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# Installation

The information in this chapter will enable you to:

- Mount the 6270 properly
- Connect all inputs and outputs properly
- Verify that the complete system is installed properly

*To ensure proper installation, you should perform all the bench test procedures in Chapter 2, Getting Started, **before** proceeding with the permanent installation process in this chapter.*

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## Installation Precautions

To help ensure personal safety and long life of system components, pay special attention to the following installation precautions.

### WARNING

Always remove power to the 6270 before performing wiring installation or changing DIP switch settings.

### Heat & Humidity

Operate the 6270 system at an ambient temperature between 32° and 122°F (0° to 50°C). Keep the relative humidity below 95%.

### Electrical Noise

Minimize the potential for electrical noise before installing the 6270, rather than attempting to solve such problems after installation. You can prevent electrical noise by observing the following installation precautions:

*For more information on electrical noise, refer to Appendix A.*

- Do not route high-voltage wires and low-level signals in the same conduit.
- Ensure that all components are properly grounded.
- Ensure that all wiring is properly shielded.

### Airborne Contaminants

Contaminants that may come in contact with the 6270 should be carefully controlled. Particulate contaminants, especially electrically conductive material such as metal shavings, can damage the 6270.

## Follow Installation Procedure

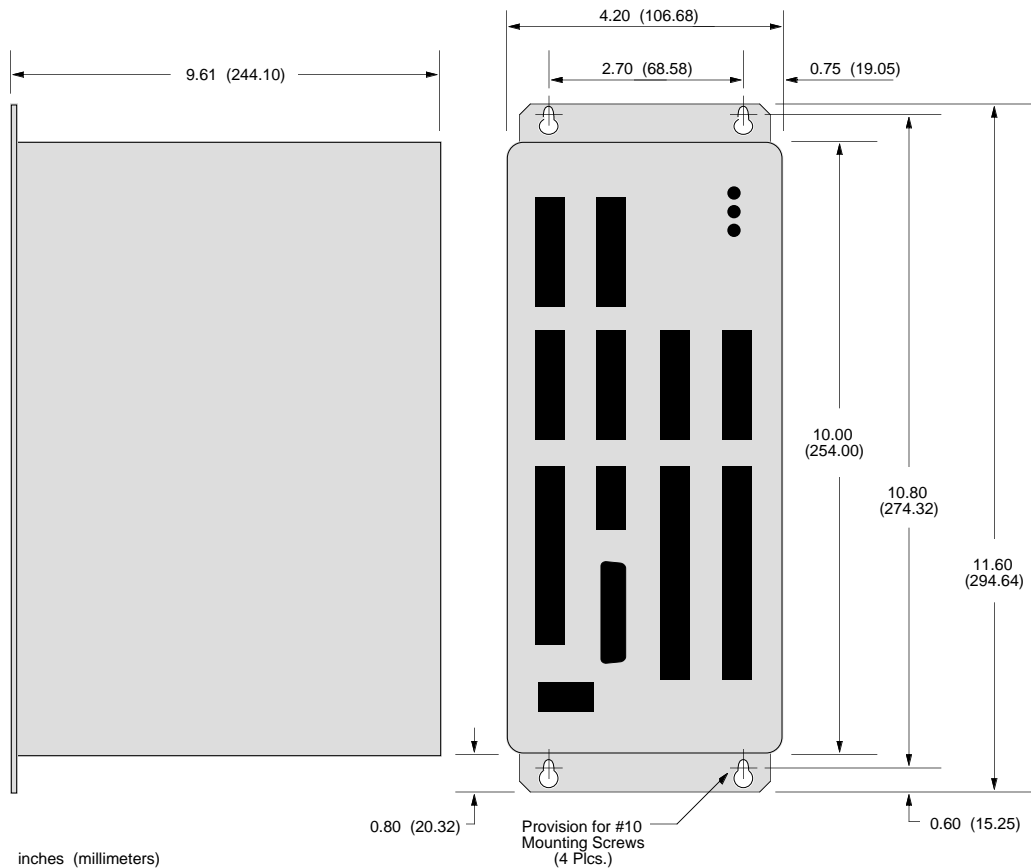
To ensure proper installation of the 6270 system, this chapter is organized in logical, linear steps. *Deviating from this prescribed format may result in system problems.*

- ① Mount the 6270 Motion Controller
- ② Perform system connections
- ③ Perform the system test

### ① Mount the 6270

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The 6270 should be installed in an enclosure that will protect it from atmospheric contaminants such as oil, metal, moisture, and dirt. Refer to the National Electrical Manufacturers Association (NEMA) specifications that pertain to your particular operating environment. The drawing below illustrates the 6270's dimensions.



### Panel Layout

If you mount the 6270 in an enclosure with other equipment, be sure to maintain at least 2 inches of unrestricted air-flow space around the chassis. The maximum allowable ambient temperature directly below the 6270 is 122°F (50°C). Fan cooling may be necessary if adequate air flow is not provided.

## ② System Connections

This section describes procedures for the following 6270 system connections:

- Servo valves and drives
- End-of-travel and home limits
- Linear displacement transducers (LDTs)
- Encoder
- Auxiliary +5VDC output
- Enable input (ENBL)
- Programmable inputs and outputs (including auxiliary outputs **OUT-A** and **OUT-B**)
- Output pull-up (**OUT-P**)
- Trigger inputs (**TRG-A** and **TRG-B**)
- RP240 Remote Operator Panel
- Joystick and analog inputs
- ANI analog inputs (6270-ANI option only)
- Extending cables

Refer to the bench test procedures in Chapter 2 for the following connections:

- Power
- RS-232C communications

Refer to Chapter 5 for connection procedures on the following:

- PLC
- Thumbwheels
- RS-232C daisy-chain

### NOTE

Refer to Chapter 6, *Hardware Reference*, for system specifications and detailed I/O circuit drawings and signal descriptions. Active High and Active Low conventions are described in the *Overview*, page iii.

## Servo Valve and Servo Drive Connections

### CAUTION

Before connecting to your motor/drive or valve system, be sure that power is **not** applied to the 6270.

### Pin Outs

The following table describes the pin outs for the **DRIVE** connectors. The **DRIVE** connectors are used for drive connections and for valve connections.

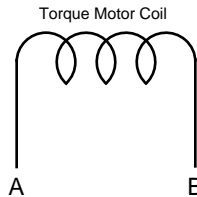
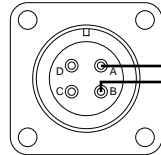
Pin #	Name	In/Out	Description (I/O circuit drawings are provided in Chapter 6)
1	SHLD	----	Shield—internally connect to chassis (earth) ground.
2	COM	----	Signal common for shutdown. Not connected to any ground or other COM.
3	SHTNC	OUT	Shutdown relay output to drives that require a closed contact to disable the drive. 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 <b>DRIVE11</b> command. Shutdown active ( <b>DRIVE00</b> ): this output is internally connected to COM. Shutdown inactive ( <b>DRIVE11</b> ): this output is disconnected from COM.
4	SHTNO	OUT	Shutdown relay output to drives that require an open contact to disable the drive. 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 <b>DRIVE11</b> command. Shutdown active ( <b>DRIVE00</b> ): this output is disconnected from COM. Shutdown inactive ( <b>DRIVE11</b> ): this output is internally connected to COM.
5	DFT	IN	Drive fault input. Set active level with the <b>DRFLVL</b> command.
6	AGND	----	Analog ground.
7	ANI	IN	±10V, 14-Bit analog input ( <b>available only with the 6270-ANI option</b> ).
8	CMD-	OUT	Command signal return.
9	CMD+	OUT	Command output signal (±10V is default; for optional current settings, see Ch. 6).

If you are controlling a valve...

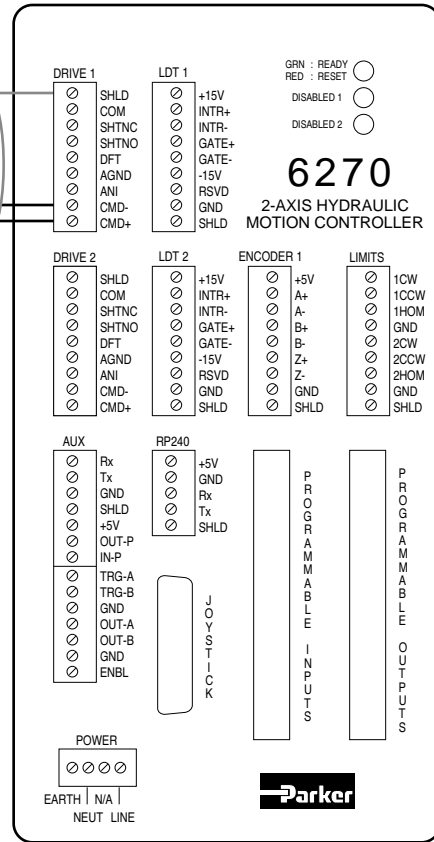
The 6270 can control servo valves operating from a voltage of  $\pm 10V$  or from a current of  $\pm 20mA$ ,  $\pm 50mA$ ,  $\pm 60mA$ ,  $\pm 80mA$ ,  $\pm 100mA$  or  $\pm 150mA$ . The default setting is for  $\pm 10V$  operation. If you need to select one of the current settings refer to the instructions found in the *Optional DIP Switch and Jumper Settings* section of Chapter 6, *Hardware Reference*.

