


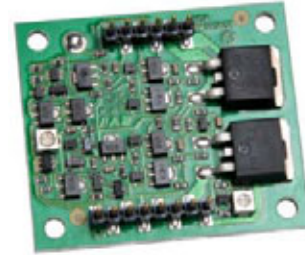
PowerAmp Design

COMPACT HIGH VOLTAGE OP AMP

PAD136
Rev C

KEY FEATURES

- **LOW COST**
- **SMALL SIZE 40 X 45mm**
- **HIGH VOLTAGE – 200 VOLTS**
- **HIGH OUTPUT CURRENT – 15A PEAK**
- **125 WATT DISSIPATION CAPABILITY**
- **200V/ μ S SLEW RATE**
-  **RoHS COMPLIANT**



PAD136

APPLICATIONS

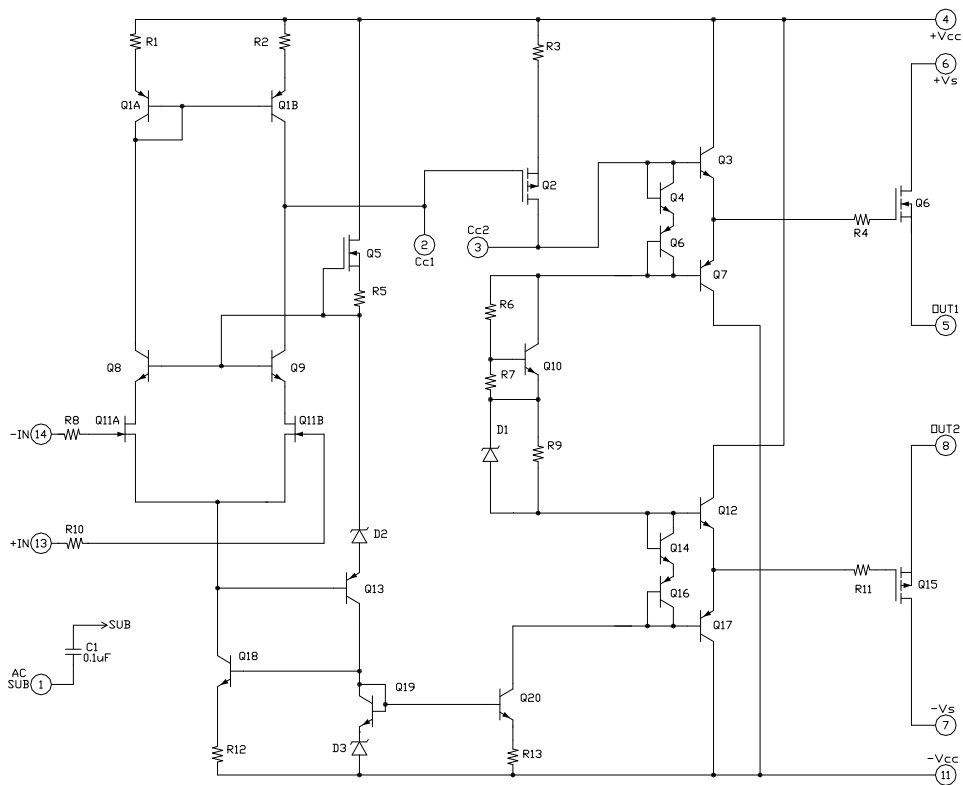
- **INDUSTRIAL INK JET PRINT HEADS**
- **HIGH VOLTAGE INSTRUMENTATION**
- **PIEZO TRANSDUCER DRIVE**

