

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 8 Ω 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.

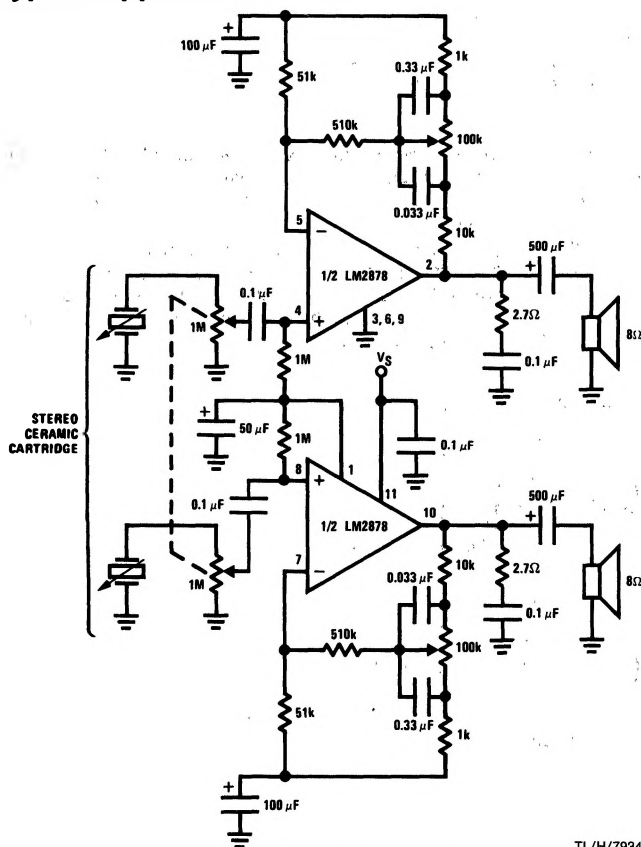
Features

- 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

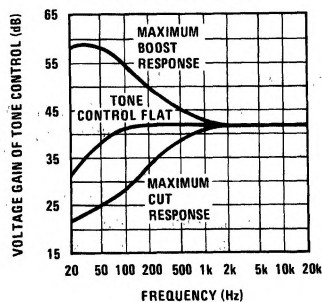
Applications

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

Typical Applications



Frequency Response of Bass Tone Control



TL/H/7934-2

TL/H/7934-1

FIGURE 1. Stereo Phonograph Amplifier with Bass Tone Control

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) | $\pm 0.7V$ |
| Operating Temperature (Note 2) | $0^{\circ}C$ to $+70^{\circ}C$ |

| | |
|---------------------------------------|-----------------------------------|
| Storage Temperature | $-65^{\circ}C$ to $+150^{\circ}C$ |
| Junction Temperature | $+150^{\circ}C$ |
| Lead Temperature (Soldering, 10 sec.) | $+260^{\circ}C$ |
| Thermal Resistance | |
| θ_{JC} | $10^{\circ}C/W$ |
| θ_{JA} | $55^{\circ}C/W$ |

Electrical Characteristics $V_S = 22V$, $T_{TAB} = 25^{\circ}C$, $R_L = 8\Omega$, $A_V = 50$ (34 dB) unless otherwise specified.

