National Semiconductor

LM2878 Dual 5 Watt Power Audio Amplifier

General Description

The LM2878 is a high voltage stereo power amplifier designed to deliver 5W/channel continuous into 8Ω loads. The amplifier is ideal for use with low regulation power supplies due to the absolute maximum rating of 35V and its superior power supply rejection. The LM2878 is designed to operate with a low number of external components, and still provide flexibility for use in stereo phonographs, tape recorders, and AM-FM stereo receivers. The flexibility of the LM2878 allows it to be used as a power operational amplifier, power comparator or servo amplifier. The LM2878 is internally compensated for all gains greater than 10, and comes in an 11-lead single-in-line package (SIP). The package has been redesigned, resulting in the slightly degraded thermal characteristics shown in the figure Device Dissipation vs Ambient Temperature.

Features

- Wide operating range 6V–32V
- 5W/channel output
- 60 dB ripple rejection, output referred
- 70 dB channel separation, output referred
- Low crossover distortion
- AC short circuit protected
- Internal thermal shutdown

Applications

- Stereo phonographs
- AM-FM radio receivers
- Power op amp, power comparator
- Servo amplifiers

Typical Applications

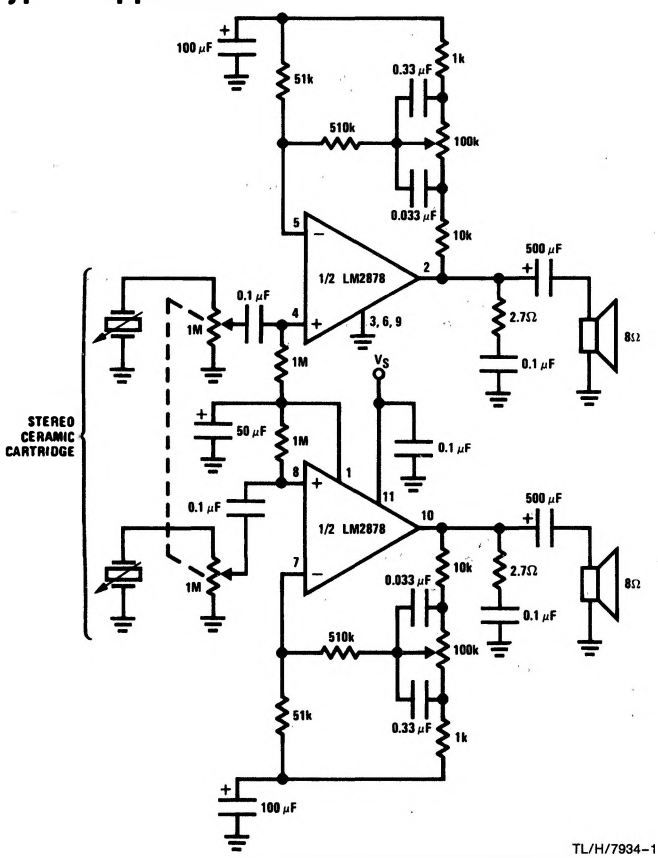

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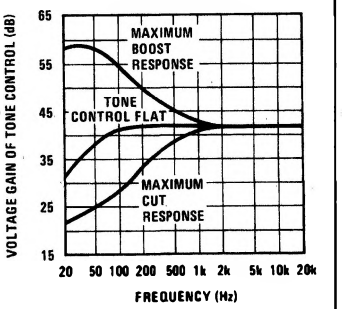
FIGURE 1. Stereo Phonograph Amplifier with Bass Tone Control

Frequency Response of Bass Tone Control



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Absolute Maximum Ratings

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

Supply Voltage	35V
Input Voltage (Note 1)	±0.7V
Operating Temperature (Note 2)	0°C to +70°C
Storage Temperature	−65°C to +150°C
Junction Temperature	+150°C
Lead Temperature (Soldering, 10 sec.)	+260°C
Thermal Resistance	
θ_{JC}	10°C/W
θ_{JA}	55°C/W

Electrical Characteristics

V_S = 22V, T_{TAB} = 25°C, R_L = 8Ω, A_V = 50 (34 dB) unless otherwise specified.