DESCRIPTION

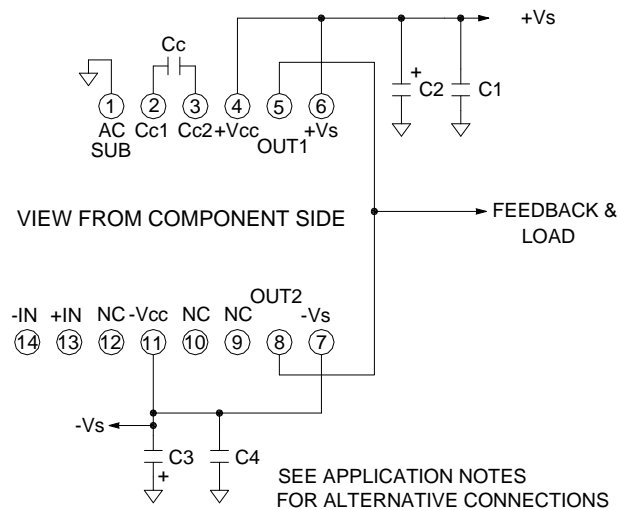
The PAD136 compact high voltage op amp is constructed with surface mount components to provide a cost effective solution for many industrial applications such as an ink jet print head driver. With a footprint only 40 X 45mm the PAD136 offers outstanding performance that rivals more expensive hybrid components. User selectable external compensation tailors the amplifier's response to the application requirements. The PAD136 is built on a thermally conductive but electrically insulating substrate. No BeO is used in the PAD136.

PowerAmp Design ♦ **PAD136** ♦ **COMPACT HIGH VOLTAGE OP AMP**

EQUIVALENT CIRCUIT



PINOUT & CONNECTIONS



SEE APPLICATION NOTES FOR ALTERNATIVE CONNECTIONS

PHASE COMPENSATION	SLEW RATE
GAIN	$\frac{C_c}{C_c}$
≥ 20	10pF 200V/uS
≥ 10	22pF 150V/uS
≥ 6	47pF 80V/uS
≥ 1	150pF 25V/uS

Power Amp Design ♦ PAD136 ♦ COMPACT HIGH VOLTAGE OP AMP

ABSOLUTE MAXIMUM RATINGS			
SUPPLY VOLTAGE, +Vs to -Vs ⁴	200V	TEMPERATURE, pin solder,	10s, 300°C
SUPPLY VOLTAGE, +Vcc to -Vcc ⁴	200V	TEMPERATURE, junction ²	150°C
INPUT VOLTAGE +Vcc to -Vcc		TEMPERATURE RANGE, storage	105°C
DIFFERENTIAL INPUT VOLTAGE	± 20V	OPERATING TEMPERATURE, substrate	-40 to 105° C
OUTPUT CURRENT, peak, within SOA	15A	POWER DISSIPATION, internal, DC	125W

PARAMETER	TEST CONDITIONS ¹	MIN	TYP	MAX	UNITS
INPUT					
OFFSET VOLTAGE			1	5	mV
OFFSET VOLTAGE vs. temperature	Full temperature range		20	50	μV/°C
OFFSET VOLTAGE vs. supply				3	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		110	118		dB
NOISE	100kHz bandwidth, 1kΩ R _s		10		μV RMS
GAIN					
OPEN LOOP	R _L = 10kΩ, C _C = 10pF	108			dB
GAIN BANDWIDTH PRODUCT @ 1MHz	C _C = 10pF		4		MHz
PHASE MARGIN	Full temperature range	60			degree
OUTPUT					
VOLTAGE SWING	I _O = 7A	+Vs-8	+Vs-6.5		V
VOLTAGE SWING	I _O = -7A	-Vs+8	-Vs+6.5		V
CURRENT, continuous, DC				7	A
CURRENT, pulse, ≤10mS, within SOA				15	A
SLEW RATE, A _v = +65	C _C = 15pF		200		V/μS
SETTLING TIME, to 0.1%	2V Step, C _C = 15pF		4		μS
RESISTANCE	No load, DC		4		Ω
POWER SUPPLY					
VOLTAGE		± 15	± 75	± 100	V
CURRENT, quiescent			29	32	mA
THERMAL					
RESISTANCE, AC, junction to case ⁵	Full temperature range, f ≥ 60Hz			2.1	°C/W
RESISTANCE, DC junction to case	Full temperature range			3.1	°C/W
TEMPERATURE RANGE, substrate		-40		105	°C

