LOW-VOLTAGE HIGH-SPEED QUADRUPLE DIFFERENTIAL LINE DRIVER WITH ±15-kV IEC ESD PROTECTION

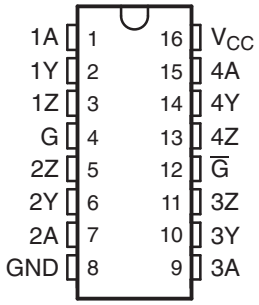
FEATURES

- Meets or Exceeds Standards TIA/EIA-422-B and ITU Recommendation V.11
- Operates From a Single 3.3-V Power Supply
- ESD Protection for RS422 Bus Pins
  - ±15-kV Human-Body Model (HBM)
  - ±8-kV IEC61000-4-2, Contact Discharge
  - ±15-kV IEC61000-4-2, Air-Gap Discharge
- Switching Rates up to 32 MHz
- Propagation Delay Time . . . 8 ns Typ
- Pulse Skew Time . . . 500 ps Typ
- High Output-Drive Current . . . ±30 mA
- Controlled Rise and Fall Times . . . 5 ns Typ
- Differential Output Voltage With 100-Ω Load . . . 2.6 V Typ
- Accepts 5-V Logic Inputs With 3.3-V Supply
- I_{off} Supports Partial-Power-Down Mode Operation
- Driver Output Short-Protection Circuit
- Glitch-Free Power-Up/Power-Down Protection

SUPPORTS DEFENSE, AEROSPACE, AND MEDICAL APPLICATIONS

- Controlled Baseline
- One Assembly/Test Site
- One Fabrication Site
- Available in Extended (–55°C/105°C) Temperature Range(1)
- Extended Product Life Cycle
- Extended Product-Change Notification
- Product Traceability

D PACKAGE
(TOP VIEW)



(1) Additional temperature ranges are available – contact factory

DESCRIPTION/ORDERING INFORMATION

The AM26LV31E is a quadruple differential line driver with 3-state outputs. This driver has ±15-kV ESD (HBM and IEC61000-4-2, Air-Gap Discharge) and ±8-kV ESD (IEC61000-4-2, Contact Discharge) protection. This device is designed to meet TIA/EIA-422-B and ITU Recommendation V.11 drivers with reduced supply voltage.

The device is optimized for balanced-bus transmission at switching rates up to 32 MHz. The outputs have high current capability for driving balanced lines, such as twisted-pair transmission lines, and provide a high impedance in the power-off condition.

The AM26LV31ES is characterized for operation from –55°C to 105°C.

ORDERING INFORMATION

T_A	PACKAGE(1)(2)		ORDERABLE PART NUMBER	TOP-SIDE MARKING
–55°C to 105°C	SOIC – D	Tape and reel	AM26LV31ESDREP	A26LV31ESP

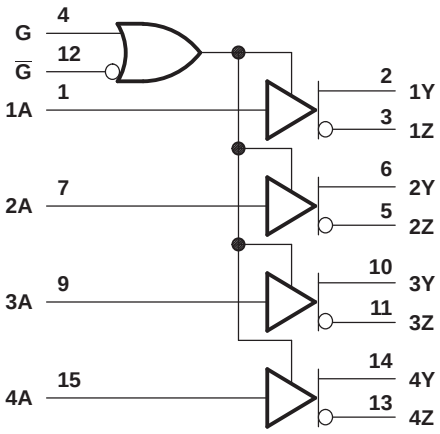
(1) Package drawings, thermal data, and symbolization are available at www.ti.com/packaging.
(2) For the most current package and ordering information, see the Package Option Addendum at the end of this document, or see the TI website at www.ti.com.

