

AKD SYSTEM CONFIGURATION WITH KOLLMORGEN DDL LINEAR MOTORS

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7/20/2018
Rev. N

This document shows the wiring requirements for connecting the DDL linear motors to the AKD servo drive. It also describes the setup procedure for configuring the AKD drive in the Workbench software.

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AKD SYSTEM CONFIGURATION WITH KOLLMORGEN DDL LINEAR MOTORS: STANDARD CONVENTION

AKD System Configuration with Kollmorgen DDL linear motors with standard convention

Overview

This procedure covers the case where the feedback (PL.FB) counts up or positive when moving the coil in the same direction as the motor lead exit. In the case the feedback counts down or negative using this convention the standard procedure can still be followed assuming your feedback type is one where wiring changes can change the sign or direction of the feedback. If your feedback type does not allow the feedback count to be resolved by wiring, please follow the conventions in Appendix A.

Feedback Types that can be inverted by wiring:

Incremental Encoder with or without Halls

Sine Encoder with or without Halls

Types that cannot be inverted:

BiSS

EnDAT

Hiperface

Hiperface DSL

Renishaw BISS C

AKD SYSTEM CONFIGURATION WITH KOLLMORGEN DDL LINEAR MOTORS: STANDARD CONVENTION

System Wiring Configuration

1. AKD System Cable Diagram

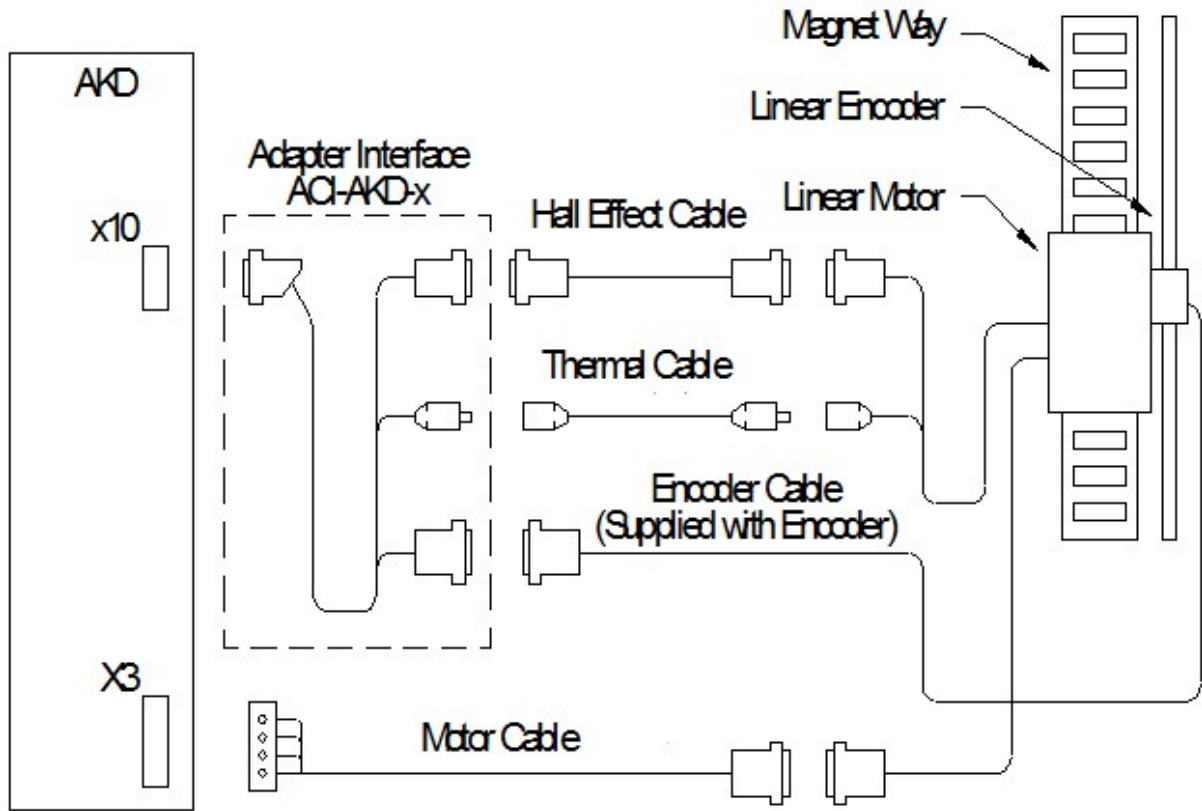
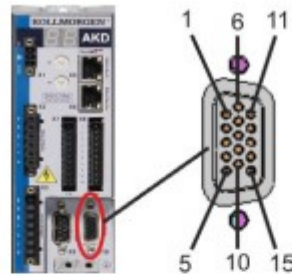


Figure 1

AKD SYSTEM CONFIGURATION WITH KOLLMORGEN DDL LINEAR MOTORS: STANDARD CONVENTION

2. AKD FEEDBACK X10

Feedback connector (X10)



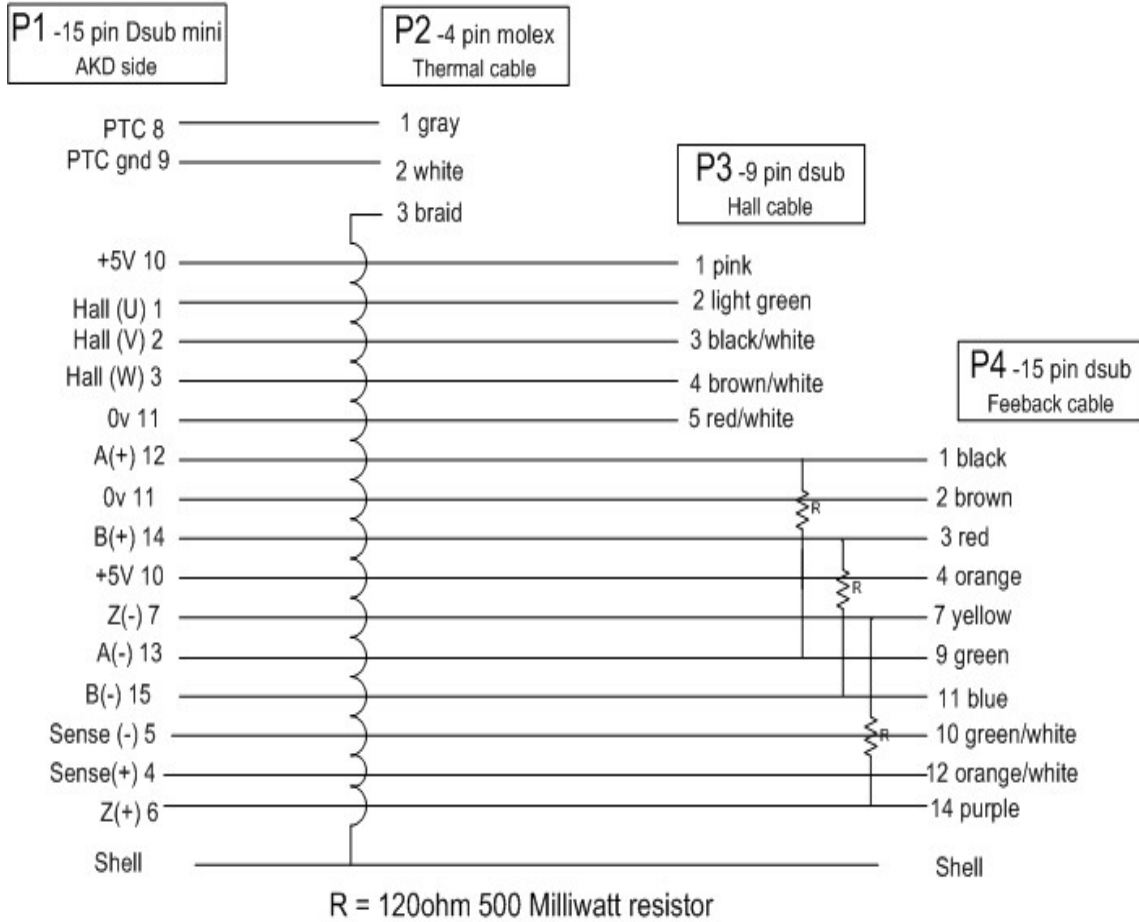
PIN	SFD	SFD3/DSL	Resolver	BiSS B (analog)	BiSS C (digital)	EnDAT 2.1	EnDAT 2.2	Hiperface	Sine Enc. +Hall	Tamagawa Smart Abs*	Incr. Enc. +Hall
1	-	-	-	-	-	-	-	-	Hall U	-	Hall U
2	-	-	-	CLK+	CLK+	CLK+	CLK+	-	Hall V	-	Hall V
3	-	-	-	CLK-	CLK-	CLK-	CLK-	-	Hall W	-	Hall W
4	SEN+	-	-	SEN+	SEN+	SEN+	SEN+	SEN+	SEN+	SEN+	SEN+
5	SEN-	-	-	SEN-	SEN-	SEN-	SEN-	SEN-	SEN-	SEN-	SEN-
6	COM+	COM+	R1 Ref+	DAT+	DAT+	DAT+	DAT+	DAT+	Zero+	SD+	Zero+
7	COM-	COM-	R2 Ref-	DAT-	DAT-	DAT-	DAT-	DAT-	Zero-	SD-	Zero-
8	-	-	Thermal control (+)								
9	-	-	Thermal control (-)								
10	+5V	+5V	-	+5V	+5V	+5V	+5V	+8 to +9 V	+5V	+5V	+5V
11	0V	0V	-	0V	0V	0V	0V	0V	0V	0V	0V
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-

