CA Series
Digital Servodrive

Installation and Operation Manual
Rev. 3

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Custom Motors, Inc. extends no warranty with respect to the merchantability or fitness of this product for any particular purpose. It is the customer's responsibility to determine whether it is suitable for the specific application and whether it meets performance, reliability and safety requirements when used in that application. Custom Motors, Inc. reserves the right to make improvements to the product as well as this documentation at any time without notice.

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Chapter 1 - Welcome

This manual provides information about Custom Motors, Inc.'s CA Series Servodrives and CM Series Servo motors --- providing both technical descriptions and information required for their installation, operation and maintenance.

The manual is divided into the following chapters:

Chapter 1	**Welcome** introduces you to this manual and how it is organized.
Chapter 2	**General Description** gives an overview of the CA Series Servodrive product family.
Chapter 3	**Installation** provides instructions on how to install your CA Series Servodrives. It also provides a complete hardware description of the CA Series Servodrives.
Chapter 4	**Operation** documents the power up and initial configuration approach for the CA Series Servodrive.
Chapter 5	**Getting Started** provides detailed instructions on how to run your CA Series Servodrive system for the first time.
Chapter 6	**Specifications** provides a detailed list of performance specifications for CA Series Drives and CM-Series brushless servomotors.
Chapter 7	**Maintenance and Troubleshooting** documents the various status and alarm indicators.
Chapter 8	**Software Commands**
Appendixes	**Appendixes** contain a detailed drawing set.

Chapter 2 - General Description

2 General Description

This manual covers CA Series Servodrives, which control a wide variety of AC Servomotors.

CA Series Servodrive Capabilities and Features

- **Simple Setup:** All drive configuration settings are set by the user's application software using the RS-232 interface or RS-485 eliminating drive jumpers, address switches, and potentiometers.
- **All Digital:** High speed DSP-controlled current loops for precise torque mode and velocity mode operation.
- **Standard Line Voltage Input:** CA Series Drives can be operated directly on commercial power lines which supply at either 115 (+15%, -20%) or 230 (+15%, -20%) VAC for the main power as well as the control power.
- **Fault Detection and Protection:** Detection and protection against:

  Motor short
  Peak & RMS drive current limit
  Peak & RMS motor current limit
  Missing phase detection (CA25, CA35, & CA60 only)
  Encoder open wire detection
  Hall sensor phasing error
  Motor over temperature

- **Diagnostics:** A 7-segment display shows alarm status. Individual LED indicates bus power.
- **Variety of Commutation Options:** CA Series Drives can be configured for sinusoidal or trapezoidal commutation for AC brushless motors, as well as for DC motor operation to control DC motors, voice coils and other single phase actuators.
- **Soft Start:** Circuitry is provided to reduce Servodrive in-rush current.
- **Torque Mode Operation:** Torque mode operation allows extremely high load inertia to motor inertia ratios.
- **Velocity Mode Operation:** Velocity mode operation allows for fast and precise velocity control.
- **Wide Current Loop Bandwidth:** For high positioning accuracy and response.
- **Small Package:** CA Series Drives have a small footprint to conserve panel space.
- **Shunt Regulation:** All Models except CA05 have shunt regulation circuitry. If an application requires regenerative operation, regenerative discharge resistors can be mounted external to the Servodrive.

CA Series Drive Model Number Description

CA## -E

Current

##	=	continuous rated current, amps (05, 10, 17, 25, 35, 60)
E	=	encoder

CM-Series Servomotor Capabilities and Features

- **Wide Power Range:** Output power ratings from 0.1 to 18 HP.
- **Wide Torque Range:** Continuous stall torques from 1 to 1,200 in.-lbs.
- **Low to High Speed:** Maximum motor speeds from 0 to 5,000 RPM.
- **High Torque-to-Inertia Ratios:** Motors with high *Torque-to-Inertia* ratios deliver a higher percentage of rated power to the load in applications that require high acceleration and deceleration rates.
- **Durable Construction:** Service life is maximized by the brushless motor construction, high thermal efficiency frame and rugged sealed bearings. Standard IP-65 motor sealing permits operation in harsh industrial environments.
- **Industrial Internal Position Transducer** The standard rugged internal position encoder measures 8,192 precise increments of position, or counts, per revolution.
- **Low Torque Ripple:** Sinusoidal construction combined with precise sinusoidal electronic commutation provide low motor output torque ripple.
- **Fail-Safe Brake:** An optional fail-safe brake is available integral to the motor.
- **High Speed:** Maximum motor speeds from 2,000 to 4,500 RPM.
- **High Torque-to-Inertia Ratios:** Motors with high *Torque-to-Inertia* ratios deliver a higher percentage of rated power to the load in applications which require high acceleration and deceleration rates.
- **Durable Construction:** Service life is maximized by the brushless motor construction, high thermal efficiency frame and rugged sealed bearings. Standard IP-65 motor sealing with optional IP-67 sealing permits motor operation in harsh industrial environments.
- **Industrial Internal Position Transducer:** The rugged internal position transducer measures 4096 to 32,768 (depending on selected motor) precise increments of position, or counts, per revolution.

- **Low Torque Ripple:** Sinusoidal construction combined with precise sinusoidal electronic commutation provide low motor output torque ripple.
- **Fail-Safe Brake:** An optional fail-safe brake is available integral to the motor.

Chapter 3 – Installation

3 Installation

Receiving and Inspection

Custom Motors, Inc. Servodrives, Servomotors, and their associated accessories are put through rigorous tests at the factory before shipment. After unpacking, however, check for damage, which may have been sustained in transit. The bolts and screws should all be tight, and motor output shafts should rotate freely by hand. Check the Servodrives and any accessories for bent or broken components or any other physical damage before installation.

Servodrive Panel and Environment Considerations

Servodrives are designed for panel mounting, with the panel in turn mounted in a metallic enclosure (supplied by the machine builder). For optimal EMC (ElectroMagnetic Compatibility) shielding, the enclosure should have continuous ground continuity maintained between all metal panels.

For high quality servo performance, proper wiring, grounding and shielding techniques must be considered.

The Servodrive environment should be maintained as follows:

- Ambient operating temperature should be at or below 50ºC.
- If the electrical panel is subjected to vibration, mount the units on shock absorbing material.
- Avoid use in corrosive atmospheres which may cause damage over time.
- Select a location with minimum exposure to oil, water, hot air, high humidity, excessive dust, or metallic particles.
- The proper mounting orientation for the Servodrive is vertical on a panel using the mounting holes (3 with CA05, CA8.2, CA14, 4 with CA25, CA35 and CA60) on the base plate.
- Allow sufficient clearance around Servodrives for airflow, and provide proper ventilation. Section 0 shows the minimum clearance between drives.
- External regenerative discharge resistors should be mounted in an enclosure separate from the Servodrive enclosure, if possible. Regenerative discharge resistors can become extremely hot, so proper ventilation must be provided.

Servodrive Outline Drawings – See pages 69 and 70

Additional clearance above, below and on each side of the Servodrives is also required for heat dissipation:

CA05 and CA8.2
Add 2” (51 mm) clearance top and bottom.
Add 1” (25 mm) clearance each side.

CA14
Add 2” (51 mm) clearance top and bottom.
Add 1.2” (31 mm) clearance each side.

CA25, CA35 and CA60
Add 2” (51 mm) clearance top.
Add 4” (102 mm) clearance bottom.
Add 1” (25 mm) clearance each side.

UltraTools Software Configuration

The following drive settings are configured with UltraTools:

- **Motor Model Number**
  - **Continuous Stall Current**
  - **Peak Current**
  - **Maximum Speed** of motor
  - **Resistance** measured phase-to-phase
  - **Inductance** measured phase-to-phase
  - **Number of Poles**
  - **Hall Offset**
  - **Maximum Drive Input Voltage** based on motor’s rating
  - **Commutation Feedback Type**:
    Incremental encoder with separate U,V,W hall inputs -or-
    Incremental encoder with encoded U,V,W hall information -or-
    U,V,W hall inputs without incremental encoder
  - **Feedback Resolution** (Counts per revolution)
  - **Thermal Switch** in motor is present/not present
  - **Thermal Time Constant** of motor.
- **Motor Over Temperature Handling** (Ignore/Error/Drive Alarm)
- **Hardware Travel Limit Inputs** (Enable/Disable)
- **Input Voltage for Drive** (115/230)
- **Regen Resistor Resistance** (Ohms)
- **Regen Resistor Rated Power** (Watts)

These settings can be stored in a (.udp) file, downloaded to the CA Series drive, and stored in the drive’s EEPROM.

Servodrive Power Considerations

Supply Power

CA Series Drives can be operated, through line filters or an isolation transformer, on commercial power lines which supply either 115 (+15%, -20%) or 230 (+15%, -20%) VAC, 50/60 Hz. Suitable for use on a circuit capable of delivering not more than 5000 rms symmetrical amperes, 240 V maximum.

To prevent power line accidents due to grounding error, contact error, or to protect the system from a fire, circuit breakers or fuses must be installed according to the number and size (current capacity) of CA Series Drives used. Slow-blow circuit breakers or fuses should be used because the Servodrives draw substantial inrush current at power up.

Shielding, Power Line Filtering & Noise Suppression

The Servodrive uses high voltage switching power transistors in the main DC Bus circuit. When these transistors are switched, the $^{di}/_{dt}$ or $^{dv}/_{dt}$ switching noise may sometimes prove objectionable depending on the wiring and/or grounding method. The Servodrive also utilizes a microprocessor, which can be susceptible to power line interference caused either by the output switching transistors or other equipment on the power line, such as welders, electrical discharge machines, induction heating equipment, etc. Careful layout of wiring and power line filtering will help prevent noise interference. Recommendations with respect to wiring and grounding are described later in this section.

It is recommended that line filters be installed to eliminate electro-magnetic interference coming into the system from the power line, as well as block switching noise from being transmitted back out to the power line from the Servodrives.

Sizing Fuses, Line Filters, and Transformers

To determine current requirements for fuses, line filters and transformers for main power, use the following conservative formulas:

$$\textbf{Required Power} \text{ (in KVA)} = \frac{1.1 * \textbf{Rated Power of Motor} \text{ (in Watts)}}{1000}$$

$$\textbf{Required Current} \text{ (in Amps)} = \frac{1.1 * \textbf{RatedPower of Motor} \text{ (in Watts)}}{\textbf{Incoming Line Voltage} \text{ (in Volts AC)}}$$

In cases where the motor is substantially over-sized for an application, consider substituting the actual power required by the application into the above formulas, instead of the motor's rated power.

Power Dissipation

Use the following table to determine cabinet cooling requirements:

	Dissipated Power (Watts)			
	Control Power Max	Control Power Typical	Main Power	**External** Regen Resistor (if used)
				—
CA05	45	20	120	—
CA8.2	45	20	240	1500 max.
CA14	45	20	400	2100 max.
CA25	56	31	650	3200 max.
CA35	56	31	900	4000 max.
CA60	56	31	1550	4800 max.

***Table 1**, Power Dissipation*

Main power dissipation in shown in the table for the rated output power of the drive. The actual dissipated main power may be lower, depending on the motor and/or application requirements. To more closely estimate main power dissipation, use the conservative formula: 0.1*(rated power of the motor). In cases where the motor is substantially oversized for the application, use 0.1*(the power required by the application).

Power dissipated in the regen resistor is dependent on the regen resistor connected to the drive, as well as the application requirements. The table shows the rated capability of the regen transistor in the Servodrive.

Line Filters

Once the incoming power service is determined, the appropriate main power line filter can be selected from the following chart. In the case of a system using multiple Servodrives, only one line filter is required per cabinet.

Servo Drive	Main Power Input Voltage	Total Continuous Current	Main Power Line Filter
CA05	Single phase		
		Up to 30 Amps	SAC-LF230U
CA8.2 CA14 CA25 CA35 CA60	Three-phase	Up to 30 Amps	SAC-LF30C
		30 – 55 Amps	SAC-LF55C
		55 – 100 Amps	SAC-LF100C

***Table 2**, Line Filter Recommendations*

The following methods are recommended for the proper installation of line filters:

1) The filter must be mounted on the same panel as, and as close as possible to, the Servodrive(s).

2) Paint or other panel covering material should be removed before mounting the filter.

3) All SAC-LF___C line filter ground connections should be tied to the earth ground with a single wire (preferably braid), and **the filter must be grounded before connecting the Servodrives.**

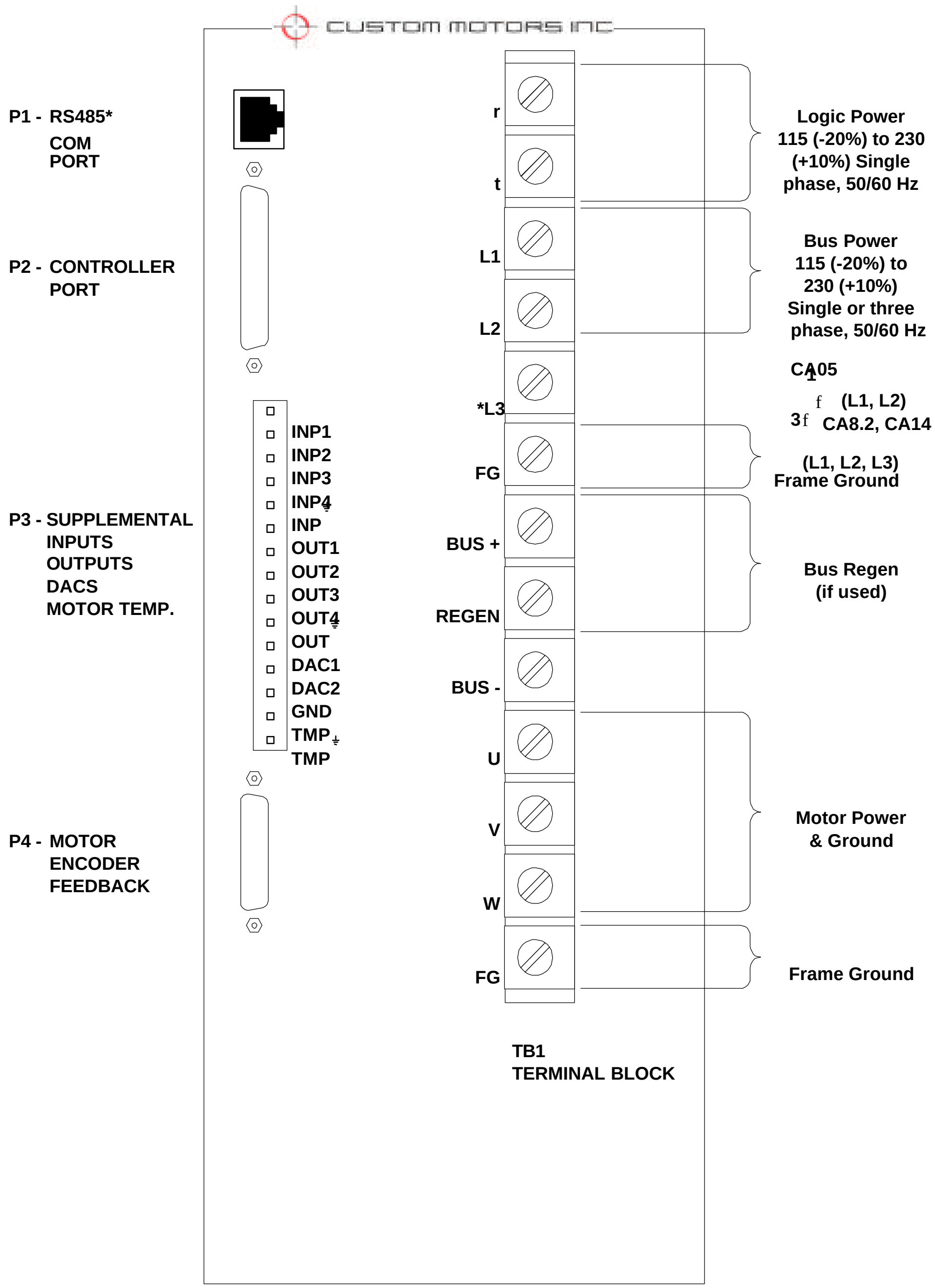
4) Line filters should not be touched for a minimum of 10 seconds after removal of the supply power.

5) Separate the input and output leads by a minimum of 10 inches (250 mm). Do not bundle them or run them in the same duct or wireway.

Do not bundle the ground lead with the filter output lines or other signal lines, and do not run them in the same duct.

Servo Drive Connections

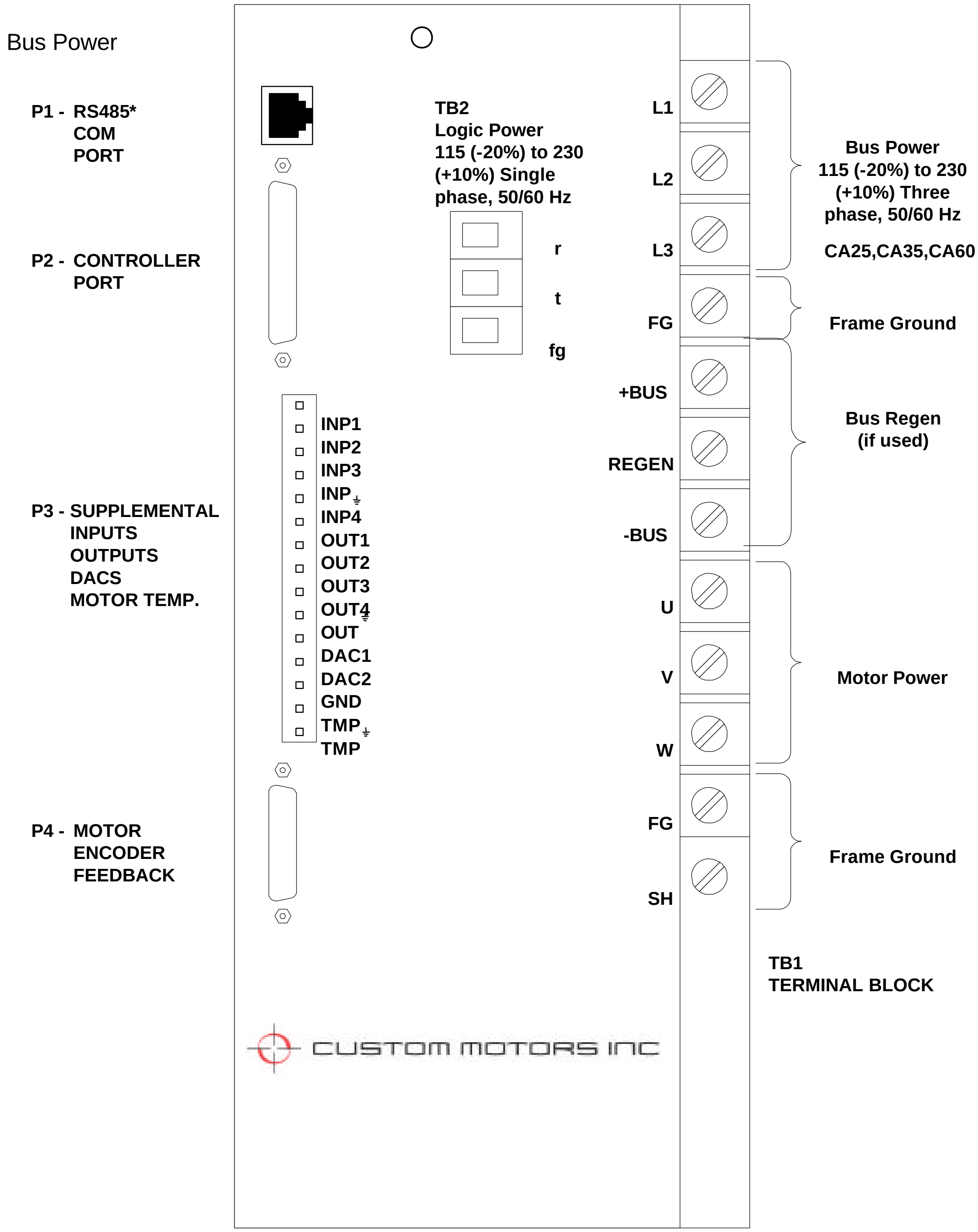
This section describes the Servodrive connections at TB1, TB2 (CA25 – CA60 only), and P1, P2, P3, and P4. Signal descriptions are given in **Table 3** through **Table** . The remainder of Section 0 shows additional wiring information.



P1 Com Port can be software converted to RS232

L3 – Not used on CA05

***Figure 1**, CA Series Drive Connections Overview* (CA05, CA8.2, CA14)



P1 Com Port can be software converted to RS232.

***Figure 2**, CA Series Drive Connections Overview* (CA25, CA35, CA60)

Power Terminal Block (TB1)

Refer to the Servodrive Connector Part Numbers section (page 63) of the Specifications chapter for further information.

Signal	Function	Description
R, T	Logic Power (CA05, CA8.2, CA14 only)	Single phase 115 (-20%) to 230 (+15%) VAC, 50/60 Hz control logic input power.
L1, L2, L3 – or – **L1, L2**	Bus Power	**(CA8.2, CA14, CA25, CA35, CA60):** Three phase 115 (+15%, -20%) or 230 (+15%, -20%) VAC, 50/60 Hz**.** **(CA05):** Single phase 115 (+15%, -20%) to 230 (+15%, -20%) VAC, 50/60 Hz. The input voltage should match the UltraTools software setting, to ensure proper operation of low bus voltage faults and inrush current limiting.
FG	Ground	Ground for input power
Bus + **Bus -**	Bus Regen	**Nominal bus voltage:** **325 VDC for 230 VAC input** **163 VDC for 115 VAC input** These terminals can be used for connecting bus power between Servodrives. If an external regen resistor is used (CA8.2, CA14, CA25, CA35, CA60 only), it is connected between **Bus +** and **REGEN.** See Section 0, External Regen Resistor Wiring (RG) (page 312).
REGEN	Regen Resistor	If an external regen resistor is used (CA8.2, CA14, CA25, CA35, CA60 only), it is connected between **Bus +** and **REGEN.** See Section 0, External Regen Resistor Wiring (RG) (page 312).
U,V,W	Motor Power	Single or Three-phase power to the motor. See: • CM-Series Servomotor Connection (page 36) The motor type must match the UltraTools software setting, to ensure proper operation.
FG	Ground	Ground connection for motor frame ground
SH	Shield Ground	Connection for motor shield ground (CA25 – CA60 only)

Table 3, *Power Terminal Block (TB1) Description*

Logic Power Terminal Block (TB2) (CA25, CA35, CA60 only)

Refer to the Servodrive Connector Part Numbers section (page 65) of the Specifications chapter for further information.

Signal	Function	Description
r, t	Logic Power	Single phase 115 (-20%) to 230 (+15%) VAC, 50/60 Hz control logic input power.
FG	Ground	Ground for input logic power

Table 4, *Logic Power Terminal Block (TB2) Description (CA25, CA35, CA60)*

RS232 Communications Port (P1)

The P1 connector is used to communicate with external system communications devices, such as a PC running the UltraTools setup and diagnostic program. The port is an RS232 communications port that makes use of an RJ-11 connector. The internal port includes an auto baud rate detect feature which detects the baud rate of incoming data after receiving two successive carriage return / line feeds. The standard protocol of 8 data bits, parity none, and 1 stop bit is supported, as well as others, in speeds ranging from 1200 baud to 38400 baud. The standard Xon/Xoff communication protocol is used for handshaking. The only connections necessary for RS232 communication are GND, TX, and RXA (pins 1, 2, and 3). The remaining lines (pins 4, 5, and 6) are for future expansion. When connecting between the CA Series Servodrive and an external PC, etc., the TX transmit line must connect to the PC serial communications receive line, and the RXA receive line must connect to the PC transmit line.

Standard cables are available from Custom Motors, Inc. Systems Corporation to facilitate connection between the CA Series Servodrive and an external desktop or laptop PC. Refer to the Servodrive Connector Part Numbers section (page 65) of the Specifications chapter for further information.

Pin	Signal	Description
1	GND	Ground
2	TX	Transmit
3	RXA	Receive
4	/RXA	
5	TXA	
6	/TXA	

Table 5A, *RS232 Communications Port (P1) Description*

RS485 Communications Port 1

CA-Series Operation Manual

CA-Series servodrives support an RS485 multi-drop network. Servodrives with this feature enabled use RS485/422 differential signals and addressing protocol to determine which drive responds to commands on the communications bus.

Documentation for electrical connections can be found in the CA-Series Installation & Operation Manual. This document describes the software commands and features added to support operation. Two commands, RS-485 and RS-485EN were added as well as some operational changes as documented below.

NOTE: If more than 4 CA-Series drives are connected together on the same RS485 communications bus, the terminating resistors for all the drives *except the first and last* on the network must be removed. Refer to the Termination Resistor section for further information.

RS-485 Node ID

Format1:	RS-485 {node ID}
Format2:	RS-485?
Type	Direct Mode Command
Argument Type:	Unsigned Integer, 0 to 16
See Also:	RS-485EN, STORE

The RS-485 command sets the node ID for the current drive. The STORE command must be used to save the drive node ID in flash, otherwise, the drive ID will revert to the last value saved in flash the next time the logic power is cycled. A value of 0 will disable RS485 communications, the drive will operate in RS232 mode. Note, it is best to cycle power or issue a reset command after the STORE command. RS485 address changes become effective immediately, however, hardware configuration changes are only done at power up or reset. Thus, changing between RS232 and RS485 with the RS-485 command will change the interface from single ended RS232 to differential RS485 after the next reset, not immediately. See the section Debugging RS485 Communications below for additional help.

Hardware configuration to RS485 is delayed for 30 seconds after power up. The drive will power up configured for RS232. If RS485 has been selected by storing a non-zero address then a P will flash on the display during this initial mode. While in this mode you are able to use RS232 communications and query the drives node address and disable RS485 mode if desired. Also while in this mode RS485 communications will not work. This feature provides a method to reset a servodrive with an unknown RS485 address while the differential RS485 drivers are not available.

