

# 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

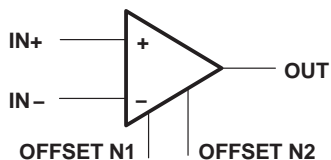
### description

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

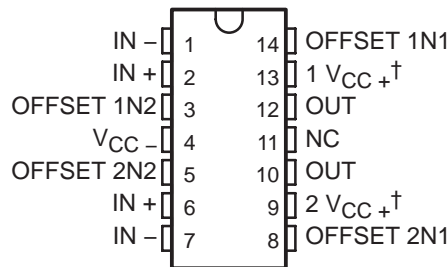
The high common-mode input voltage range and the absence of latch-up make this amplifier ideal for voltage-follower applications. The device is short-circuit protected and the internal frequency compensation ensures stability without external components. A low-value potentiometer may be connected between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

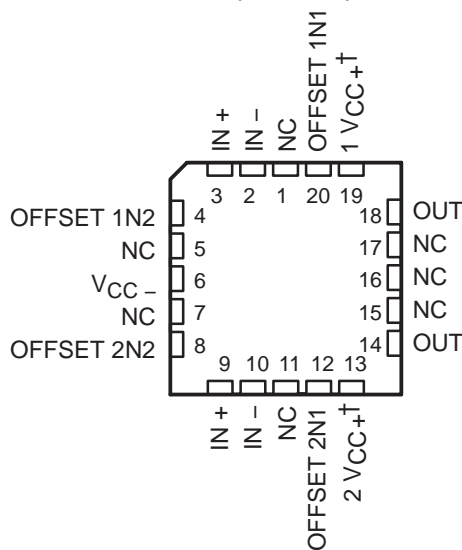
### symbol (each amplifier)



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.



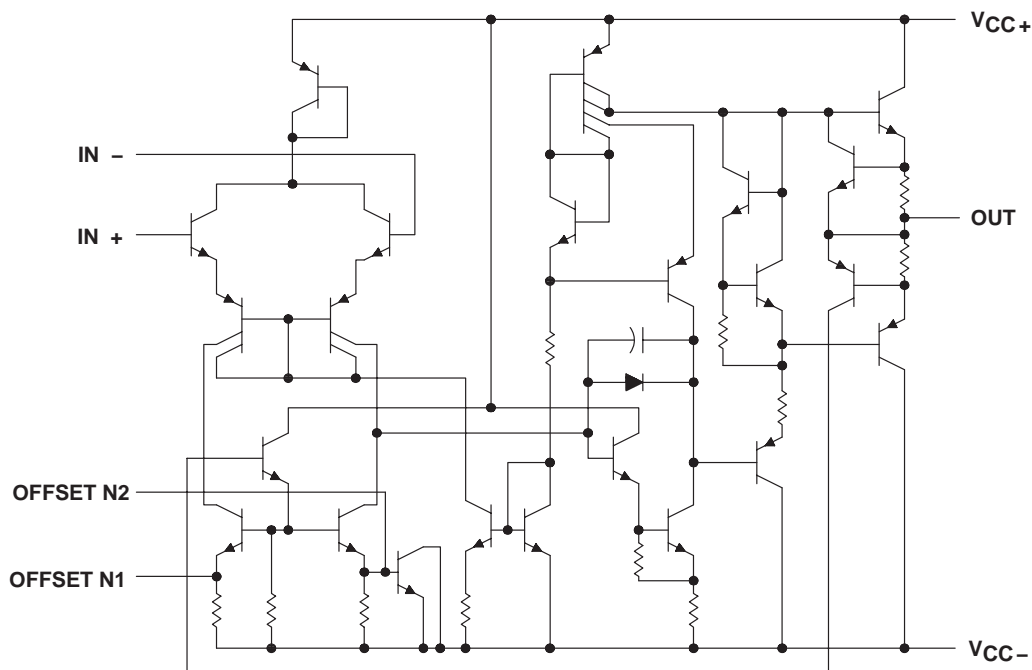
POST OFFICE BOX 655303 • DALLAS, TEXAS 75265  
POST OFFICE BOX 1443 • HOUSTON, TEXAS 77001

Copyright © 1990, Texas Instruments Incorporated

# uA747C, uA747M DUAL GENERAL-PURPOSE OPERATIONAL AMPLIFIERS

SLOS009A – D971, FEBRUARY 1971 – REVISED OCTOBER 1990

## 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	$T_A \leq 25^{\circ}\text{C}$ 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