CLK = CLOCK, DAT = DATA, SEN = SENSE, * = for AKD with "NB" (rev 8+) only

AKD SYSTEM CONFIGURATION WITH KOLLMORGEN DDL LINEAR MOTORS: STANDARD CONVENTION

3. ACI-AKD-A (Heidenhain Sin/Cos)

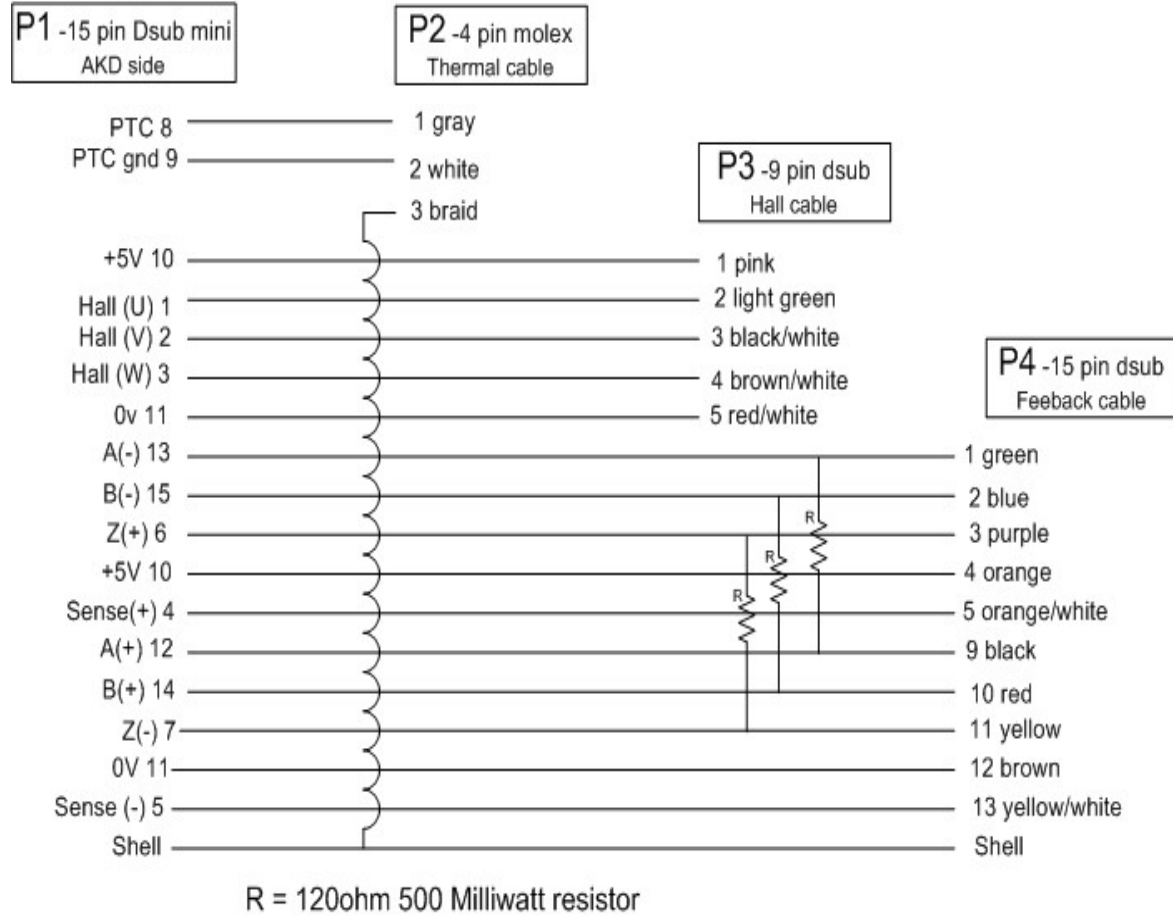
ACI-AKD-A (Heidenhain type)



AKD SYSTEM CONFIGURATION WITH KOLLMORGEN DDL LINEAR MOTORS: STANDARD CONVENTION

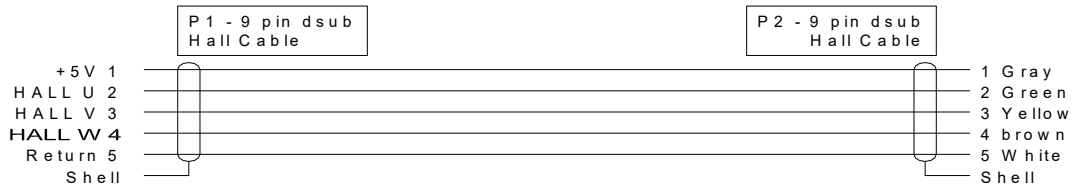
4. ACI-AKD-B (Renishaw Sin/Cos)

ACI-AKD-B (Renishaw Sine/Cos type)

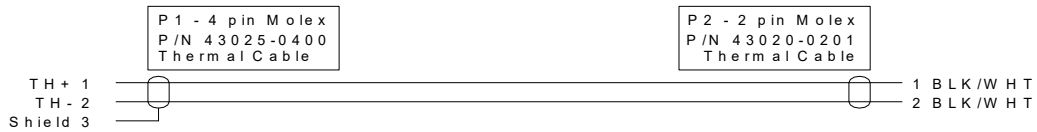


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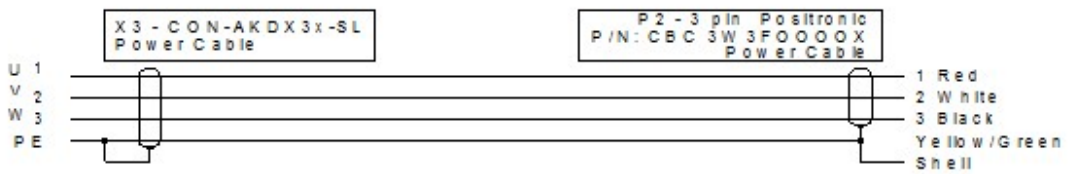
5. Hall Effect Cable



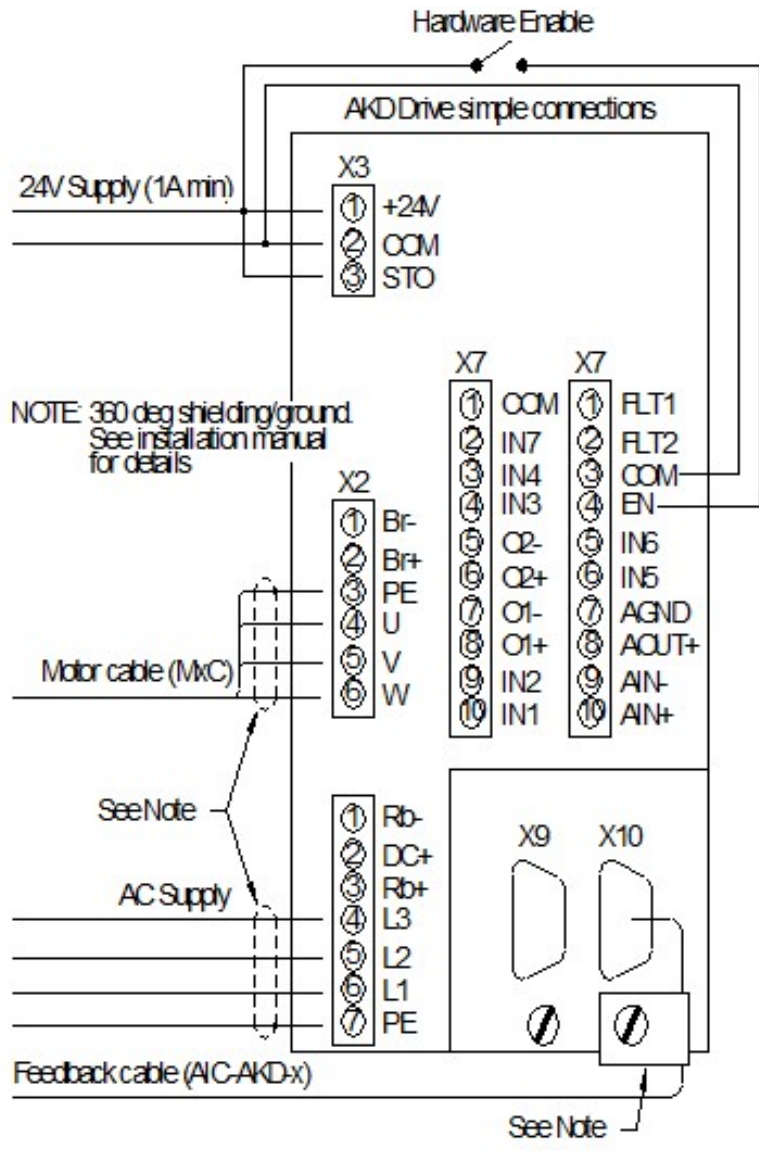
6. Thermal Sensor Cable



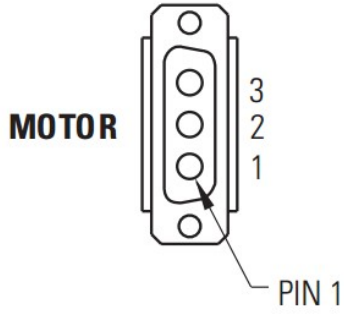
7. Motor Power Cable



8. Minimum Wiring Requirement for the AKD Drive




9. DDL Motor Coil Connections



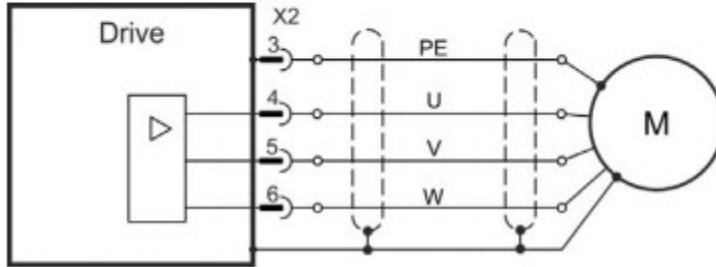
Motor Connector Pin Numbers	Motor Coil Wire Color	AKD Drive Connection Connector X2
1	Red	U
2	White	V
3	Black	W
Connector Shell	Grn/Yel	PE GND
Connector Shell	Violet	Shield

AKD SYSTEM CONFIGURATION WITH KOLLMORGEN DDL LINEAR MOTORS: STANDARD CONVENTION

AKD-x003 to 024, power connector X2



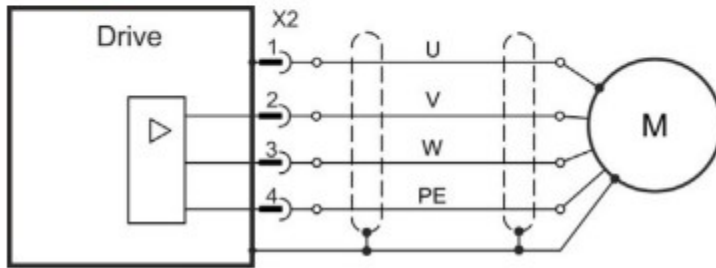
Pin	Signal	Description
1	-BR	Motor holding brake (→ p. 112)
2	+BR	Motor holding brake (→ p. 112)
3	PE	Protective earth (motor housing)
4	U	Motor phase U
5	V	Motor phase V
6	W	Motor phase W



AKD-x048, power connector X2



Pin	Signal	Description
1	U	Motor phase U
2	V	Motor phase V
3	W	Motor phase W
4	PE	Protective earth (motor housing)



Configure the AKD Drive Using the Workbench Software

Install AKD Workbench. The software program can be found on the website (<http://www.kollmorgen.com/en-us/products/drives/servo/akd/>), (<http://kdn.kollmorgen.com/>) and the Product Support Package (PSP) CD-ROM packaged with the drive. Follow the installation instructions. (If in doubt, install "Kollmorgen WorkBench GUI Full Version.")

