

# **ServoSTAR CD and PicoDrive Users' Manual**

## **Addendum for Series 5**

**Revision 4.0**

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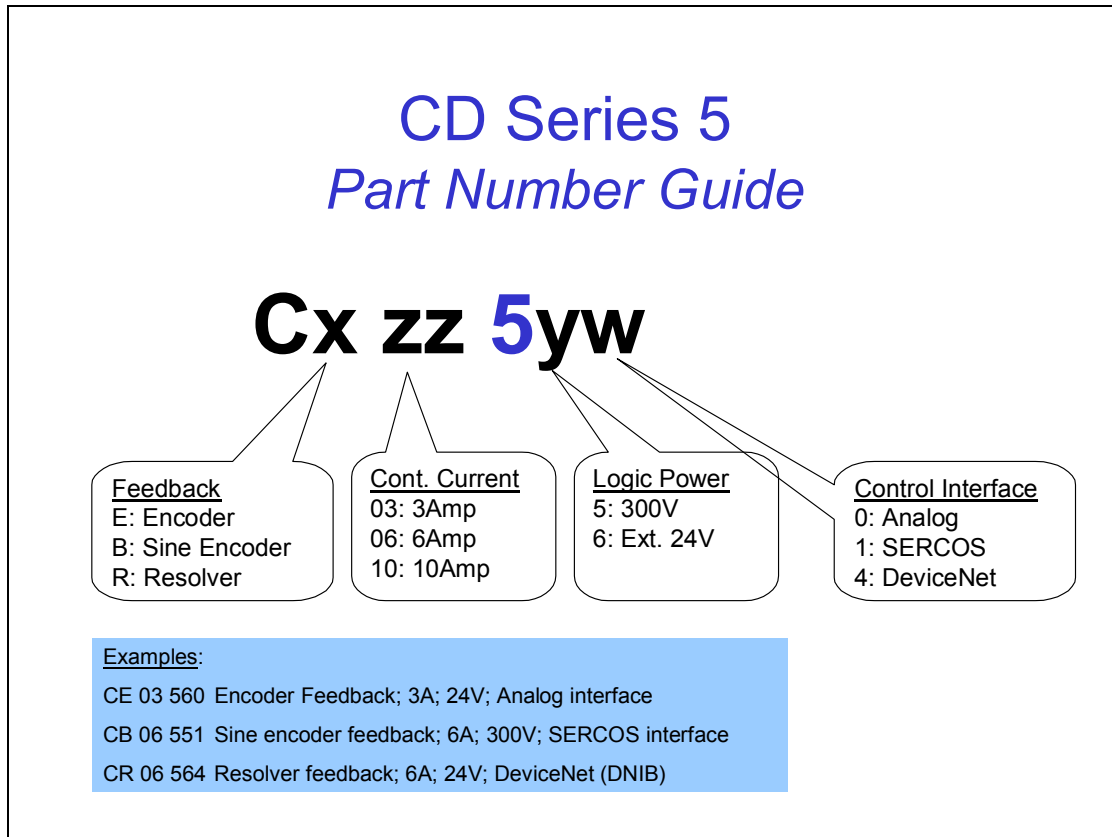
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## 1. Introduction

### 1.1 Background

The ServoSTAR™ Series 5 servo amplifiers incorporate a number of features that are not present in the previous amplifiers. The addition of these features has been made possible due to an upgrade that was made to the digital control board. This document describes the new features. The document describes the new instructions, and refers at times to instructions that exist in previous versions.

### 1.2 Part number for CD



## 1.3 Part number for PicoDrive

## PicoDrive Series 5 Part Number Guide

Px y zz 56w

Feedback

E: Encoder  
B: Sine Encoder  
R: Resolver

Bus Voltage

2: 24V  
8: 80V

Cont. Current

01: 1Amp  
05: 5Amp  
10: 10Amp

Control Interface

0: Analog  
1: SERCOS FO  
3: SERCOS Copper

Examples:

PE2 05 560    Encoder Feedback; 24V Bus; 5A; Analog interface

PB8 05 561    Sine encoder feedback; 80V bus; 5A; SERCOS interface

Notes:

