

# 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

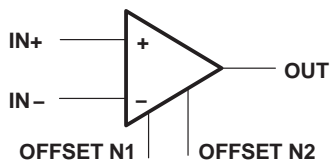
### description

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

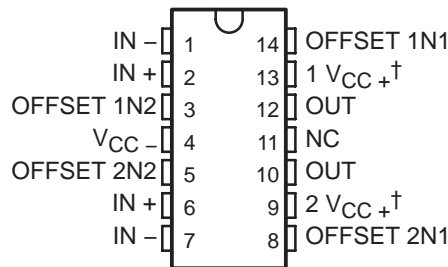
The high common-mode input voltage range and the absence of latch-up make this amplifier ideal for voltage-follower applications. The device is short-circuit protected and the internal frequency compensation ensures stability without external components. A low-value potentiometer may be connected between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

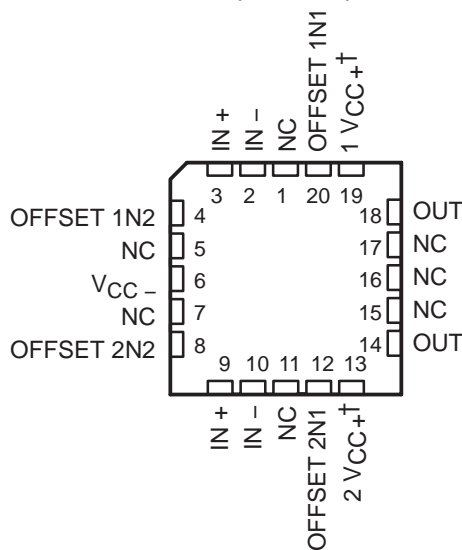
### symbol (each amplifier)



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 AT 25°C	PACKAGE				
		14-PIN				20-PIN
		SMALL OUTLINE (D)	CERAMIC DIP (J)	PLASTIC DIP (N)	FLAT PACK (W)	CHIP CARRIER (FK)
0°C to 70°C	6 mV	uA747CD	—	uA747CN	—	—
–55°C to 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.



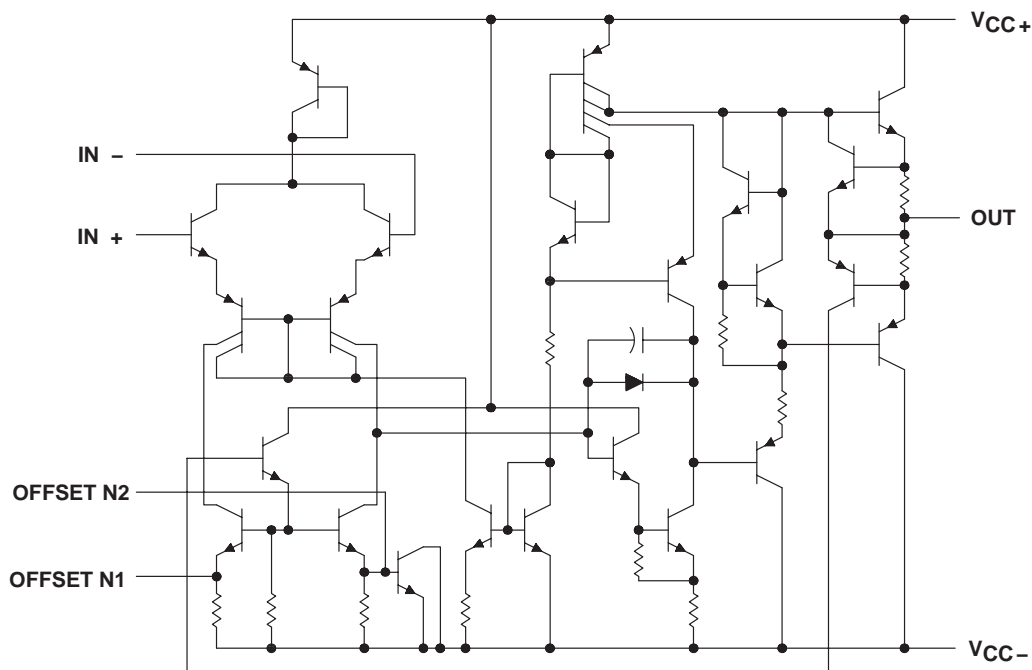
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# uA747C, uA747M DUAL GENERAL-PURPOSE OPERATIONAL AMPLIFIERS