SLOS009A – D971, FEBRUARY 1971 – REVISED OCTOBER 1990

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

PARAMETER	TEST CONDITIONS†	T <sub>A</sub> ‡	uA747C			uA747M			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
V <sub>IO</sub>	Input offset voltage	V <sub>O</sub> = 0	25°C	1	6	1	5	mV	
			Full range		7.5		6		
ΔV <sub>IO(adj)</sub>	Offset voltage adjust range		25°C	±15		±15		mV	
I <sub>IO</sub>	Input offset current		25°C	20	200	20	200	nA	
			Full range		300		500		
I <sub>IB</sub>	Input bias current		25°C	80	500	80	500	nA	
			Full range		800		1500		
V <sub>ICR</sub>	Common-mode input voltage range		25°C	±12	±13	±12	±13	V	
			Full range		±12		±12		
V <sub>O(PP)</sub>	Maximum peak-to-peak output voltage swing		R <sub>L</sub> = 10 kΩ	25°C	24	28	24	28	V
			R <sub>L</sub> ≥ 10 kΩ	Full range	24		24		
			R <sub>L</sub> = 2 kΩ	25°C	20	26	20	26	
			R <sub>L</sub> ≥ 2 kΩ	Full range	20		20		
A <sub>VD</sub>	Large-signal differential voltage amplification	R <sub>L</sub> ≥ 2 kΩ, V <sub>O</sub> = ± 10 V	25°C	25	200	50	200	V/mV	
			Full range	15		25			
r <sub>i</sub>	Input resistance		25°C	0.3	2	0.3*	2	MΩ	
r <sub>o</sub>	Output resistance	See Note 5	25°C	75		75		Ω	
C <sub>i</sub>	Input capacitance		25°C	1.4		1.4		pF	
CMRR	Common-mode rejection ratio	V <sub>IC</sub> = V <sub>ICR</sub>	25°C	70	90	70	90	dB	
			Full range	70		70			
k <sub>SVS</sub>	Supply-voltage sensitivity (ΔV <sub>IO</sub> / ΔV <sub>CC</sub> )	V <sub>CC</sub> = ± 9 V to ± 15 V	25°C	30	150	30	150	μV/V	
			Full range		150		150		
I <sub>OS</sub>	Short-circuit output current		25°C	±25	±40	±25	±40	mA	
I <sub>CC</sub>	Supply current (each amplifier)	No load	25°C	1.7	2.8	1.7	2.8	mA	
			Full range		3.3		3.3		
P <sub>D</sub>	Power dissipation (each amplifier)	No load, V <sub>O</sub> = 0	25°C	50	85	50	85	mW	
			Full range		100		100		
V <sub>O1</sub> /V <sub>O2</sub>	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<sub>A</sub> = 25°C

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
t <sub>r</sub>	V <sub>I</sub> = 20 mV, R <sub>L</sub> = 2 kΩ, C <sub>L</sub> = 100 pF, See Figure 1		0.3		μs
Overshoot factor			5%		
SR	V <sub>I</sub> = 10 mV, R <sub>L</sub> = 2 kΩ, C <sub>L</sub> = 100 pF, See Figure 1		0.5		V/μs



