OpticDirect 120112 User Guide

Updated 6/20/16

Overview

The OpticDirect interface board allows MPU11 based control systems to interface to Yaskawa Sigma 5 or Delta ASDA-A2-U servo drives. OpticDirect simplifies wiring to compatible drives and eliminates long runs of wire that can pick up electrical noise.

OpticDirect Features

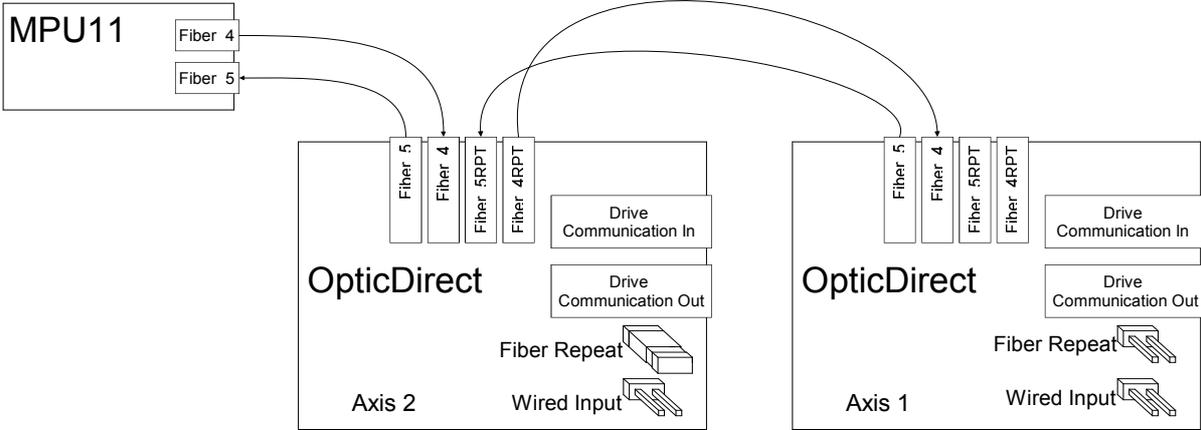|	
Application:	Third Party Drive Interface
Code Name:	YASINTF
Number of Axes:	1
Maximum number of Axes:	8 with 8 OpticDirect cards in series
DAC resolution:	16 bits
Analog Output Voltage:	-10 to +10 Volts
Control Interface:	2 fiber optics or wire
Dimensions (W*D*H):	6.13 * 4.32 * 0.95 inches

OpticDirect Connection Overview

Up to eight OpticDirect boards can be connected to a MPU11 motion control card. The OpticDirect's will negotiate their axis numbers based on the order they are connected. The last OpticDirect in the communication chain will initiate communication and start numbering axes at 1. LED1 will flash one segment at a time during startup while each OpticDirect determines its location in the communication chain. After about 10 seconds negotiation completes, LED1 shows the axis number, and normal operation begins. If the decimal point is lit and a number is flashing on LED1, this indicates an error condition that can be found in the "LED1 Error Codes" section.

Fiber optic or wire connections are available on OpticDirect to allow connection to various other drive devices. For optimum noise immunity, fiber optic connections should be used between OpticDirect boards. "Drive Communication In" and "Drive Communication Out" headers are provided for wire connection to devices that do not support repeating on fibers.
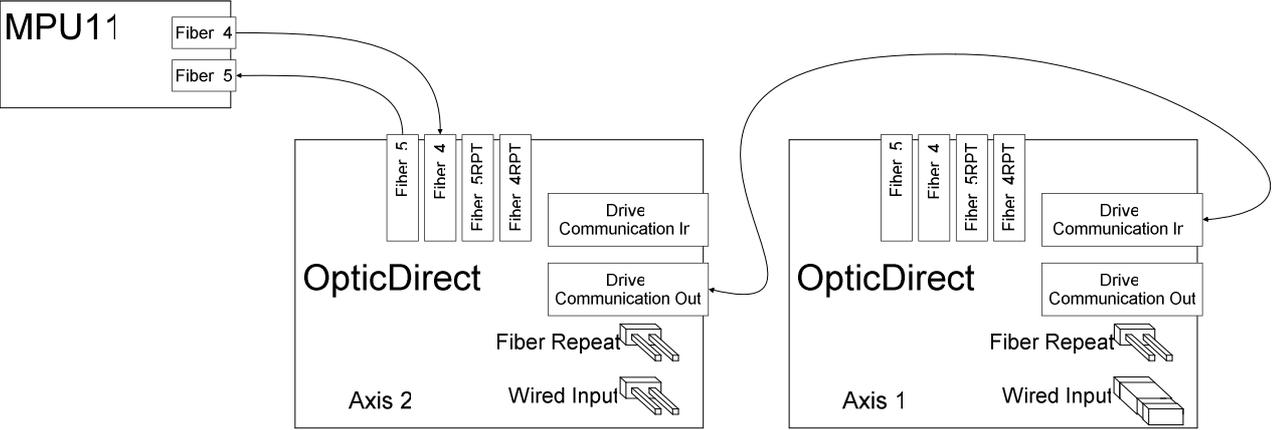
Jumper Functions

