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USER MANUAL

3U DIGITAL PWM AMPLIFIER

3U Digital PWM Amplifier

4Ax-603397-xUxx

January 28, 2003

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INTRODUCTION

The 3U Digital PWM Amplifier board is a 3U-size amplifier designed to drive AC Induction, Permanent Magnet Brushless, DC Brushed type motors. This amplifier unit comes in two packages: Two 680W continuous power amplifiers or one 1360W continuous power amplifier. The 3U Digital PWM Amplifier may be interfaced conveniently to the PMAC controller via ACC-24E2 or ACC-8F.

Typically, the amplifier is purchased with the Delta Tau 3U power supply and backplane interface card to distribute the power to the unit.

Part Number	Description
603428-10x	170V Power Supply for 3U Amplifiers
603435-10x	Backplane Assembly for 3U Amplifiers

Theory of Operation

The 3U Digital PWM Amplifier is a 3-phase direct PWM drive, utilizing the latest in smart power technology from the world's leading vendors and the cutting edge algorithms of the PMAC2/UMAC controller family. The 3U Digital PWM Amplifier can drive all of the motor types commonly used in programmable motion control in both rotary and linear forms.

The 3U Digital PWM Amplifier is based on PWM (Pulse Width Modulation), a technique employing both frequency and phase to approximate sinusoidal currents and to control AC and DC motors.

Each axis of the 3U Digital PWM Amplifier uses a three H-bridge legs scheme. Each leg employs a top and bottom IGBT transistor. The motor windings are connected between the center points of top and bottom pairs. When two appropriate IGBT transistors in the bridge are turned on, the current flows through any two motor windings. Any two (top and bottom) bridge transistors are turned on by a logic from PMAC2 with no other conditioning necessary, except an optical isolation. The 3U Digital PWM Amplifier performs no control functions itself; it simply accepts direct PWM commands from the PMAC2. PMAC2 requires the position feedback and the feedback about the current fed to the motors to commutate each controlled axis.

The current feedback is provided in digital form as a part of a serial data stream of 18 bits (12 bits report the current feedback and remaining 6 bits report fault conditions) from the current feedback A/D converters which are located in the 3U Digital PWM Amplifier. Each axis has its own "mask" word that tells the PMAC2 how many bits to expect from the A/D converter. The clock and the strobe for the digital feedback are programmable at the PMAC2.

The position feedback is generally fed to PMAC2/UMAC via ACC 8F or ACC-24E2. The position feedback is not connected to the Quad Amp in any way.

Power Supply Considerations

The 3U Digital PWM Amplifier requires a single power supply of +50V to +170V max. The current requirement can vary depending on the load, but should not exceed 8A (4A per channel) continuous and 16A peak (8A per channel) for a 1-second period.

The logic power for the amplifier is derived from the BUS voltage. Typically, the BUS voltage can be brought in from the amplifier backplane assembly card.

Any shunt resistors connected to the amplifiers are connected to the amplifier backplane assembly.

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Specifications

Power Stage

Description	Specification
BUS Voltage (standard unit)	60V DC minimum 170V DC maximum
Max Continuous Current (per amp)	4A (RMS)
Peak Current (per amp)	8A
Maximum PWM Frequency	15 KHz
MAX ADC Current Loop Feedback	12A

Environmental

Description	Specification
Operating Temperature	0°C to 55°C (32°F to 135°F)
Storage Temperature	-12°C to 82°C (10°F to 180°F)
Humidity	0% to 95%, Non-Condensing

3U Power Supply

Description	Specification
Main AC Input Voltage	120V AC
Frequency	50/60 Hz
Main BUS Voltage	170V

