TPA83/ TPA83A

Power Operational Amplifier

THALER CORPORATION • 2015 N. FORBES BOULEVARD • TUCSON, AZ. 85745 • (520) 882-4000

FEATURES

- LOW BIAS CURRENT, LOW NOISE – FET Input
- FULLY PROTECTED INPUT – Up to ±150V
- WIDE SUPPLY RANGE - ±15V to ±150V
- HIGH OUTPUT CURRENT - 75mA
- POWER BANDWIDTH – 60kHz

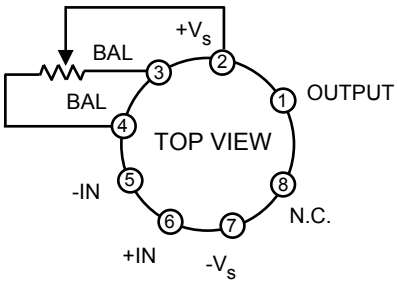
APPLICATIONS

- HIGH VOLTAGE INSTRUMENTATION
- PROGRAMMABLE POWER SUPPLIES
- ELECTROSTATIC TRANSDUCERS & DEFLECTION

DESCRIPTION

The TPA83 input stage is protected against over voltage (differential or common) up to the power supply rails. High accuracy and low noise is achieved with an FET/NPN cascoded input stage. All internal biasing is referenced by a FET current source into a zener diode. The zener diode voltage is selected so that the zener TC matches the V_{BE} at the input stage current source. As a result the TPA83 features excellent power supply rejection and a large input voltage range. The output stage is biased for class A/B mode, delivering a clean low distortion signal. Current limiting is internal and requires no external components. If the amplifier is used to drive inductive loads then external flyback diodes against the rails are recommended. The amplifier is internally compensated for all gain settings.

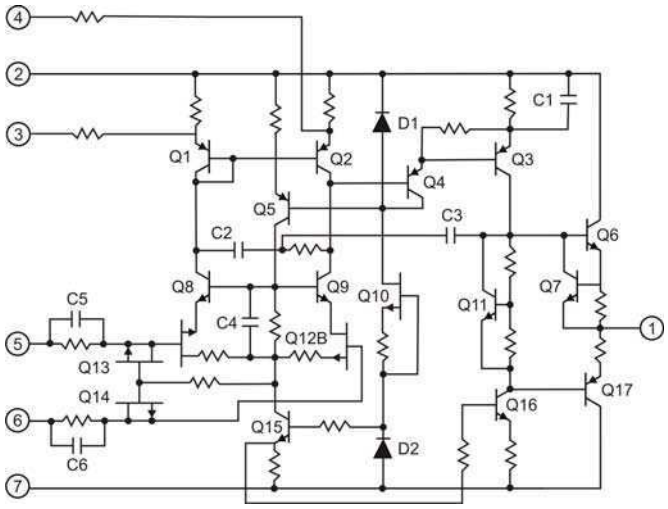
EXTERNAL CONNECTIONS AND PIN CONFIGURATIONS



NOTE:

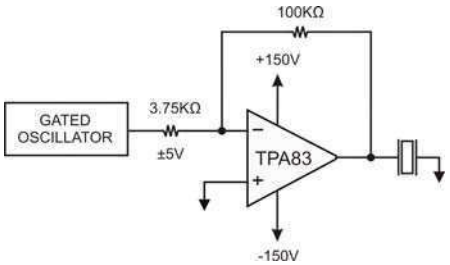
1) Pin 8 not internally connected.
2) Input offset trimpot optional. Recommended value of 100KΩ

EQUIVALENT SCHEMATIC



APPLICATION

High voltage amplifiers are often used to drive piezo electric transducers. If used dynamically at resonance frequencies the impedance can be reactive and it may be necessary to protect the output with diodes against the power supplies. For many applications of these transducers however the load is mainly capacitive and no external components are required. In these applications the useful frequency range is limited by the current drive capability of the amplifier. With its 75mA drive capability the TPA83 can drive transducers with 2nF of capacitance at 40kHz with full output voltage swing.