If the RS-485? command is entered, the node ID for the current drive will be returned.

Examples:

» RS-485 1	; sets current drive node ID to 1
» RS-485 ?	; returns the current node ID
» STORE	; saves the current drive node ID in flash memory
» RESET	; resets the drive which configures for RS485 mode

RS-485EN

Enable RS-485 Node

Format1:	RS-485EN {node ID}
Type	Direct Mode Command
Argument Type:	Unsigned Integer, 0 to 16
See Also:	RS-485

The RS-485EN command sets the active node ID for the RS-485 communications. If node ID matches this servodrives address, then it will become the active drive. If there is no match then the command is ignored. When a servodrive is not the RS485 active drive all commands except RS-485EN are ignored. See the section Debugging RS485 Communications below for additional help.

Examples:

» RS-485EN 1 ; enable communications with drive node ID 1

» RS-485 ? ; returns the current node ID

» RS-485EN 2 ; enable communications with drive node ID 2

Status Display Changes

The Status LED display functions as documented in the CA-Series Operation Manual with the following additions.

When the drive is disabled and this drive is the active RS485 drive then the display will show a c1 or c2, changing the C to a lower case c. A portion of the STATUS LED table is replaced by:

If drive is not using RS485 or in not the active RS485 drive

C1 Drive disabled by hardware enable input (Check hardware enable input)

C2 Drive disabled by software enable command (Check DRVENA command)

If drive is using RS485 and is the active RS485 drive (RS-485EN <node> received with this node addressed)

c1 Drive disabled by hardware enable input (Check hardware enable input)

c2 Drive disabled by software enable command (Check DRVENA command)

notice that the c is lower case.

When the servodrive is enabled the display is a rapidly rotating figure 8 pattern. When the drive is the active RS485 drive then this pattern will rotate half as fast.

At power up or reset the drive

Debugging RS485 Communications

Setting up a RS485 communication network can be frustrating when a problem develops and it's not clear what the problem is. A number of features are available to assist with this process.

1) In RS485 mode, just as in RS232 mode, initial carriage returns are needed to autobaud the drive so that it configures for the correct baud rate. Wait until the drive enters RS485 mode before issuing the carriage returns. (See the next item.)
2) During the 1st 30 seconds after power up (while the P is flashing) the drive is in RS232 mode and the RS485 address can be queried (RS-485?) or RS485 operation can be disabled (RS-485 0).
3) While RS485 mode is enabled the display changes when the drive is the active drive on the network. This aids in determining that the address communications are working.

RS485 Terminating Resistors

An RS485 communications bus requires signal line terminating resistors on the first and last nodes (drives) on the network. All CA-Series drives are shipped with the terminating resistors installed.

For networks consisting of four drives or less, simply connect the drives together on the network. The total impedance of the terminating resistors should be high enough to allow proper operation.

For Networks with more than four drives, the terminating resistors in all the drives *except the first and last* in the network must be removed as per the following instructions:

1) Disable all power (bus and logic) into the drive and wait for the BUS POWER LED to turn off.
2) Remove the CA-Series drive cover.
3) Remove socketed resistor R98, which is located next to IC chip A30 near the status LED.

4) Replace the CA-Series drive cover.
5) Reapply logic power and test.

Pin	**Signal**	**Description**
1	GND	GND
2	TX	RS232
3	RXA	RS232 (single ended) and RS485 (differential)
4	/RXA	RS485 inverted side of receiver
5	TXA	RS485 – positive side of differential transmitter
6	/TXA	RS485 – inverted side of differential transmitter

Table 5B, *RS485 Communications Port (P1) Description*

Controller Port (P2)

The DB25 connector at P2 is designed to connect an external controller to the CA Series Servodrive. The signals present on this connector should provide all that is needed to permit an external controller to control the operation of the power output section of the Servodrive.

(Continued on next page)

Pin		Description
1	**Velocity/Torque Analog Command Signal Input (+)**	This input is the positive input of the analog command signal for velocity or torque. **Note**: In order for the CA Series Servodrive to control motor motion through this analog signal, the Servodrive must be operating in ANALOG mode, not SERIAL mode. ANALOG is the default startup mode for the Servodrive when it first powers up. Please refer to the software commands later in this manual. **Differential Input**: For differential input, the analog command signal is applied between P2 pin1 (positive input) and P2 pin 2 (negative input). **Single-ended Non-inverted Input**: For single-ended non-inverted input, the signal is applied to P2 pin 1 with respect to common, which is analog ground, pin 4. To achieve single-ended input, P2 pin 2 must be jumpered to pin3.
2	**Velocity/Torque Analog Command Signal Inverted Input (–)**	When using differential inputs, this input is the negative input of the analog command signal for velocity or torque. When using single-ended non-inverted input mode, pin 2 must be jumpered to pin 3. When using single-ended inverted input mode, pin 1 must be jumpered to pin 3, and the command signal is applied to this pin (pin 2). See pin 1 above.
3	**Analog Ground**	Single-ended jumper reference. This ground is provided to facilitate operation with single-ended input.
4	**Analog Ground**	Shield for differential input, or single-ended common.
5	**+ 5 volts**	For external use (10 ma max.)
6	**Encoder Reference Output Z –**	Index or marker channel compliment reference
7	**Encoder Reference Output Z +**	Index or marker channel reference
8	**Encoder Reference Output B +**	Encoder data channel B reference. See Section 0, Commutation Feedback Signals.
9	**Encoder Reference Output B –**	Encoder data channel B compliment reference
10	**Encoder Reference Output A +**	Encoder data channel A reference. See Section 0, Commutation Feedback Signals.
11	**Encoder Reference Output A –**	Encoder data channel A compliment reference

***Table 6**, Controller Port (P2) Description*

(continued on next page)

Pin	Signal	Description
12*	**Dedicated Fault Output Common**	This pin provides a common for **Fault Output** (pin 13). This is an isolated output.
13*	**Dedicated Fault Output**	This output will normally be closed if no fault condition exists. If a fault condition occurs, this output will be opened until the fault condition causing it is cleared. Cycling P2 pin 24 will not clear this fault output by itself. The fault can only be cleared by first correcting the condition causing the fault, and then by performing a Fault reset using pin 24 or sending the FAULT 0 command via the RS232 port or completely resetting or repowering the Servodrive.
14*	**Digital Input 1 (INP1)**	This input provides a convenient means for sending an input signal from the controller to a user selectable input. This isolated input is identical to **INP1** on P3. See 0, Shared Digital Inputs & Outputs.
15*	**Digital Input 2 (INP2)**	This input provides a convenient means for sending a second input signal from the controller to a user selectable input. This isolated input is identical to **INP2** on P3. See 0, Shared Digital Inputs & Outputs.
16*	**Digital Input Common**	This pin provides a common for both of the digital input connections. These are all isolated inputs.
17*	**Digital Output 1 (OUT1)**	This output provides a convenient means for sending an output signal from the Servodrive back to the controller. This isolated output is identical to **OUT1** on P3. See 0, Shared Digital Inputs & Outputs.
18*	**Digital Output 2 (OUT2)**	This output provides a convenient means for sending a second output signal from the Servodrive back to the controller. This isolated output is identical to **OUT2** on P3. See 0, Shared Digital Inputs & Outputs.
19*	**Digital Output 3 (OUT3)**	This output provides a convenient means for sending a third output signal from the Servodrive back to the controller. This isolated output is identical to **OUT3** on P3. See 0, Shared Digital Inputs & Outputs, below.
20	**Digital Output Common**	This pin provides a common for all three of the digital output connections. These are all isolated outputs.
21	**Reserved**	**Do not connect to this terminal.**
22	**Reserved**	**Do not connect to this terminal.**
23*	**Dedicated Drive Enable Input**	By default, this input must be pulled high in order to enable the Servodrive. If this input is held open, output to the motor will be disabled. This default setting can be reversed by changing the INPFN98 setting in the command mode, or by changing the drive enable input setting in UltraTools.
24*	**Dedicated Fault Reset Input**	In the event that a Servodrive fault occurs, it can be cleared and reset by closing this input for a minimum of 4 milliseconds and then reopening it. This default setting can be reversed by changing the INPFN99 setting in the command mode, or by changing the drive reset input setting in UltraTools.
25*	**Dedicated Drive Enable / Fault Reset Common**	This pin provides a common for the Drive Enable and Fault Reset Inputs. These are both isolated outputs.

Table 6*, Controller Port (P2) Description*

* All of the inputs and outputs noted for P2 above follow the hardware setup described in **Figure 4, Making Digital I/O Connections**, later in this chapter.

Shared Digital Inputs & Outputs

Please note that the two digital inputs (**INP1** & **INP2**) and three digital outputs (**OUT1** – **OUT3**) brought out by this P2 connector to the controller are identical to the I/O of the same name on the P3 connector. They are included on P2 for convenience in connecting with the controller. The digital outputs can be monitored at both P2 and P3 without confusion or harmful results. However, the digital inputs must be controlled at only one location, either P2 or P3. If the inputs (**INP1** & **INP2**) are actually controlled at P2, then no connection should be made to these inputs on the P3 connector. If the inputs are controlled at P3, then no connection should be made to them at the P2 connector. See **Figure 3**:

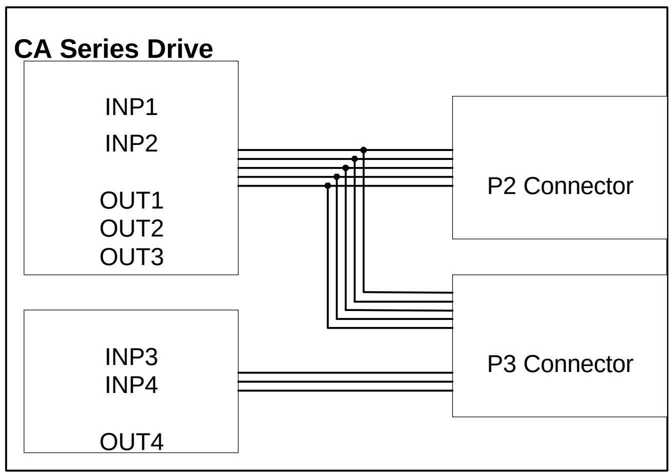


***Figure 3**, Shared Digital Inputs & Outputs*

Supplemental Input Port (P3)

This quick-disconnecting Phoenix style header provides connections for the digital I/O, the DACs, and the motor temperature input. The digital inputs and outputs are user definable as to function and provide flexibility in handling such things as Servodrive faults, etc. The two DAC outputs can help monitor signal levels and other items of interest. The motor temperature condition tracked on this connector provides protection against damaging the motor. Please note that the motor temperature wiring hookup must agree with the MOTMODE software command of the Servodrive. That is, if ‘Overtemp:’ in the motor setup in UltraTools indicates to IGNORE the motor temperature sensor (MOTMODE 0), then no connection should be made to the TMP terminals on P3, or an ‘F4’ motor temperature error will occur. Likewise, if the choice is to indicate a fault (MOTMODE 1 and 2), then a valid motor temperature connection MUST be made, or an ‘F4’ motor temperature error will occur.

Pin	Signal	Description
1*	**Digital Input 1 (INP1)**	Fully isolated digital input. See 0, Shared Digital Inputs & Outputs.
2*	**Digital Input 2 (INP2)**	Fully isolated digital input. See 0, Shared Digital Inputs & Outputs.
3*	**Digital Input 3 (INP3)**	Fully isolated digital input.
4*	**Digital Input 4 (INP4)**	Fully isolated digital input.
5*	**Digital Input Common**	This pin provides a common for all of the digital input connections. These are all isolated inputs.
6*	**Digital Output 1 (OUT1)**	Fully isolated, user definable digital output. See 0, Shared Digital Inputs & Outputs.
7*	**Digital Output 2 (OUT2)**	Fully isolated, user definable digital output. See 0, Shared Digital Inputs & Outputs.
8*	**Digital Output 3 (OUT3)**	Fully isolated, user definable digital output. See 0, Shared Digital Inputs & Outputs.
9*	**Digital Output 4 (OUT4)**	Fully isolated, user definable digital output.
10*	**Digital Output Common**	This pin provides a common for all of the digital output connections. These are all isolated outputs.
* All of the inputs and outputs noted for P2 above follow the hardware setup described in **Figure 4, Making Digital I/O Connections**, later in this chapter.		

Table 7, *Supplemental I/O Port (P3) Description (continued from previous page)*

Pin	Signal	Description
11	**Digital – to - Analog Output 1 (DAC1)**	Torque Monitor ±10 VDC analog signal. 3 VDC = rated torque.
12	**Digital – to - Analog Output 2 (DAC2)**	Velocity Monitor ±10 VDC analog signal. The scaling depends on the maximum speed of the motor: Max speed 5000 rpm or higher: 1 VDC = 1000 rpm. Max speed between 2000-4999 rpm: 2 VDC = 1000 rpm. Max speed 1999 rpm or lower: 5 VDC = 1000 rpm. The maximum speed normally defaults to the maximum speed printed on the side of the motor, but for G-Series motors rated for 460 VAC (MAC-Gxxxx**4**), but operated at 230 VAC, it is limited to half of the maximum speed printed on the side of the motor.
13	**DAC Signal Common**	This pin provides a common for the two digital to analog outputs.
14*	**Motor Temperature Input**	This is the input pin for the normally closed motor thermal switch. These motor temperature pins are located close to the feedback connector, the normal source for the motor temperature input wires. The MOTMODE command defines how the drive will react to this input. **Note**: Failure to monitor the motor temperature outputs could result in damage to the motor and could void your warranty.
15*	**Motor Temperature Common**	This pin provides a common for the Motor Temperature Input.
* All of the inputs and outputs noted for P2 above follow the hardware setup described in **Figure 4, Making Digital I/O Connections**, later in this chapter.		

Table 7, *Supplemental I/O Port (P3) Description (continued from previous page)*

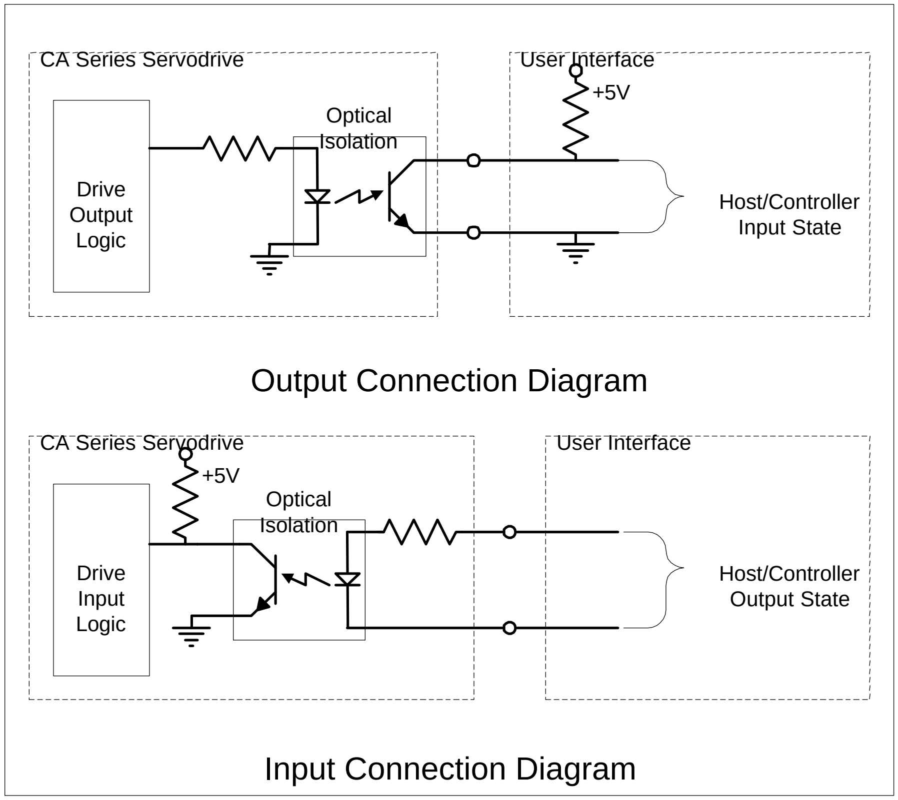


***Figure 4**, Making Digital I/O Connections*

Feedback Port (P4)

The DB15 connector at P4 provides a simple and effective method for connecting the servomotor feedback to the CA Series Servodrive. This supplies the necessary encoder and Hall's information to the DSP which allow it to track velocity and also provide commutation control to the servomotor.

Refer to the Servodrive Connector Part Numbers section (page 65) of the Specifications chapter for further information.

Pin	Signal	Description
1	ENC PWR	+5.3 VDC power supply output for the motor encoder (450 mA max). This power is derived from the input control power at pins **r,t**.
2	DGND	Common for the +5.3 VDC supply (ENC PWR).
3 **4**	ENCZ' ENCZ	Differential input, "once per revolution" marker signal from the motor encoder.
5 **6**	ENCB' ENCB	Differential input, quadrature feedback channel B from the motor encoder.
7 **8**	ENCA' ENCA	Differential input, quadrature feedback channel A from the motor encoder.
9	SHIELD	Motor encoder shield termination point
10 **11** **12** **13** **14** **15**	W' W V' V U' U	Differential or single-ended input, commutation feedback channels U, V and W from the motor encoder. The U, V and W (pins 15, 13 & 11) inputs are intended for use with single ended commutation feedback. If the feedback signals are open collector outputs, external biasing hardware may be required. The U', V' and W' (pins 14, 12 & 10) inputs are internally biased and no connection or external circuitry is required for use with single ended feedback.

***Table 8**, Feedback Port (P4) Connections*

External Regen Resistor Wiring (RG)

Regenerative (regen) shunt circuitry, for use with external regen resistors, is provided on Servodrive models CA8.2, CA14, CA25, CA35, and CA60. Regen resistors are connected between the **Bus +** and **REGEN** terminals on TB1 (refer to **Figure 5**).

The following methods are recommended for proper installation of regen resistors:

1. **Regen resistors can become very hot as part of normal operation and should be mounted in a ventilated, "touch safe" enclosure.** Mounting enclosures and regen resistors are not included and must be supplied by the user.
2. Regen resistor wiring should have heat resistant, non-combustible insulation.
3. Regen resistor, and other system, wiring should be routed so that it is not in contact with the regen resistors.
4. **Switching voltages exceeding 400 VDC maybe present on the Bus+ and REGEN terminals (and across the regen resistor).** Use appropriate high voltage safety and noise suppression wiring methods.
5. Mounting and wiring practices should be in accordance with NEC (National Electric Code) or UL (Underwriters Laboratories) specifications and in compliance with local ordinances.

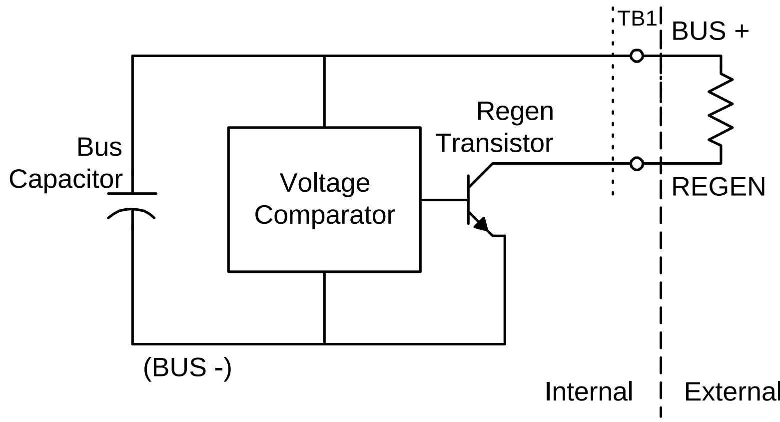


***Figure 5**, Regen Resistor Connection*

For information on how the shunt circuitry operates, as well as information on sizing regen resistors, see regenerative loads (page 50).

Bus Sharing Wiring (CA25 – CA60)

DC Bus sharing is supported on Servodrive models ***CA25, CA35, and CA60 only***. To configure these drives for bus sharing, the **Bus +** and **Bus –** terminals are connected as shown in **Figure 6**. Drives should be connected so that the highest power drives are in the center of the bus-sharing chain. Bus wiring between drives should be less than 12 inches in length to minimize oscillatory effects. As long as the total system regenerative load can be dissipated, there is no limit to the number of drives that can share the DC bus.

For information on how the bus sharing operates, see Bus Sharing. (Page 53)

The following methods are recommended for proper configuration of bus sharing:

1. Wiring should have heat resistant, non-combustible insulation, rated at 600V or more.
2. **Switching voltages exceeding 400 VDC maybe present on the Bus+ and BUS- terminals.** Use appropriate high voltage safety and noise suppression wiring methods.
3. Mounting and wiring practices should be in accordance with NEC (National Electric Code) or UL (Underwriters Laboratories) specifications and in compliance with local ordinances.
4. If an external regen resistor is to be used in conjunction with bus sharing, it should be connected to the largest Servodrive in the bus-shared network. **No more than one regen resistor may be used in any bus sharing configuration**. See Chapter 4 for more information on regen resistor installation.

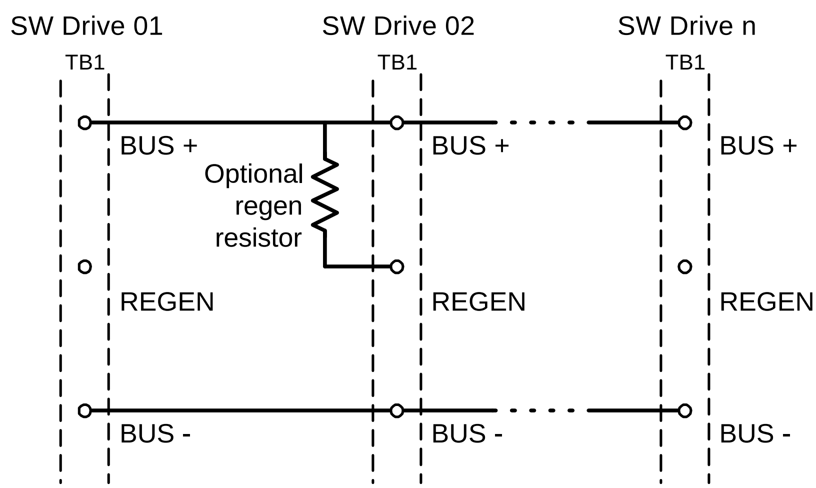


***Figure 6**, Bus Sharing Connections*

Servomotor Installation

Motor Use and Environment

A standard CA-Series (IP65) is designed for use as described below:

- Either horizontal or vertical mounting orientation
- Indoors, clean and dry
- Free from corrosive and/or explosive gases or liquids
- If the location is subject to excessive water or oil, protect the motor with a cover. The motor can withstand a small amount of splashed water or oil.
- Accessible for inspection and cleaning

- Face mounting: the structural integrity of the mounting can be critical to obtaining the maximum performance from your Servomotor application.
- CM-Series Servomotors: Ambient Temperature: 0ºC to +40ºC.

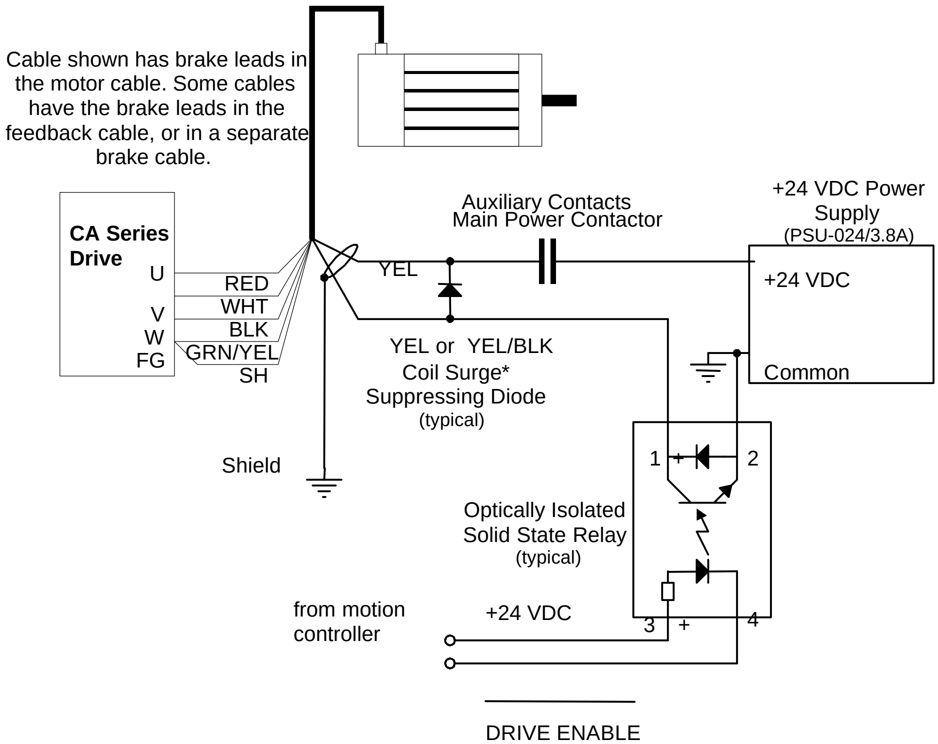


***Figure 7**, Fail-Safe Brake Interlock Circuit*

Recommended Servomotor Wiring Methods

1) See Tables 9, 10, 11, 12, 13 and 14 for correct power and feedback cable part numbers.
2) When the motor is mounted to the machine and grounded through the machine frame, $^{dv}/_{dt}$ current flows from the Servodrive through the floating capacity of the motor. To prevent the noise effects from this current, and also for safety, the motor housing (terminal D of the motor connector) should be connected to the frame of the Servodrive (TB2 pin fg), which should be directly grounded to the control panel frame using braided copper wire.
3) When motor wiring is contained in metal conduits, the conduits and boxes must be grounded. Use wires of 12 AWG or heavier for grounding to the case (preferably flat woven silver-plated copper braid).
4) If possible, route motor feedback and motor power cables in separate conduits or ductwork, separated by a minimum of 10 inches (25 cm).

