BLX Servo Drive Positioner
User Guide

Software Version: Issue 3.8 onwards

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IMPORTANT INFORMATION FOR USERS

Installation and Operation of Digiplan Equipment

It is important that Digiplan motion control equipment is installed and operated in such a way that all applicable safety requirements are met. It is your responsibility as a user to ensure that you identify the relevant safety standards and comply with them; failure to do so may result in damage to equipment and personal injury. In particular, you should study the contents of this user guide carefully before installing or operating the equipment.

Under no circumstances will the suppliers of the equipment be liable for any incidental, consequential or special damages of any kind whatsoever, including but not limited to lost profits arising from or in any way connected with the use of the equipment or this user guide.

SAFETY WARNING

High-performance motion control equipment is capable of producing rapid movement and very high forces. Unexpected motion may occur especially during the development of controller programs. **KEEP WELL CLEAR** of any machinery driven by stepper or servo motors. Never touch it while it is in operation.

This product is sold as a motion control component to be installed in a complete system using good engineering practice. Care must be taken to ensure that the product is installed and used in a safe manner according to local safety laws and regulations. In particular, the product must be enclosed such that no part is accessible while power may be applied.

User Guide Change Summary

The following is a summary of the primary changes to this user guide since the last version was released. This user guide, version 1600.137.05, supersedes version 1600.137.04.

When a user guide is updated, the new or changed text is differentiated with a change bar in the outside margin (this paragraph is an example). If an entire chapter is changed, the change bar is located on the outside margin of the chapter title.

Changes introduced at revision 05 are:

Minor additions to Chapter 2.

Table 2-2 Switch Type Selection added.

Chapter 3, software scaling explanation changed.

Chapter 4, using Windows™ terminal emulator added.

Chapter 5, note added to SSB command and following commands HELP 13 added.

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How To Use This Manual

This manual is designed to help you install, develop and maintain your system. Each chapter begins with a list of specific objectives that should be met after you have read the chapter. This section is intended to help you find and use the information in this manual.

Assumptions

This user guide assumes that you have the skills or fundamental understanding of the following:

- Basic electronics concepts (voltage, switches, current, resistors, etc.)
- Basic motion control concepts (torque, velocity, distance, etc.)

With this basic level of understanding, you will be able to effectively use this manual to install, develop and maintain your system.

Contents of This Manual

This user guide contains the following information:

Chapter 1: Introduction

This chapter provides a description of the positioner and a brief account of its specific features.

Chapter 2: Interfacing Signals

This chapter details the input and output signal connections to the positioner. It also describes the signal characteristics and shows examples of interfacing circuit arrangements.

Chapter 3: Basic Motion Control Concepts

For those unfamiliar with motion control systems, this chapter explains the basic concepts It will help you to become familiar with the system and provide a basis for understanding the use of the command set.

Chapter 4: Communicating with the Positioner

This chapter will enable you to set up communications with the positioner.

Chapter 5: Programming

Chapter 5 lists the motion control commands of the positioner. It describes their use and explains the variable parameters associated with them. You should study this chapter before starting to program the system.

Developing Your Application

Before you attempt to develop and implement your application, you should consider the following:

- Recognize and clarify the requirements of your application. Clearly define what you expect the system to do.
- Follow the guidelines and instructions outlined in this user guide. **Do not skip any steps or procedures.** Proper implementation can be ensured only if all procedures are completed in the proper sequence.

Chapter 1. INTRODUCTION

Chapter Objectives

The information in this chapter will enable you to understand the basic functions and features of the positioner.

Product Description

The positioner performs position control and indexing functions using an industry standard RS232C interface. It is easily controlled from computers, terminals and most programmable controllers.

The programming language is based on Digiplan's X-code and the positioner is capable of storing and executing complex motion programs from its non-volatile memory (battery backed-up RAM).

Features

- High speed operation
- RS232C command interface
- 1 to 8 devices can be daisy-chained on a single RS232C port using zero delay daisy chaining (ZDDC)
- 6K program memory for storing up to 63 sequences and parameters
- Automatic load and execution of motion programs (sequences) at power up
- Sequence execution can be initiated by external switches, computer, or programmable controller
- Sequence upload, download, and memory verification from the computer, or programmable controller
- Encoder following - the axis follows the encoder of another axis
- Encoder superposition - the motion is the sum of the encoder following input and an internally generated index.
- Optically isolated inputs for Home position, End-of-travel limits, Emergency Stop and jog functions
- 7 optically isolated user-definable inputs
- Programmable resolution
- Analogue outputs for signal monitoring

- 3 optically-isolated programmable outputs:-
  One configurable as user-programmable, watchdog output or composite fault output
  One configurable as user-programmable or as an in position output
  One is user-programmable only
- A 24v supply for opto-I/O is available
- Single LED combined fault indicator
- Registration mode
- Servo self-tuning

Front Panel Indicator

A red LED fault indicator is the only front panel indicator. It signals a number of fault conditions according to the number of times it flashes. Table 1-1 lists the fault conditions against the corresponding number of flashes.

