

KC1

User Guide



Edition January 2013, Revision B

Valid for Firmware version 1.8

Patents Pending

Part Number 903-400006-00

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

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Record of Document Revisions:

Revision	Remarks
06/2012	Initial Release
01/2013	Updated for firmware release 1.8

Hardware Revision (HR)

Hardware Revision	Recommended Firmware	Minimum Firmware	Recommended Workbench	Minimum Workbench	Remarks
A	M_01-08-00-003	M_01-06-06-001	1.8.0.xxxxx	1.6.6.xxxxx	Initial Revision

EnDat is a registered trademark of Dr. Johannes Heidenhain GmbH

Windows is a registered trademark of Microsoft Corporation

Current patents:

US Patent 5,646,496 (used in control card R/D)

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

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

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

Printed in the China

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1 About the KC1 User Guide

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1.1 About this User Guide

This guide describes the operation and use of the KC1 drive. Each section details a specific topic related to the use of the product in basic terms which will help you get the most from the product. Each section includes examples to help guide you in setting up and using the various features available in the drive.

This guide is for users who have installed and tested the drive according to the *KC1 Installation Manual*. The *KC1 Installation Manual* is included on the Kollmorgen website and contains critical safety information.

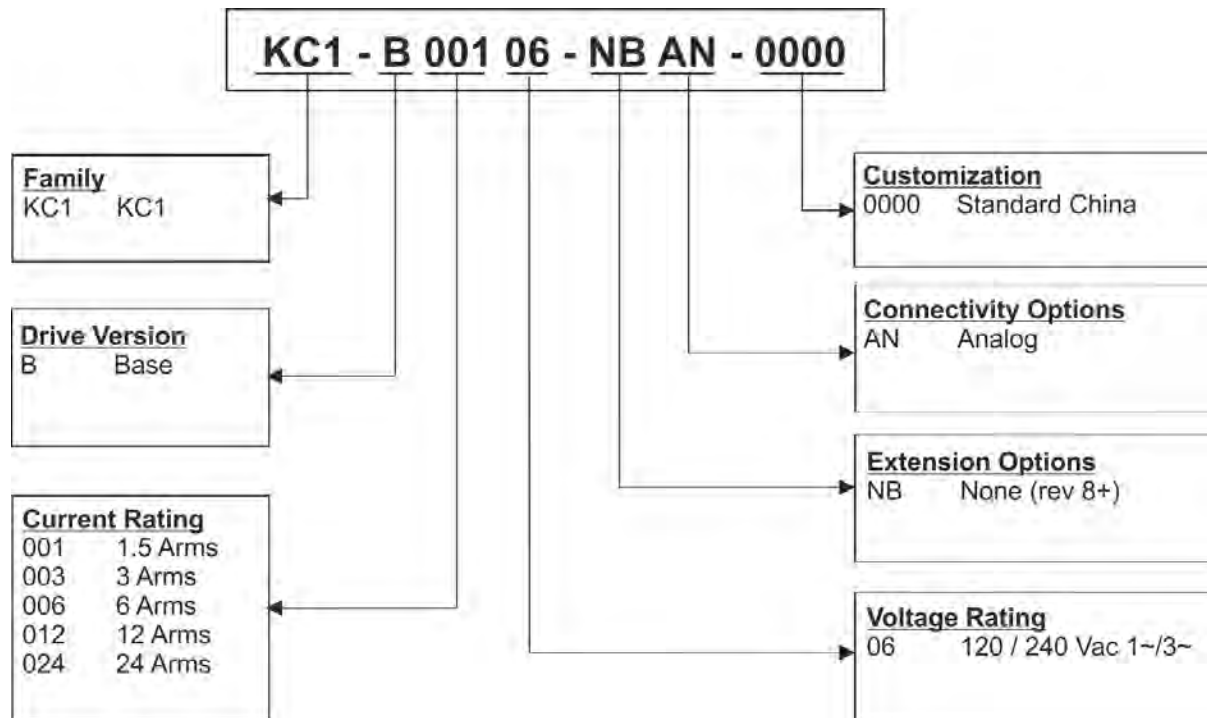
1.2 Abbreviations

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

2 KC1 Models

KC1 drive models are available in a variety of combinations of features. The part number identifies the features included in your model.

The figure below shows part number identification for drive features.



3 Initial Drive Setup

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3.1 Initial Drive Setup

The [KC1 Quick Start Guide](#) provides details for initial drive setup. Initial drive setup consists of the following general steps:

Hardware Installation:

1. Install the drive on your conductive panel and connect the Protective Earth ground.
2. Connect the logic power you will need to operate all of the control logic to X1.
3. Connect the motor power to X2.
4. Connect the feedback to X10.
5. Connect the inputs and outputs you will be using on X7 and X8.
6. Bring AC power to the unit and connect AC power to X3 or X4.
7. Connect drive communications to X11.
8. Confirm that you can communicate with the drive and that your PC is linked to the KC1.

Software Installation and Drive Communication Setup:

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

WorkBench System Requirements

Required Components: Microsoft .NET Framework 2.0

Supported Operating Systems:

- Windows XP
- Windows Vista
- Windows 7

3.2 Display Codes

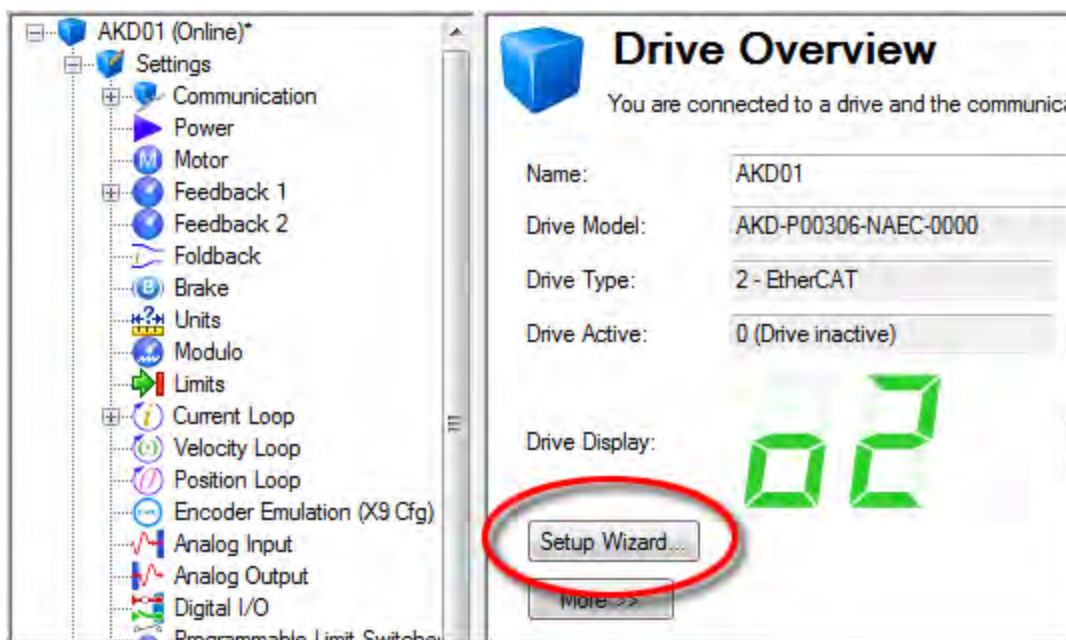
During drive operation the drive display shows the following codes depending on the drive status.

Display Code	Status
o0	Normal operation, current mode, no faults
o1	Normal operation, velocity mode, no faults
o2	Normal operation, position mode, no faults
F [3 digit code, flashing]	Fault (see Fault and Warning Messages)
n [3 digit code, flashing]	Warning (see Fault and Warning Messages)
I,P [IP address]	Displaying drive IP address
--	Powered on and FPGA loading. If continuous then operational and resident FPGA images are corrupt.
[.]	Drive enabled
[.] (flashing)	Drive in an internal dynamic brake mode (DRV.ACTIVE (pg 365) = 3).
dd	Operational started reboot, waiting for the resifnet to start.
d2	Firmware download: corrupted operational FPGA; resident FPGA is functional.
d3	Firmware download: HW download (HW switch was pressed - Rev 3 and higher).
d4	Firmware download: Corrupted operational FW.
d5	Firmware download: SW download (download command was issued from the operational FW).
d9	Start firmware download
dL	Loading image process is running.

Display Code	Status
dF (flashing)	Failure during firmware download.
Sb	Special mode: Burn-in
Fr	Blackfin Reset
] [Resident completed and waiting for the operational to start
FP	Kernel Panic
FE	Blackfin Exception

3.3 KC1 Setup Wizard

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



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

4 Connecting the Drive

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4.1 Connected and Disconnected States

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

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

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

4.2 Disconnected

When WorkBench is disconnected from a drive, no communication exists between your PC and the drive. The drive becomes disconnected because of one of the following conditions:

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

To restore communication:

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

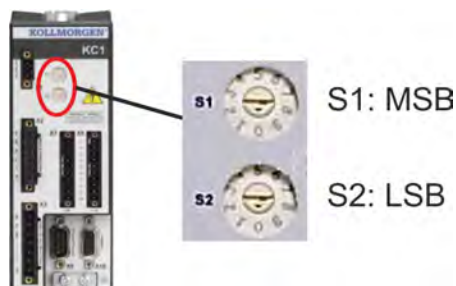
4.3 Setting the IP Address

The IP address can be flashed across the LED display if the B1 button is pressed.



4.3.1 Setting the IP Address with Rotary Switches

You can use the rotary switches to set the IP address of the KC1.



Rotary Switch Setting	Drive IP Address
00	DHCP/AutoIP address. The IP address of the drive is obtained from the DHCP server on your network. If no DHCP server is found the IP addresses is an AutoIP address (it is internally generated following the AutoIP protocol and will be of the form 169.254.xx.xx).
01 to 99	Static IP Address. The IP address is 192.168.0.nn, where nn is the number from the rotary switch. This setting generates addresses in a range from 192.168.0.1 to 192.168.0.99. Example:if S1 is set to 2 and S2 is set to 5 – the IP address is 192.168.0.25

NOTE

The PC subnet mask must be set to 255.255.255.0 or 255.255.255.128
 When connecting the KC1 directly to a PC, use static IP addressing (not 00).

Static IP addressing

When connecting the drive directly to a PC, static IP addressing must be used. Set rotary switches S1 and S2 to a number different from 00.

This setting generates addresses in a range from 192.168.0.001 to 192.168.0.099.

Dynamic IP addressing (DHCP and Auto-IP)

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

If your PC is directly connected to the drive, and set to obtain an IP address automatically in the TCP/IP settings, a connection will be established with both devices using compatible automatically generated addresses. It can take up to 60 seconds for a PC to configure an Automatic Private IP Address (169.254.x.x).

Changing the IP address

If the switches are altered while 24 V Logic power is supplied to the drive, you must switch off and then switch on again the 24 V supply voltage. This action will reset the address.

4.3.2 Setting IP address with Software

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

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

Mode 0

Rotary Switches (default)

Mode 1

Fixed IP address (insert fixed TCP/IP). Use this mode to set a fixed IP address for the drive which is independent of the rotary switches.

Mode 2

DHCP/IP independent of the rotary switches. This is the same behavior as switch setting "00" in Mode 0, however it allows the user to still use the rotary switch settings.

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

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

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

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

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

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

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



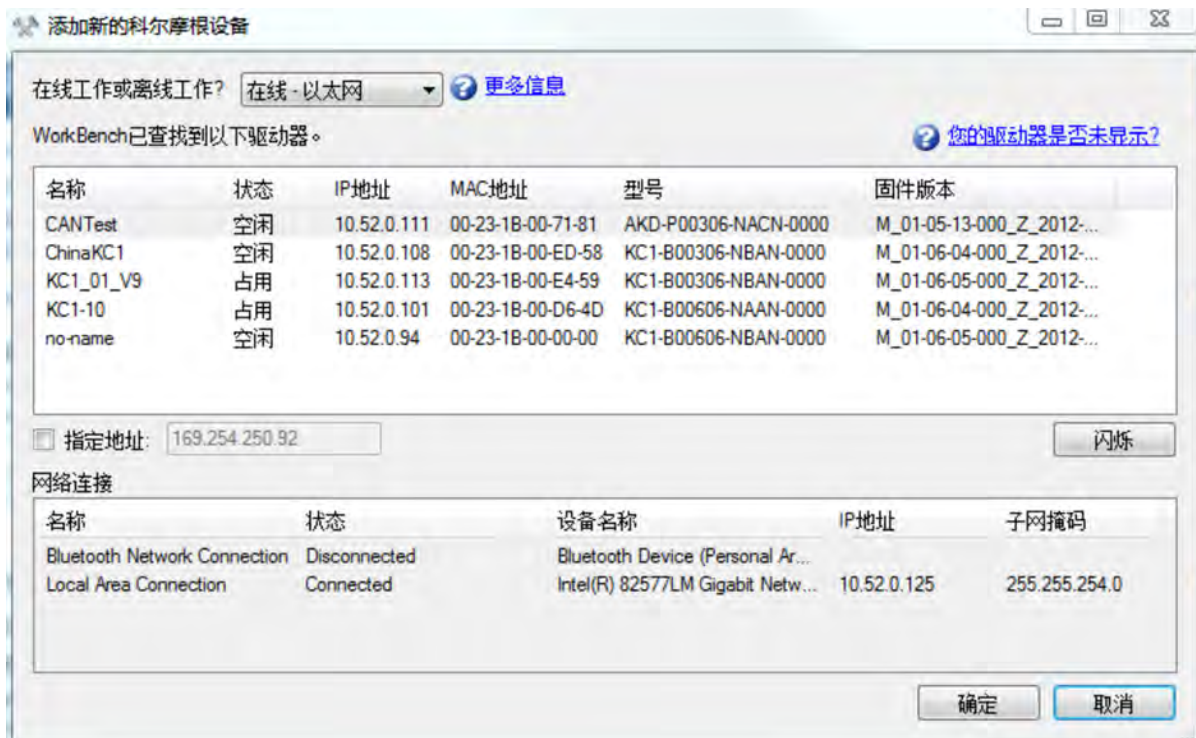
4.4 Confirm Connection with the Drive

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

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

4.5 Connect To Another Drive

Click on [Add New Kollmorgen Device...](#) in the bottom left corner of WorkBench to bring up the following window:



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

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

Button or Dialog Box	Description
Status	Only one user at a time can connect to a drive. If someone else is connected to the drive, it is Busy . If Free is displayed, then you can connect.
Blink	Clicking Blink forces the display on the selected drive to alternate between the whole display being on and the whole display being off for 20 seconds.
MAC Address	Displays the MAC address of the drive. The MAC address is unique and is also printed on the label on the side of the drive.
IP Address	Displays the IP address of the drive. You can enter a raw IP address (1.2.3.4) or a DNS name. You can also specify a port number different from the default (port 23) by appending the IP address (for example, 1.2.3.4:1000).
Specify Address	If your drive does not appear in the list, you can enter its IP address (for example, 1.2.3.4) or a DNS name. You can also specify a port number different from the default (port 23) by appending the IP address (for example, 1.2.3.4:1000).
Configure Discovery Protocol	<p>After selecting a discovery protocol from the list below, you can configure the discovery mode using the following four options:</p> <ol style="list-style-type: none"> 1. Ping 2. Broadcast 3. Broadcast and Ping 4. No Discovery

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4.6 Troubleshooting Connection and Communication Problems

4.6.1 Device Not Shown

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

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

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

4.6.2 Find and Enter IP Address

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

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

5 Communicating with the Drive

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5.1 Overview

In order to use the drive, you must be able to communicate with the drive using WorkBench and an Ethernet connection. With some basic network knowledge, you can quickly establish communication with your drive. The drive uses TCP/IP (a worldwide standard for high-speed communication); both the KC1 and your PC need to understand each other through this standard in order to communicate. This section explains how to establish a TCP/IP link between your PC and a drive.

5.2 Identifying the Drive IP Address

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

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

NOTE

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

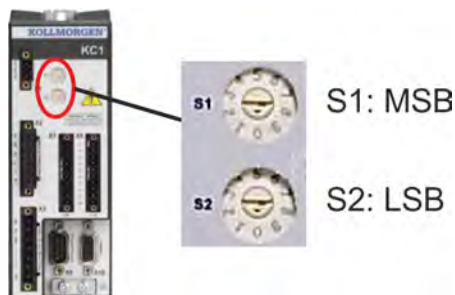
5.2.1 Automatic (Dynamic) IP Addressing

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

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

5.2.2 Static IP Addressing — Rotary Switches

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



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

Example:

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

In order for the drive to connect to the PC, the PC network configuration must find this address. First, identify which network port you are using to communicate with the drive. Once you have identified the port, you can access the properties area of the network connection (on your PC) and set up the proper masking to allow the two devices to communicate. The configuration is set up in the “Use the following IP address:”. Set the IP address to 192.168.0.100 and the Subnet mask to 255.255.255.0. This allows the

two devices to recognize each other and connect point to point (note that S1 = 0 and S2 = 0 is automatic (dynamic) IP addressing).

Rotary Switch Functions

The following rotary switch settings are used to perform specific functions. After setting the rotary switches, hold down the B1 button on the top of the drive for 5 seconds.

S1	S2	Function
0	0	Resets IP address

5.2.3 Static IP Addressing — Software Assigned

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

- IP.MODE – set Mode=1 to set a static IP address. Set Mode=0 to use rotary switches or DHCP.
- IP.ADDRESS – specifies the address of the drive
- IP.SUBNET – specifies the subnet mask that the drive can communicate with
- IP.GATEWAY – specifies the gateway IP address if the drive needs to communicate outside of its specified subnet

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

Notes:

- The software assigned static IP address will take precedence over the rotary switches and DHCP.
- To revert back to DHCP settings, or to use the rotary switches to set the address, set IP.MODE=0 and issue the IP.RESET command.

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

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

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

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

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

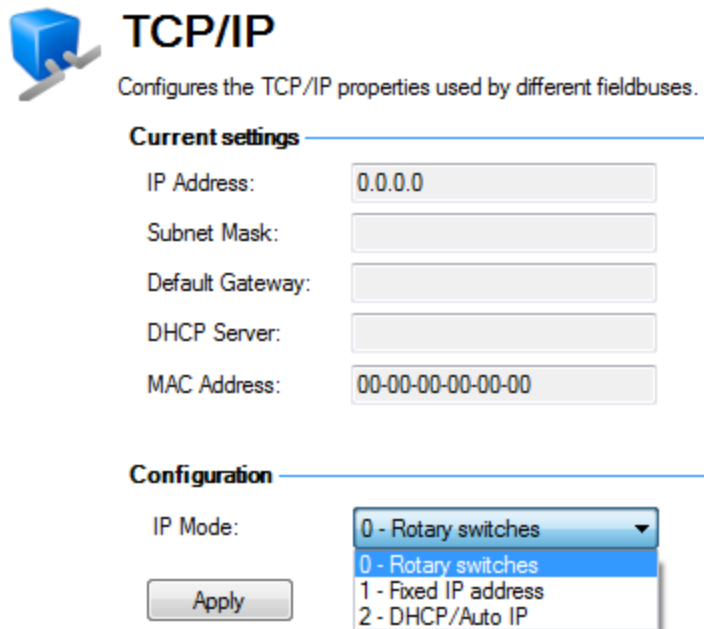
5.3 Communication View

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



5.3.1 TCP/IP View

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



5.3.1.1 TCP/IP Communication Protocols

IP Address

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

MAC Address

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

Every KC1 drive is given a unique MAC address when it is manufactured and this MAC address cannot be changed. The MAC address of every drive is printed on the sticker on the side of the drive.

5.4 Rotary Switches

5.4.1 Overview

The rotary switches on the KC1 are used for configuring the drive without the need for a GUI:

5.4.2 Rotary Switch functions

- IP/Network Addressing (refer to)

6 Using WorkBench

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6.1 Welcome Screen

This view lets you select which KC1 drive you wish to work with. You can work with a physical drive via the Ethernet port of your PC ([online](#)) or with a drive simulation ([offline](#)).

KOLLMORGEN [®] [Learn more about this topic](#)
[Quick Start Guide](#)

Because Motion Matters™

Welcome to Kollmorgen WorkBench.
 Do you want to work online or offline? Online - Ethernet [Tell me more](#)

WorkBench has found the following drives. [Is your device is not shown?](#)

Name	Status	IP Address	MAC Address	Model Number	Firmware Version
AKD_SQ	Free	10.50.67.50	00-23-1B-00-51-D5	AKD-B00606-NASQ-0000	M_01-06-06-000
dusty	Free	10.50.67.78	00-23-1B-00-53-AF	AKD-P00306-NAEC-0000	M_01-06-00-003
GEAR_01	Busy	10.50.67.32	00-23-1B-00-01-58	AKD-P00606-NAEC-0000	01-06-07-000-33306-alpha
GEAR_02	Free	10.50.67.62	00-23-1B-00-50-9E	AKD-P00306-NAEC-0000	01-06-07-000-33306-alpha
loOpt1	Free	10.50.67.58	00-23-1B-00-E3-23	AKD-P00306-ICAN-0000	M_01-06-06-000
loOpt2	Busy	10.50.67.55	00-23-1B-00-E5-65	AKD-P00306-ICAN-0000	M_01-06-07-000
KASBox2JB	Busy	10.50.67.81	00-23-1B-00-50-AA	AKD-P00306-NAEC-0000	M_01-06-00-003
MMDP	Free	10.50.67.77	00-23-1B-F0-00-6D	AKD-M00306-MCEC-0000	M_01-06-00-003

Specify Address: Blink Connect

Network Connections Configure Discovery Protocol

Name	Status	Device Name	IP Address	Mask	Discovery Proto...
Bluetooth Network Connection	Disconnected	Bluetooth Device (Per...			Broadcast & Ping
Local Area Connection	Connected	Intel(R) 82577LM Giga...	10.50.67.44	255.255.255.0	Broadcast & Ping
Wireless Network Connection	Connected	Intel(R) Centrino(R) Ad...	10.50.71.19	255.255.255.128	Broadcast & Ping

6.2 Online

Select **Online** to display a list of the KC1 drives that WorkBench has found on your local network. You can select one of these drives from the list and click to continue. This will connect you to the drive and you will be given the option to use a wizard to setup the drive.

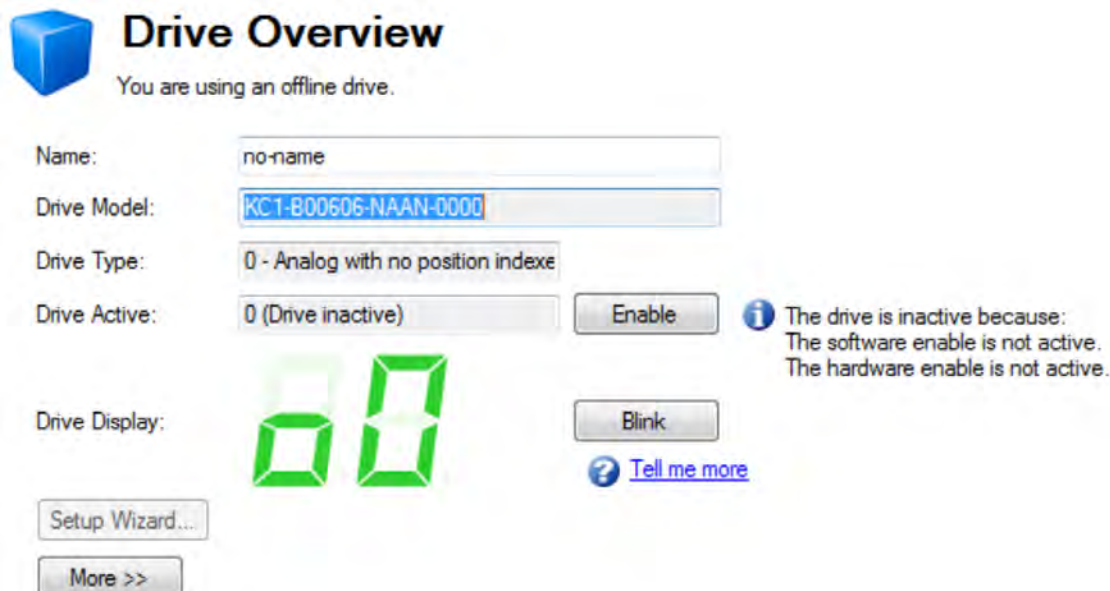
Button or Dialog Box	Description
Name	The name that someone has given the drive. By default, the name is "No_Name". You can change the name by connecting to the drive and navigating to the top item in the navigation tree.
Status	Only one user can connect to an KC1 at a time. If someone else is connected to the drive, then the status is Busy . If no one is connected to the drive, then the status is Free and you will be able to connect.
Blink	Clicking Blink will force the display on the selected drive to repeatedly flash the display LEDs.
MAC Address	This is the MAC address of the drive. The MAC address is unique and is also printed on the label on the side of the drive.
IP Address	This is the IP address of the drive.
Specify Address	If your drive does not appear in the list, you can enter its IP address (e.g. 1.2.3.4) or a DNS name. You can optionally specify a port number different than the default port 23 by appending it. For example, 1.2.3.4:1000 would be port 1,000.

6.3 Offline

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

6.4 Drive Overview

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



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

Button or Dialog Box	Description	Parameter
Name	Names each drive in use with a unique identifier.	DRV.NAME (pg 412)
Drive Model	Displays the model number of this drive. The model number is also on the label on the side of the drive. If you are offline , then you can change the type of drive that you are simulating.	DRV.INFO (pg 403)
Drive Type	Selects the drive type for your drive. Only "0-Analog with no position indexer" available for KC1.	DRV.TYPE (pg 427)
Drive Active	The drive is active when it is enabled and also supplies voltage to the motor.	DRV.ACTIVE (pg 365)
Enable	Click Enable to turn on the power stage in the drive and apply voltage to the motor. This command may fail for many reasons; see "DRV.EN " (=> p. 390) for further details.	DRV.EN (pg 390)
Disable	Click Disable to turn off the power stage and remove the voltage applied to the motor.	DRV.DIS (pg 377)
Drive Display	This graphic replicates the two-digit seven-segment display located on the front face of the drive. The seven-segment display shows a code that indicates the state of the drive and any faults that may be present. WorkBench shows a copy of what the drive display currently shows. A key to the display is here .	

Button or Dialog Box	Description	Parameter
Blink	Click Blink to force the display to alternate between the whole display being on and the whole display being off for 20 seconds. You can use this button to confirm that you are communicating with the correct drive hardware.	DRV.BLINKDISPLAY (pg 366)
Setup Wizard	The Setup wizard takes you through the essential configuration steps so that you can control the motor movement.	
More	Click More to display Serial Number, Firmware Version, Cumulative On Time, and Update Firmware.	
Serial Number	This text box displays the unique serial number of the drive you are communicating with. The serial number is also shown on the label on the side of the drive.	DRV.INFO (pg 403)
Firmware Version	This text box displays the version of the firmware code running inside the drive.	DRV.VER (pg 428)
Download	Click Download to retrieve the latest KC1 firmware from Kollmorgen™. See Downloading Firmware (pg 251)	
Cumulative On Time	This text box displays the cumulative time this drive has been powered on. When the drive is powered on, this value continues counting from the value it had when the drive was last turned off.	DRV.RUNTIME (pg 421)
Update Firmware	Use this box to select the firmware version you want your drive to run.	

6.4.1 Online and Offline

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

6.4.1.1 Online Drive

An "online drive" means that WorkBench is working with a specific physical drive on your network. Each online drive can either be connected to WorkBench (WorkBench has an active connection with the drive and data is being passed between WorkBench and the drive) or it can be disconnected (there is no communication between WorkBench and the drive). If communications are lost (for example a network cable is disconnected) with a drive then WorkBench will switch the drive to the disconnected state. Only one PC can be connected to a drive at a time.

6.4.1.2 Offline Drive


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

6.4.1.3 Switching Between Online and Offline

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



6.5 Watch

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

The watch window displays at the bottom of the WorkBench screen. By default, the watch window shows position, velocity, and current for the selected drive. The list can be customized as shown below.

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



6.6 Settings

6.6.1 Navigation Tree

The Settings view allows you to configure the drive to fit your specific application. When you click Settings in the navigation pane located to the left of the WorkBench screen, additional views for configuring your drive appear. By default, only settings applicable to your current drive operation mode and command source will appear in this tree. To show all settings available for the KC1 (even if these settings are not used with the current operation mode and command source), right click on **Settings** and select **Show all Settings**.

6.6.2 Settings View

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

Settings

Select which mode of operation and command source the drive should work in.

Command Source:

0 - Service
▼

Operation Mode:

2 - Position Mode
▼

i Gearing command source requires operation mode to be Position.

Home

Motion Task

Service Motion

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

Related Topics

Using Command Source and Operating Modes (pg 112) for details on configuring the drive for your application.

7 Configuring Drive Power

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7.1 Power

7.1.1 Drive Setup for Power and Bus

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

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

Button or Dialog Box	Description	Parameter
Measured Bus Voltage	Reads the current DC bus voltage.	VBUS.VALUE (pg 693)
Over Voltage Fault Level	Reads the over voltage fault level.	VBUS.OVFTHRESH (pg 687)
Under Voltage Fault Level	Reads the under voltage fault level.	VBUS.UVFTHRESH (pg 690)
Under Voltage Fault Mode	Sets under voltage mode.	VBUS.UVMODE (pg 691)
Operating Voltage	Sets the operating voltage.	VBUS.HALFVOLT (pg 686)
Regen Resistor Type	Sets the regen resistor type to either -1-External Regen or 0-Internal Regen (if available) .	REGEN.TYPE (pg 652)
Regen Power	Reads the regen power (only visible for external regen).	REGEN.POWER (pg 648)
External Regen Resistance	Sets the external, user-defined regen resistor resistance (only visible for external regen).	REGEN.REXT (pg 650)
External Regen Heat Up Time	Sets the external regen resistor thermal protection time constant (only visible for external regen).	REGEN.TEXT (pg 651)
External Regen Power	Sets the regen resistor's power fault level for an external regen resistor (only visible for external regen).	REGEN.WATTEXT (pg 653)

See Regeneration (pg 48) for more information about regen resistors and sizing regen resistors.

7.1.1.1 Operating Voltage

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

- DC-bus over-voltage threshold (see VBUS.OVFTHRESH (pg 687)).
- The regen-resistor enable/disable voltage thresholds.
- The inrush-relay enable/disable voltage thresholds.

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

7.1.1.2 Direct DC Mains Operation

Direct DC input is available on all standard KC1 models. The DC input should be run into the AC input connection. Positive and negative DC lines should use L1 and L2 connections (polarity is not critical). L1 and L2 connections are found on either the X3 connector or the X4 connector depending on the model.

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

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

When you determine the maximum nominal DC voltage applied to the drive, you should also consider the regeneration circuit, in addition to the over voltage level. Running the drive slightly below the over voltage level is not possible because the drive does not have the capability to dissipate regenerated energy. This practice can also be harmful to the regen circuit. A good practice is not to exceed the nominal DC voltage produced by a standard AC installation. For the KC1-zzzzz06, 340 Vdc is the equivalent DC voltage for a 240 Vac supply.

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

Model	Under Voltage Level	Over Voltage Level
KC1-zzzzz06	90 Vdc	420 Vdc

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

Power
Monitor the Bus Voltage and configure the Regen. Resistor.

Bus Voltage

Operating Voltage:

Measured Bus Voltage: Vdc

Over Voltage Fault Level: Vdc

Under Voltage Fault Level: Vdc

Under Voltage Fault Mode:

Regen. Resistor

Regen. Resistor Type:

Regen. Power: W

7.2 Regeneration

7.2.1 Overview

Regeneration, or "shunting", dissipates energy from the DC bus during deceleration of the motor load. During deceleration, the motor acts as a generator that pumps energy back into the system. If this energy is not dissipated, then the bus energy level can exceed acceptable levels (VBUS.OVFTHRESH (pg 687)). If the system exceeds the maximum bus voltage, then the drive generates an over voltage fault (F501) and shuts down. A regeneration resistor, or regen resistor, is an external device that dissipates excess energy and allows the drive to function normally during deceleration.

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

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

7.2.2 Regen Resistor Options

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

Regen. Resistor

Regen. Resistor Type:	-1 - External Regen	Select Resistor:	<User Defined>
External Regen Resistance:	330		BAFP-100-33 DE-201437
External Regen Heat Up Time:	100.000		BAFP-200-33 DE-201438
External Regen Power:	1,000		BAR-250-33 DE-106254
Regen. Power:	0		BAR-500-33 DE-106255
			BAR-1500-33 DE-106258
			BAS-3000-33 DE-201407
			<User Defined>

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

NOTE

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

7.2.3 Calculating Motor Peak Energy and Regen Resistor Size

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

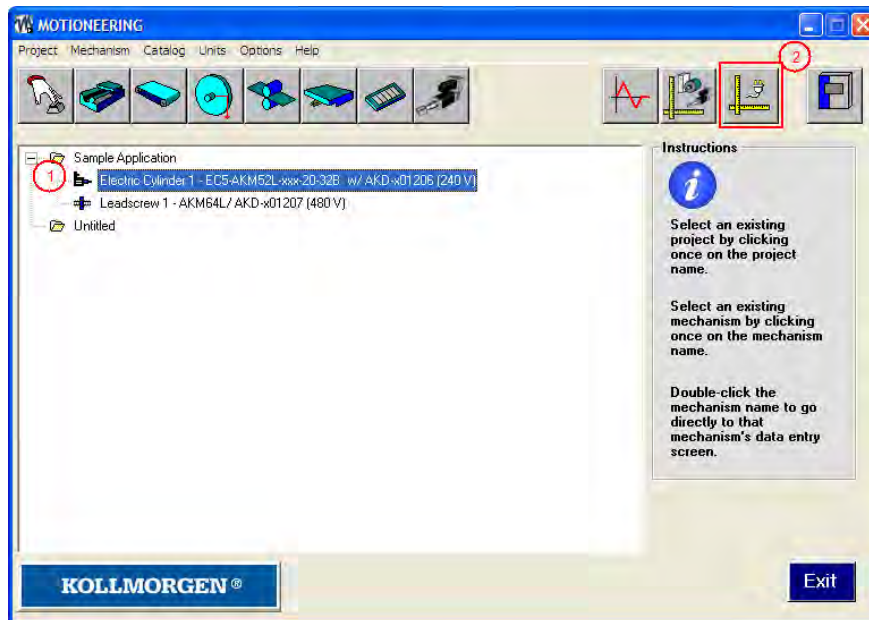
The calculation for peak kinetic energy requires values for several factors that affect the generation of energy in a motion system:

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

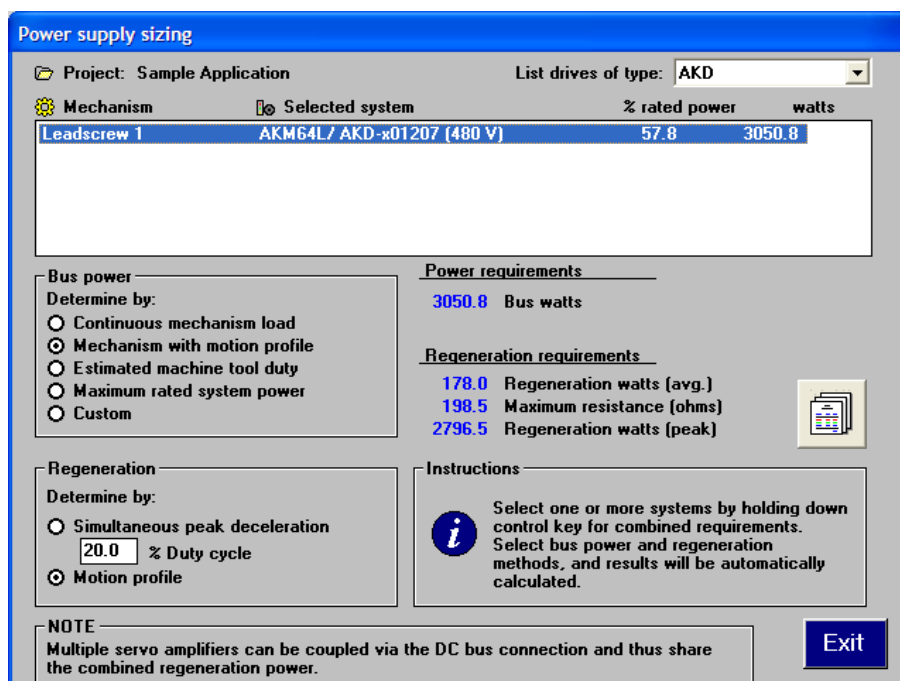
Regen resistor sizing information for your particular application can be calculated using the Motioneering® Application Engine. You can download this program here:

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

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



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



7.2.4 Selecting a Compatible Regen Resistor

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

NA Part Number	EU Part Number	Resistor Type	KC1-x-00306	KC1-x-00606	KC1-x-01206	KC1-x-02406
BAFP-100-33	DE-201437	External Resistor, 100 W, 33 ohms	x	x	x	
BAFP-200-33	DE-201438	External Resistor, 200 W, 33 ohms	x	x	x	
BAR-250-33	DE-106254	External Resistor, 250 W, 33 ohms	x	x	x	
BAR-500-33	DE-106255	External Resistor, 500 W, 33 ohms	x	x	x	
BAR-1500-33	DE-106258	External Resistor, 1500 W, 33 ohms	x	x	x	
BAS-3000-33	DE-201407	External Resistor, 3000 W, 33 ohms	x	x	x	
BAR-600-23	DE-200613	External Resistor, 600 W, 23 ohms				
BAR-1000-23	DE-200614	External Resistor, 1000 W, 23 ohms				
BAS-2000-23	DE-200615	External Resistor, 2000 W, 23 ohms				
BAS-3000-23	DE-200616	External Resistor, 3000 W, 23 ohms				
BAS-4000-23	DE-200617	External Resistor, 4000 W, 23 ohms				
BAR-500-15	DE-201439	External Resistor, 500 W, 15 ohms				x
BAR-1000-15	DE-201440	External Resistor, 1000 W, 15 ohms				x
BAS-2000-15	DE-103871	External Resistor, 2000 W, 15 ohms				x
BAS-3000-15	DE-103872	External Resistor, 3000 W, 15 ohms				x
BAS-6000-15	DE-103873	External Resistor, 6000 W, 15 ohms				x

7.2.5 Configuring Regen Parameter Values

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

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

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

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

Related Parameters

REGEN Parameters (pg 647)

VBUS.OVWTHRESH (pg 688)

VBUS.VALUE (pg 693)

8 Configuring Motor Settings

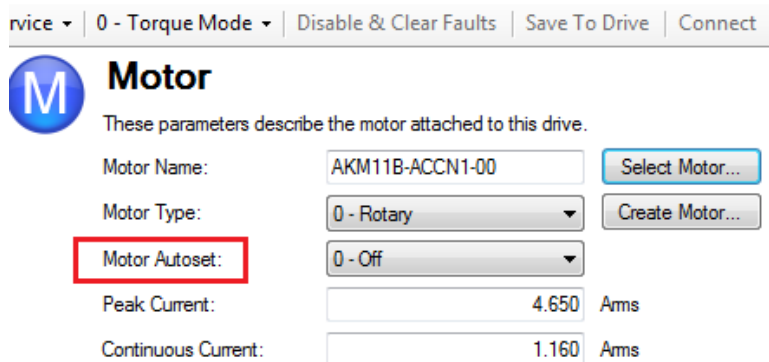
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8.1 Motor

8.1.1 Overview

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

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



All of the appropriate Kollmorgen™ motors compatible with the KC1 drive are contained in the motor database. For motors that are not listed, click **Select Motor** to open a custom motor view in which you can input the appropriate motor parameters.

8.1.2 Motor Setup

For SFD, Endat, and BiSS Mode C feedback devices, the drive will automatically be detected and the correct motor parameters will be automatically set in the KC1 drive. If your motor is detected automatically, the parameters in the **Motor** view are shaded and not accessible. If you have a non-plug and play standard device (such as an incremental encoder), you can use this screen to enter the standard AKM, Cartridge motor, DDR, or DDL motor. Other motors can be entered using the **Custom Motor** selection and setting up the parameters (see section on non memory motors). Select the standard motor from the drop-down list and select **OK**. The KC1 drive will now show all of the appropriate parameters needed for the motor to operate properly.

8.1.3 Using the Motor View

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

- **Motor Name:** The motor part number read from the autaset device, or the name from the motor database. When entering a custom motor name, the motor name should not contain any spaces.
- **Motor Type:** This field allows you to select the proper parameters for a rotary motor or a linear motor (linear motors are a future feature).
- **Motor Autaset:** This setting allows the drive to automatically set up a plug and play motor (MOTOR.AUTOSSET = 1). With **Motor Autaset** turned off (MOTOR.AUTOSSET = 0), you can access the motor database to select a catalog or custom motor.

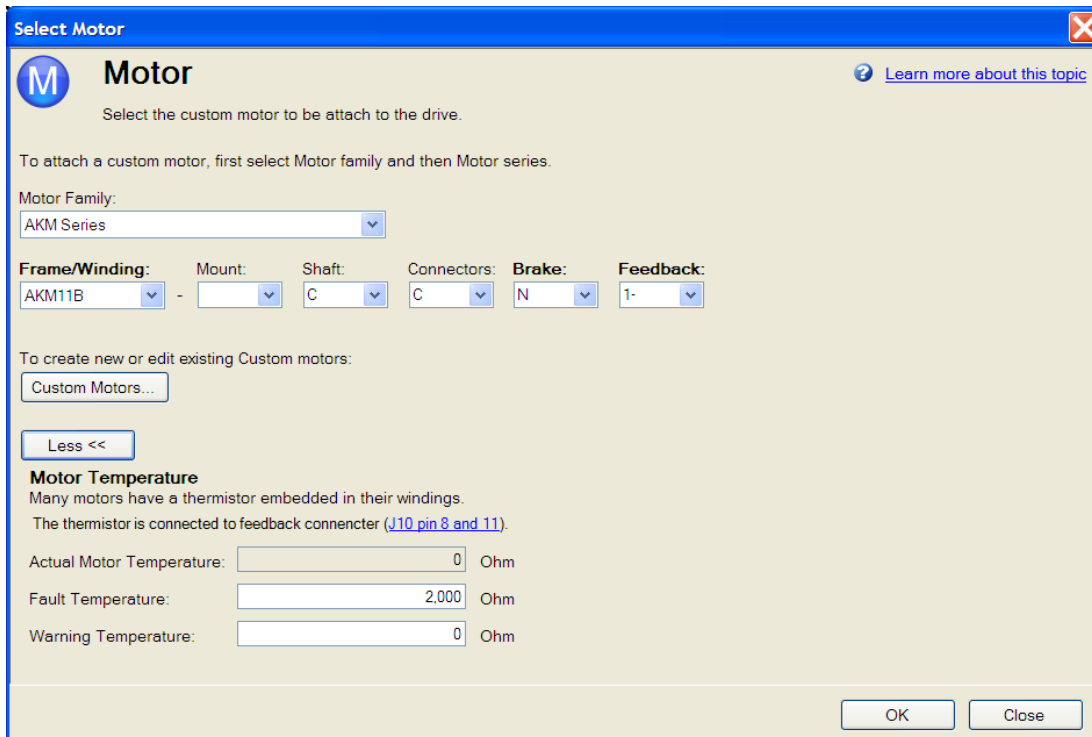
The next set of parameters displayed are specific to the electrical and mechanical characteristics of the motor connected to the KC1 drive.

- **Peak Current:** Motor peak current rating in Amps rms.
- **Continuous Current:** Motor continuous current rating in Amps rms.

- Inertia: Motor rotor inertia in Kg-cm².
- Torque Constant: Motor torque constant in Nm/Arms.
- Inductance: Motor rated inductance in milliHenries
- Motor Poles: Number of motor poles.
- Maximum Speed: Motor maximum rated speed
- Motor Resistance: Motor winding resistance in Ohms.
- Maximum Voltage: Motor maximum rated voltage in Volts rms.
- Motor Phase: Motor phase offset (used to set motor commutation as required - for most devices this is set to 0).
- Coil Thermal Constant: Motor coil thermal time constant in mHz.

8.1.4 Selecting a Motor

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



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

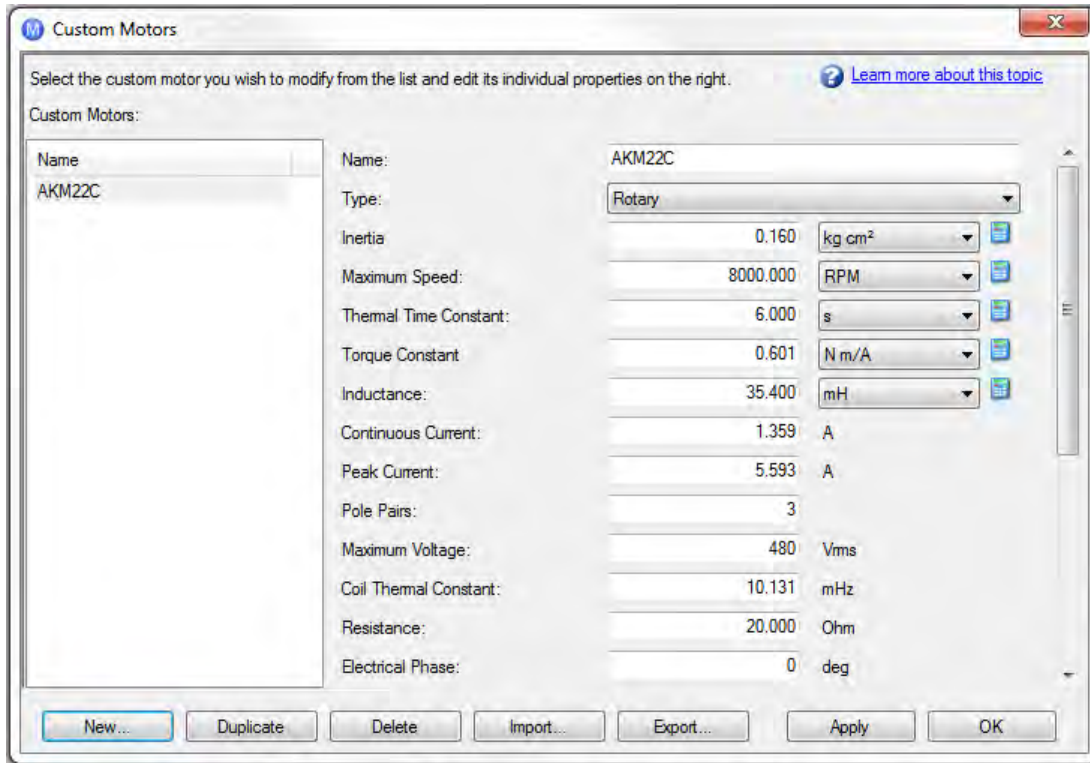
1. WorkBench first checks the motor name with custom motors for a match.
2. If a match is not found, then WorkBench checks the name with the standard motors database for a match.
3. If a match is not found, then an AKM motor is selected.

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

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

8.1.4.1 Configuring Custom Motors

From the Select Motor screen, click on **Custom Motor** to create and edit custom motors in the following screen:



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

The actions available in the custom motor screen include:

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

When entering any of the motor data, be certain the units are correct. The KC1 drive uses the motor parameters to set up the various feedback loops and limits associated with the motor selected.

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

8.1.4.2 Validating Motor Parameters

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

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

Related Parameters

MOTOR Parameters (pg 563)



8.2 Feedback 1

The Feedback view allows you to configure the primary position feedback device fitted to your motor. When you select your feedback device from the Feedback Selection list, the appropriate feedback configuration choices appear below the dial.

8.2.1 Overview

The KC1 offers a variety of feedback solutions, which allow you to optimize your system based on your specific machine needs. The available feedback options include SFD, incremental encoder, as well as line-count, single, and absolute variations. Your motor model number will indicate the type of feedback that you have. With some incremental encoders, parameters are set up in the encoder itself, and the KC1 drive recognizes the feedback automatically and sets up the drive accordingly. This automatic recognition is called "plug and play". Currently, SFD and Endat are plug and play encoders. Other feedback types require that you enter parameters manually.

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

		Primary	Secondary
SFD		Yes	No
Incremental (Digital) Encoder	With Halls and Index	Yes	No
	No Halls with Index	Yes	Yes
	No Halls with No Index	Yes	Yes
EnDAT 2.2	All Digital	Yes	Yes
BiSS	All Digital (Mode C)	Yes	No

8.2.2 Using Feedback Options

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

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

8.2.2.1 Auto

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

8.2.2.2 Incremental Encoder

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

8.2.2.3 Endat 2.2

Endat 2.2 (All digital) encoders are plug and play compatible, and the system will properly recognize these encoders. With the KC1 set in **Auto**, this encoder type is detected and the feedback and motor parameters are loaded automatically.

8.2.2.4 BiSS Mode C

BiSS Mode C will be plug and play in a future release. Currently, the device is programmed with the motor and feedback information and once selected will sets up the feedback and motor parameters in the KC1.

8.2.2.5 SFD

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

8.2.3 Using Wake and Shake Mode 0 (WS.MODE 0)

8.2.3.1 Overview

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

- Incremental encoders without Halls or commutation channels.

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

8.2.3.2 Configuring WS


You can configure WS after your motor has been connected to the KC1 according to the *KC1 Installation Manual*. The WS procedure is initiated automatically when both the hardware and software enable signals become logic high.

Before attempting to enable the drive, the drive must be compensated for the motor and the KC1 servo loops must be stable.

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

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

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



Wake and Shake

Wake and Shake will determine alignment offset between feedback and the electrical phases of the motor.

Mode

Sets the method used for Wake and Shake

0 - Standard Wake and Shake

Arm

Arm
Idle

Motor Phase: deg

Settings

Number of Wake and Shake Loops:	5	Counts
Time the current vector applied to motor:	2	ms
Maximum allowed velocity:	100.000	rpm
Maximum allowed current:	2.796	Ams

More >>

Arm

Click **Arm** to set WS to start at the next drive enable (WS.ARM (pg 724)). This area also shows the current status of the wake and shake process. See WS.STATE (pg 735) for a detailed explanation of the possible states.

WS.ARM is not restricted to any feedback type.

Settings

- **Number of Wake and Shake Loops.** The WS feature uses the mean of all wake and shake repetitions, called "loops", to establish commutation (WS.NUMLOOPS (pg 734); see Using WS: Advanced (pg 59) for a discussion of loops). If fewer than five loops are used, commutation may be incorrect, possibly causing poor performance or stability.
- **Time the current vector applied to motor.** This box specifies the duration of the current pulse used for commutation. Increasing this value (WS.T (pg 736)) increases the movement of the system.
- **Maximum allowed velocity.** If a velocity (VL.FB (pg 704)) higher than this value (WS.VTHRESH (pg 742)) is detected while WS is running, then a fault will be generated.
- **Maximum allowed current.** This value (WS.IMAX (pg 732)) is directly proportional to the movement. A value that is too low may fail to cause movement; a value that is too high value may cause an over speed fault.
- **Maximum allowed movement (WS.DISTMAX (pg 729)).** If the total motion from the starting position (the position at the time the drive is enabled after a WS.ARM command) exceeds WS.DISTMAX a fault will occur. Setting WS.DISTMAX to zero disables this feature.
- **Minimum allowed movement (WS.DISTMIN).** If the total motion from the starting position is less than WS.DISTMIN (pg 730) a fault will occur. This will prevent poor initialization from broken wires, incorrect current settings, very high friction, etc. Setting WS.DISTMIN to zero disables this feature.

8.2.3.3 Wake and Shake, More View

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

Less <<

Wake and Shake Movement

Minimum Distance:	<input type="text" value="182.044"/>	Counts16Bit
Maximum Distance:	<input type="text" value="2,730.667"/>	Counts16Bit

Delay Time

Delay Time between current steps:	<input type="text" value="5"/>	ms
Delay Time between coarse angle to fine angle:	<input type="text" value="50"/>	ms
Delay Time between loops in Mode 0:	<input type="text" value="100"/>	ms
Delay Time after first current-pulse injection:	<input type="text" value="2,000"/>	ms

Wake and Shake Movement

Use these boxes to set values for the maximum (WS.DISTMAX (pg 729)) and minimum (WS.DISTMIN (pg 730)) movement required for finding commutation.

Delay Times

Delay time is the time that elapses when switching different current vectors. Use these boxes to set specific time delays for current steps(WS.TDELAY1 (pg 737)),coarse to fine angle (WS.TDELAY2 (pg 738)) and time between loops in mode 0 (WS.TDELAY3 (pg 739)).

8.2.3.4 Special Cases for WS

Operation with Motor Brake

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

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

End of Travel Limits

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

1. If the motor is resting against a rigid end stop, the movement of the motor may be impeded below the minimum threshold set by WS.DISTMIN. This lack of movement causes a fault.
2. If the motor is actuating a limit sensor/switch, the system (PLC, SWLS.LIMIT0 and SWLS.LIMIT1) may be preventing the KC1 from producing motion. If descriptive motion is not achieved, the system faults.

Large Load Inertia or High Friction System

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

8.2.3.5 Using WS: Advanced

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

1. Coarse Phase. The drive sequentially pulses a user-specified current, WS.IMAX (pg 732), at each electrical quadrant (0°, 90°, 180°, 270°). Based on the resulting observed movement, an approximate location is calculated.
2. Fine Phase. The drive makes small adjustments to the coarse phase while monitoring movement during velocity mode (command velocity = 0) to find a precise position.

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

The drive normally indicates warning F478 (pg 238) before WS is initiated and successful. If WS fails, the commutation is not valid and the drive indicates one of the following faults:

- F473 (pg 237): Insufficient movement. The maximum movement during WS was less than WS.DISTMIN.
- F475 (pg 238): Excessive movement. The movement during WS exceeded WS.DISTMAX.
- F476 (pg 238): Fine-Coarse deltat too large. The phase calculated during the fine phase and coarse phase differed by more than 10 degrees.
- F478 (pg 238): Overspeed. The feedback velocity (VL.FB) exceeded WS.VTHRESH during WS.
- F479 (pg 238): Loop angle delta too large. The difference between the phase determined in different cycles (loops) exceeded 30 degrees.
- F482 (pg 238): Commutation not initialized. WS is required (feedback is one of the types listed in the Overview) but WS has not been successfully performed.
- F483 (pg 238) to F485 (pg 238): U, V, or W phase missing. Intermittent or broken motor connection.

Maximizing WS Reliability

The following suggestions will help you achieve successful commutation:

- Incorrect determination of MOTOR.PHASE may cause a system runaway. Since the typical movement during correct operation of WS is very small, you can use the velocity overspeed parameters

(WS.VTHRESH and DRV.VTHRESH) to prevent a runaway. Prior to enabling the drive, set DRV.VTHRESH 100 mm/s for linear motors or 200 rpm for rotary motors. After a successful enable, DRV.VTHRESH can be returned to the normal operating value.

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

CAUTION

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

8.2.3.6 Troubleshooting WS

Problem	Possible Cause	Remedy
Excessive Movement	<ul style="list-style-type: none"> • Brake slips on vertical system. • External forces on motor too great. 	<ul style="list-style-type: none"> • Check brake. • Remove forces acting on motor. • Lower WS.IMAX.
Insufficient Movement	<ul style="list-style-type: none"> • Motor brake too rigid. • Motor resting on rigid end-stop. • Too much friction on motor track. • Foreign objects impeding movement of motor. • Motor load very large, and impedes sufficient movement. • WS.DISTMIN manually set too high • WS.IMAX too low 	<ol style="list-style-type: none"> Check brake Check physical location of motor Check friction and cleanliness of motor track Increase WS.IMAX value
Excessive Movement	<ul style="list-style-type: none"> • Brake slips on vertical system. • External forces on motor too great. 	<ul style="list-style-type: none"> • Check brake. • Remove forces acting on motor. • Lower WS.IMAX.

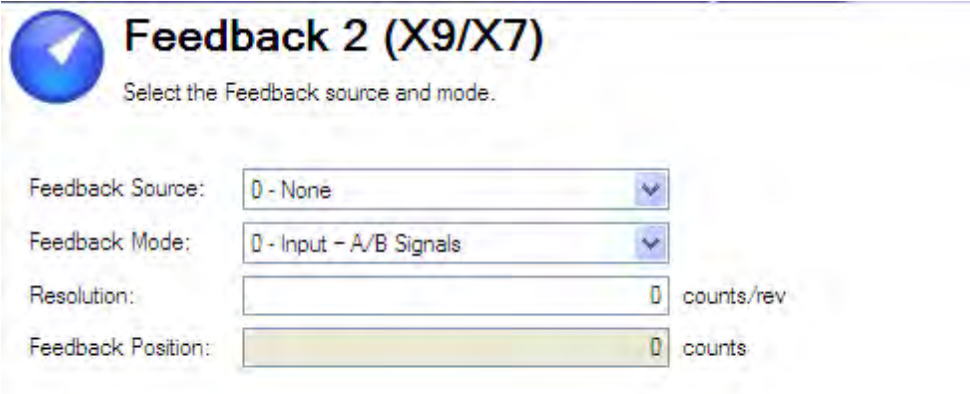
Problem	Possible Cause	Remedy
Insufficient Movement	<ul style="list-style-type: none"> • Motor brake too rigid. • Motor resting on rigid end-stop. • Too much friction on motor track. • Foreign objects impeding movement of motor. • Motor load very large, and impedes sufficient movement. WS.DISTMIN manually set too high WS.IMAX too low 	<ul style="list-style-type: none"> • Check brake. • Check physical location of motor. • Check friction and cleanliness of motor track Increase WS.IMAX value
U, V, or W Phase Missing Fault	Intermittent or broken motor connection.	Check connections to motor phases.
Commutation Not Initialized Fault	Wake and Shake is required but WS procedure has previously been canceled (WS.DISARM) or has failed.	Correct errors and rerun WS procedure.
Other	<ul style="list-style-type: none"> • Drive not configured correctly. 	<ul style="list-style-type: none"> • Check drive compensation • Verify amplifier feedback

Related Parameters

- WS Parameters (pg 723)
- DRV.IPEAK (pg 405)
- FB1.SELECT (pg 459)
- MOTOR.BRAKE (pg 565)
- MOTOR.PHASE (pg 580)
- MOTOR.IPEAK (pg 575)

8.3 Feedback 2

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



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

- Source 0 – This simple indicates you are not using either connector as a feedback source.
- Source 1 – This is tied to the use of connector X9 (consider for emulated encoder connection).

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

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

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

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

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

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

Encoder Emulation Output

The drive offers the flexibility to use connector X9 for an encoder emulation output. This output can be set up using the Encoder Emulation (pg 62) view.

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

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

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

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

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

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

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

8.3.1 Encoder Emulation

8.3.1.1 Overview

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

8.3.1.2 Using Encoder Emulation

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

8.3.1.3 Function Settings

Function settings for the X9 connector are assigned through the DRV.EMUEMODE (pg 384) parameter.

Emulation Mode

0-Input (No EEO Output). While in Emulation Mode, the EEO connector (X9) is configured as an input. This is the recommended setting and should be used in coordination with FB2.MODE (pg 467) to select the type of inputs the secondary feedback will accept. See Feedback 2 (FB2 Parameters (pg 465)) for definitions for the EEO Connector (X9). Note that this mode is also deprecated and will behave as it did with firmware versions prior to M_01-03-00-000.

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

8.3.1.4 Output Modes 1 and 2

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

If you are using the KC1 as a master, the slave drives use the master's encoder output signals as command input and follows these commands (velocity and direction). The drives operate from an internal supply voltage.

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

[Output Mode 1 - A quad B with Once per Rev Index Pulse Connection Diagram](#)

This output mode simulates an encoder signal from the X9 port to another KC1 or external controller. EEO resolution (DRV.EMUERES (pg 388)) defines how many counts are outputted for one revolution of the primary feedback.

Index offset (DRV.EMUEZOFFSET (pg 389)) determines the point during the revolution of the primary feedback when the index pulse (X9 pins 7&8) is output through the X9 port. The pulse will occur once every revolution of the primary feedback is at the positive value of the offset. Notice that the offset's resolution is set based on 1rev = 65536, or a 16-bit scale. This is fixed and independent of the Resolution setting of the A and B channel above.



Encoder Emulation (X9 Cfg)

The encoder emulation page is used to configure the X9 connector on the drive.

Emulation Mode:	<input type="text" value="1 - Output - A/B with once per rev index"/>	
Emulation Resolution:	<input type="text" value="2,048"/>	lines/rev
Index Offset:	<input type="text" value="32,768"/>	1 rev=65536
	<input type="checkbox"/> Direction of the motor is forward	

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

Mode 2– A quad B with absolute index pulse

[Output Mode 2 - A quad B with Absolute Index Pulse Connection Diagram](#)

When mode 2 is chosen, a box will appear for an absolute index point to be entered (DRV.EMUEMTURN (pg 386)). The absolute index pulse will be output when the motor position reaches the full offset. The sum of the Absolute Offset (the revolutions) and the Index Offset (a fraction of a revolution) make up the "Full Offset". The index offset is fixed as 1rev = 65536, which is a 16-bit scale.

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



Encoder Emulation (X9 Cfg)

The encoder emulation page is used to configure the X9 connector on the drive.

Emulation Mode:	<input type="text" value="2 - Output - A/B with absolute index"/>	
Emulation Resolution:	<input type="text" value="0"/>	lines/rev
Absolute Offset:	<input type="text" value="0"/>	rev
Index Offset:	<input type="text" value="0"/>	1 rev=65536
Full Offset:	<input type="text" value="0.000000"/>	rev
	<input type="checkbox"/>	Direction of the motor is forward

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

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

Mode 3-A quad B signals

[Input Mode 3 - A quad B Signals Connection Diagram](#)

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

Mode 4-Pulse/direction signals

[Input Mode 4 - Pulse/direction Signals Connection Diagram](#)

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

Mode 5-Up/down signals

[Input Mode 5 - Up/down Signals Connection Diagram](#)

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

Mode 6- Output - with once per rev index and Input - Step and Direction

This mode allows you to output emulated encoder signals from the X9 (Emulated Encoder) connector, and input a step handwheel signal into the X7 (High Speed Opto IO) connector simultaneously. Mode 6 and 7 are identical, with the exception that the emulated encoder has an incremental Z pulse (Z pulse occurs every revolution) in mode 6, and an absolute Z pulse (Z pulse occurs at one absolute position) in mode 7.

Mode 7 - Output - with absolute Index and Input - Step and Direction

This mode allows you to output emulated encoder signals from the X9 (Emulated Encoder) connector, and input a step handwheel signal into the X7 (High Speed Opto IO) connector simultaneously. Mode 6 and 7 are identical, with the exception that the emulated encoder has an incremental Z pulse (Z pulse occurs every revolution) in mode 6, and an absolute Z pulse (Z pulse occurs at one absolute position) in mode 7.

Resolution

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

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

Related Parameters and Commands

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

DRV.EMUEDIR (pg 383)

DRV.EMUEMODE (pg 384)

DRV.EMUEMTURN (pg 386)

DRV.EMUERES (pg 388)

DRV.EMUEZOFFSET (pg 389)

8.4 Non-Plug and Play Feedback Devices

To set up a KC1 drive with a non-plug and play feedback device, you must select a motor from the list of standard or custom motors or enter the motor parameters manually. Once the motor data is entered into WorkBench, an initial set of parameters can be calculated and downloaded to the drive.

8.4.1 Parameters

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

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

8.4.2 Calculations

WorkBench uses the following equations to calculate parameter values.

Current Loop

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

Then, with this frequency:

$$IL.KP = 2 * \pi * (\text{desired bandwidth in Hz}) * (\text{motor L line-line in H})$$

Setting the D and Q components

Velocity Loop

$$VL.KP = (2 * \pi * 75) * (2 * Jm / Kt) = 300 * \pi * Jm / Kt$$

$$VL.KI = 5$$

Slider Tuning

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

Input - Motor Data

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

Constants

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

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

Output - Control Loop Gains

$$VL.KP = 2 * \pi * BW * J_m * (1+Q) * 0.0001/K_t$$

$$VL.KPI = BW * 0.08 - 1 \quad (\text{minimum of } 1)$$

$$PL.KP = BW/5$$

8.5 Foldback

The foldback feature in the KC1 protects both the motor and the drive from overheating. Two current foldback algorithms run in parallel in the drive: the drive foldback algorithm and the motor foldback algorithm. Each algorithm uses different sets of parameters. Each algorithm has its own foldback current limit, IL.DIFOLD (drive foldback) and IL.MIFOLD (motor foldback). The overall foldback current limit is the minimum of the two at any given moment.

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

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

8.5.1 Drive Foldback

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

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

8.5.2 Setting up motor foldback

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

If you are using a custom motor, use the Motor view in WorkBench to set custom values needed for foldback configuration. The parameter entries required for the drive to apply motor foldback protection properly

are coil thermal constant (MOTOR.CTFO), peak current of the motor (MOTOR.IPEAK), and continuous current of the motor (MOTOR.ICONT). These values are used to setup the algorithm for motor foldback.

8.5.3 Setting Fault and Warning Levels

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

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

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

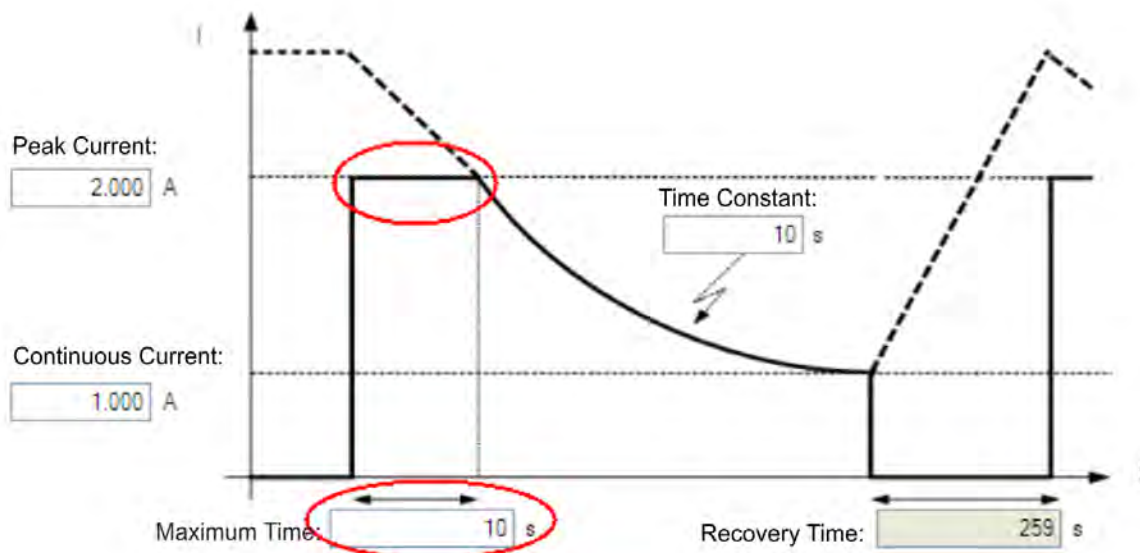
Motor Current Limit:	<input type="text" value="16.508"/>	Ams	Fault Level:	<input type="text" value="9.000"/>	Ams
Overall Current Limit:	<input type="text" value="16.508"/>	Ams	User Fault Level:	<input type="text" value="9.000"/>	Ams
Current Command:	<input type="text" value="0.000"/>	Ams	Warning Level:	<input type="text" value="0.000"/>	Ams

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

Motor Current Limit:	<input type="text" value="16.508"/>	Ams	Fault Level:	<input type="text" value="7.500"/>	Ams
Overall Current Limit:	<input type="text" value="16.508"/>	Ams	User Fault Level:	<input type="text" value="7.500"/>	Ams
Current Command:	<input type="text" value="0.000"/>	Ams	Warning Level:	<input type="text" value="0.000"/>	Ams

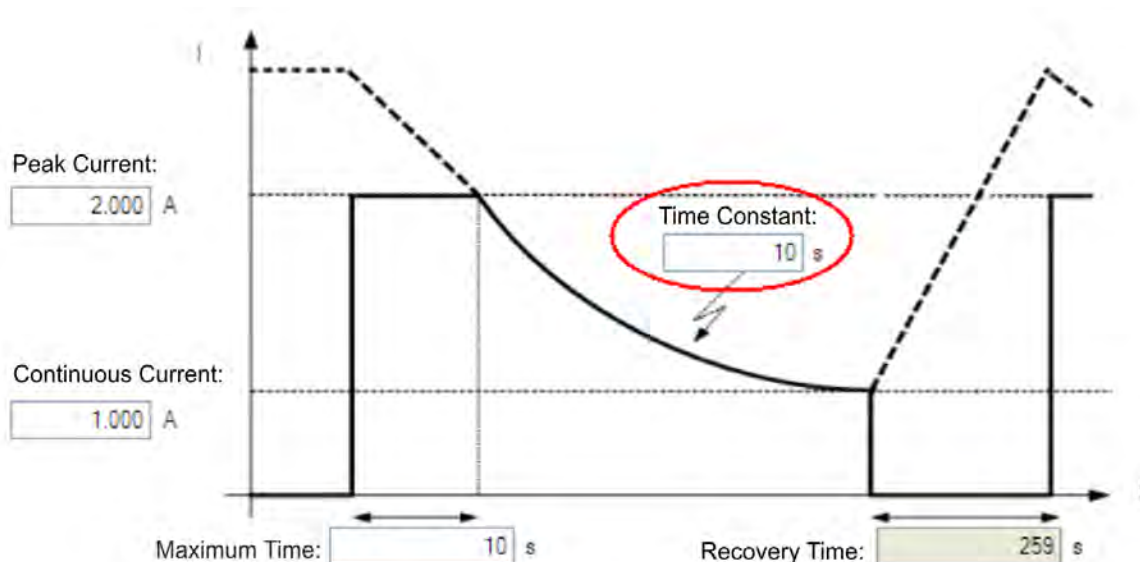
8.5.4 Motor Peak Current Time

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



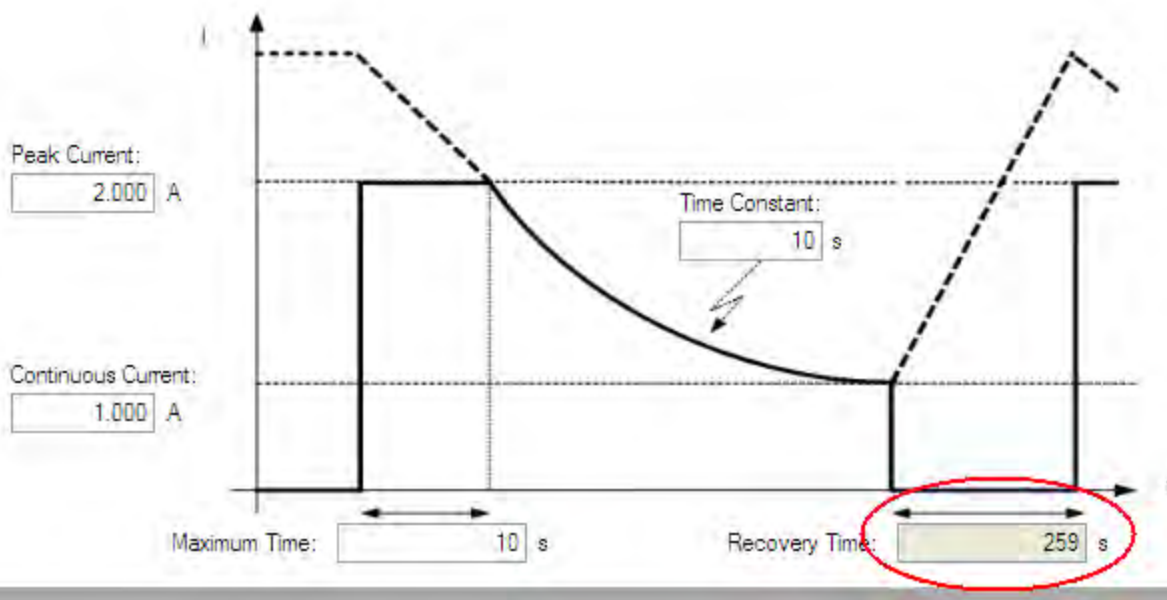
8.5.5 Motor Foldback Ramp

Once the maximum time for motor peak current has elapsed, if the move profile still demands peak current from KC1, the drive will exponentially lower the current applied to the motor. The Time Constant (IL.MFOLDT) dictates the profile. A smaller time constant represents a steeper decline in current applied to the motor.



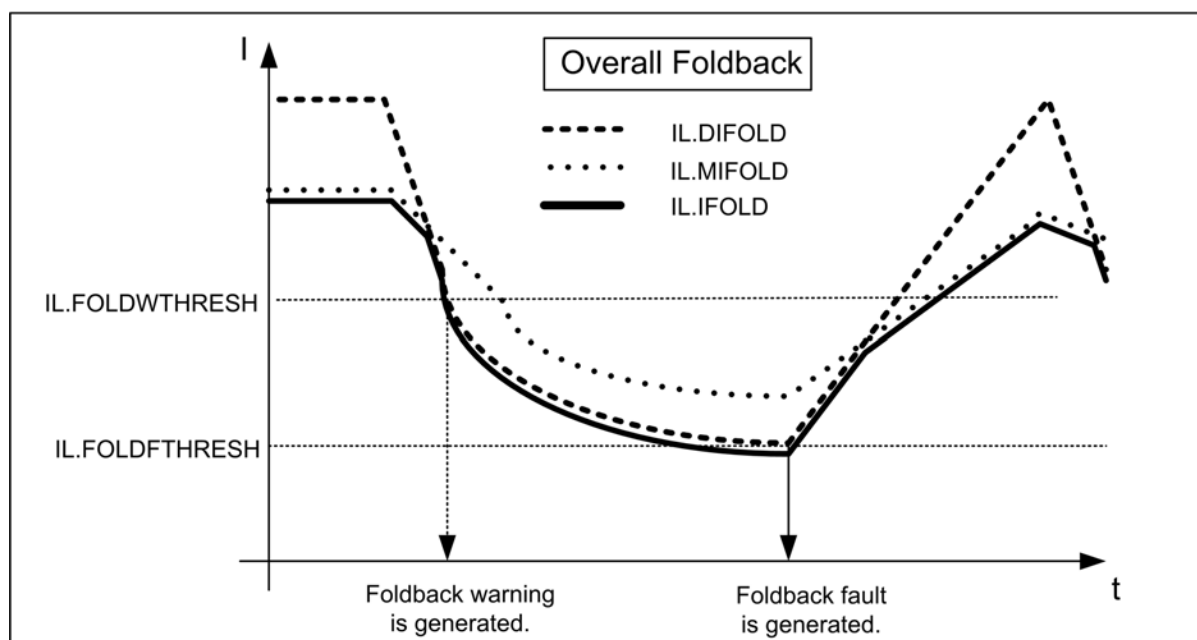
8.5.6 Motor Recovery

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



8.5.7 Overall Foldback

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



8.6 (B) Brake

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

Button or Dialog Box	Description	Parameter
Brake Control	Does this motor have a brake?	MOTOR.BRAKE

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

9 Using KC1 in a Vertical Axis

NOTE For firmware versions 1-06 and later.

The drive should be configured to execute a controlled stop action in the event of a disable command (DRV.DISMODE = 2 or 3). This allows the motor to stop and the brake to be applied before the drive stops holding up the axis and removes power. With a vertical axis application where the motor is equipped with a brake that is controlled by KC1, it is recommended to set up the axis to immediately apply the brake in the event of the drive disabling for any reason. By setting MOTOR.BRAKEIMM (pg 566) = 1 (default is 0=off) the brake will be applied immediately in the event of the drive disabling.

Drive disabling can occur as a result of:

- Hardware Enable removed
- Software Enable removed
- Safe Torque Off (STO) activated
- Fault Condition
- Controlled Stop Input – any input configured as (DINx.MODE = 13 controlled stop)

NOTE For a digital input initiated controlled stop (A fault that results in controlled stop. See Fault and Warning Messages (pg 227)), or a software disable that is configured for a controlled stop (see DRV.DISMODE (pg 378)), the brake will be applied at the end of the controlled stop.

It is still important to setup the brake delays. This can be done in the brake screen under the settings section in WorkBench. These brake delays are used to delay the disabling of the power stage when motion is stopped and the drive is disabled. This is only pertinent for Controlled Stop and Software Disable of the drive. This prevents a slight drop of the load between the disable and the brake engagement. In other cases (Fault, Hardware Enable, STO) hardware disconnection prevents KC1 from delaying the disable.

There is an advanced setting for the Hardware Disable. A programmable delay is available on the HW Enable input so the drive can hold the load before the disable. With a vertical load some movement could occur when the drive is disabled with a hardware input because the power stage was disabled immediately, before the brake could apply. DRV.HWENDELAY (pg 400) is available which will delay the disabling of the power stage. During this delay time, the drive will apply the brake immediately and simultaneously attempt to follow normal disable procedures. The value is limited to a maximum of 167 ms. During this time, the drive will attempt to bring the load velocity to 0 RPM. If DRV.HWENDELAY = 0, the feature is off (this is default).

Vertical Application Desired Response	Customer Disable Condition	Configuration Needed	Parameter Settings Needed
Controlled stop when possible. If not possible, apply motor brake immediately.	Normal disable	Command CS using input. Do not disable power stage or command other disables until CS completes and brake applies.	DRV.DISMODE = 2. Controlled stop then disable. Set: DRV.DISTO , CS.VTHRESH , CS.DEC , CS.TO .
	E-stop, or safety condition		
	Fault CS	Do not disable power stage or command other disables until CS completes and brake applies.	
	Fault Dynamic Brake	N/A	N/A
	Fault Power stage disable	None	MOTOR.BRAKEIMM = 1
Controlled stop when possible. If not possible, dynamic brake.	Normal disable	Command CS using input. Do not disable power stage or command other disables until CS completes and brake applies.	DRV.DISMODE = 3. Controlled stop then disable. Set: DRV.DISTO , CS.VTHRESH , CS.DEC , CS.TO .
	E-stop, or safety condition		
	Fault CS	Do not disable power stage or command other disables until CS completes and brake applies.	
	Fault Dynamic Brake	N/A	N/A
	Fault Power stage disable	None	MOTOR.BRAKEIMM = 1

10 Configuring with Linear Motors

10.1 Connecting a DDL Motor to an KC1 Drive

Before Connecting a DDL motor to an KC1 drive, the following tasks must be accomplished:

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

Connect Hall sensor, Linear Scale, and motor temperature cables through the ACI-KC1 cable assembly to the KC1's X10 Feedback Connector.

Connect the motor power leads to the KC1 motor power connector X2 with the following connections:

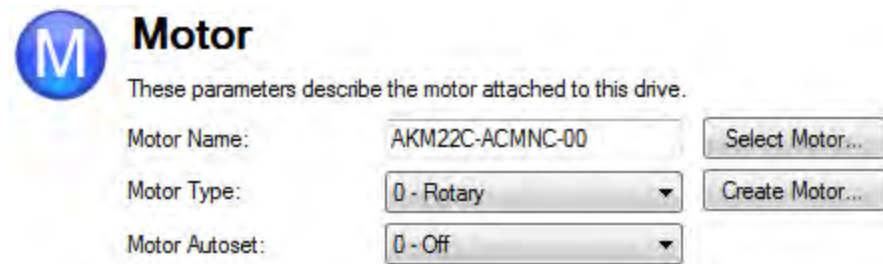
Red -> U

White -> V

Black -> W

Yellow / Green -> PE

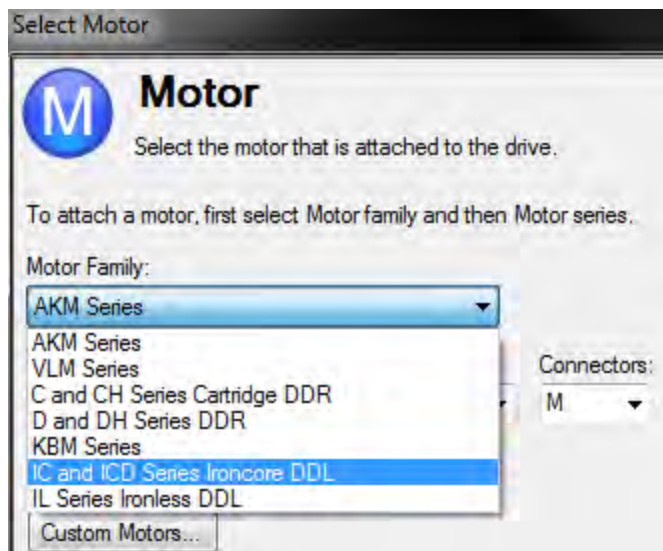
Apply 24 volt logic power to the KC1 and launch WorkBench from a computer to interface with the KC1 drive. From the main tree, under **Settings**, select **Motor** and click on **Select Motor**.



NOTE

If "Select Motor" is grayed out, Motor Autaset may need to be set to "0 -Off" to enable the Select Motor option.

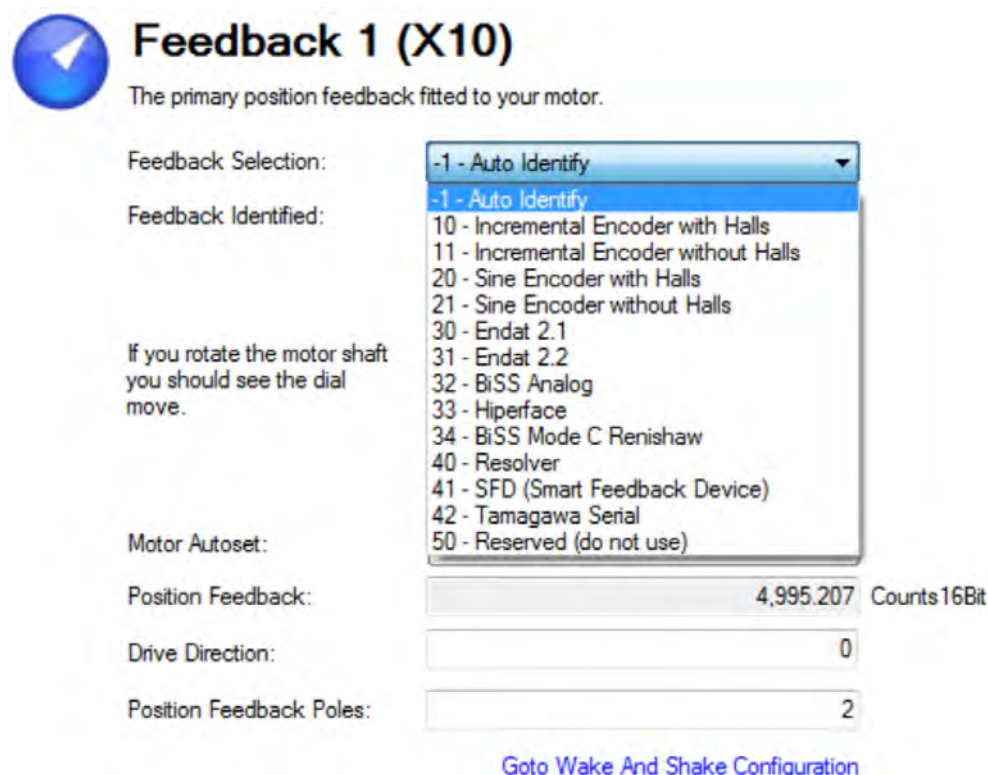
On the Select Motor screen, for Motor Family select either **IC and ICD Series Ironcore DDL** or **IL Series Ironless DDL**. On the Select Motor screen for "Name" select the appropriate motor part number.



Click OK.

From the main tree, under Settings, select **Feedback 1**.

Under Feedback Selection, select **10 – Incremental Encoder with Halls** to correspond to the Linear Scale that is integrated with the motor.



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

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

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

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

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

11 Selecting Units for Your Application

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11.1 Selecting and Saving Units

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

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

11.2 Units Example

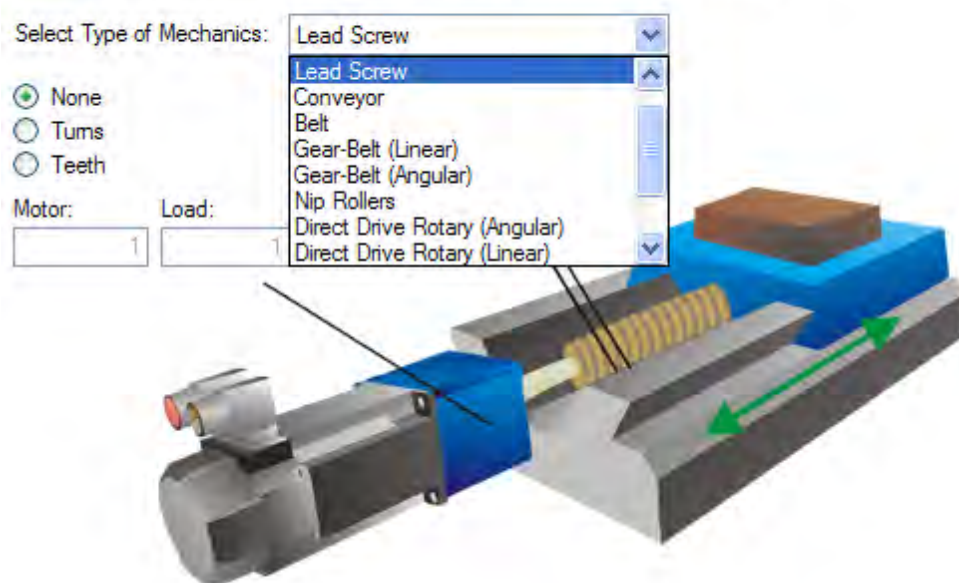
1. Select type of mechanics

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



Units

You can select the units used for positions, velocities and accelerations.



2. Select Position Units

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



For position units, five selections are available:


- 0 –Counts (4,294,967,296/rev)
- 1 –Radians (2π /rev)
- 2 –Degree (360/rev)
- 3 –Custom (set by user according to mechanics of machine)
- 4 –Counts (16-bit) (65,536 /rev)


Custom Units


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


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

Position Unit:  

Velocity Unit: 

Acceleration Unit: 

Custom Position Unit: 


3. Select Velocity Units

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

4. Select Acceleration Units

For acceleration, select **Custom/s^2** to set the measurement to mm/sec².

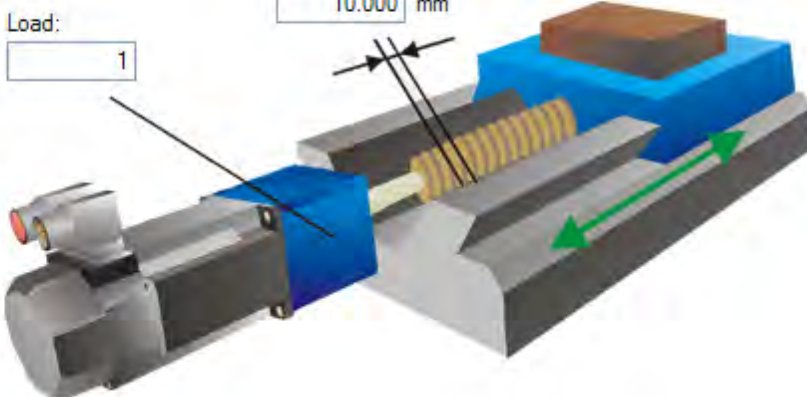
Once the chosen units of measurement are established, the details of the mechanics need to be entered to establish the scaling of the chosen units.

Select Type of Mechanics: 

None
 Turns
 Teeth

Motor: Load:

Lead: mm



In this example, a lead screw with a 10 mm lead and a 5:1 gearbox has been selected. A 10 mm lead means the load will traverse 10 mm for every turn of the screw. A scale factor is applied based on the values entered for the chosen mechanics. This scaling is done through UNIT.PIN and UNIT.POUT parameters in the KC1, which are automatically adjusted when the mechanics values are entered.

UNIT.PIN and UNIT.POUT can be directly entered using the **Motor Only** selection from the **Select Type of Mechanics** box. In this example, scaling is adjusted as follows:

Custom

UNIT.PIN Label: = UNIT.POUT rev.

UNIT.PIN is calculated as follows:

$$10 \text{ mm/screw turn} * 1 \text{ screw turn}/5 \text{ motor turns} = 2 \text{ mm/motor turn}$$

Related Parameters

UNIT Parameters (pg 675)

DRV.NVSAVE (pg 416)

MOTOR.TYPE (pg 591)

12 Configuring General Drive Settings

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12.1 Digital Inputs and Outputs

12.1.1 Overview

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

12.1.2 Using Digital I/O

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

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

12.1.3 Digital Inputs

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

Mode 0: Off

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

Mode 1: Fault Reset

When an input configured with this mode becomes active, the drive will try to clear all active faults. This mode is edge triggered, so the action occurs only once. If the condition that triggered the fault is still present, the fault condition will remain. See Fault and Warning Messages (pg 227) for details regarding the behavior of individual faults.

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

Mode 2: Start Motion Task

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

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

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

Example:

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

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

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

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

```
<Create a rising edge of the input>
```

```
<Motion Task 1 executed>
```

Mode 3: Motion Task Select Bit

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

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

Example

Assume:

DIN1.MODE = DIN2.MODE=DIN3.MODE =3

The state of input 1 and 3 is 1.

The state of input 2 is 0.

Motion task 5 ($5 = 2^0+2^2$) will be executed.

Mode 4: Motion Task Start Selected

This mode is used to start the motion task that is stored in the drive by giving the motion task number.

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

Motion task number "0" initiates homing/reference traverse. A rising edge starts the motion task. A falling edge has no effect.

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

Mode 5: Start Home

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

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

Mode 6: Start Jog

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

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

Mode 7: Reserved

Mode 8: Zero Latch

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

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

Mode 9: Command Buffer

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

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

Example

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

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

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

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

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

You can also set the command buffers from the **Digital I/O** view in WorkBench; see Command Buffer (pg 89)

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

Mode 10: Control Fault Relay

This mode is used to create an external fault.

Input state is 0 – drive regular behavior

Input state is 1 – “Fault 245 – external fault” is issued.

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

Mode 11: Home reference

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

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

Mode 12: Reserved

Mode 13: Controlled Stop

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

This mode is valid for all opmodes and command sources.

Mode 14: Reserved

Mode 15: Quick Stop

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

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

Mode 16: Activate Electronic Gearing

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

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

Mode 17: Activate Electronic Gear Position Shift

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

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

Example

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

Mode 18: Positive Limit Switch

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

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

CAUTION

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

Mode 19: Negative Limit Switch

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

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

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

Mode 20: Brake Release

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

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

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

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

Mode 21: Current Limit

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

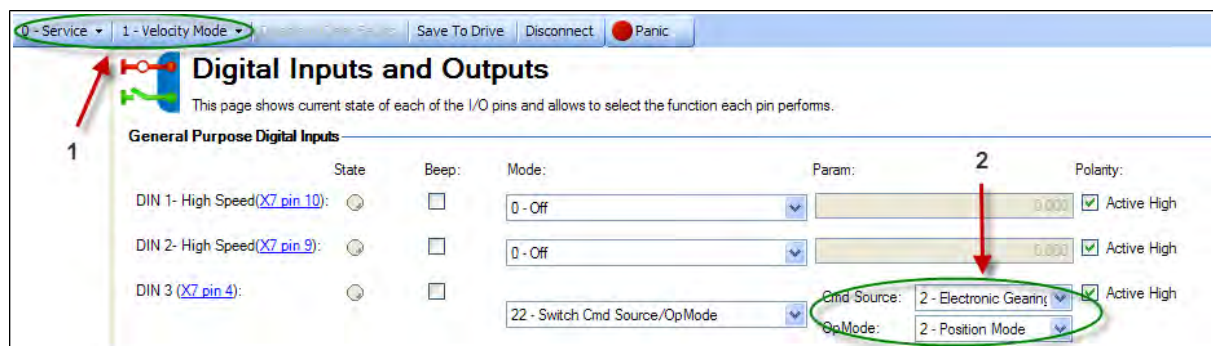
This mode is valid for all opmodes and command source combinations.

Mode 22: Switch Command Source and Opmode

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

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

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



DINX.PARAM	Command Source	Opmode
0	0-service	0-torque
1	0-service	1-velocity
2	0-service	2-position

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

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

Example

Assume:

Input 1 is configured for electronic gearing/position.

Input 2 is configured for service/velocity.

Input 3 is configured for fieldbus/position.

The system is in service/torque.

Result:

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

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

If input 2 goes active first, then the system will go to service/velocity

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

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

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

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

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

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

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

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

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

$$DINx.PARAM = 0xFFRR \text{ (F=Falling edge; R = Rising edge)}$$

The following values are used in this mode:

Value	Description
0x00	Zero the measured analog voltage.
0x01	Multiply the analog voltage with 1.
0x02	Multiply the analog voltage with -1.

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

Example 1

DINx.PARAM = 513 = 0x0201

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

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

Example 2

DINx.PARAM = 256 = 0x0100

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

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

Example 3

DINx.PARAM = 1540 = 0x0604

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

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

Mode 22: Switch Command Source and Opmode

After performing a controlled stop the drive will not be re-enabled when the signal is high. Instead, the drive needs to be re-enabled by the user.

12.1.4 Digital Outputs

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

NOTE

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

- The power supply driving the output is removed.
- The output is turned off from the firmware.
- The 24V supply to the KC1 is power cycled.

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

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

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

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

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

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

$$\text{target_position_area} = \text{motion_task_target_position} \pm \text{MT.TPOSWND}$$

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

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

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

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

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

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

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

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

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

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

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

Mode 9: Reserved.

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

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

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

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

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

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

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

Use DOUTx.PARAM to set x.

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

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

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

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

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

Example

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

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

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

Mode 17 - Reserved

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

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

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

Mode 19 – Encoder Z pulse: This is the same signal as the encoder Z signal from encoder emulation (EEO, connect X9). The Z signal from Digital output mode 19 is 24V output and from X9 is RS422 output. EEO will output the position feedback signal when it is used as an output. For detailed descriptions of EEO see Encoder Emulation (pg 62).

Mode 20 – No Controlled Stop Active: This output mode produces a high signal if no controlled stop is active. When a controlled stop is executed, the signal goes low and stays low until the controlled stop has finished.

Mode 21 – Fault Disabling Power Stage: This output mode produces a low signal when a fault will disable the power stage immediately, or when the hardware enable input is low. The output stays low as long as the fault is not cleared by the user or the hardware enable signal is low.

NOTE DOUTx.STATE always returns 0 in mode 19.

Summary of Opmode and Command Source Dependencies

DINx.MODE	Mode Description	Opmode	Command Source
0	Off	all	all
1	Fault Reset	all	all
2	Start Motion Task	2-Position	0-Service
3	Motion Task Select Bit	2-Position	0-Service
4	Motion Task Start Selected	2-Position	0-Service
5	Start Home	2-Position	0-Service
6	Start Jog	2-Position	0-Service
8	Zero Latch	all	all
9	Command Buffer	all	all

DINx.MODE	Mode Description	Opmode	Command Source
10	Control Fault Relay	all	all
11	Home Reference	2-Position	0-Service
13	Controlled Stop	all	all
15	Quick Stop	all	0-Service
16	Activate Electronic Gearing	2-Position	2-Electronic Gearing
17	Electronic Gear Position Shift	2-Position	2-Electronic Gearing
18	Positive Limit Switch	all	all
19	Negative Limit Switch	all	all
20	Brake Release	all	all
21	Current Limitation	all	all
22	Switch CmdSource/Op-mode	all	all
23	Analog In Sign Control	all	3-Analog

DOUx.MODE	Mode Description	Opmode	Command Source
0	User- (Default=0)	all	all
1	Mains Ready	all	all
2	Software Limit	all	all
3	Move Complete	2-Position	0-Service
4	Position Error Monitor	2-Position	all
5	Position > x	all	all
6	Position < x	all	all
7	Warning	all	all
8	Enable	all	all
10	Motor Brake	all	all
11	Drive Fault	all	all
12	Absolute Velocity > x	all	all
13	Absolute Velocity < x	all	all
14	Homing Complete	2-Position	0-Service
15	Programmable Limit Switch	all	all
16	Command Buffer Active	all	all
17	Mt in position		
19	Encoder Z Pulse	all	all

12.2 Command Buffer

12.2.1 Overview

The Command Buffer input mode (Digital Inputs and Outputs (pg 81)) allows you to change values for parameters using a digital input.

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



Digital Inputs and Outputs

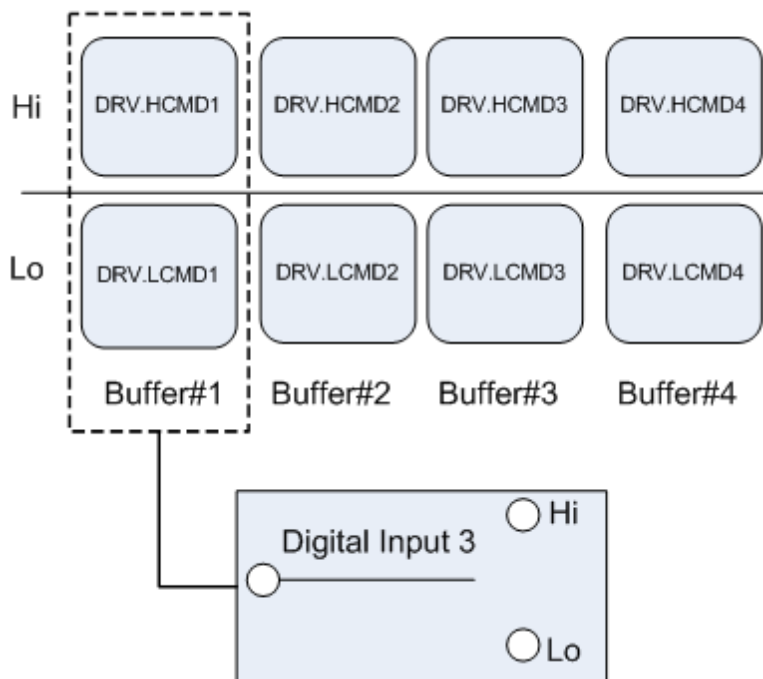
This page shows current state of each of the I/O pins and allows to select the function each pin performs.

General Purpose Digital Inputs

	State	Beep:	Mode:	Param:	Polarity:
DIN 1- High Speed(X7 pin 10):	<input type="radio"/>	<input type="checkbox"/>	0 - Off	0.000	<input checked="" type="checkbox"/> Active High
DIN 2- High Speed(X7 pin 9):	<input type="radio"/>	<input type="checkbox"/>	0 - Off	0.000	<input checked="" type="checkbox"/> Active High
DIN 3 (X7 pin 4):	<input checked="" type="radio"/>	<input type="checkbox"/>	9 - Command Buffer	Buffer # 1 <input type="button" value="Edit"/>	<input checked="" type="checkbox"/> Active High
DIN 4 (X7 pin 3):	<input type="radio"/>	<input type="checkbox"/>	0 - Off	0.000	<input checked="" type="checkbox"/> Active High
DIN 5 (X8 pin 6):	<input type="radio"/>	<input type="checkbox"/>	0 - Off	0.000	<input checked="" type="checkbox"/> Active High
DIN 6 (X8 pin 5):	<input type="radio"/>	<input type="checkbox"/>	0 - Off	0.000	<input checked="" type="checkbox"/> Active High
DIN 7 (X7 pin 2):	<input type="radio"/>	<input type="checkbox"/>	0 - Off	1.000	<input checked="" type="checkbox"/> Active High

The graphic below explains the architecture of the buffers.

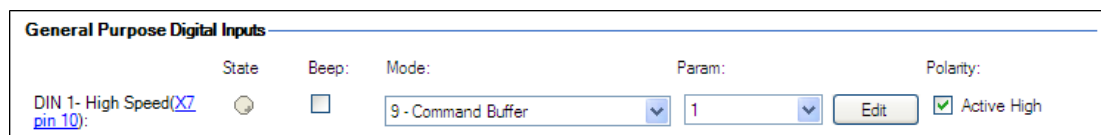
Available buffers in KC1:



12.2.2 Editing the Command Buffers

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

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



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

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



The command buffer editor screen has following properties:

Button or Dialog Box	Description
Command Buffer Number	The identification number of the command buffer (1, 2, 3, 4).
High Command Buffer	Adds sequence of commands to the High command buffer parameter. Contents are saved to the keyword DIN.HCMDx. A maximum of 128 characters can be set to drive along with the separator “;”. Commands must be entered line by line and when saving to the drive each commands will be formed into single line separated by “;”.
Low Command Buffer	Adds sequence of commands to the Low command buffer parameter. Contents are saved to the keyword DIN.LCMDx. A maximum of 128 characters can be set to drive along with the separator “;”. Commands must be entered line by line and when saving to the drive each commands will be formed into single line separated by “;”.
Ok	Saves the sequence of commands to the drive.
Close	Closes the screen and returns to Digital I/O view. If contents are not saved to drive before closing the screen, confirmation message “The commands have been modified and not save to drive. Do you want close without saving?” is displayed.

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

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

12.2.3 Behavior of the Command Buffer

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

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

12.2.4 Delays for the Buffer

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

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

DRV.EN (100 ms min)

DRV.DIS (50 ms min)

Example:

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

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

12.3 Digital Inputs (X7/X8)

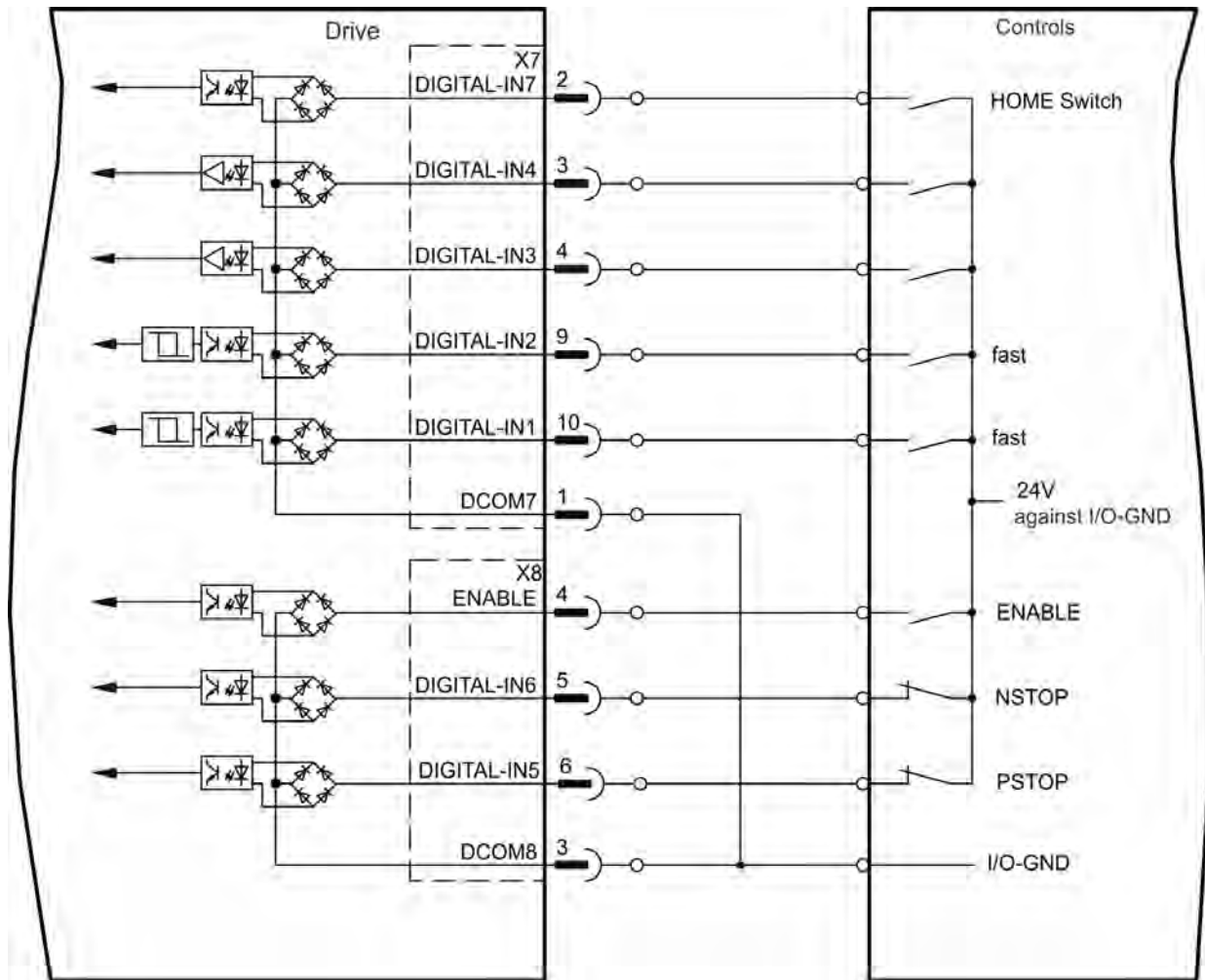
The drive provides 8 digital inputs (see page 1). These can be used to initiate pre-programmed functions that are stored in the drive. A list of these pre-programmed functions is included in the WorkBench. Digital Input 8 is not programmable but is fixed to the ENABLE function.

If an input is programmed, it must be saved to the drive.

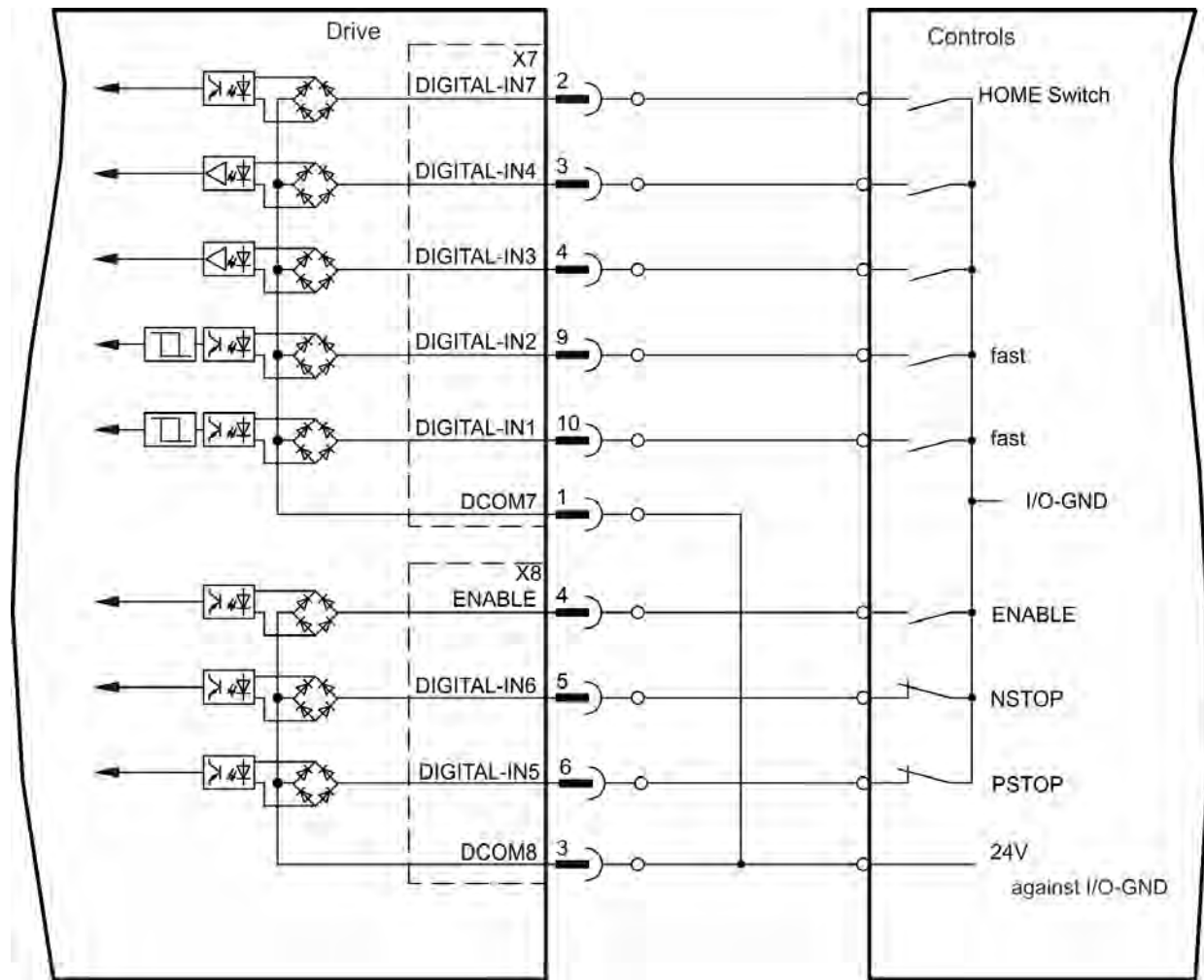
NOTE Depending on the selected function, the inputs are high or low active.

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

Digital Input Wiring Diagram (Source type connection, example)



Digital Input Wiring Diagram (Sink type connection, example)



12.3.1 Digital Inputs 1 and 2

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

Technical characteristics

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

12.3.2 Digital Inputs 3 to 7

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

For more information refer to the setup software.

Technical characteristics

Choose the function you require in WorkBench.

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

12.3.3 Digital Input 8 (ENABLE)

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

- Floating, reference common line is DCOM8
- Sink or Source type wiring is possible
- High: 3.5 to 30 V/2 to 15 mA , Low: -2 to +2 V/<15 mA
- Update rate: direct connection to hardware (FPGA)

NOTE

The Hardware Enable input and the Software Enable signal (via fieldbus or WorkBench) are serial, that means wiring of Hardware Enable is mandatory.

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

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

12.4 Analog Input

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

Button or Dialog Box	Description	Parameter
Offset	The offset adds a bias to the analog input command. This offset is commonly used to remove any biases that may be present on the analog input signal.	AIN.OFFSET (pg 283)
Input Voltage	The value of the analog input after the offset, deadband, and low pass filters.	AIN.VALUE (pg 285)
Scale	If the opmode is current mode, then this value is the amount of current that will be commanded for each volt on the analog input. If the opmode is velocity mode, then this value is the velocity that will be commanded for each volt on the analog input.	AIN.ISCALE (pg 281), AIN.VSCALE (pg 286), or AIN.PSCALE (pg 284)
Torque Command	The current or velocity command that is sent to the control loops.	IL.CMD (pg 520)PL.CMD (pg 599)or VL.CMD (pg 701)

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

Button or Dialog Box	Description	Parameter
Low Pass Filter	The break point frequency for the low pass filter.	AIN.CUTOFF (pg 276)
Deadband	The threshold for the deadband. This parameter is commonly used to reduce noise while the drive is stationary.	AIN.DEADBAND (pg 277)

Both analog input views provide a link to the encoder emulation output setup; see Encoder Emulation (pg 62)for more details on this feature.

Related Parameters

AIN Parameters (pg 275)

12.5 Analog Output

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

Button or Dialog Box	Description	Parameter
Analog Output Mode	Select which internal signal is output by the analog output.	AOUT.MODE (pg 295)
Analog Output Value (user)	Enter the analog output value (when AOUT.MODE (pg 295) = 0, analog output signal is determined by the user)	AOUT.VALUEU (pg 299)

Button or Dialog Box	Description	Parameter
Analog Output Value	Displays the voltage that this analog output generates.	AOUT.VALUE (pg 298)
Analog Velocity Scale Factor	Scales the analog output (AOUT.VALUE (pg 298)) for AOUT.MODE = 1, 2, or 3.	AOUT.VSCALE (pg 300)
Analog Output Offset	Sets the analog output 2 offset.	AOUT.OFFSET (pg 296)
Low Pass Filter	Enables a software-based low pass filter of the analog output value. 0 Hz is a pass-through or "disable" of this feature.	AOUT.CUTOFF (pg 293)

The analog output modes consist of the following:

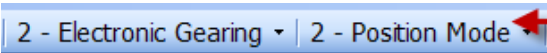
AOUT.MODE	Description
0	User variable. The analog output signal is determined by the user (using AOUT.VALUEU).
1	Actual velocity. The analog signal describes the current velocity value (VL.FB).
2	Velocity error. The analog signal describes the velocity error value.
3	Velocity command. The analog signal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

12.6 Electronic Gearing

12.6.1 Overview

Electronic gearing is the act of sending a digital pulse position command to the KC1 drive. The X9 connector is used for controlling the drive through an A/B type signal, pulse and direction (also called step and direction), or up/down command. A common application for electronic gearing is using servos with a stepper controller or daisy chaining multiple KC1 drives from one master drive as slave drives.

In order to command an KC1 using electronic gearing, the command source (DRV.CMDSOURCE) must be set to **2-Electronic Gearing** and the opmode (DRV.OPMODE) must be set to **2-Position Mode**.

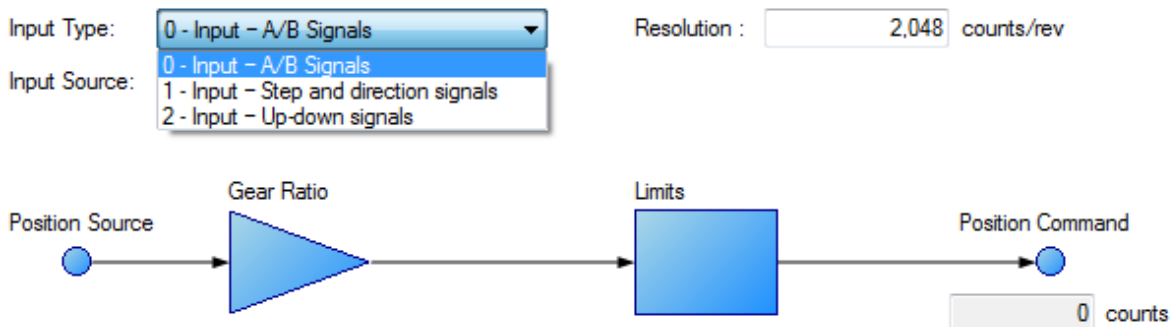
 **In Workbench Toolbar**

The input modes of the X9 connector are used to set up the KC1 for electronic gearing.

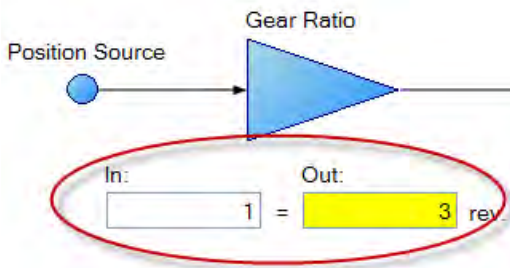


Electronic Gearing

Electronic Gearing allows the drive to follow a position being supplied to the drive.



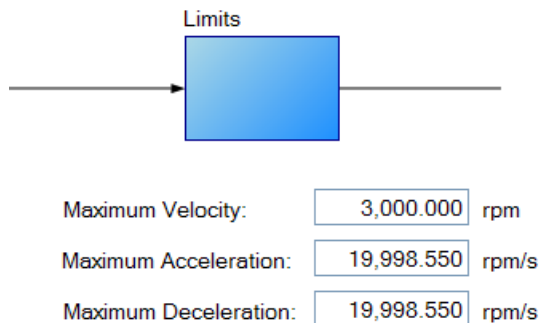
Resolution is the post-quadrature value of the counts/revolution of the input. Additionally, a gear ratio can be applied to affect the output ratio of the motor.



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

12.6.2 Limits

Electronic Gearing has independent limits, as shown below:



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

NOTE

Since the master determines the trajectory profile of the slave, it is not common to need to set GEAR limits to change the profile from the master. Erratic motion may result since they can clamp the servo command. If you are experiencing problems, first increase these limits to their maximums.

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

The Gearing type defines how gearing starts if the master is already moving—

- Velocity Matching
- Position Matching

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

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

12.6.3 Determining Maximum Cable Length

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

NOTE This information is only applicable when using an external encoder as either a secondary feedback input or a gearing command (DRV.EMUEMODE3). Not applicable for any other X9 mode or when using two KC1s in a master/slave system.

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

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

X9 port characteristics:

Nominal Supply Voltage: 5 V

Tolerance: 5%

Minimum Supply Voltage: 4.75 V

Maximum current: 0.25 A

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

Sample Application Hardware:

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

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

Minimum Supply Voltage: 4.5 V calculated based on tolerance above

Maximum required encoder supply current: 50 mA

Example cable:

Lapp Li2YCY - 24AWG (0.22 mm²)

Loop resistance: 0.186 Ohms/m

Sample Calculations:

Maximum Permissible voltage cable drop = 0.25 V
 = (Minimum Supply Voltage from KC1) 4.75 V – (Minimum supply voltage of RI-36H encoder) 4.5V

Maximum permissible resistance of cable run to X9 = 5 Ohms
 = (Max voltage cable drop) 0.25V ÷ (Maximum encoder current) 0.05A

Maximum permissible cable length for example application = 26.9 m
 = (Max cable resistance) 5 Ohms ÷ 0.186 Ohms/m

Related Parameters

GEAR Parameters (pg 479)

DRV.CMDSOURCE (pg 371)

- DRV.EMUEMODE (pg 384)
- DRV.EMUERES (pg 388)
- DRV.HANDWHEEL (pg 395)
- DRV.OPMODE (pg 418)

12.7 Limits

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

Button or Dialog Box	Description	Parameter
Current Limits		
Positive Peak Current	The maximum positive current allowed.	IL.LIMITP (pg 543)
Negative Peak Current	The maximum negative current allowed.	IL.LIMITN (pg 542)
Velocity Limits		
Positive Speed Limit	The maximum speed allowed in the positive direction.	VL.LIMITP (pg 717)
Negative Speed Limit	The maximum speed allowed in the negative direction.	VL.LIMITN (pg 716)
Over Speed Limit	The threshold velocity for an over speed fault.	VL.THRESH (pg 721)
Position Limits		
Maximum Position Error	The maximum position error. If the position error PL.ERR is larger than PL.ERRFTHRESH, then the drive generates a fault	PL.ERRFTHRESH (pg 601)
Position Limit 0	The minimum position the drive can reach before generating a negative software position fault.	SWLS.LIMIT0 (pg 669)
Position Limit 1	The maximum position the drive can reach before generating a positive software position fault.	SWLS.LIMIT1 (pg 670)
Acceleration Limits		
Acceleration	The acceleration ramp used to profile some types of motion.	DRV.ACC (pg 364)
Deceleration	The deceleration ramp used to profile some types of motion.	DRV.DEC (pg 374)
Motor Limits	Motor limits are set through the Motor Foldback Screen (see Foldback (pg 66))	

12.7.1 Limits

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

- **Current Limits:** The current limits are set based on the drive ratings. You can change these limits to be lower than the default values for the drive, however, this may effect the expected performance of your application.
- **Velocity Limits:** The velocity limits are set based on the motor ratings. You can modify these settings above the ratings of the motor if the application requires some overhead, but be aware the motor has mechanical limitations and may be damaged if run above those limits. It is best to leave these at the default ratings for the motor selected.
- **Position Limits:** The position limits can be set based on your specific machine application requirements. The Maximum Position Error can be set to cause a fault when the position error exceeds the

value you insert here. Position Limit 0 is tied to the clockwise (positive) motor direction. As the motor reaches the position entered, the motor will stop and display a warning n107. Position Limit 1 is tied to the counterclockwise (negative) motor direction. As the motor reaches the position entered, the motor will stop and display a warning n108.