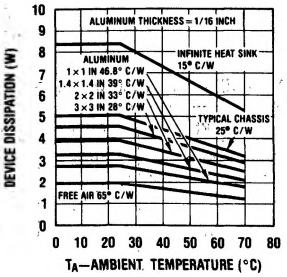
Parameter	Conditions	Min	Typ	Max	Units
Total Supply Current	P_O = 0W		10	50	mA
Operating Supply Voltage		6		32	V
Output Power/Channel	f = 1 kHz, THD = 10%, T_{TAB} = 25°C f = 1 kHz, THD = 10%, V_S = 12V	5	5.5 1.3		W W
Distortion	f = 1 kHz, R_L = 8Ω P_O = 50 mW		0.20		%
	P_O = 0.5W		0.15		%
	P_O = 2W		0.14		%
Output Swing	R_L = 8Ω		V_S − 6V		Vp-p
Channel Separation	C_{BYPASS} = 50 μF, C_{IN} = 0.1 μF f = 1 kHz, Output Referred V_O = 4 Vrms	−50	−70		dB
PSRR Power Supply Rejection Ratio	C_{BYPASS} = 50 μF, C_{IN} = 0.1 μF f = 120 Hz, Output Referred V_{ripple} = 1 Vrms	−50	−60		dB
PSRR Negative Supply	Measured at DC, Input Referred		−60		dB
Common-Mode Range	Split Supplies ±15V, Pin 1 Tied to Pin 11		±13.5		V
Input Offset Voltage			10		mV
Noise	Equivalent Input Noise R_S = 0, C_{IN} = 0.1 μF BW = 20 − 20 kHz		2.5		μV
	CCIR•ARM		3.0		μV
	Output Noise Wideband R_S = 0, C_{IN} = 0.1 μF, A_V = 200		0.8		mV
Open Loop Gain	R_S = 51Ω, f = 1 kHz, R_L = 8Ω		70		dB
Input Bias Current			100		nA
Input Impedance	Open Loop		4		MΩ
DC Output Voltage	V_S = 22V	10	11	12	V
Slew Rate			2		V/μS
Power Bandwidth	3 dB Bandwidth at 2.5W		65		kHz
Current Limit			1.5		A

Note 1: ±0.7V applies to audio applications; for extended range, see Application Hints.

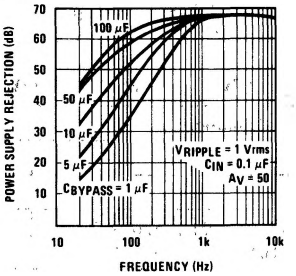
Note 2: For operation at ambient temperature greater than 25°C, the LM2878 must be derated based on a maximum 150°C junction temperature using a thermal resistance which depends upon device mounting techniques.

Typical Performance Characteristics

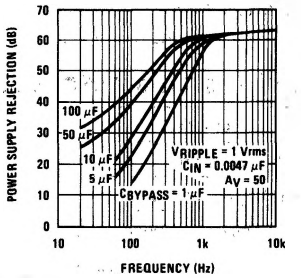
Device Dissipation vs Ambient Temperature



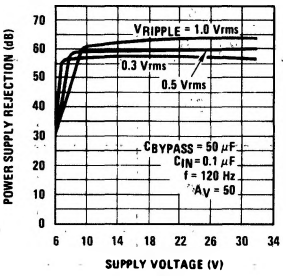
Power Supply Rejection Ratio (Referred to the Output) vs Frequency



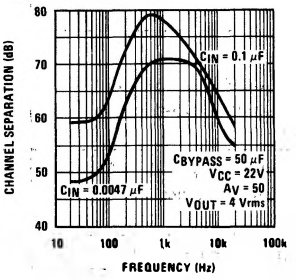
Power Supply Rejection Ratio (Referred to the Output) vs Frequency