LED indicator	Fault
Off	No fault
Flashes once	drive de-energised by ST1 or OFF Command
Flashes three times	EPROM changed with different memory map
Flashes four times	excessive following error
Flashes five times	memory failure - failed checksum
Flashes seven times	prolonged maximum torque demand
Flashes eight times	emergency stop input seen

Table 1-1. Fault LED Indications

Positioner Specification

Parameter	Value
Command Input	RS232C
Type	3-wire (Tx, Rx, Gnd). Minimum voltage swing = ±3V
Parameters	9600 baud, 8 data bits, 1 stop bit, no parity
Connector	Removable screw terminals
Configuration	Up to 8 interfaces can be controlled from a single RS232C port using zero delay daisy chain. Device address set up by jumper links on the board.
Operating Ranges	
Position	±1 to 268,435,455 steps
Velocity	0.0001 to 100 revs/sec
Acceleration	0.06 to 999,999 revs/sec^2
Maximum Encoder Frequency	100 kHz (lines/sec before multiplication)
Resolution Ranges	
Feedback encoder	1 to 32,767 counts/rev
User-programmed	1 to 32,767 steps/rev
Co-ordinate System	Incremental or absolute
Operating Modes	Preset, preset with speed change, continuous
Positioner Loop Update	Every 2 milliseconds
Motion Program Storage	
Memory Type	Battery-backed RAM
Memory Capacity	6400 characters total
Number of Programs	63
Program Length	Variable up to memory limit
Program Selection	a) Via RS232C, b) Automatic execution at power up, c) Binary address on sequence select inputs
Digital Servo Loop	
Update Time	500 microseconds
Servo Tuning	RS232C. Values stored in battery-backed RAM. Servo self-tuning facility.
Tuning Parameters	PIVF or PID options with digital filter
Opto-isolated I/P's	Home, Limits, jog ±, emergency stop, 7 user-definable inputs (also used for program selection):- 12-24V on max at 4mA. 30V off max. Max. reverse voltage -5V.
Optically-isolated O/P's	3 user-definable: can also be assigned as watchdog, In Position and Fault outputs. NPN open-collector, common to isolated ground. 300 mA on max. 30V off max. 2.5V at 300 mA max voltage in the on state.
Analogue Monitor O/P's	Velocity and position error. ±2.5V relative to interface 0V
Power Requirements	+5V, derived from the drive module

Table 1-2. Positioner Specification

Chapter 2. INTERFACING SIGNALS

Chapter Objectives

This chapter defines the electrical and functional requirements for all of the signals connected to the positioner.

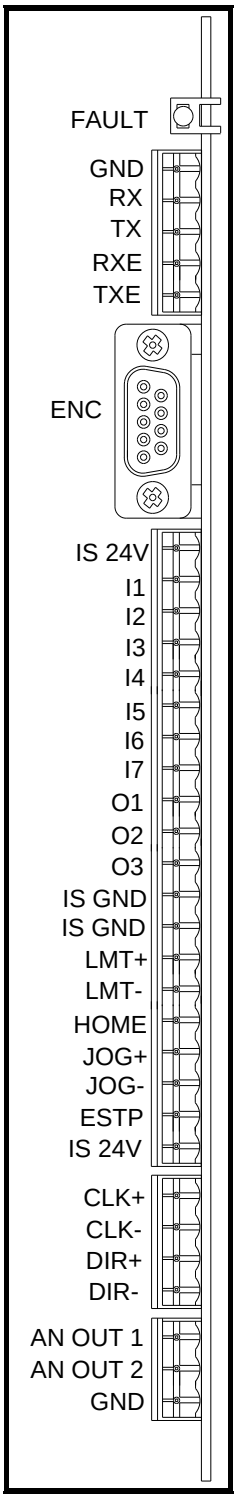

Figure 2-1. Signal Connections

Encoder Connector

Pin	Signal Name	Function	Signal Type
1	A+	ENC A CHANNEL	K
2	A-		
3	B+	ENC B CHANNEL	K
4	B-		
5	Z+	ENC Z CHANNEL	K
6	Z-		
7	5V ENC.	ENC SUPPLY	E
8	GND	ENC GND	E
9	GND	ENC GND	E

Main Connector

	GND	Signal ground	D
	RX	Receive input	C
	TX	Transmit output	C
	RXE	ZDDC receive line	C
	TXE	ZDDC transmit line	C

	IS 24VDC	Power supply (100mA max.)	
	I1	User input	A
	I2	User input	A
	I3	User input	A
	I4	User input	A
	I5	User input	A
	I6	User input	A
	I7	User input	A
	O1	Output 1	B
	O2	Output 2	B
	O3	Output 3	B
	ISOL GND	Power supply	F
	ISOL GND	Power supply	F
	LMT +	+Limit switch input	A
	LMT -	-Limit switch input	A
	HOME	Home switch input	A
	JOG +	+Jog switch input	A
	JOG -	-Jog switch input	A
	E stop	Emergency stop input	A
	IS 24VDC	Power supply (100mA max.)	