ABSOLUTE MAXIMUM RATINGS

Supply Voltage, $+V_s$ to $-V_s$	300V	Temperature, pin solder – 10s max.	300°C
Output Current, within SOA	Internally Limited	Temperature, junction[1]	175°C
Power Dissipation, internal at 25°C	17.5W	Temperature range, storage	-65 to +150°C
Input Voltage, differential	±300V	Operating temperature range, case	-55 to +125°C
Input Voltage, common mode	±300V		

SPECIFICATIONS

PARAMETER	CONDITIONS [2,6]	TPA83 MIN	TPA83 TYP	TPA83 MAX	TPA83A MIN	TPA83A TYP	TPA83A MAX	UNITS
INPUT								
Offset Voltage, initial	T_c= 25°C		±1.5	±3		±0.5	±1	mV
Offset Voltage, vs. temp.	full temperature range		±10	±25		±5	±10	µV/°C
Offset Voltage, vs. supply	T_c = 25°C		±0.5			±0.2		µV/V
Offset Voltage, vs. time	T_c= 25°C		±75			*		µV/√kh
Bias Current, initial[3]	T_c = 25°C		5	50		3	10	pA
Bias Current, vs. supply	T_c = 25°C		.01			*		pA/V
Offset Current, initial[3]	T_c = 25°C		±2.5	±50		±1.5	±10	pA
Offset Current, vs. supply	T_c = 25°C		±0.01			*		pA/V
Input Impedance, DC	T_c = 25°C		10^1			*		Ω
Input Capacitance	full temperature range		6			*		pF
Common Mode Volt. Range[4]	full temperature range	$+V_s$-10			*			V
Common Mode Rejection, DC	full temperature range		130			*		dB
GAIN								
Open Loop Gain at 10Hz	T_c = 25°C, 2kΩ load	96	116		*	*		dB
Unity Gain Crossover Freq.	T_c = 25°C, 2kΩ load		5		3	*		MHz
Power Bandwidth	T_c = 25°C, 10kΩ load		60		40	*		kHz
Phase Margin	full temp range		60			*		°
OUTPUT								
Voltage Swing[4], full load	full temp range, I_o = 75mA	$\pm V_s$-10	±Vs-5		*	*		V
Voltage Swing[4]	full temp range, I_o = 15mA	$\pm V_s$-5	±Vs-3		*	*		V
Current, peak	T_c = 25°C	75			*			mA
Current, short circuit	T_c = 25°C		100			*		mA
Slew Rate[6]	T_c = 25°C, 2kΩ load	20	30		*	*		V/µs
Capacitive Load, unity gain	full temp range			10			*	nF
Capacitive Load, gain > 4	full temp range			SOA			*	µF
Settling Time to 0.1%	T_c = 25°C, 2kΩ load, 10V step		12			*		µs
POWER SUPPLY								
Voltage	full temp range	± 15	± 150	± 150	*	*	*	V
Current, quiescent	T_c = 25°C		6	8		*	*	mA
THERMAL								
Resistance, AC junction to case[5]	F > 60Hz		4.26			*		°C/W
Resistance, DC junction to case	F < 60Hz		6.22	8.57		*	*	°C/W
Resistance, case to air			30			*		°C/W
Temperature Range, case	Meets full range specs	-25		85	*		*	°C

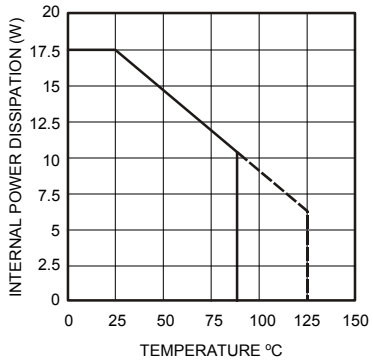
Notes: *Same as previous Model.

