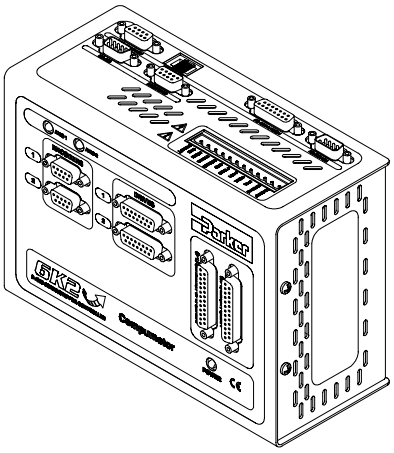
Automation

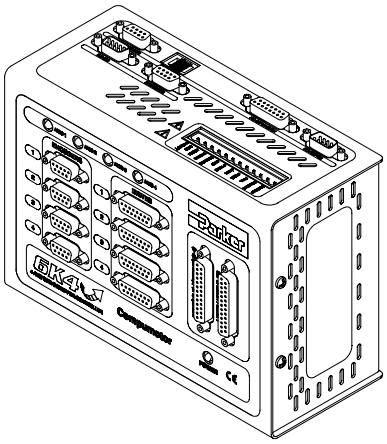
p/n 88-017547-01 A

6K Series Hardware Installation Guide

Effective: November 9, 1998



6K2 (2-axis Controller)



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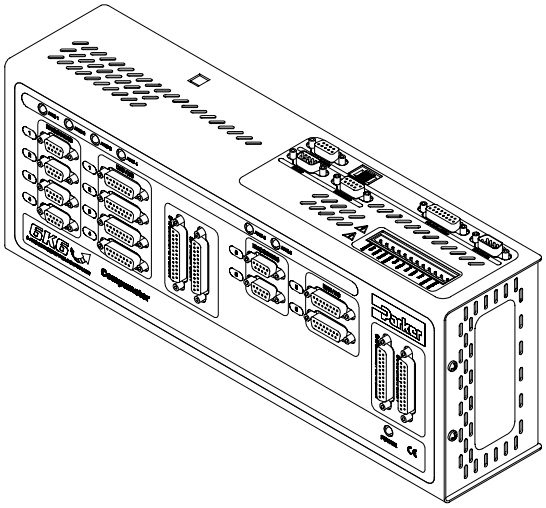
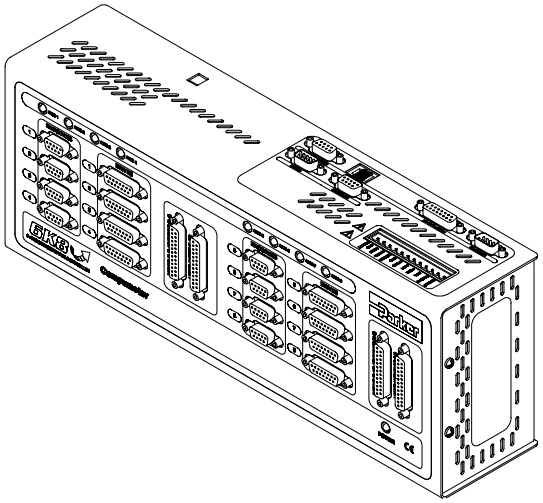


6K6 (6-axis Controller)



6K8 (8-axis Controller)

IMPORTANT

User Information

WARNING

6K Series products are used to control electrical and mechanical components of motion control systems. You should test your motion system for safety under all potential conditions. Failure to do so can result in damage to equipment and/or serious injury to personnel.

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ABOUT THIS GUIDE

Purpose of This Guide

This document is designed to help you install and troubleshoot your 6K Series controller. Programming related issues are covered in the *6K Series Programmer's Guide* and the *6K Series Command Reference*.

What You Should Know

To install and troubleshoot the 6K Series controller, you should have a fundamental understanding of:

- Electronics concepts, such as voltage, current, switches.
- Mechanical motion control concepts, such as inertia, torque, velocity, distance, force.
- Ethernet or serial (RS-232 or RS-485) communication, depending on which communication protocol you are using.

Related Publications

- *6K Series Command Reference*, Parker Hannifin Corporation, Compumotor Division; part number 88-017136-01
- *6K Series Programmer's Guide*, Parker Hannifin Corporation, Compumotor Division; part number 88-017137-01
- Current Parker Compumotor catalog
- Schram, Peter (editor). *The National Electric Code Handbook (Third Edition).* Quincy, MA: National Fire Protection Association

Online Manuals This manual (in Acrobat PDF format) is available from our web site: `http://www.compumotor.com`

CHAPTER ONE

1 Installation

IN THIS CHAPTER

Before You Begin

⚠ WARNINGS ⚠

The 6K controller is used to control your system's electrical and mechanical components. Therefore, you should test your system for safety under all potential conditions. Failure to do so can result in damage to equipment and/or serious injury to personnel.

ALWAYS REMOVE POWER TO THE 6K CONTROLLER BEFORE:

- Connecting and electrical devices (e.g., drive, encoder, I/O brick, inputs, outputs, etc.)
- Accessing and adjusting internal DIP switches

Recommended Installation Process

1. Check the ship kit to make sure that you have all the items (see page 3).
2. Review the general specifications table (see page 4).
3. (optional) Set internal DIP switches for using the "RS-232/485" connector as an RS-485 serial port (default function is RS-232 and configured for connection to an RP240).
4. Mount the 6K controller (see page 6).
5. Connect all electrical system components (see pages 8-29).
   Installation instructions for the EVM32 expansion I/O are provided on page 43.
6. Test the installation (see page 30).
7. Mount the motors and/or couple the loads.
8. Tune any servo axes or axes using the ZETA drive. Use the tuning utility in Motion Planner (see page 51).
9. Program your motion control functions. Programming instructions are provided in the *6K Series Programmer's Guide* and the *6K Series Command Reference*. Use the programming tools provided in Motion Planner (found in your ship kit).

Electrical Noise Guidelines

- 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.

6K Series Controller Ship Kit

NOTE

If an item is messing, call the factory (see phone numbers on inside front cover).

Part Name	Part Number
One of the following 6K products:	
6K2 two-axis controller	6K2
6K2 with ship kit	6K2-SK
6K4 four-axis controller	6K4
6K4 with ship kit	6K4-SK
6K6 six-axis controller	6K6
6K6 with ship kit	6K6-SK
6K8 eight-axis controller	6K8
6K8 with ship kit	6K8-SK
Ship kit items (for -SK part numbers):	
6K Series Hardware Installation Guide	88-017547-01
6K Series Command Reference	88-017136-01
6K Series Programmer's Guide	88-017137-01
Motion Planner CD-ROM	95-017633-01
Mounting bracket (1 of 2)	53-012068-02
Mounting bracket (2 of 2)	53-017556-01
Screws (4) to attach mounting brackets (6-32 x ¼)	51-006037-01
Ethernet cable (5-foot, RJ-45, cross-over)	71-017635-01
Peel-and-stick labels for onboard I/O cables	87-017636-01

Optional Accessories

Part Name	Part Number
Drive cable to Parker step & direction drives, 10-foot	71-016137-10
Drive cable to ± 10V drives, 10-foot (no connector at drive end)	71-017003-10
VM25 25-pin screw-terminal adapter for onboard I/O (with 2-foot cable)	VM25
60 Watt power supply (DIN rail mountable)	PS-60W
EVM32 expansion I/O modules. Each module can hold up to four SIM cards for total of up to 128 I/O points. Up to eight EVM32 modules may be connected to your 6K controller.	
EVM32 baseboard, DIN rail mountable (with 2-foot cable)	EVM32-BASE
SIM card with eight digital inputs	SIM8-IN
SIM card with eight digital outputs	SIM8-OUT-EVM32
SIM card with eight 12-bit analog inputs	SIM8-AN-IN
100-foot cable	71-016949-100

6K Series General Specifications

Parameter	Specification
Power (DC input)	24VDC ±10%, 2A max. (current requirements depend on type/amount of I/O used)
Environmental	
Operating temperature	32 to 122°F (0 to 50°C)
Storage temperature	-22 to 185°F (-30 to 85°C)
Humidity	0 to 95% non-condensing
Performance	
Command output	± 10V or Step & Direction
Servo update	As fast as 62.5 µs per axis
Stepping accuracy	± 0 counts from preset total
Position range	± 2,147,483,648 counts
Velocity range	Stepper axes: 1 to 2,000,000 counts/sec; Servo axes: 1 to 12,000,000 counts/sec;
Acceleration range	1 to 50,000,000 counts/sec/sec
Communication Interface	
Serial	
Connection	RS-232: 3-wire connections (Rx, Tx and GND) on "RS-232" or "RS-232/485" connectors. The "RS-232/485" connector's default configuration is for RS-232 and set for use with an RP240 (see page 28). RS-485: 2- and 4-wire connections to "RS-232/485" connector. Requires DIP switch changes (see page 5).
Maximum units in daisy chain	99 (use ADDR command to set individual addresses for each unit).
Communication parameters	8 data bits; No parity; Baud rate: 9600 (set with BAUD command; range: 1200-38400).
Ethernet	10Base-T (10Mbps twisted pair); TCP/IP protocol. RJ-45 connector. Default IP address is 192.168.10.30 (use NTADDR on RS-232 port to change address).
Onboard Inputs	
Encoder inputs	Differential comparator accepts two-phase quadrature incremental encoders with differential or single-ended outputs. To use single-ended encoders, jumper pin 8 to pin 9 (not available on Master Encoder connector). The "Master Encoder" connector may not be used for servo feedback or stepper stall detect. Maximum voltage = 5VDC. Switching levels (TTL): Low ≤ 0.4V, High ≥ 2.4V. Maximum frequency = 12.0 MHz post quadrature.
Limit inputs ("LIMITS/HOME" connectors)	Voltage range = 0-24VDC. Factory default is sourcing current, voltage reference is 24VDC*. To make all limit inputs sink current, connect the "LIM-P" terminal to the "GND" terminal (see connector on top of 6K chassis).
Trigger inputs ("TRIGGERS/OUTPUTS" connectors)	Voltage range = 0-24VDC. Factory default is sourcing current, voltage reference is 24VDC*. To make all trigger inputs sink current, connect the "TRIG-P" terminal to the "GND" terminal (see connector on top of 6K chassis).
Master trigger input ("MASTER TRIG")	(same specification as the rest of the trigger inputs)
Drive Fault input (pin 5 on "DRIVE" connectors)	Voltage range = 0-24VDC. Factory default is sourcing current, voltage reference is 24VDC*. To make all drive fault inputs sink current, connect the "CNTRL-P" terminal to the "GND" terminal (see connector on top of 6K chassis).
"ENABLE" input	Voltage range = 0-24VDC. Voltage reference is 24VDC*. Internal 6.8 KΩ pull-up to 24VDC. If this input is opened, motion is killed and the program in progress is terminated. If ENABLE is not grounded when motion is commanded, motion will not occur, and the error message "WARNING: ENABLE INPUT ACTIVE" will be displayed to the terminal emulator. (see connector on top of 6K chassis).
Onboard Outputs	
Digital outputs ("TRIGGERS/OUTPUTS" connectors)	Open-collector outputs; will sink up to 300 mA.
+5VDC output (pin 1 on "ENCODER")	Internally supplied +5VDC. Provides up to 250 mA per encoder.
Servo drive command out (pin 3 on "DRIVE")	Command signal output to the drive. ±10VDC analog output. 12-bit DAC. Load should be > 2 KΩ impedance.
Servo drive shutdown (pins 7 & 8 on "DRIVE")	Shutdown relay output. Max rating: 175VDC, 0.25A, 3W.
Step, Direction, Shutdown (pins 1,2,11 on "DRIVE")	Differential line drive output. Signal high > 3.5VDC @ +30mA, signal low < 1.0VDC @ -30mA. +output for each driver is active high, -output is active low. Step pulse width is 0.3-20 µs (depending on PULSE command — default is 0.5 µs).
Flyback diode output ("OUT DIODE")	Connected to 24VDC power with external jumper — allows you to use internal flyback diode for onboard outputs that are driving inductive loads. DISCONNECT the jumper if the onboard outputs are not driving inductive loads.

* The voltage reference (VINref) is +24VDC, unless you connect an external 5-24VDC supply to the "VINref" terminal (see connector on top of 6K chassis). Switching levels: Low ≤ 1/3 VINref, High ≥ 2/3 VINref.

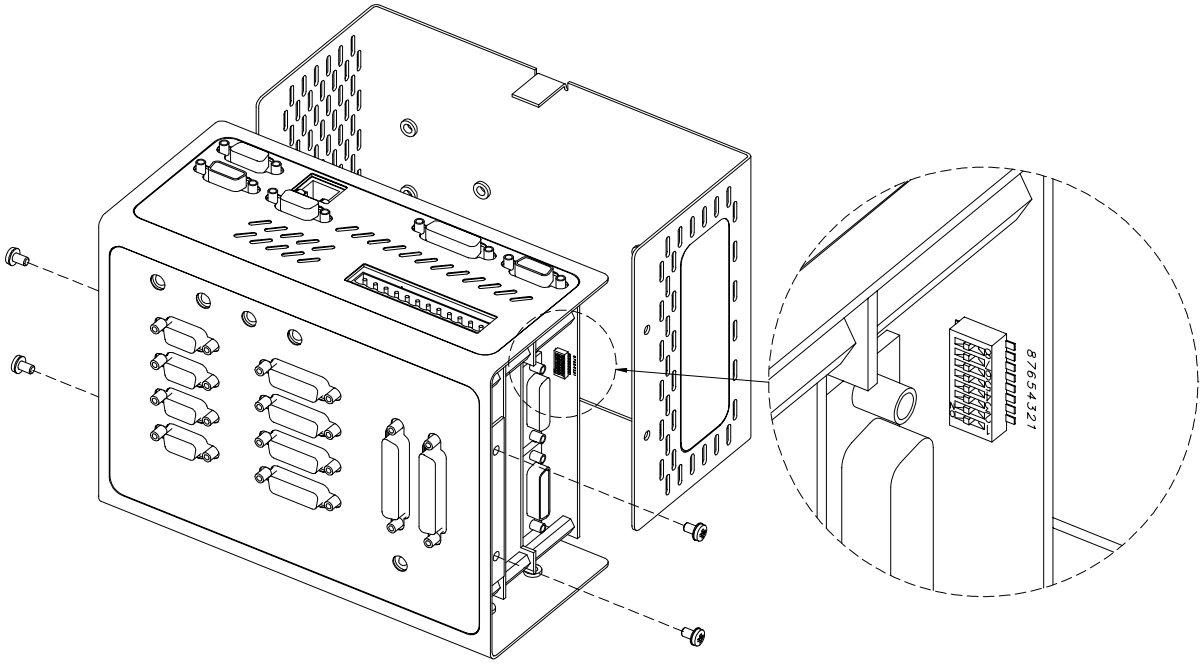
RS-485 Setup (Optional)

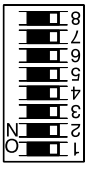
READ THIS FIRST

The “RS-232/485” connector (also referred to as “COM2”) is factory-configured for RS-232 communication; this makes it compatible with an RP240 remote operator panel. If you are not using RS-485 communication, skip this section and proceed to Mounting.

⚠ CAUTIONS ⚠

- **REMOVE POWER** before removing the 6K’s enclosure.
- While handling the 6K’s printed circuit assemblies, be sure to observe proper grounding techniques to prevent electrostatic discharge (ESD).





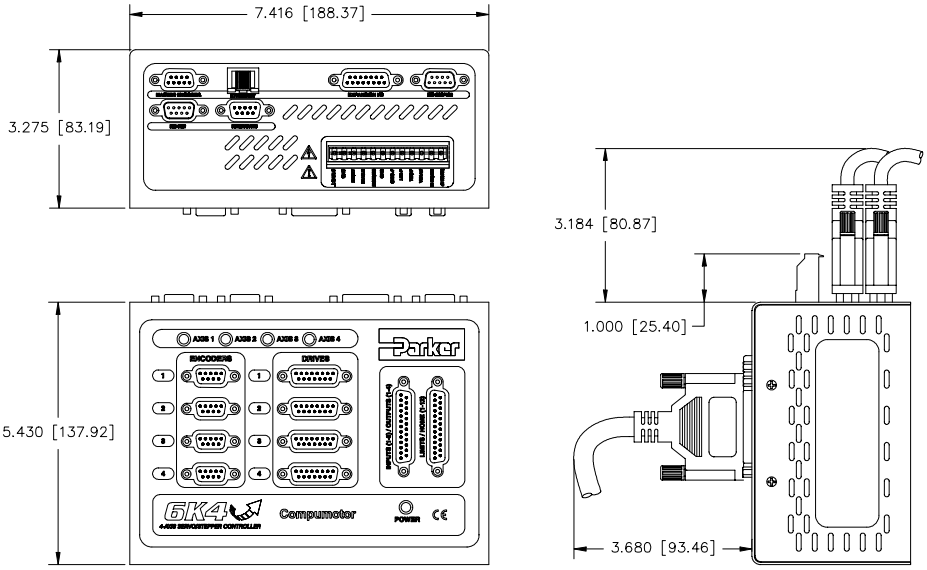
DIP Switch	RS-485 2-Wire	RS-485 4-Wire	RS-232
8..... 2-wire RS-485	ON	OFF	OFF
7..... 4-wire RS-485	OFF	ON	OFF
6..... *reserved*	OFF	OFF	OFF
5..... Enable RS-485	ON	ON	OFF
4..... 120Ω Rx termination resistor	ON *	ON	OFF
3..... 120Ω Tx termination resistor	ON *	ON	OFF
2..... 681Ω Tx+ bias resistor	ON	ON	OFF
1..... 681Ω Tx- bias resistor	ON	ON	OFF

* For 2-wire RS-485, use switch #3 or switch #4 for 120Ω termination (not both).

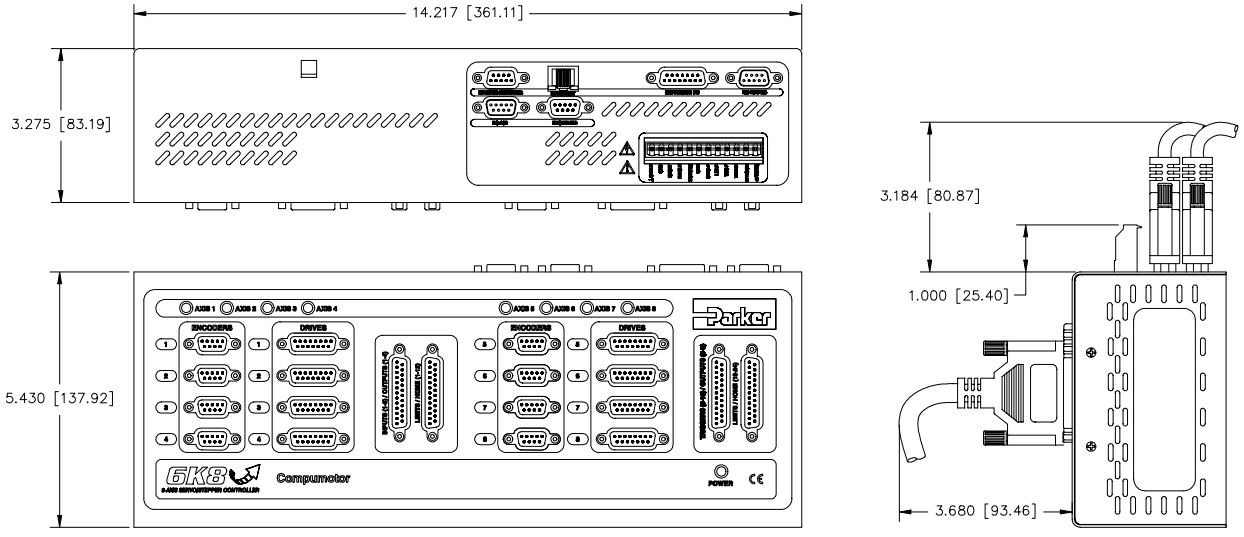
6K Series Dimensions & Mounting

Dimensions

6K2 & 6K4



6K6 & 6K8



Mounting

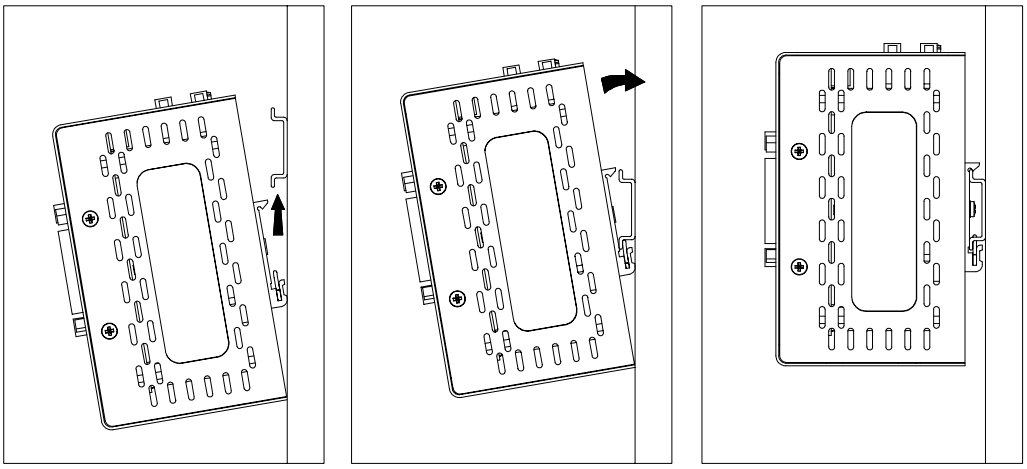
Environmental Considerations:

Temperature. Operate the 6K in ambient temperatures between 32°F (0°C) and 122°F (50°C). Provide a minimum of 4 inches (100.6 mm) of unrestricted air-flow space around the 6K chassis. Fan cooling may be necessary if adequate air flow is not provided.