- **Acceleration Limits:** This field allows you to raise accelerations to give the system crisp moves. These limits default to a low value, so you may wish to change these after the mechanics and other sections of your system are defined.



12.8 Programmable Limit Switch

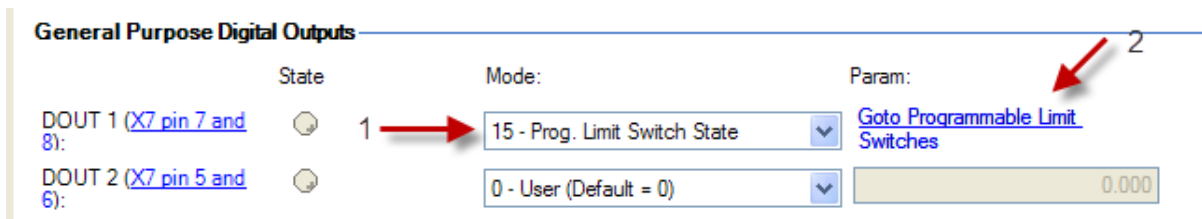
12.8.1 Overview

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

12.8.2 Using Programmable Limit Switches

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

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



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



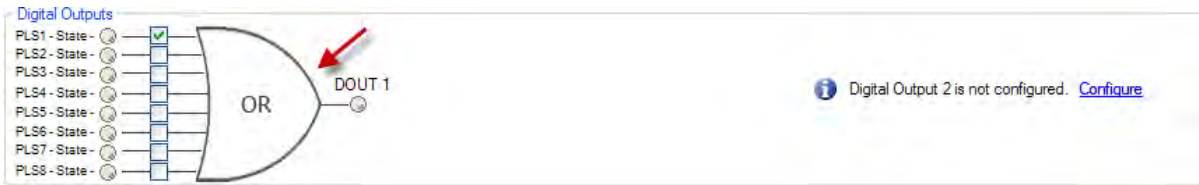
Programmable Limit Switches

[Learn more about this topic](#)

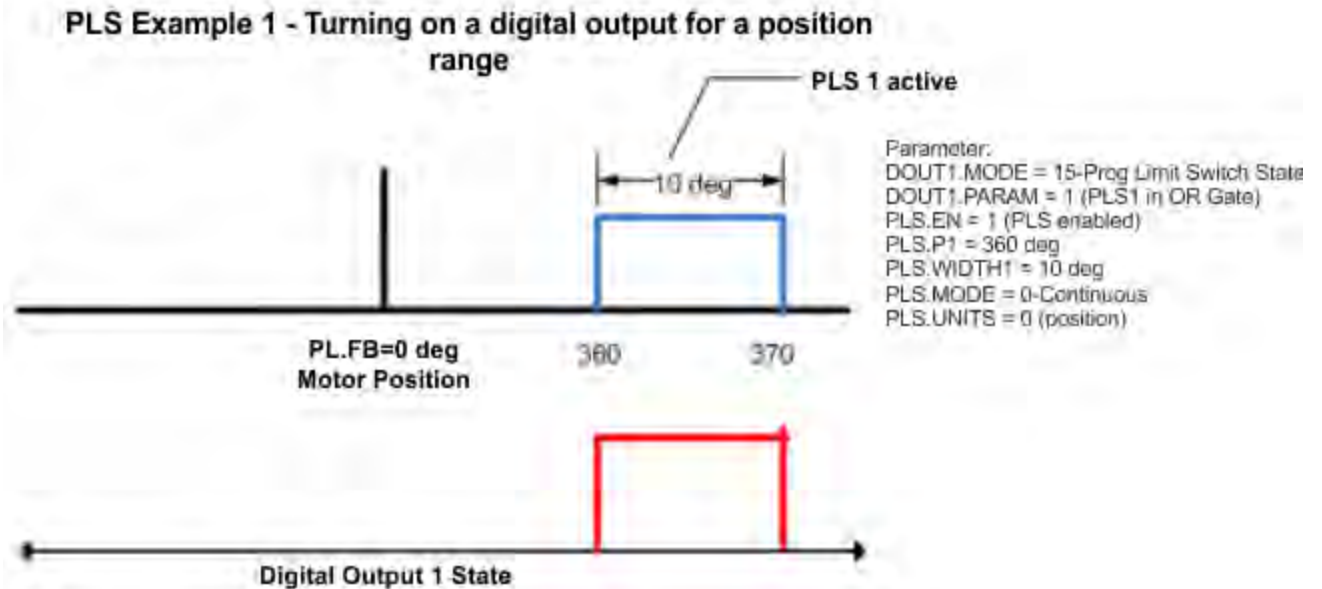
This page allows to configure the Programmable Limit Switches(PLSs) and see their current states.

PLS Configuration	Enabled	State	Mode:	Position:	Units:	Width/Time:	
PLS1	<input checked="" type="checkbox"/>	<input type="radio"/>	0 - Continuous	0.000 μm	0 - Position	0.000 μm	Reset
PLS2	<input type="checkbox"/>	<input type="radio"/>	0 - Continuous	0.000 μm	0 - Position	0.000 μm	Reset
PLS3	<input type="checkbox"/>	<input type="radio"/>	0 - Continuous	0.000 μm	0 - Position	0.000 μm	Reset
PLS4	<input type="checkbox"/>	<input type="radio"/>	0 - Continuous	0.000 μm	0 - Position	0.000 μm	Reset
PLS5	<input type="checkbox"/>	<input type="radio"/>	0 - Continuous	0.000 μm	0 - Position	0.000 μm	Reset
PLS6	<input type="checkbox"/>	<input type="radio"/>	0 - Continuous	0.000 μm	0 - Position	0.000 μm	Reset
PLS7	<input type="checkbox"/>	<input type="radio"/>	0 - Continuous	0.000 μm	0 - Position	0.000 μm	Reset
PLS8	<input type="checkbox"/>	<input type="radio"/>	0 - Continuous	0.000 μm	0 - Position	0.000 μm	Reset

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



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



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

Programmable Limit Switches [Learn more about this topic](#)

This page allows to configure the Programmable Limit Switches(PLSs) and see their current states.

PLS Configuration	Enabled	State	Mode:	Position:	Units:	Width/Time:	
PLS1	<input checked="" type="checkbox"/>	<input type="radio"/>	0-Continuous	360.000 deg	0-Position	10.000 deg	Reset
PLS2	<input checked="" type="checkbox"/>	<input type="radio"/>	0-Continuous	1.000.000 deg	0-Position	10.000 deg	Reset
PLS3	<input checked="" type="checkbox"/>	<input type="radio"/>	0-Continuous	2.000.000 deg	0-Position	10.000 deg	Reset
PLS4	<input type="checkbox"/>	<input type="radio"/>	0-Continuous	0.000 deg	0-Position	0.000 deg	Reset
PLS5	<input type="checkbox"/>	<input type="radio"/>	0-Continuous	0.000 deg	0-Position	0.000 deg	Reset
PLS6	<input type="checkbox"/>	<input type="radio"/>	0-Continuous	0.000 deg	0-Position	0.000 deg	Reset
PLS7	<input type="checkbox"/>	<input type="radio"/>	0-Continuous	0.000 deg	0-Position	0.000 deg	Reset
PLS8	<input type="checkbox"/>	<input type="radio"/>	0-Continuous	0.000 deg	0-Position	0.000 deg	Reset

Current Position: Position Feedback: 121.549 deg

12.8.3 Single Shot Mode

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

Programmable Limit Switches

This page allows to configure the Programmable Limit Switches (PLSs) and see their current states. [Learn more about this topic](#)

PLS Configuration

Enabled	State	Mode	Position	Units	Width/Time	Reset
<input checked="" type="checkbox"/>	<input checked="" type="radio"/>	1-Single shot	360.000 deg	0-Position	10.000 deg	Reset
<input type="checkbox"/>	<input checked="" type="radio"/>	0-Continuous	1.000.000 deg	0-Position	10.000 deg	Reset
<input type="checkbox"/>	<input checked="" type="radio"/>	0-Continuous	2.000.000 deg	0-Position	10.000 deg	Reset
<input type="checkbox"/>	<input checked="" type="radio"/>	0-Continuous	0.000 deg	0-Position	0.000 deg	Reset
<input type="checkbox"/>	<input checked="" type="radio"/>	0-Continuous	0.000 deg	0-Position	0.000 deg	Reset
<input type="checkbox"/>	<input checked="" type="radio"/>	0-Continuous	0.000 deg	0-Position	0.000 deg	Reset
<input type="checkbox"/>	<input checked="" type="radio"/>	0-Continuous	0.000 deg	0-Position	0.000 deg	Reset
<input type="checkbox"/>	<input checked="" type="radio"/>	0-Continuous	0.000 deg	0-Position	0.000 deg	Reset

Digital Outputs

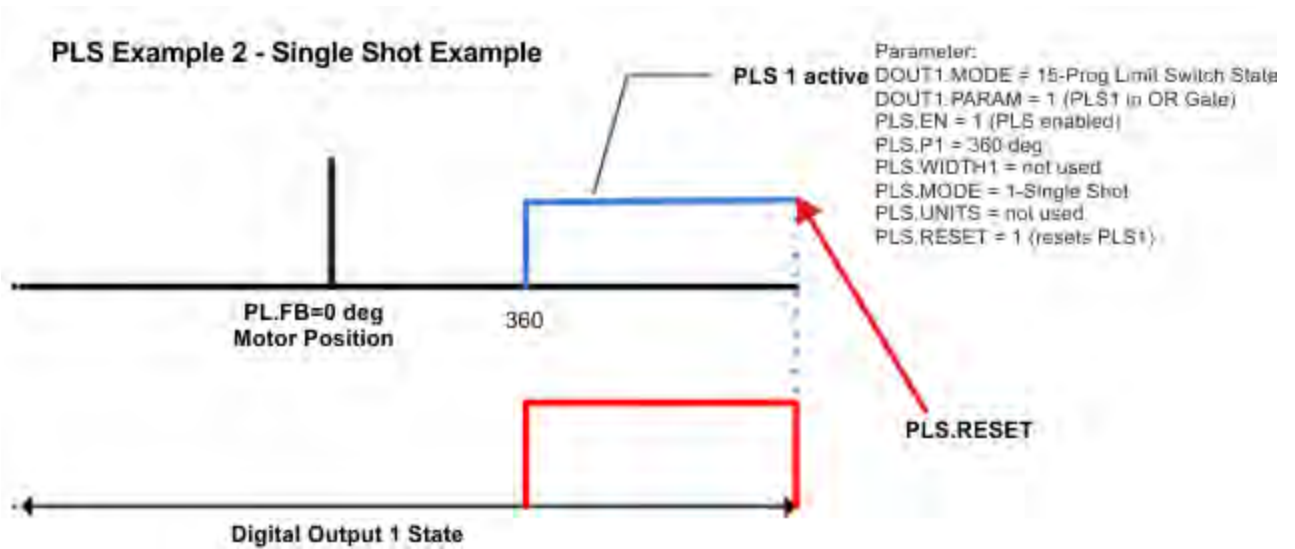
PLS1 - State
 PLS2 - State
 PLS3 - State
 PLS4 - State
 PLS5 - State
 PLS6 - State
 PLS7 - State
 PLS8 - State

OR Gate: DOUT 1

1 (points to Mode dropdown) **3** (points to Width/Time input) **2** (points to Reset button)

2 Digital Output 2 is not configured. [Configure](#)

Single Shot Example:



Related Parameters

PLS Parameters (pg 616)

Digital Inputs and Outputs (pg 81)

12.9 Enable/Disable

12.9.1 Enable Modes

The KC1 offers several options for hardware and software enables, as well as safe torque off (STO) to cover a variety of conditions.

Hardware Enable Mode

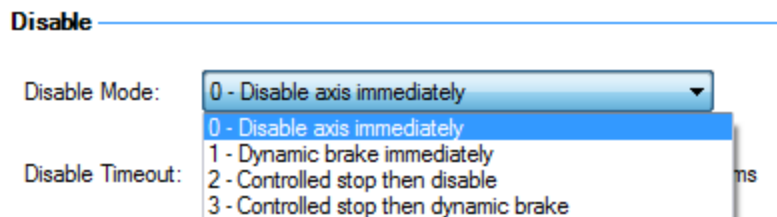
The KC1 has two methods hardware enable methods. These methods are controlled by DRV.HWE-NMODE. Mode 0 allows for the drive to enable and clear faults on the rising edge of the hardware enable input. Mode 1 will NOT clear any faults on the rising edge of the hardware enable input, allowing you to review any current faults and manually clearing.

Software Enable Default

In addition, the Software Enable has two methods for enabling the KC1. These are controlled by DRV.E-NDEFAULT. Default 0 leaves the software in the disabled state upon start-up. Default 1 enables the software upon start-up.

12.9.2 Disable Modes

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



Mode 0: Immediately disable drive.

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

Mode 1: Dynamic Brake to a stop.

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

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

Mode 2: Controlled stop, then disable.

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

Mode 3: Controlled stop, then dynamic brake.

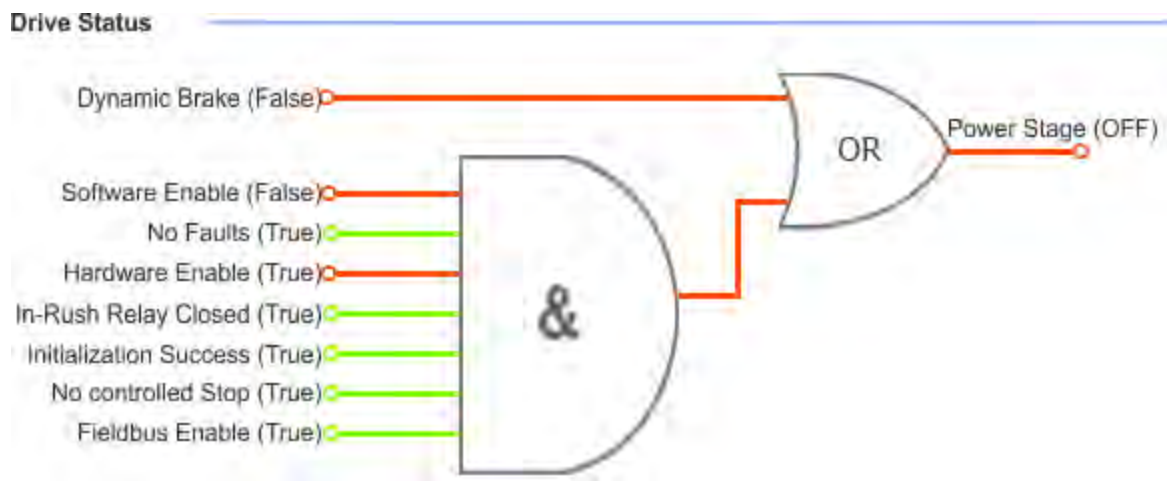
Similar to Mode 2, the motor will decelerate at a controlled rate (CS.DEC) until CS.VTHRESH is reached for a period of time (CS.TO). The drive will then dynamically brake and disable under the same conditions as described in Mode 2.

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

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

12.9.3 Drive Status

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



12.9.4 Controlled Stop

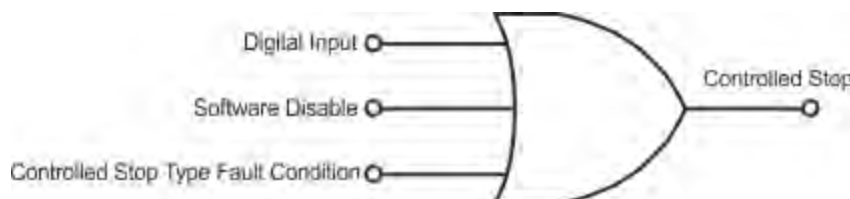
The Controlled Stop area displays values for parameters associated with controlled stop.

Button or Dialog Box	Description	Parameter
Velocity Threshold	Sets the velocity threshold for controlled stop process.	CS.VTHRESH (pg 336)
Velocity Threshold Timeout	Sets the velocity threshold, which is the time value for the drive velocity to be within CS.VTHRESH before the drive disables	CS.TO (pg 335)
Deceleration	Sets the deceleration value for the controlled stop process.	CS.DEC (pg 333)
Control stop Input	Displays the list of digital inputs configured to controlled stop mode separated by ','. When no controlled stop mode is configured, this box displays the message: No CS Input Configured . Configure Input link will opens the Digital I/O screen where you can configure the controlled stop mode.	

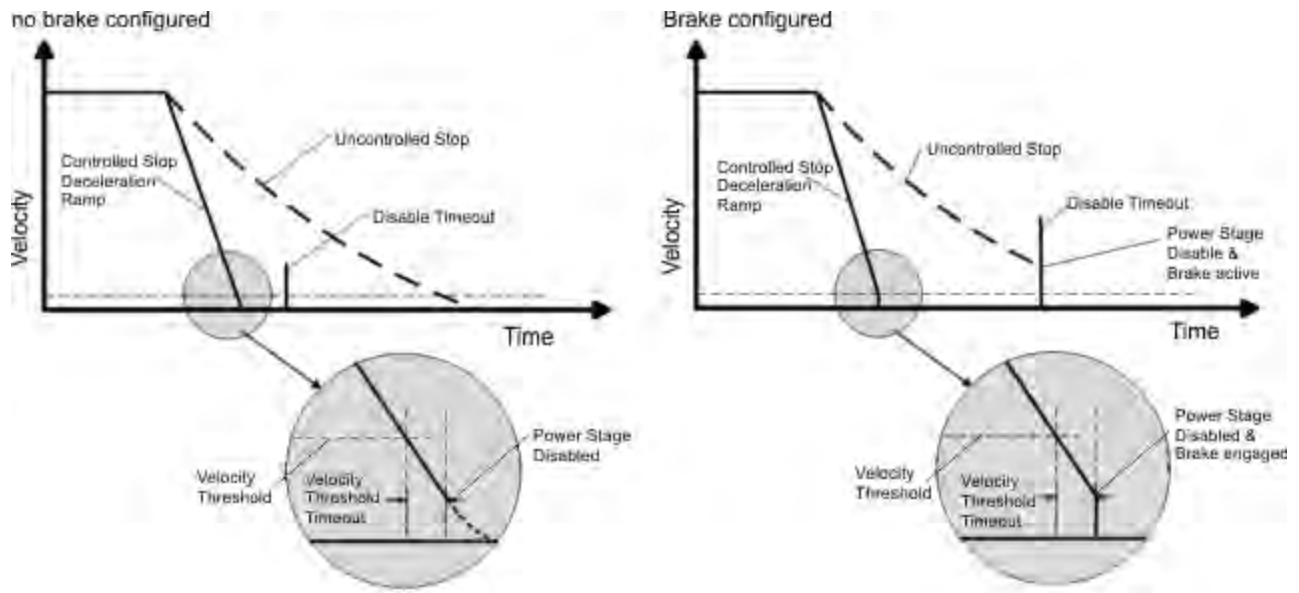
12.9.5 More/Less Button

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

Control stop status diagram



Controlled Stop Block Diagram



12.10 Controlled Stop

In a controlled stop, drive motion is brought to a standstill in a controlled manner. The drive commands a zero velocity from the motor. The motor decelerates at the prescribed deceleration value (CS.DEC (pg 333)).

A controlled stop can occur in three ways:

- The user configures a programmable digital input to mode 13 using `DINx.MODE`. For example, if [DIN1.MODE 13](#) is applied, digital input 1 is set to controlled stop.
- Either a controller or the user (through the WorkBench terminal window) initiates a software disable (`DRV.DIS`) command.
- A fault initiates a controlled stop from the drive. See Fault and Warning Messages (pg 227) for the faults which initiate a controlled stop.

The controlled stop mechanism is activated in the following cases:

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

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

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

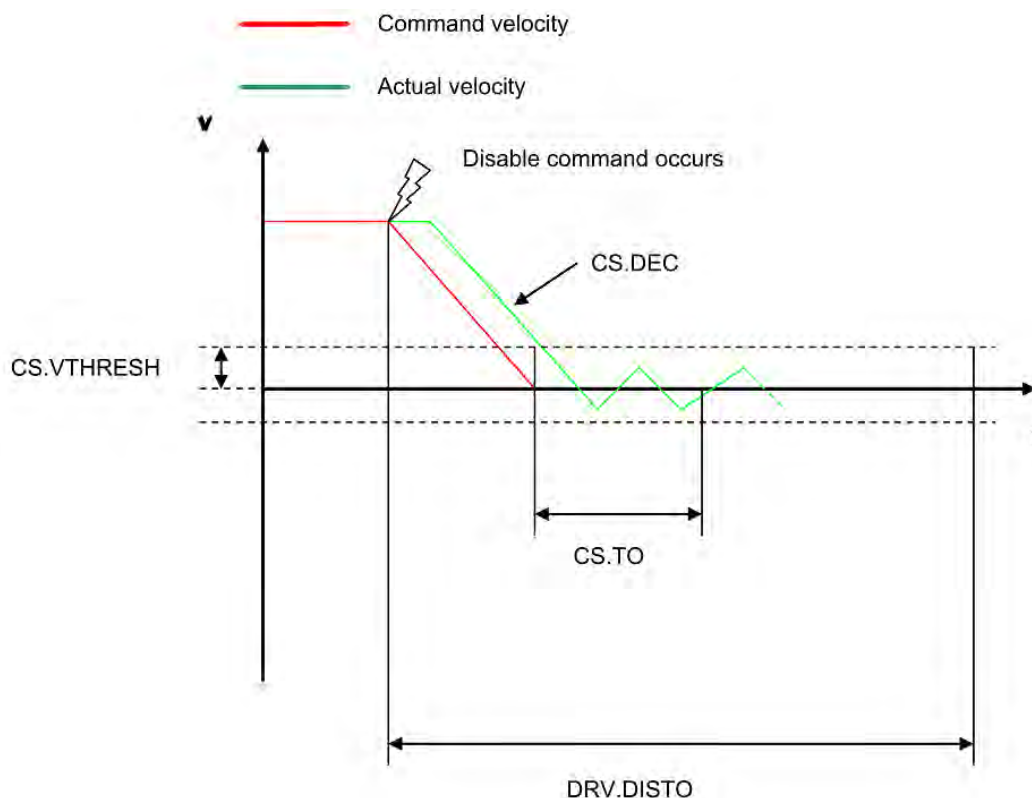
Use the drive CS parameters to configure a controlled stop as follows:

1. `CS.DEC`: Deceleration ramp that is used for disable.
2. `CS.VTHRESH`: Velocity 0 threshold. The motor shaft is considered as stopped as soon as the actual velocity (filtered through a 10 Hz filter, such as `VL.FBFILTER`) is within \pm `CS.VTHRESH`.
3. `CS.TO`: Velocity 0 time. The actual velocity must be consecutively within $0 \pm$ `CS.VTHRESH` for the time `CS.TO`, before the drive completes the CS process. This value is used since the

motor can overshoot out of the V_{EL0} window depending on the gains, deceleration ramp, motor inertia and so on.

4. DRV.DISTO: Disable time out. This parameter sets an overall and independent running check as to whether or not the drive can achieve the disable state. If the V_{EL0} window set in step 3 is too small, it is possible that the drive may never reach the end of the CS process. The DRV.DISTO parameter and functionality addresses this issue by disabling the drive after the DRV.DISTO time elapses, even if the CS process did not end.

Controlled Stop Diagram



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

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

The drive issues a fault FF703 (pg 242) in case that the DRV.DISTO counter expires during a controlled stop procedure.

Related Parameters and Commands

CS Parameters (pg 332)

CS.STATE (pg 334): Reads the current state of controlled stop process (0 = controlled stop is not occurring. 1 = controlled stop is occurring).

DIN1.MODE TO DIN24.MODE (pg 344)

DRV.DIS (pg 377)

DRV.DISTO (pg 381)

DRV.DISMODE (pg 378)

Related topics:

Emergency Stop (pg 108)

Digital Inputs and Outputs (pg 81)

Fault and Warning Messages (pg 227)

12.11 Dynamic Braking

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

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

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

12.11.1 Drive Regeneration

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

KC1-B00106 to KC1-B00606

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

KC1-B01206 to KC1-B02406

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

Related Topics

See section 6.14 *Dynamic Braking* in the *KC1 Installation Manual* for detailed information on dynamic braking.

DRV.DISMODE (pg 378)

DRV.DBILIMIT (pg 373)

12.12 Emergency Stop

12.12.1 Stop / Emergency Stop / Emergency Off

The control functions Stop, Emergency Stop and Emergency Off are defined by IEC 60204. Notes for safety aspects of these functions can be found in ISO 13849 and IEC 62061.

NOTE

The parameter DRV.DISMODE must be set to 2 to implement the different stop categories. Consult the *KC1 User Guide* for configuring the parameter.



WARNING

Functional safety, e.g. with hanging load (vertical axes), requires an additional mechanical brake which must be safely operated, for example by a safety control.

Set parameter MOTOR.BRAKEIMM to 1 with vertical axes, to apply the motor holding brake immediately after faults or Hardware Disable.

12.12.1.1 Stop

The stop function shuts down the machine in normal operation. The stop function is defined by IEC 60204.

NOTE

The Stop Category must be determined by a risk evaluation of the machine.

Stop function must have priority over assigned start functions. The following stop categories are defined:

Stop Category 0

Shut-down by immediate switching-off the energy supply to the drive machinery (this is an uncontrolled shut-down). With the approved safety function STO the drive can be stopped using its internal electronics (IEC 61508 SIL2).

Stop Category 1

A controlled shut-down, whereby the energy supply to the drive machinery is maintained to perform the shut-down, and the energy supply is only interrupted when the shut-down has been completed.

Stop Category 2

A controlled shut-down, whereby the energy supply to the drive machinery is maintained.

Stop Category 0 and Stop Category 1 stops must be operable independently of the operating mode, whereby a Category 0 stop must have priority.

If necessary, provision must be made for the connection of protective devices and lock-outs. If applicable, the stop function must signal its status to the control logic. A reset of the stop function must not create a hazardous situation.

12.12.1.2 Emergency Stop

The Emergency Stop function is used for the fastest possible shutdown of the machine in a dangerous situation. The Emergency Stop function is defined by IEC 60204. Principles of emergency stop devices and functional aspects are defined in ISO 13850.

The Emergency Stop function will be triggered by the manual actions of a single person. It must be fully functional and available at all times. The user must understand instantly how to operate this mechanism (without consulting references or instructions).

NOTE

The Stop Category for the Emergency Stop must be determined by a risk evaluation of the machine.

In addition to the requirements for stop, the Emergency Stop must fulfil the following requirements:

- Emergency Stop must have priority over all other functions and controls in all operating modes.
- The energy supply to any drive machinery that could cause dangerous situations must be switched off as fast as possible, without causing any further hazards (Stop Category 0) or must be controlled in such a way, that any movement that causes danger, is stopped as fast as possible (Stop Category 1).
- The reset must not initiate a restart.

12.12.1.3 Emergency Off

The Emergency Off function is used to switch-off the electrical power supply of the machine. This is done to prevent users from any risk from electrical energy (for example electrical impact). Functional aspects for Emergency Off are defined in IEC 60364-5-53.

The Emergency Off function will be triggered by the manual actions of a single person.

NOTE

The result of a risk evaluation of the machine determines the necessity for an Emergency Off function.

Emergency Off is done by switching off the supply energy by electro-mechanical switching devices. This results in a category 0 stop. If this stop category is not possible in the application, then the Emergency Off function must be replaced by other measures (for example by protection against direct touching).

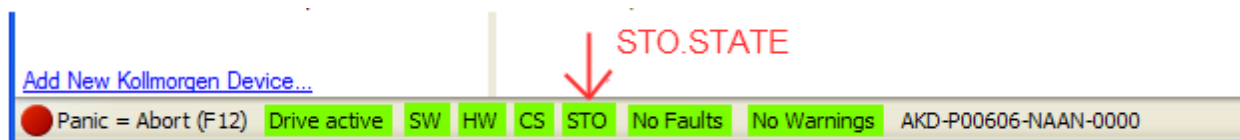
12.13 Safe Torque Off (STO)

Safe torque off (STO) is a restart lock safety feature that prevents a system restart. The STO input provides direct electrical control of the power stage of the KC1 drive; it bypasses the processor and will disable the power stage irrespective of software or other hardware signals.

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

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

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



12.14 Under Voltage Fault Behavior

You can adjust the conditions for an under voltage fault using VBUS.UVMODE in the WorkBench Terminal (pg 203) View:

VBUS.UVMODE = 1 (default)

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

VBUS.UVMODE = 0

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

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

- WorkBench alert: 502 Bus Under Voltage
- Drive LED alert: Left LED displays [F], right LED displays [u-V].\
- Fault relay output turns on.

13 Using Command Source and Operating Modes

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13.1 Overview

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



Settings

[Learn more about this topic](#)

Select which mode of operation and command source the drive should work in. The AKD drive can work in many different modes, each mode is suited to

Command Source:	Operation Mode:
<input type="text" value="2 - Electronic Gearing"/>	<input type="text" value="2 - Position Mode"/>

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

13.2 Using Command Source and Operation Modes

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

13.2.1 Command Source

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

13.2.1.1 Service

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

13.2.1.2 Electronic Gearing

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

13.2.1.3 Analog

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

13.2.2 Operation Mode

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

Related Parameters

DRV.CMDSOURCE (pg 371)

DRV.OPMODE (pg 418)

13.3 Current Loop

13.3.1 Overview

The current loop is active when the drive operates in current torque (current) mode (DRV.OPMODE (pg 418) = 0). The parameters that govern the current loop are shown in the Current Loop view. The various types of tuning for the drive adjust these parameters automatically, so you normally do not need to adjust the current loop parameters in the current loop screen. The Current Loop view includes an active block diagram. If you click on a block in the diagram, the appropriate tab opens below.

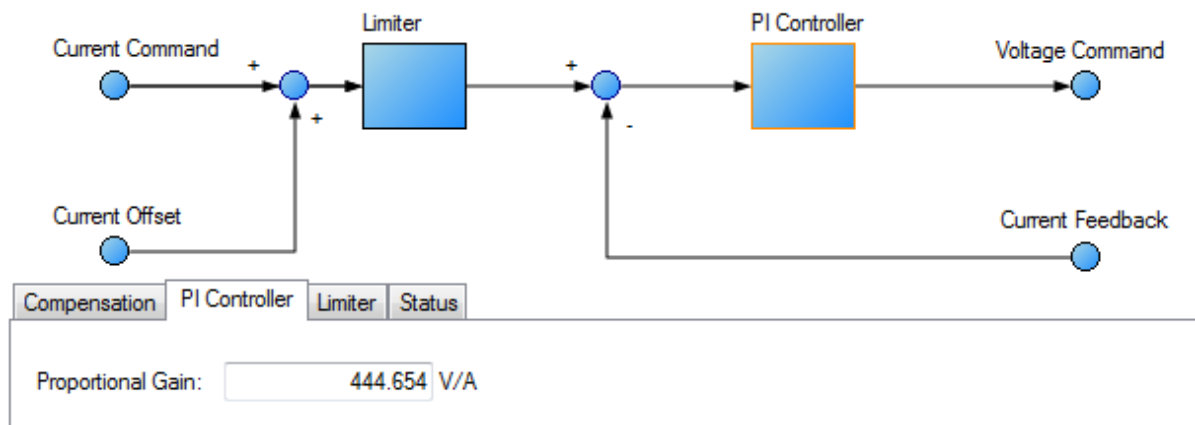
A more detailed block diagram for the current loop is included in Block Diagrams (pg 254)

13.3.2 Current Loop Gain

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

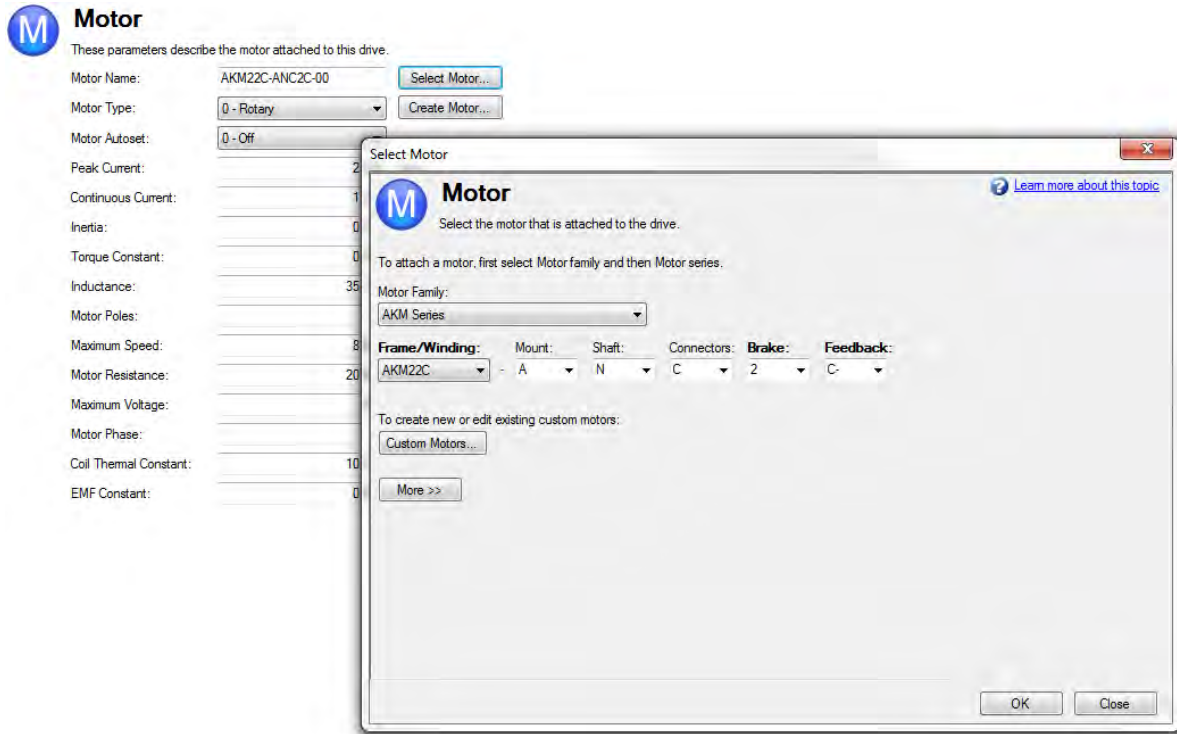
Current Loop

Parameters for controlling the torque/force of the motor. Usually no changes are needed with correct motor data.



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

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



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

Related Parameters

IL Parameters (pg 518)

DRV.OPMODE (pg 418)



13.3.3 Current Loop Gain Scheduling

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

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

- Audible chirping occurs.
- Chirping gets louder with higher commanded current.
- Instability occurs under high current loads (at or near MOTOR.IPEAK (pg 575))

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

13.3.3.1 Using the Gain Scheduling View in WorkBench

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

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


Current Loop Gain = $2000 * 2\pi * \text{Motor Inductance (H)}$

Example

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

Current Loop Gain = $2000 * 2 \pi * 0.00319 = 40.01$

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



Gain Scheduling

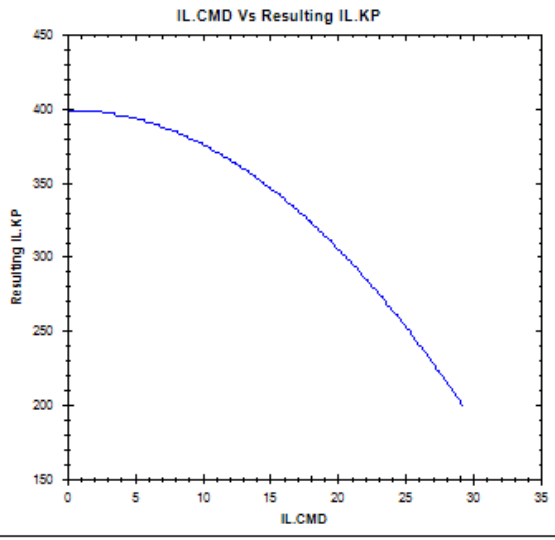
Advanced user current loop gain lookup table for special motors that have varying inductance.

[Learn more about this topic](#)

Drive I_{Peak} : Ams

Proportional Gain : V/A

IL.CMD (A)	Table Index	Value (%)	Resulting IL.KP
0.000	0	100.000	400.072
0.115	1	99.607	398.500
0.229	2	99.607	398.500
0.344	3	99.607	398.500
0.459	4	99.607	398.500
0.573	5	99.607	398.500
0.688	6	99.607	398.500
0.803	7	99.607	398.500
0.917	8	99.607	398.500
1.032	9	99.607	398.500
1.146	10	99.607	398.500
1.261	11	99.607	398.500
1.376	12	99.607	398.500



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

Example

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

$$40.124 * 0.90 = 36.112$$

Using the Terminal View for Gains Scheduling

You can also use the Terminal to set up the Gains Scheduling Table. If you use the Terminal, then two parameters are required for each lookup table point: IL.KPLOOKUPINDEX (pg 538) and IL.KPLOOKUPVALUE (pg 539). IL.KPLOOKUPINDEX specifies the lookup table index (0 – 255), and IL.KPLOOKUPVALUE specifies the scaling term (0 – 100%) to scale IL.KP.

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

$$\text{IL.CMD Range} = \text{DRV.IPEAK}/157 * \text{IL.KPLOOKUPINDEX}$$

A full list of table values can also be retrieved using IL.KPLOOKUPVALUES (pg 540), which returns a comma delimited table as follows:

```
-->IL.KPLOOKUPVALUES
Index Value
0, 100.000
1, 100.000
2, 100.000
3, 100.000
4, 100.000
5, 100.000
6, 100.000
7, 100.000
8, 100.000
9, 100.000
10, 100.000
```

13.4 Velocity Loop

13.4.1 Overview

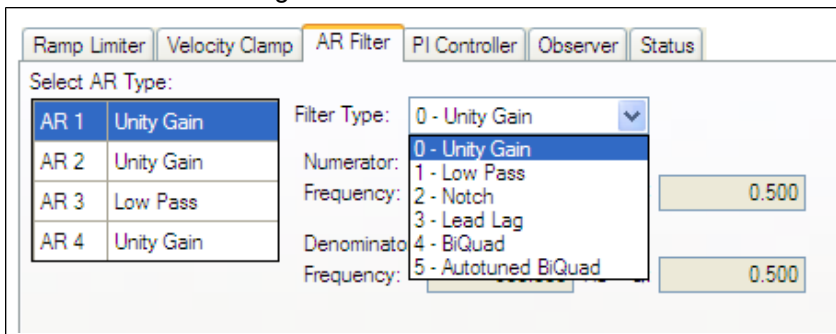
The velocity loop is active when the drive operates in velocity mode (DRV.OPMODE (pg 418) = 1) or position mode (DRV.OPMODE = 2). The parameters that govern the velocity loop are shown in the Velocity Loop view. This view is only available while in Operation Mode 1 or 2 (set in the Settings view). The various types of tuning for the drive adjust these parameters automatically, so you normally do not need to adjust the velocity loop parameters in the velocity loop screen.

A detailed block diagram for the velocity loop is included in Block Diagrams (pg 254).

13.4.2 Tabs in the Velocity Loop View

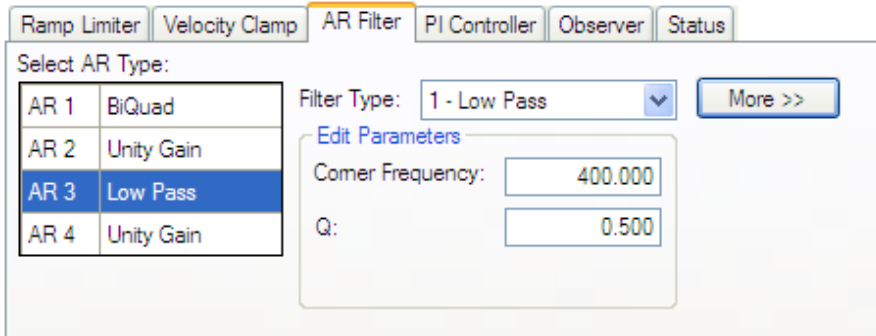
The velocity view includes an active block diagram. If you click on a block in the diagram, the appropriate tab opens below.

- **Ramp limiter** . The ramp limiter consists of the acceleration limits of the drive. These acceleration limits override electronic gearing acceleration limits, so they must be set higher than the highest required gearing acceleration value. These acceleration and deceleration limits are also shown in the Service Motion view and the Limits view (DRV.ACC (pg 364) and DRV.DEC (pg 374)).
- **Velocity clamp**. The velocity clamp affects the maximum speed of the drive when the command source is service (DRV.CMDSOURCE (pg 371) = 0). This speed limit affects motion commanded in service motion. These limits are also found in the limit screen on WorkBench. (VL.LIMITP (pg 717) and VL.LIMITN (pg 716))
- **AR1, AR2, AR3, AR4**: These values are the independent bilinear quadratic (bi-quad) filters inside the drive. AR1 and AR2 are in the forward path and AR3 and AR4 are in the feedback path. These bi-quad filters can each be configured in five different modes.



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

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



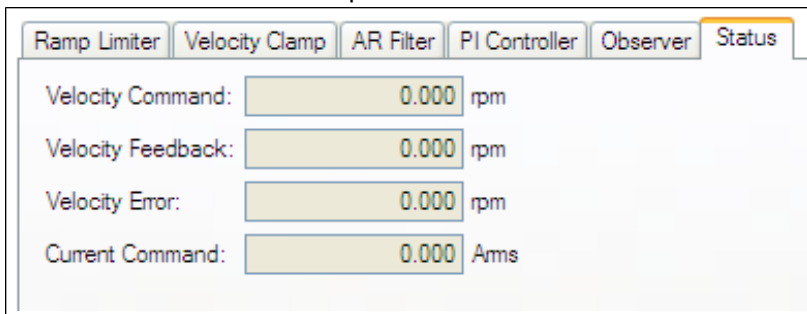
2–Notch

3–Lead Lag

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

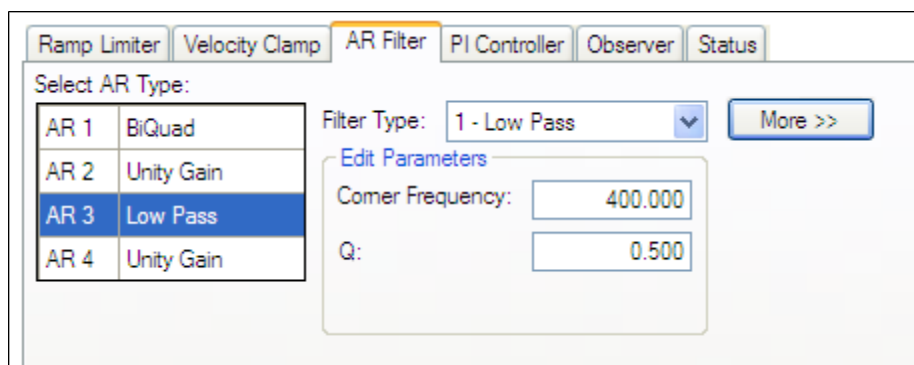
5–Autotuned Biquad . When the PST sets a filter after the PST process is complete, the values are input into the Bi-Quad filter and are shown as read only values.

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



13.4.3 Velocity Loop Default Settings and Changes

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



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

Velocity Loop Changes Based on Slider Tuning

Slider tuning (see Slider Tuning (pg 146)) uses the slider control to adjust the proportional gain and integral gain values of the velocity loop based on the desired bandwidth. If you adjust the bandwidth using the slider tuner and then return to the velocity loop screen, you will see different values inside the proportional

gain and integral gain fields. No adjustment is made to the filters automatically by using the slider tuner. Only the proportional and integral terms are adjusted.

Velocity Loop Changes Based on PST

When the PST (see Using the Performance Servo Tuner (pg 146)) is used, changes are made to the proportional gain, integral gain, filters, and other parameters not related to the velocity loop screen directly. The values adjusted are dependent on the drive, motor, load, and the PST settings. The filters that are adjusted by the PST are automatically put into mode **5-Autotuned Bi-quad**.

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

13.4.4 Biquad Filters

Filters in the KC1 all exist as digital biquad filters in the servo loops. Lowpass, LeadLag, and Resonator filters are derived by the following equations. WorkBench handles all the math involved for the user. Enter the values in the fields for the type of filter desired.

Generate a Biquad as a Lowpass at Frequency F

Numerator Frequency = 5000

Numerator Q = $\text{Sqrt}(2)/2$ (this is 0.707)

Denominator Frequency = **F**

Denominator Q = $\text{Sqrt}(2)/2$ (this is 0.707)

Generate a Biquad as a LeadLag at Frequency F, Gain G

Numerator Frequency = $F * 10^{(-G/80)}$

Numerator Q = $\text{Sqrt}(2)/2$ (this is 0.707)

Denominator Frequency = $F * 10^{(G/80)}$

Denominator Q = $\text{Sqrt}(2)/2$ (this is 0.707)

Generate a Biquad as a Resonator at Frequency F, Gain G, Bandwidth Q

Numerator Frequency = **F**

Numerator Q = $10^{(-G/40)} * Q$

Denominator Frequency = **F**

Denominator Q = $10^{(G/40)} * Q$

Related Parameters

VL Parameters (pg 694) | DRV.ACC (pg 364) | DRV.CMDSOURCE (pg 371) | DRV.DEC (pg 374) | DRV.OPMODE (pg 418)

Related Topics

Limits (pg 100) | | Service Motion (pg 137) | | Tuning Your System (pg 145)

13.5 Position Loop

13.5.1 Overview

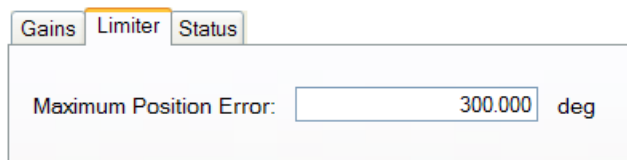
The position loop is active when the drive operates in position mode (DRV.OPMODE (pg 418) = 2). The parameters that govern the position loop are shown in the Position Loop view. The various types of tuning inside KC1 adjust these parameters, so you normally do not need to adjust the position loop parameters in the position loop screen.

A detailed block diagram for the position loop is included in Block Diagrams (pg 254).

13.5.2 Tabs in the Position Loop View

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

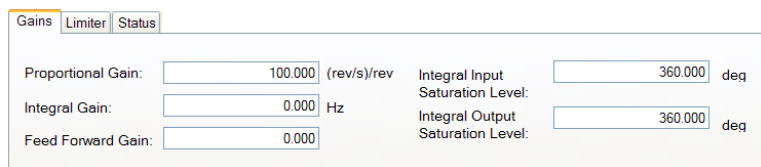
- **Gains.** This tab shows the gains for the position loop.
- **Limiters.** The value in the **Maximum Position Error** box (PL.ERRFTHRESH (pg 601)) limits the position error (PL.ERR (pg 600)) that can be present. When the maximum position error is exceeded, the drive generates fault F439 (pg 236), Following Error. If the maximum position error is set to 0 (default) then the maximum position error is ignored.



- **Status.** This tab shows the present value of commanded position (PL.CMD (pg 599)), position feedback (PL.FB (pg 605)), position error (PL.ERR (pg 600)), and velocity command (VL.CMD (pg 701)).

13.5.3 Position Loop Default Behavior and Changes

By default, only a proportional gain (PL.KP (pg 611)) is applied in the position loop.



Position Loop Changes Based on Slider Tuning

Slider Tuning (see Slider Tuning (pg 146)) adjusts the proportional gain of the position loop (along with velocity loop view parameters; see Velocity Loop (pg 117)). If you adjust the bandwidth using the slider tuner, then when you return to the position loop screen, you will see a change to the proportional gain only. No adjustment is made to the integral gain or feedforward gain through the slider tuner. The integral saturation levels are not applicable when the integral gain is set to 0. In the **Gains** tab, the boxes for these values may be populated with default values whether or not the integral gain is set to 0.

Position Loop Changes Based on PST

When the Performance Servo Tuner (PST, see Using the Performance Servo Tuner (pg 146)) is used, changes are made to the position loop proportional gain, integral gain, feedforward gain and other parameters not related to the Position Loop view directly. The values adjusted are dependent on the drive, motor, load, and the PST settings.

Related Parameters

PL Parameters (pg 598)

DRV.OPMODE (pg 418)

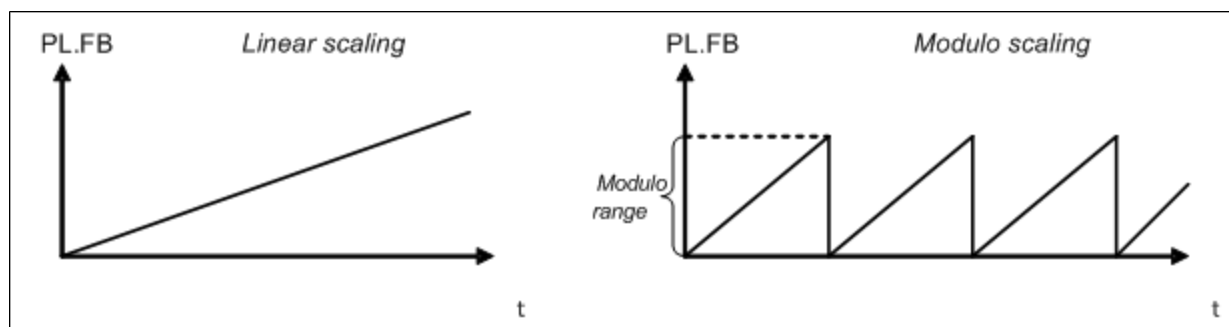
VL.CMD (pg 701)



13.5.4 Modulo Position

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

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



13.5.4.1 Setting up the modulo axis in WorkBench

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

Modulo

[Learn more about this topic](#)

Modulo is used to set a rollover value for the position scale.

Modulo Position: 1 - Enabled

Modulo Range Begin/End: deg

Modulo Range Begin/End: deg

Direction For Absolute Motion Task: 1 - Positive

Position Feedback: deg

Button or Box	Description
Modulo Position	Enables or disables modulo (PL.MODPEN (pg 615))
Modulo Range Begin/End	Sets the beginning and end of the modulo range (PL.MODP1 (pg 612), PL.MODP2 (pg 613))

Button or Box	Description
Direction for Absolute Motion Task	Sets the direction of an Absolute Motion task when Modulo is enabled. The direction can be set to always positive, or always move negative. The "Shortest Distance" mode will determine the shortest distance to the target and move in that direction. The "inside range" mode will move in the direction that allows the motor to stay in between the defined scale and therefore not to wrap around. Shortest Distance is more commonly used than Inside Range mode. (PL.MODPDIR (pg 614))
Position Feedback	Reads and displays the position feedback (PL.FB (pg 605))

13.5.4.2 Setting up the modulo axis from the Terminal

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

- PL.MODPEN (pg 615): Enables or disables the modulo-axis feature.
- PL.MODP1 (pg 612): Defines either the beginning or the end of the modulo range, depending on the PL.MODP2 setting.
- PL.MODP2 (pg 613): Defines either the beginning or the end of the modulo range, depending on the PL.MODP1 setting.

13.5.4.3 Parameters affected by the modulo axis

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

- PL.FB (pg 605): The actual position of the drive is converted into modulo scaling.
- PL.CMD (pg 599): The command position of the drive is converted into modulo scaling.
- CAP0.PLFB (CAP0.PLFB, CAP1.PLFB (pg 324)): The actual position of the drive, which has been captured by the capture engine 0, is converted into modulo scaling.
- CAP1.PLFB (CAP0.PLFB, CAP1.PLFB (pg 324)): The actual position of the drive, which has been captured by the capture-engine 1, is converted into modulo scaling.

13.5.4.4 Drive functions affected by modulo axis

Software limit switch

The software limit switches in the drive compare the actual position (PL.FB (pg 605)) with threshold values. Motion is stopped when the actual position exceeds the software limits. Since PL.FB is affected by the modulo-axis feature, the software limit switches monitor the modulo-converted PL.FB value. Software limit switches with thresholds outside of the modulo range never limit motion.

Programmable limit switch

The programmable limit switches compare the actual position (PL.FB (pg 605)) with selectable thresholds and then status flags are set to "true" when the actual position is currently within these position limits. The programmable limit switches monitor the modulo-converted PL.FB value. Programmable limit switches that are set outside the modulo-range never become active.

Digital output Modes 5 and 6

The digital output modes 5 and 6 (position greater than x, position less than x) compare the actual position of the drive with thresholds and activate the associated outputs when PL.FB (pg 605) is lower or higher than the threshold. The digital output mode functionality monitors the modulo-converted PL.FB value. Position thresholds that are set outside the modulo range continuously activate or deactivate the digital output.

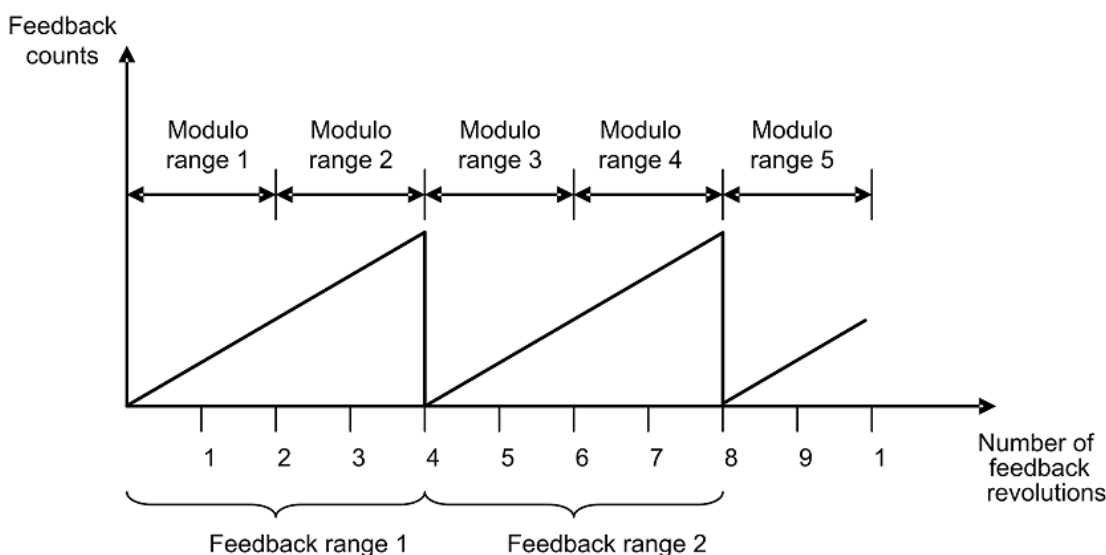
13.5.4.5 Using the modulo position feature with multiturn encoders

A special case exists for the following combinations of events:

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

After powerup of the drive, the actual position (PL.FB (pg 605)) will be read from the multiturn feedback device. This position can be considered as a position within the feedback range as described in the figures below.

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

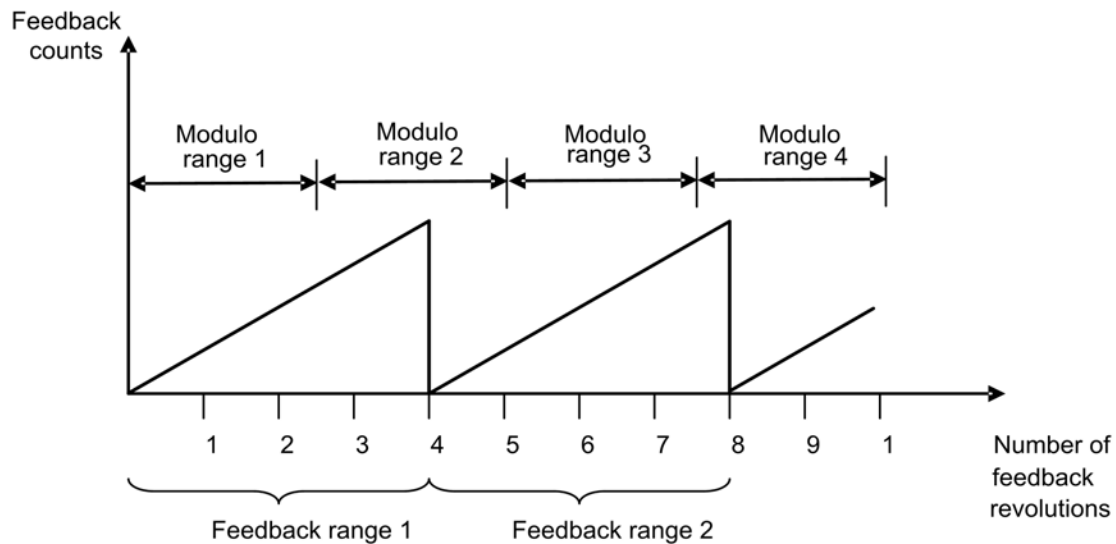


As described in the figure above, the selected modulo range of the drive is repeated exactly at the point where the connected multiturn feedback rolls over (Modulo range 1, 3, 5...). The application can move for several multiturn feedback ranges and the drive can recalculate the modulo position correctly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

Example

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

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



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

Example

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

14 Creating Motion

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14.1 Homing

14.1.1 Overview

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

14.1.2 Using Homing

The KC1 includes a variety of homing methods (set with HOME.MODE (pg 508)) to accommodate your machine needs:

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

Each of these homing methods offers a different way to achieve a home reference point based on your particular system mechanics. All homing methods provide the options of adjusting the acceleration, deceleration, and speed for homing moves. In addition, once the homing move is completed, you can either set an offset position or make an offset move as required. Homing modes, guidance for mode selection, and homing examples are included in *Selecting and Using Homing Modes* (pg 128).

NOTE

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

Home Default Window

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

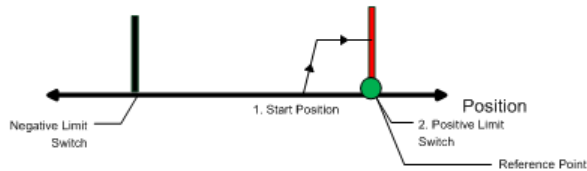


Home

This page is used to issue a homing command. The home command is used to zero the drives position.

Select the type of homing motion you wish to use:

1 - Find limit input



[Goto Drive Motion Status](#)

Settings

Acceleration: $\mu\text{m}/\text{s}^2$

Deceleration: $\mu\text{m}/\text{s}^2$

Direction:

Distance: μm

Position: μm

Position Lag: μm

Velocity: $\mu\text{m}/\text{s}$

Negative Limit Switch: [Configure Inputs](#)

Max Distance: μm i Disabled when value is 0.

Controls

Found:

Done:

Active:

Error:

Position Feedback: μm

Auto Homing:

Mode Selection:

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

Settings:

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

Controls:

- **Found:** When the home reference is found, then this indicator is green.
- **Done:** When the home move is complete, this indicator is green.
- **Active:** This indicator will be green while the Home move is taking place.
- **Error:** This indicator will be red if something in the homing sequence failed.

- **Position Feedback:** This window reports the current value for PL.PFB.
- Auto Homing: Allows the system to auto-home on power up.
- **Start/Stop:** Click this button to start or stop the selected homing method.

14.1.3 Selecting and Using Homing Modes

Homing Mode 0: Home Using Current Position

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

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

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

Homing Mode 0 Example

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

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

Homing Mode 1: Find Limit Input

The find limit input mode creates a move to a limit input. This method can be used if you have a positive or negative limit switch available that you want to establish as a home reference point.

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

The sequence of this homing mode is as follows:

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

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

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

CAUTION active. This action will cause a homing error fault.

Homing Mode 1 Example

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

1. Select Mode 1 from the drop-down box and enter 20 into the Position box.
2. Set the direction to positive. When Start is selected, the motor will move until it encounters the positive end of travel switch.
3. As soon as the switch is triggered, the motor will reverse direction until the switch is no longer active.
4. As soon as the switch is no longer active, the position will be set to -20 degrees and the motor will ramp to 0. Depending on the velocity you are homing with, and the settings of the acceleration/deceleration ramps, the position feedback will be close to the position you entered.

Homing Mode 2: Find Input Limit then Find Zero Angle

Similar to the Find Input Limit method, the find input limit then find zero angle¹ mode follows the same steps, but upon completion of the move, it continues to move to find the zero angle reference of the motor.

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

The specific steps are as follows:

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

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

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

Homing Mode 2 Example

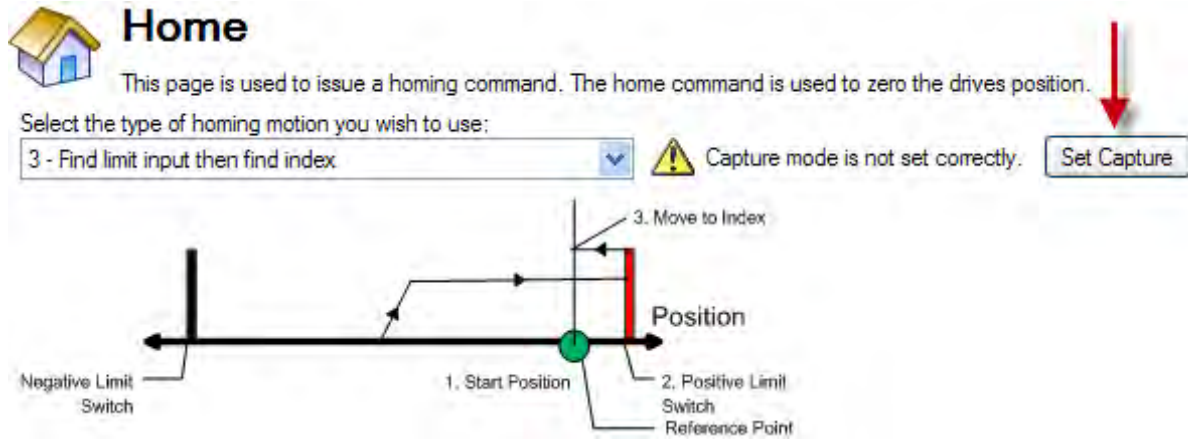
Use the positive end of travel limit as home reference and then move to the zero angle of the motor

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

Homing Mode 3: Find Input Limit then Find Index

¹Mechanical zero angle of the feedback = 0 degree.

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



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

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

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

Homing Mode 3 Example

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

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

Homing Mode 4: Find Home Input

Homing Mode 4 establishes the home reference based on an external home switch connected to a drive

digital input (DINx.MODE - 11 Home Reference).

The sequence of this homing mode is as follows:

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

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

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

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

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

Homing Mode 4 Example

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

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

Homing Mode 5: Find Home Input then Find Zero Angle

The sequence of this homing mode is as follows:

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

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

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

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

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

Homing Mode 5 Example

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

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

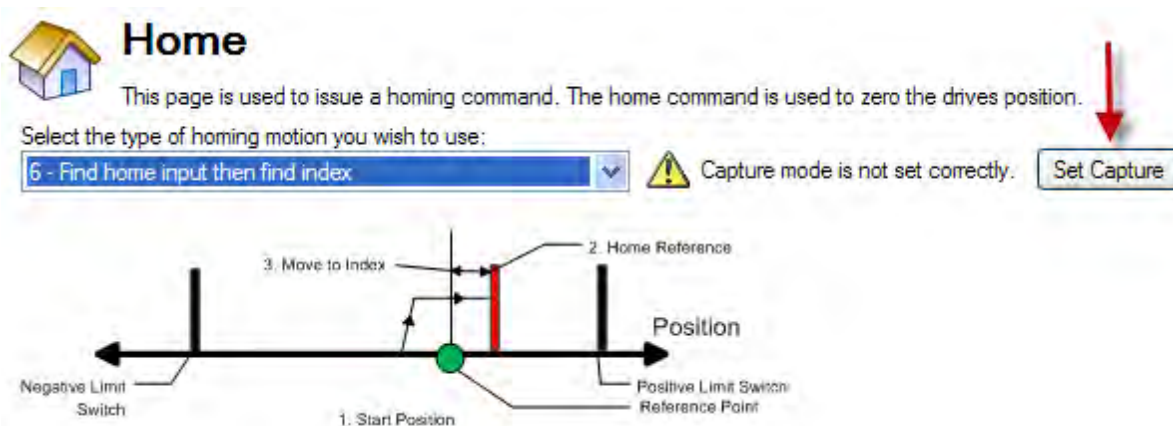
Homing Mode 6: Find Home Input then Find Index

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

This homing mode starts motion until a digital input, which is assigned to act as a home-switch, has been activated. The motor moves afterwards with a reduced velocity (HOME.FEEDRATE) until the index signal has been detected by the drive.

NOTE

This method requires that Capture Mode is turned on. This is done in the home screen. With Mode 6 selected, a "Set Capture" button will appear (see arrow below). Pressing the button sets the Position Capture mechanism correctly for proper homing with an index pulse..



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

The sequence of this homing mode is as follows:

1. The motor starts to move according to the HOME.DIR command.

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

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

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

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

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

Homing Mode 7: Find Zero Angle

The sequence of this homing mode is as follows:

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

Homing Mode 7 Example

Move in the positive direction towards the zero angle location.

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

Homing mode 8: Move Until Position Error Exceeded

This method is also referred to as move to hard or mechanical stop. The KC1 has several options related to this method as well. For this basic method, the motor will move until it encounters a hard stop, causing the position error to exceed a specific threshold you set. Once the threshold is exceeded, the motion stops and home reference is established. You can use the Distance or Position as described initially in this section.

 Be sure to choose the direction appropriately to move off of the stop if using the distance offset.

The sequence in this homing mode is as follows:

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

Homing Mode 8 Example

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

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

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

The sequence in this homing mode is as follows:

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

Homing Mode 9 Example


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

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

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

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

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



Home


This page is used to issue a homing command. The home command is used to zero the drives position.

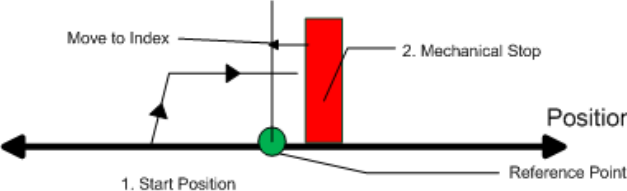
Select the type of homing motion you wish to use:

10 - Move until position error exceeded then find index

⚠ Capture mode is not set correctly.

Set Capture





Goto Drive Motion Status

Settings

Acceleration: rpm/s

Deceleration: rpm/s

Direction:

Distance: deg

Position: deg

Position Lag: deg

Velocity: rpm

Velocity Factor: %

Peak Current: Ams

Controls

Found:

Done:

Active:

Error:

Position Feedback: deg

Auto Homing:

⚠ Drive is inactive.

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

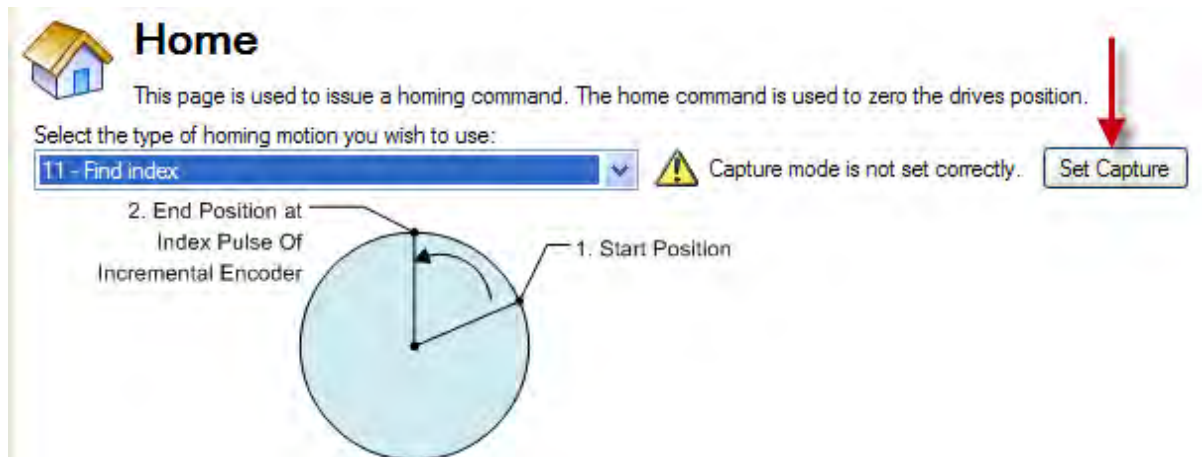
Homing Mode 10 Example: Move Until Position Error Exceeded then Find Index.

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

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

Homing Mode 11: Find Index Signal

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



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

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

Homing Mode 11 Example: Find Index Signal.

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

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

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

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

The sequence of this homing mode is as follows:

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

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

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

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

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

Homing Mode 13: Absolute Mode - Use Feedback Position

This mode should be selected when using a multi-turn feedback device with KC1. Since the feedback keeps track of its value at all times, the drive takes the value of the feedback at power up. The homing flag is also set. Use auto-home with this mode (HOME.AUTOMOVE). The multi-turn device is initially referenced using FB1.OFFSET. This value is set in the drive using the terminal screen and will need to be saved to the drive. Single-turn absolute devices can also utilize this mode if they are used in applications like a rotary index table where the entire range is within 360 degrees.

14.1.4 Using Homing: Advanced

The various homing methods in the KC1 offer several options for setting up your home reference. When using any of the methods that use homing switches and limits, please refer to the Input/Output section for proper wiring techniques.

Related Parameters and Commands

HOME Parameters (pg 500)

PL.FB (pg 605)

CAP0.MODE, CAP1.MODE (pg 323): Sets index capture method

Related Topics

Digital Inputs and Outputs (pg 81)

DIN Parameters (pg 337)

DOUT Parameters (pg 353)

14.2 Service Motion

Service Motion allows you to set up simple motion (Command Source must be set to Mode 0 - Service). It is typically used during initial set up to exercise the system. It can be used to help troubleshoot the system, execute tuning, make repetitive moves for verification of mechanical set up, or for other general simple motion needs. There are multiple ways to set up motion depending on the desired result in torque, velocity or position modes. In all modes, you can run a momentary pulse, set up reversing motion, or initiate continuous motion.

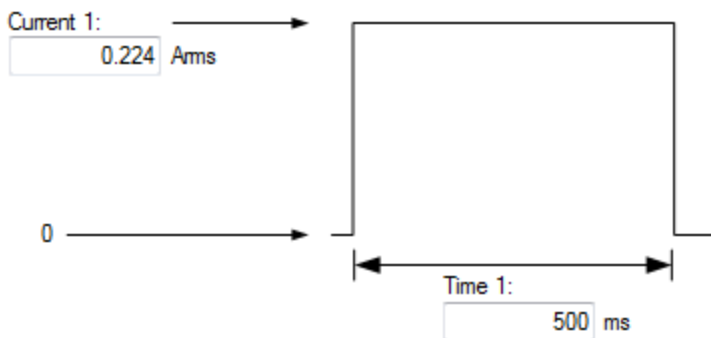


Service Motion

Service motion allows you to start and stop some test motions.

Service Motion Mode: Pulse Reversing Continuous

Group:



Drive is inactive.

Position Feedback: Counts16Bit

Velocity Feedback: rpm

Current Feedback: Ams

The chart below identifies the commands available on the **Service Motion** view:

Button or Dialog Box	Description
Pulse	Alternates between the commanded current or velocity and zero velocity. You can specify the time period between the commanded value and the return to zero. Setting a time to zero will generate a continuous command.
Reversing	Alternates between the two commanded values. You can specify the time the command will be held in each state.
Continuous	Runs the commanded current or velocity continuously.
Group	Selects parameter group to be used with service motion. Group 1 selects parameter group for SM.MODE 0, and group 2 selects parameter group for SM.MODE 2. See SM.MODE (pg 657) for more details.
Current 1/Current 2	Sets the two different currents.
Time 1/Time 2	Sets the time for which the different commands are generated. Setting a time to zero generates a continuous command.
Start/Stop	Starts and stops the motion.
Position Feedback	Displays the present position of the motor.
Velocity Feedback	Displays the present velocity of the motor.
Current Feedback	Displays the present current of the motor.

The **Drive Motion Status** view indicates when the drive is performing service motion.

Related Topics

Drive Motion Status (pg 139)

Related Parameters

SM.I1 (pg 655)

SM.I2 (pg 656)

SM.I2 (pg 656)

SM.MOVE (pg 660)

SM.T1 (pg 661)

SM.T2 (pg 662)

SM.V1 (pg 663)

SM.V2 (pg 664)

14.3 Jog Move

This screen verifies that the servo system is able to command motion. Verify the settings for velocity, acceleration, and deceleration. Adjust these settings if necessary. Click **Jog** and continuous motion will occur until you click **Stop**. If motion does not occur, check for warnings, faults, or prompts from Work-Bench.

If erratic motion and or vibration occur when motion is commanded, open the wizard **Tuning** screen and reduce the desired bandwidth significantly. If erratic motion continues, exit the **Setup Wizard** and use the **Performance Servo Tuner** and **Service Motion** screens in the settings tree for more advanced setup of the servo system.

NOTE

In order to tune the system the drive must be in service-type command source and either velocity or position opmode. If the drive is in torque opmode, then a popup screen will allow you to switch into velocity mode.

14.4 Drive Motion Status

Drive Motion Status allows you to view the current status of the drive internal motion. An LED indicates the status of various possible motion states (as read by the DRV.MOTIONSTAT (pg 411) parameter). The **Drive Motion Status** box displays the DRV.MOTIONSTAT (pg 411) output in hexadecimal form. The boxes below **Drive Motion Status** indicate the drive state. When drive motion is activated, a green LED is shown. When error occurs, a red LED is shown as indicated below:



Drive Motion Status

This page indicates the current status of the drive internal motion.

Drive Motion Status:

Motion Active Mode

- Homing
- Service Motion
- Motion Task
- Electronic Gearing

Emergency Stop

- Procedure in progress
- Error has occurred

Home

- Position found
- Routine finished
- Error has occurred

Motion Task

- Target velocity reached
- Target position reached
- Unable to start/Invalid MT
- Target position crossed when stopping

Electronic Gearing

- Slave is synchronized

Related Topics

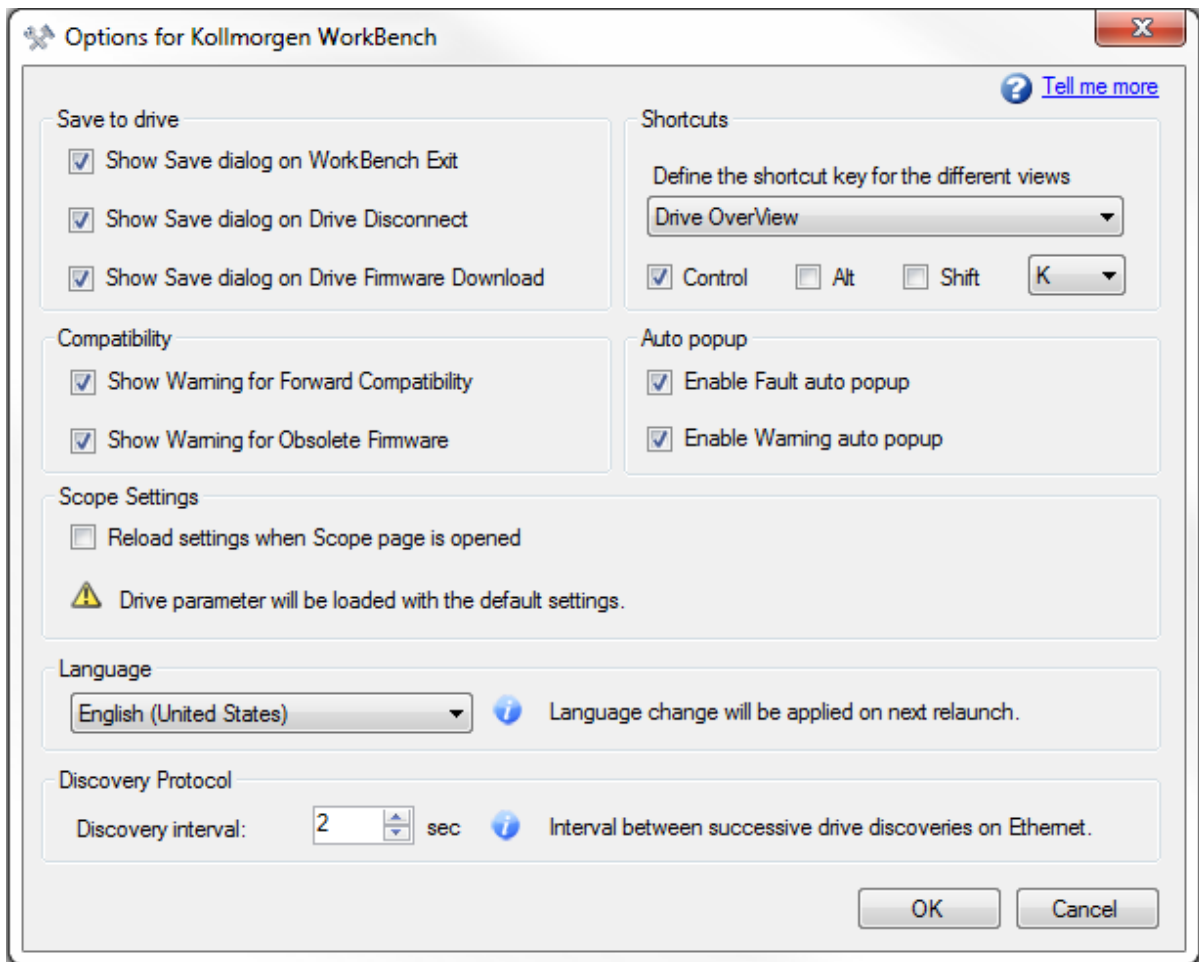
[Service Motion \(pg 137\)](#) | [Emergency Stop \(pg 108\)](#) | [DRV.MOTIONSTAT \(pg 411\)](#)

15 Saving Your Drive Configuration

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15.1 Save Options

WorkBench offers several options for saving your drive configuration. From the WorkBench menu, if you select **Tools** and then **Options**, the following window appears:



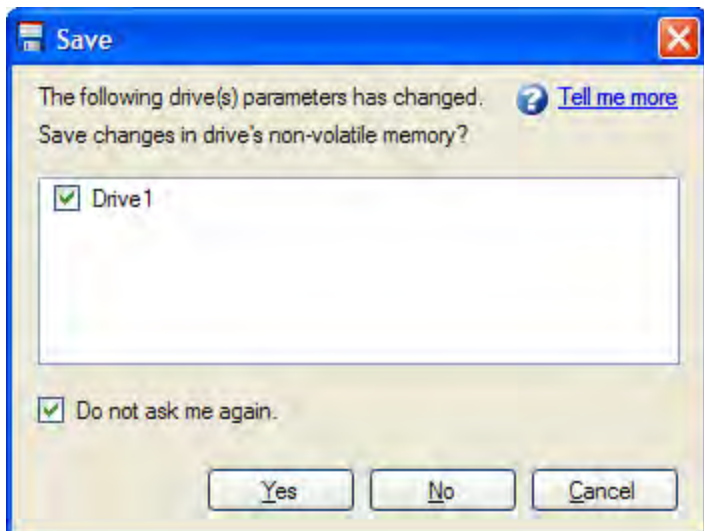
The **Save** options are applied as follows:

Button or Dialog Box	Description
Show Save dialog on WorkBench exit	If this box is checked, then every time you exit WorkBench a dialog will ask you if you wish to save the drive parameters to nonvolatile memory. If this box is not checked, the dialog will not be shown.
Show Save dialog on Drive Disconnect	If this box is checked, then every time you disconnect from a drive a dialog will ask you if you wish to save the drive's parameters to nonvolatile memory. If this box is not checked the dialog will not be shown.
Show Save dialog on Drive Firmware Download	If this box is checked and any parameter is changed, then every time you download a firmware to a drive, a dialog will ask you if you wish to save the drive's parameters to nonvolatile memory. If this box is not checked, the dialog will not be shown.

When the **Scope Settings** box is checked the default drive settings will be overwritten with selected Scope setting parameters each time the Scope page is opened. Otherwise, the drive will with default drive settings.

15.2 Save On Exit

When you exit WorkBench while connected to a drive, the following dialog box appears:



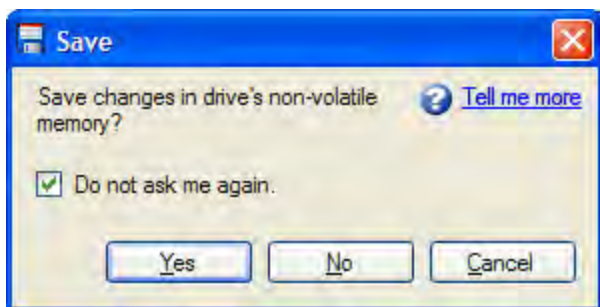
As you are working with a drive, all the changes you make are stored in the volatile memory within the drive. If you power cycle the drive or loose power to the drive then any changes you have made to the drive would be lost. You can save the drive parameters to nonvolatile memory at any time and these saved parameters will be restored when the drive next powers up.

While you are connected to the drive, WorkBench monitors all the changes you make to the drives parameters. An asterisk in the navigation tree shows if a parameter has been changed. If you do not change any drive parameters, this dialog will not be shown.

Button or Dialog Box	Description
Yes	Saves the parameters to the nonvolatile memory within the selected drives and then exits WorkBench.
No	WorkBench will exit. No drive parameters will not be saved to nonvolatile memory.
Cancel	This will stop the exit command and WorkBench will remain open.
Do not ask me again	If you check this WorkBench will not show this dialog again. There is an option in the Options dialogue to restore this setting.

15.3 Save On Disconnect

When you disconnect from the drive, you may see this dialog box:



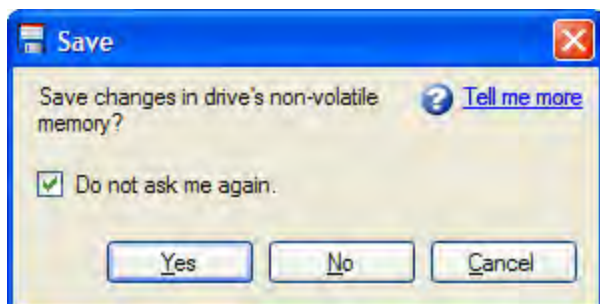
As you work with a drive, all the changes you make are stored in the volatile memory within the drive. If you restart the drive or lose power to the drive, then any changes you made to the drive would be lost. You can save the drive parameters to nonvolatile memory at any time, and these saved parameters will be restored when the drive next powers up.

While you are connected to the drive, WorkBench monitors all the changes you make to the drive parameters. An asterisk in the navigation tree shows if a parameter has been changed. If you do not change any drive parameters, this dialog box will not be shown.

Button or Dialog Box	Description
Yes	Saves the parameters to the nonvolatile memory within the drive and then finish disconnecting.
No	Disconnects the drive. The drive parameters are not saved to nonvolatile memory.
Cancel	Stops the disconnect command. You remain connected to the drive.
Do not ask me again	Does not display this dialog box again. If you check this box, WorkBench does not show this dialog again. The Options dialog includes a command to restore this setting.

15.4 Save On Firmware Download

When you download firmware to the drive, you may see this dialog box:



As you work with a drive, all the changes you make are stored in the volatile memory within the drive. If you restart the drive or lose power to the drive, then any changes you made to the drive are lost. To save these changes, you can save the drive parameters to nonvolatile memory at any time. If you save the changes to the nonvolatile memory, these saved changes will be restored when the drive next powers up. While you are connected to the drive, WorkBench monitors all of the changes that you make to the drive parameters. An asterisk in the navigation tree indicates that a parameter has been changed. If you do not change any drive parameters, this dialog box will not be shown.

Button or Dialog Box	Description
Yes	Saves the parameters to the nonvolatile memory within the drive and then opens dialog box for the user to select the firmware file for downloading.
No	The drive parameters are not saved to nonvolatile memory. It opens dialog box for the user to select the firmware file for downloading.
Cancel	Stops the download command.
Do not ask me again	Does not display this dialog box again. If you check this box, WorkBench does not show this dialog again. The Options dialog includes a command to restore this setting.

16 Tuning Your System

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16.1 Introduction

Most servo systems require some level of tuning (setting up the desired response of the system usually with the load attached). This can be done through several methods available within WorkBench.



Slider Tuning - Slider tuning offers a very simplistic approach to tuning and can get you under-way quickly. With this method, just the proportional and integral gains are adjusted based on the desired bandwidth you wish to achieve. You can take into account your load inertia if it is known. None of the Bi-quad filters are impacted by the slider tuning.



Performance Servo Tuner - This is an easy way to get a more sophisticated tuning accomplished. The details of how the PST works are included in the advanced section of this subject. However, the PST approach is a simple one-button solution that lets the system configure all of the tuning parameters for you. The PST is a robust solution to get your system tuned and ready to operate in a wide variety of mechanical configurations and loads.

Manual Tuning - Certain applications may require manual tuning where you set the gains and filters based on the specific performance you are looking for. You may also need to "tweak" the tuning that was set up in either the slider or the PST section to optimize your application performance.



16.2 Slider Tuning

This view allows you to vary the tuning of your drive using the slider.

16.2.1 Gentle, Medium, and Stiff

These buttons select three of the most common bandwidths:

- Gentle works in all but the most challenging situations.
- Medium is the default and works in most situations.
- Stiff works for unloaded motors.

16.2.2 The Slider

As you drag the slider to the right, the stiffness increases. In many situations, you cannot drag the slider fully to the right side because the system will become unstable.

16.2.3 Inertia Ratio

If you know the inertia ratio of your load, then entering it can improve the performance of your system. If you do not know the inertia of your load then WorkBench will assume a ratio of 1:1, which will give good performance in many configurations. The inertia ratio is the ratio of your load with respect to the inertia of your motor.



16.3 Using the Performance Servo Tuner

16.3.0.1 Overview

The Performance Servo Tuner (PST) tunes your system quickly and easily. The advanced technology in the PST achieves high performance and stability for both simple and complicated loads. The PST can work in a "one button" mode that requires no decisions from the user. It can also be set up in specific

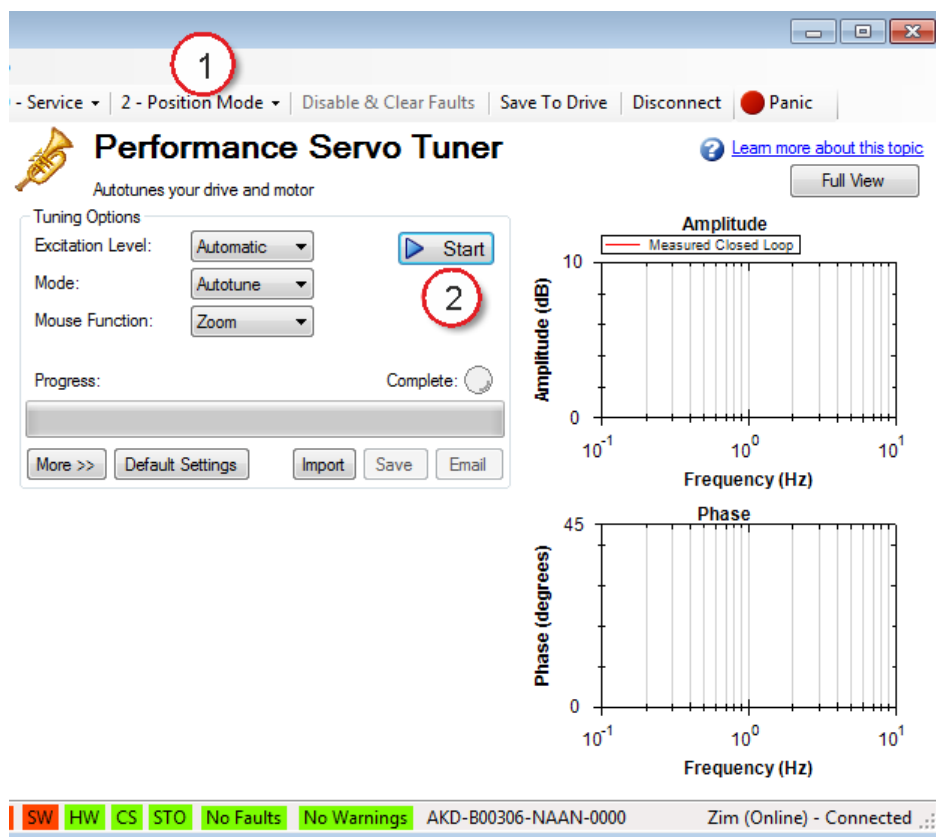
modes to control how the PST operates for specific requirements. Finally, the PST collects frequency response data (a Bode plot) that can be used for advanced analysis.

NOTE The PST will not work reliably on a vertical axis since the motor may rest against an end stop; in this case, the inertia will not always be correctly identified.

16.3.0.2 Using the PST

The PST defaults to a “one button” mode, in which the PST is completely automatic after pushing the start button. In the **Settings** select your desired operation mode, navigate to the **Performance Servo Tuner** view, and then tune your system as follows:

1. Select whether you would like the drive to be tuned in **1-Velocity** or **2-Position** Mode. If the drive is in torque mode, the PST will tune in position mode by default. This is set by using the tool bar and changing the mode to either velocity or position. The drive must be disabled in order to change the operation mode.
2. Click **Start**.



The PST will then perform several tests and display results as shown below. The progress bar (1) shows the relative progress of the PST, so you can estimate when the tuning will be finished. When the tuning is complete, the green **Complete** LED (2) illuminates, and a Bode plot (3) is displayed showing the frequency response of the tuned system.

Performance Servo Tuner
Autotunes your drive and motor

Tuning Options
 Excitation Level: Manual
 Mode: Autotune
 Mouse Function: Zoom
 Progress: Complete
 Complete: ●

Buttons: Less << | Default Settings | Import | Save | Email

Measurement Tab:
 Current Amplitude: 0.095
 Velocity Amplitude: 3.063
 Smoothing %: 1.000
 FFT Points: 4096
 Number Points: 60000
 Measurement: Closed Loop
 Injection Point: Current
 Excitation Type: PRB
 Velocity Max: 1000.00 (RPM)
 Excite Gap: 2

Amplitude
 Measured Closed Loop
 Amplitude (dB) vs Frequency (Hz)

Phase
 Phase (degrees) vs Frequency (Hz)

Annotations: 1 (Progress bar), 2 (Save button), 3 (Amplitude plot)

Saving and Emailing Bode Plots

To save screenshots and raw data of a Bode plot, click on either **Save** (1), or **Email** (2).

Tuning Options
 Excitation Level: Manual
 Mode: Autotune
 Mouse Function: Zoom
 Progress: Complete
 Complete: ●

Buttons: Less << | Default Settings | Import | Save | Email

Annotations: 1 (Save button), 2 (Email button)

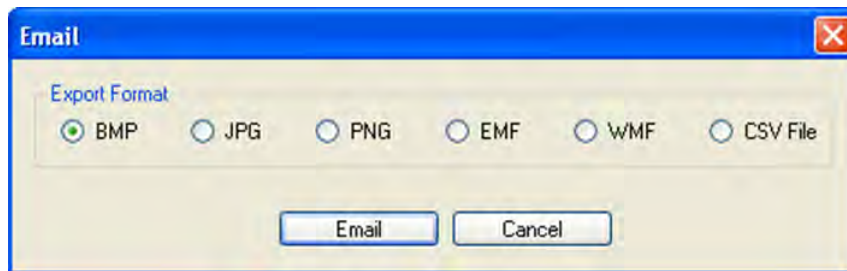
Clicking **Save** opens a prompt to select how to save the screenshot or data. Selecting BMP, JPG, PNG, EMF, or WMF saves the Bode plot as an image. Choosing CSV saves the raw data that is currently plotted as a comma delimited file. Click **Save** to save the file to your hard drive in the desired format.

Save Image/CSV

Export Format
 BMP
 JPG
 PNG
 EMF
 WMF
 CSV File

Buttons: Save | Cancel

Clicking **Email** opens a similar prompt. Select the file format in which you wish to save the image or raw data, and an email will be created for you with the file automatically attached for your convenience. Click **Email** to create the email with the selected file attachment.



Importing a Frequency Response

If you have previously saved a frequency response measurement into a CSV file, it can be imported for later viewing. Click the **Import** button, and browse to your saved CSV file. You can import while in offline mode for convenience. Importing a frequency response is useful for off-site developers to analyze a machine tool.

16.3.0.3 Measurement Options

By default, the PST determines the excitation level automatically and autotunes the drive and motor.

The PST also allows you to enter a manual excitation level or to take only Bode measurements (without autotuning the system).

Using Manual Excitation Levels

By default, the PST is set to use the automatic excitation level. To obtain the automatic excitation level, the PST runs a friction test at the beginning to determine how much excitation is needed to break friction and get an accurate measurement.

To change this excitation level, click on the **Excitation Level** drop-down box (1), and select **Manual**. Then enter a new **Current Amplitude** (2) in amps.

Note: If the **Injection Point** is set to **Current**, then the **Current Amplitude** box will be enabled to enter an excitation level; if the **Injection Point** is set to **Velocity**, the **Velocity Amplitude** box will be enabled to enter an excitation level.

Performance Servo Tuner
Autotunes your drive and motor

[Learn more about this topic](#) Full View

Tuning Options

Excitation Level: Manual 1 Start

Mode: Autotune

Mouse Function: Zoom

Progress: Complete Complete:

Less << Default Settings Import Save Email

Autotuner Measur 2 Plots Cursors

Current Amplitude: 0.095 Measurement: Closed Loop

Velocity Amplitude: 3.063 Injection Point: Current

Smoothing %: 1.000 Excitation Type: PRB

FFT Points: 4096 Velocity Max: 1000.00 (RPM)

Number Points: 60000 Excite Gap: 2

Amplitude

Amplitude (dB) vs Frequency (Hz)

Phase

Phase (degrees) vs Frequency (Hz)

SW HW CS STO No Faults No Warnings AKD-B00306-NAAN-0000 Zim (Onl... ..)

16.3.0.4 Taking a Bode Measurement without the PST

You may wish to take only the frequency response of a system, rather than using the PST. To take a frequency response measurement without the PST, click on the **Mode** drop-down box (1) and select **Bode Plot**, then click **Start** (2).

Tuning Options

Excitation Level: Manual Start

Mode: Bode Plot 1 2

Mouse Function: Zoom

Progress: Complete Complete:

Less << Default Settings Import Save Email

16.3.1 Using the Performance Servo Tuner: Advanced

The Performance Servo Tuner (PST) can be set up to use specific modes or limits in tuning to provide tuning in ways you can control, while still taking advantage of the PST's ability to make decisions quickly and effectively for you.

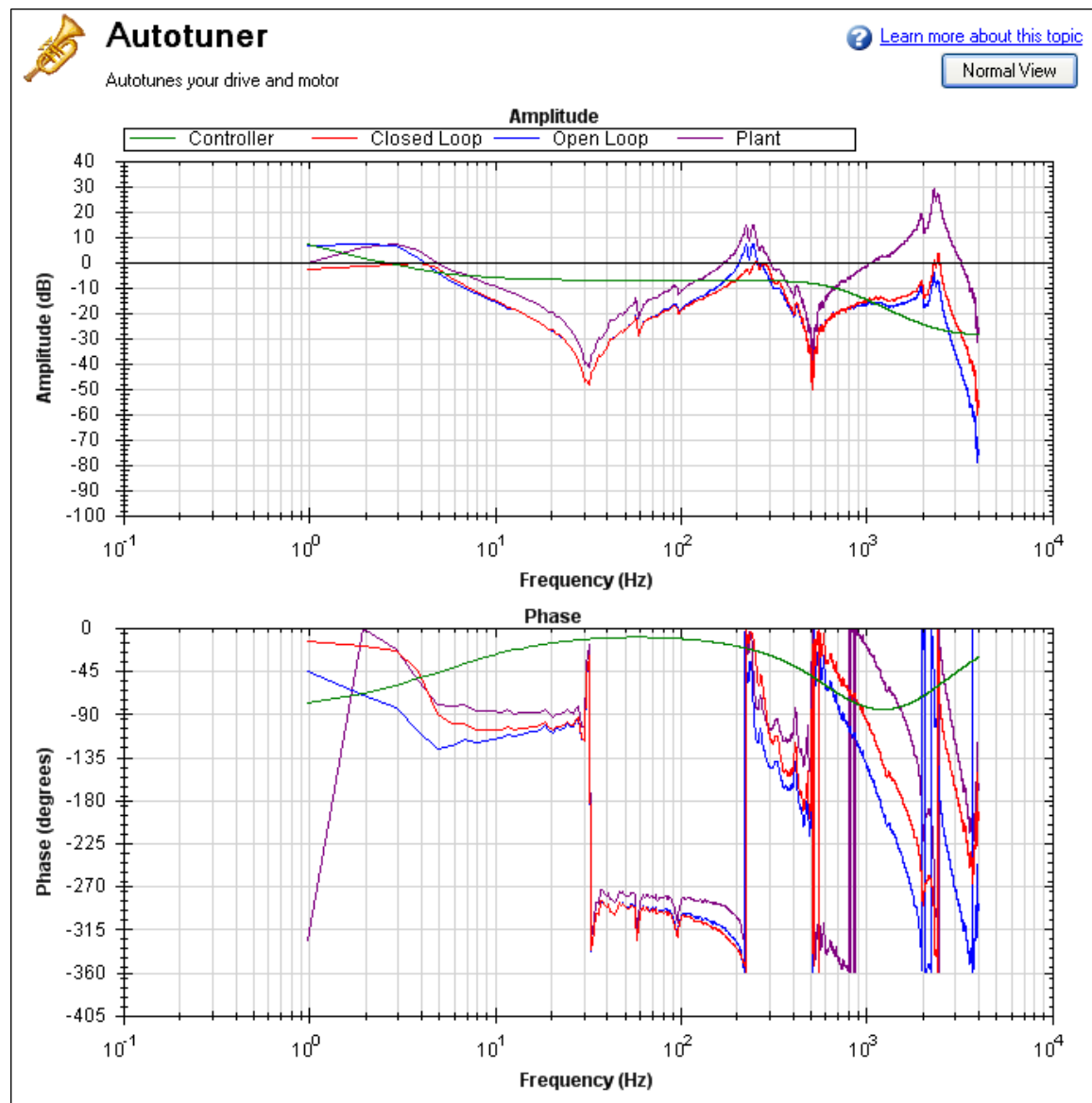
To use the advanced modes of the PST, click the **More** button to display the additional features for advanced autotuning:

16.3.1.1 Typical Cases for Advanced PST Use

Tuning Systems with Low-Frequency Resonances

Systems with low-frequency resonances are challenging because low frequency data is difficult to measure. While the PST can tune these systems, you can expect lower system performance. If your system

has a first anti-resonance of 30 Hz (pictured below), you can expect approximately 15 Hz (half the frequency of the first anti-resonance) of closed loop bandwidth.

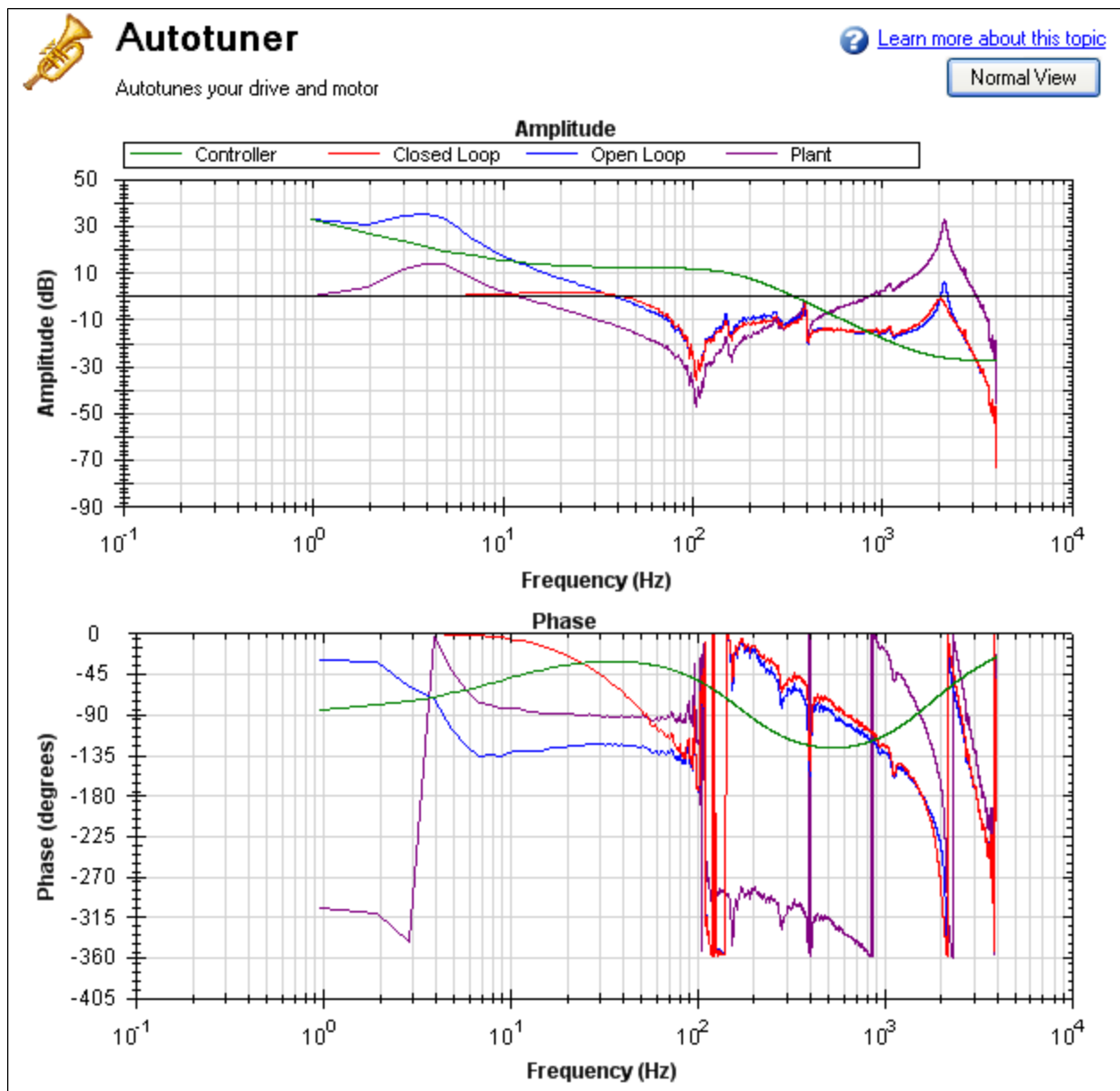


In addition, in order to accurately measure the low frequency resonances, the fast Fourier transform (FFT) resolution must be sufficiently fine to accurately measure the low-frequency resonance. A good place to start is to have an FFT resolution of 1/10 of the frequency of the lowest anti-node. In the case shown above, an anti-resonance of 30 Hz is present, so the resolution should be approximately 3 Hz FFT resolution. The PST can function with the resonance if it is accurately measured, as shown below. To adjust the FFT resolution, adjust **FFT Points** in the **Recording Options** tab as needed.

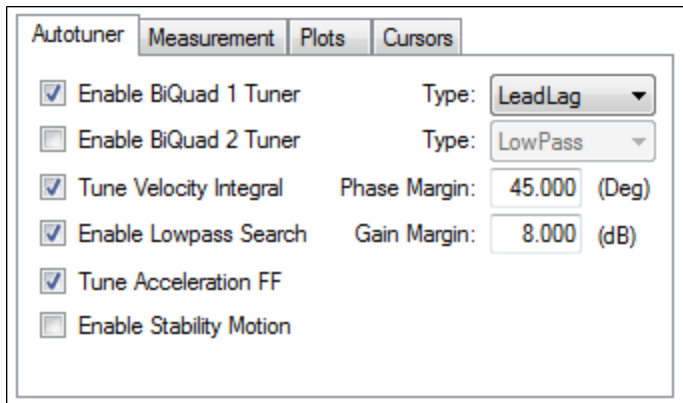
Autotuner	Measurement	Plots	Cursors
Current Amplitude: 0.095	Measurement: Closed Loop		
Velocity Amplitude: 3.063	Injection Point: Current		
Smoothing %: 1.000	Excitation Type: PRB		
FFT Points: 4096	Velocity Max: 1000.00 (RPM)		
Number Points: 60000	Excite Gap: 2		

Tuning Systems with High-Frequency Resonances

Some systems have resonances at very high frequencies (greater than 1 kHz). When the resonance is this large, it can prove a challenge in tuning, because these systems generate high noise levels that are often audible. An example of a large resonance is shown below. This example is from a steel flywheel mounted to an AKM 22E motor. The source of the resonance is the spring mass relationship between the motor rotor, shaft, and flywheel.

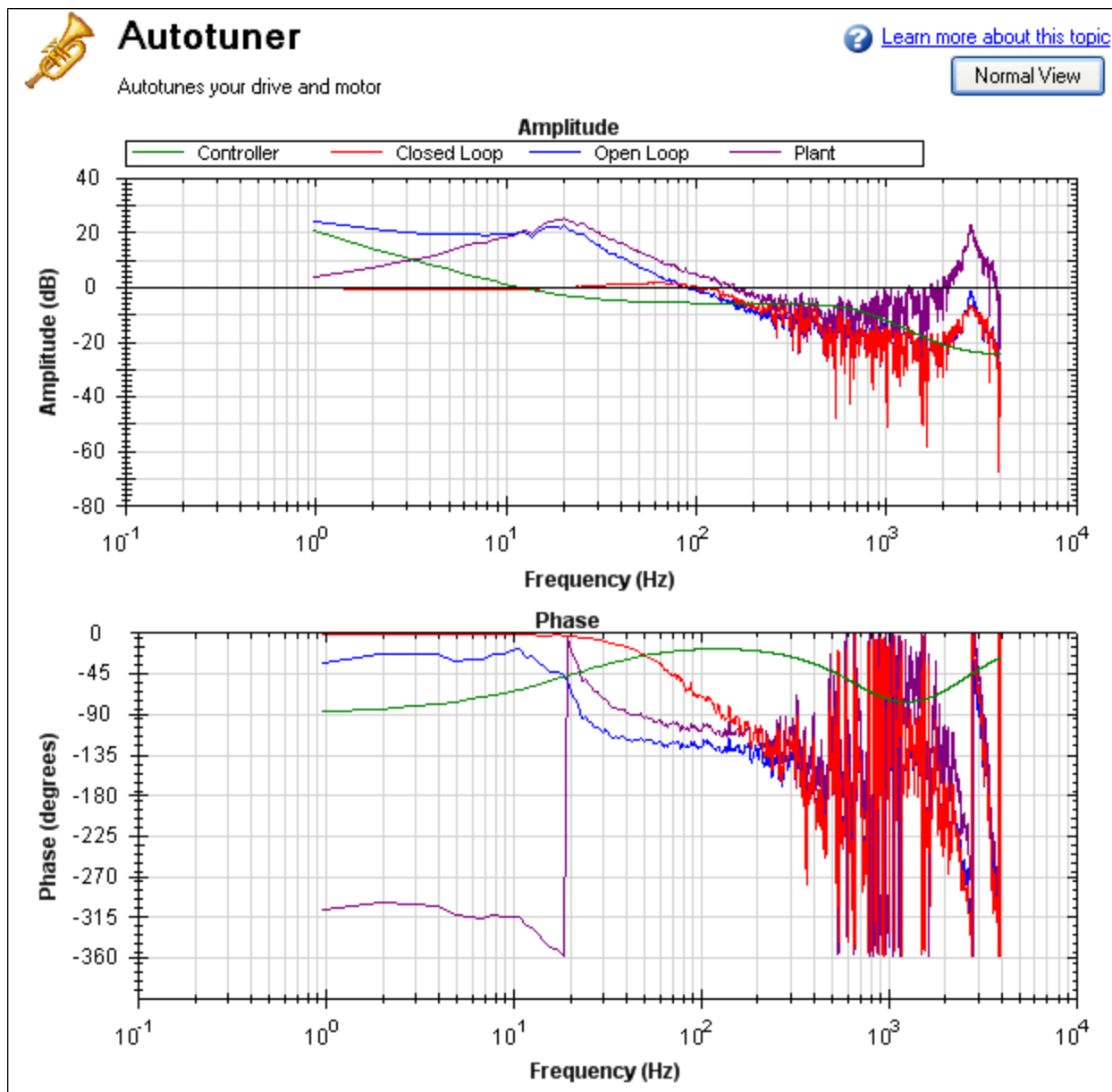


One way to resolve this problem is to use a low-pass filter in the feedback path. To use this filter, simply check the **Enable Lowpass Search** in the PST, which is the default behavior.



Tuning systems with noisy frequency responses

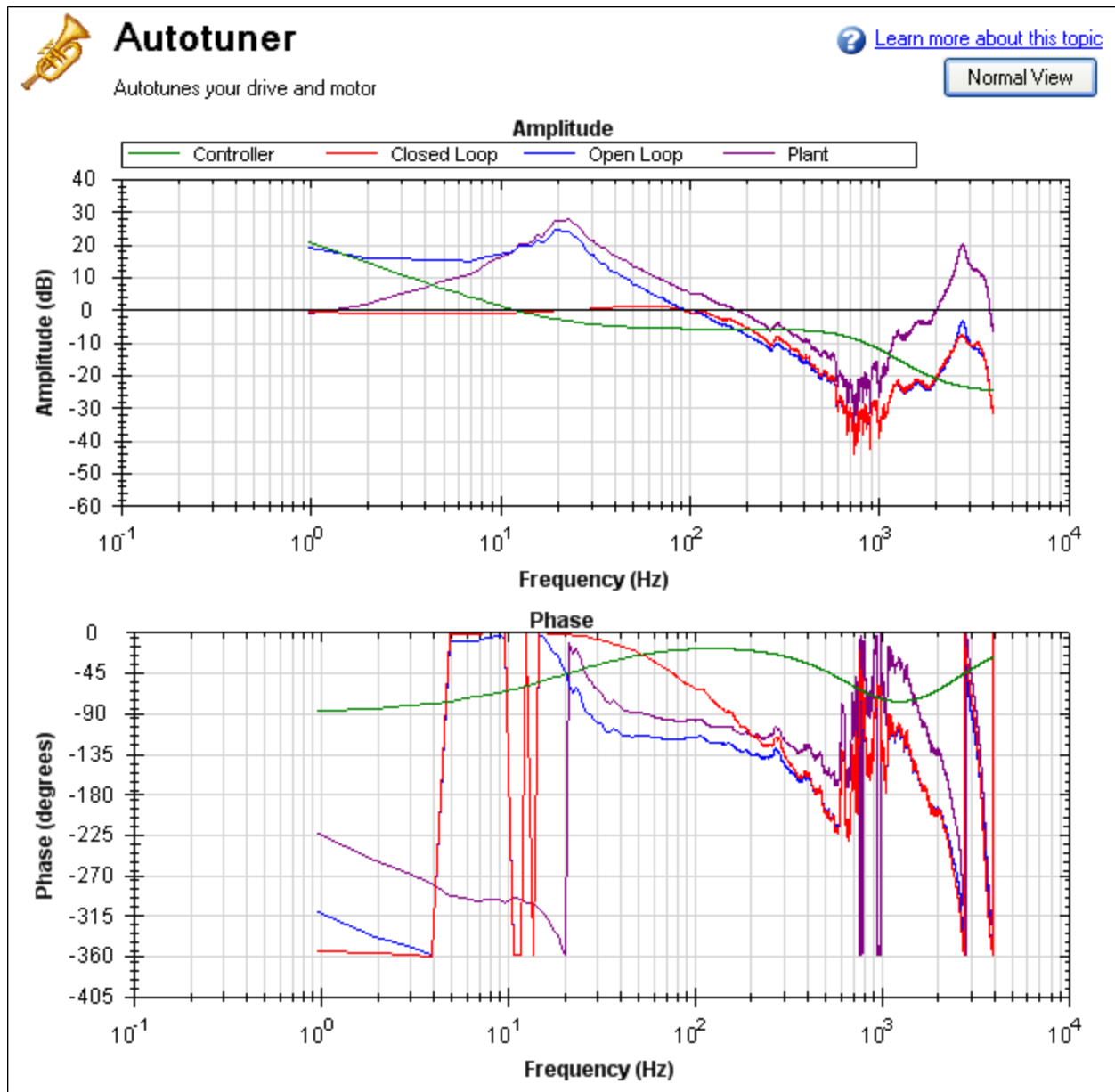
When using a motor with a low-resolution incremental encoder or resolver, the high frequency response may be noisy. Below is a Bode plot created after autotuning of an incremental encoder with 8,192 counts per revolution.



To make the Bode plot easier to read, increase the smoothing factor (1) in the advanced **Measurement Options**.

Autotuner	Measurement	Plots	Cursors
Current Amplitude:	0.095	Measurement:	Closed Loop ▾
Velocity Amplitude:	3.063	Injection Point:	Current ▾
Smoothing %:	4.000	Excitation Type:	PRB ▾
FFT Points:	4096	Velocity Max:	1000.00 (RPM)
Number Points:	60000	Excite Gap:	2

After increasing the smoothing percentage, the Bode plot traces become cleaner and easier to read:



16.3.1.2 PST Options

When you click **More** in the PST view, the following options are displayed:

Autotuner Measurement Plots Cursors

- Enable BiQuad 1 Tuner Type: LeadLag ▼
- Enable BiQuad 2 Tuner Type: LowPass ▼
- Tune Velocity Integral Phase Margin: 45.000 (Deg)
- Enable Lowpass Search Gain Margin: 8.000 (dB)
- Tune Acceleration FF
- Enable Stability Motion

Enable BiQuad 1 Tuner

Check this box to use the first anti-resonance filter in the forward path (AR1). You can specify the type of filter to use in the **Type** box to the right of **Enable BiQuad 1 Tuner**.

Enable BiQuad 2 Tuner

Check this box to use the second anti-resonance filter in the forward path (AR2). You can specify the type of filter to use in the **Type** box to the right of **Enable BiQuad 2 Tuner**. Enabling this option may significantly slow your computer during this operation.

Biquad Type

For Biquad 1 and 2, you can choose what type of filter to implement. The four options are:

1. **LeadLag**: The LeadLag filter is the default, and will work for most servo systems.
2. **Lowpass**: A Lowpass filter requires the least amount of processing time. The PST will place the lowpass to get the maximum bandwidth possible.
3. **Resonator**: The Resonator filter is like a Notch filter with tunable bandwidth and notch depth. The Resonator takes longer to calculate than the LeadLag filter.
4. **Custom**: The Custom filter takes the longest to calculate and does not restrict the PST to a filter shape. This filter type provides excellent results, but may significantly slow your computer while the filter is calculated.

Tune Acceleration FF

This box turns on and off the acceleration feedforward tuner. If this box is checked, the PST will measure the inertia attached to the motor shaft, and using this measurement, will calculate an appropriate acceleration feedforward and write it to the drive (IL.KACFF (pg 534))

Enable Stability Motion

When this checkbox is checked, after the PST has completed, the PST will command a short move in the clockwise direction, then back to its origin and monitor the motor's parameters to determine if the tuning is stable. If an instability is detected, the drive will generate Fault F133 (pg 229): Instability during Autotune.

Phase and Gain Margins

The PST always ensures that the tuning satisfies stability criteria that can be adjusted in units of phase margin (in degrees) and gain margin (in dB). The PST uses default values for phase and gain margin, but you can adjust these values to ensure higher stability or to allow the PST to be more aggressive by using lower gain and phase margins.

Tune Velocity Integral

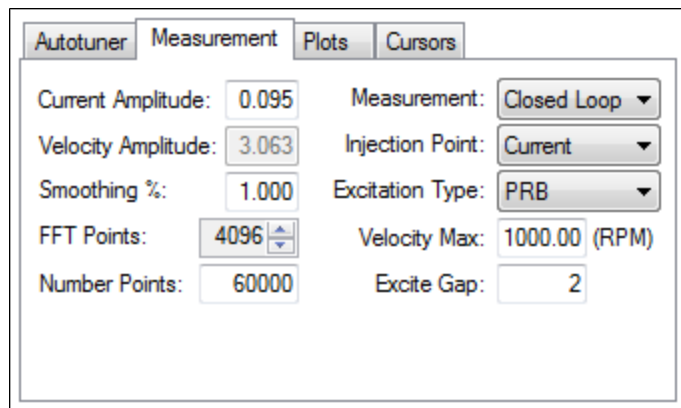
Check this box to tune VL.KI (velocity loop integral gain). If this box is unchecked, the PST will set VL.KI to zero.

Enable Low Pass Search

Check this to tune a fourth-order low pass filter in the feedback path (AR 3 and 4). If this box is unchecked, the PST will not modify the anti-resonance filters in the feedback path.

16.3.1.3 Measurement Options

The PST screen also provides options for measurements:



Current Amplitude

This box sets the amplitude of the current used to excite the system during a current injection mode excitation. This amplitude applies to all excitation types when the **Injection Point** is set to **Current**. The **Current Amplitude** box is disabled if the **Injection Point** is set to anything else.

Velocity Amplitude

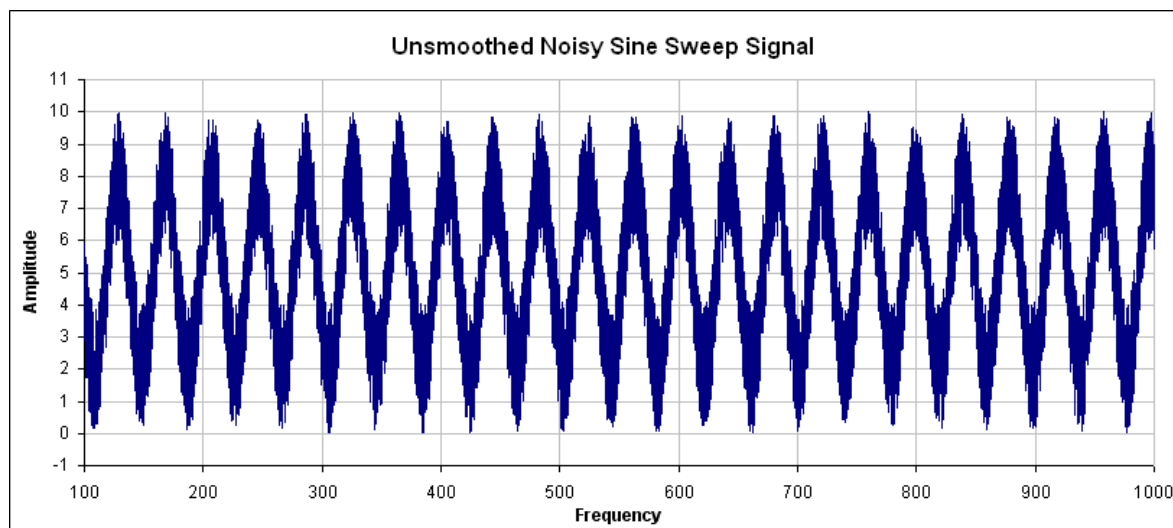
This box sets the amplitude of the velocity used to excite the system during a velocity injection mode excitation. This amplitude applies to all excitation types when the **Injection Point** is set to **Velocity**. The **Velocity Amplitude** box is disabled if the **Injection Point** is set to anything else.

