C H A P T E R ⑥

Hardware Reference

Use this chapter as a quick-reference tool for 6270 system specifications (general specifications, I/O circuit drawings & pin outs, and DIP switch & jumper settings).

General Specifications

Parameter	Specification
Power	
AC or DC Input	85-240VAC (single-phase), 50/60Hz, 1.8A @ 120VAC; or 110 - 340VDC
Status LED	Refer to the *Common Problems & Solutions* table in Chapter 7
Environmental	
Operating Temperature	32°F to 122°F (0°C to 50°C)
Storage Temperature	-22°F to 185°F (-30°C to 85°C)
Humidity	0% to 95% non-condensing
Performance	
Position Range	±2,147,483,648 counts
Velocity Range	1 to 1,600,000 counts/sec
Acceleration Range	1 to 2,147,483,648 counts/sec^2
Velocity Accuracy	±0.02% of maximum rate
Velocity Repeatability	±0.02% of set rate
Motion Trajectory Update Period	Default is 1.6 ms (depends on SSFR and INDAX command values)
Servo Sampling Update Period	Default is 400 µs (depends on SSFR and INDAX command values)
System Update Period	Default is 1.6 ms (depends on SSFR and INDAX command values)
LDT Position Sampling Period	Default is 1.6 ms (depends on SSFR, INDAX, and LDTUPD values)
RS-232C Interface	
Connections	3-wire (Rx, Tx and GND) connection to the AUX connector (opto iso)
Maximum number of daisy-chained 6270s	Up to 99 units
Address settings	DIP switch Selectable (see *Optional DIP Switch Settings*), or use ADDR
Communication Parameters	9600 baud (auto-baud option—see *Optional DIP Switch Settings*), 8 data bits, 1 stop bit, no parity bit, full duplex
Inputs (see also *I/O Pin Outs & Circuit Drawings*)	**All inputs are optically isolated**
Home, CW/CCW Limits, Joystick Trigger, Joystick Release, Axes Select, Joystick Velocity, Drive Fault (DFT), Enable (ENBL)	TTL-compatible*; internal 6.8 KΩ pull-ups to 5V; voltage range is 0 - 24V.
Linear Displacement Transducer (LDT)	Differential comparator inputs for displacement or Start/Stop pulse. Maximum frequency = 48 MHz.
Incremental Encoder	Differential comparator accepts two-phase quadrature encoders with differential (recommended) or single-ended outputs (+5VDC TTL-compatible*). Maximum frequency = 1.2 MHz. Minimum time between transitions = 833 ns.
24 Programmable	TTL-compatible* with internal 6.8 KΩ pull-up (connect IN-P to +5V to source current or connect IN-P to GND to sink current). Voltage range = 0V - 24V. 50-pin plug is compatible with OPTO-22™ signal conditioning equipment. Controllable with the 6000 Series programming language.
Triggers (triggers [TRG-A and TRG-B] on AUX connector)	TTL-compatible* with internal 6.8 KΩ pull-up to +5VDC. Controllable with the 6000 Series programming language.
Analog (Joystick)	Voltage range = 0 - 2.5VDC, 8-bit A/D converter. **Input voltage must not exceed 5V.**
Analog (±10V optional inputs)	Voltage range = ±10VDC, 14-bit A/D converter (accuracy is 12 bits). **(6270-ANI only)**

* TTL-compatible voltage levels: Low ≤ 0.4V, High ≥ 2.4V

Specifications Table *(continued)*

Outputs (see also *I/O Pin Outs & Circuit Drawings*)	**All outputs are optically isolated**
26 Programmable (includes OUT-A and OUT-B on AUX connector)	Can be pulled up by connecting OUT-P to +5V on the AUX connector, or to a user-supplied voltage of up to 24V. 50-pin plug is compatible with OPTO-22™ signal conditioning equipment. Controllable with the 6000 Series programming language.
LDT Interrogate (INTR)	TTL-compatible*, open collector output. Max. voltage in OFF state (not sinking current) = 24V, max. current in ON state (sinking) = 30mA.
Command Out (CMD)	12-bit DAC. Load should be > 2KΩ impedance. Output is jumper selectable (see *Optional DIP Switch and Jumper Settings* section below): ±10V (default), ±20mA, ±50mA, ±60mA, ±80mA, ±100mA, or ±150mA.
Shutdown (SHTNO, SHTNC, and COM)	Shutdown relay output. Max. rating: 175VDC, 0.25A, 3W.

* TTL-compatible voltage levels: Low ≤ 0.4V, High ≥ 2.4V

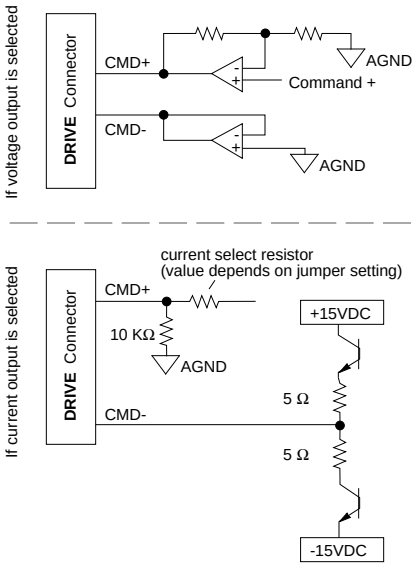
I/O Pin Outs & Circuit Drawings

This section, organized by connector, provides pin outs and circuit drawings for all 6270 inputs and outputs. **All inputs and outputs are optically isolated.**

Drive Connectors

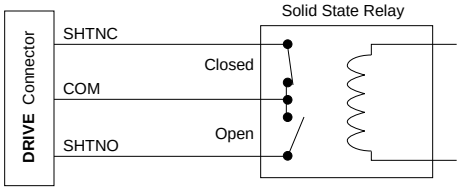
Pin #	In/Out	Name	Description
1	-----	SHLD	Shield—internally connect to chassis (earth) ground.
2	-----	COM	Signal common to which the shutdown relay outputs are referenced. Electrically isolated from any ground.
3	OUT	SHTNC	Shutdown relay output to drives that require a closed contact to disable the drive(see circuit drawing below). The shutdown relay is active (disabling the drive) when no power is applied to the 6270. When the 6270 is powered up, the shutdown relay remains active until you issue the `DRIVE11` command. Shutdown active (`DRIVEØØ`): This output is internally connected to COM. Shutdown inactive (`DRIVE11`): This output is disconnected from COM.
4	OUT	SHTNO	Shutdown relay output to drives that require an open contact to disable the drive(see circuit drawing below). The shutdown relay is active (disabling the drive) when no power is applied to the 6270. When the 6270 is powered up, the shutdown relay remains active until you issue the `DRIVE11` command. Shutdown active (`DRIVEØØ`): This output is disconnected from COM. Shutdown inactive (`DRIVE11`): This output is internally connected to COM.
5	IN	DFT	Drive fault input. Set active level with the `DRFLVL` command. The drive fault input will not be recognized until you enable the input functions with the `INFEN1` command. — see circuit diagram below
6	-----	AGND	Analog ground. This is the ground reference for the ANI input.
7	IN	ANI	±10V, 14-bit analog input (12-bit accuracy). ANI Voltage reported with `[ANI]` & `TANI` commands. ANI position (counts) reported with `[PANI]` & `TPANI` commands or `[FB]` & `TFB` commands. **(6270-ANI option only).**
8	OUT	CMD-	Command signal return. — see circuit diagram below
9	OUT	CMD+	Command output signal (jumper selectable: ±10V is default; current settings are available). — see circuit diagrams

