DC3IO Revision 040914 User Guide

1/11/07

Overview

The DC3IO is a three axis DC brush motor drive with an integrated PLC. A range of motor drive currents may be ordered, although 12 and 15 amps per axis configurations are the most popular. The PLC section includes 30 inputs, 31 digital outputs, and one analog output (see the PLC section for details). The DC3IO is operated by a CPU10 or compatible motion control card equipped with an IO2PIC. The DC3IO is an upgrade from the SERVO3IO, optimized for Centroid "S" series control systems.

DC3IO Features

Drive Application:	DC Brush Motors
Number of Axes:	3
Current rating per axis:	3 to 15 Amps
Motor Voltage:	30 to 120 Volts
PLC Inputs:	30
PLC Outputs:	31
Spindle Analog resolution:	12 bits
Control Interface:	5 fiber optics to CPU10 compatible motion control card with IO2PIC
Dimensions (W*D*H):	16 * 8 * 5.25 inches

Drive Section

The DC3IO drive section is based on Centroid's proven DC brush motor drive technology. Several built in features allow for easy integration with a variety of hardware.

Each axis can be built with a range of current ratings determined by the windings on the current sensor. Current ratings of 3, 6, 9, 12, and 15 amps can be provided on the DC3IO.

Open collector output drivers are provided for a brake on each axis (see "DC3IO Connections" and "PLC Section" for wiring details). The brake output drivers can be wired to a 5 volt relay to release motor brakes when each axis is enabled.

A drive fault relay output is provided for connection of the E-stop power loop. The relay contacts stay closed as long as valid data is received on drive fibers 4 and 5 and no serious faults exist.

An analog current request output is provided on the 3rd (Z on a mill) axis for running third party drives. This feature is particularly useful for C axis lathe applications. The current request signal swings from –10 volts to +10 volts and is centered at 0 volts. This signal is used for spindle control in positioning mode. See the "DC3IO Connections" page to locate the C axis analog and C axis common pins.

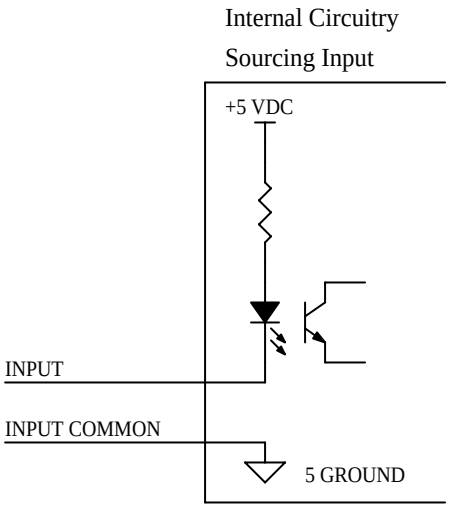
PLC Section

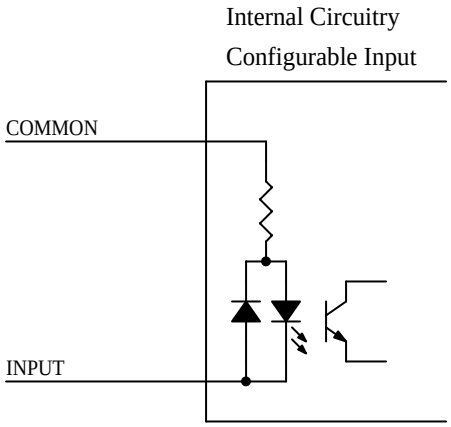
The DC3IO has 30 inputs, 31 digital outputs, and one analog output. Some I/O is dedicated to a particular function, but 21 inputs and 29 digital outputs can be used for any purpose. See the "DC3IO I/O Map" for an overview.

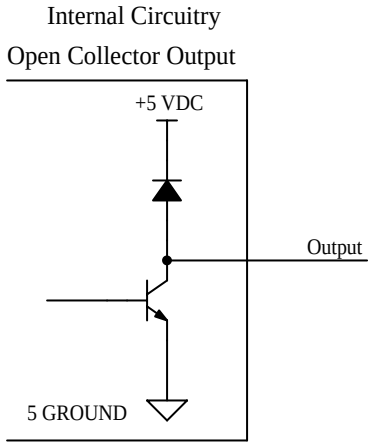
Twelve inputs are configurable types, 16 are sourcing, and 2 are internally wired. The internal drive fault and error check inputs are dedicated and not user definable. X-, X+, Y-, Y+, Z-, and Z+ limit inputs are not configurable for other uses since they are hard wired to drive circuitry that inhibits axis motion. The emergency stop input is also dedicated and has increased pull up current. The 21 remaining inputs can be configured for special purposes if necessary.