Smooth %

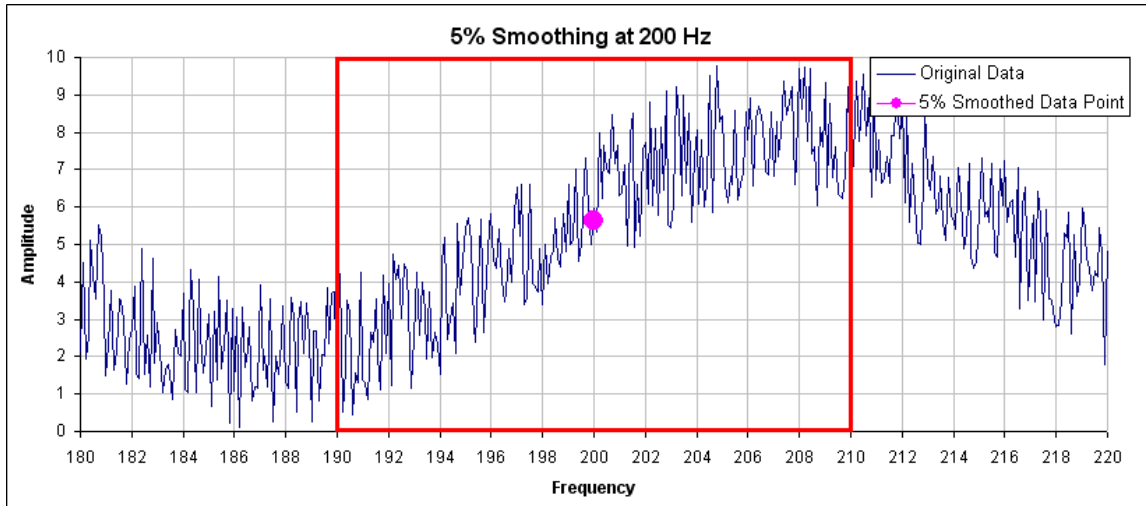
This value applies a moving average smoothing filter to the frequency response gathered during auto-tuning. This process reduces noise in the frequency response that can occur when making short frequency response measurements, using low resolution encoders, conducting low amplitude frequency response tests, or for other reasons. The smoothing filter iterates through each frequency on the FFT plot. For each frequency, all frequencies within the **Smooth %** range will have their magnitudes averaged.

For example, if you smooth a Bode plot with 5% smoothing, at 100 Hz, it will average all the values between 95Hz and 105Hz; when the filter gets to 1000 Hz, the filter will average all the values between 950 Hz and 1050 Hz.

As an example, assume a noisy sine sweep signal and use a 5% smoothing factor. Below is a noisy signal with a range of 100 Hz to 1000 Hz.

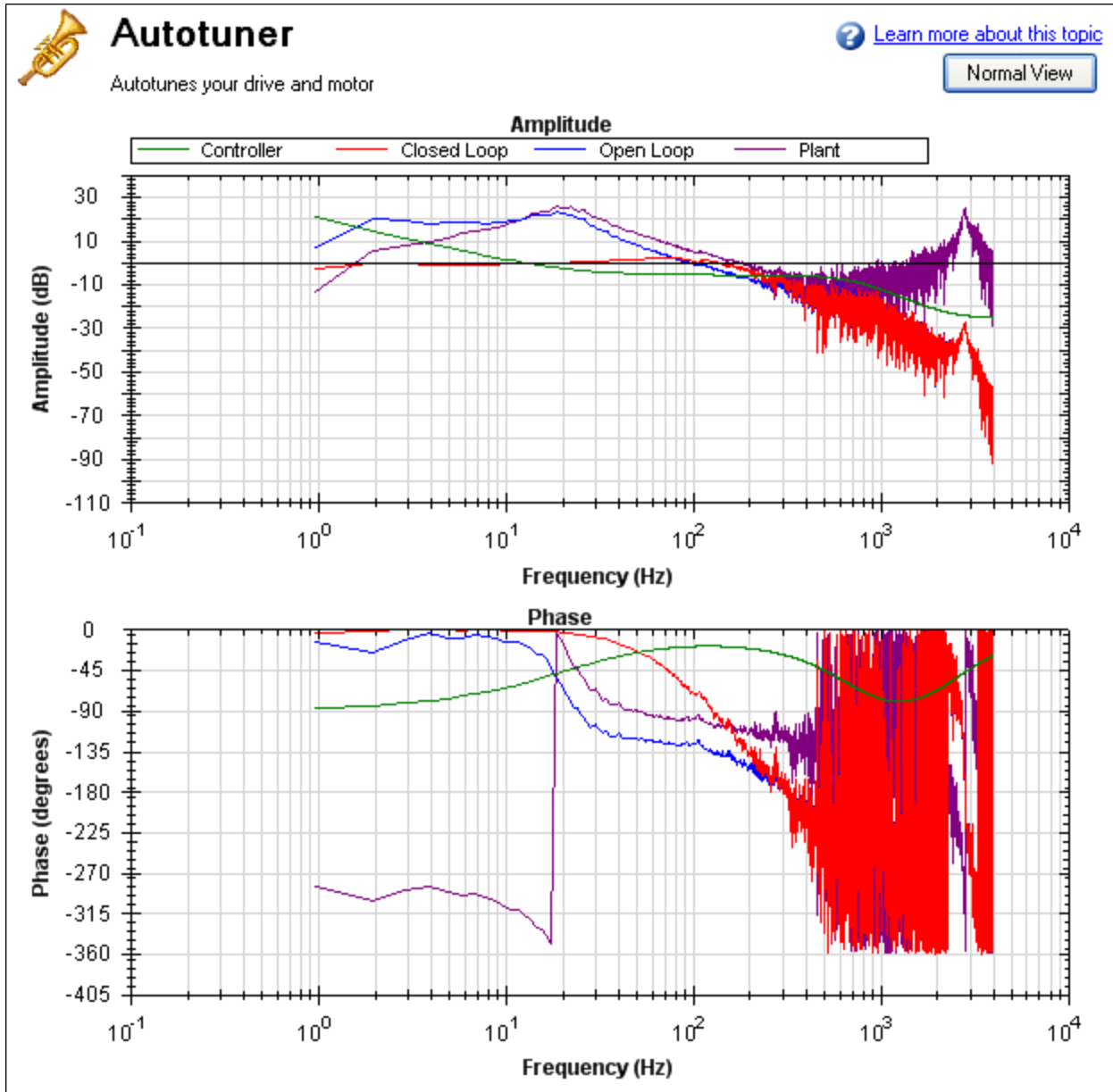


In this example, examining how the smoothing filter affects a single point shows how the smoothing filter works on a full plot. If you zoom in on 200 Hz +/- 5%, this gives a range of 190 Hz – 210Hz. The smoothing filter averages this range of values and puts the average right on 200 Hz. The figure below shows the zoomed data around 200 Hz and the averaged value of all frequencies +/- 5% (the red box illustrates the range of frequencies being smoothed).

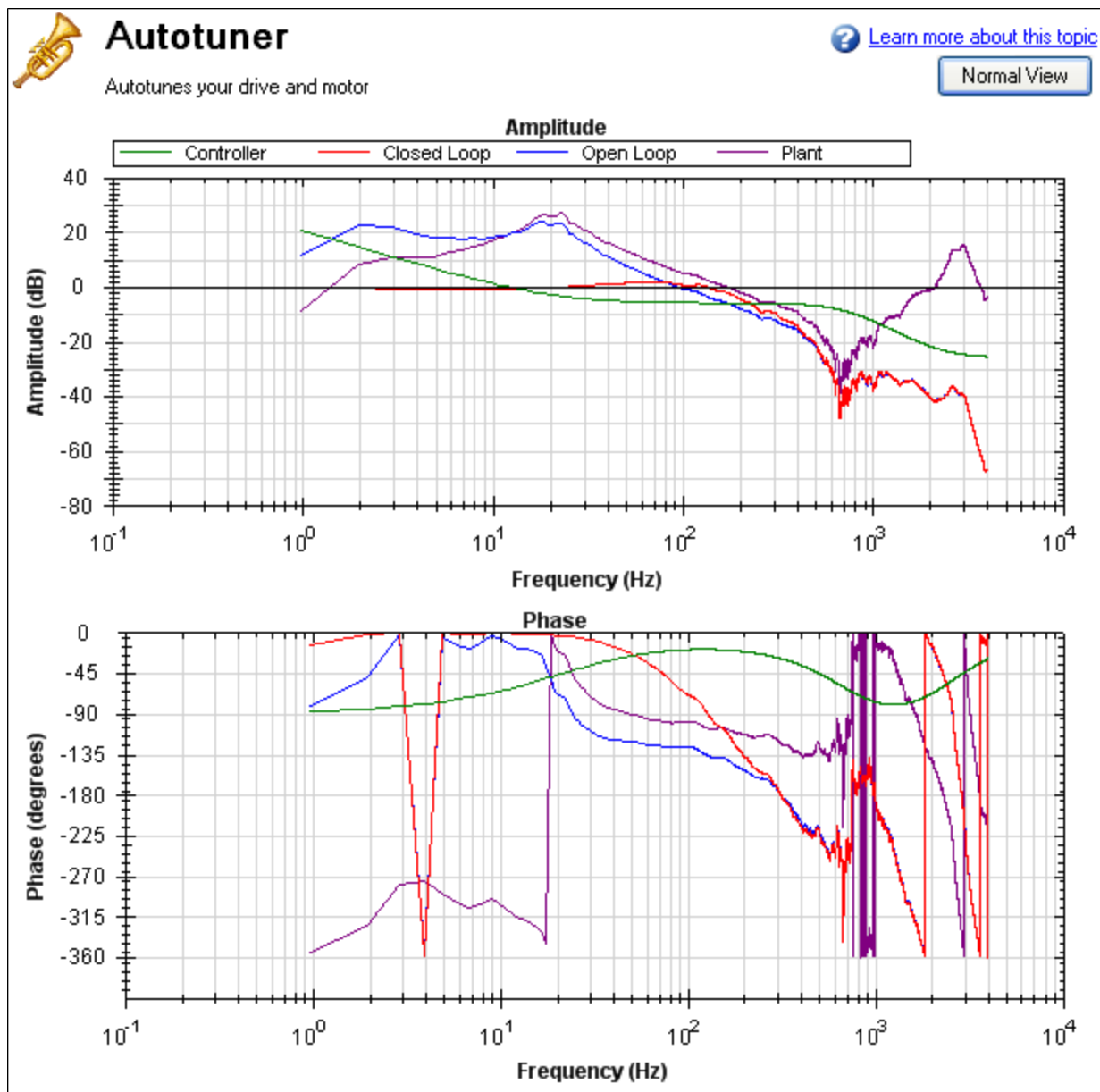


In the PST, the smoothing filter will do this analysis for every frequency point on the Bode plot. If the data is too noisy, then you can increase the smoothing percentage to smooth the noise out and see the underlying data patterns. A comparison of a system with 0.1% smoothing and 8% smoothing is shown below.

0.1% smoothing



8% Smoothing



Note: Smoothing decreases the peaks of resonances; if smoothing is too high, a resonance may be completely hidden. If the PST cannot identify a resonance due to high smoothing, the system may become unstable.

Measurement

This box sets the measurement type used during a measurement. The PST functions only if **Plant** measurement is selected; autotune does not function in other measurement modes.

- **Closed Loop** directly measures the closed loop frequency response of the servo.
- **Plant** directly measures the plant, including drive, motor, and mechanics coupled to the motor.
- **Controller** directly measures the controller response, which includes the tuning in the velocity and position loops, and anti-resonance filters 1 & 2.

Injection Point

The **Injection Point** box sets the source location of the excitation used during autotuning. **Current** mode uses a torque disturbance at the torque output. During current injection point measurements, the excitation will use the **Current Amplitude** value to set the size of the excitation.

Velocity mode uses a velocity command to excite the system. During velocity injection point measurements, the excitation will use the **Velocity Amplitude** value to set the size of the excitation.

Excitation Type

The **Excitation Type** box allows you to choose the type of excitation. Noise, pseudo random binary (PRB), and sine are the options available.

- **Noise** uses a pseudo random noise signal to excite the system. The signal varies between +/- current or velocity amplitude (depending on injection point). The signal contains a frequency spectrum that goes from a lower limit equal to:

$$16,000/(\text{Excite Gap} * \text{Number Points}) \text{ Hz}$$

to a higher limit equal to:

$$(16,000/\text{Excite Gap}) \text{ Hz}$$

The richness of the frequency spectrum comes from variance in the amplitude of the noise signal.

- **PRB** uses a pseudo random binary signal to excite the system. The signal is either + or – current or velocity amplitude (depending on the injection point). The signal contains a frequency spectrum that goes from a lower limit equal to the larger of:

$$(16,000/(2^{\text{BODE.PRBDDEPTH (pg 313)}} * \text{Excite Gap})) \text{ or } 16,000/(\text{Excite Gap} * \text{Number Points}) \text{ Hz}$$

to a higher limit equal to:

$$(16,000/\text{Excite Gap}) \text{ Hz}$$

BODE.PRBDDEPTH (pg 313) is set to 19 by the PST. The richness of the frequency spectrum comes from variance in the phase of the signal, not the amplitude.

- **Sine** requires that you specify the start frequency, end frequency, and frequency step size. The sine sweep takes significantly longer than a noise or PRB measurement, but is often cleaner. Be careful when selecting a step size: too large of a step size may miss important resonances, and too small of a step size increases measurement time.

FFT Points

The **FFT Points** box is only visible and applicable in noise and PRB measurements. **FFT Points** sets the resolution of the FFT's measurement. The frequency resolution is equal to

$$16,000/(\text{Excite Gap} * \text{FFT Points})$$

By increasing **FFT Points**, the resolution becomes finer, but noise in the frequency response increases.

Excite Gap

The **Excite Gap** box is only visible and applicable in noise and PRB measurements. This box sets how frequently the test excitation is updated. The excite gap minimum value is 1; this value is normally set to 2 for autotuning. The excite rate is 16,000/gap. You can limit high frequency excitation by increasing the **Excite Gap** value.

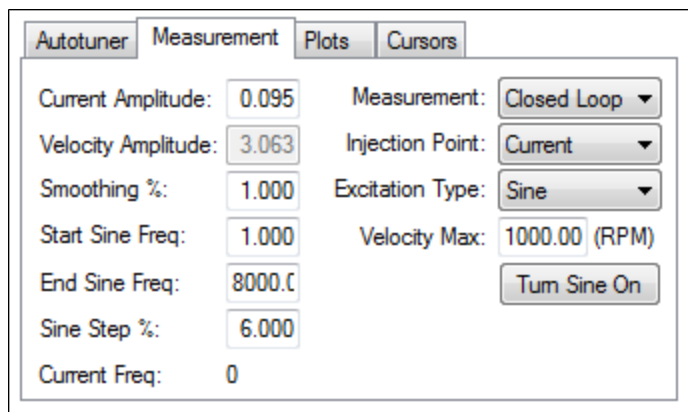
Number Points

The **Number Points** box is only visible and applicable in noise and PRB measurements. This box sets the length of recording while measuring the frequency response of the system. The measurement length is:

$$\text{Number Points} * \text{Excite Gap} / 16,000 \text{ seconds}$$

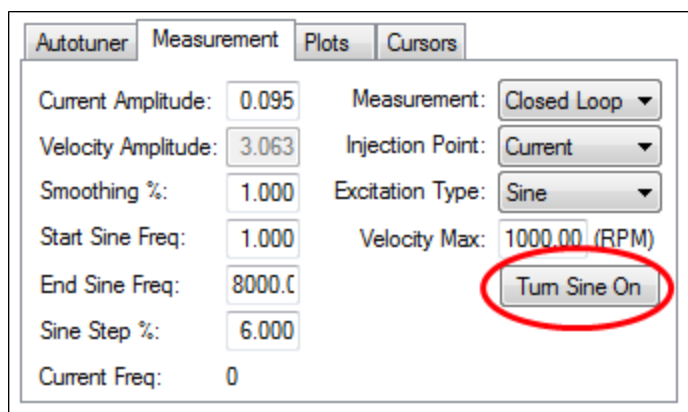
Velocity Max

The **Velocity Max** box allows the user to specify the maximum velocity the motor should be able to move while performing excitation. This box is not in effect for normal drive operation; it is only visible during the PST excitation phases. This value is implemented as soon as the PST begins, and as soon as the PST is finished, the previous overspeed threshold (VL.THRESH (pg 721)) is restored.



If **Excitation Type** box is set to **Sine**, different configuration options become available.

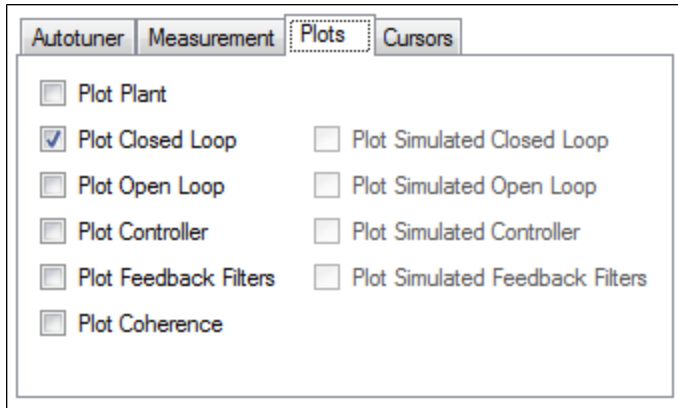
- **Start Sine Freq:** The Sine sweep test will begin at this frequency. The start frequency must be greater than zero and less than the end sine frequency. **Start Sine Freq** is only visible and applicable to Sine measurements.
- **End Sine Freq:** The Sine sweep test will end at this frequency. The end frequency must be less than or equal to 8,000, and more than the sine start frequency. **End Sine Freq** is only visible and applicable in Sine measurements
- **Sine Step %:** This box sets the sine step size. The sine sweep is discrete, not continuous. Each frequency is a multiple of the previous. For example, if the first frequency was 1 and the step size was 6%, the second frequency would be $1 * 1.06 = 1.06$ Hz, the third frequency would be $1.06 * 1.06 = 1.12$ Hz. This continues until the current frequency exceeds the **End Sine Frequency** value. **Sine Step %** is only visible and applicable in Sine measurements
- **Current Freq:** This field displays the current frequency of the sine sweep . **Current Freq** is only visible and applicable in Sine measurements
- **Turn Sine On:** This button allows the user to excite the system at a single sine frequency. When this button is pressed, it grays out boxes that do not apply. You may change the sine frequency and amplitude. To stop the sine excitation, click **Turn Sine Off**. **Turn Sine On** is only visible and applicable in Sine measurements.



NOTE

When the sine excitation is used on low resolution encoders, high frequency excitation may cause less than 1 count of encoder movement. If this occurs, no movement is detected on the motor for that excitation frequency. If this occurs, a data point for that frequency will not be plotted, as this results in a calculation of 0dB for gain and -infinity for phase.

16.3.1.4 Plot Options



By default, only the measured closed loop plot is selected. You can control which of these responses are displayed on the Bode plot by checking or unchecking the **Plot Plant**, **Plot Closed Loop**, **Plot Open Loop**, **Plot Controller**, and **Plot Coherence** checkboxes shown. The options **Plot Simulated Closed Loop**, **Plot Simulated Open Loop**, **Plot Simulated Controller**, and **Plot Simulated Feedback Filters** are only available in Bode plot mode, not PST mode.

Coherence

The coherence option is only available for noise and PRB measurements; it is not available for Sine excitation measurements.

Coherence is an indicator of how accurate your data is. For example, 0 dB (1 in linear numbers) means you have perfect coherence. Another way to think of this concept is that for one unit of input, you get one unit of output. Coherence is calculated as follows:

$$Coherence = \frac{(P_{xy} \times P_{xy}^*)^2}{(P_{xx} \times P_{xx}^*) + (P_{yy} \times P_{yy}^*)}$$

where:

P_{xx} = Power Spectral Density of Input signal

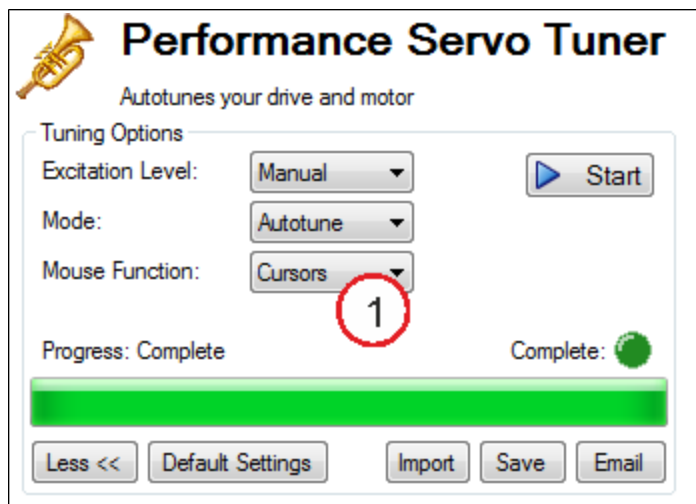
P_{yy} = Power Spectral Density of Output signal

P_{xy} = Cross Spectral Density of Input and Output

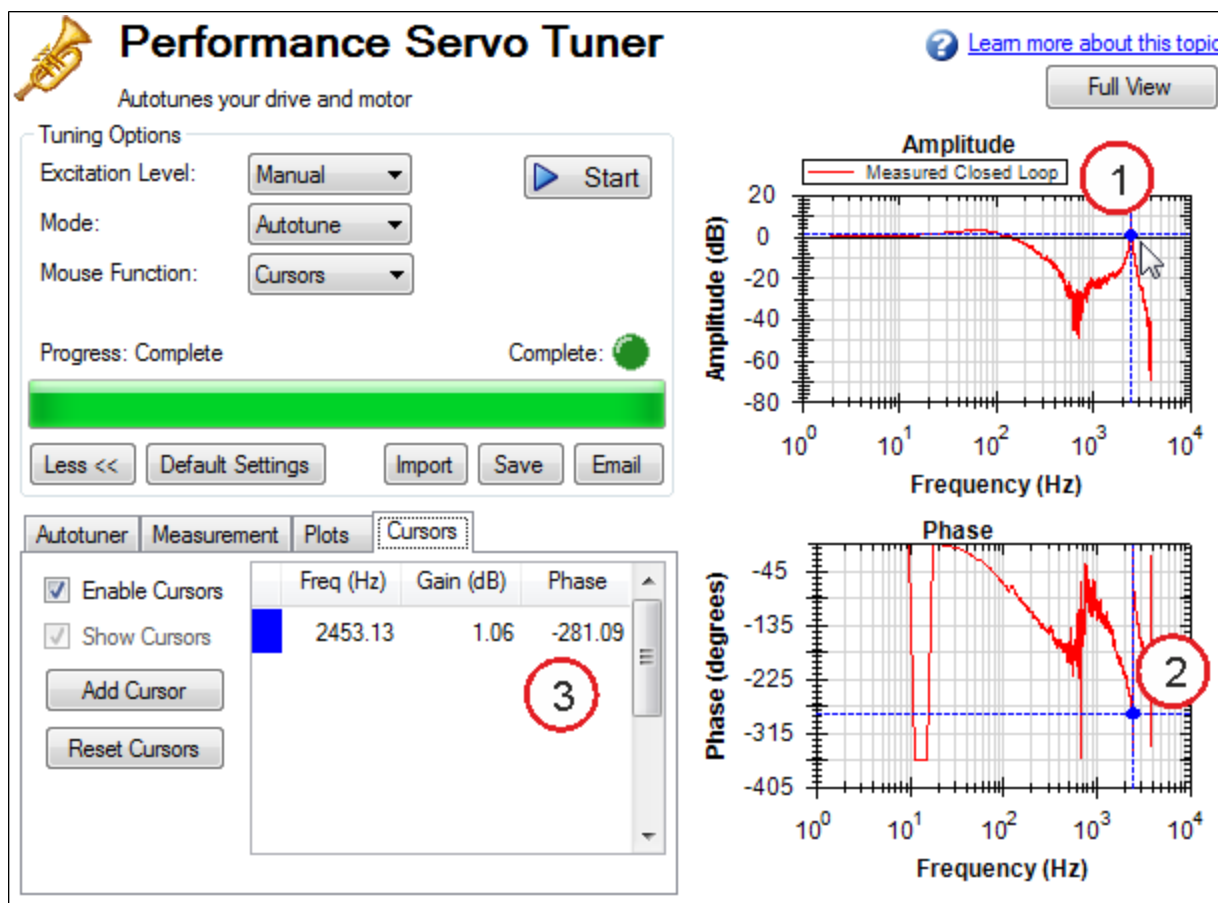
* designates complex conjugate

Cursors

Enabling cursors allows you to note specific points of interest on the Bode plot and create a table of reference points in the summary table. To enable cursors, choose Cursors from the Mouse Function drop-down(1).



To move the cursor, move your mouse over the cursor in either the Amplitude (1), or Phase (2) plots, click and hold the left mouse button, and drag the cursor to a new location. Notice as you drag the mouse, the Frequency, Gain and Phase change in the summary window (3).



To add more cursors, click **Add Cursor**; you can add 10 cursors to the Bode Plot. When selecting a cursor, the cursor closest to the mouse will be selected. While dragging the cursor, the cursor will snap to the closest trace on the plot.

When cursors are enabled, zoom functions on the graph are disabled. To re-enable zooming, switch the Mouse Function to Zoom.

The dotted crosshair lines are only drawn for the active cursor selected; to remove all cursors from the screen, but retain their position, uncheck **Show Cursors** . To reset all cursors, click **Reset Cursors**.

Note: If a CSV file is saved or emailed after placing a cursor on the Bode plot, a cursor summary is included in the CSV raw data.

16.3.1.5 Resizing Bode Plots

In the PST view, the **Full View** and **Normal View** button (1) in the upper right of the window allows you to see the Bode Plot in greater or less detail. When viewing the Bode Plot in full view, the PST settings are hidden behind the Bode Plot. To access the PST settings, click the **Normal View** button in the upper right of the window.

Simple measurement normal view

Performance Servo Tuner
Autotunes your drive and motor

[Learn more about this topic](#) Full View

Tuning Options

Excitation Level: ▶ Start

Mode:

Mouse Function:

Progress: Complete Complete:

Less << Default Settings Import Save Email

Measurement

Current Amplitude: Measurement:

Velocity Amplitude: Injection Point:

Smoothing %: Excitation Type:

FFT Points: Velocity Max:

Number Points: Excite Gap:

Amplitude

— Measured Closed Loop

Amplitude (dB) vs Frequency (Hz)

Phase

Phase (degrees) vs Frequency (Hz)

Simple measurement full view

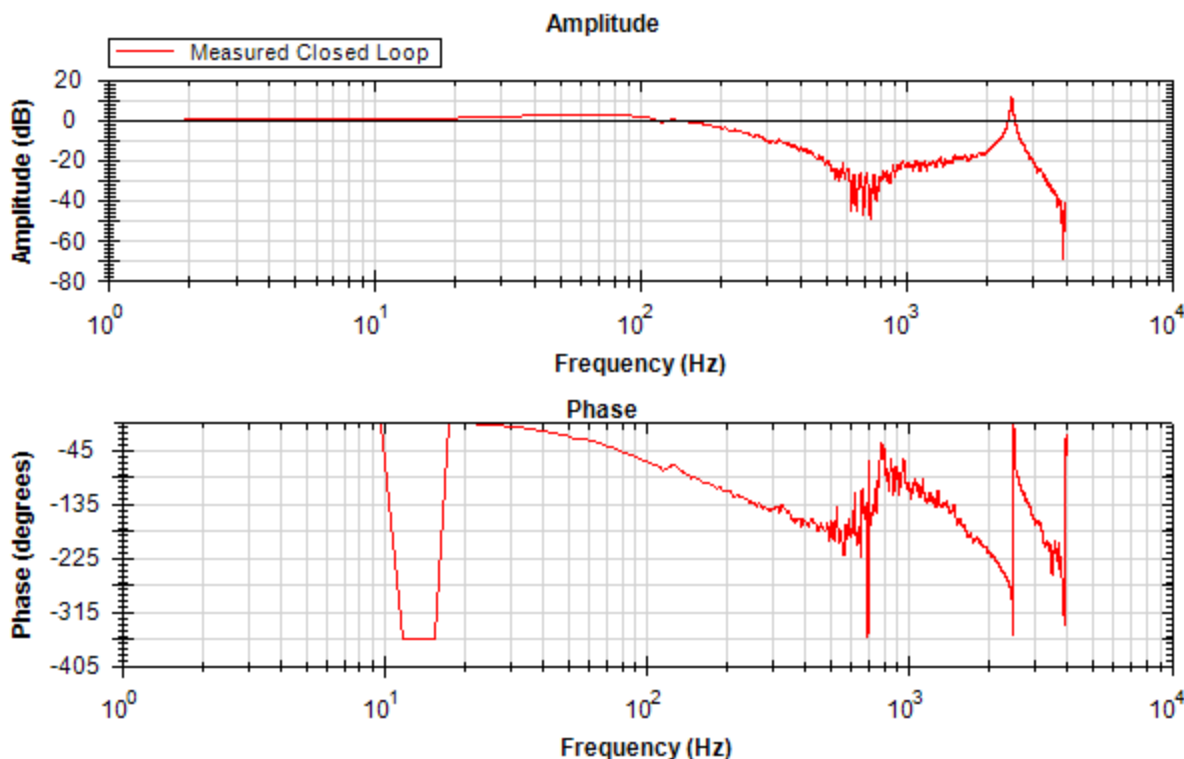


Performance Servo Tuner

Autotunes your drive and motor

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Normal View



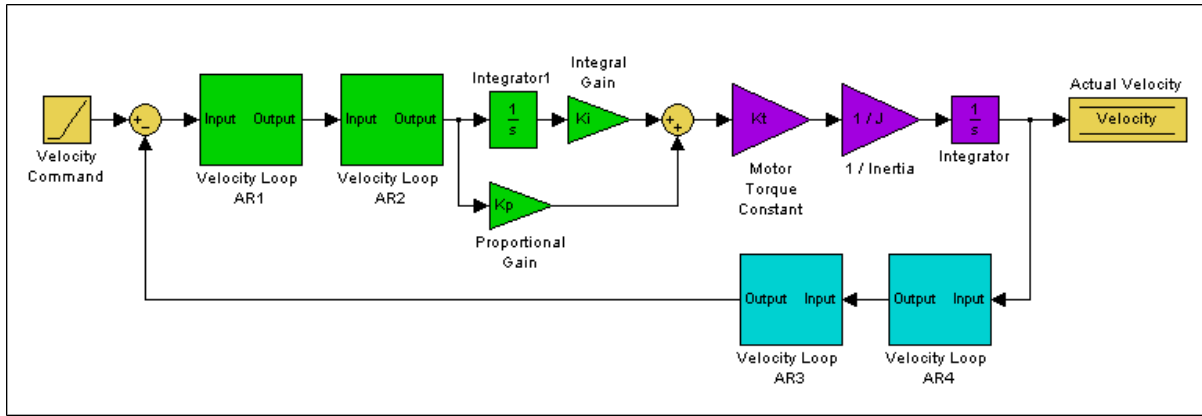
Reading and Understanding the Bode Plot

You can operate the PST without understanding how to read a Bode plot; however, understanding Bode plots will help you to use more advanced tuning techniques, which are covered more in depth in the Tuning Guide (pg 175) documentation.

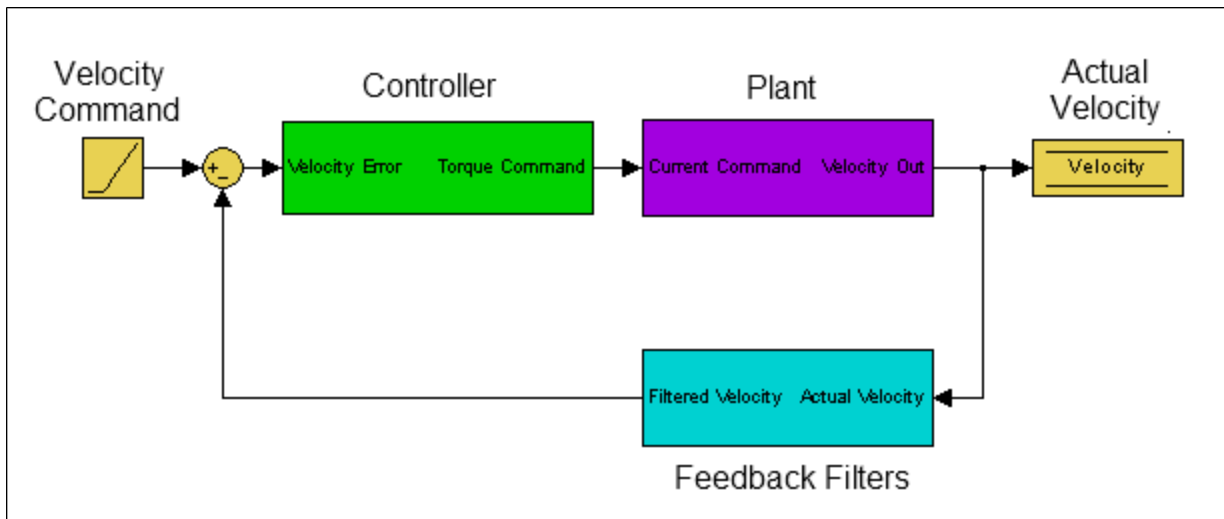
Four Bode plot traces are displayed by default:

1. Controller (green): This trace represents the frequency response of the tuning in the velocity loop and position Loop, this trace also includes anti-resonance filter 1 and 2 (also referred to as [C]).
2. Closed loop (red): This trace shows the frequency response of $G/(1 + G * H)$ where $G = C * P$, and H is the frequency response of anti-resonance filters 3 and 4.
3. Open loop (purple): This trace shows the frequency response of $G * H$, where $G = C * P$, and H is the frequency response of anti-resonance filters 3 and 4.
4. Plant: This trace shows the frequency response of the mechanics of the drive and motor (also referred to as [P])

The diagram of the velocity loop on the drive below explains the frequency response that each of these traces represents: Tuning Guide (pg 175)



These blocks can be grouped into Controller, Plant, and Feedback sections:



All of the green blocks have been grouped together to create the Controller [C]. The Controller is the portion of the control loop containing all velocity and position loop tuning, including the forward path filters.

All of the purple blocks have been combined to make the Plant [P]. The plant represents the mechanical and electrical properties of the motor, drive and any mechanical bodies attached to the motor.

The two feedback filters have been combined into one block. This value is never measured directly; however it contributes to both the Open Loop [G] and Closed Loop [T] frequency responses.

The definition of the Open Loop [G] frequency response is:

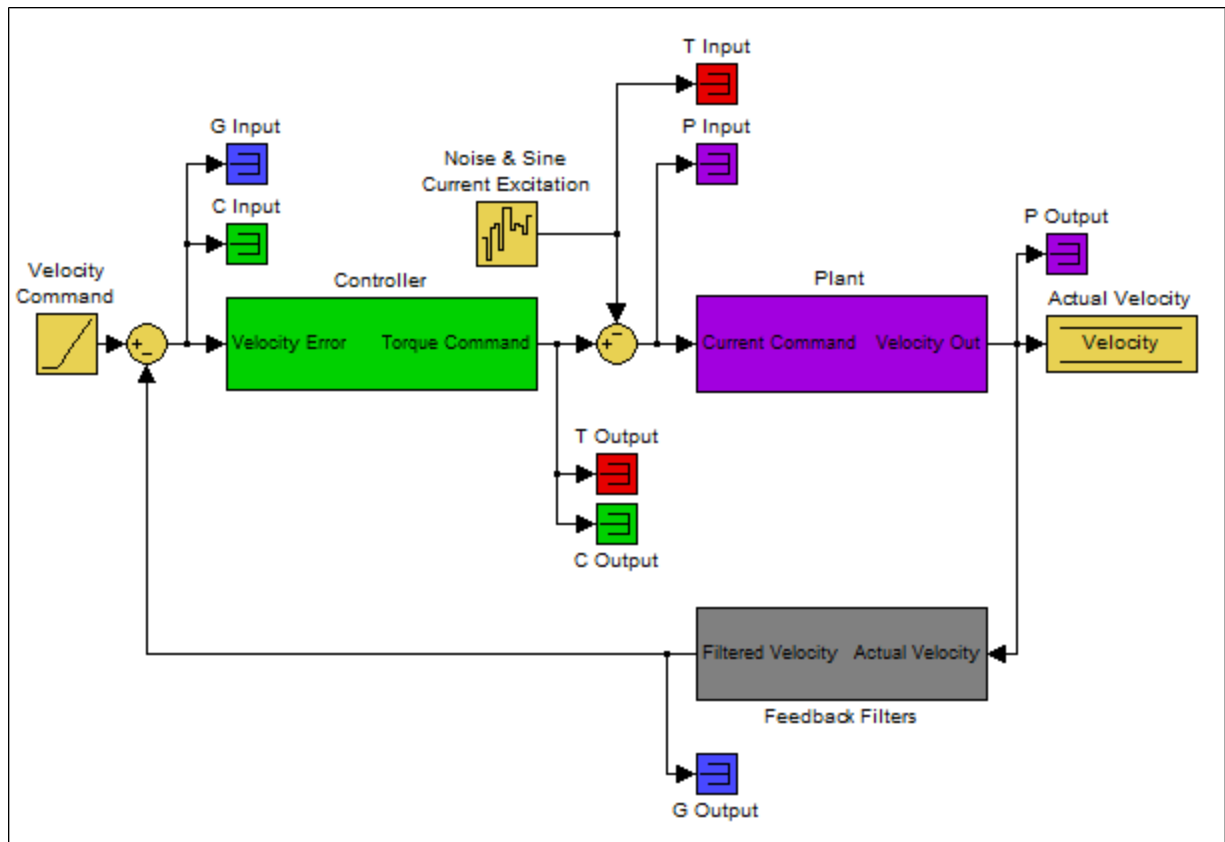
$$Open\ Loop = Controller \times Plant \times Feedback\ Filters$$

The definition of the Closed Loop [T] frequency response is:

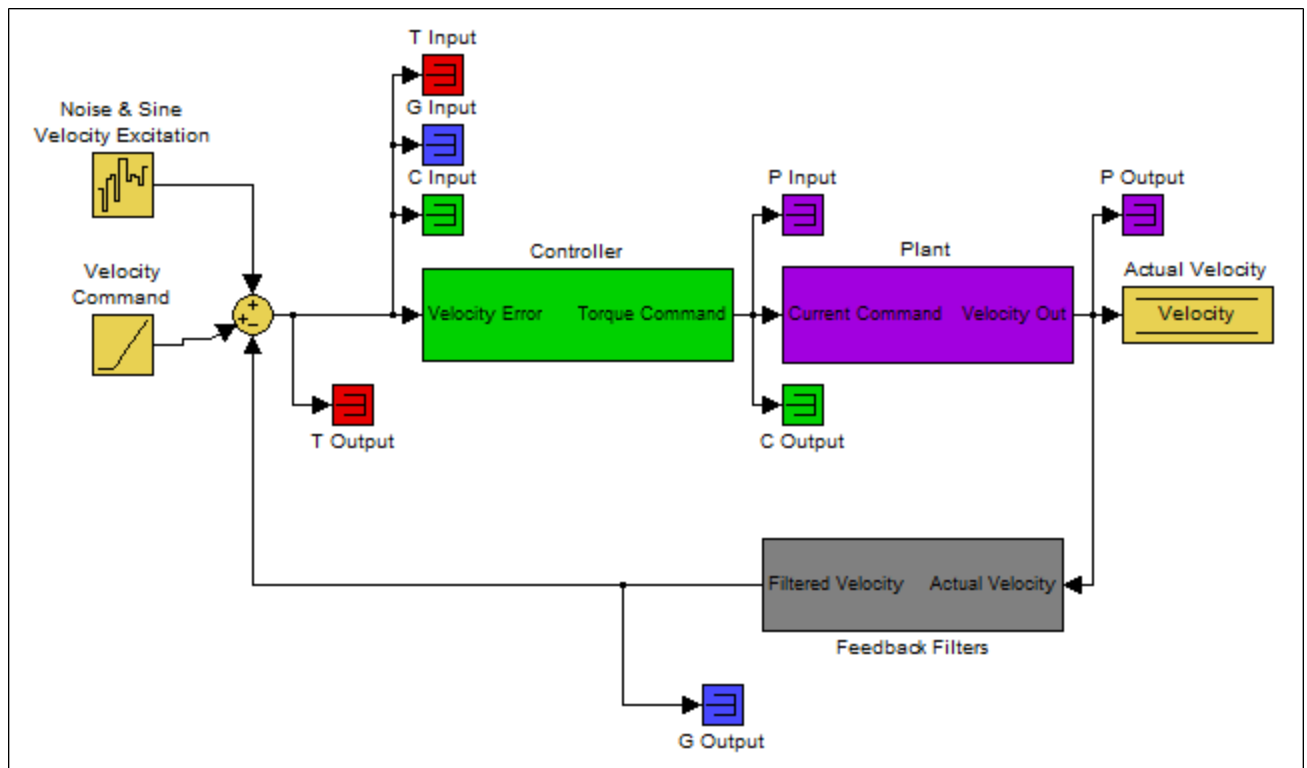
$$ClosedLoop = \frac{Controller \times Plant}{1 + Controller \times Plant \times FeedbackFilters}$$

Below is a diagram of measurement points (input and output) for each of these frequency responses. The input and output markers have been color coded with the color they appear in the PST:

Current Excitation:



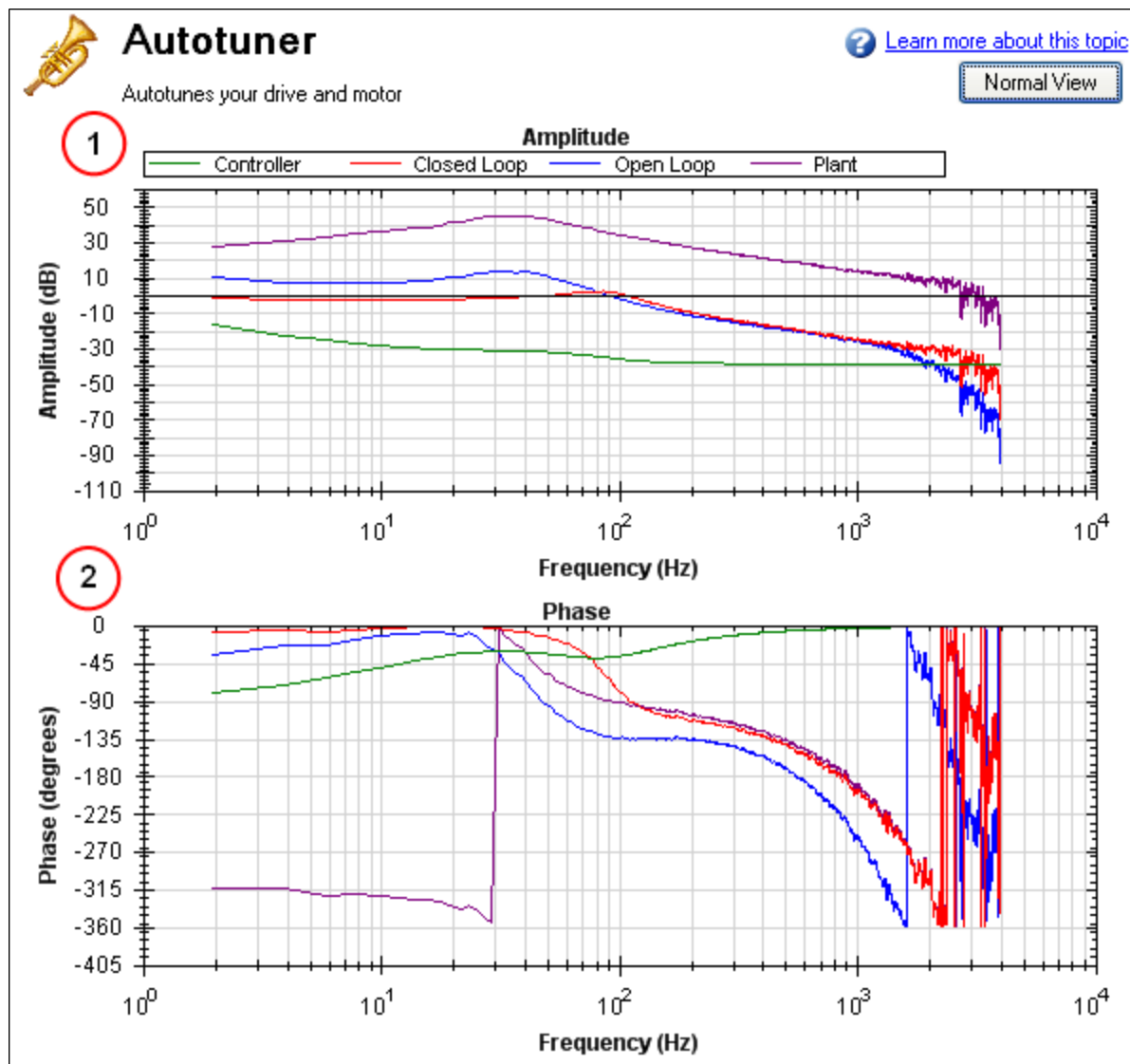
Velocity Excitation:



The resulting plots are the frequency response of output/input for each measurement. For more information regarding these traces, please refer to the Tuning Guide (pg 175) documentation.

Below is a Bode plot of a motor with no load. The top plot is the magnitude plot (1); this plot shows the gain of the system with respect to frequency. This plot is often used to determine the bandwidth of the servo system.

The lower plot is the phase plot (2). This plot is used in conjunction with the magnitude plot to determine stability, and helps you to understand what kind of latencies exist in the servo system, or if latencies are induced by filters in the velocity loop.



Using the Performance Servo Tuner to Manually Tune Systems

Often, you must manually adjust a control loop in order to obtain optimal machine performance. You can use the Performance Servo Tuner (PST) interface to tune your control loop for best performance. A powerful feature of the manual tuning interface is the ability to simulate the frequency response before it is measured. This feature allows the user to take a base measurement, disable the motor, adjust tuning parameters, and simulate the frequency response of the motor without taking a new measurement. This process saves time and protects equipment from dangerous oscillations.

To begin the manual tuning process, put the Performance Servo Tuner into Bode Plot mode.

Performance Servo Tuner

Autotunes your drive and motor

[Learn more about this topic](#)

Full View

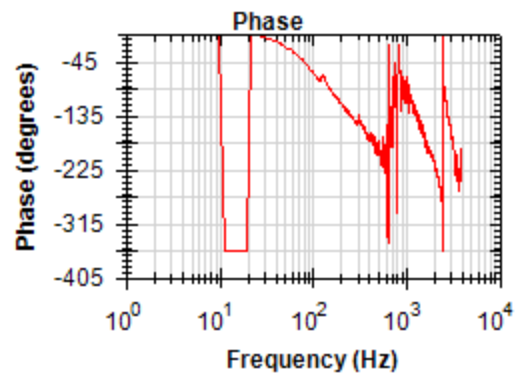
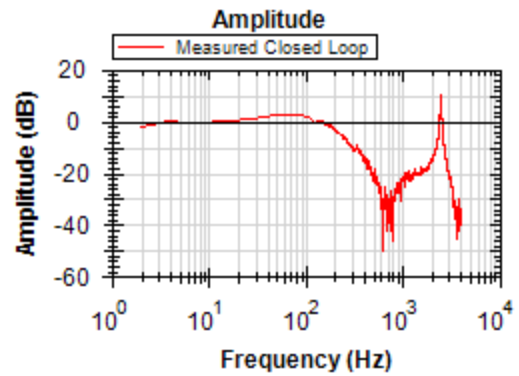
Tuning Options

Excitation Level:

Mode: **1**

Mouse Function:

Progress: Complete Complete:



Measurement | **Tuning** | Plots | Cursors

Current Amplitude: Measurement:

Velocity Amplitude: Injection Point:

Smoothing %: Excitation Type:

FFT Points: Velocity Max:

Number Points: Excite Gap:

Several differences exist between PST and Bode Plot Interfaces:

- When the PST is put into Bode Plot mode, the **Autotuner** tab is removed from the advanced features, and replaced with a **Tuning** tab.
- The **Plots** tab unlocks simulated traces for closed loop, open loop, controller, and feedback filters.

Using the Tuning Simulation

To simulate tuning, there must be a valid Plant Plot in the PST (whether measured with a Bode Plot measurement or a full Autotune).

To selecting simulated plot traces, click on the **Plots** tab and check the following boxes:

Measurement | **Plots** | Tuning | Cursors

Plot Plant

Plot Closed Loop Plot Simulated Closed Loop

Plot Open Loop Plot Simulated Open Loop

Plot Controller Plot Simulated Controller

Plot Feedback Filters Plot Simulated Feedback Filters

Plot Coherence

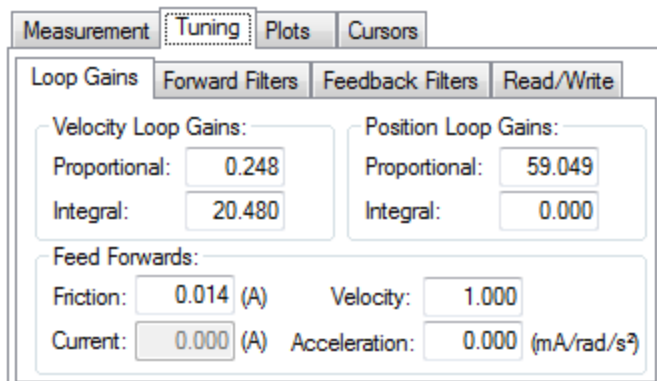
These selected boxes are the most common configuration for tuning; however, simulation will occur regardless of the checkboxes selected.

The boxes on the left plot the existing frequency response of the drive based on the tuning parameters that are loaded. The boxes marked "Simulated" (on the right) use the plant data from the measurement and the

tuning parameters in the PST to simulate the performance of those tuning parameters without loading them to the drive.

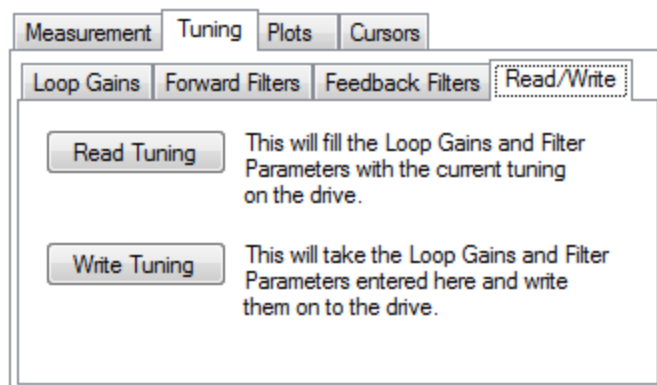
Using the Performance Servo Tuner Manual Tuning Interface

To use the PST manual tuning interface, click on the **Tuning** tab.



This tuning interface loads the tuning parameters on the drive each time a measurement is taken. Tuning parameters are split up into Loop Gains (Velocity Loop, Position Loop), Forward Path Biquad Filters, and Feedback Path Biquad Filters.

After modifying tuning gains, you must click on the **Read/Write** tab and click the **Write Tuning** button.

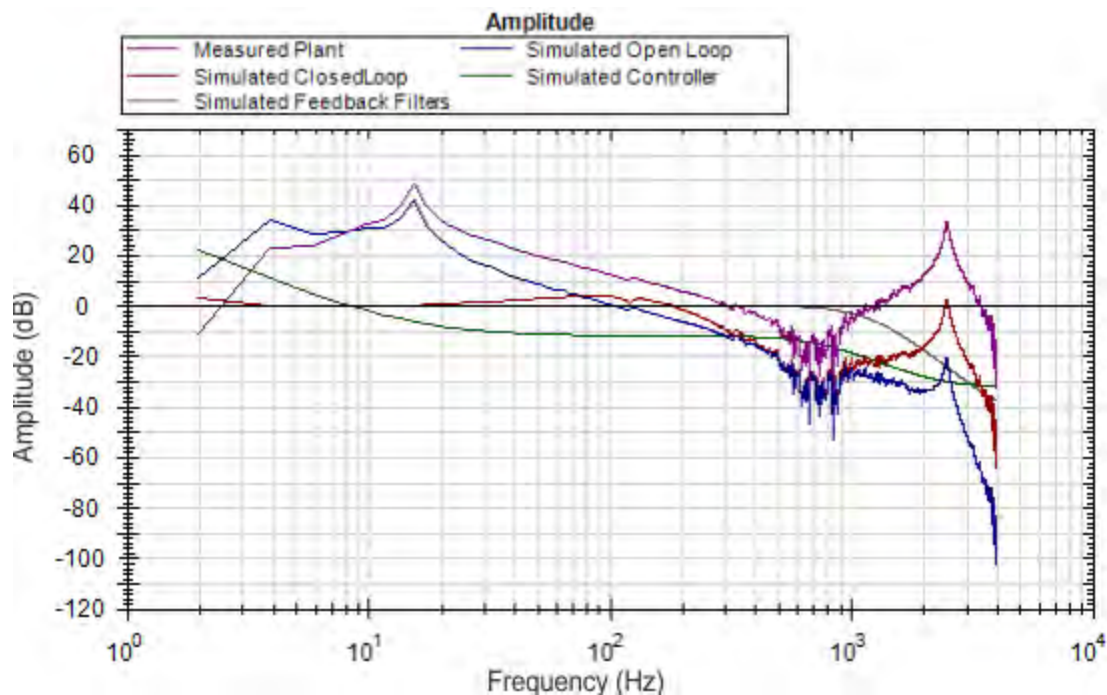


To restore the tuning on the drive to the PST interface, click the **Read Tuning** button.

Note: If tuning gains are modified and a Bode Measurement is made without clicking the **Write Tuning** button, the PST will overwrite the tuning gains in the interface with the tuning parameters on the drive.

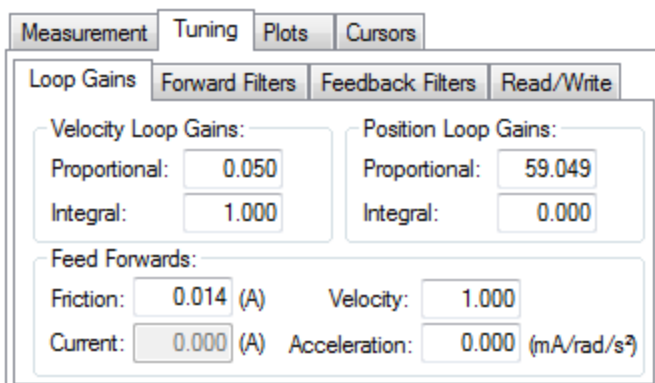
Simulating Modified Loop Gains with the Performance Servo Tuner

Here is the frequency response of a test system after using the PST.

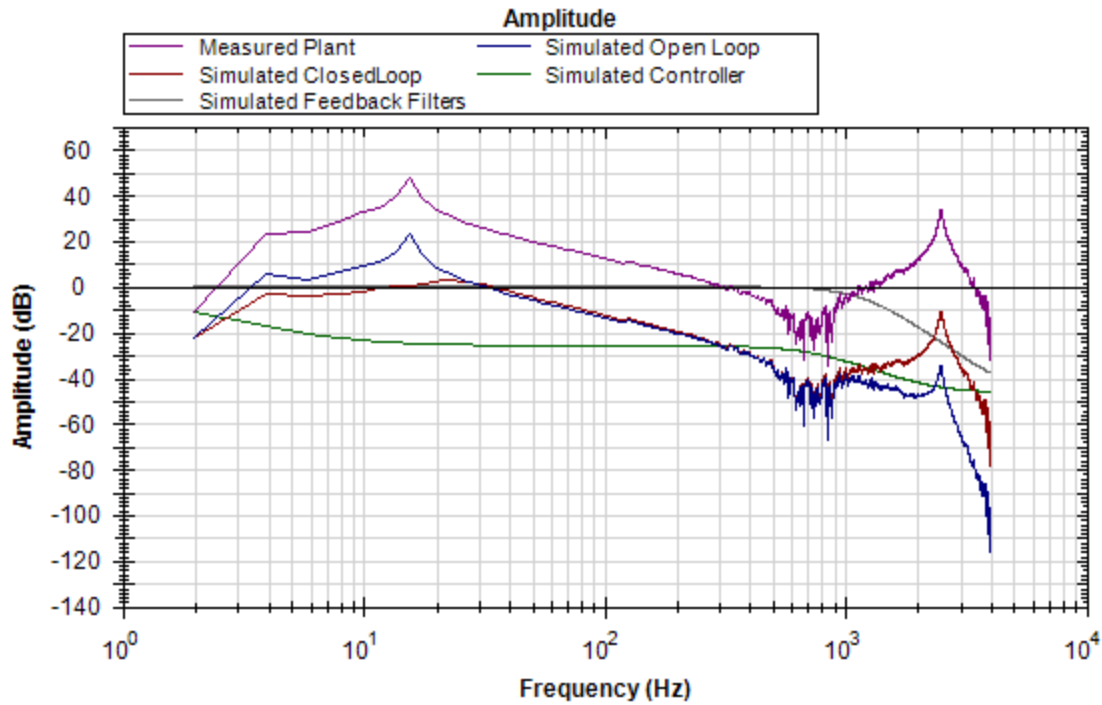


The Velocity Loop Proportional gain here is 0.248. If an application did not need to be tuned as stiff as this, then you could use the PST simulator to detune the motor to the desired bandwidth. A followup Bode Measurement can verify that the simulated response is correct.

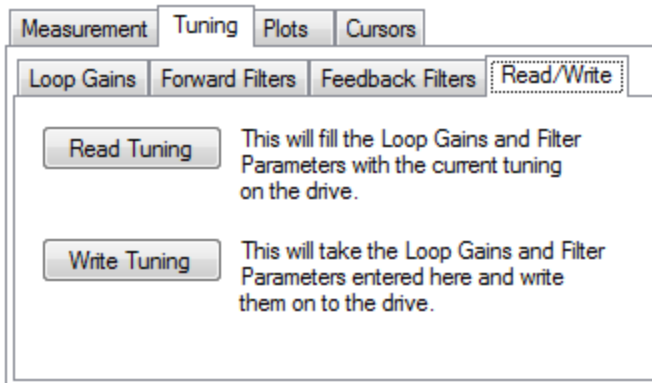
Use the boxes in the **Loop Gains** tab to change tuning gains until the desired frequency response is achieved.



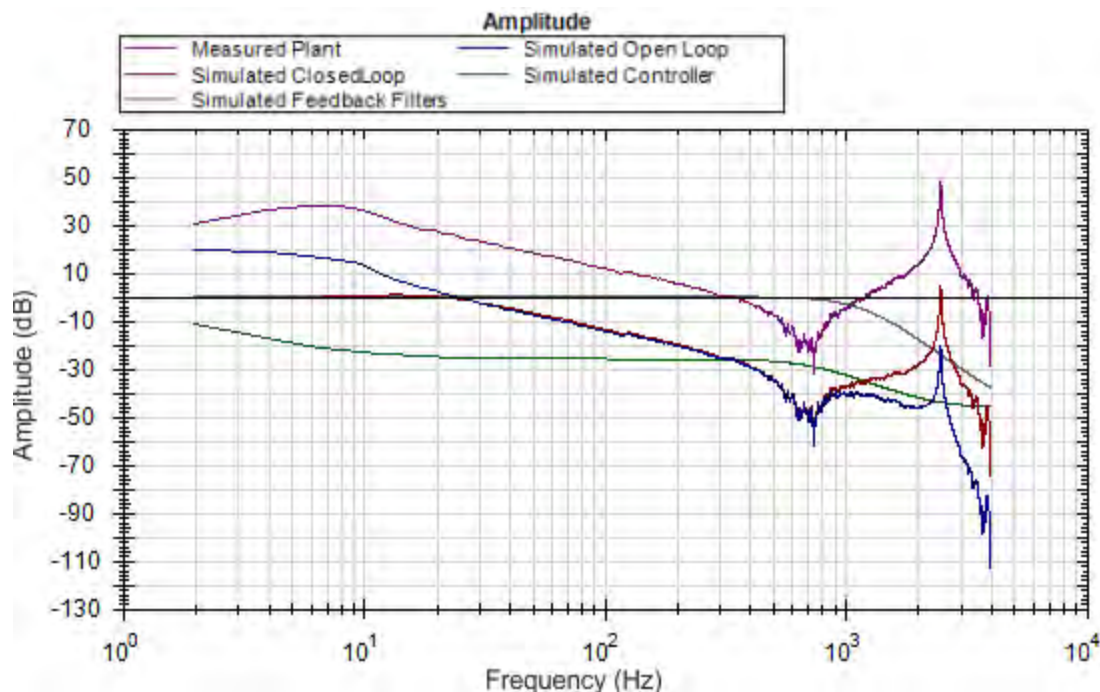
The de-tuning of velocity loop proportional and integral gains simulated that the bandwidth of the servo has been detuned from ~100 Hz to ~30 Hz.



Next, write the tuning parameters to the drive using the **Write Tuning** button on the **Read/Write** tab.



Now, complete a Bode Plot measurement to compare the simulated result with the new measured result.



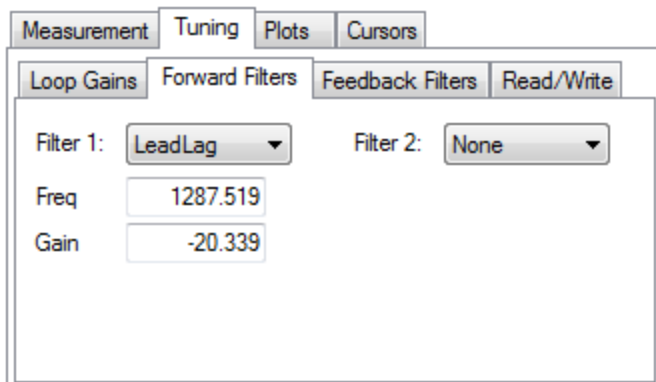
The new measured Bode Plot indicates we achieved slightly lower than 30 Hz bandwidth. The servo is stable, and tuning can be refined until desired performance is reached.

Simulating Filters with the Performance Servo Tuner

Resonances add many challenges to tuning a servo. Using the correct filter in an application can greatly improve system performance when resonances are present.

The Bode plot in this example shows a sharp, high-magnitude resonance at 2500 Hz. Because this is the only resonance, this is an indicator that a resonator (a tunable notch) filter may increase performance.

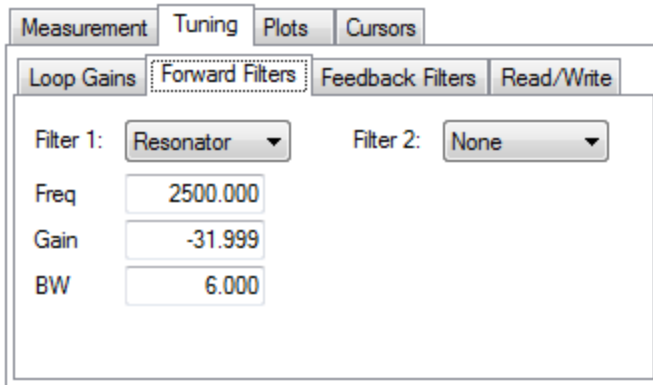
Click on the **Forward Filters** tab:



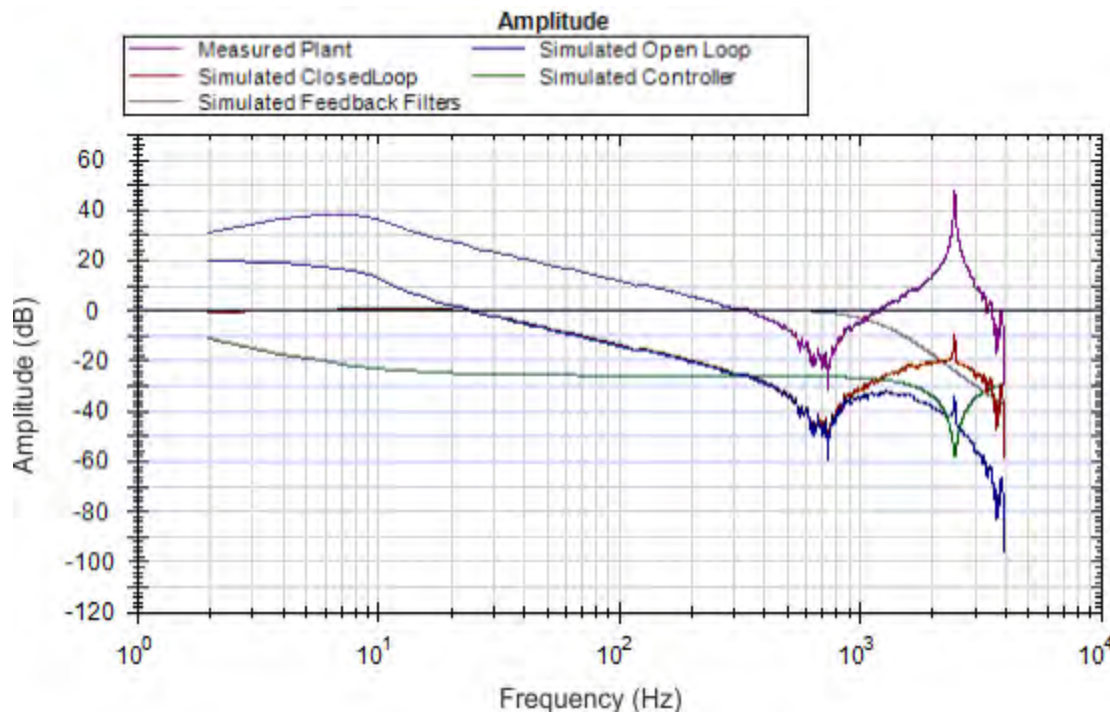
The results of the autotune are still on the drive, and provide adequate tuning. A lead lag filter is the default tuning filter, and is a good general case filter for most servo loops.

Because this test fixture has such a prominent single resonance, we can improve performance (and reduce noise) by placing a notch filter at this resonance.

By tuning a Resonator to best cancel the resonance in the plant, the resonance in the open loop, and therefore the closed loop can be minimized.



The resulting frequency response using the above resonator configuration is shown below:



Notice the attenuation of the resonance in the blue and red traces (open loop and closed loop, respectively).

Using Filters to Reduce Noise

To reduce noise, it is best to place filters in the feedback path. This placement attenuates the noise resulting from a noisy encoder being amplified by the current loop. This noise can be filtered by a forward path filter, however if a filter is placed in the forward path that introduces phase lag (like a lowpass), then your motion profile will exhibit that phase lag in the command signal. If the filter is placed in the feedback path, this lag will be avoided.

16.4 Tuning Guide

16.4.1 Overview

This section covers tuning the velocity and position loops in the KC1. Servo tuning is the process of setting the various drive coefficients that are needed for the drive to optimally control the servo motor for your application. There are different ways to tune, and several are covered here. We will give you guidance on what the different methods of tuning are and when to use them.

The KC1 works in three major operation modes: torque, velocity, and position operation mode. No servo loop tuning is required for torque mode. Velocity loop and position loop tuning are covered below.

The KC1 has an auto tuner that will provide the tuning that many applications will need. This section describes the tuning process and how to tune the KC1, specifically for cases where the user does not want to use the auto tuner.

Tuning in this section will focus on tuning in the time domain. This means that we will look at the velocity or position response vs. time as the criteria we use to decide how well tuned a control loop is tuned.

16.4.2 Determining Tuning Criteria

Choosing the proper specifications for a machine is a prerequisite for tuning. Unless you have a clear understanding of the type of performance needed to push the machine into production, the tuning process will cause more problems and headaches than it solves. Take time to layout ALL the requirements of the machine—nothing is too trivial to consider.

- Determine what the most important criteria are. The machine was likely designed and developed with a certain performance in mind. Include ALL performance criteria in the specification. Do not concern yourself with whether or not the criteria sound scientific. (i.e. If the motion needs to visibly look smooth, put it in the specification. If it can't have any noise, put it in the specification.) At the end of the development phase, the machine's performance should match the performance previously set in the specification. This will ensure that the machine meets its performance goals and that it is ready for production.
- Test the machine with realistic motion. Do not simply tune the machine to make short linear motion, when it will make long, s-curve motions in the real world. Unless you test the machine with realistic motion, there is no way to determine if it is ready for production.
- Determine some specific, quantitative criteria for identifying unacceptable motion. It's better to be able to tell when a motion is unacceptable than to try and figure out the exact point where acceptable motion becomes unacceptable. Here are some examples of motion criteria:
 - a. +/- x position error counts during the entire motion.
 - b. Settling within +/- x position error counts, within y milliseconds.
 - c. Velocity tolerance of x% measured over y samples.
- It is important to focus on the things that will get the machine into production with reliable performance, based on a fundamental understanding of the system.

After you have constructed a detailed servo performance specification, you are now ready to start tuning your system.

16.4.3 Before You Tune

In the worst case, if something goes wrong during tuning, the servo can run away violently. You need to make sure that the system is capable of safely dealing with a servo run away. The drive has several features that can make a servo run away safer:

- Make sure that the limit switches turn the drive off when tripped. If a complete run away occurs, the motor can move to a limit switch very quickly.
- Make sure the max motor speed is set accurately. If a complete run away occurs, the motor can reach max speed quickly and the drive will then disable.

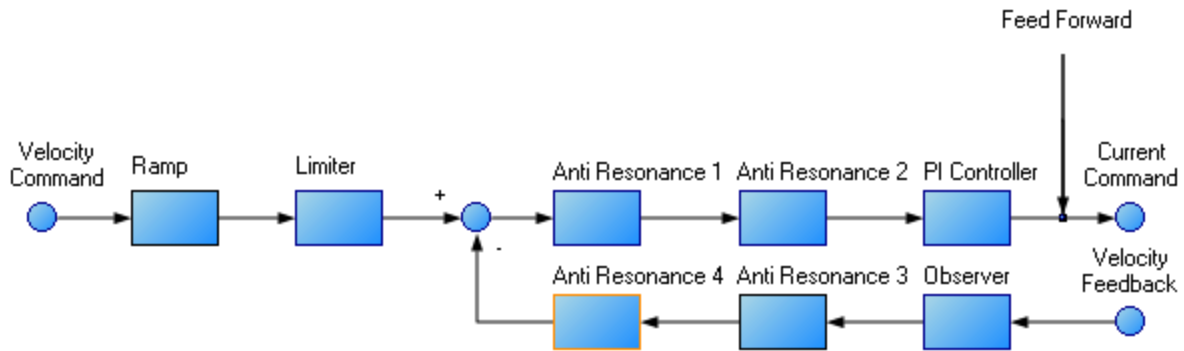
16.4.4 Closed Loop Tuning Methods

The closed loop control loop is responsible for the desired position and / or velocity (trajectory) of the motor and commanding the appropriate current to the motor to achieve that trajectory. The challenge in closed loop control loops is to make a system that not only follows the desired trajectory, but also is stable in all conditions and resist external forces, and do all of this at the same time.

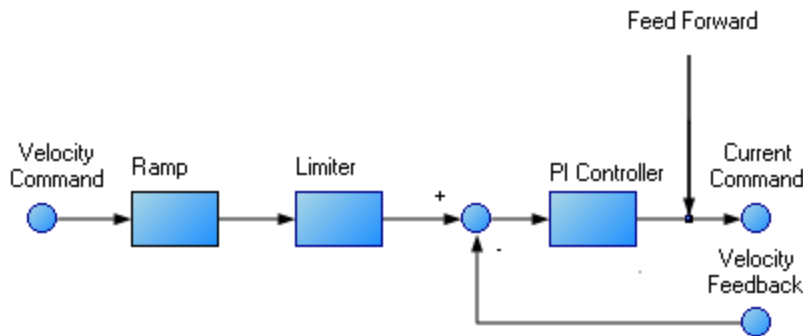
When in velocity operation mode, only the velocity loop is tuned. When in position operation mode, both the velocity and position loops must be tuned.

16.4.4.1 Tuning the Velocity Loop

The velocity loop on the KC1 consists of a PI (proportional, integral) in series with two anti-resonance filters (ARF) in the forward path and two-anti resonance filters in series in the feedback path.



To perform basic tuning of the velocity loop, you can use just the PI block and set ARF1 and ARF2 to unity (no effect) and set the observer to 0 (no effect). Using just the PI block simplifies the process of tuning the velocity loop. To start tuning you can adjust the PI Controller block first. A simplified velocity loop without anti-resonant filters and observer is shown below. This is how you can think of the loop before the anti resonant filters and observer is used.



Procedure for simple velocity loop tuning:

1. Set DRV.OPMODE to velocity or position, as appropriate for your application. If DRV.OPMODE is set to position, set VL.KVFF to 1.0.
2. Set VL.KP to 0.
3. Set VL.KI to 0.
4. Set service motion to make a motion that is similar to the move speeds that will be used in the real application. Do not set the service motion to a speed higher than $\frac{1}{2}$ of the maximum motor speed, to allow for safe overshoot during tuning. Set acceleration to an appropriate value for your application. Set service motion to reversing. Set time1 and time2 equal to 3 times the expected settling time for the system. 1.0 second is a reasonable value for time1 and time2, if you don't know the expected settling time.
5. Enable the drive and start the service motion. You should see no motion, as there are no velocity loop tuning gains at this point.
6. When adjusting VL.KP and VL.KI, below record VL.FB and VL.CMD. These are the traces that are used to determine the performance of the velocity loop.

Channels							Time-base and Trigger		Service Motion		Servo Gains		Observer		All Gains		AR F	
Id	Source	Color	Hide	Y Axis	Filter	Filter Freq...												
1	Current feedback (IL.FB)	Red	<input type="checkbox"/>	Current	<input type="checkbox"/>	400												
2	Velocity command (VL.CM...)	Green	<input type="checkbox"/>	Velocity	<input type="checkbox"/>	400												
3	Velocity feedback (VL.FB)	Blue	<input type="checkbox"/>	Velocity	<input type="checkbox"/>	400												
4	None	Purple	<input type="checkbox"/>	Default	<input type="checkbox"/>	400												
5	None	Pink	<input type="checkbox"/>	Default	<input type="checkbox"/>	400												
6	None	Yellow	<input type="checkbox"/>	Default	<input type="checkbox"/>	400												

Idle

Stop Motion

Enable Drive

Start Recording

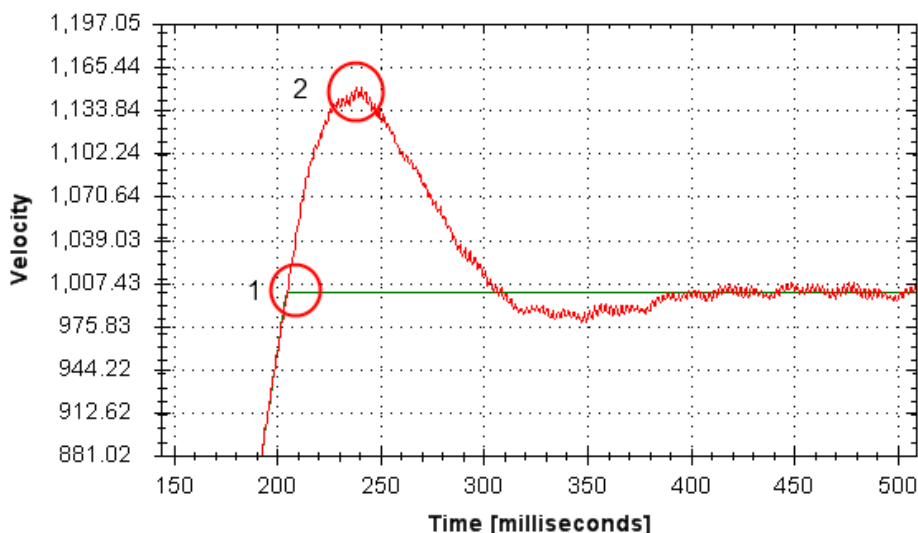
Refresh

7. Adjust VL.KP. Keep increasing VL.KP by a factor of 2 until you either:

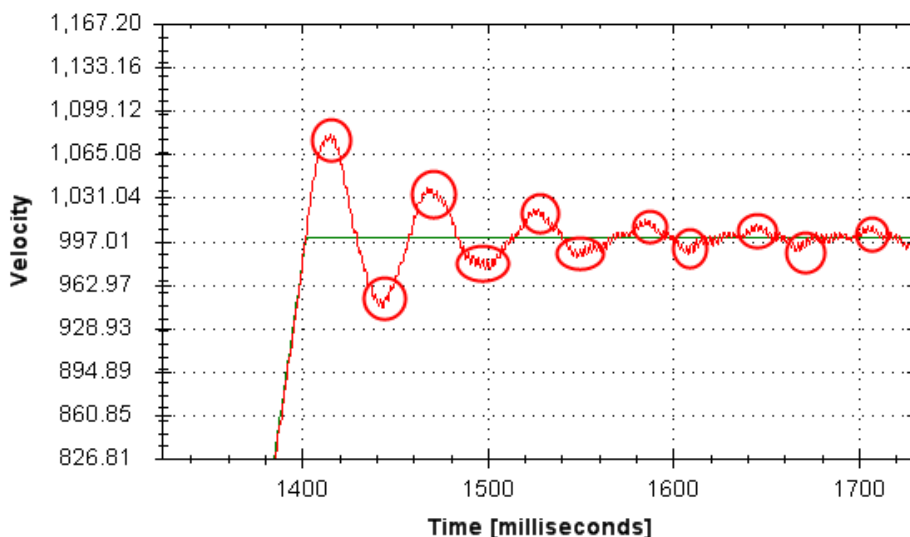
- Hear an objectionable noise from the system (buzzing, humming, etc) or
- See velocity overshoot. No velocity overshoot should be present when using only VL.KP.
- When you reach one of the limits above, decrease VL.KP to the value where there were no objectionable noises or overshoot.

8. Adjust VL.KI. Increase VL.KI by a factor of 1.5 until you either:

- Hear or see objectionable noise or shuddering from the system
- See > 15% overshoot
- Here is an example of 15% overshoot. This is zoomed in view of a service motion commanded to 1000 RPM (location 1), where the overshoot peaks at 1150 RPM (location 2).



- Here is an example of 11 overshoots. Each overshoot is shown by a red circle.

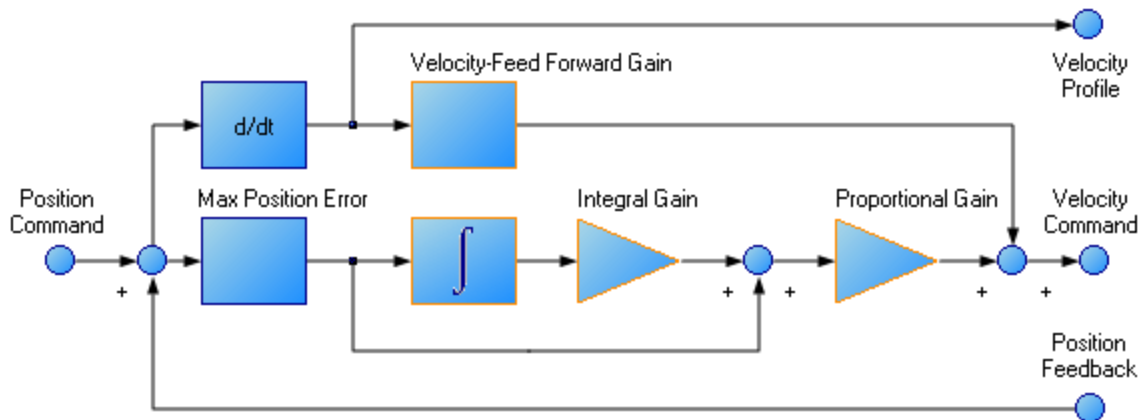


- When you reach one of the limits above, decrease VL.KI to the value where there were no objectionable noises or overshoot.
9. Stop the service motion

16.4.4.2 Tuning the Position Loop

The position loop is a second loop that builds upon a correctly tuned velocity loop to provide accurate control over position. The position loop is a simple element that consists of a PI loop. It is simplest to tune the P and I terms in the velocity loop and use only the P term in the position loop.

At most, use only three non-zero P and I terms from both the velocity loop and the position loop. One combination would be VL.KP, VL.KI, and PL.KP. Another valid combination would be VL.KP, PL.KP, and PL.KI. The VL.KP, VL.KI, and PL.KP combination is shown here.



Procedure for tuning position loop:

1. Set VL.KVFF to 1
 2. Increase PL.KP until either:
 - You see 25% overshoot, or
 - You see > 3 overshoots, or
 - You hear objectionable noises from the system.
- When you reach one of the limits above, decrease PL.KP to the value where there were no objectionable noises or overshoot.

16.4.5 Torque Feedforward Tuning Methods

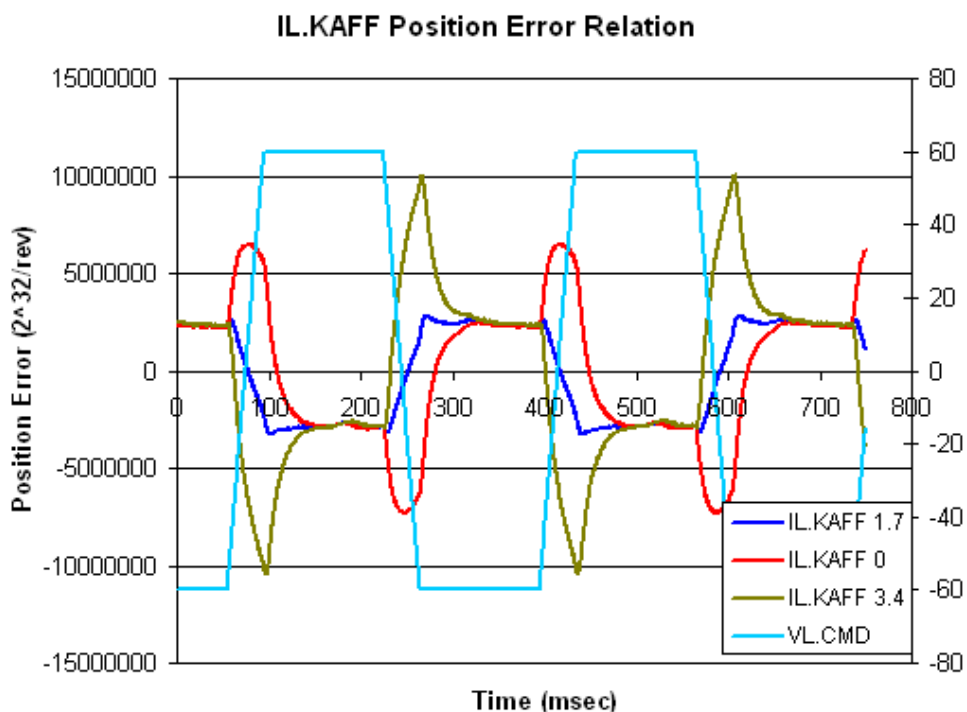
The torque based feedforward terms on the KC1 effectively model the physics of your motor and allow the drive to command the appropriate current, even before the encoder has time to send data back to the drive. Torque based feedforward terms allow you to lower following error with virtually no stability penalty.

16.4.5.1 Shape Based Feedforward Tuning

To adjust IL.KAFF:

- Tune the VL.KP and VL.KI as shown above in the velocity loop tuning section. Set DRV.OPMODE to velocity (or set PL.KP and PL.KI to 0 and vl.kvff to 1).
- Set up a short, repeating service motion with accelerations that are representative of the moves you will use in your application (exact values for acceleration are not critical).
- Turn up IL.KAFF until the position error (PL.ERR) is proportional to the inverted velocity command. The adjustment of IL.KAFF will focus on removing bumps on acceleration and deceleration. The

picture below has an ideal value of IL.KAFF of 1.7.



16.4.6 Using Anti-Resonance Filters

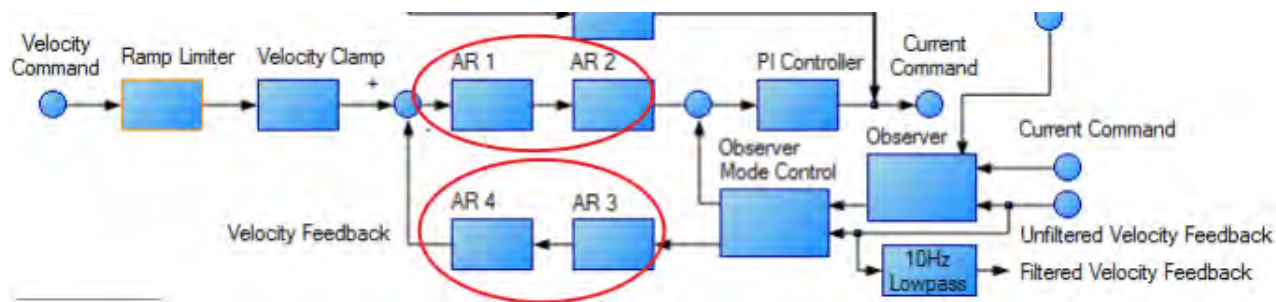
The KC1 has four anti-resonance filters. Two filters are in the forward path and two are in the feedback path.

Similarities

- Both types are typically used to enhance stability and performance of the system.

Differences

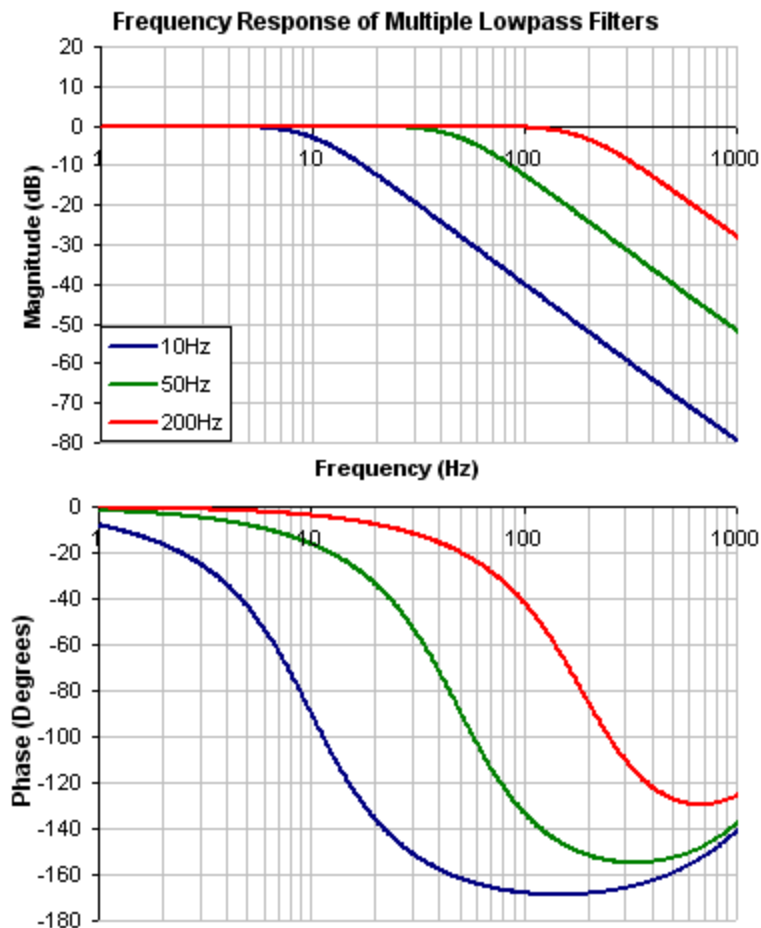
- Forward path filters result in higher phase lag in closed loop system response.
- Forward path filters limit spectrum from reaching the motor / feedback path filters only filter the feedback after it has been to the motor.



16.4.6.1 Types of Anti-Resonance Filters

Low Pass

A low pass filter allows signals through below a corner frequency and attenuates the signals above the same corner frequency. The behavior at the corner frequency can be specified with the low-pass Q.



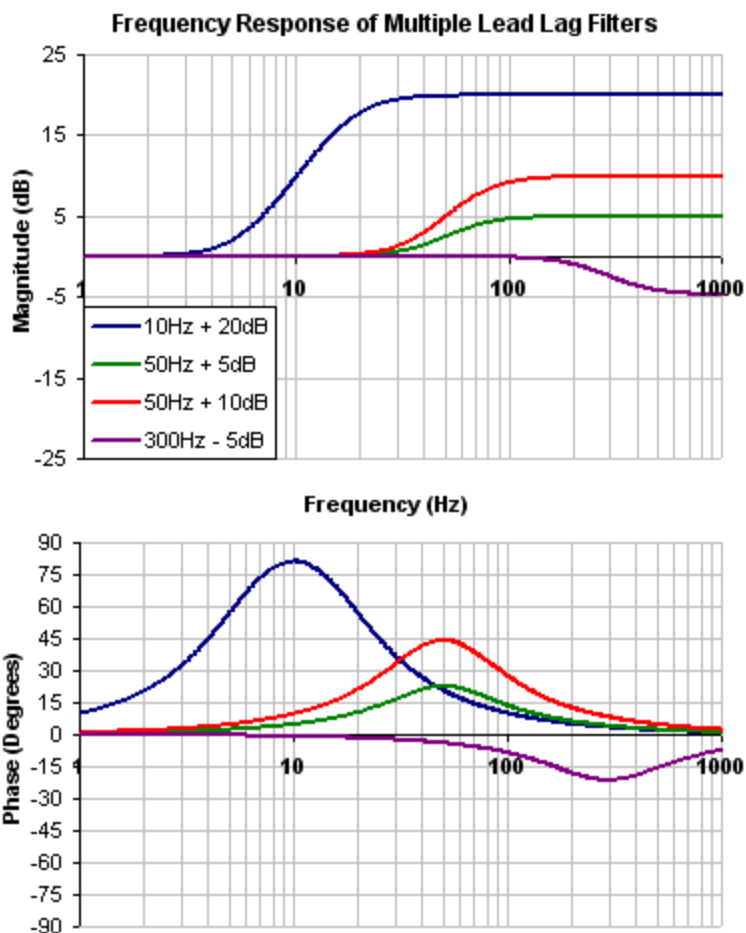
To specify a lowpass filter, you must specify the frequency and Q for both the zero and pole on anti-resonance filter 1. To do this, see the following example using the terminal commands that sets:

- Filter Type = Biquad
- Zero frequency = 700 Hz (This is the Lowpass cutoff frequency)
- Zero Q = 0.707
- Pole frequency = 5000 Hz
- Pole Q = 0.707

```
VL.ARTYPE1 0
VL.ARZF1 700
VL.ARZQ1 0.707
VL.ARPF1 5000
VL.ARPQ1 0.707
```

Lead Lag

A lead lag filter is a filter that has 0 dB gain at low frequencies and a gain that you specify at high frequencies. You also specify the frequency that the gain at which the transition occurs.



To specify a Lead Lag filter, you must specify the Center Frequency and high frequency Gain (dB). To do this, see the following example by clicking on the Velocity Loop:

Click on Velocity Loop (1), then select the AR1 Tab (2), using the Filter Type drop-down, select Lead Lag (3), lastly, enter the desired Center Frequency and Gain of the Lead Lag filter (4).

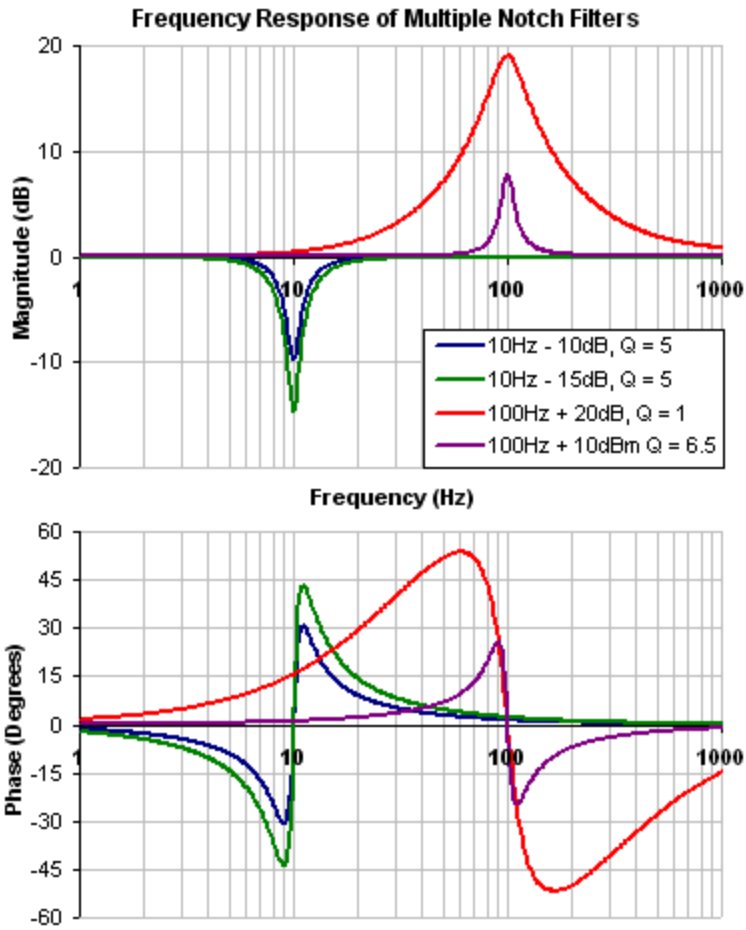
Velocity Loop
The parameters for controlling the velocity of the motor.

The interface includes a block diagram with components like Ramp Limiter, Velocity Clamp, AR 1-4, PI Controller, Observer, and various compensation blocks. A configuration table is shown below:

AR Type	Filter Type	Center Frequency (Hz)	Gain (dB)
AR 1	Lead Lag	500,000	0.000
AR 2	Unity Gain		
AR 3	Low Pass		
AR 4	Unity Gain		

Notch

A notch filter changes gain at a specific frequency. You specify the frequency at which the gain change occurs (Frequency (Hz)), how wide of a frequency range the cut occurs (Q), and how much the gain changes (Notch Depth (dB)).



To specify a notch filter, you must specify the Frequency (Hz), Depth (dB) and Width (Q) of the notch. To do this, see the following example by clicking on the Velocity Loop:

Click on Velocity Loop (1), then select the AR1 Tab (2), using the Filter Type drop-down, select Notch (3), lastly, enter the desired Frequency, Depth and Q of the Notch filter (4).

Velocity Loop
The parameters for controlling the velocity of the motor.

Velocity Profile

Velocity Command

Acceleration Feed Forward

Friction Compensation

Viscous Damping Compensation

AR 1

AR 2

AR 3

AR 4

PI Controller

Observer Mode Control

Observer

10Hz Lowpass

Current Command

Ramp Limiter

Velocity Clamp

Velocity Feedback

Velocity Loop **1**

Select AR Type:

AR 1	Notch 2
AR 2	Unity Gain
AR 3	Low Pass
AR 4	Unity Gain

Filter Type: 2 - Notch **3**

Edit Parameters

Frequency (Hz): 500,000

Depth (dB) **4**: 0,000

Q: 0,600

Numerator: Frequency: 500,000 Hz

Denominator: Frequency: 500,000 Hz

Biquad

A biquad is a flexible filter that can be thought up as being made up of two simpler filters; a zero (numerator) and a pole (denominator). In fact, the pre-defined filters mentioned above are really just special cases of the biquad.

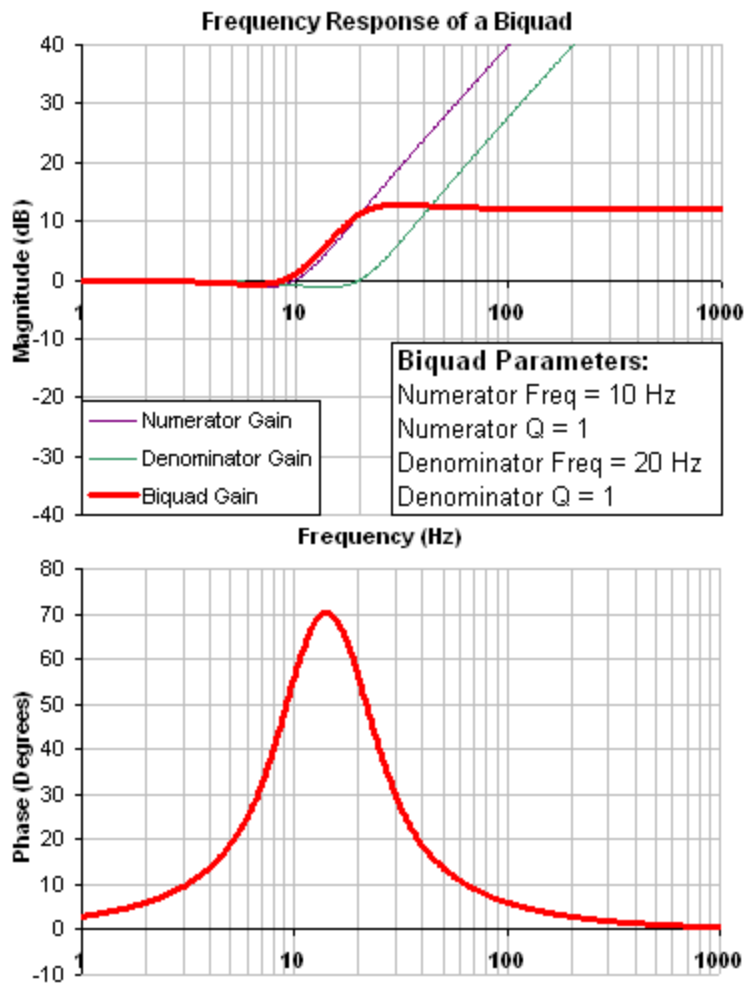
Both the zero (numerator) and the pole (denominator) have a flat frequency response at low frequencies and a rising frequency response at high frequencies. The transition frequency and damping must be specified for both the numerator and denominator.

Analyzing the numerator and denominator, the frequency response calculation is simple:

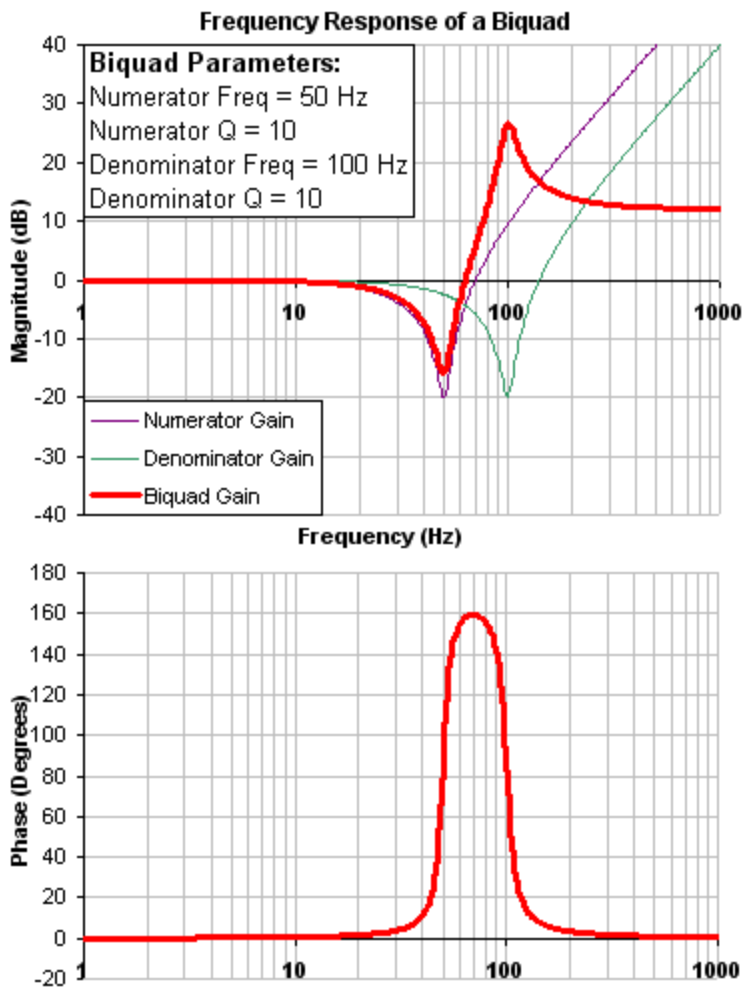
If the numerator and denominator are plotted in dB, the biquad response is numerator – denominator.

Understanding how the numerator and denominator work is crucial in understanding how a biquad frequency response is created.

Below is an example of a biquad filter similar to a Lead Lag filter type. To help understand how to determine the frequency response of the biquad, the numerator and denominator response have been plotted. If the denominator is subtracted from the numerator, the biquad response is the result.

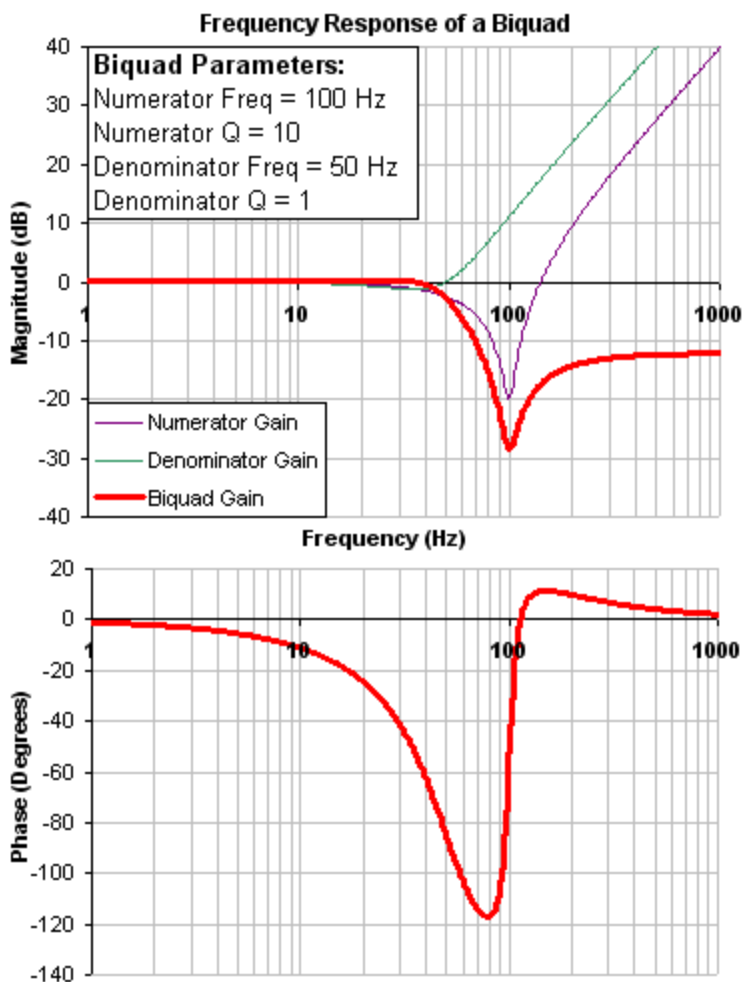


The biquad filter is very flexible, which allows custom filters to be designed. Below is an example of a resonance filter using a biquad. Notice how the high Q values affect the numerator and denominator. This gives a biquad frequency response similar to a mechanical resonance.



The previous two examples used a numerator frequency lower than the denominator frequency, yielding a positive gain in high frequencies. If the denominator frequency is lower than the numerator frequency, then high frequencies will have a negative gain.

Below is an example where the numerator frequency is higher than the denominator. Notice the high frequencies have a negative gain.



To specify a biquad filter, you must specify the frequency and Q for both the zero and the pole on anti-resonance filter 3. To do this, see the following example using the terminal commands that sets:

- Filter Type = Biquad
- Zero frequency = 100 Hz
- Zero Q = 0.7
- Pole frequency = 1000 Hz
- Pole Q = 0.8

```
VL.ARTYPE3 0
VL.ARZF3 100
VL.ARZQ3 0.7
VL.ARPF3 1000
VL.ARPQ3 0.8
```

16.4.6.2 Biquad Calculations

In the s-domain, the linear biquad response is calculated:

$$\text{Biquad Frequency Response} = \frac{s^2 + \frac{\omega_N}{Q_N} s + \omega_N^2}{s^2 + \frac{\omega_D}{Q_D} s + \omega_D^2}$$

To convert from idealized s-domain behavior to a more realistic z-domain behavior, we convert using a pole / zero transform. To calculate the frequency response for an individual frequency:

$$t = 62.5 \mu \text{ sec}$$

$$N_{Rad} = 1 - (2Q_N)^{-2}$$

$$N_{2Unscaled} = 1$$

$$\text{if}(N_{Rad} > 0): N_{1Unscaled} = -2e^{-2\omega_N \zeta_N t} \cos(\omega_N t \sqrt{1 - \zeta^2})$$

$$\text{if}(N_{Rad} \leq 0): N_{1Unscaled} = -2e^{-2\omega_N \zeta_N t} \cosh(\omega_N t \sqrt{1 - \zeta^2})$$

$$N_{0Unscaled} = e^{-2\omega_N \zeta_N t}$$

$$D_{Rad} = 1 - (2Q_D)^{-2}$$

$$D_2 = 1$$

$$\text{if}(D_{Rad} > 0): D_1 = -2e^{-2\omega_D \zeta_D t} \cos(\omega_D t \sqrt{1 - \zeta^2})$$

$$\text{if}(D_{Rad} \leq 0): D_1 = -2e^{-2\omega_D \zeta_D t} \cosh(\omega_D t \sqrt{1 - \zeta^2})$$

$$D_0 = e^{-2\omega_D \zeta_D t}$$

$$N_{Scale} = \frac{N_{0Unscaled} + N_{1Unscaled} + N_{2Unscaled}}{D_0 + D_1 + D_2}$$

$$N_2 = N_{2Unscaled} / N_{Scale}$$

$$N_1 = N_{1Unscaled} / N_{Scale}$$

$$N_0 = N_{0Unscaled} / N_{Scale}$$

$$\angle_z = \omega t = 2\pi * freq * t$$

$$Num_{Re} = N_2 \cos(2\angle_z) + N_1 \cos(\angle_z) + N_0$$

$$Num_{Im} = N_2 \sin(2\angle_z) + N_1 \sin(\angle_z)$$

$$Den_{Re} = D_2 \cos(2\angle_z) + D_1 \cos(\angle_z) + D_0$$

$$Den_{Im} = D_2 \sin(2\angle_z) + D_1 \sin(\angle_z)$$

$$Gain_{dB} = 20 \log_{10} \left(\frac{\sqrt{Num_{Re}^2 + Num_{Im}^2}}{\sqrt{Den_{Re}^2 + Den_{Im}^2}} \right)$$

$$Phase_{deg} = \frac{180}{\pi} \left(\tan^{-1} \left(\frac{Num_{Re}}{Num_{Im}} \right) - \tan^{-1} \left(\frac{Den_{Re}}{Den_{Im}} \right) \right)$$

16.4.6.3 Common Uses Of Anti-Resonance Filters

Low pass filters in the feedback path. This is a common way to deal with noisy feedback sensors. When used in combination with noisy feedback sensors, significant reduction in audible noise can result.

Lead / lag filters in the forward path. This is a common way to achieve phase lead for control loops without exciting high frequency resonances.

Low pass filters in the forward path. This is a common way to limit high frequency energy from reaching a system that can not productively use energy at these high frequencies. This is also used to lower the effect of system resonances over a wide range of frequencies.

Notch filters are used to cancel system resonances. Notch filters are designed to be the opposite in amplitude of system resonances. Notch filters are applied to very specific frequencies, and therefore you must know your system resonance frequencies accurately to use them effectively.

17 Scope

17.1 Overview

The scope allows you to plot up to six different parameters from the drive. Use **Full View** and **Normal View** to toggle between the scope setup (normal) and a larger view of only the scope output (full). You can configure, save, and restore scope settings from the normal view. The lower right corner of the normal view also includes a box that indicates status and drive and scope control buttons (**Enable Drive**, **Start Recording**, and **Refresh**).

17.2 Using the Scope

You can set up scope plots using the tabs summarized below:

Tab	Function
Channels	Select data source, plot axes, and plot appearance.
Time Base and Trigger	Select how much data to record and when to start recording the data.
Service Motion	Generate basic motion.
Servo Gains	Adjust the servo loop gains.
All Gains	View all current tuning gains in the drive and manually edit gains.
AR1, AR2, AR3, AR4	Adjust filter settings.
Save and Print	Save the plot as a raw data file or as an image file; email the plot; print the plot; open the data file in Excel.
Measure	Display basic data read from the plots.
Cursors	Turn on the cursors and view the data at the cursor positions.
Display	Pan, zoom, and control the grid and background color.

17.2.1 Scope Channels Tab

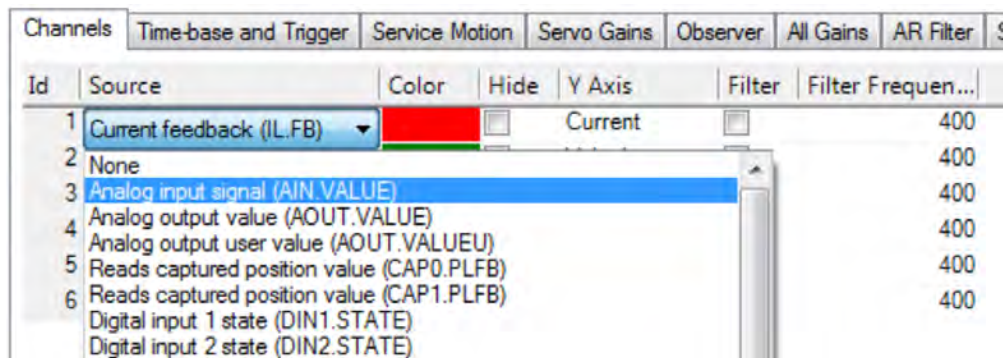
The **Channels** tab allows you to select and record up to six channels simultaneously. Select the data to record for each channel from the lists in the **Source**, **Color**, **Y-axis**, and **Filter** and **Filter Frequency** columns. Once a recording is shown on the scope screen, you can click **Hide** to remove a channel from the scope display.

Channels						
Time-base and Trigger						
Service Motion						
Servo Gains						
Observer						
All Gains						
AR Filter						
Id	Source	Color	Hide	Y Axis	Filter	Filter Freq...
1	Current feedback (IL.FB)		<input type="checkbox"/>	Current	<input type="checkbox"/>	400
2	Velocity command (VL.CM...)		<input type="checkbox"/>	Velocity	<input type="checkbox"/>	400
3	Velocity feedback (VL.FB)		<input type="checkbox"/>	Velocity	<input type="checkbox"/>	400
4	None		<input type="checkbox"/>	Default	<input type="checkbox"/>	400
5	None		<input type="checkbox"/>	Default	<input type="checkbox"/>	400
6	None		<input type="checkbox"/>	Default	<input type="checkbox"/>	400

17.2.1.1 Source Column

To set a channel to record, click the source you want to set and choose the appropriate channel. You can choose from None (no data is collected on that channel), preset trace types, or enter a user defined trace.

Choosing “<User Defined>” allows you to record data from pre-defined locations. These locations are provided by the factory to collect less common values.



17.2.1.2 Color Column

For valid sources, you can click on the color in the Color tab and choose a different color than the default, or create a custom color.

17.2.1.3 Hide Column

You can check the **Hide** box to hide a given plot trace. This feature can make it easier to focus on specific data as needed.

17.2.1.4 Y-Axis Column

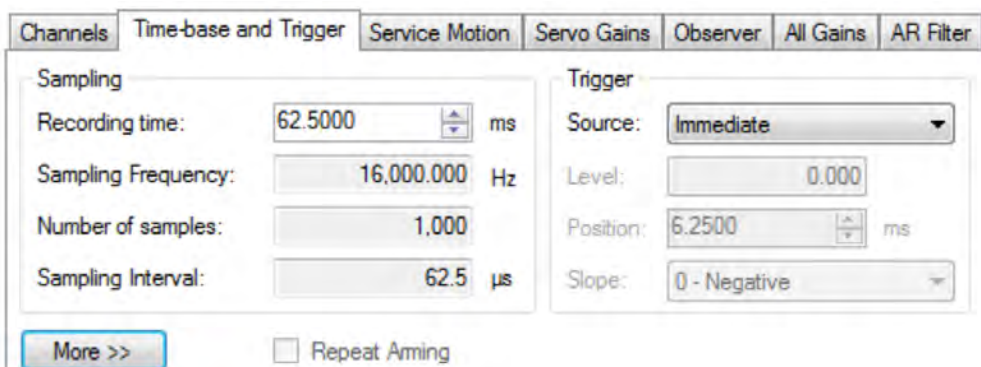
The Y-axis column allows you to choose on which Y-axis the channel will be displayed. Several predefined Y-axis groups exist. Click on the item in the column to change the label for the trace.

17.2.1.5 Filter and Filter Frequency Column

Check this box and use the frequency column to apply a low pass filter to the data collected. The filter is applied when the data is collected. It is not applied to data already collected if this is checked after the data is collected.

17.2.2 Scope Time-base and Trigger Tab

Use the **Time-base and Trigger** tab to select how much data to record and when to start (trigger) recording the data. You can set length of recording in ms and the sampling frequency in Hz. The number of samples is a calculated value displayed for reference. The trigger can be set to trigger immediately when you click **Start Recording** or to trigger when a specified value for a given signal is reached. The default **Time-base and Trigger** view specifies recording time, sampling frequency, and either an immediate trigger or a trigger based on a specified signal. Click the **More** button in this view to specify a given number of samples, sampling frequency, sampling interval, and access additional trigger options.



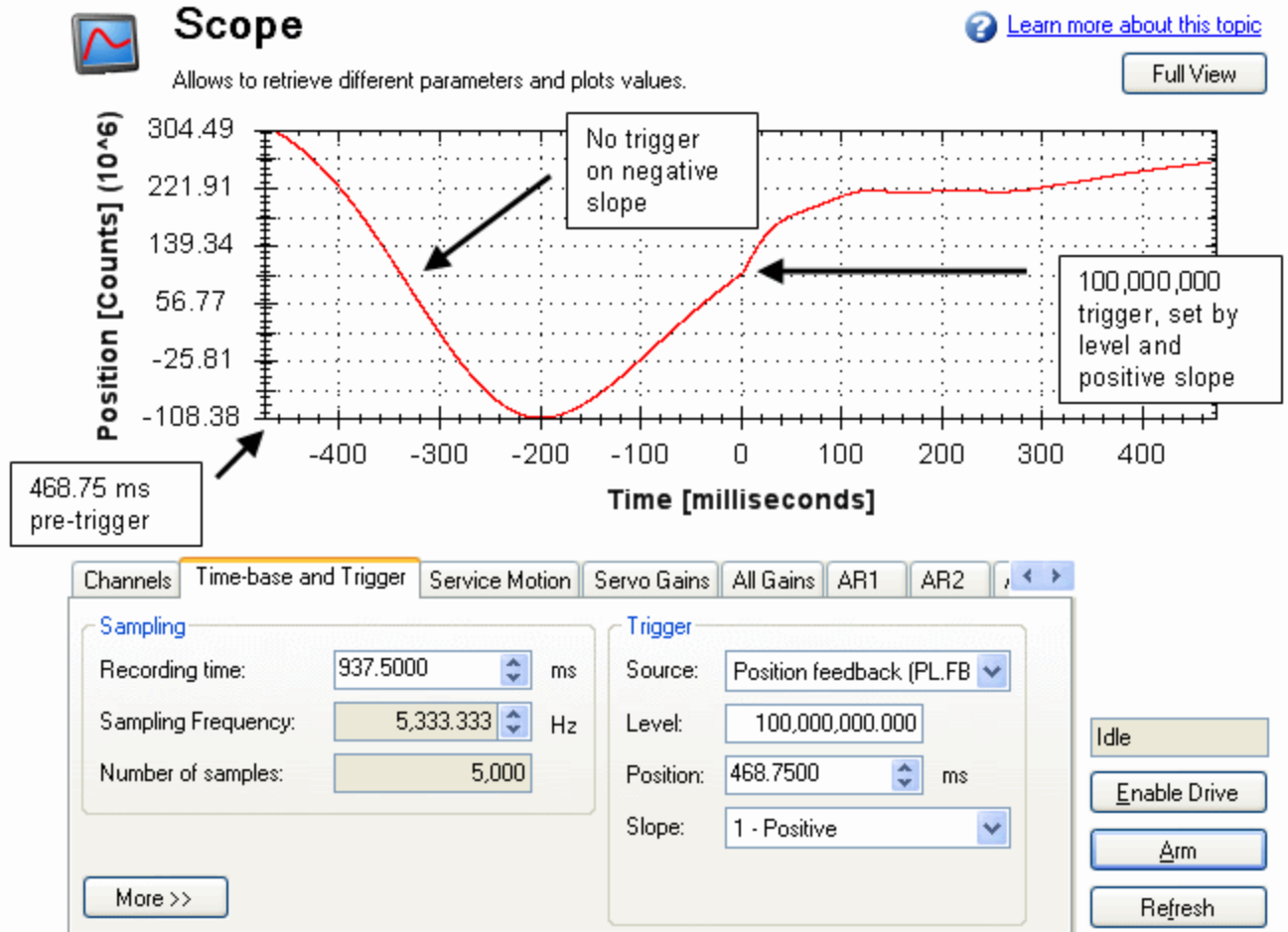
In this tab, you can set length of recording in ms and the sampling frequency in Hz. The number of samples is a calculated value displayed for reference. You can also choose the trigger source to be

Immediate (triggers as soon as you click the **Start Recording** button) or to be one of many predefined sources.

If you choose a source other than **Immediate**, you can set the level, position, and slope for the trigger value.

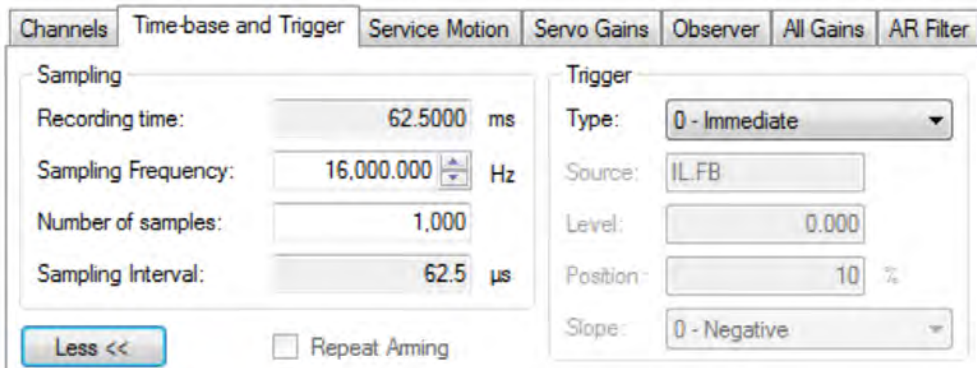
- Level sets the value of the source that triggers the recording to start.
- Position sets the amount of time that the scope displays before the trigger occurred.
- Slope sets whether the source data must pass the level value in a positive or negative direction.