NOTES:

1. Unless otherwise noted: T_C = 25°C, compensation C_C = 150pF, 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 to the output stage. +Vcc and -Vcc denote the positive and negative supply voltages to the small signal stages. +Vcc and -Vcc may not be more than + and - 20V greater than +Vs and -Vs respectively.
5. Rating applies if the output current alternates between both output transistors at a rate faster than 60Hz.
6. Power supply voltages +Vcc and -Vcc must not be less than +Vs and -Vs respectively. Total voltage +Vcc to -Vcc 200V maximum.

SAFETY FIRST

The operating voltages of the PAD136 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.

MOUNTING THE PAD136 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 PAD136 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 hex male-female spacers and torque to 4.7 in lb [53 N cm] max. Mount the amplifier to the mother board with 4-40 X 1/4” screws. See Dimensional Information for additional recommendations.

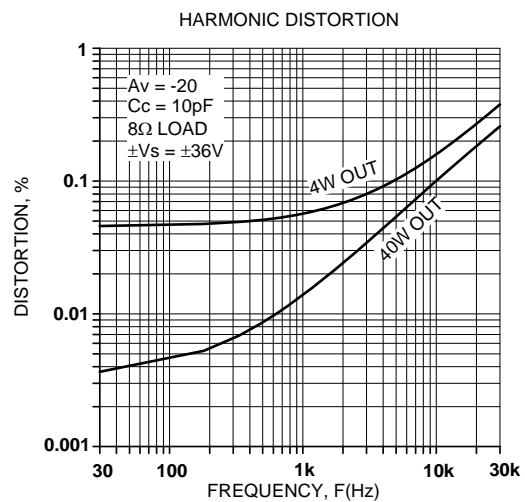
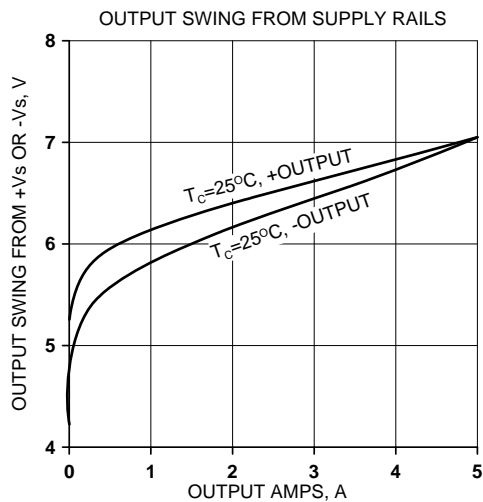
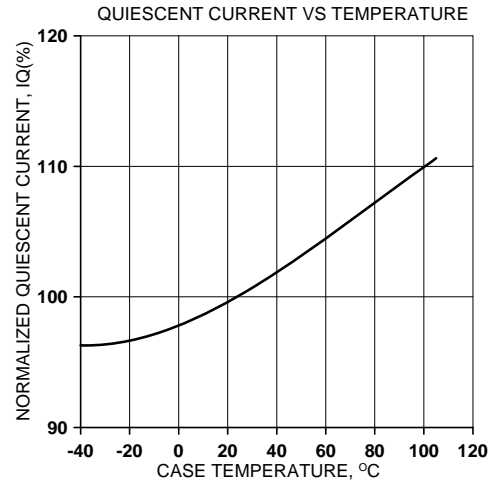
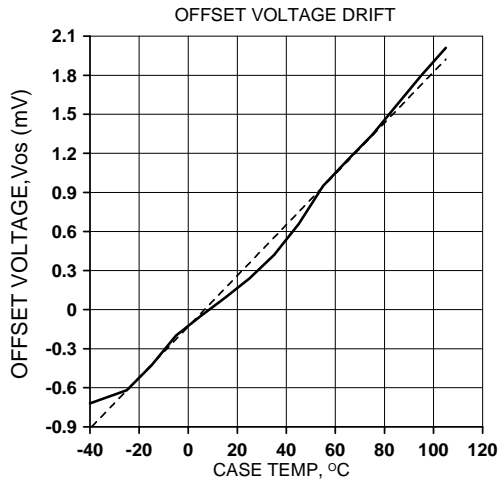
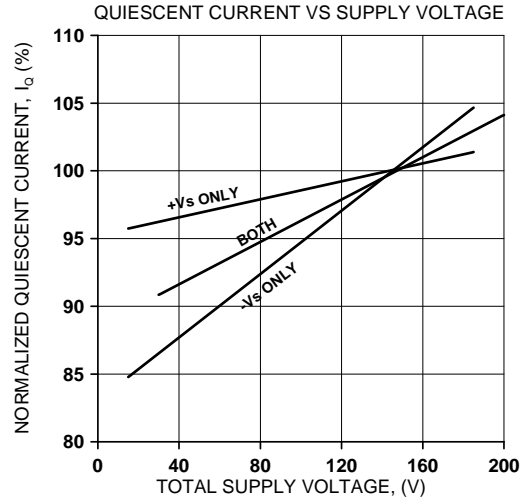
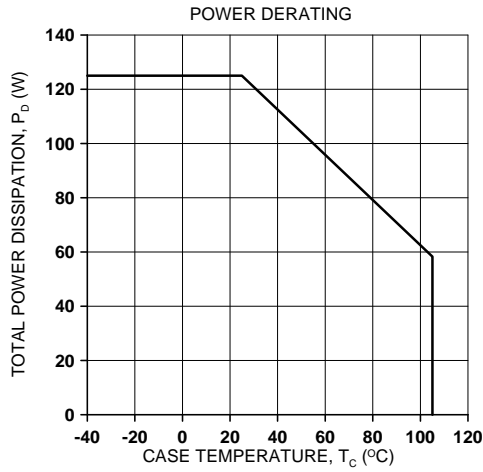
PHASE COMPENSATION