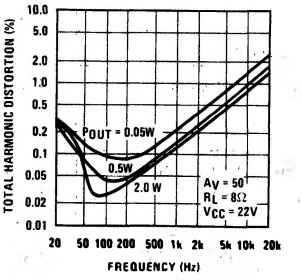
Power Supply Rejection Ratio (Referred to the Output) vs Supply Voltage



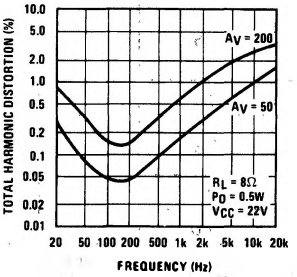
Channel Separation (Referred to the Output) vs Frequency



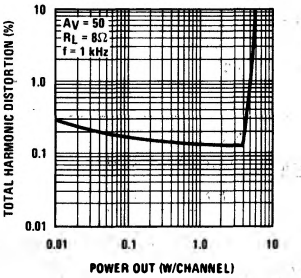
Total Harmonic Distortion vs Frequency



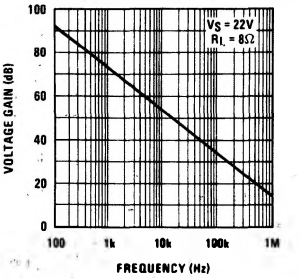
Total Harmonic Distortion vs Frequency



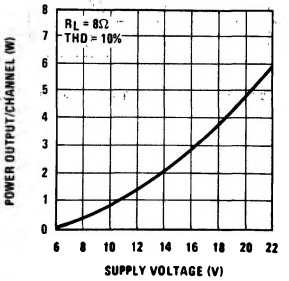
Total Harmonic Distortion vs Power Out



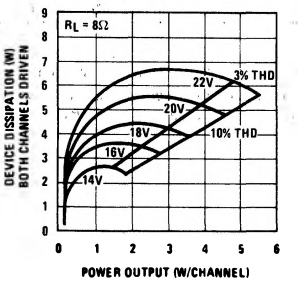
Open Loop Gain vs Frequency



Power Output/Channel vs Supply Voltage



Power Dissipation vs Power Out



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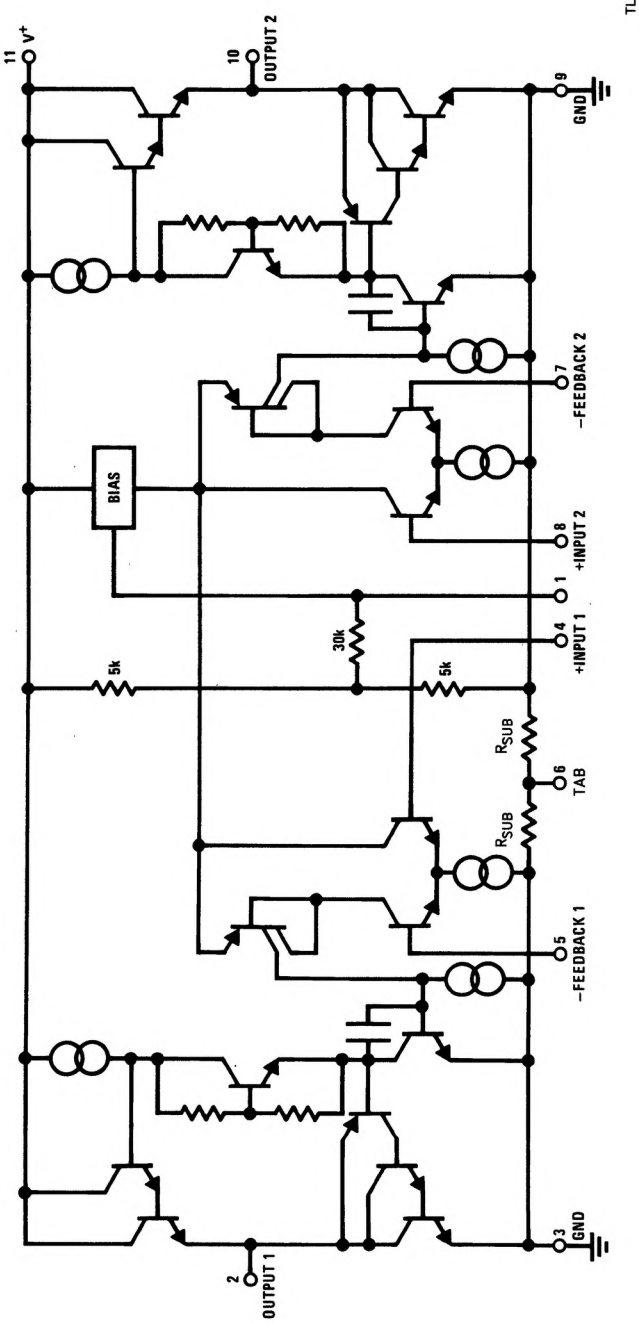
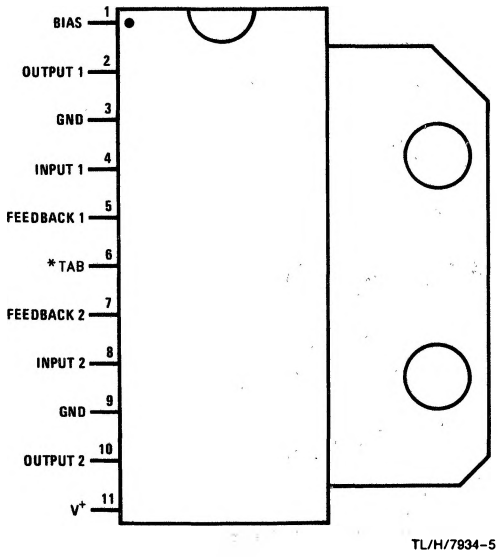
Equivalent Schematic Diagram



Connection Diagram

Single-In-Line Package



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Top View

*Pin 6 must be connected to GND.

Order Number LM2878P
See NS Package Number P11A

Application Hints

