QuickPack® *QPA3202*
PIEZO POWER AMPLIFIER

Table of Contents

Description

The QPA3202 is a single-channel, linear power amplifier specifically designed for driving Midé's line of Quickpack/PowerAct transducers and other piezoelectric capacitive transducers. It offers a fixed or adjustable DC gain up to 50 V/V with a bipolar output range from +200V to –200V. The QPA3202 has a bandwidth of 8 kHz and a minimum current limit of 0.2 Amperes. An analog output jack is provided on the face of the amplifier for precisely monitoring scaled (1/50) output voltage.

The QPA3202 is equipped with thermal overload protection and output short-circuit protection. In the event of a fault, the device enters a shutdown mode during which time the output is disabled until power is recycled and the fault is cleared. LED indicators alert the user when a fault condition has occurred.

The amplifier is packaged in a compact aluminum enclosure measuring 12 x 9 x 4 inches with a total weight of 5.5 kg (12.1 lbs). It is designed for benchtop or rack-mount operation. Its low-cost, simple functions and high performance make the QPA3202 a suitable choice for a wide range of piezoelectric transducer applications.

Features:

- Differential output range from +200V to –200V
- Peak output current > 2A
- Fixed and adjustable DC gain up to 50V/V
- Precision output voltage monitor (1/50 scale)
- Short-circuit and thermal overload protection
- Simple interface and small form factor

Ordering Information:

- QPA3202: User selectable 110V @ 60Hz or 220V @ 50Hz AC input
- Contact Midé for custom designs

Accessories:

- AC Power cable (included)
- Output cables and transducers sold separately

QPA3202 Specifications

Maximum Ratings:		
Analog Input Voltage	V_{in}	+/-10 V
Operating Temperature	T_a	40° C
Storage Temperature	T_s	85° C

Table 1: Electrical Characteristics Ambient temperature 25C unless otherwise stated. Load capacitance 1uF or less

Parameter	Symbol	Conditions/Notes	Min	Typ	Max	Units
Power Characteristics						
Power Dissipation	P_{dis}	No load, V_{out} = 0 V		15 W		W
Input Characteristics						
Input voltage range	V_{in}			+/-5 V		V
Input impedance	Z_{in}			1000		Ohms
Output Characteristics						
Positive output voltage limit	$+V_{lim}$	DC input signal	210			V
Negative output voltage limit	$-V_{lim}$	DC input signal			-210	V
Maximum positive peak current	$+I_{lim}$		2			A
Maximum negative peak current	$-I_{lim}$				-2	A
Output offset voltage	V_{os}	Vin = 0, Av = 50		+/-500		mV
Fixed DC Gain	A_v		49.0	50	51.0	V/V
Max Adjustable Gain	A_{vmax}			50		V/V
Min Adjustable Gain	A_{vmin}			15		V/V
Voltage monitor scale		1% accuracy		0.02		V/V
Voltage monitor output impedance				1000		Ohms
Dynamic Performance						
-3dB Bandwidth	**BW**	Small signal input, no load		8		kHz
Noise		RMS amplitude < 20 MHz		20		mV_{rms}
Physical						
Length	**L**			23		cm
Width	**W**			30.5		cm
Height	**H**			9.5		cm
Weight	**M**			5.5		kg

Notes: Fused on rear panel: 1.25A, 250V 5x20mm Time-Lag Fuse | Output connector plug: Conxall 6282-2PG-3DC

Applications Information

WARNING: To reduce the risk of fire or shock hazard, do not expose this product to rain or moisture.

CAUTION

RISK OF ELECTRIC SHOCK. DO NOT OPEN.

CAUTION: TO REDUCE THE RISK OF ELECTRIC SHOCK, DO NOT REMOVE COVER OR BACK. NO USER-SERVICEABLE PARTS INSIDE. REFER SERVICING TO QUALIFIED PERSONNEL.

This symbol is intended to alert you to the presence of uninsulated dangerous voltage within the product's enclosure that might be of sufficient magnitude to constitute a risk of electric shock. Do not open the product's case.

Warning! To reduce the risk of injury:

- Read all instructions and warnings before using this product.
- **This product creates a hazardous voltage at its terminals**. Do not connect loads or touch the output terminal while power is on. Do not touch the piezoelectric actuator during operation.
- Provide adequate space for ventilation to avoid excessive internal heating. Do not block rear or side vents. Do not install this product in a closed cabinet.
- This product must be grounded. Use only with a three-pronged AC power cord having an equipment-grounding conductor and grounding plug.
- This product should not be use in warm environments or near products that emit heat.
- Do not use if this product exhibits a marked change in performance or appears to function abnormally.

User Interface

Figure 1: User interface of the QPA3202

All controls and signal terminations of the QPA3202 are on the face of the instrument as illustrated in Figure 1. The AC power cord receptacle and fuse are on the rear panel Figure 2. At the left are three multi-colored LED indicators that alert the user to the instrument status. When the power switch is closed and the amplifier is on, the green LED marked *PWR* will be illuminated. The output of the amplifier requires a Conxall connector, however the input and monitor connections are made using a BNC connector.

Figure 2: User interface of the QPA3202

The QPA3202 offers protection features that prevent damage to the amplifier in the event of a fault. If the output is short-circuited, or if the internal temperature of the amplifier exceeds its threshold, the amplifier goes into shutdown mode. In this mode, the output is disabled until the user clears the fault and recycles the power. Shutdown mode is signified by the illumination of red LEDs on the face of the amplifier. The LED marked *OC* is illuminated after an over-current (short-circuit) fault while the LED marked *OT* is illuminated during an over-temperature fault.

