

PowerAmp Design

COMPACT POWER OP AMP

PAD01

Rev D

KEY FEATURES

- LOW COST
- HIGH VOLTAGE – 100 VOLTS
- HIGH OUTPUT CURRENT – 5A
- 30 WATT DISSIPATION CAPABILITY
- 50 WATT OUTPUT CAPABILITY
- SMALL FOOTPRINT – 30mm SQUARE
-  RoHS COMPLIANT

APPLICATIONS

- SMALL MOTOR DRIVE
- HIGH VOLTAGE INSTRUMENTATION
- SEMICONDUCTOR TESTING
- LCD TESTING

DESCRIPTION

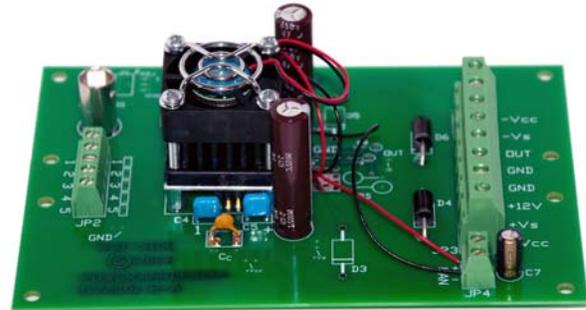
The PAD01 compact operational amplifier is constructed with surface mount components to provide a low cost solution for many industrial applications. With a footprint only 30mm square, similar to the footprint area of the TO3 hybrid package, the PAD01 offers outstanding performance that outperforms the more expensive hybrid amplifiers. External compensation tailors the amplifier's response to the application requirements. Current limit is programmable with a single resistor. The amplifier circuitry is built on a thermally conductive but electrically insulating metal substrate. No BeO is used in the PAD01.



