

# uA747C, uA747M

## DUAL GENERAL-PURPOSE OPERATIONAL AMPLIFIERS

SLOS009A – D971, FEBRUARY 1971 – REVISED OCTOBER 1990

- No Frequency Compensation Required
- Low Power Consumption
- Short-Circuit Protection
- Offset-Voltage Null Capability
- Wide Common-Mode and Differential Voltage Ranges
- No Latch-Up
- Designed to Be Interchangeable With Fairchild  $\mu$ A747C and  $\mu$ A747M

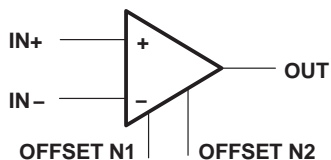
### description

The uA747 is a dual general-purpose operational amplifier featuring offset-voltage null capability. Each half is electrically similar to uA741.

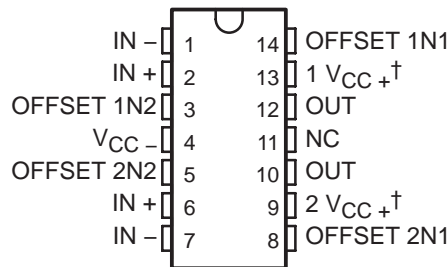
The high common-mode input voltage range and the absence of latch-up make this amplifier ideal for voltage-follower applications. The device is short-circuit protected and the internal frequency compensation ensures stability without external components. A low-value potentiometer may be connected between the offset null inputs to null out the offset voltage as shown in Figure 2.

The uA747C is characterized for operation from 0°C to 70°C; the uA747M is characterized for operation over the full military temperature range of –55°C to 125°C.

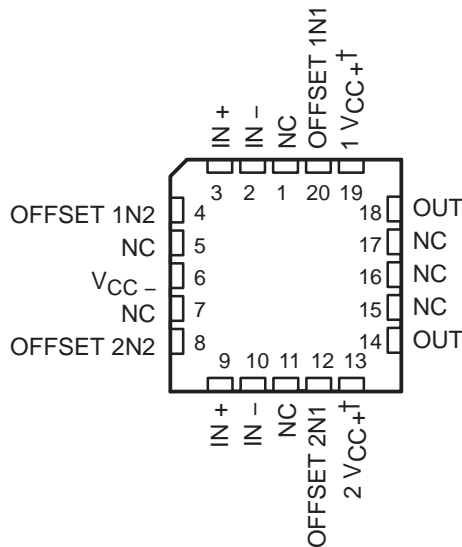
### symbol (each amplifier)



D, J, N, OR W PACKAGE  
(TOP VIEW)



uA747m ... FK PACKAGE  
(TOP VIEW)



NC – No internal connection

† The two positive supply terminals (1  $V_{CC+}$  and 2  $V_{CC+}$ ) are connected together internally.

### AVAILABLE OPTIONS

| $T_A$                | $V_{IO}$ Max<br>AT 25°C | PACKAGE              |                    |                    |                  |                      |
|----------------------|-------------------------|----------------------|--------------------|--------------------|------------------|----------------------|
|                      |                         | 14-PIN               |                    |                    |                  | 20-PIN               |
|                      |                         | SMALL OUTLINE<br>(D) | CERAMIC DIP<br>(J) | PLASTIC DIP<br>(N) | FLAT PACK<br>(W) | CHIP CARRIER<br>(FK) |
| 0°C<br>to<br>70°C    | 6 mV                    | uA747CD              | —                  | uA747CN            | —                | —                    |
| –55°C<br>to<br>125°C | 5 mV                    | —                    | uA747MJ            | —                  | uA747MW          | uA747MFK             |

The D package is available taped and reeled. Add the suffix R to the device type, (i.e., uA747CDR).

PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.



