

AM26LS31x Quadruple Differential Line Driver

Check for Samples: [AM26LS31](#), [AM26LS31C](#), [AM26LS31M](#)

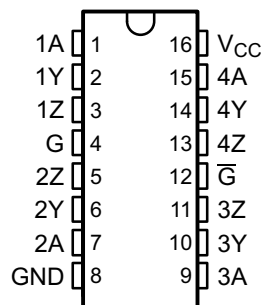
FEATURES

- Meets or Exceeds the Requirements of ANSI TIA/EIA-422-B and ITU
- Operates From a Single 5-V Supply
- TTL Compatible
- Complementary Outputs
- High Output Impedance in Power-Off Conditions
- Complementary Output-Enable Inputs
- On Products Compliant to MIL-PRF-38535, All Parameters Are Tested Unless Otherwise Noted. On All Other Products, Production Processing Does Not Necessarily Include Testing of All Parameters.

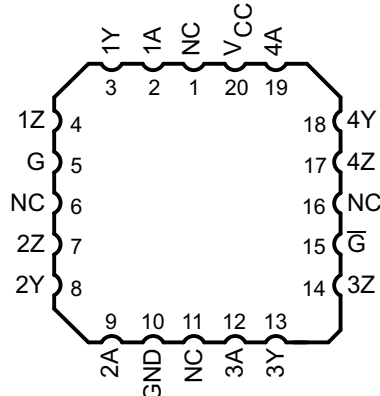
DESCRIPTION

The AM26LS31 device is a quadruple complementary-output line driver designed to meet the requirements of ANSI TIA/EIA-422-B and ITU (formerly CCITT) Recommendation V.11. The 3-state outputs have high-current capability for driving balanced lines such as twisted-pair or parallel-wire transmission lines, and they are in the high-impedance state in the power-off condition. The enable function is common to all four drivers and offers the choice of an active-high or active-low enable ($\overline{G}$, $\overline{G}$) input. Low-power Schottky circuitry reduces power consumption without sacrificing speed.

**D, DB, N, NS, J, OR W PACKAGE
(TOP VIEW)**



**FK PACKAGE
(TOP VIEW)**



Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

AM26LS31, AM26LS31C, AM26LS31M

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This integrated circuit can be damaged by ESD. Texas Instruments recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

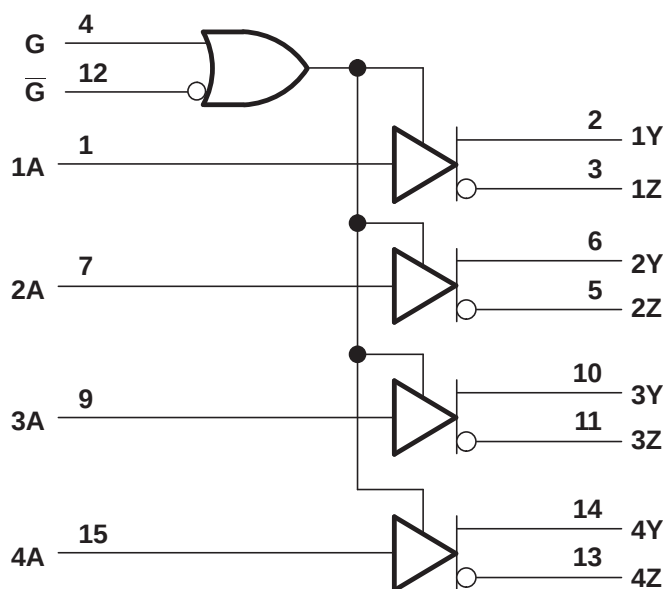
ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

Function Table⁽¹⁾
(Each Driver)

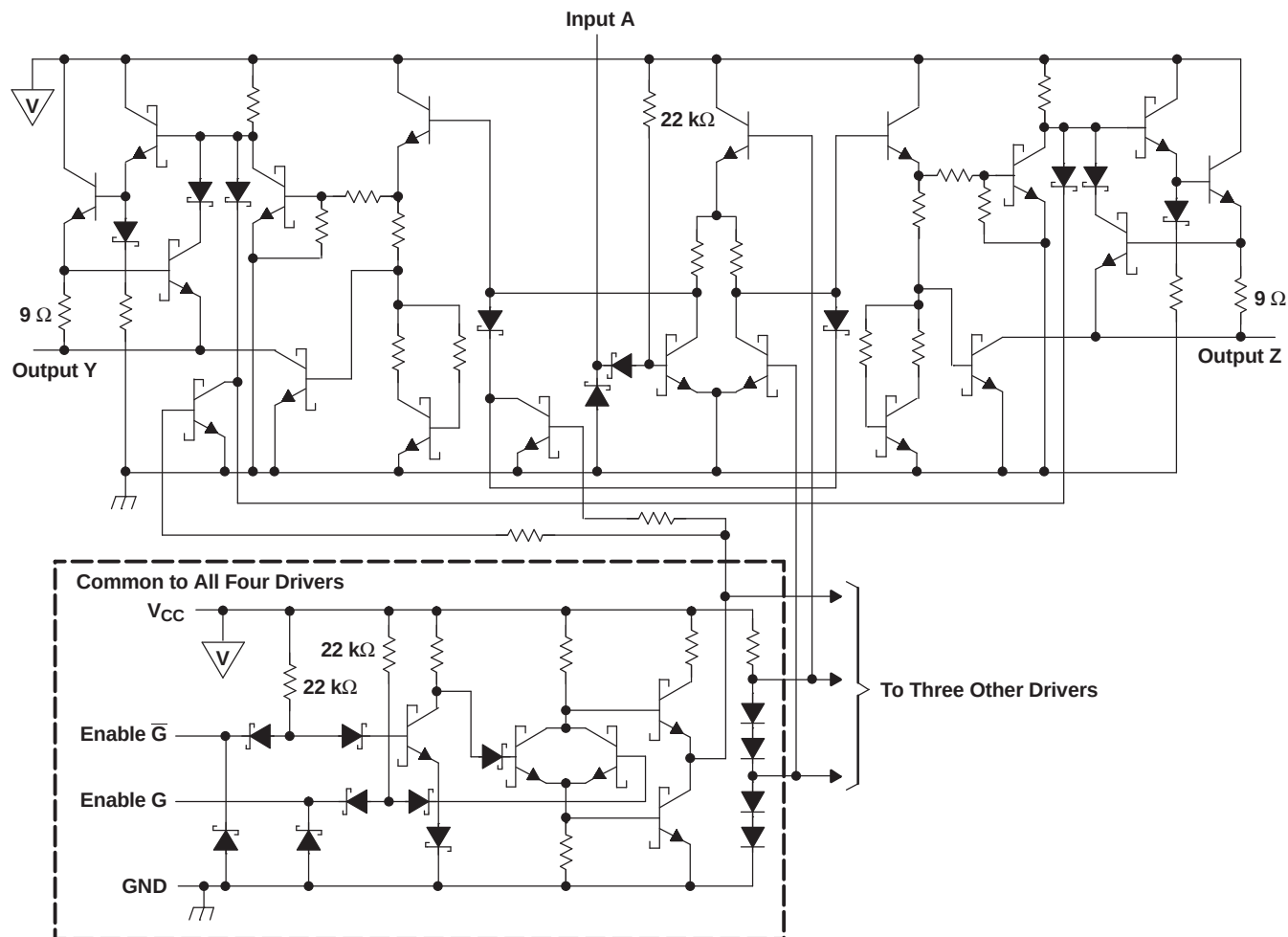
INPUT A	ENABLES		OUTPUTS	
	G	$\overline{G}$	Y	Z
H	H	X	H	L
L	H	X	L	H
H	X	L	H	L
L	X	L	L	H
X	L	H	Z	Z

(1) H = high level, L = low level,
X = irrelevant,
Z = high impedance (off)

Logic Diagram (Positive Logic)



Schematic (Each Driver)



All resistor values are nominal.