The LM2878 is an improved LM378 in typical audio applications. In the LM2878, the internal voltage regulator for the input stage is generated from the voltage on pin 1. Normally, the input common-mode range is within ±0.7V of this pin 1 voltage. Nevertheless the common-mode range can be increased by externally forcing the voltage on pin 1. One way to do this is to short pin 1 to the positive supply, pin 11.

The only special care required with the LM2878 is to limit the maximum input differential voltage to ±7V. If this differential voltage is exceeded, the input characteristics may change.

Figure 2 shows a power op amp application with $A_V = 1$. The 100k and 10k resistors set a noise gain of 10 and are dictated by amplifier stability. The 10k resistor is bootstrapped by the feedback so the input resistance is dominated by the 1 MΩ resistor.

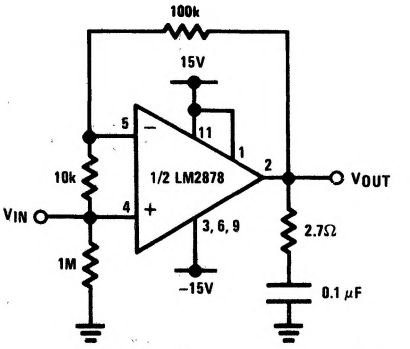

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FIGURE 2. Operational Power Amplifier, $A_V = 1$