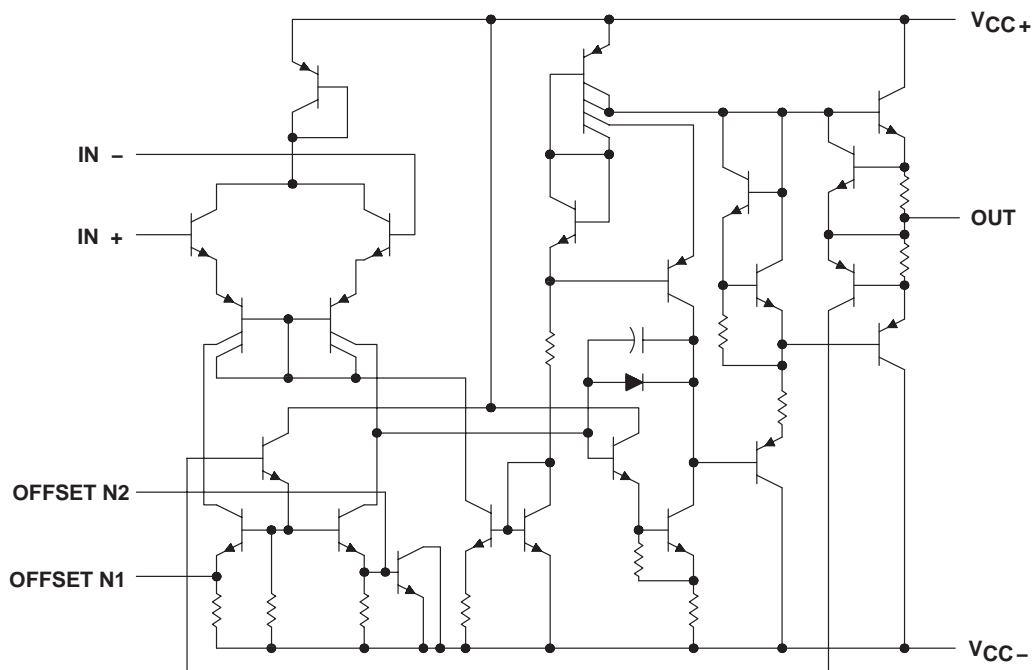
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# uA747C, uA747M DUAL GENERAL-PURPOSE OPERATIONAL AMPLIFIERS

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## schematic (each amplifier)



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

|  | uA747C                       | uA747M         | 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 any input (see Notes 1 and 3)                    | $\pm 15$                     | $\pm 15$       | V                  |
| Voltage between any offset null terminal (N1/N2) and $V_{CC-}$ | $\pm 0.5$                    | $\pm 0.5$      | V                  |
| Duration of output short circuit (see Note 4)                  | unlimited                    | unlimited      |                    |
| Continuous total dissipation                                   | See Dissipation Rating Table |                |                    |
| Operating free-air temperature range                           | 0 to 70                      | -55 to 125     | $^{\circ}\text{C}$ |
| Storage temperature range                                      | -65 to 150                   | -65 to 150     | $^{\circ}\text{C}$ |
| Case temperature for 60 seconds                                |                              | FK package     | 260                |
| Lead temperature 1,6 mm (1/16 inch) from case for 60 seconds   |                              | J or W package | 300                |
| Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds   |                              | D or N package | 260                |

- 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 15 V, whichever is less.  
 4. The output may be shorted to ground or either power supply. For the uA747M only, the unlimited duration of the short circuit applies at (or below) 125 $^{\circ}\text{C}$  case temperature or 75 $^{\circ}\text{C}$  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       | 800 mW  | 7.6 mW/ $^{\circ}\text{C}$  | 45 $^{\circ}\text{C}$ | 608 mW                                     | —   |
| FK      | 800 mW  | 11.0 mW/ $^{\circ}\text{C}$ | 77 $^{\circ}\text{C}$ | 800 mW                                     | 275 mW                                      |
| J       | 800 mW  | 11.0 mW/ $^{\circ}\text{C}$ | 77 $^{\circ}\text{C}$ | 800 mW                                     | 275 mW                                      |
| N       | 800 mW  | 9.2 mW/ $^{\circ}\text{C}$  | 63 $^{\circ}\text{C}$ | 736 mW                                     | —   |
| W       | 800 mW  | 8.0 mW/ $^{\circ}\text{C}$  | 50 $^{\circ}\text{C}$ | 640 mW                                     | 200 mW                                      |