Internal Command Signal Output Circuit

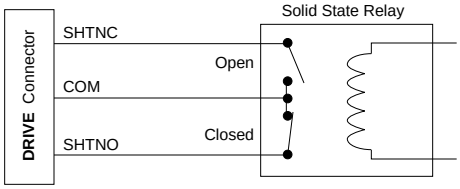


Internal Shutdown Output Circuit

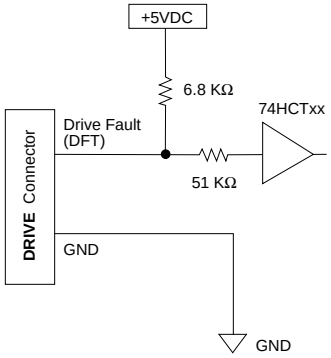
Shutdown Active:



Shutdown Inactive:



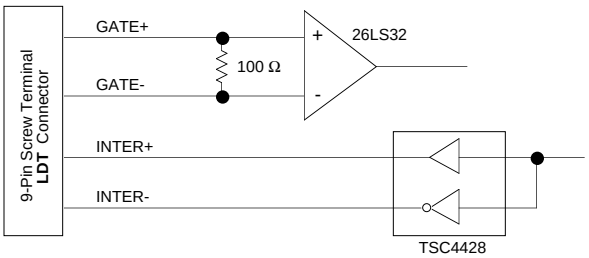
Internal Drive Fault Input Circuit



Linear Displacement Transducer (**LDT**) Connectors

Pin	In/Out	Name	Description
9	-----	+15V	Power connection for LDT
8	OUT	INTR+	Interrogate output to LDT (+) (sampling rate default is 1.5 ms, adjust with LDTUPD command)
7	OUT	INTR-	Interrogate output to LDT (-)
6	IN	GATE+	Return pulse from LDT (+)
5	IN	GATE-	Return pulse from LDT (+)
4	-----	-15V	Power connection for LDT
3	-----	RSVD	Reserved for future enhancements
2	-----	GND	Isolated logic ground
1	-----	SHLD	Internally connected to chassis ground (earth)

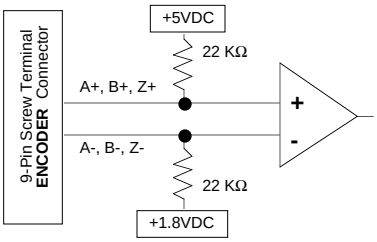
Internal Encoder Input Circuit



Encoder Connector (For Use With Incremental Encoder Only)

Pin	In/Out	Name	Compumotor E Series Encoder Cable Colors	Description
9	OUT	+5V	Red	+5VDC output to power the encoder
8	IN	A +	Brown	A+ channel quadrature signal
7	IN	A -	Brown/White	A- channel quadrature signal
6	IN	B +	Green	B+ channel quadrature signal
5	IN	B -	Green/White	B- channel quadrature signal
4	IN	Z +	Orange	Z+ channel quadrature signal
3	IN	Z -	Orange/White	Z- channel quadrature signal
2	-----	GND	Black	Isolated logic ground
1	-----	SHLD	Shield	Internally connected to chassis ground (earth)

Internal Encoder Input Circuit



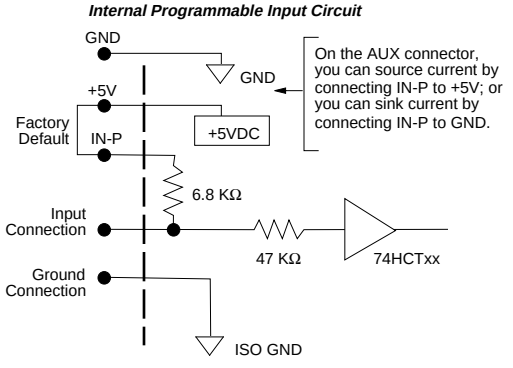
Programmable I/O Connectors

Pin	OUTPUTS Connector	INPUTS Connector
49	+5VDC	+5VDC
47	Output #1 (LSB)	Input #1 (LSB)
45	Output #2	Input #2
43	Output #3	Input #3
41	Output #4	Input #4
39	Output #5	Input #5
37	Output #6	Input #6
35	Output #7	Input #7
33	Output #8	Input #8
31	Output #9	Input #9
29	Output #10	Input #10
27	Output #11	Input #11
25	Output #12	Input #12

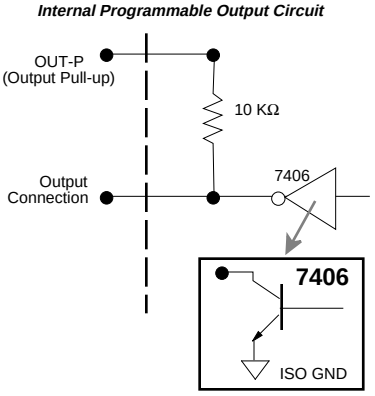
Pin	OUTPUTS Connector	INPUTS Connector
23	Output #13	Input #13
21	Output #14	Input #14
19	Output #15	Input #15
17	Output #16	Input #16
15	Output #17	Input #17
13	Output #18	Input #18
11	Output #19	Input #19
09	Output #20	Input #20
07	Output #21	Input #21
05	Output #22	Input #22
03	Output #23	Input #23
01	Output #24 (MSB)	Input #24 (MSB)

All even-numbered pins are connected to logic ground.

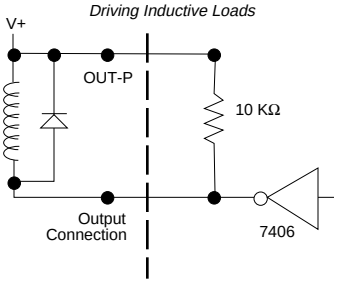
Internal Programmable Input Circuit



Internal Programmable Output Circuit



Driving Inductive Loads



Use an external diode when driving inductive loads. Connect the diode in parallel to the inductive load, attaching the anode to the 6270 output and the cathode to the supply voltage of the inductive load.

