

TL022C, TL022M DUAL LOW-POWER OPERATIONAL AMPLIFIERS

SLOS076 – SEPTEMBER 1973 – REVISED SEPTEMBER 1990

- Very Low Power Consumption
- Power Dissipation With ± 2 -V Supplies
170 μ W Typ
- Low Input Bias and Offset Currents
- Output Short-Circuit Protection
- Low Input Offset Voltage
- Internal Frequency Compensation
- Latch-Up-Free Operation
- Popular Dual Operational Amplifier Pinout

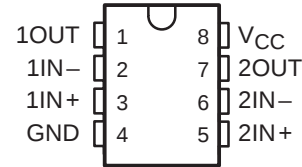
**TL022M IS NOT RECOMMENDED FOR
NEW DESIGNS**

description

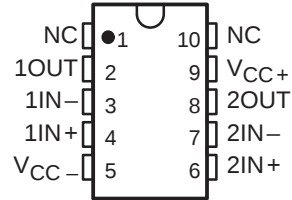
The TL022 is a dual low-power operational amplifier designed to replace higher power devices in many applications without sacrificing system performance. High input impedance, low supply currents, and low equivalent input noise voltage over a wide range of operating supply voltages result in an extremely versatile operational amplifier for use in a variety of analog applications including battery-operated circuits. Internal frequency compensation, absence of latch-up, high slew rate, and output short-circuit protection assure ease of use.

The TL022C is characterized for operation from 0°C to 70°C. The TL022M is characterized for operation over the full military temperature range of –55°C to 125°C.

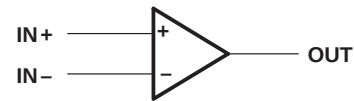
TL022M . . . JG PACKAGE
TL022C . . . D OR P PACKAGE
(TOP VIEW)



TL022M . . . U PACKAGE
(TOP VIEW)



symbol (each amplifier)



AVAILABLE OPTIONS

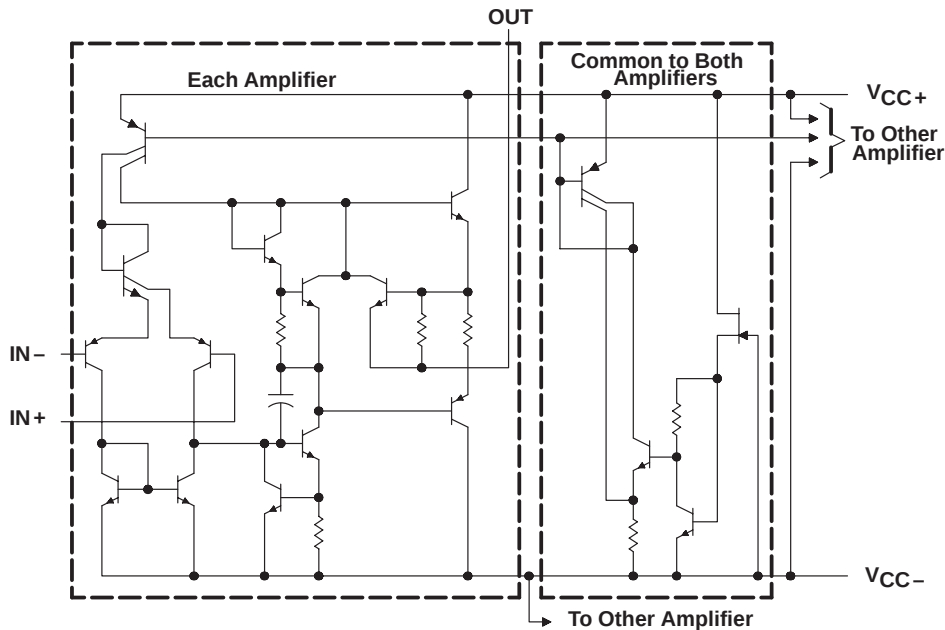
T _A	V _{IO} max AT 25°C	PACKAGE			
		SMALL OUTLINE (D)	CERAMIC DIP (JG)	PLASTIC DIP (P)	CERAMIC FLAT PACK (U)
0°C to 70°C	5 mV	TL022CD	—	TL022CP	—
–55°C to 125°C	5 mV	—	TL022MJG	—	TL022MU

The D package is available taped and reeled. Add the suffix R to the device type (i.e. TL022CDR).

