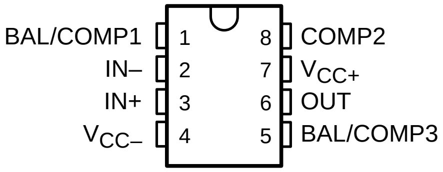
LM118, LM218, LM318
FAST GENERAL-PURPOSE OPERATIONAL AMPLIFIERS

The LM118 and LM218 are obsolete and are no longer supplied.

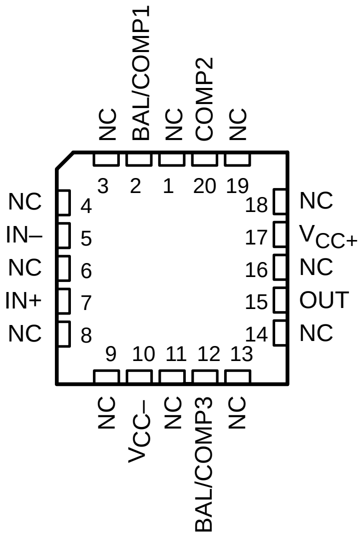
SLOS063B – JUNE 1976 – REVISED DECEMBER 2002

- **Small Signal Bandwidth . . . 15 MHz Typ**
- **Slew Rate . . . 50 V/µs Min**
- **Bias Current . . . 250 nA Max (LM118, LM218)**
- **Supply Voltage Range . . . ±5 V to ±20 V**
- **Internal Frequency Compensation**
- **Input and Output Overload Protection**
- **Same Pin Assignments as General-Purpose Operational Amplifiers**

LM118 . . . JG PACKAGE
LM218 . . . D OR P PACKAGE
LM318 . . . D, P, OR PS PACKAGE
(TOP VIEW)



LM118 . . . FK PACKAGE
(TOP VIEW)



NC – No internal connection

description/ordering information

The LM118, LM218, and LM318 are precision, fast operational amplifiers designed for applications requiring wide bandwidth and high slew rate. They feature a factor-of-ten increase in speed over general-purpose devices without sacrificing dc performance.

These operational amplifiers have internal unity-gain frequency compensation. This considerably simplifies their application because no external components are necessary for operation. However, unlike most internally compensated amplifiers, external frequency compensation may be added for optimum performance. For inverting applications, feed-forward compensation boosts the slew rate to over 150 V/µs and almost double the bandwidth. Overcompensation can be used with the amplifier for greater stability when maximum bandwidth is not needed. Further, a single capacitor can be added to reduce the settling time for 0.1% error band to under 1 µs.

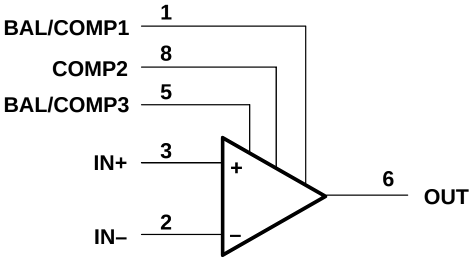
The high speed and fast settling time of these operational amplifiers make them useful in A/D converters, oscillators, active filters, sample-and-hold circuits, and general-purpose amplifiers.

ORDERING INFORMATION

T_A	V_{IO}max AT 25°C	PACKAGE[†]		ORDERABLE PART NUMBER	TOP-SIDE MARKING
0°C to 70°C	10 mV	PDIP (P)	Tube of 50	LM318P	LM318P
		SOIC (D)	Tube of 75	LM318D	LM318
			Reel of 2500	LM318DR	
		SOP (PS)	Reel of 2000	LM318PSR	LM18

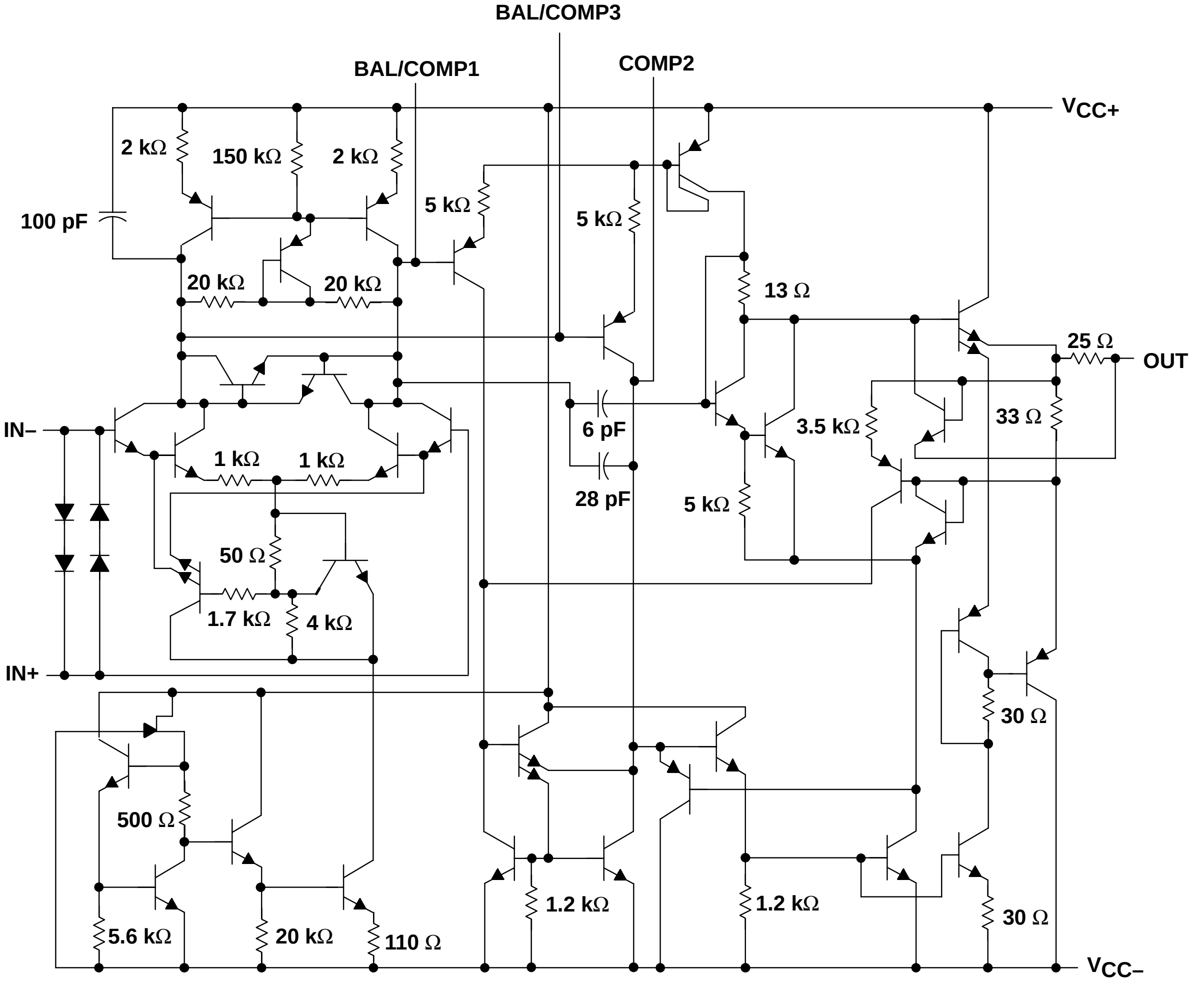
[†] Package drawings, standard packing quantities, thermal data, symboliztion, and PCB design guidelines are available at www.ti.com/sc/package.

