



# PA77 • PA77A

## POWER OPERATIONAL AMPLIFIERS

### FEATURES

- 10 PIN POWER DIP™ PACKAGE (PD10/60S)—150 WATTS
- VERY HIGH CURRENT—±20 AMPS
- HIGH SLEW RATE AND POWER BANDWIDTH
- WIDE COMMON MODE RANGE
- EXTERNAL SHUTDOWN CONTROL
- THERMAL ALARM OUTPUT

### APPLICATIONS

- LINEAR AND ROTARY MOTOR DRIVES
- YOKE/MAGNETIC FIELD EXCITATION
- PROGRAMMABLE POWER SUPPLIES TO ±40V
- AUDIO UP TO 300W

### DESCRIPTION

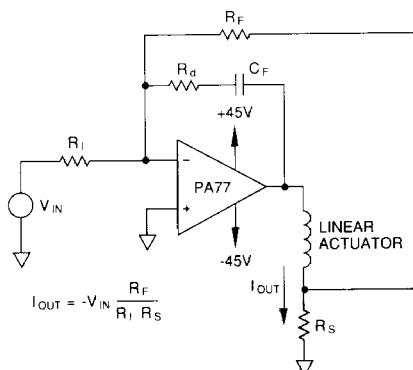
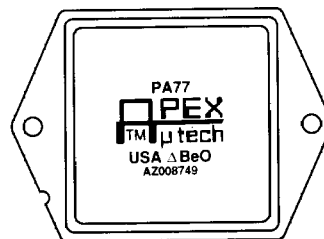
The PA77 is a high power, wide bandwidth power amplifier that combines small signal monolithic technology with a high power MOSFET output stage. The 150 watt rating of the PA77 supports 20 amps of continuous output current and 30 amps surge current. Unique among power amplifiers is a thermal flag output which indicates when maximum thermal limits of the amplifier are exceeded. A shutdown input is also provided that disables the amplifier's output on command. When the thermal flag output is connected to the shutdown input a thermal overload will disable the amplifier's output until power is cycled and the fault removed. With external components other interconnection schemes are possible to interface with system monitoring circuits. The thermal sensing circuitry of the PA77 directly measures the output stage operating temperature as well as the package temperature and will limit the output current as necessary to maintain the temperature within maximum limits. A single external current limiting sense resistor sets maximum output current capability. External compensation tailors performance to user needs.

This hybrid integrated circuit utilizes thick film conductors, ceramic capacitors and silicon semiconductors to maximize reliability, minimize size and give top performance. Ultrasonically bonded aluminum wires provide reliable interconnections at all operating temperatures. The 10 pin Power Dip™ package (PD10/60S) is hermetically sealed and electrically isolated from the internal circuits. Insulating washers are not recommended.

### TYPICAL APPLICATION

Positioning with a linear actuator involves producing torque. Torque is a direct function of current in the actuator. This circuit provides current as a function of input voltage. Therefore, there is output torque control as a function of input voltage. In this configuration the output load must be able to float with respect to ground, since  $R_s$  provides current sense feedback referenced to ground.

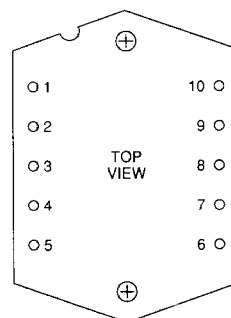
Note that the actuator load is in the feedback loop of the power op amp. Being highly inductive, this load tends towards a high imped-



CURRENT CONTROL FOR LINEAR ACTUATOR

ance, as frequency increases, which increases the closed loop gain of the op amp. This "zero" in the feedback path can cause instability.  $R_d$  and  $C_f$  provide an alternate feedback path for the high frequencies and keep the op amp feedback loop closed at a lower gain, thereby ensuring stability. For a detailed discussion of this compensation technique refer to AN #5, "Precision Magnetic Deflection" and AN #13, "Voltage to Current Conversion."