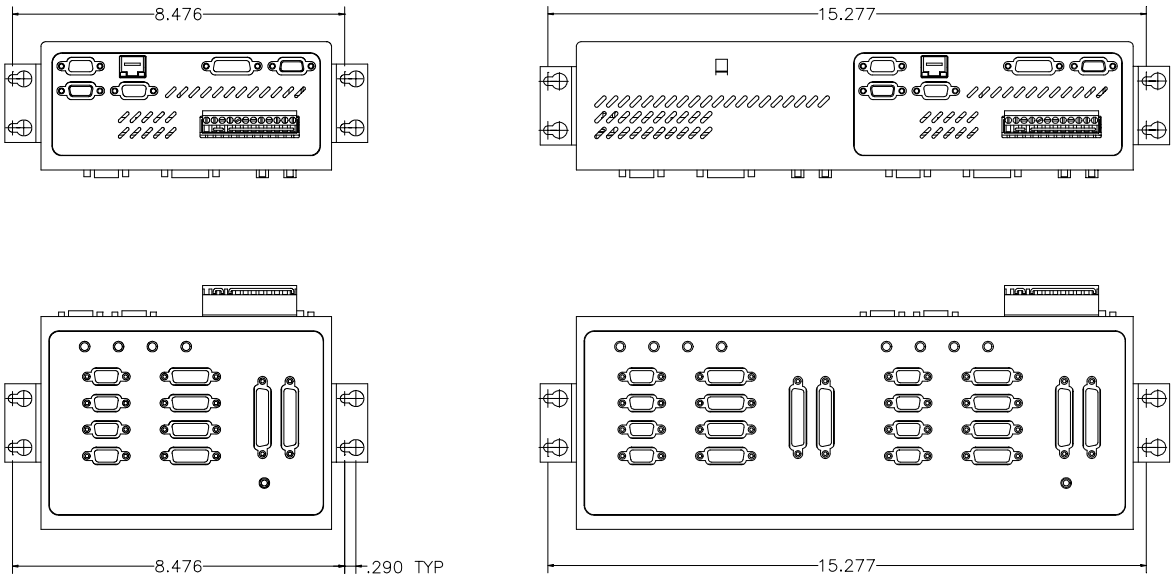
Humidity. Keep below 95%, non-condensing.

Airborne Contaminants, Liquids. Particulate contaminants, especially electrically conductive material, such as metal shavings and grinding dust, can damage the 6K. No not allow liquids or fluids to come in contact with the 6K or its cables.

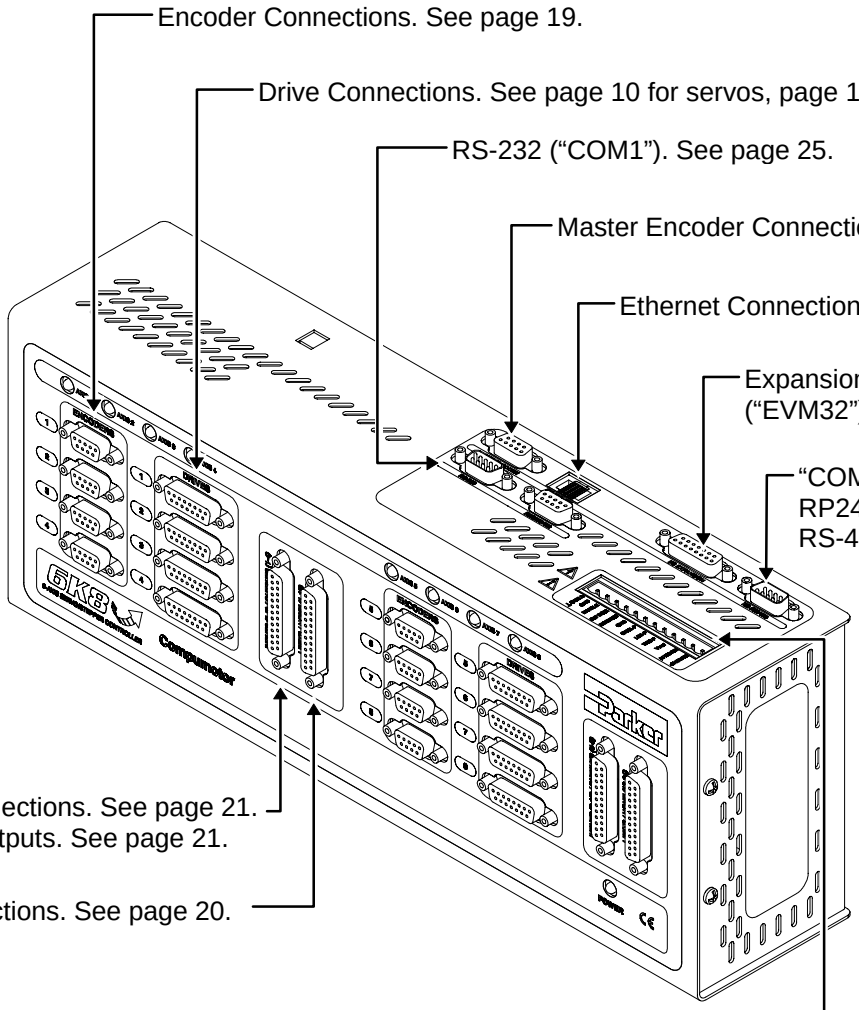
Mounting Option — DIN Rail



Mounting Option — Brackets *(brackets provided in ship kit)*



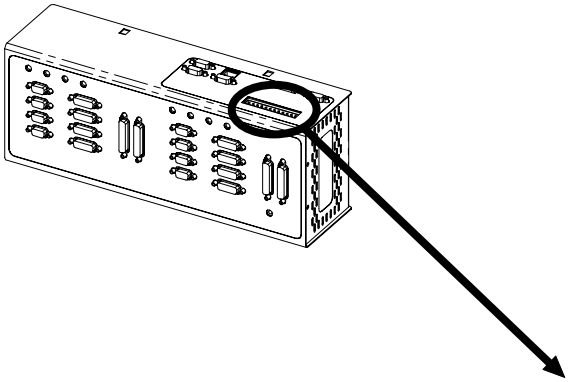
6K Series Electrical Connections



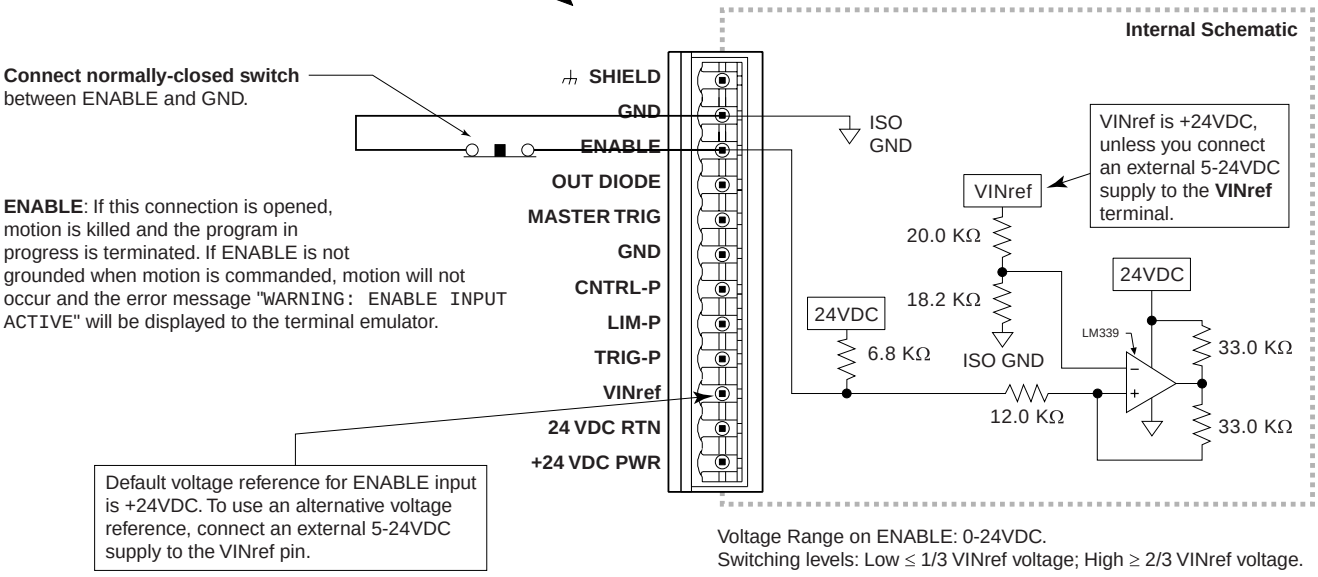
- +24 VDC PWR .....+24VDC power input. See page 29.
- 24 VDC RTN .....24VDC power return. See page 29.
- VINref.....Voltage reference for trigger, limit, drive fault, and enable inputs (default is 24VDC; if 24VDC is desired, it is not necessary to connect an external power source to the VINref terminal). Switching: ≤ 1/3 VINref = Low; ≥ 2/3 VINref = High.
- TRIG-P *.....Pull-up for trigger inputs. No connection necessary for pull-up to 24VDC. See page 21.
- LIM-P * .....Pull-up for limit inputs. No connection necessary for pull-up to 24VDC. See page 20.
- CNTRL-P * .....Pull-up for drive fault inputs. No connection necessary for pull-up to 24VDC. See page 10 and 15.
- GND.....Isolated logic ground.
- MASTER TRIG.....Master Trigger Input. See page 10.
- OUT DIODE .....The 6K is shipped from the factory with this pin connected to 24VDC power with an external jumper; this uses the internal flyback diode for onboard outputs that are driving inductive loads. DISCONNECT the jumper if the onboard outputs are <u>not</u> driving inductive loads.
- ENABLE.....Enable Input (**must be connected to GND to allow motion**). See page 9.
- GND.....Isolated logic ground.
- SHIELD .....Internally connected to chassis earth ground.

* The only reason to use the pull-up terminals is to change the respective inputs from sourcing VINref (factory default) to sinking. If sourcing inputs is appropriate for your application, then leave the pull-ups not connected. Note that the factory default is for the inputs to source 24VDC; if sourcing other than 24VDC is desired, connect the other voltage to the VINref terminal (e.g., to source 12VDC, connect a user-supplied 12VDC supply to the VINref terminal.

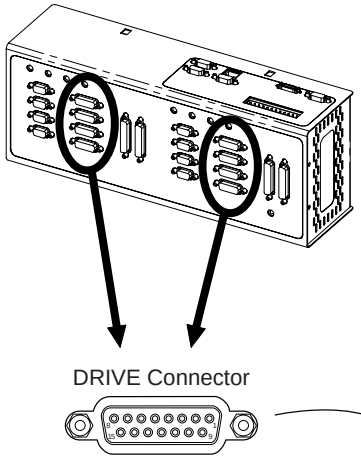
Enable Input



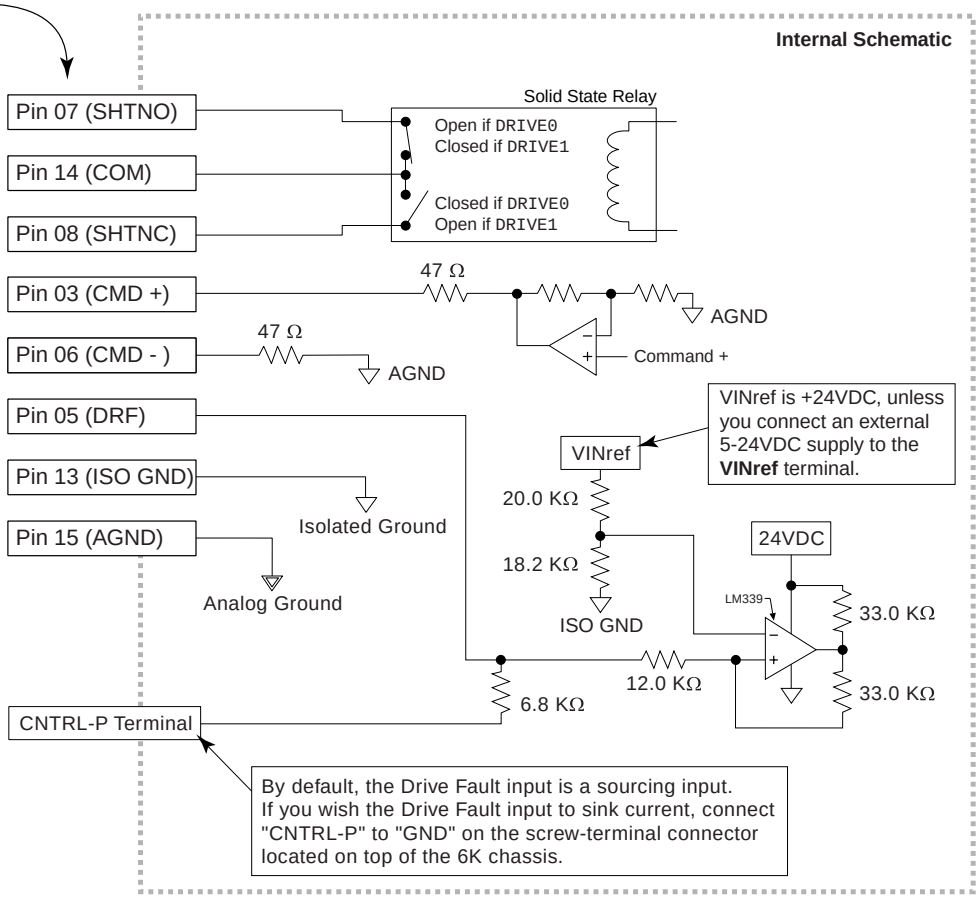
The 6K controller is shipped from the factory with the ENABLE input jumpered to ground, thus allowing motion “out of the box” for bench-testing purposes. Use the diagram below as a guide for connecting the ENABLE input according to your application’s needs.



INTERNAL SCHEMATICS



Drive Cable:
Maximum recommended length is 15 feet (4.56 m).
Use 22 AWG wire.



PIN OUTS & SPECIFICATIONS — SERVO DRIVES ONLY (15-pin "DRIVE" connectors)

Pin *	Name	In/Out	71-017003-10 Cable Colors ***	Description
3	CMD +	OUT	Black	Command signal output to the drive. ±10VDC analog output. 12-bit DAC. Load should be >2kΩ impedance.
5	DFT	IN	Green	Drive fault input. Set active level with the DRFLVL command (default is active low). The drive fault input will not be recognized until you send a DRFEN1 command (enables the input) to the axis. Voltage range for the DFT input is 0-24V. Switching levels: Low ≤ 1/3 VINref voltage, High ≥ 2/3 VINref voltage (factory default VINref voltage is +24VDC, but you can connect a different voltage to the VINref terminal**). To make DFT a sinking input, connect the CNTRL-P terminal** to the GND terminal**.
6	CMD –	IN	Red	Command signal return.
7	SHTNO	OUT	Brown	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 6K. When the 6K is powered up, the shutdown relay remains active until you issue the DRIVE1 command to the axis. Max. rating: 175VDC, 0.25A, 3W. Shutdown active (DRIVEØ): this output is disconnected from COM. Shutdown inactive (DRIVE1): this output is internally connected to COM. (see schematic above)
8	SHTNC	OUT	Gray	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 6K. When the 6K is powered up, the shutdown relay remains active until you issue the DRIVE1 command to the axis. Max. rating: 175VDC, 0.25A, 3W. Shutdown active (DRIVEØ): this output is internally connected to COM. Shutdown inactive (DRIVE1): this output is disconnected from COM. (see schematic above)
13	ISO GND	-----	White	Isolated logic ground.
14	COM	-----	Yellow	Signal common for shutdown. Not connected to any ground or other COM.
15	AGND	-----	Blue	Analog ground.

* Pin 1, 2, 4, and 9-12 are reserved for connection to a step & direction drive (see page 15).
** The VINref, CNTRL-P, and GND terminals are located on the screw-terminal connector on top of the 6K chassis.
*** The servo drive cable (p/n 71-017003-10) is a 10-foot cable with no connector on the drive end of the cable. It is sold as an accessory.

CONNECTIONS TO THE APEX SERIES DRIVE

APEX Drive Connections		6K Connections			
Signal Name		Signal Name	Connector	Pin	
Enable In	↔	SHTNO	DRIVE	07	
Fault Out	↔	DFT	DRIVE	05	
Gnd	↔	AGND	DRIVE	15	← Jumper AGND to COM.
		COM	DRIVE	14	←
Command +	↔	CMD +	DRIVE	03	
Command –	↔	CMD –	DRIVE	06	
CHA +	↔	A +	ENCODER	02	
CHA –	↔	A –	ENCODER	03	
CHB +	↔	B +	ENCODER	04	
CHB –	↔	B –	ENCODER	05	
CHZ +	↔	Z +	ENCODER	06	
CHZ –	↔	Z –	ENCODER	07	
Gnd	↔	GND	ENCODER	09	

CONNECTIONS TO THE BD-E DRIVE

BD-E Drive Connections				6K Connections		
Signal Name	**Connector**	**Pin**		**Signal Name**	**Connector**	**Pin**
V2	User I/O	01	↔	CMD –	DRIVE	06
V1	User I/O	02	↔	CMD +	DRIVE	03
GND	User I/O	04	↔	GND	ENCODER	09
$\overline{RST}$	User I/O	05	↔	COM	DRIVE	14
+15V	User I/O	06	↔	SHTNO	DRIVE	07
				SHTNC	DRIVE	08
$\overline{FT}$	User I/O	09	↔	DFT	DRIVE	05
AOP	User I/O	10	↔	A +	ENCODER	02
$\overline{AOP}$	User I/O	11	↔	A –	ENCODER	03
BOP	User I/O	12	↔	B +	ENCODER	04
$\overline{BOP}$	User I/O	13	↔	B –	ENCODER	05
ZOP	User I/O	14	↔	Z +	ENCODER	06
$\overline{ZOP}$	User I/O	15	↔	Z –	ENCODER	07

Jumper SHTNC to ground (GND).

NOTE: These connections will work only of the BD-E's jumper LK2 is set to position B (this is not the factory default setting).

CONNECTIONS TO THE DYNASERV DRIVE

Dynaserv Drive Connections				6K Connections		
Signal Name	**Connector**	**Pin**		**Signal Name**	**Connector**	**Pin**
A +	DN1	13	↔	A +	ENCODER	02
V1	DN1	14	↔	A –	ENCODER	03
SRVON	DN1	23	↔	SHTNO	DRIVE	07
Vcc	DN1	24	↔	+5V	ENCODER	01
B +	DN1	29	↔	B +	ENCODER	04
B –	DN1	30	↔	B –	ENCODER	05
Z +	DN1	43	↔	Z +	ENCODER	06
Z –	DN1	44	↔	Z –	ENCODER	07
VIN	DN1	49	↔	CMD +	DRIVE	03
AGND	DN1	50	↔	AGND	DRIVE	15
				COM	DRIVE	14
				GND	ENCODER	09

Jumper COM to ground (GND).

