PA35

FEATURES

Not recommended for new design in.

- LOW COST
- WIDE COMMON MODE RANGE Includes negative supply
- WIDE SUPPLY VOLTAGE RANGE
  Single supply: 5V to 40V
  Split supplies: ±2.5V to ±20V
- HIGH EFFICIENCY — |Vs–2.8V| at 2.5A typ
- HIGH OUTPUT CURRENT — 1.7A min
- INTERNAL CURRENT LIMIT
- LOW DISTORTION
- PACKAGING OPTIONS
  - 7 TO-220 Plastic Package (PA35CD)
  - 7 TO-220 with Staggered Lead Form (PA35CX)
  - 7 DDPAK Surface Mount Package (PA35CC)

APPLICATIONS

- HALF & FULL BRIDGE MOTOR DRIVERS
- AUDIO POWER AMPLIFIER
- IDEAL FOR SINGLE SUPPLY SYSTEMS
  5V Peripherals, 12V Automotive, 28V Avionic

DESCRIPTION

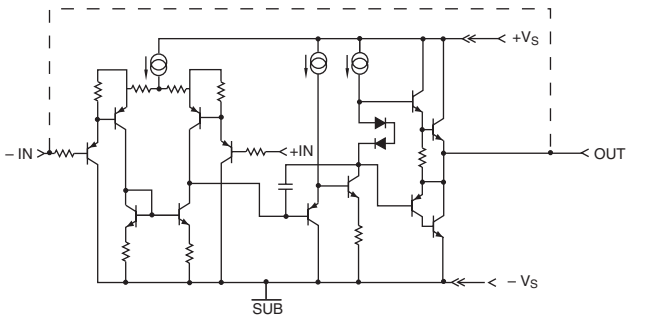
The PA35 consists of a monolithic power operational amplifier in three standard package designs. The surface mount version of the PA35, the PA35CC, is an industry standard non-hermetic plastic 7-pin DDPAK. The through hole versions of the PA35, the PA35CD and PA35CX, are industry standard non-heremetic plastic 7-pin TO-220 packages. The PA35CX is a staggered lead formed PA35CD and offers industry standard 100 mil spacing. This allows for easier PC board layout. (Please reference to the lead form datasheet drawing LF005 for package dimensions of the PA35CX.

The wide common mode input range includes the negative rail, facilitating single supply applications. It is possible to have a "ground based" input driving a single supply amplifier with ground acting as the "second" or "bottom" supply of the amplifier.

The output stage is also well protected. They possess internal current limit circuits. While the device is well protected, the Safe Operating Area (SOA) curve must be observed. Proper heatsinking is required for maximum reliability.

The monolithic amplifier is directly attached to the metal tabs of the PA35CC, PA35CD, and PA35CX. The metal tabs are directly tied to -Vs.

