

# uA748C, uA748M GENERAL-PURPOSE OPERATIONAL AMPLIFIERS

SLOS095 – D921, DECEMBER 1970 – REVISED OCTOBER 1990

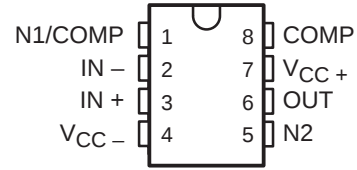
- Frequency and Transient Response Characteristics Adjustable
- Short-Circuit Protection
- Offset-Voltage Null Capability
- Wide Common-Mode and Differential Voltage Ranges
- Low Power Consumption
- No Latch-Up
- Same Pin Assignments as uA709

## description

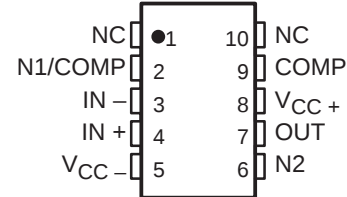
The uA748 is a general-purpose operational amplifier that offers the same advantages and attractive features as the uA741 except for internal compensation. External compensation can be as simple as a 30-pF capacitor for unity-gain conditions and, when the closed-loop gain is greater than one, can be changed to obtain wider bandwidth or higher slew rate. This circuit features high gain, large differential and common-mode input voltage range, and output short-circuit protection. Input offset-voltage adjustment can be provided by connecting a variable resistor between the offset null pins as shown in Figure 12.

The uA748C is characterized for operation from 0°C to 70°C; the uA748M is characterized for operation over the full military temperature range of –55°C to 125°C.

uA748C . . . D OR P PACKAGE  
uA748M . . . JG PACKAGE  
(TOP VIEW)

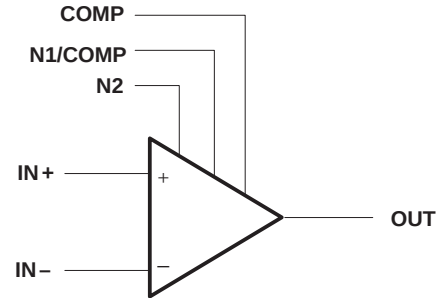


uA748M . . . U FLAT PACKAGE  
(TOP VIEW)



NC – No internal connection

## symbol



## AVAILABLE OPTIONS

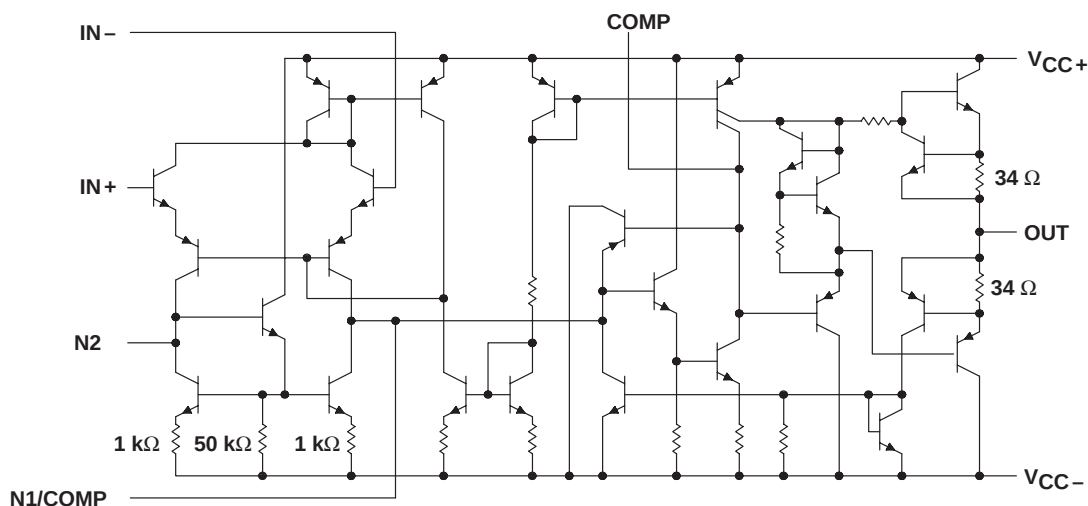
| T <sub>A</sub>       | V <sub>IO</sub> max<br>AT 25°C | PACKAGE              |                     |                    |                  |
|----------------------|--------------------------------|----------------------|---------------------|--------------------|------------------|
|                      |                                | 8-PIN                |                     |                    | 10-PIN           |
|                      |                                | SMALL OUTLINE<br>(D) | CERAMIC DIP<br>(JG) | PLASTIC DIP<br>(P) | FLAT PACK<br>(U) |
| 0°C<br>to<br>70°C    | 6 mV                           | uA748CD              | —                   | uA748CP            | —                |
| –55°C<br>to<br>125°C | 5 mV                           | —                    | uA748MJG            | —                  | uA747MU          |