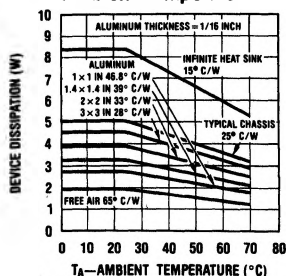
| Parameter | Conditions | Min | Typ | Max | Units |
|-----------------------------------|---|-----|------------|-----|------------|
| Total Supply Current | $P_O = 0W$ | | 10 | 50 | mA |
| Operating Supply Voltage | | 6 | | 32 | V |
| Output Power/Channel | $f = 1\text{ kHz}$, THD = 10%, $T_{TAB} = 25^{\circ}C$ $f = 1\text{ kHz}$, THD = 10%, $V_S = 12V$ | 5 | 5.5 1.3 | | W W |
| Distortion | $f = 1\text{ kHz}$, $R_L = 8\Omega$ $P_O = 50\text{ mW}$ | | 0.20 | | % |
| | $P_O = 0.5W$ | | 0.15 | | % |
| | $P_O = 2W$ | | 0.14 | | % |
| Output Swing | $R_L = 8\Omega$ | | $V_S - 6V$ | | Vp-p |
| Channel Separation | $C_{BYPASS} = 50\mu F$, $C_{IN} = 0.1\mu F$ $f = 1\text{ kHz}$, Output Referred $V_O = 4\text{ Vrms}$ | -50 | -70 | | dB |
| PSRR Power Supply Rejection Ratio | $C_{BYPASS} = 50\mu F$, $C_{IN} = 0.1\mu F$ $f = 120\text{ Hz}$, Output Referred $V_{ripple} = 1\text{ Vrms}$ | -50 | -60 | | dB |
| PSRR Negative Supply | Measured at DC, Input Referred | | -60 | | dB |
| Common-Mode Range | Split Supplies $\pm 15V$, Pin 1 Tied to Pin 11 | | ± 13.5 | | V |
| Input Offset Voltage | | | 10 | | mV |
| Noise | Equivalent Input Noise $R_S = 0$, $C_{IN} = 0.1\mu F$ $BW = 20 - 20\text{ kHz}$ | | 2.5 | | μV |
| | CCIR•ARM | | 3.0 | | μV |
| | Output Noise Wideband $R_S = 0$, $C_{IN} = 0.1\mu F$, $A_V = 200$ | | 0.8 | | mV |
| Open Loop Gain | $R_S = 51\Omega$, $f = 1\text{ kHz}$, $R_L = 8\Omega$ | | 70 | | dB |
| Input Bias Current | | | 100 | | nA |
| Input Impedance | Open Loop | | 4 | | M Ω |
| 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: $\pm 0.7V$ applies to audio applications; for extended range, see Application Hints.

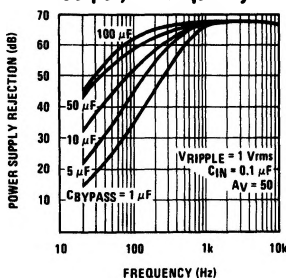
Note 2: For operation at ambient temperature greater than $25^{\circ}C$, the LM2878 must be derated based on a maximum $150^{\circ}C$ junction temperature using a thermal resistance which depends upon device mounting techniques.

Typical Performance Characteristics

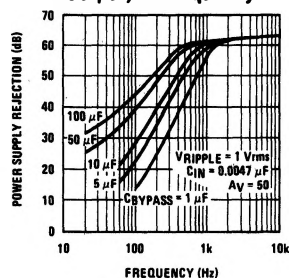
Device Dissipation vs Ambient Temperature



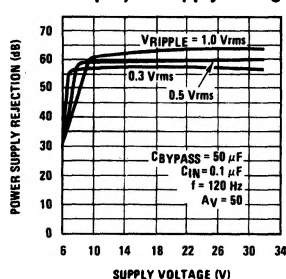
Power Supply Rejection Ratio (Referred to the Output) vs Frequency



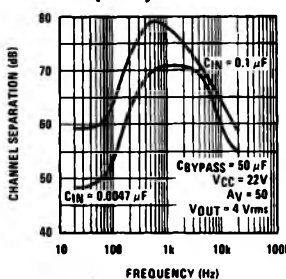
Power Supply Rejection Ratio (Referred to the Output) vs Frequency



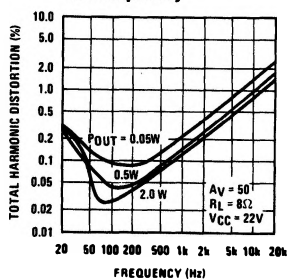
Power Supply Rejection Ratio (Referred to the Output) vs Supply Voltage



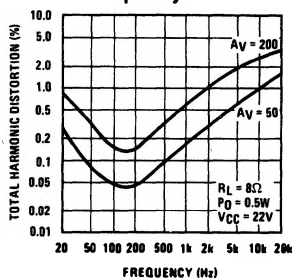
Channel Separation (Referred to the Output) vs Frequency