- Product is made with mUCB2
- 80V/10A only available on special request

## 1.4 Summary of New Features

| Feature                  | Description                                                                                                                                                            |
|--------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Sine encoder             | Sine encoder feedback is supported on the main control board. Interpolation level can be set up to 4096 (MSININT).                                                     |
| Sine encoder calibration | Sine encoder signals can be calibrated in order to increase the accuracy of the interpolation (SININIT).                                                               |
| Stegmann Hiperface       | Support Hiperface (Stegmann) interface. MENCTYPE=10                                                                                                                    |
| SERCOS                   | SERCOS level-A compliance is implemented.<br>All serial commands are supported by SERCOS IDNs                                                                          |
| Support for CD600        | Added support for SERVOSTAR CD600 (Two power IDs were added, 6/12 and 10/18). "ServoStar CD600" should appear as the drive model in the response to VER command.       |
| Encoder simulation       | Pulse up/pulse down mode for encoder simulation was added with ENCOUTMOD command.                                                                                      |
| Encoder initialization   | For feedback devices without an absolute position indication, a zero motion encoder initialization process is supported (Wake-no-Shake encoder initialization process) |
| Software Resolver        | The resolver-to-digital (RDC) conversion is done in the Series 5 products using software techniques                                                                    |
| Extended I/O             | Additional I/O; <b>relevant to the CD ONLY, and not to the PicoDrive</b>                                                                                               |

### **1.5 Differences from Previous Models**

- TRUN, the drive run time counter, is NOT reset by CLREEPROM. Use the TRUN 0 instruction to reset this counter.

## 2. Encoder Simulation

### 2.1 Overview

The encoder simulation signal is generally generated in the A-quad-B format. The ENCOUTMOD instruction enables the user to change this format to a pulse up/down signal.

### 2.2 The Instructions

#### 2.2.1 ENCOUTMOD

|                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|-------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Syntax for set:   | ENCOUTMOD <value>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Syntax for query: | ENCOUTMOD                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Description:      | Queries or sets the encoder simulation signal format. When set to 0, the encoder simulation signal will have the A-quad-B format, with A leading B for positive rotation. When set to the value 1, the encoder simulation signal will have a pulse up/down format. When motion is positive, an encoder pulse train will be generated on the A signal and no signal will be generated on the B signal line. When motion is negative, an encoder pulse train will be generated on the B signal and the A signal line will be forced low. |
| Type:             | Switch variable (R/W)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Range:            | 0: Encoder simulation has A-quad-B format<br>1: Encoder simulation has a pulse up/down format                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Default:          | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Opmodes:          | All                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Drive Status:     | Disabled                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Firmware:         | V6.2.0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| EEPROM:           | Yes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Limitations:      | Not yet supported by MotionLink                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

### 3. Sine/Cosine Calibration

#### 3.1 Overview

The software Sine Encoder and software Resolver algorithms are based on sampling the incoming sine and cosine signals. Although the process is transparent to the user, and therefore does not require additional commands, the accuracy of the process depends on the sampling accuracy of the sine and cosine values. In order to prevent accuracy degradation due to electronic component tolerances, the sine and cosine values must be gain- and offset-compensated.

The process of finding the gain and offset compensation parameters is called "Sine Zero". The process matches an amplifier to an encoder or resolver, and hence must be done after replacing a motor or an amplifier. After the process terminates the gain and offset values are stored in the non-volatile memory and are loaded each time the amplifier is powered on.

The process includes finding 128 maximum and minimum, Sine and Cosine peaks and calculating the average gain and offset values. Due to accuracy restrictions the motor must be rotated at a slow speed so that the Sine/Cosine waves generated will be at a frequency low enough for a valid result. The speed must be such that the frequency of the Sine/Cosine signals does not exceed 250Hz. For a rotary motor, the maximum motor speed in RPM can be calculated from

$$60 \times 250 / (\text{MENCRES} \times \text{MSININT})$$

For a linear motor, the maximum motor speed in mm/sec can be calculated from

$$250 \times \text{MPITCH} / (\text{MSININT} \times \text{MENCRES})$$

#### 3.2 The Process

During calibration the motor can be moved manually or under servo control (preferably under velocity control). The following steps should be taken:

1. Initialize the process by entering the instruction *SININIT* (without parameters)
2. Move the motor in either direction. While moving the motor, query the status using the *SIN/INT* instruction.
3. The process is complete when *SIN/INT* returns a value of 3 (done) or 5 (fault).