1) Long term operation at the maximum junction temperature will result in reduced product life. Derate internal power dissipation to achieve high MTTF.
2) The power supply voltage for all specifications is the typical rating unless otherwise noted as a test condition.
3) Doubles for every 10°C of temperature increase.
4. $+V_s$ and $-V_s$ denote the positive and negative supply rail respectively. Total V_s is measured from $+V_s$ to $-V_s$.
5. Rating applies if the output current alternates between both output transistors at a rate faster than 60Hz.
6. Signal slew rates at pins 5 and 6 must be limited to less than 1V/ns to avoid damage. When faster waveforms are unavoidable, resistors in series with those pins, limiting current to 150mA will protect the amplifier from damage.

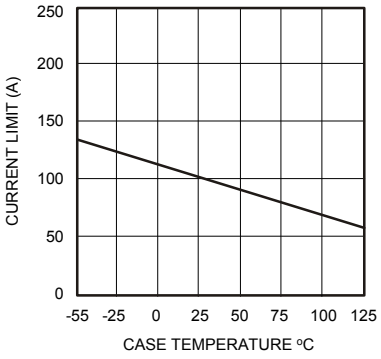
Caution: The internal substrate contains beryllia (BeO). Do not crush, break, machine or subject the substrate to temperatures in excess of 850°C.