The D package is available taped and reeled. Add the suffix R to the device type, (e.g., uA748CDR).

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## schematic



Resistor values shown are nominal.

## absolute maximum ratings over operating free-air temperature range (unless otherwise noted)

|                                                                         | uA748C                       | uA748M     | UNIT |
|-------------------------------------------------------------------------|------------------------------|------------|------|
| Supply voltage, $V_{CC+}$ (see Note 1)                                  | 18                           | 22         | V    |
| Supply voltage, $V_{CC-}$ (see Note 1)                                  | -18                          | -22        | V    |
| Differential input voltage (see Note 2)                                 | $\pm 30$                     | $\pm 30$   | V    |
| Input voltage (either input, see Notes 1 and 3)                         | $\pm 15$                     | $\pm 15$   | V    |
| Voltage range between either offset null terminal (N1/N2) and $V_{CC-}$ | -0.5 to 2                    | -0.5       | V    |
| Duration of output short circuit (see Note 4)                           | unlimited                    | unlimited  |      |
| Continuous total power dissipation                                      | See Dissipation Rating Table |            |      |
| Operating free-air temperature range                                    | 0 to 70                      | -55 to 125 | °C   |
| Storage temperature range                                               | -65 to 150                   | -65 to 150 | °C   |
| Lead temperature 1,6 mm (1/16 inch) from case for 60 seconds            | JG or U package              | 300        | °C   |
| Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds            | D or P package               | 260        | °C   |

NOTES: 1. All voltage values, unless otherwise noted, are with respect to the midpoint between  $V_{CC+}$  and  $V_{CC-}$ .  
 2. Differential voltages are at the noninverting input terminal with respect to the inverting input terminal.  
 3. The magnitude of the input voltage must never exceed the magnitude of the supply voltage or 15V, whichever is less.  
 4. The output may be shorted to ground or either power supply. For the uA748M only, the unlimited duration of the short circuit applies at (or below) 125°C case temperature or 75°C free-air temperature

DISSIPATION RATING TABLE

| PACKAGE | $T_A \leq 25^\circ\text{C}$<br>POWER RATING | DERATING<br>FACTOR | DERATE<br>ABOVE $T_A$ | $T_A = 70^\circ\text{C}$<br>POWER RATING | $T_A = 125^\circ\text{C}$<br>POWER RATING |
|---------|---------------------------------------------|--------------------|-----------------------|------------------------------------------|-------------------------------------------|
| D       | 500 mW                                      | 5.8 mW/°C          | 64°C                  | 464 mW                                   | N/A                                       |
| JG      | 500 mW                                      | 8.4 mW/°C          | 90°C                  | 500 mW                                   | 210 mW                                    |
| P       | 500 mW                                      | N/A                | N/A                   | 500 mW                                   | N/A                                       |
| U       | 500 mW                                      | 5.4 mW/°C          | 57°C                  | 432 mW                                   | 135 mW                                    |

