- **Short-Circuit Protection**
- **Offset-Voltage Null Capability**
- **Large Common-Mode and Differential Voltage Ranges**
- **No Frequency Compensation Required**
- **Low Power Consumption**
- **No Latch-Up**
- **Designed to Be Interchangeable With Fairchild µA741**

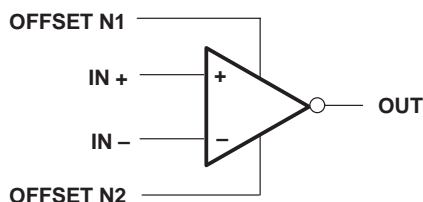## description

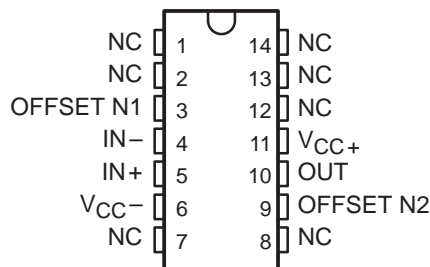The µA741 is a general-purpose operational amplifier featuring offset-voltage null capability.

The high common-mode input voltage range and the absence of latch-up make the 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 µA741C is characterized for operation from 0°C to 70°C. The µA741I is characterized for operation from −40°C to 85°C.The µA741M is characterized for operation over the full military temperature range of −55°C to 125°C.
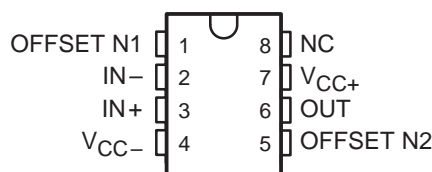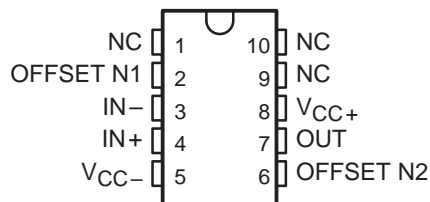
symbol

µA741M . . . J PACKAGE
(TOP VIEW)

NC	1	14	NC
NC	2	13	NC
OFFSET N1	3	12	NC
IN−	4	11	V_{CC+}
IN+	5	10	OUT
V_{CC-}	6	9	OFFSET N2
NC	7	8	NC

µA741M . . . JG PACKAGE
µA741C, µA741I . . . D, P, OR PW PACKAGE
(TOP VIEW)

OFFSET N1	1	8	NC
IN−	2	7	V_{CC+}
IN+	3	6	OUT
V_{CC-}	4	5	OFFSET N2

µA741M . . . U PACKAGE
(TOP VIEW)

NC	1	10	NC
OFFSET N1	2	9	NC
IN−	3	8	V_{CC+}
IN+	4	7	OUT
V_{CC-}	5	6	OFFSET N2

µA741M . . . FK PACKAGE
(TOP VIEW)
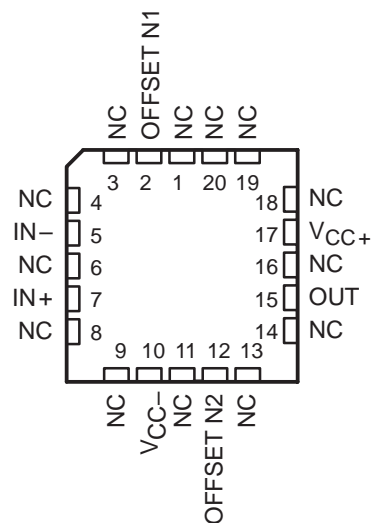
NC – No internal connection

TEXAS INSTRUMENTS

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µA741, µA741Y
GENERAL-PURPOSE OPERATIONAL AMPLIFIERS

SLOS094B – NOVEMBER 1970 – REVISED SEPTEMBER 2000

AVAILABLE OPTIONS

| | PACKAGED DEVICES | | | | | | | CHIP FORM (Y) |
T$_A$	SMALL OUTLINE (D)	CHIP CARRIER (FK)	CERAMIC DIP (J)	CERAMIC DIP (JG)	PLASTIC DIP (P)	TSSOP (PW)	FLAT PACK (U)	
0°C to 70°C	µA741CD				µA741CP	µA741CPW		µA741Y
−40°C to 85°C	µA741ID				µA741IP			
−55°C to 125°C		µA741MFK	µA741MJ	µA741MJG			µA741MU	

The D package is available taped and reeled. Add the suffix R (e.g., µA741CDR).

