Quad Amplifier

Delta Tau Data Systems, the world leader in high-performance motion control, introduces a universal multi-axis Digital servo drive, the Delta Tau **Quad Amplifier**. The **Quad Amp** is a highly compact combination of one to four digital PWM amplifiers and power supply packaged together. The combination of a Quad Amp and the cutting-edge control algorithms of the PMAC2 controller family results in previously unobtainable levels of performance for permanent magnet and AC induction motors.

Features

- 'Plug and Play' with PMAC 2, PMAC Turbo controllers, and MACRO
- Up to 4 axis mix or match package
- Up to 50 HP (37 kW) total continuous power
- Complete package-no need for external power supply
- Digital Current feedback
- LED Status indicator
- No dimension change if upgraded from 1, 2 or 3 axis to 4-axis unit
- Accepts 35-480 VAC Bus input, and provides separate Bus & Control Voltage Capability
- Three phase or single-phase operation-no modification needed!
- Braking (shunt) resistors up to 10 HP provided
- Lower cost (DC input only) Quad Amp available
- Up to 15 kHz PWM (user selectable)
- Active Hall-effect current sensors used

Capabilities

The **Quad Amp** can drive all of the motor types commonly used in the motion control industry in both rotary and linear forms: permanent-magnet brush-less motors (a.k.a. DC brush-less, AC brush-less, AC servo), AC induction motors, and DC brush motors.

Applications /usage

The **Quad Amp** design is particularly well suited for the machine tool industry, providing one, two, or three axes of control with a fourth and higher-powered spindle axis. The spindle axis is capable of full position control for functions such as rigid tapping as well as the normal velocity control, even if an induction motor is used for the spindle. With a PC and PMAC2 in one integrated package, or a stand-alone PMAC2 providing all of the computational and control circuitry, and the **Quad Amp** providing all of the power circuitry in another integrated package, virtually **all** of the machine electronics have been taken care of.
Delta Tau's PMAC2, and **Quad Amp** package provides a Machine Tool Builder with these advantages:

- maximum motor torque at all speeds
- smooth controlled acceleration
- smooth controlled de-acceleration
- reduce electric power consumption
- cooler running motors
- solid state diagnostics
- motor protection circuits
- reduced mechanical stress

Protection

Every **Quad Amp** has two layers of protection:

IGBT protection	Quad Amp built-in protection
• Over current	• Heat sink over temperature • High PWM frequency • DAC (non PWM)
• Ground fault	• Motor over temperature • Bus under voltage
• Substrate over temperature	• Bus over voltage • General PS/Soft Start fault

The Quad Amp protection circuits detect and respond to any motor or control fault conditions in less than 1.0 microsecond.

Performance

Delta Tau's PMAC 2 technology results in simple power circuits. This technology increases reliability and performance by using IGBTs (Insulated Gate Bipolar Transistor). The **Quad Amp**'s IGBTs produce power waveforms by simply accepting optically isolated PWM signals from the PMAC 2 family controllers. The **Quad Amp** performs no control function itself, it isolates and level shifts the PWM signals at the required frequency and magnitude to obtain the desired torque, velocity, and position. This direct PWM method, along with the digital current feedback using active Hall-effect sensors, permits advanced PMAC2 algorithms, such as sinusoidal commutation, vector control, field-oriented current-loop closure, field weakening, third-harmonic injection, and I^2T protection. These algorithms operate on the motor as directly as possible, thus increasing performance:

- Higher velocity and position bandwidth
- Greater stiffness
- Faster acceleration
- No pot tweaking or personality modules
- Low noise
- Easier setup
- System stability
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The system setup is accomplished by setting software parameters in the PMAC2 family controller using ***P2Setup*** software.

Reliability

To ensure a high reliability, each Quad Amp is thoroughly tested.

