

# $\mu$ A759 • $\mu$ A77000 Power Operational Amplifiers

Linear Division Operational Amplifiers

### Description

The  $\mu$ A759 and  $\mu$ A77000 are high performance monolithic operational amplifiers constructed using the Fairchild Planar Epitaxial process. The  $\mu$ A759 provides 325 mA and the  $\mu$ A77000 provides 250 mA output current and feature small signal characteristics better than the  $\mu$ A741. The amplifiers are designed to operate from a single or dual power supply with the input common mode range including the negative supply. The high gain and high output power provide superior performance whenever an operational amplifier is needed. The  $\mu$ A759 and  $\mu$ A77000 employ internal current limiting, thermal shutdown, and safe-area compensation making them essentially indestructible. These amplifiers are intended for a wide range of applications including voltage regulators, audio amplifiers, servo amplifiers, and power drivers.

- **Output Current**  
 $\mu$ A759 — 325 mA Minimum  
 $\mu$ A77000 — 250 mA Minimum
- **Internal Short Circuit Current Limiting**
- **Internal Thermal Overload Protection**
- **Internal Output Transistors Safe-Area Protection**
- **Input Common Mode Voltage Range Includes Ground Or Negative Supply**

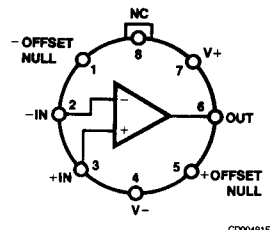
### Absolute Maximum Ratings

|   |                    |
|---|--------------------|
| <b>Storage Temperature Range</b>            |                    |
| Metal Can                                   | -65°C to +175°C    |
| Power Watt                                  | -65°C to +150°C    |
| <b>Operating Junction Temperature Range</b> |                    |
| Extended ( $\mu$ A759M)                     | -55 to +150°C      |
| Commercial ( $\mu$ A759C, $\mu$ A77000C)    | 0°C to +125°C      |
| <b>Lead Temperature</b>                     |                    |
| Metal Can (soldering, 60 s)                 | 300°C              |
| Power Watt (soldering, 10 s)                | 265°C              |
| Internal Power Dissipation <sup>1</sup>     | Internally Limited |
| Supply Voltage                              | ± 18 V             |
| Differential Input Voltage                  | 30 V               |
| Input Voltage <sup>2</sup>                  | ± 15 V             |

### Notes

1. Although the internal power dissipation is limited, the junction temperature must be kept below the maximum specified temperature in order to meet data sheet specifications. To calculate the maximum junction temperature or heat sink required, use the thermal resistance values which follow the Electrical Characteristics Table.
2. For a supply voltage less than 30 V between V+ and V-, the absolute maximum input voltage is equal to the supply voltage.

### Connection Diagram 8-Lead Metal Package (Top View)



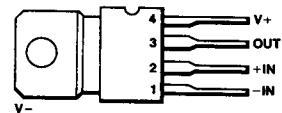
CD00491F

Lead 4 connected to case.

### Order Information

| Device Code  | Package Code | Package Description |
|--------------|--------------|---------------------|
| $\mu$ A759HM | 5W           | Metal               |
| $\mu$ A759HC | 5W           | Metal               |