schematic
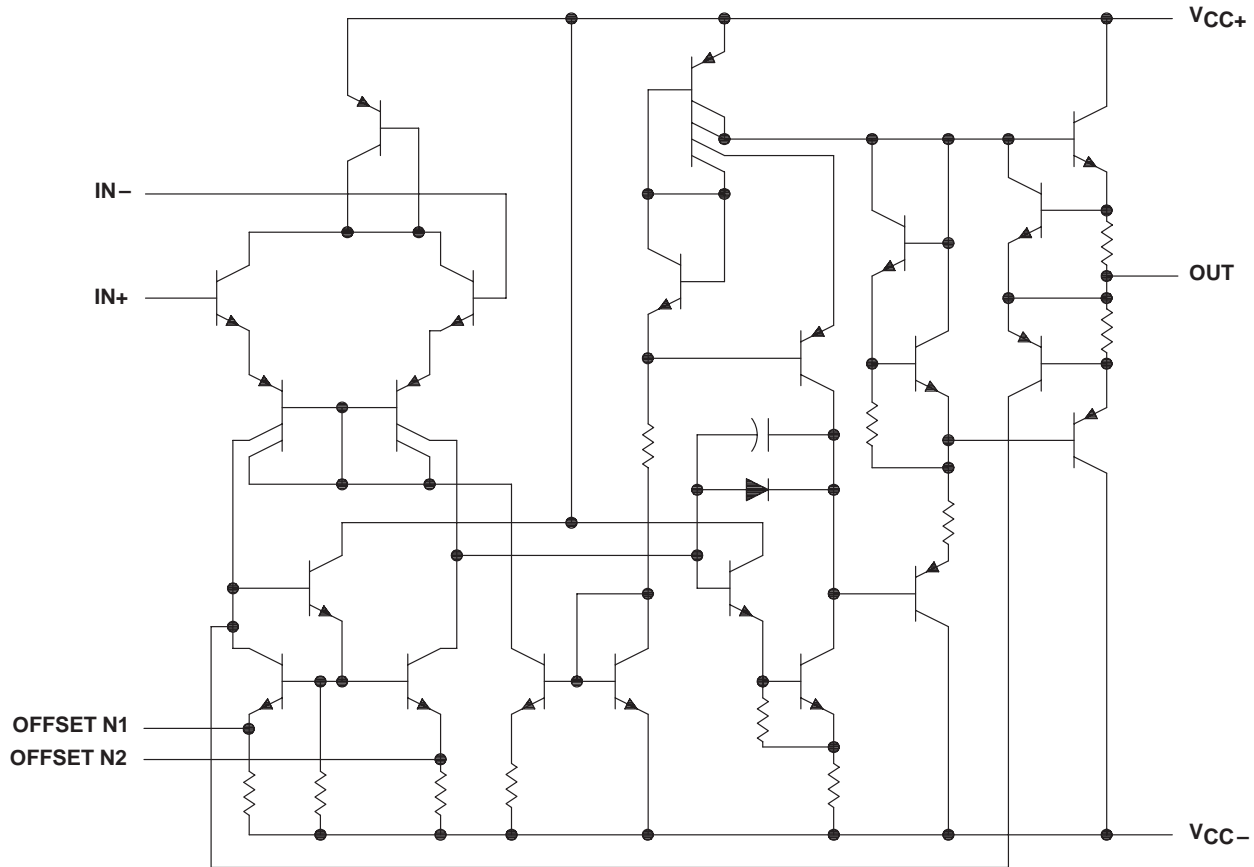
Component Count	
Transistors	22
Resistors	11
Diode	1
Capacitor	1

μA741Y chip information

This chip, when properly assembled, displays characteristics similar to the μA741C. Thermal compression or ultrasonic bonding may be used on the doped-aluminum bonding pads. Chips may be mounted with conductive epoxy or a gold-silicon preform.

BONDING PAD ASSIGNMENTS

CHIP THICKNESS: 15 TYPICAL

BONDING PADS: 4 × 4 MINIMUM

T$_J$max = 150°C.

TOLERANCES ARE ±10%.

ALL DIMENSIONS ARE IN MILS.

µA741, µA741Y
GENERAL-PURPOSE OPERATIONAL AMPLIFIERS

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

		µA741C	µA741I	µA741M	UNIT
Supply voltage, V_{CC+} (see Note 1)		18	22	22	V
Supply voltage, V_{CC-} (see Note 1)		−18	−22	−22	V
Differential input voltage, V_{ID} (see Note 2)		±15	±30	±30	V
Input voltage, V_I any input (see Notes 1 and 3)		±15	±15	±15	V
Voltage between offset null (either OFFSET N1 or OFFSET N2) and V_{CC-}		±15	±0.5	±0.5	V
Duration of output short circuit (see Note 4)		unlimited	unlimited	unlimited	
Continuous total power dissipation		See Dissipation Rating Table			
Operating free-air temperature range, T_A		0 to 70	−40 to 85	−55 to 125	°C
Storage temperature range		−65 to 150	−65 to 150	−65 to 150	°C
Case temperature for 60 seconds	FK package			260	°C
Lead temperature 1,6 mm (1/16 inch) from case for 60 seconds	J, JG, or U package			300	°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds	D, P, or PW package	260	260		°C

† Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

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 IN+ with respect to IN−.
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 µA741M 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	$T_A \leq 25°C$ POWER RATING	DERATING FACTOR	DERATE ABOVE T_A	$T_A = 70°C$ POWER RATING	$T_A = 85°C$ POWER RATING	$T_A = 125°C$ POWER RATING
D	500 mW	5.8 mW/°C	64°C	464 mW	377 mW	N/A
FK	500 mW	11.0 mW/°C	105°C	500 mW	500 mW	275 mW
J	500 mW	11.0 mW/°C	105°C	500 mW	500 mW	275 mW
JG	500 mW	8.4 mW/°C	90°C	500 mW	500 mW	210 mW
P	500 mW	N/A	N/A	500 mW	500 mW	N/A
PW	525 mW	4.2 mW/°C	25°C	336 mW	N/A	N/A
U	500 mW	5.4 mW/°C	57°C	432 mW	351 mW	135 mW