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**electrical characteristics at specified free-air temperature,  $V_{CC} \pm = \pm 15$  V,  $C_C = 30$  pF**

| PARAMETER                                                                | TEST CONDITIONS†                                    | uA748C            |     |          | uA748M            |     |          | UNIT       |
|--------------------------------------------------------------------------|-----------------------------------------------------|-------------------|-----|----------|-------------------|-----|----------|------------|
|                                                                          |                                                     | MIN               | TYP | MAX      | MIN               | TYP | MAX      |            |
| $V_{IO}$ Input offset voltage                                            | $V_O = 0$ 25°C                                      | 1                 |     | 6        | 1                 |     | 5        | mV         |
|                                                                          |                                                     | Full range        |     | 7.5      | Full range        |     | 6        |            |
| $I_{IO}$ Input offset current                                            | $V_O = 0$ 25°C                                      | 20                |     | 200      | 20                |     | 200      | nA         |
|                                                                          |                                                     | Full range        |     | 300      | Full range        |     | 500      |            |
| $I_{IB}$ Input bias current                                              | $V_O = 0$ 25°C                                      | 80                |     | 500      | 80                |     | 500      | nA         |
|                                                                          |                                                     | Full range        |     | 800      | Full range        |     | 1500     |            |
| $V_{ICR}$ Common-mode input voltage range                                | 25°C                                                | $\pm 12$ $\pm 13$ |     |          | $\pm 12$ $\pm 13$ |     |          | V          |
|                                                                          |                                                     | Full range        |     | $\pm 12$ | Full range        |     | $\pm 12$ |            |
| $V_{O(PP)}$ Maximum peak output voltage swing                            | $R_L = 10$ k $\Omega$ 25°C                          | $\pm 12$ $\pm 14$ |     |          | $\pm 12$ $\pm 14$ |     |          | V          |
|                                                                          | $R_L \geq 10$ k $\Omega$ Full range                 | $\pm 12$          |     |          | $\pm 12$          |     |          |            |
|                                                                          | $R_L = 2$ k $\Omega$ 25°C                           | $\pm 10$ $\pm 13$ |     |          | $\pm 10$ $\pm 13$ |     |          |            |
|                                                                          | $R_L \geq 2$ k $\Omega$ Full range                  | $\pm 10$          |     |          | $\pm 10$          |     |          |            |
| $A_{VD}$ Large-signal differential voltage amplification                 | $R_L \geq 2$ k $\Omega$ , $V_O = \pm 10$ V          | 20                |     | 200      | 50                |     | 200      | V/mV       |
|                                                                          |                                                     | Full range        |     | 15       | Full range        |     | 25       |            |
| $r_i$ Input resistance                                                   | 25°C                                                | 0.3               | 2   |          | 0.3               | 2   |          | M $\Omega$ |
| $r_o$ Output resistance                                                  | $V_O = 0$ ,<br>See Note 5 25°C                      | 75                |     |          | 75                |     |          | $\Omega$   |
| $C_i$ Input capacitance                                                  | 25°C                                                | 1.4               |     |          | 1.4               |     |          | pF         |
| CMRR Common-mode rejection ratio                                         | $V_{IC} = V_{ICRmin}$ ,<br>$V_O = 0$ 25°C           | 70                |     | 90       | 70                |     | 90       | dB         |
|                                                                          |                                                     | Full range        |     | 70       | Full range        |     | 70       |            |
| $k_{SVS}$ Supply-voltage sensitivity ( $\Delta V_{IO} / \Delta V_{CC}$ ) | $V_{CC} = \pm 9$ V to $\pm 15$ V,<br>$V_O = 0$ 25°C | 30                |     | 150      | 30                |     | 150      | $\mu$ V/V  |
|                                                                          |                                                     | Full range        |     | 150      | Full range        |     | 150      |            |
| $I_{OS}$ Short-circuit output current                                    | 25°C                                                | $\pm 25$ $\pm 40$ |     |          | $\pm 25$ $\pm 40$ |     |          | mA         |
| $I_{CC}$ Supply current                                                  | No load, $V_O = 0$ 25°C                             | 1.7               |     | 2.8      | 1.7               |     | 2.8      | mA         |
|                                                                          |                                                     | Full range        |     | 3.3      | Full range        |     | 3.3      |            |
| $P_D$ Power dissipation (each amplifier)                                 | No load, $V_O = 0$ 25°C                             | 50                |     | 85       | 50                |     | 85       | mW         |
|                                                                          |                                                     | Full range        |     | 100      | Full range        |     | 100      |            |

