

# μA741, μA741Y GENERAL-PURPOSE OPERATIONAL AMPLIFIERS

SLOS094B – NOVEMBER 1970 – REVISED SEPTEMBER 2000

- 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

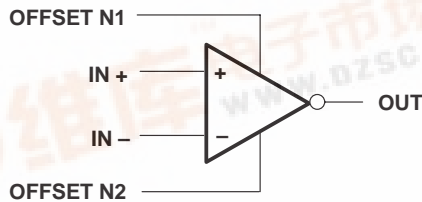
## description

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

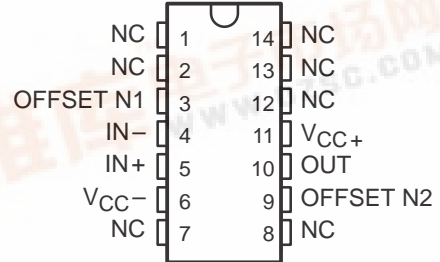
The high common-mode input voltage range and the absence of latch-up make the amplifier ideal for voltage-follower applications. The device is short-circuit protected and the internal frequency compensation ensures stability without external components. A low value potentiometer may be connected between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

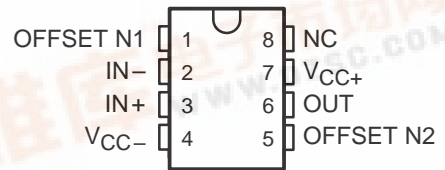
## symbol



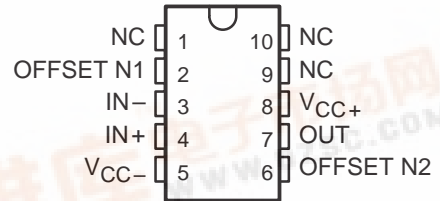
μA741M ... J PACKAGE  
(TOP VIEW)



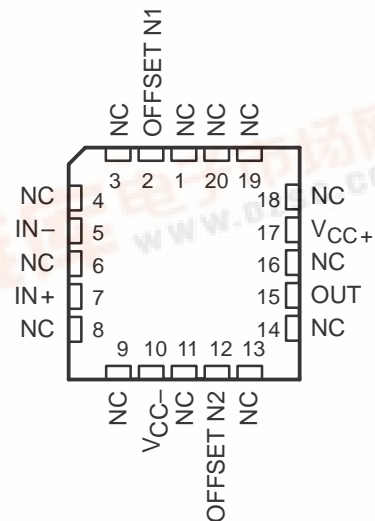
μA741M ... JG PACKAGE  
μA741C, μA741I ... D, P, OR PW PACKAGE  
(TOP VIEW)



μA741M ... U PACKAGE  
(TOP VIEW)



μA741M ... FK PACKAGE  
(TOP VIEW)



NC – No internal connection



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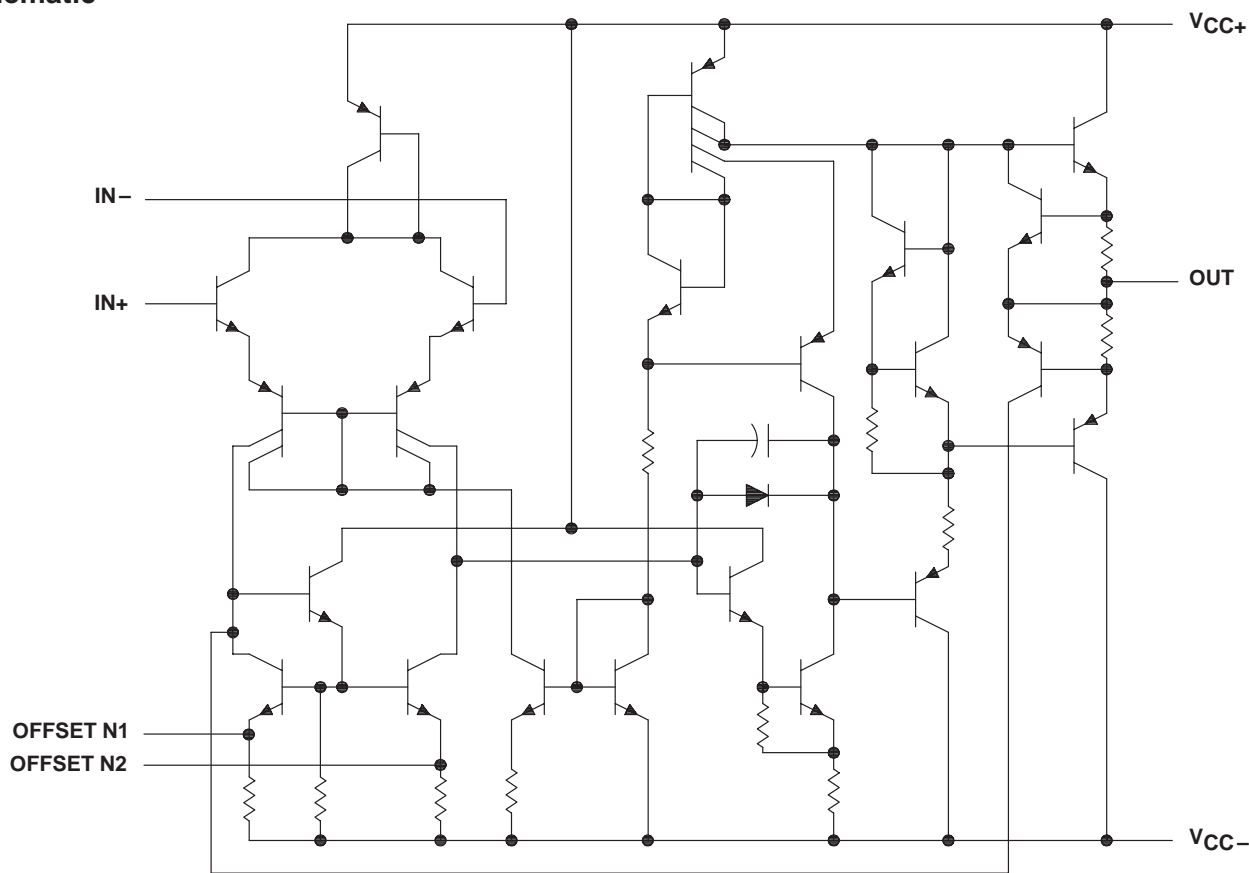
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## AVAILABLE OPTIONS