TEXAS INSTRUMENTS
POST OFFICE BOX 655303 • DALLAS, TEXAS 75265

electrical characteristics at specified free-air temperature, $V_{CC\pm} = \pm15$ V (unless otherwise noted)

PARAMETER		TEST CONDITIONS	T_A†	µA741C MIN	µA741C TYP	µA741C MAX	µA741I, µA741M MIN	µA741I, µA741M TYP	µA741I, µA741M MAX	UNIT
V_{IO}	Input offset voltage	$V_O = 0$	25°C		1	6		1	5	mV
			Full range			7.5			6	
$\Delta V_{IO(adj)}$	Offset voltage adjust range	$V_O = 0$	25°C		±15			±15		mV
I_{IO}	Input offset current	$V_O = 0$	25°C		20	200		20	200	nA
			Full range			300			500	
I_{IB}	Input bias current	$V_O = 0$	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_{OM}	Maximum peak output voltage swing	$R_L = 10$ kΩ	25°C	±12	±14		±12	±14		V
		$R_L \geq 10$ kΩ	Full range	±12			±12			
		$R_L = 2$ kΩ	25°C	±10	±13		±10	±13		
		$R_L \geq 2$ kΩ	Full range	±10			±10			
A_{VD}	Large-signal differential voltage amplification	$R_L \geq 2$ kΩ	25°C	20	200		50	200		V/mV
		$V_O = \pm10$ V	Full range	15			25			
r_i	Input resistance		25°C	0.3	2		0.3	2		MΩ
r_o	Output resistance	$V_O = 0$, See Note 5	25°C		75			75		Ω
C_i	Input capacitance		25°C		1.4			1.4		pF
CMRR	Common-mode rejection ratio	$V_{IC} = V_{ICR}$min	25°C	70	90		70	90		dB
			Full range	70			70			
k_{SVS}	Supply voltage sensitivity ($\Delta V_{IO}/\Delta V_{CC}$)	$V_{CC} = \pm9$ V to ±15 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	$V_O = 0$, No load	25°C		1.7	2.8		1.7	2.8	mA
			Full range			3.3			3.3	
P_D	Total power dissipation	$V_O = 0$, No load	25°C		50	85		50	85	mW
			Full range			100			100	

† All characteristics are measured under open-loop conditions with zero common-mode input voltage unless otherwise specified. Full range for the µA741C is 0°C to 70°C, the µA741I is −40°C to 85°C, and the µA741M 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, $V_{CC\pm} = \pm15$ V, $T_A = 25$°C

PARAMETER		TEST CONDITIONS		µA741C MIN	µA741C TYP	µA741C MAX	µA741I, µA741M MIN	µA741I, µA741M TYP	µA741I, µA741M MAX	UNIT
t_r	Rise time	$V_I = 20$ mV, $C_L = 100$ pF,	$R_L = 2$ kΩ, See Figure 1		0.3			0.3		µs
	Overshoot factor				5%			5%		
SR	Slew rate at unity gain	$V_I = 10$ V, $C_L = 100$ pF,	$R_L = 2$ kΩ, See Figure 1		0.5			0.5		V/µs

μA741, μA741Y
GENERAL-PURPOSE OPERATIONAL AMPLIFIERS

electrical characteristics at specified free-air temperature, $V_{CC\pm} = \pm15$ V, $T_A = 25°C$ (unless otherwise noted)

PARAMETER		TEST CONDITIONS	μA741Y MIN	μA741Y TYP	μA741Y MAX	UNIT
V_{IO}	Input offset voltage	$V_O = 0$		1	6	mV
$\Delta V_{IO(adj)}$	Offset voltage adjust range	$V_O = 0$		±15		mV
I_{IO}	Input offset current	$V_O = 0$		20	200	nA
I_{IB}	Input bias current	$V_O = 0$		80	500	nA
V_{ICR}	Common-mode input voltage range		±12	±13		V
V_{OM}	Maximum peak output voltage swing	$R_L = 10$ kΩ	±12	±14		V
		$R_L = 2$ kΩ	±10	±13		
A_{VD}	Large-signal differential voltage amplification	$R_L \geq 2$ kΩ	20	200		V/mV
r_i	Input resistance		0.3	2		MΩ
r_o	Output resistance	$V_O = 0$, See Note 5		75		Ω
C_i	Input capacitance			1.4		pF
CMRR	Common-mode rejection ratio	$V_{IC} = V_{ICR}$min	70	90		dB
k_{SVS}	Supply voltage sensitivity ($\Delta V_{IO}/\Delta V_{CC}$)	$V_{CC} = \pm9$ V to ±15 V		30	150	μV/V
I_{OS}	Short-circuit output current			±25	±40	mA
I_{CC}	Supply current	$V_O = 0$, No load		1.7	2.8	mA
P_D	Total power dissipation	$V_O = 0$, No load		50	85	mW

† All characteristics are measured under open-loop conditions with zero common-mode voltage unless otherwise specified.
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, $V_{CC\pm} = \pm15$ V, $T_A = 25°C$