TYPICAL PERFORMANCE CURVES

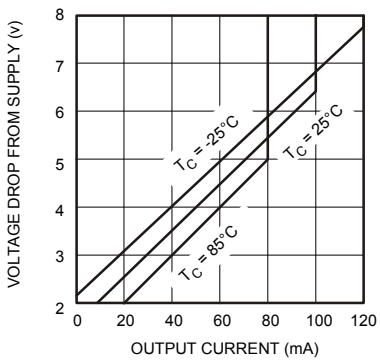
POWER DERATING



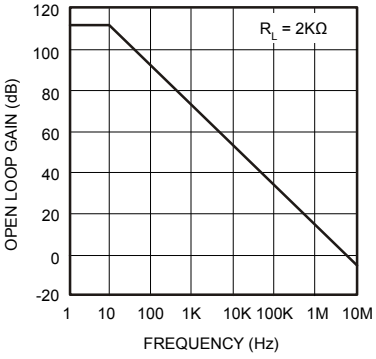
CURRENT LIMIT



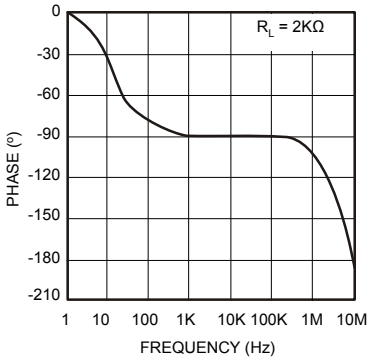
OUTPUT VOLTAGE SWING



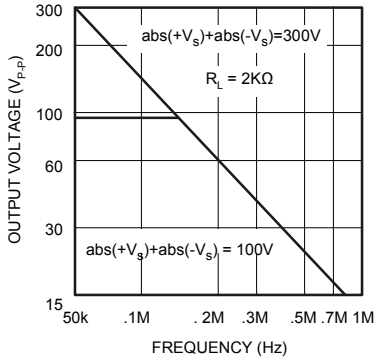
SMALL SIGNAL RESPONSE



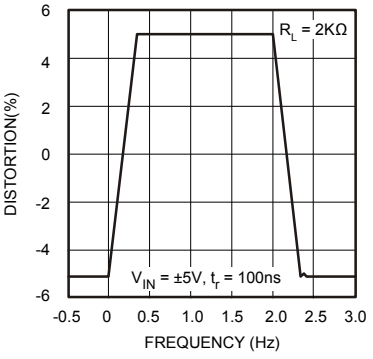
PHASE RESPONSE



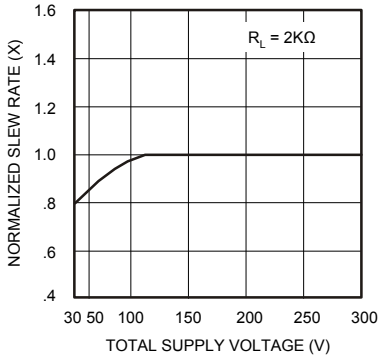
POWER RESPONSE



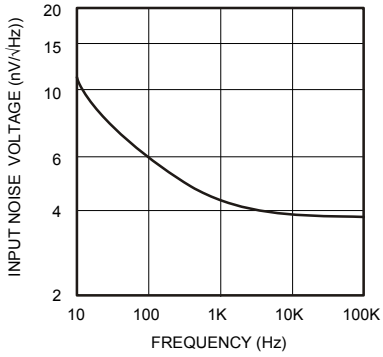
HARMONIC DISTORTION



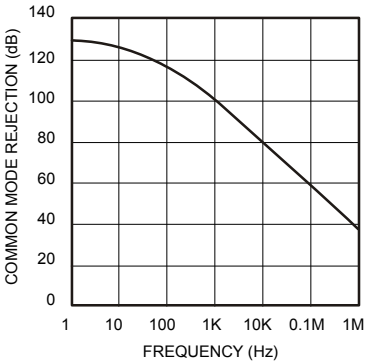
SLEW RATE VS. SUPPLY



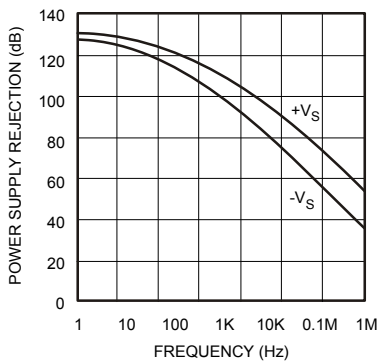
INPUT NOISE



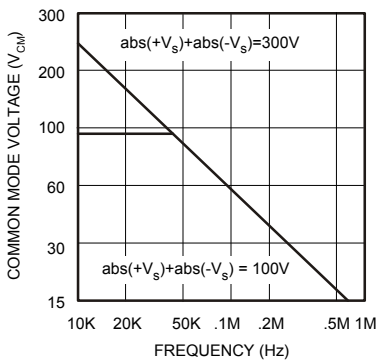
COMMON MODE REJECTION



POWER SUPPLY REJECTION



COMMON MODE VOLTAGE



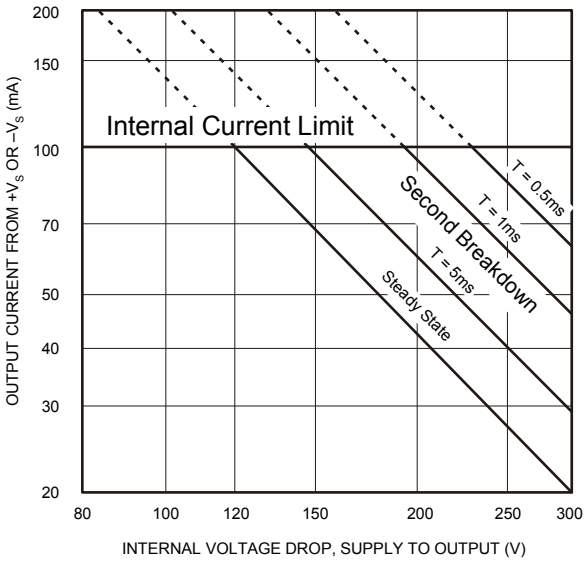
DISCUSSION OF PERFORMANCE

SAFE OPERATING AREA (SOA)

The bipolar output stage of this high voltage amplifier has two distinct limitations.

1)The internal current limit, which limits maximum available output current.

2)The second breakdown effect, which occurs whenever the simultaneous collector current and collector-emitter voltage exceed specified limits.



The SOA curves combine the effect of all limits for this Power Op Amp. For a given application, the direction and magnitude of the output current should be calculated or measured and checked against the SOA curves. This is simple for resistive loads but more complex for reactive and EMF generating loads. The following guidelines may save extensive analytical efforts:

1) Under transient conditions, capacitive and dynamic loads up to the following maximums are safe:

±Vs	C(Max)	L(Max)
150V	0.7F	1.5H
125V	2μF	2.5H
100V	5μF	6.0H
75V	60μF	30H
50V	All	All

2) Short circuits to ground are safe with dual supplies up to 120V or single supplies up to 120V.