#### 3.3 The Instructions

##### 3.3.1 SININIT

|               |                                                   |
|---------------|---------------------------------------------------|
| Syntax:       | SININIT                                           |
| Description:  | Initialize or reset the sine calibration process. |
| Type:         | Command                                           |
| Range:        | N/A                                               |
| Default:      | 0                                                 |
| Opmodes:      | All                                               |
| Drive Status: | Disabled                                          |
| Firmware:     | 6.2.0                                             |
| EEPROM:       | No                                                |
| Limitations:  | None                                              |

**3.3.2 SININITST**

Syntax: SININITST

Description: Queries the status of the sine calibration process. The following values may be returned by the query:

- 0 - no request
- 1 - process running
- 2 - motor velocity too high. The sine frequency must not exceed 250Hz. When speed is reduced, the status returns to 1 (running).
- 3 - process completed
- 4 - defaults loaded. Defaults are loaded when the calibration process has never been performed, such as in a new drive.
- 5 – Internal failure

Type: Read-only

Range: 0 .. 5

Opmodes: All

Drive Status: Enabled \ Disabled

Firmware: 6.2.0

EEPROM: No

**3.3.3 SINPARAM**

|                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |  |
|-------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| Syntax for set:   | SINPARAM <Sine offset> <Cosine offset> <Sine to Cosine match gain> <Sine to Cosine match scale> <full-scale gain> <full-scale scale> <sup>1</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |  |
| Syntax for query: | SINPARAM                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |  |
| Description:      | <p>Queries or sets the sine calibration values. There are four calibration parameters when working with a Sine Encoder, and six calibration parameters when working with a Resolver. All are signed hexadecimal values.</p> <p><u>Sine offset and cosine offset:</u><br/>Multiply by (10000/32768) to get value in Millivolts. This offset is at the ADC terminal (after the sine and cosine signals were amplified).</p> <p><u>Sin to cos match gain and scale:</u><br/>The algorithm requires that the sine and cosine signals should have the same amplitude. This value equals (gain / 2<sup>scale</sup>), and represents the amplitude difference of the sine and cosine signals. It should be close to 1. The firmware multiplies the Sine signal samples by this value to get the same amplitude for the Sine and the Cosine signals.</p> <p><u>Full-scale gain and scale (relevant for Resolver ONLY):</u><br/>The algorithm requires that the sine and cosine signals should be scaled to 32768. The final value equals (gain / 2<sup>scale</sup>), and it represents the factor to multiply the sine and cosine signals. It should be in the range 1.2 to 1.3. The firmware multiplies the sine <i>and</i> cosine signals samples by this value.</p> |  |
| Type:             | Read only                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |  |
| Range:            | <p>Sine offset: -32768 .. 32767</p> <p>Cosine offset: -32768 .. 32767</p> <p>Sine to Cosine match gain: 1 .. 32767</p> <p>Sine to Cosine match scale: 1 .. 15</p> <p>full-scale gain: 1 .. 32767</p> <p>full-scale scale: 1 .. 15</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |  |
| Default:          | 0h 0h 4000h Eh 4000h Eh (last 2 are for Resolver ONLY)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |  |
| Units:            | Internal                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |  |
| Opmodes:          | All                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |  |
| Drive Status:     | Disabled                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |  |
| Firmware:         | 6.3.3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |  |
| EEPROM:           | Yes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |  |
| Limitations:      | Not yet supported by MotionLink                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |  |

<sup>1</sup> Last 2 parameters relevant for Resolver feedback only

## 4. Encoder Initialization

### 4.1 Overview

In brushless 3-phase motors the torque generated by the motor depends on the three phase currents and on the motor position. In order to properly control the motor and extract maximum torque out of the available motor and power stage, the controller must be provided with the current motor position. In encoder-based systems, the initial position for commutation initialization may be found using hall sensors switching, index finding, or an appropriate commutation-lock algorithm (or a combination of the three methods).