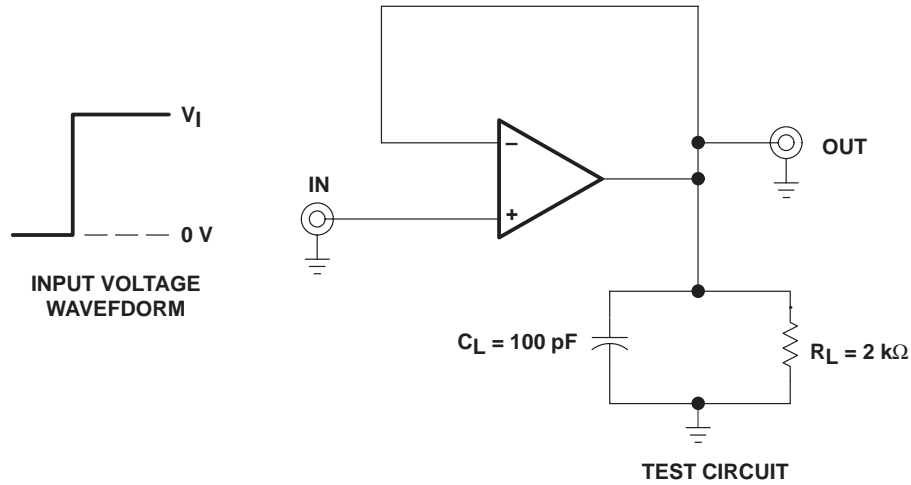| PARAMETER		TEST CONDITIONS	μA741Y MIN	μA741Y TYP	μA741Y MAX	UNIT
t_r	Rise time	$V_I = 20$ mV, $R_L = 2$ kΩ,		0.3		μs
	Overshoot factor	$C_L = 100$ pF, See Figure 1		5%		
SR	Slew rate at unity gain	$V_I = 10$ V, $R_L = 2$ kΩ, $C_L = 100$ pF, See Figure 1		0.5		V/μs

PARAMETER MEASUREMENT INFORMATION

Figure 1. Rise Time, Overshoot, and Slew Rate

APPLICATION INFORMATION

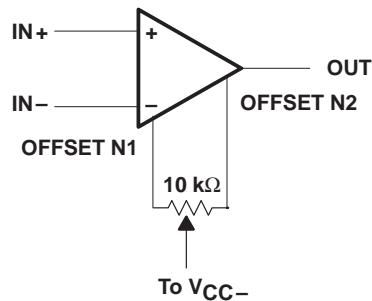Figure 2 shows a diagram for an input offset voltage null circuit.

Figure 2. Input Offset Voltage Null Circuit

TEXAS
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TYPICAL CHARACTERISTICS†

INPUT OFFSET CURRENT
vs
FREE-AIR TEMPERATURE

Figure 3

INPUT BIAS CURRENT
vs
FREE-AIR TEMPERATURE

Figure 4

MAXIMUM PEAK OUTPUT VOLTAGE
vs
LOAD RESISTANCE
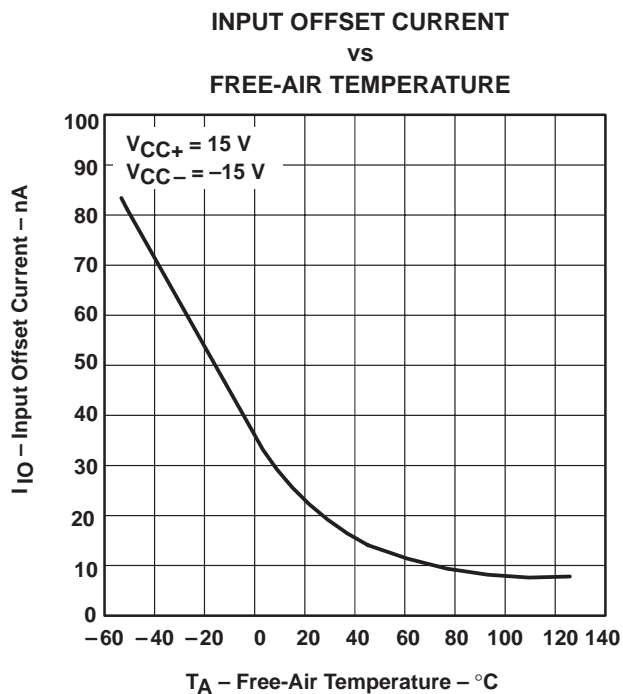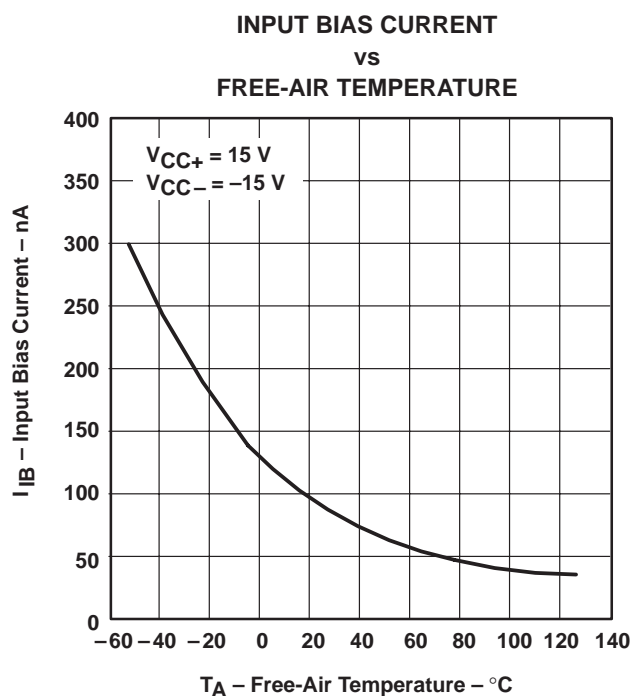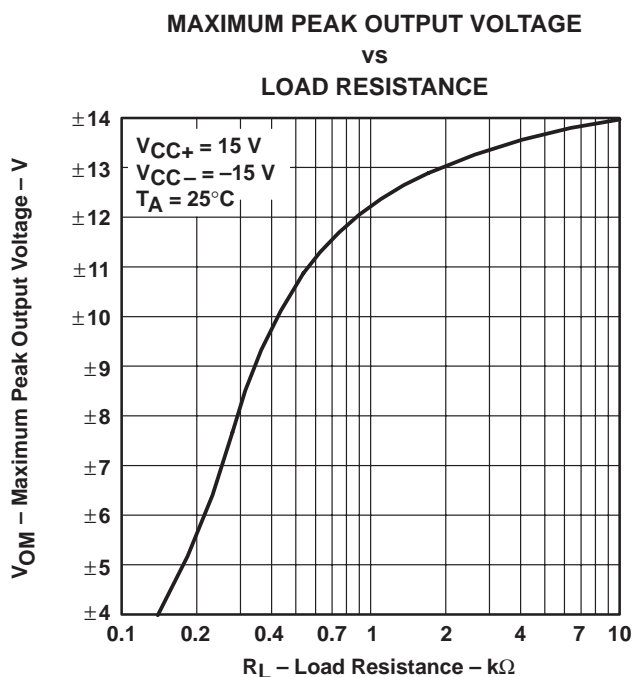