# uA747C, uA747M DUAL GENERAL-PURPOSE OPERATIONAL AMPLIFIERS

SLOS009A – D971, FEBRUARY 1971 – REVISED OCTOBER 1990

## PARAMETER MEASUREMENT INFORMATION

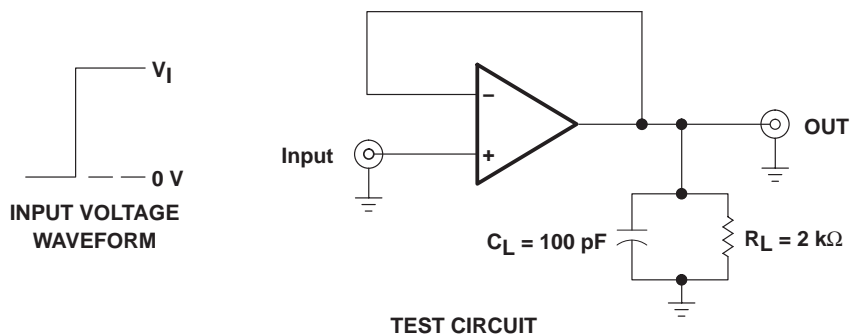


Figure 1. Rise Time, Overshoot, and Slew Rate

## APPLICATION INFORMATION

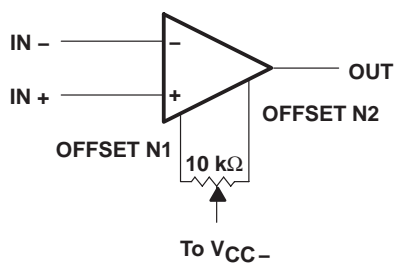
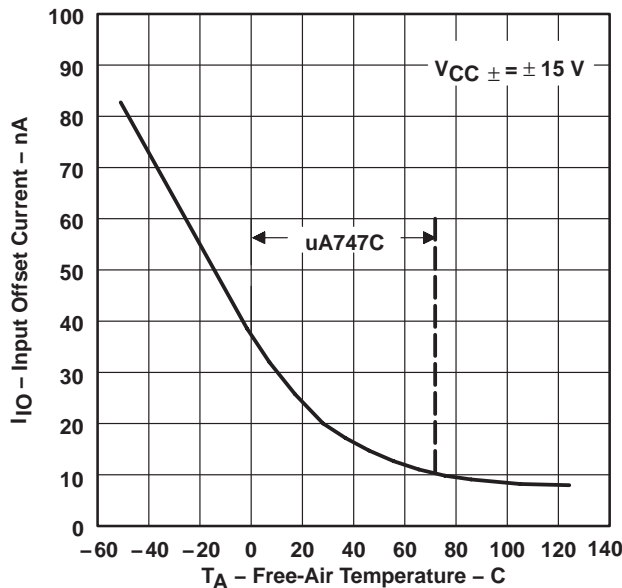