Encoder initialization without motion uses a commutation-lock algorithm.

Since, on power up, the absolute motor position is unknown, two methods may be implemented:

- Applying a forced commutation to move the motor to a predetermined position where the torque generated is zero and updating controller variables accordingly.
- Using a motion control algorithm that will “bring” the commutation angle of the motor from the initial, unknown position to the current motor position (instead of moving the motor).

The first method described is currently implemented on the ServoSTAR™ CD. The disadvantage of this method is that it requires the motor to be moved, which produces a “jumpy” motion that may not be tolerable in some cases (for example - linear motors applications).

The second method is designed to solve this problem by implementing a closed loop commutation-lock algorithm that adjusts the commutation angle to the motor position rather than moving the motor to a predetermined place. The motor will move very slightly; motion of at least  $\pm 4$  electrical degrees is expected.

### 4.2 The Process

1. Disable the drive
2. Select the encoder initialization process by entering the instruction *INITMODE 2*
3. Set the encoder initialization current using the *INENCSTART* instruction. Set this to the maximum allowed application current.
4. Set the gain for the process using the *INITGAIN* instruction. This gain is typically set to 1000.
5. Initialize the process by entering the instruction *ENCSTART*
6. Begin the process by enabling the drive
7. Monitor the process by reading the status word *STATUS2* and the status of *ACTIVE*

If the process completes successfully, the drive will be enabled, and *ACTIVE* will be set to 1. If the process is not successful, bit 2 in the first word of *STATUS2* will be set.

### 4.3 The Instructions

#### 4.3.1 INITMODE

|                   |                                                                                                                                             |
|-------------------|---------------------------------------------------------------------------------------------------------------------------------------------|
| Syntax for set:   | INITMODE <value>                                                                                                                            |
| Syntax for query: | INITMODE                                                                                                                                    |
| Description:      | Selects the encoder initialization mode. Modes 0 and 1 both cause motor movement, while mode 2 initializes the encoder with minimal motion. |
| Type:             | R/W                                                                                                                                         |
| Range:            | 0: soft exponential ramp of the current (motor will rotate CW and                                                                           |

CCW several times, fault occurs if unsuccessful)  
 1: hard step (motor jerks into position, fault occurs if unsuccessful)  
 2: Initialization with minimal motion

Default: 0  
 Opmodes: All  
 Drive Status: Disable  
 EEPROM: Yes

**4.3.2 STATUS2**

Syntax for query: STATUS2

Description: Returns drive status words to the serial port. Six words are transferred in ASCII-HEX format, with each word preceded by the letter "H". The encoder initialization status is reported in word 5, which is described below. Bit 2 in the first word indicates if the encoder initialization process has failed.

Range: The bits in status word 5 are described in the following table. Bits 4-7 are relevant for INITMODE 2.

| STATUS2 Word 5:<br>Encoder Initialization Status Word                                                                                                                          |                                                                                                                                                                                                           |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| If the drive has experienced a fault during encoder initialization (Bit 5 of STATUS Word 1 = 1), the condition that caused that fault will have its bit set to 1 in this word. |                                                                                                                                                                                                           |
| Bit                                                                                                                                                                            | Description                                                                                                                                                                                               |
| 0 (LSB)                                                                                                                                                                        | MENCRES, MPOLES or low IENCSTART failure                                                                                                                                                                  |
| 1                                                                                                                                                                              | Phase A current mismatch                                                                                                                                                                                  |
| 2                                                                                                                                                                              | Phase C current mismatch                                                                                                                                                                                  |
| 3                                                                                                                                                                              | Limit switch tripped                                                                                                                                                                                      |
| 4                                                                                                                                                                              | Internal fault                                                                                                                                                                                            |
| 5                                                                                                                                                                              | Runaway – algorithm failed to due excessive motion. This may be due to the values of either IENCSTART or INITGAIN being too high. Make sure IENCSTART is set correctly, and reduce the value of INITGAIN. |
| 6                                                                                                                                                                              | Motion profile mismatch. Adjust the value of INITGAIN.                                                                                                                                                    |
| 7                                                                                                                                                                              | Insufficient motion. Increase IENCSTART or INITGAIN.                                                                                                                                                      |
| 8-15                                                                                                                                                                           | Not used                                                                                                                                                                                                  |