# uA747C, uA747M

## DUAL GENERAL-PURPOSE OPERATIONAL AMPLIFIERS

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### electrical characteristics at specified free-air temperature, $V_{CC} \pm = \pm 15\text{ V}$

| PARAMETER  | TEST CONDITIONS†   | $T_A$ ‡    | uA747C |     |     | uA747M |     |      | 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 |        | 6   |      |      |
| $\Delta V_{IO}(\text{adj})$ Offset voltage adjust range                  |  | 25°C       | ±15    |     |     | ±15    |     |      | mV   |
| $I_{IO}$ Input offset current  |  | 25°C       | 20     | 200 |     | 20     | 200 | nA   |      |
|  |  | Full range |        | 300 |     | 500    |     |      |      |
| $I_{IB}$ Input bias current  |  | 25°C       | 80     | 500 |     | 80     | 500 | nA   |      |
|  |  | Full range |        | 800 |     | 1500   |     |      |      |
| $V_{ICR}$ Common-mode input voltage range                                |  | 25°C       | ±12    | ±13 |     | ±12    | ±13 | V    |      |
|  |  | Full range | ±12    |     |     | ±12    |     |      |      |
| $V_{O(PP)}$ Maximum peak-to-peak output voltage swing                    | $R_L = 10\text{ k}\Omega$                                | 25°C       | 24     | 28  |     | 24     | 28  | V    |      |
|  | $R_L \geq 10\text{ k}\Omega$                             | Full range | 24     |     |     | 24     |     |      |      |
|  | $R_L = 2\text{ k}\Omega$                                 | 25°C       | 20     | 26  |     | 20     | 26  |      |      |
|  | $R_L \geq 2\text{ k}\Omega$                              | Full range | 20     |     |     | 20     |     |      |      |
| $A_{VD}$ Large-signal differential voltage amplification                 | $R_L \geq 2\text{ k}\Omega$ ,<br>$V_O = \pm 10\text{ V}$ | 25°C       | 25     | 200 |     | 50     | 200 | V/mV |      |
|  |  | Full range | 15     |     |     | 25     |     |      |      |
| $r_i$ Input resistance   |  | 25°C       | 0.3    | 2   |     | 0.3*   | 2   | MΩ   |      |
| $r_o$ Output resistance  | See Note 5   | 25°C       |        | 75  |     | 75     |     | Ω    |      |
| $C_i$ Input capacitance  |  | 25°C       |        | 1.4 |     | 1.4    |     | pF   |      |
| CMRR Common-mode rejection ratio   | $V_{IC} = V_{ICR}$                                       | 25°C       | 70     | 90  |     | 70     | 90  | dB   |      |
|  |  | Full range | 70     |     |     | 70     |     |      |      |
| $k_{SVS}$ Supply-voltage sensitivity ( $\Delta V_{IO} / \Delta V_{CC}$ ) | $V_{CC} = \pm 9\text{ V}$ to $\pm 15\text{ V}$           | 25°C       | 30     | 150 |     | 30     | 150 | μV/V |      |
|  |  | Full range |        | 150 |     |        | 150 |      |      |
| $I_{OS}$ Short-circuit output current                                    |  | 25°C       | ±25    | ±40 |     | ±25    | ±40 | mA   |      |
| $I_{CC}$ Supply current (each amplifier)                                 | No load  | 25°C       | 1.7    | 2.8 |     | 1.7    | 2.8 | mA   |      |
|  |  | Full range |        | 3.3 |     |        | 3.3 |      |      |
| $P_D$ Power dissipation (each amplifier)                                 | No load, $V_O = 0$                                       | 25°C       | 50     | 85  |     | 50     | 85  | mW   |      |
|  |  | Full range |        | 100 |     |        | 100 |      |      |
| $V_{O1}/V_{O2}$ Channel separation                                       |  | 25°C       | 120    |     |     | 120    | 0   | dB   |      |

† All characteristics are measured under open-loop conditions with zero common-mode input voltage unless otherwise specified.

‡ Full range for uA747C is 0°C to 70°C and for uA747M is –55°C to 125°C.

\*On products compliant to MIL-STD-883, Class B, this parameter is not production tested.