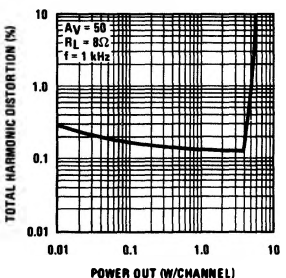
Total Harmonic Distortion vs Frequency



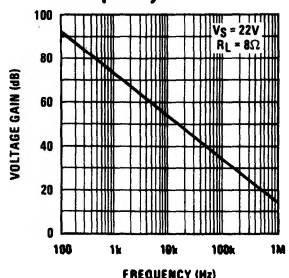
Total Harmonic Distortion vs Frequency



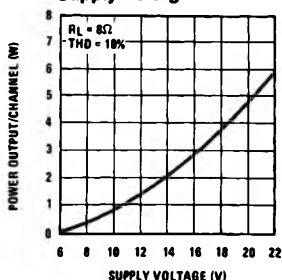
Total Harmonic Distortion vs Power Out



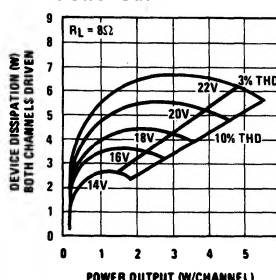
Open Loop Gain vs Frequency



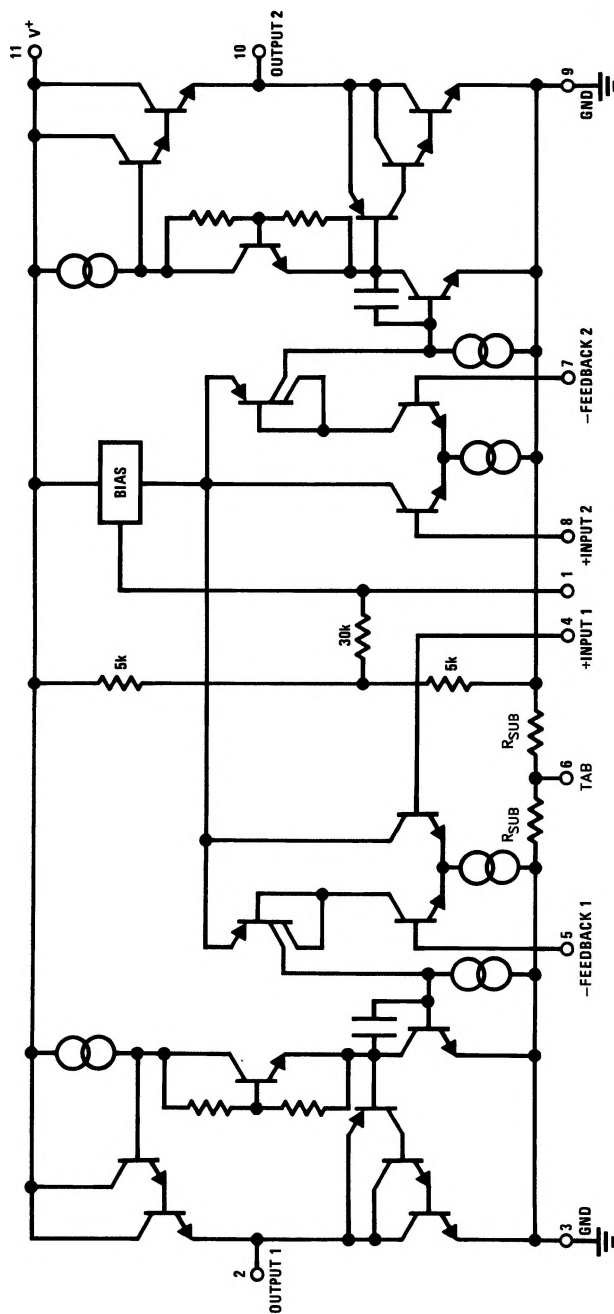
Power Output/Channel vs Supply Voltage



Power Dissipation vs Power Out



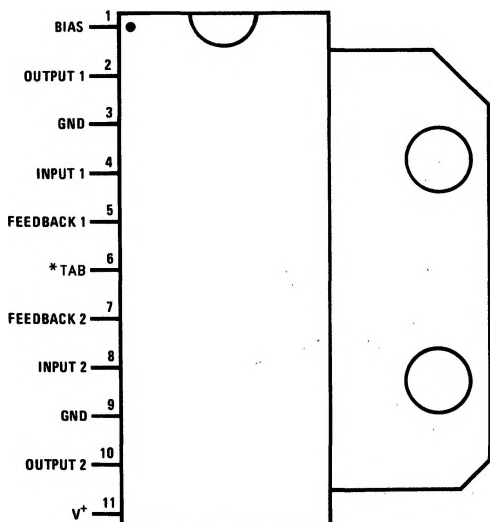
Equivalent Schematic Diagram



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Connection Diagram

Single-In-Line Package



Top View

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*Pin 6 must be connected to GND.