AM26LS31, AM26LS31C, AM26LS31M

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Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted)⁽¹⁾

		MIN	MAX	UNIT
V _{CC}	Supply voltage ⁽²⁾		7	V
V _I	Input voltage		7	V
	Output off-state voltage		5.5	V
θ _{JA}	Package thermal impedance ⁽³⁾	D package	73	°C/W
		DB package	82	
		N package	67	
		NS package	64	
	Lead temperature 1,6 mm (1/16 in) from case for 10 s		260	°C
	Lead temperature 1,6 mm (1/16 in) from case for 60 s	J package	300	°C
T _{stg}	Storage temperature range	–65	150	°C

- (1) 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.
- (2) All voltage values, except differential output voltage V_{OD}, are with respect to network GND.
- (3) The package thermal impedance is calculated in accordance with JESD 51-7.

Recommended Operating Conditions

		MIN	NOM	MAX	UNIT	
V _{CC}	Supply voltage	AM26LS31C	4.75	5	5.25	V
		AM26LS31M	4.5	5	5.5	
V _{IH}	High-level input voltage	2			V	
V _{IL}	Low-level input voltage	0.8			V	
I _{OH}	High-level output current	−20			mA	
I _{OL}	Low-level output current	20			mA	
T _A	Operating free-air temperature	AM26LS31C	0	70	°C	
		AM26LS31M	−55	125		

Electrical Characteristics

over operating free-air temperature range (unless otherwise noted)⁽¹⁾

PARAMETER	TEST CONDITIONS	MIN	TYP ⁽²⁾	MAX	UNIT
V _{IK}	Input clamp voltage	V _{CC} = MIN, I _I = –18 mA		–1.5	V
V _{OH}	High-level output voltage	V _{CC} = MIN, I _{OH} = –20 mA	2.5		V
V _{OL}	Low-level output voltage	V _{CC} = MIN, I _{OL} = 20 mA		0.5	V
I _{OZ}	Off-state (high-impedance-state) output current	V _{CC} = MIN,	V _O = 0.5 V	–20	μA
			V _O = 2.5 V	20	
I _I	Input current at maximum input voltage	V _{CC} = MAX, V _I = 7 V		0.1	mA
I _{IH}	High-level input current	V _{CC} = MAX, V _I = 2.7 V		20	μA
I _{IL}	Low-level input current	V _{CC} = MAX, V _I = 0.4 V		–0.36	mA
I _{OS}	Short-circuit output current ⁽³⁾	V _{CC} = MAX	–30	–150	mA
I _{CC}	Supply current	V _{CC} = MAX, All outputs disabled	32	80	mA

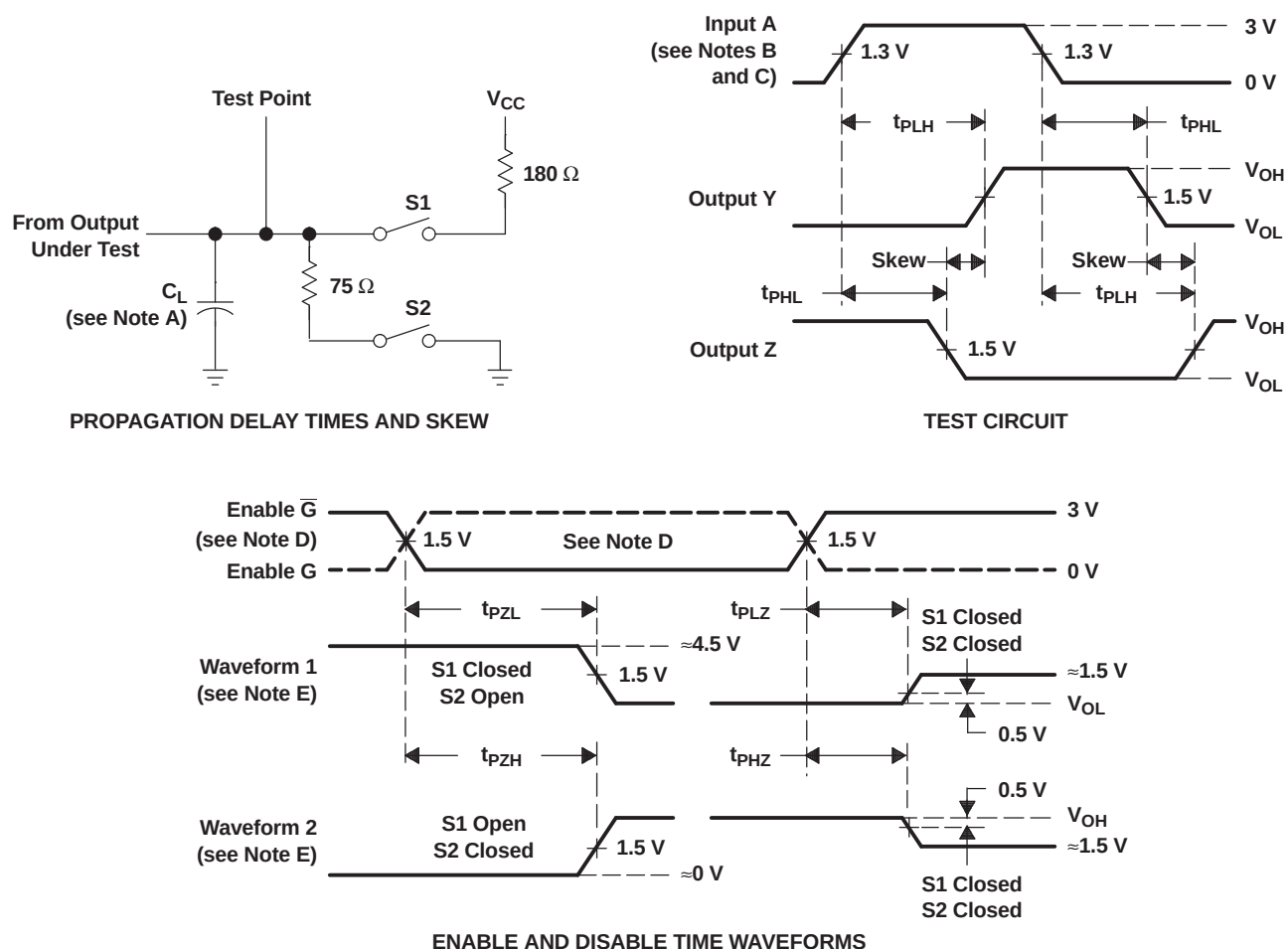
- (1) For C-suffix devices, V_{CC} min = 4.75 V and V_{CC} max = 5.25 V. For M-suffix devices, V_{CC} min = 4.5 V and V_{CC} max = 5.5 V.
- (2) All typical values are at V_{CC} = 5 V and T_A = 25°C.
- (3) Not more than one output should be shorted at a time, and duration of the short circuit should not exceed one second.