TL022C, TL022M
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schematic



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

	TL022C	TL022M	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)	± 30	± 30	V
Input voltage (any input, see Notes 1 and 3)	± 15	± 15	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	$^{\circ}\text{C}$
Lead temperature 1,6 mm (1/16 inch) from case for 60 seconds	JG or U package	300	$^{\circ}\text{C}$
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds	D or P 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 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 TL022M 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	680 mW	5.8 mW/ $^{\circ}\text{C}$	33 $^{\circ}\text{C}$	464 mW	—
JG	680 mW	8.4 mW/ $^{\circ}\text{C}$	69 $^{\circ}\text{C}$	672 mW	210 mW
P	680 mW	8.0 mW/ $^{\circ}\text{C}$	65 $^{\circ}\text{C}$	640 mW	—
U	675 mW	5.4 mW/ $^{\circ}\text{C}$	25 $^{\circ}\text{C}$	432 mW	135 mW

TL022C, TL022M

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recommended operating conditions

	MIN	MAX	UNIT
Supply voltage, V_{CC+}	5	15	V
Supply voltage, V_{CC-}	-5	-15	V

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

PARAMETER		TEST CONDITIONS†		TL022C			TL022M			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
V _{IO}	Input offset voltage	V _O = 0, R _S = 50 Ω	25°C	1		5	1		5	mV
			Full range	7.5		6				
I _{IO}	Input offset current	V _O = 0	25°C	15		80	5		40	nA
			Full range	200		100				
I _{IB}	Input bias current	V _O = 0	25°C	100		250	50		100	nA
			Full range	400		250				
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 kΩ	25°C	20	26		20	26		V
		R _L ≥ 10 kΩ	Full range	20		20				
A _{VD}	Large-signal differehtial voltage amplification	R _L ≥ 10 kΩ, V _O = ±10 V	25°C	60	80		72	86		dB
			Full range	60		66				
B ₁	Unity-gain bandwidth		25°C	0.5			0.5		MHz	
CMRR	Common-mode rejection ratio	V _{IC} = V _{ICRmin} , R _S = 50 Ω	25°C	60	72		60	72		dB
			Full range	60		60				
k _{SVS}	Supply voltage sensitivity (ΔV _{IO} /ΔV _{CC})	V _{CC} = ± 9 V to ±15 V, R _S = 50 Ω	25°C	30		200	30		150	μV/V
			Full range	200		150				
V _n	Equivalent input noise voltage	A _{VD} = 20 dB, B = 1 Hz, f = 1 kHz	25°C	50			50		nV/Hz	
I _{OS}	Short-circuit output current		25°C	±6			±6		mA	
I _{CC}	Supply current (both amplifiers)	V _O = 0, No load	25°C	130		250	130		250	μA
			Full range	250		250				
P _D	Total dissipation (both amplifiers)	V _O = 0, No load	25°C	3.9		7.5	3.9		6	mW
			Full range	7.5		6				

† All characteristics are measured under open-loop conditions with zero common-mode input voltage unless otherwise specified. Full range for TL022C is 0°C to 70°C and for TL022M is -55°C to 125°C.

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	$V_I = 20 \text{ mV}$, $R_L = 10 \text{ k}\Omega$, $C_L = 100 \text{ pF}$, See Figure 1	0.3			μs
Overshoot factor		5%			
SR Slew rate at unity gain	$V_I = 10 \text{ V}$, $R_L = 10 \text{ k}\Omega$, $C_L = 100 \text{ pF}$, See Figure 1	0.5			$\text{V}/\mu\text{s}$



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PARAMETER MEASUREMENT INFORMATION