	CLK IN +	Clock input	I
	CLK IN -	Clock input	I
	DIR IN +	Direction input	I
	DIR IN -	Direction input	I

	AN OUT 1	Analogue output	G
	AN OUT 2	Analogue output	G
	AN GND	Analogue ground	H

Table 2-1. Positioner Signal Types

Key to Table 2-1

A Optically isolated inputs referenced to ISOL GND. 12-24V applied at input represents logic 1
B Open collector optically isolated outputs referenced to ISOL GND.The parameters of these outputs are:-
30V absolute maximum
300 mA absolute maximum
Maximum output voltage 2.5V at 300 mA
C RS232C data signals
D Interface 0v (RS232C)
E Encoder supply voltage (5v)
F Interface 0v
G Analogue monitoring output ±2.5v relative to GND(VE)
H Analogue monitoring ground
I Differential optically isolated inputs, TTL levels
K Differential optically isolated encoder inputs, TTL levels

Signal Descriptions

(Refer to Figure 2-1)

Encoder Input

Balanced differential line receivers are used on the A, B and Z inputs.

Clock

When clock and direction control is used, the clock signal controls the acceleration, deceleration and speed of the motor. It is a balanced input.

Direction

The two direction inputs + and - are balanced inputs controlling the direction of rotation when clock and direction control is used such that:

If the + input is positive with respect to the - input, the rotation is CW when viewing the shaft end of the motor.

If the positive input is negative with respect to the - input the rotation is CCW.

Inputs 1 to 7

These optically isolated connections can be read by the positioner for use by the controller. They can also be used for triggering sequences (see commands IS, TRE). Input I5 can be assigned as a controlled stop line using the command SSE. This input triggers an internal S command which interrupts all other indexing activity. Alternative functions can be assigned to inputs 4 to 7 as follows:-

Input 7 is a sequence select line if OSD is set to 1

Input 4 is a sequence select line if SSF is set to 1

Input 5 is stop input if SSE is set to 1

Input 6 clears a pause if SSB is set to 1

E stop

The ESTOP connection is a fail safe input which needs current to be sourced into it to keep the drive energised. It provides a hardware-only path to drive energisation. If current is momentarily stopped the resident positioner software will suppress re-energisation of the drive when the supply returns.

The ESTOP input must be physically connected to the +24V on I/O3, preferably through a normally closed emergency stop switch. This circuit arrangement is shown in Figure 2-9.

+ and - Limits

When activated, the + and - limit inputs trigger a controlled stop and prevent further movement in the same direction as the active limit (the convention is positive direction = CW rotation). These inputs need current sourced into them in order to allow motion in the specified direction. They can be disabled by the LD3 command. The system will not operate without limit switch connections or use of the LD3 command.

CAUTION

Damage may occur to the system mechanics due to excessive travel if the LD3 command is used. You should also ensure that clockwise rotation of the motor shaft (when viewing the motor from the shaft end) produces movement towards the + limit switch.

+Jog, -Jog

These inputs provide a switch activated method of moving in the positive or negative direction respectively at a constant velocity previously defined using the JV command.

The inputs can also be used as user definable inputs for input triggers etc.

Home

The home position is a reference position defined by the user and usually activated by a switch. The positioner can be programmed to search for (or datum to) this position.
See the GA, GHF, GH and PZ commands.

Output O1

If SSD is set to 0, O1 functions as a user defined output.
If SSD is set to 1, then this output becomes a composite fault indicator with a watchdog function. If the software for some reason

enters an illegal state, then the output will become high impedance and the drive will de-energise. The output sinks current during normal operation.

The Watchdog function is always operational. Even if SSD0 is selected, the output will still become high impedance and the drive will de-energise in the event of a watchdog timeout.

(See commands IO, O, SSD).

Output O2

If SSC is set to 0, O2 functions as a user-definable output.
If SSC is set to 1, O2 is configured to indicate "in-position".
The user defines the criteria for being in position using CIT and CEW commands.

(See commands IO, O, SSC, CIP and CEW).

Output O3

This is a user-definable output with no alternative fixed function.

AN-OUT 1

This is an analogue output for position monitoring. The output voltage is from +2.5V (representing a position error of 128 steps lagging the commanded position) to -2.5v (representing a position error of 128 steps in advance of the commanded position). The error corresponding to intermediate voltages is proportional to the full scale.

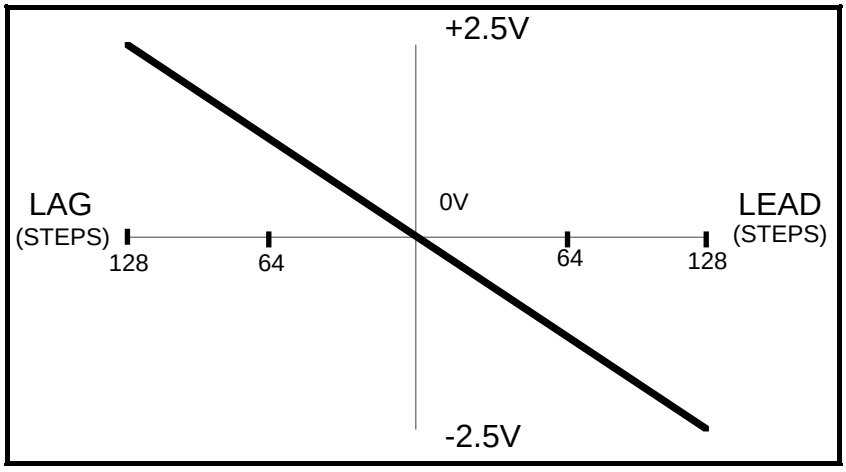

Figure 2-2. AN-OUT 1 Graph

AN-OUT2

This is an analogue output for velocity monitoring. The output is +2.5V (representing a CW speed of 256,000 steps/sec) to -2.5V (representing an CCW speed of 256,000 steps/sec). The speed corresponding to intermediate voltages is proportional to the

full scale.