Connect the valve to the 6270's DRIVE connector. The illustration below shows connections to Parker Fluidpower's BD15 and BD30 valves.

### Electrical Connector for Parker Fluidpower's BD15 and BD30 Valves



If you wish to reverse the valve's operation, swap the connections between pin A and pin B.



If you are using a servo drive...

Before you connect the drives to the 6270, configure your drives and connect the motors according to the user documentation for your drives.

The 6270 provides a standard  $\pm 10V$  analog control signal for use with any servo drive. Connect the drive to the 6270's 9-pin screw terminal connector (DRIVE 1 or DRIVE 2) as illustrated below.

<b>&lt;&lt;WARNING&gt;&gt;</b>	<b>SAFETY FIRST</b>	<b>&lt;&lt;WARNING&gt;&gt;</b>
If your drive does not have a shutdown input, install a manual emergency-stop switch for the drive's power supply.		

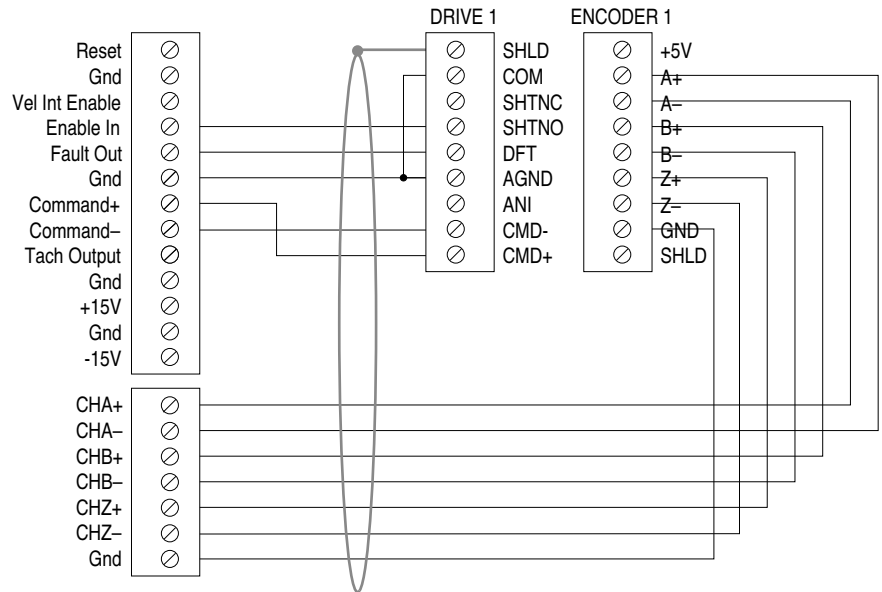
## APEX Series Drive

## 6270

APEX Series Drive	6270
Enable In	↔ SHTNO
Fault Out	↔ DFT
Gnd	↔ AGND
Command+	↔ CMD+
Command-	↔ CMD-
CHA+	↔ A-
CHA-	↔ A+
CHB+	↔ B+
CHB-	↔ B-
CHZ+	↔ Z+
CHZ-	↔ Z-
Gnd	↔ GND

### NOTE:

Apex Series CHA+ connected to 6270's A-  
Apex Series CHA- connected to 6270's A+

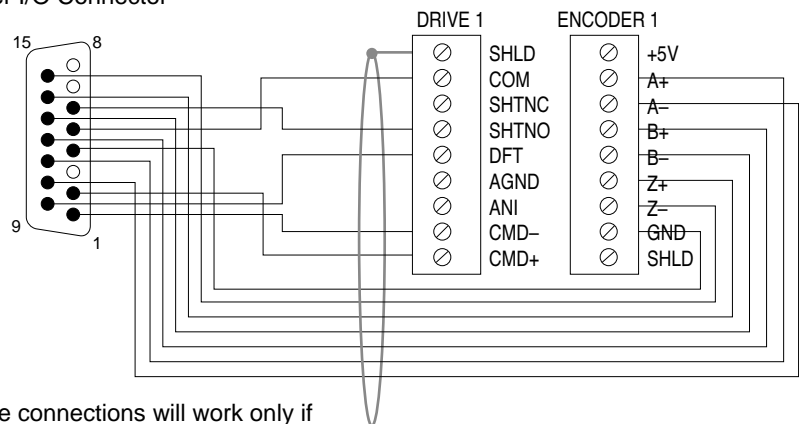


## BL Drive

## 6270

BL Drive	6270
V2 (pin 1)	↔ CMD-
V1 (pin 2)	↔ CMD+
GND (pin 4)	↔ GND
RST (pin 5)	↔ COM
+15V (pin 6)	↔ SHTNO
FT (pin 9)	↔ DFT
AOP (pin 10)	↔ A-
AOP (pin 11)	↔ A+
BOP (pin 12)	↔ B+
BOP (pin 13)	↔ B-
ZOP (pin 14)	↔ Z+
ZOP (pin 15)	↔ Z-

User I/O Connector



**NOTE:** These connections will work only if BL jumper LK2 is set to position B (not the factory default position).

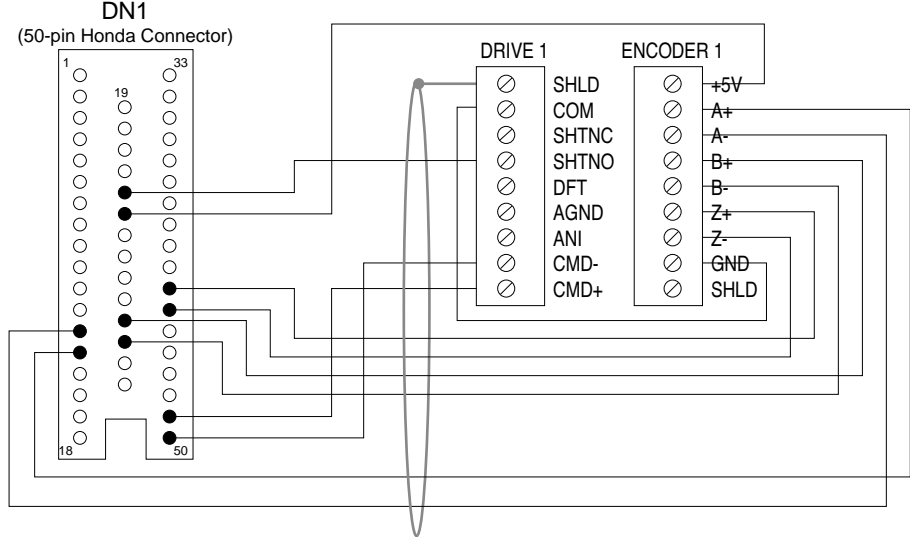
## Dynaserv Drive

## 6270

Dynaserv Drive	6270
A+ (pin 13)	↔ A-
A- (pin 14)	↔ A+
SRVON (pin 23)	↔ SHTNO
Vcc (pin 24)	↔ +5V
B+ (pin 29)	↔ B+
B- (pin 30)	↔ B-
Z+ (pin 43)	↔ Z+
Z- (pin 44)	↔ Z-
VIN (pin 49)	↔ CMD+
AGND (pin 50)	↔ CMD-

### NOTE:

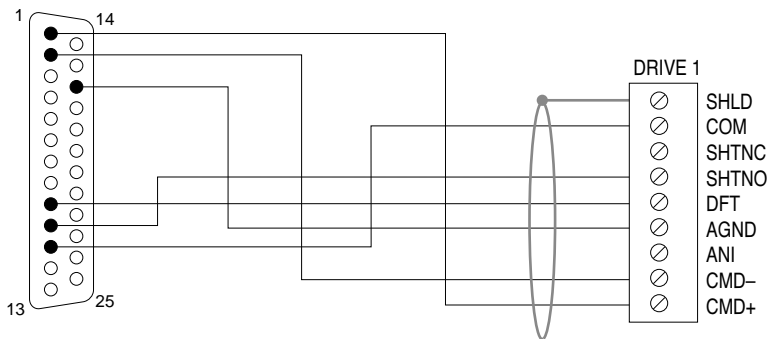
Dynaserv A+ connected to 6270's A-  
 Dynaserv A- connected to 6270's A+  
 6270 GND connected to 6270 COM



## OEM670 Drive

## 6270

OEM670 Drive	6270
CMD+ (pin 1)	↔ CMD+
CMD- (pin 2)	↔ CMD-
FAULT (pin 9)	↔ DFT
ENABLE (pin 10)	↔ SHTNO
GND (pin 11)	↔ COM
GND (pin 16)	↔ AGND



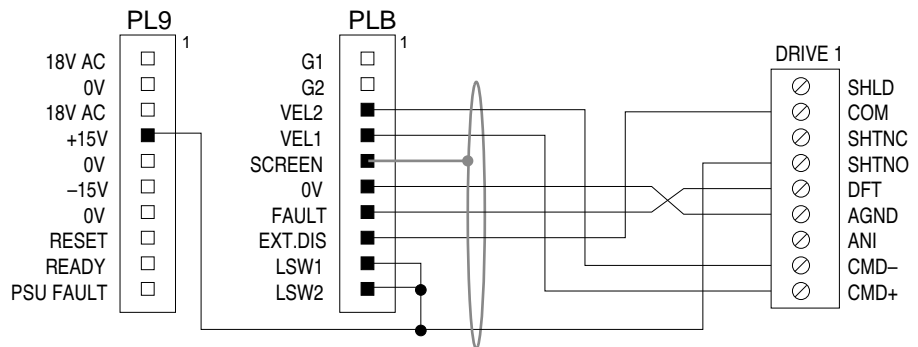
## UD2 & UD5 Drives

(UR3, UR4 or UR8 Rack)

## 6270

UD2 & UD5 Drives	6270
+15V, LSW1 & LSW2	↔ SHTNO
VEL2	↔ CMD-
VEL1	↔ CMD+
0V	↔ AGND
FAULT	↔ DFT
EXT.DIS	↔ COM

**NOTE:** These connections will work only if UD2/5 jumper LK1 is set to the 0V position (not the factory default position).



