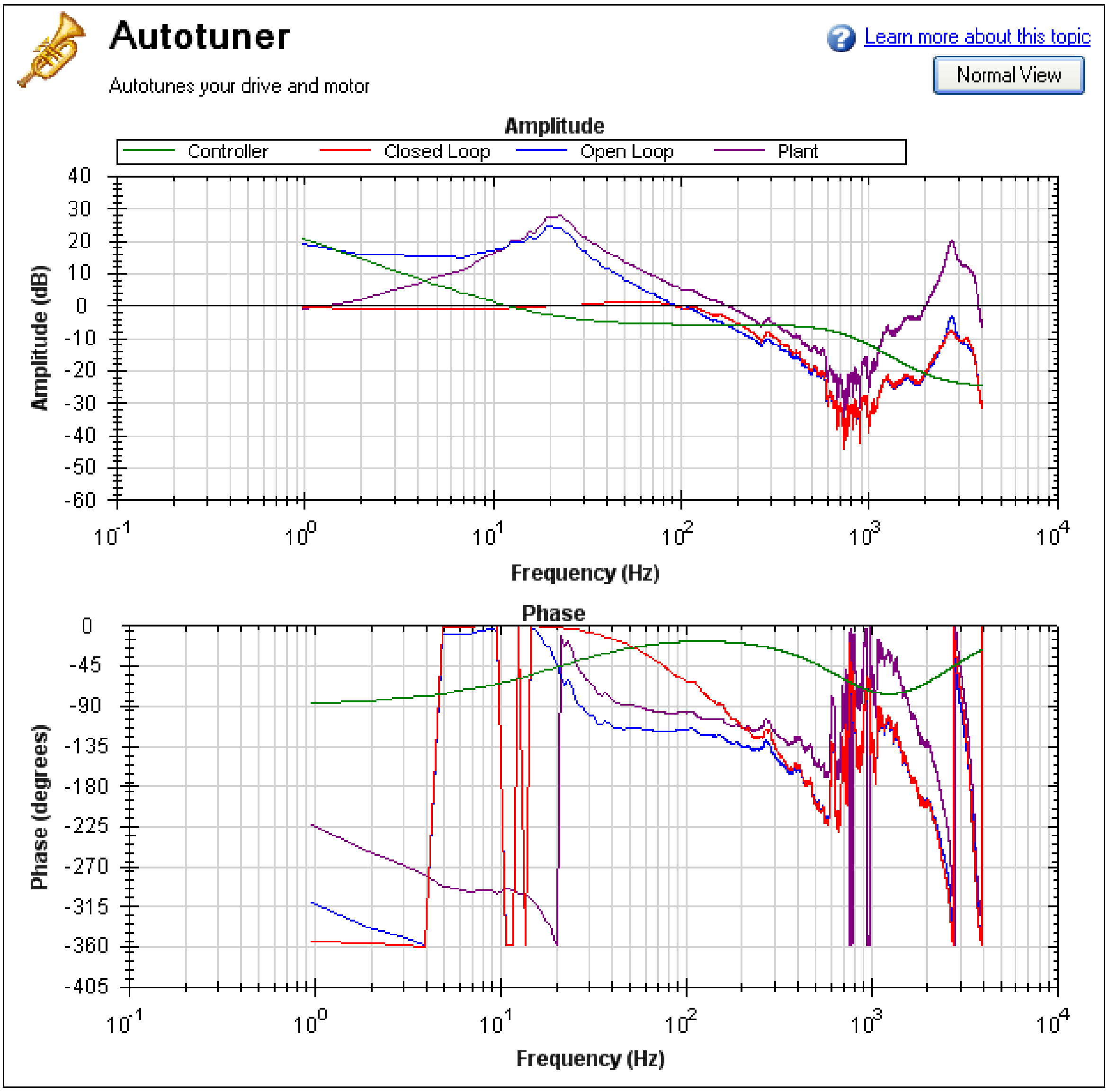
When using a motor with a low-resolution incremental encoder or resolver, the high frequency response may be noisy. Below is a Bode plot created after autotuning of an incremental encoder with 8,192 counts per revolution.



To make the Bode plot easier to read, increase the smoothing factor (1) in the advanced **Measurement Options**.

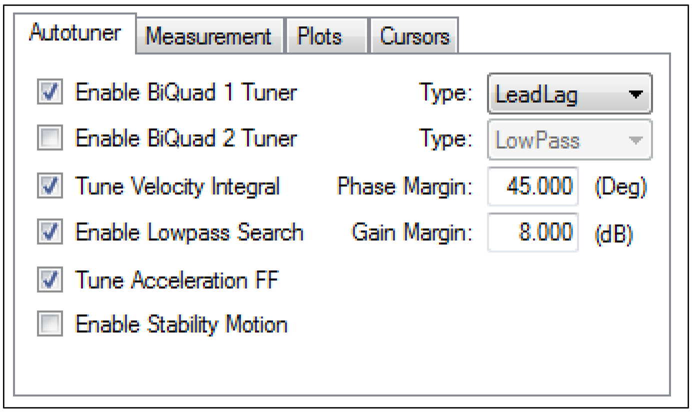


After increasing the smoothing percentage, the Bode plot traces become cleaner and easier to read:



15.3.5.2 PST Options

When you click **More** in the PST view, the following options are displayed:



Enable BiQuad 1 Tuner

Check this box to use the first anti-resonance filter in the forward path (AR1). You can specify the type of filter to use in the **Type** box to the right of **Enable BiQuad 1 Tuner**.

Enable BiQuad 2 Tuner

Check this box to use the second anti-resonance filter in the forward path (AR2). You can specify the type of filter to use in the **Type** box to the right of **Enable BiQuad 2 Tuner**. Enabling this option may significantly slow your computer during this operation.

Biquad Type

For Biquad 1 and 2, you can choose what type of filter to implement. The four options are:

1. **LeadLag**: The LeadLag filter is the default, and will work for most servo systems.
2. **Lowpass**: A Lowpass filter requires the least amount of processing time. The PST will place the lowpass to get the maximum bandwidth possible.
3. **Resonator**: The Resonator filter is like a Notch filter with tunable bandwidth and notch depth. The Resonator takes longer to calculate than the LeadLag filter.
4. **Custom**: The Custom filter takes the longest to calculate and does not restrict the PST to a filter shape. This filter type provides excellent results, but may significantly slow your computer while the filter is calculated.

Tune Acceleration FF

This box turns on and off the acceleration feedforward tuner. If this box is checked, the PST will measure the inertia attached to the motor shaft, and using this measurement, will calculate an appropriate acceleration feedforward and write it to the drive (IL.KACCFF)

Enable Stability Motion

When this checkbox is checked, after the PST has completed, the PST will command a short move in the clockwise direction, then back to its origin and monitor the motor's parameters to determine if the tuning is stable. If an instability is detected, the drive will generate Fault F133: Instability during Autotune.

Phase and Gain Margins

The PST always ensures that the tuning satisfies stability criteria that can be adjusted in units of phase margin (in degrees) and gain margin (in dB). The PST uses default values for phase and gain margin, but you can adjust these values to ensure higher stability or to allow the PST to be more aggressive by using lower gain and phase margins.

Tune Velocity Integral

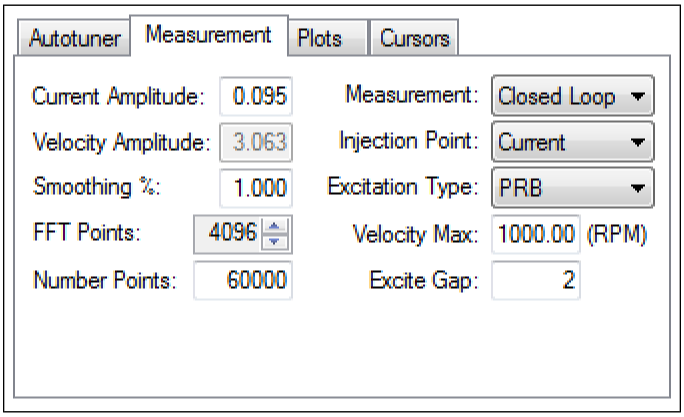
Check this box to tune VL.KI (velocity loop integral gain). If this box is unchecked, the PST will set VL.KI to zero.

Enable Low Pass Search

Check this to tune a fourth-order low pass filter in the feedback path (AR 3 and 4). If this box is unchecked, the PST will not modify the anti-resonance filters in the feedback path.

15.3.5.3 Measurement Options

The PST screen also provides options for measurements:



Current Amplitude

This box sets the amplitude of the current used to excite the system during a current injection mode excitation. This amplitude applies to all excitation types when the **Injection Point** is set to **Current**. The **Current Amplitude** box is disabled if the **Injection Point** is set to anything else.

Velocity Amplitude

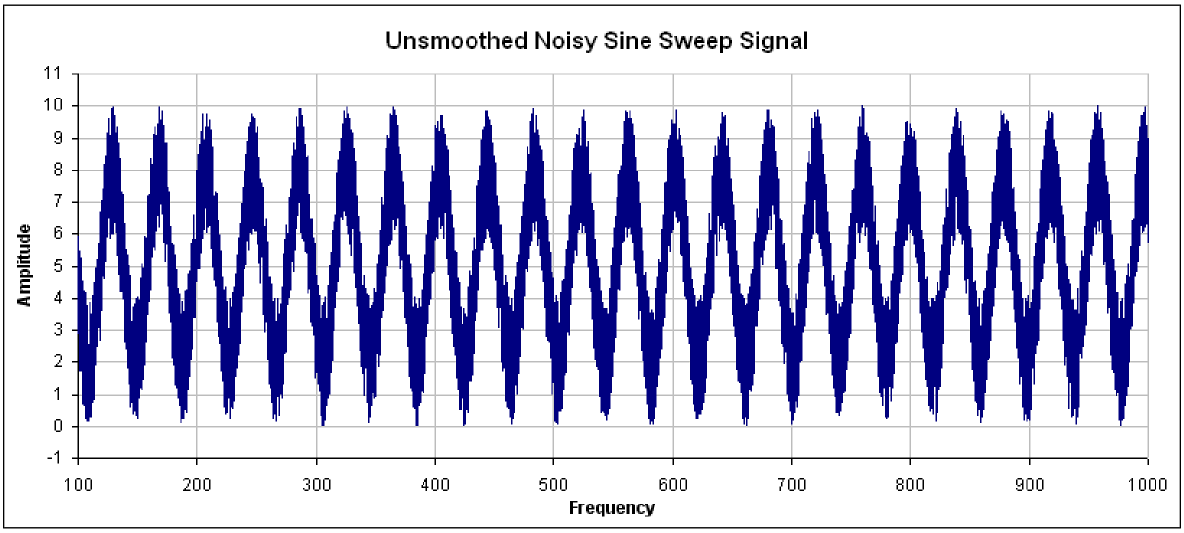
This box sets the amplitude of the velocity used to excite the system during a velocity injection mode excitation. This amplitude applies to all excitation types when the **Injection Point** is set to **Velocity**. The **Velocity Amplitude** box is disabled if the **Injection Point** is set to anything else.

Smooth %

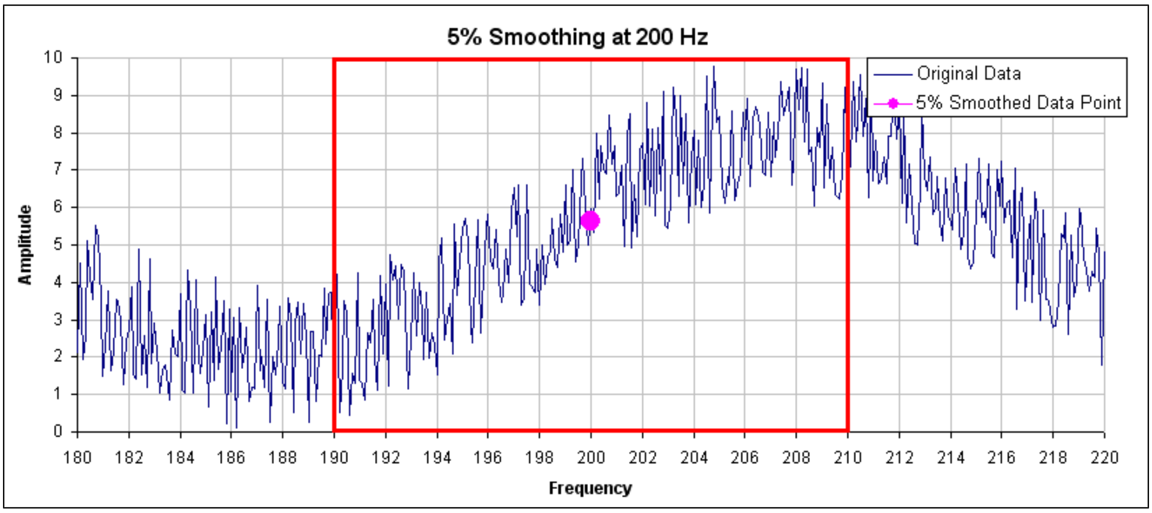
This value applies a moving average smoothing filter to the frequency response gathered during autotuning. This process reduces noise in the frequency response that can occur when making short frequency response measurements, using low resolution encoders, conducting low amplitude frequency response tests, or for other reasons. The smoothing filter iterates through each frequency on the FFT plot. For each frequency, all frequencies within the **Smooth %** range will have their magnitudes averaged.

For example, if you smooth a Bode plot with 5% smoothing, at 100 Hz, it will average all the values between 95Hz and 105Hz; when the filter gets to 1000 Hz, the filter will average all the values between 950 Hz and 1050 Hz.

As an example, assume a noisy sine sweep signal and use a 5% smoothing factor. Below is a noisy signal with a range of 100 Hz to 1000 Hz.

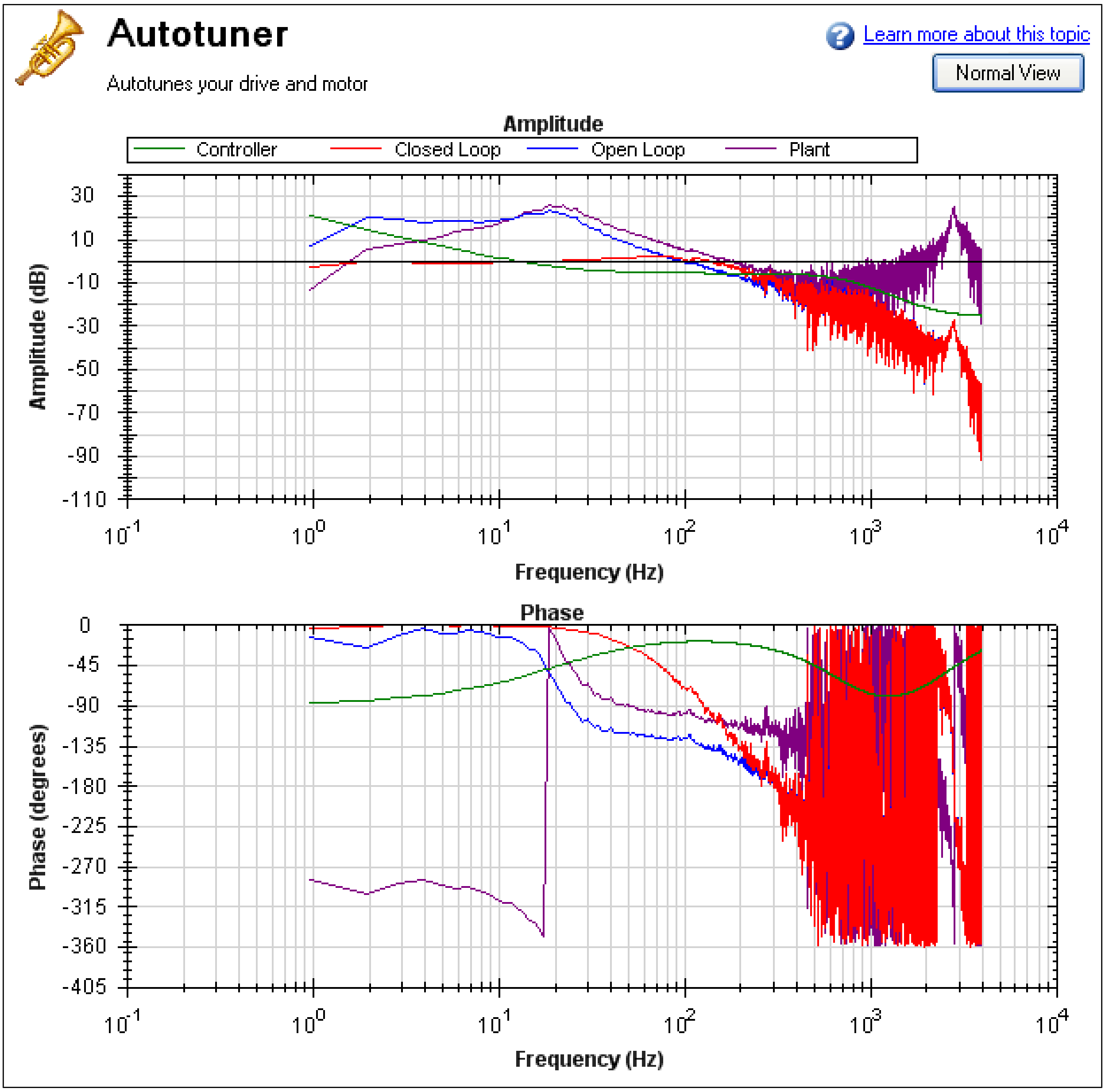


In this example, examing how the smoothing filter affects a single point shows how the smoothing filter works on a full plot. If you zoom in on 200 Hz +/- 5%, this gives a range of 190 Hz – 210Hz. The smoothing filter averages this range of values and puts the average right on 200 Hz. The figure below shows the zoomed data around 200 Hz and the averaged value of all frequencies +/- 5% (the red box illustrates the range of frequencies being smoothed).

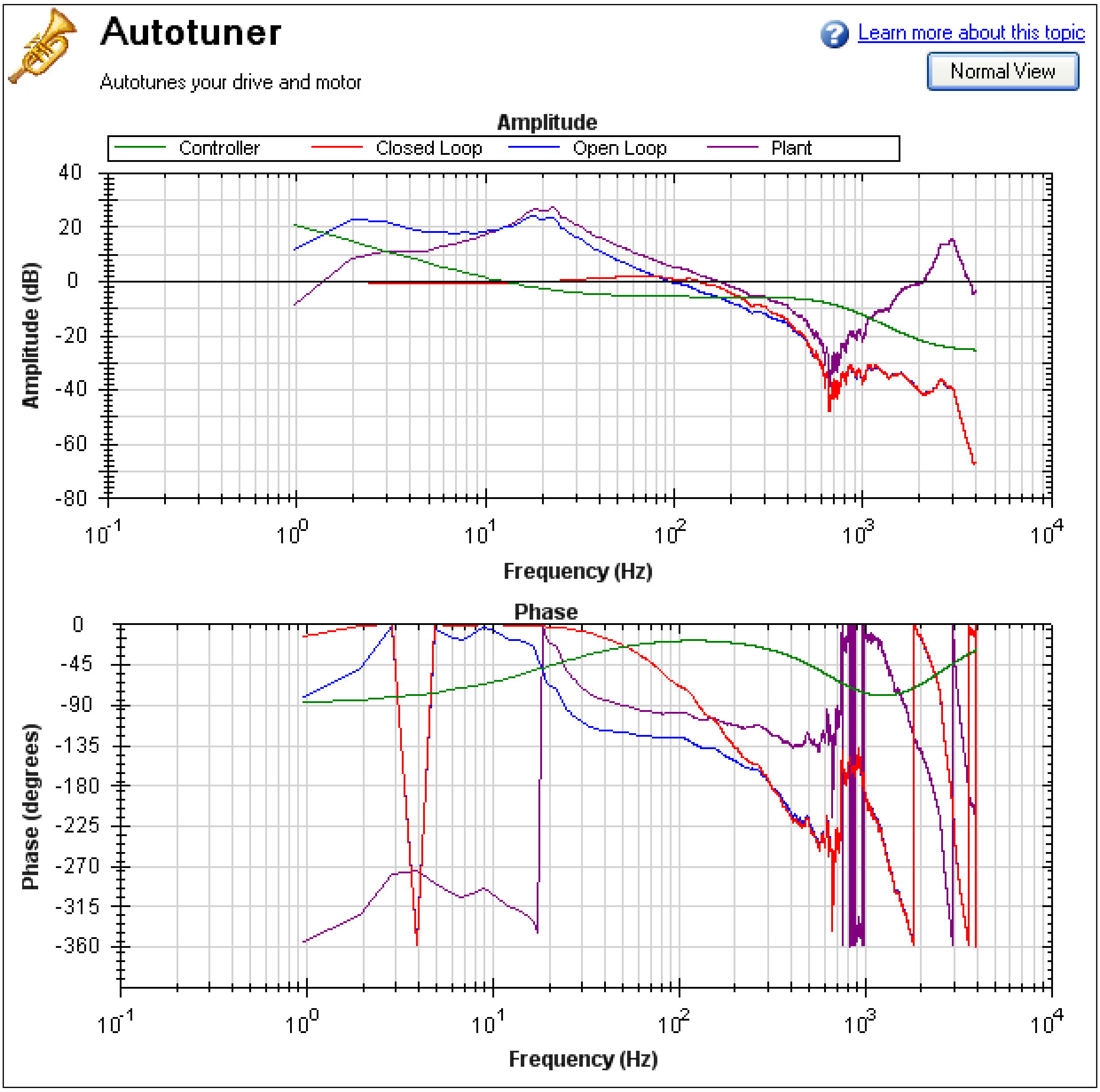


In the PST, the smoothing filter will do this analysis for every frequency point on the Bode plot. If the data is too noisy, then you can increase the smoothing percentage to smooth the noise out and see the underlying data patterns. A comparison of a system with 0.1% smoothing and 8% smoothing is shown below.

0.1% smoothing


Autotuner
Autotunes your drive and motor
Learn more about this topic
Normal View
Amplitude
Controller
Closed Loop
Open Loop
Plant
Amplitude (dB)
30
10
-10
-30
-50
-70
-90
-110
10^{-1}
10^{0}
10^{1}
10^{2}
10^{3}
10^{4}
Frequency (Hz)
Phase
Phase (degrees)
0
-45
-90
-135
-180
-225
-270
-315
-360
-405
10^{-1}
10^{0}
10^{1}
10^{2}
10^{3}
10^{4}
Frequency (Hz)

8% Smoothing



Note: Smoothing decreases the peaks of resonances; if smoothing is too high, a resonance may be completely hidden. If the PST cannot identify a resonance due to high smoothing, the system may become unstable.

Measurement

This box sets the measurement type used during a measurement. The PST functions only if **Plant** measurement is selected; autotune does not function in other measurement modes.

- **Closed Loop** directly measures the closed loop frequency response of the servo.
- **Plant** directly measures the plant, including drive, motor, and mechanics coupled to the motor.
- **Controller** directly measures the controller response, which includes the tuning in the velocity and position loops, and anti-resonance filters 1 & 2.

Injection Point

The **Injection Point** box sets the source location of the excitation used during autotuning. **Current** mode uses a torque disturbance at the torque output. During current injection point measurements, the excitation will use the **Current Amplitude** value to set the size of the excitation.

Velocitymode uses a velocity command to excite the system. During velocity injection point measurements, the excitation will use the **Velocity Amplitude**value to set the size of the excitation.

Excitation Type

Excitation Type box allows you to chooses the type of excitation. Noise, pseudo random binary (PRB), and sine are the options available.

- **Noise** uses a pseudo random noise signal to excite the system. The signal varies between +/- current or velocity amplitude (depending on injection point). The signal contains a frequency spectrum that goes from a lower limit equal to:

  16,000/(Excite Gap * Number Points) Hz

  to a higher limit equal to:

  (16,000/Excite Gap) Hz

  The richness of the frequency spectrum comes from variance in the amplitude of the noise signal.

- **PRB** uses a pseudo random binary signal to excite the system. The signal is either + or – current or velocity amplitude (depending the injection point). The signal contains a frequency spectrum that goes from a lower limit equal to the larger of:

  (16,000/(2^BODE.PRBDEPTH * Excite Gap)) or 16,000/(Excite Gap * Number Points) Hz

  to a higher limit equal to:

  (16,000/Excite Gap) Hz

  BODE.PRBDEPTH is set to 19 by the PST. The richness of the frequency spectrum comes from variance in the phase of the signal, not the amplitude.

- **Sine** requires that you specify the start frequency, end frequency, and frequency step size. The sine sweep takes significantly longer than a noise or PRB measurement, but is often cleaner. Be careful when selecting a step size: too large of a step size may miss important resonances, and too small of a step size increases measurement time.

FFT Points

The **FFT Points**box is only visible and applicable in noise and PRB measurements. **FFT Points** sets the resolution of the FFT's measurement. The frequency resolution is equal to

16,000/(Excite Gap * FFT Points)

By increasing **FFT Points**, the resolution becomes finer, but noise in the frequency response increases.

Excite Gap

The **Excite Gap** box is only visible and applicable in noise and PRB measurements. This box sets how frequently the test excitation is updated. The excite gap minimum value is 1; this value is normally set to 2 for autotuning. The excite rate is 16,000/gap. You can limit high frequency excitation by increasing the **Excite Gap** value.

Number Points

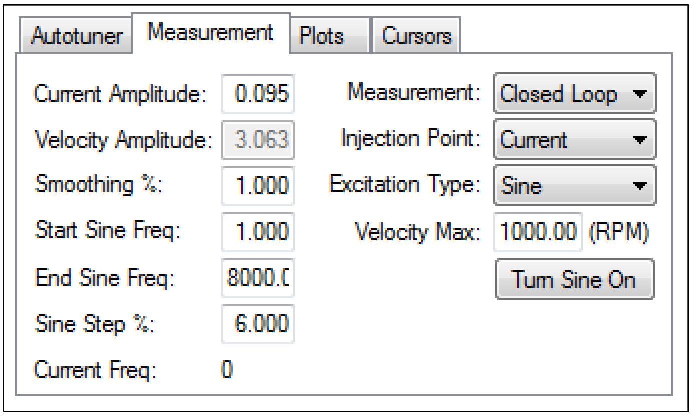
The **Number Points** box is only visible and applicable in noise and PRB measurements. This box sets the length of recording while measuring the frequency response of the system. The measurement length is:

Number Points * Excite Gap/16,000 seconds

Velocity Max

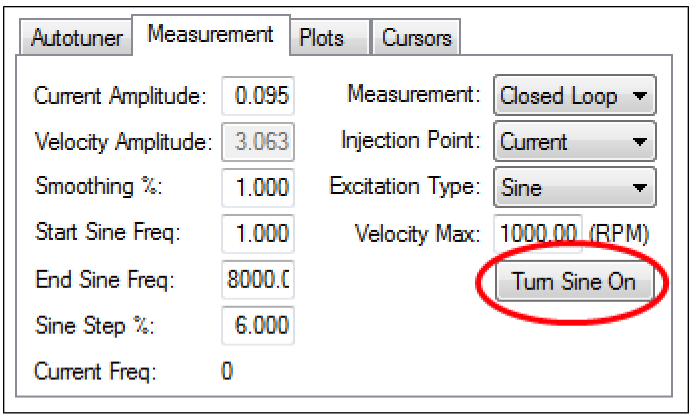
The **Velocity Max** box allows the user to specify the maximum velocity the motor should be able to move while performing excitation. This box is not in effect for normal drive operation; it is only visible during the

PST excitation phases. This value is implemented as soon as the PST begins, and as soon as the PST is finished, the previous overspeed threshold (VL.THRESH) is restored.



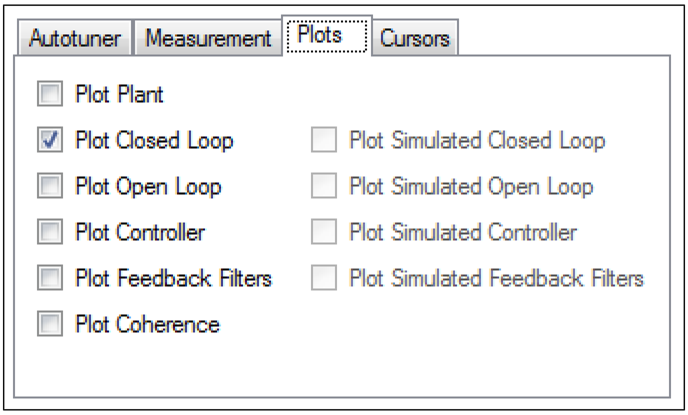
If **Excitation Type** box is set to **Sine**, different configuration options become available.

- **Start Sine Freq**: The Sine sweep test will begin at this frequency. The start frequency must be greater than zero and less than the end sine frequency. **Start Sine Freq** is only visible and applicable to Sine measurements.
- **End Sine Freq**: The Sine sweep test will end at this frequency. The end frequency must be less than or equal to 8,000, and more than the sine start frequency. **End Sine Freq** is only visible and applicable in Sine measurements
- **Sine Step %**: This box sets the sine step size. The sine sweep is discrete, not continuous. Each frequency is a multiple of the previous. For example, if the first frequency was 1 and the step size was 6%, the second frequency would be 1 * 1.06 = 1.06 Hz, the third frequency would be 1.06 * 1.06 = 1.12 Hz. This continues until the current frequency exceeds the **End Sine Frequency** value. **Sine Step %** is only visible and applicable in Sine measurements
- **Current Freq**: This field displays the current frequency of the sine sweep . **Current Freq** is only visible and applicable in Sine measurements
- **Turn Sine On**: This button allows the user to excite the system at a single sine frequency. When this button is pressed, it grays out boxes that do not apply. You may change the sine frequency and amplitude. To stop the sine excitation, click **Turn Sine Off**. **Turn Sine On** is only visible and applicable in Sine measurements.



NOTE **When the sine excitation is used on low resolution encoders, high frequency excitation may cause less than 1 count of encoder movement. If this occurs, no movement is detected on the motor for that excitation frequency. If this occurs, a data point for that frequency will not be plotted, as this results in a calculation of 0dB for gain and -infinity for phase.**

15.3.5.4 Plot Options



By default, only the measured closed loop plot is selected. You can control which of these responses are displayed on the Bode plot by checking or unchecking the **Plot Plant**, **Plot ClosedLoop**, **Plot Open Loop**, **Plot Controller**, and **Plot Coherence** checkboxes shown. The options **Plot Simulated Closed Loop**, **Plot Simulated Open Loop**, **Plot Simulated Controller**, and **Plot Simulated Feedback Filters** are only available in Bode plot mode, not PST mode.

Coherence

The coherence option is only available for noise and PRB measurements; it is not available for Sine excitation measurements.

Coherence is an indicator of how accurate your data is. For example, 0 dB (1 in linear numbers) means you have perfect coherence. Another way to think of this concept is that for one unit of input, you get one unit of output. Coherence is calculated as follows:

$$\boxed{Coherence = \frac{(Pxy \times Pxy^*)^2}{(Pxx \times Pxx^*) + (Pyy \times Pyy^*)}}$$

where:

Pxx = Power Spectral Density of Input signal

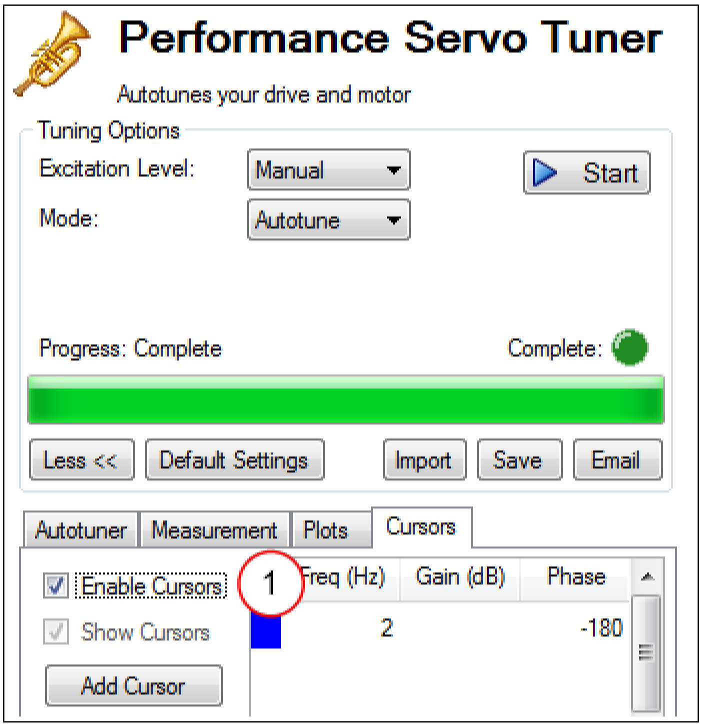
Pyy = Power Spectral Density of Output signal

Pxy = Cross Spectral Density of Input and Output

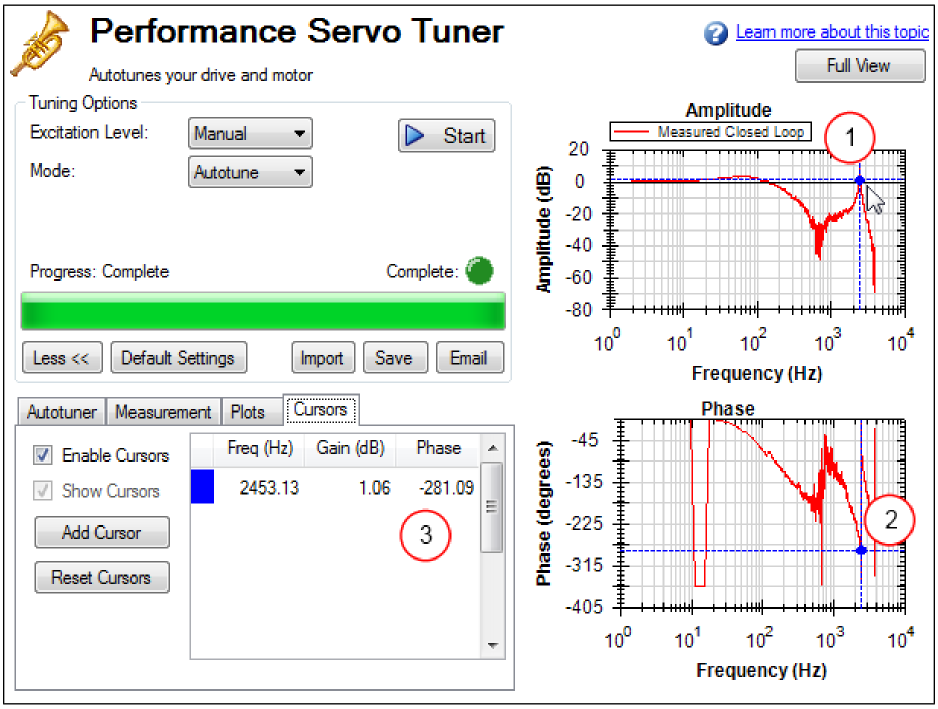
* designates complex conjugate

Cursors

Enabling cursors allows you to note specific points of interest on the Bode plot and create a table of reference points in the summary table. To enable cursors, click the **Enable Cursors** checkbox (1).



To move the cursor, move your mouse over the cursor in either the Amplitude (1), or Phase (2) plots, click and hold the left mouse button, and drag the cursor to a new location. Notice as you drag the mouse, the Frequency, Gain and Phase change in the summary window (3).



To add more cursors, click **Add Cursor**; you can add 10 cursors to the Bode Plot. When selecting a cursor, the cursor closest to the mouse will be selected. While dragging the cursor, the cursor will snap to the closest trace on the plot.

When cursors are enabled, zoom functions on the graph are disabled. To re-enable zooming, un-check **Enable Cursors**.

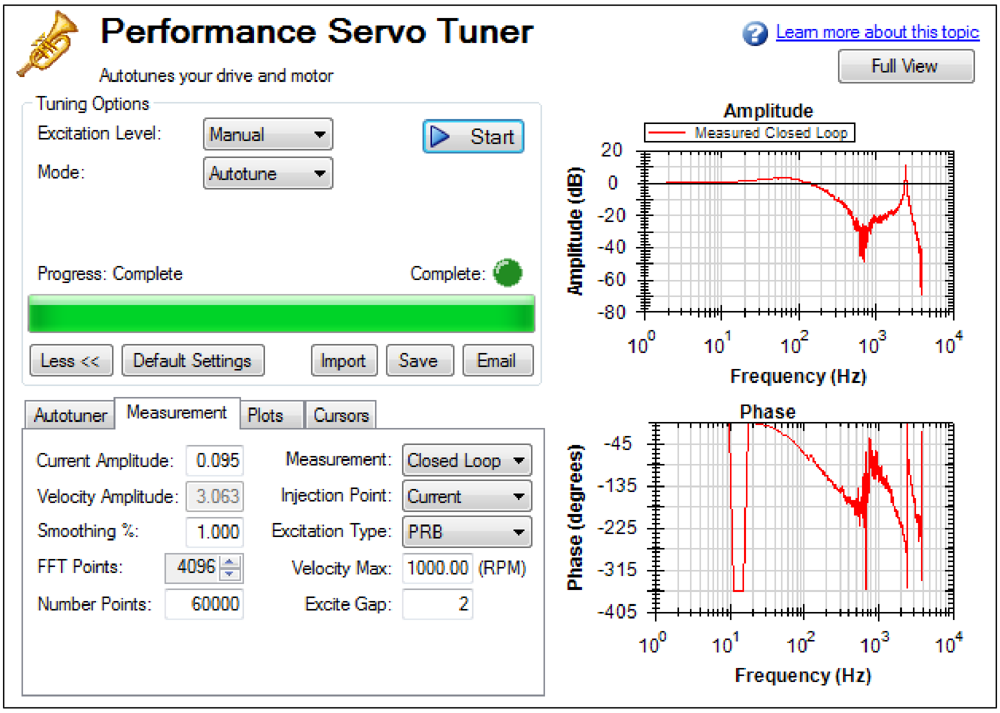
The dotted crosshair lines are only drawn for the active cursor selected; to remove all cursors from the screen, but retain their position, uncheck **Show Cursors** . To reset all cursors, click **Reset Cursors**.

Note: If a CSV file is saved or emailed after placing a cursor on the Bode plot, a cursor summary is included in the CSV raw data.

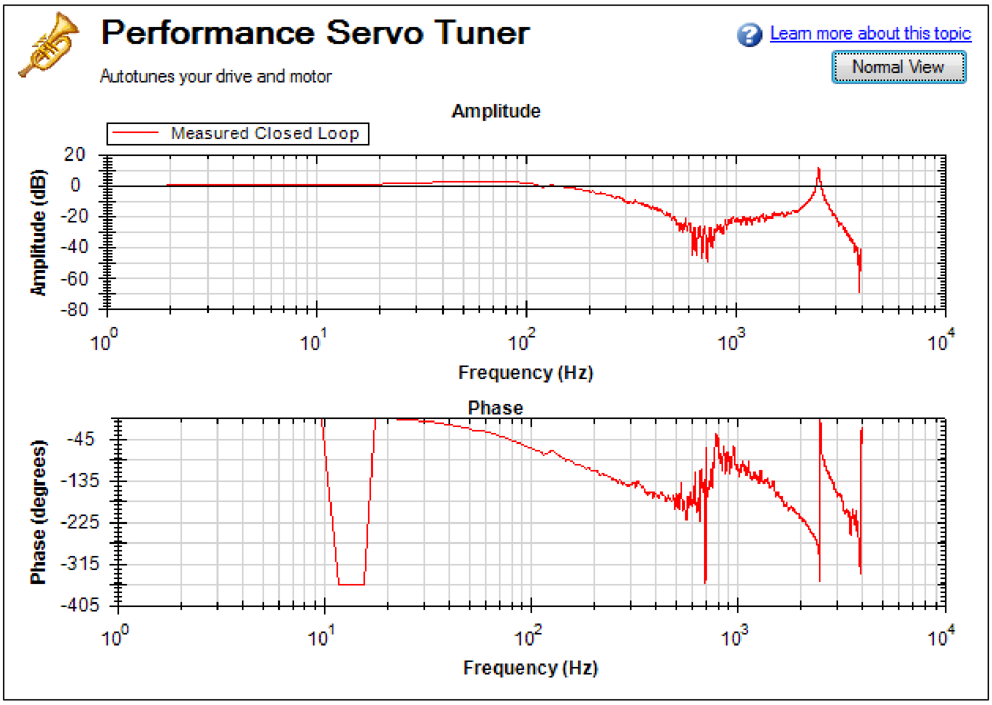
15.3.5.5 Resizing Bode Plots

In the PST view, the **Full View**and **Normal View**button (1) in the upper right of the window allows you to see the Bode Plot in greater or less detail. When viewig the Bode Plot in full view, the PST settings are hidden behind the Bode Plot. To access the PST settings, click the **Normal View** button in the upper right of the window.

Simple measurement normal view



Simple measurement full view



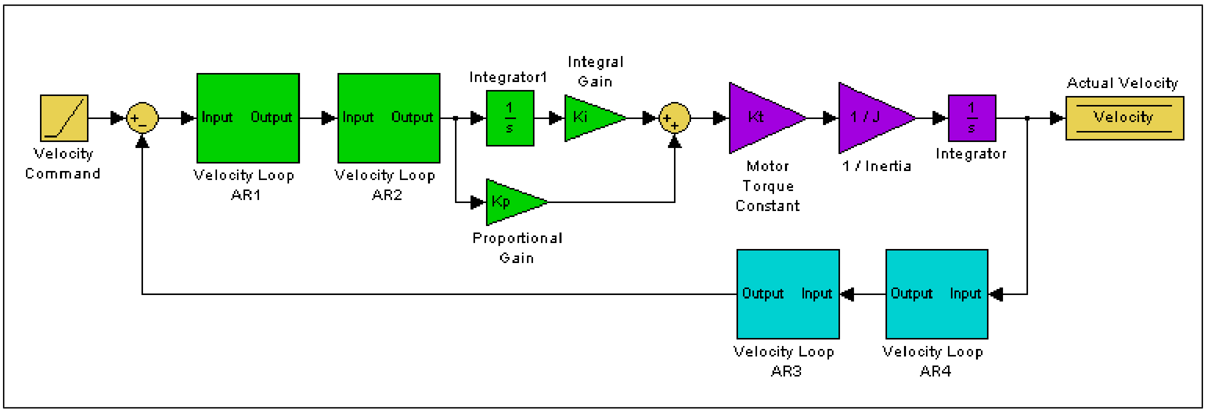
Reading and Understanding the Bode Plot

You can operate the PST without understanding how to read a Bode plot; however, understanding Bode plots will help you to use more advanced tuning techniques, which are covered more in depth in the Advanced Tuning For Velocity and Position Loops documentation.

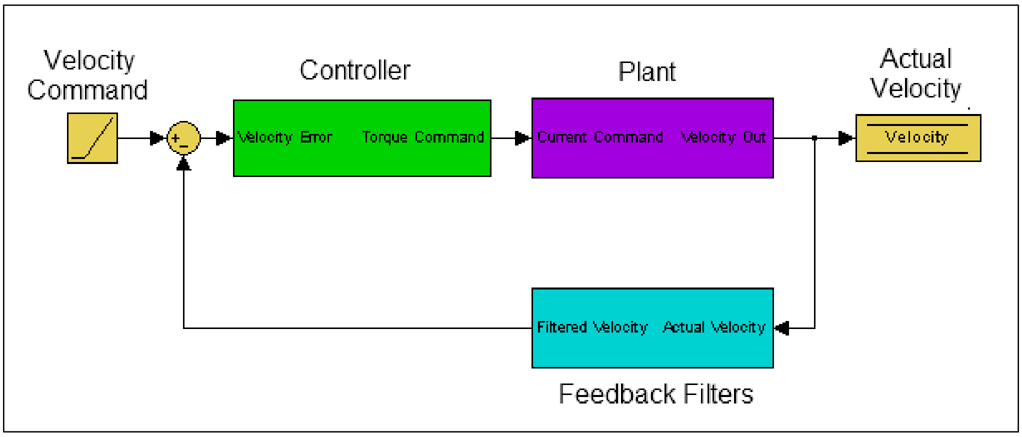
Four Bode plot traces are displayed by default:

1. Controller (green): This trace represents the frequency response of the tuning in the velocity loop and position Loop, this trace also includes anti-resonance filter 1 and 2 (also referred to as [C]).
2. Closed loop (red): This trace shows the frequency response of G/(1 + G * H) where G = C * P, and H is the frequency response of anti-resonance filters 3 and 4.
3. Open loop (purple): This trace shows the frequency response of G * H, where G = C * P, and H is the frequency response of anti-resonance filters 3 and 4.
4. Plant: This trace shows the frequency response of the mechanics of the drive and motor (also referred to as [P])

The diagram of the velocity loop on the drive below explains the frequency response that each of these traces represents:15.4 Tuning Guide



These blocks can be grouped into Controler, Plant, and Feedback sections:



All of the green blocks have been grouped together to create the Controller [C]. The Controller is the portion of the control loop containing all velocity and position loop tuning, including the forward path filters.

All of the purple blocks have been combined to make the Plant [P]. The plant represents the mechanical and electrical properties of the motor, drive and any mechanical bodies attached to the motor.

The two feedback filters have been combined into one block. This value is never measured directly; however it contributes to both the Open Loop [G] and Closed Loop [T] frequency responses.

The definition of the Open Loop [G] frequency response is:

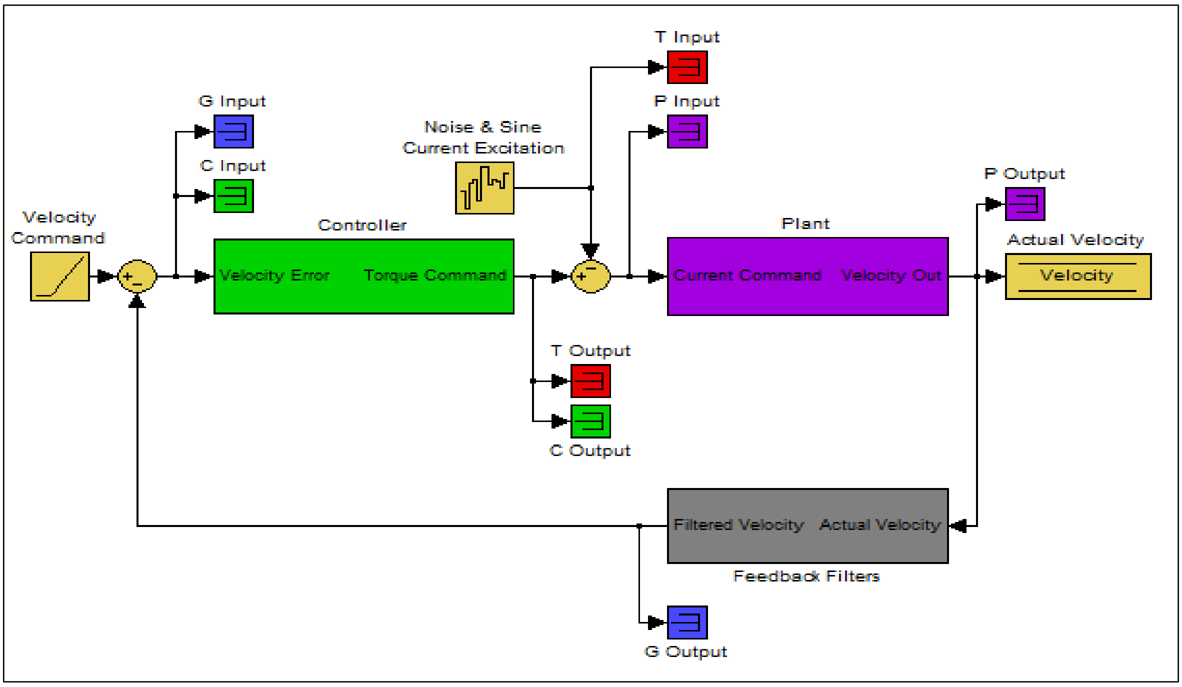
Open Loop = Controller x Plant x Feedback Filters

The definition of the Closed Loop [T] frequency response is:

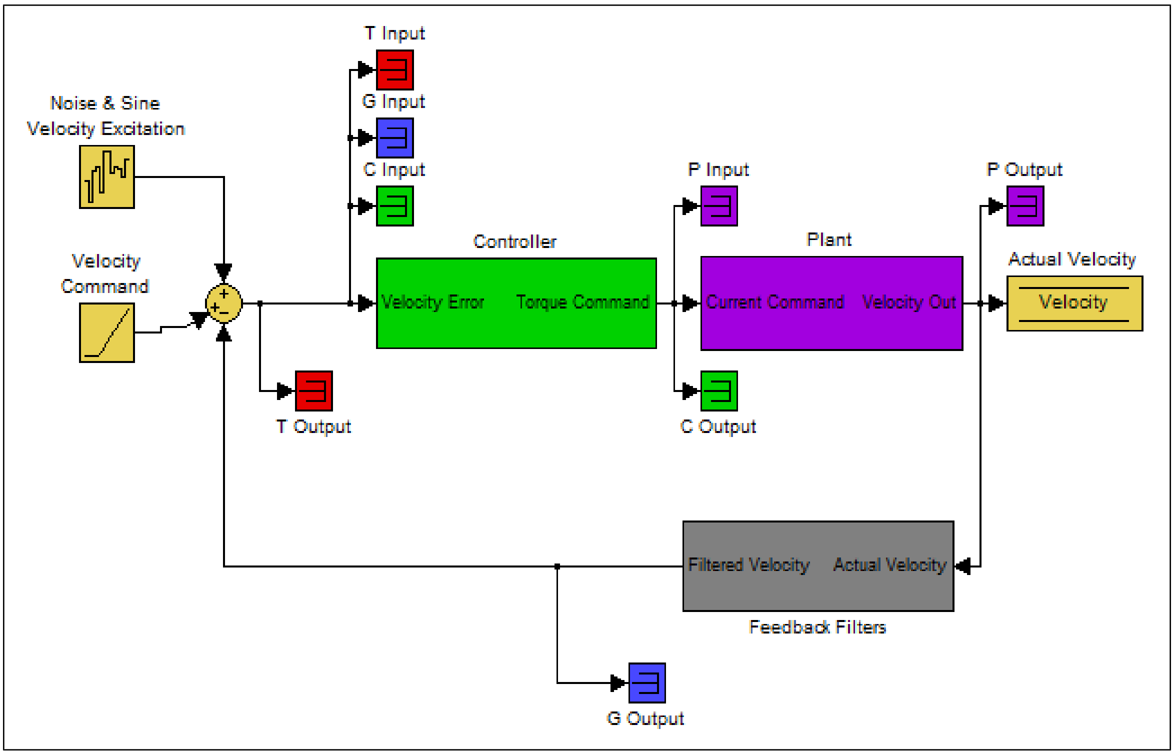
$$ClosedLoop = \frac{Controller \times Plant}{1 + Controller \times Plant \times FeedbackFilters}$$

Below is a diagram of measurement points (input and output) for each of these frequency responses. The input and output markers have been color coded with the color they appear in the PST:

Current Excitation:



Velocity Excitation:

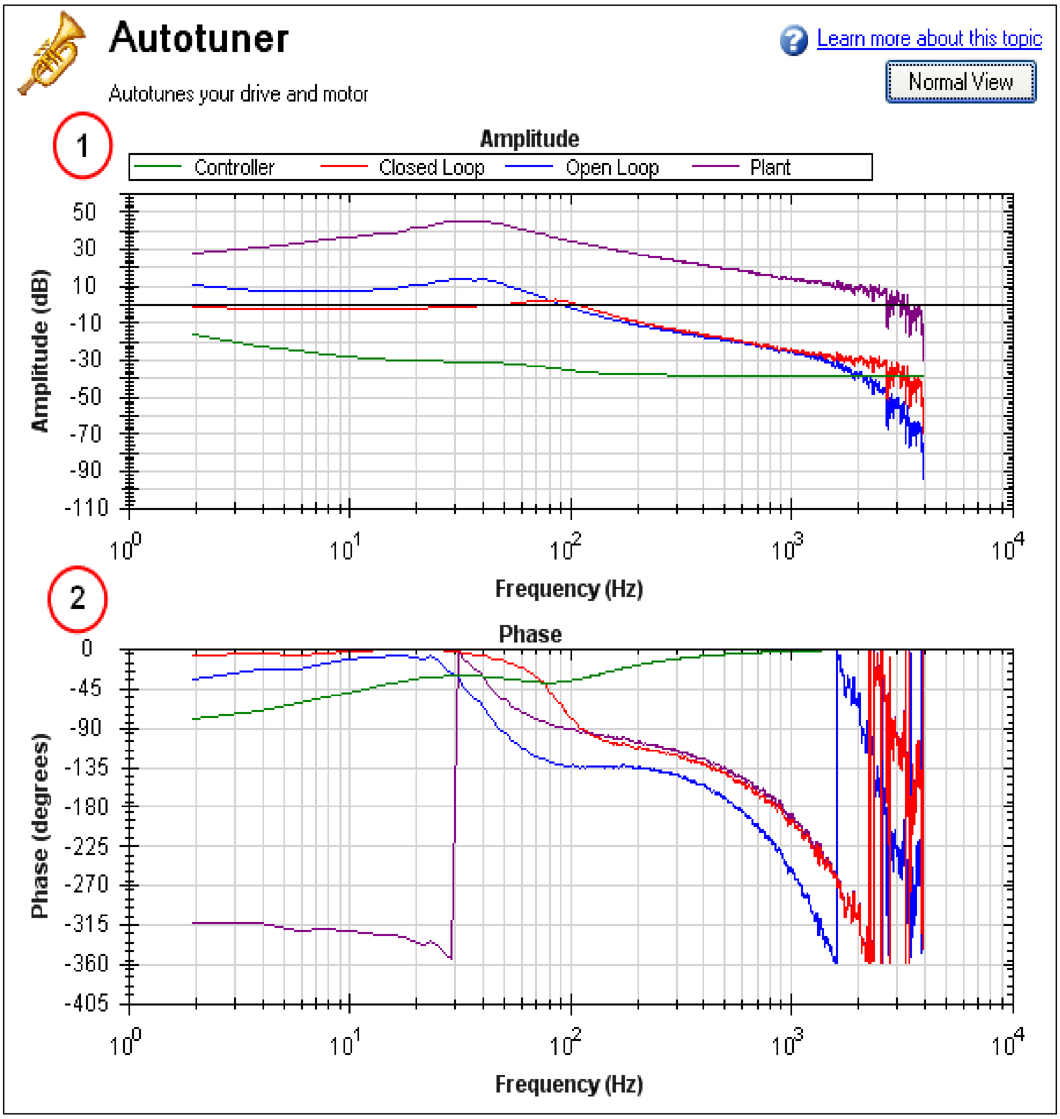


The resulting plots are the frequency response of output/input for each measurement.

For more information regarding these traces, please refer to the Advanced Tuning For Velocity and Position Loops documentation.

Below is a Bode plot of a motor with no load. The top plot is the magnitude plot (1); this plot shows the gain of the system with respect to frequency. This plot is often used to determine the bandwidth of the servo system.

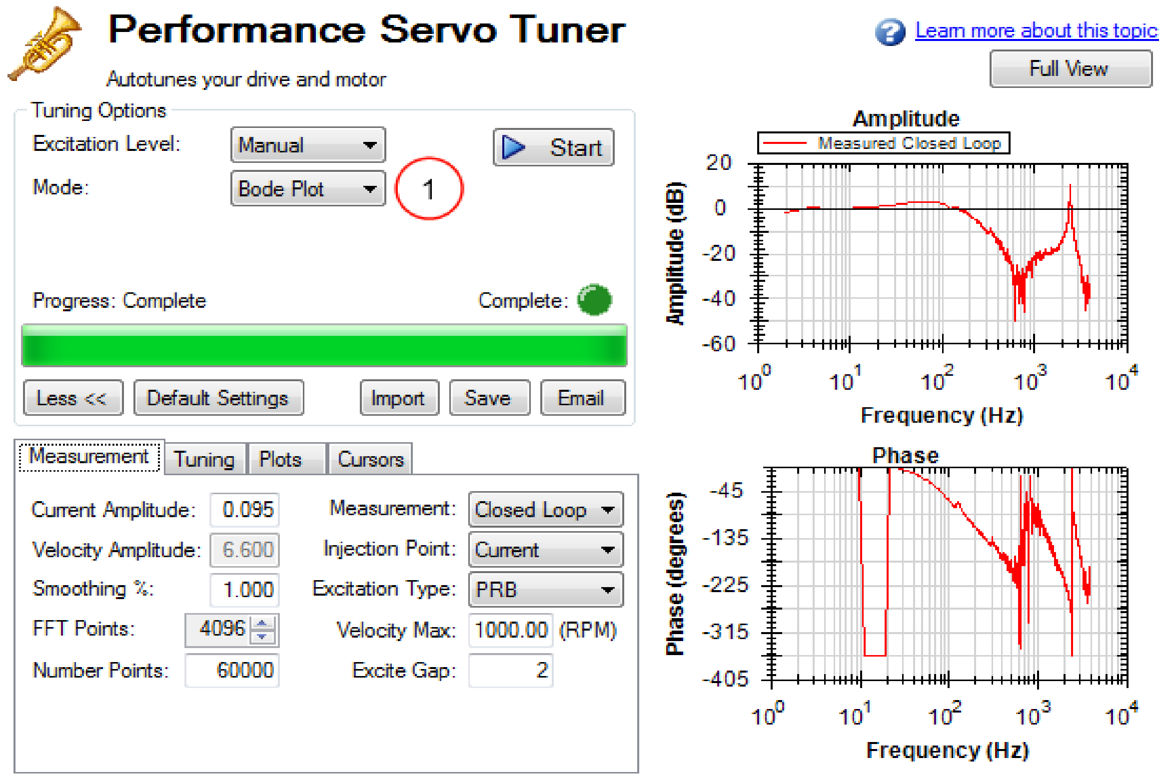
The lower plot is the phase plot (2). This plot is used in conjunction with the magnitude plot to determine stability, and helps you to understand what kind of latencies exist in the servo system, or if latencies are induced by filters in the velocity loop.



Using the Performance Servo Tuner to Manually Tune Systems

Often, you must manually adjust a control loop in order to obtain optimal machine performance. You can use the Performance Servo Tuner (PST) interface to tune your control loop for best performance. A powerful feature of the manual tuning interface is the ability to simulate the frequency response before it is measured. This feature allows the user to take a base measurement, disable the motor, adjust tuning parameters, and simulate the frequency response of the motor without taking a new measurement. This process saves time and protects equipment from dangerous oscillations.

To begin the manual tuning process, put the Performance Servo Tuner into Bode Plot mode.



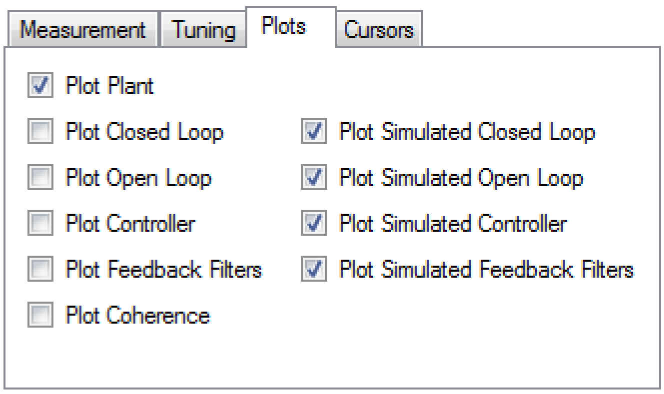
Several differences exist between PST and Bode Plot Interfaces:

- When the PST is put into Bode Plot mode, the **Autotuner** tab is removed from the advanced features, and replaced with a **Tuning** tab.
- The **Plots** tab unlocks simulated traces for closed loop, open loop, controller, and feedback filters.

Using the Tuning Simulation

To simulate tuning, there must be a valid Plant Plot in the PST (whether measured with a Bode Plot measurement or a full Autotune).

To selecting simulated plot traces, click on the **Plots** tab and check the following boxes:

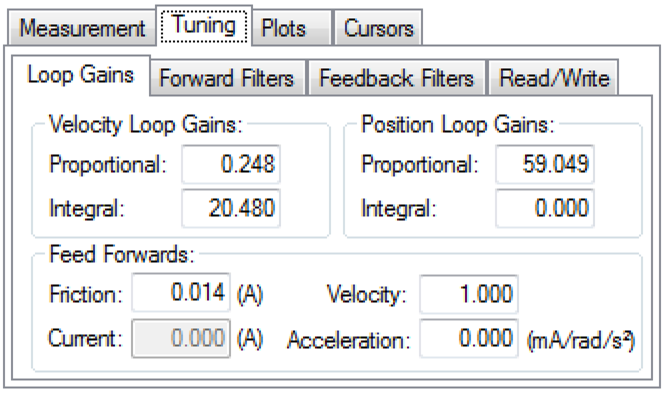


These selected boxes are the most common configuration for tuning; however, simulation will occur regardless of the checkboxes selected .

The boxes on the left plot the existing frequency response of the drive based on the tuning parameters that are loaded. The boxes marked "Simulated" (on the right) use the plant data from the measurement and the tuning parameters in the PST to simulate the performance of those tuning parameters without loading them to the drive.

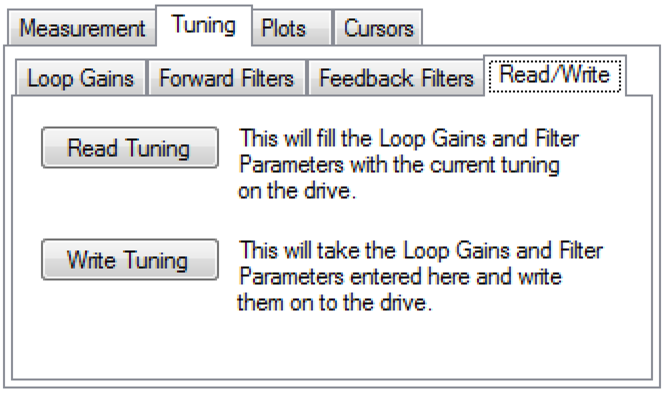
Using the Performance Servo Tuner Manual Tuning Interface

To use the PST manual tuning interface, click on the **Tuning** tab.



This tuning interface loads the tuning parameters on the drive each time a measurement is taken. Tuning parameters are split up into Loop Gains (Velocity Loop, Position Loop), Forward Path Biquad Filters, and Feedback Path Biquad Filters.

After modifying tuning gains, you must click on the **Read/Write** tab and click the **Write Tuning** button.

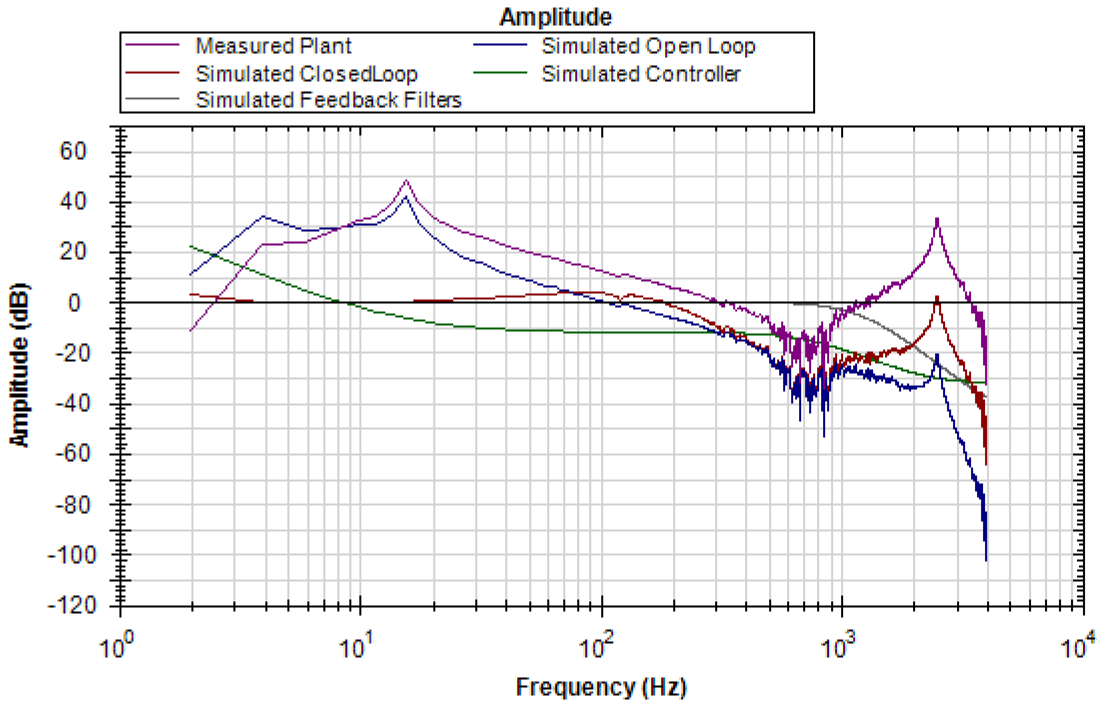


To restore the tuning on the drive to the PST interface, click the **Read Tuning** button.

Note: If tuning gains are modified and a Bode Measurement is made without clicking the **Write Tuning** button, the PST will overwrite the tuning gains in the interface with the tuning parameters on the drive.

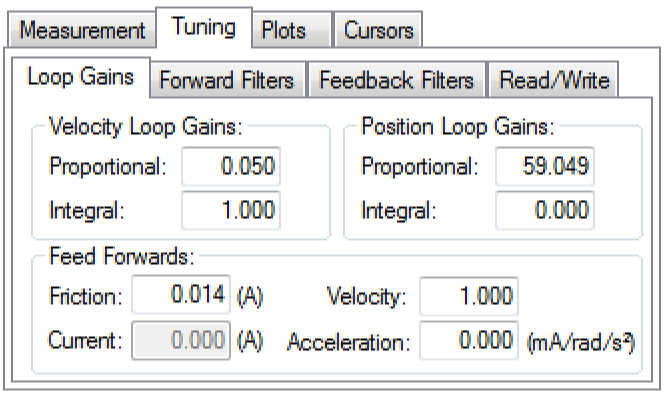
Simulating Modified Loop Gains with the Performance Servo Tuner

Here is the frequency response of a test system after using the PST.

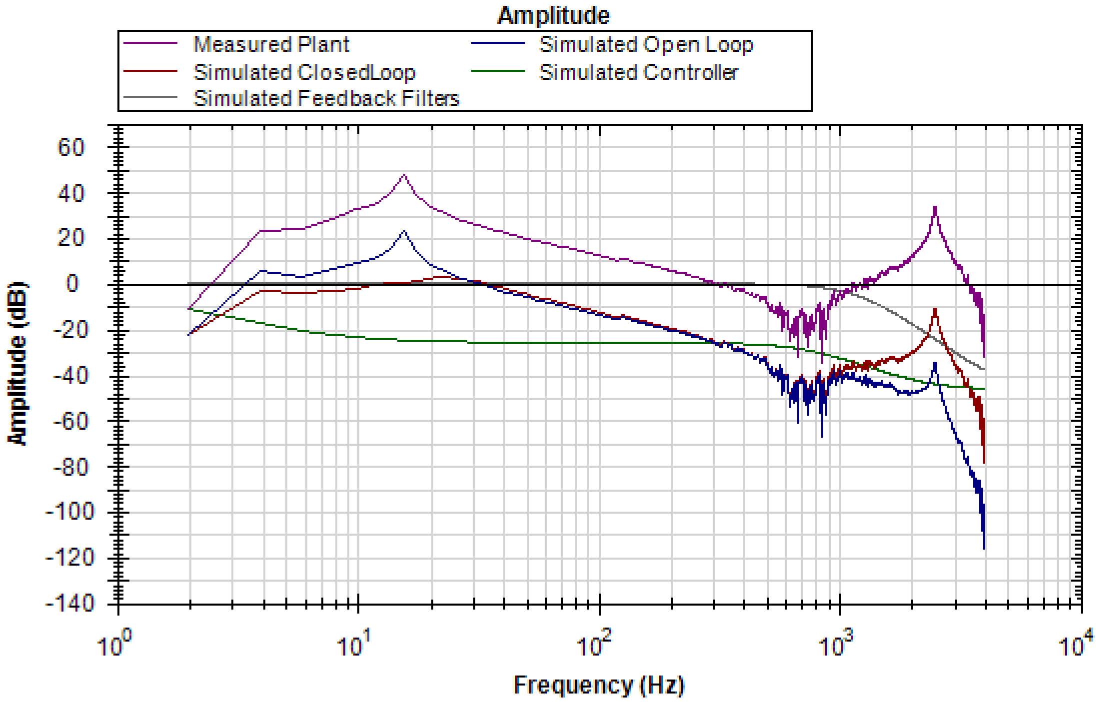


The Velocity Loop Proportional gain here is 0.248. If an application did not need to be tuned as stiff as this, then you could use the PST simulator to detune the motor to the desired bandwidth. A followup Bode Measurement can verify that the simulated response is correct.

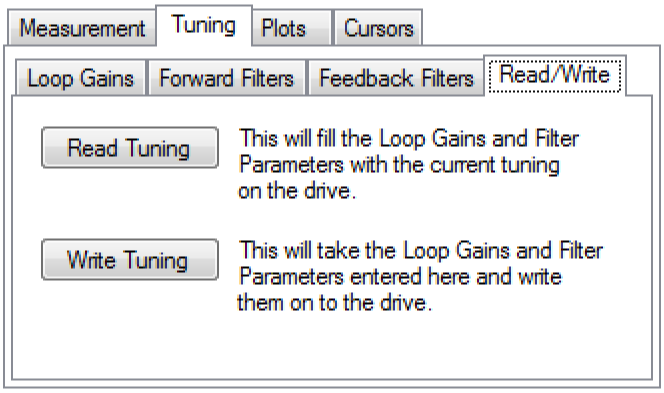
Use the boxes in the **Loop Gains** tab to change tuning gains until the desired frequency response is achieved.



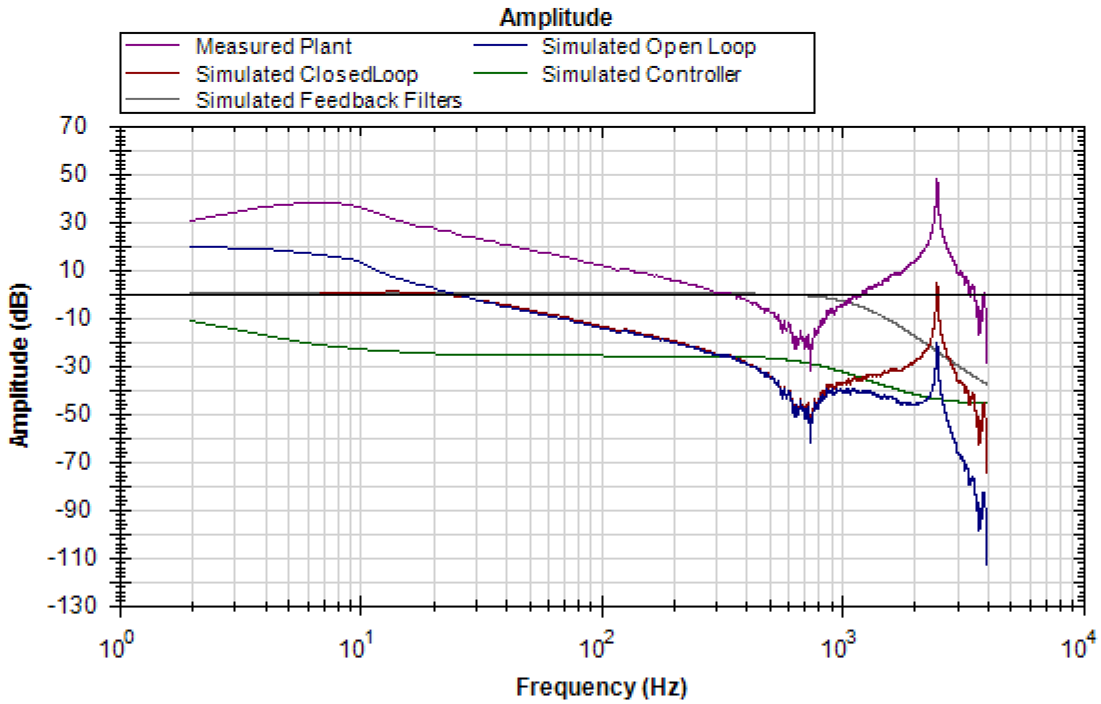
The detuning of velocity loop proportional and integral gains simulated that the bandwidth of the servo has been detuned from ~100 Hz to ~30 Hz.



Next, write the tuning parameters to the drive using the **Write Tuning** button on the **Read/Write** tab.



Now, complete a Bode Plot measurement to compare the simulated result with the new measured result.



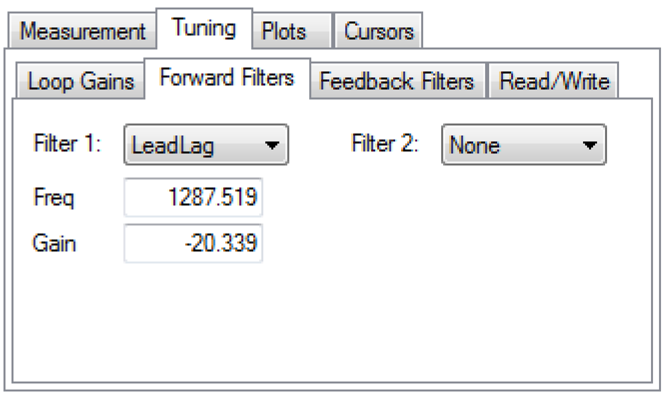
The new measured Bode Plot indicates we achieved slightly lower than 30 Hz bandwidth. The servo is stable, and tuning can be refined until desired performance is reached.

Simulating Filters with the Performance Servo Tuner

Resonances add many challenges to tuning a servo. Using the correct filter in an application can greatly improve system performance when resonances are present.

The Bode plot in this example shows a sharp, high-magnitude resonance at 2500 Hz. Because this is the only resonance, this is an indicator that a resonator (a tunable notch) filter may increase performance.

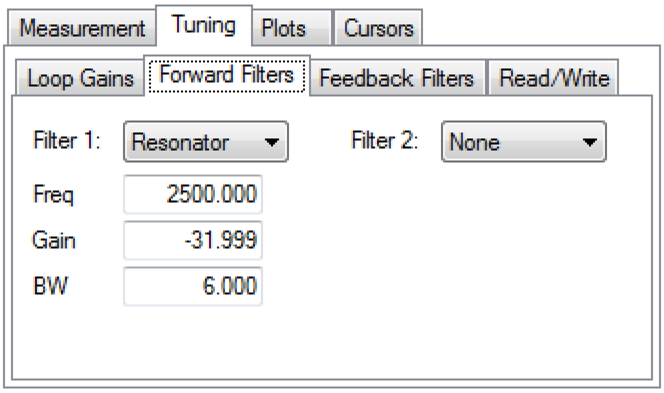
Click on the **Forward Filters** tab:



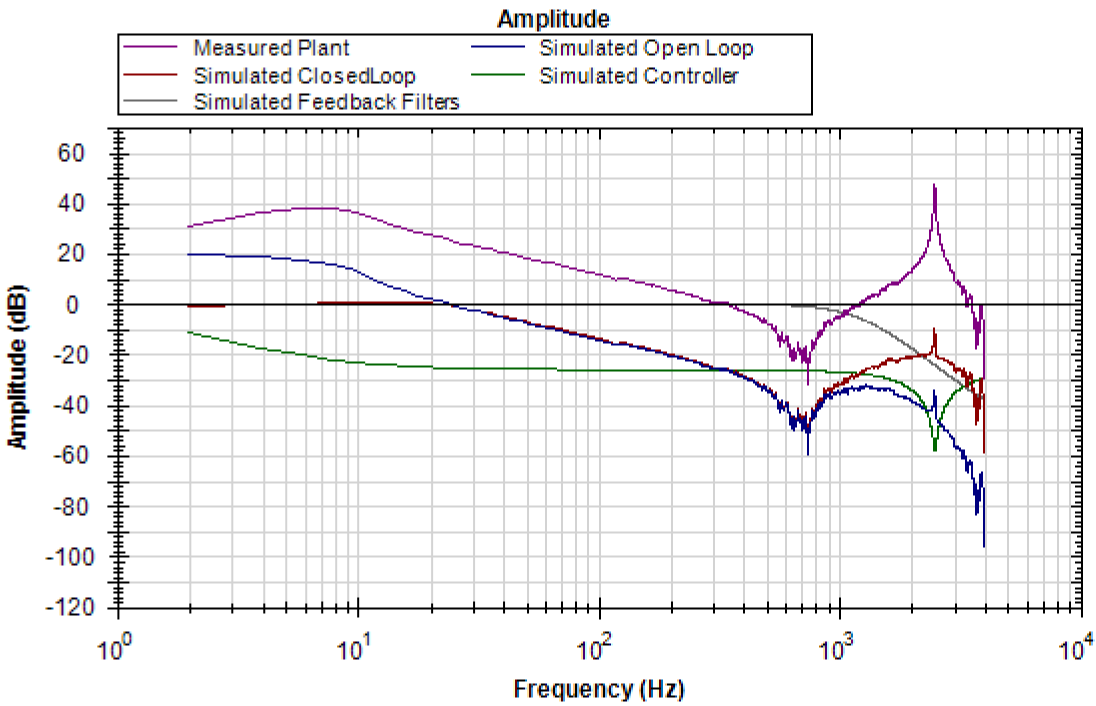
The results of the autotune are still on the drive, and provide adequate tuning. A lead lag filter is the default tuning filter, and is a good general case filter for most servo loops.

Because this test fixture has such a prominent single resonance, we can improve performance (and reduce noise) by placing a notch filter at this resonance.

By tuning a Resonator to best cancel the resonance in the plant, the resonance in the open loop, and therefore the closed loop can be minimized.



The resulting frequency response using the above resonator configuration is shown below:



Notice the attenuation of the resonance in the blue and red traces (open loop and closed loop, respectively).

Using Filters to Reduce Noise

To reduce noise, it is best to place filters in the feedback path. This placement attenuates the noise resulting from a noisy encoder being amplified by the current loop. This noise can be filtered by a forward path filter, however if a filter is placed in the forward path that introduces phase lag (like a lowpass) then your motion profile will exhibit that phase lag in the command signal. If the filter is placed in the feedback path, this lag will be avoided.

15.4 Tuning Guide

15.4.1 Overview

This section covers tuning the velocity and position loops in the AKD. Servo tuning is the process of setting the various drive coefficients that are needed for the drive to optimally control the servo motor for your application. There are different ways to tune, and several are covered here. We will give you guidance on what the different methods of tuning are and when to use them.

The AKD works in three major operation modes: torque, velocity, and position operation mode. No servo loop tuning is required for torque mode. Velocity loop and position loop tuning are covered below.

The AKD has an auto tuner that will provide the tuning that many applications will need. This section describes the tuning process and how to tune the AKD, specifically for cases where the user does not want to use the auto tuner.

Tuning in this section will focus on tuning in the time domain. This means that we will look at the velocity or position response vs. time as the criteria we use to decide how well tuned a control loop is tuned.

15.4.2 Determining Tuning Criteria

Choosing the proper specifications for a machine is a prerequisite for tuning. Unless you have a clear understanding of the type of performance needed to push the machine into production, the tuning process will cause more problems and headaches than it solves. Take time to layout ALL the requirements of the machine—nothing is too trivial to consider.

- Determine what the most important criteria are. The machine was likely designed and developed with a certain performance in mind. Include ALL performance criteria in the specification. Do not concern yourself with whether or not the criteria sound scientific. (i.e. If the motion needs to visibly look smooth, put it in the specification. If it can't have any noise, put it in the specification.) At the end of the development phase, the machine's performance should match the performance previously set in the specification. This will ensure that the machine meets its performance goals and that it is ready for production.
- Test the machine with realistic motion. Do not simply tune the machine to make short linear motion, when it will make long, s-curve motions in the real world. Unless you test the machine with realistic motion, there is no way to determine if it is ready for production.
- Determine some specific, quantitative criteria for identifying unacceptable motion. It's better to be able to tell when a motion is unacceptable than to try and figure out the exact point where acceptable motion becomes unacceptable. Here are some examples of motion criteria:

  a. +/– x position error counts during the entire motion.
  b. Settling to within +/- x position error counts, within y milliseconds.
  c. Velocity tolerance of x% measured over y samples.

- DO NOT pick criteria based on what is the most popular technique of the day. It is important to focus on the things that will get the machine into production with reliable performance, based on fundamental understanding of the system.

After you have constructed a detailed servo performance specification, you are now ready to start tuning your system.

15.4.3 Before You Tune

In the worst case, if something goes wrong during tuning, the servo can run away violently. You need to make sure that the system is capable of safely dealing with a servo run away. The drive has several features that can make a servo run away safer:

- Make sure that the limit switches turn the drive off when tripped. If a complete run away occurs, the motor can move to a limit switch very quickly.
- Make sure the max motor speed is set accurately. If a complete run away occurs, the motor can reach max speed quickly and the drive will then disable.

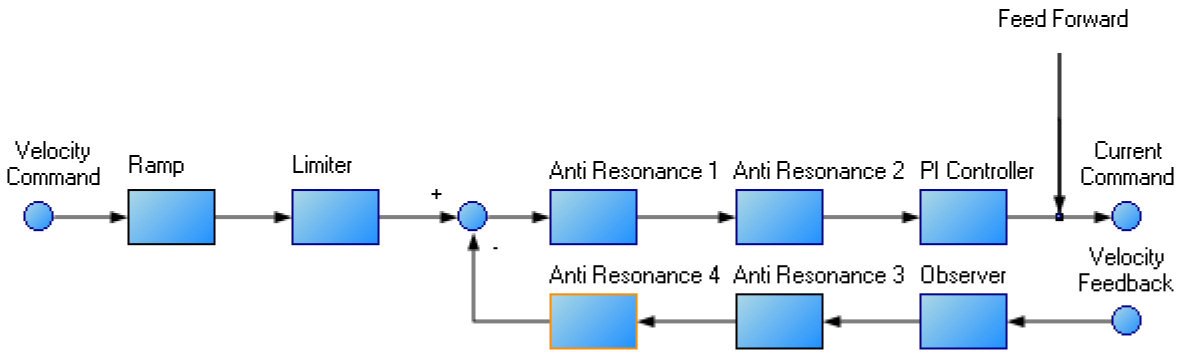
15.4.4 Closed Loop Tuning Methods

The closed loop control loop is responsible for the desired position and / or velocity (trajectory) of the motor and commanding the appropriate current to the motor to achieve that trajectory. The challenge in closed loop control loops is to make a system that not only follows the desired trajectory, but also is stable in all conditions and resist external forces, and do all of this at the same time.

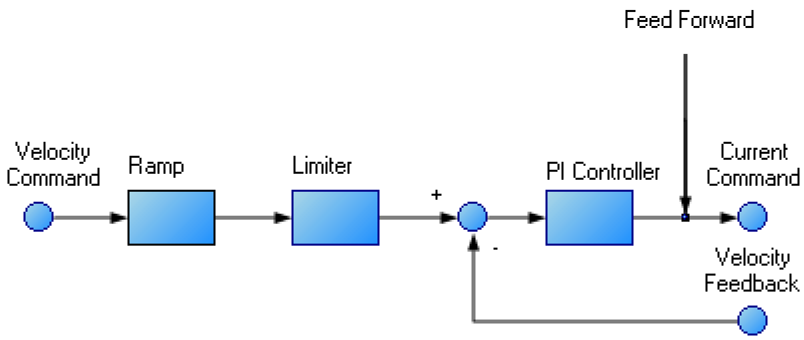
When in velocity operation mode, only the velocity loop is tuned. When in position operation mode, both the velocity and position loops must be tuned.

15.4.4.1 Tuning the Velocity Loop

The velocity loop on the AKD consists of a PI (proportional, integral) in series with two anti resonance filters (ARF) in the forward path and two anti resonance filters in series in the feedback path.



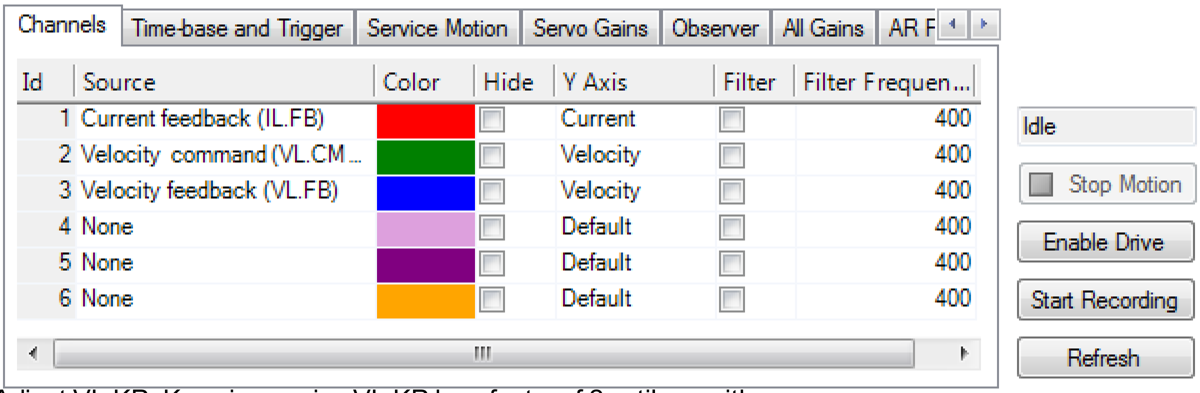
To perform basic tuning of the velocity loop, you can use just the PI block and set ARF1 and ARF2 to unity (no effect) and set the observer to 0 (no effect). Using just the PI block simplifies the process of tuning the velocity loop. To start tuning you can adjust the PI Controller block first. A simplified velocity loop without anti resonant filters and observer is shown below. This is how you can think of the loop before the anti resonant filters and observer is used.



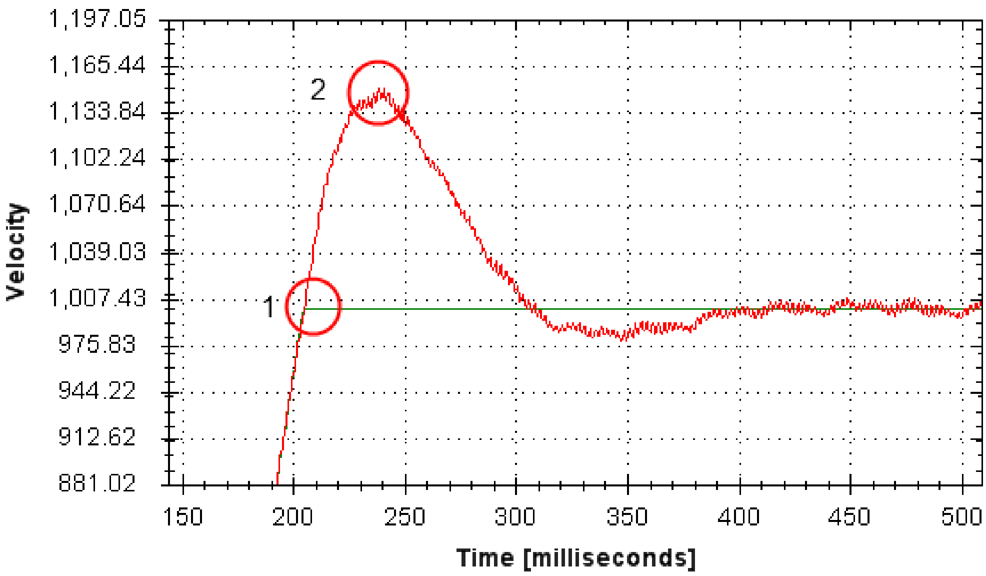
Procedure for simple velocity loop tuning:

1. Set DRV.OPMODE to velocity or position, as appropriate for your application. If DRV.OPMODE is set to position, set VL.KVFF to 1.0.
2. Set VL.KP to 0.
3. Set VL.KI to 0.
4. Set service motion to make a motion that is similar to the move speeds that will be used in the real application. Do not set the service motion to a speed higher than ½ of the maximum motor speed, to allow for safe overshoot during tuning. Set acceleration to an appropriate value for your application. Set service motion to reversing. Set time1 and time2 equal to 3 times the expected settling time for the system. 1.0 second is a reasonable value for time1 and time2, if you don't know the expected settling time.
5. Enable the drive and start the service motion. You should see no motion, as there are no velocity loop tuning gains at this point.

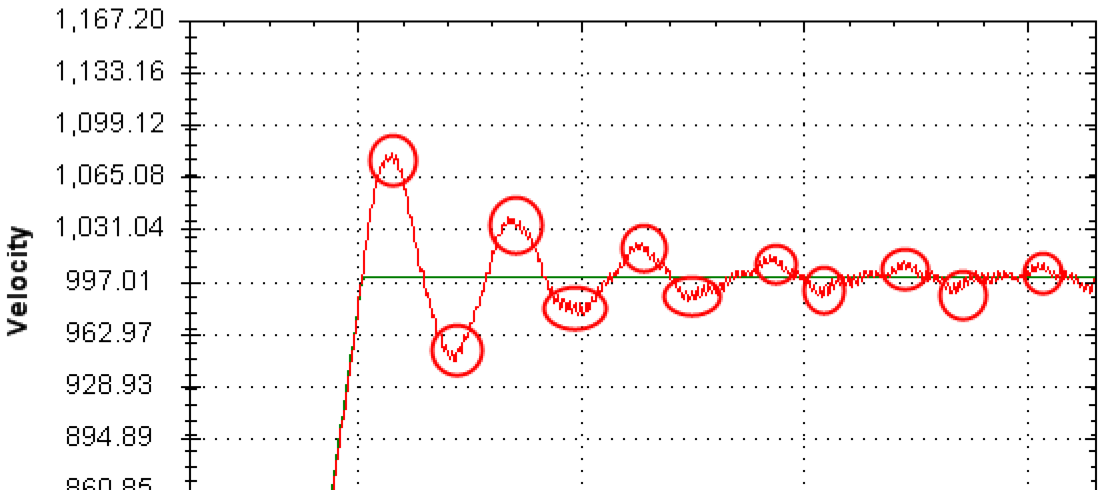
6. When adjusting VL.KP and VL.KI, below record VL.FB and VL.CMD. These are the traces that are used to determine the performance of the velocity loop.



7. Adjust VL.KP. Keep increasing VL.KP by a factor of 2 until you either:
   - Hear an objectionable noise from the system (buzzing, humming, etc.)
   - See velocity overshoot. No velocity overshoot should be present when using only VL.KP.
   - When you reach one of the limits above, decrease VL.KP to the value where there were no objectionable noises or overshoot.
8. Adjust VL.KI. Increase VL.KI by a factor of 1.5 until you either:
   - Hear or see objectionable noise or shuddering from the system
   - See > 15% overshoot
   - Here is an example of 15% overshoot. This is zoomed in view of a service motion commanded to 1000 RPM (location 1), where the overshoot peaks at 1150 RPM (location 2).



   - Here is an example of 11 overshoots. Each overshoot is shown by a red circle.



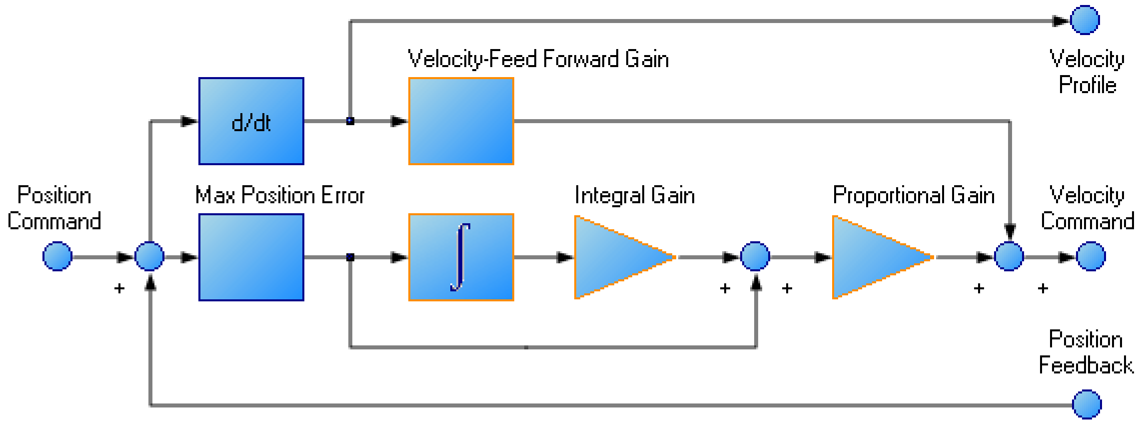
- When you reach one of the limits above, decrease VL.KI to the value where there were no objectionable noises or overshoot.

9. Stop the service motion

15.4.4.2 Tuning the Position Loop

The position loop is a second loop that builds upon a correctly tuned velocity loop to provide accurate control over position. The position loop is a simple element that consists of a PI loop. It is simplest to tune the P and I terms in the velocity loop and use only the P term in the position loop.

At most, use only three non-zero P and I terms from both the velocity loop and the position loop. One combination would be VL.KP, VL.KI, and PL.KP. Another valid combination would be VL.KP, PL.KP, and PL.KI. The VL.KP, VL.KI, and PL.KP combination is shown here.



Procedure for tuning position loop:

1. Set VL.KVFF to 1
2. Increase PL.KP until either:

- You see 25% overshoot
- You see > 3 overshoots
- You hear objectionable noises from the system.
- When you reach one of the limits above, decrease PL.KP to the value where there were no objectionable noises or overshoot.

15.4.5 Torque Feedforward Tuning Methods

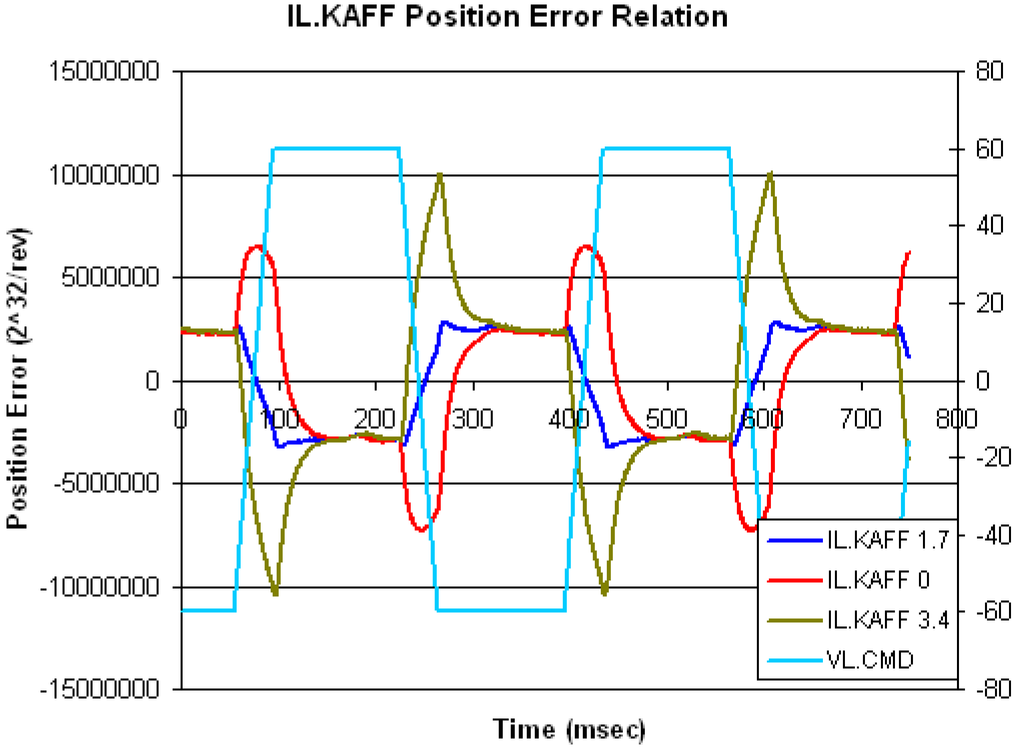
The torque based feedforward terms on the AKD effectively model the physics of your motor and allow the drive to command the appropriate current, even before the encoder has time to send data back to the drive. Torque based feedforward terms allow you to lower following error with virtually no stability penalty.

15.4.5.1 Shape Based Feedforward Tuning

To adjust IL.KAFF:

- Tune the VL.KP and VL.KI as shown above in the velocity loop tuning section. Set DRV.OPMODE to velocity (or set PL.KP and PL.KI to 0 and vl.kvff to 1).
- Set up a short, repeating service motion with accelerations that are representative of the moves you will use in your application (exact values for acceleration are not critical).
- Turn up IL.KAFF until the position error (PL.ERR) is proportional to the inverted velocity command. The adjustment of IL.KAFF will focus on removing bumps on acceleration and

deceleration. The picture below has an ideal value of IL.KAFF of 1.7.



15.4.6 Using Anti-Resonance Filters

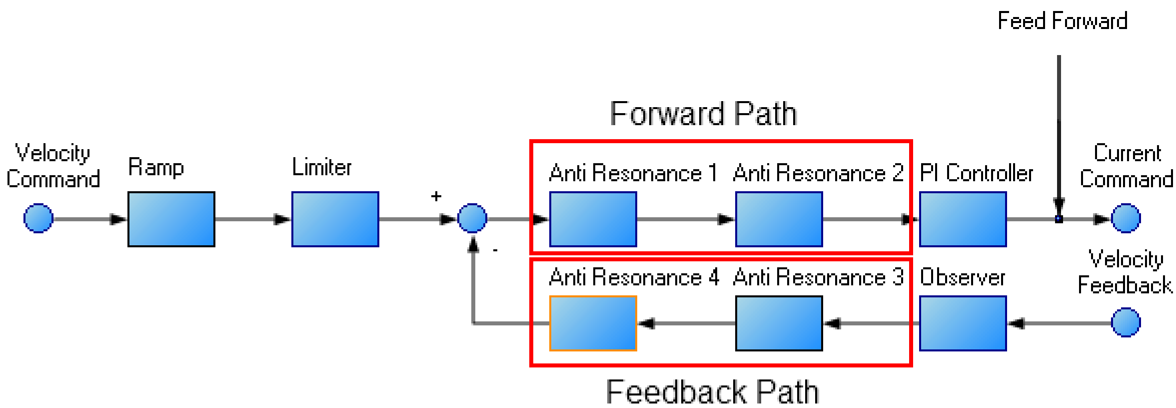
The AKD has four anti resonance filters. Two filters are in the forward path and two are in the feedback path.

Similarities

- Both types are typically used to enhance stability and performance of the system.

Differences

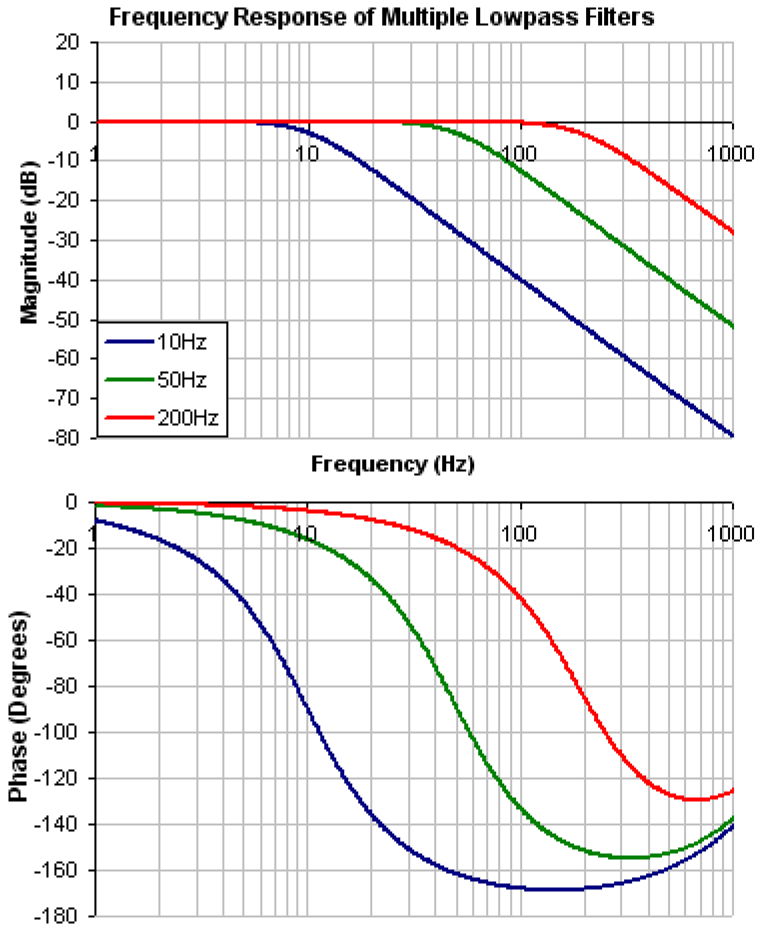
- Forward path filters result in higher phase lag in closed loop system response.
- Forward path filters limit spectrum from reaching the motor / feedback path filters only filter the feedback after it has been to the motor.



1.6.1 Types of Anti Resonance Filters

Low Pass

A low pass filter allows signals through below a corner frequency and attenuates the signals above the same corner frequency. The behavior at the corner frequency can be specified with the low pass Q.