Figure 5

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

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TYPICAL CHARACTERISTICS

MAXIMUM PEAK OUTPUT VOLTAGE
vs
FREQUENCY

V_{CC+} = 15 V
V_{CC-} = −15 V
R_L = 10 kΩ
T_A = 25°C
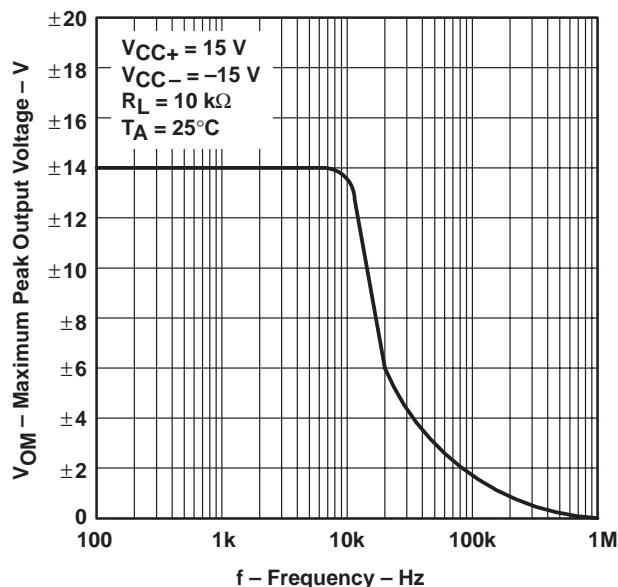
Figure 6

OPEN-LOOP SIGNAL DIFFERENTIAL
VOLTAGE AMPLIFICATION
vs
SUPPLY VOLTAGE

V_O = ±10 V
R_L = 2 kΩ
T_A = 25°C
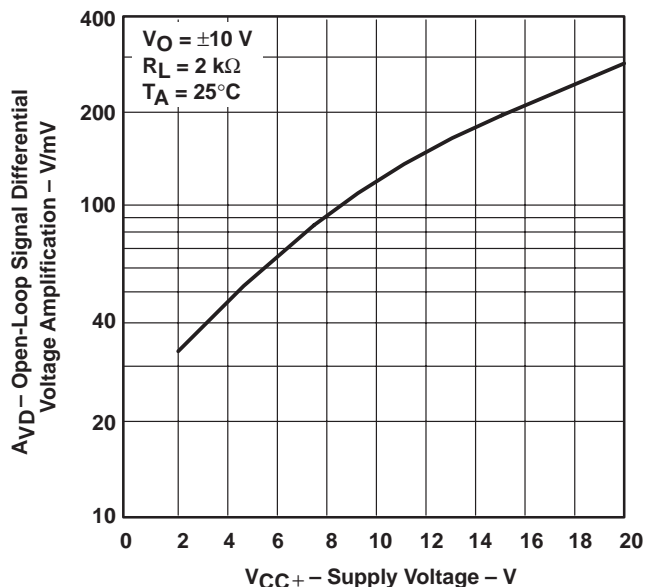
Figure 7