Default: 0  
 Opmodes: All  
 Drive Status: Disable  
 EEPROM: Yes

**4.3.3 INITGAIN**

|                   |                                                                  |
|-------------------|------------------------------------------------------------------|
| Syntax for set:   | INITGAIN <value>                                                 |
| Syntax for query: | INITGAIN                                                         |
| Description:      | Sets the gain for the encoder initialization process controller. |
| Type:             | R/W                                                              |
| Range:            | 100 - 10000                                                      |
| Default:          | 1000                                                             |
| Opmodes:          | All                                                              |
| Drive Status:     | Disable                                                          |
| EEPROM:           | Yes                                                              |
| Limitations:      | Not yet supported by MotionLink                                  |

## 5. Software Resolver Interface

### 5.1 Overview

The resolver-to-digital (RDC) conversion is done in the Series 5 products using software techniques, as opposed to using a dedicated integrated circuit. The benefits of this mechanism include:

- Enhanced system performance, since the resolution is not a function of the velocity.
- Increased accuracy due to the ability to calibrate and match the Sine and Cosine signals
- Increased reliability due to the use of fewer components

### 5.2 The Process

The SW resolver implements a 2nd order tracking filter which uses feed-forward to zero (ideally) the tracking error for constant speed. RESBW is the filter bandwidth and the tradeoff is: the higher the bandwidth, the faster the response but the more the system will be prone to noise.

The Sine and Cosine signals of the resolver should be calibrated in order to increase the accuracy of the measurement. The calibration process is described above in the section "Sine/Cosine Calibration". This process is initialized automatically at each power up; old parameters are used until the calibration process can generate new parameters. Thus, there is no need to explicitly enter the SININIT instruction.

### 5.3 The Instructions

#### 5.3.1 RESBW

|               |                                                                                                       |
|---------------|-------------------------------------------------------------------------------------------------------|
| Syntax:       | <b>RESBW &lt;value&gt;</b> to set the cut-off frequency<br><b>RESBW</b> to read the cut-off frequency |
| Description:  | Set the cut-off frequency of the filter                                                               |
| Type:         | Switch mode (R/ W)                                                                                    |
| Range:        | 300, 600, 1200                                                                                        |
| Units:        | Hz                                                                                                    |
| Default:      | 600                                                                                                   |
| Opmodes:      | All                                                                                                   |
| Drive Status: | Disabled                                                                                              |
| Firmware:     | 6.3.3                                                                                                 |
| EEPROM:       | No                                                                                                    |
| Limitations:  | None                                                                                                  |

## 6. Extended I/O

### 6.1 Overview

The ServoSTAR™ CD Series 5 hardware has been designed to have 3 additional digital inputs, which is in addition to the standard I/O present on the ServoSTAR™ CD. The Extended I/O is **not** available on the PicoDrive. These inputs are accessible through the 20-pin connector that is located on the top of the drive. The pins on this connector are arranged in two rows (A & B) of 10.

### 6.2 Connector Pin-Out

| Pin no | Function              | Description           | Comments       |
|--------|-----------------------|-----------------------|----------------|
| A1     |                       |                       |                |
| B1     |                       |                       |                |
| A2     |                       |                       |                |
| B2     |                       |                       |                |
| A3     | IN5                   |                       | Bi-directional |
| B3     | IN4                   |                       | Bi-directional |
| A4     |                       |                       |                |
| B4     | IN6                   |                       | Bi-directional |
| A5     |                       |                       |                |
| B5     | Common For IN4 to IN6 | Common For IN4 to IN7 |                |
| A6     |                       |                       |                |
| B6     |                       |                       |                |
| A7     |                       |                       |                |
| B7     |                       |                       |                |
| A8     |                       |                       |                |
| B8     |                       |                       |                |
| A9     |                       |                       |                |
| B9     |                       |                       |                |
| A10    |                       |                       |                |
| B10    |                       |                       |                |