1. Safety First

When first starting up the system, it is recommended to limit the peak current of the drive to a safe value and add wood blocks at each motor end stop to confirm it is operating correctly. If the motor was to run away at its full output force capability, it could cause serious injury or damage to the equipment.

The screenshot shows the Kollmorgen WorkBench software interface. The main window displays the 'Limits' configuration page. The left sidebar shows a 'Device Topology' tree with 'Limits' selected. The main area has a 'Limits' header and a sub-header 'This page shows all the drive limits in one place.' Below this are several sections: 'Current Limits', 'Velocity Limits', 'Position Limits', 'Acceleration Limits', and 'Motor Limits'. The 'Current Limits' section includes fields for 'Positive Peak Current' (9.000 Ams), 'Negative Peak Current' (-9.000 Ams), and 'Dynamic Break Peak Current' (1.000 Ams). The 'Velocity Limits' section includes 'Positive Speed Limit' (3,000.000 rpm), 'Negative Speed Limit' (-3,000.000 rpm), 'User Over-Speed Limit' (9,599.894 rpm), and 'Overall Over-Speed Limit' (9,599.894 rpm). The 'Position Limits' section includes 'Maximum Position Error' (655,360 Counts16Bit), 'Position Limit 0' (0 Counts16Bit), and 'Position Limit 1' (1,048,576 Counts16Bit). The 'Acceleration Limits' section includes 'Acceleration' (59.903 rpm/s) and 'Deceleration' (59.903 rpm/s). The 'Motor Limits' section has a note: 'Motor limits are set through the Motor Foldback Screen: [Goto Foldback](#)'. Annotations include a green arrow pointing to the 'Limits' icon in the tree, a red box around the 'Limits' section header, a purple box around the 'Current Limits' section, and a purple arrow pointing to the 'Positive Peak Current' field.

Section	Parameter	Value	Unit
Current Limits	Positive Peak Current:	9.000	Ams
	Negative Peak Current:	-9.000	Ams
	Dynamic Break Peak Current:	1.000	Ams
Velocity Limits	Positive Speed Limit:	3,000.000	rpm
	Negative Speed Limit:	-3,000.000	rpm
	User Over-Speed Limit:	9,599.894	rpm
	Overall Over-Speed Limit:	9,599.894	rpm
Position Limits	Maximum Position Error:	655,360	Counts16Bit
	Position Limit 0:	0	Counts16Bit
	Position Limit 1:	1,048,576	Counts16Bit
Acceleration Limits	Acceleration:	59.903	rpm/s
	Deceleration:	59.903	rpm/s

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2. Connect to the AKD Drive

Follow the instruction from the WorkBench help file.

The screenshot displays the Kollmorgen WorkBench software interface. The top menu bar includes 'File', 'Edit', 'View', 'Tools', and 'Help'. Below the menu bar, there are buttons for 'Connect' and 'Panic'. The 'Device Topology' pane on the left shows a 'Start Page' and a 'Kollmorgen Device (169.254.250.201)'. The main window displays the 'Kollmorgen WorkBench Help' content, with a 'Contents' pane on the left and a main content area on the right. The 'Contents' pane lists various topics, including 'Welcome Page', 'AKD Workbench User Manual', 'AKD Cover', 'AKD Models', 'Initial Drive Setup', 'Connecting the AKD', 'Connected and Disconnected States', 'Disconnected', 'Confirm Connection with the Device', 'Connect To Another Device', 'TwinCAT and Workbench Connection', 'Troubleshooting Connection and Communication Problems', 'Communicating with the AKD', 'Using WorkBench', 'Configuring Drive Power', 'Configuring Motor Settings', 'Using AKD in a Vertical Axis', 'Configuring with Linear Motors', 'Selecting Units for Your Application', 'Configuring General Drive Settings', 'Using Command Source and Operation', 'Creating Motion', 'Saving Your Drive Configuration', 'Tuning Your System', 'Using the Scope', 'Using Parameters and the Terminal Settings', and 'Faults and Warnings'. The main content area shows the 'Connecting the Drive' page, which includes a list of topics: 'Connected and Disconnected States', 'Disconnected', 'Confirm Connection with the Device', 'Connect To Another Device', 'TwinCAT and Workbench Connection', and 'Troubleshooting Connection and Communication Problems'. Two callout boxes provide instructions: '1: Click on the Help then on "Documentation -> AKD"' and '2: Expand "AKD User Manual" and then "connect to the AKD"'. The bottom of the interface shows a 'Watch' section with 'Enab...' and 'Device' labels, and a 'Parameter' label.

1: Click on the Help then on "Documentation -> AKD"

2: Expand "AKD User Manual" and then "connect to the AKD"

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3. Expand “Settings” and Select the Motor Setup Screen

The screenshot displays the Kollmorgen WorkBench software interface. The top menu bar includes File, Edit, View, Tools, and Help. Below the menu is a toolbar with navigation icons and control buttons: Enable, Stop, 3 - Analog, 1 - Velocity Mode, Disable & Clear Faults, and Save T. The main window is divided into two panes. The left pane, titled "Device Topology", shows a tree structure under "no-name (Online)". The "Settings" folder is expanded, revealing a list of configuration options: Communication, Power, Regen, Motor, Feedback, Feedback 2, Foldback, Brake, Units, Modulo, Limits, Current Loop, Velocity Loop, Encoder Emulation (X9 Cfg), Analog Input, Analog Output, Digital I/O, Programmable Limit Switches, Compare Engines, Enable/Disable, Position Capture, and Performance Servo Tuner. The right pane, titled "Motor", shows a large blue "M" icon and the text "Motor". Below this, it states "These parameters describe the motor attached to". The "Motor Name" field is populated with "AKM31E-ANKI". Other fields include "Motor Type" (0 - Rotary, Per), "Motor Autoset" (0 - Off), and several empty input fields for Continuous Current, Peak Current, Inertia, Torque Constant, EMF Constant, and Motor Resistance (R). Two callout boxes with arrows point to the "Settings" folder and the "Motor" item in the tree. The first callout box contains the text "1: Click here to expand the tree" and the second callout box contains the text "2: Click on 'Motor'".

1: Click here to expand the tree

2: Click on "Motor"

4. Select Motor from Pull Down List

The screenshot displays the Kollmorgen WorkBench interface. On the left is a 'Device Topology' tree with 'Motor' selected. The main window shows the 'Motor' configuration page with fields for Motor Name, Motor Type, Motor Autoselect, Continuous Current, and Peak Current. A 'Select Motor...' button is highlighted with a callout box labeled '2: Click on "Select Motor"'. The 'Motor Autoselect' dropdown is set to '0 - Off', with a callout box labeled '1: Turn off "Motor Autoselect"'. A 'Select Motor' dialog box is open, showing 'Motor Family' set to 'IC and ICD Series Ironcore DDL' (callout '3: Change Motor Family to correct motor type') and 'Name' set to 'IC11030A1' (callout '4: Select motor part number. Then click OK.'). The dialog also includes a 'Custom Motors...' button and 'OK'/'Close' buttons.



NOTE

If the motor cannot be found in the database, Custom motors can be setup using the “Edit Custom Motors” tools under “Edit” on the tool bar. Instructions for use can be found in the WorkBench help file.

5. Select Motor Temperature Sensor

The screenshot shows the Kollmorgen WorkBench software interface. The top menu bar includes File, Edit, View, Tools, and Help. Below it is a status bar with buttons for Enable, Stop, 0 - Service, 0 - Torque Mode, Disable & Clear Faults, Save To Device, Connect, and a red Panic button. The left sidebar shows the Device Topology tree, which is expanded to show the Motor Temperature configuration page. The main area displays the 'Motor Temperature' configuration page with a dropdown menu for 'Thermal Resistor Type'. The dropdown menu is open, showing the following options: 0 - Single PTC Thermistor, 1 - Single NTC Thermistor, 2 - KTY83-110 Thermistor, 3 - KTY84-130 Thermistor, 4 - PTC + KTY83-110 Thermistors, 5 - Thermal Switch, and 255 - No Thermal Sensor. Two callout boxes with arrows point to the 'Motor Temperature' item in the tree and the dropdown menu.

1: Click on the "Motor Temperature"

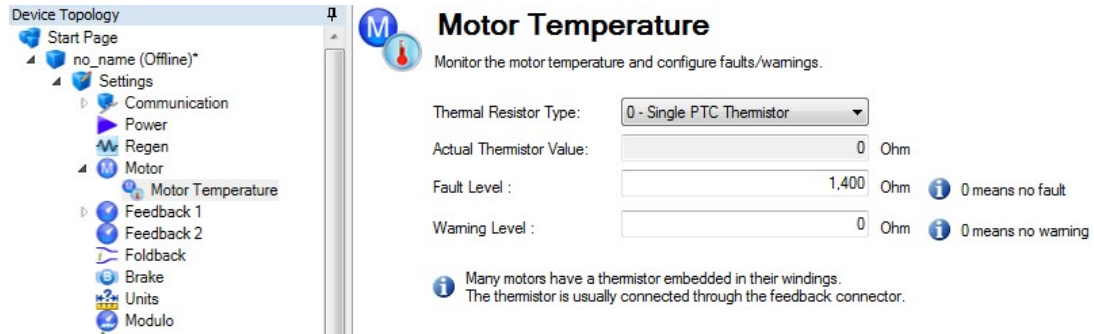
2: Select the Thermal Resistor Type for the motor

Note to double-click on "Motor" to expand the project tree if "Motor Temperature" is not visible.