Amplifier Display Codes

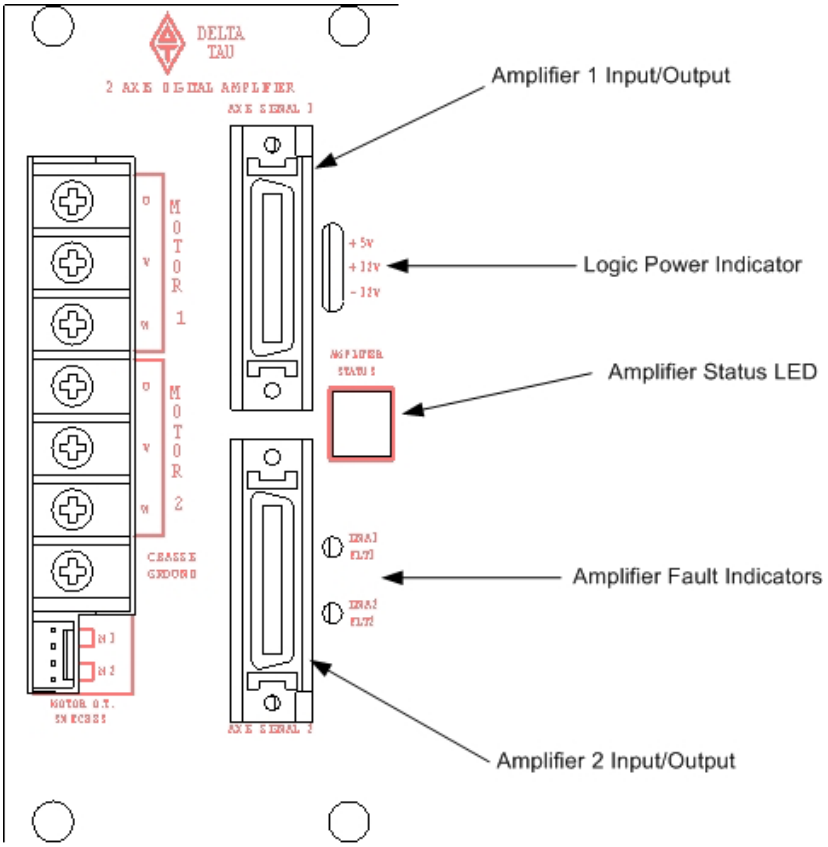
The amplifier is protected against severe electrical and temperature conditions. See the table below for a code, and explanation.

Code	Description
0	Everything is OK
1	2 sec over current, axis #1
2	Short circuit, axis # 1
3	Motor over temperature fault, axis #1
4	2 sec over current, axis # 2
5	Short circuit, axis #2
6	Motor over temperature fault, axis #2
8	Under voltage, global
9	High PWM fault, global
C	Over voltage, global

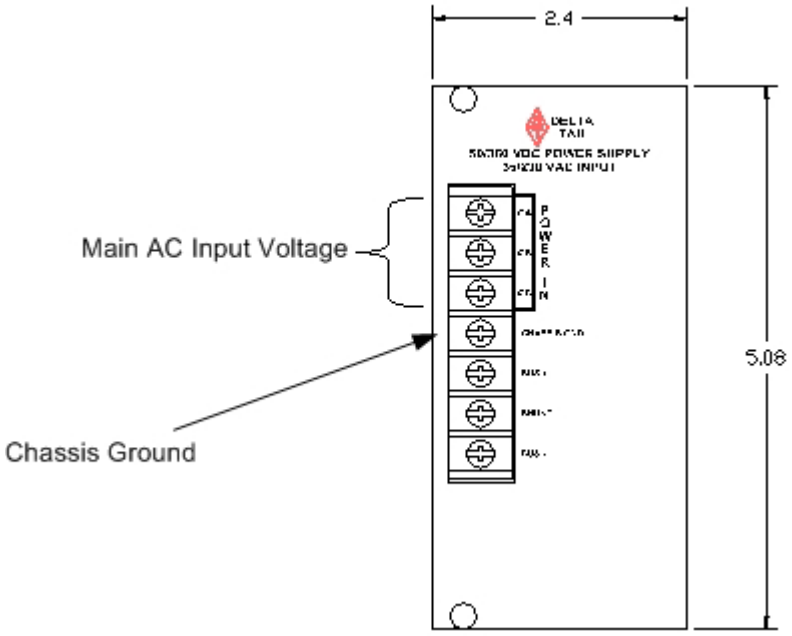
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CONNECTIONS

