

DC3IOB Revision 080910 User Guide

Updated 3/29/10

Overview

The DC3IOB is a three axis DC brush motor drive with an integrated PLC. A range of motor drive currents are selectable with jumper blocks. The integrated PLC includes 30 inputs, 31 digital outputs, and one analog output (see “PLC Section” for details).

Drive current is set using jumpers for each axis, rather than changing current sensors. The 6, 9, and 12 amp current settings can be selected on any DC3IOB. The 3 amp setting is no longer a standard option. The 15 amp current setting will only take effect on high power DC3IOBs that have heavy duty drive components.

DC3IOB Features

Drive Application:	DC Brush Motors
Number of Axes:	3
Current rating per axis:	6 to 15 Amps
Motor Voltage:	20 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 or 4 fiber optics to MPU11 motion control card
Dimensions (W*D*H):	16 * 8 * 5.25 inches

Logic Power Connection

An ATX style PC power supply provides voltage for DC3IOB logic circuits. The power supply connector may have 20 pins or 24 pins on units equipped with an ATX 2.2 compatible supply. The -5V and +5VSB pins are not used by the DC3IOB, but all other pins should be checked if troubleshooting a supply problem.

ATX 2.0 Power Connector (H14)

+3.3V	11	1	+3.3V
-12V	12	2	+3.3V
COMMON	13	3	COMMON
/POWER ON	14	4	+5V
COMMON	15	5	COMMON
COMMON	16	6	+5V
COMMON	17	7	COMMON
-5V	18	8	POWER OK
+5V	19	9	+5VSB
+5V	20	10	+12V

Optional ATX 2.2 Power Connector (H14)

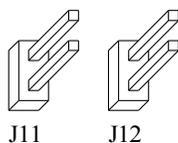
+3.3V	13	1	+3.3V
-12V	14	2	+3.3V
COMMON	15	3	COMMON
/POWER ON	16	4	+5V
COMMON	17	5	COMMON
COMMON	18	6	+5V
COMMON	19	7	COMMON
	20	8	POWER OK
+5V	×	9	+5VSB
+5V	21	10	+12V
+5V	22	11	+12V
+5V	23	12	+3.3V
COMMON	24		

Drive Section

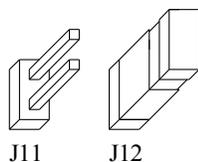
The DC3IOB drive section is based on Centroid’s proven DC brush motor drive technology. Several built in features allow for easy integration with a variety of hardware.

Each axis can be built with a range of current ratings determined by jumper settings and drive hardware. Current ratings of 6, 9, 12, and 15 amps can be provided on the DC3IOB. The following examples show the various current settings for the first, or “X”, axis. The second axis uses jumpers J13 and J14, while the third axis uses jumpers J9 and J10 for current setting.

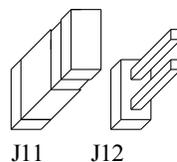
6 Amp Setting



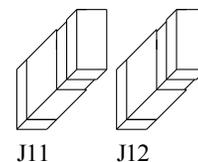
9 Amp Setting



12 Amp Setting



15 Amp Setting



Open collector output drivers are provided for a brake on each axis (see “DC3IOB 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 communication is valid 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 “DC3IOB Connections” page to locate the C axis analog and C axis common pins.

PLC Section

The DC3IOB 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.