PAD01



PAD01-1



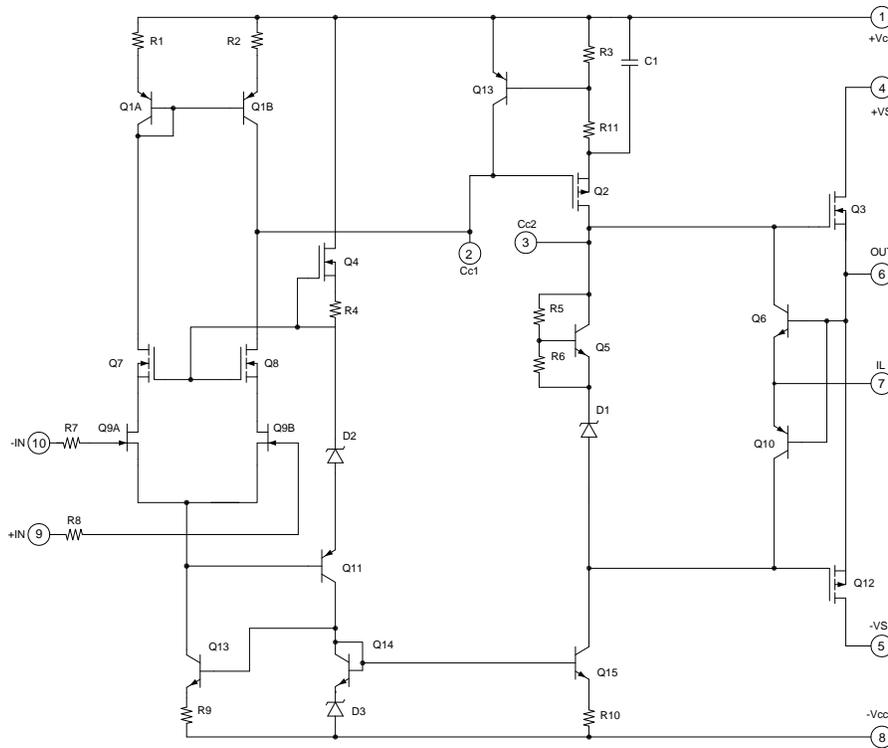
PAD01 MOUNTED IN EVAL01 EVALUATION KIT

A NEW CONCEPT

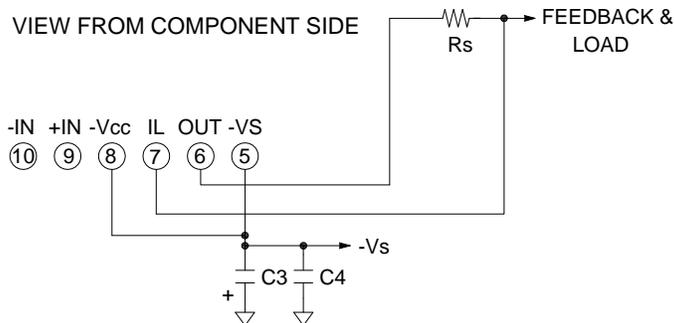
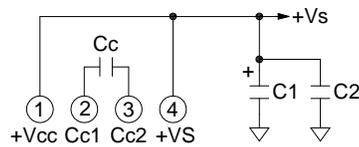
A critical task in any power amplifier application is cooling the amplifier. Until now component amplifier manufacturers often treated this task as an after-thought, left for the user to figure out. At **Power Amp Design** the best heat sink and fan combination is chosen at the start and becomes an integral part of the overall amplifier design. The result is the most compact and volumetric efficient design combination at the lowest cost. In addition, this integrated solution concept offers an achievable real-world power dissipation rating, not the ideal rating usually cited when the amplifier case is somehow kept at 25°C. The user no longer needs to specify, procure or assemble separate components.

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EQUIVALENT CIRCUIT



PINOUT & CONNECTIONS



PHASE COMPENSATION	SLEW RATE
GAIN ≥10	$\frac{C_c}{33\mu\text{F}}$ 35V/μS

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ABSOLUTE MAXIMUM RATINGS			
SUPPLY VOLTAGE, +Vs to -Vs ⁴	100V	TEMPERATURE, pin solder,	10s, 300°C
INPUT VOLTAGE	+Vcc to -Vcc	TEMPERATURE, junction ²	150°C
DIFFERENTIAL INPUT VOLTAGE	± 20V	TEMPERATURE RANGE, storage	-40 to 85°C ⁵
OUTPUT CURRENT, peak, within SOA	7A	TEMPERATURE RANGE, storage, PAD01-1	105C
POWER DISSIPATION, internal, DC	30W	OPERATING TEMPERATURE, substrate	-40 to 85°C
SUPPLY VOLTAGE, +Vcc to -Vcc	100V ⁹		

PARAMETER	TEST CONDITIONS ¹	MIN	TYP	MAX	PAD01-1 ⁹	UNITS
INPUT						
OFFSET VOLTAGE			1	5		mV
OFFSET VOLTAGE vs. temperature	Full temperature range		20	50		μV/°C
OFFSET VOLTAGE vs. supply			3	5		μV/V
BIAS CURRENT, initial ³				100		pA
BIAS CURRENT vs. supply				0.1		pA/V
OFFSET CURRENT, initial				50		pA
INPUT RESISTANCE, DC			100			G Ω
INPUT CAPACITANCE			4			pF
COMMON MODE VOLTAGE RANGE				+Vs-15		V
COMMON MODE VOLTAGE RANGE				-Vs+8		V
COMMON MODE REJECTION, DC		100	112			dB
NOISE	100kHz bandwidth, 1kΩ R _s		10			μV RMS
GAIN						
OPEN LOOP	R _L = 10kΩ, C _C =33pF	108				dB
GAIN BANDWIDTH PRODUCT @ 1MHz	C _C =33pF		4			MHz
PHASE MARGIN	Full temperature range	60				degree
OUTPUT						
VOLTAGE SWING	I _O = 5A	+Vs-8.5	+Vs-6.5			V
VOLTAGE SWING	I _O = -5A	-Vs+8.5	-Vs+6.5			V
CURRENT, continuous, DC				5		A
CURRENT, pulse, ≤10mS, within SOA				7		A
SLEW RATE, A _v = -10	C _C = 33pF		35			V/μS
SETTLING TIME, to 0.1%	2V Step, C _C = 33pF		4			μS
RESISTANCE, open loop	No load, DC		8			Ω
POWER SUPPLY						
VOLTAGE		± 15	± 45	± 50		V
CURRENT, quiescent			27	30		mA
THERMAL						
RESISTANCE, AC, junction to air or case ⁶	Full temperature range, f ≥ 60Hz			2.7 to air	1.4 to case	°C/W
RESISTANCE, DC junction to air or case	Full temperature range			4.1 to air	2.5 to case	°C/W
TEMPERATURE RANGE, substrate		-40		85	85	°C
TEMPERATURE RANGE, ambient ⁵		-40		70	NA	°C
FAN, 30mm dc brushless, ball bearing						
OPERATING VOLTAGE			12		NA	V
OPERATING CURRENT			75		NA	mA
AIR FLOW			5		NA	CFM
RPM			11000		NA	RPM
NOISE			32		NA	dB
L10, life expectancy, 45°C ⁸			60		NA	kHrs
L10, life expectancy, 25°C ⁸			70		NA	kHrs