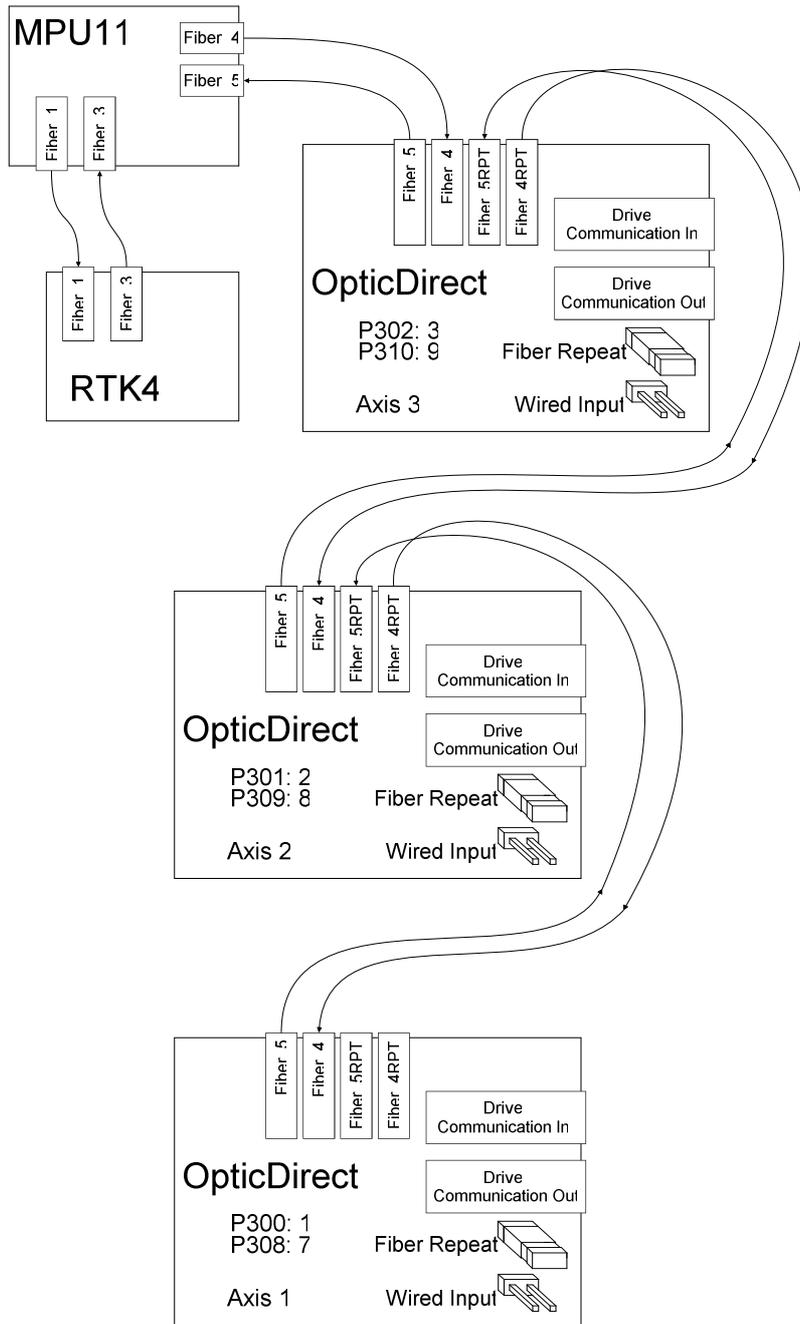| Designator	Jumper Name	Function with jumper block in place	Function with jumper block removed
J5	Wired Input	Communicate with another drive over wires (this OpticDirect is not connected to MPU11)	Communicate with MPU11 or another drive through fiber connectors
J4	Fiber Repeat	DriveBus out to another drive connects with fiber optics	DriveBus out connects to another drive over wires
J10	Config	Offset and gain trim - NEVER INSTALL THIS JUMPER	Normal operation
J11	Feedback Disable	Disables closed loop correction of DAC output - NEVER INSTALL THIS JUMPER	Normal operation

Fiber Repeat Connection Example


Wire Repeat Connection Example

Typical System Connection Example

MPU11
Fiber 4
Fiber 5
Fiber 1
Fiber 3

RTK4
Fiber 1
Fiber 3

OpticDirect
Fiber 5
Fiber 4
Fiber 5RPT
Fiber 4RPT

Drive Communication In

Drive Communication Out

P302: 3
P310: 9
Fiber Repeat

Wired Input

Axis 3

OpticDirect
Fiber 5
Fiber 4
Fiber 5RPT
Fiber 4RPT

Drive Communication In

Drive Communication Out

P301: 2
P309: 8
Fiber Repeat

Wired Input

Axis 2

OpticDirect
Fiber 5
Fiber 4
Fiber 5RPT
Fiber 4RPT

Drive Communication In

Drive Communication Out

P300: 1
P308: 7
Fiber Repeat

Wired Input

Axis 1

Motor Holding Brake Output

A brake driver relay is included on the OpticDirect. The drive's brake request output is monitored to determine when to activate the relay. The relay is not controlled by the PLC program.
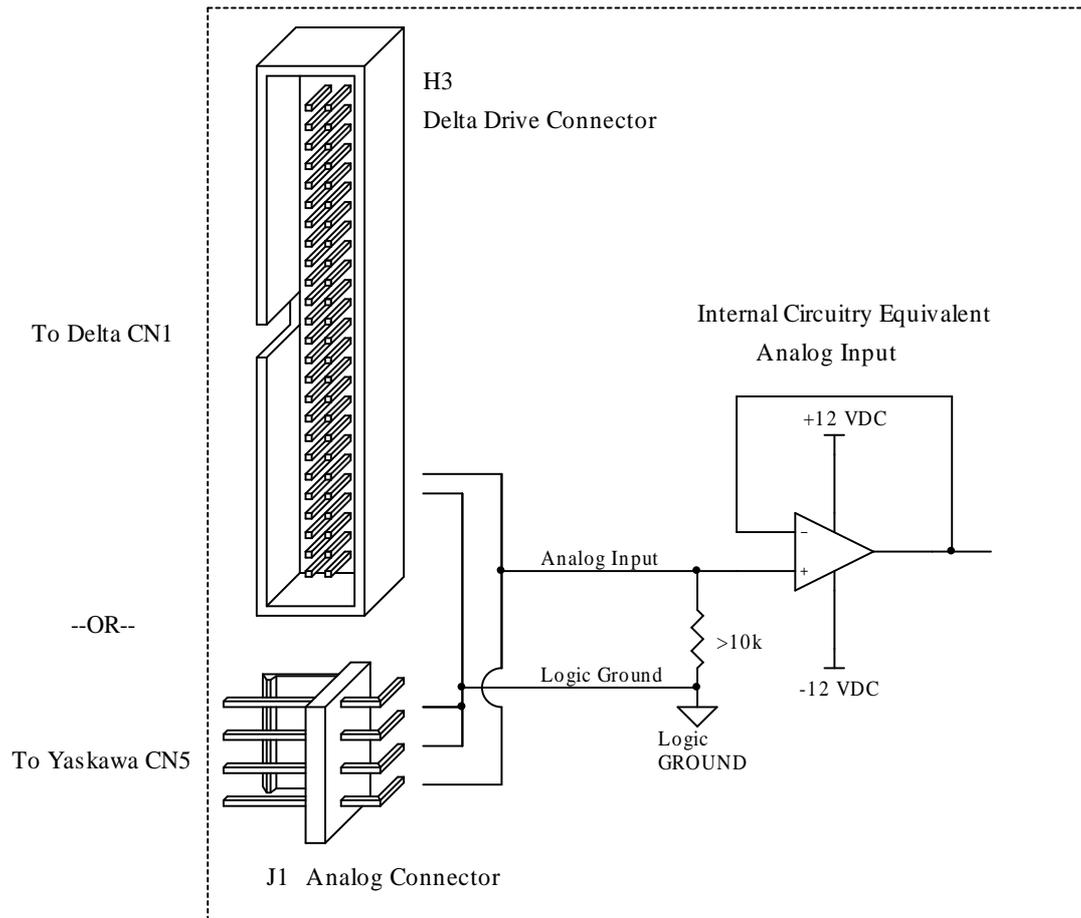
The brake solenoid will require a power supply separate from the OpticDirect supply. Noise suppression, such as a resistor and capacitor network for AC solenoids or a diode for DC solenoids is also needed. The noise suppression devices should be connected as close as possible to the solenoid coil to effectively reduce emissions.