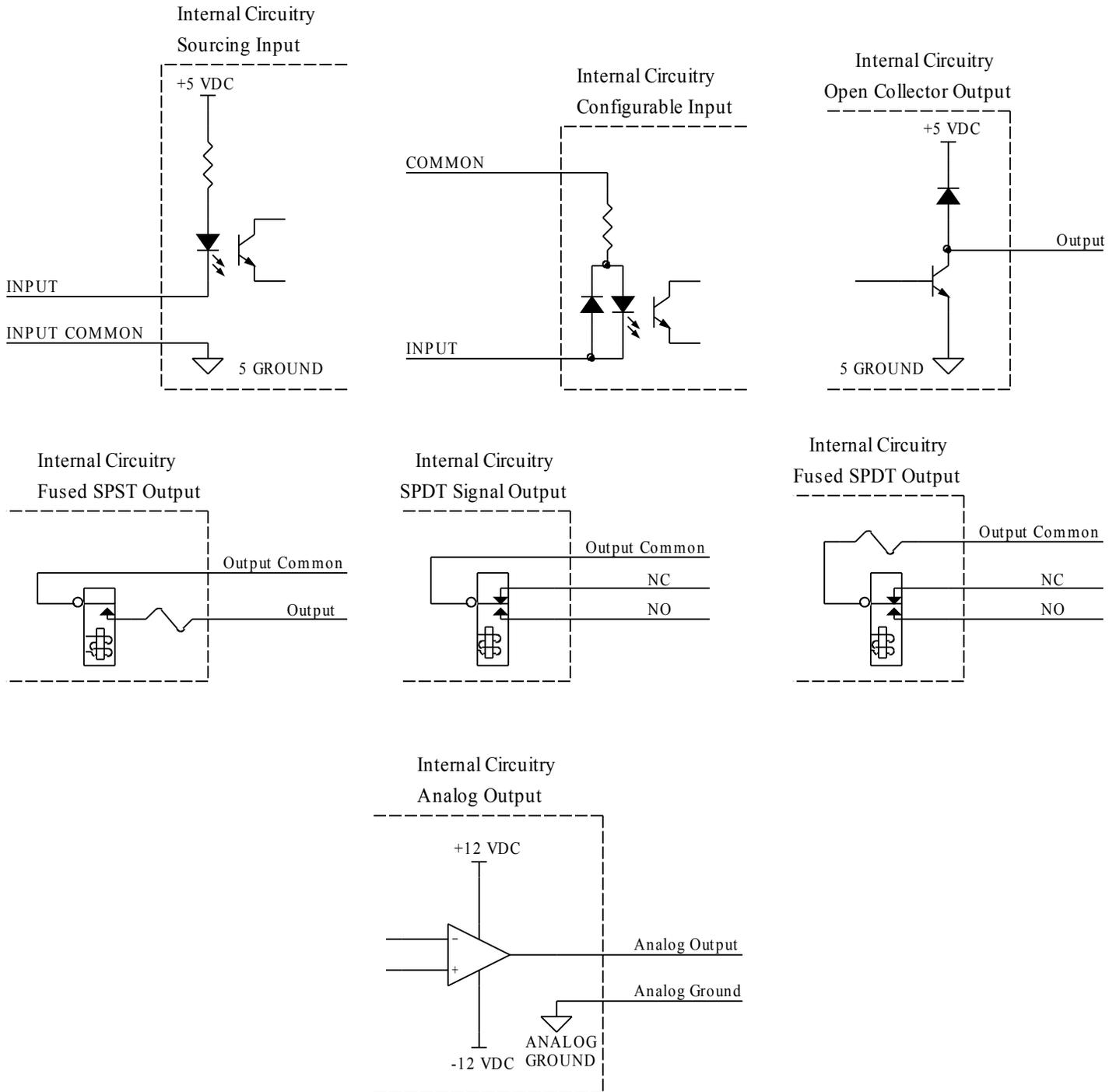
Twelve inputs are configurable types, 16 are sourcing, and 2 are internally wired. The internal drive fault and error check inputs are dedicated and not user definable. X-, X+, Y-, Y+, Z-, and Z+ limit inputs are not configurable for other uses since they are hard wired to drive circuitry that inhibits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

Several output types are used on the DC3IOB. 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 “DC3IOB I/O Map” and “DC3IOB 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 output and spindle speed bits are also dedicated, leaving 29 outputs definable for custom uses.

The DC3IOB 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.