NOTE: The Dynaserv's default setting is for Position Mode (for accepting step and direction command signals). The connections above assume the Dynaserv is reconfigured for Velocity Mode or Torque Mode. Refer to the Dynaserv user guide for additional information.

CONNECTIONS TO THE LINEARSERV DRIVE

Linearserv Connections				6K Connections		
Signal Name	**Connector**	**Pin**		**Signal Name**	**Connector**	**Pin**
Com +	CN1	01	↔	+5V	ENCODER	01
Servo On –	CN1	05	↔	SHTNO	DRIVE	07
A +	CN1	17	↔	A +	ENCODER	02
B +	CN1	19	↔	B +	ENCODER	04
Z +	CN1	21	↔	Z +	ENCODER	06
Agnd-TQ	CN1	22	↔	CMD –	DRIVE	06
Vin-TQ	CN1	23	↔	CMD +	DRIVE	03
Agnd-VEL	CN1	24	↔	CMD –	DRIVE	06
Vin-VEL	CN1	25	↔	CMD +	DRIVE	03
Com –	CN1	26	↔	AGND	DRIVE	15
Ready +	CN1	31	↔	DFT	DRIVE	05
A –	CN1	41	↔	A –	ENCODER	03
B –	CN1	43	↔	B –	ENCODER	05
Z –	CN1	45	↔	Z –	ENCODER	07
				COM	DRIVE	14
				GND	ENCODER	09

When the Linearserv is in Torque Mode, connect Agnd-TQ to CMD –, and connect Vin-TQ to CMD +.

When the Linearserv is in Velocity Mode, connect Agnd-VEL to CMD –, and connect Vin-VEL to CMD +.

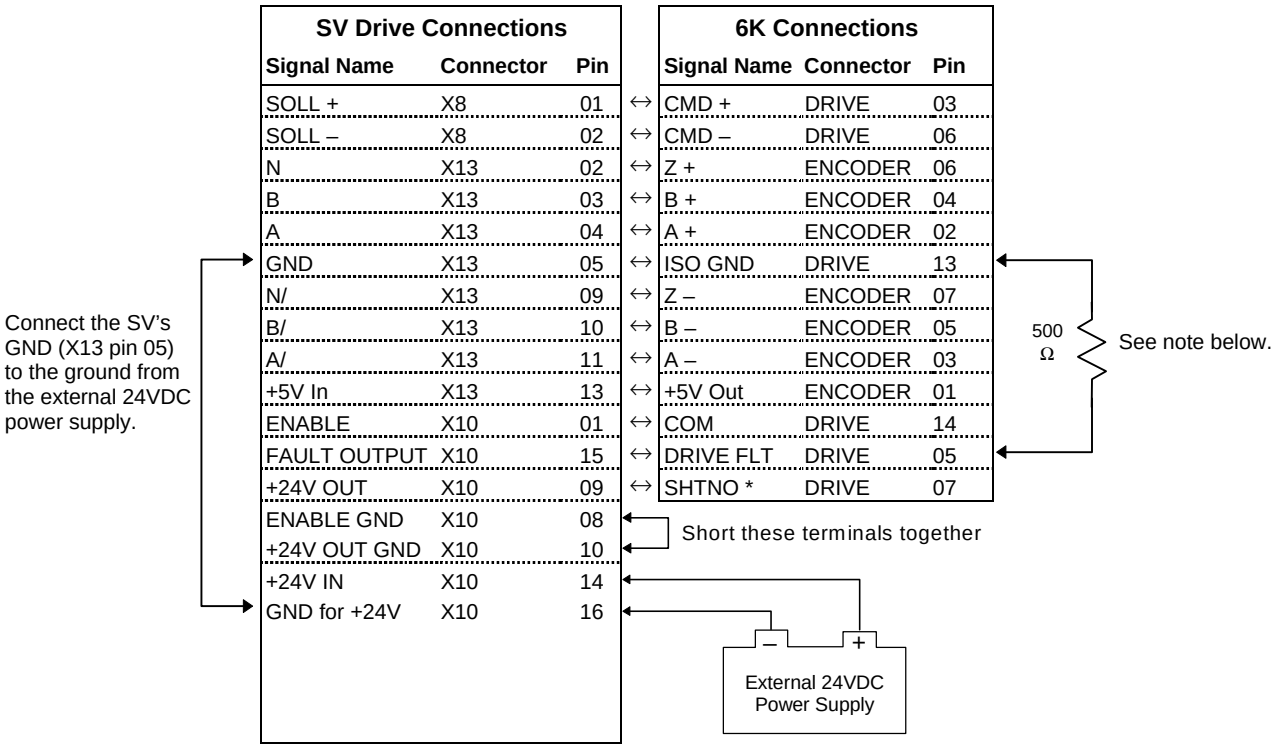
Jumper COM to ground (GND).

NOTE: The Linearserv's default setting is for Position Mode (for accepting step and direction command signals). The connections above assume the Linearserv is reconfigured for Velocity Mode or Torque Mode. Refer to the Linearserv user guide for additional information.

CONNECTIONS TO THE OEM670T & OEM675T DRIVE

OEM67x Drive Connections			6K Connections		
Signal Name	**Pin**		**Signal Name**	**Connector**	**Pin**
CMD +	01	↔	CMD +	DRIVE	03
CMD –	02	↔	CMD –	DRIVE	06
FAULT	09	↔	DFT	DRIVE	05
ENABLE	10	↔	SHTNO	DRIVE	07
GND	11	↔	COM	DRIVE	14
GND	16	↔	AGND	DRIVE	15
GND	07	↔	GND	DRIVE	13

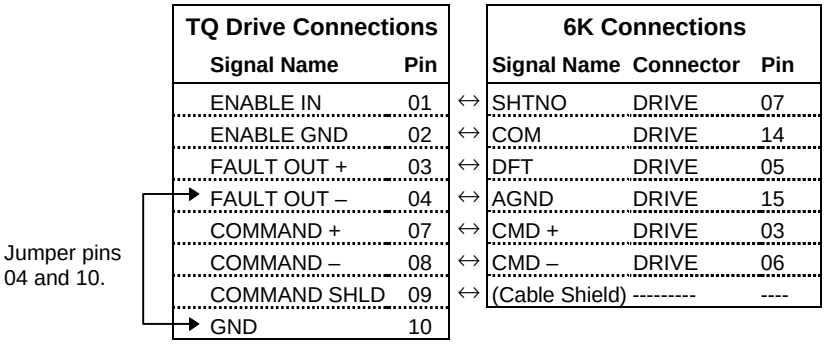
CONNECTIONS TO THE SV DRIVE



* The SHTNO relay output is active (disabling the drive) when no power is applied to the 6K. When the 6K is powered up, the shutdown relay remains active until you issue a `DRIVE1` command to the axis.

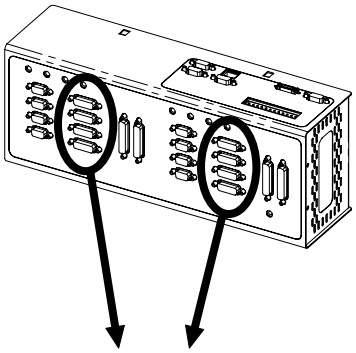
NOTE: Adding the 500Ω resistor assumes the drive fault input is pulled up. (CNTRL-P is internally pulled up to the voltage at the VINref terminal — if no voltage is connected to VINref, CNTRL-P is pulled up internally to 24VDC.) However, if all axes are SV drives, do not connect the 500Ω resistor; instead, connect the CNTRL-P pin to GND.

CONNECTIONS TO THE TQ10 DRIVE

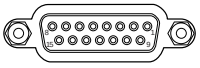


Drives: Step & Direction Drives *("DRIVES" connectors)*

INTERNAL SCHEMATICS

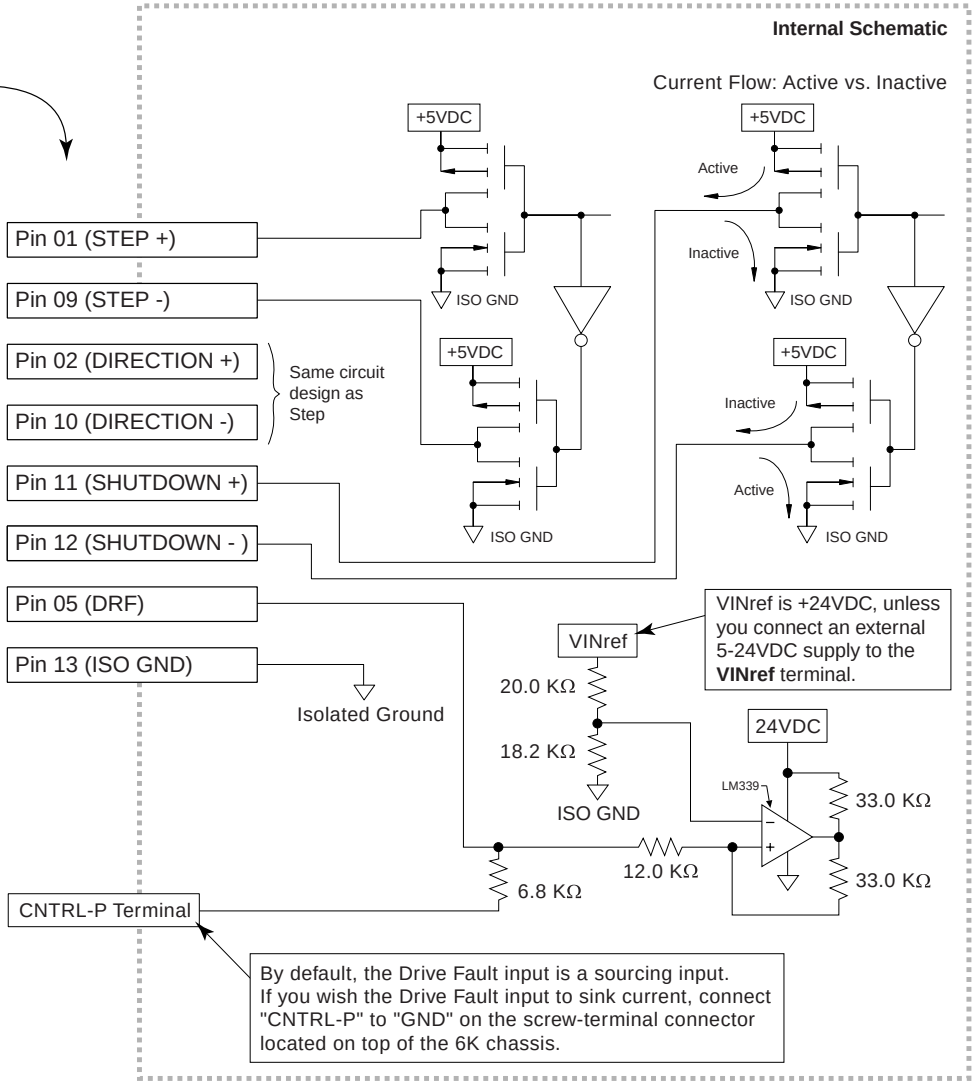


DRIVE Connector



Drive Cable:
Maximum recommended length is 50 feet (15.24 m).
Use 22 AWG wire.

Internal Schematic



PIN OUTS & SPECIFICATIONS — STEPPER DRIVES ONLY (15-pin "DRIVE" connectors)

Pin *	Name	In/Out	Description
1	Step +	OUT	Differential output. Step (pulse) output to the drive. Step + signal is active high. Signal levels: Low ≤ 1.0VDC @ -30mA, High ≥ 3.5VDC @ +30mA.
2	Direction +	OUT	Differential output. High signal on Direction + specifies motion in the positive direction; Low signal on direction + specifies motion in the negative direction. Signal levels: Low ≤ 1.0VDC @ -30mA, High ≥ 3.5VDC @ +30mA.
4	Stall	IN	Encoder-less Stall Detection input for use with the GEMINI drive.
5	DFT	IN	Drive fault input. Set active level with the DRFLVL command (default is active low). The drive fault input will not be recognized until you send a DRFEN1 command (enables the input) to the axis. Voltage range for the DFT input is 0-24V. Switching levels: Low ≤ 1/3 VINref voltage, High ≥ 2/3 VINref voltage (factory default VINref voltage is +24VDC, but you can connect a different voltage to the VINref terminal**). To make DFT a sinking input, connect the CNTRL-P terminal** to the GND terminal**.
9	Step –	OUT	Differential output. Step (pulse) output to the drive. Step – signal is active low.
10	Direction –	OUT	Differential output. Low signal on Direction – specifies motion in the positive direction; High signal on direction – specifies motion in the negative direction.
11	Shutdown +	OUT	Differential output. This signal is used to turn off current in the motor windings. High signal on Shutdown + indicates the motor winding current should be off. Signal levels: Low ≤ 1.0VDC @ -30mA, High ≥ 3.5VDC @ +30mA.
12	Shutdown –	OUT	Differential output. This signal is used to turn off current in the motor windings. Low signal on Shutdown – indicates the motor winding current should be off.
13	ISO GND	-----	Isolated logic ground.

* Pin 3-4, 6-8, and 15 are reserved for connection to a ±10V analog servo drive (see page 10).
** The VINref, CNTRL-P, and GND terminals are located on the screw-terminal connector on top of the 6K chassis.

CONNECTIONS TO THE ZETA, S, OEM750 and PDS DRIVES

Drive Connections				6K Connections		
Signal Name	**Connector**	**Pin**		**Signal Name**	**Connector**	**Pin**
Step +	25-pin	01	↔	Step +	DRIVE	01
Step –	25-pin	14	↔	Step –	DRIVE	09
Direction +	25-pin	02	↔	Direction +	DRIVE	02
Direction –	25-pin	15	↔	Direction –	DRIVE	10
Shutdown +	25-pin	16	↔	Shutdown +	DRIVE	11
Shutdown –	25-pin	17	↔	Shutdown –	DRIVE	12
Fault Output	25-pin	09	↔	Drive Fault	DRIVE	05
Fault Return	25-pin	21	↔	Ground	DRIVE	13

NOTES:
- The PDS drive requires a PULSE command setting of 1.0 (PULSE1.0).
- Use the 10-foot cable (p/n 71-016137-10) for plug compatibility.

CONNECTIONS TO THE OEM670SD DRIVE

OEM670SD Connections				6K Connections		
Signal Name	**Connector**	**Pin**		**Signal Name**	**Connector**	**Pin**
Step +	25-pin	03	↔	Step +	DRIVE	01
Step –	25-pin	14	↔	Step –	DRIVE	09
Direction +	25-pin	04	↔	Direction +	DRIVE	02
Direction –	25-pin	15	↔	Direction –	DRIVE	10
Shutdown +	25-pin	12	↔	Shutdown +	DRIVE	11
Shutdown –	25-pin	13	↔	Shutdown –	DRIVE	12
ISO Fault +	25-pin	22	↔	Drive Fault	DRIVE	05
Fault Return	25-pin	23	↔	Ground	DRIVE	13

CONNECTIONS TO THE DYNASERV DRIVE

Dynaserv Drive Connections				6K Connections		
Signal Name	**Connector**	**Pin**		**Signal Name**	**Connector**	**Pin**
Step +	DN1	45	↔	Step +	DRIVE	01
Step –	DN1	46	↔	Step –	DRIVE	09
Direction +	DN1	20	↔	Direction +	DRIVE	02
Direction –	DN1	19	↔	Direction –	DRIVE	10
Servo On –	DN1	23	↔	Shutdown +	DRIVE	11
Servo On +	DN1	24	↔	Shutdown –	DRIVE	12
Servo Ready +	DN1	15	↔	Drive Fault	DRIVE	05
Servo Ready –	DN1	16	↔	Ground	DRIVE	13
A +	DN1	13	↔	A +	ENCODER	02
A –	DN1	14	↔	A –	ENCODER	03
B +	DN1	29	↔	B +	ENCODER	04
B –	DN1	30	↔	B –	ENCODER	05
Z +	DN1	43	↔	Z +	ENCODER	06
Z –	DN1	44	↔	Z –	ENCODER	07

NOTE: These connections assume that the Dynaserv is left in its factory default setting for Position Mode (for accepting step and direction command signals). Refer to your Dynaserv user guide for verification.

CONNECTIONS TO THE LINEARSERV DRIVE

Linearserv Drive Connections				6K Connections		
Signal Name	**Connector**	**Pin**		**Signal Name**	**Connector**	**Pin**
Step +	CN1	15	↔	Step +	DRIVE	01
Step –	CN1	39	↔	Step –	DRIVE	09
Direction +	CN1	13	↔	Direction +	DRIVE	02
Direction –	CN1	37	↔	Direction –	DRIVE	10
Servo On –	CN1	05	↔	Ground	DRIVE	13
Servo On +	CN1	01	↔	Shutdown –	DRIVE	12
Servo Ready +	CN1	31	↔	Drive Fault	DRIVE	05
Servo Ready –	CN1	26	↔	Ground	DRIVE	13
A +	CN1	17	↔	A +	ENCODER	02
A –	CN1	41	↔	A –	ENCODER	03
B +	CN1	19	↔	B +	ENCODER	04
B –	CN1	43	↔	B –	ENCODER	05
Z +	CN1	21	↔	Z +	ENCODER	06
Z –	CN1	45	↔	Z –	ENCODER	07

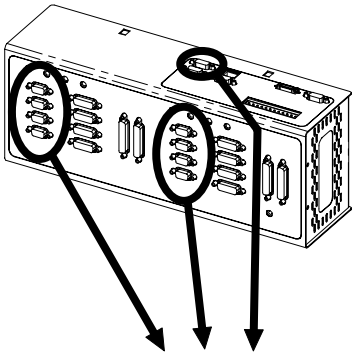
NOTE: These connections assume that the Linearserv is left in its factory default setting for Position Mode (for accepting step and direction command signals). Refer to your Linearserv user guide for verification.

CONNECTIONS TO THE PKH130M DRIVE

PKH130 Drive Connections			6K Connections		
Signal Name	**Pin**		**Signal Name**	**Connector**	**Pin**
Clock	06	↔	Step –	DRIVE	09
Direction	05	↔	Direction +	DRIVE	02
Fault	02	↔	Drive Fault	DRIVE	05
Reset	07	↔	Shutdown –	DRIVE	12
0V	08	↔	Ground	DRIVE	13

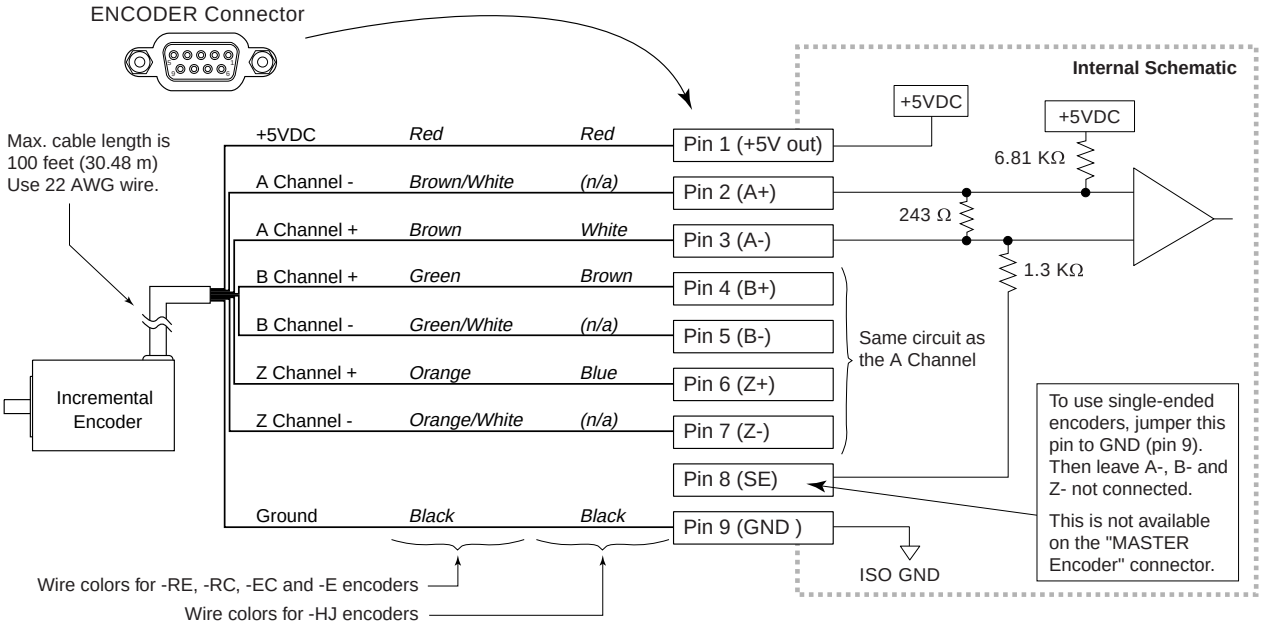
NOTE: The PKH130M drive requires a `PULSE` setting of `PULSE8.0`.