External Components *(Figure 3)*

1. R2, R5, R7, R10 Sets voltage gain $A_V = 1 + R2/R5$ for one channel and $A_V = 1 + R10/R7$ for the other channel.
2. R4, R8 Resistors set input impedance and supply bias current for the positive input.
3. R_O Works with C_O to stabilize output stage.
4. C1 Improves power supply rejection (see Typical Performance Characteristics).
5. C11 Stabilizes amplifier, may need to be larger depending on power supply filtering.
6. C4, C8 Input coupling capacitor. Pins 4 and 8 are at a DC potential of $V_S/2$. Low frequency pole set by:

$$f_L = \frac{1}{2\pi R4C4}$$

7. C5, C7 Feedback capacitors. Ensure unity gain at DC. Also low frequency pole at:

$$f_L = \frac{1}{2\pi R5C5}$$

8. C_O Works with R_O to stabilize output stage.
9. C2, C10 Output coupling capacitor. Low frequency pole given by:

$$f_L = \frac{1}{R\pi RLC2}$$

Typical Applications (Continued)

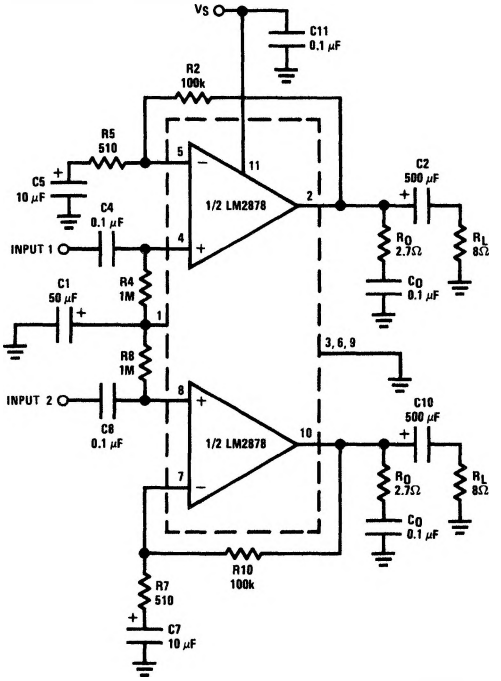

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FIGURE 3. Stereo Amplifier with $A_V = 200$

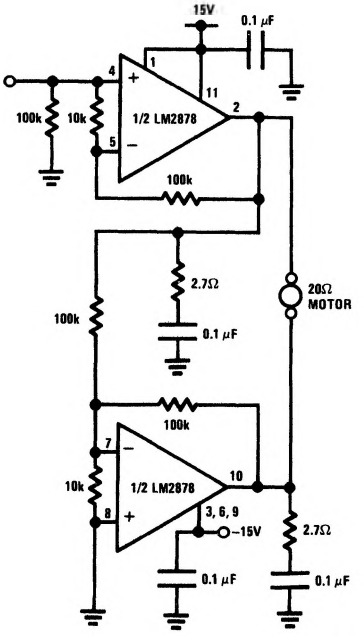

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FIGURE 4. LM2878 Servo Amplifier in Bridge Configuration

Typical Applications (Continued)

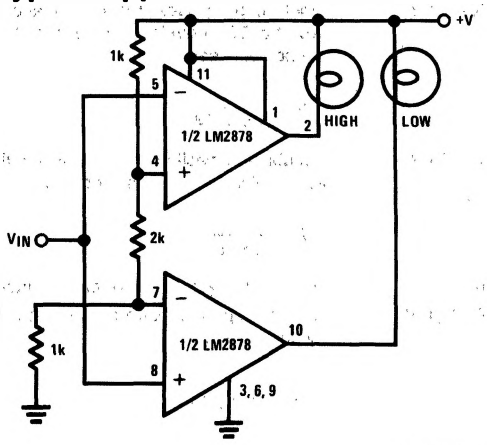

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FIGURE 5. Window Comparator Driving High, Low Lamps

Truth Table

V_{IN}	High	Low
$< \frac{1}{4}V^+$	Off	On
$\frac{1}{4}V^+$ to $\frac{3}{4}V^+$	Off	Off
$> \frac{3}{4}V^+$	On	Off