Typical Brake Wiring Example
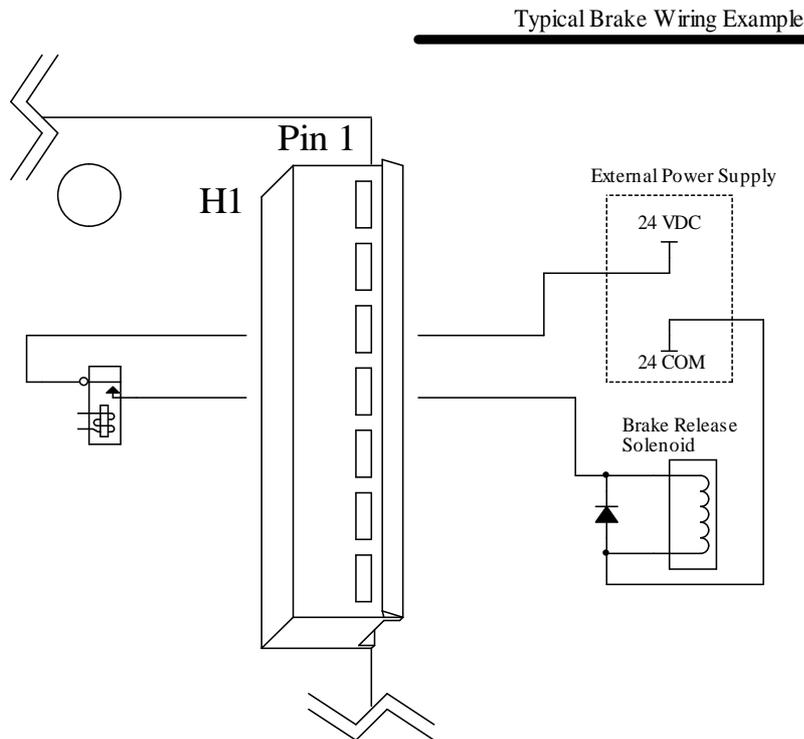
Analog Input (ADC 1)

An analog input is available though connector J1 or H3. The analog input is typically used to control CNC11 software load meters from an analog torque output created by the servo drive. The input range is -10 to +10V, which may require scaling in the PLC program to match the servo drive's output range.

See TB264 for use with Delta drives and TB267 for use with Yaskawa drives. The Tech Bulletin PLC examples may need the ADC input numbers changed to match an OpticDirect application. See the "Analog Input Locations" table that follows for correct input locations. Notice that 16 inputs are reserved for each analog input, but only the first 12 inputs are used.

```
                    H3
                    Delta Drive Connector

                                                      Internal Circuitry Equivalent
                                                           Analog Input

To Delta CN1                                          +12 VDC


                                          Analog Input              -

                                                                    +
                         --OR--                   >10k
                                          Logic Ground
                                                              -12 VDC
                                              Logic
To Yaskawa CN5                                GROUND



                    J1  Analog Connector
```

Analog Input Calculations

The analog input uses a 12 bit analog to digital converter (ADC) to generate a digital ADC result from an analog signal. The 12 bit result is a number from 0 to 4095, which corresponds to -10 to 9.995 volts.

$$\text{ADC result} = \left(\frac{4096 \text{ * Input Voltage}}{20} \right) + 2048$$

Analog Input Locations

Drive Axis	PLC Input Range	
1	929	944
2	945	960
3	961	976
4	977	992
5	993	1008
6	1009	1024
7	1025	1040
8	1041	1056

OpticDirect PLC Communication

Inputs and outputs can be accessed from the PLC program. Because OpticDirect communicates on the drive protocol, inputs must be accessed through SV_DRIVE_STATUS_1 - SV_DRIVE_STATUS_8 and outputs must be written through SV_DRIVE_CONTROL_1 - SV_DRIVE_CONTROL_8. A PLC program written for use with OpticDirect will need to be installed, as other drive types are not I/O compatible.

PLC Input Map

SV_DRIVE_STATUS_x Bits		Description
0	Not implemented	
1	Not implemented	
2	Not implemented	
3	Not implemented	
4	Not implemented	
5	Alarm bit 3	* Alarm code type reporting
6	Alarm bit 2	* Alarm code type reporting
7	Alarm bit 1	* Alarm code type reporting
8	/TGON	* Motor above requested speed
9	Brake state	* State of OpticDirect brake relay
10	/S_RDY	Drive is ready to accept commands (1 = not ready, 0 = ready)
11	Quadrature error	** Encoder signals have made an invalid transition
12	Rotation direction	** Encoder rotation direction
13	Index pulse	** Encoder index pulse
14	Differential error	** A and /A or B and /B encoder signals are not opposite states
15	Drive fault	An alarm condition is present on the drive (1 = fault, 0 = ok)

   * These bits are not used in standard systems, but are available for possible custom applications.
  ** These bits are handled by the CNC11 software and do not need to be read by the PLC program.

