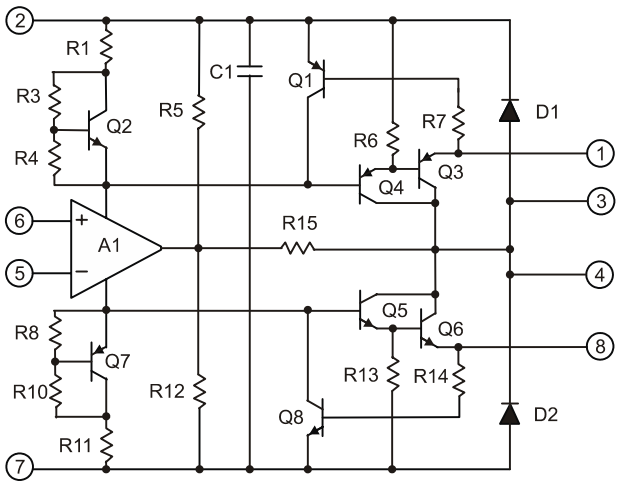
TPA02/ TPA02A
Power Operational Amplifier

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

FEATURES

- **COMMON COLLECTOR OUTPUT STAGE**
- **CLOSE TO RAIL OUTPUT – ±1.2V TO RAIL**
- **HIGH SLEW RATE – 20V/µsec.**
- **FAST SETTLING TIME – 600ns**
- **HIGH POWER BANDWIDTH – 350kHz**
- **HIGH OUTPUT CURRENT - ±5A PEAK**
- **LOW CROSSOVER DISTORTION – CLASS A/B**
- **LOW INPUT CURRENT – FET INPUT**

EQUIVALENT SCHEMATIC



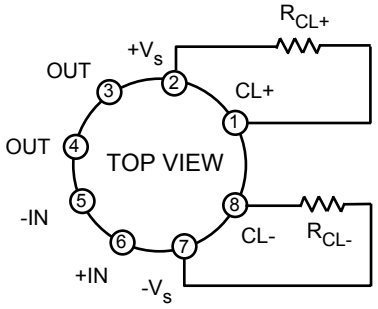
DESCRIPTION

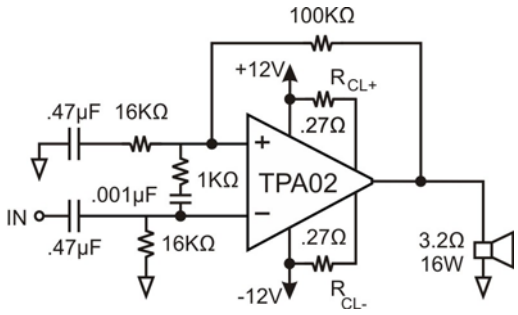
The TPA02 and TPA02A are fast, high output current operational amplifiers designed to drive resistive or reactive loads. The common collector output stage swings close to the supply rails and is protected against inductive kickback by diodes to the rails. The safe operating area (SOA) can be selected by external current limiting resistors. The output stage is biased for class A/B operation to achieve low distortion. The amplifiers are internally compensated but are not suitable for use as unity gain followers.

POWER DELIVERY EFFICIENCY AND LOW DISTORTION

Due to the common collector output stage, these amplifiers can deliver power with high efficiency particularly for low voltage applications. In the example application below the TPA02 delivers power with high efficiency and due to the high power bandwidth also low distortion.

EXTERNAL CONNECTIONS AND PIN CONFIGURATIONS





ABSOLUTE MAXIMUM RATINGS

Supply Voltage	38V	Temperature, pin solder – 10s	300°C
Output Current, within SOA	5A	Temperature, junction[1]	150°C
Power Dissipation, internal[1]	48W	Temperature range, storage	-65 to +150°C
Input Voltage, differential	$\pm V_S$ -5V	Operating temperature range, case	-55 to +125°C
Input Voltage, common mode	$\pm V_S$ -2V		