symbol



Pin numbers shown are for the D, JG, P, and PS packages.

schematic



Component values shown are nominal.

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

Supply voltage: V_{CC+} (see Note 1)		20 V
V_{CC-} (see Note 1)		–20 V
Input voltage, V_I (either input, see Notes 1 and 2)		±15 V
Differential input current, V_{ID} (see Note 3)		±10 V
Duration of output short circuit (see Note 4)		Unlimited
Operating virtual junction temperature, T_J		150°C
Package thermal impedance, θ_{JA} (see Notes 5 and 6):	D package	97°C/W
	P package	85°C/W
	PS package	95°C/W
Package thermal impedance, θ_{JC} (see Notes 7 and 8):	FK package	5.61°C/W
	JG package	14.5°C/W
Case temperature for 60 seconds: FK package		260°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds: JG package		300°C
Lead temperature 1,6 mm (1/16 inch) from case for 60 seconds: D, P, PS, or PW package		260°C
Storage temperature range, T_{stg}		–65°C to 150°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. The magnitude of the input voltage must never exceed the magnitude of the supply voltage or 15 V, whichever is less.
3. The inputs are shunted with two opposite-facing base-emitter diodes for overvoltage protection. Therefore, excessive current flows if a different input voltage in excess of approximately 1 V is applied between the inputs unless some limiting resistance is used.
4. The output can be shorted to ground or either power supply. For the LM118 and LM218 only, the unlimited duration of the short circuit applies at (or below) 85°C case temperature or 75°C free-air temperature.
5. Maximum power dissipation is a function of T_J(max), θ_{JA}, and T_A. The maximum allowable power dissipation at any allowable ambient temperautre is $P_D = (T_J(\text{max}) - T_A)/\theta_{JA}$. Operating at the absolute maximum T_J of 150°C can affect reliability.
6. The package thermal impedance is calculated in accordance with JESD 51-7.
7. Maximum power dissipation is a function of T_J(max), θ_{JC}, and T_C. The maximum allowable power dissipation at any allowable ambient temperautre is $P_D = (T_J(\text{max}) - T_C)/\theta_{JC}$. Operating at the absolute maximum T_J of 150°C can affect reliability.
8. The package thermal impedance is calculated in accordance with MIL-STD-883.

The LM118 and LM218 are obsolete and are no longer supplied.

electrical characteristics at specified free-air temperature (see Note 5)

PARAMETER		TEST CONDITIONS[†]	T_A[‡]	LM118, LM218			LM318			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
V_{IO}	Input offset voltage	V_O = 0	25°C		2	4		4	10	mV
			Full range			6			15	
I_{IO}	Input offset current	V_O = 0	25°C		6	50		30	200	nA
			Full range			100			300	
I_{IB}	Input bias current	V_O = 0	25°C		120	250		150	500	nA
			Full range			500			750	
V_{ICR}	Common-mode input voltage range	$V_{CC\pm}$ = ±15 V	Full range	±11.5			±11.5			V
V_{OM}	Maximum peak output voltage swing	$V_{CC\pm}$ = ±15 V, R_L = 2 kΩ	Full range	±12	±13		±12	±13		V
A_{VD}	Large-signal differential voltage amplification	$V_{CC\pm}$ = ±15 V, V_O = ±10 V, R_L ≥ 2 kΩ	25°C	50	200		25	200		V/mV
			Full range	25			20			
B_1	Unity-gain bandwidth	$V_{CC\pm}$ = ±15 V	25°C		15			15		MHz
r_i	Input resistance		25°C	1[*]	3		0.5	3		MΩ
CMRR	Common-mode rejection ratio	$V_{IC} = V_{ICR}$min	Full range	80	100		70	100		dB
k_{SVR}	Supply-voltage rejection ratio ($\Delta V_{CC}/\Delta V_{IO}$)		Full range	70	80		65	80		dB
I_{CC}	Supply current	V_O = 0, No load	25°C		5	8		5	10	mA

[*] On products compliant to MIL-STD-883, Class B, this parameter is not production tested.