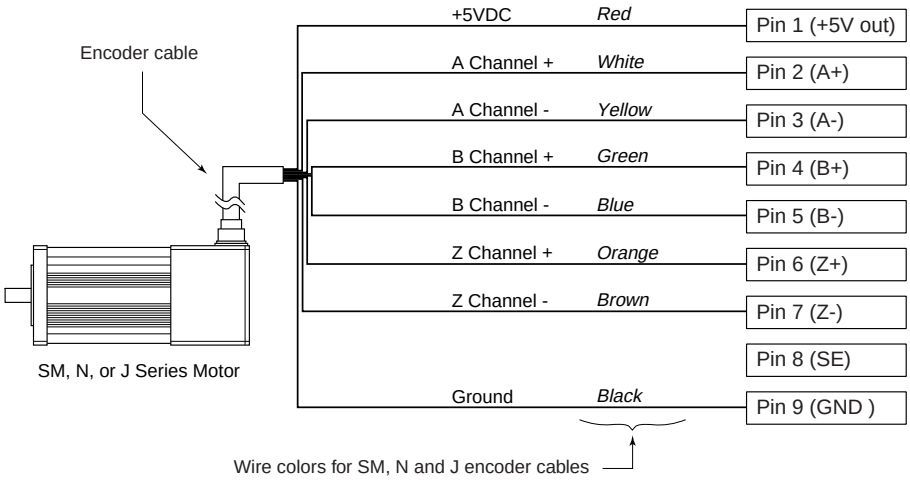
Encoders *("ENCODERS" and "MASTER ENCODER" connectors)*



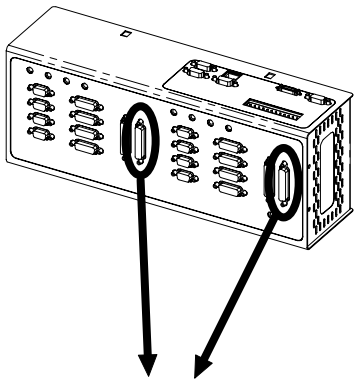
ENCODER INPUTS:
Differential comparator accepts two-phase quadrature incremental encoders with differential (recommended) or single-ended outputs. Max. frequency is 12.0 MHz post quadrature. TTL-compatible voltage levels: Low ≤ 0.4V, High ≥ 2.4V. Maximum input voltage is 5VDC.

MASTER ENCODER:
The master encoder is used for Following, and not for servo feedback or stepper stall detect. The pin outs are the same as the other encoders, except that pin 8 is ISO GND (can't use a single-ended encoder).



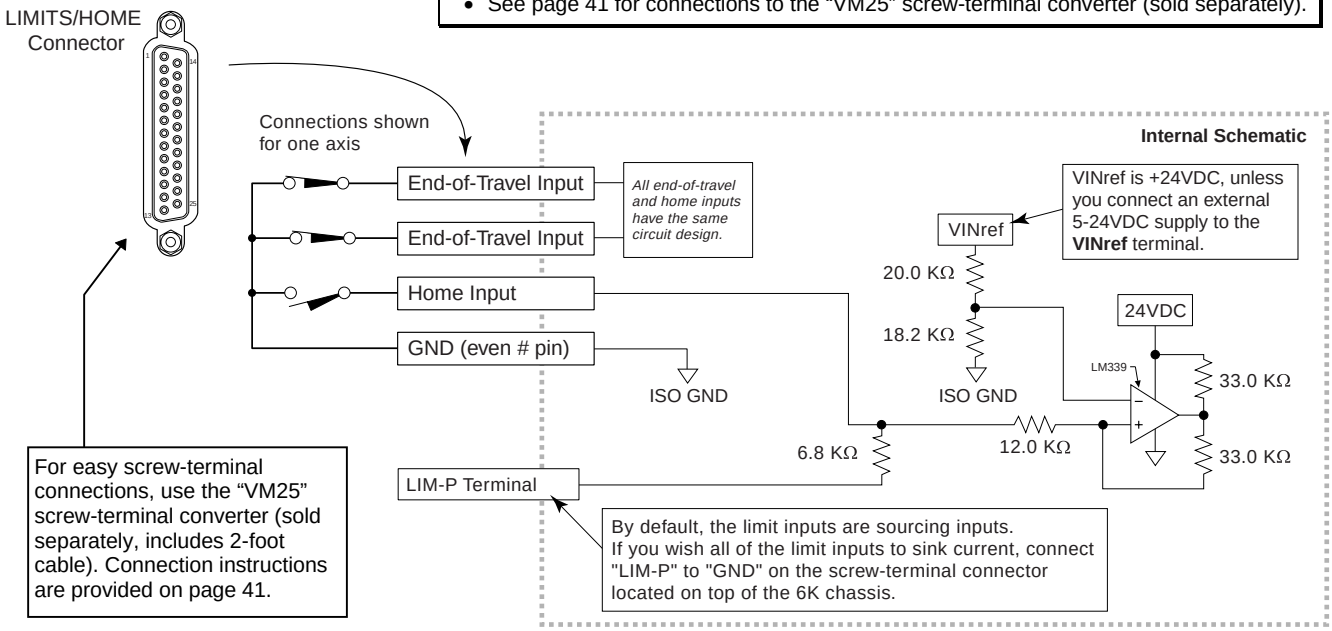


Limit Inputs *("LIMITS/HOME" connectors)*



NOTES

- Motion will not occur on an axis until you do one of the following:
  - Install end-of-travel limit switches
  - Disable end-of-travel limits with the `LHØ` command (only if load not coupled)
  - Change the active level of the limits with the `LIMLVL` command.
- End-of-travel input functionality: Mount each switch such that the load forces it to open before it reaches the physical travel limit (leave enough room for the load to stop). When the load opens the switch, the axis stops at the `LHAD` deceleration. The motor will not be able to move in that same direction until you execute a move in the opposite direction and clear the limit by closing the switch.
- Home input functionality: After initiating a homing move with the `HOM` command, the 6K waits for the home input switch to close, indicating the load has reached the desired "home" reference position.
- Refer to the Basic Operation Setup chapter in the *6K Series Programmer's Guide* for in-depth discussions about using end-of-travel limits and homing.
- See page 41 for connections to the "VM25" screw-terminal converter (sold separately).



PIN OUTS & SPECIFICATIONS

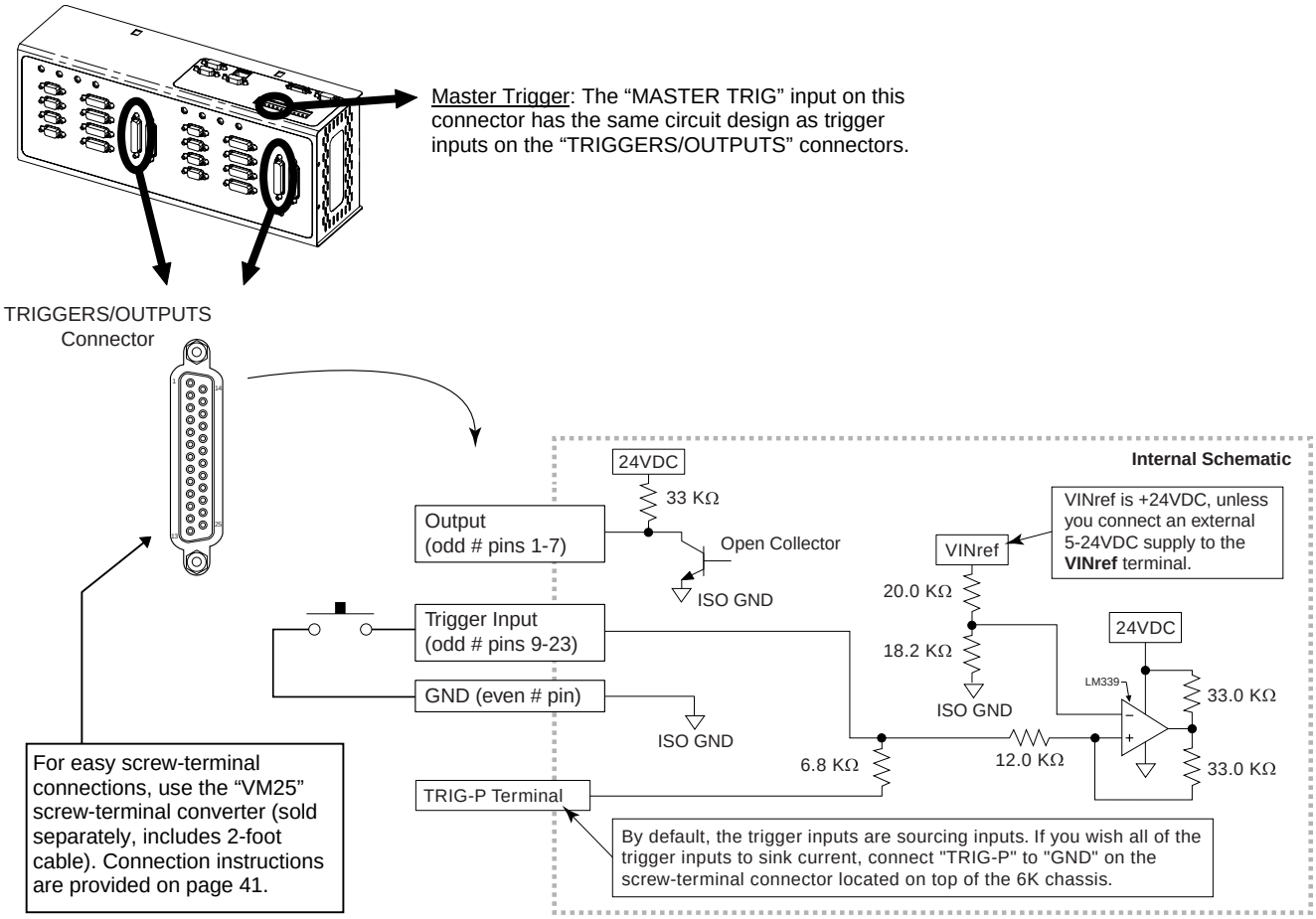
Pin #	In/Out	Axes 1-4	Axes 5-8	**Description** (input functions programmed by `LIMFNC`)
25	-----	-----	-----	RESERVED
23	IN	1POS	5POS	Positive direction end-of-travel limit, axis 1 or 5.
21	IN	1NEG	5NEG	Negative direction end-of-travel limit, axis 1 or 5.
19	IN	1HOME	5HOME	Home limit, axis 1 or 5.
17	IN	2POS	6POS	Positive direction end-of-travel limit, axis 2 or 6.
15	IN	2NEG	6NEG	Negative direction end-of-travel limit, axis 2 or 6.
13	IN	2HOME	6HOME	Home limit, axis 2 or 6.
11	IN	3POS *	7POS *	Positive direction end-of-travel limit for axis 3 or 7.
9	IN	3NEG *	7NEG *	Negative direction end-of-travel limit for axis 3 or 7.
7	IN	3HOME *	7HOME *	Home limit, or general purpose input for axis 3 or 7.
5	IN	4POS *	8POS *	Positive direction end-of-travel limit for axis 4 or 8.
3	IN	4NEG *	8NEG *	Negative direction end-of-travel limit for axis 4 or 8.
1	IN	4HOME *	8HOME *	Home limit for axis 4 or 8.

Specification for limit inputs

- Voltage range is 0-24VDC.
- Switching levels: Low ≤ 1/3 VINref voltage, High ≥ 2/3 VINref voltage (factory default VINref voltage is +24VDC, but you can connect a different voltage to the VINref terminal**). To make all limit inputs sinking inputs, connect the LIM-P terminal** to the GND terminal**.
- Status: Check with `TLIM` or `LIM`.
- Active level is set with the `LIMLVL` command. Default is active low: end-of-travel limits which require a n.c. switch and home limits which require a n.o. switch.

All even number pins are connected to isolated logic ground.
* On 6K2 and 6K6 products, these pins function as general-purpose inputs (function is set with the `LIMFNCi-A` command).
** The VINref, LIM-P, and GND terminals are located on the screw-terminal connector on top of the 6K chassis.

Onboard Programmable Inputs and Outputs



PIN OUTS & SPECIFICATIONS (25-pin “TRIGGERS/OUTPUTS” connectors)

Pin# *	In/Out	**Description** (axes 1-4)	**Description** (axes 5-8)
25	-----	RESERVED	RESERVED
23	IN	Trigger input 1 (TRIG-1A)	Trigger input 9 (TRIG-5A)
21	IN	Trigger input 2 (TRIG-1B)	Trigger input 10 (TRIG-5B)
19	IN	Trigger input 3 (TRIG-2A)	Trigger input 11 (TRIG-6A)
17	IN	Trigger input 4 (TRIG-2B)	Trigger input 12 (TRIG-6B)
15	IN	Trigger input 5 (TRIG-3A)	Trigger input 13 (TRIG-7A)
13	IN	Trigger input 6 (TRIG-3B)	Trigger input 14 (TRIG-7B)
11	IN	Trigger input 7 (TRIG-4A)	Trigger input 15 (TRIG-8A)
9	IN	Trigger input 8 (TRIG-4B)	Trigger input 16 (TRIG-8B)
7	OUT	GP Output 1	GP Output 5
5	OUT	GP Output 2	GP Output 6
3	OUT	GP Output 3	GP Output 7
1	OUT	GP Output 4	GP Output 8
		(GP = general purpose)	

Spes for Trigger Inputs

- Voltage range is 0-24VDC.
- Trigger input switching levels: Low ≤ 1/3 VINref voltage, High ≥ 2/3 VINref voltage (factory default VINref voltage is +24VDC, but you can connect a different voltage to the VINref terminal**). To make all limit inputs sinking inputs, connect the TRIG-P terminal** to the GND terminal**.
- Status: Check with `TIN` or `IN`.
- Programmable functions with the `INFNC` command. Can also be used as a “Trigger Interrupt” input (`INFNCi-H`) for position capture and registration.
- Active level is set with the `INLVL` command. Default is active low (see n.o. switch in diagram above).

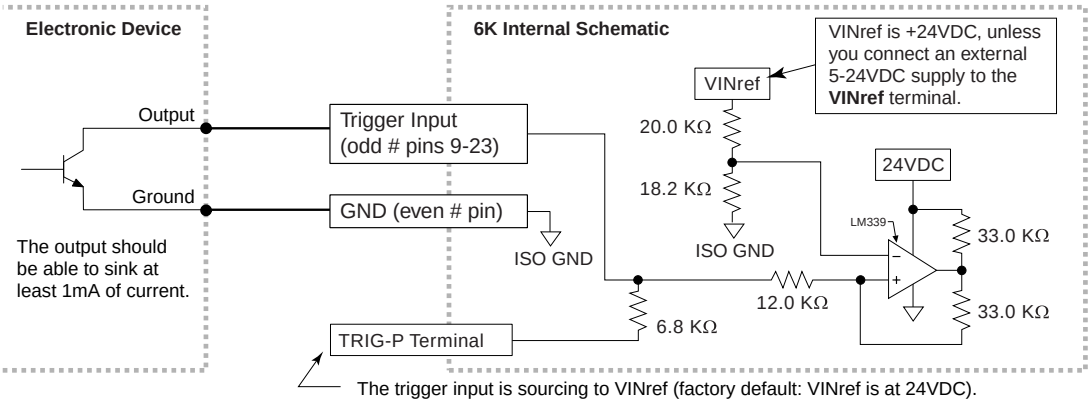
Specs for GP Outputs

- Open collector output; will sink up to 300mA.
- Status: Check with `TOUT` or `OUT`.
- Programmable functions with the `OUTFNC` command. Can also be used as an “Output on Position” output (`OUTFNCi-H`).
- Active level is set with the `OUTLVL` command. Default is active low.
- If the outputs are driving inductive loads, connect the OUT DIODE terminal to 24VDC.

* All even number pins are connected to isolated logic ground.
** The VINref, TRIG-P, and GND terminals are located on the screw-terminal connector on top of the 6K chassis.

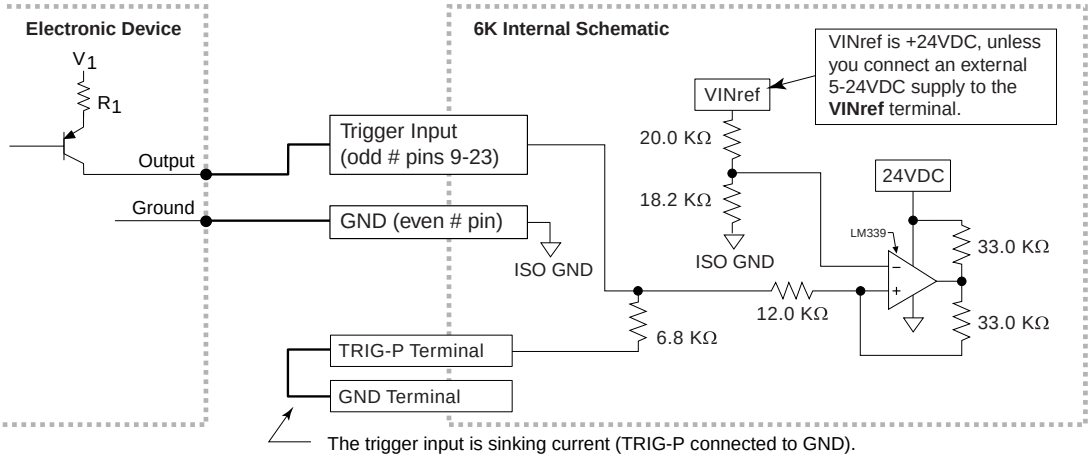
Trigger Input Connections

Connection to a Sinking Output Device



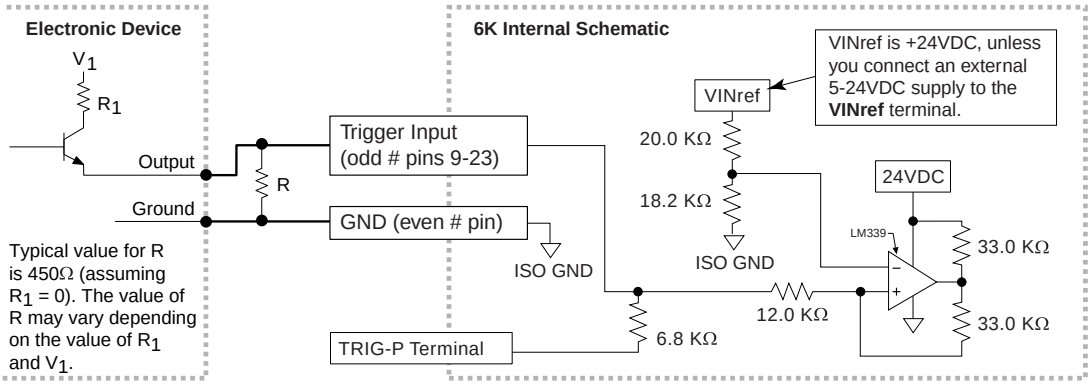
The trigger input is sourcing to VINref (factory default: VINref is at 24VDC). Therefore, no connection is required if sourcing 24VDC is appropriate for your needs. To source to a different voltage, connect a different external supply to VINref.

Connection to a Sourcing Output Device



The trigger input is sinking current (TRIG-P connected to GND).