SPECIFICATIONS

PARAMETER	CONDITIONS [2,6]	TPA02 MIN	TPA02 TYP	TPA02 MAX	TPA02A MIN	TPA02A TYP	TPA02A MAX	UNITS
INPUT								
Offset Voltage, initial	T_c= 25°C		±5	±10		±1	±3	mV
Offset Voltage, vs. temp.	full temperature range		±10	±50		*	±25	µV/°C
Offset Voltage, vs. supply	T_c = 25°C		±10			*		µV/V
Offset Voltage, vs. power	T_c= 25°C		±6			*		µV/W
Bias Current, initial	T_c = 25°C		50	200		25	100	pA
Bias Current, vs. temp.	T_c = 85°C			200			*	pA/°C
Bias Current, vs. supply	T_c = 25°C		.01			*		pA/V
Offset Current, initial	T_c = 25°C		25	100		15	50	pA
Offset Current, vs. temp.	T_c = 85°C			100			*	pa/°C
Input Impedance, DC	T_c = 25°C		1000			*		GΩ
Input Capacitance	T_c = 25°C		3			*		pF
Common Mode Volt. Range[5], Pos	full temperature range	$+V_s$-6	$+V_s$-3		*	*		V
Common Mode Volt. Range[5], Neg	full temperature range	$-V_s$+6	$+V_s$+5		*	*		V
Common Mode Rejection, DC	full temperature range	70	100		*	*		db
GAIN								
Open Loop Gain at 10Hz	T_c = 25°C, 1kΩ load		103			*		db
Open Loop Gain at 10Hz	Full temp range, 10kΩ load	86	100		*	*		db
Gain Bandwidth Product (1MHz)	T_c = 25°C, 10Ω load		4.5			*		MHz
Power Bandwidth	T_c = 25°C, 10Ω load		350			*		kHz
Phase Margin	Full temp range, 10Ω load		30			*		o
OUTPUT								
Voltage Swing[3]	T_c = 25°C,I_o = 5A, R_{CL} = .08Ω	$\pm V_s$-4	±Vs-3		*	*		V
Voltage Swing[3]	full temp range, I_o = 2A	$\pm V_s$-2	±Vs-1.2		*	*		V
Current, peak	T_c = 25°C	5			*			A
Settling Time to .1%,	T_c= 25°C, 2V step		.6			*		µs
Slew Rate	T_c = 25°C	13	20		*	*		V/µs
Capacitive Load	full temp range, Av > 10		SOA			*		
Harmonic Distortion	Po = .5W, F = 1kHz, R_L=10Ω		.004			*		%
Small Signal, rise/fall time	R_L = 10Ω, A_v = 1		100			*		ns
Small Signal, overshoot	R_L = 10Ω, A_v = 1		10			*		%
POWER SUPPLY								
Voltage	full temp range	± 7	± 15	± 19	*	*	*	V
Current, quiescent	T_c = 25°C		27	40		*	*	mA
THERMAL								
Resistance, AC junction to case[4]	F > 60Hz		1.9	2.1		*	*	°C/W
Resistance, DC junction to case	F > 60Hz		2.4	2.6		*	*	°C/W
Resistance, junction to air			30			*		°C/W
Temperature Range, case	Meets full range specs	-25		+85	-55		+125	°C

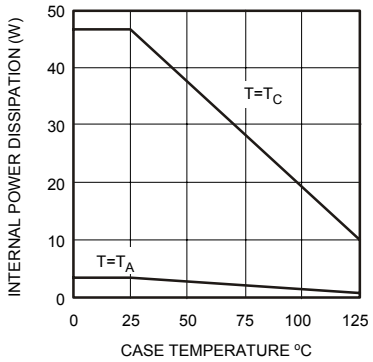
Notes: *Same as previous Model.

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. $+V_s$ and $-V_s$ denote the positive and negative supply rail respectively. Total V_s is measured from $+V_s$ to $-V_s$.
4. Rating applies if the output current alternates between both output transistors at a rate faster than 60Hz.
5. Exceeding CMV range can cause the output to latch.
6. Full temperature specifications are guaranteed but not 100% tested.

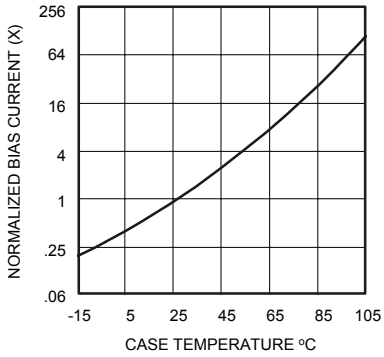
Caution: The internal substrate contains beryllia (BeO). Do not crush, break, machine or subject the substrate to temperatures in excess of 850C.