### Connection Diagram TO-202 Package (Top View)

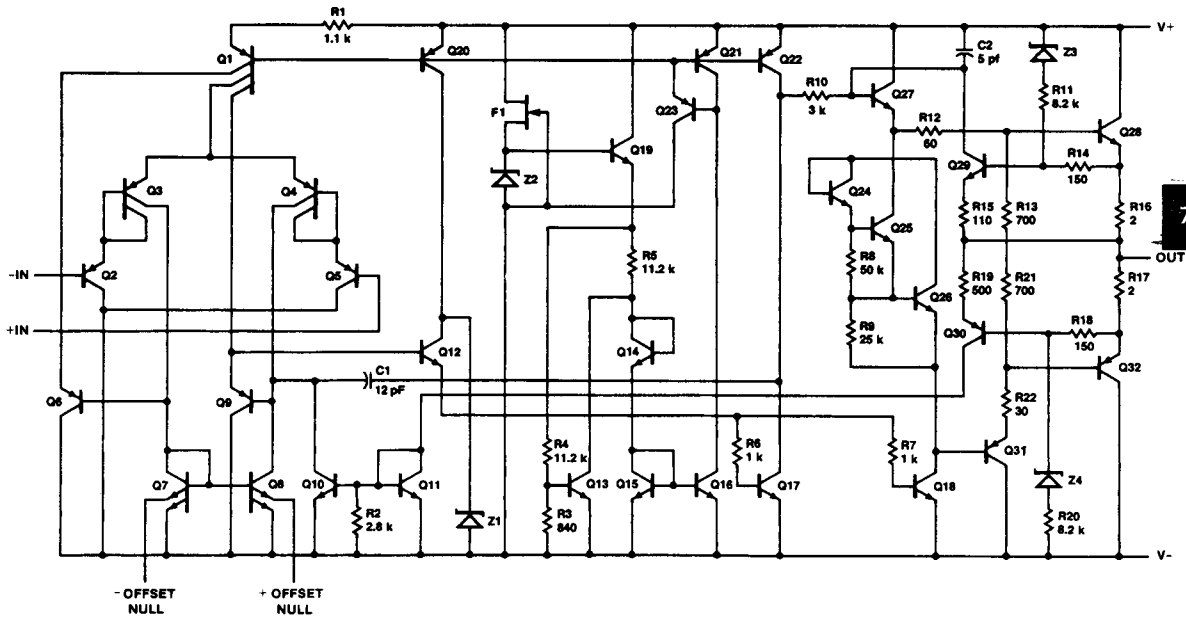


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### Order Information

| Device Code     | Package Code | Package Description |
|-----------------|--------------|---------------------|
| $\mu$ A759U1C   | 8Z           | Power Watt          |
| $\mu$ A77000U1C | 8Z           | Power Watt          |

Equivalent Circuit



**Note**  
All resistor values in ohms.

E000021F

**μA759**

**Electrical Characteristics**  $T_J = 25^\circ\text{C}$ ,  $V_{CC} = \pm 15\text{ V}$ , unless otherwise specified.

| Symbol              | Characteristic               | Condition   | Min                              | Typ          | Max | Unit             |
|---------------------|------------------------------|---|----------------------------------|--------------|-----|------------------|
| $V_{IO}$            | Input Offset Voltage         | $R_S \leq 10\text{ k}\Omega$                        |                                  | 1.0          | 3.0 | mV               |
| $I_{IO}$            | Input Offset Current         |   |                                  | 5.0          | 30  | nA               |
| $I_{IB}$            | Input Bias Current           |   |                                  | 50           | 150 | nA               |
| $Z_I$               | Input Impedance              |   | 0.25                             | 1.5          |     | M $\Omega$       |
| $I_{CC}$            | Supply Current               |   |                                  | 12           | 18  | mA               |
| $V_{IR}$            | Input Voltage Range          |   | +13<br>to V-                     | +13<br>to V- |     | V                |
| $I_{OS}$            | Output Short Circuit Current | $ V_{CC} - V_O  = 30\text{ V}$                      |                                  | $\pm 200$    |     | mA               |
| $I_{O\text{ PEAK}}$ | Peak Output Current          | $3.0\text{ V} \leq  V_{CC} - V_O  \leq 10\text{ V}$ | $\pm 325$                        | $\pm 500$    |     | mA               |
| $A_{VS}$            | Large Signal Voltage Gain    | $R_L \geq 50\ \Omega$ , $V_O = \pm 10\text{ V}$     | 50                               | 200          |     | V/mV             |
| TR                  | Transient Response           | Rise time   | $R_L = 50\ \Omega$ , $A_V = 1.0$ | 300          |     | ns               |
|                     |                              | Overshoot   |                                  | 5.0          |     | %                |
| SR                  | Slew Rate                    | $R_L = 50\ \Omega$ , $A_V = 1.0$                    |                                  | 0.6          |     | V/ $\mu\text{s}$ |
| BW                  | Bandwidth                    | $A_V = 1.0$   |                                  | 1.0          |     | MHz              |