AKD SYSTEM CONFIGURATION WITH KOLLMORGEN DDL LINEAR MOTORS: STANDARD CONVENTION

1. Thermostat Option type “TR”: PTC thermistor sensor

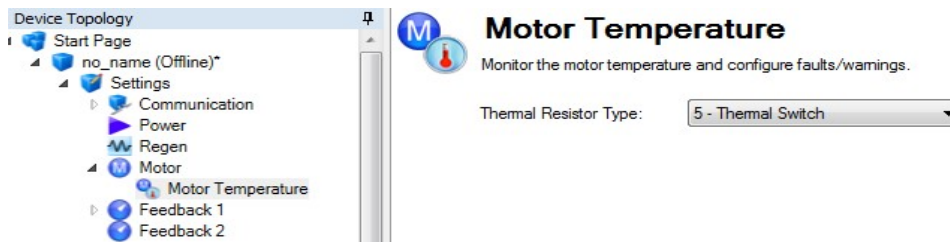
Kollmorgen DDL linear motors use a PTC thermistor sensor if the Thermostat Option selected is TR “Thermistor” (MOTOR.RTYPE = 0, “Single PTC Thermistor”). Set the value for the MOTOR.TEMPFAULT = 1400.



The screenshot shows the 'Motor Temperature' configuration window. On the left is a 'Device Topology' tree with 'no_name (Offline)*' expanded to 'Settings' > 'Motor' > 'Motor Temperature'. The main window has a title bar with a motor icon and the text 'Motor Temperature' and 'Monitor the motor temperature and configure faults/warnings.' Below this are three input fields: 'Thermal Resistor Type' is a dropdown menu set to '0 - Single PTC Thermistor'; 'Actual Thermistor Value' is a text box with '0' and 'Ohm' to its right; 'Fault Level' is a text box with '1,400' and 'Ohm' to its right, with an information icon and '0 means no fault' below it; 'Warning Level' is a text box with '0' and 'Ohm' to its right, with an information icon and '0 means no warning' below it. At the bottom, an information icon is followed by the text: 'Many motors have a thermistor embedded in their windings. The thermistor is usually connected through the feedback connector.'

2. Thermostat Option type “TS”: Thermal switch

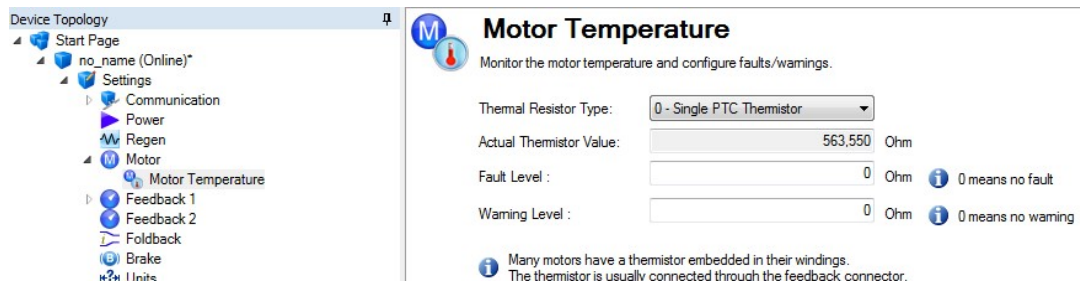
Kollmorgen DDL linear motors use a thermal switch if the Thermostat Option selected is TS Thermostat (MOTOR.RTYPE = 5, “Thermal Switch”)



The screenshot shows the 'Motor Temperature' configuration window. On the left is a 'Device Topology' tree with 'no_name (Offline)*' expanded to 'Settings' > 'Motor' > 'Motor Temperature'. The main window has a title bar with a motor icon and the text 'Motor Temperature' and 'Monitor the motor temperature and configure faults/warnings.' Below this is one input field: 'Thermal Resistor Type' is a dropdown menu set to '5 - Thermal Switch'.

3. No Thermal Sensor

In the case a thermal sensor is not used in the application, the thermal protection feature can be defeated by setting the (MOTOR.TEMPFAULT = 0, the “Fault Level”)



The screenshot shows the 'Motor Temperature' configuration window. On the left is a 'Device Topology' tree with 'no_name (Online)*' expanded to 'Settings' > 'Motor' > 'Motor Temperature'. The main window has a title bar with a motor icon and the text 'Motor Temperature' and 'Monitor the motor temperature and configure faults/warnings.' Below this are three input fields: 'Thermal Resistor Type' is a dropdown menu set to '0 - Single PTC Thermistor'; 'Actual Thermistor Value' is a text box with '563,550' and 'Ohm' to its right; 'Fault Level' is a text box with '0' and 'Ohm' to its right, with an information icon and '0 means no fault' below it; 'Warning Level' is a text box with '0' and 'Ohm' to its right, with an information icon and '0 means no warning' below it. At the bottom, an information icon is followed by the text: 'Many motors have a thermistor embedded in their windings. The thermistor is usually connected through the feedback connector.'

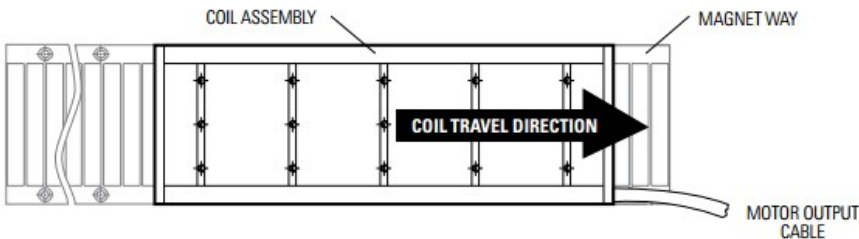
7. Configuring Encoder Feedback Resolution

The encoder resolution is based on the magnet pitch of the motor divided by the encoder resolution. The units are lines/pitch. Kollmorgen DDL motors have a magnet pitch of 32 mm. For example, if the encoder has a 20 micron pitch, enter $(32\text{mm} / 20 \text{ micron pitch} * 1000) = 1600$ line count (lines per 32mm) as your encoder resolution. The following chart provides typical encoder resolution figures and their equivalent AKD value.

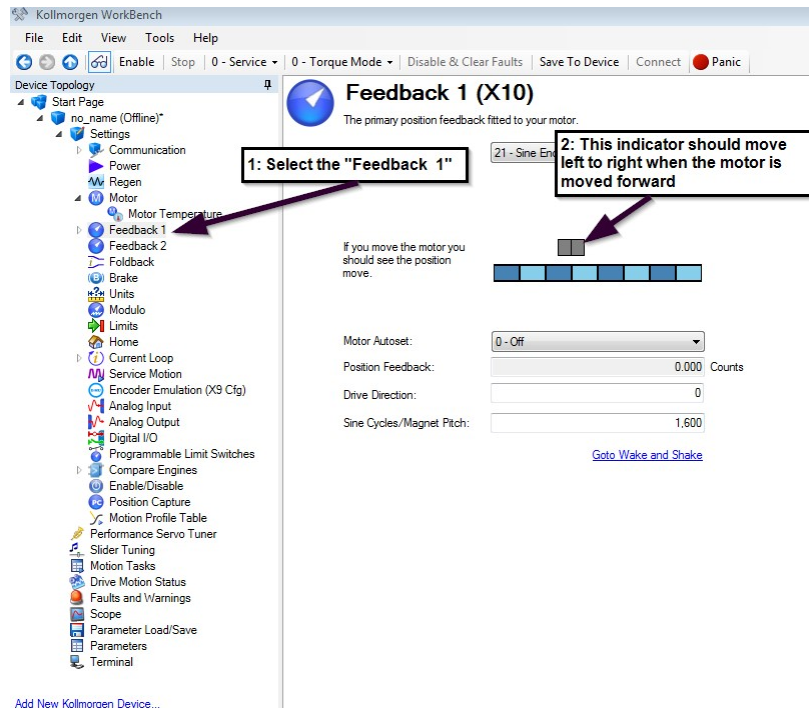
Encoder Equivalent Resolution µm Line Count	AKD Resolution lines/pitch	Encoder Equivalent Resolution µm Line Count	AKD Resolution lines/pitch
50	640	0.25	128000
40	800	0.2	160000
25	1280	0.1	320000
20	1600	0.08	400000
10	3200	0.05	640000
5	6400	0.04	800000
2.5	12800	0.02	1600000
2	16000	0.01	3200000
1	32000		
0.5	64000		
0.4	80000		

8. Test Encoder Direction and Resolution

The direction of the encoder, the motor phase sequence, and hall sequence all need to match exactly. The hall phasing also needs to match the motor phasing exactly. This is very difficult to do by trial and error. **Drive Direction has to be set to zero (“DRV.DIR =0”)**. From the commutation drawings in Figure 2 the motor “positive” direction is toward the end of the motor where the wires exit the motor. This is the standard convention. Appendix A covers the non-standard convention where the feedback counts down or negative when the coil moves in the direction of the motor output cable leads and the feedback type cannot be inverted by wiring changes on the feedback.



The Feedback test available is the movement of the indicator on the motor feedback screen.



If the encoder is counting in the wrong direction, swap the Sine+ and Sine- signal or the A and A\ signal. If this cannot be done if the Data channels of the encoder are being used. If changing the feedback direction is not possible, use Appendix A (Page 29) for the wiring configuration of the Hall sensors and the motor power connections.

9. Checking Motor Feedback Resolution

The feedback resolution can be tested by marking two lines on the magnet way 32mm apart. You can use whatever length you want, but longer is more accurate. Change the User Units to “mm”.

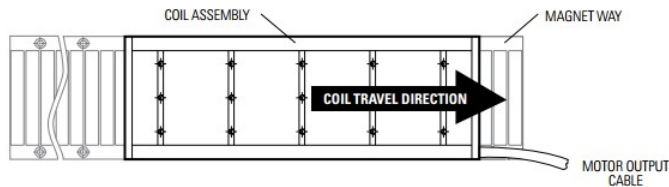
The screenshot shows the Kollmorgen WorkBench interface. On the left is the 'Device Topology' tree with 'no_name (Offline)' expanded to show 'Settings' and 'Motor'. The 'Units' configuration window is open, displaying a 3D model of a linear motor with a blue block on top. A dimension line indicates a 'Pole-Pair Pitch' of 32.000 mm. The 'Units' window has a 'Select Type of Mechanics' dropdown set to 'Motor Only'. Below this, the 'Position Unit' is set to '1 - mm', 'Velocity Unit' to '1 - mm/s', and 'Acceleration Unit' to '1 - mm/s^2'. A 'Modbus Unit' link is present. At the bottom, the 'Position' display shows '0.000 mm'. A 'Less <<' button is also visible. Four callout boxes with arrows point to specific elements: '1: Click on "Units"' points to the 'Units' icon in the topology; '2: Setup all three Units as mm.' points to the unit dropdowns; '3: Click on the "More" button to show the position feedback counter' points to the 'Less <<' button; and '4: Move the motor from one line to the other and see if the position counter changes the correct amount in the correct direction' points to the 3D motor model.