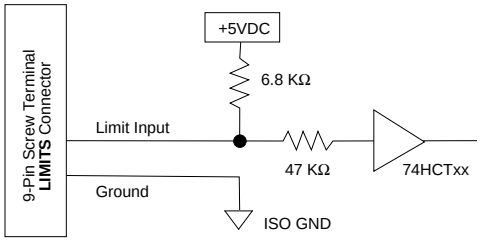
Auxiliary (**AUX**) Connector

Pin	In/Out	Name	Description
1	IN	Rx	Receive input for RS-232C interface
2	OUT	Tx	Transmit output for RS-232C interface
3	------	GND	Isolated ground for RS-232C interface
4	------	SHLD	*Shield*—Internally connected to chassis ground (earth)
5	OUT	+5V	Connect to **OUT-P** to power the 26 programmable outputs. 1.8A limit (applies to total load on all of the I/O connectors) — e.g., if 2 encoders are drawing at total of 500mA, then 1.3A is left for other purposes.
6	OUT	OUT-P	Internally connected to pull-up resistors for the 24 general-purpose programmable outputs. Connecting this input to the +5V pin (this is already done at the factory) makes the outputs TTL compatible. Connection to other voltages (max. = 24V) allows for compatibility with other signal levels.
7	IN	IN-P	Internally connected to pull-up resistors for the 24 general-purpose programmable inputs. Connect this input to the +5V pin (already done at the factory) to source current; or connect to GND to sink current. Connection to other voltages (max. = 24V) allows for compatibility with other signal levels. Does not apply to triggers.
8	IN	TRG-A	Trigger input A: Like programmable inputs, but can function as a position latch input that latches positions within 1 encoder count of the trigger being activated (see `INFNC` command). Internal circuit is identical to the limit input (see limit input circuit drawing below).
9	IN	TRG-B	Same function as trigger input A above
10	------	GND	Isolated ground
11	OUT	OUT-A	Auxiliary programmable output A: Function and circuit is identical to the other 24 programmable outputs (see programmable I/O circuit drawing above)
12	OUT	OUT-B	Same function as auxiliary programmable output A above
13	------	GND	Isolated ground
14	IN	ENBL	Enable input. Normally grounded. When contact to ground is broken, the analog output signal to the drive is set to ØV and the shutdown outputs are activated; this occurs independent of the DSP and the microprocessor. Internal input circuit is identical to the limit circuit below.

Limits Connector

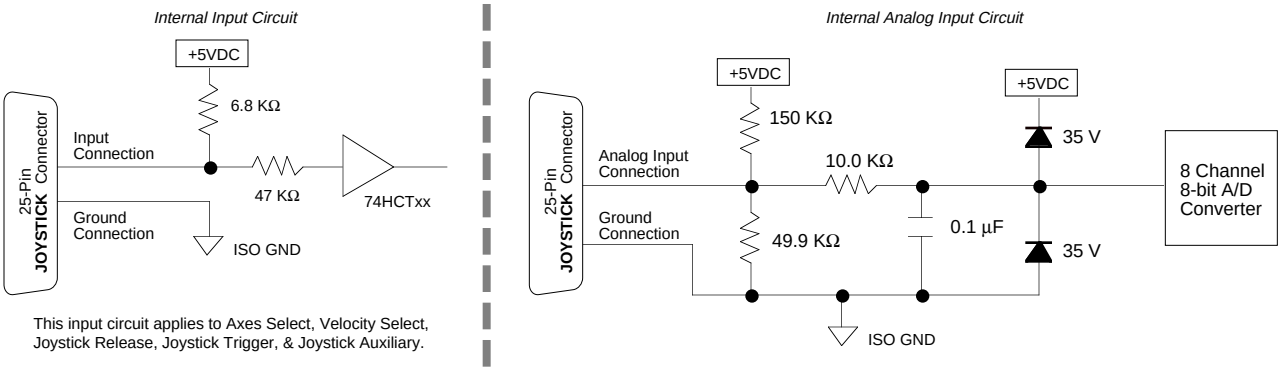
Pin	In/Out	Name	Description
9	IN	1CW	Clockwise limit input for axis 1
8	IN	1CCW	Counter-clockwise limit input for axis 1
7	IN	1HOM	Home limit input for axis 1
6	—	GND	Isolated ground
5	IN	2CW	Clockwise limit input for axis 2
4	IN	2CCW	Counter-clockwise limit input for axis 2
3	IN	2HOM	Home limit input for axis 2
2	—	GND	Isolated ground
1	—	SHLD	*Shield*—Internally connected to chassis ground (earth)

Internal Limit Input Circuit



Joystick Connector

Pin	In/Out	Name	Description
1	IN	Analog Channel 1	8-bit, analog input for joystick control of axis. Input voltage must not exceed 5V.
2	IN	Analog Channel 2	8-bit, analog input for joystick control of axis. Input voltage must not exceed 5V.
3	IN	Analog Channel 3	8-bit, analog input for joystick control of axis. Input voltage must not exceed 5V.
8	—	Shield	Shield
14	—	Ground	Isolated Ground
15	IN	Axes Select	If using only one analog channel, you can use this input to alternately control axes 1 or 2
16	IN	Velocity Select	Input to select high or low velocity range (as defined with `JOYVH` or `JOYVL` command)
17	IN	Joystick Release	When low (grounded), joystick mode can be enabled. When high (not grounded), program execution will continue with the first command after the joystick enable (`JOY`) statement.
18	IN	Joystick Trigger	Status of this active-low input can be read by a program (using the `INO` or `TINO` commands) to control program flow, or to enter the 6270 into joystick mode.
19	IN	Joystick Auxiliary	Status of this active-low input can be read by a program (using the `INO` or `TINO` commands) to control program flow.
23	OUT	+5VDC (out)	+5VDC power output



RP240 Connector

Pin	In/Out	Name	Description
5	—	Shield	Shield
4	OUT	Tx	Transmit output to RP240's Rx input
3	IN	Rx	Receive input from RP240's Tx output
2	—	Ground	Ground
1	OUT	+5VDC (out)	+5VDC power output

Optional DIP Switch and Jumper Settings

The 6270 is equipped with a four-position DIP switch package you can use to select the 6270's device address (used for daisy-chaining multiple 6270s with one RS-232C circuit), and to use the 6270's auto baud rate feature.

NOTE

As an alternative to setting the address with the DIP switch package, you can automatically establish an *n + 1* unique address configuration with the ADDR command. Refer to the *RS-232C Daisy-Chaining* section in Chapter 5 for details.

The 6270 is also equipped with jumpers you can use to select a variety of command output voltage or current settings.

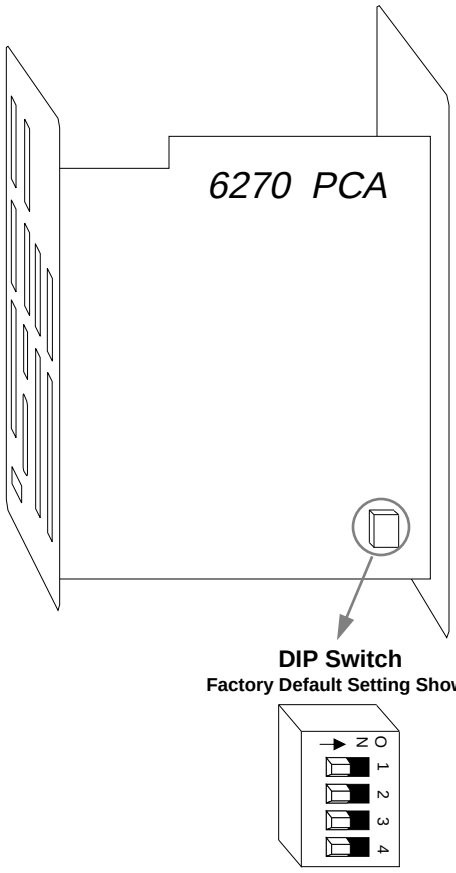
Accessing the DIP Switch Package and Jumpers

CAUTION

While handling the 6270 printed circuit assembly (PCA), be sure to observe proper grounding techniques to prevent electro-static discharge (ESD).