FUNCTION TABLE(1)

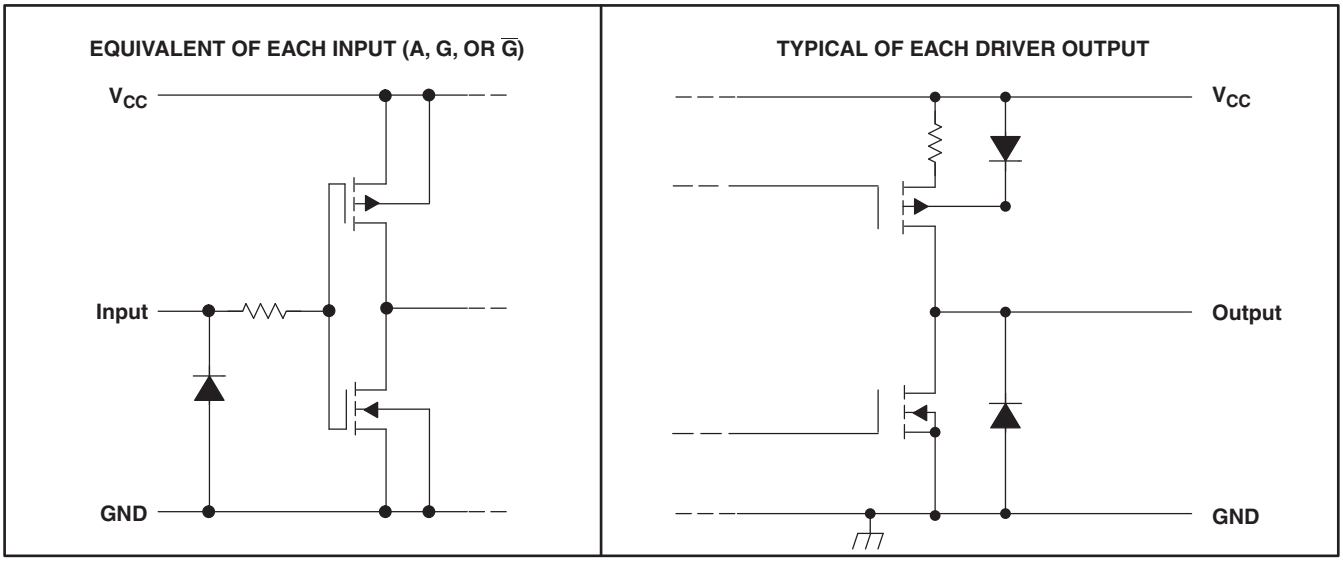
INPUT A	ENABLES		OUTPUTS	
	G	$\overline{G}$	Y	Z
H	H	X	H	L
L	H	X	L	H
H	X	L	H	L
L	X	L	L	H
X	L	H	Z	Z

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

LOGIC DIAGRAM



SCHEMATIC



ABSOLUTE MAXIMUM RATINGS(1)

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

			MIN	MAX	UNIT
V_{CC}	Supply voltage range(2)		–0.5	6	V
V_I	Input voltage range		–0.5	6	V
V_O	Output voltage range		–0.5	6	V
I_{IK}	Input clamp current	$V_I < 0$		–20	mA
I_{OK}	Output clamp current	$V_O < 0$		–20	mA
I_O	Continuous output current			±150	mA
	Continuous current through V_{CC} or GND			±200	mA
T_J	Operating virtual junction temperature			150	°C
θ_{JA}	Package thermal impedance(3)(4)			73	°C/W
T_A	Operating free-air temperature range		–55	105	°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 input voltage are with respect to the network GND.
(3) Maximum power dissipation is a function of $T_{J(max)}$, θ_{JA}, and T_A. The maximum allowable power dissipation at any allowable ambient temperature is $P_D = (T_{J(max)} – T_A)/\theta_{JA}$. Selecting the maximum of 150°C can affect reliability.
(4) The package thermal impedance is calculated in accordance with JESD 51-7.