TYPICAL PERFORMANCE CURVES

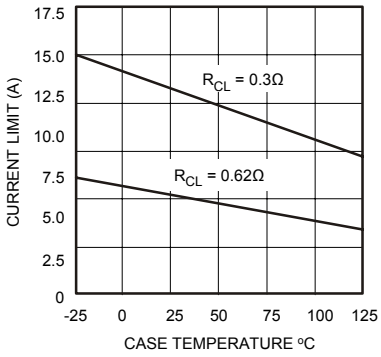
POWER DERATING



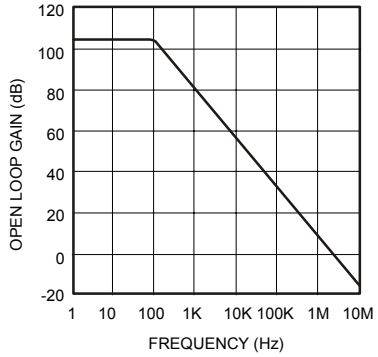
BIAS CURRENT



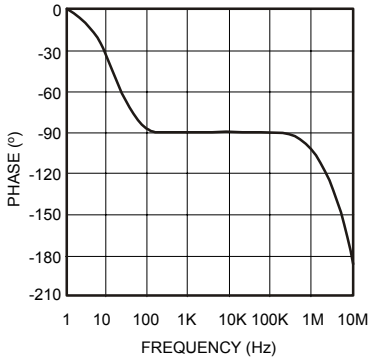
CURRENT LIMIT



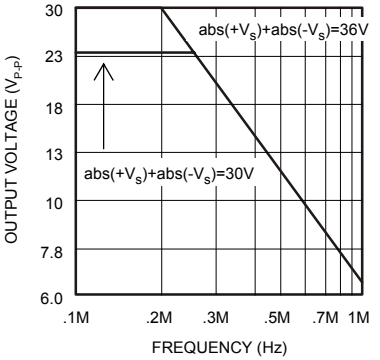
SMALL SIGNAL RESPONSE



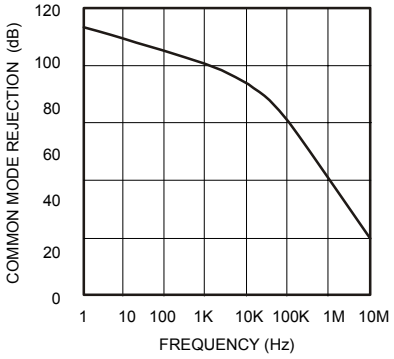
PHASE RESPONSE



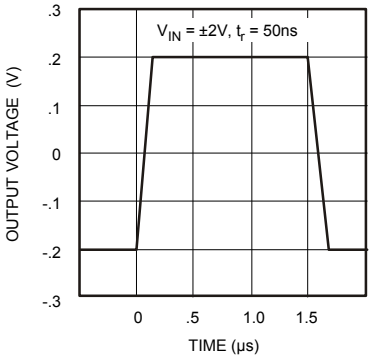
POWER RESPONSE



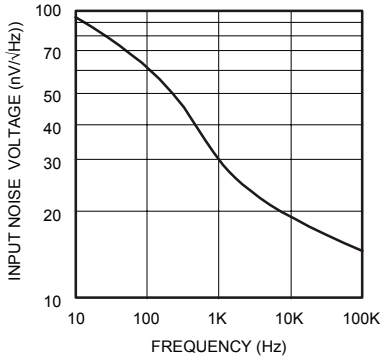
COMMON MODE REJECTION



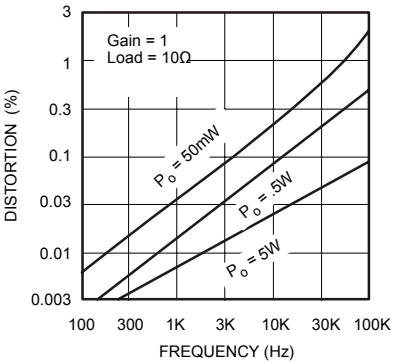
PULSE RESPONSE



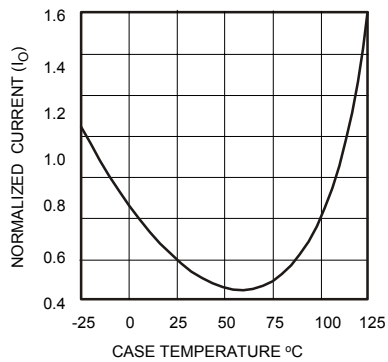
INPUT NOISE



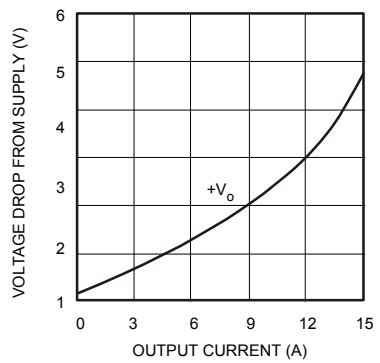
HARMONIC DISTORTION



QUIESCENT CURRENT



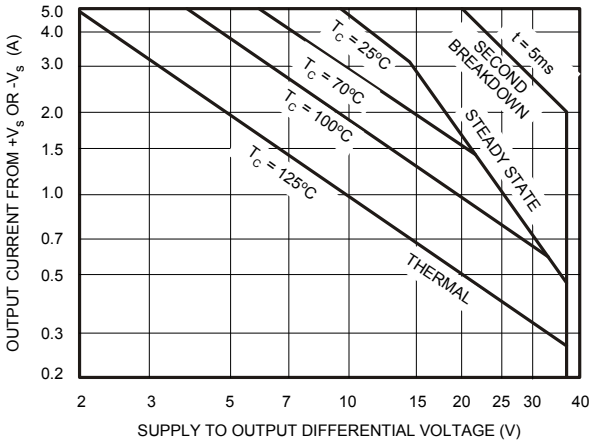
OUTPUT VOLTAGE SWING



DISCUSSION OF PERFORMANCE

SAFE OPERATING AREA (SOA)

SOA



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:

	Capacitive Load		Inductive Load	
$\pm V_s$	I_{LIM} = 2A	I_{LIM} = 5A	I_{LIM} = 2A	I_{LIM}= 5A
18V	2mF	0.7mF	0.2H	10mH
15V	10mF	2.2mF	0.7H	25mH
10V	25mF	10mF	5H	50mH