Figure 2. Input Offset Voltage Null Circuit

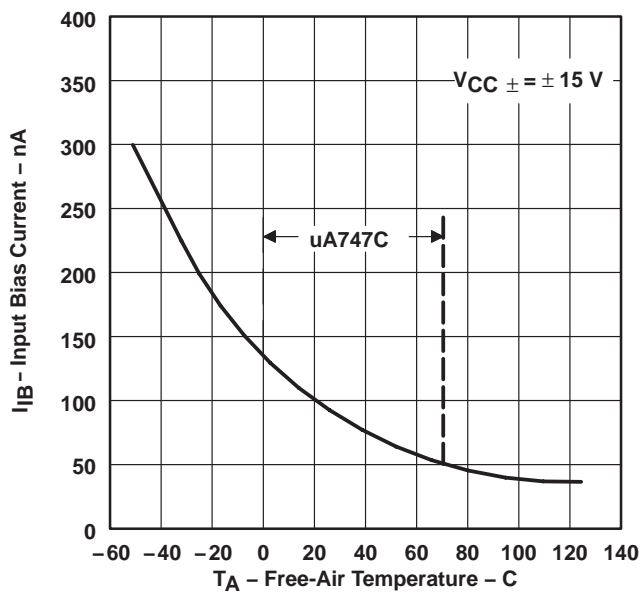
**TYPICAL CHARACTERISTICS†**

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



**Figure 3**

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



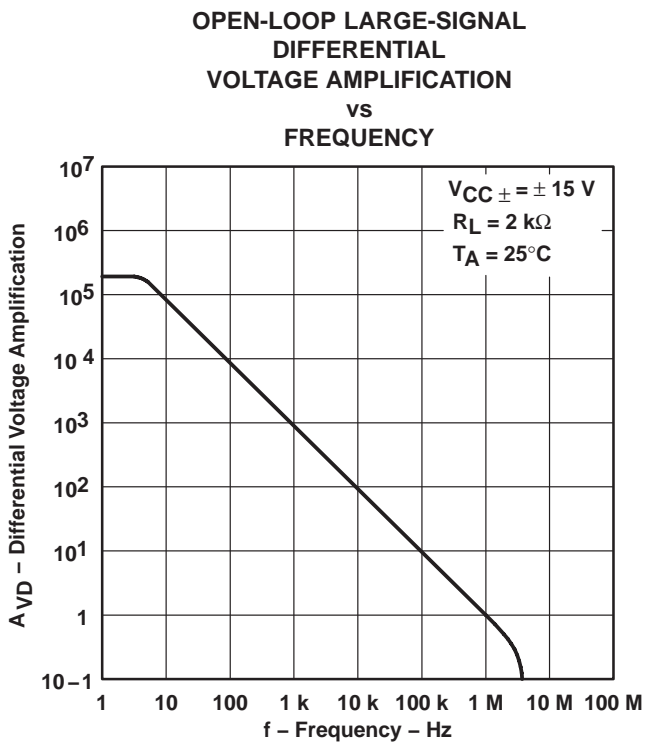
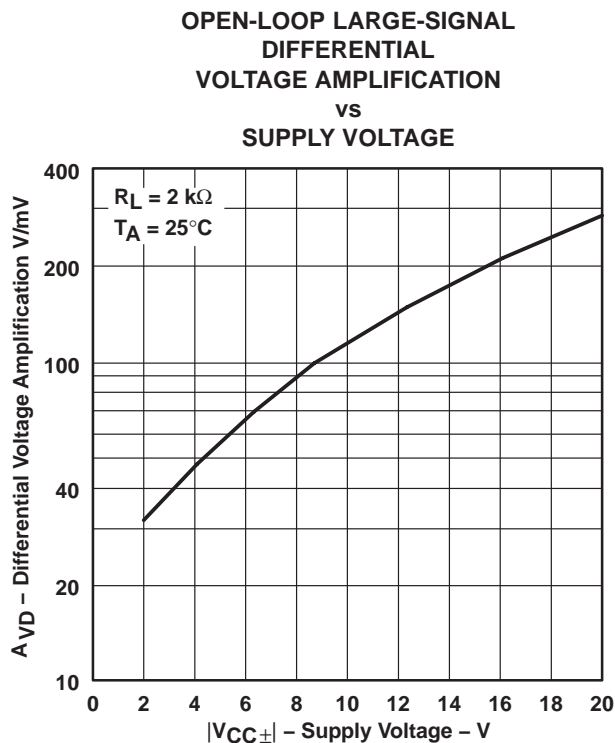
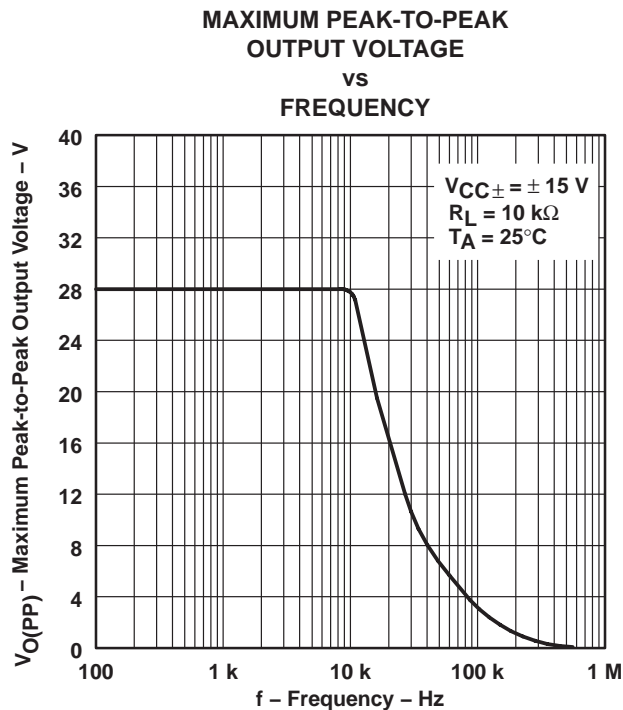
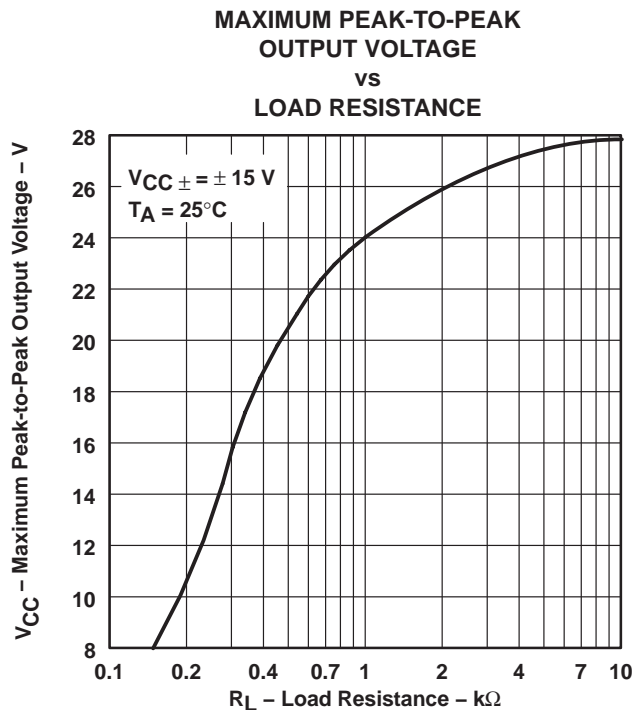
**Figure 4**