1. Remove power before removing the 6270's enclosure.
2. Lay the 6270 on its back (the side with the mounting brackets).
3. Using a Phillips screwdriver, remove the four screws on the front panel and the two screws on the bottom panel.
4. Gently slide the enclosure away from the chassis.

The illustration below shows the DIP switch package and jumpers and lists the optional settings.



Switch #3	Switch #2	Switch #1	Device Address	
OFF	OFF	OFF	Ø	(default)
OFF	OFF	ON	1	
OFF	ON	OFF	2	
OFF	ON	ON	3	
ON	OFF	OFF	4	
ON	OFF	ON	5	
ON	ON	OFF	6	
ON	ON	ON	7	

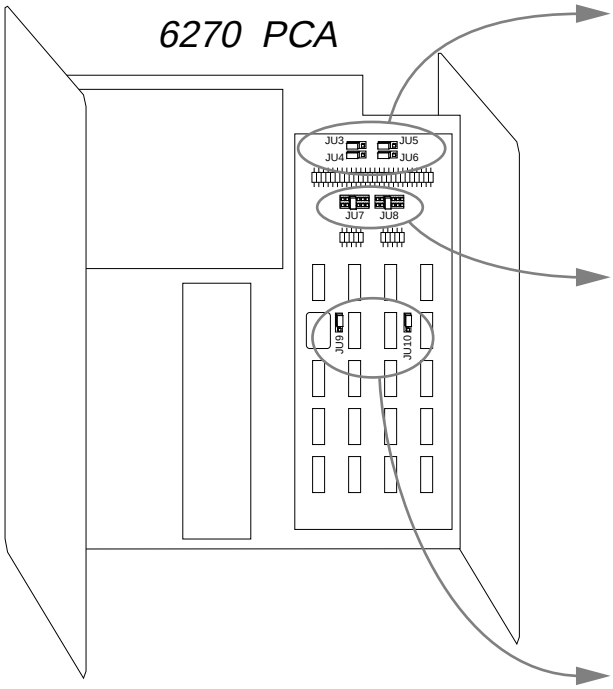
* Device address is checked upon power up or reset.

Switch #4 ON = Auto Baud Enabled
Switch #4 OFF = Auto Baud Disabled (default)

Following these steps to implement the Auto Baud feature:

1. Change Switch #4 to the ON position.
2. Connect the terminal to the 6270's RS-232C serial port on the AUX connector.
3. Power up the terminal.
4. Cycle power to the 6270 and immediately press the space bar several times.
5. The 6270 should send a message to the terminal confirming the baud rate (i.e., `*9600`). You should now be communicating to the 6270 via the terminal. If no baud rate messages is received, verify steps 1 through 3 and repeat step 4.
6. Change Switch #4 to the OFF position.
7. Cycle power to the 6270. You should be communicating to the 6270 via the terminal at the previously determined rate.

NOTE: If Auto Baud is enabled, the 6270 performs its auto baud routine every time it is powered up or reset. The 6270 is capable of matching 1200, 2400, 4800, and 9600 baud. Once the baud rate has been determined, the 6270 stores that baud rate in non-volatile memory; therefore, Switch #4 should be set to the OFF position after the baud rate has been determined.



CURRENT OR VOLTAGE CONTROL

Note: Two jumper settings are required for each axis

JUMPER	FUNCTION	OPTIONS
JU5 and JU6	Axis #1	Position 1/2 = ±10 volt output Position 2/3 = current output (select range with JU8)
JU3 and JU4	Axis #2	Position 1/2 = ±10 volt output Position 2/3 = current output (select range with JU7)

CURRENT RANGE OPTIONS

JUMPER	FUNCTION	OPTIONS
JU8	Axis #1	Position 1/2 = ± 20 mA Position 3/4 = ± 50 mA Position 5/6 = ± 60 mA Position 7/8 = ± 80 mA Position 9/10 = ± 100 mA Position 11/12 = ± 150 mA
JU7	Axis #2	Position 1/2 = ± 20 mA Position 3/4 = ± 50 mA Position 5/6 = ± 60 mA Position 7/8 = ± 80 mA Position 9/10 = ± 100 mA Position 11/12 = ± 150 mA

LDT FEEDBACK OPTIONS

JUMPER	FUNCTION	OPTIONS
JU9	Axis #1	Position 1/2 = pulse duration feedback Position 2/3 = start/stop feedback
JU10	Axis #2	Position 1/2 = pulse duration feedback Position 2/3 = start/stop feedback

C H A P T E R ⑦

Troubleshooting

The information in this chapter will enable you to isolate and resolve system hardware and software problems.

Troubleshooting Basics

If your system does not function properly (or as you expect it to operate), the first thing that you must do is identify and isolate the problem. When you have accomplished this, you can effectively begin to resolve the problem.

The first step is to isolate each system component and ensure that each component functions properly when it is run independently. You may have to dismantle your system and put it back together piece by piece to detect the problem. If you have additional units available, you may want to exchange them with existing components in your system to help identify the source of the problem.

Determine if the problem is mechanical, electrical, or software-related. Can you repeat or re-create the problem? Do not attempt to make quick rationalizations about problems. Random events may appear to be related, but they are not necessarily contributing factors to your problem. You must carefully investigate and decipher the events that occur before the subsequent system problem.

You may be experiencing more than one problem. You must isolate and solve one problem at a time. Log (document) all testing and problem isolation procedures. You may need to review and consult these notes later. This will also prevent you from duplicating your testing efforts.

If you are having difficulty isolating a problem be sure to document all occurrences of the problem along with as much specific information, such as time of occurrence, 6270 status, and anything else that was happening when the problem occurred.

Once you have isolated a problem, take the necessary steps to resolve it. Refer to the problem solutions contained in this chapter.

Reducing Electrical Noise

For detailed information on reducing electrical noise, refer to Appendix A.

Error Messages and Debug Tools

A list of all possible error messages, and their causes, is provided in the ***6000 Series Software Reference Guide***. For instructions on using the 6270's program debug tools (Trace mode, Single-Step mode, I/O activation, bad command detection, etc.) refer to *Program Debug Tools* in the *Programming Guide* section of the ***6000 Series Software Reference Guide***.

Common Problems & Solutions

The following table presents some guidelines to help you isolate problems with your motion control system. Some common symptoms are listed along with a list of possible causes and remedies.

- Look for the symptom that most closely resembles what you are experiencing.
- Look through the list of possible causes so that you better understand what may be preventing proper operation.
- Start from the top of the list of remedies and use the suggested procedures to isolate the problem.
- Refer to other sections of the manual for more information on 6270 set up, system connections, and feature implementation. You may also need to refer to the ***6000 Series Software Reference Guide***.