T <sub>A</sub>	PACKAGED DEVICES							CHIP FORM (Y)
	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



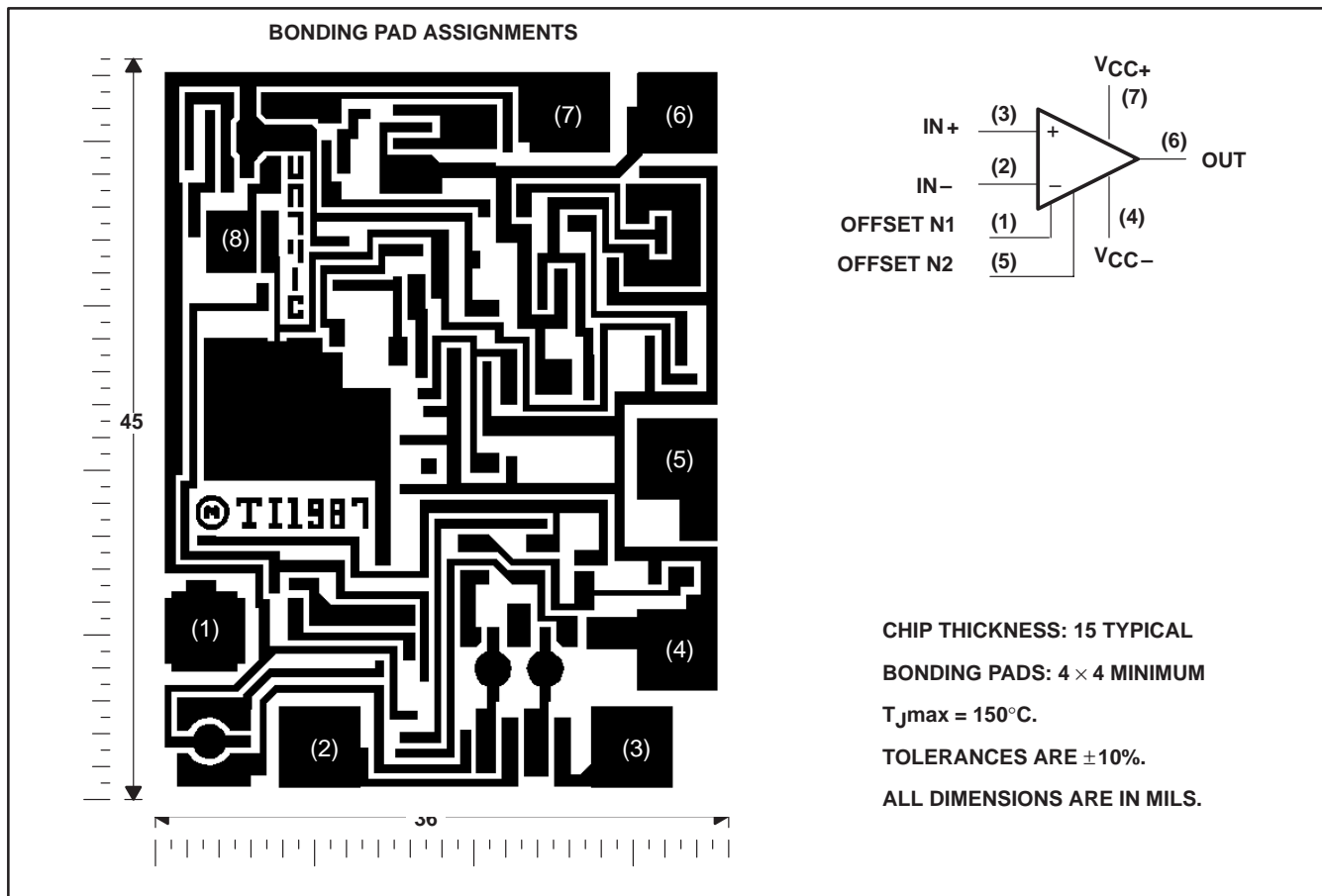
Component Count	
Transistors	22
Resistors	11
Diode	1
Capacitor	1

# μA741, μA741Y GENERAL-PURPOSE OPERATIONAL AMPLIFIERS

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## 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.



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## 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	$T_A \leq 25^\circ\text{C}$ POWER RATING	DERATING FACTOR	DERATE ABOVE $T_A$	$T_A = 70^\circ\text{C}$ POWER RATING	$T_A = 85^\circ\text{C}$ POWER RATING	$T_A = 125^\circ\text{C}$ 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

# μA741, μA741Y GENERAL-PURPOSE OPERATIONAL AMPLIFIERS

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**electrical characteristics at specified free-air temperature,  $V_{CC\pm} = \pm 15$  V (unless otherwise noted)**

PARAMETER	TEST CONDITIONS	$T_A$ †	μA741C			μA741I, μA741M			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	
$\Delta V_{IO(adj)}$ 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
	$V_O = \pm 10$ 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	$V_{IC} = V_{ICRmin}$	25°C		70	90		70	90	dB
		Full range		70			70		
$k_{SVS}$ Supply voltage sensitivity ( $\Delta V_{IO}/\Delta V_{CC}$ )	$V_{CC} = \pm 9$ V to $\pm 15$ 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,  $V_{CC\pm} = \pm 15$  V,  $T_A = 25^\circ\text{C}$**

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

# μA741, μA741Y GENERAL-PURPOSE OPERATIONAL AMPLIFIERS

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electrical characteristics at specified free-air temperature,  $V_{CC\pm} = \pm 15\text{ V}$ ,  $T_A = 25^\circ\text{C}$  (unless otherwise noted)

PARAMETER		TEST CONDITIONS	μA741Y			UNIT
			MIN	TYP	MAX	
$V_{IO}$	Input offset voltage	$V_O = 0$		1	6	mV
$\Delta V_{IO(\text{adj})}$	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	$R_L = 10\text{ k}\Omega$	±12	±14		V
		$R_L = 2\text{ k}\Omega$	±10	±13		
$A_{VD}$	Large-signal differential voltage amplification	$R_L \geq 2\text{ k}\Omega$	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	$V_{IC} = V_{ICR\text{min}}$	70	90		dB
$k_{SVS}$	Supply voltage sensitivity ( $\Delta V_{IO}/\Delta V_{CC}$ )	$V_{CC} = \pm 9\text{ V to } \pm 15\text{ V}$		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