If a drive fault occurs, you must cycle power to the drives, unless you control RESET (PL9 pin 8 on UR4 & UR8 racks, PL4 pin 8 on UR3 rack) with one of the 6270's general-purpose outputs. For additional instructions on detecting and reacting to UD rack faults, contact the Compumotor or Digiplan Applications Department.

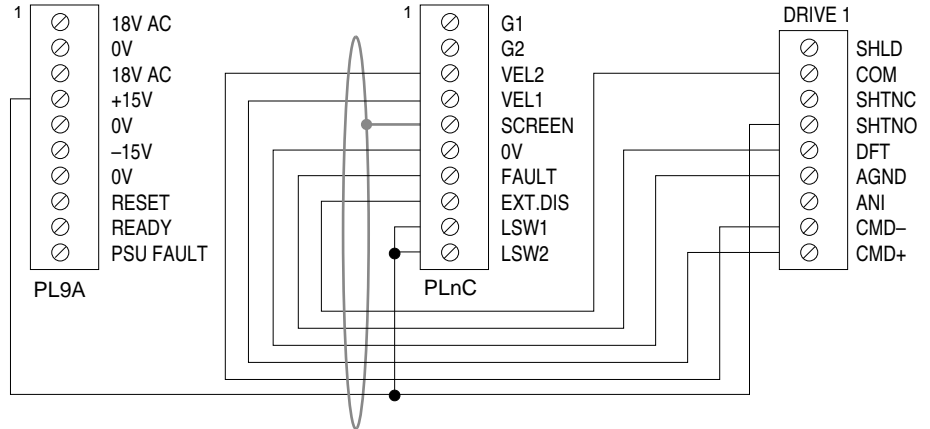
## UD12 Drive

(UR4 Rack)

## 6270

UD12 Drive	6270
+15V, LSW & LSW2	↔ SHTNO
VEL2	↔ CMD-
VEL1	↔ CMD+
0V	↔ AGND
FAULT	↔ DFT
EXT.DIS	↔ SHLD

**NOTE:** These connections will work only if UD12 jumper LK3 is set to position A (not the factory default position).



If a drive fault occurs, you must cycle power to the drives, unless you control RESET (pin 8 on the PL9 connector) with one of the 6270's general-purpose outputs.

For additional instructions on detecting and reacting to UD rack faults, contact the Compumotor or Digiplan Applications Department.

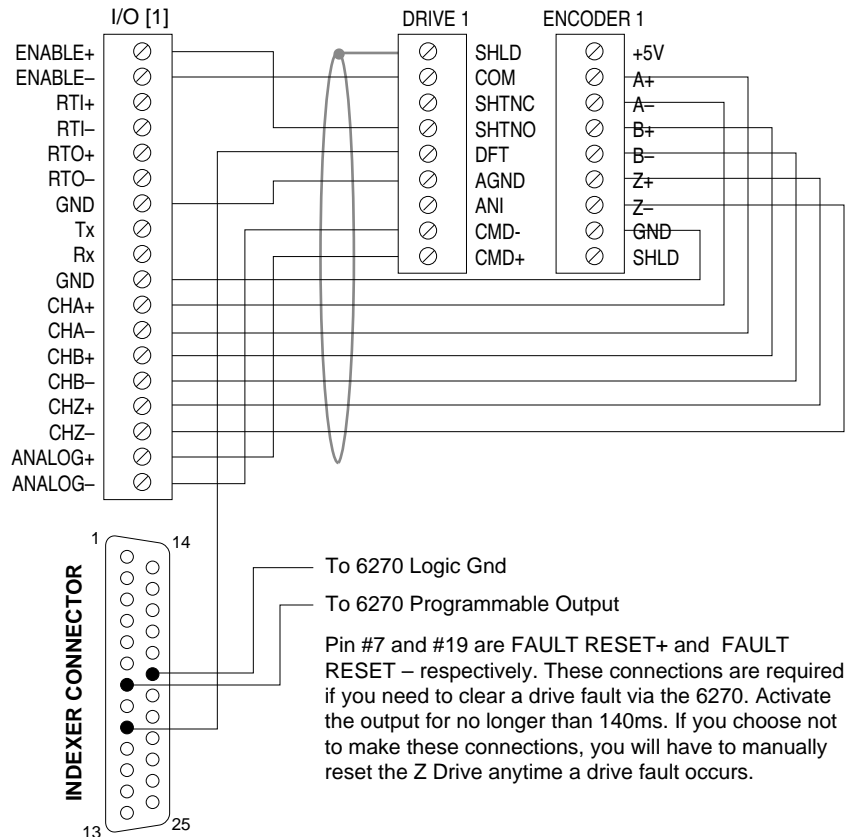
## Z Drive

## 6270

Z Drive	6270
ENABLE+	↔ SHTNO
ENABLE-	↔ COM
GND	↔ AGND
GND	↔ GND
CHA+	↔ A-
CHA-	↔ A+
CHB+	↔ B+
CHB-	↔ B-
CHZ+	↔ Z+
CHZ-	↔ Z-
ANALOG+	↔ CMD+
ANALOG-	↔ CMD-
<b>Indexer Connector</b>	
DRIVE FAULT (pin 9)	↔ DFT

**NOTE:**

Z Drive CHA+ connected to 6270's A-  
Z Drive CHA- connected to 6270's A+



To 6270 Logic Gnd

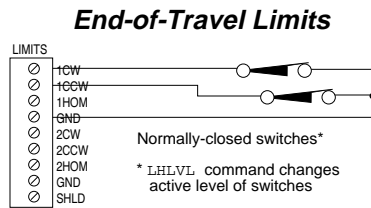
To 6270 Programmable Output

Pin #7 and #19 are FAULT RESET+ and FAULT RESET - respectively. These connections are required if you need to clear a drive fault via the 6270. Activate the output for no longer than 140ms. If you choose not to make these connections, you will have to manually reset the Z Drive anytime a drive fault occurs.

## End-of-Travel Limit Connections

The 6270 provides end-of-travel limit inputs for both axes via the LIMITS connector. End-of-travel inputs serve as safety stops that prevent the load from crashing into mechanical stops and damaging equipment or injuring personnel. The drawing below illustrates typical end-of-travel limit switch connections.

In linear applications, the position direction (CW) is assumed to correspond to extension, and the negative direction (CCW) to retraction. In rotary applications, the CW or CCW direction is determined either by the direction the motor shaft, or by the sign (+ or -) of the commanded position (e.g., the D+8000 distance command indicates a 8,000-unit move in the clockwise direction). *This convention is accurate only if you connect the drive or valve as described earlier in this chapter.*



### NOTE

Motion will not occur until you do one of the following:

- Install limit switches
- Disable the limits with the LH command
- Change the active level of the limits with the LHLVL command

*Use of hardware (and software) end-of-travel limits is discussed in detail in the End-of-Travel Limits section in Chapter 5.*

Mount normally-closed switches such that the load forces them to open before it reaches the physical travel limit (**leave enough room for the load to stop**). When the load opens the limit switch, the servo mechanism comes to a halt. The actual stopping distance depends on load's speed and the Hard Limit Deceleration (LHADA and/or LHAD) setting. The servo mechanism will not be able to move in that same direction until you clear the limit (close the switch) **and** execute a move in the opposite direction (or you can disable the limits with the LH command, but this is recommended only if the load is not attached to the servo mechanism). Use the TLIM or TAS commands to check the status of the limit switches.

### << CAUTION >>

### RUNAWAY

### << CAUTION >>

If a *runaway* occurs (servo mechanism starts moving, usually at the fastest possible velocity, due to servo instability), the 6270 will shut down the drive if the maximum position error (set with the SMPER command) is exceeded **before** an end-of-travel limit (either hardware or software) is encountered. However, if the maximum position error is **not** exceeded by the time the limit is encountered, the 6270 **may not be able to stop the servo mechanism**.

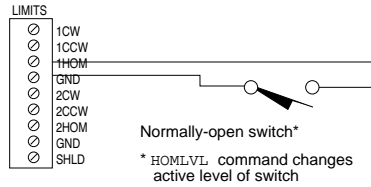
## Home Limit Connections

Use the Home input to establish a *home* position or zero position reference point. The home input (TTL compatible) is used for homing the servo mechanism. If you are using encoder feedback, the encoder's Z channel pulse can be used in conjunction with the home switch to determine the home position. To use the encoder's Z channel, the HOMZ command must be enabled.