An example of triggering is shown below:



17.2.2.1 Scope Time-base and Trigger, More View

Click **More** to display additional options for configuring the time-base and trigger.



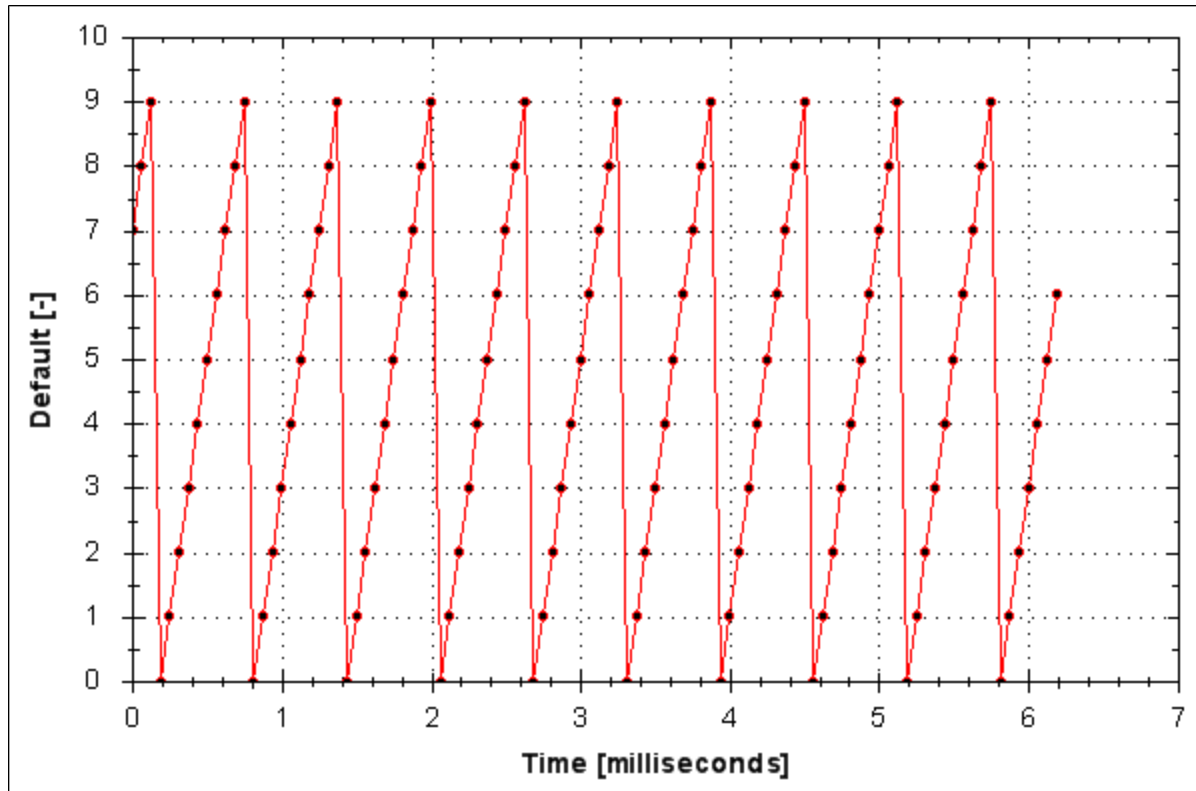
In the **Sampling** area of this view, you can specify the recording length by entering a sampling frequency and a number of samples. Here, the recording time is a calculated value displayed for reference.

What is triggering?

Triggering allows you to precisely control the start point of data collected in the scope. For example, if you are looking for a large spike, you can set the trigger to start the scope to begin recording when it sees the large spike. This section describes the triggering functionality of the scope.

Test Signal

As an example, it is useful to examine variations on a record of a test signal that generates a sawtooth signal. The signal starts at 0 and increases by one every drive sample (1/16,000 second) to a maximum of 9, and then returns to 0. This signal continues indefinitely. The record of this signal is shown below.



17.2.2.2 Trigger Type

The **Trigger** area in the **More** view offers more flexibility than the default view. You can specify four types of trigger types (REC.TRIGTYPE):

- **Immediate - 0.** This mode will start recording as soon as the recording command (REC.TRIG) is received by the drive.
- **Command / On Next Command - 1.** This trigger type lets you specify a trigger on the next telnet command received by the drive. This is useful in a telnet session via Hyperterminal (or a similar program). WorkBench is constantly sending telnet commands, so this is not typically used in a WorkBench session.
- **Parameter / On Source Signal - 2.** This trigger type lets you specify a trigger source and set of conditions to trigger recording of data. This is very similar to the triggering used on oscilloscopes.
- **Boolean - 3.** This trigger type lets you trigger on a boolean (0 or 1), such as drive active status.

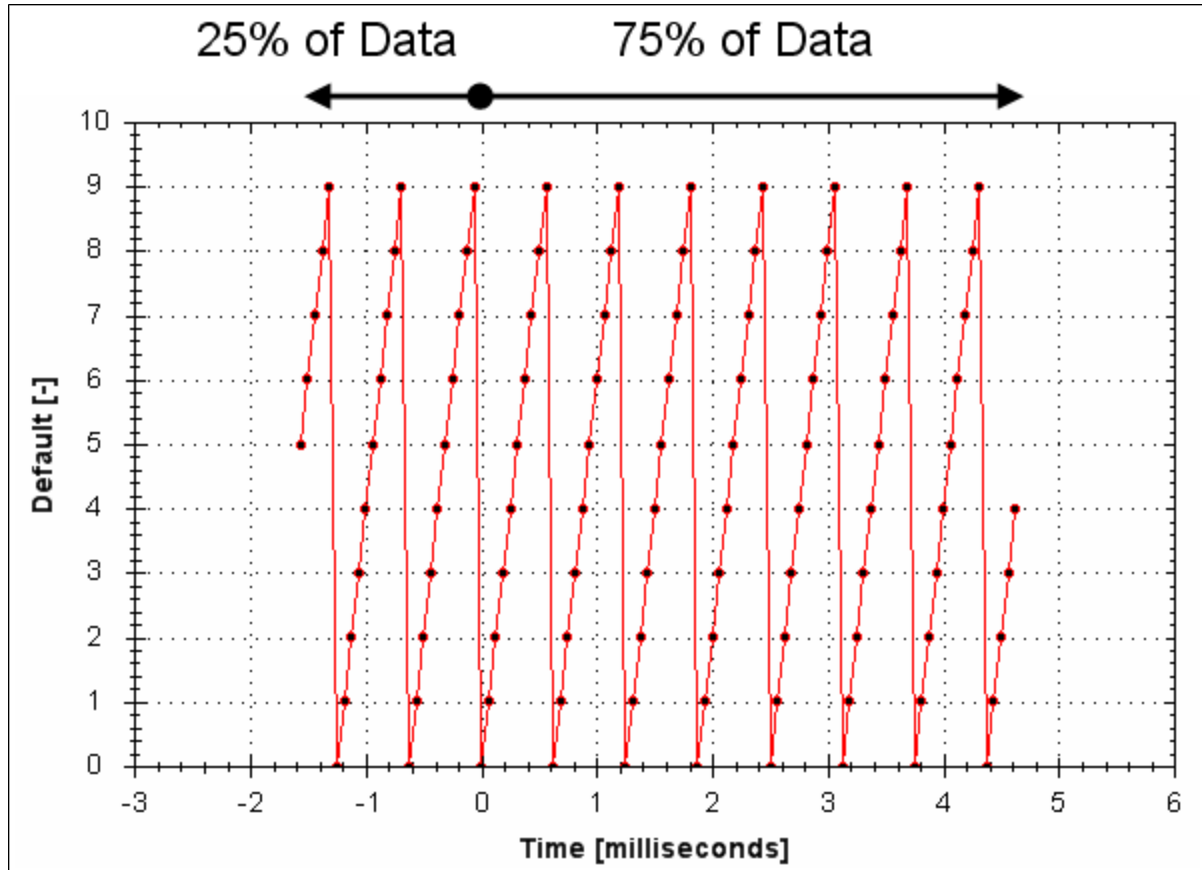
17.2.2.3 Trigger Position

Trigger Position (REC.TRIGPOS) allows you to collect data that occurs before the trigger occurs. If you have a rare condition, you may want to see the conditions that led up to it. Trigger position lets you control how much signal is collected before the trigger condition occurred.

Trigger position is specified in units of percent (%). If you specify a trigger position of X% , X% of the data is before 0 ms in the data time and 100-X% (the rest of the data) is at or greater than 0 ms. In the picture below, trigger position is set to 25% (REC.TRIGPOS 25).

In the WorkBench scope, the 0 time point is clear. When collecting the data via REC.RETRIEVE or similar commands, the time is not returned, so some caution should be used when the trigger point is important to understand.

Trigger position is not used in trigger type "Immediate" (TRIGTYPE 0).



17.2.2.4 Trigger Value

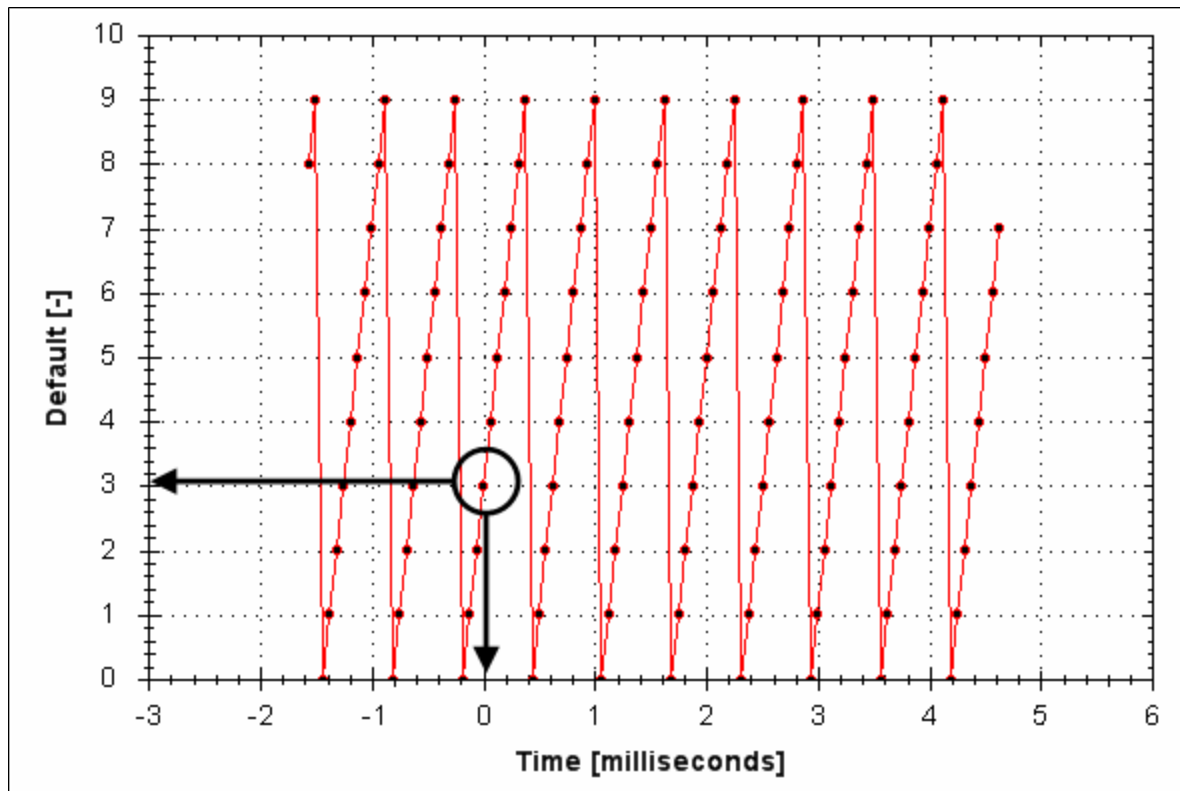
The trigger value (REC.TRIGVAL) specifies a target value that should trigger the recording to start. The trigger value is used in trigger type Parameter / On Next Signal only.

The trigger value is not used in the boolean trigger type. Use the trigger slope to set the polarity of the boolean trigger.

When the trigger slope is positive, the trigger value will trigger when:

- The trigger source is less than the trigger value in the previous recording sample
- The trigger source is greater than or equal to the trigger value in the current recording sample

Below is an example showing triggering of trigger value of 3 (REC.TRIGVAL 3) and positive trigger slope (REC.TRIGSLOPE 1). You can see that the recording triggers at time zero when the source reaches the value of 3.



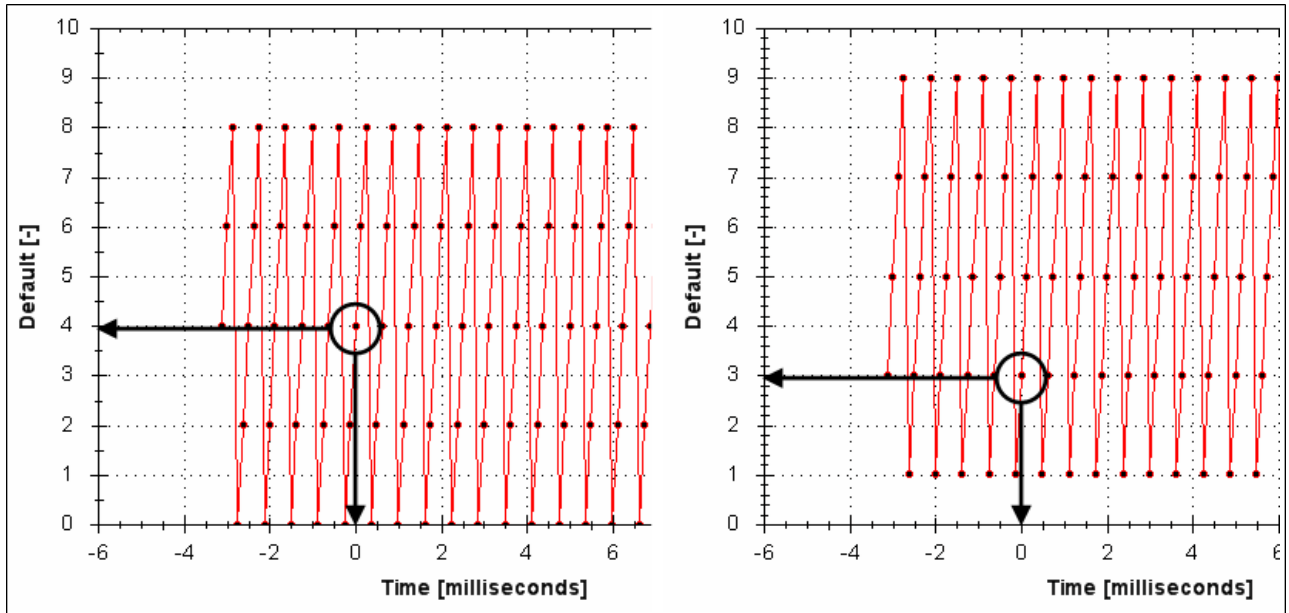
When the trigger slope is negative, the trigger value will trigger when:

- The trigger source is greater than the trigger value in the previous recording sample.
- The trigger source is less than or equal to the trigger value in the current recording sample.

17.2.2.5 Effects of Recorder Gap

When the recording rate is less than 16,000 Hz ($REC.GAP > 1$), there can be some impact on the triggering of the recorder. When using pretriggering and a recording rate of less than 16,000 Hz, the trigger only evaluates every N samples, where N is the value of $REC.GAP$. Two effects result from this condition:

1. You cannot be sure of the moment that the recorder is triggered any closer than N samples. An example of this is shown below where the trigger value is set to 3, the trigger slope is positive and the recorder gap is 2. Both examples are the same data, but one instance collected and triggered on the odd data. The other example collected and triggered on the even data.



2. You can miss triggers, whose duration is less than N samples, where N is the value of REC.GAP. This is because the trigger is only evaluated every N samples.

A workaround for the above effects is available by setting the recorder trigger position to zero (REC.TRI-GPOS 0). This eliminates conflicts between pretrigger and post-trigger timing and will guarantee trigger evaluation every sample, eliminating the cases above.

17.2.2.6 Trigger Slope

Trigger Slope specifies whether you trigger on a positive or negative change in the trigger source. The effect of the trigger slope is different for trigger type Boolean and On Next Signal modes.

Boolean Trigger Type

When using Boolean type:

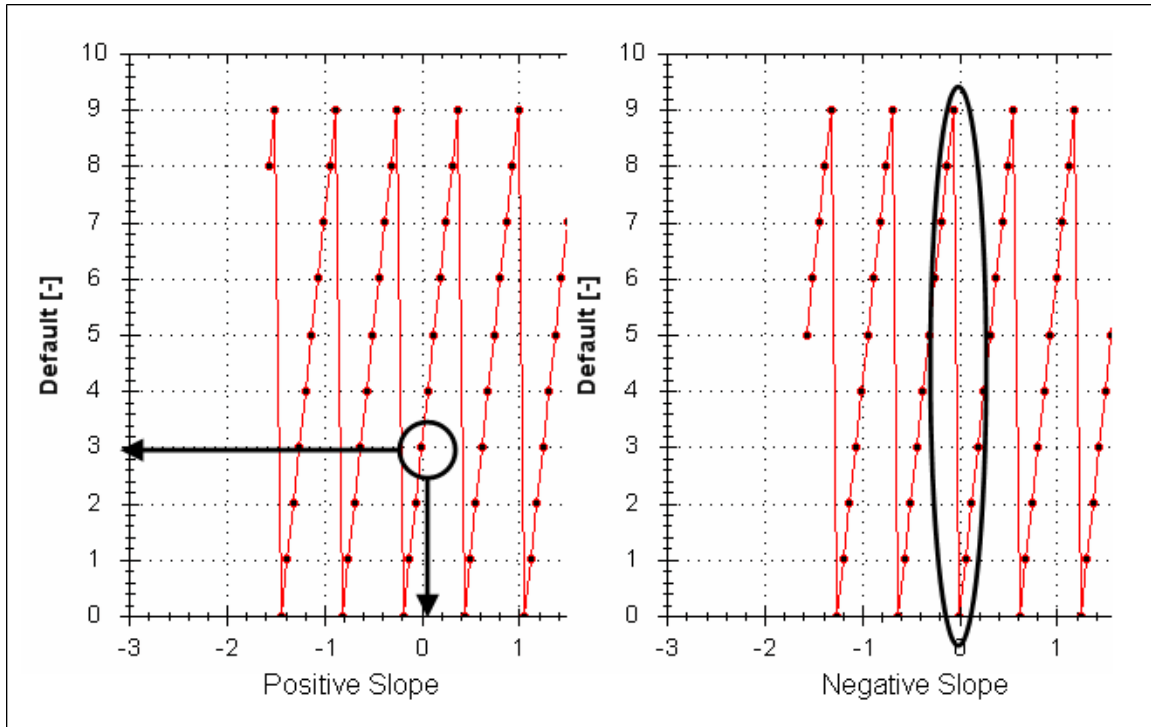
- A positive slope will trigger when the trigger source is 1
- A negative slope will trigger when the trigger source is 0

The boolean trigger type is a state trigger. There is no need to transition from 0 to 1 to trigger with the positive slope. If the trigger source is 1 from the start, the positive slope will immediately trigger.

On Next Signal Trigger Type

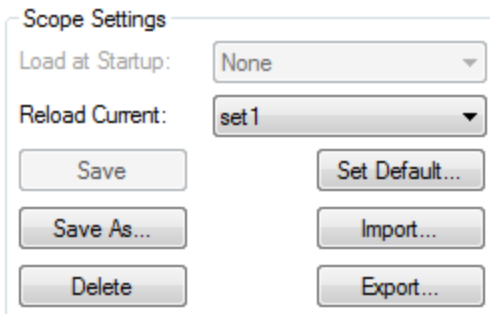
The "On Next Signal" trigger type allows you to specify if the recorder should trigger when the signal crosses the trigger level in the positive or negative direction. The signal only needs to reach the trigger level; it does not need to pass the trigger level.

In the examples below, the trigger value is set to 3 (REC.TRIGVAL 3.000). You can see that with positive slope, the trigger occurs exactly when the signal transitions from 2 to 3, because it reached 3. The negative slope case triggers when the signal transitions from 9 to 0, because it crossed 3 on the way.



17.3 Scope Settings

Scope settings are used to store and retrieve the scope parameters. You can save multiple settings, called "presets", under different names. You can save, delete, import, or export the presets. The settings are stored in WorkBench project file (default.wbproj) and settings are common to all the drives in WorkBench.

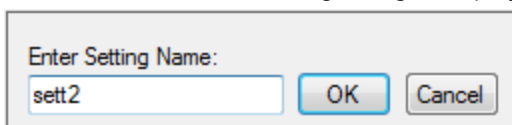


17.3.1 Load a setting (preset) to Scope screen

In Scope Settings section, the existing presets are listed in the **Select Setting** box. To load a setting to the scope screen, select the desired preset from the **Select Setting** list.

17.3.2 Create a new preset

1. Modify any scope parameters.
2. Select the **Settings** tab.
3. Click **Save As**. The following dialog is displayed:



4. Enter the setting name and click **OK**. The current settings are saved as a preset with the given name and displayed in the list.

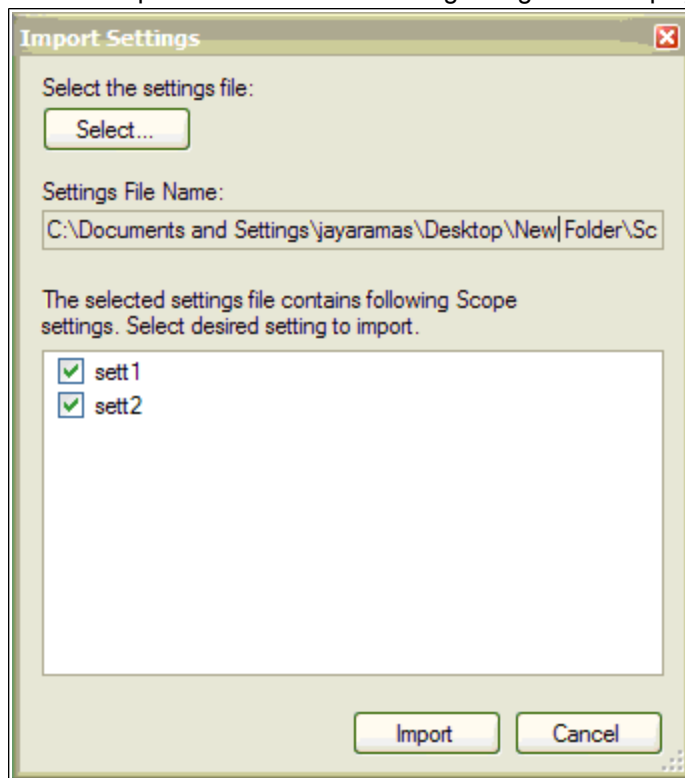
17.3.3 Save or delete preset

Save saves any modification to the open preset. **Delete** deletes the open preset.

17.3.4 Import preset

Import the presets contained in the selected settings file as follows:

1. Click on Import button and the following dialog will be displayed.

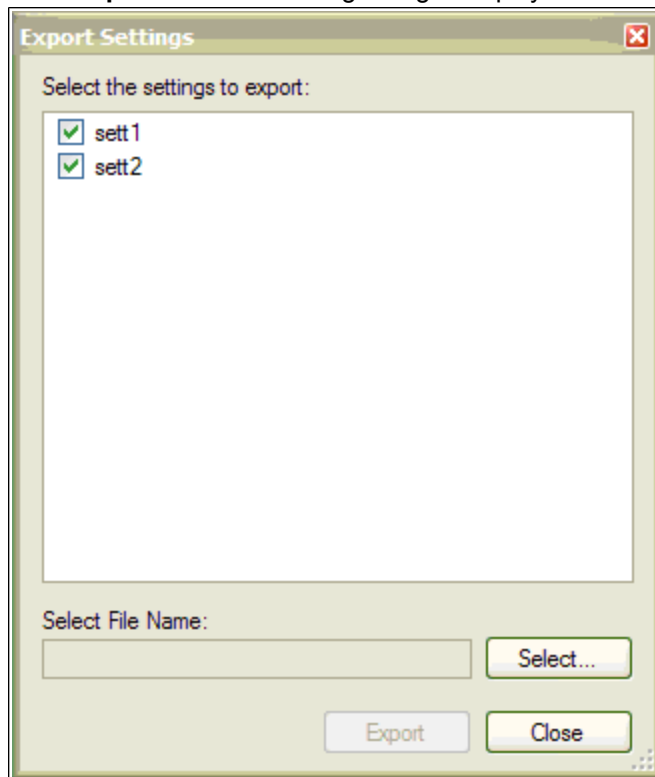


2. Select the settings file by clicking "Select..." button.
3. All the scope presets will be displayed contained in the selected settings file.
4. Select/Deselect the presets and then click on Import.
5. If preset name already exists in application the confirmation message will be shown to user to replace it or to ignore.

17.3.5 Export preset

Export a preset to a file as follows:

1. Click **Export** and the following dialog is displayed:



2. The existing presets are displayed and user can select/deselect the preset to export.
3. Select the file name to export.
4. Click **Export** to export the selected presets to a file.

17.3.6 Scope axis scaling and zooming

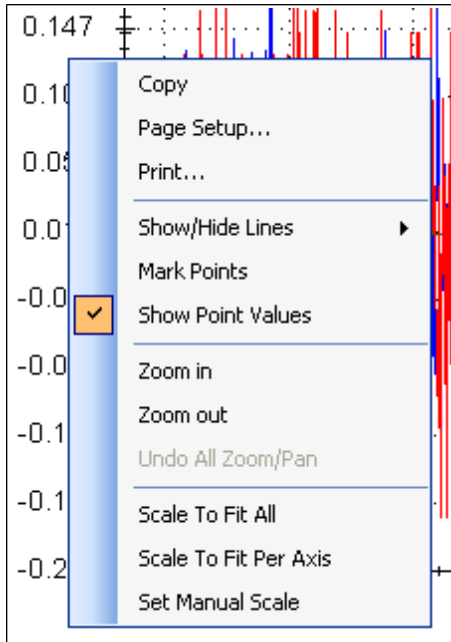
The scope provides two mechanisms for determining how you view the data:

- Scaling: you can choose the scale for the different axes.
- Zooming: you can choose a particular portion of the scope that you want to observe more in details, and then come back to previous scaling.

Two different scaling modes are provided on each axis:

- Manual: you can determine the minimum and maximum value of the axis (X or Y axis).
- Scale to fit: the program will compute a scale for this axis that will display all the curves bound to it (X or Y axis).

These functionalities are accessible through the contextual menu when right-clicking in the axis zone. A simple left-click in the axis zone will provide the manual range functionality. A supplementary functionality allows you to perform a scale to fit on all axes is also available, which allows a good overview.

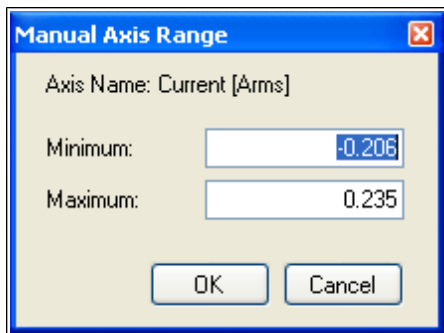


The zoom functionality allows you to navigate in a portion of the graphic. When you reset the zoom, the initial scales are shown.

In the display tab, when “Remember Axis Scale” is set, the scales of the axes are kept between two sequential recordings. You can fine tune the scale to visualize a particular behavior and record a second time and see the same behaviour without having to redo all the tuning. When not checked, a scale to fit all will be performed after each record. This setting is reset when exiting WorkBench and should be explicitly set at next startup.

17.3.7 Manual range per axis

After recording data, right click anywhere on the y-axis and select **Set Manual Scale** to open a dialog box to set the range for the axis. Enter the Y-axis minimum value and Y-axis maximum value. Click **OK** to reset the Y-axis to new range.



17.3.8 Unit display on Y axis

The unit on the Y-axis is displayed if all scope signals units are identical for that Y-axis. If different units apply to different signals, the units are displayed as [-]. For example, if the velocity Y-axis has signals VL.FB and IL.CMD, then the unit displayed is [-], since the units for these parameters are different. If IL.CMD is hidden, then the correct unit for VL.FB, rpm, is displayed.

Related Parameters:

BODE Parameters (pg 301)

18 Using Parameters and the Terminal Screen

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18.1 Terminal

18.1.1 Overview

The terminal mode provides a quick and easy way to issue commands to the drive directly. Typically used by "power users" who are familiar with the command set, the terminal mode can help in setup, troubleshooting, and other diagnostic actions. When using the terminal mode, WorkBench shows the parameter and command set in a popup view and uses an autocomplete tool to help you select the proper parameter or command. Right-click in the command entry area to open a popup menu for editing commands and for clearing the screen. The terminal also provides a macro editor that allows a series of commands to be executed via a single command (called a macro). Macros are useful when you must frequently execute a sequence of commands.

18.1.2 Using the Terminal

Click Terminal in the navigation tree to issue parameters and commands in the terminal mode. You can enter parameters and commands at the prompt as shown in this example:



Terminal

A command line interface to the drive. Type a command and press return.

```
Offline-->DRV.EN
Offline-->drv.stop
```

DRV.STOP	Stop current motion
DRV.TEMPERATURES	Temperatures
DRV.TYPE	Drive type
DRV.VER	Drive version
DRV.VERIMAGE	Version as it is written in the flash
DRV.WARNING1	Drive: id of current warning at index 1 (lower index is higher
DRV.WARNING2	Drive: id of current warning at index 2 (lower index is higher
DRV.WARNING3	Drive: id of current warning at index 3 (lower index is higher
DRV.WARNINGLIST	DRV.WARNINGLIST
DRV.WARNINGS	Drive warnings
DRV.ZERO	Drive zero mode
FAULT130.ACTION	Gets/Sets the Resulting Action for Fault 130
FAULT131.ACTION	Gets/Sets the Resulting Action for Fault 131
FAULT132.ACTION	Gets/Sets the Resulting Action for Fault 132
FAULT134.ACTION	Gets/Sets the Resulting Action for Fault 134

Macro 1

Macro 2

Macro 3

Macro 4

Macro 5

Edit Macros...

The terminal supports the following keyboard shortcuts:

Keyboard Shortcut	Description
F2	Executes the last command.
Up Arrow	Gets the previous command from the command history.
Down Arrow	Gets the next command from the command history.
CTRL+J	Shows the list of commands that the drive supports.

Keyboard Shortcut	Description
CTRL+L	Opens the Parameter Load/Save view.
ESC	Hides the command list if command list is open. Clears the line if command list is not open.
Enter (Return)	Executes the current command. This command sends the text you have typed to the drive and then prints the text the drive returns on the next line.

18.1.3 Macros

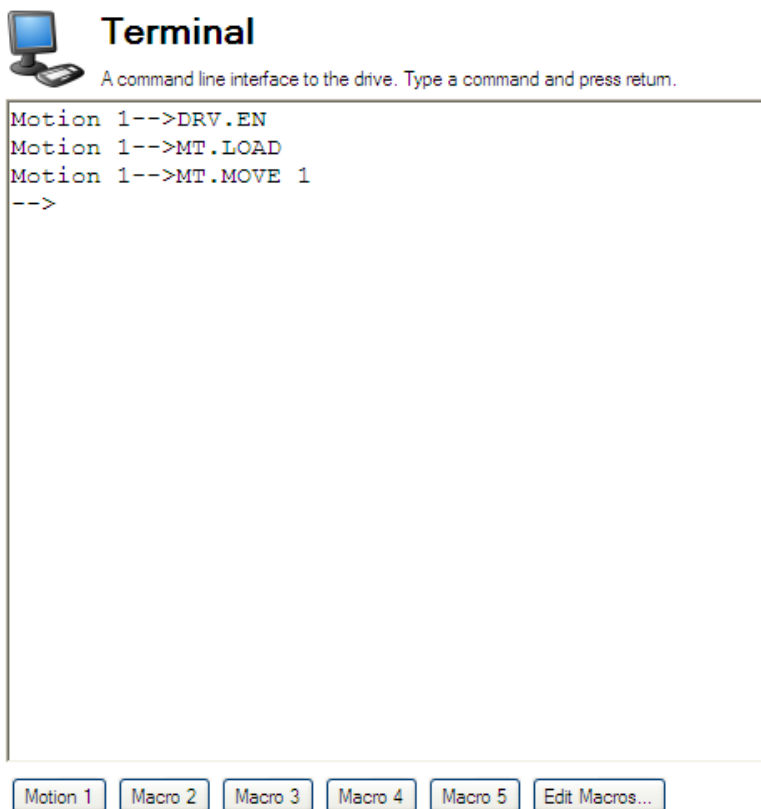
Macros are a short sequence of instructions that can be sent to the drive using a single button. You can create up to five macros within the terminal mode using the macro editor. Each of the macros can be given a name and will appear as a button below the Terminal screen area. When you select the button, the command set tied to that macro will appear in the Terminal area and the commands will be executed. If there are commands which are not entered correctly, the terminal screen area will indicate the errors.

You can access macros and the macro editor from the buttons are located at the bottom of the terminal screen. Click a macro button to execute the associated macro. The **Edit Macros** button opens the macro editor used to create and edit macros. You can also assign custom names to the macro buttons with this editor.

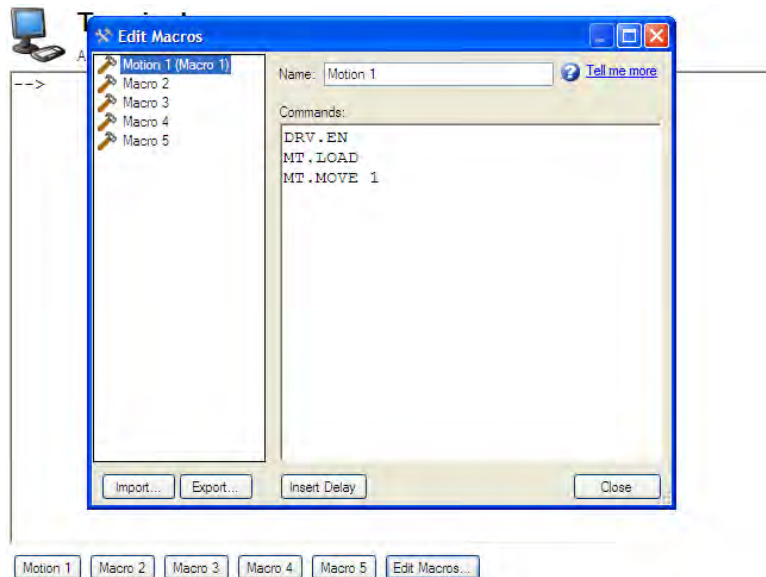
Creating a Macro from Terminal commands

You can create a macro from a sequence of terminal commands as follows:

1. Enter the sequence of commands.



2. Copy the sequence of commands, then click **Edit Macro**. Select a macro from the tree on the left, then paste the sequence of commands into the Commands area of the Edit Macros window.



3. Select **Save** to save your macro.

Macro Editor

The macro editor allows you to create and modify up to five macros. WorkBench automatically saves the macros that you create. If you exit WorkBench and then start WorkBench again, the macros you defined will still be available.

To create or edit a macro from the editor, open the **Terminal** screen and click on **Edit Macros** (located at the bottom of the screen). Select the macro you wish to edit from the tree on the left, then use the features described below to build the macro. You can add comments in the macro after the ";" symbol.

Button or Dialog Box	Description
Name	Allows you to give each macro a unique name. This name will be shown on the button in the terminal view.
Commands	Displays the commands that are sent to the drive when you use this macro. The response from the drive is displayed in the terminal.
Import	Overwrites the selected macro with the contents of a macro file exported from another computer.
Export	Sends the selected macro to a text file so that you can import it into WorkBench running on another computer.
Insert Delay	Inserts a step into the macro that causes a delay for a specified number of milliseconds before continuing. A line that starts with #delay 5000 will pause the execution of the macro for 5000 milliseconds.
Close	Closes this window and returns to the terminal view.

18.2 Viewing Parameters

You can view and edit parameters in the **Parameters** screen. You can view and write parameters in the **Terminal** screen.

18.3 Parameter List

This screen displays a list of the current values of all the parameters that the drive supports. You can sort some of the rows by clicking the column headers.



Parameters

This page lists all the current values of all the drive parameters on the drive.

Full Name	Value	Units	Parameter	Read/Write
Analog Input				
Analog input low pass filter cutoff freq...	5,000.000	Hz	AIN.CUTOFF	read-write
Analog input signal deadband	0.000	V	AIN.DEADBAND	read-write
Analog Input Deadband Mode	0 - Deadband		AIN.DEADBANDMO...	read-write
Analog input torque scale	0.001	Arms/V	AIN.ISCALE	read-write
Analog input mode	1 - Command Source		AIN.MODE	read-write
Analog input offset	0.000	V	AIN.OFFSET	read-write
Analog input position scale	0.000	Counts 16...	AIN.PSCALE	read-write
Analog input signal	0.000	V	AIN.VALUE	read-only
Analog input velocity scale	0.060	rpm/V	AIN.VSCALE	read-write
<ul style="list-style-type: none"> ⊕ Analog Output ⊕ Bode ⊕ Bus Volts ⊕ Controlled Stop ⊕ Current Loop ⊕ Digital Input ⊕ Digital Output ⊕ Drive ⊕ Electronic Gearing ⊕ Fieldbuses ⊕ GUI Parameters ⊕ Hardware Limit Switches ⊕ Homing ⊕ TCP/IP ⊕ Motion Tasks ⊕ Motor ⊕ Position Capture ⊕ Position Feedback ⊕ Position Loop ⊕ Programmable Limit Switches ⊕ Recorder ⊕ Regen Resistors ⊕ Service Motion ⊕ Software Limit Switches ⊕ Units ⊕ Velocity Loop ⊕ Wake & Shake ⊕ Misc 				

Button or Dialog Box	Description
Refresh	Reads all the parameters from the drive and update the contents of the table.
Print	Sends the data that you see on the screen to the printer.
eMail	Opens an email message and attaches a comma separated file to the email message.
More/Less	Adds two more columns to the table with the range and default values for each parameter.



18.4 Parameter Load/Save

To copy a configuration (all the drive parameters that are stored in the drive's nonvolatile memory) from one drive to another, click the **Save to File** button on the first drive and then use the **Load from File** on the second drive. If you wish the second drive to keep these new parameters after the drive is turned off, then you can save the parameters to the nonvolatile memory with **Save To Drive**.

Button or Dialog Box	Description
Save To File	Copies all the drive parameters and creates a file.
Load From Drive	Sets all the drive parameters within the drive to the values contained within the file you select.
Save to Drive	Saves all drive parameters into the nonvolatile memory of the drive. Each time the drive powers on, it will start with these saved parameters.
Default	Returns all the drive parameters back to their default values. Any changes you have made are lost.

18.5 Parameter Comparer

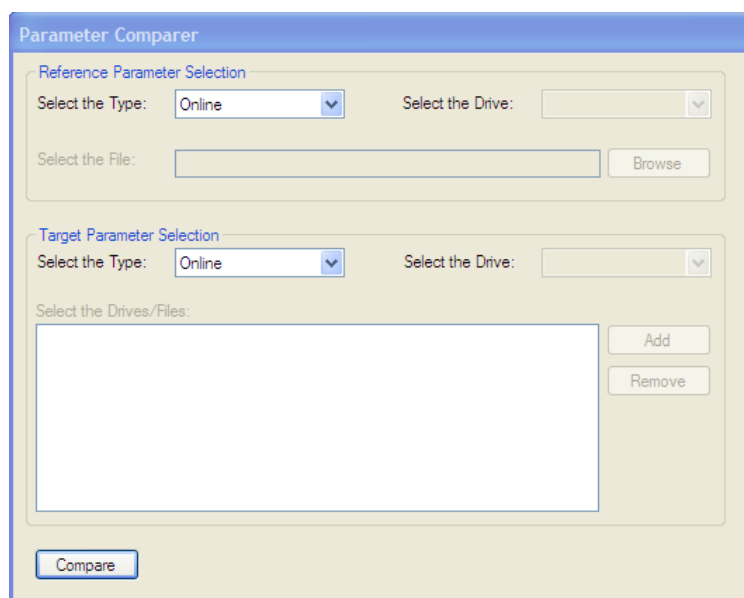
The **Parameter Comparer** tool is used to compare parameters from different drives. You can select this tool from the menu bar, **Tools> Parameter Comparer**.

Parameters can be compared between the following:

- Drives (Online / Offline)
- Drives and Files
- File and Drives
- File and Files

The **Parameter Comparer** screen includes the three sections shown below:

- Reference Parameter Selection
- Target Parameter Selection
- Display Comparison



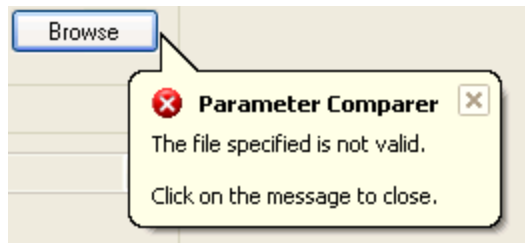
18.5.1 Reference Parameter Selection

You can select the drive type (Online/Offline) and file to compare in the Reference Parameter Selection area.

When a drive type (Online/Offline) is selected, the drives connected to the WorkBench are displayed in the **Select the drive** box. By default, the first drive is selected. If no drives are connected, then the **Select the drive** box will be in disabled state.

If **File Selection** is chosen from the **Select the Type** box, then the Select the drive box is disabled and the **Select the File** box and **Browse** button become enabled for the user to browse the parameter file (*.KC1).

A warning message is displayed if you select an incorrect file, as shown below:

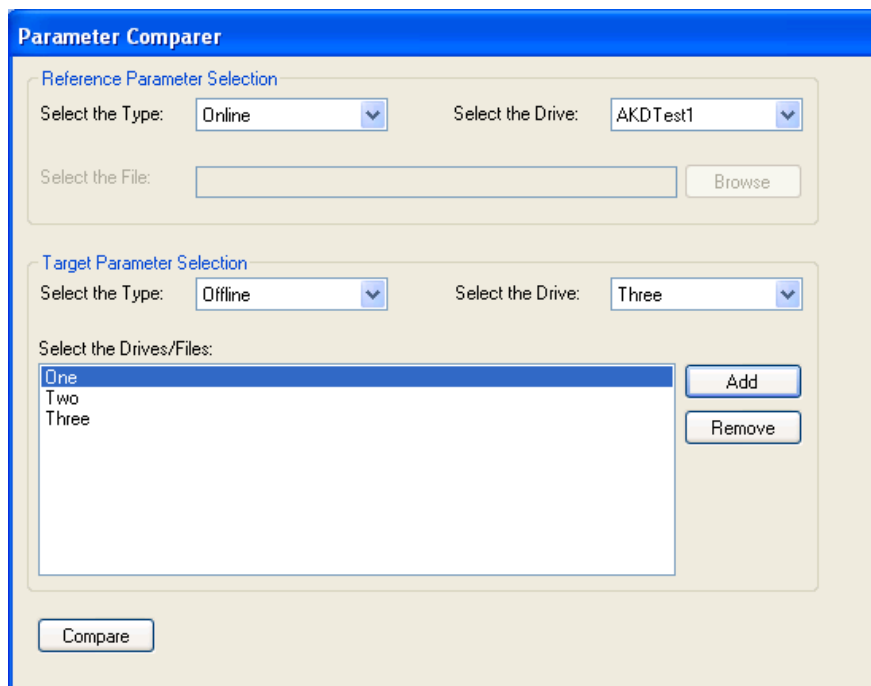


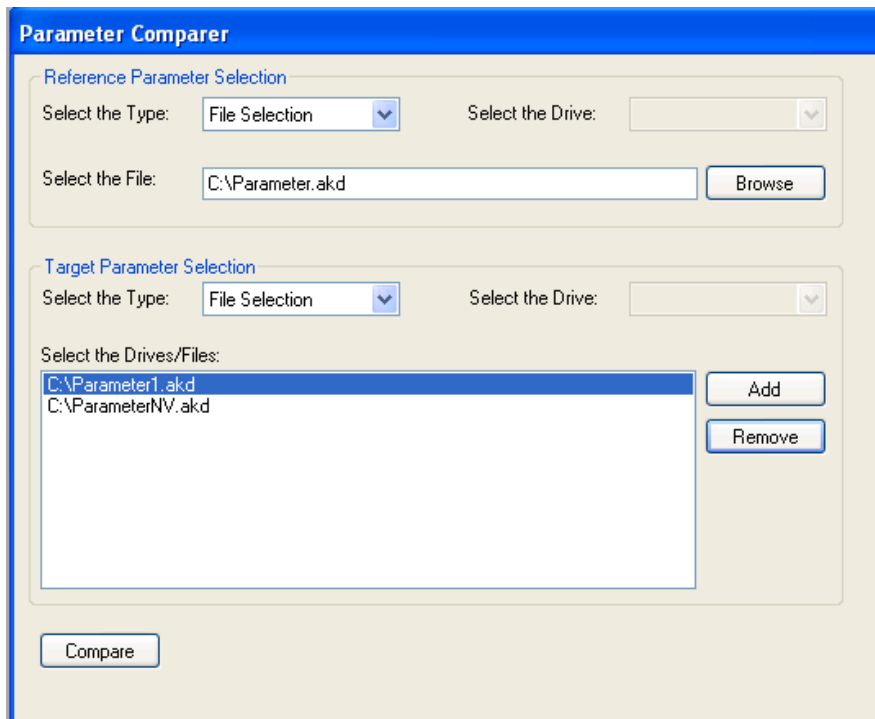
18.5.2 Target Parameter Selection

Target Parameter Selection includes the following:

- Select the Type box to select the type (drive (online/offline) and File).
- **Select the Drive** box to select the drives connected to the WorkBench.
- **Select the Drives/Files** box to load files or drives which are to be compared.
- **Add** button to add Drives/Files selected to the list box.
- **Remove** button to remove the selected item from the list box.

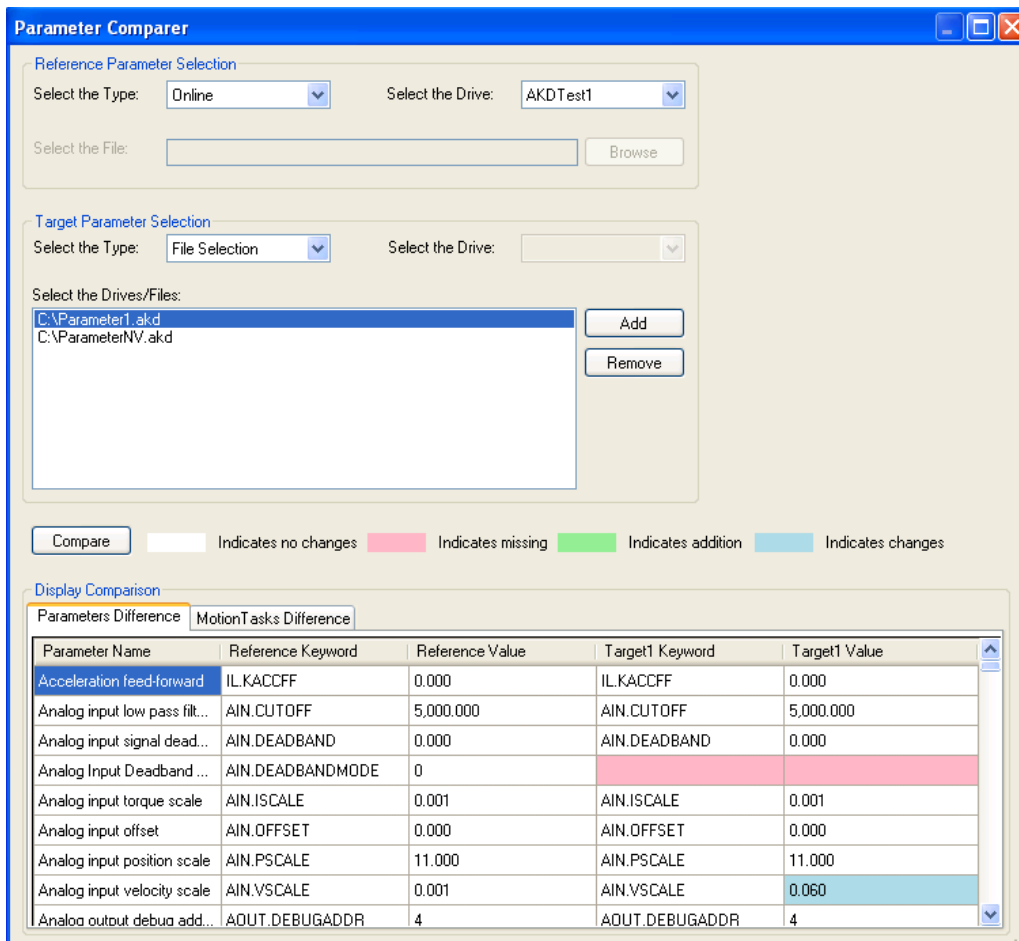
Many target drives/files parameters can be compared with one reference drive/file parameters as shown below.





18.5.3 Display the comparison

Clicking **Compare** displays the comparison shown below:



Display Comparison contains the Parameter Difference section which displays:

- Parameter name
- Reference keyword
- Reference value
- Target keyword
- Target value

	Keyword exists in the reference file /drive and does not exist in the Target files/drives.
	Parameter does not exist in reference file/drive and exists in Target files/drives.
	Keyword exists in both reference and target files/drives, and the value or the parameter keyword changes.
	Reference and target parameter do not vary.

18.6 Summary of Parameters and Commands

This table contains an alphabetical list of parameters and commands, with a brief description for each. The parameter name and description are linked to the parameter tables. Generally speaking, all parameters and commands are active in all opmodes, with the following exceptions:

Parameter or Command	Active in Opmodes
GEAR (all parameters and commands)	2 (position) only
HOME (all parameters and commands)	2 (position) only
MT (all parameters and commands)	2 (position) only
SM.I1, SM.I2	0 (torque) only
SM.V1, SM.V2	1 (velocity) only
SM.VPM1, SM.VPM2	2 (position) only
VL (all parameters and commands)	1 (velocity) and 2 (position) only

Parameter or Command	Type	Description
Analog Input (AIN)		
AIN.CUTOFF (pg 276)	NV	Sets the analog input low-pass filter cutoff frequency.
AIN.DEADBAND (pg 277)	NV	Sets the analog input signal deadband.
AIN.DEADBANDMODE (pg 279)	NV	Sets the analog input deadband mode.
AIN.ISCALE (pg 281)	NV	Sets the analog current scale factor.
AIN.MODE (pg 282)	NV	Analog input mode
AIN.OFFSET (pg 283)	NV	Sets the analog input offset.
AIN.PSCALE (pg 284)	NV	Sets the analog position scale factor.
AIN.VALUE (pg 285)	R/O	Reads the value of the analog input signal.
AIN.VSCALE (pg 286)	NV	Sets analog velocity scale factor.
AIN.ZERO (pg 287)	Command	Zeroes the analog input signal.
Analog Input 2 (AIN2)		
AIN2.CUTOFF (pg 1)	NV	Sets the analog input 2 low-pass filter cutoff frequency.
AIN2.DEADBAND (pg 1)	NV	Sets the analog input 2 signal deadband.
AIN2.DEADBANDMODE	NV	Sets the analog input 2 deadband mode.
AIN2.MODE	NV	Analog input 2 mode.
AIN2.OFFSET	NV	Sets the analog input 2 offset.
AIN2.VALUE	R/O	Reads the value of the analog input 2 signal.
AIN2.ZERO	Command	Zeroes the analog input 2 signal.

Parameter or Command	Type	Description
Analog Input/Output (AIO)		
AIO.ISCALE (pg 289)	NV	Sets the analog current scale factor.
AIO.VSCALE (pg 291)	NV	Sets velocity scale factor.
AIO.PSCALE (pg 290)	NV	Sets position scale factor.
Analog Output (AOUT)		
AOUT.CUTOFF (pg 293)	NV	Sets the analog output low-pass filter cutoff frequency.
AOUT.ISCALE (pg 294)	NV	Sets the analog current scale factor.
AOUT.MODE (pg 295)	NV	Sets the analog output mode.
AOUT.OFFSET (pg 296)	NV	Sets the analog output offset.
AOUT.PSCALE (pg 297)	NV	Sets the analog position scale factor.
AOUT.VALUE (pg 298)	NV	Reads the analog output value.
AOUT.VALUEU (pg 299)	R/W	Sets the analog output value.
AOUT.VSCALE (pg 300)	NV	Sets the velocity scale factor for analog output.
Analog Output 2 (AOUT2)		
AOUT2.CUTOFF (pg 1)	NV	Sets the analog output 2 low-pass filter cutoff frequency.
AOUT2.MODE	NV	Sets the analog output 2 mode.
AOUT2.OFFSET	NV	Sets the analog output 2 offset.
AOUT2.VALUE	NV	Reads the analog output 2 value.
AOUT2.VALUEU	R/W	Sets the analog output 2 value.
Bode plot (BODE)		
BODE.EXCITEGAP (pg 302)	R/W	Controls how often the excitation is updated.
BODE.FREQ (pg 303)	R/W	Sets the frequency of the sine excitation source.
BODE.IAMP (pg 304)	R/W	Sets current command value used during the Bode procedure.
BODE.IFLIMIT (pg 305)	R/W	Sets the current fault duration limit in seconds for the BODE.MODE 5 stability test.
BODE.IFTHRESH (pg 306)	R/W	Sets the current fault threshold for the BODE.MODE 5 stability test.
BODE.INJECTPOINT (pg 307)	R/W	Sets whether the excitation uses current or velocity excitation type.
BODE.MODE (pg 308)	R/W	Sets the mode of the excitation.
BODE.MODETIMER (pg 311)	R/W	Sets the watchdog timer of the excitation.
BODE.PRBDDEPTH (pg 313)	R/W	Sets the length of the PRB signal before it repeats.
BODE.VAMP (pg 314)	R/W	Sets the amplitude of the excitation when in velocity mode.
BODE.VFLIMIT (pg 315)	R/W	Sets the velocity fault duration limit (seconds) for the BODE.MODE 5 stability test
BODE.VFTHRESH (pg 316)	R/W	Sets the current fault threshold for the BODE.MODE 5 stability test.
Capture (CAP)		
CAP0.EDGE, CAP1.EDGE (pg 318)	NV	Selects the capture edge.
CAP0.EN, CAP1.EN (pg 319)	NV	Enables or disables the related capture engine.

Parameter or Command	Type	Description
CAP0.EVENT, CAP1.EVENT (pg 320)	NV	Controls the precondition logic.
CAP0.FILTER, CAP1.FILTER (pg 322)	R/W	Controls the precondition logic.
CAP0.MODE, CAP1.MODE (pg 323)	NV	Selects the captured value.
CAP0.PLFB, CAP1.PLFB (pg 324)	R/O	Reads captured position value.
CAP0.PREEDGE, CAP1.PREEDGE (pg 325)	NV	Selects the capture precondition edge.
CAP0.PREFILTER, CAP1.PREFILTER	NV	Sets the filter for the precondition input source.
CAP0.PRESELECT, CAP1.PRESELECT (pg 326)	NV	Sets the precondition trigger.
CAP0.STATE, CAP1.STATE (pg 327)	R/O	Indicates whether or not trigger source was captured.
CAP0.T, CAP1.T (pg 328)	R/O	Reads time capture (if time capture was configured).
CAP0.TRIGGER, CAP1.TRIGGER (pg 329)	NV	Specifies the trigger source for the position capture.
Central Power Supply (CPS)		
CPS.STOSTATE (pg 331)	R/O	Returns the status of the safe torque signal for each of a CPS device's strings.
Controlled Stop (CS)		
CS.DEC (pg 333)	NV	Sets the deceleration value for the controlled stop process.
CS.STATE (pg 334)	NV	Returns the internal status of the controlled stop process.
CS.TO (pg 335)	NV	Sets the time value for the drive velocity to be within CS.VTHRESH (pg 336).
CS.VTHRESH (pg 336)	NV	Sets the velocity threshold for the controlled stop.
Digital Input (DIN)		
DIN.HCMD1 TO DIN.HCMD4 (pg 338)	NV	A buffer of commands to be used in digital input "command buffer" mode.
DIN.LCMD1 to DIN.LCMD4 (pg 339)	NV	A buffer of commands to be used in digital input "command buffer" mode.
DIN.ROTARY (PG 340)	R/O	Reads the rotary knob value.
DIN.STATES (PG 341)	R/O	Reads the digital input states.
DIN1.FILTER TO DIN7.FILTER (pg 342)	R/W	Filter mode for digital inputs 1 to 7.
DIO9.INV to DIO11.INV (pg 351)	R/W	Inverting the output voltage of the IO, when in the output direction.
DIN1.MODE TO DIN24.MODE (pg 344)	NV	Sets the digital input modes.
DIN1.PARAM TO DIN7.PARAM (pg 346)	R/W	Sets a value used as an extra parameter for digital inputs nodes.
DIN1.STATE TO DIN7.STATE (pg 348)	R/O	Reads a specific digital input state.

Parameter or Command	Type	Description
DIN21.FILTER to DIN31.FILTER (pg 1)	R/W	Filter mode for digital inputs 21 to 32.
DIN21.STATE to DIN31.STATE	R/O	Reads a specific digital input state.
DIO		
DIO9.INV to DIO11.INV (pg 351)	NV	Inverting the output voltage of the IO, when in the output direc- tion.
DIO9.DIR to DIO11.DIR (pg 352)	NV	Changing direction of the IOs from the X9 connector.
Digital Output (DOUT)		
DOUT.RELAYMODE (pg 354)	R/W	Indicates faults relay mode.
DOUT.STATES (PG 355)	R/O	Reads the state of the two digital outputs.
DOUT1.MODE to DOUT19.MODE (pg 356)	NV	Sets the digital output mode.
DOUT1.PARAM AND DOUT2.PARAM (pg 357)	NV	Sets extra parameters for the digital outputs.
DOUT1.STATE AND DOUT2.STATE (pg 358)	R/O	Reads the digital output state.
DOUT1.STATEU AND DOUT2.STATEU (pg 359)	R/W	Sets the state of the digital output node.
DOUT21.STATE to DOUT31.STATE (pg 1)	R/O	Reads the digital output state.
DOUT21.STATEU to DOUT31.STATEU (pg 1)	R/W	Sets the state of the digital output node.
Drive (DRV)		
DRV.ACC (PG 364)	NV	Describes the acceleration ramp for the velocity loop.
DRV.ACTIVE (PG 365)	R/O	Reads the enable status of an axis.
DRV.BLINKDISPLAY (PG 366)	Command	Causes the display to blink for 10 seconds.
DRV.BOOTTIME (pg 367)	R/O	Returns the time when the current session booted up.
DRV.CLRFAULHIST (PG 368)	Command	Clears the fault history log in the NV.
DRV.CLRFAULTS (PG 369)	Command	Tries to clear all active faults in the drive.
DRV.CMDDELAY (pg 370)	R/W	Issues a delay before next command is executed.
DRV.CMDSOURCE (PG 371)	NV	Sets the command source (service, fieldbus, analog input, gear- ing, digital, or Bode).
DRV.CRASHDUMP (pg 372)	Command	Retrieves diagnostic information after the drive crashes.
DRV.DBILIMIT (pg 373)	NV	Sets the maximum amplitude of the current for dynamic braking.
DRV.DEC (PG 374)	NV	Sets the deceleration value for the velocity loop.
DRV.DIFVAR (pg 375)	R/O	Lists all parameters which differ from their default value.
DRV.DIR (pg 376)	R/W	Changes drive direction.
DRV.DIS (PG 377)	Command	Disables the axis (software).
DRV.DISMODE (pg 378)	NV	Selects among disable immediately or stop and then disable options.

Parameter or Command	Type	Description
DRV.DISSOURCES (PG 379)	R/O	Returns the possible reason for a drive disable.
DRV.DISSOURCESMASK (pg 380)	R/O	Returns a bitmap of all bits in DRV.DISSOURCES that can be set to one on a given drive.
DRV.DISTO (pg 381)	R/W	Sets the emergency timeout
DRV.EMUJEDIR (pg 383)	R/W	Sets the direction of the emulated encoder output (EEO) signal.
DRV.EMUJEMODE (pg 384)	R/W	Sets the mode of the emulated encoder output (EEO) connector.
DRV.EMUJEMTURN (pg 386)	R/W	Defines the location of the index pulse on the EEO (emulated encoder output) when DRV.EMUJEMODE=2.
DRV.EMUJEPULSEWIDTH (pg 387)		Sets the encoder output pulse width for modes 6 to 7.
DRV.EMUJERES (pg 388)	R/W	Sets the resolution of the EEO (emulated encoder output).
DRV.EMUJEZOFFSET (pg 389)	R/W	Sets the location of the EEO (emulated encoder output) index pulse (when DRV.EMUJEMODE=1).
DRV.EN (PG 390)	Command	Enables the axis (software).
DRV.ENDEFAULT (pg 391)	R/W	Sets the default state of the software enable.
DRV.FAULTLIST (PG 392)	R/O	Reads the last 10 faults from NV memory.
DRV.FAULTS (PG 394)	R/O	Reads the active faults.
DRV.FAULT1 to DRV.FAULT10 (pg 393)	R/O	Location of fault codes for any active fault conditions.
DRV.HANDWHEEL (pg 395)	R/O	Reads the EEO input value.
DRV.HANDWHEELSRC (pg 396)	NV	Selects the feedback for handwheel operation.
DRV.HELP (PG 397)	R/O	Reads the minimum, maximum, and default values for a specific parameter or command.
DRV.HELPALL (pg 398)	R/O	Retrieves the minimum, maximum, default, and actual values for all available parameters and commands.
DRV.HWENABLE (pg 399)	R/O	Status of the hardware enable.
DRV.HWENDELAY (pg 400)	NV	Delay time between inactive Hardware Enable input and drive disable.
DRV.HWENMODE (pg 401)	R/W	Selects the action that the hardware enable digital input will perform.
DRV.ICONT (PG 402)	R/O	Reads the continuous rated current value.
DRV.INFO (PG 403)	R/O	Reads general information about the drive.
DRV.IPEAK (PG 405)	R/O	Reads the peak rated current value.
DRV.IZERO (pg 406)	R/W	Sets the current that will be used during the DRV.ZERO procedure.
DRV.LIST (PG 407)	R/O	Reads the list of available parameters and commands.
DRV.LOGICVOLTS (pg 408)	R/O	Reads the logic voltages.
DRV.NAME (PG 412)	NV	Sets and reads the name of the drive.
DRV.NVCHECK (pg 413)	R/O	NV Parameter Checksum
DRV.NVLIST (PG 414)	R/O	Lists the NV parameters and values from the RAM.

Parameter or Command	Type	Description
DRV.NVLOAD (pg 415)	W/O	Loads all data from the NV memory of the drive into the RAM parameters.
DRV.NVSAVE (PG 416)	Command	Saves the drive parameters from the RAM to the NV memory.
DRV.ONTIME (pg 417)	R/O	Returns how long the drive has been running since last power up.
DRV.OPMODE (PG 418)	NV	Sets the drive operation mode (current, velocity, or position).
DRV.READFORMAT (PG 419)	R/W	Sets the value returned to either decimal or hexadecimal.
DRV.RSTVAR (PG 420)	Command	Sets default values in the drive without re-booting the drive and without resetting the NV memory.
DRV.RUNTIME (PG 421)	R/O	Returns how long the drive has been running since first activated.
DRV.SETUPREQBITS (pg 422)	R/O	Reads the bitwise set status of parameters that must be set before the drive can be enabled.
DRV.SETUPREQLIST (pg 423)	R/O	Reads the list of parameters that must be set before the drive can be enabled.
DRV.STOP (PG 424)	Command	This command stops all drive motion.
DRV.TEMPERATURES (pg 425)	R/O	Reads the temperature of drive components.
DRV.TIME (pg 426)	R/W	A continuous time counter in the drive.
DRV.TYPE (pg 427)	R/O	Selects the operational fieldbus on CC drive models.
DRV.VER (PG 428)	R/O	Reads the drive version.
DRV.VERIMAGE (PG 429)	R/O	Returns the version data from each image.
DRV.WARNINGS (pg 431)	R/O	Reads the active warnings.
DRV.WARNING1 to DRV.WARNING10 (pg 430)	R/O	Location of fault codes for any active warning conditions.
DRV.ZERO (pg 432)	R/W	Sets the zero mode. The procedure is activated when the drive is enabled.
EtherNet/IP (EIP)		
EIP.CONNECTED (pg 1)	R/O	Returns state of EtherNet/IP connection.
EIP.POSUNIT	R/W	Unit scaling for Position values over EtherNet/IP.
EIP.PROFUNIT	R/W	Unit scaling for Velocity and Acceleration values over EtherNet/IP.
Fault (FAULT)		
FAULTx.ACTION (pg 434)	R/W	Gets/Sets the Fault Action for Fault 130, 131, 132, 134, 139, 451, and 702.
Feedback 1 (FB1)		
FB1.BISSBITS (pg 436)	NV	Specifies the number of Biss Sensor (Position) Bits for the BiSS Mode C encoder in use.
FB1.ENCRES (PG 437)	NV	Sets the resolution of the motor encoder.
FB1.HALLSTATE (PG 438)	R/O	Reads the Hall switch values (encoder feedback
FB1.HALLSTATEU (pg 439)	R/O	Reads the state of Hall switch U.
FB1.HALLSTATEV (pg 440)	R/O	Reads the state of Hall switch V.

Parameter or Command	Type	Description
FB1.HALLSTATEW (pg 441)	R/O	Reads the state of Hall switch W.
FB1.IDENTIFIED (PG 442)	R/O	Reads the type of feedback device used by the drive/motor.
FB1.INITSIGNED (pg 443)	NV	Sets initial feedback value as signed or unsigned.
FB1.MECHPOS (PG 444)	R/O	Reads the mechanical position.
FB1.MEMVER (PG 445)	R/O	Returns the memory feedback version.
FB1.OFFSET (pg 446)	NV	Sets position feedback offset.
FB1.ORIGIN (pg 447)	NV	Adds to the initial feedback position.
FB1.P (pg 449)	R/O	Reads position from the primary feedback.
FB1.PDIR (pg 450)	NV	Sets the counting direction for feedback channel 1.
FB1.PFIND (pg 451)	R/W	A procedure that allows the user to find the commutation angle for encoder feedback, which has no halls.
FB1.PFINDCMDU (pg 452)	R/W	Current value used during the phase finding procedure (PFB.PFIND=1)
FB1.POFFSET (pg 453)	NV	Sets the offset for primary feedback.
FB1.POLES (PG 454)	R/O	Reads the number of feedback poles.
FB1.PSCALE (pg 455)	R/W	Sets position scaling value for fieldbus transferred position objects.
FB1.PUNIT (pg 456)	NV	Sets the unit for FB1.P.
FB1.RESKTR (pg 457)	NV	Sets the resolver nominal transformation ratio.
FB1.RESREFPHASE (pg 458)	NV	Sets the electrical degrees of phase lag in the resolver.
FB1.SELECT (PG 459)	NV	Sets user entered type or identified type (-1).
FB1.TRACKINGCAL (pg 461)	NV	Controls tracking calibration algorithm.
FB1.USERBYTE0 to FB1.USERBYTE7 (pg 462)	R/W	Reads and writes data stored in two 32 bit words in the Endat feedback device.
FB1.USERDWORD0 to FB1.USERWORD1 (pg 463)	R/W	Reads and writes data stored in two 32 bit words in the Endat feedback device.
FB1.USERWORD1 to FB1.USERWORD3 (pg 464)	R/W	Reads and writes data stored in two 32 bit words in the Endat feedback device.
Feedback 2 (FB2)		
FB2.ENCRESP (pg 466)	NV	Sets the secondary feedback (FB2) resolution
FB2.MODE (pg 467)	R/W	Sets the mode for the second feedback inputs, EEO connector (X9) and high speed opto inputs (pins 9 and 10 on X7).
FB2.P (pg 468)	R/O	Reads position from the secondary feedback.
FB2.DIR (pg 469)	R/W	Sets the counting direction for feedback channel 2.
FB2.POFFSET (pg 470)	NV	Sets the offset for secondary feedback.
FB2.PUNIT (pg 471)	NV	Sets the unit for FB2.P.
FB2.SOURCE (pg 472)	R/W	Sets the source for the second feedback input. Choices are the EEO connectors (X9) which are RS485 inputs, or the X7 connector's high speed opto inputs (pins 9 and 10).
Feedback 3 (FB3)		
FB3.MODE (pg 474)	NV	Selects the type of feedback connected to X9.

Parameter or Command	Type	Description
FB3.P (pg 475)	RO	Reads position from the tertiary feedback.
FB3.PDIR (pg 476)	NV	Sets the counting direction for feedback channel 3.
FB3.POFFSET (pg 477)	NV	Sets the offset for tertiary feedback.
FB3.PUNIT (pg 478)	NV	Sets the unit for FB3.P.
Fieldbus (FBUS)		
FBUS.PARAM1 TO FBUS.PARAM20	NV	Set fieldbus specific meanings.
FBUS.PLLSTATE	R/O	Returns the status of the PLL.
FBUS.PLLTHRESH	NV	Sets number of successful synchronized cycles needed to lock the PLL.
FBUS.PROTECTION (pg 1)	R/W	Controls which parameters are blocked when accessed from telnet while a fieldbus is operational
FBUS.SAMPLEPERIOD	NV	Sets fieldbus sample period.
FBUS.STATE (pg 1)	R/O	Reads the state of the fieldbus.
FBUS.SYNCACT	R/O	Reads actual distance from the desired sync distance.
FBUS.SYNCDIST	NV	Sets time target for synchronization.
FBUS.SYNCWND	NV	Sets symmetrically arranged window around the desired sync distance.
FBUS.TYPE	R/O	Shows the active fieldbus type.
Gearing (GEAR)		
GEAR.ACCMAX (pg 480)	R/W	Sets the maximum allowed acceleration value; active in opmode 2 (position) only.
GEAR.DECMAX (pg 481)	R/W	Sets the maximum allowed deceleration value; active in opmode 2 (position) only.
GEAR.IN (pg 482)	R/W	Sets the denominator of the electronic gearing ratio; active in opmode 2 (position) only.
GEAR.MODE (pg 483)	R/W	Selects electronic gearing mode; active in opmode 2 (position) only.
GEAR.MOVE (pg 485)	Command	Starts the electronic gearing; active in opmode 2 (position) only.
GEAR.OUT (pg 486)	R/W	Sets the numerator of the electronic gearing ratio; active in opmode 2 (position) only.
GEAR.VMAX (pg 487)	R/W	Reads the maximum allowed velocity value; active in opmode 2 (position) only.
Homing (HOME)		
HOME.ACC (pg 501)	R/W	Sets homing acceleration; active in opmode 2 (position) only.
HOME.AUTOMOVE (pg 502)	R/W	Sets homing auto move flag.
HOME.DEC (pg 503)	R/W	Sets homing deceleration; active in opmode 2 (position) only.
HOME.DIR (pg 504)	NV	Sets homing direction; active in opmode 2 (position) only.
HOME.DIST (pg 505)	R/W	Sets homing distance; active in opmode 2 (position) only.
HOME.FEEDRATE (pg 506)	R/W	Sets homing velocity factor; active in opmode 2 (position) only.
HOME.IPEAK (pg 507)	R/W	Sets the current limit during homing procedure to a mechanical stop; active in opmode 2 (position) only.
HOME.MODE (pg 508)	R/W	Selects the homing mode; active in opmode 2 (position) only.
HOME.MOVE (pg 509)	Command	Starts a homing procedure; active in opmode 2 (position) only.

Parameter or Command	Type	Description
HOME.P (pg 510)	R/W	Sets home position; active in opmode 2 (position) only.
HOME.PERRTHRESH (pg 511)	R/W	Sets the position lag threshold; active in opmode 2 (position) only.
HOME.REQUIRE (pg 512)	NV	Defines if the axis must be homed before a motion task can be executed.
HOME.SET (pg 513)	Command	Immediately sets the home position; active in opmode 2 (position) only.
HOME.V (pg 514)	R/W	Sets homing velocity; active in opmode 2 (position) only.
Hardware Limit Switch (HWLS)		
HWLS.NEGSTATE (pg 516)	R/O	Reads the status of the negative hardware limit switch.
HWLS.POSSTATE (pg 517)	R/O	Reads the status of the positive hardware limit switch.
Current Loop (IL)		
IL.CMD (PG 520)	R/O	Reads the value of the q-component current command.
IL.CMDACC (pg 521)	R/O	Returns the commanded acceleration from the trajectory generator.
IL.CMDU (PG 522)	R/W	Sets the user current command.
IL.DIFOLD (PG 523)	R/O	Reads the drive foldback current limit.
IL.FB (PG 524)	R/O	Reads the actual value of the d-component current.
IL.FBSOURCE (pg 525)	R/W	Sets the feedback source for the current loop. Only applies when MOTOR.TYPE = 4.
IL.FF (pg 526)	R/O	Displays the current loop overall feedforward value.
IL.FOLDFTHRESH (PG 527)	NV	Reads the foldback fault level.
IL.FOLDFTHRESHU (pg 528)	NV	Sets the user value for the foldback fault level.
IL.FOLDWTHRESH (PG 529)	NV	Sets the foldback warning level.
IL.IFOLD (pg 531)	R/O	Reads the overall foldback current limit.
IL.IUFB (PG 532)	R/O	Reads the sigma-delta measured current in the u-winding of the motor.
IL.KACFF (pg 534)	R/W	Sets current loop acceleration feedforward gain value
IL.KBUSFF (pg 535)	R/W	Current loops fieldbus injected feed-forward gain
IL.KP (PG 536)	NV	Sets the proportional gain of the q-component of the PI regulator.
IL.KPDRATIO (PG 537)	NV	Sets the proportional gain of the d-component current PI-regulator as a percentage of IL.KP
IL.KPLOOKUPINDEX (pg 538)	R/W	Sets the index into the Current Loop Gain Scheduling Table.
IL.KPLOOKUPVALUE (pg 539)	R/W	Sets the value of the current loop gain scheduling index.
IL.KPLOOKUPVALUES (pg 540)	R/W	Gets the Current Loop Gain Scheduling Table.
IL.KVFF (pg 541)	R/W	Current loop velocity feed-forward gain.
IL.LIMITN (PG 542)	NV	Sets the negative user (application-specific) current limit.

Parameter or Command	Type	Description
IL.LIMITP (PG 543)	NV	Sets the positive user (application-specific) current limit.
IL.MFOLDD (PG 544)	NV	Sets the motor foldback maximum time at motor peak current.
IL.MFOLDR (PG 545)	R/O	Sets the motor foldback recovery time.
IL.MFOLDT (PG 546)	NV	Sets the motor foldback time constant of the exponential current drop (foldback).
IL.MI2T (pg 547)	R/O	Motor I2t load.
IL.MI2TWITHRESH (pg 548)	NV	Motor I2t load warning threshold.
IL.MIFOLD (PG 549)	R/O	Sets the motor foldback current limit.
IL.MIMODE (pg 550)	NV	Motor protection mode.
IL.OFFSET (pg 551)	RW	A constant current command added to compensate for gravity.
IL.VCMD (PG 552)	R/O	Sets the output of the q-component PI regulator.
IL.VUFB (PG 553)	R/O	Reads the measured voltage on the u-winding of the motor.
IL.VVFB (PG 554)	R/O	Reads the measured voltage on the v-winding of the motor.
IP (Internet Protocol) Parameters		
IP.ADDRESS (pg 556)	NV	Gets/Sets the IP address of the drive.
IP.GATEWAY (pg 557)	NV	Gets/Sets the gateway IP of the drive.
IP.MODE (pg 558)	NV	Sets method of acquiring IP Address.
IP.RESET (pg 559)	Command	Implements new IP settings..
IP.SUBNET (pg 560)	NV	Gets/Sets the IP Subnet mask of the drive.
LOAD Parameters		
LOAD.INERTIA (pg 562)	NV	Sets the load inertia.
MODBUS Parameters		
MODBUS.PIN	R/W	Gets / Sets the Modbus User Units Input parameter
MODBUS.POUT	R/W	Gets / Sets the Modbus User Units Output parameter.
MODBUS.PSCALE	R/W	Gets/Sets the Feedback Resolution (per rev) over Modbus.
MODBUS.SCALING	NV	Selects the scaling mode for Modbus values.
MODBUS.UNITLABEL	R/W	Labels the scaled resolution of a single motor turn.
Parameter or Command	Type	Description
Motor Parameters		
MOTOR.AUTOSET (pg 564)	NV	Determines which drive parameters are calculated automatically.
MOTOR.BRAKE (PG 565)	NV	Sets the presence or absence of a motor brake.
MOTOR.BRAKEIMM (pg 566)	NV	Brake Immediately: in the case of a drive disable, apply the brake in all situations.
MOTOR.BRAKERLS (pg 567)	Command	Allows a user to release or apply the motor brake.
MOTOR.BRAKESTATE (pg 568)	R/O	Reads the actual status of the motor brake.
MOTOR.CTF0 (pg 569)	NV	Sets the thermal constant of the motor coil.
MOTOR.ICONT (PG 570)	NV	Sets the motor continuous current.
MOTOR.IDDATAVALID (pg 571)	R/O	Reports the status of the motor memory.
MOTOR.IMID (pg 572)	R/W	The direct-axis current set point used for induction machine closed-loop control.

Parameter or Command	Type	Description
MOTOR.IMTR (pg 573)	R/W	Rotor time constant.
MOTOR.INERTIA (PG 574)	NV	Sets the motor inertia.
MOTOR.IPEAK (PG 575)	NV	Sets the motor peak current.
MOTOR.KE (pg 576)		Sets the motor back EMF constant.
MOTOR.KT (PG 577)	NV	Sets the torque constant of the motor.
MOTOR.LQLL (PG 578)	NV	Sets the line-to-line motor Lq.
MOTOR.NAME (PG 579)	NV	Sets the motor name.
MOTOR.PHASE (PG 580)	NV	Sets the motor phase.
MOTOR.PITCH (PG 581)	NV	Sets the motor pitch.
MOTOR.POLES (PG 582)	NV	Sets the number of motor poles.
MOTOR.R (PG 583)	NV	Sets the stator winding resistance phase-phase in ohms.
MOTOR.RTYPE (pg 584)	NV	Defines the type of thermal resistor inside the motor.
MOTOR.TBRAKEAPP (PG 585)	NV	The delay time used for applying the motor brake.
MOTOR.TBRAKERLS (PG 586)	NV	The delay time used for releasing the motor brake.
MOTOR.TBRAKETO (pg 587)	NV	Brake apply timeout for vertical axis.
MOTOR.TEMP (pg 588)	R/O	Reads the motor temperature represented as the resistance of the motor PTC or NTC.
MOTOR.TEMPFAULT (pg 589)	NV	Sets the motor temperature fault level.
MOTOR.TEMPWARN (pg 590)	NV	Sets the motor temperature warning level.
MOTOR.TYPE (PG 591)	NV	Sets the motor type.
MOTOR.VMAX (PG 593)	NV	Sets the maximum motor speed.
MOTOR.VOLTMAX (PG 594)	NV	Sets the motor maximum voltage.
MOTOR.VOLTMIN (pg 595)	NV	Sets the minimum voltage for V/f control.
MOTOR.VOLTRATED (pg 596)	NV	Sets the motor rated voltage.
MOTOR.VRATED (pg 597)	NV	Sets the motor rated velocity (not maximum velocity).
Position Loop (PL)		
PL.CMD (PG 599)	NV	Reads the position command directly from the entry to the position loop.
PL.ERR (PG 600)	NV	Reads the position error present when the drive is controlling the position loop.
PL.ERRFTHRESH (pg 601)	NV	Sets the maximum position error.
PL.ERRMODE (pg 603)	R/W	Sets the type of following error warning and fault usage.
PL.ERRWTHRESH (pg 604)	NV	Sets the position error warning level.
PL.FB (PG 605)	R/O	Reads the position feedback value.
PL.FBSOURCE (pg 606)	NV	Sets the feedback source for the position loop.
PL.FILTERTIME (pg 607)	R/W	Sets the position command filter period.
PL.INTINMAX (PG 608)	NV	Limits the input of the position loop integrator by setting the input saturation.

Parameter or Command	Type	Description
PL.INTOUTMAX (PG 609)	NV	Limits the output of the position loop integrator by setting the output saturation.
PL.KI (PG 610)	NV	Sets the integral gain of the position loop.
PL.KP (PG 611)	NV	Sets the proportional gain of the position regulator PID loop.
PL.MODP1 (pg 612)	R/W	Sets modulo range parameter.
PL.MODP2 (pg 613)	R/W	Sets the beginning or end modulo range parameter.
PL.MODPDIR (pg 614)	R/W	Sets the direction for absolute motion tasks.
PL.MODPEN (pg 615)	R/W	Enables the modulo position.
Programmable Limit Switch (PLS)		
PLS.EN (pg 617)	R/W	Enables programmable limit switch (PLS).
PLS.MODE (pg 618)	NV	Selects programmable limit switch mode.
PLS.P1 TO PLS.P8 (pg 619)	NV	Sets the trigger point for programmable limit switches.
PLS.RESET (pg 620)	W/O	Resets programmable limit switch.
PLS.STATE (pg 621)	R/O	Reads the programmable limit switch state.
PLS.T1 TO PLS.T8 (pg 622)	R/W	Sets programmable limit switch time.
PLS.UNITS (pg 623)	R/W	Sets programmable limit switch (PLS) units.
PLS.WIDTH1 TO PLS.WIDTH8 (pg 625)	R/W	Programmable Limit Switch Width
Recorder (REC)		
REC.ACTIVE (PG 627)	R/O	Indicates if data recording is in progress (active).
REC.CH1 to REC.CH6 (pg 628)	R/W	Sets recording channels 1 to 6.
REC.DONE (PG 629)	R/O	Checks whether or not the recorder has finished recording.
REC.GAP (PG 630)	R/W	Specifies the gap between consecutive samples.
REC.NUMPOINTS (PG 631)	R/W	Sets the number of points to record.
REC.OFF (PG 632)	R/W	Turns the recorder OFF.
REC.RECPRMLIST (pg 633)	R/O	Reads the list of recordable parameters.
REC.RETRIEVE (PG 634)	R/O	Transfers all the recorded data to the communication channel.
REC.RETRIEVEDATA (pg 635)	R/W	Retrieves the recorded data without the header.
REC.RETRIEVEFRMT (pg 636)	R/W	Sets the format for recorded data output.
REC.RETRIEVEHDR (pg 637)	R/O	Retrieves the recorded header without the data.
REC.RETRIEVESIZE (pg 638)	R/W	Sets the number of samples that REC.RETRIEVEDATA returns.
REC.STOPTYPE (pg 639)	R/W	Sets the recorder stop type.
REC.TRIG (PG 640)	Command	Triggers the recorder.
REC.TRIGPARAM (pg 641)	R/W	Sets the parameter that triggers the recorder.
REC.TRIGPOS (pg 642)	R/W	Sets the trigger position in the recording buffer.
REC.TRIGPRMLIST (pg 643)	R/O	Reads the list of possible trigger parameters.
REC.TRIGSLOPE (PG 644)	R/W	Sets the trigger slope.

Parameter or Command	Type	Description
REC.TRIGTYPE (PG 645)	R/W	Sets the trigger type.
REC.TRIGVAL (PG 646)	R/W	Sets the trigger value.
Regen Resistor (REGEN)		
REGEN.POWER (PG 648)	R/O	Reads regen resistor's calculated power.
REGEN.POWERFILTERED (pg 649)	R/O	Returns a filtered version of REGEN.POWER .
REGEN.REXT (PG 650)	N/V	Sets the external, user-defined regen resistor resistance.
REGEN.TEXT (pg 651)	R/W	Sets the external regen resistor thermal protection time constant.
REGEN.TYPE (PG 652)	N/V	Sets the regen resistor type.
REGEN.WATTEXT (PG 653)	R/W	Sets the regen resistor's power fault level for an external regen resistor.
SD card (SD)		
SD.LOAD (pg 1)	Command	Loads the drive state (BASIC program and NV parameters) from the SD card to the (s equipped with IO option card only).
SD.SAVE (pg 1)	Command	Saves the drive state (BASIC program and NV parameters) to the SD card (s equipped with IO option card only).
SD.STATUS (pg 1)	R/O	Reads the status of the SD card.
Service Motion (SM)		
SM.I1 (pg 655)	R/W	Sets service motion current 1; active in opmode 0 (torque) only.
SM.I2 (pg 656)	R/W	Sets service motion current 2; active in opmode 0 (torque) only.
SM.MODE (pg 657)	R/W	Sets the service motion mode.
SM.MOVE (pg 660)	Command	Starts the service motion.
SM.T1 (pg 661)	R/W	Sets the service motion time 1.
SM.T2 (pg 662)	R/W	Sets the service motion time 2.
SM.V1 (pg 663)	R/W	Sets service motion velocity 1; active in opmode 1 (velocity) and 2 (position).
SM.V2 (pg 664)	R/W	Sets service motion velocity 2; active in opmode 1 (velocity) and 2 (position).
Safe Torque Off (STO)		
STO.STATE (pg 666)	R/O	Returns the status of the safe torque off.
Software Limit Switch (SWLS)		
SWLS.EN (pg 668)	NV	Enables and disables software travel limit switches.
SWLS.LIMIT0 (pg 669)	NV	Sets the position of the software travel limit switch 0.
SWLS.LIMIT1 (pg 670)	NV	Sets the position of the software travel limit switch 0.
SWLS.STATE (pg 671)	R/O	Reads the actual status of software limit switches.
Temperature (TEMP)		
TEMP.CONTROL (pg 673)	R/O	Reads the temperature of the control board temperature sensor.
TEMP.POWER1 to TEMP.POWER3 (pg 674)	R/O	Reads the temperature of the power board(s) temperature sensor(s).
Units (UNIT)		

Parameter or Command	Type	Description
UNIT.ACCLINEAR (PG 676)	NV	Sets the linear acceleration/deceleration units.
UNIT.ACCROTARY (PG 677)	NV	Sets the rotary acceleration/deceleration units.
UNIT.LABEL (pg 678)	NV	Sets user-defined name for user-defined position units.
UNIT.PIN (PG 679)	NV	Sets gear IN for the unit conversion.
UNIT.PLINEAR (PG 680)	NV	Sets the linear position units.
UNIT.POUT (PG 681)	NV	Sets gear out for the unit conversion.
UNIT.PROTARY (PG 682)	NV	Sets the position units when the motor type (MOTOR.TYPE (pg 591)) is rotary.
UNIT.VLINEAR (PG 683)	NV	Sets the linear velocity units.
UNIT.VROTARY (PG 684)	NV	Sets the velocity units when the motor type (MOTOR.TYPE (pg 591)) is rotary.
Bus Volatage (VBUS)		
VBUS.HALFVOLT (pg 686)	NV	Changing voltage thresholds for HV and MV Drives
VBUS.OVFTHRESH (pg 687)	R/O	Reads the over voltage fault level.
VBUS.OVWTHRESH (pg 688)	N/V	Sets voltage level for over voltage warning.
VBUS.RMSLIMIT (pg 689)	R/O	Reads the limit for the bus capacitors load.
VBUS.UVFTRESH (pg 690)	R/O	Sets the under voltage fault level.
VBUS.UVMODE (pg 691)	NV	Indicates undervoltage (UV) mode.
VBUS.UVWTHRESH (pg 692)	NV	Sets voltage level for undervoltage warning.
VBUS.VALUE (pg 693)	R/O	Reads DC bus voltage.
Velocity Loop (VL)		
VL.ARPF1 TO VL.ARPF4 (pg 695)	R/W	Sets the natural frequency of the pole (denominator) of anti-resonance (AR) filters 1, 2, 3, and 4; active in opmodes 1 (velocity) and 2 (position) only.
VL.ARPQ1 TO VL.ARPQ4 (pg 696)	R/W	Sets the Q of the pole (denominator) of anti-resonance (AR) filter 1; active in opmodes 1 (velocity) and 2 (position) only.
VL.ARTYPE1 TO VL.A-RTYPE4 (pg 697)	NV	Indicates the method used to calculate BiQuad coefficients; active in opmodes 1 (velocity) and 2 (position) only.
VL.ARZF1 TO VL.ARZF4 (pg 698)	R/W	Sets the natural frequency of the zero (numerator) of anti-resonance (AR) filter 1; active in opmodes 1 (velocity) and 2 (position) only.
VL.ARZQ1 TO VL.ARZQ4 (pg 699)	R/W	Sets the Q of the zero (numerator) of anti-resonance filter #1; active in opmodes 1 (velocity) and 2 (position) only.
VL.BUSFF (pg 700)	R/O	Displays the velocity loop feedforward value injected by the field-bus; active in opmodes 1 (velocity) and 2 (position) only.
VL.CMD (PG 701)	R/O	Reads the actual velocity command; active in opmodes 1 (velocity) and 2 (position) only.
VL.CMDU (PG 702)	R/W	Sets the user velocity command; active in opmodes 1 (velocity) and 2 (position) only.
VL.ERR (PG 703)	R/O	Sets the velocity error; active in opmodes 1 (velocity) and 2 (position) only.

Parameter or Command	Type	Description
VL.FB (PG 704)	R/O	Reads the velocity feedback; active in opmodes 1 (velocity) and 2 (position) only.
VL.FBFILTER (pg 705)	R/O	Filters VL.FB (pg 704) value; active in opmodes 1 (velocity) and 2 (position) only.
VL.FBSOURCE (pg 706)	NV	Sets feedback source for the velocity loop; active in opmodes 1 (velocity) and 2 (position) only.
VL.FBUNFILTERED (pg 707)	R/O	Reads the velocity feedback.
VL.FF (pg 708)	R/O	Displays the velocity loop overall feedforward value; active in opmodes 1 (velocity) and 2 (position) only.
VL.GENMODE (PG 709)	NV	Selects mode of velocity generation (Observer, d/dt); active in opmodes 1 (velocity) and 2 (position) only.
VL.KBUSFF (pg 710)	R/W	Sets the velocity loop acceleration feedforward gain value; active in opmodes 1 (velocity) and 2 (position) only.
VL.KI (pg 711)	NV	Sets the velocity loop integral gain for the PI controller; active in opmodes 1 (velocity) and 2 (position) only.
VL.KP (pg 713)	NV	Sets velocity loop proportional gain for the PI controller; active in opmodes 1 (velocity) and 2 (position) only.
VL.KVFF (pg 715)	R/W	Sets the velocity loop velocity feedforward gain value; active in opmodes 1 (velocity) and 2 (position) only.
VL.LIMITN (PG 716)	NV	Sets the velocity lower limit; active in opmodes 1 (velocity) and 2 (position) only.
VL.LIMITP (PG 717)	NV	Sets the velocity high limit; active in opmodes 1 (velocity) and 2 (position) only.
VL.LMJR (pg 717)	R/W	Sets the ratio of the estimated load moment of inertia relative to the motor moment of inertia; active in opmodes 1 (velocity) and 2 (position) only.
VL.MODEL (pg 719)	R/O	Reads the observer velocity signal; active in opmodes 1 (velocity) and 2 (position) only.
VL.OBSBW (pg 720)	NV	Sets the bandwidth of the observer in Hz.
VL.THRESH (PG 721)	NV	Sets the over speed fault value; active in opmodes 1 (velocity) and 2 (position) only.
Wake and Shake (WS)		
WS.ARM (pg 724)	Command	Sets wake and shake to start at the next drive enable.
WS.CHECKMODE (pg 725)	R/W	Select the type of commutation check to execute after Wake and Shake finds a new commutation angle.
WS.CHECKT (pg 726)	R/W	Sets the amount of time a communication error must be present before an error is thrown.
WS.CHECKV (pg 727)	R/W	This parameter sets the velocity threshold which has to be exceeded to activate commutation monitoring.
WS.DISARM (pg 728)	Command	Cancel ARM requests and resets wake and shake to the IDLE state.
WS.DISTMAX (pg 729)	R/W	Sets maximum movement allowed for wake and shake.
WS.DISTMIN (pg 730)	R/W	Sets the minimum movement required for wake and shake.
WS.FREQ (pg 731)	R/W	Sets the sine frequency of excitation for WS.MODE 2.
WS.IMAX (pg 732)	R/W	Sets maximum current used for wake and shake.
WS.MODE (pg 733)	R/W	Sets the method used for wake and shake.

Parameter or Command	Type	Description
WS.NUMLOOPS (pg 734)	R/W	Sets the number of repetitions for wake and shake.
WS.STATE (pg 735)	R/O	Reads wake and shake status.
WS.T (pg 736)	R/W	Sets wake and shake current-vector appliance time.
WS.TDELAY1 (pg 737)	NV	Delay for wake and shake timing.
WS.TDELAY2 (pg 738)	NV	Sets the delay for wake and shake timing.
WS.TDELAY3 (pg 739)	NV	Sets the delay for wake and shake between loops in mode 0.
WS.TIRAMP (pg 740)	R/W	Sets the ramp time for the ramp up current in Wake & Shake mode 1.
WS.TSTANDSTILL (pg 741)	R/W	Sets the calming time of the motor for Wake & Shake mode 1.
WS.VTHRESH (pg 742)	NV	Defines the maximum allowed velocity for Wake & Shake.

19 Faults and Warnings

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19.1 Fault and Warning Messages

When a fault occurs, the drive fault relay is opened, the output stage is switched off (motor loses all torque), or the load is dynamically braked. The specific drive behavior depends on the type of fault. The LED display on the front panel of the drive shows the number of the fault that occurred. If a warning is issued prior to the fault, the warning is shown on the LED and has the same number as the associated fault. Warnings do not trip the power stage of the drive or fault relay output.

The left side of the LED displays F for a fault or n for a warning. The right side displays the fault or warning number as follows: 1-0-1-[break]. The highest priority fault is displayed on the LED. Multiple faults may be present when a fault condition is occurring. Check the KC1WorkBench Fault Screen or read the status of DRV.FAULTS through the controller or HMI for the entire list of faults.

Once the fault cause is remedied, you can clear the fault using any one of the following methods:

For more detailed information on clearing drive faults, see Clearing Faults.

Fault	Message/Warning	Cause	Remedy	Drive Response to Fault Activate Fault Relay
..		1. 24V Control Power input voltage dip. or 2. Auxillary encoder 5V (X9-9) shorted.	1. Insure adequate 24V supply current capacity for the system. or 2. Check and fix X9 wiring.	
F0		Reserved.	N/A	N/A
F101	Firmware type mismatch.	Installed firmware is not compatible with the drive hardware.	Load compatible firmware into the drive.	No change
n101	The FPGA is a lab FPGA.	The FPGA is a lab version FPGA.	Load the released FPGA version that is compatible with the operational firmware.	N/A
F102	Resident firmware failed.	Software failure detected.	Restart drive. If issue persists, contact technical support.	No change
n102	Operational FPGA is not a default FPGA.	The FPGA minor version is larger than the operational firmware default FPGA minor version	Load the released FPGA version that is compatible with the operational firmware.	N/A
F103	Resident FPGA failed.	Software failure detected. Load resident FPGA failure occurred (several cases according to flow-chart, including incompatible image to FPGA type and fieldbus type).	Restart drive. If issue persists, contact technical support.	No change

Fault	Message/Warning	Cause	Remedy	Drive Response to Fault Activate Fault Relay
F104	Operational FPGA failed.	Software failure detected. Load operational FPGA failure occurred (several cases according to flow-chart).	Restart drive. If issue persists, contact technical support.	No change
F105	Non-volatile memory stamp invalid.	Non-volatile memory stamp is corrupted or invalid.	Reset the drive to default memory values using Parameter Load in Work-Bench.	N/A
F106	Non-volatile memory data	Non-volatile memory data is corrupted or invalid. When this fault occurs after a firmware download, it is not an indication of a problem (clear the fault and perform a "save" to the drive).	Reset the drive to default memory values using Parameter Load in Work-Bench.	N/A
n107	Positive switch limit exceeded.	Positive software position limit is exceeded.	Move the load away from the limits.	N/A
n108	Negative switch limit exceeded.	Negative software position limit is exceeded.	Move the load away from the limits.	N/A
F121	Homing error.	Drive did not finish homing sequence.	Check homing sensor, homing mode, and homing configuration.	N/A
F123 n123	Invalid motion task.	Invalid motion task.	Check motion task settings and parameters to make sure that the values entered will produce a valid motion task.	N/A
F125 n125	Synchronization lost.	The fieldbus lost synchronization.	Check fieldbus connection (X5 and X6 if you are using EtherCAT; X12 and X13 if you are using CANopen) or the settings of your EtherCAT or CANopen master.	√
F126 n126	Too much movement.	Too much movement was created during a Bode plot. Motor is unstable and is not following drive instructions.	Check that the system is closed loop stable. Refer to the system tuning guide.	N/A
F127	Incomplete emergency stop procedure.	Incomplete emergency stop procedure (problem with the emergency stop motion task).	Disconnect power from drive and check emergency stop procedure.	N/A

Fault	Message/Warning	Cause	Remedy	Drive Response to Fault Activate Fault Relay
F128	MPOLES/FPOLES not an integer.	Ratio of motor poles to feedback poles must be a whole number.	Change to a compatible feedback device.	√
F129	Heartbeat lost.	Heartbeat lost.	Check CANopen cabling. Reduce bus load or increase the heartbeat update time.	√
F130	Secondary feedback supply over current.	5V power supply was shorted out on X9.	Check X9 connection.	√
F131	Secondary feedback A/B line break.	Problem in secondary feedback detected.	Check secondary feedback (X9 connection).	√
F132	Secondary feedback Z line break.	Problem in secondary feedback detected.	Check secondary feedback (X9 connection).	√
F133	Fault number changed to F138. See F138 for details.			
F134	Secondary feedback illegal state.	Feedback signals were detected in an illegal combination.	Check X9 connection.	√
F135 n135	Homing is needed.	Attempt to issue motion task before the axis is homed. Axis must be homed before motion task can start.	Change opmode or home axis.	No change
F136	Firmware and FPGA versions are not compatible	The FPGA version does not match the firmware FPGA version constants.	Load the FPGA version that is compatible with the firmware.	√
n137	Homing and feedback mismatch	The configured homing mode is not supported by the motor feedback type used.	Change homing mode.	N/A
F138	Instability during autotune	Drive current (IL.CMD) or velocity feedback (VL.FB) exceeds allowable limit (BODE.IFLIMIT or BODE.VFLIMIT). This fault only occurs in BODE.MODE 5. This fault often occurs when complex mechanics, belts, and compliant loads are present.	Change BODE.MODE if appropriate. If BODE.MODE 5 is appropriate and the fault occurs at the end of an Autotuning, then the motor is not robustly stable. You can manually adjust Autotuner settings. Manual tuning may be required to make the motor stable.	√

Fault	Message/Warning	Cause	Remedy	Drive Response to Fault Activate Fault Relay
F139	Target Position Overshot due to invalid Motion task activation.	The drive cannot decelerate from its current speed to reach the end point of the second motion task without moving past it. Increase the deceleration rate in the move or trigger the move earlier.	Change Motion task profile and clear fault with DRV.CLRFAULTS. Or change the value of FAULT139.ACTION = 1 to ignore this condition.	No change
n140	VBUS.HALFVOLT has changed. Save the parameters and reboot the drive.	The user has changed the numerical value of VBUS.HALFVOLT. This change only takes effect after a DRV.NVSAVE command and after rebooting the KC1.	Save the parameters in the non-volatile memory via a DRV.NVSAVE command and turn off/on the 24[V] power supply in order to reboot the drive or restore the original setting of VBUS.HALFVOLT.	N/A
n151	Not enough distance to move; motion exception.	<p>For trapezoidal and customer table motion tasks: The target velocity specified in the motion task cannot be reached via using the selected acceleration and deceleration since the distance to travel is not sufficient.</p> <p>For a 1:1 profile: The selected acceleration and deceleration will be extended since there is too much distance to travel and the motion task would exceed its maximum allowed velocity.</p>	Activation of any new motion or using of DRV.CLRFAULTS will clear the warning. Check motion task settings and parameters to make sure that the values entered will produce a valid motion task.	N/A

Fault	Message/Warning	Cause	Remedy	Drive Response to Fault Activate Fault Relay
n152	Not enough distance to move; following motion exception.	A new motion task activated, when one motion task is already active and the target position specified in the motion task parameters cannot be reached with specified target velocity, acceleration and deceleration parameters. The motion task will directly decelerate to into the target position or ramps down to velocity 0 and start another move to reach target position of the next motion task.	Activation of any new motion or using of DRV.CLRFAULTS will clear the warning. Check motion task settings and parameters to make sure that the values entered will produce a valid motion task.	N/A
n153	Velocity limit violation, exceeding max limit.	A new target velocity calculated internally due to an exception, and is being limited due to user velocity limit.	Activation of any new motion or using of DRV.CLRFAULTS will clear the warning. Check motion task target velocity settings and parameters to make sure that the values entered will not exceed the VL.LIMITP and VL.LIMITN setting.	N/A
n154	Following motion failed; check motion parameters.	Activation of the following motion task failed due to incompatible parameters, or motion task does not exist.	Activation of any new motion or using of DRV.CLRFAULTS will clear the warning. Check following motion task settings and parameters to make sure that the values entered will produce a valid motion task.	N/A
n156	Target position crossed due to stop command.	The motion task crosses the target position after triggering a DRV.STOP command. This situation can happen when processing a change-on-the-fly motion task and triggering a DRV.STOP command close to the target position of the currently running motion task.	Activation of any new motion or using of DRV.CLRFAULTS will clear the warning.	N/A

Fault	Message/Warning	Cause	Remedy	Drive Response to Fault Activate Fault Relay
n157	Homing index pulse not found.	A homing mode with index detection is activated, and index pulse is not detected while moving across the range determined by the hardware limit switches.	Activation of any new motion or using of DRV.CLRFAULTS will clear the warning.	N/A
n158	Homing reference switch not found.	A homing mode with reference switch detection is activated and the reference switch is not detected while moving across the range determined by the hardware limit switches.	Activation of any new motion or using of DRV.CLRFAULTS will clear the warning.	N/A
n159	Failed to set motion task parameters	Invalid motion task parameters assignment. This warning can appear upon an MT.SET command.	Activation of any new motion or using of DRV.CLRFAULTS will clear the warning. Check motion task settings and parameters.	N/A
n161	Homing procedure failed.	Homing error observed during the operation of homing procedure.	Activation of any new motion or using of DRV.CLRFAULTS will clear the warning.	N/A
n163	MT.NUM exceeds limit.	This warning appears with n160. This warning is triggered when you try to trigger a motion task > 128 (such as MT.MOVE 130).	Trigger only motion tasks between 0 and 128. Activation of any new motion or using of DRV.CLRFAULTS will clear the warning.	
n164	Motion task is not initialized.	This warning appears with n160. This warning is triggered when you try to trigger a non-initialized motion task.	Initialize the motion task first before starting the task. Activation of any new motion or using of DRV.CLRFAULTS will clear the warning.	
n165	Motion task target position is out.	This warning appears with n160. This warning is triggered when you try to trigger a motion task with an absolute target position outside of the selected modulo range (see also MT.CNTL).	Move the absolute target position of the motion task within the modulo range. Activation of any new motion or using of DRV.CLRFAULTS will clear the warning.	

Fault	Message/Warning	Cause	Remedy	Drive Response to Fault Activate Fault Relay
n168	Invalid bit combination in the motion task control word.	This warning appears with n160. This warning is triggered when you try to trigger a motion task with an invalid bit combination in the motion task control word (see also MT.CNTL).	Correct the MT.CNTL setting for the specific motion task. Activation of any new motion or using of DRV.CLRFAULTS will clear the warning.	
n169	1:1 profile cannot be triggered on the fly.	This warning appears with n160. This warning is triggered when you try to trigger a 1:1 profile table motion task while another motion task is currently running.	1:1 profile table motion tasks should be started from velocity 0. Activation of any new motion or using of DRV.CLRFAULTS will clear the warning.	
n170	Customer profile table is not initialized.	This warning appears with n160. This warning is triggered when you try to trigger a motion task that uses a customer profile table for generating the velocity profile and when the selected profile table is empty (see MT.CNTL and MT.TNUM).	Change the MT.TNUM parameter for this specific motion task in order to use an initialized profile table. Activation of any new motion or using of DRV.CLRFAULTS will clear the warning.	
F201	Internal RAM failed.	Hardware failure detected.	Restart drive. If issue persists, contact technical support.	No change
F202	External RAM failed.	Hardware failure detected.	Restart drive. If issue persists, contact technical support.	No change
F203	Code integrity failed.	Software failure detected. FPGA register access failure occurred.	Restart drive. If issue persists, contact technical support.	No change
F204 to F232	EEPROM failure detected	EEPROM failure detected	Restart drive. If issue persists, exchange drive.	
F234-F237 n234-n237	Temperature sensor high.	High temperature limit reached.	Check cabinet ventilation system.	
F240-F243 n240-n243	Temperature sensor low.	Low temperature limit reached.	Check cabinet ventilation system.	

Fault	Message/Warning	Cause	Remedy	Drive Response to Fault Activate Fault Relay
F245	External fault.	This fault is user generated and is caused by user settings.	Users can configure a digital input to trigger this fault (DINx.MODE = 10). The fault occurs according to this input setting. Clear the input to clear the fault.	N/A
F247	Bus voltage exceed allowed thresholds.	Hardware problem in bus measurement.	Troubleshoot and repair hardware problem.	No change
F248	Option board EEPROM corrupted.	EEPROM failure detected.	Restart drive. If issue persists, exchange drive.	
F249	Option board downstream checksum.	Communications with the I/O on the option board failed.	DRV.CLRFAULTS. If issue persists If issue persists, contact technical support.	
F250	Option board upstream checksum.	Communications with the I/O on the option board failed.	DRV.CLRFAULTS. If issue persists If issue persists, contact technical support.	
F251	Option board watchdog.	Communications with the I/O on the option board failed.	DRV.CLRFAULTS. If issue persists If issue persists, contact technical support.	
F252	Firmware and option board FPGA types are not compatible.	The option board FPGA is not compatible with this hardware.	Download the correct firmware file for this drive.	
F253	Firmware and option board FPGA versions are not compatible.	The version of the option board FPGA is not compatible with this firmware.	Download the correct firmware file for this drive.	
F301 n301	Motor overheated.	Motor overheated.	Check ambient temperature. Check motor mounting heat sink capability	√
F302	Over speed.	Motor exceeded VL.THRESH value.	Increase VL.THRESH or lower velocity command.	√
F303	Runaway.	Motor did not follow command values.	Current command to the motor is too high for too long. Reduce servo gains, or reduce command trajectory aggressiveness.	√
F304 n304	Motor foldback.	Maximum motor power has been exceeded; the power has been limited to protect the motor	Motion is requiring too much power. Change move profile to reduce load on motor. Check for load jamming or sticking. Check that current limits are set correctly.	√

Fault	Message/Warning	Cause	Remedy	Drive Response to Fault Activate Fault Relay
F305	Brake open circuit.	Motor brake open circuit. Fault threshold is 200 mA.	Check cabling and general functionality. For special low current brake applications, the F305 fault can be bypassed using the setting motor.brake = 100.	√
F306	Brake short circuit.	Motor brake short circuit.	Check cabling and general functionality.	√
F307	Brake closed during enable state.	Motor brake closed unexpectedly.	Check cabling and general functionality.	√
F308	Voltage exceeds motor rating.	Drive bus voltage exceeds the motor's defined voltage rating.	Make sure that the motor fits the driving rating.	√
F309	Motor I2t load. reduce load	Motor I2t load (IL.MI2T) has exceeded the warning threshold IL.MI2TWITHRESH. This warning can only be generated in the case that the motor protection mode IL.MIMODE has been set to 1.	Reduce the load of the drive by adjusting lower acceleration / deceleration ramps.	TBD
F312	Brake released when it should be applied.	Brake disengaged unexpectedly.	Check cabling and general functionality.	√
F401	Failed to set feedback type.	Feedback is not connected or wrong feedback type selected	Check primary feedback (X10 connection).	√
F402	Analog signal amplitude fault.	Analog signal amplitude is too low. Analog fault (resolver signal amplitude or sin/cos amplitude)	Check primary feedback (X10 connection), resolver and sine/cos encoder only.	√
F403	EnDat communication fault.	General communication problem with feedback.	Check primary feedback (X10 connection), EnDat only	√
F404	Hall error.	Hall sensor returns invalid Hall state (111, 000); either all Hall sensors are on or off. Legal Hall states are 001, 011, 010, 110, 100, and 101. This fault can be caused by a broken connection in any one of the Hall signals.	Check the feedback wiring; check all feedback connectors to ensure all pins are positioned correctly.	√

Fault	Message/Warning	Cause	Remedy	Drive Response to Fault Activate Fault Relay
F405	BiSS watchdog fault.	Bad communication with the feedback device.	Check primary feedback (X10 connection), Biss only.	√
F406	BiSS multicycle fault.			√
F407	BiSS sensor fault.			√
F408-F416	SFD feedback fault.	Bad communication with the SFD device.	Check primary feedback (X10 connection). If fault persists, internal feedback failure. Return to manufacturer for repair.	
F417	Broken wire in primary feedback.	In primary feedback, a broken wire was detected (incremental encoder signal amplitude).	Check feedback cable continuity.	√
F418	Primary feedback power supply.	Power supply fault for primary feedback.	Check primary feedback (X10 connection).	√
F419	Encoder init procedure failed	Phase find procedure did not complete successfully.	Check encoder wiring, reduce/balance motor load prior to phase finding.	√
F420	FB3 EnDat Communications Fault.	A communication error was detected with the EnDat 2.2 device connected to the X9 connector.	Check pinout and FB3 configuration and reconnect feedback. If problems persist, contact customer support.	
F421	SFD position sensor fault	Sensor or sensor wiring failure inside motor.	Try resetting the fault. If it reappears return motor for repair.	√
F438 n439	Following error (numeric)	Motor did not follow command values. Motor exceeded maximum allowed position following error (numeric).	Check for increased load, jamming or sticking. Is position error set too low?	√
F439 n439	Following error (user).	Motor did not follow command values. Motor exceeded maximum allowed position following error (user).	Check feedback commutation setup and tuning parameters.	√
F450	Following error (presentation).	Motor did not follow command values. Motor exceeded maximum allowed position following error (presentation).	Check feedback commutation setup and tuning parameters.	√

Fault	Message/Warning	Cause	Remedy	Drive Response to Fault Activate Fault Relay
F451 n451	Feedback battery fault.	The external battery voltage is too low. The F451 fault is generated if the AKD is not powered. The n451 warning is generated if the AKD is powered. This fault can be inhibited with FAULT451.ACTION.	Check or replace the external battery.	√
F453	Tamagawa communication fault (timeout).	Bad communication with the feedback device.	Check the cabling to the drive and if the problem persists then return the feedback to the manufacturer for repair.	√
F454	Tamagawa communication fault (transfer incomplete).	Cabling or shielding fault, or internal feedback failure.		√
F456	Tamagawa communication fault (CRC).			√
F457	Tamagawa communication fault (start timeout).			√
F458	Tamagawa communication fault (UART Overrun).			√
F459	Tamagawa communication fault (UART Framing).			√
F460	Tamagawa encoder fault (over speed).	This fault is generated when the shaft is rotated above a maximum speed that can be maintained while the external battery is powered and the drive is powered off.	Reset the fault on the drive with DRV.CLRFAULTS.	√
F461	Tamagawa encoder fault (counting Error).	When the feedback is powered on the position (within one revolution) was incorrect because of a problem with the feedback device.	Reset the fault on the drive with DRV.CLRFAULTS, if the problem persists then clean the feedback code plate.	√
F462	Tamagawa encoder fault (counting overflow).	Multi-turn counter has overflowed.	Reset the fault on the drive with DRV.CLRFAULTS.	√
F463	Feedback overheat fault.	The temperature of the encoder substrate exceeds overheating detection temperature during main power-on.	Reset the fault on the drive with DRV.CLRFAULTS after temperature of encoder is lowered.	√
F464	Tamagawa encoder fault (multi-turn error).	Any bit-jump occurs in the multi-turn signal during main power-on.	Return to the origin. Reset the fault on the drive with DRV.CLRFAULTS.	√
F473	Wake and Shake. Insufficient movement	There was less movement than defined by WS.DIS-TMIN.	Increase WS.IMAX and/or WS.T. Or try using WS.MODE 1 or 2.	√

Fault	Message/Warning	Cause	Remedy	Drive Response to Fault Activate Fault Relay
F475	Wake and Shake. Excess movement.	WS.DISTMAX has been exceeded in WS.MODE 0. Or more than 360 degrees was traveled in WS.MODE 2.	Increase WS.DISTMAX value or reduce WS.IMAX or WS.T. Wake and Shake is not supported for vertical/overhung loads.	√
F476	Wake and Shake. Fine-coarse delta too large.	The angle difference between the coarse and fine calculation was larger than 72 deg.	Modify WS.IMAX or WS.T and try again.	√
F478 n478	Wake and Shake. Over-speed.	WS.VTHRESH was exceeded.	Increase WS.VTHRESH value or reduce WS.IMAX or WS.T.	√
F479 n479	Wake and Shake. Loop angle delta too large.	The angle between complete loops was larger than 72 deg.	Modify WS.IMAX or WS.T and try again.	√
F480	Fieldbus command velocity too high.	Fieldbus command velocity exceeds VL.LIMITP.	Lower fieldbus command trajectory, or increase the value of VL.LIMITP.	√
F481	Fieldbus command velocity too low.	Fieldbus command velocity exceeds VL.LIMITN.	Increase fieldbus command trajectory, or decrease the value of VL.LIMITN.	√
F482	Commutation not initialized.	The motor requires the commutation initialization (there are no encoder commutation tracks, Hall sensors, etc.) and no successful Wake and Shake sequence has been performed	Clear any faults, activate the Wake and Shake procedure (WS.ARM) and enable the drive.	√
F483	Motor U phase missing.	No current was detected in the motor's U phase during Wake and Shake initialization (Mode 0 only).	Check the motor connections and WS.IMAX (very low current may produce this error).	√
F484	Motor V phase missing.	No current was detected in the motor's V phase during Wake and Shake initialization (Mode 0 only).	Check the motor connections and WS.IMAX (very low current may produce this error).	√
F485	Motor W phase missing.	No current was detected in the motor's W phase during Wake and Shake initialization (Mode 0 only).	Check the motor connections and WS.IMAX (very low current may produce this error).	√
F486	Motor velocity exceeds EMU-speed.	Motor velocity exceeds the maximum speed the emulated encoder output can generate.	Reduce value of DRV.EMU-EPULSEIDTH.	N/A

Fault	Message/Warning	Cause	Remedy	Drive Response to Fault Activate Fault Relay
F487	Wake and Shake - Validating Positive Movement Failed.	After applying a positive current, motor moved in the wrong direction.	Check motor phase wiring and motor encoder wiring is correct.	√
F489	Wake and Shake - Validating Negative Movement Failed.	After applying a negative current, motor moved in the wrong direction.	Check motor phase wiring and motor encoder wiring is correct.	√
F490	Wake and Shake - Validating Comm. angle timed out.	During one of the W&S validation stages, the drive stopped responding to commands.	Contact customer support.	√
F491	Wake and Shake - Validating Comm. angle moved too far - Bad Comm Angle.	After applying a current, the motor moved too far (>15 electrical degrees).	This indicates a poor motor phase angle was found by Wake and Shake. Revise Wake and Shake parameters, and re-run Wake and Shake.	√
F492	Wake and Shake - Validating Comm. angle required more than MOTOR.ICONT.	A current larger than MOTOR.ICONT was used to excite the motor.	This indicates one of the following: <ul style="list-style-type: none"> • Phase angle is incorrect due to a bad wake and shake. • Motor has very high friction requiring high current to break free. • Motor power cable is disconnected or improperly wired. 	√
F493	Invalid commutation detected - motor accelerating in the wrong direction. Motor phase may be incorrect.	The velocity of the motor exceeded WS.CHECKV and the sign of the current was not equal to the sign of motor acceleration or the sign of motor velocity for a period of time larger than WS.CHECKT.	1. Check motor phase wiring 2. Re-configure wake and shake (if Mode 0 or 1 is used) 3. Re-run wake and shake to determine correct commutation angle	√
F501 n501	Bus over voltage.	Bus voltage too high. Usually, this problem is load related.	Reduce load or change motion profile. Check system regen capacity; add capacity if needed. Check mains voltage.	√

Fault	Message/Warning	Cause	Remedy	Drive Response to Fault Activate Fault Relay
F502	Bus under voltage. Warning issued prior to fault.	Bus voltage below threshold value.	Check mains voltage.	√
F503 n503	Bus capacitor overload.	Single phase AC input on a drive only rated for three-phase input or excessive single-phase power load.	Check mains voltage.	√
F504- F518	Internal supply voltage fault	Internal supply voltage fault detected	Check wiring for electromagnetic compatibility (EMC). If issue persists exchange drive.	
F519	Regen short circuit.	Regen resistor short circuit.	Regen IGBT short circuit. Contact technical support.	√
F521 n521	Regen over power.	Too much power stored in regen resistor.	Either get larger regen resistor or use DC bus sharing to dissipate power.	√
F523	Bus over voltage FPGA	Bus over voltage hard fault.	Check mains voltage and check system brake capacity.	√
F524 n524	Drive foldback.	Maximum drive power has been exceeded. The power has been limited to protect the drive.	Motion requires too much power. Change profile to reduce load .	√
F525	Output over current.	Current exceeds drive peak.	Check for short or feedback faults.	√
F526	Current sensor short circuit.	Current sensor short circuit.	Restart drive. If issue persists, contact technical support.	√
F527	Iu current AD converter stuck.	Hardware failure detected.	Restart drive. If issue persists, contact technical support.	√
F528	Iv current AD converter stuck.	Hardware failure detected.	Restart drive. If issue persists, contact technical support.	√
F529	Iu current offset limit exceeded.	Hardware failure detected.	Restart drive. If issue persists, contact technical support.	√
F530	Iv current offset limit exceeded.	Hardware failure detected.	Restart drive. If issue persists, contact technical support.	√
F531	Power stage fault.	Hardware failure detected.	Restart drive. If issue persists, replace drive.	√

Fault	Message/Warning	Cause	Remedy	Drive Response to Fault Activate Fault Relay
F532	Drive motor parameters setup incomplete.	Before a motor can be enabled, you must configure a minimum set of parameters. These parameters have not been configured.	Issue the command <code>DRV.SETUPREQLIST</code> to display the list of the parameters that you must configure. Configure these parameters either manually or automatically. You can manually configure these parameters in three ways: (1) set each parameter individually; (2) use the setup wizard to select the motor; or (3) select the motor type from the motor data base in the Motor window (<code>MOTOR.AUTOSSET</code> must be set to 0 (off)). If you use the Motor window, you must first select the feedback type. If the motor has Biss Analog, Endat, or SFD feedback (feedback with memory), then these parameters are set automatically when <code>MOTOR.AUTOSSET</code> is set to 1 (on).	N/A
F534	Failed to read motor parameters from feedback device.	Motor either does not have motor feedback memory, or the motor feedback memory is not programmed properly so the parameters cannot be read.	Try to read parameters again by clicking the Disable and Clear Faults button, or by issuing the <code>DRV.CLRFAULTS</code> command. If this attempt is not successful, then set <code>MOTOR.AUTOSSET</code> to 0 (off) and program the parameters using the setup wizard or manually set up the parameters. If the motor has motor memory (Biss Analog, Endat, and SFD motors have motor memory), return the motor to have the memory programmed.	N/A
F535	Power-board over-temperature fail.	The power-board temperature sensor indicates more than 85 °C.	Reduce the load of the drive or ensure better cooling.	