[†] All characteristics are measured under open-loop conditions with common-mode input voltage, unless otherwise specified.

[‡] Full range for LM118 is –55°C to 125°C, full range for LM218 is –25°C to 85°C, and full range for LM318 is 0°C to 70°C.

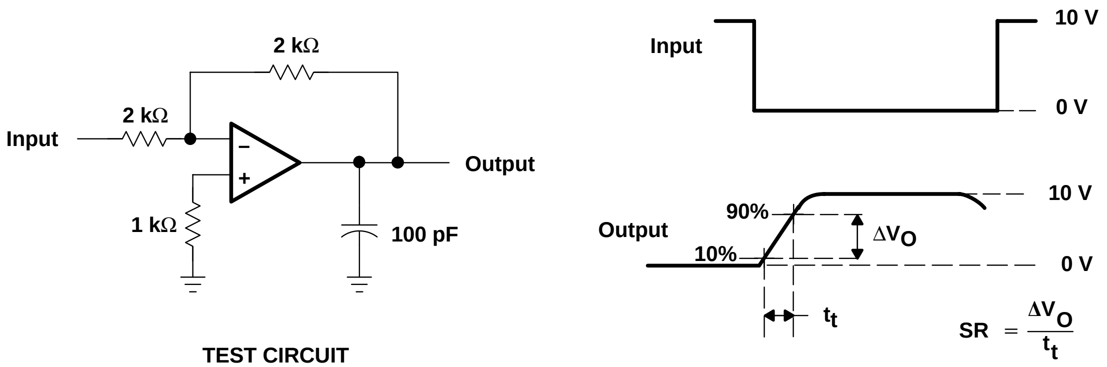
NOTE 9: Unless otherwise noted, V_{CC} = ±5 V to ±20 V. All typical values are at $V_{CC\pm}$ = ±15 V and T_A = 25°C.

operating characteristics, $V_{CC\pm}$ = ±15 V, T_A = 25°C

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
SR	Slew rate at unity gain	ΔV_I = 10 V, C_L = 100 pF, See Figure 1	50[*]	70		V/μs

[*] On products compliant to MIL-STD-883, Class B, this parameter is not production tested.

PARAMETER MEASUREMENT INFORMATION



TEST CIRCUIT

VOLTAGE WAVEFORMS

Figure 1. Slew Rate

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
JM38510/10107BPA	OBSOLETE	CDIP	JG	8		TBD	Call TI	Call TI	-55 to 125		
LM118FKB	OBSOLETE	LCCC	FK	20		TBD	Call TI	Call TI	-55 to 125		
LM118JG	OBSOLETE	CDIP	JG	8		TBD	Call TI	Call TI	-55 to 125		
LM118JGB	OBSOLETE	CDIP	JG	8		TBD	Call TI	Call TI	-55 to 125		
LM318D	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	LM318	Samples
LM318DE4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	LM318	Samples
LM318DG4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	LM318	Samples
LM318DR	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	LM318	Samples
LM318DRG4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	LM318	Samples
LM318P	ACTIVE	PDIP	P	8	50	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type	0 to 70	LM318P	Samples
LM318PE4	ACTIVE	PDIP	P	8	50	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type	0 to 70	LM318P	Samples
LM318PSR	ACTIVE	SO	PS	8	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	L318	Samples

(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), 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)

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

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

(6) Lead/Ball Finish - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead/Ball Finish values may wrap to two lines if the finish value exceeds the maximum column width.

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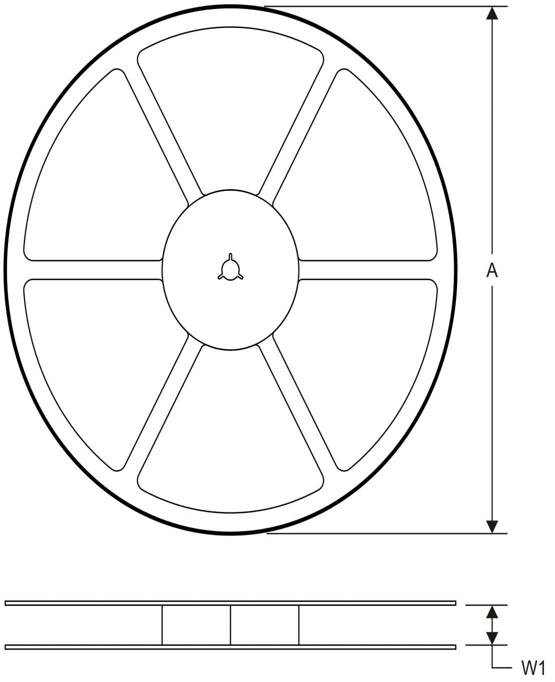
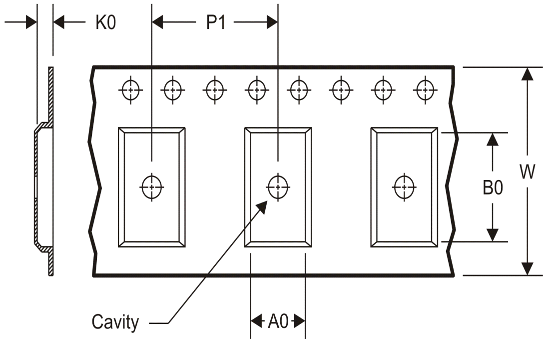
TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