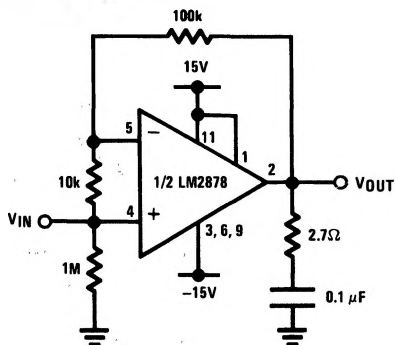
Order Number LM2878P
See NS Package Number P11A

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 $\pm 0.7V$ 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 $\pm 7V$. 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 M Ω 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:

$$f_L = \frac{1}{2\pi R4 C4}$$

7. C5, C7

Feedback capacitors. Ensure unity gain at DC. Also low frequency pole at:

$$f_L = \frac{1}{2\pi R5 C5}$$

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)

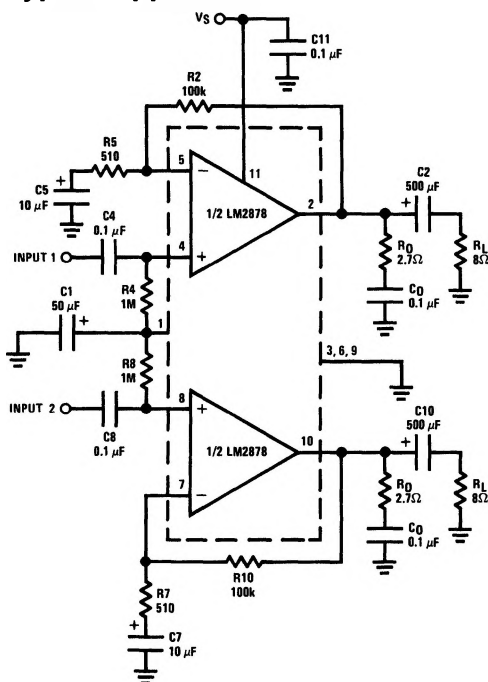


FIGURE 3. Stereo Amplifier with $A_V = 200$

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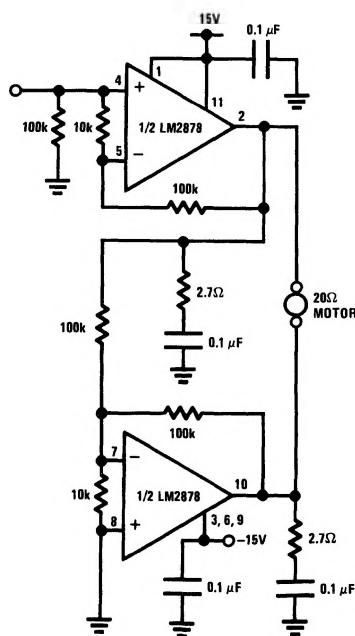
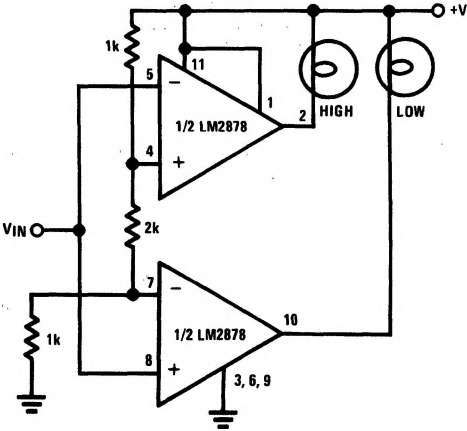


FIGURE 4. LM2878 Servo Amplifier in Bridge Configuration

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Typical Applications (Continued)



Truth Table

| V _{IN} | High | Low |
|--|------|-----|
| < 1/4 V ⁺ | Off | On |
| 1/4 V ⁺ to 3/4 V ⁺ | Off | Off |
| > 3/4 V ⁺ | On | Off |

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FIGURE 5. Window Comparator Driving High, Low Lamps