Connection to a Combination of Sinking and Sourcing Outputs

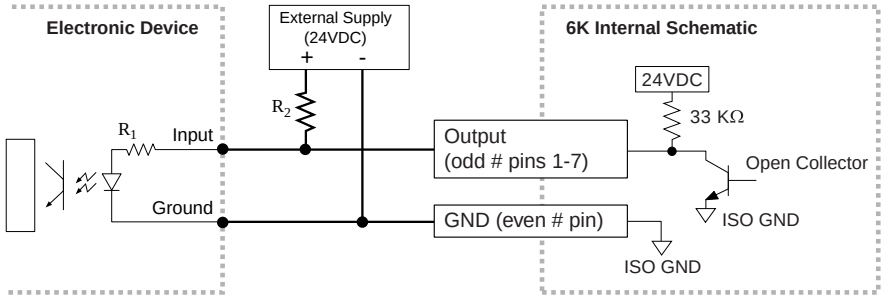


If you are connecting to a combination of sinking and sourcing output, connect the VINref terminal to the voltage supply (factory default is internally connected to 24VDC) to accommodate the sinking outputs. Then for each input connected to a sourcing output, wire an external resistor between the trigger input and GND. The resistor provides a path for current to flow from the device when the output is active.

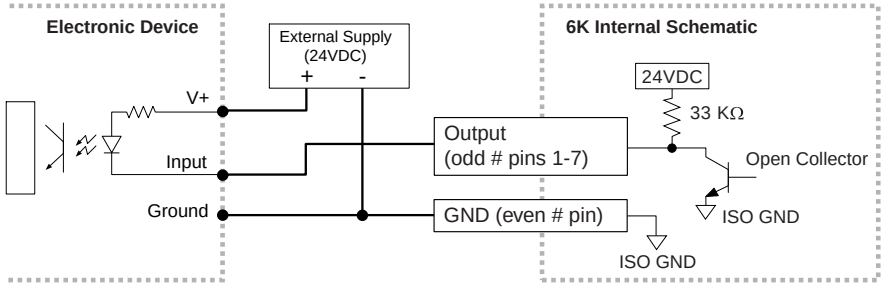
Programming Tip: If connecting to sinking output, set the trigger's `INLVL` setting to active low (`INLVL0`). If connecting to a sourcing output, set the trigger's `INLVL` setting to active high (`INLVL1`). Thus, when the output is active, the `TIN/IN` status will report a "1" (indicates that the input is active), regardless of the type of output that is connected.

Programmable Output Connections

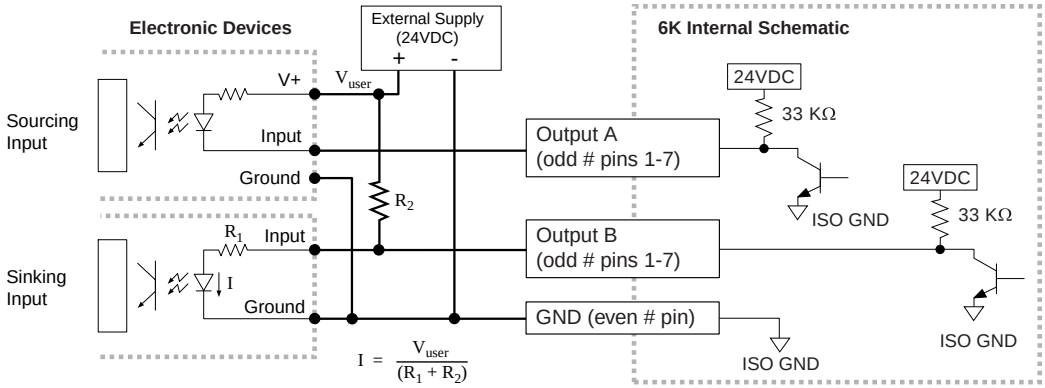
Connection to a Sinking Input (active high)



Connection to a Sourcing Input (active low)

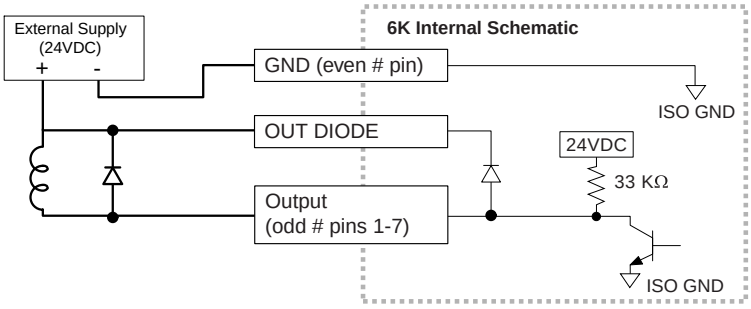


Connection to a Combination of Sinking & Sourcing Inputs



Connection to an Inductive Load (active low)

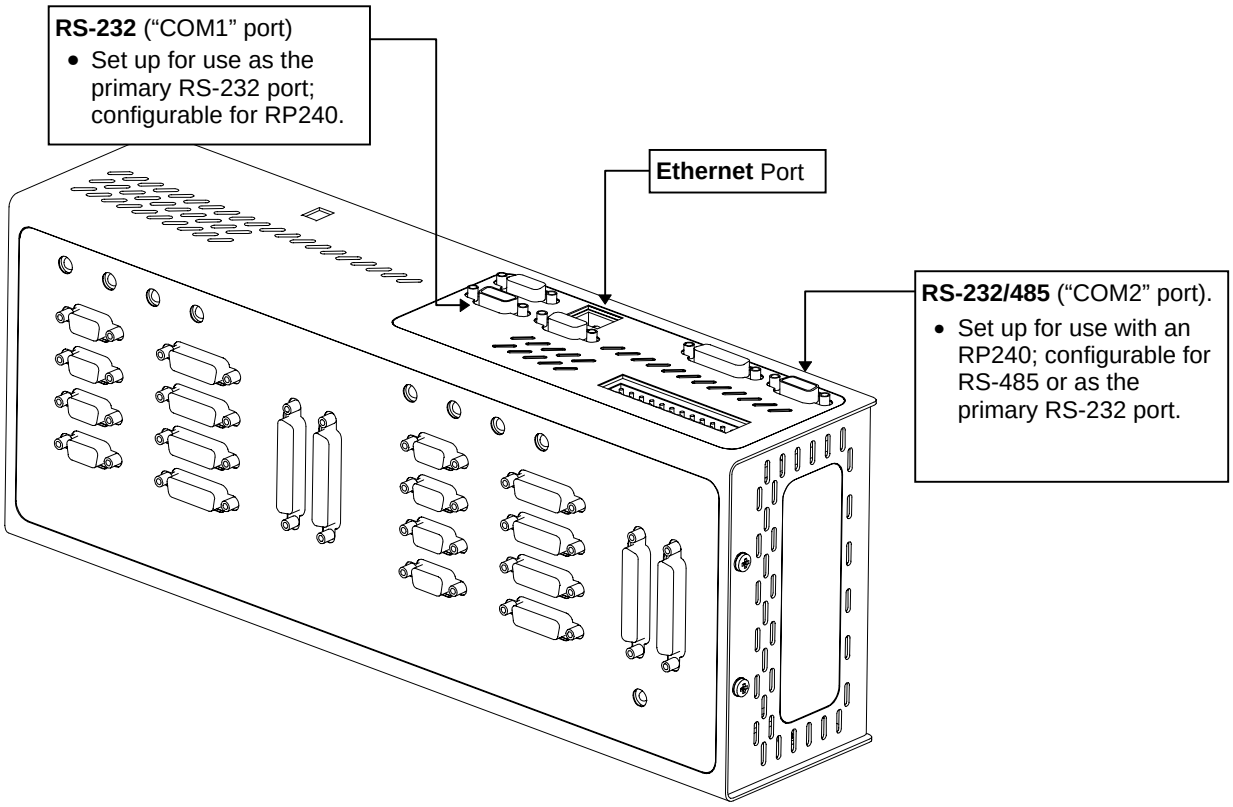
Use an external diode when driving inductive loads.



Programming Tip: If connecting to an active-high sinking input, set the output's `OUTLVL` setting to active high (`OUTLVL1`). If connecting to an active-low sourcing input, set the output's `OUTLVL` setting to active low (`OUTLVL0`). Thus, when the 6K's output is activated, current will flow through the attached input and the `TOUT/OUT` status will report a "1" (indicates the output is active), regardless of the type of input that is connected.

Communication Interface

Communication Interface Options

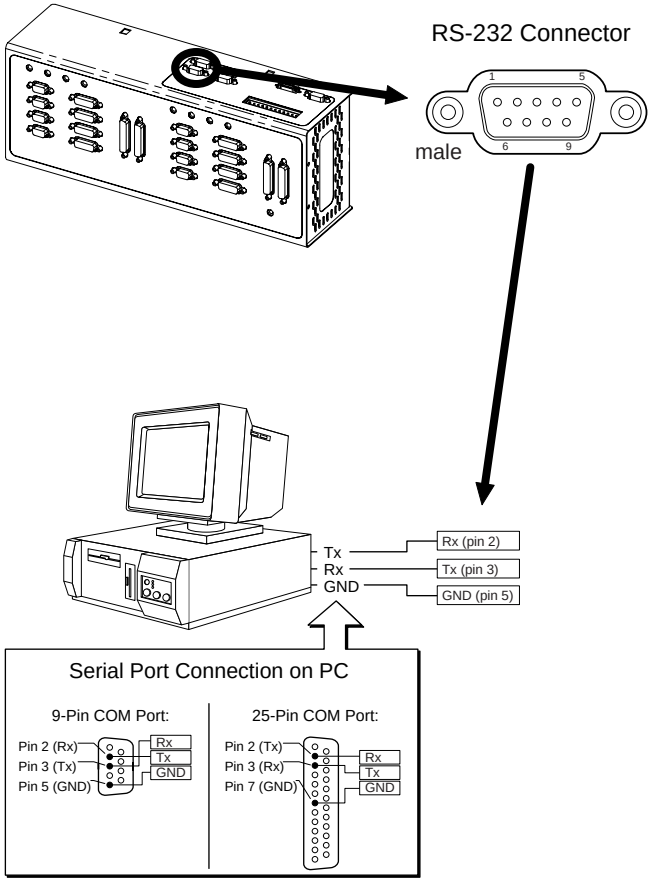


USING MULTIPLE PORTS

You can communicate to either the Ethernet port or the RS-232 port (COM1) at any given time; the port that you communicate to first is the only one that is recognized until you cycle power.

You can communicate to the Ethernet port or the RS-232 port (COM1) while the 6K is also communicating with an RP240 via the RS-232/485 port (COM2).

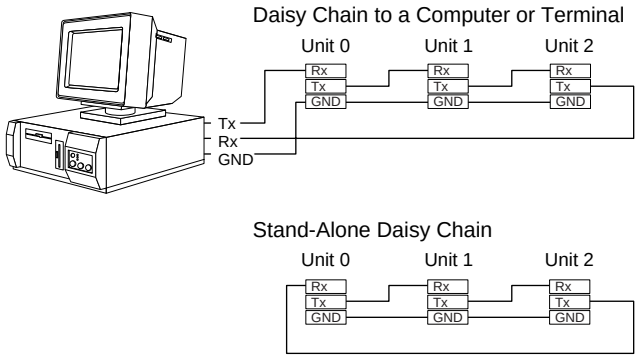
RS-232 Communication



PIN OUTS FOR RS-232 COMMUNICATION

Pin	Description
2	Rx (receive). Connect to Tx on your computer.
3	Tx (transmit). Connect to Rx on your computer.
5	GND (isolate ground). Connect to GND on your computer.

- Maximum RS-232 cable length is 50 feet (15.25 meters).
- The 6K, by default, communicates at 9600 baud. To change this setting, use the BAUD command.
- To establish unique addresses for daisy-chained units, use the ADDR command.

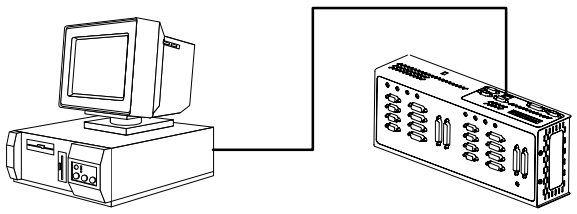


Ethernet Communication

NOTES

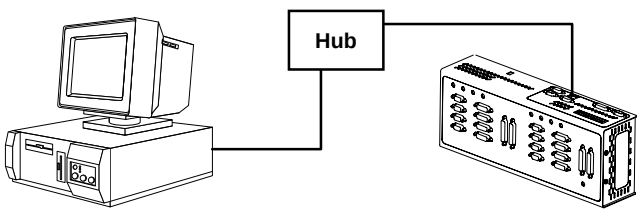
- Status LEDs:
  - Green LED is on when the Ethernet physical connection is OK.
  - Yellow LED is on when the 6K is transmitting over the Ethernet interface.
- Connect to a standard 10Mbps Ethernet card. IP address default is 192.168.10.30. To change the IP address, use the NTADDR command. To ascertain the Ethernet address, use the TNTMAC command.

Direct PC-to-6K Connection



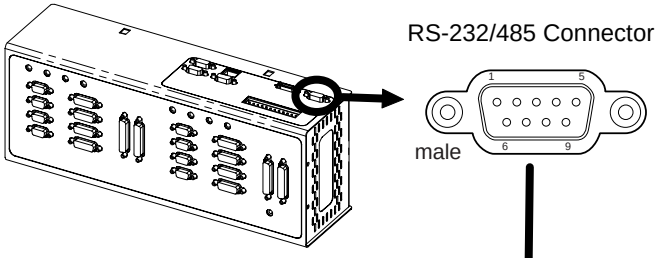
NOTE: Use a "Crossover" Ethernet (10Base-T) cable.
A 10-foot cable is provided in the ship kit (p/n 71-017635-01).

Network Hub Connection



NOTE: Use a "Straight-Through" Ethernet (10Base-T) cable.

RS-485 Communication

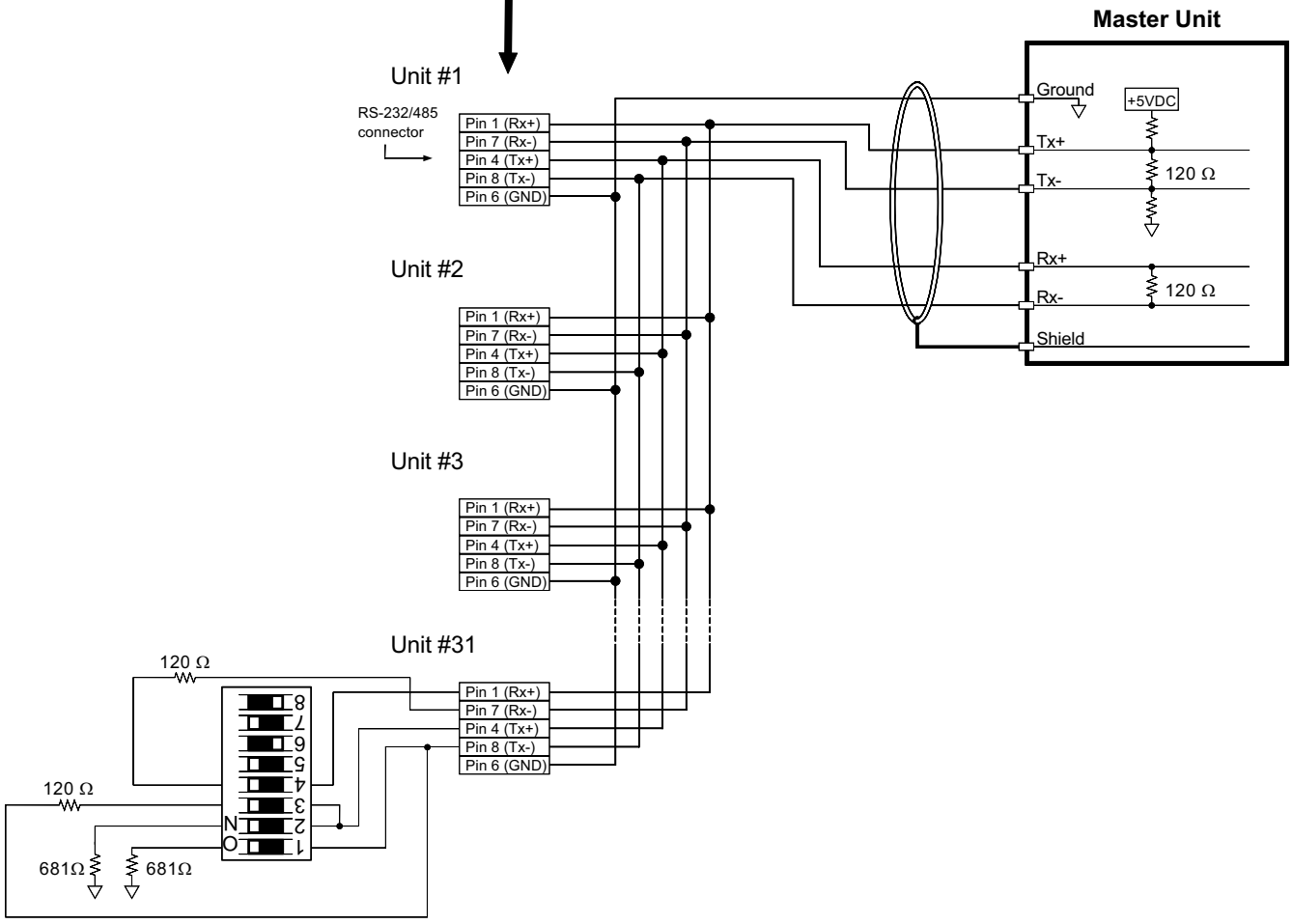


PIN OUTS FOR RS-485 COMMUNICATION

Pin	Description
1	Rx + (also called RD B)
4	Tx + (also called TD B)
6	GND (isolate ground)
7	Rx – (also called RD A)
8	Tx – (also called TD A)

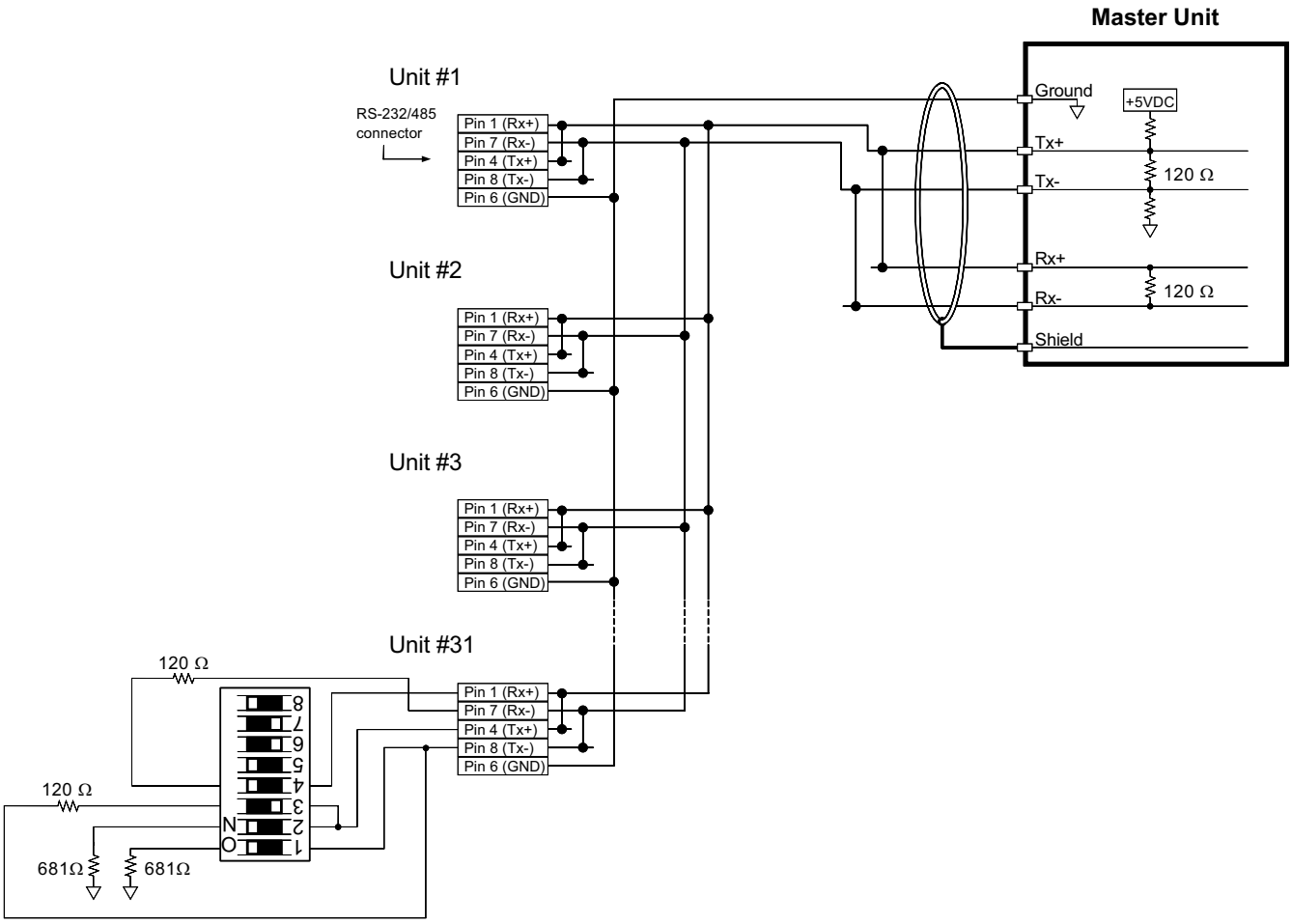
- Maximum RS-485 cable length is 4000 feet (1220 meters).
- To establish unique addresses for multi-drop units, use the ADDR command.
- Use termination resistors at both ends of the multi-drop. Keep stubs as short as possible.
- Recommended cables: 2-wire: Belden 9841
  4-wire: Belden 9842
- Refer to the diagrams below (or page 5) for necessary DIP switch settings for 2-wire and 4-wire configuration.