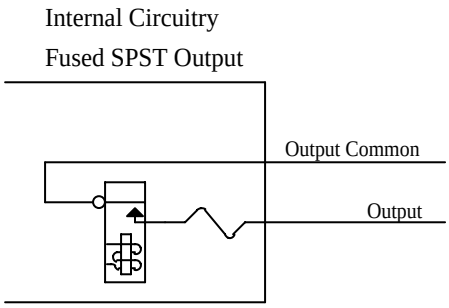
Several output types are used on the DC3IO. Relay outputs are provided for common functions. Signal relays are used on spindle outputs to provide a reliable connection on low level outputs when connecting an inverter. Fused power relays are provided for the rotary clamp and other higher level outputs. Outputs that are not used on many systems are open collector type. These outputs will usually need to drive an external 5 volt relay to interface with higher power devices. Check the "DC3IO I/O Map" and "DC3IO Specifications" sections to determine an output's type and capability. The spindle direction output is not available for other uses. The spindle analog section uses this output to determine polarity when configured as a bipolar output (-5 to +5 or –10 to +10). Internal error checking and spindle speed bits are also dedicated, leaving 29 outputs definable for custom uses.

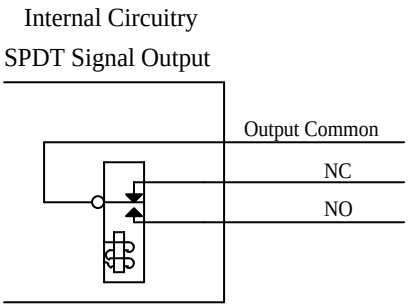
The DC3IO analog output for spindle control has a 12bit resolution. This should not be confused with the C axis analog output described in the "Drive Section". Four analog output ranges can be selected. See the "Spindle Analog Output Adjustment" section for jumper settings.