To specify a lowpass filter, you must specify the frequency and Q for both the zero and pole on anti resonance filter 1. To do this, see the following example using the terminal commands that sets:

- Filter Type = Biquad
- Zero frequency = 700 Hz (This is the Lowpass cutoff frequency)
- Zero Q = 0.707
- Pole frequency = 5000 Hz
- Pole Q = 0.707

VL.ARTYPE1 0

VL.ARZF1 700

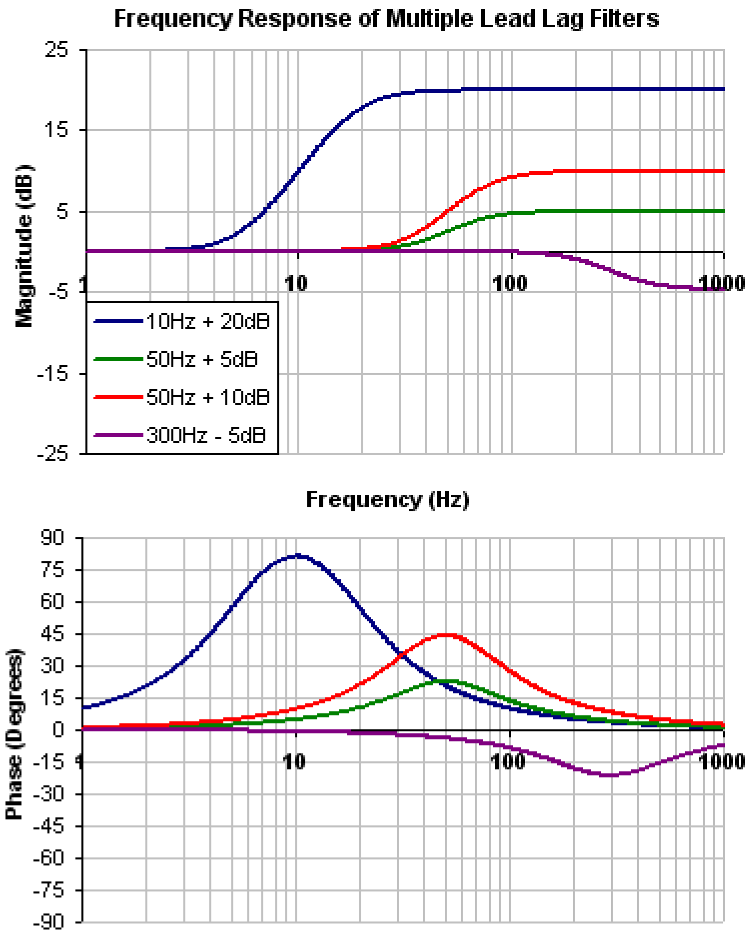
VL.ARZQ1 0.707

VL.ARPF1 5000

VL.ARPQ1 0.707

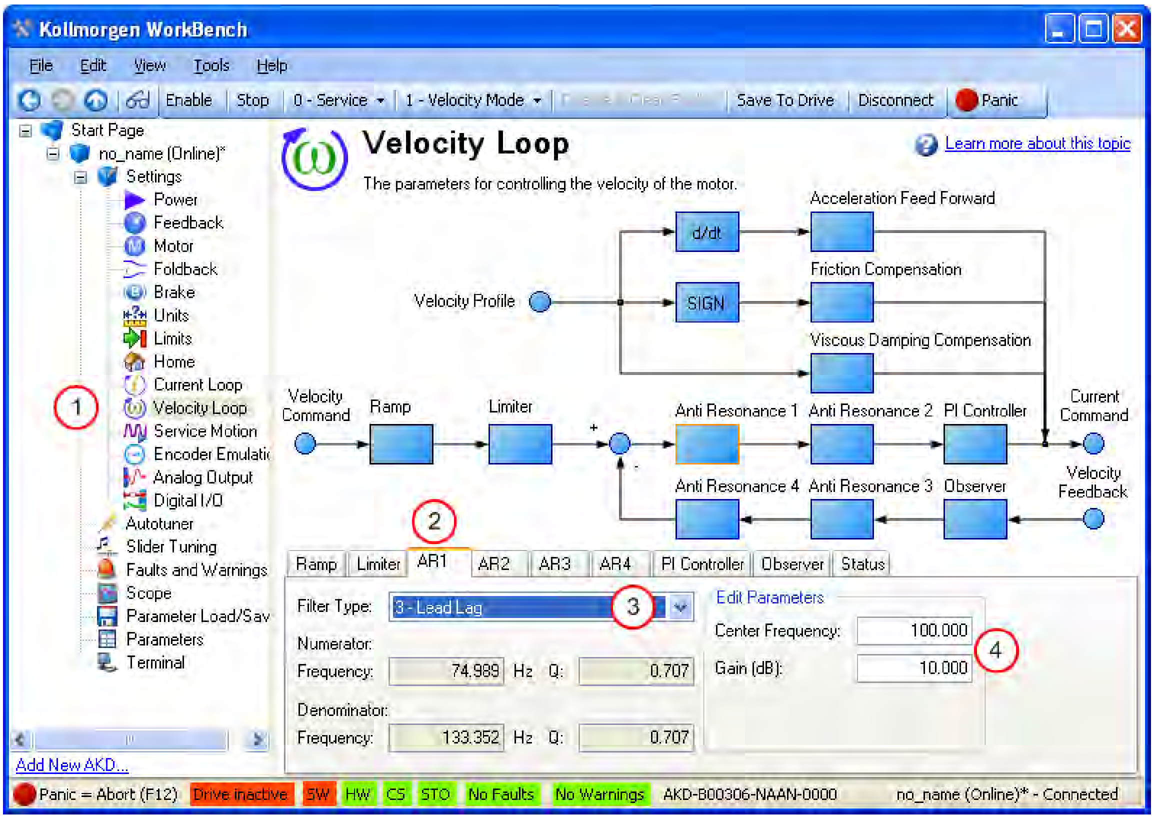
Lead Lag

A lead lag filter is a filter that has 0 dB gain at low frequencies and a gain that you specify at high frequencies. You also specify the frequency that the gain at which the transition occurs.



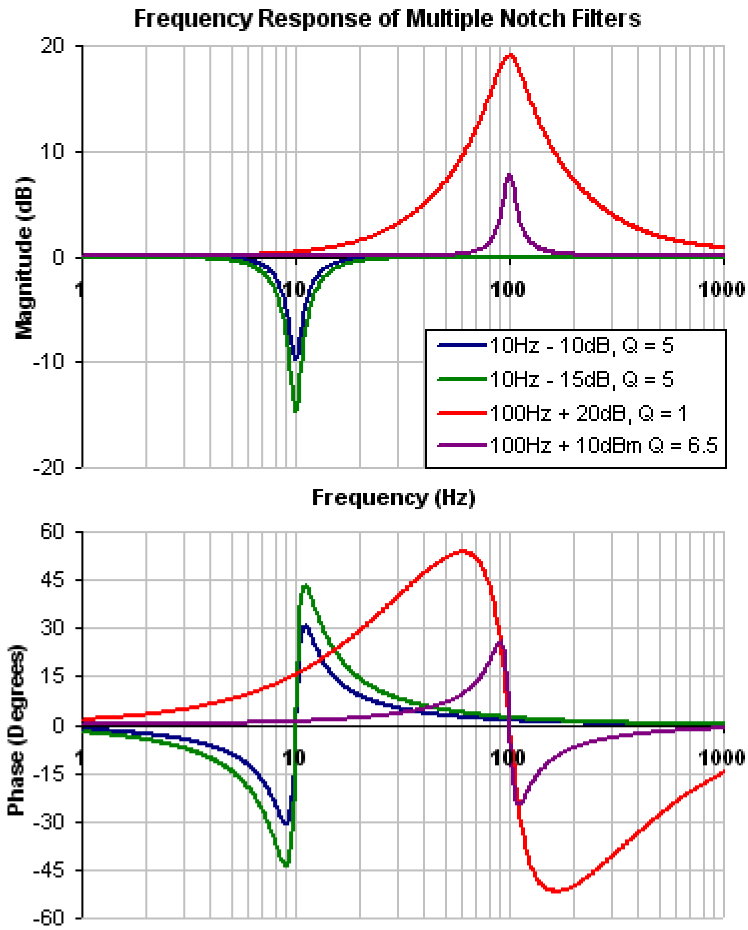
To specify a Lead Lag filter, you must specify the Center Frequency and high frequency Gain (dB). To do this, see the following example by clicking on the Velocity Loop:

Click on Velocity Loop (1), then select the AR1 Tab (2), using the Filter Type drop down, select Lead Lag (3), lastly, enter the desired Center Frequency and Gain of the Lead Lag filter (4).



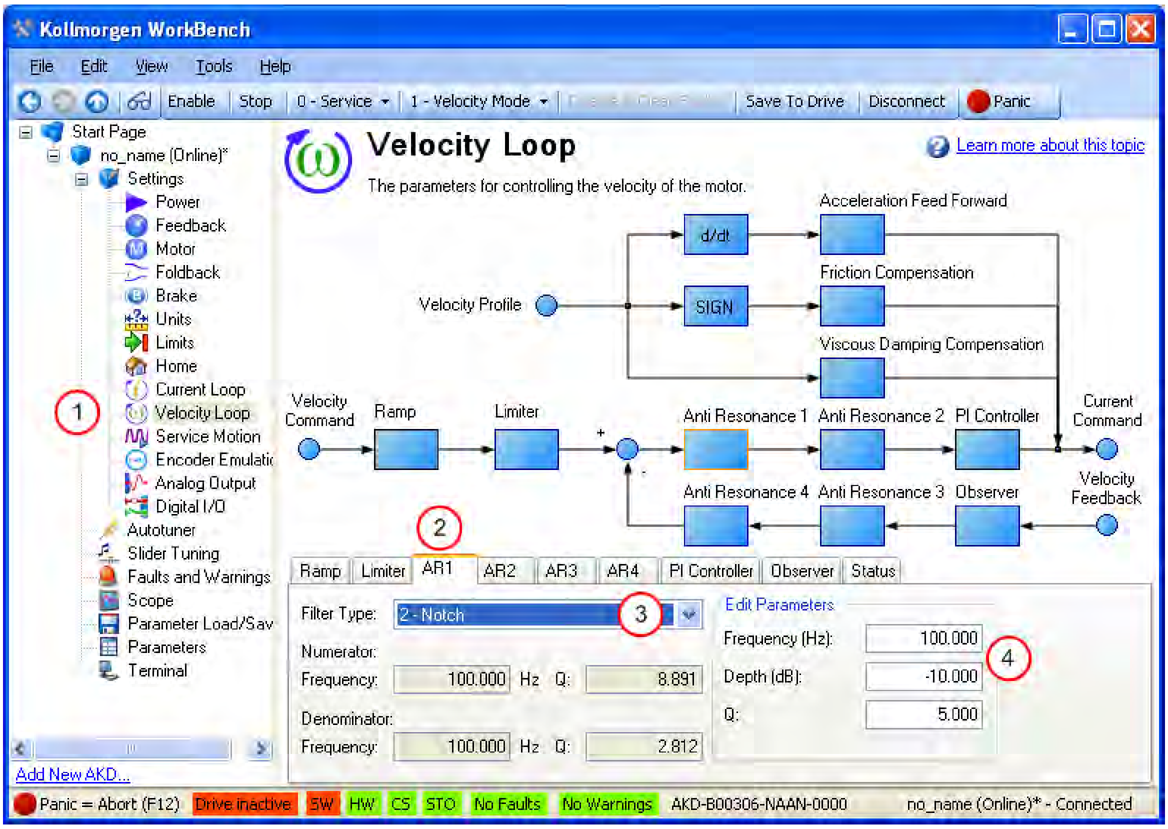
Notch

A notch filter changes gain at a specific frequency. You specify the frequency at which the gain change occurs (Frequency (Hz)), how wide of a frequency range the cut occurs (Q), and how much the gain changes (Notch Depth (dB)).



To specify a notch filter, you must specify the Frequency (Hz), Depth (dB) and Width (Q) of the notch. To do this, see the following example by clicking on the Velocity Loop:

Click on Velocity Loop (1), then select the AR1 Tab (2), using the Filter Type drop down, select Notch (3), lastly, enter the desired Frequency, Depth and Q of the Notch filter (4).



Biquad

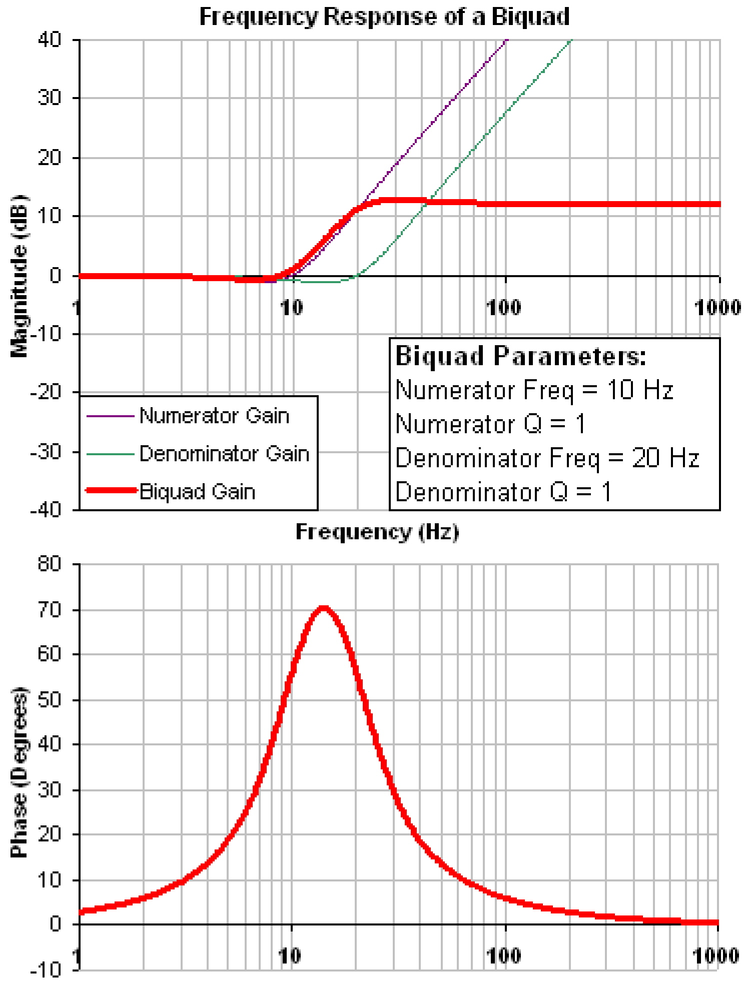
A biquad is a flexible filter that can be thought up as being made up of two simpler filters; a zero (numerator) and a pole (denominator). In fact, the pre-defined filters mentioned above are really just special cases of the biquad.

Both the zero (numerator) and the pole (denominator) have a flat frequency response at low frequencies and a rising frequency response at high frequencies. The transition frequency and damping must be specified for both the numerator and denominator.

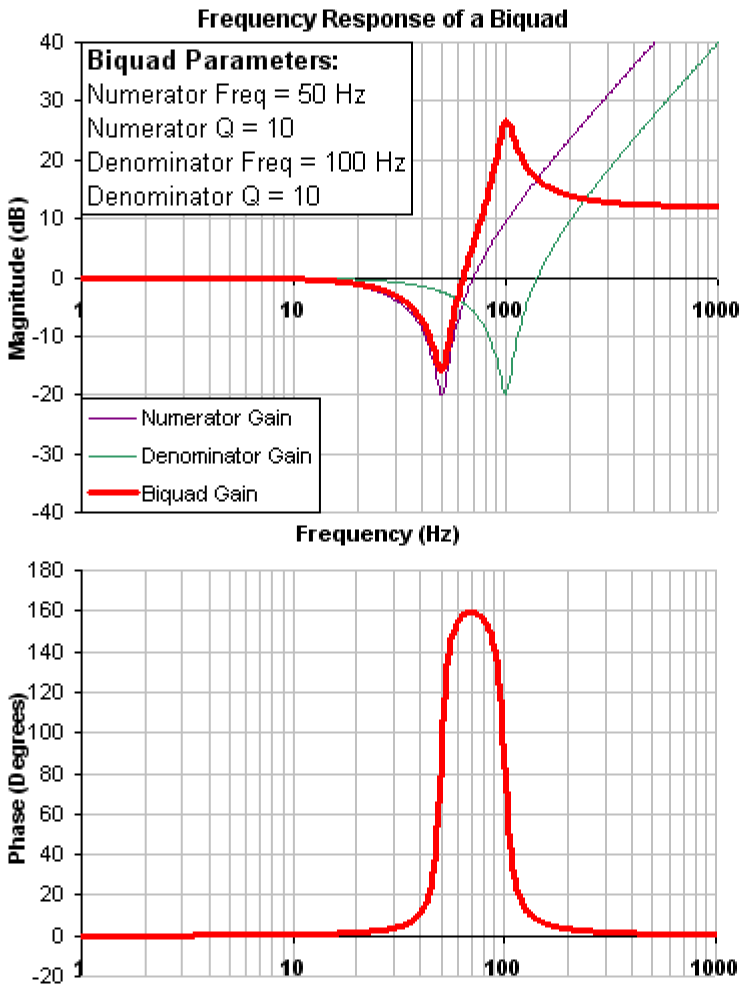
Analyzing the numerator and denominator, the frequency response calculation is simple:

If the numerator and denominator are plotted in dB, the biquad response is numerator – denominator. Understanding how the numerator and denominator work is crucial in understanding how a biquad frequency response is created.

Below is an example of a biquad filter similar to a Lead Lag filter type. To help understand how to determine the frequency response of the biquad, the numerator and denominator response have been plotted. If the denominator is subtracted from the numerator, the biquad response is the result.

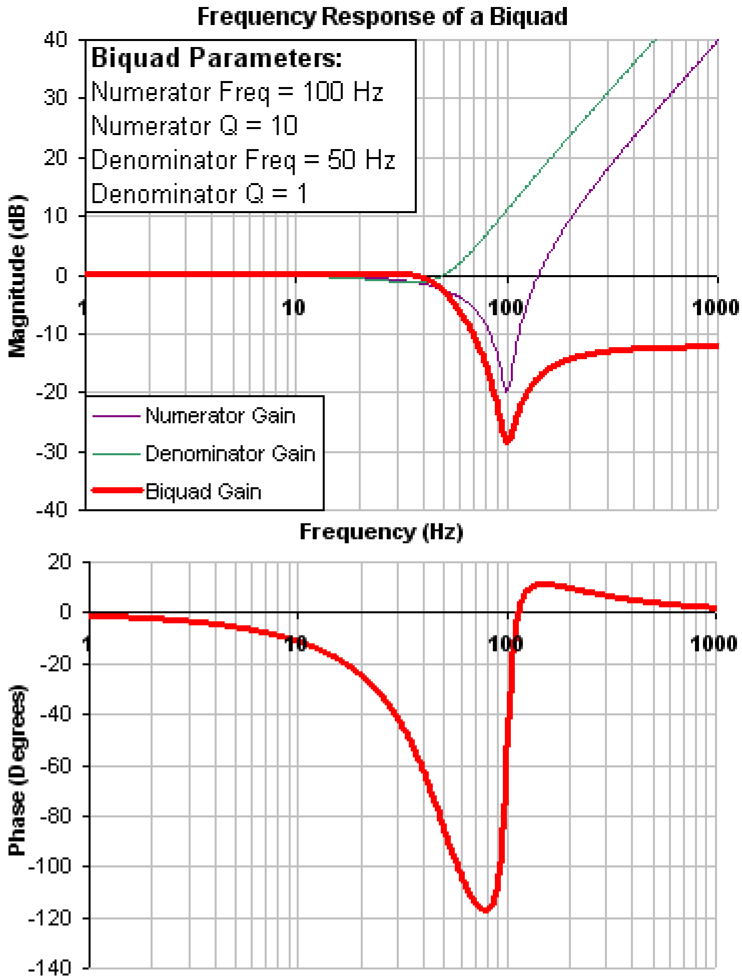


The biquad filter is very flexible, this allows custom filters to be designed. Below is an example of a resonance filter using a biquad, notice how the high Q values affect the numerator and denominator. This gives a biquad frequency response similar to a mechanical resonance.



The previous two examples used a numerator frequency lower than the denominator frequency, yielding a positive gain in high frequencies. If the denominator frequency is lower than the numerator frequency, then high frequencies will have a negative gain.

Below is an example where the numerator frequency is higher than the denominator, notice the high frequencies have a negative gain.



To specify a biquad filter, you must specify the frequency and Q for both the zero and pole on anti resonance filter 3. To do this, see the following example using the terminal commands that sets:

- Filter Type = Biquad
- Zero frequency = 100 Hz
- Zero Q = 0.7
- Pole frequency = 1000 Hz
- Pole Q = 0.8

VL.ARTYPE3 0

VL.ARZF3 100

VL.ARZQ3 0.7

VL.ARPF3 1000

VL.ARPQ3 0.8

15.4.6.1 Biquad Calculations

In the s-domain, the linear biquad response is calculated:

$$\text{Biquad Frequency Response} = \frac{s^2 + \frac{\omega_N}{Q_N}s + \omega_N^2}{s^2 + \frac{\omega_D}{Q_D}s + \omega_D^2}$$

To convert from idealized s-domain behavior to a more realistic z-domain behavior, we convert using a pole / zero transform. To calculate the frequency response for an individual frequency:

$$t = 62.5\mu\,\text{sec}$$

$$N_{Rad} = 1-(2Q_N)^{-2}$$

$$N_{2Unscaled} = 1$$

$$if(N_{Rad} > 0): N_{1Unscaled} = -2e^{-2\omega_N \zeta_N t}\cos(\omega_N t\sqrt{1-\zeta^2})$$

$$if(N_{Rad} <= 0): N_{1Unscaled} = -2e^{-2\omega_N \zeta_N t}\cosh(\omega_N t\sqrt{1-\zeta^2})$$

$$N_{0Unscaled} = e^{-2\omega_N \zeta_N t}$$

$$D_{Rad} = 1-(2Q_D)^{-2}$$

$$D_2 = 1$$

$$if(D_{Rad} > 0): D_1 = -2e^{-2\omega_D \zeta_D t}\cos(\omega_D t\sqrt{1-\zeta^2})$$

$$if(D_{Rad} <= 0): D_1 = -2e^{-2\omega_D \zeta_D t}\cosh(\omega_D t\sqrt{1-\zeta^2})$$

$$D_0 = e^{-2\omega_D \zeta_D t}$$

$$N_{Scale} = \frac{N_{0Unscaled} + N_{1Unscaled} + N_{2Unscaled}}{D_0 + D_1 + D_2}$$

$$N_2 = N_{2Unscaled} / N_{Scale}$$

$$N_1 = N_{1Unscaled} / N_{Scale}$$

$$N_0 = N_{0Unscaled} / N_{Scale}$$

$$\angle_Z = \omega t = 2\pi * freq * t$$

$$Num_{Re} = N_2 Cos(2\angle_Z) + N_1 Cos(\angle_Z) + N_0$$

$$Num_{Im} = N_2 Sin(2\angle_Z) + N_1 Sin(\angle_Z)$$

$$Den_{Re} = D_2 Cos(2\angle_Z) + D_1 Cos(\angle_Z) + D_0$$

$$Den_{Im} = D_2 Sin(2\angle_Z) + D_1 Sin(\angle_Z)$$

$$Gain_{dB} = 20\log_{10}\left(\frac{\sqrt{Num_{Re}^2 + Num_{Im}^2}}{\sqrt{Den_{Re}^2 + Den_{Im}^2}}\right)$$

$$Phase_{deg} = \frac{180}{\pi}\left(\tan^{-1}\left(\frac{Num_{Re}}{Num_{Im}}\right) - \tan^{-1}\left(\frac{Den_{Re}}{Den_{Im}}\right)\right)$$

15.4.6.2 Common Uses Of Anti Resonance Filters

Low pass filters in the feedback path. This is a common way to deal with noisy feedback sensors. When used in combination with noisy feedback sensors, significant reduction in audible noise can result.

Lead / lag filters in the forward path. This is a common way to achieve phase lead for control loops without exciting high frequency resonances.

Low pass filters in the forward path. This is a common way to limit high frequency energy from reaching a system that can not productively use energy at these high frequencies. This is also used to lower the effect of system resonances over a wide range of frequencies.

Notch filters are used to cancel system resonances. Notch filters are designed to be the opposite in amplitude of system resonances. Notch filters are applied to very specific frequencies, and therefore you must know your system resonance frequencies accurately to use them effectively.

16 Scope

16.1 Overview

The scope allows you to plot up to six different parameters from the drive. Use **Full View** and **Normal View** to toggle between the scope setup (normal) and a larger view of only the scope output (full). You can configure, save, and restore scope settings from the normal view. The lower right corner of the normal view also includes a box that indicates status and drive and scope control buttons (**Enable Drive**, **Start Recording**, and **Refresh**).

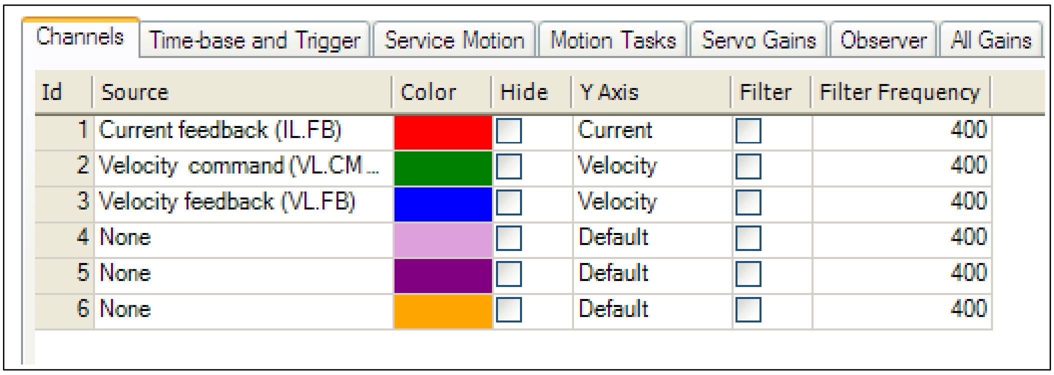
16.2 Using the Scope

You can set up scope plots using the tabs summarized below:

Tab	Function
Channels	Select data source, plot axes, and plot appearance.
Time Base and Trigger	Select how much data to record and when to start recording the data.
Service Motion	Generate basic motion.
Servo Gains	Adjust the servo loop gains.
All Gains	View all current tuning gains in the drive and manually edit gains.
AR1, AR2, AR3, AR4	Adjust filter settings.
Save and Print	Save the plot as a raw data file or as an image file; email the plot; print the plot;open the data file in Excel.
Measure	Display basic data read from the plots.
Cursors	Turn on the cursors and view the data at the cursor positions.
Display	Pan, zoom, and control the grid and background color.

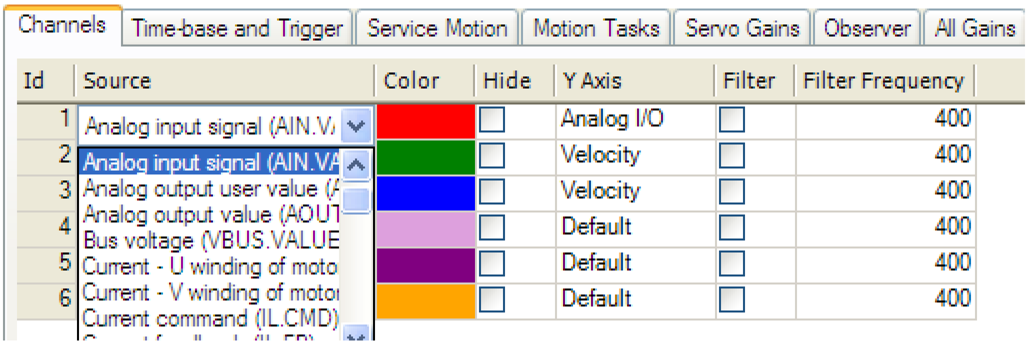
16.2.1 Scope Channels Tab

The **Channels** tab allows you to select and record up to six channels simultaneously. Select the data to record for each channel from the lists in the **Source**, **Color**, **Y-axis**, and **Filter** and **Filter Frequency** columns. Once a recording is shown on the scope screen, you can click **Hide** to remove a channel from the scope display.



16.2.1.1 Source Column

To set a channel to record, click the source you want to set and choose the appropriate channel. You can choose from None (no data is collected on that channel), preset trace types, or enter a user defined trace. Choosing “<User Defined>” allows you to record data from pre-defined locations. These locations are provided by the factory to collect less common values.



16.2.1.2 Color Column

For valid sources, you can click on the color in the Color tab and choose a different color than the default, or create a custom color.

16.2.1.3 Hide Column

You can check the **Hide** box to hide a given plot trace. This feature can make it easier to focus on specific data as needed.

16.2.1.4 Y-Axis Column

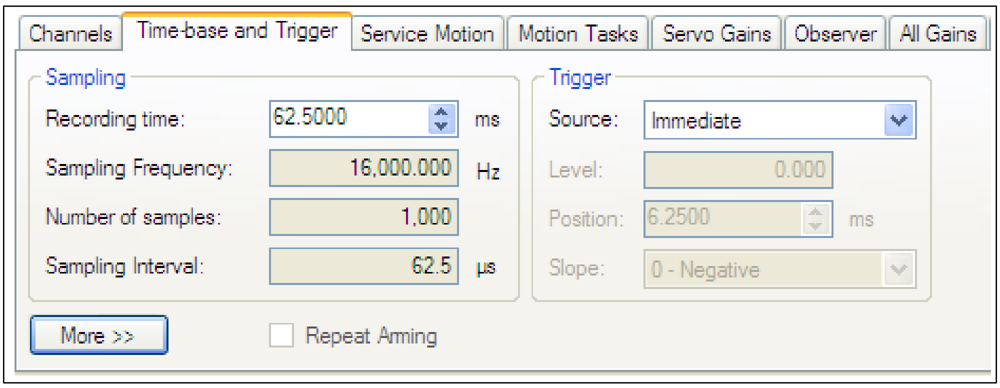
The Y-axis column allows you to choose on which Y-axis the channel will be displayed. Several predefined Y-axis groups exists. Click on the item in the column to change the label for the trace.

16.2.1.5 Filter and Filter Frequency Column

Check this box and use the frequency column to apply a low pass filter to the data collected. The filter is applied when the data is collected. It is not applied to data already collected if this is checked after the data is collected.

16.2.2 Scope Time-base and Trigger Tab

Use the **Time-base and Trigger** tab to select how much data to record and when to start (trigger) recording the data. You can set length of recording in ms and the sampling frequency in Hz. The number of samples is a calculated value displayed for reference.The trigger can be set to trigger immediately when you click **Start Recording**or to trigger when a specified value for a given signal is reached. The default **Time-base and Trigger** view specifies recording time, sampling frequency, and either an immediate trigger or a trigger based on a specified signal. Click the **More** button in this view to specify a given number of samples, sampling frequency, sampling interval, and access additional trigger options.

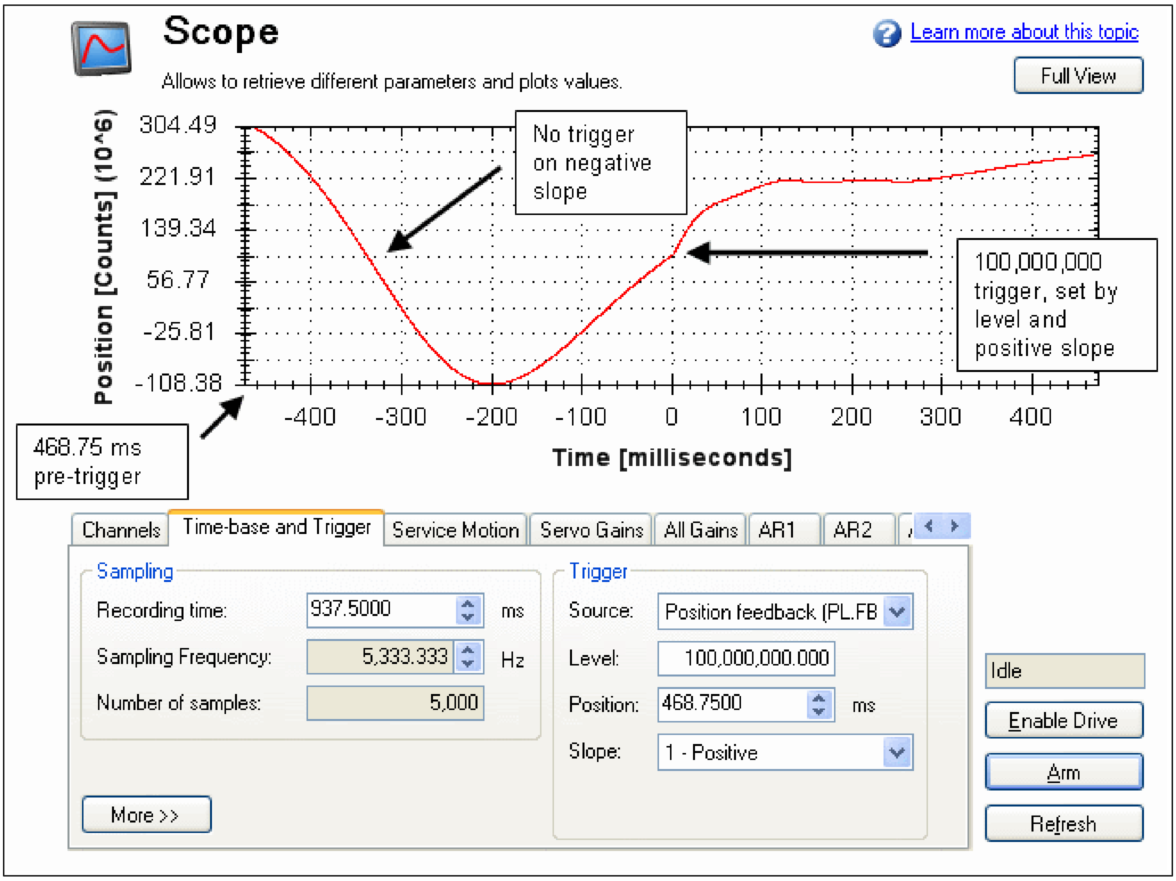


In this tab, you can set length of recording in ms and the sampling frequency in Hz. The number of samples is a calculated value displayed for reference. You can also choose the trigger source to be **Immediate** (triggers as soon as you click the **Start Recording** button) or to be one of many predefined sources.

If you choose a source other than **Immediate**, you can set the level, position, and slope for the trigger value.

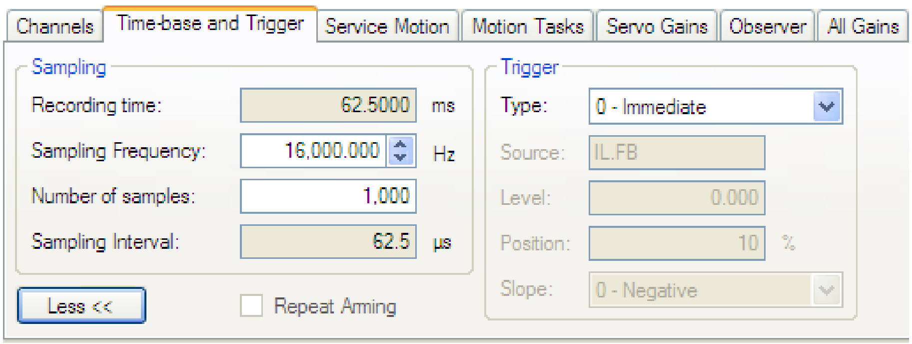
- Level sets the value of the source that triggers the recording to start.
- Position sets the amount of time that the scope displays before the trigger occurred.
- Slope sets whether the source data must pass the level value in a positive or negative direction.

An example of triggering is shown below:



16.2.2.1 Scope Time-base and Trigger, More View

Click **More** to display additional options for configuring the time-base and trigger.



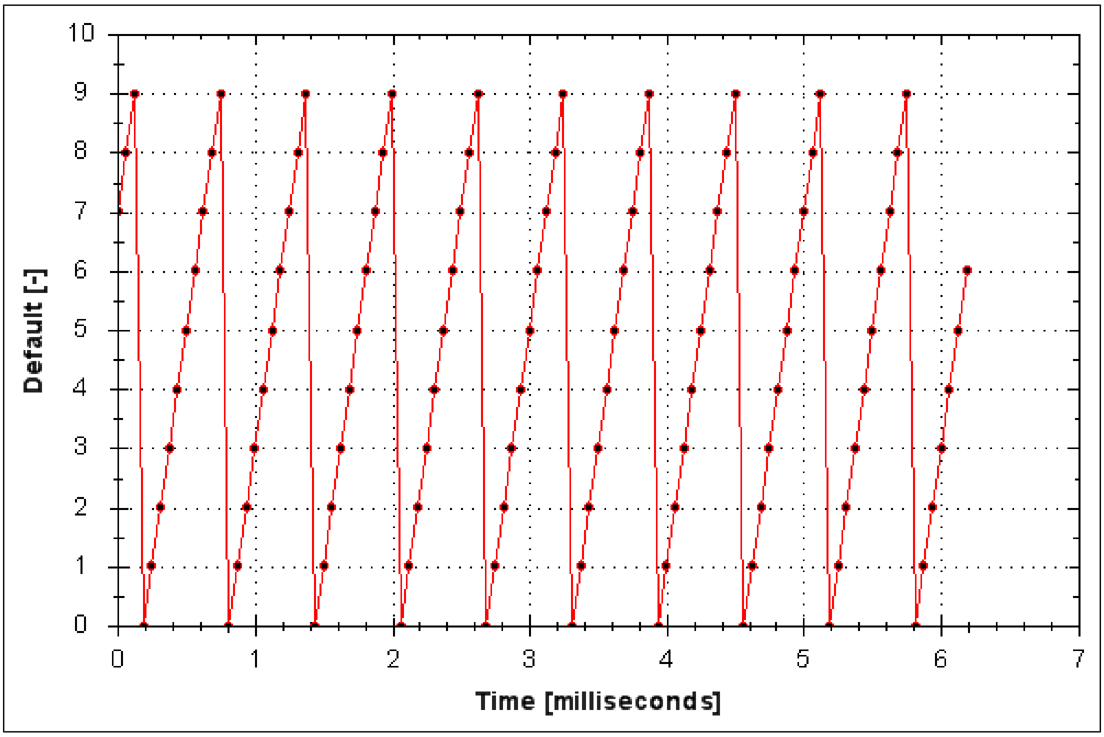
In the **Sampling** area of this view, you can specify the recording length by entering a sampling frequency and a number of samples. Here, the recording time is a calculated value displayed for reference.

What is triggering?

Triggering allows you to precisely control the start point of data collected in the scope. For example, if you are looking for a large spike, you can set the trigger to start the scope to begin recording when it sees the large spike. This section describes the triggering functionality of the scope.

Test Signal

As an example, it is useful to examine variations on a record of a test signal that generates a sawtooth signal. The signal starts at 0 and increases by one every drive sample (1/16,000 second) to a maximum of 9, then returns to 0. This signal continues indefinitely. The record of this signal is shown below.



16.2.2.2 Trigger Type

The **Trigger** area in the **More** view offers more flexibility than the default view. You can specify four types of trigger types (REC.TRIGTYPE):

- **Immediate - 0**. This mode will start recording as soon as the recording command (REC.TRIG) is received by the drive.
- **Command / On Next Command – 1**. This trigger type lets you specify a trigger on the next telnet command received by the drive. This is useful in a telnet session via Hyperterminal (or a similar program).WorkBench is constantly sending telnet commands, so this is not typically used in a WorkBench session.
- **Parameter / On Source Signal – 2**. This trigger type lets you specify a trigger source and set of conditions to trigger recording of data. This is very similar to the triggering used on oscilloscopes.
- **Boolean – 3**. This trigger type lets you trigger on a boolean (0 or 1), such as drive active status.

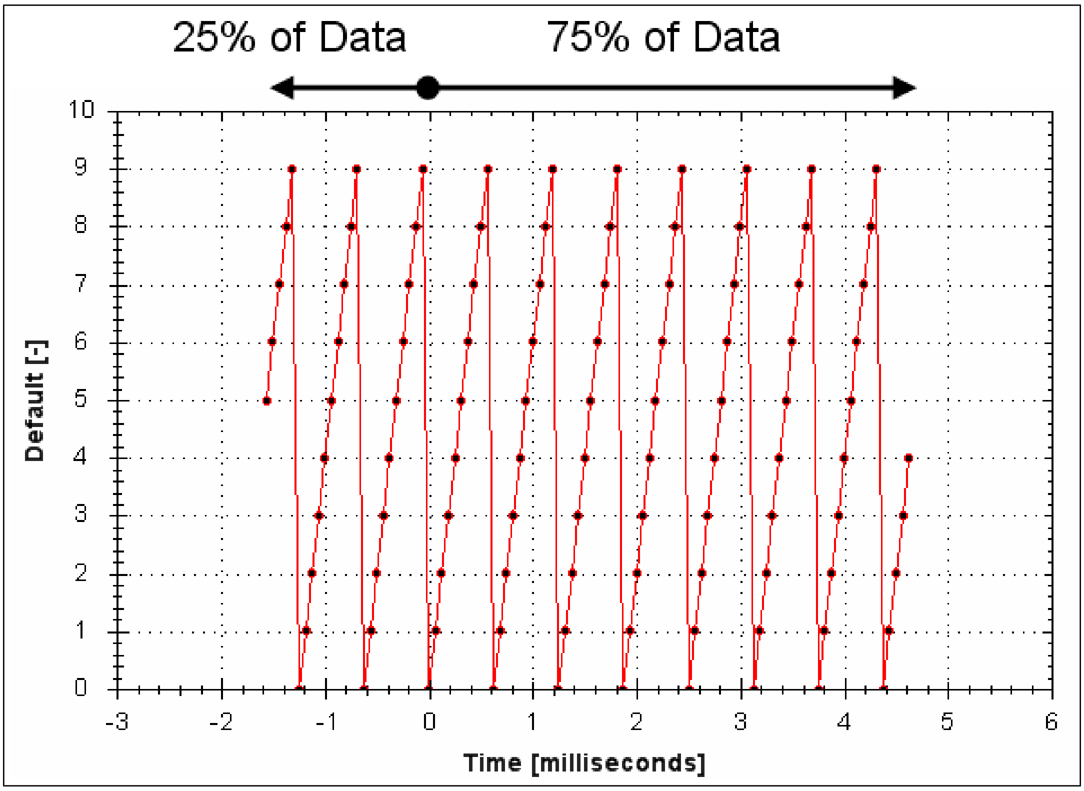
16.2.2.3 Trigger Position

Trigger Position (REC.TRIGPOS) allows you to collect data that occurs before the trigger occurs. If you have a rare condition, you may want to see the conditions that led up to it. Trigger position lets you control how much signal is collected before the trigger condition occurred.

Trigger position is specified in units of percent (%). If you specify a trigger position of X% , X% of the data is before 0 ms in the data time and 100-X% (the rest of the data) is at or greater than 0 ms. In the picture below, trigger position is set to 25% (REC.TRIGPOS 25).

In the WorkBench scope, the 0 time point is clear. When collecting the data via REC.RETRIEVE or similar commands, the time is not returned, so some caution should be used when the trigger point is important to understand.

Trigger position is not used in trigger type “Immediate” (TRIGTYPE 0).



16.2.2.4 Trigger Value

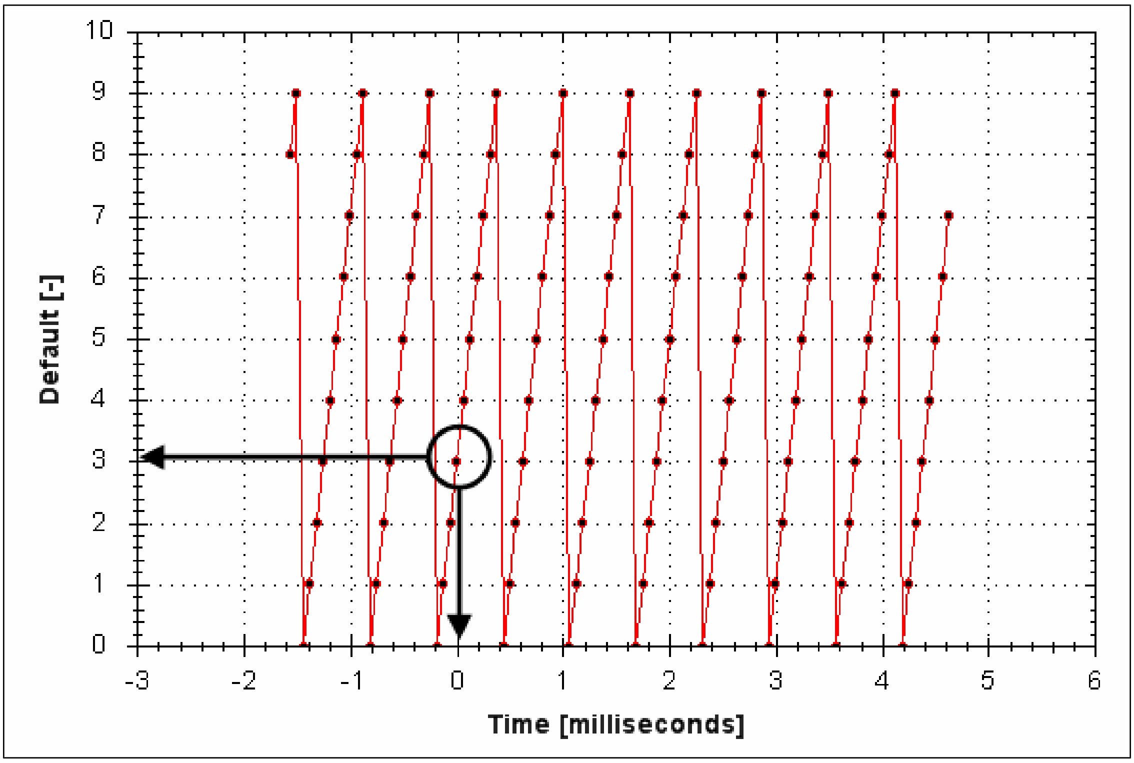
The trigger value (REC.TRIGVAL) specifies a target value that should trigger the recording to start. The trigger value is used in trigger type Parameter / On Next Signal only.

The trigger value is not used in the boolean trigger type. Use the trigger slope to set the polarity of the boolean trigger.

When the trigger slope is positive, the trigger value will trigger when:

- The trigger source is less than the trigger value in the previous recording sample
- The trigger source is greater than or equal to the trigger value in the current recording sample

Below is an example showing triggering of trigger value of 3 (REC.TRIGVAL 3) and positive trigger slope (REC.TRIGSLOPE 1). You can see that the recording triggers at time zero when the source reaches the value of 3.



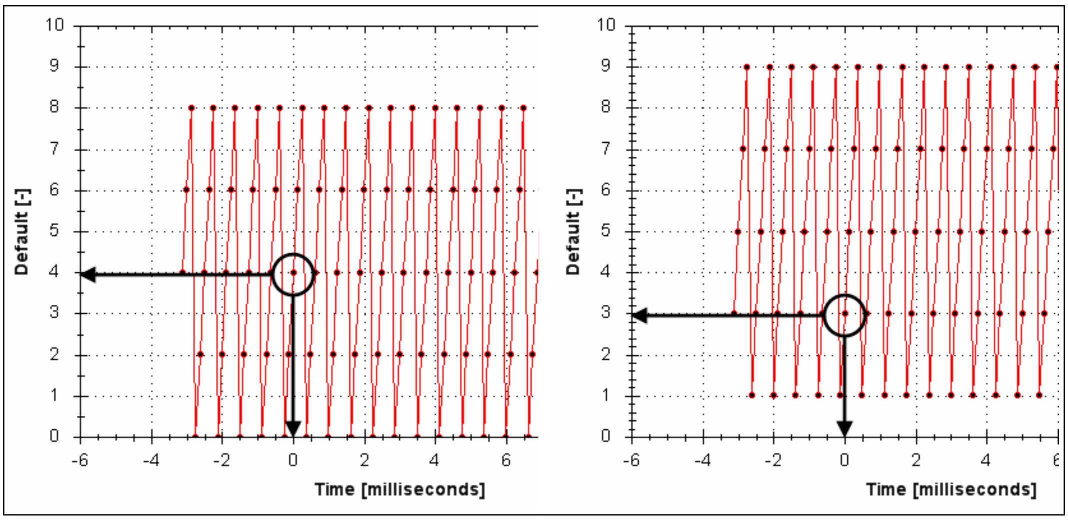
When the trigger slope is negative, the trigger value will trigger when:

- The trigger sources is greater than the trigger value in the previous recording sample.
- The trigger source is less than or equal to the trigger value in the current recording sample.

16.2.2.5 Effects of Recorder Gap

When the recording rate is less than16,000 Hz (REC.GAP > 1), there can be some impact on the triggering of the recorder. When using pretriggering and a recording rate of less than 16,000 Hz, the trigger only evaluates every N samples, where N is the value of REC.GAP. Two effects result from this condition:

1. You cannot be sure of the moment that the recorder is triggered any closer than N samples. An example of this is shown below where the trigger value is set to 3, the trigger slope is positive and the recorder gap is 2. Both examples are the same data, but one instance collected and triggered on the odd data. The other example collected and triggered on the even data.



2. You can miss triggers, whose duration is less than N samples, where N is the value of REC.GAP. This is because the trigger is only evaluated every N samples.

A workaround for the above effects is available by setting the recorder trigger position to zero (REC.TRIGPOS 0). This eliminates conflicts between pretrigger and post-trigger timing and will guarantee trigger evaluation every sample, eliminating the cases above.

16.2.2.6 Trigger Slope

Trigger Slope specifies whether you trigger on a positive or negative change in the trigger source. The effect of the trigger slope is different for trigger type Boolean and On Next Signal modes.

Boolean Trigger Type

When using Boolean type:

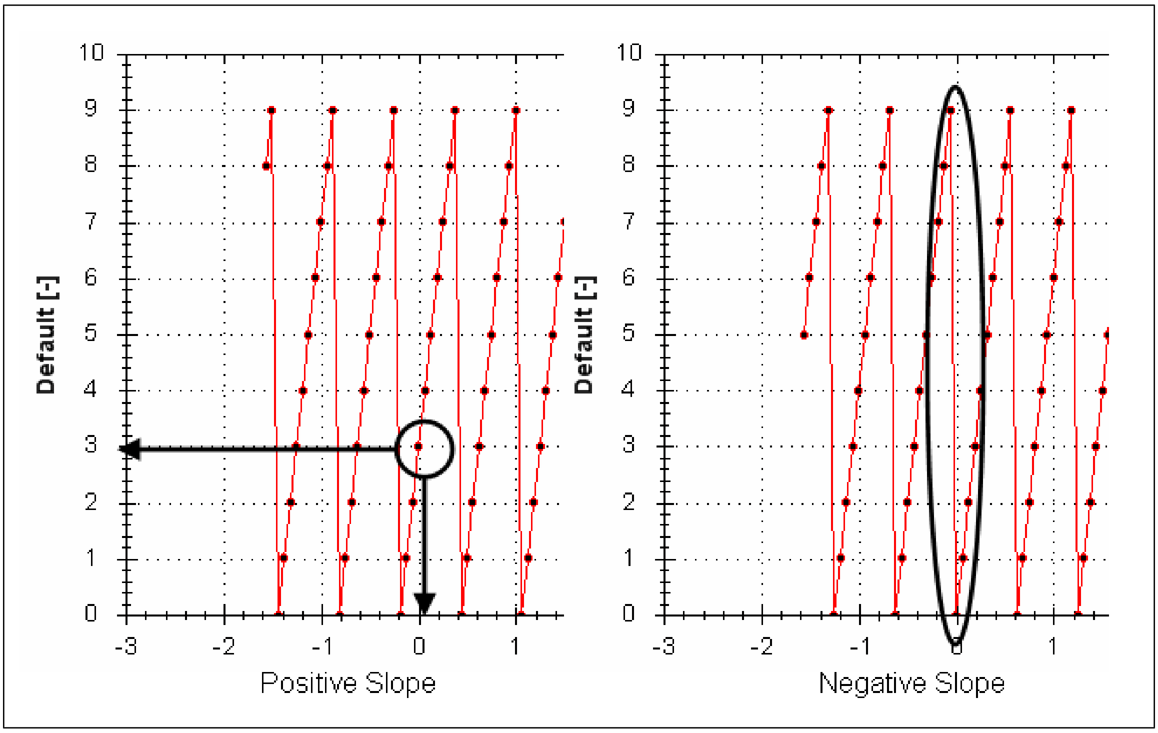
- A positive slope will trigger when the trigger source is 1
- A negative slope will trigger when the trigger source is 0

The boolean trigger type is a state trigger. There is no need to transition from 0 to 1 to trigger with the positive slope. If the trigger source is 1 from the start, the positive slope will immediately trigger.

On Next Signal Trigger Type

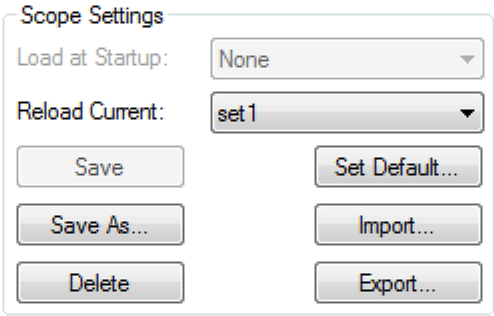
With "On Next Signal" trigger type allows you to specify if the recorder should trigger when the signal crosses the trigger level in the positive or negative direction. The signal only needs to reach the trigger level; it does not need to pass the trigger level.

In the examples below, the trigger value is set to 3 (REC.TRIGVAL 3.000). You can see that with positive slope, the trigger occurs exactly when the signal transitions from 2 to 3, because it reached 3. The negative slope case triggers when the signal transitions from 9 to 0, because it crossed 3 on the way.



16.3 Scope Settings

Scope settings are used to store and retrieve the scope parameters.You can save multiple settings, called "presets", under different names. You can save, delete, import, or export the presets. The settings are stored in WorkBench project file (default.wbproj) and settings are common to all the drives in WorkBench.

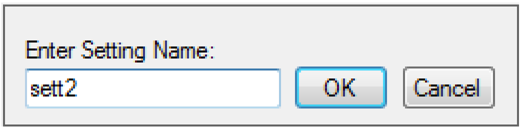


16.3.1 Load a setting (preset) to Scope screen

In Scope Settings section, the existing presets are listed in the **Select Setting** box. To load a setting to the scope screen, select the desired preset from the **Select Setting** list.

16.3.2 Create a new preset

1. Modify any scope parameters.
2. Select **Save and Print** tab.
3. Click **Save current settings As**. The following dialog is displayed:



4. Enter the setting name and click **OK**. The current settings are saved as a preset with the given name and displayed in the list.

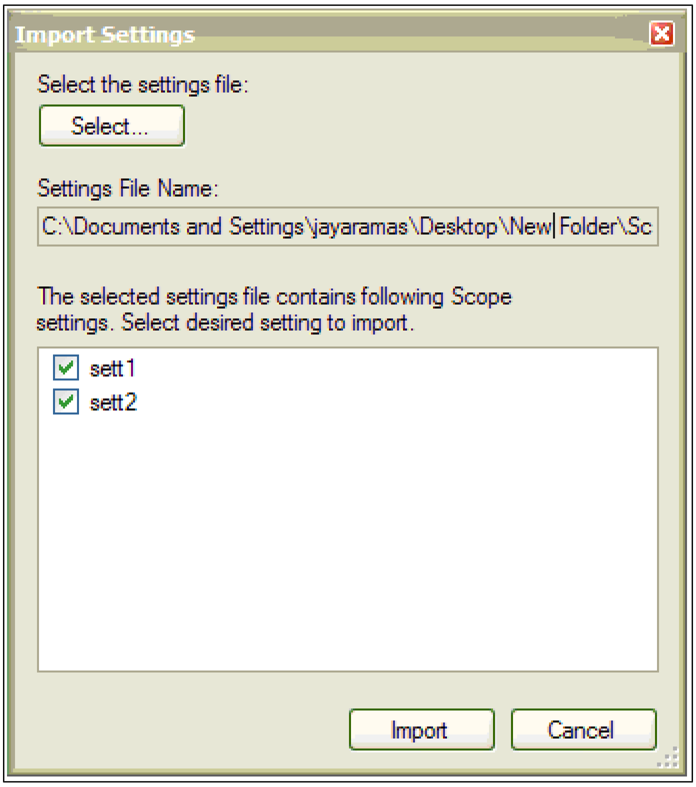
16.3.3 Save or delete preset

Save saves any modification to the open preset. **Delete** deletes the open preset.

16.3.4 Import preset

Import the presets contained in the selected settings file as follows:

1. Click on Import button following dialog will be displayed.

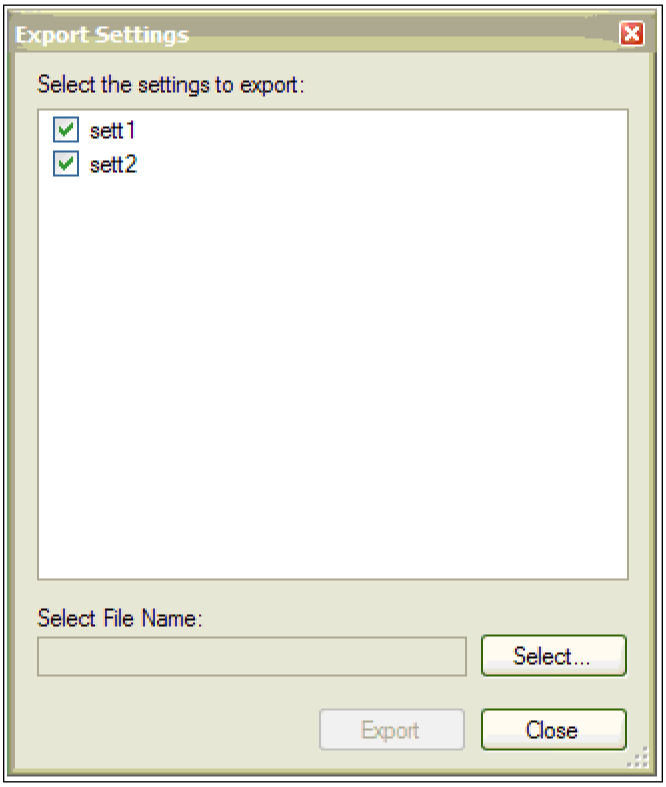


2. Select the settings file by clicking “Select…” button.
3. All the scope presets will be displayed contained in the selected settings file.
4. Select/Deselect the presets and then click on Import.
5. If preset name already exists in application the confirmation message will be shown to user to replace it or to ignore.

16.3.5 Export preset

Export a preset to a file as follows:

1. Click **Export** and the following dialog is displayed:



2. The existing presets are displayed and user can select/deselect the preset to export.
3. Select the file name to export.
4. Click **Export** to export the selected presets to a file.

16.3.6 Scope axis scaling and zooming

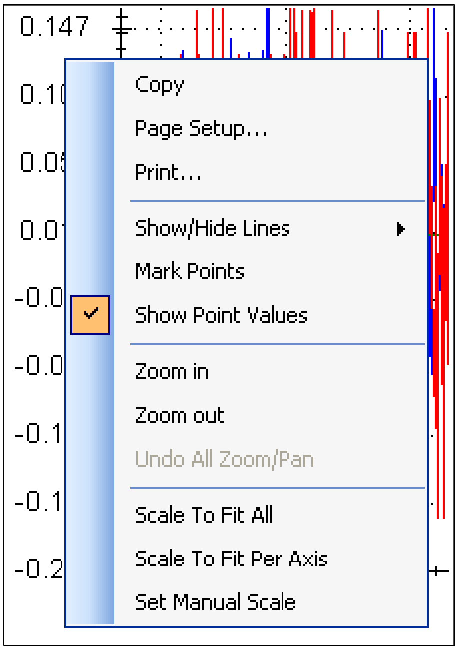
The scope provides two mechanisms to allow the you to visualize the data:

- Scaling: you can choose the scale for the different axes.
- Zooming: you can choose a particular portion of the scope that you want to observe more in details, and then come back to previous scaling.

Two different scaling modes are provided on each axis:

- Manual: you can determine the minimum and maximum value of the axis (X or Y axis).
- Scale to fit: the program will compute a scale for this axis that will display all the curves bound to it (X or Y axis).

These functionalities are accessible through the contextual menu when right-clicking in the axis zone. A simple left-click in the axis zone will provide the manual range functionality. A supplementary functionality allows you to perform a scale to fit on all axes is also available, which allows a good overview.

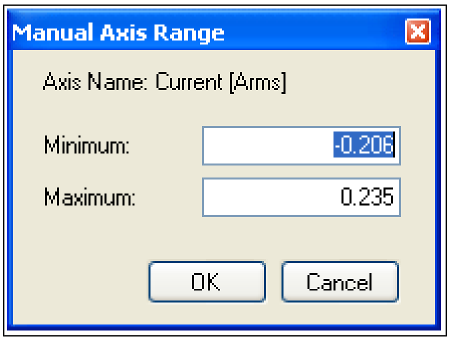


The zoom functionality allows you to navigate in a portion of the graphic. When you reset the zoom, the initial scales are shown.

In the display tab, when "Remember Axis Scale" is set, the scales of the axes are kept between two sequential recordings. You can fine tune the scale to visualize a particular behavior and record a second time and see the same behaviour without having to redo all the tuning. When not checked, a scale to fit all will be performed after each record. This setting is reseted when exiting WorkBench and should be explicitly set at next startup.

16.3.7 Manual range per axis

Click **Manual Y Axis** to open a dialog box to set the range for the axis. Enter the Y-axis minimum value and Y-axis maximum value. Click **OK** to reset the Y-axis to new range.



16.3.8 Unit display on Y axis

The unit on the Y-axis is displayed if all scope signals units are identical for that Y-axis. If different units apply to different signals, the units are displayed as [-]. For example, if the velocity Y-axis has signals VL.FB and IL.CMD, then the unit displayed is [-], since the units for these parameters are different. If IL.CMD is hidden, then the correct unit for VL.FB, rpm, is displayed.

Related Parameters:

BODE Parameters

17 Using Parameters and the Terminal Screen

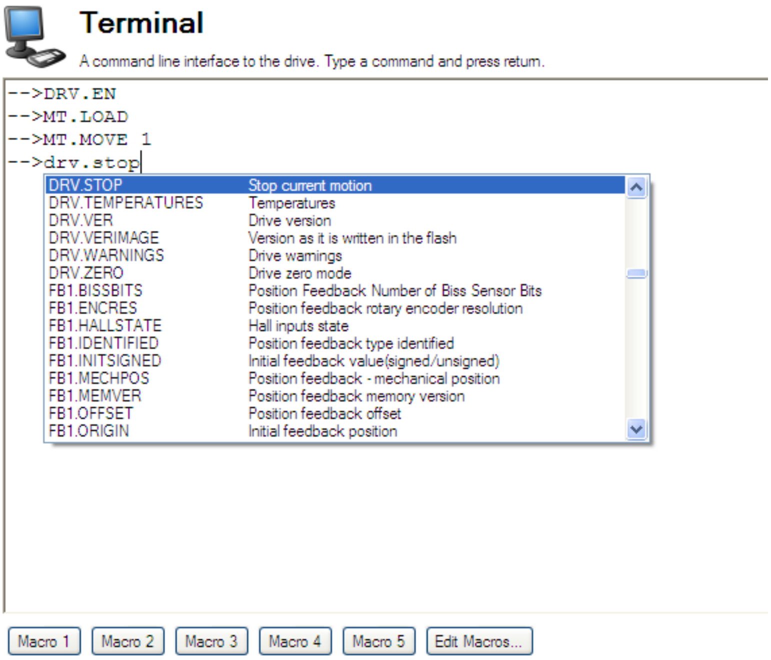
17.1 Terminal

17.1.1 Overview

The terminal mode provides a quick and easy way to issue commands to the drive directly. Typically used by "power users" who are familiar with the command set, the terminal mode can help in setup, troubleshooting, and other diagnostic actions. When using the terminal mode, WorkBench shows the parameter and command set in a popup view and uses an autocomplete tool to help you select the proper parameter or command. Right-click in the command entry area to open a popup menu for editing commands and for clearing the screen. The terminal also provides a macro editor that allows a series of commands to be executed via a single command (called a macro). Macros are useful when you must frequently execute a sequence of commands.

17.1.2 Using the Terminal

Click Terminal in the navigation tree to issue parameters and commands in the terminal mode. You can enter parameters and commands at the prompt as shown in this example:



The terminal supports the following keyboard shortcuts:

Keyboard Shortcut	Description
F2	Executes the last command.
Up Arrow	Gets the previous command from the command history.
Down Arrow	Gets the next command from the command history.
CTRL+J	Shows the list of commands that the drive supports.
CTRL+L	Opens the Parameter Load/Save view.
ESC	Hides the command list if command list is open. Clears the line if command list is not open.
Enter (Return)	Executes the current command. This command sends the text you have typed to the drive and then prints the text the drive returns on the next line.

17.1.3 Macros

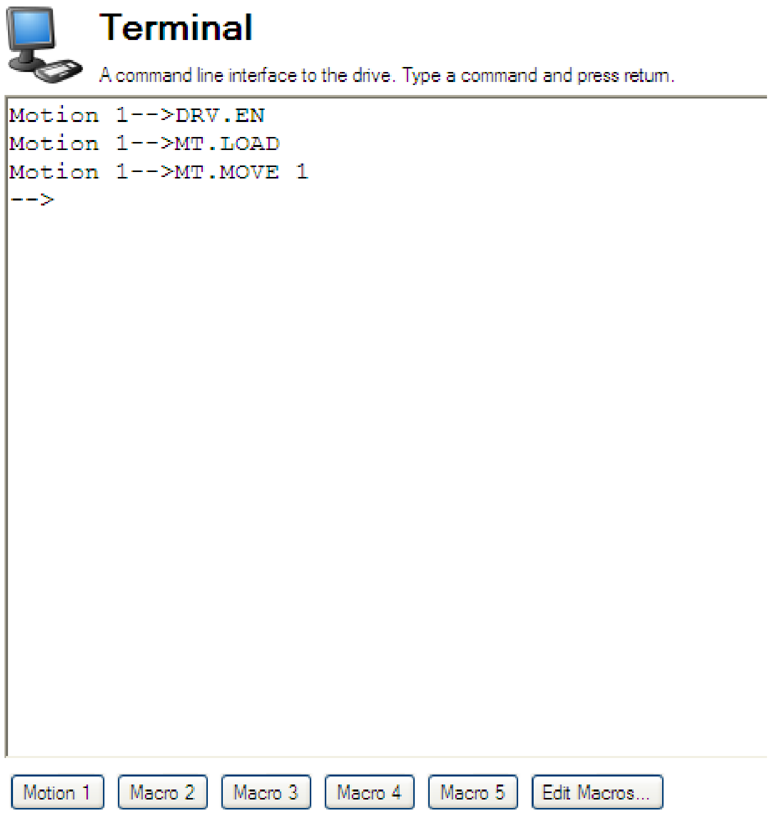
Macros are a short sequence of instructions that can be sent to the drive using a single button. You can create up to five macros within the terminal mode using the macro editor. Each of the macros can be given a name and will appear as a button below the Terminal screen area. When you select the button, the command set tied to that macro will appear in the Terminal area and the commands will be executed. If there are commands which are not entered correctly, the terminal screen area will indicate the errors.

You can access macros and the macro editor from the buttons are located at the bottom of the terminal screen. Click a macro button to execute the associated macro. The **Edit Macros** button opens the macro editor used to create and edit macros. You can also assign custom names to the macro buttons with this editor.

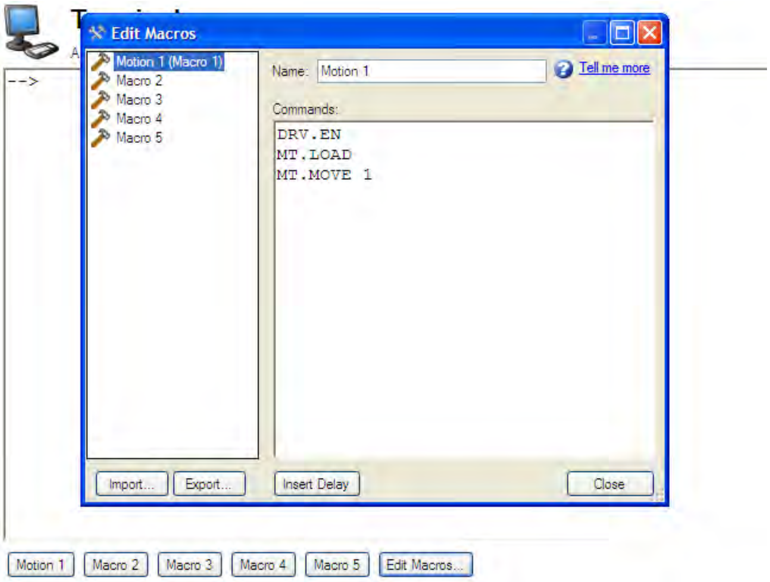
17.1.3.1 Creating a Macro from Terminal commands

You can create a macro from a sequence of terminal commands as follows:

1. Enter the sequence of commands.



2. Copy the sequence of commands, then click **Edit Macro**. Select a macro from the tree on the left, then paste the sequence of commands into the Commands area of the Edit Macros window.



3. Select **Save** to save your macro.

17.1.3.2 Macro Editor

The macro editor allows you to create and modify up to five macros.WorkBench automatically saves the macros that you create. If you exit WorkBench and then start WorkBench again, the macros you defined will still be available.

To create or edit a macro from the editor, open the **Terminal** screen and click on **Edit Macros** (located at the bottom of the screen). Select the macro you wish to edit from the tree on the left, then use the features described below to build the macro. You can add comments in the macro after the ";" symbol.

Button or Dialog Box	Description
Name	Allows you to give each macro a unique name. This name will be shown on the button in the terminal view.
Commands	Displays the commands that are sent to the drive when you use this macro. The response from the drive is displayed in the terminal.
Import	Overwrites the selected macro with the contents of a macro file exported from another computer.
Export	Sends the selected macro to a text file to that you can import into WorkBench running on another computer.
Insert Delay	Inserts a step into the macro that causes a delay for a specified number of milliseconds before continuing. A line that starts with #delay 5000 will pause the execution of the macro for 5000 milliseconds.
Close	Closes this window and returns to the terminal view.

17.2 Viewing Parameters

You can view and edit parameters in the **Parameters** screen. You can view and write parameters in the **Terminal** screen.

17.3 Parameter List

This screen displays a list of the current values of all the parameters that the drive supports. You can sort some of the rows by clicking the column headers.

Button or Dialog Box	Description
Refresh	Reads all the parameters from the drive and update the contents of the table.
Print	Sends the data that you see on the screen to the printer.
eMail	Opens an email message and attaches a comma separated file to the email message.
More/Less	Adds two more columns to the table with the range and default values for each parameter.

17.4 Parameter Load/Save

To copy a configuration (all the drive parameters that are stored in the drives nonvolatile memory) from one drive to another, click the **Save to File** button on the first drive and then use the **Load from File** on the second drive. If you wish the second drive to keep these new parameters after the drive is turned off, then you can save the parameters to the nonvolatile memory with **Save To Drive**.

Button or Dialog Box	Description
Save To File	Copies all the drive parameters and creates a file.
Load From Drive	Sets all the drive parameters within the drive to the values contained within the file you select.
Save to Drive	Saves all drive parameters into the nonvolatile memory of the drive. Each time the drive powers on, it will start with these saved parameters.
Default	Returns all the drive parameters back to their default values. Any changes you have made are lost.

17.5 Parameter Comparer

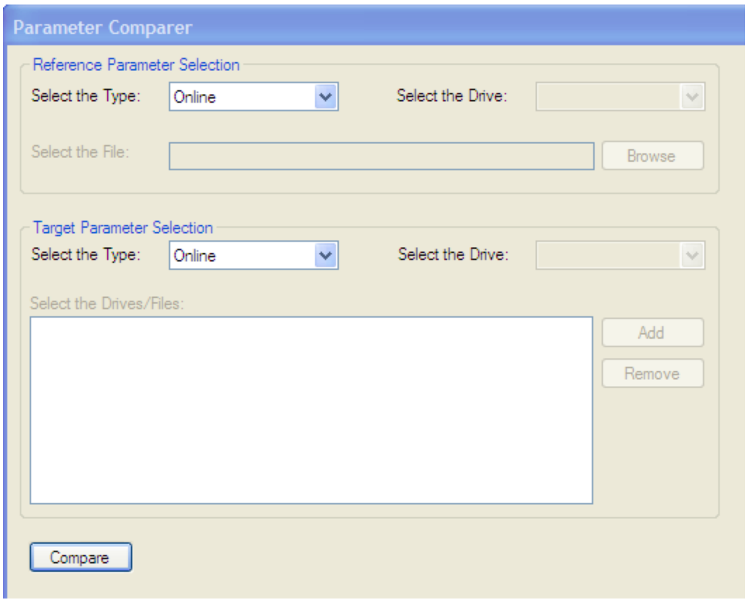
The **Parameter Comparer** tool is used to compare parameters from different drives and to compare motion tasks of different drives. You can select this tool from the menu bar, **Tools**> **Parameter Comparer**.

Parameters can be compared between the following:

- Drives (Online / Offline)
- Drives and Files
- File and Drives
- File and Files

The **Parameter Comparer** screen includes the three sections shown below:

- Reference Parameter Selection
- Target Parameter Selection
- Display Comparison



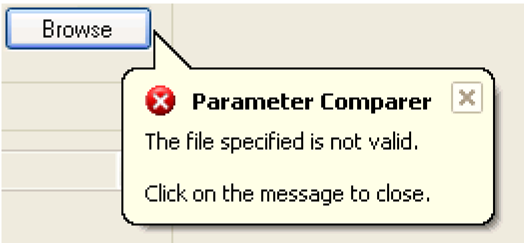
17.5.1 Reference Parameter Selection

You can select the drive type (Online/Offline) and file to compare in the **Reference Parameter Selection**area.

When a drive type (Online/Offline) is selected , the drives connected to the WorkBench are displayed in the **Select the drive** box. By default, the first drive is selected. If no drives are connected, then the **Select the drive**box will be in disabled state.

If **File Selection** is chosen from the **Select the Type** box, then the **Select the drive** box is disabled and the **Select the File** box and **Browse** button become enabled for the user to browse the parameter file (*.akd).

A warning message is displayed if you select an incorrect file, as shown below:

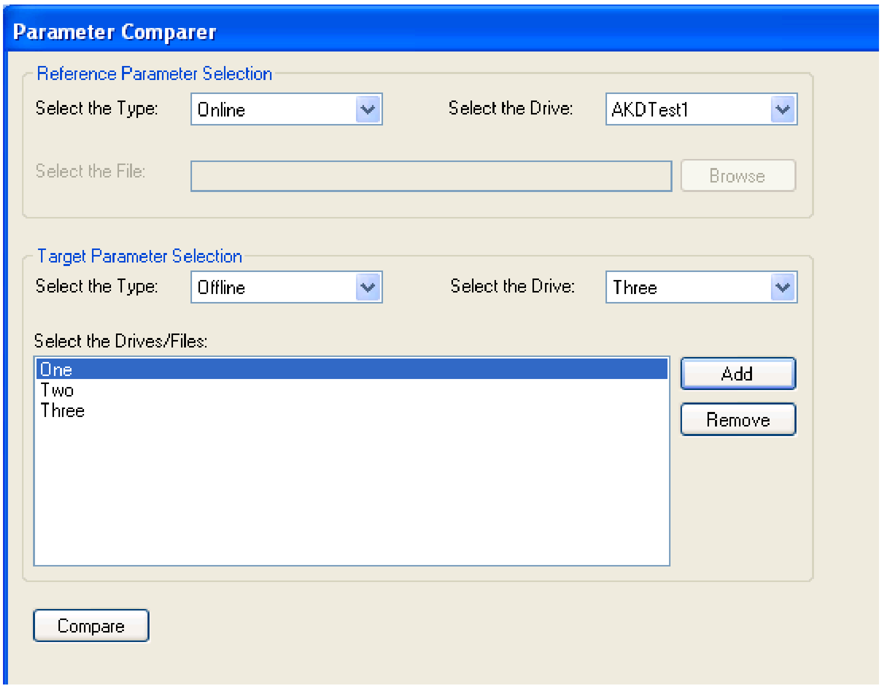


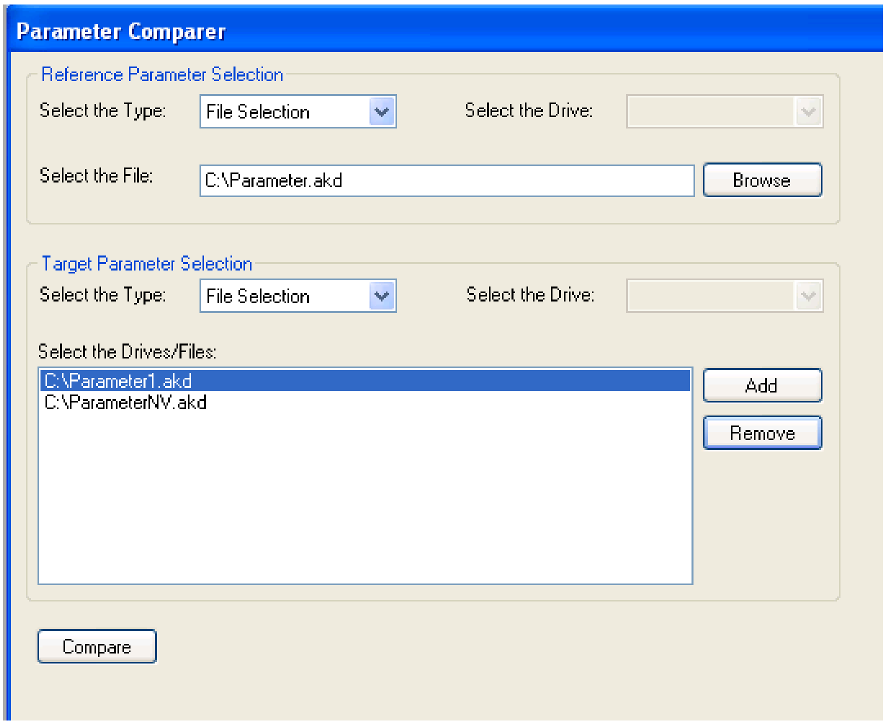
17.5.2 Target Parameter Selection

Target Parameter Selection includes the following:

- **Select the Type** box to select the type (drive (online/offline) and File).
- **Select the Drive** box to select the drives connected to the WorkBench.
- **Select the Drives/Files** box to load files or drives which are to be compared.
- **Add** button to add Drives/Files selected to the list box.
- **Remove** button to remove the selected item from the list box.

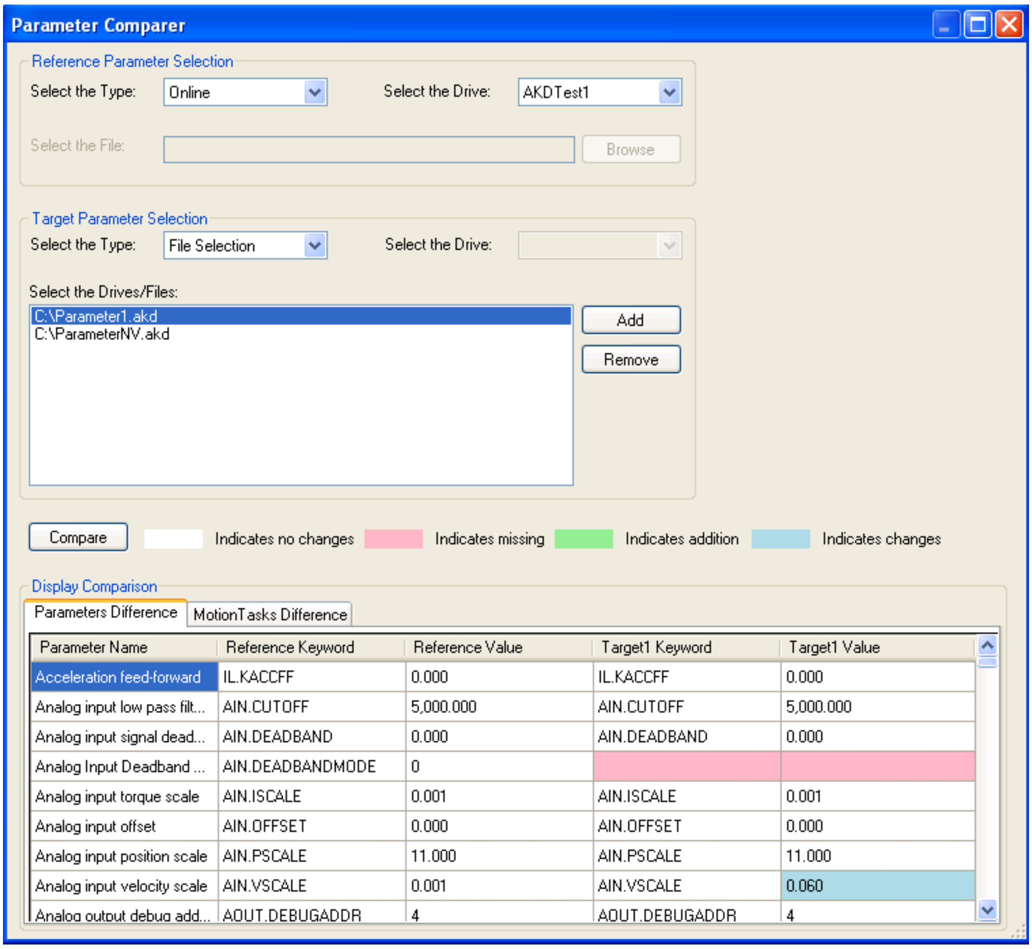
Many target drives/files parameters can be compared with one reference drive/file parameters as shown below.





17.5.3 Display the comparison

Clicking **Compare**displays the comparison shown below:



Display Comparison contains two sections:

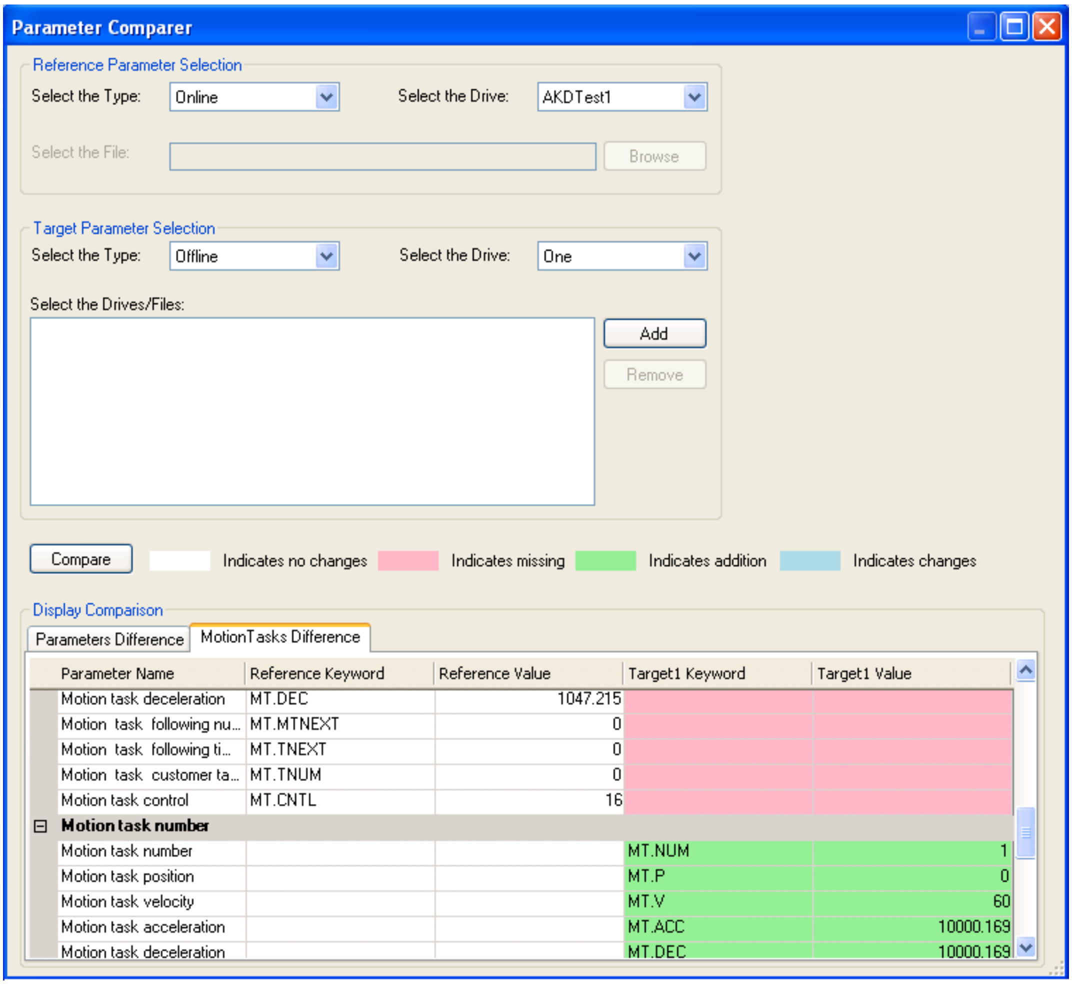
- Parameters Difference
- Motion Tasks Difference

Each of these sections displays:

- Parameter name
- Reference keyword
- Reference value
- Target keyword
- Target value

17.5.4 Motion Task Comparison

Motion Task Comparison is displayed as shown below:



A separate section is shown for each motion task.

Motion Tasks Difference and **Parameters Difference**are color coded as shown in the table below.

	Keyword exists in the reference file /drive and does not exists in the Target files/drives.
	Parameter does not exist in reference file/drive and exists in Target files/drives.
	Keyword exists in both reference and target files/drives, and the value or the parameter keyword changes.
	Reference and target parameter do not vary.

If you click the **Compare** button without selecting the drive or file, you will receive a message prompting you to make a selection.

Summary of Parameters and Commands

This table contains an alphabetical list of parameters and commands, with a brief description for each. The parameter name and description are linked to the parameter tables. The description field also notes if a parameter is not active in all opmodes. Generally speaking, all parameters and commands are active in all opmodes, with the following exceptions:

Parameter or Command	Active in Opmodes
GEAR (all parameters and commands)	2 (position) only

Parameter or Command	Active in Opmodes
HOME (all parameters and commands)	2 (position) only
MT (all parameters and commands)	2 (position) only
SM.I1, SM.I	0 (torque) only
SM.V1, SM.V2	1 (velocity) only
SM.VPM1, SM.VPM2	2 (position) only
VL (all parameters and commands)	1 (velocity) and 2 (position) only

Parameter or Command	Type	Description
Analog Input (AIN)		
AIN.CUTOFF	NV	Sets the analog input low-pass filter cutoff frequency.
AIN.DEADBAND	NV	Sets the analog input signal deadband.
AIN.DEADBANDMODE	NV	Sets the analog input deadband mode.
AIN.ISCALE	NV	Sets the analog current scale factor.
AIN.OFFSET	NV	Sets the analog input offset.
AIN.PSCALE	NV	Sets the analog position scale factor.
AIN.VALUE	R/O	Reads the value of the analog input signal.
AIN.VSCALE	NV	Sets analog velocity scale factor.
AIN.ZERO	Command	Zeroes the analog input signal.
Analog Input/Output (AIO)		
AIO.ISCALE	NV	Sets the analog current scale factor.
AIO.VSCALE	NV	Sets velocity scale factor.
AIO.PSCALE	NV	Sets position scale factor.
Analog Output (AOUT)		
AOUT.CUTOFF	NV	Sets the analog output low-pass filter cutoff frequency.
AOUT.DEBUGADDR	NV	Sets the memory address to debug.
AOUT.DEBUGSCALE	NV	Sets the scale to be used for debug.
AOUT.ISCALE	NV	Sets the analog current scale factor.
AOUT.MODE	NV	Sets the analog output mode.
AOUT.OFFSET	NV	Sets the analog input offset.
AOUT.PSCALE	NV	Sets the analog position scale factor.
AOUT.VALUE	NV	Reads the analog output value.
AOUT.VALUEU	R/W	Sets the analog output value.
AOUT.VSCALE	NV	Sets velocity scale factor for analog output.
Bode plot (BODE)		
BODE.EXCITEGAP	R/W	Controls how often the excitation is updated.
BODE.FREQ	R/W	Sets the frequency of the sine excitation source.
BODE.IAMP	R/W	Sets current command value used during the Bode procedure.
BODE.IFLIMIT	R/W	Sets the current fault duration limit in seconds for the BODE.MODE 5 stability test.
BODE.IFTHRESH	R/W	Sets the current fault threshold for the BODE.MODE 5 stability test.
BODE.INJECTPOINT	R/W	Sets whether the excitation uses current or velocity excitation type.
BODE.MODE	R/W	Sets the mode of the excitation.
BODE.MODETIMER	R/W	Sets the watchdog timer of the excitation.

Parameter or Command	Type	Description
BODE.PRBDEPTH	R/W	Sets the length of the PRB signal before it repeats.
BODE.VAMP	R/W	Sets the amplitude of the excitation when in velocity mode.
BODE.VFLIMIT	R/W	Sets the velocity fault duration limit (seconds) for the BODE.MODE 5 stability test
BODE.VFTHRESH	R/W	Sets the current fault threshold for the BODE.MODE 5 stability test.
Capture (CAP)		
CAP0.EDGE, CAP1.EDGE	NV	Selects the capture edge.
CAP0.EN, CAP1.EN	NV	Enables or disables the related capture engine.
CAP0.EVENT, CAP1.EVENT	NV	Controls the precondition logic.
CAP0.FILTER, CAP1.FILTER	R/W	Controls the precondition logic.
CAP0.MODE, CAP1.MODE	NV	Selects the captured value.
CAP0.PLFB, CAP1.PLFB	R/O	Reads captured position value.
CAP0.PREEDGE, CAP1.PREEDGE	NV	Selects the capture precondition edge.
CAP0.PREFILTER, CAP1.PREFILTER	NV	Sets the filter for the precondition input source.
CAP0.PRESELECT, CAP1.PRESELECT	NV	Sets the precondition trigger.
CAP0.STATE, CAP1.STATE	R/O	Indicates whether or not trigger source was captured.
CAP0.T, CAP1.T	R/O	Reads time capture (if time capture was configured).
CAP0.TRIGGER, CAP1.TRIGGER	NV	Specifies the trigger source for the position capture.
Controlled Stop (CS)		
CS.DEC	NV	Sets the deceleration value for the controlled stop process.
CS.STATE	NV	Returns the internal status of the controlled stop process.
CS.TO	NV	Sets the time value for the drive velocity to be within CS.VTHRESH.
CS.VTHRESH	NV	Sets the velocity threshold for the controlled stop.
Digital Input (DIN)		
DIN.HCMD1 TO DIN.HCMD4	NV	A buffer of commands to be used in digital input "command buffer" mode.
DIN.LCMD1 to DIN.LCMD4	NV	A buffer of commands to be used in digital input "command buffer" mode.
DIN.ROTARY	R/O	Reads the rotary knob value.
DIN.STATES	R/O	Reads the digital input states.
DIN1.FILTER TO DIN7.FILTER	R/W	Filter mode for digital inputs 1 to 7.
DIO9.INV to DIO11.INV	R/W	DIO9.INV to DIO11.INV
DIN1.MODE TO DIN7.MODE	NV	Sets the digital input modes.
DIN1.PARAM TO DIN7.PARAM	R/W	Sets a value used as an extra parameter for digital inputs nodes.

Parameter or Command	Type	Description
DIN1.STATE TO DIN7.STATE	R/O	Reads a specific digital input state.
Digital Output (DOUT)		
DOUT.CTRL	NV	Sets the source of digital outputs (firmware or fieldbus).
DOUT.RELAYMODE	R/W	Indicates faults relay mode.
DOUT.STATES	R/O	Reads the state of the two digital outputs.
DOUT1.MODE to DOUT17.MODE	NV	Sets the digital output mode.
DOUT1.PARAM AND DOUT2.PARAM	NV	Sets extra parameters for the digital outputs.
DOUT1.STATE AND DOUT2.STATE	R/O	Reads the digital output state.
DOUT1.STATEU AND DOUT2.STATEU	R/W	Sets the state of the digital output node.
Drive (DRV)		
DRV.ACC	NV	Describes the acceleration ramp for the velocity central loop.
DRV.ACTIVE	R/O	Reads the enable status of an axis.
DRV.BLINKDISPLAY	Command	Causes the display to blink for 10 seconds.
DRV.CLRFAULTHIST	Command	Clears the fault history log in the NV.
DRV.CLRFAULTS	Command	Tries to clear all active faults in the drive.
DRV.CMDDELAY	R/W	Issues a delay before next command is executed.
DRV.CMDSOURCE	NV	Sets the command source (service, fieldbus, analog input, gearing, digital, or Bode).
DRV.CRASHDUMP	Command	Retrieves diagnostic information after the drive crashes.
DRV.DBILIMIT	NV	Sets the maximum amplitude of the current for dynamic braking.
DRV.DEC	NV	Sets the deceleration value for the velocity loop.
DRV.DIFFVAR	R/O	Lists all parameters which differ from their default value.
DRV.DIR	R/W	Changes drive direction.
DRV.DIS	Command	Disables the axis (software).
DRV.DISMODE	NV	Selects among disable immediately or stop and then disable options.
DRV.DISSOURCES	R/O	Returns the possible reason for a drive disable.
DRV.DISTO	R/W	Sets the emergency timeout
DRV.EMUEDIR	R/W	Sets the direction of the emulated encoder output (EEO) signal.
DRV.EMUEMODE	R/W	Sets the mode of the emulated encoder output (EEO) connector.
DRV.EMUEMTURN	R/W	Defines the location of the index pulse on the EEO (emulated encoder output) when DRV.EMUEMODE=2.
DRV.EMUEPULSEWIDTH		Sets the encoder output pulse width for modes 6 to 7.
DRV.EMUERES	R/W	Sets the resolution of the EEO (emulated encoder output).
DRV.EMUEZOFFSET	R/W	Sets the location of the EEO (emulated encoder output) index pulse (when DRV.EMUEMODE=1).
DRV.EN	Command	Enables the axis (software).
DRV.ENDEFAULT	R/W	Sets the default state of the software enable.
DRV.FAULTHIST	R/O	Reads the last 10 faults from NV memory.

Parameter or Command	Type	Description
DRV.FAULTS	R/O	Reads the active faults.
DRV.HANDWHEEL	R/O	Reads the EEO input value.
DRV.HELP	R/O	Reads the minimum, maximum, and default values for a specific parameter or command.
DRV.HELPALL	R/O	Retrieves the minimum, maximum, default, and actual values for all available parameters and commands.
DRV.HWENMODE	R/W	Selects the action that the hardware enable digital input will perform.
DRV.ICONT	R/O	Reads the continuous rated current value.
DRV.INFO	R/O	Reads general information about the drive.
DRV.IPEAK	R/O	Reads the peak rated current value.
DRV.IZERO	R/W	Sets the current that will be used during the DRV.ZERO procedure.
DRV.LIST	R/O	Reads the list of available parameters and commands.
DRV.LOGICVOLTS		Reads the logic voltages.
DRV.NAME	NV	Sets and reads the name of the drive.
DRV.NVCHECK	R/O	NV Parameter Checksum
DRV.NVLIST	R/O	Lists the NV parameters and values from the RAM.
DRV.NVLOAD	W/O	Loads all data from the NV memory of the drive into the RAM parameters.
DRV.NVSAVE	Command	Saves the drive parameters from the RAM to the NV memory.
DRV.ONTIME	R/O	Returns how long the drive has been running since last power up.
DRV.OPMODE	NV	Sets the drive operation mode (current, velocity, or position).
DRV.READFORMAT	R/W	Sets the value returned to either decimal or hexadecimal.
DRV.RSTVAR	Command	Sets default values in the drive without re-booting the drive and without resetting the NV memory.
DRV.RUNTIME	R/O	Returns how long the drive has been running since first activated.
DRV.SETUPREQBITS	R/O	Reads the bitwise set status of parameters that must be set before the drive can be enabled
DRV.SETUPREQLIST	R/O	Reads the list of parameters that must be set before the drive can be enabled.
DRV.STOP	Command	This command stops all drive motion.
DRV.TEMPERATURES	R/O	Reads the temperature of drive components.
DRV.TYPE	R/O	Selects the operational fieldbus on CC drive models.
DRV.VER	R/O	Reads the drive version.
DRV.VERIMAGE	R/O	Returns the version data from each image.
DRV.WARNINGS	R/O	Reads the active warnings.
DRV.ZERO	R/W	Sets the zero mode. The procedure is activated when the drive is enabled.
EtherNet/IP (EIP)		
EIP.POSUNIT	R/W	Unit scaling for Position values over EtherNet/IP.
EIP.PROFUNIT	R/W	Unit scaling for Velocity and Acceleration values over EtherNet/IP.
Feedback 1 (FB1)		

Parameter or Command	Type	Description
FB1.BISSBITS	NV	Specifies the number of Biss Sensor (Position) Bits for the BiSS Mode C encoder in use.
FB1.ENCRES	NV	Sets the resolution of the motor encoder.
FB1.HALLSTATE	R/O	Reads the Hall switch values (encoder feedback
FB1.HALLSTATEU	R/O	Reads the state of Hall switch U.
FB1.HALLSTATEV	R/O	Reads the state of Hall switch V.
FB1.HALLSTATEW	R/O	Reads the state of Hall switch W.
FB1.IDENTIFIED	R/O	Reads the type of feedback device used by the drive/motor.
FB1.INITSIGNED	NV	Sets initial feedback value as signed or unsigned.
FB1.MECHPOS	R/O	Reads the mechanical position.
FB1.MEMVER	R/O	Returns the memory feedback version.
FB1.OFFSET	NV	Sets position feedback offset.
FB1.ORIGIN	NV	Adds to the initial feedback position.
FB1.PFIND	R/W	A procedure that allows the user to find the commutation angle for encoder feedback, which has no halls.
FB1.PFINDCMDU	R/W	Current value used during the phase finding procedure (PFB.PFIND=1)
FB1.POLES	R/O	Reads the number of feedback poles.
FB1.PSCALE	R/W	Sets position scaling value for fieldbus transferred position objects.
FB1.RESKTR	NV	Sets the resolver nominal transformation ratio.
FB1.RESREFPHASE	NV	Sets the electrical degrees of phase lag in the resolver.
FB1.SELECT	NV	Sets user entered type or identified type (–1).
FB1.TRACKINGCAL	NV	Controls tracking calibration algorithm.
Feedback 2 (FB2)		
FB2.ENCRES	NV	Sets the secondary feedback (FB2) resolution.
FB2.MODE	R/W	Sets the mode for the second feedback inputs, EEO connector (X9) and high speed opto inputs (pins 9 and 10 on X7).
FB2.SOURCE	R/W	Sets the source for the second feedback input. Choices are the EEO connectors (X9) which are RS485 inputs, or the X7 connector's high speed opto inputs (pins 9 and 10).
Feedback 3 (FB3)		
FB3.MODE	NV	Selects the type of feedback connected to X9.
FB3.P	RO	Reads position from the tertiary feedback.
Fieldbus (FBUS)		
FBUS.PARAM1 TO FBUS.PARAM20	NV	Set fieldbus specific meanings.
FBUS.PLLSTATE	R/O	Returns the status of the PLL
FBUS.PLLTHRESH	NV	Sets number of successful synchronized cycles needed to lock the PLL.
FBUS.SAMPLEPERIOD	NV	Sets fieldbus sample period.
FBUS.SYNCACT	R/O	Reads actual distance from the desired sync distance.
FBUS.SYNCDIST	NV	Sets time target for synchronization.
FBUS.SYNCWND	NV	Sets symmetrically arranged window around the desired sync distance.
FBUS.TYPE	R/O	Shows the active fieldbus type.
Gearing (GEAR)		

Parameter or Command	Type	Description
GEAR.ACCMAX	R/W	Sets the maximum allowed acceleration value; active in opmode 2 (position) only.
GEAR.DECMAX	R/W	Sets the maximum allowed deceleration value; active in opmode 2 (position) only.
GEAR.IN	R/W	Sets the denominator of the electronic gearing ratio; active in opmode 2 (position) only.
GEAR.MODE	R/W	Selects electronic gearing mode; active in opmode 2 (position) only.
GEAR.MOVE	Command	Starts the electronic gearing; active in opmode 2 (position) only.
GEAR.OUT	R/W	Sets the numerator of the electronic gearing ratio; active in opmode 2 (position) only.
GEAR.VMAX	R/W	Reads the maximum allowed velocity value; active in opmode 2 (position) only.
Homing (HOME)		
HOME.ACC	R/W	Sets homing acceleration; active in opmode 2 (position) only.
HOME.AUTOMOVE	R/W	Sets homing auto move flag.
HOME.DEC	R/W	Sets homing deceleration; active in opmode 2 (position) only.
HOME.DIR	NV	Sets homing direction; active in opmode 2 (position) only.
HOME.DIST	R/W	Sets homing distance; active in opmode 2 (position) only.
HOME.FEEDRATE	R/W	Sets homing velocity factor; active in opmode 2 (position) only.
HOME.IPEAK	R/W	Sets the current limit during homing procedure to a mechanical stop; active in opmode 2 (position) only.
HOME.MODE	R/W	Selects the homing mode; active in opmode 2 (position) only.
HOME.MOVE	Command	Starts a homing procedure; active in opmode 2 (position) only.
HOME.P	R/W	Sets home position; active in opmode 2 (position) only.
HOME.PERRTHRESH	R/W	Sets the position lag threshold; active in opmode 2 (position) only.
HOME.REQUIRE	NV	Defines if the axis must be homed before a motion task can be executed.
HOME.SET	Command	Immediately sets the home position; active in opmode 2 (position) only.
HOME.V	R/W	Sets homing velocity; active in opmode 2 (position) only.
Hardware Limit Switch (HWLS)		
HWLS.NEGSTATE	R/O	Reads the status of the negative hardware limit switch.
HWLS.POSSTATE	R/O	Reads the status of the positive hardware limit switch.
Current Loop (IL)		
IL.BUSFF	R/O	Displays the current feedforward value injected by the field-bus.
IL.CMD	R/O	Reads the value of the q-component current controller inside the FPGA.
IL.CMDU	R/W	Sets the user current command.
IL.DIFOLD	R/O	Reads the drive foldback current limit.
IL.FB	R/O	Reads the actual value of the d-component current.
IL.FF	R/O	Displays the current loop overall feedforward value.