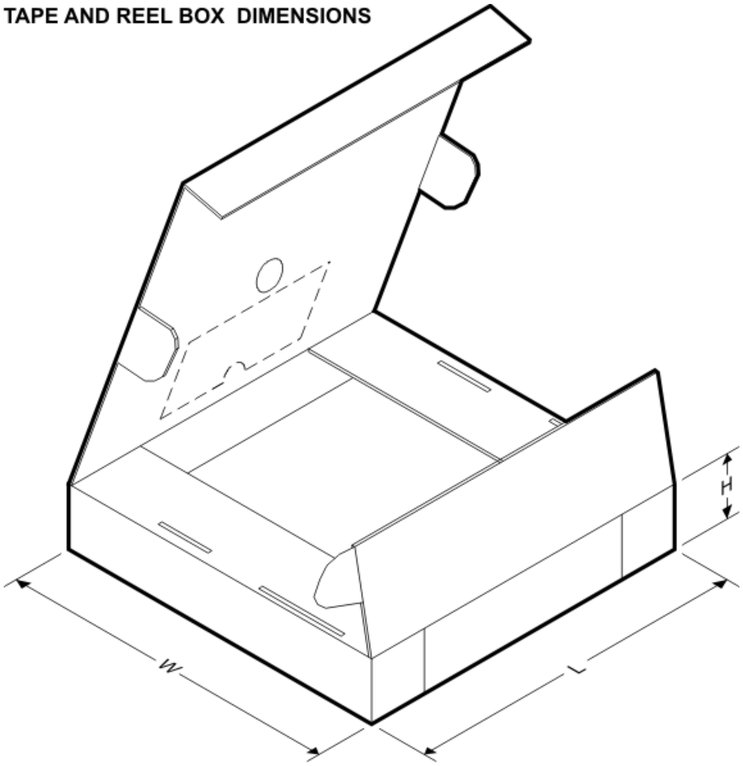
A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

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
LM318DR	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1
LM318PSR	SO	PS	8	2000	330.0	16.4	8.2	6.6	2.5	12.0	16.0	Q1

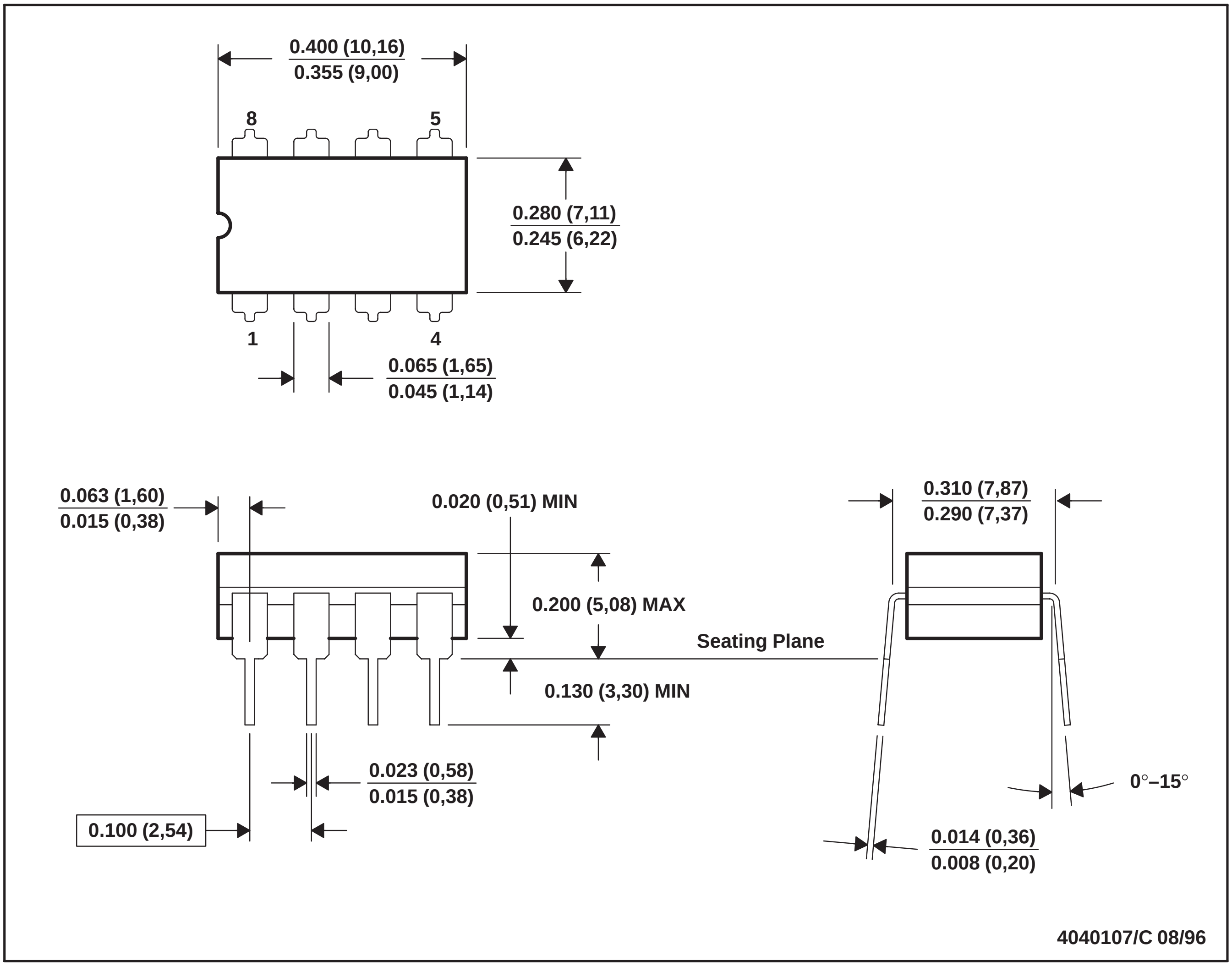
TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
LM318DR	SOIC	D	8	2500	340.5	338.1	20.6
LM318PSR	SO	PS	8	2000	367.0	367.0	38.0