*Homing is discussed in detail in the Homing section in Chapter 5.*

The 6270 is shipped configured for use with normally-open home switches. You can, if you wish, reverse the home input polarity (to use normally-closed switches) with the HOMLVL command. The most common way to use the *home* switch is to mount it at a *home reference position*. The drawing below illustrates typical home limit switch connections to the 6270.

## Home Limit



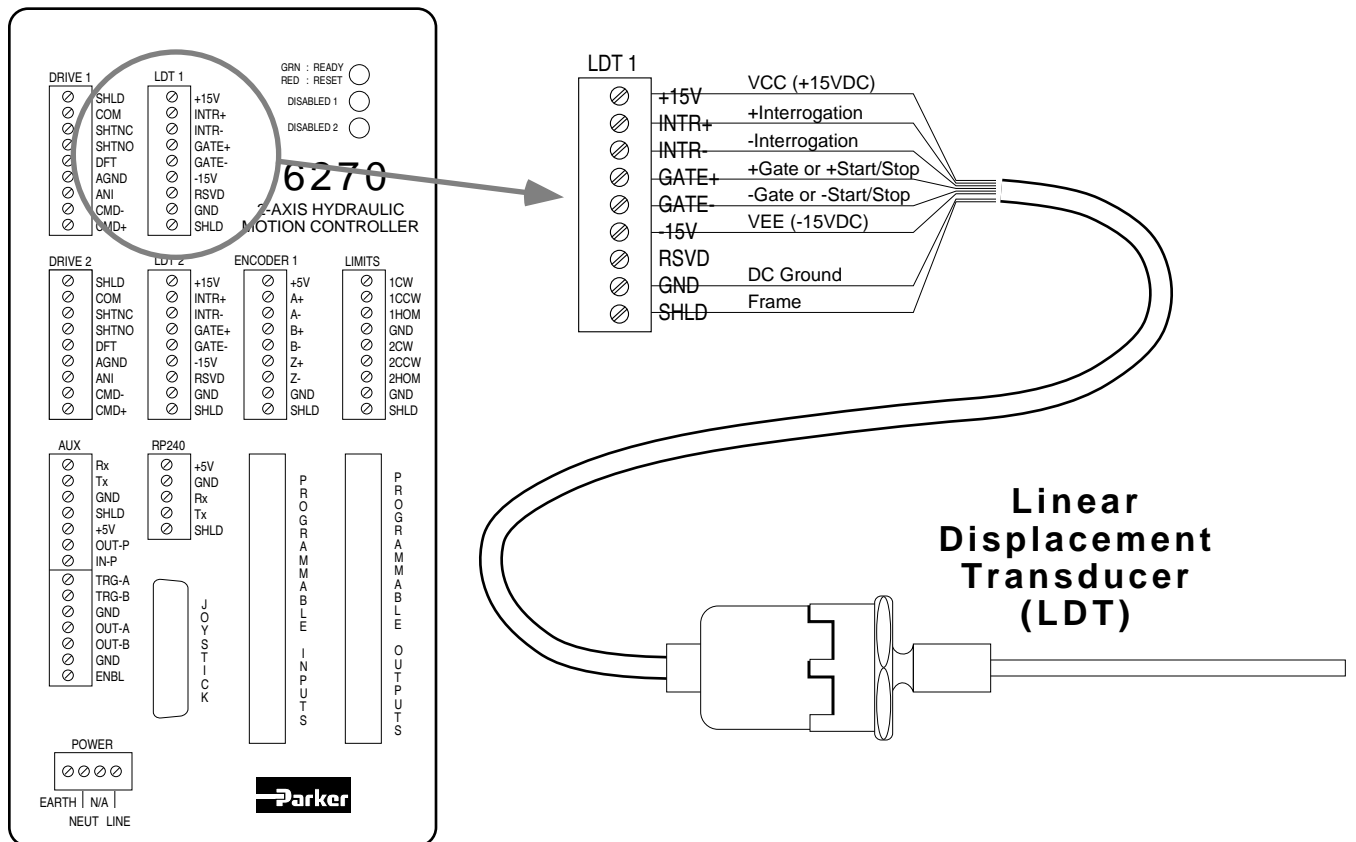
### CAUTION

Proper homing performance cannot be guaranteed when the home and end-of-travel limit inputs are tied together.

## LDT Connections

The 6270 supports pulse-feedback duration LDTs and start-stop LDTs. A jumper inside the 6270 determines which type of LDT feedback is supported (default is pulse-feedback duration LDTs). If you will be using one or more start-stop LDTs, change the jumper settings as instructed in the *Optional DIP Switch and Jumper Settings* section of Chapter 6, *Hardware Reference*.

Connect the LDT(s) to the 6270 as illustrated below.

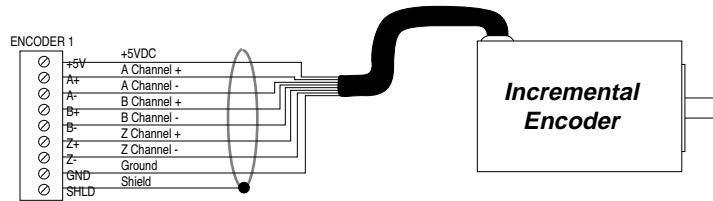


## Encoder Connections

The 6270 supports one incremental encoder **and it can be used as a feedback device only for axis 1**. The incremental encoder must meet the following requirements:

- Use an incremental encoder with two-phase quadrature output. An index or Z channel output is optional. **Differential outputs are recommended.**
- It must be a 5V encoder to use the 6270's +5V output. Otherwise, it must be separately powered, with TTL-compatible or open-collector outputs.

The illustration below shows the wiring techniques that you must use to connect an encoder to the 6270. Refer to Chapter 6 for the 6270's encoder input circuit drawing. *If you are using an encoder with a BL or Dynaserv drive, refer to the connection illustrations earlier in the Servo Drive Connections section.*



**Note for Using Single-Ended Encoders**

If you are using a single-ended encoder leave the 6270's A-, B-, and Z- terminals not connected.

Encoder Pin Outs Pin out descriptions for the ENCODER connector (9-pin phoenix) are as follows.

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

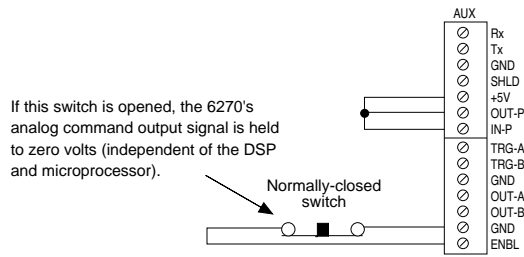
### Auxiliary +5V Output Connection

The 6270 provides +5VDC output on the AUX, ENCODER, and RP240 connectors. As much as 1.5A is available. 1.5A is sufficient power for the total load on all the I/O connectors. For example, using an encoder drawing 250mA and one RP240 drawing 100mA, 1.15A would be left for other purposes. The drawing below illustrates example connections for powering the output pull-up.

### Enable Input Connection

The ENBL (enable) input is located on the AUX connector. The 6270 is shipped with ENBL wired to GND to allow motion.

See the illustration below for an example connection using a normally-closed switch. Opening the switch changes the ±10V analog command output to zero volts and activates the shutdown outputs; this is done independent of microprocessor and DSP control, and, if error bit #9 of the ERROR command is enabled, the error program (ERRORP) will be executed. If motion is commanded while ENBL in not grounded the error message "WARNING: ENABLE INPUT INACTIVE" will be displayed.

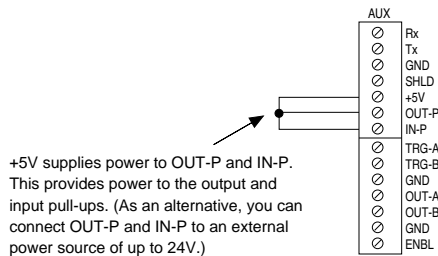


The encoder's position is retained when the ENBL input is activated. If you enable ERROR bit #9, you can check the status of the ENBL input with the TINO, INO, TER and ER commands.

## Programmable Inputs & Outputs Connections

The PROGRAMMABLE INPUTS connector provides 24 general-purpose programmable inputs and the PROGRAMMABLE OUTPUTS connector provides 24 general-purpose programmable outputs. Two additional (and functionally identical) programmable outputs, OUT-A and OUT-B, are available on the AUX connector. Two additional trigger (*position latch*) inputs are available on the AUX connector, but due to their functional differences they are discussed later in the *Triggers* section. All these inputs and outputs are optically isolated and TTL compatible.

When the 6270 is shipped from the factory, all 26 programmable outputs and the 24 general-purpose programmable inputs are pulled up to +5VDC using the pull-up (OUT-P and IN-P) terminals on the AUX connector (see illustration below). If +5VDC logic is not to be used, disconnect the pull-up terminal(s) from the +5V terminal and use an external power source of up to 24VDC. The trigger inputs (TRG-A & TRG-B) are internally tied to 5V, but can have up to 24V connected to them. *Even if you use a 24V supply, the switching thresholds remain at the TTL level ( $\leq 0.4V = Low, \geq 2.4V = High$ ).*



*Changing inputs from sourcing to sinking.*

If you wish to have the 24 general-purpose programmable inputs sink current instead of source current, you can connect IN-P to GND.