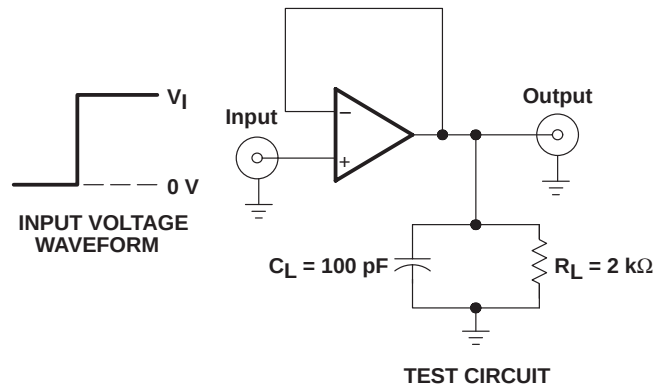


Figure 1. Rise Time, Overshoot Factor, and Slew Rate

TYPICAL CHARACTERISTICS

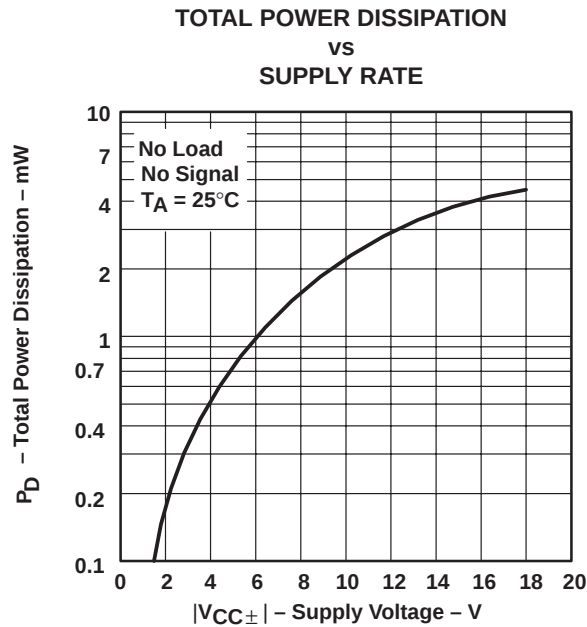


Figure 2

PACKAGING INFORMATION

Orderable part number	Status (1)	Material type (2)	Package Pins	Package qty Carrier	RoHS (3)	Lead finish/ Ball material (4)	MSL rating/ Peak reflow (5)	Op temp (°C)	Part marking (6)
TL022CD	Obsolete	Production	SOIC (D) 8	-	-	Call TI	Call TI	0 to 70	TL022C
TL022CDR	Active	Production	SOIC (D) 8	2500 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	0 to 70	TL022C
TL022CDR	Active	Production	SOIC (D) 8	2500 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	0 to 70	TL022C
TL022CDR	Active	Production	SOIC (D) 8	2500 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	0 to 70	TL022C
TL022CDR.A	Active	Production	SOIC (D) 8	2500 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	0 to 70	TL022C
TL022CDR.A	Active	Production	SOIC (D) 8	2500 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	0 to 70	TL022C
TL022CDR.A	Active	Production	SOIC (D) 8	2500 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	0 to 70	TL022C
TL022CDRG4	Active	Production	SOIC (D) 8	2500 LARGE T&R	-	Call TI	Call TI	0 to 70	
TL022CDRG4	Active	Production	SOIC (D) 8	2500 LARGE T&R	-	Call TI	Call TI	0 to 70	
TL022CDRG4	Active	Production	SOIC (D) 8	2500 LARGE T&R	-	Call TI	Call TI	0 to 70	
TL022CP	Active	Production	PDIP (P) 8	50 TUBE	Yes	NIPDAU	N/A for Pkg Type	0 to 70	TL022CP
TL022CP	Active	Production	PDIP (P) 8	50 TUBE	Yes	NIPDAU	N/A for Pkg Type	0 to 70	TL022CP
TL022CP	Active	Production	PDIP (P) 8	50 TUBE	Yes	NIPDAU	N/A for Pkg Type	0 to 70	TL022CP
TL022CP.A	Active	Production	PDIP (P) 8	50 TUBE	Yes	NIPDAU	N/A for Pkg Type	0 to 70	TL022CP
TL022CP.A	Active	Production	PDIP (P) 8	50 TUBE	Yes	NIPDAU	N/A for Pkg Type	0 to 70	TL022CP
TL022CP.A	Active	Production	PDIP (P) 8	50 TUBE	Yes	NIPDAU	N/A for Pkg Type	0 to 70	TL022CP
TL022CPSR	Active	Production	SO (PS) 8	2000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	0 to 70	T022
TL022CPSR	Active	Production	SO (PS) 8	2000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	0 to 70	T022
TL022CPSR	Active	Production	SO (PS) 8	2000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	0 to 70	T022
TL022CPSR.A	Active	Production	SO (PS) 8	2000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	0 to 70	T022
TL022CPSR.A	Active	Production	SO (PS) 8	2000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	0 to 70	T022
TL022CPSR.A	Active	Production	SO (PS) 8	2000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	0 to 70	T022
TL022CPSR.B	Active	Production	SO (PS) 8	2000 LARGE T&R	-	Call TI	Call TI	0 to 70	
TL022CPSR.B	Active	Production	SO (PS) 8	2000 LARGE T&R	-	Call TI	Call TI	0 to 70	
TL022CPSR.B	Active	Production	SO (PS) 8	2000 LARGE T&R	-	Call TI	Call TI	0 to 70	
TL022CPSRG4	Active	Production	SO (PS) 8	2000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	0 to 70	T022
TL022CPSRG4	Active	Production	SO (PS) 8	2000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	0 to 70	T022
TL022CPSRG4	Active	Production	SO (PS) 8	2000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	0 to 70	T022

⁽¹⁾ **Status:** For more details on status, see our [product life cycle](#).