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

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



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## PARAMETER MEASUREMENT INFORMATION

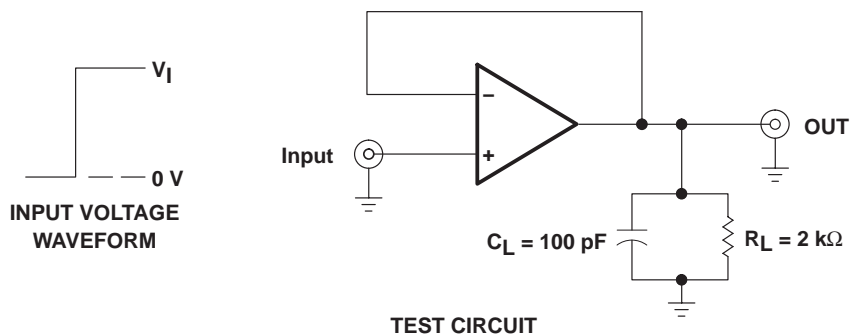


Figure 1. Rise Time, Overshoot, and Slew Rate

## APPLICATION INFORMATION

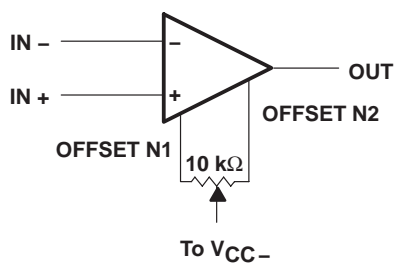
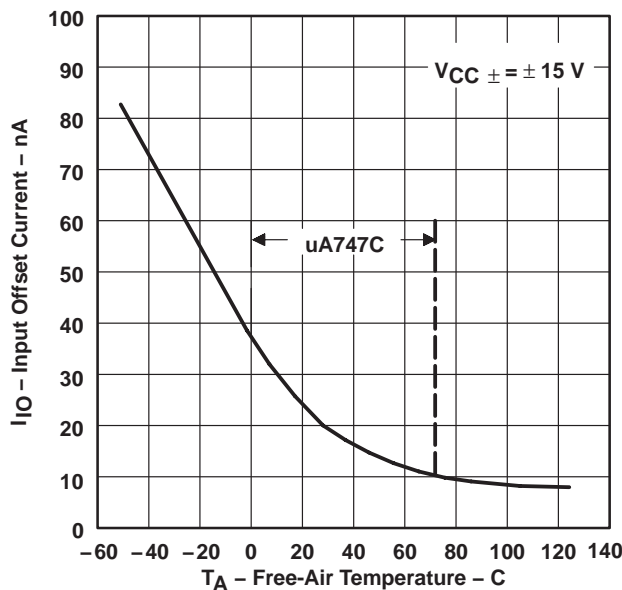