The following specifications apply for  $-55^\circ\text{C} \leq T_J \leq +150^\circ\text{C}$

|          |                              |   |          |            |     |      |
|----------|------------------------------|---|----------|------------|-----|------|
| $V_{IO}$ | Input Offset Voltage         | $R_S \leq 10\text{ k}\Omega$                    |          |            | 4.5 | mV   |
| $I_{IO}$ | Input Offset Current         |   |          |            | 60  | nA   |
| $I_{IB}$ | Input Bias Current           |   |          |            | 300 | nA   |
| CMR      | Common Mode Rejection        | $R_S \leq 10\text{ k}\Omega$                    | 80       | 100        |     | dB   |
| PSRR     | Power Supply Rejection Ratio | $R_S \leq 10\text{ k}\Omega$                    | 80       | 100        |     | dB   |
| $A_{VS}$ | Large Signal Voltage Gain    | $R_L \geq 50\ \Omega$ , $V_O = \pm 10\text{ V}$ | 25       | 200        |     | V/mV |
| $V_{OP}$ | Output Voltage Swing         | $R_L = 50\ \Omega$                              | $\pm 10$ | $\pm 12.5$ |     | V    |

**μA759C**

**Electrical Characteristics**  $T_J = 25^\circ\text{C}$ ,  $V_{CC} = \pm 15\text{ V}$ , unless otherwise specified.

| Symbol              | Characteristic               | Condition   | Min                              | Typ             | Max | Unit |
|---------------------|------------------------------|---|----------------------------------|-----------------|-----|------|
| $V_{IO}$            | Input Offset Voltage         | $R_S \leq 10\text{ k}\Omega$                        |                                  | 1.0             | 6.0 | mV   |
| $I_{IO}$            | Input Offset Current         |   |                                  | 5.0             | 50  | nA   |
| $I_{IB}$            | Input Bias Current           |   |                                  | 50              | 250 | nA   |
| $Z_I$               | Input Impedance              |   | 0.25                             | 1.5             |     | MΩ   |
| $I_{CC}$            | Supply Current               |   |                                  | 12              | 18  | mA   |
| $V_{IR}$            | Input Voltage Range          |   | +13<br>to $V^-$                  | +13<br>to $V^-$ |     | V    |
| $I_{OS}$            | Output Short Circuit Current | $ V_{CC} - V_O  = 30\text{ V}$                      |                                  | ±200            |     | mA   |
| $I_{O\text{ PEAK}}$ | Peak Output Current          | $3.0\text{ V} \leq  V_{CC} - V_O  \leq 10\text{ V}$ | ±325                             | ±500            |     | mA   |
| $A_{VS}$            | Large Signal Voltage Gain    | $R_L \geq 50\ \Omega$ , $V_O = \pm 10\text{ V}$     | 25                               | 200             |     | V/mV |
| TR                  | Transient Response           | Rise time   | $R_L = 50\ \Omega$ , $A_V = 1.0$ | 300             |     | ns   |
|                     |                              | Overshoot   |                                  | 10              |     | %    |
| SR                  | Slew Rate                    | $R_L = 50\ \Omega$ , $A_V = 1.0$                    |                                  | 0.5             |     | V/μs |
| BW                  | Bandwidth                    | $A_V = 1.0$   |                                  | 1.0             |     | MHz  |

The following specifications apply for  $0^\circ \leq T_J \leq +125^\circ\text{C}$

|          |                              |   |     |       |     |      |
|----------|------------------------------|---|-----|-------|-----|------|
| $V_{IO}$ | Input Offset Voltage         | $R_S \leq 10\text{ k}\Omega$                    |     |       | 7.5 | mV   |
| $I_{IO}$ | Input Offset Current         |   |     |       | 100 | nA   |
| $I_{IB}$ | Input Bias Current           |   |     |       | 400 | nA   |
| CMR      | Common Mode Rejection        | $R_S \leq 10\text{ k}\Omega$                    | 70  | 100   |     | dB   |
| PSRR     | Power Supply Rejection Ratio | $R_S \leq 10\text{ k}\Omega$                    | 80  | 100   |     | dB   |
| $A_{VS}$ | Large Signal Voltage Gain    | $R_L \geq 50\ \Omega$ , $V_O = \pm 10\text{ V}$ | 25  | 200   |     | V/mV |
| $V_{OP}$ | Output Voltage Swing         | $R_L = 50\ \Omega$                              | ±10 | ±12.5 |     | V    |