Problem	Cause	Solution
Erratic operation	1. Electrical Noise	1. Reduce electrical noise or move the 6270 away from noise source (refer also to Appendix A)
	2. Improper shielding	2. Ground Joystick Release input (refer also to Appendix A)
	3. Improper wiring	3. Check wiring for opens, shorts, and mis-wired connections
LEDs: DISABLED1/2 LEDs are red	1. Shutdown input active	1. Issue `DRIVE11` command
	2. No AC power to drive or valve	2. Check AC power to drive or valve
	3. Drive or valve not connected	3. Connect drive or valve
	4. Position error (LDT not connected)	4. Connect LDT and issue `DRIVE11` command
	5. LDT read error (LDT not connected, LDT failure, or `LDTUPD` setting too fast)	5.a. Connect LDT and issue `DRIVE11` command 5.b. Replace faulty LDT and issue `DRIVE11` command 5.c. Increase the `LDTUPD` value and issue `DRIVE11` command NOTE: To enable an axis (`DRIVE11`) without an LDT connected, connect **GATE+** to **GND** on the **LDT** connector.
LEDs: STATUS LED is off	1. No AC power	1. Check AC power
LEDs: STATUS LED is red	1. Internal Board Monitor Alarm (BMA) has detected a non-recoverable fault	1.a. Recycle power to the 6270 1.b. Ensure +5V is not shorted to GND on the I/O connections
Missing counts from feedback device	1. Improper wiring	1. Check wiring
	2. Feedback device slipping	2. Check and tighten feedback device coupling
	3. Feedback device too hot	3. Reduce encoder temperature with heatsink, thermal insulator, etc.
	4. Electrical noise	4.a. Shield wiring (refer also to Appendix A) 4.b. Use encoder with differential outputs
	5. Feedback device frequency too high	5. Peak encoder frequency must be below 1.2 MHz post-quadrature; peak frequency must account for velocity ripple
	6. LDT read error (LDT not connected, LDT failure, or `LDTUPD` setting too fast)	6.a. Connect LDT and issue `DRIVE11` command 6.b. Replace faulty LDT and issue `DRIVE11` command 6.c. Increase the `LDTUPD` value and issue `DRIVE11` command NOTE: To enable an axis (`DRIVE11`) without an LDT connected, connect **GATE+** to **GND** on the **LDT** connector.

Problems, Causes & Solutions *(continued)*

Problem	Cause	Solution
Load does not move in joystick mode	1. Joystick Release input not grounded 2. Improper wiring	1. Ground Joystick Release input 2. Check wiring for opens, shorts, and mis-wired connections
Runaway (if encoder or LDT counts positive when turned clockwise or extended)	1. Direction connections reversed	1. Switch CMD– with the CMD+ connection to drive or valve NOTE: The CMD+/– Connection is not differential. Do not connect CMD+ to ground on your valve/drive
No Motion	1. Status LED off or red 2. Limits engaged 3. Drive fault level incorrect. 4. Improper wiring 5. Load is jammed 6. No torque from motor 7. Maximum position error exceeded 8. Drive has activated the Drive fault input 9. ENBL input is not grounded to GND	1. See status LED problems above. 2a. Move load off of limits or disable limits with `LHØ,Ø` 2b. If using soft limits, make sure `LSCW>LSCCW` 3. Set drive fault level using `DRFLVLxx` (for S, Z, and K drives, use `DRFLVL11`) 4. Check command, shutdown, drive fault, and limit connections. 5. Remove power and clear jam 6. See problem: *No Torque* 7. Check to see if `TAS` bit #23 is set, and issue the `DRIVE1` command to the axis that exceeded the position error limit. 8a. Check to see if `TAS` bit #14 is set, and check the `DRFLVL` command to ensure the drive fault level is correct. 8b. Inspect the drive to determine the cause 9. Ground the ENBL input to GND and reset
No RS-232C Communication	1. Improper RS-232C Interface or communication parameters 2. RS-232C disabled 3. In daisy chain, unit may not be set to proper address	1. See *RS-232C Troubleshooting* section 2. Enable RS-232C with the `E` command (all units if daisy-chained) 3. Verify DIP switch settings (see *Optional DIP Switch Settings* in Chapter 6), verify proper application of the `ADDR` command
No Torque/Force	1. Improper wiring 2. No power to drive 3. Drive or valve failed 4. Drive faulted 5. Shutdown issued	1. Check wiring to the drive, or valve, as well as other system wiring 2. Check power to drive 3. Check drive or valve status 4. Check drive status 5. Enable drive or valve with `DRIVE11`
Power-up Program does not execute	1. ENBL input is not grounded to GND 2. `STARTP` program is not defined	1. Ground the ENBL input to GND and reset 2. Check the response to the `STARTP` command. If no program is reported, define the `STARTP` program and reset
Program access denied: receive the message `*ACCESS DENIED` when trying to use the `DEF`, `DEL`, `ERASE`, `INFNC`, or `MEMORY` commands	1. Program security function has been enabled (`INFNCi-Q`) and the program access input has not been activated	1.a. Activate the assigned program access input, perform your programming changes, then deactivate the program access input. 1.b. Refer to the instructions in the `INFNC` command description in the ***6000 Series Software Reference Guide***.
Program execution: stops at the `INFEN1` command	1. `INFEN1` enables drive fault monitoring, but the drive fault level (`DRFLVL`) command is set incorrectly for the drive being used.	1. Issue the correct `DRFLVL` command for your drive (refer to the `DRFLVL` command)
Program execution: the first time a program is run, the move distances are incorrect. Upon downloading the program the second time, move distances are correct.	1. Scaling parameters were not issued when the program was downloaded; or scaling parameters have been changed since the program was defined	1. Issue the scaling parameters (`SCALE1`, `SCLA`, `SCLD`, `SCLV`, `PSCLA`, `PSCLV`) before saving any programs
Programmable inputs not working	1. IN-P (input pullup) not connected 2. If external power supply is used, the grounds must be connected together 3. Improper wiring	1.a. When inputs will be pulled down to 0V by an external device, connect IN-P to +5V or to another positive supply 1.b. When inputs will be pulled up to 5V or higher by an external device, connect IN-P to 0V 2. Connect external power supply's ground to ground (GND) 3. Check wiring for opens, shorts, and mis-wired connections
Programmable outputs not working	1. Output connected such that it must source current (pull to positive voltage) 2. OUT-P not connected to +5V or other positive voltage source 3. If external power supply is used, the grounds must be connected together 4. Improper wiring	1. Outputs are open-collector and can only sink current -- change wiring. 2. Connect OUT-P to +5V supplied or other voltage in system 3. Connect the external power supply's ground to ground (GND) 4. Check wiring for opens, shorts, and mis-wired connections

Problems, Causes & Solutions *(continued)*

Problem	Cause	Solution
Trigger inputs not working	1. Improper wiring	1. Check wiring for opens, shorts, and mis-wired connections
Wrong Direction—Stable	1. Command output (CMD) connections and feedback device connections or mounting are reversed	1. Software remedy: Issue the `CMDDIR1` command to the affected axis. This reverses the polarity of the commanded direction and the feedback direction so that servo stability is maintained. Hardware remedy: Switch CMD- with the CMD+ connection to drive or valve (if your valve or drive does not accept differential outputs this will not work). You will also have to change the feedback device wiring or mounting so that it counts in same direction as the commanded direction.
Wrong Direction—Unstable	1. Not tuned properly 2. Phase of encoder reversed or mounting of ANI input or LDT is such that it counts in the opposite direction as the commanded direction.	1. Refer to Chapter 4 for tuning instructions 2. Software remedy: For the affected axis, issue the appropriate feedback polarity reversal command (`LDTPOL1` if LDT, `ANIPOL1` if ANI analog input, or `ENCPOL1` if encoder). Hardware remedy: If encoder feedback, swap the PHA+ and PHA- connections to the 6270. If LDT or ANI feedback, change the mounting so that the counting direction is reversed.
Wrong Speed or Distance	1. Wrong resolution setting 2. Wrong scaling value	1.a. Encoder feedback: Check and set resolution on 6270 with `ERESx,x` 1.b. LDT feedback: Check and set resolution on 6270 with `LDTRESx,x` 2. Check the scaling parameters (`SCALE1`, `SCLA`, `SCLD`, `SCLV`, `PSCLA`, `PSCLV`)

RS-232C Troubleshooting

If you are having problems communicating with the 6270, try the following procedure to troubleshoot the communications interface.