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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	$^{\circ}\text{C}$
Lead temperature 1,6 mm (1/16 inch) from case for 60 seconds	J or W package	300	$^{\circ}\text{C}$
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds	D or N package	260	$^{\circ}\text{C}$

- 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 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	$T_A \leq 25^{\circ}\text{C}$ POWER RATING	DERATING FACTOR	DERATE ABOVE $T_A$	$T_A = 70^{\circ}\text{C}$ POWER RATING	$T_A = 125^{\circ}\text{C}$ 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	$R_L \geq 2\text{ k}\Omega$ , $V_O = \pm 10\text{ V}$	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

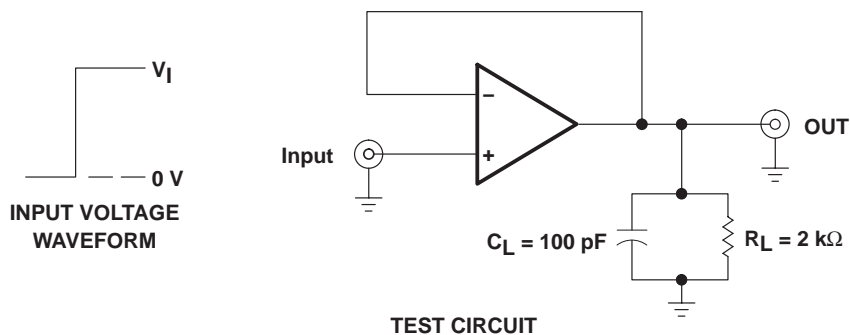


Figure 1. Rise Time, Overshoot, and Slew Rate

## APPLICATION INFORMATION

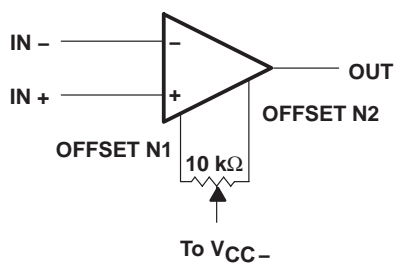
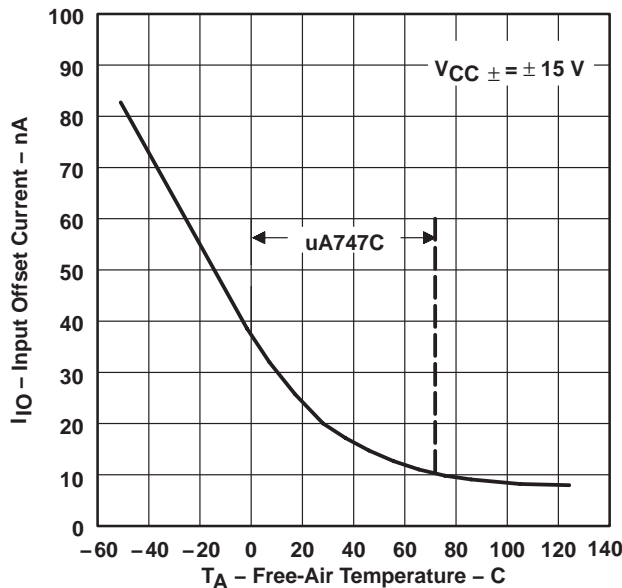