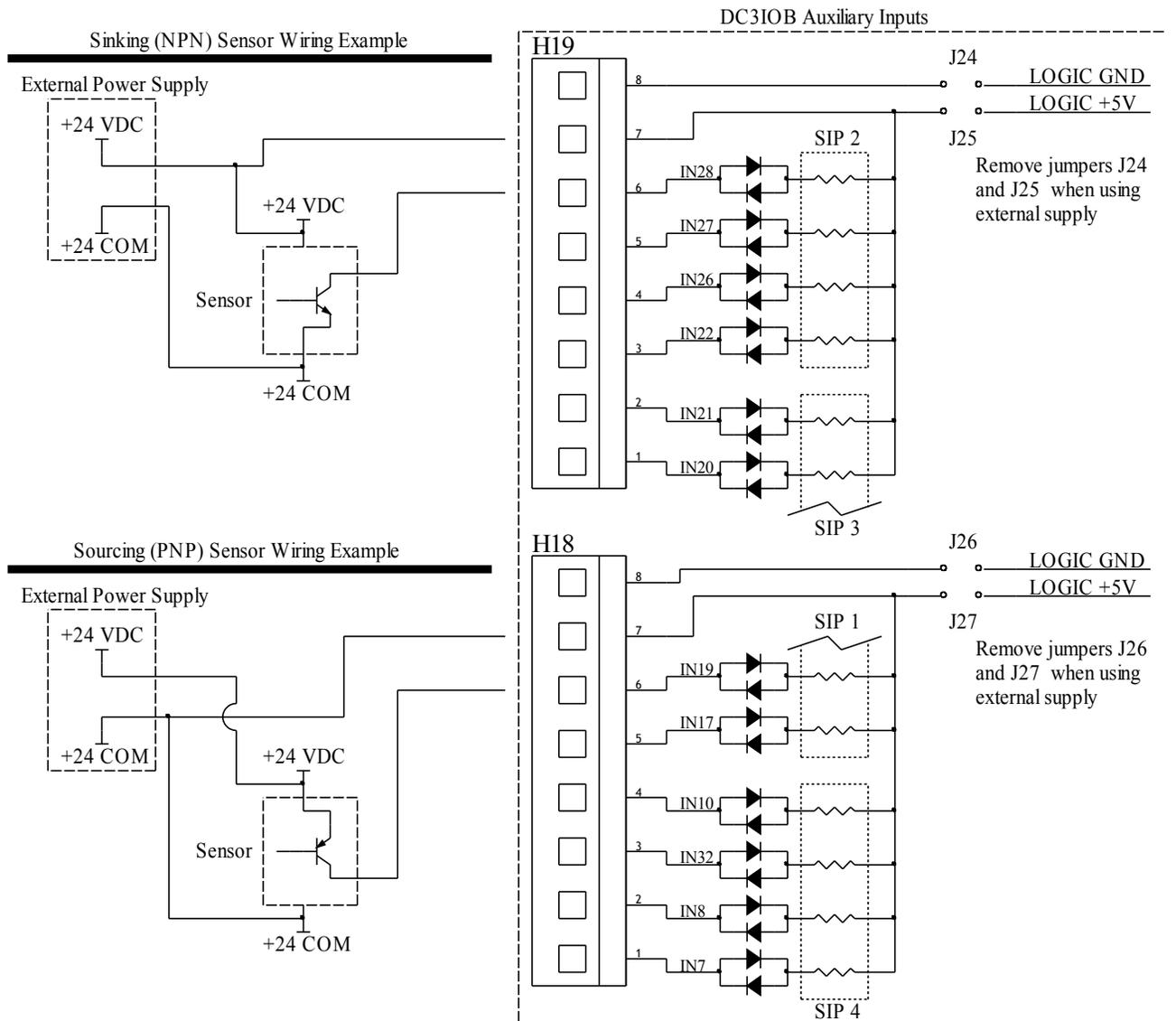


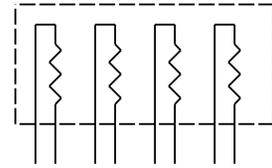
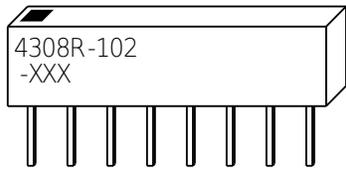
Auxiliary Configurable Inputs

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 “DC3IOB Specifications” chart to ensure reliable operation. Resistor packs SIP1, SIP2, SIP3, and SIP4 must be changed to match the input voltage for auxiliary inputs. Sinking or sourcing operation is determined by the wiring configuration.

Jumpers J24 through J27 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 H18 and H19. Make sure there are no jumper blocks on J24, J25, J26, or J27 before applying external power, or the DC3IOB will be damaged.

Auxiliary Inputs Schematic





SIP Input Reference

SIP Designator	Related Inputs
SIP1	17,19
SIP2	22,26,27,28
SIP3	20,21
SIP4	7,8,32,10

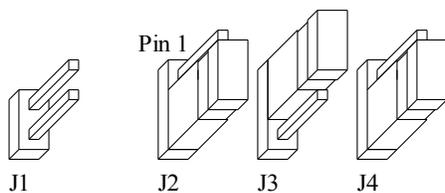
SIP Input Voltage Selection

SIP Value Marking	Resistor Value (Ohms)	Input Voltage
471	470	5
102	1.0k	12
222	2.2k	24

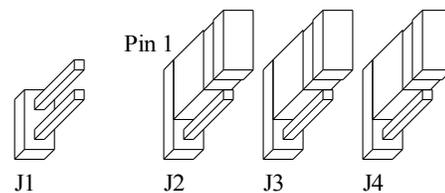
Spindle Analog Output Adjustment

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, J3, and J4 according to the diagrams below. Trimming the output can be accomplished with VR1 and VR2 potentiometers. See the “DC3IOB 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) (VR2) at the minimum possible spindle speed. This adjustment is intended only to null the voltage level when 0 RPM is commanded. The “GAIN” pot (VR1) 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.