NOTES:

1. Unless otherwise noted: T_c = 25°C, compensation C_c = 100pF, DC input specifications are ± value given, power supply voltage is typical rating.
2. Derate internal power dissipation to achieve high MTBF.
3. Doubles for every 10°C of case temperature increase.
4. +Vs and -Vs denote the positive and negative supply voltages.
5. Limited by fan characteristics. During operation, even though the heat sink may be at 85°C the fan will be at a lower temperature.
6. Rating applies if the output current alternates between both output transistors at a rate faster than 60Hz.
7. L10 refers to the time it takes for 10% of a population of fans to fail. Lower ambient temperature increases fan life.
8. Specifications for the PAD01-1 are the same as for the PAD01 except as shown in this column.
9. +Vcc and -Vcc not to exceed +Vs and -Vs respectively by more than 20V

SAFETY FIRST

The operating voltages of the PAD01 are potentially deadly. When developing an application circuit, it is wise to begin with power supply voltages as low as possible while checking for circuit functionality. Increase supply voltages slowly as confidence in the application circuit increases. Always use a “hands-off” method whereby test equipment probes are attached only when power is off.

COOLING FAN

The PAD01 relies on its fan for proper cooling of the amplifier. Make sure that air flow from the fan and to the heat sink remains unobstructed. Air is drawn into the heat sink fin area and exhausted via the fan out of the top of the amplifier assembly. To eliminate electrical noise created by the cooling fan we recommend a 47µF capacitor placed directly at the point where the fan wires connect to the PCB. See application note AN-24 for further details.

CURRENT LIMIT

The current limiting function is connected as shown in Figure 1. It is best to connect Rs directly to OUT to avoid any significant parasitic resistance, Rp, as shown in Figure 1. The sense voltage for current limit is approximately 0.7V. Thus:

$$I_L = 0.7V/R_S$$

Where I_L is the value of the limited current and R_S is the value of the current limit sense resistor.

In addition, the sense voltage has a temperature coefficient approximately equal to $-2.2mV/°C$.

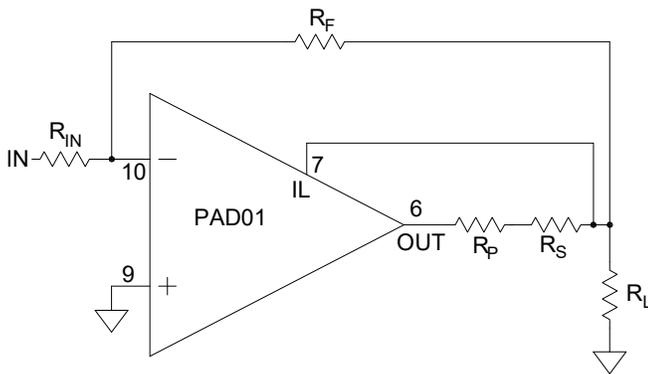


Figure 1

MOUNTING THE PAD01 AMPLIFIER

The amplifier is supplied with four 4-40 M/F hex spacers at the four corners of the amplifier. Once the amplifier is seated,