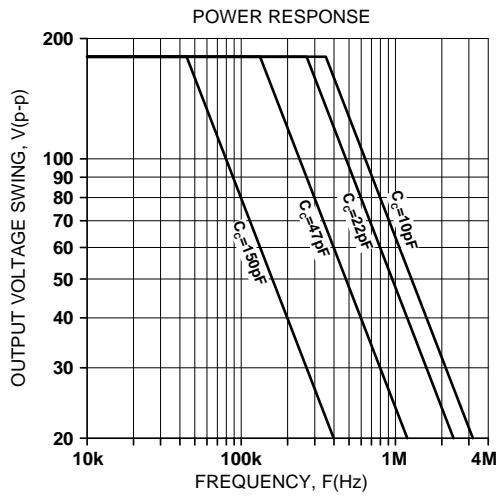
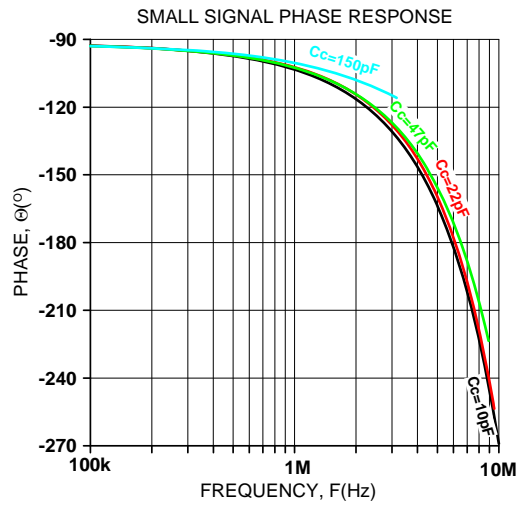
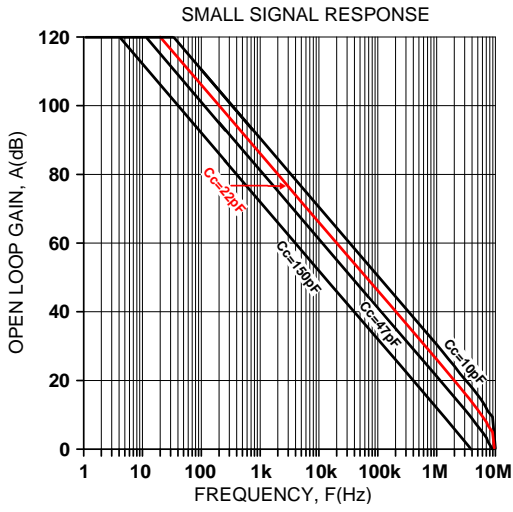
The PAD136 **must** be phase compensated. The compensation capacitor, C_c , is connected between pins 2 and 3. The compensation capacitor must be an NPO type capacitor rated for the full supply voltage (200V). On page 2, under Amplifier Pinout and Connections, you will find a table that gives recommended 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 15pF is not recommended.