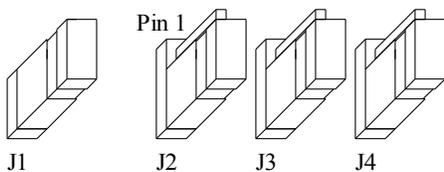
0 to 10 VDC Jumper Settings



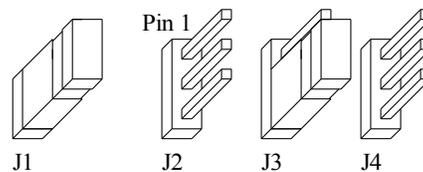
0 to 5 VDC Jumper Settings



-5 to +5 VDC Jumper Settings



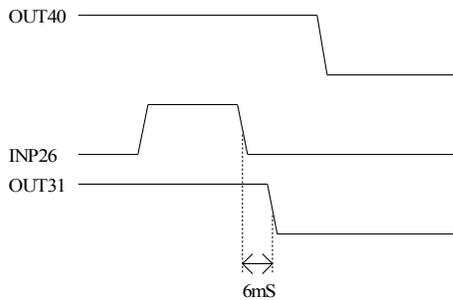
-10 to +10 VDC Jumper Settings



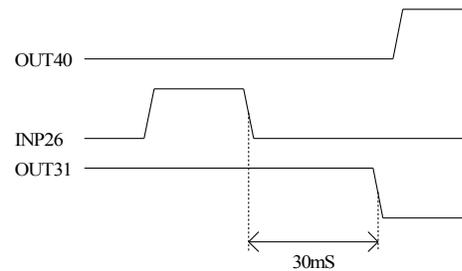
Fast I/O Operation

The Fast I/O is a hard-coded function that is enabled in legacy mode 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 in legacy mode, since using this output for purposes other than Fast I/O enable could cause confusion. In MPU11 mode, the Fast I/O feature is not available, and output 40 is an open collector output.

Legacy Mode Timing - Fast I/O Enabled



Legacy Mode Timing - Normal PLC Operation



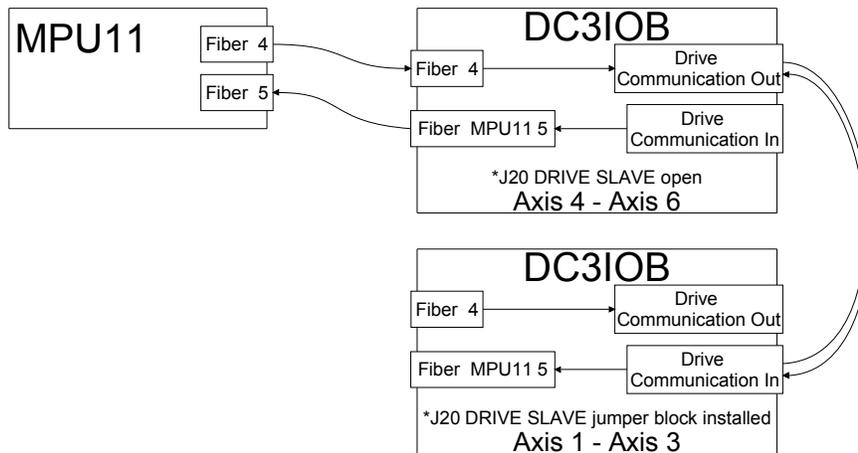
Drive Features

Other drives may be connected to the DC3IOB through the “Drive Communication In” and “Drive Communication Out” connectors. The “Drive Communication Out” goes to drives further away from the MPU11 in the communication chain, and is always active. The “Drive Communication In” connector gets data from drives closer to MPU11, and must be enabled by installing a jumper block on J20 “DRIVE SLAVE” pins. Shorting the pins of J20 will cause the drive to look for communication on the “Drive Communication In” cable connection rather than fiber optic connections “4” and “MPU11 5”.