•If the inductive load is driven near steady state conditions, allowing the output voltage to drop more than 8V below the supply rail with I_{LIM} = 5A, or 17V below the supply rail with I_{LIM} = 2A while the amplifier is current limiting, the inductor should be capacitively coupled or the current limit must be lowered to meet SOA criteria.

These simplified limits may be exceed with further analysis using the operating conditions for a specific application.

2. The amplifier can handle any EMF generating or reactive load and short circuits to the supply rails or shorts to common if the current limits are set as follows at Tc = 85°C.

$\pm V_s$	Short to $\pm V_S$ C,L or EMF Load	Short to Common
18V	0.5A	1.7A
15V	0.7A	2.8A
10V	1.6A	4.2A

CURRENT LIMIT

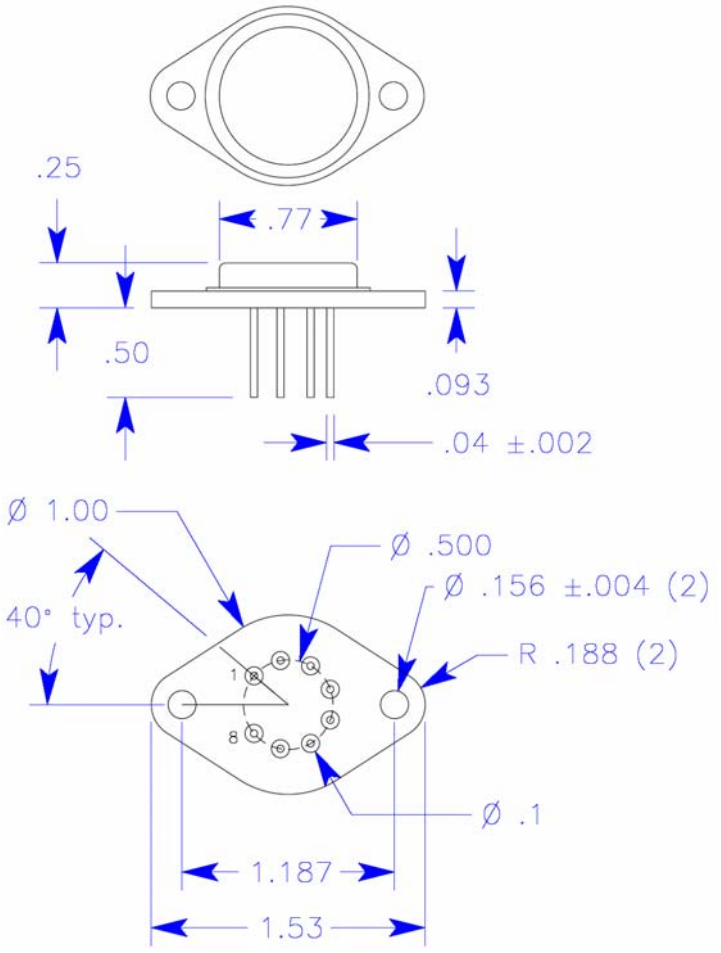
Proper operation requires the use of two current limit resistors, connected as shown in the external connections diagram. The minimum value for R_{CL} is 0.12 ohm, however for optimum reliability it should be set as high as possible.

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