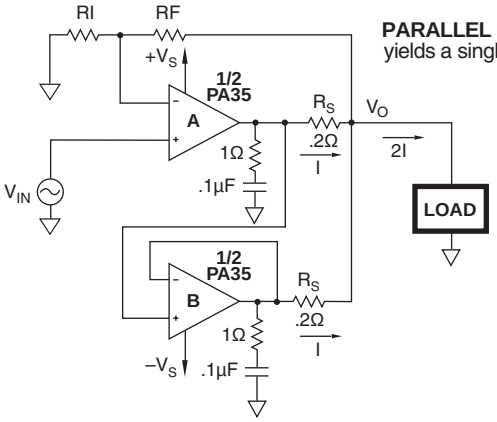
EQUIVALENT SCHEMATIC



NOTE: INTERNAL BONDING REPRESENTED BY DASHED LINE

TYPICAL APPLICATION

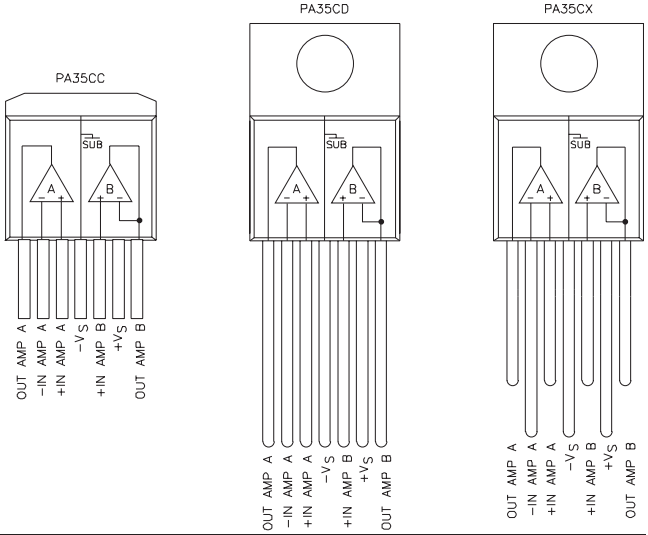
Ref: APPLICATION NOTES 8, 20, 26



PARALLEL CONNECTION
yields a single 3.4A amplifier

Combining the power op amp (master channel A) and the unity gain buffer (slave channel B) in a parallel connection yields a single 3.4A amplifier. RI and RF can set up channel A for the required gain for the overall circuit. Small values of R_S (sense resistors) are used on the outputs to improve current sharing characteristics. The master amplifier can be configured in inverting or non-inverting gain configurations. (See PA21/25/26/37 Datasheet for additional application descriptions.)

EXTERNAL CONNECTIONS



ABSOLUTE MAXIMUM RATINGS

SUPPLY VOLTAGE, total	5V to 40V
OUTPUT CURRENT	1.7A
POWER DISSIPATION, internal, (per amplifier)	18.5W
POWER DISSIPATION, internal (both amplifiers)	27.5W
INPUT VOLTAGE, differential	$\pm V_S$
INPUT VOLTAGE, common mode	$+V_S$, $-V_S$–.5V
JUNCTION TEMPERATURE, max[1]	150°C
TEMPERATURE, pin solder—10 sec max	220°C
TEMPERATURE RANGE, storage	–65°C to 150°C
OPERATING TEMPERATURE RANGE, case	–40°C to 125°C

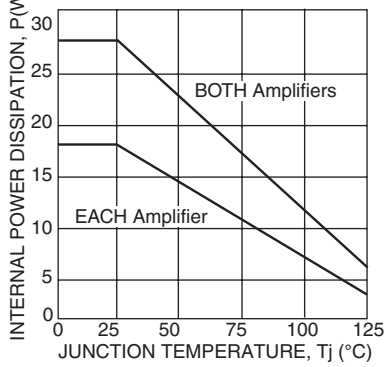
SPECIFICATIONS

		PA35			
PARAMETER	**TEST CONDITIONS[2]**	**MIN**	**TYP**	**MAX**	**UNITS**
INPUT					
OFFSET VOLTAGE, initial			1.5	10	mV
OFFSET VOLTAGE, vs. temperature	Full temperature range		15		µV/°C
BIAS CURRENT, initial		35	1000		nA
COMMON MODE RANGE	Full temperature range	$-V_S$–.3		$+V_S$–2	dB
COMMON MODE REJECTION, DC	Full temperature range	60	85		dB
POWER SUPPLY REJECTION	Full temperature range	60	80		dB
GAIN					
OPEN LOOP GAIN	Full temperature range	80	100		dB
GAIN BANDWIDTH PRODUCT	A_V = 40dB		600		kHz
PHASE MARGIN	Full temperature range		65		°
POWER BANDWIDTH	$V_{O(P-P)}$ = 28V		13.6		kHz
OUTPUT					
CURRENT, peak		1.7			A
SLEW RATE		.5	1.2		V/µs
CAPACITIVE LOAD DRIVE	A_V = 1		.22		µF
VOLTAGE SWING	Full temp. range, I_O = 100mA	$\lvert V_S \rvert$ –1.0	$\lvert V_S \rvert$ –0.8		V
POWER SUPPLY					
VOLTAGE, V_{SS}[3]		5	30	40	V
CURRENT, quiescent, total			45	90	mA
THERMAL					
RESISTANCE, DC junction to case (single)			5.44	6.80	°C/W
RESISTANCE, AC junction to case (single)			4.07	5.10	°C/W
RESISTANCE, DC junction to case (both)			3.64	4.55	
RESISTANCE, AC junction to case (both)			2.73	3.41	
RESISTANCE, junction to air (CD,CX)				60	°C/W
RESISTANCE, junction to air (CC)[4]				27	°C/W
TEMPERATURE RANGE, case	Meets full range specifications	–25		85	°C

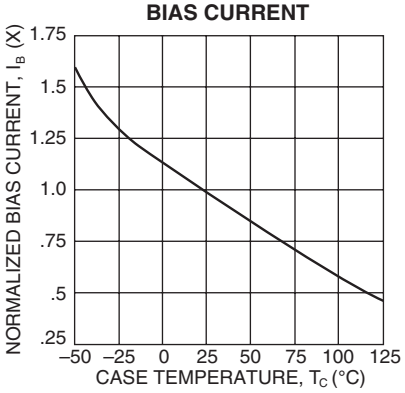
NOTES:

1. Long term operation at the maximum junction temperature will result in reduced product life. Derate internal power dissipation to achieve high MTTF.
2. Unless otherwise noted, the following conditions apply: $\pm V_S$ = ±15V, T_C = 25°C.
3. $+V_S$ and $-V_S$ denote the positive and negative supply rail respectively. V_{SS} denotes the total rail-to-rail supply voltage.
4. Heat tab attached to 3/32" FR-4 board with 2oz. copper. Topside copper area (heat tab directly attached) = 1000 sq. mm, backside copper area = 2500 sq. mm, board area = 2500 sq. mm.