3) Short circuits to the supply rails are safe with total supply voltages up to 120V.

4) The output stage is protected against transient flyback. For protection against sustained high energy flyback, external fast recovery diodes should be used.

INDUCTIVE LOADS

Two external diodes as shown in Figure 1 are required to protect these amplifiers against flyback (kickback) pulses exceeding the supply voltages of the amplifiers when driving inductive loads. For component selection, these external diodes must be very quick such as ultra fast recovery diodes with no more than 200 nanoseconds of reverse recovery time. Be sure the diode voltage rating is greater than the total of both supplies. The diode will turn on to divert the flyback energy into the rails thus protecting the output transistors from destruction due to reverse bias.

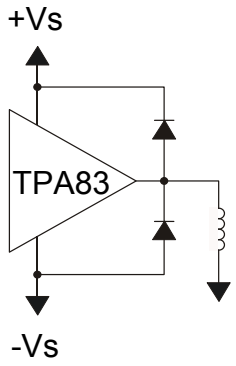


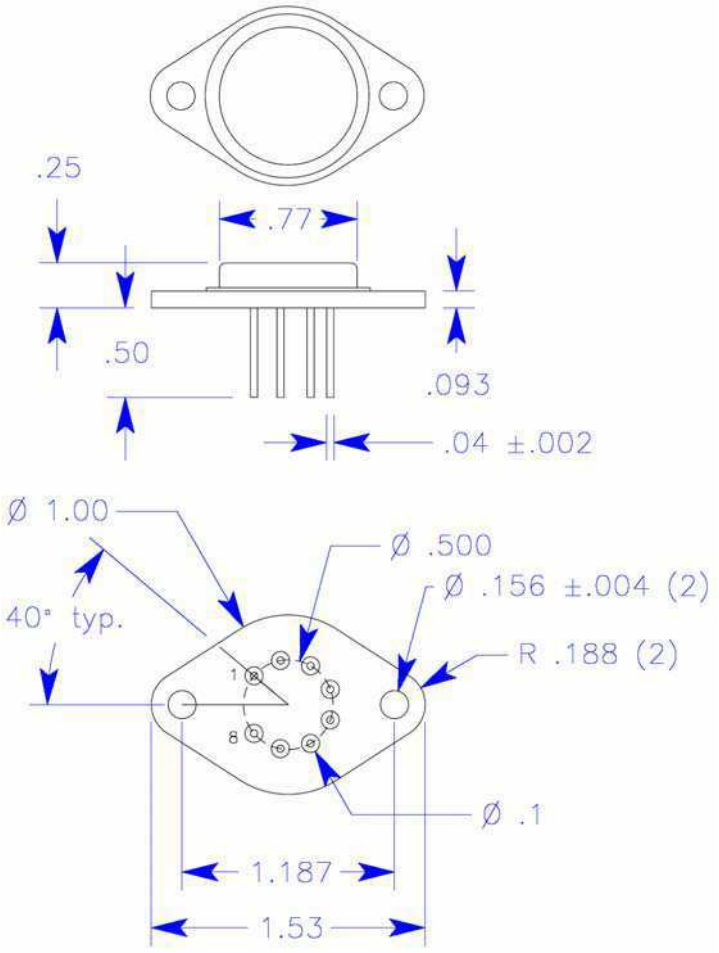
Figure 1. Protection, Inductive Load

DEVICE MOUNTING

The case (mounting flange) is electrically isolated and should be mounted directly to a heatsink with thermal compound. Screws with Belville spring washers are recommended to maintain positive clamping pressure on heatsink mounting surfaces. Long periods of thermal cycling can loosen mounting screws and increase thermal resistance.

Since the case is electrically isolated (floating) with respect to the internal circuits, it is recommended to connect it to common or other convenient AC ground potential.

MECHANICAL



TO3-8 Package