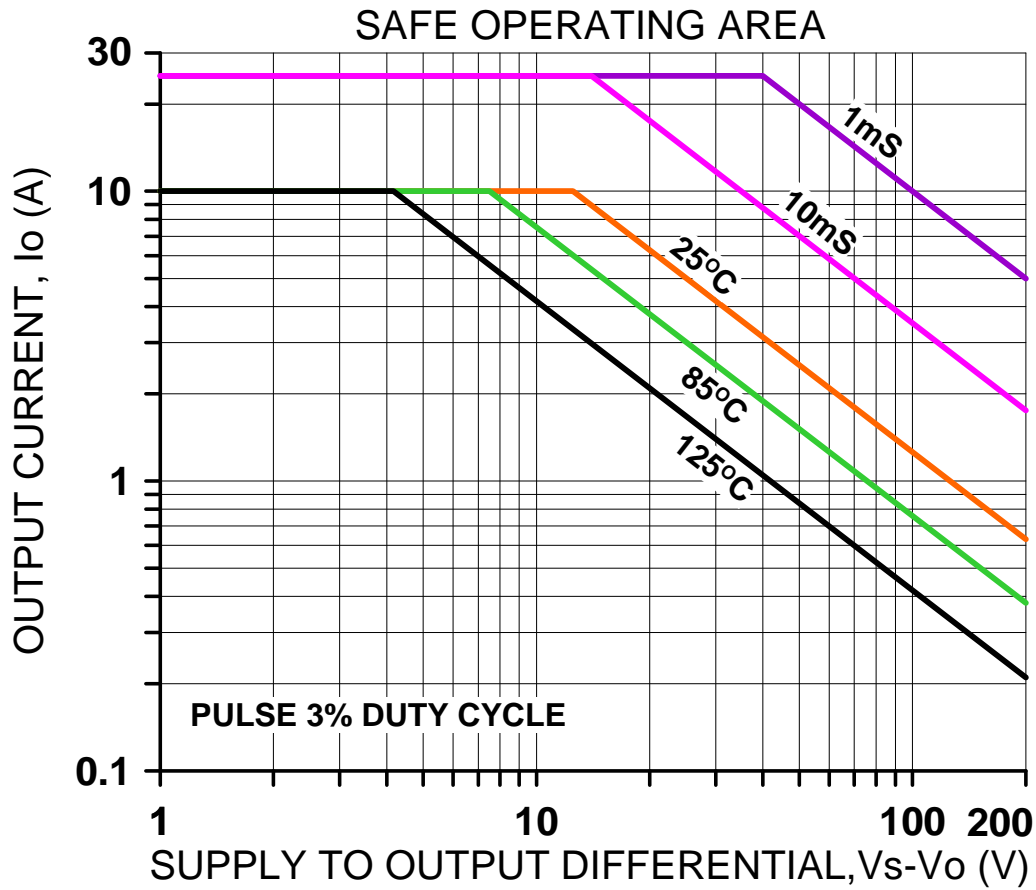
SINGLE HIGH-CURRENT SUPPLY OPERATION

It is often desirable to operate the PAD136 with a single high-current power supply as this reduces system cost. Figure 2 in the application circuits section shows one way to do this. However, in this case the input signal should be offset slightly to prevent the output from being driven to ground. When the output swings closer to ground than 10V the output transistor connected to the negative supply must recover from being over-driven. This causes a delay in the output going to a high condition. If the input signal is offset slightly so that the output is not driven to less than 10V this delay is avoided. The resulting output signal will then vary from 10V to 150V. For a circuit gain of +65 the required input signal then becomes 0.156V to 2.344V.

For custom applications the PAD136 can be ordered with its offset voltage set to produce the same effect. This option is desirable in applications where adjusting the input signal is difficult.