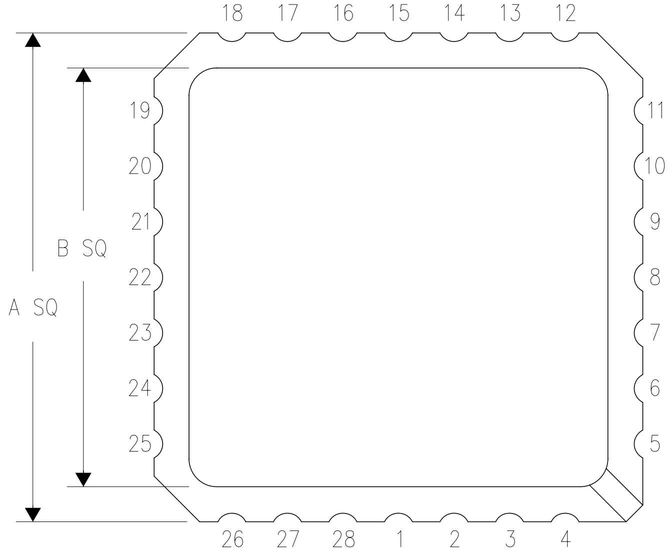
JG (R-GDIP-T8) **CERAMIC DUAL-IN-LINE**



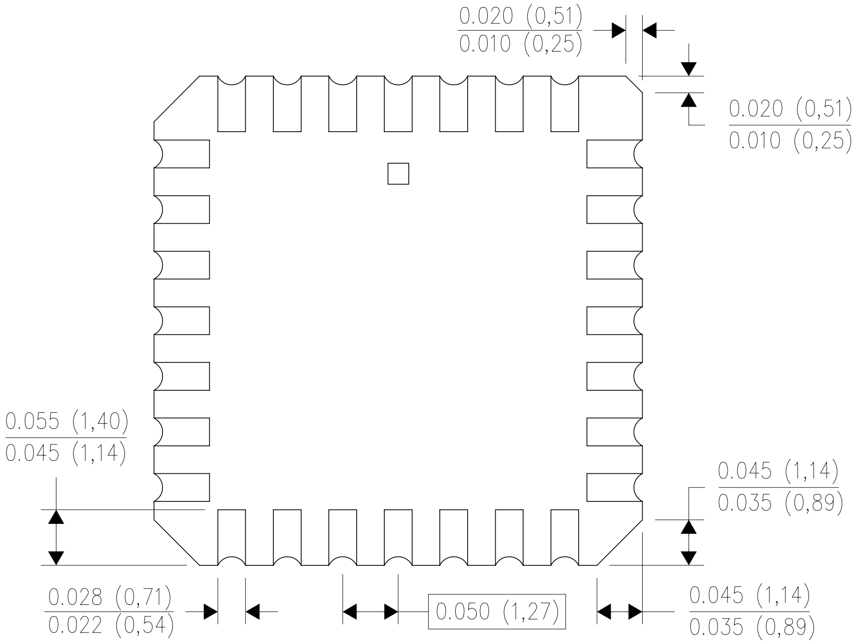
NOTES:
- A. All linear dimensions are in inches (millimeters).
- B. This drawing is subject to change without notice.
- C. This package can be hermetically sealed with a ceramic lid using glass frit.
- D. Index point is provided on cap for terminal identification.
- E. Falls within MIL STD 1835 GDIP1-T8

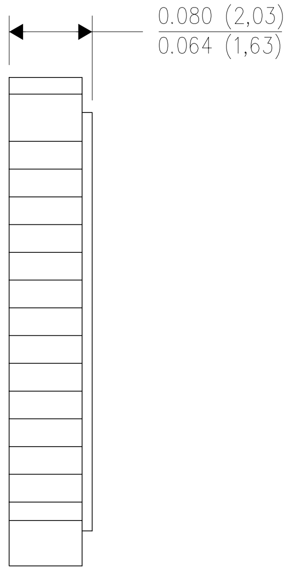
FK (S-CQCC-N**) LEADLESS CERAMIC CHIP CARRIER

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	0.740 (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)