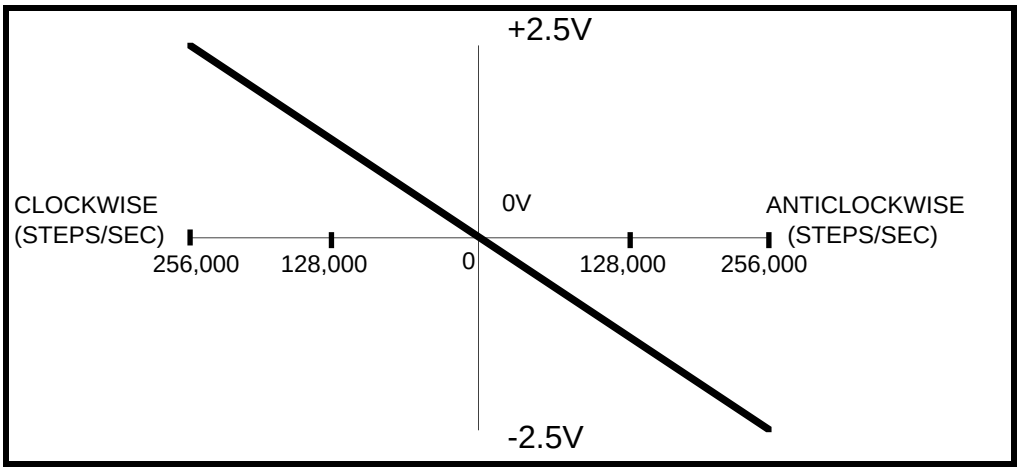

Figure 2-3. AN-OUT 2 Graph

Controller Connections

The RX input to accepts ASCII data from the controller at RS232C signal levels.

The TX output sends ASCII data from the positioner to the controller at RS232C signal levels.

The TXE and RXE connections are for connection to other positioners in the system using the Zero Delay Daisy Chain.

Encoder Connector

With jumper links 1 to 6 on the adaptor board (see Figure 4-3) in position B the positioner will respond to the encoder which is plugged into the Motor Feedback socket on the drive. With these jumper links in position A, the positioner will respond to a separate encoder which can be connected to this socket.

Interfacing Circuit Arrangements

This section describes some suitable circuits for interfacing to the positioner.

Figure 2-4 shows the general circuit arrangement of the inputs and outputs of the positioner. Both types of circuit are optically isolated to give immunity from noise and transients.