These I/O are typically used with normally-open or normally-closed switches; however, they can also be used with I/O module racks, PLCs, and thumbwheels (including the Compumotor TM8).

If you are using PLCs or thumbwheels, refer to the connection instructions and application considerations provided in the *Programmable Inputs and Outputs* section of Chapter 5.

Also provided in the *Programmable Inputs and Outputs* section are instructions for defining and controlling programmable inputs and outputs via programs written with the 6000 Series programming language.

## Programmable I/O Pin Outs

The following table lists the pin outs on the two 50-pin flat cable headers labeled **PROGRAMMABLE INPUTS** and **PROGRAMMABLE OUTPUTS**. Refer to Chapter 6, *Hardware Reference*, for internal I/O schematics.

PROGRAMMABLE INPUTS Connector				PROGRAMMABLE OUTPUTS Connector			
Pin #	Function	Pin #	Function	Pin #	Function	Pin #	Function
49	+5 VDC	23	Input #13	49	+5 VDC	23	Output #13
47	Input #1 (LSB)	21	Input #14	47	Output #1 (LSB)	21	Output #14
45	Input #2	19	Input #15	45	Output #2	19	Output #15
43	Input #3	17	Input #16	43	Output #3	17	Output #16
41	Input #4	15	Input #17	41	Output #4	15	Output #17
39	Input #5	13	Input #18	39	Output #5	13	Output #18
37	Input #6	11	Input #19	37	Output #6	11	Output #19
35	Input #7	09	Input #20	35	Output #7	09	Output #20
33	Input #8	07	Input #21	33	Output #8	07	Output #21
31	Input #9	05	Input #22	31	Output #9	05	Output #22
29	Input #10	03	Input #23	29	Output #10	03	Output #23
27	Input #11	01	Input #24 (MSB)	27	Output #11	01	Output #24 (MSB)
25	Input #12			25	Output #12		

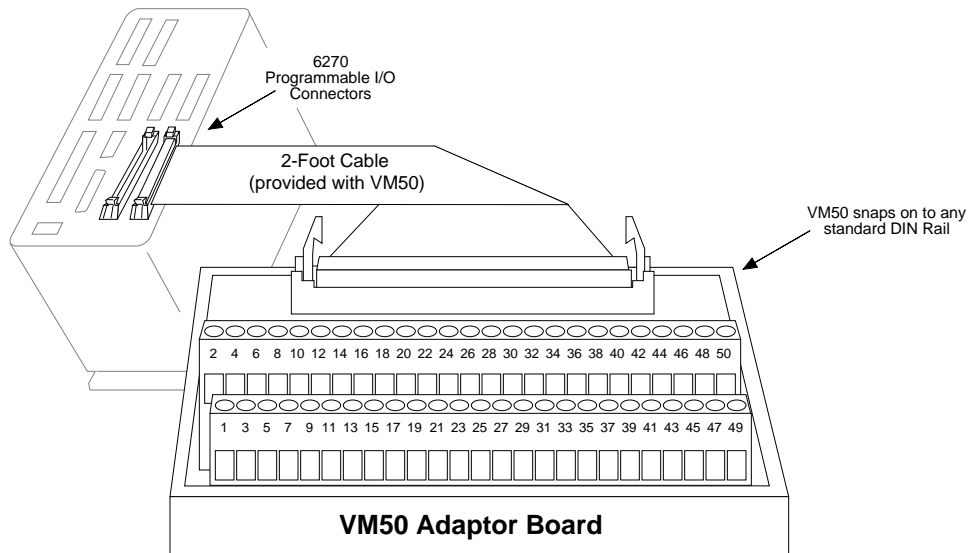
**NOTE:** All even-numbered pins are connected to logic ground (DC ground).

## Optional VM50 Adaptor

If you wish to use screw terminal connections for the 24 programmable I/O, Parker Compumotor offers the VM50 adaptor (p/n VM50). If you wish to use screw terminal connections for both the 24 inputs **and** the 24 outputs, you will need two VM50 adaptors.

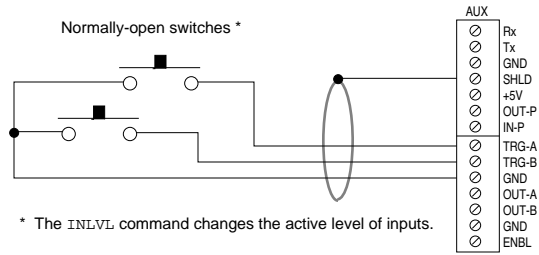
The pin numbers on the VM50's screw terminals correspond to the same pin outs on the **PROGRAMMABLE INPUTS** and **PROGRAMMABLE OUTPUTS** connectors. The VM50 simply attaches to the 6270 via the 2-foot, 50-pin ribbon cable that comes with the VM50 (see drawing below).

To order the VM50, contact your distributor or ATC.



## Trigger Input Connections

The 6270 provides two trigger (*position latch*) inputs. Like the programmable inputs described earlier, trigger inputs can be connected to PLC outputs, discrete switches, or electronic sensors, and are monitored under program control. The status of triggers A and B is represented respectively by bits 25 and 26 in the IN, INFNC, INLVL, ONIN, and TIN commands.



### Programming Tip:

Using the WAIT command, the 6270 can be programmed to wait until one or more trigger inputs switch to a desired state before executing the next command.

## Position Latch Feature

The trigger inputs function identically to the regular 24 programmable inputs, except when they are programmed with the Trigger Interrupt Function (INFNCi-H) command to function as position latch inputs.

When configured as position latch inputs, the input enable/disable (INEN) command has no effect on the trigger inputs. The position latch feature is discussed in the *Programmable Inputs and Outputs* section in Chapter 5.

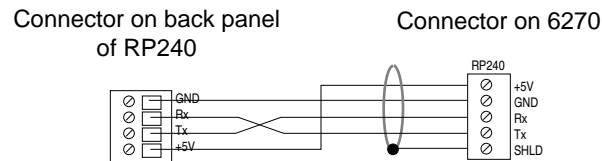
## RP240 Remote Operator Panel Connections (RP240 is optional)

Refer to the RP240 Remote Operator Panel Interface section in Chapter 5 for additional user information.

Using a four-wire shielded cable, connect the RP240 to the 6270's RP240 connector (see below). For cable lengths up to 50 feet, use 20 AWG wire (*cable lengths longer than 50 feet are not recommended*). Refer to the **RP240 User Guide** for mounting instructions.

### NOTE

For the 6270 to recognize the RP240, the RP240 connection must be made prior to powering up (or resetting) the 6270. If you **connect the RP240 to the 6270 before powering up the 6270**, the 6270 will recognize the RP240 and send the \*RP240 CONNECTED message to the RS-232C terminal. If the 6270 does not detect a RP240 upon power up or reset, then the following message will be sent to the RS-232C terminal: \*NO REMOTE PANEL.



HINT: If you are not using an RP240, you can send text strings to another RS-232C device (using the DWRITE command).

## Joystick and Analog Input Connections

You can use the three analog inputs on the JOYSTICK connector for 2-axis joystick control of the axes, and/or as a low-resolution analog input (8-bit A/D, 1mV/bit) for process control.

The Daedal JS6000 joystick is compatible with the 6270. To order the JS6000, contact Daedal at (800) 245-6903 or contact your local distributor.

Refer to Chapter 5 for a detailed discussion of joystick control.

The input range of the analog input is 0V to 2.5V. A joystick with a linear taper 5KΩ potentiometer (pot) with 60° of travel is recommended (*the pot has 300° of travel, but typically only 60° is usable with a joystick*). The pot should be adjusted so that its resistance is close to 0Ω when the joystick is all the way to one side, and about 1KΩ when the joystick is all the way to the other side. Also, connect a 1KΩ resistor between the analog input and +5V.

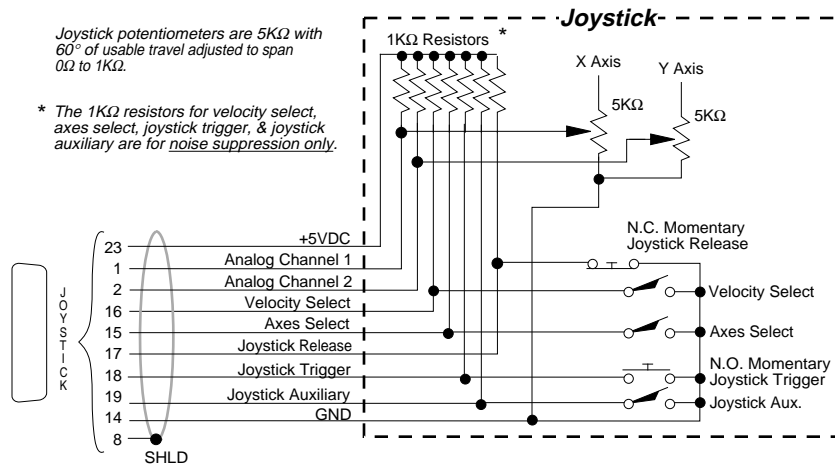
## Joystick Connector Pin Outs

The JOYSTICK connector is a 25-pin D connector. The pin-out descriptions are provided in the table below. The 6270's internal analog input circuit diagram is provided in Chapter 6, *Hardware Reference*.