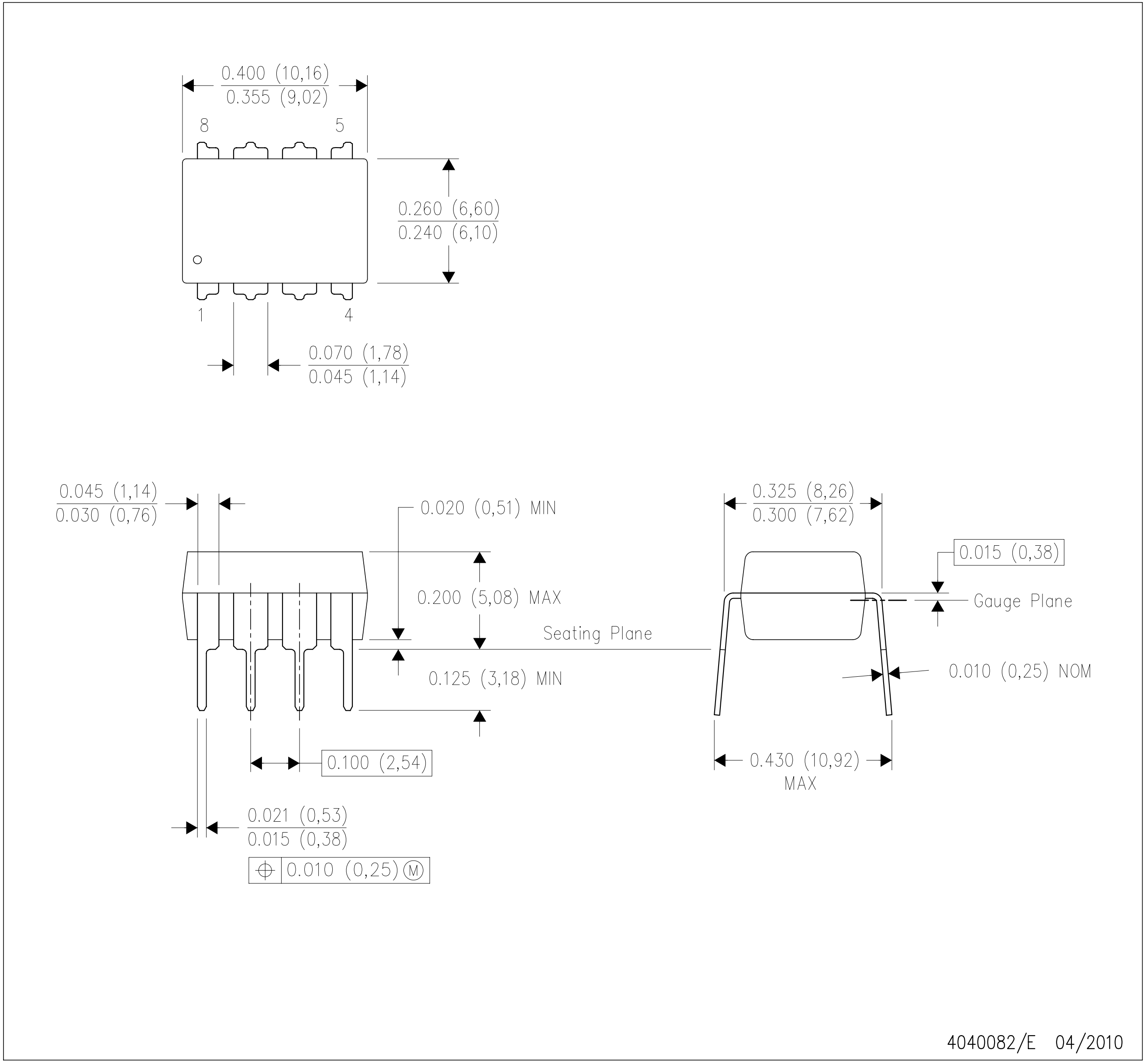




4040140/D 01/11

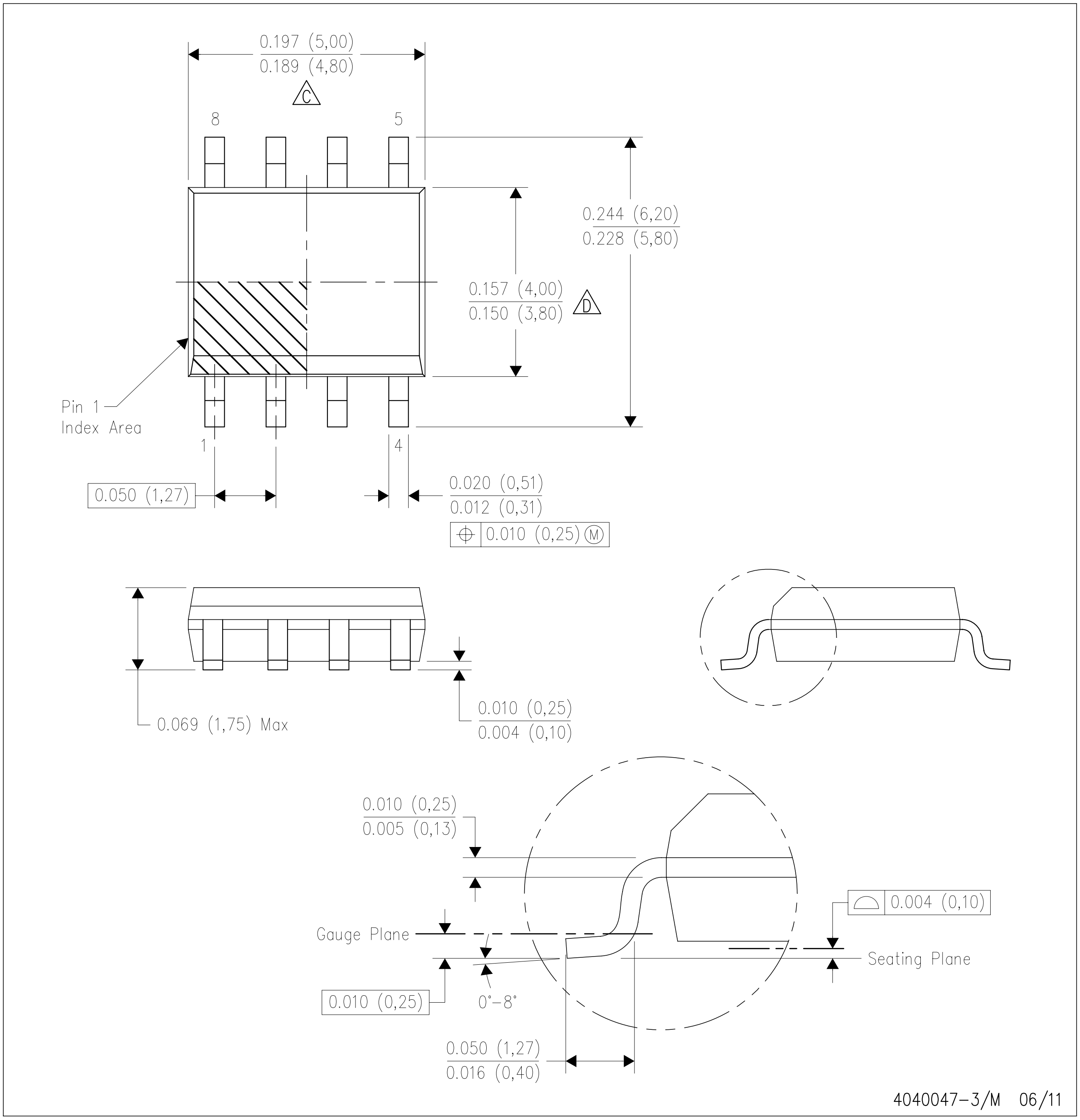
NOTES:
- A. All linear dimensions are in inches (millimeters).
- B. This drawing is subject to change without notice.
- C. This package can be hermetically sealed with a metal lid.
- D. Falls within JEDEC MS-004