OPEN-LOOP LARGE-SIGNAL DIFFERENTIAL
VOLTAGE AMPLIFICATION
vs
FREQUENCY

V_{CC+} = 15 V
V_{CC-} = −15 V
V_O = ±10 V
R_L = 2 kΩ
T_A = 25°C
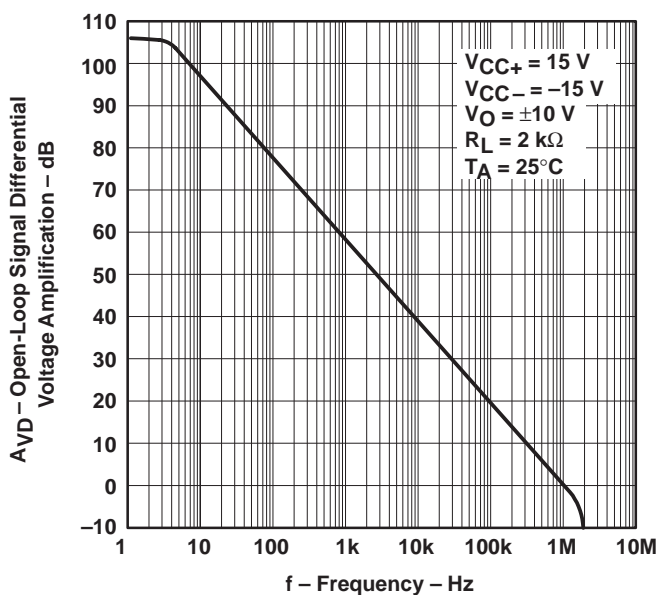
TYPICAL CHARACTERISTICS