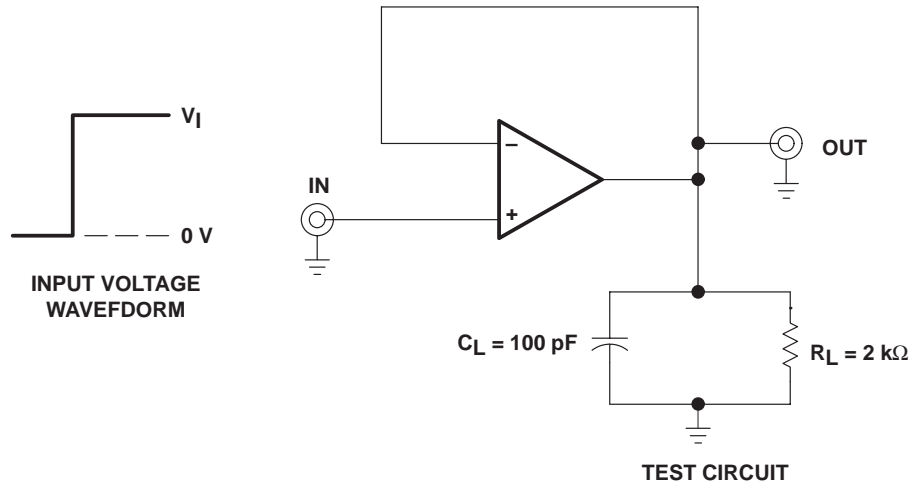
† All characteristics are measured under open-loop conditions with zero common-mode voltage unless otherwise specified.