Figure 2. Input Offset Voltage Null Circuit

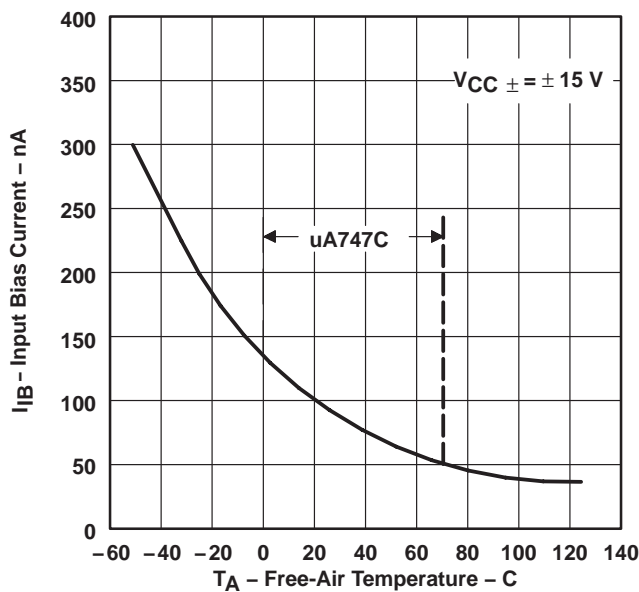
**TYPICAL CHARACTERISTICS†**

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



**Figure 3**

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



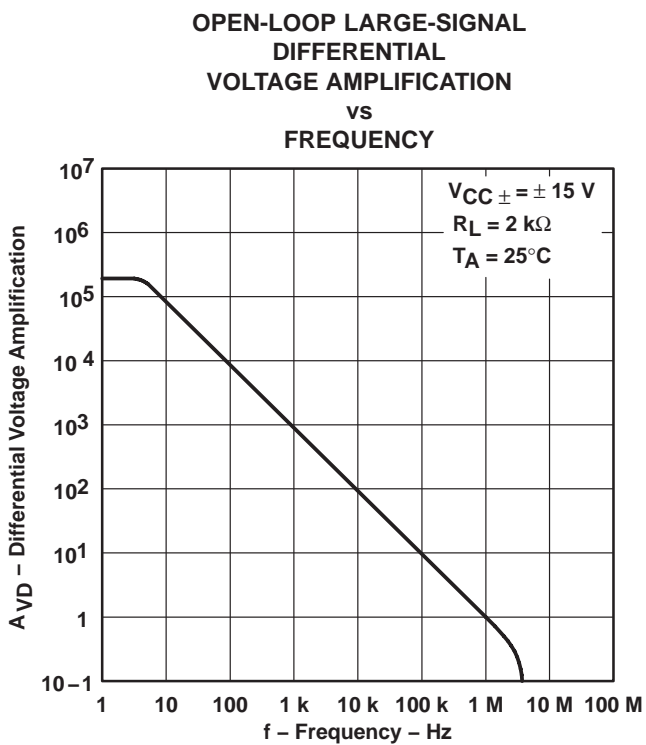
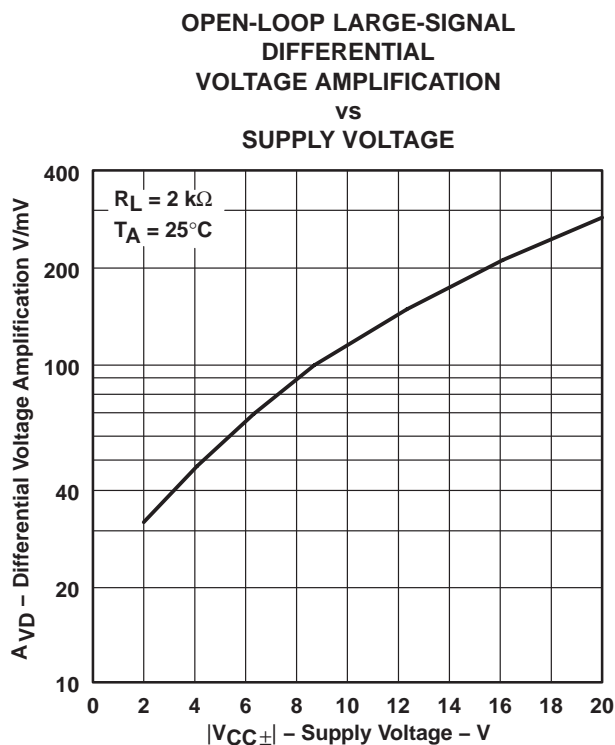
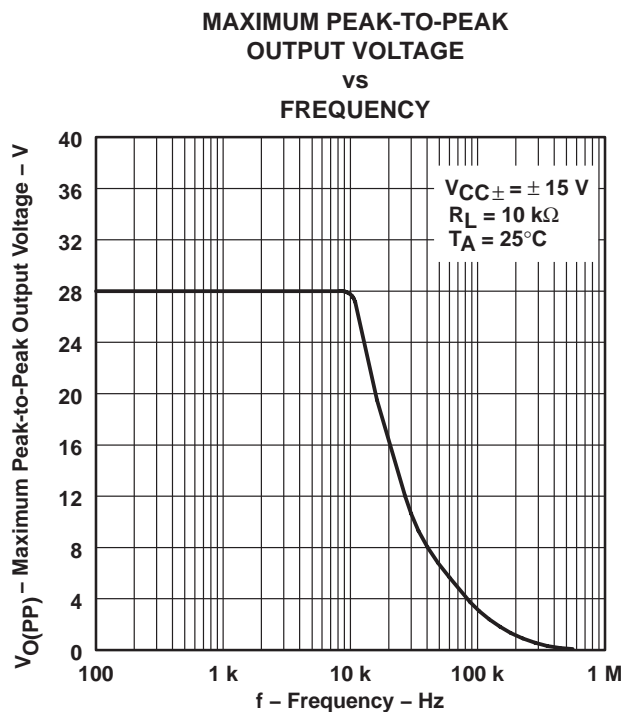
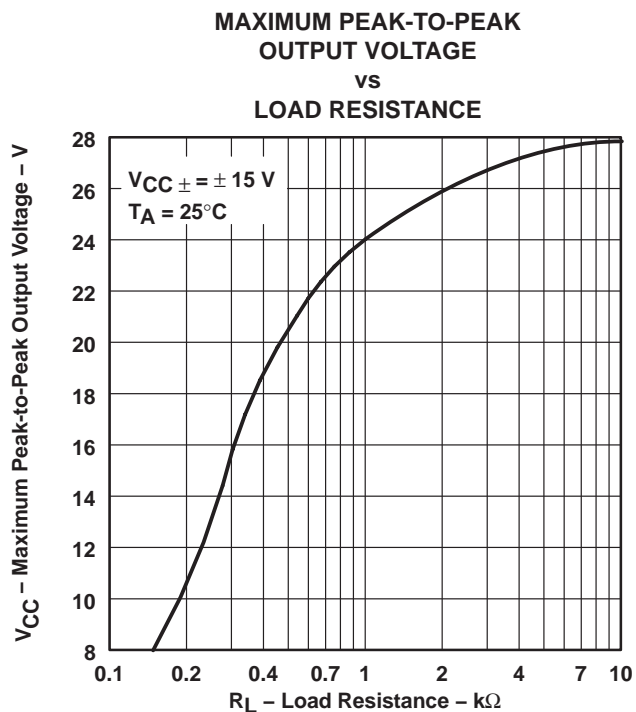
**Figure 4**