COMMON-MODE REJECTION RATIO
vs
FREQUENCY

V_{CC+} = 15 V
V_{CC-} = −15 V
B_S = 10 kΩ
T_A = 25°C

CMRR – Common-Mode Rejection Ratio – dB

f – Frequency – Hz
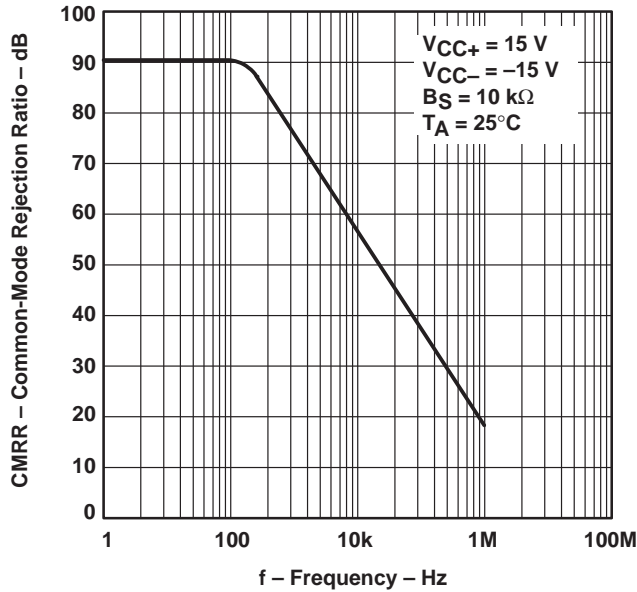
Figure 8

OUTPUT VOLTAGE
vs
ELAPSED TIME

90%

10%

t_r

V_{CC+} = 15 V
V_{CC-} = −15 V
R_L = 2 kΩ
C_L = 100 pF
T_A = 25°C

V_O – Output Voltage – mV

t – Time – µs
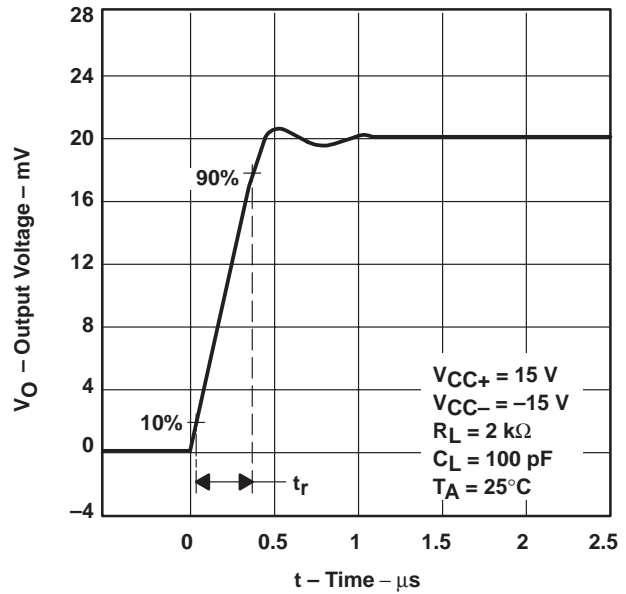
Figure 9

VOLTAGE-FOLLOWER
LARGE-SIGNAL PULSE RESPONSE

V_{CC+} = 15 V
V_{CC-} = −15 V
R_L = 2 kΩ
C_L = 100 pF
T_A = 25°C

V_O

V_I

Input and Output Voltage – V

t – Time – µs

Figure 10

TEXAS
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PACKAGING INFORMATION

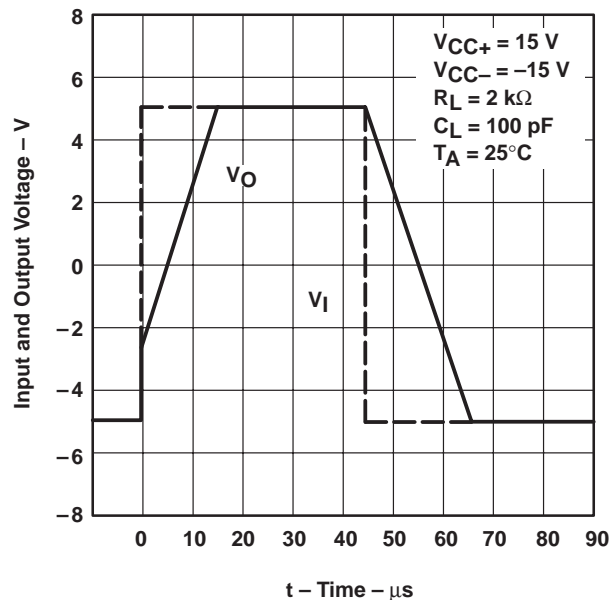| Orderable Device	Status [1]	Package Type	Package Drawing	Pins	Package Qty	Eco Plan [2]	Lead/Ball Finish	MSL Peak Temp [3]
UA741CD	ACTIVE	SOIC	D	8	75	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/Level-1-235C-UNLIM
UA741CDR	ACTIVE	SOIC	D	8	2500	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/Level-1-235C-UNLIM
UA741CJG	OBSOLETE	CDIP	JG	8		TBD	Call TI	Call TI
UA741CJG4	OBSOLETE	CDIP	JG	8		TBD	Call TI	Call TI
UA741CP	ACTIVE	PDIP	P	8	50	Pb-Free (RoHS)	CU NIPDAU	Level-NC-NC-NC
UA741CPSR	ACTIVE	SO	PS	8	2000	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/Level-1-235C-UNLIM
UA741MFKB	OBSOLETE	LCCC	FK	20		TBD	Call TI	Call TI
UA741MJ	OBSOLETE	CDIP	J	14		TBD	Call TI	Call TI
UA741MJB	OBSOLETE	CDIP	J	14		TBD	Call TI	Call TI
UA741MJG	OBSOLETE	CDIP	JG	8		TBD	Call TI	Call TI
UA741MJGB	OBSOLETE	CDIP	JG	8		TBD	Call TI	Call TI

[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] Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS) 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.
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)

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

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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.

JG (R-GDIP-T8)   **CERAMIC DUAL-IN-LINE**

$$\frac{0.400\ (10,16)}{0.355\ (9,00)}$$

8   5

$$\frac{0.280\ (7,11)}{0.245\ (6,22)}$$

1   4

$$\frac{0.065\ (1,65)}{0.045\ (1,14)}$$

$$\frac{0.063\ (1,60)}{0.015\ (0,38)}$$

0.020 (0,51) MIN

$$\frac{0.310\ (7,87)}{0.290\ (7,37)}$$

0.200 (5,08) MAX

Seating Plane

0.130 (3,30) MIN

$$\frac{0.023\ (0,58)}{0.015\ (0,38)}$$

0.100 (2,54)

$$\frac{0.014\ (0,36)}{0.008\ (0,20)}$$

0°–15°

4040107/C 08/96

NOTES: A. All linear dimensions are in inches (millimeters).
           B. This drawing is subject to change without notice.
           C. This package can be hermetically sealed with a ceramic lid using glass frit.
           D. Index point is provided on cap for terminal identification.
           E. Falls within MIL STD 1835 GDIP1-T8

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)

B

14   8

1   7

$\dfrac{0.065\ (1,65)}{0.045\ (1,14)}$

C

0.005 (0,13) MIN

$\dfrac{0.060\ (1,52)}{0.015\ (0,38)}$

0.200 (5,08) MAX

Seating Plane

0.130 (3,30) MIN

$\dfrac{0.026\ (0,66)}{0.014\ (0,36)}$

0.100 (2,54)

A

0°—15°

$\dfrac{0.014\ (0,36)}{0.008\ (0,20)}$

4040083/F 03/03

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

FK (S-CQCC-N**)   **LEADLESS CERAMIC CHIP CARRIER**

28 TERMINAL SHOWN

NO. OF TERMINALS **	A		B	
	MIN	MAX	MIN	MAX
20	0.342 (8,69)	0.358 (9,09)	0.307 (7,80)	0.358 (9,09)
28	0.442 (11,23)	0.458 (11,63)	0.406 (10,31)	0.458 (11,63)
44	0.640 (16,26)	0.660 (16,76)	0.495 (12,58)	0.560 (14,22)
52	0.739 (18,78)	0.761 (19,32)	0.495 (12,58)	0.560 (14,22)
68	0.938 (23,83)	0.962 (24,43)	0.850 (21,6)	0.858 (21,8)
84	1.141 (28,99)	1.165 (29,59)	1.047 (26,6)	1.063 (27,0)