- Overnight cycle
- Output power check on each axis
- 15-step final test
- Heat cycle in Burn-in chamber
- Protection verification
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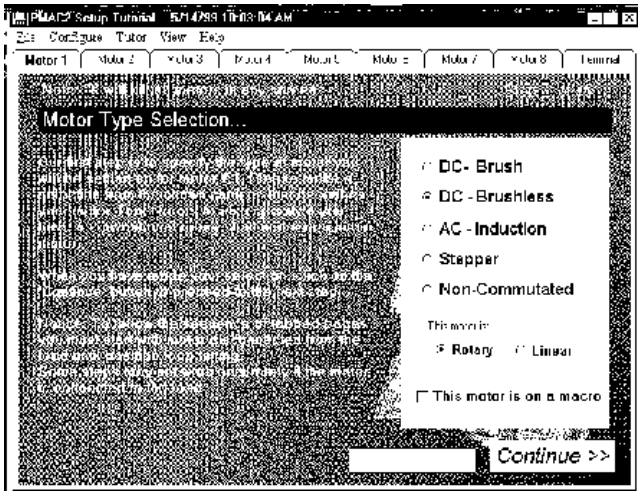
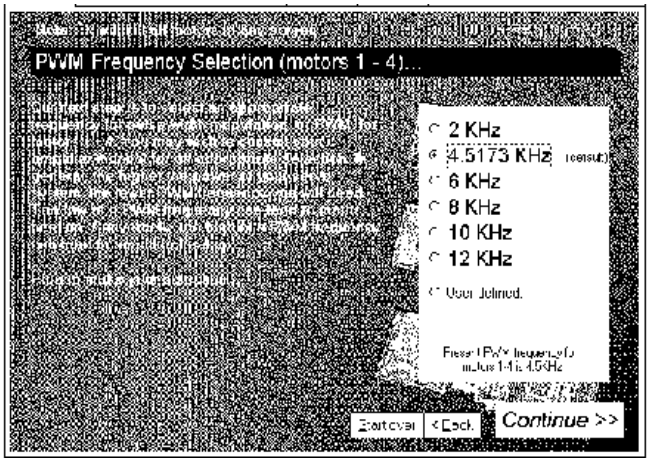
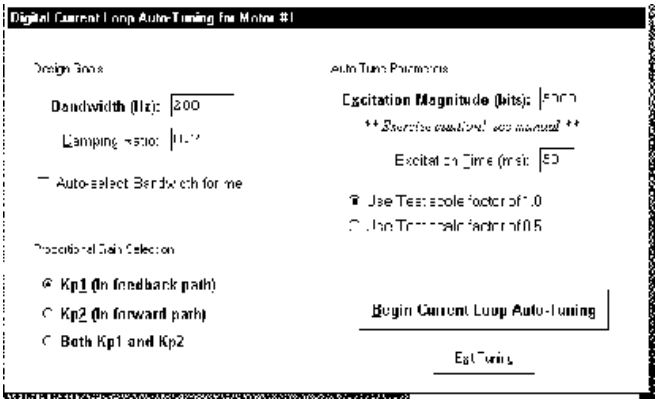
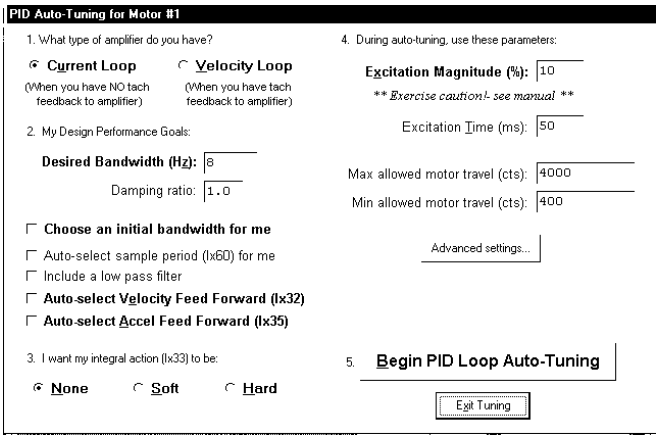
P2 Setup

The P2 Setup is an easy to use interactive program that helps to setup PMAC2 family controllers with the **Quad Amp** and a motor. It allows the user to tune digital current, torque, velocity and position loops. The final settings can be easily saved to a disk for backup, replacement, and duplication from system to system.









Flexible Configuration/Mounting

The **Quad Amp** is configurable at the factory for your particular motor power requirements. The available versions are DC input only and two AC input voltage modes.