Parameter or Command	Type	Description
IL.FOLDFTHRESH	NV	Reads the foldback fault level.
IL.FOLDFTHRESHU	NV	Sets the user value for the foldback fault level.
IL.FOLDWTHRESH	NV	Sets the foldback warning level.
IL.IFOLD	R/O	Reads the overall foldback current limit.
IL.IUFB	R/O	Reads the sigma-delta measured current in the u-winding of the motor.
IL.KACCFF	R/W	Sets current loop acceleration feedforward gain value
IL.KBUSFF	R/W	Current loops fieldbus injected feed-forward gain
IL.KP	NV	Sets the proportional gain of the q-component of the PI regulator.
IL.KPDRATIO	NV	Sets the proportional gain of the d-component current PI-regulator as a percentage of IL.KP
IL.KPLOOKUPINDEX	R/W	Sets the index into the Current Loop Gain Scheduling Table.
IL.KPLOOKUPVALUE	R/W	Sets the value of the current loop gain scheduling index.
IL.KPLOOKUPVALUES	R/W	Gets the Current Loop Gain Scheduling Table.
IL.KVFF	R/W	Current loop velocity feed-forward gain.
IL.LIMITN	NV	Sets the negative user (application-specific) current limit.
IL.LIMITP	NV	Sets the positive user (application-specific) current limit.
IL.MFOLDD	NV	Sets the motor foldback maximum time at motor peak current.
IL.MFOLDR	R/O	Sets the motor foldback recovery time.
IL.MFOLDT	NV	Sets the motor foldback time constant of the exponential current drop (foldback).
IL.MI2T	R/O	Motor I2t load
IL.MI2TWTHRESH	NV	Motor I2t load warning threshold
IL.MIFOLD	R/O	Sets the motor foldback current limit.
IL.MIMODE	NV	Motor protection mode
IL.OFFSET	RW	A constant current command added to compensate for gravity.
IL.VCMD	R/O	Sets the output of the q-component PI regulator.
IL.VUFB	R/O	Reads the measured voltage on the u-winding of the motor.
IL.VVFB	R/O	Reads the measured voltage on the v-winding of the motor.
IP (Internet Protocol)Parameters		
IP.ADDRESS	IP Address	Gets/Sets the IP address of the drive
IP.GATEWAY	IP Address	Gets/Sets the gateway IP of the drive
IP.MODE	N/A	Sets method of acquiring IP Address.
IP.RESET	N/A	Implements new IP settings.
IP.SUBNET	IP Address	Gets/Sets the IP Subnet mask of the drive
LOAD Parameters		
LOAD.INERTIA	NV	Sets the load inertia.
MODBUS Parameters		
MODBUS.PIN	?	Gets / Sets the Modbus User Units Input parameter
MODBUS.POUT	?	Gets / Sets the Modbus User Units Output parameter.
MODBUS.PSCALE	?	Gets/Sets the Feedback Resolution (per rev) over Modbus.
MODBUS.SCALING	NV	Selects the scaling mode for Modbus values.
MODBUS.UNITLABEL	?	Labels the scaled reslution of a single motor turn.

Motor Parameters		

MOTOR.AUTOSET	NV	Determines which drive parameters are calculated automatically.
MOTOR.BRAKE	NV	Sets the presence or absence of a motor brake.
MOTOR.BRAKERLS	Command	Allows a user to release the motor brake.
MOTOR.BRAKESTATE	R/O	Reads the actual status of the motor brake.
MOTOR.CTF0	NV	Sets the thermal constant of the motor coil.
MOTOR.ICONT	NV	Sets the motor continuous current.
MOTOR.IDDATAVALID	R/O	Reports the status of the motor memory.
MOTOR.INERTIA	NV	Sets the motor inertia.
MOTOR.IPEAK	NV	Sets the motor peak current.
MOTOR.KE		Sets the motor back EMF constant.
MOTOR.KT	NV	Sets the torque constant of the motor.
MOTOR.LQLL	NV	Sets the line-to-line motor Lq.
MOTOR.NAME	NV	Sets the motor name.
MOTOR.PHASE	NV	Sets the motor phase.
MOTOR.PITCH	NV	Sets the motor pitch.
MOTOR.POLES	NV	Sets the number of motor poles.
MOTOR.R	NV	Sets the stator winding resistance phase-phase in ohms.
MOTOR.RTYPE	NV	Defines the type of thermal resistor inside the motor.
MOTOR.TBRAKEAPP	NV	The delay time used for applying the motor brake.
MOTOR.TBRAKERLS	NV	The delay time used for releasing the motor brake.
MOTOR.TEMP	R/O	Reads the motor temperature represented as the resistance of the motor PTC.
MOTOR.TEMPFAULT	NV	Sets the motor temperature fault level.
MOTOR.TEMPWARN	NV	Sets the motor temperature warning level.
MOTOR.TYPE	NV	Sets the motor type.
MOTOR.VMAX	NV	Sets the maximum motor speed.
MOTOR.VOLTMAX	NV	Sets the motor maximum voltage.
MOTOR.VOLTMIN	NV	Sets the minimum voltage for V/f control.
MOTOR.VOLTRATED	NV	Sets the motor rated voltage.
MOTOR.VRATED	NV	Sets the motor rated velocity (not maximum velocity).
Motion Task (MT)		
MT.ACC	R/W	Specifies motion task acceleration; active in opmode 2 (position) only.
MT.CLEAR	Command	Clears motion tasks from the drive; active in opmode 2 (position) only.
MT.CNTL	R/W	Sets motion task control word; active in opmode 2 (position) only.
MT.CONTINUE	Command	Continues a stopped motion task; active in opmode 2 (position) only.
MT.DEC	R/W	Sets motion task deceleration; active in opmode 2 (position) only.
MT.EMERGMT	R/W	Selects a motion task to be triggered after an emergency stop procedure; active in opmode 2 (position) only.
MT.HOMEREQUIRE	NV	Removed in 01-04-00-000
MT.LIST	Command	Lists all initialized motion tasks in the drive; active in opmode 2 (position) only.
MT.LOAD	Command	Reads/loads a motion task number from the drive; active in opmode 2 (position) only.
MT.MOVE	Command	Starts a motion task; active in opmode 2 (position) only.
MT.MTNEXT	R/W	Specifies following motion task number; active in opmode 2 (position) only.
MT.NUM	R/W	Sets the motion task number; active in opmode 2 (position) only.
MT.P	R/W	Sets the motion task position; active in opmode 2 (position) only.

MT.PARAMS	Command	Shows a motion task; active in opmode 2 (position) only.
MT.SET	Command	Sets the motion task in the drive; active in opmode 2 (position) only.
MT.TNEXT	R/W	Specifies following motion task time; active in opmode 2 (position) only.
MT.TNUM	R/W	Motion task customer table number.
MT.TNVSAVE	Command	Saves the motion profile tables to the nonvolatile memory.
MT.TPOSWND	R/W	Sets the motion task target position window; active in opmode 2 (position) only.
MT.TVELWND	R/W	Sets the motion task target velocity window; active in opmode 2 (position) only.
MT.V	R/W	Sets the motion task velocity; active in opmode 2 (position) only.
MT.VCMD	R/O	Reads the derivative of PL.CMD; active in opmode 2 (position) only.
Position Loop (PL)		
PL.CMD	NV	Reads the position command directly from the entry to the position loop.
PL.ERR	NV	Reads the position error present when the drive is controlling the position loop.
PL.ERRFTHRESH	NV	Sets the maximum position error.
PL.ERRMODE	R/W	Sets the type of following error warning and fault usage.
PL.ERRWTHRESH	NV	Sets the position error warning level.
PL.FB	R/O	Reads the position feedback value.
PL.FBSOURCE	NV	Sets the feedback source for the position loop.
PL.INTINMAX	NV	Limits the input of the position loop integrator by setting the input saturation.
PL.INTOUTMAX	NV	Limits the output of the position loop integrator by setting the output saturation.
PL.KI	NV	Sets the integral gain of the position loop.
PL.KP	NV	Sets the proportional gain of the position regulator PID loop.
PL.MODP1	R/W	Sets modulo range parameter.
PL.MODP2	R/W	Sets the beginning or end modulo range parameter.
PL.MODPDIR	R/W	Sets the direction for absolute motion tasks.
PL.MODPEN	R/W	Enables the modulo position.
Programmable Limit Switch (PLS)		
PLS.EN	R/W	Enables programmable limit switch (PLS).
PLS.MODE	NV	Selects programmable limit switch mode.
PLS.P1 TO PLS.P8	NV	Sets the trigger point for programmable limit switches.
PLS.RESET	W/O	Resets programmable limit switch.
PLS.STATE	R/O	Reads the programmable limit switch state.
PLS.T1 TO PLS.T8	R/W	Sets programmable limit switch time.
PLS.UNITS	R/W	Sets programmable limit switch (PLS) units.
PLS.WIDTH1 TO PLS.WIDTH8	R/W	Programmable Limit Switch Width
Recorder (REC)		
REC.ACTIVE	R/O	Indicates if data recording is in progress (active).
REC.CH1 to REC.CH6	R/W	Sets recording channels 1 to 6.
REC.DONE	R/O	Checks whether or not the recorder has finished recording.
REC.GAP	R/W	Specifies the gap between consecutive samples.

REC.NUMPOINTS	R/W	Sets the number of points to record.
REC.OFF	R/W	Turns the recorder OFF.
REC.RECPRMLIST	R/O	Reads the list of recordable parameters.
REC.RETRIEVE	R/O	Transfers all the recorded data to the communication channel.
REC.RETRIEVEDATA	R/W	Retrieves the recorded data without the header.
REC.RETRIEVEFRMT	R/W	Sets the format for recorded data output.
REC.RETRIEVEHDR	R/O	Retrieves the recorded header without the data.
REC.RETRIEVESIZE	R/W	Sets the number of samples that REC.RETRIEVEDATA returns.
REC.STOPTYPE	R/W	Sets the recorder stop type.
REC.TRIG	Command	Triggers the recorder.
REC.TRIGPARAM	R/W	Sets the parameter that triggers the recorder.
REC.TRIGPOS	R/W	Sets the trigger position in the recording buffer.
REC.TRIGPRMLIST	R/O	Reads the list of possible trigger parameters.
REC.TRIGSLOPE	R/W	Sets the trigger slope.
REC.TRIGTYPE	R/W	Sets the trigger type.
REC.TRIGVAL	R/W	Sets the trigger value.
Regen Resistor (REGEN)		
REGEN.POWER	R/O	READS REGEN RESISTOR'S CALCULATED POWER.
REGEN.REXT	N/V	SETS THE EXTERNAL, USER-DEFINED REGEN RESISTOR RESISTANCE.
REGEN.TEXT	R/W	Sets the external regen resistor thermal protection time constant.
REGEN.TYPE	N/V	SETS THE REGEN RESISTOR TYPE.
REGEN.WATTEXT	R/W	SETS THE REGEN RESISTOR'S POWER FAULT LEVEL FOR AN EXTERNAL REGEN RESISTOR.
Service Motion (SM)		
SM.I1	R/W	Sets service motion current 1; active in opmode 0 (torque) only.
SM.I2	R/W	Sets service motion current 2; active in opmode 0 (torque) only.
SM.MODE	R/W	Sets the service motion mode.
SM.MOVE	Command	Starts the service motion.
SM.T1	R/W	Sets the service motion time 1.
SM.T2	R/W	Sets the service motion time 2.
SM.V1	R/W	Sets service motion velocity 1; active in opmode 1 (velocity) and 2 (position).
SM.V2	R/W	Sets service motion velocity 2; active in opmode 1 (velocity) and 2 (position).
STO		
STO.STATE	R/O	Returns the status of the safe torque off.
SWLS		
SWLS.EN	NV	Enables and disables software travel limit switches.
SWLS.LIMIT0	NV	Sets the position of the software travel limit switch 0.
SWLS.LIMIT1	NV	Sets the position of the software travel limit switch 0.
SWLS.STATE	R/O	Reads the actual status of software limit switches.
Units (UNIT)		
UNIT.ACCLINEAR	NV	Sets the linear acceleration/deceleration units.
UNIT.ACCROTARY	NV	Sets the rotary acceleration/deceleration units.
UNIT.LABEL	NV	Sets user-defined name for user-defined position units.
UNIT.PIN	NV	Sets gear IN for the unit conversion.

UNIT.PLINEAR	NV	Sets the linear position units.
UNIT.POUT	NV	Sets gear out for the unit conversion.
UNIT.PROTARY	NV	Sets the position units when the motor type (MOTOR.TYPE) is rotary.
UNIT.VLINEAR	NV	Sets the linear velocity units.
UNIT.VROTARY	NV	Sets the velocity units when the motor type (MOTOR.TYPE) is rotary.
Bus voltage (VBUS)		
VBUS.HALFVOLT	NV	Changing voltage thresholds for HV and MV Drives
VBUS.OVFTHRESH	R/O	Reads the over voltage fault level.
VBUS.OVWTHRESH	N/V	Sets voltage level for over voltage warning.
VBUS.RMSLIMIT	R/O	Reads the limit for the bus capacitors load.
VBUS.UVFTHRESH	R/O	Sets the under voltage fault level.
VBUS.UVMODE	NV	Indicates undervoltage (UV) mode.
VBUS.UVWTHRESH	NV	Sets voltage level for undervoltage warning.
VBUS.VALUE	R/O	Reads DC bus voltage.
Velocity Loop (VL)		
VL.ARPF1 TO VL.ARPF4	R/W	Sets the natural frequency of the pole (denominator) of anti-resonance (AR) filters 1, 2, 3, and 4; active in opmodes 1 (velocity) and 2 (position) only.
VL.ARPQ1 TO VL.ARPQ4	R/W	Sets the Q of the pole (denominator) of anti-resonance (AR) filter 1; active in opmodes 1 (velocity) and 2 (position) only.
VL.ARTYPE1 TO VL.ARTYPE4	NV	Indicates the method used to calculate BiQuad coefficients; active in opmodes 1 (velocity) and 2 (position) only.
VL.ARZF1 TO VL.ARZF4	R/W	Sets the natural frequency of the zero (numerator) of anti-resonance (AR)filter 1; active in opmodes 1 (velocity) and 2 (position) only.
VL.ARZQ1 TO VL.ARZQ4	R/W	Sets the Q of the zero (numerator) of anti-resonance filter #1; active in opmodes 1 (velocity) and 2 (position) only.
VL.BUSFF	R/O	Displays the velocity loop feedforward value injected by the field-bus; active in opmodes 1 (velocity) and 2 (position) only.
VL.CMD	R/O	Reads the actual velocity command; active in opmodes 1 (velocity) and 2 (position) only.
VL.CMDU	R/W	Sets the user velocity command; active in opmodes 1 (velocity) and 2 (position) only.
VL.ERR	R/O	Sets the velocity error; active in opmodes 1 (velocity) and 2 (position) only.
VL.FB	R/O	Reads the velocity feedback; active in opmodes 1 (velocity) and 2 (position) only.
VL.FBFILTER	R/O	Filters VL.FB value; active in opmodes 1 (velocity) and 2 (position) only.
VL.FBSOURCE	NV	Sets feedback source for the velocity loop; active in opmodes 1 (velocity) and 2 (position) only.
VL.FBUNFILTERED	R/O	Reads the velocity feedback.
VL.FF	R/O	Displays the velocity loop overall feedforward value; active in opmodes 1 (velocity) and 2 (position) only.
VL.GENMODE	NV	Selects mode of velocity generation (Observer, d/dt); active in opmodes 1 (velocity) and 2 (position) only.
VL.KBUSFF	R/W	Sets the velocity loop acceleration feedforward gain value; active in opmodes 1 (velocity) and 2 (position) only.
VL.KI	NV	Sets the velocity loop integral gain for the PI controller; active in opmodes 1 (velocity) and 2 (position) only.

VL.KP	NV	Sets velocity loop proportional gain for the PI controller; active in opmodes 1 (velocity) and 2 (position) only.
VL.KVFF	R/W	Sets the velocity loop velocity feedforward gain value; active in opmodes 1 (velocity) and 2 (position) only.
VL.LIMITN	NV	Sets the velocity lower limit; active in opmodes 1 (velocity) and 2 (position) only.
VL.LIMITP	NV	Sets the velocity high limit; active in opmodes 1 (velocity) and 2 (position) only.
VL.LMJR	R/W	Sets the ratio of the estimated load moment of inertia relative to the motor moment of inertia; active in opmodes 1 (velocity) and 2 (position) only.
VL.MODEL	R/O	Reads the observer velocity signal; active in opmodes 1 (velocity) and 2 (position) only.
VL.OBSBW	NV	Sets the bandwidth of the observer in Hz.
VL.OBSMODE	NV	Sets the observer operating mode.
VL.THRESH	NV	Sets the over speed fault value; active in opmodes 1 (velocity) and 2 (position) only.
Virtual Machine (VM)		
VM.STATE	R/O	Returns the state of the AKD Virtual Machine.
Wake and Shake (WS)		
WS.ARM	Command	Sets wake and shake to start at the next drive enable.
WS.DISARM	Command	Cancels ARM requests and resets wake and shake to the IDLE state.
WS.DISTMAX	R/W	Sets maximum movement allowed for wake and shake.
WS.DISTMIN	R/W	Sets the minimum movement required for wake and shake.
WS.IMAX	R/W	Sets maximum current used for wake and shake.
WS.MODE	R/W	Sets the method used for wake and shake.
WS.NUMLOOPS	R/W	Sets the number of repetitions for wake and shake.
WS.STATE	R/O	Reads wake and shake status
WS.T	R/W	Sets wake and shake current-vector appliance time
WS.TDELAY1	NV	Delay for wake and shake timing
WS.TDELAY2	NV	Sets the delay for wake and shake timing.
WS.TDELAY3	NV	Sets the delay for wake and shake between loops in mode 0.
WS.VTHRESH	NV	Defines the maximum allowed velocity for Wake & Shake

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18 Faults and Warnings

18.1 Fault and Warning Messages

When a fault occurs, the drive fault relay is opened, the output stage is switched off (motor loses all torque), or the load is dynamically braked. The specific drive behavior depends on the type of fault. The LED display on the front panel of the drive shows the number of the fault that occurred. If a warning is issued prior to the fault, the warning is shown on the LED and has the same number as the associated fault. Warnings do not trip the power stage of the drive or fault relay output.

The left side of the LED displays F for a fault or n for a warning. The right side displays the fault or warning number as follows: 1-0-1-[break]. The highest priority fault is displayed on the LED. Multiple faults may be present when a fault condition is occurring. Check the AKDWorkBench Fault Screen or read the status of DRV.FAULTS through the controller or HMI for the entire list of faults.

NOTE	More information about fault messages and clearing faults can be found in the WorkBench online help. Procedures for clearing faults are described in the online help topic entitled "Faults and Warnings".

Fault	Message/Warning	Cause	Remedy
..		1. 24V Control Power input voltage dip. or 2. Auxillary encoder 5V (X9-9) shorted.	1. Insure adequate 24V supply current capacity for the system. or 2. Check and fix X9 wiring.
F0		Reserved.	N/A
F101	Firmware type mismatch.	Installed firmware is not compatible with the drive hardware.	Load compatible firmware into the drive.
n101	The FPGA is a lab FPGA.	The FPGA is a lab version FPGA.	Load the released FPGA version that is compatible with the operational firmware.
F102	Resident firmware failed.	Software failure detected.	Restart drive. If issue persists, contact technical support.
n102	Operational FPGA is not a default FPGA.	The FPGA minor version is larger than the operational firmware default FPGA minor version	Load the released FPGA version that is compatible with the operational firmware.
F103	Resident FPGA failed.	Software failure detected. Load resident FPGA failure occurred (several cases according to flowchart, including incompatible image to FPGA type and fieldbus type).	Restart drive. If issue persists, contact technical support.
F104	Operational FPGA failed.	Software failure detected. Load operational FPGA failure occurred (several cases according to flowchart).	Restart drive. If issue persists, contact technical support.
F105	Non-volatile memory stamp invalid.	Non-volatile memory stamp is corrupted or invalid.	Reset the drive to default memory values using **Parameter Load** in WorkBench.

Fault	Message/Warning	Cause	Remedy
F106	Non-volatile memory data	Non-volatile memory data is corrupted or invalid. When this fault occurs after a firmware download, it is not an indication of a problem (clear the fault and perform a “save” to the drive).	Reset the drive to default memory values using **Parameter Load** in WorkBench.
F107 n107	Positive switch limit exceeded.	Positive software position limit is exceeded.	Move the load away from the limits.
F108 n108	Negative switch limit exceeded.	Negative software position limit is exceeded.	Move the load away from the limits.
F121	Homing error.	Drive did not finish homing sequence.	Check homing sensor.
F123 n123	Invalid motion task.	Invalid motion task.	Check motion task settings and parameters to make sure that the values entered will produce a valid motion task.
F125 n125	Synchronization lost.	The fieldbus lost synchronization.	Check fieldbus connection (X5 and X6 if you are using EtherCAT; X12 and X13 if you are using CANopen) or the settings of your EtherCAT or CANopen master.
F126 n126	Too much movement.	Too much movement was created during a Bode plot. Motor is unstable and is not following drive instructions.	Check that the system is closed loop stable. Refer to the system tuning guide.
F127	Incomplete emergency stop procedure.	Incomplete emergency stop procedure (problem with the emergency stop motion task).	Disconnect power from drive and check emergency stop procedure.
F128	MPOLES/FPOLES not an integer.	Ratio of motor poles to feedback poles must be a whole number.	Change to a compatible feedback device.
F129	Heartbeat lost.	Heartbeat lost.	Check CANopen cabling. Reduce bus load or increase the heartbeat update time.
F130	Secondary feedback supply over current.	Problem in secondary feedback detected.	Check X9 connection.
F131	Emulated encoder line break.	Problem in secondary feedback detected.	Check secondary feedback (X9 connection).
F132	Emulated encoder Z break.	Problem in secondary feedback detected.	Check secondary feedback (X9 connection).
F133	Fault number changed to to F138. See F138 for details.		
F134	Secondary feedback illegal state.	Problem in secondary feedback detected.	Check X9 connection.
F135 n135	Homing is needed.	Attempt to issue motion task before the axis is homed. Axis must be homed before motion task can start.	Change opmode or home axis.

Fault	Message/Warning	Cause	Remedy
F136	FPGA version mismatch. Firmware and FPGA versions are not compatible	The FPGA version does not match the firmware FPGA version constants.	Load the FPGA version that is compatible with the firmware.
n137	Homing and feedback mismatch	The configured homing mode is not supported by the motor feedback type used.	Change homing mode.
F138	Instability during autotune	Drive current (IL.CMD) or velocity feedback (VL.FB) exceeds allowable limit (BODE.IFLIMIT or BODE.VFLIMIT). This fault only occurs in BODE.MODE 5. This fault often occurs when complex mechanics, belts, and compliant loads are present.	Change BODE.MODE if appropriate. If BODE.MODE 5 is appropriate and the fault occurs at the end of an Autotuning, then the motor is not robustly stable. You can manually adjust Autotuner settings. Manual tuning may be required to make the motor stable.
F139	Target Position Overshot due to invalid Motion task activation.	The target position will be passed, as the profile did not allow for proper movement to the end point. Refer to section 4.2.2.1 of AKD_customer_profile_application_note.doc.	Cleared by activating a valid motion Or by DRV.CLRFAULTS command.
n140	VBUS.HALFVOLT has changed. Save the parameters and reboot the drive.	The user has changed the numerical value of VBUS.HALFVOLT. This change only takes effect after a DRV.NVSAVE command and after rebooting the AKD.	Save the parameters in the non-volatile memory via a DRV.NVSAVE command and turn off/on the 24[V] power supply in order to reboot the drive or restore the original stetting of VBUS.HALFVOLT.
n151	Not enough distance to move; motion exception.	For trapezoidal and customer table motion tasks: The target velocity specified in the motion task cannot be reached via using the selected acceleration and deceleration since the distance to travel is not sufficient. For a 1:1 profile: The selected acceleration and deceleration will be extended since there is too much distance to travel and the motion task would exceed its maximum allowed velocity.	Activation of any new motion or using of DRV.CLRFAULTS will clear the warning. Check motion task settings and parameters to make sure that the values entered will produce a valid motion task.

Fault	Message/Warning	Cause	Remedy
n152	Not enough distance to move; following motion exception.	A new motion task activated, when one motion task is already active and the target position specified in the motion task parameters cannot be reached with specified target velocity, acceleration and deceleration parameters. The motion task will directly decelerate to into the target position or ramps down to velocity 0 and start another move to reach target position of the next motion task.	Activation of any new motion or using of DRV.CLRFAULTS will clear the warning. Check motion task settings and parameters to make sure that the values entered will produce a valid motion task.
n153	Velocity limit violation, exceeding max limit.	A new target velocity calculated internally due to an exception, and is being limited due to user velocity limit.	Activation of any new motion or using of DRV.CLRFAULTS will clear the warning. Check motion task target velocity settings and parameters to make sure that the values entered will not exceed the VL.LIMITP and VL.LIMITN setting.
n154	Following motion failed; check motion parameters.	Activation of the following motion task failed due to incompatible parameters, or motion task does not exist.	Activation of any new motion or using of DRV.CLRFAULTS will clear the warning. Check following motion task settings and parameters to make sure that the values entered will produce a valid motion task.
n156	Target position crossed due to stop command.	The motion task crosses the target position after triggering a DRV.STOP command. This situation can happen when processing a change-on-the-fly motion task and triggering a DRV.STOP command close to the target position of the currently running motion task.	Activation of any new motion or using of DRV.CLRFAULTS will clear the warning.
n157	Homing index pulse not found.	A homing mode with index detection is activated, and index pulse is not detected while moving across the range determined by the hardware limit switches.	Activation of any new motion or using of DRV.CLRFAULTS will clear the warning.
n158	Homing reference switch not found.	A homing mode with reference switch detection is activated and the reference switch is not detected while moving across the range determined by the hardware limit switches.	Activation of any new motion or using of DRV.CLRFAULTS will clear the warning.
n159	Failed to set motion task parameters	Invalid motion task parameters assignment. This warning can appear upon an MT.SET command.	Activation of any new motion or using of DRV.CLRFAULTS will clear the warning. Check motion task settings and parameters.

Fault	Message/Warning	Cause	Remedy
n160	Motion task activation failed.	Activation of the motion task failed due to incompatible parameters, or motion task does not exist. This warning can appear upon an MT.MOVE command.	Activation of any new motion or using of DRV.CLRFAULTS will clear the warning. Check motion task settings and parameters to make sure that the values entered will produce a valid motion task.
n161	Homing procedure failed.	Homing error observed during the operation of homing procedure.	Activation of any new motion or using of DRV.CLRFAULTS will clear the warning.
n163	MT.NUM exceeds limit.	This warning appears with n160. This warning is triggered when you try to trigger a motion task > 128 (such as MT.MOVE 130).	Trigger only motion tasks between 0 and 128. Activation of any new motion or using of DRV.CLRFAULTS will clear the warning.
n164	Motion task is not initialized.	This warning appears with n160. This warning is triggered when you try to trigger a non-initialized motion task.	Initialize the motion task first before starting the task. Activation of any new motion or using of DRV.CLRFAULTS will clear the warning.
n165	Motion task target position is out.	This warning appears with n160. This warning is triggered when you try to trigger a motion task with an absolute target position outside of the selected modulo range (see also MT.CNTL).	Move the absolute target position of the motion task within the modulo range.Activation of any new motion or using of DRV.CLRFAULTS will clear the warning.
n168	Invalid bit combination in the motion task control word.	This warning appears with n160. This warning is triggered when you try to trigger a motion task with an invalid bit combination in the motion task control word (see also MT.CNTL).	Correct the MT.CNTL setting for the specific motion task. Activation of any new motion or using of DRV.CLRFAULTS will clear the warning.
n169	1:1 profile cannot be triggered on the fly.	This warning appears with n160. This warning is triggered when you try to trigger a 1:1 profile table motion task while another motion task is currently running.	1:1 profile table motion tasks should be started from velocity 0. Activation of any new motion or using of DRV.CLRFAULTS will clear the warning.
n170	Customer profile table is not initialized.	This warning appears with n160. This warning is triggered when you try to trigger a motion task that uses a customer profile table for generating the velocity profile and when the selected profile table is empty (see MT.CNTL and MT.TNUM.	Change the MT.TNUM parameter for this specific motion task in order to use an initialized profile table. Activation of any new motion or using of DRV.CLRFAULTS will clear the warning.
F201	Internal RAM failed.	Hardware failure detected.	Restart drive. If issue persists, contact technical support.
F202	External RAM failed.	Hardware failure detected.	Restart drive. If issue persists, contact technical support.

Fault	Message/Warning	Cause	Remedy
F203	Code integrity failed.	Software failure detected. FPGA register access failure occurred.	Restart drive. If issue persists, contact technical support.
F204 to F232	EEPROM failure detected	EEPROM failure detected	Restart drive. If issue persists, exchange drive.
F234-F237 n234-n237	Temperature sensor high.	High temperature limit reached.	Check cabinet ventilation system.
F240-F243 n240-n243	Temperature sensor low.	Low temperature limit reached.	Check cabinet ventilation system.
F245	External fault.	This fault is user generated and is caused by user settings.	Users can configure a digital input to trigger this fault (DINx.MODE = 10). The fault occurs according to this input setting. Clear the input to clear the fault.
F247	Bus voltage exceed allowed thresholds.	Hardware problem in bus measurement.	Troubleshoot and repair hardware problem.
F301 n301	Motor overheated.	Motor overheated.	Check ambient temperature. Check motor mounting heat sink capability
F302	Over speed.	Motor exceeded VL.THRESH value.	Look for overshoot or lower requested speed.
F303	Runaway.	Motor did not follow command values.	Gains are too low; motor is being over driven.
F304 n304	Motor foldback.	Maximum motor power has been exceeded; the power has been limited to protect the motor	Motion is requiring too much power. Change move profile to reduce load on motor. Check for load jamming or sticking. Check that current limits are set correctly.
F305	Brake open circuit.	Motor brake open circuit. Fault threshold is 200 mA.	Check cabling and general functionality. For special low current brake applications, the F305 fault can be bypassed using the setting motor.brake = 100.
F306	Brake short circuit.	Motor brake short circuit.	Check cabling and general functionality.
F307	Brake closed during enable state.	Motor brake closed unexpectedly.	Check cabling and general functionality.
F308	Voltage exceeds motor rating.	Drive bus voltage exceeds the motor's defined voltage rating.	Make sure that the motor fits the driving rating.

Fault	Message/Warning	Cause	Remedy
F309	Motor I2t load. reduce load	Motor I2t load (IL.MI2T) has exceeded the warning threshold IL.MI2TWTHRESH. This warning can only be generated in the case that the motor protection mode IL.MIMODE has been set to 1.	Reduce the load of the drive by adjusting lower acceleration / deceleration ramps.
F401	Failed to set feedback type.	Feedback is not connected or wrong feedback type selected	Check primary feedback (X10 connection).
F402	Analog signal amplitude fault.	Analog signal amplitude is too low. Analog fault (resolver signal amplitude or sin/cos amplitude)	Check primary feedback (X10 connection), resolver and sine/cos encoder only.
F403	EnDat communication fault.	General communication problem with feedback.	Check primary feedback (X10 connection), EnDat only
F404	Hall error.	Hall sensor returns invalid Hall state (111, 000); either all Hall sensors are on or off. Legal Hall states are 001, 011, 010, 110, 100, and 101. This fault can be caused by a broken connection in any one of the Hall signals.	Check the feedback wiring; check all feedback connectors to ensure all pins are positioned correctly.
F405	BiSS watchdog fault.	Bad communication with the feedback device.	Check primary feedback (X10 connection), Biss only.
F406	BiSS multicycle fault.		
F407	BiSS sensor fault.		
F408-F416	SFD feedback fault.	Bad communication with the SFD device.	Check primary feedback (X10 connection).If fault persists, internal feedback failure. Return to manufacturer for repair.
F417	Broken wire in primary feedback.	In primary feedback, a broken wire was detected (incremental encoder signal amplitude).	Check feedback cable continuity.
F418	Primary feedback power supply.	Power supply fault for primary feedback.	Check primary feedback (X10 connection).
F419	Encoder init procedure failed	Phase find procedure did not complete successfully.	Check encoder wiring, reduce/balance motor load prior to phase finding.
F420	FB3 EnDat Communications Fault.	A communication error was detected with the EnDat 2.2 device connected to the X9 connector.	TBD
F424	Resolver amplitude low.	Resolver signal amplitude is below minimum level.	Check primary feedback (X10 connection).
F425	Resolver amplitude high.	Resolver signal amplitude is above maximum level.	Check primary feedback (X10 connection).
F426	Resolver error.	Resolver excitation fault.	Check primary feedback (X10 connection).
F427	Analog low.	Analog signal amplitude low.	Check primary feedback (X10 connection).
F428	Analog high.	Analog signal amplitude high.	Check primary feedback (X10 connection).

Fault	Message/Warning	Cause	Remedy
F429	Incremental low.	Incremental encoder signal amplitude is below minimum level.	Check primary feedback (X10 connection).
F430	Incremental high.	Incremental encoder signal amplitude is above maximum level.	Check primary feedback (X10 connection).
F432	Communication fault.	General communication problem with secondary feedback.	Check secondary feedback (X10 connection).
F437	Close to limit.	Drive or motor over current or over speed warning.	Check for increased load, jamming or sticking. Is position error set too low?
F438 n439	Following error (numeric)	Motor did not follow command values. Motor exceeded maximum allowed position following error (numeric).	Check for increased load, jamming or sticking. Is position error set too low?
F439 n439	Following error (user).	Motor did not follow command values. Motor exceeded maximum allowed position following error (user).	Check feedback commutation setup and tuning parameters.
F450	Following error (presentation).	Motor did not follow command values. Motor exceeded maximum allowed position following error (presentation).	Check feedback commutation setup and tuning parameters.
F473	Wake and Shake. Insufficient movement	There was less movement than defined by WS.DISTMIN.	Increase WS.IMAX and/or WS.T
F475	Wake and Shake. Excess movement.	WS.DISTMAX has been exceeded.	Increase WS.DISTMAX value or reduce WS.IMAX or WS.T.
F476	Wake and Shake. Fine-coarse delta too large.	The angle difference between the coarse and fine calculation was larger than 72 deg.	Modify WS.IMAX or WS.T and try again.
F478 n478	Wake and Shake. Overspeed.	WS.VTHRESH was exceeded.	Increase WS.VTHRESH value or reduce WS.IMAX or WS.T.
F479 n479	Wake and Shake. Loop angle delta too large.	The angle between complete loops was larger than 72 deg.	Modify WS.IMAX or WS.T and try again.
F480	Fieldbus command velocity too high.	Fieldbus command velocity exceeds VL.LIMITP.	Lower fieldbus command trajectory, or increase the value of VL.LIMITP.
F481	Fieldbus command velocity too low.	Fieldbus command velocity exceeds VL.LIMITN.	Increase fieldbus command trajectory, or decrease the value of VL.LIMITN.
F482	Commutation not initialized.	The motor requires the commutation initialization (there are no encoder commutation tracks, Hall sensors, etc.) and no successful Wake and Shake sequence has been performed	Clear any faults, activate the Wake and Shake procedure (WS.ARM) and enable the drive.
F483	Motor U phase missing.	No current was detected in the motor's U phase during Wake and Shake initialization (Mode 0 only).	Check the motor connections and WS.IMAX (very low current may produce this error).

Fault	Message/Warning	Cause	Remedy
F484	Motor V phase missing.	No current was detected in the motor's V phase during Wake and Shake initialization (Mode 0 only).	Check the motor connections and WS.IMAX (very low current may produce this error).
F485	Motor W phase missing.	No current was detected in the motor's W phase during Wake and Shake initialization (Mode 0 only).	Check the motor connections and WS.IMAX (very low current may produce this error).
F486	Motor velocity exceeds EMU-speed.	Motor velocity exceeds the maximum speed the emulated encoder output can generate.	Reduce value of DRV.EMUEPULSEIDTH.
F501 n501	Bus over voltage.	Bus voltage too high. Usually, this problem is load related.	Reduce load or change motion profile. Check system regen capacity; add capacity if needed. Check mains voltage.
F502	Bus under voltage. Warning issued prior to fault.	Bus voltage below threshold value.	Check mains voltage.
F503 n503	Bus capacitor overload.	Single phase AC input on a drive only rated for three-phase input or excessive single-phase power load.	Check mains voltage.
F504-F518	Internal supply voltage fault	Internal supply voltage fault detected	Check wiring for electromagnetic compatibility (EMC). If issue persists exchange drive.
F519	Regen short circuit.	Regen resistor short circuit.	Regen IGBT short circuit. Contact technical support.
F520	Regen overload.	Regen resistor overload.	Motor is being overhauled or motor is being stopped too quickly.
F521 n521	Regen over power.	Too much power stored in regen resistor.	Either get larger regen resistor or use DC bus sharing to dissipate power.
F523	Bus over voltage FPGA	Bus over voltage hard fault.	Check mains voltage and check system brake capacity.
F524 n524	Drive foldback.	Maximum drive power has been exceeded. The power has been limited to protect the drive.	Motion requires too much power. Change profile to reduce load .
F525	Output over current.	Current exceeds drive peak.	Check for short or feedback faults.
F526	Current sensor short circuit.	Current sensor short circuit.	Restart drive. If issue persists, contact technical support.
F527	Iu current AD converter stuck.	Hardware failure detected.	Restart drive. If issue persists, contact technical support.
F528	Iv current AD converter stuck. Iv current AD converter stuck.	Hardware failure detected.	Restart drive. If issue persists, contact technical support.

Fault	Message/Warning	Cause	Remedy
F529	Iu current offset limit exceeded.	Hardware failure detected.	Restart drive. If issue persists, contact technical support.
F530	Iv current offset limit exceeded.	Hardware failure detected.	Restart drive. If issue persists, contact technical support.
F531	Power stage fault.	Hardware failure detected.	Restart drive. If issue persists, replace drive.
F532	Drive motor parameters setup incomplete.	Before a motor can be enabled, you must configure a minimum set of parameters. These parameters have not been configured.	Issue the command DRV.SETUPREQLIST to display the list of the parameters that you must configure. Configure these parameters either manually or automatically. You can manually configure these parameters in three ways: (1) set each parameter individually; (2) use the setup wizard to select the motor; or (3) select the motor type from the motor data base in the Motor window (MOTOR.AUTOSET must be set to 0 (FALSE)). If you use the Motor window, you must first select the feedback type. If the motor has Biss Analog, Endat, or SFD feedback (feedback with memory), then these parameters are set automatically when MOTOR.AUTOSET is set to 1 (TRUE).
F534	Failed to read motor parameters from feedback device.	Motor either does not have motor feedback memory, or the motor feedback memory is not programmed properly so the parameters cannot be read.	Try to read parameters again by clicking the **Disable** and **Clear Faults** button, or by issuing the DRV.CLRFAULTS command. If this attempt is not successful, then set MOTOR.AUTOSET to 0 (false) and program the parameters using the setup wizard or manually set up the parameters. If the motor has motor memory (Biss Analog, Endat, and SFD motors have motor memory), return the motor to have the memory programmed.

Fault	Message/Warning	Cause	Remedy
F535	Power-board over-temperature fail.	The power-board temperature sensor indicates more than 85 °C.	Reduce the load of the drive or ensure better cooling.
F601	Modbus data rate is too high.	Modbus controller data rate is too high.	Reduce data rate.
F602	Safe torque off.	Safe torque off function has been triggered.	Reapply supply voltage to STO if safe to do so.
F701	Fieldbus runtime.	Runtime communication fault.	Check fieldbus connections (X11), settings, and control unit.
F702 n702	Fieldbus communication lost.	All fieldbus communication was lost.	Check fieldbus connections (X11), settings, and control unit.
F703	Emergency timeout occurred while axis should disable	Motor did not stop in the timeout defined.	Change timeout value, change stop parameters, improve tuning.

18.2 Clearing Faults

You can clear drive faults in four ways: 1. using the WorkBench toolbar; 2. using the WorkBench terminal screen, 3.using the CANopen interface; or 4.using an external digital signal. In the first three methods, clearing the fault automatically disables the drive (by issuing the DRV.DIS command). After the fault is cleared, you must then enable the drive again (by issuing the DRV.EN command). In the fourth method, clearing the fault does not automatically disable the drive. Once the fault is cleared, the drive will immediately become enabled again when no fault conditions exist.

The external digital signal method is useful when the application does not require a field bus, therefore the controller cannot issue fieldbus commands (for example, DRV.EN). The fault clearing function is simpler in this case. The controller can clear a fault condition with a single output and no fieldbus command is required. The hardware enable input is still utilized for safety. Many machines are set to disable when a fault occurs, therefore, the enable circuit is connected only after the fault clear circuit is toggled.

1. Using the WorkBench toolbar. Click the **Clear Fault** button to clear the fault, then click the **Enable** button to enable the drive again.

2. Using an ASCII command. In WorkBench terminal screen, enter DRV.CLRFAULTS, then enter DRV.EN to enable the drive.

3. Using the CANopen interface (Object 6040h: Controlword DS402). The ASCII control commands are built up from the logical combination of the bits in the control word and external signals (enable output stage). You can configure the **Reset Fault** bits in the control word to clear the fault. See 1 Object 6040h: Control word (DS402) in the CANopen manual for details on clearing faults using this method. After the fault is cleared, you must enable the drive.

4. Using an external digital signal. First, provide a disable command to the drive, since this command is not automatically issued when the fault is cleared using an external digital signal. You must provide this disable command after the drive has disabled itself and before the clear fault command is issued in order for the clear fault command to be accepted.

Digital input mode 1 clears a fault condition. In the WorkBench terminal screen, enter DINx.MODE 1, with x set to the corresponding digital input number. See the Installation Manual (11.3 Digital Inputs (X7/X8) for digital input numbers and corresponding pin connections.

Example:

DIN2.MODE 1 sets digital input 2 (pin 9 on connector X7) to perform the clear fault function. Any free digital input shown in Table x can be set to mode 1 (Reset faults).

18.3 Parameter and Command Error Messages

Error Message	Meaning	Remedy	Occurrence
Error: Parameter or command was not found.	Parameter or command string was not recognized as a known command.	Check the entered string for accuracy. Consult the reference guide or enter DRV.LIST in the WorkBench terminal screen to find valid parameters and commands.	General.
Error: Not a trigger parameter.	Parameter cannot be used for triggering the scope.	Use a different parameter as a trigger value.	Recorder parameters.
Error: Parameter not recordable.	Parameter cannot be scoped.	Do not scope this parameter.	Recorder parameters.
Error: Wrong argument for parameter or command.	Argument was not accepted.	Check the entered argument for accuracy. Consult the reference guide or enter DRV.LIST in the WorkBench terminal screen to find valid parameter and command arguments.	General.
Error: No arguments allowed for parameter or command.	Parameter or command supports no arguments.	Enter parameter or command again with no arguments.	Commands and read-only parameters
Error: Too many arguments for parameter or command.	Too many arguments provided for this parameter or command.	Enter again with fewer arguments.	All parameters and commands with no or one argument.
Error: No float allowed.	Float number was entered, but only integer numbers are allowed.	Enter integer value instead.	All parameters and commands with integer arguments.
Error: Parameter or command is read-only.	Argument was not accepted because the parameter or command is read-only.	Enter again with no arguments.	Commands and all read-only parameters.
Error: Parameter is temporarily write protected.	Argument was not accepted because the parameter is currently read-only.	Check reference guide or WorkBench help to determine if the parameter is read-only, read-write, or nonvolatile.	Some parameters that come from the Smart Feedback Device (SFD).
Error: Argument greater than maximum value.	Entered argument was beyond maximum value.	Enter a value that is within the allowable range. See reference guide or WorkBench help for ranges.	Commands and read-write parameters.
Error: Too many characters in parameter or command.	Parameter or command string was too long.	Shorten string and enter again.	General.
Error: Argument less than minimum value.	Entered argument was too small.	Enter value that is within the limits.	Commands and read-write parameters.
Error: Argument is out of data range.	Entered argument was not withing the data range limits.	Enter value that is within the limits.	Commands and read-write parameters.

Error Message	Meaning	Remedy	Occurrence
Error: Parameter or command is password protected.	Use of this parameter or command requires a password.	Contact technical support to obtain password. Enter valid password.	Password protected parameters and commands.
Error: Wrong operation mode for parameter or command.	Requested parameter or command cannot be performed in this operation mode.	Change to valid operation mode.	
Error: Drive enabled. Disable drive and continue.	Action can only be performed if drive is disabled.	Disable drive and repeat action.	
Error: Drive disabled. Enable drive and continue.	Action can only be performed if drive is enabled.	Enable drive and repeat action.	
Error: Data value is invalid.	Entered data was not valid.	Provide valid data.	
Error: Argument must be an even number.	Argument is not an even number.	Enter a value divisible by two without remainder.	
Error: Argument must be an odd number.	Argument must be an odd number.	Enter a value not divisible by two with remainder.	
Error: Axis is not homed.	Axis is not homed.	Home axis and repeat action.	
Error: All recorder channels empty.	No data is specified to record.	Specify the data to be recorded and start again.	Recorder commands.
Error: Process already active.	Required action is already running.	Wait until action is finished and start again if needed.	
Error: Motor is currently in motion.	Action can only be performed if motor is not moving.	Stop motion and repeat action.	Motion tasks, service motion, and others.
Error: EEPROM is bad or does not exist.	EEPROM is damaged.	Restart drive. If fault persists, replace the drive and consult technical support.	
Error: Unknown board.			
Error: Fault exists.Correct fault condition and then clear faults.	A fault is present in the system.	Clear the fault, disable the drive, and then enable the drive again.	
Error: Cannot clear faults. Issue software or hardware disable first.		Clear hardware or software enable and repeat action.	
Error: EEPROM is busy.			
Error: Invalid motor/feedback poles ratio.			
Error: Unknown Fault.	Situation should not happen.	Clear fault. If fault recurs, consult technical support.	Unknown.
Error: Invalid motor/feedback poles ratio.			

Error Message	Meaning	Remedy	Occurrence
Error: Invalid motion task parameter.			
Error: Invalid motion task number.			
Error: Invalid motion task velocity.			
Error: Invalid motion task acceleration or deceleration.			
Error: Invalid motion task customer profile table number.			
Error: Invalid motion task following number.			
Error: Function not available for the active command source.			
Error: Invalid Bode plot mode for this function.			
Error: Invalid sine-sweep Bode plot mode.			
Error: Bode plot start frequency greater than or equal to end frequency.			
Error: Function not available while a controlled stop is in process.			
Error: Not enough memory available.			
Error: Function not available while a Bode-plot measurement is active.			
Error: Iu/Iv offset calculation not finished.			
Error: Buffer overflow.			
Error: Cannot save to EEPROM while inrush relay is closed.			
Error: Test mode is off.			
Error: Cannot change digital input mode. Issue software or hardware disable first.			

Error Message	Meaning	Remedy	Occurrence
Error: Internal drive procedure active: controlled stop, burn-in, phase find, or zero.			
Error: General motion fault.			

18.4 CANopen Emergency Messages and Error Codes

Emergency messages are triggered by internal equipment errors. They have a high ID-priority to ensure quick access to the bus. An emergency message contains an error field with pre-defined error/fault numbers (2 bytes), an error register (1byte), the error category (1 byte), and additional information.
Error numbers from 0000h to 7FFFh are defined in the communication or drive profile. Error numbers from FF00h to FFFFh have manufacturer-specific definitions. The following table describes the various error codes:

Error Code	Fault/Warning Code	Description
0x0000	0	Emergency error free
0x1080	-	-
0x1081	-	-
0x3110	F523	Bus over voltage
0x3120	F247	Bus under voltage
0x3130	F503	Phase failure
0x3180	n503	Warning: Supply missing phase
0x3210	F501	DC link over-voltage
0x3220	F502	DC link under-voltage
0x3280	n502	Warning: Bus under voltage.
0x3281	n521	Warning: Dynamic Braking I2T.
0x3282	F519	Regen short circuit.
0x4210	F234	Excess temperature, device (control board)
0x4310	F235	Excess temperature, drive (heat sink)
0x4380	F236	Power temperature sensor 2 high
0x4381	F237	Power temperature sensor 3 high.
0x4382	F535	
0x4390	n234	Warning: Control temperature sensor 1 high.
0x4391	n235	Warning: Power temperature sensor 1 high.
0x4392	n236	Warning: Power temperature sensor 2 high.
0x4393	n237	Warning: Power temperature sensor 3 high.
0x4394	n240	Warning: Control temperature sensor 1 low.
0x4395	n241	Warning: Power temperature sensor 1 low.
0x4396	n242	Warning: Power temperature sensor 2 low.
0x4397	n243	Warning: Control temperature sensor 1 low.
0x4398	F240	Control temperature sensor 1 low.
0x4399	F241	Power temperature sensor 1 low.
0x439A	F242	Power temperature sensor 2 low.
0x439B	F243	Power temperature sensor 3 low.
0x5113	F512	5V0 under voltage

Error Code	Fault/Warning Code	Description
0x5114	F505	1V2 under voltage
0x5115	F507	2V5 under voltage
0x5116	F509	3V3 under voltage
0x5117	F514	+12V0 under voltage
0x5118	F516	-12V0 under voltage
0x5119	F518	Analog 3V3 under voltage
0x5180	F504	1V2 over voltage
0x5181	F506	2V5 over voltage
0x5182	F508	3V3 over voltage
0x5183	F510	5V0 over voltage
0x5184	F513	+12V0 over voltage
0x5185	F515	-12V0 over voltage
0x5186	F517	Analog 3V3 over voltage
0x5510	F201	Internal RAM failed.
0x5530	F105	Hardware memory, non-volatile memory stamp invalid.
0x5580	F106	Hardware memory, non-volatile memory data
0x5581	F202	Hardware memory, external Ram for resident firmware failed
0x5582	F203	Hardware memory, code integrity failed for resident firmware
0x5583	F102	Hardware memory, resident firmware failed
0x5584	F103	Hardware memory, resident FPGA failed
0x5585	F104	Hardware memory, operational FPGA failed
0x6380	F532	Drive motor parameters setup incomplete.
0x7180	F301	Motor overheat
0x7182	F305	Motor open circuit
0x7183	F306	Motor short circuit
0x7184	F307	Motor brake applied
0x7185	F436	
0x7186	n301	Warning: Motor overheated.
0x7187	F308	Voltage exceeds motor rating.
0x7303	F426	Resolver 1 fault
0x7305	F417	Incremental sensor 1 fault
0x7380	F402	Feedback 1 analogue fault
0x7381	F403	Feedback 1 EnDat communication fault
0x7382	F404	Feedback 1 illegal hall
0x7383	F405	Feedback 1 BiSS watchdog
0x7384	F406	Feedback 1 BiSS multi cycle
0x7385	F407	Feedback 1 BiSS sensor
0x7386	F408	Feedback 1 SFD configuration
0x7387	F409	Feedback 1 SFD UART overrun
0x7388	F410	Feedback 1 SFD UART frame
0x7389	F412	Feedback 1 SFD UART parity
0x738A	F413	Feedback 1 SFD transfer timeout
0x738B	F415	Feedback 1 SFD mult. corrupt position
0x738C	F416	Feedback 1 SFD Transfer incomplete

Error Code	Fault/Warning Code	Description
0x738D	F418	Feedback 1 power supply fault
0x738E	F401	Feedback 1 failed to set feedback
0x7390	n414	Warning: SFD single corrupted position.
0x7391	F419	Encoder init procedure failed
0x7392	F534	Failed to read motor parameters from feedback device.
0x73A0	F424	Feedback 2 resolver amplitude low
0x73A1	F425	Feedback 2 resolver amplitude high
0x73A2	F425	Feedback 2 resolver fault
0x73A3	F427	Feedback 2 analogue low
0x73A4	F428	Feedback 2 analogue high
0x73A5	F429	Feedback 2 incremental low
0x73A6	F430	Feedback 2 incremental high
0x73A7	F431	Feedback 2 halls
0x73A8	F432	Feedback 2 communication
0x73A9	-	Reserved
0x73AA	-	Reserved
0x73C0	F473	Wake and Shake. Insufficient movement
0x73C1	F475	Wake and Shake. Excess movement.
0x73C2	F476	Wake and Shake. Fine-coarse delta too large.
0x73C3	F478	Wake and Shake. Overspeed.
0x73C4	F479	Wake and Shake. Loop angle delta too large.
0x73C5	F482	Commutation not initialized
0x73C6	F483	Motor U phase missing.
0x73C7	F484	Motor V phase missing.
0x73C8	F485	Motor W phase missing.
0x73C9	n478	Warning: Wake and Shake. Overspeed.
0x73CA	n479	Warning: Wake and Shake. Loop angle delta too large.
0x8130	F129	Life Guard Error or Heartbeat Error
0x8180	n702	Warning: Fieldbus communication lost.
0x8280	F601	
0x8311	F304	Excess torque
0x8331	F524	Torque fault
0x8380	n524	Warning: Drive foldback
0x8381	n304	Warning: Motor foldback
0x8382	n309	Warning:
0x8480	F302	Velocity overspeed
0x8482	F480	Fieldbus command velocity too high
0x8481	F703	Emergency timeout occurred while axis should disable
0x8483	F481	Fieldbus command velocity too low.
0x8580	F107	Software limit switch, positive
0x8581	F108	Software limit switch, negative
0x8582	N107	Warning: Positive software position limit is exceeded.
0x8583	n108	Warning: Negative software position limit is exceeded.
0x8611	F439	Following error

Error Code	Fault/Warning Code	Description
0x8684	n123	Warning: Motion global warning
0x8685	F138	Instability during autotune
0x8686	F151	Not enough distance to move; Motion Exception
0x8687	F152	Not enough distance to move; Following Motion Exception
0x8688	F153	Velocity Limit Violation, Exceeding Max Limit
0x8689	F154	Following Motion Failed; Check Motion Parameters
0x868a	F156	Target Position crossed due to Stop command
0x86a0	F157	Homing Index pulse not found
0x86a1	F158	Homing Reference Switch not found
0x86a2	F159	Failed to set motion task parameters
0x86a3	F160	Motion Task Activation Failed
0x86a4	F161	Homing Procedure Failed
0x86a5	F139	Target Position Over Short due to invalid Motion task activation.
0x86a6	n163	Warning: MT.NUM exceeds limit.
0x86a7	n164	Warning: Motion task is not initialized.
0x86a8	n165	Warning: Motion task target position is out.
0x86a9	n167	Warning:
0x86aa	n168	Warning: Invalid bit combination in the motion task control word.
0x86ab	n169	Warning: 1:1 profile cannot be triggered on the fly.
0x86ac	n170	Warning: Customer profile table is not initialized.
0x86ad	n171	Warning:
0x86ae	n172	Warning:
0x86B0	F438	Following error (numeric)
0x8780	F125	Fieldbus synchronization lost
0x8781	n125	Warning: Fieldbus PLL unlocked.
0x8AF0	F137	Homing and Feedback mismatch
0x8AF1	n140	Warning:
0xFF00	F701	Fieldbus runtime fault
0xFF01	F702	Fieldbus communication lost
0xFF02	F529	Iu offset limit exceeded
0xFF03	F530	Iv offset limit exceeded
0xFF04	F521	Stored energy reached critical point
0xFF05	F527	Iu detection stuck
0xFF06	F528	Iv detection stuck
0xFF07	F525	Control output over current
0xFF08	F526	Current sensor short circuit
0xFF09	F128	Axis dpoles
0xFF0A	F531	Power stage fault
0xFF0B	F602	Safe torque off
0xFF0C	F131	Emulated encoder line break.
0xFF0D	F130	Secondary feedback supply over current.
0xFF0E	F134	Secondary feedback illegal state.
0xFF0F	F245	External fault.
0xFF10	n414	Warning: SFD single corrupted position.

Error Code	Fault/Warning Code	Description
0xFF11	F101	Not compatible Firmware
0xFF12	n439	Warning: Following error (user)
0xFF13	n438	Warning: Following error (numeric)
0xFF14	n102	Warning: Operational FPGA is not a default FPGA.
0xFF15	n101	Warning: The FPGA is a laboratory FPGA
0xFF16	n602	Warning: Safe torque off.

18.5 Unknown Fault

This fault message occurs when an undefined fault condition is encountered.

18.5.1 Remedies

1. Click **Clear Fault**.

19 Troubleshooting the AKD

Drive problems occur for a variety of reasons, depending on the conditions in your installation. The causes of faults in multi-axis systems can be especially complex. If you cannot resolve a fault or other issue using the troubleshooting guidance presented below, customer support can give you further assistance.

Problem	Possible Causes	Remedy
HMI message: Communication fault	— wrong cable used — cable plugged into wrong position on drive or PC — wrong PC interface selected	— plug cable into the correct sockets on the drive and PC — select correct interface
Motor does not rotate	— drive not enabled — software enable not set — break in setpoint cable — motor phases swapped — brake not released — drive is mechanically blocked — motor pole no. set incorrectly — feedback set up incorrectly	— apply ENABLE signal — set software enable — check setpoint cable — correct motor phase sequence — check brake control — check mechanism — set motor pole no. — set up feedback correctly
Motor oscillates	— gain is too high (speed controller) — feedback cable shielding broken — AGND not wired up	— reduce VL.KP (speed controller) — replace feedback cable — join AGND to CNC-GND
Drive reports following error	— Irms or Ipeak set too low —current or velocity limits apply — accel/decel ramp is too long	—verify motor/drive sizing —verify that IL.LIMITN, IL.LIMITP, VL.LIMITN, or VL.LIMITP is not limiting the drive —reduce DRV.ACC/DRV.DEC
Motor overheating	— motor operating above its rating	—verify motor/drive sizing —verify motor continuous and peak current values are set correctly
Drive too soft	—Kp (speed controller) too low —Ki (speed controller) too low —filters set too high	—increase VL.KP (speed controller) —increase VL.KI (speed controller) —refer to documentation regarding reducing filtering (VL.AR*)
Drive runs roughly	—Kp (speed controller) too high —Ki (speed controller) too high — filters set too low	—reduce VL.KP (speed controller) —reduce VL.KI (speed controller) —refer to documentation regarding increasing filtering (VL.AR*)
During the installation, a dialog box saying “Please wait while the installer finishes determining your disk space requirements” appears and never disappears.	—MSI installer issue.	—Cancel the installation. —Make sure that you have enough disk space on your hard disk (~500MB to allow Windows .NET update if necessary), if not make some space. —Relaunch the installer (you may need to try several times, the problem is random).

20 Firmware and Firmware Updates

20.1 Downloading Firmware

To download firmware, click **More** on the **AKD Overview** screen (see 6.4 AKD Overview). The information displayed includes the current firmware version. Click **Download** to display the **Download Firmware** view and update the firmware.

When you download the firmware, you may see a **Save** dialog box; see 14.4 Save On Firmware Download for more information about saving your drive configuration prior to a firmware download.

During the download , you cannot perform any actions with the drive.

⚠ CAUTION	While WorkBench is downloading firmware to your drive, do not remove the 24 V logic power. If you remove the 24 V logic power during a firmware download, a severe drive crash can occur. If a crash occurs, the drive will restart in a special mode and WorkBench will prompt you to reload the firmware.

During the firmware download, the Download Firmware view displays a progress bar and the following messages as the download proceeds:

1. **Reading the firmware file**. This step duration depends on where the file is physically stored.
2. **Resetting the drive**. This step takes about 10 seconds.
3. **Erasing the old firmware**. This step takes about 20 seconds.
4. **Downloading the new firmware to the drive**. The drive downloads the new firmware and then programs the new firmware into the nonvolatile memory of the drive. This step takes about 20 seconds.
5. **Resetting the drive**. This step takes about 10 seconds.

During the download process, the drive LED displays [dL]. Additional codes may appear during the download; see 3.2 Display Codes for a description of display codes related to a firmware download.

20.2 Firmware Compatibility

WorkBench is compatible with all previous drive firmware versions. Any new WorkBench versions issued are compatible with older firmware versions. WorkBench forward compatibility, however, cannot be ensured. When a behavior in the firmware changes, an older WorkBench version may not function correctly with the new firmware. Kollmorgen recommends that you update WorkBench when you install new firmware.

The table below describes compatibility between WorkBench and firmware versions:

	Firmware version M_01-01-00-zzz	Firmware version M_01-02-00-zzz	Firmware version M_01-03-00-zzz	Firmware version M_01-04-00-zzz	Firmware version M_01-05-00-zzz
WorkBench Version 1.1.x.x	√	x	x	x	x
WorkBench Version 1.2.x.x	√	√	x	x	x
WorkBench Version 1.3.x.x	√	√	√	x	x
WorkBench Version 1.4.xx	√	√	√	√	x

	Firmware version M_01-01-00-zzz	Firmware version M_01-02-00-zzz	Firmware version M_01-03-00-zzz	Firmware version M_01-04-00-zzz	Firmware version M_01-05-00-zzz
WorkBench Version 1.5.x.x	√	√	√	√	√

Any new firmware not listed here may have compatibility issues with WorkBench. Please check for latest version of WorkBench on the Kollmorgen website:

http://www.kollmorgen.com/akd_software

20.3 Invalid Firmware

When WorkBench connects to a drive, it checks to make sure that the drive is executing a compatible version of the drive firmware. If the drive is executing invalid firmware, then WorkBench cannot operate correctly and shows this window.

Button	Description
Download	This command allows you to select a different version of the firmware and download it to the drive.
Disconnect	This command stops all communications with the drive and return to the disconnected state.

20.4 Forcing the drive into firmware download mode

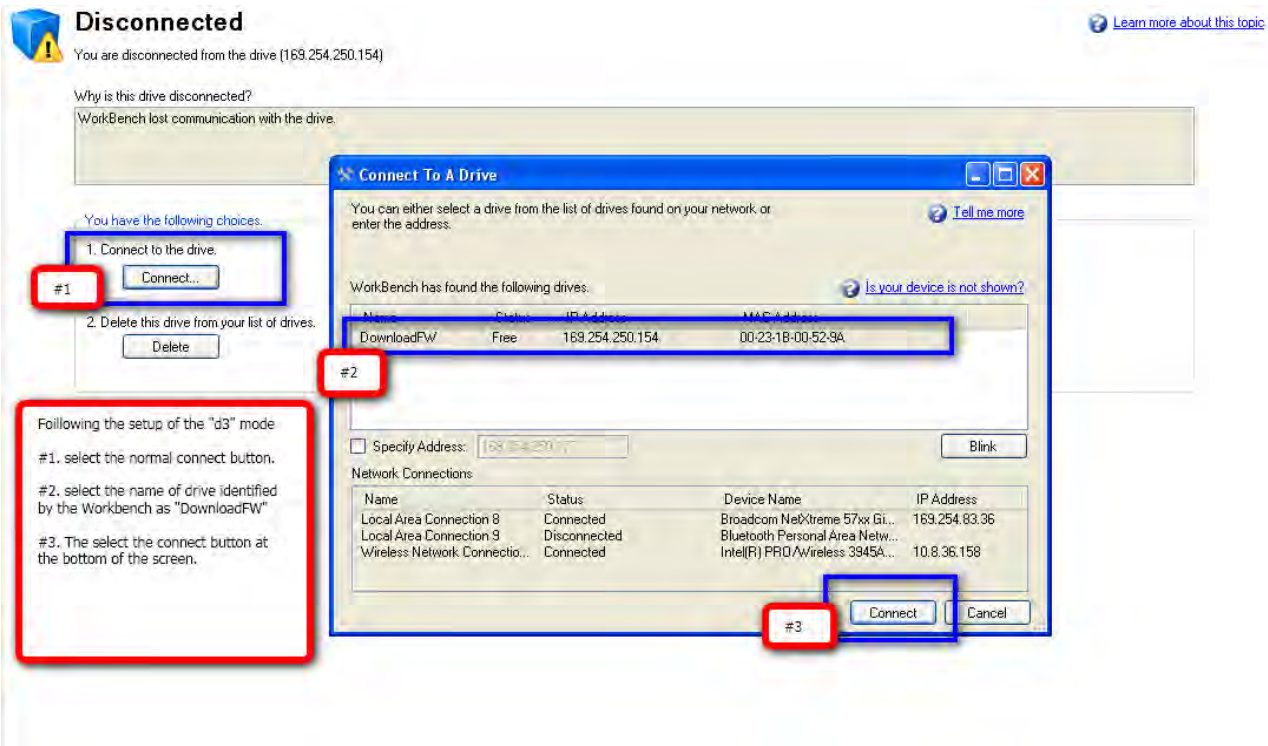
20.4.1 Forced download of AKD firmware.

In most cases, you can download firmware using the WorkBench without setting the hardware into a specific download state. If you are unable to connect to WorkBench for some reason, the following “forced firmware download” procedure is needed.

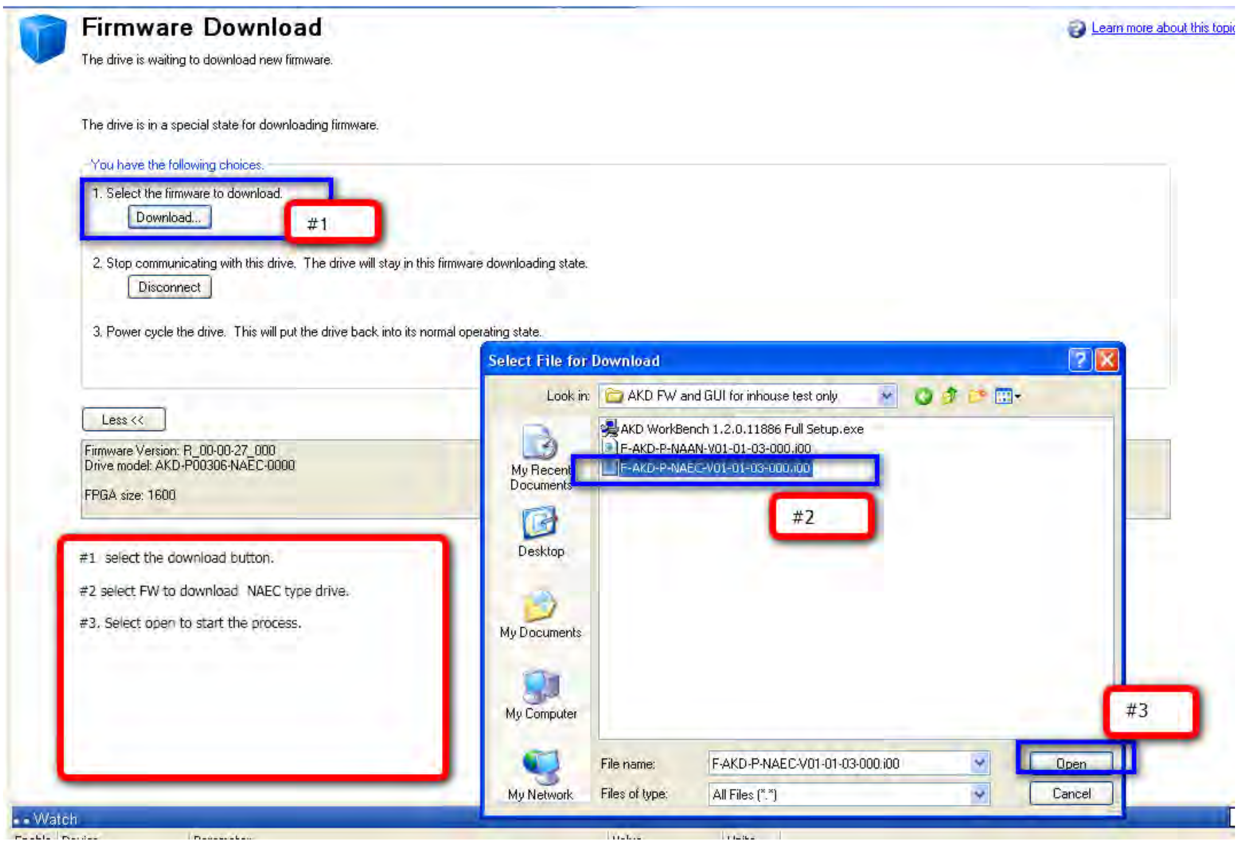
Power the AKD unit down then:

1. Depress the B1 button (display of IP Address Button) while powering up the drive. Continue to depress the button until the drive display shows "d3 " (5-10 sec).
2. Once the display on the drive shows "d3" , have the EtherNet cable connected to the drive Point to Point.
3. The drive can now be connected to WorkBench in download mode.
4. Select the firmware to be downloaded; click **Open** to start the process.

WorkBench will display the **Disconnected** view. See the screenshots below for the download connection sequence.



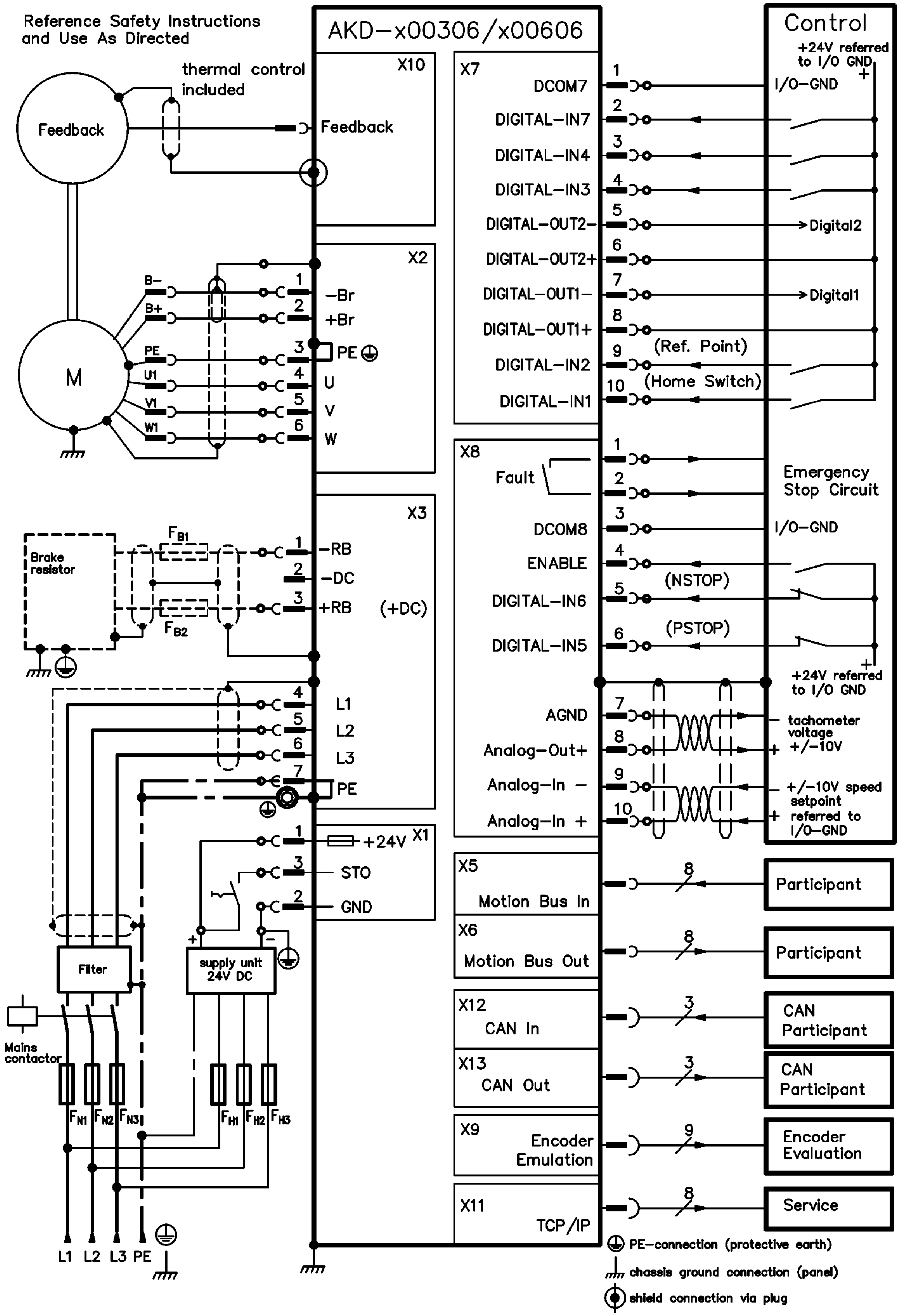
The **Firmware Download** view appears next. See the screenshot below for the firmware selection and download sequence.



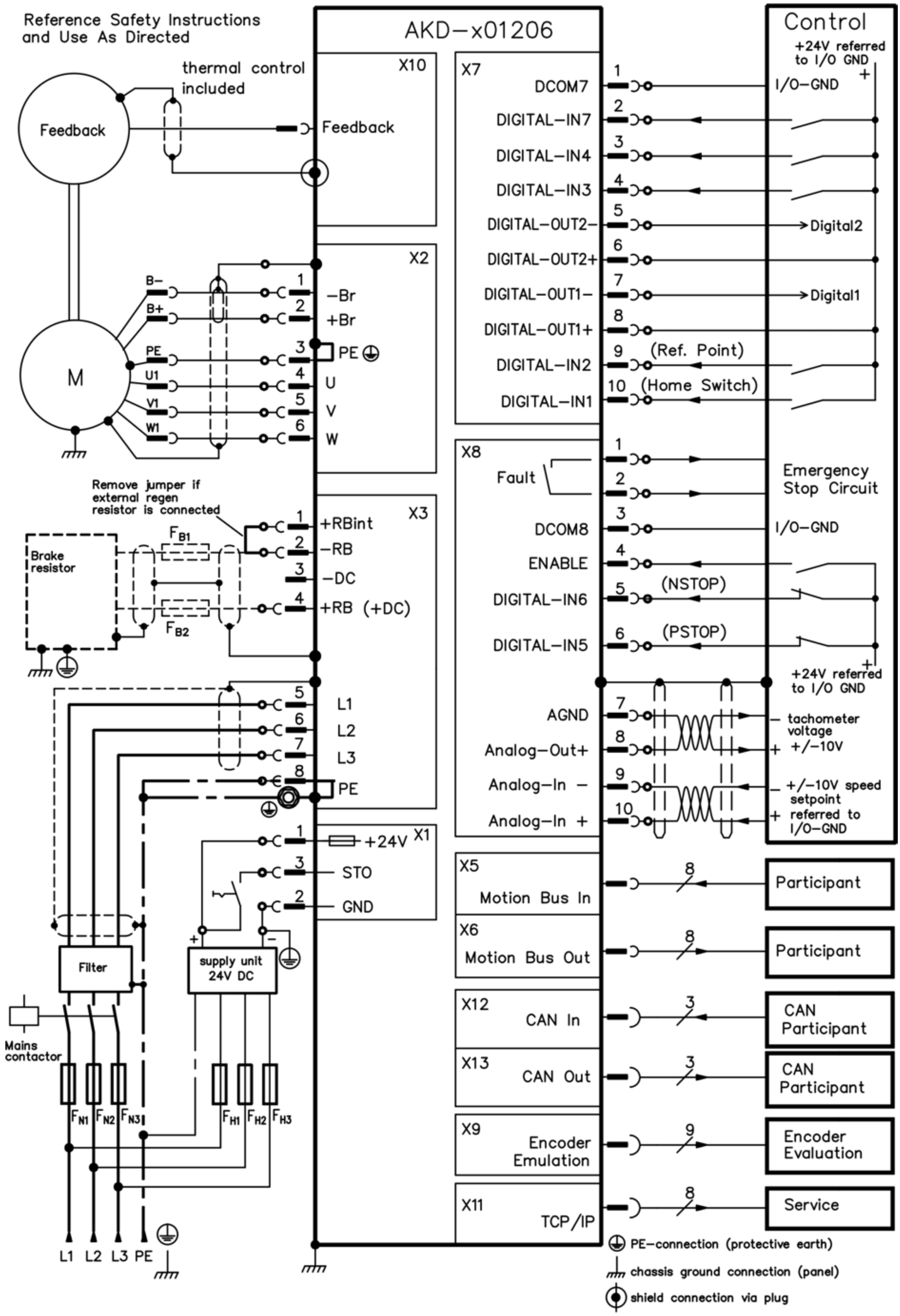
5. Next, the **Downloading Firmware** view appears and the progress bar displays the firmware download progress.
6. Once the download is complete, open the **AKD Overview** screen. The **Firmware Version** box displays the new firmware version, which confirms your successful download.

21 Connection Diagrams

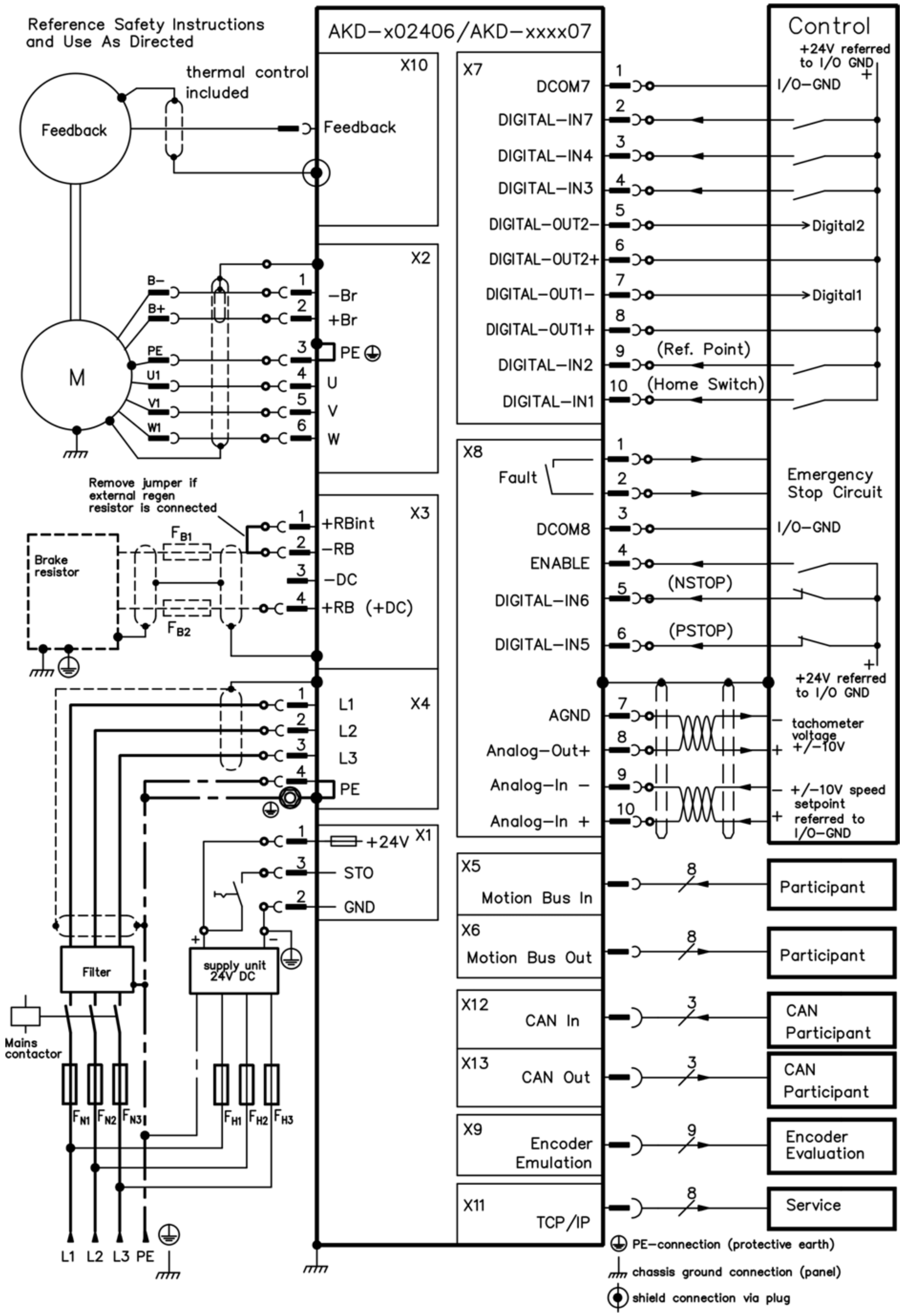
21.1 Connection Diagram, AKD-x00306 to x00606



21.2 Connection Diagram, AKD-x01206

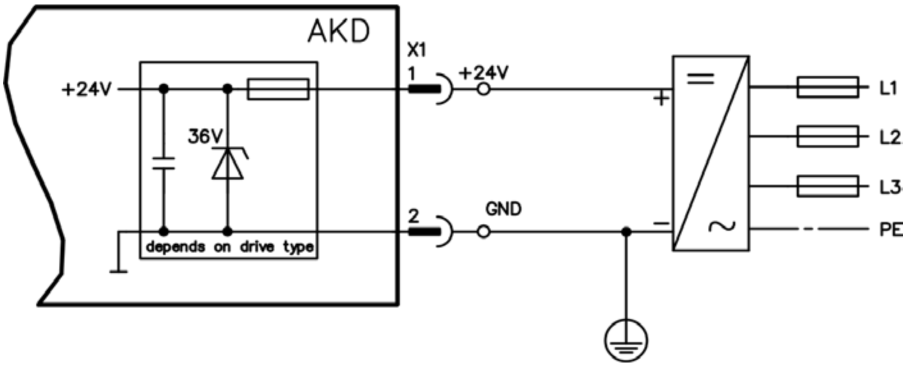


21.3 Connection Diagram, AKD-x02406 and AKD-xzzz07



21.4 24 V Auxiliary Supply (X1)

The following diagram describes external 24 Vdc power supply, electrically isolated, for example, via an isolating transformer. The required current rating depends on the use of motor brake and option card (see page 1 or following).



Pin	Signal	Description
1	+24	+24 Vdc Auxiliary voltage
2	GND	24V Supply GND
3	STO	STO enable (Safe Torque Off)

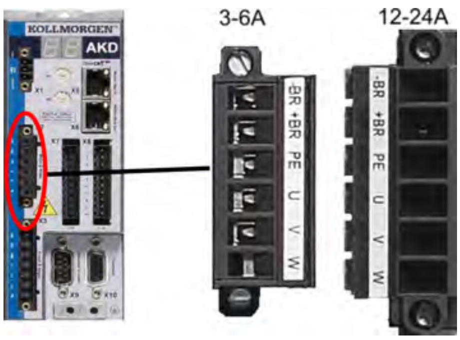
21.5 Motor Connection

Together with the motor supply cable and motor winding, the power output of the drive forms an oscillating circuit. Characteristics such as cable capacity, cable length, motor inductance, and frequency ("Electrical Data -xzzz06" (=> p. 1) or "Electrical Data -xzzz07" (=> p. 1)) determine the maximum voltage in the system.

NOTICE **The dynamic voltage rise can lead to a reduction in the motor operating life and, on unsuitable motors, to flashovers in the motor winding.**

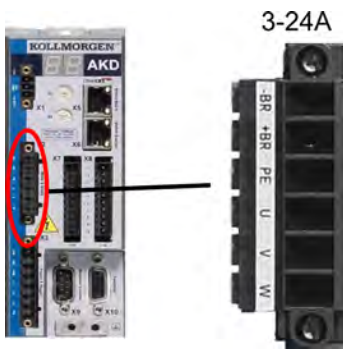
- **Only install motors with insulation class F (acc. to IEC60085) or above.**
- **Only install cables that meet the requirements "Wiring" (=> p. 1).**

Connector X2 AKD-xzzz06



Pin	Signal	Description
1	-BR	Motor holding brake, negative
2	+BR	Motor holding brake, positive
3	PE	Protective earth (motor housing)
4	U	Motor phase U
5	V	Motor phase V
6	W	Motor phase W

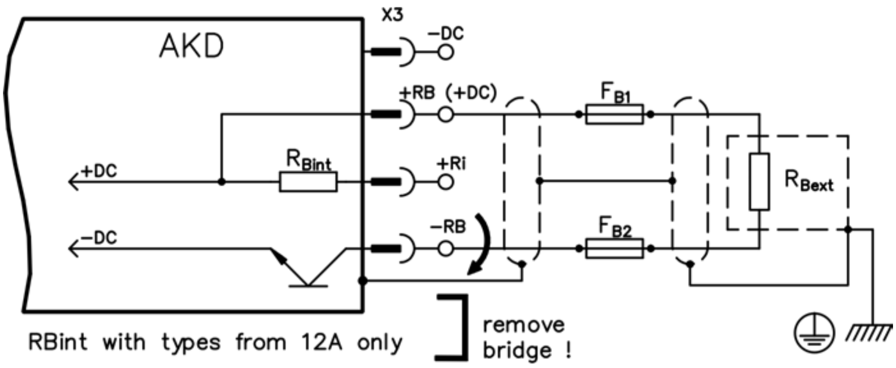
Connector X2 AKD-xzzz07



Pin	Signal	Description
1	-BR	Motor holding brake, negative
2	+BR	Motor holding brake, positive
3	PE	Protective earth (motor housing)
4	U	Motor phase U
5	V	Motor phase V
6	W	Motor phase W

21.6 External Regen Resistor (X3)

For technical data on the brake circuit "Dynamic Braking" (=> p. 1). Fusing (such as fusible cut-outs) to be provided by the user see page 1.



AKD-x00306 to AKD-x00606 (X3)		
Pin	Signal	Description
1	-RB	External Regen Resistor negative
3	+RB	External Regen Resistor positive

AKD-x01206 (X3)		
Pin	Signal	Description
1	+Rbint	Internal RegenResistor positive
2	-RB	External RegenResistor negative
4	+RB	External RegenResistor positive

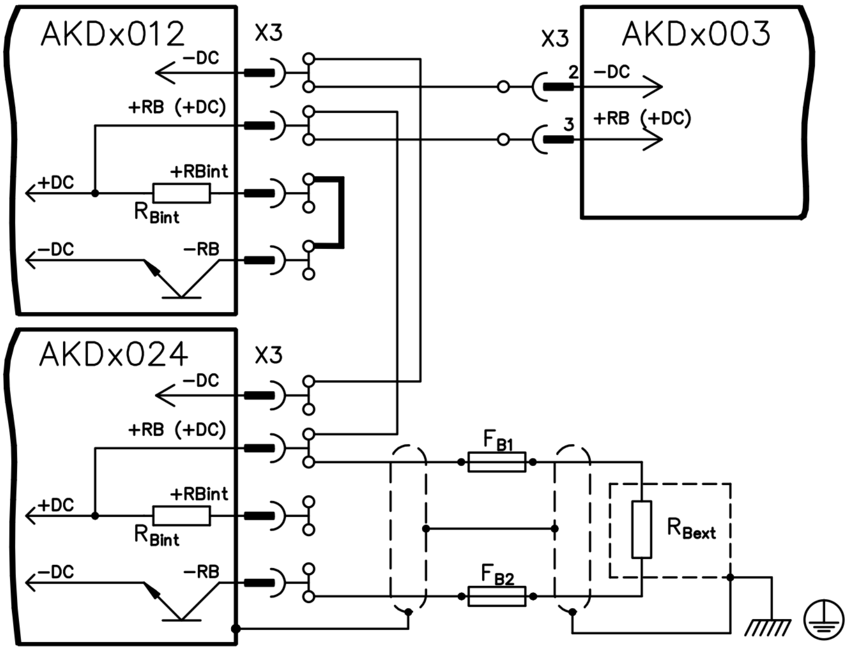
AKD-x02406 & AKD-xzzz07 (X3)		
Pin	Signal	Description
2	-RB	External RegenResistor negative
4	+RB	External RegenResistor positive

21.7 DC Bus Link (X3)

The DC bus link can be connected in parallel so that the regen power is divided between all the drives that are connected to the same DC bus link circuit.

Every drive must have it's own power connection to mains voltage, even if the DC bus link is used.

NOTICE **The drive can be destroyed if DC bus link voltages are different. Only drives with mains supply from the same mains (identical mains supply voltage) may be connected by the DC bus link. Use unshielded single cores (cross section see page 1) with a maximum length of 200 mm. Use shielded cables for longer lengths.**



AKD-x00306 to AKD-x00606 (X3)		
Pin	**Signal**	**Description**
2	-DC	DC-Link Bus negative
3	+DC (+RB)	DC-Link Bus positive

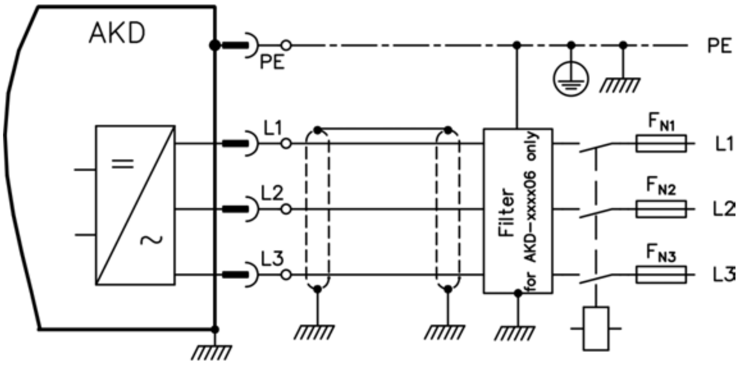
AKD-x01206 (X3)		
Pin	**Signal**	**Description**
3	-DC	DC-Link Bus negative
4	+DC (+RB)	DC-Link Bus positive

AKD-x02406 & AKD-xzzz07 (X3)		
Pin	Signal	Description
3	-DC	DC-Link Bus negative
4	+DC (+RB)	DC-Link Bus positive

21.8 Mains Supply Connection (X3, X4)

21.8.1 Three Phase connection (all AKD types)

- Directly to 3-phase supply network, supply networks see page 1
- Filtering for AKD-xzzz06 to be provided by the user.
- Fusing (such as fusible cut-outs) to be provided by the user see page 1.



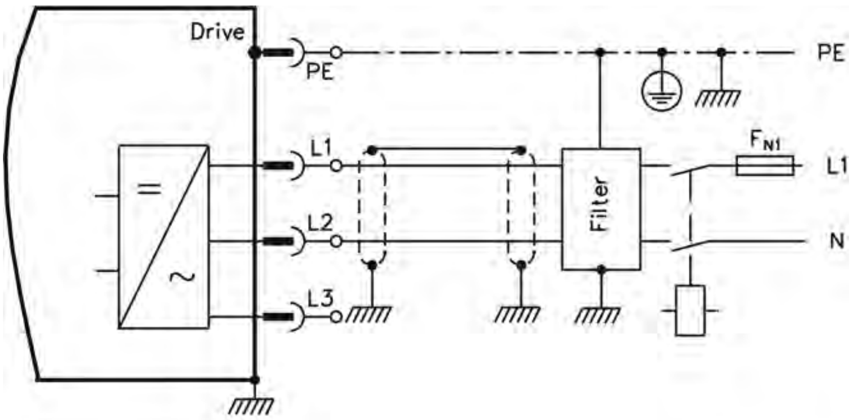
AKD-x00306 to AKD-x00606 (X3)		
Pin	Signal	Description
4	L1	Line 1
5	L2	Line 2
6	L3	Line 3
7	PE	Protective Earth

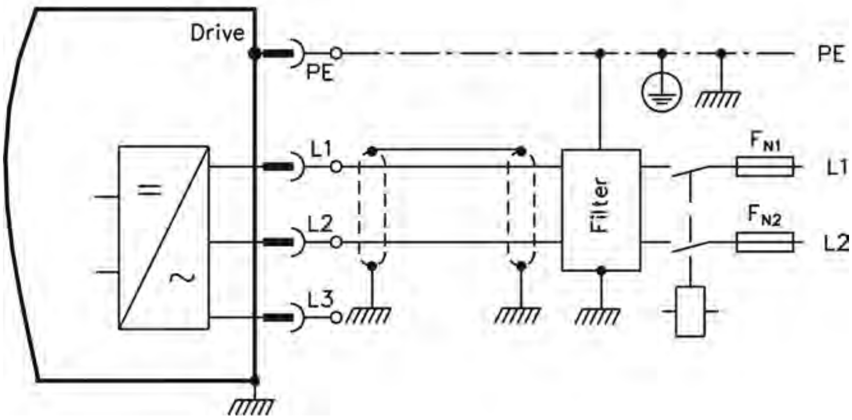
AKD-x01206 (X3)		
Pin	Signal	Description
5	L1	Line 1
6	L2	Line 2
7	L3	Line 3
8	PE	Protective Earth

AKD-x02406 & AKD-xzzz07 (X4)		
Pin	Signal	Description
1	L1	Line 1
2	L2	Line 2
3	L3	Line 3
4	PE	Protective Earth

21.8.2 Single phase connection (AKD-xzzz06 only)

- Directly to single-phase supply network (120 V$_{-10\%}$ to 240 V$^{+10\%}$) with neutral line or Directly to two-phase supply network (120 V$_{-10\%}$ to 240 V$^{+10\%}$) without neutral line
- Supply networks see page 1
- Leave L3 open circuit
- Filtering to be provided by the user.
- Fusing (such as fusible cut-outs) to be provided by the user see page 1.



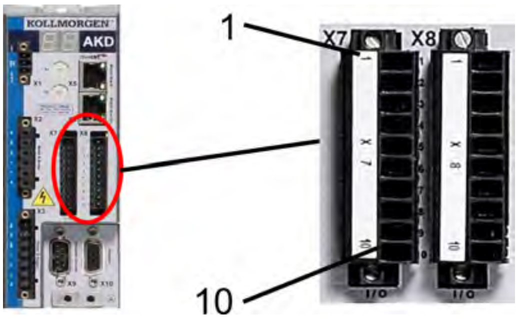


AKD-x00306 to AKD-x00606 (X3)		
Pin	Signal	Description
4	L1	Line 1
5	L2 (N)	Neutral or Line 2
7	PE	Protective Earth

AKD-x01206 (X3)		
Pin	Signal	Description
5	L1	Line 1
6	L2 (N)	Neutral or Line 2
8	PE	Protective Earth

21.9 I/O Connection

All standard digital and analog I/O signals are connected to X7 and X8.



21.9.1 I/O Connectors (X7 and X8)

Conn.	Pin	Signal	Abbreviation	Function	Specials
X7	1	Digital Common X7	DCOM7	Common line for X7 pins 2, 3, 4, 9, 10	-
X7	2	Digital Input 7	DIGITAL-IN 7	Programmable	-
X7	3	Digital Input 4	DIGITAL-IN 4	Programmable	-
X7	4	Digital Input 3	DIGITAL-IN 3	Programmable	-
X7	5	Digital Output 2-	DIGITAL-OUT2-	Programmable	-
X7	6	Digital Output 2+	DIGITAL-OUT2+	Programmable	-
X7	7	Digital Output 1-	DIGITAL-OUT1-	Programmable	-
X7	8	Digital Output 1+	DIGITAL-OUT1+	Programmable	-
X7	9	Digital Input 2	DIGITAL-IN 2	Programmable	high speed
X7	10	Digital Input 1	DIGITAL-IN 1	Programmable	high speed
X8	1	Fault Relay Output	Fault Relay Output	Fault Relay Output	-
X8	2	Fault Relay Output	Fault Relay Output	Fault Relay Output	-
X8	3	Digital Common X8	DCOM8	Common line for X8 pins 4, 5, 6	-
X8	4	Digital Input 8	DIGITAL-IN 8	Output stage enable	not programmable
X8	5	Digital Input 6	DIGITAL-IN 6	Programmable	-
X8	6	Digital Input 5	DIGITAL-IN 5	Programmable	-
X8	7	Analog Ground	AGND	Analog GND	-
X8	8	Analog Output +	Analog-Out	Actual velocity voltage	-
X8	9	Analog Input -	Analog-In-	Velocity set point	-
X8	10	Analog Input +	Analog-In+		-

Digital common lines for X7 and X8 are not common to each other.
The DCOMx line should be connected to the 0V of the I/O supply when using sensors of type "Source" with digital inputs.
The DCOMx line should be connected to the 24V of the I/O supply when using sensors of type "Sink" with digital inputs.

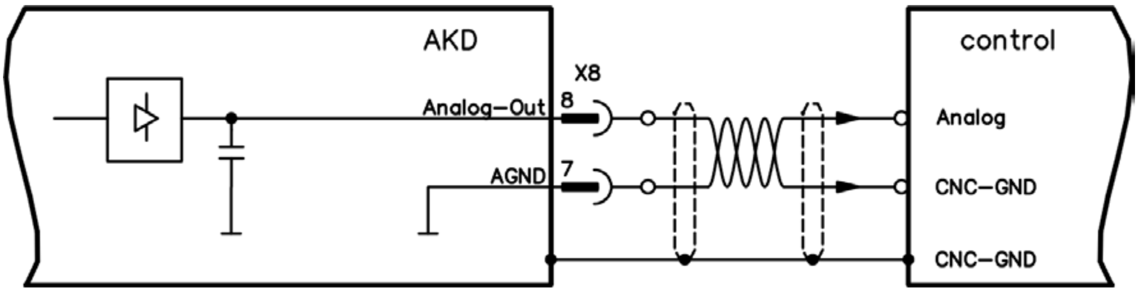
21.10 Analog Output (X8)

Terminals X8/7-8 can be used to output converted analog values of digital measurements recorded in the drive. A list of the pre-programmed functions is included in the WorkBench setup software.

Technical characteristics

- Output voltage range referring to AGND: ±10 V
- Resolution: 16 Bit and fully monotonic
- Unadjusted offset: < 50 mV
- Offset drift typ: 250 µV/°C
- Gain or slope tolerance: +/- 3%
- Nonlinearity: < 0.1% of full scale or 10 mV
- Output impedance: 110 ohms
- Specification complies with IEC 61131-2 Table 11
- -3 dB Bandwidth: >8 kHz
- Maximum output current: 20 mA
- Capacitive load: any value but response speed limited by max Iout and by Rout
- Protected for short circuit to AGND

Analog Output Wiring Diagram



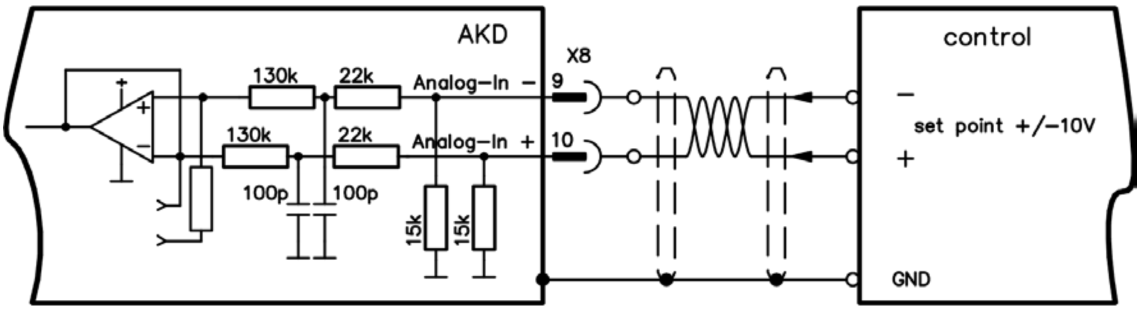
21.11 Analog Input (X8)

The drive is fitted with one differential input for analog torque, velocity, or position control.

Technical characteristics

- Differential input voltage range: ± 12.5 V
- Maximum input voltage referring to I/O Return: -12.5, +16.0 V
- Resolution: 16 Bit and fully monotonic
- Unadjusted offset: < 50 mV
- Offset drift typ: 250 µV / ° C
- Gain or slope tolerance: +/- 3%
- Nonlinearity: < 0.1% of full scale or 12.5 mV
- Common Mode Rejection Ratio: > 30 dB at 60 Hz
- Input impedance: > 13k Ohms
- Signal to noise ratio referred to full scale:
  - AIN.CUTOFF = 3000 Hz: 14 bit
  - AIN.CUTOFF = 800 Hz: 16 bit

Analog Input Wiring Diagram



Application examples for set point input Analog-In:

- adjustable external current limit
- reduced-sensitivity input for setting-up/jog operation
- pre-control/override

Defining the direction of rotation

Standard setting: clockwise rotation of the motor shaft (looking at the shaft end) affected by positive voltage between terminal X8/10 (+) and terminal X8/9 (-)

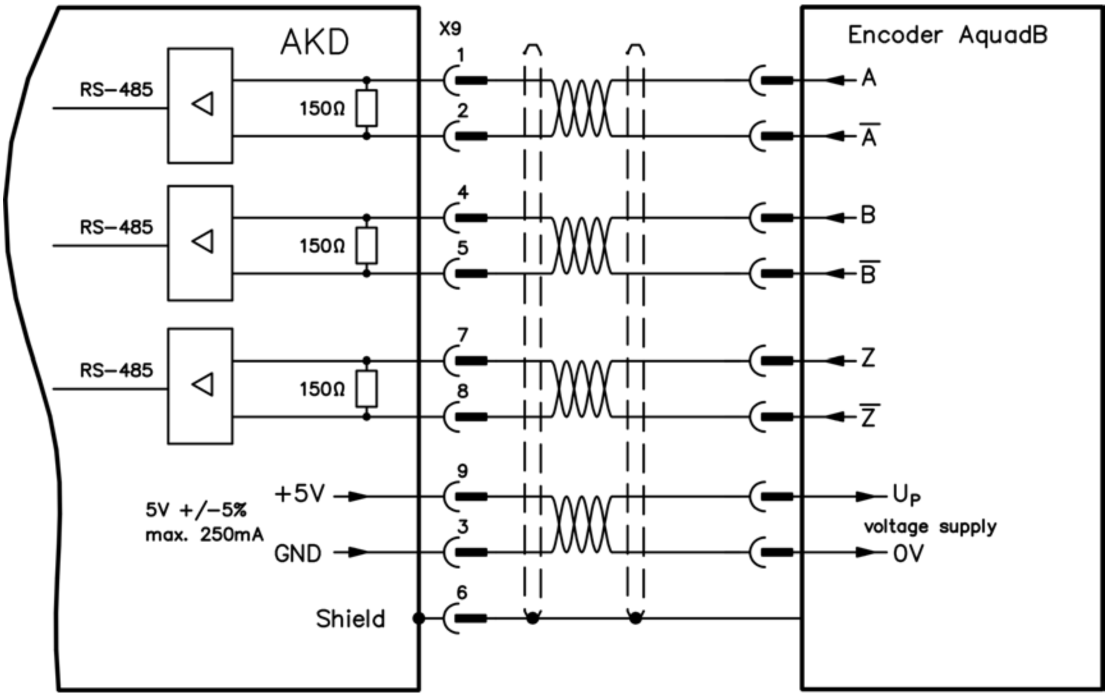
To reverse the direction of rotation, swap the connections to terminals X8/9-10, or change the DRV.DIR parameter in the “Feedback” screen page.