4-Wire Connections (plus ground):



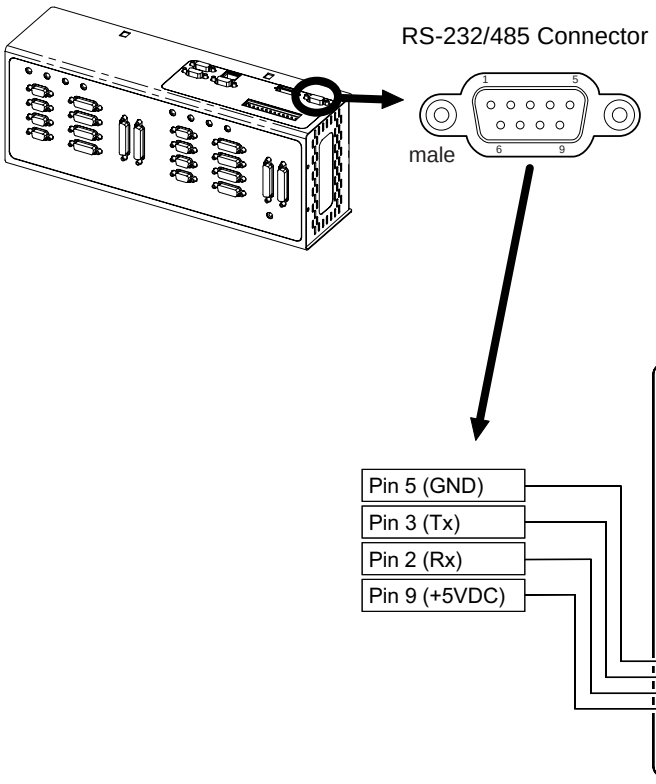
The DIP switch shown above is configured for RS-485 4-wire.
DIP switches 1-4 select internal resistor values (ON selects the resistor).
Use these resistors only for the last unit (or for a single unit).
Refer to page 5 for instructions on how to access and set the switches.

2-Wire Connections (plus ground):



The DIP switch shown above is configured for RS-485 2-wire.
DIP switches 1-4 select internal resistor values (ON selects the resistor).
Use these resistors only for the last unit (or for a single unit).
Refer to page 5 for instructions on how to access and set the switches.

RP240 Remote Operator Panel



NOTE FOR RS-485 USERS

If you configured the "RS-232/485" connector for RS-485 communication (see page 5), you must connect the RP240 to the "RS-232" connector.

NOTE: You will have to issue these commands to configure the "RS-232" connector for use with an RP240:

```
PORT1.....Select "RS-232" (COM1) as the affected port.
DRPCHK1 ....On power up, check for RP240 on COM1.
```

NOTE: Refer to the *Model RP240 User Guide* for RP240 specifications and mounting instructions.

Expansion I/O

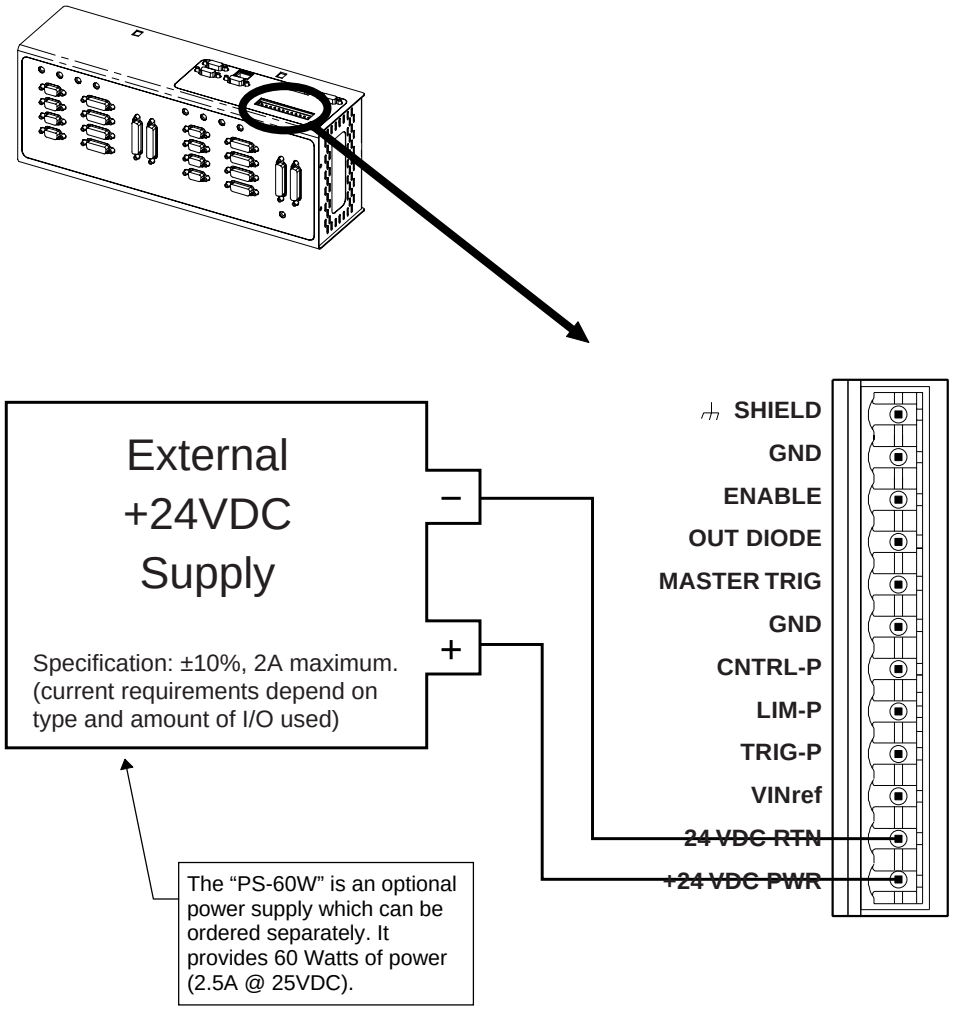
See Appendix B (page 43)

The 6K product allows you to expand your system I/O by connecting up to eight EVM32 expansion I/O bricks. EVM32 bricks are sold separately from the 6K controller. Each I/O brick can hold from 1 to 4 of these I/O SIM modules in any combination:

- Digital Inputs SIM (8 inputs)
- Digital Outputs SIM (8 outputs)
- Analog Inputs SIM (8 inputs)

Refer to page 43 for instructions on connecting the expansion I/O.

24VDC Power Input



Guide to Power Requirements

6K2 or 6K4..... 24 Watts (1A @ 24VDC)
6K6 or 6K8..... 36 Watts (1.5A @ 24VDC)
For each encoder..... Add 1.5 Watts
For each output..... Add ≤ 7.5 Watts (up to 300mA/output)

For example, a 6K4 with 4 encoders connected and 4 digital outputs (300mA @ 224VDC) requires 60 Watts of power.

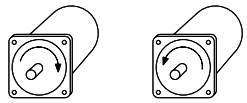
Testing the Installation

⚠ WARNING ⚠

This test procedure allows you to control your system I/O. Therefore, you should make sure that exercising the I/O will not damage equipment or injure personnel.

Test Setup:

1. If you haven't already done so, made the necessary communication connections (see page 24).
2. Install Motion Planner (CD is provided in your ship).
3. Launch Motion Planner and click on the "Terminal" window tab to view the terminal emulator. You now have live communication with the 6K product.

Connections	Test Procedure	Response Format (left to right)
End-of-travel and Home Limits	**NOTE**: If you are not using end-of-travel limits, issue the Disable Limits (@LHØ) command and ignore the first two bits in each response field. 1. Enable the hardware end-of-travel limits with the @LH3 command. 2. Close the end-of-travel switches and open the home switches. 3. Enter the TLIM command. The response should be *TLIM11Ø_11Ø_11Ø … 4. Open the end-of-travel switches and close the home switches. 5. Enter the TLIM command. The response should be *TLIMØØ1_ØØ1_ØØ1 … 6. Close the end-of-travel switches and open the home. 7. Enter the TLIM command. The response should be *TLIM11Ø_11Ø_11Ø …	TLIM response: bit 1 = Axis 1 POS limit bit 2 = Axis 1 NEG limit bit 3 = Axis 1 HOM limit bit 4 = Axis 2 POS limit bit 5 = Axis 2 NEG limit bit 6 = Axis 2 HOM limit and so on (3 inputs/axis) … "POS" means positive travel. "NEG" means negative travel. "HOM" means home.
Encoder (not coupled to the load or motor)	1. Enter these commands, (preset the RETURN key after each command): ENCCNT1, L, TPE, T.3, and then LN. This will begin a continuous display of all encoder positions. Press the RETURN key to move the display to the next line and save the current value. 2. 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. 3. When finished, enter the ^K (ctrl-K) command to stop the continuous report-back.	TPE response (encoder counts): ±encoder1, ±encoder1, … Direction of rotation:  Clockwise (positive counts) Counter-clockwise (negative counts)
Trigger Inputs	1. Open the trigger input switches or turn off the device driving the inputs. 2. Enter the TIN command. Response should be *TINØØØØ_ØØØØ_Ø or *TINØØØØ_ØØØØ_ØØØØ_ØØØØ_Ø. 3. Close the trigger input switches or turn on the device driving the inputs. 4. Enter the TIN command. Response should be *TIN1111_1111_1 or *TIN1111_1111_1111_1111_1.	TIN response: Bits 1-n, from left to right, represent trigger inputs 1-n. Bit #17 represents the Master Trigger ("MASTER TRG"). The 6K2 & 6K4 have 9 inputs, the 6K6 & 6K8 have 17 inputs.
Onboard Outputs	1. Enter the @OUT1 command to turn on (sink current on) all programmable outputs. Verify that the device(s) connected to the outputs activated properly. 2. Enter the TOUT command. Response should be *TOUT1111 or *TOUT1111_1111. 3. Enter the @OUTØ command to turn off all programmable outputs. Verify that the device(s) connected to the outputs de-activated properly. 4. Enter the TOUT command. Response should be *TOUTØØØØ or *TOUTØØØØ_ØØØØ.	TOUT response: Bits 1-n, from left to right, represent outputs 1-n. The 6K2 & 6K4 have 4 outputs, the 6K6 & 6K8 have 8 outputs.

RP240	1. Cycle power to the 6K.
	2. If the RP240 is connected properly, the RP240's status LED should be green and one of the lines on the computer or terminal display should read *RP24Ø CONNECTED. 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 *NO REMOTE PANEL, the RP240 Rx and Tx lines are probably switched. Remove power and correct.
	3. Assuming you have not written a program to manipulate the RP240 display, the RP240 screen should display the following:
	`COMPUMOTOR 6Kn CONTROLLER`
	`RUN JOG STATUS DRIVE DISPLAY ETC`
		ASSUMPTIONS
		• RP240 connected to the COM 2 ("RS-232/485").
		• COM 2 configured for RP240. To verify, type these commands:
		PORT2 <cr>
		DRPCHK<cr>
		The system response should report "*DRPCHK3".

Enable Input	1. Open the enable input (ENABLE) switch. 2. Enter the TINO command. Response should be *TINOØØØØ_ØØØØ. 3. Close the ENABLE switch. 4. Enter the TINO command. Response should be *TINOØØØØ_Ø1ØØ.	TINO response: bit 6 = Enable (ENABLE) input, all other bits are not used.

What's Next?

By now, you should have completed the following tasks, as instructed earlier in this chapter:

1. Check the ship kit to make sure that you have all the items (see page 3).
2. Review the general specifications table (see page 4).
3. (optional) Set internal DIP switches for using the "RS-232/485" connector as an RS-485 serial port (default function is RS-232 and configured for connection to an RP240).
4. Mount the 6K controller (see page 6).
5. Connect all electrical system components (see pages 8-29).
   Installation instructions for the EVM32 expansion I/O are provided on page 43.
6. Test the installation (see page 30).

NEXT …

1. Mount the motors and/or couple the loads.
2. Tune any servo axes. Use the tuning facility in Motion Planner (see page 51).

AND FINALLY …

After completing all necessary hardware installation tasks, you are ready to program your motion control functions. Knowing your system's motion control requirements, refer now to the *6K Series Programmer's Guide* for descriptions of the 6K's software features and instructions on how to implement them in your application. Be sure to keep the *6K Series Command Reference* at hand as a reference for the 6K Series command descriptions.

For assistance with your programming effort, we recommend that you use the programming tools provided in Motion Planner for Windows (found in your ship kit).

CHAPTER TWO

2 Troubleshooting

IN THIS CHAPTER

Troubleshooting Basics

When 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? Random events may appear to be related, but they are not necessarily contributing factors to your 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.

Once you isolate the problem, refer to the problem solutions contained in this chapter. If the problem persists, contact your local technical support resource (see *Technical Support* below).

Technical Support

If you cannot solve your system problems using this documentation, contact your local Automation Technology Center (ATC) or distributor for assistance.

If you need to talk to our in-house application engineers, please contact us at the numbers listed on the inside cover of this manual. (These numbers are also provided when you issue the `HELP` command.)

Solutions to Common Problems

NOTE

Some software-related causes are provided because it is sometimes difficult to identify a problem as either hardware or software related.

Problem	Cause	Solution
Communication (Ethernet) errors.	1. Ethernet card not installed correctly.	1. Refer to the user instructions that came with your Ethernet card.
	2. Ethernet or IP address conflict.	2. Refer to the configuration instructions in the *Programmer's Guide*.
	3. Connection to Ethernet port is compromised or miswired.	3. Check the connections according to page 24.
Communication (serial) not operative, or receive garbled characters. NOTE: Refer also to the diagnostic procedures on page 38.	1. Improper interface connections or communication protocol.	1. Check the connections according to page 24.
	2. COM port disabled.	2.a. Enable serial communication with the `E1` command. 2.b. If using RS-485, make sure the internal jumpers are set accordingly (see page 5). Make sure COM 2 port is enabled for sending 6K language commands (execute the `PORT2` and `DRPCHKØ` commands).
	3. In daisy chain, unit may not be set to proper address.	3. Verify proper application of the `ADDR` command.
Direction is reversed. (stepper axes only)	1. Direction connections to the drive are reversed.	1. Switch DIR+ with DIR- connection to drive (see page 15).
	2. Phase of step motor reversed (motor does not move in the commanded direction).	2. Switch A+ with A- connection from drive to motor. SOFTWARE ALTERNATIVE: If the motor (and the encoder if one is used) is reversed, use the `CMDDIR1` command to reverse the polarity of both the commanded direction and the polarity of the encoder counts).
	3. Phase of encoder reversed (reported `TPE` direction is reversed).	3. Swap the A+ and A– connection at the ENCODER connector.
Direction is reversed, servo condition is stable. (servo axes only)	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 drive or valve 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.
Direction is reversed, servo condition is unstable. (servo axes only)	1. Not tuned properly.	1. Refer to tuning instructions on page 51.
	2. Phase of encoder reversed or mounting of ANI input is such that it counts in the opposite direction as the commanded direction.	2. Software remedy for encoder feedback only: For the affected axis, issue `ENCPOL1`. Hardware remedy: If using encoder feedback, swap the A+ and A- connections to the 6K product. If using ANI feedback, change the mounting so that the counting direction is reversed.

Problem	Cause	Solution
Distance, velocity, and accel are incorrect as programmed.	1. Incorrect resolution setting.	1.a. Stepper axes: Set the resolution on the to match the 6K product's DRES command setting (default DRES setting is 25,000 steps/rev). 1.b. Match the 6K product's ERES command setting (default ERES setting is 4,000 counts/rev) to match the post-quadrature resolution of the encoder. ERES values for Compumotor encoders: Stepper axes: • RE, -RC, -EC, & -E Series Encoders: .... ERES4000 • HJ Series Encoders: ..... ERES2048 Servo axes (SM, N or J Series Servo Motors): • SM/N/JxxxxD-xxxx:..... ERES2000 • SM/N/JxxxxE-xxxx:..... ERES4000 Dynaserv (stepper and servo): • DR10xxB..... ERES507904 • DR1xxxE..... ERES614400 • DR1xxxA..... ERES819200 • DR5xxxB..... ERES278528 • DR5xxxA..... ERES425894 • DM10xxB ..... ERES655360 • DM1xxxA ..... ERES1024000 • DM1004x ERES655360
	2. Pulse width too narrow. (stepper axes)	2. Set pulse width to drive specifications using the PULSE command.
	3. Wrong scaling values.	3. Check the scaling parameters (SCALE1, SCLA, SCLD, SCLV, SCLMAS).
Erratic operation.	1. Electrical Noise.	1. Reduce electrical noise or move product away from noise source.
	2. Improper shielding.	2. Shield for noise immunity.
	3. Improper wiring.	3. Check wiring for opens, shorts, & mis-wired connections.
Feedback device (encoder or ANI) counts missing.	1. Improper wiring.	1. Check wiring.
	2. Feedback device slipping.	2. Check and tighten feedback device coupling.
	3. Encoder too hot.	3. Reduce encoder temperature with heatsink, thermal insulator, etc.
	4. Electrical noise.	4a. Shield wiring. 4b. Use encoder with differential outputs.
	5. Encoder frequency too high.	5. Peak encoder frequency must be below 12.0 MHz post-quadrature. Peak frequency must account for velocity ripple.
Joystick mode: Motor does not move.	1. Joystick Release input not grounded.	1.a. If an input is not assigned the "Joystick Release" input function, do so with the INFNCi-M command. 1.b. Ground the Joystick Release input.
	2. Improper wiring.	2. Check wiring for opens, shorts, and mis-wired connections.
LEDs:	*All other LED states indicate hardware*	
"POWER" LED is off.	1. No power.	1. Check 24VDC power connection and restore power.
"POWER" LED is red.	1. General fault. 2. ENABLE input not grounded.	1. Reset the controller by one of these methods: • Cycle power • Issue the RESET command 2. Ground the ENABLE input.
An "AXIS" LED is on (red).	1. Drive was commanded to shut down (DRIVE0). If Disable Drive on Kill mode is enabled (KDRIVE1), a kill command or kill input will also disabled the drive. 2. Servo Axes: Maximum position error (SMPER value) exceeded. Could be caused by disconnected or mismounted feedback device.	1. Re-enable the drive by sending a DRIVE1 command to the affected axis. 2. (verify position error by checking to see if TAS/TASF bit #23 is set) Check feedback device connection and mounting and re-enable drive by sending DRIVE1 command to the affected axis.