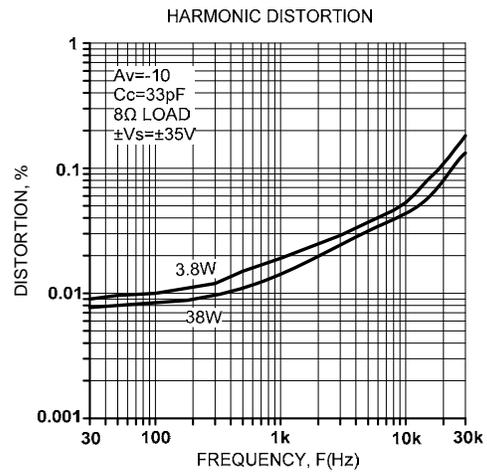
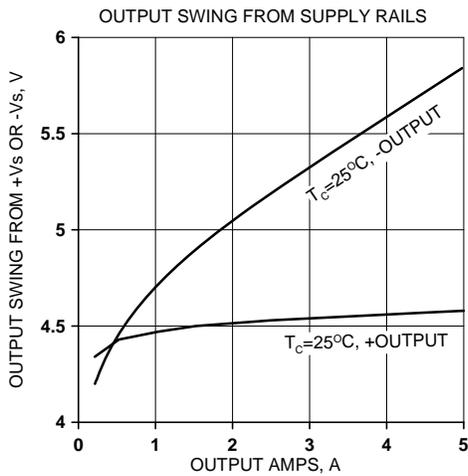
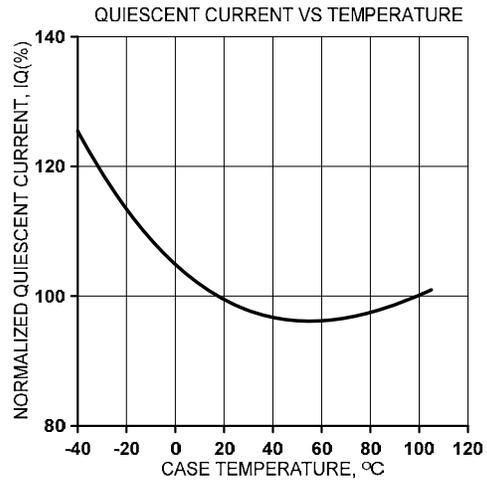
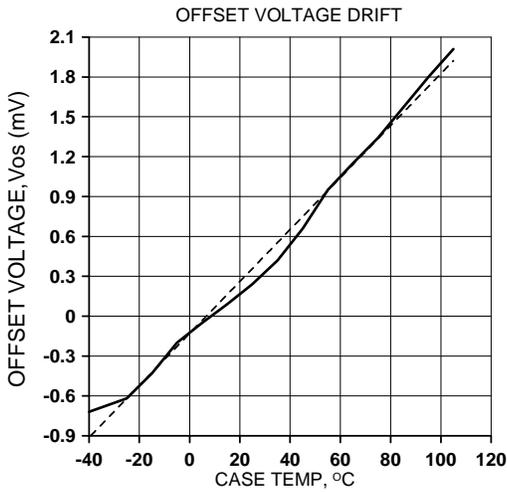
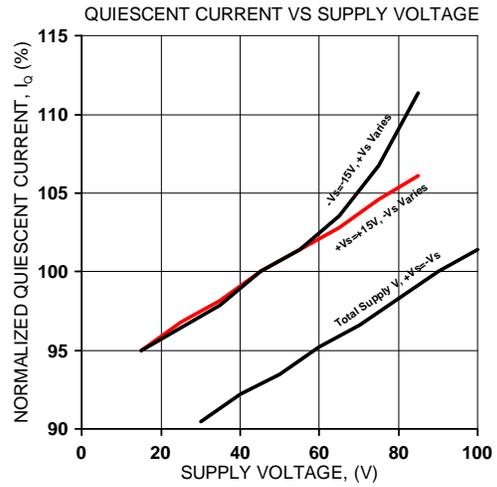
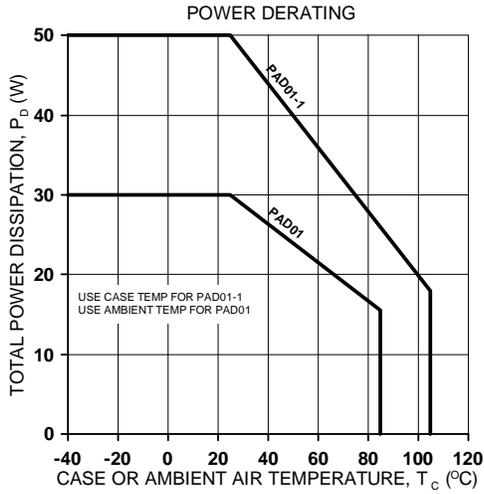
secure the module with the provided 4-40 X 3/16" nuts and torque to 4.7 in lb [53 N cm] max. See “**Dimensional Information**” for a detailed drawing. It is recommended that the heat sink be grounded to the system ground. This can easily be done by providing a grounded circuit board pad around any (or all) of the holes for the mounting studs.