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

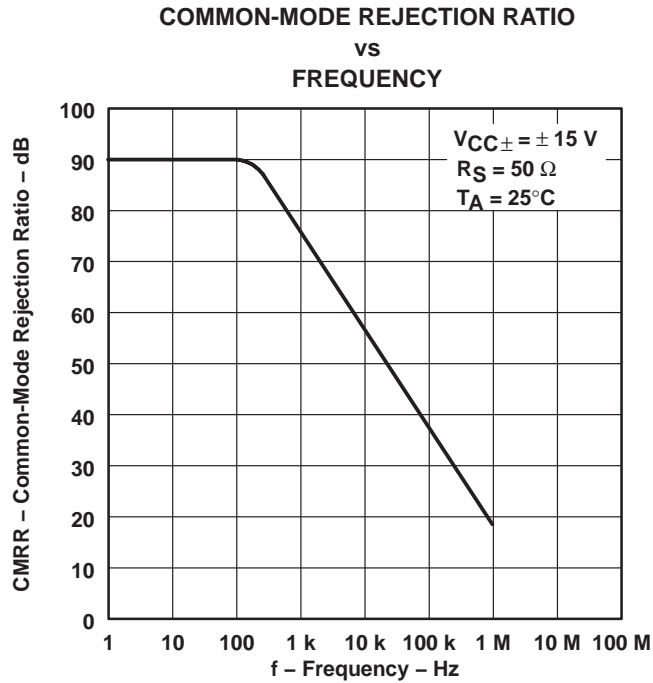
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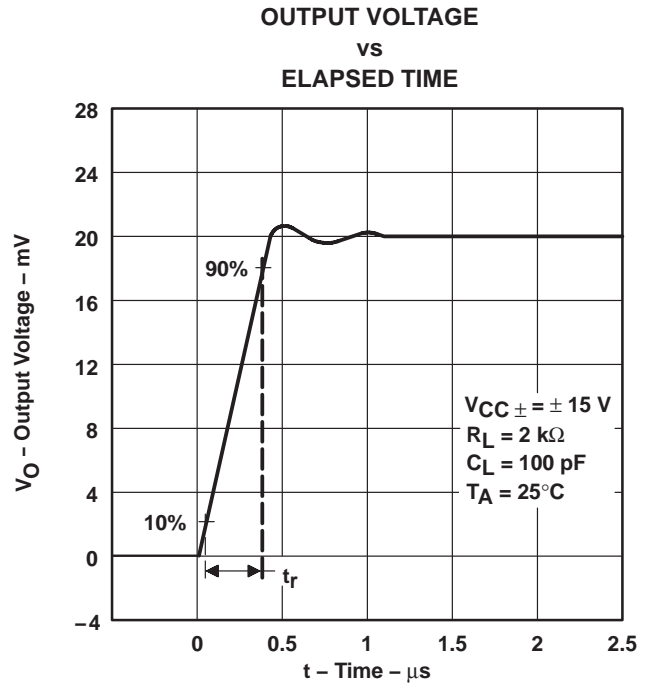
## TYPICAL CHARACTERISTICS