RECOMMENDED OPERATING CONDITIONS

		MIN	NOM	MAX	UNIT
V_{CC}	Supply voltage	3	3.3	3.6	V
V_I	Input voltage	0		5.5	V
V_{IH}	High-level input voltage	2			V
V_{IL}	Low-level input voltage			0.8	V
I_{OH}	High-level output current			–30	mA
I_{OL}	Low-level output current			30	mA
T_A	Operating free-air temperature	–55		105	°C

ELECTRICAL CHARACTERISTICS

over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP(1)	MAX	UNIT
V_{OH}	High-level output voltage	V_{IH} = 2 V, V_{IL} = 0.8 V, I_{OH} = –20 mA	2.4	3		V
V_{OL}	Low-level output voltage	V_{IH} = 2 V, V_{IL} = 0.8 V, I_{OL} = 20 mA		0.2	0.4	V
$\|V_{OD1}\|$	Differential output voltage	I_O = 0 mA	2		4	V
$\|V_{OD2}\|$	Differential output voltage	R_L = 100 Ω (see Figure 1)(2)	2	2.6		V
$\Delta\|V_{OD}\|$	Change in magnitude of differential output voltage	R_L = 100 Ω (see Figure 1)(2)			±0.4	V
V_{OC}	Common-mode output voltage	R_L = 100 Ω (see Figure 1)(2)		1.5	2	V
$\Delta\|V_{OC}\|$	Change in magnitude of common-mode output voltage	R_L = 100 Ω (see Figure 1)(2)			±0.4	V
$I_{O(OFF)}$	Output current with power off	V_{CC} = 0, V_O = –0.25 V or 5.5 V			±127	µA
I_{OZ}	High-impedance state output current	V_O = –0.25 V or 5.5 V, G = 0.8 V or $\overline{G}$ = 2 V			±127	µA
I_I	Input current	V_{CC} = 0 or 3.6 V, V_I = 0 or 5.5 V			±10	µA
I_{OS}	Short-circuit output current	V_O = V_{CC} or GND(3)	–30		–150	mA
I_{CC}	Supply current (total package)	V_I = V_{CC} or GND, No load, enable			100	µA
C_{pd}	Power dissipation capacitance	No load(4)		160		pF

(1) All typical values are at V_{CC} = 3.3 V, T_A = 25°C.
(2) Refer to TIA-EIA-422-B for exact conditions.
(3) Not more than one output should be shorted at a time, and the duration of the short circuit should not exceed one second.
(4) C_{pd} determines the no-load dynamic current consumption: $I_S = C_{pd} \times V_{CC} \times f + I_{CC}$

SWITCHING CHARACTERISTICS

over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP(1)	MAX	UNIT
t_{PHL}	Propagation delay time, high- to low-level output	See Figure 2	4	8	12	ns
t_{PLH}	Propagation delay time, low- to high-level output		3.5	8	12	ns
t_t	Transition time (t_r or t_f)	See Figure 2		5	10	ns
t_{PZH}	Output-enable time to high level	See Figure 3		10	20	ns
t_{PZL}	Output-enable time to low level	See Figure 4		10	20	ns
t_{PHZ}	Output-disable time from high level	See Figure 3		10	20	ns
t_{PLZ}	Output-disable time from low level	See Figure 4		10	20	ns
$t_{sk(p)}$	Pulse skew	See Figure 2(2)(3)		0.5	3	ns
$t_{sk(o)}$	Skew limit (pin to pin)				1.5	ns
$t_{sk(lim)}$	Skew limit (device to device)				3	ns
$f_{(max)}$	Maximum operating frequency	See Figure 2		32		MHz

(1) All typical values are at V_{CC} = 3.3 V, T_A = 25°C.
(2) Pulse skew is defined as the $|t_{PLH} - t_{PHL}|$ of each channel of the same device.
(3) Skew limit (device to device) is the maximum difference in propagation delay times between any two channels of any two devices.

ESD PROTECTION

PARAMETER	TEST CONDITIONS	TYP	UNIT
Driver output	HBM	±15	kV
	IEC61000-4-2, Air-Gap Discharge	±15	
	IEC61000-4-2, Contact Discharge	±8	