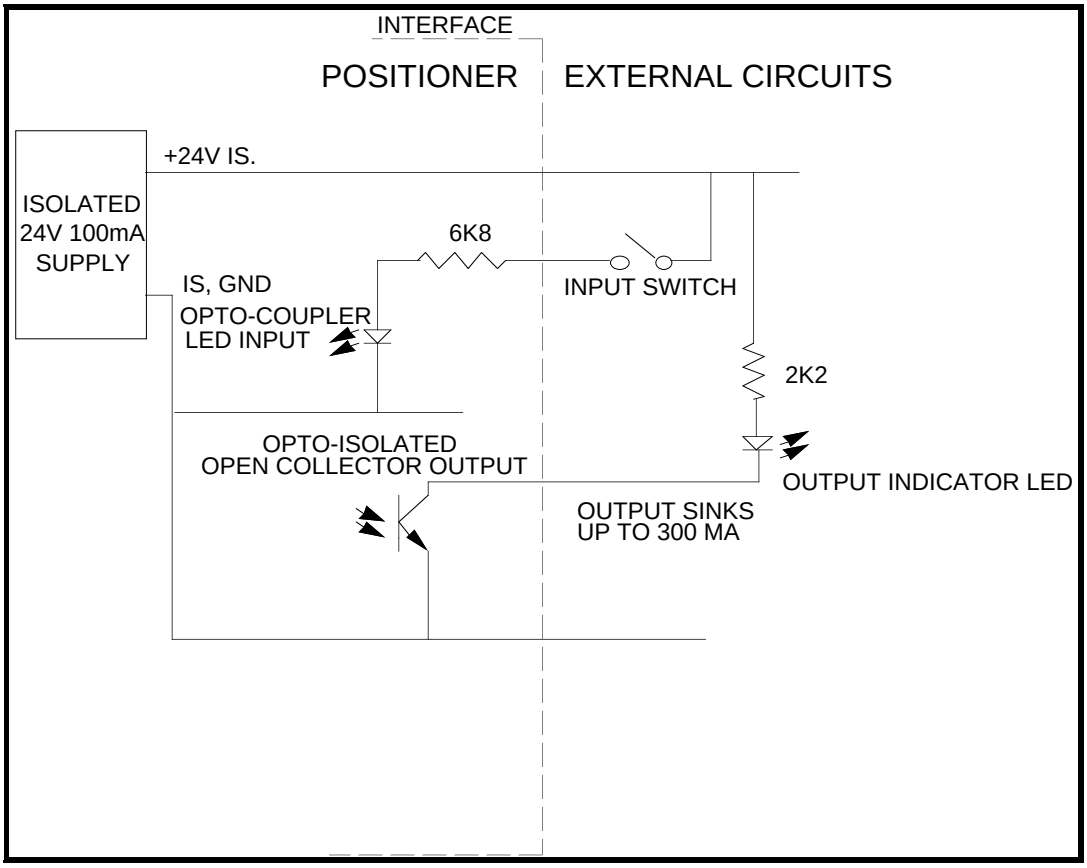

Figure 2-4. Inputs and Outputs - General Arrangement

Coupling Optically Isolated Outputs and Inputs

An output can be coupled to an input on another positioner as shown in Figure 2-5.This connection may be required when running sequences on two axes with a need to couple the two sequences. Using this arrangement, setting the output to 1 causes the open collector output transistor to turn on, diverting current from the input. With no input current, the input is at 0 level, so a data inversion occurs.

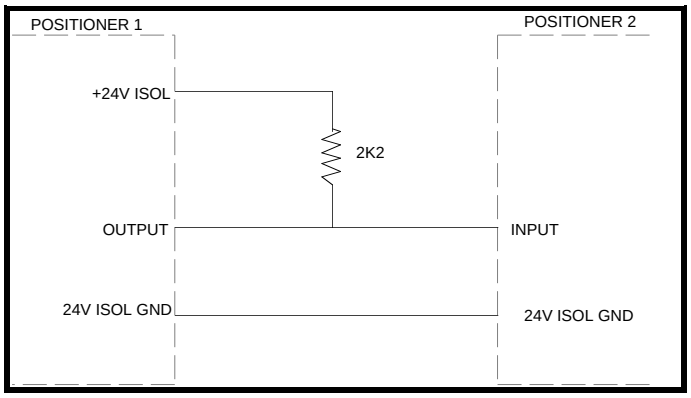

Figure 2-5. Input to Output Coupling

Clock and Direction Inputs

These balanced inputs may be driven from a single-ended output via a differential line driver such as the National Semiconductor DS8830, which accepts a TTL level input and provides a balanced output. Each of the two circuits in the DS8830 should have their four inputs connected together and to the input signal if this device is used (See Figure 2-6). Connecting the clock/direction source equipment ground to the positioner ground should be avoided since this would violate the isolation conditions.

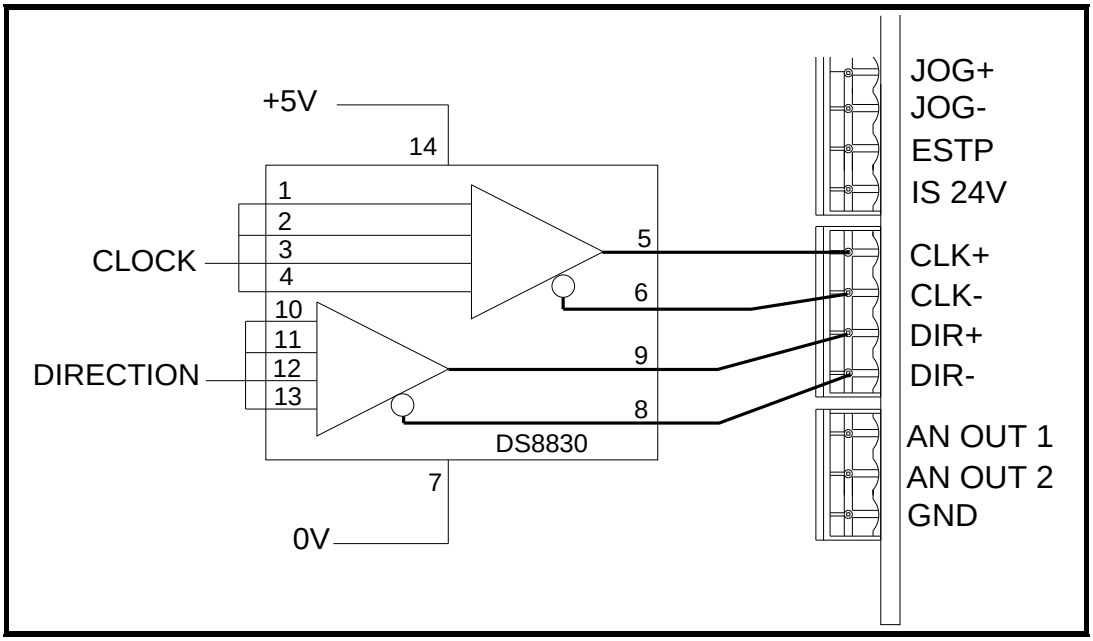

Figure 2-6. Clock and Direction Inputs

Limit and Home Inputs

Both limit inputs are optically-isolated, requiring to be connected to +24V when they are not operational. If disconnected or taken to 0V, they are operational and will prevent movement of the axis. Two methods of switching these inputs are shown in Figures 2-7 and 2-8. NPN proximity switches and mechanical switches are the examples shown. The limits can be disabled with the LD3 command.