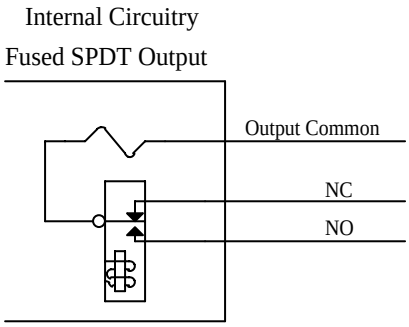


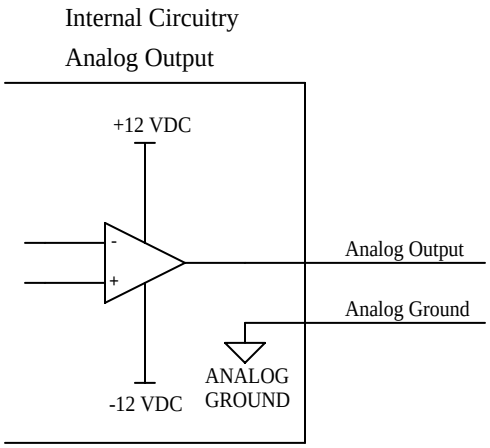










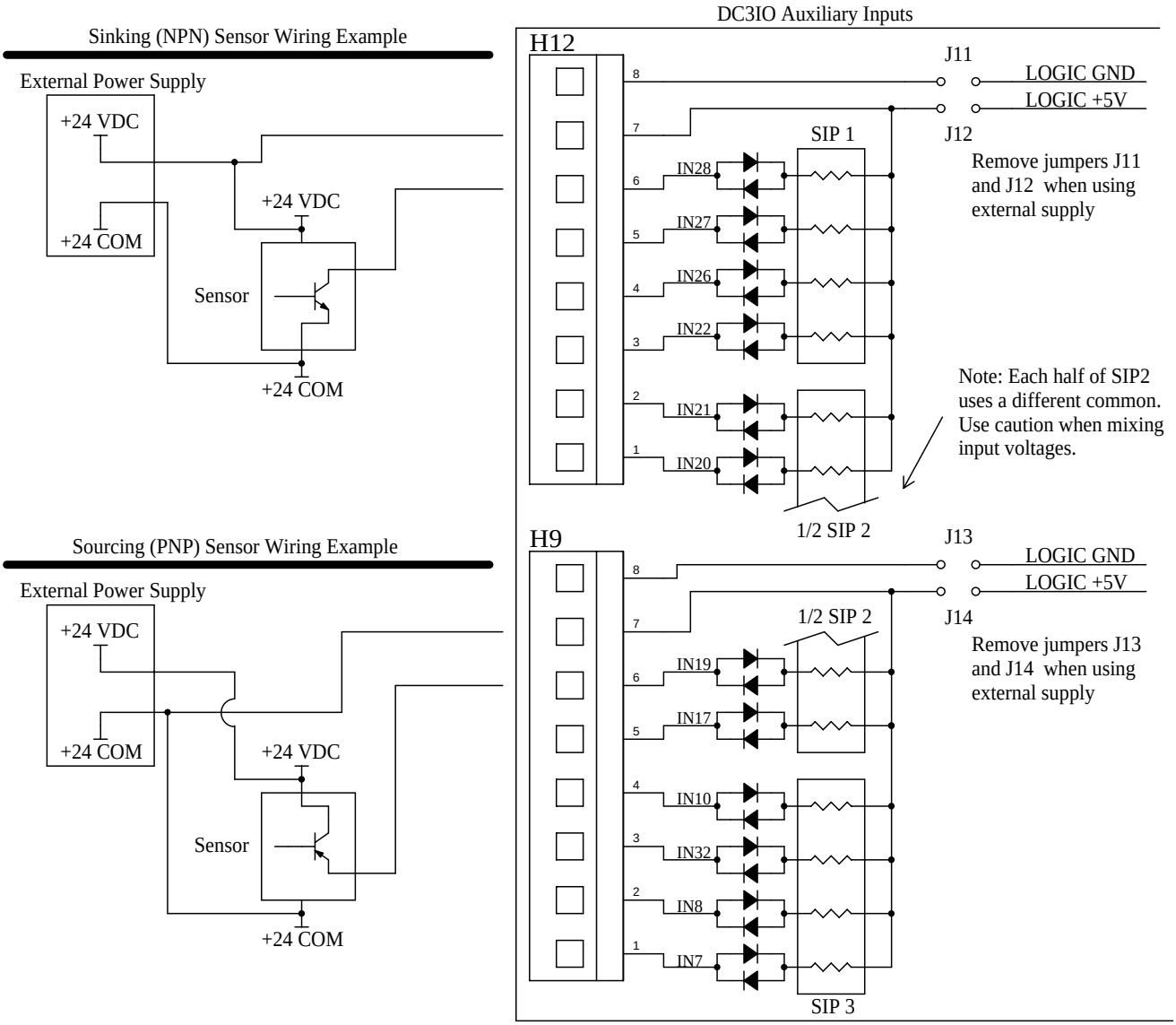


Auxiliary Configurable Inputs

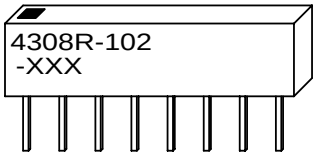
Configurable inputs are available through the auxiliary input connectors for custom applications. These inputs can be used with 5, 12, or 24 VDC sensors or switches. Compare the specifications of sensors to the "DC3IO Specifications" chart to ensure reliable operation. Resistor packs SIP1, SIP2, and SIP3 must be changed to match the input voltage for auxiliary inputs. Sinking or sourcing operation is determined by the wiring configuration.

Jumpers J11 through J14 may be installed to power the inputs from the DC3IO's logic power supply. External power may be wired through pins 7 and 8 of H12 and H9. Make sure there are no jumper blocks on J11, J12, J13, or J14 before applying external power, or the DC3IO will be damaged.

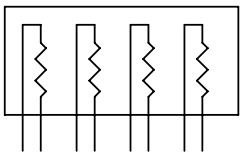
Auxiliary Inputs Schematic



SIP Identification - XXX Indicates Value



SIP Internal Wiring / Pinout



SIP Input Reference

SIP Designator	Related Inputs
SIP1	22,26,27,28
SIP2	17,19,20,21
SIP3	7,8,32,10

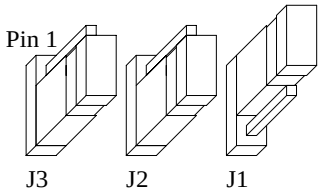
SIP Input Voltage Selection

SIP Value Marking	Resistor Value (Ohms)	Input Voltage
471	470	5
122	1.2k	12
222	2.2k	24