† All characteristics are measured under open-loop conditions with zero common-mode input voltage unless otherwise specified. Full range for uA748C is 0°C to 70°C and for uA748M is –55°C to 125°C.

NOTE 5: This typical value applies only at frequencies above a few hundred hertz because of the effects of drift and thermal feedback.

**operating characteristics,  $V_{CC} \pm = \pm 15$  V,  $T_A = 25^\circ\text{C}$**

| PARAMETER                  | TEST CONDITIONS                                                                   | MIN | TYP | MAX | UNIT       |
|----------------------------|-----------------------------------------------------------------------------------|-----|-----|-----|------------|
| $t_r$ Rise time            | $V_I = 20$ mV, $R_L = 2$ k $\Omega$ , $C_L = 100$ pF, $C_C = 30$ pF, See Figure 1 | 0.3 |     |     | $\mu$ s    |
| Overshoot factor           |                                                                                   | 5%  |     |     |            |
| SR Slew rate at unity gain | $V_I = 10$ V, $R_L = 2$ k $\Omega$ , $C_L = 100$ pF, $C_C = 30$ pF, See Figure 1  | 0.5 |     |     | V/ $\mu$ s |

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## PARAMETER MEASUREMENT INFORMATION

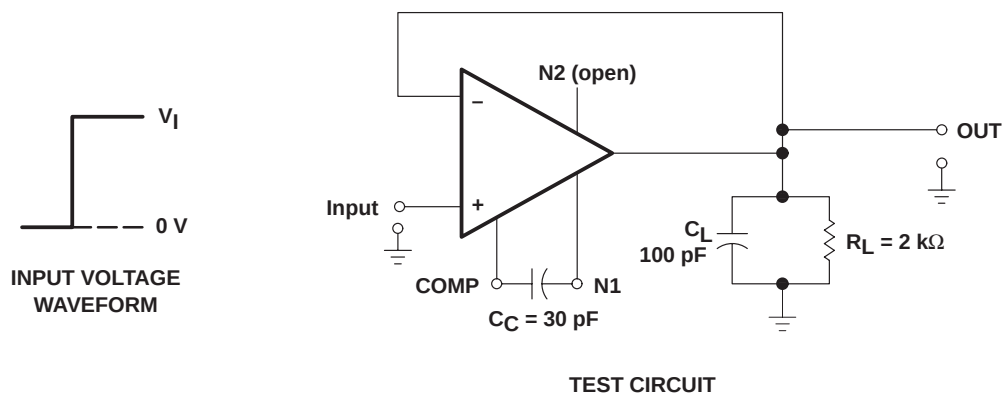


Figure 1. Rise Time, Overshoot, and Slew Rate

## TYPICAL CHARACTERISTICS†

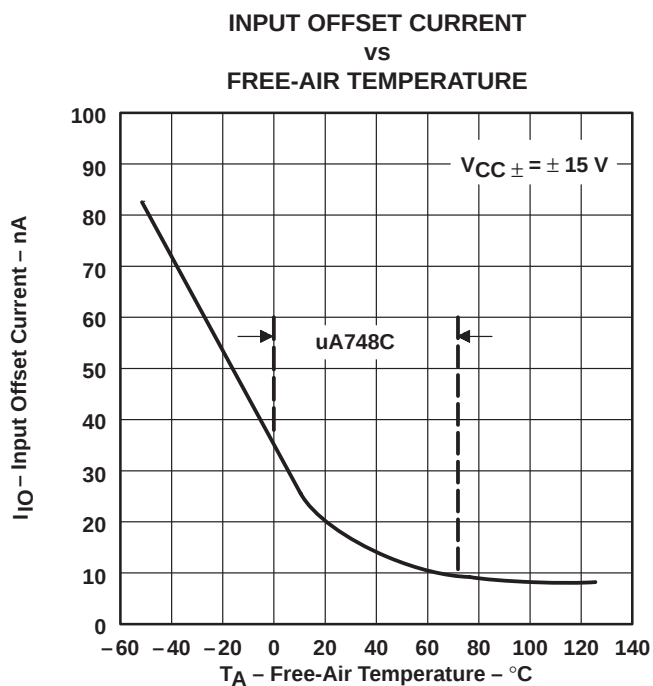


Figure 2

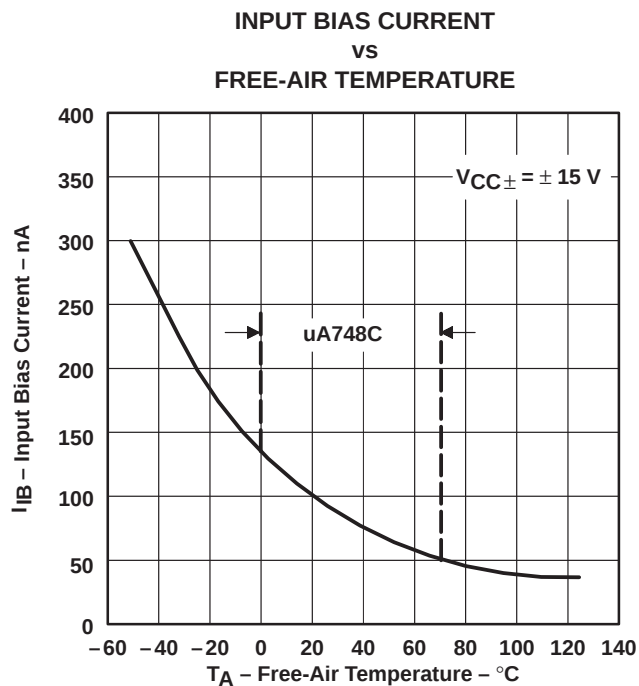


Figure 3

† Data at high and low temperatures are applicable only within the rated operating free-air temperature range of the particular devices.