PLC Output Map

SV_DRIVE_CONTROL_x Bits		Description
0	Not implemented	
1	Not implemented	
2	Not implemented	
3	Not implemented	
4	Not implemented	
5	Not implemented	
6	Not implemented	
7	/POS_CLR	Position clear (Precision mode only) (1 = run, 0 = clear)
8	P-OT	* Open collector output on H1
9	N-OT	* Open collector output on H1
10	/P-CON	* Control method switching
11	/P-CL	* Positive torque limit
12	/N-CL	* Negative torque limit
13	Absolute send	* Send absolute position
14	Alarm reset	Alarm reset (1 = reset, 0 = run)
15	Enable	*** Axis Enable (1 = enable, 0 = disable)

   * These bits are not used in standard systems, but are available for possible custom applications.
  *** This bit is controlled by the MPUl1 firmware. Do not attempt to change it in the PLC program.

CNC11 Software Setup

Drive and encoder assignment parameters must be set for each OpticDirect board. Parameters 300 to 307 define the OpticDirect number that will be used for each axis in the software. When setting up OpticDirect, the drive assignment parameter values may be 1 through 8. For example, parameter 300 may be set to 1 to use OpticDirect number 1 (displayed on LED1) as the first axis. If parameter 300 is set to 2, OpticDirect number 2 will be the first axis in the software.

Encoder parameters 308 to 315 define the encoder port that will be used for each axis in the software. OpticDirect boards transmit encoder information over the DriveBus protocol, so the numbers entered into parameters 308 to 315 will be from 7 to 14. For example, parameter 308 will be set to 7 to use the encoder from OpticDirect number 1 for axis 1 in the software.

The configuration chapter of the M-Series Operator's Manual contains additional information on the drive assignment and encoder assignment parameters.

CNC11 Parameters for OpticDirect

Parameter	Description	Valid Values	Notes
300	CNC11 axis 1 assignment	1 to 8	The OpticDirect Axis number as displayed on LED1 is entered into these parameters to arrange the axis order as needed.
301	CNC11 axis 2 assignment	1 to 8	
302	CNC11 axis 3 assignment	1 to 8	
303	CNC11 axis 4 assignment	1 to 8	
304	CNC11 axis 5 assignment	1 to 8	
305	CNC11 axis 6 assignment	1 to 8	
306	CNC11 axis 7 assignment	1 to 8	
307	CNC11 axis 8 assignment	1 to 8	
308	CNC11 encoder 1 assignment	7 to 14	OpticDirect encoder numbers start at 7 for OpticDirect 1 and continue through 14.
309	CNC11 encoder 2 assignment	7 to 14	
310	CNC11 encoder 3 assignment	7 to 14	
311	CNC11 encoder 4 assignment	7 to 14	
312	CNC11 encoder 5 assignment	7 to 14	
313	CNC11 encoder 6 assignment	7 to 14	
314	CNC11 encoder 7 assignment	7 to 14	
315	CNC11 encoder 8 assignment	7 to 14	

OpticDirect Specifications

Characteristic	Min.	Typ.	Max.	Unit
Supply Voltage	22	24	26	V
Supply Current	0.25	-	-	A
Relay Output Current	0.1	-	10	A @ 125VAC
Relay Output Current	0.1	-	5	A @ 30VDC
Input Operating current	9	11	15	mA
Analog Output Resolution	-	16	-	bits
Analog Output Voltage	-10	-	10	V
Analog Output Current	0	1	5	mA
Fiber Optic Length	-	-	100	feet
Drive Communication Cable Length	-	-	30	feet
Size: 6.13 * 4.32 * 0.95				Inches

OpticDirect Troubleshooting

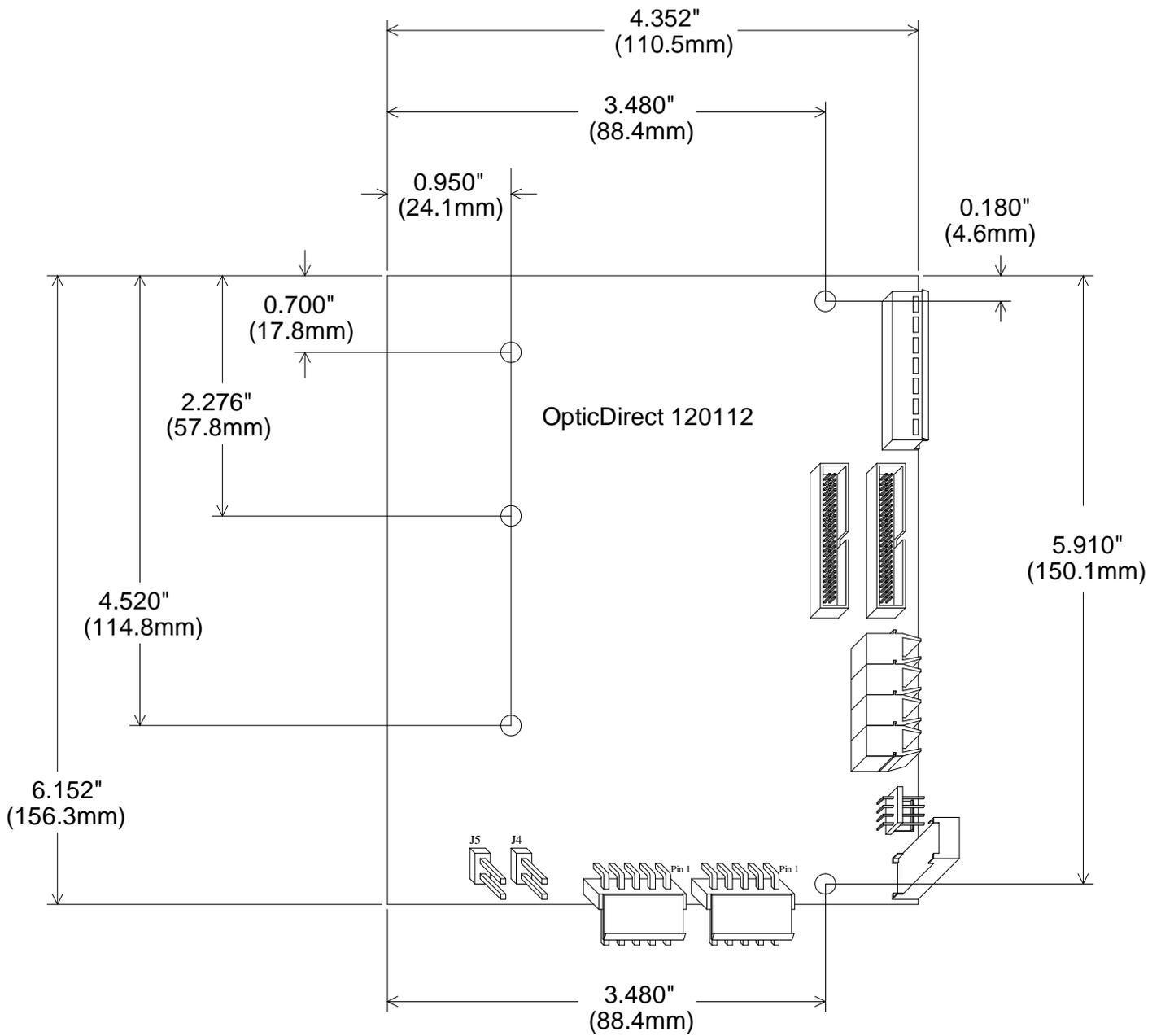| Symptom	Possible Cause	Corrective Action
+24V LED not lit	power connection to H1 is faulty	correct wiring or power supply problem
ENABLE LED not lit and no error on LED1	Main enable off	Check for errors in software preventing MPU11 from enabling drives
	Axis not enabled	Move axis
Incorrect Axis Number or Communication Failure	Incorrect communication connection	Make sure "FIBER REPEAT" and "WIRED INPUT" jumpers are set properly