Switching Characteristics

$V_{CC} = 5\text{ V}$ (see [Figure 1](#))

PARAMETER		TEST CONDITIONS		$T_A = 25^\circ\text{C}$			AM26LS31M		UNIT
				MIN	TYP	MAX	MIN	MAX	
t_{PLH}	Propagation delay time, low- to high-level output	$C_L = 30\text{ pF}$, S1 and S2 open			14	20		30	ns
t_{PHL}	Propagation delay time, high- to low-level output				14	20		30	
t_{PZH}	Output enable time to high level	$C_L = 30\text{ pF}$	$R_L = 75\ \Omega$		25	40		60	ns
t_{PZL}	Output enable time to low level		$R_L = 180\ \Omega$		37	45		68	
t_{PHZ}	Output disable time from high level	$C_L = 10\text{ pF}$, S1 and S2 closed			21	30		45	ns
t_{PLZ}	Output disable time from low level				23	35		53	
t_{SKEW}	Output-to-output skew	$C_L = 30\text{ pF}$, S1 and S2 open			1	6		9	ns

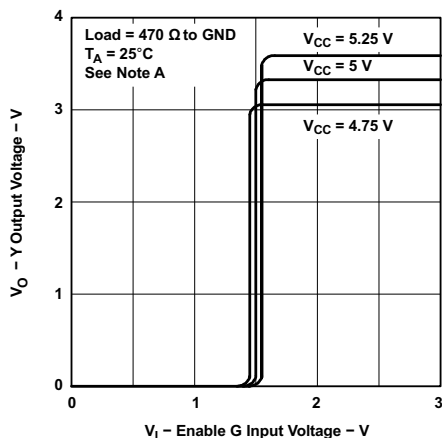
Parameter Measurement Information



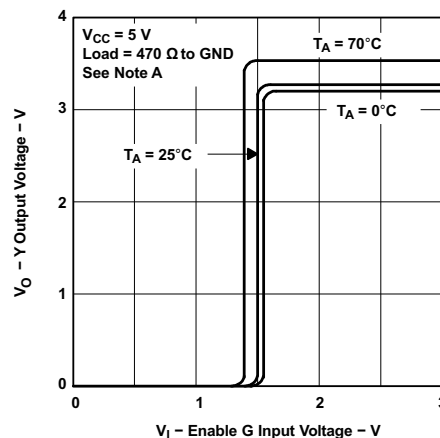
- NOTES:
- A. C_L includes probe and jig capacitance.
 - B. All input pulses are supplied by generators having the following characteristics: $PRR \leq 1$ MHz, $Z_O \approx 50 \Omega$, $t_r \leq 15$ ns, $t_f \leq 6$ ns.
 - C. When measuring propagation delay times and skew, switches S1 and S2 are open.
 - D. Each enable is tested separately.
 - E. Waveform 1 is for an output with internal conditions such that the output is low, except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high, except when disabled by the output control.

Figure 1. Test Circuit and Voltage Waveforms

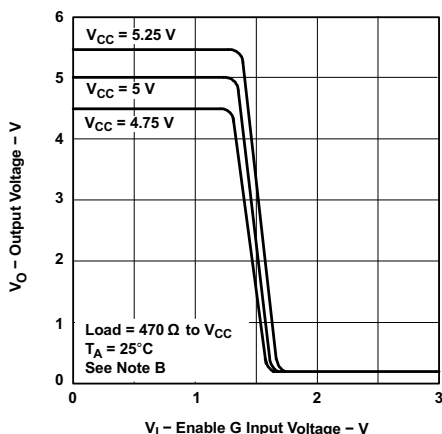
Typical Characteristics



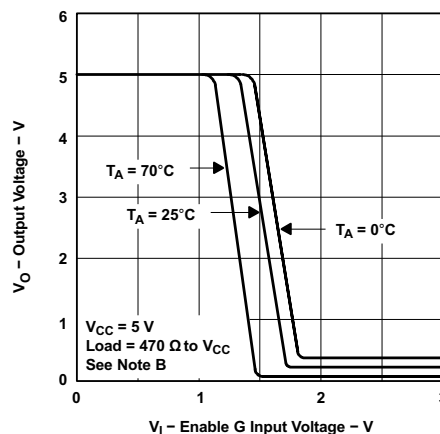
**Figure 2. Output Voltage
vs
Enable G Input Voltage**



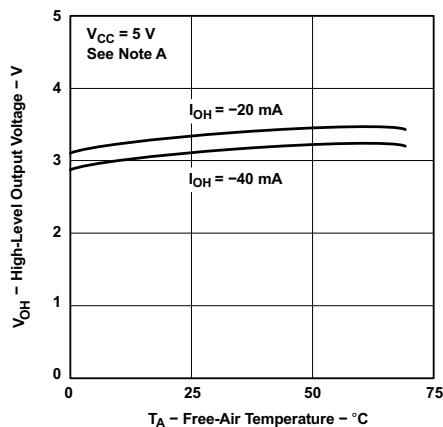
**Figure 3. Output Voltage
vs
Enable G Input Voltage**



**Figure 4. Output Voltage
vs
Enable G Input Voltage**



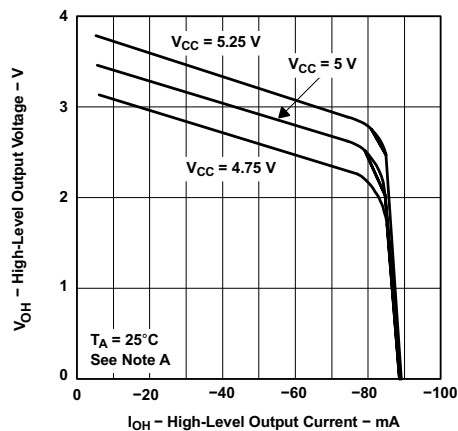
**Figure 5. Output Voltage
vs
Enable G Input Voltage**



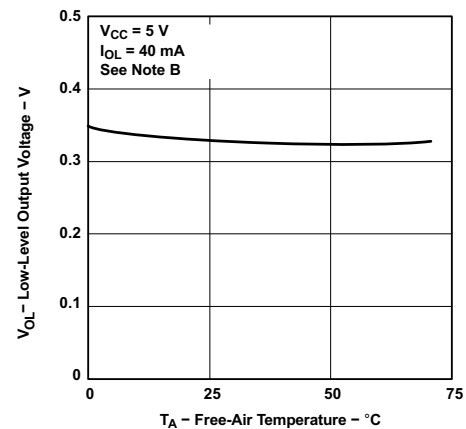
**Figure 6. High-Level Output Voltage
vs
Free-Air Temperature**

- A. The A input is connected to V_{CC} during testing of the Y outputs and to ground during testing of the Z outputs.
B. The A input is connected to ground during testing of the Y outputs and to V_{CC} during testing of the Z outputs.

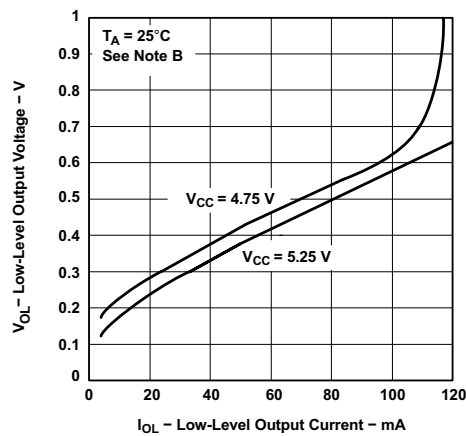
Typical Characteristics (continued)



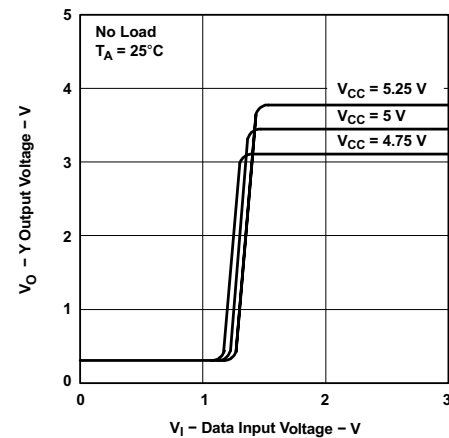
**Figure 7. High-Level Output Voltage
vs
High-Level Output Current**



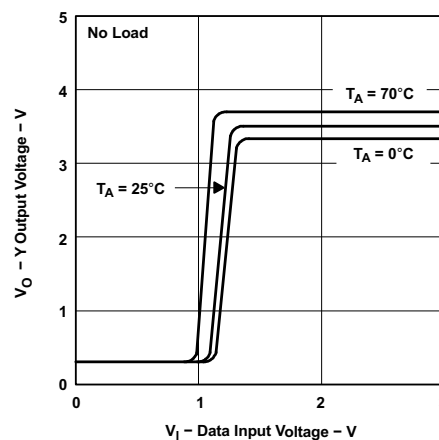
**Figure 8. Low-Level Output Voltage
vs
Free-Air Temperature**