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

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

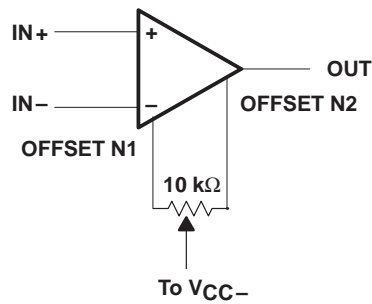
**PARAMETER MEASUREMENT INFORMATION**



**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**

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## TYPICAL CHARACTERISTICS†

INPUT OFFSET CURRENT  
vs  
FREE-AIR TEMPERATURE

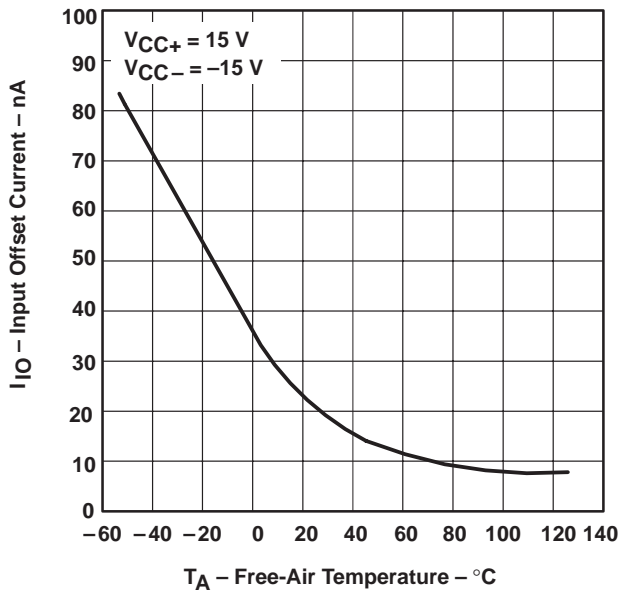


Figure 3

INPUT BIAS CURRENT  
vs  
FREE-AIR TEMPERATURE

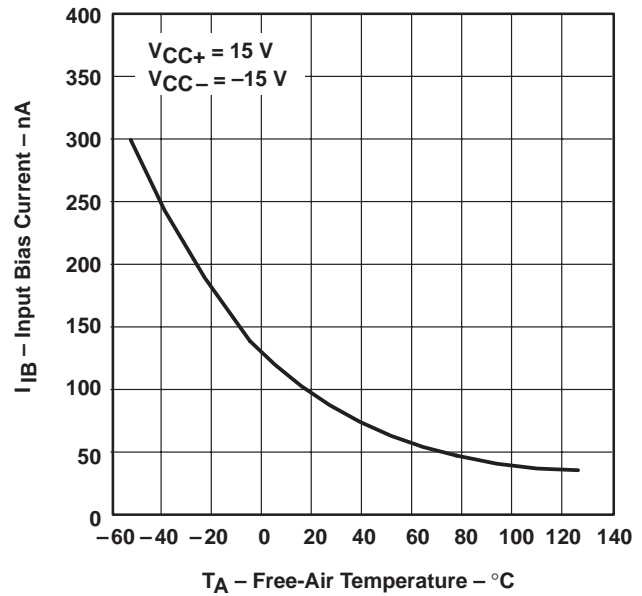


Figure 4

MAXIMUM PEAK OUTPUT VOLTAGE  
vs  
LOAD RESISTANCE

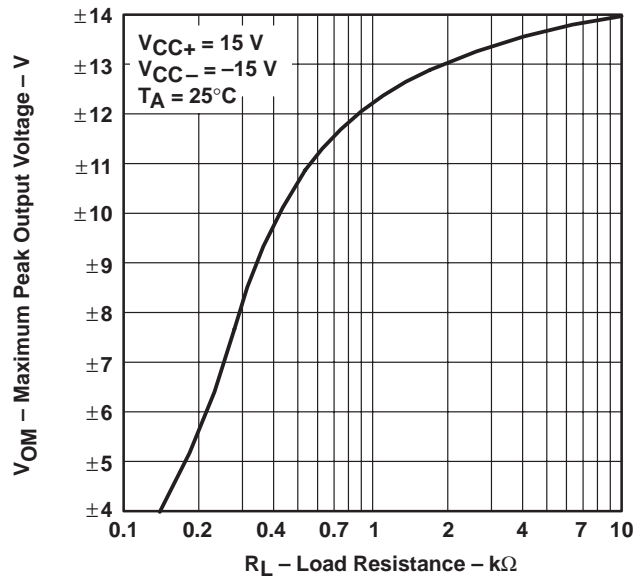


Figure 5

† 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

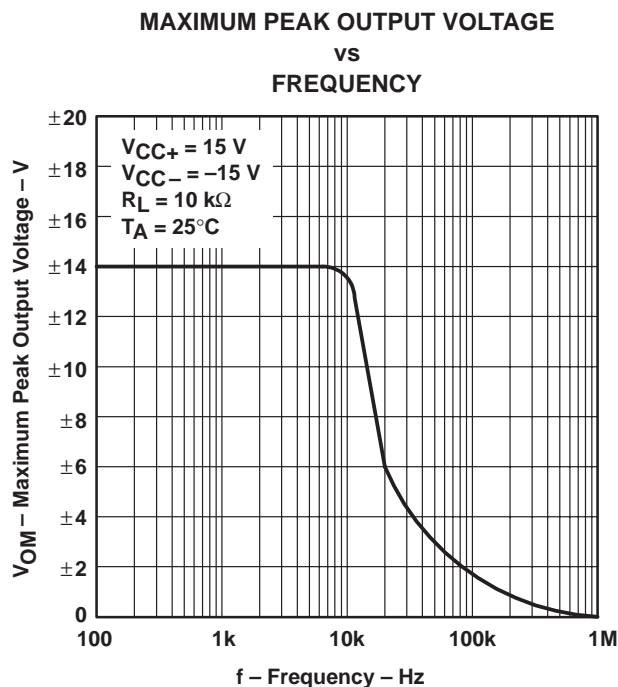


Figure 6

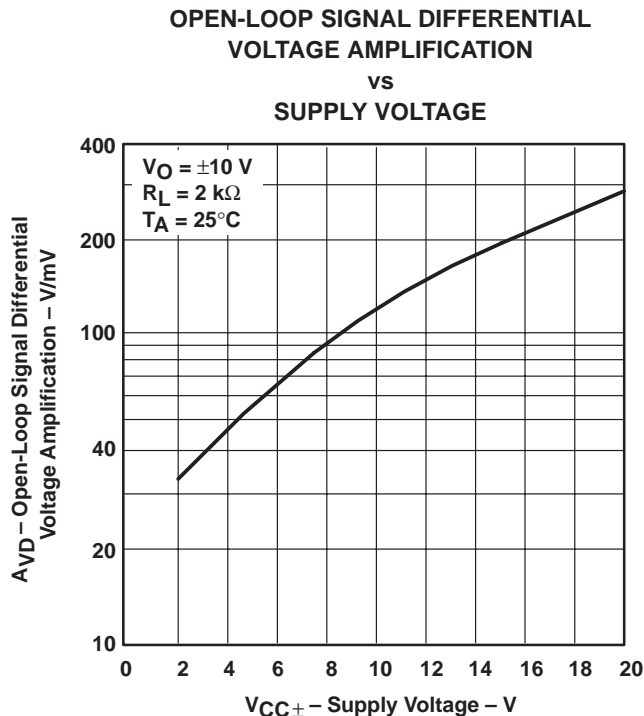
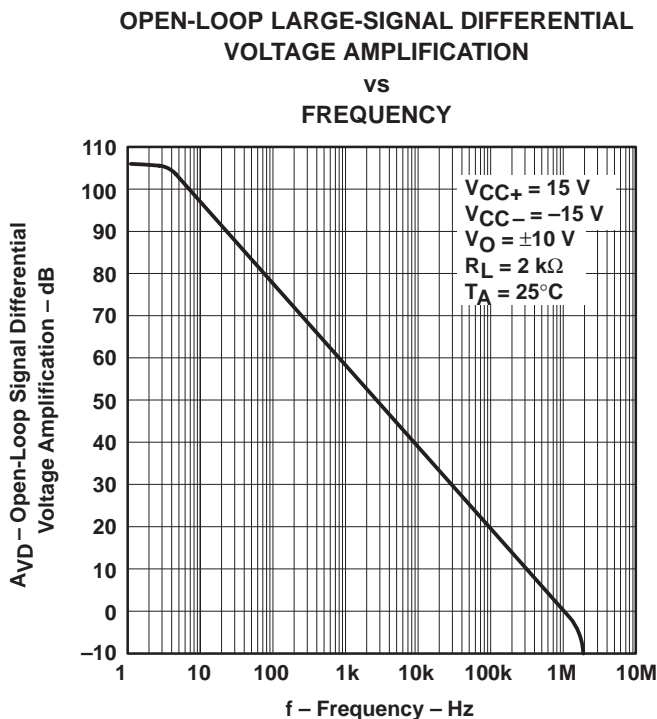