**μA77000**

**Electrical Characteristics**  $T_J = 25^\circ\text{C}$ ,  $V_{CC} = \pm 15\text{ V}$ , unless otherwise specified.

| Symbol              | Characteristic               | Condition   | Min                              | Typ          | Max | Unit             |
|---------------------|------------------------------|---|----------------------------------|--------------|-----|------------------|
| $V_{IO}$            | Input Offset Voltage         | $R_S \leq 10\text{ k}\Omega$                        |                                  | 1.0          | 8.0 | mV               |
| $I_{IO}$            | Input Offset Current         |   |                                  | 5.0          | 50  | nA               |
| $I_{IB}$            | Input Bias Current           |   |                                  | 50           | 250 | nA               |
| $Z_I$               | Input Impedance              |   | 0.25                             | 1.5          |     | M $\Omega$       |
| $I_{CC}$            | Supply Current               |   |                                  | 12           | 18  | mA               |
| $V_{IR}$            | Input Voltage Range          |   | +13<br>to V-                     | +13<br>to V- |     | V                |
| $I_{OS}$            | Output Short Circuit Current | $ V_{CC} - V_O  = 30\text{ V}$                      |                                  | $\pm 200$    |     | mA               |
| $I_{O\text{ PEAK}}$ | Peak Output Current          | $3.0\text{ V} \leq  V_{CC} - V_O  \leq 10\text{ V}$ | $\pm 250$                        | $\pm 400$    |     | mA               |
| $A_{VS}$            | Large Signal Voltage Gain    | $R_L \geq 50\ \Omega$ , $V_O = \pm 10\text{ V}$     | 25                               | 200          |     | V/mV             |
| TR                  | Transient Response           | Rise time   | $R_L = 50\ \Omega$ , $A_V = 1.0$ | 300          |     | ns               |
|                     |                              | Overshoot   |                                  | 10           |     | %                |
| SR                  | Slew Rate                    | $R_L = 50\ \Omega$ , $A_V = 1.0$                    |                                  | 0.5          |     | V/ $\mu\text{s}$ |
| BW                  | Bandwidth                    | $A_V = 1.0$   |                                  | 1.0          |     | MHz              |

The following specifications apply for  $0^\circ \leq T_J \leq +125^\circ\text{C}$

|          |                              |   |          |            |     |      |
|----------|------------------------------|---|----------|------------|-----|------|
| $V_{IO}$ | Input Offset Voltage         | $R_S \leq 10\text{ k}\Omega$                    |          |            | 10  | mV   |
| $I_{IO}$ | Input Offset Current         |   |          |            | 100 | nA   |
| $I_{IB}$ | Input Bias Current           |   |          |            | 400 | nA   |
| CMR      | Common Mode Rejection        | $R_S \leq 10\text{ k}\Omega$                    | 70       | 100        |     | dB   |
| PSRR     | Power Supply Rejection Ratio | $R_S \leq 10\text{ k}\Omega$                    | 80       | 100        |     | dB   |
| $A_{VS}$ | Large Signal Voltage Gain    | $R_L \geq 50\ \Omega$ , $V_O = \pm 10\text{ V}$ | 25       | 200        |     | V/mV |
| $V_{OP}$ | Output Voltage Swing         | $R_L = 50\ \Omega$                              | $\pm 10$ | $\pm 12.5$ |     | V    |

| Package         | Typ                   | Max                   | Typ                   | Max                   |
|-----------------|-----------------------|-----------------------|-----------------------|-----------------------|
|                 | $\theta_{JC}$<br>°C/W | $\theta_{JC}$<br>°C/W | $\theta_{JA}$<br>°C/W | $\theta_{JA}$<br>°C/W |
| Power Watt (U1) | 8.0                   | 12                    | 75                    | 80                    |
| Metal Can (H)   | 30                    | 40                    | 120                   | 150                   |

$$P_{D\text{ Max}} = \frac{T_{J\text{ Max}} - T_A}{\theta_{JC} + \theta_{CA}} \text{ or}$$