LED1 status display will show the base or first axis number for the drive. For example, a DC3IOB that is running axes 3, 4, and 5 will display 3 on LED1 as long as no error codes are present. The axis farthest from the MPU11 in the communication chain will always be axis 1. Axis numbers increase along the chain toward the MPU11, up to a maximum axis number of 8.

If error codes exist, the decimal point on LED1 will light and an error number will flash. See the “LED1 Error Codes” chart for information on error codes.

Drive Communication Connection for Two DC3IOBs

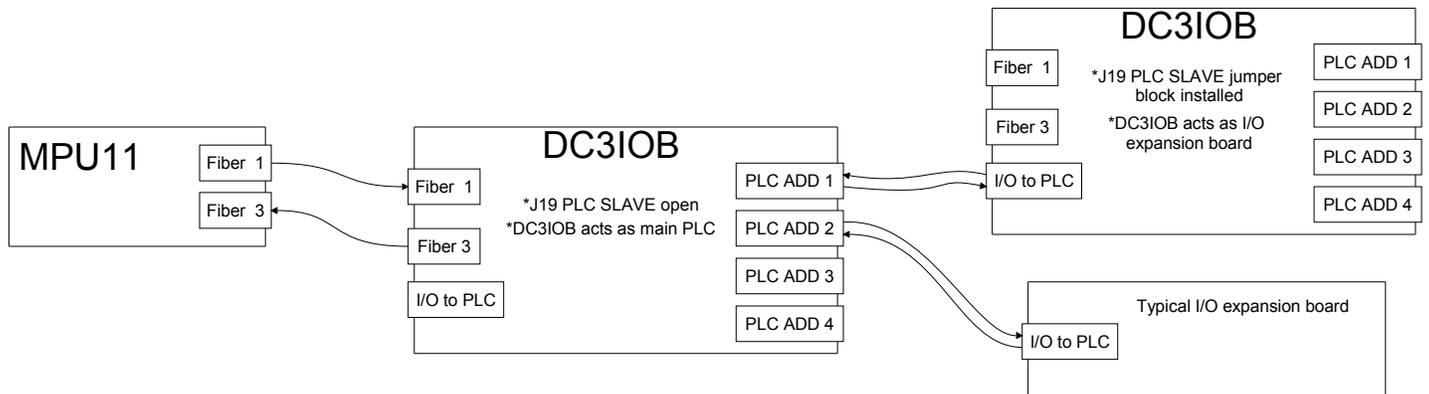


PLC Features

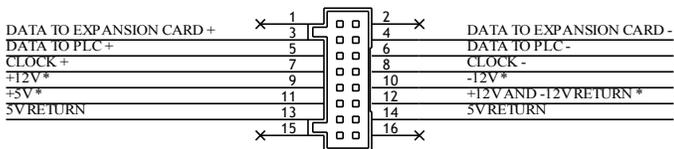
PLC I/O expansion is possible through the four “PLC ADD” connectors. Each PLC expansion port can accept 16 – 128 inputs, outputs, or inputs and outputs in 16 bit increments. This allows for digital I/O, DACs, ADCs, or other devices to be added to the system as needed.

If two DC3IOB units are used in a system, one DC3IOB PLC may act as an expansion board to the other DC3IOB to double the system’s I/O. The DC3IOB connected to the MPU11 through fibers 1 and 3 will act as the main PLC card. The second DC3IOB must have a jumper block on the pins of J19 “PLC SLAVE” to communicate through the “I/O to PLC” connector H6. An expansion cable may then be run from the “I/O to PLC” connector to any of the four “PLC ADD” connectors on the DC3IOB communicating with MPU11.

PLC Communication Connection for Two DC3IOBs

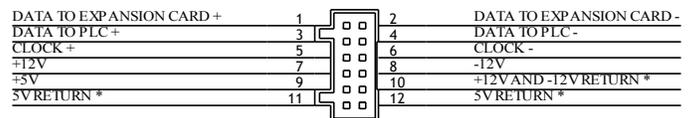


I/O TO PLC Connector Pinout



* Power supply voltages are noted as part of the standard, but are not used by the DC3IOB since it has its own power supply.