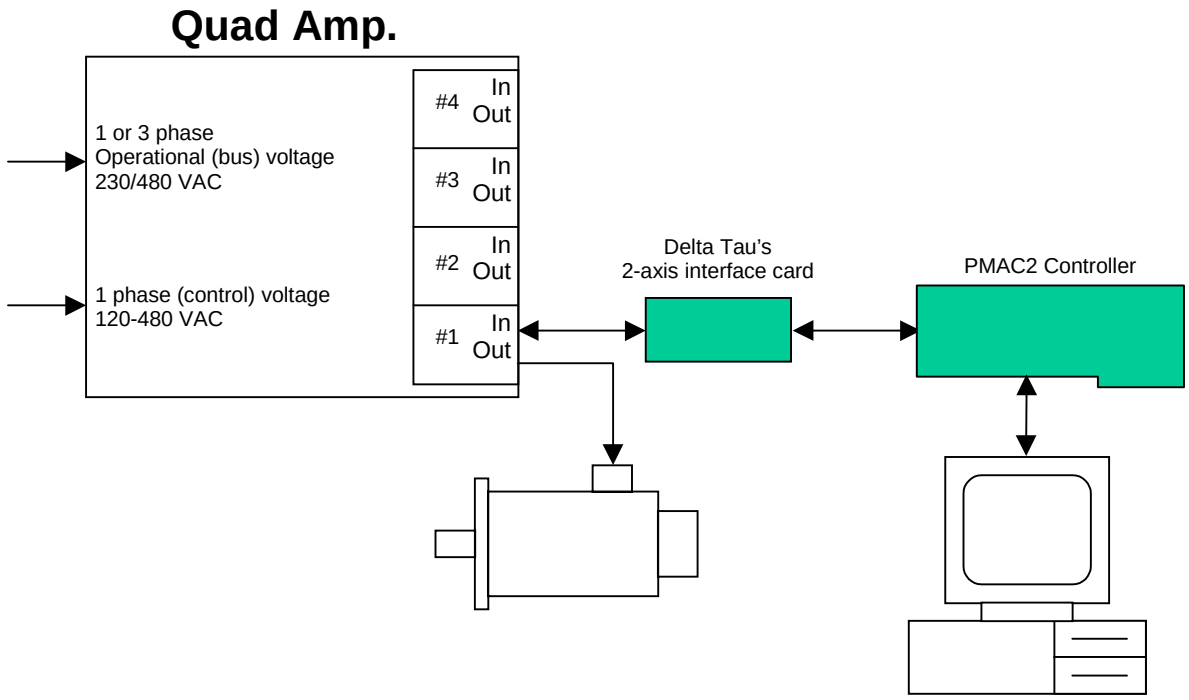
Power supply option	VAC Input	Continuous output limit	Heat Sink size	Notes
(no option, DC input only)		up to 50 HP (37 kW)	small or large	
1	230	up to 10 HP (7.5 kW)	small	
2	230	up to 50 HP (37 kW)	large	
2A	480	up to 50 HP (37 kW)	large	

There are two types of mounting configurations available, External and Internal. In the **External** version, the heatsink cooling fins are mounted externally through an opening in a panel, with external air blowing on the cooling fins, such as an external air plenum. In the **Internal** version, the **Quad Amp** is foot mounted to an electrical panel, with its cooling fins internal to the electrical cabinet.

Mounting Opt #	Mounting Type	Fans	Internal Shunt Resistor
3	External	No*	Yes
3A	External	No*	Yes
3B	External	No*	No**
4	Internal	Yes	Yes
4A	Internal	Yes	Yes

* User must supply cooling fans.
**User must supply external shunt resistors.