Figure 2. Input Offset Voltage Null Circuit

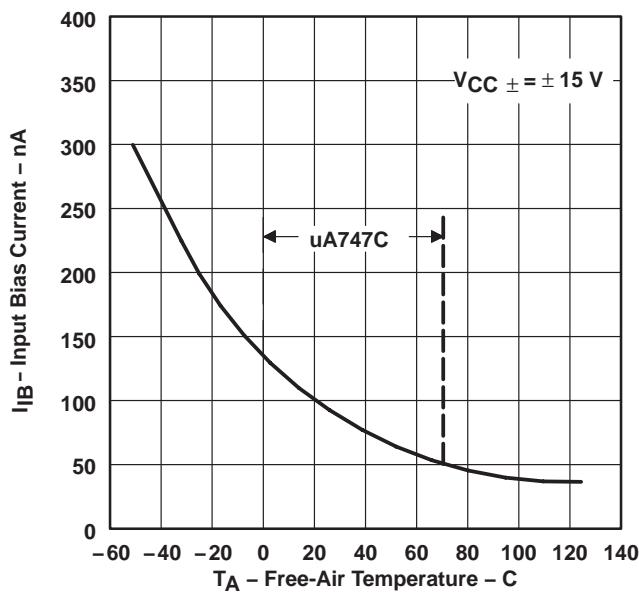
**TYPICAL CHARACTERISTICS†**

**INPUT OFFSET CURRENT  
vs  
FREE-AIR TEMPERATURE**



**Figure 3**

**INPUT BIAS CURRENT  
vs  
FREE-AIR TEMPERATURE**



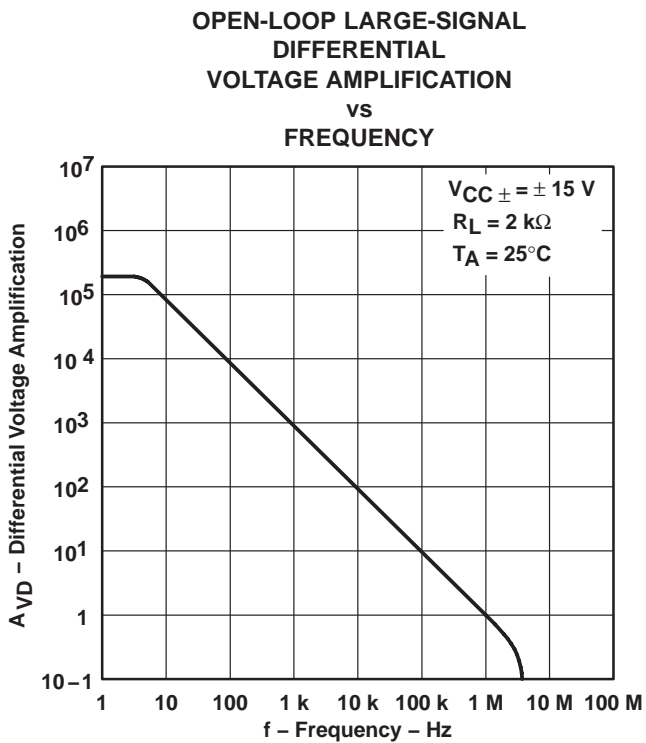
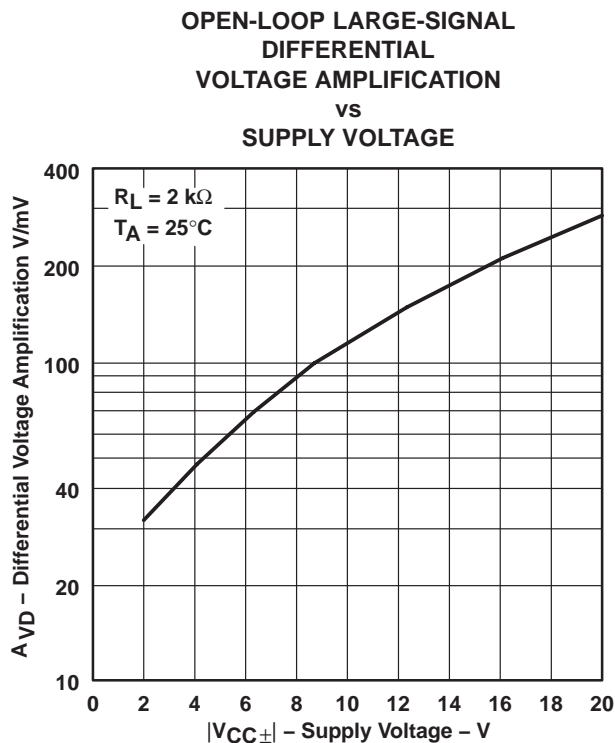
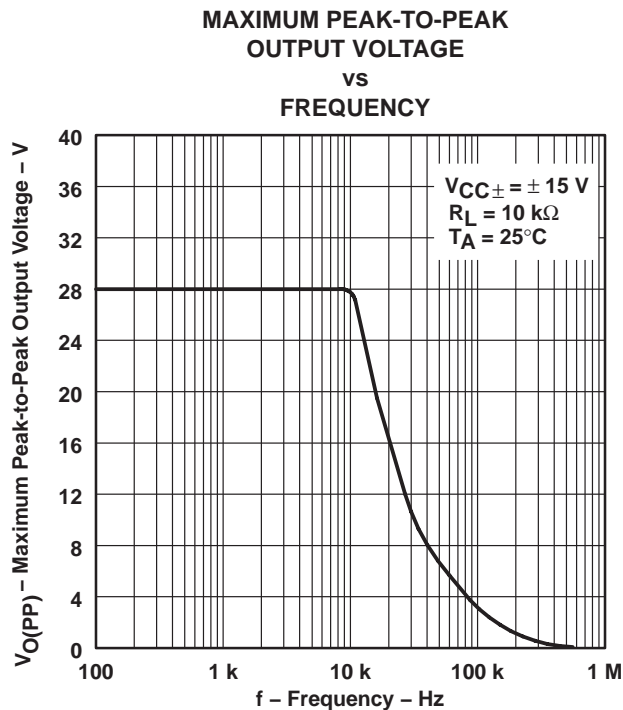
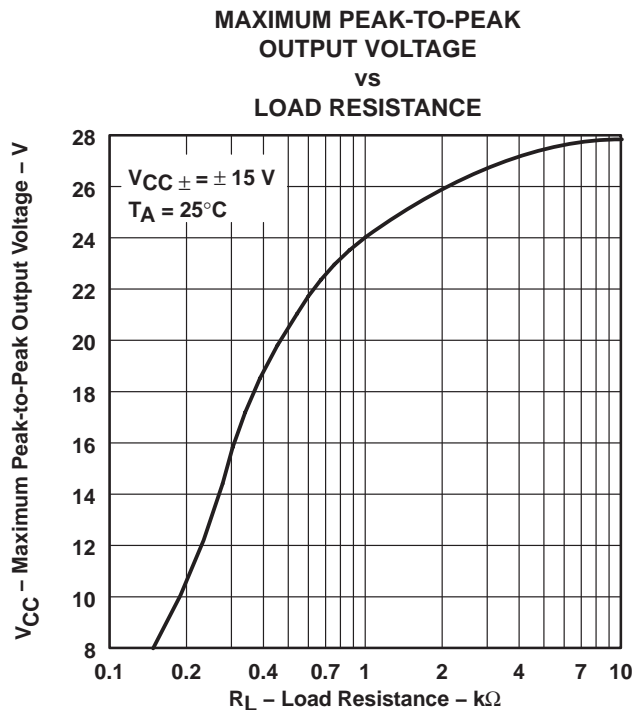
**Figure 4**