PLC ADD 1 – 4 Connector Pinouts



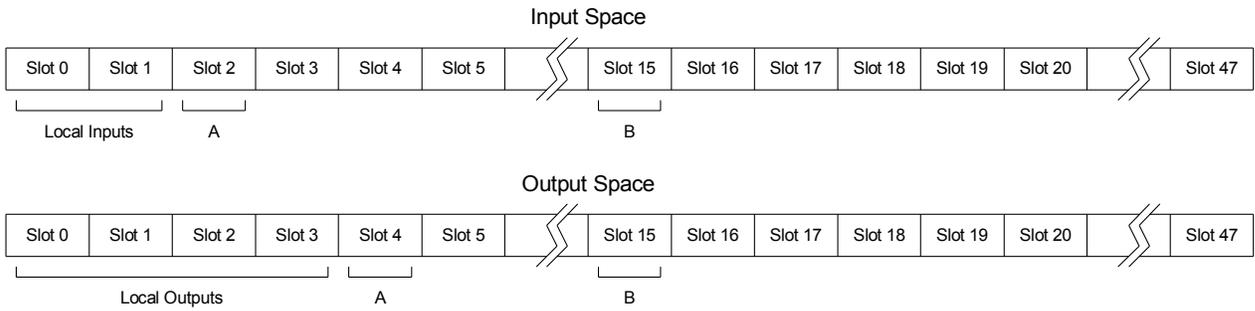
* +12V AND -12V RETURN and 5V RETURN are connected on the DC3IOB

PLC Expansion Details

PLC I/O is arranged in 16 bit groups or slots. As a general rule, slots 0-14 are used for individual I/Os such as switches and have a programmable debounce time for the inputs. Slots 15-47 are reserved for ADCs, DACs, or other devices that do not require debounce. Every device using I/O space must use space in 16 bit multiples by reserving slots. A DC3IOB operating as a PLC uses 2 slots for its inputs and 4 slots for outputs. PLC expansion boards with inputs and outputs must have a matching number of input and output slots. Therefore, a DC3IOB acting as an expansion board (PLC slave jumper installed) will use 4 slots for inputs and 4 slots for outputs. The I/O map remains unchanged for a DC3IOB working as an expansion card, except that it is shifted up in the I/O space based on the slots it is assigned to.

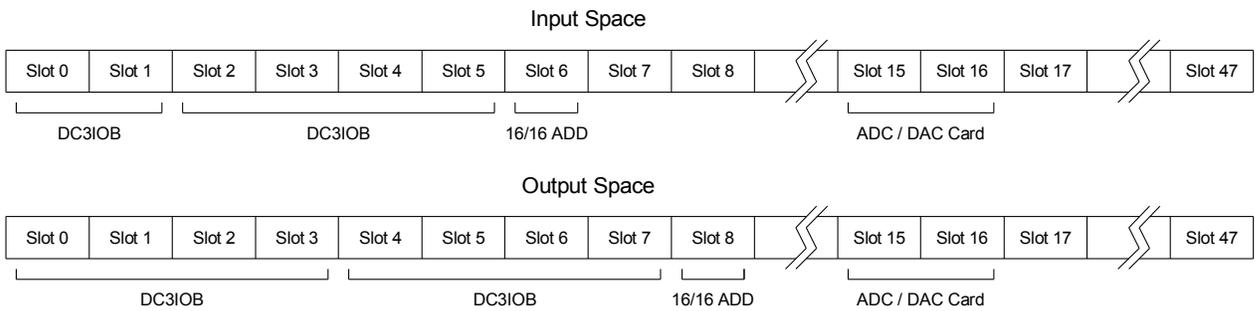
Assignment of I/O slots occurs in a linear fashion starting at the main PLC, then “PLC ADD” port 1, “PLC ADD” port 2, etc. In the following general example, local inputs and outputs represent a DC3IOB working as the main PLC. Devices plugged into the “PLC ADD” ports that require debounce will be assigned starting at the slots marked “A”, while devices that do not require debounce will start being assigned at the slots marked “B”.