Figure 7



# $\mu$ A741, $\mu$ A741Y GENERAL-PURPOSE OPERATIONAL AMPLIFIERS

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## TYPICAL CHARACTERISTICS

COMMON-MODE REJECTION RATIO  
vs  
FREQUENCY

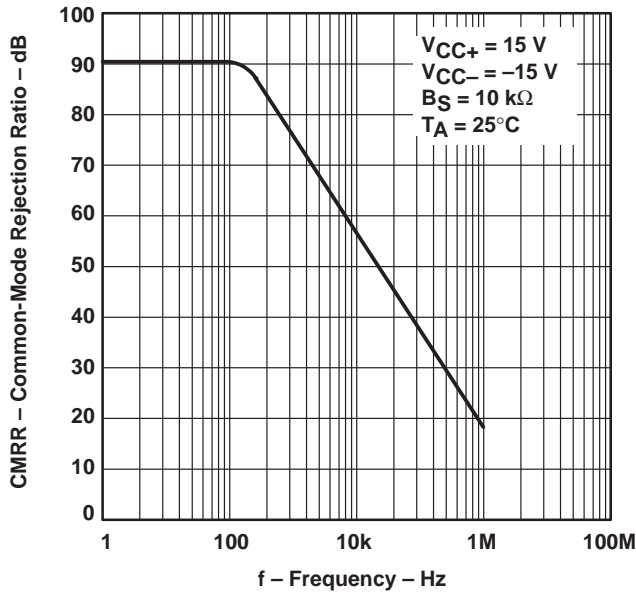


Figure 8

OUTPUT VOLTAGE  
vs  
ELAPSED TIME

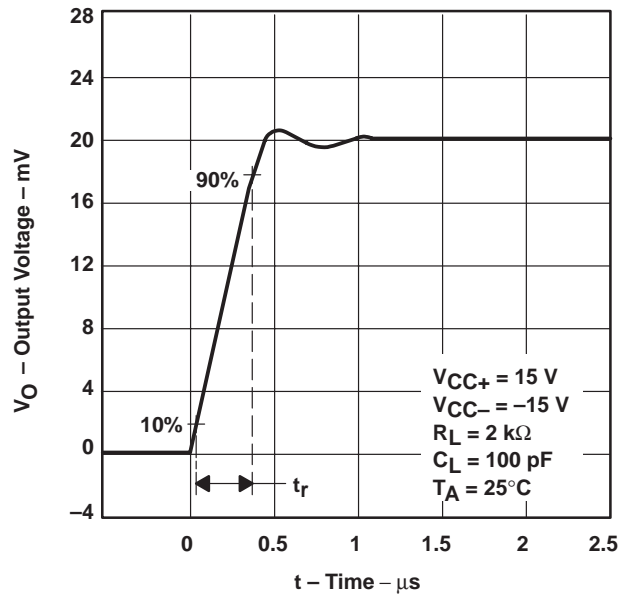


Figure 9

VOLTAGE-FOLLOWER  
LARGE-SIGNAL PULSE RESPONSE

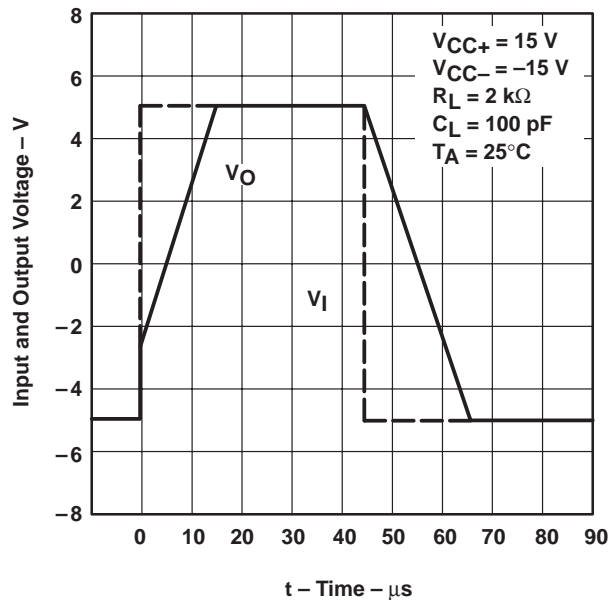


Figure 10

## 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>
UA741CD	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
UA741CDE4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
UA741CDG4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
UA741CDR	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
UA741CDRE4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
UA741CDRG4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-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	N / A for Pkg Type
UA741CPE4	ACTIVE	PDIP	P	8	50	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
UA741CPSR	ACTIVE	SO	PS	8	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
UA741CPSRE4	ACTIVE	SO	PS	8	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-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

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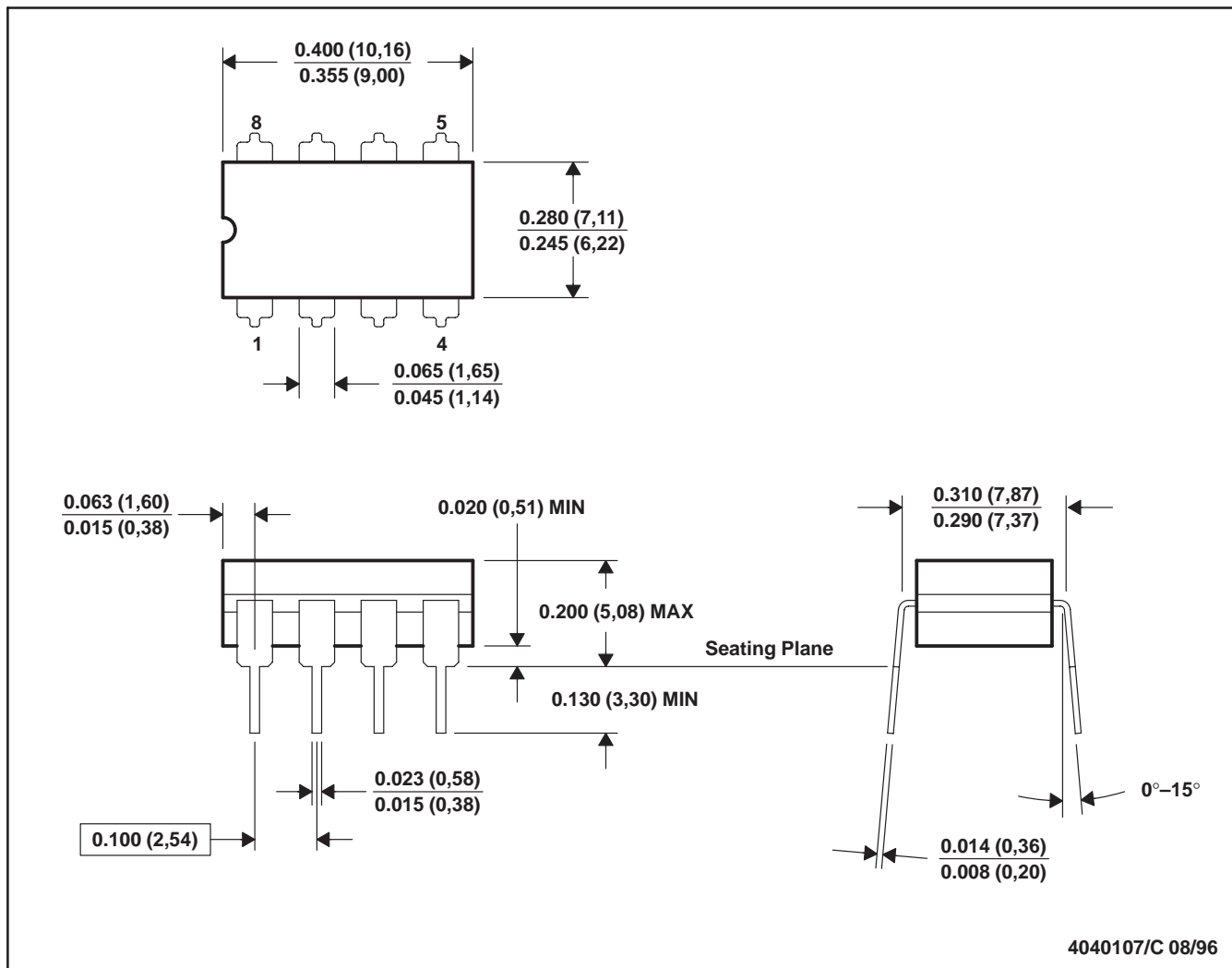
In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