21.12 Command encoder signal connection

21.12.1 Incremental encoder input 5 V (X9)

A 5 V A quad B encoder, or the encoder emulation output of another drive can be connected to this input and used as a commander encoder, dual loop feedback, gearing or camming input. Don't use for primary motor feedback connection!

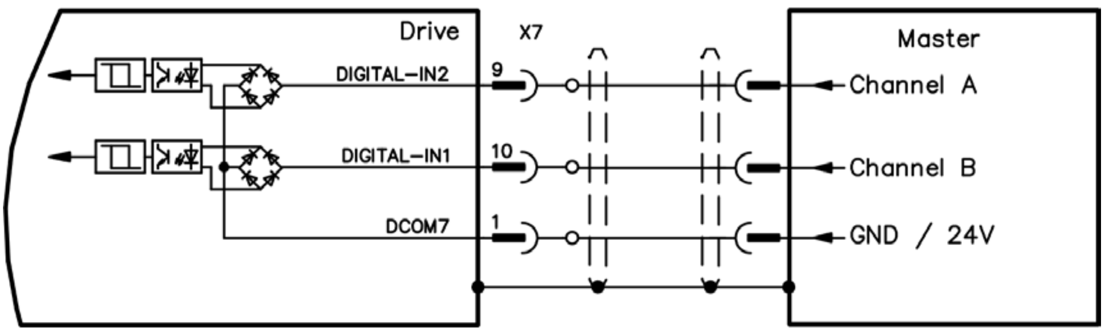
Connection Diagram



21.12.2 Incremental encoder input 24 V (X7)

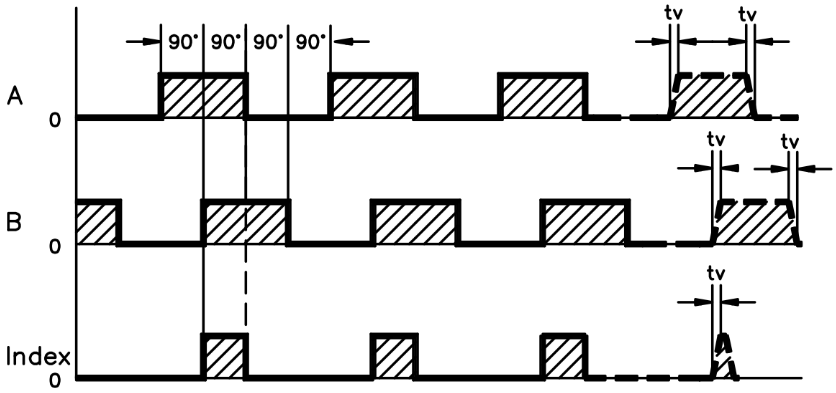
A 24 V A quad B encoder can be connected to the digital inputs 1 and 2 and used as a commander encoder, dual loop feedback, gearing or camming input. Don't use for primary motor feedback connection!

Connection Diagram



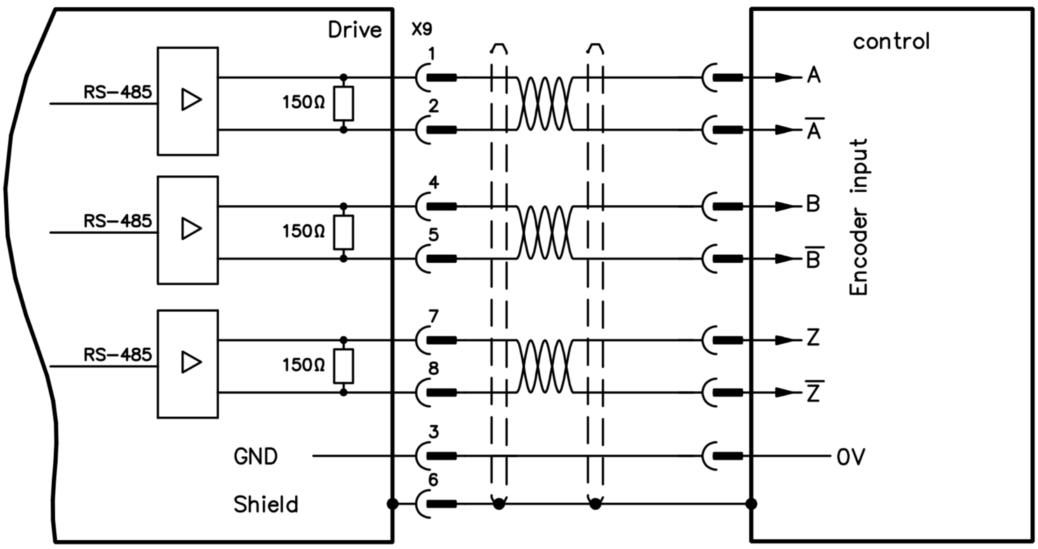
21.12.3 Emulated Encoder Output (EEO) - A quad B (X9)

The drive calculates the motor shaft position from the cyclic- absolute signals of the primary feedback, generating incremental-encoder compatible pulses from this information. Pulse outputs on the SubD connector X9 are 3 signals, A, B and Index, with 90° phase difference (i.e. in quadrature, hence the alternative term "A quad B" output), with a zero pulse.
The resolution (before multiplication) can be set by the DRV.EMUERES parameter. Use the DRV.EMUEZOFFSET parameter to adjust + save the zero pulse position within one mechanical turn. The drivers operate from an internal supply voltage.



tv max. 30ns

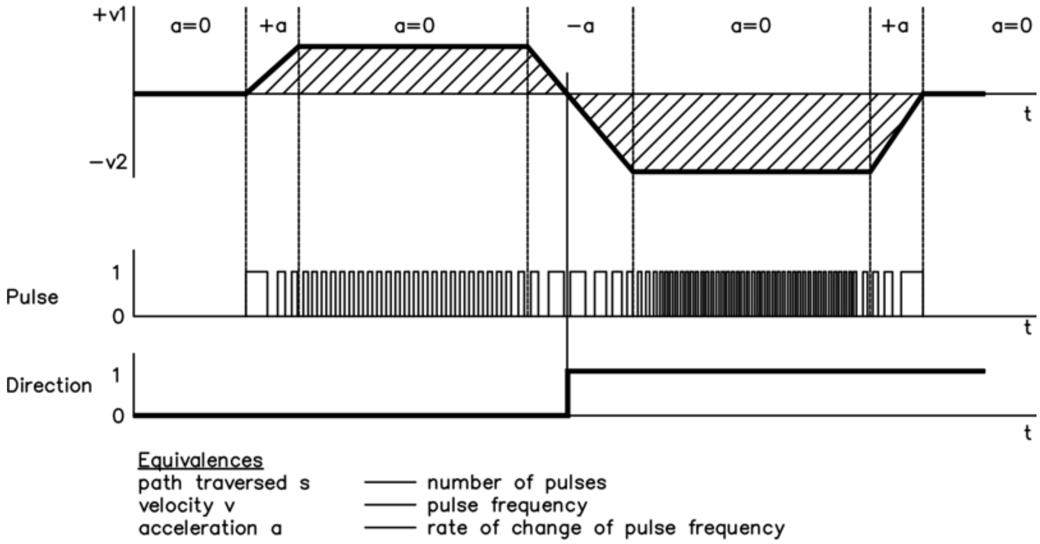
Connection Diagram



21.13 Pulse / Direction signal connection

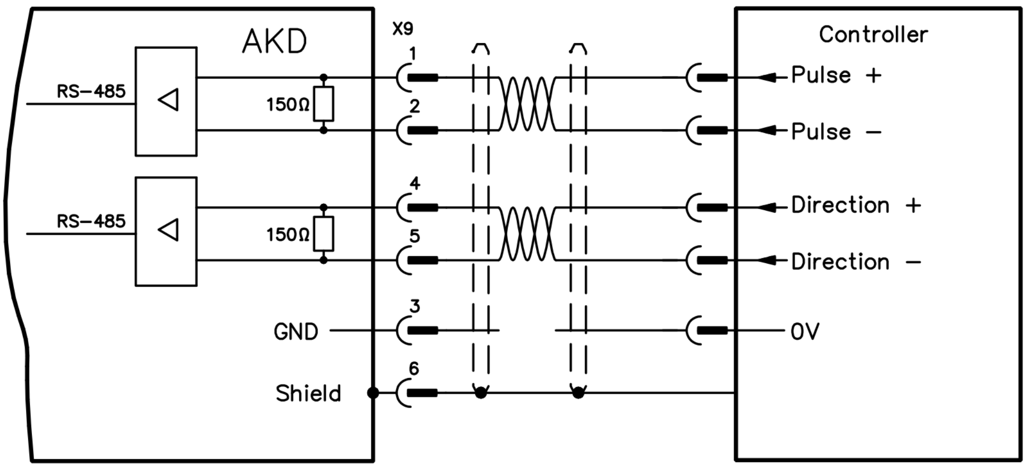
The drive can be connected to a stepper-motor controller. Set parameters for the drive with WorkBench. The number of pulses can be adjusted, so that the drive can be adapted to match any stepper controller.

Speed profile and signal diagram



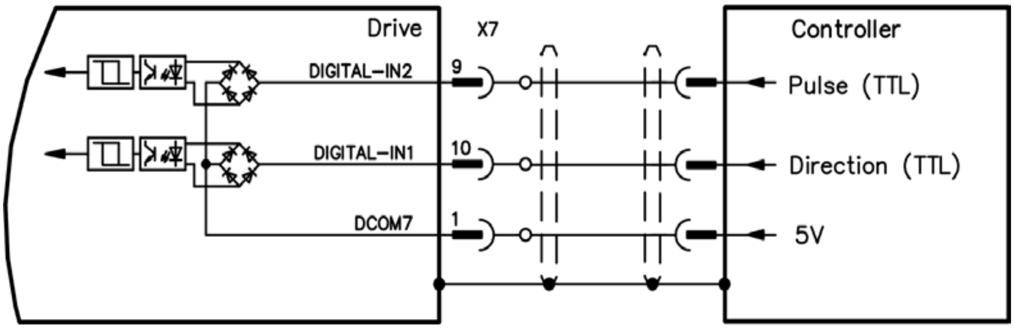
21.13.1 Pulse / Direction input 5 V (X9)

Connection to 5 V signal level stepper-motor controllers.



21.13.2 Pulse / Direction Input 5V (X7)

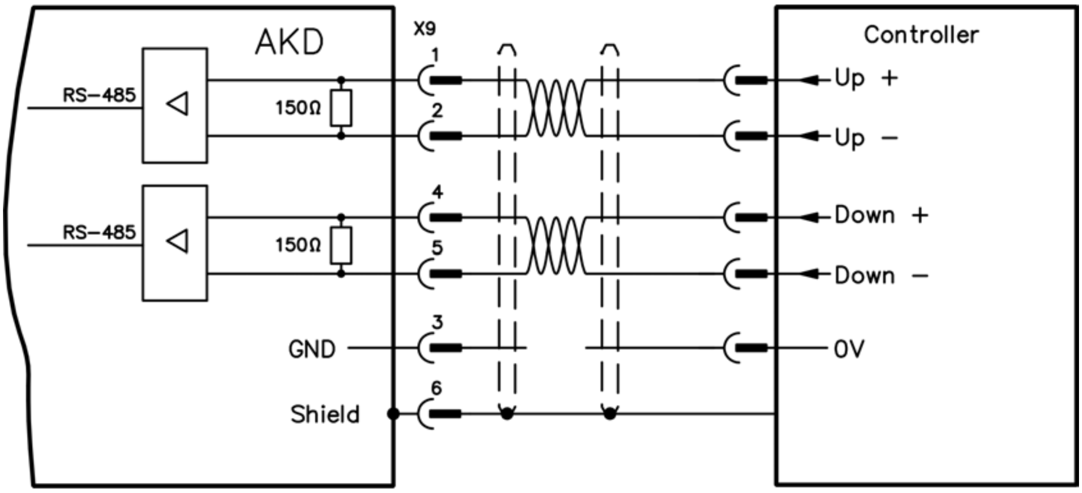
Connection industry standard 5V logic stepper-motor controllers with Pulse/Direction or Step/Direction outputs. Note that the X7 opto inputs can work with 5V up to 24V logic and so these inputs can be driven by 24V logic inputs as well.



21.14 Up / Down signal connection

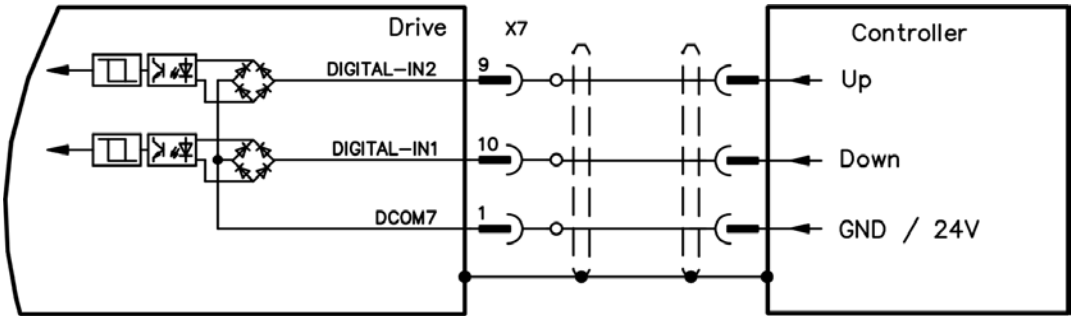
21.14.1 Up / Down input 5 V (X9)

The drive can be connected to a third-party controller which delivers5 V up-down signals

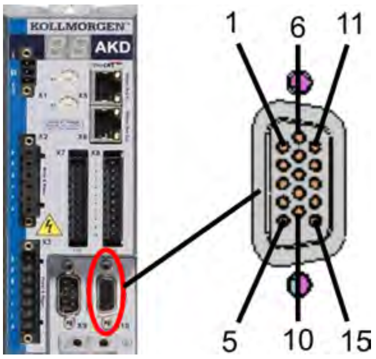


21.14.2 Up / Down input 24 V (X7)

The drive can be connected to a third-party controller which delivers 24 V up-down signals.



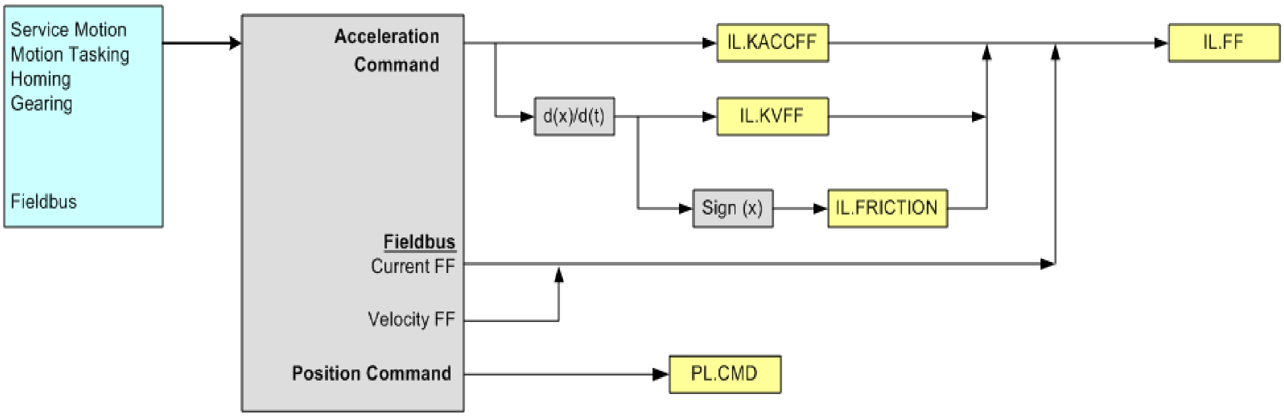
21.15 Feedback Connector (X10)



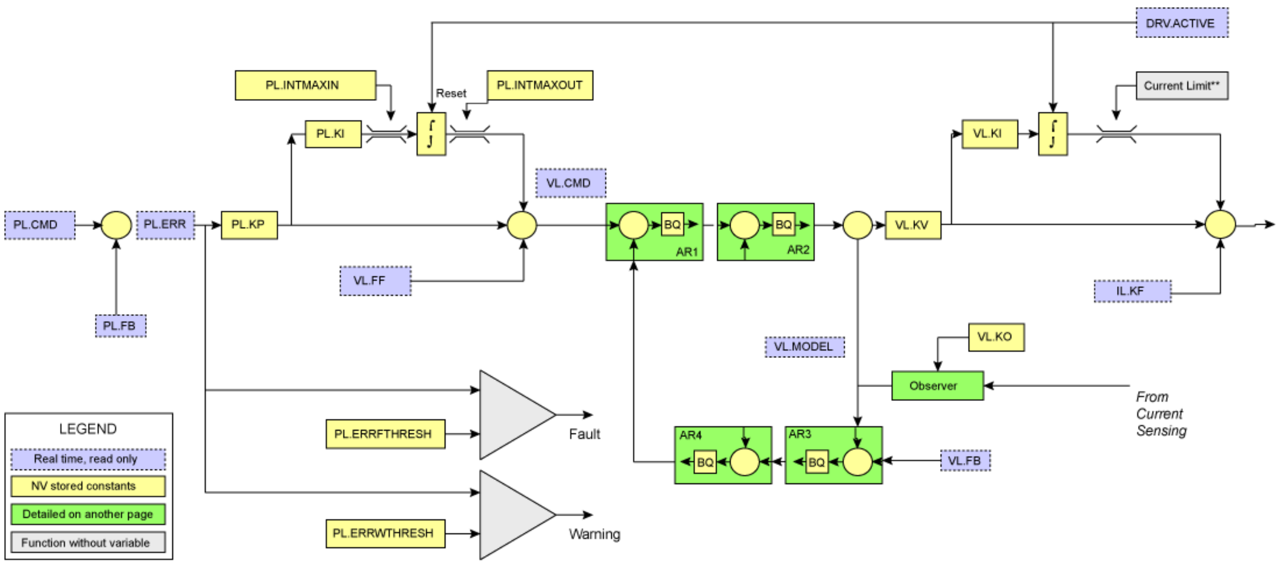
Pin	SFD	Resolver	BiSS (analog)	EnDAT 2.1	EnDAT 2.2	Hiper-face	Sine Encoder +Hall	Incremental Encoder +Hall
1	-	-	-	-	-	-	Hall U	Hall U
2	-	-	CLOCK+	CLOCK+	CLOCK+	-	Hall V	Hall V
3	-	-	CLOCK-	CLOCK-	CLOCK-	-	Hall W	Hall W
4	SENSE+	-	SENSE+	SENSE+	SENSE+	SENSE+	SENSE+	SENSE+
5	SENSE-	-	SENSE-	SENSE-	SENSE-	SENSE-	SENSE-	SENSE-
6	COM+	R1 Ref+	DATA+	DATA+	DATA+	DATA+	Zero+	Zero+
7	COM-	R2 Ref-	DATA-	DATA-	DATA-	DATA-	Zero-	Zero-
8	-	Thermal control (PTC)						
9	-	Thermal control (PTC, GND)						
10	+5 V	-	+5 V	+5 V	+5 V	+8 to +9 V	+5 V	+5 V
11	0 V	-	0 V	0 V	0 V	0 V	0 V	0 V
12	-	S1 SIN+	A+	A+	-	SIN+	A+	A+
13	-	S3 SIN-	A-	A-	-	SIN-	A-	A-
14	-	S2 COS+	B+	B+	-	COS+	B+	B+
15	-	S4 COS-	B-	B-	-	COS-	B-	B-

22 Block Diagrams

22.1 Block Diagram for Current Loop



22.2 Block Diagram for Position/Velocity Loop



23 Appendix A - FieldBus Manuals

The fieldbus manuals describe the different options for connecting and communicating with the AKD drive. Links to these manuals are listed below

23.1 AKD Modbus Communication

This manual describes Modbus communication, a simple communication protocol used for reporting data from an industrial device to an HMI or PLC. This manual can be found here: Modbus

23.2 AKD EtherCAT Communication

This manual describes the installation, setup, range of functions, and software protocol for the EtherCAT AKD product series. The manual can be found online at: AKD_EtherCat_en Rev D.pdf

A pdf format is also available on the CD-ROM included with the drive.

23.3 AKD CANopen Communication

This manual describes the installation, setup, range of functions, and software protocol for the CANopen AKD product series. The manual can be found online at: AKD_CANopen_en Rev D.pdf

A pdf format is also available on the CD-ROM included with the drive.

23.4 AKD PROFINET

This manual describes the installation, setup, range of functions, and software protocol for the PROFINET AKD product series. The manual can be found online at: Kollmorgen.com

A pdf format is also available on the CD-ROM included with the drive.

23.5 AKD SynqNet Communication

This manual describes the installation, setup, range of functions, and software protocol for the SynqNet AKD product series. The manual can be found online at: Kollmorgen.com

A pdf format is also available on the CD-ROM included with the drive.

23.6 AKD EtherNet/IP Communication

This manual describes the installation, setup, range of functions, and software protocol for the EtherNet/IP AKD product series. The manual can be found online at: Kollmorgen.com

A pdf format is also available on the CD-ROM included with the drive.

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24 Modbus

24.1 Overview

Modbus is a simple communication protocol often used for reporting data from an industrial device to an HMI (see HMI Modbus Communication with AKD)or PLC. Modbus TCP extends the protocol to TCP/IP networks by embedding the same Protocol Data Unit within TCP/IP packets. The AKD supports a Modbus TCP service channel for connections with up to three masters.

Most drive parameters are supported over Modbus TCP (see 24.9 Modbus Parameter Table, with the exception of commands which output character strings. For information about the Modbus protocol, please see: http://www.Modbus.org/specs.php.

24.2 Modbus Installation and Setup

Modbus TCP is provided over the service port on the top of the drive (X11 connector, the connector used for WorkBench). Connect the drive and a device such as an HMI to a working Ethernet network. For ease of testing and configuration, connect a PC running WorkBench to the same network.

After booting, the drive will flash its Ethernet IP address on the front display. The drive can be accessed at this address for Modbus on port 502. WorkBench uses the same address, but a different port number.

Once the devices are connected, the connected device can open a connection to the AKD using these settings:

- IP Address: read from drive display or Workbench connect screen
- Port: 502
- Add Modbus CRC code: No

24.3 Overview of Messaging

All parameters with an internal data width of 32-bit and lower are mapped to Modbus as 32-bit (2 register) values. The contents of both registers must be read or written in the same message, by setting the Starting Address to the lowest index of the parameter and the Quantity of Registers to two.

All parameters with an internal data width of 64-bit are mapped to Modbus as 64-bit (4 register) values. The contents of all four registers must be read or written in the same message by setting the Starting Address to the lowest index of the parameter and the Quantity of Registers to four.

Parameters are scaled as in the Terminal window of WorkBench, but note that floating point values are scaled by an additional factor of 1,000 to retain precision. Drive commands which do not accept or return a value (such as DRV.EN) are executed by writing to the parameter. The data value is ignored and read attempts will result in a value of zero.

.

24.4 Supported Functions

Two Modbus functions are currently supported:

- Read Holding Registers. Function code = 0x03 (3).
- Write Multiple Registers. Function code = 0x10 (16).

To allow only 32-bit and 64-bit access, the quantity of registers is limited to two registers for 32-bit variables and four registers for 64-bit variables. You can also read/write to a single register for certain parameters. Other quantities return an exception response.

24.5 Read Holding Registers (0x03)

This function code is used to read all registers of one drive parameter.

Request

Function Code	1 Byte	0x03
Starting Address	2 Bytes	0x0000-0xFFFF (see 24.9 Modbus Parameter Table)
Quantity of Registers	2 Bytes	Two 32-bit values or four 64-bit values

Normal Response

Function Code	1 Byte	0x03
Byte Count	1 Byte	2 x N*
Register Value	N* x 2 Bytes	Data

*N = Quantity of Registers

Error Response

Function Code	1 Byte	0x83
Exception Code	1 Byte	See Exception Response Codes

Following is an example of reading the position loop feedback PL.FB at index 588 (0x024C), with an actual value of 0x1 2A05 F200.

Request

Function	03
Starting Address	02 4C
Quantity of Registers	00 04

Response

Function	03
Byte Count	08
Register 588	00 00
Register 589	00 01
Register 590	2A 05
Register 591	F2 00

24.6 Write Multiple Registers (0x10)

This function code is used to write all registers of one drive parameter.

Request

Function Code	1 Byte	0x10
Starting Address	2 Bytes	0x0000-0xFFFF (see Modbus index in parameter lists)

Quantity of Registers	2 Bytes	2 (32-bit values) or 4 (64-bit values)
Byte Count	1 Byte	2 x N*
Register Value	N* x 2 Bytes	Data

*N = Quantity of Registers

Normal Response

Function Code	1 Byte	0x10
Starting Address	2 Bytes	0x0000-0xFFFF
Quantity of Registers	2 Bytes	2 or 4

Error Response

Function Code	1 Byte	0x90
Exception Code	1 Byte	See Exception Response Codes

Following is an example of setting the mode of digital input 1 (DIN1.MODE) at index 122 (0x007A) to a value of 3.

Request

Function	10
Starting Address	00 7A
Quantity of Registers	00 02
Byte Count	04
Register 122	00 00
Register 123	00 03

Response

Function	10
Starting Address	00 7A
Quantity of Registers	00 02

24.7 Exception Response Codes

Standard Codes

Description	Exception Code
Illegal Function	1
Illegal data address	2
Illegal Data Value	3

Description	Exception Code
Slave Device Failure	4
Acknowledge	5
Slave Device Busy	6
Memory Parity Error	8
Gateway Path Unavailable	10
Gateway Target Device Failed To Respond	11

Manufacturer Codes

Description	Exception Code
Illegal Block Size (must be two registers for 32-bit and four registers for 64-bit parameters)	32
Unknown Parameter (bad address)	33
Error Processing Command (such as "Data value is greater than maximum")	34
Byte Count field is invalid in request	35

24.8 Modbus Dynamic Mapping

Modbus dynamic mapping allows you to map any of the fixed register addresses to a new register address. By re-ordering the sequence block, read/write access of the re-mapped parameters becomes possible.

In general, all parameters are mapped as 32-bit values and occupy at least two Modbus registers. Parameters with a 64-bit data width occupy four Modbus registers. All 64-bit parameters are also mapped as 32-bit value (two registers) starting at register address 2000 (see Modbus 64-bit Parameters to 32-bit Mapping).

24.8.1 Configuring Dynamic Mapping

The start address for dynamically mapped registers is 8192 (0x2000).

Mapping works as follows:

1. Enable dynamic mapping by writing a 1 (one) to register address 4096 (0x1000). Writing a 1 enables the configuration mode of dynamic mapping. Writing a zero puts it into "run" mode, in which you can use the mapped parameter.

2. The mapping is now register oriented. Next, write the valid fixed register address of the parameter you would like to map to an address starting at 8192. To map a 32-bit parameter, you must map the corresponding two registers.

   Example

   AOUT.VSCALE

   Write 36 (hi-word) to address 8192 and 37 (lo-word) to address 8193.

   The register oriented mapping allows you to optimize the data width for block transfers. To map a parameter with a data width of 16-bit, only the lo-word register needs to be mapped.

3. **Example**

   MODBUS.DIO

Write 941 to address 8194

MODBUS.DIO fixed addresses are 940 (hi-word) and 941 (lo-word). Only the lo-word is of interest (16-bit value), because only the lo-word contains the actual value.

4. Disable dynamic mapping by writing a 0 (zero) to register address 4096 (0x1000). Disabling dynamic mapping puts it in a mode where you can now access the value of the mapped parameter and use the mapped register.

   The fixed mapping starting at address 0 is still valid.

An example of the entire mapping process is included below:

Example

To re-map MODBUS.DIO (16-bit), MODBUS.DRVSTAT (16-bit), and DRV.MOTIONSTAT (32-bit):

1. Enable dynamic mapping.
2. Block write transfer to address 0x2000 (8192).

   Values: 941, 945, 268, 269
3. Modbus telegram:

   Function: 0x10; Address: 0x20, 0x00; Number of Registers: 0x00, 0x04; Data Length in Byte: 0x08; Data: 0x03, 0xAD, 0x03, 0xB1, 0x01, 0x0C, 0x01, 0x0d
4. Disable dynamic mapping.
5. Execute DRV.NVSAVE to store the mapping table non-volatile.
6. The re-mapped addresses are:

   0x2000 : MODBUS.DIO

   0x2001 : MODBUS.DRVSTAT

   0x2002 : DRV.MOTIONSTAT (hi-word)

   0x2003 : DRV.MOTIONSTAT (lo-word)

24.8.2 Saving and Resetting Dynamic Mapping

Use the following parameters to save and reset dynamic mapping:

- DRV.NVSAVE. Save parameters AND the dynamic mapping table non-volatile.
- DRV.RSTVAR. Set parameters to default value AND clear the dynamic mapping table.

24.8.3 Modbus Dynamic mapping through WorkBench Terminal

WorkBench provides an interface for configuring dynamic mapping. This allows you to save the dynamic mapping table in the WorkBench parameter file.

24.8.3.1 Modbus Overview

A value is identified through a register address and each register is a 16 bit word. To guarantee backwards compatability, each AKD parameter must have a fixed register address. However, the amount of registers needed to access a parameter depends on the parameter's data type. So if a parameter's data type is changed, the number of registers may change as well, which will result in different register addresses for all the following parameters. To avoid these register shifts, all parameters are mapped as either 32 bit words (2 registers) or 64 bit words (4 registers).

Modbus data is specified as big endian. A lower register address holds a higher rank of significance.

32 bit example:

Register address 0 → high 16 bit word

Register address 1 → low 16 bit word

24.8.3.2 Dynamic Mapping via Telnet

The following parameters can be set for dynamic mapping in WorkBench.

Parameter	Function
MODBUS.DYNMAP1	Enable dynamic mapping.
MODBUS.DYNMAP 0	Disable dynamic mapping.
MODBUS.CLRDYNMAP	Clear dynamic mapping table.

Map a complete parameter using register address. Map all registers from high to low.

Example:

PL.CMD (register address 570)

```
MODBUS.DYNMAP 1
MODBUS.CLRDYNMAP (optional)
MODBUS.ADDR8192 570
MODBUS.ADDR8193 571
MODBUS.ADDR8194 572
MODBUS.ADDR8195 573
...
MODBUS.DYNMAP 0
```

Map only the significant register from an 8 bit parameter. CAP0.EVENT, register address 58, is mapped as a 32 bit value. 58 is the high 16 bit word, and 59 is the low 16 bit word containing the parameter value. Only register 59 needs to be mapped:

```
MODBUS.ADDR8196 59
```

24.8.4 Scaling Parameters

You can scale parameters accessed through Modbus. This scaling is independent from the units of UNIT.PIN and UNIT.POUT. Instead, the user units are defined by MODBUS parameters:

- MODBUS.PIN (default = 1)
- MODBUS.POUT (default = 1)
- MODBUS.PSCALE (default = 20)

With the default settings shown above, the units are as follows:

- Position [counts (PSCALE bit per rev)]
- Velocity [counts/sec]
- Acceleration / Deceleration [counts/sec2]
- Current (Torque) [mA]

24.8.4.1 Modbus scaling example

If MODBUS.PSCALE = 20 then all position information is 20 bits.

```
POSITION = 2^20 COUNTS/REV
VELOCITY = 2^20 COUNTS/SEC
ACC/DEC = 2^20/SEC^2
```

This means that there will be 2^20 or 1,048,576 position units per rev. This affects all parameters (velocity is in position units/sec, accel and decel are in position units/sec^2)

NOTE	With 20 bits per rev, and 32 bits of data available, you can have 32 bits-20 bits = 12 bits of revs (4096 revs) before the 32 bit data is full and goes negative

The other scaling factors in Modbus are MODBUS.PIN and MODBUS.POUT.

MODBUS.PIN and MODBUS.POUT are the scaling ratio to help relate the Modbus position resolution to the drive position units resolution (or simply scale Modbus User Units). It allows you to work in user units through Modbus.

For example, if you set up the drive user units to be 10,000 counts/rev:

```
UNIT.PIN = 10,000
UNIT.POUT = 1
```

Then to have Modbus reflect the same units, set up the Modbus units:

```
MODBUS.PIN = 2^MODBUS.PSCALE = 1,048,576
MODBUS.POUT = UNIT.PIN/UNIT.POUT * 1,000 = 10,000,000
'use this also to account for the lack of a decimal point in Modbus
data
```

Then in Modbus:

```
Counts/rev = 10,000
' In Modbus you would read 10,000,000 but the data represents
10,000.000 since Modbus shows only integers.
```

24.8.5 Modbus specific registers (Parameters)

The following parameters provide a shortcut to digital I/O, status information, and commands.

Parameter	Bit
MODBUS.DIO	Bit 0 to 6: DIN.STATES Bit 16 and 17: DOUT.STATES
MODBUS.DRVSTAT	Parameters collected: Bit 0: DRV.ACTIVE (drive active) Bit 1: STO.STATUS (STO status) Bit 2: HWLS.POSSTATE (positive HW limit) Bit 3: HWLS.NEGSTATE (negative HW limit) Bit 4: SWLS.STATE (positive SW limit) Bit 5: SWLS.STATE (negative SW limit)
MODBUS.DRV	Bit 0: DRV.STOP (write 1 to execute) Bit 1: DRV.EN (write 1 to enable drive) and DRV.DIS (write 0 to disable drive)
MODBUS.HOME	Bit 0: HOME.MOVE (write 1 to execute) Bit 1: HOME.SET (write 1 to execute)

Parameter	Bit
MODBUS.MOTOR	Bit 0: MOTOR.BRAKE Bit 1: MOTOR.BRAKERLS
MODBUS.MT	Bit 0: MT.CLEAR number from MT.NUM Bit 1: MT.CONTINUE Bit 2: MT.LOAD number from MT.NUM Bit 3: MT.SET Bit 4: MT.MOVE (number from MT.NUM) Note: when both bit 2 and 4 are set then MT.SET is executed first and MT.MOVE second to start the motion task.
MODBUS.SM	Bit 0: One direction (sets SM.MODE to either 0 or 1) Bit 1: Start move Edge-triggered: • 0 → 1 : Start motion (execution of SM.MOVE) • 1 → 0 : Stop motion (execution of DRV.STOP)

24.8.6 32-bit versus 16-bit Values

Modbus mirrors all parameters either as 32-bit or 64-bit values. The minimum data width of 32-bit supports backward compatibility, which means that if the internal data width changes, this change has no effect on the register address of consecutive parameters. Dynamic mapping allows you to map only the registers that are relevant to the application and thus reduces communication overhead.

24.8.7 Mapping of 64-bit Parameters to 32-bit Parameters

All 64-bit parameters are mapped as 32-bit parameters starting at register address 2000. Only the 32-bit lo-word is mapped with the same scaling as the 64-bit parameter. Chapter 7 contains the general mapping table (chapter 7.2) and the 64-bit to 32-bit mapping table (chapter 7.3).

24.8.8 Fault Registers

Fault registers MODBUS.FAULT1 (register address 954) to MODBUS.FAULT10 (register address 972) contain the fault state of the drive.

You can obtain the current fault state as follows:

1. Read MODBUS.FAULT1.
2. If MODBUS.FAULT1 is zero, then the drive is fault free.
3. A nonzero value of MODBUS.FAULT1 is a fault number.
4. If MODBUS.FAULT1 is nonzero, the following fault registers (MODBUS.FAULT2 to MODBUS.FAULT10) contain possible further fault numbers.
5. A value of zero indicates no further faults

24.8.9 Mapping Table

The tables below show Modbus addresses and attributes. The attributes are described as follows:

Attribute	Description
64-bit Parameter	Parameter is internally a 64-bit parameter.
8-bit, 16-bit, 32-bit	Internal data size, mapped as 32-bit (2 registers).
64-bit	Internal data size, mapped as 64-bit (4 registers).
Low 32 bit word	Internally a 64-bit value, only the low 32-bit word is mapped (2 registers).

Attribute	Description
Signed	Sign bit is significant (negative/positive values are accepted).
Command	Executes a command.
Command, data width	Executes a command with numerical argument (for example, MT.NUM).

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24.9 Modbus Parameter Table

Parameter	Modbus Register Address	64-bit	Attribute
AIN.CUTOFF	0		32-bit
AIN.DEADBAND	2		16-bit
AIN.ISCALE	4		32-bit
AIN.OFFSET	6		16-bit, sig
AIN.PSCALE	8	64-bit	64-bit
AIN.VALUE	12		16-bit
AIN.VSCALE	14		32-bit
AIN.ZERO	16		Command
AOUT.ISCALE	18		32-bit
AOUT.MODE	20		16-bit
AOUT.OFFSET	22		16-bit, sig
AOUT.PSCALE	24	64-bit	64-bit
AOUT.VALUE	28	64-bit	64-bit, sig
AOUT.VALUEU	32	64-bit	64-bit, sig
AOUT.VSCALE	36		32-bit
BODE.EXCITEGAP	38		8-bit
BODE.FREQ	40		32-bit
BODE.IAMP	42		16-bit, sig
BODE.INJECTPOINT	44		8-bit
BODE.MODE	46		8-bit
BODE.MODETIMER	48		32-bit
BODE.PRBDEPTH	50		8-bit
BODE.VAMP	52	64-bit	low 32-bit
CAP0.EDGE	54		8-bit
CAP0.EN	56		8-bit
CAP0.EVENT	58		8-bit
CAP0.FILTER	60		8-bit
CAP0.MODE	62		8-bit
CAP0.PLFB	64	64-bit	64-bit, sig
CAP0.PREEDGE	68		8-bit
CAP0.PREFILTER	70		8-bit
CAP0.PRESELECT	72		8-bit
CAP0.STATE	74		8-bit
CAP0.T	76		32-bit
CAP0.TRIGGER	78		8-bit
CAP1.EDGE	80		8-bit
CAP1.EN	82		8-bit
CAP1.EVENT	84		8-bit
CAP1.FILTER	86		8-bit
CAP1.MODE	88		8-bit
CAP1.PLFB	90	64-bit	64-bit, signed
CAP1.PREEDGE	94		8-bit
CAP1.PREFILTER	96		8-bit
CAP1.PRESELECT	98		8-bit
CAP1.STATE	100		8-bit
CAP1.T	102		32-bit
CAP1.TRIGGER	104		8-bit
CS.DEC	106	64-bit	64bit
CS.STATE	110		8-bit
CS.TO	112		32-bit
CS.VTHRESH	114	64-bit	low 32-bit word
DIN.ROTARY	116		8-bit
DIN.STATES	118		8-bit
DIN1.INV	120		8-bit
DIN1.MODE	122		16-bit
DIN1.PARAM	124	64-bit	64-bit, signed
DIN1.STATE	128		8-bit
DIN2.INV	130		8-bit
DIN2.MODE	132		16-bit
DIN2.PARAM	134	64-bit	64-bit, signed
DIN2.STATE	138		8-bit
DIN3.INV	140		8-bit
DIN3.MODE	142		16-bit
DIN3.PARAM	144	64-bit	64-bit, signed
DIN3.STATE	148		8-bit
DIN4.INV	150		8-bit
DIN4.MODE	152		16-bit
DIN4.PARAM	154	64-bit	64-bit, signed
DIN4.STATE	158		8-bit
DIN5.INV	160		8-bit
DIN5.MODE	162		16-bit
DIN5.PARAM	164	64-bit	64-bit, signed
DIN5.STATE	168		8-bit
DIN6.INV	170		8-bit
DIN6.MODE	172		16-bit
DIN6.PARAM	174	64-bit	64-bit, signed
DIN6.STATE	178		8-bit
DIN7.INV	180		8-bit
DIN7.MODE	182		16-bit
DIN7.PARAM	184	64-bit	64-bit, signed
DIN7.STATE	188		8-bit
DOUT.CTRL	190		8-bit

Parameter	Modbus Register Address	64-bit	Attribute	Parameter	Modbus Register Address	64-bit	Attribute
DOUT.RELAYMODE	192		8-bit	FB1.INITSIGNED	286		8-bit, signed
DOUT.STATES	194		8-bit	FB1.MECHPOS	288		32-bit
DOUT1.MODE	196		8-bit	FB1.OFFSET	290	64-bit	64-bit, signed
DOUT1.PARAM	198	64-bit	64-bit, sig	FB1.ORIGIN	294	64-bit	64-bit
DOUT1.STATE	202		8-bit	FB1.PFIND	298		8-bit
DOUT1.STATEU	204		8-bit	FB1.PFINDCMDU	300		16-bit
DOUT2.MODE	206		8-bit	FB1.POLES	302		16-bit
DOUT2.PARAM	208	64-bit	64-bit, sig	FB1.PSCALE	304		8-bit
DOUT2.STATE	212		8-bit	FB1.RESKTR	306		16-bit
DOUT2.STATEU	214		8-bit	FB1.RESREFPHASE	308		32-bit, signed
DRV.ACC	216	64-bit	64-bit	FB1.SELECT	310		8-bit, signed
DRV.ACTIVE	220		8-bit	FB1.TRACKINGCAL	312		8-bit
DRV.CLRFAULTHIST	222		Command	FBUS.PARAM01	314		32-bit
DRV.CLRFAULTS	224		Command	FBUS.PARAM02	316		32-bit
DRV.CMDSOURCE	226		8-bit	FBUS.PARAM03	318		32-bit
DRV.DBILIMIT	228		16-bit	FBUS.PARAM04	320		32-bit
DRV.DEC	230	64-bit	64-bit	FBUS.PARAM05	322		32-bit
DRV.DIR	234		8-bit	FBUS.PARAM06	324		32-bit
DRV.DIS	236		Command	FBUS.PARAM07	326		32-bit
DRV.DISMODE	238		8-bit	FBUS.PARAM08	328		32-bit
DRV.DISSOURCES	240		16-bit	FBUS.PARAM09	330		32-bit
DRV.DISTO	242		32-bit	FBUS.PARAM10	332		32-bit
DRV.EMUEDIR	244		8-bit	FBUS.PARAM11	334		32-bit
DRV.EMUEMODE	246		16-bit	FBUS.PARAM12	336		32-bit
DRV.EMUEMTURN	248		32-bit	FBUS.PARAM13	338		32-bit
DRV.EMUERES	250		32-bit	FBUS.PARAM14	340		32-bit
DRV.EMUEZOFFSET	252		16-bit	FBUS.PARAM15	342		32-bit
DRV.EN	254		Command	FBUS.PARAM16	344		32-bit
DRV.ENDEFAULT	256		8-bit	FBUS.PARAM17	346		32-bit
DRV.HANDWHEEL	258		32-bit	FBUS.PARAM18	348		32-bit
DRV.HWENMODE	260		8-bit	FBUS.PARAM19	350		32-bit
DRV.ICONT	262		16-bit Sigr	FBUS.PARAM20	352		32-bit
DRV.IPEAK	264		16-bit Sigr	FBUS.PLLTHRESH	354		16-bit
DRV.IZERO	266		16-bit	FBUS.SAMPLEPERIOD	356		8-bit
DRV.MOTIONSTAT	268		32-bit	FBUS.SYNCACT	358		32-bit
DRV.OPMODE	270		8-bit	FBUS.SYNCDIST	360		32-bit
DRV.RSTVAR	272		Command	FBUS.SYNCWND	362		32-bit
DRV.STOP	274		Command	FBUS.TYPE	364		8-bit
DRV.TYPE	276		8-bit	GEAR.ACCMAX	366	64-bit	64-bit
DRV.ZERO	278		8-bit	GEAR.DECMAX	370	64-bit	64-bit
FB1.BISSBITS	280		8-bit	GEAR.IN	374		16-bit
FB1.ENCRES	282		32-bit	GEAR.MODE	376		16-bit
FB1.IDENTIFIED	284		8-bit	GEAR.MOVE	378		Command

Parameter	Modbus Register Address	64-bit	Attribute	Parameter	Modbus Register Address	64-bit	Attribute
GEAR.OUT	380		16-bit, sig	IL.VVFB	478		16-bit, signed
GEAR.VMAX	382	64-bit	low 32bit v	MOTOR.AUTOSET	480		8-bit
HOME.ACC	384	64-bit	64-bit	MOTOR.BRAKE	482		8-bit
HOME.AUTOMOVE	388		8-bit	MOTOR.BRAKERLS	484		8-bit
HOME.DEC	390	64-bit	64-bit	MOTOR.CTF0	486		32-bit
HOME.DIR	394		16-bit	MOTOR.ICONT	488		32-bit
HOME.DIST	396	64-bit	64-bit, sig	MOTOR.IDDATAVALID	490		8-bit
HOME.FEEDRATE	400		16-bit	MOTOR.INERTIA	492		32-bit
HOME.IPEAK	402	64-bit	64-bit, sig	MOTOR.IPEAK	494		32-bit
HOME.MODE	406		16-bit	MOTOR.KT	496		32-bit
HOME.MOVE	408		Command	MOTOR.LQLL	498		32-bit
HOME.P	410	64-bit	64-bit, sig	MOTOR.PHASE	500		16-bit
HOME.PERRTHRESH	414	64-bit	64-bit, sig	MOTOR.PITCH	502		32-bit
HOME.SET	418		Command	MOTOR.POLES	504		16-bit
HOME.V	420	64-bit	Low 32-bit	MOTOR.R	506		32-bit
HWLS.NEGSTATE	422		8-bit	MOTOR.RTYPE	508		8-bit
HWLS.POSSTATE	424		8-bit	MOTOR.TBRAKEAPP	510		16-bit
IL.BUSFF	426		16-bit, sig	MOTOR.TBRAKERLS	512		16-bit
IL.CMD	428		16-bit, sig	MOTOR.TBRAKETO	990		16-bit
IL.CMDU	430		16-bit, sig	MOTOR.TEMP	514		32-bit
IL.FB	432		16-bit, sig	MOTOR.TEMPFAULT	516		32-bit
IL.FF	434		16-bit	MOTOR.TEMPWARN	518		32-bit
IL.FOLDFTHRESH	436		16-bit	MOTOR.TYPE	520		8-bit
IL.FOLDFTHRESHU	438		32-bit, sig	MOTOR.VMAX	522		16-bit
IL.FOLDWTHRESH	440		32-bit, sig	MOTOR.VOLTMAX	524		16-bit
IL.FRICTION	442		32-bit	MOTOR.VOLTMIN	998		16.bit
IL.IFOLD	444		32-bit	MOTOR.VOLTRATED	992		16-bit
IL.IUFB	446		16-bit, sig	MOTOR.VRATED	994	Yes	64-bit, signed
IL.IVFB	448		16-bit, sig	MT.ACC	526	64-bit	64-bit
IL.KACCFF	450		32-bit, sig	MT.CLEAR	530		16-bit, signed
IL.KBUSFF	452		32-bit	MT.CNTL	532		32-bit
IL.KP	454		16-bit	MT.CONTINUE	534		Command
IL.KPDRATIO	456		32-bit	MT.DEC	536	64-bit	64-bit
IL.KVFF	458		32-bit, sig	MT.EMERGMT	540		16-bit, signed
IL.LIMITN	460		16-bit, sig	MT.LOAD	542		Command
IL.LIMITP	462		16-bit, sig	MT.MOVE	544		Command 16-bit
IL.MFOLDD	464		32-bit	MT.MTNEXT	546		8-bit
IL.MFOLDR	466		32-bit	MT.NUM	548		8-bit
IL.MFOLDT	468		32-bit	MT.P	550	64-bit	64-bit, signed
IL.MIFOLD	470		32-bit	MT.SET	554		Command 8-bit
IL.OFFSET	472		32-bit, sig	MT.TNEXT	556		16-bit
IL.VCMD	474		16-bit, sig	MT.TNUM	558		8-bit
IL.VUFB	476		16-bit, sig	MT.TPOSWND	560	64-bit	64-bit, signed

Parameter	Modbus Register Address	64-bit	Attribute
MT.TVELWND	564		32-bit
MT.V	566	64-bit	low 32-bit
MT.VCMD	568	64-bit	low 32-bit signed
PL.CMD	570	64-bit	64-bit
PL.ERR	574	64-bit	64-bit
PL.ERRMODE	578		8-bit
PL.ERRFTHRESH	580	64-bit	64-bit
PL.ERRWTHRESH	584	64-bit	64-bit
PL.FB	588	64-bit	64-bit, sig
PL.FBSOURCE	592		8-bit
PL.INTINMAX	594	64-bit	64-bit
PL.INTOUTMAX	598	64-bit	64-bit
PL.KI	602		32-bit
PL.KP	604		32-bit
PL.MODP1	606	64-bit	64-bit, sig
PL.MODP2	610	64-bit	64-bit, sig
PL.MODPDIR	614		8-bit
PL.MODPEN	616		8-bit
PLS.EN	618		16-bit
PLS.MODE	620		16-bit
PLS.P1	622	64-bit	64-bit, sig
PLS.P2	626	64-bit	64-bit, sig
PLS.P3	630	64-bit	64-bit, sig
PLS.P4	634	64-bit	64-bit, sig
PLS.P5	638	64-bit	64-bit, sig
PLS.P6	642	64-bit	64-bit, sig
PLS.P7	646	64-bit	64-bit, sig
PLS.P8	650	64-bit	64-bit, sig
PLS.RESET	654		16-bit
PLS.STATE	656		16-bit
PLS.T1	658		16-bit
PLS.T2	660		16-bit
PLS.T3	662		16-bit
PLS.T4	664		16-bit
PLS.T5	666		16-bit
PLS.T6	668		16-bit
PLS.T7	670		16-bit
PLS.T8	672		16-bit
PLS.UNITS	674		8-bit
PLS.WIDTH1	676	64-bit	64-bit, sig
PLS.WIDTH2	680	64-bit	64-bit, sig
PLS.WIDTH3	684	64-bit	64-bit, sig
PLS.WIDTH4	688	64-bit	64-bit, signed
PLS.WIDTH5	692	64-bit	64-bit, signed
PLS.WIDTH6	696	64-bit	64-bit, signed
PLS.WIDTH7	700	64-bit	64-bit, signed
PLS.WIDTH8	704	64-bit	64-bit, signed
REC.ACTIVE	708		8-bit
REC.DONE	710		8-bit
REC.GAP	712		16-bit
REC.NUMPOINTS	714		16-bit
REC.OFF	716		Command
REC.STOPTYPE	718		8-bit
REC.TRIG	720		Command
REC.TRIGPOS	722		8-bit
REC.TRIGSLOPE	726		
REC.TRIGTYPE	728		8-bit
REC.TRIGVAL	730	64-bit	8-bit
REGEN.POWER	734	64-bit	64-bitSigned,
REGEN.REXT	738		64-bit
REGEN.TEXT	740		8-bit
REGEN.TYPE	742		32-bit
REGEN.WATTEXT	744		8-bitSigned,
SM.I1	746		16-bit
SM.I2	748		16-bitSigned,
SM.MODE	750		16-bitSigned,
SM.MOVE	752		16-bit
SM.T1	754		Command
SM.T2	756		16-bit
SM.V1	758	64-bit	16-bit
SM.V2	760	64-bit	low 32-bit word, signed
STO.STATE	762		low 32-bit word, signed
SWLS.EN	764		8-bit
SWLS.LIMIT0	766	64-bit	16-bit
SWLS.LIMIT1	770	64-bit	64-bitSigned,
SWLS.STATE	774		64-bitSigned,
UNIT.ACCLINEAR	776		16-bit
UNIT.ACCROTARY	778		8-bit
UNIT.PIN	780		8-bit
UNIT.PLINEAR	782		32-bit
UNIT.POUT	784		8-bit
UNIT.PROTARY	786		32-bit
UNIT.VLINEAR	788		8-bit
UNIT.VROTARY	790		8-bit

Parameter	Modbus Register Address	64-bit	Attribute
VBUS.CALGAIN	792		8-bit
VBUS.OVFTHRESH	794		32-bit
VBUS.OVWTHRESH	796		16-bit
VBUS.RMSLIMIT	798		16-bit
VBUS.UVFTHRESH	800		8-bit
VBUS.UVMODE	802		16-bit
VBUS.UVWTHRESH	804		8-bit
VBUS.VALUE	806		16-bit
VL.ARPF1	808		32-bit
VL.ARPF2	810		32-bit
VL.ARPF3	812		32-bit
VL.ARPF4	814		32-bit
VL.ARPQ1	816		32-bit
VL.ARPQ2	818		32-bit
VL.ARPQ3	820		32-bit
VL.ARPQ4	822		32-bit
VL.ARTYPE1	824		8-bit
VL.ARTYPE2	826		8-bit
VL.ARTYPE3	828		8-bit
VL.ARTYPE4	830		8-bit
VL.ARZF1	832		32-bit
VL.ARZF2	834		32-bit
VL.ARZF3	836		32-bit
VL.ARZF4	838		32-bit
VL.ARZQ1	840		32-bit
VL.ARZQ2	842		32-bit
VL.ARZQ3	844		32-bit
VL.ARZQ4	846		32-bit
VL.BUSFF	848		32-bit, sig
VL.CMD	850	64-bit	low 32-bit signed
VL.CMDU	852	64-bit	low 32-bit signed
VL.ERR	854		32-bit, sig
VL.FB	856	64-bit	low 32-bit signed
VL.FBFILTER	858	64-bit	low 32-bit signed
VL.FBSOURCE	860		8-bit
VL.FF	862		32-bit, sig
VL.GENMODE	864		16-bit
VL.KBUSFF	866		32-bit
VL.KI	868		32-bit
VL.KO	870		32-bit
VL.KP	872		32-bit
VL.KVFF	874		32-bit
VL.LIMITN	876	64-bit	low 32-bit word, signed
VL.LIMITP	878	64-bit	low 32-bit word
VL.LMJR	880		32-bit
VL.MODEL	882		32-bit, signed
VL.OBSBW	884		32-bit
VL.OBSMODE	886		32-bit
VL.THRESH	888	64-bit	low 32-bit word, signed
WS.ARM	890		Command
WS.DISTMIN	892	64-bit	64-bit, signed
WS.DISTMIN	896	64-bit	64-bit, signed
WS.IMAX	900		16-bit, signed
WS.MODE	902		8-bit
WS.NUMLOOPS	904		8-bit
WS.STATE	906		8-bit
WS.T	908		16-bit
WS.TDELAY1	910		16-bit
WS.TDELAY2	912		16-bit
WS.TDELAY3	914		16-bit
WS.VTHRESH	916	64-bit	low 32-bit word, signed
DIN1.FILTER	918		16-bit
DIN2.FILTER	920		16-bit
DIN3.FILTER	922		16-bit
DIN4.FILTER	924		16-bit
DIN5.FILTER	926		16-bit
DIN6.FILTER	928		16-bit
DIN7.FILTER	930		16-bit
FB1.HALLSTATEU	932		
FB1.HALLSTATEV	934		
FB1.HALLSTATEW	936		
DRV.NVSAVE	938		Command
MODBUS.DIO	940		32-bit
MODBUS.DRV	942		32-bit
MODBUS.DRVSTAT	944		32-bit
MODBUS.HOME	946		32-bit
MODBUS.MOTOR	948		32-bit
MODBUS.MT	950		32-bit
MODBUS.SM	952		32-bit
MODBUS.FAULT1	954		16-bit
MODBUS.FAULT2	956		16-bit

Parameter	Modbus Register Address	64-bit	Attribute
MODBUS.FAULT3	958		16-bit
MODBUS.FAULT4	960		16-bit
MODBUS.FAULT5	962		16-bit
MODBUS.FAULT6	964		16-bit
MODBUS.FAULT7	966		16-bit
MODBUS.FAULT8	968		16-bit
MODBUS.FAULT9	970		16-bit
MODBUS.FAULT10	972		16-bit
MODBUS.PIN	974		32-bit
MODBUS.POUT	976		32-bit
MODBUS.PSCALE	978		16-bit
MODBUS.UNITLABEL	980		
MOTOR.HFPHASEREAD	982		16-bit
FB2.ENCRES	984		32-bit
FB2.MODE	986		16-bit
"FB2.SOURCE" (=> p. 238)	988		16-bit

24.10 Modbus 64-bit Parameters to 32-bit Mapping

Parameter	Address	64-bit	A
AIN.PSCALE_32	2000	Yes	lo
AOUT.PSCALE_32	2002	Yes	lo
AOUT.VALUE_32	2004	Yes	lo
AOUT.VALUEU_32	2006	Yes	lo
CAP0.PLFB_32	2008	Yes	lo
CAP1.PLFB_32	2010	Yes	lo
CS.DEC_32	2012	Yes	lo
DIN1.PARAM_32	2014	Yes	lo
DIN2.PARAM_32	2016	Yes	lo
DIN3.PARAM_32	2018	Yes	lo
DIN4.PARAM_32	2020	Yes	lo
DIN5.PARAM_32	2022	Yes	lo
DIN6.PARAM_32	2024	Yes	lo
DIN7.PARAM_32	2026	Yes	lo
DOUT1.PARAM_32	2028	Yes	lo
DOUT2.PARAM_32	2030	Yes	lo
DRV.ACC_32	2032	Yes	lo
DRV.DEC_32	2034	Yes	lo
FB1.OFFSET_32	2036	Yes	lo
FB1.ORIGIN_32	2038	Yes	lo

Parameter	Address	64-bit	Attributes
GEAR.ACCMAX_32	2040	Yes	low 32-bit word
GEAR.DECMAX_32	2042	Yes	low 32-bit word
HOME.ACC_32	2044	Yes	low 32-bit word
HOME.DEC_32	2046	Yes	low 32-bit word
HOME.DIST_32	2048	Yes	low 32-bit word, s
HOME.IPEAK_32	2050	Yes	low 32-bit word, s
HOME.P_32	2052	Yes	low 32-bit word, s
HOME.PERRTHRESH_32	2054	Yes	low 32-bit word, s
MOTOR.VRATED_32	2126	Yes	low 32-bit word, s
MT.ACC_32	2056	Yes	low 32-bit word
MT.DEC_32	2058	Yes	low 32-bit word
MT.P_32	2060	Yes	low 32-bit word, s
MT.TPOSWND_32	2062	Yes	low 32-bit word, s
PL.CMD_32	2064	Yes	low 32-bit word
PL.ERR_32	2066	Yes	low 32-bit word
PL.ERRFTHRESH_32	2068	Yes	low 32-bit word
PL.ERRWTHRESH_32	2070	Yes	low 32-bit word
PL.FB_32	2072	Yes	low 32-bit word, s
PL.INTINMAX_32	2074	Yes	low 32-bit word
PL.INTOUTMAX_32	2076	Yes	low 32-bit word
PL.MODP1_32	2078	Yes	low 32-bit word, s
PL.MODP2_32	2080	Yes	low 32-bit word, s
PLS.P1_32	2082	Yes	low 32-bit word, s
PLS.P2_32	2084	Yes	low 32-bit word, s
PLS.P3_32	2086	Yes	low 32-bit word, s
PLS.P4_32	2088	Yes	low 32-bit word, s
PLS.P5_32	2090	Yes	low 32-bit word, s
PLS.P6_32	2092	Yes	low 32-bit word, s
PLS.P7_32	2094	Yes	low 32-bit word, s
PLS.P8_32	2096	Yes	low 32-bit word, s
PLS.WIDTH1_32	2098	Yes	low 32-bit word, s
PLS.WIDTH2_32	2100	Yes	low 32-bit word, s
PLS.WIDTH3_32	2102	Yes	low 32-bit word, s
PLS.WIDTH4_32	2104	Yes	low 32-bit word, s
PLS.WIDTH5_32	2106	Yes	low 32-bit word, s
PLS.WIDTH6_32	2108	Yes	low 32-bit word, s
PLS.WIDTH7_32	2110	Yes	low 32-bit word, s
PLS.WIDTH8_32	2112	Yes	low 32-bit word, s
REC.TRIGVAL_32	2114	Yes	low 32-bit word, s
REGEN.POWER_32	2116	Yes	low 32-bit word
SWLS.LIMIT0_32	2118	Yes	low 32-bit word, s
SWLS.LIMIT1_32	2120	Yes	low 32-bit word, s
WS.DISTMAX_32	2122	Yes	low 32-bit word, s
WS.DISTMIN_32	2124	Yes	low 32-bit word, s
MOTOR.VRATED_32	2126	Yes	low 32-bit word, si

25 Appendix B - Parameter and Command Reference Guide

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AKD™

Parameter and Command Reference Guide

Edition: October 2011

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Patents Pending

Part Number: 903-200006-00

Original Document

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Revision History

Record of Document Revisions:

Revision	Remarks
12/2009	Launch version
2/2010, Rev -	Added WS feature, revised analog I/O scale functions (AIN), multiple parameter updates.
6/2010, Rev A	Modified parameters current to firmware version M_01-02-00-000. Added parameters to capture (CAP), programmable limit switch (PLS), wake and shake (WS), field bus parameters (FBUS), position loop (PL). Deleted parameters in drive (DRV), regen (REGEN), bode (BODE), feedback (FB1), GUI, and SUP.
-	Parameter and Command Reference Guide combined with User Guide in 9/2010. All revisions after 9/2010 are noted in the User Guide revisions.

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Current patents:

US Patent 5,646,496 (used in control card R/D and 1 Vp-p feedback interface)

US Patent 5,162,798 (used in control card R/D)

US Patent 6,118,241 (used in control card simple dynamic braking)

Technical changes which improve the performance of the device may be made without prior notice.

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26 About the Parameter and Command Reference Guide

This reference guide provides descriptive information about each parameter and command used in the drive firmware. Parameters and commands are used to configure the drive or to return status information from the drive using the WorkBench terminal screen. The use of these parameters and commands to perform various drive functions is detailed in related sections of the AKD User Guide.

Drive parameters and commands include the following:

AIN Parameters	FB3 Parameters	PL Parameters
AIO Parameters	FBUS Parameters	PLS Parameters
AOUT Parameters	GEAR Parameters	REC Parameters and Commands
BODE Parameters	GUI Parameters	REGEN Parameters
CAP Parameters	HOME Parameters	SM Parameters
CS Parameters	HWLS Parameters	STO Parameters
DIN Parameters	IL Parameters	SWLS Parameters
DOUT Parameters	IP Parameters	UNIT Parameters
DRV Parameters	MODBUS Paramters	VBUS Parameters
FB1 Parameters	MOTOR Parameters	VL Parameters
FB2 Parameters	MT Parameters and Commands	WS Parameters

A summary table of basic information for all parameters and commands is also available:

Summary of Parameters and Commands

For each parameter or command, this reference guide presents the following tables of information, followed by a description of the command, examples, and links to related information in the User Guide, as appropriate.

General Information	
Type	One of four types: • Command: Action or W/O command. • NV Parameter: R/W and stored in nonvolatile (NV) memory • R/W Parameter: Can be either read from or written to the drive. • R/O Parameter. Can only be read from the drive
Description	Brief description of the parameter or command and notes if the parameter or command is not active in all opmodes.
Units	Appropriate units (see Table of Units for unit descriptions)
Range	Permissible range; multiple ranges are sometimes present.
Default Value	Determined at setup process time or motor ID; otherwise set to 0.010.
Data Type	Integer, Boolean, Float, or String
See Also	Links to related information such as other parameters, block diagrams, schematics, or other sections of the product manual.
Start Version	The minimum firmware version number required to use the parameter or command

Fieldbus	Index/Subindex	Object Start Version
Fieldbus type, such as EtherCAT COE and CANopen or Modbus.	Index/subindex values for the parameter or command. The index value may be linked to the Object Dictionary for each fieldbus, if the object dictionary contains more detailed information about the object.	The minimum firmware version number required to use the fieldbus.

Additional data types may include the following:

Type	Description
Error	Illegal type=0
b	Boolean
U8	8 x unsigned numbers
S8	8 x signed numbers
U16	16 x unsigned numbers
S16	16 x signed numbers
U32	32 x unsigned numbers
S32	32 x signed numbers
U64	64 x unsigned numbers
S64	64 x signed numbers

Parameter and Command Naming Conventions

Abbreviation	Term
ACC	Acceleration
APP	Apply
CLR	Clear
CS	Controlled Stop
I	Current
D	Current d-component
DEC	Deceleration
DIR	Direction
DIS	Disable
DIST	Distance
EMUE	Emulated encoder
EN	Enable
ERR	Error
F	Fault
FB	Feedback
FF	Feedforward
K	Gain
INT	Integrator
LIM	Limit
L	Loop
MAX	Maximum
MIN	Minimum
N	Negative
NV	Nonvolatile
P	Position, Proportional, Positive
RLS	Release
R	Resistance
STATE	Status, State, Stat
THRESH	Threshold
T	Time
TMAX	Timeout
U	User
V	Velocity, Volt
W	Warning

Summary of Parameters and Commands

This table contains an alphabetical list of parameters and commands, with a brief description for each. The parameter name and description are linked to the parameter tables. The description field also notes if a parameter is not active in all opmodes. Generally speaking, all parameters and commands are active in all opmodes, with the following exceptions:

Parameter or Command	Active in Opmodes
GEAR (all parameters and commands)	2 (position) only

Parameter or Command	Active in Opmodes
HOME (all parameters and com-mands)	2 (position) only
MT (all parameters and commands)	2 (position) only
SM.I1, SM.I	0 (torque) only
SM.V1, SM.V2	1 (velocity) only
SM.VPM1, SM.VPM2	2 (position) only
VL (all parameters and commands)	1 (velocity) and 2 (position) only

Parameter or Command	Type	Description
Analog Input (AIN)		
AIN.CUTOFF	NV	Sets the analog input low-pass filter cutoff frequency.
AIN.DEADBAND	NV	Sets the analog input signal deadband.
AIN.DEADBANDMODE	NV	Sets the analog input deadband mode.
AIN.ISCALE	NV	Sets the analog current scale factor.
AIN.OFFSET	NV	Sets the analog input offset.
AIN.PSCALE	NV	Sets the analog position scale factor.
AIN.VALUE	R/O	Reads the value of the analog input signal.
AIN.VSCALE	NV	Sets analog velocity scale factor.
AIN.ZERO	Command	Zeroes the analog input signal.
Analog Input/Output (AIO)		
AIO.ISCALE	NV	Sets the analog current scale factor.
AIO.VSCALE	NV	Sets velocity scale factor.
AIO.PSCALE	NV	Sets position scale factor.
Analog Output (AOUT)		
AOUT.CUTOFF	NV	Sets the analog output low-pass filter cutoff frequency.
AOUT.DEBUGADDR	NV	Sets the memory address to debug.
AOUT.DEBUGSCALE	NV	Sets the scale to be used for debug.
AOUT.ISCALE	NV	Sets the analog current scale factor.
AOUT.MODE	NV	Sets the analog output mode.
AOUT.OFFSET	NV	Sets the analog input offset.
AOUT.PSCALE	NV	Sets the analog position scale factor.
AOUT.VALUE	NV	Reads the analog output value.
AOUT.VALUEU	R/W	Sets the analog output value.
AOUT.VSCALE	NV	Sets velocity scale factor for analog output.
Bode plot (BODE)		
BODE.EXCITEGAP	R/W	Controls how often the excitation is updated.
BODE.FREQ	R/W	Sets the frequency of the sine excitation source.
BODE.IAMP	R/W	Sets current command value used during the Bode procedure.
BODE.IFLIMIT	R/W	Sets the current fault duration limit in seconds for the BODE.MODE 5 stability test.
BODE.IFTHRESH	R/W	Sets the current fault threshold for the BODE.MODE 5 sta-bility test.
BODE.INJECTPOINT	R/W	Sets whether the excitation uses current or velocity excitation type.
BODE.MODE	R/W	Sets the mode of the excitation.
BODE.MODETIMER	R/W	Sets the watchdog timer of the excitation.

Parameter or Command	Type	Description
BODE.PRBDEPTH	R/W	Sets the length of the PRB signal before it repeats.
BODE.VAMP	R/W	Sets the amplitude of the excitation when in velocity mode.
BODE.VFLIMIT	R/W	Sets the velocity fault duration limit (seconds) for the BODE.MODE 5 stability test
BODE.VFTHRESH	R/W	Sets the current fault threshold for the BODE.MODE 5 stability test.
Capture (CAP)		
CAP0.EDGE, CAP1.EDGE	NV	Selects the capture edge.
CAP0.EN, CAP1.EN	NV	Enables or disables the related capture engine.
CAP0.EVENT, CAP1.EVENT	NV	Controls the precondition logic.
CAP0.FILTER, CAP1.FILTER	R/W	Controls the precondition logic.
CAP0.MODE, CAP1.MODE	NV	Selects the captured value.
CAP0.PLFB, CAP1.PLFB	R/O	Reads captured position value.
CAP0.PREEDGE, CAP1.PREEDGE	NV	Selects the capture precondition edge.
CAP0.PREFILTER, CAP1.PREFILTER	NV	Sets the filter for the precondition input source.
CAP0.PRESELECT, CAP1.PRESELECT	NV	Sets the precondition trigger.
CAP0.STATE, CAP1.STATE	R/O	Indicates whether or not trigger source was captured.
CAP0.T, CAP1.T	R/O	Reads time capture (if time capture was configured).
CAP0.TRIGGER, CAP1.TRIGGER	NV	Specifies the trigger source for the position capture.
Controlled Stop (CS)		
CS.DEC	NV	Sets the deceleration value for the controlled stop process.
CS.STATE	NV	Returns the internal status of the controlled stop process.
CS.TO	NV	Sets the time value for the drive velocity to be within CS.VTHRESH.
CS.VTHRESH	NV	Sets the velocity threshold for the controlled stop.
Digital Input (DIN)		
DIN.HCMD1 TO DIN.HCMD4	NV	A buffer of commands to be used in digital input "command buffer" mode.
DIN.LCMD1 to DIN.LCMD4	NV	A buffer of commands to be used in digital input "command buffer" mode.
DIN.ROTARY	R/O	Reads the rotary knob value.
DIN.STATES	R/O	Reads the digital input states.
DIN1.FILTER TO DIN7.FILTER	R/W	Filter mode for digital inputs 1 to 7.
DIO9.INV to DIO11.INV	R/W	DIO9.INV to DIO11.INV
DIN1.MODE TO DIN7.MODE	NV	Sets the digital input modes.
DIN1.PARAM TO DIN7.PARAM	R/W	Sets a value used as an extra parameter for digital inputs nodes.

Parameter or Command	Type	Description
DIN1.STATE TO DIN7.STATE	R/O	Reads a specific digital input state.
Digital Output (DOUT)		
DOUT.CTRL	NV	Sets the source of digital outputs (firmware or fieldbus).
DOUT.RELAYMODE	R/W	Indicates faults relay mode.
DOUT.STATES	R/O	Reads the state of the two digital outputs.
DOUT1.MODE to DOUT17.MODE	NV	Sets the digital output mode.
DOUT1.PARAM AND DOUT2.PARAM	NV	Sets extra parameters for the digital outputs.
DOUT1.STATE AND DOUT2.STATE	R/O	Reads the digital output state.
DOUT1.STATEU AND DOUT2.STATEU	R/W	Sets the state of the digital output node.
Drive (DRV)		
DRV.ACC	NV	Describes the acceleration ramp for the velocity central loop.
DRV.ACTIVE	R/O	Reads the enable status of an axis.
DRV.BLINKDISPLAY	Command	Causes the display to blink for 10 seconds.
DRV.CLRFAULTHIST	Command	Clears the fault history log in the NV.
DRV.CLRFAULTS	Command	Tries to clear all active faults in the drive.
DRV.CMDDELAY	R/W	Issues a delay before next command is executed.
DRV.CMDSOURCE	NV	Sets the command source (service, fieldbus, analog input, gearing, digital, or Bode).
DRV.CRASHDUMP	Command	Retrieves diagnostic information after the drive crashes.
DRV.DBILIMIT	NV	Sets the maximum amplitude of the current for dynamic braking.
DRV.DEC	NV	Sets the deceleration value for the velocity loop.
DRV.DIFFVAR	R/O	Lists all parameters which differ from their default value.
DRV.DIR	R/W	Changes drive direction.
DRV.DIS	Command	Disables the axis (software).
DRV.DISMODE	NV	Selects among disable immediately or stop and then disable options.
DRV.DISSOURCES	R/O	Returns the possible reason for a drive disable.
DRV.DISTO	R/W	Sets the emergency timeout
DRV.EMUEDIR	R/W	Sets the direction of the emulated encoder output (EEO) signal.
DRV.EMUEMODE	R/W	Sets the mode of the emulated encoder output (EEO) connector.
DRV.EMUEMTURN	R/W	Defines the location of the index pulse on the EEO (emulated encoder output) when DRV.EMUEMODE=2.
DRV.EMUEPULSEWIDTH		Sets the encoder output pulse width for modes 6 to 7.
DRV.EMUERES	R/W	Sets the resolution of the EEO (emulated encoder output).
DRV.EMUEZOFFSET	R/W	Sets the location of the EEO (emulated encoder output) index pulse (when DRV.EMUEMODE=1).
DRV.EN	Command	Enables the axis (software).
DRV.ENDEFAULT	R/W	Sets the default state of the software enable.
DRV.FAULTHIST	R/O	Reads the last 10 faults from NV memory.

Parameter or Command	Type	Description
DRV.FAULTS	R/O	Reads the active faults.
DRV.HANDWHEEL	R/O	Reads the EEO input value.
DRV.HELP	R/O	Reads the minimum, maximum, and default values for a specific parameter or command.
DRV.HELPALL	R/O	Retrieves the minimum, maximum, default, and actual values for all available parameters and commands.
DRV.HWENMODE	R/W	Selects the action that the hardware enable digital input will perform.
DRV.ICONT	R/O	Reads the continuous rated current value.
DRV.INFO	R/O	Reads general information about the drive.
DRV.IPEAK	R/O	Reads the peak rated current value.
DRV.IZERO	R/W	Sets the current that will be used during the DRV.ZERO procedure.
DRV.LIST	R/O	Reads the list of available parameters and commands.
DRV.LOGICVOLTS		Reads the logic voltages.
DRV.NAME	NV	Sets and reads the name of the drive.
DRV.NVCHECK	R/O	NV Parameter Checksum
DRV.NVLIST	R/O	Lists the NV parameters and values from the RAM.
DRV.NVLOAD	W/O	Loads all data from the NV memory of the drive into the RAM parameters.
DRV.NVSAVE	Command	Saves the drive parameters from the RAM to the NV memory.
DRV.ONTIME	R/O	Returns how long the drive has been running since last power up.
DRV.OPMODE	NV	Sets the drive operation mode (current, velocity, or position).
DRV.READFORMAT	R/W	Sets the value returned to either decimal or hexadecimal.
DRV.RSTVAR	Command	Sets default values in the drive without re-booting the drive and without resetting the NV memory.
DRV.RUNTIME	R/O	Returns how long the drive has been running since first activated.
DRV.SETUPREQBITS	R/O	Reads the bitwise set status of parameters that must be set before the drive can be enabled
DRV.SETUPREQLIST	R/O	Reads the list of parameters that must be set before the drive can be enabled.
DRV.STOP	Command	This command stops all drive motion.
DRV.TEMPERATURES	R/O	Reads the temperature of drive components.
DRV.TYPE	R/O	Selects the operational fieldbus on CC drive models.
DRV.VER	R/O	Reads the drive version.
DRV.VERIMAGE	R/O	Returns the version data from each image.
DRV.WARNINGS	R/O	Reads the active warnings.
DRV.ZERO	R/W	Sets the zero mode. The procedure is activated when the drive is enabled.
EtherNet/IP (EIP)		
EIP.POSUNIT	R/W	Unit scaling for Position values over EtherNet/IP.
EIP.PROFUNIT	R/W	Unit scaling for Velocity and Acceleration values over EtherNet/IP.
Feedback 1 (FB1)		

Parameter or Command	Type	Description
FB1.BISSBITS	NV	Specifies the number of Biss Sensor (Position) Bits for the BiSS Mode C encoder in use.
FB1.ENCRES	NV	Sets the resolution of the motor encoder.
FB1.HALLSTATE	R/O	Reads the Hall switch values (encoder feedback
FB1.HALLSTATEU	R/O	Reads the state of Hall switch U.
FB1.HALLSTATEV	R/O	Reads the state of Hall switch V.
FB1.HALLSTATEW	R/O	Reads the state of Hall switch W.
FB1.IDENTIFIED	R/O	Reads the type of feedback device used by the drive/motor.
FB1.INITSIGNED	NV	Sets initial feedback value as signed or unsigned.
FB1.MECHPOS	R/O	Reads the mechanical position.
FB1.MEMVER	R/O	Returns the memory feedback version.
FB1.OFFSET	NV	Sets position feedback offset.
FB1.ORIGIN	NV	Adds to the initial feedback position.
FB1.PFIND	R/W	A procedure that allows the user to find the commutation angle for encoder feedback, which has no halls.
FB1.PFINDCMDU	R/W	Current value used during the phase finding procedure (PFB.PFIND=1)
FB1.POLES	R/O	Reads the number of feedback poles.
FB1.PSCALE	R/W	Sets position scaling value for fieldbus transferred position objects.
FB1.RESKTR	NV	Sets the resolver nominal transformation ratio.
FB1.RESREFPHASE	NV	Sets the electrical degrees of phase lag in the resolver.
FB1.SELECT	NV	Sets user entered type or identified type (–1).
FB1.TRACKINGCAL	NV	Controls tracking calibration algorithm.
Feedback 2 (FB2)		
FB2.ENCRES	NV	Sets the secondary feedback (FB2) resolution.
FB2.MODE	R/W	Sets the mode for the second feedback inputs, EEO connector (X9) and high speed opto inputs (pins 9 and 10 on X7).
FB2.SOURCE	R/W	Sets the source for the second feedback input. Choices are the EEO connectors (X9) which are RS485 inputs, or the X7 connector's high speed opto inputs (pins 9 and 10).
Feedback 3 (FB3)		
FB3.MODE	NV	Selects the type of feedback connected to X9.
FB3.P	RO	Reads position from the tertiary feedback.
Fieldbus (FBUS)		
FBUS.PARAM1 TO FBUS.PARAM20	NV	Set fieldbus specific meanings.
FBUS.PLLSTATE	R/O	Returns the status of the PLL
FBUS.PLLTHRESH	NV	Sets number of successful synchronized cycles needed to lock the PLL.
FBUS.SAMPLEPERIOD	NV	Sets fieldbus sample period.
FBUS.SYNCACT	R/O	Reads actual distance from the desired sync distance.
FBUS.SYNCDIST	NV	Sets time target for synchronization.
FBUS.SYNCWND	NV	Sets symmetrically arranged window around the desired sync distance.
FBUS.TYPE	R/O	Shows the active fieldbus type.
Gearing (GEAR)		

Parameter or Command	Type	Description
GEAR.ACCMAX	R/W	Sets the maximum allowed acceleration value; active in opmode 2 (position) only.
GEAR.DECMAX	R/W	Sets the maximum allowed deceleration value; active in opmode 2 (position) only.
GEAR.IN	R/W	Sets the denominator of the electronic gearing ratio; active in opmode 2 (position) only.
GEAR.MODE	R/W	Selects electronic gearing mode; active in opmode 2 (position) only.
GEAR.MOVE	Command	Starts the electronic gearing; active in opmode 2 (position) only.
GEAR.OUT	R/W	Sets the numerator of the electronic gearing ratio; active in opmode 2 (position) only.
GEAR.VMAX	R/W	Reads the maximum allowed velocity value; active in opmode 2 (position) only.
Homing (HOME)		
HOME.ACC	R/W	Sets homing acceleration; active in opmode 2 (position) only.
HOME.AUTOMOVE	R/W	Sets homing auto move flag.
HOME.DEC	R/W	Sets homing deceleration; active in opmode 2 (position) only.
HOME.DIR	NV	Sets homing direction; active in opmode 2 (position) only.
HOME.DIST	R/W	Sets homing distance; active in opmode 2 (position) only.
HOME.FEEDRATE	R/W	Sets homing velocity factor; active in opmode 2 (position) only.
HOME.IPEAK	R/W	Sets the current limit during homing procedure to a mechanical stop; active in opmode 2 (position) only.
HOME.MODE	R/W	Selects the homing mode; active in opmode 2 (position) only.
HOME.MOVE	Command	Starts a homing procedure; active in opmode 2 (position) only.
HOME.P	R/W	Sets home position; active in opmode 2 (position) only.
HOME.PERRTHRESH	R/W	Sets the position lag threshold; active in opmode 2 (position) only.
HOME.REQUIRE	NV	Defines if the axis must be homed before a motion task can be executed.
HOME.SET	Command	Immediately sets the home position; active in opmode 2 (position) only.
HOME.V	R/W	Sets homing velocity; active in opmode 2 (position) only.
Hardware Limit Switch (HWLS)		
HWLS.NEGSTATE	R/O	Reads the status of the negative hardware limit switch.
HWLS.POSSTATE	R/O	Reads the status of the positive hardware limit switch.
Current Loop (IL)		
IL.BUSFF	R/O	Displays the current feedforward value injected by the field-bus.
IL.CMD	R/O	Reads the value of the q-component current controller inside the FPGA.
IL.CMDU	R/W	Sets the user current command.
IL.DIFOLD	R/O	Reads the drive foldback current limit.
IL.FB	R/O	Reads the actual value of the d-component current.
IL.FF	R/O	Displays the current loop overall feedforward value.

Parameter or Command	Type	Description
IL.FOLDFTHRESH	NV	Reads the foldback fault level.
IL.FOLDFTHRESHU	NV	Sets the user value for the foldback fault level.
IL.FOLDWTHRESH	NV	Sets the foldback warning level.
IL.IFOLD	R/O	Reads the overall foldback current limit.
IL.IUFB	R/O	Reads the sigma-delta measured current in the u-winding of the motor.
IL.KACCFF	R/W	Sets current loop acceleration feedforward gain value
IL.KBUSFF	R/W	Current loops fieldbus injected feed-forward gain
IL.KP	NV	Sets the proportional gain of the q-component of the PI regulator.
IL.KPDRATIO	NV	Sets the proportional gain of the d-component current PI-regulator as a percentage of IL.KP
IL.KPLOOKUPINDEX	R/W	Sets the index into the Current Loop Gain Scheduling Table.
IL.KPLOOKUPVALUE	R/W	Sets the value of the current loop gain scheduling index.
IL.KPLOOKUPVALUES	R/W	Gets the Current Loop Gain Scheduling Table.
IL.KVFF	R/W	Current loop velocity feed-forward gain.
IL.LIMITN	NV	Sets the negative user (application-specific) current limit.
IL.LIMITP	NV	Sets the positive user (application-specific) current limit.
IL.MFOLDD	NV	Sets the motor foldback maximum time at motor peak current.
IL.MFOLDR	R/O	Sets the motor foldback recovery time.
IL.MFOLDT	NV	Sets the motor foldback time constant of the exponential current drop (foldback).
IL.MI2T	R/O	Motor I2t load
IL.MI2TWTHRESH	NV	Motor I2t load warning threshold
IL.MIFOLD	R/O	Sets the motor foldback current limit.
IL.MIMODE	NV	Motor protection mode
IL.OFFSET	RW	A constant current command added to compensate for gravity.
IL.VCMD	R/O	Sets the output of the q-component PI regulator.
IL.VUFB	R/O	Reads the measured voltage on the u-winding of the motor.
IL.VVFB	R/O	Reads the measured voltage on the v-winding of the motor.
IP (Internet Protocol)Parameters		
IP.ADDRESS	IP Address	Gets/Sets the IP address of the drive
IP.GATEWAY	IP Address	Gets/Sets the gateway IP of the drive
IP.MODE	N/A	Sets method of acquiring IP Address.
IP.RESET	N/A	Implements new IP settings.
IP.SUBNET	IP Address	Gets/Sets the IP Subnet mask of the drive
LOAD Parameters		
LOAD.INERTIA	NV	Sets the load inertia.
MODBUS Parameters		
MODBUS.PIN	?	Gets / Sets the Modbus User Units Input parameter
MODBUS.POUT	?	Gets / Sets the Modbus User Units Output parameter.
MODBUS.PSCALE	?	Gets/Sets the Feedback Resolution (per rev) over Modbus.
MODBUS.SCALING	NV	Selects the scaling mode for Modbus values.
MODBUS.UNITLABEL	?	Labels the scaled reslution of a single motor turn.

Motor Parameters		

MOTOR.AUTOSET	NV	Determines which drive parameters are calculated automatically.
MOTOR.BRAKE	NV	Sets the presence or absence of a motor brake.
MOTOR.BRAKERLS	Command	Allows a user to release the motor brake.
MOTOR.BRAKESTATE	R/O	Reads the actual status of the motor brake.
MOTOR.CTF0	NV	Sets the thermal constant of the motor coil.
MOTOR.ICONT	NV	Sets the motor continuous current.
MOTOR.IDDATAVALID	R/O	Reports the status of the motor memory.
MOTOR.INERTIA	NV	Sets the motor inertia.
MOTOR.IPEAK	NV	Sets the motor peak current.
MOTOR.KE		Sets the motor back EMF constant.
MOTOR.KT	NV	Sets the torque constant of the motor.
MOTOR.LQLL	NV	Sets the line-to-line motor Lq.
MOTOR.NAME	NV	Sets the motor name.
MOTOR.PHASE	NV	Sets the motor phase.
MOTOR.PITCH	NV	Sets the motor pitch.
MOTOR.POLES	NV	Sets the number of motor poles.
MOTOR.R	NV	Sets the stator winding resistance phase-phase in ohms.
MOTOR.RTYPE	NV	Defines the type of thermal resistor inside the motor.
MOTOR.TBRAKEAPP	NV	The delay time used for applying the motor brake.
MOTOR.TBRAKERLS	NV	The delay time used for releasing the motor brake.
MOTOR.TEMP	R/O	Reads the motor temperature represented as the resistance of the motor PTC.
MOTOR.TEMPFAULT	NV	Sets the motor temperature fault level.
MOTOR.TEMPWARN	NV	Sets the motor temperature warning level.
MOTOR.TYPE	NV	Sets the motor type.
MOTOR.VMAX	NV	Sets the maximum motor speed.
MOTOR.VOLTMAX	NV	Sets the motor maximum voltage.
MOTOR.VOLTMIN	NV	Sets the minimum voltage for V/f control.
MOTOR.VOLTRATED	NV	Sets the motor rated voltage.
MOTOR.VRATED	NV	Sets the motor rated velocity (not maximum velocity).
Motion Task (MT)		
MT.ACC	R/W	Specifies motion task acceleration; active in opmode 2 (position) only.
MT.CLEAR	Command	Clears motion tasks from the drive; active in opmode 2 (position) only.
MT.CNTL	R/W	Sets motion task control word; active in opmode 2 (position) only.
MT.CONTINUE	Command	Continues a stopped motion task; active in opmode 2 (position) only.
MT.DEC	R/W	Sets motion task deceleration; active in opmode 2 (position) only.
MT.EMERGMT	R/W	Selects a motion task to be triggered after an emergency stop procedure; active in opmode 2 (position) only.
MT.HOMEREQUIRE	NV	Removed in 01-04-00-000
MT.LIST	Command	Lists all initialized motion tasks in the drive; active in opmode 2 (position) only.
MT.LOAD	Command	Reads/loads a motion task number from the drive; active in opmode 2 (position) only.
MT.MOVE	Command	Starts a motion task; active in opmode 2 (position) only.
MT.MTNEXT	R/W	Specifies following motion task number; active in opmode 2 (position) only.
MT.NUM	R/W	Sets the motion task number; active in opmode 2 (position) only.
MT.P	R/W	Sets the motion task position; active in opmode 2 (position) only.

MT.PARAMS	Command	Shows a motion task; active in opmode 2 (position) only.
MT.SET	Command	Sets the motion task in the drive; active in opmode 2 (position) only.
MT.TNEXT	R/W	Specifies following motion task time; active in opmode 2 (position) only.
MT.TNUM	R/W	Motion task customer table number.
MT.TNVSAVE	Command	Saves the motion profile tables to the nonvolatile memory.
MT.TPOSWND	R/W	Sets the motion task target position window; active in opmode 2 (position) only.
MT.TVELWND	R/W	Sets the motion task target velocity window; active in opmode 2 (position) only.
MT.V	R/W	Sets the motion task velocity; active in opmode 2 (position) only.
MT.VCMD	R/O	Reads the derivative of PL.CMD; active in opmode 2 (position) only.
Position Loop (PL)		
PL.CMD	NV	Reads the position command directly from the entry to the position loop.
PL.ERR	NV	Reads the position error present when the drive is controlling the position loop.
PL.ERRFTHRESH	NV	Sets the maximum position error.
PL.ERRMODE	R/W	Sets the type of following error warning and fault usage.
PL.ERRWTHRESH	NV	Sets the position error warning level.
PL.FB	R/O	Reads the position feedback value.
PL.FBSOURCE	NV	Sets the feedback source for the position loop.
PL.INTINMAX	NV	Limits the input of the position loop integrator by setting the input saturation.
PL.INTOUTMAX	NV	Limits the output of the position loop integrator by setting the output saturation.
PL.KI	NV	Sets the integral gain of the position loop.
PL.KP	NV	Sets the proportional gain of the position regulator PID loop.
PL.MODP1	R/W	Sets modulo range parameter.
PL.MODP2	R/W	Sets the beginning or end modulo range parameter.
PL.MODPDIR	R/W	Sets the direction for absolute motion tasks.
PL.MODPEN	R/W	Enables the modulo position.
Programmable Limit Switch (PLS)		
PLS.EN	R/W	Enables programmable limit switch (PLS).
PLS.MODE	NV	Selects programmable limit switch mode.
PLS.P1 TO PLS.P8	NV	Sets the trigger point for programmable limit switches.
PLS.RESET	W/O	Resets programmable limit switch.
PLS.STATE	R/O	Reads the programmable limit switch state.
PLS.T1 TO PLS.T8	R/W	Sets programmable limit switch time.
PLS.UNITS	R/W	Sets programmable limit switch (PLS) units.
PLS.WIDTH1 TO PLS.WIDTH8	R/W	Programmable Limit Switch Width
Recorder (REC)		
REC.ACTIVE	R/O	Indicates if data recording is in progress (active).
REC.CH1 to REC.CH6	R/W	Sets recording channels 1 to 6.
REC.DONE	R/O	Checks whether or not the recorder has finished recording.
REC.GAP	R/W	Specifies the gap between consecutive samples.

REC.NUMPOINTS	R/W	Sets the number of points to record.
REC.OFF	R/W	Turns the recorder OFF.
REC.RECPRMLIST	R/O	Reads the list of recordable parameters.
REC.RETRIEVE	R/O	Transfers all the recorded data to the communication channel.
REC.RETRIEVEDATA	R/W	Retrieves the recorded data without the header.
REC.RETRIEVEFRMT	R/W	Sets the format for recorded data output.
REC.RETRIEVEHDR	R/O	Retrieves the recorded header without the data.
REC.RETRIEVESIZE	R/W	Sets the number of samples that REC.RETRIEVEDATA returns.
REC.STOPTYPE	R/W	Sets the recorder stop type.
REC.TRIG	Command	Triggers the recorder.
REC.TRIGPARAM	R/W	Sets the parameter that triggers the recorder.
REC.TRIGPOS	R/W	Sets the trigger position in the recording buffer.
REC.TRIGPRMLIST	R/O	Reads the list of possible trigger parameters.
REC.TRIGSLOPE	R/W	Sets the trigger slope.
REC.TRIGTYPE	R/W	Sets the trigger type.
REC.TRIGVAL	R/W	Sets the trigger value.
Regen Resistor (REGEN)		
REGEN.POWER	R/O	READS REGEN RESISTOR'S CALCULATED POWER.
REGEN.REXT	N/V	SETS THE EXTERNAL, USER-DEFINED REGEN RESISTOR RESISTANCE.
REGEN.TEXT	R/W	Sets the external regen resistor thermal protection time constant.
REGEN.TYPE	N/V	SETS THE REGEN RESISTOR TYPE.
REGEN.WATTEXT	R/W	SETS THE REGEN RESISTOR'S POWER FAULT LEVEL FOR AN EXTERNAL REGEN RESISTOR.
Service Motion (SM)		
SM.I1	R/W	Sets service motion current 1; active in opmode 0 (torque) only.
SM.I2	R/W	Sets service motion current 2; active in opmode 0 (torque) only.
SM.MODE	R/W	Sets the service motion mode.
SM.MOVE	Command	Starts the service motion.
SM.T1	R/W	Sets the service motion time 1.
SM.T2	R/W	Sets the service motion time 2.
SM.V1	R/W	Sets service motion velocity 1; active in opmode 1 (velocity) and 2 (position).
SM.V2	R/W	Sets service motion velocity 2; active in opmode 1 (velocity) and 2 (position).
STO		
STO.STATE	R/O	Returns the status of the safe torque off.
SWLS		
SWLS.EN	NV	Enables and disables software travel limit switches.
SWLS.LIMIT0	NV	Sets the position of the software travel limit switch 0.
SWLS.LIMIT1	NV	Sets the position of the software travel limit switch 0.
SWLS.STATE	R/O	Reads the actual status of software limit switches.
Units (UNIT)		
UNIT.ACCLINEAR	NV	Sets the linear acceleration/deceleration units.
UNIT.ACCROTARY	NV	Sets the rotary acceleration/deceleration units.
UNIT.LABEL	NV	Sets user-defined name for user-defined position units.
UNIT.PIN	NV	Sets gear IN for the unit conversion.

UNIT.PLINEAR	NV	Sets the linear position units.
UNIT.POUT	NV	Sets gear out for the unit conversion.
UNIT.PROTARY	NV	Sets the position units when the motor type (MOTOR.TYPE) is rotary.
UNIT.VLINEAR	NV	Sets the linear velocity units.
UNIT.VROTARY	NV	Sets the velocity units when the motor type (MOTOR.TYPE) is rotary.
Bus voltage (VBUS)		
VBUS.HALFVOLT	NV	Changing voltage thresholds for HV and MV Drives
VBUS.OVFTHRESH	R/O	Reads the over voltage fault level.
VBUS.OVWTHRESH	N/V	Sets voltage level for over voltage warning.
VBUS.RMSLIMIT	R/O	Reads the limit for the bus capacitors load.
VBUS.UVFTHRESH	R/O	Sets the under voltage fault level.
VBUS.UVMODE	NV	Indicates undervoltage (UV) mode.
VBUS.UVWTHRESH	NV	Sets voltage level for undervoltage warning.
VBUS.VALUE	R/O	Reads DC bus voltage.
Velocity Loop (VL)		
VL.ARPF1 TO VL.ARPF4	R/W	Sets the natural frequency of the pole (denominator) of anti-resonance (AR) filters 1, 2, 3, and 4; active in opmodes 1 (velocity) and 2 (position) only.
VL.ARPQ1 TO VL.ARPQ4	R/W	Sets the Q of the pole (denominator) of anti-resonance (AR) filter 1; active in opmodes 1 (velocity) and 2 (position) only.
VL.ARTYPE1 TO VL.ARTYPE4	NV	Indicates the method used to calculate BiQuad coefficients; active in opmodes 1 (velocity) and 2 (position) only.
VL.ARZF1 TO VL.ARZF4	R/W	Sets the natural frequency of the zero (numerator) of anti-resonance (AR)filter 1; active in opmodes 1 (velocity) and 2 (position) only.
VL.ARZQ1 TO VL.ARZQ4	R/W	Sets the Q of the zero (numerator) of anti-resonance filter #1; active in opmodes 1 (velocity) and 2 (position) only.
VL.BUSFF	R/O	Displays the velocity loop feedforward value injected by the field-bus; active in opmodes 1 (velocity) and 2 (position) only.
VL.CMD	R/O	Reads the actual velocity command; active in opmodes 1 (velocity) and 2 (position) only.
VL.CMDU	R/W	Sets the user velocity command; active in opmodes 1 (velocity) and 2 (position) only.
VL.ERR	R/O	Sets the velocity error; active in opmodes 1 (velocity) and 2 (position) only.
VL.FB	R/O	Reads the velocity feedback; active in opmodes 1 (velocity) and 2 (position) only.
VL.FBFILTER	R/O	Filters VL.FB value; active in opmodes 1 (velocity) and 2 (position) only.
VL.FBSOURCE	NV	Sets feedback source for the velocity loop; active in opmodes 1 (velocity) and 2 (position) only.
VL.FBUNFILTERED	R/O	Reads the velocity feedback.
VL.FF	R/O	Displays the velocity loop overall feedforward value; active in opmodes 1 (velocity) and 2 (position) only.
VL.GENMODE	NV	Selects mode of velocity generation (Observer, d/dt); active in opmodes 1 (velocity) and 2 (position) only.
VL.KBUSFF	R/W	Sets the velocity loop acceleration feedforward gain value; active in opmodes 1 (velocity) and 2 (position) only.
VL.KI	NV	Sets the velocity loop integral gain for the PI controller; active in opmodes 1 (velocity) and 2 (position) only.

VL.KP	NV	Sets velocity loop proportional gain for the PI controller; active in opmodes 1 (velocity) and 2 (position) only.
VL.KVFF	R/W	Sets the velocity loop velocity feedforward gain value; active in opmodes 1 (velocity) and 2 (position) only.
VL.LIMITN	NV	Sets the velocity lower limit; active in opmodes 1 (velocity) and 2 (position) only.
VL.LIMITP	NV	Sets the velocity high limit; active in opmodes 1 (velocity) and 2 (position) only.
VL.LMJR	R/W	Sets the ratio of the estimated load moment of inertia relative to the motor moment of inertia; active in opmodes 1 (velocity) and 2 (position) only.
VL.MODEL	R/O	Reads the observer velocity signal; active in opmodes 1 (velocity) and 2 (position) only.
VL.OBSBW	NV	Sets the bandwidth of the observer in Hz.
VL.OBSMODE	NV	Sets the observer operating mode.
VL.THRESH	NV	Sets the over speed fault value; active in opmodes 1 (velocity) and 2 (position) only.
Virtual Machine (VM)		
VM.STATE	R/O	Returns the state of the AKD Virtual Machine.
Wake and Shake (WS)		
WS.ARM	Command	Sets wake and shake to start at the next drive enable.
WS.DISARM	Command	Cancels ARM requests and resets wake and shake to the IDLE state.
WS.DISTMAX	R/W	Sets maximum movement allowed for wake and shake.
WS.DISTMIN	R/W	Sets the minimum movement required for wake and shake.
WS.IMAX	R/W	Sets maximum current used for wake and shake.
WS.MODE	R/W	Sets the method used for wake and shake.
WS.NUMLOOPS	R/W	Sets the number of repetitions for wake and shake.
WS.STATE	R/O	Reads wake and shake status
WS.T	R/W	Sets wake and shake current-vector appliance time
WS.TDELAY1	NV	Delay for wake and shake timing
WS.TDELAY2	NV	Sets the delay for wake and shake timing.
WS.TDELAY3	NV	Sets the delay for wake and shake between loops in mode 0.
WS.VTHRESH	NV	Defines the maximum allowed velocity for Wake & Shake

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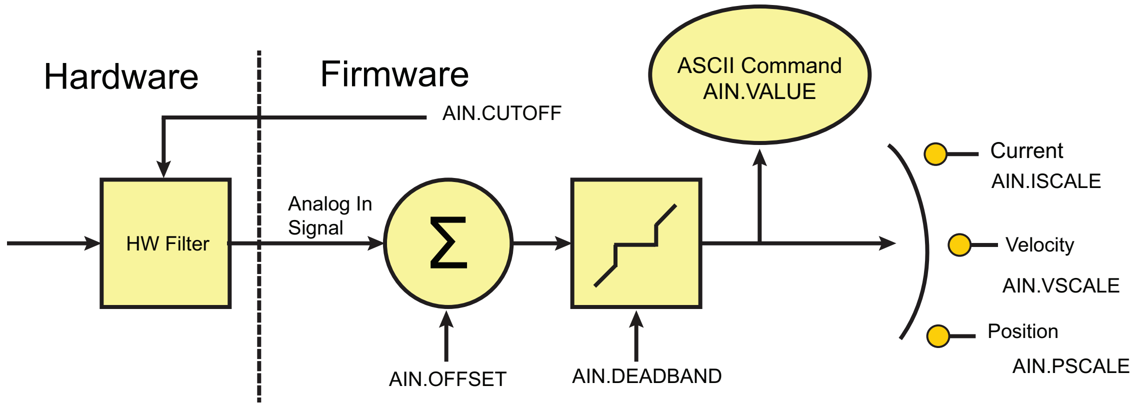
27 AIN Parameters

This section describes the analog input (AIN) parameters. AIN parameters function as shown in the block diagram below:

Analog Input Block Diagram



27.1 AIN.CUTOFF

General Information	
Type	NV Parameter
Description	Sets the analog input low-pass filter cutoff frequency.
Units	Hz
Range	0 to 10,000 Hz
Default Value	5,000 Hz
Data Type	Float
See Also	Analog Input Block Diagram
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	0	M_01-03-00-000

Description

AIN.CUTOFF sets the break frequency in Hz for two cascaded single-pole low-pass filters on the hardware command input. Since the two poles are cascaded at the same frequency, the -3 dB frequency is 0.64*AIN.CUTOFF in hertz and the 10% to 90% step response rise time is 0.53/AIN.CUTOFF in seconds.

Suggested operating values are as follows:

- Analog torque opmode: 5 kHz
- Analog velocity opmode: 2.5 kHz
- General purpose analog input high resolution: 500 Hz

Related Topics

11.4 Analog Input

Velocity Controller Environment Block Diagram (for the drive controller environment).