PLC Expansion Location Assignment General Example



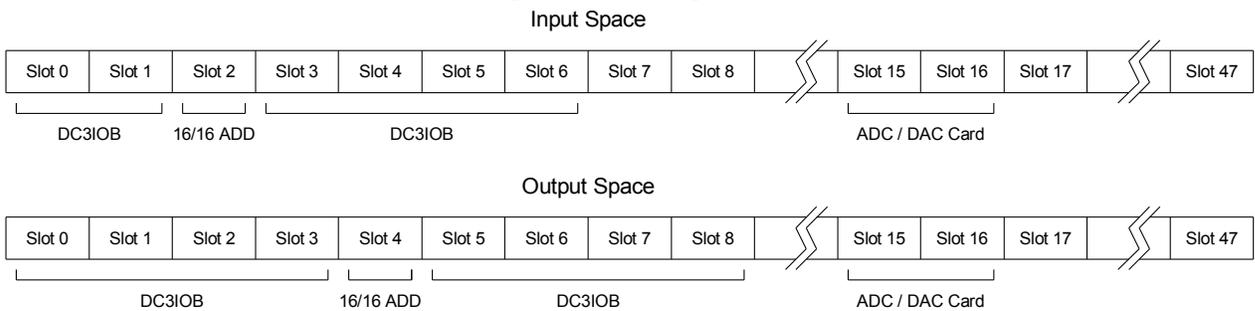
Example 2 illustrates I/O assignments on a system that has a DC3IOB main PLC, a DC3IOB plugged into “PLC ADD 1”, a 16/16 digital I/O expansion card connected to “PLC ADD 2”, and an ADC/DAC expansion card plugged into PLC ADD 3. Note that the ADC/DAC expansion card is assigned starting at slot 15 since it does not require debounce.

PLC Expansion Example 2



Example 3 shows the results of plugging an ADC/DAC expansion card into “PLC ADD 1”, a 16/16 digital I/O expansion card into “PLC ADD 2”, and a DC3IOB into “PLC ADD 3”. The location of the ADC/DAC expansion card I/O is unaffected since it is the only device in the example that does not require debounce. The 16/16 digital I/O expansion card and DC3IOB have changed locations since the 16/16 is plugged into a lower number “PLC ADD” port and is therefore assigned I/O locations before the DC3IOB.

PLC Expansion Example 3



DC3IOB I/O MAP

Input Specification				Input Location	
Number	Function	Type	Use	Connector	Pin
1	X- Limit	Sourcing	Dedicated	H21	1
2	X+ Limit	Sourcing	Dedicated	H21	2
3	Y- Limit	Sourcing	Dedicated	H21	4
4	Y+ Limit	Sourcing	Dedicated	H21	5
5	Z- Limit	Sourcing	Dedicated	H21	7
6	Z+ Limit	Sourcing	Dedicated	H21	8
7	W- Limit	Configurable	General	H18	1
8	W+ Limit	Configurable	General	H18	2
9	Range	Sourcing	General	H20	11
10	5th+ Limit	Configurable	General	H18	4
11	Emergency Stop	Sourcing	Dedicated	H21	10
12	Servo Drive Fault	Internal	Dedicated	N/A	N/A
13	TTI	Sourcing	General	H21	11
14	Probe	Sourcing	General	H20	1
15	Probe Detect	Sourcing	General	H20	2
16	Error Check	Internal	Dedicated	N/A	N/A
17	Door Interlock	Configurable	General	H18	5
18	Low Lube	Sourcing	General	H20	4
19	Spindle Zero Speed	Configurable	General	H18	6
20	Spindle At Speed	Configurable	General	H19	1
21	Spindle Orient Complete	Configurable	General	H19	2
22	Tool Clamped	Configurable	General	H19	3
23	NOT USED	N/A	N/A	N/A	N/A
24	Tool Release Switch	Sourcing	General	H20	5
25	Spindle Drive Fault	Sourcing	General	H20	7
26	Tool Counter *	Configurable	General	H19	4
27	Carousel Out / TP Up	Configurable	General	H19	5
28	Carousel In / TP Dwn	Configurable	General	H19	6
29	NOT USED	N/A	N/A	N/A	N/A
30	Rotary Home	Sourcing	General	H20	8
31	Rotary Clamped	Sourcing	General	H20	10
32	Air Pressure Low	Configurable	General	H18	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

*In MPU11 compatibility mode, Output 40 is Auxiliary 17 Open Collector on H5 pin 8