# MECHANICAL DATA

MCER001A – JANUARY 1995 – REVISED JANUARY 1997

JG (R-GDIP-T8)

CERAMIC DUAL-IN-LINE



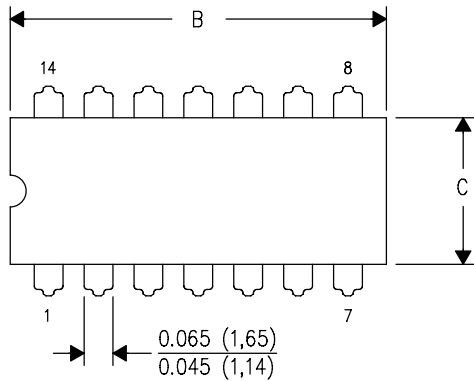
4040107/C 08/96

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

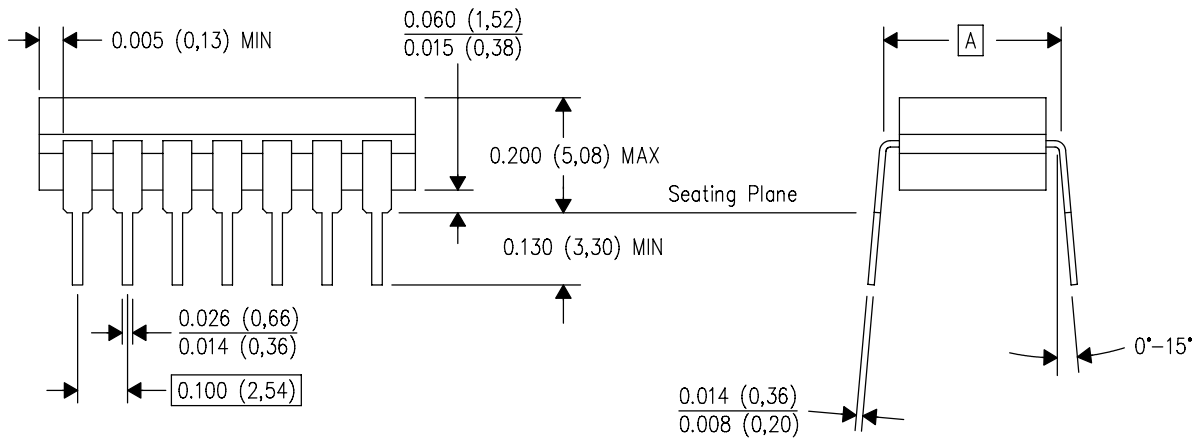
J (R-GDIP-T\*\*)

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:
- 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.