Motors with Integral Fail-Safe Brakes

NOTE: **The integral fail-safe brakes supplied on CM-Series motors are intended for holding purposes (preventing the movement of a stopped motor) only and should not be used for braking a motor in motion. Using an integral fail-safe brake to stop a motor in motion may result in damage to the motor-brake unit.** An external brake should be used for fail-safe stopping a motor in motion.

Figure 7 shows the recommended safety and fault interlock wiring for motors with fail-safe brakes.

- When the main power contactor opens, the brake engages.
- When /DRIVE ENABLE is asserted, the brake disengages.

Use a separate +24 VDC power supply for coil power! Most motion controller power and I/O supplies should **not** be used for switching inductive loads.

Required for CM40, CM60, CM80, CM100 and CM130 MM Series ONLY. CM142 and CM190 Series Coil Surge Suppressing Diode internal to motor brake assembly.

CM-Series Servomotor Connections

CM Motors	Motor Power Cable	Motor Encoder Cable	Interface Diagram
Amplifier CA05-10-E (4.1 ARMS)			
CM401P8.8MK2048CT CM401Q17.8MK2048CT CM402P8.0MK2048CT CM402Q16.1MK2048CT CM403P9.8MK2048CT CM403Q17.6MK2048CT CM601P11MK2048CT CM601Q22MK2048CT CM602P10.5MK2048CT CM602Q21MK2048CT CM603P12.8MK2048CT* CM603Q21MK2048CT CM801P12.3MK2048CT CM801Q24MK2048CT CM802Q26MK2048CT CM803Q24MK2048CT CM804Q27MK2048CT	CMPxxM-16T	CMExxM-TM	Interface - 01
CM1001R64MK2048CT	CMPBxxM-14A	CMExxM-AM	Interface - 03

*****Consult factory when ordering motor part number CM603P12.8MK2048CT to clarify proper amplifier.

Table 9 , *Cable Drawings for CM 40-60-80 MM Series Motors* ***Without*** *Brakes*

CM Motors	Motor Power Cable	Motor Encoder Cable	Interface Diagram
Amplifier CA8.2-14-E (8.2 ARMS)			
CM603P12.8MK2048CT*	CMPxxM-16T	CMExxM-TM	Interface - 01
CM1001Q32MK2048CT CM1002R64MK2048CT CM1003R69MK2048CT CM1301R58MK2048CT	CMPBxxM-14A	CMExxM-AM	Interface - 03
Amplifier CA14-24-E (14.0 ARMS)			
CM1002Q32MK2048CT CM1003Q34MK2048CT CM1301Q29MK2048CT CM1302R62MK2048CT CM1303R62MK2048CT	CMPBxxM-12A	CMExxM-AM	Interface - 03
Amplifier CA25-50-E (25.0 ARMS)			
CM1302Q31MK2048CT CM1303Q31MK2048CT	CMPBxxM-10A	CMExx-M-AM	Interface - 02

*****Consult factory when ordering motor part number CM603P12.8MK2048CT to clarify proper amplifier.

Table 10, *Cable Drawings for CM 100-130 MM Series Motors* ***Without*** *Brakes*

CM Motors	Motor Power Cable	Motor Encoder Cable	Interface Diagram
Amplifier CA05-10-E (4.1 ARMS)			
CM1421R230	CMPxxM-14D	CMExxM-CM	Interface - 05
Amplifier CA8.2-14-E (8.2 ARMS)			
CM1421Q115 CM1421R115 CM1422R230 CM1423R230	CMPxxM-14D	CMExxM-CM	Interface – 05
CM1901R324	CMPxxM-14C	CMExxM-CM	Interface – 05
Amplifier CA14-24-E (14.0 ARMS)			
CM1421Q70 CM1422Q115 CM1422R115 CM1424R230	CMPxxM-12D	CMExxM-CM	Interface - 05
CM1902R324	CMPxxM-12C	CMExxM-CM	Interface - 05
Amplifier CA25-50-E (25.0 ARMS)			
CM1422Q70 CM1423Q80 CM1423Q115 CM1423R115 CM1424Q115 CM1424R115	CMPxxM-10D	CMExxM-CM	Interface - 04

Table 11, *Cable Drawings for CM 142-190 MM Series Motors* ***Without*** *Brakes* *(continued on next page)*

CM Motors	Motor Power Cable	Motor Encoder Cable	Interface Diagram
Amplifier CA25-50-E **(25.0 ARMS)**			
CM1902Q162 CM1901R162 CM1902Q162 CM1902R162 CM1903R324 CM1904R324	CMPxxM-10C	CMExxM-CM	Interface – 04
Amplifier CA60-120-E **(60.0 ARMS)**			
CM1424Q80	CMPxxM-08D	CMExxM-CM	Interface – 04
CM1901Q80 CM1902Q80 CM1903Q162 CM1903R162 CM1904Q162 CM1904R162	CMPxxM-08C	CMExxM-CM	Interface - 04

Table 11, *Cable Drawings for CM 142-190 MM Series Motors* ***Without*** *Brakes (continued)*

CM Motors	Motor Power Cable	Motor Encoder Cable	Interface Diagram
Amplifier CA05-10-E (4.1 ARMS)			
CM401P8.8MK2048CTB CM401Q17.8MK2048CTB CM402P8.0MK2048CTB CM402Q16.1MK2048CTB CM403P9.8MK2048CTB CM403Q17.6MK2048CTB CM601P11MK2048CTB CM601Q22MK2048CTB CM602P10.5MK2048CTB CM602Q21MK2048CTB CM603P12.8MK2048CTB* CM603Q21MK2048CTB CM801P12.3MK2048CTB CM801Q24MK2048CTB CM802Q26MK2048CTB CM803Q24MK2048CTB CM804Q27MK2048CTB	CMPBxxM-16T	CMExxM-TM	Interface - 01
CM1001R64MK2048CTB	CMPBxxM-14A	CMExxM-AM	Interface - 03

*****Consult factory when ordering motor part number CM603P12.8MK2048CTB to clarify proper amplifier.

Table 12, *Cable Drawings for CM 40-60-80 MM Series Motors* ***With*** *Brakes*

CM Motors	Motor Power Cable	Motor Brake Cable	Motor Encoder Cable	Interface Diagram
Amplifier CA8.2-14-E (8.2 ARMS)				
CM603P12.8MK2048CTB*	CMPBxxM-16T	CMBxxM-18G	CMExxM-TM	Interface - 01
CM1001Q32MK2048CTB CM1002R64MK2048CTB CM1003R69MK2048CTB CM1301R58MK2048CTB	CMPBxxM-14A	CMBxxM-18G	CMExxM-AM	Interface - 03
Amplifier CA14-24-E **(14.0 ARMS)**				
CM1002Q32MK2048CTB CM1003Q34MK2048CTB CM1301Q29MK2048CTB CM1302R62MK2048CTB CM1303R62MK2048CTB	CMPBxxM-12A	CMBxxM-18G	CMExxM-AM	Interface - 02
Amplifier CA25-50-E (25.0 ARMS)				
CM1302Q31MK2048CTB CM1303Q31MK2048CTB	CMPBxxM-10A	CMBxxM-18G	CMExx-M-AM	Interface - 04

*****Consult factory when ordering motor part number CM603P12.8MK2048CT to clarify proper amplifier.

Table 13, *Cable Drawings for CM 100-130 MM Series Motors* ***With*** *Brakes*

CM Motors	Motor Power Cable	Motor Brake Cable	Motor Encoder Cable	Interface Diagram
Amplifier CA05-10-E (4.1 ARMS)				
CM1421R230	CMPxxM-14D	CMBxxM-18G	CMExxM-CM	Interface - 05
Amplifier CA8.2-14-E (8.2 ARMS)				
CM1421Q115 CM1421R115 CM1422R230 CM1423R230	CMPxxM-14D	CMBxxM-18G	CMExxM-CM	Interface – 05
CM1901R324	CMPxxM-14C	CMBxxM-18G	CMExxM-CM	Interface – 05
Amplifier CA14-24-E (14.0 ARMS)				
CM1421Q70 CM1422Q115 CM1422R115 CM1424R230	CMPxxM-12D	CMBxxM-18G	CMExx-CM	Interface - 05
CM1902R324	CMPxxM-12C	CMBxxM-18G	CMExxM-CM	Interface – 05
Amplifier CA25-50-E (25.0 ARMS)				
CM1422Q70 CM1423Q80 CM1423Q115 CM1423R115 CM1424Q115 CM1424R115	CMPxxM-10D	CMBxxM-18G	CMExx-CM	Interface - 04

Table 14, *Cable Drawings for CM 142-190 MM Series Motors* ***With*** *Brakes* *(continued on next page)*

CM Motors	Motor Power Cable	Motor Brake Cable	Motor Encoder Cable	Interface Diagram
Amplifier CA25-50-E (25.0 ARMS)				
CM1902Q162 CM1901R162 CM1902Q162 CM1902R162 CM1903R324 CM1904R324	CMPxxM-10C	CMBxxM-18G	CMExxM-CM	Interface – 04
Amplifier CA60-120-E (60.0 ARMS)				
CM1424Q80	CMPxxM-08D	CMBxxM-18G	CMExxM-CM	Interface – 04
CM1901Q80 CM1902Q80 CM1903Q162 CM1903R162 CM1904Q162 CM1904R162	CMPxxM-08C	CMBxxM-18G	CMExxM-CM	Interface - 04

Table 14, *Cable Drawings for CM 142-190 MM Series Motors* ***With*** *Brakes (continued)*

Coupling the Servomotor to the Load

Good alignment of motor and the driven machine is essential to prevent vibration, increase bearing and coupling life, and to prevent shaft and bearing failures.

With a direct drive application a torsionally rigid flexible coupling should be used. Timing belts and gearboxes are also commonly used in servo applications. Shaft loading should be kept to a minimum. The allowable shaft bearing loading is listed in the Specifications Section.

In either case, it is preferable to attach the coupling or pulley to the shaft with a clamping arrangement rather than transmit torque through the keyway, because of the reversing shock torques, which the Servomotor can generate. A number of mechanical approaches afford this type of attachment including tapered hubs, split hubs, ringfeder devices, etc.

Chapter 4 – Operation

Power On and Off Sequencing

Appendix A shows the recommended interlock approaches for both single and multiple axes. Note its features:

1) ESTOP interlocks

a) The recommended E-Stop switch is a maintained-contact red mushroom head push-button, which must be manually pulled out (reset) after it has been pressed (asserted). It should be powered by 115 or 230 VAC, and must conduct current for the Servomotor to provide output torque.

c) The E-Stop Reset should be a momentary contact pushbutton. It must be asserted after all power is applied and the E-Stop switch is closed. It must be closed long enough for the main power contactor coil circuit to be energized, and the main power auxiliary relay to "pull-in".

e) If the E-Stop switch is pressed (asserted), the main circuit power is disconnected, and torque is prevented at the motor(s).

2) Servodrive faults

If any fault condition occurs within a Servodrive, the Status display will indicate the fault code.

To reset a High Bus Voltage Fault, the main input power must be disabled long enough to discharge the power capacitors. This will be indicated by the BUS POWER LED on the Servodrive no longer being illuminated.

To reset a Motor Over Temperature Fault, the motor must be sufficiently cool.

Not only must any alarm condition, including E-Stop, be cleared before motor power can be restored, but the E-Stop Reset push-button must then be depressed long enough for all the relays to pull-up again.

Servodrive Status Indications

The Servodrive status indication consists of a 1-digit 7-segment LED display (Status) and a yellow LED indicating bus power.

If an alarm condition is present on the Servodrive, the output transistors are disabled, and an appropriate error code is displayed on the Status display. The control power should be maintained in case of a Servodrive fault, so that the status indicators can indicate the unit's status until the cause of the fault is determined.

If any wiring changes are necessary, **turn off the control and main power circuits and wait for the BUS POWER LED to go completely off to avoid possible electrical shock.**

See Notes next page

Notes:

1) After the conditions causing a Servodrive fault have been corrected, reset the drive.
2) If the fault is due to the motor or drive being over temperature, the Servodrive will not reset until the component has cooled down.

Bus Power LED Status Indicator

The Bus Power LED is an amber colored LED located near terminal R of the Logic Power input on TB1. This LED provides an indication of the state of the bus power on the terminals of TB1 and internal to the CA Series Servodrive. If the LED is lit, there is voltage on the bus. If it is not lit, any voltage on the bus has decayed to very low levels.

⚠ **WARNING: If the BUS POWER LED is lit, high voltages may be present on the BUS POWER and BUS/REGEN terminals of TB1 on the Servodrive. These voltages may be LETHAL. Appropriate precautions must be taken when working with or near these terminals to avoid personal INJURY or DEATH!**

LED Label	**Color**	**Illuminated when…**
BUS POWER	Yellow	Main DC Bus Power is on.

***Table 15**, Bus Power LED Status Indicator*

Status ID

The segmented STATUS LED located above the RS232 connector P1 provides valuable information on any fault condition that may occur in the Servodrive.

If the Status LED is a rapidly rotating segment display, the Servodrive is alive and operating, and no fault condition exists. When a drive alarm exists, the Status display will show the alarm code (shown on the next page in). There is a more detailed table of alarm codes which shows cause-and-effect for many of these alarms in Section 0, Servodrive Troubleshooting Guide (page 66).

All drive alarms cause torque to be disabled at the motor. Drive alarms ***90 – 99*** and ***9A-9F*** may require cycling control power to clear the alarm. All other alarms can be cleared by setting ALARM@=0 (after the cause of the alarm has been cleared).

Alarm Code[1]	Alarm@	Condition	Description
90-99 9A-9F	144-159	Internal Drive Error	Should be reported to Custom Motors, Inc. Customer Service Internal error ***98*** indicates that the manufacturing calibration of the drive has not been done.
A0	160	Drive RMS Over Current	The actual RMS current has exceeded the drive's rated continuous current longer than the allowed time (2 seconds at peak current).
A1	161	Peak Over Current	The peak current rating for the drive or motor was exceeded. The motor's peak current rating is an UltraTools setting.
A3	163	Low Bus Voltage	The bus voltage is below 90 VDC (usually due to disabled main power).
A6	166	Drive Not Configured	An attempt was made to enable torque before the drive's setup parameters have been configured.
A8	168	Invalid Commutation Position	An invalid commutation position was detected, possibly due to an encoder failure.
A9	169	Phase Loss	Loss of a main power phase.
AA	170	No Bus Voltage	No bus voltage was detected. The SCR has not been commanded ON when trying to enable the drive
AB	171	Soft Start Error	An overtemperature condition was detected in the drive powerblock, or a failure of the inrush current resistor.
C1	193	Hardware Disable	Analog (Ext Ctrllr) Mode. Drive disabled by hardware enable input (Check hardware enable input).
C2	194	Software Disable	Serial (Utools) Mode. Drive disabled by software enable command (Check DRVENA command).
c1		Hardware Disable	RS485 Mode ***
c2		Software Disable	RS485 Mode ***

Alarm Code[1]	Alarm@	Condition	Description
F1	241	Motor RMS Over Current	The motor's rating for continuous current has been exceeded by the actual RMS current for longer than allowed by the thermal time constant of the motor. (UltraTools software setting)
F2	242	Power Module Fault	The Power Module's self-protection has detected a short circuit, over current, over temperature or control supply under voltage.
F3	243	High Bus Voltage	The bus voltage is excessive. The trip point depends on the rated voltage of the motor, an UltraTools software setting: • Motor rated for 115 VAC: trip point = 237 VDC • Motor rated for 230 VAC or above: trip point = 425 VDC
F4	244	Motor Over Temperature	Open contact at P3 pins 14-15. See Section 0, page 56.
F7	247	Motor Encoder Open Wire	At least one motor encoder feedback channel (ENCA, ENCA', ENCB, ENCB') is not connected properly. (P4 pins 5,6,7,8)
F8	248	Watchdog Timeout	DSP Watchdog timeout error.

***Table 16**,* Servodrive Alarm Codes

Servodrive Commutation Modes

By default, Servodrives are configured to control permanent magent brushless DC servomotors using sine-wave commutation. The Drive can be configured for trapezoidal commutation using the SIXSTEP command. This can be useful when integrating third-party motors.

Commutation Feedback Signals

Commutation position signals are illustrated in **Figure 8** (page 47).

The U, V and W signals are "on" for 180^{o} spaced 120^{o} apart and allow the Drive to determine motor position for commanding current. These signals are used to determine rotor position whenever the Drive is operating in trapezoidal commutation mode (SIXSTEP).

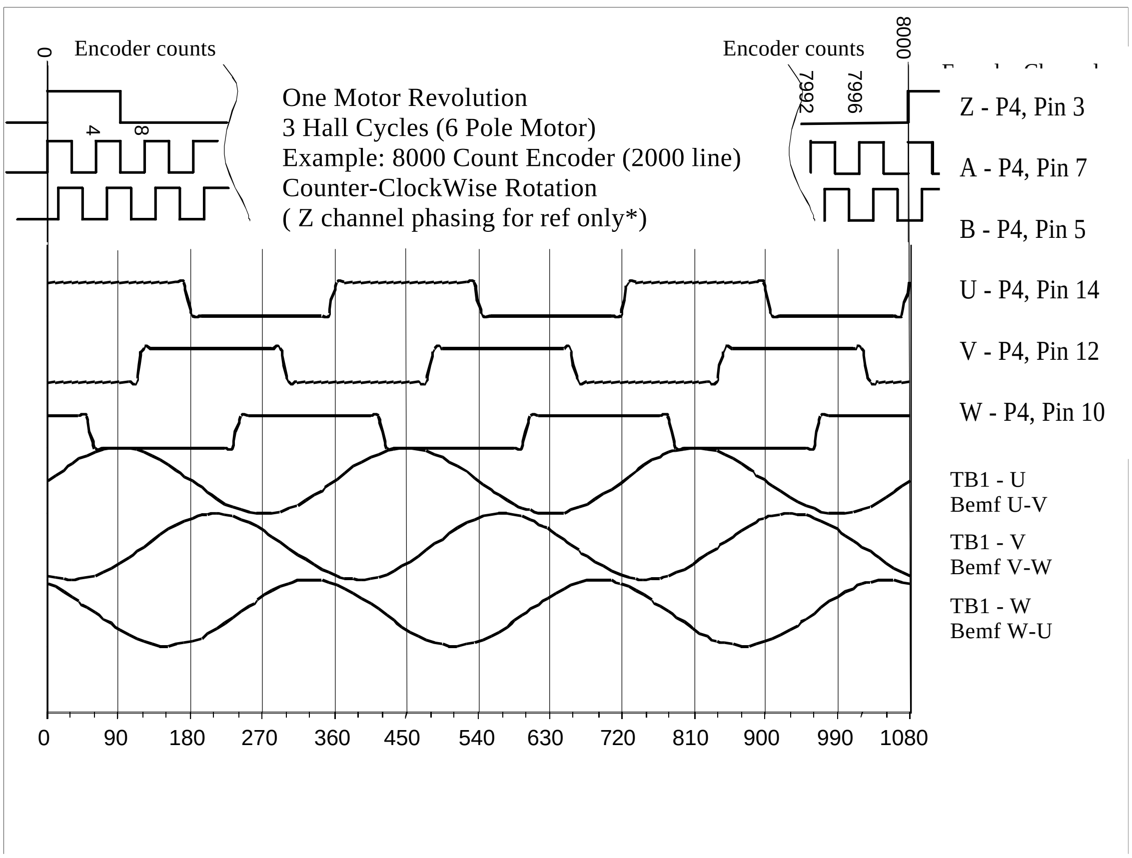


***Figure 8**, Hall signals and Motor Back EMF waveforms*

If the motor's back emf and commutation signals are not directly in phase, the HOFFSET parameter can be used to compensate for the offset.

The state of the commutation signals can be displayed using the HALL variable and **Table *17,*** Valid Hall States

To verify that the commutation feedback is correct, rotate the motor shaft clockwise or counter-clockwise and confirm that the HALL value proceeds through the sequence indicated in the diagram below, once per commutation cycle.

Counter-Clockwise Rotation		**Clockwise Rotation**	
W, V, U	**HALL**	**W, V, U**	**HALL**
101	5	100	4
001	1	110	6
011	3	010	2
010	2	011	3
110	6	001	1
100	4	101	5
Note: Clockwise and Counter-Clockwise shaft rotation refers to rotation when viewing the end of the motor shaft			

Table 17, Valid Hall States

Quadrature Feedback Signals

Quadrature position signals for "Forward" and "Reverse" travel are illustrated in **Figure 9**.

Channel A and Channel B are phase quadrature signals, which allow the Servodrive and associated digital positioning electronics to determine both travel distance and direction. Programmable motion controllers, such as Custom Motors, Inc.'s, typically decode each transition of both encoder channels, yielding a resolution of four times the linecount specification per revolution e.g. A position encoder with 2,048 linecount, when decoded by a customer supplied controller, yields a positioning resolution of 8,192 cts/rev.

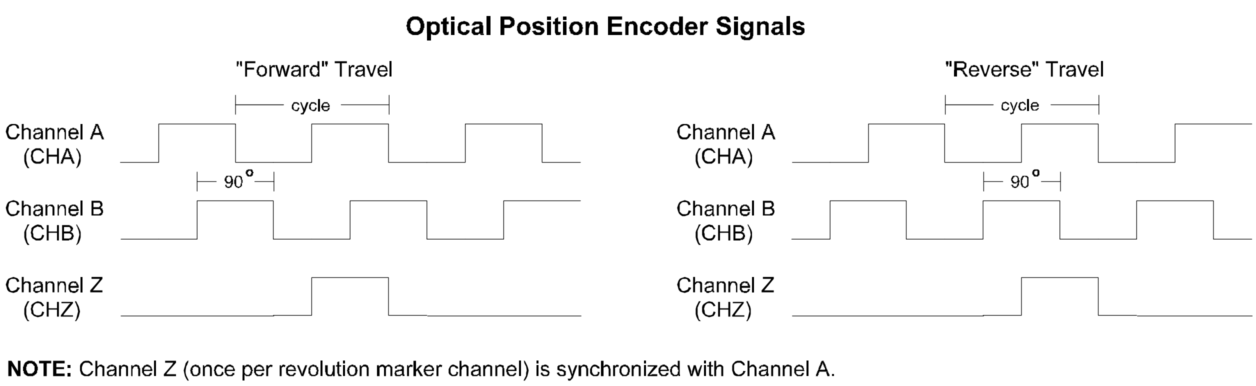


***Figure 9**, Quadrature Encoder Channel Description*

Regenerative Loads

Regenerative loading occurs when the direction of power flow is from the machine to the motor: the motor is acting as a generator. Another way of describing this is that the load torque is acting in a direction to ‘help’ the motor to move in the commanded direction of motion. This can occur for a variety of reasons including:

1) Decelerating the machine faster than it would coast, especially from high speeds and with large inertial loads;

2) Using the motor to act as a brake on an unwind stand for a roll of material, where the tension in the web causes the motor to brake while moving forward; and

3) Using the motor to lower a vertical load that is not counterbalanced.

In many cases, this extra energy is dissipated by machine friction, or stored temporarily in the drive’s power capacitors. However, if the amount of regenerative energy is excessive, it must be shunted to an external regenerative resistor, in order to prevent a high bus voltage condition. For assistance determining if your application has a regenerative load component, contact your Custom Motors, Inc. Applications Engineer.

Shunt Regulator

Servodrive models CA8.2 through CA60 have shunt regulator circuitry for dissipating excessive regenerative voltage.

The shunt regulator consists of a voltage comparator and a switching transistor. When the voltage comparator detects excess bus voltage, it turns on the shunt regulator transistor, dissipating energy from the Servodrive capacitors to the external regen resistor. The on-time duty cycle is controlled by the Servodrive, so that the average current is appropriate for the regen resistor specified in the UltraTools project software setting.

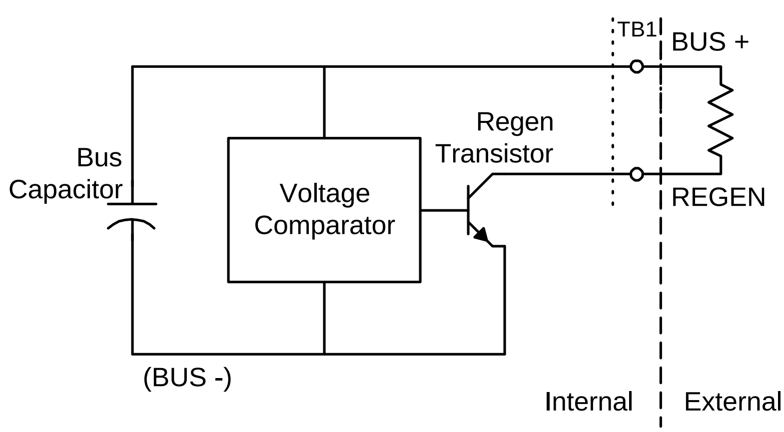


Figure 10, *Simplified Schematic of Shunt Regulator*

Sizing a Regen Resistor: Application-specific Formulas

Regardless of the type of application, the value of interest is **Average Regenerative Power**.