**Figure 9. Low-Level Output Voltage
vs
Low-Level Output Current**



**Figure 10. Y Output Voltage
vs
Data Input Voltage**



**Figure 11. Y Output Voltage
vs
Data Input Voltage**

A. The A input is connected to V_{CC} during testing of the Y outputs and to ground during testing of the Z outputs.

B. The A input is connected to ground during testing of the Y outputs and to V_{CC} during testing of the Z outputs.

REVISION HISTORY

Changes from Revision I (February 2006) to Revision J	Page
• Updated document to new TI data sheet format - no specification changes.	1
• Deleted Ordering Information table.	1
• Updated Features.	1
• Added ESD warning.	2

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
5962-7802301M2A	ACTIVE	LCCC	FK	20	1	TBD	POST-PLATE	N / A for Pkg Type	-55 to 125	5962- 7802301M2A AM26LS31 MFKB	Samples
5962-7802301MEA	ACTIVE	CDIP	J	16	1	TBD	A42	N / A for Pkg Type	-55 to 125	5962-7802301ME A AM26LS31MJB	Samples
5962-7802301MFA	ACTIVE	CFP	W	16	1	TBD	A42	N / A for Pkg Type	-55 to 125	5962-7802301MF A AM26LS31MWB	Samples
5962-7802301Q2A	ACTIVE	LCCC	FK	20	1	TBD	POST-PLATE	N / A for Pkg Type		5962- 7802301Q2A AM26LS31M	Samples
AM26LS31CD	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	AM26LS31C	Samples
AM26LS31CDBR	ACTIVE	SSOP	DB	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	SA31C	Samples
AM26LS31CDBRE4	ACTIVE	SSOP	DB	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	SA31C	Samples
AM26LS31CDE4	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	AM26LS31C	Samples
AM26LS31CDG4	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	AM26LS31C	Samples
AM26LS31CDR	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU CU SN	Level-1-260C-UNLIM	0 to 70	AM26LS31C	Samples
AM26LS31CDRE4	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	AM26LS31C	Samples
AM26LS31CDRG4	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	AM26LS31C	Samples
AM26LS31CN	ACTIVE	PDIP	N	16	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type	0 to 70	AM26LS31CN	Samples
AM26LS31CNE4	ACTIVE	PDIP	N	16	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type	0 to 70	AM26LS31CN	Samples
AM26LS31CNSR	ACTIVE	SO	NS	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	26LS31	Samples

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
AM26LS31MFKB	ACTIVE	LCCC	FK	20	1	TBD	POST-PLATE	N / A for Pkg Type	-55 to 125	5962-7802301M2A AM26LS31 MFKB	Samples
AM26LS31MJB	ACTIVE	CDIP	J	16	1	TBD	A42	N / A for Pkg Type	-55 to 125	5962-7802301ME A AM26LS31MJB	Samples
AM26LS31MWB	ACTIVE	CFP	W	16	1	TBD	A42	N / A for Pkg Type	-55 to 125	5962-7802301MF A AM26LS31MWB	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.

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.

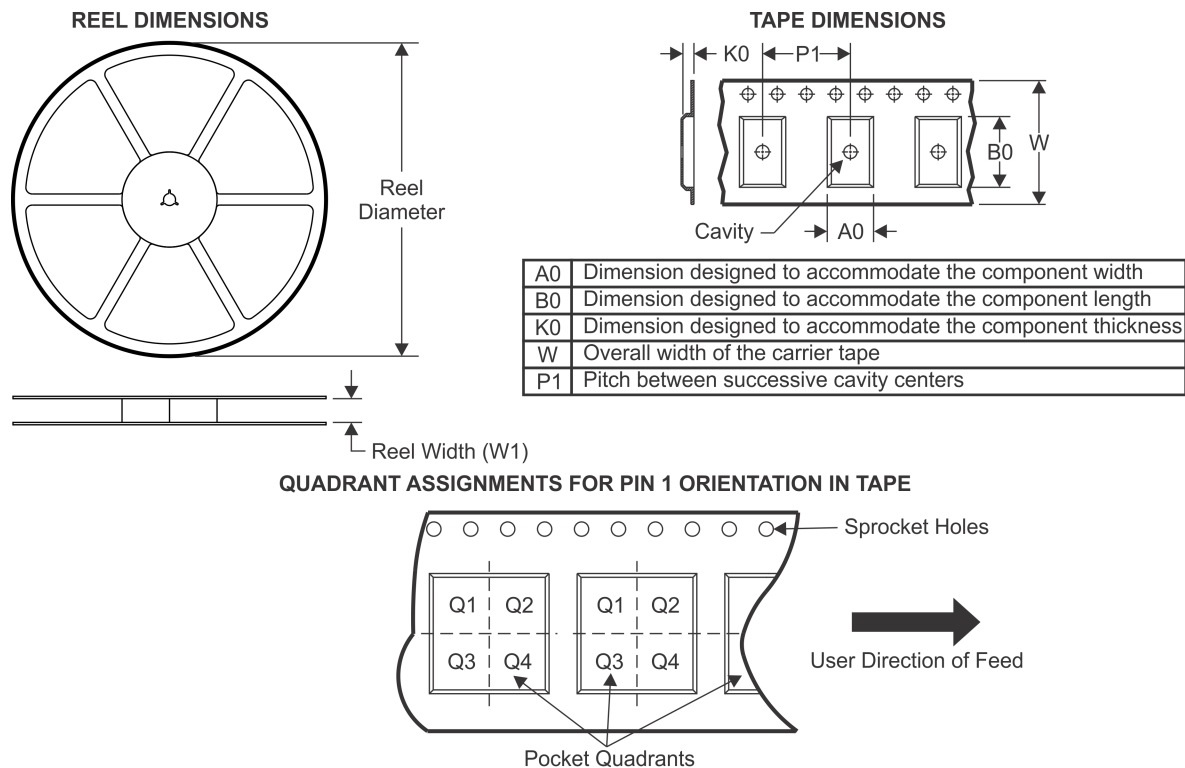
In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

OTHER QUALIFIED VERSIONS OF AM26LS31, AM26LS31M :

- Catalog: [AM26LS31](#)
- Military: [AM26LS31M](#)

NOTE: Qualified Version Definitions:

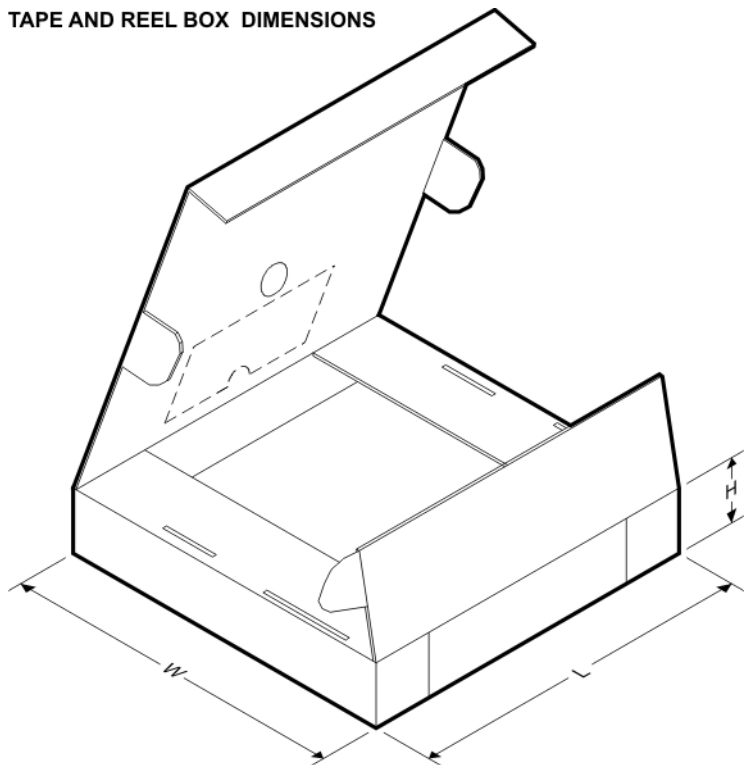
- Catalog - TI's standard catalog product
- Military - QML certified for Military and Defense Applications