Pin	In/Out	Name	Description
1	IN	Analog Channel 1	8-bit analog input for joystick control of axis (can override with the <code>ANVOEN</code> and <code>ANVO</code> commands)
2	IN	Analog Channel 2	8-bit analog input for joystick control of axis (can override with the <code>ANVOEN</code> and <code>ANVO</code> commands)
3	IN	Analog Channel 3	8-bit analog input for joystick control of axis (can override with the <code>ANVOEN</code> and <code>ANVO</code> commands)
4	—	Unused	-----
8	—	Shield	Shield
14	—	Ground	Ground
15	IN	Axes Select	If only using one analog input, 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 <code>JOYVH</code> or <code>JOYVL</code> command)
17	IN	Joystick Release	Input to release the 6270 from joystick mode ( <code>JOY</code> ). Same as issuing the <code>!JOYØØ</code> command. Program execution will continue with the first statement after the joystick enable ( <code>JOY1</code> ) command.
18	IN	Joystick Trigger	Status of this active-low input can be read by a program (using the <code>INO</code> or <code>TINO</code> 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 <code>INO</code> or <code>TINO</code> commands) to control program flow, or to teach positions to a program.
23	OUT	+5VDC (out)	+5VDC power output

## Analog Inputs

You can use the analog inputs for joystick control of the axes. An analog input can command an axis velocity from full CW to full CCW. The following drawing illustrates a typical joystick connection example.



**Axes Select Input** You can define two configurations (`JOYAXH` and `JOYAXL`) that define which axes are controlled by which channels. The axes select input allows you to select the current configuration. An axes select input *high* references the `JOYAXH` command. An axes select input *low* references the `JOYAXL` command.

One possible configuration is as follows: With axes select input high, analog channel #1 controls axis one and analog channel #2 controls axis two (`JOYAXH1, 2`). With axes select input low, analog channel #3 controls both axes (`JOYAXL3, 3`).

**Velocity Select Input** This input may be used to select either the high (high level-on input) or low (low level-on input) velocity range as defined with the `JOYVH` and `JOYVL` commands, respectively. The high range could be used to quickly move to a location while the low range could be used for accurate positioning. Refer to the illustration above. *When this input is not connected, the low velocity range is selected.*

**Joystick Release Input** The joystick release input allows you to indicate to the 6270 that you have finished using the joystick and program execution may continue with the next statement. When a program enables joystick control of motion, program execution will stop and then resume when the user is finished with joystick mode (assuming the Continuous Command Execution Mode is disabled with the `COMEXCØ` command).

The joystick release input has an internal pull-up resistor to +5V. When the joystick release input is not grounded, joystick enable statements (JOY1) will be disabled upon execution. To enable the joystick mode, the joystick release input must be inactive (connected to ground). Refer to the illustration above.

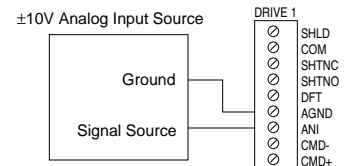
**Joystick Trigger Input** The status of this input can be read by a program and may be used to control program flow (see INO and TINO command). Refer to the illustration above.

**Joystick Auxiliary Input** The status of this input can be read by a program and may be used to control program flow (see INO and TINO command). Refer to the illustration above.

## ANI Analog Input Connections (6270-ANI Option Only)

 Application considerations are discussed in Chapter 5.

The 6270-ANI option offers two  $\pm 10V$ , 14-bit analog inputs (one ANI terminal found on each of the DRIVE connectors). These inputs are sampled at the servo sample rate (set with the SSFR command). The ANI input values are reported with the TANI and ANI commands (voltage) and the TPANI and PANI commands (position).



### Polarity Reversal

If the ANI analog input counts in the wrong direction (opposite from the commanded direction), instead of reversing the mounting of the ANI input you can use the ANIPOL command to reverse the polarity. For example, if the ANI input on axis 2 only is reversed, issue the ANIPOLx1 command (or if the ANI on axis 1 only is reversed, use ANIPOL1x).

## Extending 6270 System Cables

This section describes options for extending 6270 system LDT/encoder and I/O cables.

**Encoder/LDT-to-6270 Cables**

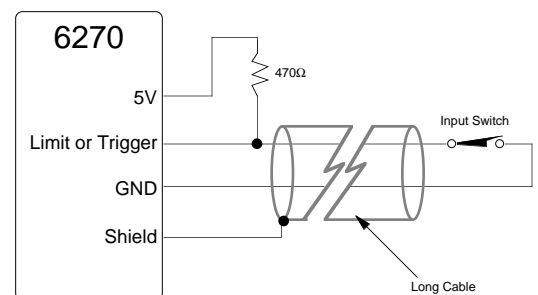
The maximum cable length between the LDTs or encoder and the 6270 is 100 feet. If you wish to lengthen these cables yourself, use 24 AWG wire. Be sure to shield the cable with the shield connected only to SHLD (pin 1 on the ENCODER connector or LDT connector).

**I/O Cables**

To avoid interference from external noise, shield all I/O cables, regardless of the length. The maximum length of cables is determined by the environment in which the equipment will be used. For cables longer than 50 feet or in electrically noisy environments, you should follow the guidelines below.

- Use a minimum wire size of 22 AWG wire.
- Use twisted pair shielded cables and connect the shield to the SHLD terminal on the 6270 connector. Leave the other end of the shield disconnected.
- Do not route these signals in the same conduit or wiring trays as high-voltage AC.

Limit and trigger inputs are internally pulled up to +5VDC and are TTL compatible. In electrically noisy environments or when using long cable lengths, use an external pull-up resistor with a value of 330 $\Omega$  to 2.2K $\Omega$  between the input and +5V. The external resistor lowers the input impedance makes the input less susceptible to electrical noise.



### ③ Installation Verification

#### WARNING

This installation verification section is intended to be executed with the drives (or valves) not connected to the 6270. **Do not proceed until you are sure they are not connected.**

- Step 1* Return to the *Test Procedure* in Chapter 2 to test the power interface and the RS-232C interface.
- Step 2* Use the information in the following table to test the features appropriate to your application. If you receive responses other than those expected, check your system wiring and refer to the command descriptions in the **6000 Series Software Reference Guide** for assistance.

#### NOTE

The following table is based on the assumption that you have **not** changed the active levels of the 6270's inputs and outputs. Verify these settings with the following *status* commands:

Command Entered	Response Should Be
INLVL	*INLVL0000_0000_0000_0000_0000_0000_00
HOMLVL	*HOMLVL00
LHLVL	*LHLVL0000
OUTLVL	*OUTLVL0000_0000_0000_0000_0000_0000_00

Connections	Test Procedure	Response Format (left to right)
Hardware End-of-travel and Home limits	<p><b>NOTE:</b> If you are not using hardware end-of-travel limits, issue the Disable Limits (LH0,0) command and ignore the first two bits in each response field.</p> <ol style="list-style-type: none"> <li>1. Enable hard limits using the LH3,3</li> <li>2. Close the end-of-travel switches and open the home switches.</li> <li>3. Enter the TLIM command. The response should be *TLIM110_110.</li> <li>4. Open the end-of-travel switches and close the home switches.</li> <li>5. Enter the TLIM command. The response should be *TLIM001_001.</li> <li>6. Close the CW end-of-travel switch on axis 1 and open the home switch on axis 2.</li> <li>7. Enter the TLIM command. The response should be *TLIM101_000.</li> </ol>	<p>TLIM response:</p> <p>bit 1 = axis 1 CW limit  bit 2 = axis 1 CCW limit  bit 3 = axis 1 home limit  bit 4 = axis 2 CW limit  bit 5 = axis 2 CCW limit  bit 6 = axis 2 home limit</p>
Analog Output Signal	<ol style="list-style-type: none"> <li>1. If the servo devices are connected to the 6270's DRIVE connectors, disconnect them now.</li> <li>2. Set all the gains to zero by entering the following: SGP0,0, SGI0,0, SGV0,0, SGAF0,0, SGVF0,0</li> <li>3. Enable the 6270 to send out the analog command by entering the DRIVE11 command.</li> <li>4. Set the DAC output limit to 10 volts by entering the DACLIM10,10 command.</li> <li>5. Drive the analog output to the maximum positive range by entering the SOFFS10,10 command.</li> <li>6. Enter the TDAC command to check the analog output value. The response should be *TDAC+10,+10.</li> <li>7. Using a Digital Volt Meter (DVM), measure the actual analog output voltage between the CMD+ (analog command) and CMD- (analog command return) terminals. Compare the DVM reading to the entry for the SOFFS command (see step 5). If the reading deviates more than 0.1V from +10V, then there is either a problem with the system's grounding connection or the 6270's DAC is not functioning properly.</li> <li>8. Repeat steps 5 through 7, using these servo output offset values:  SOFFS-10,-10  SOFFS0,0  SOFFS5,5  SOFFS5,5</li> </ol>	<p>TDAC response (output voltage):  ±axis 1, ±axis 2</p> <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <p><i>Current/Voltage Conversion</i></p> <p>If you have configured the 6270's jumpers for current control, convert the voltage readings to current values and use an ammeter to measure current (mA range ÷ 10 volts = mA/volt). For example, if using ±20mA output, the conversion is 2mA/volt.</p> </div>