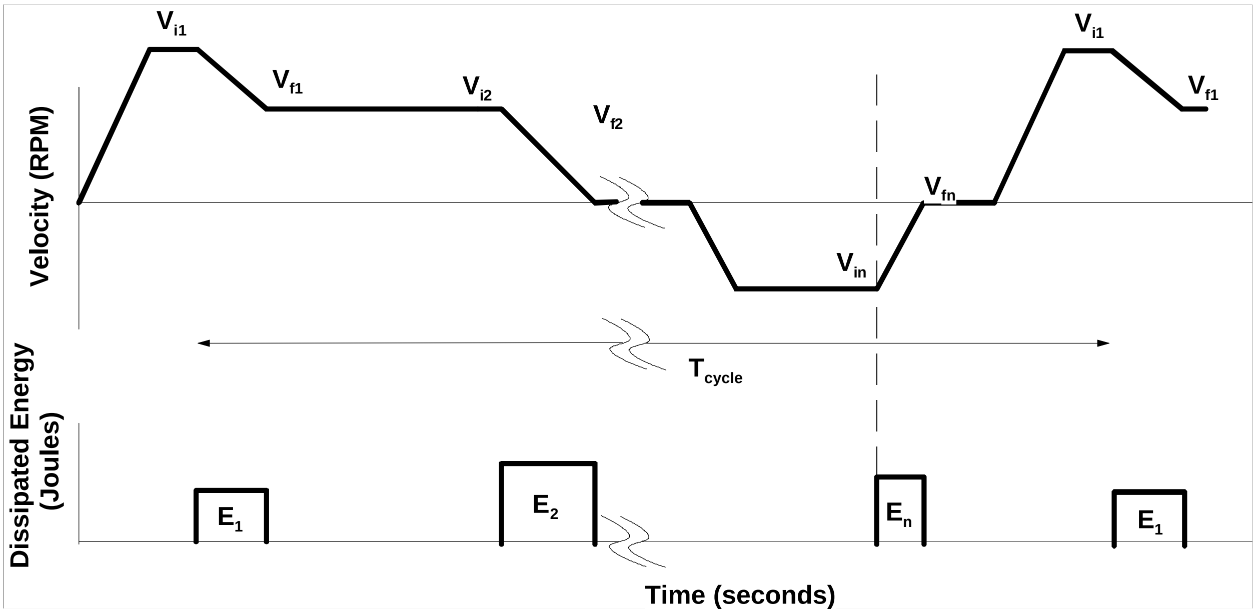


Figure 11*, Regeneration During Deceleration*

Sizing a Regen Resistor: Regeneration Due To Decleration

Regeneration during a motor's deceleration is due to the decreasing kinetic energy of the rotating inertia. Not all of this energy will make it back to the DC bus; some or all of it may be absorbed by machine friction and motor losses. In the case of sizing regen resistors, neglecting frictional losses is a <u>conservative</u> approach to sizing a regen resistor.

Each deceleration in a cycle results in a loss of kinetic energy at the motor. Depending on frictional losses, some or all of this energy may make it back to the drive as **Regenerative Energy**. Rotational kinetic energy at any velocity can be calculated with the general equation $E = \frac{1}{2} I \omega^2$. Applying the appropriate units conversions:

$$E_{regen} = \tfrac{1}{2} I \cdot (V_i^2 - V_f^2) \cdot (0.00124) \qquad \textit{(Equation 1)}$$

where: E_{regen} is the loss of kinetic energy during a deceleration (Joules)
I is the total system inertia (motor + load) (in-lb-sec^2)
V_i is the initial speed of the motor before deceleration (RPM)
V_f is the final speed of the motor after deceleration (RPM)
(0.00124) is a units conversion: $\frac{(2\pi \mathrm{rad/rev})^2 \cdot (4.448\,\mathrm{N/lb})(25.4\,\mathrm{mm/in})}{(60\,\mathrm{sec/min})^2 (1000\,\mathrm{mm/m})}$

Average Regenerative Power for the total cycle can be calculated as:

$$P_{avg} = \frac{E_1 + E_2 + \Lambda + E_n}{T_{cycle}} \qquad \textit{(Equation 2)}$$

where P_{avg} is the average dissipated power over the entire cycle (Watts)
E_1 is the energy dissipated by the 1st decel in the cycle (Joules)

E_2 is the energy dissipated by the 2nd decel in the cycle (Joules)
…
E_n is the energy dissipated by the Nth decel in the cycle (Joules)
N is the number of decelerations in the cycle
T_{cycle} is the total repetitive cycle time (seconds)

Sizing a Regen Resistor: Regeneration Due To Web Tension (motor acting as brake)

The regeneration in a tensioned-web application is due to the web tension pulling the braking motor along in the same direction that it is moving.

Average Regenerative Power is calculated with the general formula: $P = T\omega$. Applying the appropriate units conversions:

$$P_{avg} = (0.0118) * T \cdot V \qquad \textit{(Equation 3)}$$

where P_{avg} is the continuous regenerated power (Watts)
T is the torque at the motor due to web tension (in-lb)
V is the velocity of the motor shaft (RPM)
(0.0118) is a conversion: $\frac{(2\pi \text{rad/rev})(25.4\text{mm/in})(4.448\text{N/lb})}{(60\text{sec/min})(1000\text{mm/m})}$

Sizing a Regen Resistor: Regeneration Due to Vertical Load

In an application where the motor is supporting the weight of an uncounterbalanced load, regeneration may occur when the load is being lowered. This is due to gravity 'helping' the motor lower the load.

Instantaneous Regenerative Power can be calculated with the formula $P = T\omega$. Applying the appropriate units conversions:

$P_{instant} = (0.0118) * T * V$ *(Equation 4)*

where $P_{instant}$ is the instantaneous regenerated power (Watts)
T is the torque at the motor due to load weight (in-lb)
V is the speed of the motor during downward motion (RPM)
(0.0118) is a conversion: $\frac{(2\pi \text{rad/rev})(25.4\text{mm/in})(4.448\text{N/lb})}{(60\text{sec/min})(1000\text{mm/m})}$

Average Regenerative Power for the total cycle can be calculated as:

$$P_{avg} = \frac{P_1 \cdot T_1 + P_2 \cdot T_2 + \Lambda + P_n \cdot T_n}{T_{cycle}} \qquad \textit{(Equation 5)}$$

where P_{avg} is the average dissipated power over the entire cycle (Watts)
P_1 is the power dissipated by the cycle's 1st downward move (Joules)
T_1 is the time spent in the cycle's 1^{st} downward move (seconds)
P_2 is the power dissipated by the cycle's 2nd downward move (Joules)
T_2 is the time spent in the cycle's 2^{nd} downward move (seconds)

…
P_n is the energy dissipated by the cycle's Nth downward move(Joules)
T_n is the time spent in the cycles Nth downward move (seconds)
N is the total number of downward moves in the cycle
T_{cycle} is the total repetitive cycle time (seconds)

Sizing a Regen Resistor: Use Average Regenerative Power

Once Average Regenerative Power has been determined using one of the methods in section 0, the sizing of the resistor is nearly complete.

The wattage of the regenerative resistor should be greater than or equal to the application's calculated Average Regenerative Power.

The next section shows the minimum resistance requirements, as well additional limitations on the regen power that can be shunted, based on the Servodrive's shunt transistor.

Sizing a Regen Resistor: Regen Transistor and Resistor Limitations

The amount of energy that can be dissipated by an external regen resistor may be limited by the current capability of the switching transistor.

Table 118 below shows the rated maximum continuous current of the Servodrive's regen transistor circuitry, as well as the minimum resistance for any external regen resistor.

NOTE: **Do not use a lower resistance than shown in the table below! Too low a resistance may result in peak currents that are too high for the regen transistor, and could result in damage to the transistor.**

		Regen Transistor		
Servodrive	**Regen Resistor**[1]	Peak Current[2]	Maximum Continuous Current	Bus Capacitance
CA05	Regen Transistor not available.			540 µF
CA8.2	50 Ω	8.5 A	3.75 A	1,170 µF
CA14	35 Ω	12 A	5 A	1,410 µF
CA25	7.8 Ω	50 A	27 A	3,360 µF
CA35			30 A	
CA60	5.0 Ω	75 A	41 A	

1 Minimum resistance.

2 Calculated using minimum resistance.

***Table 18**, Regen Resistor Selection Requirements*

The amount of energy that can be dissipated by a regen resistor may also be limited by the resistors own current and power ratings. The peak current that will be seen by the resistor is shown in **Table 1111**. This current is limited by the regen resistor's resistance value, so if a higher resistance is used, the peak current will be lower.

The average current that will be seen by the resistor is limited by the Servodrive using an on-off duty cycle. This limits the average current so that neither the wattage of the resistor (an UltraTools software setting) nor the continuous current of the regen transistor is exceeded on a continuous basis.

Regen Resistor	Resistance	Wattage	Peak Current
SAC-SWRR/0055	50 Ω	55 W	8.5 A
SAC-SWRR/0095	40 Ω	95 W	11 A
SAC-SWRR/0700	54 Ω	700 W	7.9 A
SAC-SWRR/0845	40 Ω	845 W	11 A
SAC-SWRR/0846	10 Ω	846 W	43 A
SAC-SWRR/1700	6.5 Ω	1,700 W	65 A

Table 19*, Standard Regen Resistor Specifications*

The voltage seen by the resistor will range between the Turn-On level and the High-Bus level, as shown below in **Table 20**.

Nominal Input Voltage (VAC)	Nominal Bus Voltage (VDC)	Turn On Regen Transistor (VDC)	High Bus Voltage Alarm (VDC)
230	325	395	425

Table 20*, Regen Transistor Turn-On and other Bus Voltage Levels*

Bus Sharing

The extra energy generated by regenerative loads can also be dissipated through bus sharing. In a shared-bus configuration, the bus capacitors are all connected in parallel, magnifying the total bus capacitance by the number of drives present (see **Figure 12**). Also, the regenerative energy generated by one drive can be used to reduce the input power requirements of any other active drives on the shared bus. However, if the amount of regenerative energy available is excessive, it must be still be shunted to an external regenerative resistor, in order to prevent a high bus voltage condition. For assistance in determining how to use bus sharing in your application, contact your CUSTOM MOTORS, INC. Sales and Applications Engineer.

Bus Sharing Limitations

Bus sharing is supported by Servodrive models ***CA25, CA35, and CA60 only***, and is subject to the following restrictions:

- ♦ Drives that are sharing the DC bus must also be connected to a main input power source and a control input power source.
- ♦ Main input power should be applied to all shared-bus drives within 0.1 seconds to prevent possible damage to internal drive control circuits.

- Bus wiring between drives should be less than 12 inches in length to minimize oscillatory effects.
- **Only one regen resistor may be used in a bus sharing network.** That regen resistor must be sized to handle the regenerative power produced by all of the drives in a shared bus configuration. See Section 0, egenerative Loads for more information on sizing regen resistors.

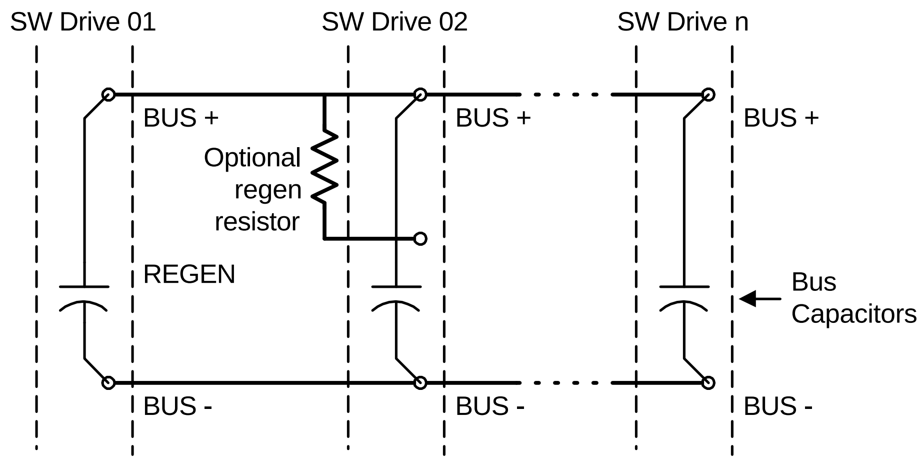


***Figure 12**, Shared Bus Capacitors*

Shunt Regulator Overload

If regenerated voltage is excessive, a High Bus Voltage fault (***F3***) may occur. A High Bus Voltage fault will not reset until the voltage level has dropped to an acceptable level. This will occur faster if you disable main power.

If High Bus Voltage faults recur, one of the following actions may resolve the problem:

- Increase the wattage of the external regenerative discharge resistor.
  For this change to be effective, you must also change the UltraTools software settings for the Servodrive:
  Regen Resistor Power.
- Reduce the commanded current limit for the Controller.
- Reduce the commanded deceleration.
- Decrease the maximum motor speed.
- Reduce the inertial load seen by the motor, either by removing part of the load, or by increasing the gear ratio (motor-to-load).

Servomotor Temperature Protection

The thermostat contact wiring is part of the Motor Feedback Cable (P3 connector on the Servodrive). When the thermal contact opens, the behavior of the Servodrive will depend on the Servodrive's software configuration in UltraTools:

UltraTools Configurations		
Thermal Switch Exists on Motor	**Motor OverTemp Handling**	**Behavior of Servodrive**
No	No Connection	A closed contact will cause a drive alarm ***F4***. The drive will not be disabled.
Yes	Fault, no disable	If the drive torque is enabled with open OverTemp contacts, a drive alarm ***F4*** will immediately occur. The drive will not be disabled.
Yes	Fault, disable	If the drive torque is enabled with open OverTemp contacts, a drive alarm ***F4*** will immediately disable torque to the motor.

Table 21, *Motor Over-Temperature Input (P3 pins 14-15)*

CM Series Servomotors have embedded thermostats, which open when the motor winding temperature exceeds 155ºC.

Chapter 5 – Getting Started

Test Run

Before doing a test run, check the following points listed in this section. Correct any problems before proceeding.

Servomotor Check

Before test run, check the following.

- Motor mounting and grounding are correct.
- Bolts and nuts are tight.
- Motor Power and Feedback Cables are properly attached.

Servodrive Check

- The control and main power voltage should be 115 (+15%, -20%) or 230 (+15%, -20%) VAC, 50/60 Hz. **The absolute maximum is 265 VAC.**
- The main power voltage depends on the servomotor:
- **CHECK POWER BEFORE APPLYING IT TO THE SERVODRIVE.**
- Check that feedback connector P4 is firmly seated.
- Check that Power terminal block connections (r,t,L1,L2,L3, FG, BUS+,REGEN,BUS-,U,V,W, and FG) are tight.
- Motor wiring is correct.
- The main power interlock circuit disables main power under a Servodrive alarm condition.

Preparation for Test Run

During test run, the driven machine should not be attached to the Servomotor. If it is necessary to start with the driven machine connected to the motor, proceed with great care.

- After checking items above, turn on the control power.
- Enable the main power circuit and measure main DC Bus voltage.
- The front of the Servodrive provides important status indications, described in Chapter 4, Servodrive Status Indications (page 45).

Establishing Communications

Apply Logic Power

Apply Logic Power to the Servodrive. The 8-segment display should indicate a “C2” status code. This code indicates that the drive is software disabled, which is the factory default mode. If the display indicates anything other than “C2”, see Section 0, Servodrive Troubleshooting Guide to determine the nature of the code.

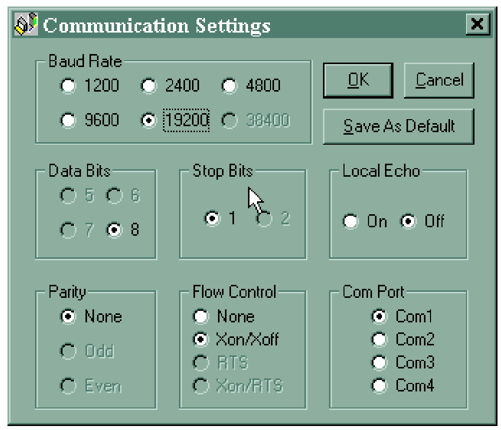
Connect Communication Cable

Plug the communication cable that came with UltraTools into the drive and the Windows-based PC on which you installed UltraTools.

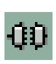
Check Communication Parameters

Launch UltraTools, and click the **Com Set Up** toolbar button to edit the communication parameters.

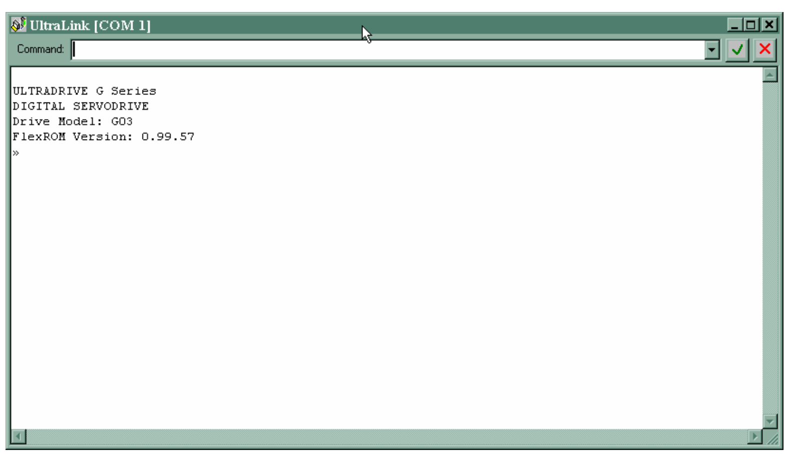
Set the communication parameters to match your hardware configuration in the **Communication Setup** dialog.



Connect to the Drive



Click the **Connect/Disconnect** toolbar button to establish a connection with the Servodrive. The following should be observed in the UltraLink Window.



You are now connected to the CA Series Servodrive and may enter commands directly.

Defining a Servomotor to Use with the Servodrive

Click the Motor Setup toolbar button.

- In the Drive Configuration dialog, select the Motor/Drive tab.
- If you were connected and communicating with a CA Series drive, the Drive Selection field is “grayed out” indicating that UltraTools has already “talked” with the drive and knows what the drive model number is.
- If you have a Custom Motors, Inc. motor or a custom (non-Custom Motors, Inc.) motor, select the Custom Motors, Inc. motor series. (You will use Edit later to define your custom motor.)
- Select your specific Custom Motors, Inc. motor using the Motor Selection pull-down menu. If using a custom motor, you may select any motor similar to the one you’re using.
- If you are using a custom (non-Custom Motors, Inc.) motor, click on the Edit button now to redefine the motor parameters per your motor.
- For custom motors, fill in all motor and drive configuration and operational mode fields. Remember to give this motor configuration file a descriptive name in the Model Name entry
- Save your custom motor configuration file by clicking the Save Setup to Disk button at the bottom of the dialog.
- Send your Custom Motors, Inc. or custom motor configuration data to the Servodrive by clicking on the Send Setup to Servodrive button. This tells the CA Series Servodrive all it needs to know to drive the motor you’re using.
- Make sure you save the configuration data in the Servodrive by clicking the Store Servo in EEPROM button. This will save the setup configuration in EEPROM for use after the Servodrive is restarted.

Checking your Configuration

Check your configuration by commanding some amount of current to check rotation. Use the following commands to produce current in the Servodrive:

- Type Serial and press enter
- Type INPFN98 +
or
Select the N.O. Drive Enable Input option on the Inputs tab in the Motor Config window, to allow the UltraTools Drive Enable/Disable icons to work in Serial Mode.
- Type CMD 1000 and press enter [1000 may be replaced with any number between +/- 32767 appropriate to produce current and rotation]. It should be noted that an unloaded motor should require relatively small command values to produce adequate current for rotation.
- If you are unable to produce rotation in both directions with small current commands, check your setup, particularly the motor pole count and encoder counts per rev values found in the Electrical/Thermal tab called by the Edit button in the Motor/Drive Setup Dialog. If these values are correct, check the motor feedback and power wiring to ensure proper phasing of the motor.

Chapter 6 - Servodrive Specifications

Servodrive Environmental Specifications

Operating Temperature:	0 to +50°C
Storage Temperature:	-20 to +70 °C
Operating and Storage Humidity	10 to 90%, non-condensing

***Table 22**, Servodrive Environmental Specifications*

Servodrive Mechanical Specifications

Mounting Method: Also see outline drawings in (pages 69 & 70).		Vertical panel mounting, three 10-32 (M5) screws (four screws for CA25, CA35, & CA60).	
Dimensions:			
CA05 and CA8.2			
Height:	add 2" (51 mm) clearance top and bottom	9.0 inches	(229 mm)
Width:	add 1" (25 mm) clearance each side	2.66 inches	(66 mm)
Depth:	includes clearance for attached cables	10.5 inches	(267 mm)
Weight:	CA05	3.8 lbs	(1.7 kg)
	CA8.2	4.2 lbs	(1.9 kg)
CA14			
Height:	add 2" (51 mm) clearance top and bottom	9.0 inches	(229 mm)
Width:	add 1.2" (31 mm) clearance each side	3.8 inches	(97 mm)
Depth:	includes clearance for attached cables	10.5 inches	(267 mm)
Weight:		5.9 lbs	(2.7 kg)
CA25, CA35 and CA60			
Height:	add 2" (51 mm) top, 4" (102 mm) bottom clearance	12.00 inches	(305 mm)
Width:	add 1" (25 mm) clearance each side	6.89 inches	(175 mm)
Depth:	includes allowance for attached cables	11.1 inches	(282 mm)
Weight:		17.8 lbs	(8.1 kg)

***Table 23**, Servodrive Mechanical Specifications*

Servodrives General Electrical Specifications

Incoming Main Power Line Voltage – **TB1** pins **L1, L2, L3**	
WARNING: Use the servomotor's voltage rating to determine the maximum input voltage for the Servodrive.	
CA05:	Single Phase, 50/60 Hz 115 (+15%, -20%) or 230 (+15%, -20%) VAC
CA8.2, CA14, CA 25, CA35, CA60:	Three Phase, 50/60 Hz 115 (+15%, -20%) or 230 (+15%, -20%) VAC
Incoming Control Power Line Voltage – CA05 – : **TB1** pins **r, t** CA25 – CA60: **TB2** pins **r, t**	Single Phase, 50/60 Hz 115 (-20%) to 230 (+15%) VAC
Main DC Bus Voltage – **TB1** pins **BUS+, BUS-**	
115 VAC nominal input power:	163 VDC nominal level
230 VAC nominal input power:	325 VDC nominal level
Shunt Regulator Activation DC Bus Voltage:	
115 VAC motors:	207 VDC
230 VAC motors:	395 VDC
High Bus Voltage Fault Activation DC Bus Voltage:	
115 VAC motors:	237 VDC
230 VAC motors:	425 VDC
Low Bus Voltage Fault Activation DC Bus Voltage:	
115 VAC nominal input power:	94 VDC
230 VAC nominal input power:	205 VDC

***Table 24**, Servodrive General Electrical Specifications*

Servodrive Output (TB1 pins U, V, W) Specifications

	Single Phase 115 VAC Input			Single Phase 230 VAC Input		
Drive Model	**Rated Output Power (KVA)**	**Cont Current (Amps RMS/Æ)**	**Peak Current 2 sec (Amps RMS/Æ)**	**Rated Output Power (KVA)**	**Cont Current (Amps RMS/Æ)**	**Peak Current 2 sec (Amps RMS/Æ)**
CA05	0.49	4.2	7.4	0.98	4.1	7.1
CA8.2	0.58	5.1	8.8	1.17	4.9	8.5
CA14	0.98	8.6	14.8	1.97	8.2	14.3
CA25 CA35 CA60	Not Available			Not Available		

***Table 25**, Servodrive Output (**TB1** pins **U, V, W**) Specifications for Single Phase Input Power*

	Three Phase 230 VAC Input		
Drive Model	**Rated Output Power (KVA)**	**Cont Current (Amps RMS/Æ)**	**Peak Current 2 sec (Amps RMS/Æ)**
CA05	Not Available		
CA8.2	1.95	8.2	14.2
CA14	3.32	13.9	24.1
CA25	5.98	25.0	50.0
CA35	8.37	35.0	70.0
CA60	15	60.0	120.0

***Table 26**, Servodrive Output (**TB1** pins, **U ,V, W**) Specifications for Three Phase Input Power*

Servodrive Supplemental I/O Specification (P3)

INP1-INP4 & GND P3 pins 1-5	**Optically-coupled Digital Inputs**
Current to turn on	0.7 mA minimum 7.0 mA maximum
Voltage max.	27 VDC

OUT1-OUT4 & GND P3 pins 6-10	**Optically-coupled Digital Outputs**
Max. sink current	33 mA
Low level voltage High level voltage	0.7 VDC maximum (Ic = 33 mA) V+S - 0.5 VDC
Absolute maximum	27 VDC

DAC1, DAC2 & GND P3 pins 11-13	**Analog Outputs & Analog Ground**
Voltage output range	+/- 10 VDC
Current Output	5 mA maximum
Load Resistance	2K ohms minimum
DAC1: Velocity Monitor DAC2: Current Monitor	

TMP, TMP GND P3 pins 14-15	**Temperature**
Should be normally sinking current to prevent an over temperature condition.	
Current to turn on	2.5 mA
Voltage max.	+12 VDC maximum

Servodrive Motor Encoder Feedback Specifications (P4)

ENC PWR, GND P4 pins 1, 2	**Encoder Power Supply**
+5 VDC	5.3 VDC, +/-5% 450 mA max.