27.2 AIN.DEADBAND

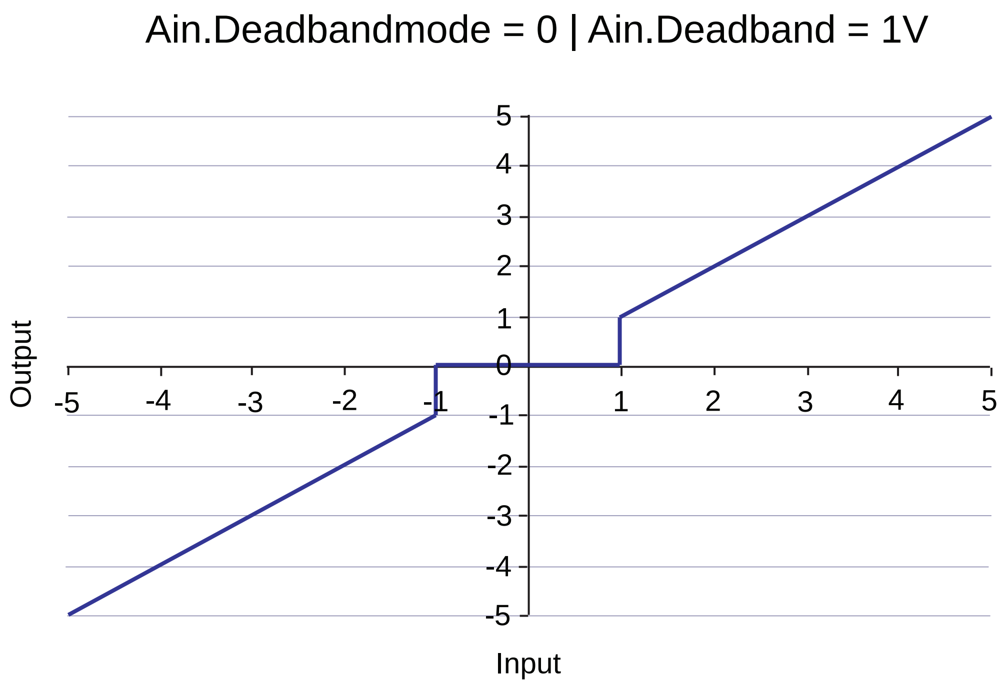
General Information	
Type	NV Parameter
Description	Sets the analog input signal dead-band.
Units	V
Range	0 to 12.5 V
Default Value	0 V
Data Type	Float
See Also	Analog Input Block Diagram
Start Version	M_01-00-00-000

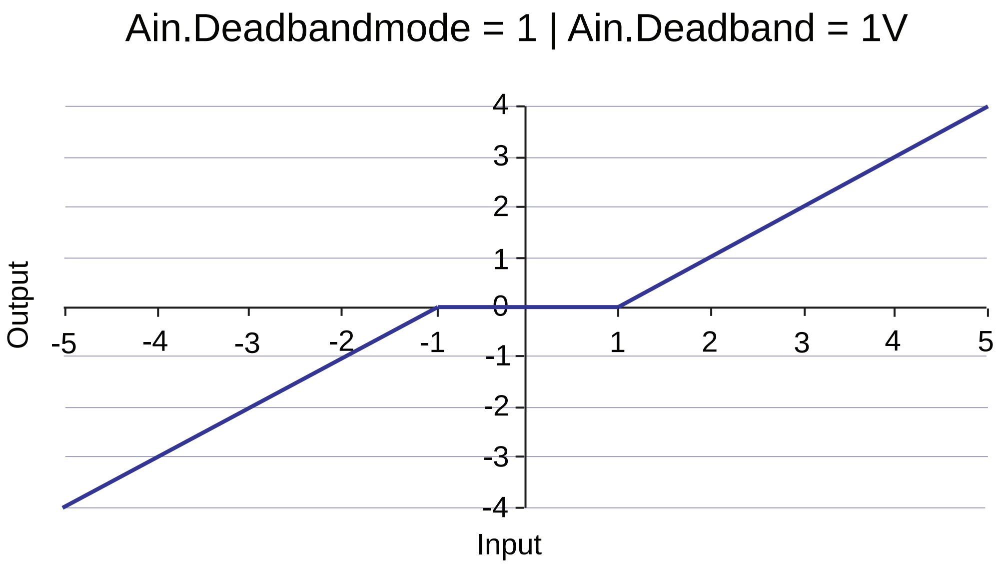
Fieldbus	Index/Subindex	Object Start Version
Modbus	2	M_01-03-00-000

Description

AIN.DEADBAND sets the deadband of the analog input signal. When AIN.DEADBANDMODE is set to 0, and the value of the analog input is less than the value of AIN.DEADBAND, the analog command will be 0. When the analog input is greater or equal to the AIN.DEADBAND, then the analog command will be generated using the scaling specified.

When AIN.DEADBANDMODE is set to 1, the analog command is 0 if the input is less than the deadband value. When the input is greater than the deadband, the output is equal to (Input - Deadband) * Scaling. Below are illustrations of this behavior.





Related Topics

11.4 Analog Input

Velocity Controller Environment Block Diagram (for the drive controller environment).

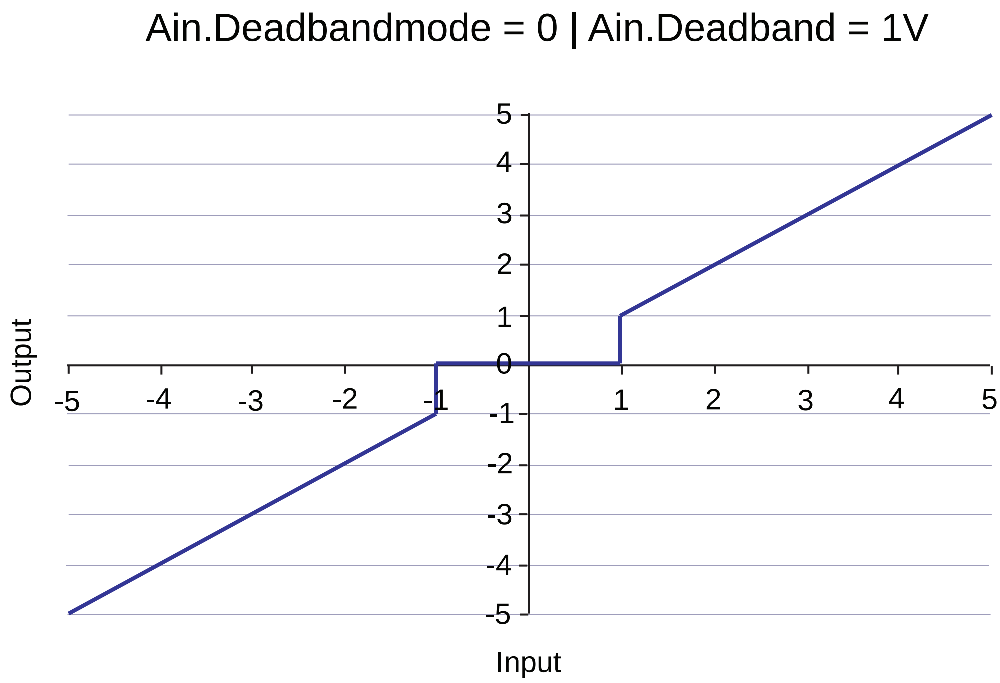
27.3 AIN.DEADBANDMODE

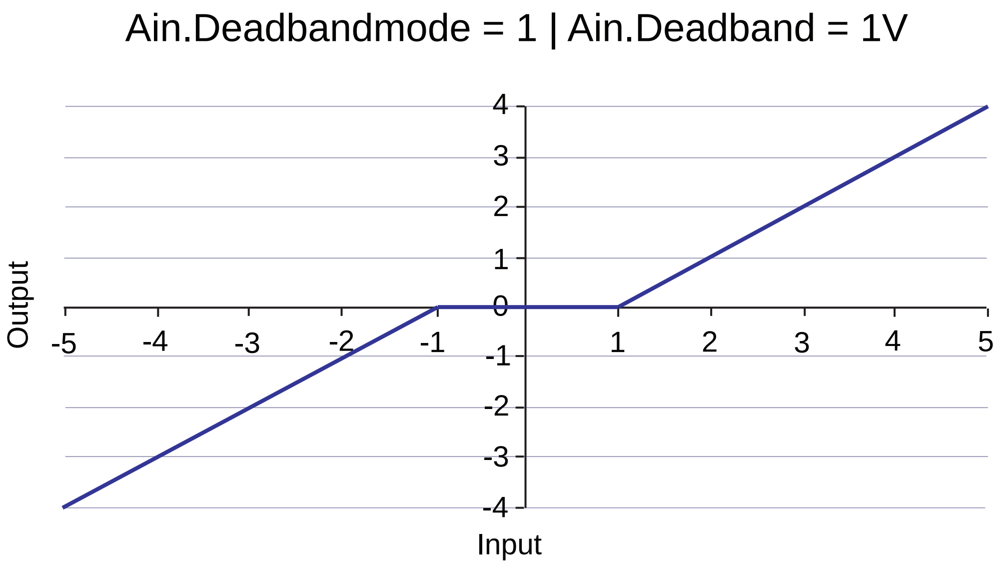
General Information	
Type	NV Parameter
Description	Sets the analog input deadband mode.
Units	N/A
Range	0 to 1
Default Value	0
Data Type	Integer
See Also	AIN.DEADBAND
Start Version	M_01-03-06-000

Description

When AIN.DEADBANDMODE is set to 0, and the value of the analog input is less than the value of AIN.DEADBAND, the analog command will be 0. When the analog input is greater or equal to the AIN.DEADBAND, then the analog command will be generated using the scaling specified.

When AIN.DEADBANDMODE is set to 1, the analog command is 0 if the input is less than the deadband value. When the input is greater than the deadband, the output is equal to (Input - Deadband) * Scaling. Below are illustrations of this behavior.





Related Topics

11.4 Analog Input

Velocity Controller Environment Block Diagram (for the drive controller environment).

27.4 AIN.ISCALE

General Information	
Type	NV Parameter
Description	Sets the analog current scale factor.
Units	A/V
Range	0.001 to 22.4 A/V
Default Value	0.001 A/V
Data Type	Float
See Also	Analog Input Block Diagram
Start Version	M_01-01-01-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	4	M_01-03-00-000

Description

AIN.ISCALE sets the analog current scale factor that scales the analog input (AIN.VALUE) for DRV.OPMODE = 1 (analog torque mode).

The value entered is the motor current per 10 V of analog input. This value may be either higher or lower than 100%, but the actual analog input will be limited by the application current limit (IL.LIMITN and IL.LIMITP).

Related Topics

11.4 Analog Input

Velocity Controller Environment Block Diagram (for the drive controller environment).

27.5 AIN.MODE

General Information	
Type	NV Parameter
Description	Analog input mode
Units	N/A
Range	0 to 2
Default Value	1
Data Type	Integer
See Also	Analog Input Block Diagram
Start Version	M_01-04-09-000

SynqNet Information	
Range	0

Description

The parameter AIN.MODE is used to assign a functionality to the voltage measured on the analog input pin.

0 – The analog input value is not used by any function.

1 – This mode only works when DRV.CMDSOURCE is set to 3 (analog). The measured voltage will be scaled with:

- AIN.ISCALE if DRV.OPMODE has been set to 0 (torque mode)
- AIN.VSCALE if DRV.OPMODE has been set to 1 (velocity mode)
- AIN.PSCALE if DRV.OPMODE has been set to 2 (position mode).

Afterwards, the value will be forwarded as a command value to the control-loops.

2 – This mode is used for generating a target velocity of a motion task. This mode works when DRV.OPMODE is set to 2 (position) and DRV.CMDSOURCE is set to 0 (service). The measured voltage will be scaled with AIN.VSCALE.

A motion task with the control-word bit 16 set to true (see also MT.CNTL) will capture the velocity-scaled value upon a motion task trigger command and use this value as the target velocity to be reached by that motion task.

Related Topics

MT.CNTL

DRV.OPMODE

27.6 AIN.OFFSET

General Information	
Type	NV Parameter
Description	Sets the analog input offset.
Units	V
Range	–10 to +10 V
Default Value	0 V
Data Type	Float
See Also	Analog Input Block Diagram, AIN.ZERO
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	6	M_01-03-00-000

Description

AIN.OFFSET sets the analog offset, which is added to the analog input command to the drive. This value compensates for the analog input signal (AIN.VALUE) offset or drift.

Related Topics

11.4 Analog Input

Velocity Controller Environment Block Diagram (for the drive controller environment).

27.7 AIN.PSCALE

General Information	
Type	NV Parameter
Description	Sets the analog position scale factor.
Units	Depends on UNIT.PROTARY or UNIT.PLINEAR Rotary: counts/V,rad/V, deg/V, (custom units)/V, 16-bit counts/V Linear: counts/V, mm/V, µm/V, (custom units)/V, 16-bit counts/V
Range	Rotary: 1 to 9,223,372,036,854,775 counts/V 0 to 13,493,026.816 rad/V 0.06 to 179.0 deg/V 0 to 10,737,418.240 (PIN/POUT)/V 0 to 140,737,488,355.327 16-bit counts/V Linear: 1 to 9,223,372,036,854,775 counts/V 0 to 2,147,483.648 mm/V 0 to 2,147,483,648.000 µm/V 0 to 10,737,418.240 (PIN/POUT)/V 0 to 140,737,488,355.327 16-bit counts/V
Default Value	Rotary: 1 counts/V 0 rad/V 0 deg/V 0 (PIN/POUT)/V 0 16-bit counts/V Linear: 1 count/V 0 rad/V 0 deg/V 0 (PIN/POUT)/V 0 16-bit counts/V
Data Type	Float
See Also	N/A
Start Version	M_01-01-01-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CAN-open	3472h/0	M_01-00-00-000
Modbus	8 (64-bit)	M_01-03-00-000

Description

AIN.PSCALE is an analog position scale factor that scales the analog input (AIN.VALUE) for DRV.OPMODE = 2 , DRV.CMDSOURCE = 3 (analog position mode).

Related Topics

11.4 Analog Input

Velocity Controller Environment Block Diagram (for the drive controller environment).

27.8 AIN.VALUE

General Information	
Type	R/O Parameter
Description	Reads the value of the analog input signal.
Units	V
Range	-12.5 to +12.5 V
Default Value	N/A
Data Type	Float
See Also	AIN.OFFSET, AIN.ZERO, Analog Input Block Diagram
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CANopen	3470h/4 3509h/0	M_01-00-00-000
Modbus	12	M_01-03-00-000

Description

AIN.VALUE reads the analog input value after the value is filtered (as shown in the Analog Input Block Diagram).

Related Topics

11.4 Analog Input

Velocity Controller Environment Block Diagram (for the drive controller environment).

27.9 AIN.VSCALE

General Information	
Type	NV Parameter
Description	Sets analog velocity scale factor.
Units	Depends on UNIT.VROTARY or UNIT.ACCLINEAR Rotary: rpm/V, rps/V, (deg/s)/V, [(custom units)/s]/V, (rad/s)/V Linear: counts/s/V, (mm/s)/V, (µm/s)/V, [(custom units)/s]/V
Range	Rotary: 0.060 to 60,000 rpm/V 0.001 to 1,000 rps/V 0.359 to 360,000 (deg/s)/V 0.005 to 5,000 [(custom units)/s]/V 0.006 to 6,283.186 (rad/s)/V Linear: 0.001 to 1.000 counts/s/V 0.001*MOTOR.PITCH to 1,000.000*MOTOR.PITCH (mm/s)/V 0.998*MOTOR.PITCH to 1,000,000.000*MOTOR.PITCH (µm/s)/V 0.005 to 5,000 [(custom units)/s]/V
Default Value	Rotary: 0.060 rpm/V 0.001 rps/V 0.359 (deg/s)/V 0.005 [(custom units)/s]/V 0.006 (rad/s)/V Linear: 0.001 counts/s/V 0.001*MOTOR.PITCH (mm/s)/V 0.998*MOTOR.PITCH (µm/s)/V 0.005 to 5,000 [(custom units)/s]/V
Data Type	Float
See Also	N/A
Start Version	M_01-02-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CAN-open	3629h/0	M_01-00-00-000
Modbus	14	M_01-03-00-000

Description

AIN.VSCALE is an analog velocity scale factor that scales the analog input AIN.VALUE) for DRV.OPMODE = 1 (analog velocity mode).

The value entered is the motor velocity per 10 V of analog input. This value may be either higher or lower than the application velocity limit (VL.LIMITP orVL.LIMITN), but the actual analog I/O will be limited by VL.LIMITP or VL.LIMITN.

Related Topics

11.4 Analog Input

Velocity Controller Environment Block Diagram (for the drive controller environment).

27.10 AIN.ZERO

General Information	
Type	Command
Description	Zeroes the analog input signal.
Units	N/A
Range	N/A
Default Value	N/A
Data Type	N/A
See Also	AIN.VALUE, AIN.OFFSET
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CANopen	N/A	M_01-00-00-000
Modbus	16	M_01-03-00-000

Description

AIN.ZERO causes the drive to zero the analog input signal (AIN.VALUE). You may need to execute this command more than once to achieve zero offset, and AIN.OFFSET is modified in this process.

Related Topics

11.4 Analog Input

Velocity Controller Environment Block Diagram (for the drive controller environment).

28 AIO Parameters

This section describes the AIO parameters.

28.1 AIO.ISCALE

General Information	
Type	NV Parameter
Description	Sets the analog current scale factor.
Units	A/V
Range	0.001 to 22.4 A/V
Default Value	0.001 A/V
Data Type	Float
See Also	Analog Input Block Diagram
Start Version End Version	M_01-00-00-000 M_01-01-01-000

Description

AIO.ISCALE sets the analog current scale factor that scales the following:

- The analog input (AIN.VALUE) for DRV.OPMODE = 0 (analog torque mode), DRV.CMDSOURCE = 3 (analog).
- The analog output (AOUT.VALUE) for AOUT.MODE = 5 or 6. The value entered is the motor current per 1 V of analog input or output. This value may be either higher or lower than 100%, but the actual analog I/O will be limited by the application current limit (IL.LIMITN and IL.LIMITP).

28.2 AIO.PSCALE

General Information	
Type	NV Parameter
Description	Sets position scale factor.
Units	Depends on UNIT.PROTARY or UNIT.PLINEAR Rotary: counts/V,rad/V, deg/V, (custom units)/V, 16-bit counts/V Linear: counts/V, mm/V, um/V, (custom units)/V, 16-bit counts/V
Range	Rotary: 1 to 9,223,372,036,854,775 counts/V 0 to 13,493,026.816 rad/V 0 to 773,094,113.280 deg/V 0 to 10,737,418.240 (custom units)/V 0 to 140,737,488,355.327 16-bit counts/V Linear: 1 to 9,223,372,036,854,775 counts/V 0 to 2147483.648 mm/V 0 to 2147483648.000 um/V 0 to 10737418.240 (custom units)/V 0 to 140737488355.327 16-bit counts/V
Default Value	Rotary: 1 counts/V 0 rad/V 0 deg/V 0 (custom units)/V 0 16-bit counts/V Linear: 1 count/V 0 rad/V 0 deg/V 0 (custom units)/V 0 counts16 bit/V
Data Type	Float
See Also	Analog Input Block Diagram
Start Version End Version	M_01-00-00-000 M_01-01-01-000

Description

AIO.PSCALE is an analog position scale factor that scales:

1. The analog input (AIN.VALUE) for DRV.OPMODE = 2 , DRV.CMDSOURCE = 3 (analog position mode)

2. The analog output (AOUT.VALUE) for AOUT.MODE = 6, or 7. (actual position or position error) per 10 V of analog input or output.

28.3 AIO.VSCALE

General Information	
Type	NV Parameter
Description	Sets velocity scale factor.
Units	Depends on UNIT.VROTARY or UNIT.ACCLINEAR Rotary: rpm/V, rps/V, (deg/s)/V, [(custom units)/s]/V, (rad/s)/V Linear: counts/s/V, (mm/s)/V, (um/s)/V, [(custom units)/s]/V
Range	Rotary: 0.060 to 60,000 rpm/V 0.001 to 1,000 rps/V 0.359 to 360,000 (deg/s)/V 0.005 to 5,000 [(custom units)/s]/V 0.006 to 6,283.186 (rad/s)/V Linear: 0.001 to 1.000 counts/s/V 0.001*MOTOR.PITCH to 1,000.000*MOTOR.PITCH (mm/s)/V 0.998*MOTOR.PITCH to 1,000,000.000*MOTOR.PITCH (um/s)/V 0.005 to 5,000 [(custom units)/s]/V
Default Value	Rotary: 0.060 rpm/V 0.001 rps/V 0.359 (deg/s)/V 0.005 [(custom units)/s]/V 0.006 (rad/s)/V Linear: 0.001 counts/s/V 0.001*MOTOR.PITCH (mm/s)/V 0.998*MOTOR.PITCH (um/s)/V 0.005 to 5,000 [(custom units)/s]/V
Data Type	Float
See Also	Analog Input Block Diagram
Start Version End Version	M_01-00-00-000 M_01-01-01-000

Description

AIO.VSCALE is an analog velocity scale factor that scales:

1. The analog input (AIN.VALUE) for DRV.OPMODE = 2 (analog velocity mode)
2. The analog output (AOUT.VALUE) for AOUT.MODE = 1, 3, or 7. The value entered is the motor velocity per 10 V of analog input or output. This value may be either higher or lower than the application velocity limit (VL.LIMITP or VL.LIMITN), but the actual analog I/O will be limited by VL.LIMITP or VL.LIMITN.

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29 AOUT Parameters

This section describes the AOUT parameters.

29.1 AOUT.CUTOFF

General Information	
Type	NV Parameter
Description	Sets the analog output low-pass filter cutoff frequency.
Units	Hz
Range	0 to 10,000 Hz
Default Value	0 Hz
Data Type	Float
See Also	Analog Output
Start Version	M_01-04-01

Description

AOUT.CUTOFF sets the cutoff frequency in Hz for a single-pole low-pass filter on the Analog Output.

A value of 0 Hz will turn off the filter and will allow all frequencies to pass through.

The filter can be used with all modes of Analog Output.

Related Topics

11.5 Analog Output

29.2 AOUT.DEBUGADDR

General Information	
Type	NV Parameter
Description	Sets the memory address to debug.
Units	N/A
Range	4 to 4,292,870,142
Default Value	4
Data Type	Integer
See Also	AOUT.MODE
Start Version	M_01-01-01-000

Description

AOUT.DEBUGADDR sets the memory address to debug when AOUT.MODE = 9 (debug mode).

Related Topics

11.5 Analog Output

29.3 AOUT.DEBUGSCALE

General Information	
Type	NV Parameter
Description	Sets the scale to be used for debug.
Units	N/A
Range	0.001 to 9,223,372,036,854,775.000
Default Value	1
Data Type	Float
See Also	AOUT.MODE
Start Version	M_01-01-01-000

Description

AOUT.DEBUGSCALE sets the scale to be used for debug when AOUT.MODE = 9 (debug mode).

Related Topics

11.5 Analog Output

29.4 AOUT.ISCALE

General Information	
Type	NV Parameter
Description	Sets the analog current scale factor.
Units	A/V
Range	0.001 to 22.4 A/V
Default Value	0.001 to 22.4 A/V
Data Type	Float
See Also	AOUT.VALUE
Start Version	M_01-01-01-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	18	M_01-03-00-000

Description

AOUT.ISCALE sets the analog current scale factor that scales the analog output (AOUT.VALUE) for AOUT.MODE = 4 or 5. The value entered is the motor current per 10 V of analog input or output. This value may be either higher or lower than 100%, but the actual analog I/O will be limited by the application current limit (IL.LIMITN and IL.LIMITP).

Related Topics

11.5 Analog Output

29.5 AOUT.MODE

General Information	
Type	NV Parameter
Description	Sets the analog output mode.
Units	N/A
Range	0 to 11
Default Value	0
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CAN-open	3470h/1	M_01-00-00-000
Modbus	20	M_01-03-00-000

SynqNet Information	
Range	12

Description

AOUT.MODE sets the analog output functionality.

AOUT.MODE	Description
0	User variable. The analog output signal is determined by the user (using AOUT.VALUEU).
1	Actual velocity. The analog signal describes the current velocity value (VL.FB).
2	Velocity error. The analog signal describes the velocity error value.
3	Velocity command. The analog signal describes the velocity command value.
4	Actual current. The analog signal describes the actual current value.
5	Current command. The analog signal describes the current command value.
6	Actual position. The analog signal describes the current position value.
7	Position error. The analog signal describes the position error value.
8	Triangle wave. The analog signal is a triangle wave (sawtooth pattern).
9	Debug mode. In this mode the user can define a drive variable to monitor via the analog output (AOUT.VALUEU).
10	Unfiltered Velocity (VL.FBUNFILTERED)
11	Filtered Velocity - 10Hz Lowpass (VL.FBFILTER)

Example

You can use AOUT.MODE and AOUT.VALUEU to configure an output signal as follows:

```
-->AOUT.MODE 0
-->AOUT.VALUEU 5
-->AOUT.VALUEU 4.33
```

Related Topics

11.5 Analog Output

29.6 AOUT.OFFSET

General Information	
Type	NV Parameter
Description	Sets the analog input off-set.
Units	V
Range	-10 to +10 V
Default Value	0 V
Data Type	Float
See Also	N/A
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	22	M_01-03-00-000

Description

This parameter sets the analog input offset.

Related Topics

11.5 Analog Output

29.7 AOUT.PSCALE

General Information	
Type	NV Parameter
Description	Sets the analog position scale factor.
Units	Depends on UNIT.PROTARY or UNIT.PLINEAR Rotary: counts/V,rad/V, deg/V, (custom units)/V, 16-bit counts/V Linear: counts/V, mm/V, µm/V, (custom units)/V, 16-bit counts/V
Range	Rotary: 1 to 9,223,372,036,854,775 counts/V 0 to 13,493,026.816 rad/V 0 to 773,094,113.280 deg/V 0 to 10,737,418.240 (custom units)/V 0 to 140,737,488,355.327 16-bit counts/V Linear: 1 to 9,223,372,036,854,775 counts/V 0 to 2,147,483.648 mm/V 0 to 2,147,483,648.000 µm/V 0 to 10,737,418.240 (custom units)/V 0 to 140,737,488,355.327 16-bit counts/V
Default Value	Rotary: 1 counts/V 0 rad/V 0 deg/V 0 (custom units)/V 0 16-bit counts/V Linear: 1 counts/V 0 rad/V 0 deg/V 0 (custom units)/V 0 counts16 bit/V
Data Type	Float
See Also	AOUT.VALUE
Start Version	M_01-01-01-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CAN-open	3471h/0	M_01-00-00-000
Modbus	24 (64-bit)	M_01-03-00-000

Description

AOUT.PSCALE is an analog position scale factor that scales the analog output (AOUT.VALUE) for AOUT.MODE = 6, or 7 (actual position or position error) per 10 V of analog input or output.

Related Topics

11.5 Analog Output

29.8 AOUT.VALUE

General Information	
Type	R/O Parameter
Description	Reads the analog output value.
Units	V
Range	–10 to +10 V
Default Value	0
Data Type	Float
See Also	N/A
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CAN-open	3470h/2	M_01-00-00-000
Modbus	28 (64-bit)	M_01-03-00-000

Description

AOUT.VALUE reads the analog output value. This parameter can also be used to set the value of the analog output when AOUT.MODE = 0 (analog output signal is determined by the user).

Related Topics

11.5 Analog Output

29.9 AOUT.VALUEU

General Information	
Type	R/W Parameter
Description	Sets the analog output value.
Units	V
Range	–10 to +10 V
Default Value	0
Data Type	Float
See Also	N/A
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CAN-open	3470h/3	M_01-00-00-000
Modbus	32 (64-bit)	M_01-03-00-000

Description

AOUT.VALUEU reads/writes the analog output value when AOUT.MODE = 0 (analog output signal is determined by the user).

Related Topics

11.5 Analog Output

29.10 AOUT.VSCALE

General Information	
Type	NV Parameter
Description	Sets velocity scale factor for analog output.
Units	Depends on UNIT.VROTARY or UNIT.ACCLINEAR Rotary: rpm/V, rps/V, (deg/s)/V, [(custom units)/s]/V, (rad/s)/V Linear: counts/s/V, (mm/s)/V, (µm/s)/V, [(custom units)/s]/V
Range	Rotary: 0.060 to 60,000 rpm/V 0.001 to 1,000 rps/V 0.359 to 360,000 (deg/s)/V 0.005 to 5,000 [(custom units)/s]/V 0.006 to 6,283.186 (rad/s)/V Linear: 0.001 to 1.000 counts/s/V 0.001*MOTOR.PITCH to 1,000.000*MOTOR.PITCH (mm/s)/V 0.998*MOTOR.PITCH to 1,000,000.000*MOTOR.PITCH (µm/s)/V 0.005 to 5,000 [(custom units)/s]/V
Default Value	Rotary: 0.060 rpm/V 0.001 rps/V 0.359 (deg/s)/V 0.005 [(custom units)/s]/V 0.006 (rad/s)/V Linear: 0.001 counts/s/V 0.001*MOTOR.PITCH (mm/s)/V 0.998*MOTOR.PITCH (µm/s)/V 0.005 [(custom units)/s]/V
Data Type	Float
See Also	AOUT.VALUE
Start Version	M_01-01-01-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CANopen	3470h/5	M_01-00-00-000
Modbus	36	M_01-03-00-000

Description

AOUT.VSCALE is an analog velocity scale factor that scales the analog output (AOUT.VALUE) for AOUT.MODE = 1, 2, or 3. The value entered is the motor velocity per 10 V of analog output. This value may be either higher or lower than the application velocity limit (VL.LIMITP or VL.LIMITN), but the actual analog I/O will be limited by VL.LIMITP or VL.LIMITN.

30 BODE Parameters

This section describes the BODE parameters.

30.1 BODE.EXCITEGAP

General Information	
Type	R/W Parameter
Description	Controls how often the excitation is updated.
Units	Drive samples
Range	1 to 255 drive samples
Default Value	2 drive samples
Data Type	N/A
See Also	BODE.MODE
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	38	M_01-03-00-000

Description

BODE.EXCITEGAP controls how often the excitation is updated. The excitation is updated every n drive samples, where n is BODE.EXCITEGAP. For example, if BODE.EXCITEGAP = 2, then the excitation is updated every 2/(16,000 Hz) = 1/8,000 Hz = 0.000125 sec. When measuring a system, update the excitation only as often as the data is recorded.

Example

Set excitation update rate to 8,000 Hz:

```
-->BODE.EXCITEGAP 2
```

Set excitation update rate to 4,000 Hz:

```
-->BODE.EXCITEGAP 4
```

Get excitation update rate (already set to 8000 Hz):

```
-->BODE.EXCITEGAP 2
```

Related Topics

15.3 Using the Performance Servo Tuner

15.3.5 Using the Performance Servo Tuner: Advanced

16 Scope

1.2.1.5 Bode (set command source)

6.7 Settings

F126

Error: Invalid Bode plot mode for this function. and other errors)

30.2 BODE.FREQ

General Information	
Type	R/W Parameter
Description	Sets the frequency of the sine excitation source.
Units	Hz
Range	0 to 8,000 Hz
Default Value	0 Hz
Data Type	Float
See Also	BODE.MODE BODE.INJECTPOINT, BODE.IAMP, BODE.VAMP
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	40	M_01-03-00-000

Description

BODE.FREQ sets the frequency of the sine excitation source in Hz. The sine excitation source is used to take frequency response measurements of a system.

Example

Setting up a sine excitation source of 0.2 A at 50 Hz:

```
-->BODE.INJECTPOINT 1
-->BODE.IAMP 0.2
-->BODE.FREQ 50.0
-->BODE.MODE 2
```

Related Topics

15.3 Using the Performance Servo Tuner

15.3.5 Using the Performance Servo Tuner: Advanced

16 Scope

1.2.1.5 Bode (set command source)

6.7 Settings

F126

Error: Invalid Bode plot mode for this function. and others)

30.3 BODE.IAMP

General Information	
Type	R/W Parameter
Description	Sets current command value used during the Bode procedure.
Units	A
Range	+/- Combined drive and motor current limit
Default Value	0.2 A
Data Type	Float
See Also	BODE.INJECTPOINT, BODE.FREQ
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	42	M_01-03-00-000

Description

BODE.IAMP sets the amplitude of the excitation when in current mode as set in BODE.INJECTPOINT. When using BODE.MODE = 1 and BODE.INJECTPOINT = 1, this parameter will determine the level of noise injected to commanded current value.

Example

Set the excitation current to 0.2 A:

```
-->BODE.IAMP 0.2
```

Get the excitation current (already set to 0.2 A):

```
-->BODE.IAMP 0.200 [A]
```

Related Topics

15.3 Using the Performance Servo Tuner

15.3.5 Using the Performance Servo Tuner: Advanced

16 Scope

1.2.1.5 Bode (set command source)

6.7 Settings

F126

Error: Invalid Bode plot mode for this function. and others)

30.4 BODE.IFLIMIT

General Information	
Type	R/W Parameter
Description	Sets the current fault duration limit in seconds for the BODE.MODE 5 stability test.
Units	s
Range	0.001 to 60.000
Default Value	0
Data Type	Decimal
See Also	BODE.MODE,BODE.MODETIMER, BODE.IFTHRESH, BODE.VFLIMIT, BODE.VFTHRESH
Start Version	M_01-02-10-000

Description

When BODE.MODE is set to 5, the firmware monitors the drive current (IL.CMD). When IL.CMD goes above BODE.IFTHRESH, an internal counter records the length of time IL.CMD was above BODE.IFTHRESH. If the internal counter reaches BODE.IFLIMIT, Fault 133 – Instability during Autotune will be generated.

The smaller BODE.IFLIMIT, the quicker Fault 133 will be generated when IL.CMD exceeds BODE.IFLIMIT.

Example

Set BODE.IFTHRESH to 6 Amps:

```
-->BODE.IFTHRESH 6
```

Set BODE.IFLIMIT to 0.500 seconds:

```
-->BODE.IFLIMIT 0.5
```

Set BODE.MODE to 5 to enable stability detection:

```
BODE.MODE 5
```

Related Topics

15.3 Using the Performance Servo Tuner

15.3.5 Using the Performance Servo Tuner: Advanced

F133

30.5 BODE.IFTHRESH

General Information	
Type	R/W Parameter
Description	Sets the current fault threshold for the BODE.MODE 5 stability test.
Units	A
Range	0.001 to DRV.IPEAK or MOTOR.IPEAK (whichever is lowest) A
Default Value	0 A
Data Type	Decimal
See Also	BODE.MODE,BODE.MODETIMER, BODE.VFLIMIT, BODE.VFTHRESH , BODE.IFLIMIT
Start Version	M_01-02-10-000

Description

When BODE.MODE is set to 5, the firmware monitors the drive current (IL.CMD). When IL.CMD goes above BODE.IFTHRESH, an internal counter records the length of time IL.CMD was above BODE.IFTHRESH. If the internal counter reaches BODE.IFLIMIT, Fault 133 (Instability during Autotune) is generated.

Example

Set BODE.IFTHRESH to 6 Amps:

```
-->BODE.IFTHRESH 6
```

Set BODE.IFLIMIT to 0.500 seconds:

```
-->BODE.IFLIMIT 0.5
```

Set BODE.MODE to 5 to enable stability detection:

```
BODE.MODE 5
```

Related Topics

15.3 Using the Performance Servo Tuner

15.3.5 Using the Performance Servo Tuner: Advanced

F133

30.6 BODE.INJECTPOINT

General Information	
Type	R/W Parameter
Description	Sets whether the excitation uses current or velocity excitation type.
Units	N/A
Range	0 to 2
Default Value	0
Data Type	Integer
See Also	BODE.IAMP, BODE.MODE, BODE.VAMP
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	44	M_01-03-00-000

Description

BODE.INJECTPOINT sets whether the excitation uses current or velocity excitation type.

BODE.INJECTPOINT	Description
0	None
1	Current
2	Velocity

Example

Set BODE.INJECTPOINT to current:

```
-->BODE.INJECTPOINT 1
```

Get BODE.INJECTPOINT (already set to current):

```
-->BODE.INJECTPOINT 1
```

Related Topics

15.3 Using the Performance Servo Tuner

15.3.5 Using the Performance Servo Tuner: Advanced

16 Scope

1.2.1.5 Bode (set command source)

6.7 Settings

F126

Error: Invalid Bode plot mode for this function. and others)

30.7 BODE.MODE

General Information	
Type	R/W Parameter
Description	Sets the mode of the excitation.
Units	N/A
Range	0 to 4
Default Value	0
Data Type	Integer
See Also	BODE.INJECTPOINT BODE.VAMP
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	46	M_01-03-00-000

Description

BODE.MODE sets the mode of the excitation. The excitation can be set to the modes shown in the table below. BODE.MODE is always set to **None** when Ethernet communication is disconnected. The peak amplitude of the excitation is set by either BODE.IAMP or BODE.VAMP (depending on BODE.INJECTPOINT).

BODE.MODE is subject to a watchdog timer (BODE.MODETIMER) as follows:

- If BODE.MODETIMER is 0, then BODE.MODE is not affected.
- If BODE.MODETIMER is set to a value greater than 0, then BODE.MODE will be set to 0 (None) after the BODE.MODETIMER time milliseconds.
- If BODE.MODE is a nonzero value, and you reset BODE.MODE to another nonzero value, you will reset the watchdog timer. This mechanism is intended to turn off the excitation signal if you lose communication with the drive.

BODE.MODE	Description	Comments
0	None	Turns all excitation off
1	PRB	Uses Pseudo Random Binary (PRB) excitation. PRB is a signal that is always +/- peak amplitude, varying only in phase. PRB excitation results in a flat excitation frequency spectrum. PRB results in a high peak excitation amplitude, which can help minimize friction in a frequency response test. PRB excitation repeats every (2^BODE.PRBDEPTH) / BODE.EXCITEGAP drive samples. This repetition can be used to reveal the effects of friction.
2	Sine	Uses Sine excitation
3	Noise	Uses random noise excitation. Noise is a random number generator that varies between +/- peak amplitude.
4	Offset	Sets a torque offset equal to BODE.IAMP

Example

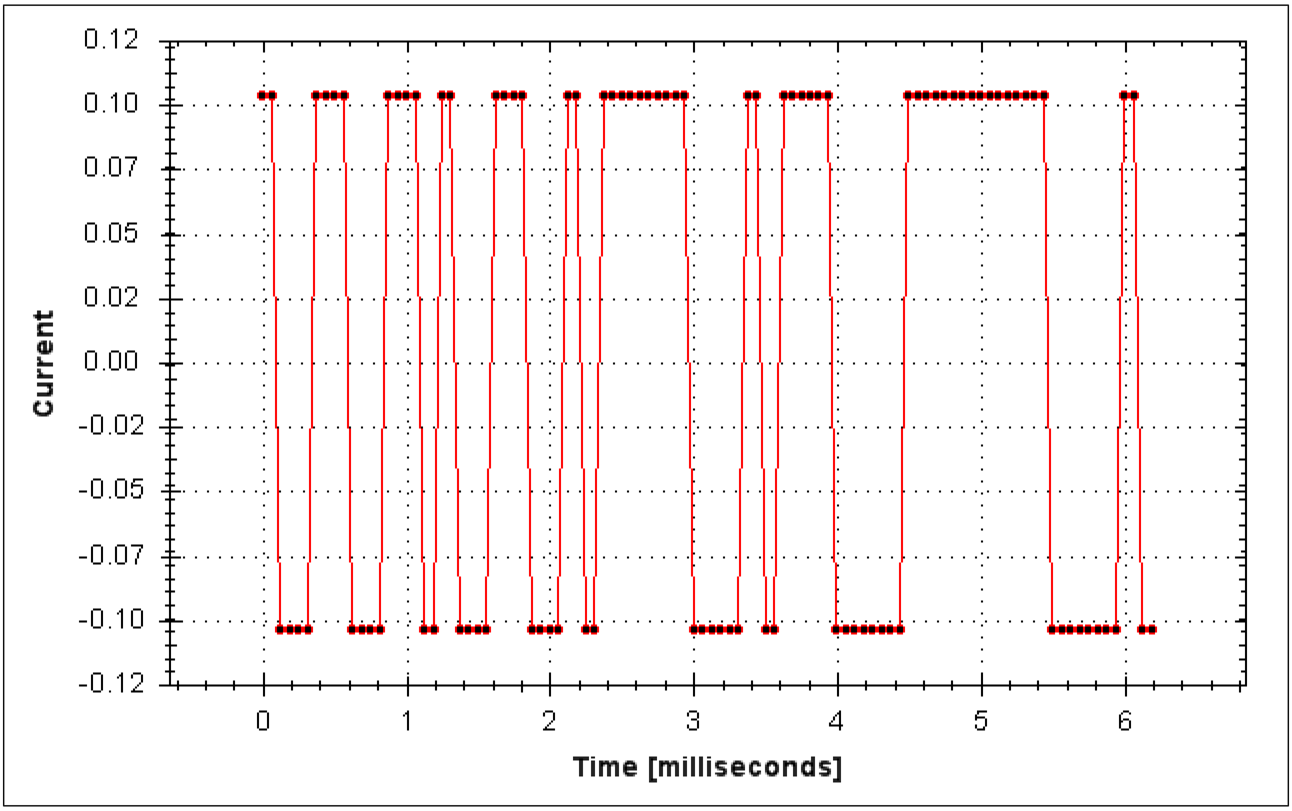
Set BODE.MODE to PRB:

```
-->BODE.MODE 1
```

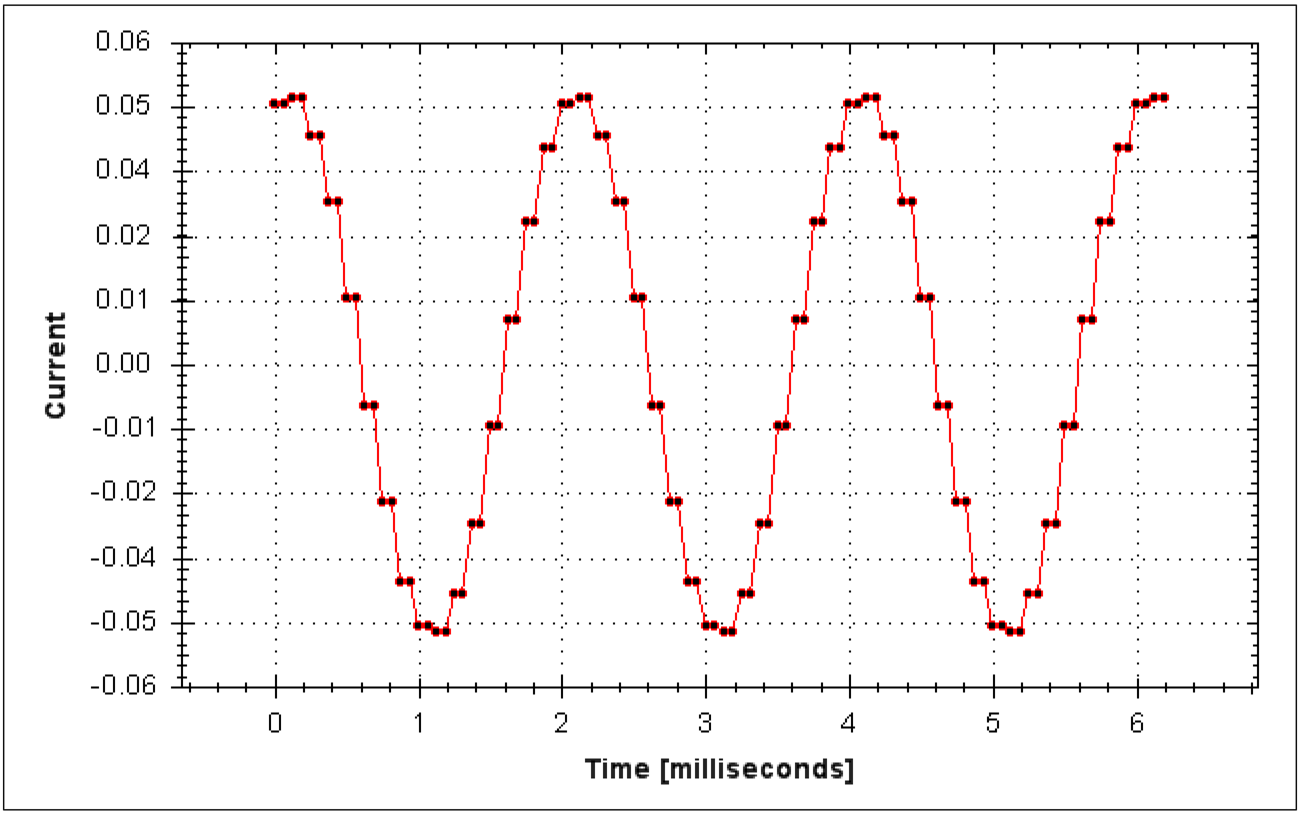
Get BODE.MODE (already set to PRB):

`-->BODE.MODE 1`

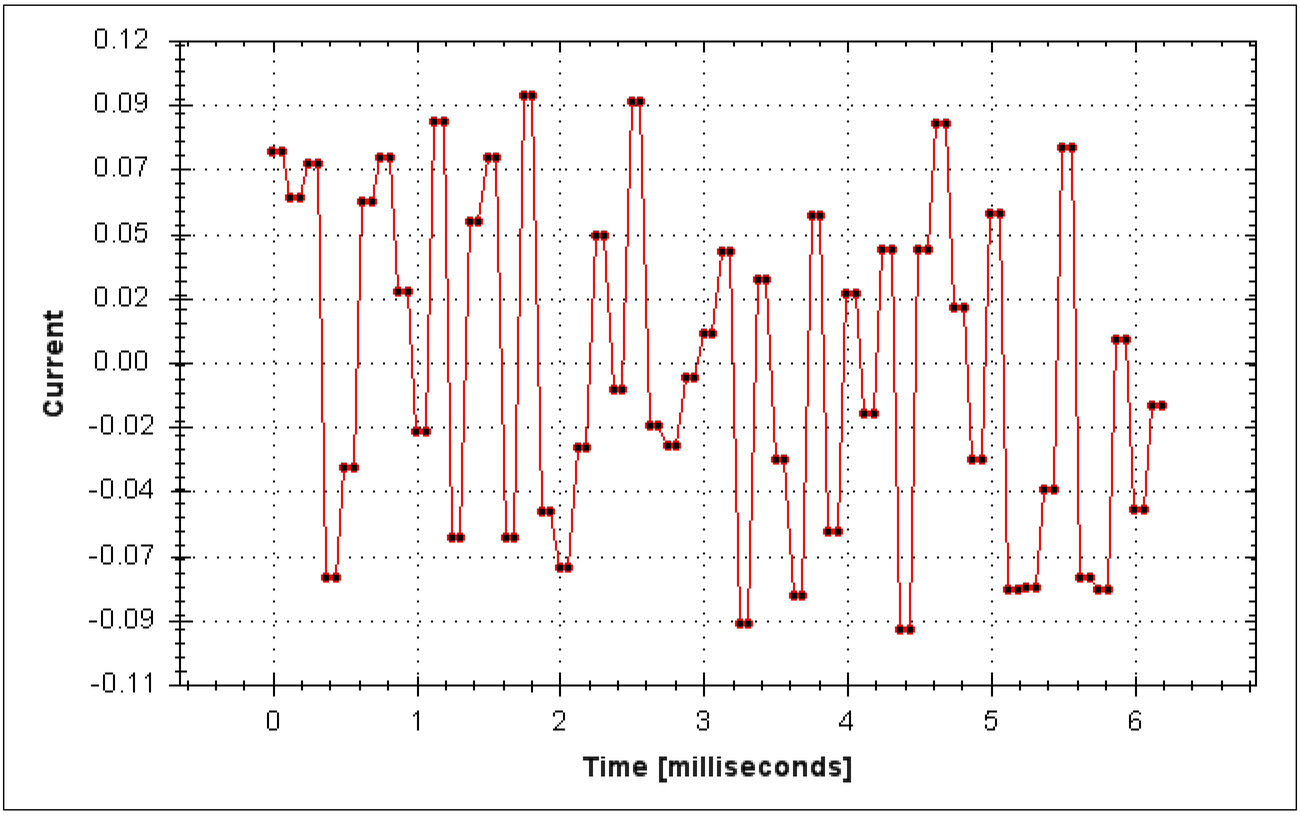
PRB excitation:



Sine excitation:



Noise excitation:



Related Topics

15.3 Using the Performance Servo Tuner

15.3.5 Using the Performance Servo Tuner: Advanced

16 Scope

1.2.1.5 Bode (set command source)

6.7 Settings

F126

Error: Invalid Bode plot mode for this function. and others)

30.8 BODE.MODETIMER

General Information	
Type	R/W Parameter
Description	Sets the watchdog timer of the excitation.
Units	ms
Range	0 to 268,435,456
Default Value	0
Data Type	Integer
See Also	BODE.MODE
Start Version	M_1-03-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	48	M_01-03-00-000

Description

BODE.MODETIMER sets the watchdog timer for the excitation. This watchdog is used to automatically turn off the excitation of the system if communication is lost. It is highly recommended that you use the watchdog for any excitation measurements. The WorkBench Performance Servo Tuner and Bode tool automatically use these values, requiring no action from you.

If the BODE.MODETIMER is a nonzero value, the Bode watchdog is enabled. BODE.MODE will be set to 0 (None) after the BODE.MODETIMER value elapses. To reset the watchdog timer, reset BODE.MODE to a nonzero value.

BODE.MODETIMER	Comments
0	BODE.MODE is left at the value you set it to.
> 0	Uses pseudo random binary (PRB) excitation. PRB is a signal that is always +/- peak amplitude, varying only in phase. PRB excitation results in a flat excitation frequency spectrum. PRB also results in a high peak excitation amplitude, which can help minimize friction in a frequency response test. PRB excitation repeats every (2^BODE.PRBDEPTH)/BODE.EXCITEGAP drive samples. This repetition can be used to reveal the effects of friction.

Example

Disable BODE.MODETIMER:

-->BODE.MODETIMER //

Set to 0 to disable the watchdog

0

-->BODE.MODE // Observe starting state of the Bode mode

0

-->BODE.MODE 1 // Set Bode mode to PRB

-->BODE.MODE // Observe Bode mode state is the same after 0.5 seconds

1

-->BODE.MODE // Observe Bode mode state is the same after 10 seconds

1

Enable BODE.MODETIMER:

-->BODE.MODETIMER 1000 // Set watchdog to 1 second

-->BODE.MODE 1 // Set Bode mode to PRB

-->BODE.MODE // Observe Bode mode state is the same after 0.5 seconds

1

-->BODE.MODE // Observe Bode mode state has been set to zero after 1.0 seconds

0

Enable and reenable BODE.MODETIMER:

-->BODE.MODETIMER 2500 // Set watchdog to 2.5 seconds

-->BODE.MODE 1 // Set Bode mode to PRB

-->BODE.MODE // Observe Bode mode state is the same after 1.5 seconds

1

-->BODE.MODE 1 // Set Bode mode to PRB, resetting the watchdog timer to the original 2.5 second value

set above.

-->BODE.MODE // Observe Bode mode state is the same after 3.0 seconds after the original enabling of BODE.MODE 1

-->BODE.MODE // Observe Bode mode state has been set to zero after 4.0 seconds after the original enabling

of BODE.MODE

0

Related Topics

15.3 Using the Performance Servo Tuner

15.3.5 Using the Performance Servo Tuner: Advanced

16 Scope

1.2.1.5 Bode (set command source)

6.7 Settings

F126

Error: Invalid Bode plot mode for this function. and others)

30.9 BODE.PRBDEPTH

General Information	
Type	R/W Parameter
Description	Sets the length of the PRB signal before it repeats.
Units	NA
Range	4 to 19
Default Value	19
Data Type	Integer
See Also	BODE.MODE, BODE.INJECTPOINT, BODE.IAMP, BODE.VAMP
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	50	M_01-03-00-000

Description

BODE.PRBDEPTH sets the length of the PRB signal before it repeats. This applies only when BODE.MODE = PRB. The PRB excitation will repeat after (2^BODE.PRBDEPTH) / BODE.E-XCITEGAP drive samples.

Example

Set BODE.PRBDEPTH to 19:

```
-->BODE.PRBDEPTH 19
```

Get BODE.PRBDEPTH (already set to 19):

```
-->BODE.PRBDEPTH 19
```

Related Topics

15.3 Using the Performance Servo Tuner

15.3.5 Using the Performance Servo Tuner: Advanced

16 Scope

1.2.1.5 Bode (set command source)

6.7 Settings

F126

Error: Invalid Bode plot mode for this function. and others)

30.10 BODE.VAMP

General Information	
Type	R/W Parameter
Description	Sets the amplitude of the excitation when in velocity mode.
Units	Depends on UNIT.VROTARY or UNIT.VLINEARUNIT.A-CCLINEAR Rotary: rpm, rps, deg/s, custom units/s, rad/s Linear: counts/s, mm/s, µm/s, custom units/s
Range	Rotary: 0.000 to 15,000.000 rpm 0.000 to 250.000 rps 0.000 to 90,000.000 degree/s 0.000 to 1,250.000 custom units/s 0.000 to 1,570.796 rad/s Linear: 0.000 to 1,073,741,824,000.000 counts/s 0.000 to 8,000.000 mm/s 0.000 to 8,000,000.000 µm/s 0.000 to 1,250.000 custom units/s
Default Value	0
Data Type	Float
See Also	BODE.MODE, BODE.INJECTPOINT
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	52	M_01-03-00-000

Description

BODE.VAMP sets the amplitude of the excitation when in velocity mode as set in BODE.I-NJECTPOINT.

Example

Set the excitation velocity to 100 RPM

```
-->BODE.VAMP 100
```

Get the excitation velocity(already set to 100 RPM)

```
-->BODE.VAMP
```

100.000 [rpm]

Related Topics

15.3 Using the Performance Servo Tuner

15.3.5 Using the Performance Servo Tuner: Advanced

16 Scope

1.2.1.5 Bode (set command source)

6.7 Settings

F126

Error: Invalid Bode plot mode for this function. and others)

30.11 BODE.VFLIMIT

General Information	
Type	R/W Parameter
Description	Sets the velocity fault duration limit (seconds) for the BODE.MODE 5 stability test
Units	s
Range	0.001 to 60.000
Default Value	0
Data Type	Decimal
See Also	BODE.MODE, BODE.MODETIMER, BODE.IFLIMIT, BODE.IFTHRESH, BODE.VFTHRESH
Start Version	M_01-02-10-000

Description

When BODE.MODE is set to 5, the firmware monitors the drive feedback velocity VL.FB. When VL.FB goes above BODE.VFTHRESH, an internal counter records the length of time VL.FB was above BODE.VFTHRESH. If the internal counter reaches BODE.VFLIMIT, Fault 133 – Instability during Autotune will be generated.

The smaller BODE.VFLIMIT, the quicker Fault 133 will be generated when VL.FB exceeds BODE.VFLIMIT.

Example

Set BODE.VFTHRESH to 10 RPM:

```
-->BODE.VFTHRESH 10
```

Set BODE.VFLIMIT to 0.500 seconds

```
-->BODE.VFLIMIT 0.5
```

Set BODE.MODE to 5 to enable stability detection

```
-->BODE.MODE 5
```

Related Topics

15.3 Using the Performance Servo Tuner

15.3.5 Using the Performance Servo Tuner: Advanced

F133

30.12 BODE.VFTHRESH

General Information	
Type	R/W Parameter
Description	Sets the current fault threshold for the BODE.MODE 5 stability test.
Units	Depends on UNIT.VROTARY or UNIT.VLINEARUNIT.ACCLINEAR Rotary: rpm, rps, deg/s, custom units/s, rad/s Linear: counts/s, mm/s, µm/s, custom units/s
Range	Rotary: 0.000 to 15,000.000 rpm 0.000 to 250.000 rps 0.000 to 90,000.000 deg/s 0.000 to 1,250.000 custom units/s 0.000 to 1,570.796 rad/s Linear: 0.000 to 1,073,741,824,000.000 counts/s 0.000 to 8,000.000 mm/s 0.000 to 8,000,000.000 µm/s 0.000 to 1,250.000 custom units/s
Default Value	0
Data Type	Decimal
See Also	BODE.MODE, BODE.MODETIMER, BODE.IFLIMIT, BODE.IFTHRESH, BODE.VFLIMIT
Start Version	M_01-02-10-000

Description

When BODE.MODE is set to 5, the firmware monitors the drive feedback velocity VL.FB. When VL.FB goes above BODE.VFTHRESH, an internal counter records the length of time VL.FB was above BODE.VFTHRESH. If the internal counter reaches BODE.VFLIMIT, Fault 133 – Instability during Autotune will be generated.

The smaller BODE.VFLIMIT, the quicker Fault 133 will be generated when VL.FB exceeds BODE.VFLIMIT.

Example

Set BODE.VFTHRESH to 10 RPM:

```
-->BODE.VFTHRESH 10
```

Set BODE.VFLIMIT to 0.500 seconds:

```
-->BODE.VFLIMIT 0.5
```

Set BODE.MODE to 5 to enable stability detection:

```
-->BODE.MODE 5
```

Related Topics

15.3 Using the Performance Servo Tuner

15.3.5 Using the Performance Servo Tuner: Advanced

F133

31 CAP Parameters

This section describes the CAP parameters.

31.1 CAP0.EDGE, CAP1.EDGE

General Information	
Type	NV Parameter
Description	Selects the capture edge.
Units	N/A
Range	1 to 3
Default Value	1
Data Type	U8
See Also	CAP0.PREEDGE, CAP1.PREEDGE
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex		Object Start Version
Modbus	54	CAP0.EDGE	M_01-03-00-000
	80	CAP1.EDGE	

Description

The filtered trigger source is monitored for rising edge, falling edge, or both edges. The event mode logic may ignore the precondition edge detection; however, the trigger always uses edge detection.

The precondition logic has an identical feature controlled by CAP0.PREEDGE, CAP1.PREEDGE.

Value	Description
0	Reserved
1	Rising edge
2	Falling edge
3	Both edges

Related Topics

8.9 Using Position Capture

31.2 CAP0.EN, CAP1.EN

General Information	
Type	NV Parameter
Description	Enables or disables the related capture engine.
Units	N/A
Range	0 to 1
Default Value	0
Data Type	Boolean
See Also	N/A
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex		Object Start Version
Modbus	56	CAP0.EN	M_01-03-00-000
	82	CAP1.EN	

Description

This parameter enables or disables the related capture engine. After each successful capture event, this parameter is reset to 0 and must be activated again for the next capture. Also note that CAP0.PLFB, CAP1.PLFB is set to 0 when this parameter is set to 1.

0 = Disable

1 = Enable

Related Topics

8.9 Using Position Capture

31.3 CAP0.EVENT, CAP1.EVENT

General Information	
Type	NV Parameter
Description	Controls the precondition logic.
Units	N/A
Range	0 to 3
Default Value	0
Data Type	U8
See Also	N/A
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex		Object Start Version
EtherCAT COE and CAN-open	3460h /5	CAP0.EVENT	M_01-00-00-000
	3460h /6	CAP1.EVENT	
Modbus	58	CAP0.EVENT	M_01-03-00-000
	84	CAP1.EVENT	

Description

The event mode controls use of the precondition logic. If this field is not 0, then the precondition input is selected by CAPx.TRIGGER. If this field is 1, then the precondition edge is selected by the CAPx.PREEDGE. The four event modes are listed below.

Event	Description
0	Precondition settings ignored.
1	Trigger on first trigger event after selected edge on precondition input.
2	Trigger on first trigger event to occur while precondition input is 1
3	Trigger on first trigger event to occur while precondition input is 0.

Example

Event 0

The following diagram shows an example of Event = 0 (trigger on edge, trigger edge = rising). In this mode, the precondition logic is ignored.

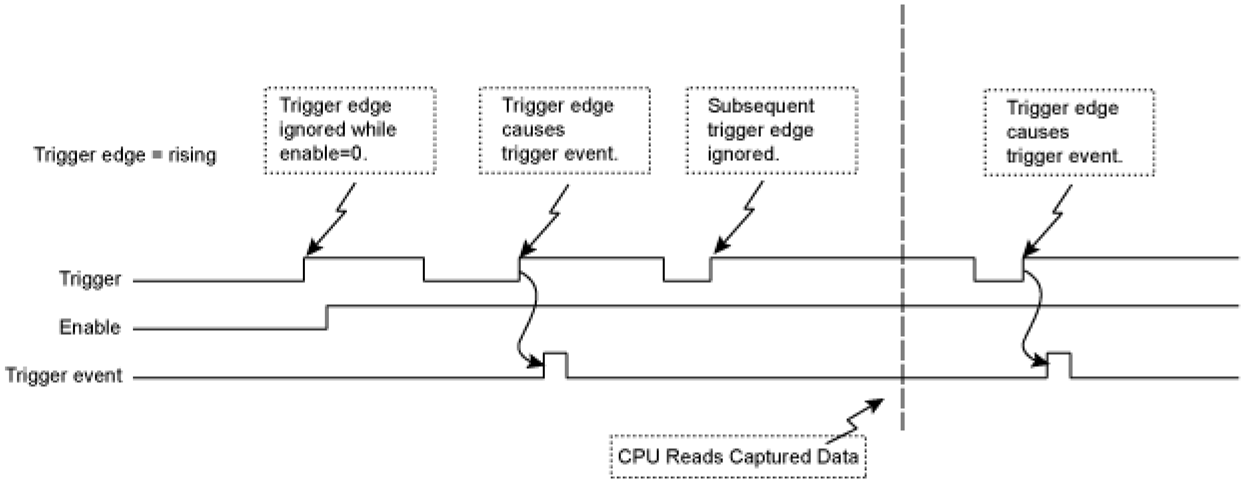


Figure 1: Trigger Edge Mode

Events 2 and 3 (Trigger edge while precondition = 0 or 1)

In these events, the precondition logic samples the current (post-filter) state of the selected pre-condition source input. The capture engine looks for a trigger edge while the precondition input is at a “1” or “0” state.

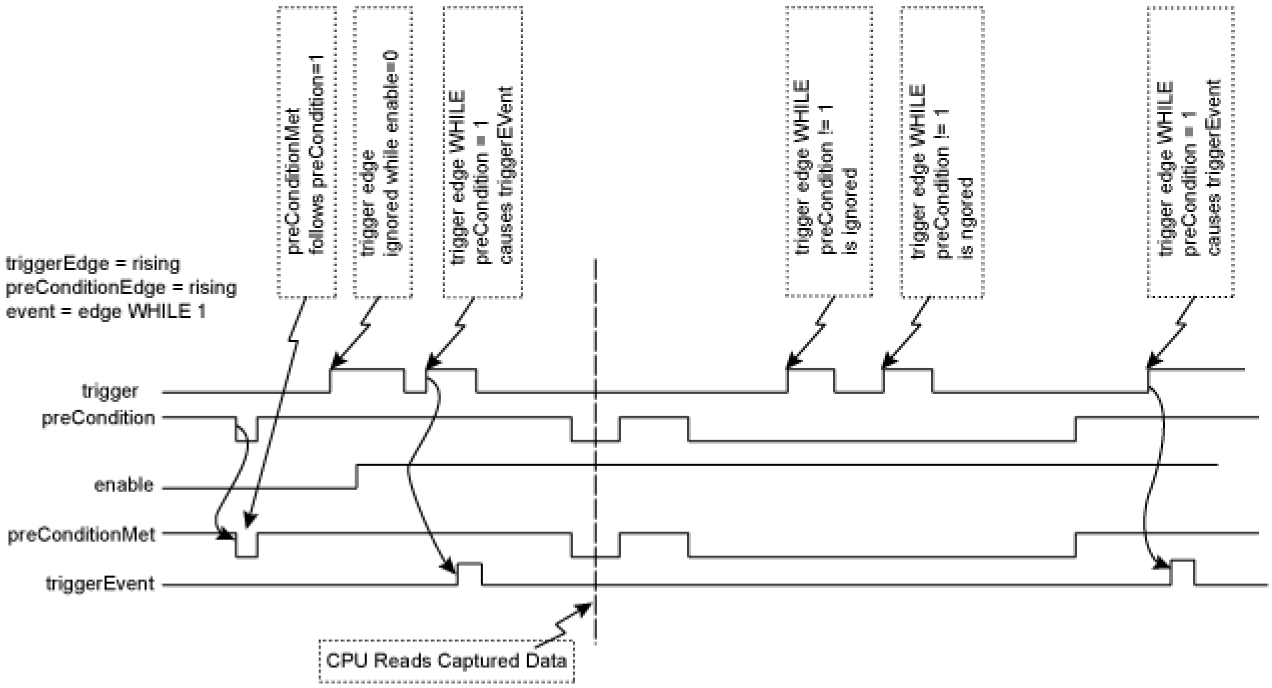


Figure 2: Trigger edge WHILE precondition edge

Event 1 (Trigger edge after precondition)

In this event, each trigger event requires Enable=1, a new precondition edge, followed by a new trigger edge. The sequence requirements are shown in the figure below.

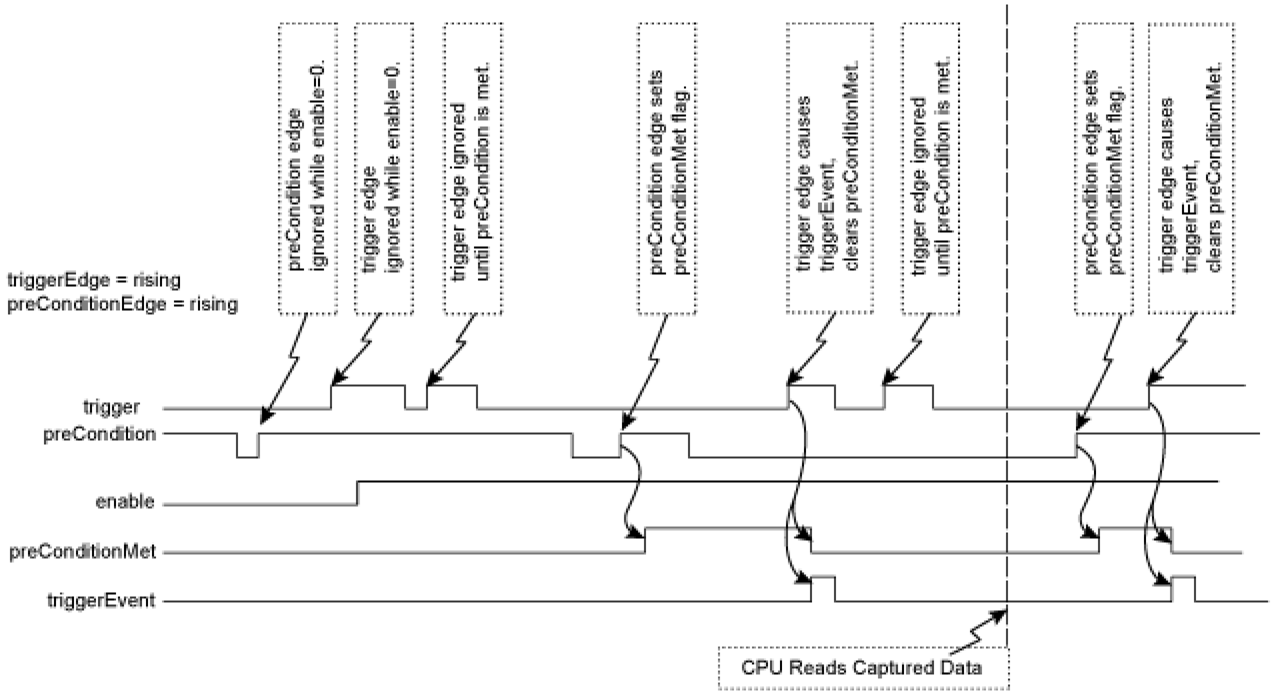


Figure 3: Trigger edge after precondition edge

Note: If the precondition and trigger edges occur at the same time, it is not a valid trigger event. A subsequent trigger edge must occur after the precondition edge. The same time resolves to a single 40 ns clock tick in the trigger event logic (after the optional filter function as well as any sensor, cable, or noise delays).

Related Topics

8.9   Using Position Capture

31.4 CAP0.FILTER, CAP1.FILTER

General Information	
Type	R/W Parameter
Description	Sets the filter for the capture source input.
Units	N/A
Range	0 to 2
Default Value	0
Data Type	U8
See Also	CAP0.PREFILTER, CAP1.PREFILTER
Start Version	M_01-00-00-000
End Version	M_01-03-00-000

Description

These parameters are not functional in M_01-03-00-000. In future releases, you can use DINx.FILTER to select a filter on the input channel.

Related Topics

DIN1.FILTER TO DIN7.FILTER

31.5 CAP0.MODE, CAP1.MODE

General Information	
Type	NV Parameter
Description	Selects the captured value.
Units	N/A
Range	0 to 3
Default Value	0
Data Type	U8
See Also	N/A
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex		Object Start Version
EtherCAT COE and CAN-open	3460h /3	CAP0.MODE	M_01-00-00-000
	3460h /4	CAP1.MODE	
Modbus	62	CAP0.MODE	M_01-03-00-000
	88	CAP1.MODE	

Description

Mode 0 is the standard position capture, which stores PL.FB. Data can be retrieved with CAP0.PLFB, CAP1.PLFB.

Mode 1 is the drive internal time capture. Data can be retrieved with CAP0.T, CAP1.T.

Mode 2 is the KAS EtherCAT distributed clock time (DCT) capture. Instead of using a position value, the DCT is calculated. There is no user parameter to retrieve the captured DCT. Attempting to set Mode = 2 with anything other than an EtherCAT system will result in an invalid parameter error.

Mode 3 is the capture of the primary encoder signal. This mode is used to home onto a feedback index. This mode sets the other parameters needed for this mode. These parameters can be changed later, but this is not recommended unless the input source of the index signal varies. Parameters set in this mode are:

- CAPx.TRIGGER 10: index mark of primary encoder
- CAPx.EDGE 1: rising edge
- CAPx.EVENT 0: ignore precondition

Also the capture engine is immediately enabled and is continuously triggered again.

Mode 4 is similar to Mode 0 (standard position capture), except that the re-enabling of the capture is done automatically. This mode can be used for the registration move.

Related Topics

8.9 Using Position Capture

31.6 CAP0.PLFB, CAP1.PLFB

General Information	
Type	R/O Parameter
Description	Reads captured position value.
Units	Depends on UNIT.PROTARY or UNIT.PLINEAR Rotary: counts, rad, deg, custom units, 16-bit counts Linear: counts, mm, µm, custom units, 16-bit counts
Range	Full range of a signed 64 bit variable
Default Value	0
Data Type	S64
See Also	UNIT.PROTARY, UNIT.PLINEAR
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex		Object Start Version
EtherCAT COE and CAN-open	20A0h /0	CAP0.PLFB	M_01-00-00-000
	20A1h /0	CAP0.PLFB	
	20A2h /0	CAP1.PLFB	
	20A3h /0	CAP1.PLFB	
Modbus	64 (64-bit)	CAP0.PLFB	M_01-03-00-000
	90 (64-bit)	CAP1.PLFB	

Description

This parameter reads the captured position value scaled to actual set units. See UNIT.PR-OTARY or UNIT.PIN for these units.

Related Topics

8.9 Using Position Capture

31.7 CAP0.PREEDGE, CAP1.PREEDGE

General Information	
Type	NV Parameter
Description	Selects the capture precondition edge.
Units	N/A
Range	1 to 3
Default Value	1
Data Type	U8
See Also	CAP0.EDGE, CAP1.EDGE
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex		Object Start Version
EtherCAT COE and CAN-open	3460h /7	CAP0.PREEDGE	M_01-00-00-000
	3460h /8	CAP1.PREEDGE	
Modbus	68	CAP0.PREEDGE	M_01-03-00-000
	94	CAP1.PREEDGE	

Description

The precondition edge is monitored for rising edge, falling edge, or both. The event mode logic may ignore the precondition edge detection (trigger always uses edge detection).

The filtered trigger source has an identical feature controlled by CAP0.EDGE, CAP1.EDGE.

Value	Description
0	Reserved
1	Rising edge
2	Falling edge
3	Both edges

Related Topics

8.9 Using Position Capture

31.8 CAP0.PREFILTER, CAP1.PREFILTER

General Information	
Type	NV Parameter
Description	Sets the filter for the precondition input source.
Units	N/A
Range	0 to 2
Default Value	0
Data Type	U8
See Also	CAP0.FILTER, CAP1.FILTER
Start Version End Version	M_01-00-00-000 M_01-03-00-000

Description

These parameters are not functional in M_01-03-00-000. In future releases, you can use DINx.FILTER to select a filter on the input channel.

Related Topics

DIN1.FILTER TO DIN7.FILTER

31.9 CAP0.PRESELECT, CAP1.PRESELECT

General Information	
Type	NVParameter
Description	Sets the precondition trigger.
Units	N/A
Range	0 to 11
Default Value	0
Data Type	U8
See Also	CAP0.TRIGGER, CAP1.TRIGGER
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex		Object Start Version
EtherCAT COE and CANopen	3460h/9	CAP0.PRESELECT	M_01-00-00-000
	3460h /10	CAP1.PRESELECT	
Modbus	72	CAP0.PRESELECT	M_01-03-00-000
	98	CAP1.PRESELECT	

Description

This parameter specifies the input signal for the precondition trigger.

Trigger Source	Input Name
0	General Input 1 (X7)
1	General Input 2 (X7)
2	General Input 3 (X7)
3	General Input 4 (X7)
4	General Input 5 (X8)
5	General Input 6 (X7)
6	General Input 7 (X7)
7	RS485 Input 1 (X9)
8	RS485 Input 2 (X9)
9	RS485 Input 3 (X9)
10	Primary Index

Related Topics

8.9 Using Position Capture

31.10 CAP0.STATE, CAP1.STATE

General Information	
Type	R/O Parameter
Description	Indicates whether or not trigger source was captured.
Units	N/A
Range	0 to 1
Default Value	0
Data Type	Boolean
See Also	N/A
Start Version	M_01-00-00-000

<table>
<tr><th>Fieldbus</th><th>Index/Subindex</th><th>Object Start Version</th></tr>
<tr><td>Modbus</td><td><table><tr><td>74</td><td>CAP.STATE</td></tr><tr><td>100</td><td>CAP1.STATE</td></tr></table></td><td>M_01-03-00-000</td></tr>
</table>

Description

When enabling the capture (CAP0.EN, CAP1.EN), this parameter is set to 0 until the next event is captured.

0 = Not captured

1 = Captured

Related Topics

8.9 Using Position Capture

31.11 CAP0.T, CAP1.T

General Information	
Type	R/O Parameter
Description	Reads time capture (if time capture was configured).
Units	ns
Range	N/A
Default Value	N/A
Data Type	U32
See Also	CAP0.MODE, CAP1.MODE
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex		Object Start Version
EtherCAT COE and CANopen	20A0h/0	CAP0.T	M_01-00-00-000
	20A1h/0	CAP0.T	
	20A2h/0	CAP1.T	
	20A3h/0	CAP1.T	
Modbus	76	CAP0.T	M_01-03-00-000
	102	CAP1.T	

Description

If time capture was configured, the captured time is stored in this parameter. The reference time is the occurrence of the last MTS signal (recurring every 62.5 µs), so this is a purely drive internal time.

Related Topics

8.9 Using Position Capture

31.12 CAP0.TRIGGER, CAP1.TRIGGER

General Information	
Type	NV Parameter
Description	Specifies the trigger source for the position capture.
Units	N/A
Range	0 to 11
Default Value	0
Data Type	U8
See Also	CAP0.PRESELECT, CAP1.PRESELECT
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex		Object Start Version
EtherCAT COE and CANopen	3460h /1	CAP0.TRIGGER	M_01-00-00-000
	3460h /2	CAP1.TRIGGER	
Modbus	78	CAP0.TRIGGER	M_01-03-00-000
	104	CAP1.TRIGGER	

Description

This parameter specifies the trigger source (capture input signal).

Trigger Source	Input Name
0	General Input 1
1	General Input 2
2	General Input 3
3	General Input 4
4	General Input 5
5	General Input 6
6	General Input 7
7	RS485 Input 1
8	RS485 Input 2
9	RS485 Input 3
10	Primary Index
11	Tertiary Index

Related Topics

8.9 Using Position Capture

32 CS Parameters

Controlled stop (CS) parameters set the values for the controlled stop process.

32.1 CS.DEC

General Information	
Type	NV Parameter
Description	Sets the deceleration value for the controlled stop process.
Units	Depends on UNIT.ACCROTARY or UNIT.ACCLINEAR Rotary: rps/s, rpm/s, deg/s^2, (custom units)/s^2, rad/s^2 Linear: counts/s^2, mm/s^2, µm/s^2, (custom units)/s^2
Range	Rotary: 0.002 to 833,333.333 rps/s 0.112 to 50,000,000.000 rpm/s 0.009 to 300,000,000.000 deg/s^2 0.155 to 4,166,666.752 (custom units)/s^2 0.012 to 5,235,987.968 rad/s^2 Linear: 16,000.000 to 3,579,139,408,000.000 counts/s^2 0.031*MOTOR.PITCH to 833333.333*MOTOR.PITCH mm/s^2 30.994*MOTOR.PITCH to 833333333.333*MOTOR.PITCH µm/s^2 0.155 to 4,166,666.667 (custom units)/s^2
Default Value	Rotary: 166.669 rps/s 10,000.000 rpm/s 60,000.000 deg/s^2 833.333 (custom units)/s^2 1,047.2 rad/s^2 Linear: 715,840,000.000 counts/s^2 166.714*MOTOR.PITCHMOTOR.PITCH mm/s^2 166,714.191*MOTOR.PITCHMOTOR.PITCH µm/s^2 833.571 (custom units)/s^2
Data Type	Float
See Also	CS.VTHRESH, CS.TO, DRV.DIS, DIN1.MODE TO DIN7.MODE, DRV.DISMODE, DRV.DISSOURCES
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CAN-open	3440h/1	M_01-00-00-000
Modbus	106 (64-bit)	M_01-03-00-000

Description

This parameter sets the deceleration value for the controlled stop process.

Related Topics

11.11 Controlled Stop

11.1 Digital Inputs and Outputs

18.1 Fault and Warning Messages (this table indicates faults for which a controlled stop occurs)

32.2 CS.STATE

General Information	
Type	R/O Parameter
Description	Returns the internal status of the controlled stop process.
Units	N/A
Range	N/A
Default Value	N/A
Data Type	N/A
See Also	CS.DEC, CS.VTHRESH, CS.TODRV.DISMODE, DRV.DI-SSOURCES
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CAN-open	3441h/0	M_01-00-00-000
Modbus	110	M_01-03-00-000

Description

CS.STATE returns the internal state machine value of the controlled stop.

0 = controlled stop is not occurring.

1 = controlled stop is occurring

Related Topics

11.11 Controlled Stop

11.1 Digital Inputs and Outputs

18.1 Fault and Warning Messages (this table indicates faults for which a controlled stop occurs)

32.3 CS.TO

General Information	
Type	NV Parameter
Description	Sets the time value for the drive velocity to be within CS.VTHRESH.
Units	ms
Range	1 to 30,000 ms
Default Value	6 ms
Data Type	Integer
See Also	CS.DEC, CS.VTHRESH, CS.STATE, DRV.DIS, DIN1.MODE TO DIN7.MODE, DRV.DISMODE, DRV.DISSOURCES
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CANopen	3440h/3	M_01-00-00-000
Modbus	112	M_01-03-00-000

Description

CS.TO is the time value for the drive velocity to be within CS.VTHRESH before the drive disables.

Example

Set time value to 100 ms:

```
-->CS.TO 100
```

Related Topics

11.11 Controlled Stop

11.1 Digital Inputs and Outputs

18.1 Fault and Warning Messages (this table indicates faults for which a controlled stop occurs)

32.4 CS.VTHRESH

General Information	
Type	NV Parameter
Description	Sets the velocity threshold for the controlled stop.
Units	rpm, rps, deg/s, custom units/s
Range	Rotary: 0.000 to 15,000.000 rpm 0.000 to 250.000 rps 0.000 to 90,000.000 deg/s 0.000 to 1,250.000 custom units/s 0.000 to 1,570.796 rad/s Linear: 0.000 to 1,073,741,824,000.000 counts/s 0.000 to 8,000.000 mm/s 0.000 to 8,000,000.000 µm/s 0.000 to 1,250.000 custom units/s
Default Value	5 rpm
Data Type	Float
See Also	CS.DEC, CS.TO, CS.STATE, DRV.DIS, DIN1.MODE TO DIN7.MODE, DRV.DISMODE, DRV.DISSOURCES
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT and CAN-open	3440h/2	M_01-00-00-000
Modbus	114	M_01-03-00-000

Description

CS.VTHRESH is the velocity threshold for the controlled stop algorithm.

Example

Set velocity threshold for controlled stop at 100 rpm:

```
-->CS.VTHRESH 100
```

Related Topics

11.11 Controlled Stop

11.1 Digital Inputs and Outputs

18.1 Fault and Warning Messages (this table indicates faults for which a controlled stop occurs)

33 DIN Parameters

This section describes the DIN parameters.

33.1 DIN.HCMD1 TO DIN.HCMD4

General Information	
Type	NV parameter
Description	A buffer of commands to be used in digital input "command buffer" mode.
Units	None
Range	A string of up to 128 characters
Default Value	<Empty>
Data Type	String
See Also	DINx.MODE, DINx.PARAM, DIN.LCMDx
Start Version	M_01-02-08-000

Description

DIN.HCMDx sets the string of commands to be used in the digital input mode command buffer. Digital input mode **9-Command buffer** can execute four different sets of command buffers.

Each set of command buffers contains two buffers:

- High buffer: Executes upon a rising edge of a digital input.
- Low buffer: Executes upon a falling edge of a digital input.

DIN.HCMDx sets the string for the four high buffers (depending on x).

Example

Set the command buffer mode to digital input 1:

```
DIN1.MODE 9
```

Set the first sets of buffers to digital input 1:

```
DIN1.PARAM 1
```

Set the command DRV.OPMODE 0 to the high buffer:

```
DIN.HCMD1 DRV.OPMODE 1
```

Now, upon a rising edge in digital input 1, the drive mode is 1.

Related Topics

11.2 Command Buffer

11.1 Digital Inputs and Outputs

33.2 DIN.LCMD1 to DIN.LCMD4

General Information	
Type	NV parameter
Description	A buffer of commands to be used in digital input "command buffer" mode.
Units	N/A
Range	A string of up to 128 characters
Default Value	Empty
Data Type	String
See Also	DIN1.MODE TO DIN7.MODE, DIN1.PARAM TO DIN7.PARAM, DIN.HCMD1 TO DIN.HCMD4
Start Version	M_01-02-08-000

Description

DIN.LCMDx sets the string of commands to be used in the digital input mode command buffer. Digital input mode **9-Command buffer** can execute four different sets of command buffers.

Each set of command buffers contains two buffers:

- High buffer: Executes upon a rising edge of a digital input.
- Low buffer: Executes upon a falling edge of a digital input.

DIN.LCMDx sets the string for the four "low" buffers, depending on x.

Example

Set the command buffer mode to digital input 1:

```
DIN1.MODE 9
```

Set the first sets of buffers to digital input 1:

```
DIN1.PARAM 1
```

Set the command DRV.OPMODE 0 to the "low buffer":

```
DIN.LCMD1 DRV.OPMODE 0
```

Now, upon a falling edge in digital input 1, the drive mode is 0.

Related Topics

11.2 Command Buffer

11.1 Digital Inputs and Outputs

33.3 DIN.ROTARY

General Information	
Type	R/O Parameter
Description	Reads the rotary knob value.
Units	N/A
Range	0 to 99
Default Value	N/A
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	116	M_01-03-00-000

Description

DIN.ROTARY reads the rotary knob value.

Related Topics

11.1 Digital Inputs and Outputs

33.4 DIN.STATES

General Information	
Type	R/O Parameter
Description	Reads the digital input states.
Units	N/A
Range	0000000 to 1111111
Default Value	N/A
Data Type	String
See Also	N/A
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	118	M_01-03-00-000

Description

DIN.STATES reads the states of the seven digital inputs. The leftmost bit represents digital input 1 (DIN1) and the rightmost bit represents digital input 7 (DIN7).

Related Topics

11.1 Digital Inputs and Outputs

33.5 DIN1.FILTER TO DIN7.FILTER

General Information	
Type	R/W Parameter
Description	Filter mode for digital inputs 1 to 7.
Units	N/A
Range	0 to 3
Default Value	1 for DIN1 and DIN2 2 for DIN3 to DIN7
Data Type	Integer
See Also	N/A
Start Version	M_01-03-07-000

Description

This parameter sets the digital input filter configuration for channel x when followed with the values defined below. DINx.FILTER retrieves this information when not followed by data.

Value	Description
DINX.FILTER 0	The drive digital input channel detects all input signals with an input pulse width of ≥ 40 ns (no filtering applied).
DINX.FILTER 1	The drive digital input channel detects all input signals with an input pulse width of ≥ 10.24 µs, ± 0.64 µs (fast filter applied).
DINX.FILTER 2	The drive digital input channel detects all input signals with an input pulse width of ≥ 163 µs, ± 10.24 µs (standard filter applied).
DINX.FILTER 3	The drive digital input channel detects all input signals with an input pulse width of ≥ 2.62 ms, ± 0.16384 ms (slow filter applied).

Related Topics

Digital Inputs and Outputs

33.6 DIN1.INV to DIN7.INV

General Information	
Type	RW Parameter
Description	Sets the indicated polarity of a digital input mode.
Units	N/A
Range	0 to 1
Default Value	0
Data Type	Boolean
See Also	N/A
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex		Object Start Version
Modbus	120	DIN1.INV	M_01-03-00-000
	130	DIN2.INV	
	140	DIN3.INV	
	150	DIN4.INV	
	160	DIN5.INV	
	170	DIN6.INV	
	180	DIN7.INV	

Description

Sets the indicated polarity of a digital input mode.

Example

```
DIN1.INV = 0 : Input is active high.
DIN1.INV = 1 : Input is active low.
```

Related Topics

Digital Inputs and Outputs

33.7 DIN1.MODE TO DIN7.MODE

General Information	
Type	R/W Parameter
Description	Sets the digital input modes.
Units	N/A
Range	0 to 22
Default Value	0
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex		Object Start Version
EtherCAT COE and CAN-open	3562h /0	DIN1.MODE	M_01-00-00-000
	3565h /0	DIN2.MODE	
	3568h /0	DIN3.MODE	
	356Bh /0	DIN4.MODE	
	36F6h /0	DIN5.MODE	
	36F9h /0	DIN6.MODE	
	36FCh /0	DIN7.MODE	
	60FDh /0	DIN1.MODE TO DIN7.MODE	
Modbus	122	DIN1.MODE	M_01-03-00-000
	132	DIN2.MODE	
	142	DIN3.MODE	
	152	DIN4.MODE	
	162	DIN5.MODE	
	172	DIN6.MODE	
	182	DIN7.MODE	

SynqNet Information	
Range	0

Description

DIN1.MODE to DIN7.MODE parameters set the functionality of the digital inputs 1 through 7. Digital inputs and corresponding X7 and X8 pin connectors are described in the *AKD Instal-*

lation Manual, section 8.16.4, Digital Inputs. The table below summarizes the digital input modes; for detailed descriptions of each mode, see 11.1 Digital Inputs and Outputs.

DINx.MODE	Description	Task
0	No function; off	0 - None
1	Fault reset	1 - Background
2	Start motion task (use DINx.PARAM for this task)	2 - 1 KHz
3	Motion task select bit (see Motion Tasks)	3 - Background
4	Motion task start selected (see Motion Tasks)	4 - 1 kHz
5	Start home (see Homing)	5 - Background
6	Start jog	6 - Background
7	Reserved	7 - Background
8	Zero latch	8 - Background
9	Command buffer	9 - Background
10	Control fault relay	10 - Background
11	Home reference	11 - 1 kHz
12	Reserved	12 - None
13	Controlled stop (see Controlled Stop)	13 - 1 kHz
14	Reserved	14 - None
15	Quick stop	15 - Background
16	Activate electronic gearing (see Electronic Gearing)	16 - Background
17	Activate electronic gear position shift	17 - Background
18	Positive limit switch	18 - 4 kHz
19	Negative limit switch	19 - 4kHz
20	Brake release	20 - Background
21	Current limit	21 - 4 kHz
22	Opmode and Command Source switch	22 - Background
23	Change algebraic sign of the measured analog input voltage.	23 - 1 kHz

Related Topics

11.2 Command Buffer

11.1 Digital Inputs and Outputs

11.1.3 Digital Inputs

11.11 Controlled Stop

13.1 Homing

13.2 Motion Tasks

11.7 Electronic Gearing

18.2 Clearing Faults

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32 CS Parameters

33.8 DIN1.PARAM TO DIN7.PARAM

General Information	
Type	R/W Parameter
Description	Sets a value used as an extra parameter for digital inputs nodes.
Units	N/A
Range	-9,223,372,036,854,775,000 to +9,223,372,036,854,775,000
Default Value	0
Data Type	Float
See Also	N/A
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex		Object Start Version
Modbus	124 (64-bit)	DIN1.PARAM	M_01-03-00-000
	134 (64-bit)	DIN2.PARAM	
	144 (64-bit)	DIN3.PARAM	
	154 (64-bit)	DIN4.PARAM	
	164 (64-bit)	DIN5.PARAM	
	174 (64-bit)	DIN6.PARAM	
	184 (64-bit)	DIN7.PARAM	

Description

This parameter sets a value that is used as an extra parameter for digital inputs nodes.

Example

The digital input mode "Start motion task" is used to start a motion task. This mode uses an extra parameter as the ID of the motion task to be started.

Related Topics

11.1 Digital Inputs and Outputs

33.9 DIN1.STATE TO DIN7.STATE

General Information	
Type	R/O Parameter
Description	Reads a specific digital input state.
Units	N/A
Range	0 to 1
Default Value	N/A
Data Type	Boolean
See Also	N/A
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex		Object Start Version
Modbus	128	DIN1.STATE	M_01-03-00-000
	138	DIN2.STATE	
	148	DIN3.STATE	
	158	DIN4.STATE	
	168	DIN5.STATE	
	178	DIN6.STATE	
	188	DIN7.STATE	

Description

DIN1.STATE to DIN7.STATE reads the state of one digital input according to the number identified in the command.

Related Topics

11.1 Digital Inputs and Outputs

33.10 DIN9.STATE to DIN11.STATE

General Information	
Type	NV Parameter
Description	Shows on selected pin if signal is high or low.
Units	N/A
Range	0 to 1
Default Value	0
Data Type	U8
See Also	N/A
Start Version	M_01-05-00-000

Description

This parameter allows the user to see the actual level of the input signal, when the IO is set to input mode. Parameter value is 0 if signal is low and 1 if signal is high. DIOx.INV can affect the value in this register.

This parameter can be read at any time. The value is only guaranteed to correspond to the output on the X9 connector when DRV.EMUEMODE is set to 10 and the DIOX.DIR is 0.

Related Topics

DIO9.DIR to DIO11.DIR

DIO9.INV to DIO11.INV

DRV.EMUEMODE

34 DIO Parameters

This section describes the DIO parameters.

34.1 DIO9.INV to DIO11.INV

General Information	
Type	NV Parameter
Description	Inverting the output voltage of the IO, when in the output direction.
Units	NA
Range	0 to 1
Default Value	0
Data Type	U8
See Also	NA
Start Version	M_01-05-00-000

Description

This parameter changes the logic sense of the differential input/output signals. When false, a logic 1 occurs when the + signal is higher than the – signal. When true, a logic 1 occurs when the – signal is higher than the + signal.

The drive output parameters DOUTx.STATE and DOUTx.STATEU are not affected by changes in this parameter. The drive input parameters DINx.STATE will be affected.

This parameter can be set at any time. It will be ignored unless DRV.EMUEMODE is set to 10.

Related Topics

DIN1.STATE TO DIN7.STATE

DOUT1.STATE AND DOUT2.STATE

DOUT1.STATEU AND DOUT2.STATEU

DRV.EMUEMODE

34.2 DIO9.DIR to DIO11.DIR

General Information	
Type	NV Parameter
Description	Changing direction of the IOs from the X9 connector.
Units	N/A
Range	0 to 1
Default Value	0
Data Type	U8
See Also	NA
Start Version	M_01-05-00-000

Description

This parameter changes the direction of the general purpose IO from the X9 connector. If DIOx.DIR is set 0 then the IO configured as an input, while if DIOx.DIR is 1 the IO is configured as an output.

DIO9.DIR controls pins 1 and 2

DIO10.DIR controls pins pin 4 and 5

DIO11.DIR controls pins pin 7 and 8.

This parameter can be set at any time. It will be ignored unless DRV.EMUEMODE is set to 10.

Related Topics

DIN1.STATE TO DIN7.STATE

DOUT1.STATE AND DOUT2.STATE

DOUT1.STATEU AND DOUT2.STATEU

DIO9.INV to DIO11.INV

DRV.EMUEMODE

35 DOUT Parameters

This section describes the DOUT parameters.

35.1 DOUT.CTRL

General Information	
Type	NV Parameter
Description	Sets the source of digital outputs (firmware or field-bus).
Units	N/A
Range	0 to 1
Default Value	0
Data Type	Boolean
See Also	N/A
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	190	M_01-03-00-000

SynqNet Information	
Range	1

Description

DOUT.CTRL sets the source of the digital outputs:

0 = Firmware controlled

1 = Fieldbus controlled

Related Topics

11.1.4 Digital Outputs

35.2 DOUT.RELAYMODE

General Information	
Type	R/W Parameter
Description	Indicates faults relay mode.
Units	N/A
Range	0 to 1
Default Value	0
Data Type	Boolean
See Also	N/A
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	192	M_01-03-00-000

Description

DOUT.RELAYMODE indicates the faults relay mode as follows:

If DOUT.RELAYMODE= 0 and faults exist, then the relay is open.

If DOUT.RELAYMODE= 0 and faults do not exist, then the relay is closed.

If DOUT.RELAYMODE = 1 and the drive is disabled, then the relay is open.

If DOUT.RELAYMODE = 1 and the drive is enabled, then the relay is closed.

Related Topics

11.1.4 Digital Outputs

35.3 DOUT.STATES

General Information	
Type	R/O Parameter
Description	Reads the state of the two digital outputs.
Units	N/A
Range	0 to 11
Default Value	N/A
Data Type	String
See Also	N/A
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	194	M_01-03-00-000

Description

DOUT.STATES reads the states of the two digital outputs. The rightmost bit represents DOUT2 and the leftmost bit represents DOUT1.

Related Topics

11.1.4 Digital Outputs

35.4 DOUT1.MODE to DOUT17.MODE

General Information	
Type	NV Parameter
Description	Sets the digital output mode.
Units	N/A
Range	0 to 17
Default Value	0
Data Type	Integer
See Also	DOUT1.PARAM AND DOUT2.PARAM
Start Version	M_01-04-02-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	196 DOUT1.MODE 206 DOUT2.MODE	M_01-03-00-000

Description

DOUTx.MODE sets the functionality of the digital outputs. The table below summarizes the digital output modes; for detailed descriptions of each mode, see 11.1 Digital Inputs and Outputs.

DOUTx.MODE	Description
0	User (default = 0)
1	Mains ready
2	Software limit switch reached
3	Move complete
4	In position
5	Position greater than x
6	Position less than x
7	Drive produced warning
8	Drive enabled
10	Motor brake
11	Drive produced fault
12	Absolute velocity greater than x
13	Absolute velocity less than x
14	Homing complete
15	PLS.STATE bits or connected
16	Description Command buffer Active
17	Mt in Position

Related Topics

11.1.4 Digital Outputs

35.5 DOUT1.PARAM AND DOUT2.PARAM

General Information	
Type	NV Parameter
Description	Sets extra parameters for the digital outputs.
Units	N/A
Range	DOUT1.PARAM: –357,913.941 to 357,913.941 DOUT2.PARAM: –79,164,837,199.872 to 79,164,837,199.856
Default Value	0
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex		Object Start Version
Modbus	198 (64-bit)	DOUT1.PARAM	M_01-03-00-000
	208 (64-bit)	DOUT2.PARAM	

Description

DOUT1.PARAM and DOUT2.PARAM set the extra parameter needed for the digital outputs calculations, respectively.

Related Topics

11.1.4 Digital Outputs

35.6 DOUT1.STATE AND DOUT2.STATE

General Information	
Type	R/O Parameter
Description	Reads the digital output state.
Units	N/A
Range	0 to 1
Default Value	N/A
Data Type	Boolean
See Also	N/A
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex		Object Start Version
Modbus	202	DOUT1.STATE	M_01-03-00-000
	212	DOUT2.STATE	

Description

DOUT1.STATE and DOUT2.STATE read the state of one digital output according to the value stated in the command. These parameters can also be used to set a value of one digital output (only if the output mode is idle).

Related Topics

11.1.4 Digital Outputs

35.7 DOUT1.STATEU AND DOUT2.STATEU

General Information	
Type	R/W Parameter
Description	Sets the state of the digital output node.
Units	N/A
Range	0 to 1
Default Value	0
Data Type	N/A
See Also	N/A
Start Version	M_01-01-01-000

Fieldbus	Index/Subindex		Object Start Version
Modbus	204	DOUT1.STATEU	M_01-03-00-000
	214	DOUT2.STATEU	

Description

DOUT1.STATEU and DOUT2.STATEU set the state of the digital output node as follows:

0 = deactivated

1 = activated

DOUT1.STATEU and DOUT2.STATEU are used when DOUT1.MODE to DOUT17.MODE = 0 (user mode).

Related Topics

11.1.4 Digital Outputs

35.8 DOUT9.STATE to DOUT11.STATE

General Information	
Type	NV parameter
Description	Shows on selected pin if signal is high or low.
Units	N/A
Range	0 to 1
Default Value	0
Data Type	U8
See Also	N/A
Start Version	M_01-05-00-000

Description

This parameter allows the user to see the actual level of the output signal, when the IO is set to output mode. Parameter value is 0 if signal is low and 1 if signal is high. DIOx.INV can affect the signals driven onto the X9 connector.

This parameter can be read at any time. The value is only guaranteed to correspond to the output on the X9 connector when DRV.EMUEMODE is set to 10 and the DIOX.DIR is 0.

Related Topics

DIO9.DIR to DIO11.DIR

DIO9.INV to DIO11.INV

DOUT9.STATEU to DOUT11.STATEU

DRV.EMUEMODE

35.9 DOUT9.STATEU to DOUT11.STATEU

General Information	
Type	NV Parameter
Description	Allows user to set level of selected pin to high or low.
Units	N/A
Range	0 to 1
Default Value	0
Data Type	U8
See Also	N/A
Start Version	M_01-05-00-000

Description

This parameter allows the user to set the level of the output signal, when the IO is set to output mode. Parameter value is 0 if signal is low and 1 if signal is high. DIOx.INV can affect the signals driven onto the X9 connector.

This parameter can be written at any time. The value is only guaranteed to correspond to the output on the X9 connector when DRV.EMUEMODE is set to 10 and the DIOX.DIR is 0.

Example

The following settings set the direction for the differential signals on pin 4 and 5, so that the output will have a high level signal.

First set the following settings:

DRV.EMUEMODE 10

DIO10.DIR 1

DOUT10.STATEU 1

Then change the level of the signal:

DOUT.STATEU 0

or

DIO10.INV

Note: Inverting the signal will also alter the signal in input mode.

Related Topics

DIO9.DIR to DIO11.DIR

DIO9.INV to DIO11.INV

DOUT9.STATEU to DOUT11.STATEU

DRV.EMUEMODE

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36 DRV Parameters

This section describes the DRV parameters.

36.1 DRV.ACC

General Information	
Type	NV Parameter
Description	Describes the acceleration ramp for the velocity loop.
Units	Depends on UNIT.ACCROTARY or UNIT.ACCLINEAR Rotary: rps/s, rpm/s, deg/s², (custom units)/s², rad/s² Linear: counts/s², mm/s², µm/s², (custom units)/s²
Range	Note: The range and default values of (custom units)/s² units depend on the values of PIN and POUT. The range and default values listed in this table are derived from the default values of PIN and POUT. Rotary: 0.002 to 833,333.333 rps/s 0.112 to 50,000,000.000 rpm/s 0.009 to 300,000,000.000 deg/s² 0.155 to 4,166,666.752 (custom units)/s² 0.012 to 5,235,987.968 rad/s² Linear: 16,000.000 to 3,579,139,408,000.000 counts/s² 0.031*MOTOR.PITCH to 833,333.333*MOTOR.PITCH mm/s² 30.995*MOTOR.PITCH to 2,147,483.647*MOTOR.PITCH µm/s² 0.155 to 2,147,483.647 (custom units)/s²
Default Value	Note: The range and default values of (custom units)/s² units depend on the values of PIN and POUT. The range and default values listed in this table are derived from the default values of PIN and POUT. Rotary: 166.669 rps/s 10,000.000 rpm/s 60,000.000 deg/s² 833.333 (custom units)/s² 1,047.2 rad/s² Linear: 715,840,000.000 counts/s² 166.714*MOTOR.PITCH mm/s² 166,714.191*MOTOR.PITCH µm/s² 833.571 (custom units)/s²
Data Type	Float
See Also	DRV.DEC, UNIT.ACCLINEAR, UNIT.ACCROTARY
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CANopen	3501h/0	M_01-00-00-000
Modbus	216 (64-bit)	M_01-03-00-000

Description

Describes the acceleration ramp for the velocity central loop.

Related Topics

11.8 Limits

36.2 DRV.ACTIVE

General Information	
Type	R/O Parameter
Description	Reads the enable status of an axis.
Units	N/A
Range	0, 1, 3
Default Value	N/A
Data Type	Integer
See Also	DRV.EN,DRV.DISSOURCES
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	220	M_01-03-00-000

Description

DRV.ACTIVE reads the enable status of an axis as follows:

- DRV.ACTIVE = 0 drive disabled
- DRV.ACTIVE = 1 drive enabled
- DRV.ACTIVE = 3 drive enabled and in dynamic brake mode

There is no state 2.

When the drive is in state 3, the drive display shows a blinking decimal point. Additionally, if the drive is in state 3 the Parameter Load/Save view does not allow you to download a parameter file.

If an axis is not enabled (DRV.ACTIVE is 0), but DRV.EN is 1 and the hardware enable is high, read the value of DRV.DISSOURCES to query the reason that the drive is not enabled.