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
AM26LS31CDBR	SSOP	DB	16	2000	330.0	16.4	8.2	6.6	2.5	12.0	16.0	Q1
AM26LS31CDR	SOIC	D	16	2500	330.0	16.4	6.5	10.3	2.1	8.0	16.0	Q1
AM26LS31CDR	SOIC	D	16	2500	330.0	16.4	6.5	10.3	2.1	8.0	16.0	Q1
AM26LS31CDRG4	SOIC	D	16	2500	330.0	16.4	6.5	10.3	2.1	8.0	16.0	Q1
AM26LS31CDRG4	SOIC	D	16	2500	330.0	16.4	6.5	10.3	2.1	8.0	16.0	Q1

TAPE AND REEL BOX DIMENSIONS



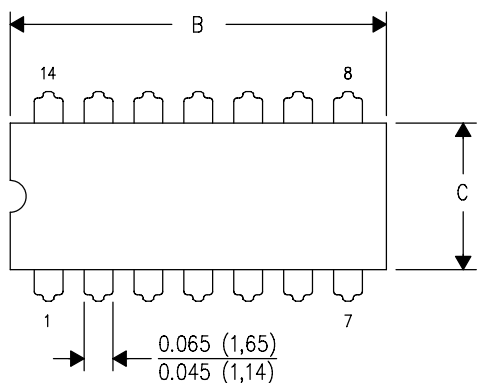
*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
AM26LS31CDBR	SSOP	DB	16	2000	367.0	367.0	38.0
AM26LS31CDR	SOIC	D	16	2500	333.2	345.9	28.6
AM26LS31CDR	SOIC	D	16	2500	367.0	367.0	38.0
AM26LS31CDRG4	SOIC	D	16	2500	367.0	367.0	38.0
AM26LS31CDRG4	SOIC	D	16	2500	333.2	345.9	28.6

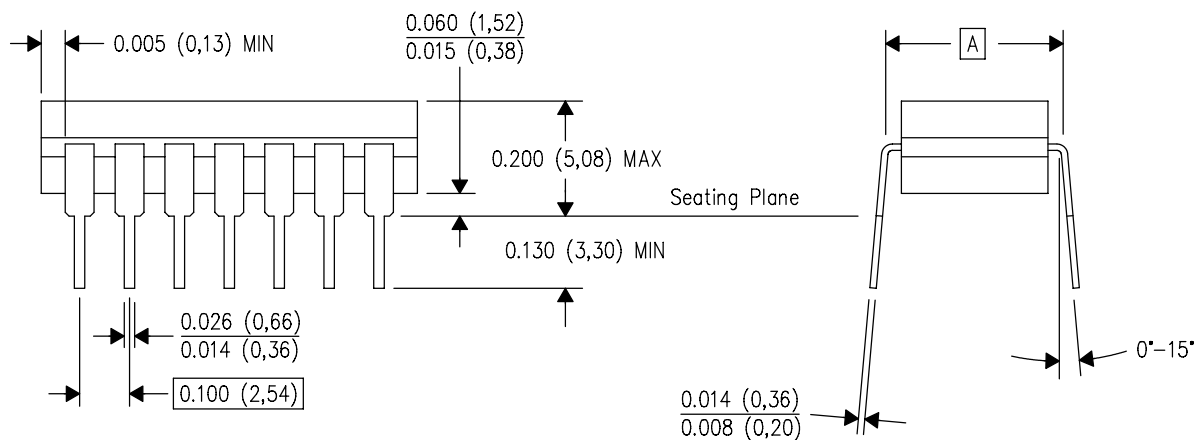
J (R-GDIP-T**)

14 LEADS SHOWN

CERAMIC DUAL IN-LINE PACKAGE



PINS ** DIM	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)

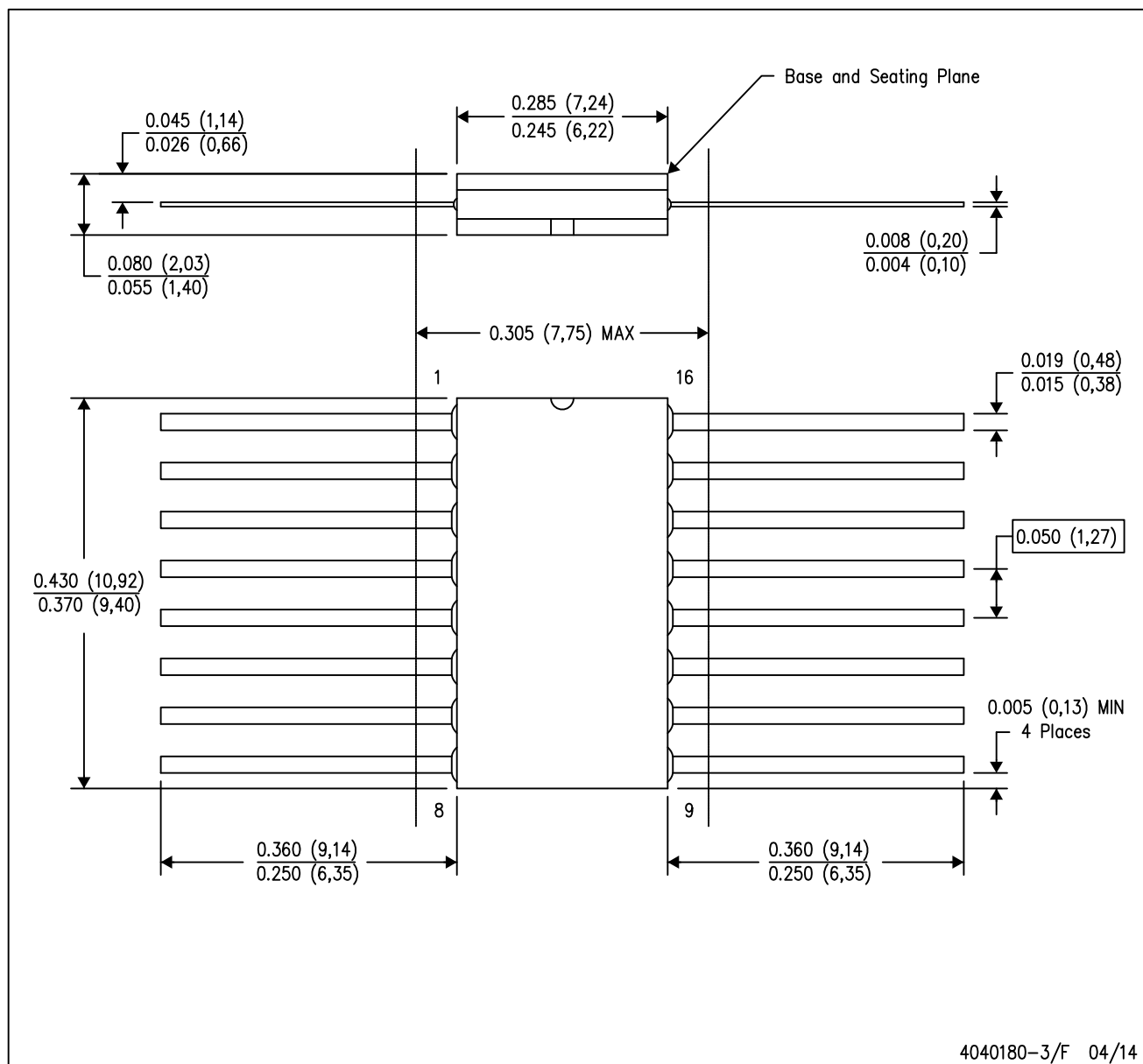


4040083/F 03/03

- 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.