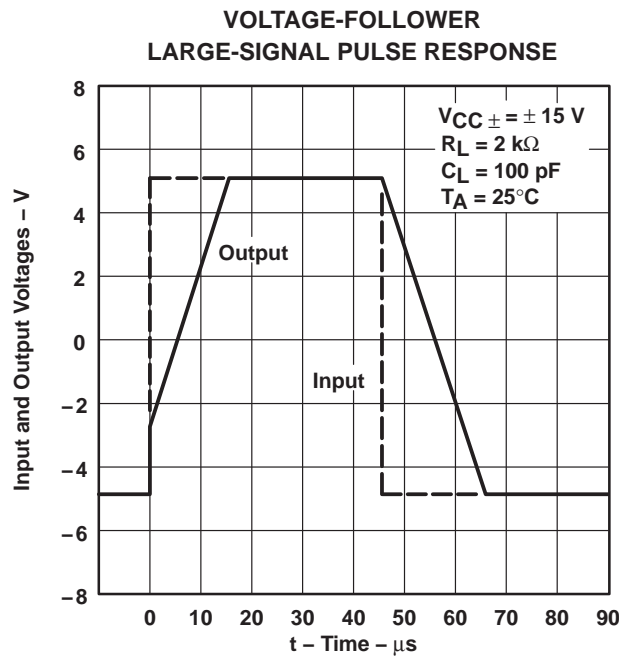
**TYPICAL CHARACTERISTICS**



**Figure 9**



**Figure 10**



**Figure 11**

**PACKAGING INFORMATION**

Orderable Device	Status <sup>(1)</sup>	Package Type	Package Drawing	Pins	Package Qty	Eco Plan <sup>(2)</sup>	Lead/ Ball Finish	MSL Peak Temp <sup>(3)</sup>	Samples (Requires Login)
UA747-1MJ	OBSOLETE	CDIP	J	14		TBD	Call TI	Call TI	Samples Not Available
UA747CD	OBSOLETE	SOIC	D	14		TBD	Call TI	Call TI	Samples Not Available
UA747CD	OBSOLETE	SOIC	D	14		TBD	Call TI	Call TI	Samples Not Available
UA747CDR	OBSOLETE	SOIC	D	14		TBD	Call TI	Call TI	Samples Not Available
UA747CDR	OBSOLETE	SOIC	D	14		TBD	Call TI	Call TI	Samples Not Available
UA747CN	ACTIVE	PDIP	N	14	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type	Contact TI Distributor or Sales Office
UA747CN	ACTIVE	PDIP	N	14	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type	Contact TI Distributor or Sales Office
UA747CNE4	ACTIVE	PDIP	N	14	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type	Contact TI Distributor or Sales Office
UA747CNE4	ACTIVE	PDIP	N	14	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type	Contact TI Distributor or Sales Office

<sup>(1)</sup> 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.

<sup>(2)</sup> Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

**TBD:** The Pb-Free/Green conversion plan has not been defined.

**Pb-Free (RoHS):** TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

**Pb-Free (RoHS Exempt):** This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

**Green (RoHS & no Sb/Br):** TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

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

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J (R-GDIP-T\*\*)

14 LEADS SHOWN

CERAMIC DUAL IN-LINE PACKAGE



DIM \ PINS **	14	16	18	20
A	0.300 (7,62) BSC	0.300 (7,62) BSC	0.300 (7,62) BSC	0.300 (7,62) BSC
B MAX	0.785 (19,94)	.840 (21,34)	0.960 (24,38)	1.060 (26,92)
B MIN	—	—	—	—
C MAX	0.300 (7,62)	0.300 (7,62)	0.310 (7,87)	0.300 (7,62)
C MIN	0.245 (6,22)	0.245 (6,22)	0.220 (5,59)	0.245 (6,22)



4040083/F 03/03

- NOTES:
- All linear dimensions are in inches (millimeters).
  - This drawing is subject to change without notice.
  - This package is hermetically sealed with a ceramic lid using glass frit.
  - Index point is provided on cap for terminal identification only on press ceramic glass frit seal only.
  - Falls within MIL STD 1835 GDIP1-T14, GDIP1-T16, GDIP1-T18 and GDIP1-T20.