3U Amplifier Faceplate Connections



Power Supply Faceplate



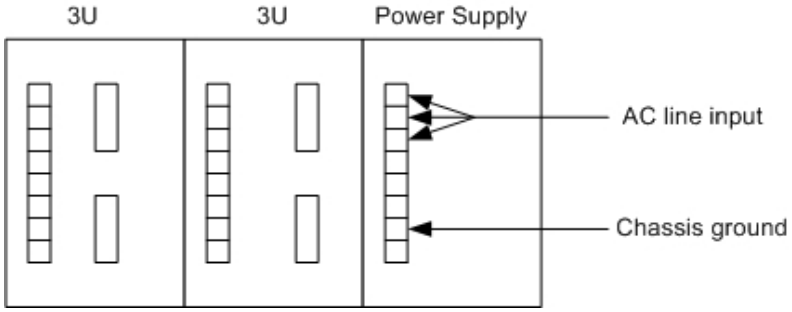
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Hardware Connections to the Assembly

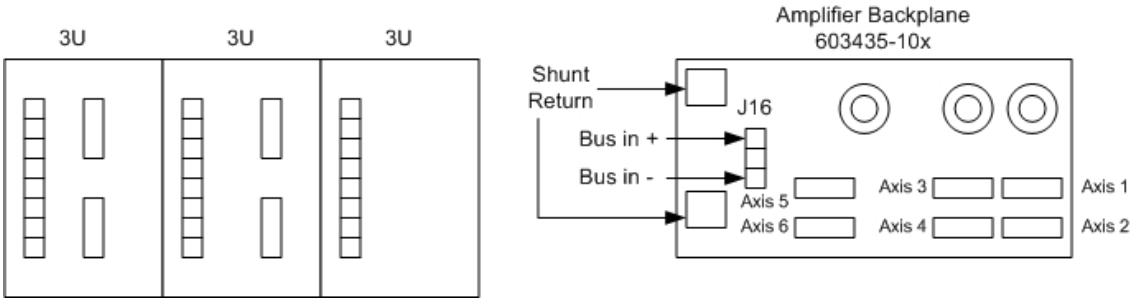
Power-DC Bus

The amplifier requires an external DC bus supply. The bus can be supplied via Delta Tau Power Supply (part of the UMAC line product), or via customer provided DC source. Such a source can be connected to the UMAC PWM backplane, or directly to the J1 connector of the 3U power board via quick-disconnect terminals.

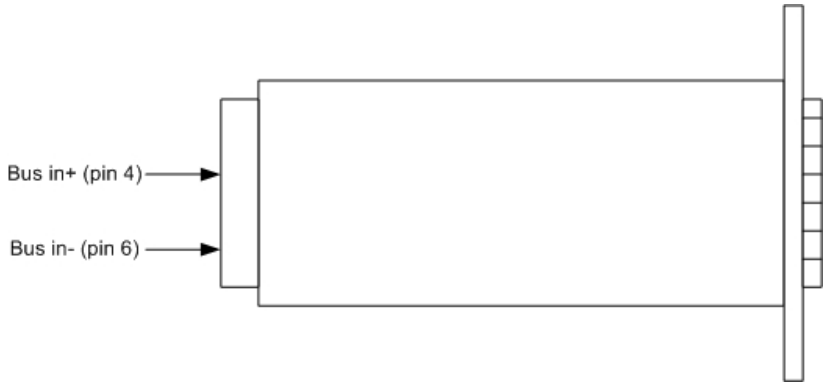
The graphic below shows two 3U PWM amplifiers and a Delta Tau Power Supply in a rack. The DC bus is distributed through the backplane.



Below are shown three 3U PWM amplifiers and a Delta Tau Power Supply in a rack. The DC bus must be connected to the backplane.



The DC bus can be connected to a stand-alone 3U amplifier via quick-disconnect terminals as shown:

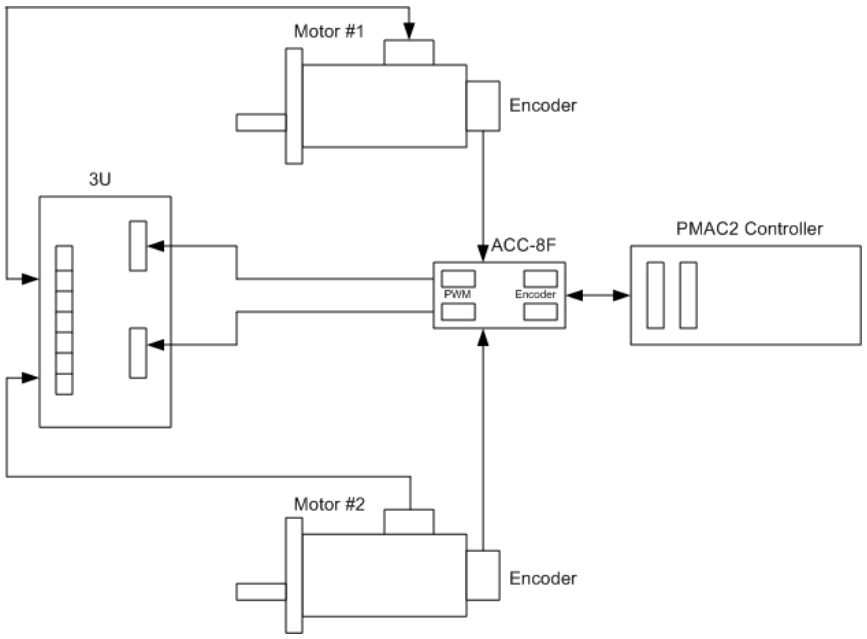


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Power-AC Input

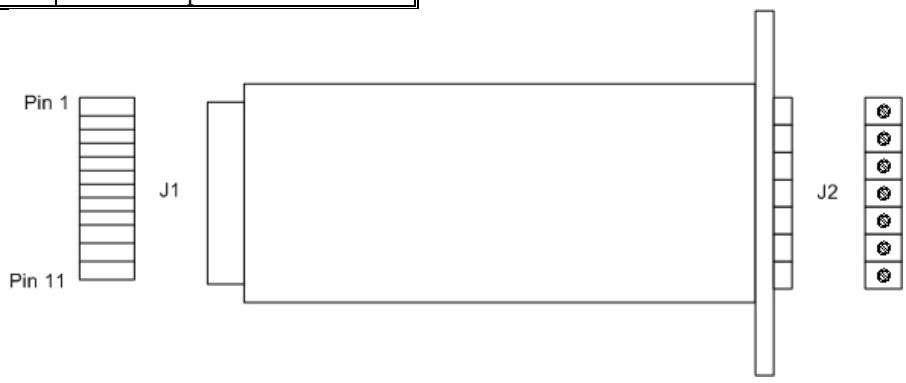
AC input voltage is applied to the power supply assembly **ONLY.** The power supply accepts three-phase or single-phase AC voltage. For a single-phase operation, connect AC line and Neutral to any of the AC inputs (A, B, C), and connect AC ground to Chassis GND terminal.

Typical 3U Wiring Diagram



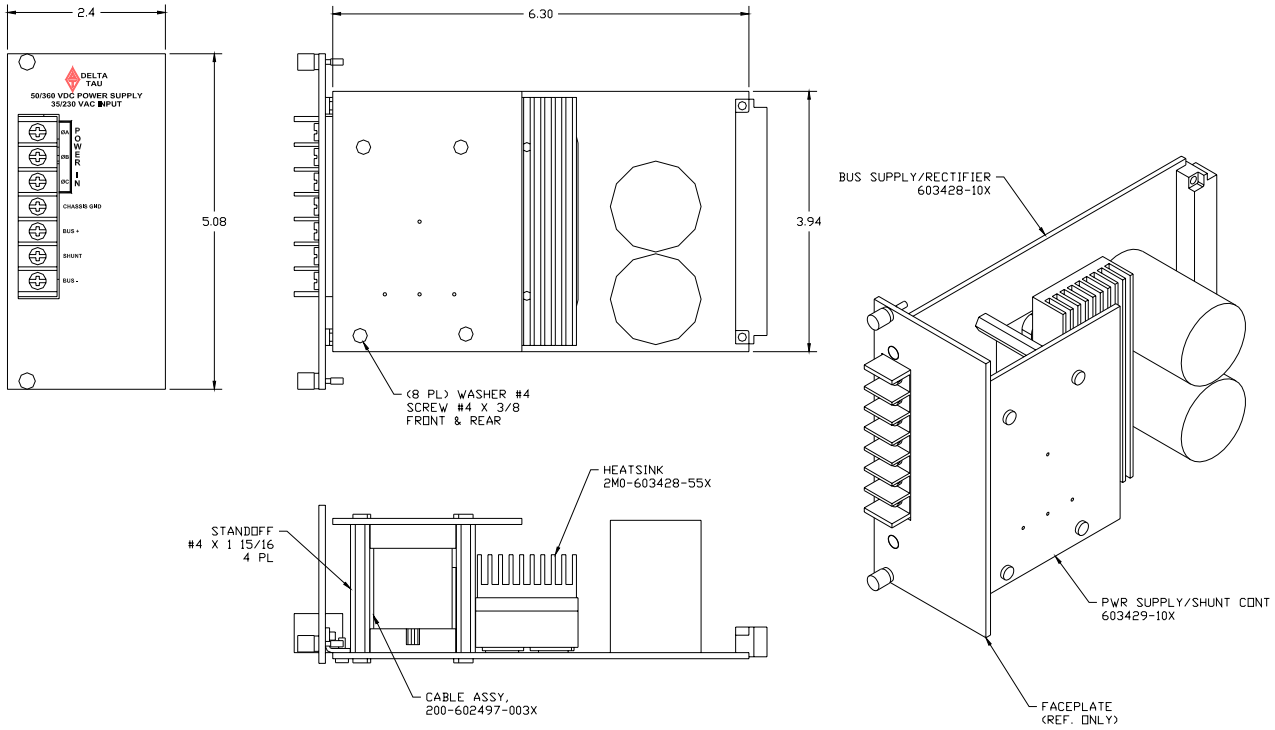
Amplifier Power Section Pinout (603391-10x)