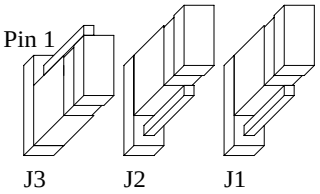
Spindle Analog Output Adjustment

Output voltage range can be set to 0 to +5VDC, 0 to +10VDC, -5 to +5VDC, or -10 to +10VDC by setting jumpers J1, J2, and J3 according to the diagrams below. Trimming the output can be accomplished with VR6 and VR7 potentiometers. See the "DC3IO Connections" diagram for the location of adjustment hardware. The analog levels are adjusted at the factory for the 0 to +10VDC range, so only slight adjustments should be needed for each installation. Only adjust the "OFFSET" potentiometer (pot) (VR6) at the minimum possible spindle speed. This adjustment is intended only to null the voltage level when 0 RPM is commanded. The "GAIN" pot (VR7) should be used at maximum speed to match actual RPM with commanded RPM. Adjustments to the analog output should be very minor and cannot be used to compensate for incorrect inverter or control settings.

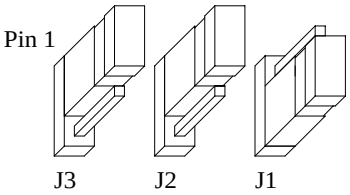
0 to 10 VDC Jumper Settings



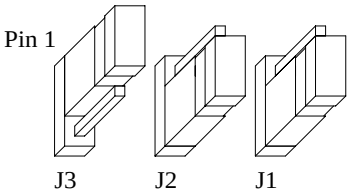
0 to 5 VDC Jumper Settings



-5 to +5 VDC Jumper Settings



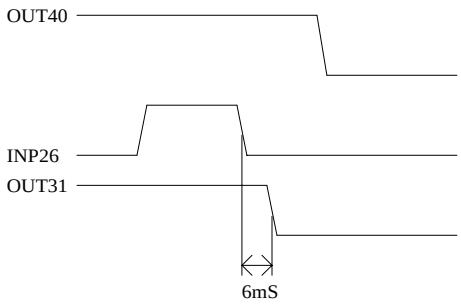
-10 to +10 VDC Jumper Settings



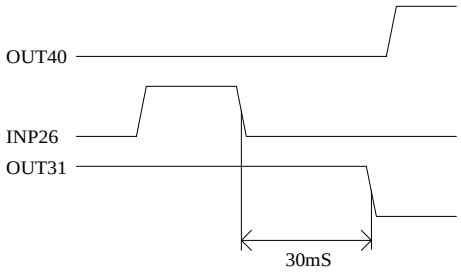
Fast I/O Operation

The Fast I/O is a hard-coded function that is enabled when output 40 is turned on in the PLC program. The Fast I/O immediately turns off output 31 when a falling edge is detected on input 26. This is done immediately before sending any data back to the control. The function is self-resetting - after output 31 is turned off, output 40 must be turned on again in order to reactivate the Fast I/O. The Fast I/O feature was developed to prevent a tool carousel from moving too far due to communication delays. When output 40 is off, output 31 and input 26 work normally. Output 40 is not a physical output, since using this output for purposes other than Fast I/O enable could cause confusion.