W (R-GDFP-F16)

CERAMIC DUAL FLATPACK



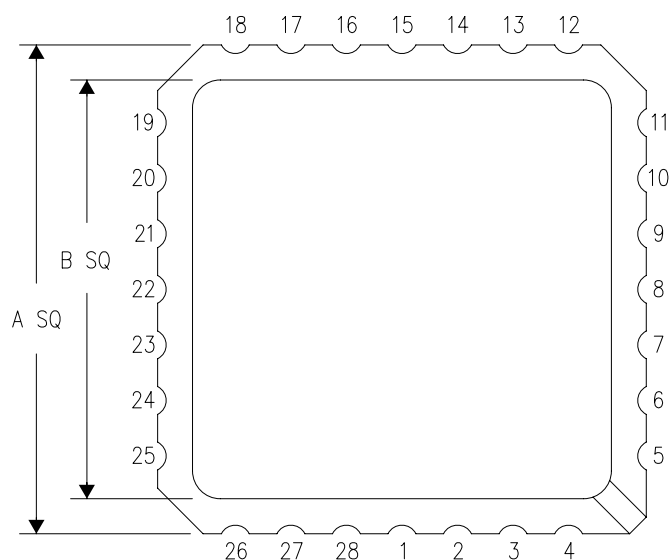
NOTES:

- 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 only.
- E. Falls within MIL STD 1835 GDFP2-F16

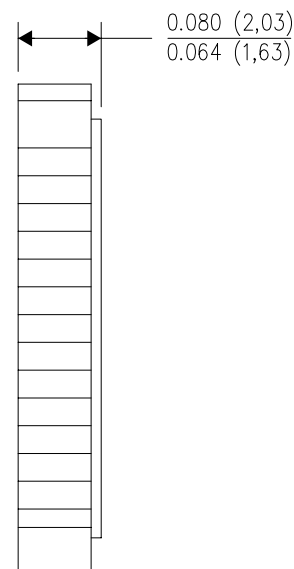
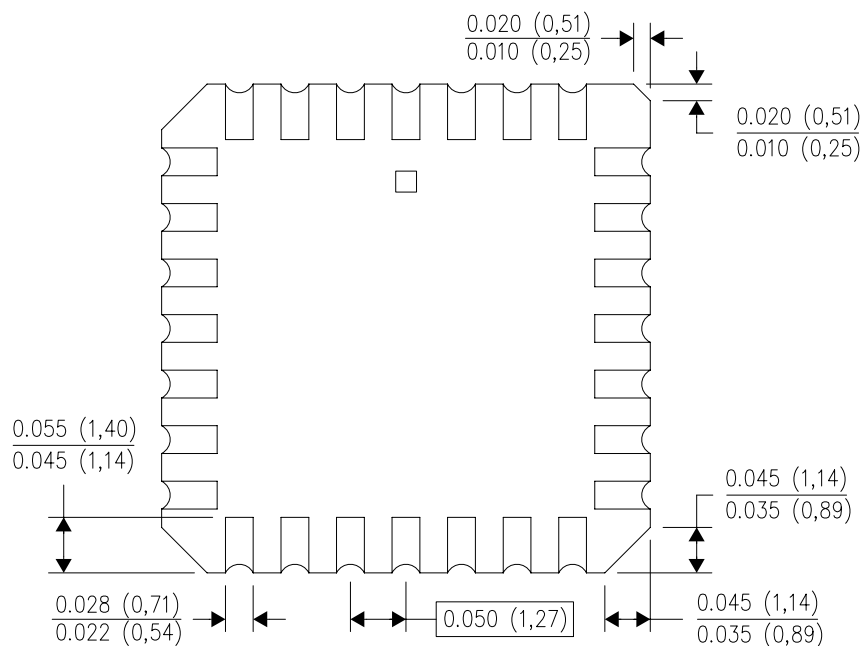
FK (S-CQCC-N**)

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)



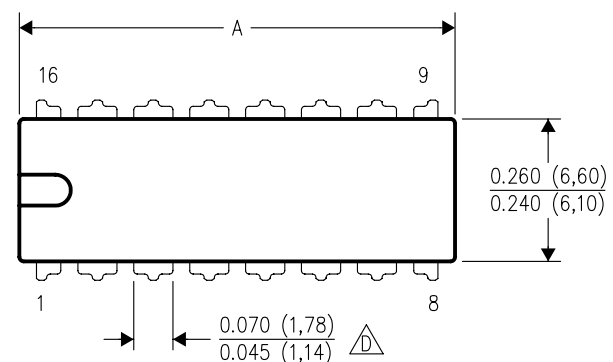
4040140/D 01/11

- NOTES:
- 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.
 - Falls within JEDEC MS-004

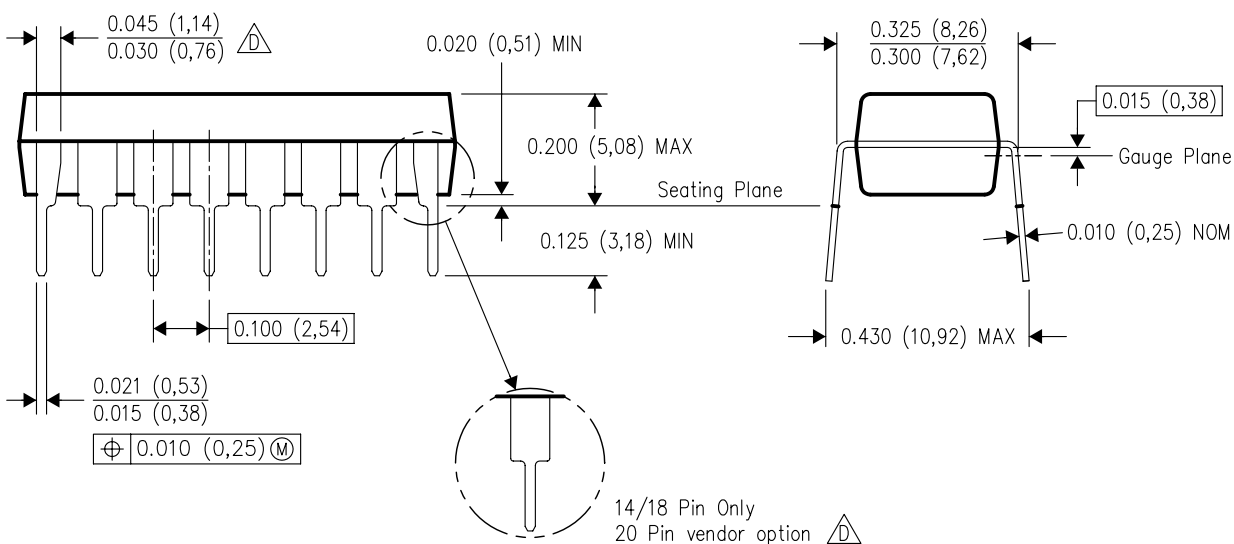
N (R-PDIP-T**)

16 PINS SHOWN

PLASTIC DUAL-IN-LINE PACKAGE



PINS ** DIM	14	16	18	20
A MAX	0.775 (19,69)	0.775 (19,69)	0.920 (23,37)	1.060 (26,92)
A MIN	0.745 (18,92)	0.745 (18,92)	0.850 (21,59)	0.940 (23,88)
MS-001 VARIATION	AA	BB	AC	AD