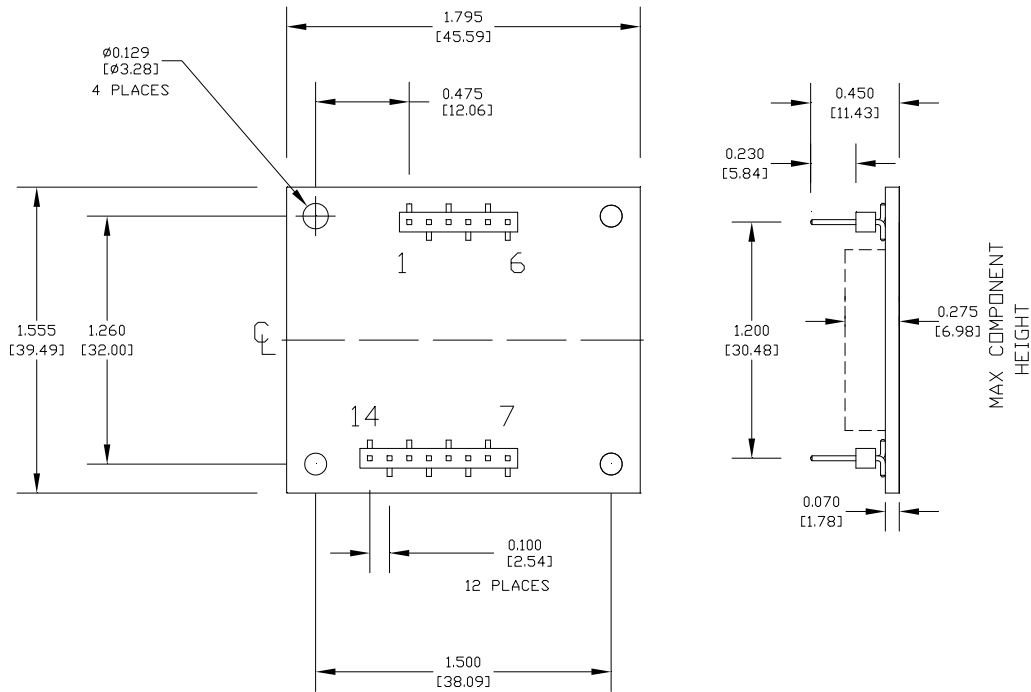




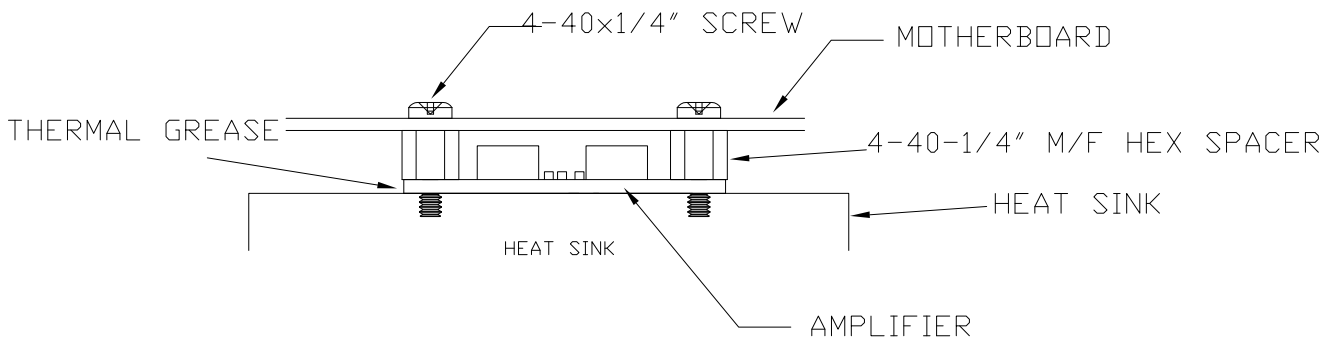


SAFE OPERATING AREA

The safe operating area (SOA) of a power amplifier is its single most important specification. The SOA graph presented above serves as a first approximation to help you decide if the PAD136 will meet the demands of your application.



- NOTES: 1: DIMENSIONS ARE INCHES, [mm]