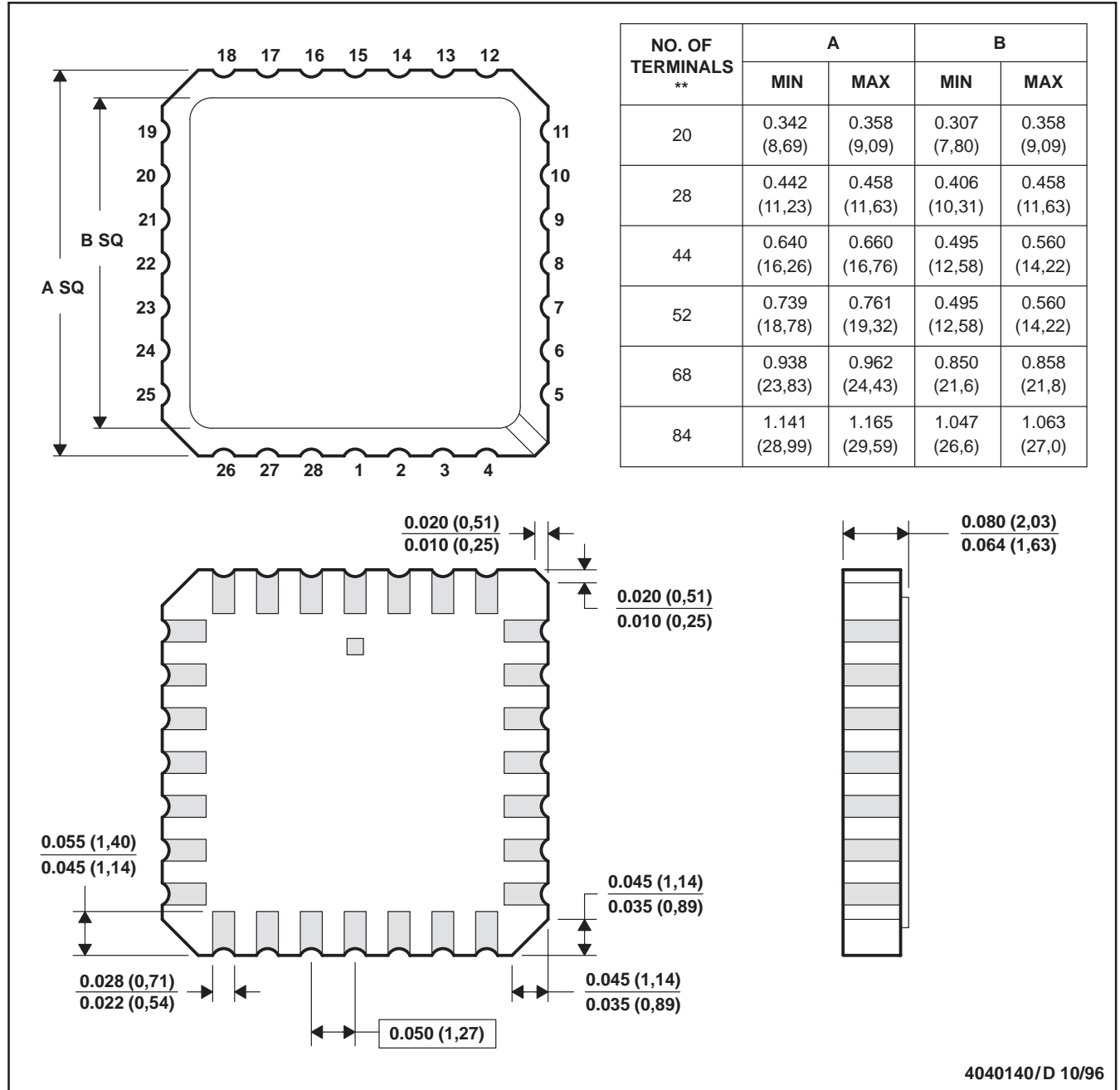
# MECHANICAL DATA

MLCC006B – OCTOBER 1996

## FK (S-CQCC-N\*\*)

## LEADLESS CERAMIC CHIP CARRIER

28 TERMINAL SHOWN



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

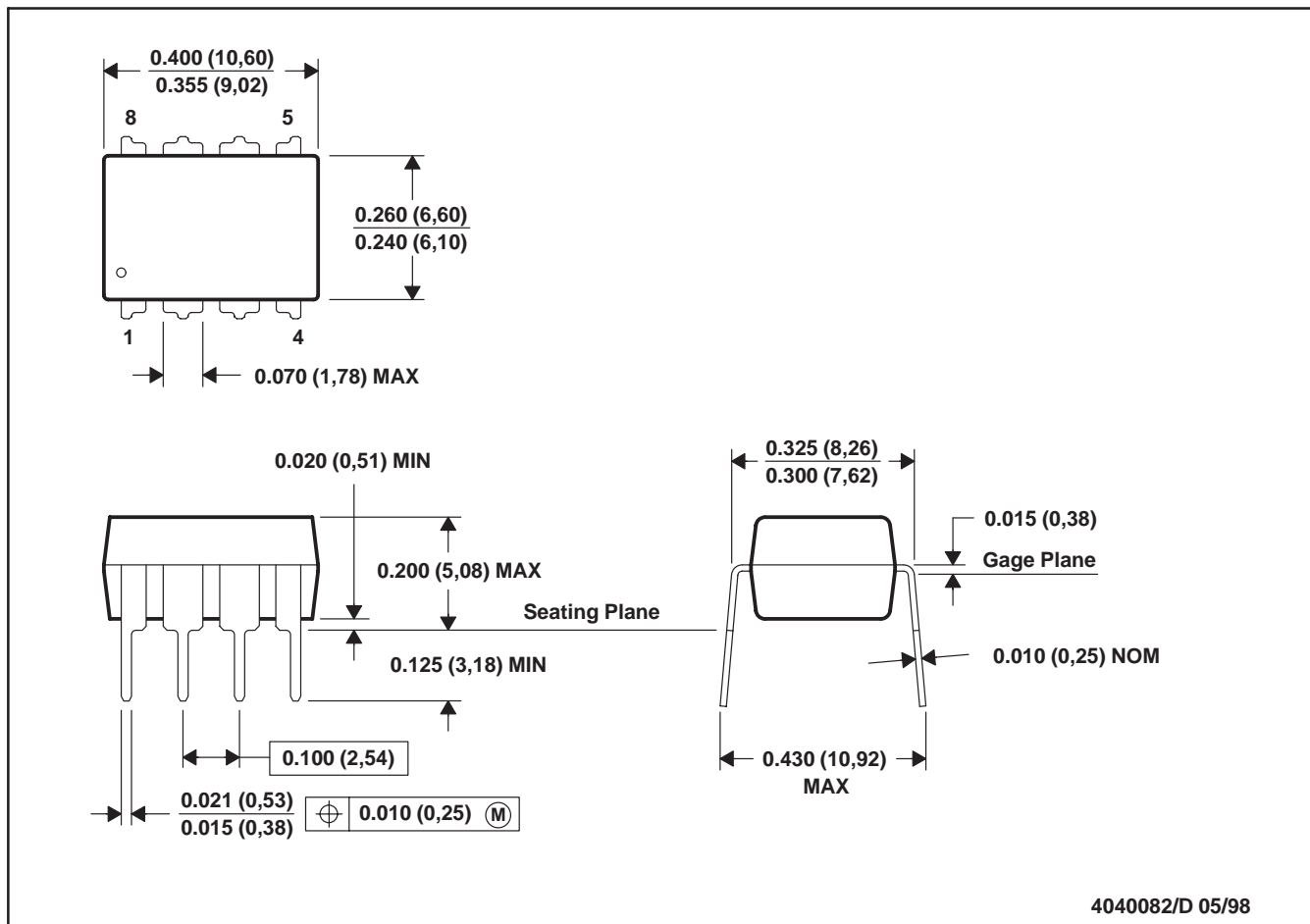
4040140/D 10/96

# MECHANICAL DATA

MPDI001A – JANUARY 1995 – REVISED JUNE 1999

## P (R-PDIP-T8)

## PLASTIC DUAL-IN-LINE



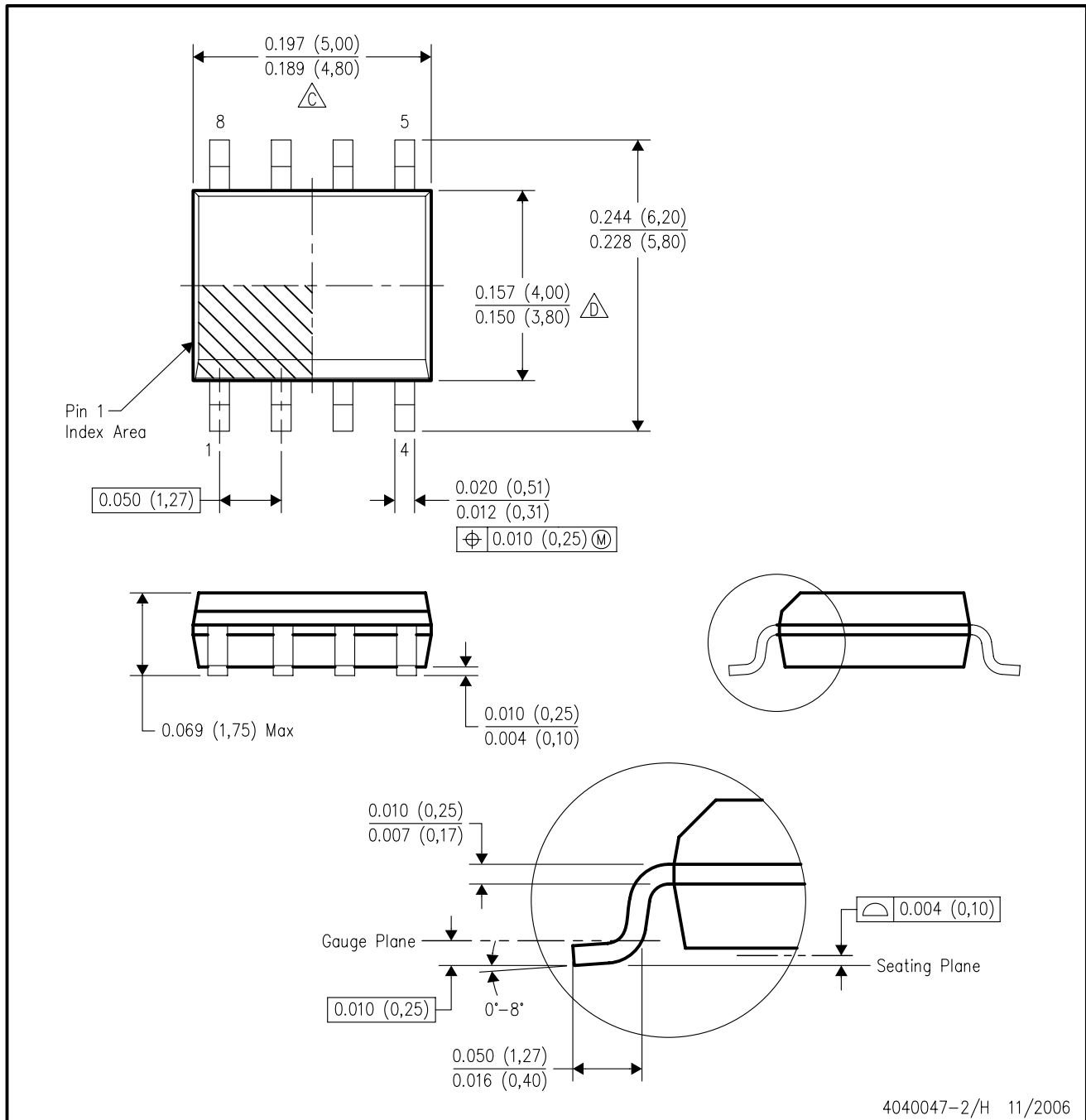
- NOTES: A. All linear dimensions are in inches (millimeters).  
 B. This drawing is subject to change without notice.  