PARAMETER MEASUREMENT INFORMATION

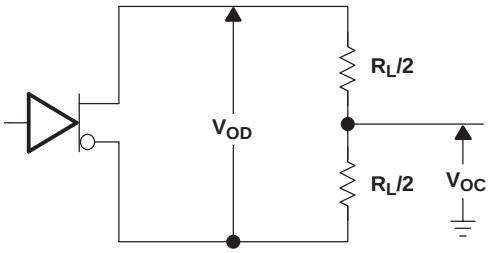
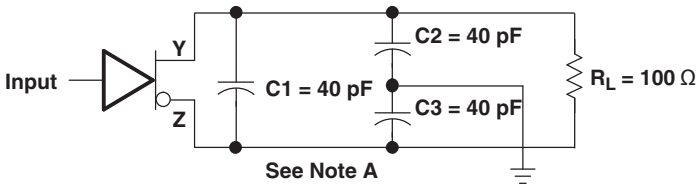
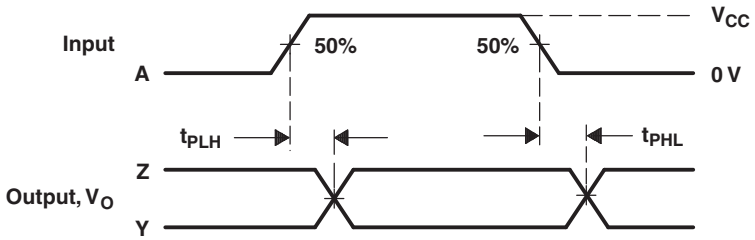
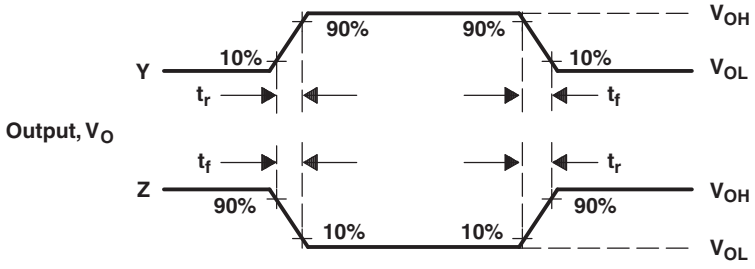


Figure 1. Test Circuit, V_{OD} and V_{OC}





PROPAGATION DELAY TIMES

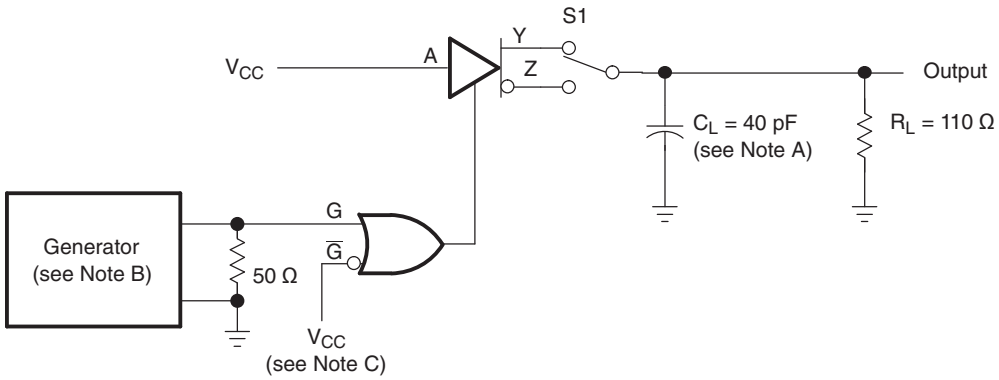


RISE AND FALL TIMES

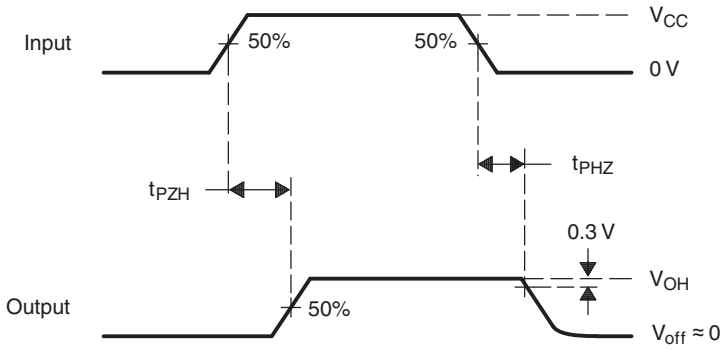
NOTES: A. C_L includes probe and jig capacitance.
B. The input pulse is supplied by a generator having the following characteristics: PRR = 32 MHz, 50% duty cycle, t_r and t_f ≤ 2 ns.