The GO HOME function of the positioner is initiated by issuing the GO HOME (GH) command. When the command is issued, the direction in which it should search for home and the velocity must be included.

(See the GA, SS, SR, GHP and GHF commands).

A normally open, load activated switch to a current source is the most common way of detecting the home position (See Figure 2-7). When the positioner receives the command "GO HOME", it initiates a move in the direction and at the velocity specified, looking for the home limit input to change state.

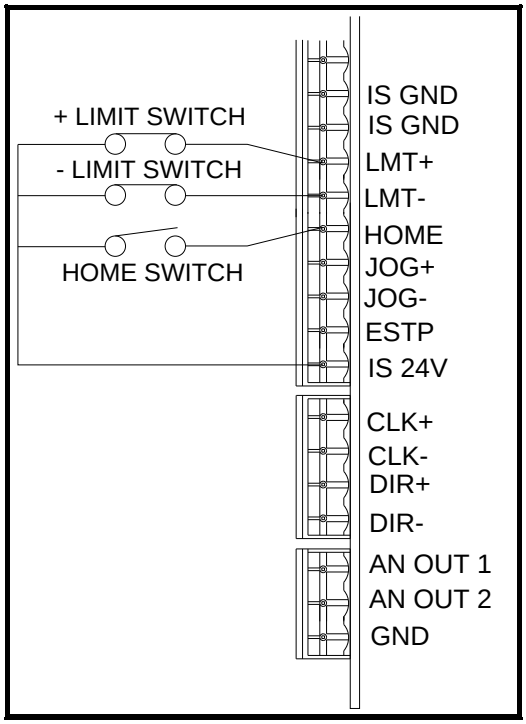

Figure 2-7. Limit and Home Switch Connections

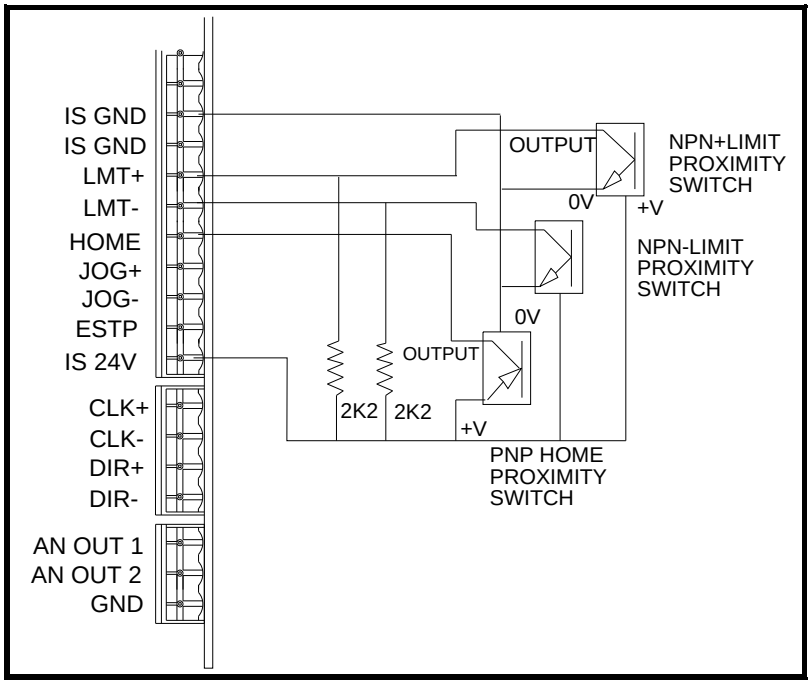

Figure 2-8. Limit and Home Proximity

Note the NPN limit switches shown in Figure 2-8 are normally open (the limit input is held inactive by the additional 2K2 resistor connected to the isolated +24V supply). Once a limit is reached the NPN transistor will turn ON, activating the limit input. Table 2-2 provides a summary of switch types for use as Home or EOT switching.

Usage	Logic	Switch type
HOME	PNP	N.O.
	NPN	N.C. use external resistor
END OF TRAVEL	PNP	N.C
	NPN	N.O. use external resistor

Table 2-2. Switch Type Selection

ESTOP Input

The ESTOP input must have current sourced to it to keep the drive energised. It is usually connected to the +24V supply via a normally closed push button as shown in Figure 2-9. If the push-button is pressed, the drive immediately de-energises.