Related Topics

3.2 Display Codes

11.10 Enable/Disable

36.3 DRV.BLINKDISPLAY

General Information	
Type	Command
Description	Causes the display to blink for 10 seconds.
Units	N/A
Range	N/A
Default Value	N/A
Data Type	N/A
See Also	N/A
Start Version	M_01-00-00-000

Description

DRV.BLINKDISPLAY causes the drive display located on the front of the drive to blink for 10 seconds.

This command allows the user to identify the drive that is currently communicating with WorkBench.

36.4 DRV.CLRFAULTHIST

General Information	
Type	Command
Description	Clears the fault history log in the NV.
Units	N/A
Range	N/A
Default Value	N/A
Data Type	N/A
See Also	DRV.FAULTHIST
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	222	M_01-03-00-000

Description

DRV.CLRFAULTHIST clears the fault history from the nonvolatile memory of the drive.

This command erases all faults returned by DRV.FAULTHIST.

36.5 DRV.CLRFAULTS

General Information	
Type	Command
Description	Tries to clear all active faults in the drive.
Units	N/A
Range	N/A
Default Value	N/A
Data Type	N/A
See Also	DRV.FAULTS, DRV.EN, DRV.DIS
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	224	M_01-03-00-000

Description

When DRV.CLRFAULTS is sent, the drive will try to clear all active faults. When a fault occurs, the fault is registered in the drive fault handler. DRV.CLRFAULTS clears the fault from the drive fault handler. However, if the fault still exists in the system, DRV.CLRFAULTS fails and the fault is re-registered in the fault handler.

If the DRV.CLRFAULTS succeeds, then the reply to DRV.FAULTS states that no faults exist. If the condition that triggered the fault is still present, the fault condition will remain. See18.1 Fault and Warning Messages for details regarding the behavior of individual faults.

Note that executing a drive disable (DRV.DIS) followed by a drive enable (DRV.EN) has the same effect as executing DRV.CLRFAULTS.

Related Topics

18.2 Clearing Faults

36.6 DRV.CMDDELAY

General Information	
Type	Command
Description	Issues a delay before next command is executed.
Units	ms
Range	0 to 5,000 ms
Default Value	0 ms
Data Type	Float
See Also	N/A
Start Version	M_01-03-00-000

Description

This parameter is used when drive commands are used in a script and a delay is needed between the execution of two consecutive commands. DRV.CMDDELAY creates a delay in the execution of drive commands. In the period of time specified, no commands are executed. This feature is especially useful for command buffers.t

Example

If the script is:

```
DRV.EN
IL.CMDU 0.1
```

then DRV.CMDDELAY is used between the two entries to delay execution 5 ms until the drive is enabled:

```
DRV.EN
DRV.CMDDELAY 5
IL.CMDU 0.1
```

Related Topics

11.2 Command Buffer

36.7 DRV.CMDSOURCE

General Information	
Type	NV Parameter
Description	Sets the command source (service, fieldbus, analog input, gearing, digital, or Bode).
Units	N/A
Range	0 to 3
Default Value	0
Data Type	Integer
See Also	DRV.OPMODE
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	226	M_01-03-00-000

SynqNet Information	
Range	0

Description

DRV.CMDSOURCE specifies the source of the command to the drive. DRV.OPMODE sets the operation mode to the relevant control loop.

DRV.CMDSOURCE values can be set as follows:

Value	Description
0	Service, TCP/IP command
1	Fieldbus command
2	Gearing command
3	Analog command

DRV.CMDSOURCE can be changed while the drive is enabled or disabled. If you use the terminal to change the operation mode, then it is recommended that you disable the drive before changing the command source.

WARNING	If you change DRV.CMDSOURCE from the terminal while the drive is enabled, the system may experience a step change in demand.

Example

To set the command source to the TCP/IP channel and the operation mode to velocity:

```
-->DRV.CMDSOURCE 0
-->DRV.OPMODE 1
```

Related Topics

12 Using Command Source and Operating Modes

36.8 DRV.CRASHDUMP

General Information	
Type	Command
Description	Retrieves diagnostic information after the drive crashes.
Units	N/A
Range	N/A
Default Value	N/A
Data Type	N/A
See Also	N/A
Start Version	M_01-00-00-000

Description

Drives rarely crash, but if a crash occurs, information that can help diagnose the cause of a crash is saved to the nonvolatile (NV) memory within the drive. After the drive is restarted, you can use the DRV.CRASHDUMP command to retrieve this diagnostic information, which can be emailed to Kollmorgen for further support.

If the drive crashes (display flashes an F and three bars), it saves the diagnostic information to a specific block of the drive NV memory. The DRV.CRASHDUMP command then prints the diagnostic information from this NV memory block. Subsequent crash conditions will overwrite the NV memory block. Since the NV memory block is overwritten, but never erased, the DRV.CRASHDUMP command always shows the diagnostic information for the most recent crash.

36.9 DRV.DBILIMIT

General Information	
Type	NV Parameter
Description	Sets the maximum amplitude of the current for dynamic braking.
Units	Arms
Range	0 to minimum of drive peak current (DRV.IPEAK) and motor peak current (MOTOR.IPEAK).
Default Value	Minimum of drive continuous current (DRV.ICONT) and motor continuous current (MOTOR.ICONT).
Data Type	Float
See Also	DRV.DISMODE
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CANopen	3444h/0	M_01-00-00-000
Modbus	228	M_01-03-00-000

Description

This parameter sets the maximum amplitude of the current for dynamic braking.

Example

Setting DRV.DBILIMIT to 2 limits the dynamic brake current to 2 Arms.

Related Topics

11.11 Controlled Stop

32 CS Parameters

11.12 Dynamic Braking

36.10 DRV.DEC

General Information	
Type	NV Parameter
Description	Sets the deceleration value for the velocity loop.
Units	Depends on UNIT.ACCROTARY or UNIT.ACCLINEAR Rotary: rps/s, rpm/s, deg/s², (custom units)/s², rad/s² Linear: counts/s², mm/s², µm/s², (custom units)/s²
Range	Rotary: 0.002 to 833,333.333 rps/s 0.112 to 50,000,000.000 rpm/s 0.009 to 300,000,000.000 deg/s² 0.155 to 4,166,666.752 (custom units)/s² 0.012 to 5,235,987.968 rad/s² Linear: 16,000.000 to 3,579,139,408,000.000 counts/s² 0.031*MOTOR.PITCH to 833,333.333*MOTOR.PITCH mm/s² 30.994*MOTOR.PITCH to 833,333,333.333*MOTOR.PITCH µm/s² 0.155 to 4,166,666.667 (custom units)/s²
Default Value	Rotary: 166.669 rps/s 10,000.000 rpm/s 60,000.000 deg/s² 833.333 (custom units)/s² 1,047.2 rad/s² Linear: 715,840,000.000 counts/s² 166.71*MOTOR.PITCH4MOTOR.PITCH mm/s² 166,714.191*MOTOR.PITCHMOTOR.PITCH µm/s² 833.571 (custom units)/s²
Data Type	Float
See Also	DRV.ACC, UNIT.ACCROTARY, UNIT.ACCLINEAR, DRV.O-PMODE
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CAN-open	3522h/0	M_01-00-00-000
Modbus	230 (64-bit)	M_01-03-00-000

Description

DRV.DEC sets the deceleration value for the velocity loop command (VL.CMDU) and for the analog

velocity command (AIN.VALUE). The operation mode (DRV.OPMODE) must be set to velocity mode for this command to function.

Related Topics

11.11 Controlled Stop

11.8 Limits

36.11 DRV.DIFFVAR

General Information	
Type	R/O
Description	Lists all parameters which differ from their default value.
Units	N/A
Range	N/A
Default Value	N/A
Data Type	N/A
Start Version	M_01-04-19-000

Description

This parameter displays all parameters which have different values than their default setting. The actual value of each parameter is directly shown after the command name and the corresponding default value is then shown in brackets.

This command also shows differences in parameters which hold a string, such as DRV.NAME.

Example

```
-->DRV.DIFFVAR
DRV.EMUEMODE 10 (0)
DRV.NAME MyDrive(no-name)
FB1.ENCRES 0(1024)
IL.KP 50.009(24.811)
PL.KP 99.998(49.999)
VL.KP 0.108(0.000)
```

36.12 DRV.DIR

General Information	
Type	R/W Parameter
Description	Changes drive direction.
Units	N/A
Range	0 to 1
Default Value	0
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

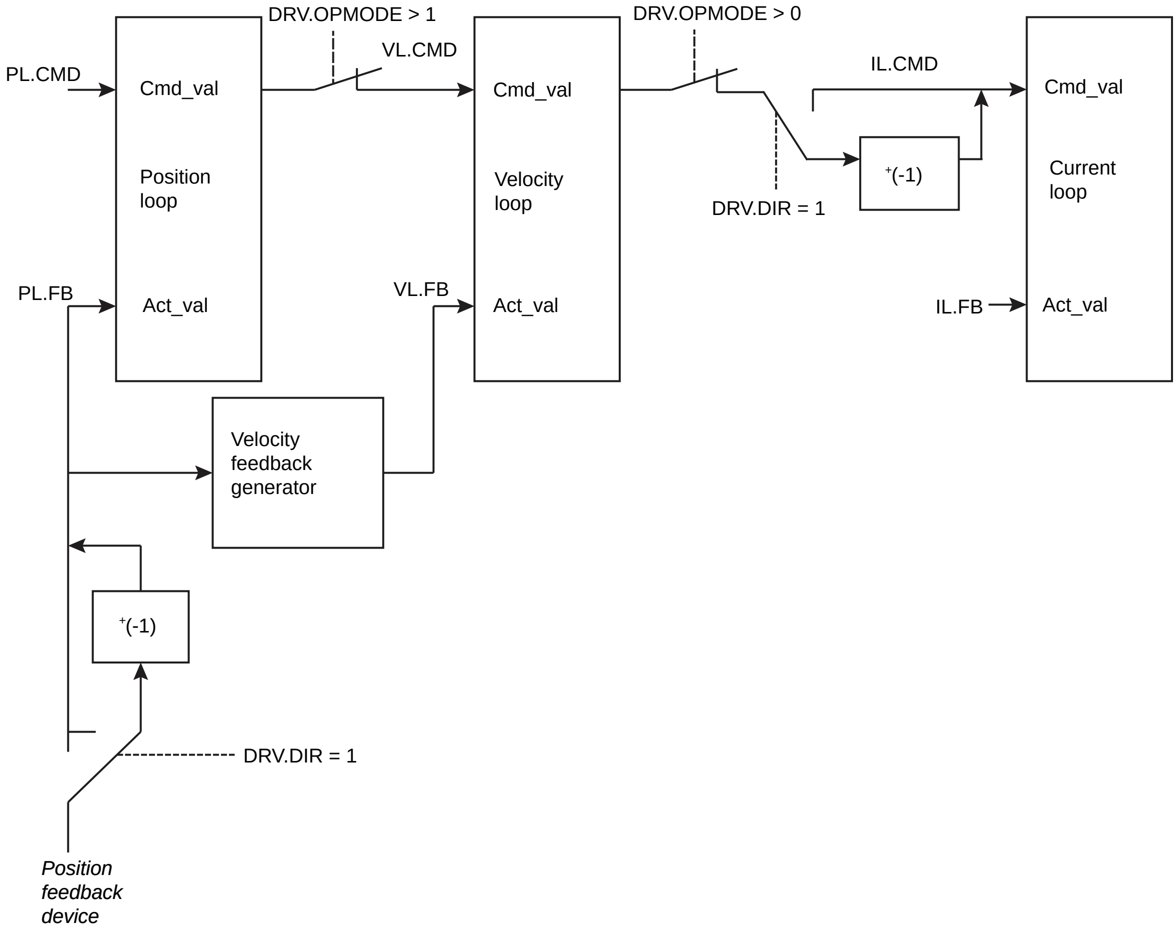
Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CAN-open	352Ah/0	M_01-00-00-000
Modbus	234	M_01-03-00-000

Description

DRV.DIR changes the direction of the motor by changing the algebraic sign of the current command and position feedback value according to the figure below.

Note the following when using DRV.DIR:

- You can only change the DRV.DIR command when the drive is disabled.
- The drive status changes to "Axis not homed" as soon as the DRV.DIR parameter changes value (see DRV.MOTIONSTAT).
- You must verify the settings of the hardware limit switches. If necessary, switch the positive and negative hardware limit switches by swapping the wires at the digital inputs.



DRV.OPMODE > 1
VL.CMD
DRV.OPMODE > 0
IL.CMD
PL.CMD
Cmd_val
Position
loop
PL.FB
Act_val
Cmd_val
Velocity
loop
VL.FB
Act_val
*(-1)
DRV.DIR = 1
Cmd_val
Current
loop
IL.FB
Act_val
Velocity
feedback
generator
*(-1)
DRV.DIR = 1
Position
feedback
device

36.13 DRV.DIS

General Information	
Type	Command
Description	Disables the axis (software).
Units	N/A
Range	N/A
Default Value	Analog drive software enabled. All other types of drive software disabled.
Data Type	N/A
See Also	DRV.EN, DRV.DISSOURCES, DRV.ACTIVE, DRV.DISMODE, DRV.DISTO
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CANopen	3443h/0	M_01-00-00-000
Modbus	236	M_01-03-00-000

Description

DRV.DIS issues a software disable to the drive. The method by which the drive will be disabled (either immediately or with a ramp down first) is controlled by DRV.DISMODE.

By querying the value of DRV.ACTIVE, you can check whether the drive is currently enabled or disabled.

By querying the value of DRV.DISSOURCES, you can check whether the software enable bit is high (software enabled was issued by executing DRV.EN) or the software enable bit is low (software disable was issued by executing DRV.DIS).

If DRV.DIS is commanded the emergency timeout is started. If the drive does not disable or activate dynamic brake within DRV.DISTO, fault "F703" (=> p. 258) is reported.

Related Topics

18.2 Clearing Faults

11.11 Controlled Stop

11.2 Command Buffer

36.14 DRV.DISMODE

General Information	
Type	NV Parameter
Description	Selects among disable immediately or stop and then disable options.
Units	N/A
Range	0 to 3
Default Value	0
Data Type	Integer
See Also	DRV.DBILIMIT ,DRV.DISTO, CS.VTHRESH
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CAN-open	35FFh/0	M_01-00-00-000
Modbus	238	M_01-03-00-000

SynqNet Information	
Range	0 to 2

Description

DRV.DISMODE sets the drive reaction to a DRV.DIS command.

NOTE	You must disable the drive in order to set DRV.DI-SMODE.

Value	Behavior
0	Disable axis immediately.
1	Use dynamic brake to ramp down. The drive remains in the dynamic brake state after the motor has stopped. The drive is disabled in the sense that it does not close the control loop and cannot perform a motion, but PWM stays active.
2	Use a controlled stop to ramp down and then disable the drive.
3	Use a controlled stop to ramp down, and then use dynamic brake. The drive remains in the dynamic brake state after the motor has stopped. The drive is disabled in the sense that it does not close the control loop and cannot perform a motion, but PWM stays active.

In all cases described above, if a brake is configured (MOTOR.BRAKE), the brake closes if VL.FB drops below CS.VTHRESH.

⚠ WARNING	Be careful with vertical loads when modifying this parameter. Coordinate this parameter's correct setting properly with the drive brake settings. If these settings are not coordinated, then vertical loads may have no stopping or holding force when the drive is disabled and the load could fall.

Related Topics

11.11 Controlled Stop
32 CS Parameters
11.12 Dynamic Braking

36.15 DRV.DISSOURCES

General Information	
Type	R/O Parameter
Description	Returns the possible reason for a drive disable.
Units	N/A
Range	N/A
Default Value	N/A
Data Type	N/A
See Also	DRV.ACTIVE, DRV.FAULTS, DRV.EN, DRV.DIS
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	240	M_01-03-00-000

Description

DRV.DISSOURCES is a bitwise parameter that returns the status of possible causes of a drive disable. If this parameter is 0, then the drive is enabled.

The return value specific bits are as follows:

Bit	Status and Response
0	Software disable (execute DRV.EN to issue software enable)
1	Fault exists (read DRV.FAULTS to get the active faults)
2	Hardware disable (remote enable input is low)
3	In-rush disable (the in-rush relay is opened)
4	Initialization disable (the drive did not finish the initialization process)
5	Controlled stop disable from a digital input.

Related Topics

11.11 Controlled Stop

36.16 DRV.DISTO

General Information	
Type	R/W Parameter
Description	Sets the emergency time-out
Units	ms
Range	0 to 120,000 ms
Default Value	1,000 ms
Data Type	U32
See Also	DRV.DIS, DRV.DISMODE
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CAN-open	3445h/0	M_01-00-00-000
Modbus	242	M_01-03-00-000

Description

This timer starts when DRV.DIS is issued (regardless of the DRV.DIS origin). After this time-out elapses, the actual state of the drive is compared to the DRV.DISMODE setting. If the actual state does not match the DRV.DISMODE setting, a fault is reported and the hardware immediately executes the DRV.DISMODE setting (for instance, disable or activate dynamic brake). Setting DRV.DISTO to 0 will disable the timeout.

Related Topics

11.11 Controlled Stop

36.17 DRV.EMUEDIR

General Information	
Type	R/W Parameter
Description	Sets the direction of the emulated encoder output (EEO) signal.
Units	N/A
Range	0 to 1
Default Value	0
Data Type	N/A
See Also	DRV.EMUEMODE
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CANopen	3493h/0	M_01-00-00-000
Modbus	244	M_01-03-00-000

Description

This parameter allows the user to change the direction of the emulated encoder output. DRV.DIR also affects the output direction (through an XOR, "exclusive or", operation). The drive uses DRV.DIR and DRV.EMUEDIR to decide the direction of the emulated encoder output. If DRV.DIR and DRV.EMUEDIR have the same value, then DRV.EMUEDIR is set to 0 (meaning an increase in the motor feedback will result an increase of the encoder emulation output and vice-versa). If these parameters have different values, then DRV.EMUEDIR is set to 1 (meaning an increase in the motor feedback will result in a decrease of the encoder emulation output and vice-versa).

36.18 DRV.EMUEMODE

General Information	
Type	R/W Parameter
Description	Sets the mode of the emulated encoder output (EEO) connector.
Units	N/A
Range	0 to 11
Default Value	0
Data Type	Integer
See Also	DRV.EMUERES, DRV.EMUEZOFFSET, DRV.EMUE-MTURN
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CAN-open	3534h/0	M_01-00-00-000
Modbus	246	M_01-03-00-000

Description

When the emulated encoder output (EEO) is configured to generate an absolute index pulse (DRV.EMUEMODE is 2, 7 or 9) this parameter and DRV.EMUEZOFFSET define the location of the Z pulse. DRV.EMUEMTURN is used to define which turn of the position range the Z pulse is located. DRV.EMUEZOFFSET is used to define the position of the Z pulse within one revolution.

This parameter sets the EEO connector to act as either an input or output as follows.

Setting	Function
0 (rec-ommended)	Input (see FB2.MODE to select the type of inputs the secondary feedback will accept)
1	EEO Output, A/B with once per rev index
2	EEO Output, A/B with absolute index pulse.
3	Input, A/B signals (Deprecated)
4	Input, step and direction signals (Deprecated)
5	Input, CW/CCW (Up/Down) Signals (Deprecated)
6	Step/Dir with one Z-pulse/rev
7	Step/Dir with one absolute Z-pulse (depends on DRV.EMUEOFFSET and DRV.EMUETURN)
8	CW/CCW output with one Z-pulse/rev
9	CW/CCW output with one absoulte Z-pulse (depends on DRV.EMUEOF-FSET and DRV.EMUETURN)
10	Allows the X9 connector to be used as a General Purpose I/O or SynqNet fieldbus controlled I/O (See DIO9.DIR to DIO11.DIR)
11	FB3 Input (Tertiary feedback is reported with FB3.P). Use FB3.MODE to select the feedback type.

Modes 3 to 5 are backwards compatible but deprecated. Refer to FB2.MODE and FB2.SOURCE instead.

Note: If you are using multi-turn or single tune absolute feedback devices the Z pulse from generated by the EEO will always be aligned with the same mechanical position of the of the primary feedback position. If you are using an incremental feedback device then the origin of the primary feedback is not at the same mechanical position each time the drive powers up.

Related Topics

8.4.1 Encoder Emulation

36.19 DRV.EMUEMTURN

General Information	
Type	R/W Parameter
Description	Defines the location of the index pulse on the EEO (emulated encoder output) when DRV.EMUEMODE=2.
Units	revolutions
Range	0 to 4,294,967,295
Default Value	0
Data Type	Integer
See Also	DRV.EMUEMODE, DRV.EMUERES
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CANopen	3491h/0	M_01-00-00-000
Modbus	248	M_01-03-00-000

Description

When the emulated encoder output (EEO) is configured to generate an absolute index pulse (DRV.EMUEMODE is 2, 7 or 9) this parameter and DRV.EMUEZOFFSET define the location of the Z pulse. DRV.EMUEMTURN is used to define which turn of the position range the Z pulse is located. DRV.EMUEZOFFSET is used to define the position of the Z pulse within one revolution.

Note: If you are using multi-turn or single tune absolute feedback devices the Z pulse from generated by the EEO will always be aligned with the same mechanical position of the of the primary feedback position. If you are using an incremental feedback device then the origin of the primary feedback is not at the same mechanical position each time the drive powers up.

Related Topics

8.4.1 Encoder Emulation

36.20 DRV.EMUEPULSEWIDTH

General Information	
Type	TBD
Description	Sets the encoder output pulse width for modes 6 to 7.
Units	us(microseconds)
Range	4.08 us to 2621.48 us
Default Value	4.08 us
Data Type	Float
See Also	DRV.EMUEMODE
Start Version	

Description

EMU Encoder Out Pulse Width Register

Sets pulse width for CW/CCW and Step and Direction modes. This parameter does not effect the A quad B mode. To calculate emuOutPulseWidth:

(Desired pulse width -40 nsec)/520 nsec

Requirement		DSFPGA-03-306
Bits	Bits	Description
11:0	emuOutPulseWidth	Read/Write 12 bit unsigned number minimum resolution is 520 nsec. Reset state – 0
15:12		reserved

- Register is in counts (12 bit)
- Register * 520ns + 40ns is the actual pulse with.
- Register = 1 = pulse width is 560ns = 0.56us (minimum value)
- For each register increment the pulse width is raised by 0.52us

Example

```
50 usecs pulse width
emuOutPulseWidth = (50 usecs - 40 nsec)/520 nsec = 96
actual pulse = 96*520 nsec + 40 nsec = 49.88 usecs.
```

Related Topics

8.4.1 Encoder Emulation

36.21 DRV.EMUERES

General Information	
Type	R/W Parameter
Description	Sets the resolution of the EEO (emulated encoder output).
Units	lines/rev (when DRV.EMUEMODE = 1, 2, or 3) counts/rev (when DRV.EMUEMODE = 4 or 5)
Range	0 to 16,777,215 lines per revolution
Default Value	0 lines per revolution
Data Type	Integer
See Also	DRV.EMUEMODE
Start Version	M_01-00-00-000 (resolution increased from 65,535 to 16,777,215 in M_01-04-00-000)

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CANopen	3535h/0	M_01-00-00-000
Modbus	250	M_01-03-00-000

Description

This parameter sets the emulated encoder (EEO) resolution. DRV.EMUERES also defines how many lines are output for one revolution of the primary feedback (when this port is configured as an output), or how many lines will be considered a full revolution of the handwheel (when this port is configured as an input).

Related Topics

8.4.1 Encoder Emulation

36.22 DRV.EMUEZOFFSET

General Information	
Type	R/W Parameter
Description	Sets the location of the EEO (emulated encoder output) index pulse (when DRV.EMUEMODE=1).
Units	1/65536 rev
Range	0 to 65535 rev
Default Value	0 rev
Data Type	Integer
See Also	DRV.EMUEMODE, DRV.EMUEMTURN
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CANopen	3537h/0	M_01-00-00-000
Modbus	252	M_01-03-00-000

Description

When emulated encoder output (EEO) multiturn is selected (DRV.EMUEMODE=1), this parameter is used by itself to define the position if the Z pulse within one revolution.When the primary feedback position (within a revolution) equals this value, an index pulse will output. Also, if DRV.EMUEMODE=1 then this parameter is used in conjunction with DRV.EMUEMTURN.

When the EEO is configured to generate an absolute index pulse (DRV.EMUEMODE is 2, 7 or 9) this parameter and DRV.EMUEZOFFSET define the location of the Z pulse. DRV.EMUEMTURN is used to define which turn of the position range the Z pulse is located and DRV.EMUEZOFFSET is used to define the position of the Z pulse within one revolution.

Note: If you are using multi-turn or single tune absolute feedback devices the Z pulse from generated by the EEO will always be aligned with the same mechanical position of the of the primary feedback position. If you are using an incremental feedback device then the origin of the primary feedback is not at the same mechanical position each time the drive powers up.

Related Topics

8.4.1 Encoder Emulation

36.23 DRV.EN

General Information	
Type	Command
Description	Enables the axis (software).
Units	N/A
Range	N/A
Default Value	Analog drive software is enabled. All other types of drive software are disabled.
Data Type	N/A
See Also	DRV.DIS, DRV.DISSOURCES DRV.A-CTIVE
Start Version	M_01-00-00-000

Description

DRV.EN issues a software enable to the drive. You can query the value of DRV.ACTIVE to check whether the drive is currently enabled or disabled.

You can also query the value of DRV.DISSOURCES to check whether the software enable bit is high (software enabled was issued by executing DRV.EN) or the software enable bit is low (software disable was issued by executing DRV.DIS). If the drive software enable bit is low and DRV.EN is executed, then drive faults are automatically cleared during the software enable process.

Related Topics

18.2 Clearing Faults

11.2 Command Buffer

11.10 Enable/Disable

36.24 DRV.ENDEFAULT

General Information	
Type	R/W Parameter
Description	Sets the default state of the software enable.
Units	N/A
Range	0 to 1
Default Value	0
Data Type	Boolean
See Also	N/A
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	256	M_01-03-00-000

Description

DRV. ENDEFAULT sets the default state of the software enable on power up for drives without fieldbuses (DRV.CMDSOURCE other than 1).

Related Topics

11.10 Enable/Disable

36.25 DRV.FAULTHIST

General Information	
Type	R/O Parameter
Description	Reads the last 10 faults from NV memory.
Units	N/A
Range	N/A
Default Value	N/A
Data Type	N/A
See Also	DRV.FAULTS, DRV.CLRFAULTHIST
Start Version	M_01-00-00-000

Description

DRV.FAULTHISTORY returns the last 50 faults that occurred in the drive. The faults are shown with their fault number (which matches the one displayed on the drive display) and a time stamp that indicates when they last occurred.

Issue a DRV.CLRFAULTHIST to clear this fault log.

36.26 DRV.FAULTS

General Information	
Type	R/O Parameter
Description	Reads the active faults.
Units	N/A
Range	N/A
Default Value	N/A
Data Type	N/A
See Also	DRV.CLRFAULTS, DRV.FAULTHIST, DRV.CLRFAU-LTHIST
Start Version	M_01-00-00-000

Description

DRV.FAULTS returns a list of all currently active faults in the system, preceded by their fault number which matches the number displayed on the drive display.

To clear the faults, either issue a DRV.CLRFAULTS or issue a DRV.DIS followed by DRV.EN.

If no active faults are in the system, then after executing DRV.CLRFAULTS the value read by DRV.FAULTS is "No faults active".

Example

```
-->DRV.FAULTS
502: Bus under voltage.
-->
```

36.27 DRV.HANDWHEEL

General Information	
Type	R/O Parameter
Description	Reads the EEO input value.
Units	1/4,294,967,296 rev
Range	0 to 4,294,967,295 rev
Default Value	0 rev
Data Type	Integer
See Also	DRV.EMUERES, DRV.EMUEMODE
Start Version End Version	M_01-00-00-000 M_01-03-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CANopen	2050h/0	M_01-00-00-000
Modbus	258	M_01-03-00-000

Description

When the EEO is selected as an input (DRV.EMUEMODE=3,4,5), this parameter reads the EEO value (where 4,294,967,296 is a full revolution, then the value rolls over). DRV.EMUERES defines the how many counts constitute a revolution on the EEO. This parameter represents the feedback 2 positions when feedback 2 is configured to be active.

When secondary feedback is selected (DRV.EMUEMODE is 0 and FB2.SOURCE = 1 (X9), or FB2.SOURCE = 2 (X7)), this parameter represents the secondary feedback position (where 4,294,967,296 is a full revolution, then the value rolls over). FB2.ENCRES defines how many counts define a revolution for the secondary feedback.

Related Topics

8.4.1 Encoder Emulation

36.28 DRV.HELP

General Information	
Type	R/O Parameter
Description	Reads the minimum, maximum, and default values for a specific parameter or command.
Units	N/A
Range	N/A
Default Value	N/A
Data Type	N/A
See Also	N/A
Start Version	M_01-00-00-000

Description

This parameter returns more information about a specific parameter or command.

In most cases, except special parameters, this command tells you the minimum, maximum, default, and actual value of a parameter. Exceptions are commands that do not have these values (such as DRV.EN) or information commands (such as DRV.VER).

Related Topics

17.1 Terminal

36.29 DRV.HELPALL

General Information	
Type	R/O Parameter
Description	Retrieves the minimum, maximum, default, and actual values for all available parameters and commands.
Units	N/A
Range	N/A
Default Value	N/A
Data Type	N/A
See Also	N/A
Start Version	M_01-00-00-000

Description

This parameter retrieves all information about all parameters and commands in the firmware. In most cases, DRV.HELPALL returns the minimum, maximum, default, and actual value for each parameter and command. Exceptions include parameters and commands that do not have these values (such as DRV.EN) or pure INFO commands (such as DRV.VER).

Related Topics

17.1 Terminal

36.30 DRV.HWENMODE

General Information	
Type	R/W Parameter
Description	Selects the action that the hardware enable digital input will perform.
Units	N/A
Range	0 to 1
Default Value	0
Data Type	Integer
See Also	N/A
Start Version	M_01-03-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CANopen	3506h/0	M_01-03-00-000
Modbus	260	M_01-03-00-000

Description

This parameter selects the action that the hardware enable digital input will perform.

0 = The rising edge of the hardware enable will clear the drive faults.

1 = The rising edge of the hardware enable will not clear the drive faults.

The high/low state of the hardware enable is always used to control the active enable state of the drive.

Related Topics

11.10 Enable/Disable

36.31 DRV.ICONT

General Information	
Type	R/O Parameter
Description	Reads the continuous rated current value.
Units	Arms
Range	N/A
Default Value	N/A
Data Type	Float
See Also	DRV.IPEAK
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	262	M_01-03-00-000

Description

DRV.ICONT returns the drive continuous rated current in Arms.

The value of the continuous current is read automatically on drive boot from the power EEPROM of the drive. This value cannot be modified.

36.32 DRV.INFO

General Information	
Type	R/O Parameter
Description	Reads general information about the drive.
Units	N/A
Range	N/A
Default Value	N/A
Data Type	String
See Also	N/A
Start Version	M_01-00-00-000

Description

DRV.INFO returns general information about the drive.

Example

```
Advanced Kollmorgen Drive
-------------------------------------------------------------------
---
Drive model : AKD-P00306-NACC-0000
Drive type : Position Indexer
Continuous current : 3.000 Arms
Peak current: 9.000 Arms
Voltage : 120/240 Vac
Option Board : Not applicable
Connectivity : EtherCAT

Product serial number: R-0939-00048
Hardware version : --
Mac address: 00-23-1B-00-50-F1
Processor ID: 0xE5040003

Firmware version: M_01-04-16-000_Z_2011-09-12_14-03-45_AP
Operational image : M_01-04-16-000_Z_2011-09-12_14-03-45_AP
Resident image : R_00-00-28-000
Revision : 19074
Source Location: local

FPGA Version: FP0003_0103_00_00
Operational image : FP0003_0103_00_00
Resident image : FPB003_0100_00_00
Size: 1600

Control board serial number : 4-0921-00196
Part number : 0
Revision : 7
Board ID : Standard
```

```
Power board serial number : 4-0922-00156
Part number : 0

TCP/IP IP address : 169.254.250.241
Subnet mask : 255.255.0.0
Default gateway : 0.0.0.0
DHCP server : 0.0.0.0

Temporary fieldbus type : EtherCAT
FPGA size : 1600
```

36.33 DRV.IPEAK

General Information	
Type	R/O Parameter
Description	Reads the peak rated current value.
Units	Arms
Range	N/A
Default Value	N/A
Data Type	Float
See Also	DRV.ICONT
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	264	M_01-03-00-000

Description

DRV.IPEAK returns the drive peak rated current in Arms.

The value of the peak current is read automatically on drive boot from the power EEPROM of the drive. This value cannot be modified.

Related Topics

8.6 Foldback

8.3.9 Using Wake and Shake (WS)

36.34 DRV.IZERO

General Information	
Type	R/W Parameter
Description	Sets the current that will be used during the DRV.ZERO procedure.
Units	Arms
Range	Drive peak current to 0 Arms
Default Value	0 Arms
Data Type	Float
See Also	DRV.ZERO
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	266	M_01-03-00-000

Description

This parameter sets the current that is used during the DRV.ZERO procedure.

36.35 DRV.LIST

General Information	
Type	R/O Parameter
Description	Reads the list of available parameters and commands.
Units	N/A
Range	N/A
Default Value	N/A
Data Type	String
See Also	N/A
Start Version	M_01-00-00-000

Description

DRV.LIST reads the list of available commands and parameters from the drive.

To filter this list, enter DRV.LIST followed by the prefix of the commands and parameters that you wish
to display.

Example

Return a list of all available commands in the system:

```
-->DRV.LIST
```

Return all commands with the prefix DRV:

```
-->DRV.LIST DRV
```

36.36 DRV.LOGICVOLTS

General Information	
Type	R/O Parameter
Description	Reads the logic voltages.
Units	mv , Ω
Range	N/A
Default Value	N/A
Data Type	String
See Also	N/A
Start Version	M_01-00-00-000

Description

DRV.LOGICVOLTS reads the logic voltages data of 1.2 V, 2.5 V, 3.3 V, 5 V, 12 V, –12 V, and 3.3 AV.

Example

Below is an example of the output for this command:

```
ch0 = 1.2V    : 1211 mv
ch1 = 2.5V      :2488 mv
ch2 = 3.3V      :3274 mv
ch3 = 5V        :4950 mv
ch4 = 12V     :11892 mv
ch5 = -12V     :-11912 mv
ch6 = 3.3AV    :3300 mv
ch7 = R ohm    :100000 ohm
```

36.37 DRV.MEMADDR

General Information	
Type	R/W Parameter
Description	Sets the read and write address.
Units	N/A
Range	N/A
Default Value	U8
Data Type	N/A
See Also	DRV.MEMDATA
Start Version	M_01-00-00-000

Description

DRV.MEMADDR sets the address that is used by DRV.MEMDATA. The input can be either an internal parameter of the drive or any direct address from the DSP address space (SDRAM, internal RAM, or asynchronous memory). The input value can be either decimal or hexadecimal with 0x prefix.

Type extension can be one of the following:

U8,S8,U16,S16,U32,S32,U64,S64.

Examples

Setting to an internal parameter:

```
-->DRV.MEMADDR CCommandHandler.Debug1
```

Setting to an internal address:

```
-->DRV.MEMADDR 0xffabcde.u16
```

36.38 DRV.MEMDATA

General Information	
Type	R/W Parameter
Description	Sets or reads a value from an internal address.
Units	N/A
Range	N/A
Default Value	N/A
Data Type	N/A
See Also	DRV.MEMADDR
Start Version	M_01-00-00-000

Description

DRV.MEMDATA reads a value from the address that was set by DRV.MEMADDR or writes a value to this address. The input value can be either decimal or hexadecimal with 0x prefix.

Examples

Read a value from internal address:

```
-->DRV.MEMDATA 01
```

Write a hexadecimal value to an internal address:

```
-->DRV.MEMADDR 0x01
```

36.39 DRV.MOTIONSTAT

General Information	
Type	R/O Parameter
Description	Reads the motion status of the drive.
Units	N/A
Range	0 to 4,294,967,295
Default Value	N/A
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CAN-open	3492h/0	M_01-00-00-000
Modbus	268	M_01-03-00-000

Description

This command indicates the current status of the drive internal motion (see table below).

Bit	Significance	Description
0	0x00000001	Motion task is active (high active)
1	0x00000002	Home position found /reference point set (high active)
2	0x00000004	Home routine finished (high active). Bits 1 and 2 both must be set to confirm that the homing process is complete.
3	0x00000008	Homing active (high active)
4	0x00000010	Homing error condition has occurred (high active)*
5	0x00000020	Slave in electronic gearing mode synchronized (high active)
6	0x00000040	Electronic gearing is active (high active)
7	0x00000080	Emergency stop procedure in progress (high active)
8	0x00000100	Emergency stop procedure has an error (high active)
9	0x00000200	Service motion active (high active)
10	0x00000400	A motion task could not be activated /invalid MT (high active)**
11	0x00000800	Motion task target position has been reached. See also MT.TPOSWND (high active).
12	0x00001000	Motion task target velocity has been reached. See also MT.TVELWND (high active).
13	0x00002000	Motion task encountered an exception. A motion task exception can happen during a static motion task activation, or during activation of motion task on the fly (when velocity is not zero). The status bit will be reset automatically on successful activation of any motion, or by a command DRV.CLRFAULT.

Bit	Significance	Description
14	0x00004000	The target position of a motion task has been crossed. This situation occurs for motion tasks with a change on the fly when triggering the DRV.STOP command just before the reaching the target velocity of the current active motion task. The ramp-down procedure with the motion task deceleration ramp causes the target position to be crossed (high active).

* A possible error condition for homing to a reference switch could be that no reference switch was found between two hardware limit switches.

** A possible error condition for an invalid motion task could be that a motion task tried to trigger automatically following motion task that has never been initialized (called an "empty motion" task).

Related Topics

Drive Motion Status

36.40 DRV.NAME

General Information	
Type	NV Parameter
Description	Sets and reads the name of the drive.
Units	N/A
Range	N/A
Default Value	No-Name
Data Type	String
See Also	N/A
Start Version	M_01-00-00-000

Description

You can assign a unique name to any drive. This name is one way to identify the drive in a multiple drive network (for instance, in a TCP/IP network on which multiple drives reside).

From the terminal screen, DRV.NAME returns the name of the drive as ASCII characters.

36.41 DRV.NVCHECK

General Information	
Type	R/O Parameter
Description	NV Parameter Check-sum
Units	None
Range	N/A
Default Value	N/A
Data Type	Integer
See Also	DRV.NVLIST
Start Version	M_01-04-12-000

Fieldbus	Index/Subindex	Object Start Version
EtherCat COE and CANopen	2019h/0	M_01-04-12-000
Modbus	994	M_01-04-12-000

Description

DRV.NVCHECK returns a checksum of all the drives NV parameters. This parameter can be used to detect changes in parameters.

In some applications a master device needs to confirm the AKD drive contains an expected set of drive parameters. Reading and checking all the drive parameters individually is viable but this would be a long process involving many reads over the network. DRV.NVCHECK is a checksum on all the NV parameters and this parameter can be read in a single transaction. DRV.NVCHECK will return the same number if all the drive parameters match. If any of the drive parameters are changed then DRV.NVCHECK will return a different value.

36.42 DRV.NVLIST

General Information	
Type	R/O Parameter
Description	Lists the NV parameters and values from the RAM.
Units	N/A
Range	N/A
Default Value	N/A
Data Type	N/A
See Also	N/A
Start Version	M_01-00-00-000

Description

DRV.NVLIST lists all the drive parameters that reside in NV memory.

The list includes each parameter name, followed by its current value from the RAM.

36.43 DRV.NVLOAD

General Information	
Type	W/O Parameter
Description	Loads all data from the NV memory of the drive into the RAM parameters.
Units	N/A
Range	N/A
Default Value	N/A
Data Type	N/A
See Also	DRV.NVLOAD DRV.NVLIST
Start Version	M_01-00-00-000

Description

DRV.NVLOAD loads all data from the NV memory of the drive into the RAM parameters.

36.44 DRV.NVSAVE

General Information	
Type	Command
Description	Saves the drive parameters from the RAM to the NV memory.
Units	N/A
Range	N/A
Default Value	N/A
Data Type	N/A
See Also	DRV.RSTVAR
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CANopen	1010h/1 35EBh/0	M_01-00-00-000
Modbus	N/A	N/A

Description

DRV.NVSAVE saves the current drive parameter values from the RAM to the NV memory.

The drive parameters that were saved to the NV are read from the NV on the next drive boot, causing the values to be automatically set to the saved values on every drive boot.

Executing DRV.RSTVAR does not modify the values of the NV, but instead sets the drive values in RAM to their defaults.

36.45 DRV.ONTIME

General Information	
Type	R/O Parameter
Description	Returns how long the drive has been running since last power up.
Units	Days:Hours:Minutes:Seconds
Range	N/A
Default Value	N/A
Data Type	String
See Also	Returns how long the drive has been running since first activated.
Start Version	M_01-00-00-000

Description

This parameter returns the length of time that the drive has been running for the current session (since the last power up).

36.46 DRV.OPMODE

General Information	
Type	NV Parameter
Description	Sets the drive operation mode (current, velocity, or position).
Units	N/A
Range	0 to 2
Default Value	0
Data Type	Integer
See Also	DRV.CMDSOURCE
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CANopen	35B4h/0	M_01-00-00-000
Modbus	270	M_01-03-00-000

Description

DRV.OPMODE specifies the operation mode of the drive. You must also use DRV.CMDSOURCE to set the source of the command to the drive.

The operation mode values can be set as follows:

Mode	Description
0	Current (torque) operation mode
1	Velocity operation mode
2	Position operation mode

DRV.OPMODE can be changed while the drive is enabled or disabled. If you are using the terminal to change the operation mode, then it is recommended that you disable the drive before changing the operation mode. If you change the operation mode from the terminal while the drive is enabled, the system may experience a step change in demand.

Example

Set the source of the command to a TCP/IP channel and the desired operation mode to velocity:

```
-->DRV.CMDSOURCE 0
-->DRV.OPMODE 1
```

Related Topics

12 Using Command Source and Operating Modes

11.11 Controlled Stop

12.3 Current Loop

11.1 Digital Inputs and Outputs

12.4 Velocity Loop

12.5 Position Loop

8.3.9 Using Wake and Shake (WS)

36.47 DRV.READFORMAT

General Information	
Type	R/W Parameter
Description	Sets the value returned to either decimal or hexadecimal.
Units	N/A
Range	10 or 16
Default Value	10
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

Description

DRV.READFORMAT sets the return values type to either decimal or hexadecimal.

Format	Description
10	Sets the read values to decimal format
16	Sets the read values to hexadecimal format

36.48 DRV.RSTVAR

General Information	
Type	Command
Description	Sets default values in the drive without re-booting the drive and without resetting the NV memory.
Units	N/A
Range	N/A
Default Value	N/A
Data Type	N/A
See Also	
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	272	M_01-03-00-000

Description

DRV.RSTVAR causes the drive to return to the default values without the need to re-boot the drive first and without resetting the NV memory. Use DRV.RSTVAR to return to the default settings and recover a working drive.

36.49 DRV.RUNTIME

General Information	
Type	R/O Parameter
Description	Returns how long the drive has been running since first activated.
Units	Days:Hours:Minutes:Seconds
Range	N/A
Default Value	N/A
Data Type	String
See Also	N/A
Start Version	M_01-00-00-000

Description

DRV.RUNTIME returns the length of time that the drive has been running since it was first activated. This time includes the current session and the total amount of time from all previous sessions.

36.50 DRV.SETUPREQBITS

General Information	
Type	R/O Parameter
Description	Reads the bitwise set status of parameters that must be set before the drive can be enabled
Units	N/A
Range	N/A
Default Value	N/A
Data Type	N/A
See Also	DRV.SETUPREQLIST, MOTOR.AUTOSET
Start Version	M_01-00-00-000

Description

This parameter returns the bitwise set status of parameters that needs to be set up before the drive can be enabled. Only when this parameter returns 0 can the drive be enabled.

Parameter	Bits
IL.KP	0x00000001
MOTOR.IPEAK	0x00000002
MOTOR.ICONT	0x00000004
MOTOR.VMAX	0x00000008
MOTOR.POLES	0x00000010
MOTOR.PHASE	0x00000020

Please note that if MOTOR.AUTOSET is set to 1 (parameters automatically calculated from motor ID data), then all values in the list will be initialized from the feedback device. Otherwise, the parameters must be set manually.

Example

```
-->DRV.SETUPREQBITS
0
-->
```

36.51 DRV.SETUPREQLIST

General Information	
Type	R/O Parameters
Description	Reads the list of parameters that must be set before the drive can be enabled.
Units	N/A
Range	N/A
Default Value	N/A
Data Type	N/A
See Also	DRV.SETUPREQBITS, MOTOR.AUTOSET
Start Version	M_01-00-00-000

Description

This parameter returns the list of parameters that must be set before the drive can be enabled and also whether or not each one of those parameters is set. Only when all commands have value of 0 can the drive be enabled.

Please note that if MOTOR.AUTOSET is set to 1 (parameters automatically calculated from motor ID data), then all values in the list will be initialized from the feedback device. Otherwise, the parameters must be set manually.

Example

```
-->DRV.SETUPREQLIST
IL.KP 0
MOTOR.ICONT 0
MOTOR.IPEAK 0
MOTOR.POLES 0
-->
```

36.52 DRV.STOP

General Information	
Type	Command
Description	This command stops all drive motion.
Units	N/A
Range	N/A
Default Value	N/A
Data Type	N/A
See Also	N/A
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CAN-open	35FEh/0	M_01-00-00-000
Modbus	274	M_01-03-00-000

Description

This command stops all drive motion.

36.53 DRV.TEMPERATURES

General Information	
Type	R/O Parameter
Description	Reads the temperature of drive components.
Units	°C
Range	55 to 125 °C
Default Value	N/A
Data Type	String
See Also	N/A
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CANopen	3610h/0 3611h/0	M_01-00-00-000
Modbus	N/A	M_01-03-00-000

Description

DRV.TEMPERATURES reads the temperature in different parts of the drive (power and control boards). The temperature is read from temperature sensors located in the drive.

Example

Below is an example of the output for this command :

```
Control Temperature: 39 °C
Power1  Temperature: 31 °C
Power2  Temperature: Sensor does not exist.
Power3  Temperature: Sensor does not exist.
```

36.54 DRV.TYPE

General Information	
Type	R/O on analog, EtherCAT and CANopen models R/W on the CC drive model.
Description	Selects the operational fieldbus on CC drive mod-els.
Units	N/A
Range	0 to 3
Default Value	2
Data Type	Integer
See Also	FBUS.TYPE, DRV.INFO
Start Version	M_01-03-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	276	M_01-03-00-000

Description

DRV.TYPE allows you to select the operational fieldbus for your drive. This parameter is read-write on the CC drive models and read-only on the analog, EtherCAT, and CANopen drive models. To change the operational fieldbus of your drive:

1. Set DRV.TYPE to one of the following values:

   0 = Analog (no EtherCAT or CANopen) with no position indexer functionality.

   1 = Analog (no EtherCAT or CANopen) with position indexer functionality.

   2 = EtherCAT

   3 = CANopen

   4 = SynqNet

   5 = EtherNet/IP

   6 = BASIC Langauge (not fieldbus)

   7 = Profinet

2. Save the parameters to the NV memory on the drive by issuing the DRV.NVSAVE command
3. Power cycle the 24 V supply to the drive. When the drive has finished powering up, it will be working with the new selection.

Changing DRV.TYPE does not immediately change the type of the drive fieldbus selection. You must power cycle the drive to start the drive with the selected functionality.

You cannot use EtherCAT and CANopen at the same time. Use FBUS.TYPE or DRV.INFO to identify the fieldbus currently in use.

DRV.TYPE does not change if you use DRV.RSTVAR.

Related Topics

2 AKD Models

36.55 DRV.VER

General Information	
Type	R/O Parameter
Description	Reads the drive version.
Units	N/A
Range	N/A
Default Value	N/A
Data Type	String
See Also	N/A
Start Version	M_01-00-00-000

Description

DRV.VER reads both FPGA and firmware versions.

The version data presented is hard coded in the firmware code.

Example

Below is an example of the output for this command:

```
Danaher Motion - Digital Servo Drive
-------------------------------------
FPGA version : FP0004_0001_00_07
Firmware Version : M_0-0-15_T_2009-01-19_10-36-28_IR
```

36.56 DRV.VERIMAGE

General Information	
Type	R/O Parameter
Description	Returns the version data from each image.
Units	N/A
Range	N/A
Default Value	N/A
Data Type	String
See Also	N/A
Start Version	M_01-00-00-000

Description

DRV.VERIMAGE reads the versions of the different images in the drive. This parameter returns the version data from each image .i00 file.

Example

Below is an example of the output for this parameter:

```
Danaher Motion - Digital Servo Drive
------------------------------------
Resident Firmware: R_0-0-11
Operational Firmware: M_0-0-15
Resident FPGA: FPB004_0001_00_07
Operational FPGA : FP0004_0001_00_07
```

36.57 DRV.WARNINGS

General Information	
Type	R/O Parameter
Description	Reads the active warn-ings.
Units	N/A
Range	N/A
Default Value	N/A
Data Type	N/A
See Also	N/A
Start Version	M_01-00-00-000

Description

DRV.WARNINGS returns a list of all currently active warnings in the system.

36.58 DRV.ZERO

General Information	
Type	R/W Parameter
Description	Sets the zero mode. The procedure is activated when the drive is enabled.
Units	N/A
Range	0 to 1
Default Value	0
Data Type	Integer
See Also	DRV.IZERO
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	278	M_01-03-00-000

Description

The zero procedure is a sequence in which phase commutation is initialized. During this procedure, the motor is held at a certain known electrical position (by applying a current defined by DRV.IZERO). After the motor rests at this position, the commutation angle is calculated and set automatically.

37 EIP Parameters

This section describes the EIP parameters.

37.1 EIP.POSUNIT

General Information	
Type	R/W
Description	Unit scaling for Position values over EtherNet/IP.
Units	N/A
Range	0 to 4,294,967,295
Default Value	65536
Data Type	Integer
Start Version	M_01-05-00-000

Description

Position values are scaled according to the Ethernet/IP Position Controller Device standard. One “Position Units” scaling value is defined, which gives the number of actual position feedback counts (at 32 bits per revolution) equal to one position unit.

From Workbench, this scaling parameter is visible in the Ethernet/IP screen or as EIP.POSUNIT in the terminal. From Ethernet/IP, this value can be accessed at attribute 0x04 Position Units of the Position Controller object.

The default value is 2^16 = 65536, which provides 2^32 / 2^16 = 2^16 counts per revolution. A value of 1 would provide 2^32 / 1 = 2^32 counts per revolution.

Related Topics

EIP.PROFUNIT

37.2 EIP.PROFUNIT

General Information	
Type	R/W
Description	Unit scaling for Velocity and Acceleration values over EtherNet/IP.
Units	N/A
Range	0 to 4,294,967,295
Default Value	65536
Data Type	Integer
Start Version	M_01-05-00-000

Description

Velocity and Acceleration values are scaled according to the EtherNet/IP Position Controller Device standard. One “Profile Units” scaling value is defined, which affects both velocity and acceleration.

For velocity values, Profile Units gives the number of actual position feedback counts (at 32 bits per revolution) per second equal to one velocity unit. For acceleration values, Profile Units gives the number of actual position feedback counts (at 32 bits per revolution) per second^2 equal to one acceleration unit.

From Workbench, this scaling parameter is visible in the EtherNet/IP screen or as EIP.PROFUNIT in the terminal. From EtherNet/IP, this value can be accessed at attribute 0x05 Profile Units of the Position Controller object.

The default value is 2^16 = 65536, which provides 2^32 / 2^16 = 2^16 counts per second per revolution. A value of 1 would provide 2^32 / 1 = 2^32 counts per second per revolution.

Related Topics

EIP.POSUNIT

38 FB1 Parameters

This section describes the FB1 parameters.

38.1 FB1.BISSBITS

General Information	
Type	NV Parameter
Description	Specifies the number of Biss Sensor (Position) Bits for the BiSS Mode C encoder in use.
Units	bits
Range	0 to 64 bits
Default Value	32 bits
Data Type	Integer
See Also	FB1.SELECT, FB1.IDENTIFIED
Start Version	M_01-01-00-100 and M_01-01-03-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	280	M_01-03-00-000

Description

FB1.BISSBITS specifies the number of BiSS sensor (position) bits for the BiSS Mode C encoder in use. Typically the value is either 26 or 32 for a BiSS Mode C Renishaw encoder. The required value for this parameter is provided by the feedback device manufacturer for the particular device being used.

Related Topics

8.2 Feedback 1

38.2 FB1.ENCRES

General Information	
Type	NV Parameter
Description	Sets the resolution of the motor encoder.
Units	Encoder counts
Range	0 to 2^{32}-1
Default Value	1,024
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CAN-open	3533h/0	M_01-00-00-000
Modbus	282	M_01-03-00-000

Description

This parameter sets or gets the resolution of the motor encoder (encoder feedback systems only) in number of counts per revolution for a rotary motor and the number of encoder pitches per motor pole pitch for a linear motor. The number of encoder counts per revolution is obtained by multiplying the motor catalog resolution in units of PPR by four. For example, for a 1024 PPR resolution motor, the number of encoder counts per revolution is 1024*4 = 4096. For this motor FB1.ENCRES must be set to 4096.

For linear motors, the value of FB1.ENCRES is set to the number of encoder pitches per motor pole pitch. For a motor with 32 mm pole pitch, and a 40 µm encoder pitch, the value for FB1.-ENCRES should be set to 32 mm/40 µm = 800.

Related Topics

8.2 Feedback 1

38.3 FB1.HALLSTATE

General Information	
Type	R/O Parameter
Description	Reads the Hall switch values (encoder feed-back only).
Units	Binary
Range	0 0 0 to 1 1 1
Default Value	N/A
Data Type	String
See Also	N/A
Start Version	M_01-00-00-000

Description

FB1.HALLSTATE reads the Hall switch values (encoder feedback only).

Related Topics

8.2 Feedback 1

38.4 FB1.HALLSTATEU

General Information	
Type	R/O Parameter
Description	Reads the state of Hall switch U.
Units	N/A
Range	0 and 1
Default Value	1
Data Type	Integer
See Also	FB1.HALLSTATE
Start Version	M_01-03-07-000

Description

FB1.HALLSTATEU reads the state of Hall switch U.

Related Topics

8.2 Feedback 1

38.5 FB1.HALLSTATEV

General Information	
Type	R/O Parameter
Description	Reads the state of Hall switch V.
Units	N/A
Range	0 and 1
Default Value	1
Data Type	Integer
See Also	FB1.HALLSTATE
Start Version	M_01-03-07-000

Description

FB1.HALLSTATEV reads the state of Hall switch V.

Related Topics

8.2 Feedback 1

38.6 FB1.HALLSTATEW

General Information	
Type	R/O Parameter
Description	Reads the state of Hall switch W.
Units	N/A
Range	0 and 1
Default Value	1
Data Type	Integer
See Also	FB1.HALLSTATE
Start Version	M_01-03-07-000

Description

FB1.HALLSTATEW reads the state of Hall switch W.

Related Topics

8.2 Feedback 1

38.7 FB1.IDENTIFIED

General Information	
Type	R/O Parameter
Description	Reads the type of feedback device used by the drive/motor.
Units	N/A
Range	N/A
Default Value	N/A
Data Type	Integer
See Also	FB1.SELECT
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	284	M_01-03-00-000

Description

This parameter is set according to FB1.SELECT on drive power up if FB1.SELECT is not –1; otherwise the parameter value is read from the drive memory.

Type	Description
0	Unknown
10	Incremental encoder with A/B Quad, marker pulse and Hall
11	Incremental encoder with A/B Quad, marker pulse and no Hall
20	Sine Encoder , with marker pulse and Hall
21	Sine encoder , with marker pulse & No Halls
30	EnDat 2.1 with Sine Cosine
31	EnDat 2.2
32	BiSS with Sine Cosine
33	HIPERFACE
34	BiSS Mode C Renishaw
40	Resolver
41	SFD

Related Topics

8.2 Feedback 1

38.8 FB1.INITSIGNED

General Information	
Type	NV Parameter
Description	Sets initial feedback value as signed or unsigned.
Units	N/A
Range	0 to 1
Default Value	0
Data Type	Integer
See Also	FB1.ORIGIN
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	286	M_01-03-00-000

Description

This parameter sets whether the initial value of the feedback read from the feedback device will be set as a signed or as an unsigned value.

0 = Unsigned

1 = Signed

The drive internal process for the feedback initialization is as follows:

1. Reads the position feedback.
2. Adds the origin to the feedback.
3. Determines modulo from Step 2 by the actual feedback bits.
4. Sets the position feedback sign according to FB1.INITSIGNED.

Related Topics

8.2 Feedback 1

38.9 FB1.MECHPOS

General Information	
Type	R/O Parameter
Description	Reads the mechanical position.
Units	counts
Range	0 to 4,294,967,295 counts
Default Value	N/A
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	288	M_01-03-00-000

Description

FB1.MECHPOS reads the mechanical angle which is equal to the lower 32 bits in the 64-bit position feedback word.

Related Topics

8.2 Feedback 1

38.10 FB1.MEMVER

General Information	
Type	R/O Parameter
Description	Returns the memory feedback version.
Units	N/A
Range	N/A
Default Value	N/A
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

Description

FB1.MEMVER returns the memory feedback version (only applicable for feedbacks with memory).

Related Topics

8.2 Feedback 1

38.11 FB1.OFFSET

General Information	
Type	NV Parameter
Description	Sets position feedback offset.
Units	Depends on UNIT.ACCROTARY or UNIT.PLINEAR Rotary: counts, rad, deg, custom units, 16-bit counts Linear: counts, mm, µm, custom units, 16-bit counts
Range	Rotary: -5,123,372,000,000,005.000 to 5,123,372,000,000,005.000 counts -7495.067 to 7495.067 rad -429,436.096 to 429,436.096 deg -5,964.390 to 5,964.390 [custom units] -78,176,452.637 to 78,176,452.636 16-bit counts Linear: -5,123,372,000,000,005.000 to 5,123,372,000,000,005.000 counts -1192.878*MOTOR.PITCH to 1192.878*MOTOR.PITCH mm -1192877.952*MOTOR.PITCH to 1192877.952*MOTOR.PITCH µm -5964.390 to 5964.390 custom units -78176452.637 to 78176452.636 16-bit counts
Default Value	0
Data Type	Float
See Also	PL.FB
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CAN-open	3490h/0	M_01-00-00-000
Modbus	290 (64-bit)	M_01-03-00-000

Description

FB1.OFFSET is a value added to the position feedback (PL.FB).

Example

If PL.FB is 10 deg and FB1.OFFSET is set to –10 deg, then the next read of PL.FB will return ~0 deg.

Related Topics

8.2 Feedback 1

38.12 FB1.ORIGIN

General Information	
Type	NV Parameter
Description	Adds to the initial feedback position.
Units	Depends on UNIT.ACCROTARY or UNIT.A-CCLINEAR Rotary: counts, rad, deg, custom units, 16-bit counts Linear: counts, mm, µm, custom units, 16-bit counts
Range	Rotary: 0.000 to 5,123,372,000,000.000 counts 0.000 to 7,495.067 rad 0.000 to 429,436.096 deg 0.000 to 5,964.390 custom units 0.000 to 78,176,452.636 16-bit counts Linear: 0.000 to 5,123,372,000,000.000 counts 0.000 to 1,192.878 mm 0.000 to 1,192,877.952 µm 0.000 to 5,964.390 custom units 0.000 to 78,176,452.636 counts16 Bit
Default Value	0 counts
Data Type	Float
See Also	FB1.INITSIGNED
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CAN-open	3656h/0	M_01-00-00-000
Modbus	294 (64-bit)	M_01-03-00-000

Description

FB1.ORIGIN is a value that is added to the feedback device position. Initial value and modulo are determined from the number of bits of the feedback:

Initial position value = (<feedback from device> + FB1.ORIGIN) modulo <number of feedback bits>

The number of feedback bits is set according to the feedback type. For memory feedbacks it is the number of feedback bits; for none memory it is always single turn.

The drive internal process for the feedback initialization is as follows:

1. Reads the position feedback.
2. Adds the origin to the feedback.
3. Determines modulo from Step 2 by the actual feedback bits.
4. Sets the position feedback sign according to FB1.INITSIGNED.

Example

This example uses UNIT.PROTARY set to 2 (degrees)

It also assumes that the drive is connected to a single turn feedback device with memory.

FB1.ORIGIN is set to 22 and saved into NV memory.

Drive boots and reads from feedback device position 340 degrees. According to the description section above, calculation will be:

(340 + 22) modulo 360 = 2 degrees.

Therefore the initial feedback value will be set to 2 degrees.

Related Topics

8.2 Feedback 1

38.13 FB1.PFIND

General Information	
Type	R/W Parameter
Description	A procedure that allows the user to find the commutation angle for encoder feedback, which has no halls.
Units	NA
Range	0, 1
Default Value	0
Data Type	Integer
See Also	FB1.PFINDCMDU
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	298	M_01-03-00-000

Description

A procedure that allows the user to find the commutation angle for encoder feedback (which has no Halls).

Related Topics

8.2 Feedback 1

38.14 FB1.PFINDCMDU

General Information	
Type	R/W Parameter
Description	Current value used during the phase finding procedure (PFB.PFIND=1)
Units	A
Range	0 to DRV.IPEAK
Default Value	0
Data Type	Float
See Also	PFB.PFIND
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	300	M_01-03-00-000

Description

FB1.PFINDCMDU sets the current value used during the phase finding procedure.

Related Topics

8.2 Feedback 1

38.15 FB1.POLES

General Information	
Type	R/W Parameter
Description	Reads the number of feedback poles.
Units	N/A
Range	2 to 128
Default Value	2
Data Type	Integer
See Also	MOTOR.POLES
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	302	M_01-03-00-000

Description

FB1.POLES sets the number of individual poles in the feedback device. This variable is used for the commutation function, as well as for velocity feedback scaling, and represents the number of individual poles (not pole pairs). The division value of motor poles (MOTOR.POLES) and feedback poles (FB1.POLES) must be an integer when moving drive to enable, otherwise a fault is issued.

Related Topics

8.2 Feedback 1

38.16 FB1.PSCALE

General Information	
Type	R/W Parameter
Description	Sets position scaling value for fieldbus transferred position objects.
Units	N/A
Range	0 to 32
Default Value	20
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	304	M_01-03-00-000

Description

Position values transfered over fieldbus are converted from native 64-bit values to a maximum 32-bit position value. This parameter sets the resolution/revolution of position values back to the controller.

FB1.PSCALE determines the counts per revolution of position values delivered by fieldbus. The default value is 20, which yields 2^20 counts/revolution. This scaling is used for CAN PDOs 6064 (Position Actual Value) and 60F4 (Following Error Actual Value).

Example

The drive always works internally with 64-bit position values. The drive internal 64-bit actual position should contain the following value:

0x0000.0023.1234.ABCD

The lower 32 bits represent the mechanical angle of the feedback. The upper 32 bits represent the number of turns.

FB1.PSCALE = 20

The 32-bit position is: 0x0231234A

FB1.PSCALE = 16

The 32-bit position is: 0x00231234

Related Topics

8.2 Feedback 1

38.17 FB1.RESKTR

General Information	
Type	NV Parameter
Description	Sets the resolver nominal transformation ratio.
Units	N/A
Range	0.001 to 50.000
Default Value	0.5
Data Type	Float
See Also	N/A
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	306	M_01-03-00-000

Description

This parameter sets the resolver nominal transformation ratio. It affects the resolver excitation output amplitude.

The value can be obtained from the resolver data sheet.

Related Topics

8.2 Feedback 1

38.18 FB1.RESREFPHASE

General Information	
Type	NV Parameter
Description	Sets the electrical degrees of phase lag in the resolver.
Units	electrical degrees
Range	-180 to 180°
Default Value	-2°
Data Type	Float
See Also	N/A
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	308	M_01-03-00-000

Description

This parameter sets the electrical degrees of phase lag in the resolver.

See the motor resolver datasheet for the value for this parameter .

Related Topics

8.2 Feedback 1

38.19 FB1.SELECT

General Information	
Type	NV Parameter
Description	Sets user entered type or identified type (–1).
Units	N/A
Range	–1, 10, 20, 30, 31, 32, 40, 41
Default Value	–1
Data Type	Integer
See Also	FB1.IDENTIFIED
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CAN-open	353Bh/0	M_01-00-00-000
Modbus	310	M_01-03-00-000

Description

FB1.SELECT sets the feedback type manually (see FB1.IDENTIFIED) or allows the drive to automatically identify the feedback type on power up.

FB1.SELECT Input Values

Input Value	Description
–1	The drive automatically identifies the type of feedback as part of the power up process. Setting this value does not modify FB1.IDENTIFIED, unless it is saved in the NV memory for the next power up. If a feedback with memory is connected to the drive, the value of FB1.IDENTIFIED is set automatically to the feedback identified and all parameters read from the feedback are set according to the values read from the feedback. If no feedback is connected or a feedback with no memory is connected, the value of FB1.IDENTIFIED is set to 0 (no feedback identified) and all values normally read from the feedback are read from NV memory (if stored in NV) otherwise they are set to the default values.
10	Manually sets the type to incremental encoder. This input sets the value of FB1.IDENTIFIED to 10. If the feedback setting fails, FB1.IDENTIFIED is automatically set to 0 (no feedback identified).
20	Manually sets the type to sine encoder. This input sets the value of FB1.IDENTIFIED to 20. If the feedback setting fails, FB1.IDENTIFIED is automatically set to 0 (no feedback identified).
30	Manually sets the type to Endat 2.1. This input sets the value of FB1.IDENTIFIED to 30. If the feedback setting fails, FB1.IDENTIFIED is automatically set to 0 (no feedback identified).
31	Manually sets the type to Endat 2.2. This input sets the value of FB1.IDENTIFIED to 31. If the feedback setting fails, FB1.IDENTIFIED is automatically set to 0 (no feedback identified).
32	Manually sets the type to BiSS. This input sets the value of FB1.IDENTIFIED to 32. If the feedback setting fails, FB1.IDENTIFIED is automatically set to 0 (no feedback identified).

Input Value	Description
33	Manually sets the type to Hiperface. This input sets the value of FB1.IDENTIFIED to 33. If the feedback setting fails, FB1.IDENTIFIED is automatically set to 0 (no feedback identified). Note that all Hiperface feedback types are supported by the AKD. This includes SEL/SEK 37, SEL/SEK 52, SKM/SKS 36, SRS/SRM 50, SRS/SRM 60, SEK 90, SEK160, and SEK 260. The AKD drive will support any new Hiperface device, since any new device will be released with a label type of 0xFF. Devices with this label type have all of the pertinent information to configure these devices (number of single turn bits, number of multi-turn bits, and number of sine/cosine periods) stored in their memory. The AKD is able to read this information, and automatically configure the drive for proper operation. Note that the devices SEK 90, SEK 160, and SEK 260 are label type 0xFF.
40	Manually sets the type to resolver. This input sets the value of FB1.IDENTIFIED to 40. If the feedback setting fails, FB1.IDENTIFIED is automatically set to 0 (no feedback identified).
41	Manually sets the type to SFD. This input sets the value of FB1.IDENTIFIED to 41. If the feedback setting fails, FB1.IDENTIFIED is automatically set to 0 (no feedback identified).

FB1.SELECT Feedback Types

Type	Description
0	Unknown
10	Incremental encoder with A/B Quad, marker pulse and Hall
11	Incremental encoder with A/B Quad, marker pulse and no Hall
20	Sine Encoder , with marker pulse and Hall
21	Sine encoder , with marker pulse & No Halls
30	EnDat 2.1 with Sine Cosine
31	EnDat 2.2
32	BiSS with Sine Cosine
33	HIPERFACE
34	BiSS Mode C Renishaw
40	Resolver
41	SFD

Related Topics

8.2 Feedback 1

38.20 FB1.TRACKINGCAL

General Information	
Type	NV Parameter
Description	Controls tracking calibration algorithm.
Units	N/A
Range	0 to 1
Default Value	0
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	312	M_01-03-00-000

Description

This parameter turns the tracking calibration algorithm on or off for sine-cosine or resolver.

0 = Tracking calibration is off.

1 = Tracking calibration is on.

Related Topics

8.2 Feedback 1

39 FB2 Parameters

This section describes the FB2 parameters.

39.1 FB2.ENCRES

General Information	
Type	NV Parameter
Description	Sets the secondary feedback (FB2) resolution.
Units	counts/rev
Range	0 to 262,140 counts/rev
Default Value	0
Data Type	Integer
See Also	FB2.MODE, FB2.SOURCE
Start Version	M_01-03-00-000

Description

This parameter sets the feedback 2 (FB2) resolution and defines how many counts input into the secondary feedback will be considered a full revolution.

Related Topics

8.4 Feedback 2

39.2 FB2.MODE

General Information	
Type	R/W Parameter
Description	Sets the mode for the second feedback inputs, EEO connector (X9) and high speed opto inputs (pins 9 and 10 on X7).
Units	N/A
Range	0 to 2
Default Value	0
Data Type	Integer
See Also	FB2.ENCRES, PL.FBSOURCE
Start Version	M_01-03-00-000

Description

This parameter sets the feedback 2 input type as follows:

0 = Input A/B Signals

1 = Input Step and Direction Signals

2 = Input, up-down signals

Related Topics

8.4 Feedback 2

FB2.SOURCE

39.3 FB2.SOURCE

General Information	
Type	R/W Parameter
Description	Sets the source for the second feedback input. Choices are the EEO connectors (X9) which are RS485 inputs, or the X7 connector’s high speed opto inputs (pins 9 and 10).
Units	N/A
Range	0 to 2
Default Value	0
Data Type	Integer
See Also	FB2.ENCRES, FB2.MODE, PL.FBSOURCE
Start Version	M_01-03-00-000

Description

This parameter sets the secondary feedback source to be either the EEO connector (X9) or the high speed opto inputs on the I/O Connector (X7) as follows:

0 = None

1 = Feedback Source X9 (EEO connector)

2 = Feedback Source X7 (High Speed Opto Inputs on the I/O Connector)

Related Topics

8.4 Feedback 2

40 FB3 Parameters

This section describes the FB3 parameters.

40.1 FB3.MODE

General Information	
Type	NV Parameter
Description	Selects the type of feedback connected to X9.
Units	N/A
Range	0
Default Value	0
Data Type	Integer
See Also	NA
Start Version	M_01-04-15-000

Fieldbus	Index/Subindex
Modbus	1044

Description

This parameter selects the type of feedback connected to X9. The position is reported as the tertiary feedback position, by FB3.P.

Value	Feedback
0	Endat 2.2 Feedback Device

This parameter is only supported on drives with model numbers similar to AKD-x-xxxxx-NBxx-xxxx.

40.2 FB3.P

General Information	
Type	R/O Parameter
Description	Reads position from the tertiary feedback.
Units	None
Range	N/A
Default Value	N/A
Data Type	Integer
See Also	N/A
Start Version	M_01-04-15-000

Fieldbus	Index/Subindex
Modbus	1046

Description

This parameter reads the position back from the tertiary feedback device that is connected to X9. This is the raw position read back from the device.

This parameter is only supported on drives with model numbers similar to AKD-x-xxxxx-NBxx-xxxx.

41 FBUS Parameters

This section describes the FBUS parameters.

41.1 FBUS.PARAM1 TO FBUS.PARAM20

General Information	
Type	NV Parameter
Description	Set fieldbus specific meanings.
Units	N/A
Range	See table below.
Default Value	See table below.
Data Type	Unsigned 32
See Also	CANopen Communication Manual, EtherCAT Communication Manual
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CANopen	36E5h/0 FBUS.PARAM01; 36E6h/0 FBUS.PARAM02; 36E7h/0 FBUS.PARAM03; 36E8h/0 FBUS.PARAM04; 36E9h/0 FBUS.PARAM05; 36EAh/0 FBUS.PARAM06; 36Ebh/0 FBUS.PARAM07; 36ECh/0 FBUS.PARAM08; 36EDh/0 FBUS.PARAM09; 36EEh/0 FBUS.PARAM10	M_01-00-00-000

36E5h/0	FBUS.PARAM01	36EAh/0	FBUS.PARAM06
36E6h/0	FBUS.PARAM02	36Ebh/0	FBUS.PARAM07
36E7h/0	FBUS.PARAM03	36ECh/0	FBUS.PARAM08
36E8h/0	FBUS.PARAM04	36EDh/0	FBUS.PARAM09
36E9h/0	FBUS.PARAM05	36EEh/0	FBUS.PARAM10

EtherCAT COE and CANopen Range	EtherCAT COE	CANopen
	N/A	125; 250; 500; 1000
FBUS.PARAM01	0 to 1	0 to 1
FBUS.PARAM02	1,001 to 65,535	N/A
FBUS.PARAM03	0 to 1	0 to 1
FBUS.PARAM04	0 to 1	0 to 1
FBUS.PARAM05		

EtherCAT COE and CANopen Default Value	EtherCAT COE	CANopen
	N/A	125
FBUS.PARAM01	1	0
FBUS.PARAM02	0	N/A
FBUS.PARAM03	1	0
FBUS.PARAM04	0	0
FBUS.PARAM05		

Fieldbus	Index/Subindex				Object Start Version
Modbus	314	FBUS.PARAM01	334	FBUS.PARAM11	M_01-03-00-000
	316	FBUS.PARAM02	336	FBUS.PARAM12	
	318	FBUS.PARMA	338	FBUS.PARAM13	
	320	FBUS.PARAM04	340	FBUS.PARAM14	
	322	FBUS.PARAM05	342	FBUS.PARAM15	
	324	FBUS.PARAM06	344	FBUS.PARAM16	
	326	FBUS.PARAM07	346	FBUS.PARAM17	
	328	FBUS.PARAM08	348	FBUS.PARAM18	
	330	FBUS.PARAM09	350	FBUS.PARAM19	
	332	FBUS.PARAM10	352	FBUS.PARAM20	

Description

FBUS.PARAM01 sets the baud rate for the CANopen bus. Supported baud rates are 125, 250, 500 and 1000 kBaud.

FBUS.PARAM02 switches the phase locked loop (PLL) for synchronized use: 0 = OFF, 1 = ON

FBUS.PARAM03 sets the configured station alias for EtherCAT.

FBUS.PARAM04 switches the surveillance of SYNC-signals: 0 = OFF, 1 = ON

FBUS.PARAM05 is used to configure some special behaviors of the DS402.

FBUS.PARAM06 - FBUS.PARAM10 are reserved.

FBUS.PARAM04 Additional Notes

FBUS.PARAM04 enables (1) or disables(0) the synchronization supervision of the CANOpen or EtherCAT fieldbus.

Default values:

- CANOpen: disabled (0)
- EtherCAT: enabled (1)

The synchronization supervision is active when:

- FBUS.PARAM04 = 1
- The first CANOpen Sync message or first EtherCAT frame was received.

When more than three CANOpen sync messages or seven EtherCAT frames have not been received, and the drive is enabled, fault F125, "Synchronization lost", occurs.

FBUS.PARAM05 Additional Notes

Bit 0 configures the behavior of DS402 state machine in case of fault resets.

- Bit 0 = 1: Faults can only be reset using DS402 control word bit 7.
- Bit 0 = 0: The reset can also be done via telnet or digital input and the DS402 state machine reflects this condition.
- Bit 1 = 1: The state of the hardware enable does not change the state machine state Operation Enable.
- Bit 0 = 0: If the state Operation Enable or Switched on is active it falls back to the state switched On Disabled, if the Hardware enable goes to 0.

- Bit 2 = 1: Workbench/Telnet can not software enable the drive, when CAN/EtherCAT are Operational.
- Bit 0 = 0: Workbench/Telnet can software enable the drive.
- Bit 3 = 1: DS402-state machine is not influenced, if the software-enable is taken away via Telnet.
- Bit 0 = 0: DS402-state machine is influenced, if the software-enable is taken away via Telnet.

41.2 FBUS.PLLSTATE

General Information	
Type	R/O Parameter
Description	Returns the status of the PLL
Units	N/A
Range	N/A
Default Value	N/A
Data Type	N/A
See Also	FBUS.PARAM1 TO FBUS.PARAM20, Fieldbus documentation
Start Version	M_01-02-00-000

Description

FBUS.PLLSTATE returns the status of the phase locked loop (PLL). The PLL states are as follows:

PLL State	Description
PLL not activated	This state is set using FBUS.PARAM02. Not each fieldbus or operation mode needs synchronization.
PLL activated, but unlocked	The PLL is activated but has not yet been locked successfully. This state is related to the fieldbus master, as well as to the fieldbus mode of operation.
PLL activated and locked	PLL is fully operational and locked

For more information, see the *AKD CANopen Manual*, Phase Locked Loop.

41.3 FBUS.PLLTHRESH

General Information	
Type	NV Parameter
Description	Sets number of successful synchronized cycles needed to lock the PLL.
Units	N/A
Range	0 to 10,000
Default Value	0
Data Type	Integer, U32
See Also	Appendix B: Fieldbus Manuals
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	354	M_01-03-00-000

Description

This parameter sets number of successful synchronized cycles needed to lock the PLL.

41.4 FBUS.SAMPLEPERIOD

General Information	
Type	NV Parameter
Description	Sets fieldbus sample period.
Units	Whole multiples of MTS 250 µs
Range	4 to 128 and value must be a power of 4
Default Value	32 = 2 ms
Data Type	U8
See Also	Appendix B: Fieldbus Manuals
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CAN-open	60C2h/0	M_01-00-00-000
Modbus	356	M_01-03-00-000

Description

This parameter sets the fieldbus cycle time. It is normally written in the startup phase of the field busses via the object 60C2 subindex 1 (interpolation time units) and 2 (interpolation time index), where the index stands for a power of 10 seconds (for instance, -3 stands for milliseconds) and the units are the counts of these units. Kollmorgen recommends the following standard cycle rates, 250 us (4), 500 us (8), 1 ms (16), 2 ms (32), 4 ms (64).

41.5 FBUS.SYNCACT

General Information	
Type	R/O Parameter
Description	Reads actual distance from the desired sync distance.
Units	ns
Range	0 to 250,000 ns
Default Value	0 ns
Data Type	Integer, U 32
See Also	Appendix B: Fieldbus Manuals
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	358	M_01-03-00-000

Description

This parameter reads actual distance from the desired sync distance.

41.6 FBUS.SYNCDIST

General Information	
Type	NV Parameter
Description	Sets time target for synchronization.
Units	ns
Range	0 to 250,000 ns
Default Value	100,000 ns
Data Type	Integer, U32
See Also	Appendix B: Fieldbus Manuals
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	360	M_01-03-00-000

Description

This parameter sets time target for synchronization.

41.7 FBUS.SYNCWND

General Information	
Type	NV Parameter
Description	Sets symmetrically arranged window around the desired sync distance.
Units	ns
Range	0 to 1,000,000 ns
Default Value	50,000 ns
Data Type	Integer, U2
See Also	Appendix B: Fieldbus Manuals
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	362	M_01-03-00-000

Description

This parameter sets symmetrically arranged window around the desired sync distance.

41.8 FBUS.TYPE

General Information	
Type	R/O Parameter
Description	Shows the active fieldbus type.
Units	N/A
Range	0 to 5
Default Value	0
Data Type	U8
See Also	Fieldbus Manuals
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	364	M_01-03-00-000

Description

FBUS.TYPE shows the active fieldbus type.

0 = Analog

1 = SynqNet

2 = EtherCAT

3 = CANopen

4 = EthernetIP

5 = Profinet

42 GEAR Parameters

This section describes the GEAR parameters.

42.1 GEAR.ACCMAX

General Information	
Type	R/W Parameter
Description	Sets the maximum allowed acceleration value; active in opmode 2 (position) only.
Units	Depends on UNIT.ACCROTARY or UNIT.ACCLINEAR Rotary: rps/s, rpm/s, deg/s^2, (custom units)/s^2, rad/s^2 Linear: counts/s^2, mm/s^2, µm/s^2, (custom units)/s^2
Range	Rotary: 0.002 to 833,333.333 rps/s 0.112 to 50,000,000.000 rpm/s 0.009 to 300,000,000.000 deg/s² 0.155 to 4,166,666.752 (custom units)/s² 0.012 to 5,235,987.968 rad/s² Linear: 16,000.000 to 3,579,139,408,000.000 counts/s^2 0.031*MOTOR.PITCH to 833,333.333*MOTOR.PITCH mm/s^2 30.994*MOTOR.PITCH to 83,3333,333.333*MOTOR.PITCH µm/s^2 0.155 to 4,166,666.667 (custom units)/s^2
Default Value	Rotary: 166.669 rps/s 10,000.000 rpm/s 60,000.000 deg/s² 833.333 (custom units)/s² 1,047.2 rad/s² Linear: 715,840,000.000 counts/s² 166.714*MOTOR.PITCHMOTOR.PITCH mm/s² 166,714.191*MOTOR.PITCHMOTOR.PITCH µm/s² 833.571 (custom units)/s²
Data Type	Float
See Also	UNIT.ACCROTARY, UNIT.ACCLINEAR, GEAR.DECMAX
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	366 (64-bit)	M_01-03-00-000

Description

This parameter limits the acceleration of the slave to a numerical higher value.

Related Topics

11.7 Electronic Gearing

42.2 GEAR.DECMAX

General Information	
Type	R/W Parameter
Description	Sets the maximum allowed deceleration value; active in opmode 2 (position) only.
Units	Depends on UNIT.ACCROTARY or UNIT.ACCLINEAR Rotary: rps/s, rpm/s, deg/s², (custom units)/s², rad/s² Linear: counts/s², mm/s², µm/s², (custom units)/s²
Range	Rotary: 0.002 to 833,333.333 rps/s 0.112 to 50,000,000.000 rpm/s 0.009 to 300,000,000.000 deg/s² 0.155 to 4,166,666.752 (custom units)/s² 0.012 to 5,235,987.968 rad/s² Linear: 16,000.000 to 3,579,139,408,000.000 counts/s² 0.031*MOTOR.PITCH to 833,333.333*MOTOR.PITCH mm/s² 30.994*MOTOR.PITCH to 833,333,333.333*MOTOR.PITCH µm/s² 0.155 to 4,166,666.667 (custom units)/s²
Default Value	Rotary: 166.669 rps/s 10,000.000 rpm/s 60,000.000 deg/s² 833.333 (custom units)/s² 1,047.2 rad/s² Linear: 715,840,000.000 counts/s² 166.714*MOTOR.PITCHMOTOR.PITCH mm/s² 166,714.191*MOTOR.PITCHMOTOR.PITCH µm/s² 833.571 (custom units)/s²
Data Type	Float
See Also	UNIT.ACCROTARY, UNIT.ACCLINEAR, GEAR.ACCMAX
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	370 (64-bit)	M_01-03-00-000

Description

This parameter limits the deceleration of the slave to a numerical higher value.

Related Topics

11.7 Electronic Gearing

42.3 GEAR.IN

General Information	
Type	R/W Parameter
Description	Sets the denominator of the electronic gearing ratio; active in opmode 2 (position) only.
Units	N/A
Range	1 to 65,535
Default Value	1
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	374	M_01-03-00-000

Description

This parameter sets the denominator of the gear ratio for the electronic gearing mode. The gear ratio is used in order to increase and decrease the slave velocity. The slave velocity can be calculated by the following formula:

Slave velocity = Master velocity * GEAR.OUT/GEAR.IN

Be sure that you set the external master source number of signals per revolution correctly. Also, select the gear ratio so that the maximum electronic gearing velocity (GEAR.VELMAX) is not exceeded.

Master velocitymax * GEAR.OUT/GEAR.IN < GEAR.VELMAX

Related Topics

11.7 Electronic Gearing

42.4 GEAR.MODE

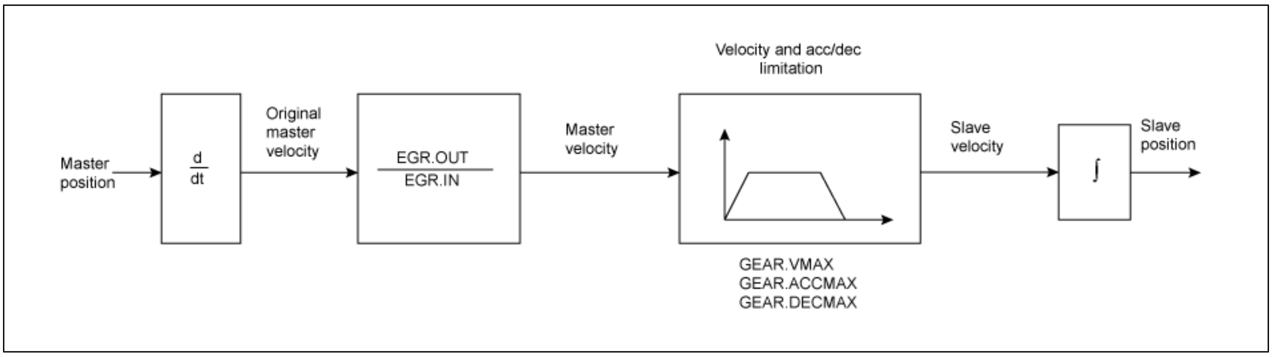
General Information	
Type	R/W Parameter
Description	Selects electronic gearing mode; active in opmode 2 (position) only.
Units	N/A
Range	0 to 1
Default Value	0
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	376	M_01-03-00-000

Description

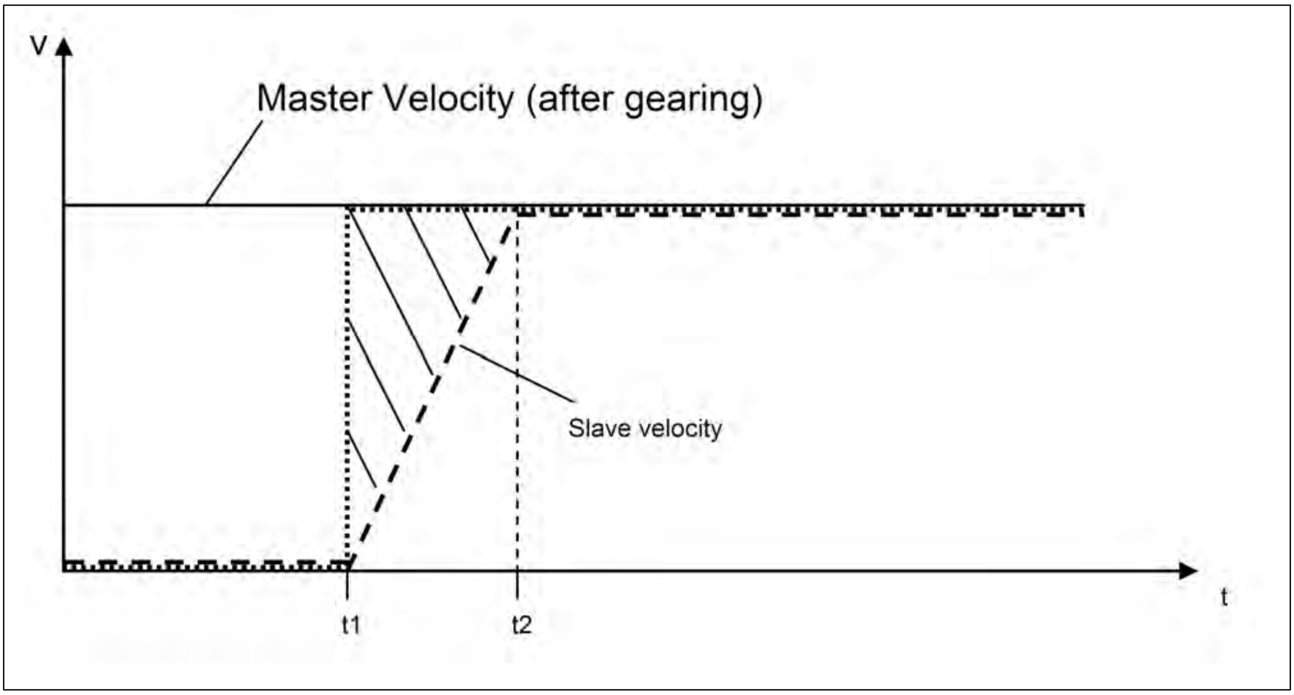
This parameter selects the electronic gearing mode at the beginning of the electronic gearing procedure. The gearing mode determines drive synchronization. In the context of electronic gearing, synchronization means that the slave follows the master pulses without losing counts due to acceleration or velocity limitations.

- Mode 0: The slave is not immediately synchronized after a GEAR.MOVE command. The slave accelerates until the master velocity (velocity after the gearing) has been reached. The drive is synchronized as soon as the velocity of the master has been reached.
- Mode 1: The slave is immediately synchronized after a GEAR.MOVE command.



Block diagram of the electronic gearing feature

The slave position is forwarded to the position loop. Ensure that DRV.OPMODE has been set to 2 and DRV.CMDSOURCE has been set to 2. The slave is able to reach the master velocity according to the GEAR.VMAX setting. GEAR.VMAX does not limit the slave velocity.



Acceleration process for GEAR.MODE 0

Time	Description
t<t1	The master sends already signals to the slave drive, but the GEAR.MOVE command has not been triggered yet.
t = t1	A GEAR.MOVE command has been triggered.
t1<t<t2	The slave accelerates according to the GEAR.ACCMAX setting. The position, which is marked with solid lines, will be ignored.
t=t2	The slave has reached the master velocity and is from now on considered as synchronized. Synchronization means that the slave will not lose any more position counts coming from the master.
t>t2	The slave follows the master input signals.

Related Topics

11.7 Electronic Gearing

42.5 GEAR.MOVE

General Information	
Type	Command
Description	Starts the electronic gearing; active in opmode 2 (position) only.
Units	N/A
Range	N/A
Default Value	N/A
Data Type	N/A
See Also	N/A
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	378	M_01-03-00-000

Description

The command GEAR.MOVE starts the electronic gearing procedure according to the selected electronic gearing mode. The electronic gearing process can be stopped using the DRV.STOP command.

Related Topics

11.7 Electronic Gearing

42.6 GEAR.OUT

General Information	
Type	R/W Parameter
Description	Sets the numerator of the electronic gearing ratio; active in opmode 2 (position) only.
Units	N/A
Range	-32,768 to +32,767
Default Value	1
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	380	M_01-03-00-000

Description

This parameter is the numerator of the gear ratio for the electronic gearing mode. The gear ratio is used in order to increase/decrease the slave velocity. The slave velocity can be calculated by the following formula:

Slave velocity = Master velocity * GEAR.OUT/GEAR.IN

Make sure that the external master source has been set properly. Also, be certain to select a gear ratio such that the maximum electronic gearing velocity (GEAR.VELMAX) will not be exceeded.

Master velocitymax * GEAR.OUT/GEAR.IN < GEAR.VELMAX

Related Topics

11.7 Electronic Gearing

42.7 GEAR.VMAX

General Information	
Type	R/W Parameter
Description	Reads the maximum allowed velocity value; active in opmode 2 (position) only.
Units	Depends on UNIT.ACCROTARY or UNIT.ACCLINEAR Rotary: rpm, rps, deg/s, custom units/s, rad/s Linear: counts/s, mm/s, µm/s, custom units/s
Range	Rotary: 0.000 to 15,000.000 rpm 0.000 to 250.000 rps 0.000 to 90,000.000 deg/s 0.000 to 1,250.000 custom units/s 0.000 to 1,570.796 rad/s Linear: 0.000 to 1,073,741,824,000.000 counts/s 0.000 to 250.000*MOTOR.PITCH mm/s 0.000 to 250,000.000*MOTOR.PITCH µm/sec 0.000 to 1,250.000 custom units/s
Default Value	Rotary: 3,000 rpm 50 rps 18,000.002 deg/s 250.000 custom units/s 314.159 rad/s Linear: 0.050 counts/s 50 mm/s 50,000.004MOTOR.PITCH µm/s 250.000 custom units/s
Data Type	Float
See Also	N/A
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	382	M_01-03-00-000

Description

This parameter limits the maximum velocity of the slave drive.

Related Topics

11.7 Electronic Gearing

43 GUI Parameters

GUI parameters are used within WorkBenchfor data reporting and data storage.

43.1 GUI.DISPLAY

General Information	
Type	R/O Parameter
Description	Reads drive display data.
Units	N/A
Range	N/A
Default Value	N/A
Data Type	Display
See Also	N/A
Start Version	M_01-00-00-000

Description

This parameter reports to the GUI what the drive currently is displaying. For all GUI commands, the data is compressed and formatted for the GUI, not for the user.

43.2 GUI.PARAM01

General Information	
Type	NV Parameter
Description	Used by the GUI to store data.
Units	N/A
Range	2,147,483,648 to 2,147,483,647
Default Value	0
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

Description

The GUI uses this parameter to store data. Only the GUI can modify this data (not the user).

43.3 GUI.PARAM02

General Information	
Type	NV Parameter
Description	Used by the GUI to store data.
Units	N/A
Range	2,147,483,648 to 2,147,483,647
Default Value	0
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

Description

The GUI uses this parameter to store data. Only the GUI can modify this data (not the user).

43.4 GUI.PARAM03

General Information	
Type	NV Parameter
Description	Used by the GUI to store data.
Units	N/A
Range	2,147,483,648 to 2,147,483,647
Default Value	0
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

Description

The GUI uses this parameter to store data. Only the GUI can modify this data (not the user).

43.5 GUI.PARAM04

General Information	
Type	NV Parameter
Description	Used by the GUI to store data.
Units	N/A
Range	2,147,483,648 to 2,147,483,647
Default Value	0
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

Description

The GUI uses this parameter to store data. Only the GUI can modify this data (not the user).

43.6 GUI.PARAM05

General Information	
Type	NV Parameter
Description	Used by the GUI to store data.
Units	N/A
Range	2,147,483,648 to 2,147,483,647
Default Value	0
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

Description

The GUI uses this parameter to store data. Only the GUI can modify this data (not the user).

43.7 GUI.PARAM06

General Information	
Type	NV Parameter
Description	Used by the GUI to store data.
Units	N/A
Range	2,147,483,648 to 2,147,483,647
Default Value	0
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

Description

The GUI uses this parameter to store data. Only the GUI can modify this data (not the user).

43.8 GUI.PARAM07

General Information	
Type	NV Parameter
Description	Used by the GUI to store data.
Units	N/A
Range	2,147,483,648 to 2,147,483,647
Default Value	0
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

Description

The GUI uses this parameter to store data. Only the GUI can modify this data (not the user).

43.9 GUI.PARAM08

General Information	
Type	NV Parameter
Description	Used by the GUI to store data.
Units	N/A
Range	2,147,483,648 to 2,147,483,647
Default Value	0
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

Description

The GUI uses this parameter to store data. Only the GUI can modify this data (not the user).

43.10 GUI.PARAM09

General Information	
Type	NV Parameter
Description	Used by the GUI to store data.
Units	N/A
Range	2,147,483,648 to 2,147,483,647
Default Value	0
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

Description

The GUI uses this parameter to store data. Only the GUI can modify this data (not the user).

43.11 GUI.PARAM10

General Information	
Type	NV Parameter
Description	Used by the GUI to store data.
Units	N/A
Range	2,147,483,648 to 2,147,483,647
Default Value	0
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

Description

The GUI uses this parameter to store data. Only the GUI can modify this data (not the user).

44 HOME Parameters

This section describes the HOME parameters.

44.1 HOME.ACC

General Information	
Type	R/W Parameter
Description	Sets homing acceleration; active in opmode 2 (position) only.
Units	Depends on UNIT.ACCROTARY or UNIT.ACCLINEAR Rotary: rps/s, rpm/s, deg/s^2, (custom units)/s^2, rad/s^2 Linear: counts/s^2, mm/s^2, µm/s^2, (custom units)/s^2
Range	Rotary: 0.002 to 833,333.333 rps/s 0.112 to 50,000,000.000 rpm/s 0.009 to 300,000,000.000 deg/s^2 0.155 to 4,166,666.752 (custom units)/s^2 0.012 to 5,235,987.968 rad/s^2 Linear: 16,000.000 to 3,579,139,408,000.000 counts/s^2 0.031*MOTOR.PITCH to 833,333.333*MOTOR.PITCH mm/s^2 30.994*MOTOR.PITCH to 833,333,333.333*MOTOR.PITCH µm/s^2 0.155 to 4,166,666.667 (custom units)/s^2
Default Value	Rotary: 166.669 rps/s 10,000.000 rpm/s 60,000.000 deg/s^2 833.333 (custom units)/s^2 1,047.2 rad/s^2 Linear: 715,840,000.000 counts/s^2 166.714*MOTOR.PITCHMOTOR.PITCH mm/s^2 166,714.191*MOTOR.PITCHMOTOR.PITCH µm/s^2 833.571 (custom units)/s^2
Data Type	Float
See Also	UNIT.ACCROTARY, UNIT.ACCLINEAR
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CAN-open	3502h/0 609Ah/0	M_01-00-00-000
Modbus	384 (64-bit)	M_01-03-00-000

Description

This parameter determines the acceleration of the motor during the homing procedure.

Related Topics

13.1 Homing

44.2 HOME.AUTOMOVE

General Information	
Type	R/W Parameter
Description	Sets homing auto move flag.
Units	N/A
Range	0 to 1
Default Value	0
Data Type	Integer
See Also	HOME.MODE
Start Version	M_01-02-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	388	M_01-03-00-000

Description

HOME.AUTOMOVE allows the drive to start a homing procedure after enabling the drive.

HOME.AUTOMOVE = 0: The drive is not allowed to start automatically a homing procedure after the enable command.

HOME.AUTOMOVE = 1: The drive automatically starts a homing procedure after the enable command.

When HOME.AUTOMOVE is set to 1, the drive continuously checks the following conditions:

1. Is the drive enabled (DRV.ACTIVE = 1)?
2. Is the drive in DRV.OPMODE = 2?
3. Has the command source been adjusted to 0 (DRV.CMDSOURCE = 0)?
4. Is no other motion currently active (see DRV.MOTIONSTAT)?

As soon as all of the conditions above are true, the drive activates the homing procedure, which has been selected via the HOME.MODE setting. The automatic homing procedure is finished as soon as the homing procedure has been successfully triggered by the drive. From now on the drive will not attempt to trigger any additional homing procedure.

HOME.AUTOMOVE is not functional in release M_01-03-00-000 for homing procedures which require an external index signal (HOME.MODE 3, 6, 10, and 11).

Related Topics:

13.1 Homing

44.3 HOME.DEC

General Information	
Type	R/W Parameter
Description	Sets homing deceleration; active in opmode 2 (position) only.
Units	Depends on UNIT.ACCROTARY or UNIT.ACCLINEARUNIT.A-CCLINEAR Rotary: rps/s, rpm/s, deg/s^2, (custom units)/s^2, rad/s^2 Linear: counts/s^2, mm/s^2, µm/s^2, (custom units)/s^2
Range	Rotary: 0.002 to 833,333.333 rps/s 0.112 to 50,000,000.000 rpm/s 0.009 to 300,000,000.000 deg/s² 0.155 to 4,166,666.752 (custom units)/s² 0.012 to 5,235,987.968 rad/s² Linear: 16,000.000 to 3,579,139,408,000.000 counts/s^2 0.031*MOTOR.PITCH to 833,333.333*MOTOR.PITCH mm/s^2 30.994*MOTOR.PITCH to 833,333,333.333*MOTOR.PITCH µm/s^2 0.155 to 4,166,666.667 (custom units)/s^2
Default Value	Rotary: 166.669 rps/s 10,000.000 rpm/s 60,000.000 deg/s² 833.333 (custom units)/s² 1,047.2 rad/s² Linear: 715,840,000.000 counts/s² 166.714*MOTOR.PITCHMOTOR.PITCHmm/s² 166,714.191MOTOR.PITCH µm/s² 833.571 (custom units)/s²
Data Type	Float
See Also	UNIT.ACCROTARY, UNIT.ACCLINEAR
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CAN-open	3524h/0 609Ah/0	M_01-00-00-000
Modbus	390 (64-bit)	M_01-03-00-000

Description

This parameter sets the deceleration of the motor during the homing procedure.

Related Topics:

13.1 Homing

44.4 HOME.DIR

General Information	
Type	NV Parameter
Description	Sets homing direction; active in opmode 2 (position) only.
Units	N/A
Range	0 to 1
Default Value	1
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CAN-open	6098h	M_01-00-00-000
Modbus	394	M_01-03-00-000

Description

This parameter determines the direction in which the motor should start to move during a homing procedure.

0 = Movement in negative direction.

1 = Movement in positive direction.

Related Topics

13.1 Homing

44.5 HOME.DIST

General Information	
Type	R/W Parameter
Description	Sets homing distance; active in opmode 2 (position) only.
Units	Depends on UNIT.PROTARY or UNIT.PLINEARUNIT.A-CCLINEAR Rotary: counts, rad, deg, custom units, 16-bit counts Linear: counts, mm, µm, custom units, 16-bit counts
Range	N/A
Default Value	0
Data Type	Float
See Also	N/A
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	396	M_01-03-00-000

Description

This parameter takes effect only after the homing procedure is complete (see the HOME.MODE description). HOME.DIST specifies an additional movement after the homing procedure is complete. The drive uses the homing acceleration, deceleration, and velocity parameters for this movement. This parameter can be used to let the motor move away from the home position by the value of HOME.DIST.

A value not equal to 0 triggers an additional movement of the selected homing distance after the general homing procedure. A value of 0 for HOME.DIST causes no additional movement.

Related Topics

13.1 Homing

44.6 HOME.FEEDRATE

General Information	
Type	R/W Parameter
Description	Sets homing velocity factor; active in opmode 2 (position) only.
Units	%
Range	0 to 100%
Default Value	50%
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CAN-open	6099h/2	M_01-00-00-000
Modbus	400	M_01-03-00-000

Description

This parameter is used in order to reduce the velocity during the index search (index = zero-pulse of a feedback device). This parameter determines the percentage of the homing velocity (HOME.V) that should be used during the index-search.