$$= \frac{T_{J\text{ Max}} - T_A}{\theta_{JA}} \text{ (Without a heat sink)}$$

$$\theta_{CA} = \theta_{CS} + \theta_{SA}$$

Solving  $T_J$ :

$$T_J = T_A + P_D(\theta_{JC} + \theta_{CA}) \text{ or}$$

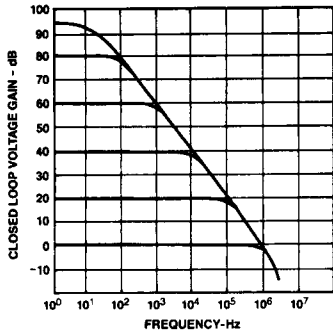
$$= T_A + P_D\theta_{JA} \text{ (Without a heat sink)}$$

Where:

- $T_J$  = Junction Temperature
- $T_A$  = Ambient Temperature
- $P_D$  = Power Dissipation
- $\theta_{JA}$  = Junction to ambient thermal resistance
- $\theta_{JC}$  = Junction to case thermal resistance
- $\theta_{CA}$  = Case to ambient thermal resistance
- $\theta_{CS}$  = Case to heat sink thermal resistance
- $\theta_{SA}$  = Heat sink to ambient thermal resistance

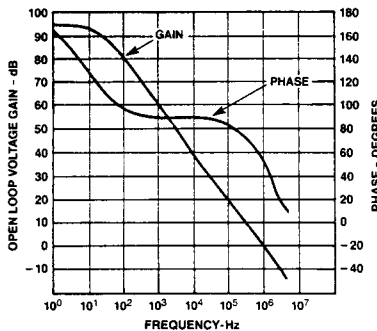
### Typical Performance Curves

Frequency Response For Various Closed Loop Gains



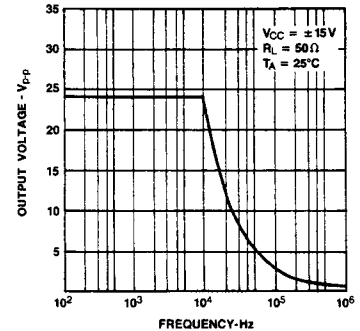
PC02471F

Open Loop vs Frequency Response



PC02480F

Output Voltage vs Frequency



PC02481F

### Mounting Hints

#### Metal Can Package (μA759HC/μA759HM)

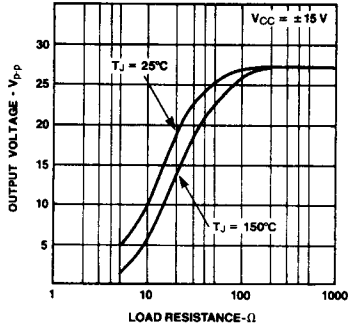
The μA759 in the 8-Lead TO-99 metal can package must be used with a heat sink. With ±15 V power supplies, the μA759 can dissipate up to 540 mW in its quiescent (no load) state. This would result in a 100°C rise in chip temperature to 125°C (assuming a 25°C ambient temperature). In order to avoid this problem, it is advisable to use either a slip on or stud mount heat sink with this package. If a stud mount heat sink is used, it may be necessary to use insulating washers between the stud and the chassis because the case of the μA759 is internally connected to the negative power supply terminal.

#### Power Watt Package (μA759U1C/μA77000U1C)

The μA759U1C and μA77000U1C are designed to be attached by the tab to a heat sink. This heat sink can be either one of the many heat sinks which are commercially available, a piece of metal such as the equipment chassis, or a suitable amount of copper foil as on a double sided PC board. The important thing to remember is that the negative power supply connection to the op amp must be made through the tab. Furthermore, adequate heat sinking must be provided to keep the chip temperature below 125°C under worst case load and ambient temperature conditions.

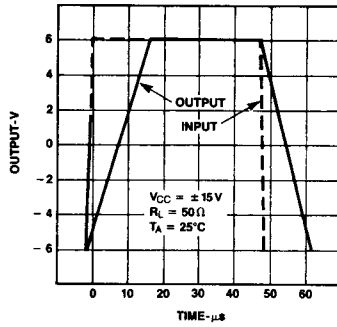
Typical Performance Curves (Cont.)