Problem	Cause	Solution
Motion does not occur.	1. “AXIS” LED is red, or “POWER” LED is off or red.	1. See LED troubleshooting as noted above.
	2. End-of-travel limits are active.	2.a. Move load off of limits or disable limits by sending the LHØ command to the affected axis. 2.b. Software limits: Set LSPOS to a value greater than LSNEG.
	3. Step pulse too narrow for drive to recognize (stepper axes only).	3. Set pulse width to drive specifications using the PULSE command.
	4. Drive fault level incorrect.	4. Set drive fault level using the DRFLVL command.
	5. Improper wiring.	5. Check drive fault & limit connections. Stepper Axes: check step and direction connections. Servo Axes: check command and shutdown connections.
	6. ENABLE input is not grounded.	6. Ground the ENABLE input connection.
	7. Load is jammed.	7. Remove power and clear jam.
	8. No torque from motor.	8. See problem: *Torque, loss of*.
	9. Max. position error (SMPER value) exceeded. (servo axes only)	9. Check to see if TAS/TASF bit #23 is set, and issue the DRIVE1 command to the axis that exceeded the position error limit.
	10. Drive has activated the drive fault input.	10. Check to see if TAS/TASF bit #14 is set, and check the drive fault level (DRFLVL).
Power-up Program does not execute.	1. ENABLE input is not grounded.	1. Ground the ENABLE input to GND and reset the product. (see page 9)
	2. STARTP program is not defined.	2. Check the response to the STARTP command. If no program is reported, define the STARTP program and reset (refer to the STARTP command description).
Runaway (SERVOS ONLY)	1. Direction connections reversed. (if encoder counts positive when turned clockwise or extended).	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 drive.
Torque, loss of.	1. Improper wiring.	1. Check wiring to the drive, as well as other system wiring.
	2. No power to drive .	2. Check power to drive.
	3. Drive failed.	3. Check drive status.
	4. Drive faulted.	4. Check drive status.
	5. Shutdown issued to drive.	5. Re-enable drive by sending the DRIVE1 command to the affected axis.

Resolving Serial Communication Problems

General Notes

- Power up your computer or terminal BEFORE you power up the 6K.
- Make sure the serial interface is connected as instructed on page 24. Shield the cable to earth ground at one end only. The maximum RS-232 cable length is 50 feet (15.25 meters).
- RS-232: Handshaking must be disabled. Most software packages allow you to do this.
- RS-485: Make sure the internal DIP switches are configured as instructed on page 5.

Test the Interface

1. Power up the computer or terminal and launch the terminal emulator.
2. Power up the 6K. A power-up message should be displayed, followed by a prompt (>).
3. Type "TREV" and press the ENTER key. (The TREV command reports the software revision.) The screen should now look as follows (if not, see Problem/Remedy table below).

```
*PARKER COMPUMOTOR 6K MOTION CONTROLLER

>TREV
*TREV92-016740-01-5.0 6K
```

Problem	Remedy (based on the possible causes)
No Response	• COM port not enabled for 6000 language communication. If RS-232 connected to "RS-232" connector : issue "PORT1" and "DRPCHKØ" commands. If RS-232 connected to "RS-232/485" connector: issue "PORT2" and "DRPCHKØ" commands. If RS-485 connected to "RS-232/485" connector: issue "PORT2" and "DRPCHKØ" commands.
	• Serial communication may be disabled; enable with the E1 command.
	• RS-232: Echo may be disabled; enable with the ECHO1 command.
	• If you are using an RS-232 connection between the host computer and the master 6K connected to multiple 6Ks in an RS-485 multi-drop, make sure the master 6K has these settings executed in the order given (you should place these settings in your power-up STARTP program): PORT1 (select RS-232 port, COM1, for configuration) ECHO3 (echo to both COM ports) PORT2 (select RS-232/485 port, COM2, for configuration) ECHO2 (echo to the other COM port, COM1)
	• Faulty wiring. See instructions on page 24. RS-485: verify internal DIP switch settings on page 5. Also check for shorts or opens.
	• Is the cable or computer/terminal bad? Here's a test: 1. Disconnect the serial cable from the 6K end only. 2. Connect the cable's Rx and Tx lines together (this echoes the characters back to the host). 3. Issue the TREV command. If nothing happens, the cable or computer/terminal may be faulty.
	• The controller may be executing a program. Issue the !K command or the <ctrl>K command to kill the program.
Garbled Characters	• Verify setup: 9600 baud (range is 9600-1200), 8 data bits, 1 stop bit, no parity; RS-232: Full duplex; RS-485: Half duplex (verify internal DIP switch settings on page 5).
	• RS-485: Transmission line not properly terminated. See page 5 for internal DIP switch settings. See page 24for connections and calculating termination resistors (if not using the internal resistors via internal DIP switches).
	• Faulty wiring. See instructions on page 24. RS-485: verify internal DIP switch settings on page 5. Also check for shorts or opens.
Double Characters	• Your terminal emulator is set to half-duplex; set it to full-duplex.

Product Return Procedure

Step 1

Obtain the serial number and the model number of the defective unit, and secure a purchase order number to cover repair costs in the event the unit is determined by the manufacturers to be out of warranty.

Step 2

Before you return the unit, have someone from your organization with a technical understanding of the 6K system and its application include answers to the following questions:

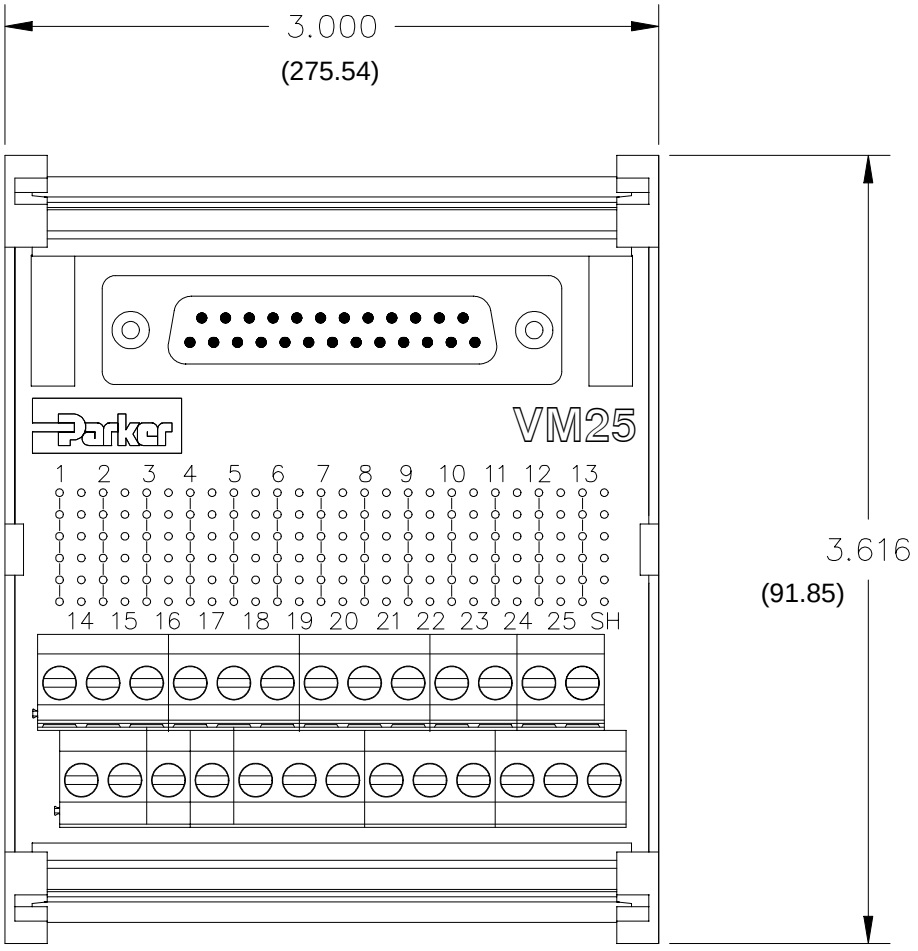
- What is the extent of the failure/reason for return?
- How long did it operate?
- Did any other items fail at the same time?
- What was happening when the unit failed (e.g., installing the unit, cycling power, starting other equipment, etc.)?
- How was the product configured (in detail)?
- Which, if any, cables were modified and how?
- With what equipment is the unit interfaced?
- What was the application?
- What was the system environment (temperature, enclosure, spacing, contaminants, etc.)?
- What upgrades, if any, are required (hardware, software, user guide)?

Step 3

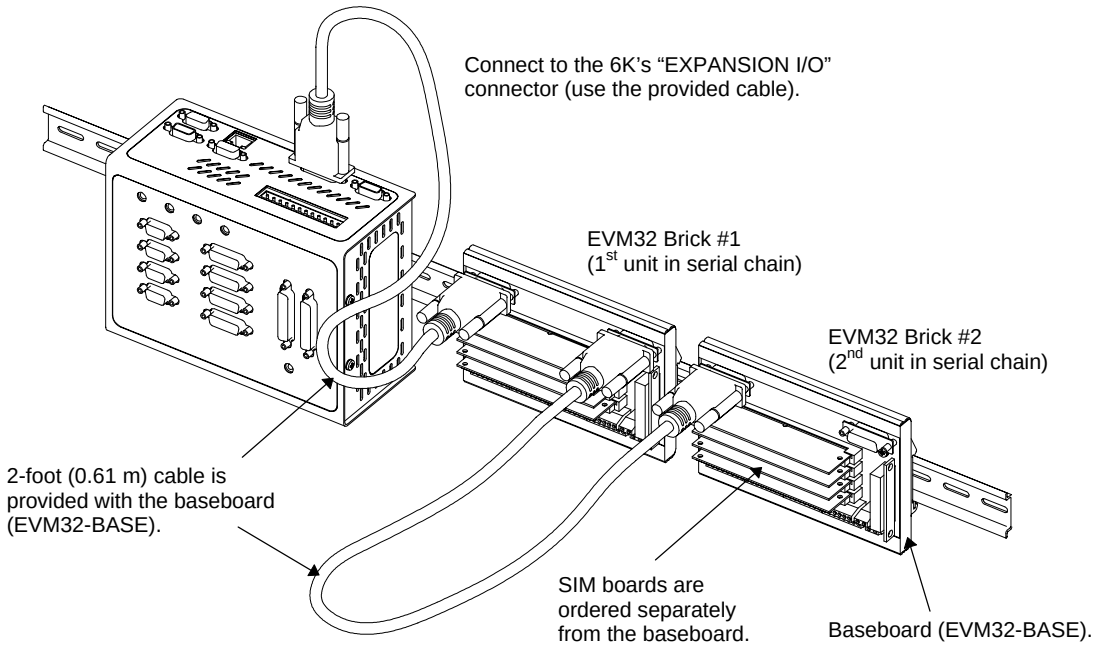
Call for return authorization. Refer to the *Technical Assistance* phone numbers provided on the inside front cover of this document. The support personnel will also provide shipping guidelines.

Appendix A. VM25 Installation

The VM25 provides screw-terminal connections for the I/O on the 25-pin connectors, which are the "TRIGGERS/OUTPUTS" and "LIMITS/HOME" connectors. The VM25 comes with a 2-foot cable that provides easy connection between the VM25 and the 6K's 25-pin connector. The VM25 is ordered separately (part number is "VM25").



Appendix B. EVM32 Installation



EVM32 Description

The EVM32 is a family of I/O modules (or "bricks") that is sold as accessories to the 6K Controllers. The purpose of the EVM32 is to provide more I/O than the 6K offers onboard. Up to eight DIN-rail mountable EVM32 bricks can be connected in a serial chain to the 6K. Each EVM32 brick can hold from 1 to 4 of these I/O SIM boards in any combination (each SIM board provides 8 I/O points, for a total of 32 I/O points per I/O brick):

- Digital inputs
- Digital outputs
- Analog inputs

Order an EVM32 brick and up to four I/O SIM boards per brick (see table below).

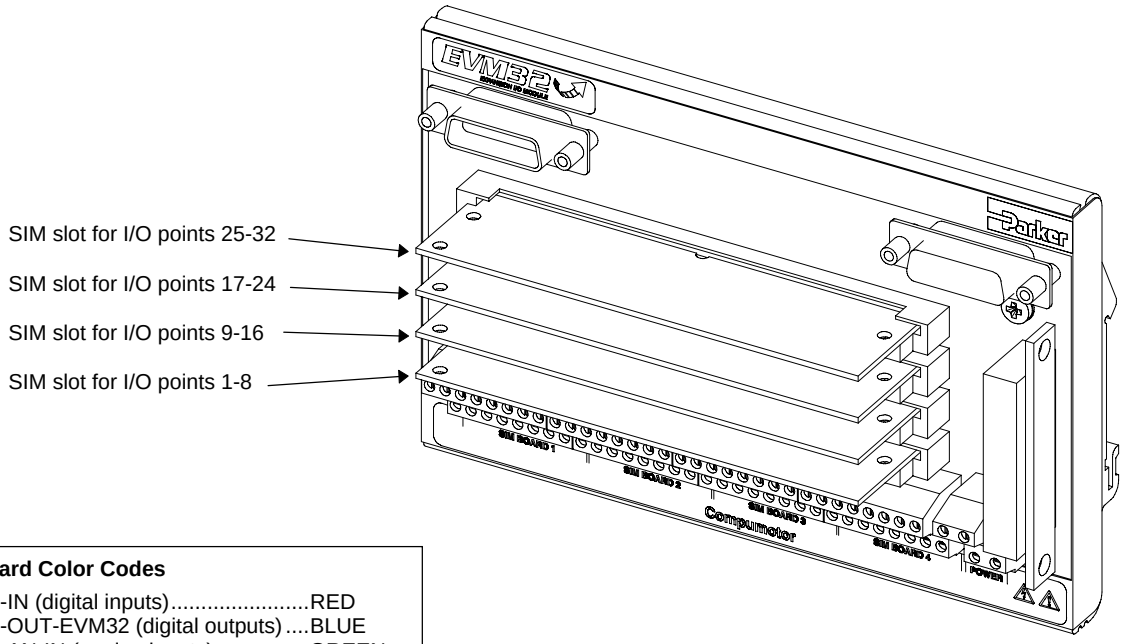
Product (p/n)	Description
EVM32-Base	EVM32 baseboard, extrusion with built-in DIN rail mount (includes 2-foot cable).
SIM8-IN	SIM board with 8 digital inputs. Color code: RED.
SIM8-OUT-EVM32	SIM board with 8 digital outputs. Color code: BLUE.
SIM8-AN-IN	SIM board with 8 analog inputs (12-bit, ±10V inputs). Color code: GREEN.
71-016949-02	2-foot cable for connection to 6K or between I/O bricks (included with EVM32-BASE).
71-016949-100	100-foot cable for connection to 6K or between I/O bricks.

EVM32 Specifications

Parameter	Specification
Power (DC input)	
V+	User-supplied voltage that drives output circuitry.
V+ range	12-24VDC.
V+ current	1.5A @ 12VDC or 0.75A @ 24VDC; plus the sum of the load current on outputs that are in sourcing mode.
Environmental	
Operating temperature	32 to 122°F (0 to 50°C)
Storage temperature	-22 to 185°F (-30 to 85°C)
Humidity	0 to 95% non-condensing
Dimensions	
EMV32 module	3.3 inches x 6.25 inches (83.82 mm x 158.75 mm)
Digital Inputs	
Switching levels	Low ≤ 1/3 V+ voltage; High ≥ 2/3 V+ voltage.
Voltage range	Voltage range = 0-24VDC. Voltage of input signals should not exceed voltage level of V+. (Input circuitry of EVM32 has diodes to protect against voltages that exceed V+, but performance may degrade.)
Sinking/Sourcing	Sinking: Connect jumper for selected SIM board to position 3 (factory default). Sourcing: Connect jumper for selected SIM board to position 1.
Impedance	6 KΩ, minimum. Requires input current (sinking or sourcing) of 0.111mA per volt of user-supplied voltage to V+ (e.g., 2.67mA if V+ = 24V).
Active level	Set by the 6K controller (`INLVL` command setting) — default is active low, but can be set to active high.
Input frequency	50 kHz (the maximum frequency is limited practically to 500 Hz by the 2 ms update rate of the 6K controller).
Status	Check with the `TIO` command.
Digital Outputs	
Sinking/Sourcing	Sinking: Connect jumper for selected SIM board to position 3 (factory default). Sourcing: Connect jumper for selected SIM board to position 1.
Voltage (sinking — jumper in position 3)	Output voltage level is less than or equal to 0.4VDC when sinking up to 50mA. (≤ 0.4 VDC for 50 mA). Output voltage level is less than or equal to 2.5VDC when sinking up to 300mA. (≤ 2.5 VDC for 300 mA).
Voltage (sourcing — jumper in position 1)	Output voltage level may be up to 2 volts less than the user-supplied voltage V+ when sourcing up to 50mA. Output voltage level may be up to 2.5 volts less than the user-supplied voltage V+ when sourcing up to 300mA.
Current	300mA maximum per output; continuous duty at 50°C ambient temperature.
Active level	Set with the `OUTLVL` command — default is active low.
Rise time, Fall time	Load dependent; typically 40ns per 1000 pF.
Under-voltage protection	The under-voltage lockout circuit is meant to prevent the output driver from sinking or sourcing when the user-supplied voltage at V+ drops below +5VDC.
Thermal shutdown	The thermal shutdown protection is intended to protect the device from marginal environmental factors. It must not be considered short circuit protection. The thermal resistance between the FET junction and the thermal protection circuit on the SIM cards is great enough that the rapid rise in junction temperature caused by a short circuit will not transfer fast enough to protect the device from damage.
Short-circuit protection	Digital outputs are NOT short-circuit protected.
Status	Check with the `TIO` command.
Analog Inputs	
Input voltage range	12-bit A/D converter, ±10VDC; unipolar/bipolar range selectable `ANIRNG` command. Unipolar: 0V to 10VDC, or 0V to 5V; Bipolar: -10 to +10V (factory default), or -5V to +5V.
Input current (worst case load)	Unipolar: 720µA @ 0V to 10VDC range; 360µA @ 0V to 5V range. Bipolar: -1200µA @ -10V and 720µA @ +10V; -600µA @ -5V and 360µA @ +5V.
Input dynamic resistance	Unipolar: 21KΩ; Bipolar: 16KΩ
Fault tolerance	±16.5V
Sample rate	Each input requires 2ms (e.g., 4 ms for 2 inputs, 16ms for 8 inputs); therefore, to maximize performance, you should disable unused inputs with `ANIEN` command.
Status	Check with the `TIO` command.

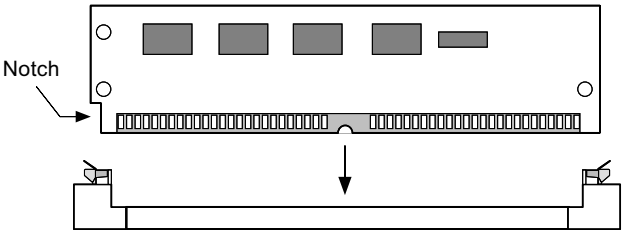
Installing the SIM Boards

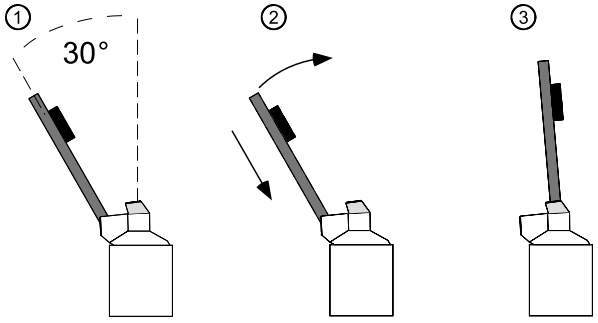
CAUTION: Remove power to the EMV32 baseboard before installing or removing SIM boards.