Related Topics

13.1 Homing

44.7 HOME.IPEAK

General Information	
Type	R/W Parameter
Description	Sets the current limit during homing procedure to a mechanical stop; active in opmode 2 (position) only.
Units	A
Range	± Drive peak current A
Default Value	[(1/120) * DRV.IPEAK] A
Data Type	Float
See Also	HOME.MODE
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CANopen	35E2h/0	M_01-00-00-000
Modbus	402 (64-bit)	M_01-03-00-000

Description

This parameter sets the intermediate current limit during a homing procedure to a mechanical stop (HOME.MODE 8 and 9). The current-controller limit (IL.LIMITP and IL.LIMITN) is set to ±HOME.IPEAK while the homing procedures are active.

HOME.IPEAK is active as soon as the homing procedure starts and remains active until the home position is found. Previous current limit settings are re-activated before the motor covers the homing distance (HOME.DIST ≠ 0).

Related Topics

13.1 Homing13.1.3.9 Homing mode 8: Move Until Position Error Exceeded

44.8 HOME.MODE

General Information	
Type	R/W Parameter
Description	Selects the homing mode; active in opmode 2 (position) only.
Units	N/A
Range	0 to 10
Default Value	0
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CAN-open	6098h	M_01-00-00-000
Modbus	406	M_01-03-00-000

Description

HOME.MODE specifies the homing procedure of the drive. The homing modes available in the drive are summarized in the following table; see 13.1 Homing for a detailed discussion and examples for each mode:

Mode	Description
0	Home using current position
1	Find limit input
2	Find input limit then find zero angle
3	Find input limit then find index
4	Find home input, including hardware limit switches
5	Find home input then find zero angle, including hardware limit switches
6	Find home input then find index, including hardware limit switches.
7	Find zero angle
8	Move until position error exceeded
9	Move until position error exceeded, then find zero angle
10	Move until position error exceeded, then find index
11	Find index signal, without any precondition
12	Homing to a home-switch, including mechanical stop detection
13	Home using the feedback position

Related Topics

13.1 Homing

44.9 HOME.MOVE

General Information	
Type	Command
Description	Starts a homing procedure; active in opmode 2 (position) only.
Units	N/A
Range	N/A
Default Value	N/A
Data Type	N/A
See Also	N/A
Start Version	M_01-00-00-000

Description

The HOME.MOVE command starts a homing procedure. The DRV.OPMODE must be set to 2 (closed position loop) and DRV.CMDSOURCE must be set to 0 (TCP/IP command).

Related Topics

13.1 Homing

44.10 HOME.P

General Information	
Type	R/W Parameter
Description	Sets home position; active in opmode 2 (position) only.
Units	Depends on UNIT.PROTARY or UNIT.PLINEAR Rotary: counts, rad, deg, custom units, 16-bit counts Linear: counts, mm, µm, custom units, 16-bit counts
Range	N/A
Default Value	0
Data Type	Float
See Also	N/A
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CAN-open	607Ch/0	M_01-00-00-000
Modbus	410 (64-bit)	M_01-03-00-000

Description

This parameter sets the home position. The command and actual position of the drive will be set to this value as soon as a homing event occurs. The homing events differ in each homing mode.

Related Topics

13.1 Homing

44.11 HOME.PERRTHRESH

General Information	
Type	R/W Parameter
Description	Sets the position lag threshold; active in opmode 2 (position) only.
Units	Depends on UNIT.PROTARY or UNIT.PLINEAR Rotary: counts, rad, deg, custom units, 16-bit counts Linear: counts, mm, µm, custom units, 16-bit counts
Range	N/A
Default Value	N/A
Data Type	Float
See Also	N/A
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CAN-open	3482h/0	M_01-00-00-000
Modbus	414 (64-bit)	M_01-03-00-000

Description

This parameter is used for the homing modes against a mechanical stop (HOME.MODE = 8 and 9). The absolute value of the following error (PL.ERR) is compared with HOME.PERRT-HRESH in order to detect a mechanical stop.

Related Topics

13.1.3.9 Homing mode 8: Move Until Position Error Exceeded

44.12 HOME.REQUIRE

General Information	
Type	NV Parameter
Description	Defines if the axis must be homed before a motion task can be executed.
Units	N/A
Range	0 to 1
Default Value	1
Data Type	Integer
See Also	N/A
Start Version	M_01-03-00-005

Description

This parameter defines whether or not the axis must be homed before a motion task can be executed.

- HOME.REQUIRE = 1: Homing must be complete ("Home Done" is true) before a motion task can execute.
- HOME.REQUIRE = 0: The axis does not need to be homed before a motion task can execute. When HOME.REQUIRE is set to 0, "Home Done" can be either true or false before a motion task can execute.

Related Topics

13.1 Homing

13.2 Motion Tasks

44.13 HOME.SET

General Information	
Type	Command
Description	Immediately sets the home position; active in opmode 2 (position) only.
Units	N/A
Range	N/A
Default Value	N/A
Data Type	N/A
See Also	N/A
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CAN-open	35F0h/0	M_01-00-00-000
Modbus	418	M_01-03-00-000

Description

The HOME.SET command immediately homes the drive. The drive can be homed in an enabled or disabled state. Motion in the current mode of operation (DRV.OPMODE=0) or velocity mode of operation (DRV.OPMODE=1) is not affected by the HOME.SET command. Motion in the position mode of operation (DRV.OPMODE=2) is immediately aborted when the HOME.SET command is issued.

Related Topics

13.1 Homing

44.14 HOME.V

General Information	
Type	R/W Parameter
Description	Sets homing velocity; active in opmode 2 (position) only.
Units	Depends on UNIT.VROTARY or UNIT.VLINEAR Rotary: rpm, rps, deg/s, custom units/s, rad/s Linear: counts/s, mm/s, µm/s, custom units/s
Range	Rotary: 0.000 to 15,000.000 rpm 0.000 to 250.000 rps 0.000 to 90,000.000 deg/s 0.000 to 1,250.000 custom units/s 0.000 to 1,570.796 rad/s Linear: 0.000 to 1,073,741,824,000.000 counts/s 0.000 to 250.000*MOTOR.PITCH mm/s 0.000 to 250,000.000*MOTOR.PITCH µm/sec 0.000 to 1,250.000 custom units/s
Default Value	Rotary: 60 rpm 1 rps 359.999 deg/s 5 (custom units)/s 6.283 rad/s Linear: 0.001 counts/s 1*MOTOR.PITCH mm/s 999.998*MOTOR.PITCH µm/sec 5.000 custom units/s
Data Type	Float
See Also	N/A
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CAN-open	6099h/1	M_01-00-00-000
Modbus	420	M_01-03-00-000

Description

This parameter sets the velocity of the motor during the homing procedure.

Related Topics

13.1 Homing

45 HWLS Parameters

This section describes the HWLS parameters.

45.1 HWLS.NEGSTATE

General Information	
Type	R/O Parameter
Description	Reads the status of the negative hardware limit switch.
Units	0 to 1
Range	N/A
Default Value	Boolean
Data Type	HWLS.POSSTATE
See Also	N/A
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	422	M_01-03-00-000

Description

HWLS.NEGSTATE reads the status of the negative HW limit switch as follows:

0 = Low

1 = High

Related Topics

11.1 Digital Inputs and Outputs

45.2 HWLS.POSSTATE

General Information	
Type	R/O Parameter
Description	Reads the status of the positive hardware limit switch.
Units	N/A
Range	0 to 1
Default Value	N/A
Data Type	Boolean
See Also	HWLS.NEGSTATE
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	424	M_01-03-00-000

Description

HWLS.POSSTATE reads the status of the positive hardware limit switch as follows:

0 = Low

1 = High

Related Topics

11.1 Digital Inputs and Outputs

46 IL Parameters

This section describes the IL parameters.

46.1 IL.BUSFF

General Information	
Type	R/O Parameter
Description	Displays the current feedforward value injected by the field-bus.
Units	Arms
Range	N/A
Default Value	N/A
Data Type	Float
See Also	IL.KBUSFF
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	426	M_01-03-00-000

Description

This parameter displays the current feedforward value injected by the fieldbus.

Related Topics

12.3 Current Loop

46.2 IL.CMD

General Information	
Type	R/O Parameter
Description	Reads the value of the q-component current controller inside the FPGA.
Units	Arms
Range	± Drive peak current (DRV.IPEAK)
Default Value	N/A
Data Type	Float
See Also	DRV.IPEAK
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	428	M_01-03-00-000

Description

IL.CMD displays the q-component current command value of the current loop after any limitation (such as a parameter setting or I^2t calculation).

IL.CMD is limited also by motor peak current, IL.LIMITN and IL.LIMITP.

Related Topics

11.4 Analog Input

12.3 Current Loop

46.3 IL.CMDU

General Information	
Type	R/W Parameter
Description	Sets the user current command.
Units	Arms
Range	Minimum range value = maximum of IL.LIMITN and -MOTOR.IPEAK Maximum range value = minimum of IL.LIMITP and MOTOR.IPEAK
Default Value	0 Arms
Data Type	Float
See Also	DRV.IPEAK, DRV.OPMODE,DRV.CMDSOURCE
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	430	M_01-03-00-000

Description

This parameter sets the user current command value.

The current command value, which is provided to the current loop (IL.CMD), can be limited further using a parameter setting or I^2t calculation. IL.CMDU is limited also by motor peak current, IL.LIMITN and IL.LIMITP.

Related Topics

12.3 Current Loop

46.4 IL.DIFOLD

General Information	
Type	R/O Parameter
Description	Reads the drive foldback current limit.
Units	Arms
Range	0 to 2,147,483.647 Arms
Default Value	N/A
Data Type	Float
See Also	Foldback
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CAN-open	3559h/0	M_01-00-00-000

Description

IL.DIFOLD is the output of the drive foldback algorithm. It is an artificial current, which can be higher or lower than the drive peak current (DRV.IPEAK). When IL.DIFOLD is lower than the existing current limit (such as IL.LIMITP), it becomes the active current limit.

IL.DIFOLD decreases when the actual current is higher than drive continuous current and increases (up to a certain level) when the actual current is lower than drive continuous current.

Related Topics

12.3 Current Loop

46.5 IL.FB

General Information	
Type	R/O Parameter
Description	Reads the actual value of the d-component current.
Units	Arms
Range	± Drive peak current (DRV.IPEAK)
Default Value	N/A
Data Type	Float
See Also	N/A
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CANopen	3558h/0	M_01-00-00-000
Modbus	432	M_01-03-00-000

Description

This parameter reads the measured, de-rotated actual current value of the motor.

Note: Internally the resolution of the current scale is 20130 increments. For an AKD with a peak current of 9 amps, the current resolution applied is 9/20130 = .447 mA. For a 48 amp peak current drive, the resolution is 48/20130 = 2.38 mA. The current scaling is hard coded and cannot be changed by decreasing the peak current settings in the drive.

Related Topics

12.3 Current Loop

46.6 IL.FF

General Information	
Type	R/O Parameter
Description	Displays the current loop overall feedforward value
Units	Arms
Range	N/A
Default Value	N/A
Data Type	Float
See Also	IL.KBUSFF, IL.KVFF, IL.OFFSET, IL.FRICTION, IL.KACCFF
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	434	M_01-03-00-000

Description

This parameter displays the current loop overall feedforward value.

Related Topics

12.3 Current Loop

46.7 IL.FOLDFTHRESH

General Information	
Type	R/O Parameter
Description	Reads the foldback fault level.
Units	Arms
Range	0 to 500 Arms
Default Value	Drive peak current (DRV.IPEAK)
Data Type	Float
See Also	Foldback
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CAN-open	3420h/0	M_01-00-00-000
Modbus	436	M_01-03-00-000

Description

IL.FOLDFTHRESH is the fault level of the current foldback algorithm. If IL.IFOLD drops below the value for IL.FOLDFTHRESH, then a fault is generated and the drive is disabled.

To avoid reaching the current foldback fault level, set IL.FOLDFTHRESHU well below the continuous current value for both the drive and the motor or set the IL.FOLDFTHRESHU value to zero.

Related Topics

12.3 Current Loop

46.8 IL.FOLDFTHRESHU

General Information	
Type	NV Parameter
Description	Sets the user value for the foldback fault level.
Units	Arms
Range	0 to 500 Arms
Default Value	Drive peak current (DRV.IPEAK)
Data Type	Float
See Also	IL.FOLDFTHRESH, Foldback
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CAN-open	3421h/0	M_01-00-00-000
Modbus	438	M_01-03-00-000

Description

IL.FOLDFTHRESHU is the fault level of the current foldback algorithm. The value of IL.FOLDFTHRESH is the minimum of DRV.IPEAK, MOTOR.IPEAK, and IL.FOLDFTHR-ESHU.

Related Topics

12.3   Current Loop

46.9 IL.FOLDWTHRESH

General Information	
Type	NV Parameter
Description	Sets the foldback warning level.
Units	Arms
Range	0 to 500 Arms
Default Value	0 A
Data Type	Float
See Also	Foldback
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CAN-open	355Ah/0	M_01-00-00-000
Modbus	440	M_01-03-00-000

Description

IL.FOLDWTHRESH is the warning level of the current foldback algorithm. When IL.IFOLD drops **below** IL.FOLDWTHRESH a warning is generated.

To ensure that the current foldback warning level is never reached, IL.FOLDWTHRESH should be set well below the continuous current value for both the drive and the motor. You can also set the IL.FOLDFTHRESH value to zero.

Related Topics

12.3 Current Loop

46.10 IL.FRICTION

General Information	
Type	R/W Parameter
Description	Sets friction compensation value.
Units	A
Range	0 to the minimum of user positive current limit (IL.LIMITP) and motor peak current (MOTOR.IPEAK).IL.LIMITP
Default Value	0
Data Type	Float
See Also	IL.FF
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CANopen	3422h/0	M_01-00-00-000
Modbus	442	M_01-03-00-000

Description

Position command derivative sign is multiplied by this value to be injected to the current command.

Related Topics

12.3 Current Loop

46.11 IL.IFOLD

General Information	
Type	R/O Parameter
Description	Reads the overall foldback current limit.
Units	A
Range	0 to 2,147,483.647 A
Default Value	N/A
Data Type	Float
See Also	Foldback
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CAN-open	3425h/0	M_01-00-00-000
Modbus	444	M_01-03-00-000

Description

Two current foldback algorithms run in parallel in the drive: the drive foldback algorithm and the motor foldback algorithm. Each algorithm uses different sets of parameters.

Each algorithm has its own foldback current limit, IL.DIFOLD and IL.MIFOLD. The overall foldback current limit is the minimum of the two at any given moment.

`IL.IFOLD = min (IL.DIFOLD, IL.MIFOLD).`

IL.DIFOLD is an artificial current, which can be higher or lower than the drive or motor peak current. When IL.IFOLD becomes lower than the existing current limit (such as IL.LIMITP), it becomes the active current limit.

Related Topics

12.3 Current Loop

46.12 IL.IUFB

General Information	
Type	R/O Parameter
Description	Reads the sigma-delta measured current in the u-winding of the motor.
Units	A
Range	± Drive peak current (DRV.IPEAK)
Default Value	N/A
Data Type	Float
See Also	N/A
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	446	M_01-03-00-000

Description

This parameter displays the measured current in the u-winding of the motor.

Related Topics

12.3 Current Loop

46.13 IL.IVFB

General Information	
Type	R/O Parameter
Description	Sets the sigma-delta measured current in the u-winding of the motor.
Units	A
Range	± Drive peak current (DRV.IPEAK)
Default Value	0 A
Data Type	Float
See Also	N/A
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	448	M_01-03-00-000

Description

IL.IVFB is an offset value that is added to the measured current in the u-winding of the motor. This value is used for compensating for an error in the current measurement. The drive measures 256 times the current in the u-winding when powering-up the drive. Afterwards, the drive calculates the average value of the measured current and uses this value for the offset value.

Related Topics

12.3 Current Loop

46.14 IL.KACCFF

General Information	
Type	R/W Parameter
Description	Sets current loop acceleration feedforward gain value
Units	mArms/(rad/s²)
Range	0.0 to 2.0 mArms/(rad/s²)
Default Value	0 mArms/(rad/s²)
Data Type	Float
See Also	IL.FF
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CAN-open	3426h/0	M_01-00-00-000
Modbus	450	M_01-03-00-000

Description

This value sets the gain for the acceleration feedforward (a scaled second derivative of the position command is added to the current command value) .

This parameter is valid only in the position mode (DRV.OPMODE = 2).

Related Topics

12.3 Current Loop

46.15 IL.KBUSFF

General Information	
Type	RW
Description	Current loops fieldbus injected feed-forward gain
Units	NA
Range	0 to 2
Default Value	0
Data Type	Float
See Also	IL.FF, IL.BUSFF
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	452	M_01-03-00-000

Description

This parameter scales the feedforward term added by the fieldbus to the current command. The nominal feedforward value can be multiplied by this gain value.

This parameter is only used in the position mode (DRV.OPMODE = 2).

Related Topics

12.3 Current Loop

46.16 IL.KP

General Information	
Type	NV Parameter
Description	Sets the proportional gain of the q-component of the PI regulator.
Units	V/A
Range	0 to 2,000 V/A
Default Value	Read from the motor or, if no memory, 50.009 V/A
Data Type	Float
See Also	N/A
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CANopen	3598h/0	M_01-00-00-000
Modbus	454	M_01-03-00-000

Description

IL.KP is used to modify the proportional gain of the PI-loop that controls the q-component of the current.

Related Topics

12.3 Current Loop

46.17 IL.KPDRATIO

General Information	
Type	NV Parameter
Description	Sets the proportional gain of the d-component current PI-regulator as a percentage of IL.KP
Units	N/A
Range	0 to 100
Default Value	1
Data Type	Float
See Also	IL.KP
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CANopen	3596h/0	M_01-00-00-000
Modbus	456	M_01-03-00-000

Description

This parameter modifies the proportional gain of the PI-loop, which controls the d-component of the current.

Related Topics

12.3 Current Loop

46.18 IL.KPLOOKUPINDEX

General Information	
Type	R/W Parameter
Description	Sets the index into the Current Loop Gain Scheduling Table.
Units	N/A
Range	0 to 255
Default Value	0
Data Type	Integer
See Also	IL.KPLOOKUPVALUEIL.KPLOOKUPVALUESIL.KP
Start Version	M_01-04-00-000

Description

This parameter sets the index into the Current Loop Gain Scheduling Table. The table is 256 records long, spanning 0 A to 1.62 * DRV.IPEAK.

To determine the level of current that corresponds to a table index, use the following equation:

```
IL.CMD = (Table Index /157) * DRV.IPEAK
```

Related Topics

Current Loop Gain Scheduling

Current Loop

46.19 IL.KPLOOKUPVALUE

General Information	
Type	R/W Parameter
Description	Sets the value of the current loop gain scheduling index.
Units	%
Range	0 to 100.000%
Default Value	0
Data Type	Float
See Also	IL.KPLOOKUPINDEXIL.KPLOOKUPVALUESIL.KP
Start Version	M_01-04-00-000

Description

This parameter sets the value at the current index into the Current Loop Gain Scheduling Table. The table is 256 records long, spanning 0 A to 1.62 * DRV.IPEAK. The value can range from 0% to 100% and determines what percentage of IL.KP will be applied to the current loop.

To determine what level of current corresponds to a table index, use the following equation:

```
IL.CMD = (Table Index/157) * DRV.IPEAK
```

Example

Assume:

DRV.IPEAK = 9 A

IL.KPLOOKUPINDEX = 100

IL.KPLOOKUPVALUE = 50

IL.KP = 240

When IL.CMD = 100/157 * 9 = 5.73 A, IL.KP will not be 240, but will be 50% * 240 = 120.

Related Topics

Current Loop Gain Scheduling

Current Loop

46.20 IL.KPLOOKUPVALUES

General Information	
Type	R/W Parameter
Description	Gets the Current Loop Gain Scheduling Table.
Units	N/A
Range	N/A
Default Value	N/A
Data Type	Table
See Also	IL.KPLOOKUPINDEX , IL.KPLOOKUPVALUEIL.KP
Start Version	M_01-04-00-000

Description

Retrieves the Current Loop Gain Scheduling Table in a comma delimited table.

This table is 256 records long, and the table will return values in the following format:

```
-->IL.KPLOOKUPVALUES
Index Value
0, 100.000
1, 100.000
2, 100.000
3, 100.000
4, 100.000
5, 100.000
6, 100.000
7, 100.000
8, 100.000
9, 100.000
10, 100.000
```

Related Topics

Current Loop Gain Scheduling

Current Loop

46.21 IL.KVFF

General Information	
Type	R/W
Description	Current loop velocity feed-forward gain.
Units	N/A
Range	0 to 2
Default Value	0
Data Type	Float
See Also	IL.FF
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	458	M_01-03-00-000

Description

This parameter sets the gain for the velocity loop feedforward. The nominal feedforward value can be multiplied by this gain value.

This parameter is only used in position mode (DRV.OPMODE = 2).

Related Topics

12.3 Current Loop

46.22 IL.LIMITN

General Information	
Type	NV Parameter
Description	Sets the negative user (application-specific) current limit.
Units	A
Range	Negative drive peak current (DRV.IPEAK) to 0 A
Default Value	Negative drive peak current (DRV.IPEAK)
Data Type	Float
See Also	IL.LIMITP
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CAN-open	356Fh/0	M_01-00-00-000
Modbus	460	M_01-03-00-000

Description

This parameter sets the negative user limit clamp value of the torqueproducing q-component current command (IL.CMD). The current command is additionally limited by the motor peak current setting (MOTOR.IPEAK) and by the present value of the foldback I^2t peak motor current protection.

Related Topics

12.3 Current Loop

46.23 IL.LIMITP

General Information	
Type	NV Parameter
Description	Sets the positive user (application-specific) current limit.
Units	A
Range	0 A to drive peak current (DRV.IPEAK)
Default Value	Drive peak current (DRV.IPEAK)
Data Type	Float
See Also	IL.LIMITN
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CAN-open	356Eh/0	M_01-00-00-000
Modbus	462	M_01-03-00-000

Description

This parameter sets the positive user limit clamp value of the torque-producing q-component current command (IL.CMD). The current command is additionally limited by the motor peak current setting (MOTOR.IPEAK) and by the present value of the foldback I²t peak motor current protection.

Related Topics

12.3 Current Loop

46.24 IL.MFOLDD

General Information	
Type	R/O Parameter
Description	Sets the motor foldback maximum time at motor peak current.
Units	s
Range	0.1 to 2400 s
Default Value	10 s
Data Type	Float
See Also	Foldback
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	464	M_01-03-00-000

Description

IL.MFOLDD sets the maximum time allowed for the motor to remain at peak current before starting to fold towards the motor continuous current. When at motor peak current, IL.MFOLDD is the amount of time before the foldback algorithm starts to reduce the current.

Related Topics

12.3 Current Loop

46.25 IL.MFOLDR

General Information	
Type	R/O Parameter
Description	Sets the motor foldback recovery time.
Units	s
Range	0.1 to 65,535 s
Default Value	Calculated from other foldback parameters.
Data Type	Float
See Also	Foldback
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	466	M_01-03-00-000

Description

IL.MFOLDR sets the recovery time for the motor foldback algorithm. If 0 current is applied for at least the recovery time duration, it is possible to apply motor peak current for the duration of IL.MFOLDD time.

The IL.MFOLDR value is automatically calculated from other foldback parameters.

Related Topics

12.3 Current Loop

46.26 IL.MFOLDT

General Information	
Type	R/O Parameter
Description	Sets the motor foldback time constant of the exponential current drop (fold-back).
Units	s
Range	0.1 to 2,400 s
Default Value	10 s
Data Type	Float
See Also	Foldback
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	468	M_01-03-00-000

Description

IL.MFOLDT sets the time constant of the exponential drop (foldback) of the current towards motor continuous current.

Related Topics

12.3 Current Loop

46.27 IL.MI2T

General Information	
Type	R/O parameter
Description	Motor I2t load
Units	%
Range	0 to 100%
Default Value	N/A
Data Type	Float
See Also	IL.MIMODE, IL.MI2TWTHRESH
Start Version	M_01-04-01-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CAN-open		
Modbus		

Description

This parameter returns the motor I2t load in percent. The supplied current will be limited by IL.M-IFOLD to MOTOR.ICONT case that the load reaches a value of 100%. The current limit IL.M-IFOLD will be restored to MOTOR.IPEAK in case that the load falls under 95%.

Related Topics

1 Motor I2t algorithm

46.28 IL.MI2TWTHRESH

General Information	
Type	NV Parameter
Description	Motor I2t load warning threshold
Units	%
Range	0 to 100%
Default Value	N/A
Data Type	Integer
See Also	IL.MIMODE, IL.MI2T
Start Version	M_01-04-01-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CANopen		
Modbus		

Description

This parameter defines a warning threshold for the IL.MI2T value. A warning n309 will be generated as soon as the IL.MI2T exceeds the IL.MI2TWTHRESH value. The warning n309 will be cleared as soon as IL.MI2T falls below the threshold.

Related Topics

8.6 Foldback

46.29 IL.MIFOLD

General Information	
Type	R/O Parameter
Description	Sets the motor foldback current limit.
Units	A
Range	0 to 2147483.647 A
Default Value	N/A
Data Type	Float
See Also	Foldback
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CAN-open	35A4h/0	M_01-00-00-000
Modbus	470	M_01-03-00-000

Description

IL.MIFOLD sets the output of the motor foldback algorithm. It is an artificial current, which can be higher or lower than the motor peak current. When IL.MIFOLD becomes lower than the existing current limit (IL.LIMITP) it becomes the active current limit.

IL.MIFOLD decreases when the actual current is higher than motor continuous current and increases (up to a certain level) when the actual current is lower than the motor continuous current.

Related Topics

12.3 Current Loop

46.30 IL.MIMODE

General Information	
Type	NV parameter
Description	Motor protection mode
Units	N/A
Range	0 to 1
Default Value	0
Data Type	Integer
See Also	IL.MI2T, IL.MI2TWTHRESH
Start Version	M_01-04-01-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CAN-open		
Modbus		

Description

This parameter determines the method of the motor protection.

0 – The motor foldback mechanism is responsible for protecting the motor from overload.

1 – The motor I2t mechanism is responsible for protecting the motor from overload.

Related Topics

8.6 Foldback

46.31 IL.OFFSET

General Information	
Type	RW Parameter
Description	A constant current command added to compensate for gravity.
Units	A
Range	[IL.LIMITN to IL.LIMITP
Default Value	0 A
Data Type	Float
See Also	IL.FF
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CANopen	3423h/0	M_01-00-00-000
Modbus	472	M_01-03-00-000

Description

This value is added to the overall current loop feedforward value.

Related Topics

12.3 Current Loop

46.32 IL.VCMD

General Information	
Type	R/O Parameter
Description	Sets the output of the q-component PI regulator.
Units	Vrms
Range	0 Vrms to bus voltage
Default Value	N/A
Data Type	Integer
See Also	IL.VDCMD
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	474	M_01-03-00-000

Description

Sets the output of the current loop that controls the q-component of the current.

Related Topics

12.3 Current Loop

46.33 IL.VUFB

General Information	
Type	R/O Parameter
Description	Reads the measured voltage on the u-winding of the motor.
Units	V
Range	–1200*VBusScale to +1200*VBusScale
Default Value	N/A
Data Type	Integer
See Also	IL.VVFB
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	476	M_01-03-00-000

Description

Reads the measured voltage on the u-winding of the motor.

Related Topics

12.3   Current Loop

46.34 IL.VVFB

General Information	
Type	R/O Parameter
Description	Reads the measured voltage on the v-winding of the motor.
Units	V
Range	–1200*VBusScale to +1200*VBusScale
Default Value	N/A
Data Type	Integer
See Also	IL.VUFB
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	478	M_01-03-00-000

Description

The range for this parameter depends on whether the drive model is an MV/240 Vac or an HV/480 Vac.

The VBusScale parameter sets the drive model:

MV/240 Vac: VBusScale = 1

HV/480 Vac: VBusScale = 2

VBusScale is used for multiple parameter ranges that are model dependent, such as IL.KP.

Related Topics

12.3 Current Loop

47 IP Parameters

This section describes the IP parameters.

47.1 IP.ADDRESS

General Information	
Type	NV Parameter
Description	Gets/Sets the IP address of the drive
Units	N/A
Range	0.0.0.0 to 255.255.255.255
Default Value	0.0.0.0
Data Type	IP Address
See Also	Communicating with the Drive
Start Version	M_01-04-05-000

Description

This Parameter sets the IP address of the drive. If this parameter has not been set by the user, it will return 0.0.0.0.

By default, DHCP is active, and the drive will acquire an IP Address on its own. When the drive is in DHCP mode, IP.ADDRESS will return 0.0.0.0.

Notes:

- Even when the drive is in DHCP, the actual IP Address will not be returned using this command. The value the user has stored will be returned.
- IP.ADDRESS will only be used by the drive when IP.MODE = 1

If manually setting the IP.ADDRESS, the IP.SUBNET and IP.GATEWAYmust be set up. After the IP.RESET command is issued, the new IP settings will be active only if IP.MODE has been set to 1.

Recovering communications with a drive on an un-reachable IP address

Sometimes a drive may be configured for an IP Address, and the drive needs to be taken off-line, and bench tested, or otherwise used outside of its saved IP Settings. If IP.MODE has been set to 1 (using software defined static IP) the drive will boot up on an IP Address that may be unreachable with the host computer's settings.

If the IP address prevents communication the IP settings can be reset to default by the following procedure:

1. Set both rotary switches to 0
2. Hold down button B1 (top-side of drive) for 5 seconds.

The display will flash 0.0.0.0 and then attempt to discover an address by DHCP. Without removing logic power from the drive, use Workbench to connect to the drive, reconfigure the IP address settings as desired, and store the values to non-volatile memory.

Related Topics

IP.GATEWAY

IP.RESET

IP.SUBNET

IP.MODE

47.2 IP.GATEWAY

General Information	
Type	NV Parameter
Description	Gets/Sets the gateway IP of the drive
Units	N/A
Range	0.0.0.0 to 255.255.255.255
Default Value	0.0.0.0
Data Type	IP Address
See Also	Communicating with the Drive
Start Version	M_01-04-05-000

Description

This Parameter sets the Gateway IP of the drive. This parameter determines what IP the drive can communicate with outside of its current subnet.

By default, DHCP is active, and the drive will acquire an IP Address on its own. When the drive is in DHCP mode, IP.GATEWAY will return 0.0.0.0.

Notes:

- When the drive is in DHCP, the actual IP GATEWAY will not be returned using this command. The value the user has stored will be returned.
- IP.GATEWAY will only be used by the drive when IP.MODE = 1

If manually setting the IP.ADDRESS, the IP.SUBNET and IP.GATEWAY must be set up. After the IP.RESET command is issued, the new IP settings will be active only if IP.MODE has been set to 1.

Recovering communications with a drive on an un-reachable IP address

Sometimes a drive may be configured for an IP Address, and the drive needs to be taken off-line, and bench tested, or otherwise used outside of its saved IP Settings. If IP.MODE has been set to 1 (using software defined static IP) the drive will boot up on an IP Address that may be unreachable with the host computer's settings.

If the IP address prevents communication the IP settings can be reset to default by the following procedure:

1. Set both rotary switches to 0
2. Hold down button B1 (top-side of drive) for 5 seconds.

The display will flash 0.0.0.0 and then attempt to discover an address by DHCP. Without removing logic power from the drive, use Workbench to connect to the drive, reconfigure the IP address settings as desired, and store the values to non-volatile memory.

Related Topics

IP.ADDRESS

IP.RESET

IP.SUBNET

47.3 IP.MODE

47.3 IP.MODE

General Information	
Type	NV Parameter
Description	Sets method of acquiring IP Address.
Units	N/A
Range	0 to 2
Default Value	0
Data Type	Integer
See Also	N/A
Start Version	M_01-04-013-000

Description

This command determines which method of acquiring an IP Address the drive will take.

Note: Mode 0 and Mode 1 contain multiple methods of acquiring an IP Address. In these modes each method will be implemented in the order they are listed below until an IP Address is acquired

The drive will attempt to acquire a new IP Address as soon as the IP.RESET command is issued.

IP Mode	Mode of Acquiring IP Address
0	Rotary Switches, DHCP, Auto IP
1	IP.ADDRESS, IP.SUBNET, IP.GATEWAY
2	DHCP, Auto IP

Recovering communications with a drive on an un-reachable IP address

Sometimes a drive may be configured for an IP Address, and the drive needs to be taken off-line, and bench tested, or otherwise used outside of its saved IP Settings. If IP.MODE has been set to 1 (using software defined static IP) the drive will boot up on an IP Address that may be unreachable with the host computer's settings.

If the IP address prevents communication the IP settings can be reset to default by the following procedure:

1. Set both rotary switches to 0
2. Hold down button B1 (top-side of drive) for 5 seconds.

The display will flash 0.0.0.0 and then attempt to discover an address by DHCP. Without removing logic power from the drive, use Workbench to connect to the drive, reconfigure the IP address settings as desired, and store the values to non-volatile memory.

Related Topics

IP.ADDRESS

IP.GATEWAY

IP.RESET

IP.SUBNET

47.4 IP.RESET

General Information	
Type	Command
Description	Implements new IP settings
Units	N/A
Range	N/A
Default Value	N/A
Data Type	N/A
See Also	Communicating with the Drive
Start Version	M_01-04-05-000

Description

When this command is issued a new IP will be acquired using IP.MODE to select what method is used.

Notes:

1. When issuing this command, it is likely the connection to the drive will be severed, and a new connection will need to be made.
2. IP.RESET will return an error if issued while the drive is enabled. IP.RESET is allowed when drive is disabled, or in dynamic braking mode.
3. Ensure all values of IP.ADDRESS, IP.SUBNET, and IP.GATEWAY are configured if using IP.MODE 1

Recovering communications with a drive on an un-reachable IP address

Sometimes a drive may be configured for an IP Address, and the drive needs to be taken offline, and bench tested, or otherwise used outside of its saved IP Settings. If IP.MODE has been set to 1 (using software defined static IP) the drive will boot up on an IP Address that may be unreachable with the host computer's settings.

If the IP address prevents communication the IP settings can be reset to default by the following procedure:

1. Set both rotary switches to 0
2. Hold down button B1 (top-side of drive) for 5 seconds.

The display will flash 0.0.0.0 and then attempt to discover an address by DHCP. Without removing logic power from the drive, use Workbench to connect to the drive, reconfigure the IP address settings as desired, and store the values to non-volatile memory.

Related Topics

IP.ADDRESS

IP.GATEWAY

IP.SUBNET

IP.MODE

47.5 IP.SUBNET

General Information	
Type	NV Parameter
Description	Gets/Sets the IP Subnet mask of the drive
Units	N/A
Range	0.0.0.0 to 255.255.255.255
Default Value	0.0.0.0
Data Type	IP Address
See Also	5 Communicating with the Drive
Start Version	M_01-04-05-000

Description

This Parameter sets the IP Subnet mask of the drive. This parameter determines what IP addresses the drive will be allowed to communicate with.

By default, DHCP is active, and the drive will acquire an IP Address on its own. When the drive is in DHCP mode, IP.SUBNET will return 0.0.0.0.

Notes:

- When the drive is in DHCP, the actual IP Subnet mask will not be returned using this command. The value the user has stored will be returned.
- IP.SUBNET will only be used by the drive when IP.MODE = 1

If manually setting the IP.ADDRESS, the IP.SUBNET and IP.GATEWAYmust be set up. After the IP.RESET command is issued, the new IP settings will be active only if IP.MODE has been set to 1.

Recovering communications with a drive on an un-reachable IP address

Sometimes a drive may be configured for an IP Address, and the drive needs to be taken off-line, and bench tested, or otherwise used outside of its saved IP Settings. If IP.MODE has been set to 1 (using software defined static IP) the drive will boot up on an IP Address that may be unreachable with the host computer's settings.

If the IP address prevents communication the IP settings can be reset to default by the following procedure:

1. Set both rotary switches to 0
2. Hold down button B1 (top-side of drive) for 5 seconds.

The display will flash 0.0.0.0 and then attempt to discover an address by DHCP. Without removing logic power from the drive, use Workbench to connect to the drive, reconfigure the IP address settings as desired, and store the values to non-volatile memory.

Related Topics

IP.ADDRESS

IP.GATEWAY

IP.RESET

47.3 IP.MODE

48 LOAD.INERTIA

General Information	
Type	NV Parameter
Description	Sets the load inertia.
Units	$kgcm^2$ for rotary motors kg for linear motors
Range	1 to 1,000,000 $kgcm^2$ or kg
Default Value	0 $kgcm^2$ or kg
Data Type	Float
See Also	N/A
Start Version	M_01-03-06-000

Description

LOAD.INERTIA sets the load inertia.

Related Topics

Motor

49 MODBUS Paramters

This section describes the MODBUS parameters.

49.1 MODBUS.PIN

General Information	
Type	R/W
Description	Gets / Sets the Modbus User Units Input parameter
Units	N/A
Range	1 to 4294967295
Default Value	1
Data Type	Integer
See Also	N/A
Start Version	M_01-04-00-000

Description

MODBUS.PIN andMODBUS.POUT are used to apply user specified units to the feedback values retrieved over Modbus.

To use this parameter correctly, first the MODBUS.PSCALE must be known, this value determines the resolution per revolution of the motor for Modbus. Then the ratio of MODBUS.POUT/MODBUS.PIN is applied to convert counts/rev into User Units/rev.

Example

Use Modbus Scaling to return feedback in Radians

```
MODBUS.PSCALE = 16 (65536 counts/rev or pole pitch)
MODBUS.PIN = 5215189
MODBUS.POUT = 500000
```

If the motor is currently resting with a Modbus raw position 36,462 Counts (MODBUS.PSCALE is set to return 65,536 per rev)

If the user requests the position using PL.FB over Modbus, the position will be returned as:

```
36,462 * 500000 / 5215189 = 3495 (Radians * 1000)
```

Which equals 3.495 Radians

Related Topics

MODBUS.PSCALE

MODBUS.POUT

8.4.1 Encoder Emulation

49.2 MODBUS.POUT

General Information	
Type	R/W
Description	Gets / Sets the Modbus User Units Output parameter.
Units	N/A
Range	1 to 4294967295
Default Value	1
Data Type	Integer
See Also	N/A
Start Version	M_01-04-00-000

Description

MODBUS.PIN and MODBUS.POUT are used to apply User specified Units to the feedback values retrieved over Modbus.

To use this parameter correctly, first the MODBUS.PSCALE must be known. This value determines the resolution per revolution of the motor for Modbus. Then the ratio of MODBUS.POUT/MODBUS.PIN is applied to convert counts/rev into User Units/rev.

Example: Use Modbus Scaling to return feedback in Radians

```
MODBUS.PSCALE = 16 (65536 counts/rev or pole pitch)
MODBUS.PIN = 5215189
MODBUS.POUT = 500000
```

If the motor is currently resting with a Modbus raw position 36,462 Counts (MODBUS.PSCALE is set to return 65,536 per rev).

If the user requests the position using PL.FB over Modbus, the position will be returned as:

```
36,462 * 500000 / 5215189 = 3495 (Radians * 1000)
```

Which equals 3.495 Radians

Related Topics

MODBUS.PSCALE

MODBUS.PIN

8.4.1 Encoder Emulation

49.3 MODBUS.PSCALE

General Information	
Type	R/W
Description	Gets/Sets the Feedback Resolution (per rev) over Modbus.
Units	
Range	10 to 31
Default Value	20
Data Type	Integer
See Also	N/A
Start Version	M_01-04-00-000

Description

This parameter determines the number of encoder counts per mechanical revolution reported over Modbus.

```
Modbus Resolution = 2^(MODBUS.PSCALE).
```

Notes:

- This scaling affects Position, Velocity and Acceleration when reading values over Modbus. This scaling term does not affect units over any other communication.
- Additionally, see MODBUS.PIN and MODBUS.POUT, as these are applied on top of MODBUS.PSCALE to allow for user customizable units.

Related Topics

MODBUS.POUT

MODBUS.PIN

49.4 MODBUS.SCALING

General Information	
Type	NV Parameter
Description	Selects the scaling mode for Modbus values.
Units	N/A
Range	0 to 1
Default Value	1
Data Type	U8
See Also	N/A
Start Version	M_01-04-15-000

Description

Modbus has its own scaling algorithms. For some simple HMI's, it is desirable to use Workbench units instead of these Modbus-specific units. The parameter MODBUS.SCALING allows users to disable Modbus scaling and enable WB (Telnet) scaling.

Setting	Description
0	Modbus uses same scaling units as Workbench (set by UNIT parameters)
1	Modbus uses the Modbus-specific scaling units (set by MODBUS parameters)

Related Topics

MODBUS Paramters

UNIT Parameters

8.4.1 Encoder Emulation

49.5 MODBUS.UNITLABEL

General Information	
Type	R/W
Description	Labels the scaled reslution of a single motor turn.
Units	N/A
Range	N/A
Default Value	N/A
Data Type	String
See Also	N/A
Start Version	M_01-04-00-000

Description

The Modbus UnitLabel value is used to label the scaled resolution of a single motor turn.

Related Topics

Motor

50 MOTOR Parameters

This section describes the MOTOR parameters.

50.1 MOTOR.AUTOSET

General Information	
Type	NV Parameter
Description	Determines which drive parameters are calculated automatically.
Units	N/A
Range	0 to 1
Default Value	0
Data Type	Boolean
See Also	N/A
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CANopen	3451h/0	M_01-00-00-000
Modbus	480	M_01-03-00-000

Description

This parameter determines whether or not certain drive parameters (for example, IL.KP or MOTOR.POLES) are calculated automatically. A value of 1 causes the parameters to be automatically calculated from the motor ID data (read from memory-supporting feedback devices, such as SFD, Endat, and BISS). Automatically calculated parameters are read-only. A value of 0 disables the automatic calculation and you must set the parameters manually. Manually set parameters are read-write.

Related Topics

8.1 Motor

50.2 MOTOR.BRAKE

General Information	
Type	NV Parameter
Description	Sets the presence or absence of a motor brake.
Units	N/A
Range	0 to 1
Default Value	0
Data Type	Boolean
See Also	N/A
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CAN-open	3587h/0	M_01-00-00-000
Modbus	482	M_01-03-00-000

Description

The MOTOR.BRAKE parameter notifies the firmware whether a brake exists or not. It does not apply or release the brake. If a brake is found to be present, the firmware considers hardware indications regarding the brake circuits (such as open circuit or short circuit). If a brake does not exist, then the firmware ignores the hardware indications since they are irrelevant.

Value	Status
0	Motor brake does not exist.
1	Motor brake exists and brake hardware circuitry checks are enabled.

Enabling the MOTOR.BRAKE (value set to 1) when no motor brake exists creates a fault.

The motor brake is polled every 16 ms.

Related Topics

8.1 Motor

50.3 MOTOR.BRAKERLS

General Information	
Type	Command
Description	Allows a user to release the motor brake.
Units	N/A
Range	0 to 1
Default Value	0
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CAN-open	3450h/0	M_01-00-00-000
Modbus	484	M_01-03-00-000

Description

This command allows a user to release the motor brake.

0 = Drive controls the brake.

1 = Brake is released.

Note: A digital input mode is also used for the same purpose. The two mechanisms are independent.

Related Topics

8.1 Motor

50.4 MOTOR.BRAKESTATE

General Information	
Type	R/O Parameter
Description	Reads the actual status of the motor brake.
Units	N/A
Range	Brake released or not present. Brake applied.
Default Value	Brake applied or not present.
Data Type	String
See Also	N/A
Start Version	M_01-00-00-000

Description

This parameter reads the actual status of the motor brake and can only show two states:

1 = Brake released or not present

2 = Brake applied

Related Topics

8.1 Motor

50.5 MOTOR.CTF0

General Information	
Type	NV Parameter
Description	Sets the thermal constant of the motor coil.
Units	mHz
Range	0.265 to 16,000 mHz
Default Value	10 mHz
Data Type	Float
See Also	N/A
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CAN-open	3454h/0	M_01-00-00-000
Modbus	486	M_01-03-00-000

Description

This parameter is used to configure the thermal constant of the motor coil, which is the break frequency of a single-pole low-pass filter model of the thermal dynamics of the motor coil.

This parameter, together with MOTOR.IPEAK and MOTOR.ICONT, determine the motor fold-back parameters IL.MFOLDD,IL.MFOLDT, and IL.MFOLDR.

Calculating MOTOR.CTF0

Given a motor coil/winding thermal time constant T in seconds, then:

```
MOTOR.CTF0 = 1/(2πT)
```

Related Topics

8.1 Motor

50.6 MOTOR.ICONT

General Information	
Type	NV Parameter
Description	Sets the motor continuous current.
Units	A
Range	0.1 to 500 A
Default Value	1.0 A
Data Type	Float
See Also	N/A
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CANopen	358Eh/0	M_01-00-00-000
Modbus	488	M_01-03-00-000

Description

This parameter is used to configure the motor continuous current.

Related Topics

8.1 Motor

50.7 MOTOR.IDDATAVALID

General Information	
Type	R/O Parameter
Description	Reports the status of the motor memory.
Units	N/A
Range	N/A
Default Value	0
Data Type	Integer
See Also	N/A
Start Version	M_01-02-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	490	M_01-03-00-000

Description

MOTOR.IDDATAVALID reports the status of the motor memory status.

The valid values for this keyword are the following:

Value	Description
0	Error in identification
1	Success in identification
2	Identification in process
3	Identification not started yet
4	Success recognizing feedback, but failed to varify OEM data integrity

Related Topics

8.1 Motor

50.8 MOTOR.INERTIA

General Information	
Type	NV Parameter
Description	Sets the motor inertia.
Units	kgcm² for rotary motors kg for linear motors
Range	1 to 200,000 kgcm² or kg
Default Value	100 kgcm² or kg
Data Type	Float
See Also	N/A
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CAN-open	35ABh/0	M_01-00-00-000
Modbus	492	M_01-03-00-000

Description

This parameter sets the motor inertia.

Related Topics

8.1 Motor

50.9 MOTOR.IPEAK

General Information	
Type	NV Parameter
Description	Sets the motor peak current.
Units	mA
Range	0.200 to 1,000 A
Default Value	2.000 A
Data Type	Float
See Also	IL.LIMITP, IL.LIMITN
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CANopen	358Fh/0	M_01-00-00-000
Modbus	494	M_01-03-00-000

Description

This parameter configures the drive for the motor's peak, instantaneous-rated current. MOTOR.IPEAK is used to limit clamp the magnitude of the torque producing q-component current command (IL.CMD).

Related Topics

8.1 Motor

50.10 MOTOR.KE

General Information	
Type	NV Parameter
Description	Sets the motor back EMF constant.
Units	Vpeak/krpm for Rotary Motors Vpeak/m/s for Linear Motors
Range	0.0 to 100,000
Default Value	0
Data Type	Float
See Also	N/A
Start Version	M_01-03-06-000

Description

MOTOR.KE defines the back EMF constant for the motor. The back EMF constant defines how much voltage is generated at the motors coils. The relationship between MOTOR.KE and speed is described by the following equation:

```
Coil Voltage = MOTOR.KE * VL.FB
```

Where:

VL.FB is in units of krpm for rotary motors and in units of m/s for linear motors

Related Topics

Motor

50.11 MOTOR.KT

General Information	
Type	NV Parameter
Description	Sets the torque constant of the motor.
Units	Nm/A
Range	0.001 Nm/A to 1,000,000.000 Nm/A for rotary motors. 0.001 Nm/A to 1,000,000.000 N/A for linear motors.
Default Value	0.1 Nm/A
Data Type	Float
See Also	N/A
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CAN-open	3593h/0	M_01-00-00-000
Modbus	496	M_01-03-00-000

Description

This parameter is the torque constant of the motor in Nm/A.The value can be online checked according to the following equation:

```
Kt = 60 *√3 * Ui/( 2 * π* n)
```

Where:

Ui = induced voltage of the motor
n = actual rotor velocity

Related Topics

8.1 Motor

50.12 MOTOR.LQLL

General Information	
Type	NV Parameter
Description	Sets the line-to-line motor Lq.
Units	mH
Range	1 to 2^{32} H
Default Value	17.000 H
Data Type	Float
See Also	N/A
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CAN-open	3455h/0	M_01-00-00-000
Modbus	498	M_01-03-00-000

Description

This parameter is used to configure the motor line-to-line inductance.

Related Topics

8.1 Motor

50.13 MOTOR.NAME

General Information	
Type	NV Parameter
Description	Sets the motor name.
Units	N/A
Range	11 chars
Default Value	N/A
Data Type	String
See Also	N/A
Start Version	M_01-00-00-000

Description

This parameter is used to set the motor name.

Related Topics

8.1 Motor

50.14 MOTOR.PHASE

General Information	
Type	NV Parameter
Description	Sets the motor phase.
Units	Electrical degrees
Range	0 to 360°
Default Value	0°
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CAN-open	359Ch/0	M_01-00-00-000
Modbus	500	M_01-03-00-000

Description

This parameter sets the motor phase.

Related Topics

8.1 Motor

50.15 MOTOR.PITCH

General Information	
Type	NV Parameter
Description	Sets the motor pitch.
Units	µm
Range	1,000 to 1,000,000 µm
Default Value	1.000 µm
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	502	M_01-03-00-000

Description

This parameter defines the pole-to-pair pitch for the linear motor in micrometers.

Related Topics

8.1 Motor

50.16 MOTOR.POLES

General Information	
Type	NV Parameter
Description	Sets the number of motor poles.
Units	N/A
Range	0 to 128
Default Value	6
Data Type	Integer
See Also	FB1.POLES
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CAN-open	359Dh/0	M_01-00-00-000
Modbus	504	M_01-03-00-000

Description

MOTOR.POLES sets the number of motor poles. This command is used for commutation control and represents the number of individual magnetic poles of the motor (not pole pairs). The division value of motor poles (MOTOR.POLES) and feedback poles (FB1.POLES) must be an integer when setting drive to enable, otherwise a fault is issued.

Related Topics

8.1 Motor

50.17 MOTOR.R

General Information	
Type	NV Parameter
Description	Sets the stator winding resistance phase-phase in ohms.
Units	Ω
Range	0.001 to 650 Ω
Default Value	10 Ω
Data Type	Float
See Also	N/A
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CAN-open	3456h/0	M_01-00-00-000
Modbus	506	M_01-03-00-000

Description

MOTOR.R sets the stator winding resistance phase-to-phase in ohms.

Related Topics

8.1 Motor

50.18 MOTOR.RTYPE

General Information	
Type	NV Parameter
Description	Defines the type of thermal resistor inside the motor.
Units	N/A
Range	0 to 1
Default Value	0
Data Type	Boolean
See Also	N/A
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	508	M_01-03-00-000

Description

This parameter defines the type of thermal resistor used inside of the motor to measures motor temperature.

0 = PTC

1 = NTC

Related Topics

8.1 Motor

50.19 MOTOR.TBRAKEAPP

General Information	
Type	NV Parameter
Description	The delay time used for applying the motor brake.
Units	ms
Range	0 to 1,000 ms
Default Value	75 ms
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CAN-open	366Eh/0	M_01-00-00-000
Modbus	510	M_01-03-00-000

Description

This parameter is used to configure the mechanical delay when applying the motor brake. MOTOR.TBRAKEAPP is a time delay that is applied when a brake exists and the drive is disabled at the end of a controlled stop. This delay lasts from the time that the brake is commanded to apply until the time that the drive is disabled.

This feature allows you to disable the drive and apply the brake on a vertical application without the load falling. Without this time delay, if you immediately disable the drive, then the load falls during the time needed for the brake to mechanically apply.

Related Topics

8.1 Motor

50.20 MOTOR.TBRAKERLS

General Information	
Type	NV Parameter
Description	The delay time used for releasing the motor brake.
Units	ms
Range	0 to 1,000 ms
Default Value	75 ms
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CAN-open	366Fh/0	M_01-00-00-000
Modbus	512	M_01-03-00-000

Description

This parameter is used to configure the mechanical delay when releasing the motor brake. MOTOR.TBRAKERLS is a time delay that is applied when a brake exists and the drive is enabled. When the drive is enabled, the brake is commanded to release and, during the MOTOR.TBRAKERLS period of time, the drive does not accept a motion command. This delay allows the brake to fully release before the drive begins a new motion.

Related Topics

8.1 Motor

50.21 MOTOR.TEMP

General Information	
Type	R/O Parameter
Description	Reads the motor temperature represented as the resistance of the motor PTC.
Units	Ω
Range	0 to 2^{32} Ω
Default Value	N/A
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CAN-open	3612h/0	M_01-00-00-000
Modbus	514	M_01-03-00-000

Description

This parameter is used to get the motor temperature which is represented as the resistance of the motor PTC.

Related Topics

8.1 Motor

50.22 MOTOR.TEMPFAULT

General Information	
Type	NV Parameter
Description	Sets the motor temperature fault level.
Units	Ω
Range	0 to 2,000,000,000 Ω
Default Value	0 Ω = switched off
Data Type	Integer
See Also	MOTOR.TEMP
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CAN-open	3586h/0	M_01-00-00-000
Modbus	516	M_01-03-00-000

Description

This parameter is used to configure the motor temperature fault level as a resistance threshold of the motor PTC.

A zero value prevents any warning from being issued.

Related Topics

8.1 Motor

50.23 MOTOR.TEMPWARN

General Information	
Type	NV Parameter
Description	Sets the motor temperature warning level.
Units	Ω
Range	0 to 2,000,000,000 Ω
Default Value	0 Ω = switched off
Data Type	Integer
See Also	MOTOR.TEMP
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CAN-open	3453h/0	M_01-00-00-000
Modbus	518	M_01-03-00-000

Description

This parameter is used to configure the motor temperature warning level as a resistance threshold of the motor PTC.

A zero value prevents any warning from being created.

Related Topics

8.1 Motor

50.24 MOTOR.TYPE

General Information	
Type	NV Parameter
Description	Sets the motor type.
Units	N/A
Range	0 to 1
Default Value	0
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	520	M_01-03-00-000

Description

MOTOR.TYPE sets the drive control algorithms to different motor types as follows:

0 = Rotary motor

1 = Linear motor

Related Topics

8.1 Motor

50.25 MOTOR.VMAX

General Information	
Type	NV Parameter
Description	Sets the maximum motor speed.
Units	rpm
Range	100 to 40,000 rpm
Default Value	3,000 rpm
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CAN-open	35A3h/0	M_01-00-00-000
Modbus	522	M_01-03-00-000

Description

This parameter is used to configure the maximum speed of the motor.

Related Topics

8.1 Motor

50.26 MOTOR.VOLTMAX

General Information	
Type	NV Parameter
Description	Sets the motor maximum voltage.
Units	Vrms
Range	110 to 900 Vrms
Default Value	230 Vrms
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CANopen	3452h/0	M_01-00-00-000
Modbus	524	M_01-03-00-000

Description

This parameter sets the maximum permissible motor voltage. For instance, if a motor that is rated for a 400 V supply is connected to the drive, then the MOTOR.VOLTMAX setting is 400. This value also sets regen resistor and over voltage thresholds in the drive to acceptable values for the motor so that the motor windings are not damaged.

Related Topics

8.1 Motor

50.27 MOTOR.VOLTMIN

General Information	
Type	NV Parameter
Description	Sets the minimum voltage for V/f control.
Units	%
Range	0 to 100%
Default Value	2%
Data Type	U16
See Also	MOTOR.VRATED, MOTOR.VOLTRATED
Start Version	

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CANopen	3457h/3	M_01-00-00-000
Modbus		M_01-03-00-000

Description

This parameter configures the drive for the induction motor's minimum voltage at standstill. It is given as a percentage (%) of the motor's rated voltage. MOTOR.VOLTMIN is used to calculate the constant volts per Hertz characteristics of the drive and motor and should be set to a value that generates a current of about 40% of the rated current at standstill.

Related Topics

8.1 Motor

50.28 MOTOR.VOLTRATED

General Information	
Type	NV Parameter
Description	Sets the motor rated voltage.
Units	V
Range	50 to 1,000 V
Default Value	230 V
Data Type	U16
See Also	MOTOR.VRATED, MOTOR.VOLTMIN
Start Version	M_01-03-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CANopen	3457h/2	M_01-03-00-000
Modbus	Modbus Parameter Table	M_01-03-00-000

Description

This parameter configures the drive for the induction motor's rated voltage as indicated on the nameplate.

MOTOR.VOLTRATED is used to calculate the constant Volts per Hertz characteristics of the drive and motor.

Related Topics

Motor

50.29 MOTOR.VRATED

General Information	
Type	NV Parameter
Description	Sets the motor rated velocity (not maximum velocity)
Units	Depends on UNIT.VROTARY or UNIT.VLINEARUNIT.A-CCLINEAR Rotary: rpm, rps, deg/s, custom units/s, rad/s Linear: counts/s, mm/s, µm/s, custom units/s
Range	Rotary: 0.000 to 15,000.000 rpm 0.000 to 250.000 rps 0.000 to 90,000.000 deg/s 0.000 to 1,250.000 custom units/s 0.000 to 1,570.796 rad/s Linear: 0.000 to 1,073,741,824,000.000 counts/s 0.000 to 8,000.000 mm/s 0.000 to 8,000,000.000 µm/s 0.000 to 1,250.000 custom units/s
Default Value	0 rpm
Data Type	U16
See Also	MOTOR.VOLTRATED, MOTOR.VOLTMIN
Start Version	M_01-03-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CAN-open	3457h/1	M_01-03-00-000
Modbus	Modbus Parameter Table	M_01-03-00-000

Description

This parameter configures the drive for the rated velocity of the induction motor as indicated on the nameplate.

MOTOR.VRATED is used to calculate the constant volts per Hertz characteristics of the drive and motor.

Related Topics

Motor

51 MT Parameters and Commands

This section describes the MT parameters and commands.

51.1 MT.ACC

General Information	
Type	R/W Parameter
Description	Specifies motion task acceleration; active in opmode 2 (position) only.
Units	Depends on UNIT.ACCROTARY or UNIT.ACCLINEAR Rotary: rps/s, rpm/s, deg/s², (custom units)/s², rad/s² Linear: counts/s², mm/s², µm/s², (custom units)/s²
Range	Rotary: 0.002 to 833,333.333 rps/s 0.112 to 50,000,000.000 rpm/s 0.009 to 300,000,000.000 deg/s² 0.155 to 4,166,666.752 (custom units)/s² 0.012 to 5,235,987.968 rad/s² Linear: 16,000.000 to 3,579,139,408,000.000 counts/s² 0.031*MOTOR.PITCH to 833,333.333*MOTOR.PITCH mm/s² 30.994*MOTOR.PITCH to 833,333,333.333*MOTOR.PITCHµm/s² 0.155 to 4,166,666.667 (custom units)/s²
Default Value	Rotary: 166.669 rps/s 10,000.000 rpm/s 60,000.000 deg/s² 833.333 (custom units)/s² 1,047.2 rad/s² Linear: 715,840,000.000 counts/s² 166.714*MOTOR.PITCHMOTOR.PITCH mm/s² 166,714.191*MOTOR.PITCHMOTOR.PITCH µm/s² 833.571 (custom units)/s²
Data Type	Float
See Also	MT.NUM , MT.P, MT.V, MT.CNTL, MT.DEC, MT.TNUM, MT.MTNEXT , MT.TNEXT, MT.SET , MT.LOAD
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CANopen	6083h/0	M_01-00-00-000
Modbus	526 (64-bit)	M_01-03-00-000

Description

MT.ACC specifies the motion task acceleration and is used by the MT.SET and MT.LOAD command. This parameter is a temporary value, since a motion task is only set after a MT.SET command. The motion task acceleration is further limited by the maximum allowed acceleration DRV.ACC

A value of 0 for MT.ACC should not be used when setting a motion task via MT.SET because this value causes a validity check of the MT.SET command to fail.

A value of 0 for MT.ACC after an MT.LOAD command displays an empty (not initialized) motion task.

Related Topics

13.2 Motion Tasks

51.2 MT.CLEAR

General Information	
Type	Command
Description	Clears motion tasks from the drive; active in opmode 2 (position) only.
Units	N/A
Range	N/A
Default Value	N/A
Data Type	N/A
See Also	MT.NUM , MT.P, MT.V, MT.CNTL, MT.ACC,MT.DEC, MT.TNUM, MT.MTNEXT , MT.TNEXT, MT.SET , MT.LOAD
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	530	M_01-03-00-000

Description

MT.CLEAR clears a motion task from the drive. This command needs one argument in order to clear a motion task. A motion task consists of the following parameters: MT.NUM , MT.P, MT.V, MT.CNTL, MT.ACC,MT.DEC, MT.TNUM, MT.MTNEXT , MT.TNEXT

A value of –1 clears all motion tasks in the drive (MT.CLEAR –1).

Example

MT.CLEAR 5: Clear motion task number 5.

After performing a command such as MT.PARAMS 5, the drive displays the following:

```
5   0.000 Counts   0.000 rpm   0   0.000 rpm/s   0.000 rpm/s   0
0   0 ms
```

A value of 0 for velocity, acceleration, or deceleration displays motion task as uninitialized.

Related Topics

13.2 Motion Tasks

51.3 MT.CNTL

General Information	
Type	R/W Parameter
Description	Sets motion task control word; active in opmode 2 (position) only.
Units	N/A
Range	0 to 4,294,967,295
Default Value	0
Data Type	Integer
See Also	MT.NUM , MT.P, MT.V, MT.ACCMT.V, MT.DEC, MT.TNUM, MT.MTNEXT MT.MTNEXT , MT.SET , MT.LOAD
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CANopen	35AFh/0 6086h/0	M_01-00-00-000
Modbus	532	M_01-03-00-000

Description

MT.CNTL specifies the motion task control word, which is used by the MT.SET and MT.LOAD commands. The control word describes the behavior of the motion task. This parameter is a temporary value, since a motion task is only set after an MT.SET command is issued.

Since this parameter is read bitwise, it can combine multiple functions into a single word. The meaning of each bit is described in the tables below.

Table 1: Motion Task (MT) Bit Descriptions

Bit	Meaning	Description
0	0x00001	See Table 2: MT Type.
1	0x00002	
2	0x00004	
3	0x00008	
4	0x00010	If this bit is 0, then the next MT is not executed. If this bit is 1, then the next MT is executed.
5	0x00020	See Table 3: Next MT Start Type.
6	0x00040	
7	0x00080	
8	0x00100	
9	0x00200	
10	0x00400	See Table 4: MT Acceleration Type.
11	0x00800	
12	0x01000	Activates the override functionality for a trapezoidal MT. If this bit is 1, a motion task with override functionality must be activated (see bit 5).

Bit	Meaning	Description
13	0x02000	If this bit is 0, then an attempt to trigger any new motion task will be accepted while this motion task is currently running. If this bit is 1, then an attempt to trigger any new motion task will be denied while this motion task is currently running.
14	0x04000	If this bit is set, the motion task that is supposed to be started cannot be started from velocity 0. The motion can be started if a motion task already running will be interrupted.
15	0x08000	Reserved.
16	0x10000	The motion task target velocity will be taken from an external source such as an analog input signal (see AIN.MODE for further details).

Table 2: MT Type

Bits 3, 2, 1, 0	Description
0000	Absolute. The target position is defined by the MT.P value.
1000	Reserved.
0001	Relative to Command Position. The target position is defined as: Target position = PL.CMD + MT.P
0011	Relative to Previous Target Position. The target position is defined as: Target position = Target position of the last motion task + MT.P
0101	Reserved.
0111	Relative to Feedback Position. The target position is defined as: Target position = PL.FB + MT.P

Table 3: Next MT Start Type

Bits 9, 8, 7, 6, 5	Description
00000	Switches over to next MT after stopping. After an MT ends, the next MT starts immediately.
00001	Switches over to next MT after stopping and delay. After an MT ends, the MT following time (MT.TNEXTelapse in order to start the next MT.
10000	Switches over to the next MT at present MT speed (change on the fly). After reaching the target position of an MT, the next MT starts. The drive then accelerates with the adjusted acceleration ramp of this next MT to the target velocity of this next MT. The MT.TNEXT setting is ignored.
11000	Switches over to the next MT at next MT speed (change on the fly).When the target position of an MT is reached, the drive has already accelerated with the acceleration ramp of the next MT to the target velocity of the next MT. Thus, the drive begins the next MT at the next MT target velocity. The MT.TNEXT setting is ignored if adjusted.

Table 4: MT Acceleration Type

Bits 11, 10	Description
00	Trapezoidal acceleration and deceleration.
01	1:1 motion profile table motion task. The drive follows the customer motion profile table without inserting a constant velocity phase between the acceleration and deceleration process. This setting allows the usage of nonsymmetric velocity profiles. The MT.TNUM parameter defines which table to use for the 1:1 profile handling.
11	Standard motion profile table motion task. The drive accelerates according to the shape of the motion profile table by stepping through the first half of the customer table. Then the drive inserts a constant velocity phase until the brake point is reached. Finally, the drive decelerates by stepping through the second half of the customer profile table. The MT.TNUM parameter defines which table to use for the 1:1 profile handling. This mode allows also a change on the fly between motion tasks (see Table 3 above). See "AKD Customer Profile Application Note" on the Kollmorgen web site (www.kollmorgen.com) for additional details.

Related Topics

13.2 Motion Tasks

51.4 MT.CONTINUE

General Information	
Type	Command
Description	Continues a stopped motion task; active in opmode 2 (position) only.
Units	N/A
Range	N/A
Default Value	0
Data Type	N/A
See Also	MT.NUM , MT.P, MT.V, MT.CNTL, MT.ACCMT.V, MT.DEC, MT.TNUM, MT.MTNEXT MT.MTNEXT , MT.SET , MT.LOAD
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	534	M_01-03-00-000

Description

MT.CONTINUE continues a motion task that has been stopped by the DRV.STOP command.

Related Topics

13.2 Motion Tasks

51.5 MT.DEC

General Information	
Type	R/W Parameter
Description	Sets motion task deceleration; active in opmode 2 (position) only.
Units	Depends on UNIT.ACCROTARY or UNIT.ACCLINEAR Rotary: rps/s, rpm/s, deg/s², (custom units)/s², rad/s² Linear: counts/s², mm/s², µm/s², (custom units)/s²
Range	Rotary: 0.002 to 833,333.333 rps/s 0.112 to 50,000,000.000 rpm/s 0.009 to 300,000,000.000 deg/s² 0.155 to 4,166,666.752 (custom units)/s² 0.012 to 5,235,987.968 rad/s² Linear: 16,000.000 to 3,579,139,408,000.000 counts/s² 0.031*MOTOR.PITCH to 833333.333*MOTOR.PITCH mm/s² 30.994*MOTOR.PITCH to 833333333.333*MOTOR.PITCH µm/s² 0.155 to 4166666.667 (custom units)/s²
Default Value	Rotary: 166.669 rps/s 10,000.000 rpm/s 60,000.000 deg/s² 833.333 (custom units)/s² 1,047.2 rad/s² Linear: 715,840,000.000 counts/s² 166.714*MOTOR.PITCHMOTOR.PITCH mm/s² 166,714.191*MOTOR.PITCHMOTOR.PITCH µm/s² 833.571 (custom units)/s²
Data Type	Float
See Also	MT.ACC, MT.NUM , MT.P, MT.V, MT.CNTL, MT.TNUM, MT.MTNEXT , MT.TNEXT, MT.SET , MT.LOAD
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CANopen	6084h/0	M_01-00-00-000
Modbus	536 (64-bit)	M_01-03-00-000

Description

MT.DEC specifies the motion task deceleration and is used by the MT.SET and MT.LOAD commands. This parameter is a temporary value, since a motion task is only set after an MT.SET command is issued. The motion task deceleration is further limited by the maximum allowed acceleration, DRV.DEC.

A value of 0 for MT.DEC should not be used when setting a motion task via MT.SET because this value causes a validity check of the MT.SET command to fail.

A value of 0 for MT.DEC after an MT.LOAD command displays an empty (not initialized) motion task.

Related Topics

13.2 Motion Tasks

51.6 MT.EMERGMT

General Information	
Type	R/W Parameter
Description	Selects a motion task to be triggered after an emergency stop procedure; active in opmode 2 (position) only.
Units	N/A
Range	1 to 128
Default Value	0
Data Type	N/A
See Also	MT.NUM , MT.P, MT.V, MT.CNTL, MT.ACC, MT.DEC, MT.TNUM, MT.MTNEXT , MT.TNEXT, MT.SET , MT.LOAD
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	540	M_01-03-00-000

Description

MT.EMERGMT selects the motion task to be triggered after an emergency stop procedure.

A value of –1 shows that no motion task must be started after a ramp-down procedure in a closed position loop mode of operation.

Related Topics

13.2 Motion Tasks

51.7 MT.HOMEREQUIRE

General Information	
Type	NV Parameter
Description	Removed in 01-04-00-000
Units	N/A
Range	0 to 1
Default Value	1
Data Type	Integer
See Also	N/A
Start Version	M_01-03-00-005 (removed in 01-04-00-000)

Description

Removed in 01-04-00-000.

Related Topics

13.2 Motion Tasks

51.8 MT.LIST

General Information	
Type	Command
Description	Lists all initialized motion tasks in the drive; active in opmode 2 (position) only.
Units	N/A
Range	0
Default Value	N/A
Data Type	MT.NUM , MT.P, MT.V, MT.CNTL, MT.ACC, MT.DEC, MT.TNUM, MT.MTNEXT , MT.TNEXT, MT.SET , MT.LOAD
See Also	M_01-00-00-000
Start Version	N/A

Description

MT.LIST reads every initialized motion task from the drive. A motion task consists of the following parameters: MT.NUM , MT.P, MT.V, MT.CNTL, MT.ACC, MT.DEC, MT.TNUM, MT.MTNEXT , and MT.TNEXT.

A motion task is considered as initialized as soon as MT.V, MT.ACC, and MT.DEC of that specific motion task have values not equal to 0.

Related Topics

13.2 Motion Tasks

51.9 MT.LOAD

General Information	
Type	Command
Description	Reads/loads a motion task number from the drive; active in opmode 2 (position) only.
Units	N/A
Range	N/A
Default Value	0
Data Type	N/A
See Also	MT.NUM , MT.P, MT.V, MT.CNTL, MT.ACC, MT.DEC, MT.TNUM, MT.MTNEXT , MT.TNEXT, MT.SET
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	542	M_01-03-00-000

Description

MT.LOAD reads out a motion task number MT.NUM from the drive. A motion task consists of the following parameters: MT.NUM, MT.P, MT.V, MT.CNTL, MT.ACC, MT.DEC, MT.TNUM, MT.MTNEXT , MT.TNEXT. These parameters belong to the motion task number MT.NUM and are refreshed by MT.LOAD.

Related Topics

13.2 Motion Tasks

51.10 MT.MOVE

General Information	
Type	Command
Description	Starts a motion task; active in opmode 2 (position) only.
Units	N/A
Range	N/A
Default Value	0
Data Type	N/A
See Also	MT.NUM , MT.P, MT.V, MT.CNTL, MT.ACC, MT.DEC, MT.TNUM, MT.MTNEXT , MT.TNEXT, MT.SET , MT.LOAD
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	544	M_01-03-00-000

Description

MT.MOVE starts a motion task. This command needs one argument in order to start a motion task. The drive must be homed, otherwise the motion task will not start (see also HOME commands).

Example

MT.MOVE 3 -> Start motion task number 3.

Related Topics

13.2 Motion Tasks

Mode 2: Start Motion Task in 11.1 Digital Inputs and Outputs (see also **Modes 3: Motion Task Select Bit** and **Mode 4: Motion Task Start Selected** in this topic)

51.11 MT.MTNEXT

General Information	
Type	R/W Parameter
Description	Specifies following motion task number; active in opmode 2 (position) only.
Units	N/A
Range	0 to 128
Default Value	0
Data Type	Integer
See Also	MT.NUM , MT.P, MT.V, MT.CNTL, MT.ACC, MT.DEC, MT.TNUM, MT.TNEXT, MT.SET , MT.LOAD
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CANopen	35BCh/0	M_01-00-00-000
Modbus	546	M_01-03-00-000

Description

MT.MTNEXT specifies the number of the following motion task and is used by the MT.SET and MT.LOAD command. This parameter is a temporary value. A motion task is only set after an MT.SET command.

The motion task control word can be selected so that a following motion task is executed after a first motion task. This parameter displays which motion task should be started after the first motion task.

Related Topics

13.2 Motion Tasks

51.12 MT.NUM

General Information	
Type	R/W Parameter
Description	Sets the motion task number; active in opmode 2 (position) only.
Units	N/A
Range	0 to 128
Default Value	0
Data Type	Integer
See Also	MT.P, MT.V, MT.CNTL, MT.ACC, MT.DEC, MT.TNUM, MT.MTNEXT , MT.TNEXT, MT.SET , MT.LOAD
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CANopen	365Bh/0	M_01-00-00-000
Modbus	548	M_01-03-00-000

Description

MT.NUM specifies the motion task number, which is used by the MT.SET and MT.LOAD commands. This parameter is a temporary value. A motion task is only set after an MT.SET command is issued.

Related Topics

13.2 Motion Tasks

51.13 MT.P

General Information	
Type	R/W Parameter
Description	Sets the motion task position; active in opmode 2 (position) only.
Units	Depends on UNIT.PROTARY or UNIT.PLINEAR
Range	N/A
Default Value	0
Data Type	Float
See Also	MT.NUM , MT.V, MT.CNTL, MT.ACC, MT.DEC, MT.TNUM, MT.MTNEXT , MT.TNEXT, MT.SET , MT.LOAD
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CANopen	607Ah /0	M_01-00-00-000
Modbus	550 (64-bit)	M_01-03-00-000

Description

MT.P specifies the motion task position, which is used by the MT.SET and MT.LOAD command. Depending on the motion task control word (MT.CNTL), the MT.P command can either be the target position of the motion task or a relative distance. This parameter is a temporary value. A motion task is only set after an MT.SET command.

Related Topics

13.2 Motion Tasks

51.14 MT.PARAMS

General Information	
Type	Command
Description	Shows a motion task; active in opmode 2 (position) only.
Units	N/A
Range	N/A
Default Value	0
Data Type	N/A
See Also	MT.NUM , MT.P, MT.V, MT.CNTL, MT.ACC, MT.DEC, MT.TNUM, MT.MTNEXT , MT.TNEXT, MT.SET , MT.LOAD
Start Version	M_01-00-00-000

Description

MT.PARAMS displays a motion task. This command needs one argument in order to show a motion task. If you enter MT.PARAMS without an argument, the drive returns the current or last active motion task.

Example

MT.PARAMS 5

The drive responds as follows:

```
7   5222.000 Counts   135.000 rpm   1   550.746 rpm/s   654.458
rpm/s   0   0   0 ms
```

Related Topics

13.2 Motion Tasks

51.15 MT.SET

General Information	
Type	Command
Description	Sets the motion task in the drive; active in opmode 2 (position) only.
Units	N/A
Range	N/A
Default Value	0
Data Type	N/A
See Also	MT.NUM , MT.P, MT.V, MT.CNTL, MT.ACC, MT.DEC, MT.TNUM, MT.MTNEXT , MT.TNEXT, MT.LOAD
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CANopen	3431h/0	M_01-00-00-000
Modbus	554	M_01-03-00-000

Description

MT.SET sends a motion task to the drive. A motion task consists of the following parameters: MT.NUM , MT.P, MT.V, MT.CNTL, MT.ACC, MT.DEC, MT.TNUM, MT.MTNEXT , and MT.TNEXT.

The motion task number (MT.NUM) with the parameters above is sent to the drive only after the MT.SET command.

Related Topics

13.2 Motion Tasks

51.16 MT.TNEXT

General Information	
Type	R/W Parameter
Description	Specifies following motion task time; active in opmode 2 (position) only.
Units	ms
Range	0 to 65,535 ms
Default Value	0 ms
Data Type	Integer
See Also	MT.NUM , MT.P, MT.V, MT.CNTL, MT.ACC, MT.DEC, MT.TNUM, MT.MTNEXT , MT.SET , MT.LOAD
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CANopen	35BDh/0	M_01-00-00-000
Modbus	556	M_01-03-00-000

Description

MT.TNEXTspecifies the time that must elapse before starting a following motion task. This value is used by the MT.SET and MT.LOAD command. This parameter is a temporary value. A motion task is only set after an MT.SET command.

The motion task control word can be selected so that a following motion task is executed after a first motion task and this additional delay time.

Related Topics

13.2 Motion Tasks

51.17 MT.TNUM

General Information	
Type	R/W Parameter
Description	Sets the motion task customer table number; active in opmode 2 (position) only.
Units	N/A
Range	0 to 7
Default Value	0
Data Type	Integer
See Also	MT.NUM , MT.P, MT.V, MT.CNTL, MT.ACC, MT.DEC, MT.MTNEXT , MT.TNEXT, MT.SET , MT.LOAD
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	558	M_01-03-00-000

Description

MT.TNUM specifies the customer profile table and is used by the MT.SET and MT.LOAD command. This parameter is a temporary value. A motion task is only set after an MT.SET command.

The drive can have up to eight customer specific profile tables. The drive performs an S-curve acceleration with these profile tables. The shapes of these tables have an impact on the shape of the motion task acceleration and deceleration. The motion task control word specifies if a customer profile table is used or not.

This parameter has no impact when a trapezoidal motion task acceleration and deceleration profile is selected (see Table 4: MT Acceleration Typein the MT.CNTL description).

Related Topics

13.2 Motion Tasks

51.18 MT.TNVSAVE

General Information	
Type	Command
Description	Saves the motion profile tables to the nonvolatile memory.
Units	N/A
Range	N/A
Default Value	N/A
Data Type	N/A
See Also	MT.TDWNLDS, MT.TDWNLDV
Start Version	M_01-04-00-000

Description

This command saves all motion profile tables, which are used for motion tasking, to the nonvolatile memory. The nonvolatile memory for these tables can be cleared by triggering this command while no motion profile table is available in the volatile memory (empty array in the volatile memory). The nonvolatile memory for these tables can be deleted as follows:

```
-->MT.TDWNLDS 1
-->MT.TDWNLDS 2
-->MT.TNVSAVE
```

The first two commands are needed in order to delete all motion profile tables in the volatile memory. The following MT.TNVSAVE command detects that there is no data available in the volatile memory and therefore deletes the nonvolatile memory sector.

WorkBench also uses this command for the firmware download procedure.

51.19 MT.TPOSWND

General Information	
Type	R/W Parameter
Description	Sets the motion task target position window; active in opmode 2 (position) only.
Units	Depends on UNIT.PROTARY or UNIT.PLINEAR Rotary: counts, rad, deg, custom units, 16-bit counts Linear: counts, mm, µm, custom units, 16-bit counts
Range	N/A
Default Value	0.5 rev
Data Type	Float
See Also	DRV.MOTIONSTAT
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CAN-open	35C6h/0	M_01-00-00-000
Modbus	560 (64-bit)	M_01-03-00-000

Description

Within DRV.MOTIONSTAT, MT.TPOSWND is used to indicate that the target position of a motion task has been reached. DRV.MOTIONSTAT displays a "Target Position Reached" bit as soon as the following statement becomes true:

abs(actual_position – target_position) < MT.TPOSWND

Related Topics

13.2 Motion Tasks

51.20 MT.TVELWND

General Information	
Type	R/W Parameter
Description	Sets the motion task target velocity window; active in opmode 2 (position) only.
Units	Depends on UNIT.VROTARY or UNIT.VLINEAR Rotary: rpm, rps, deg/s, custom units/s, rad/s Linear: Counts/s, mm/s, µm/s, custom units/s
Range	Rotary: 0.000 to 15,000.000 rpm 0.000 to 250.000 rps 0.000 to 90,000.000 deg/s 0.000 to 1,250.000 custom units/s 0.000 to 1,570.796 rad/s Linear: 0.000 to 1,073,741,824,000.000 counts/s 0.000 to 250.000*MOTOR.PITCH mm/s 0.000 to 250,000.000*MOTOR.PITCH µm/sec 0.000 to 1,250.000 custom units/s
Default Value	Rotary: 60.000 rpm 1.000 rps 359.999 deg/s 5.000 custom units/s 6.283 rad/s Linear: 0.001 counts/s 1.000*MOTOR.PITCH mm/s 999.998*MOTOR.PITCH µm/sec 5.000 custom units/s
Data Type	Float
See Also	DRV.MOTIONSTAT
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CAN-open	3856h/0	M_01-00-00-000
Modbus	564	M_01-03-00-000

Description

Within DRV.MOTIONSTAT, MT.TVELWND is used to indicate that the target velocity of a motion task has been reached. DRV.MOTIONSTAT displays a "Target Velocity Reached" bit as soon as the following statement becomes true:

(target velocity – MT.TVELWND) < actual velocity < (target velocity + MT)

Related Topics

13.2 Motion Tasks

51.21 MT.V

General Information	
Type	R/W Parameter
Description	Sets the motion task velocity; active in opmode 2 (position) only.
Units	Depends on UNIT.VROTARY or UNIT.VLINEAR Rotary: rpm, rps, deg/s, custom units/s, rad/s Linear: counts/s, mm/s, µm/s, custom units/s
Range	Rotary: 0.000 to 15,000.000 rpm 0.000 to 250.000 rps 0.000 to 90,000.000 deg/s 0.000 to 1,250.000 custom units/s 0.000 to 1,570.796 rad/s Linear: 0.000 to 1,073,741,824,000.000 counts/s 0.000 to 250.000*MOTOR.PITCH mm/s 0.000 to 250,000.000*MOTOR.PITCH µm/sec 0.000 to 1,250.000 custom units/s
Default Value	0
Data Type	Float
See Also	MT.NUM , MT.P, MT.CNTL, MT.ACC, MT.DEC, MT.TNUM, MT.MTNEXT , MT.TNEXT, MT.SET , MT.LOAD
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CANopen	6081h/0	M_01-00-00-000
Modbus	566	M_01-03-00-000

Description

MT.V specifies the motion task velocity, which is used by the MT.SET and MT.LOAD command. This parameter is a temporary value. A motion task is only set after an MT.SET command. The motion task velocity is furthermore limited by VL.LIMITP or VL.LIMITN depending on the direction of the motion task.

A value of 0 should not be used when setting a motion task via MT.SET because this value causes a validity check of the MT.SET command to fail.

A value of 0 after an MT.LOAD command displays an empty (not initialized) motion task.

Related Topics

13.2 Motion Tasks

51.22 MT.VCMD

General Information	
Type	R/O Parameter
Description	Reads the derivative of PL.CMD; active in opmode 2 (position) only.
Units	Depends on UNIT.VROTARY or UNIT.VLINEAR
Range	N/A
Default Value	N/A
Data Type	Float
See Also	N/A
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	568	M_01-03-00-000

Description

MT.VCMD returns the derivative of the position loop trajectory (PL.CMD), which is therefore a velocity. MT.VCMD is updated while the drive is in DRV.OPMODE 2 and is processing the following motion types:

- Motion tasking
- Homing
- Electronic gearing
- Service motion
- External trajectory coming from a fieldbus
- External trajectory calculated from an analog input signal

Related Topics

13.2 Motion Tasks

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52 PL Parameters

This section describes the PL parameters.

52.1 PL.CMD

General Information	
Type	R/O Parameter
Description	Reads the position command directly from the entry to the position loop.
Units	Depends on UNIT.PROTARY or UNIT.PLINEARUNIT.ACCLINEAR Rotary: counts, rad, deg, (custom units), 16-bit counts Linear: counts, mm, µm, (custom units), 16-bit counts
Range	N/A
Default Value	N/A
Data Type	Float
See Also	PL.FB
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	570 (64-bit)	M_01-03-00-000

Description

PL.CMD reads the position command as it is received in the position loop entry.

Related Topics

12.5 Position Loop

11.4 Analog Input

52.2 PL.ERR

General Information	
Type	R/O Parameter
Description	Reads the position error present when the drive is controlling the position loop.
Units	counts, rad, deg, (custom units)
Range	N/A
Default Value	N/A
Data Type	Float
See Also	PL.FB
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CAN-open	35C5h/0 60F4h/0	M_01-00-00-000
Modbus	574 (64-bit)	M_01-03-00-000

Description

PL.ERR reads the position error present when the drive is controlling the position loop. PL.ERR is the difference between the actual position of the motor shaft (PL.FB) and the commanded position of the drive (PL.CMD). If the drive is not in the position operating mode (DRV.OPMODE = 2), then the PL.ERR value is not generated by the drive and this parameter is read as 0.

Related Topics

12.5 Position Loop

52.3 PL.ERRFTHRESH

General Information	
Type	NV Parameter
Description	Sets the maximum position error.
Units	Depends on UNIT.ACCROTARY or UNIT.A-CCLINEAR Rotary: counts, rad, deg, (custom units), 16-bit counts Linear: counts, mm, µm, (custom units), 16-bit counts
Range	Rotary: 0.000 to 5,123,372,000,000,005.000 counts 0.000 to 7,495,067.136 rad 0.000 to 429,436,076.032 deg 0.000 to 5,964,389.888 (custom units) 0.000 to 78,176,452,636.718 16-bit counts Linear: 0.000 to 5,123,372,000,000,005.000 counts 0.000 to 1,192,877.952*MOTOR.PITCH mm 0.000 to 1,192,878,014.464*MOTOR.PITCH µm 0.000 to 5,964,389.888 (custom units) 0.000 to 78,176,452,636.718 16-bit counts
Default Value	Rotary: 42,949,672,960.000 counts 62.832 rad 3,600.000 deg 50.000 (custom units) 655,360.000 16-bit counts Linear: 42,949,672,960.000 counts 10.000*MOTOR.PITCHMOTOR.PITCHmm 10,000.000*MOTOR.PITCH µm 50.000 (custom units) 655,360.000 16-bit counts
Data Type	Float
See Also	PL.ERR
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CAN-open	35C7h/0 6065h/0	M_01-00-00-000
Modbus	580 (64-bit)	M_01-03-00-000

Description

This parameter sets the maximum position error. If the position error PL.ERR is larger than PL.ERRFTHRESH the drive generates a fault. If PL.ERRFTHRESH is set to 0, the maximum position error is ignored.

Example

Set position rotary units to 2 (degrees). Setting PL.ERRFTHRESH to 1000 states that is the position error is larger than 1000 degrees, the drive will generate a fault.

UNIT.PROTARY 2

PL.ERRFTHRESH 1000

Related Topics

12.5 Position Loop

52.4 PL.ERRMODE

General Information	
Type	R/W Parameter
Description	Sets the type of following error warning and fault usage.
Units	0- Standard following error 1-Enhanced following error
Range	0 to 1
Default Value	0
Data Type	Boolean
See Also	PL.ERR, PL.ERRFTHRESH, PL.ERRWTHRESH
Start Version	M_01-02-09-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	578	M_01-03-00-000

Description

PL.ERRMODE sets the type of following error warning and fault usage.

Mode 0 - following error magnitude fault

In Mode 0, the values of PL.ERRFTHRESH and PL.ERRWTHRESH are compared against the value of PL.ERR. If the absolute value of PL.ERR is larger than PL.ERRWTHRESH, then a warning is generated. If the absolute value of PL.ERR is larger than PL.ERRFTHRESH, then a fault is generated.

Mode 1 - deviation from predicted trajectory fault

In Mode 1, the values of PL.ERRFTHRESH and PL.ERRWTHRESH are compared against the following value:

<error> = abs(PL.ERR - [(VL.CMD – VL.FF) / PL.KP])

If the absolute value of <error> is larger than PL.ERRWTHRESH for a consecutive period of 100 ms, then a warning is generated. If the absolute value of <error> is larger than PL.ERR-FTHRESH for a consecutive period of 100 ms, then a fault is generated.

In mode 1, if PL.KI is not 0 then the following error prediction mechanism is turned off. When the drive is disabled, the following error limit tests are turned off and the warnings are cleared. A value of 0 in PL.ERRFTHRESH or PL.ERRWTHRESH disables the respective functionality.

Example

Assuming

PL.ERRMODE = 0, PL.ERRFTHRESH=1.2, PL.ERRWTHRESH=1, then PL.ERR reads 1.1.

In this case the warning is generated, but the fault is not.

Assuming PL.ERRMODE = 0, PL.ERRFTHRESH=1.2, PL.ERRWTHRESH=1, then PL.ERR reads 1.3.

In this case the warning is generated, as well as the fault.

Related Topics

12.5 Position Loop

52.5 PL.ERRWTHRESH

General Information	
Type	NV Parameter
Description	Sets the position error warning level.
Units	Depends on UNIT.PROTARY or UNIT.PLINEARUNIT.A-CCLINEAR Rotary: counts, rad, deg, (custom units), 16-bit counts Linear: counts, mm, µm, (custom units), 16-bit counts
Range	Rotary: 0.000 to 5,123,372,000,000,005.000 counts 0.000 to 7,495,067.136 rad 0.000 to 429,436,076.032 deg 0.000 to 5,964,389.888 (custom units) 0.000 to 78,176,452,636.718 16-bit counts Linear: 0.000 to 5,123,372,000,000,005.000 counts 0.000 to 1,192,877.952*MOTOR.PITCH mm 0.000 to 1,192,878,014.464*MOTOR.PITCH µm 0.000 to 5,964,389.888 (custom units) 0.000 to 78,176,452,636.718 16-bit counts
Default Value	0.000 deg
Data Type	Float
See Also	PL.ERR
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CAN-open	3483h/0	M_01-00-00-000
Modbus	580 (64-bit)	M_01-03-00-000

Description

If this value is not equal 0 and the position error PL.ERR is larger than this value, the drive will generate a warning.

If PL.ERRWTHRESH is set to 0 the warning is not issued.

Example

Set position rotary units to 2 degrees. If you set PL.ERRWTHRESH to 100 and the position error is larger than 100 degrees, then the drive will generate a warning.

UNIT.PROTARY 2

PL.ERRWTHRESH 100

Related Topics

12.5 Position Loop

52.6 PL.FB

General Information	
Type	R/O Parameter
Description	Reads the position feedback value.
Units	Depends on UNIT.PROTARY or UNIT.PLINEARUNIT.ACCLINEAR Rotary: counts, rad, deg, (custom units), 16-bit counts Linear: counts, mm, µm, (custom units), 16-bit counts
Range	N/A
Default Value	N/A
Data Type	Float
See Also	FB1.OFFSET
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CANopen	6064h /0	M_01-00-00-000
Modbus	588 (64-bit)	M_01-03-00-000

Description

PL.FB returns the position feedback value.

Note that this value is not the pure feedback value read from the feedback device, but also includes the value of the FB1.OFFSET and an internal offset set automatically by the FW when a homing switch is actuated.

Related Topics

12.5 Position Loop

Selecting and Using Homing Modes

52.7 PL.FBSOURCE

General Information	
Type	NV Parameter
Description	Sets the feedback source for the position loop.
Units	N/A
Range	Range will differ depending on drive model. 0 to 1 (for AKD-x-xxxxx-NAxx-xxxx) 0 to 2 (for AKD-x-xxxxx-NBxx-xxxx)
Default Value	0
Data Type	Boolean
See Also	VL.FBSOURCE
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	592	M_01-03-00-000

Description

This parameter determines the feedback source that the position loop uses. A value of 0 for this parameter selects the primary feedback, a value of 1 selects the secondary feedback. If you use the secondary feedback as the source for the position loop, then FB2.MODE mode should be set as 0 (A/B signals). A/B signals are the only supported feedback type as secondary feedback into the position loop. Other settings for FB2.MODE are intended as pulse inputs or a gearing command when PL.FBSOURCE remains 0.

0	Primary Feedback connected to X10.
1	Secondary Feedback (DRV.HANDWHEEL) connected to X7 or X9.
2	Tertiary Feedback connected to X9 (only supported with AKD-x-xxxxx-NBxx-xxxx).

Related Topics

12.5 Position Loop

52.8 PL.INTINMAX

General Information	
Type	NV Parameter
Description	Limits the input of the position loop integrator by setting the input saturation.
Units	Depends on UNIT.PROTARY or UNIT.PLINEAR Rotary: counts, rad, deg, (custom units), 16-bit counts Linear: counts, mm, µm, (custom units), 16-bit counts
Range	Rotary: 0.000 to 18,446,744,073,709.000 counts 0.000 to 26,986.052 rad 0.000 to 1,546,188.288 deg 0.000 to 21,474.836 (custom units) 0.000 to 281,474,976.710 16-bit counts Linear: 0.000 to 18,446,744,073,709.000 counts 0.000 to 4,294.968*MOTOR.PITCH mm 0.000 to 4,294,967.296*MOTOR.PITCH µm 0.000 to 21,474.836 (custom units) 0.000 to 281,474,976.710 16-bit counts
Default Value	Rotary: 3,999,989,760.000 counts 5.852 rad 335.275 deg 4.657 (custom units) 61,035.000 16-bit counts Linear: 3,999,989,760.000 counts 0MOTOR.PITCH mm 9MOTOR.PITCH µm 4.657 (custom units) 61,035.000 16-bit counts
Data Type	Float
See Also	PL.FB
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CANopen	3481h/1	M_01-00-00-000
Modbus	594 (64-bit)	M_01-03-00-000

Description

PL.INTINMAX limits the input of the position loop integrator by setting the input saturation. When used in concert with PL.INSATOUT, this variable allows you to make the position loop integrator effective near the target position. Far from the target position, however,the integrator is not dominant in the loop dynamics.

Related Topics

12.5 Position Loop

52.9 PL.INTOUTMAX

General Information	
Type	NV Parameter
Description	Limits the output of the position loop integrator by setting the output saturation.
Units	Depends on UNIT.PROTARY or UNIT.PLINEAR Rotary: counts, rad, deg, (custom units), 16-bit counts Linear: counts, mm, µm, (custom units), 16-bit counts
Range	Rotary: 0.000 to 18,446,744,073,709.000 counts 0.000 to 26,986.052 rad 0.000 to 1,546,188.288 deg 0.000 to 21,474.836 (custom units) 0.000 to 281,474,976.710 counts16 bit Linear: 0.000 to 18,446,744,073,709.000 counts 0.000 to 4,294.968*MOTOR.PITCH mm 0.000 to 4,294,967.296*MOTOR.PITCH µm 0.000 to 21,474.836 (custom units) 0.000 to 281,474,976.710 16-bit counts
Default Value	Rotary: 3,999,989,760.000 counts 5.852 rad 335.275 deg 4.657 (custom units) 61,035.000 16-bit counts Linear: 3,999,989,760.000 counts 0MOTOR.PITCH mm 9MOTOR.PITCH µm 4.657 (custom units) 61,035.000 16-bit counts
Data Type	Float
See Also	PL.INTINMAX
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CANopen	3481h/2	M_01-00-00-000
Modbus	598 (64-bit)	M_01-03-00-000

Description

PL.INTOUTMAX limits the output of the position loop integrator by setting the output saturation.

When used in concert with PL.INTINMAX, this variable allows you to make the position loop integrator effective near the target position. Far from the target position, however, the integrator is not dominant in the loop dynamics.

Related Topics

12.5 Position Loop

52.10 PL.KI

General Information	
Type	NV Parameter
Description	Sets the integral gain of the position loop.
Units	Hz
Range	0 to 250 Hz
Default Value	0 Hz
Data Type	Float
See Also	PL.KP, PL.KD
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CAN-open	3480h/0	M_01-00-00-000
Modbus	602	M_01-03-00-000

Description

PL.KI sets the integral gain of the position regulator PID loop.

Related Topics

12.5 Position Loop

52.11 PL.KP

General Information	
Type	NV Parameter
Description	Sets the proportional gain of the position regulator PID loop.
Units	(rev/s)/rev
Range	0 to 2,147,483.008 (rev/s)/rev
Default Value	100 rps/rev
Data Type	Float
See Also	PL.KI, PL.KD
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CAN-open	3542h/0	M_01-00-00-000
Modbus	604	M_01-03-00-000

Description

PL.KP sets the proportional gain of the position regulator PID loop.

Related Topics

12.5 Position Loop

52.12 PL.MODP1

General Information	
Type	R/W parameter
Description	Sets modulo range parameter.
Units	Depends on UNIT.PROTARY and UNIT.PLINEAR
Range	N/A
Default Value	N/A
Data Type	Float
See Also	N/A
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CANopen	3637h/0	M_01-00-00-000
Modbus	606 (64-bit)	M_01-03-00-000

Description

This parameter is either the beginning or the end of the modulo range, depending on whether this value is smaller or larger than PL.MODP2. If you set PL.MODP1 equal to PL.MODP2, an error message occurs.

Condition	Beginning of the modulo-range	End of the modulo-range
PL.MODP1 < PL.MODP2	PL.MODP1	PL.MODP2
PL.MODP2 < PL.MODP1	PL.MODP2	PL.MODP1

Related Topics

12.5 Position Loop

52.13 PL.MODP2

General Information	
Type	R/W Parameter
Description	Sets the beginning or end modulo range parameter.
Units	Depends on UNIT.PROTARY and UNIT.PLINEAR.
Range	N/A
Default Value	N/A
Data Type	Float
See Also	N/A
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CAN-open	3638h/0	M_01-00-00-000
Modbus	610 (64-bit)	M_01-03-00-000

Description

This parameter is either the beginning or the end of the modulo range, depending on whether this value is smaller or larger than PL.MODP1.

Condition	Beginning of the modulo range	End of the modulo range
PL.MODP1 < PL.MODP2	PL.MODP1	PL.MODP2
PL.MODP2 < PL.MODP1	PL.MODP2	PL.MODP1

Related Topics

12.5 Position Loop

52.14 PL.MODPDIR

General Information	
Type	R/W Parameter
Description	Sets the direction for absolute motion tasks.
Units	N/A
Range	0 to 2
Default Value	0
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CAN-open	3430h/0	M_01-00-00-000
Modbus	614	M_01-03-00-000

Description

This parameter defines the direction of an absolute motion task when the modulo position has been activated. For more details about absolute motion tasks, see .13.2 Motion Tasks. For absolute motion tasks, you can only select a target position within the modulo range.

PL.MODPDIR Settings

Value	Motion	Description
0	Inside Range	The motor moves in a negative direction if the target position of the absolute motion task is less than the current position. The motor moves in positive direction if the target position of the absolute motion task is greater than the current position.
1	Positive	The motor always moves in a positive direction relative to the target position of the absolute motion task.
2	Negative	The motor always moves in a negative direction relative to the target position of the absolute motion task.
3	Shortest Distance	The motor always moves the shortest distance in order to reach the target position within the modulo-range.

52.15 PL.MODPEN

General Information	
Type	R/W Parameter
Description	Enables the modulo position.
Units	N/A
Range	0 to 1
Default Value	0
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

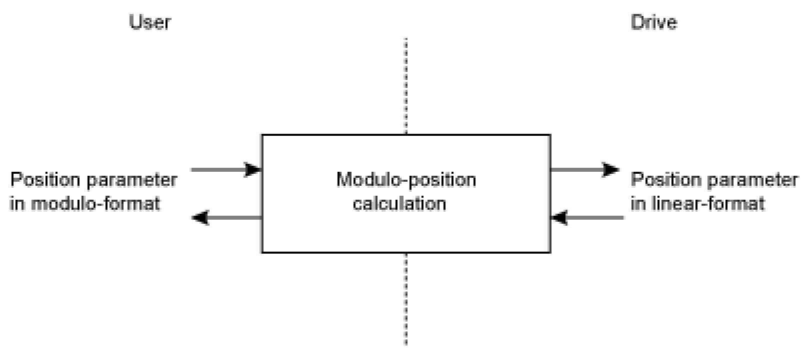
Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CANopen	35CFh/0	M_01-00-00-000
Modbus	616	M_01-03-00-000

Description

A value of 0 disables the modulo-position and a value of 1 enables the modulo-position feature. The modulo-position feature can be used for circular applications such as round tables.

The position loop of the drive uses always a linear position variable but the data-exchange between the user and the drive uses the modulo-position calculation in order to convert values from linear format into modulo format and vice versa.

The following figure shows the interface between the user and the drive for PL.MODPEN=1:



Related Topics

12.5 Position Loop

53 PLS Parameters

This section describes the PLS parameters.

53.1 PLS.EN

General Information	
Type	R/W Parameter
Description	Enables programmable limit switch (PLS).
Units	N/A
Range	0 to 255
Default Value	0
Data Type	Integer
See Also	PLS.MODE, PLS.RESET, PLS.STATE, PLS.UNITS, PLS.P1 to PLS.P8, PLS.WIDTH1 to PLS.WIDTH8, PLS.T1 to PLS.T8
Start Version	M_01-02-03-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CANopen	34A3h/1	M_01-02-03-000
Modbus	618	M_01-03-00-000

Description

PLS.EN is a bit variable which determines the mode of an individual PLS. Eight PLSs are available in the drive.

Example

Bit Value	Behavior
Bit 0 = 0	Disables PLS 1
Bit 0 = 1	Enables PLS 1
Bit 7 = 0	Disables PLS 8
Bit 7 = 1	Enables PLS 8

Related Topics

11.9 Programmable Limit Switch

53.2 PLS.MODE

General Information	
Type	R/W Parameter
Description	Selects programmable limit switch mode.
Units	N/A
Range	0 to 255
Default Value	0
Data Type	Integer
See Also	PLS.EN, PLS.RESET, PLS.STATE, PLS.UNITS, PLS.P1 to PLS.P8, PLS.WIDTH1 to PLS.WIDTH8, PLS.T1 to PLS.T8
Start Version	M_01-02-03-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CANopen	34A3h/3	M_01-02-03-000
Modbus	620	M_01-03-00-000

Description

PLS.MODE is a bit variable which determines the mode of an individual PLS. Eight PLSs are available in the drive.

Example

Bit Value	Behavior
Bit 0 = 0	PLS 1 is monitored continuously.
Bit 0 = 1	PLS 1 is monitored until it is triggered once (single-shot method). The PLS observation can be re-armed using the PLS.RESET command.
Bit 7 = 0	PLS 8 is monitored continuously.
Bit 7 = 1	PLS 8 is monitored until it is triggered once (single-shot method). The PLS observation can be re-armed using the PLS.RESET command.