***Table 27**, Servodrive Supplemental I/O Specifications (P3)*

ENCA, ENCA', ENCB, ENCB' **P4 pins 5, 6, 7, 8**	**Differential Digital Inputs**
Common Mode Input	-15 VDC to +15 VDC max.
Absolute Max. Input Voltage	+/-25 VDC
Maximum Encoder Counts per Electrical Cycle	32,768 (after 4x decode)
Maximum Encoder Data Rate:	2 MHz
Quadrature Specification	90^{o} +/-45^{o}
Differential Turn On Voltage V_{ID} > 0.7 V –0.7 V > V_{ID} > 0.7 V V_{ID} < -0.7 V *Where V_{ID} = (ENCx) – (ENCx')*	<u>Receiver Output</u> H ? L

ENCZ, ENCZ', U, U', V, V', W, W' **P4 pins 3, 4, 10, 11, 12, 13 , 14, 15**	**Differential or Single-Ended Digital Input**
Common Mode Input	-12 VDC to +12 VDC max.
Absolute Max. Input Voltage	+/-25 VDC
Differential Turn On Voltage V_{ID} > 0.2 V –0.2 V > V_{ID} > 0.2 V V_{ID} < -0.2 V *Where V_{ID} = (ENCx) – (ENCx')*	<u>Receiver Output</u> H ? L

***Table 28**, Servodrive Motor Encoder Feedback Specifications (P4)*

Servodrive Connector Part Numbers

		Mating Connector		
Label	**Signal**	**Description**	**Manufacturer & Part Number**	**Custom Motors, Inc. P/N**
P1	RS485 Com Port			
P1	RS232 Com Port	RJ11 Modular Jack	Custom Motors, Inc. P/N CMM03M-M-005	
P2	Controller Port	25 pin male D-sub	Amp 207464-1 (conn.) Amp 745254-6 (pin) Amp 206478-3 (shell) Amp 90406-1 (tool)	86-50100 86-50101 86-50102
P3	Supplemental I/O	15 pos TB plug	Phoenix 1803701	86-50103
P4	Motor Feedback	15 pin male D-sub	Amp 205206-1 (conn.) Amp 745254-6 (pin) Amp 749915-2 (shell) Amp 90406-1 (tool)	86-50104 86-50101 86-50105
TB2	Logic Power (CA25-CA60 only)	3 pos TB plug	Phoenix 1804917	86-50106

Table 29*, Servodrive Connector Part Numbers*

Chapter 7 - Maintenance and Troubleshooting

Servodrive Troubleshooting Guide

Indication	ALARM@	Status	Description
90-99 **9A-9F**	144-153 154-159	Internal Drive Error	An unexpected failure has occurred in the Servodrive software or hardware.
Defective hardware or software ⇒ Report error to Custom Motors, Inc. Customer Service.			

Indication	ALARM@	Status	Description
A0	160	Drive Over Current (RMS)	The maximum rating for the continuous current output of the drive has been exceeded for more than 2 seconds at peak current.
When enabling axis with Servomotor connected		• Incorrect servomotor wiring ⇒ See Chapter 3 (page 19) for correct wiring. • Defective Servomotor ⇒ Replace Servomotor	
After applying control power with Servomotor disconnected		• Defective Servodrive ⇒ Replace Servodrive	
Under load or during acceleration.		• Drive and/or motor may be undersized for the application.	

Indication	ALARM@	Status	Description
A1	161	Over Current (Peak)	The maximum rating for the peak current output of the drive or the motor has been exceeded.
When enabling axis		UltraTools has not yet configured the drive.	
Indication	**ALARM@**	**Status**	**Description**
A3 Bus Power LED not on	163	Low Bus Voltage	The bus voltage is too low. The trip point depends on the nominal input voltage, an UltraTools software setting: • 115 VAC nominal input: trip point = 94 VDC • 230 VAC nominal input: trip point = 205 VDC
When the AC input voltage applied to L1 and L2 is at least 88 VAC		• Input voltage does not match UltraTools software setting ⇒ Decrease software setting or increase applied AC input voltage. • Main fuses blown or circuit breaker tripped ⇒ Correct main input power problem, and replace fuses or reset circuit breaker. • Defective Servodrive ⇒ Replace Servodrive	
When the AC input voltage applied to L1 and L2 is at least 88 VAC or 166 VAC, depending on UltraTools software setting		• Main fuses blown or circuit breaker tripped ⇒ Correct main input power problem, and replace fuses or reset circuit breaker • Defective Servodrive ⇒ Replace Servodrive	

Indication	ALARM@	Status	Description
A6	166	Drive Not Configured	An attempt was made to enable torque before the drive's setup parameters have been configured.

Indication	ALARM@	Status	Description
A8	168	Invalid Commutation Position	A Drive was commanded to enable when the commutation position was invalid.
A9	169	Phase Loss	Loss of a main power phase was detected.
AA	170	No Bus Voltage	No bus voltage was detected. The SCR has not been commanded ON when trying to enable the drive.

AB	171	Soft Start Error	An overtemperature condition was detected in the drive powerblock, or a failure of the inrush current resistor.

Indication	ALARM @	Status	Description
C1	193	Hardware Disable	Drive disabled by the hardware enable input.
Check the hardware enable input (P2-23).			
Indication	**ALARM @**	**Status**	**Description**
C2	194	Software Disable	Drive disabled by a software enable command.
Check the DRVENA command setting.			
c1		Hardware Disable	Drive disabled by hardware enable input RS485 mode.
c2		Software Disable	Drive disabled by software enable command RS485 mode.

Indication	ALARM@	Status	Description
F1	241	Motor Over Current (RMS)	The motor's rating for continuous current has been exceeded by the actual RMS current for longer than allowed by the thermal time constant of the motor.
Indication	**ALARM@**	**Status**	**Description**
F2	242	Power Module Fault	The Power Module's self-protection has detected a short circuit, over current, over temperature or control supply under voltage.
Indication	**ALARM@**	**Status**	**Description**
F3	243	High Bus Voltage	The bus voltage is excessive. The trip point depends on the rated voltage of the motor, a UltraTools software setting: • Motor rated for 115 VAC: trip point = 237 VDC • Motor rated for 230 VAC (or above): trip point = 425 VDC
When power is applied to the main circuit		• Applied voltage exceeds the Servomotor's rating ⇒ Reduce applied voltage. • UltraTools software settings for Servodrive Input Voltage are lower than desired applied voltage ⇒ Increase setting in UltraTools software. Defective Servodrive ⇒ Replace Servodrive	
While motor is in regeneration, or when drives share bus power, if any of the motors is in regeneration. Regeneration may exist during deceleration, or during downward motion in a non-counterbalanced vertical application, or in a tensioned unwind application.		• A regenerative discharge resistor is required by the application but is not present ⇒ Install regen resistor, reduce inertial load, or reduce max speed and/or acceleration. • The regenerative resistor installed has been damaged and is no longer fully functional ⇒ Install higher-wattage regenerative resistor, and reduce inertial load, or reduce max speed and/or acceleration.	

Indication	ALARM@	Status	Description
F4 HITEMP LED is on	244	Motor Over Temperature	The thermal contact has opened (P3 pins 14 & 15) indicating that the motor is over temperature. This condition can not be reset until the motor has sufficiently cooled.
When the motor is hot		• Motor is overloaded ⇒ Reduce motor load • Excessive ambient temperature ⇒ Reduce ambient temperature to 25°C	
When the motor is cool to the touch		• Faulty motor feedback wiring ⇒ Check cable and all termination points. • Defective thermal switch in motor ⇒ Disconnect motor and test for continuity at motor pins. (See motor pinouts in Appendix D). • Motor has no thermal switch, and UltraTools software settings are configured to expect a closed contact. ⇒ Disable Thermal Contact in UltraTools • Defective Servodrive ⇒ Replace Servodrive	
Indication	**ALARM@**	**Status**	**Description**
F7	247	Motor Encoder Open Wire	At least one motor encocer feedback channel (ENCA, ENCA', ENCB, ENCB' is not connected properly. (P4 pins 5,6,7,8).
Indication	**ALARM@**	**Status**	**Description**
F8	248	Watchdog Timeout	DSP Watchdog timeout error.

Servomotor Troubleshooting Guide

Problem	Cause	What to do
Motor does not start	Loose Connection ⇒ Tighten connection	
	Wrong wiring ⇒ Correct wiring	
	Overload ⇒ Reduce load or use a larger motor	
	Motor defective	Measure voltage across motor terminals U, V, & W on the Servodrive. If correct, replace motor, otherwise replace Servodrive.
	Servodrive Defective	
Locked Rotor	Wrong order of U, V, W	Check cabling.
Unstable Operation	Wrong motor selected in UltraTools	Check & correct that software matches motor.
	Improper Tuning	Check that Inertial load specified in UltraTools is less than or equal to the actual load seen by the motor. Check other tuning parameters.
	Wrong Wiring	Inspect and correct wiring of motor terminals U, V, & W and/or the encoder.
Motor Overheats	Excessive ambient temperature	Reduce ambient temperature below 40ºC, or use a larger motor.
	Motor dirty	Clean motor surface
	Overload	Reduce load or use a larger motor.
Unusual Noise	Motor loosely mounted	Tighten mounting bolts
	Motor misaligned	Realign
	Coupling out of balance	Balance coupling
	Noisy bearing	Check alignment, loading of bearing, lubrication.
	Vibration of driven machine	Check the machine's mechanical operation.
	Improper grounding and/or shielding	Check the servomotor, Servodrive, and power supply grounding and shielding.
	Incorrect servo control loop tuning	Check the servo control loop tuning parameters.
Poor Velocity Regulation	Single phase main power (L1 & L2 only) on a drive expecting 3-phase power (CA8.2, CA14, G20)	Use 3-phase power.