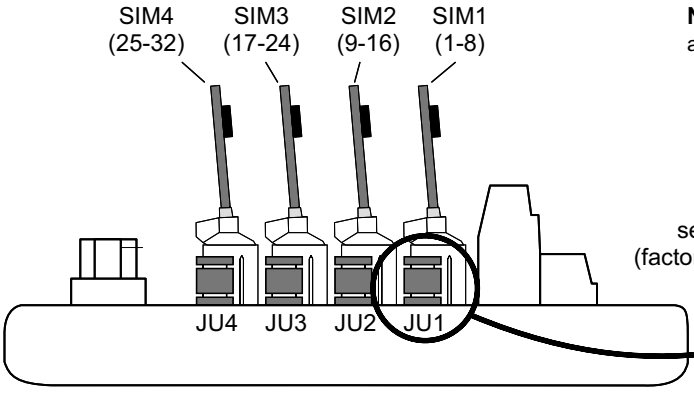
SIM Board Color Codes

SIM8-IN (digital inputs).....RED
SIM8-OUT-EVM32 (digital outputs)....BLUE
SIM8-AN-IN (analog inputs) .....GREEN

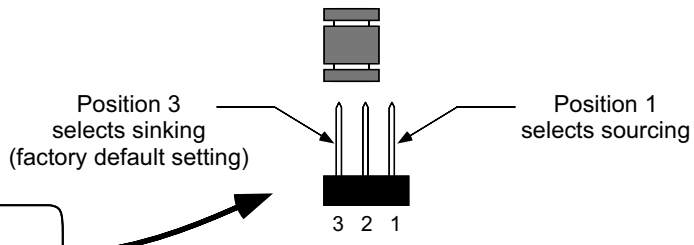




Setting Jumpers (selecting sinking/sourcing)



NOTE: The jumper setting affects only digital inputs (SIM8-IN) and digital outputs (SIM8-OUT-VM32).

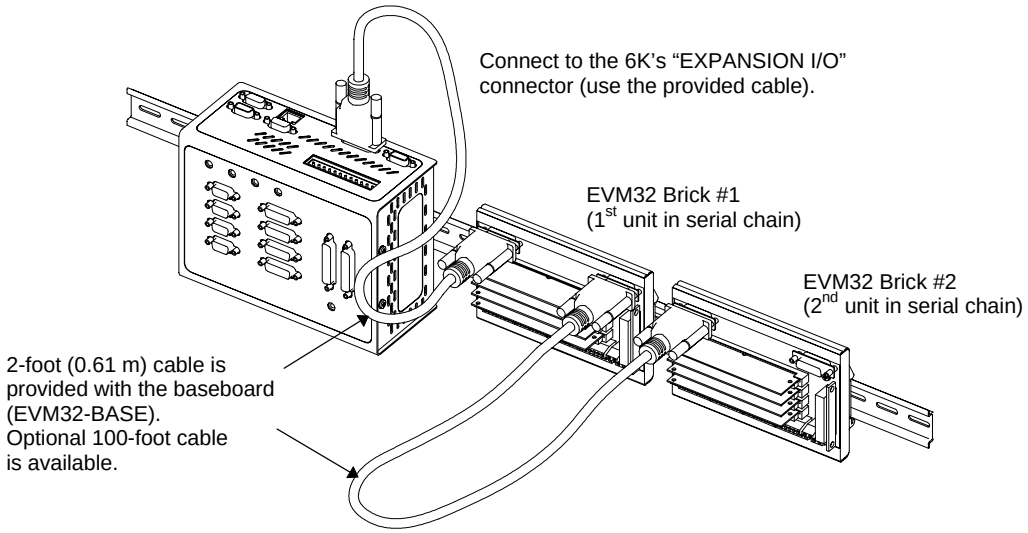


Electrical Connections

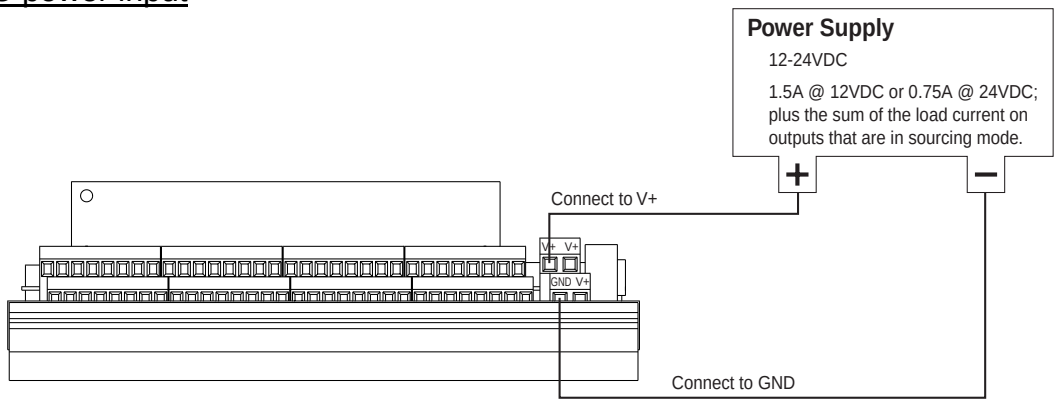
Connection to the 6K controller and between VM32 I/O bricks

> ⚠ **CAUTION** ⚠
>
> Remove power to the 6K controller and the EMV32 baseboard before connection or disconnecting the EVM32 baseboard to the 6K controller or to other EVM32 units.

If the VM32 I/O brick is disconnected (or if it loses power), the controller will perform a kill (all tasks) and set error bit #18. When the 6K controller powers up and detects an output SIM on a VM32, it will set the active level (`OUTLVL` command) according to the jumper setting selected. To check the status of one or more VM32 I/O bricks, use the `TIO` command.



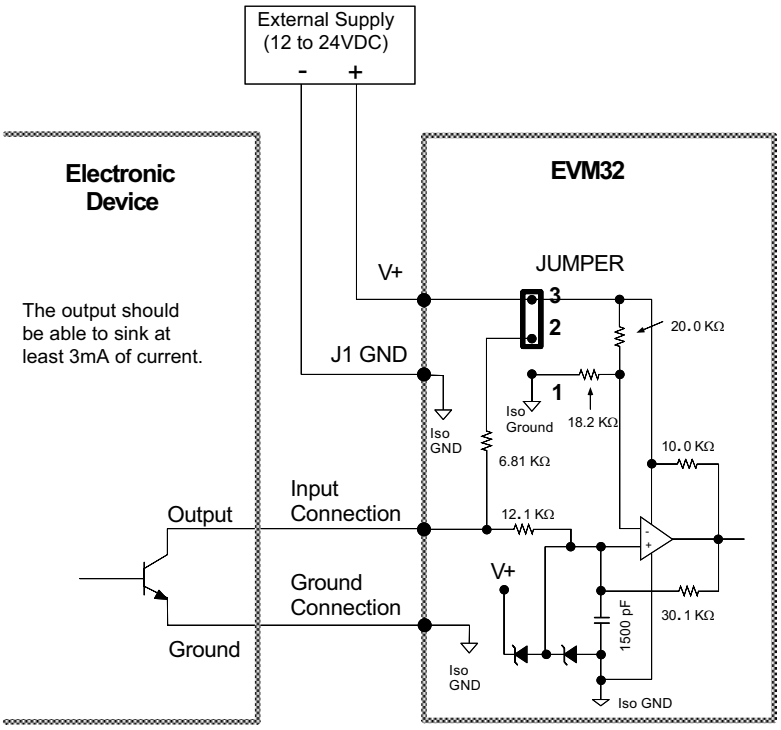
24VDC power input



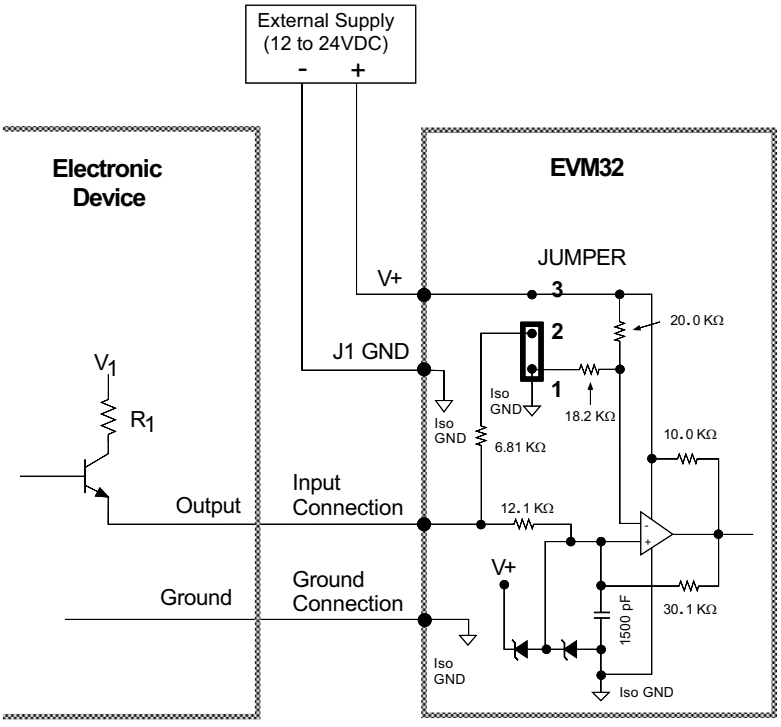
Digital Inputs

CAUTION: Remove power to the EMV32 baseboard before connecting I/O.

Sinking



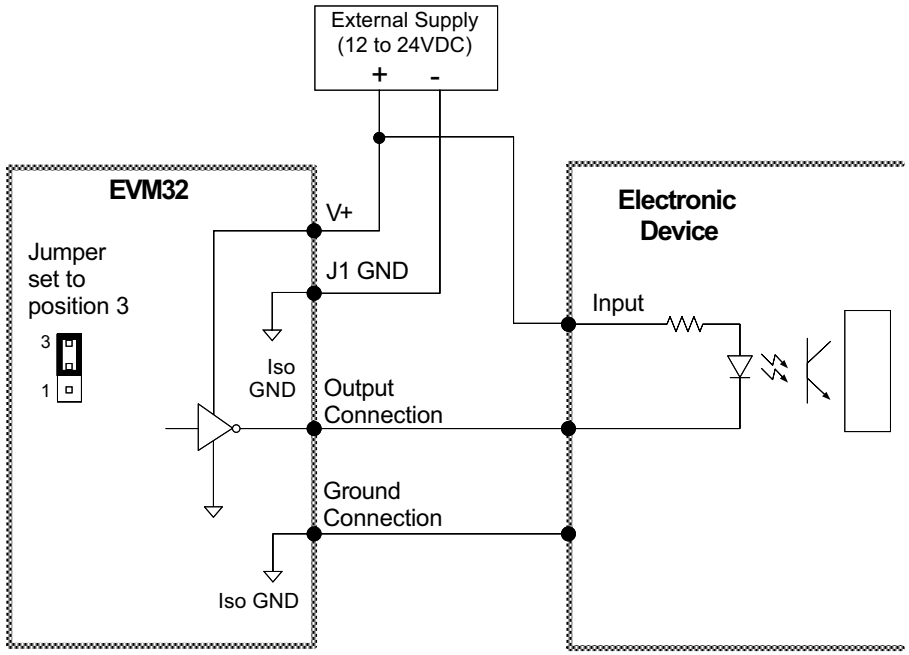
Sourcing



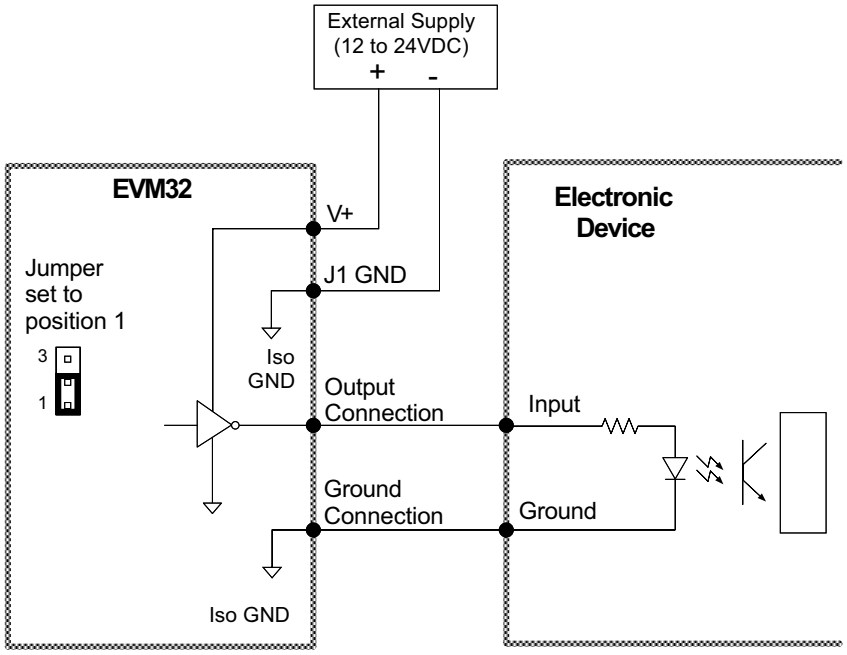
Digital Outputs

CAUTION: Remove power to the EMV32 baseboard before connecting I/O.
NOTE: Use an external diode when driving inductive loads. Connect the diode in parallel to the inductive load.

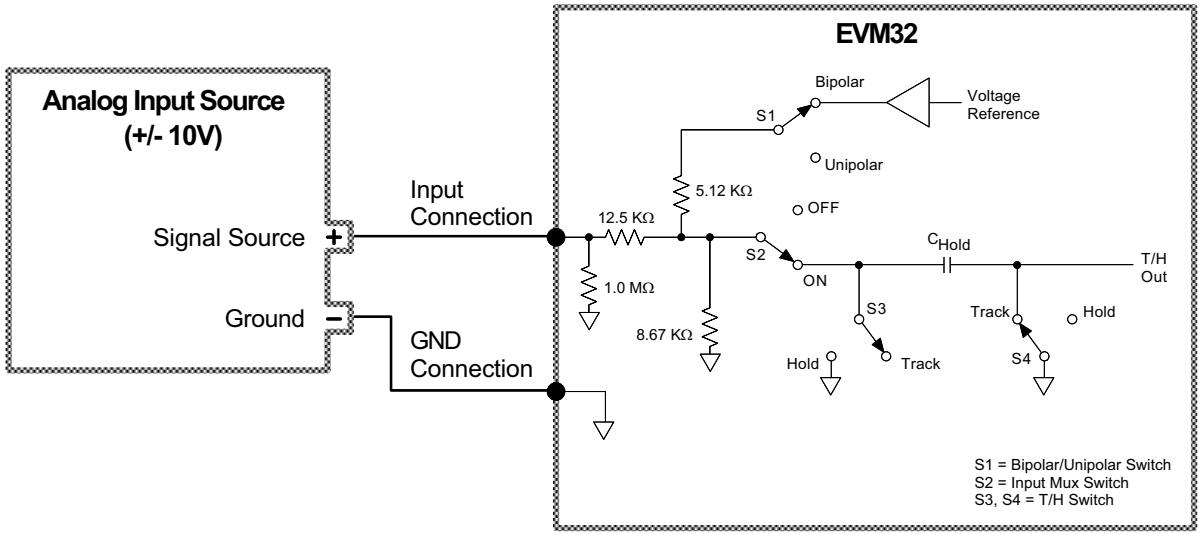
Sinking



Sourcing



Analog Inputs



Appendix C. Servo Tuning

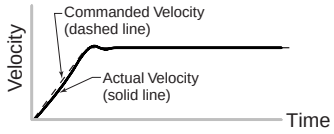
The tuning process is a subset of the controller setup process that Motion Planner helps you with in the Editor.

To assure optimum performance you should tune your servo system. The goal of the tuning process is to define the gain settings, servo performance, and feedback setup (see command list below) that you can incorporate into your application program. (Typically, these commands are placed into a setup program). Servo tuning should be performed as part of the application *setup process*, as described below.

To tune your servo system:

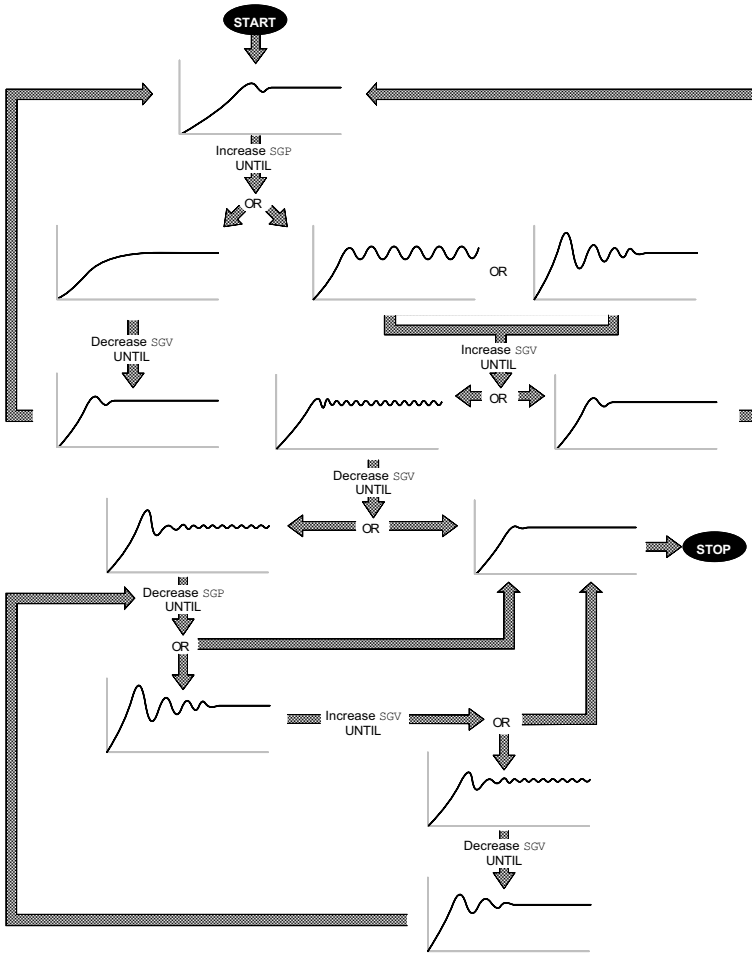
1. After you launch Motion Planner, you will see the Editor window. Click on one of the Application Wizard buttons to launch an application wizard. In the wizard, be sure to select "Setup Program". When you are finished with the wizard, icons for the selected program elements, including the Setup Program, will be placed in the Editor window. Double-click the Setup icon to launch the setup wizard. As you fill in the wizard screens, you will come to the Servo Tuner portion ...

1st Order Response:



2. Click the "Start" button to send the pre-programmed step output to the drive. Notice that the graph display draws the commanded and actual velocity profiles so that you can graphically tune your servo system.

   Optimize the proportional (SGP) and velocity (SGV) values by iteratively changing gains and viewing the results on the graph display. The object is to achieve a 1st order response (minimal overshoot and close position tracking). The typical process is:



3. Repeat step 2 for each axis.
4. Continue with the rest of the Setup wizard. When you finish the wizard, it automatically inserts the tuning gains, along with the other setup elements, into your setup program.

Tuning-Related Commands (see *6K Series Command Reference* for details)

Tuning Gains:

SGP ..... Sets the proportional gain in the **P**IV&F servo algorithm.

SGI ..... Sets the integral gain in the P**I**V&F servo algorithm.

SGV ..... Sets the velocity gain in the PI**V**&F servo algorithm.

SGAF ..... Sets the acceleration feedforward gain in the PIV&$\mathbf{F_a}$ algorithm.

SGVF ..... Sets the velocity feedforward gain in the PIV&$\mathbf{F_v}$ algorithm.

SGILIM..... Sets a limit on the correctional control signal that results from the integral gain action trying to compensate for a position error that persists too long.

SGENB ..... Enables a previously-saved set of PIV&F gains. A set of gains (specific to the current feedback source selected with the SFB command) is saved using the SGSET command.

SGSET ..... Saves the presently-defined set of PIV&F gains as a *gain set* (specific to the current feedback source on each axis). Up to 5 gain sets can be saved and enabled at any point in a move profile, allowing different gains at different points in the profile.

Feedback Setup:

SFB..... Selects the servo feedback device (encoder or analog input). To use analog input feedback, you must first use the ANIFB command to configure the targeted analog input to be used for feedback.
IMPORTANT: Parameters for scaling, tuning gains, max. position error (SMPER), and position offset (PSET) are specific to the feedback device selected (with the SFB command) at the time the parameters are entered (see programming examples in *Programmer's Guide*).

ERES ..... Encoder resolution.

SMPER ..... Sets the maximum allowable error between the commanded position and the actual position as measured by the feedback device. If the error exceeds this limit, the controller activates the Shutdown output and sets the DAC output to zero (plus any SOFFS offset). If there is no offset, the motor will freewheel to a stop. You can enable the ERROR command to continually check for this error condition (ERROR.12-1), and when it occurs to branch to a programmed response defined in the ERRORP program.

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