1. Power-up your computer or terminal *and then* power-up the 6270.
2. The serial port of your computer/terminal may require hardware handshaking. If so, you must disable handshaking with your terminal emulator software package. You can also disable hardware handshaking by connecting the computer's/terminal's RTS & CTS lines together (usually pins 4 and 5) and DSR & DTR lines together (usually pins 6 to 20).
3. Verify that the computer/terminal and 6270 are configured to the same baud rate, number of data bits, number of stop bits, and parity. If your terminal is not capable of 9600 baud, you can use the 6270's *auto-baud* function to automatically set the 6270's baud rate equal to the terminal's baud rate. Refer to the *Optional DIP Switch and Jumper Settings* section in Chapter 6 for instructions.
4. Check to make sure you are using DC common or signal ground as your reference, *not* earth ground.
5. Cable lengths for RS-232C should not exceed 50 feet. As with any control signal, be sure to shield the cable to earth ground at one end only.
6. Press the return key several times. The cursor should move down one or two lines each time you press the return key. If your terminal displays garbled characters, check the terminal's protocol set-up; the baud rate setting probably does not match the 6270's setting (see step ③ above). The problem could also be caused by a poor ground connection.
7. If the cursor does not move after pressing the space bar:
   a. Disconnect the RS-232C cable from the 6270.
   b. Connect the RS-232C cable's Rx and Tx lines together at the end that connects to the 6270.
   c. Press the space bar. If the cursor does not move, either the computer (or terminal) or the cable is defective.
8. Once you are able to make the cursor move, enter some characters. These characters should appear on the computer or terminal display. If each character appears twice, your host is set to half-duplex; set it to full-duplex.

Appendix A: Reducing Electrical Noise

Noise-related difficulties can range in severity from minor positioning errors to damaged equipment from runaway loads crashing blindly through limit switches. In microprocessor-controlled equipment such as the 6270, the processor constantly retrieves instructions from memory in a controlled sequence. If an electrical disturbance occurs, it may cause the processor to misinterpret an instruction or access the wrong data. This can be catastrophic to the program and force you to reset the processor.

Sources of Noise

Being invisible, electrical noise can be very mysterious, but it invariably comes from the following sources:

- Power line noise
- Externally conducted noise
- Transmitted noise
- Ground loops

The following electrical devices are notorious for generating unwanted electrical noise conditions:

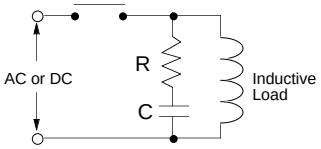
- Coil-driven devices: conducted and power line noise
- SCR-fired heaters: transmitted and power line noise
- Valves, motors & motor drives: transmitted and power line noise
- Welders (electric): transmitted and power line noise

Power Line Noise

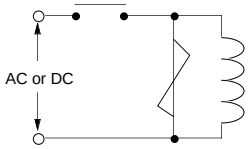
Power line noise is usually easy to resolve due to the wide availability of line filtering equipment for the industry. Only the most severe situations call for an isolation transformer. Line filtering equipment is required when other devices connected to the local power line are switching large amounts of current, especially if the switching occurs at a high frequency.

Any device having coils is likely to disrupt the power line when it is switched off. Surge suppressers, such as metal oxide varistors (MOVs) are capable of limiting this type of electrical noise. A series resistor/capacitor (RC) network across the coil is also effective (resistance: 500 to 1,000 Ω; capacitance: 0.1 to 0.2 μF). Coil-driven devices (inductive loads) include relays, solenoids, contractors, clutches, brakes, and motor starters.

Typical RC Network



MOV

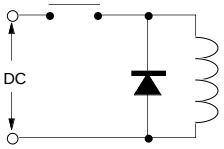


Externally Conducted Noise

Externally-conducted noise is similar to power line noise, but the disturbances are created on signal and ground wires that are connected to the 6270. This kind of noise can get into logic circuit ground or into the processor power supply and scramble the program. The problem here is that control equipment often shares a common DC ground wire that may be connected to several devices, such as a DC power supply, programmable controller, remote switches, etc. When a noisy device such as a relay or solenoid is attached to the DC ground, it may cause disturbances within the 6270.

To solve a noise problem caused by DC mechanical relays and solenoids, you can connect a diode backwards across the coil to clamp the induced voltage *kick* that the coil will produce. The diode should be rated at 4 times the coil voltage and 10 times the coil current. Using solid state relays is another way to eliminate this problem.

Diode



Multiple devices on the same circuit should be grounded together at a single point.

Furthermore, power supplies and programmable controllers often have DC common tied to Earth (AC power ground). As a rule, it is preferable to have the 6270 signal ground or DC common floating with respect to Earth. This prevents noisy equipment which is grounded to Earth from sending noise into the 6270. When floating the signal ground is not possible, you should make the Earth ground connection at only one point.

In many cases, optical isolation may be required to completely eliminate electrical contact between the 6270 and a noisy environment. Solid state relays provide this type of isolation.

Transmitted Noise

Transmitted noise is picked up by external connections to the 6270, and in severe cases can attack the 6270 when there are no external connections. The 6270's sheet metal enclosure will typically shield the electronics from this, but openings in the enclosure for connections and front panel controls may *leak*.

When high current contacts open, they draw an arc, producing a burst of broad spectrum radio frequency noise that can be picked up on a limit switch or other wiring. High-current and high-voltage wires have an electrical field around them and may induce noise on signal wiring, especially when they are tied in the same wiring bundle or conduit.

When this kind of problem occurs, you should consider shielding signal cables or isolating the signals. A proper shield surrounds the signal wires to intercept electrical fields, but this shield must be tied to Earth to drain the induced voltages. At the very least, wires should be run in twisted pairs to limit straight line antenna effects.

Installing the 6270 in a NEMA enclosure ensures protection from this kind of noise, unless noise-producing equipment is also mounted inside the enclosure. Connections external to the enclosure must be shielded.

Even the worst noise problems in environments near 600 amp welders and 25kW transmitters have been solved using enclosures, conduit, optical isolation, and single-point ground techniques.

Ground Loops

Ground Loops are the most mysterious noise problems. They seem to occur most often in systems where a control computer is using RS-232C communication. Symptoms like garbled transmissions and intermittent operation are typical.

The problem occurs in systems where multiple Earth ground connections exist, particularly when these connections are far apart.