LED1 Error Codes

Error Number	Meaning	Cause	Corrective Action
1	Communication Failure	OpticDirect has lost communication from the MPU11	Make sure MPU11 is connected and running. Check fiber 4 or wired connection. Make sure "WIRED INPUT" jumper is set properly.
2	Not Used		
3	Not Used		
4	Not Used		
5	Not Used		
6	Power Supply Off	+12v or -12v supplies have not started yet	Wait a few seconds for supplies to start. Start up is sequenced, so this condition can only be seen on the last few axes.
7	Communication out of sync	Excessive communication jitter, or re-sync after communication loss	Check fiber cables and connectors for dirty connections or cracks. Check wires and crimps if wired connection is used. This error is not a problem if it only appears for a few seconds during turn on or turn off.
8	Too many counts per interrupt	Power cycle of control without power cycling OpticDirect or bad communication packet while traveling at more than 1/2 max rate	Cycle Estop to clear. Not a cause for concern unless error occurs while running motors.
9	Not Used		

OpticDirect Connections

OpticDirect 120112

Pin 1

H1

+24VDC
24V Return
Brake Relay 1
Brake Relay 2
Reserved
Reserved
Reserved

Delta Drive Connector

Yaskawa Drive Connector

Fiber 5

Fiber 4

Fiber 5 Repeat

Fiber 4 Repeat

ADC In 1
Logic GND

Drive Communication Out

Drive Communication In

J5 J4

Pin 1

Pin 1

Wired Input

Fiber Repeat

Logic GND
Drive Out RX+
Drive Out RX-
Drive Out TX-
Drive Out TX+

Logic GND
Drive In RX+
Drive In RX-
Drive In TX-
Drive In TX+

OpticDirect Dimensions

4.352"
(110.5mm)

3.480"
(88.4mm)

0.950"
(24.1mm)

0.180"
(4.6mm)

0.700"
(17.8mm)

2.276"
(57.8mm)

OpticDirect 120112

5.910"
(150.1mm)

4.520"
(114.8mm)

6.152"
(156.3mm)

J5 J4

Pin 1   Pin 1

3.480"
(88.4mm)

OpticDirect Setup with Delta ASDA-A2-U Drive

OpticDirect Mechanical Mounting on Delta ASDA-A2-U

The following parts are required:

1. Your Delta ASDA-A2-U series drive
2. OpticDirect board

3. Optic Direct mounting plate with (5) 6-32 x 3/8" standoffs installed

4. Optic Direct cover plate
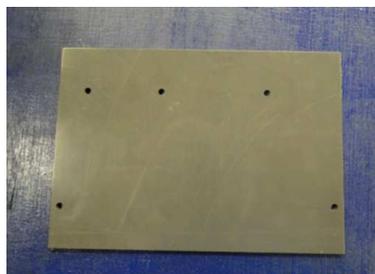
5. (5) 6-32 x 1" standoffs
6. (5) 6-32 nylon insert lock nuts

7. 5 inch long ribbon cable labeled "DELTA"

Installation:

1. Fit the OpticDirect over the 6-32 standoffs on the mounting plate (only one way it will fit).
2. Secure the OpticDirect to the OpticDirect mounting plate with 6-32 x 1" standoffs.
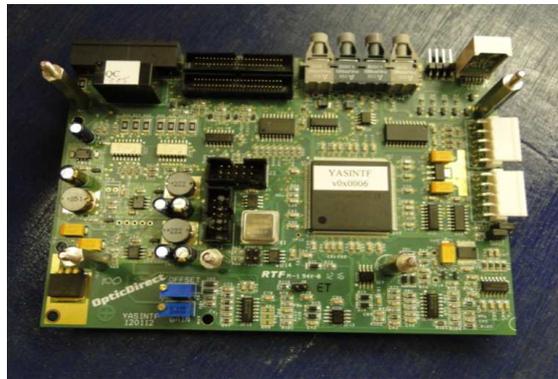
3. Install the Optic Direct Cover plate with 6-32 nylon insert lock nuts.
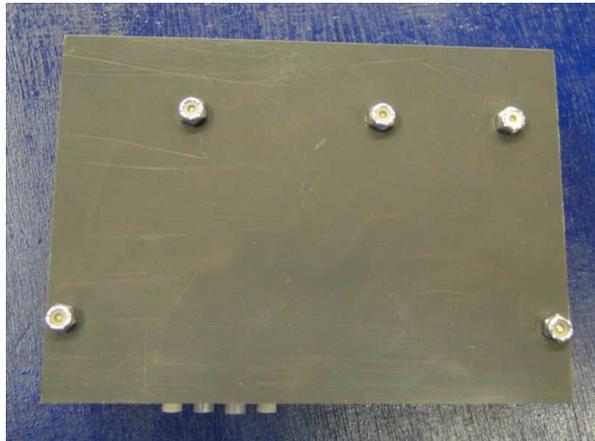
4. You are now ready to install the OpticDirect onto the Delta Drive. When doing this you want to line up the ribbon cable connection on the OpticDirect and the CN1 connection on the delta as close to straight as possible. On larger drives this will be the mounting height for the OpticDirect. On smaller drives such as the 750watt drive you must mount the OpticDirect flush with the top of the drive and flush with the front of the drive.
   A. Install the ribbon cable, plugging into the 2nd connection back marked "DELTA".