Timing Diagram - Fast I/O Enabled



Timing Diagram - Normal PLC Operation



DC3IO I/O MAP

Input Specification				Input Location	
Number	Function	Type	Use	Connector	Pin
1	X- Limit	Sourcing	Dedicated	H14	1
2	X+ Limit	Sourcing	Dedicated	H14	2
3	Y- Limit	Sourcing	Dedicated	H14	4
4	Y+ Limit	Sourcing	Dedicated	H14	5
5	Z- Limit	Sourcing	Dedicated	H14	7
6	Z+ Limit	Sourcing	Dedicated	H14	8
7	W- Limit	Configurable	General	H9	1
8	W+ Limit	Configurable	General	H9	2
9	Range	Sourcing	General	H13	11
10	5th+ Limit	Configurable	General	H9	4
11	Emergency Stop	Sourcing	Dedicated	H14	10
12	Servo Drive Fault	Internal	Dedicated	N/A	N/A
13	TT1	Sourcing	General	H14	11
14	Probe	Sourcing	General	H13	1
15	Probe Detect	Sourcing	General	H13	2
16	Error Check	Internal	Dedicated	N/A	N/A
17	Door Interlock	Configurable	General	H9	5
18	Low Lube	Sourcing	General	H13	4
19	Spindle Zero Speed	Configurable	General	H9	6
20	Spindle At Speed	Configurable	General	H12	1
21	Spindle Orient Complete	Configurable	General	H12	2
22	Tool Clamped	Configurable	General	H12	3
23	NOT USED	N/A	N/A	N/A	N/A
24	Tool Release Switch	Sourcing	General	H13	5
25	Spindle Drive Fault	Sourcing	General	H13	7
26	Tool Counter *	Configurable	General	H12	4
27	Carousel Out / TP Up	Configurable	General	H12	5
28	Carousel In / TP Dwn	Configurable	General	H12	6
29	NOT USED	N/A	N/A	N/A	N/A
30	Rotary Home	Sourcing	General	H13	8
31	Rotary Clamped	Sourcing	General	H13	10
32	Air Pressure Low	Configurable	General	H9	3
33	NOT USED	N/A	N/A	N/A	N/A
34	NOT USED	N/A	N/A	N/A	N/A
35	NOT USED	N/A	N/A	N/A	N/A
36	NOT USED	N/A	N/A	N/A	N/A
37	NOT USED	N/A	N/A	N/A	N/A
38	NOT USED	N/A	N/A	N/A	N/A
39	NOT USED	N/A	N/A	N/A	N/A
40	NOT USED	N/A	N/A	N/A	N/A
41	NOT USED	N/A	N/A	N/A	N/A
42	NOT USED	N/A	N/A	N/A	N/A
43	NOT USED	N/A	N/A	N/A	N/A
44	NOT USED	N/A	N/A	N/A	N/A
45	NOT USED	N/A	N/A	N/A	N/A
46	NOT USED	N/A	N/A	N/A	N/A
47	NOT USED	N/A	N/A	N/A	N/A
48	NOT USED	N/A	N/A	N/A	N/A
49	NOT USED	N/A	N/A	N/A	N/A
50	NOT USED	N/A	N/A	N/A	N/A
51	NOT USED	N/A	N/A	N/A	N/A
52	NOT USED	N/A	N/A	N/A	N/A
53	NOT USED	N/A	N/A	N/A	N/A
54	NOT USED	N/A	N/A	N/A	N/A
55	NOT USED	N/A	N/A	N/A	N/A
56	NOT USED	N/A	N/A	N/A	N/A
57	NOT USED	N/A	N/A	N/A	N/A
58	NOT USED	N/A	N/A	N/A	N/A
59	NOT USED	N/A	N/A	N/A	N/A
60	NOT USED	N/A	N/A	N/A	N/A
61	NOT USED	N/A	N/A	N/A	N/A
62	NOT USED	N/A	N/A	N/A	N/A

* Fast I/O Related

Output Specification			Output Location	
Number	Function	Type	Connector	Pin
1	Emergency Stop	Open Collector	H7	1
2	Lube Pump	Fused Relay SPST	H10	7,8
3	Flood Pump	Fused Relay SPST	H10	9,10
4	Mist Solenoid	Fused Relay SPST	H11	7,8
5	Carousel Direction	Open Collector	H7	2
6	Carousel Out Solenoid	Open Collector	H7	3
7	Tool Clamp Solenoid	Open Collector	H7	4
8	Air Blow Through	Open Collector	H7	5
9	Carousel In Solenoid	Open Collector	H7	6
10	Orient	Open Collector	H7	7
11	Spindle Chiller	Open Collector	H7	8
12	Spindle Cooling Fan	Open Collector	H6	1
13	Spindle Direction	Signal Relay SPDT	H10	1,2,3
14	Spindle Enable	Signal Relay SPDT	H11	1,2,3
15	Inverter Reset	Signal Relay SPDT	H10	4,5,6
16	Error Check	Internal	N/A	N/A
17	Spin. Speed Bit 0	Internal	N/A	N/A
18	Spin. Speed Bit 1	Internal	N/A	N/A
19	Spin. Speed Bit 2	Internal	N/A	N/A
20	Spin. Speed Bit 3	Internal	N/A	N/A
21	Spin. Speed Bit 4	Internal	N/A	N/A
22	Spin. Speed Bit 5	Internal	N/A	N/A
23	Spin. Speed Bit 6	Internal	N/A	N/A
24	Spin. Speed Bit 7	Internal	N/A	N/A
25	Spin. Speed Bit 8	Internal	N/A	N/A
26	Spin. Speed Bit 9	Internal	N/A	N/A
27	Spin. Speed Bit 10	Internal	N/A	N/A
28	Spin. Speed Bit 11	Internal	N/A	N/A
29	Gear Change	Open Collector	H6	2
30	Rotary Clamp Solenoid	Fused Relay SPDT	H11	4,5,6
31	Carousel Enable *	Open Collector	H6	3
32	Red Light	Open Collector	H6	4
33	Green Light	Open Collector	H6	5
34	Yellow Light	Open Collector	H6	6
35	Worklight	Open Collector	H6	7
36	Auxiliary 1	Open Collector	H6	8
37	Auxiliary 2	Open Collector	H4	1
38	Auxiliary 3	Open Collector	H4	2
39	Auxiliary 4	Open Collector	H4	3
40	Fast I/O Enable *	N/A	N/A	N/A
41	NOT USED	N/A	N/A	N/A
42	NOT USED	N/A	N/A	N/A
43	NOT USED	N/A	N/A	N/A
44	NOT USED	N/A	N/A	N/A
45	NOT USED	N/A	N/A	N/A
46	NOT USED	N/A	N/A	N/A
47	NOT USED	N/A	N/A	N/A
48	NOT USED	N/A	N/A	N/A
49	NOT USED	N/A	N/A	N/A
50	NOT USED	N/A	N/A	N/A
51	NOT USED	N/A	N/A	N/A
52	NOT USED	N/A	N/A	N/A
53	NOT USED	N/A	N/A	N/A
54	NOT USED	N/A	N/A	N/A
55	NOT USED	N/A	N/A	N/A
56	NOT USED	N/A	N/A	N/A
57	NOT USED	N/A	N/A	N/A
58	NOT USED	N/A	N/A	N/A
59	Auxiliary 13	Open Collector	H4	4
60	Auxiliary 14	Open Collector	H4	5
61	Auxiliary 15	Open Collector	H4	6
62	Auxiliary 16	Open Collector	H4	7
	Drive Fault	Power Relay SPST	H11	9,10
	X Brake	Open Collector	H3	1
	Y Brake	Open Collector	H3	2
	Z Brake	Open Collector	H3	3