## TYPICAL CHARACTERISTICS

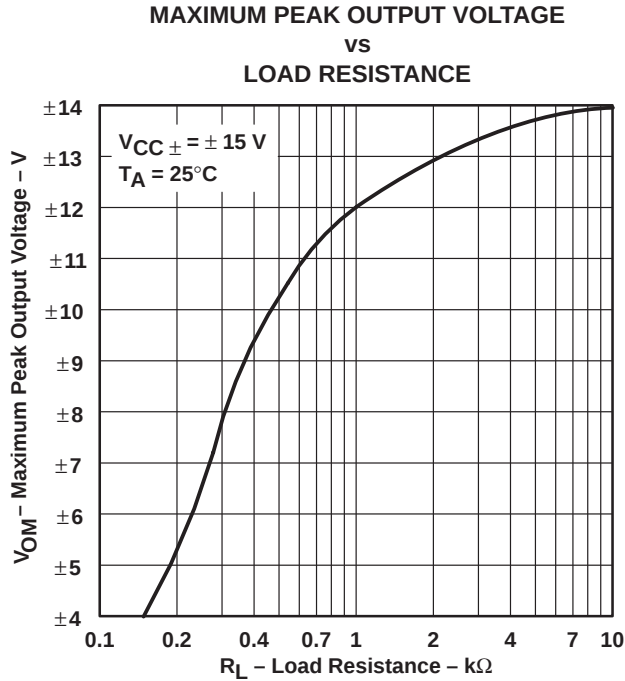


Figure 4

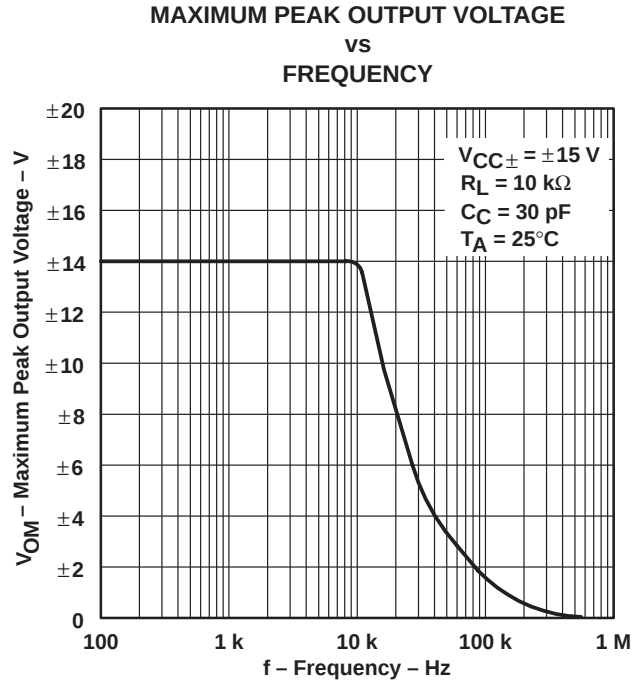


Figure 5

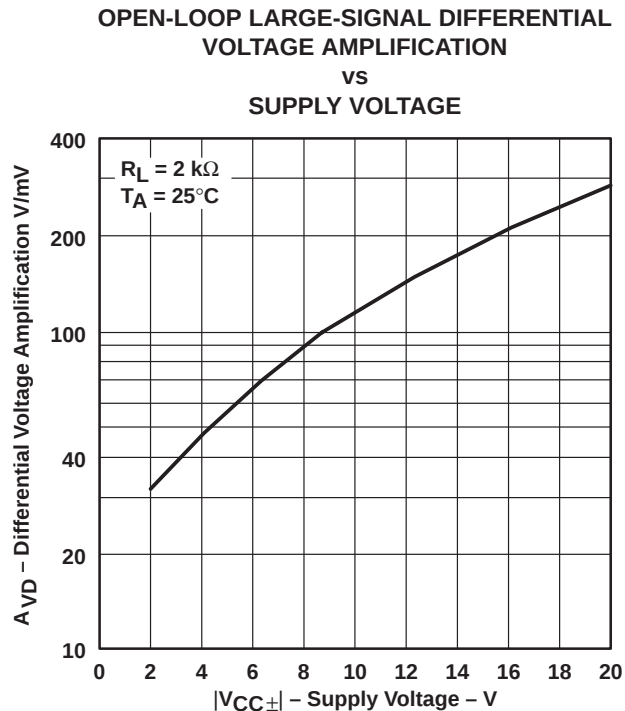


Figure 6

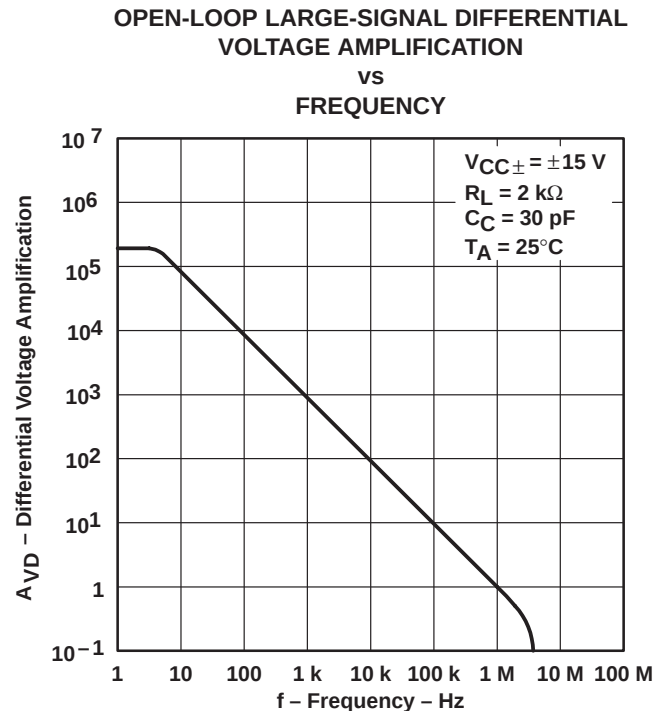


Figure 7

# uA748C, uA748M GENERAL-PURPOSE OPERATIONAL AMPLIFIERS