### EXTERNAL CONNECTIONS\*



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\* To be determined

# PA77 ABSOLUTE MAXIMUM RATINGS

SUPPLY VOLTAGE, +Vs to -Vs	90V
OUTPUT CURRENT, within SOA	30A
POWER DISSIPATION, internal	150W
INPUT VOLTAGE, differential	±20V
INPUT VOLTAGE, common mode	±Vs
TEMPERATURE, pin solder- 10sec	300°C
TEMPERATURE, junction <sup>2</sup>	150°C
TEMPERATURE, storage	-65 to 150°C
OPERATING TEMPERATURE RANGE, case	-55 to 125°C

## SPECIFICATIONS

PARAMETER	TEST CONDITIONS <sup>(1)</sup>	PA77			PA77A			UNITS
		MIN	TYP	MAX	MIN	TYP	MAX	
<b>INPUT</b>								
OFFSET VOLTAGE, initial	Full temperature range		8	20		2	5	mV
OFFSET VOLTAGE, vs. temperature			30	50		10	30	μV/°C
OFFSET VOLTAGE, vs. supply	Full temperature range		15			*		μV/V
OFFSET VOLTAGE, vs. power			30			10		μV/W
BIAS CURRENT, initial	Full temperature range		20	200		10	50	nA
BIAS CURRENT, vs. supply			10			*		nA/V
OFFSET CURRENT, initial	Full temperature range		25	50		15	30	nA
INPUT IMPEDANCE, DC			10 <sup>6</sup>			*		Ω
INPUT CAPACITANCE	Full temperature range		6			*		pF
COMMON MODE VOLTAGE RANGE			±Vs± 6			*		V
COMMON MODE REJECTION, DC	Full temperature range, V <sub>CM</sub> = ±20V	86	98			*		dB
<b>GAIN</b>								
OPEN LOOP GAIN at 10Hz	Full temperature range, I <sub>O</sub> = 20A 10A load	94	102			*	*	dB
GAIN BANDWIDTH PRODUCT				2			*	
POWER BANDWIDTH	Full temperature range		120			*		kHz
PHASE MARGIN				60			*	
<b>OUTPUT</b>								
SATURATION VOLTAGE <sup>3</sup>	I <sub>O</sub> = 20A	30	7.0	8.0		*	*	V
CURRENT, peak							*	*
SETTLING TIME to .1%	Av = -10, 10V step		2.5			*		μs
SLEW RATE			Av = -10	30			*	
CAPACITIVE LOAD, Av = 1	Full temperature range			10			*	nF
<b>POWER SUPPLY</b>								
VOLTAGE	Full temperature range	±10	±40	±45		*	*	V
CURRENT, quiescent				50	65		*	*
CURRENT, disable mode	Full temperature range		10	13		*	*	mA
<b>THERMAL</b>								
RESISTANCE, AC <sup>2</sup> junction to case	Full temperature range, F>60Hz		.42	.48		*	*	°C/W
RESISTANCE, DC junction to case			Full temperature range, F<60Hz	.7	.8		*	*
RESISTANCE, junction to air <sup>5</sup>	Full temperature range		12			*	*	°C/W
TEMPERATURE RANGE, case	Meets full range specifications	-25		85		*	*	°C

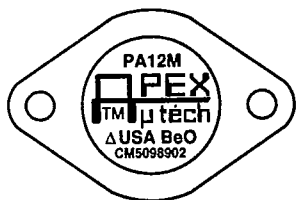
**NOTES:** \* The specification of PA77A is identical to the specification for PA77 in applicable column to the left.

1. Unless otherwise noted: T<sub>c</sub> = 25°C. DC input specifications are +/- value given. Power supply voltage is typical rating.
2. Long term operation at the maximum junction temperature will result in reduced product life. Derate internal power dissipation to achieve high MTTF. For guidance, refer to the heatsink data sheet.
3. Specified values are the difference between either supply voltage and the maximum obtainable output voltage for any rated supply voltage, i.e., |V<sub>s</sub>| - |V<sub>o</sub>|.
4. Rating applies if the output current alternates between both output transistors at a rate faster than 60Hz.
5. The PA77 must be used with a heatsink or the quiescent power may drive the unit to junction temperatures higher than 150°C.