 2: PINS 0.025" SQUARE [0.635mm], GOLD PLATED
 3: RECOMMENDED HOLE FOR MOUNTING 0.129" D. x2 [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.



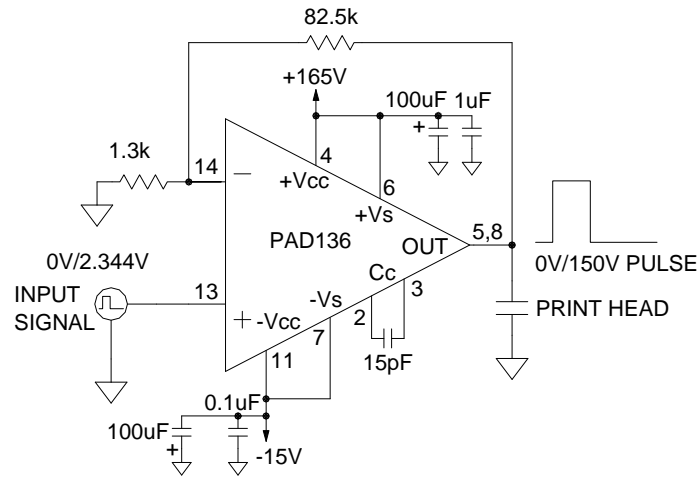


FIGURE 1.
TYPICAL DUAL SUPPLY PRINT HEAD DRIVE CIRCUIT

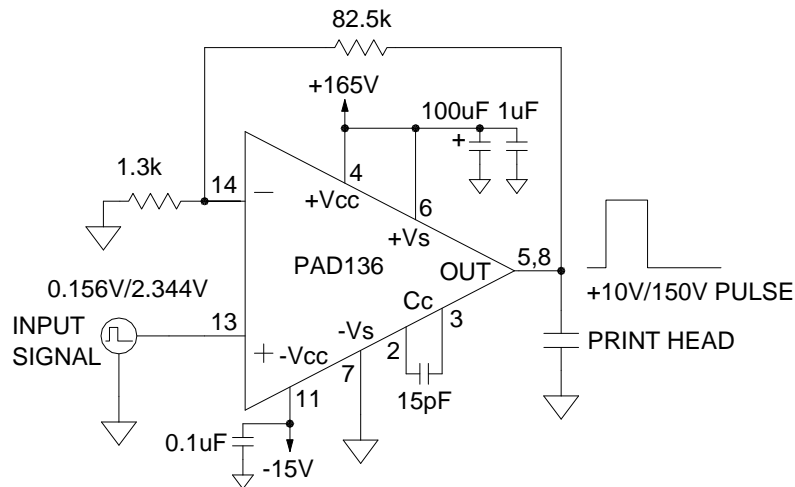


FIGURE 2.
SINGLE HIGH-CURRENT POWER SUPPLY PRINT HEAD DRIVE CIRCUIT