B. Now turn the unit over and remove the red cover from the double sided tape.

5. Install the OpticDirect unit on to the Delta Drive on the right side flush with the front and the ribbon cable lined up with the CN1 connector, not exceeding flush with the top. Making sure the tape is well seated. A 750 watt drive is shown.
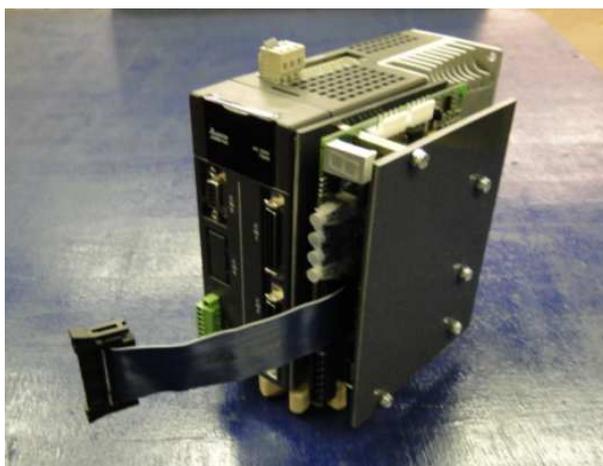
6. Now plug the ribbon cable into the CN1 connector. This completes the mechanical installation.

Parameter Setup for OpticDirect and Delta ASDA-A2-U in Precision Mode

Install the OpticDirect boards and set up CNC11 before continuing with parameter setup. CNC11 version 3.07 rev 14 or higher is required for precision mode.

The following section describes settings that must be changed to run the Delta ASDA-A2-U drives in precision mode. See Tech Bulletin 268 for further information on Delta precision mode setup.

Delta ASDA-A2-U Settings

Delta Parameter	Value	Notes
P1-00	0x1000	AB Phase pulse, line drivers, fastest filter
P1-00	0x1000	Encoder is AB Pulse output
P1-01	0x0100	position mode Pt, CW Negative
P1-01	2	Velocity Mode control
P1-40	*	Motor Maximum Commanded RPM
P1-41	200	Maximum Analog Torque command
P1-44	320000	Delta encoder PPR (lines, or counts/4), the gear ratio numerator
P1-45	8192	Centroid encoder PPR (lines, or counts/4), the gear ratio denominator
P1-46	8192	Encoder output PPR (lines, or counts/4)
P1-55	*	Maximum allowed RPM of motor
P2-10	0x0101	DI1 = Drive Enable
P2-11	0x0000	DI2 = not used
P2-12	0x0000	DI3 = not used
P2-13	0x0000	DI4 = not used
P2-14	0x0102	DI5 = Reset Servo Drive
P2-15	0x0000	disable DI6
P2-16	0x0000	disable DI7
P2-17	0x0000	Disable EMGS function
P2-18	0x0103	DO1 = zero speed
P2-19	0x0101	DO2 = /S ready
P2-21	0x0108	DO4 = Motor Brake Output
P2-66	0x0004	Auto-reset Undervolt error

* The value for P1-40 should be set to 10% over the max rate that CNC11 will command at 10VDC on the analog output. This means that if the motor will be commanded at 3000 RPM, this parameter should be set to about 3300 RPM. Also, Parameter 01-55 should be set about 5% above P1-40, or 3450 RPM in this example, to avoid issues at max rate.

CNC11 Settings

CNC11 Setting	Value	Notes
Kp	0	CNC11 PID Menu
Ki	0	CNC11 PID Menu
Kd	0	CNC11 PID Menu
Limit	2560000	CNC11 PID Menu
Kg	0	CNC11 PID Menu
Kv1	0	CNC11 PID Menu
Ka	0	CNC11 PID Menu
Parameter 256	2	CNC11 Parameter, Enable Precision Mode
Encoder counts / rev	32768	CNC11 Motor Parameters Menu

After the listed settings are changed to the correct values, run CNC11's Tune (<F1>, <F3>, <F4>, <F5>) function to automatically set remaining CNC11 parameters.