## 6.3 The Instructions

### 6.3.1 INx

|               |                                                                                                                                              |
|---------------|----------------------------------------------------------------------------------------------------------------------------------------------|
| Syntax:       | IN4 (to read the value of digital input # 4)<br>IN5 (to read the value of digital input # 5)<br>IN6 (to read the value of digital input # 6) |
| Description:  | This is used to read the state of the digital inputs on the extended I/O connector.                                                          |
| Type:         | Switch (Read-only)                                                                                                                           |
| Range:        | 0 (OFF), 1=( ON)                                                                                                                             |
| Units:        | N/A                                                                                                                                          |
| Opmodes:      | All                                                                                                                                          |
| Drive Status: | Enabled \ Disabled                                                                                                                           |
| Firmware:     | 6.3.3                                                                                                                                        |
| EEPROM:       | No                                                                                                                                           |

**6.3.2 INxMODE**

|               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|---------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Syntax:       | IN4MODE <value><br>IN5MODE <value><br>IN6MODE <value>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Description:  | <p>INxMODE sets the functionality of the Inx input, where "x" is one of 4, 5, or 6. The function list is:</p> <p>INXMODE= 0: No function<br/> INXMODE= 1: CW limit switch<br/> INXMODE= 2: CCW limit switch<br/> INXMODE= 7: Trigger incremental move / jog<br/> INXMODE= 8: Use second current limit (ILIM2)<br/> INXMODE= 9: Switch OPMODE from 1 to 3<br/> INXMODE= 12: Search for absolute machine zero/ Move to absolute machine zero (home)<br/> INXMODE= 13: Trigger absolute move (MAPOS at MASPEED)<br/> INXMODE= 14: Binary MIDIST / MISPEED selection code MSB<br/> INXMODE= 15: Binary MIDIST / MISPEED selection code LSB<br/> INXMODE= 17: Trigger active disable (see DISSPEED)<br/> INXMODE= 18: Control fault relay (see Notes below)<br/> INXMODE= 19: Hold position<br/> INXMODE= 20: When OPMODE= 1, an active input switches to OPMODE= 4 (must be disabled or 0 velocity)<br/> INXMODE= 21: Trigger incremental move (see Notes below)<br/> INXMODE= 22: Triggers incremental move when MODMODE= 1. Distance = (PROTARY / DIVISIONS)<br/> INXMODE= 23: Trigger incremental move when MODMODE= 1. Distance = (2 * PROTARY / DIVISIONS)<br/> INXMODE= 24: Change OPMODE 8 to OPMODE 4 using digital input.<br/> INXMODE= 25: Upon transition from 0 to 1, the faults are cleared if REMOTE= 0 or SWEN= 0.<br/> INXMODE=26: Upon transition from 0 to 1, the number of counts represented by PFB will be output on the Equivalent Encoder Output, interrupting the regular generation of equivalent encoder output pulses. The digital Output (O1) will be set high if O1MODE is set to the value 13. At the end of the generation of the PFB pulses, the equivalent encoder output will revert to generation of encoder pulses, and the digital output will be set lo.</p> |
| Type:         | Switch Mode (Read/Write)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Range:        | 1,2,7,8,9,12,13,14,15,17,18,19,20,21,22,23,24,25                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Default:      | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Units:        | N/A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Opmodes:      | dependent on function                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Drive Status: | Enabled \ Disabled                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Firmware:     | 6.3.3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| EEPROM:       | No                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |

**6.3.3 ININVx**

Syntax: ININV4 <value>  
ININV5 <value>  
ININV6 <value>

Description: INxMODE is used to invert the polarity of digital inputs 4, 5 and 6.

Type: Switch Mode (Read/Write)

Range: 0 – user input not inverted.  
1 – user input inverted.

Default: 0

Units: N/A

Opmodes: dependent on function

Drive Status: Enabled \ Disabled

Firmware: 6.3.3

EEPROM: No