Figure 2. Test Circuit and Voltage Waveforms, t_{PHL} and t_{PLH}

PARAMETER MEASUREMENT INFORMATION (continued)



TEST CIRCUIT



VOLTAGE WAVEFORMS

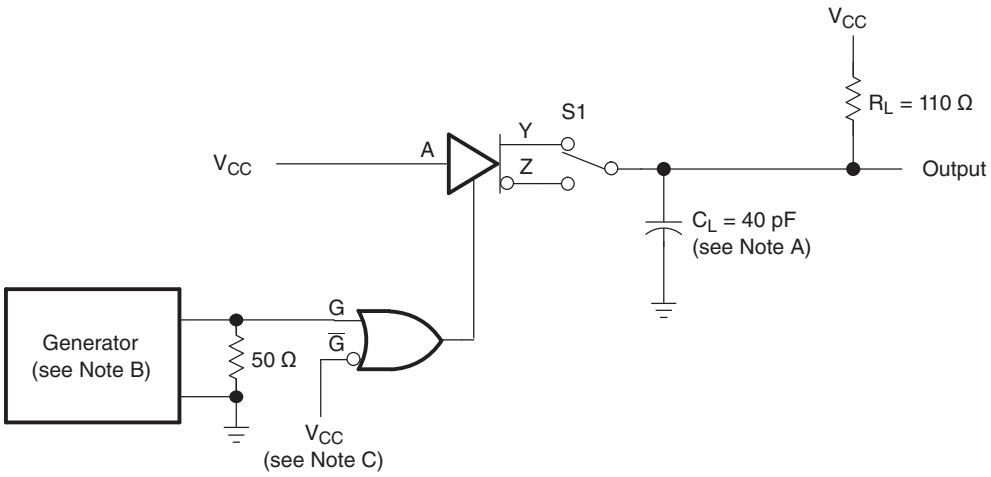
A. C_L includes probe and jig capacitance.

B. The input pulse is supplied by a generator having the following characteristics: PRR = 10 MHz, duty cycle = 50%, $t_r = t_f \leq 2$ns.

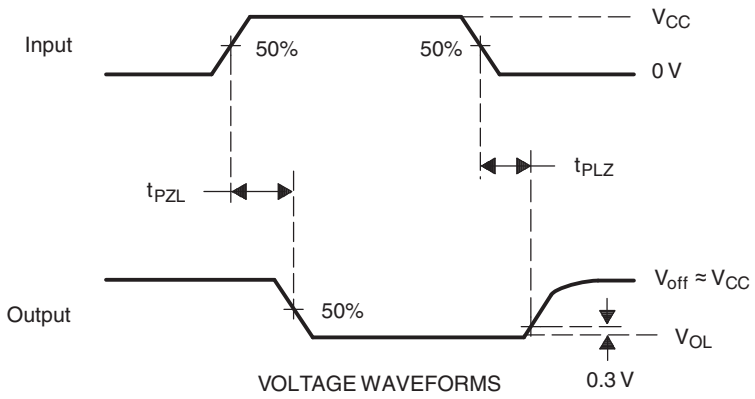
C. To test the active-low enable $\overline{G}$, ground G and apply an inverted waveform $\overline{G}$.

Figure 3. Test Circuit and Voltage Waveforms, t_{PZH} and t_{PHZ}

PARAMETER MEASUREMENT INFORMATION (continued)



TEST CIRCUIT



VOLTAGE WAVEFORMS

A. C_L includes probe and jig capacitance.

B. The input pulse is supplied by a generator having the following characteristics: PRR = 10 MHz, duty cycle = 50%, $t_r = t_f \leq 2$ns.

C. To test the active-low enable $\overline{G}$, ground G and apply an inverted waveform $\overline{G}$.

Figure 4. Test Circuit and Voltage Waveforms, t_{PZL} and t_{PLZ}

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)	Op Temp (°C)	Top-Side Markings (4)	Samples
AM26LV31ESDREP	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-55 to 105	A26LV31ESP	Samples
V62/09603-01XE	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-55 to 105	A26LV31ESP	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) Multiple Top-Side Markings will be inside parentheses. Only one Top-Side 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 Top-Side Marking for that device.