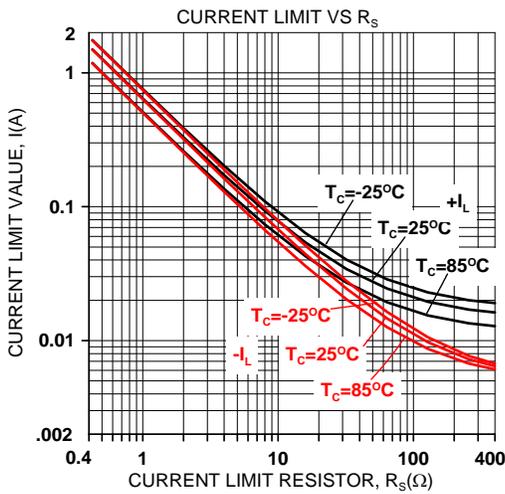
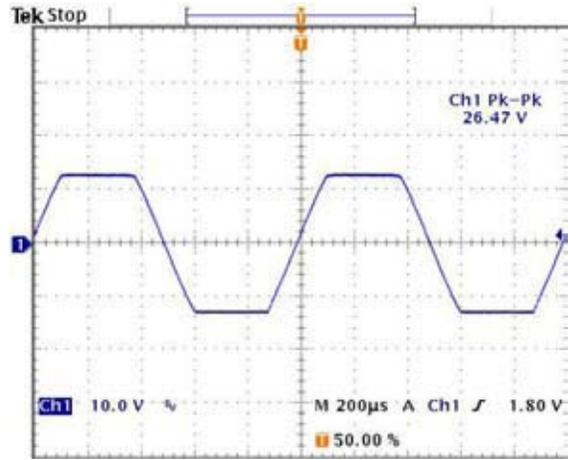
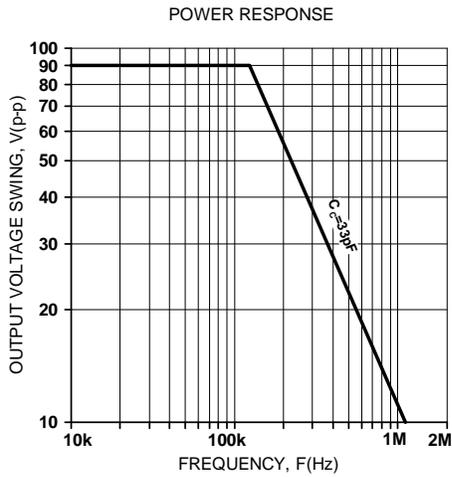
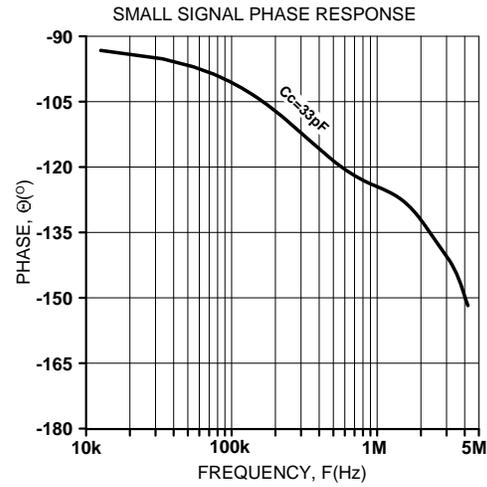
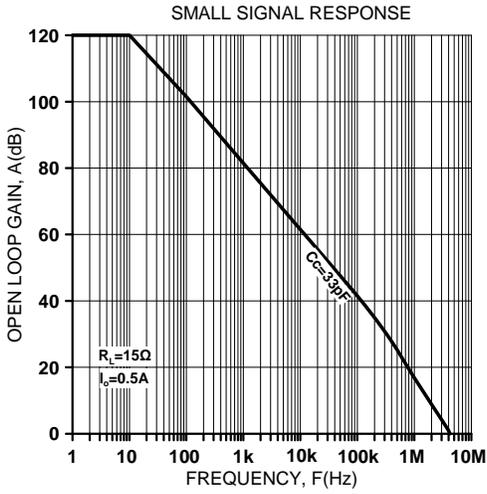
MOUNTING THE PAD01-1 AMPLIFIER