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

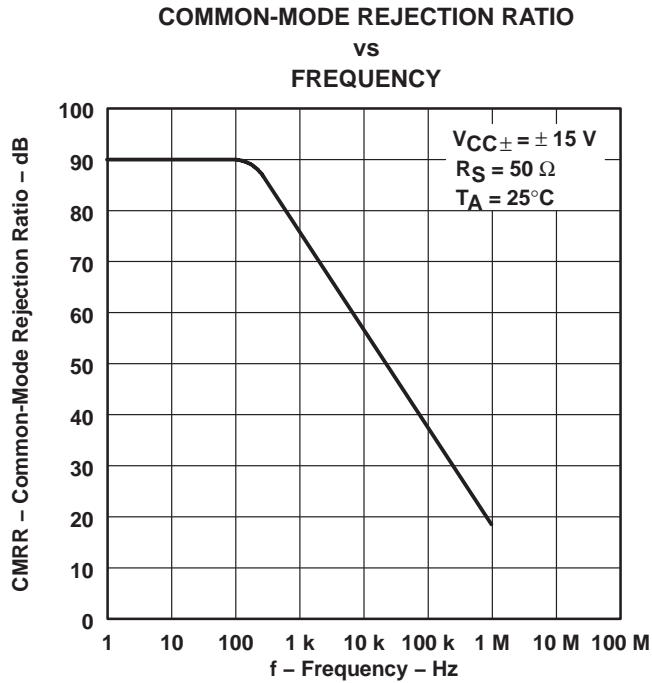
# uA747C, uA747M DUAL GENERAL-PURPOSE OPERATIONAL AMPLIFIERS