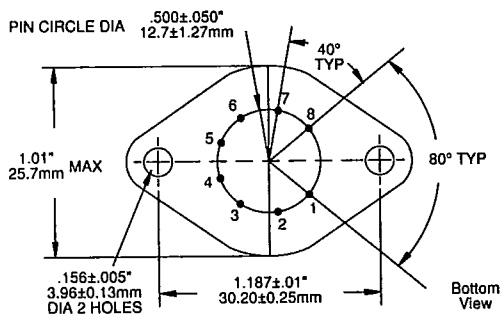
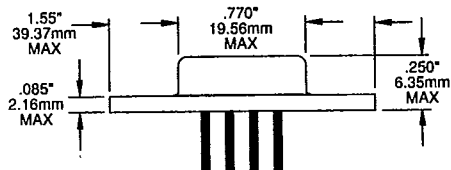
**CAUTION:** The internal substrate contains beryllia (BeO). Do not break the seal. If broken, do not crush, machine, or subject to temperatures in excess of 850°C to avoid generating toxic fumes.

# PACKAGE OUTLINE DIMENSIONS

## STANDARD 8 PIN TO-3



NOTE: ESD triangle (Δ) on top of package denotes pin 1 location.



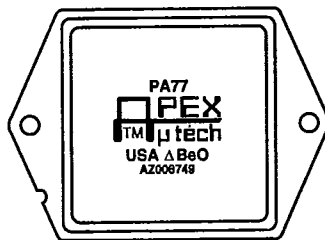
PIN DIAMETER: .967/1.07mm or .038/.042"  
 PIN LENGTH: 11.4/12.7mm or .450/.500"  
 PIN MATERIAL, STD: Nickel plated alloy 52, solderable  
 PIN MATERIAL, MIL: Gold plated alloy 52, solderable  
 PACKAGE: Hermetic, nickel plated steel  
 WEIGHT: 15 grams or .53 ounces  
 ISOLATION: 500VDC any pin to case  
 SOCKETS: APEX PN: MS03  
 CAGE JACKS: APEX PN: MS02 (Set of 8)  
 HEATSINKS: APEX PN: HS01 thru HS05

### CAUTION

Recommended mounting torque is 4 – 7 in·lbs (.45 – .79 N·m)

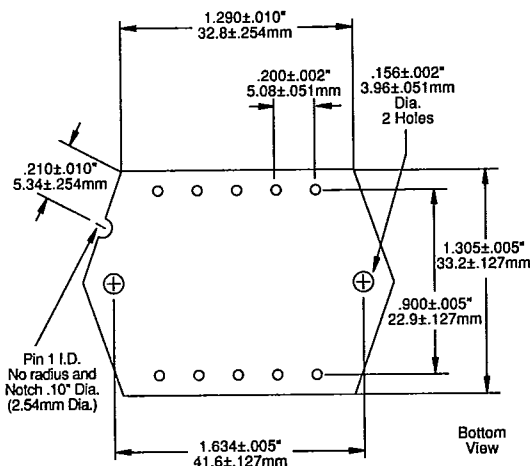
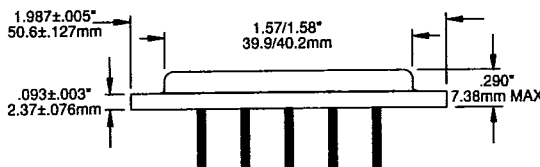
## POWER PD10

T-90-20



NOTE: Notch on package base denotes pin 1 location.

## PD10/60S



PIN DIAMETER: 1.47/1.58mm or .058/.062"  
 PIN LENGTH: 11.4/12.7mm or .450/.500"  
 PIN MATERIAL, STD: Nickel plated steel  
 PACKAGE: Hermetic, nickel plated steel  
 WEIGHT: 36 grams or 1.27 ounces  
 ISOLATION: 500VDC any pin to case  
 CAGE JACKS: MS04 (Set of 12)

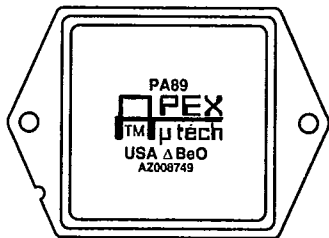
### CAUTION

Recommended mounting torque is 8 – 10 in·lbs (.90 – 1.13 N·m)