Fault	Message/Warning	Cause	Remedy	Drive Response to Fault Activate Fault Relay
F601	Modbus data rate is too high.	Modbus controller data rate is too high.	Reduce data rate.	
F602	Safe torque off.	Safe torque off function has been triggered.	Reapply supply voltage to STO if safe to do so.	√
n603	OPMODE incompatible with CMDSOURCE	This warning is generated when the drive is enabled and the gearing command source is selected at the same time as torque or velocity op-mode.	Select a different DRV.OPMODE and DRV.CMDSOURCE combination.	N/A
n604	EMUEMODE incompatible with DRV.HANDWHEELSRC.	Emulated encode mode is incompatible with the selected handwheel source.	Select a compatible emulated encode mode or change handwheel source.	N/A
F701	Fieldbus runtime.	Runtime communication fault.	Check fieldbus connections (X11), settings, and control unit.	√
F702 n702	Fieldbus communication lost.	All fieldbus communication was lost.	Check fieldbus connections (X11), settings, and control unit.	√
F703	Emergency timeout occurred while axis should disable	Motor did not stop in the timeout defined.	Change timeout value, change stop parameters, improve tuning.	√

19.2 Clearing Faults

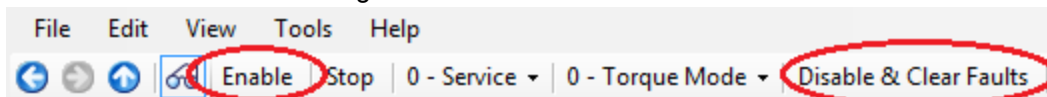
You can clear drive faults in several ways:

1. using the WorkBench toolbar
2. using the WorkBench terminal screen
3. using an external digital signal

In the first two methods, clearing the fault automatically disables the drive (by issuing the DRV.DIS command). After the fault is cleared, you must then enable the drive again (by issuing the DRV.EN command). In the third method, clearing the fault does not automatically disable the drive. Once the fault is cleared, the drive will immediately become enabled again when no fault conditions exist.

The external digital signal method is useful when the application does not require a field bus, therefore the controller cannot issue fieldbus commands (for example, DRV.EN). The fault clearing function is simpler in this case. The controller can clear a fault condition with a single output and no fieldbus command is required. The hardware enable input is still utilized for safety. Many machines are set to disable when a fault occurs, therefore, the enable circuit is connected only after the fault clear circuit is toggled.

1. Using the WorkBench toolbar. Click the **Clear Fault** button to clear the fault, then click the **Enable** button to enable the drive again.



2. Using an ASCII command. In WorkBench terminal screen, enter DRV.CLRFAULTS, then enter DRV.EN to enable the drive.
3. Using an external digital signal. First, provide a disable command to the drive, since this command is not automatically issued when the fault is cleared using an external digital signal. You must provide this disable command after the drive has disabled itself and before the clear fault command is issued in order for the clear fault command to be accepted.

Digital input mode 1 clears a fault condition. In the WorkBench terminal screen, enter DINx.MODE 1, with x set to the corresponding digital input number. See the Installation Manual (Digital Inputs (X7/X8) (pg 92) for digital input numbers and corresponding pin connections.

Example:

DIN2.MODE 1 sets digital input 2 (pin 9 on connector X7) to perform the clear fault function. Any free digital input shown in Table x can be set to mode 1 (Reset faults).

19.3 Parameter and Command Error Messages

Error Message	Meaning	Remedy	Occurrence
Error: Parameter or command was not found.	Parameter or command string was not recognized as a known command.	Check the entered string for accuracy. Consult the reference guide or enter DRV.LIST in the WorkBench terminal screen to find valid parameters and commands.	General.
Error: Not a trigger parameter.	Parameter cannot be used for triggering the scope.	Use a different parameter as a trigger value.	Recorder parameters.
Error: Parameter not recordable.	Parameter cannot be scoped.	Do not scope this parameter.	Recorder parameters.

Error Message	Meaning	Remedy	Occurrence
Error: Wrong argument for parameter or command.	Argument was not accepted.	Check the entered argument for accuracy. Consult the reference guide or enter DRV.LIST in the WorkBench terminal screen to find valid parameter and command arguments.	General.
Error: No arguments allowed for parameter or command.	Parameter or command supports no arguments.	Enter parameter or command again with no arguments.	Commands and read-only parameters
Error: Too many arguments for parameter or command.	Too many arguments provided for this parameter or command.	Enter again with fewer arguments.	All parameters and commands with no or one argument.
Error: No float allowed.	Float number was entered, but only integer numbers are allowed.	Enter integer value instead.	All parameters and commands with integer arguments.
Error: Parameter or command is read-only.	Argument was not accepted because the parameter or command is read-only.	Enter again with no arguments.	Commands and all read-only parameters.
Error: Parameter is temporarily write protected.	Argument was not accepted because the parameter is currently read-only.	Check reference guide or WorkBench help to determine if the parameter is read-only, read-write, or nonvolatile.	Some parameters that come from the Smart Feedback Device (SFD).
Error: Argument greater than maximum value.	Entered argument was beyond maximum value.	Enter a value that is within the allowable range. See reference guide or WorkBench help for ranges.	Commands and read-write parameters.
Error: Too many characters in parameter or command.	Parameter or command string was too long.	Shorten string and enter again.	General.
Error: Argument less than minimum value.	Entered argument was too small.	Enter value that is within the limits.	Commands and read-write parameters.
Error: Argument is out of data range.	Entered argument was not within the data range limits.	Enter value that is within the limits.	Commands and read-write parameters.
Error: Parameter or command is password protected.	Use of this parameter or command requires a password.	Contact technical support to obtain password. Enter valid password.	Password protected parameters and commands.
Error: Wrong operation mode for parameter or command.	Requested parameter or command cannot be performed in this operation mode.	Change to valid operation mode.	

Error Message	Meaning	Remedy	Occurrence
Error: Drive enabled. Disable drive and continue.	Action can only be performed if drive is disabled.	Disable drive and repeat action.	
Error: Drive disabled. Enable drive and continue.	Action can only be performed if drive is enabled.	Enable drive and repeat action.	
Error: Data value is invalid.	Entered data was not valid.	Provide valid data.	
Error: Argument must be an even number.	Argument is not an even number.	Enter a value divisible by two without remainder.	
Error: Argument must be an odd number.	Argument must be an odd number.	Enter a value not divisible by two with remainder.	
Error: Axis is not homed.	Axis is not homed.	Home axis and repeat action.	
Error: All recorder channels empty.	No data is specified to record.	Specify the data to be recorded and start again.	Recorder commands.
Error: Process already active.	Required action is already running.	Wait until action is finished and start again if needed.	
Error: Motor is currently in motion.	Action can only be performed if motor is not moving.	Stop motion and repeat action.	Motion tasks, service motion, and others.
Error: EEPROM is bad or does not exist.	EEPROM is damaged.	Restart drive. If fault persists, replace the drive and consult technical support.	
Error: Unknown board.			
Error: Fault exists. Correct fault condition and then clear faults.	A fault is present in the system.	Clear the fault, disable the drive, and then enable the drive again.	
Error: Cannot clear faults. Issue software or hardware disable first.		Clear hardware or software enable and repeat action.	
Error: EEPROM is busy.			
Error: Invalid motor/feedback poles ratio.			
Error: Unknown Fault.	Situation should not happen.	Clear fault. If fault recurs, consult technical support.	Unknown.
Error: Invalid motor/feedback poles ratio.			
Error: Invalid motion task parameter.			

Error Message	Meaning	Remedy	Occurrence
Error: Invalid motion task number.			
Error: Invalid motion task velocity.			
Error: Invalid motion task acceleration or deceleration.			
Error: Invalid motion task customer profile table number.			
Error: Invalid motion task following number.			
Error: Function not available for the active command source.			
Error: Invalid Bode plot mode for this function.			
Error: Invalid sine-sweep Bode plot mode.			
Error: Bode plot start frequency greater than or equal to end frequency.			
Error: Function not available while a controlled stop is in process.			
Error: Not enough memory available.			
Error: Function not available while a Bode-plot measurement is active.			
Error: Iu/Iv offset calculation not finished.			
Error: Buffer overflow.			

Error Message	Meaning	Remedy	Occurrence
Error: Cannot save to EEPROM while inrush relay is closed.			
Error: Test mode is off.			
Error: Cannot change digital input mode. Issue software or hardware disable first.			
Error: Internal drive procedure active: controlled stop, burn-in, phase find, or zero.			
Error: General motion fault.			

19.4 Unknown Fault

This fault message occurs when an undefined fault condition is encountered.

19.4.1 Remedies

1. Click **Clear Fault**.

20 Troubleshooting the KC1

Drive problems occur for a variety of reasons, depending on the conditions in your installation. The causes of faults in multi-axis systems can be especially complex. If you cannot resolve a fault or other issue using the troubleshooting guidance presented below, customer support can give you further assistance.

Problem	Possible Causes	Remedy
HMI message: Communication fault	<ul style="list-style-type: none"> wrong cable used, cable plugged into wrong position on drive or PC wrong PC interface selected 	<ul style="list-style-type: none"> plug cable into the correct sockets on the drive and PC select correct interface
Drive does not enable	<ul style="list-style-type: none"> HW Enable not wired HW or SW Enable not set 	<ul style="list-style-type: none"> connect HW Enable (X8 pin 4) Apply 24V to HW Enable and select SW Enable in Work-Bench / Fieldbus
Motor does not rotate	<ul style="list-style-type: none"> drive not enabled software enable not set break in setpoint cable motor phases swapped brake not released drive is mechanically blocked motor pole no. set incorrectly feedback set up incorrectly 	<ul style="list-style-type: none"> apply ENABLE signal set software enable check setpoint cable correct motor phase sequence check brake control check mechanism set motor pole no. set up feedback correctly
Motor oscillates	<ul style="list-style-type: none"> gain is too high (speed controller) feedback cable shielding broken AGND not wired up 	<ul style="list-style-type: none"> reduce VL.KP (speed controller) replace feedback cable join AGND to CNC-GND
Drive reports following error	<ul style="list-style-type: none"> I_{rms} or I_{peak} set too low current or velocity limits apply accel/decel ramp is too long 	<ul style="list-style-type: none"> verify motor/drive sizing verify that IL.LIMITN/P, VL.LIMITN/P are not limiting the drive reduce DRV.ACC/DRV.DEC
Motor overheating	<ul style="list-style-type: none"> motor operating above its rating motor current settings incorrect 	<ul style="list-style-type: none"> verify motor/drive sizing verify motor continuous and peak current values are set correctly
Drive too soft	<ul style="list-style-type: none"> K_p (speed controller) too low K_i (speed controller) too low filters set too high 	<ul style="list-style-type: none"> increase VL.KP (speed controller) increase VL.KI (speed controller) refer to documentation regarding reducing filtering (VL.AR*)

Problem	Possible Causes	Remedy
Drive runs roughly	<ul style="list-style-type: none"> • Kp (speed controller) too high • Ki (speed controller) too high • filters set too low 	<ul style="list-style-type: none"> • reduce VL.KP (speed controller) • reduce VL.KI (speed controller) • refer to documentation regarding increasing filtering (VL.AR*)
During installation, the message "Please wait while the installer finishes determining your disk space requirements" appears and never disappears.	<ul style="list-style-type: none"> • MSI installer issue. • Harddisk space not sufficient 	<ul style="list-style-type: none"> • Cancel the installation. Relaunch the installer (you may need to try several times, the problem is random). • Make sure that you have enough disk space on your hard disk (~500MB to allow Windows .NET update if necessary), if not make some space.

21 Firmware and Firmware Updates

21.1	Downloading Firmware	251
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21.1 Downloading Firmware

To download firmware, click **More** on the **KC1 Overview** screen (see Drive Overview (pg 41)). The information displayed includes the current firmware version. Click **Download** to display the **Download Firmware** view and update the firmware.

When you download the firmware, you may see a **Save** dialog box; see Save On Firmware Download (pg 144) for more information about saving your drive configuration prior to a firmware download.

During the download, you cannot perform any actions with the drive.

CAUTION While WorkBench is downloading firmware to your drive, do not remove the 24 V logic power. If you remove the 24 V logic power during a firmware download, a severe drive crash can occur. If a crash occurs, the drive will restart in a special mode and WorkBench will prompt you to reload the firmware.

During the firmware download, the Download Firmware view displays a progress bar and the following messages as the download proceeds:

1. **Reading the firmware file.** This step duration depends on where the file is physically stored.
2. **Resetting the drive.** This step takes about 10 seconds.
3. **Erasing the old firmware.** This step takes about 20 seconds.
4. **Downloading the new firmware to the drive.** The drive downloads the new firmware and then programs the new firmware into the nonvolatile memory of the drive. This step takes about 20 seconds.
5. **Resetting the drive.** This step takes about 10 seconds.

During the download process, the drive LED displays [dL]. Additional codes may appear during the download; see Display Codes (pg 26) for a description of display codes related to a firmware download.

21.1.1 Firmware Compatibility

WorkBench is compatible with all previous drive firmware versions. Any new WorkBench versions issued are compatible with older firmware versions. WorkBench forward compatibility, however, cannot be ensured. When a behavior in the firmware changes, an older WorkBench version may not function correctly with the new firmware. Kollmorgen recommends that you update WorkBench when you install new firmware.

The table below describes compatibility between WorkBench and firmware versions.

	Firmware version M_01-01-00-zzz	Firmware version M_01-02-00-zzz	Firmware version M_01-03-00-zzz	Firmware version M_01-04-00-zzz	Firmware version M_01-05-00-zzz
WorkBench Version 1.1.x.x	√	x	x	x	x
WorkBench Version 1.2.x.x	√	√	x	x	x
WorkBench Version 1.3.x.x	√	√	√	x	x
WorkBench Version 1.4.xx	√	√	√	√	x
WorkBench Version 1.5.x.x	√	√	√	√	√

Any new firmware not listed here may have compatibility issues with WorkBench. Please check for latest version of WorkBench on the Kollmorgen™ website:

<http://www.kollmorgen.com/zh-cn/products/drives/servo/kc1/>

21.2 Invalid Firmware

When WorkBench connects to a drive, it checks to make sure that the drive is executing a compatible version of the drive firmware. If the drive is executing invalid firmware, then WorkBench cannot operate correctly and shows this window.

Button	Description
Download	This command allows you to select a different version of the firmware and download it to the drive.
Disconnect	This command stops all communications with the drive and return to the disconnected state.

21.3 Forcing the drive into firmware download mode

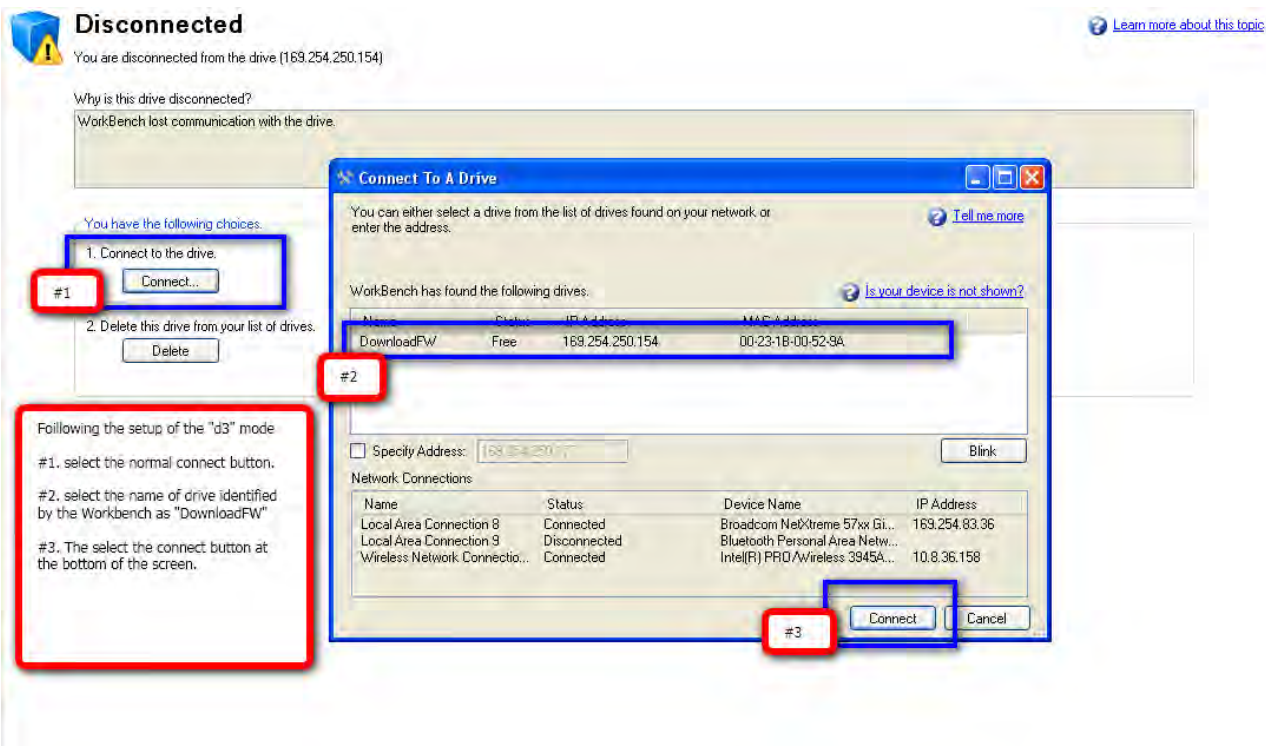
21.3.0.1 Forced download of KC1 firmware.

In most cases, you can download firmware using the WorkBench without setting the hardware into a specific download state. If you are unable to connect to WorkBench for some reason, the following “forced firmware download” procedure is needed.

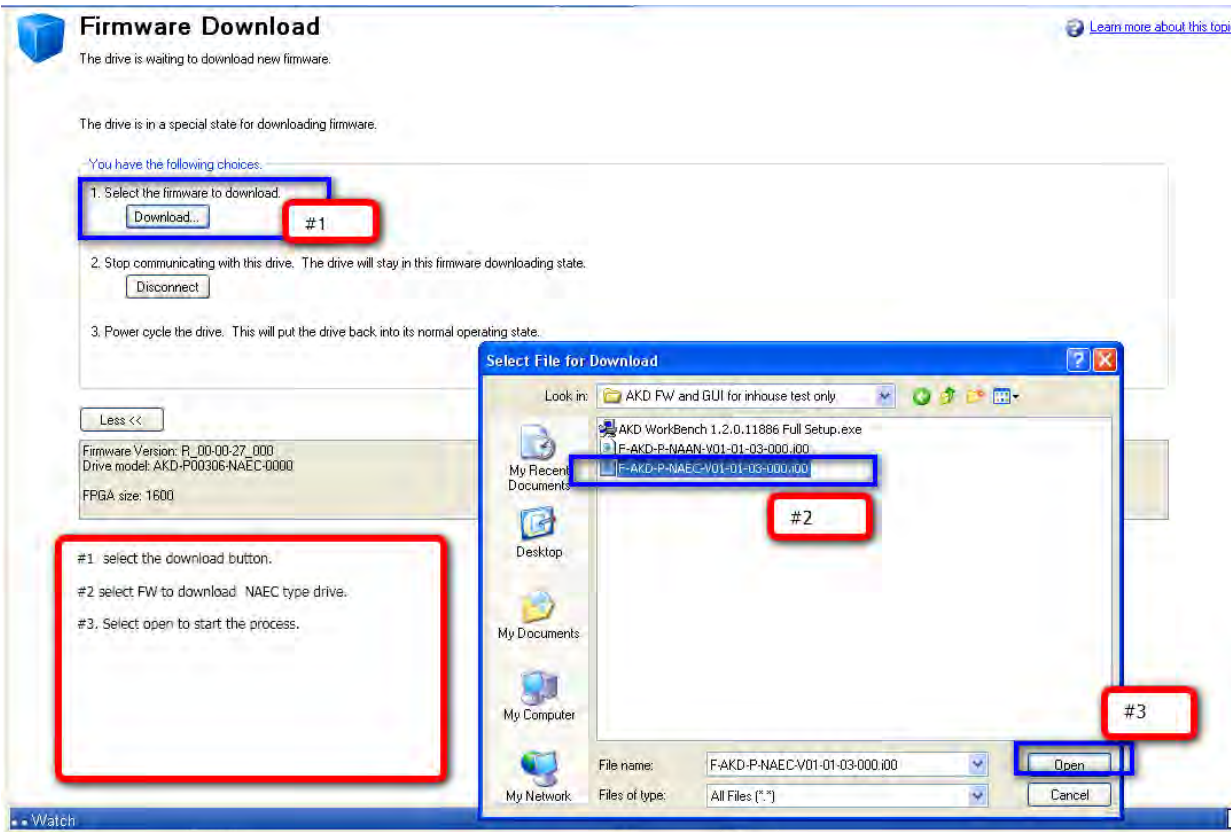
Power the KC1 unit down then:

- Depress the B1 button (display of IP Address Button) while powering up the drive. Continue to depress the button until the drive display shows "d3" (5-10 sec).
- Once the display on the drive shows "d3" , have the EtherNet cable connected to the drive Point to Point.
- The drive can now be connected to WorkBench in download mode.
- Select the firmware to be downloaded; click **Open** to start the process.

WorkBench will display the **Disconnected** view. See the screenshots below for the download connection sequence.



The **Firmware Download** view appears next. See the screenshot below for the firmware selection and download sequence.

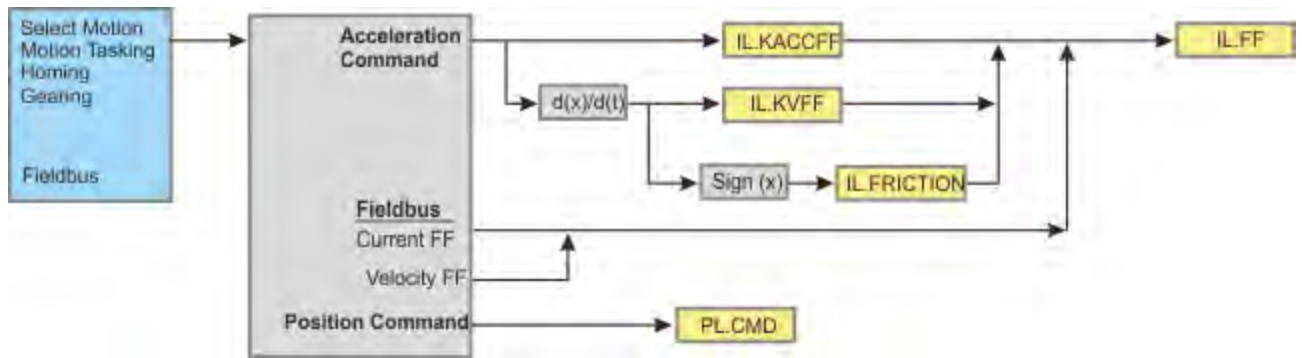


- Next, the **Downloading Firmware** view appears and the progress bar displays the firmware download progress.
- Once the download is complete, open the **KC1 Overview** screen. The **Firmware Version** box displays the new firmware version, which confirms your successful download.

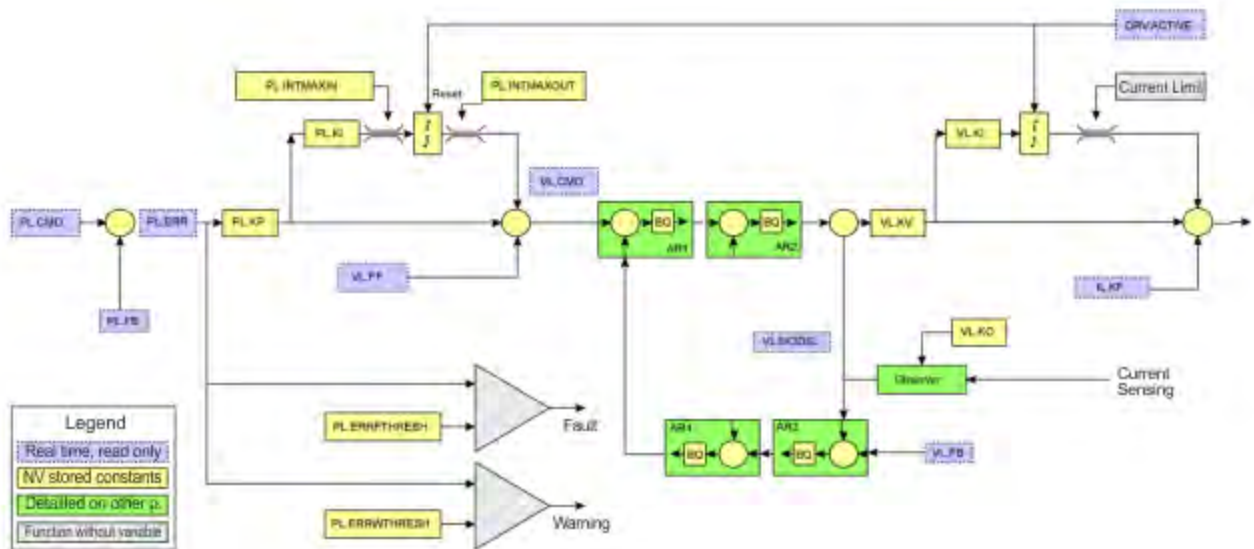
22 Block Diagrams

22.1 Block Diagram for Current Loop	255
22.2 Block Diagram for Position/Velocity Loop	255

22.1 Block Diagram for Current Loop



22.2 Block Diagram for Position/Velocity Loop



23 Appendix A - Parameter and Command Reference Guide

23.1 About the Parameter and Command Reference Guide

This reference guide provides descriptive information about each parameter and command used in the drive firmware. Parameters and commands are used to configure the drive or to return status information from the drive using the WorkBench terminal screen. The use of these parameters and commands to perform various drive functions is detailed in related sections of the KC1 User Guide.

Drive parameter and command categories include the following:

AIN Parameters (pg 275)	FB2 Parameters (pg 465)	PL Parameters (pg 598)
AIO Parameters (pg 288)	FB3 Parameters (pg 473)	PLS Parameters (pg 616)
AOUT Parameters (pg 292)	GEAR Parameters (pg 479)	REC Parameters (pg 626)
BODE Parameters (pg 301)	GUI Parameters (pg 488)	REGEN Parameters (pg 647)
CAP Parameters (pg 317)	HOME Parameters (pg 500)	SM Parameters (pg 654)
CPS Parameters (pg 330)	HWLS Parameters (pg 515)	STO Parameters (pg 665)
CS Parameters (pg 332)	IL Parameters (pg 518)	SWLS Parameters (pg 667)
DIN Parameters (pg 337)	IP Parameters (pg 555)	UNIT Parameters (pg 675)
DIO Parameters (pg 350)	LOAD-Parameter (pg 561)	TEMP Parameters (pg 672)
DOUT Parameters (pg 353)	MOTOR Parameters (pg 563)	VBUS Parameters (pg 685)
DRV Parameters (pg 362)	MT Parameters and Commands	VL Parameters (pg 694)
EIP Parameters		WS Parameters (pg 723)
FB1 Parameters (pg 435)		

A summary table of information for all parameters and commands is also available:

[Summary of Parameters and Commands](#)

For each parameter or command, this reference guide presents the following tables of information, followed by a description of the command, examples, and links to related information in the User Guide, as appropriate.

General Information	
Type	One of four types: <ul style="list-style-type: none"> • Command: Action or W/O command. • NV Parameter: R/W and stored in nonvolatile (NV) memory • R/W Parameter: Can be either read from or written to the drive. • R/O Parameter: Can only be read from the drive
Description	Brief description of the parameter or command and notes if the parameter or command is not active in all opmodes.
Units	Appropriate units
Range	Permissible range; multiple ranges are sometimes present.
Default Value	Determined at setup process time or motor ID; otherwise set to 0.010.
Data Type	Integer, Boolean, Float, or String
See Also	Links to related information such as other parameters, block diagrams, schematics, or other sections of the product manual.
Start Version	The minimum firmware version number required to use the parameter or command

Additional data types may include the following:

Type	Description
Error	Illegal type=0
b	Boolean

Type	Description
U8	8 x unsigned numbers
S8	8 x signed numbers
U16	16 x unsigned numbers
S16	16 x signed numbers
U32	32 x unsigned numbers
S32	32 x signed numbers
U64	64 x unsigned numbers
S64	64 x signed numbers

23.1.1 Parameter and Command Naming Conventions

Abbreviation	Term
ACC	Acceleration
APP	Apply
CLR	Clear
CS	Controlled Stop
I	Current
D	Current d-component
DEC	Deceleration
DIR	Direction
DIS	Disable
DIST	Distance
EMUE	Emulated encoder
EN	Enable
ERR	Error
F	Fault
FB	Feedback
FF	Feedforward
K	Gain
INT	Integrator
LIM	Limit
L	Loop
MAX	Maximum
MIN	Minimum
N	Negative
NV	Nonvolatile
P	Position, Proportional, Positive
RLS	Release
R	Resistance
STATE	Status, State, Stat
THRESH	Threshold
T	Time
TMAX	Timeout
U	User

Abbreviation	Term
V	Velocity, Volt
W	Warning

23.1.2 Summary of Parameters and Commands

This table contains an alphabetical list of parameters and commands, with a brief description for each. The parameter name and description are linked to the parameter tables. Generally speaking, all parameters and commands are active in all opmodes, with the following exceptions:

Parameter or Command	Active in Opmodes
GEAR (all parameters and commands)	2 (position) only
HOME (all parameters and commands)	2 (position) only
MT (all parameters and commands)	2 (position) only
SM.I1, SM.I2	0 (torque) only
SM.V1, SM.V2	1 (velocity) only
SM.VPM1, SM.VPM2	2 (position) only
VL (all parameters and commands)	1 (velocity) and 2 (position) only

Parameter or Command	Type	Description
Analog Input (AIN)		
AIN.CUTOFF (pg 276)	NV	Sets the analog input low-pass filter cutoff frequency.
AIN.DEADBAND (pg 277)	NV	Sets the analog input signal deadband.
AIN.DEADBANDMODE (pg 279)	NV	Sets the analog input deadband mode.
AIN.ISCALE (pg 281)	NV	Sets the analog current scale factor.
AIN.MODE (pg 282)	NV	Analog input mode
AIN.OFFSET (pg 283)	NV	Sets the analog input offset.
AIN.PSCALE (pg 284)	NV	Sets the analog position scale factor.
AIN.VALUE (pg 285)	R/O	Reads the value of the analog input signal.
AIN.VSCALE (pg 286)	NV	Sets analog velocity scale factor.
AIN.ZERO (pg 287)	Command	Zeroes the analog input signal.
Analog Input 2 (AIN2)		
AIN2.CUTOFF (pg 1)	NV	Sets the analog input 2 low-pass filter cutoff frequency.
AIN2.DEADBAND (pg 1)	NV	Sets the analog input 2 signal deadband.
AIN2.DEADBANDMODE	NV	Sets the analog input 2 deadband mode.
AIN2.MODE	NV	Analog input 2 mode.
AIN2.OFFSET	NV	Sets the analog input 2 offset.
AIN2.VALUE	R/O	Reads the value of the analog input 2 signal.
AIN2.ZERO	Command	Zeroes the analog input 2 signal.
Analog Input/Output (AIO)		
AIO.ISCALE (pg 289)	NV	Sets the analog current scale factor.
AIO.VSCALE (pg 291)	NV	Sets velocity scale factor.
AIO.PSCALE (pg 290)	NV	Sets position scale factor.
Analog Output (AOUT)		
AOUT.CUTOFF (pg 293)	NV	Sets the analog output low-pass filter cutoff frequency.

Parameter or Command	Type	Description
AOUT.ISCALE (pg 294)	NV	Sets the analog current scale factor.
AOUT.MODE (pg 295)	NV	Sets the analog output mode.
AOUT.OFFSET (pg 296)	NV	Sets the analog output offset.
AOUT.PSCALE (pg 297)	NV	Sets the analog position scale factor.
AOUT.VALUE (pg 298)	NV	Reads the analog output value.
AOUT.VALUEU (pg 299)	R/W	Sets the analog output value.
AOUT.VSCALE (pg 300)	NV	Sets the velocity scale factor for analog output.
Analog Output 2 (AOUT2)		
AOUT2.CUTOFF (pg 1)	NV	Sets the analog output 2 low-pass filter cutoff frequency.
AOUT2.MODE	NV	Sets the analog output 2 mode.
AOUT2.OFFSET	NV	Sets the analog output 2 offset.
AOUT2.VALUE	NV	Reads the analog output 2 value.
AOUT2.VALUEU	R/W	Sets the analog output 2 value.
Bode plot (BODE)		
BODE.EXCITEGAP (pg 302)	R/W	Controls how often the excitation is updated.
BODE.FREQ (pg 303)	R/W	Sets the frequency of the sine excitation source.
BODE.IAMP (pg 304)	R/W	Sets current command value used during the Bode procedure.
BODE.IFLIMIT (pg 305)	R/W	Sets the current fault duration limit in seconds for the BODE.MODE 5 stability test.
BODE.IFTHRESH (pg 306)	R/W	Sets the current fault threshold for the BODE.MODE 5 stability test.
BODE.INJECTPOINT (pg 307)	R/W	Sets whether the excitation uses current or velocity excitation type.
BODE.MODE (pg 308)	R/W	Sets the mode of the excitation.
BODE.MODETIMER (pg 311)	R/W	Sets the watchdog timer of the excitation.
BODE.PRBDDEPTH (pg 313)	R/W	Sets the length of the PRB signal before it repeats.
BODE.VAMP (pg 314)	R/W	Sets the amplitude of the excitation when in velocity mode.
BODE.VFLIMIT (pg 315)	R/W	Sets the velocity fault duration limit (seconds) for the BODE.MODE 5 stability test
BODE.VFTHRESH (pg 316)	R/W	Sets the current fault threshold for the BODE.MODE 5 stability test.
Capture (CAP)		
CAP0.EDGE, CAP1.EDGE (pg 318)	NV	Selects the capture edge.
CAP0.EN, CAP1.EN (pg 319)	NV	Enables or disables the related capture engine.
CAP0.EVENT, CAP1.EVENT (pg 320)	NV	Controls the precondition logic.
CAP0.FILTER, CAP1.FILTER (pg 322)	R/W	Controls the precondition logic.
CAP0.MODE, CAP1.MODE (pg 323)	NV	Selects the captured value.

Parameter or Command	Type	Description
CAP0.PLFB, CAP1.PLFB (pg 324)	R/O	Reads captured position value.
CAP0.PREEDGE, CAP1.PREEDGE (pg 325)	NV	Selects the capture precondition edge.
CAP0.PREFILTER, CAP1.PREFILTER	NV	Sets the filter for the precondition input source.
CAP0.PRESELECT, CAP1.PRESELECT (pg 326)	NV	Sets the precondition trigger.
CAP0.STATE, CAP1.STATE (pg 327)	R/O	Indicates whether or not trigger source was captured.
CAP0.T, CAP1.T (pg 328)	R/O	Reads time capture (if time capture was configured).
CAP0.TRIGGER, CAP1.TRIGGER (pg 329)	NV	Specifies the trigger source for the position capture.
Central Power Supply (CPS)		
CPS.STOSTATE (pg 331)	R/O	Returns the status of the safe torque signal for each of a CPS device's strings.
Controlled Stop (CS)		
CS.DEC (pg 333)	NV	Sets the deceleration value for the controlled stop process.
CS.STATE (pg 334)	NV	Returns the internal status of the controlled stop process.
CS.TO (pg 335)	NV	Sets the time value for the drive velocity to be within CS.VTHRESH (pg 336).
CS.VTHRESH (pg 336)	NV	Sets the velocity threshold for the controlled stop.
Digital Input (DIN)		
DIN.HCMD1 TO DIN.HCMD4 (pg 338)	NV	A buffer of commands to be used in digital input "command buffer" mode.
DIN.LCMD1 to DIN.LCMD4 (pg 339)	NV	A buffer of commands to be used in digital input "command buffer" mode.
DIN.ROTARY (PG 340)	R/O	Reads the rotary knob value.
DIN.STATES (PG 341)	R/O	Reads the digital input states.
DIN1.FILTER TO DIN7.FILTER (pg 342)	R/W	Filter mode for digital inputs 1 to 7.
DIO9.INV to DIO11.INV (pg 351)	R/W	Inverting the output voltage of the IO, when in the output direction.
DIN1.MODE TO DIN24.MODE (pg 344)	NV	Sets the digital input modes.
DIN1.PARAM TO DIN7.PARAM (pg 346)	R/W	Sets a value used as an extra parameter for digital inputs nodes.
DIN1.STATE TO DIN7.STATE (pg 348)	R/O	Reads a specific digital input state.
DIN21.FILTER to DIN31.FILTER (pg 1)	R/W	Filter mode for digital inputs 21 to 32.
DIN21.STATE to DIN31.STATE	R/O	Reads a specific digital input state.
DIO		

Parameter or Command	Type	Description
DIO9.INV to DIO11.INV (pg 351)	NV	Inverting the output voltage of the IO, when in the output direction.
DIO9.DIR to DIO11.DIR (pg 352)	NV	Changing direction of the IOs from the X9 connector.
Digital Output (DOUT)		
DOUT.RELAYMODE (pg 354)	R/W	Indicates faults relay mode.
DOUT.STATES (PG 355)	R/O	Reads the state of the two digital outputs.
DOUT1.MODE to DOUT19.MODE (pg 356)	NV	Sets the digital output mode.
DOUT1.PARAM AND DOUT2.PARAM (pg 357)	NV	Sets extra parameters for the digital outputs.
DOUT1.STATE AND DOUT2.STATE (pg 358)	R/O	Reads the digital output state.
DOUT1.STATEU AND DOUT2.STATEU (pg 359)	R/W	Sets the state of the digital output node.
DOUT21.STATE to DOUT31.STATE (pg 1)	R/O	Reads the digital output state.
DOUT21.STATEU to DOUT31.STATEU (pg 1)	R/W	Sets the state of the digital output node.
Drive (DRV)		
DRV.ACC (PG 364)	NV	Describes the acceleration ramp for the velocity loop.
DRV.ACTIVE (PG 365)	R/O	Reads the enable status of an axis.
DRV.BLINKDISPLAY (PG 366)	Command	Causes the display to blink for 10 seconds.
DRV.BOOTTIME (pg 367)	R/O	Returns the time when the current session booted up.
DRV.CLRFAULTHIST (PG 368)	Command	Clears the fault history log in the NV.
DRV.CLRFAULTS (PG 369)	Command	Tries to clear all active faults in the drive.
DRV.CMDDELAY (pg 370)	R/W	Issues a delay before next command is executed.
DRV.CMDSOURCE (PG 371)	NV	Sets the command source (service, fieldbus, analog input, gearing, digital, or Bode).
DRV.CRASHDUMP (pg 372)	Command	Retrieves diagnostic information after the drive crashes.
DRV.DBILIMIT (pg 373)	NV	Sets the maximum amplitude of the current for dynamic braking.
DRV.DEC (PG 374)	NV	Sets the deceleration value for the velocity loop.
DRV.DIFVAR (pg 375)	R/O	Lists all parameters which differ from their default value.
DRV.DIR (pg 376)	R/W	Changes drive direction.
DRV.DIS (PG 377)	Command	Disables the axis (software).
DRV.DISMODOE (pg 378)	NV	Selects among disable immediately or stop and then disable options.
DRV.DISSOURCES (PG 379)	R/O	Returns the possible reason for a drive disable.
DRV.DISSOURCESMASK (pg 380)	R/O	Returns a bitmap of all bits in DRV.DISSOURCES that can be set to one on a given drive.
DRV.DISTO (pg 381)	R/W	Sets the emergency timeout

Parameter or Command	Type	Description
DRV.EMUEDIR (pg 383)	R/W	Sets the direction of the emulated encoder output (EEO) signal.
DRV.EMUEMODE (pg 384)	R/W	Sets the mode of the emulated encoder output (EEO) connector.
DRV.EMUEMTURN (pg 386)	R/W	Defines the location of the index pulse on the EEO (emulated encoder output) when DRV.EMUEMODE=2.
DRV.EMUEPULSEWIDTH (pg 387)		Sets the encoder output pulse width for modes 6 to 7.
DRV.EMUERES (pg 388)	R/W	Sets the resolution of the EEO (emulated encoder output).
DRV.EMUZOFFSET (pg 389)	R/W	Sets the location of the EEO (emulated encoder output) index pulse (when DRV.EMUEMODE=1).
DRV.EN (PG 390)	Command	Enables the axis (software).
DRV.ENDEFAULT (pg 391)	R/W	Sets the default state of the software enable.
DRV.FAULTLIST (PG 392)	R/O	Reads the last 10 faults from NV memory.
DRV.FAULTS (PG 394)	R/O	Reads the active faults.
DRV.FAULT1 to DRV.FAULT10 (pg 393)	R/O	Location of fault codes for any active fault conditions.
DRV.HANDWHEEL (pg 395)	R/O	Reads the EEO input value.
DRV.HANDWHEELSRC (pg 396)	NV	Selects the feedback for handwheel operation.
DRV.HELP (PG 397)	R/O	Reads the minimum, maximum, and default values for a specific parameter or command.
DRV.HELPALL (pg 398)	R/O	Retrieves the minimum, maximum, default, and actual values for all available parameters and commands.
DRV.HWENABLE (pg 399)	R/O	Status of the hardware enable.
DRV.HWENDELAY (pg 400)	NV	Delay time between inactive Hardware Enable input and drive disable.
DRV.HWENMODE (pg 401)	R/W	Selects the action that the hardware enable digital input will perform.
DRV.ICONT (PG 402)	R/O	Reads the continuous rated current value.
DRV.INFO (PG 403)	R/O	Reads general information about the drive.
DRV.IPEAK (PG 405)	R/O	Reads the peak rated current value.
DRV.IZERO (pg 406)	R/W	Sets the current that will be used during the DRV.ZERO procedure.
DRV.LIST (PG 407)	R/O	Reads the list of available parameters and commands.
DRV.LOGICVOLTS (pg 408)	R/O	Reads the logic voltages.
DRV.NAME (PG 412)	NV	Sets and reads the name of the drive.
DRV.NVCHECK (pg 413)	R/O	NV Parameter Checksum
DRV.NVLIST (PG 414)	R/O	Lists the NV parameters and values from the RAM.
DRV.NVLOAD (pg 415)	W/O	Loads all data from the NV memory of the drive into the RAM parameters.
DRV.NVSAVE (PG 416)	Command	Saves the drive parameters from the RAM to the NV memory.
DRV.ONTIME (pg 417)	R/O	Returns how long the drive has been running since last power up.

Parameter or Command	Type	Description
DRV.OPMODE (PG 418)	NV	Sets the drive operation mode (current, velocity, or position).
DRV.READFORMAT (PG 419)	R/W	Sets the value returned to either decimal or hexadecimal.
DRV.RSTVAR (PG 420)	Command	Sets default values in the drive without re-booting the drive and without resetting the NV memory.
DRV.RUNTIME (PG 421)	R/O	Returns how long the drive has been running since first activated.
DRV.SETUPREQBITS (pg 422)	R/O	Reads the bitwise set status of parameters that must be set before the drive can be enabled.
DRV.SETUPREQLIST (pg 423)	R/O	Reads the list of parameters that must be set before the drive can be enabled.
DRV.STOP (PG 424)	Command	This command stops all drive motion.
DRV.TEMPERATURES (pg 425)	R/O	Reads the temperature of drive components.
DRV.TIME (pg 426)	R/W	A continuous time counter in the drive.
DRV.TYPE (pg 427)	R/O	Selects the operational fieldbus on CC drive models.
DRV.VER (PG 428)	R/O	Reads the drive version.
DRV.VERIMAGE (PG 429)	R/O	Returns the version data from each image.
DRV.WARNINGS (pg 431)	R/O	Reads the active warnings.
DRV.WARNING1 to DRV.WARNING10 (pg 430)	R/O	Location of fault codes for any active warning conditions.
DRV.ZERO (pg 432)	R/W	Sets the zero mode. The procedure is activated when the drive is enabled.
EtherNet/IP (EIP)		
EIP.CONNECTED (pg 1)	R/O	Returns state of EtherNet/IP connection.
EIP.POSUNIT	R/W	Unit scaling for Position values over EtherNet/IP.
EIP.PROFUNIT	R/W	Unit scaling for Velocity and Acceleration values over EtherNet/IP.
Fault (FAULT)		
FAULTx.ACTION (pg 434)	R/W	Gets/Sets the Fault Action for Fault 130, 131, 132, 134, 139, 451, and 702.
Feedback 1 (FB1)		
FB1.BISSBITS (pg 436)	NV	Specifies the number of Biss Sensor (Position) Bits for the BiSS Mode C encoder in use.
FB1.ENCRES (PG 437)	NV	Sets the resolution of the motor encoder.
FB1.HALLSTATE (PG 438)	R/O	Reads the Hall switch values (encoder feedback
FB1.HALLSTATEU (pg 439)	R/O	Reads the state of Hall switch U.
FB1.HALLSTATEV (pg 440)	R/O	Reads the state of Hall switch V.
FB1.HALLSTATEW (pg 441)	R/O	Reads the state of Hall switch W.
FB1.IDENTIFIED (PG 442)	R/O	Reads the type of feedback device used by the drive/motor.
FB1.INITSIGNED (pg 443)	NV	Sets initial feedback value as signed or unsigned.
FB1.MECHPOS (PG 444)	R/O	Reads the mechanical position.

Parameter or Command	Type	Description
FB1.MEMVER (PG 445)	R/O	Returns the memory feedback version.
FB1.OFFSET (pg 446)	NV	Sets position feedback offset.
FB1.ORIGIN (pg 447)	NV	Adds to the initial feedback position.
FB1.P (pg 449)	R/O	Reads position from the primary feedback.
FB1.PDIR (pg 450)	NV	Sets the counting direction for feedback channel 1.
FB1.PFIND (pg 451)	R/W	A procedure that allows the user to find the commutation angle for encoder feedback, which has no halls.
FB1.PFINDCMDU (pg 452)	R/W	Current value used during the phase finding procedure (PFB.PFIND=1)
FB1.POFFSET (pg 453)	NV	Sets the offset for primary feedback.
FB1.POLES (PG 454)	R/O	Reads the number of feedback poles.
FB1.PSCALE (pg 455)	R/W	Sets position scaling value for fieldbus transferred position objects.
FB1.PUNIT (pg 456)	NV	Sets the unit for FB1.P.
FB1.RESKTR (pg 457)	NV	Sets the resolver nominal transformation ratio.
FB1.RESREFPHASE (pg 458)	NV	Sets the electrical degrees of phase lag in the resolver.
FB1.SELECT (PG 459)	NV	Sets user entered type or identified type (-1).
FB1.TRACKINGCAL (pg 461)	NV	Controls tracking calibration algorithm.
FB1.USERBYTE0 to FB1.USERBYTE7 (pg 462)	R/W	Reads and writes data stored in two 32 bit words in the Endat feedback device.
FB1.USERDWORD0 to FB1.USERWORD1 (pg 463)	R/W	Reads and writes data stored in two 32 bit words in the Endat feedback device.
FB1.USERWORD1 to FB1.USERWORD3 (pg 464)	R/W	Reads and writes data stored in two 32 bit words in the Endat feedback device.
Feedback 2 (FB2)		
FB2.ENCRESP (pg 466)	NV	Sets the secondary feedback (FB2) resolution
FB2.MODE (pg 467)	R/W	Sets the mode for the second feedback inputs, EEO connector (X9) and high speed opto inputs (pins 9 and 10 on X7).
FB2.P (pg 468)	R/O	Reads position from the secondary feedback.
FB2.DIR (pg 469)	R/W	Sets the counting direction for feedback channel 2.
FB2.POFFSET (pg 470)	NV	Sets the offset for secondary feedback.
FB2.PUNIT (pg 471)	NV	Sets the unit for FB2.P.
FB2.SOURCE (pg 472)	R/W	Sets the source for the second feedback input. Choices are the EEO connectors (X9) which are RS485 inputs, or the X7 connector's high speed opto inputs (pins 9 and 10).
Feedback 3 (FB3)		
FB3.MODE (pg 474)	NV	Selects the type of feedback connected to X9.
FB3.P (pg 475)	RO	Reads position from the tertiary feedback.
FB3.PDIR (pg 476)	NV	Sets the counting direction for feedback channel 3.
FB3.POFFSET (pg 477)	NV	Sets the offset for tertiary feedback.
FB3.PUNIT (pg 478)	NV	Sets the unit for FB3.P.
Fieldbus (FBUS)		

Parameter or Command	Type	Description
FBUS.PARAM1 TO FBUS.PARAM20	NV	Set fieldbus specific meanings.
FBUS.PLLSTATE	R/O	Returns the status of the PLL.
FBUS.PLLTHRESH	NV	Sets number of successful synchronized cycles needed to lock the PLL.
FBUS.PROTECTION (pg 1)	R/W	Controls which parameters are blocked when accessed from tel-net while a fieldbus is operational
FBUS.SAMPLEPERIOD	NV	Sets fieldbus sample period.
FBUS.STATE (pg 1)	R/O	Reads the state of the fieldbus.
FBUS.SYNCACT	R/O	Reads actual distance from the desired sync distance.
FBUS.SYNCDIST	NV	Sets time target for synchronization.
FBUS.SYNCWND	NV	Sets symmetrically arranged window around the desired sync distance.
FBUS.TYPE	R/O	Shows the active fieldbus type.
Gearing (GEAR)		
GEAR.ACCMAX (pg 480)	R/W	Sets the maximum allowed acceleration value; active in opmode 2 (position) only.
GEAR.DECMAX (pg 481)	R/W	Sets the maximum allowed deceleration value; active in opmode 2 (position) only.
GEAR.IN (pg 482)	R/W	Sets the denominator of the electronic gearing ratio; active in opmode 2 (position) only.
GEAR.MODE (pg 483)	R/W	Selects electronic gearing mode; active in opmode 2 (position) only.
GEAR.MOVE (pg 485)	Command	Starts the electronic gearing; active in opmode 2 (position) only.
GEAR.OUT (pg 486)	R/W	Sets the numerator of the electronic gearing ratio; active in opmode 2 (position) only.
GEAR.VMAX (pg 487)	R/W	Reads the maximum allowed velocity value; active in opmode 2 (position) only.
Homing (HOME)		
HOME.ACC (pg 501)	R/W	Sets homing acceleration; active in opmode 2 (position) only.
HOME.AUTOMOVE (pg 502)	R/W	Sets homing auto move flag.
HOME.DEC (pg 503)	R/W	Sets homing deceleration; active in opmode 2 (position) only.
HOME.DIR (pg 504)	NV	Sets homing direction; active in opmode 2 (position) only.
HOME.DIST (pg 505)	R/W	Sets homing distance; active in opmode 2 (position) only.
HOME.FEEDRATE (pg 506)	R/W	Sets homing velocity factor; active in opmode 2 (position) only.
HOME.IPEAK (pg 507)	R/W	Sets the current limit during homing procedure to a mechanical stop; active in opmode 2 (position) only.
HOME.MODE (pg 508)	R/W	Selects the homing mode; active in opmode 2 (position) only.
HOME.MOVE (pg 509)	Command	Starts a homing procedure; active in opmode 2 (position) only.
HOME.P (pg 510)	R/W	Sets home position; active in opmode 2 (position) only.
HOME.PERRTHRESH (pg 511)	R/W	Sets the position lag threshold; active in opmode 2 (position) only.
HOME.REQUIRE (pg 512)	NV	Defines if the axis must be homed before a motion task can be executed.

Parameter or Command	Type	Description
HOME.SET (pg 513)	Command	Immediately sets the home position; active in opmode 2 (position) only.
HOME.V (pg 514)	R/W	Sets homing velocity; active in opmode 2 (position) only.
Hardware Limit Switch (HWLS)		
HWLS.NEGSTATE (pg 516)	R/O	Reads the status of the negative hardware limit switch.
HWLS.POSSTATE (pg 517)	R/O	Reads the status of the positive hardware limit switch.
Current Loop (IL)		
IL.CMD (PG 520)	R/O	Reads the value of the q-component current command.
IL.CMDACC (pg 521)	R/O	Returns the commanded acceleration from the trajectory generator.
IL.CMDU (PG 522)	R/W	Sets the user current command.
IL.DIFOLD (PG 523)	R/O	Reads the drive foldback current limit.
IL.FB (PG 524)	R/O	Reads the actual value of the d-component current.
IL.FBSOURCE (pg 525)	R/W	Sets the feedback source for the current loop. Only applies when MOTOR.TYPE = 4.
IL.FF (pg 526)	R/O	Displays the current loop overall feedforward value.
IL.FOLDFTHRESH (PG 527)	NV	Reads the foldback fault level.
IL.FOLDFTHRESHU (pg 528)	NV	Sets the user value for the foldback fault level.
IL.FOLDWTHRESH (PG 529)	NV	Sets the foldback warning level.
IL.IFOLD (pg 531)	R/O	Reads the overall foldback current limit.
IL.IUFB (PG 532)	R/O	Reads the sigma-delta measured current in the u-winding of the motor.
IL.KACFF (pg 534)	R/W	Sets current loop acceleration feedforward gain value
IL.KBUSFF (pg 535)	R/W	Current loops fieldbus injected feed-forward gain
IL.KP (PG 536)	NV	Sets the proportional gain of the q-component of the PI regulator.
IL.KPDRATIO (PG 537)	NV	Sets the proportional gain of the d-component current PI-regulator as a percentage of IL.KP
IL.KPLOOKUPINDEX (pg 538)	R/W	Sets the index into the Current Loop Gain Scheduling Table.
IL.KPLOOKUPVALUE (pg 539)	R/W	Sets the value of the current loop gain scheduling index.
IL.KPLOOKUPVALUES (pg 540)	R/W	Gets the Current Loop Gain Scheduling Table.
IL.KVFF (pg 541)	R/W	Current loop velocity feed-forward gain.
IL.LIMITN (PG 542)	NV	Sets the negative user (application-specific) current limit.
IL.LIMITP (PG 543)	NV	Sets the positive user (application-specific) current limit.
IL.MFOLDD (PG 544)	NV	Sets the motor foldback maximum time at motor peak current.
IL.MFOLDR (PG 545)	R/O	Sets the motor foldback recovery time.
IL.MFOLDT (PG 546)	NV	Sets the motor foldback time constant of the exponential current drop (foldback).

Parameter or Command	Type	Description
IL.MI2T (pg 547)	R/O	Motor I2t load.
IL.MI2TWITHRESH (pg 548)	NV	Motor I2t load warning threshold.
IL.MIFOLD (PG 549)	R/O	Sets the motor foldback current limit.
IL.MIMODE (pg 550)	NV	Motor protection mode.
IL.OFFSET (pg 551)	RW	A constant current command added to compensate for gravity.
IL.VCMD (PG 552)	R/O	Sets the output of the q-component PI regulator.
IL.VUFB (PG 553)	R/O	Reads the measured voltage on the u-winding of the motor.
IL.VVFB (PG 554)	R/O	Reads the measured voltage on the v-winding of the motor.
IP (Internet Protocol) Parameters		
IP.ADDRESS (pg 556)	NV	Gets/Sets the IP address of the drive.
IP.GATEWAY (pg 557)	NV	Gets/Sets the gateway IP of the drive.
IP.MODE (pg 558)	NV	Sets method of acquiring IP Address.
IP.RESET (pg 559)	Command	Implements new IP settings..
IP.SUBNET (pg 560)	NV	Gets/Sets the IP Subnet mask of the drive.
LOAD Parameters		
LOAD.INERTIA (pg 562)	NV	Sets the load inertia.
MODBUS Parameters		
MODBUS.PIN	R/W	Gets / Sets the Modbus User Units Input parameter
MODBUS.POUT	R/W	Gets / Sets the Modbus User Units Output parameter.
MODBUS.PSCALE	R/W	Gets/Sets the Feedback Resolution (per rev) over Modbus.
MODBUS.SCALING	NV	Selects the scaling mode for Modbus values.
MODBUS.UNITLABEL	R/W	Labels the scaled resolution of a single motor turn.
Parameter or Command	Type	Description
Motor Parameters		
MOTOR.AUTOSET (pg 564)	NV	Determines which drive parameters are calculated automatically.
MOTOR.BRAKE (PG 565)	NV	Sets the presence or absence of a motor brake.
MOTOR.BRAKEIMM (pg 566)	NV	Brake Immediately: in the case of a drive disable, apply the brake in all situations.
MOTOR.BRAKERLS (pg 567)	Command	Allows a user to release or apply the motor brake.
MOTOR.BRAKESTATE (pg 568)	R/O	Reads the actual status of the motor brake.
MOTOR.CTF0 (pg 569)	NV	Sets the thermal constant of the motor coil.
MOTOR.ICONT (PG 570)	NV	Sets the motor continuous current.
MOTOR.IDDATAVALID (pg 571)	R/O	Reports the status of the motor memory.
MOTOR.IMID (pg 572)	R/W	The direct-axis current set point used for induction machine closed-loop control.
MOTOR.IMTR (pg 573)	R/W	Rotor time constant.
MOTOR.INERTIA (PG 574)	NV	Sets the motor inertia.
MOTOR.IPEAK (PG 575)	NV	Sets the motor peak current.
MOTOR.KE (pg 576)		Sets the motor back EMF constant.
MOTOR.KT (PG 577)	NV	Sets the torque constant of the motor.

Parameter or Command	Type	Description
MOTOR.LQLL (PG 578)	NV	Sets the line-to-line motor Lq.
MOTOR.NAME (PG 579)	NV	Sets the motor name.
MOTOR.PHASE (PG 580)	NV	Sets the motor phase.
MOTOR.PITCH (PG 581)	NV	Sets the motor pitch.
MOTOR.POLES (PG 582)	NV	Sets the number of motor poles.
MOTOR.R (PG 583)	NV	Sets the stator winding resistance phase-phase in ohms.
MOTOR.RTYPE (pg 584)	NV	Defines the type of thermal resistor inside the motor.
MOTOR.TBRAKEAPP (PG 585)	NV	The delay time used for applying the motor brake.
MOTOR.TBRAKERLS (PG 586)	NV	The delay time used for releasing the motor brake.
MOTOR.TBRAKETO (pg 587)	NV	Brake apply timeout for vertical axis.
MOTOR.TEMP (pg 588)	R/O	Reads the motor temperature represented as the resistance of the motor PTC or NTC.
MOTOR.TEMPFAULT (pg 589)	NV	Sets the motor temperature fault level.
MOTOR.TEMPWARN (pg 590)	NV	Sets the motor temperature warning level.
MOTOR.TYPE (PG 591)	NV	Sets the motor type.
MOTOR.VMAX (PG 593)	NV	Sets the maximum motor speed.
MOTOR.VOLTMAX (PG 594)	NV	Sets the motor maximum voltage.
MOTOR.VOLTMIN (pg 595)	NV	Sets the minimum voltage for V/f control.
MOTOR.VOLTRATED (pg 596)	NV	Sets the motor rated voltage.
MOTOR.VRATED (pg 597)	NV	Sets the motor rated velocity (not maximum velocity).
Position Loop (PL)		
PL.CMD (PG 599)	NV	Reads the position command directly from the entry to the position loop.
PL.ERR (PG 600)	NV	Reads the position error present when the drive is controlling the position loop.
PL.ERRFTHRESH (pg 601)	NV	Sets the maximum position error.
PL.ERRMODE (pg 603)	R/W	Sets the type of following error warning and fault usage.
PL.ERRWTHRESH (pg 604)	NV	Sets the position error warning level.
PL.FB (PG 605)	R/O	Reads the position feedback value.
PL.FBSOURCE (pg 606)	NV	Sets the feedback source for the position loop.
PL.FILTERTIME (pg 607)	R/W	Sets the position command filter period.
PL.INTINMAX (PG 608)	NV	Limits the input of the position loop integrator by setting the input saturation.
PL.INTOUTMAX (PG 609)	NV	Limits the output of the position loop integrator by setting the output saturation.
PL.KI (PG 610)	NV	Sets the integral gain of the position loop.
PL.KP (PG 611)	NV	Sets the proportional gain of the position regulator PID loop.
PL.MODP1 (pg 612)	R/W	Sets modulo range parameter.

Parameter or Command	Type	Description
PL.MODP2 (pg 613)	R/W	Sets the beginning or end modulo range parameter.
PL.MODPDIR (pg 614)	R/W	Sets the direction for absolute motion tasks.
PL.MODPEN (pg 615)	R/W	Enables the modulo position.
Programmable Limit Switch (PLS)		
PLS.EN (pg 617)	R/W	Enables programmable limit switch (PLS).
PLS.MODE (pg 618)	NV	Selects programmable limit switch mode.
PLS.P1 TO PLS.P8 (pg 619)	NV	Sets the trigger point for programmable limit switches.
PLS.RESET (pg 620)	W/O	Resets programmable limit switch.
PLS.STATE (pg 621)	R/O	Reads the programmable limit switch state.
PLS.T1 TO PLS.T8 (pg 622)	R/W	Sets programmable limit switch time.
PLS.UNITS (pg 623)	R/W	Sets programmable limit switch (PLS) units.
PLS.WIDTH1 TO PLS.WIDTH8 (pg 625)	R/W	Programmable Limit Switch Width
Recorder (REC)		
REC.ACTIVE (PG 627)	R/O	Indicates if data recording is in progress (active).
REC.CH1 to REC.CH6 (pg 628)	R/W	Sets recording channels 1 to 6.
REC.DONE (PG 629)	R/O	Checks whether or not the recorder has finished recording.
REC.GAP (PG 630)	R/W	Specifies the gap between consecutive samples.
REC.NUMPOINTS (PG 631)	R/W	Sets the number of points to record.
REC.OFF (PG 632)	R/W	Turns the recorder OFF.
REC.RECPRMLIST (pg 633)	R/O	Reads the list of recordable parameters.
REC.RETRIEVE (PG 634)	R/O	Transfers all the recorded data to the communication channel.
REC.RETRIEVEDATA (pg 635)	R/W	Retrieves the recorded data without the header.
REC.RETRIEVEFRMT (pg 636)	R/W	Sets the format for recorded data output.
REC.RETRIEVEHDR (pg 637)	R/O	Retrieves the recorded header without the data.
REC.RETRIEVESIZE (pg 638)	R/W	Sets the number of samples that REC.RETRIEVEDATA returns.
REC.STOPTYPE (pg 639)	R/W	Sets the recorder stop type.
REC.TRIG (PG 640)	Command	Triggers the recorder.
REC.TRIGPARAM (pg 641)	R/W	Sets the parameter that triggers the recorder.
REC.TRIGPOS (pg 642)	R/W	Sets the trigger position in the recording buffer.
REC.TRIGPRMLIST (pg 643)	R/O	Reads the list of possible trigger parameters.
REC.TRIGSLOPE (PG 644)	R/W	Sets the trigger slope.
REC.TRIGTYPE (PG 645)	R/W	Sets the trigger type.
REC.TRIGVAL (PG 646)	R/W	Sets the trigger value.
Regen Resistor (REGEN)		
REGEN.POWER (PG 648)	R/O	Reads regen resistor's calculated power.

Parameter or Command	Type	Description
REGEN.POWERFILTERED (pg 649)	R/O	Returns a filtered version of REGEN.POWER .
REGEN.REXT (PG 650)	N/V	Sets the external, user-defined regen resistor resistance.
REGEN.TEXT (pg 651)	R/W	Sets the external regen resistor thermal protection time constant.
REGEN.TYPE (PG 652)	N/V	Sets the regen resistor type.
REGEN.WATTEXT (PG 653)	R/W	Sets the regen resistor's power fault level for an external regen resistor.
SD card (SD)		
SD.LOAD (pg 1)	Command	Loads the drive state (BASIC program and NV parameters) from the SD card to the (s equipped with IO option card only).
SD.SAVE (pg 1)	Command	Saves the drive state (BASIC program and NV parameters) to the SD card (s equipped with IO option card only).
SD.STATUS (pg 1)	R/O	Reads the status of the SD card.
Service Motion (SM)		
SM.I1 (pg 655)	R/W	Sets service motion current 1; active in opmode 0 (torque) only.
SM.I2 (pg 656)	R/W	Sets service motion current 2; active in opmode 0 (torque) only.
SM.MODE (pg 657)	R/W	Sets the service motion mode.
SM.MOVE (pg 660)	Command	Starts the service motion.
SM.T1 (pg 661)	R/W	Sets the service motion time 1.
SM.T2 (pg 662)	R/W	Sets the service motion time 2.
SM.V1 (pg 663)	R/W	Sets service motion velocity 1; active in opmode 1 (velocity) and 2 (position).
SM.V2 (pg 664)	R/W	Sets service motion velocity 2; active in opmode 1 (velocity) and 2 (position).
Safe Torque Off (STO)		
STO.STATE (pg 666)	R/O	Returns the status of the safe torque off.
Software Limit Switch (SWLS)		
SWLS.EN (pg 668)	NV	Enables and disables software travel limit switches.
SWLS.LIMIT0 (pg 669)	NV	Sets the position of the software travel limit switch 0.
SWLS.LIMIT1 (pg 670)	NV	Sets the position of the software travel limit switch 0.
SWLS.STATE (pg 671)	R/O	Reads the actual status of software limit switches.
Temperature (TEMP)		
TEMP.CONTROL (pg 673)	R/O	Reads the temperature of the control board temperature sensor.
TEMP.POWER1 to TEMP.POWER3 (pg 674)	R/O	Reads the temperature of the power board(s) temperature sensor(s).
Units (UNIT)		
UNIT.ACCLINEAR (PG 676)	NV	Sets the linear acceleration/deceleration units.
UNIT.ACCROTARY (PG 677)	NV	Sets the rotary acceleration/deceleration units.
UNIT.LABEL (pg 678)	NV	Sets user-defined name for user-defined position units.
UNIT.PIN (PG 679)	NV	Sets gear IN for the unit conversion.

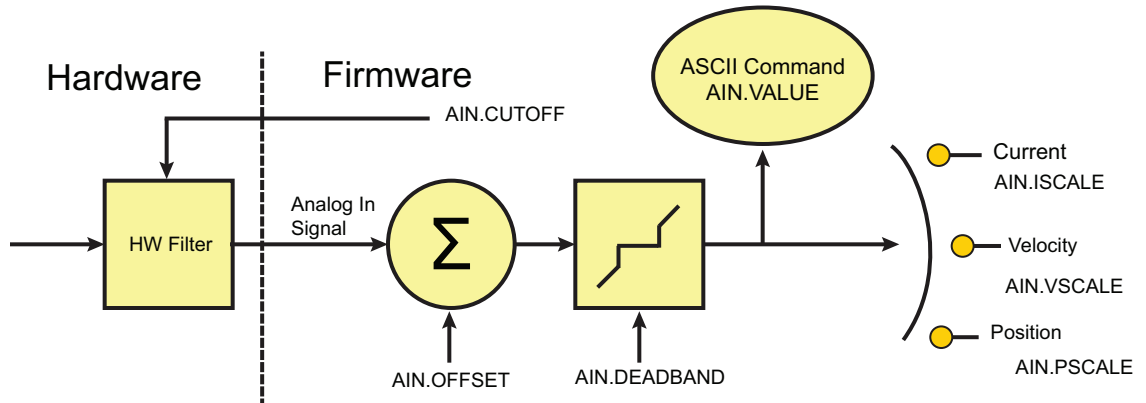
Parameter or Command	Type	Description
UNIT.PLINEAR (PG 680)	NV	Sets the linear position units.
UNIT.POUT (PG 681)	NV	Sets gear out for the unit conversion.
UNIT.PROTARY (PG 682)	NV	Sets the position units when the motor type (MOTOR.TYPE (pg 591)) is rotary.
UNIT.VLINEAR (PG 683)	NV	Sets the linear velocity units.
UNIT.VROTARY (PG 684)	NV	Sets the velocity units when the motor type (MOTOR.TYPE (pg 591)) is rotary.
Bus Volatage (VBUS)		
VBUS.HALFVOLT (pg 686)	NV	Changing voltage thresholds for HV and MV Drives
VBUS.OVFTHRESH (pg 687)	R/O	Reads the over voltage fault level.
VBUS.OVWTHRESH (pg 688)	N/V	Sets voltage level for over voltage warning.
VBUS.RMSLIMIT (pg 689)	R/O	Reads the limit for the bus capacitors load.
VBUS.UVFTHRESH (pg 690)	R/O	Sets the under voltage fault level.
VBUS.UVMODE (pg 691)	NV	Indicates undervoltage (UV) mode.
VBUS.UVWTHRESH (pg 692)	NV	Sets voltage level for undervoltage warning.
VBUS.VALUE (pg 693)	R/O	Reads DC bus voltage.
Velocity Loop (VL)		
VL.ARPF1 TO VL.ARPF4 (pg 695)	R/W	Sets the natural frequency of the pole (denominator) of anti-resonance (AR) filters 1, 2, 3, and 4; active in opmodes 1 (velocity) and 2 (position) only.
VL.ARPQ1 TO VL.ARPQ4 (pg 696)	R/W	Sets the Q of the pole (denominator) of anti-resonance (AR) filter 1; active in opmodes 1 (velocity) and 2 (position) only.
VL.ARTYPE1 TO VL.A-RTYPE4 (pg 697)	NV	Indicates the method used to calculate BiQuad coefficients; active in opmodes 1 (velocity) and 2 (position) only.
VL.ARZF1 TO VL.ARZF4 (pg 698)	R/W	Sets the natural frequency of the zero (numerator) of anti-resonance (AR) filter 1; active in opmodes 1 (velocity) and 2 (position) only.
VL.ARZQ1 TO VL.ARZQ4 (pg 699)	R/W	Sets the Q of the zero (numerator) of anti-resonance filter #1; active in opmodes 1 (velocity) and 2 (position) only.
VL.BUSFF (pg 700)	R/O	Displays the velocity loop feedforward value injected by the field-bus; active in opmodes 1 (velocity) and 2 (position) only.
VL.CMD (PG 701)	R/O	Reads the actual velocity command; active in opmodes 1 (velocity) and 2 (position) only.
VL.CMDU (PG 702)	R/W	Sets the user velocity command; active in opmodes 1 (velocity) and 2 (position) only.
VL.ERR (PG 703)	R/O	Sets the velocity error; active in opmodes 1 (velocity) and 2 (position) only.
VL.FB (PG 704)	R/O	Reads the velocity feedback; active in opmodes 1 (velocity) and 2 (position) only.
VL.FBFILTER (pg 705)	R/O	Filters VL.FB (pg 704) value; active in opmodes 1 (velocity) and 2 (position) only.
VL.FBSOURCE (pg 706)	NV	Sets feedback source for the velocity loop; active in opmodes 1 (velocity) and 2 (position) only.

Parameter or Command	Type	Description
VL.FBUNFILTERED (pg 707)	R/O	Reads the velocity feedback.
VL.FF (pg 708)	R/O	Displays the velocity loop overall feedforward value; active in opmodes 1 (velocity) and 2 (position) only.
VL.GENMODE (PG 709)	NV	Selects mode of velocity generation (Observer, d/dt); active in opmodes 1 (velocity) and 2 (position) only.
VL.KBUSFF (pg 710)	R/W	Sets the velocity loop acceleration feedforward gain value; active in opmodes 1 (velocity) and 2 (position) only.
VL.KI (pg 711)	NV	Sets the velocity loop integral gain for the PI controller; active in opmodes 1 (velocity) and 2 (position) only.
VL.KP (pg 713)	NV	Sets velocity loop proportional gain for the PI controller; active in opmodes 1 (velocity) and 2 (position) only.
VL.KVFF (pg 715)	R/W	Sets the velocity loop velocity feedforward gain value; active in opmodes 1 (velocity) and 2 (position) only.
VL.LIMITN (PG 716)	NV	Sets the velocity lower limit; active in opmodes 1 (velocity) and 2 (position) only.
VL.LIMITP (PG 717)	NV	Sets the velocity high limit; active in opmodes 1 (velocity) and 2 (position) only.
VL.LMJR (pg 717)	R/W	Sets the ratio of the estimated load moment of inertia relative to the motor moment of inertia; active in opmodes 1 (velocity) and 2 (position) only.
VL.MODEL (pg 719)	R/O	Reads the observer velocity signal; active in opmodes 1 (velocity) and 2 (position) only.
VL.OBSBW (pg 720)	NV	Sets the bandwidth of the observer in Hz.
VL.THRESH (PG 721)	NV	Sets the over speed fault value; active in opmodes 1 (velocity) and 2 (position) only.
Wake and Shake (WS)		
WS.ARM (pg 724)	Command	Sets wake and shake to start at the next drive enable.
WS.CHECKMODE (pg 725)	R/W	Select the type of commutation check to execute after Wake and Shake finds a new commutation angle.
WS.CHECKT (pg 726)	R/W	Sets the amount of time a communication error must be present before an error is thrown.
WS.CHECKV (pg 727)	R/W	This parameter sets the velocity threshold which has to be exceeded to activate commutation monitoring.
WS.DISARM (pg 728)	Command	Cancel ARM requests and resets wake and shake to the IDLE state.
WS.DISTMAX (pg 729)	R/W	Sets maximum movement allowed for wake and shake.
WS.DISTMIN (pg 730)	R/W	Sets the minimum movement required for wake and shake.
WS.FREQ (pg 731)	R/W	Sets the sine frequency of excitation for WS.MODE 2.
WS.IMAX (pg 732)	R/W	Sets maximum current used for wake and shake.
WS.MODE (pg 733)	R/W	Sets the method used for wake and shake.
WS.NUMLOOPS (pg 734)	R/W	Sets the number of repetitions for wake and shake.
WS.STATE (pg 735)	R/O	Reads wake and shake status.
WS.T (pg 736)	R/W	Sets wake and shake current-vector appliance time.
WS.TDELAY1 (pg 737)	NV	Delay for wake and shake timing.
WS.TDELAY2 (pg 738)	NV	Sets the delay for wake and shake timing.
WS.TDELAY3 (pg 739)	NV	Sets the delay for wake and shake between loops in mode 0.

Parameter or Command	Type	Description
WS.TIRAMP (pg 740)	R/W	Sets the ramp time for the ramp up current in Wake & Shake mode 1.
WS.TSTANDSTILL (pg 741)	R/W	Sets the calming time of the motor for Wake & Shake mode 1.
WS.VTHRESH (pg 742)	NV	Defines the maximum allowed velocity for Wake & Shake.

23.2 AIN Parameters

This section describes the analog input (AIN) parameters. AIN parameters function as shown in the block diagram below:



23.2.1 AIN.CUTOFF	276
23.2.2 AIN.DEADBAND	277
23.2.3 AIN.DEADBANDMODE	279
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23.2.6 AIN.OFFSET	283
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23.2.8 AIN.VALUE	285
23.2.9 AIN.VSCALE	286
23.2.10 AIN.ZERO	287

23.2.1 AIN.CUTOFF

General Information	
Type	NV Parameter
Description	Sets the analog input low-pass filter cutoff frequency.
Units	Hz
Range	0 to 10,000 Hz
Default Value	5,000 Hz
Data Type	Float
See Also	AIN Parameters (pg 275)
Start Version	M_01-00-00-000

Description

AIN.CUTOFF sets the break frequency in Hz for two cascaded single-pole low-pass filters on the hardware command input. Since the two poles are cascaded at the same frequency, the -3 dB frequency is $0.64 \cdot \text{AIN.CUTOFF}$ in hertz and the 10% to 90% step response rise time is $0.53/\text{AIN.CUTOFF}$ in seconds.

Suggested operating values are as follows:

- Analog torque opmode: 5 kHz
- Analog velocity opmode: 2.5 kHz
- General purpose analog input high resolution: 500 Hz

Related Topics

Analog Input (pg 96)

23.2.2 AIN.DEADBAND

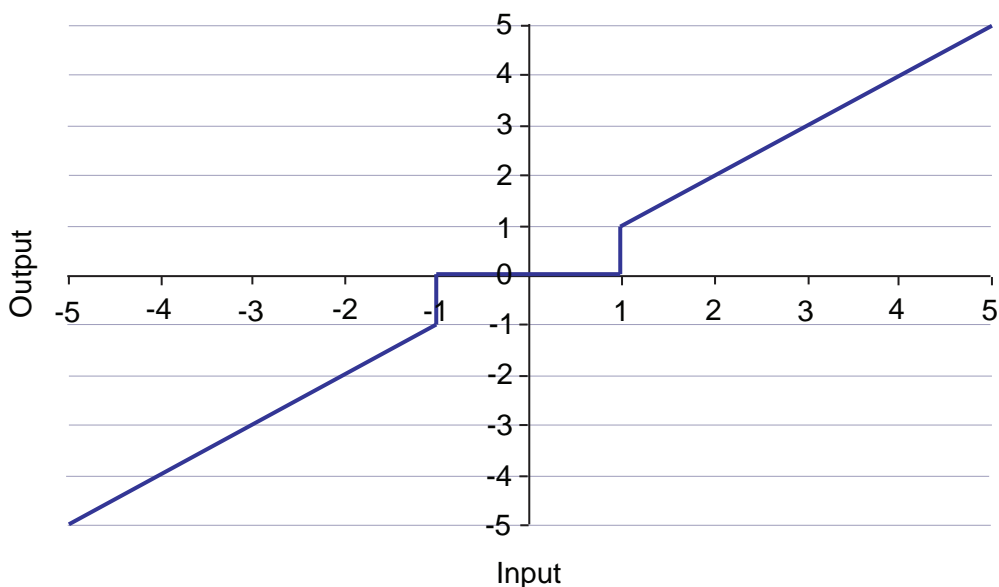
General Information	
Type	NV Parameter
Description	Sets the analog input signal dead-band.
Units	V
Range	0 to 12.5 V
Default Value	0 V
Data Type	Float
Start Version	M_01-00-00-000

Description

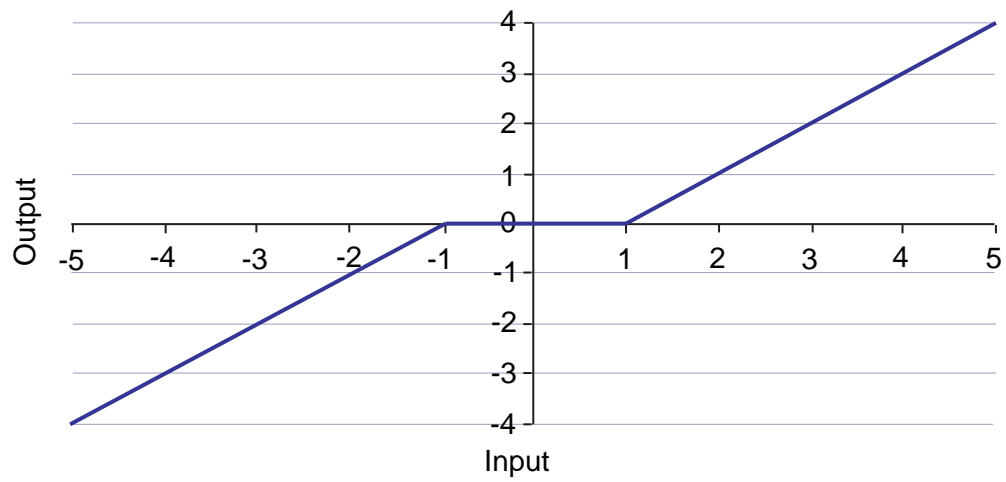
AIN.DEADBAND sets the deadband of the analog input signal. When AIN.DEADBANDMODE is set to 0, and the value of the analog input is less than the value of AIN.DEADBAND, the analog command will be 0. When the analog input is greater or equal to the AIN.DEADBAND, then the analog command will be generated using the scaling specified.

When AIN.DEADBANDMODE is set to 1, the analog command is 0 if the input is less than the deadband value. When the input is greater than the deadband, the output is equal to (Input - Deadband) * Scaling. Below are illustrations of this behavior.

$$\text{Ain.Deadbandmode} = 0 \mid \text{Ain.Deadband} = 1\text{V}$$



Ain.Deadbandmode = 1 | Ain.Deadband = 1V



Related Topics

[Analog Input \(pg 96\)](#)

[Block Diagram for Position/Velocity Loop \(pg 255\) \(for the drive controller environment\).](#)

[AIN Parameters \(pg 275\)](#)

23.2.3 AIN.DEADBANDMODE

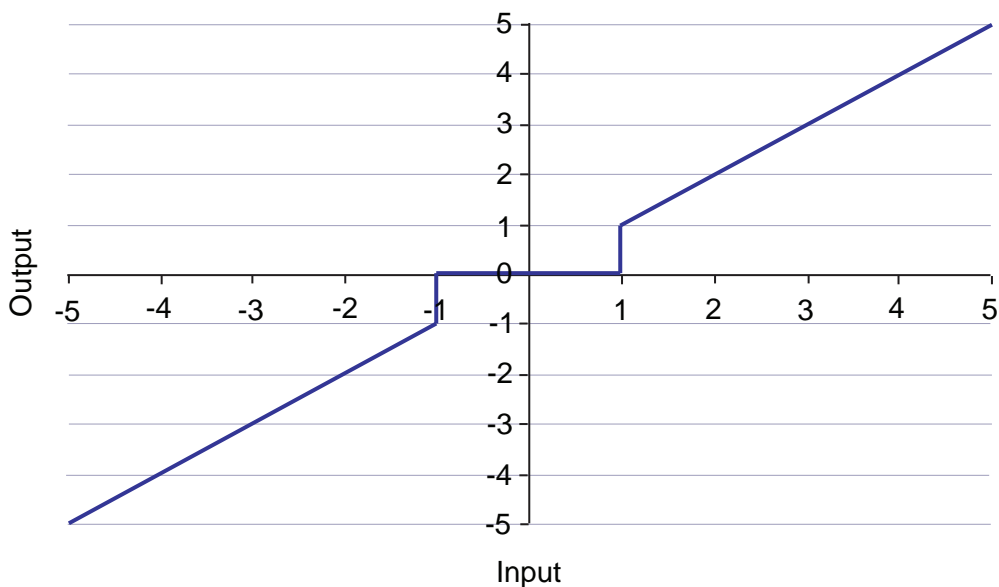
General Information	
Type	NV Parameter
Description	Sets the analog input deadband mode.
Units	N/A
Range	0 to 1
Default Value	0
Data Type	Integer
See Also	AIN.DEADBAND (pg 277)
Start Version	M_01-03-06-000

Description

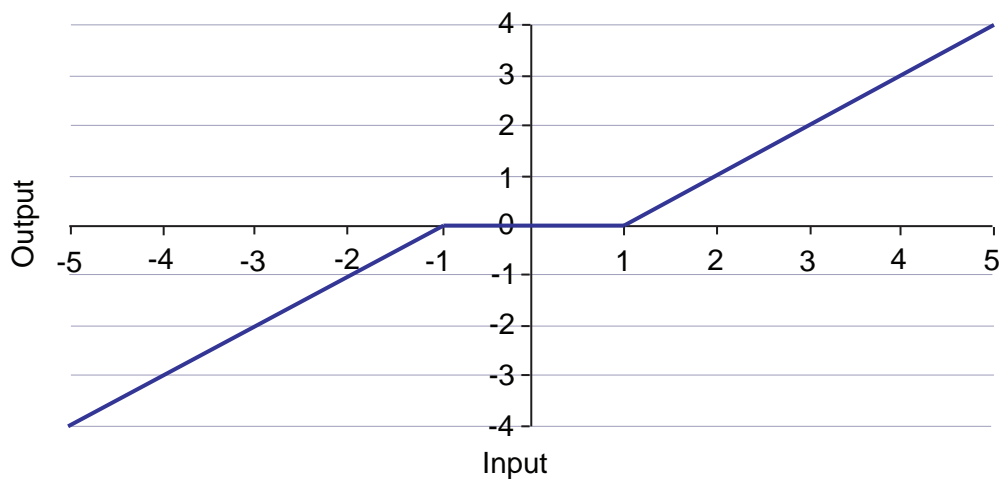
When AIN.DEADBANDMODE is set to 0, and the value of the analog input is less than the value of AIN.DEADBAND, the analog command will be 0. When the analog input is greater or equal to the AIN.DEADBAND, then the analog command will be generated using the scaling specified.

When AIN.DEADBANDMODE is set to 1, the analog command is 0 if the input is less than the deadband value. When the input is greater than the deadband, the output is equal to (Input - Deadband) * Scaling. Below are illustrations of this behavior.

$$\text{Ain.Deadbandmode} = 0 \mid \text{Ain.Deadband} = 1V$$



Ain.Deadbandmode = 1 | Ain.Deadband = 1V



Related Topics

[Analog Input \(pg 96\)](#)

[Block Diagram for Position/Velocity Loop \(pg 255\)\(for the drive controller environment\).](#)

23.2.4 AIN.ISCALE

General Information	
Type	NV Parameter
Description	Sets the analog current scale factor.
Units	A/V
Range	0.001 to 22.4 A/V
Default Value	0.001 A/V
Data Type	Float
See Also	AIN Parameters (pg 275)
Start Version	M_01-01-01-000

Description

AIN.ISCALE sets the analog current scale factor that scales the analog input (AIN.VALUE) for DRV.OPMODE (pg 418) = 1 (analog torque mode).

The value entered is the motor current per 10 V of analog input. This value may be either higher or lower than 100%, but the actual analog input will be limited by the application current limit (IL.LIMITN (pg 542) and IL.LIMITP (pg 543)).

Related Topics

Analog Input (pg 96)

Block Diagram for Position/Velocity Loop (pg 255) (for the drive controller environment).

23.2.5 AIN.MODE

General Information	
Type	NV Parameter
Description	Analog input mode
Units	N/A
Range	0 to 2
Default Value	1
Data Type	Integer
See Also	AIN Parameters (pg 275)
Start Version	M_01-04-09-000

Description

The parameter AIN.MODE is used to assign a functionality to the voltage measured on the analog input pin.

0 – The analog input value is not used by any function.

1 – This mode only works when DRV.CMDSOURCE is set to 3 (analog). The measured voltage will be scaled with:

- AIN.ISCALE if DRV.OPMODE has been set to 0 (torque mode)
- AIN.VSCALE if DRV.OPMODE has been set to 1 (velocity mode)
- AIN.PSCALE if DRV.OPMODE has been set to 2 (position mode)

Afterwards, the value will be forwarded as a command value to the control-loops.

2 – This mode is used for generating a target velocity of a motion task. This mode works when DRV.OPMODE is set to 2 (position) and DRV.CMDSOURCE is set to 0 (service). The measured voltage will be scaled with AIN.VSCALE.

Related Topics

MT.CNTL

DRV.OPMODE (pg 418)

23.2.6 AIN.OFFSET

General Information	
Type	NV Parameter
Description	Sets the analog input offset.
Units	V
Range	-10 to +10 V
Default Value	0 V
Data Type	Float
See Also	AIN Parameters (pg 275), AIN.ZERO (pg 287)
Start Version	M_01-00-00-000

Description

AIN.OFFSET sets the analog offset, which is added to the analog input command to the drive. This value compensates for the analog input signal (AIN.VALUE (pg 285)) offset or drift.

Related Topics

Analog Input (pg 96)

Block Diagram for Position/Velocity Loop (pg 255) (for the drive controller environment).

23.2.7 AIN.PSCALE

General Information	
Type	NV Parameter
Description	Sets the analog position scale factor.
Units	Depends on UNIT.PROTARY (pg 682) or UNIT.PLINEAR (pg 680) Rotary: counts/V, rad/V, deg/V, (Custom Units (pg 77))/V, 16-bit counts/V Linear: counts/V, mm/V, $\mu\text{m}/\text{V}$, (Custom Units (pg 77))/V, 16-bit counts/V
Range	Rotary: 1 to 9,223,372,036,854,775 counts/V 0 to 13,493,026.816 rad/V 0.06 to 179.0 deg/V 0 to 10,737,418.240 (PIN/POUT)/V 0 to 140,737,488,355.327 16-bit counts/V Linear: 1 to 9,223,372,036,854,775 counts/V 0 to 2,147,483.648 mm/V 0 to 2,147,483,648.000 $\mu\text{m}/\text{V}$ 0 to 10,737,418.240 (PIN/POUT)/V 0 to 140,737,488,355.327 16-bit counts/V
Default Value	Rotary: 1 counts/V 0 rad/V 0 deg/V 0 (PIN/POUT)/V 0 16-bit counts/V Linear: 1 count/V 0 rad/V 0 deg/V 0 (PIN/POUT)/V 0 16-bit counts/V
Data Type	Float
Start Version	M_01-01-01-000

Description

AIN.PSCALE is an analog position scale factor that scales the analog input (AIN.VALUE (pg 285)) for DRV.OPMODE (pg 418) = 2, DRV.CMDSOURCE (pg 371) = 3 (analog position mode).

Related Topics

Analog Input (pg 96)

Block Diagram for Position/Velocity Loop (pg 255) (for the drive controller environment).

23.2.8 AIN.VALUE

General Information	
Type	R/O Parameter
Description	Reads the value of the analog input signal.
Units	V
Range	-12.5 to +12.5 V
Default Value	N/A
Data Type	Float
See Also	AIN.OFFSET (pg 283), AIN.ZERO (pg 287), AIN Parameters (pg 275)
Start Version	M_01-00-00-000

Description

AIN.VALUE reads the analog input value after the value is filtered (as shown in the Analog Input Block Diagram).

Related Topics

Analog Input (pg 96)

Block Diagram for Position/Velocity Loop (pg 255) (for the drive controller environment).

23.2.9 AIN.VSCALE

General Information	
Type	NV Parameter
Description	Sets analog velocity scale factor.
Units	Depends on UNIT.VROTARY (pg 684) or UNIT.ACCLINEAR (pg 676) Rotary: rpm/V, rps/V, (deg/s)/V, [(Custom Units (pg 77))/s]/V, (rad/s)/V Linear: counts/s/V, (mm/s)/V, (µm/s)/V, [(Custom Units (pg 77))/s]/V
Range	Rotary: 0.060 to 60,000 rpm/V 0.001 to 1,000 rps/V 0.359 to 360,000 (deg/s)/V 0.005 to 5,000 [(Custom Units (pg 77))/s]/V 0.006 to 6,283.186 (rad/s)/V Linear: 0.001 to 1.000 counts/s/V 0.001*MOTOR.PITCH (pg 581) to 1,000.000*MOTOR.PITCH (pg 581) (mm/s)/V 0.998*MOTOR.PITCH (pg 581) to 1,000,000.000*MOTOR.PITCH (pg 581) (µm/s)/V 0.005 to 5,000 [(Custom Units (pg 77))/s]/V
Default Value	Rotary: 0.060 rpm/V 0.001 rps/V 0.359 (deg/s)/V 0.005 [(Custom Units (pg 77))/s]/V 0.006 (rad/s)/V Linear: 0.001 counts/s/V 0.001*MOTOR.PITCH (pg 581) (mm/s)/V 0.998*MOTOR.PITCH (pg 581) (µm/s)/V 0.005 to 5,000 [(Custom Units (pg 77))/s]/V
Data Type	Float
See Also	N/A
Start Version	M_01-02-00-000

Description

AIN.VSCALE is an analog velocity scale factor that scales the analog input AIN.VALUE (pg 285) for DRV.OPMODE (pg 418) = 1 (analog velocity mode).

The value entered is the motor velocity per 1 V of analog input. This value may be either higher or lower than the application velocity limit (VL.LIMITP (pg 717) or VL.LIMITN (pg 716)), but the actual analog I/O will be limited by VL.LIMITP (pg 717) or VL.LIMITN (pg 716).

Related Topics

Analog Input (pg 96)

Block Diagram for Position/Velocity Loop (pg 255) (for the drive controller environment).

23.2.10 AIN.ZERO

General Information	
Type	Command
Description	Zeroes the analog input signal.
Units	N/A
Range	N/A
Default Value	N/A
Data Type	N/A
See Also	AIN.VALUE (pg 285), AIN.OFFSET (pg 283)
Start Version	M_01-00-00-000

Description

AIN.ZERO causes the drive to zero the analog input signal (AIN.VALUE (pg 285)). You may need to execute this command more than once to achieve zero offset, and AIN.OFFSET is modified in this process.

Related Topics

Analog Input (pg 96)

Block Diagram for Position/Velocity Loop (pg 255) (for the drive controller environment).

23.3 AIO Parameters

This section describes the AIO parameters.

23.3.1 AIO.ISCALE	289
23.3.2 AIO.PSCALE	290
23.3.3 AIO.VSCALE	291

23.3.1 AIO.ISCALE

General Information	
Type	NV Parameter
Description	Sets the analog current scale factor.
Units	A/V
Range	0.001 to 22.4 A/V
Default Value	0.001 A/V
Data Type	Float
See Also	AIN Parameters (pg 275)
Start Version	M_01-00-00-000
End Version	M_01-01-01-000

Description

AIO.ISCALE sets the analog current scale factor that scales the following:

- The analog input (AIN.VALUE (pg 285)) for DRV.OPMODE (pg 418) = 0 (analog torque mode), DRV.CMDSOURCE = 3 (analog).
- The analog output (AOUT.VALUE (pg 298)) for AOUT.MODE (pg 295) = 5 or 6. The value entered is the motor current per 1 V of analog input or output. This value may be either higher or lower than 100%, but the actual analog I/O will be limited by the application current limit (IL.LIMITN and IL.LIMITP).

23.3.2 AIO.PSCALE

General Information	
Type	NV Parameter
Description	Sets position scale factor.
Units	Depends on UNIT.PROTARY (pg 682) or UNIT.PLINEAR (pg 680) Rotary: counts/V, rad/V, deg/V, (Custom Units (pg 77))/V, 16-bit counts/V Linear: counts/V, mm/V, um/V, (Custom Units (pg 77))/V, 16-bit counts/V
Range	Rotary: 1 to 9,223,372,036,854,775 counts/V 0 to 13,493,026.816 rad/V 0 to 773,094,113.280 deg/V 0 to 10,737,418.240 (Custom Units (pg 77))/V 0 to 140,737,488,355.327 16-bit counts/V Linear: 1 to 9,223,372,036,854,775 counts/V 0 to 2147483.648 mm/V 0 to 2147483648.000 um/V 0 to 10737418.240 (Custom Units (pg 77))/V 0 to 140737488355.327 16-bit counts/V
Default Value	Rotary: 1 counts/V 0 rad/V 0 deg/V 0 (Custom Units (pg 77))/V 0 16-bit counts/V Linear: 1 count/V 0 rad/V 0 deg/V 0 (Custom Units (pg 77))/V 0 counts 16 bit/V
Data Type	Float
See Also	Analog Input Block Diagram
Start Version	M_01-00-00-000
End Version	M_01-01-01-000

Description

AIO.PSCALE is an analog position scale factor that scales:

1. The analog input (AIN.VALUE (pg 285)) for DRV.OPMODE (pg 418) = 2, DRV.CMDSOURCE (pg 371) = 3 (analog position mode)
2. The analog output (AOUT.VALUE (pg 298)) for AOUT.MODE (pg 295) = 6, or 7. (actual position or position error) per 10 V of analog input or output.

23.3.3 AIO.VSCALE

General Information	
Type	NV Parameter
Description	Sets velocity scale factor.
Units	Depends on UNIT.VROTARY (pg 684) or UNIT.ACCLINEAR (pg 676) Rotary: rpm/V, rps/V, (deg/s)/V, [(Custom Units (pg 77))/s]/V, (rad/s)/V Linear: counts/s/V, (mm/s)/V, (um/s)/V, [(Custom Units (pg 77))/s]/V
Range	Rotary: 0.060 to 60,000 rpm/V 0.001 to 1,000 rps/V 0.359 to 360,000 (deg/s)/V 0.005 to 5,000 [(Custom Units (pg 77))/s]/V 0.006 to 6,283.186 (rad/s)/V Linear: 0.001 to 1.000 counts/s/V 0.001*MOTOR.PITCH (pg 581) to 1,000.000*MOTOR.PITCH (pg 581) (mm/s)/V 0.998*MOTOR.PITCH (pg 581) to 1,000,000.000*MOTOR.PITCH (pg 581) (um/s)/V 0.005 to 5,000 [(Custom Units (pg 77))/s]/V
Default Value	Rotary: 0.060 rpm/V 0.001 rps/V 0.359 (deg/s)/V 0.005 [(Custom Units (pg 77))/s]/V 0.006 (rad/s)/V Linear: 0.001 counts/s/V 0.001*MOTOR.PITCH (pg 581) (mm/s)/V 0.998*MOTOR.PITCH (pg 581) (um/s)/V 0.005 to 5,000 [(Custom Units (pg 77))/s]/V
Data Type	Float
See Also	Analog Input Block Diagram
Start Version	M_01-00-00-000
End Version	M_01-01-01-000

Fieldbus Information

Description

AIO.VSCALE is an analog velocity scale factor that scales:

- The analog input (AIN.VALUE) for DRV.OPMODE = 2 (analog velocity mode)
- The analog output (AOUT.VALUE) for AOUT.MODE = 1, 3, or 7. The value entered is the motor velocity per 10 V of analog input or output. This value may be either higher or lower than the application velocity limit (VL.LIMITP or VL.LIMITN), but the actual analog I/O will be limited by VL.LIMITP or VL.LIMITN.

23.4 AOUT Parameters

This section describes the AOUT parameters.

23.4.1 AOUT.CUTOFF	293
23.4.2 AOUT.ISCALE	294
23.4.3 AOUT.MODE	295
23.4.4 AOUT.OFFSET	296
23.4.5 AOUT.PSCALE	297
23.4.6 AOUT.VALUE	298
23.4.7 AOUT.VALUEU	299
23.4.8 AOUT.VSCALE	300

23.4.1 AOUT.CUTOFF

General Information	
Type	NV Parameter
Description	Sets the analog output low-pass filter cutoff frequency.
Units	Hz
Range	0 to 10,000 Hz
Default Value	0 Hz
Data Type	Float
See Also	Analog Output (pg 96)
Start Version	M_01-04-01

Description

AOUT.CUTOFF sets the cutoff frequency in Hz for a single-pole low-pass filter on the Analog Output.

A value of 0 Hz will turn off the filter and will allow all frequencies to pass through.

The filter can be used with all modes of Analog Output.

Related Topics

Analog Output (pg 96)

23.4.2 AOUT.ISCALE

General Information	
Type	NV Parameter
Description	Sets the analog current scale factor.
Units	A/V
Range	0.001 to 22.4 A/V
Default Value	0.001 to 22.4 A/V
Data Type	Float
See Also	AOUT.VALUE (pg 298)
Start Version	M_01-01-01-000

Description

AOUT.ISCALE sets the analog current scale factor that scales the analog output (AOUT.VALUE) for AOUT.MODE = 4 or 5. The value entered is the motor current per 10 V of analog input or output. This value may be either higher or lower than 100%, but the actual analog I/O will be limited by the application current limit (IL.LIMITN (pg 542) and IL.LIMITP (pg 543)).

Related Topics

Analog Output (pg 96)

23.4.3 AOUT.MODE

General Information	
Type	NV Parameter
Description	Sets the analog output mode.
Units	N/A
Range	0 to 11
Default Value	0
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

Description

AOUT.MODE sets the analog output functionality.

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

Example

You can use AOUT.MODE and AOUT.VALUEU to configure an output signal as follows:

```
-->AOUT.MODE 0
-->AOUT.VALUEU 5
-->AOUT.VALUEU 4.33
```

Related Topics

Analog Output (pg 96)

23.4.4 AOUT.OFFSET

General Information	
Type	NV Parameter
Description	Sets the analog output offset.
Units	V
Range	-10 to +10 V
Default Value	0 V
Data Type	Float
See Also	N/A
Start Version	M_01-00-00-000

Description

This parameter sets the analog output offset.

Related Topics

Analog Output (pg 96)

23.4.5 AOUT.PSCALE

General Information	
Type	NV Parameter
Description	Sets the analog position scale factor.
Units	Depends on UNIT.PROTARY (pg 682) or UNIT.PLINEAR (pg 680) Rotary: counts/V, rad/V, deg/V, (Custom Units (pg 77))/V, 16-bit counts/V Linear: counts/V, mm/V, μm/V, (Custom Units (pg 77))/V, 16-bit counts/V
Range	Rotary: 1 to 9,223,372,036,854,775 counts/V 0 to 13,493,026.816 rad/V 0 to 773,094,113.280 deg/V 0 to 10,737,418.240 (Custom Units (pg 77))/V 0 to 140,737,488,355.327 16-bit counts/V Linear: 1 to 9,223,372,036,854,775 counts/V 0 to 2,147,483.648 mm/V 0 to 2,147,483,648.000 μm/V 0 to 10,737,418.240 (Custom Units (pg 77))Custom Units (pg 77))/V 0 to 140,737,488,355.327 16-bit counts/V
Default Value	Rotary: 1 counts/V 0 rad/V 0 deg/V 0 (Custom Units (pg 77))/V 0 16-bit counts/V Linear: 1 counts/V 0 rad/V 0 deg/V 0 (Custom Units (pg 77))/V 0 counts 16 bit/V
Data Type	Float
See Also	AOUT.VALUE (pg 298)
Start Version	M_01-01-01-000

Description

AOUT.PSCALE is an analog position scale factor that scales the analog output (AOUT.VALUE (pg 298)) for AOUT.MODE (pg 295) = 6, or 7 (actual position or position error) per 10 V of analog input or output.

Related Topics

Analog Output (pg 96)

23.4.6 AOUT.VALUE

General Information	
Type	R/O Parameter
Description	Reads the analog output value.
Units	V
Range	-10 to +10 V
Default Value	0
Data Type	Float
See Also	N/A
Start Version	M_01-00-00-000

Description

AOUT.VALUE reads the analog output value.

Related Topics

Analog Output (pg 96)

23.4.7 AOUT.VALUEU

General Information	
Type	R/W Parameter
Description	Sets the analog output value.
Units	V
Range	-10 to +10 V
Default Value	0
Data Type	Float
See Also	N/A
Start Version	M_01-00-00-000

Description

AOUT.VALUEU reads/writes the analog output value when AOUT.MODE (pg 295) = 0 (analog output signal is determined by the user).

Related Topics

Analog Output (pg 96)

23.4.8 AOUT.VSCALE

General Information	
Type	NV Parameter
Description	Sets the velocity scale factor for analog output.
Units	Depends on UNIT.VROTARY or UNIT.ACCLINEAR Rotary: rpm/V, rps/V, (deg/s)/V, [(custom units)/s]/V, (rad/s)/V Linear: counts/s/V, (mm/s)/V, (μm/s)/V, [(custom units)/s]/V
Range	Rotary: 0.060 to 60,000 rpm/V 0.001 to 1,000 rps/V 0.359 to 360,000 (deg/s)/V 0.005 to 5,000 [(custom units)/s]/V 0.006 to 6,283.186 (rad/s)/V Linear: 0.001 to 1.000 counts/s/V 0.001*MOTOR.PITCH to 1,000.000*MOTOR.PITCH (mm/s)/V 0.998*MOTOR.PITCH to 1,000,000.000*MOTOR.PITCH(μm/s)/V 0.005 to 5,000 [(custom units)/s]/V
Default Value	Rotary: 0.060 rpm/V 0.001 rps/V 0.359 (deg/s)/V 0.005 [(custom units)/s]/V 0.006 (rad/s)/V Linear: 0.001 counts/s/V 0.001*MOTOR.PITCH (mm/s)/V 0.998*MOTOR.PITCH (μm/s)/V 0.005 [(custom units)/s]/V
Data Type	Float
See Also	AOUT.VALUE
Start Version	M_01-00-00-000

Description

AOUT.VSCALE is an analog velocity scale factor that scales the analog output (AOUT.VALUE) for AOUT.MODE = 1, 2, or 3. The value entered is the motor velocity per 10 V of analog output. This value may be either higher or lower than the application velocity limit (VL.LIMITP or VL.LIMITN), but the actual analog I/O will be limited by VL.LIMITP or VL.LIMITN.

Related Topics

Analog Output (pg 96)

23.5 BODE Parameters

This section describes the BODE parameters.

23.5.1 BODE.EXCITEGAP	302
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23.5.1 BODE.EXCITEGAP

General Information	
Type	R/W Parameter
Description	Controls how often the excitation is updated.
Units	Drive samples
Range	1 to 255 drive samples
Default Value	2 drive samples
Data Type	N/A
See Also	BODE.MODE (pg 308)
Start Version	M_01-00-00-000

Description

BODE.EXCITEGAP controls how often the excitation is updated. The excitation is updated every n drive samples, where n is BODE.EXCITEGAP. For example, if BODE.EXCITEGAP = 2, then the excitation is updated every $2/(16,000 \text{ Hz}) = 1/8,000 \text{ Hz} = 0.000125 \text{ sec}$. When measuring a system, update the excitation only as often as the data is recorded.

Example

Set excitation update rate to 8,000 Hz:

```
-->BODE.EXCITEGAP 2
```

Set excitation update rate to 4,000 Hz:

```
-->BODE.EXCITEGAP 4
```

Get excitation update rate (already set to 8000 Hz):

```
-->BODE.EXCITEGAP 2
```

Related Topics

Using the Performance Servo Tuner (pg 146) | Using the Performance Servo Tuner: Advanced (pg 150)

Scope (pg 191)

Settings (pg 43)

F126 (pg 228)

Error: Invalid Bode plot mode for this function. (pg 246) and other errors)

23.5.2 BODE.FREQ

General Information	
Type	R/W Parameter
Description	Sets the frequency of the sine excitation source.
Units	Hz
Range	0 to 8,000 Hz
Default Value	0 Hz
Data Type	Float
See Also	BODE.MODE (pg 308) BODE.INJECTPOINT (pg 307), BODE.IAMP, BODE.VAMP (pg 314)
Start Version	M_01-00-00-000

Description

BODE.FREQ sets the frequency of the sine excitation source in Hz. The sine excitation source is used to take frequency response measurements of a system.

Example

Setting up a sine excitation source of 0.2 A at 50 Hz:

```
-->BODE.INJECTPOINT 1
-->BODE.IAMP 0.2
-->BODE.FREQ 50.0
-->BODE.MODE 2
```

Related Topics

Using the Performance Servo Tuner (pg 146)

Using the Performance Servo Tuner: Advanced (pg 150)

Scope (pg 191)

Settings (pg 43)

F126 (pg 228)

Error: Invalid Bode plot mode for this function. (pg 246) (and others)

23.5.3 BODE.IAMP

General Information	
Type	R/W Parameter
Description	Sets current command value used during the Bode procedure.
Units	A
Range	+/- Combined drive and motor current limit
Default Value	0.2 A
Data Type	Float
See Also	BODE.INJECTPOINT (pg 307), BODE.FREQ (pg 303)
Start Version	M_01-00-00-000

Description

BODE.IAMP sets the amplitude of the excitation when in current mode as set in BODE.INJECTPOINT. When using BODE.MODE (pg 308) = 1 and BODE.INJECTPOINT (pg 307) = 1, this parameter will determine the level of noise injected to commanded current value.

Example

Set the excitation current to 0.2 A:

```
-->BODE.IAMP 0.2
```

Get the excitation current (already set to 0.2 A):

```
-->BODE.IAMP 0.200 [A]
```

Related Topics

Using the Performance Servo Tuner (pg 146)

Using the Performance Servo Tuner: Advanced (pg 150)

Scope (pg 191)

Settings (pg 43)

F126 (pg 228)

Error: Invalid Bode plot mode for this function. (pg 246) (and others)

23.5.4 BODE.IFLIMIT

General Information	
Type	R/W Parameter
Description	Sets the current fault duration limit in seconds for the BODE.MODE 5 stability test.
Units	s
Range	0.001 to 60.000
Default Value	0
Data Type	Decimal
See Also	BODE.MODE (pg 308), BODE.MODETIMER (pg 311), BODE.IFTHRESH (pg 306), BODE.VFLIMIT (pg 315), BODE.VFTHRESH (pg 316)
Start Version	M_01-02-10-000

Description

When BODE.MODE is set to 5, the firmware monitors the drive current (IL.CMD (pg 520)). When IL.CMD goes above BODE.IFTHRESH (pg 306), an internal counter records the length of time IL.CMD was above BODE.IFTHRESH. If the internal counter reaches BODE.IFLIMIT, Fault 133 – Instability during Autotune will be generated.

The smaller BODE.IFLIMIT, the quicker Fault 133 will be generated when IL.CMD exceeds BODE.IFLIMIT.

Example

Set BODE.IFTHRESH to 6 Amps:

```
-->BODE.IFTHRESH 6
```

Set BODE.IFLIMIT to 0.500 seconds:

```
-->BODE.IFLIMIT 0.5
```

Set BODE.MODE to 5 to enable stability detection:

```
BODE.MODE 5
```

Related Topics

Using the Performance Servo Tuner (pg 146)

Using the Performance Servo Tuner: Advanced (pg 150)

F133 (pg 229)

23.5.5 BODE.IFTHRESH

General Information	
Type	R/W Parameter
Description	Sets the current fault threshold for the BODE.MODE 5 stability test.
Units	A
Range	0.001 to DRV.IPEAK or MOTOR.IPEAK (whichever is lowest) A
Default Value	0 A
Data Type	Decimal
See Also	BODE.MODE (pg 308), BODE.MODETIMER (pg 311), BODE.VFLIMIT (pg 315), BODE.VFTHRESH (pg 316), BODE.IFLIMIT (pg 305)
Start Version	M_01-02-10-000

Description

When BODE.MODE (pg 308) is set to 5, the firmware monitors the drive current (IL.CMD (pg 520)). When IL.CMD goes above BODE.IFTHRESH, an internal counter records the length of time IL.CMD was above BODE.IFTHRESH. If the internal counter reaches BODE.IFLIMIT (pg 305), Fault 133 (Instability during Autotune) is generated.

Example

Set BODE.IFTHRESH to 6 Amps:

```
-->BODE.IFTHRESH 6
```

Set BODE.IFLIMIT to 0.500 seconds:

```
-->BODE.IFLIMIT 0.5
```

Set BODE.MODE to 5 to enable stability detection:

```
BODE.MODE 5
```

Related Topics

Using the Performance Servo Tuner (pg 146)

Using the Performance Servo Tuner: Advanced (pg 150)

F133 (pg 229)

23.5.6 BODE.INJECTPOINT

General Information	
Type	R/W Parameter
Description	Sets whether the excitation uses current or velocity excitation type.
Units	N/A
Range	0 to 2
Default Value	0
Data Type	Integer
See Also	BODE.IAMP (pg 304), BODE.MODE (pg 308), BODE.VAMP (pg 314)
Start Version	M_01-00-00-000

Description

BODE.INJECTPOINT sets whether the excitation uses current or velocity excitation type.

BODE.INJECTPOINT	Description
0	None
1	Current
2	Velocity

Example

Set BODE.INJECTPOINT to current:

```
-->BODE.INJECTPOINT 1
```

Get BODE.INJECTPOINT (already set to current):

```
-->BODE.INJECTPOINT 1
```

Related Topics

Using the Performance Servo Tuner (pg 146)

Using the Performance Servo Tuner: Advanced (pg 150)

Scope (pg 191)

Settings (pg 43)

F126 (pg 228)

Error: Invalid Bode plot mode for this function. (pg 246) and others)

23.5.7 BODE.MODE

General Information	
Type	R/W Parameter
Description	Sets the mode of the excitation.
Units	N/A
Range	0 to 4
Default Value	0
Data Type	Integer
See Also	BODE.INJECTPOINT (pg 307)BODE.VAMP (pg 314)
Start Version	M_01-00-00-000

Description

BODE.MODE sets the mode of the excitation. The excitation can be set to the modes shown in the table below. BODE.MODE is always set to **None** when Ethernet communication is disconnected. The peak amplitude of the excitation is set by either BODE.IAMP or BODE.VAMP (depending on BODE.INJECTPOINT).

BODE.MODE is subject to a watchdog timer (BODE.MODETIMER) as follows:

- If BODE.MODETIMER is 0, then BODE.MODE is not affected.
- If BODE.MODETIMER is set to a value greater than 0, then BODE.MODE will be set to 0 (None) after the BODE.MODETIMER time milliseconds.
- If BODE.MODE is a nonzero value, and you reset BODE.MODE to another nonzero value, you will reset the watchdog timer. This mechanism is intended to turn off the excitation signal if you lose communication with the drive.

BODE.MODE	Description	Comments
0	None	Turns all excitation off
1	PRB	Uses Pseudo Random Binary (PRB) excitation. PRB is a signal that is always +/- peak amplitude, varying only in phase. PRB excitation results in a flat excitation frequency spectrum. PRB results in a high peak excitation amplitude, which can help minimize friction in a frequency response test. PRB excitation repeats every $(2^{BODE.PRBDEPTH}) / BODE.EXCITEGAP$ drive samples. This repetition can be used to reveal the effects of friction.
2	Sine	Uses Sine excitation
3	Noise	Uses random noise excitation. Noise is a random number generator that varies between +/- peak amplitude.
4	Offset	Sets a torque offset equal to BODE.IAMP

Example

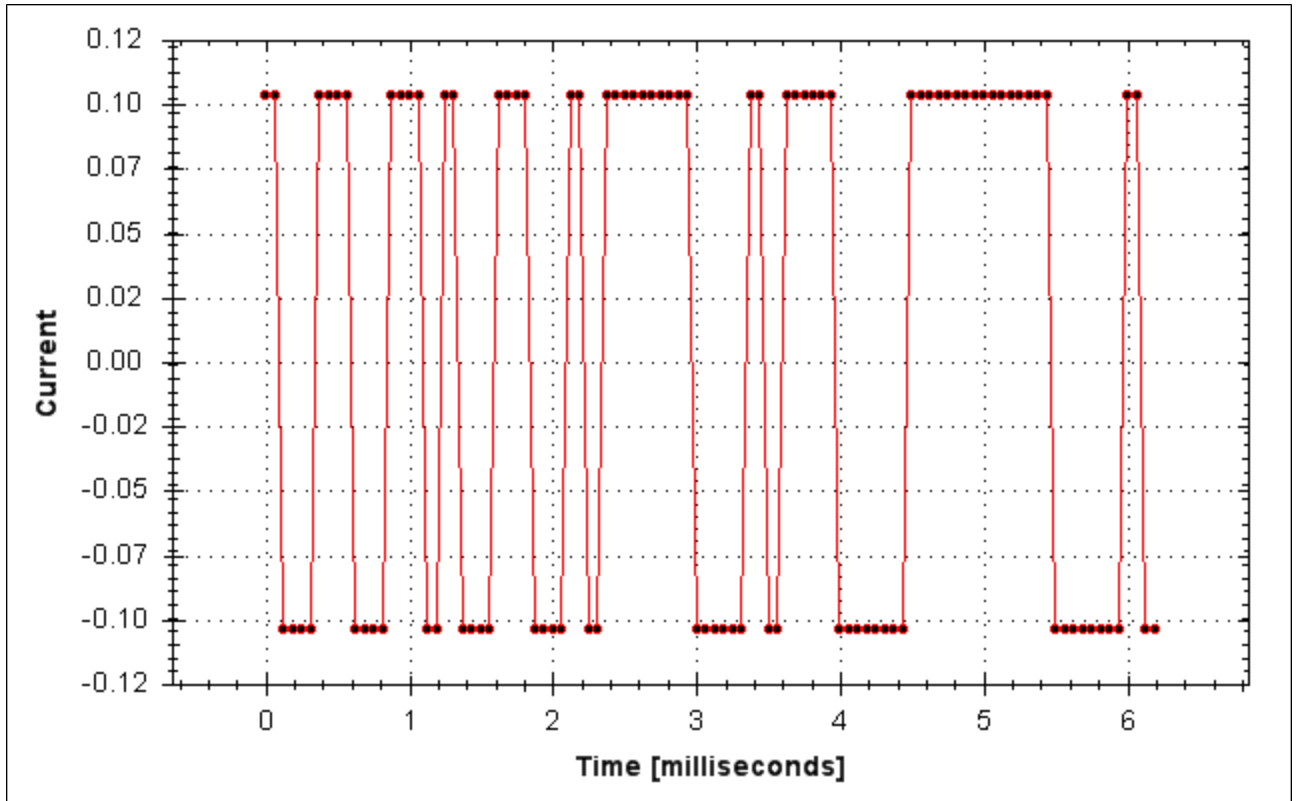
Set BODE.MODE to PRB:

```
-->BODE.MODE 1
```

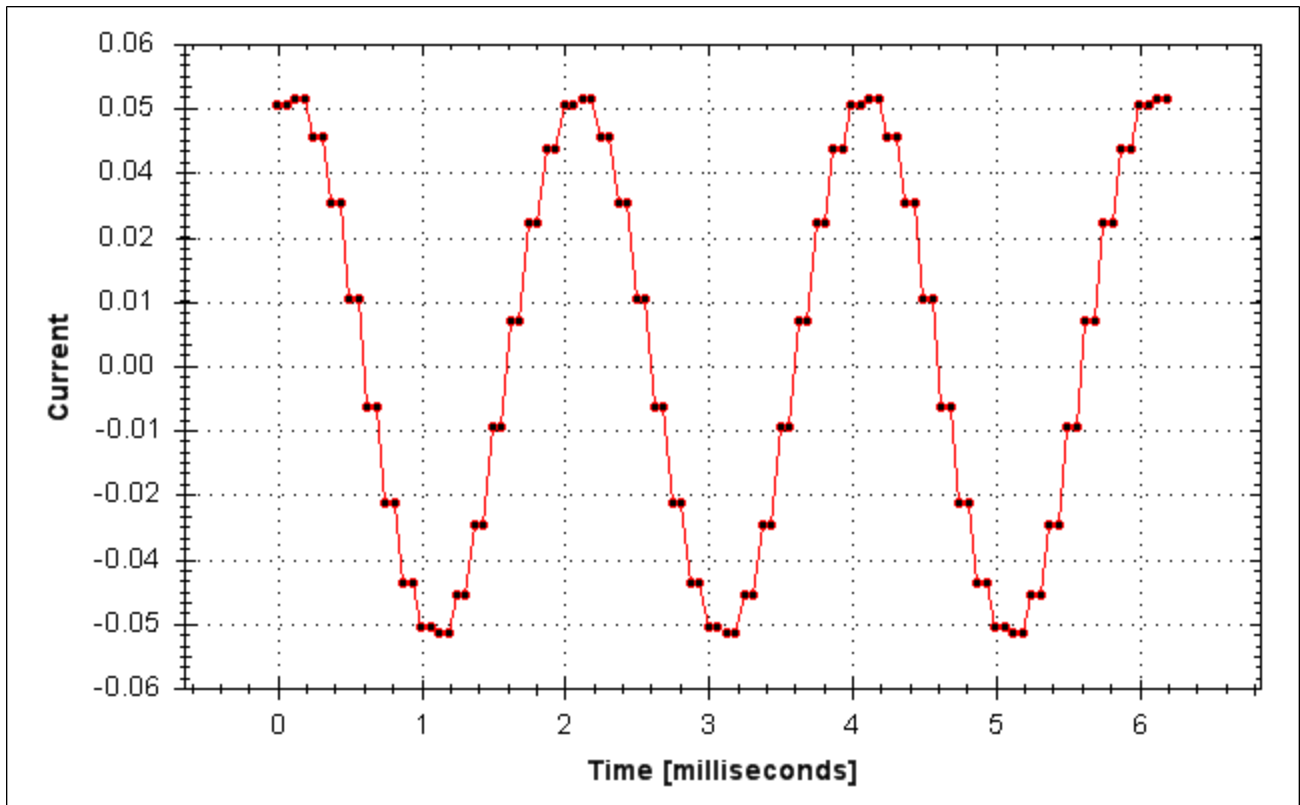
Get BODE.MODE (already set to PRB):

```
-->BODE.MODE 1
```

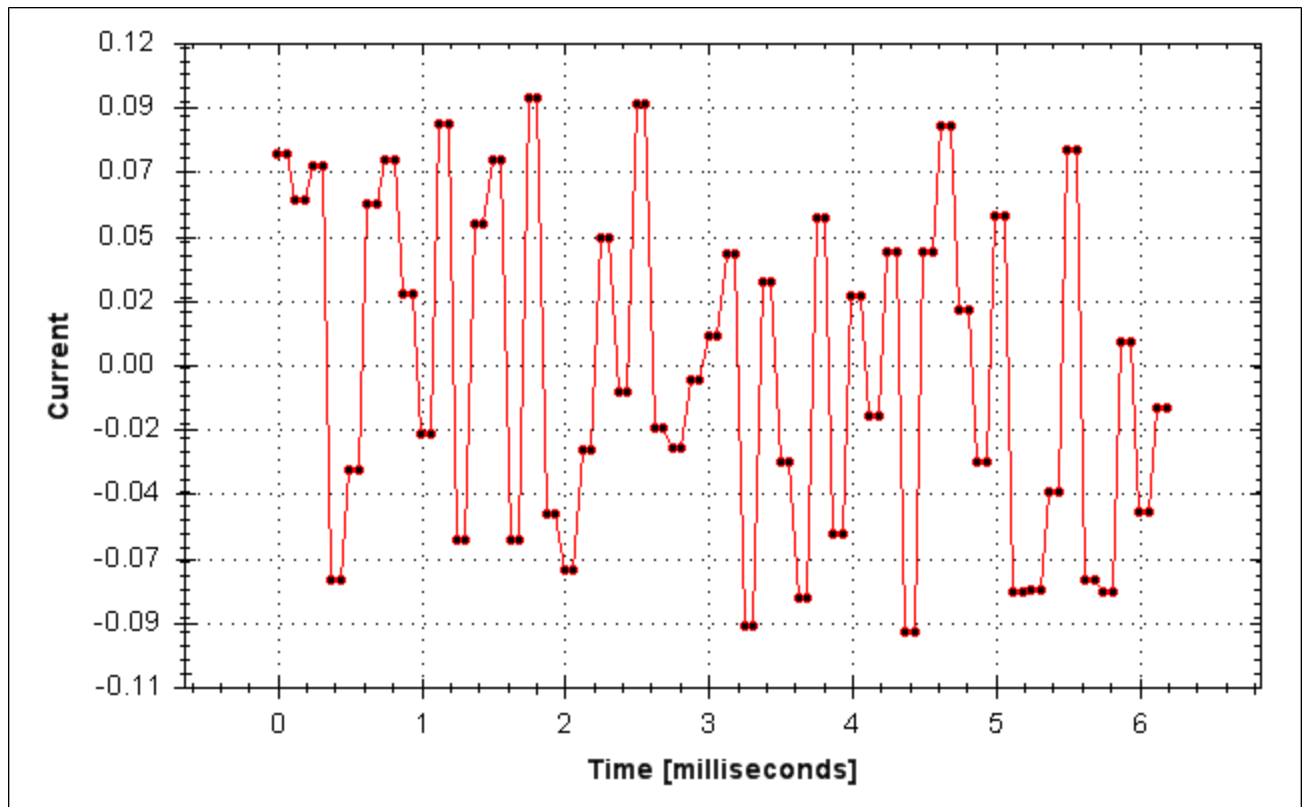
PRB excitation:



Sine excitation:



Noise excitation:



Related Topics

Using the Performance Servo Tuner (pg 146)

Using the Performance Servo Tuner: Advanced (pg 150)

Scope (pg 191)

Settings (pg 43)

F126 (pg 228)

Error: Invalid Bode plot mode for this function. (pg 246) and others)

23.5.8 BODE.MODETIMER

General Information	
Type	R/W Parameter
Description	Sets the watchdog timer of the excitation.
Units	ms
Range	0 to 268,435,456
Default Value	0
Data Type	Integer
See Also	BODE.MODE (pg 308)
Start Version	M_1-03-00-000

Description

BODE.MODETIMER sets the watchdog timer for the excitation. This watchdog is used to automatically turn off the excitation of the system if communication is lost. It is highly recommended that you use the watchdog for any excitation measurements. The WorkBench Performance Servo Tuner and Bode tool automatically use these values, requiring no action from you.