Related Topics

11.9 Programmable Limit Switch

53.3 PLS.P1 TO PLS.P8

General Information	
Type	R/W Parameter
Description	Sets the trigger point for programmable limit switches.
Units	Depends on UNIT.PROTARY or UNIT.PLINEAR
Range	N/A
Default Value	0
Data Type	Float
See Also	UNIT.PROTARY
Start Version	M_01-02-03-000

Fieldbus	Index/Subindex		Object Start Version
EtherCAT COE and CANopen	34A0h/1	PLS.P1	M_01-02-03-000
	34A0h/2	PLS.P2	
	34A0h/3	PLS.P3	
	34A0h/4	PLS.P4	
	34A0h/5	PLS.P5	
	34A0h/6	PLS.P6	
	34A0h/7	PLS.P7	
	34A0h/8	PLS.P8	
Modbus	622 (64-Bit)	PLS.P1	M_01-03-00-000
	626 (64-Bit)	PLS.P2	
	630 (64-Bit)	PLS.P3	
	634 (64-Bit)	PLS.P4	
	638 (64-Bit)	PLS.P5	
	642 (64-Bit)	PLS.P6	
	646 (64-Bit)	PLS.P7	
	650 (64-Bit)	PLS.P8	

Description

PLS.P1 to PLS.P8 define the trigger point of the PLS. For further information about how these parameters affect PLS behavior, see the PLS.UNITS parameter description.

Related Topics

11.9 Programmable Limit Switch

53.4 PLS.RESET

General Information	
Type	W/O Parameter
Description	Resets programmable limit switch.
Units	N/A
Range	0 to 255
Default Value	N/A
Data Type	Integer
See Also	PLS.EN, PLS.MODE, PLS.STATE, PLS.UNITS, PLS.Px (x=1…8), PLS.WIDTHx (x=1…8), PLS.Tx (x=1…8)
Start Version	M_01-02-03-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CANopen	34A3h/2	M_01-02-03-000
Modbus	654	M_01-03-00-000

Description

This parameter is a bit variable and is used in order to re-arm the corresponding PLS.STATE observation for another single-shot PLS use (see also PLS.MODE).

Example

Bit Value	Behavior
Bit 0 = 0	The PLS 1 observation (PLS.STATE bit 0) is not re-armed.
Bit 0 = 1	The PLS 1 observation (PLS.STATE bit 0) is re-armed.
Bit 7 = 0	The PLS 8 observation (PLS.STATE bit 7) is not re-armed.
Bit 7 = 1	The PLS 8 observation (PLS.STATE bit 7) is re-armed.

Related Topics

11.9 Programmable Limit Switch

53.5 PLS.STATE

General Information	
Type	R/O Parameter
Description	Reads the programmable limit switch state.
Units	N/A
Range	N/A
Default Value	N/A
Data Type	Integer
See Also	PLS.EN, PLS.RESET, PLS.UNITS, PLS.MODE, PLS.P1 TO PLS.P8, PLS.WIDTH1 TO PLS.WIDTH8, PLS.T1 TO PLS.T8
Start Version	M_01-02-03-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CANopen	34A3h/4	M_01-02-03-000
Modbus	656	M_01-03-00-000

Description

This parameter is a bit variable and displays the current status of the individual programmable limit switches.

Example

Bit 0 = 0: Programmable Limit Switch 1 (PLS 1) is not active.

Bit 0 = 1: Programmable Limit Switch 1 (PLS 1) is active.

Bit 7 = 0: Programmable Limit Switch 8 (PLS 8) is not active.

Bit 7 = 1: Programmable Limit Switch 8 (PLS 8) is not active.

Related Topics

11.9 Programmable Limit Switch

53.6 PLS.T1 TO PLS.T8

General Information	
Type	R/W parameter
Description	Sets programmable limit switch time
Units	ms
Range	0 to 65,536 ms
Default Value	500 ms
Data Type	Integer
See Also	PLS.EN, PLS.RESET, PLS.STATE, PLS.UNITS, PLS.MODE, PLS.WIDTH1 TO PLS.WIDTH8, PLS.P1 TO PLS.P8
Start Version	M_01-02-03-000

Fieldbus	Index/Subindex		Object Start Version
EtherCAT COE and CANopen	34A2h /1	PLS.T1	M_01-02-03-000
	34A2h /2	PLS.T2	
	34A2h /3	PLS.T3	
	34A2h /4	PLS.T4	
	34A2h /5	PLS.T5	
	34A2h /6	PLS.T6	
	34A2h /7	PLS.T7	
	34A2h /8	PLS.T8	
Modbus	658	PLS.T1	M_01-03-00-000
	660	PLS.T2	
	662	PLS.T3	
	664	PLS.T4	
	666	PLS.T5	
	668	PLS.T6	
	670	PLS.T7	
	672	PLS.T8	

Description

These parameters define the time of the PLS pulse for time-based PLS handling.

For further information about the PLS functionality, especially the meaning of the PLS.T1 to PLS.T8 parameter, refer to the PLS.UNITS parameter.

Related Topics

11.9 Programmable Limit Switch

53.7 PLS.UNITS

General Information	
Type	R/W parameter
Description	Sets programmable limit switch (PLS) units.
Units	N/A
Range	0 to 255
Default Value	0
Data Type	Integer
See Also	PLS.EN, PLS.RESET, PLS.STATE, PLS.MODE, PLS.P1 TO PLS.P8PLS.WIDTH1 TO PLS.WIDTH8, PLS.T1 TO PLS.T8
Start Version	M_01-02-03-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CAN-open	34A4h/0	M_01-02-03-000
Modbus	674	M_01-03-00-000

Description

PLS.UNITS is a bit variable which determines the behavior of the eight PLSs available in the drive. This parameter is used to select the units for the PLS pulse.

Examples

Bit Value	Behavior
Bit 0 = 0 Position-based PLS handling.	The PLS.STATE parameter displays an active PLS 1 when the position is within the range of PLS.P1 + PLS.WIDTH1 (PLS.P1 <= PL.FB <= PLS.P1+PLS.WIDTH1). When the parameter PLS.WIDTH1 has been set to the value of 0, this bit will be activated as soon as PLS.FB >= PL.P1.
Bit 0 = 1 Time-based PLS handling.	After PLS.P1 is crossed, the PLS.STATE parameter displays an active PLS 1 for a PLS.T1 ms period of time.
Bit 7 = 0 Position-based PLS handling.	The PLS.STATE parameter displays an active PLS 8 when the position is within the range of PLS.P8 + PLS.WIDTH8 (PLS.P8 <= PL.FB <= PLS.P8+PLS.WIDTH8). When the parameter PLS.WIDTH8 has been set to the value of 0, this bit will be activated as soon as PLS.FB >= PL.P8.
Bit 7 = 1 Time-based PLS handling.	After PLS.P8 has been crossed. the PLS.STATE parameter displays an active PLS 8 for a PLS.T8 ms period of time.

Continuous position-based PLS handling

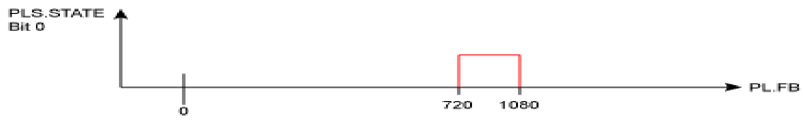
PLS.P1 = 720

PLS.WIDTH1 = 360

PLS.UNITS bit 0 (for PLS 1) = low; PLS.T1 is not considered.

PLS.EN bit 0 (for PLS 1) = high

PLS.MODE bit 0 (for PLS 1) = low



Time-based PLS handling

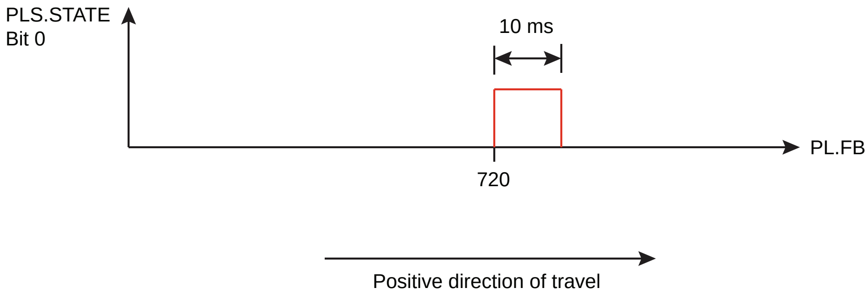
PLS.P1 = 720

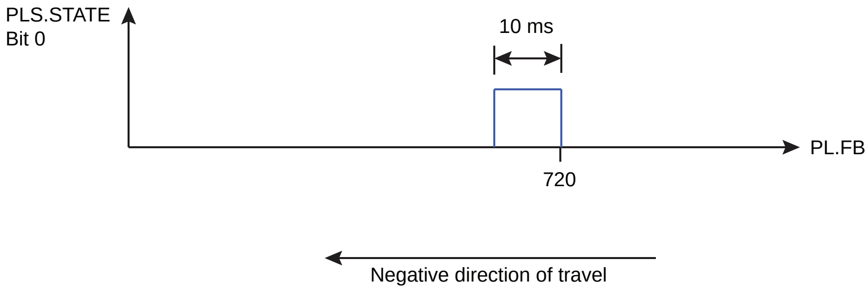
PLS.T1 = 10

PLS.UNITS bit 0 (for PLS 1) = low; PLS.WIDTH1 is not considered.

PLS.EN bit 0 (for PLS 1) = high

PLS.MODE bit 0 (for PLS 1) = low





Related Topics

11.9 Programmable Limit Switch

53.8 PLS.WIDTH1 TO PLS.WIDTH8

General Information	
Type	R/W parameter
Description	Programmable Limit Switch Width
Units	Depends on UNIT.PROTARY or UNIT.PLINEAR
Range	N/A
Default Value	0
Data Type	Float
See Also	PLS.EN, PLS.RESET, PLS.STATE, PLS.UNITS, PLS.MODE, PLS.P1 TO PLS.P8, PLS.T1 TO PLS T8
Start Version	M_01-02-03-000

Fieldbus	Index/Subindex		Object Start Version
EtherCAT COE and CANopen	34A1h /1	PLS.WIDTH1	M_01-02-03-000
	34A1h /2	PLS.WIDTH2	
	34A1h /3	PLS.WIDTH3	
	34A1h /4	PLS.WIDTH4	
	34A1h /5	PLS.WIDTH5	
	34A1h /6	PLS.WIDTH6	
	34A1h /7	PLS.WIDTH7	
	34A1h /8	PLS.WIDTH8	
Modbus	676 (64-Bit)	PLS.WIDTH1	M_01-03-00-000
	680 (64-Bit)	PLS.WIDTH2	
	684 (64-Bit)	PLS.WIDTH3	
	688 (64-Bit)	PLS.WIDTH4	
	692 (64-Bit)	PLS.WIDTH5	
	696 (64-Bit)	PLS.WIDTH6	
	700 (64-Bit)	PLS.WIDTH7	
	704 (64-Bit)	PLS.WIDTH8	

Description

These parameter define the width of the PLS pulse for position-based PLS handling. For further information about the PLS functionality, especially the meaning of the PLS.WIDTH1 to PLS.WIDTH8 parameter, refer to the PLS.UNITS parameter.

Related Topics

11.9 Programmable Limit Switch

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54 REC Parameters

This section describes the REC parameters.

54.1 REC.ACTIVE

General Information	
Type	R/O Parameter
Description	Indicates if data recording is in progress (active).
Units	N/A
Range	0 to 1
Default Value	N/A
Data Type	Boolean
See Also	REC.DONE, REC.OFF
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	708	M_01-03-00-000

Description

REC.ACTIVE indicates whether or not data recording is in progress. Recording is in progress if the trigger was met and the recorder is recording all data.

Related Topics

16 Scope

54.2 REC.CH1 to REC.CH6

General Information	
Type	R/W Parameter
Description	Sets recording channels 1 to 6.
Units	N/A
Range	N/A
Default Value	CH1 = IL.FB CH2 = IL.CMD CH3 = VL.FB CH4 = Empty CH5 = Empty CH6 = Empty
Data Type	String
See Also	REC.TRIG
Start Version	M_01-00-00-000

Description

REC.CHx specifies the recording channels.

There are 3 options to set the recording channels values:

- Set 0, CLR, or CLEAR. This setting clears the recording channel.
- Set one of the recordable commands. The list of recordable commands can be obtain by executing REC.RECPRMLIST.
- Set an internal value or variable of the drive (same as for DRV.MEMADDR input).

Related Topics

16 Scope

54.3 REC.DONE

General Information	
Type	R/O Parameter
Description	Checks whether or not the recorder has finished recording.
Units	N/A
Range	0 to 1
Default Value	N/A
Data Type	Boolean
See Also	REC.ACTIVE, REC.OFF
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	710	M_01-03-00-000

Description

REC.DONE indicates that the recorder has finished recording. This value is reset to 0 when the recorder trigger is set. The drive also resets this value when the recording has finished or when REC.OFF is executed.

Related Topics

16 Scope

54.4 REC.GAP

General Information	
Type	R/W Parameter
Description	Specifies the gap between consecutive samples.
Units	N/A
Range	1 to 65,535
Default Value	1
Data Type	Integer
See Also	REC.TRIG
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	712	M_01-03-00-000

Description

REC.GAP specifies the gap between consecutive samples. The recording base rate is 16 kHz, thus a gap of 1 means that a sample is recorded every 62.5 µs.

Related Topics

16 Scope

54.5 REC.NUMPOINTS

General Information	
Type	R/W Parameter
Description	Sets the number of points to record.
Units	N/A
Range	1 to 65,535
Default Value	1,000
Data Type	Integer
See Also	REC.TRIG
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	714	M_01-03-00-000

Description

REC.NUMPOINTS specifies the number of points (samples) to record.

Related Topics

16 Scope

54.6 REC.OFF

General Information	
Type	R/W Parameter
Description	Turns the recorder OFF.
Units	N/A
Range	N/A
Default Value	N/A
Data Type	N/A
See Also	REC.ACTIVE, REC.DONE
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	716	M_01-03-00-000

Description

REC.OFF turns the recorder off. In order to set the recorder again, the recorder must first be armed and then a trigger set.

Related Topics

16 Scope

REC.READY

54.7 REC.RECPRMLIST

General Information	
Type	R/O Parameter
Description	Reads the list of recordable parameters.
Units	N/A
Range	N/A
Default Value	N/A
Data Type	N/A
See Also	REC.CH1 to REC.CH6
Start Version	M_01-00-00-000

Description

This command returns the list of recordable parameters. You can use a recordable parameter as an input to any of the recording channels.

Note that an internal address or a registered variable can be used as input to any of the channels in addition to the list.

Related Topics

16 Scope

54.8 REC.RETRIEVE

General Information	
Type	R/O Parameter
Description	Transfers all the recorded data to the communication channel.
Units	N/A
Range	N/A
Default Value	N/A
Data Type	String
See Also	N/A
Start Version	M_01-00-00-000

Description

REC.RETRIEVE causes the drive to transfer all the recorded data to the communication channel.

Example

The following format is the retrieve reply format (for N samples, G sample gap, and M parameters, where M<=6):

```
Recording
<N>,<G>
<parameter name 1> … <parameter name M>
Value11 … Value1M
Value N1 …  ValueNM
```

Related Topics

16 Scope

54.9 REC.RETRIEVEDATA

General Information	
Type	R/W Parameter
Description	Retrieves the recorded data without the header.
Units	N/A
Range	N/A
Default Value	N/A
Data Type	N/A
See Also	REC.RETRIEVE, REC.RETRIEVEHDR, REC.R-ETRIEVESIZE
Start Version	M_01-00-00-000

Description

REC.RETRIEVEDATA retrieves a section of recorded data according to REC.R-ETRIEVESIZE from the received index; if no index is received, the drive retrieves the data from next section. An index is supplied to enable multiple retrieves and to give better control on the buffer in case of overflow. If no index or a negative value is present, then the index is ignored.

WorkBench uses this parameter to retrieve the data continuously for real time recoding.

The size of the data returned by this command depends on the number set by REC.R-ETRIEVESIZE.

Use REC.RETRIEVE for complete recording information view.

Notes:

- If REC.RETRIEVESIZE is larger than the buffer size, then it simply returns the whole buffer (no error).
- If the index is received, the data will be continuously returned starting from the given index (default starting index is 0).
- If the index is out of the bounds of the buffer, then it will be ignored.
- If recorder is active and REC.STOPTYPE==0, then this parameter returns an error.
- If REC.STOPTYPE==1, then this parameter returns the next section of data in the buffer (even if it reached the end of the buffer, it will return to the beginning of the buffer and add the data from index 0.)
- If REC.STOPTYPE==1 and the retrieve is too slow (gets overrun by the recorder), an overflow error message is returned instead of the retrieved data.
- If REC.STOPTYPE==0 and no index is received, continuously send the sections of data until the end of the buffer is reached. Then, return to the beginning of buffer and continue.
- A new REC.TRIG command automatically sets the index to 0.

Example

The following example retrieves data from index 100 in the size of 10 (hence places 100 to 109 in the buffer)

```
REC.NUMPOINTS 1000
REC.RETRIVESIZE 10
REC.TRIG
REC.RETRIEVEDATA 100
```

Related Topics

16 Scope

54.10 REC.RETRIEVEFRMT

General Information	
Type	R/W Parameter
Description	Sets the format for recorded data output.
Units	N/A
Range	0 to 1; 0 = Standard format, 1 = Internal format (high speed)
Default Value	1
Data Type	Integer
See Also	REC.RETRIEVE, REC.RETRIEVEDATA
Start Version	M_01-00-00-000

Description

Recorded data is transferred to the communication channel in one of two formats: standard or internal high speed. The standard (slower) format cannot be used for continuous recording, but is more easily read. The high speed format allows continuous data recording (needed for auto-tuning). WorkBench supports both formats.

Example

The following recorder data is in standard format:

```
10,1
IL.FB,VL.CMD,VL.FB
-0.086,0.000,2.661
0.000,0.000,3.605
0.029,0.000,-0.486
```

The following recorder data is in internal format:

```
10,1
IL.FB,VL.CMD,VL.FB
F3-0x56,F30x0,F30xA65
F30x0,F30x0,F30xE15
F30x1D,F30x0,F3-0x1E6
```

Related Topics

16 Scope

54.11 REC.RETRIEVEHDR

General Information	
Type	R/O Parameter
Description	Retrieves the recorded header without the data.
Units	N/A
Range	N/A
Default Value	N/A
Data Type	N/A
See Also	REC.RETRIEVE, REC.RETRIEVEDATA
Start Version	M_01-00-00-000

Description

This command retrieves the recorded header without the data of the recording.

WorkBench uses this parameter to retrieve the header once before continuously reading the data for RT recoding.

Use REC.RETRIEVE for complete recording information view.

Related Topics

16 Scope

54.12 REC.RETRIEVESIZE

General Information	
Type	R/W Parameter
Description	Sets the number of samples that REC.RETRIEVEDATA returns.
Units	recorder samples
Range	0 to 65,535 recorder samples
Default Value	1,000 recorder samples
Data Type	Integer
See Also	REC.RETRIEVEDATA, REC.RETRIEVEHDR
Start Version	M_01-00-00-000

Description

This parameter sets the number of samples that REC.RETRIEVEDATA returns.

WorkBench also uses this parameter to set the number of samples returned when retrieving the data continuously for RT recoding.

Use REC.RETRIEVE for the complete recording information view.

Related Topics

16 Scope

54.13 REC.STOPTYPE

General Information	
Type	R/W Parameter
Description	Sets the recorder stop type.
Units	N/A
Range	0 or 1
Default Value	0
Data Type	Integer
See Also	REC.RETRIEVEDATA, REC.R-ETRIEVESIZE
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	718	M_01-03-00-000

Description

This parameter sets the stop type for the recording.

0 = Recorder runs, continuously filling the recording circular buffer.

1 = Recorder fills in the buffer once.

To stop RT recording, execute REC.OFF.

Related Topics

16 Scope

54.14 REC.TRIG

General Information	
Type	Command
Description	Triggers the recorder.
Units	N/A
Range	N/A
Default Value	N/A
Data Type	N/A
See Also	REC.RETRIEVE, REC.OFF
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	720	M_01-03-00-000

Description

REC.TRIG starts the trigger according to the trigger type defined by REC.TRIGTYPE.

REC.TRIG sets the value of REC.DONE to 0.

After calling REC.TRIG, the data that was recorded by previous recording is deleted and cannot be retrieved.

No REC parameters can be set after a call to REC.TRIG until the recorder has finished or until REC.OFF is executed.

Related Topics

16 Scope

54.15 REC.TRIGPARAM

General Information	
Type	R/W Parameter
Description	Sets the parameter that triggers the recorder.
Units	N/A
Range	N/A
Default Value	IL.FB
Data Type	String
See Also	REC.TRIG
Start Version	M_01-00-00-000

Description

REC.TRIGPARAM sets the parameter on which the recorder triggers.

This parameter is only used when REC.TRIGTYPE = 2.

Input values are:

1. One of the set drive parameters list that can be set as a trigger. The available parameters for trigger are: PL.ERR, PL.CMD, PL.FB, VL.CMD, VL.FB, IL.CMD, and IL.FB.
2. Internal value or variable of the drive (same as for DRV.MEMADDR input).

Related Topics

16 Scope

54.16 REC.TRIGPOS

General Information	
Type	R/W Parameter
Description	Sets the trigger position in the recording buffer.
Units	%
Range	1 to 100%
Default Value	10%
Data Type	Integer
See Also	REC.TRIG, REC.NUMPOINTS
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	722	M_01-03-00-000

Description

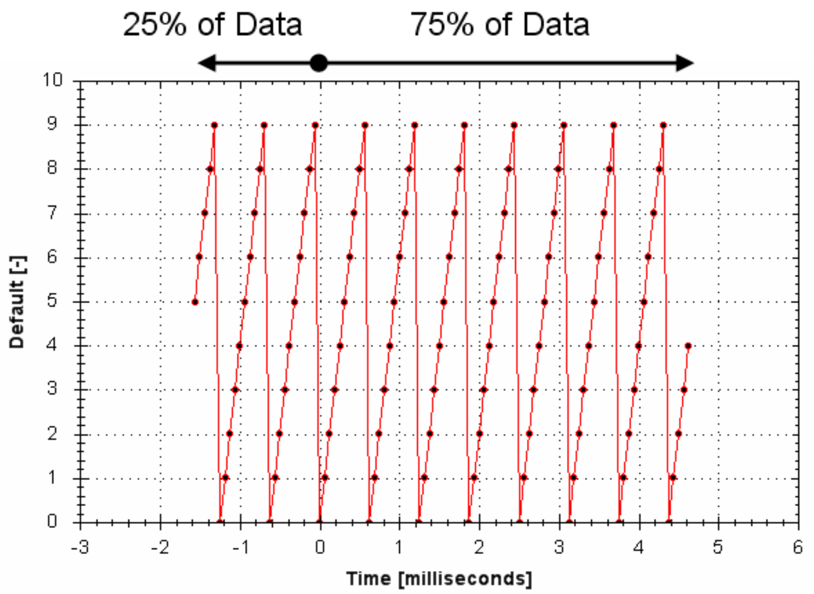
REC.TRIGPOS sets the trigger position in the recording buffer. The recording buffer size is defined by REC.NUMPOINTS. The input value is a percentage of the buffer (that is, a value of 25 means saving 25% of the buffer data before the trigger occurs and 75% after it occurs). This parameter is only used when REC.TRIGTYPE = 2 or 3.

Trigger Position

Trigger position (REC.TRIGPOS) allows you to collect data that occurs before the trigger occurs. In some instances, you may want to see the conditions prior to the trigger. Trigger position lets you control how much signal is collected before the trigger condition occurred .

Trigger position is specified in units of percent (%). If you specify a trigger position of x% , then x% of the data is before 0 ms in the data time and 100-x% (the rest of the data) is at or greater than 0 ms. In the figure below, the trigger position is set to 25% (REC.TRIGPOS 25).

In the WorkBench scope, the 0 time point is clear. When collecting the data using REC.RETRIEVE or similar commands, the time is not returned, so some caution should be used when the trigger point is important to understand.



Related Topics

16 Scope

54.17 REC.TRIGPRMLIST

General Information	
Type	R/O Parameter
Description	Reads the list of possible trigger parameters.
Units	N/A
Range	N/A
Default Value	N/A
Data Type	N/A
See Also	REC.TRIGPARAM
Start Version	M_01-00-00-000

Description

This command returns the list of trigger parameters. Each one of those parameters can serve as the trigger parameter (input to REC.TRIGPARAM).

Note that an internal address or a registered variable can be used as input to REC.TRIGPARAM in addition to the list that this parameter returns.

Related Topics

16 Scope

54.18 REC.TRIGSLOPE

General Information	
Type	R/W Parameter
Description	Sets the trigger slope.
Units	0 = Negative 1 = Positive
Range	0 to 1
Default Value	0
Data Type	Boolean
See Also	REC.TRIG, REC.NU-MPOINTS
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	726	M_01-03-00-000

Description

REC.TRIGSLOPE sets the recorder trigger slope. This parameter is only used when REC.TRI-GTYPE = 2 or 3.

Related Topics

16 Scope

54.19 REC.TRIGTYPE

General Information	
Type	R/W Parameter
Description	Sets the trigger type.
Units	0 = immediate 1 = command 2 = parameter 3 = boolean
Range	0 to 2
Default Value	0
Data Type	Integer
See Also	REC.TRIG, REC.TRIGPARAM, REC.TRIGVAL, REC.TRIGSLOPE REC.TRIGPOS
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	728	M_01-03-00-000

Description

REC.TRIGTYPE sets the type of trigger.

Input values are as follows:

Value	Description
0	Recording starts immediately
1	Recording starts on the next command executed through the TCP/IP. The trigger location in the buffer is set according to REC.TRIGPOS.
2	Recording starts per the values of REC.TRIGPARAM, REC.TRIGVAL, REC.TRIGSLOPE, and REC.TRIGPOS.
3	Recording starts when the value of REC.TRIGPARAM is 0 for REC.TRIGSLOPE = 0 or 1 for REC.TRIGSLOPE = 1

Related Topics

16 Scope

54.20 REC.TRIGVAL

General Information	
Type	R/W Parameter
Description	Sets the trigger value.
Units	The units of the parameter are chosen according to the unit type.
Range	0 to 2
Default Value	0
Data Type	Integer
See Also	REC.TRIG, REC.TRIGPARAM, REC.TRIGVAL, REC.TRIGSLOPE, REC.TRIGPOS
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	730 (64-bit)	M_01-03-00-000

Description

REC.TRIGVAL is the value that must be met by REC.TRIGPARAM for the trigger to occur. The units of this parameter are set according to the units of REC.TRIGPARAM.

Related Topics

16 Scope

55 REGEN Parameters

This section describes the REGEN parameters.

55.1 REGEN.POWER

General Information	
Type	R/O parameter
Description	Reads regen resistor's calculated power.
Units	Watt
Range	N/A
Default Value	N/A
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CAN-open	3416h/0	M_01-00-00-000
Modbus	734 (64-bit)	M_01-03-00-000

Description

This parameter reads regen resistor's calculated power, which is determined as follows:

$(V^2 / R) * DutyCycle$

Related Topics

7.2 Regeneration

55.2 REGEN.REXT

General Information	
Type	NV Parameter
Description	Sets the external, user-defined regen resistor resistance.
Units	Ω
Range	0 to 255 Ω
Default Value	0 Ω
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CANopen	35C2h/0	M_01-00-00-000
Modbus	738	M_01-03-00-000

Description

REGEN.REXT sets the external user-defined regen resistor resistance. This variable is needed for the regen resistor temperature estimation algorithm.

Related Topics

7.2 Regeneration

55.3 REGEN.TEXT

General Information	
Type	R/W Parameter
Description	Sets the external regen resistor thermal protection time constant.
Units	s
Range	0.1 to 1,200 s
Default Value	100 s
Data Type	Float
See Also	REGEN.WATTEXT, REGEN.REXT
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CAN-open	3415h/0	M_01-00-00-000
Modbus	740	M_01-03-00-000

Description

REGEN.TEXT is a thermal time constant used to protect an external regeneration (regen) resistor from overheating and failing. Its value is the time-to-fault when input power steps from 0 to 150% of REGEN.WATTEXT. The drive's regen resistor protection algorithm continuously calculates the power dissipated in the resistor and processes that power value through a single pole low pass filter to model the regen resistor's thermal inertia. When the filtered regen power on the output of the filter exceeds REGEN.WATTEXT, a fault occurs. REGEN.TEXT sets the time constant of this thermal inertia filter.

REGEN.TEXT can often be found directly on power resistor data sheets. On the data sheets, find the peak overload curve and then find the safe allowed time to be at 150% of the regen resistor's continuous power rating. Another way regen resistor peak overload capability is often specified is by giving the energy rating in joules of the resistor. If you have the energy rating E then:

REGEN.TEXT = (1.1)*((joule limit)/REGEN.WATTEXT)

Example

The external regen resistor is rated for 250 W continuous, is 33 ohm, and has a joule rating of 500 joules. To use this resistor, the drive settings become:

REGEN.TYPE = -1 (External Regen)

REGEN.REXT = 33

REGEN.WATTEXT = 250

REGEN.TEXT = (1.1)*(500 j)/(250 W) = 2.2 sec

Related Topics

7.2 Regeneration

55.4 REGEN.TYPE

General Information	
Type	NV Parameter
Function	Sets the regen resistor type.
WorkBench Location (Screen/Dialog Box)	Power/Regen Resistor Type
Units	N/A
Range	–1 to 0
Default Value	0
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CAN-open	3412h/0	M_01-00-00-000
Modbus	742	M_01-03-00-000

Description

You can specify a user-defined external regen resistor, select an internal regen resistor, or choose from a list of predefined regen resistors. The values for REGEN.TYPE are shown below:

Type	Description
–1	External user-defined regen resistor
0	Internal regen resistor

If you specify a user-defined regen resistor, then you must also define this resistor's resistance (REGEN.REXT), heatup time (REGEN.REXT), and power (REGEN.WATTEXT).

Related Topics

7.2 Regeneration

55.5 REGEN.WATTEXT

General Information	
Type	R/W parameter
Description	Sets the regen resistor's power fault level for an external regen resistor.
Units	W
Range	0 to 62,000 W
Default Value	1000 W
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CAN-open	3414h/0	M_01-00-00-000
Modbus	744	M_01-03-00-000

Description

Sets the regen resistor's power fault level for an external regen resistor (when REGEN.TYPE = -1).

Above this fault level, the regen resistor's PWM wil be 0 and a fault will be issued.

Related Topics

7.2 Regeneration

56 SM Parameters

This section describes the SM parameters.

56.1 SM.I1

General Information	
Type	R/W Parameter
Description	Sets service motion current 1; active in opmode 0 (torque) only.
Units	A
Range	–Drive peak current to +Drive peak current
Default Value	0.025 · Drive peak current
Data Type	Float
See Also	SM.ACCTYPE, SM.I2, SM.MODE, SM.MOVE, SM.T1, SM.T2, SM.V1, SM.V2, SM.VPM1, SM.VPM2
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	746	M_01-03-00-000

Description

SM.I1 defines the current that is used in service motion modes 0 and 1 (see SM.MODE).

Related Topics

13.4 Service Motion

56.2 SM.I2

General Information	
Type	R/W Parameter
Description	Sets service motion current 2; active in opmode 0 (torque) only.
Units	A
Range	–Drive peak current to +Drive peak current
Default Value	0.025 · Drive peak current
Data Type	Float
See Also	SM.ACCTYPE, SM.I1, SM.MODE, SM.MOVE, SM.T1, SM.T2, SM.V1, SM.V2, SM.VPM1, SM.VPM2
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	748	M_01-03-00-000

Description

SM.I2 defines the current that is used in service motion mode 1 (see SM.MODE).

Related Topics

13.4 Service Motion

56.3 SM.MODE

General Information	
Type	R/W Parameter
Description	Sets the service motion mode.
Units	N/A
Range	0 to 1
Default Value	0
Data Type	Integer
See Also	SM.I1, SM.I2, SM.MOVE, SM.T1 SM.T2, SM.V1, SM.V2, DRV.ACCDRV.DEC
Start Version	M_01-01-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	750	M_01-03-00-000

Description

SM.MODE defines the mode of service motion for each loop. Two types of service motion are available :

1. A constant motion in one direction (endless or for a certain amount of time).
2. An alternating motion.

The possible modes for this parameter are described in the following table:

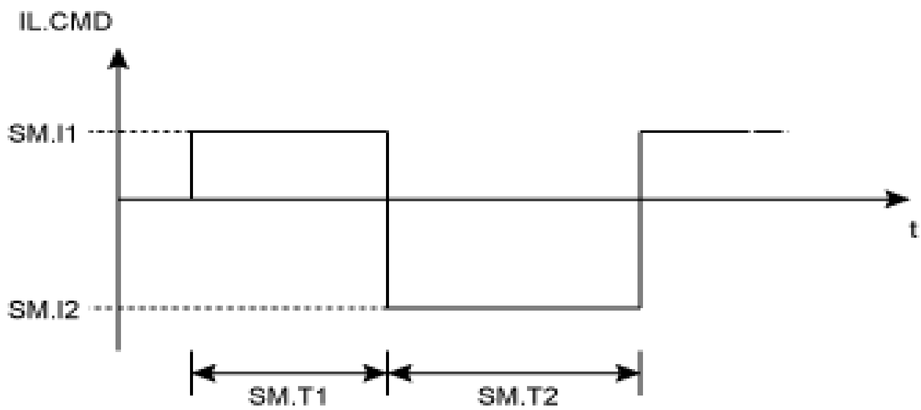
SM.MODE	Description	Requirements
0	Constant motion in closed current loop mode of operation. • DRV.OPMODE 0: The drive generates a constant current command value (SM.I1) for a certain amount of time (if SM.T1>0) or endless (if SM.T1=0). The drive will not generate any ramps in this mode of operation. • DRV.OPMODE 1 or 2: The drive generates a constant velocity command value (SM.V1) for a certain amount of time (if SM.T1>0) or endless (if SM.T1=0). The drive generates acceleration and deceleration ramps according to the DRV.ACC and DRV.DEC setting in this mode of operation. The service motion can be stopped by using the DRV.STOP command.	DRV.OPMODE = 0,1, or 2 DRV.CMDSOURCE = 0

SM.MODE	Description	Requirements
1	• DRV.OPMODE 0: The drive generates a current command value (SM.I1) for a certain amount of time (SM.T1). Afterwards the drive generates a current command value (SM.I2) for another certain amount of time (SM.T2). This sequence is repeated as long as a DRV.STOP command occurs. The drive will not generate any ramps in this mode of operation. • DRV.OPMODE 1 or 2: The drive generates a velocity command value (SM.V1) for a certain amount of time (SM.T1). Afterwards the drive generates a velocity command value (SM.V2) for another certain amount of time (SM.T2). This sequence is repeated as long as a DRV.STOP command occurs. The drive will generate an acceleration and deceleration ramps according to the DRV.ACC and DRV.DEC setting in this mode of operation.	DRV.OPMODE = 0, 1, or 2 DRV.CMDSOURCE = 0

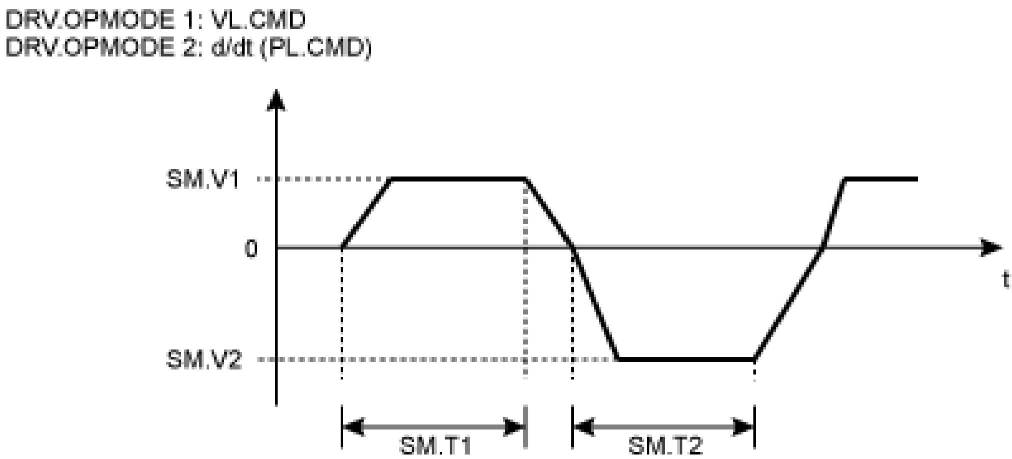
Ramps

The drive uses DRV.ACC and DRV.DEC for the ramps in DRV.OPMODE 1 (closed velocity) and 2 (closed position). The drive does not generate any ramps in service motion mode 0 and 1.

Service Motion for DRV.OPMODE 0 and SM.MODE 1



Service motion for DRV.OPMODE 1 or 2 and SM.MODE 1



The deceleration process from SM.V1 or SM.V2 to 0 is not included in SM.T1 and SM.T2, respectively. SM.T1 and SM.T2 start as soon as the command value has reached the velocity 0.

Related Topics

13.4 Service Motion

56.4 SM.MOVE

General Information	
Type	Command
Description	Starts the service motion.
Units	N/A
Range	N/A
Default Value	N/A
Data Type	N/A
See Also	SM.MODE
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	752	M_01-03-00-000

Description

This command starts the service motion that has been selected by the SM.MODE parameter.

Related Topics

13.4 Service Motion

56.5 SM.T1

General Information	
Type	R/W Parameter
Description	Sets the service motion time 1.
Units	ms
Range	0 to 65,535 ms
Default Value	500 ms
Data Type	Integer
See Also	SM.I1, SM.I2, SM.MODE, SM.MOVE, SM.T2, SM.V1, SM.V2, SM.VPM1, SM.VPM2
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	754	M_01-03-00-000

Description

SM.T1 defines the time of the service motion that is used in all service motion modes (see SM.MODE). For an alternating service motion mode, SM.T1 may not be set to 0.

Related Topics

13.4 Service Motion

56.6 SM.T2

General Information	
Type	R/W Parameter
Description	Sets the service motion time 2.
Units	ms
Range	1 to 65,535 ms
Default Value	500 ms
Data Type	Integer
See Also	SM.I1, SM.I2, SM.MODE, SM.MOVE, SM.T1, SM.V1, SM.V2, SM.VPM1, SM.VPM2
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	756	M_01-03-00-000

Description

SM.T2 defines the time of the service motion that is used in service motion modes 1, 3, and 5 (see SM.MODE).

Related Topics

13.4 Service Motion

56.7 SM.V1

General Information	
Type	R/W Parameter
Description	Sets service motion velocity 1; active in opmode 1 (velocity) and 2 (position).
Units	Depends on UNIT.ACCROTARY or UNIT.ACCLINEAR Rotary: rpm, rps, deg/s, custom units/s, rad/s Linear: Counts/s, mm/s, µm/s, custom units/s
Range	Rotary: -15,000.000 to 15,000.000 rpm -250.000 to 250.000 rps -90,000.000 to 90,000.000 deg/s -1,250.000 to 1,250.000 custom units/s -1,570.796 to 1,570.796 rad/s Linear: -1,073,741,824,000.000 to 1,073,741,824,000.000 counts/s -250.000*MOTOR.PITCH to 250.000*MOTOR.PITCH mm/s -250,000.000*MOTOR.PITCH to 250,000.000*MOTOR.PITCH µm/s -1,250.000 to 1,250.000 custom units/s
Default Value	Rotary: 60.000 rpm 1.000 rps 359.999 deg/s 5.000 custom units/s 6.283 rad/s Linear: 0.001 Counts/s 1.000*MOTOR.PITCH mm/s 999.998*MOTOR.PITCH µm/sec 5.000 custom units/s
Data Type	Float
See Also	SM.I1, SM.I2, SM.MODE, SM.MOVE, SM.T1, SM.T2, SM.V2
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	758	M_01-03-00-000

Description

SM.V1 defines the velocity that is used in service motion modes 0 and 1 (see SM.MODE) in the closed velocity and position mode of operation.

Related Topics

13.4 Service Motion

56.8 SM.V2

General Information	
Type	R/W Parameter
Description	Sets service motion velocity 2; active in opmode 1 (velocity) and 2 (position).
Units	Depends on UNIT.ACCROTARY or UNIT.ACCLINEAR Rotary: rpm, rps, deg/s, custom units/s, rad/s Linear: counts/s, mm/s, µm/s, custom units/s
Range	Rotary: -15,000.000 to 15,000.000 rpm -250.000 to 250.000 rps -90,000.000 to 90,000.000 deg/s -1,250.000 to 1,250.000 custom units/s -1,570.796 to 1,570.796 rad/s Linear: -1,073,741,824,000.000 to 1,073,741,824,000.000 counts/s -250.000*MOTOR.PITCH to 250.000*MOTOR.PITCH mm/s -250,000.000*MOTOR.PITCH to 250,000.000*MOTOR.PITCH µm/s -1,250.000 to 1,250.000 custom units/s
Default Value	Rotary: -60.000 rpm -1.000 rps -359.999 deg/s -5.000 custom units/s -6.283 rad/s Linear: -0.001 counts/s -1.000*MOTOR.PITCH mm/s -999.998*MOTOR.PITCH µm/sec -5.000 custom units/s
Data Type	Float
See Also	SM.I1, SM.I2, SM.MODE, SM.MOVE, SM.T1, SM.T2, SM.V1
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	760	M_01-03-00-000

Description

SM.V2 defines the velocity that is used in service motion mode 1 (see SM.MODE) in the closed velocity and position mode of operation.

Related Topics

13.4 Service Motion

57 STO Parameters

This section describes the STO parameters.

57.1 STO.STATE

General Information	
Type	R/O Parameter
Description	Returns the status of the safe torque off.
Units	N/A
Range	0 to 1
Default Value	N/A
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	762	M_01-03-00-000

Description

STO.STATE returns the status of the safe torque off.

1 - Safe torque on (no safe torque off fault).

0 - Safe torque off (safe torque off fault).

Related Topics

11.8 Limits

11.14 Safe Torque Off (STO)

58 SWLS Parameters

This section describes the SWLS parameters.

58.1 SWLS.EN

General Information	
Type	NV Parameter
Description	Enables and disables software travel limit switches.
Units	N/A
Range	0 to 3
Default Value	0
Data Type	U8
See Also	36.39 DRV.MOTIONSTAT
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	764	M_01-03-00-000

Description

This parameter enables the software travel limit switches. The software limit switches are only active if the axis is homed.

Example

Bit 0 = 0: Disable SWLS.LIMIT0

Bit 0 = 1: Enable SWLS.LIMIT0

Bit 1 = 0: Disable SWLS.LIMIT1

Bit 1 = 1: Enable SWLS.LIMIT1

Related Topics

11.8 Limits

13.1 Homing

44 HOME Parameters

58.2 SWLS.LIMIT0

General Information	
Type	NV Parameter
Description	Sets the position of the software travel limit switch 0.
Units	Position units
Range	-9,007,199,254,740,992 to 9,007,199,254,740,991
Default Value	0
Data Type	S64
See Also	UNIT.PROTARY, UNIT.PLINEAR
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CAN-open	607Dh/1	M_01-00-00-000
Modbus	766 (64-bit)	M_01-03-00-000

Description

This parameter sets the compare register for the software limit switch 0. This value can be either the lower or the upper software limit switch register, depending on the configuration of the software limit switches. Whichever switch is set largest is the positive limit switch; the other switch becomes the negative limit switch. These switches can be used in addition to hardware limit switches. The software limit switches are only active if the axis is homed. For more information about homing, please refer to the HOME Parameters and DRV.MOTIONSTAT.

Related Topics

11.8 Limits

13.1 Homing

44 HOME Parameters

58.3 SWLS.LIMIT1

General Information	
Type	NV Parameter
Description	Sets the position of the software travel limit switch 0.
Units	Position units
Range	-9,007,199,254,740,992 to 9,007,199,254,740,991
Default Value	1,048,576.000 counts, 16-bit (firmware versions M_01-02-00-000 and above) 68,719,476,736 counts (for firmware version M_01-01-00-000)
Data Type	S64
See Also	UNIT.PROTARY, UNIT.PLINEAR
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CAN-open	607Dh/2	M_01-00-00-000
Modbus	770 (64-bit)	M_01-03-00-000

Description

This parameter sets the compare register for the software limit switch 1. This value can be either the lower or the upper software limit switch register, depending on the configuration of the software limit switches. Whichever switch is set largest is the positive limit switch; the other switch becomes the negative limit switch. These switches can be used in addition to hardware limit switches. The software limit switches are only active if the axis is homed. For more information about homing, please refer to the HOME Parameters and DRV.MOTIONSTAT.

Related Topics

11.8 Limits

13.1 Homing

44 HOME Parameters

36.39 DRV.MOTIONSTAT

58.4 SWLS.STATE

General Information	
Type	R/O Parameter
Description	Reads the actual status of software limit switches.
Units	N/A
Range	0 to 3
Default Value	0
Data Type	U8
See Also	N/A
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	774	M_01-03-00-000

Description

This parameter reads the status word of the software limit switches. The status word indicates the result of the compare between the software limit switch compare register and the actual position of the position loop.

Example

Bit 0 = 0: SWLS.LIMIT0 is not active.

Bit 0 = 1: SWLS.LIMIT0 is active.

Bit 1 = 0: SWLS.LIMIT1 is not active.

Bit 1 = 1: SWLS.LIMIT1 is active.

Bits 2 to 7 are currently not in use.

Related Topics

11.8 Limits

13.1 Homing

44 HOME Parameters

59 UNIT Parameters

This section describes the UNIT parameters.

59.1 UNIT.ACCLINEAR

General Information	
Type	NV Parameter
Description	Sets the linear acceleration/deceleration units.
Units	N/A
Range	0 to 3
Default Value	0
Data Type	Integer
See Also	DRV.ACC, DRV.DEC, MOTOR.TYPE
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	776	M_01-03-00-000

Description

UNIT.ACCLINEAR sets the units type for the acceleration and deceleration parameters, when the motor type (MOTOR.TYPE) is linear.

Type	Description
0	[custom units]/s^2
1	millimeters per second squared (mm/s^2)
2	micrometers per second squared (µm/s^2)
3	Feedback counts/s^2

Related Topics

10 Selecting Units for Your Application

59.2 UNIT.ACCROTARY

General Information	
Type	NV Parameter
Description	Sets the rotary acceleration/deceleration units.
Units	rpm/s, rps/s, deg/s^2 , [custom units]/s^2
Range	0 to 3 rpm/s
Default Value	0 rpm/s
Data Type	Integer
See Also	DRV.ACC, MOTOR.TYPE
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CAN-open	3659h/0	M_01-00-00-000
Modbus	778	M_01-03-00-000

Description

UNIT.ACCROTARY sets the acceleration/deceleration units when the motor type (MOTOR.TYPE) is rotary.

Type	Description
0	rpm/s
1	rps/s
2	deg/s^2
3	(custom units)/s^2

Related Topics

10 Selecting Units for Your Application

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59.3 UNIT.LABEL

General Information	
Type	NV Parameter
Description	Sets user-defined name for user-defined position units.
Units	N/A
Range	Maximum 16 characters, no spaces
Default Value	custom units
Data Type	String
See Also	UNIT.PLINEAR, UNIT.POUT
Start Version	M_01-00-00-000

Description

If you define a special position unit with UNIT.PLINEAR and UNIT.POUT, then you can give this unit a descriptive name. You can name the unit anything you wish, as long as the name is limited to 16 characters and includes no spaces. The label used for velocity and acceleration are in terms of this descriptive name.

This parameter is descriptive only and does not influence drive internal functions in any way.

Related Topics

10 Selecting Units for Your Application

59.4 UNIT.PIN

General Information	
Type	NV Parameter
Description	Sets gear IN for the unit conversion.
Units	User units
Range	0 to 4,294,967,295
Default Value	100
Data Type	Integer
See Also	UNIT.POUT
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CANopen	35CAh/0 6092h/1	M_01-00-00-000
Modbus	780	M_01-03-00-000

Description

UNIT.PIN is used in conjunction with UNIT.POUT to set application specific units. This parameter is used as follows in the drive unit conversion:

- For position, this parameter sets the units as [custom units]/rev.
- For velocity, this parameter sets the units as [custom units]/s.
- For acceleration/deceleration, this parameter sets the units as [custom units]/s^2.

Related Topics

10 Selecting Units for Your Application

59.5 UNIT.PLINEAR

General Information	
Type	NV Parameter
Description	Sets the linear position units.
Units	N/A
Range	0 to 4
Default Value	0
Data Type	Integer
See Also	PL.FB, PL.CMD, MOTOR.TYPE
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	782	M_01-03-00-000

Description

UNIT.PLINEAR sets the units type for the position parameters when the motor type (MOTOR.TYPE) is linear.

Type	Description
0	32-bit counts
1	Millimeters (mm)
2	Micrometers (µm)
3	(PLINEAR/POUT) per revolution
4	16-bit counts

Related Topics

10 Selecting Units for Your Application

59.6 UNIT.POUT

General Information	
Type	NV Parameter
Description	Sets gear out for the unit conversion.
Units	User units.
Range	0 to 4,294,967,295
Default Value	20
Data Type	Integer
See Also	UNIT.PLINEAR
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CANopen	35CBh/0 6092h/2	M_01-00-00-000
Modbus	784	M_01-03-00-000

Description

UNIT.POUT is used in conjunction with UNIT.PLINEAR to set application specific units in UNIT.POUT. This parameter is used as follows in the drive unit conversion:

- For position, this parameter sets the units as [custom units]/rev.
- For velocity, this parameter sets the units as [custom units]/s.
- For acceleration/deceleration, this parameter sets the units as [custom units]/s^2.

Related Topics

10 Selecting Units for Your Application

59.7 UNIT.PROTARY

General Information	
Type	NV Parameter
Description	Sets the position units when the motor type (MOTOR.TYPE) is rotary.
Units	counts, rad, deg, custom units, 16-bit counts
Range	0 to 4
Default Value	4 16-bit counts (for firmware versions M_01-02-00-000 and above) 0 counts (for firmware version M_01-01-00-000)
Data Type	Integer
See Also	PL.FB, PL.CMD, MOTOR.TYPE
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CAN-open	3660h/0	M_01-00-00-000
Modbus	786	M_01-03-00-000

Description

UNIT.PROTARY sets the position units when the motor type (MOTOR.TYPE) is rotary.

Value	Units
0	counts
1	radians
2	degrees
3	custom units
4	16-bit counts

Related Topics

10 Selecting Units for Your Application

59.8 UNIT.VLINEAR

General Information	
Type	NV Parameter
Description	Sets the linear velocity units.
Units	N/A
Range	0 to 3
Default Value	0
Data Type	Integer
See Also	VL.FB, VL.CMDU, VL.CMD, MOTOR.TYPE
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	788	M_01-03-00-000

Description

UNIT.VLINEAR sets the units type for the velocity parameters when the motor type (MOTOR.TYPE) is linear.

Type	Description
0	(custom units) per second
1	Micrometers per second
2	Millimeters per second
3	Counts per second

Related Topics

10 Selecting Units for Your Application

59.9 UNIT.VROTARY

General Information	
Type	NV Parameter
Description	Sets the velocity units when the motor type (MOTOR.TYPE) is rotary.
Units	rpm, rps, deg/s, (custom units)/s
Range	0 to 3
Default Value	0 rpm
Data Type	Integer
See Also	VL.FB, VL.CMDU, VL.CMD, MOTOR.TYPE
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CAN-open	365Fh/0	M_01-00-00-000
Modbus	790	M_01-03-00-000

Description

UNIT.VROTARY sets the velocity units when the motor type (MOTOR.TYPE) is rotary.

Value	Units
0	rpm
1	rps
2	deg/s
3	(custom units)/s

Related Topics

10 Selecting Units for Your Application

60 VBUS Parameters

This section describes the VBUS parameters.

60.1 VBUS.HALFVOLT

General Information	
Type	NV Parameter
Description	Changing voltage thresholds for HV and MV Drives
Units	N/A
Range	0 to 1
Default Value	0
Data Type	Integer
See Also	N/A
Start Version	M_01-04-01-000

Description

This parameter is used in order to change some specific voltage thresholds in order to allow HV (high voltage) Drives working with MV (medium voltage) thresholds and to allow MV (medium voltage) Drives working with LV (low voltage) thresholds.

This parameter has an impact on the following voltage-thresholds:

1) DC-bus over-voltage threshold (see VBUS.OVFTHRESH).

2) The regen-resistor enable/disable voltage thresholds.

3) The inrush-relay enable/disable voltage thresholds.

A power-cycle is needed after changing the value of VBUS.HALFVOLT and after saving the parameter on the NV memory of the Drive, since the voltage thresholds mentioned above are read during the boot-sequence of the Drive.

The VBUS.HALFVOLT command takes only effect for a HV or MV Drive.

VBUS.HALFVOLT = 0: The original voltage thresholds are used for the functions mentioned above.

VBUS.HALFVOLT = 1: Setting the parameter to 1 on a HV Drive causes the AKD to use the voltage thresholds of a MV Drive for the functions mentioned above. Setting the parameter to 1 on a MV Drive causes the AKD to use the voltage thresholds of a LV Drive for the functions mentioned above.

The sequence must be as follows:

1) Change the value of VBUS.HALFVOLT.

2) Trigger a DRV.NVSAVE command.

3) Power cycle the Drive in order to activate the new configuration.

Note

The DC-bus under voltage fault threshold (see VBUS.UVFTHRESH) is a user selectable command. It means that the user is responsible for setting the under voltage threshold to a proper value in case that the AKD is supplied with a lower DC-bus voltage than the rated voltage.

60.2 VBUS.OVFTHRESH

General Information	
Type	R/O Parameter
Description	Reads the over voltage fault level.
Units	Vdc
Range	0 to 900 Vdc
Default Value	N/A
Data Type	Integer
See Also	VBUS.UVFTHRESH
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	794	M_01-03-00-000

Description

VBUS.OVFTHRESH reads the over voltage fault level for the DC bus.

This value is read from the drive EEPROM and varies according to the drive type.

Related Topics

7.2 Regeneration

60.3 VBUS.OVWTHRESH

General Information	
Type	NV Parameter
Description	Sets voltage level for over voltage warning.
Units	Vdc
Range	0 to 900 Vdc
Default Value	0 Vdc (warning disabled)
Data Type	U16
See Also	N/A
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	796	M_01-03-00-000

Description

If VBUS.VALUE value exceeds VBUS.OVWTHRESH, then a warning is generated.

Related Topics

7.2 Regeneration

60.4 VBUS.RMSLIMIT

General Information	
Type	R/O Parameter
Description	Reads the limit for the bus capacitors load.
Units	Vrms
Range	N/A
Default Value	N/A
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	798	M_01-03-00-000

Description

This parameter reads the limit of the bus capacitor load. When the bus capacitor loads exceeds this limit, the drive generates fault F503.

Excessive bus capacitor load may indicate a disconnected main supply phase.

Related Topics

7.2 Regeneration

60.5 VBUS.UVFTHRESH

General Information	
Type	R/W Parameter
Description	Sets the under voltage fault level.
Units	Vdc
Range	90 to 420 Vdc
Default Value	90 Vdc
Data Type	Integer
See Also	VBUS.OVFTHRESH
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	800	M_01-03-00-000

Description

VBUS.UVFTHRESH sets the undervoltage fault level of the DC bus.

The default value is read from the EEPROM, but can by modified by the user and stored on the NV RAM. This value varies according to drive type.

Related Topics

7.2 Regeneration

60.6 VBUS.UVMODE

General Information	
Type	N/V Parameter
Description	Indicates undervoltage (UV) mode.
Units	N/A
Range	0 to 1
Default Value	1
Data Type	Boolean
See Also	N/A
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	802	M_01-03-00-000

Description

This parameter indicates undervoltage (UV) mode.

When VBUS.UVMODE - 0, an undervoltage fault is issued whenever the DC bus goes below the undervoltage threshold.

When VBUS.UVMODE = 1, an undervoltage fault is issued whenever the DC bus goes below the

under voltage threshold and the controller attempts to enable the drive (software or hardware enable).

Related Topics

7.2 Regeneration

60.7 VBUS.UVWTHRESH

General Information	
Type	NV Parameter
Description	Sets voltage level for undervoltage warning.
Units	Vdc
Range	0 to 900 Vdc
Default Value	10 volts above the default value of the under voltage fault threshold (VBUS.UVFTHRESH). The default value of VBUS.UVFTHRESH is hardware dependent.
Data Type	U16
See Also	VBUS.UVFTHRESH
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	804	M_01-03-00-000

Description

If VBUS.VALUE value drops below VBUS.UVWTHRESH, then a warning is generated.

Related Topics

7.2 Regeneration

60.8 VBUS.VALUE

General Information	
Type	R/O Parameter
Description	Reads DC bus voltage.
Units	Vdc
Range	0 to 900 Vdc
Default Value	N/A
Data Type	Float
See Also	N/A
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CANopen	361Ah/0	M_01-00-00-000
Modbus	806	M_01-03-00-000

Description

VBUS.VALUE reads the DC bus voltage.

Related Topics

7.2 Regeneration

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61 VL Parameters

This section describes the VL parameters.

61.1 VL.ARPF1 TO VL.ARPF4

General Information	
Type	R/W Parameter
Description	Sets the natural frequency of the pole (denominator) of anti-resonance (AR) filters 1, 2, 3, and 4; active in opmodes 1 (velocity) and 2 (position) only.
Units	Hz
Range	5 to 5,000 Hz
Default Value	500 Hz
Data Type	Float
See Also	VL.ARPQ1 TO VL.ARPQ4, VL.ARZF1 TO VL.ARZF4, Sets the Q of the zero (numerator) of anti-resonance filter #1; active in opmodes 1 (velocity) and 2 (position) only.
Start Version	M_01-02-00-000

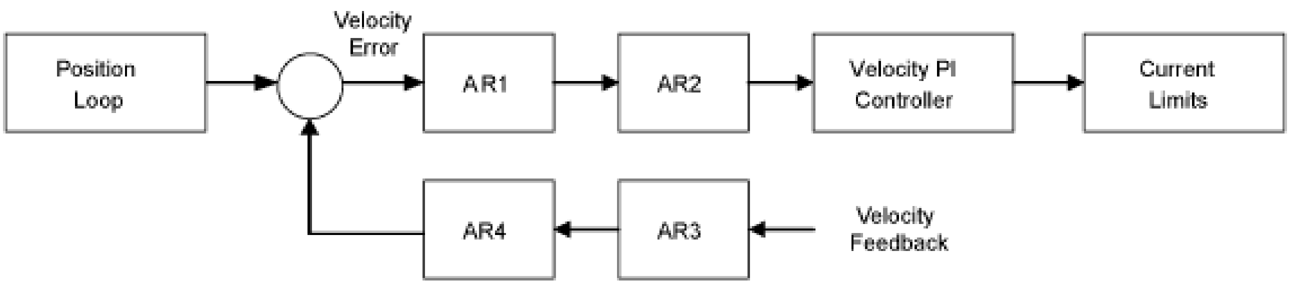
Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CANopen	3406h/1 VL.ARPF1 3406h/2 VL.ARPF2 3406h/3 VL.ARPF3 3406h/4 VL.ARPF4	M_01-02-00-000
Modbus	808 VL.ARPF1 810 VL.ARPF2 812 VL.ARPF3 814 VL.ARPF4	M_01-03-00-000

Description

VL.ARPF1 sets the natural frequency of the pole (denominator) of AR filter 1. This value is F_P in the approximate transfer function of the filter:

$$ARx(s) = [s^2/(2\pi F_Z)^2 + s/(Q_Z 2\pi F_Z) + 1] / [s^2/(2\pi F_P)^2 + s/(Q_P 2\pi F_P) + 1]$$

The following block diagram describes the AR filter function; note that AR1 and AR2 are in the forward path, while AR3 and AR4 are applied to feedback:



AR1, AR2, AR3, and AR4 are used in velocity and position mode, but are disabled in torque mode.

Discrete time transfer function (applies to all AR filters)

The velocity loop compensation is actually implemented as a digital discrete time system function on the DSP. The continuous time transfer function is converted to the discrete time domain by a backward Euler mapping:

$\mathbf{s} \approx (1-z^{-1})/t$, where $t = 62.5$ µs

The poles are prewarped to F_P and the zeros are prewarped to F_Z.

Related Topics

12.4 Velocity Loop

61.2 VL.ARPQ1 TO VL.ARPQ4

General Information	
Type	R/W Parameter
Description	Sets the Q of the pole (denominator) of anti-resonance (AR) filter 1; active in opmodes 1 (velocity) and 2 (position) only.
Units	None
Range	0.2 to 20
Default Value	0.5
Data Type	Float
See Also	VL.ARPF1 TO VL.ARPF4, VL.ARZF1 TO VL.ARZF4, VL.ARZQ1 TO VL.ARZQ4
Start Version	M_01-02-00-000

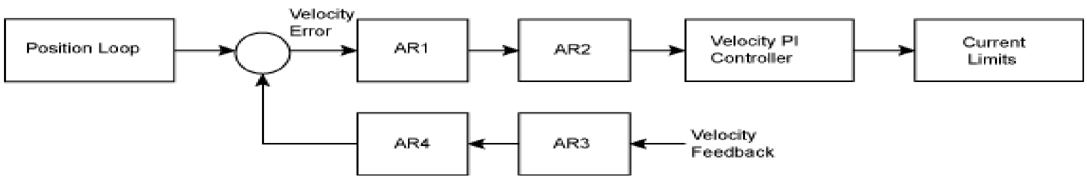
Fieldbus	Index/Subindex		Object Start Version
EtherCAT COE and CANopen	3406h/5	VL.ARPQ1	M_01-02-00-000
	3406h/6	VL.ARPQ2	
	3406h/7	VL.ARPQ3	
	3406h/8	VL.ARPQ4	
Modbus	816	VL.ARPQ1	M_01-03-00-000
	818	VL.ARPQ2	
	820	VL.ARPQ3	
	822	VL.ARPQ4	

Description

VL.ARPQ1 sets the Q (quality factor) of the pole (denominator) of AR filter 1. This value is Q_P in the approximate transfer function of the filter:

$$ARx(\mathbf{s}) = [\mathbf{s}^2/(2\pi F_Z)^2+\mathbf{s}/(Q_Z 2\pi F_Z) + 1]/ [\mathbf{s}^2/(2\pi F_P)^2 +\mathbf{s}/(Q_P 2\pi F_P) + 1]$$

The following block diagram describes the AR filter function; note that AR1 and AR2 are in the forward path, while AR3 and AR4 are applied to feedback:



AR1, AR2, AR3, and AR4 are used in velocity and position mode, but are disabled in torque mode.

Discrete time transfer function (applies to all AR filters)

The velocity loop compensation is actually implemented as a digital discrete time system function on the DSP. The continuous time transfer function is converted to the discrete time domain by a backward Euler mapping:

$\mathbf{s} \approx (1-z^{-1})/t$, where $t = 62.5$ µs

The poles are prewarped to F_P and the zeros are prewarped to F_Z.

Related Topics

12.4 Velocity Loop

61.3 VL.ARTYPE1 TO VL.ARTYPE4

General Information	
Type	NV Parameter
Description	Indicates the method used to calculate BiQuad coefficients; active in opmodes 1 (velocity) and 2 (position) only.
Units	N/A
Range	0
Default Value	0
Data Type	U8
See Also	N/A
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex		Object Start Version
EtherCAT COE and CAN-open	3405h /1	VL.ARTYPE1	M_01-00-00-000
	3405h /2	VL.ARTYPE2	
	3405h /3	VL.ARTYPE3	
	3405h /4	VL.ARTYPE4	
Modbus	824	VL.ARTYPE1	M_01-03-00-000
	826	VL.ARTYPE2	
	828	VL.ARTYPE3	
	830	VL.ARTYPE4	

Description

These parameters indicate the method used to calculate the biquad coefficients VL.ARPFx, VL.ARPQx, VL.ARZFx, and VL.ARZQx. A value of 0 indicates that the coefficients are set directly. This parameter has no effect on the filter itself, but is only used to determine the original design parameters. Currently, only the value of 0 is supported.

Related Topics

12.4 Velocity Loop

61.4 VL.ARZF1 TO VL.ARZF4

General Information	
Type	R/W Parameter
Description	Sets the natural frequency of the zero (numerator) of anti-resonance (AR)filter 1; active in opmodes 1 (velocity) and 2 (position) only.
Units	Hz
Range	5 to 5,000 Hz
Default Value	500 Hz
Data Type	Float
See Also	VL.ARPF1 TO VL.ARPF4,VL.ARPQ1 TO VL.ARPQ4, VL.ARZQ1 TO VL.ARZQ4
Start Version	M_01-02-00-000

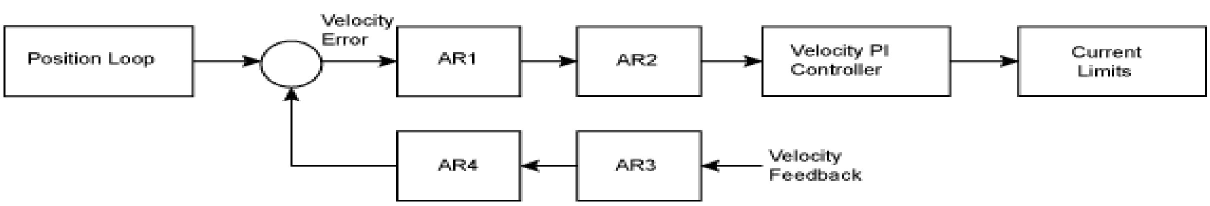
Fieldbus	Index/Subindex		Object Start Version
EtherCAT COE and CANopen	3406h /9	VL.ARZF1	M_01-02-00-000
	3406h /A	VL.ARZF2	
	3406h /B	VL.ARZF3	
	3406h /C	VL.ARZF4	
Modbus	832	VL.ARZF1	M_01-03-00-000
	834	VL.ARZF2	
	836	VL.ARZF3	
	838	VL.ARZF4	

Description

VL.ARZF1 sets the natural frequency of the zero (numerator) of AR filter 1. This value is F_Z in the approximate transfer function of the filter:

$$ARx(\mathbf{s}) = [\mathbf{s}^2/(2\pi F_Z)^2 + \mathbf{s}/(Q_Z 2\pi F_Z) + 1] / [\mathbf{s}^2/(2\pi F_P)^2 + \mathbf{s}/(Q_P 2\pi F_P) + 1]$$

The following block diagram describes the AR filter function; note that AR1 and AR2 are in the forward path, while AR3 and AR4 are applied to feedback:



AR1, AR2, AR3, and AR4 are used in velocity and position mode, but are disabled in torque mode.

Discrete time transfer function (applies to all AR filters)

The velocity loop compensation is actually implemented as a digital discrete time system function on the DSP. The continuous time transfer function is converted to the discrete time domain by a backward Euler mapping:

s ≈ $(1-z^{-1})/t$, where t = 62.5 µs

The poles are prewarped to F_P and the zeros are prewarped to F_Z.

Related Topics

12.4 Velocity Loop

61.5 VL.ARZQ1 TO VL.ARZQ4

General Information	
Type	R/W Parameter
Description	Sets the Q of the zero (numerator) of anti-resonance filter #1; active in opmodes 1 (velocity) and 2 (position) only.
Units	N/A
Range	0.1 to 5
Default Value	0.5
Data Type	Float
See Also	VL.ARPF1 TO VL.ARPF4, VL.ARPQ1 TO VL.ARPQ4, VL.ARZF1 TO VL.ARZF4
Start Version	M_01-02-00-000

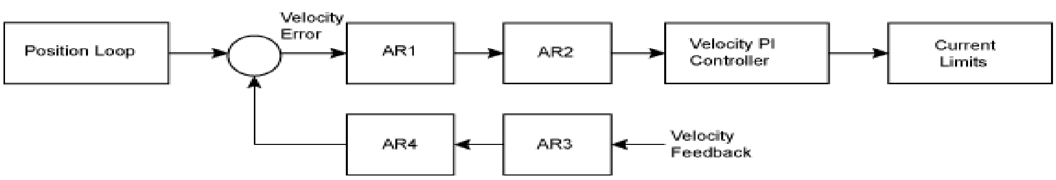
Fieldbus	Index/Subindex		Object Start Version
EtherCAT COE and CANopen	3406h/D	VL.ARZQ1	M_01-02-00-000
	3406h/E	VL.ARZQ2	
	3406h/F	VL.ARZQ3	
	3406h/10	VL.ARZQ4	
Modbus	832	VL.ARZQ1	M_01-03-00-000
	834	VL.ARZQ2	
	836	VL.ARZQ3	
	838	VL.ARZQ4	

Description

VL.ARZQ1 sets the Q (quality factor) of the zero (numerator) of AR filter 1. This value is Q_Z in the approximate transfer function of the filter:

$$AR1(\mathbf{s}) = [\mathbf{s}^2/(2\pi F_Z)^2+\mathbf{s}/(Q_Z 2\pi F_Z) + 1]/ [\mathbf{s}^2/(2\pi F_P)^2 +\mathbf{s}/(Q_P 2\pi F_P) + 1]$$

The following block diagram describes the AR filter function; note that AR1 and AR2 are in the forward path, while AR3 and AR4 are applied to feedback:



AR1, AR2, AR3 and AR4 are used in velocity and position mode, but are disabled in torque mode.

Discrete time transfer function (applies to all AR filters)

The velocity loop compensation is actually implemented as a digital discrete time system function on the DSP. The continuous time transfer function is converted to the discrete time domain by a backward Euler mapping:

$\mathbf{s} \approx (1-z^{-1})/t$, where $t = 62.5\ \mu s$.

The poles are prewarped to F_P and the zeros are prewarped to F_Z.

Related Topics

12.4 Velocity Loop

61.6 VL.BUSFF

General Information	
Type	R/O Parameter
Description	Displays the velocity loop feedforward value injected by the field-bus; active in opmodes 1 (velocity) and 2 (position) only.
Units	Depends on UNIT.VROTARY or UNIT.VLINEARUNIT.ACCLINEAR Rotary: rpm, rps, deg/s, (custom units)/s, rad/s Linear: counts/s, mm/s, µm/s, (custom units)/s
Range	0.0 to VL.LIMITP
Default Value	0.0
Data Type	Float
See Also	VL.FF, VL.KBUSFF
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CAN-open	60B1h/0	M_01-00-00-000
Modbus	848	M_01-03-00-000

Description

This parameter displays the velocity loop feedforward value injected by the fieldbus.

Related Topics

12.4 Velocity Loop

61.7 VL.CMD

General Information	
Type	R/O Parameter
Description	Reads the actual velocity command; active in opmodes 1 (velocity) and 2 (position) only.
Units	Depends on UNIT.VROTARY or UNIT.VLINEARUNIT.ACCLINEAR Rotary: rpm, rps, deg/s, (custom units)/s, rad/s Linear: counts/s, mm/s, µm/s, (custom units)/s
Range	N/A
Default Value	N/A
Data Type	Float
See Also	VL.FB, VL.CMDU, VL.LIMITP, VL.LIMITN
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CANopen	606Bh/0	M_01-00-00-000
Modbus	850	M_01-03-00-000

Description

VL.CMD returns the actual velocity command as it is received in the velocity loop entry after all velocity limits (such as VL.LIMITN and VL.LIMITP). See velocity loop design diagram for more details.

Related Topics

11.4 Analog Input

12.4 Velocity Loop

12.5 Position Loop

22 Block Diagrams

61.8 VL.CMDU

General Information	
Type	R/W Parameter
Description	Sets the user velocity command; active in opmodes 1 (velocity) and 2 (position) only.
Units	Depends on UNIT.VROTARY or UNIT.VLINEARUNIT.ACCLINEAR Rotary: rpm, rps, deg/s, custom units/s, rad/s Linear: counts/s, mm/s, µm/s, custom units/s
Range	Rotary -15,000.000 to 15,000.000 rpm -250.000 to 250.000 rps -90000.000 to 90000.000 deg/s -1250.000 to 1250.000 custom units/s -1570.796 to 1570.796 rad/s Linear -1,073,741,824,000.000 to 1,073,741,824,000.000 counts/s -8,000.000 to 8,000.000 mm/s -8,000,000.000 to 8,000,000.000 µm/s -1,250.000 to 1,250.000 custom units/s
Default Value	0
Data Type	Float
See Also	VL.FB, VL.CMD, DRV.OPMODE, DRV.CMDSOURCE, VL.LIMITN, VL.LIMITP
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CANopen	60FFh/0	M_01-00-00-000
Modbus	852	M_01-03-00-000

Description

VL.CMDU sets the user velocity command.

When DRV.OPMODE is set to 1 (velocity loop) and DRV.CMDSOURCE is set to 0 (TCP/IP channel), then setting this value when the drive is enabled will cause the drive to rotate at the required velocity.

Related Topics

12.4 Velocity Loop

61.9 VL.ERR

General Information	
Type	R/O Parameter
Description	Sets the velocity error; active in opmodes 1 (velocity) and 2 (position) only.
Units	Depends on UNIT.VROTARY or UNIT.VLINEAR Rotary: rpm, rps, deg/s, (custom units)/s, rad/s Linear: counts/s, mm/s, µm/s, (custom units)/s
Range	N/A
Default Value	N/A
Data Type	Float
See Also	VL.CMD, VL.FB
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CAN-open	3407h/4	M_01-00-00-000
Modbus	854	M_01-03-00-000

Description

VL.ERR sets the velocity error. It is calculated in the velocity loop as the difference between VL.CMD and VL.FB.

Related Topics

12.4 Velocity Loop

61.10 VL.FB

General Information	
Type	R/O Parameter
Description	Reads the velocity feedback; active in opmodes 1 (velocity) and 2 (position) only.
Units	Depends on UNIT.VROTARY or UNIT.VLINEARUNIT.ACCLINEAR Rotary: rpm, rps, deg/s, (custom units)/s, rad/s Linear: counts/s, mm/s, µm/s, (custom units)/s
Range	N/A
Default Value	N/A
Data Type	Float
See Also	VL.CMDU
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CANopen	3618h/0 606Ch/0	M_01-00-00-000
Modbus	856	M_01-03-00-000

Description

VL.FB returns the velocity feedback as it is received in the velocity loop, after passing through Filter 3 and Filter 4.

Related Topics

12.4 Velocity Loop

61.11 VL.FBFILTER

General Information	
Type	R/O Parameter
Description	Filters VL.FB value; active in opmodes 1 (velocity) and 2 (position) only.
Units	Depends on UNIT.VROTARY or UNIT.VLINEAR Rotary: rpm, rps, deg/s, (custom units)/s, rad/s Linear: counts/s, mm/s, µm/s, (custom units)/s
Range	N/A
Default Value	N/A
Data Type	Float
See Also	VL.FB
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CAN-open	3407h/1	M_01-00-00-000
Modbus	858	M_01-03-00-000

Description

This parameter returns the same value as VL.FB, filtered through a 10 Hz filter.

Related Topics

12.4 Velocity Loop

61.12 VL.FBSOURCE

General Information	
Type	NV Parameter
Description	Sets feedback source for the velocity loop; active in opmodes 1 (velocity) and 2 (position) only.
Units	N/A
Range	0 to 1
Default Value	0
Data Type	Boolean
See Also	PL.FBSOURCE
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	860	M_01-03-00-000

Description

This parameter determines the feedback source to be used by the velocity loop. A value of 0 selects the primary feedback, 1 selects the secondary feedback.

Related Topics

12.4 Velocity Loop

61.13 VL.FBUNFILTERED

General Information	
Type	R/O Parameter
Description	Reads the velocity feedback.
Units	Depends on UNIT.VROTARY or UNIT.VLINEAR, UNIT.ACCLINEAR Rotary: rpm, rps, deg/s, (custom units)/s, rad/s Linear: counts/s, mm/s, µm/s, (custom units)/s
Range	N/A
Default Value	N/A
Data Type	Float
See Also	VL.FB, VL.FBFILTER
Start Version	M_01-03-06-000

Description

VL.FBUNFILTERED reads the raw velocity feedback before any filters affect the value of this feedback.

Related Topics

Velocity Loop

61.14 VL.FF

General Information	
Type	R/O Parameter
Description	Displays the velocity loop overall feedforward value; active in opmodes 1 (velocity) and 2 (position) only.
Units	Depends on UNIT.ACCROTARY or UNIT.ACCLINEAR Rotary: rpm, rps, deg/s, (custom units)/s, rad/s Linear: counts/s, mm/s, µm/s, (custom units)/s
Range	0 to VL.LIMITP
Default Value	0
Data Type	Float
See Also	VL.KBUSFF
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	862	M_01-03-00-000

Description

This parameter displays the velocity loop overall feedforward value.

Related Topics

12.4 Velocity Loop

VL.KVFF

61.15 VL.GENMODE

General Information	
Type	NV Parameter
Description	Selects mode of velocity generation (Observer, d/dt); active in opmodes 1 (velocity) and 2 (position) only.
Units	N/A
Range	0 to 1
Default Value	0
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	864	M_01-03-00-000

Description

This parameter is used to select the velocity generator mode.

Mode	Description
0	d/dt mode: The derivative of the mechanical angle of the drive is fed to a first order low pass.
1	Luenberger Observer mode

Related Topics

12.4 Velocity Loop

61.16 VL.KBUSFF

General Information	
Type	R/W Parameter
Description	Sets the velocity loop acceleration feedforward gain value; active in opmodes 1 (velocity) and 2 (position) only.
Units	NA
Range	0.0 to 2.0
Default Value	0.0
Data Type	Float
See Also	VL.BUSFF
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CANopen	3407h/3	M_01-00-00-000
Modbus	866	M_01-03-00-000

Description

This parameter sets the gain for the acceleration feedforward (a scaled second derivative of the position command is added to the velocity command value).

The nominal feedforward value can be multiplied by this gain value.

This will have affect only when using position mode (DRV.OPMODE = 2).

Related Topics

12.4 Velocity Loop

61.17 VL.KI

General Information	
Type	NV Parameter
Description	Sets the velocity loop integral gain for the PI controller; active in opmodes 1 (velocity) and 2 (position) only.
Units	Hz
Range	0 to 1,000 Hz
Default Value	160 Hz
Data Type	Float
See Also	VL.KP
Start Version	M_01-00-00-000

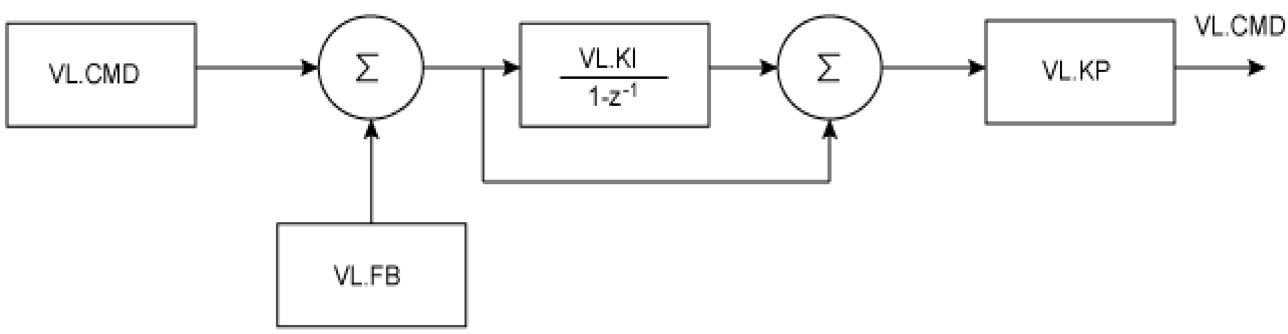
Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CANopen	354Dh/0	M_01-00-00-000
Modbus	868	M_01-03-00-000

Description

VL.KI sets the integral gain of the velocity loop.

A factor of 2π is included in the time calculation, therefore a PI velocity loop with a constant error of 1 rps in which VL.KI is set to 160 and VL.KP is set to 1, will take (1000/160)*2π ms to increase the integral gain to 1. Therefore, the total gain is 2 at this time (see velocity loop structure below).

Velocity Loop Structure



Related Topics

12.4 Velocity Loop

61.18 VL.KO

General Information	
Type	R/W Parameter
Description	Scales the observer velocity signal; active in opmodes 1 (velocity) and 2 (position) only.
Units	Internal
Range	0 to 65,535
Default Value	0
Data Type	Float
See Also	VL.MODEL
Start Version	M_01-00-01-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	870	M_01-03-00-000

Description

VL.KO is used to scale the observer model to match the load. When VL.KO is tuned properly, Reads the observer velocity signal; active in opmodes 1 (velocity) and 2 (position) only. will match VL.FB, except when there is an unspecified offset between the two.

Related Topics

12.4 Velocity Loop

61.19 VL.KP

General Information	
Type	NV Parameter
Description	Sets velocity loop proportional gain for the PI controller; active in opmodes 1 (velocity) and 2 (position) only.
Units	A/(rad/sec)
Range	0.001 to 2,147,483.008
Default Value	1
Data Type	Float
See Also	VL.KI
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CANopen	3548h/0	M_01-00-00-000
Modbus	872	M_01-03-00-000

Description

VL.KP sets the proportional gain of the velocity loop.

The idealized velocity loop bandwidth in Hz is:

Rotary motor:

Bandwidth (Hz) = VL.KP *K_t/ (2π *J_m)

Where:

K_t= motor torque constant, in units of Nm/Arms

J_m = motor inertia, in units of kg*m²

Linear motor:

Bandwidth (Hz) = VL.KP * K_t / (Motor Pitch (mm) * J_m)

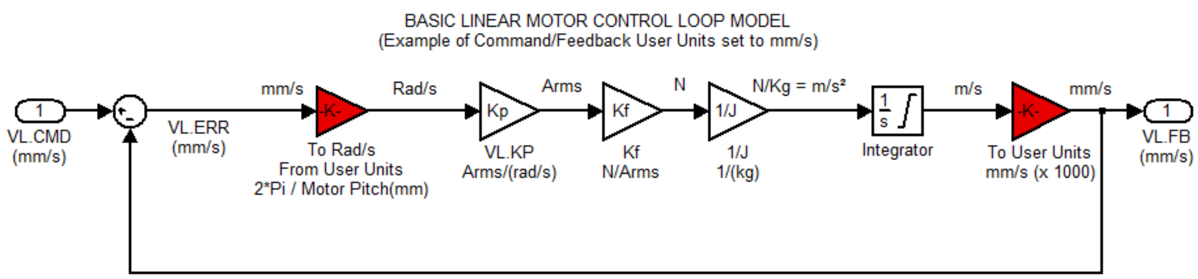
Where:

K_t= motor torque constant, in units of Nm/Arms

J_m = motor inertia, in units of kg

The drive uses the same control loop for both linear and rotary motors. VL.KP units are in Arms /(rad/s). If you want to tune in units of Arms/(mm/s), then you must manually convert the units.

The diagram below shows how linear motors are implemented at the control loop level.



The red blocks are automatically handled at the drive level.

2π radians is the linear equivalent of one full mechanical revolution of a rotary motor - and is equal to the MOTOR.PITCH of a linear motor.

Example

To convert VL.KP = 0.320 Arms/(rad/s) to Arms/(mm/s), where MOTOR.PITCH is 32 mm:

```
VL.KP = 0.320 Arm /rad/s * (2π rad / 32mm MOTOR.PITCH)
VL.KP = 0.32 * 2π / 32 = 0.063 Arms / (mm/s)
```

Related Topics

Velocity Controller Environment Block Diagram

61.20 VL.KVFF

General Information	
Type	R/W Parameter
Description	Sets the velocity loop velocity feedforward gain value; active in opmodes 1 (velocity) and 2 (position) only.
Units	NA
Range	0.0 to 2.0
Default Value	0.0
Data Type	Float
See Also	VL.FF
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CANopen	3407h/2 354Bh/0	M_01-00-00-000
Modbus	874	M_01-03-00-000

Description

This parameter sets the gain for the velocity feedforward (a scaled derivative of the position command is added to the velocity command value). The nominal feedforward value can be multiplied by this gain value.

This parameter is only used in the position mode (DRV.OPMODE = 2).

Related Topics

12.4 Velocity Loop

61.21 VL.LIMITN

General Information	
Type	NV Parameter
Description	Sets the velocity lower limit; active in opmodes 1 (velocity) and 2 (position) only.
Units	Depends on UNIT.VROTARY or UNIT.VLINEAR Rotary: rpm, rps, deg/s, custom units/s, rad/s Linear: counts/s, mm/s, µm/s, custom units/s
Range	Rotary: -15,000.000 to 0.000 rpm -250.000 to 0.000 rps -90,000.000 to 0.000 deg/s -1,250.000 to 0.000 custom units/s -1570.796 to 0.000 rad/s Linear: -1,073,741,824,000.000 to 0.000 counts/s -250.000*MOTOR.PITCH to 0.000 mm/s -250,000.000*MOTOR.PITCH to 0.000 µm/sec -1,250.000 to 0.000 custom units/s
Default Value	Rotary: -3,000.000 rpm -50.000 rps -18,000.002 deg/s -250.000 (custom units)/s -314.159 rad/s Linear: -0.050 counts/s -50*MOTOR.PITCH mm/s -50,000.004*MOTOR.PITCH µm/sec -250.000 custom units/s
Data Type	Float
See Also	VL.LIMITP, VL.CMD
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CAN-open	3623h/0	M_01-00-00-000
Modbus	876	M_01-03-00-000

Description

VL.LIMITN sets the velocity command negative limit.

If the input to the velocity loop is lower than VL.LIMITN, then the actual velocity command VL.CMD is limited by the value of VL.LIMITN.

Related Topics

12.4 Velocity Loop

61.22 VL.LIMITP

General Information	
Type	NV Parameter
Description	Sets the velocity high limit; active in opmodes 1 (velocity) and 2 (position) only.
Units	Depends on UNIT.VROTARY or UNIT.VLINEAR Rotary: rpm, rps, deg/s, custom units/s, rad/s Linear: counts/s, mm/s, µm/s, custom units/s
Range	Rotary: 0.000 to 15,000.000 rpm 0.000 to 250.000 rps 0.000 to 90,000.000 deg/s 0.000 to 1,250.000 custom units/s 0.000 to 1570.796 rad/s Linear: 0.000 to 1,073,741,824,000.000 counts/s 0.000 to 250.000*MOTOR.PITCH mm/sec 0.000 to 250,000.000*MOTOR.PITCH µm/s 0.000 to 1,250.000 custom units/s
Default Value	Rotary: 3,000.000 rpm 50.000 rps 18,000.002 deg/s 250.000 (custom units)/s 314.159 rad/s Linear: 0.050 counts/s 50.000*MOTOR.PITCH mm/sec 50,000.004*MOTOR.PITCH µm/sec 250.000 custom units/s
Data Type	Float
See Also	VL.LIMITN, VL.CMD
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CAN-open	3622h/0	M_01-00-00-000
Modbus	878	M_01-03-00-000

Description

VL.LIMITP sets the velocity command positive limit.

If the input to the velocity loop is higher than VL.LIMITP, then the actual velocity command VL.CMD is limited by the value of VL.LIMITP.

Related Topics

12.4 Velocity Loop

61.23 VL.LMJR

General Information	
Type	R/W Parameter
Description	Sets the ratio of the estimated load moment of inertia relative to the motor moment of inertia; active in opmodes 1 (velocity) and 2 (position) only.
Units	NA
Range	0 to 100.0
Default Value	0
Data Type	Float
See Also	IL.FF
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	880	M_01-03-00-000

Description

This parameter is used in the internal calculation of the current loop acceleration feed forward gain value.

Related Topics

12.4 Velocity Loop

61.24 VL.MODEL

General Information	
Type	R/O Parameter
Description	Reads the observer velocity signal; active in opmodes 1 (velocity) and 2 (position) only.
Units	Depends on UNIT.VROTARY or UNIT.VLINEAR, UNIT.ACCLINEAR Rotary: rpm, rps, deg/s, (custom units)/s, rad/s Linear: counts/s, mm/s, µm/s, (custom units)/s
Range	N/A
Default Value	N/A
Data Type	Float
See Also	VL.FB, VL.KO
Start Version	M_01-00-01-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	882	M_01-03-00-000

Description

VL.MODEL is the observer velocity output. When VL.KO is tuned properly, VL.MODEL will match VL.FB, except when there is an unspecified offset between the two.

Related Topics

12.4 Velocity Loop

61.25 VL.OBSBW

General Information	
Type	NV Parameter
Description	Sets the bandwidth of the observer in Hz.
Units	Hz
Range	10 to 4,000 Hz
Default Value	30 Hz
Data Type	Float
See Also	N/A
Start Version	M_01-03-00-004

Fieldbus	Index/Subindex	Object Start Version
Modbus	884	M_01-03-00-000

Description

This parameter sets the bandwidth of the observer in Hz. The observer passes the velocity feedback through a PID control loop that behaves like a low-pass filter with a bandwidth of VL.OBSBW.

Related Topics

12.4 Velocity Loop

61.26 VL.OBSMODE

General Information	
Type	NV Parameter
Description	Sets the observer operating mode.
Units	N/A
Range	0 to 1
Default Value	0
Data Type	Integer
See Also	N/A
Start Version	M_01-03-00-004

Fieldbus	Index/Subindex	Object Start Version
Modbus	886	M_01-03-00-000

Description

This parameter sets the observer operating mode. When VL.OBSMODE = 0, the observer is not part of the control loop; that is, VL.FB is used as the velocity feedback signal to the velocity loop. When VL.OBSMODE = 1, the observer is part of the control loop; VL.MODEL is used as the velocity feedback signal.

Related Topics

12.4 Velocity Loop

61.27 VL.THRESH

General Information	
Type	NV Parameter
Description	Sets the over speed fault value; active in opmodes 1 (velocity) and 2 (position) only.
Units	Depends on UNIT.VROTARY or UNIT.VLINEAR Rotary: rpm, rps, deg/s, custom units/s, rad/s Linear: counts/s, mm/s, µm/s, custom units/s
Range	Rotary: 0.000 to 15,000.000 rpm 0.000 to 250.000 rps 0.000 to 90,000.000 deg/s 0.000 to 1,250.000 custom units/s 0.000 to 1,570.796 rad/s Linear: 0.000 to 1,073,741,824,000.000 counts/s 0.000 to 250.000*MOTOR.PITCH mm/s 0.000 to 250,000.000*MOTOR.PITCHMOTOR.PITCHµm/s 0.000 to 1,250.000 custom units/s
Default Value	Rotary: 3,600 rpm 60 rps 21,600.000 deg/s 300.000 custom units/s 376.991 rad/s Linear: 0.060 counts/s 60.000*MOTOR.PITCH mm/s 60,000.04*MOTOR.PITCHMOTOR.PITCHµm/s 300.000 custom units/s
Data Type	Float
See Also	VL.CMD, VL.CMDU
Start Version	M_01-00-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CANopen	3627h/0	M_01-00-00-000
Modbus	888	M_01-03-00-000

Description

VL.THRESH sets the threshold for the velocity over which an over speed fault is generated.

The value is considered as an absolute value, hence it applies for both negative and positive velocities.

Example

VL.THRESH is set to 600 rpm. A velocity (VL.FB) of 700 rpm will generate an over speed fault.

Related Topics

12.4 Velocity Loop

62 VM Parameters

This section describes the VM parameters.

62.1 VM.STATE

General Information	
Type	R/O
Description	Returns the state of the AKD Virtual Machine.
Units	N/A
Range	0 to 5
Default Value	None
Data Type	Integer
Start Version	M_01-00-00-000

Description

VM.STATE contains the state of the Virtual Machine. The following numeric values correspond to the following states.

1. Valid program is currently being executed.
2. There is no valid program in the drive.
3. Valid program exists, not running now, but ready to go.
4. Valid program has terminated.
5. Program encountered run-time error.
6. Program is invalid (e.g. bad CRC).

63 WS Parameters

This section describes the WS parameters.

63.1 WS.ARM

General Information	
Type	Command
Description	Sets wake and shake to start at the next drive enable.
Units	N/A
Range	N/A
Default Value	N/A
Data Type	N/A
See Also	N/A
Start Version	M_01-01-00-101, M_01-02-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CANopen	3494h/6	M_01-00-00-000
Modbus	890	M_01-03-00-000

Description

This command sets wake and shake to start at the next drive enable. Feedback type is not relevant for this command. If WS.STATE is 0 and the drive is disabled, then WS.STATE will change to 1 after issuing WS.ARM. With this command, wake and shake can be repeated if desired.

Related Topics

8.3.9 Using Wake and Shake (WS)

63.2 WS.DISARM

General Information	
Type	Command
Description	Cancels ARM requests and resets wake and shake to the IDLE state.
Units	N/A
Range	N/A
Default Value	N/A
Data Type	N/A
See Also	N/A
Start Version	M_01-04-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CAN-open	N/A	
Modbus	N/A	

Description

This command disables wake and shake immediately. Feedback type is not relevant for this command. If WS.ARM has been issued, the request to execute the wake and shake algorithm at the next enable is cancelled. WS.STATE is set to IDLE.

Related Topics

8.3.9 Using Wake and Shake (WS))

63.3 WS.DISTMAX

General Information	
Type	R/W Parameter
Description	Sets maximum movement allowed for wake and shake.
Units	deg (position units)
Range	0 to 90 deg
Default Value	15 deg
Data Type	S64
See Also	N/A
Start Version	M_01-01-00-101, M_01-02-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CAN-open	3494h/2	M_01-00-00-000
Modbus	892 (64-bit)	M_01-03-00-000

Description

This parameter sets the maximum movement that is allowed for finding commutation. If this value is too small, FF475, "Wake and Shake. Too much movement", may occur before wake and shake is finished. The bigger this value, the more movement is allowed for wake and shake. This value is application dependent.

Related Topics

8.3.9 Using Wake and Shake (WS)

63.4 WS.DISTMIN

General Information	
Type	R/W Parameter
Description	Sets the minimum movement required for wake and shake.
Units	Actual position units
Range	0 to 90 deg
Default Value	1 deg
Data Type	S64
See Also	N/A
Start Version	M_01-01-00-101, M_01-02-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CAN-open	36D1h/0	M_01-00-00-000
Modbus	896 (64-bit)	M_01-03-00-000

Description

This parameter sets the minimum movement that is required for commutation finding. If this value is too small, the the commutation finding might fail if too little current is used. The larger this value, the more movement is needed in order to avoid F473: "Wake and Shake: Too little movement".

Related Topics

8.3.9 Using Wake and Shake (WS)

63.5 WS.IMAX

General Information	
Type	R/W Parameter
Description	Sets maximum current used for wake and shake.
Units	Arms
Range	0 to (lower value of MOTOR.IPEAK and DRV.IPEAK) Arms
Default Value	(half of maximum) Arms
Data Type	U16
See Also	MOTOR.IPEAK, DRV.IPEAK
Start Version	M_01-01-00-101, M_01-02-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CAN-open	3494h/1	M_01-00-00-000
Modbus	900	M_01-03-00-000

Description

This parameter defines the maximum current used for wake and shake. If the selected current is too low, the minimum required movement may not occur. If the selected current is too high, the movement may be too fast (overspeed) or too large (over maximum movement).

The maximum of this parameter is the lower value of MOTOR.IPEAK and DRV.IPEAK. The default value of this parameter is the half of its maximum. This value depends on the specific application.

Related Topics

8.3.9 Using Wake and Shake (WS)

63.6 WS.MODE

General Information	
Type	R/W Parameter
Description	Sets the method used for wake and shake.
Units	N/A
Range	0 to 1
Default Value	0
Data Type	U8
See Also	N/A
Start Version	M_01-01-00-101, M_01-02-00-000

Fieldbus	Index/Subindex	Object Start Version
Modbus	902	M_01-03-00-000

Description

This parameter sets the method used for finding commutation.

0 = Standard wake and shake

Two iterations are used to find the correct angle in this mode. Coarse (current mode) and fine (velocity mode) iterations are done in a loop (WS.NUMLOOPS times). The average angle of all loops is calculated and used.

1 = Commutation alignment by fixed commutation vector (Zero Method)

The motor poles are set to 0, current mode is activated, and WS.IMAX is applied. The angle in which the motor settles is used for commutation. Other settings are restored (such as motor poles and operation mode).

Related Topics

8.3.9 Using Wake and Shake (WS)

63.7 WS.NUMLOOPS

General Information	
Type	R/W Parameter
Description	Sets the number of repetitions for wake and shake.
Units	counts
Range	0 to 20 counts
Default Value	5 counts
Data Type	U8
See Also	N/A
Start Version	M_01-01-00-101, M_01-02-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CAN-open	36E2h/0	M_01-00-00-000
Modbus	904	M_01-03-00-000

Description

This parameter sets the maximum number of wake and shake repetitions. MOTOR.PHASE is calculated as mean value of all wake and shake repetitions.

Related Topics

8.3.9 Using Wake and Shake (WS)

63.8 WS.STATE

General Information	
Type	R/O Parameter
Description	Reads wake and shake status
Units	N/A
Range	N/A
Default Value	Only valid before the first enable occurs. 11 - for feedback types that do not require wake and shake 1 - for feedback types that require wake and shake
Data Type	U8
See Also	N/A
Start Version	M_01-01-00-101, M_01-02-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CAN-open	3494h/5	M_01-00-00-000
Modbus	906	M_01-03-00-000

Description

WS switches different current vectors and records position feedback in order to establish commutation alignment.

WS.STATE 0 = wake and shake successful (DONE).

WS.STATE 1 = wake and shake configured and will be done at next enable (ARMED).

WS.STATE 2 = wake and shake running. (ACTIVE)

WS.STATE 10 = error occurred during wake and shake (ERROR).

WS.STATE 11 = wake and shake not required (IDLE).

Related Topics

8.3.9 Using Wake and Shake (WS)

63.9 WS.T

General Information	
Type	R/W Parameter
Description	Sets wake and shake current-vector appliance time
Units	ms
Range	1 to 200 ms
Default Value	2 ms
Data Type	U8
See Also	WS.IMAX, WS.DISTMAX
Start Version	M_01-01-00-101, M_01-02-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CAN-open	36D0h/0	M_01-00-00-000
Modbus	908	M_01-03-00-000

Description

This parameter defines the duration for each different current-vector while the coarse angle calculation. The move distance is proportional to the WS.T and WS.IMAX value.

Related Topics

8.3.9 Using Wake and Shake (WS)

63.10 WS.TDELAY1

General Information	
Type	NV Parameter
Description	Delay for wake and shake timing
Units	ms
Range	0 to 200 ms
Default Value	5 ms
Data Type	U8
See Also	N/A
Start Version	M_01-01-00-101, M_01-02-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CAN-open	3683h/0	M_01-00-00-000
Modbus	910	M_01-03-00-000

Description

WS.TDELAY1 defines the delay time of the wake and shake function. This time is a delay time between the switching of different current vectors during the wake and shake procedure. This time should be increased in the case of movement interferences between single current vectors.

Related Topics

8.3.9 Using Wake and Shake (WS)

63.11 WS.TDELAY2

General Information	
Type	NV Parameter
Description	Sets the delay for wake and shake timing.
Units	ms
Range	0 to 200 ms
Default Value	50 ms
Data Type	U8
See Also	N/A
Start Version	M_01-01-00-101, M_01-02-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CANopen	3685h/0	M_01-00-00-000
Modbus	912	M_01-03-00-000

Description

WS.TDELAY2 defines the delay between switching from coarse angle calculation to fine angle calculation during the wake and shake procedure. This time should be increased in the case of interferences between the coarse calculation done in current mode and the fine calculation done in velocity mode. Choosing too large a value increases the wake and shake duration.

Related Topics

8.3.9 Using Wake and Shake (WS)

63.12 WS.TDELAY3

General Information	
Type	NV Parameter
Description	Sets the delay for wake and shake between loops in mode 0.
Units	ms
Range	0 to 2,000 ms
Default Value	100 ms
Data Type	U16
See Also	N/A
Start Version	M_01-01-00-102, M_01-02-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CAN-open	3494h/3	M_01-00-00-000
Modbus	914	M_01-03-00-000

Description

WS.TDELAY3 defines the delay between complete loops in mode 0 only. Decreasing this value makes the wake and shake procedure faster, but may lead to problems if the motor moves too long. Increasing this value will make wake and shake significantly longer.

Related Topics

8.3.9 Using Wake and Shake (WS)

63.13 WS.VTHRESH

General Information	
Type	NV Parameter
Description	Defines the maximum allowed velocity for Wake & Shake
Units	Depends on UNIT.VROTARY or UNIT.VLINEARUNIT.A-CCLINEAR Rotary: rpm, rps, deg/s, custom units/s, rad/s Linear: counts/s, mm/s, µm/s, custom units/s
Range	Rotary: 0.000 to 15,000.000 rpm 0.000 to 250.000 rps 0.000 to 90,000.000 degree/s 0.000 to 1,250.000 custom units/s 0.000 to 1,570.796 rad/s Linear: 0.000 to 1,073,741,824,000.000 counts/s 0.000 to 8,000.000 mm/s 0.000 to 8,000,000.000 µm/s 0.000 to 1,250.000 custom units/s
Default Value	100 rpm
Data Type	U16
See Also	N/A
Start Version	M_01-01-00-101, M_01-02-00-000

Fieldbus	Index/Subindex	Object Start Version
EtherCAT COE and CAN-open	3494h/4	M_01-00-00-000
Modbus	916	M_01-03-00-000

Description

This parameter defines the maximum allowed velocity that occurs while commutation finding is active. This supervision runs in real time, but only while wake and shake is active (WS.STATE 2 or greater, for Mode 0). If at any time while wake and shake is running a velocity higher than this value is detected, fault F478 is generated. Setting WS.VTHRESH to zero disables this feature. For Mode 1, WS.VTHRESH is only used after the initial phase-finding.

Related Topics

8.3.9 Using Wake and Shake (WS)

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About Kollmorgen

Kollmorgen is a leading provider of motion systems and components for machine builders. Through world-class knowledge in motion, industry-leading quality and deep expertise in linking and integrating standard and custom products, Kollmorgen delivers breakthrough solutions that are unmatched in performance, reliability and ease-of-use, giaving machine builders an irrefutable marketplace advantage.

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