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



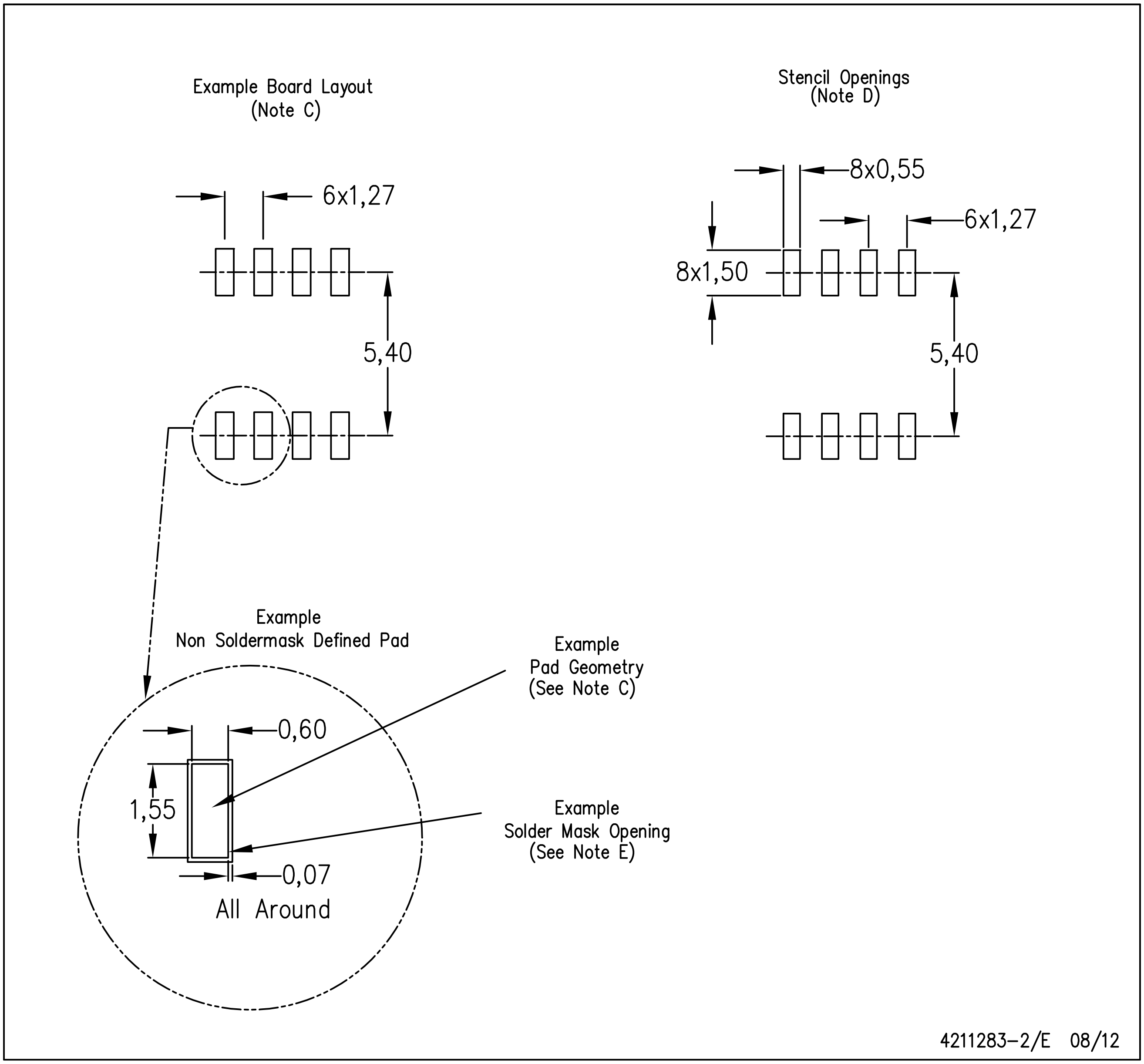
NOTES:
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Falls within JEDEC MS-001 variation BA.