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

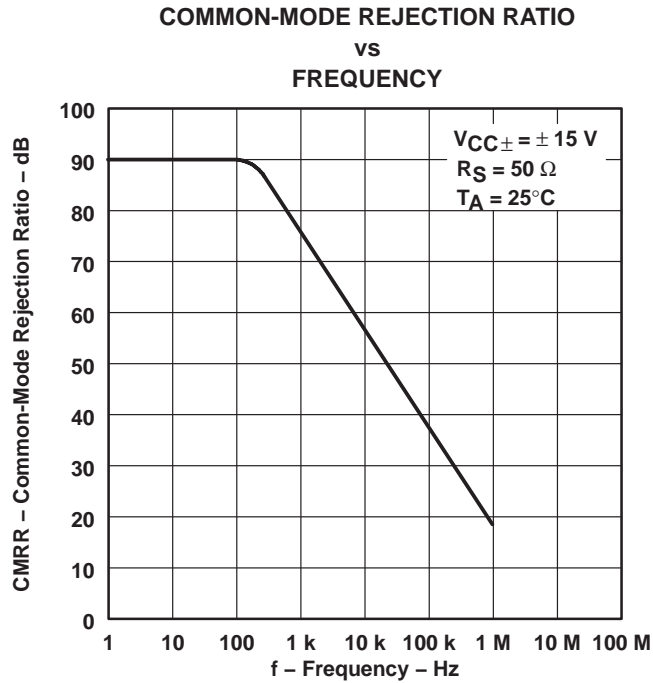
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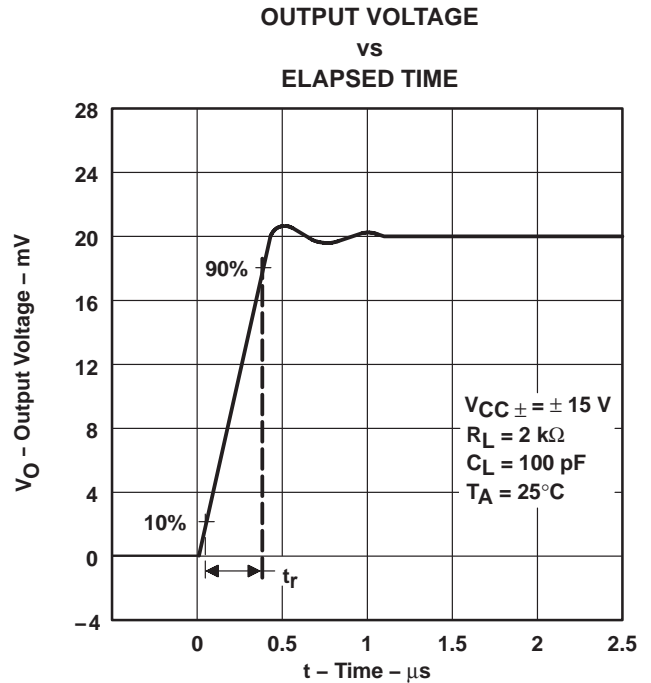
## TYPICAL CHARACTERISTICS