If the BODE.MODETIMER is a nonzero value, the Bode watchdog is enabled. BODE.MODE will be set to 0 (None) after the BODE.MODETIMER value elapses. To reset the watchdog timer, reset BODE.MODE to a nonzero value.

BODE.MODETIMER	Comments
0	BODE.MODE is left at the value you set it to.
> 0	<p>Uses pseudo random binary (PRB) excitation. PRB is a signal that is always +/- peak amplitude, varying only in phase.</p> <p>PRB excitation results in a flat excitation frequency spectrum. PRB also results in a high peak excitation amplitude, which can help minimize friction in a frequency response test.</p> <p>PRB excitation repeats every $(2^{BODE.PRBDEPTH})/BODE.EXCITEGAP$ drive samples. This repetition can be used to reveal the effects of friction.</p>

Example

Disable BODE.MODETIMER:

```
-->BODE.MODETIMER //
```

Set to 0 to disable the watchdog

```
0
```

```
-->BODE.MODE // Observe starting state of the Bode mode
```

```
0
```

```
-->BODE.MODE 1 // Set Bode mode to PRB
```

```
-->BODE.MODE // Observe Bode mode state is the same after 0.5 seconds
```

```
1
```

```
-->BODE.MODE // Observe Bode mode state is the same after 10 seconds
```

```
1
```

Enable BODE.MODETIMER:

```
-->BODE.MODETIMER 1000 // Set watchdog to 1 second
-->BODE.MODE 1 // Set Bode mode to PRB
-->BODE.MODE // Observe Bode mode state is the same after 0.5 seconds
1
-->BODE.MODE // Observe Bode mode state has been set to zero after 1.0 seconds
0
```

Enable and reenable BODE.MODETIMER:

```
-->BODE.MODETIMER 2500 // Set watchdog to 2.5 seconds
-->BODE.MODE 1 // Set Bode mode to PRB
-->BODE.MODE // Observe Bode mode state is the same after 1.5 seconds
1
-->BODE.MODE 1 // Set Bode mode to PRB, resetting the watchdog timer to the original 2.5
second value
set above.
-->BODE.MODE // Observe Bode mode state is the same after 3.0 seconds after the original
enabling of BODE.MODE 1
-->BODE.MODE // Observe Bode mode state has been set to zero after 4.0 seconds after the
original enabling
of BODE.MODE
0
```

Related Topics

Using the Performance Servo Tuner (pg 146)

Using the Performance Servo Tuner: Advanced (pg 150)

Scope (pg 191)

Settings (pg 43)

F126 (pg 228)

Error: Invalid Bode plot mode for this function. (pg 246) and others)

23.5.9 BODE.PRBDEPTH

General Information	
Type	R/W Parameter
Description	Sets the length of the PRB signal before it repeats.
Units	NA
Range	4 to 19
Default Value	19
Data Type	Integer
See Also	BODE.MODE (pg 308), BODE.INJECTPOINT (pg 307), BODE.IAMP (pg 304), BODE.VAMP (pg 314)
Start Version	M_01-00-00-000

Description

BODE.PRBDEPTH sets the length of the PRB signal before it repeats. This applies only when BODE.MODE = PRB. The PRB excitation will repeat after $(2^{\text{BODE.PRBDEPTH}}) / \text{BODE.E-XCITEGAP}$ drive samples.

Example

Set BODE.PRBDEPTH to 19:

```
-->BODE.PRBDEPTH 19
```

Get BODE.PRBDEPTH (already set to 19):

```
-->BODE.PRBDEPTH 19
```

Related Topics

Using the Performance Servo Tuner (pg 146)

Using the Performance Servo Tuner: Advanced (pg 150)

Scope (pg 191)

Settings (pg 43)

F126 (pg 228)

Error: Invalid Bode plot mode for this function. (pg 246) and others)

23.5.10 BODE.VAMP

General Information	
Type	R/W Parameter
Description	Sets the amplitude of the excitation when in velocity mode.
Units	Depends on UNIT.VROTARY (pg 684) or UNIT.VLINEAR (pg 683)UNIT.A-CCLINEAR (pg 676) Rotary: rpm, rps, deg/s, (Custom Units (pg 77))/V, rad/s Linear: counts/s, mm/s, μm/s, (Custom Units (pg 77))/V
Range	Rotary: 0.000 to 15,000.000 rpm 0.000 to 250.000 rps 0.000 to 90,000.000 degree/s 0.000 to 1,250.000 Custom Units (pg 77)/s 0.000 to 1,570.796 rad/s Linear: 0.000 to 1,073,741,824,000.000 counts/s 0.000 to 8,000.000 mm/s 0.000 to 8,000,000.000 μm/s 0.000 to 1,250.000 Custom Units (pg 77)/s
Default Value	0
Data Type	Float
See Also	BODE.MODE (pg 308), BODE.INJECTPOINT (pg 307)
Start Version	M_01-00-00-000

Description

BODE.VAMP sets the amplitude of the excitation when in velocity mode as set in BODE.INJECTPOINT.

Example

Set the excitation velocity to 100 RPM

```
-->BODE.VAMP 100
```

Get the excitation velocity(already set to 100 RPM)

```
-->BODE.VAMP
```

```
100.000 [rpm]
```

Related Topics

Using the Performance Servo Tuner (pg 146)

Using the Performance Servo Tuner: Advanced (pg 150)

Scope (pg 191)

Settings (pg 43)

F126 (pg 228)

Error: Invalid Bode plot mode for this function. (pg 246) and others)

23.5.11 BODE.VFLIMIT

General Information	
Type	R/W Parameter
Description	Sets the velocity fault duration limit (seconds) for the BODE.MODE 5 stability test
Units	s
Range	0.001 to 60.000
Default Value	0
Data Type	Decimal
See Also	BODE.MODE, BODE.MODETIMER, BODE.IFLIMIT, BODE.IFTHRESH, BODE.VFTHRESH
Start Version	M_01-02-10-000

Description

When BODE.MODE is set to 5, the firmware monitors the drive feedback velocity VL.FB. When VL.FB goes above BODE.VFTHRESH, an internal counter records the length of time VL.FB was above BODE.VFTHRESH. If the internal counter reaches BODE.VFLIMIT, Fault 133 – Instability during Autotune will be generated.

The smaller BODE.VFLIMIT, the quicker Fault 133 will be generated when VL.FB exceeds BODE.VFLIMIT.

Example

Set BODE.VFTHRESH to 10 RPM:

```
-->BODE.VFTHRESH 10
```

Set BODE.VFLIMIT to 0.500 seconds

```
-->BODE.VFLIMIT 0.5
```

Set BODE.MODE to 5 to enable stability detection

```
-->BODE.MODE 5
```

Related Topics

Using the Performance Servo Tuner (pg 146)

Using the Performance Servo Tuner: Advanced (pg 150)

F133 (pg 229)

23.5.12 BODE.VFTHRESH

General Information	
Type	R/W Parameter
Description	Sets the current fault threshold for the BODE.MODE 5 stability test.
Units	Depends on UNIT.VROTARY (pg 684) or UNIT.VLINEAR (pg 683)UNIT.A-CCLINEAR (pg 676) Rotary: rpm, rps, deg/s, (Custom Units (pg 77))/V, rad/s Linear: counts/s, mm/s, µm/s, (Custom Units (pg 77))/V
Range	Rotary: 0.000 to 15,000.000 rpm 0.000 to 250.000 rps 0.000 to 90,000.000 deg/s 0.000 to 1,250.000 Custom Units (pg 77)/s 0.000 to 1,570.796 rad/s Linear: 0.000 to 1,073,741,824,000.000 counts/s 0.000 to 8,000.000 mm/s 0.000 to 8,000,000.000 µm/s
Default Value	0
Data Type	Decimal
See Also	BODE.MODE, BODE.MODETIMER, BODE.IFLIMIT, BODE.IFTHRESH, BODE.VFLIMIT
Start Version	M_01-02-10-000

Description

When BODE.MODE is set to 5, the firmware monitors the drive feedback velocity VL.FB. When VL.FB goes above BODE.VFTHRESH, an internal counter records the length of time VL.FB was above BODE.VFTHRESH. If the internal counter reaches BODE.VFLIMIT, Fault 133 – Instability during Autotune will be generated.

The smaller BODE.VFLIMIT, the quicker Fault 133 will be generated when VL.FB exceeds BODE.VFLIMIT.

Example

Set BODE.VFTHRESH to 10 RPM:

```
-->BODE.VFTHRESH 10
```

Set BODE.VFLIMIT to 0.500 seconds:

```
-->BODE.VFLIMIT 0.5
```

Set BODE.MODE to 5 to enable stability detection:

```
-->BODE.MODE 5
```

Related Topics

Using the Performance Servo Tuner (pg 146)

Using the Performance Servo Tuner: Advanced (pg 150)

F133 (pg 229)

23.6 CAP Parameters

This section describes the CAP parameters.

23.6.1 CAP0.EDGE, CAP1.EDGE	318
23.6.2 CAP0.EN, CAP1.EN	319
23.6.3 CAP0.EVENT, CAP1.EVENT	320
23.6.4 CAP0.FILTER, CAP1.FILTER	322
23.6.5 CAP0.MODE, CAP1.MODE	323
23.6.6 CAP0.PLFB, CAP1.PLFB	324
23.6.7 CAP0.PREEDGE, CAP1.PREEDGE	325
23.6.8 CAP0.PRESELECT, CAP1.PRESELECT	326
23.6.9 CAP0.STATE, CAP1.STATE	327
23.6.10 CAP0.T, CAP1.T	328
23.6.11 CAP0.TRIGGER, CAP1.TRIGGER	329

23.6.1 CAP0.EDGE, CAP1.EDGE

General Information	
Type	NV Parameter
Description	Selects the capture edge.
Units	N/A
Range	1 to 3
Default Value	1
Data Type	U8
See Also	CAP0.PREEDGE, CAP1.PREEDGE (pg 325)
Start Version	M_01-00-00-000

Description

The filtered trigger source is monitored for rising edge, falling edge, or both edges. The event mode logic may ignore the precondition edge detection; however, the trigger always uses edge detection.

The precondition logic has an identical feature controlled by CAP0.PREEDGE, CAP1.PREEDGE (pg 325).

Value	Description
0	Reserved
1	Rising edge
2	Falling edge
3	Both edges

Related Topics

- 1 Using Position Capture

23.6.2 CAP0.EN, CAP1.EN

General Information	
Type	NV Parameter
Description	Enables or disables the related capture engine.
Units	N/A
Range	0 to 1
Default Value	0
Data Type	Boolean
See Also	N/A
Start Version	M_01-00-00-000

Description

This parameter enables or disables the related capture engine. After each successful capture event, this parameter is reset to 0 and must be activated again for the next capture. Also note that CAP0.PLFB, CAP1.PLFB (pg 324) is set to 0 when this parameter is set to 1.

0 = Disable

1 = Enable

Related Topics

- Using Position Capture

23.6.3 CAP0.EVENT, CAP1.EVENT

General Information	
Type	NV Parameter
Description	Controls the precondition logic.
Units	N/A
Range	0 to 3
Default Value	0
Data Type	U8
See Also	N/A
Start Version	M_01-00-00-000

Description

The event mode controls use of the precondition logic. If this field is not 0, then the precondition input is selected by CAPx.TRIGGER. If this field is 1, then the precondition edge is selected by the CAPx.PREEDGE. The four event modes are listed below.

Event	Description
0	Precondition settings ignored.
1	Trigger on first trigger event after selected edge on precondition input.
2	Trigger on first trigger event to occur while precondition input is 1
3	Trigger on first trigger event to occur while precondition input is 0.

Example

Event 0

The following diagram shows an example of Event = 0 (trigger on edge, trigger edge = rising). In this mode, the precondition logic is ignored.

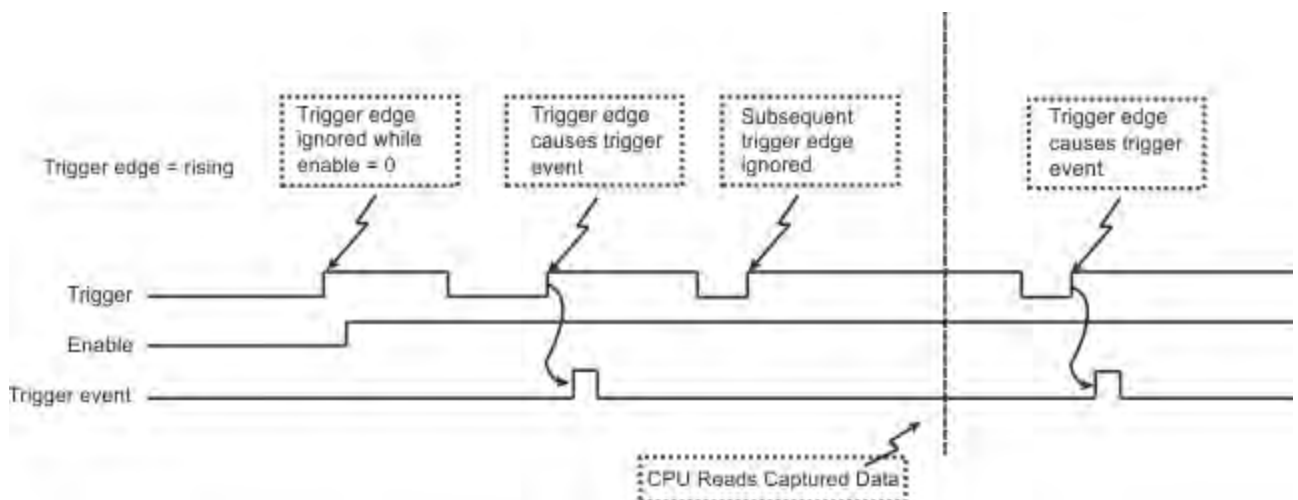


Figure 1: Trigger Edge Mode

Events 2 and 3 (Trigger edge while precondition = 0 or 1)

In these events, the precondition logic samples the current (post-filter) state of the selected precondition source input. The capture engine looks for a trigger edge while the precondition input is at a "1" or "0" state.

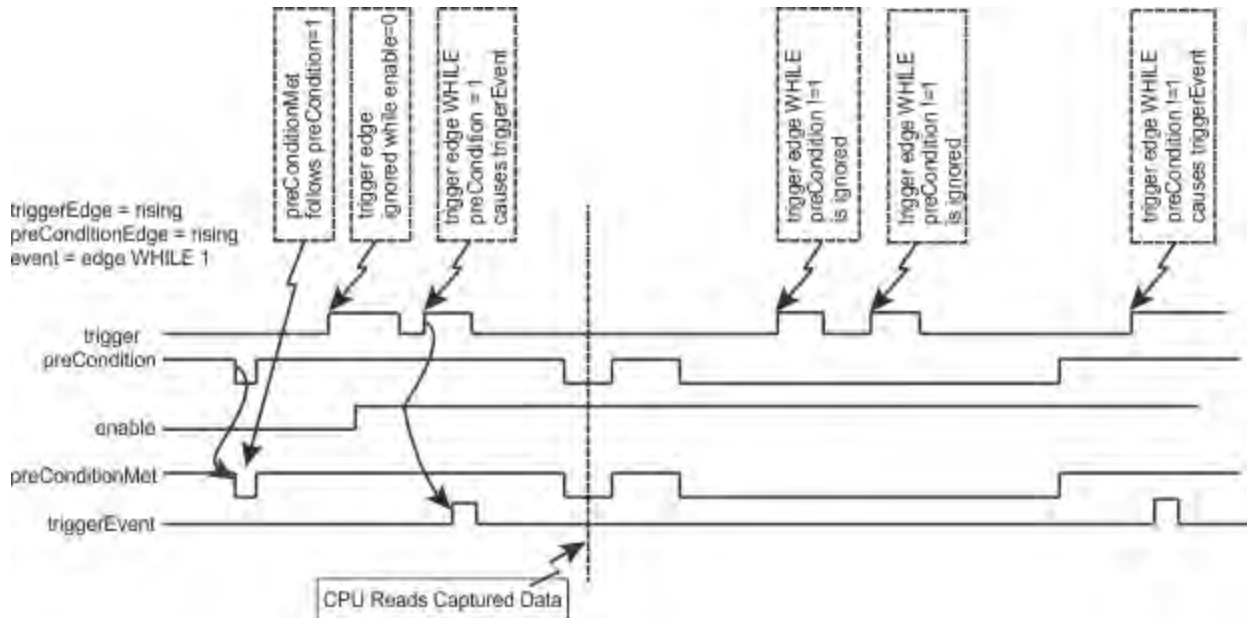


Figure 2: Trigger edge WHILE precondition edge

Event 1 (Trigger edge after precondition)

In this event, each trigger event requires Enable=1, a new precondition edge, followed by a new trigger edge. The sequence requirements are shown in the figure below.

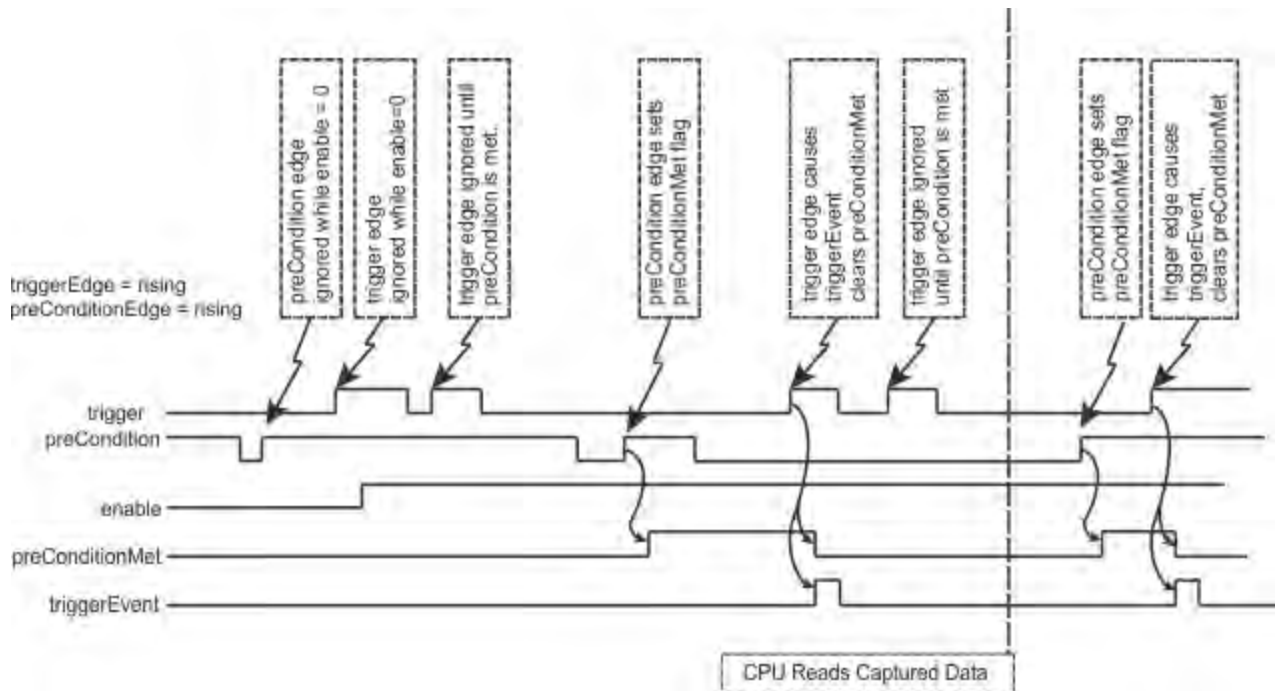


Figure 3: Trigger edge after precondition edge

Note: If the precondition and trigger edges occur at the same time, it is not a valid trigger event. A subsequent trigger edge must occur after the precondition edge. The same time resolves to a single 40 ns clock tick in the trigger event logic (after the optional filter function as well as any sensor, cable, or noise delays).

Related Topics

- 1 Using Position Capture

23.6.4 CAP0.FILTER, CAP1.FILTER

General Information	
Type	R/W Parameter
Description	Sets the filter for the capture source input.
Units	N/A
Range	0 to 2
Default Value	0
Data Type	U8
See Also	DIN1.FILTER TO DIN7.FILTER (pg 342)
Start Version	M_01-00-00-000
End Version	M_01-03-00-000

Description

These parameters are not functional in M_01-03-00-000. In future releases, you can use DINx.FILTER to select a filter on the input channel.

Related Topics

DIN1.FILTER TO DIN7.FILTER (pg 342)

23.6.5 CAP0.MODE, CAP1.MODE

General Information	
Type	NV Parameter
Description	Selects the captured value.
Units	N/A
Range	0 to 4
Default Value	0
Data Type	U8
See Also	N/A
Start Version	M_01-00-00-000

Description

Mode 0 is the standard position capture, which stores PL.FB (pg 605). Data can be retrieved with CAP0.PLFB, CAP1.PLFB (pg 324).

Mode 1 is the drive internal time capture. Data can be retrieved with CAP0.T, CAP1.T (pg 328).

Mode 3 is the capture of the primary encoder signal. This mode is used to home onto a feedback index. This mode sets the other parameters needed for this mode. These parameters can be changed later, but this is not recommended unless the input source of the index signal varies. Parameters set in this mode are:

- CAPx.TRIGGER 10: index mark of primary encoder
- CAPx.EDGE 1: rising edge
- CAPx.EVENT 0: ignore precondition

Also the capture engine is immediately enabled and is continuously triggered again.

Mode 4 is similar to Mode 0 (standard position capture), except that the re-enabling of the capture is done automatically. This mode can be used for the registration move.

Related Topics

- 1 Using Position Capture

23.6.6 CAP0.PLFB, CAP1.PLFB

General Information	
Type	R/O Parameter
Description	Reads captured position value.
Units	Depends on UNIT.PROTARY (pg 682) or UNIT.PLINEAR (pg 680) Rotary: counts, rad, deg, Custom Units (pg 77), 16-bit counts Linear: counts, mm, μ m, Custom Units (pg 77), 16-bit counts
Range	Full range of a signed 64 bit variable
Default Value	0
Data Type	S64
See Also	UNIT.PROTARY (pg 682), UNIT.PLINEAR (pg 680)
Start Version	M_01-00-00-000

Description

This parameter reads the captured position value scaled to actual set units. See UNIT.PROTARY (pg 682) or UNIT.PIN (pg 679) for these units.

Related Topics

- Using Position Capture

23.6.7 CAP0.PREEDGE, CAP1.PREEDGE

General Information	
Type	NV Parameter
Description	Selects the capture precondition edge.
Units	N/A
Range	1 to 3
Default Value	1
Data Type	U8
See Also	CAP0.EDGE, CAP1.EDGE (pg 318)
Start Version	M_01-00-00-000

Description

The precondition edge is monitored for rising edge, falling edge, or both. The event mode logic may ignore the precondition edge detection (trigger always uses edge detection).

The filtered trigger source has an identical feature controlled by CAP0.EDGE, CAP1.EDGE (pg 318).

Value	Description
0	Reserved
1	Rising edge
2	Falling edge
3	Both edges

Related Topics

- Using Position Capture

23.6.8 CAP0.PRESELECT, CAP1.PRESELECT

General Information	
Type	NVParameter
Description	Sets the precondition trigger.
Units	N/A
Range	0 to 11
Default Value	0
Data Type	U8
See Also	CAP0.TRIGGER, CAP1.TRIGGER (pg 329)
Start Version	M_01-00-00-000

Description

This parameter specifies the input signal for the precondition trigger.

Trigger Source	Input Name
0	General Input 1 (X7)
1	General Input 2 (X7)
2	General Input 3 (X7)
3	General Input 4 (X7)
4	General Input 5 (X8)
5	General Input 6 (X7)
6	General Input 7 (X7)
7	RS485 Input 1 (X9)
8	RS485 Input 2 (X9)
9	RS485 Input 3 (X9)
10	Primary Index

Related Topics

- Using Position Capture

23.6.9 CAP0.STATE, CAP1.STATE

General Information	
Type	R/O Parameter
Description	Indicates whether or not trigger source was captured.
Units	N/A
Range	0 to 1
Default Value	0
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

Description

When enabling the capture (CAP0.EN, CAP1.EN (pg 319)), this parameter is set to 0 until the next event is captured.

0 = Not captured or Capture Disabled

1 = Captured

Related Topics

- Using Position Capture

23.6.10 CAP0.T, CAP1.T

General Information	
Type	R/O Parameter
Description	Reads time capture (if time capture was configured).
Units	ns
Range	N/A
Default Value	N/A
Data Type	U32
See Also	CAP0.MODE, CAP1.MODE (pg 323)
Start Version	M_01-00-00-000

Description

If time capture was configured, the captured time is stored in this parameter. The reference time is the occurrence of the last MTS signal (recurring every 62.5 μ s), so this is a purely drive internal time.

Related Topics

- 1 Using Position Capture

23.6.11 CAP0.TRIGGER, CAP1.TRIGGER

General Information	
Type	NV Parameter
Description	Specifies the trigger source for the position capture.
Units	N/A
Range	0 to 11
Default Value	0
Data Type	U8
See Also	CAP0.PRESELECT, CAP1.PRESELECT (pg 326)
Start Version	M_01-00-00-000

Description

This parameter specifies the trigger source (capture input signal).

Trigger Source	Input Name
0	General Input 1
1	General Input 2
2	General Input 3
3	General Input 4
4	General Input 5
5	General Input 6
6	General Input 7
7	RS485 Input 1
8	RS485 Input 2
9	RS485 Input 3
10	Primary Index
11	Tertiary Index

Related Topics

- Using Position Capture

23.7 CPS Parameters

This section describes the CPS parameters.

23.7.1 CPS.STOSTATE	331
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23.7.1 CPS.STOSTATE

General Information	
Type	R/O Parameter
Description	Returns the status of the safe torque signal for each of a CPS device's strings.
Units	N/A
Range	0 to 3
Default Value	N/A
Data Type	Integer
Start Version	M_01-09-00-000

Description

CPS.STOSTATE returns the status of the safe torque signal for each of a CPS device's strings. Bit 0 represents the first string, and bit 1 represents the second string. If a bit is 1 then the safe torque signal is present and drives on that string can be enabled.

CPS.STOSTATE Value	Description
0	No signal on any string
1	A signal is present on only the first string. Drives on the first string can be enabled.
2	A signal is present on only the second string. Drives on the second string can be enabled.
3	A signal is present on both strings. All drives on both strings can be enabled.

23.8 CS Parameters

Controlled stop (CS) parameters set the values for the controlled stop process.

23.8.1 CS.DEC	333
23.8.2 CS.STATE	334
23.8.3 CS.TO	335
23.8.4 CS.VTHRESH	336

23.8.1 CS.DEC

General Information	
Type	NV Parameter
Description	Sets the deceleration value for the controlled stop process.
Units	Depends on UNIT.ACCROTARY (pg 677) or UNIT.ACCLINEAR (pg 676) Rotary: rps/s, rpm/s, deg/s ² , (Custom Units (pg 77))/s ² , rad/s ² Linear: counts/s ² , mm/s ² , μm/s ² , (Custom Units (pg 77))/s ²
Range	Rotary: 0.002 to 833,333.333 rps/s 0.112 to 50,000,000.000 rpm/s 0.009 to 300,000,000.000 deg/s ² 0.155 to 4,166,666.752 (Custom Units (pg 77))/s ² 0.012 to 5,235,987.968 rad/s ² Linear: 16,000.000 to 3,579,139,408,000.000 counts/s ² 0.031*MOTOR.PITCH (pg 581) to 833333.333*MOTOR.PITCH (pg 581) mm/s ² 30.994*MOTOR.PITCH (pg 581) to 833333333.333*MOTOR.PITCH (pg 581) μm/s ² 0.155 to 4,166,666.667 (Custom Units (pg 77))/s ²
Default Value	Rotary: 166.669 rps/s 10,000.000 rpm/s 60,000.000 deg/s ² 833.333 (Custom Units (pg 77))/s ² 1,047.2 rad/s ² Linear: 715,840,000.000 counts/s ² 166.714*MOTOR.PITCH (pg 581)MOTOR.PITCH (pg 581) mm/s ² 166,714.191*MOTOR.PITCH (pg 581)MOTOR.PITCH (pg 581) μm/s ² 833.571 (Custom Units (pg 77))/s ²
Data Type	Float
See Also	CS.VTHRESH (pg 336), CS.TO (pg 335), DRV.DIS, DIN1.MODE TO DIN24.MODE (pg 344), DRV.DISMODE (pg 378), DRV.DISSOURCES (pg 379)
Start Version	M_01-00-00-000

Description

This parameter sets the deceleration value for the controlled stop process.

Related Topics

Controlled Stop (pg 106)

Digital Inputs and Outputs (pg 81)

Fault and Warning Messages (pg 227) (this table indicates faults for which a controlled stop occurs)

23.8.2 CS.STATE

General Information	
Type	R/O Parameter
Description	Returns the internal status of the controlled stop process.
Units	N/A
Range	N/A
Default Value	N/A
Data Type	N/A
See Also	CS.DEC (pg 333), CS.VTHRESH (pg 336), CS.TO (pg 335)DRV.DISMODE (pg 378), DRV.DISSOURCES (pg 379)
Start Version	M_01-00-00-000

Description

CS.STATE returns the internal state machine value of the controlled stop.

0 = controlled stop is not occurring.

1 = controlled stop is occurring

Related Topics

Controlled Stop (pg 106)

Digital Inputs and Outputs (pg 81)

Fault and Warning Messages (pg 227) (this table indicates faults for which a controlled stop occurs)

23.8.3 CS.TO

General Information	
Type	NV Parameter
Description	Sets the time value for the drive velocity to be within CS.VTHRESH (pg 336).
Units	ms
Range	1 to 30,000 ms
Default Value	6 ms
Data Type	Integer
See Also	CS.DEC (pg 333), CS.VTHRESH (pg 336), CS.STATE, DRV.DIS, DIN1.MODE TO DIN24.MODE (pg 344), DRV.DISMODE (pg 378), DRV.DISSOURCES (pg 379)
Start Version	M_01-00-00-000

Description

CS.TO is the time value for the drive velocity to be within CS.VTHRESH (pg 336) before the drive disables.

Example

Set time value to 100 ms:

```
-->CS.TO 100
```

Related Topics

Controlled Stop (pg 106)

Digital Inputs and Outputs (pg 81)

Fault and Warning Messages (pg 227) (this table indicates faults for which a controlled stop occurs)

23.8.4 CS.VTHRESH

General Information	
Type	NV Parameter
Description	Sets the velocity threshold for the controlled stop.
Units	rpm, rps, deg/s, Custom Units (pg 77)/s
Range	Rotary: 0.000 to 15,000.000 rpm 0.000 to 250.000 rps 0.000 to 90,000.000 deg/s 0.000 to 1,250.000 Custom Units (pg 77)/s 0.000 to 1,570.796 rad/s Linear: 0.000 to 1,073,741,824,000.000 counts/s 0.000 to 8,000.000 mm/s 0.000 to 8,000,000.000 μm/s 0.000 to 1,250.000 Custom Units (pg 77)/s
Default Value	5 rpm
Data Type	Float
See Also	CS.DEC (pg 333), CS.TO (pg 335), CS.STATE (pg 334), DRV.DIS (pg 377), DIN1.MODE TO DIN24.MODE (pg 344), DRV.DISMODE (pg 378), DRV.DI-SSOURCES (pg 379)
Start Version	M_01-00-00-000

Description

CS.VTHRESH is the velocity threshold for the controlled stop algorithm.

Example

Set velocity threshold for controlled stop at 100 rpm:

```
-->CS.VTHRESH 100
```

Related Topics

Controlled Stop (pg 106)

Digital Inputs and Outputs (pg 81)

Fault and Warning Messages (pg 227) (this table indicates faults for which a controlled stop occurs)

23.9 DIN Parameters

This section describes the DIN parameters.

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23.9.1 DIN.HCMD1 TO DIN.HCMD4

General Information	
Type	NV parameter
Description	A buffer of commands to be used in digital input "command buffer" mode.
Units	None
Range	A string of up to 128 characters
Default Value	<Empty>
Data Type	String
See Also	DINx.MODE, DINx.PARAM, DIN.LCMDx
Start Version	M_01-02-08-000

Description

DIN.HCMDx sets the string of commands to be used in the digital input mode command buffer. Digital input mode **9-Command buffer** can execute four different sets of command buffers.

Each set of command buffers contains two buffers:

- High buffer: Executes upon a rising edge of a digital input.
- Low buffer: Executes upon a falling edge of a digital input.

DIN.HCMDx sets the string for the four high buffers (depending on x).

Example

Set the command buffer mode to digital input 1:

```
DIN1.MODE 9
```

Set the first sets of buffers to digital input 1:

```
DIN1.PARAM 1
```

Set the command DRV.OPMODE 0 to the high buffer:

```
DIN.HCMD1 DRV.OPMODE 1
```

Now, upon a rising edge in digital input 1, the drive mode is 1.

Related Topics

Command Buffer (pg 89)

Digital Inputs and Outputs (pg 81)

23.9.2 DIN.LCMD1 to DIN.LCMD4

General Information	
Type	NV parameter
Description	A buffer of commands to be used in digital input "command buffer" mode.
Units	N/A
Range	A string of up to 128 characters
Default Value	Empty
Data Type	String
See Also	DIN1.MODE TO DIN24.MODE (pg 344), DIN1.PARAM TO DIN7.PARAM (pg 346), DIN.HCMD1 TO DIN.HCMD4 (pg 338)
Start Version	M_01-02-08-000

Description

DIN.LCMDx sets the string of commands to be used in the digital input mode command buffer. Digital input mode **9-Command buffer** can execute four different sets of command buffers.

Each set of command buffers contains two buffers:

- High buffer: Executes upon a rising edge of a digital input.
- Low buffer: Executes upon a falling edge of a digital input.

DIN.LCMDx sets the string for the four "low" buffers, depending on x.

Example

Set the command buffer mode to digital input 1:

```
DIN1.MODE 9
```

Set the first sets of buffers to digital input 1:

```
DIN1.PARAM 1
```

Set the command DRV.OPMODE 0 to the "low buffer":

```
DIN.LCMD1 DRV.OPMODE 0
```

Now, upon a falling edge in digital input 1, the drive mode is 0.

Related Topics

Command Buffer (pg 89)

Digital Inputs and Outputs (pg 81)

23.9.3 DIN.ROTARY

General Information	
Type	R/O Parameter
Description	Reads the rotary knob value.
Units	N/A
Range	0 to 99
Default Value	N/A
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

Description

DIN.ROTARY reads the rotary knob value.

Related Topics

Digital Inputs and Outputs (pg 81)

23.9.4 DIN.STATES

General Information	
Type	R/O Parameter
Description	Reads the digital input states.
Units	N/A
Range	0000000 to 1111111
Default Value	N/A
Data Type	String
See Also	N/A
Start Version	M_01-00-00-000

Description

DIN.STATES reads the states of the seven digital inputs. The leftmost bit represents digital input 1 (DIN1) and the rightmost bit represents digital input 7 (DIN7).

Related Topics

Digital Inputs and Outputs (pg 81)

23.9.5 DIN1.FILTER TO DIN7.FILTER

General Information	
Type	R/W Parameter
Description	Filter mode for digital inputs 1 to 7.
Units	N/A
Range	0 to 3
Default Value	1 for DIN1 and DIN2 2 for DIN3 to DIN7
Data Type	Integer
See Also	N/A
Start Version	M_01-03-07-000

Description

This parameter sets the digital input filter configuration for channel x when followed with the values defined below. DINx.FILTER retrieves this information when not followed by data.

Value	Description
DINX.FILTER 0	The drive digital input channel detects all input signals with an input pulse width of ≥ 40 ns (no filtering applied).
DINX.FILTER 1	The drive digital input channel detects all input signals with an input pulse width of ≥ 10.24 μ s, ± 0.64 μ s (fast filter applied).
DINX.FILTER 2	The drive digital input channel detects all input signals with an input pulse width of ≥ 163 μ s, ± 10.24 μ s (standard filter applied).
DINX.FILTER 3	The drive digital input channel detects all input signals with an input pulse width of ≥ 2.62 ms, ± 0.16384 ms (slow filter applied).

Related Topics

Digital Inputs and Outputs (pg 81)

23.9.6 DIN1.INV to DIN7.INV

General Information	
Type	RW Parameter
Description	Sets the indicated polarity of a digital input mode.
Units	N/A
Range	0 to 1
Default Value	0
Data Type	Boolean
See Also	N/A
Start Version	M_01-00-00-000

Description

Sets the indicated polarity of a digital input mode.

Example

DIN1.INV = 0 : Input is active high.

DIN1.INV = 1 : Input is active low.

Related Topics

Digital Inputs and Outputs (pg 81)

23.9.7 DIN1.MODE TO DIN24.MODE

General Information	
Type	R/W Parameter
Description	Sets the digital input modes.
Units	N/A
Range	0 to 24
Default Value	0
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

Description

This parameter sets the functionality of the digital inputs 1 through 7. Digital inputs and corresponding X7 and X8 pin connectors are described in the *KC1 Installation Manual*, section 8.16.4, Digital Inputs. The table below summarizes the digital input modes; for detailed descriptions of each mode, see Digital Inputs and Outputs (pg 81).

DINx.MODE	Description	Task
0	No function; off	0 - None
1	Fault reset	1 - Background
3	Motion task select bit (see Motion Tasks)	3 - Background
4	Motion task start selected (see Motion Tasks)	4 - 1 kHz
5	Start home (see Homing (pg 126))	5 - Background
6	Start jog	6 - Background
7	Reserved	7 - None
8	Zero latch	8 - Background
9	Command buffer	9 - Background
10	Control fault relay	10 - Background
11	Home reference	11 - 1 kHz
12	Reserved	12 - None
13	Controlled Stop (pg 106)	13 - 1 kHz
14	Reserved	14 - None
15	Quick stop	15 - Background
16	Activate electronic gearing (see Electronic Gearing (pg 97))	16 - Background
17	Activate electronic gear position shift	17 - Background
18	Positive limit switch	18 - 4 kHz
19	Negative limit switch	19 - 4kHz
20	Brake release	20 - Background
21	Current limit	21 - 4 kHz
22	Opmode and Command Source switch	22 - Background
23	Change algebraic sign of the measured analog input voltage.	23 - 1 kHz
24	Reserved	24 - 1 kHz
25	Controlled stop without re-enable.	25 - 1 kHz

Related Topics

Command Buffer (pg 89)
Digital Inputs and Outputs (pg 81)
Digital Inputs (pg 81)
Controlled Stop (pg 106)
Homing (pg 126)
0.1 Motion Tasks
Electronic Gearing (pg 97)
Clearing Faults (pg 243)
F245 (pg 234)
CS Parameters (pg 332)

23.9.8 DIN1.PARAM TO DIN7.PARAM

General Information	
Type	R/W Parameter
Description	Sets a value used as an extra parameter for digital inputs nodes.
Units	N/A
Range	-9,223,372,036,854,775,000 to +9,223,372,036,854,775,000 Note: Varies based on DINx.MODE. See below.
Default Value	0
Data Type	Float
See Also	N/A
Start Version	M_01-00-00-000

Description

This parameter sets a value that is used as an extra parameter for digital inputs nodes.

Example

The digital input mode "Start motion task" is used to start a motion task. This mode uses an extra parameter as the ID of the motion task to be started.

Range

DINx.PARAM is used for various Digital Input modes. This causes the parameter's range to change based on the current Digital Input mode selected with the corresponding DINx.MODE

Listed below are the possible ranges for each Digital input mode.

If an input mode is not listed, then the default range above is used.

Input Mode	Min	Max	Notes
2	0	128	
6	Velocity Min	Velocity Max	This value changes based on user selected velocity units.
9	0	4	
17	Position Min	Position Max	This value changes based on user selected position units.
21	0	DRV.IPEAK	This value changes based on the specific KC1s drive limits.
22	0	32	See Digital Input Mode 22 for details.
23	0	2056	See Digital Input Mode 23 for details.

Dependency on DINx.MODE

Typically, the user can set DINx.PARAM before the corresponding DINx.MODE is set. However, if DINx.PARAM is set before DINx.MODE is set, and the value of DINx.PARAM is outside the new DINx.MODE's range, then DINx.PARAM will be set to zero.

Example:

DIN1.MODE is set to 0 by default

DIN1.PARAM is set to 200

DIN1.MODE is changed to 2 (execute motion tasks)

200 is larger than the maximum for DIN1.MODE 2, so DIN1.PARAM will be set to 0 to prevent errors.

Related Topics

Digital Inputs and Outputs (pg 81)

23.9.9 DIN1.STATE TO DIN7.STATE

General Information	
Type	R/O Parameter
Description	Reads a specific digital input state.
Units	N/A
Range	0 to 1
Default Value	N/A
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

Description

DIN1.STATE to DIN7.STATE reads the state of one digital input according to the number identified in the command.

Related Topics

Digital Inputs and Outputs (pg 81)

23.9.10 DIN9.STATE to DIN11.STATE

General Information	
Type	NV Parameter
Description	Shows on selected pin if signal is high or low.
Units	N/A
Range	0 to 1
Default Value	0
Data Type	U8
See Also	N/A
Start Version	M_01-05-00-000

Description

This parameter allows the user to see the actual level of the input signal, when the IO is set to input mode. Parameter value is 0 if signal is low and 1 if signal is high. DIOx.INV can affect the value in this register.

This parameter can be read at any time. The value is only guaranteed to correspond to the output on the X9 connector when DRV.EMUEMODE is set to 10 and the DIOX.DIR is 0.

Related Topics

DIO9.DIR to DIO11.DIR (pg 352)

DIO9.INV to DIO11.INV (pg 351)

DRV.EMUEMODE (pg 384)

23.10 DIO Parameters

This section describes the DIO parameters.

23.10.1 DIO9.INV to DIO11.INV	351
23.10.2 DIO9.DIR to DIO11.DIR	352

23.10.1 DIO9.INV to DIO11.INV

General Information	
Type	NV Parameter
Description	Inverting the output voltage of the IO, when in the output direction.
Units	NA
Range	0 to 1
Default Value	0
Data Type	U8
Start Version	M_01-05-00-000

Description

This parameter changes the logic sense of the differential input/output signals. When false, a logic 1 occurs when the + signal is higher than the – signal. When true, a logic 1 occurs when the – signal is higher than the + signal.

The drive output parameters DOUTx.STATE and DOUTx.STATEU are not affected by changes in this parameter. The drive input parameters DINx.STATE will be affected.

This parameter can be set at any time. It will be ignored unless DRV.EMUEMODE is set to 10.

Related Topics

DIN1.STATE TO DIN7.STATE (pg 348)

DOUT1.STATE AND DOUT2.STATE (pg 358)

DOUT1.STATEU AND DOUT2.STATEU (pg 359)

DRV.EMUEMODE (pg 384)

23.10.2 DIO9.DIR to DIO11.DIR

General Information	
Type	NV Parameter
Description	Changing direction of the IOs from the X9 connector.
Units	N/A
Range	0 to 1
Default Value	0
Data Type	U8
Start Version	M_01-05-00-000

Description

This parameter changes the direction of the general purpose IO from the X9 connector. If DIOx.DIR is set 0 then the IO configured as an input, while if DIOx.DIR is 1 the IO is configured as an output.

DIO9.DIR controls pins 1 and 2

DIO10.DIR controls pins pin 4 and 5

DIO11.DIR controls pins pin 7 and 8.

This parameter can be set at any time. It will be ignored unless DRV.EMUEMODE is set to 10.

Related Topics

DIN1.STATE TO DIN7.STATE (pg 348)

DOUT1.STATE AND DOUT2.STATE (pg 358)

DOUT1.STATEU AND DOUT2.STATEU (pg 359)

DIO9.INV to DIO11.INV (pg 351)

DRV.EMUEMODE (pg 384)

23.11 DOUT Parameters

This section describes the DOUT parameters.

23.11.1 DOUT.RELAYMODE	354
23.11.2 DOUT.STATES	355
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23.11.4 DOUT1.PARAM AND DOUT2.PARAM	357
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23.11.6 DOUT1.STATEU AND DOUT2.STATEU	359
23.11.7 DOUT9.STATE to DOUT11.STATE	360
23.11.8 DOUT9.STATEU to DOUT11.STATEU	361

23.11.1 DOUT.RELAYMODE

General Information	
Type	R/W Parameter
Description	Indicates faults relay mode.
Units	N/A
Range	0 to 1
Default Value	0
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

Description

DOUT.RELAYMODE indicates the faults relay mode as follows:

If DOUT.RELAYMODE= 0 and faults exist, then the relay is open.

If DOUT.RELAYMODE= 0 and faults do not exist, then the relay is closed.

If DOUT.RELAYMODE = 1 and the drive is disabled, then the relay is open.

If DOUT.RELAYMODE = 1 and the drive is enabled, then the relay is closed.

Related Topics

Digital Outputs (pg 86)

23.11.2 DOUT.STATES

General Information	
Type	R/O Parameter
Description	Reads the state of the two digital outputs.
Units	N/A
Range	0 to 11
Default Value	N/A
Data Type	String
See Also	N/A
Start Version	M_01-00-00-000

Description

DOUT.STATES reads the states of the two digital outputs. The rightmost bit represents DOUT2 and the leftmost bit represents DOUT1.

Related Topics

Digital Outputs (pg 86)

23.11.3 DOUT1.MODE to DOUT19.MODE

General Information	
Type	NV Parameter
Description	Sets the digital output mode.
Units	N/A
Range	0 to 19
Default Value	0
Data Type	Integer
See Also	DOUT1.PARAM AND DOUT2.PARAM (pg 357)
Start Version	M_01-04-02-000

Description

DOUTx.MODE sets the functionality of the digital outputs. The table below summarizes the digital output modes; for detailed descriptions of each mode, see Digital Inputs and Outputs (pg 81).

DOUTx.MODE	Description
0	User (default = 0)
1	Mains ready
2	Software limit switch reached
3	Move complete
4	In position
5	Position greater than x
6	Position less than x
7	Drive produced warning
8	Drive enabled
9	Reserved
10	Motor brake
11	Drive produced fault
12	Absolute velocity greater than x
13	Absolute velocity less than x
14	Homing complete
15	PLS.STATE bits or connected
16	Description Command buffer Active
19	Encoder Z pulse
20	No Controlled Stop Active
21	Fault Disabling Power Stage

Related Topics

Digital Outputs (pg 86)

23.11.4 DOUT1.PARAM AND DOUT2.PARAM

General Information	
Type	NV Parameter
Description	Sets extra parameters for the digital outputs.
Units	N/A
Range	0 Note: Range changes based on Digital Output Mode. See below.
Default Value	0
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

Description

DOUT1.PARAM and DOUT2.PARAM set the extra parameter needed for the digital outputs calculations, respectively.

Range

DOUTx.PARAM is used for various Digital Output modes. This causes the parameter's range to change based on the current Digital Output mode selected with the corresponding DOUTx.MODE.

Below is a list of the possible range for each Digital Output Mode.

If an output mode is not listed, then the default range of 0 is used.

Input Mode	Min	Max	Notes
4	Position Min	Position Max	This value changes based on user selected position units.
5	Position Min	Position Max	This value changes based on user selected position units.
6	Position Min	Position Max	This value changes based on user selected position units.
12	0	Velocity Max	This value changes based on user selected velocity units.
13	0	Velocity Max	This value changes based on user selected velocity units.

Dependency on DOUTx.MODE

Since the default range of DOUTx.PARAM does not allow a user to enter a value, DOUTx.MODE must be set to a mode which uses DOUTx.PARAM before a value can be set. Each time DOUTx.MODE is changed, DOUTx.PARAM is automatically set to zero to prevent unintended interactions.

Related Topics

Digital Outputs (pg 86)

23.11.5 DOUT1.STATE AND DOUT2.STATE

General Information	
Type	R/O Parameter
Description	Reads the digital output state.
Units	N/A
Range	0 to 1
Default Value	N/A
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

Description

DOUT1.STATE and DOUT2.STATE read the state of one digital output according to the value stated in the command.

Related Topics

Digital Outputs (pg 86)

23.11.6 DOUT1.STATEU AND DOUT2.STATEU

General Information	
Type	R/W Parameter
Description	Sets the state of the digital output node.
Units	N/A
Range	0 to 1
Default Value	0
Data Type	Integer
See Also	N/A
Start Version	M_01-01-01-000

Description

DOUT1.STATEU and DOUT2.STATEU set the state of the digital output node as follows:

0 = deactivated

1 = activated

DOUT1.STATEU and DOUT2.STATEU are used when DOUT1.MODE to DOUT19.MODE (pg 356) = 0 (user mode).

Related Topics

Digital Outputs (pg 86)

23.11.7 DOUT9.STATE to DOUT11.STATE

General Information	
Type	NV parameter
Description	Shows on selected pin if signal is high or low.
Units	N/A
Range	0 to 1
Default Value	0
Data Type	U8
See Also	N/A
Start Version	M_01-05-00-000

Description

This parameter allows the user to see the actual level of the output signal, when the IO is set to output mode. Parameter value is 0 if signal is low and 1 if signal is high. DIOx.INV can affect the signals driven onto the X9 connector.

This parameter can be read at any time. The value is only guaranteed to correspond to the output on the X9 connector when DRV.EMUEMODE is set to 10 and the DIOX.DIR is 0.

Related Topics

[DIO9.DIR to DIO11.DIR \(pg 352\)](#)

[DIO9.INV to DIO11.INV \(pg 351\)](#)

[DOUT9.STATEU to DOUT11.STATEU \(pg 361\)](#)

[DRV.EMUEMODE \(pg 384\)](#)

23.11.8 DOUT9.STATEU to DOUT11.STATEU

General Information	
Type	NV Parameter
Description	Allows user to set level of selected pin to high or low.
Units	N/A
Range	0 to 1
Default Value	0
Data Type	U8
See Also	N/A
Start Version	M_01-05-00-000

Description

This parameter allows the user to set the level of the output signal, when the IO is set to output mode. Parameter value is 0 if signal is low and 1 if signal is high. DIOx.INV can affect the signals driven onto the X9 connector.

This parameter can be written at any time. The value is only guaranteed to correspond to the output on the X9 connector when DRV.EMUEMODE is set to 10 and the DIOX.DIR is 0.

Example

The following settings set the direction for the differential signals on pin 4 and 5, so that the output will have a high level signal.

First set the following settings:

```
DRV.EMUEMODE 10
DIO10.DIR 1
DOUT10.STATEU 1
```

Then change the level of the signal:

```
DOUT.STATEU 0
```

or

```
DIO10.INV
```

Note: Inverting the signal will also alter the signal in input mode.

Related Topics

DIO9.DIR to DIO11.DIR (pg 352)

DIO9.INV to DIO11.INV (pg 351)

DRV.EMUEMODE (pg 384)

23.12 DRV Parameters

This section describes the DRV parameters.

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23.12.1 DRV.ACC

General Information	
Type	NV Parameter
Description	Describes the acceleration ramp for the velocity loop.
Units	Depends on or Rotary: rps/s, rpm/s, deg/s ² , (custom units)/s ² , rad/s ² Linear: counts/s ² , mm/s ² , μm/s ² , (custom units)/s ²
Range	Note: The range and default values of (custom units)/s ² units depend on the values of PIN and POUT. The range and default values listed in this table are derived from the default values of PIN and POUT. Rotary: 0.002 to 833,333.333 rps/s 0.112 to 50,000,000.000 rpm/s 0.009 to 300,000,000.000 deg/s ² 0.155 to 4,166,666.752 (custom units)/s ² 0.012 to 5,235,987.968 rad/s ² Linear: 16,000.000 to 3,579,139,408,000.000 counts/s ² 0.031*MOTOR.PITCH (pg 581) to 833,333.333*MOTOR.PITCH (pg 581) mm/s ² 30.995*MOTOR.PITCH (pg 581) to 2,147,483.647*MOTOR.PITCH (pg 581) μm/s ² 0.155 to 2,147,483.647 (custom units)/s ²
Default Value	Note: The range and default values of (custom units)/s ² units depend on the values of PIN and POUT. The range and default values listed in this table are derived from the default values of PIN and POUT. Rotary: 166.669 rps/s 10,000.000 rpm/s 60,000.000 deg/s ² 833.333 (custom units)/s ² 1,047.2 rad/s ² Linear: 715,840,000.000 counts/s ² 166.714*MOTOR.PITCH (pg 581) mm/s ² 166,714.191*MOTOR.PITCH (pg 581) μm/s ² 833.571 (custom units)/s ²
Data Type	Float
See Also	DRV.DEC (pg 374), ,
Start Version	M_01-00-00-000

Description

Describes the acceleration ramp for the velocity central loop.

Related Topics

12.7 Limits

23.12.2 DRV.ACTIVE

General Information	
Type	R/O Parameter
Description	Reads the enable status of an axis.
Units	N/A
Range	0, 1, 3
Default Value	N/A
Data Type	Integer
See Also	DRV.EN (pg 390), DRV.DISSOURCES (pg 379)
Start Version	M_01-00-00-000

Description

DRV.ACTIVE reads the enable status of an axis as follows:

- DRV.ACTIVE = 0 drive disabled
- DRV.ACTIVE = 1 drive enabled
- DRV.ACTIVE = 3 drive enabled and in dynamic brake mode

There is no state 2.

When the drive is in state 3, the drive display shows a blinking decimal point. Additionally, if the drive is in state 3 the Parameter Load/Save view does not allow you to download a parameter file.

If an axis is not enabled (DRV.ACTIVE is 0), but DRV.EN (pg 390) is 1 and the hardware enable is high, read the value of DRV.DISSOURCES (pg 379) to query the reason that the drive is not enabled.

Related Topics

12.9 Enable/Disable

23.12.3 DRV.BLINKDISPLAY

General Information	
Type	Command
Description	Causes the display to blink for 10 seconds.
Units	N/A
Range	N/A
Default Value	N/A
Data Type	N/A
See Also	N/A
Start Version	M_01-00-00-000

Description

DRV.BLINKDISPLAY causes the drive display located on the front of the drive to blink for 10 seconds.

This command allows the user to identify the drive that is currently communicating with Work-Bench.

23.12.4 DRV.BOOTTIME

General Information	
Type	R/O
Description	Returns the time when the current session booted up.
Units	Days:Hours:Minutes:Seconds
Range	N/A
Default Value	N/A
Data Type	String
Start Version	M_01-06-05-000

Description

DRV.BOOTTIME returns the time that the current session started running. This time includes total amount of time from all previous sessions.

This keyword can be used with DRV.RUNTIME to determine the length of time the drive has been running since it was last power cycled.

Session Time = DRV.RUNTIME – DRV.BOOTTIME

Related Topics

DRV.RUNTIME (pg 421)

23.12.5 DRV.CLRFAULTHIST

General Information	
Type	Command
Description	Clears the fault history log in the NV.
Units	N/A
Range	N/A
Default Value	N/A
Data Type	N/A
Start Version	M_01-00-00-000

Description

DRV.CLRFAULTHIST clears the fault history from the nonvolatile memory of the drive. This command erases all faults returned by DRV.FAULTHIST (pg 392).

23.12.6 DRV.CLRFAULTS

General Information	
Type	Command
Description	Tries to clear all active faults in the drive.
Units	N/A
Range	N/A
Default Value	N/A
Data Type	N/A
See Also	DRV.FAULTS (pg 394), DRV.EN (pg 390), DRV.DIS (pg 377)
Start Version	M_01-00-00-000

Description

When DRV.CLRFAULTS is sent, the drive will try to clear all active faults. When a fault occurs, the fault is registered in the drive fault handler. DRV.CLRFAULTS clears the fault from the drive fault handler. However, if the fault still exists in the system, DRV.CLRFAULTS fails and the fault is re-registered in the fault handler.

If the DRV.CLRFAULTS succeeds, then the reply to DRV.FAULTS states that no faults exist. If the condition that triggered the fault is still present, the fault condition will remain.

See Fault and Warning Messages (pg 227) for details regarding the behavior of individual faults.

Note that executing a drive disable (DRV.DIS (pg 377)) followed by a drive enable (DRV.EN (pg 390)) has the same effect as executing DRV.CLRFAULTS.

Related Topics

Clearing Faults (pg 243)

23.12.7 DRV.CMDDELAY

General Information	
Type	Command
Description	Issues a delay before next command is executed.
Units	ms
Range	0 to 5,000 ms
Default Value	0 ms
Data Type	Float
See Also	N/A
Start Version	M_01-03-00-000

Description

This parameter is used when drive commands are used in a script and a delay is needed between the execution of two consecutive commands. DRV.CMDDELAY creates a delay in the execution of drive commands. In the period of time specified, no commands are executed. This feature is especially useful for command buffers.t

Example

If the script is:

```
DRV.EN
IL.CMDU 0.1
```

then DRV.CMDDELAY is used between the two entries to delay execution 5 ms until the drive is enabled:

```
DRV.EN
DRV.CMDDELAY 5
IL.CMDU 0.1
```

Related Topics

23.12.8 DRV.CMDSOURCE

General Information	
Type	NV Parameter
Description	Sets the command source (service, fieldbus, analog input, gearing, digital, or Bode).
Units	N/A
Range	0 to 5
Default Value	0
Data Type	Integer
See Also	DRV.OPMODE (pg 418)
Start Ver- sion	M_01-00-00-000

Description

DRV.CMDSOURCE specifies the source of the command to the drive. DRV.OPMODE (pg 418) sets the operation mode to the relevant control loop.

DRV.CMDSOURCE values can be set as follows:

Value	Description
0	Service, TCP/IP command
1	Fieldbus command
2	Gearing command
3	Analog command
5	Program command

If DRV.CMDSOURCE is set to 5 then DRV.OPMODE must be set to 3.

DRV.CMDSOURCE can be changed while the drive is enabled or disabled. If you use the terminal to change the operation mode, then it is recommended that you disable the drive before changing the command source.



WARNING If you change DRV.CMDSOURCE from the terminal while the drive is enabled, the system may experience a step change in command.

Example

To set the command source to the TCP/IP channel and the operation mode to velocity:

```
-->DRV.CMDSOURCE 0
-->DRV.OPMODE 1
```

Related Topics

23.12.9 DRV.CRASHDUMP

General Information	
Type	Command
Description	Retrieves diagnostic information after the drive crashes.
Units	N/A
Range	N/A
Default Value	N/A
Data Type	N/A
See Also	N/A
Start Version	M_01-00-00-000

Description

Drives rarely crash, but if a crash occurs, information that can help diagnose the cause of a crash is saved to the nonvolatile (NV) memory within the drive. After the drive is restarted, you can use the DRV.CRASHDUMP command to retrieve this diagnostic information, which can be emailed to Kollmorgen for further support.

If the drive crashes (display flashes an F and three bars), it saves the diagnostic information to a specific block of the drive NV memory. The DRV.CRASHDUMP command then prints the diagnostic information from this NV memory block. Subsequent crash conditions will overwrite the NV memory block. Since the NV memory block is overwritten, but never erased, the DRV.CRASHDUMP command always shows the diagnostic information for the most recent crash.

23.12.10 DRV.DBILIMIT

General Information	
Type	NV Parameter
Description	Sets the maximum amplitude of the current for dynamic braking.
Units	Arms
Range	0 to minimum of drive peak current (DRV.IPEAK) and motor peak current (MOTOR.IPEAK).
Default Value	Minimum of drive continuous current (DRV.ICONT) and motor continuous current (MOTOR.ICONT).
Data Type	Float
See Also	DRV.DISMODE (pg 378)
Start Version	M_01-00-00-000

Description

This parameter sets the maximum amplitude of the current for dynamic braking.

Example

Setting DRV.DBILIMIT to 2 limits the dynamic brake current to 2 Arms.

Related Topics

- 12.10 Controlled Stop
- 23.8 CS Parameters
- 12.11 Dynamic Braking

23.12.11 DRV.DEC

General Information	
Type	NV Parameter
Description	Sets the deceleration value for the velocity loop.
Units	Depends on or Rotary: rps/s, rpm/s, deg/s ² , (custom units)/s ² , rad/s ² Linear: counts/s ² , mm/s ² , μm/s ² , (custom units)/s ²
Range	Rotary: 0.002 to 833,333.333 rps/s 0.112 to 50,000,000.000 rpm/s 0.009 to 300,000,000.000 deg/s ² 0.155 to 4,166,666.752 (custom units)/s ² 0.012 to 5,235,987.968 rad/s ² Linear: 16,000.000 to 3,579,139,408,000.000 counts/s ² 0.031*MOTOR.PITCH to 833,333.333*MOTOR.PITCH mm/s ² 30.994*MOTOR.PITCH to 833,333,333.333*MOTOR.PITCH μm/s ² 0.155 to 4,166,666.667 (custom units)/s ²
Default Value	Rotary: 166.669 rps/s 10,000.000 rpm/s 60,000.000 deg/s ² 833.333 (custom units)/s ² 1,047.2 rad/s ² Linear: 715,840,000.000 counts/s ² 166.71*MOTOR.PITCH4MOTOR.PITCH (pg 581) mm/s ² 166,714.191*MOTOR.PITCHMOTOR.PITCH (pg 581) μm/s ² 833.571 (custom units)/s ²
Data Type	Float
See Also	DRV.ACC (pg 364), , , DRV.OPMODE (pg 418)
Start Version	M_01-00-00-000

Description

DRV.DEC sets the deceleration value for the velocity loop command (VL.CMDU (pg 702)) and for the analog

velocity command (). The operation mode (DRV.OPMODE (pg 418)) must be set to velocity mode for this command to function.

Related Topics

12.10 Controlled Stop

12.7 Limits

23.12.12 DRV.DIFVAR

General Information	
Type	R/O
Description	Lists all parameters which differ from their default value.
Units	N/A
Range	N/A
Default Value	N/A
Data Type	N/A
Start Version	M_01-05-01-000

Description

This parameter displays all parameters which have different values than their default setting. The actual value of each parameter is directly shown after the command name and the corresponding default value is then shown in brackets.

This command also shows differences in parameters which hold a string, such as DRV.NAME.

Example

```
-->DRV.DIFVAR
DRV.EMUEMODE 10 (0)
DRV.NAME MyDrive(no-name)
FB1.ENCRESES 0(1024)
IL.KP 50.009(24.811)
PL.KP 99.998(49.999)
VL.KP 0.108(0.000)
```

23.12.13 DRV.DIR

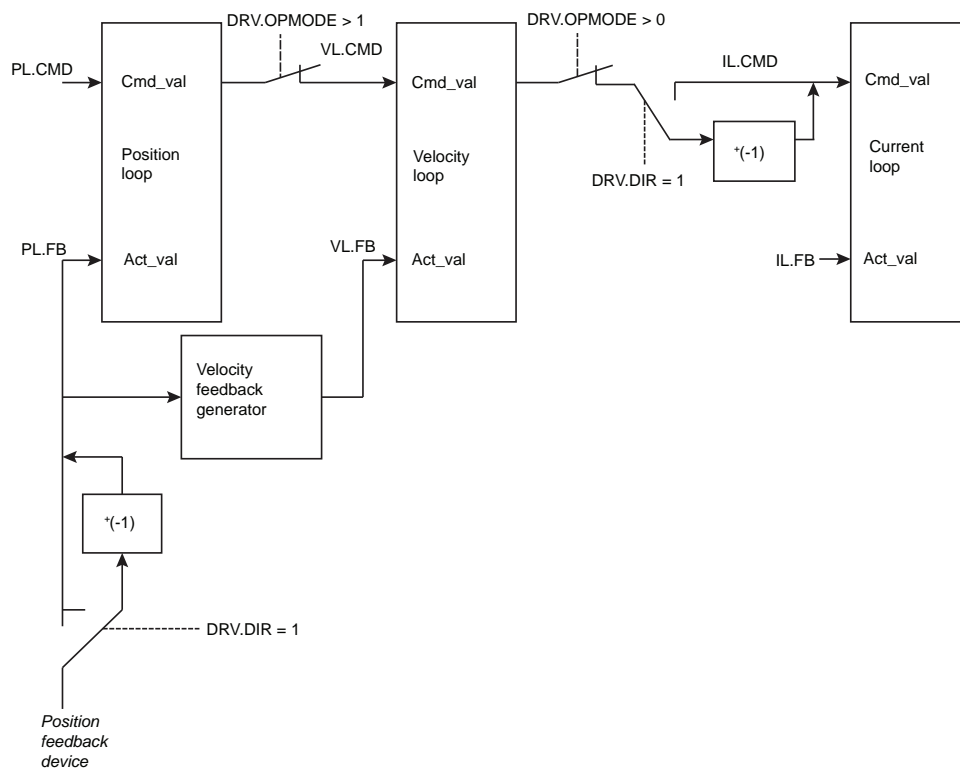
General Information	
Type	R/W Parameter
Description	Changes drive direction.
Units	N/A
Range	0 to 1
Default Value	0
Data Type	Integer
Start Version	M_01-00-00-000

Description

DRV.DIR changes the direction of the motor by changing the algebraic sign of the current command and position feedback value according to the figure below.

Note the following when using DRV.DIR:

- You can only change the DRV.DIR command when the drive is disabled.
- The drive status changes to "Axis not homed" as soon as the DRV.DIR parameter changes value (see DRV.MOTIONSTAT (pg 411)).
- You must verify the settings of the hardware limit switches. If necessary, switch the positive and negative hardware limit switches by swapping the wires at the digital inputs.



23.12.14 DRV.DIS

General Information	
Type	Command
Description	Disables the axis (software).
Units	N/A
Range	N/A
Default Value	Analog drive software enabled. All other types of drive software disabled.
Data Type	N/A
See Also	DRV.EN (pg 390), DRV.DISSOURCES (pg 379), DRV.ACTIVE (pg 365), DRV.DISMODOE (pg 378), DRV.DISTO (pg 381)
Start Version	M_01-00-00-000

Description

DRV.DIS issues a software disable to the drive. The method by which the drive will be disabled (either immediately or with a ramp down first) is controlled by DRV.DISMODOE (pg 378).

By querying the value of DRV.ACTIVE (pg 365), you can check whether the drive is currently enabled or disabled.

By querying the value of DRV.DISSOURCES (pg 379), you can check whether the software enable bit is high (software enabled was issued by executing DRV.EN) or the software enable bit is low (software disable was issued by executing DRV.DIS).

If DRV.DIS is commanded the emergency timeout is started. If the drive does not disable or activate dynamic brake within DRV.DISTO (pg 381), fault "F703" (=> p. 242) is reported.

Related Topics

19.2 Clearing Faults

12.10 Controlled Stop

23.12.15 DRV.DISMODE

General Information	
Type	NV Parameter
Description	Selects among disable immediately or stop and then disable options.
Units	N/A
Range	0 to 3
Default Value	0
Data Type	Integer
See Also	DRV.DBILIMIT (pg 373) ,DRV.DISTO (pg 381), CS.VTHRESH (pg 336)
Start Version	M_01-00-00-000

Description

DRV.DISMODE sets the drive reaction to a DRV.DIS (pg 377) command.

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

Value	Behavior
0	Disable axis immediately.
1	Use dynamic brake to ramp down. The drive remains in the dynamic brake state after the motor has stopped. The drive is disabled in the sense that it does not close the control loop and cannot perform a motion, but PWM stays active.
2	Use a controlled stop to ramp down and then disable the drive.
3	Use a controlled stop to ramp down, and then use dynamic brake. The drive remains in the dynamic brake state after the motor has stopped. The drive is disabled in the sense that it does not close the control loop and cannot perform a motion, but PWM stays active.

In all cases described above, if a brake is configured (MOTOR.BRAKE (pg 565)), the brake closes if VL.FB (pg 704) drops below CS.VTHRESH (pg 336).

WARNING Be careful with vertical loads when modifying this parameter. Coordinate this parameter's correct setting properly with the drive brake settings. If these settings are not coordinated, then vertical loads may have no stopping or holding force when the drive is disabled and the load could fall.

Related Topics

- 12.10 Controlled Stop
- 23.8 CS Parameters
- 12.11 Dynamic Braking

23.12.16 DRV.DISSOURCES

General Information	
Type	R/O Parameter
Description	Returns the possible reason for a drive disable.
Units	N/A
Range	N/A
Default Value	N/A
Data Type	Integer
See Also	DRV.ACTIVE, DRV.FAULTS, DRV.EN, DRV.DIS
Start Version	M_01-00-00-000

Description

DRV.DISSOURCES is a bitwise parameter that returns the status of possible causes of a drive disable. If this parameter is 0, then the drive is enabled.

The return value specific bits are as follows:

Bit	Status and Response
0	Software disable (execute DRV.EN to issue software enable)
1	Fault exists (read DRV.FAULTS to get the active faults)
2	Hardware disable (remote enable input is low)
3	In-rush disable (the in-rush relay is opened)
4	Initialization disable (the drive did not finish the initialization process)
5	Controlled stop disable from a digital input.
6	Field Bus requested disable (SynqNet and EtherNet/IP only)
7	AKD-C requested disable (AKD-N only)

Related Topics

Controlled Stop (pg 106)

23.12.17 DRV.DISSOURCESMASK

General Information	
Type	R/O parameter
Description	Returns a bitmap of all bits in DRV.DISSOURCES that can be set to one on a given drive.
Units	N/A
Range	N/A
Default Value	N/A
Data Type	Integer
Start Version	M_01-07-00-000

Description

DRV.DISSOURCESMASK is a bitwise parameter that returns all possible causes of a drive disable. If a bit is set, the drive can be disabled for this reason.

The return value specific bits are as follows:

Bit	Status and Response
0	Software triggered disable
1	Fault exists
2	Hardware Enable input inactive
3	In-rush relay state prevents enable
4	Initialization not complete
5	Controlled stop requested from digital input
6	Field bus requested disable
7	AKD-C requested disable (AKD-N only)
8	Pre-charge successful (AKD-C only)

For most AKD models, this parameter will return the value 63.

For EtherNet/IP and SynqNet version of the drive, the parameter will return the value 127.

For AKD-N, this parameter will return the value 179.

For AKD-C, this parameter will return the value 286.

Related Topics

DRV.DISSOURCES (pg 379)

23.12.18 DRV.DISTO

General Information	
Type	R/W Parameter
Description	Sets the emergency timeout
Units	ms
Range	0 to 120,000 ms
Default Value	1,000 ms
Data Type	U32
See Also	DRV.DIS (pg 377), DRV.DISMODE (pg 378)
Start Version	M_01-00-00-000

Description

This timer starts when DRV.DIS (pg 377) is issued (regardless of the DRV.DIS (pg 377) origin). After this timeout elapses, the actual state of the drive is compared to the DRV.DISMODE (pg 378) setting. If the actual state does not match the DRV.DISMODE (pg 378) setting, a fault is reported and the hardware immediately executes the DRV.DISMODE setting (for instance, disable or activate dynamic brake). Setting DRV.DISTO to 0 will disable the timeout.

Related Topics

12.10 Controlled Stop

23.12.19 DRV.EMUECHECKSPEED

General Information	
Type	TBD
Description	Enable / disable motor velocity vs. maximum emulated encoder velocity monitoring function. See Fault F486 for details.
Units	None
Range	0 to 1
Default Value	0 (disabled)
Data Type	Boolean
See Also	DRV.EMUEMODE (pg 384)
Start Version	

Description

Enables comparison of the current motor velocity against the maximum speed the emulated encoder output can generate. The maximum speed is based on lines/rev (DRV.EMUERES) and the pulse width (DRV.EMUEPULSEWIDTH). If the motor velocity exceeds this speed, fault F486 is raised.

Related Topics

23.12.20 DRV.EMUEDIR

General Information	
Type	R/W Parameter
Description	Sets the direction of the emulated encoder output (EEO) signal.
Units	N/A
Range	0 to 1
Default Value	0
Data Type	Integer
See Also	DRV.EMUEMODE (pg 384)
Start Version	M_01-00-00-000

Description

This parameter allows the user to change the direction of the emulated encoder output. DRV.DIR (pg 376) also affects the output direction (through an XOR, "exclusive or", operation). The drive uses DRV.DIR (pg 376) and DRV.EMUEDIR to decide the direction of the emulated encoder output. If DRV.DIR (pg 376) and DRV.EMUEDIR have the same value, then DRV.EMUEDIR is set to 0 (meaning an increase in the motor feedback will result an increase of the encoder emulation output and vice-versa). If these parameters have different values, then DRV.EMUEDIR is set to 1 (meaning an increase in the motor feedback will result in a decrease of the encoder emulation output and vice-versa).

23.12.21 DRV.EMUEMODE

General Information	
Type	R/W Parameter
Description	Sets the mode of the emulated encoder output (EEO) connector.
Units	N/A
Range	0 to 14
Default Value	0
Data Type	Integer
See Also	DRV.EMUERES (pg 388), DRV.EMUEZOFFSET (pg 389), DRV.EMUEMTURN (pg 386)
Start Version	M_01-00-00-000

Description

When the emulated encoder output (EEO) is configured to generate an index pulse (Z pulse) once per rev (DRV.EMUEMODE is 1, 6, or 8) this parameter and DRV.EMUEZOFFSET define the location of the Z pulse. DRV.EMUEZOFFSET defines the position of the Z pulse within one revolution. The pulse is generated each time this position is reached. For example, if this value is set to 32,768 (180 degrees), the Z pulse will be generated at 180 degrees, 540 degrees, 900 degrees, and so on.

When the EEO is configured to generate an absolute index pulse (DRV.EMUEMODE is 2, 7, or 9) this parameter, DRV.EMUEZOFFSET and DRV.EMUEMTURN define the location of the Z pulse. DRV.EMUEMTURN is used to define which turn of the position range the Z pulse is located. DRV.EMUEZOFFSET is used to define the position of the Z pulse within one revolution. For example, if DRV.EMUEMTURN is set to 1, and DRV.EMUEZOFFSET is set to 32,768 (180 degrees), then the index pulse will be generated at position 540 degrees.

When the EEO is configured in pass through mode (DRV.EMUEMODE is 12, 13, or 14) the EEO Z pulse will be generated each time the encoder's physical Z pulse is generated (the physical Z pulse is "passed through").

DRV.EMUEMODE sets the EEO connector to act as either an input or output as follows.

Setting	Function
0 (recommended)	Input (see to select the type of inputs the secondary feedback will accept)
1	EEO Output, A/B with once per rev index
2	EEO Output, A/B with absolute index pulse.
3	Input, A/B signals (Deprecated)
4	Input, step and direction signals (Deprecated)
5	Input, CW/CCW (Up/Down) Signals (Deprecated)
6	Step/Dir with one Z-pulse/rev
7	Step/Dir with one absolute Z-pulse (depends on DRV.EMUEZOFFSET and DRV.EMUEMTURN)
8	CW/CCW output with one Z-pulse/rev
9	CW/CCW output with one absolute Z-pulse (depends on DRV.EMUEZOFFSET and DRV.EMUEMTURN)
10	Allows the X9 connector to be used as a General Purpose I/O or SynqNet fieldbus controlled I/O (See)

Setting	Function
11	FB3 Input (Tertiary feedback is reported with FB3.P (pg 475)). Use FB3.MODE (pg 474) to select the feedback type.
12	Output - A/B with index pass through.
13	Output - Step/Dir with index pass through.
14	Output - CW/CCW with index pass through.

Modes 3 to 5 are backwards compatible but deprecated. Refer to FB2.MODE (pg 467) and FB2.SOURCE (pg 472) instead.

NOTE If you are using multi-turn or single tune absolute feedback devices, and the once per rev or absolute Z pulse modes (DRV.EMUEMODES 1,2,6,7,8, or 9) the Z pulse generated by the EEO will always be aligned with the same mechanical position of the primary feedback position. If you are using an incremental feedback device and these modes, then the origin of the primary feedback is not at the same mechanical position each time the drive powers up. If you are using the pass through mode (DRV.EMUEMODES 12, 13, or 14) the Z pulse generated by the EEO will always be aligned with the same mechanical position of the primary feedback position.

Related Topics

23.12.22 DRV.EMUEMTURN

General Information	
Type	R/W Parameter
Description	Defines the location of the index pulse on the EEO (emulated encoder output) when DRV.EMUEMODE=2.
Units	revolutions
Range	0 to 4,294,967,295
Default Value	0
Data Type	Integer
See Also	DRV.EMUEMODE (pg 384), DRV.EMUERES (pg 388)
Start Version	M_01-00-00-000

Description

When the emulated encoder output (EEO) is configured to generate an absolute index pulse (DRV.EMUEMODE is 2, 7 or 9) this parameter and DRV.EMUEZOFFSET define the location of the Z pulse. DRV.EMUEMTURN is used to define which turn of the position range the Z pulse is located. DRV.EMUEZOFFSET is used to define the position of the Z pulse within one revolution.

Note: If you are using multi-turn or single tune absolute feedback devices the Z pulse from generated by the EEO will always be aligned with the same mechanical position of the of the primary feedback position. If you are using an incremental feedback device then the origin of the primary feedback is not at the same mechanical position each time the drive powers up.

Related Topics

23.12.23 DRV.EMUEPULSEWIDTH

General Information	
Type	TBD
Description	Sets the encoder output pulse width for modes 6 to 7.
Units	us(microseconds)
Range	4.08 us to 2621.48 us
Default Value	4.08 us
Data Type	Float
See Also	DRV.EMUEMODE (pg 384)
Start Version	

Description

EMU Encoder Out Pulse Width Register

Sets pulse width for CW/CCW and Step and Direction modes. This parameter does not effect the A quad B mode. To calculate emuOutPulseWidth:

$(\text{Desired pulse width} - 40 \text{ nsec}) / 520 \text{ nsec}$

Requirement		DSFPGA-03-306
Bits	Bits	Description
11:0	emuOutPulseWidth	Read/Write 12 bit unsigned number minimum resolution is 520 nsec. Reset state – 0
15:12		reserved

- Register is in counts (12 bit)
- Register * 520ns + 40ns is the actual pulse with.
- Register = 1 = pulse width is 560ns = 0.56us (minimum value)
- For each register increment the pulse width is raised by 0.52us

Example

50 usecs pulse width

$\text{emuOutPulseWidth} = (50 \text{ usecs} - 40 \text{ nsec}) / 520 \text{ nsec} = 96$

$\text{actual pulse} = 96 * 520 \text{ nsec} + 40 \text{ nsec} = 49.88 \text{ usecs}.$

Related Topics

23.12.24 DRV.EMUERES

General Information	
Type	R/W Parameter
Description	Sets the resolution of the EEO (emulated encoder output).
Units	lines/rev (when DRV.EMUEMODE (pg 384) = 1, 2, or 3) counts/rev (when DRV.EMUEMODE (pg 384) = 4 or 5)
Range	0 to 16,777,215 lines per revolution
Default Value	0 lines per revolution
Data Type	Integer
See Also	DRV.EMUEMODE (pg 384)
Start Version	M_01-00-00-000 (resolution increased from 65,535 to 16,777,215 in M_01-04-00-000)

Description

This parameter sets the emulated encoder (EEO) resolution. DRV.EMUERES also defines how many lines are output for one revolution of the primary feedback (when this port is configured as an output), or how many lines will be considered a full revolution of the handwheel (when this port is configured as an input).

Related Topics

23.12.25 DRV.EMUEZOFFSET

General Information	
Type	R/W Parameter
Description	Sets the location of the EEO (emulated encoder output) index pulse (when DRV.EMUEMODE=1).
Units	1/65536 rev
Range	0 to 65535 rev
Default Value	0 rev
Data Type	Integer
See Also	DRV.EMUEMODE (pg 384), DRV.EMUEMTURN (pg 386)
Start Version	M_01-00-00-000

Description

When emulated encoder output (EEO) multiturn is selected (DRV.EMUEMODE (pg 384)=1), this parameter is used by itself to define the position of the Z pulse within one revolution. When the primary feedback position (within a revolution) equals this value, an index pulse will output. Also, if DRV.EMUEMODE=1 then this parameter is used in conjunction with DRV.EMUEMTURN.

When the EEO is configured to generate an absolute index pulse (DRV.EMUEMODE is 2, 7 or 9) this parameter and DRV.EMUEZOFFSET define the location of the Z pulse. DRV.EMUEMTURN is used to define which turn of the position range the Z pulse is located and DRV.EMUEZOFFSET is used to define the position of the Z pulse within one revolution.

Note: If you are using multi-turn or single turn absolute feedback devices the Z pulse from generated by the EEO will always be aligned with the same mechanical position of the primary feedback position. If you are using an incremental feedback device then the origin of the primary feedback is not at the same mechanical position each time the drive powers up.

Related Topics

23.12.26 DRV.EN

General Information	
Type	Command
Description	Enables the axis (software).
Units	N/A
Range	N/A
Default Value	Analog drive software is enabled. All other types of drive software are disabled.
Data Type	N/A
See Also	DRV.DIS (pg 377), DRV.DISSOURCES (pg 379) DRV.ACTIVE (pg 365)
Start Version	M_01-00-00-000

Description

DRV.EN issues a software enable to the drive. You can query the value of DRV.ACTIVE (pg 365) to check whether the drive is currently enabled or disabled.

You can also query the value of DRV.DISSOURCES (pg 379) to check whether the software enable bit is high (software enabled was issued by executing DRV.EN) or the software enable bit is low (software disable was issued by executing DRV.DIS). If the drive software enable bit is low and DRV.EN is executed, then drive faults are automatically cleared during the software enable process.

Related Topics

19.2 Clearing Faults

12.9 Enable/Disable

23.12.27 DRV.ENDEFAULT

General Information	
Type	R/W Parameter
Description	Sets the default state of the software enable.
Units	N/A
Range	0 to 1
Default Value	0
Data Type	Boolean
See Also	N/A
Start Version	M_01-00-00-000

Description

DRV. ENDEFAULT sets the default state of the software enable on power up for drives without fieldbuses (DRV.CMDSOURCE other than 1).

NOTE

It is recommended to not use this parameter with a BASIC program (keep DRV.ENDEFAULT = 0 / default value). Instead set DRV.SWENABLE = 1 at the beginning of the BASIC program.

Related Topics

Enable/Disable (pg 103)

23.12.28 DRV.FAULTHIST

General Information	
Type	R/O Parameter
Description	Reads the last 10 faults from NV memory.
Units	N/A
Range	N/A
Default Value	N/A
Data Type	N/A
See Also	DRV.FAULTS (pg 394), DRV.CLRFAULTHIST (pg 368)
Start Version	M_01-00-00-000

Description

DRV.FAULTHISTORY returns the last 50 faults that occurred in the drive. The faults are shown with their fault number (which matches the one displayed on the drive display) and a time stamp that indicates when they last occurred.

Issue a DRV.CLRFAULTHIST (pg 368) to clear this fault log.

23.12.29 DRV.FAULT1 to DRV.FAULT10

General Information	
Type	R/O
Description	Location of fault codes for any active fault conditions.
Units	N/A
Range	Any supported fault code or 0.
Default Value	N/A
Data Type	Integer
Start Version	tbd

Description

These parameters are holding registers where any active faults will be kept. A value of zero represents that no fault is present. Non-zero values correspond to specific fault codes in the drive (see fault and warning messages). The registers are populated in the order of when the fault occurs (DRV.FAULT1, DRV.FAULT2, DRV.FAULT3, and so on).

Notes:

- If DRV.FAULT1 value is 0, then the drive does not have any faults.
- Only active faults are shown. This is not a fault history.
- Warnings are not shown in the registers, only faults.

Related Topics

Modbus | DRV.ACTIVE | DRV.WARNING1 to DRV.WARNING10 (pg 430)

23.12.30 DRV.FAULTS

General Information	
Type	R/O Parameter
Description	Reads the active faults.
Units	N/A
Range	N/A
Default Value	N/A
Data Type	N/A
See Also	DRV.CLRFAULTS (pg 369), DRV.FAULTHIST (pg 392), DRV.CLRFAULTHIST (pg 368)
Start Version	M_01-00-00-000

Description

DRV.FAULTS returns a list of all currently active faults in the system, preceded by their fault number which matches the number displayed on the drive display.

To clear the faults, either issue a DRV.CLRFAULTS or issue a DRV.DIS followed by DRV.EN.

If no active faults are in the system, then after executing DRV.CLRFAULTS the value read by DRV.FAULTS is "No faults active".

Example

```
-->DRV.FAULTS
502: Bus under voltage.
-->
```

23.12.31 DRV.HANDWHEEL

General Information	
Type	R/O Parameter
Description	Reads the EEO input value.
Units	1/4,294,967,296 rev
Range	0 to 4,294,967,295 rev
Default Value	0 rev
Data Type	Integer
See Also	DRV.EMUERES (pg 388), DRV.EMUEMODE (pg 384)
Start Version	M_01-00-00-000
End Version	M_01-03-00-000

Description

When the EEO is selected as an input (DRV.EMUEMODE (pg 384)=3,4,5), this parameter reads the EEO value (where 4,294,967,296 is a full revolution, then the value rolls over). DRV.EMUERES (pg 388) defines the how many counts constitute a revolution on the EEO. This parameter represents the feedback 2 positions when feedback 2 is configured to be active. When secondary feedback is selected (DRV.EMUEMODE is 0 and FB2.SOURCE = 1 (X9), or FB2.SOURCE = 2 (X7)), this parameter represents the secondary feedback position (where 4,294,967,296 is a full revolution, then the value rolls over). FB2.ENCRES defines how many counts define a revolution for the secondary feedback.

Related Topics

23.12.32 DRV.HANDWHEELSRC

General Information	
Type	NV Parameter
Description	Selects the feedback for handwheel operation.
Units	None
Range	2-3
Default Value	2
Data Type	U8
See Also	N/A
Start Version	M_01-05-08-000

Description

This command sets the feedback which will be used as the handwheel source. If the selected Feedback is incompatible with the selected emulated encoder mode, a warning will be displayed.

Feedback 3 is only supported on drives with model numbers similar to KC1-x-xxxxx-NBxx-xxxx and will only work with Endat 2.2 multiturn encoder.

23.12.33 DRV.HELP

General Information	
Type	R/O Parameter
Description	Reads the minimum, maximum, and default values for a specific parameter or command.
Units	N/A
Range	N/A
Default Value	N/A
Data Type	N/A
See Also	N/A
Start Version	M_01-00-00-000

Description

This parameter returns more information about a specific parameter or command.

In most cases, except special parameters, this command tells you the minimum, maximum, default, and actual value of a parameter. Exceptions are commands that do not have these values (such as DRV.EN (pg 390)) or information commands (such as DRV.VER (pg 428)).

Related Topics

Terminal (pg 203)

23.12.34 DRV.HELPALL

General Information	
Type	R/O Parameter
Description	Retrieves the minimum, maximum, default, and actual values for all available parameters and commands.
Units	N/A
Range	N/A
Default Value	N/A
Data Type	N/A
See Also	N/A
Start Version	M_01-00-00-000

Description

This parameter retrieves all information about all parameters and commands in the firmware. In most cases, DRV.HELPALL returns the minimum, maximum, default, and actual value for each parameter and command. Exceptions include parameters and commands that do not have these values (such as DRV.EN (pg 390)) or pure INFO commands (such as DRV.VER (pg 428)).

Related Topics

Terminal (pg 203)

23.12.35 DRV.HWENABLE

General Information	
Type	R/O
Description	Status of the hardware enable.
Units	N/A
Range	0 to 1
Default Value	N/A
Data Type	Integer
Start Version	tbd

Description

Status of the Hardware Enable.

0 - not enabled

1 - enabled

Notes: This parameter reflects the status of the hardware enable only, not if the status of the power stage. The status of the power stage enable is determined by DRV.ACITVE.

Related Topics

DRV.DISSOURCES (pg 379) | DRV.ACTIVE

23.12.36 DRV.HWENDELAY

General Information	
Type	NV Parameter
Description	Delay time between inactive Hardware Enable input and drive disable.
Units	Milliseconds
Range	0 to 167 ms
Default Value	0 ms
Data Type	Integer
Start Version	01-05-08-000

Description

By default, when the Hardware Disable input deactivates, the drive is immediately disabled. However, on a vertical axis this may allow the load to drop slightly before the brake is applied.

To ensure that the brake is applied before the power stage is disabled, set DRV.HWENDELAY to a value which allows the brake to apply fully.

While the brake is applying, the drive will also attempt to decelerate the motor using the standard drive disable settings such as DRV.DISMODE, CS.DEC, CS.VTHRESH and CS.TO.

NOTE

Prior to version 01-05-08-000, the brake would only apply when velocity dropped below CS.VTHRESH or MOTOR.TBRAKETO expired. Starting with 01-05-08-000, the brake will now apply immediately when the Hardware Enable Input line is deactivated.

Related Topics

DRV.DISMODE (pg 378) | CS.DEC (pg 333) | CS.VTHRESH (pg 336) | CS.TO (pg 335) | MOTOR.TBRAKEAPP (pg 585)

23.12.37 DRV.HWENMODE

General Information	
Type	R/W Parameter
Description	Selects the action that the hardware enable digital input will perform.
Units	N/A
Range	0 to 1
Default Value	0
Data Type	Integer
See Also	N/A
Start Version	M_01-03-00-000

Description

This parameter selects the action that the hardware enable digital input will perform.

0 = The rising edge of the hardware enable will clear the drive faults.

1 = The rising edge of the hardware enable will not clear the drive faults.

The high/low state of the hardware enable is always used to control the active enable state of the drive.

Related Topics

12.9 Enable/Disable

23.12.38 DRV.ICONT

General Information	
Type	R/O Parameter
Description	Reads the continuous rated current value.
Units	Arms
Range	N/A
Default Value	N/A
Data Type	Float
See Also	DRV.IPEAK (pg 405)
Start Version	M_01-00-00-000

Description

DRV.ICONT returns the drive continuous rated current in Arms.

23.12.39 DRV.INFO

General Information	
Type	R/O Parameter
Description	Reads general information about the drive.
Units	N/A
Range	N/A
Default Value	N/A
Data Type	String
See Also	N/A
Start Version	M_01-00-00-000

Description

DRV.INFO returns general information about the drive.

Example

Advanced Kollmorgen™ Drive

 Drive model : KC1-B00306-NBAN-0000

Drive type : Base

Continuous current : 3.000 Arms

Peak current : 9.000 Arms

Voltage : 120/240 Vac

Option board : Not applicable

Connectivity : Analog

Product serial number : R-1207-00219

Hardware Version : D

MAC address : 00-23-1B-00-E4-5C

Processor ID : 0xE5040003

Firmware Version : M_01-06-01-000_Z_2012-04-12_15-48-26_TI

Operational image : M_01-06-01-000_Z_2012-04-12_15-48-26_TI

Resident image : R_00-00-37-000

Revision : 30037

Source Location : local

Firmware Build : Standard

FPGA Version : FP0007_0301_00_00

Operational image : FP0007_0301_00_00

Resident image : FPB007_0301_00_00

Size : 45

Control board Serial number : 4-0140-29153

Part number : 105-200500-01 Rev L

Revision : 9

Board ID : Standard

Power board Serial number : 4-0203-35992

Part number : 105-232000-01 Rev K

TCP/IP IP Address : 169.254.250.92
Subnet Mask : 255.255.0.0
Default Gateway : 0.0.0.0
DHCP Server : 0.0.0.0

23.12.40 DRV.IPEAK

General Information	
Type	R/O Parameter
Description	Reads the peak rated current value.
Units	Arms
Range	N/A
Default Value	N/A
Data Type	Float
See Also	DRV.ICONT (pg 402)
Start Version	M_01-00-00-000

Description

DRV.IPEAK returns the drive peak rated current in Arms.

Related Topics

8.5 Foldback

23.12.41 DRV.IZERO

General Information	
Type	NV Parameter
Description	Sets the current that will be used during the DRV.ZERO procedure.
Units	Arms
Range	Drive peak current to 0 Arms
Default Value	0 Arms
Data Type	Float
See Also	DRV.ZERO (pg 432)
Start Version	M_01-00-00-000

Description

This parameter sets the current that is used during the DRV.ZERO (pg 432) procedure.

23.12.42 DRV.LIST

General Information	
Type	R/O Parameter
Description	Reads the list of available parameters and commands.
Units	N/A
Range	N/A
Default Value	N/A
Data Type	String
See Also	N/A
Start Version	M_01-00-00-000

Description

DRV.LIST reads the list of available commands and parameters from the drive.

To filter this list, enter DRV.LIST followed by the prefix of the commands and parameters that you wish to display.

Example

Return a list of all available commands in the system:

```
-->DRV.LIST
```

Return all commands with the prefix DRV:

```
-->DRV.LIST DRV
```

23.12.43 DRV.LOGICVOLTS

General Information	
Type	R/O Parameter
Description	Reads the logic voltages.
Units	mv , Ω
Range	N/A
Default Value	N/A
Data Type	String
See Also	N/A
Start Version	M_01-00-00-000

Description

DRV.LOGICVOLTS reads the logic voltages data of 1.2 V, 2.5 V, 3.3 V, 5 V, 12 V, -12 V, and 3.3 AV.

Example

Below is an example of the output for this command:

```
ch0 = 1.2V      : 1211 mv
ch1 = 2.5V      :2488 mv
ch2 = 3.3V      :3274 mv
ch3 = 5V        :4950 mv
ch4 = 12V       :11892 mv
ch5 = -12V      : -11912 mv
ch6 = 3.3AV     :3300 mv
ch7 = R ohm     :100000 ohm
```


23.12.44 DRV.MEMADDR

General Information	
Type	R/W Parameter
Description	Sets the read and write address.
Units	N/A
Range	N/A
Default Value	U8
Data Type	N/A
See Also	DRV.MEMDATA (pg 410)
Start Version	M_01-00-00-000

Description

DRV.MEMADDR sets the address that is used by DRV.MEMDATA. The input can be either an internal parameter of the drive or any direct address from the DSP address space (SDRAM, internal RAM, or asynchronous memory). The input value can be either decimal or hexadecimal with 0x prefix.

Type extension can be one of the following:

U8,S8,U16,S16,U32,S32,U64,S64.

Examples

Setting to an internal parameter:

```
-->DRV.MEMADDR CCommandHandler.Debug1
```

Setting to an internal address:

```
-->DRV.MEMADDR 0xffabcde.u16
```

23.12.45 DRV.MEMDATA

General Information	
Type	R/W Parameter
Description	Sets or reads a value from an internal address.
Units	N/A
Range	N/A
Default Value	N/A
Data Type	N/A
See Also	DRV.MEMADDR (pg 409)
Start Version	M_01-00-00-000

Description

DRV.MEMDATA reads a value from the address that was set by DRV.MEMADDR (pg 409) or writes a value to this address. The input value can be either decimal or hexadecimal with 0x prefix.

Examples

Read a value from internal address:

```
-->DRV.MEMDATA 01
```

Write a hexadecimal value to an internal address:

```
-->DRV.MEMADDR 0x01
```

23.12.46 DRV.MOTIONSTAT

General Information	
Type	R/O Parameter
Description	Reads the motion status of the drive.
Units	N/A
Range	0 to 4,294,967,295
Default Value	N/A
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

Description

This command indicates the current status of the drive internal motion (see table below).

Bit	Significance	Description
0	0x00000001	Motion task is active (high active)
1	0x00000002	Home position found /reference point set (high active)
2	0x00000004	Home routine finished (high active). Bits 1 and 2 both must be set to confirm that the homing process is complete.
3	0x00000008	Homing active (high active)
4	0x00000010	Homing error condition has occurred (high active)*
5	0x00000020	Slave in electronic gearing mode synchronized (high active)
6	0x00000040	Electronic gearing is active (high active)
7	0x00000080	Emergency stop procedure in progress (high active)
8	0x00000100	Emergency stop procedure has an error (high active)
9	0x00000200	Service motion active (high active)
10	0x00000400	A motion task could not be activated /invalid MT (high active)**
11	0x00000800	Motion task target position has been reached. See also (high active).
12	0x00001000	Motion task target velocity has been reached. See also (high active).
13	0x00002000	Motion task encountered an exception. A motion task exception can happen during a static motion task activation, or during activation of motion task on the fly (when velocity is not zero). The status bit will be reset automatically on successful activation of any motion, or by a command DRV.CLRFAULT.
14	0x00004000	The target position of a motion task has been crossed. This situation occurs for motion tasks with a change on the fly when triggering the DRV.STOP (pg 424) command just before the reaching the target velocity of the current active motion task. The ramp-down procedure with the motion task deceleration ramp causes the target position to be crossed (high active).

* A possible error condition for homing to a reference switch could be that no reference switch was found between two hardware limit switches.

** A possible error condition for an invalid motion task could be that a motion task tried to trigger automatically following motion task that has never been initialized (called an "empty motion" task).

Related Topics

23.12.47 DRV.NAME

General Information	
Type	NV Parameter
Description	Sets and reads the name of the drive.
Units	N/A
Range	N/A
Default Value	No-Name
Data Type	String
See Also	N/A
Start Version	M_01-00-00-000

Description

You can assign a unique name to any drive under the following conditions:

- Only use ASCII characters
- Max length of 10 characters
- No spaces in name

This name is one way to identify the drive in a multiple drive network (for instance, in a TCP/IP network on which multiple drives reside).

From the terminal screen, DRV.NAME returns the name of the drive as ASCII characters.

23.12.48 DRV.NVCHECK

General Information	
Type	R/O Parameter
Description	NV Parameter Checksum
Units	None
Range	N/A
Default Value	N/A
Data Type	Integer
See Also	DRV.NVLIST
Start Version	M_01-04-12-000

Description

DRV.NVCHECK returns a checksum of all the drives NV parameters. This parameter can be used to detect changes in parameters.

In some applications a master device needs to confirm the KC1 drive contains an expected set of drive parameters. Reading and checking all the drive parameters individually is viable but this would be a long process involving many reads over the network. DRV.NVCHECK is a checksum on all the NV parameters and this parameter can be read in a single transaction. DRV.NVCHECK will return the same number if all the drive parameters match. If any of the drive parameters are changed then DRV.NVCHECK will return a different value.

23.12.49 DRV.NVLIST

General Information	
Type	R/O Parameter
Description	Lists the NV parameters and values from the RAM.
Units	N/A
Range	N/A
Default Value	N/A
Data Type	N/A
See Also	N/A
Start Version	M_01-00-00-000

Description

DRV.NVLIST lists all the drive parameters that reside in NV memory.

The list includes each parameter name, followed by its current value from the RAM.

23.12.50 DRV.NVLOAD

General Information	
Type	R/O Parameter
Description	Loads all data from the NV memory of the drive into the RAM parameters.
Units	N/A
Range	N/A
Default Value	N/A
Data Type	N/A
See Also	DRV.NVLOAD DRV.NVLIST
Start Version	M_01-00-00-000

Description

DRV.NVLOAD loads all data from the NV memory of the drive into the RAM parameters.

23.12.51 DRV.NVSAVE

General Information	
Type	Command
Description	Saves the drive parameters from the RAM to the NV memory.
Units	N/A
Range	N/A
Default Value	N/A
Data Type	N/A
See Also	DRV.RSTVAR (pg 420)
Start Version	M_01-00-00-000

Description

DRV.NVSAVE saves the current drive parameter values from the RAM to the NV memory. The drive parameters that were saved to the NV are read from the NV on the next drive boot, causing the values to be automatically set to the saved values on every drive boot. Executing DRV.RSTVAR does not modify the values of the NV, but instead sets the drive values in RAM to their defaults.

23.12.52 DRV.ONTIME

General Information	
Type	R/O Parameter
Description	Returns how long the drive has been running since last power up.
Units	Days:Hours:Minutes:Seconds
Range	N/A
Default Value	N/A
Data Type	String
See Also	Returns how long the drive has been running since first activated. (pg 421)
Start Version	M_01-00-00-000

Description

This parameter returns the length of time that the drive has been running for the current session (since the last power up).

23.12.53 DRV.OPMODE

General Information	
Type	NV Parameter
Description	Sets the drive operation mode (current, velocity, or position).
Units	N/A
Range	0 to 2
Default Value	0
Data Type	Integer
See Also	DRV.CMDSOURCE (pg 371)
Start Version	M_01-00-00-000

Description

DRV.OPMODE specifies the operation mode of the drive. You must also use DRV.CMDSOURCE to set the source of the command to the drive.

The operation mode values can be set as follows:

Mode	Description
0	Current (torque) operation mode
1	Velocity operation mode
2	Position operation mode

DRV.OPMODE can be changed while the drive is enabled or disabled. If you are using the terminal to change the operation mode, then it is recommended that you disable the drive before changing the operation mode. If you change the operation mode from the terminal while the drive is enabled, the system may experience a step change in demand.

Example

Set the source of the command to a TCP/IP channel and the desired operation mode to velocity:

```
-->DRV.CMDSOURCE 0
-->DRV.OPMODE 1
```

Related Topics

12.10 Controlled Stop

13.3 Current Loop

13.4 Velocity Loop

13.5 Position Loop

23.12.54 DRV.READFORMAT

General Information	
Type	R/W Parameter
Description	Sets the value returned to either decimal or hexadecimal.
Units	N/A
Range	10 or 16
Default Value	10
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

Description

DRV.READFORMAT sets the return values type to either decimal or hexadecimal.

Format	Description
10	Sets the read values to decimal format
16	Sets the read values to hexadecimal format

23.12.55 DRV.RSTVAR

General Information	
Type	Command
Description	Sets default values in the drive without re-booting the drive and without resetting the NV memory.
Units	N/A
Range	N/A
Default Value	N/A
Data Type	N/A
See Also	
Start Version	M_01-00-00-000

Description

DRV.RSTVAR causes the drive to return to the default values without the need to re-boot the drive first and without resetting the NV memory. Use DRV.RSTVAR to return to the default settings and recover a working drive.

23.12.56 DRV.RUNTIME

General Information	
Type	R/O Parameter
Description	Returns how long the drive has been running since first activated.
Units	Days:Hours:Minutes:Seconds
Range	N/A
Default Value	N/A
Data Type	String
See Also	N/A
Start Version	M_01-00-00-000

Description

DRV.RUNTIME returns the length of time that the drive has been running since it was first activated. This time includes the current session and the total amount of time from all previous sessions.

23.12.57 DRV.SETUPREQBITS

General Information	
Type	R/O Parameter
Description	Reads the bitwise set status of parameters that must be set before the drive can be enabled.
Units	N/A
Range	N/A
Default Value	N/A
Data Type	N/A
See Also	DRV.SETUPREQLIST (pg 423), MOTOR.AUTOSSET (pg 564)
Start Version	M_01-00-00-000

Description

This parameter returns the bitwise set status of parameters that needs to be set up before the drive can be enabled. Only when this parameter returns 0 can the drive be enabled.

Parameter	Bits
IL.KP	0x00000001
MOTOR.IPEAK	0x00000002
MOTOR.ICONT	0x00000004
MOTOR.VMAX	0x00000008
MOTOR.POLES	0x00000010
MOTOR.PHASE	0x00000020

Please note that if MOTOR.AUTOSSET (pg 564) is set to 1 (parameters automatically calculated from motor ID data), then all values in the list will be initialized from the feedback device. Otherwise, the parameters must be set manually.

23.12.58 DRV.SETUPREQLIST

General Information	
Type	R/O Parameters
Description	Reads the list of parameters that must be set before the drive can be enabled.
Units	N/A
Range	N/A
Default Value	N/A
Data Type	N/A
See Also	DRV.SETUPREQBITS (pg 422), MOTOR.AUTOSSET (pg 564)
Start Version	M_01-00-00-000

Description

This parameter returns the list of parameters that must be set before the drive can be enabled and also whether or not each one of those parameters is set. Only when all commands have value of 0 can the drive be enabled.

Please note that if MOTOR.AUTOSSET (pg 564) is set to 1 (parameters automatically calculated from motor ID data), then all values in the list will be initialized from the feedback device. Otherwise, the parameters must be set manually.

Example

```
-->DRV.SETUPREQLIST
IL.KP 0
MOTOR.ICONT 0
MOTOR.IPEAK 0
MOTOR.POLES 0
-->
```

23.12.59 DRV.STOP

General Information	
Type	Command
Description	This command stops all drive motion.
Units	N/A
Range	N/A
Default Value	N/A
Data Type	N/A
See Also	N/A
Start Version	M_01-00-00-000

Description

This command stops all drive motion.

23.12.60 DRV.TEMPERATURES

General Information	
Type	R/O Parameter
Description	Reads the temperature of drive components.
Units	°C
Range	55 to 125 °C
Default Value	N/A
Data Type	String
See Also	N/A
Start Version	M_01-00-00-000

Description

DRV.TEMPERATURES reads the temperature in different parts of the drive (power and control boards). The temperature is read from temperature sensors located in the drive.

Example

Below is an example of the output for this command :

```
Control Temperature: 39 °C
Power1 Temperature: 31 °C
Power2 Temperature: Sensor does not exist.
Power3 Temperature: Sensor does not exist.
```

23.12.61 DRV.TIME

General Information	
Type	R/W
Description	A continuous time counter in the drive.
Units	Milliseconds
Range	0 to 4294967295 (~ 49 days)
Default Value	N/A
Data Type	Integer
Start Version	tbd

Description

A continuous time counter in the drive. The timer starts at zero and counts up until it rolls over. If a new value is written to the timer, it continues to count up starting at the written value.

Related Topics

DRV.RUNTIME (pg 421) | WHEN.DRV.TIME

23.12.62 DRV.TYPE

General Information	
Type	R/O on analog, EtherCAT and CANopen models R/W on the CC drive model.
Description	Selects the operational fieldbus on CC drive models.
Units	N/A
Range	0 to 7
Default Value	2
Data Type	Integer
See Also	FBUS.TYPE, DRV.INFO (pg 403)
Start Version	M_01-03-00-000

Description

DRV.TYPE allows you to select the operational fieldbus for your drive. This parameter is read-write on the CC drive models and read-only on the analog, EtherCAT, and CANopen drive models. To change the operational fieldbus of your drive:

1. Set DRV.TYPE to one of the following values:
 - 0 = Analog (no EtherCAT or CANopen) with no position indexer functionality.
 - 1 = Analog (no EtherCAT or CANopen) with position indexer functionality.
 - 2 = EtherCAT
 - 3 = CANopen
 - 4 = SynqNet
 - 5 = EtherNet/IP
 - 6 = BASIC Language (not fieldbus)
 - 7 = Profinet
2. Save the parameters to the NV memory on the drive by issuing the DRV.NVSAVE command
3. Power cycle the 24 V supply to the drive. When the drive has finished powering up, it will be working with the new selection.

Changing DRV.TYPE does not immediately change the type of the drive fieldbus selection. You must power cycle the drive to start the drive with the selected functionality.

You cannot use EtherCAT and CANopen at the same time. Use FBUS.TYPE or DRV.INFO to identify the fieldbus currently in use.

DRV.TYPE does not change if you use DRV.RSTVAR.

Related Topics

KC1 Models (pg 24)

23.12.63 DRV.VER

General Information	
Type	R/O Parameter
Description	Reads the drive version.
Units	N/A
Range	N/A
Default Value	N/A
Data Type	String
See Also	N/A
Start Version	M_01-00-00-000

Description

DRV.VER reads both FPGA and firmware versions.

The version data presented is hard coded in the firmware code.

Example

Below is an example of the output for this command:

```
Danaher Motion - Digital Servo Drive
```

```
-----
```

```
FPGA version : FP0004_0001_00_07
```

```
Firmware Version : M_0-0-15_T_2009-01-19_10-36-28_IR
```

23.12.64 DRV.VERIMAGE

General Information	
Type	R/O Parameter
Description	Returns the version data from each image.
Units	N/A
Range	N/A
Default Value	N/A
Data Type	String
See Also	N/A
Start Version	M_01-00-00-000

Description

DRV.VERIMAGE reads the versions of the different images in the drive. This parameter returns the version data from each image .i00 file.

Example

Below is an example of the output for this parameter:

```
Danaher Motion - Digital Servo Drive
-----
Resident Firmware: R_0-0-11
Operational Firmware: M_0-0-15
Resident FPGA: FPB004_0001_00_07
Operational FPGA : FP0004_0001_00_07
```

23.12.65 DRV.WARNING1 to DRV.WARNING10

General Information	
Type	R/O
Description	Location of fault codes for any active warning conditions.
Units	N/A
Range	Any supported fault code or 0
Default Value	N/A
Data Type	Integer
Start Version	tbd

Description

These parameters are holding registers where any active warnings will be displayed. A value of zero represents that no warning is present. Non-zero values correspond to specific warning codes in the drive (see fault and warning messages). The registers are populated in the order of when the warning occurs (DRV.WARNING1, DRV.WARNING2, DRV.WARNING3, and so on).

Notes:

- If DRV.WARNING1 value is 0, then the drive does not have any faults.
- Only active warnings are shown. This is not a warning history.
- Faults are not shown in the registers, only warnings.

Related Topics

DRV.FAULT1 to DRV.FAULT10 (pg 393) | Modbus

23.12.66 DRV.WARNINGS

General Information	
Type	R/O Parameter
Description	Reads the active warnings.
Units	N/A
Range	N/A
Default Value	N/A
Data Type	N/A
See Also	N/A
Start Version	M_01-00-00-000

Description

DRV.WARNINGS returns a list of all currently active warnings in the system.

23.12.67 DRV.ZERO

General Information	
Type	R/W Parameter
Description	Sets the zero mode. The procedure is activated when the drive is enabled.
Units	N/A
Range	0 to 1
Default Value	0
Data Type	Integer
See Also	DRV.IZERO (pg 406)
Start Version	M_01-00-00-000

Description

The zero procedure is a sequence in which phase commutation is initialized. During this procedure, the motor is held at a certain known electrical position (by applying a current defined by DRV.IZERO (pg 406)). After the motor rests at this position, the commutation angle is calculated and set automatically.

23.13 FAULT Parameters

This section describes the FAULT parameters.

23.13.1 FAULTx.ACTION	434
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23.13.1 FAULTx.ACTION

General Information	
Type	R/W
Description	Gets/Sets the Fault Action for Fault 130, 131, 132, 134, 139, 451, and 702.
Units	N/A
Range	0 to 1
Default Value	0
Data Type	Integer
Start Version	M_01-04-16-000

Description

This Parameter determines the action the drive should take when Fault 130, 131, 132, 134, 139, 451, or 702 occurs.

Parameter Value	Drive Action
0	Disable Amplifier
1	Ignore (fault will not be reported)

23.14 FB1 Parameters

This section describes the FB1 parameters.

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23.14.1 FB1.BISSBITS

General Information	
Type	NV Parameter
Description	Specifies the number of Biss Sensor (Position) Bits for the BiSS Mode C encoder in use.
Units	bits
Range	0 to 64 bits
Default Value	32 bits
Data Type	Integer
See Also	FB1.SELECT (pg 459), FB1.IDENTIFIED (pg 442)
Start Version	M_01-01-00-100 and M_01-01-03-000

Description

FB1.BISSBITS specifies the number of BiSS sensor (position) bits for the BiSS Mode C encoder in use. Typically the value is either 26 or 32 for a BiSS Mode C Renishaw encoder. The required value for this parameter is provided by the feedback device manufacturer for the particular device being used.

Related Topics

Feedback 1 (pg 56)

23.14.2 FB1.ENCRES

General Information	
Type	Depends on FB1.IDENTIFIED. See table in description below.
Description	Sets the resolution of the motor encoder.
Units	Encoder counts
Range	0 to $2^{32}-1$
Default Value	1,024
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

Description

This parameter sets or gets the resolution of the motor encoder (encoder feedback systems only) in number of counts per revolution for a rotary motor and the number of encoder pitches per motor pole pitch for a linear motor. The number of encoder counts per revolution is obtained by multiplying the motor catalog resolution in units of PPR by four. For example, for a 1024 PPR resolution motor, the number of encoder counts per revolution is $1024 * 4 = 4096$. For this motor FB1.ENCRES must be set to 4096.

For linear motors, the value of FB1.ENCRES is set to the number of encoder pitches per motor pole pitch. For a motor with 32 mm pole pitch, and a 40 μm encoder pitch, the value for FB1.ENCRES should be set to $32 \text{ mm} / 40 \mu\text{m} = 800$.

Depending on the value of FB1.IDENTIFIED, FB1.ENCRES changes between read-only and read-write. The following table lists the FB1.IDENTIFIED values and FB1.ENCRES's corresponding type.

FB1.IDENTIFIED value	FB1.ENCRES type
10 (Incremental encoder)	R/W
11 (Incremental encoder, no halls)	R/W
20 (Sine encoder)	R/W
21 (Sine encoder, no halls)	R/W
30 (Endat 2.1)	R/O
31 (Endat 2.2)	R/O
32 (biSS)	R/O
33 (hiperface)	R/O
34 (biSS Mode C)	R/W
40 (Resolver)	R/W
41 (sfd)	R/O
42 (Tamagawa)	R/O

Related Topics

8.2 Feedback 1

23.14.3 FB1.HALLSTATE

General Information	
Type	R/O Parameter
Description	Reads the Hall switch values (encoder feedback only).
Units	Binary
Range	0 0 0 to 1 1 1
Default Value	N/A
Data Type	String
See Also	N/A
Start Version	M_01-00-00-000

Description

FB1.HALLSTATE reads the Hall switch values (encoder feedback only).

Related Topics

Feedback 1 (pg 56)

23.14.4 FB1.HALLSTATEU

General Information	
Type	R/O Parameter
Description	Reads the state of Hall switch U.
Units	N/A
Range	0 and 1
Default Value	1
Data Type	Integer
See Also	FB1.HALLSTATE (pg 438)
Start Version	M_01-03-07-000

Description

FB1.HALLSTATEU reads the state of Hall switch U.

Related Topics

Feedback 1 (pg 56)

23.14.5 FB1.HALLSTATEV

General Information	
Type	R/O Parameter
Description	Reads the state of Hall switch V.
Units	N/A
Range	0 and 1
Default Value	1
Data Type	Integer
See Also	FB1.HALLSTATE (pg 438)
Start Version	M_01-03-07-000

Description

FB1.HALLSTATEV reads the state of Hall switch V.