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

PLASTIC DUAL-IN-LINE PACKAGE

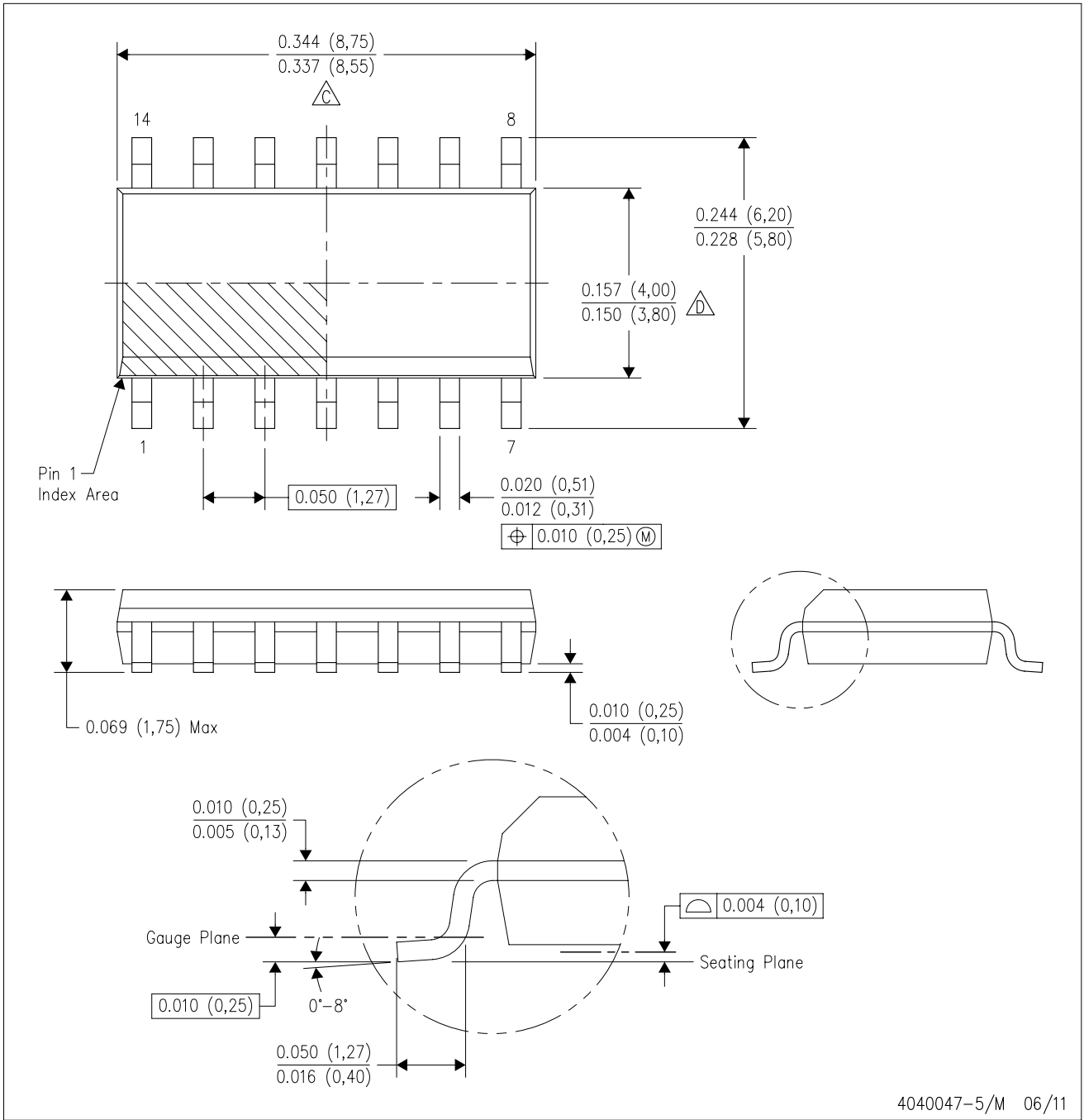
16 PINS SHOWN



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

D (R-PDSO-G14)

PLASTIC SMALL OUTLINE



4040047-5/M 06/11

- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0,15) each side.
  - D. Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
  - E. Reference JEDEC MS-012 variation AB.

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