Simple connectivity



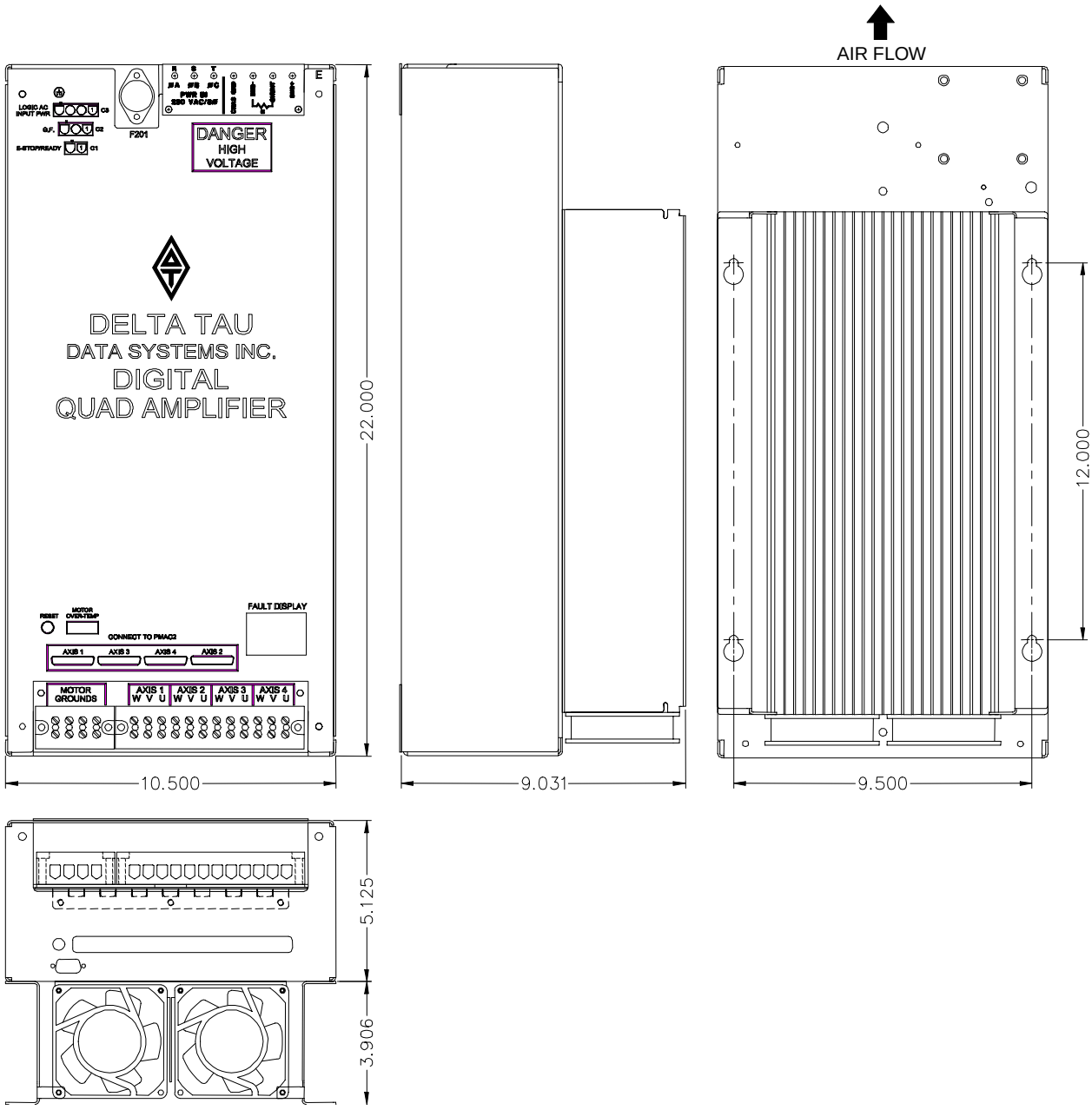
Connecting the **Quad Amp** is simplicity itself. Connect 1 or 3-phase operational 230VAC or 460VAC (depending on model ordered) and ground via 4 screw terminals. In addition, connect single-phase control AC input power to amplifier via Molex style connector. For each axis, connect the 2 or 3 motor phases and ground via screw terminals. Connect one integrated 36-pin cable between Delta Tau 2-axis interface card (ACC 8F, for example) and the **Quad Amp** for each motor (position feedback and flags connect only to the interface board, not to the amp, simplifying system wiring). If necessary, connect an external shunt resistor and/or external circuit breaker.

Control voltage — All **Quad Amp**s have an independent external control AC input voltage connector. The control voltage is used within the amplifier to supply voltage to internal logic power supplies and to operate cooling fans. It is selectable from 120 to 480 VAC single phase and it is set at the factory. However, the settings can be changed in the field by simply changing the taps on a transformer inside of the **Quad Amp**.
The control voltage can be the same as the operational bus voltage or it can be a separate A.C. voltage.

Operational voltage — 1 or 3-phase VAC operational voltage is converted into a DC bus via 3-phase bridge rectifier and filter capacitors.