OTHER QUALIFIED VERSIONS OF AM26LV31E-EP :

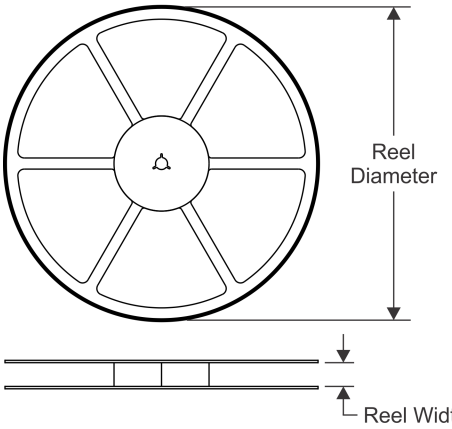
- Catalog: AM26LV31E

NOTE: Qualified Version Definitions:

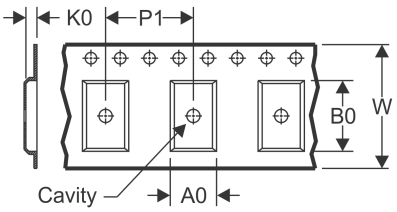
- Catalog - TI's standard catalog product

TAPE AND REEL INFORMATION

REEL DIMENSIONS

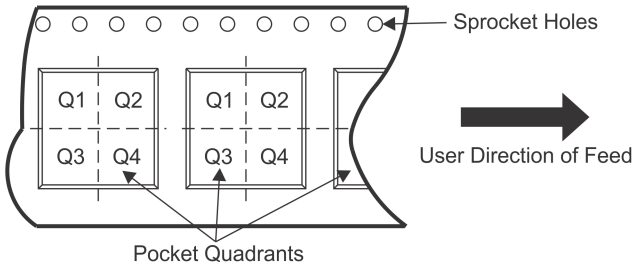


TAPE DIMENSIONS



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

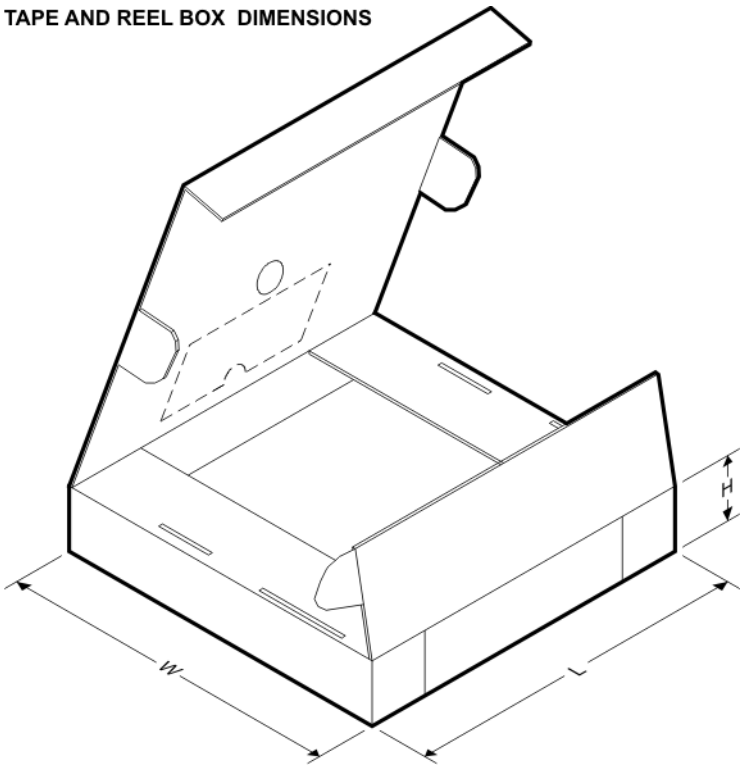
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*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
AM26LV31ESDREP	SOIC	D	16	2500	330.0	16.4	6.5	10.3	2.1	8.0	16.0	Q1