Related Topics

Feedback 1 (pg 56)

23.14.6 FB1.HALLSTATEW

General Information	
Type	R/O Parameter
Description	Reads the state of Hall switch W.
Units	N/A
Range	0 and 1
Default Value	1
Data Type	Integer
See Also	FB1.HALLSTATE (pg 438)
Start Version	M_01-03-07-000

Description

FB1.HALLSTATEW reads the state of Hall switch W.

Related Topics

Feedback 1 (pg 56)

23.14.7 FB1.IDENTIFIED

General Information	
Type	R/O Parameter
Description	Reads the type of feedback device used by the drive/motor.
Units	N/A
Range	N/A
Default Value	N/A
Data Type	Integer
See Also	FB1.SELECT
Start Version	M_01-00-00-000

Description

This parameter is set according to FB1.SELECT on drive power up if FB1.SELECT is not -1; otherwise the parameter value is read from the drive memory.

Type	Description
0	Unknown
10	Incremental encoder with A/B Quad, marker pulse and Hall
11	Incremental encoder with A/B Quad, marker pulse and no Hall
20	Sine Encoder , with marker pulse and Hall
21	Sine encoder , with marker pulse & No Halls
30	EnDat 2.1 with Sine Cosine
31	EnDat 2.2
32	BiSS with Sine Cosine
33	HIPERFACE
34	BiSS Mode C Renishaw
40	Resolver
41	SFD
42	Tamagawa

Related Topics

Feedback 1 (pg 56)

23.14.8 FB1.INITSIGNED

General Information	
Type	NV Parameter
Description	Sets initial feedback value as signed or unsigned.
Units	N/A
Range	0 to 1
Default Value	1
Data Type	Integer
See Also	FB1.ORIGIN
Start Version	M_01-00-00-000

Description

This parameter sets whether the initial value of the feedback read from the feedback device will be set as a signed or as an unsigned value.

0 = Unsigned

1 = Signed

The drive internal process for the feedback initialization is as follows:

1. Reads the position feedback.
2. Adds the origin to the feedback.
3. Determines modulo from Step 2 by the actual feedback bits.
4. Sets the position feedback sign according to FB1.INITSIGNED.

Related Topics

Feedback 1 (pg 56)

23.14.9 FB1.MECHPOS

General Information	
Type	R/O Parameter
Description	Reads the mechanical position.
Units	counts
Range	0 to 4,294,967,295 counts
Default Value	N/A
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

Description

FB1.MECHPOS reads the mechanical angle which is equal to the lower 32 bits in the 64-bit position feedback word.

Related Topics

Feedback 1 (pg 56)

23.14.10 FB1.MEMVER

General Information	
Type	R/O Parameter
Description	Returns the memory feedback version.
Units	N/A
Range	N/A
Default Value	N/A
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

Description

FB1.MEMVER returns the memory feedback version (only applicable for feedbacks with memory).

Related Topics

Feedback 1 (pg 56)

23.14.11 FB1.OFFSET

General Information	
Type	NV-Parameter
Description	Sets position feedback offset.
Units	Depends on UNIT.ACCROTARY or UNIT.PLINEAR Rotary: counts, rad, deg, Custom Units (pg 77), 16-bit counts Linear: counts, mm, μm, Custom Units (pg 77), 16-bit counts
Range	Rotary: -5,123,372,000,000,005.000 to 5,123,372,000,000,005.000 counts -7495.067 to 7495.067 rad -429,436.096 to 429,436.096 deg -5,964.390 to 5,964.390 [Custom Units (pg 77)] -78,176,452.637 to 78,176,452.636 16-bit counts Linear: -5,123,372,000,000,005.000 to 5,123,372,000,000,005.000 counts -1192.878*MOTOR.PITCH (pg 581) to 1192.878*MOTOR.PITCH mm -1192877.952*MOTOR.PITCH to 1192877.952*MOTOR.PITCH μm -5964.390 to 5964.390 Custom Units (pg 77) -78176452.637 to 78176452.636 16-bit counts
Default Value	0
Data Type	Float
Start Version	M_01-00-00-000

Description

FB1.OFFSET is a value added to the position feedback (PL.FB (pg 605)).

Example

If PL.FB is 10 deg and FB1.OFFSET is set to -10 deg, then the next read of PL.FB will return ~0 deg.

Related Topics

Feedback 1 (pg 56) | PL.FB (pg 605)

23.14.12 FB1.ORIGIN

General Information	
Type	NV Parameter
Description	Adds to the initial feedback position.
Units	Depends on or Rotary: counts, rad, deg, custom units, 16-bit counts Linear: counts, mm, µm, custom units, 16-bit counts
Range	Rotary: 0.000 to 5,123,372,000,000.000 counts 0.000 to 7,495.067 rad 0.000 to 429,436.096 deg 0.000 to 5,964.390 custom units 0.000 to 78,176,452.636 16-bit counts Linear: 0.000 to 5,123,372,000,000.000 counts 0.000 to 1,192.878 mm 0.000 to 1,192,877.952 µm 0.000 to 5,964.390 custom units 0.000 to 78,176,452.636 counts 16 Bit
Default Value	0 counts
Data Type	Float
See Also	FB1.INITSIGNED
Start Version	M_01-00-00-000

Description

FB1.ORIGIN is a value that is added to the feedback device position. Initial value and modulo are determined from the number of bits of the feedback:

Initial position value = (<feedback from device> + FB1.ORIGIN) modulo <number of feedback bits>

The number of feedback bits is set according to the feedback type. For memory feedbacks it is the number of feedback bits; for none memory it is always single turn.

The drive internal process for the feedback initialization is as follows:

1. Reads the position feedback.
2. Adds the origin to the feedback.
3. Determines modulo from Step 2 by the actual feedback bits.
4. Sets the position feedback sign according to FB1.INITSIGNED.

Example

This example uses set to 2 (degrees)

It also assumes that the drive is connected to a single turn feedback device with memory.

FB1.ORIGIN is set to 22 and saved into NV memory.

Drive boots and reads from feedback device position 340 degrees. According to the description section above, calculation will be:

$(340 + 22) \text{ modulo } 360 = 2 \text{ degrees.}$

Therefore the initial feedback value will be set to 2 degrees.

Related Topics

8.2 Feedback 1

23.14.13 FB1.P

General Information	
Type	R/O Parameter
Description	Reads position from the primary feedback.
Units	Depends on FB1.UNIT counts or custom units.
Range	N/A
Default Value	N/A
Data Type	S64
Start Version	M_01-05-08-000

Description

This parameter reads the position of the primary feedback device connected to X10. The position can be read as counts or in customer units. This is the raw position read back from the device. The output format is 32:32, the upper 32 bits represent the multi-turns and the lower 32 bits represent the position of the feedback.

Related Topics

Feedback 1 (pg 56) | FB1.PUNIT (pg 456) | FB1.PIN | FB1.POUT

23.14.14 FB1.PDIR

General Information	
Type	NV-Parameter
Description	Sets the counting direction for feedback channel 1.
Units	None
Range	0 to 1
Default Value	0
Data Type	U8
See Also	N/A
Start Version	M_01-05-11-000

Description

FB1.PDIR will change the sign and with it the direction of feedback channel 1.

Example

If position feedback = 35,185.932 counts and you set:

→ FB1.PDIR 1

then position feedback = -35,185.932 counts

23.14.15 FB1.PFIND

General Information	
Type	R/W Parameter
Description	A procedure that allows the user to find the commutation angle for encoder feedback, which has no halls.
Units	NA
Range	0, 1
Default Value	0
Data Type	Integer
See Also	FB1.PFINDCMDU (pg 452)
Start Version	M_01-00-00-000

Description

A procedure that allows the user to find the commutation angle for encoder feedback (which has no Halls).

Related Topics

Feedback 1 (pg 56)

23.14.16 FB1.PFINDCMDU

General Information	
Type	R/W Parameter
Description	Current value used during the phase finding procedure (PFB.PFIND=1)
Units	A
Range	0 to DRV.IPEAK
Default Value	0
Data Type	Float
See Also	PFB.PFIND
Start Version	M_01-00-00-000

Description

FB1.PFINDCMDU sets the current value used during the phase finding procedure.

Related Topics

Feedback 1 (pg 56)

23.14.17 FB1.POFFSET

General Information	
Type	NV-Parameter
Description	Sets the offset for primary feedback.
Units	counts, custom units
Range	-5,123,372,000,000,005.000 to 5,123,372,000,000,005.000 counts or -10,485,760.000 to 10,485,760.000 custom units
Default Value	0
Data Type	S64
See Also	N/A
Start Version	M_01-05-11-000

Description

FB1.POFFSET is the value added to the primary feedback position (FB1.P (pg 449)).

Example

If FB1.P is 10000 counts and FB1.POFFSET is set to -10000 counts, then the next read of FB1.P will return ~0 counts.

23.14.18 FB1.POLES

General Information	
Type	R/W Parameter
Description	Reads the number of feedback poles.
Units	N/A
Range	2 to 128
Default Value	2
Data Type	Integer
See Also	MOTOR.POLES
Start Version	M_01-00-00-000

Description

FB1.POLES sets the number of individual poles in the feedback device. This variable is used for the commutation function, as well as for velocity feedback scaling, and represents the number of individual poles (not pole pairs). The division value of motor poles (MOTOR.POLES) and feedback poles (FB1.POLES) must be an integer when moving drive to enable, otherwise a fault is issued.

Related Topics

Feedback 1 (pg 56)

23.14.19 FB1.PSCALE

General Information	
Type	R/W Parameter
Description	Sets position scaling value for fieldbus transferred position objects.
Units	N/A
Range	0 to 32
Default Value	20
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

Description

Position values transferred over fieldbus are converted from native 64-bit values to a maximum 32-bit position value. This parameter sets the resolution/revolution of position values back to the controller.

FB1.PSCALE determines the counts per revolution of position values delivered by fieldbus. The default value is 20, which yields 2^{20} counts/revolution. This scaling is used for CAN PDOs 6064 (Position Actual Value) and 60F4 (Following Error Actual Value).

Example

The drive always works internally with 64-bit position values. The drive internal 64-bit actual position should contain the following value:

0x0000.0023.1234.ABCD

The lower 32 bits represent the mechanical angle of the feedback. The upper 32 bits represent the number of turns.

FB1.PSCALE = 20

The 32-bit position is: 0x0231234A

FB1.PSCALE = 16

The 32-bit position is: 0x00231234

Related Topics

Feedback 1 (pg 56)

23.14.20 FB1.PUNIT

General Information	
Type	NV Parameter
Description	Sets the unit for FB1.P.
Units	N/A
Range	0, 3
Default Value	0
Data Type	U8
See Also	N/A
Start Version	M_01-05-11-000

Description

FB1.UNIT sets the position unit for FB1.P.

Value	Description
0	Counts (32.32 format)
3	(FB1.PIN/FB1.POUT) per revolution.

Related Topics

FB1.P (pg 449)

23.14.21 FB1.RESKTR

General Information	
Type	NV Parameter
Description	Sets the resolver nominal transformation ratio.
Units	N/A
Range	0.001 to 50.000
Default Value	0.5
Data Type	Float
See Also	N/A
Start Version	M_01-00-00-000

Description

This parameter sets the resolver nominal transformation ratio. It affects the resolver excitation output amplitude.

The value can be obtained from the resolver data sheet.

Related Topics

Feedback 1 (pg 56)

23.14.22 FB1.RESREFPHASE

General Information	
Type	NV Parameter
Description	Sets the electrical degrees of phase lag in the resolver.
Units	electrical degrees
Range	-180 to 180°
Default Value	-2°
Data Type	Float
See Also	N/A
Start Version	M_01-00-00-000

Description

This parameter sets the electrical degrees of phase lag in the resolver. See the motor resolver datasheet for the value for this parameter .

Related Topics

Feedback 1 (pg 56)

23.14.23 FB1.SELECT

General Information	
Type	NV Parameter
Description	Sets user entered type or identified type (-1).
Units	N/A
Range	-1, 10, 20, 30, 31, 32, 40, 41, 42
Default Value	-1
Data Type	Integer
See Also	FB1.IDENTIFIED
Start Version	M_01-00-00-000

Description

FB1.SELECT sets the feedback type manually (see FB1.IDENTIFIED) or allows the drive to automatically identify the feedback type on power up.

FB1 5V Power Supply Notes:

If FB1.SELECT = -1, the 5V power supply will only turn on during the initialization phase. If the feedback type cannot be automatically detected, the 5V power supply will be turned off, and remain off until a DRV.CLRFAULTS is issued (which will re-start the FB1 initialization), OR FB1.SELECT is manually set to a specific feedback type.

When FB1.SELECT is manually set to a specific feedback type, the FB1 5V power supply will remain on, unless a short is detected. This is useful for encoder types that may require calibration.

FB1.SELECT Input Values

Input Value	Description
-1	The drive automatically identifies the type of feedback as part of the power up process. Setting this value does not modify FB1.IDENTIFIED, unless it is saved in the NV memory for the next power up. If a feedback with memory is connected to the drive, the value of FB1.IDENTIFIED is set automatically to the feedback identified and all parameters read from the feedback are set according to the values read from the feedback. If no feedback is connected or a feedback with no memory is connected, the value of FB1.IDENTIFIED is set to 0 (no feedback identified) and all values normally read from the feedback are read from NV memory (if stored in NV) otherwise they are set to the default values.
10	Manually sets the type to incremental encoder. This input sets the value of FB1.IDENTIFIED to 10. If the feedback setting fails, FB1.IDENTIFIED is automatically set to 0 (no feedback identified).
20	Manually sets the type to sine encoder. This input sets the value of FB1.IDENTIFIED to 20. If the feedback setting fails, FB1.IDENTIFIED is automatically set to 0 (no feedback identified).
30	Manually sets the type to Endat 2.1. This input sets the value of FB1.IDENTIFIED to 30. If the feedback setting fails, FB1.IDENTIFIED is automatically set to 0 (no feedback identified).
31	Manually sets the type to Endat 2.2. This input sets the value of FB1.IDENTIFIED to 31. If the feedback setting fails, FB1.IDENTIFIED is automatically set to 0 (no feedback identified).

Input Value	Description
32	Manually sets the type to BiSS. This input sets the value of FB1.IDENTIFIED to 32. If the feedback setting fails, FB1.IDENTIFIED is automatically set to 0 (no feedback identified).
33	<p>Manually sets the type to Hiperface. This input sets the value of FB1.IDENTIFIED to 33. If the feedback setting fails, FB1.IDENTIFIED is automatically set to 0 (no feedback identified).</p> <p>Note that all Hiperface feedback types are supported by the KC1. This includes SEL/SEK 37, SEL/SEK 52, SKM/SKS 36, SRS/SRM 50, SRS/SRM 60, SEK 90, SEK160, and SEK 260. The KC1 drive will support any new Hiperface device, since any new device will be released with a label type of 0xFF. Devices with this label type have all of the pertinent information to configure these devices (number of single turn bits, number of multi-turn bits, and number of sine/cosine periods) stored in their memory. The KC1 is able to read this information, and automatically configure the drive for proper operation. Note that the devices SEK 90, SEK 160, and SEK 260 are label type 0xFF.</p>
40	Manually sets the type to resolver. This input sets the value of FB1.IDENTIFIED to 40. If the feedback setting fails, FB1.IDENTIFIED is automatically set to 0 (no feedback identified).
41	Manually sets the type to SFD. This input sets the value of FB1.IDENTIFIED to 41. If the feedback setting fails, FB1.IDENTIFIED is automatically set to 0 (no feedback identified).

FB1.SELECT Feedback Types

Type	Description
0	Unknown
10	Incremental encoder with A/B Quad, marker pulse and Hall
11	Incremental encoder with A/B Quad, marker pulse and no Hall
20	Sine Encoder , with marker pulse and Hall
21	Sine encoder , with marker pulse & No Halls
30	EnDat 2.1 with Sine Cosine
31	EnDat 2.2
32	BiSS with Sine Cosine
33	HIPERFACE
34	BiSS Mode C Renishaw
40	Resolver
41	SFD
42	Tamagawa

Related Topics

8.2 Feedback 1

23.14.24 FB1.TRACKINGCAL

General Information	
Type	NV Parameter
Description	Controls tracking calibration algorithm.
Units	N/A
Range	0 to 1
Default Value	0
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

Description

This parameter turns the tracking calibration algorithm on or off for sine-cosine or resolver.

0 = Tracking calibration is off.

1 = Tracking calibration is on.

Related Topics

Feedback 1 (pg 56)

23.14.25 FB1.USERBYTE0 to FB1.USERBYTE7

General Information	
Type	R/W
Description	Reads and writes data stored in two 32 bit words in the Endat feedback device.
Units	N/A
Range	0 to 255
Default Value	0
Data Type	Integer
Start Version	M_01-05-08-000

Description

FB1.USERBYTE, FB1.USERWORD, and FB1.USERDWORD share two 32bit words in the Endat feedback device. These three parameters offer different ways to store and access the data stored in these two 32bit words. The table below defines each parameters function. The values are automatically stored non-volatile in the feedback device.

Parameter	Bits	Attributes
FB1.USERBYTE0 to FB1.USERBYTE7	8 bit	signed or unsigned char
FB1.USERWORD0 to FB1.USERWORD3	16 bit	signed or unsigned short
FB1.USERDWORD0 to FB1.USERDWORD1	32 bit	singed or unsigned int

The parameters overlap each other in the following way:

BYTE0	BYTE1	BYTE2	BYTE3	BYTE4	BYTE5	BYTE6	BYT7
WORD0		WORD1		WORD2		WORD3	
DWORD0				DWORD1			

For example, if BYTE1 is modified, WORD0 and DWORD0 are modified as well.

Example

```
-->FB1.USERDWORD1 65536
-->FB1.USERBYTE1
0
-->FB1.USERBYTE2
1
-->FB1.USERBYTE3
0

-->FB1.USERBYTE3 1 (write to the highest byte of FB1.USERDWORD0)
-->FB1.USERDWORD0
16842752
-->FB1.USERWORD0
0
-->FB1.USERWORD1
257
```

Related Topics

Feedback 1 (pg 56) | FB1.USERWORD1 to FB1.USERWORD3 (pg 464) | FB1.USERDWORD0 to FB1.USERWORD1 (pg 463)

23.14.26 FB1.USERDWORD0 to FB1.USERWORD1

General Information	
Type	R/W
Description	Reads and writes data stored in two 32 bit words in the Endat feedback device.
Units	N/A
Range	0 to 4,294,967,295
Default Value	0
Data Type	Integer
Start Version	M_01-05-08-000

Description

FB1.USERBYTE, FB1.USERWORD, and FB1.USERDWORD share two 32bit words in the Endat feedback device. These three parameters offer different ways to store and access the data stored in these two 32bit words. The table below defines each parameters function. The values are automatically stored non-volatile in the feedback device.

Parameter	Bits	Attributes
FB1.USERBYTE0 to FB1.USERBYTE7	8 bit	signed or unsigned char
FB1.USERWORD0 to FB1.USERWORD3	16 bit	signed or unsigned short
FB1.USERDWORD0 to FB1.USERDWORD1	32 bit	singed or unsigned int

The parameters overlap each other in the following way:

BYTE0	BYTE1	BYTE2	BYTE3	BYTE4	BYTE5	BYTE6	BYT7
WORD0		WORD1		WORD2		WORD3	
DWORD0				DWORD1			

For example, if BYTE1 is modified, WORD0 and DWORD0 are modified as well.

Example

```
-->FB1.USERDWORD1 65536
-->FB1.USERBYTE1
0
-->FB1.USERBYTE2
1
-->FB1.USERBYTE3
0

-->FB1.USERBYTE3 1 (write to the highest byte of FB1.USERDWORD0)
-->FB1.USERDWORD0
16842752
-->FB1.USERWORD0
0
-->FB1.USERWORD1
257
```

Related Topics

Feedback 1 (pg 56) | FB1.USERBYTE0 to FB1.USERBYTE7 (pg 462) | FB1.USERWORD1 to FB1.USERWORD3 (pg 464)

23.14.27 FB1.USERWORD1 to FB1.USERWORD3

General Information	
Type	R/W
Description	Reads and writes data stored in two 32 bit words in the Endat feedback device.
Units	N/A
Range	0 to 65,535
Default Value	0
Data Type	Integer
Start Version	M_01-05-08-000

Description

FB1.USERBYTE, FB1.USERWORD, and FB1.USERDWORD share two 32bit words in the Endat feedback device. These three parameters offer different ways to store and access the data stored in these two 32bit words. The table below defines each parameters function. The values are automatically stored non-volatile in the feedback device.

Parameter	Bits	Attributes
FB1.USERBYTE0 to FB1.USERBYTE7	8 bit	signed or unsigned char
FB1.USERWORD0 to FB1.USERWORD3	16 bit	signed or unsigned short
FB1.USERDWORD0 to FB1.USERDWORD1	32 bit	singed or unsigned int

The parameters overlap each other in the following way:

BYTE0	BYTE1	BYTE2	BYTE3	BYTE4	BYTE5	BYTE6	BYT7
WORD0		WORD1		WORD2		WORD3	
DWORD0				DWORD1			

For example, if BYTE1 is modified, WORD0 and DWORD0 are modified as well.

Example

```
-->FB1.USERDWORD1 65536
-->FB1.USERBYTE1
0
-->FB1.USERBYTE2
1
-->FB1.USERBYTE3
0

-->FB1.USERBYTE3 1 (write to the highest byte of FB1.USERDWORD0)
-->FB1.USERDWORD0
16842752
-->FB1.USERWORD0
0
-->FB1.USERWORD1
257
```

Related Topics

Feedback 1 (pg 56) | FB1.USERBYTE0 to FB1.USERBYTE7 (pg 462) | FB1.USERDWORD0 to FB1.USERWORD1 (pg 463)

23.15 FB2 Parameters

This section describes the FB2 parameters.

23.15.1 FB2.ENCRES	466
23.15.2 FB2.MODE	467
23.15.3 FB2.P	468
23.15.4 FB2.DIR	469
23.15.5 FB2.POFFSET	470
23.15.6 FB2.PUNIT	471
23.15.7 FB2.SOURCE	472

23.15.1 FB2.ENCRES

General Information	
Type	NV Parameter
Description	Sets the secondary feedback (FB2) resolution
Units	counts/rev
Range	0 to 262,140 counts/rev
Default Value	0
Data Type	Integer
See Also	FB2.MODE, FB2.SOURCE (pg 472)
Start Version	M_01-03-00-000

Description

This parameter sets the feedback 2 (FB2) resolution and defines how many counts input into the secondary feedback will be considered a full revolution.

Related Topics

Feedback 2 (pg 61)

23.15.2 FB2.MODE

General Information	
Type	R/W Parameter
Description	Sets the mode for the second feedback inputs, EEO connector (X9) and high speed opto inputs (pins 9 and 10 on X7).
Units	N/A
Range	0 to 2
Default Value	0
Data Type	Integer
See Also	FB2.ENCRES (pg 466), PL.FBSOURCE (pg 606)
Start Version	M_01-03-00-000

Description

This parameter sets the feedback 2 input type as follows:

0 = Input A/B Signals

1 = Input Step and Direction Signals

2 = Input, up-down signals

Related Topics

Feedback 2 (pg 61)

FB2.SOURCE

23.15.3 FB2.P

General Information	
Type	R/O Parameter
Description	Reads position from the secondary feedback.
Units	Depends on FB2.UNIT counts or custom units.
Range	N/A
Default Value	N/A
Data Type	U64
See Also	FB1.HALLSTATE (pg 438)
Start Version	M_01-05-08-000

Description

This parameter reads the position back from the secondary feedback device that is connected to X7 or X9, depending on the value of DRV.EMUEMODE. The position can be read as 32-bit counts or in customer units.

Related Topics

Feedback 1 (pg 56) | DRV.EMUEMODE (pg 384) | FB2.PUNIT (pg 471) | FB2.PIN | FB2.POUT | FB2.DIR (pg 469)

23.15.4 FB2.DIR

General Information	
Type	NV-Parameter
Description	Sets the counting direction for feedback channel 2.
Units	None
Range	0 to 1
Default Value	0
Data Type	U8
See Also	N/A
Start Version	M_01-05-11-000

Description

FB2.DIR will change the sign and with it the direction of feedback channel 2.

23.15.5 FB2.POFFSET

General Information	
Type	NV-Parameter
Description	Sets the offset for secondary feedback.
Units	counts, custom units
Range	-5,123,372,000,000,005.000 to 5,123,372,000,000,005.000 counts or -10,485,760.000 to 10,485,760.000 custom units
Default Value	0
Data Type	S64
See Also	N/A
Start Version	M_01-05-11-000

Description

FB2.POFFSET is the value added to the primary feedback position (FB2.P (pg 468)).

Example

If FB2.P is 10000 counts and FB2.POFFSET is set to -10000 counts, then the next read of FB2.P will return ~0 counts.

23.15.6 FB2.PUNIT

General Information	
Type	NV Parameter
Description	Sets the unit for FB2.P.
Units	N/A
Range	0, 3
Default Value	0
Data Type	U8
See Also	N/A
Start Version	M_01-05-11-000

Description

FB2.UNIT sets the position unit for FB2.P.

Value	Description
0	Counts (32 bit format)
3	(FB2.PIN/FB2.POUT) per revolution.

Related Topics

FB2.P (pg 468)

23.15.7 FB2.SOURCE

General Information	
Type	R/W Parameter
Description	Sets the source for the second feedback input. Choices are the EEO connectors (X9) which are RS485 inputs, or the X7 connector's high speed opto inputs (pins 9 and 10).
Units	N/A
Range	0 to 2
Default Value	0
Data Type	Integer
See Also	FB2.ENCRES, FB2.MODE, PL.FBSOURCE (pg 606)
Start Version	M_01-03-00-000

Description

This parameter sets the secondary feedback source to be either the EEO connector (X9) or the high speed opto inputs on the I/O Connector (X7) as follows:

0 = None

1 = Feedback Source X9 (EEO connector)

2 = Feedback Source X7 (High Speed Opto Inputs on the I/O Connector)

FB2 5V Power Supply Notes:

If FB2.SOURCE = 0 or 2 (X7), the 5V power supply will remain off.

If FB2.SOURCE = 1 (X9) the FB2 5V power supply will remain on unless a short is detected.

This is useful for encoder types that may require calibration.

Related Topics

Feedback 2 (pg 61)

23.16 FB3 Parameters

This section describes the FB3 parameters.

23.16.1 FB3.MODE	474
23.16.2 FB3.P	475
23.16.3 FB3.PDIR	476
23.16.4 FB3.POFFSET	477
23.16.5 FB3.PUNIT	478

23.16.1 FB3.MODE

General Information	
Type	NV Parameter
Description	Selects the type of feedback connected to X9.
Units	N/A
Range	0
Default Value	0
Data Type	Integer
See Also	NA
Start Version	M_01-04-15-000

Description

This parameter selects the type of feedback connected to X9. The position is reported as the tertiary feedback position, by FB3.P.

Value	Feedback
0	Endat 2.2 Feedback Device

This parameter is only supported on drives with model numbers similar to KC1-x-xxxxx-NBxx-xxxx.

23.16.2 FB3.P

General Information	
Type	R/O Parameter
Description	Reads position from the tertiary feedback.
Units	Depends on FB3.UNIT counts or custom units.
Range	N/A
Default Value	N/A
Data Type	S64
See Also	N/A
Start Version	M_01-04-15-000

Description

This parameter reads the position back from the tertiary feedback device that is connected to X9, when DRV.EMUEMODE = 11. The position can be read as 64-bit signed count or in customer units. Values read by this parameter depend on FB3.Dir and FB3.OFFSET.

This parameter is only supported on drives with model numbers similar to KC1-x-xyzz-NBxx-yyzz and will only work with Endat 2.2 multiturn encoder. The output format is 32:32 the upper 32 bits represents the multiturns and the lower 32 bits for position of the feedback.

Related Topics

DRV.EMUEMODE (pg 384) | FB3.PUNIT (pg 478) | FB3.PIN | FB3.POUT | FB3.PDIR (pg 476)
|

23.16.3 FB3.PDIR

General Information	
Type	NV-Parameter
Description	Sets the counting direction for feedback channel 3.
Units	None
Range	0 to 1
Default Value	0
Data Type	U8
See Also	N/A
Start Version	M_01-05-11-000

Description

FB3.PDIR will change the sign and with it the direction of feedback channel 3.

Example

If position feedback = 35,185.932 and you set:

→ FB3.PDIR 1

then position feedback = -35,185.932

23.16.4 FB3.POFFSET

General Information	
Type	NV-Parameter
Description	Sets the offset for tertiary feedback.
Units	counts, custom units
Range	-5,123,372,000,000,005.000 to 5,123,372,000,000,005.000 counts or -10,485,760.000 to 10,485,760.000 custom units
Default Value	0
Data Type	S64
See Also	N/A
Start Version	M_01-05-11-000

Description

FB3.POFFSET is the value added to the primary feedback position (FB3.P (pg 475)).

Example

If FB3.P is 10000 counts and FB3.POFFSET is set to -10000 counts, then the next read of FB3.P will return ~0 counts.

23.16.5 FB3.PUNIT

General Information	
Type	NV Parameter
Description	Sets the unit for FB3.P.
Units	N/A
Range	0, 3
Default Value	0
Data Type	U8
See Also	N/A
Start Version	M_01-05-11-000

Description

FB3.UNIT sets the position unit for FB3.P.

Value	Description
0	Counts (32.32 format)
3	(FB3.PIN/FB3.POUT) per revolution.

Related Topics

FB3.P (pg 475)

23.17 GEAR Parameters

This section describes the GEAR parameters.

23.17.1 GEAR.ACCMAX	480
23.17.2 GEAR.DECMAX	481
23.17.3 GEAR.IN	482
23.17.4 GEAR.MODE	483
23.17.5 GEAR.MOVE	485
23.17.6 GEAR.OUT	486
23.17.7 GEAR.VMAX	487

23.17.1 GEAR.ACCMAX

General Information	
Type	NV Parameter
Description	Sets the maximum allowed acceleration value; active in opmode 2 (position) only.
Units	Depends on UNIT.ACCROTARY (pg 677) or UNIT.ACCLINEAR (pg 676) Rotary: rps/s, rpm/s, deg/s ² , (Custom Units (pg 77))/s ² , rad/s ² Linear: counts/s ² , mm/s ² , μm/s ² , (Custom Units (pg 77))/s ²
Range	Rotary: 0.004 to 4,000,000 rps/s 0.224 to 240,000,008.192 rpm/s 1.341 to 1,439,999,983.616 deg/s ² 0.023 to 25,132,740.608 rad/s ² Linear: 16,000.000 to 3,579,139,408,000.000 counts/s ² 0.031*MOTOR.PITCH (pg 581) to 833,333.333*MOTOR.PITCH (pg 581) mm/s ² 30.994*MOTOR.PITCH (pg 581) to 83,3333,333.333*MOTOR.PITCH (pg 581) μm/s ²
Default Value	Rotary: 166.669 rps/s 10,000.170 rpm/s 60,001.016 deg/s ² 1,047.215 rad/s ² Linear: 715,840,000.000 counts/s ² 166.714*MOTOR.PITCHMOTOR.PITCH (pg 581) mm/s ² 166,714.191*MOTOR.PITCHMOTOR.PITCH (pg 581) μm/s ²
Data Type	Float
See Also	UNIT.ACCROTARY (pg 677), UNIT.ACCLINEAR (pg 676), GEAR.DECMAX (pg 481)
Start Version	M_01-00-00-000

Description

This parameter limits the acceleration of the slave to a numerical higher value.

Related Topics

Electronic Gearing (pg 97)

23.17.2 GEAR.DECMAX

General Information	
Type	NV Parameter
Description	Sets the maximum allowed deceleration value; active in opmode 2 (position) only.
Units	Depends on UNIT.ACCROTARY (pg 677) or UNIT.ACCLINEAR (pg 676) Rotary: rps/s, rpm/s, deg/s ² , (Custom Units (pg 77))/s ² , rad/s ² Linear: counts/s ² , mm/s ² , μm/s ² , (Custom Units (pg 77))/s ²
Range	Rotary: 0.002 to 833,333.333 rps/s 0.112 to 50,000,000.000 rpm/s 0.009 to 300,000,000.000 deg/s ² 0.155 to 4,166,666.752 (Custom Units (pg 77))/s ² 0.012 to 5,235,987.968 rad/s ² Linear: 16,000.000 to 3,579,139,408,000.000 counts/s ² 0.031*MOTOR.PITCH (pg 581) to 833,333.333*MOTOR.PITCH (pg 581) mm/s ² 30.994*MOTOR.PITCH (pg 581) to 833,333,333.333*MOTOR.PITCH (pg 581) μm/s ² 0.155 to 4,166,666.667 (Custom Units (pg 77))/s ²
Default Value	Rotary: 166.669 rps/s 10,000.000 rpm/s 60,000.000 deg/s ² 833.333 (Custom Units (pg 77))/s ² 1,047.2 rad/s ² Linear: 715,840,000.000 counts/s ² 166.714*MOTOR.PITCHMOTOR.PITCH (pg 581) mm/s ² 166,714.191*MOTOR.PITCHMOTOR.PITCH (pg 581) μm/s ² 833.571 (Custom Units (pg 77))/s ²
Data Type	Float
See Also	UNIT.ACCROTARY (pg 677), UNIT.ACCLINEAR (pg 676), GEAR.ACCMAX (pg 480)
Start Version	M_01-00-00-000

Description

This parameter limits the deceleration of the slave to a numerical higher value.

Related Topics

Electronic Gearing (pg 97)

23.17.3 GEAR.IN

General Information	
Type	NV Parameter
Description	Sets the denominator of the electronic gearing ratio; active in opmode 2 (position) only.
Units	N/A
Range	1 to 65,535
Default Value	1
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

Description

This parameter sets the denominator of the gear ratio for the electronic gearing mode. The gear ratio is used in order to increase and decrease the slave velocity. The slave velocity can be calculated by the following formula:

$$\text{Slave velocity} = \text{Master velocity} * \text{GEAR.OUT (pg 486)}/\text{GEAR.IN}$$

Be sure that you set the external master source number of signals per revolution correctly. Also, select the gear ratio so that the maximum electronic gearing velocity (GEAR.VMAX (pg 487)) is not exceeded.

$$\text{Master velocity}_{\text{max}} * \text{GEAR.OUT (pg 486)}/\text{GEAR.IN} < \text{GEAR.VMAX (pg 487)}$$

Related Topics

Electronic Gearing (pg 97)

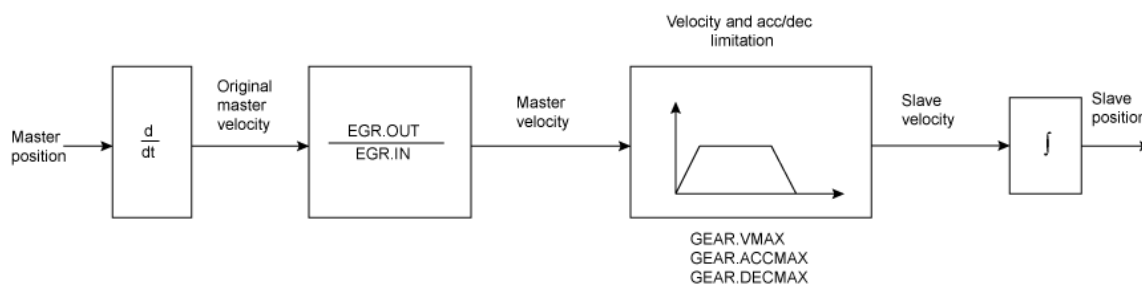
23.17.4 GEAR.MODE

General Information	
Type	NV Parameter
Description	Selects electronic gearing mode; active in opmode 2 (position) only.
Units	N/A
Range	0 to 1
Default Value	0
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

Description

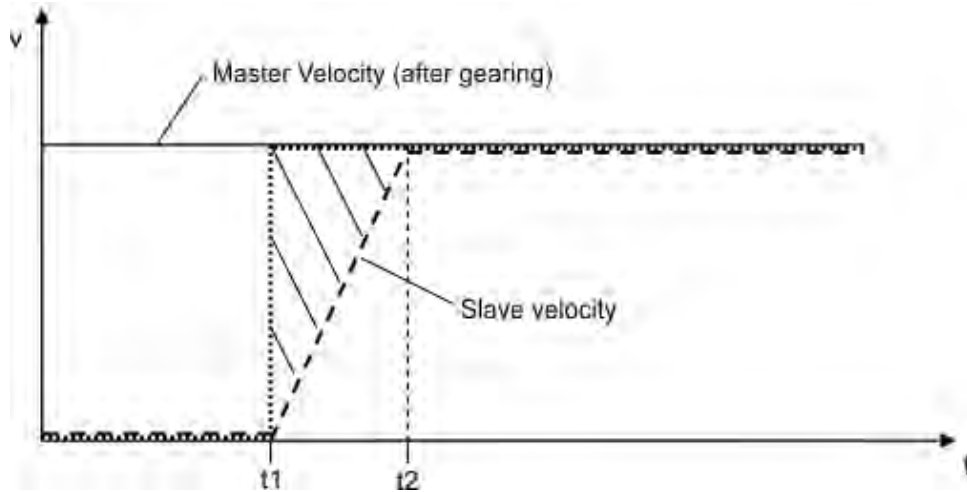
This parameter selects the electronic gearing mode at the beginning of the electronic gearing procedure. The gearing mode determines drive synchronization. In the context of electronic gearing, synchronization means that the slave follows the master pulses without losing counts due to acceleration or velocity limitations.

- Mode 0: The slave is not immediately synchronized after a GEAR.MOVE command. The slave accelerates until the master velocity (velocity after the gearing) has been reached. The drive is synchronized as soon as the velocity of the master has been reached.
- Mode 1: The slave is immediately synchronized after a GEAR.MOVE command.



Block diagram of the electronic gearing feature

The slave position is forwarded to the position loop. Ensure that DRV.OPMODE has been set to 2 and DRV.CMDSOURCE has been set to 2. The slave is able to reach the master velocity according to the GEAR.VMAX setting. GEAR.VMAX does not limit the slave velocity.



Acceleration process for GEAR.MODE 0

Time	Description
$t < t_1$	The master sends already signals to the slave drive, but the GEAR.MOVE command has not been triggered yet.
$t = t_1$	A GEAR.MOVE command has been triggered.
$t_1 < t < t_2$	The slave accelerates according to the GEAR.ACCMAX setting. The position, which is marked with solid lines, will be ignored.
$t = t_2$	The slave has reached the master velocity and is from now on considered as synchronized. Synchronization means that the slave will not lose any more position counts coming from the master.
$t > t_2$	The slave follows the master input signals.

Related Topics

Electronic Gearing (pg 97)

23.17.5 GEAR.MOVE

General Information	
Type	Command
Description	Starts the electronic gearing; active in opmode 2 (position) only.
Units	N/A
Range	N/A
Default Value	N/A
Data Type	N/A
See Also	N/A
Start Version	M_01-00-00-000

Description

The command GEAR.MOVE starts the electronic gearing procedure according to the selected electronic gearing mode. The electronic gearing process can be stopped using the DRV.STOP (pg 424) command.

Related Topics

Electronic Gearing (pg 97)

23.17.6 GEAR.OUT

General Information	
Type	NV Parameter
Description	Sets the numerator of the electronic gearing ratio; active in opmode 2 (position) only.
Units	N/A
Range	-32,768 to +32,767
Default Value	1
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

Description

This parameter is the numerator of the gear ratio for the electronic gearing mode. The gear ratio is used in order to increase/decrease the slave velocity. The slave velocity can be calculated by the following formula:

$$\text{Slave velocity} = \text{Master velocity} * \text{GEAR.OUT/GEAR.IN (pg 482)}$$

Make sure that the external master source has been set properly. Also, be certain to select a gear ratio such that the maximum electronic gearing velocity (GEAR.VMAX (pg 487)) will not be exceeded.

$$\text{Master velocity}_{\text{max}} * \text{GEAR.OUT/GEAR.IN (pg 482)} < \text{GEAR.VMAX (pg 487)}$$

Related Topics

Electronic Gearing (pg 97)

23.17.7 GEAR.VMAX

General Information	
Type	NV Parameter
Description	Reads the maximum allowed velocity value; active in opmode 2 (position) only.
Units	Depends on UNIT.ACCROTARY (pg 677) or UNIT.ACCLINEAR (pg 676) Rotary: rpm, rps, deg/s, Custom Units (pg 77)/s, rad/s Linear: counts/s, mm/s, μm/s, Custom Units (pg 77)/s
Range	Rotary: 0.000 to 15,000.000 rpm 0.000 to 250.000 rps 0.000 to 90,000.000 deg/s 0.000 to 1,250.000 Custom Units (pg 77)/s 0.000 to 1,570.796 rad/s Linear: 0.000 to 1,073,741,824,000.000 counts/s 0.000 to 250.000*MOTOR.PITCH (pg 581) mm/s 0.000 to 250,000.000*MOTOR.PITCH (pg 581) μm/sec 0.000 to 1,250.000 Custom Units (pg 77)/s
Default Value	Rotary: 3,000 rpm 50 rps 18,000.002 deg/s 250.000 Custom Units (pg 77)/s 314.159 rad/s Linear: 0.050 counts/s 50 mm/s 50,000.004MOTOR.PITCH (pg 581) μm/s 250.000 Custom Units (pg 77)/s
Data Type	Float
See Also	N/A
Start Version	M_01-00-00-000

Description

This parameter limits the maximum velocity of the slave drive.

Related Topics

Electronic Gearing (pg 97)

23.18 GUI Parameters

GUI parameters are used within WorkBench for data reporting and data storage.

23.18.1 GUI.DISPLAY	489
23.18.2 GUI.PARAM01	490
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23.18.4 GUI.PARAM03	492
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23.18.8 GUI.PARAM07	496
23.18.9 GUI.PARAM08	497
23.18.10 GUI.PARAM09	498
23.18.11 GUI.PARAM10	499

23.18.1 GUI.DISPLAY

General Information	
Type	R/O Parameter
Description	Reads drive display data.
Units	N/A
Range	N/A
Default Value	N/A
Data Type	Display
See Also	N/A
Start Version	M_01-00-00-000

Description

This parameter reports to the GUI what the drive currently is displaying. For all GUI commands, the data is compressed and formatted for the GUI, not for the user.

23.18.2 GUI.PARAM01

General Information	
Type	NV Parameter
Description	Used by the GUI to store data.
Units	N/A
Range	2,147,483,648 to 2,147,483,647
Default Value	0
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

Description

The GUI uses this parameter to store data. Only the GUI can modify this data (not the user).

23.18.3 GUI.PARAM02

General Information	
Type	NV Parameter
Description	Used by the GUI to store data.
Units	N/A
Range	2,147,483,648 to 2,147,483,647
Default Value	0
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

Description

The GUI uses this parameter to store data. Only the GUI can modify this data (not the user).

23.18.4 GUI.PARAM03

General Information	
Type	NV Parameter
Description	Used by the GUI to store data.
Units	N/A
Range	2,147,483,648 to 2,147,483,647
Default Value	0
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

Description

The GUI uses this parameter to store data. Only the GUI can modify this data (not the user).

23.18.5 GUI.PARAM04

General Information	
Type	NV Parameter
Description	Used by the GUI to store data.
Units	N/A
Range	2,147,483,648 to 2,147,483,647
Default Value	0
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

Description

The GUI uses this parameter to store data. Only the GUI can modify this data (not the user).

23.18.6 GUI.PARAM05

General Information	
Type	NV Parameter
Description	Used by the GUI to store data.
Units	N/A
Range	2,147,483,648 to 2,147,483,647
Default Value	0
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

Description

The GUI uses this parameter to store data. Only the GUI can modify this data (not the user).

23.18.7 GUI.PARAM06

General Information	
Type	NV Parameter
Description	Used by the GUI to store data.
Units	N/A
Range	2,147,483,648 to 2,147,483,647
Default Value	0
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

Description

The GUI uses this parameter to store data. Only the GUI can modify this data (not the user).

23.18.8 GUI.PARAM07

General Information	
Type	NV Parameter
Description	Used by the GUI to store data.
Units	N/A
Range	2,147,483,648 to 2,147,483,647
Default Value	0
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

Description

The GUI uses this parameter to store data. Only the GUI can modify this data (not the user).

23.18.9 GUI.PARAM08

General Information	
Type	NV Parameter
Description	Used by the GUI to store data.
Units	N/A
Range	2,147,483,648 to 2,147,483,647
Default Value	0
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

Description

The GUI uses this parameter to store data. Only the GUI can modify this data (not the user).

23.18.10 GUI.PARAM09

General Information	
Type	NV Parameter
Description	Used by the GUI to store data.
Units	N/A
Range	2,147,483,648 to 2,147,483,647
Default Value	0
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

Description

The GUI uses this parameter to store data. Only the GUI can modify this data (not the user).

23.18.11 GUI.PARAM10

General Information	
Type	NV Parameter
Description	Used by the GUI to store data.
Units	N/A
Range	2,147,483,648 to 2,147,483,647
Default Value	0
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

Description

The GUI uses this parameter to store data. Only the GUI can modify this data (not the user).

23.19 HOME Parameters

This section describes the HOME parameters.

23.19.1 HOME.ACC	501
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23.19.1 HOME.ACC

General Information	
Type	R/W Parameter
Description	Sets homing acceleration; active in opmode 2 (position) only.
Units	Depends on UNIT.ACCROTARY (pg 677) or UNIT.ACCLINEAR (pg 676) Rotary: rps/s, rpm/s, deg/s ² , (Custom Units (pg 77))/s ² , rad/s ² Linear: counts/s ² , mm/s ² , μm/s ² , (Custom Units (pg 77))/s ²
Range	Rotary: 0.002 to 833,333.333 rps/s 0.112 to 50,000,000.000 rpm/s 0.009 to 300,000,000.000 deg/s ² 0.155 to 4,166,666.752 (Custom Units (pg 77))/s ² 0.012 to 5,235,987.968 rad/s ² Linear: 16,000.000 to 3,579,139,408,000.000 counts/s ² 0.031*MOTOR.PITCH (pg 581) to 833,333.333*MOTOR.PITCH (pg 581) mm/s ² 30.994*MOTOR.PITCH (pg 581) to 833,333,333.333*MOTOR.PITCH (pg 581) μm/s ² 0.155 to 4,166,666.667 (Custom Units (pg 77))/s ²
Default Value	Rotary: 166.669 rps/s 10,000.000 rpm/s 60,000.000 deg/s ² 833.333 (Custom Units (pg 77))/s ² 1,047.2 rad/s ² Linear: 715,840,000.000 counts/s ² 166.714*MOTOR.PITCHMOTOR.PITCH (pg 581) mm/s ² 166,714.191*MOTOR.PITCHMOTOR.PITCH (pg 581) μm/s ² 833.571 (Custom Units (pg 77))/s ²
Data Type	Float
See Also	UNIT.ACCROTARY (pg 677), UNIT.ACCLINEAR (pg 676)
Start Version	M_01-00-00-000

Description

This parameter determines the acceleration of the motor during the homing procedure.

Related Topics

Homing (pg 126)

23.19.2 HOME.AUTOMOVE

General Information	
Type	R/W Parameter
Description	Sets homing auto move flag.
Units	N/A
Range	0 to 1
Default Value	0
Data Type	Integer
See Also	HOME.MODE (pg 508)
Start Version	M_01-02-00-000

Description

HOME.AUTOMOVE allows the drive to start a homing procedure after enabling the drive.

HOME.AUTOMOVE = 0: The drive is not allowed to start automatically a homing procedure after the enable command.

HOME.AUTOMOVE = 1: The drive automatically starts a homing procedure after the enable command.

When HOME.AUTOMOVE is set to 1, the drive continuously checks the following conditions:

1. Is the drive enabled (DRV.ACTIVE (pg 365) = 1)?
2. Is the drive in DRV.OPMODE (pg 418) = 2?
3. Has the command source been adjusted to 0 (DRV.CMDSOURCE (pg 371) = 0)?
4. Is no other motion currently active (see DRV.MOTIONSTAT (pg 411))?

As soon as all of the conditions above are true, the drive activates the homing procedure, which has been selected via the HOME.MODE (pg 508) setting. The automatic homing procedure is finished as soon as the homing procedure has been successfully triggered by the drive. From now on the drive will not attempt to trigger any additional homing procedure.

HOME.AUTOMOVE is not functional in release M_01-03-00-000 for homing procedures which require an external index signal (HOME.MODE 3, 6, 10, and 11).

Related Topics:

Homing (pg 126)

23.19.3 HOME.DEC

General Information	
Type	R/W Parameter
Description	Sets homing deceleration; active in opmode 2 (position) only.
Units	Depends on UNIT.ACCROTARY (pg 677) or UNIT.ACCLINEAR (pg 676) UNIT.ACCLINEAR (pg 676) Rotary: rps/s, rpm/s, deg/s ² , (Custom Units (pg 77))/s ² , rad/s ² Linear: counts/s ² , mm/s ² , μm/s ² , (Custom Units (pg 77))/s ²
Range	Rotary: 0.002 to 833,333.333 rps/s 0.112 to 50,000,000.000 rpm/s 0.009 to 300,000,000.000 deg/s ² 0.155 to 4,166,666.752 (Custom Units (pg 77))/s ² 0.012 to 5,235,987.968 rad/s ² Linear: 16,000.000 to 3,579,139,408,000.000 counts/s ² 0.031*MOTOR.PITCH (pg 581) to 833,333.333*MOTOR.PITCH (pg 581) mm/s ² 30.994*MOTOR.PITCH (pg 581) to 833,333,333.333*MOTOR.PITCH (pg 581) μm/s ² 0.155 to 4,166,666.667 (Custom Units (pg 77))/s ²
Default Value	Rotary: 166.669 rps/s 10,000.000 rpm/s 60,000.000 deg/s ² 833.333 (Custom Units (pg 77))/s ² 1,047.2 rad/s ² Linear: 715,840,000.000 counts/s ² 166.714*MOTOR.PITCHMOTOR.PITCH (pg 581)mm/s ² 166,714.191MOTOR.PITCH (pg 581) μm/s ² 833.571 (Custom Units (pg 77))/s ²
Data Type	Float
See Also	UNIT.ACCROTARY (pg 677), UNIT.ACCLINEAR (pg 676)
Start Version	M_01-00-00-000

Description

This parameter sets the deceleration of the motor during the homing procedure.

Related Topics:

Homing (pg 126)

23.19.4 HOME.DIR

General Information	
Type	NV Parameter
Description	Sets homing direction; active in opmode 2 (position) only.
Units	N/A
Range	0 to 1
Default Value	1
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

Description

This parameter determines the direction in which the motor should start to move during a homing procedure.

0 = Movement in negative direction.

1 = Movement in positive direction.

Related Topics

Homing (pg 126)

23.19.5 HOME.DIST

General Information	
Type	R/W Parameter
Description	Sets homing distance; active in opmode 2 (position) only.
Units	Depends on UNIT.PROTARY (pg 682) or UNIT.PLINEAR (pg 680)UNIT.A-CCLINEAR (pg 676) Rotary: counts, rad, deg, Custom Units (pg 77), 16-bit counts Linear: counts, mm, μ m, Custom Units (pg 77), 16-bit counts
Range	N/A
Default Value	0
Data Type	Float
See Also	N/A
Start Version	M_01-00-00-000

Description

This parameter takes effect only after the homing procedure is complete (see the HOME.MODE (pg 508) description). HOME.DIST specifies an additional movement after the homing procedure is complete. The drive uses the homing acceleration, deceleration, and velocity parameters for this movement. This parameter can be used to let the motor move away from the home position by the value of HOME.DIST.

A value not equal to 0 triggers an additional movement of the selected homing distance after the general homing procedure. A value of 0 for HOME.DIST causes no additional movement.

Related Topics

Homing (pg 126)

23.19.6 HOME.FEEDRATE

General Information	
Type	R/W Parameter
Description	Sets homing velocity factor; active in opmode 2 (position) only.
Units	%
Range	0 to 100%
Default Value	50%
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

Description

This parameter is used in order to reduce the velocity during the index search (index = zero-pulse of a feedback device). This parameter determines the percentage of the homing velocity (HOME.V (pg 514)) that should be used during the index-search.

Related Topics

Homing (pg 126)

23.19.7 HOME.IPEAK

General Information	
Type	R/W Parameter
Description	Sets the current limit during homing procedure to a mechanical stop; active in opmode 2 (position) only.
Units	A
Range	± Drive peak current A
Default Value	[(1/120) * DRV.IPEAK (pg 405)] A
Data Type	Float
See Also	HOME.MODE (pg 508)
Start Version	M_01-00-00-000

Description

This parameter sets the intermediate current limit during a homing procedure to a mechanical stop (HOME.MODE (pg 508) 8 and 9). The current-controller limit (IL.LIMITP (pg 543) and IL.LIMITN (pg 542)) is set to ±HOME.IPEAK while the homing procedures are active.

HOME.IPEAK is active as soon as the homing procedure starts and remains active until the home position is found. Previous current limit settings are re-activated before the motor covers the homing distance (HOME.DIST (pg 505) ≠ 0).

Related Topics

Homing (pg 126) Homing mode 8: Move Until Position Error Exceeded (pg 133)

23.19.8 HOME.MODE

General Information	
Type	R/W Parameter
Description	Selects the homing mode; active in opmode 2 (position) only.
Units	N/A
Range	0 to 10
Default Value	0
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

Description

HOME.MODE specifies the homing procedure of the drive. The homing modes available in the drive are summarized in the following table; see Homing (pg 126) for a detailed discussion and examples for each mode:

Mode	Description
0	Home using current position
1	Find limit input
2	Find input limit then find zero angle
3	Find input limit then find index
4	Find home input, including hardware limit switches
5	Find home input then find zero angle, including hardware limit switches
6	Find home input then find index, including hardware limit switches.
7	Find zero angle
8	Move until position error exceeded
9	Move until position error exceeded, then find zero angle
10	Move until position error exceeded, then find index
11	Find index signal, without any precondition
12	Homing to a home-switch, including mechanical stop detection
13	Home using the feedback position

Related Topics

Homing (pg 126)

23.19.9 HOME.MOVE

General Information	
Type	Command
Description	Starts a homing procedure; active in opmode 2 (position) only.
Units	N/A
Range	N/A
Default Value	N/A
Data Type	N/A
See Also	N/A
Start Version	M_01-00-00-000

Description

The HOME.MOVE command starts a homing procedure. The DRV.OPMODE (pg 418) must be set to 2 (closed position loop) and DRV.CMDSOURCE must be set to 0 (TCP/IP command).

Related Topics

Homing (pg 126)

23.19.10 HOME.P

General Information	
Type	R/W Parameter
Description	Sets home position; active in opmode 2 (position) only.
Units	Depends on UNIT.PROTARY (pg 682) or UNIT.PLINEAR (pg 680) Rotary: counts, rad, deg, Custom Units (pg 77), 16-bit counts Linear: counts, mm, μ m, Custom Units (pg 77), 16-bit counts
Range	N/A
Default Value	0
Data Type	Float
See Also	N/A
Start Version	M_01-00-00-000

Description

This parameter sets the home position. The command and actual position of the drive will be set to this value as soon as a homing event occurs. The homing events differ in each homing mode.

Related Topics

Homing (pg 126)

23.19.11 HOME.PERRTHRESH

General Information	
Type	R/W Parameter
Description	Sets the position lag threshold; active in opmode 2 (position) only.
Units	Depends on UNIT.PROTARY (pg 682) or UNIT.PLINEAR (pg 680) Rotary: counts, rad, deg, Custom Units (pg 77), 16-bit counts Linear: counts, mm, μ m, Custom Units (pg 77), 16-bit counts
Range	N/A
Default Value	N/A
Data Type	Float
See Also	N/A
Start Version	M_01-00-00-000

Description

This parameter is used for the homing modes against a mechanical stop (HOME.MODE (pg 508) = 8 and 9). The absolute value of the following error (PL.ERR (pg 600)) is compared with HOME.PERRTHRESH in order to detect a mechanical stop.

Related Topics

Homing mode 8: Move Until Position Error Exceeded (pg 133)

23.19.12 HOME.REQUIRE

General Information	
Type	NV Parameter
Description	Defines if the axis must be homed before a motion task can be executed.
Units	N/A
Range	0 to 1
Default Value	1
Data Type	Integer
See Also	N/A
Start Version	M_01-03-00-005

Description

This parameter defines whether or not the axis must be homed before a motion task can be executed.

- HOME.REQUIRE = 1: Homing must be complete ("Home Done" is true) before a motion task can execute.
- HOME.REQUIRE = 0: The axis does not need to be homed before a motion task can execute. When HOME.REQUIRE is set to 0, "Home Done" can be either true or false before a motion task can execute.

Related Topics

Homing (pg 126)

1 Motion Tasks

23.19.13 HOME.SET

General Information	
Type	Command
Description	Immediately sets the home position; active in opmode 2 (position) only.
Units	N/A
Range	N/A
Default Value	N/A
Data Type	N/A
See Also	N/A
Start Version	M_01-00-00-000

Description

The HOME.SET command immediately homes the drive. The drive can be homed in an enabled or disabled state. Motion in the current mode of operation (DRV.OPMODE (pg 418)=0) or velocity mode of operation (DRV.OPMODE (pg 418)=1) is not affected by the HOME.SET command. Motion in the position mode of operation (DRV.OPMODE (pg 418)=2) is immediately aborted when the HOME.SET command is issued.

Related Topics

Homing (pg 126)

23.19.14 HOME.V

General Information	
Type	R/W Parameter
Description	Sets homing velocity; active in opmode 2 (position) only.
Units	Depends on UNIT.VROTARY (pg 684) or UNIT.VLINEAR (pg 683) Rotary: rpm, rps, deg/s, Custom Units (pg 77)/s, rad/s Linear: counts/s, mm/s, μm/s, Custom Units (pg 77)/s
Range	Rotary: 0.000 to 15,000.000 rpm 0.000 to 250.000 rps 0.000 to 90,000.000 deg/s 0.000 to 1,250.000 Custom Units (pg 77)/s 0.000 to 1,570.796 rad/s Linear: 0.000 to 1,073,741,824,000.000 counts/s 0.000 to 250.000*MOTOR.PITCH (pg 581) mm/s 0.000 to 250,000.000*MOTOR.PITCH (pg 581) μm/sec 0.000 to 1,250.000 Custom Units (pg 77)/s
Default Value	Rotary: 60 rpm 1 rps 359.999 deg/s 5 (Custom Units (pg 77))/s 6.283 rad/s Linear: 0.001 counts/s 1*MOTOR.PITCH (pg 581) mm/s 999.998*MOTOR.PITCH (pg 581) μm/sec 5.000 Custom Units (pg 77)/s
Data Type	Float
See Also	N/A
Start Version	M_01-00-00-000

Description

This parameter sets the velocity of the motor during the homing procedure.

Related Topics

Homing (pg 126)

23.20 HWLS Parameters

This section describes the HWLS parameters.

23.20.1 HWLS.NEGSTATE	516
23.20.2 HWLS.POSSTATE	517

23.20.1 HWLS.NEGSTATE

General Information	
Type	R/O Parameter
Description	Reads the status of the negative hardware limit switch.
Units	0 to 1
Range	N/A
Default Value	Integer
Data Type	HWLS.POSSTATE (pg 517)
See Also	N/A
Start Version	M_01-00-00-000

Description

HWLS.NEGSTATE reads the status of the negative HW limit switch as follows:

0 = Low

1 = High

Related Topics

23.20.2 HWLS.POSSTATE

General Information	
Type	R/O Parameter
Description	Reads the status of the positive hardware limit switch.
Units	N/A
Range	0 to 1
Default Value	N/A
Data Type	Integer
See Also	HWLS.NEGSTATE (pg 516)
Start Version	M_01-00-00-000

Description

HWLS.POSSTATE reads the status of the positive hardware limit switch as follows:

0 = Low

1 = High

Related Topics

23.21 IL Parameters

This section describes the IL parameters.

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23.21.21 IL.KPLOOKUPVALUES	540
23.21.22 IL.KVFF	541
23.21.23 IL.LIMITN	542
23.21.24 IL.LIMITP	543
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23.21.26 IL.MFOLDR	545
23.21.27 IL.MFOLDT	546
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23.21.29 IL.MI2TWTHRESH	548
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23.21.32 IL.OFFSET	551
23.21.33 IL.VCMD	552
23.21.34 IL.VUFB	553

23.21.35 IL.VVFB	554
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23.21.1 IL.CMD

General Information	
Type	R/O Parameter
Description	Reads the value of the q-component current command.
Units	Arms
Range	± Drive peak current (DRV.IPEAK)
Default Value	N/A
Data Type	Float
See Also	DRV.IPEAK (pg 405)
Start Version	M_01-00-00-000

Description

IL.CMD displays the q-component current command value of the current loop after any limitation (such as a parameter setting or I^2t calculation).

IL.CMD is limited also by motor peak current, IL.LIMITN (pg 542) and IL.LIMITP (pg 543).

Related Topics

13.3 Current Loop

23.21.2 IL.CMDACC

General Information	
Type	R/O Parameter
Description	Returns the commanded acceleration from the trajectory generator.
Units	Depends on UNIT.ACCLINEAR (pg 676) or UNIT.ACCROTARY (pg 677).
Range	+/- 64bit
Default Value	0
Data Type	Float
Start Version	M_01-08-03-000

Description

Use IL.CMDACC to monitor the commanded acceleration for a given motion. This keyword is useful for tuning acceleration feedforward (IL.KACCFF).

Related Topics

IL.KACCFF (pg 534) | Tuning Guide (pg 175)

23.21.3 IL.CMDU

General Information	
Type	R/W Parameter
Description	Sets the user current command.
Units	Arms
Range	Minimum range value = maximum of IL.LIMITN and -MOTOR.IPEAK Maximum range value = minimum of IL.LIMITP and MOTOR.IPEAK
Default Value	0 Arms
Data Type	Float
See Also	DRV.IPEAK (pg 405), DRV.OPMODE (pg 418), DRV.CMDSOURCE (pg 371)
Start Version	M_01-00-00-000

Description

This parameter sets the user current command value.

The current command value, which is provided to the current loop (IL.CMD), can be limited further using a parameter setting or I^2t calculation. IL.CMDU is limited also by motor peak current, IL.LIMITN (pg 542) and IL.LIMITP (pg 543).

Related Topics

Current Loop (pg 114)

23.21.4 IL.DIFOLD

General Information	
Type	R/O Parameter
Description	Reads the drive foldback current limit.
Units	Arms
Range	0 to 2,147,483.647 Arms
Default Value	N/A
Data Type	Float
See Also	Foldback
Start Version	M_01-00-00-000

Description

IL.DIFOLD is the output of the drive foldback algorithm. It is an artificial current, which can be higher or lower than the drive peak current (DRV.IPEAK). When IL.DIFOLD is lower than the existing current limit (such as IL.LIMITP (pg 543)), it becomes the active current limit.

IL.DIFOLD decreases when the actual current is higher than drive continuous current and increases (up to a certain level) when the actual current is lower than drive continuous current.

Related Topics

13.3 Current Loop

23.21.5 IL.FB

General Information	
Type	R/O Parameter
Description	Reads the actual value of the d-component current.
Units	Arms
Range	± Drive peak current (DRV.IPEAK)
Default Value	N/A
Data Type	Float
See Also	N/A
Start Version	M_01-00-00-000

Description

This parameter reads the measured, de-rotated actual current value of the motor.

Note: Internally the resolution of the current scale is 20130 increments. For an KC1 with a peak current of 9 amps, the current resolution applied is $9/20130 = .447$ mA. For a 48 amp peak current drive, the resolution is $48/20130 = 2.38$ mA. The current scaling is hard coded and cannot be changed by decreasing the peak current settings in the drive.

Related Topics

13.3 Current Loop

23.21.6 IL.FBSOURCE

General Information	
Type	R/W
Description	Sets the feedback source for the current loop. Only applies when MOTOR.TYPE = 4.
Units	N/A
Range	0 to 1
Default Value	0
Data Type	Integer
Start Version	M_01-08-00-000

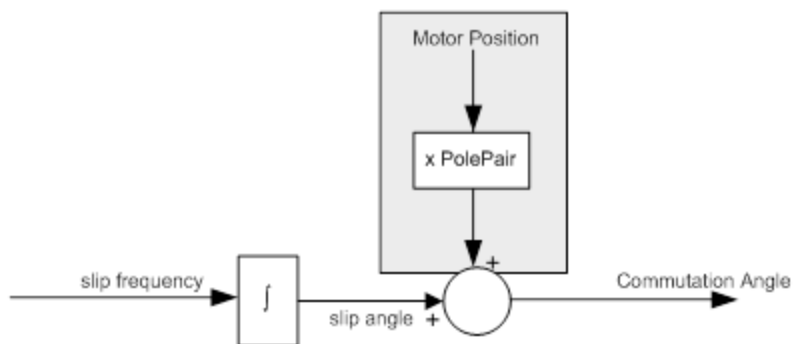
Description

This parameter selects the feedback source that current loop uses for commutation angle calculation.

0 = Primary feedback

1 = Secondary feedback

For induction motor closed loop control the commutation angle is set as shown in the following figure.



Related Topics

MOTOR.TYPE (pg 591)

23.21.7 IL.FF

General Information	
Type	R/O Parameter
Description	Displays the current loop overall feedforward value
Units	Arms
Range	N/A
Default Value	N/A
Data Type	Float
See Also	IL.KBUSFF (pg 535), IL.KVFF (pg 541), IL.OFFSET (pg 551), IL.FRICTION (pg 530), IL.KACFF (pg 534)
Start Version	M_01-00-00-000

Description

This parameter displays the current loop overall feedforward value.

Related Topics

Current Loop (pg 114)

23.21.8 IL.FOLDFTHRESH

General Information	
Type	R/O Parameter
Description	Reads the foldback fault level.
Units	Arms
Range	0 to 500 Arms
Default Value	Drive peak current (DRV.IPEAK)
Data Type	Float
See Also	Foldback
Start Version	M_01-00-00-000

Description

IL.FOLDFTHRESH is the fault level of the current foldback algorithm. If IL.IFOLD (pg 531) drops below the value for IL.FOLDFTHRESH, then a fault is generated and the drive is disabled.

To avoid reaching the current foldback fault level, set IL.FOLDFTHRESHU well below the continuous current value for both the drive and the motor or set the IL.FOLDFTHRESHU value to zero.

Related Topics

13.3 Current Loop

23.21.9 IL.FOLDFTHRESHU

General Information	
Type	NV Parameter
Description	Sets the user value for the foldback fault level.
Units	Arms
Range	0 to 500 Arms
Default Value	Drive peak current (DRV.IPEAK)
Data Type	Float
See Also	IL.FOLDFTHRESH (pg 527), Foldback (pg 66)
Start Version	M_01-00-00-000

Description

IL.FOLDFTHRESHU is the fault level of the current foldback algorithm. The value of IL.FOLDFTHRESH is the minimum of DRV.IPEAK (pg 405), MOTOR.IPEAK (pg 575), and IL.FOLDFTHRESHU.

Related Topics

13.3 Current Loop

23.21.10 IL.FOLDWTHRESH

General Information	
Type	NV Parameter
Description	Sets the foldback warning level.
Units	Arms
Range	0 to 500 Arms
Default Value	0 A
Data Type	Float
See Also	Foldback
Start Version	M_01-00-00-000

Description

IL.FOLDWTHRESH is the warning level of the current foldback algorithm. When IL.IFOLD (pg 531) drops **below** IL.FOLDWTHRESH a warning is generated.

To ensure that the current foldback warning level is never reached, IL.FOLDWTHRESH should be set well below the continuous current value for both the drive and the motor. You can also set the IL.FOLDFTHRESH (pg 527) value to zero.

Related Topics

13.3 Current Loop

23.21.11 IL.FRICTION

General Information	
Type	R/W Parameter
Description	Sets friction compensation value.
Units	A
Range	0 to the minimum of user positive current limit (IL.LIMITP) and motor peak current (MOTOR.IPEAK).IL.LIMITP (pg 543)
Default Value	0
Data Type	Float
See Also	IL.FF
Start Version	M_01-00-00-000

Description

Position command derivative sign is multiplied by this value to be injected to the current command.

NOTE

IL.FRICTION is active in Position and Velocity modes (DRV.OPMODE = 1, 2), but not active in Torque mode (DRV.OPMODE = 0).

Related Topics

13.3 Current Loop

23.21.12 IL.IFOLD

General Information	
Type	R/O Parameter
Description	Reads the overall foldback current limit.
Units	A
Range	0 to 2,147,483.647 A
Default Value	N/A
Data Type	Float
See Also	Foldback
Start Version	M_01-00-00-000

Description

Two current foldback algorithms run in parallel in the drive: the drive foldback algorithm and the motor foldback algorithm. Each algorithm uses different sets of parameters.

Each algorithm has its own foldback current limit, IL.DIFOLD and IL.MIFOLD. The overall foldback current limit is the minimum of the two at any given moment.

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

IL.DIFOLD is an artificial current, which can be higher or lower than the drive or motor peak current. When IL.IFOLD becomes lower than the existing current limit (such as IL.LIMITP (pg 543)), it becomes the active current limit.

Related Topics

13.3 Current Loop

23.21.13 IL.IUFB

General Information	
Type	R/O Parameter
Description	Reads the sigma-delta measured current in the u-winding of the motor.
Units	A
Range	± Drive peak current (DRV.IPEAK)
Default Value	N/A
Data Type	Float
See Also	N/A
Start Version	M_01-00-00-000

Description

This parameter displays the measured current in the u-winding of the motor.

Related Topics

Current Loop (pg 114)

23.21.14 IL.IVFB

General Information	
Type	R/O Parameter
Description	Sets the sigma-delta measured current in the u-winding of the motor.
Units	A
Range	± Drive peak current (DRV.IPEAK)
Default Value	0 A
Data Type	Float
See Also	N/A
Start Version	M_01-00-00-000

Description

IL.IVFB is an offset value that is added to the measured current in the u-winding of the motor. This value is used for compensating for an error in the current measurement. The drive measures 256 times the current in the u-winding when powering-up the drive. Afterwards, the drive calculates the average value of the measured current and uses this value for the offset value.

Related Topics

Current Loop (pg 114)

23.21.15 IL.KACCFF

General Information	
Type	R/W Parameter
Description	Sets current loop acceleration feedforward gain value
Units	mArms/(rad/s ²)
Range	0.0 to 2.0 mArms/(rad/s ²)
Default Value	0 mArms/(rad/s ²)
Data Type	Float
See Also	IL.FF (pg 526)
Start Version	M_01-00-00-000

Description

This value sets the gain for the acceleration feedforward (a scaled second derivative of the position command is added to the current command value) .

This parameter is valid only in the position mode (DRV.OPMODE = 2).

Related Topics

13.3 Current Loop

23.21.16 IL.KBUSFF

General Information	
Type	NV Parameter
Description	Current loops fieldbus injected feed-forward gain
Units	NA
Range	0 to 2
Default Value	0
Data Type	Float
See Also	IL.FF (pg 526), IL.BUSFF
Start Version	M_01-00-00-000

Description

This parameter scales the feedforward term added by the fieldbus to the current command. The nominal feedforward value can be multiplied by this gain value.

This parameter is only used in the position mode (DRV.OPMODE = 2).

Related Topics

Current Loop (pg 114)

23.21.17 IL.KP

General Information	
Type	NV Parameter
Description	Sets the proportional gain of the q-component of the PI regulator.
Units	V/A
Range	0 to 2,000 V/A
Default Value	Read from the motor or, if no memory, 50.009 V/A
Data Type	Float
See Also	N/A
Start Version	M_01-00-00-000

Description

IL.KP is used to modify the proportional gain of the PI-loop that controls the q-component of the current.

Related Topics

13.3 Current Loop

23.21.18 IL.KPDRATIO

General Information	
Type	NV Parameter
Description	Sets the proportional gain of the d-component current PI-regulator as a percentage of IL.KP
Units	N/A
Range	0 to 100
Default Value	1
Data Type	Float
See Also	IL.KP (pg 536)
Start Version	M_01-00-00-000

Description

This parameter modifies the proportional gain of the PI-loop, which controls the d-component of the current.

Related Topics

13.3 Current Loop

23.21.19 IL.KPLOOKUPINDEX

General Information	
Type	R/W Parameter
Description	Sets the index into the Current Loop Gain Scheduling Table.
Units	N/A
Range	0 to 255
Default Value	0
Data Type	Integer
See Also	IL.KPLOOKUPVALUE (pg 539)IL.KPLOOKUPVALUES (pg 540)IL.KP (pg 536)
Start Version	M_01-04-00-000

Description

This parameter sets the index into the Current Loop Gain Scheduling Table. The table is 256 records long, spanning 0 A to 1.62 * DRV.IPEAK.

To determine the level of current that corresponds to a table index, use the following equation:

$$IL.CMD = (\text{Table Index} / 157) * DRV.IPEAK$$

Related Topics

Current Loop (pg 114)

23.21.20 IL.KPLOOKUPVALUE

General Information	
Type	R/W Parameter
Description	Sets the value of the current loop gain scheduling index.
Units	%
Range	0 to 100.000%
Default Value	0
Data Type	Float
See Also	IL.KPLOOKUPINDEX (pg 538)IL.KPLOOKUPVALUES (pg 540)IL.KP (pg 536)
Start Version	M_01-04-00-000

Description

This parameter sets the value at the current index into the Current Loop Gain Scheduling Table. The table is 256 records long, spanning 0 A to $1.62 * \text{DRV.IPEAK}$. The value can range from 0% to 100% and determines what percentage of IL.KP will be applied to the current loop.

To determine what level of current corresponds to a table index, use the following equation:

$$\text{IL.CMD} = (\text{Table Index}/157) * \text{DRV.IPEAK}$$

Example

Assume:

$\text{DRV.IPEAK} = 9 \text{ A}$

$\text{IL.KPLOOKUPINDEX} = 100$

$\text{IL.KPLOOKUPVALUE} = 50$

$\text{IL.KP} = 240$

When $\text{IL.CMD} = 100/157 * 9 = 5.73 \text{ A}$, IL.KP will not be 240, but will be $50\% * 240 = 120$.

Related Topics

Current Loop (pg 114)

23.21.21 IL.KPLOOKUPVALUES

General Information	
Type	R/W Parameter
Description	Gets the Current Loop Gain Scheduling Table.
Units	N/A
Range	N/A
Default Value	N/A
Data Type	Table
See Also	IL.KPLOOKUPINDEX (pg 538), IL.KPLOOKUPVALUE (pg 539)IL.KP (pg 536)
Start Version	M_01-04-00-000

Description

Retrieves the Current Loop Gain Scheduling Table in a comma delimited table.

This table is 256 records long, and the table will return values in the following format:

```
-->IL.KPLOOKUPVALUES
```

```
Index Value
```

```
0, 100.000
```

```
1, 100.000
```

```
2, 100.000
```

```
3, 100.000
```

```
4, 100.000
```

```
5, 100.000
```

```
6, 100.000
```

```
7, 100.000
```

```
8, 100.000
```

```
9, 100.000
```

```
10, 100.000
```

Related Topics

Current Loop (pg 114)

23.21.22 IL.KVFF

General Information	
Type	R/W
Description	Current loop velocity feed-forward gain.
Units	N/A
Range	0 to 2
Default Value	0
Data Type	Float
See Also	IL.FF (pg 526)
Start Version	M_01-00-00-000

Description

This parameter sets the gain for the velocity loop feedforward. The nominal feedforward value can be multiplied by this gain value.

This parameter is only used in position mode (DRV.OPMODE (pg 418) = 2).

Related Topics

Current Loop (pg 114)

23.21.23 IL.LIMITN

General Information	
Type	NV Parameter
Description	Sets the negative user (application-specific) current limit.
Units	A
Range	Negative drive peak current (DRV.IPEAK) to 0 A
Default Value	Negative drive peak current (DRV.IPEAK)
Data Type	Float
See Also	IL.LIMITP (pg 543)
Start Version	M_01-00-00-000

Description

This parameter sets the negative user limit clamp value of the torqueproducing q-component current command (IL.CMD (pg 520)). The current command is additionally limited by the motor peak current setting (MOTOR.IPEAK (pg 575)) and by the present value of the foldback I²t peak motor current protection.

Related Topics

13.3 Current Loop

23.21.24 IL.LIMITP

General Information	
Type	NV Parameter
Description	Sets the positive user (application-specific) current limit.
Units	A
Range	0 A to drive peak current (DRV.IPEAK)
Default Value	Drive peak current (DRV.IPEAK)
Data Type	Float
See Also	IL.LIMITN (pg 542)
Start Version	M_01-00-00-000

Description

This parameter sets the positive user limit clamp value of the torque-producing q-component current command (IL.CMD (pg 520)). The current command is additionally limited by the motor peak current setting (MOTOR.IPEAK (pg 575)) and by the present value of the foldback I²t peak motor current protection.

Related Topics

13.3 Current Loop

23.21.25 IL.MFOLDD

General Information	
Type	R/O Parameter
Description	Sets the motor foldback maximum time at motor peak current.
Units	s
Range	0.1 to 2400 s
Default Value	10 s
Data Type	Float
See Also	Foldback
Start Version	M_01-00-00-000

Description

IL.MFOLDD sets the maximum time allowed for the motor to remain at peak current before starting to fold towards the motor continuous current. When at motor peak current, IL.MFOLDD is the amount of time before the foldback algorithm starts to reduce the current.

Related Topics

Current Loop (pg 114)

23.21.26 IL.MFOLDER

General Information	
Type	R/O Parameter
Description	Sets the motor foldback recovery time.
Units	s
Range	0.1 to 65,535 s
Default Value	Calculated from other foldback parameters.
Data Type	Float
See Also	Foldback
Start Version	M_01-00-00-000

Description

IL.MFOLDER sets the recovery time for the motor foldback algorithm. If 0 current is applied for at least the recovery time duration, it is possible to apply motor peak current for the duration of IL.MFOLDD time.

The IL.MFOLDER value is automatically calculated from other foldback parameters.

Related Topics

Current Loop (pg 114)

23.21.27 IL.MFOLDT

General Information	
Type	R/O Parameter
Description	Sets the motor foldback time constant of the exponential current drop (foldback).
Units	s
Range	0.1 to 2,400 s
Default Value	10 s
Data Type	Float
See Also	Foldback
Start Version	M_01-00-00-000

Description

IL.MFOLDT sets the time constant of the exponential drop (foldback) of the current towards motor continuous current.

Related Topics

Current Loop (pg 114)

23.21.28 IL.MI2T

General Information	
Type	R/O parameter
Description	Motor I2t load.
Units	%
Range	0 to 100%
Default Value	N/A
Data Type	Float
See Also	IL.MIMODE, IL.MI2TWITHRESH (pg 548)
Start Version	M_01-04-01-000

Description

This parameter returns the motor I2t load in percent. The supplied current will be limited by IL.M-IFOLD to MOTOR.ICONT case that the load reaches a value of 100%. The current limit IL.M-IFOLD will be restored to MOTOR.IPEAK in case that the load falls under 95%.

Related Topics

- 1 Motor I2t algorithm

23.21.29 IL.MI2TWITHRESH

General Information	
Type	NV Parameter
Description	Motor I2t load warning threshold.
Units	%
Range	0 to 100%
Default Value	N/A
Data Type	Integer
See Also	IL.MIMODE, IL.MI2T (pg 547)
Start Version	M_01-04-01-000

Description

This parameter defines a warning threshold for the IL.MI2T value. A warning n309 will be generated as soon as the IL.MI2T exceeds the IL.MI2TWITHRESH value. The warning n309 will be cleared as soon as IL.MI2T falls below the threshold.

Related Topics

Foldback (pg 66)

23.21.30 IL.MIFOLD

General Information	
Type	R/O Parameter
Description	Sets the motor foldback current limit.
Units	A
Range	0 to 2147483.647 A
Default Value	N/A
Data Type	Float
See Also	Foldback
Start Version	M_01-00-00-000

Description

IL.MIFOLD sets the output of the motor foldback algorithm. It is an artificial current, which can be higher or lower than the motor peak current. When IL.MIFOLD becomes lower than the existing current limit (IL.LIMITP (pg 543)) it becomes the active current limit.

IL.MIFOLD decreases when the actual current is higher than motor continuous current and increases (up to a certain level) when the actual current is lower than the motor continuous current.

Related Topics

13.3 Current Loop

23.21.31 IL.MIMODE

General Information	
Type	NV parameter
Description	Motor protection mode.
Units	N/A
Range	0 to 1
Default Value	0
Data Type	Integer
See Also	IL.MI2T (pg 547), IL.MI2TWTHRESH (pg 548)
Start Version	M_01-04-01-000

Description

This parameter determines the method of the motor protection.

0 – The motor foldback mechanism is responsible for protecting the motor from overload.

1 – The motor I2t mechanism is responsible for protecting the motor from overload.

Related Topics

Foldback (pg 66)

23.21.32 IL.OFFSET

General Information	
Type	RW Parameter
Description	A constant current command added to compensate for gravity.
Units	A
Range	[IL.LIMITN (pg 542) to IL.LIMITP (pg 543)
Default Value	0 A
Data Type	Float
See Also	IL.FF
Start Version	M_01-00-00-000

Description

This value is added to the overall current loop feedforward value.

Related Topics

13.3 Current Loop

23.21.33 IL.VCMD

General Information	
Type	R/O Parameter
Description	Sets the output of the q-component PI regulator.
Units	Vrms
Range	0 Vrms to bus voltage
Default Value	N/A
Data Type	Integer
See Also	IL.VDCMD
Start Version	M_01-00-00-000

Description

Sets the output of the current loop that controls the q-component of the current.

Related Topics

Current Loop (pg 114)

23.21.34 IL.VUFB

General Information	
Type	R/O Parameter
Description	Reads the measured voltage on the u-winding of the motor.
Units	V
Range	-1200*VBusScale to +1200*VBusScale
Default Value	N/A
Data Type	Integer
See Also	IL.VVFB (pg 554)
Start Version	M_01-00-00-000

Description

Reads the measured voltage on the u-winding of the motor.

Related Topics

Current Loop (pg 114)

23.21.35 IL.VVFB

General Information	
Type	R/O Parameter
Description	Reads the measured voltage on the v-winding of the motor.
Units	V
Range	-1200*VBusScale to +1200*VBusScale
Default Value	N/A
Data Type	Integer
See Also	IL.VUFB (pg 553)
Start Version	M_01-00-00-000

Description

The range for this parameter depends on whether the drive model is an MV/240 Vac or an HV/480 Vac.

The VBusScale parameter sets the drive model:

MV/240 Vac: VBusScale = 1

HV/480 Vac: VBusScale = 2

VBusScale is used for multiple parameter ranges that are model dependent, such as IL.KP.

Related Topics

Current Loop (pg 114)

23.22 IP Parameters

This section describes the IP parameters.

23.22.1 IP.ADDRESS	556
23.22.2 IP.GATEWAY	557
23.22.3 IP.MODE	558
23.22.4 IP.RESET	559
23.22.5 IP.SUBNET	560

23.22.1 IP.ADDRESS

General Information	
Type	NV Parameter
Description	Gets/Sets the IP address of the drive.
Units	N/A
Range	0.0.0.0 to 255.255.255.255
Default Value	0.0.0.0
Data Type	IP Address
See Also	
Start Version	M_01-04-05-000

Description

This Parameter sets the IP address of the drive. If this parameter has not been set by the user, it will return 0.0.0.0.

By default, DHCP is active, and the drive will acquire an IP Address on its own. When the drive is in DHCP mode, IP.ADDRESS will return 0.0.0.0.

Notes:

- Even when the drive is in DHCP, the actual IP Address will not be returned using this command. The value the user has stored will be returned.
- IP.ADDRESS will only be used by the drive when IP.MODE = 1

If manually setting the IP.ADDRESS, the IP.SUBNET and IP.GATEWAY must be set up. After the IP.RESET command is issued, the new IP settings will be active only if IP.MODE has been set to 1.

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

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

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

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

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

Related Topics

IP.GATEWAY

IP.RESET

IP.SUBNET

IP.MODE

23.22.2 IP.GATEWAY

General Information	
Type	NV Parameter
Description	Gets/Sets the gateway IP of the drive.
Units	N/A
Range	0.0.0.0 to 255.255.255.255
Default Value	0.0.0.0
Data Type	IP Address
See Also	Communicating with the Drive
Start Version	M_01-04-05-000

Description

This Parameter sets the Gateway IP of the drive. This parameter determines what IP the drive can communicate with outside of its current subnet.

By default, DHCP is active, and the drive will acquire an IP Address on its own. When the drive is in DHCP mode, IP.GATEWAY will return 0.0.0.0.

Notes:

- When the drive is in DHCP, the actual IP GATEWAY will not be returned using this command. The value the user has stored will be returned.
- IP.GATEWAY will only be used by the drive when IP.MODE = 1

If manually setting the IP.ADDRESS (pg 556), the IP.SUBNET (pg 560) and IP.GATEWAY must be set up. After the IP.RESET (pg 559) command is issued, the new IP settings will be active only if IP.MODE (pg 558) has been set to 1.

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

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

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

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

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

Related Topics

IP.ADDRESS (pg 556)

IP.RESET (pg 559)

IP.SUBNET (pg 560)

IP.MODE (pg 558)

23.22.3 IP.MODE

General Information	
Type	NV Parameter
Description	Sets method of acquiring IP Address.
Units	N/A
Range	0 to 2
Default Value	0
Data Type	Integer
See Also	N/A
Start Version	M_01-04-013-000

Description

This command determines which method of acquiring an IP Address the drive will take.

NOTE

Mode 0 and Mode 1 contain multiple methods of acquiring an IP Address. In these modes each method will be implemented in the order they are listed below until an IP Address is acquired

The drive will attempt to acquire a new IP Address as soon as the IP.RESET (pg 559) command is issued.

IP Mode	Mode of Acquiring IP Address
0	Rotary Switches, DHCP, Auto IP
1	IP.ADDRESS, IP.SUBNET, IP.GATEWAY
2	DHCP, Auto IP

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

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

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

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

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

Related Topics

IP.ADDRESS (pg 556)

IP.GATEWAY (pg 557)

IP.RESET (pg 559)

IP.SUBNET (pg 560)

23.22.4 IP.RESET

General Information	
Type	Command
Description	Implements new IP settings.
Units	N/A
Range	N/A
Default Value	N/A
Data Type	N/A
See Also	Communicating with the Drive
Start Version	M_01-04-05-000

Description

When this command is issued a new IP will be acquired using IP.MODE (pg 558) to select what method is used.

Notes:

- When issuing this command, it is likely the connection to the drive will be severed, and a new connection will need to be made.
- IP.RESET will return an error if issued while the drive is enabled. IP.RESET is allowed when drive is disabled, or in dynamic braking mode.
- Ensure all values of IP.ADDRESS (pg 556), IP.SUBNET (pg 560), and IP.GATEWAY (pg 557) are configured if using IP.MODE 1

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

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

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

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

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

Related Topics

IP.ADDRESS (pg 556)

IP.GATEWAY (pg 557)

IP.SUBNET (pg 560)

IP.MODE

23.22.5 IP.SUBNET

General Information	
Type	NV Parameter
Description	Gets/Sets the IP Subnet mask of the drive.
Units	N/A
Range	0.0.0.0 to 255.255.255.255
Default Value	0.0.0.0
Data Type	IP Address
See Also	
Start Version	M_01-04-05-000

Description

This Parameter sets the IP Subnet mask of the drive. This parameter determines what IP addresses the drive will be allowed to communicate with.

By default, DHCP is active, and the drive will acquire an IP Address on its own. When the drive is in DHCP mode, IP.SUBNET will return 0.0.0.0.

Notes:

- When the drive is in DHCP, the actual IP Subnet mask will not be returned using this command. The value the user has stored will be returned.
- IP.SUBNET will only be used by the drive when IP.MODE = 1

If manually setting the IP.ADDRESS, the IP.SUBNET and IP.GATEWAY must be set up. After the IP.RESET command is issued, the new IP settings will be active only if IP.MODE has been set to 1.

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

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

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

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

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

Related Topics

IP.ADDRESS

IP.GATEWAY

IP.RESET

23.22.3 IP.MODE

23.23 LOAD-Parameter

This section describes the LOAD parameters.

23.23.1 LOAD.INERTIA	562
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23.23.1 LOAD.INERTIA

General Information	
Type	NV Parameter
Description	Sets the load inertia.
Units	kgcm ² for rotary motors kg for linear motors
Range	1 to 1,000,000 kgcm ² or kg
Default Value	0 kgcm ² or kg
Data Type	Float
See Also	N/A
Start Version	M_01-03-06-000

Description

LOAD.INERTIA sets the load inertia.

Related Topics

Motor (pg 53)

23.24 MOTOR Parameters

This section describes the MOTOR parameters.

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23.24.1 MOTOR.AUTOSET

General Information	
Type	NV Parameter
Description	Determines which drive parameters are calculated automatically.
Units	N/A
Range	0 to 1
Default Value	0
Data Type	Boolean
See Also	N/A
Start Version	M_01-00-00-000

Description

This parameter determines whether or not certain drive parameters (for example, IL.KP or MOTOR.POLES) are calculated automatically. A value of 1 causes the parameters to be automatically calculated from the motor ID data (read from memory-supporting feedback devices, such as SFD, Endat, and BISS). Automatically calculated parameters are read-only. A value of 0 disables the automatic calculation and you must set the parameters manually. Manually set parameters are read-write.

Related Topics

8.1 Motor

23.24.2 MOTOR.BRAKE

General Information	
Type	NV Parameter
Description	Sets the presence or absence of a motor brake.
Units	N/A
Range	0 to 1
Default Value	0
Data Type	Boolean
See Also	N/A
Start Version	M_01-00-00-000

Description

The MOTOR.BRAKE parameter notifies the firmware whether a brake exists or not. It does not apply or release the brake. If a brake is found to be present, the firmware considers hardware indications regarding the brake circuits (such as open circuit or short circuit). If a brake does not exist, then the firmware ignores the hardware indications since they are irrelevant.

Value	Status
0	Motor brake does not exist.
1	Motor brake exists and brake hardware circuitry checks are enabled.

Enabling the MOTOR.BRAKE (value set to 1) when no motor brake exists creates a fault.

The motor brake is polled every 16 ms.

Related Topics

8.1 Motor

23.24.3 MOTOR.BRAKEIMM

General Information	
Type	NV Parameter
Description	Brake Immediately: in the case of a drive disable, apply the brake in all situations.
Units	N/A
Range	0 to 1
Default Value	0 (Inactive)
Data Type	Boolean
See Also	N/A
Start Version	M_01-05-11-000

Description

With the standard configuration, when the drive disables, the brake will not apply until velocity falls below CS.VTHRESH for CS.TO milliseconds. However, in some machines (such as a vertical axis) the brake should be applied immediately whenever the drive disables.

To ensure that the brake is applied immediately after any disable (due to fault, disable command, etc), set MOTOR.BRAKEIMM = 1.

Related Topics

Motor (pg 53) | CS.VTHRESH (pg 336) | CS.TO (pg 335) | MOTOR.TBRAKETO (pg 587) | DRV.DISTO (pg 381)

23.24.4 MOTOR.BRAKERLS

General Information	
Type	Command
Description	Allows a user to release or apply the motor brake.
Units	N/A
Range	0 to 2
Default Value	0
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

Description

This command allows a user to release or apply the motor brake.

0 = Drive controls the brake.

1 = Brake is released.

2 = Brake is applied.

NOTE

A digital input mode is also used for the same purpose. The two mechanisms are independent.

NOTE

The CANopen-object 0x345A sub 1/2 can be used to control the brake state. See [CANopen manual](#) on kollmorgen.com. (Functionality starts with firmware 1.7.4.0)

Related Topics

Motor (pg 53)

23.24.5 MOTOR.BRAKESTATE

General Information	
Type	R/O Parameter
Description	Reads the actual status of the motor brake.
Units	N/A
Range	Brake released or not present. Brake applied.
Default Value	Brake applied or not present.
Data Type	String
See Also	N/A
Start Version	M_01-00-00-000

Description

This parameter reads the actual status of the motor brake and can only show two states:

1 = Brake released or not present

2 = Brake applied

Related Topics

Motor (pg 53)

23.24.6 MOTOR.CTF0

General Information	
Type	NV Parameter
Description	Sets the thermal constant of the motor coil.
Units	mHz
Range	0.265 to 16,000 mHz
Default Value	10 mHz
Data Type	Float
See Also	N/A
Start Version	M_01-00-00-000

Description

This parameter is used to configure the thermal constant of the motor coil, which is the break frequency of a single-pole low-pass filter model of the thermal dynamics of the motor coil.

This parameter, together with MOTOR.IPEAK (pg 575) and MOTOR.ICONT (pg 570), determine the motor foldback parameters IL.MFOLDD (pg 544), IL.MFOLDT (pg 546), and IL.MFOLDR (pg 545).

Calculating MOTOR.CTF0

Given a motor coil/winding thermal time constant T in seconds, then:

$$\text{MOTOR.CTF0} = 1 / (2\pi T)$$

Related Topics

8.1 Motor

23.24.7 MOTOR.ICONT

General Information	
Type	NV Parameter
Description	Sets the motor continuous current.
Units	A
Range	0.1 to 500 A
Default Value	1.0 A
Data Type	Float
See Also	N/A
Start Version	M_01-00-00-000

Description

This parameter is used to configure the motor continuous current.

Related Topics

8.1 Motor

23.24.8 MOTOR.IDDATAVALID

General Information	
Type	R/O Parameter
Description	Reports the status of the motor memory.
Units	N/A
Range	N/A
Default Value	0
Data Type	Integer
See Also	N/A
Start Version	M_01-02-00-000

Description

MOTOR.IDDATAVALID reports the status of the motor memory status.

The valid values for this keyword are the following:

Value	Description
0	Error in identification
1	Success in identification
2	Identification in process
3	Identification not started yet
4	Success recognizing feedback, but failed to verify OEM data integrity

Related Topics

Motor (pg 53)

23.24.9 MOTOR.IMID

General Information	
Type	R/W
Description	The direct-axis current set point used for induction machine closed-loop control.
Units	Amps
Range	0 to DRIVE.IPEAK
Default Value	0
Data Type	Float
Start Version	M_01-08-00-000

Description

The value of IL.IMID can be estimated using the motor name plate information.

The following rule should generally be used:

$$I_{d,rms} \cong I_R * \sqrt{1 - (\cos \varphi)^2} * 0.8$$

In which I_d is the value for IL.IMID, the preset rotor flux building current, I_r is the name plate phase current, $\cos \varphi$ is the name plate power factor at rated and operation, and **0.8** is an empirical factor (accounts for the angle error due to voltage drop on the leakage induction).

Related Topics

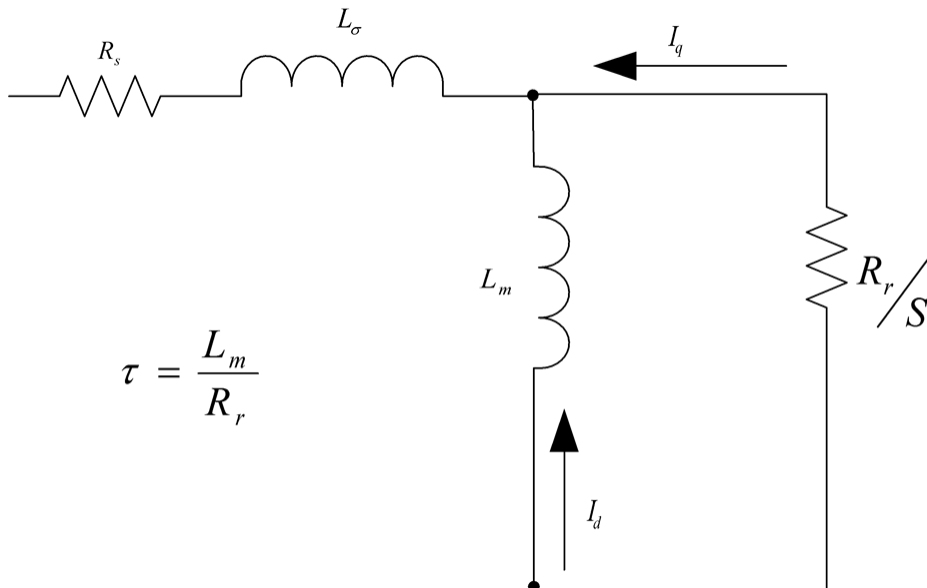
Motor (pg 53)

23.24.10 MOTOR.IMTR

General Information	
Type	R/W
Description	Rotor time constant.
Units	Ms
Range	1 to 16,000
Default Value	100
Data Type	Integer
Start Version	M_01-08-00-000

Description

The rotor time constant is calculated as the ratio between rotor magnetizing inductance L_m and rotor resistance R_r from the following equivalent circuit of an induction machine.



Alternatively, the rotor time constant can be estimated from the rated current, magnetizing current (MOTOR.IMID (pg 572)) and rated slip frequency as follows:

$$\tau = \frac{\sqrt{I_{s,rms}^2 - I_{d,rms}^2}}{I_{d,rms} * \omega_{slip}}$$

where $I_{s,rms}$ is the rated current, $I_{d,rms}$ is the rated magnetizing current, and ω_{slip} is the rated slip frequency in rad/s.

NOTE

τ is in seconds for the above formulas. It needs to be converted to ms for the MOTOR.IMTR setting:
 MOTOR.IMTR(ms) = $\tau * 1000$

Related Topics

Motor (pg 53)

23.24.11 MOTOR.INERTIA

General Information	
Type	NV Parameter
Description	Sets the motor inertia.
Units	kgcm ² for rotary motors kg for linear motors
Range	1 to 200,000 kgcm ² or kg
Default Value	100 kgcm ² or kg
Data Type	Float
See Also	N/A
Start Version	M_01-00-00-000

Description

This parameter sets the motor inertia.

Related Topics

8.1 Motor

23.24.12 MOTOR.IPEAK

General Information	
Type	NV Parameter
Description	Sets the motor peak current.
Units	mA
Range	0.200 to 1,000 A
Default Value	2.000 A
Data Type	Float
See Also	IL.LIMITP (pg 543), IL.LIMITN (pg 542)
Start Version	M_01-00-00-000

Description

This parameter configures the drive for the motor's peak, instantaneous-rated current. MOTOR.IPEAK is used to limit clamp the magnitude of the torque producing q-component current command (IL.CMD (pg 520)).

Related Topics

8.1 Motor

23.24.13 MOTOR.KE

General Information	
Type	NV Parameter
Description	Sets the motor back EMF constant.
Units	Vpeak/krpm for Rotary Motors Vpeak/m/s for Linear Motors
Range	0.0 to 100,000
Default Value	0
Data Type	Float
See Also	N/A
Start Version	M_01-03-06-000

Description

MOTOR.KE defines the back EMF constant for the motor. The back EMF constant defines how much voltage is generated at the motors coils. The relationship between MOTOR.KE and speed is described by the following equation:

$$\text{Coil Voltage} = \text{MOTOR.KE} * \text{VL.FB}$$

Where:

VL.FB is in units of krpm for rotary motors and in units of m/s for linear motors

Related Topics

Motor (pg 53)

23.24.14 MOTOR.KT

General Information	
Type	NV Parameter
Description	Sets the torque constant of the motor.
Units	Nm/A
Range	0.001 Nm/A to 1,000,000.000 Nm/A for rotary motors. 0.001 Nm/A to 1,000,000.000 N/A for linear motors.
Default Value	0.1 Nm/A
Data Type	Float
See Also	N/A
Start Version	M_01-00-00-000

Description

This parameter is the torque constant of the motor in Nm/A. The value can be online checked according to the following equation:

$$K_t = 60 \cdot \sqrt{3} \cdot U_i / (2 \cdot \pi \cdot n)$$

Where:

U_i = induced voltage of the motor

n = actual rotor velocity

Related Topics

8.1 Motor

23.24.15 MOTOR.LQLL

General Information	
Type	NV Parameter
Description	Sets the line-to-line motor Lq.
Units	mH
Range	1 to 2^{32} H
Default Value	17.000 H
Data Type	Float
See Also	N/A
Start Version	M_01-00-00-000

Description

This parameter is used to configure the motor line-to-line inductance.

Related Topics

8.1 Motor

23.24.16 MOTOR.NAME

General Information	
Type	NV Parameter
Description	Sets the motor name.
Units	N/A
Range	11 chars
Default Value	N/A
Data Type	String
See Also	N/A
Start Version	M_01-00-00-000

Description

This parameter is used to set the motor name.

Related Topics

Motor (pg 53)

23.24.17 MOTOR.PHASE

General Information	
Type	NV Parameter
Description	Sets the motor phase.
Units	Electrical degrees
Range	0 to 360°
Default Value	0°
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

Description

This parameter sets the motor phase.

Related Topics

8.1 Motor

23.24.18 MOTOR.PITCH

General Information	
Type	NV Parameter
Description	Sets the motor pitch.
Units	μm
Range	1,000 to 1,000,000 μm
Default Value	1.000 μm
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

Description

This parameter defines the pole-to-pair pitch for the linear motor in micrometers.

Related Topics

Motor (pg 53)

23.24.19 MOTOR.POLES

General Information	
Type	NV Parameter
Description	Sets the number of motor poles.
Units	N/A
Range	0 to 128
Default Value	6
Data Type	Integer
See Also	FB1.POLES (pg 454)
Start Version	M_01-00-00-000

Description

MOTOR.POLES sets the number of motor poles. This command is used for commutation control and represents the number of individual magnetic poles of the motor (not pole pairs). The division value of motor poles (MOTOR.POLES) and feedback poles (FB1.POLES) must be an integer when setting drive to enable, otherwise a fault is issued.

Related Topics

8.1 Motor

23.24.20 MOTOR.R

General Information	
Type	NV Parameter
Description	Sets the stator winding resistance phase-phase in ohms.
Units	Ω
Range	0.001 to 650 Ω
Default Value	10 Ω
Data Type	Float
See Also	N/A
Start Version	M_01-00-00-000

Description

MOTOR.R sets the stator winding resistance phase-to-phase in ohms.

Related Topics

8.1 Motor

23.24.21 MOTOR.RTYPE

General Information	
Type	NV Parameter
Description	Defines the type of thermal resistor inside the motor.
Units	N/A
Range	0 to 1
Default Value	0
Data Type	Boolean
See Also	N/A
Start Version	M_01-00-00-000

Description

This parameter defines the type of thermal resistor used inside of the motor to measure motor temperature.

0 = PTC

1 = NTC

Related Topics

Motor (pg 53)

23.24.22 MOTOR.TBRAKEAPP

General Information	
Type	NV Parameter
Description	The delay time used for applying the motor brake.
Units	ms
Range	0 to 1,000 ms
Default Value	75 ms
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

Description

This parameter is used to configure the mechanical delay when applying the motor brake. MOTOR.TBRAKEAPP is a time delay that is applied when a brake exists and the drive is disabled at the end of a controlled stop. This delay lasts from the time that the brake is commanded to apply until the time that the drive is disabled.

This feature allows you to disable the drive and apply the brake on a vertical application without the load falling. Without this time delay, if you immediately disable the drive, then the load falls during the time needed for the brake to mechanically apply.

Related Topics

8.1 Motor

23.24.23 MOTOR.TBRAKERLS

General Information	
Type	NV Parameter
Description	The delay time used for releasing the motor brake.
Units	ms
Range	0 to 1,000 ms
Default Value	75 ms
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

Description

This parameter is used to configure the mechanical delay when releasing the motor brake. MOTOR.TBRAKERLS is a time delay that is applied when a brake exists and the drive is enabled. When the drive is enabled, the brake is commanded to release and, during the MOTOR.TBRAKERLS period of time, the drive does not accept a motion command. This delay allows the brake to fully release before the drive begins a new motion.

Related Topics

8.1 Motor

23.24.24 MOTOR.TBRAKETO

General Information	
Type	NV Parameter
Description	Brake apply timeout for vertical axis.
Units	Milliseconds
Range	-1 to 30,000
Default Value	-1 (function disabled)
Data Type	Integer
See Also	CS.VTHRESH (pg 336), CS.TO (pg 335), DRV.DISTO (pg 381)
Start Version	01-05-07-000

Description

When a drive is disabled (due to user command, digital input, or fault), the brake will normally not be applied until velocity has fallen below CS.VTHRESH (pg 336). In some instances, such as a vertical axis, it may be desirable to apply the brake regardless of velocity.

MOTOR.TBRAKETO sets the maximum time allowed to pass between drive disable and application of the motor brake. After this time, the brake will be applied even if velocity is higher than CS.VTHRESH (pg 336).

To disable the timer, set the value to -1.

NOTE

Prior to version 01-05-07-000, this timeout was only applied when the Hardware Enable was deactivated and the default was 30,000. From 01-05-07-000 on this timeout is applied in all conditions and the default is -1.

23.24.25 MOTOR.TEMP

General Information	
Type	R/O Parameter
Description	Reads the motor temperature represented as the resistance of the motor PTC or NTC.
Units	Ω
Range	0 to $2^{32} \Omega$
Default Value	N/A
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

Description

This parameter returns the motor temperature, which is represented as the resistance of the motor's PTC or NTC.

Related Topics

8.1 MotorMOTOR.RTYPE (pg 584)

23.24.26 MOTOR.TEMPFAULT

General Information	
Type	NV Parameter
Description	Sets the motor temperature fault level.
Units	Ω
Range	0 to 2,000,000,000 Ω
Default Value	0 Ω = switched off
Data Type	Integer
See Also	MOTOR.TEMP (pg 588)
Start Version	M_01-00-00-000

Description

This parameter is used to configure the motor temperature fault level as a resistance threshold of the motor PTC.

A zero value prevents any warning from being issued.

Related Topics

8.1 Motor

23.24.27 MOTOR.TEMPWARN

General Information	
Type	NV Parameter
Description	Sets the motor temperature warning level.
Units	Ω
Range	0 to 2,000,000,000 Ω
Default Value	0 Ω = switched off
Data Type	Integer
See Also	MOTOR.TEMP (pg 588)
Start Version	M_01-00-00-000

Description

This parameter is used to configure the motor temperature warning level as a resistance threshold of the motor PTC.

A zero value prevents any warning from being created.

Related Topics

8.1 Motor

23.24.28 MOTOR.TYPE

General Information	
Type	NV Parameter
Description	Sets the motor type.
Units	N/A
Range	0, 1, 2, 4
Default Value	0
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

Description

MOTOR.TYPE sets the drive control algorithms to different motor types as follows:

0 = Rotary motor

1 = Linear motor

2 = Induction Motor V/f Open Loop Control

4 = Induction Motor Closed Loop Control

The following table shows which MOTOR parameters must be configured for either permanent magnet, induction motor v/f open loop, or induction motor closed loop motor types.

Keyword	Permanent Magnet	Induction Motor v/f Open Loop	Induction Motor Closed Loop
MOTOR.NAME (pg 579)	Yes	Yes	Yes
MOTOR.TYPE	Yes	Yes	Yes
MOTOR.AUTOSSET (pg 564)	Yes	No	Yes
MOTOR.IPEAK (pg 575)	Yes	Yes	Yes
MOTOR.ICONT (pg 570)	Yes	Yes	Yes
MOTOR.INERTIA (pg 574)	Yes	Yes	Yes
MOTOR.KT (pg 577)	Yes	No	No
MOTOR.LQLL (pg 578)	Yes	No	Yes
MOTOR.POLES (pg 582)	Yes	Yes	Yes
MOTOR.VMAX (pg 593)	Yes	Yes	Yes
MOTOR.R (pg 583)	Yes	Yes	Yes
MOTOR.VOLTMAX (pg 594)	Yes	Yes	Yes
MOTOR.PHASE (pg 580)	Yes	No	No
MOTOR.CTF0 (pg 569)	Yes	Yes	Yes
MOTOR.KE (pg 576)	Yes	No	No
MOTOR.IMTR (pg 573)	No	No	Yes
MOTOR.IMID (pg 572)	No	No	Yes
MOTOR.VOLTRATED (pg 596)	No	Yes	No

Keyword	Permanent Magnet	Induction Motor v/f Open Loop	Induction Motor Closed Loop
MOTOR.VRATED (pg 597)	No	Yes	No
MOTOR.VOLTMIN (pg 595)	No	Yes	No

Related Topics

Motor (pg 53)

23.24.29 MOTOR.VMAX

General Information	
Type	NV Parameter
Description	Sets the maximum motor speed.
Units	rpm
Range	100 to 40,000 rpm
Default Value	3,000 rpm
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

Description

This parameter is used to configure the maximum speed of the motor.

Related Topics

8.1 Motor

23.24.30 MOTOR.VOLTMAX

General Information	
Type	NV Parameter
Description	Sets the motor maximum voltage.
Units	Vrms
Range	110 to 900 Vrms
Default Value	230 Vrms
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

Description

This parameter sets the maximum permissible motor voltage. For instance, if a motor that is rated for a 400 V supply is connected to the drive, then the MOTOR.VOLTMAX setting is 400. This value also sets regen resistor and over voltage thresholds in the drive to acceptable values for the motor so that the motor windings are not damaged.

Related Topics

8.1 Motor

23.24.31 MOTOR.VOLTMIN

General Information	
Type	NV Parameter
Description	Sets the minimum voltage for V/f control.
Units	%
Range	0 to 100%
Default Value	2%
Data Type	U16
See Also	MOTOR.VRATED (pg 597), MOTOR.VOLTRATED (pg 596)
Start Version	

Description

This parameter configures the drive for the induction motor's minimum voltage at standstill. It is given as a percentage (%) of the motor's rated voltage. MOTOR.VOLTMIN is used to calculate the constant volts per Hertz characteristics of the drive and motor and should be set to a value that generates a current of about 40% of the rated current at standstill.

Related Topics

8.1 Motor

23.24.32 MOTOR.VOLTRATED

General Information	
Type	NV Parameter
Description	Sets the motor rated voltage.
Units	V
Range	50 to 1,000 V
Default Value	230 V
Data Type	U16
See Also	MOTOR.VRATED (pg 597), MOTOR.VOLTMIN (pg 595)
Start Version	M_01-03-00-000

Description

This parameter configures the drive for the induction motor's rated voltage as indicated on the nameplate.

MOTOR.VOLTRATED is used to calculate the constant Volts per Hertz characteristics of the drive and motor.

Related Topics

Motor (pg 53)

23.24.33 MOTOR.VRATED

General Information	
Type	NV Parameter
Description	Sets the motor rated velocity (not maximum velocity)
Units	Depends on or Rotary: rpm, rps, deg/s, custom units/s, rad/s Linear: counts/s, mm/s, μm/s, custom units/s
Range	Rotary: 0.000 to 15,000.000 rpm 0.000 to 250.000 rps 0.000 to 90,000.000 deg/s 0.000 to 1,250.000 custom units/s 0.000 to 1,570.796 rad/s Linear: 0.000 to 1,073,741,824,000.000 counts/s 0.000 to 8,000.000 mm/s 0.000 to 8,000,000.000 μm/s 0.000 to 1,250.000 custom units/s
Default Value	0 rpm
Data Type	U16
See Also	MOTOR.VOLTRATED (pg 596), MOTOR.VOLTMIN (pg 595)
Start Version	M_01-03-00-000

Description

This parameter configures the drive for the rated velocity of the induction motor as indicated on the nameplate.

MOTOR.VRATED is used to calculate the constant volts per Hertz characteristics of the drive and motor.

Related Topics

Motor (pg 53)

23.25 PL Parameters

This section describes the PL parameters.

23.25.1 PL.CMD	599
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23.25.14 PL.MODP2	613
23.25.15 PL.MODPDIR	614
23.25.16 PL.MODPEN	615

23.25.1 PL.CMD

General Information	
Type	R/O Parameter
Description	Reads the position command directly from the entry to the position loop.
Units	Depends on or Rotary: counts, rad, deg, (custom units), 16-bit counts Linear: counts, mm, μ m, (custom units), 16-bit counts
Range	N/A
Default Value	N/A
Data Type	Float
See Also	PL.FB (pg 605)
Start Version	M_01-00-00-000

Description

PL.CMD reads the position command as it is received in the position loop entry.

Related Topics

PL.ERR (pg 600) | PL.ERRFTHRESH (pg 601) | PL.ERRMODE (pg 603) |
PL.ERRWTHRESH (pg 604)

13.5 Position Loop

23.25.2 PL.ERR

General Information	
Type	R/O Parameter
Description	Reads the position error present when the drive is controlling the position loop.
Units	counts, rad, deg, (custom units)
Range	N/A
Default Value	N/A
Data Type	Float
See Also	PL.FB (pg 605)
Start Version	M_01-00-00-000

Description

PL.ERR reads the position error present when the drive is controlling the position loop. PL.ERR is the difference between the actual position of the motor shaft (PL.FB (pg 605)) and the commanded position of the drive (PL.CMD (pg 599)). If the drive is not in the position operating mode (DRV.OPMODE (pg 418) = 2), then the PL.ERR value is not generated by the drive and this parameter is read as 0.

Related Topics

PL.ERRFTHRESH (pg 601) | PL.ERRMODE (pg 603) | PL.ERRWTHRESH (pg 604)

13.5 Position Loop

23.25.3 PL.ERRFTHRESH

General Information	
Type	NV Parameter
Description	Sets the maximum position error.
Units	Depends on or Rotary: counts, rad, deg, (custom units), 16-bit counts Linear: counts, mm, µm, (custom units), 16-bit counts
Range	Rotary: 0.000 to 5,123,372,000,000,005.000 counts 0.000 to 7,495,067.136 rad 0.000 to 429,436,076.032 deg 0.000 to 5,964,389.888 (custom units) 0.000 to 78,176,452,636.718 16-bit counts Linear: 0.000 to 5,123,372,000,000,005.000 counts 0.000 to 1,192,877.952*MOTOR.PITCH (pg 581) mm 0.000 to 1,192,878,014.464*MOTOR.PITCH (pg 581) µm 0.000 to 5,964,389.888 (custom units) 0.000 to 78,176,452,636.718 16-bit counts
Default Value	Rotary: 42,949,672,960.000 counts 62.832 rad 3,600.000 deg 50.000 (custom units) 655,360.000 16-bit counts Linear: 42,949,672,960.000 counts 10.000*MOTOR.PITCHMOTOR.PITCH (pg 581)mm 10,000.000*MOTOR.PITCH µm 50.000 (custom units) 655,360.000 16-bit counts
Data Type	Float
See Also	PL.ERR
Start Version	M_01-00-00-000

Description

This parameter sets the maximum position error. If the position error PL.ERR (pg 600) is larger than PL.ERRFTHRESH the drive generates a fault. If PL.ERRFTHRESH is set to 0, the maximum position error is ignored.

Example

Set position rotary units to 2 (degrees). Setting PL.ERRFTHRESH to 1000 states that is the position error is larger than 1000 degrees, the drive will generate a fault.

UNIT.PROTARY 2

PL.ERRFTHRESH 1000

Related Topics

[PL.ERR \(pg 600\)](#) | [PL.ERRMODE \(pg 603\)](#) | [PL.ERRWTHRESH \(pg 604\)](#)

[13.5 Position Loop](#)

23.25.4 PL.ERRMODE

General Information	
Type	NV Parameter
Description	Sets the type of following error warning and fault usage.
Units	0- Standard following error 1-Enhanced following error
Range	0 to 1
Default Value	0
Data Type	Boolean
See Also	PL.ERR (pg 600), PL.ERRFTHRESH (pg 601), PL.ERRWTHRESH (pg 604)
Start Version	M_01-02-09-000

Description

PL.ERRMODE sets the type of following error warning and fault usage.

Mode 0 - following error magnitude fault

In Mode 0, the values of PL.ERRFTHRESH and PL.ERRWTHRESH are compared against the value of PL.ERR. If the absolute value of PL.ERR is larger than PL.ERRWTHRESH, then a warning is generated. If the absolute value of PL.ERR is larger than PL.ERRFTHRESH, then a fault is generated.

Mode 1 - deviation from predicted trajectory fault

In Mode 1, the values of PL.ERRFTHRESH and PL.ERRWTHRESH are compared against the following value:

$$\langle \text{error} \rangle = \text{abs}(\text{PL.ERR} - [(\text{VL.CMD} - 1 * \text{VL.FF}) / \text{PL.KP}])$$

If the absolute value of $\langle \text{error} \rangle$ is larger than PL.ERRWTHRESH for a consecutive period of 100 ms, then a warning is generated. If the absolute value of $\langle \text{error} \rangle$ is larger than PL.ERRFTHRESH for a consecutive period of 100 ms, then a fault is generated.

In mode 1, if PL.KI is not 0 then the following error prediction mechanism is turned off. When the drive is disabled, the following error limit tests are turned off and the warnings are cleared. A value of 0 in PL.ERRFTHRESH or PL.ERRWTHRESH disables the respective functionality.

Example

Assuming

PL.ERRMODE = 0, PL.ERRFTHRESH=1.2, PL.ERRWTHRESH=1, then PL.ERR reads 1.1.

In this case the warning is generated, but the fault is not.

Assuming PL.ERRMODE = 0, PL.ERRFTHRESH=1.2, PL.ERRWTHRESH=1, then PL.ERR reads 1.3.

In this case the warning is generated, as well as the fault.

Related Topics

PL.ERR (pg 600) | PL.ERRFTHRESH (pg 601) | PL.ERRWTHRESH (pg 604)

Position Loop (pg 120)

23.25.5 PL.ERRWTHRESH

General Information	
Type	NV Parameter
Description	Sets the position error warning level.
Units	Depends on or Rotary: counts, rad, deg, (custom units), 16-bit counts Linear: counts, mm, µm, (custom units), 16-bit counts
Range	Rotary: 0.000 to 5,123,372,000,000,005.000 counts 0.000 to 7,495,067.136 rad 0.000 to 429,436,076.032 deg 0.000 to 5,964,389.888 (custom units) 0.000 to 78,176,452,636.718 16-bit counts Linear: 0.000 to 5,123,372,000,000,005.000 counts 0.000 to 1,192,877.952*MOTOR.PITCH (pg 581) mm 0.000 to 1,192,878,014.464*MOTOR.PITCH (pg 581) µm 0.000 to 5,964,389.888 (custom units) 0.000 to 78,176,452,636.718 16-bit counts
Default Value	0.000 deg
Data Type	Float
See Also	PL.ERR (pg 600)
Start Version	M_01-00-00-000

Description

If this value is not equal 0 and the position error PL.ERR (pg 600) is larger than this value, the drive will generate a warning.

If PL.ERRWTHRESH is set to 0 the warning is not issued.

Example

Set position rotary units to 2 degrees. If you set PL.ERRWTHRESH to 100 and the position error is larger than 100 degrees, then the drive will generate a warning.

UNIT.PROTARY 2

PL.ERRWTHRESH 100

Related Topics

PL.ERR (pg 600) | PL.ERRFTHRESH (pg 601) | PL.ERRMODE (pg 603)

13.5 Position Loop

23.25.6 PL.FB

General Information	
Type	R/O Parameter
Description	Reads the position feedback value.
Units	Depends on or Rotary: counts, rad, deg, (custom units), 16-bit counts Linear: counts, mm, μm , (custom units), 16-bit counts
Range	N/A
Default Value	N/A
Data Type	Float
See Also	FB1.OFFSET
Start Version	M_01-00-00-000

Description

PL.FB returns the position feedback value.