Ground Loops—Noise Scenario

Suppose a 6270 is controlling an axis, and the limit switches use an external power supply. The 6270 is controlled by a computer in another room. If the power supply Common is connected to Earth, the potential exists for ground loop problems. This is because most computers have their RS-232C signal common tied to Earth. The loop starts at the 6270 system limit switch ground, goes to Earth through the drive, and on to Earth at the computer. From there, the loop returns to the 6270 system through RS-232C signal ground. If a voltage potential exists between drive Earth and remote computer Earth, ground current will flow through the RS-232C ground, creating unpredictable results.

The way to test for and ultimately eliminate a ground loop is to lift or *cheat* Earth ground connections in the system until the symptoms disappear.

Defeating Noise

The best time to handle electrical noise problems is before they occur. When a motion system is in the design process, the designer should consider the following set of guidelines for system wiring (in order of importance):

1. Put surge suppression components on all electrical coils: Resistor/capacitor filters, MOVs, Zener and clamping diodes.
2. Shield all remote connections, use twisted pairs. Shields should be tied to Earth at one end.
3. Put all microelectronic components in an enclosure. Keep noisy devices outside. Watch internal temperature.
4. Ground signal common wiring at one point. Float this ground from Earth if possible.
5. Tie all mechanical grounds to Earth at one point. Run chassis and motor grounds to the frame, and the frame to Earth.
6. Isolate remote signals. Solid state relays or opto isolators are recommended.
7. Filter the power line. Use common RF filters, and use an isolation transformer for worst case.

A noise problem must be identified before it can be solved. The obvious way to approach a problem situation is to eliminate potential noise sources until the symptoms disappear, as in the case of ground loops. When this is not practical, use the above guidelines to *shotgun* the installation.

References

Information about the equipment referred to may be obtained by calling the numbers listed below.

- Corcom line filters, (214) 386-5515
- Opto-22 optically isolated relays, (408) 496-6611
- Crydom optically isolated relays, (415) 463-2250
- Potter Brumfield optically isolated relays, (812) 386-1000
- Teal power line isolation filters, (800) 888-8325

Appendix B: Alphabetical Command List

Command Name	Command Description
[<cr>]	Carriage Return
[<lf>]	Line Feed
[:]	Colon
!	Immediate Command Identifier
@	Global Command Identifier
;	Begin Comment
$	Label Deceleration
#	Step Through a Program
'	Enter Data (Single quote)
[.]	Bit Select
["]	Begin and End String
[\ ]	ASCII Character Designator
[=]	Assignment or Equivalence
[>]	Greater Than
[>=]	Greater Than or Equal
[<]	Less Than
[<=]	Less Than or Equal
[<>]	Not Equal
[( )]	Operation Priority Level
[+]	Addition
[-]	Subtraction
[*]	Multiplication
[/]	Division
[&]	Boolean And
[|]	Boolean Or
[^]	Boolean Exclusive Or
[~( )]	Boolean Not
[>>]	Shift from Right to Left
[<<]	Shift from Left to Right
A	Acceleration
[A]	Acceleration Assignment
AA	Average Acceleration for S-curve
AD	Deceleration
[AD]	Deceleration Assignment
ADA	Average Deceleration for S-curve
ADDR	Daisy-Chain Address
[AND]	And
[ANI]	Analog Input Value (for -ANI Option)
ANIPOL	ANI Input Polarity
[ANV]	Analog Input Value
ANVO	Analog Input Voltage Override
ANVOEN	Analog Input Voltage Override Enable
[AS]	Axis Status Value
[ATAN( )]	Inverse Tangent
[b]	Binary Identifier
BP	Set a Program Break Point
BREAK	Terminate Program Execution
C	Continue
[CA]	Value of Captured ANI Input
CMDDIR	Commanded Direction Polarity
COMEXC	Enable Continuous Command Mode
COMEXL	Continue Command Execution on Limit
COMEXR	Continue Motion on Pause/Resume Input
COMEXS	Continue Command Execution on Stop
[COS( )]	Cosine

Command Name	Command Description
D	Distance
[D]	Distance Assignment
[DAC]	Current DAC Commanded Voltage
DACLIM	DAC Limit
DACMIN	Minimum DAC Output Voltage
[DAT]	Data Assignment
DATA	Data Statement
[DATP]	Data Program
DATPTR	Set Data Pointer
DATRST	Reset Data Pointer
DATSIZ	Data Program Size
DATTCH	Data Teach
DCLEAR	Clear RP240 Display
DEF	Define a Program/Subroutine
DEL	Delete a Program/Subroutine
DJOG	Enable RP240 Jog Mode
DLED	Turn RP240 LEDs On/Off
DPASS	Set RP240 Password
DPCUR	Position Cursor on RP240 Display
[DPTR]	Data Pointer Assignments
[DREAD]	Read Numeric Keypad on RP240
[DREADF]	Read Function Key on RP240
DREADI	RP240 Data Read Immediate Mode
DRFLVL	Drive Fault Level
DRIVE	Drive Shutdown
DVAR	Display Variable on RP240 Display
DWRITE" "	Write Text to the RP240 Display
E	RS-232C Enable
ECHO	Echo Enable
ELSE	Else Condition of IF Statement
ENCPOL	Encoder Polarity
END	Program/Subroutine End
EOL	End of Line Terminating Characters
EOT	End of Transmission Characters
[ER]	Error Value
ERASE	Erase all Programs/Subroutines
ERES	Encoder Resolution
ERRBAD	Bad Prompt
ERRDEF	Program Definition Prompt
ERRLVL	Error Detection Level
ERROK	Good Prompt
ERROR	Error Program Enable
ERRORP	Error Program
[FB]	Position of Feedback Device
GO	Initiate Motion
GOL	Initiate Linear Interpolated Motion
GOSUB	Execute a Subroutine with Return
GOTO	Execute a Subroutine without Return
[h]	Hexadecimal Identifier
HALT	Terminate Program Execution
HELP	Applications Help
HOM	Go Home
HOMA	Home Acceleration
HOMAA	Average Homing Acceleration
HOMAD	Home Deceleration
HOMADA	Average Homing Deceleration
HOMBAC	Home Backup Enable
HOMDF	Home Direction Final
HOMEDG	Home Reference Edge