DC3IO Specifications

Characteristic	Min.	Typ.	Max.	Unit
5 Volt Supply Current	2	-	-	A
12 Volt Supply Current	0.5	-	-	A
Input Pullup Voltage (Vinp)	-	5	-	V
Input On Voltage	Vinp-1.25	-	-	V
Input Off Voltage	-	-	1.25	V
Power Relay Output Current	0.01	-	10	A @ 125VAC
Power Relay Output Current	0.01	-	5	A @ 30VDC
Signal Relay Output Current	0.001	-	0.5	A @ 125VAC
Signal Relay Output Current	0.001	-	1	A @ 24VDC
Open Collector Output Current	-	-	500	mA
Open Collector Output Voltage	-	5	-	V
Input Operating current	9	11	15	mA
Analog Output Resolution	-	12	-	bits
Analog Output Voltage	0	-	10	V
Analog Output Current	0	1	20	mA
Motor Output Current	6	12	15	A
Motor Supply Voltage	30	115	130	V
Size: 16 * 8 * 5.25 (W*D*H)				Inches

DC3IO Troubleshooting

Symptom	Possible Cause	Corrective Action
All status LEDs out	Logic power not applied	Measure +5V and +12V at the connector, correct wiring or supply problems
USV LED out	No motor voltage	Measure voltage at input terminals, check contactors, wiring, and fuses accordingly
	Insufficient motor voltage	Voltage should be over 30 VDC
DF LED out	Motion control card hasn't booted up	Start software, wait for the main screen to load
	Fibers 4 and 5 connected incorrectly or faulty	Check connections one at a time, swap with a known good set of fibers
	"Servo Power Removed" due to fault	Restart system to reset runaway or other serious fault condition
	Incorrect .HEX file	Make sure CNC8.HEX is loading
PLC OK LED out	Motion control card hasn't booted up	Start software, wait for the main screen to load
	Fibers 1, 2, or 3 connected incorrectly or faulty	Check connections one at a time, swap with a known good set of fibers
	Incorrect PIC on CPU7	Install IO2PIC
LEDs on, but motor doesn't run	Axis Fuse blown	Check fuses with a meter, replace as necessary
	Limits tripped	Push down the limit defeat switches
No analog output or non-linear output	Incorrect Parameter 31 setting	Set P31 to -1
XVCC LED out	Overload has damaged PLC section	Return for Repair
+12, -12, or +5 LED out	Overload has damaged analog section	Return for Repair
Input doesn't work with sensor	Incorrect wiring	Correct wiring for sensor type (sinking or sourcing), check that SIP values are appropriate for the input voltage
	Voltage drop across sensor is too high	Use 3-wire sensors with lower voltage drop spec.

DC3IO Connections