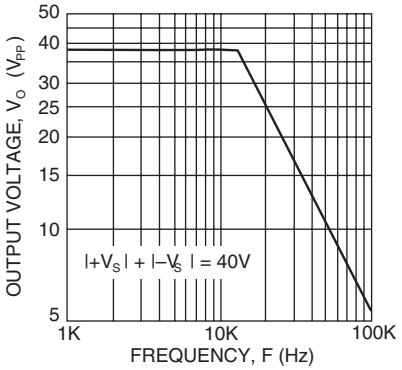
POWER DERATING



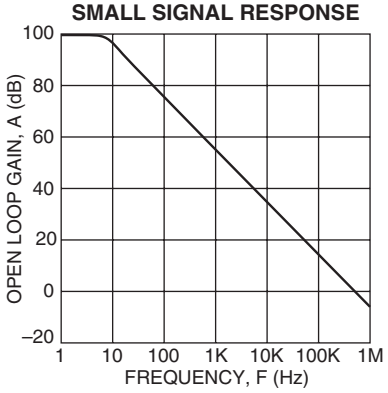
BIAS CURRENT



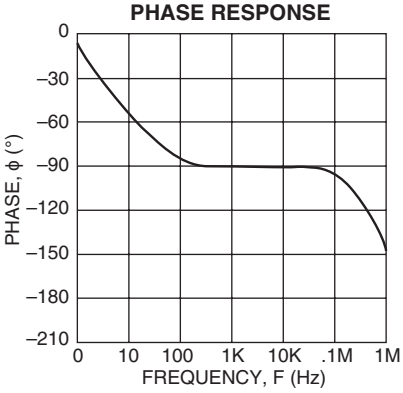
POWER RESPONSE



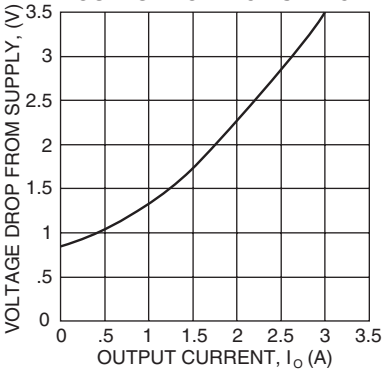
SMALL SIGNAL RESPONSE



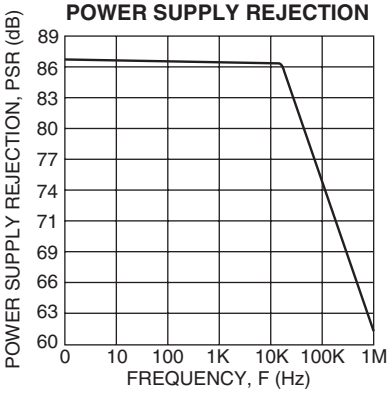
PHASE RESPONSE



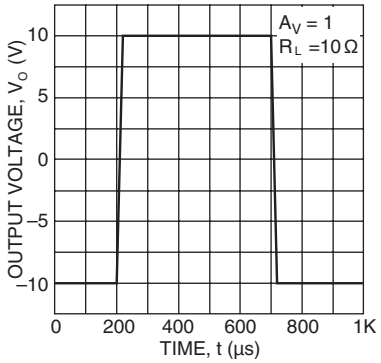
OUTPUT VOLTAGE SWING



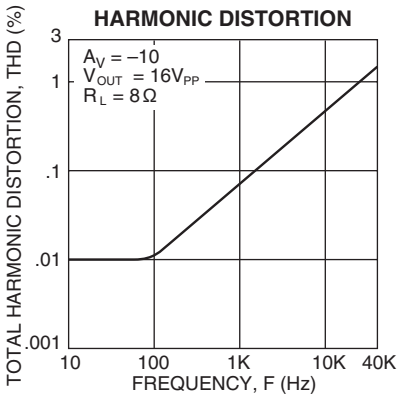
POWER SUPPLY REJECTION



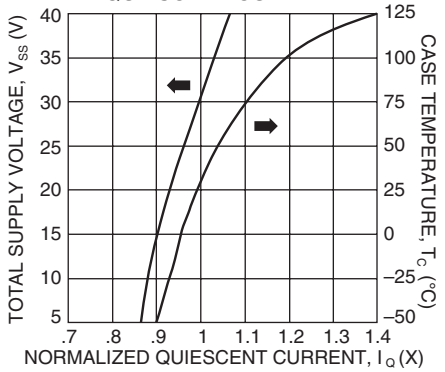
PULSE RESPONSE



HARMONIC DISTORTION



QUIESCENT CURRENT

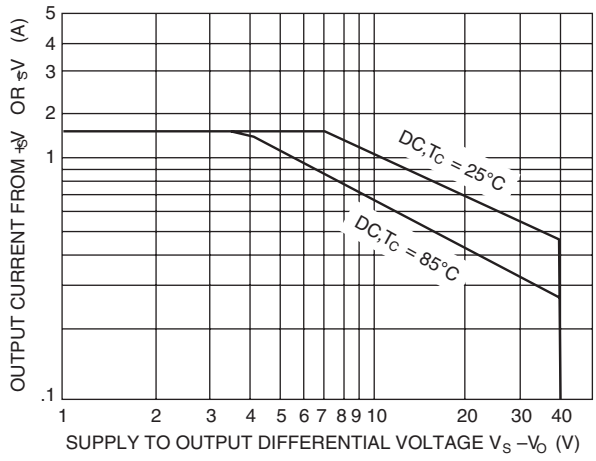


GENERAL

Please read Application Note 1 "General Operating Considerations" which covers stability, supplies, heat sinking, mounting, current limit, SOA interpretation, and specification interpretation. Visit www.apexmicrotech.com for design tools that help automate tasks such as calculations for stability, internal power dissipation, current limit and heat sink selection. The "Application Notes" and "Technical Seminar" sections contain a wealth of information on specific types of applications. Package outlines, heat sinks, mounting hardware and other accessories are located in the "Packages and Accessories" section. Evaluation Kits are available for most Apex product models, consult the "Evaluation Kit" section for details. For the most current version of all Apex product data sheets, visit www.apexmicrotech.com.

CURRENT LIMIT

Current limit is internal to the amplifier, the typical value is shown in the current limit specification.



SAFE OPERATING AREA (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.

Under transient conditions, capacitive and dynamic* inductive loads up to the following maximum are safe:

±Vs	CAPACITIVE LOAD	INDUCTIVE LOAD
20V	200µF	7.5mH
15V	500µF	25mH
10V	5mF	35mH
5V	50mF	150mH

* If the inductive load is driven near steady state conditions, allowing the output voltage to drop more than 6V below the supply rail while the amplifier is current limiting, the inductor should be capacitively coupled or the supply voltage must be lowered to meet SOA criteria.

NOTE: For protection against sustained, high energy flyback, external fast-recovery diodes should be used.