Command Name	Command Description
HOMLVL	Home Active Level
HOMV	Home Velocity
HOMVF	Home Velocity Final
HOMZ	Home to Z-channel Enable
IF( )	If Statement
[IN]	Input Status
INDAX	Participating Axes
INDEB	Input Debounce Time
INDUSE	Enable/Disable User Status
INDUST	User Status
INEN	Input Enable
INFEN	Input Function Enable/Disable
INFNC	Input Function
INLVL	Input Active Level
[INO]	Other Input Status
INPLC	Establish PLC Data Inputs
INSELP	Select Program Enable
INSTW	Establish Thumbwheel Data Inputs
JOG	Jog Mode Enable
JOGA	Jog Acceleration
JOGAA	Average Jogging Acceleration
JOGAD	Jog Deceleration
JOGADA	Average Jogging Deceleration
JOGVH	Jog Velocity High
JOGVL	Jog Velocity Low
JOY	Joystick Mode Enable
JOYA	Joystick Acceleration
JOYAA	Average Joystick Acceleration
JOYAD	Joystick Deceleration
JOYADA	Average Joystick Deceleration
JOYAXH	Joystick Analog Input High
JOYAXL	Joystick Analog Input Low
JOYCDB	Joystick Center Deadband
JOYCTR	Joystick Center
JOYEDB	Joystick End Deadband
JOYVH	Joystick Velocity High
JOYVL	Joystick Velocity Low
JOYZ	Joystick Zero
JUMP	Jump to a Subroutine without Return
K	Kill Motion
<ctrl>K	Immediate Kill
KDRIVE	Disable Drive on Kill
L	Loop
[LDT]	Position of LDT
LDTGRD	LDT Gradient
LDTPOL	LDT Polarity
LDTRES	LDT Resolution
LDTUPD	LDT Position Sampling Update Rate
LH	Hard Limit Enable
LHAD	Hard Limit Deceleration
LHADA	Average Hard Limit Deceleration
LHLVL	Hard Limit Active Level
[LIM]	Limit Status
LN	End Loop
LS	Soft Limit Enable
LSAD	Soft Limit Deceleration
LSADA	Average Soft Limit Deceleration
LSCCW	Soft Limit CCW Range
LSCW	Soft Limit CW Range
LX	Terminate Loop

Command Name	Command Description
MA	Absolute / Incremental Mode Enable
MC	Preset / Continuous Mode Enable
MEMORY	Configure Memory
[MOV]	Axis Moving Status
NIF	End IF Statement
[NOT]	Not
NWHILE	End WHILE Statement
ONCOND	On Condition Enable
ONIN	On an Input Condition Gosub
ONP	On Program
ONUS	On a User Status Condition Gosub
ONVARA	On Variable 1 Condition Gosub
ONVARB	On Variable 2 Condition Gosub
[OR]	Or
OUT	Output State
[OUT]	Output Status
OUTALL	Multiple Output State
OUTEN	Output Enable
OUTFEN	Output Function Enable
OUTFNC	Output Function
OUTLVL	Output Active Level
OUTPA	Output on Position — Axis 1
OUTPB	Output on Position — Axis 2
OUTPLC	Establish PLC Strobe Data Outputs
OUTTW	Establish Thumbwheel Strobe Data Outputs
PA	Path Acceleration
PAA	Average Path Acceleration for S-curve
PAD	Path Deceleration
PADA	Average Path Deceleration for S-curve
[PANI]	Position of ANI Inputs (6270-ANI Only)
[PC]	Commanded Position
[PCA]	Position of Captured ANI Input Voltage
[PCC]	Captured Commanded Position
[PCE]	Position of Captured Encoder
[PCL]	Position of Captured LDT
[PE]	Position of Encoder
[PER]	Position Error
[PI]	Pi (π)
PS	Pause Program Execution
PSCLA	Path Acceleration Scale Factor
PSCLV	Path Velocity Scale Factor
PSET	Establish Absolute Position
PV	Path Velocity
RADIAN	Radian Enable
[READ]	Read a Value from RS-232C port
REPEAT	Repeat Statement
RESET	Reset 6270
RUN	Execute a Program/Subroutine
S	Stop Motion
SCALE	Enable/Disable Scale Factors
SCLA	Accel / Decel Scale Factor
SCLD	Distance Scale Factor
SCLV	Velocity Scale Factor
SDTAMP	Servo Dither Amplitude
SDTFR	Servo Dither Frequency Ratio
SFB	Servo Feedback Source
SGAF	Servo Acceleration Feedforward Gain
SGAFN	Acceleration Feedforward — Negative
SGENB	Servo Gain Set Enable
SGI	Servo Integral Feedback Gain
SGIN	Integral Feedback Gain — Negative

Command Name	Command Description
SGILIM	Servo Integral Windup Limit
SGP	Servo Proportional Feedback Gain
SGPN	Proportional Feedback Gain — Negative
SGSET	Servo Gain Set Save
SGV	Servo Velocity Feedback Gain
SGVN	Velocity Feedback Gain — Negative
SGVF	Servo Velocity Feedforward Gain
SGVFN	Velocity Feedforward Gain — Negative
[SIN( )]	Sine
SMPER	Servo Max. Allowable Position Error
SOFFS	Servo Control Signal Offset
SOFFSN	Control Signal Offset — Negative
[SQRT( )]	Square Root
[SS]	System Status
SSFR	Servo Sampling Frequency Ratio
SSWD	Setpoint Window Distance
SSWG	Setpoint Window Gain Set
STARTP	Set Power-up Program
STEP	Program Step Mode Enable
STRGTD	Servo Target Zone Distance
STRGTE	Servo Target Zone Mode Enable
STRGTT	Servo Target Zone Timeout Period
STRGTV	Servo Target Zone Velocity
T	Time Delay
[TAN( )]	Tangent
TANI	Transfer Analog Input Value (6270-ANI only)
TANV	Transfer Analog Input Value
TAS	Transfer Axis Status
TCA	Transfer Value of Captured ANI Input
TCMDER	Transfer Command Error
TDAC	Transfer Digital-to-Analog Converter Voltage
TDIR	Transfer Directory
TDPTR	Transfer Data Pointer Status
TER	Transfer Error Status
TEX	Transfer Program Execution Status
TFB	Transfer Position of Feedback Devices
TGAIN	Transfer All Servo Gains
[TIM]	Current Timer Value
TIMST	Start Timer
TIMSTP	Stop Timer
TIN	Transfer Input Status
TINO	Transfer Other Input Status
TLABEL	Transfer Labels
TLDT	Transfer Position of LDTs
TLIM	Transfer Limit Status
TMEM	Transfer Memory Usage
TOUT	Transfer Output State
TPANI	Transfer Position of ANI Inputs (6270-ANI only)
TPC	Transfer Position Commanded
TPCA	Transfer Voltage of Captured Analog Input
TPCC	Transfer Captured Commanded Position
TPCE	Transfer Position of Captured Encoder
TPCL	Transfer Position of Captured LDT
TPE	Transfer Position of Encoder
TPER	Transfer Position Error
TPROG	Transfer Program
TRACE	Program Trace Mode Enable
TRANS	Translation Mode Enable
TREV	Transfer Revision Level
TSGSET	Transfer Servo Gain Set
TSS	Transfer System Status
TSTAT	Transfer Servo Controller Status
TSTLT	Transfer Servo Settling Time
TTIM	Transfer Time
TUS	Transfer User Status
TVEL	Transfer Present Commanded Velocity
TVELA	Transfer Present Actual Velocity
[TW]	Thumbwheel Data Read
UNTIL( )	Until Part of REPEAT Statement
[US]	User Status
V	Velocity
[V]	Velocity Assignment
VAR	Numeric Variable
VARB	Binary Variable
VARS	String Variable
VCVT( )	Variable Type Conversion
[VEL]	Current Velocity
WAIT( )	Wait for a Specific Condition
WHILE( )	While a Condition is True
WRITE" "	Transmit String to RS-232C port
WRVAR	Transmit Variable to RS-232C port
WRVARB	Transmit Binary Variable to RS-232C port
WRVARS	Transmit String Variable to RS-232C port

I N D E X

J

K

L

M

N

O

P

R

S

T

U

V

W-Z