If the position display does not match the distance the motor is moved, you may need to revisit the encoder scaling section of this manual or confirm the feedback device scale.

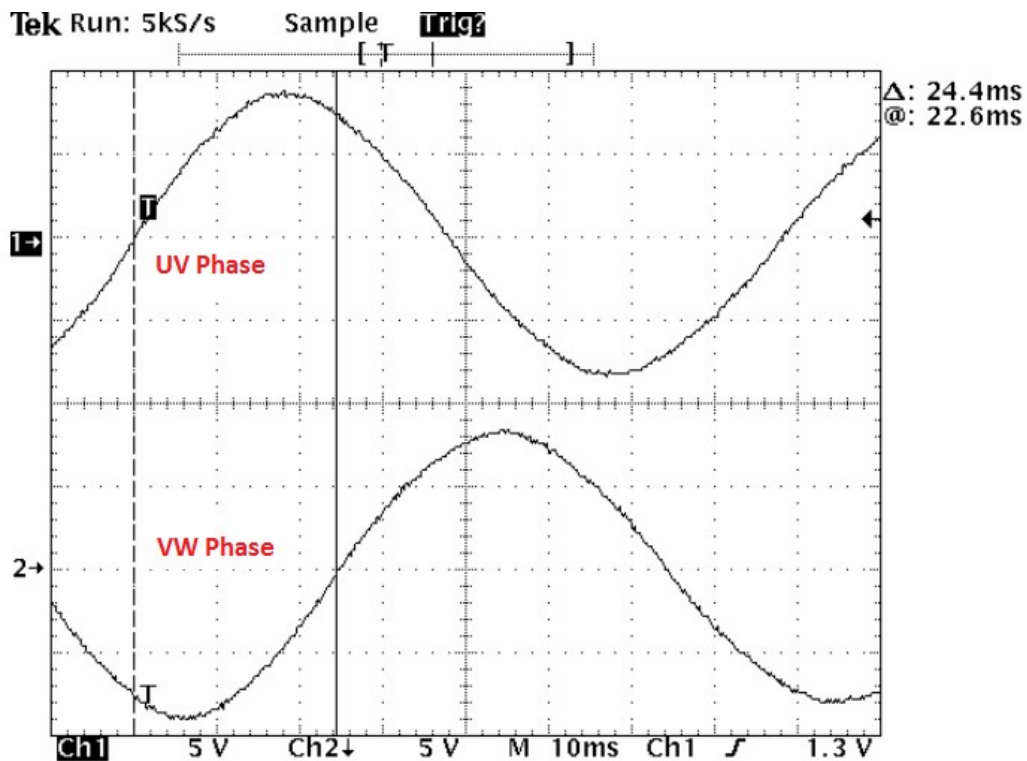
10. Check Motor Phasing of Any Servo Motor

This is useful for commissioning a third-party motor, as well as any frameless Kollmorgen motor, or any servo motor for which the phasing is unknown.

This part of the setup will require a two channel oscilloscope with isolated channels. Move the motor in the positive direction based on the motor manufactures specification. The AKD commutates a motor in the phase sequence of U V W in the positive direction.

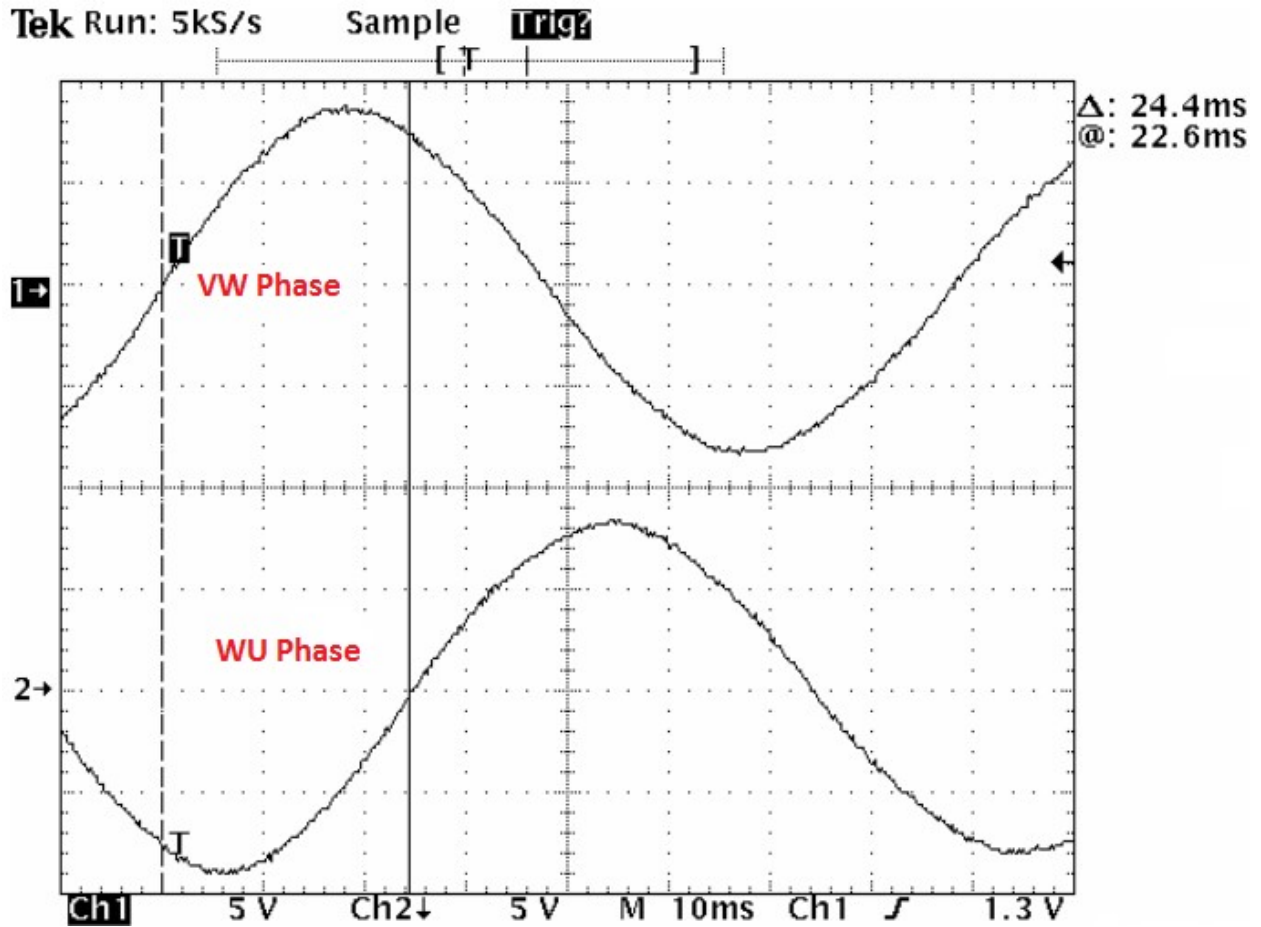


When determining the motor phasing, the U phase (U phase with reference to V phase) will lead the back emf voltage waveform by 120° of the V phase (V phase with reference to W phase).



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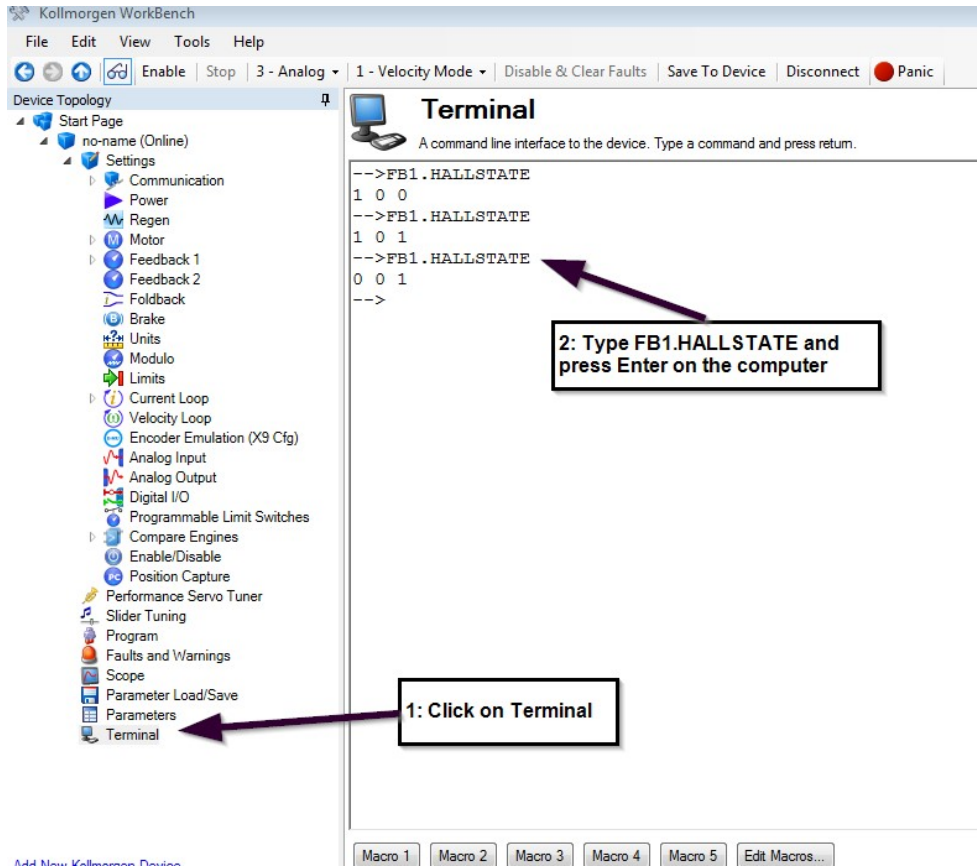
While moving the motor in a positive direction the motor V phase (V phase with reference to W phase) will lead the back emf voltage waveform by 120° of W phase (W phase with reference to U phase).



Use Figure 2 to determine the Hall Sensor alignment of the motor. Make sure the feedback position value (PL.FB) is counting in the positive direction.

10. Test Hall Sequence When Moving Motor in the Positive Direction

The hall phasing can be check with the parameter FB1.HALLSTATE. This is a binary value, where “001” is Hall U, “010” is Hall V, and “100” is Hall W.