Output Voltage vs Load Resistance



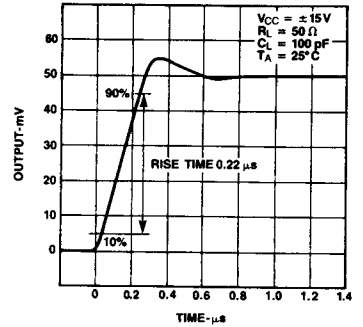
PC02501F

Voltage Follower Large Signal Pulse Response



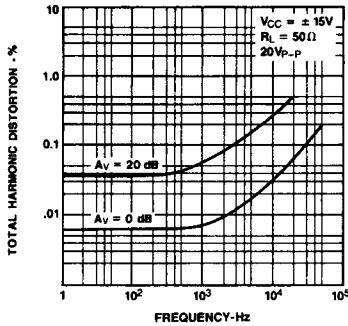
PC02510F

Voltage Follower Transient Response



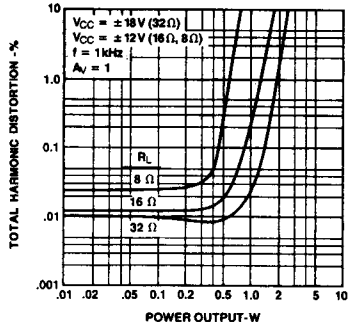
PC02520F

Total Harmonic Distortion vs Frequency



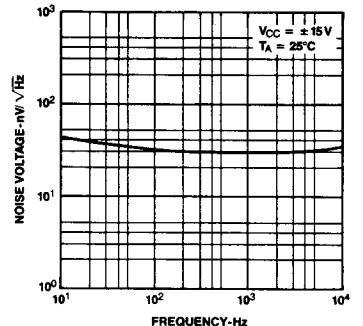
PC02531F

Total Harmonic Distortion vs Power Output



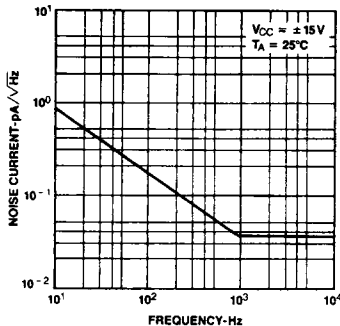
PC02541F

Input Noise Voltage vs Frequency



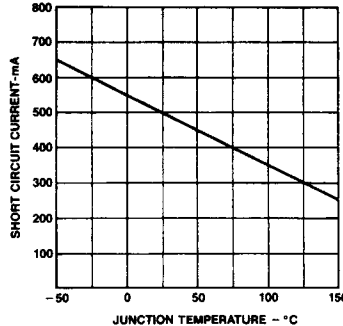
PC02550F

Noise Current vs Frequency



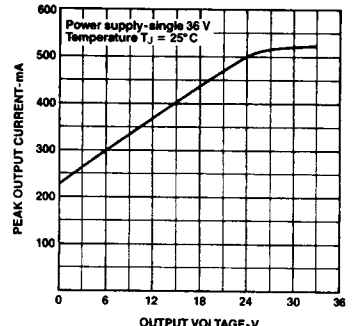
PC02561F

Short Circuit Current vs Junction Temperature



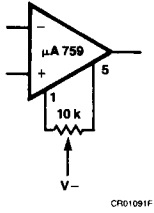
PC02571F

Peak Output Current vs Output Voltage

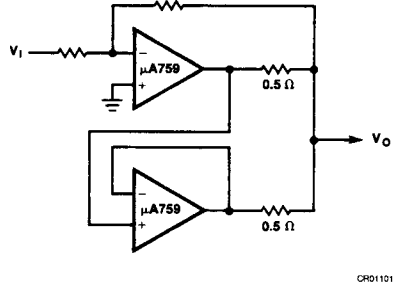


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Offset Null Circuit

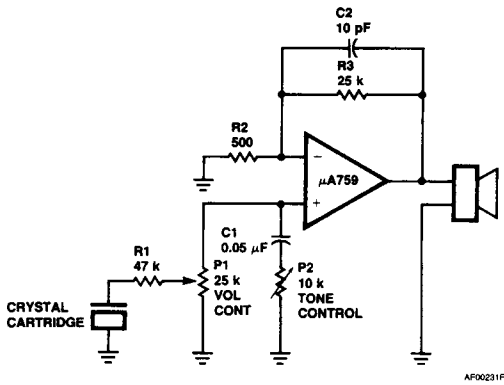


Paralleling  $\mu$ A759 Power Op Amps



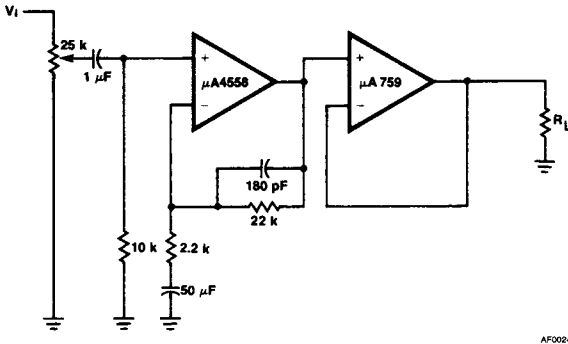