MPU11 to OpticDirect to Delta Drives Rev6/13/2012

Repeater Fibers daisy Chained from last to First drive

Flat Cable from OpticDirect To Delta CN1 Connector

Fibers From MPU11 To Last Axis

See Close-up

CN2 encoder cable From Delta Motor

Logic Power Supply 24VDC

Logic 24VDC GND

Logic +24VDC

Motor Brake Connector
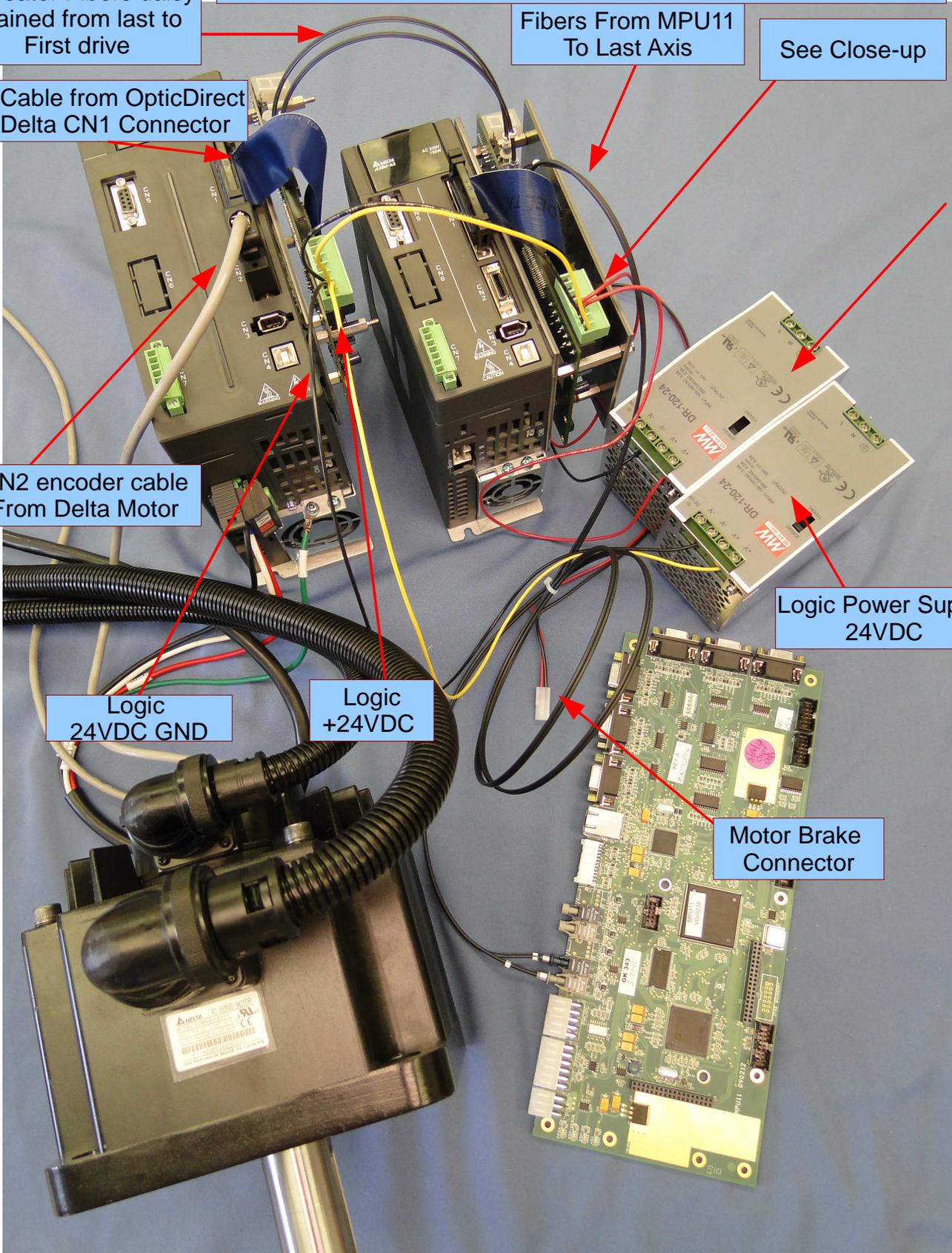
OpticDirect to Delta Hookup
Closeup Rev6/13/2012

Fiber repeater daisy-chained
To lower number drive axis

Attention:
Min Bend Radius
For Fibers
38mm/1.5"

Fibers from MPU11 to last
Highest number axis

Switched Motor
Brake Output

To motor brake connection

From Brake
24VDC

Logic 24V
Common

Logic 24VDC

24VDC Brake Power Supply
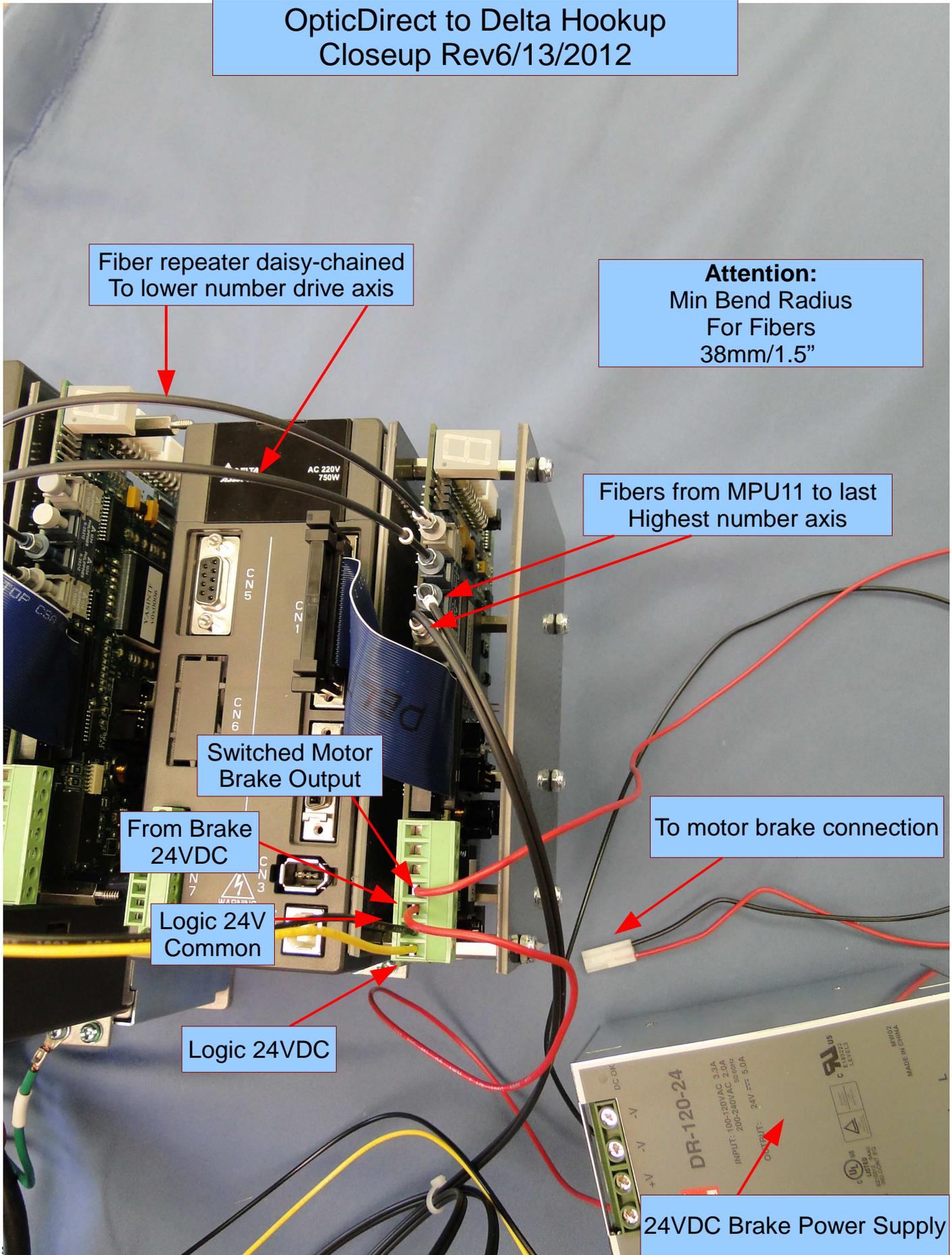
OpticDirect Setup with Yaskawa Sigma 5 Drive