AKD SYSTEM CONFIGURATION WITH KOLLMORGEN DDL LINEAR MOTORS: STANDARD CONVENTION

Hall Sensor Sequence when FeedBack (PL.FB) Is Counting Positive When Using AKD Firmware Version = or > 01-13-10-001. Do not use the parameter FB1.HALLSTATE in the oscilloscope feature to monitor Hall sensor state.

Step(CW)	FB1.HALLSTATEW	FB1.HALLSTATEV	FB1.HALLSTATEU
1	0	0	1
2	0	1	1
3	0	1	0
4	1	1	0
5	1	0	0
6	1	0	1
7	0	0	1

Hall Sensor Sequence when FeedBack (PL.FB) Is Counting Positive When Using AKD Firmware Version < 01-13-10-001. Do not use the parameter FB1.HALLSTATE in the oscilloscope feature to monitor Hall sensor state.

Step(CW)	FB1.HALLSTATEW	FB1.HALLSTATEV	FB1.HALLSTATEU
1	0	0	1
2	1	0	1
3	1	0	0
4	1	1	0
5	0	1	0
6	0	1	1
7	0	0	1

11. Motor Back emf And Hall Sensor Signal Alignment

AKD SYSTEM CONFIGURATION WITH KOLLMORGEN DDL LINEAR MOTORS: STANDARD CONVENTION

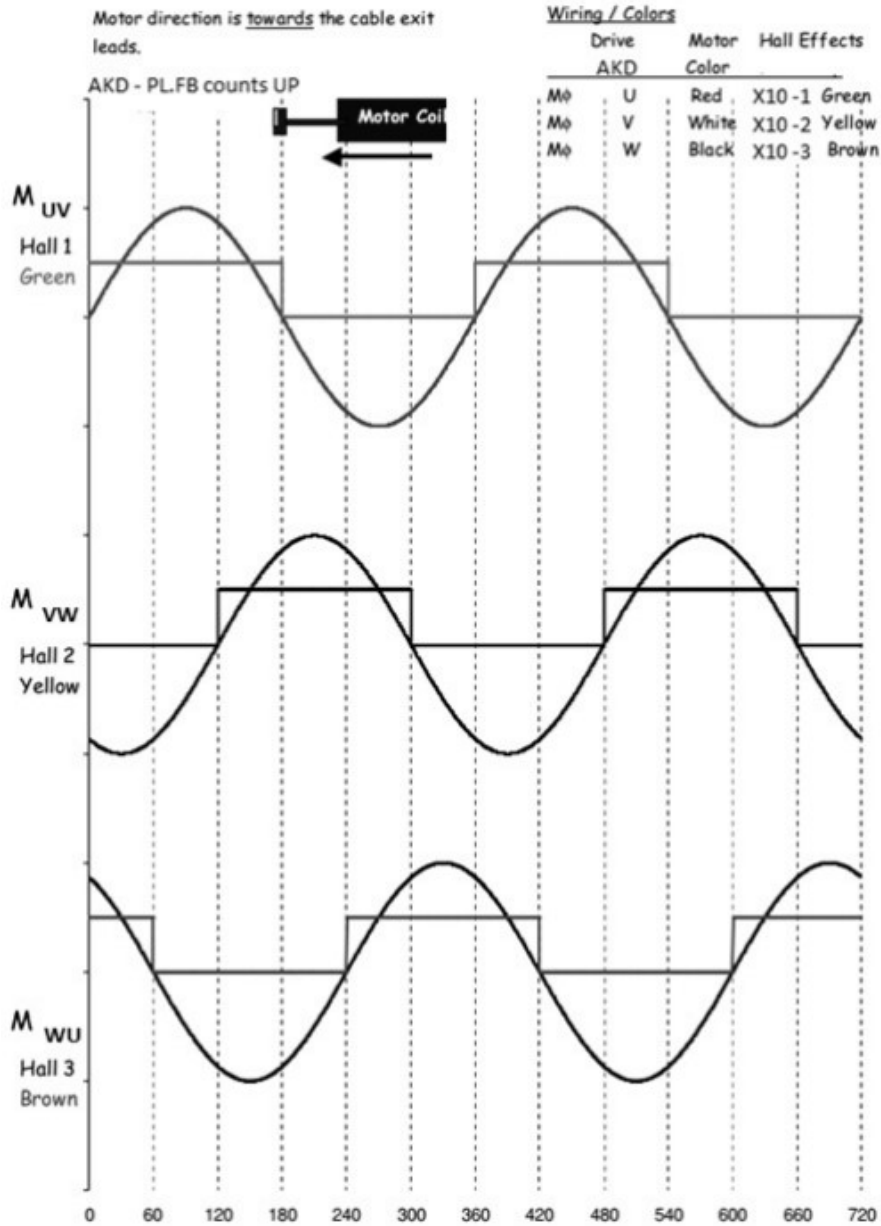
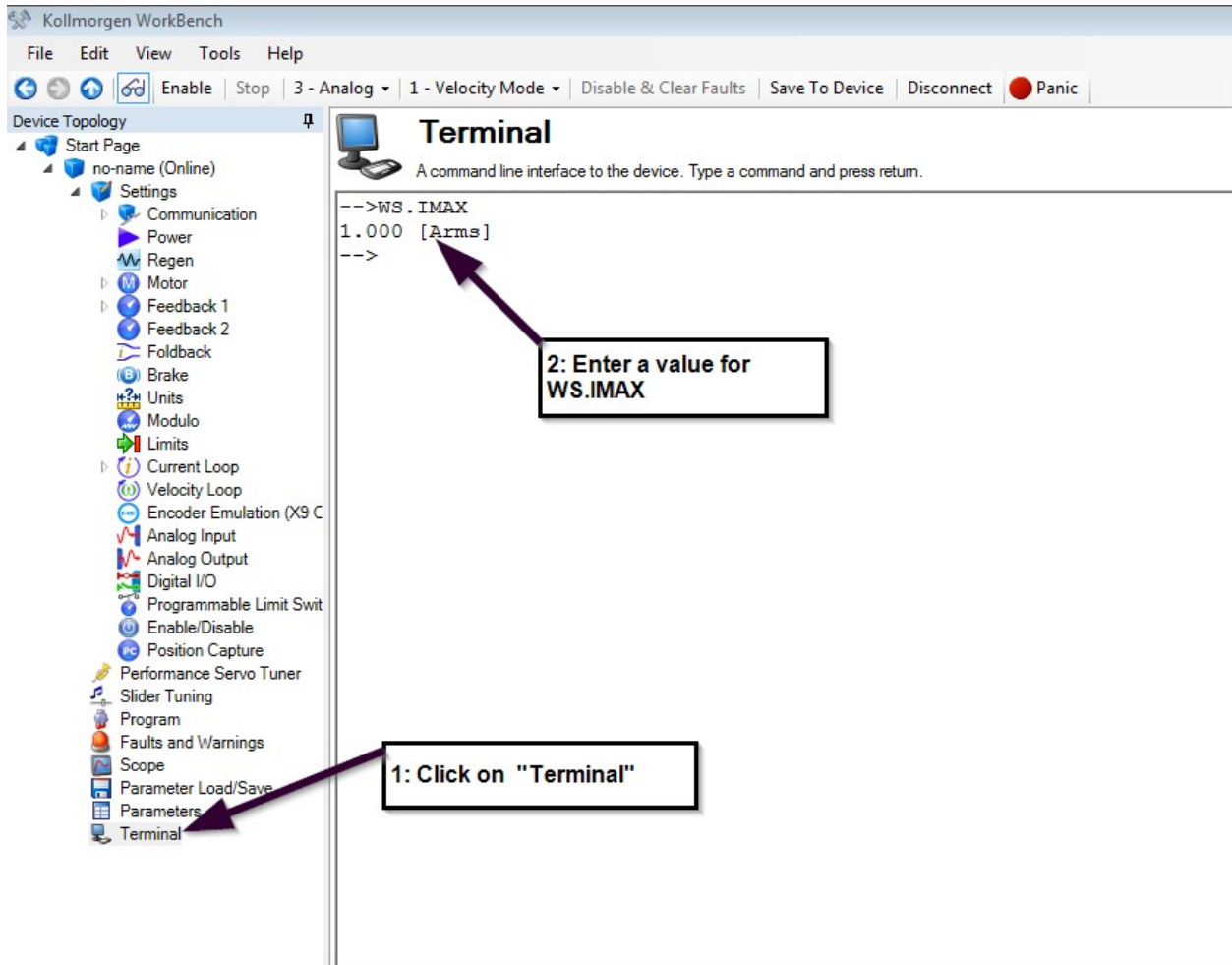


Figure 2

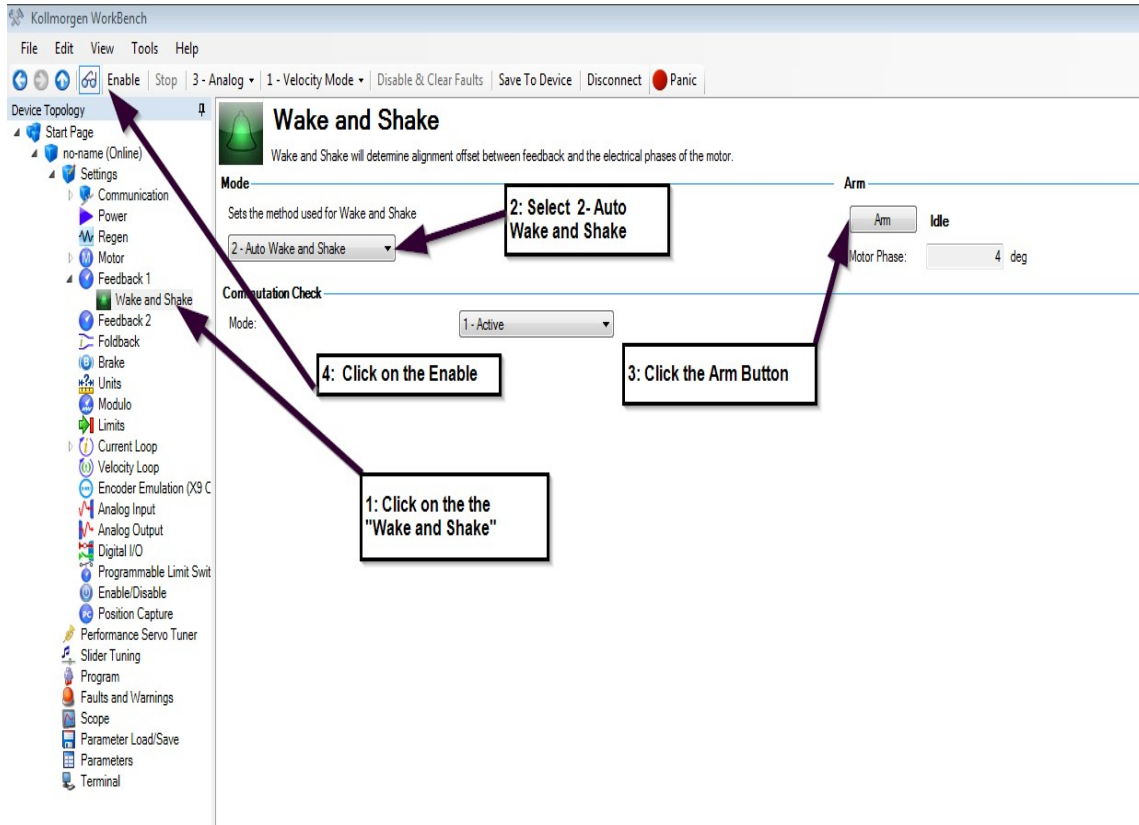
When using a Kollmorgen DDL motor in the standard convention, **MOTOR.PHASE = 120** when the feedback direction is positive toward the “Lead Exit End” of motor (that is, the end of the motor where the leads come out), and when the hall alignment and motor phasing match exactly as shown in Figure 2.