Audio Applications

Low Cost Phono Amplifier



| Speaker Impedance (ohms) | Output Power (watts) | Min Supply (volts) | V <sub>Op-p</sub> (volts) |
|--------------------------|----------------------|--------------------|---------------------------|
| 4                        | .18                  | 9                  | 2.4                       |
| 8                        | .36                  | 12                 | 4.8                       |
| 16                       | .72                  | 15                 | 9.6                       |
| 32                       | 1.44                 | 25                 | 19.2                      |

Headphone Amplifier

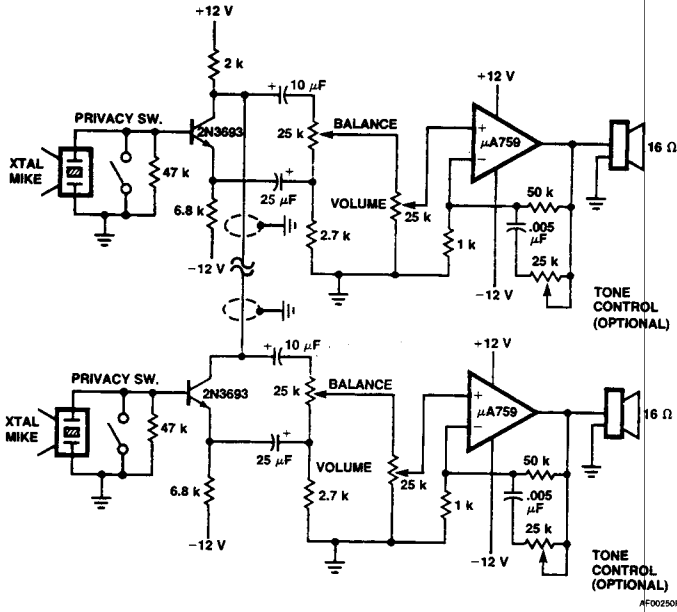


Note

1. All resistor values in ohms.



**Bi-Directional Intercom System Using  
the  $\mu$ A759 Power Op Amp**



**Features**

Circuit Simplicity

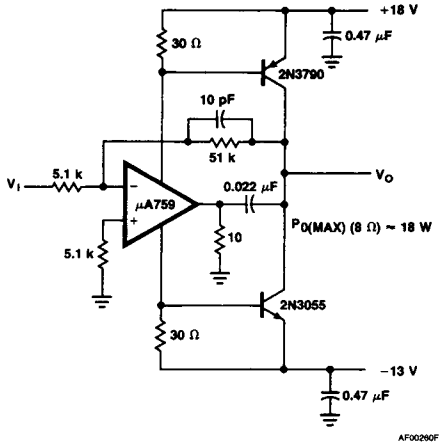
1 Watt of Audio Output

Duplex operation with only one two-wire cable as interconnect.