WARNING!!!
Turn off power before working on the Servomotor

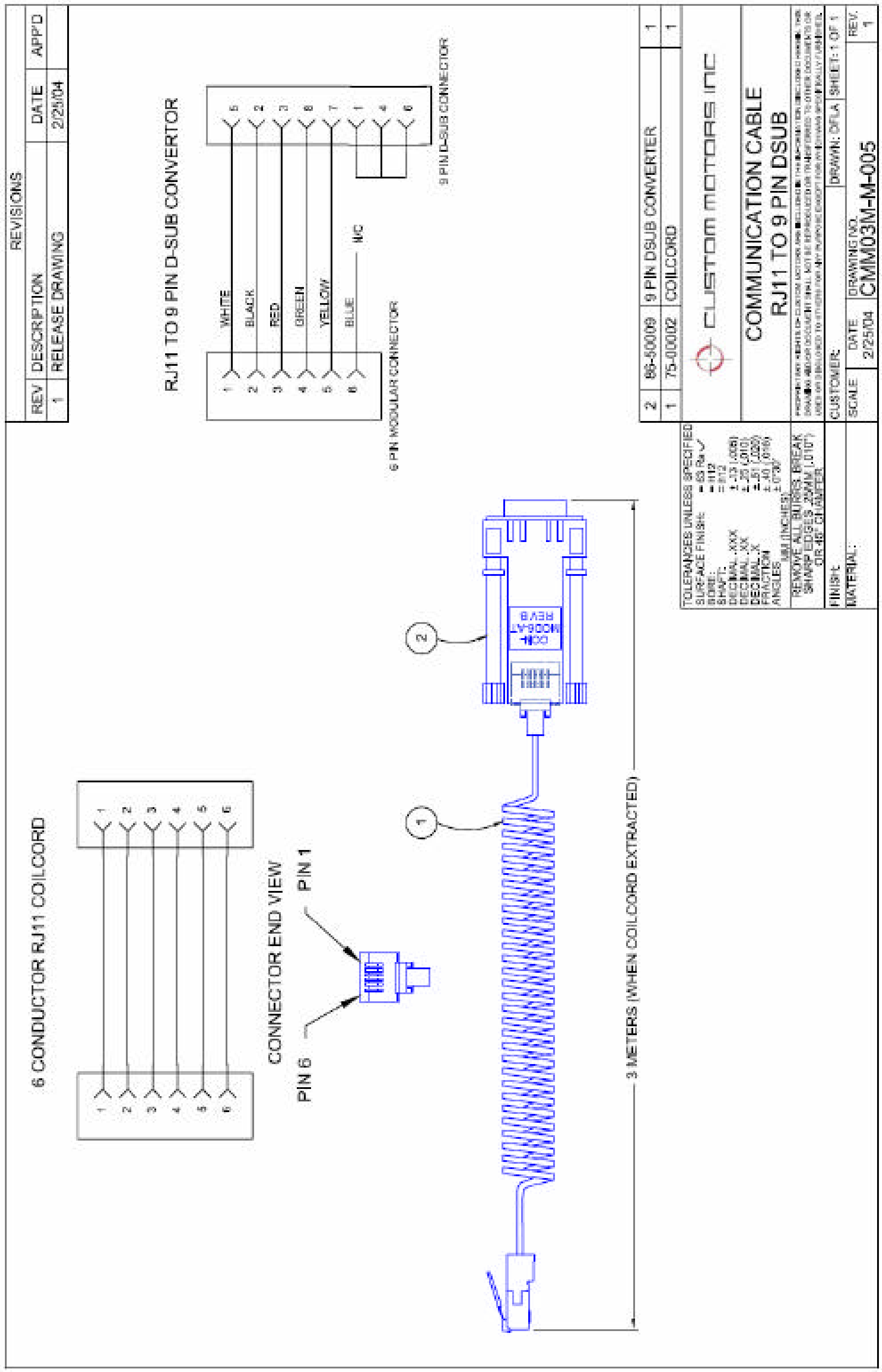


***Figure 14**, Communication Cable*

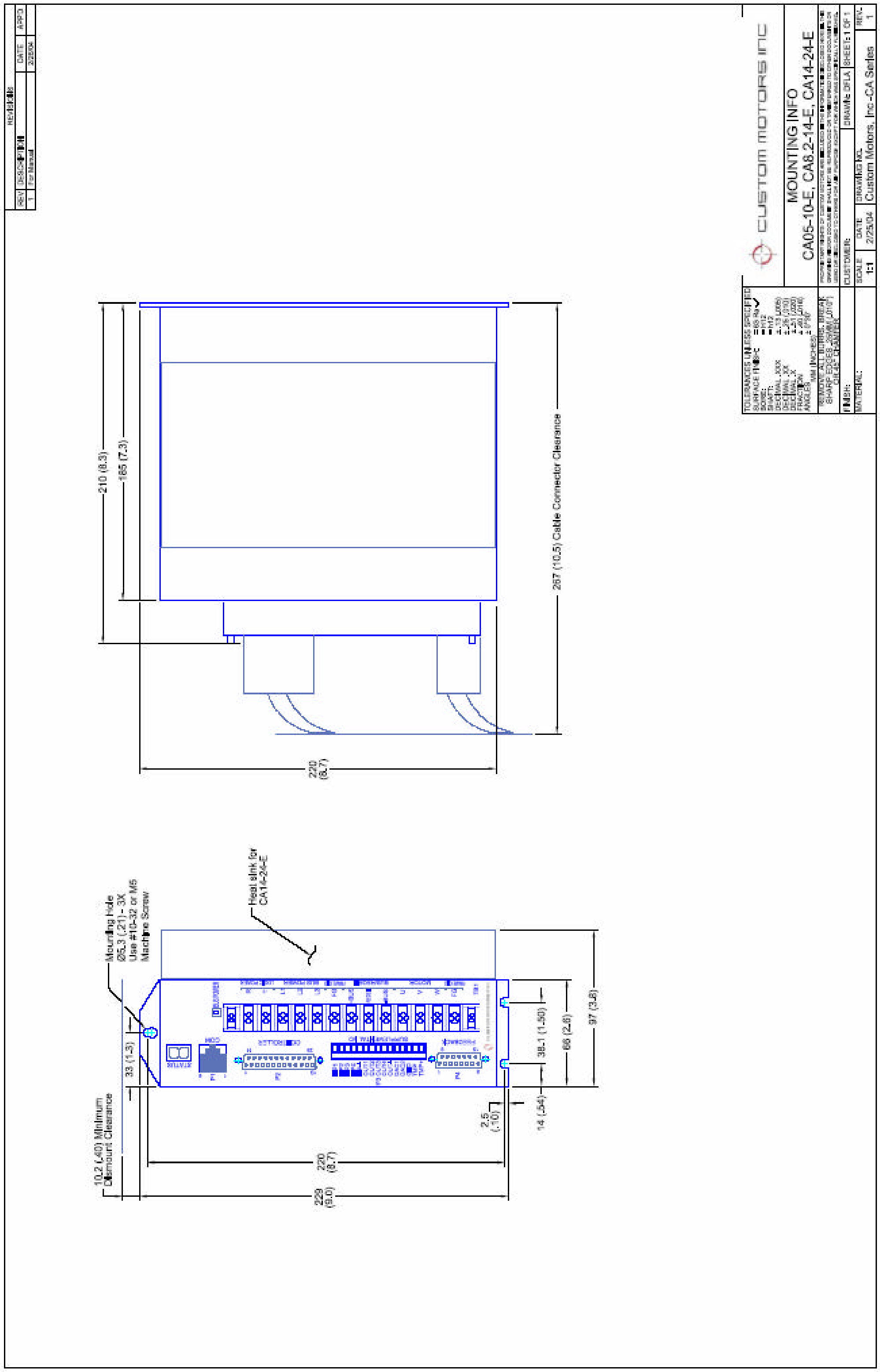


***Figure 15**, Mounting Information CA05 – CA14*

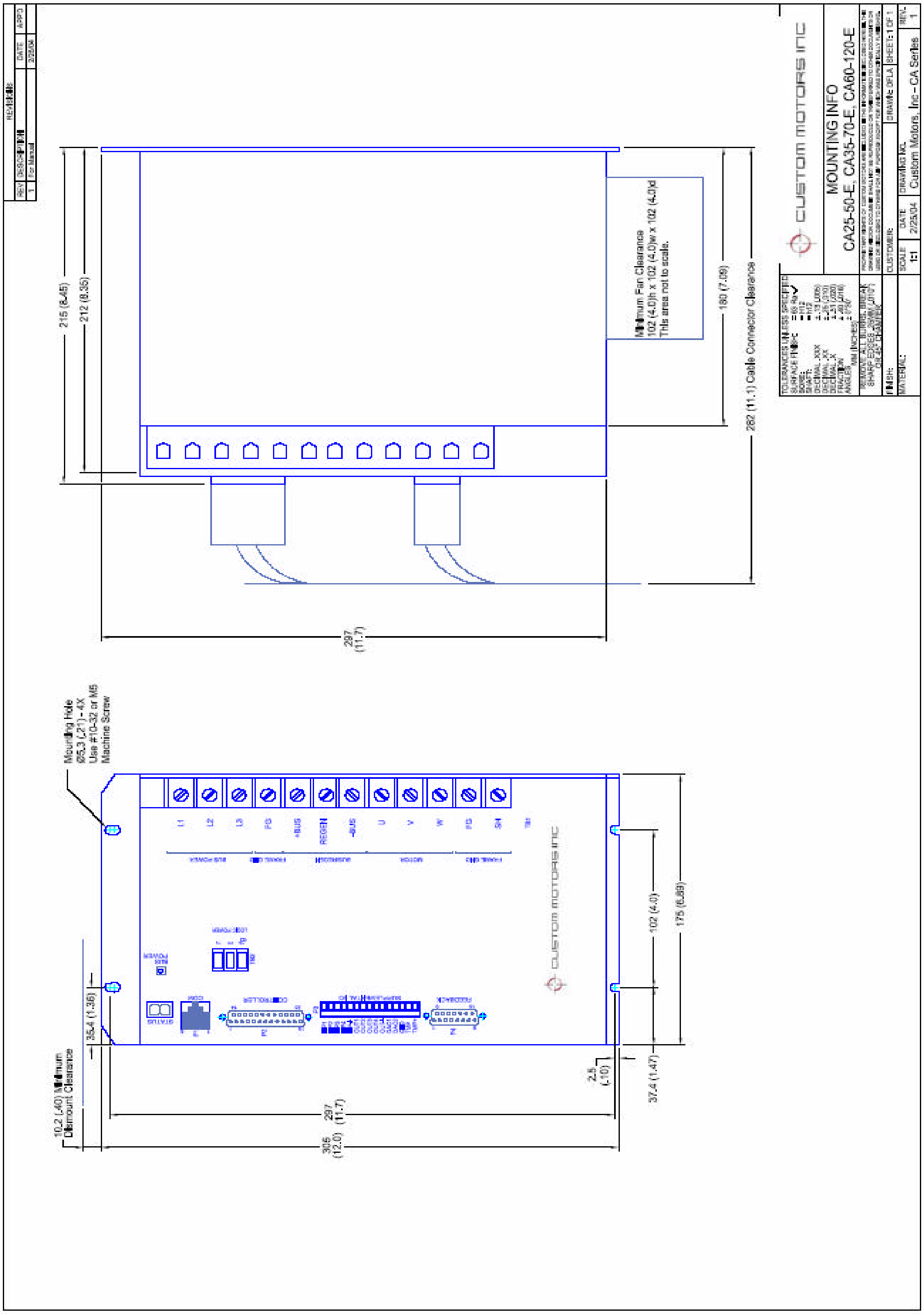


***Figure 16**, Mounting Information CA25 – CA60*

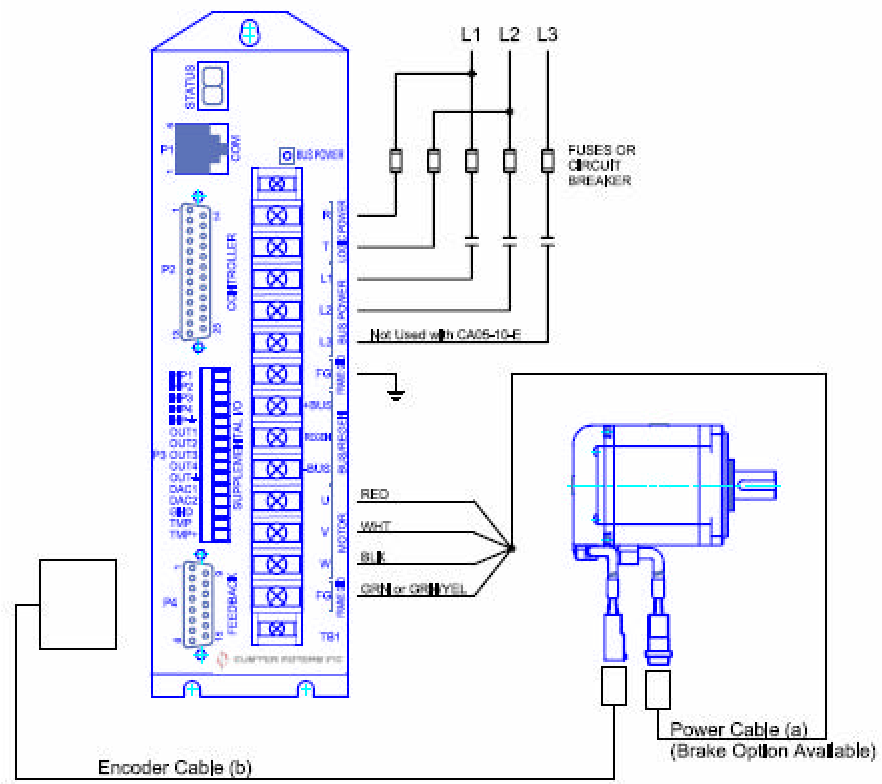


***Figure** 17, Amplifier Interface - 01*

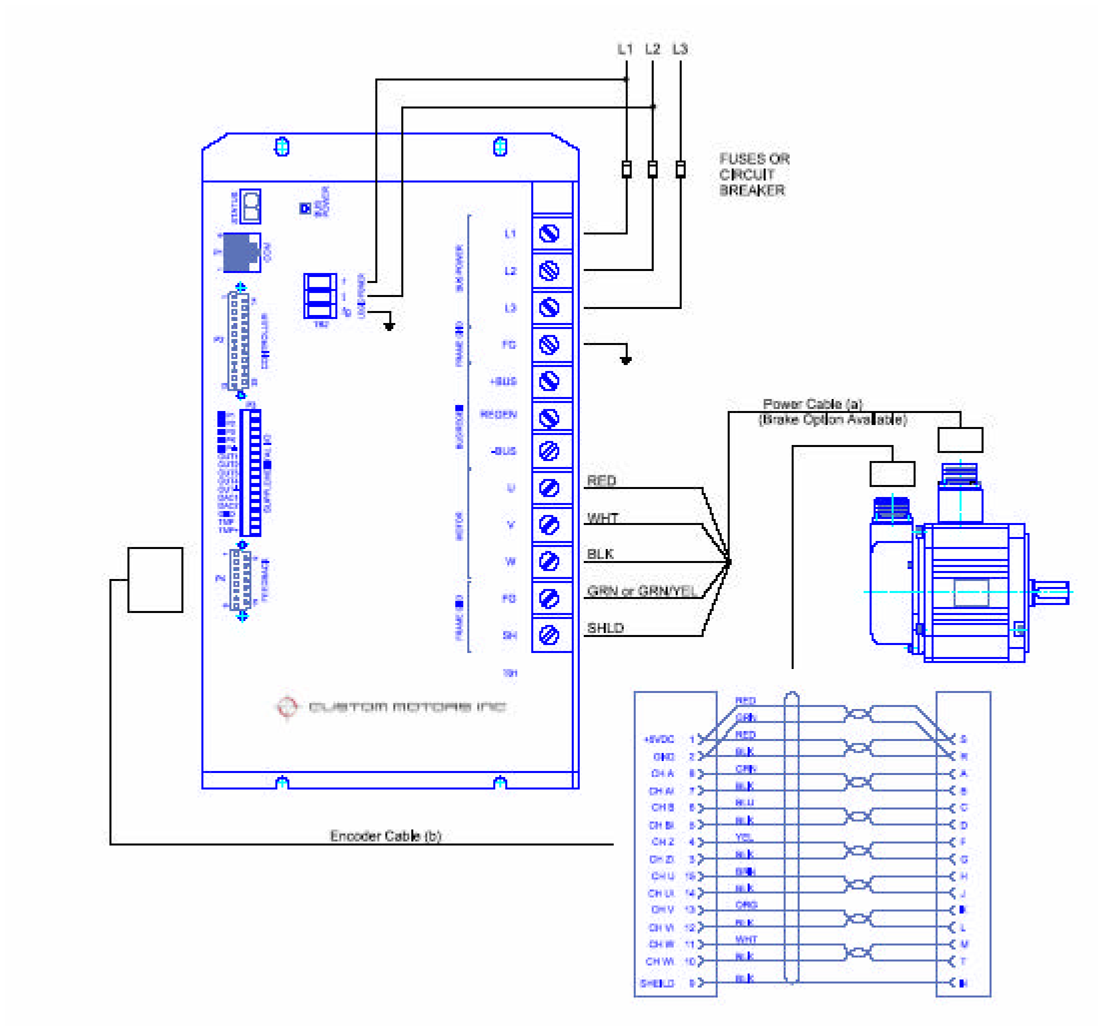


Figure 19, *Amplifier Interface - 02*

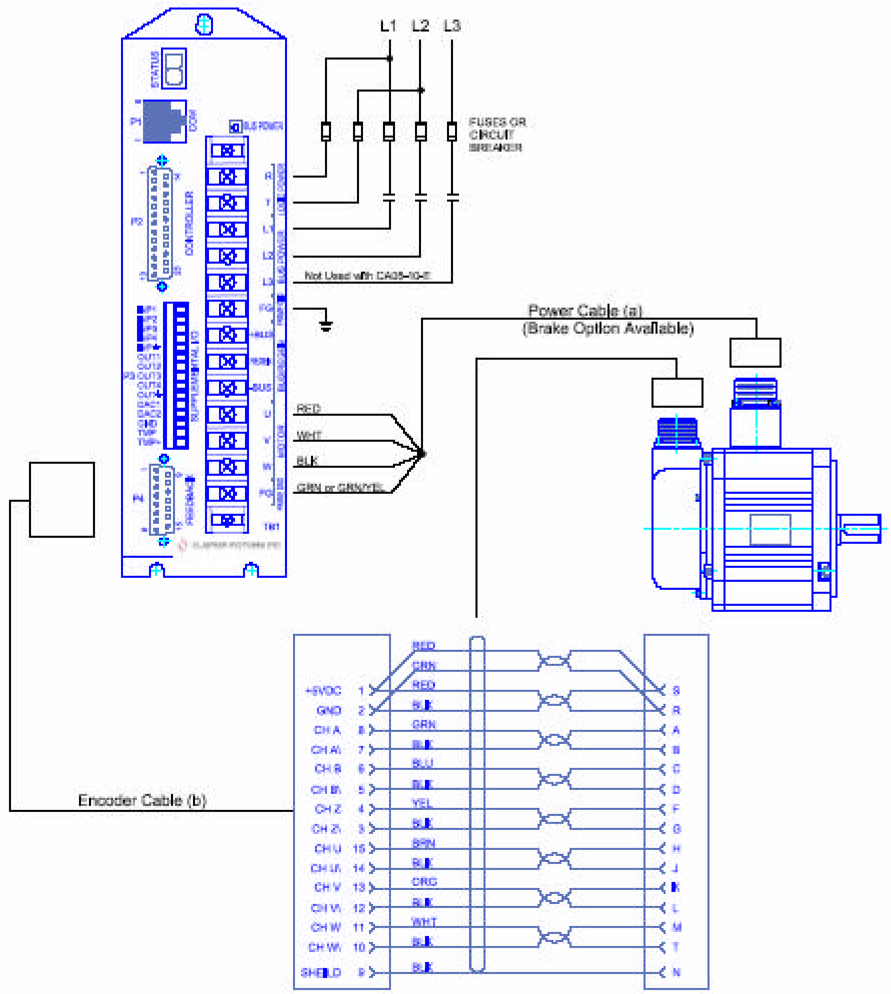


__Figure 18__, Amplifier Interface - 03

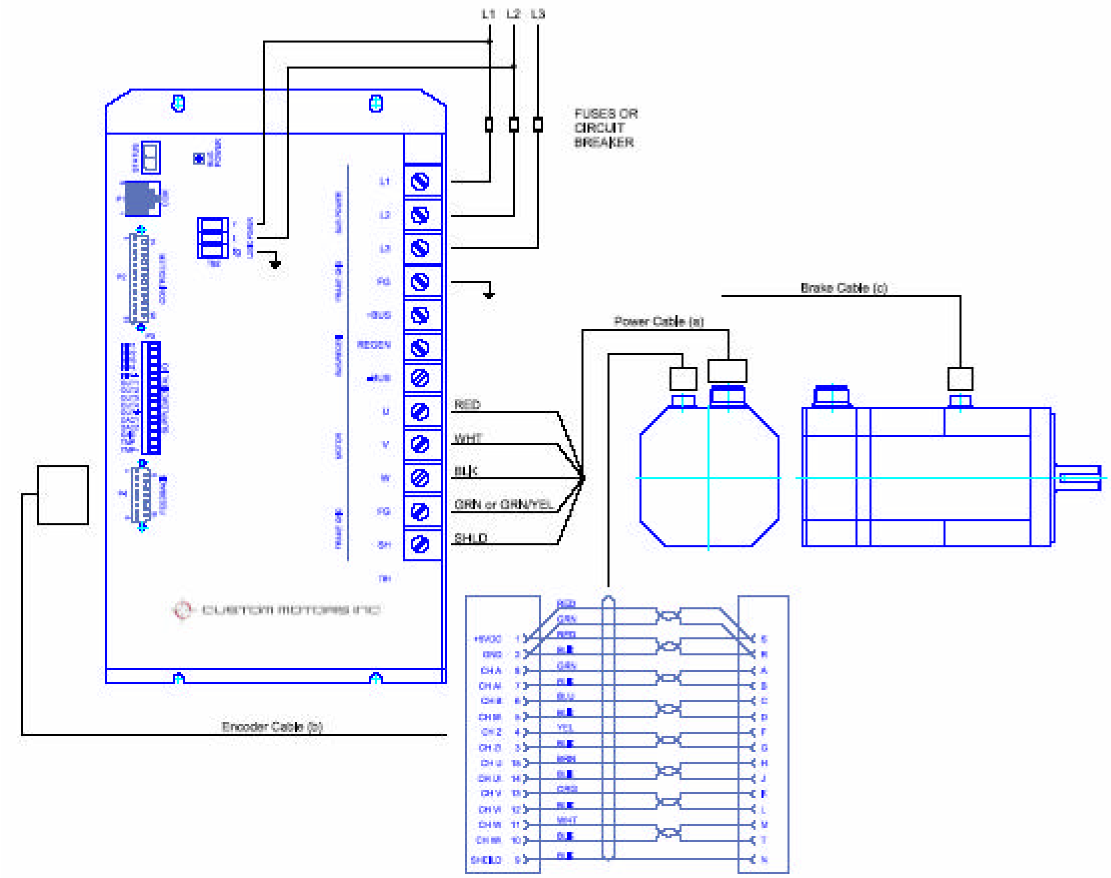


__Figure 20,__ Amplifier Interface - 04

Chapter 8 Software Commands

Software Overview

Description

This chapter provides an overview of the software features and commands used with the G Series Digital Servodrives. The G Series Digital Servodrive has an onboard RS232 COM connector, which uses an RJ-11 port. A desktop or laptop computer can be connected to the G Series servodrive through this port and can use it to set up the servodrive, communicate with the servodrive, and otherwise direct the operation of the G Series servodrive. This RS232 serial connection uses the simple Xon/Xoff protocol for controlling communication at baud rates up to 38,400 baud. The G Series servodrive includes the ability to 'auto-sense' the baud rate, meaning that at power up, it will watch for a carriage return to be sent to it from the PC (the Enter or Return key). From that character, it can detect the baud rate of the source PC and will set its own baud rate to match it. At that point, the G Series servodrive will answer back with its identification and the version number of the internal Flashram program code. The PC program available to provide this communication capability is UltraTools for the G Series.

About UltraTools for the G Series

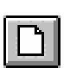
UltraTools is a special software program for the G Series digital servodrive that provides the power to make setting up the G Series servodrive as easy and as flexible as possible, all through the use of a comfortable graphical user interface. UltraTools will run on any desktop or laptop computer running Windows 95, Windows 98, or Windows NT. The program takes about five megabytes of storage space on the hard drive. Included on the distribution CD are the program and its associated help files. In addition, the CD also contains PDF files that supply valuable reference materials on the total G Series family of products.

UltraTools consists of three major components: UltraLink, UltraEditor, and UltraScope. Each fills a separate and distinct function within the tools environment. Each of these components works individually or in consort with the others to provide the power needed to set up the G Series servodrive.

UltraLink

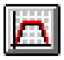
UltraLink is a communications environment that allows the user to talk directly to the G Series servodrive through its RS-232 serial port. A wide variety of communication speeds and setup parameters are supported. All of the G Series servodrive commands can be entered in this mode. Examination of the internal motor or servodrive parameter values is an easy matter. In addition, UltraLink allows for the easy downloading of a series of commands or other setup parameter sets that have been prepared for entry into the servodrive. UltraLink provides the foundation for all communication that occurs between the UltraTools and the servodrive. Also, UltraScope can talk to the G Series servodrive only if a communication port has been opened in UltraLink.

UltraEditor



The UltraEditor is a competent text editing environment that can be used to edit any of the various text files that are used with the G Series servodrive, which includes the commands or setup parameters in an UltraTools Parameter (udp) file. The editor provides the basic tools to modify text, like cut, copy, paste, find and replace, as well as simple formatting tools like tab settings.

UltraScope



UltraScope is, in effect, a digital scope that can take advantage of the sampling abilities of the G Series servodrive to provide a visual picture of the motion that is occurring with a system. It gives the user a method for defining the test motion that is to be used to set up the servodrive system. It also provides an easy way to set up the tuning parameters. It also allows the user to view (plot) all the standard motion items like current loop and velocity loop commands and the actual output that may be of interest in setting up a motion system, as well as most other parameters that you may wish to see. Defining the motion profile, the items to be plotted, the color of the plotted lines, the thickness and type of plotted lines, all these things are easy to do with UltraScope. The sample data can be saved to disk, as can the plot. The plot can be printed easily for future reference. UltraScope provides an in depth view of what is happening in the motion being examined.

Setting Manually versus Using Windows Interface

Almost all of the parameters that control the setup of the motor or the G Series Digital Servodrive can be set manually in the UltraLink window using special commands. But, before software commands can be used to actually move a motor, the servodrive must be placed into serial command mode. At power up, the G Series Digital Servodrive automatically comes up in analog mode, such that a signal on the analog input line would control the servodrive. The RS232 serial interface constantly checks for an input. To place the servodrive into serial command mode, it is necessary to send the following command to it: SERIAL. This places the servodrive into serial command mode. At this point, any of the valid software commands can be sent to the servodrive to set it up and make motion. This is done by typing the command name, followed by a space, followed by the value to set for that command if it requires one. Parameters can also be set, usually more easily, using the Windows interface through the selection of the appropriate pull down menu.

When using the immediate mode in UltraLink to set parameters, a general rule applies on how the commands that require parameters work. For those commands that set parameter values, if a command is typed and is followed by a valid argument, usually a numeric value between 0 and 32767, that command or mode will be given the value you have sent to it. If the command is entered with a question mark following it, then the current value or condition for that item will be returned from the G Series Servodrive. Some commands do not have specific parameter values, like the servo mode commands (TMODE and VMODE) and the other mode commands. In this case, typing the TMODE command will set its state to on. To find the state of the mode commands, enter the MODE command, and they will be displayed. This provides a simple technique for setting or querying the value of the internal parameters in the servodrive. Entering an invalid command name will cause an ERROR message to be returned.

G Series DSP Software Command List

Most G Series functions can be set up in one of two ways, either by selecting the appropriate menu item in the Windows interface, or by typing in a command in the UltraLink window. The available commands are listed below. Commands follow the general format of: *Command* {*argument*} where the argument is optional. Some commands, like GO, do not require an argument. Entering commands with an argument will set the command to that value. Entering the command with a question mark will cause the present value of the command to be displayed.

Motor Parameters:

ENCCNTS	Encoder counts per revolution of the motor (after 4x quadrature encoding)
HOFFSET	Set the Hall offset in electrical degrees
IMTRPK	Motor's Peak Rated Current Limit, where 1000 represents 10 amps
IMTRRMS	Motor's RMS Continuous Rated Current Limit, where 500 means 5 amps
MTRVMAX	Motor maximum speed in kHz

POLES	Total motor poles per revolution

Modes:

ANALOG	Set Analog command mode, which uses the hardware signal at P2 for motion
MODE?	Report existing states for the Servo Control, Commutation, and Command modes
SERIAL	RS232 Serial command, which uses RS232 motion commands to make motion
SINE	Set Sine Commutation Mode
SIXSTEP	Set Six Step Commutation Mode
TMODE	Set Torque Control Mode
VMODE	Set Velocity Control Mode
MOTMODE	Sets the motor overtemperature fault mode

Servodrive:

ACCEL	Acceleration of the velocity or torque signal, depending on mode (32767 max)
ADC.3DB	Analog input Bessel filter to minimize noise on the analog input line
AOFFSET	Used to adjust for the analog offset found in the Velocity/Torque command input
BUSLOW	Sets voltage at which SCR turns on, below which a ‘Low Bus Voltage’ error occurs
CMD	Set the RS232 torque or velocity command signal, depending on mode
DACFN1	Set source function for DAC1 output, (DACFN1 defaults to Velocity monitor)
DACFN2	Set source function for DAC2 output, (DACFN2 defaults to Current monitor)
DECEL	Deceleration of the velocity or torque signal, depending on mode (32767 max)
DRVENA	Enable/Disable servodrive output (in software) by setting to 1 (enable) or 0 (disable)
FAULT	Report or Clear any existing faults in the drive
HALL?	Get the Hall state for the current position of the motor (1, 3, 2, 6, 4, or 5)
HOME	Sets up a routine to reset the drive’s POS register at first instance of encoder Index
ICLAMP	User settable current limit. The output of the drive will not be allowed to exceed this.
INPx	Show existing state for digital input (x = 1…4 for INP1 to INP4), state = 1 or 0
INPFNx	Set target function for digital input (x = 1…4 for INP1 to INP4)
MINFO?	Gets a list of version, ID’s, and drive component serial numbers
OUTFAULT	Set up OUT1, OUT2 and OUT3 for binary fault data output
OUTx	Show existing state for digital output (x = 1…4 for OUT1 to OUT4), state = 1 or 0
OUTFNx	Set source function for digital output (x = 1…4 for OUT1 to OUT4)
POS	Ask for or set the encoder position information
POSHOME?	Ask for the encoder position at the completion of the last HOME command
PWMFREQ?	Ask for the current PWM frequency in Kilohertz (read only parameter)
RAMTEST	Perform a continous test of the DSP static ram memory until powered down
REM or **;**	Allow the inclusion of ‘remarks’ in a command file being sent to the servodrive
RESET	Does a DSP software reboot (faults cleared, parameters restored from EPROM)

RESTORE	Restore servodrive parameters from previously stored values inside the EPROM
STATUS?	Return drive status, including inputs, outputs, enabled condition, and fault code
STORE	Store nonvolative servodrive parameters into the EPROM for use during power up
VBUS?	Check the condition of the bus output voltage
VER?	Query for the Version Number of the G Series Flash ROM

Shunt Regulation (Regen) Parameters:

RGCLIM	Shunt Resistor Current Limit (based on ohms/watts/voltage of shunt resistor)
RGTRIP	Shunt Regulation Trip Voltage (set to 0 to disable shunt regulation) (G10 and up)

Tuning:

ICMD.3DB	Specifies a Bessel low-pass filter corner frequency for use in current loop tuning
KIS	Torque command scaling factor, where KIS = 10000 results in scale factor of 1.0
KIV	Set the current loop's current-to-voltage conversion constant
KVD	Velocity Loop Derivative Gain Constant
KVI	Velocity Loop Integral Gain Constant
KVP	Velocity Loop Proportional Gain Constant
VELOBS	Set velocity observer filter sensitivity for smoother response in velocity mode

Profile Commands:

GO	Command to begin motion in Profile mode after defining a motion profile
PRFCYCL	When PRFMODE is 3, this defines the number of cycles to run the current Profile
PRFENA	Enable/Disable profiling mode by setting to 1 (enable) or 0 (disable)
PRFHILV	High command signal level for Profile
PRFHIT	Defines how long to run the Profile at top Current/Velocity level (1 = 400 µsecs)
PRFLOLV	Low command signal level for Profile (often 0)
PRFLOT	Defines how long to run the Profile at low Current/Velocity level (1 = 400 µsecs)
PRFMODE	Profiling mode, either 1 or 2 or 3, defining the type of Profile cycle to run
STOP	Command to stop any Profile motion that is taking place

Data Gathering Commands:

DGABORT	Causes the data gathering function to be stopped or aborted
DGLOGx	Defines data gathering log source, where x = 1 to 4 for four possible channels
DGPOINTS	Number of points to log per data item
DGSTAT	Data gathering status (0 – Not set, 1 – Ready to start, 2 – Collecting, 3 – Done)
DGTRIG	Defines the type of trigger to start the data gathering, 1 = GO, or 2 = Start Now
DGUPDATE	Data Gathering update interval, where 1 = 400 µsec, 2 is 800 µsec, etc.
DGUPLD	Ask the G Series servodrive to upload the recently gathered data

Command Set

ACCEL

Acceleration Command

Format1:	ACCEL { value }
Format2:	ACCEL?
Type	Direct Mode Command
Units:	CMD units per interrupt cycle (400 µsec)
Argument Type:	Unsigned Integer, 1 to 32767
See Also:	CMD, DECEL, SERIAL

The ACCEL command sets the value of the desired torque or velocity command acceleration through the use of the RS232 serial port for use in Profile motion. ACCEL will cause motion to ramp up to the specified CMD signal at the rate given by ACCEL. An ACCEL of 2 would ramp up to a CMD of 5000 in 1 second.

If the ACCEL? command is entered, the existing value for this parameter will be returned.

Examples:

» ACCEL 65 ;Sets acceleration to 65 CMD units per interrupt

ADC.3DB

Specify a Bessel filter corner frequency for the analog input signal

Format1:	ADC.3DB { value }
Format2:	ADC.3DB?
Type	Nonvolatile Parameters
Units:	Corner Frequency in Hertz: 0, or 5 to 625 Hz

The ADC.3DB parameter specifies a Bessel filter corner frequency (3db or 45 degree phase shift point) that is applied to the ADC for the analog input signal. This filter can help reduce the effect of noise on the analog input signal. The default for the corner frequency is 0, which means no filtering is done normally. The corner frequency can range from 5 to 625 Hz. Specifying a value of ‘0’ will turn the filter off.

If the ADC.3DB? command is entered, then the drive returns the existing value for ADC.3DB.

Examples:

» ADC.3DB 20 ; Sets the Bessel filter corner frequency to 20 Hz.

ANALOG

Analog Command Mode

Format:	ANALOG
Type	Direct Mode Command
Argument Type:	none
See Also:	SERIAL, MODE?, AOFFSET

The ANALOG command sets up the drive to use the analog signal for the input command. In this mode, the desired command signal must be applied to the analog input pins at P2, and the analog-to-digital converter converts this signal for use digitally inside the servodrive. The SERIAL command provides the means to switch from analog control back to serial control through the RS-232 port.

Use the MODE? Command to determine the existing state of the command mode.

The startup mode for the G series servodrive is always ANALOG.

Examples:

» ANALOG	(This command puts the servodrive in analog mode)
» SERIAL	(This command puts the servodrive in serial mode)
» ANALOG	(This command puts the servodrive back in analog mode)

AOFFSET

Analog Offset Command

Format1:	AOFFSET { value }
Format2:	AOFFSET?
Type	Non volatile parameter
Argument Type:	Signed integer +/- 32767
See Also:	ANALOG

The AOFFSET command sets the parameter that is used to adjust for the analog offset found in the Velocity/Torque command input at pins 1-2 of Controller connector P2. The units for AOFFSET are such that 3277 represents an offset of 1 volt.

If the AOFFSET? command is entered, then the drive returns the existing value for AOFFSET.

Example:

» AOFFSET 244 : 244 would give 244/3277 = +0.0745 millivolt offset

BUSLOW

Bus Low Voltage Check Value

Format1:	BUSLOW { value }
Format2:	BUSLOW?
Type:	Nonvolatile Parameter
Units:	DC Volts
Argument Type:	Unsigned Integer, 0 to 32767
See Also:	VBUS

The BUSLOW parameter represents the minimum voltage below which a ‘Low Bus Voltage’ fault (A3) will be generated by the drive. BUSLOW is also used as the threshold below which the SCR will be turned off as part of the soft start logic.

If the BUSLOW? command is entered, the existing value for it is returned.

NOTE: A setting of 0 for BUSLOW will cause the servodrive to use the default, which is 90 DC volts, for the BUSLOW value

Example:

» BUSLOW?

90 ; The existing setting for BUSLOW is 90 volts

CMD

Current Command / Velocity Command

Format1:	CMD { value }
Format2:	CMD?
Type:	Direct Mode Command
Units:	+/-32767 equals full scale input
Argument Type:	Signed Integer, +/-32767
See Also:	SERIAL

The CMD command sets the value of the desired velocity (in velocity mode) or current (in torque mode) through the use of the R232 serial port. The SERIAL command must previously be set to 'ON' for the CMD command to work. Commands applied to the drive via the CMD command are executed within the velocity loop interrupt rate of 400 microseconds. If the CMD? command is entered, the existing value for this parameter will be returned.

The units for CMD are equivalent to the gain of the ADC input. The argument used with CMD is equivalent to the voltage input that would be applied to the ADC to achieve that number. The gain of the ADC input defaults to +/-10 = +/-32767 (full scale).

Examples:

» CMD 2000	;Sets output current command immediately
» CMD?	;Returns the output current command 2000
» CMD –2000	;Output direction changes immediately

DACFNx

Digital to Analog Output Function Command

Format1:	DACFN1 { value }
Format2:	DACFN2 { value }
Format3:	DACFN1?
Format4:	DACFN2?
Type	Nonvolatile Parameter
Argument Type:	Unsigned Integer (See table below)

The DACFNx command sets the source function for the output of the specified DACx. DACFN1 refers to DAC1 as defined by the markings on the G Series servodrive. DACFN2 refers to DAC2. Outputs for these are updated every 400 microseconds.

If either of the DACs is entered followed by a question mark (DACFN1?) the existing value for this parameter will be returned.

Following is a table indicating what values refer to what internal functions:

	FUNCTION THAT OUTPUT REFLECTS:
1	Velocity term
2	Output current term (current command term before multiplying by the commutation terms)
3	U output current term
4	V output current term
5	W output current term
6	Drive's current integrator term
7	Motor's continuous current integrator term
8	Shunt integrator term

Examples:

» DACFN1 2	;DAC1 will now report the drive current
» DACFN1 1	;DAC1 will now report the drive velocity

DECEL

Deceleration Command

Format1:	DECEL { value }
Format2:	DECEL?
Type	Direct Mode Command
Units	CMD units per interrupt cycle (400 µsec)
Argument Type:	Unsigned Integer, 1 to 32767
See Also:	CMD, ACCEL, SERIAL

The DECEL command sets the value of the desired torque or velocity command deceleration through the use of the RS232 serial port during Profile motion. DECEL will cause motion to ramp down to the specified CMD signal at the rate given by DECEL. A DECEL of 1 would ramp down from a CMD velocity of 2500 in 1 second.

If the DECEL? command is entered, the existing value for this parameter will be returned.

Example:

» DECEL 10 ;Sets deceleration to 10 CMD units per interrupt (400 µsec)

Data Gathering

Data Gathering is a feature of the G-Series servodrive in which the drive will perform real time capture of some data, buffer it and then upload it to the host. The purpose is to be able to store up to 4 related values, all synchronized, and then be able to plot them (using UltraTools), effectively making a digital scope.

Operation of data gathering is made simple with the commands defined below. The drive will store up to 4 channels of information. There are 4 buffers of 4000 points each available. The user selects which channels will be used and the information to be stored in that channels log (command DGLOGx), how many points to actually store, up to 4000 (command DGPOINTS). The logging can occur as fast as the velocity loop, 2.5kHz, or at integer multiples below using the DGUPDATE command. Once the rate is set each channel is logged at the same rate and at the same time so that all of the information is synchronized.

Logging of the data is controlled by the DGTRIG command. This command determines when the logging takes place, immediately or triggered by an event such as PROFILE generation. For each trigger command one set of data is collected. To log another set of data another DGTRIG command must be executed. Once the data is logged the DGUPLD command allows the data to be uploaded to a host computer.

Example:

```
; (Profile Example)          ;Set up or define a Profile before coming here
» DGLOG1 1                   ;log Actual Velocity
» DGLOG2 6                   ;log Velocity Error term
» DGLOG3 2                   ;log Velocity Command term
» DGPOINTS 400               ;capture 400 points
» DGUPDATE 2                 ;update every 2nd velocity loop update (every 800 µsecs)
» DGTRIG 1                   ;start data gathering on GO
» GO                         ;start the profile and the data gathering
» DGSTAT                     ;see if the data gathering is done yet
» 2
» DGSTAT                     ;see if the data gathering is done yet
» 3
» DGUPLD                     ;upload the gathered data
»
; (Capture Example -No Profile)  ;No Profile is needed for a pure capture
» DGLOG1 1                   ;log Actual Velocity
» DGLOG2 6                   ;log Velocity Error term
» DGLOG3 2                   ;log Velocity Command term
```

» DGPOINTS 400	;capture 400 points
» DGUPDATE 2	;update every 2nd velocity loop update (every 800 µsecs)
» DGTRIG 2	;start data gathering immediately
» DGSTAT	;see if the data gathering is done yet
» 2	
» DGSTAT	;see if the data gathering is done yet
» 3	
» DGUPLD	;upload the gathered data

DGABORT

Data Gathering Abort

Format:	DGABORT
Type	Direct Mode Command
Argument Type:	none
See Also:	GO, DGTRIG, DGUPLD, DGSTAT

The DGABORT command allows the user to stop or abort the collecting and sending back of the collected data points. It gives the user the power to stop the process rather than wait for it to get done by finishing normally.

Example:

» DGABORT	;Stop the G Series from sending back the remaining data points

DGLOGx

Log source

Format1:	DGLOG1	<source>
Format2:	DGLOG2	<source>
Format3:	DGLOG3	<source>
Format4:	DGLOG4	<source>
Format5:	DGLOGx?	
Type	Direct Mode Command	
Argument Type:	Unsigned integer, 0 to 8	
See Also:	GO, DGTRIG, DGPOINTS, DGUPDATE	

The DGLOGx commands define the source of the information to be logged in the given log. The servodrive can log up to four items at a time. Each item is stored in a different log, numbered 1 to 4. This command defines the item to go into each log using the table below. DGLOG1 defines the source for log #1, DGLOG2 is used for log #2, etc.