SLOS009A – D971, FEBRUARY 1971 – REVISED OCTOBER 1990

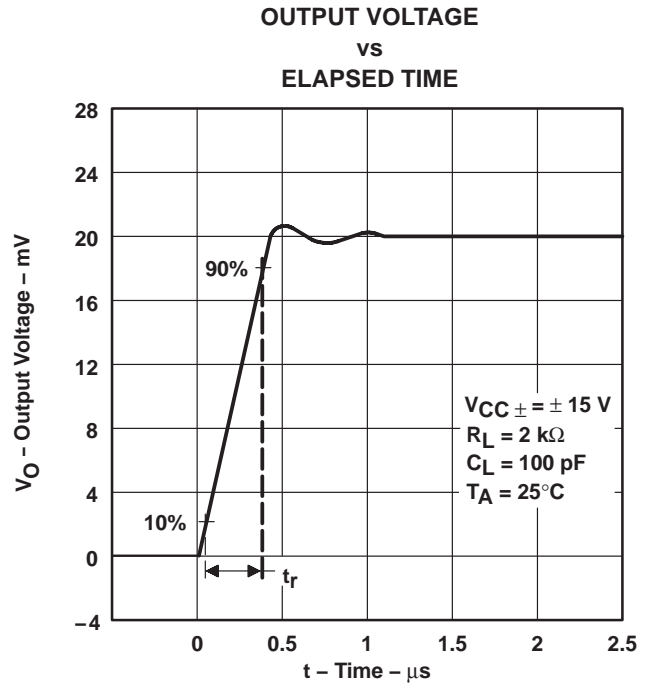
## TYPICAL CHARACTERISTICS



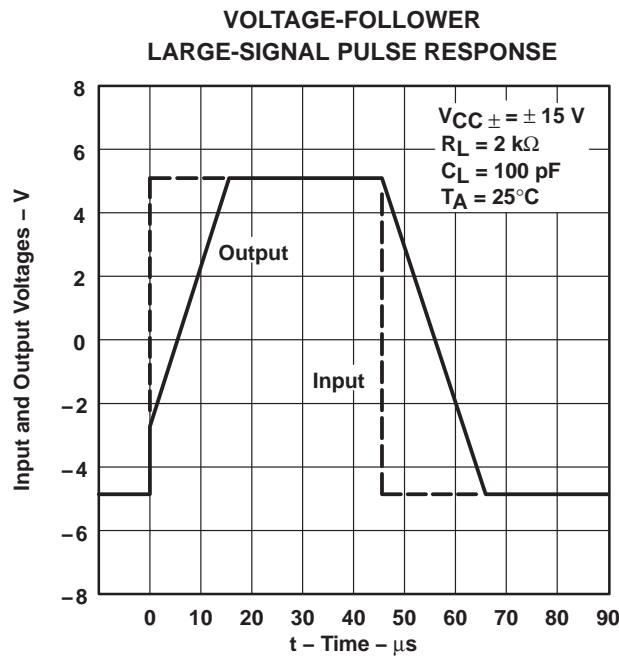
**TYPICAL CHARACTERISTICS**



**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.

**Important Information and Disclaimer:** The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and



continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

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



- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  -  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.
  -  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.

## IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its hardware products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by government requirements, testing of all parameters of each product is not necessarily performed.

TI assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using TI components. To minimize the risks associated with customer products and applications, customers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI products or services with statements different from or beyond the parameters stated by TI for that product or service voids all express and any implied warranties for the associated TI product or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

TI products are not authorized for use in safety-critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, unless officers of the parties have executed an agreement specifically governing such use. Buyers represent that they have all necessary expertise in the safety and regulatory ramifications of their applications, and acknowledge and agree that they are solely responsible for all legal, regulatory and safety-related requirements concerning their products and any use of TI products in such safety-critical applications, notwithstanding any applications-related information or support that may be provided by TI. Further, Buyers must fully indemnify TI and its representatives against any damages arising out of the use of TI products in such safety-critical applications.

TI products are neither designed nor intended for use in military/aerospace applications or environments unless the TI products are specifically designated by TI as military-grade or "enhanced plastic." Only products designated by TI as military-grade meet military specifications. Buyers acknowledge and agree that any such use of TI products which TI has not designated as military-grade is solely at the Buyer's risk, and that they are solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI products are neither designed nor intended for use in automotive applications or environments unless the specific TI products are designated by TI as compliant with ISO/TS 16949 requirements. Buyers acknowledge and agree that, if they use any non-designated products in automotive applications, TI will not be responsible for any failure to meet such requirements.

Following are URLs where you can obtain information on other Texas Instruments products and application solutions:

### Products

Audio	<a href="http://www.ti.com/audio">www.ti.com/audio</a>
Amplifiers	<a href="http://amplifier.ti.com">amplifier.ti.com</a>
Data Converters	<a href="http://dataconverter.ti.com">dataconverter.ti.com</a>
DLP® Products	<a href="http://www.dlp.com">www.dlp.com</a>
DSP	<a href="http://dsp.ti.com">dsp.ti.com</a>
Clocks and Timers	<a href="http://www.ti.com/clocks">www.ti.com/clocks</a>
Interface	<a href="http://interface.ti.com">interface.ti.com</a>
Logic	<a href="http://logic.ti.com">logic.ti.com</a>
Power Mgmt	<a href="http://power.ti.com">power.ti.com</a>
Microcontrollers	<a href="http://microcontroller.ti.com">microcontroller.ti.com</a>
RFID	<a href="http://www.ti-rfid.com">www.ti-rfid.com</a>
RF/IF and ZigBee® Solutions	<a href="http://www.ti.com/lprf">www.ti.com/lprf</a>

### Applications

Communications and Telecom	<a href="http://www.ti.com/communications">www.ti.com/communications</a>
Computers and Peripherals	<a href="http://www.ti.com/computers">www.ti.com/computers</a>
Consumer Electronics	<a href="http://www.ti.com/consumer-apps">www.ti.com/consumer-apps</a>
Energy and Lighting	<a href="http://www.ti.com/energy">www.ti.com/energy</a>
Industrial	<a href="http://www.ti.com/industrial">www.ti.com/industrial</a>
Medical	<a href="http://www.ti.com/medical">www.ti.com/medical</a>
Security	<a href="http://www.ti.com/security">www.ti.com/security</a>
Space, Avionics and Defense	<a href="http://www.ti.com/space-avionics-defense">www.ti.com/space-avionics-defense</a>
Transportation and Automotive	<a href="http://www.ti.com/automotive">www.ti.com/automotive</a>
Video and Imaging	<a href="http://www.ti.com/video">www.ti.com/video</a>
Wireless	<a href="http://www.ti.com/wireless-apps">www.ti.com/wireless-apps</a>

TI E2E Community Home Page

[e2e.ti.com](http://e2e.ti.com)

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265  
Copyright © 2011, Texas Instruments Incorporated