**Note**

1. All resistor values in ohms.

**High Slew Rate Power OP Amp/Audio Amp**



**Features**

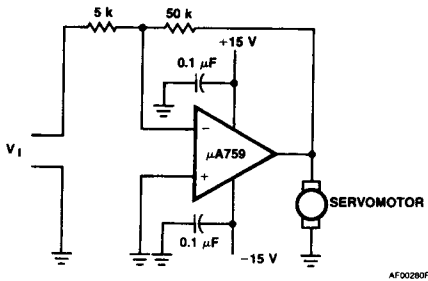
- High Slew Rate 9 V/μs
- High 3 dB Power Bandwidth 85 kHz
- 18 Watts Output Power Into an 8 Ω Load.
- Low Distortion — .2%, 10 VRMS, 1 kHz Into 8 Ω

**Design Consideration**

$A_V \geq 10$

**Servo Applications**

**DC Servo Amplifiers**



**Features**

- Circuit Simplicity
- One Chip Means Excellent Reliability

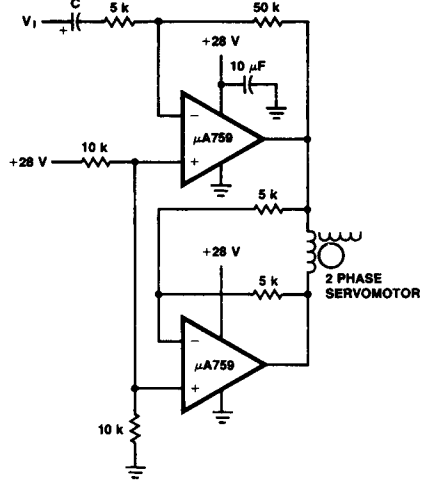
**Design Considerations**

$I_O \leq 325 \text{ mA}$

**Note**

1. All resistor values in ohms.

**AG Servo Amplifier – Bridge Type**



**Features**

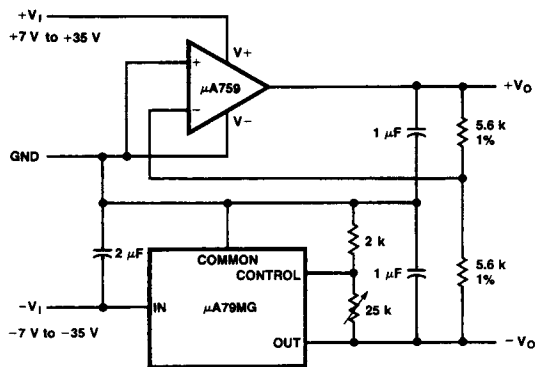
- Gain of 10
- Use of μA759 Means Simple Inexpensive Circuit

**Design Considerations**

325 mA Max Output Current

## Regulator Applications

### Adjustable Dual Tracking Regulator



AF00291F

#### Features

Wide Output Voltage Range ( $\pm 2.2$  to  $\pm 30\text{ V}$ )

Excellent Load Regulation  $\Delta V_O < \pm 5\text{ mV}$  for

$\Delta I_O = \pm 0.2\text{ A}$

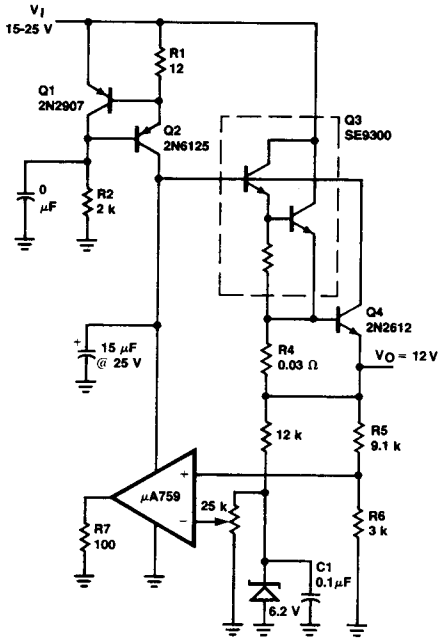
Excellent Line Regulation  $\Delta V_O < \pm 2\text{ mV}$  for  $\Delta V_1 = 10\text{ V}$

#### Note

1. All resistor values in ohms.

Regulator Applications (Cont.)

10 Amp - 12 Volt Regulator



7

Features

- Excellent Load and Line Regulation
- Excellent Temperature Coefficient-Depends Largely on Tempco of the Reference Zener

Note

1. All resistor values in ohms.