Dimensions/Weight

Delta Tau multi-axis **Quad Amp** is bundled into a compact and affordable integrated package 560mm high by 267mm wide by 229mm deep (22”x10.5”x9.0”). The weight depends on the configuration ordered, but is typically about 50 lbs. (23 kg).



Quad Amp Power Block Selection Table for 230 VAC Amplifiers

Block Opt #	Contin. Ratings	"200%" 2-minute Ratings	"300%" 2-second Ratings	Block Max DC Ratings	Axis 1 slot	Axis 2 slot	Axis 3 slot	Axis 4 slot	Total Cont. Rating
5	0.56kW 0.75HP 1.8Arms	1.12kW 1.5HP 3.6Arms	1.68kW 2.25HP 5.4Arms	600V 10A					
6	1.2kW 1.5HP 3.7Arms	2.4kW 3.0HP 7.5Arms	3.6kW 4.5HP 11.2Arms	600V 15A					
7	1.5kW 2.0HP 5Arms	3.0kW 4.0HP 10Arms	4.5kW 6.0HP 15Arms	600V 20A					
8	2.25kW 3.0HP 7Arms	4.5kW 6.0HP 14Arms	6.75kW 9.0HP 21Arms	600V 30A					
9	3.75kW 5.0HP 12Arms	7.5kW 10.0HP 24Arms	11.25kW 15.0HP 36Arms	600V 50A					
10	5.6kW 7.5HP 18Arms	11.2kW 15.0HP 37Arms	16.8kW 22.5HP 55Arms	600V 50A	N/S		N/S		
11	7.5kW 10HP 25Arms	15kW 20HP 50Arms	22.5kW 30HP 75Arms	600V 75A	N/S		N/S		
12	11.2kW 15HP 37.5Arms	22.5kW 30HP 75Arms	33kW 44HP 100Arms	600V 100A	N/S		N/S		
13	15kW 20HP 50.0Arms	30kW 40HP 100Arms	45kW 60HP 150Arms	600V 150A	N/S		N/S		
14	22.5kW 30HP 75.0Arms	45.0kW 60HP 150Arms	50kW * 60HP 150Arms	600V 200A	**	**	N/S		

Quad Amp Power Block Selection Table for 460 VAC Amplifiers

15	1.5kW 2.0HP 2.5Arms	3.0kW 4.0HP 5.0Arms	4.5kW 6.0HP 7.5Arms	1200V 10A					
16	2.25kW 3.0HP 3.5Arms	4.5kW 6.0HP 7.0Arms	6.75kW 9.0HP 10.5Arms	1200V 15A					
17	3.75kW 5.0HP 6.0Arms	7.5kW 10.0HP 12.0Arms	11.25kW 15.0HP 18.0Arms	1200V 25A					
18	7.5kW 10HP 12.5Arms	15kW 20HP 25Arms	22.5kW 30HP 37.5Arms	1200V 50A	N/S		N/S		
19	15kW 20HP 25Arms	30kW 40HP 50Arms	45kW 60HP 75Arms	1200V 75A	N/S		N/S		
20	22.5kW 30HP 37Arms	45kW 60HP 75Arms	60kW 80HP 100Arms	1200V 100A	**	**	N/S		
21	37.25kW 50HP 70Arms	56kW 75HP 105Arms	75kW 100HP 140Arms	1200v 150A	N/S	N/S	N/S		

* Options 14 & 21 – The peak overload HP and Current is 200% for two seconds.

** Two spare axes slots are available for two low power IGBT modules. Please consult factory.

N/S-Not standard. Consult factory for custom assembly.

Example #1

Application	A customer needs to retrofit a four axis application that runs off 230 VAC. The first three axes require 5 HP continuous power each and the forth spindle axis requires 15 HP continuous power.
Solution	Refer to 230 VAC selection table. Choose three Block options 9 and one option 12 for the final configuration 5/5/5/15.

Example #2

Application	A customer requires a three axis Quad Amp that runs off 460 VAC. The first two axes need to be 20 HP each and the third one needs to be 10 HP.
Solution	Refer to 460 VAC selection table. Choose two Block options 19 and one option 18. After consulting Delta Tau, the final configuration is going to be 10/20/0/20.