<source>	Information logged
0	no logging in this log
1	Actual velocity
2	Velocity Command
3	I(u) actual current phase U
4	I(v) actual current phase V
5	I(w) actual current phase W
6	Velocity Error Term
7	DC Current (same as current command prior to summing with commutation)
8	Bus Voltage (in volts)

Examples:

DGLOG1	1	; select Actual velocity to be logged on Log #1
DGLOG2	0	; turn off Log #2

DGPOINTS

Data Points Logged

Format1:	DGPOINTS { size }<# of points logged>
Format2:	DGPOINTS?
Type	Direct Mode Command
Argument Type:	Unsigned Integer, 1 to 4000
See Also:	DGLOGx, DGUPDATE, DGTRIG, DGSTART, GO

The DGPOINTS command defines how many points (samples) should be logged at the next trigger. This number of points will be logged in each active channel. Up to four data items can be sampled in a given data gathering.

If the DGPOINTS? command is entered, the existing value for this parameter will be returned.

Examples:

» DGPOINTS 2500 ; Log 2500 samples. (If DGUPDATE is 1, log 1 sec of information.)

» DGPOINTS 4000 ; Log 4000 samples. (If DGUPDATE is 2, log 3.2 sec of information.)

DGSTAT

Data Gathering Status

Format:	DGSTAT?
Type	Direct Mode Command
Argument Type:	none (0, 1, 2, or 3 can be returned)
See Also:	GO, DGTRIG

This command returns status information about the data gathering operation. 1 = trigger enabled and waiting for trigger, 2 = collecting data, 3 = data in buffer (collecting complete flag), 0 = no activity (i.e. Not triggered and not collecting data).

The function of this command is to allow a host to determine when a trigger has occurred and that all of the data has been logged before beginning the upload via DGUPLD.

Examples:

» DGSTAT?	; Check the status of the data gathering
3	; Data is in buffer, ready for the DGUPLD command

DGTRIG

Data Gathering Trigger

Format1:	DGTRIG { mode }
Format2:	DGTRIG?
Type	Direct Mode Command
Argument Type:	1 or 2
See Also:	GO, DGSTAT

The DGTRIG command defines the trigger source for starting the data gathering and enables and begins gathering . A 1 denotes that data gathering should begin when the GO command is issued. A 2 means that data gathering should begin immediately. After data has been gathered another DGTRIG is required to perform another data gathering.

If the DGTRIG? command is entered, the existing value for this parameter will be returned.

Examples:

» DGTRIG 1 ; Begin taking samples when the GO command is given.

DGUPDATE

Update rate

Format1:	DGUPDATE {# of updates}
Format2:	DGUPDATE?
Type	Direct Mode Command
Argument Type:	Unsigned Integer, 1 to 500
See Also:	DGPOINTS, DGTRIG, DGSTART, GO

The DGUPDATE command defines the ticks between data samples, that is, how often the drive will capture the desired data samples. Data gathering is based on the velocity loop update rate, 2.5 kHz (400 µsec). Samples can be logged on every loop update or some number of updates can be skipped between samples. This parameter sets the sampling rate using the formula:

$$\text{sampling rate} = \frac{\text{velocity loop update (2.5 kHz)}}{\text{<\# of updates>.}}$$

If the DGUPDATE? command is entered, the existing value for this parameter will be returned.

Examples:

» DGUPDATE 1	; Takes samples every 0.4 milliseconds, 2.5 kHz rate (2500/1)
» DGUPDATE 2	; Takes samples every 0.8 milliseconds, 1.25 kHz (2500/2)
» DGUPDATE 5	; Takes samples every 2 milliseconds, 500 Hz (2500/5)

DGUPLD

Data Gathering Upload Data

Format:	DGUPLD
Type	Direct Mode Command
Argument Type:	none
See Also:	GO, DGABORT, DGTRIG, DGPOINTS, DGSTAT, DGLOGx

The DGUPLD command is used to tell the G Series servodrive to begin sending back the data that it has just collected from a test move of some type. The data is sent back in groups of four hexadecimal characters per each data item requested by the user. Each data record (between 1 and 4 items of data as requested by the user via DGLOGx) is terminated with a carriage return and line feed. After the last data record is sent by the G Series servodrive, a # character is sent to signal the end of the data.

Example:

```
                    ;Before coming here, set up your desired Profile
» DGLOG1  1         ;log actual velocity in log #1
» DGLOG2  8         ;log bus voltage in log #2
» DGLOG3  0         ;turn off data log #3
» DGLOG4  0         ;turn off data log #4
» DGPOINTS 5        ;capture 5 points
» DGUPDATE 10       ;10 updates apart
» DGTRIG 1          ;Begin taking samples when the GO command is given.
» GO                ;When ready, we issue the GO command to get data
»
» DGUPLD            ;Once the motion is done (DGSTAT?), we upload data
FFFF0123            ;here come's the data….
FFF30124
FFFE0119
00030123
FFFF0119
#                   ;'#' signifies the end of the data log
»
```

DRVENA

Enables or Disables Servodrive Output

Format1:	DRVENA { mode }
Format2:	DRVENA?
Type	Nonvolatile Parameter
Argument Type:	0 or 1
See Also:	STATUS?, STORE

The DRVENA command is used to enable or disable the servodrive output IGBT transistors. A "0" argument disables the servodrive output, while a "1" argument enables the servodrive output. Note that the hardware enable input (Controller connector P2) must be asserted (or set for normally open operation) for this command to have any effect.

This command is used both in direct mode, to enable and disable the drive, and as a nonvolatile parameter. Setting the DRVENA mode followed by the ***STORE*** command will set the drive's startup mode to the setting of the DRVENA command when the ***STORE*** command was invoked. Entering the DRVENA? command will return either an 'ENABLED' or 'DISABLED' to indicate its present state.

Examples:

» DRVENA 1 (This command enables the servodrive)

ENCCNTS

Encoder Counts per Revolution (with quadrature)

Format1:	ENCCNTS { counts }
Format2:	ENCCNTS?
Type	Nonvolatile Parameter
Argument Type:	Unsigned Integer, 0-65535
See Also:	POLES, SIXSTEP, SINE

The EncCnts command sets the encoder line counts (multiplied) per revolution of the motor. Since this is a 16-bit value and the G Series employs quadrature multiplication, the maximum setting is 65535. Setting a value greater than 65535 will generate a “value out of range” error.

Examples:

The following example sets the encoder count to 8000 counts per revolution for a motor with a 2000 line per revolution encoder:

»ENCCNTS 8000 ; 2000 lines * 4 = 8000 counts

FAULT

Queries/Resets drive faults

Format1:	FAULT?
Format2:	FAULT 0
Type	Direct Mode Command
Argument Type:	0 (optional)
See Also:	STATUS, DRVENA, Appendix A – Fault Codes

The FAULT command will cause the drive to either clear faults (FAULT 0) or report the existing fault value in decimal (FAULT?). If the drive is enabled, the outputs will be turned on. The FAULT 0 command will not enable a drive that is either hardware or software disabled, or if the condition causing the fault has not been corrected.

Examples:

»FAULT?	; Return the current fault code decimal value
»FAULT 0	; Clears fault

GO

Profile Go

Format:	GO
Type	Direct Mode Command
Argument Type:	none
See Also:	PRFENA, STOP

The GO command allows the user to start in motion the Profile that has been defined by all of the PRF type commands. The SERIAL command must previously be set to 'ON' for this command to work.

Examples:

»PRFENA 1	; Enable profile mode
»TMODE	; Set Torque mode on (to move using Torque mode)
»PRFHILV 8000	; Set value for the high level profile command
»PRFHIT 1000	; Set time to run 'at Current', in 400 µsecs units
»PRFLOLV 0	; Set the low level command to 0
»PRFLOT 1000	; Set time to run 'at low level', also in 400 µsecs units
»PRFMODE 3	; Set PRFMODE to 3 for fixed cycles
»PRFCYCL 1	; Set PRFCYCL so we do only a single cycle in our move
»GO	; GO causes our profile motion to begin

HALL

Hall state at existing motor position

Format:	HALL?
Type	Direct Mode Command
Argument Type:	none

The HALL command provides a method for checking the Hall state inputs at the existing position of the motor. The commutation signals for W, V, and U are respectively indicated in bits 3, 2, and 1 (LSB) of the integer value returned by HALL. When the input is ON, the bit is set to 1, and when it's OFF, the bit is set to 0. The HALL value returned will normally be a single digit from 1 to 6. It should never be a 0 or a 7, which would indicate an electrical or wiring problem concerning the motor. When a motor is hooked up properly, the Hall states will normally progress in the order 1 3 2 6 4 5... when the motor is turned in a counter-clockwise motion as seen when facing the shaft of the motor (encoder counting in a positive direction). This HALL command will be fully functional when operating in SIXSTEP mode (trap mode) with the drive enabled or disabled. When operating in SINE mode, the HALL command will only update the Hall state information when the drive is disabled. Nevertheless, in SINE mode, after disabling the drive with DRVENA 0, rotating the motor shaft will provide the Hall state information normally desired. This parameter provides a means to troubleshoot the wiring of motors to the G series servodrive.

CounterClockWise Motion

W,V,U state	HALL value
101	5
001	1
011	3
010	2
110	6
100	4

Example:

» HALL? ;Ask for the Hall state

3

HOFFSET

Sets the Hall Offset

Format1: HOFFSET { value }

Format2: HOFFSET?

Type Nonvolatile Parameters

Argument Type: Signed Integer, +/-360

The HOFFSET parameter is used to set the offset between the positive portion of the back emf observed from the motor leads that will connect to the drive's U and V outputs (U with respect to V) and the +5 volt portion of the Hall signal that will connect to the drive's U Hall input when rotating the motor counter-clockwise from the face of the motor. The argument is in electrical degrees.

Examples:

» HOFFSET 30 ; Sets the Hall offset to +30 electrical degrees, i.e. the back emf leads the Hall signal by 30 electrical degrees.

HOME

Set or Query Home Status

Format1:	HOME
Format2:	HOME?
Type:	Direct Mode Command
Argument Type:	None

The HOME? command returns status of the home function. The home function zeros the position after seeing the index marker of the encoder. The HOME command enables this mode. A “0” is returned if the index marker has not yet been seen, and a “1” is returned when the index marker has been seen and the position register (POS?) has been reset.

Examples:

```
»POS?        ; Check where we are at to begin with
12345678
»HOME        ; Sets the HOMEing mode
»CMD 150     ; Set velocity and direction
»HOME?       ; Query for the Home Complete flag
0
»HOME?       ; Query for the Home Complete flag again
1            ; Home is complete
»POS?        ; Now, see where we are at after rezeroing position
23
```

ICLAMP

Set Peak Current Clamp Level As a Percentage of Peak Current

Format1:	ICLAMP { value }
Format2:	ICLAMP?
Type	Nonvolatile Parameters
Units:	Percent of Peak
Argument Type:	Unsigned Integer, 0-100
See Also:	IMTRPK, IMTRRMS

The ICLAMP parameter sets the peak current as a percentage of the IMTRPK value. The factory default value is 100, which represents 100%. Setting this limit simply clamps the input current command so that it will not be allowed to exceed this ICLAMP value. It will not generate a fault on the drive. This parameter is dynamic and may be changed on-the-fly.

This limit, ICLAMP, prevents a command of too large a value from being entered, and is an indirect limit on the output. A poorly tuned current loop may have overshoots which exceed the limit.

Examples:

» ICLAMP 50 ; Sets the input current limit to 50% of the IMTRPK value.

ICMD.3DB

Specify a Bessel corner frequency

Format1:	ICMD.3DB { value }
Format2:	ICMD.3DB?
Type	Nonvolatile Parameters
Units:	Corner Frequency in Hertz, 0 to 2500 Hz

The ICMD.3DB parameter specifies a Bessel low-pass filter corner frequency (3db or 45 degree phase shift point) that is applied to the command for current before it is applied to the current loops. This filter helps stabilize some systems due to the G Series' highly responsive current loops. The default for the corner frequency is 500 Hz and is suitable for most systems. The maximum corner frequency that can be specified is 2500 Hz. Specifying a value of '0' will turn the filter off.

If the ICMD.3DB? command is entered, then the drive returns the existing value for ICMD.3DB.

Examples:

» ICMD.3DB 1000 ; Sets the Bessel filter corner frequency to 1000 Hz.

IMTRPK

Set Peak Current Clamp Level

Format1:	IMTRPK { value }
Format2:	IMTRPK?
Type	Nonvolatile Parameters
Units:	Hundredths of amperes
Argument Type:	Unsigned Integer, 0 to 32767
See Also:	IMTRRMS, ICLAMP

The IMTRPK parameter sets the peak current (in Amps DC) by clamping the current command of the servodrive. The factory default is equal to the drive's peak current and will change based on the motor. UltraTools sets this value based on the motor data.

Examples:

» IMTRPK 500 ; Sets the peak current limit to 5 amperes.

IMTRRMS

Sets the motor RMS Current Limit

Format1:	IMTRRMS { value }
Format2:	IMTRRMS?
Type	Nonvolatile Parameter
Units:	Hundredths of amperes DC
Argument Type:	Unsigned Integer, 0 to 32767

The IMTRRMS command sets the RMS motor current-limit for the motor to the given value in hundredths of amperes. The continuous current term is integrated over a specific period of time. If the resultant RMS value is exceeded by the drive output, a servodrive fault will occur, disabling the drive.

If the IMTRRMS? command is entered, the existing value for this parameter will be returned.

Examples:

» IMTRRMS 750 ; Sets the motor RMS current limit to 7.5 amperes

INPx?

Digital Input State Command

Format1:	INP1 ?
Format2:	INP2 ?
Format3:	INP3 ?
Format4:	INP4 ?
Format5:	INP? – Returns a 4 character binary string indicating the status of all four inputs.
Type	Direct Mode Query
Argument Type:	none
See Also:	INPFNx , OUTFAULT

The INPx command allows the user to query the state of the given digital input. INP1 to INP4 refer to the digital inputs as defined by the markings at connector P3 on the servodrive. Note that INP1 and INP2 are also present on the Controller connector, P2. The value returned by the query can be either a 0 or a 1, indicating an OFF or ON condition for the input. The ON condition is defined as current flowing in the optocoupler at the input. Note that INP1 can be used in conjunction with OUTFAULT 1 to assist in querying bits 1-3 or 4-6 of the existing fault code value. See OUTFAULT.

The fifth format (INP?) returns a 4 character binary string indicating the status of all four inputs, INP1 to INP4, from left to right.

Examples:

»INP1?	; Query the existing state of INP1
0	; State of INP1 is 0 or OFF
»INP2? 1	; Query the existing state of INP2 ; State of INP2 is 1 or ON
»INP?	; Query the existing state of all INP’s
0 1 0 0	; INP1 is OFF, INP2 is ON, INP3 is OFF, INP4 is OFF

INPFNx

Digital Input Function Command

Format1:	INPFN1 { [-]value } for future use (See also OUTFAULT)
Format2:	INPFN2 { 0, 1 or –1 } [for Clockwise inhibit]
Format3:	INPFN3 { 0, 1 or –1 } [for Counter-Clockwise inhibit]
Format4:	INPFN4 { [-]value } for future use
Format5:	INPFN98 { + | - } [Dedicated drive enable setting]
Format6:	INPFN99 { + | - } [Dedicated fault reset setting]
Type	Nonvolatile Parameter
Argument Type:	Signed integer, OR + or – sign (for INPFN98 or INPFN99)

The INPFNx command sets the target function that the input defined in x is to be directed to in the G Series servodrive. INPFN1 refers to INP1 as defined by the markings on the servodrive. INPFN2 refers to INP2, INPFN3 refers to INP3, and INPFN4 refers to INP4. Placing the optional minus sign in front of the *value* inverts the assertion of the input, making it a normally closed input. Setting an INPFNx to a value of 0 will disable that INPx from going to any internal function. Following is a table indicating what values refer to what internal functions:

INPFN	**Function that Input is Directed to:**
1	Reserved for future use (See OUTFAULT for special use of INP1)
2	Clockwise rotation inhibit
3	Counter-clockwise rotation inhibit
4	Reserved for future use

INPFN98 and INPFN99 are special parameters for inverting the dedicated hardware Enable and Reset inputs (P2, pins 23 and 24. Pin 25 is common for these inputs). In the factory default mode (–), the enable input is normally closed, in that it takes current in the opto-coupler associated with the enable for the drive to operate. The factory default mode for the reset input (+) is that it takes momentary current to reset the drive and clear faults. By using the INPFN98 + command, the enable input functionality is changed to normally open, in that it takes a lack of current in the opto-coupler to enable the drive. By using the INPFN99 – command, the reset functionality is changed to normally open, in that it takes momentary loss of current to reset the drive and clear faults.

Entering the INPFNxx command followed by a question mark (INPFNxx?) will return the sign and value for that input.

Examples:

»INPFN2 -1	; NOT asserting INP2 will disable clockwise motor rotation
»INPFN3 1	; Asserting INP3 will disable counter-clockwise motor rotation
»INPFN4 0	; INP4 will be unused

»INPFN98 - ; Current must now flow through the opto-coupler to enable the drive.

»INPFN99 - ; Current must momentarily decay in reset opto-coupler to reset the drive.

»INPFN2? ; Return the current settings for input 2

-1

KIS

Sets the torque-mode command scaling

Format1:	KIS { value }
Format2:	KIS?
Type:	Nonvolatile Parameter
Argument Type:	Unsigned Integer 0-32767
See Also:	TMODE

In torque mode, the KIS parameter is used to scale the torque command. A KIS setting of 10000 equates to a gain that will achieve plus or minus peak current when the input voltage is at plus or minus 10 volts. This is considered a gain of 1.

Entering the KIS command with an argument value will set the scaling factor per that value immediately.

Entering KIS? will cause the current value to be returned.

Example:

» KIS 10000 ; This enters the a scaling factor of 100%

» KIS?

10000

KIV

Sets the Current Loop's Current-to-Voltage Conversion

Format1:	KIV { value }
Format2:	KIV?
Type:	Nonvolatile Parameter
Argument Type:	Unsigned Integer 0-32767
See Also:	RGCLIM

The Kiv parameter sets the current loop's current-to-voltage conversion constant.

Examples:

»KIV 4000

»KIV?

4000

KVD

Velocity Loop Derivative Gain

Format1:	KVD { gain }
Format2:	KVD?
Type:	Nonvolatile Parameter
Argument Type:	Unsigned Integer, 0-65535
See Also:	KVP, KVI

The KVD command sets the derivative gain of the velocity loop. The default gain should be satisfactory to achieve stability. Derivative gain sets the gain at which the velocity loop responds to feedback rate changes. Derivative gain is inherently noisy and will increase step input responsiveness. Entering the KVD command with an argument value will set the derivative gain per that value.

Entering the KVD? command will result in the existing value for this parameter being returned from the servodrive.

Example:

» KVD 2100 ; This enters the velocity loop derivative gain.

KVI

Velocity Loop Integral Gain

Format1:	KVI { gain }
Format2:	KVI?
Type:	Nonvolatile Parameter
Argument Type:	Unsigned Integer, 0-65535
See Also:	KVD, KVP

The KVI command sets the integral gain for the velocity loop. The default gain should be satisfactory to achieve stability. Integral gain 'integrates' (adds up) the error over time, and thereby increases amplifier output to eliminate or minimize velocity error. Entering the KVI command with an argument value will set the integral gain per that value.

Entering the KVI? command will cause the existing value for this parameter to be returned from the servodrive.

Example:

» KVI 4022	; This enters the velocity loop integral gain
» KVI?	; This enters the velocity loop integral gain
4022.	

KVP

Velocity Loop Proportional Gain

Format1:	KVP { gain }
Format2:	KVP?
Type:	Nonvolatile Parameter
Argument Type:	Unsigned Integer, 0-32767
See Also:	KVD, KVI

The KVP command sets the proportional gain of the velocity loop. Proportional gain is a linear component that provides a constant correction for a given amount of error. The default gain should be satisfactory to achieve stability. Entering the KVP command with an argument value will set the proportional gain per that value immediately.

Entering the KVP? command will cause the existing value for this parameter to be returned from the servodrive.

Example:

» KVP 4024 ; This enters the velocity loop proportional gain.

MINFO?

Manufacturing information and serial numbers of the drive hardware

Format:	MINFO?
Type:	Direct Mode Command
Argument Type:	none
See Also:	MODE?, STATUS?, VER?

The MINFO? command will cause the drive to return a list of information about this drive, including the hardware version, powerboard ID (drive size), and the serial numbers of the drive components. Following is a sample output:

Examples:

»MINFO?	;Ask for the manufacturing information

Hardware version: 1.0.0

Powerboard ID: 261

Drive Serial#: 23

Logic Board Serial#: 206-132

Power Board Serial#: 69-211

MODE?

Display Current Servodrive Modes

Format:	MODE?
Type	Direct Mode Query
Argument Type:	none
See Also:	TMODE, VMODE, ANALOG, SERIAL, SINE, SIXSTEP, STATUS?

The MODE? command is used to determine the state of the various operation modes inside the G Series servodrive, including Servo Control Mode (Torque/Velocity), Commutation Mode (Sine/Sixstep), and Command Mode (Analog/Serial). The response from the servodrive will define these in a three-line answer. Each line is independent of the other, so eight possible permutations can be returned.

Examples:

»MODE?	(This query displays the servodrive modes)

SERVO MODE: TORQUE CONTROL

COMMUTATION MODE: SIXSTEP

COMMAND MODE: SERIAL

MOTMODE

Set Motor Over-Temperature Mode

Format1: MOTMODE { value }

Format2: MOTMODE?

Type: Nonvolatile Parameter

Argument Type: Unsigned Integer, 0-2

The MOTMODE parameter determines how the drive will process **M**otor **O**ver-**T**emperature faults. Valid values and their definitions follow:

Value	Definition
0	The state of motor over-temperature input must be open, no connection, or a fault is generated. However, the drive will not be disabled by this fault.
1	Eight-segment LED displays fault code and asserts the internal flag associated with the motor over-temperature fault so any output mapped to it will be asserted. Also, the status of OUT1-OUT3 will be changed to indicate a motor over-temperature fault has occurred if the OUTFAULT mode is enabled. However, the drive will continue to operate.
2	Drive output is disabled. Eight-segment LED displays fault code and asserts the internal flag associated with the motor over-temperature fault so any output mapped to it will be asserted. Also, the status of OUT1-OUT3 will be changed to indicate a motor over-temperature fault has occurred if the OUTFAULT mode is enabled.

Examples:

»MOTMODE 2 ; Drive will disable output when a motor over-temperature fault occurs

»MOTMODE? ; Displays current mode

2

MTRVMAX

Maximum Motor Velocity

Format1:	MTRVMAX{ value }
Format2:	MTRVMAX?
Type:	Nonvolatile Parameter
Argument Type:	Unsigned Integer, 0 to 32767
Units:	kHz
See Also:	ENCCNTS

The MTRVMAX parameter is the maximum speed at which the motor can operate in kHz. UltraTools will use this to set up internal scaling parameters the DSP uses to control the servodrive. The MTRVMAX value should be set in UltraTools by setting the Speed input values in Motor Setup. The equivalent speed of the motor in RPM will be dependent on the setting for ENCCNTS. The relationship is: RPM = MTRVMAX * 60 / ENCCNTS

Examples:

»MTRVMAX?

800 ; The existing speed limit is 800 kHz, or 6000 RPM (ENCCNTS=8000)

OUTFAULT

Sets up OUT1, OUT2 and OUT3 for outputting binary fault data

Format1:	OUTFAULT { 0 or 1 }
Format2:	OUTFAULT?
Type	Nonvolatile Parameter
Argument Type:	Unsigned Integer, 0 or 1
See Also:	INPFNx

The OUTFAULT parameter, when set to 1, is used to dedicate outputs OUT1 to OUT3 for use in querying the lower 6 bits of the current fault code for the drive. If INP1 is 0, bits 1 to 3 will be placed in OUT1 to OUT3, respectively. If INP1 is 1 (ON), then bits 4 to 6 will be used. The OUT1, OUT2 and OUT3 outputs are located on the P3 Supplemental I/O Connector and are duplicated on the P2 Controller Connector. Valid fault codes are identical to those outlined in the Status Display section of this manual. In this manner, 2^6 or 64 fault and status codes can be decoded.

If the OUTFAULT mode is enabled, use of the OUTFNx command with output 1-3 will generate an “in use by OUTFAULT” error.

Examples:

» OUTFAULT 1 ; A binary representation of the faults will now occupy OUT1-OUT3

OUTx

Digital Output State Command

Format1:	OUT1? { value }
Format2:	OUT2? { value }
Format3:	OUT3? { value }
Format4:	OUT4? { value }
Format5:	OUT? Returns a binary representation of the inputs in a character string indicating the state of all 4 bits.
Type:	Direct Mode Query
Argument Type:	none

The OUTx command allows the user to query the state of the given digital output. OUT1 to OUT4 refer to the digital outputs as defined by the markings at the P3 Supplemental I/O connector on the servodrive. The value returned by the query can be either a 0 or a 1, indicating an OFF or ON condition for the output.

Use of the fifth format (OUT?) will return a binary representation of the outputs in a character string indicating the state of all 4 bits, OUT1 to OUT4, from left to right.