⁽²⁾ **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

⁽³⁾ **RoHS values:** Yes, No, RoHS Exempt. See the [TI RoHS Statement](#) for additional information and value definition.

⁽⁴⁾ **Lead finish/Ball material:** Parts 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.

⁽⁵⁾ **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

⁽⁶⁾ **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "--" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

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TAPE AND REEL INFORMATION



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
TL022CDR	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1
TL022CPSR	SO	PS	8	2000	330.0	16.4	8.35	6.6	2.4	12.0	16.0	Q1

TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TL022CDR	SOIC	D	8	2500	353.0	353.0	32.0
TL022CPSR	SO	PS	8	2000	353.0	353.0	32.0

TUBE



*All dimensions are nominal

Device	Package Name	Package Type	Pins	SPQ	L (mm)	W (mm)	T (μm)	B (mm)
TL022CP	P	PDIP	8	50	506	13.97	11230	4.32
TL022CP.A	P	PDIP	8	50	506	13.97	11230	4.32



PACKAGE OUTLINE

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT

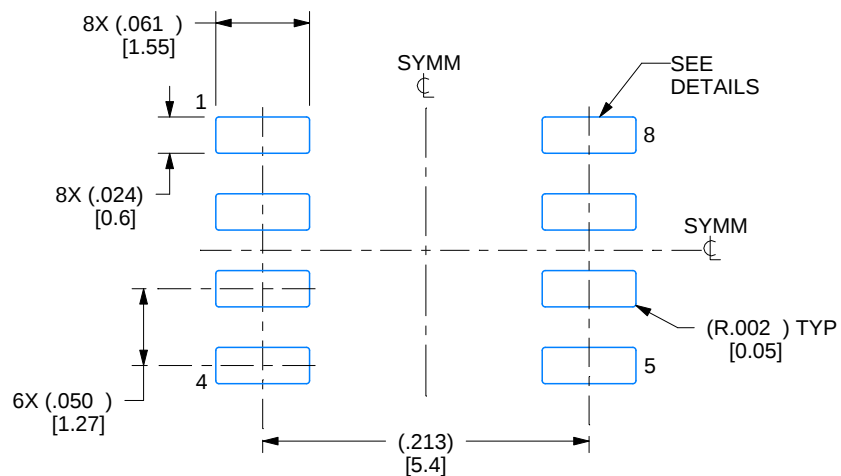


1. Linear dimensions are in inches [millimeters]. Dimensions in parenthesis are for reference only. Controlling dimensions are in inches. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed .006 [0.15] per side.
4. This dimension does not include interlead flash.
5. Reference JEDEC registration MS-012, variation AA.

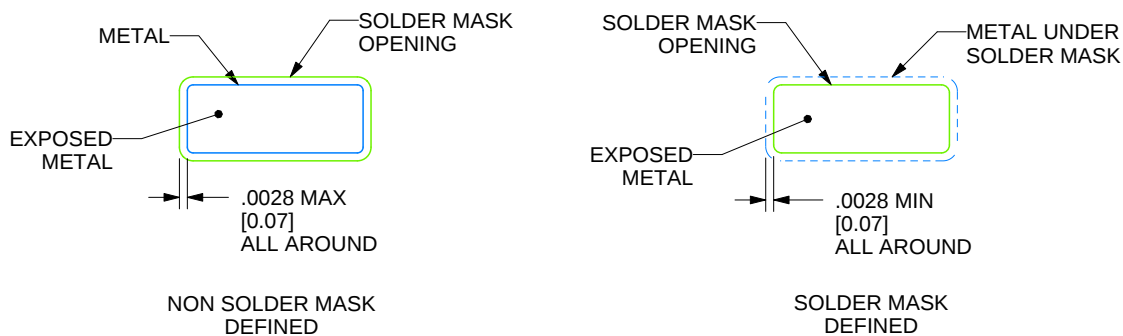
D0008A

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE:8X



SOLDER MASK DETAILS

4214825/C 02/2019

NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.