12. How to Verify the Motor's Commutation Alignment Angle (MOTOR.PHASE)

Set the Wake & Shake Current WS.IMAX equal to continuous of your linear motor in the Terminal Screen.



13. Start the Wake and Shake Routine



Start the Wake and Shake routine to find the MOTOR.PHASE offset value. When commissioning the linear motor system, the Wake and shake routine should be performed in several different positions of the motor's travel. The MOTOR.PHASE values should be no more than 5 degrees different in the different positions.

14. Verify the Motor is Setup Correctly by Jogging it in Both Directions



Make sure the AKD drive's peak current is limited before doing this exercise. A linear motor runaway can result in damage to the system equipment or possible bodily injury.

The linear motor initial commissioning is now complete!

Appendix A

Configuring a DDL Liner Motor with Feedback Counting in the Opposite Direction

Appendix A covers the case where the feedback (PL.FB) counts down or negative when moving the coil in the same direction as the motor lead exit as the established POSITIVE convention in the standard startup procedure of this guide. Appendix A also assumes the feedback type where wiring changes will not change the sign or direction of the feedback. If your feedback type that allows the feedback count to be resolved by wiring, please remedy and use the standard conventions in this document. If it is one of the types that cannot be inverted, please follow the conventions in Appendix A.

Feedback Types that can be inverted by wiring:

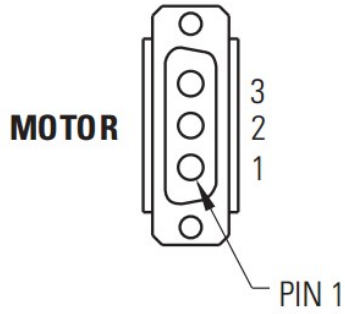
Resolver
Incremental Encoder with or without Halls
Sine Encoder with or without Halls

Types that cannot be inverted:

BISS
EnDAT
Hiperface
Hiperface DSL
SFD
SFD3
Renishaw BISS C

1. DDL Motor Coil Connections

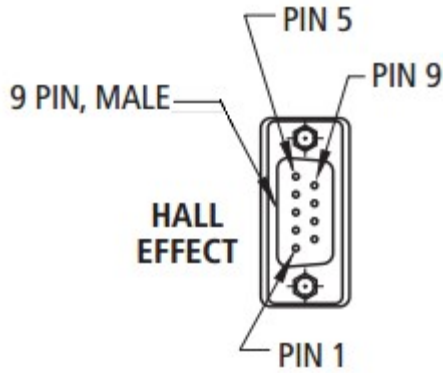
Note the standard convention of UVW has been changed to WVU (non-standard).



Motor Connector Pin Numbers	Motor Coil Wire Color	AKD Drive Connection Connector X2
1	Red	W
2	White	V
3	Black	U
Connector Shell	Grn/Yel	PE GND
Connector Shell	Violet	Shield

2. DDL Motor Hall Sensor Connections

Note the halls have been changed from the standard 1,2,3 on the drive end to 2,1,3 to coincide with the motor phase changes in motor phasing in step 1.



Motor Connector Pin Numbers	Motor Hall Effect Colors	AKD Drive Connection Connector X10 Pin No.
1	Yellow	2
2	Green	1
3	Black	3

3. Checking Motor Feedback Resolution

The feedback resolution can be tested by marking two lines on the magnet way 32mm apart. You can use whatever length you want, but longer is more accurate. Change the User Units to “mm”.

The screenshot shows the Kollmorgen WorkBench software interface. The main window is titled "Units" and contains the following elements:

- Top Bar:** File, Edit, View, Tools, Help. Status indicators: Enable, Stop, 0 - Service, 0 - Torque Mode, Disable & Clear Faults, Save To Device, Connect, Panic.
- Left Panel (Device Topology):**
 - Start Page
 - no_name (Offline)*
 - Settings
 - Communication
 - Power
 - Regen
 - Motor
 - Motor Temperature
 - Feedback 1
 - Feedback 2
 - Foldback
 - Brake
 - Units (highlighted)
 - Modulo
 - Limits
 - Home
 - Current Loop
 - Service Motion
 - Encoder Emulation (X9 Cfg)
 - Analog Input
 - Analog Output
 - Position Capture
 - Motion Profile Table
 - Performance Servo Tuner
 - Slider Tuning
 - Motion Tasks
 - Drive Motion Status
 - Faults and Warnings
 - Scope
 - Parameter Load/Save
 - Parameters
 - Terminal

- Main Panel:**
- Units Configuration:**
 - Select Type of Mechanics: Motor Only
 - Position Unit: 1 - mm
 - Velocity Unit: 1 - mm/s
 - Acceleration Unit: 1 - mm/s²
 - Modbus Unit: Goto Modbus
 - Less <<
 - Position: 0.000 mm
- 3D Model:** A motor assembly with a blue top plate and a brown cube. A green double-headed arrow indicates a distance of 32.000 mm between two lines on the magnet way. The label "Pole-Pair Pitch" is associated with this distance.

Four numbered callouts provide instructions:

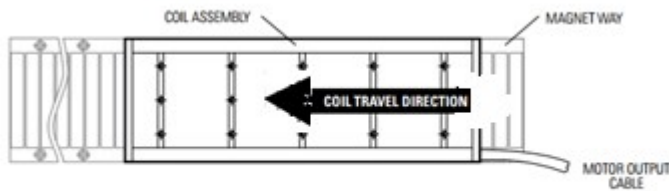
- 1: Click on "Units"
- 2: Setup all three Units as mm.
- 3: Click on the "More" button to show the position feedback counter
- 4: Move the motor from one line to the other and see if the position counter changes the correct amount in the correct direction

If the position display does not match the distance the motor is moved, you may need to revisit the encoder scaling section of this manual or confirm the feedback device scale.

4. Check Motor Phasing of Any Servo Motor

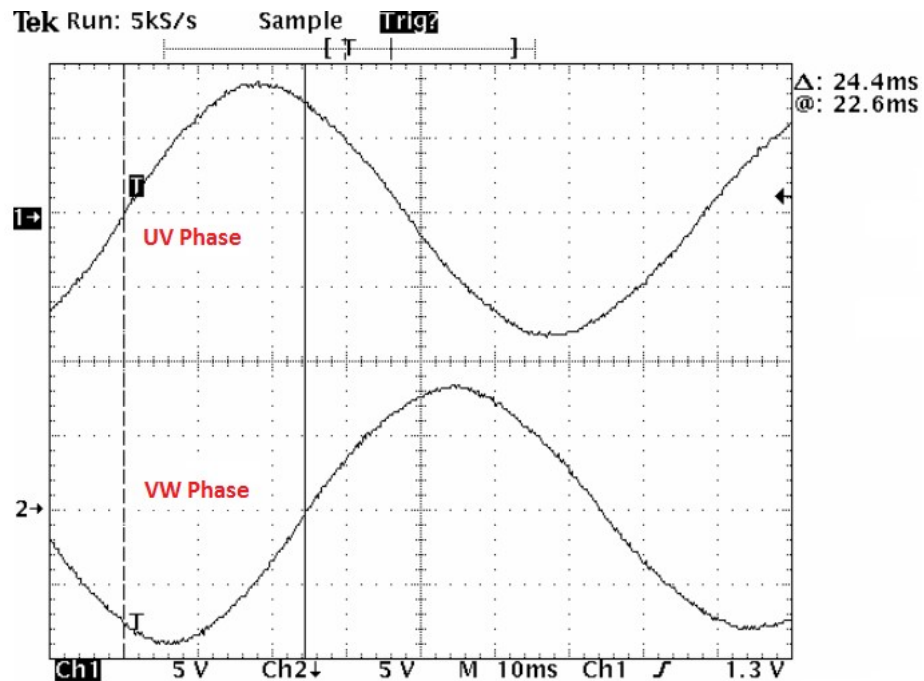
This is useful for commissioning a third-party motor, as well as any frameless Kollmorgen motor, or any servo motor for which the phasing is unknown. Note this is for the case where the feedback counts down or negative with the standard convention and the feedback type cannot resolve the direction by wiring changes.

This part of the setup will require a two channel oscilloscope with isolated channels. Move the motor in the positive direction based on the motor manufactures specification. The AKD commutates a motor in the phase sequence of U V W in the positive direction.