J1 Connector Pin Out		J2 Connector Pin Out	
Pin #	**Description**	**Pin #**	**Description**
1	Motor ground	1	Axis #1 W phase
2	Axis #1 W phase	2	Axis #1 V phase
3	Axis #2 W phase	3	Axis #1 U phase
4	Bus +	4	Axis #2 W phase
5	Shunt	5	Axis #2 V phase
6	Bus -	6	Axis #2 U phase
7	Bus +	7	Motor ground
8	Axis #1 V phase		
9	Axis #2 V phase		
10	Axis #1 U phase		
11	Axis #2 U phase		



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3U Power Supply Layout



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3U AMPLIFIER BACKPLANE BOARD (603435-10X)

The 3U Amplifier Backplane Board allows plugging the 3U digital PWM amplifiers into an assembly that distributes the BUS power for up to three 2-Axis 3U digital amplifiers. If the optional 170V power supply is used in the system, you could plug two 2-axis 3U digital amplifiers into the Amplifier Backplane Board Assembly. Any external shunts for the amplifier will be connected to the lug type connectors located on the backside of the assembly. Typically, this assembly would be placed into a 3U Rack provided by Delta Tau.

The backside of the assembly allows you to –

- Connect the motor leads to Molex Type connectors located on the backside of the assembly;
- Bring in an external DC BUS for the Amplifiers;
- Add a shunt resistor;
- Connect the power for external cooling fans.

The front side of the assembly simply allows the user to plug the amplifiers and power supply into the unit.

Front Side Connectors

Connector	Description	Notes
J3	3U Digital Amplifier Input	Traditionally for Axis #1 & Axis #2
J4	3U Digital Amplifier Input	Traditionally for Axis #3 & Axis #4
J5	170V 3U Power Supply	Make sure to plug into J5 connector.
J6	3U Digital Amplifier Input	Traditionally for Axis #5 & Axis #6

J3, J4, and J6 Amplifier Pinouts

Pin #	Description	Pin #	Description
1	Motor ground	7	Bus +
2	Axis #1 W phase	8	Axis #1 V phase
3	Axis #2 W phase	9	Axis #2 V phase
4	Bus +	10	Axis #1 U phase
5	Shunt	11	Axis #2 U phase
6	Bus -		