Output Specification			Output Location	
Number	Function	Type	Connector	Pin
1	Emergency Stop	Open Collector	H9	1
2	Lube Pump	Fused Relay SPST	H16	7,8
3	Flood Pump	Fused Relay SPST	H16	9,10
4	Mist Solenoid	Fused Relay SPST	H17	7,8
5	Carousel Direction	Open Collector	H9	2
6	Carousel Out Solenoid	Open Collector	H9	3
7	Tool Clamp Solenoid	Open Collector	H9	4
8	Air Blow Through	Open Collector	H9	5
9	Carousel In Solenoid	Open Collector	H9	6
10	Orient	Open Collector	H9	7
11	Spindle Chiller	Open Collector	H9	8
12	Spindle Cooling Fan	Open Collector	H7	1
13	Spindle Direction	Signal Relay SPDT	H16	1,2,3
14	Spindle Enable	Signal Relay SPDT	H17	1,2,3
15	Inverter Reset	Signal Relay SPDT	H16	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	H7	2
30	Rotary Clamp Solenoid	Fused Relay SPDT	H17	4,5,6
31	Carousel Enable *	Open Collector	H7	3
32	Red Light	Open Collector	H7	4
33	Green Light	Open Collector	H7	5
34	Yellow Light	Open Collector	H7	6
35	Worklight	Open Collector	H7	7
36	Auxiliary 1	Open Collector	H7	8
37	Auxiliary 2	Open Collector	H5	1
38	Auxiliary 3	Open Collector	H5	2
39	Auxiliary 4	Open Collector	H5	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	H5	4
60	Auxiliary 14	Open Collector	H5	5
61	Auxiliary 15	Open Collector	H5	6
62	Auxiliary 16	Open Collector	H5	7
	Drive Fault	Power Relay SPST	H17	9,10
	X Brake	Open Collector	H1	1
	Y Brake	Open Collector	H1	2
	Z Brake	Open Collector	H1	3

DC3IOB Specifications

Characteristic	Min.	Typ.	Max.	Unit
3.3 Volt Supply Current	1	-	-	A
5 Volt Supply Current	2	-	-	A
12 Volt Supply Current	0.2	-	-	A
-12 Volt Supply Current	0.2	-	-	A
Input Pullup Voltage (Vinp)	-	5	-	VDC
Input On Voltage	Vinp-1.25	-	-	VDC
Input Off Voltage	-	-	1.25	VDC
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	-	10	90	mA
Open Collector Output Voltage	-	5	5	VDC
Input Operating current	9	11	15	mA
Analog Output Resolution	-	12	-	bits
Analog Output Voltage	-10	-	10	VDC
Analog Output Current	0	1	20	mA
Motor Output Current Settings	6	12	15	A
Motor Supply Voltage	20	115	130	VDC
MPU11 Mode Fiber Length	-	-	100	feet
Size: 16 * 8 * 5.25 (W*D*H)				Inches

DC3IOB General Troubleshooting

Symptom	Possible Cause	Corrective Action
All status LEDs out	Logic power not applied	Measure AC coming into power supply, correct wiring or supply problems
5, 3.3, or 12 LED out	Power supply or connection problem	Measure AC coming into power supply, correct wiring or supply problems
5 LED out, 3.3 and 12 LEDs lit	5 volt logic supply missing	Damage has probably been done due to incorrect connection to the AUX OUTPUTS headers, return for repair
+12V, -12V, or +5V LED out	Analog section power loss	If other power LEDs are lit, the analog section has probably been damaged by incorrect connection, return for repair
XVCC LED out	PLC input supply missing	If 5 LED is lit, the PLC input section has probably been damaged by incorrect connection, return for repair
LED1 display flashing with decimal point lit	An error condition has been detected	See the "LED1 Error Codes" section for details on the error
LEDs on, but motor doesn't run	Axis Fuse blown	Check fuses with a meter, replace as necessary
	Limits tripped	Check limit switch wiring or pull up the limit defeat switches
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.

DC3IOB Legacy Mode Troubleshooting

Symptom	Possible Cause	Corrective Action
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
No analog output or non-linear output	Incorrect Parameter 31 setting	Set P31 to -1

DC3IOB MPU11 Mode Troubleshooting

Symptom	Possible Cause	Corrective Action
DF LED out	Motion control card hasn't booted up	Start software, wait for the main screen to load
	Fibers 4 and MPU11 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
PLC OK LED out	Motion control card hasn't booted up	Start software, wait for the main screen to load
	Fibers 1 or 3 connected incorrectly or faulty	Check connections one at a time, swap with a known good set of fibers

LED1 Error Codes

Error Number	Meaning	Cause	Corrective Action
1	Power Failure	the logic power supply is indicating to the DC3IOB that it is operating out of specification	Check power supply wiring (the grey wire and AC input in particular), replace power supply
2	15A Not Available	current selection jumpers on any axis are set to 15A, but the drive is not equipped with the appropriate FETs for long term use at 15A, so the drive will drop back to 12A	Select 12A or lower current settings or use a high power DC3IOB
3	Null Error	the self adjust routine has detected too large an offset on the current feedback	Send the drive back for repair. There is likely an internal failure causing the large offset
4	Limit Tripped	any limit switch is tripped	move away from the limit, check limit switch wiring, or use the limit defeat switches if a limit switch is not required

DC3IOB Connections