D (R–PDSO–G8) PLASTIC SMALL OUTLINE



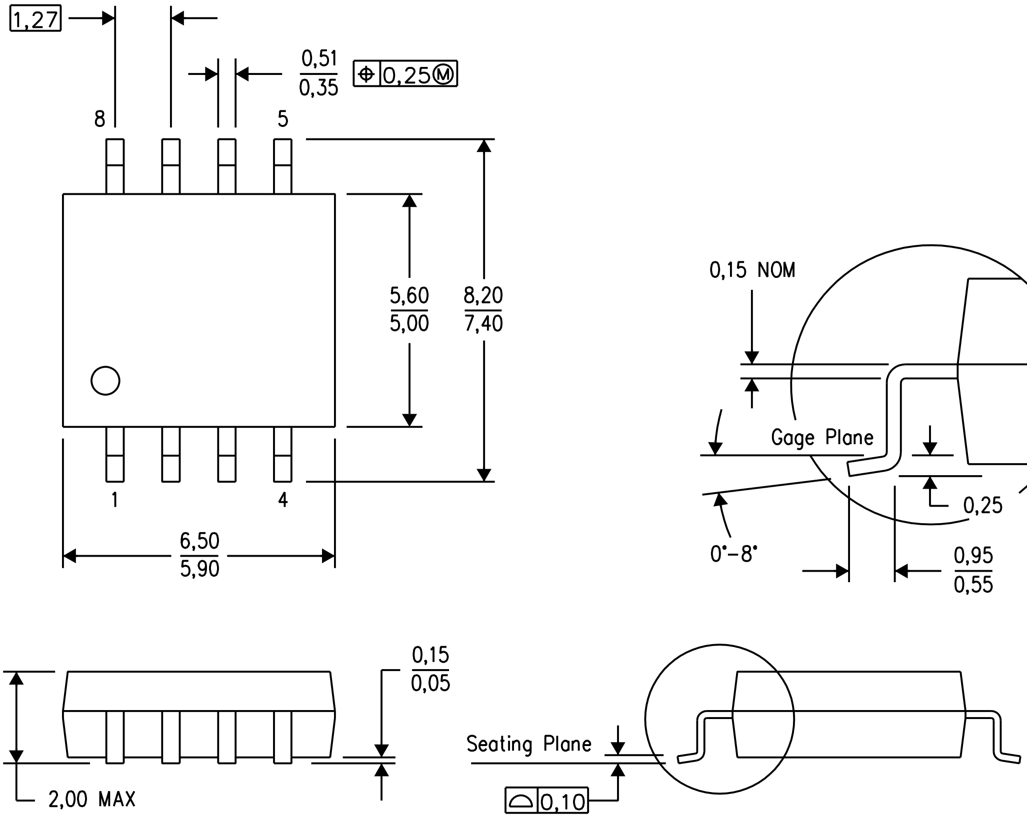
NOTES:
- A. All linear dimensions are in inches (millimeters).
- B. This drawing is subject to change without notice.
- C Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0,15) each side.
- D Body width does not include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

D (R-PDSO-G8) PLASTIC SMALL OUTLINE



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.

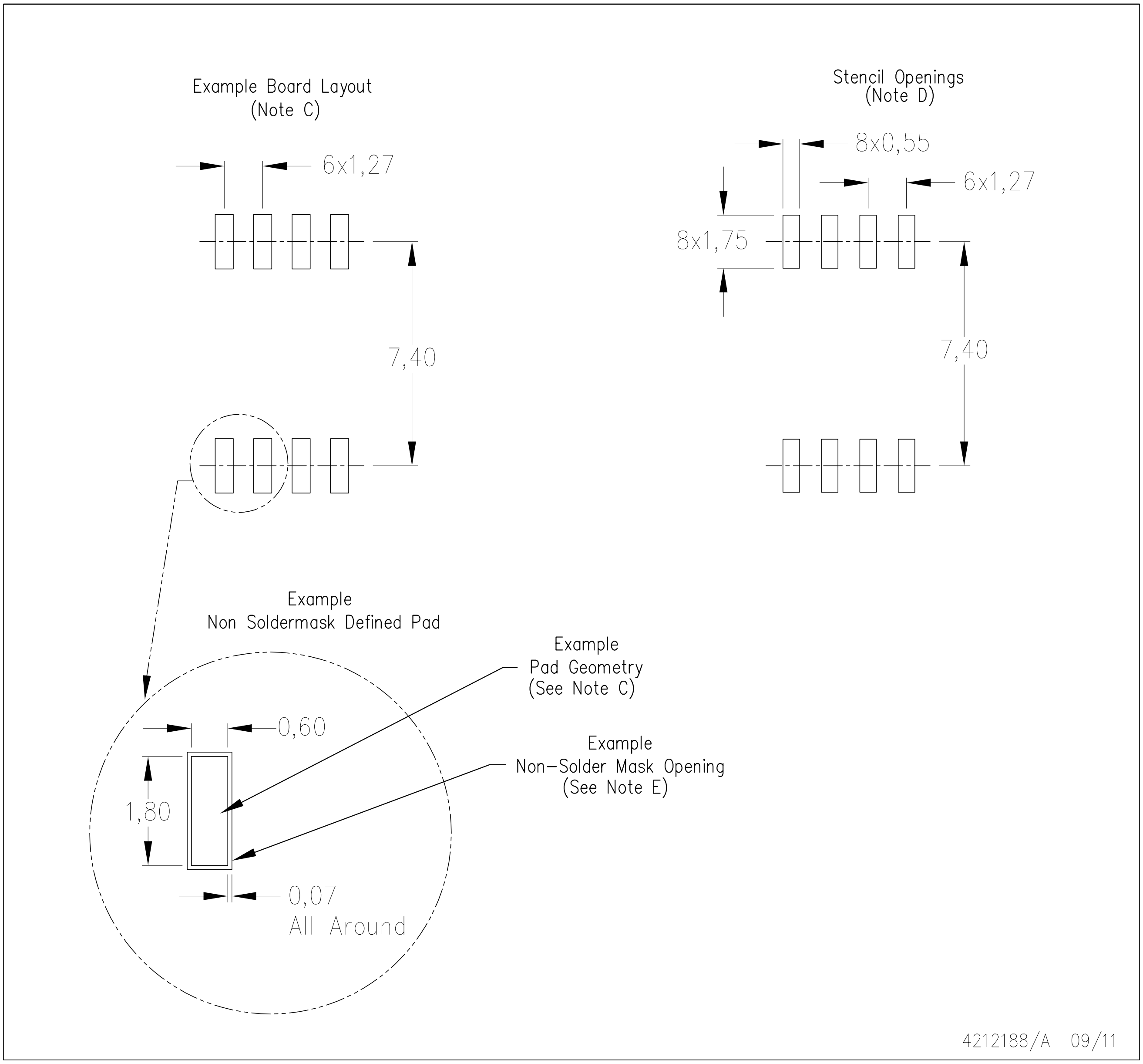
PS (R-PDSO-G8) PLASTIC SMALL-OUTLINE PACKAGE



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.

PS (R-PDSO-G8) PLASTIC SMALL OUTLINE



NOTES:
- A. All linear dimensions are in millimeters.
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- E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

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