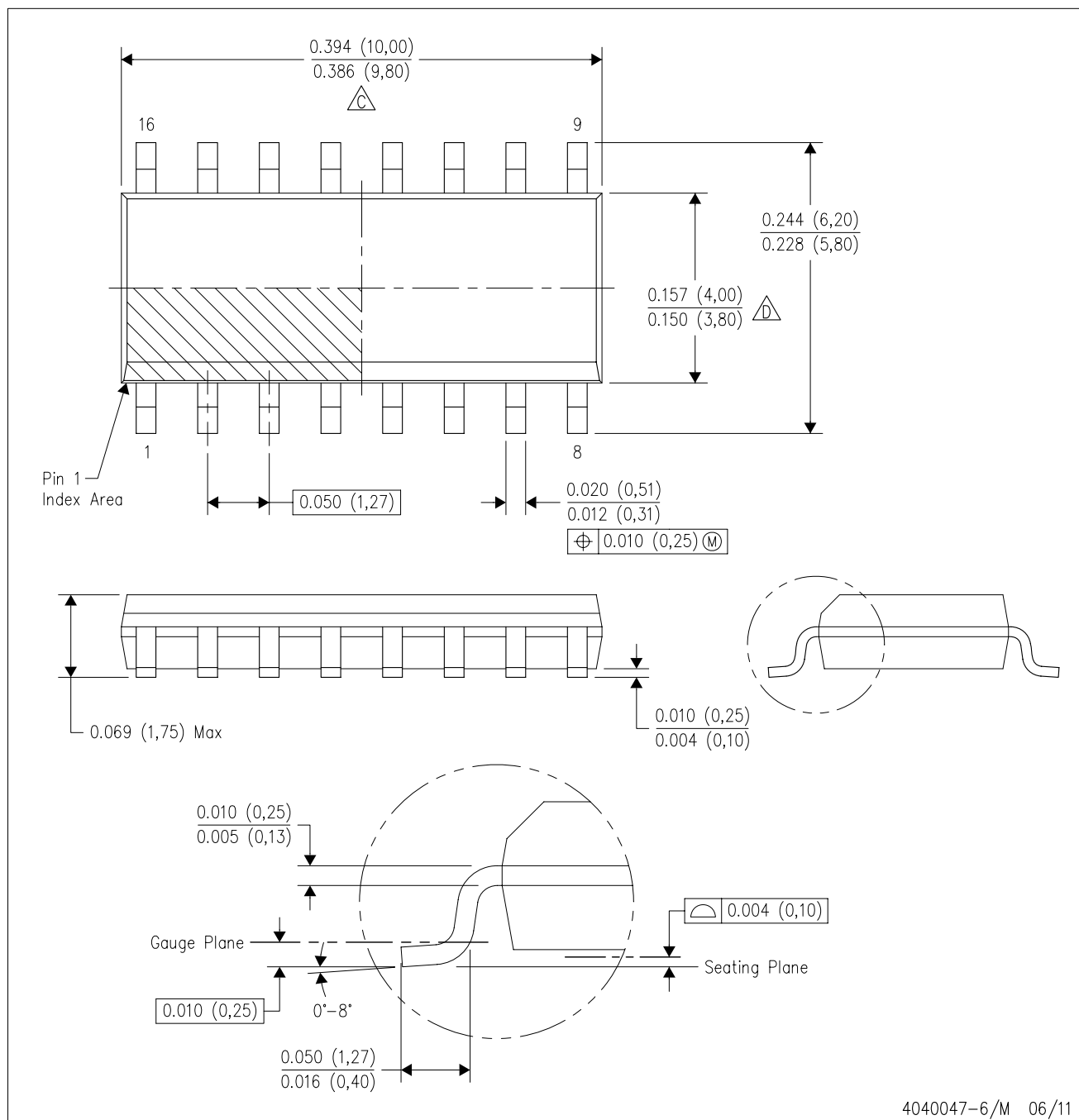
4040049/E 12/2002

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-G16)

PLASTIC SMALL OUTLINE

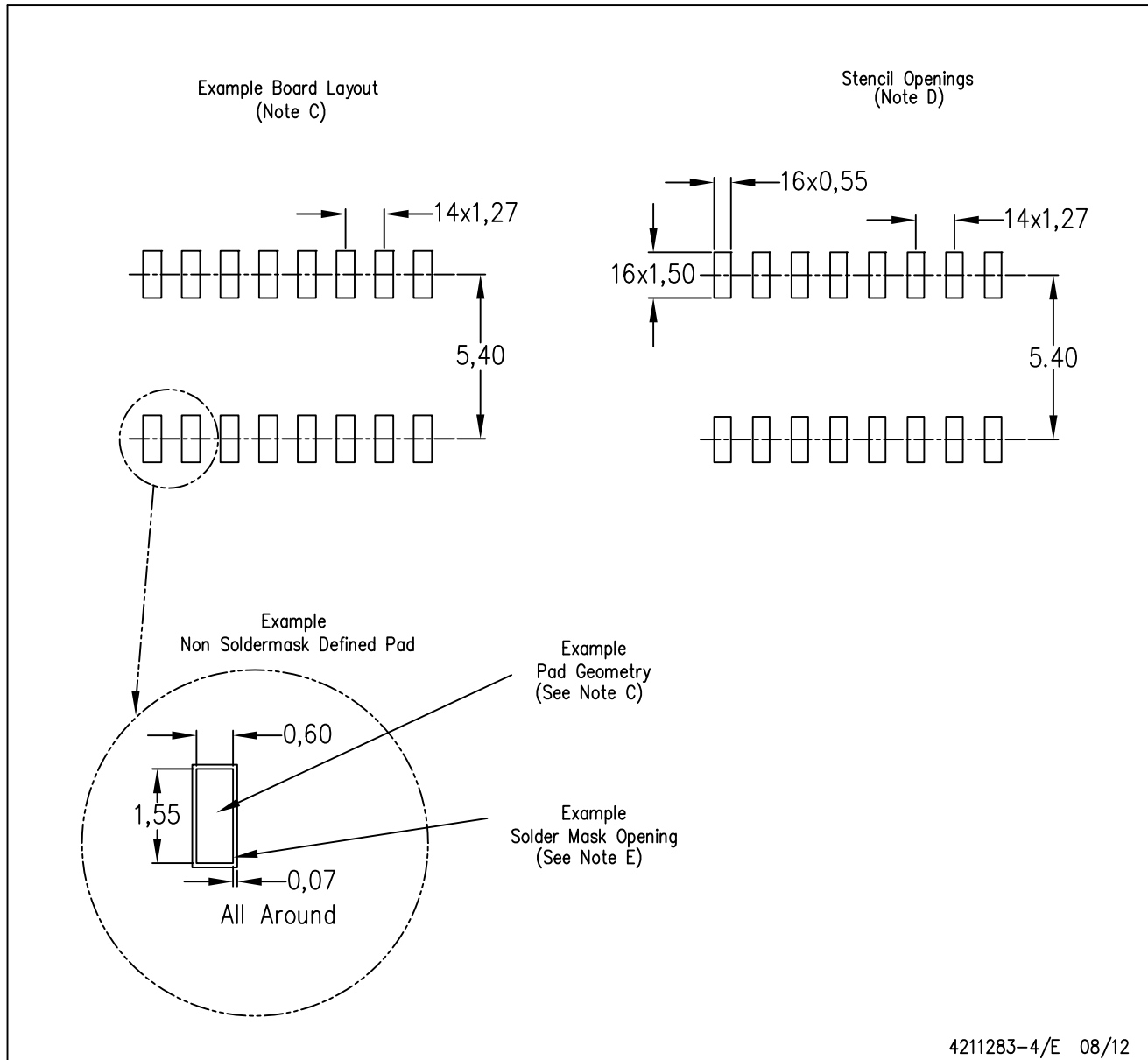


4040047-6/M 06/11

- 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 AC.