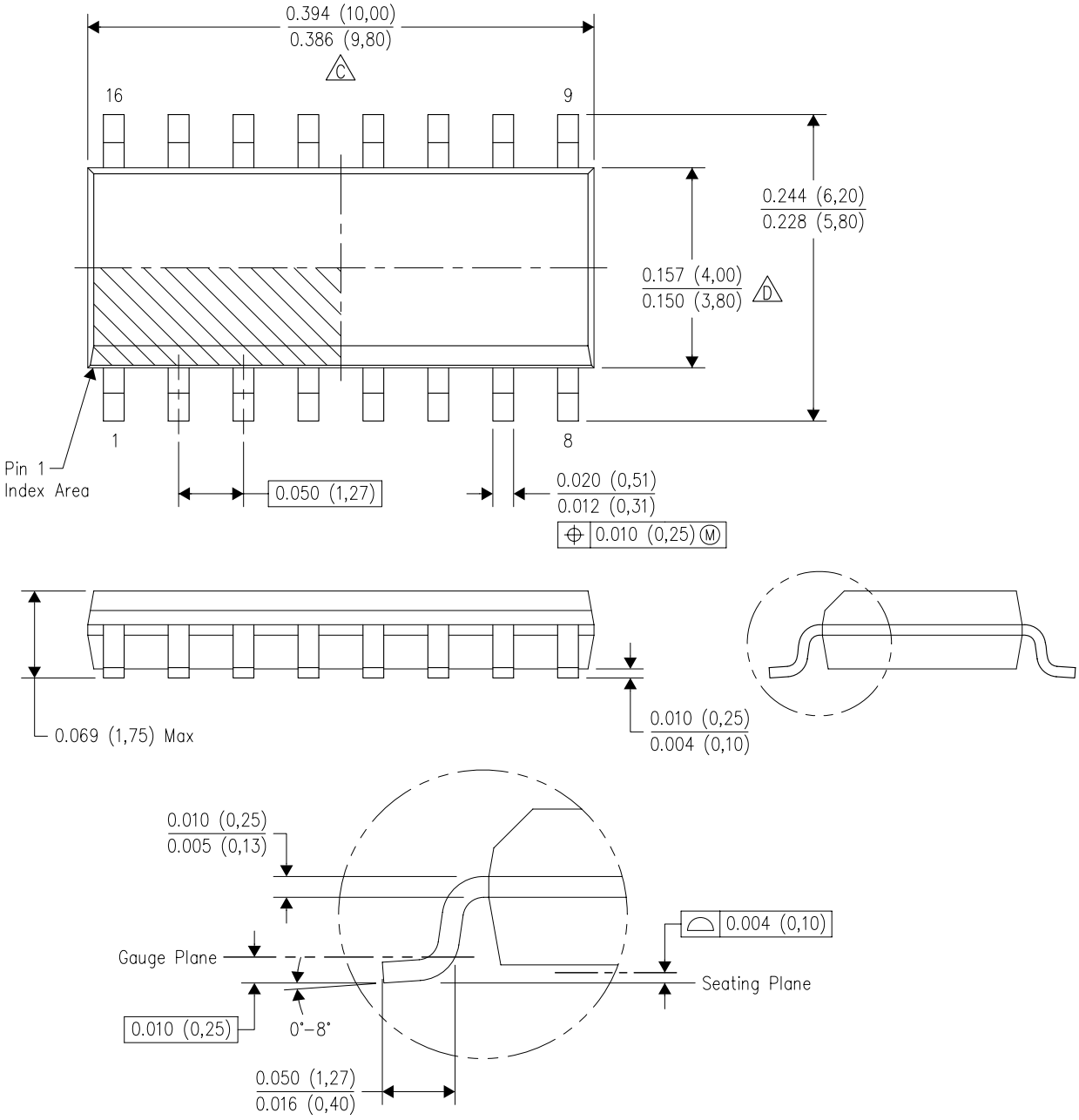
TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
AM26LV31ESDREP	SOIC	D	16	2500	346.0	346.0	33.0

D (R–PDSO–G16) 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 AC.

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