# PACKAGE OUTLINE DIMENSIONS

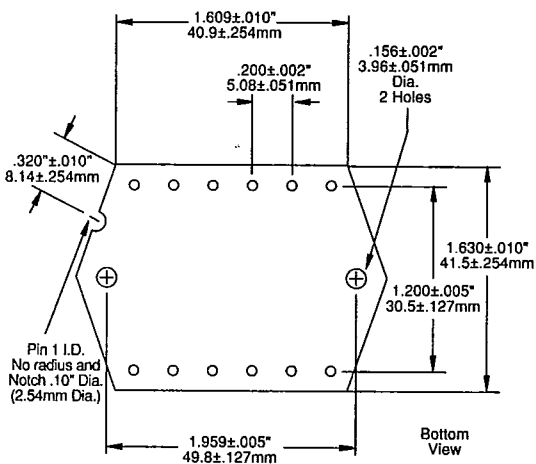
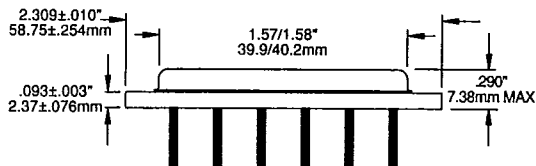
T-90-20

## HIGH VOLTAGE PD12



NOTE: Notch on package base denotes pin 1 location.

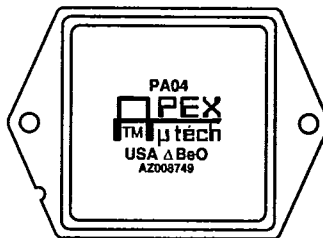
### PD12/25S



PIN DIAMETER: .585/.687mm or .023/.027"  
 PIN LENGTH: 11.4/12.7mm or .450/.500"  
 PIN MATERIAL, STD: Nickel plated steel  
 PACKAGE: Hermetic, nickel plated steel  
 WEIGHT: 53 grams or 1.87 ounces  
 ISOLATION: 1200VDC any pin to case

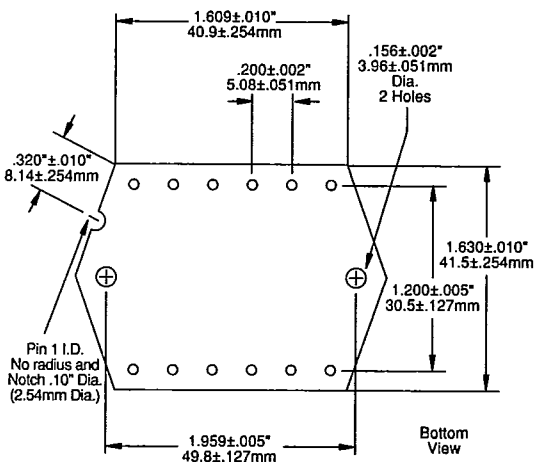
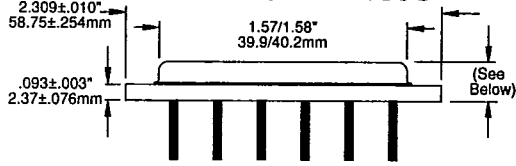
**CAUTION**  
 Recommended mounting torque  
 is 8 – 10 in•lbs (.90 – 1.13 N•m)

## HIGH POWER PD12



NOTE: Notch on package base denotes pin 1 location.

### PD12/60S & PD12/60C



PIN DIAMETER: 1.47/1.58mm or .058/.062"  
 PIN LENGTH: 11.4/12.7mm or .450/.500"  
 PIN MATERIAL, STD: Nickel plated steel  
 ISOLATION: PD12/60S: 500VDC any pin to case  
 PD12/60C: 300VDC any pin to case  
 HEIGHT: PD12/60S: 7.38mm or .290" MAX  
 PD12/60C: 8.90mm or .350" MAX  
 PACKAGE: PD12/60S: Hermetic, nickel plated steel  
 PD12/60C: Base: Nickel plated copper  
 PD12/60C: Cap: Hermetic, nickel plated steel  
 WEIGHT: PD12/60S: 53 grams or 1.87 ounces  
 PD12/60C: 58 grams or 2.05 ounces  
 CAGE JACKS: Apex PN: MS04 (Set of 12)  
 HEAT SINKS: Apex PN: HS06  
 MATING SOCKET: Apex PN: MS05

**CAUTION** Recommended mounting torque is  
 8–10 in•lbs (.90–1.13 N•m)