MONOLITHIC AMPLIFIER STABILITY CONSIDERATIONS

All monolithic power op amps use output stage topologies that present special stability problems. This is primarily due to non-complementary (both devices are NPN) output stages with a mismatch in gain and phase response for different polarities of output current. It is difficult for the op amp manufacturer to optimize compensation for all operating conditions.

The recommended R-C network of 1 ohm in series with 0.1µF from output to AC common (ground or a supply rail, with adequate bypass capacitors) will prevent local output stage oscillations.

The amplifiers are internally compensated for unity gain stability, no additional compensation is required.

THERMAL CONSIDERATIONS

The PA35 may require a thermal washer which is electrically insulating since the tab is tied to $-V_S$. This can result in thermal impedances for $R_{\theta CS}$ of up to 1°C/W or greater.

V_{BIAS} should be set midway between $+V_S$ and $-V_S$, Vref is usually ground in dual supply systems or used for level translation in single supply systems.

MOUNTING PRECAUTIONS

1. Always use a heatsink. Even unloaded, the PA35 can dissipate up to 3.6 watts. A thermal washer or thermal grease should always be used.
2. Avoid bending the leads. Such action can lead to internal damage.
3. Always fasten the tab to the heatsink before the leads are soldered to fixed terminals.
4. Strain relief must be provided if there is any probability of axial stress to the leads.

The PA35CC 7-Pin DDPAK surface mountable package has a large exposed integrated copper heatslug to which the monolithic amplifier is directly attached. The PA35CC requires surface mount techniques of heastsinking. A solder connection to an area of 1 to 2 square inches of foil is recommended for circuit board layouts. This may be adequate heatsinking but the large number of variable involved suggests temperature measurements to be made on the top of the package. Surface mount techniques include the use of a surface mount fan in combination with a surface mount heatsink on the backside of the FR4/PC board or copper slug. Do not allow the temperature to exceed 85°C.