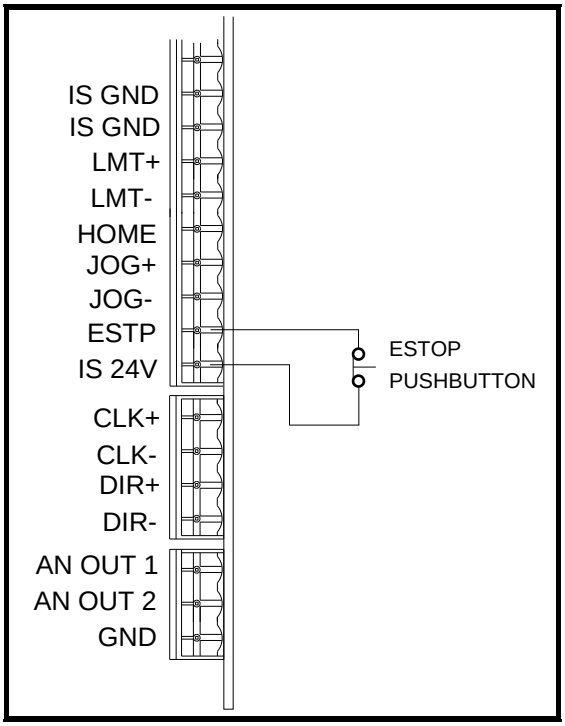

Figure 2-9. ESTOP Switch Connection

Trigger Inputs

The positioner has thirteen optically isolated inputs, any of which may be used as triggers with, for example, the TRE command.

The semi-dedicated inputs such as + and - jog must have their dedicated functions disabled when used as trigger inputs. They may be used either high true or low true but you must supply the inputs with 7 to 24 volts at 4mA per input to turn on the opto-isolators.The isolated 24V supply available at the edge connector may be used as shown in Figure 2-10.

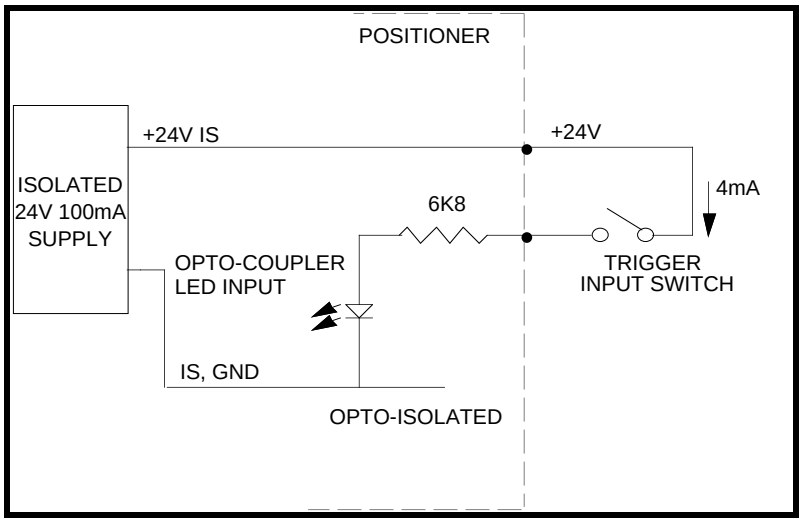

Figure 2-10. Trigger Input Connection

Jog Inputs

The jog switches provide manual control of the motor position when the jog function is enabled using the OSE command. The acceleration and speed of the motor when the jog switches are operated are set by the commands JA and JV respectively. Normally-open push buttons connected to the motherboard as shown below are frequently used for this function:

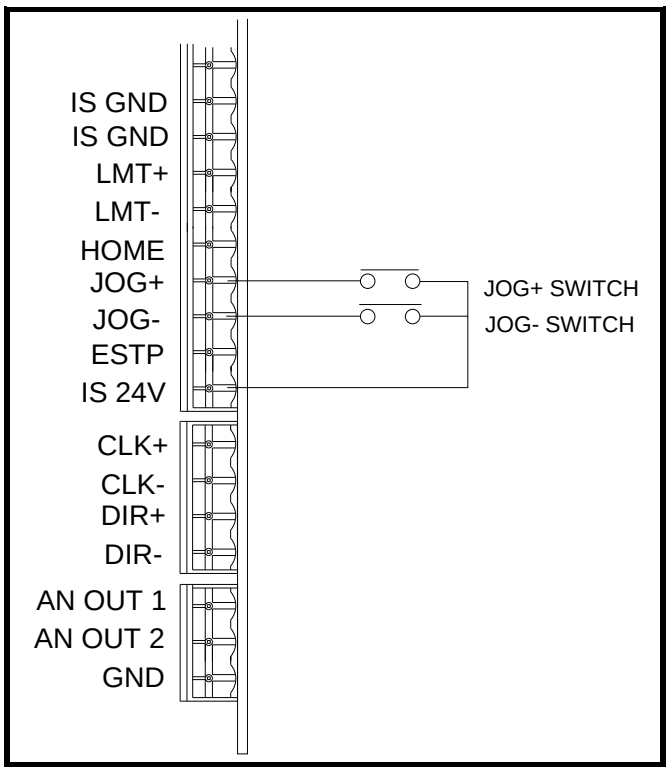

Figure 2-11. Jog Switch Connections

Composite Fault Indicator

The following example of a composite fault indicator requires Output 1 to be configured as a composite fault output. O1 sinks current while no fault exists and switches off if a fault occurs.