D (R-PDSO-G16)

PLASTIC SMALL OUTLINE

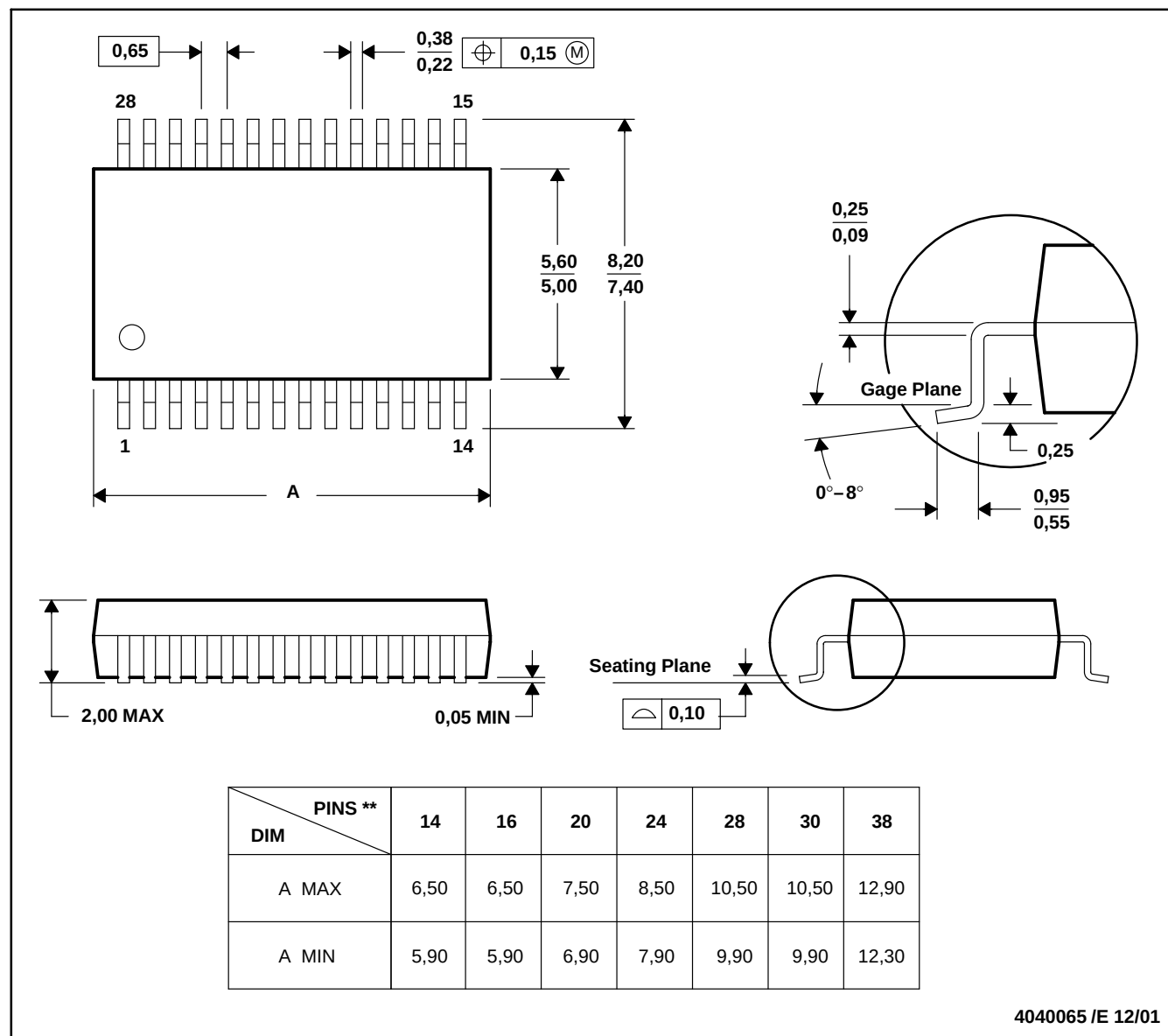


- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Publication IPC-7351 is recommended for alternate designs.
 - D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should 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.

DB (R-PDSO-G**)

PLASTIC SMALL-OUTLINE

28 PINS SHOWN



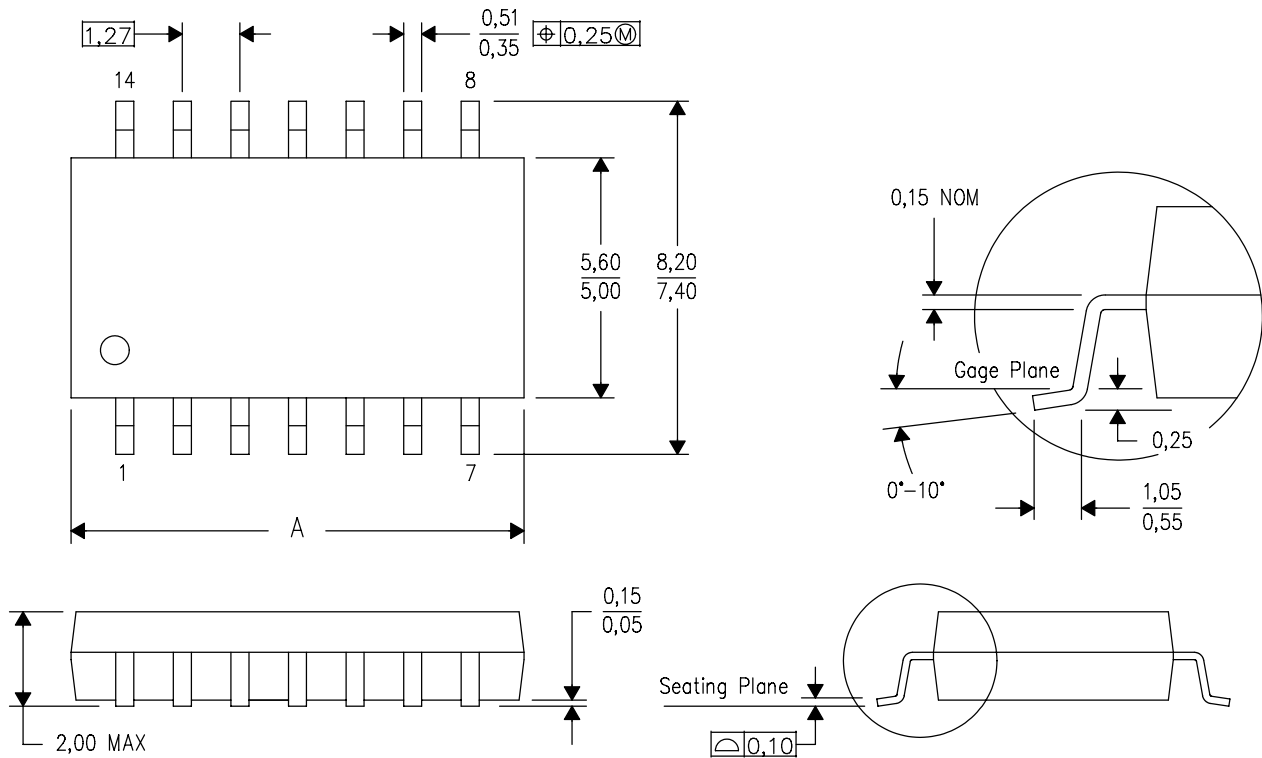
- NOTES: A. All linear dimensions are in millimeters.
 B. This drawing is subject to change without notice.
 C. Body dimensions do not include mold flash or protrusion not to exceed 0,15.
 D. Falls within JEDEC MO-150

MECHANICAL DATA

NS (R-PDSO-G**)

PLASTIC SMALL-OUTLINE PACKAGE

14-PINS SHOWN



DIM \ PINS **	14	16	20	24
A MAX	10,50	10,50	12,90	15,30
A MIN	9,90	9,90	12,30	14,70

4040062/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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