 C. Falls within JEDEC MS-001



# MECHANICAL DATA

D (R-PDSO-G8)

PLASTIC SMALL-OUTLINE PACKAGE

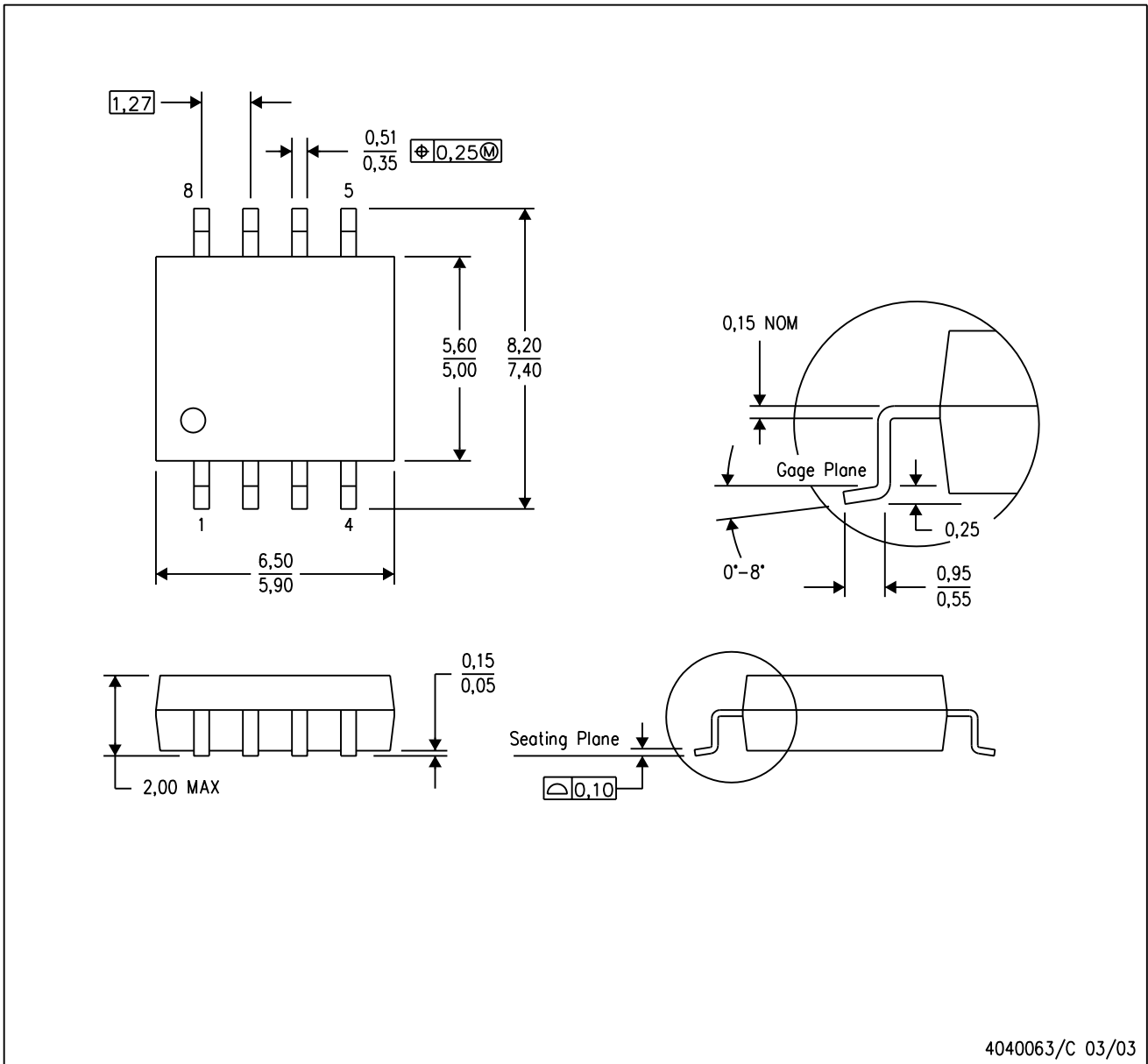


- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed .006 (0,15) per end.
  - D. Body width does not include interlead flash. Interlead flash shall not exceed .017 (0,43) per side.
  - E. Reference JEDEC MS-012 variation AA.

MECHANICAL DATA

PS (R-PDSO-G8)

PLASTIC SMALL-OUTLINE PACKAGE



- 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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