## Installation Verification (continued)

LDT Feedback	<ol style="list-style-type: none"> <li>Using an LDT, with a free magnet, place the magnet within the usable portion of the LDT.</li> <li>Enter the <code>TLDT</code> command to determine the position of the LDTs. The response should not be zero; if it is, check for proper connections and placement of the magnet within the usable portion of the LDT.</li> <li>When a valid reading is obtained, enter these commands: <code>L&lt;cr&gt;</code>, <code>TLDT&lt;cr&gt;</code>, <code>T.3&lt;cr&gt;</code>, and then <code>LN&lt;cr&gt;</code>. This will begin a continuous display of the LDT's position. Press the <code>&lt;return&gt;</code> key to move the display to the next line and save the current value.</li> <li>Move the magnet along the LDT and verify that the position changes as the magnet is moved. If you connected the LDT(s) as instructed earlier in this chapter, moving the magnet in the extension direction should increase the position reading. <i>This can also serve as a test to find the usable region of the LDT.</i></li> <li>When finished, enter the <code>^K</code> (ctrl-K) command to stop the continuous report-back.</li> </ol>	TLDT response (LDT counts): $\pm$ LDT 1, $\pm$ LDT 2
Encoder Feedback (Rotary Incremental Encoder)	<ol style="list-style-type: none"> <li>Enter these commands: <code>L&lt;cr&gt;</code>, <code>TPE&lt;cr&gt;</code>, <code>T.3&lt;cr&gt;</code>, and then <code>LN&lt;cr&gt;</code>. This will begin a continuous display of the encoder's position. Press the <code>&lt;return&gt;</code> key to move the display to the next line and save the current value.</li> <li>Manually rotate the encoder shaft and verify that the position changes as you rotate the encoder shaft. If you connected the encoder as instructed earlier in this chapter, moving the shaft clockwise should increase the position reading. If the reading does not change, or if the direction is reversed, check the connections. If the direction is reversed, swap the A+ and A- connections.</li> <li>When finished, enter the <code>^K</code> (ctrl-K) command to stop the continuous report-back.</li> </ol>	TPE response (encoder counts): $\pm$ encoder 1
ANI Analog Input Feedback <b>(6270-ANI option only)</b>	<ol style="list-style-type: none"> <li>Enter these commands: <code>L&lt;cr&gt;</code>, <code>TANI&lt;cr&gt;</code>, <code>T.3&lt;cr&gt;</code>, and then <code>LN&lt;cr&gt;</code>. This will begin a continuous display of the voltage level at the ANI inputs (pin 3 on the <b>DRIVE</b> connectors). Press the <code>&lt;return&gt;</code> key to move the display to the next line and save the current value.</li> <li>Change the voltage output from your voltage source and verify that the <code>TANI</code> report changes accordingly. If the reading does not change, check the connections.</li> <li>When finished, enter the <code>^K</code> (ctrl-K) command to stop the continuous report-back.</li> </ol>	TANI response (volts): $\pm$ ANI input #1, $\pm$ ANI input #2  <div style="border: 1px solid black; padding: 5px; text-align: center;"> <b>NOTE</b>              ANI feedback is measured in volts           </div>
Programmable Inputs (incl. triggers)	<ol style="list-style-type: none"> <li>Open the input switches or turn off the device driving the inputs.</li> <li>Enter the <code>TIN</code> command. The response should be <code>*TIN0000_0000_0000_0000_0000_0000_00</code>.</li> <li>Close the input switches or turn on the device driving the inputs.</li> <li>Enter the <code>TIN</code> command. The response should be <code>*TIN1111_1111_1111_1111_1111_1111_11</code>.</li> </ol>	TIN response: bits 1-24 = prog. inputs 1 - 24 bits 25 & 26 = TRG-A & TRG-B
Programmable Outputs	<ol style="list-style-type: none"> <li><b>CAUTION:</b> Disconnect all programmable outputs before proceeding to step 2.</li> <li>Enter the <code>OUTALL1, 26, 1</code> command to turn on (sink current on) all outputs.</li> <li>Enter the <code>TOUT</code> command. The response should be <code>*TOUT1111_1111_1111_1111_1111_1111_11</code>.</li> <li>Enter the <code>OUTALL1, 26, 0</code> command to turn off all outputs.</li> <li>Enter the <code>TOUT</code> command. The response should be <code>*TOUT0000_0000_0000_0000_0000_0000_00</code>.</li> </ol>	TOUT response: bits 1-24 = prog. outputs 1 - 24 bits 25 & 26 = OUT-A & OUT-B
RP240	<ol style="list-style-type: none"> <li>Cycle power to the 6270.</li> <li>If the RP240 is connected properly, the RP240's status LED should be green and one of the messages on the computer or terminal display should read <code>*RP240 CONNECTED</code>.  If the RP240's status LED is off, check to make sure the +5V connection is secure.  If the RP240's status LED is green, but the message on the terminal reads <code>*NO REMOTE PANEL</code>, the RP240 Rx and Tx lines are probably switched. Remove power and correct.</li> <li>Assuming you have not written a program to manipulate the RP240 display, the RP240 screen should display the following: <div style="border: 1px solid black; padding: 5px; text-align: center; margin: 10px 0;">             6270 MOTION CONTROLLER              RUN JOG STATUS DRIVE DISPLAY ETC           </div></li> </ol>	
Enable and Joystick inputs	<ol style="list-style-type: none"> <li>Open the enable input (<b>ENBL</b>) switch, and open the joystick input switches or turn off the device driving the joystick inputs.</li> <li>Enter the <code>TINO</code> command. The response should be <code>*TINO0000_0100</code>.</li> <li>Close the input switches or turn on the device driving the inputs.</li> <li>Enter the <code>TINO</code> command. The response should be <code>*TINO1111_1100</code>.</li> </ol>	TINO response: bit 1 = joystick auxiliary bit 2 = joystick trigger bit 3 = joystick axes select bit 4 = joystick velocity select bit 5 = joystick release bit 6 = Enable input bits 7 & 8 are not used

## ④ What's Next?

At this point you should have successfully completed this chapter's mounting, connection, and test procedures for your 6270 system. If you intend to use thumbwheels, PLCs or other I/O devices, or if you intend to daisy-chain multiple 6270s, refer to the connection instructions and application considerations in Chapter 5.

The following steps are recommended to prepare you for applying the 6270 in your application.

### Step 1 Attach the Load

Attach the load to the cylinder or motor, and attach the feedback device as appropriate to your application.

### Step 2 Perform the Basic System Configuration

#### NOTE

The set-up commands referred to in this step are not saved in the 6270's battery-backed RAM. Therefore, you may want to add them to the startup (STARTP) program. For information on defining the startup program, refer to the *Programming Guide* section in the **6000 Series Software Reference Guide**.

Startup Program Example:	Command	Description
>	DEF PWRUP	Begin definition of PWRUP program
-	INDAX2	Place both axes in use
-	DRFLVL11	Set drive fault level to active high
-	KDRIVE11	Enable the DISABLE ON KILL feature for both axes
-	DRIVEØØ	Disable both valves/drives
-	SFB3, 3	Select LDT feedback for both axes (subsequent scaling, gains, servo offset, PSET, and SMPER parameters are specific to LDT feedback)
-	LDTGRD9, 9	Set LDT gradient to 9µs/inch for both LDTs
-	LDTRES432, 432	Set LDT resolution to 432 counts/inch
-	LDTUPD1, 1	Set LDT position update rate equal to the system update rate (see table in SSFR command description)
-	SCLA432, 432	Set scaling for programming accel/decel in inches/sec <sup>2</sup>
-	SCLV432, 432	Set scaling for programming velocity in inches/sec
-	SCLD432, 432	Set scaling for programming distances in inches
-	SGP5Ø, 5Ø	Set proportional feedback gain
-	SGI. 2, .2	Set integral feedback gain
-	SGV3Ø, 3Ø	Set velocity feedback gain
-	PSET1Ø, 1Ø	Set current position as absolute position 10
-	SFB1	Select encoder feedback for axis 1 (subsequent scaling, gains, servo offset, PSET, and SMPER parameters are specific to encoder feedback)
-	ERES4ØØØ	Set encoder resolution to 4,000 counts/rev
-	SCLA4ØØØ	Set scaling for programming accel/decel in revs/sec <sup>2</sup>
-	SCLV4ØØØ	Set scaling for programming velocity in revs/sec
-	SCLD4ØØØ	Set scaling for programming distances in revs
-	SGP. 5	Set proportional feedback gain
-	SGI1	Set integral feedback gain
-	SGV1	Set velocity feedback gain
-	PSETØ	Set current position as absolute position zero
-	SFB2, 2	Select ANI feedback for both axes (subsequent scaling, gains, servo offset, PSET, and SMPER parameters are specific to ANI feedback)
-	SCLA819, 819	Set scaling for programming accel/decel in volts/sec <sup>2</sup>
-	SCLV819, 819	Set scaling for programming velocity in volts/sec
-	SCLD819, 819	Set scaling for programming distances in volts
-	SGP1, 1	Set proportional feedback gain
-	SGIØ, Ø	Set integral feedback gain
-	SGV. 5, .5	Set velocity feedback gain
-	PSET5, 5	Set current position as absolute position 5
-	SFB3, 3	Select LDT feedback
-	END	End definition of PWRUP program
>	STARTP PWRUP	Assign PWRUP as the startup program

### Analog Output — Voltage or Current Operation:

If will not be using  $\pm 10V$  output to the drive/valve, you may select a current range by configuring the internal jumpers (options are  $\pm 20mA$ ,  $\pm 50mA$ ,  $\pm 60mA$ ,  $\pm 80mA$ ,  $\pm 100mA$ , or  $\pm 150mA$ ). Instructions for setting the jumpers are provided in the *Optional DIP switch and Jumper Settings* section at the end of Chapter 6.