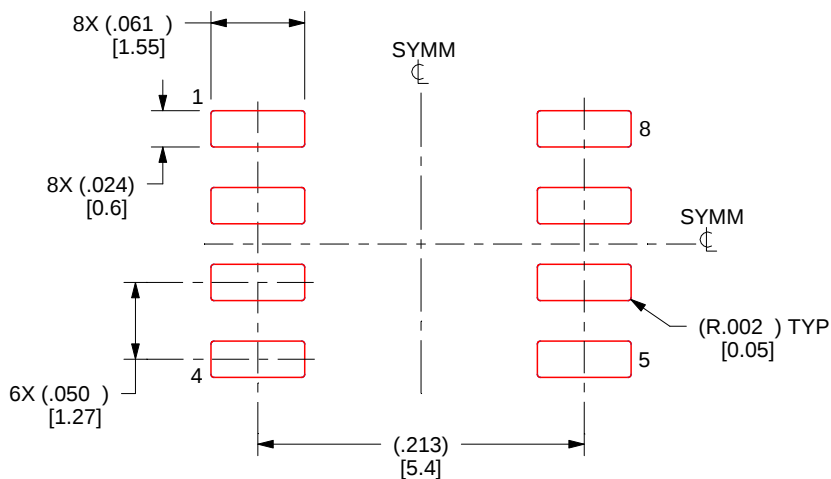
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

EXAMPLE STENCIL DESIGN

D0008A

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



SOLDER PASTE EXAMPLE
BASED ON .005 INCH [0.125 MM] THICK STENCIL
SCALE:8X

4214825/C 02/2019

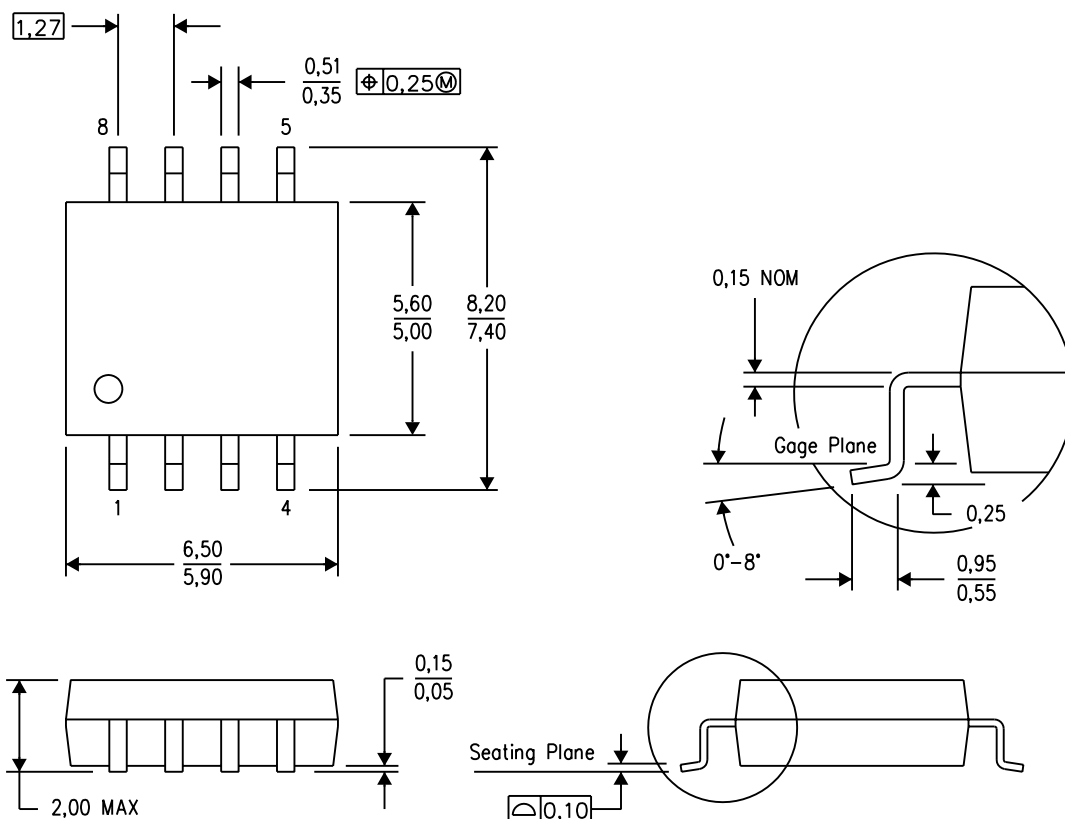
NOTES: (continued)

8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.