Examples:

»OUT1?	; Query the existing state of OUT1
0	; State of OUT1 is 0 or OFF
»OUT4?	; Query the existing state of OUT4
1	; State of OUT4 is 1 or ON
»OUT?	; Query the existing state of all OUT's
0 0 0 1	; OUT1 is OFF, OUT2 is OFF, OUT3 is OFF, OUT4 is ON

OUTFNx

Digital Output Function Command

Format1:	OUTFN1 {[-] value)
Format2:	OUTFN2 {[-] value)
Format3:	OUTFN3 {[-] value)
Format4:	OUTFN4 {[-] value)
Format5:	OUTFNx?
Type:	Nonvolatile Parameter
Argument Type:	value – selects Boolean value per table

The OUTFNx command sets the boolean fault state that OUTx is to be drawn from inside the G Series servodrive. OUTFN1 refers to OUT1 as defined by the markings on the servodrive. OUTFN2 refers to OUT2, OUTFN3 refers to OUT3, and OUTFN4 refers to OUT4. The OUTx are updated every 400 msec. If the optional minus [-] sign is placed in front of the value, then the function inverts the output. Setting an OUTFNx to a value of 0 will disable that OUTx. The following table indicates what values refer to what internal functions that can be output.

Value	Boolean selected
0	none
1	Motor RMS Overcurrent Fault
2	Drive RMS Overcurrent Fault
3	Bus Voltage Too High Fault
4	Bus Voltage Too Low Fault
5	Encoder Feedback Fault
6	IPM Fault
7	Invalid Hall State Fault
8	Motor Temperature Fault

If the optional minus [-] sign is placed in front of the *value* then the function inverts the output. Setting an OUTFNx to a value of 0 will disable that OUTx.

Examples:

»OUTFN1 -1	; OUT1 will be asserted when a motor RMS overcurrent fault does NOT exist
»OUTFN2 5	; OUT2 will be asserted when an encoder feedback fault exists
»OUTFN3 -3	; OUT3 will be asserted when a bus over-voltage fault does NOT exist
»OUTFN4 0	; OUT4 will be unused and will have no output

POLES

Sets the number of motor poles

Format1:	POLES { value }
Format2:	POLES?
Type:	Nonvolatile Parameter
Argument Type:	Unsigned Integer, 2-and up
See Also:	SIXSTEP, SINE, ENCCNTS

The POLES command sets the servodrive up for the number of poles in the servomotor.

Entering the POLES? command will cause the existing value for this parameter to be returned from the servodrive.

Example:

The following example sets the motor poles to 4 for a four-pole motor:

» POLES 4

POS

Query or Set of encoder position

Format1:	POS?
Format2:	POS { value }
Type:	Direct Mode Command
Argument Type:	Signed integer

The POS? query returns the current 32-bit position of the drive's feedback encoder. The second Format(2) provides a means for setting the value of the encoder position.

Examples:

```
»POS 1234     ; Sets encoder position to 1234
»POS 0        ; Sets encoder position to  0
»POS?         ; Query for position
32189
```

POSHOME

Position when last HOME occurred

Format: POSHOME?

Type Direct Mode Command

Argument Type: none

The POSHOME parameter provides a means for determining the encoder counts per rev of a motor. It is the value of POS when the encoder reference (ZREF or Zero pulse) occurred, during a HOME command. After the value of POS is saved in POSHOME, POS is cleared, as documented in HOME. This can be used to get a relatively accurate measurement of the distance between encoder reference signals. Step 1: Execute a HOME command and slowly move the motor through the encoder reference, watching for the HOME to be completed. HOME? will return a 1 after completion. At the reference point, POSHOME will be set to the value in POS, whatever its value is, and POS will be set to 0. Step 2: Issue another HOME command and continue to slowly move the motor through the encoder reference again, in the same direction of motion and at the same speed. At this second reference, POSHOME will be set to the value of POS, and then POS will again be set to 0. Now POSHOME contains the distance between encoder reference marks.

A word about the accuracy of POSHOME. POSHOME is NOT hardware latched. It is software latched in an interrupt routine. Therefore there is some latency from the reference mark to the interrupt routine and the storing of the value. The slower the speed, the more accurate will be the value. Secondly, the value stored is the value in POS, which is updated at the control interrupt rate. Since the reference interrupt routine is asynchronous to the control interrupt, there will be a small amount of error there. Again, the slower the motor moves, the more accurate will be the reading. And if the same direction and speed is used for this entire process, the tendency will be for the latencies mentioned above to be equal and cancel out one another. There are other uses that POSHOME could be applied to, but this is one of the handier ones, particularly when setting up a new motor with the drive.

Example:

» HOME	;Call for a HOME
CMD 30	;Move slowly to completion of the HOME
» HOME?	;Is it done HOMEing?
0	;Not yet
» HOME?	;Is it done HOMEing?
1	;Now it is (POS will be zeroed at this point, too)
» HOME	;Immediately do another HOME
» HOME?	;Is it done HOMEing?
0	;Not yet
» HOME?	;Is it done HOMEing?
1	;Now it is
» POSHOME?	;Ask for the existing value in POSHOME
8000	;Zref to Zref counts!

PRFCYCL

Profile Cycles (when Profile Mode = 3)

Format:	PRFCYCL { value }
Format2:	PRFCYCL?
Type:	Direct Mode Command
Argument Type:	Unsigned Integer, 1 to 32767
See Also:	SERIAL, PRFLOT, PRFHIT

The PRFCYCL command in conjunction with the PRFMODE command (when set to 3) will cause the existing Profile definition to be repeated according to the value of the PRFCYCL parameter. Setting PRFMODE to 3 and setting PRFCYCL to 1 will cause a single cycle of the Profile to be done at the next GO command. The SERIAL command must previously be set to 'ON' for this command to work. If PRFCYCL? is entered without a parameter, the current value for this parameter will be returned.

Examples:

» PRFMODE 3	;Sets the Profile mode to do a fixed number of cycles
» PRFCYCL 1	;This calls for only one cycle to be done

PRFENA

Enables or Disables Profile Mode

Format1:	PRFENA { mode }
Format2:	PRFENA?
Type:	Direct Mode Command
Argument Type:	0 or 1
See Also:	SERIAL, PRFMODE, PRFCYCL

The PRFENA command enables or disables profiling mode, which allows the servodrive to define and use simple profiling commands through the serial port. A "1" argument enables the profiling mode, while a "0" argument disables profiling mode. The SERIAL command must be 'ON' for this PRFENA command to work. After first enabling the profiling mode with PRFENA 1, and then defining certain profiling parameters, simple profile moves can be done.

Entering the PRFENA? command will cause the existing value for this parameter to be returned from the servodrive.

Examples:

»PRFENA 1	;Enable profile mode
»TMODE	;Set Torque mode on (to move using Torque mode)
»PRFHILV 8000	;Set value for the high signal command for the current
»PRFHIT 1000	;Set time to run 'at Current', in 400 µsecs units
»PRFLOLV 0	;Set the low level command to 0
»PRFLOT 1000	;Set time to run 'at low level', also in 400 µsecs units
»PRFMODE 3	;Set PRFMODE to 3 for fixed cycles
»PRFCYCL 1	;Set PRFCYCL so we do only a single cycle in our move
»GO	;GO causes our profile motion to begin

PRFHILV

Profile High Level Signal

Format1:	PRFHILV { value }
Format2:	PRFHILV?
Type:	Direct Mode Command
Argument Type:	Signed Integer, +/-32767
See Also:	SERIAL, PRFLOT, PRFHIT, PRFLOLV

The PRFHILV command sets the Profile definition for the actual signal level for the high velocity or high current signal level, depending on whether the profile is being run in Velocity or Torque mode. The PRFHILV signal will be on for the length of time as defined by PRFHIT. PRFHILV can be used to provide great flexibility in the Profile that is to be run, allowing for 'back and forth' movements and other variations.

Entering the PRFHILV? command will cause the existing value for this parameter to be returned from the servodrive..

Examples:

» PRFHILV 3000 ;Sets the 'high command' level to 3000

PRFHIT

Profile High Level Time

Format1:	PRFHIT { time }
Format2:	PRFHIT?
Type:	Direct Mode Command
Argument Type:	Unsigned Integer, 0 to 65535
See Also:	CMD, SERIAL, PRFLOT, PRFHILV

The PRFHIT command sets the Profile definition of the time to remain at the commanded velocity or current signal level (which is given by PRFHILV) depending on whether the Profile is run in Torque mode or Velocity mode. The SERIAL command must previously be set to 'ON' for this command to work. PRFHIT is given in 400 μsec units, e.g. 2500 = 1 second. Values higher than 65535 will be truncated to 65535.

Entering the PRFHIT? command will cause the existing value for this parameter to be returned from the servodrive.

Examples:

» PRFHIT 1000 ;Sets high command time for CMD to be 0.4 seconds

PRFLOLV

Profile Low Level Signal

Format1:	PRFLOLV { value }
Format2:	PRFLOLV?
Type:	Direct Mode Command
Argument Type:	Signed Integer, +/-32767
See Also:	SERIAL, PRFLOT, PRFHILV

The PRFLOLV command sets the Profile definition for the actual signal level for the low velocity or low current signal level, depending on whether the Profile is being run in Velocity or Torque mode. PRFLOLV is often set to 0. The PRFLOLV signal will be on for the length of time as defined by PRFLOT. PRFLOLV can be used to provide greater flexibility in the Profile that is to be run, allowing for 'back and forth' movements and other variations. The SERIAL command must previously be set to 'ON' for this command to work.

Entering the PRFLOLV? command will cause the existing value for this parameter to be returned from the servodrive.

Examples:

» PRFLOLV 1000 ; Sets the 'low command' level for the existing test mode to 1000

PRFLOT

Profile Low Level Time

Format1:	PRFLOT { time }
Format2:	PRFLOT?
Type:	Direct Mode Command
Argument Type:	Unsigned Integer, 0 to 65535
See Also:	PRFLOLV, SERIAL, PRFHIT

The PRFLOT command sets the Profile definition for the time to remain at the low velocity or current signal level, which is defined by PRFLOLV. (PRFLOLV is often set to 0.) The SERIAL command must previously be set to 'ON' for this command to work. PRFLOT is given in 400 microsecond units, e.g. 2500 = 1 second. Values higher than 65535 will be truncated to 65535.

Entering the PRFLOT? command will cause the existing value for this parameter to be returned from the servodrive.

Examples:

» PRFLOT 2500 ; Sets low command time for PRFLOLV to be 1.0 seconds.

PRFMODE

Profile Mode

Format1:	PRFMODE { mode }
Format2:	PRFMODE?
Type:	Direct Mode Command
Argument Type:	Unsigned Integer, 1 or 2 or 3
See Also:	SERIAL, PRFLOT, PRFHIT, PRFHILV , PRFLOLV, GO, STOP

The PRFMODE command sets the Profile mode that is to be used for the next Profile motion. Profiling is a feature of the G-Series servodrive in which the drive will perform predefined profile moves in one of three different, settable modes: (1) Dynamic, (2) Repetitive, and (3) Set Cycle, as defined below. The original purpose was to provide a simple method to create and plot motion using UltraTools, effectively making a digital scope. But the overall profiling capability can provide tools for specific applications, as well as being helpful debugging tools. Entering the PRFMODE? command will cause the existing value for this parameter to be returned from the servodrive.

PRFMODE 1 (Dynamic)

In the Dynamic mode (1), the ACCEL and PRFHILV values are used to accelerate or decelerate to the commanded PRFHILV command value and hold that value. If the PRFHIT timeout value is set to 0, the profiler will continue at the commanded value until either a STOP command or a GO command is entered. If PRFHIT contains a value, it will represent a timeout value for the 'at speed' motion, given in 400 µsec units. This feature provides a safety factor for PRFMODE 1. By using PRFHIT, the PRFMODE 1 motion will not continue forever without controller intervention. The minimum intervention is to send a GO command. No other parameters need to be resent. Or new settings for the PRFMODE 1 parameters can be sent, followed by the GO command. Note that the slowest setting for controller intervention is 65535/2500 = 26.2 sec. Setting PRFHIT to 2500 would require controller intervention every 1 sec. (Remember, the timeout starts after the end of the acceleration ramp.) If a STOP command is issued, the profiler will decelerate using the current DECEL value. If a new PRFHILV value is set and another GO command is issued during Profile motion, the profiler will accelerate or decelerate to the new PRFHILV value using the current ACCEL value. Following is an example of the setup:

VMODE	; Set velocity mode
PRFENA 1	; Enable profiling mode
PRFHILV 4000	; Set high signal level for the profile
PRFHIT 0	; Set timeout to 0 so motion goes on until STOP is issued
ACCEL 400	; The ACCEL defines how fast we come up to speed
DECEL 400	; The DECEL defines how fast we come to a stop
PRFMODE 1	; Select the 'Dynamic' mode for profiling
GO	; Now the Profile is defined, GO do it, STOP when done

Once the GO command is issued, the dynamic profile continues until a STOP command is issued or until a timeout occurs, if PRFHIT has a setting other than 0.

PRFMODE 2 (Repetitive)

In the Repetitive mode (2), a profile is defined using a high signal level and time, and then a low signal level and time. Acceleration and deceleration function as described above. Once profile motion is begun with a GO command, motion will accelerate to the high signal level and hold there for the high signal time. Then motion will decelerate to the low signal level and hold there for the low signal time (both of which can be 0, if desired). Then motion decelerates to 0, and the whole process begins again. This repetitive motion will continue until the STOP command is issued. Following is an example of this setup:

```
VMODE           ; Set velocity mode
PRFENA 1        ; Enable profiling mode
PRFHILV 4000    ; Set high signal level for first part of the profile
PRFHIT 1000     ; Set the time duration for the high level signal, 0.4 seconds
PRFLOLV -4000   ; Set low signal level for the second part of the profile
PRFLOT 1000     ; Set the time duration for the low level signal, 0.4 seconds
ACCEL 400       ; The ACCEL defines how fast we come up to speed
DECEL 400       ; The DECEL defines how fast we come to a stop
PRFMODE 2       ; Select the 'Repetitive' mode for repeat profiling
GO              ; Now the Profile is defined, GO do it, STOP when done
```

Once the GO command is issued, the repetitive profile continues until a STOP command is issued.

PRFMODE 3 (Set Cycle)

In the Set Cycle mode, the profiler uses all of the same parameters as in mode 2, except that PRFCYCL is used to set the number of cycles to run.

```
VMODE            ; Set velocity mode
PRFENA 1         ; Enable profiling mode
PRFHILV 4000     ; Set high signal level for first part of the profile
PRFHIT 1000      ; Set the time duration for the high level signal, 0.4 seconds
PRFLOLV –4000    ; Set low signal level for the second part of the profile
PRFLOT 1000      ; Set the time duration for the low level signal, 0.4 seconds
ACCEL 400        ; The ACCEL defines how fast we come up to speed
DECEL 400        ; The DECEL defines how fast we come to a stop
PRFMODE 3        ; Select the ‘Set Cycle’ mode for fixed cycle profiling
PRFCYCL 1        ; We tell PRFCYCL we wish to do only one cycle of motion
GO               ; Now the Profile is defined, GO do it.  It stops itself when done
```

Once the GO command is issued, the Set Cycle profile continues until the PRFCYCL number of cycles has been completed, and then it stops. If the user enters the STOP command, this will also stop the profile.

NOTE: In all modes, ACCEL is used when changing to the PRFHILV value, and DECEL is used when changing to PRFLOLV or when stopping.

The combination of these various Profiling commands allows complete flexibility in defining almost any Profile desired. The SERIAL command must previously be set to ‘ON’ for this command to work. And Profiling must be enabled using PRFENA 1.

PWMFREQ?

PWM Frequency

Format:	PWMFREQ?
Type:	Direct Mode Query
Argument Type:	None (Read Only Value)
See Also:	

The PWMFREQ? query allows the user to find out the period of the PWM signal. The delivered answer is in kHz units. This is a 'Read Only' type of value.

Examples:

```
» PWMFREQ?          ;Ask for the PWM period information
16                  ;16 corresponds to 16 kHz
```

RAMTEST

Perform a continuous test of the DSP static ram memory

Format: RAMTEST

Type: Direct Mode Command

Argument Type: None

This command will immediately disable the drive and then execute a continuous test of the DSP static ram memory. Once begun, the only way to stop this test is to cycle the logic power to the drive. The test writes a sequential pattern to the SRAM and verifies it. However, with each pass the sequence is moved one location. While running, the seven segment display will be changing with each pass through the RAM. If an error occurs at any time during the testing, the display will flash, with the pattern alternating between two vertical bars and three horizontal bars, until the power is cycled.

During a normal power-up, a single cycle of this test is performed to verify that the DSP dynamic ram is operating properly.

Example:

» RAMTEST ;Perform continuous ram test until powered down

REM or ;

Remarks

Format1: REM

Format2: ; (semicolon)

Type: Direct Mode Command

Argument Type: none

See Also:

The REM or semicolon character ";" may be followed by comments up to the max command length. The drive will ignore all text following the REM or semicolon until after the next carriage return and line feed is received. A space character must follow either the REM or the semicolon character, or a syntax error will occur.

Examples:

```
»REM This is a comment that will be completely ignored by the drive
»; This too will be completely ignored by the drive
»RESET              ; Reset the drive here
»KVP 400            ; Set the velocity loop proportional gain
»TMODE              ; Turn on torque mode
```

RESET

Software DSP Reset

Format: RESET

Type: Direct Mode Command

Argument Type: none

See Also: N/A

The RESET command resets the DSP and performs a software reboot. All faults are cleared and all setup and tuning variables are zeroed and restored automatically from EEPROM. This command is equivalent to cycling the power to the DSP.

Examples:

»RESET	;Reset the drive immediately

RESTORE

Restore Parameters from EEPROM

Format: RESTORE

Type: Direct Mode Command

Argument Type: none

See Also: STORE

The RESTORE command restores certain servomotor and servodrive parameters from EPROM into the servodrive, providing the desired startup conditions for a particular application and hardware configuration. When the servodrive is first powered up, these parameters will also be restored from the EPROM into the servodrive. The parameters restored include the servo control mode (TMODE/VMODE), the commutation mode (SINE/SIXSTEP), the command mode (ANALOG/SERIAL), the motor parameters (POLES, ENCCNTS, HOFFSET, IMTRPK, IMTRRMS, ICLAMP, MOTMODE, MTRVMAX), the current loop tuning constants, the velocity loop tuning constants, the digital input function definitions (INPFNx), the digital output function definitions (OUTFNx), the DAC function definitions (DACFNx), the Regen settings (RGTRIP, RGCLIM), and the condition of the DRVENA parameter (allows drive to start up enabled).

Examples:

»RESTORE ;Restore setup parameters from EPROM

RGCLIM

Shunt Resistor Regen Current Limit

Format1: RGCLIM { value }

Format2: RGCLIM?

Type: Nonvolatile Parameter

Argument Type: Unsigned Integer, 1 to 32767

See Also: RGTRIP

The RGCLIM command sets the maximum current limit for dissipating regenerative energy in the shunt resistor(s). Note that only G Series drives G10 and higher can make use of the shunt commands. The G3 and G5 drives are not capable of providing shunting capability.

Examples:

» RGCLIM 4315 ; Set shunt resistor current limit

RGTRIP

Shunt Resistor Regen Trip Voltage

Format1:	RGTRIP { value }
Format2:	RGTRIP?
Type:	Nonvolatile Parameter
Argument Type:	Unsigned Integer (volts)
See Also:	RGCLIM

The RGTRIP command sets the voltage at which the drive's internal shunt regulator will begin to operate by shunting excess regeneration voltage across the shunt resistor. If this parameter is set to 0, then the shunt regulation function of the servodrive will be disabled. Note that only G Series drives G10 and higher can make use of the shunt commands. The G3 and G5 drives are not capable of providing shunting capability.

Warning: Setting this value lower than the nominal bus voltage (155 VDC or 325VDC) will cause the shunt output to be on at all times.

Examples:

» RGTRIP 395 ; Set shunt regulation to begin at 395 volts

SERIAL

Serial Command Mode

Format:	SERIAL
Type:	Direct Mode Command
Argument Type:	none
See Also:	ANALOG, MODE?

The SERIAL command sets the servodrive to use the RS232 serial input for setting the desired command level and other parameters. In this mode, the desired command signal must be sent to the servodrive as an ASCII command via the serial port. The ANALOG command provides the means to switch from serial control to analog control through the use of P2.

Use the MODE? Command to determine the current state of the command mode.

Examples:

» SERIAL	(This command puts the servodrive in serial mode)
» ANALOG	(This command puts the servodrive in analog mode)
» SERIAL	(This command puts the servodrive back in serial mode)

SINE

Set Sine Commutation Mode

Format: SINE

Type: Nonvolatile Parameter

Argument Type: none

See Also: POLES, ENCCNTS, SIXSTEP, MODE?

The SINE command sets the servodrive's electronic commutation method to sinusoidal commutation. Your motor must utilize both an encoder and Hall sensors (or commutation tracks) in order to use sinusoidal mode. In sinusoidal mode, the POLES and ENCCNTS values must be set prior to setting this parameter.

Use the MODE? command to determine the existing state of the commutation mode.

Examples:

The example below sets the commutation mode to sinusoidal.

» SINE

SIXSTEP

Set SixStep Commutation Mode

Format: SIXSTEP

Type: Nonvolatile Parameter

Argument Type: none

See Also: POLES, ENCCNTS, SINE, MODE?

The SIXSTEP command sets the servodrive's commutation mode to six-step (trapezoidal) commutation. The servodrive’s velocity term is derived from the encoder attached to the drive.

Use the MODE? command to determine the existing state of the commutation mode.

Examples:

The example below sets the commutation mode to sixstep.

» SIXSTEP

STATUS?

Return Drive Status

Format: STATUS?

Type: Direct Mode Query

Argument Type: none

See Also: MODE?, VER?

The STATUS command displays the status of inputs, outputs, drive enable/disable settings and faults.

Examples:

»STATUS?

» INPUTS: (1 0 1 0); Input 1 is on, input 2 is off, input 3 is on, input 4 is off

»OUTPUTS: 0 1 0 1 ; Output 1 is off, output 2 is on, output 3 is off, output 4 is on

» DRIVE: ENABLED or HARDWARE DISABLED or DISABLED

»FAULT CODE: 0 ; Fault codes as they would appear on 8-segment LED display

STOP

Profile Stop

Format: STOP

Type: Direct Mode Command

Argument Type: none

See Also: PRFENA, GO

The STOP command allows the user to stop any motion that was initiated by the Profile GO command. The SERIAL command must previously be set to 'ON' for this command to work.

Examples:

»STOP ;Stop the Profile motion

STORE

Store Parameters into EPROM

Format:	STORE
Type:	Direct Mode Command
Argument Type:	none
See Also:	RESTORE

The STORE command stores certain servomotor and servodrive parameters into EPROM. When the servodrive is first powered up, these parameters will be restored from the EPROM into the servodrive, providing the desired startup conditions for a particular application and hardware configuration. The parameters STOREd include the servo control mode (TMODE/VMODE), the commutation mode (SINE/SIXSTEP), the command mode (ANALOG/SERIAL), the motor parameters (POLES, ENCCNTS, HOFFSET, IMTRPK, IMTRRMS, ICLAMP, MOTMODE, MTRVMAX), the current loop tuning constants, the velocity loop tuning constants, the digital input function definitions (INPFNx), the digital output function definitions (OUTFNx), the DAC function definitions (DACFNx), the Regen settings (RGTRIP, RGCLIM), and the condition of the DRVENA parameter (allows drive to start up enabled).

Examples:

»STORE	; Store setup parameters into EPROM

TMODE

Set Torque Mode

Format:	TMODE
Type:	Nonvolatile Parameter
Argument Type:	none
See Also:	VMODE, CMD, ANALOG, SERIAL, MODE?

The TMODE command sets the servodrive's input command to torque mode. This effectively changes the drive's transfer function from volts output/volt input (a voltage source or velocity mode drive) to amperes output/volt input (a current source or torque mode drive). The Kis command is used for scaling the current command in torque mode. The velocity term remains available for use by one of the drive's DACs.

If the MODE command is entered, followed by a question mark (MODE?), then the drive returns the state of all the modes of operation.

Example:

» TMODE ;Set for Torque mode

» MODE?

SERVO MODE: TORQUE CONTROL

COMMUTATION MODE: SIXSTEP

COMMAND MODE: SERIAL

VBUS

Voltage on the Bus

Format:	VBUS?
Type	Direct Mode Command
Argument Type:	none

The VBUS command provides an easy method for checking the bus voltage output level, as measured and indicated by the DSP firmware. This command can be a helpful diagnostic tool when trying to find the cause or condition of an anomaly occurring in the drive.

Example:

» VBUS? ;Ask for the bus output voltage

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VELOBS

Specify a sensitivity value for the velocity observer

Format1: VELOBS { value }

Format2: VELOBS?

Type Nonvolatile Parameters

Units: Sensitivity in units ranging from 20 to 200, where 100 is normal

The velocity observer parameter controls a filter relating to the velocity feedback that helps control the velocity loop. Input values can range from 20 to 200, where 100 is considered a normal setting. This command changes the velocity observer coefficients. Lower values will smooth low speed motion, but increase settling times on quick stops. Higher values will increase velocity response at the expense of smoothness.

If the VELOBS? command is entered, then the drive returns the existing value for VELOBS.

Example:

» VELOBS 90 ; Sets VELOBS to 90 for slightly smoother low speed motion

VER?

Version of the G Series Internal Software

Format: VER?

Type: Direct Mode Command

Argument Type: none

See Also: MODE?, STATUS?

The VER? command allows the user to find out the version of the software in the DSP for the G Series servodrive.

Examples:

»VER? ;Ask for the version information

ULTRADRIVE G Series

DIGITAL SERVODRIVE

Drive Model: G05

FlexROM Version: 1.0.0

VMODE

Set Velocity Mode

Format:	VMODE
Type:	Nonvolatile Parameter
Argument Type:	none
See Also:	TMODE, VCMD, ANALOG, SERIAL, MODE?

The VMODE command sets the servodrive input command to velocity mode. An analog or serial command applied to the servodrive would then act to control the servomotor's velocity.

Use the MODE? command to determine the existing state of the servodrive mode.

Example:

```
VMODE        ;Set for Velocity mode
```