J5 Power Supply Pinout

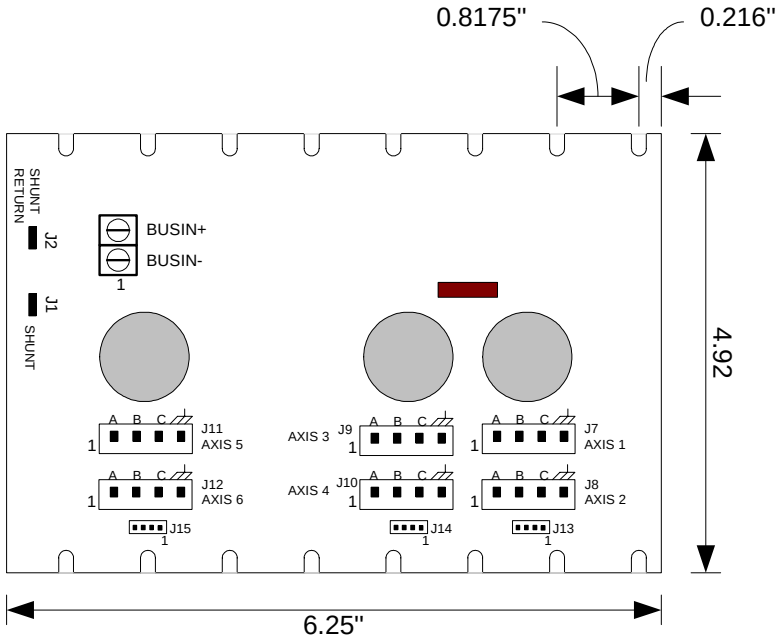
Pin #	Description	Pin #	Description
1	BUS+ INPUT	7	NC
2	SHUNT	8	NC
3	BUS- INPUT	9	FAN+
4	SHUNT Return	10	FAN-
5	BUS+ Input	11	GND (Motor GND from amp)
6	BUS-Input		

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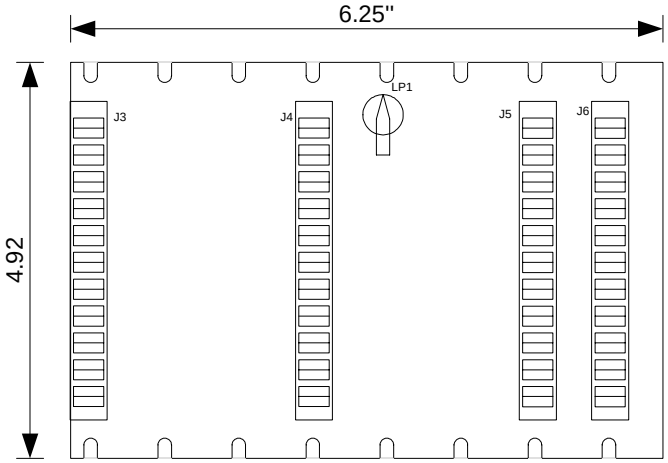
Back Side Connectors

Connector	Description	Notes
J1	Shunt Resistor Input	
J2	Shunt Resistor Return	
J7	Optional Axis 1 Motor Output	
J8	Optional Axis 2 Motor Output	
J9	Optional Axis 3 Motor Output	
J10	Optional Axis 4 Motor Output	
J11	Optional Axis 5 Motor Output	
J12	Optional Axis 6 Motor Output	
J13	Fan Power Outputs	Traditionally for the J3 Amplifier
J14	Fan Power Outputs	Traditionally for the J4 Amplifier
J15	Fan Power Outputs	Traditionally for the J6 Amplifier
J16	External BUS Supply Input	

3U Amplifier Backplane Layout (Back)



3U Amplifier Backplane Layout (Front)



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TROUBLESHOOTING AND USEFUL NOTES

Troubleshooting

Amplifier stops and displays a code
If a 3U amplifier displays other digit than 0, please refer to a section 'Protection' for an explanation of fault codes.

Amplifier is dark
If the amplifier status display, +5V, +12V, -12V, ENA1, and ENA2 are not illuminated, verify that DC bus is connected to the 3U amplifier.

If the condition described above is present, and the 3U amp is used in a UMAC rack along with a power supply, verify that AC line is connected to the power supply.

Motor does not move upon a command
Verify that PWM cables and motor leads are correctly connected to 3U amplifier. Is motor properly phased?

Cannot phase a motor
Verify that PMAC is properly configured and sees the motor's feedback.

Useful Notes

If a shunt (regen) resistor is required, use the shunt terminals on the backplane. Or, the shunt resistor can be connected directly to the 3U power board (300-603391-102) between J11 pin 5 and J11 pin 4.

The long pin on the power board connector J11 represents pin 11 (Axis #2 U phase).

If the 3U amplifier is not used in Delta Tau UMAC rack, it is a user's responsibility to assure that the proper cooling is provided for the IGBTs. Delta Tau suggests a fan capable of at least 100 CFM placed as close to the heatsinks as possible.

If the bus connection to the 3U amp is not done via Delta Tau backplane, a de-coupling capacitor (about 120 μF) for + and – bus should be used.

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