4040140/D 10/96
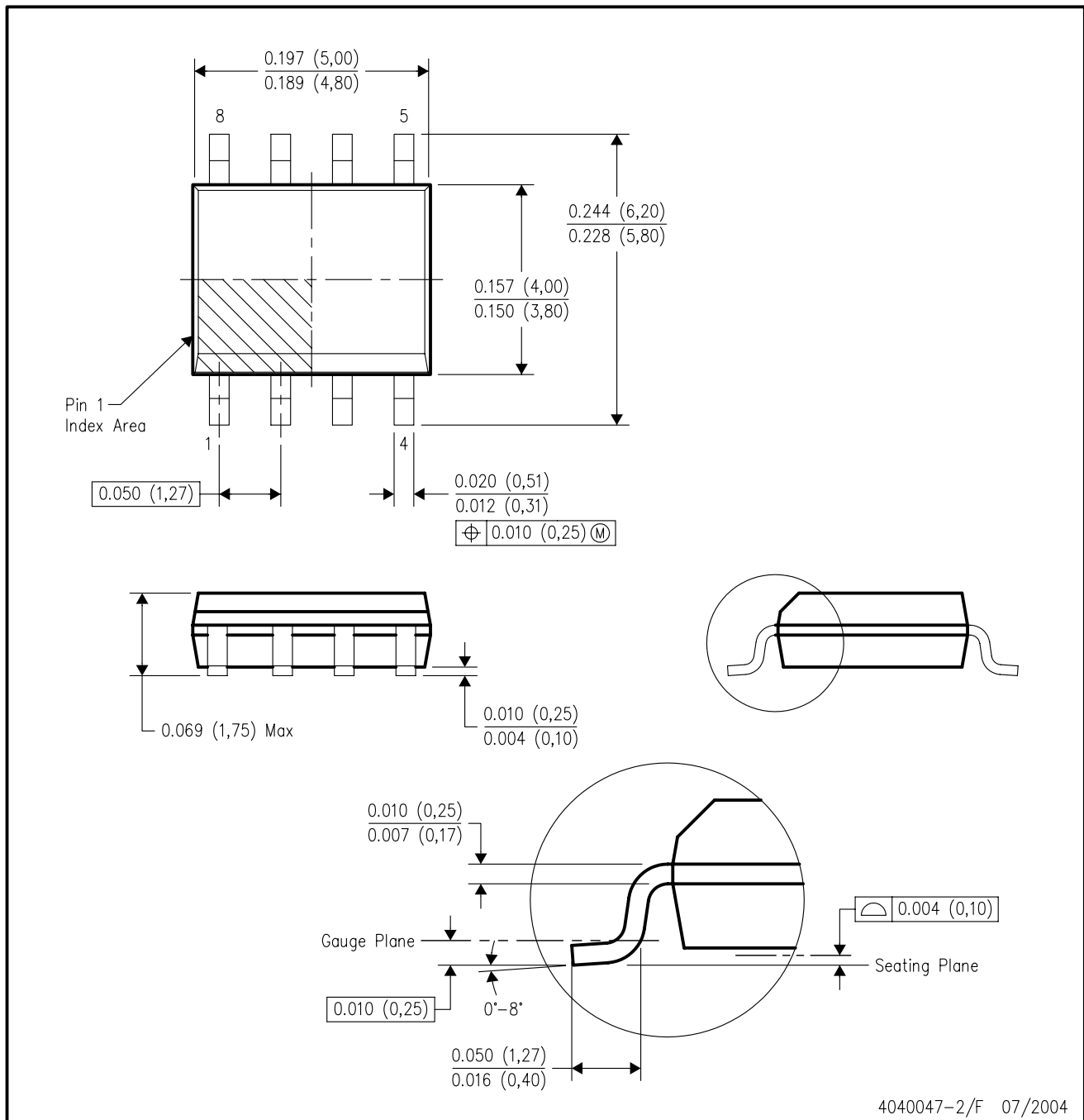
NOTES: A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. This package can be hermetically sealed with a metal lid.
D. The terminals are gold plated.
E. Falls within JEDEC MS-004

TEXAS INSTRUMENTS

POST OFFICE BOX 655303 ● DALLAS, TEXAS 75265

P (R-PDIP-T8)   **PLASTIC DUAL-IN-LINE**

0.400 (10,60)
0.355 (9,02)

8   5

0.260 (6,60)
0.240 (6,10)

1   4

0.070 (1,78) MAX

0.020 (0,51) MIN

0.200 (5,08) MAX

0.325 (8,26)
0.300 (7,62)

0.015 (0,38)

Gage Plane

Seating Plane

0.125 (3,18) MIN

0.010 (0,25) NOM

0.100 (2,54)

0.021 (0,53)
0.015 (0,38)   ⊕ 0.010 (0,25) Ⓜ

0.430 (10,92)
MAX

4040082/D 05/98

NOTES: A. All linear dimensions are in inches (millimeters).
   B. This drawing is subject to change without notice.
   C. Falls within JEDEC MS-001

For the latest package information, go to http://www.ti.com/sc/docs/package/pkg_info.htm

TEXAS INSTRUMENTS

POST OFFICE BOX 655303 ● DALLAS, TEXAS 75265

D (R−PDSO−G8)   PLASTIC SMALL−OUTLINE PACKAGE

0.197 (5,00)
0.189 (4,80)

8   5

0.244 (6,20)
0.228 (5,80)

0.157 (4,00)
0.150 (3,80)

Pin 1
Index Area

1   4

0.050 (1,27)

0.020 (0,51)
0.012 (0,31)

⊕ 0.010 (0,25) Ⓜ

0.069 (1,75) Max

0.010 (0,25)
0.004 (0,10)

0.010 (0,25)
0.007 (0,17)

Gauge Plane

0.004 (0,10)

Seating Plane

0.010 (0,25)   0°−8°

0.050 (1,27)
0.016 (0,40)

4040047−2/F   07/2004

NOTES: A.   All linear dimensions are in inches (millimeters).
         B.   This drawing is subject to change without notice.
         C.   Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15).
         D.   Falls within JEDEC MS−012 variation AA.

4040063/C 03/03

NOTES: A.   All linear dimensions are in millimeters.
         B.   This drawing is subject to change without notice.
         C.   Body dimensions do not include mold flash or protrusion, not to exceed 0,15.

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