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## TYPICAL CHARACTERISTICS

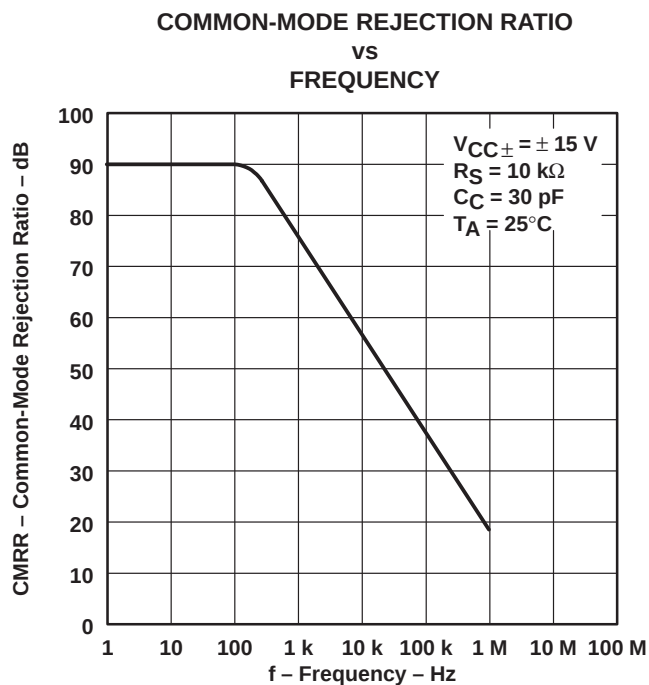


Figure 8

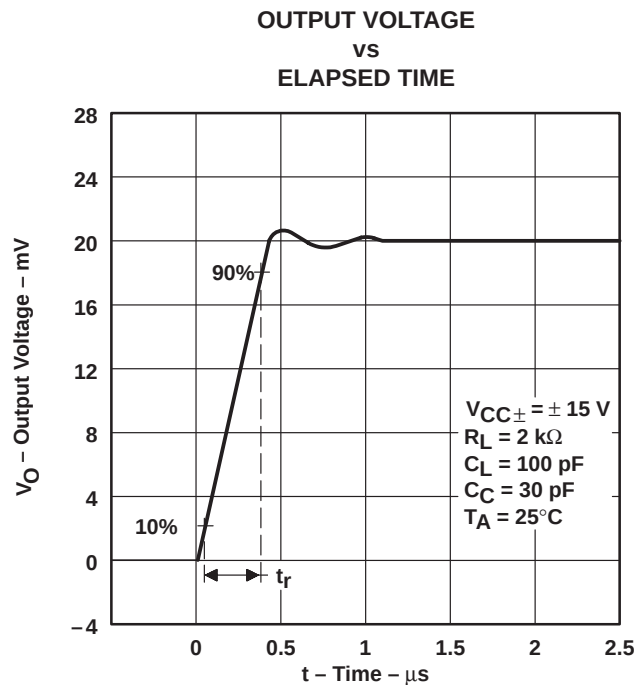


Figure 9

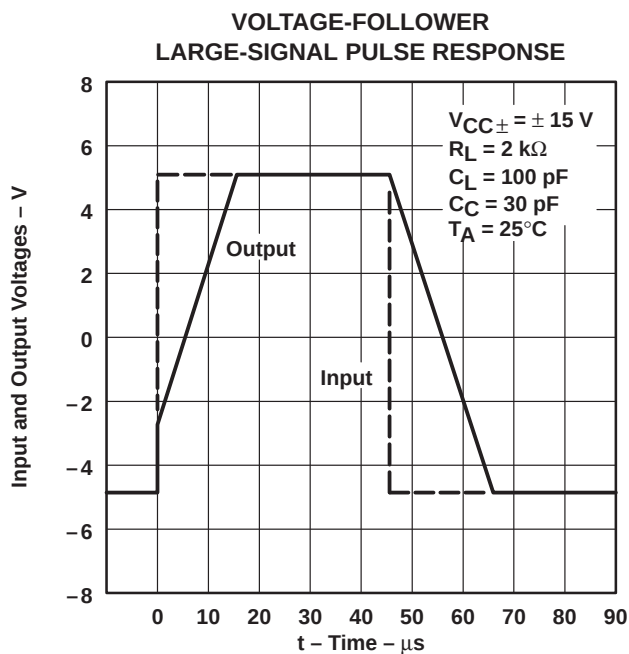


Figure 10

# TYPICAL APPLICATION DATA

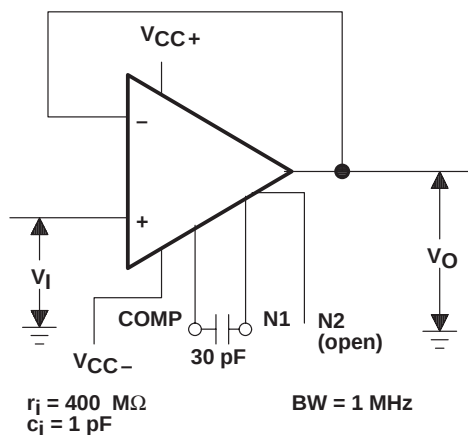
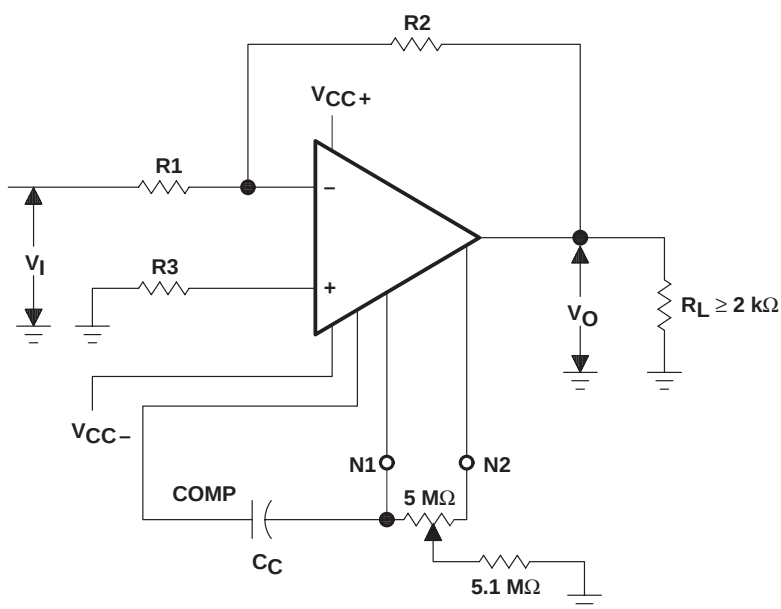


Figure 11. Unity-Gain Voltage Follower



$$\frac{V_O}{V_I} = -\frac{R_2}{R_1}$$

$$C_C \geq \frac{R_1 \cdot 30 \text{ pF}}{R_1 + R_2}$$

$$R_3 = \frac{R_1 \cdot R_2}{R_1 + R_2}$$

Figure 12. Inverting Circuit With Adjustable Gain Compensation and Offset Adjustment

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