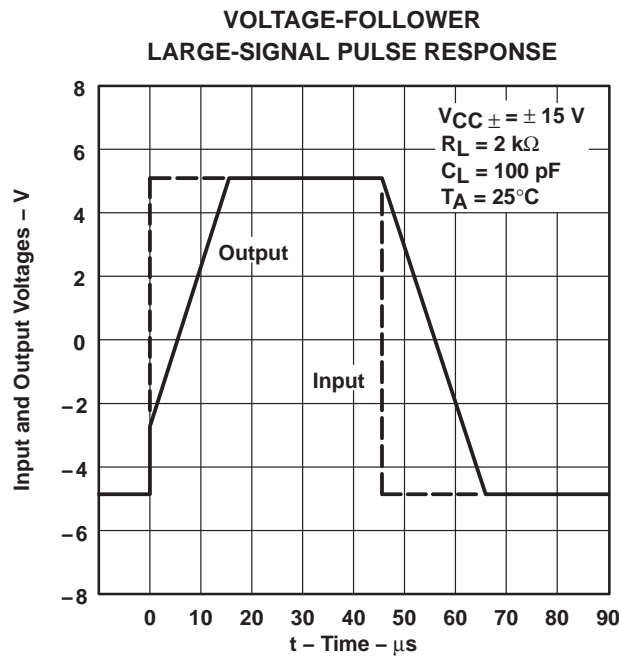
**TYPICAL CHARACTERISTICS**



**Figure 9**



**Figure 10**



**Figure 11**

## PACKAGING INFORMATION

| Orderable Device | Status<br>(1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan<br>(2) | Lead finish/<br>Ball material<br>(6) | MSL Peak Temp<br>(3) | Op Temp (°C) | Device Marking<br>(4/5) | Samples                 |
|------------------|---------------|--------------|-----------------|------|-------------|-----------------|--------------------------------------|----------------------|--------------|-------------------------|-------------------------|
| UA747CN          | ACTIVE        | PDIP         | N               | 14   | 25          | RoHS & Green    | NIPDAU                               | N / A for Pkg Type   | 0 to 70      | UA747CN                 | <a href="#">Samples</a> |
| UA747CNE4        | ACTIVE        | PDIP         | N               | 14   | 25          | RoHS & Green    | NIPDAU                               | N / A for Pkg Type   | 0 to 70      | UA747CN                 | <a href="#">Samples</a> |
| UA747CNE4        | ACTIVE        | PDIP         | N               | 14   | 25          | RoHS & Green    | NIPDAU                               | N / A for Pkg Type   | 0 to 70      | UA747CN                 | <a href="#">Samples</a> |

(1) The marketing status values are defined as follows:

**ACTIVE:** Product device recommended for new designs.

**LIFEBUY:** TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

**NRND:** Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

**PREVIEW:** Device has been announced but is not in production. Samples may or may not be available.

**OBSOLETE:** TI has discontinued the production of the device.

(2) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

**RoHS Exempt:** TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.

**Green:** TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

(3) MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

(6) Lead finish/Ball material - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

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**TUBE**


\*All dimensions are nominal

| Device    | Package Name | Package Type | Pins | SPQ | L (mm) | W (mm) | T (μm) | B (mm) |
|-----------|--------------|--------------|------|-----|--------|--------|--------|--------|
| UA747CN   | N            | PDIP         | 14   | 25  | 506    | 13.97  | 11230  | 4.32   |
| UA747CNE4 | N            | PDIP         | 14   | 25  | 506    | 13.97  | 11230  | 4.32   |

N (R-PDIP-T\*\*)

PLASTIC DUAL-IN-LINE PACKAGE

16 PINS SHOWN



- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - C Falls within JEDEC MS-001, except 18 and 20 pin minimum body length (Dim A).
  - D The 20 pin end lead shoulder width is a vendor option, either half or full width.

4040049/E 12/2002

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