OpticDirect Mechanical Mounting on Yaskawa Sigma 5
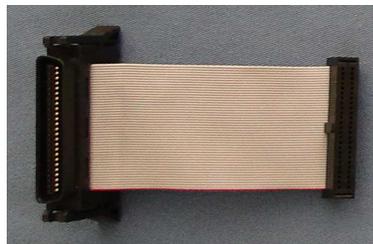
The following parts are required:

1. Your Yaskawa Sigma 5 series drive
2. OpticDirect board

5. Optic Direct cover plate
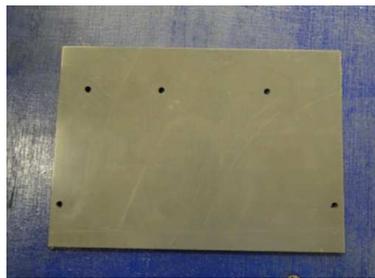
8. (5) M3 x 0.5 x 5mm standoffs
9. (5) M3 x 0.5 x 20mm standoffs
10. (5) M3 x 0.5 x 5mm screws
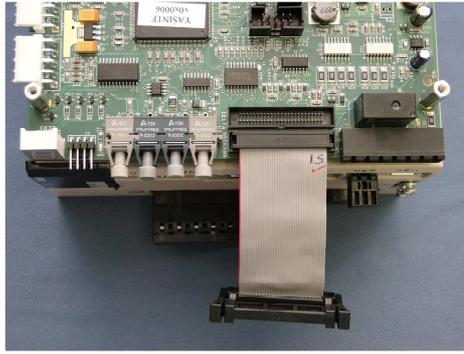11. 2.75 inch long ribbon cable

Installation:

1. Install the M3 x 0.5 x 5mm standoffs into the option board mounting holes on the right side of the drive.
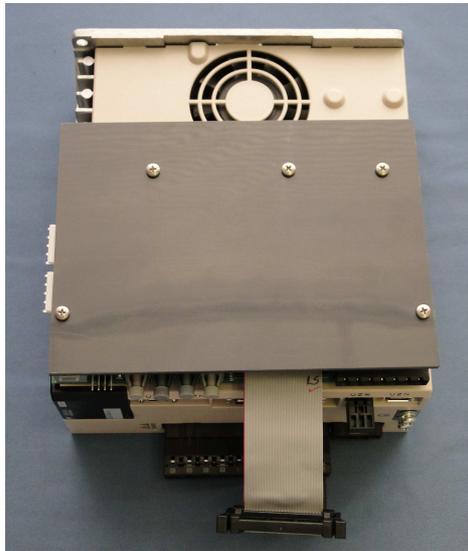

2. Secure the OpticDirect to the drive with the M3 x 0.5 x 20mm standoffs.
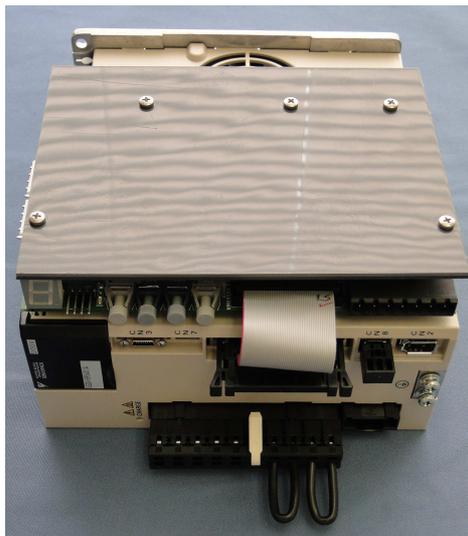
3. Plug the ribbon cable into the connector near the edge of the board labeled "YASKAWA".

4. Install the Optic Direct Cover plate with the M3 x 0.5 x 5mm screws.

5. Plug the ribbon cable into the drive's CN1 connector to complete the mechanical installation.

Parameter Setup for OpticDirect and Yaskawa Sigma 5 in Precision Mode

Install the OpticDirect boards and set up CNC11 before continuing with parameter setup. CNC11 version 3.07 rev 14 or higher is required for precision mode.

The following section describes settings that must be changed to run the Yaskawa Sigma 5 drives in precision mode. See Tech Bulletin 267 for additional Yaskawa drive setup information.

Yaskawa Sigma 5 Settings

Yaskawa Parameter	Value	Notes
Pn000	0x0010	Direction of Motor Rotation and Encoder Output Pulse
Pn10B	0x0004	Application Function for Gain Select Switch
Pn170	0x1400	Tuning-less Function Related Switch
Pn200	0x0004	Reference Pulse Form
Pn20A	8192	Number of pitches for the external encoder
Pn20E	1048576	Yaskawa encoder counts, the gear ratio numerator
Pn210	32768	Centroid encoder counts, the gear ratio denominator
Pn212	8192	Encoder output PPR (lines, or counts/4)
Pn50A	0x8101	Input Signal Selection 1
Pn50E	0x3200	Output Signal Selection 1

CNC11 Settings

CNC11 Setting	Value	Notes
Kp	0	CNC11 PID Menu
Ki	0	CNC11 PID Menu
Kd	0	CNC11 PID Menu
Limit	2560000	CNC11 PID Menu
Kg	0	CNC11 PID Menu
Kv1	0	CNC11 PID Menu
Ka	0	CNC11 PID Menu
Parameter 256	2	CNC11 Parameter, Enable Precision Mode
Encoder counts / rev	32768	CNC11 Motor Parameters Menu

After the listed settings are changed to the correct values, run CNC11's Tune (<F1>, <F3>, <F4>, <F5>) function to automatically set remaining CNC11 parameters.