The input voltage signal should be connected to the *input* BNC terminal on the amplifier front panel. A second BNC terminal marked *monitor* offers the user an analog output signal that is a scaled replica (1/50) of the output voltage for monitoring purposes. The cable leading to the piezoelectric actuator should be connected to the black circular jack marked *output*. Note that this output is a differential output and both pins on this terminal contain hazardous voltage levels that can damage equipment or cause injury. Extreme caution should be exercised when operating the QPA3202. Loads should be connected and disconnected to the output terminal only when power is off. Do not directly touch the output terminal pins or the piezoelectric actuator at any time while the power is on.

Gain Adjust

The QPA3202 offers the user a selection of either fixed or adjustable gain. Gain control is implemented by the switch and knob controls at the center of the instrument. The *gain* switch can be placed in one of two positions. When the switch is raised high in the *fix* position, the gain of the QPA3202 is fixed at 50V/V. When the switch is lowered to the *adj* position, the gain of the QPA3202 is variable in the range of 15 to 50V/V and is controlled by the knob marked *Gain Adj.*

Voltage Monitor

The QPA3202 offers an auxiliary analog output for feedback control or monitoring the differential output voltage. The *monitor* output is a replica of the load voltage scaled by a factor of 1/50 (0.02 V/V). This output should be connected only to an oscilloscope or other high-impedance monitoring device.

Output Current Limit

Piezoelectric actuators can be effectively modeled by a simple capacitor. There is significant resistance in series with the capacitor, but this is neglected here. Like any other amplifier, the drive frequency limitation of the QPA3202 is a function of its peak current capability, according to the familiar equation:

$$i(t) = C\,{dv(t)}/{dt}$$

Since the current limit of the QPA3202 is 2 Amperes (2A), the maximum output voltage slew rate is 2/C where C is the piezo capacitance. For a pure sinusoid with frequency *f* (in Hz) and amplitude V_o (zero to peak), the maximum rate or derivative is $2\pi \cdot f \cdot V_o$. Therefore, the maximum drive frequency as a function of output amplitude V_o and load capacitance C can be expressed by:

$$f_{\max} = \frac{1}{\pi \cdot V_o \cdot C}$$

The maximum frequency f_{max} is the frequency at which the output waveform becomes distorted by current-limiting. Sinusoids, for example, will become linear at zero crossings. Operation is permitted beyond this frequency provided that internal temperature limitations are not exceeded (see following sections). Large capacitive loads may also de-stabilize the amplifier. Note that this constraint is in addition to the amplifier bandwidth, which is limited to 8kHz.

Thermal Overload Protection

High internal power dissipation is common to all linear amplifiers that are designed to drive capacitive loads. This dissipation is a function of load capacitance, output voltage amplitude, and drive frequency. In general, increasing any of these variables increases power dissipation. If there are no means to limit this effect, heavy loads will cause excessive temperatures that can overheat and damage the amplifier. For this reason the QPA3202 is equipped with internal temperature monitoring circuitry. When the internal temperature exceeds a predefined threshold, the QPA3202 will enter *thermal shutdown mode*. In this mode the amplifier is automatically switched off and the *OT* LED indicator is illuminated. The instrument will remain in this condition until the user recycles the power supply and the temperature has decreased to a safe level.

Figure 3 indicates the thermal shutdown boundary as a function of frequency and load capacitance for full-scale output (200V sinusoid). This curve applies to steady-state operation only. The QPA3202 is capable of operating beyond this curve provided that the duration of operation (or duty-cycle) is low enough to prevent over-heating.

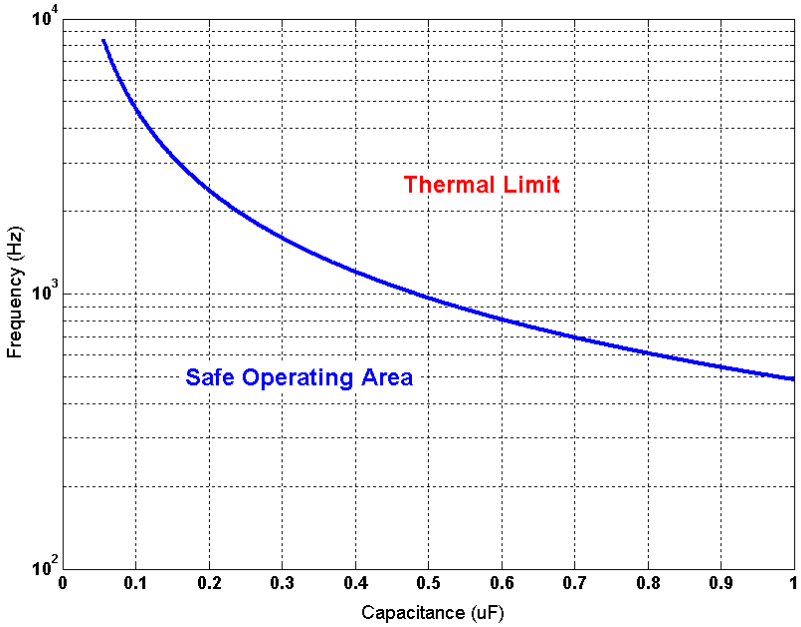

Figure 3: Thermal shutdown boundary as function of frequency and load capacitance for a full-scale (+/-200V) output signal. Operation in the shutdown range is permitted only for short durations. Signal distortion or a blown fuse may occur.