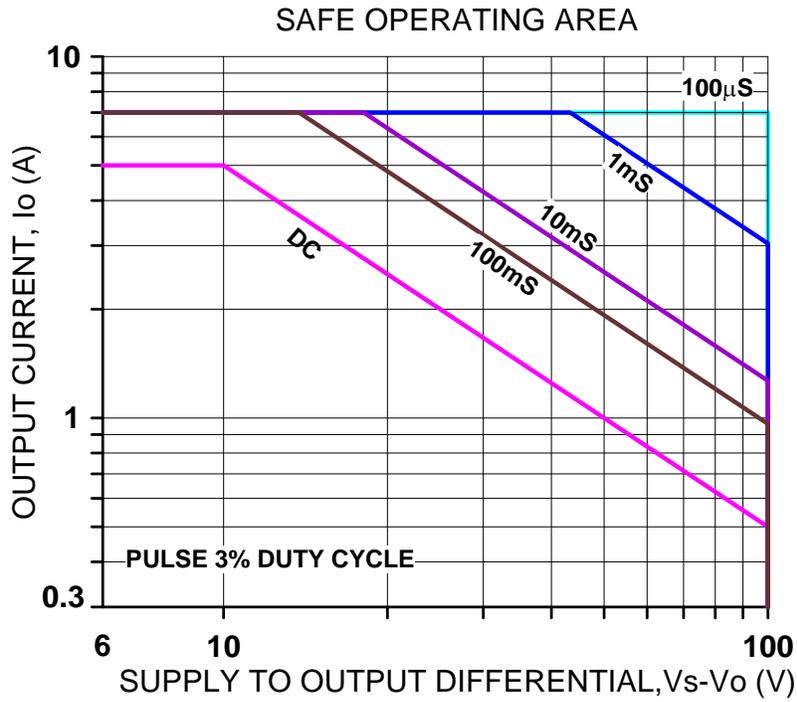
In most applications the amplifier must be attached to a heat sink. Spread a thin and even coat of heat sink grease across the back of the PAD01-1 and also the heat sink where the amplifier is to be mounted. Push the amplifier into the heat sink grease on the heat sink while slightly twisting the amplifier back and forth a few times to bed the amplifier into the heat sink grease. On the final twist align the mounting holes of the amplifier with the mounting holes in the heat sink and finish the mounting using 4-40 X 3/16" X 1/4" long hex male-female spacers and torque to 4.7 in oz [3.8 N cm] max. Provide grounded pads at the mounting holes. Mount the amplifier to the mother board with 4-40 X 1/4" screws. See Dimensional Information for additional recommendations.