MECHANICAL DATA

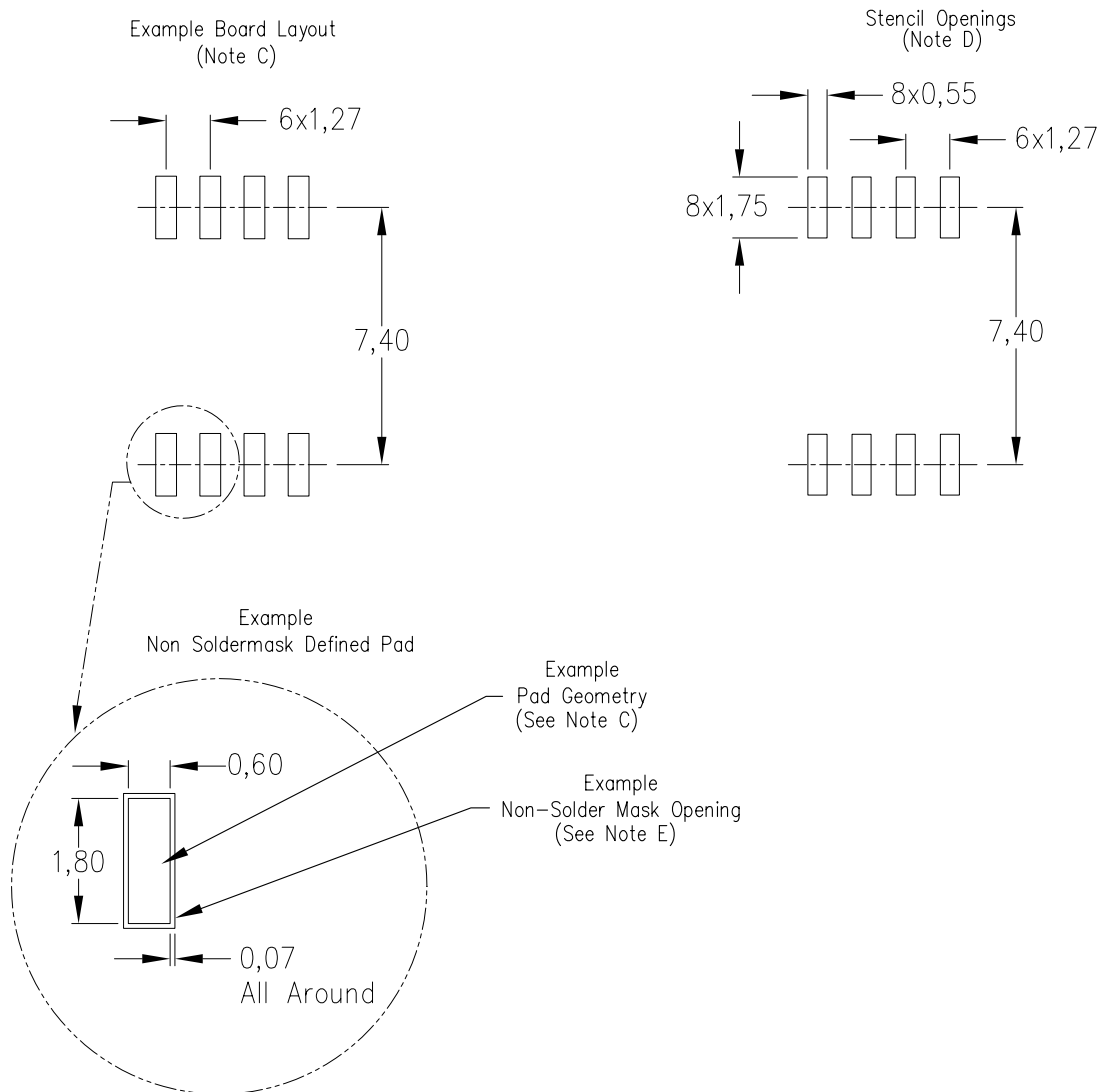
PS (R-PDSO-G8)

PLASTIC SMALL-OUTLINE PACKAGE



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.



4212188/A 09/11

NOTES:

- A. All linear dimensions are in millimeters.
- B. This drawing is subject to change without notice.
- C. Publication IPC-7351 is recommended for alternate designs.
- D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525 for other stencil recommendations.
- E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

P (R-PDIP-T8)

PLASTIC DUAL-IN-LINE PACKAGE



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

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