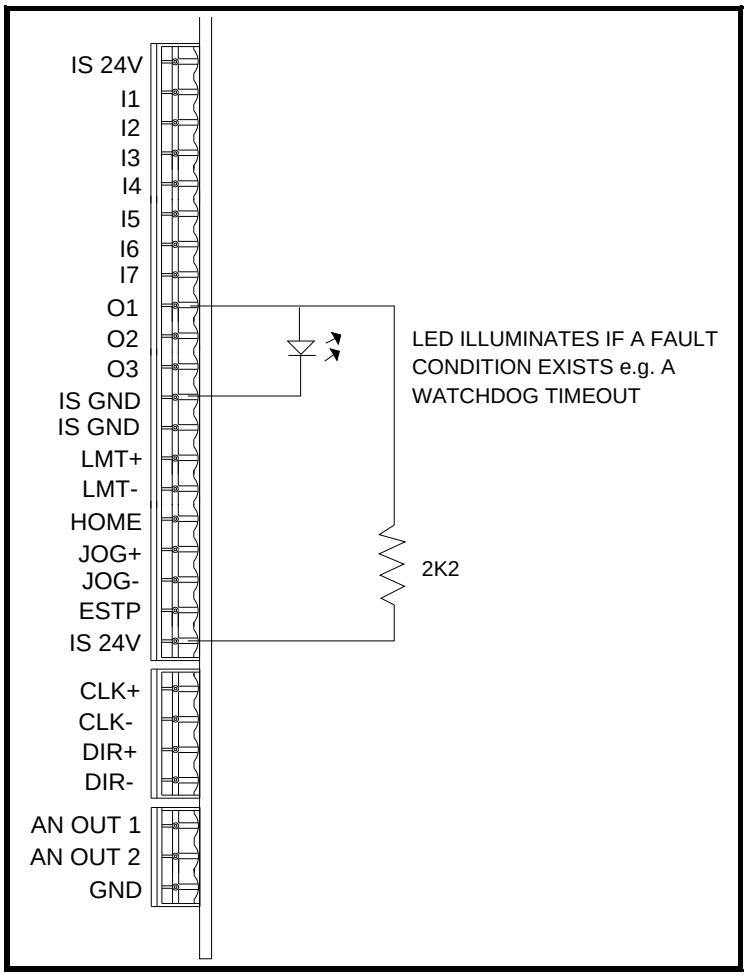

Figure 2-12. Composite Fault Indicator

In Position Indicator

The following example of an "in position" indicator requires O2 to be configured as an "in position" output by the SSC command. O2 sinks current while inside of the deadband and switches off when outside of it.

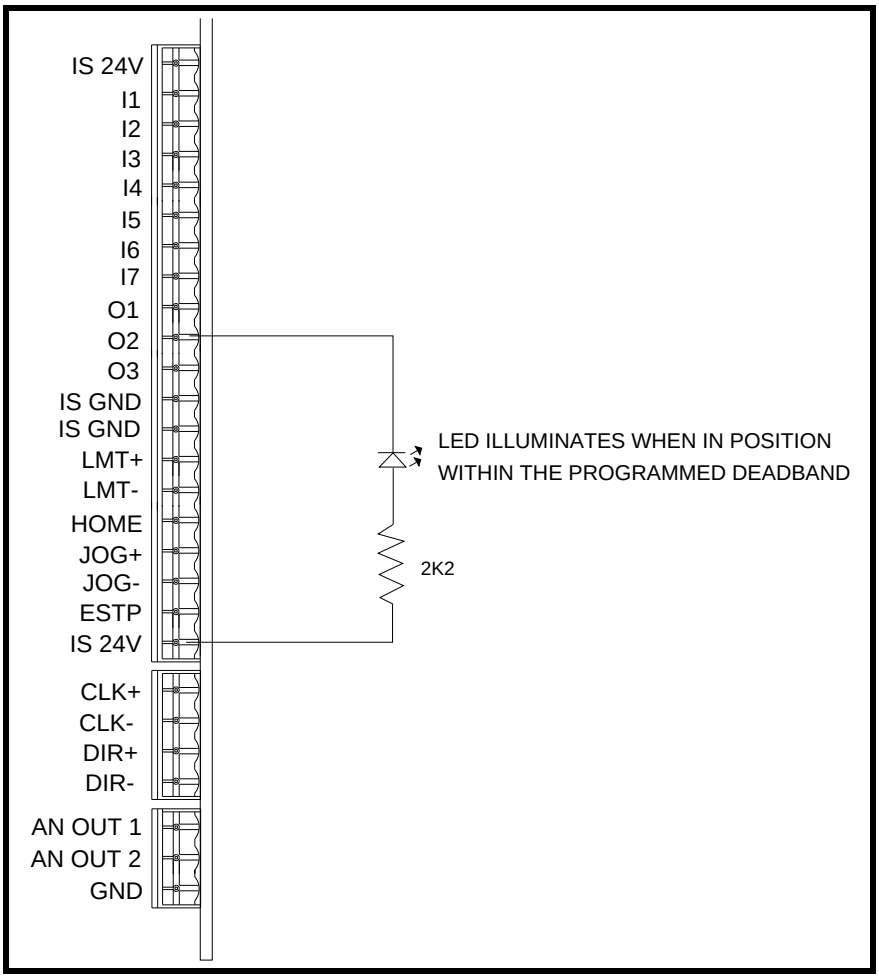

Figure 2-13. In Position Indicator