### DAC Output Limits (DACLIM and DACMIN):

If will not be using the entire  $-10V$  to  $+10V$  range of the 6270's analog output, you can set up maximum and minimum limits.

For example, if are using a 4-20mA control loop, set the analog output jumpers to operate at  $\pm 20mA$  (instructions provided in Chapter 6). Then issue these setup commands listed below. (Note that when using  $\pm 20mA$  output, you need to use the 2mA/volt equation to ascertain the proper voltage value to enter in the DACLIM, DACMIN, and SOFFS commands).

Command	Description
> DACLIM1Ø	Set DAC maximum limit to +20mA ( $20mA \div 2mA/V = 10V$ )
> DACMIN2	Set DAC minimum limit to +4mA ( $4mA \div 2mA/V = 2V$ )
> SOFFS6	Set offset analog output to the mid-range value of +12mA ( $12mA \div 2mA/V = 6V$ )

### Number of Axes (INDAX):

By configuring the number of axes in use, you limit the number of axes you can control. This may be desired if you are only using one of the two axes available. The INDAX command configures the number of axes, and affects the servo sampling rate (see SSFR command description). INDAX2 (the default setting) enables both command fields to be entered (e.g., A1, 1). If you enter INDAX1, instead of entering A1, 1 you should enter A1, and all responses from the 6270 will also only show the one field; if you enter the command A, the response will be \*A1.

### Drive Fault Level (DRFLVL) – for Drives only:

The drive fault level (DRFLVL) should be set to active high or active low for each axis (default is active low—DRFLVLØ). The DRFLVL command description provides recommended settings for known drives. When using a drive without a drive fault output, set the drive fault level to active low.

#### NOTE

Once the drive fault level has been configured, you must enable the drive fault input with the INFEN1 command before the input is usable.

### Feedback Device Selection (SFB):

Use the SFB command to select the feedback devices to be used by each axis. The syntax for the SFB command is SFB<i>, <i>, where <i> could be 1 (encoder), 2 (ANI input—6270-ANI option only), or 3 (LDT). The default setting is SFB3, 3, which selects LDT feedback for both axes. **NOTE:** Encoder feedback can be used only on axis 1. For example, if you wish to use encoder feedback on axis 1 and LDT feedback on axis 2, you would issue the SFB1, 3 command.

#### NOTE

Parameters for scaling (SCLA, SCLD, etc.), tuning gains (SGP, SGV, etc.), servo offset (SOFFS and SOFFSN), maximum position error (SMPER), and position offset (PSET) are specific to the currently selected feedback device.

If your application requires switching between feedback sources on the same axis, then for each feedback source, you must issue the appropriate SFB command and enter the scaling, gains, servo offset, SMPER, and PSET values specific to operating with that feedback source. (Refer to the startup program example above.)

## Feedback Device Set Up:

### LDT Set Up

#### LDT Gradient (LDTGRD):

The *LDTGRD* value may be changed only when the drive is disabled with the *DRIVE* command.

The *gradient* is a measure of how quickly the LDT can respond to feedback requests. It is unique to each LDT and should be printed on the unit. The 6270's default gradient setting is 9.0000  $\mu\text{s}/\text{inch}$ . The gradient is used to correct for positional differences created by different LDTs; this allows programs to be easily transported between 6270s or used with a new LDT. The LDT value is entered with the *LDTGRD* command. The 6270 uses this value to scale LDT positions so that it always provides 432 counts/inch (or a multiple of 432 if using recirculation, or 17 counts/mm).

#### LDT Resolution (LDTRES):

The *LDT resolution* is determined by the crystal frequency of the 6270 counters and the number of recirculations of the LDT. (A *recirculation* is a single request for position information from the LDT. Multiple recirculations provide greater resolution by increasing the length of the feedback pulse.) The 6270 counter frequency of 48 MHz provides a resolution of 432 counts/inch (assuming you use the LDT gradient default setting of 9  $\mu\text{s}/\text{inch}$ ). This number is multiplied by the number of recirculations. For example, if you are using LDTs with 4 recirculations, you should set the resolution of each LDT to 1728 ( $4 * 432 = 1728$ ) with the *LDTRES1728,1728* command.

#### LDT Position Update Rate (LDTUPD):

The *LDTUPD* command value is multiplied by the *system update rate* to determine the LDT position update rate. The system update rate is affected by the *INDAX* and *SSFR* command settings.

As the *LDTUPD* command value is decreased (update rate is increased), the quality of the dynamic response improves. However, if the update rate is too fast, the LDT will not have enough time to read the position and LDT read errors will occur. If a read error occurs, axis status bit #27 (reported with the *TAS* and *AS* commands) will be set. In addition, if *ERROR* bit #15 is enabled (*ERROR.15-1*), error status bit #15 (reported with the *TER* and *ER* commands) will also be set.

Formula to determine minimum allowable *LDTUPD* update rate:

$$((\text{max. length of travel in inches} * \text{LDT gradient}) * \# \text{ of recirculations}) + 140\mu\text{s}$$

### Encoder Set Up (does not apply to LDT or ANI input)

#### Encoder Resolution:

The *encoder resolution* is determined by the resolution of the encoder used with the servo drive/motor system. The encoder resolution is essentially the number of steps, or *counts* (post quadrature), per unit of travel. For example, Compumotor E Series encoders are 1,000-line encoders, and therefore have a 4,000 count/rev post-quadrature resolution.

If the encoder is mounted directly to the motor, then to ensure that the motor will move according to the programmed distance and velocity, the 6270's resolution must match the encoder's resolution. Use the *ERES* command to set the 6270's resolution (default setting is 4,000 counts/rev, selectable range is 200 to 1,024,000).

### **Kill's Effect on the Drive or Valve (KDRIVE):**

Normally, when you issue a Kill command (K, !K, or <ctrl>K) or activate a general-purpose input configured as a kill input (see `INFNCi-C` command), motion is stopped at the hard limit (LHAD/LHADA) deceleration setting and the valve or drive is left in the enabled state (DRIVE11).

However, your application may require you to *disable* (shut down or de-energize) the valve or drive in a Kill situation to, for example, prevent damage to mechanical components. If so, set the 6270 to the *Disable Drive on Kill* mode with the `KDRIVE11` command. In this mode, a kill command or kill input will shut down the valve or drive immediately. In valve/cylinder systems, the valve will then return to the null position. In drive/motor systems, the motor will *free wheel* (without control from the drive) to a stop. When the valve or drive is disabled (DRIVE00), the SHTNC relay output is connected to COM and the SHTNO relay output is disconnected from COM. To re-enable the valve or drive, issue the `DRIVE11` command.

#### *Step 3* **Determine Your Application's Motion Control Requirements**

Applications can vary greatly from one to another. Consequently, the 6270 is equipped with many motion control features to satisfy a wide variety of application requirements—but *not all features are appropriate for every application*. Therefore, you must first determine the necessary motion features you need for your application. Once you have done that, you can proceed to tune the 6270 and then implement the necessary motion control features in your application.

#### *Step 4* **Tune the Servo System**

To effectively tune the 6270 (and any velocity drives you may be using), use the interactive tuning features in the *Servo Tuner™* add-on module for *Motion Architect®*. It greatly improves your efficiency and gives you powerful graphical tools to measure the performance of the system. Instructions for using Servo Tuner to tune the 6270 are provided in the ***Servo Tuner User Guide***.

#### **NOTE**

The Servo Tuner option is an add-on module and does not automatically come with the basic Motion Architect software package. To order your copy of Servo Tuner, which is provided on a separate disk, contact your local Automation Technology Center.

If are not using Servo Tuner, refer to the empirical-type tuning procedures provided in Chapter 4.

#### *Step 5* **Implement the Necessary 6270 Features**

Chapter 5 describes how to implement the 6270's features in your application. (If you are using Following, refer to the ***6000 Series Following User Guide***.)

You will develop your application by creating and refining motion programs using the 6000 Series Command Language. We recommend you use Motion Architect® or the 6000 DOS Support Disk to aide in your programming efforts. Motion Architect and the 6000 DOS Support Disk are discussed briefly in Chapter 5, but for detailed user information refer to the ***Motion Architect User Guide*** or the ***6000 DOS Support Disk Quick Reference***.