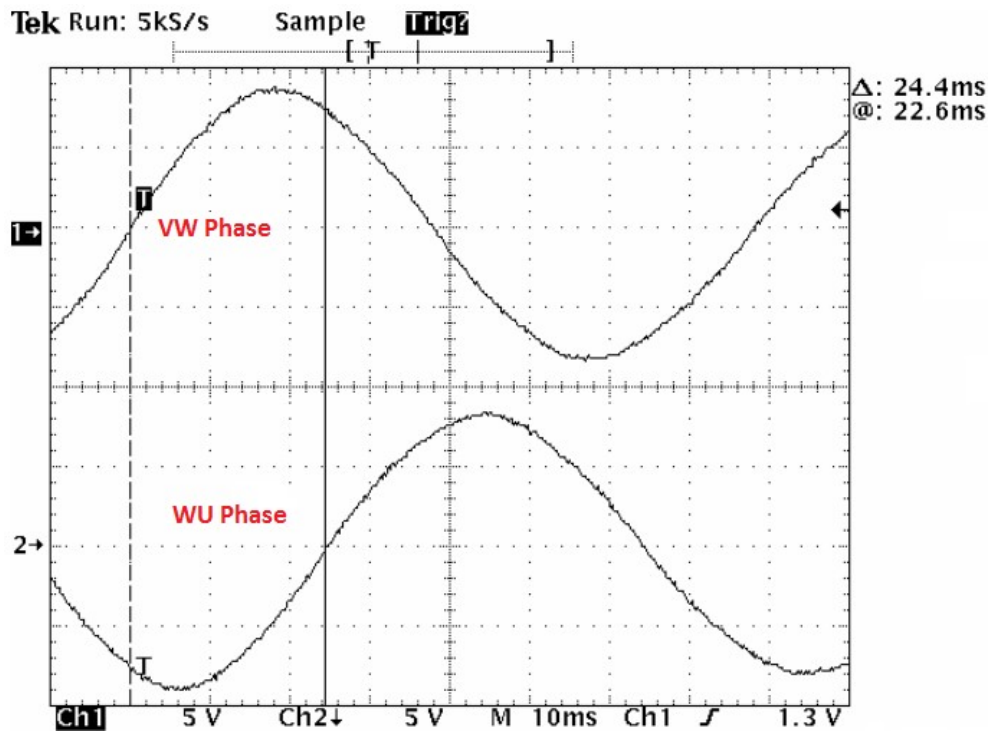


Non-Standard Convention: Feedback PL.FB counts up when the coil travel direction is AWAY from the exit motor output leads.

When determining the motor phasing, the U phase (U phase with reference to V phase) will lead the back emf voltage waveform by 120° of the V phase (V phase with reference to W phase).



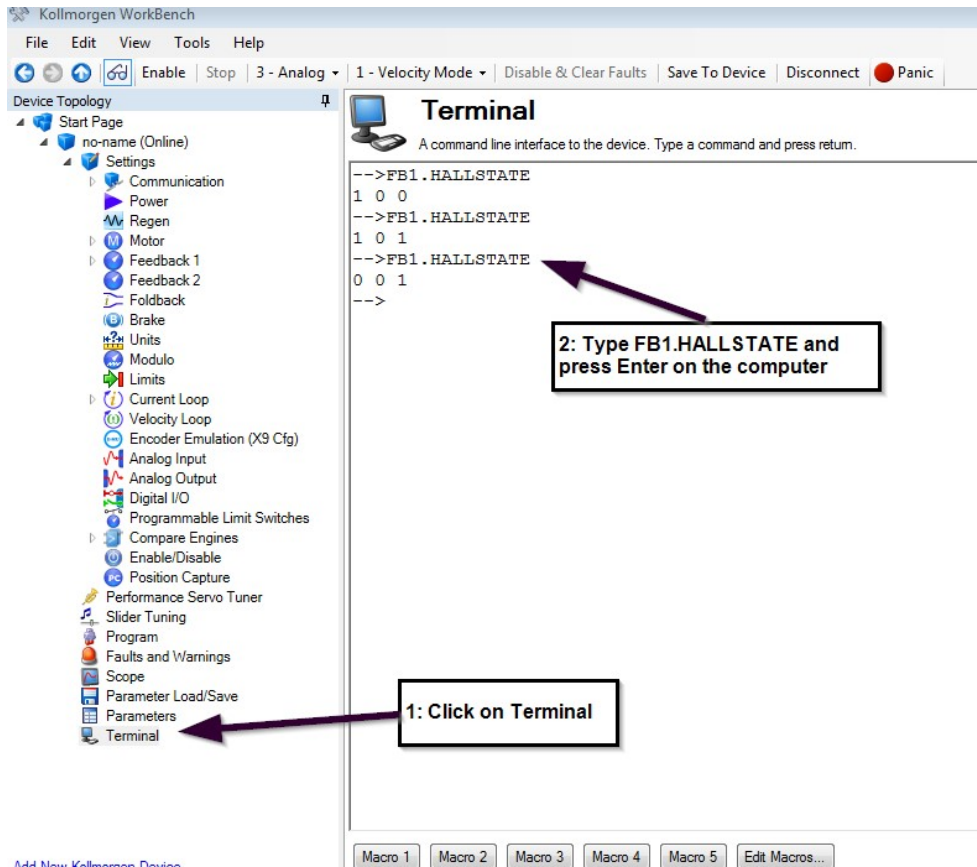
While moving the motor in a positive direction the motor V phase (V phase with reference to W phase) will lead the back emf voltage waveform by 120° of W phase (W phase with reference to U phase).



Use Figure 3 to determine the Hall Sensor alignment of the motor. Make sure the feedback position value (PL.FB) is counting in the positive direction.

5. Test Hall Sequence When Moving Motor in the Positive Direction

The hall phasing can be check with the parameter FB1.HALLSTATE. This is a binary value, where “001” is Hall U, “010” is Hall V, and “100” is Hall W.



6. Monitoring the Hall Sensors States

Hall Sensor Sequence when FeedBack (PL.FB) Is Counting Positive

When Using AKD Firmware Version = or > 01-13-10-001. Do not use

the parameter FB1.HALLSTATE in the oscilloscope feature to monitor

Hall sensor state. Note from Workbench Help that FB1.HALLSTATE reports from left to right halls W, V, U in Workbench Terminal so Terminal should follow the same convention as the chart below.

Step(CW)	FB1.HALLSTATEW	FB1.HALLSTATEV	FB1.HALLSTATEU
1	0	0	1
2	0	1	1
3	0	1	0
4	1	1	0
5	1	0	0
6	1	0	1
7	0	0	1

Hall Sensor Sequence when FeedBack (PL.FB) Is Counting Positive

When Using AKD Firmware Version < 01-13-10-001. Do not use

the parameter FB1.HALLSTATE in the oscilloscope feature to monitor

Hall sensor state. Note from Workbench Help that FB1.HALLSTATE reports from left to right halls W, V, U in Workbench Terminal so Terminal should follow the same convention as the chart below.

Step(CW)	FB1.HALLSTATEW	FB1.HALLSTATEV	FB1.HALLSTATEU
1	0	0	1
2	1	0	1
3	1	0	0
4	1	1	0
5	0	1	0
6	0	1	1
7	0	0	1

7. MOTOR BACK EMF AND HALL SENSOR SIGNAL ALIGNMENT

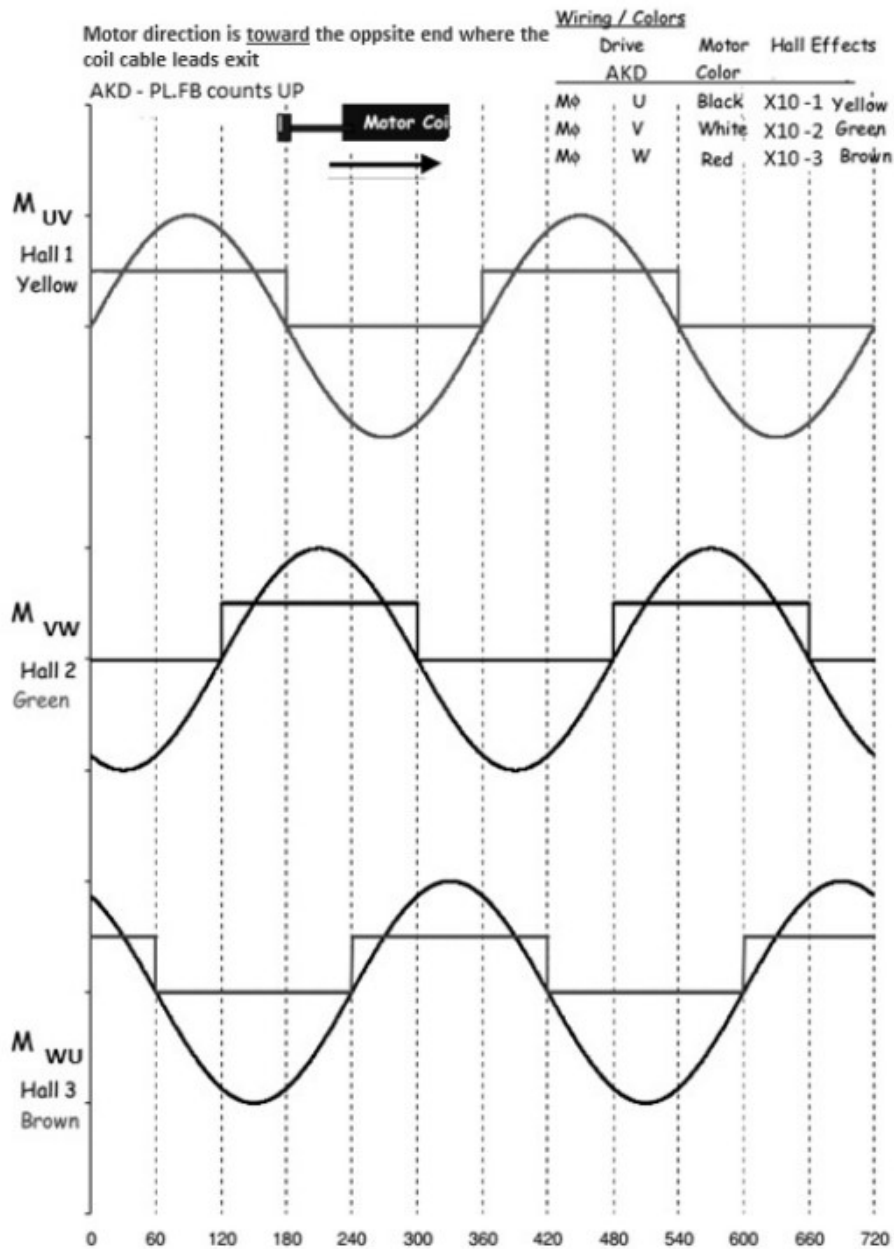


Figure 3

When using a Kollmorgen DDL motor in the non-standard convention, **MOTOR.PHASE = 120** when the feedback direction is positive away from the “Lead Exit End” of motor (that is, the end of the motor where the leads come out), and when the hall alignment and motor phasing match exactly as shown in Figure 3.

Return to **13. Start the Wake and Shake Routine** on “page 26”