PHASE COMPENSATION

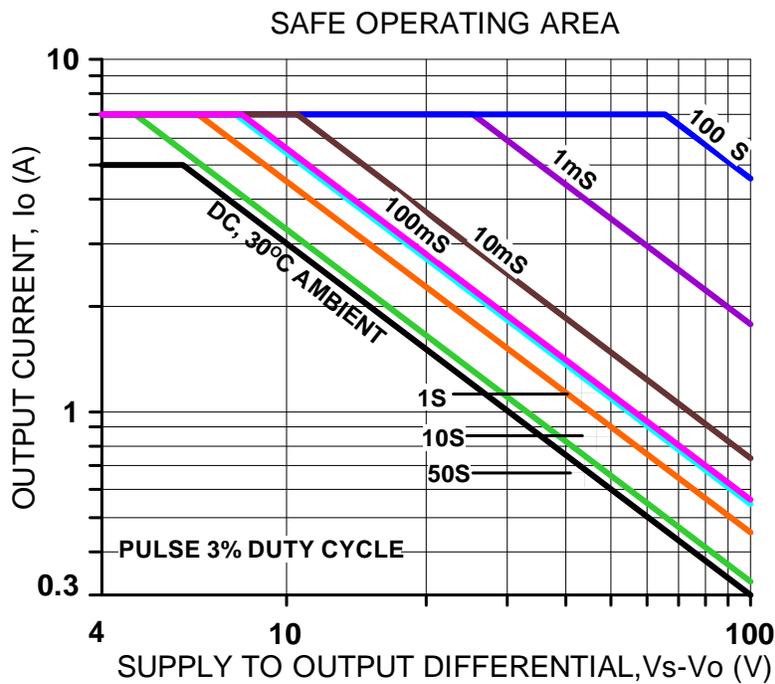
The PAD01 **must** be phase compensated. The compensation capacitor, C_C , is connected between pins 2 and 3. The compensation capacitor must be an NPO type capacitor rated for the full supply voltage (100V). On page 2, under Amplifier Pinout and Connections, you will find a table that gives recommended compensation capacitance value for various circuit gains and the resulting slew rate for each capacitor value. Consult also the small signal response and phase response plots for the selected compensation value in the Typical Performance Graphs section. A compensation capacitor less than 33pF is not recommended.



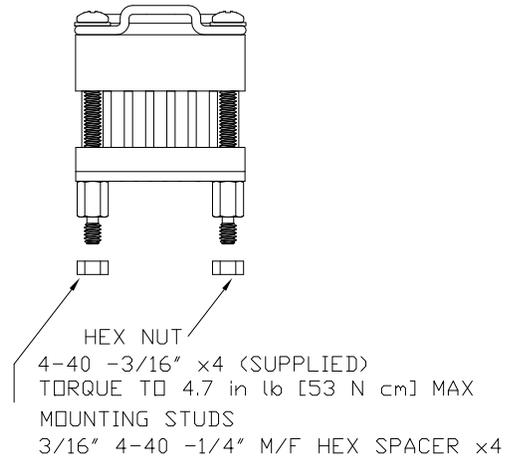
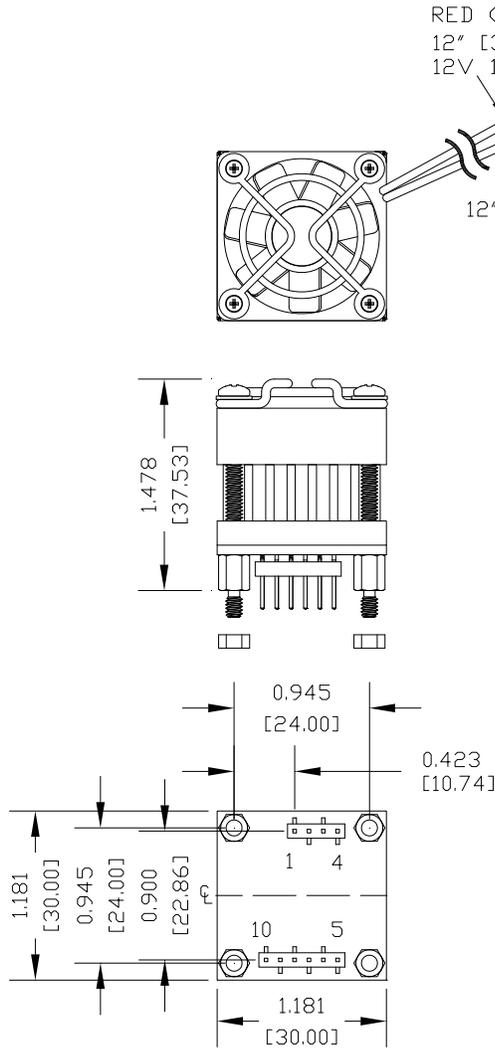