Note that this value is not the pure feedback value read from the feedback device, but also includes the value of the FB1.OFFSET and an internal offset set automatically by the FW when a homing switch is actuated.

Related Topics

PL.ERR (pg 600) | PL.ERRFTHRESH (pg 601) | PL.ERRMODE (pg 603) |
PL.ERRWTHRESH (pg 604)

13.5 Position Loop

23.25.7 PL.FBSOURCE

General Information	
Type	NV Parameter
Description	Sets the feedback source for the position loop.
Units	N/A
Range	Range will differ depending on drive model. 0 to 1 (for KC1-x-xxxxx-NAxx-xxxx) 0 to 2 (for KC1-x-xxxxx-NBxx-xxxx)
Default Value	0
Data Type	Integer
See Also	VL.FBSOURCE
Start Version	M_01-00-00-000

Description

This parameter determines the feedback source that the position loop uses. A value of 0 for this parameter selects the primary feedback, a value of 1 selects the secondary feedback. If you use the secondary feedback as the source for the position loop, then FB2.MODE mode should be set as 0 (A/B signals). A/B signals are the only supported feedback type as secondary feedback into the position loop. Other settings for FB2.MODE are intended as pulse inputs or a gearing command when PL.FBSOURCE remains 0.

0	Primary Feedback connected to X10.
1	Secondary Feedback (DRV.HANDWHEEL) connected to X7 or X9.
2	Tertiary Feedback connected to X9 (only supported with KC1-x-xxxxx-NBxx-xxxx).

Related Topics

PL.ERR (pg 600) | PL.ERRFTHRESH (pg 601) | PL.ERRMODE (pg 603) |

PL.ERRWTHRESH (pg 604)

Position Loop (pg 120)

23.25.8 PL.FILTERTIME

General Information	
Type	R/W Parameter
Description	Sets the position command filter period.
Units	Milliseconds
Range	0, 0.5, 1, 2, 4, 8, 16, 32, 64, 128, 256, 512
Default Value	0
Data Type	Float
Start Version	M_01-08-01-000

Description

PL.FILTERTIME sets the period of a "boxcar" moving average filter on the position command. When PL.FILTERTIME is greater than zero, the filter is active.

The moving average filter is applied to all Command Source types, but only active when the KC1 is in Position mode.

This feature is typically used for smoothing abrupt changes in position command, or filtering coarse command steps from low resolution controllers, or electronic gearing.

NOTE

When the filter is on (PL.FILTERTIME > 0), total motion commanded will be delayed by the period the filter is set to.

Related Topics

Electronic Gearing (pg 97)

23.25.9 PL.INTINMAX

General Information	
Type	NV Parameter
Description	Limits the input of the position loop integrator by setting the input saturation.
Units	Depends on or Rotary: counts, rad, deg, (custom units), 16-bit counts Linear: counts, mm, μm , (custom units), 16-bit counts
Range	Rotary: 0.000 to 18,446,744,073,709.000 counts 0.000 to 26,986.052 rad 0.000 to 1,546,188.288 deg 0.000 to 21,474.836 (custom units) 0.000 to 281,474,976.710 16-bit counts Linear: 0.000 to 18,446,744,073,709.000 counts 0.000 to 4,294.968*MOTOR.PITCH (pg 581) mm 0.000 to 4,294,967.296*MOTOR.PITCH (pg 581) μm 0.000 to 21,474.836 (custom units) 0.000 to 281,474,976.710 16-bit counts
Default Value	Rotary: 3,999,989,760.000 counts 5.852 rad 335.275 deg 4.657 (custom units) 61,035.000 16-bit counts Linear: 3,999,989,760.000 counts 0MOTOR.PITCH (pg 581) mm 9MOTOR.PITCH (pg 581) μm 4.657 (custom units) 61,035.000 16-bit counts
Data Type	Float
See Also	PL.FB
Start Version	M_01-00-00-000

Description

PL.INTINMAX limits the input of the position loop integrator by setting the input saturation. When used in concert with PL.INSATOUT, this variable allows you to make the position loop integrator effective near the target position. Far from the target position, however, the integrator is not dominant in the loop dynamics.

Related Topics

PL.ERR (pg 600) | PL.ERRFTHRESH (pg 601) | PL.ERRMODE (pg 603) | PL.ERRWTHRESH (pg 604)

13.5 Position Loop

23.25.10 PL.INTOUTMAX

General Information	
Type	NV Parameter
Description	Limits the output of the position loop integrator by setting the output saturation.
Units	Depends on or Rotary: counts, rad, deg, (custom units), 16-bit counts Linear: counts, mm, μm , (custom units), 16-bit counts
Range	Rotary: 0.000 to 18,446,744,073,709.000 counts 0.000 to 26,986.052 rad 0.000 to 1,546,188.288 deg 0.000 to 21,474.836 (custom units) 0.000 to 281,474,976.710 counts 16 bit Linear: 0.000 to 18,446,744,073,709.000 counts 0.000 to 4,294.968*MOTOR.PITCH (pg 581) mm 0.000 to 4,294,967.296*MOTOR.PITCH μm 0.000 to 21,474.836 (custom units) 0.000 to 281,474,976.710 16-bit counts
Default Value	Rotary: 3,999,989,760.000 counts 5.852 rad 335.275 deg 4.657 (custom units) 61,035.000 16-bit counts Linear: 3,999,989,760.000 counts 0MOTOR.PITCH (pg 581) mm 9MOTOR.PITCH (pg 581) μm 4.657 (custom units) 61,035.000 16-bit counts
Data Type	Float
See Also	PL.INTINMAX
Start Version	M_01-00-00-000

Description

PL.INTOUTMAX limits the output of the position loop integrator by setting the output saturation.

When used in concert with PL.INTINMAX, this variable allows you to make the position loop integrator effective near the target position. Far from the target position, however, the integrator is not dominant in the loop dynamics.

Related Topics

PL.ERR (pg 600) | PL.ERRFTHRESH (pg 601) | PL.ERRMODE (pg 603) | PL.ERRWTHRESH (pg 604)

13.5 Position Loop

23.25.11 PL.KI

General Information	
Type	NV Parameter
Description	Sets the integral gain of the position loop.
Units	Hz
Range	0 to 250 Hz
Default Value	0 Hz
Data Type	Float
See Also	PL.KP, PL.KD
Start Version	M_01-00-00-000

Description

PL.KI sets the integral gain of the position regulator PID loop.

Related Topics

PL.ERR (pg 600) | PL.ERRFTHRESH (pg 601) | PL.ERRMODE (pg 603) |
PL.ERRWTHRESH (pg 604)

13.5 Position Loop

23.25.12 PL.KP

General Information	
Type	NV Parameter
Description	Sets the proportional gain of the position regulator PID loop.
Units	(rev/s)/rev
Range	0 to 2,147,483.008 (rev/s)/rev
Default Value	100 rps/rev
Data Type	Float
See Also	PL.KI (pg 610),
Start Version	M_01-00-00-000

Description

PL.KP sets the proportional gain of the position regulator PID loop.

Related Topics

PL.ERR (pg 600) | PL.ERRFTHRESH (pg 601) | PL.ERRMODE (pg 603) |
PL.ERRWTHRESH (pg 604)

13.5 Position Loop

23.25.13 PL.MODP1

General Information	
Type	R/W parameter
Description	Sets modulo range parameter.
Units	Depends on UNIT.PROTARY (pg 682) and UNIT.PLINEAR (pg 680)
Range	N/A
Default Value	N/A
Data Type	Float
See Also	N/A
Start Version	M_01-00-00-000

Description

This parameter is either the beginning or the end of the modulo range, depending on whether this value is smaller or larger than PL.MODP2. If you set PL.MODP1 equal to PL.MODP2, an error message occurs.

Condition	Beginning of the modulo-range	End of the modulo-range
PL.MODP1 < PL.MODP2	PL.MODP1	PL.MODP2
PL.MODP2 < PL.MODP1	PL.MODP2	PL.MODP1

Related Topics

PL.ERR (pg 600) | PL.ERRFTHRESH (pg 601) | PL.ERRMODE (pg 603) |

PL.ERRWTHRESH (pg 604)

Position Loop (pg 120)

23.25.14 PL.MODP2

General Information	
Type	R/W Parameter
Description	Sets the beginning or end modulo range parameter.
Units	Depends on and .
Range	N/A
Default Value	N/A
Data Type	Float
See Also	N/A
Start Version	M_01-00-00-000

Description

This parameter is either the beginning or the end of the modulo range, depending on whether this value is smaller or larger than PL.MODP1 (pg 612).

Condition	Beginning of the modulo range	End of the modulo range
PL.MODP1 < PL.MODP2	PL.MODP1	PL.MODP2
PL.MODP2 < PL.MODP1	PL.MODP2	PL.MODP1

Related Topics

PL.ERR (pg 600) | PL.ERRFTHRESH (pg 601) | PL.ERRMODE (pg 603) |
 PL.ERRWTHRESH (pg 604)

13.5 Position Loop

23.25.15 PL.MODPDIR

General Information	
Type	R/W Parameter
Description	Sets the direction for absolute motion tasks.
Units	N/A
Range	0 to 2
Default Value	0
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

Description

This parameter defines the direction of an absolute motion task when the modulo position has been activated. For more details about absolute motion tasks, see .. For absolute motion tasks, you can only select a target position within the modulo range.

PL.MODPDIR Settings

Value	Motion	Description
0	Inside Range	The motor moves in a negative direction if the target position of the absolute motion task is less than the current position. The motor moves in positive direction if the target position of the absolute motion task is greater than the current position.
1	Positive	The motor always moves in a positive direction relative to the target position of the absolute motion task.
2	Negative	The motor always moves in a negative direction relative to the target position of the absolute motion task.
3	Shortest Distance	The motor always moves the shortest distance in order to reach the target position within the modulo-range.

23.25.16 PL.MODPEN

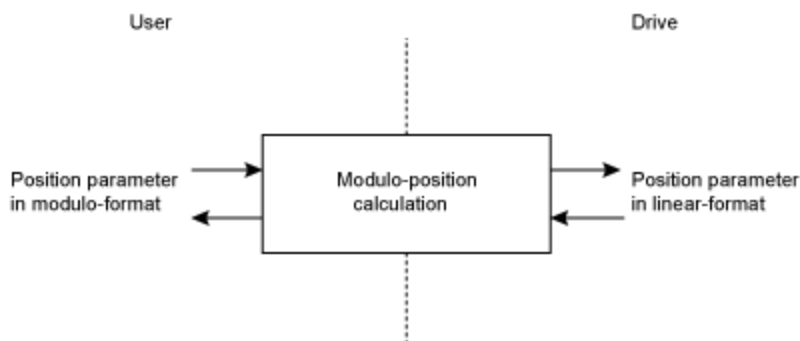
General Information	
Type	R/W Parameter
Description	Enables the modulo position.
Units	N/A
Range	0 to 1
Default Value	0
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

Description

A value of 0 disables the modulo-position and a value of 1 enables the modulo-position feature. The modulo-position feature can be used for circular applications such as round tables.

The position loop of the drive uses always a linear position variable but the data-exchange between the user and the drive uses the modulo-position calculation in order to convert values from linear format into modulo format and vice versa.

The following figure shows the interface between the user and the drive for PL.MODPEN=1:



Related Topics

Position Loop (pg 120)

23.26 PLS Parameters

This section describes the PLS parameters.

23.26.1 PLS.EN	617
23.26.2 PLS.MODE	618
23.26.3 PLS.P1 TO PLS.P8	619
23.26.4 PLS.RESET	620
23.26.5 PLS.STATE	621
23.26.6 PLS.T1 TO PLS.T8	622
23.26.7 PLS.UNITS	623
23.26.8 PLS.WIDTH1 TO PLS.WIDTH8	625

23.26.1 PLS.EN

General Information	
Type	R/W Parameter
Description	Enables programmable limit switch (PLS).
Units	N/A
Range	0 to 255
Default Value	0
Data Type	Integer
See Also	PLS.MODE (pg 618), PLS.RESET, PLS.STATE, PLS.UNITS, PLS.P1 to PLS.P8, PLS.WIDTH1 to PLS.WIDTH8, PLS.T1 to PLS.T8
Start Version	M_01-02-03-000

Description

PLS.EN is a bit variable which determines the mode of an individual PLS. Eight PLSs are available in the drive.

Example

Bit Value	Behavior
Bit 0 = 0	Disables PLS 1
Bit 0 = 1	Enables PLS 1
Bit 7 = 0	Disables PLS 8
Bit 7 = 1	Enables PLS 8

Related Topics

Programmable Limit Switch (pg 101)

23.26.2 PLS.MODE

General Information	
Type	R/W Parameter
Description	Selects programmable limit switch mode.
Units	N/A
Range	0 to 255
Default Value	0
Data Type	Integer
See Also	PLS.EN, PLS.RESET, PLS.STATE, PLS.UNITS, PLS.P1 to PLS.P8, PLS.WIDTH1 to PLS.WIDTH8, PLS.T1 to PLS.T8
Start Version	M_01-02-03-000

Description

PLS.MODE is a bit variable which determines the mode of an individual PLS. Eight PLSs are available in the drive.

Example

Bit Value	Behavior
Bit 0 = 0	PLS 1 is monitored continuously.
Bit 0 = 1	PLS 1 is monitored until it is triggered once (single-shot method). The PLS observation can be re-armed using the PLS.RESET command.
Bit 7 = 0	PLS 8 is monitored continuously.
Bit 7 = 1	PLS 8 is monitored until it is triggered once (single-shot method). The PLS observation can be re-armed using the PLS.RESET command.

Related Topics

Programmable Limit Switch (pg 101)

23.26.3 PLS.P1 TO PLS.P8

General Information	
Type	R/W Parameter
Description	Sets the trigger point for programmable limit switches.
Units	Depends on UNIT.PROTARY or UNIT.PLINEAR
Range	N/A
Default Value	0
Data Type	Float
See Also	UNIT.PROTARY (pg 682)
Start Version	M_01-02-03-000

Description

PLS.P1 to PLS.P8 define the trigger point of the PLS. For further information about how these parameters affect PLS behavior, see the PLS.UNITS parameter description.

Related Topics

Programmable Limit Switch (pg 101)

23.26.4 PLS.RESET

General Information	
Type	R/O Parameter
Description	Resets programmable limit switch.
Units	N/A
Range	0 to 255
Default Value	N/A
Data Type	Integer
See Also	PLS.EN, PLS.MODE, PLS.STATE, PLS.UNITS, PLS.Px (x=1...8), PLS.WIDTHx (x=1...8), PLS.Tx (x=1...8)
Start Version	M_01-02-03-000

Description

This parameter is a bit variable and is used in order to re-arm the corresponding PLS.STATE observation for another single-shot PLS use (see also PLS.MODE).

Example

Bit Value	Behavior
Bit 0 = 0	The PLS 1 observation (PLS.STATE bit 0) is not re-armed.
Bit 0 = 1	The PLS 1 observation (PLS.STATE bit 0) is re-armed.
Bit 7 = 0	The PLS 8 observation (PLS.STATE bit 7) is not re-armed.
Bit 7 = 1	The PLS 8 observation (PLS.STATE bit 7) is re-armed.

Related Topics

Programmable Limit Switch (pg 101)

23.26.5 PLS.STATE

General Information	
Type	R/O Parameter
Description	Reads the programmable limit switch state.
Units	N/A
Range	N/A
Default Value	N/A
Data Type	Integer
See Also	PLS.EN, PLS.RESET, PLS.UNITS, PLS.MODE, PLS.P1 TO PLS.P8, PLS.WIDTH1 TO PLS.WIDTH8, PLS.T1 TO PLS.T8
Start Version	M_01-02-03-000

Description

This parameter is a bit variable and displays the current status of the individual programmable limit switches.

Example

Bit 0 = 0: Programmable Limit Switch 1 (PLS 1) is not active.

Bit 0 = 1: Programmable Limit Switch 1 (PLS 1) is active.

Bit 7 = 0: Programmable Limit Switch 8 (PLS 8) is not active.

Bit 7 = 1: Programmable Limit Switch 8 (PLS 8) is not active.

Related Topics

Programmable Limit Switch (pg 101)

23.26.6 PLS.T1 TO PLS.T8

General Information	
Type	R/W parameter
Description	Sets programmable limit switch time
Units	ms
Range	0 to 65,536 ms
Default Value	500 ms
Data Type	Integer
See Also	PLS.EN, PLS.RESET, PLS.STATE, PLS.UNITS, PLS.MODE, PLS.WIDTH1 TO PLS.WIDTH8, PLS.P1 TO PLS.P8
Start Version	M_01-02-03-000

Description

These parameters define the time of the PLS pulse for time-based PLS handling.

For further information about the PLS functionality, especially the meaning of the PLS.T1 to PLS.T8 parameter, refer to the PLS.UNITS parameter.

Related Topics

Programmable Limit Switch (pg 101)

23.26.7 PLS.UNITS

General Information	
Type	R/W parameter
Description	Sets programmable limit switch (PLS) units.
Units	N/A
Range	0 to 255
Default Value	0
Data Type	Integer
See Also	PLS.EN (pg 617), PLS.RESET (pg 620), PLS.STATE (pg 621), PLS.MODE (pg 618), PLS.P1 TO PLS.P8 (pg 619) PLS.WIDTH1 TO PLS.WIDTH8 (pg 625), PLS.T1 TO PLS.T8 (pg 622)
Start Version	M_01-02-03-000

Description

PLS.UNITS is a bit variable which determines the behavior of the eight PLSs available in the drive. This parameter is used to select the units for the PLS pulse.

Examples

Bit Value	Behavior
Bit 0 = 0 Position-based PLS handling.	The PLS.STATE parameter displays an active PLS 1 when the position is within the range of PLS.P1 + PLS.WIDTH1 (PLS.P1 <= PL.FB <= PLS.P1+PLS.WIDTH1). When the parameter PLS.WIDTH1 has been set to the value of 0, this bit will be activated as soon as PLS.FB >= PL.P1.
Bit 0 = 1 Time-based PLS handling.	After PLS.P1 is crossed, the PLS.STATE parameter displays an active PLS 1 for a PLS.T1 ms period of time.
Bit 7 = 0 Position-based PLS handling.	The PLS.STATE parameter displays an active PLS 8 when the position is within the range of PLS.P8 + PLS.WIDTH8 (PLS.P8 <= PL.FB <= PLS.P8+PLS.WIDTH8). When the parameter PLS.WIDTH8 has been set to the value of 0, this bit will be activated as soon as PLS.FB >= PL.P8.
Bit 7 = 1 Time-based PLS handling.	After PLS.P8 has been crossed. the PLS.STATE parameter displays an active PLS 8 for a PLS.T8 ms period of time.

Continuous position-based PLS handling

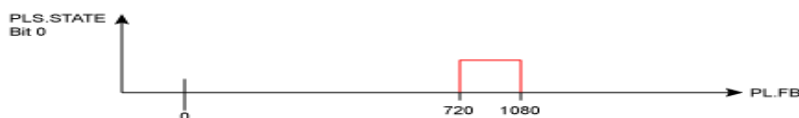
PLS.P1 = 720

PLS.WIDTH1 = 360

PLS.UNITS bit 0 (for PLS 1) = low; PLS.T1 is not considered.

PLS.EN bit 0 (for PLS 1) = high

PLS.MODE bit 0 (for PLS 1) = low



Time-based PLS handling

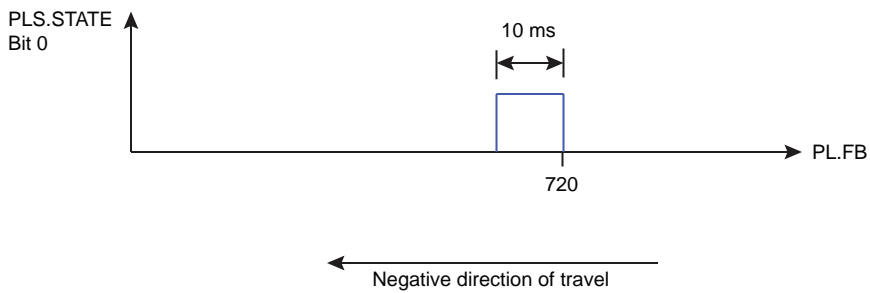
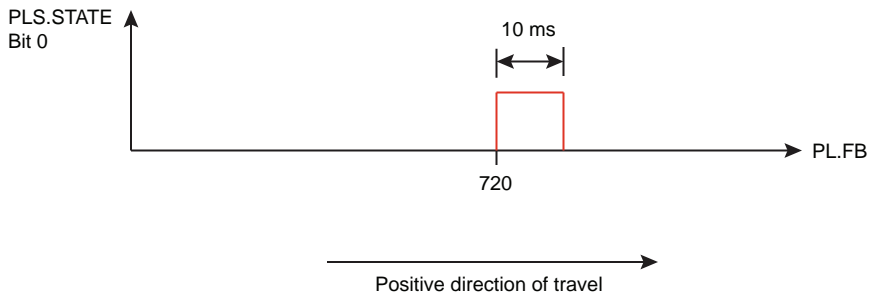
PLS.P1 = 720

PLS.T1 = 10

PLS.UNITS bit 0 (for PLS 1) = low; PLS.WIDTH1 is not considered.

PLS.EN bit 0 (for PLS 1) = high

PLS.MODE bit 0 (for PLS 1) = low



Related Topics

Programmable Limit Switch (pg 101)

23.26.8 PLS.WIDTH1 TO PLS.WIDTH8

General Information	
Type	R/W parameter
Description	Programmable Limit Switch Width
Units	Depends on UNIT.PROTARY or UNIT.PLINEAR
Range	N/A
Default Value	0
Data Type	Float
See Also	PLS.EN, PLS.RESET, PLS.STATE, PLS.UNITS, PLS.MODE, PLS.P1 TO PLS.P8, PLS.T1 TO PLS T8
Start Version	M_01-02-03-000

Description

These parameter define the width of the PLS pulse for position-based PLS handling. For further information about the PLS functionality, especially the meaning of the PLS.WIDTH1 to PLS.WIDTH8 parameter, refer to the PLS.UNITS parameter.

Related Topics

Programmable Limit Switch (pg 101)

23.27 REC Parameters

This section describes the REC parameters.

23.27.1 REC.ACTIVE	627
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23.27.7 REC.RECPRMLIST	633
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23.27.11 REC.RETRIEVEHDR	637
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23.27.18 REC.TRIGSLOPE	644
23.27.19 REC.TRIGTYPE	645
23.27.20 REC.TRIGVAL	646

23.27.1 REC.ACTIVE

General Information	
Type	R/O Parameter
Description	Indicates if data recording is in progress (active).
Units	N/A
Range	0 to 1
Default Value	N/A
Data Type	Integer
See Also	REC.DONE (pg 629), REC.OFF (pg 632)
Start Version	M_01-00-00-000

Description

REC.ACTIVE indicates whether or not data recording is in progress. Recording is in progress if the trigger was met and the recorder is recording all data.

Related Topics

Scope (pg 191)

23.27.2 REC.CH1 to REC.CH6

General Information	
Type	R/W Parameter
Description	Sets recording channels 1 to 6.
Units	N/A
Range	N/A
Default Value	CH1 = IL.FB CH2 = IL.CMD CH3 = VL.FB CH4 = Empty CH5 = Empty CH6 = Empty
Data Type	String
See Also	REC.TRIG (pg 640)
Start Version	M_01-00-00-000

Description

REC.CHx specifies the recording channels.

There are 3 options to set the recording channels values:

- Set 0, CLR, or CLEAR. This setting clears the recording channel.
- Set one of the recordable commands. The list of recordable commands can be obtain by executing REC.RECPRMLIST (pg 633).
- Set an internal value or variable of the drive (same as for DRV.MEMADDR (pg 409) input).

Related Topics

Scope (pg 191)

23.27.3 REC.DONE

General Information	
Type	R/O Parameter
Description	Checks whether or not the recorder has finished recording.
Units	N/A
Range	0 to 1
Default Value	N/A
Data Type	Integer
See Also	REC.ACTIVE, REC.OFF
Start Version	M_01-00-00-000

Description

REC.DONE indicates that the recorder has finished recording. This value is reset to 0 when the recorder trigger is set. The drive also resets this value when the recording has finished or when REC.OFF is executed.

Related Topics

Scope (pg 191)

23.27.4 REC.GAP

General Information	
Type	R/W Parameter
Description	Specifies the gap between consecutive samples.
Units	N/A
Range	1 to 65,535
Default Value	1
Data Type	Integer
See Also	REC.TRIG (pg 640)
Start Version	M_01-00-00-000

Description

REC.GAP specifies the gap between consecutive samples. The recording base rate is 16 kHz, thus a gap of 1 means that a sample is recorded every 62.5 μ s.

Related Topics

Scope (pg 191)

23.27.5 REC.NUMPOINTS

General Information	
Type	R/W Parameter
Description	Sets the number of points to record.
Units	N/A
Range	1 to 65,535
Default Value	1,000
Data Type	Integer
See Also	REC.TRIG (pg 640)
Start Version	M_01-00-00-000

Description

REC.NUMPOINTS specifies the number of points (samples) to record.

Related Topics

Scope (pg 191)

23.27.6 REC.OFF

General Information	
Type	R/W Parameter
Description	Turns the recorder OFF.
Units	N/A
Range	N/A
Default Value	N/A
Data Type	N/A
See Also	REC.ACTIVE, REC.DONE
Start Version	M_01-00-00-000

Description

REC.OFF turns the recorder off. In order to set the recorder again, the recorder must first be armed and then a trigger set.

Related Topics

Scope (pg 191)

REC.READY

23.27.7 REC.RECPRMLIST

General Information	
Type	R/O Parameter
Description	Reads the list of recordable parameters.
Units	N/A
Range	N/A
Default Value	N/A
Data Type	N/A
See Also	REC.CH1 to REC.CH6 (pg 628)
Start Version	M_01-00-00-000

Description

This command returns the list of recordable parameters. You can use a recordable parameter as an input to any of the recording channels.

Note that an internal address or a registered variable can be used as input to any of the channels in addition to the list.

Related Topics

Scope (pg 191)

23.27.8 REC.RETRIEVE

General Information	
Type	R/O Parameter
Description	Transfers all the recorded data to the communication channel.
Units	N/A
Range	N/A
Default Value	N/A
Data Type	String
See Also	N/A
Start Version	M_01-00-00-000

Description

REC.RETRIEVE causes the drive to transfer all the recorded data to the communication channel.

Example

The following format is the retrieve reply format (for N samples, G sample gap, and M parameters, where $M \leq 6$):

```
Recording
<N>, <G>
<parameter name 1> ... <parameter name M>
Value11 ... Value1M
Value N1 ... ValueNM
```

Related Topics

Scope (pg 191)

23.27.9 REC.RETRIEVEDATA

General Information	
Type	R/W Parameter
Description	Retrieves the recorded data without the header.
Units	N/A
Range	N/A
Default Value	N/A
Data Type	N/A
See Also	REC.RETRIEVE, REC.RETRIEVEHDR, REC.RETRIEVESIZE
Start Version	M_01-00-00-000

Description

REC.RETRIEVEDATA retrieves a section of recorded data according to REC.RETRIEVESIZE from the received index; if no index is received, the drive retrieves the data from next section. An index is supplied to enable multiple retrieves and to give better control on the buffer in case of overflow. If no index or a negative value is present, then the index is ignored.

WorkBench uses this parameter to retrieve the data continuously for real time recoding.

The size of the data returned by this command depends on the number set by REC.RETRIEVESIZE.

Use REC.RETRIEVE for complete recording information view.

Notes:

- If REC.RETRIEVESIZE is larger than the buffer size, then it simply returns the whole buffer (no error).
- If the index is received, the data will be continuously returned starting from the given index (default starting index is 0).
- If the index is out of the bounds of the buffer, then it will be ignored.
- If recorder is active and REC.STOPTYPE==0, then this parameter returns an error.
- If REC.STOPTYPE==1, then this parameter returns the next section of data in the buffer (even if it reached the end of the buffer, it will return to the beginning of the buffer and add the data from index 0.)
- If REC.STOPTYPE==1 and the retrieve is too slow (gets overrun by the recorder), an overflow error message is returned instead of the retrieved data.
- If REC.STOPTYPE==0 and no index is received, continuously send the sections of data until the end of the buffer is reached. Then, return to the beginning of buffer and continue.
- A new REC.TRIG (pg 640) command automatically sets the index to 0.

Example

The following example retrieves data from index 100 in the size of 10 (hence places 100 to 109 in the buffer)

```
REC.NUMPOINTS 1000
REC.RETRIVESIZE 10
REC.TRIG
REC.RETRIEVEDATA 100
```

Related Topics

Scope (pg 191)

23.27.10 REC.RETRIEVEFRMT

General Information	
Type	R/W Parameter
Description	Sets the format for recorded data output.
Units	N/A
Range	0 to 1; 0 = Standard format, 1 = Internal format (high speed)
Default Value	1
Data Type	Integer
See Also	REC.RETRIEVE (pg 634), REC.RETRIEVEDATA (pg 635)
Start Version	M_01-00-00-000

Description

Recorded data is transferred to the communication channel in one of two formats: standard or internal high speed. The standard (slower) format cannot be used for continuous recording, but is more easily read. The high speed format allows continuous data recording (needed for auto-tuning). WorkBench supports both formats.

Example

The following recorder data is in standard format:

```
10, 1
IL.FB, VL.CMD, VL.FB
-0.086, 0.000, 2.661
0.000, 0.000, 3.605
0.029, 0.000, -0.486
```

The following recorder data is in internal format:

```
10, 1
IL.FB, VL.CMD, VL.FB
F3-0x56, F30x0, F30xA65
F30x0, F30x0, F30xE15
F30x1D, F30x0, F3-0x1E6
```

Related Topics

Scope (pg 191)

23.27.11 REC.RETRIEVEHDR

General Information	
Type	R/O Parameter
Description	Retrieves the recorded header without the data.
Units	N/A
Range	N/A
Default Value	N/A
Data Type	N/A
See Also	REC.RETRIEVE, REC.RETRIEVEDATA
Start Version	M_01-00-00-000

Description

This command retrieves the recorded header without the data of the recording.

WorkBench uses this parameter to retrieve the header once before continuously reading the data for RT recoding.

Use REC.RETRIEVE for complete recording information view.

Related Topics

Scope (pg 191)

23.27.12 REC.RETRIEVESIZE

General Information	
Type	R/W Parameter
Description	Sets the number of samples that REC.RETRIEVEDATA returns.
Units	recorder samples
Range	0 to 65,535 recorder samples
Default Value	1,000 recorder samples
Data Type	Integer
See Also	REC.RETRIEVEDATA (pg 635), REC.RETRIEVEHDR (pg 637)
Start Version	M_01-00-00-000

Description

This parameter sets the number of samples that REC.RETRIEVEDATA (pg 635) returns.

WorkBench also uses this parameter to set the number of samples returned when retrieving the data continuously for RT recoding.

Use REC.RETRIEVE (pg 634) for the complete recording information view.

Related Topics

Scope (pg 191)

23.27.13 REC.STOPTYPE

General Information	
Type	R/W Parameter
Description	Sets the recorder stop type.
Units	N/A
Range	0 or 1
Default Value	0
Data Type	Integer
See Also	REC.RETRIEVEDATA, REC.RETRIEVESIZE
Start Version	M_01-00-00-000

Description

This parameter sets the stop type for the recording.

0 = Recorder runs, continuously filling the recording circular buffer.

1 = Recorder fills in the buffer once.

To stop RT recording, execute REC.OFF.

Related Topics

Scope (pg 191)

23.27.14 REC.TRIG

General Information	
Type	Command
Description	Triggers the recorder.
Units	N/A
Range	N/A
Default Value	N/A
Data Type	N/A
See Also	REC.RETRIEVE, REC.OFF
Start Version	M_01-00-00-000

Description

REC.TRIG starts the trigger according to the trigger type defined by REC.TRIGTYPE.

REC.TRIG sets the value of REC.DONE to 0.

After calling REC.TRIG, the data that was recorded by previous recording is deleted and cannot be retrieved.

No REC parameters can be set after a call to REC.TRIG until the recorder has finished or until REC.OFF is executed.

Related Topics

Scope (pg 191)

23.27.15 REC.TRIGPARAM

General Information	
Type	R/W Parameter
Description	Sets the parameter that triggers the recorder.
Units	N/A
Range	N/A
Default Value	IL.FB
Data Type	String
See Also	REC.TRIG
Start Version	M_01-00-00-000

Description

REC.TRIGPARAM sets the parameter on which the recorder triggers.

This parameter is only used when REC.TRIGTYPE = 2.

Input values are:

1. One of the set drive parameters list that can be set as a trigger. The available parameters for trigger are: PL.ERR (pg 600), PL.CMD, PL.FB, VL.CMD, VL.FB, IL.CMD, and IL.FB.
2. Internal value or variable of the drive (same as for DRV.MEMADDR input).

Related Topics

Scope (pg 191)

23.27.16 REC.TRIGPOS

General Information	
Type	R/W Parameter
Description	Sets the trigger position in the recording buffer.
Units	%
Range	1 to 100%
Default Value	10%
Data Type	Integer
See Also	REC.TRIG (pg 640), REC.NUMPOINTS (pg 631)
Start Version	M_01-00-00-000

Description

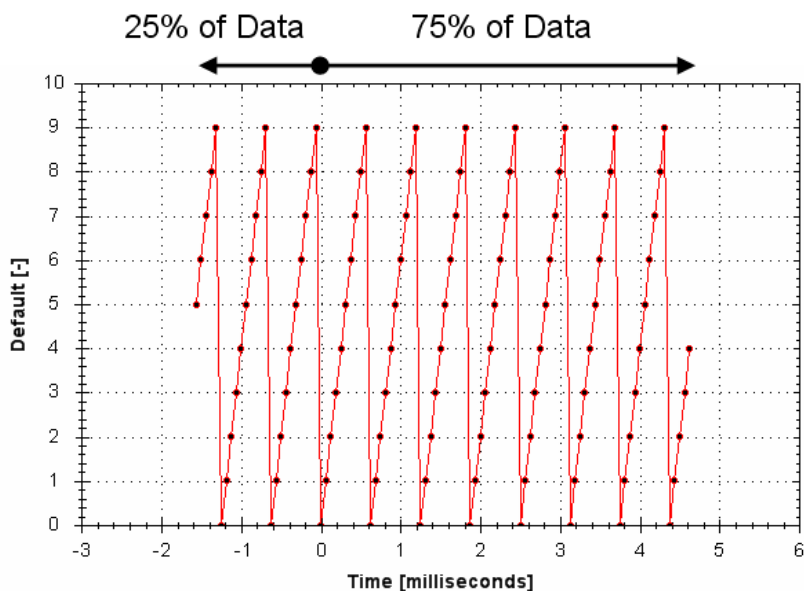
REC.TRIGPOS sets the trigger position in the recording buffer. The recording buffer size is defined by REC.NUMPOINTS. The input value is a percentage of the buffer (that is, a value of 25 means saving 25% of the buffer data before the trigger occurs and 75% after it occurs). This parameter is only used when REC.TRIGTYPE = 2 or 3.

Trigger Position

Trigger position (REC.TRIGPOS) allows you to collect data that occurs before the trigger occurs. In some instances, you may want to see the conditions prior to the trigger. Trigger position lets you control how much signal is collected before the trigger condition occurred.

Trigger position is specified in units of percent (%). If you specify a trigger position of $x\%$, then $x\%$ of the data is before 0 ms in the data time and $100-x\%$ (the rest of the data) is at or greater than 0 ms. In the figure below, the trigger position is set to 25% (REC.TRIGPOS 25).

In the WorkBench scope, the 0 time point is clear. When collecting the data using REC.R-ETRIEVE or similar commands, the time is not returned, so some caution should be used when the trigger point is important to understand.



Related Topics

Scope (pg 191)

23.27.17 REC.TRIGPRMLIST

General Information	
Type	R/O Parameter
Description	Reads the list of possible trigger parameters.
Units	N/A
Range	N/A
Default Value	N/A
Data Type	N/A
See Also	REC.TRIGPARAM
Start Version	M_01-00-00-000

Description

This command returns the list of trigger parameters. Each one of those parameters can serve as the trigger parameter (input to REC.TRIGPARAM).

Note that an internal address or a registered variable can be used as input to REC.TRIGPARAM in addition to the list that this parameter returns.

Related Topics

Scope (pg 191)

23.27.18 REC.TRIGSLOPE

General Information	
Type	R/W Parameter
Description	Sets the trigger slope.
Units	0 = Negative 1 = Positive
Range	0 to 1
Default Value	0
Data Type	Integer
See Also	REC.TRIG, REC.NU- MPOINTS
Start Version	M_01-00-00-000

Description

REC.TRIGSLOPE sets the recorder trigger slope. This parameter is only used when REC.TRIGTYPE = 2 or 3.

Related Topics

Scope (pg 191)

23.27.19 REC.TRIGTYPE

General Information	
Type	R/W Parameter
Description	Sets the trigger type.
Units	0 = immediate 1 = command 2 = parameter 3 = boolean
Range	0 to 2
Default Value	0
Data Type	Integer
See Also	REC.TRIG (pg 640), REC.TRIGPARAM, REC.TRIGVAL, REC.TRIGSLOPE REC.TRIGPOS
Start Version	M_01-00-00-000

Description

REC.TRIGTYPE sets the type of trigger.

Input values are as follows:

Value	Description
0	Recording starts immediately
1	Recording starts on the next command executed through the TCP/IP. The trigger location in the buffer is set according to REC.TRIGPOS.
2	Recording starts per the values of REC.TRIGPARAM, REC.TRIGVAL, REC.TRIGSLOPE, and REC.TRIGPOS.
3	Recording starts when the value of REC.TRIGPARAM is 0 for REC.TRIGSLOPE = 0 or 1 for REC.TRIGSLOPE = 1

Related Topics

Scope (pg 191)

23.27.20 REC.TRIGVAL

General Information	
Type	R/W Parameter
Description	Sets the trigger value.
Units	The units of the parameter are chosen according to the unit type.
Range	0 to 2
Default Value	0
Data Type	Integer
See Also	REC.TRIG (pg 640), REC.TRIGPARAM, REC.TRIGVAL, REC.TRIGSLOPE, REC.TRIGPOS
Start Version	M_01-00-00-000

Description

REC.TRIGVAL is the value that must be met by REC.TRIGPARAM for the trigger to occur. The units of this parameter are set according to the units of REC.TRIGPARAM.

Related Topics

Scope (pg 191)

23.28 REGEN Parameters

This section describes the REGEN parameters.

23.28.1 REGEN.POWER	648
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23.28.1 REGEN.POWER

General Information	
Type	R/O parameter
Description	Reads regen resistor's calculated power.
Units	Watt
Range	N/A
Default Value	N/A
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

Description

This parameter reads regen resistor's calculated power, which is determined as follows:

$$(V^2 / R) * DutyCycle$$

Related Topics

7.2 Regeneration

23.28.2 REGEN.POWERFILTERED

General Information	
Type	R/O parameter
Description	Returns a filtered version of REGEN.POWER .
Units	Watt
Range	0 to REGEN.WATTEXT
Default Value	0
Data Type	Integer
Start Version	M_01-07-01-000

Description

This parameter returns a filtered value of REGEN.POWER. A single order lowpass of $1/\text{REGEN.TEXT}$ Hz is applied to generate REGEN.POWERFILTERED.

If REGEN.POWERFILTERED exceeds the value of REGEN.WATTEXT, Fault 521 (Regen overpower) will be generated.

This keyword may be recorded in the scope screen for analysis.

Example

REGEN.TEXT = 10 (seconds)

Lowpass Filter Frequency = $1/10$ seconds = 0.1 Hz

REGEN.POWERFILTERED = REGEN.POWER * 0.1Hz lowpass

Related Topics

REGEN.POWER (pg 648) | REGEN.TEXT (pg 651) | REGEN.WATTEXT (pg 653)

23.28.3 REGEN.REXT

General Information	
Type	NV Parameter
Description	Sets the external, user-defined regen resistor resistance.
Units	Ω
Range	0 to 255 Ω
Default Value	0 Ω
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

Description

REGEN.REXT sets the external user-defined regen resistor resistance. This variable is needed for the regen resistor temperature estimation algorithm.

Related Topics

7.2 Regeneration

23.28.4 REGEN.TEXT

General Information	
Type	R/W Parameter
Description	Sets the external regen resistor thermal protection time constant.
Units	Seconds
Range	0.1 to 1,200 Seconds
Default Value	100 Seconds
Data Type	Float
See Also	REGEN.WATTEXT (pg 653), REGEN.REXT (pg 650)
Start Version	M_01-00-00-000

Description

REGEN.TEXT is the time-to-fault when input power steps from 0 to 150% of REGEN.WATTEXT. REGEN.TEXT sets the thermal time constant of the algorithm used to protect the regeneration resistor from overheating and failing. The drive's regen resistor protection algorithm continuously calculates the power dissipated in the resistor and processes that power value through a single pole low pass filter to model the regen resistor's thermal inertia. When the filtered regen power on the output of the filter (REGEN.POWERFILTERED) exceeds REGEN.WATTEXT, a fault occurs. REGEN.TEXT sets the time constant of this thermal inertial filter = (REGEN.TEXT/1.1).

REGEN.TEXT can often be found directly on power resistor data sheets. On the data sheet find the peak overload curve and then find the safe allowed time to be at 150% of the regen resistor's continuous power rating. Set REGEN.TEXT to this value in seconds. Another way regen resistor peak overload capability is often specified is by giving the nergy rating in joules of the resistor. If you have the energy rating joule limit E then:

$$\text{REGEN.TEXT} = (1.1) * ((E \text{ in joules}) / \text{REGEN.WATTEXT})$$

Example

The external regen resistor is rated for 250 W continuous, is 33 ohm, and has a joule rating of 500 joules. To use this resistor, the drive settings become:

REGEN.TYPE = -1 (External Regen)

REGEN.REXT = 33

REGEN.WATTEXT = 250

REGEN.TEXT = (1.1)*(500 j)/(250 W) = 2.2 sec

Related Topics

7.2 Regeneration

23.28.5 REGEN.TYPE

General Information	
Type	NV Parameter
Function	Sets the regen resistor type.
WorkBench Location (Screen/Dialog Box)	Power/Regen Resistor Type
Units	N/A
Range	-1 to 0
Default Value	0
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

Description

You can specify a user-defined external regen resistor, select an internal regen resistor, or choose from a list of predefined regen resistors. The values for REGEN.TYPE are shown below:

Type	Description
-1	External user-defined regen resistor
0	Internal regen resistor

If you specify a user-defined regen resistor, then you must also define this resistor's resistance (REGEN.REXT), heatup time (REGEN.REXT), and power (REGEN.WATTEXT).

Related Topics

7.2 Regeneration

23.28.6 REGEN.WATTEXT

General Information	
Type	R/W parameter
Description	Sets the regen resistor's power fault level for an external regen resistor.
Units	W
Range	0 to 62,000 W
Default Value	1000 W
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

Description

Sets the regen resistor's power fault level for an external regen resistor (when REGEN.TYPE = -1).

Above this fault level, the regen resistor's PWM will be 0 and a fault will be issued.

Related Topics

7.2 Regeneration

23.29 SM Parameters

This section describes the SM parameters.

23.29.1 SM.I1	655
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23.29.1 SM.I1

General Information	
Type	NV Parameter
Description	Sets service motion current 1; active in opmode 0 (torque) only.
Units	A
Range	–Drive peak current to +Drive peak current
Default Value	0.025 · Drive peak current
Data Type	Float
See Also	SM.ACCTYPE, SM.I2, SM.MODE, SM.MOVE, SM.T1, SM.T2, SM.V1, SM.V2, SM.VPM1, SM.VPM2
Start Version	M_01-00-00-000

Description

SM.I1 defines the current that is used in service motion modes 0 and 1 (see SM.MODE (pg 657)).

Related Topics

Service Motion (pg 137)

23.29.2 SM.I2

General Information	
Type	NV Parameter
Description	Sets service motion current 2; active in opmode 0 (torque) only.
Units	A
Range	–Drive peak current to +Drive peak current
Default Value	0.025 · Drive peak current
Data Type	Float
See Also	SM.ACCTYPE, SM.I1, SM.MODE, SM.MOVE, SM.T1, SM.T2, SM.V1, SM.V2, SM.VPM1, SM.VPM2
Start Version	M_01-00-00-000

Description

SM.I2 defines the current that is used in service motion mode 1 (see SM.MODE (pg 657)).

Related Topics

Service Motion (pg 137)

23.29.3 SM.MODE

General Information	
Type	NV Parameter
Description	Sets the service motion mode.
Units	N/A
Range	0 to 2
Default Value	0
Data Type	Integer
See Also	SM.I1 (pg 655), SM.I2 (pg 656), SM.MOVE (pg 660), SM.T1 (pg 661) SM.T2 (pg 662), SM.V1 (pg 663), SM.V2 (pg 664), DRV.ACC (pg 364)DRV.DEC (pg 374)
Start Version	M_01-01-00-000

Description

SM.MODE defines the mode of service motion for each loop. Two types of service motion are available :

- A constant motion in one direction (endless or for a certain amount of time).
- An alternating motion.

The possible modes for this parameter are described in the following table:

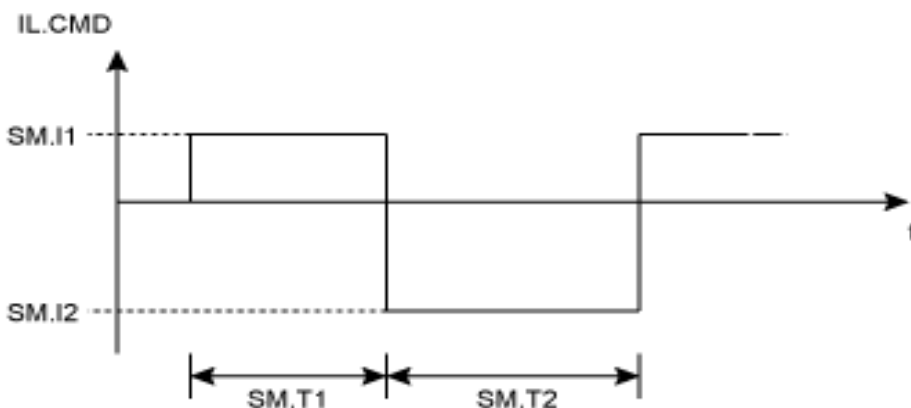
SM.MODE	Description	Requirements
0	<p>Constant motion in closed current loop mode of operation.</p> <ul style="list-style-type: none"> • DRV.OPMODE 0: The drive generates a constant current command value (SM.I1) for a certain amount of time (if SM.T1>0) or endless (if SM.T1=0). The drive will not generate any ramps in this mode of operation. • DRV.OPMODE 1 or 2: The drive generates a constant velocity command value (SM.V1) for a certain amount of time (if SM.T1>0) or endless (if SM.T1=0). The drive generates acceleration and deceleration ramps according to the DRV.ACC and DRV.DEC setting in this mode of operation. <p>The service motion can be stopped by using the DRV.STOP command.</p>	<p>DRV.OPMODE = 0,1, or 2 DRV.CMDSOURCE = 0</p>

SM.MODE	Description	Requirements
1	<ul style="list-style-type: none"> • DRV.OPMODE 0: The drive generates a current command value (SM.I1) for a certain amount of time (SM.T1). Afterwards the drive generates a current command value (SM.I2) for another certain amount of time (SM.T2). This sequence is repeated as long as a DRV.STOP command occurs. The drive will not generate any ramps in this mode of operation. • DRV.OPMODE 1 or 2: The drive generates a velocity command value (SM.V1) for a certain amount of time (SM.T1). Afterwards the drive generates a velocity command value (SM.V2) for another certain amount of time (SM.T2). This sequence is repeated as long as a DRV.STOP command occurs. The drive will generate an acceleration and deceleration ramps according to the DRV.ACC and DRV.DEC setting in this mode of operation. 	DRV.OPMODE = 0, 1, or 2 DRV.CMDSOURCE = 0
2	This mode executes the same service motion as mode 0. However, the motion is described by SM.I2, SM.T2 and SM.V2. This enables a change on the fly and is mostly used under fieldbus control.	DRV.OPMODE = 0, 1, or 2 DRV.CMDSOURCE = 0

Ramps

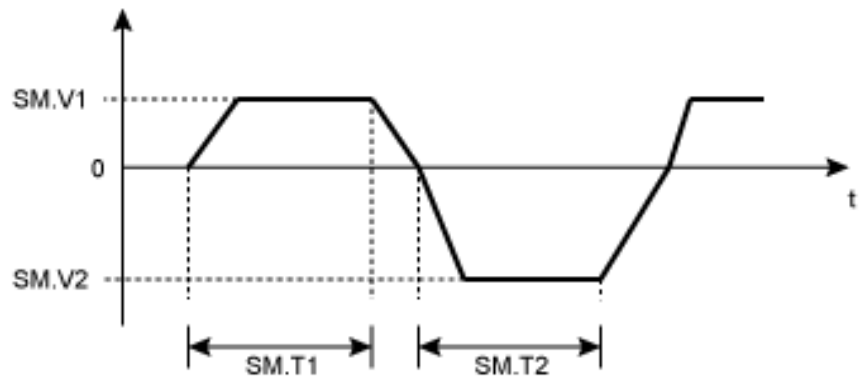
The drive uses DRV.ACC and DRV.DEC for the ramps in DRV.OPMODE 1 (closed velocity) and 2 (closed position). The drive does not generate any ramps in service motion mode 0 and 1.

Service Motion for DRV.OPMODE 0 and SM.MODE 1



Service motion for DRV.OPMODE 1 or 2 and SM.MODE 1

DRV.OPMODE 1: VL.CMD
 DRV.OPMODE 2: d/dt (PL.CMD)



The deceleration process from SM.V1 or SM.V2 to 0 is not included in SM.T1 and SM.T2, respectively. SM.T1 and SM.T2 start as soon as the command value has reached the velocity 0.

Related Topics

Service Motion (pg 137)

23.29.4 SM.MOVE

General Information	
Type	Command
Description	Starts the service motion.
Units	N/A
Range	N/A
Default Value	N/A
Data Type	N/A
See Also	SM.MODE
Start Version	M_01-00-00-000

Description

This command starts the service motion that has been selected by the SM.MODE parameter.

Related Topics

Service Motion (pg 137)

23.29.5 SM.T1

General Information	
Type	NV Parameter
Description	Sets the service motion time 1.
Units	ms
Range	0 to 65,535 ms
Default Value	500 ms
Data Type	Integer
See Also	SM.I1, SM.I2, SM.MODE, SM.MOVE, SM.T2, SM.V1, SM.V2, SM.VPM1, SM.VPM2
Start Version	M_01-00-00-000

Description

SM.T1 defines the time of the service motion that is used in all service motion modes (see SM.MODE). For an alternating service motion mode, SM.T1 may not be set to 0.

Related Topics

Service Motion (pg 137)

23.29.6 SM.T2

General Information	
Type	NV Parameter
Description	Sets the service motion time 2.
Units	ms
Range	0 to 65,535 ms
Default Value	500 ms
Data Type	Integer
See Also	SM.I1, SM.I2, SM.MODE, SM.MOVE, SM.T1, SM.V1, SM.V2, SM.VPM1, SM.VPM2
Start Version	M_01-00-00-000

Description

SM.T2 defines the time of the service motion that is used in service motion modes 1, 3, and 5 (see SM.MODE).

Related Topics

Service Motion (pg 137)

23.29.7 SM.V1

General Information	
Type	NV Parameter
Description	Sets service motion velocity 1; active in opmode 1 (velocity) and 2 (position).
Units	Depends on or Rotary: rpm, rps, deg/s, custom units/s, rad/s Linear: Counts/s, mm/s, $\mu\text{m/s}$, custom units/s
Range	Rotary: -15,000.000 to 15,000.000 rpm -250.000 to 250.000 rps -90,000.000 to 90,000.000 deg/s -1,250.000 to 1,250.000 custom units/s -1,570.796 to 1,570.796 rad/s Linear: -1,073,741,824,000.000 to 1,073,741,824,000.000 counts/s -250.000*MOTOR.PITCH (pg 581) to 250.000*MOTOR.PITCH (pg 581) mm/s -250,000.000*MOTOR.PITCH (pg 581) to 250,000.000*MOTOR.PITCH (pg 581) $\mu\text{m/s}$ -1,250.000 to 1,250.000 custom units/s
Default Value	Rotary: 60.000 rpm 1.000 rps 359.999 deg/s 5.000 custom units/s 6.283 rad/s Linear: 0.001 Counts/s 1.000*MOTOR.PITCH (pg 581) mm/s 999.998*MOTOR.PITCH (pg 581) $\mu\text{m/sec}$ 5.000 custom units/s
Data Type	Float
See Also	SM.I1, SM.I2, SM.MODE, SM.MOVE, SM.T1, SM.T2, SM.V2
Start Version	M_01-00-00-000

Description

SM.V1 defines the velocity that is used in service motion modes 0 and 1 (see SM.MODE (pg 657)) in the closed velocity and position mode of operation.

Related Topics

14.2 Service Motion

23.29.8 SM.V2

General Information	
Type	NV Parameter
Description	Sets service motion velocity 2; active in opmode 1 (velocity) and 2 (position).
Units	Depends on or Rotary: rpm, rps, deg/s, custom units/s, rad/s Linear: counts/s, mm/s, $\mu\text{m/s}$, custom units/s
Range	Rotary: -15,000.000 to 15,000.000 rpm -250.000 to 250.000 rps -90,000.000 to 90,000.000 deg/s -1,250.000 to 1,250.000 custom units/s -1,570.796 to 1,570.796 rad/s Linear: -1,073,741,824,000.000 to 1,073,741,824,000.000 counts/s -250.000*MOTOR.PITCH (pg 581) to 250.000*MOTOR.PITCH (pg 581) mm/s -250,000.000*MOTOR.PITCH (pg 581) to 250,000.000*MOTOR.PITCH (pg 581) $\mu\text{m/s}$ -1,250.000 to 1,250.000 custom units/s
Default Value	Rotary: -60.000 rpm -1.000 rps -359.999 deg/s -5.000 custom units/s -6.283 rad/s Linear: -0.001 counts/s -1.000*MOTOR.PITCH (pg 581) mm/s -999.998*MOTOR.PITCH (pg 581) $\mu\text{m/sec}$ -5.000 custom units/s
Data Type	Float
See Also	SM.I1, SM.I2, SM.MODE, SM.MOVE, SM.T1, SM.T2, SM.V1
Start Version	M_01-00-00-000

Description

SM.V2 defines the velocity that is used in service motion mode 1 (see SM.MODE) in the closed velocity and position mode of operation.

Related Topics

14.2 Service Motion

23.30 STO Parameters

This section describes the STO parameters.

23.30.1 STO.STATE	666
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23.30.1 STO.STATE

General Information	
Type	R/O Parameter
Description	Returns the status of the safe torque off.
Units	N/A
Range	0 to 1
Default Value	N/A
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

Description

STO.STATE returns the status of the safe torque off.

1 - Safe torque on (no safe torque off fault).

0 - Safe torque off (safe torque off fault).

Related Topics

12.7 Limits

23.31 SWLS Parameters

This section describes the SWLS parameters.

23.31.1 SWLS.EN	668
23.31.2 SWLS.LIMIT0	669
23.31.3 SWLS.LIMIT1	670
23.31.4 SWLS.STATE	671

23.31.1 SWLS.EN

General Information	
Type	NV Parameter
Description	Enables and disables software travel limit switches.
Units	N/A
Range	0 to 3
Default Value	0
Data Type	U8
See Also	23.12.46 DRV.MOTIONSTAT
Start Version	M_01-00-00-000

Description

This parameter enables the software travel limit switches. The software limit switches are only active if the axis is homed.

Example

Bit 0 = 0: Disable SWLS.LIMIT0

Bit 0 = 1: Enable SWLS.LIMIT0

Bit 1 = 0: Disable SWLS.LIMIT1

Bit 1 = 1: Enable SWLS.LIMIT1

Related Topics

12.7 Limits

23.31.2 SWLS.LIMIT0

General Information	
Type	NV Parameter
Description	Sets the position of the software travel limit switch 0.
Units	Position units
Range	-9,007,199,254,740,992 to 9,007,199,254,740,991
Default Value	0
Data Type	S64
See Also	,
Start Version	M_01-00-00-000

Description

This parameter sets the compare register for the software limit switch 0. This value can be either the lower or the upper software limit switch register, depending on the configuration of the software limit switches. Whichever switch is set largest is the positive limit switch; the other switch becomes the negative limit switch. These switches can be used in addition to hardware limit switches. The software limit switches are only active if the axis is homed. For more information about homing, please refer to the HOME Parameters and DRV.MOTIONSTAT.

Related Topics

12.7 Limits

23.31.3 SWLS.LIMIT1

General Information	
Type	NV Parameter
Description	Sets the position of the software travel limit switch 0.
Units	Position units
Range	-9,007,199,254,740,992 to 9,007,199,254,740,991
Default Value	1,048,576.000 counts, 16-bit (firmware versions M_01-02-00-000 and above) 68,719,476,736 counts (for firmware version M_01-01-00-000)
Data Type	S64
See Also	,
Start Version	M_01-00-00-000

Description

This parameter sets the compare register for the software limit switch 1. This value can be either the lower or the upper software limit switch register, depending on the configuration of the software limit switches. Whichever switch is set largest is the positive limit switch; the other switch becomes the negative limit switch. These switches can be used in addition to hardware limit switches. The software limit switches are only active if the axis is homed. For more information about homing, please refer to the HOME Parameters and DRV.MOTIONSTAT.

Related Topics

12.7 Limits

23.12.46 DRV.MOTIONSTAT

23.31.4 SWLS.STATE

General Information	
Type	R/O Parameter
Description	Reads the actual status of software limit switches.
Units	N/A
Range	0 to 3
Default Value	0
Data Type	U8
See Also	N/A
Start Version	M_01-00-00-000

Description

This parameter reads the status word of the software limit switches. The status word indicates the result of the compare between the software limit switch compare register and the actual position of the position loop.

Example

Bit 0 = 0: SWLS.LIMIT0 (pg 669) is not active.

Bit 0 = 1: SWLS.LIMIT0 is active.

Bit 1 = 0: SWLS.LIMIT1 (pg 670) is not active.

Bit 1 = 1: SWLS.LIMIT1 is active.

Bits 2 to 7 are currently not in use.

Related Topics

12.7 Limits

23.32 TEMP Parameters

This section describes the TEMP parameters.

23.32.1 TEMP.CONTROL	673
23.32.2 TEMP.POWER1 to TEMP.POWER3	674

23.32.1 TEMP.CONTROL

General Information	
Type	R/O Parameter
Description	Reads the temperature of the control board temperature sensor.
Units	Degrees Celsius
Range	-127 to 128
Default Value	N/A
Data Type	Integer
Start Version	M_01-09-00-000

Description

Reads the temperature of the control board temperature sensor.

Related Topics

DRV.TEMPERATURES (pg 425) | TEMP.POWER1 to TEMP.POWER3 (pg 674)

23.32.2 TEMP.POWER1 to TEMP.POWER3

General Information	
Type	R/O Parameter
Description	Reads the temperature of the power board(s) temperature sensor (s).
Units	Degrees Celsius
Range	-127 to 128
Default Value	N/A
Data Type	Integer
Start Version	M_01-09-00-000

Description

Reads the temperature of the power board(s) temperature sensor(s).

Related Topics

DRV.TEMPERATURES (pg 425) | TEMP.CONTROL (pg 673)

23.33 UNIT Parameters

This section describes the UNIT parameters.

23.33.1 UNIT.ACCLINEAR	676
23.33.2 UNIT.ACCROTARY	677
23.33.3 UNIT.LABEL	678
23.33.4 UNIT.PIN	679
23.33.5 UNIT.PLINEAR	680
23.33.6 UNIT.POUT	681
23.33.7 UNIT.PROTARY	682
23.33.8 UNIT.VLINEAR	683
23.33.9 UNIT.VROTARY	684

23.33.1 UNIT.ACCLINEAR

General Information	
Type	NV Parameter
Description	Sets the linear acceleration/deceleration units.
Units	N/A
Range	0 to 3
Default Value	0
Data Type	Integer
See Also	DRV.ACC (pg 364), DRV.DEC (pg 374), MOTOR.TYPE (pg 591)
Start Version	M_01-00-00-000

Description

UNIT.ACCLINEAR sets the units type for the acceleration and deceleration parameters, when the motor type (MOTOR.TYPE (pg 591)) is linear.

Type	Description
0	[Custom Units (pg 77)]/s ²
1	millimeters per second squared (mm/s ²)
2	micrometers per second squared (μm/s ²)
3	Feedback counts/s ²

Related Topics

Selecting Units for Your Application (pg 76)

23.33.2 UNIT.ACCROTARY

General Information	
Type	NV Parameter
Description	Sets the rotary acceleration/deceleration units.
Units	rpm/s, rps/s, deg/s ² , [Custom Units (pg 77)] /s ²
Range	0 to 3 rpm/s
Default Value	0 rpm/s
Data Type	Integer
See Also	DRV.ACC (pg 364), MOTOR.TYPE (pg 591)
Start Version	M_01-00-00-000

Description

UNIT.ACCROTARY sets the acceleration/deceleration units when the motor type (MOTOR.TYPE (pg 591)) is rotary.

Type	Description
0	rpm/s
1	rps/s
2	deg/s ²
3	(Custom Units (pg 77)) /s ²

Related Topics

Selecting Units for Your Application (pg 76)

"DRV.DEC " (=> p. 374)

23.33.3 UNIT.LABEL

General Information	
Type	NV Parameter
Description	Sets user-defined name for user-defined position units.
Units	N/A
Range	Maximum 16 characters, no spaces
Default Value	Custom Units (pg 77)
Data Type	String
See Also	UNIT.PLINEAR (pg 680), UNIT.POUT (pg 681)
Start Version	M_01-00-00-000

Description

If you define a special position unit with UNIT.PLINEAR (pg 680) and UNIT.POUT (pg 681), then you can give this unit a descriptive name. You can name the unit anything you wish, as long as the name is limited to 16 characters and includes no spaces. The label used for velocity and acceleration are in terms of this descriptive name.

This parameter is descriptive only and does not influence drive internal functions in any way.

Related Topics

Selecting Units for Your Application (pg 76)

23.33.4 UNIT.PIN

General Information	
Type	NV Parameter
Description	Sets gear IN for the unit conversion.
Units	User units
Range	0 to 4,294,967,295
Default Value	100
Data Type	Integer
See Also	UNIT.POUT (pg 681)
Start Version	M_01-00-00-000

Description

UNIT.PIN is used in conjunction with UNIT.POUT (pg 681) to set application specific units. This parameter is used as follows in the drive unit conversion:

- For position, this parameter sets the units as [Custom Units (pg 77)]/rev.
- For velocity, this parameter sets the units as [Custom Units (pg 77)]/s.
- For acceleration/deceleration, this parameter sets the units as [Custom Units (pg 77)]/s².

Related Topics

Selecting Units for Your Application (pg 76)

23.33.5 UNIT.PLINEAR

General Information	
Type	NV Parameter
Description	Sets the linear position units.
Units	N/A
Range	0 to 4
Default Value	0
Data Type	Integer
See Also	PL.FB (pg 605), PL.CMD (pg 599), MOTOR.TYPE (pg 591)
Start Version	M_01-00-00-000

Description

UNIT.PLINEAR sets the units type for the position parameters when the motor type (MOTOR.TYPE) is linear.

Type	Description
0	32-bit counts
1	Millimeters (mm)
2	Micrometers (μm)
3	(PIN/POUT) per revolution
4	16-bit counts

Related Topics

Selecting Units for Your Application (pg 76)

23.33.6 UNIT.POUT

General Information	
Type	NV Parameter
Description	Sets gear out for the unit conversion.
Units	User units.
Range	0 to 4,294,967,295
Default Value	20
Data Type	Integer
See Also	UNIT.PLINEAR (pg 680)
Start Version	M_01-00-00-000

Description

UNIT.POUT is used with UNIT.PIN (pg 679) to set application specific units in UNIT.POUT. This parameter is used as follows in the drive unit conversion:

- For position, this parameter sets the units as [Custom Units (pg 77)]/rev.
- For velocity, this parameter sets the units as [Custom Units (pg 77)]/s.
- For acceleration/deceleration, this parameter sets the units as [Custom Units (pg 77)]/s².

Related Topics

Selecting Units for Your Application (pg 76)

23.33.7 UNIT.PROTARY

General Information	
Type	NV Parameter
Description	Sets the position units when the motor type (MOTOR.TYPE (pg 591)) is rotary.
Units	counts, rad, deg, Custom Units (pg 77), 16-bit counts
Range	0 to 4
Default Value	4 16-bit counts (for firmware versions M_01-02-00-000 and above) 0 counts (for firmware version M_01-01-00-000)
Data Type	Integer
See Also	PL.FB (pg 605), PL.CMD (pg 599), MOTOR.TYPE (pg 591)
Start Version	M_01-00-00-000

Description

UNIT.PROTARY sets the position units when the motor type (MOTOR.TYPE (pg 591)) is rotary.

Value	Units
0	counts
1	radians
2	degrees
3	Custom Units (pg 77)
4	16-bit counts

Related Topics

Selecting Units for Your Application (pg 76)

23.33.8 UNIT.VLINEAR

General Information	
Type	NV Parameter
Description	Sets the linear velocity units.
Units	N/A
Range	0 to 3
Default Value	0
Data Type	Integer
See Also	VL.FB (pg 704), VL.CMDU (pg 702), VL.CMD (pg 701), MOTOR.TYPE (pg 591)
Start Version	M_01-00-00-000

Description

UNIT.VLINEAR sets the units type for the velocity parameters when the motor type (MOTOR.TYPE (pg 591)) is linear.

Type	Description
0	(Custom Units (pg 77)) per second
1	Micrometers per second
2	Millimeters per second
3	Counts per second

Related Topics

Selecting Units for Your Application (pg 76)

23.33.9 UNIT.VROTARY

General Information	
Type	NV Parameter
Description	Sets the velocity units when the motor type (MOTOR.TYPE (pg 591)) is rotary.
Units	rpm, rps, deg/s, (Custom Units (pg 77))/s
Range	0 to 3
Default Value	0 rpm
Data Type	Integer
See Also	VL.FB (pg 704), VL.CMDU (pg 702), VL.CMD (pg 701), MOTOR.TYPE (pg 591)
Start Version	M_01-00-00-000

Description

UNIT.VROTARY sets the velocity units when the motor type (MOTOR.TYPE) is rotary.

Value	Units
0	rpm
1	rps
2	deg/s
3	(Custom Units (pg 77)) /s

Related Topics

Selecting Units for Your Application (pg 76)

23.34 VBUS Parameters

This section describes the VBUS parameters.

23.34.1 VBUS.HALFVOLT	686
23.34.2 VBUS.OVFTHRESH	687
23.34.3 VBUS.OVWTHRESH	688
23.34.4 VBUS.RMSLIMIT	689
23.34.5 VBUS.UVFTHRESH	690
23.34.6 VBUS.UVMODE	691
23.34.7 VBUS.UVWTHRESH	692
23.34.8 VBUS.VALUE	693

23.34.1 VBUS.HALFVOLT

General Information	
Type	NV Parameter
Description	Changing voltage thresholds for HV and MV Drives
Units	N/A
Range	0 to 1
Default Value	0
Data Type	Integer
See Also	N/A
Start Version	M_01-04-01-000

Description

This parameter is used in order to change some specific voltage thresholds in order to allow HV (high voltage) Drives working with MV (medium voltage) thresholds and to allow MV (medium voltage) Drives working with LV (low voltage) thresholds.

This parameter has an impact on the following voltage-thresholds:

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

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

The VBUS.HALFVOLT command takes only effect for a HV or MV Drive.

VBUS.HALFVOLT = 0: The original voltage thresholds are used for the functions mentioned above.

VBUS.HALFVOLT = 1: Setting the parameter to 1 on a HV Drive causes the KC1 to use the voltage thresholds of a MV Drive for the functions mentioned above. Setting the parameter to 1 on a MV Drive causes the KC1 to use the voltage thresholds of a LV Drive for the functions mentioned above.

The sequence must be as follows:

- 1) Change the value of VBUS.HALFVOLT.
- 2) Trigger a DRV.NVSAVE command.
- 3) Power cycle the Drive in order to activate the new configuration.

Note

The DC-bus under voltage fault threshold (see VBUS.UVFTHRESH) is a user selectable command. It means that the user is responsible for setting the under voltage threshold to a proper value in case that the KC1 is supplied with a lower DC-bus voltage than the rated voltage.

23.34.2 VBUS.OVFTHRESH

General Information	
Type	R/O Parameter
Description	Reads the over voltage fault level.
Units	Vdc
Range	0 to 900 Vdc
Default Value	N/A
Data Type	Integer
See Also	VBUS.UVFTHRESH
Start Version	M_01-00-00-000

Description

VBUS.OVFTHRESH reads the over voltage fault level for the DC bus.

This value is read from the drive EEPROM and varies according to the drive type.

Related Topics

Regeneration (pg 48)

23.34.3 VBUS.OVWTHRESH

General Information	
Type	NV Parameter
Description	Sets voltage level for over voltage warning.
Units	Vdc
Range	0 to 900 Vdc
Default Value	0 Vdc (warning disabled)
Data Type	U16
See Also	N/A
Start Version	M_01-00-00-000

Description

If VBUS.VALUE value exceeds VBUS.OVWTHRESH, then a warning is generated.

Related Topics

Regeneration (pg 48)

23.34.4 VBUS.RMSLIMIT

General Information	
Type	R/O Parameter
Description	Reads the limit for the bus capacitors load.
Units	Vrms
Range	N/A
Default Value	N/A
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

Description

This parameter reads the limit of the bus capacitor load. When the bus capacitor loads exceeds this limit, the drive generates fault F503.

Excessive bus capacitor load may indicate a disconnected main supply phase.

Related Topics

Regeneration (pg 48)

23.34.5 VBUS.UVFTHRESH

General Information	
Type	R/W Parameter
Description	Sets the under voltage fault level.
Units	Vdc
Range	90 to 420 Vdc
Default Value	90 Vdc
Data Type	Integer
See Also	VBUS.OVFTHRESH
Start Version	M_01-00-00-000

Description

VBUS.UVFTHRESH sets the undervoltage fault level of the DC bus.

The default value is read from the EEPROM, but can be modified by the user and stored on the NV RAM. This value varies according to drive type.

Related Topics

Regeneration (pg 48)

23.34.6 VBUS.UVMODE

General Information	
Type	N/V Parameter
Description	Indicates undervoltage (UV) mode.
Units	N/A
Range	0 to 1
Default Value	1
Data Type	Integer
See Also	N/A
Start Version	M_01-00-00-000

Description

This parameter indicates undervoltage (UV) mode.

When VBUS.UVMODE = 0, an undervoltage fault is issued whenever the DC bus goes below the undervoltage threshold.

When VBUS.UVMODE = 1, an undervoltage fault is issued whenever the DC bus goes below the

under voltage threshold and the controller attempts to enable the drive (software or hardware enable).

Related Topics

Regeneration (pg 48)

23.34.7 VBUS.UVWTHRESH

General Information	
Type	NV Parameter
Description	Sets voltage level for undervoltage warning.
Units	Vdc
Range	0 to 900 Vdc
Default Value	10 volts above the default value of the under voltage fault threshold (VBUS.UVFTHRESH). The default value of VBUS.UVFTHRESH is hardware dependent.
Data Type	U16
See Also	VBUS.UVFTHRESH (pg 690)
Start Version	M_01-00-00-000

Description

If VBUS.VALUE value drops below VBUS.UVWTHRESH, then a warning is generated.

Related Topics

Regeneration (pg 48)

23.34.8 VBUS.VALUE

General Information	
Type	R/O Parameter
Description	Reads DC bus voltage.
Units	Vdc
Range	0 to 900 Vdc
Default Value	N/A
Data Type	Float
See Also	N/A
Start Version	M_01-00-00-000

Description

VBUS.VALUE reads the DC bus voltage.

Related Topics

7.2 Regeneration

23.35 VL Parameters

This section describes the VL parameters.

23.35.1 VL.ARPF1 TO VL.ARPF4	695
23.35.2 VL.ARPQ1 TO VL.ARPQ4	696
23.35.3 VL.ARTYPE1 TO VL.ARTYPE4	697
23.35.4 VL.ARZF1 TO VL.ARZF4	698
23.35.5 VL.ARZQ1 TO VL.ARZQ4	699
23.35.6 VL.BUSFF	700
23.35.7 VL.CMD	701
23.35.8 VL.CMDU	702
23.35.9 VL.ERR	703
23.35.10 VL.FB	704
23.35.11 VL.FBFILTER	705
23.35.12 VL.FBSOURCE	706
23.35.13 VL.FBUNFILTERED	707
23.35.14 VL.FF	708
23.35.15 VL.GENMODE	709
23.35.16 VL.KBUSFF	710
23.35.17 VL.KI	711
23.35.18 VL.KO	712
23.35.19 VL.KP	713
23.35.20 VL.KVFF	715
23.35.21 VL.LIMITN	716
23.35.22 VL.LIMITP	717
23.35.23 VL.LMJR	717
23.35.24 VL.MODEL	719
23.35.25 VL.OBSBW	720
23.35.26 VL.THRESH	721

23.35.1 VL.ARPF1 TO VL.ARPF4

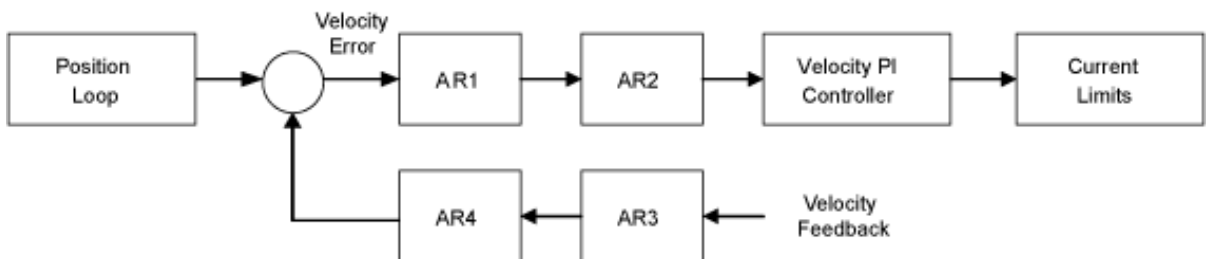
General Information	
Type	R/W Parameter
Description	Sets the natural frequency of the pole (denominator) of anti-resonance (AR) filters 1, 2, 3, and 4; active in opmodes 1 (velocity) and 2 (position) only.
Units	Hz
Range	5 to 5,000 Hz
Default Value	500 Hz
Data Type	Float
See Also	VL.ARPQ1 TO VL.ARPQ4 (pg 696), VL.ARZF1 TO VL.ARZF4 (pg 698), Sets the Q of the zero (numerator) of anti-resonance filter #1; active in opmodes 1 (velocity) and 2 (position) only. (pg 699)
Start Version	M_01-02-00-000

Description

VL.ARPF1 sets the natural frequency of the pole (denominator) of AR filter 1. This value is F_p in the approximate transfer function of the filter:

$$ARx(s) = [s^2 / (2\pi F_z)^2 + s / (Q_z 2\pi F_z) + 1] / [s^2 / (2\pi F_p)^2 + s / (Q_p 2\pi F_p) + 1]$$

The following block diagram describes the AR filter function; note that AR1 and AR2 are in the forward path, while AR3 and AR4 are applied to feedback:



AR1, AR2, AR3, and AR4 are used in velocity and position mode, but are disabled in torque mode.

Discrete time transfer function (applies to all AR filters)

The velocity loop compensation is actually implemented as a digital discrete time system function on the DSP. The continuous time transfer function is converted to the discrete time domain by a backward Euler mapping:

$$s \approx (1-z^{-1})/t, \text{ where } t = 62.5 \mu s$$

The poles are prewarped to F_p and the zeros are prewarped to F_z .

Related Topics

Velocity Loop (pg 117)

23.35.2 VL.ARPQ1 TO VL.ARPQ4

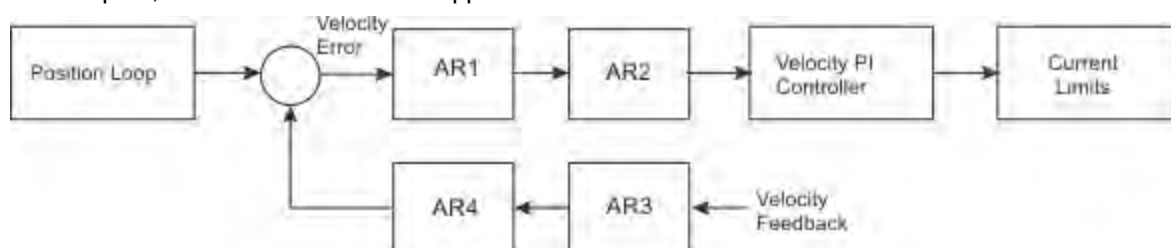
General Information	
Type	R/W Parameter
Description	Sets the Q of the pole (denominator) of anti-resonance (AR) filter 1; active in opmodes 1 (velocity) and 2 (position) only.
Units	None
Range	0.2 to 20
Default Value	0.5
Data Type	Float
See Also	VL.ARPF1 TO VL.ARPF4 (pg 695), VL.ARZF1 TO VL.ARZF4 (pg 698), VL.ARZQ1 TO VL.ARZQ4 (pg 699)
Start Version	M_01-02-00-000

Description

VL.ARPQ1 sets the Q (quality factor) of the pole (denominator) of AR filter 1. This value is Q_p in the approximate transfer function of the filter:

$$ARx(s) = [s^2 / (2\pi F_z)^2 + s / (Q_z 2\pi F_z) + 1] / [s^2 / (2\pi F_p)^2 + s / (Q_p 2\pi F_p) + 1]$$

The following block diagram describes the AR filter function; note that AR1 and AR2 are in the forward path, while AR3 and AR4 are applied to feedback:



AR1, AR2, AR3, and AR4 are used in velocity and position mode, but are disabled in torque mode.

Discrete time transfer function (applies to all AR filters)

The velocity loop compensation is actually implemented as a digital discrete time system function on the DSP. The continuous time transfer function is converted to the discrete time domain by a backward Euler mapping:

$$s \approx (1 - z^{-1}) / t, \text{ where } t = 62.5 \mu s$$

The poles are prewarped to F_p and the zeros are prewarped to F_z .

Related Topics

Velocity Loop (pg 117)

23.35.3 VL.ARTYPE1 TO VL.ARTYPE4

General Information	
Type	NV Parameter
Description	Indicates the method used to calculate BiQuad coefficients; active in opmodes 1 (velocity) and 2 (position) only.
Units	N/A
Range	0
Default Value	0
Data Type	U8
See Also	N/A
Start Version	M_01-00-00-000

Description

These parameters indicate the method used to calculate the biquad coefficients VL.ARPFx, VL.ARPQx, VL.ARZFx, and VL.ARZQx. A value of 0 indicates that the coefficients are set directly. This parameter has no effect on the filter itself, but is only used to determine the original design parameters. Currently, only the value of 0 is supported.

Related Topics

13.4 Velocity Loop

23.35.4 VL.ARZF1 TO VL.ARZF4

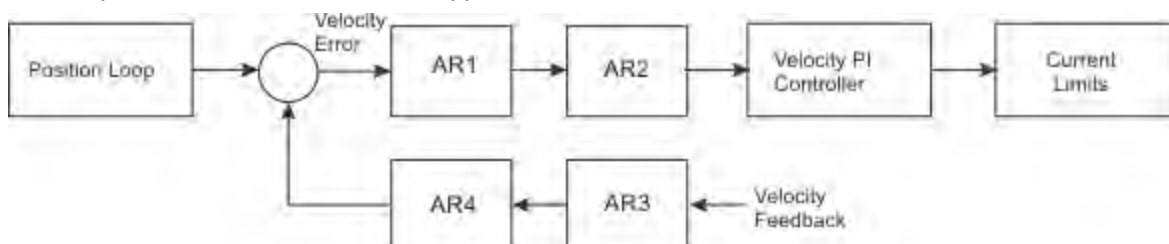
General Information	
Type	R/W Parameter
Description	Sets the natural frequency of the zero (numerator) of anti-resonance (AR) filter 1; active in opmodes 1 (velocity) and 2 (position) only.
Units	Hz
Range	5 to 5,000 Hz
Default Value	500 Hz
Data Type	Float
See Also	VL.ARPF1 TO VL.ARPF4 (pg 695), VL.ARPQ1 TO VL.ARPQ4 (pg 696), VL.ARZQ1 TO VL.ARZQ4 (pg 699)
Start Version	M_01-02-00-000

Description

VL.ARZF1 sets the natural frequency of the zero (numerator) of AR filter 1. This value is F_z in the approximate transfer function of the filter:

$$AR_x(s) = [s^2 / (2\pi F_z)^2 + s / (Q_z 2\pi F_z) + 1] / [s^2 / (2\pi F_p)^2 + s / (Q_p 2\pi F_p) + 1]$$

The following block diagram describes the AR filter function; note that AR1 and AR2 are in the forward path, while AR3 and AR4 are applied to feedback:



AR1, AR2, AR3, and AR4 are used in velocity and position mode, but are disabled in torque mode.

Discrete time transfer function (applies to all AR filters)

The velocity loop compensation is actually implemented as a digital discrete time system function on the DSP. The continuous time transfer function is converted to the discrete time domain by a backward Euler mapping:

$$s \approx (1-z^{-1})/t, \text{ where } t = 62.5 \mu\text{s}$$

The poles are prewarped to F_p and the zeros are prewarped to F_z .

Related Topics

Velocity Loop (pg 117)

23.35.5 VL.ARZQ1 TO VL.ARZQ4

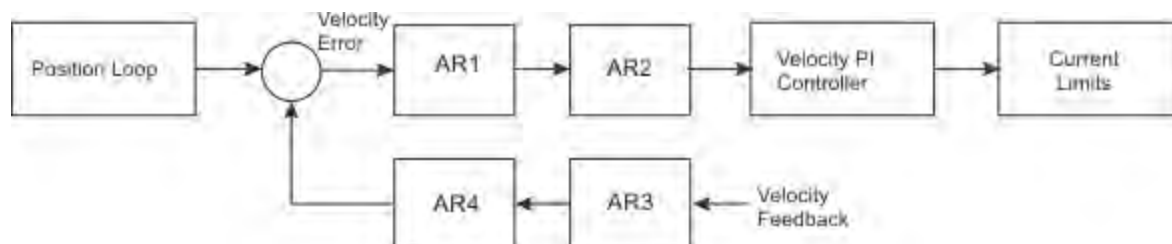
General Information	
Type	R/W Parameter
Description	Sets the Q of the zero (numerator) of anti-resonance filter #1; active in opmodes 1 (velocity) and 2 (position) only.
Units	N/A
Range	0.1 to 5
Default Value	0.5
Data Type	Float
See Also	VL.ARPF1 TO VL.ARPF4 (pg 695), VL.ARPQ1 TO VL.ARPQ4 (pg 696), VL.ARZF1 TO VL.ARZF4 (pg 698)
Start Version	M_01-02-00-000

Description

VL.ARZQ1 sets the Q (quality factor) of the zero (numerator) of AR filter 1. This value is Q_z in the approximate transfer function of the filter:

$$AR1(s) = [s^2 / (2\pi F_z)^2 + s / (Q_z 2\pi F_z) + 1] / [s^2 / (2\pi F_p)^2 + s / (Q_p 2\pi F_p) + 1]$$

The following block diagram describes the AR filter function; note that AR1 and AR2 are in the forward path, while AR3 and AR4 are applied to feedback:



AR1, AR2, AR3 and AR4 are used in velocity and position mode, but are disabled in torque mode.

Discrete time transfer function (applies to all AR filters)

The velocity loop compensation is actually implemented as a digital discrete time system function on the DSP. The continuous time transfer function is converted to the discrete time domain by a backward Euler mapping:

$$s \approx (1-z^{-1})/t, \text{ where } t = 62.5 \mu s.$$

The poles are prewarped to F_p and the zeros are prewarped to F_z .

Related Topics

Velocity Loop (pg 117)

23.35.6 VL.BUSFF

General Information	
Type	R/O Parameter
Description	Displays the velocity loop feedforward value injected by the field-bus; active in opmodes 1 (velocity) and 2 (position) only.
Units	Depends on or Rotary: rpm, rps, deg/s, (custom units)/s, rad/s Linear: counts/s, mm/s, μ m/s, (custom units)/s
Range	0.0 to VL.LIMITP (pg 717)
Default Value	0.0
Data Type	Float
See Also	VL.FF (pg 708), VL.KBUSFF (pg 710)
Start Version	M_01-00-00-000

Description

This parameter displays the velocity loop feedforward value injected by the fieldbus.

Related Topics

13.4 Velocity Loop

23.35.7 VL.CMD

General Information	
Type	R/O Parameter
Description	Reads the actual velocity command; active in opmodes 1 (velocity) and 2 (position) only.
Units	Depends on or Rotary: rpm, rps, deg/s, (custom units)/s, rad/s Linear: counts/s, mm/s, $\mu\text{m/s}$, (custom units)/s
Range	N/A
Default Value	N/A
Data Type	Float
See Also	VL.FB (pg 704), VL.CMDU (pg 702), VL.LIMITP (pg 717), VL.LIMITN (pg 716)
Start Version	M_01-00-00-000

Description

VL.CMD returns the actual velocity command as it is received in the velocity loop entry after all velocity limits (such as VL.LIMITN (pg 716) and VL.LIMITP (pg 717)). See velocity loop design diagram for more details.

Related Topics

- 13.4 Velocity Loop
- 13.5 Position Loop
- 22 Block Diagrams

23.35.8 VL.CMDU

General Information	
Type	R/W Parameter
Description	Sets the user velocity command; active in opmodes 1 (velocity) and 2 (position) only.
Units	Depends on or Rotary: rpm, rps, deg/s, custom units/s, rad/s Linear: counts/s, mm/s, μ m/s, custom units/s
Range	Rotary -15,000.000 to 15,000.000 rpm -250.000 to 250.000 rps -90000.000 to 90000.000 deg/s -1250.000 to 1250.000 custom units/s -1570.796 to 1570.796 rad/s Linear -1,073,741,824,000.000 to 1,073,741,824,000.000 counts/s -8,000.000 to 8,000.000 mm/s -8,000,000.000 to 8,000,000.000 μ m/s -1,250.000 to 1,250.000 custom units/s
Default Value	0
Data Type	Float
See Also	VL.FB (pg 704), VL.CMD (pg 701), DRV.OPMODE (pg 418), DRV.CMDSOURCE (pg 371), VL.LIMITN (pg 716), VL.LIMITP (pg 717)
Start Version	M_01-00-00-000

Description

VL.CMDU sets the user velocity command.

When DRV.OPMODE (pg 418) is set to 1 (velocity loop) and DRV.CMDSOURCE (pg 371) is set to 0 (TCP/IP channel), then setting this value when the drive is enabled will cause the drive to rotate at the required velocity.

Related Topics

13.4 Velocity Loop

23.35.9 VL.ERR

General Information	
Type	R/O Parameter
Description	Sets the velocity error; active in opmodes 1 (velocity) and 2 (position) only.
Units	Depends on or Rotary: rpm, rps, deg/s, (custom units)/s, rad/s Linear: counts/s, mm/s, $\mu\text{m/s}$, (custom units)/s
Range	N/A
Default Value	N/A
Data Type	Float
See Also	VL.CMD (pg 701), VL.FB (pg 704)
Start Version	M_01-00-00-000

Description

VL.ERR sets the velocity error. It is calculated in the velocity loop as the difference between VL.CMD (pg 701) and VL.FB (pg 704).

Related Topics

13.4 Velocity Loop

23.35.10 VL.FB

General Information	
Type	R/O Parameter
Description	Reads the velocity feedback; active in opmodes 1 (velocity) and 2 (position) only.
Units	Depends on or Rotary: rpm, rps, deg/s, (custom units)/s, rad/s Linear: counts/s, mm/s, $\mu\text{m/s}$, (custom units)/s
Range	N/A
Default Value	N/A
Data Type	Float
See Also	VL.CMDU (pg 702)
Start Version	M_01-00-00-000

Description

VL.FB returns the velocity feedback as it is received in the velocity loop, after passing through Filter 3 and Filter 4.

Related Topics

13.4 Velocity Loop

23.35.11 VL.FBFILTER

General Information	
Type	R/O Parameter
Description	Filters VL.FB (pg 704) value; active in opmodes 1 (velocity) and 2 (position) only.
Units	Depends on or Rotary: rpm, rps, deg/s, (custom units)/s, rad/s Linear: counts/s, mm/s, $\mu\text{m/s}$, (custom units)/s
Range	N/A
Default Value	N/A
Data Type	Float
See Also	VL.FB (pg 704)
Start Version	M_01-00-00-000

Description

This parameter returns the same value as VL.FB (pg 704), filtered through a 10 Hz filter.

Related Topics

13.4 Velocity Loop

23.35.12 VL.FBSOURCE

General Information	
Type	NV Parameter
Description	Sets feedback source for the velocity loop; active in opmodes 1 (velocity) and 2 (position) only.
Units	N/A
Range	0 to 1
Default Value	0
Data Type	Integer
See Also	PL.FBSOURCE (pg 606)
Start Version	M_01-00-00-000

Description

This parameter determines the feedback source to be used by the velocity loop. A value of 0 selects the primary feedback, and 1 selects the secondary feedback.

Related Topics

Velocity Loop (pg 117)

23.35.13 VL.FBUNFILTERED

General Information	
Type	R/O Parameter
Description	Reads the velocity feedback.
Units	Depends on UNIT.VROTARY or UNIT.VLINEAR, UNIT.ACCLINEAR Rotary: rpm, rps, deg/s, (custom units)/s, rad/s Linear: counts/s, mm/s, $\mu\text{m/s}$, (custom units)/s
Range	N/A
Default Value	N/A
Data Type	Float
See Also	VL.FB (pg 704), VL.FBFILTER (pg 705)
Start Version	M_01-03-06-000

Description

VL.FBUNFILTERED reads the raw velocity feedback before any filters affect the value of this feedback.

Related Topics

Velocity Loop (pg 117)

23.35.14 VL.FF

General Information	
Type	R/O Parameter
Description	Displays the velocity loop overall feedforward value; active in opmodes 1 (velocity) and 2 (position) only.
Units	Depends on or Rotary: rpm, rps, deg/s, (custom units)/s, rad/s Linear: counts/s, mm/s, μm/s, (custom units)/s
Range	0 to VL.LIMITP (pg 717)
Default Value	0
Data Type	Float
See Also	VL.KBUSFF (pg 710)
Start Version	M_01-00-00-000

Description

This parameter displays the velocity loop overall feedforward value.

Related Topics

13.4 Velocity Loop

VL.KVFF (pg 715)

23.35.15 VL.GENMODE

General Information	
Type	NV Parameter
Description	Selects mode of velocity generation (Observer, d/dt); active in opmodes 1 (velocity) and 2 (position) only.
Units	N/A
Range	0 to 1
Default Value	0
Data Type	Integer
Start Version	M_01-00-00-000

Description

This parameter is used to select the velocity generator mode.

Mode	Description
0	d/dt mode: The derivative of the mechanical angle of the drive is fed to a first order low pass.
1	Luenberger Observer mode

Related Topics

Velocity Loop (pg 117)

23.35.16 VL.KBUSFF

General Information	
Type	R/W Parameter
Description	Sets the velocity loop acceleration feedforward gain value; active in opmodes 1 (velocity) and 2 (position) only.
Units	NA
Range	0.0 to 2.0
Default Value	0.0
Data Type	Float
See Also	VL.BUSFF (pg 700)
Start Version	M_01-00-00-000

Description

This parameter sets the gain for the acceleration feedforward (a scaled second derivative of the position command is added to the velocity command value).

The nominal feedforward value can be multiplied by this gain value.

This will have affect only when using position mode (DRV.OPMODE (pg 418) = 2).

Related Topics

13.4 Velocity Loop

23.35.17 VL.KI

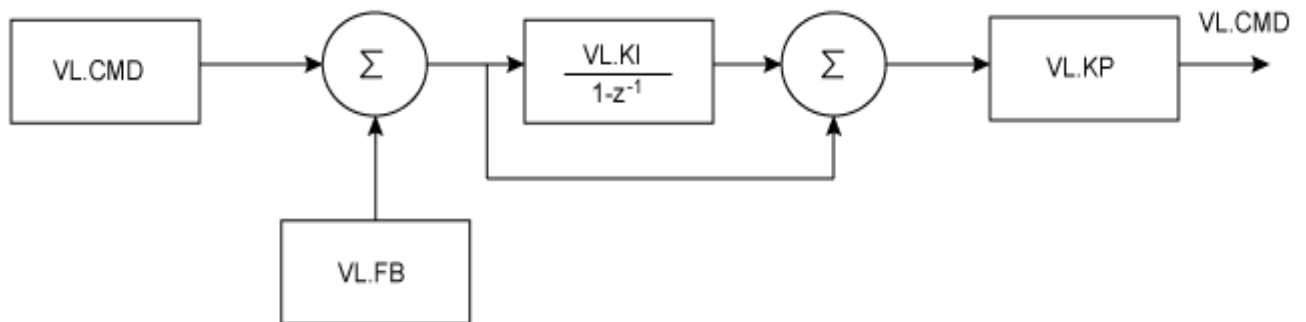
General Information	
Type	NV Parameter
Description	Sets the velocity loop integral gain for the PI controller; active in opmodes 1 (velocity) and 2 (position) only.
Units	Hz
Range	0 to 1,000 Hz
Default Value	160 Hz
Data Type	Float
See Also	VL.KP (pg 713)
Start Version	M_01-00-00-000

Description

VL.KI sets the integral gain of the velocity loop.

A factor of 2π is included in the time calculation, therefore a PI velocity loop with a constant error of 1 rps in which VL.KI is set to 160 and VL.KP (pg 713) is set to 1, will take $(1000/160) \cdot 2\pi$ ms to increase the integral gain to 1. Therefore, the total gain is 2 at this time (see velocity loop structure below).

Velocity Loop Structure



Related Topics

Velocity Loop (pg 117)

23.35.18 VL.KO

General Information	
Type	R/W Parameter
Description	Scales the observer velocity signal; active in opmodes 1 (velocity) and 2 (position) only.
Units	Internal
Range	0 to 65,535
Default Value	0
Data Type	Float
See Also	VL.MODEL (pg 719)
Start Version	M_01-00-01-000

Description

VL.KO is used to scale the observer model to match the load. When VL.KO is tuned properly, Reads the observer velocity signal; active in opmodes 1 (velocity) and 2 (position) only. (pg 719) will match VL.FB (pg 704), except when there is an unspecified offset between the two.

Related Topics

Velocity Loop (pg 117)

23.35.19 VL.KP

General Information	
Type	NV Parameter
Description	Sets velocity loop proportional gain for the PI controller; active in opmodes 1 (velocity) and 2 (position) only.
Units	A/(rad/sec)
Range	0.001 to 2,147,483.008
Default Value	1
Data Type	Float
See Also	VL.KI (pg 711)
Start Ver- sion	M_01-00-00-000

Description

VL.KP sets the proportional gain of the velocity loop.

The idealized velocity loop bandwidth in Hz is:

Rotary motor:

$$\text{Bandwidth (Hz)} = \text{VL.KP} * K_t / (2\pi * J_m)$$

Where:

K_t = motor torque constant, in units of Nm/Arms

J_m = motor inertia, in units of kg*m²

Linear motor:

$$\text{Bandwidth (Hz)} = \text{VL.KP} * K_t / (\text{Motor Pitch (mm)} * J_m)$$

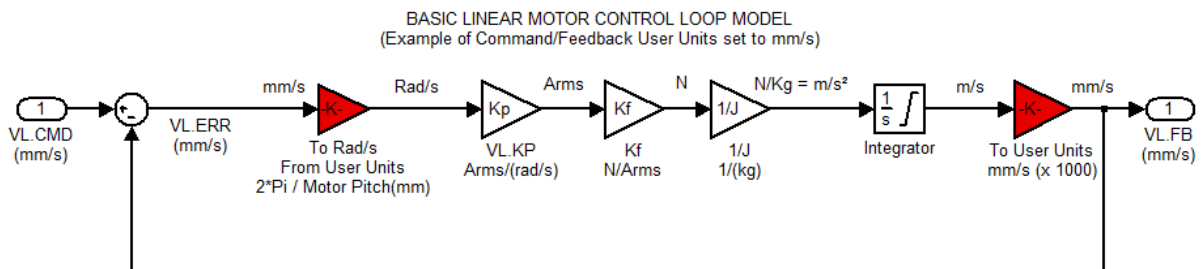
Where:

K_t = motor torque constant, in units of Nm/Arms

J_m = motor inertia, in units of kg

The drive uses the same control loop for both linear and rotary motors. VL.KP units are in Arms/(rad/s). If you want to tune in units of Arms/(mm/s), then you must manually convert the units.

The diagram below shows how linear motors are implemented at the control loop level.



The red blocks are automatically handled at the drive level.

2π radians is the linear equivalent of one full mechanical revolution of a rotary motor - and is equal to the MOTOR.PITCH of a linear motor.

Example

To convert VL.KP = 0.320 Arms/(rad/s) to Arms/(mm/s), where MOTOR.PITCH is 32 mm:

$$\text{VL.KP} = 0.320 \text{ Arm /rad/s} * (2\pi \text{ rad} / 32\text{mm MOTOR.PITCH})$$

$$VL.KP = 0.32 * 2\pi / 32 = 0.063 \text{ Arms} / (\text{mm/s})$$

Related Topics

Velocity Controller Environment Block Diagram

23.35.20 VL.KVFF

General Information	
Type	R/W Parameter
Description	Sets the velocity loop velocity feedforward gain value; active in opmodes 1 (velocity) and 2 (position) only.
Units	NA
Range	0.0 to 2.0
Default Value	0.0
Data Type	Float
See Also	VL.FF (pg 708)
Start Version	M_01-00-00-000

Description

This parameter sets the gain for the velocity feedforward (a scaled derivative of the position command is added to the velocity command value). The nominal feedforward value can be multiplied by this gain value.

This parameter is only used in the position mode (DRV.OPMODE (pg 418) = 2).

Related Topics

13.4 Velocity Loop

23.35.21 VL.LIMITN

General Information	
Type	NV Parameter
Description	Sets the velocity lower limit; active in opmodes 1 (velocity) and 2 (position) only.
Units	Depends on or Rotary: rpm, rps, deg/s, custom units/s, rad/s Linear: counts/s, mm/s, µm/s, custom units/s
Range	Rotary: -15,000.000 to 0.000 rpm -250.000 to 0.000 rps -90,000.000 to 0.000 deg/s -1,250.000 to 0.000 custom units/s -1570.796 to 0.000 rad/s Linear: -1,073,741,824,000.000 to 0.000 counts/s -250.000*MOTOR.PITCH (pg 581) to 0.000 mm/s -250,000.000*MOTOR.PITCH (pg 581) to 0.000 µm/sec -1,250.000 to 0.000 custom units/s
Default Value	Rotary: -3,000.000 rpm -50.000 rps -18,000.002 deg/s -250.000 (custom units)/s -314.159 rad/s Linear: -0.050 counts/s -50*MOTOR.PITCH (pg 581) mm/s -50,000.004*MOTOR.PITCH µm/sec -250.000 custom units/s
Data Type	Float
See Also	VL.LIMITP (pg 717), VL.CMD (pg 701)
Start Version	M_01-00-00-000

Description

VL.LIMITN sets the velocity command negative limit.

If the input to the velocity loop is lower than VL.LIMITN, then the actual velocity command VL.CMD (pg 701) is limited by the value of VL.LIMITN.

Related Topics

13.4 Velocity Loop

23.35.22 VL.LIMITP

General Information	
Type	NV Parameter
Description	Sets the velocity high limit; active in opmodes 1 (velocity) and 2 (position) only.
Units	Depends on or Rotary: rpm, rps, deg/s, custom units/s, rad/s Linear: counts/s, mm/s, μm/s, custom units/s
Range	Rotary: 0.000 to 15,000.000 rpm 0.000 to 250.000 rps 0.000 to 90,000.000 deg/s 0.000 to 1,250.000 custom units/s 0.000 to 1570.796 rad/s Linear: 0.000 to 1,073,741,824,000.000 counts/s 0.000 to 250.000*MOTOR.PITCH (pg 581) mm/sec 0.000 to 250,000.000*MOTOR.PITCH (pg 581) μm/s 0.000 to 1,250.000 custom units/s
Default Value	Rotary: 3,000.000 rpm 50.000 rps 18,000.002 deg/s 250.000 (custom units)/s 314.159 rad/s Linear: 0.050 counts/s 50.000*MOTOR.PITCH (pg 581) mm/sec 50,000.004*MOTOR.PITCH μm/sec 250.000 custom units/s
Data Type	Float
See Also	VL.LIMITN (pg 716), VL.CMD (pg 701)
Start Version	M_01-00-00-000

Description

VL.LIMITP sets the velocity command positive limit.

If the input to the velocity loop is higher than VL.LIMITP, then the actual velocity command VL.CMD (pg 701) is limited by the value of VL.LIMITP.

Related Topics

13.4 Velocity Loop

23.35.23 VL.LMJR

General Information	
Type	NV Parameter
Description	Sets the ratio of the estimated load moment of inertia relative to the motor moment of inertia; active in opmodes 1 (velocity) and 2 (position) only.
Units	NA
Range	0 to 100.0
Default Value	0
Data Type	Float
See Also	IL.FF (pg 526)
Start Version	M_01-00-00-000

Description

This parameter is used in the internal calculation of the current loop acceleration feed forward gain value.

Related Topics

Velocity Loop (pg 117)

23.35.24 VL.MODEL

General Information	
Type	R/O Parameter
Description	Reads the observer velocity signal; active in opmodes 1 (velocity) and 2 (position) only.
Units	Depends on UNIT.VROTARY or UNIT.VLINEAR, UNIT.ACCLINEAR Rotary: rpm, rps, deg/s, (custom units)/s, rad/s Linear: counts/s, mm/s, μ m/s, (custom units)/s
Range	N/A
Default Value	N/A
Data Type	Float
See Also	VL.FB (pg 704), VL.KO (pg 712)
Start Version	M_01-00-01-000

Description

VL.MODEL is the observer velocity output. When VL.KO (pg 712) is tuned properly, VL.MODEL will match VL.FB (pg 704), except when there is an unspecified offset between the two.

Related Topics

13.4 Velocity Loop

23.35.25 VL.OBSBW

General Information	
Type	NV Parameter
Description	Sets the bandwidth of the observer in Hz.
Units	Hz
Range	10 to 4,000 Hz
Default Value	30 Hz
Data Type	Float
See Also	N/A
Start Version	M_01-03-00-004

Description

This parameter sets the bandwidth of the observer in Hz. The observer passes the velocity feedback through a PID control loop that behaves like a low-pass filter with a bandwidth of VL.OBSBW.

Related Topics

Velocity Loop (pg 117)

23.35.26 VL.THRESH

General Information	
Type	NV Parameter
Description	Sets the over speed fault value; active in opmodes 1 (velocity) and 2 (position) only.
Units	Depends on or Rotary: rpm, rps, deg/s, custom units/s, rad/s Linear: counts/s, mm/s, $\mu\text{m/s}$, custom units/s
Range	Rotary: 0.000 to 15,000.000 rpm 0.000 to 250.000 rps 0.000 to 90,000.000 deg/s 0.000 to 1,250.000 custom units/s 0.000 to 1,570.796 rad/s Linear: 0.000 to 1,073,741,824.000 counts/s 0.000 to 250.000*MOTOR.PITCH (pg 581) mm/s 0.000 to 250,000.000*MOTOR.PITCHMOTOR.PITCH (pg 581) $\mu\text{m/s}$ 0.000 to 1,250.000 custom units/s
Default Value	Rotary: 3,600 rpm 60 rps 21,600.000 deg/s 300.000 custom units/s 376.991 rad/s Linear: 0.060 counts/s 60.000*MOTOR.PITCH (pg 581) mm/s 60,000.04*MOTOR.PITCHMOTOR.PITCH (pg 581) $\mu\text{m/s}$ 300.000 custom units/s
Data Type	Float
See Also	VL.CMD (pg 701), VL.CMDU (pg 702)
Start Version	M_01-00-00-000

Description

VL.THRESH sets the threshold for the velocity over which an over speed fault is generated. The value is considered as an absolute value, hence it applies for both negative and positive velocities.

Example

VL.THRESH is set to 600 rpm. A velocity (VL.FB (pg 704)) of 700 rpm will generate an over speed fault.

Related Topics

13.4 Velocity Loop

23.36 WS Parameters

This section describes the WS parameters.

23.36.1 WS.ARM	724
23.36.2 WS.CHECKMODE	725
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23.36.17 WS.TIRAMP	740
23.36.18 WS.TSTANDSTILL	741
23.36.19 WS.VTHRESH	742

23.36.1 WS.ARM

General Information	
Type	Command
Description	Sets wake and shake to start at the next drive enable.
Units	N/A
Range	N/A
Default Value	N/A
Data Type	N/A
See Also	N/A
Start Version	M_01-01-00-101, M_01-02-00-000

Description

This command sets wake and shake to start at the next drive enable. Feedback type is not relevant for this command. If WS.STATE is 0 and the drive is disabled, then WS.STATE will change to 1 after issuing WS.ARM. With this command, wake and shake can be repeated if desired.

Related Topics

Wake and Shake Overview (pg 1)

23.36.2 WS.CHECKMODE

General Information	
Type	R/W Parameter
Description	Select the type of commutation check to execute after Wake and Shake finds a new commutation angle.
Units	N/A
Range	0 to 2
Default Value	1
Data Type	Integer
Start Version	M_01-07-00-000

Description

KC1 supports several options to confirm a valid commutation after Wake and Shake has determined a new commutation angle. In some mechanical situations, such as if motion is inhibited, it is possible for Wake and Shake to select an incorrect angle. Commutation checks are designed to prevent unexpected motion if this occurs.

0 = No Commutation Check

If No Commutation Check is selected, neither passive nor active commutations checks will be executed.

1 = Active Commutation Check (default)

In the default Active Commutation Check mode, KC1 will make a short torque move after an angle has been selected. If the motor fails to move in the expected direction, a fault will be generated.

2 = Passive Commutation Check

In the Passive Commutation Check mode, KC1 will monitor torque commands and acceleration values for 10 revolutions after Wake and Shake has completed. During this time, a fault will be generated if unexpected motion is detected, such as if commanded torque and acceleration are in opposition directions. Note that this fault may also be reported if the motor experiences a large torque disturbance lasting longer than WS.CHECKT.

Related Topics

Wake and Shake Overview (pg 1) | WS.MODE (pg 733)

23.36.3 WS.CHECKT

General Information	
Type	R/W Parameter
Description	Sets the amount of time a communication error must be present before an error is thrown.
Units	ms
Range	0 to 10,000
Default Value	N/A
Data Type	U16
Start Version	M_01-06-03-000

Description

This parameter sets the amount of time a communication error must be present before an error is thrown. Commutation monitoring is disabled when this parameter is set to 0.

Related Topics

Wake and Shake Overview (pg 1) | WS.CHECKV (pg 727)

23.36.4 WS.CHECKV

General Information			
Type	R/W Parameter		
Description	This parameter sets the velocity threshold which has to be exceeded to activate commutation monitoring.		
Units	Depends on UNIT.VROTARY or UNIT.VLINEAR.		
Range	Unit	Rotary	Linear
	0	0 to 15,000 rpm	0 to 6,7108,864 counts/s
	1	0 to 250 rps	0 to 8,000 mm/s
	2	0 to 90,000 deg/s	0 to 589934 um/s
	3	0 to 1250 PIN/POUT	0 to 1250 PIN/POUT
Default Value	N/A		
Data Type	S32		
Start Version	M_01-06-03-000		

Description

This parameter sets the velocity threshold which has to be exceeded to activate commutation monitoring.

Related Topics

Wake and Shake Overview (pg 1) | WS.CHECKT (pg 726) | UNIT.VROTARY (pg 684) | UNIT.VLINEAR (pg 683)

23.36.5 WS.DISARM

General Information	
Type	Command
Description	Cancels ARM requests and resets wake and shake to the IDLE state.
Units	N/A
Range	N/A
Default Value	N/A
Data Type	N/A
See Also	N/A
Start Version	M_01-04-00-000

Description

This command disables wake and shake immediately. Feedback type is not relevant for this command. If WS.ARM (pg 724) has been issued, the request to execute the wake and shake algorithm at the next enable is cancelled. WS.STATE (pg 735) is set to IDLE.

Related Topics

Wake and Shake Overview (pg 1)

23.36.6 WS.DISTMAX

General Information	
Type	R/W Parameter
Description	Sets maximum movement allowed for wake and shake.
Units	deg (position units)
Range	0 to 90 deg
Default Value	15 deg
Data Type	S64
See Also	N/A
Start Version	M_01-01-00-101, M_01-02-00-000

Description

This parameter sets the maximum movement that is allowed for finding commutation. If this value is too small, FF475 (pg 238), "Wake and Shake. Too much movement", may occur before wake and shake is finished. The bigger this value, the more movement is allowed for wake and shake. This value is application dependent.

Related Topics

Wake and Shake Overview (pg 1)

23.36.7 WS.DISTMIN

General Information	
Type	R/W Parameter
Description	Sets the minimum movement required for wake and shake.
Units	Actual position units
Range	0 to 90 deg
Default Value	1 deg
Data Type	S64
See Also	N/A
Start Version	M_01-01-00-101, M_01-02-00-000

Description

This parameter sets the minimum movement that is required for commutation finding. If this value is too small, the the commutation finding might fail if too little current is used. The larger this value, the more movement is needed in order to avoid F473: "Wake and Shake: Too little movement".

Related Topics

Wake and Shake Overview (pg 1)

23.36.8 WS.FREQ

General Information	
Type	R/W
Description	Sets the sine frequency of excitation for WS.MODE 2.
Units	Hz
Range	0.01 - 8000
Default Value	10
Data Type	Float
Start Version	M_01-05-10-000

Description

This keyword sets the excitation frequency for Wake and Shake mode 2.

The default setting of 10Hz will work for almost all systems.

In cases where the load attached to the motor is much higher than the motor inertia (200:1) it may be necessary to lower the value of WS.FREQ.

Effects of lowering WS.FREQ:

- Wake and Shake Mode 2 will take longer to complete.
- A higher magnitude of motion will be seen on the motor because the motor has current applied in the same direction for a longer period of time.

Related Topics

WS.MODE (pg 733)

23.36.9 WS.IMAX

General Information	
Type	R/W Parameter
Description	Sets maximum current used for wake and shake.
Units	Arms
Range	0 to (lower value of MOTOR.IPEAK and DRV.IPEAK) Arms
Default Value	(half of maximum) Arms
Data Type	U16
See Also	MOTOR.IPEAK (pg 575), DRV.IPEAK (pg 405)
Start Version	M_01-01-00-101, M_01-02-00-000

Description

This parameter defines the maximum current used for wake and shake. If the selected current is too low, the minimum required movement may not occur. If the selected current is too high, the movement may be too fast (overspeed) or too large (over maximum movement).

The maximum of this parameter is the lower value of MOTOR.IPEAK and DRV.IPEAK. The default value of this parameter is the half of its maximum. This value depends on the specific application.

Related Topics

Wake and Shake Overview (pg 1)

23.36.10 WS.MODE

General Information	
Type	R/W Parameter
Description	Sets the method used for wake and shake.
Units	N/A
Range	0 to 1
Default Value	0
Data Type	U8
See Also	N/A
Start Version	M_01-01-00-101, M_01-02-00-000

Description

This parameter sets the method used for finding commutation.

0 = Standard wake and shake

Two iterations are used to find the correct angle in this mode. Coarse (current mode) and fine (velocity mode) iterations are done in a loop (WS.NUMLOOPS times). The average angle of all loops is calculated and used.

1 = Commutation alignment by fixed commutation vector (Zero Method)

The motor poles are set to 0, current mode is activated, and WS.IMAX is applied. The angle in which the motor settles is used for commutation. Other settings are restored (such as motor poles and operation mode).

Related Topics

Wake and Shake Overview (pg 1)

23.36.11 WS.NUMLOOPS

General Information	
Type	R/W Parameter
Description	Sets the number of repetitions for wake and shake.
Units	counts
Range	0 to 20 counts
Default Value	5 counts
Data Type	U8
See Also	N/A
Start Version	M_01-01-00-101, M_01-02-00-000

Description

This parameter sets the maximum number of wake and shake repetitions. MOTOR.PHASE is calculated as mean value of all wake and shake repetitions.

Related Topics

Wake and Shake Overview (pg 1)

23.36.12 WS.STATE

General Information	
Type	R/O Parameter
Description	Reads wake and shake status.
Units	N/A
Range	N/A
Default Value	Only valid before the first enable occurs. 11 - for feedback types that do not require wake and shake 1 - for feedback types that require wake and shake
Data Type	U8
See Also	N/A
Start Version	M_01-01-00-101, M_01-02-00-000

Description

WS switches different current vectors and records position feedback in order to establish commutation alignment.

WS.STATE 0 = wake and shake successful (DONE).

WS.STATE 1 = wake and shake configured and will be done at next enable (ARMED).

WS.STATE 2 = wake and shake running. (ACTIVE)

WS.STATE 10 = error occurred during wake and shake (ERROR).

WS.STATE 11 = wake and shake not required (IDLE).

Related Topics

Wake and Shake Overview (pg 1)

23.36.13 WS.T

General Information	
Type	R/W Parameter
Description	Sets wake and shake current-vector appliance time.
Units	ms
Range	1 to 200 ms
Default Value	2 ms
Data Type	U8
See Also	WS.IMAX (pg 732), WS.DISTMAX
Start Version	M_01-01-00-101, M_01-02-00-000

Description

This parameter defines the duration for each different current-vector while the coarse angle calculation. The move distance is proportional to the WS.T and WS.IMAX value.

Related Topics

Wake and Shake Overview (pg 1)

23.36.14 WS.TDELAY1

General Information	
Type	NV Parameter
Description	Delay for wake and shake timing.
Units	ms
Range	0 to 200 ms
Default Value	5 ms
Data Type	U8
See Also	N/A
Start Version	M_01-01-00-101, M_01-02-00-000

Description

WS.TDELAY1 defines the delay time of the wake and shake function. This time is a delay time between the switching of different current vectors during the wake and shake procedure. This time should be increased in the case of movement interferences between single current vectors.

Related Topics

Wake and Shake Overview (pg 1)

23.36.15 WS.TDELAY2

General Information	
Type	NV Parameter
Description	Sets the delay for wake and shake timing.
Units	ms
Range	0 to 200 ms
Default Value	50 ms
Data Type	U8
See Also	N/A
Start Version	M_01-01-00-101, M_01-02-00-000

Description

WS.TDELAY2 defines the delay between switching from coarse angle calculation to fine angle calculation during the wake and shake procedure. This time should be increased in the case of interferences between the coarse calculation done in current mode and the fine calculation done in velocity mode. Choosing too large a value increases the wake and shake duration.

Related Topics

Wake and Shake Overview (pg 1)

23.36.16 WS.TDELAY3

General Information	
Type	NV Parameter
Description	Sets the delay for wake and shake between loops in mode 0.
Units	ms
Range	0 to 2,000 ms
Default Value	100 ms
Data Type	U16
See Also	N/A
Start Version	M_01-01-00-102, M_01-02-00-000

Description

WS.TDELAY3 defines the delay between complete loops in mode 0 only. Decreasing this value makes the wake and shake procedure faster, but may lead to problems if the motor moves too long. Increasing this value will make wake and shake significantly longer.

Related Topics

Wake and Shake Overview (pg 1)

23.36.17 WS.TIRAMP

General Information	
Type	R/W Parameter
Description	Sets the ramp time for the ramp up current in Wake & Shake mode 1.
Units	ms
Range	512 to 10,000
Default Value	512
Data Type	U16
Start Version	M_01-06-07-000

Description

In Wake & Shake mode 1, a maximum current of WS.IMAX is applied to the motor. WS.TIRAMP defines a time to reach this maximum current. Longer times are useful for big inertia motors or heavy loads.

Related Topics

Wake and Shake Overview | WS.MODE (pg 733) | WS.TSTANDSTILL (pg 741)

23.36.18 WS.TSTANDSTILL

General Information	
Type	R/W Parameter
Description	Sets the calming time of the motor for Wake & Shake mode 1.
Units	ms
Range	100 to 20,000
Default Value	1000
Data Type	U16
Start Version	M_01-06-07-000

Description

In Wake & Shake mode 1, a maximum current of WS.IMAX is applied to the motor. WS.TSTANDSTILL defines a wait time, during which this maximum current is held, before detecting the commutation angle of the motor. Longer times are useful for big inertia motors or heavy loads.

Related Topics

Wake and Shake Overview | WS.MODE (pg 733) | WS.TIRAMP (pg 740)

23.36.19 WS.VTHRESH

General Information	
Type	NV Parameter
Description	Defines the maximum allowed velocity for Wake & Shake.
Units	Depends on UNIT.VROTARY (pg 684) or UNIT.VLINEAR (pg 683)UNIT.A-CCLINEAR (pg 676) Rotary: rpm, rps, deg/s, Custom Units (pg 77)/s, rad/s Linear: counts/s, mm/s, µm/s, Custom Units (pg 77)/s
Range	Rotary: 0.000 to 15,000.000 rpm 0.000 to 250.000 rps 0.000 to 90,000.000 degree/s 0.000 to 1,250.000 Custom Units (pg 77)/s 0.000 to 1,570.796 rad/s Linear: 0.000 to 1,073,741,824,000.000 counts/s 0.000 to 8,000.000 mm/s 0.000 to 8,000,000.000 µm/s 0.000 to 1,250.000 Custom Units (pg 77)/s
Default Value	100 rpm
Data Type	U16
See Also	N/A
Start Version	M_01-01-00-101, M_01-02-00-000

Description

This parameter defines the maximum allowed velocity that occurs while commutation finding is active. This supervision runs in real time, but only while wake and shake is active (WS.STATE 2 or greater, for Mode 0). If at any time while wake and shake is running a velocity higher than this value is detected, fault F478 (pg 238) is generated. Setting WS.VTHRESH to zero disables this feature. For Mode 1, WS.VTHRESH is only used after the initial phase-finding.

Related Topics

Wake and Shake Overview (pg 1)

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For assistance with your application needs, visit www.kollmorgen.com or contact us at:

Asia

Kollmorgen

Rm 2205, Scitech Tower

Beijing, China

22 Jianguomen Wai Street

Phone: +86 - 400 666 1802

Fax: +86 - 10 6515 0263

Email: sales.china@kollmorgen.com

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