PAD01-1 SAFE OPERATING AREA

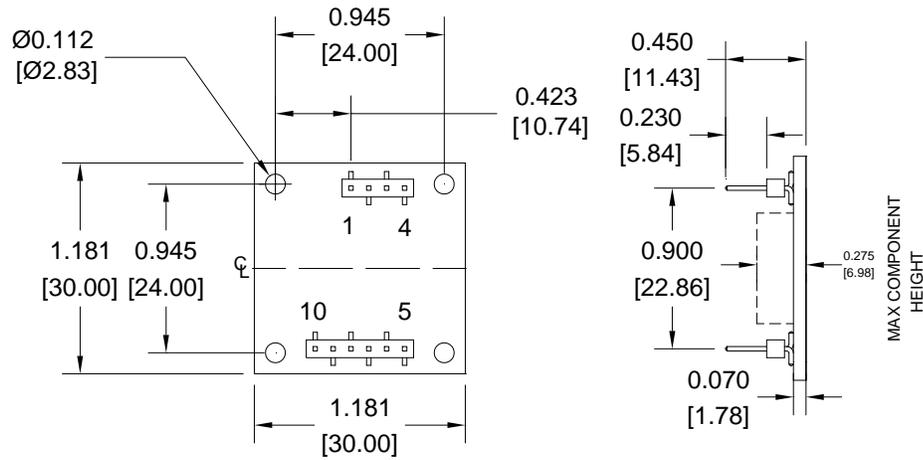


PAD01 SAFE OPERATING AREA

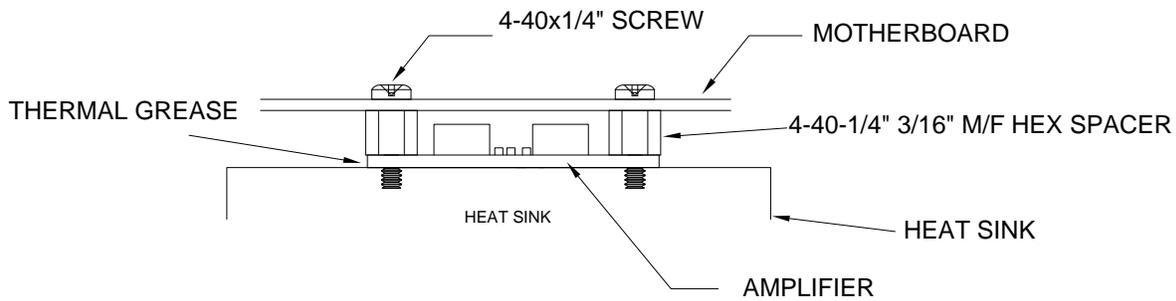


- NOTES:
1. PINS .025" SQUARE X10
 2. RECOMMENDED HOLE FOR MOUNTING 0.129" D. X4
 3. RECOMMENDED HOLE FOR PINS 0.052" D.
 4. TOTAL ASSEMBLY WEIGHT APPROX 1.4 oz [39.7 g]
 5. HEAT SINK WEIGHT APPROX 0.26 oz [7.4 g]
 6. SEE ALSO CAGE JACK ACCESSORY CJS01 FOR A SOCKET ALTERNATIVE FOR MOUNTING

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- NOTES:
- 1: DIMENSIONS ARE INCHES, [mm]
 - 2: PINS 0.025" SQUARE [0.635mm], GOLD PLATED
 - 3: RECOMMENDED HOLE FOR MOUNTING 0.129" D. x4 [3.277mm]
 - 4: RECOMMENDED HOLE FOR PINS 0.052" D. [1.321mm]
 - 5: HIGHLY RECOMMENDED THAT AMPLIFIER IS MOUNTED INTO CAGE JACKS USING PAD PART NUMBER CJS01. USE 0.062" [1.575mm] HOLE FOR CAGE JACKS.
 - 6: HIGHLY RECOMMENDED THAT AMPLIFIER IS MOUNTED INTO HEAT SINK WITH 4-40 M/F SPACERS TO PROVIDE STRAIN RELIEF FOR PINS. SEE DRAWING BELOW.



-1 VERSION MOUNTING