DS96172/DS96174 RS-485/RS-422 Quad Differential Line Drivers

Check for Samples: DS96172, DS96174

FEATURES

- **Meets EIA Standard RS-485 and RS-422A**
- **Monotonic Differential Output Switching**
- **Transmission Rate to 10 Mbs**
- **Tri-state Outputs**
- **Designed for Multipoint Bus Transmission**
- **Common Mode Output Voltage Range: −7V to +12V**
- **Operates from Single +5V Supply**
- **Thermal Shutdown Protection**
- **DS96172/DS96174 are Lead and Function Compatible with the SN75172/75174 or the AM26LS31/MC3487, Respectively**

DESCRIPTION

The DS96172 and DS96174 are high speed quad differential line drivers designed to meet EIA Standard RS-485. The devices have tri-state outputs and are optimized for balanced multipoint data bus transmission at rates up to 10 Mbps. The drivers have wide positive and negative common mode range for multipoint applications in noisy environments. Positive and negative current-limiting is provided which protects the drivers from line fault conditions over a +12V to −7.0V common mode range. A thermal shutdown feature is also provided and occurs at junction temperature of approximately 160°C. The DS96172 features an active high and active low Enable, common to all four drivers. The DS96174 features separate active high Enables for each driver pair. Compatible RS-485 receivers, transceivers, and repeaters are also offered to provide optimum bus performance. The respective device types are DS96173, DS96175, DS96176, AND DS96177.

Connection Diagrams

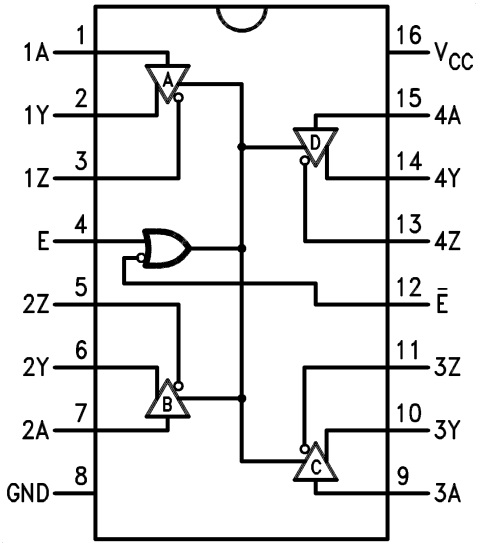


Figure 1. 16-Lead PDIP DS96172
Top View
See Package Number NFG0016E

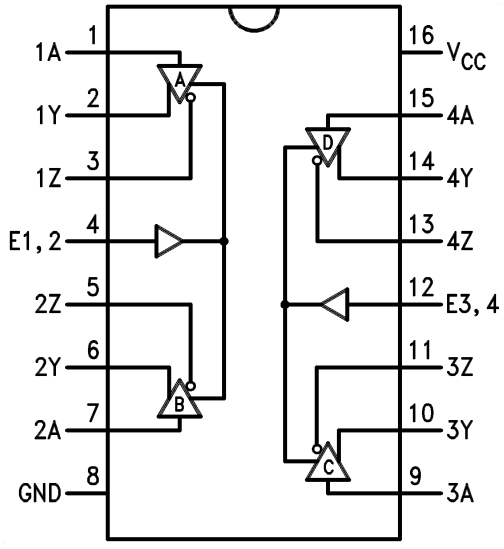


Figure 2. 16-Lead PDIP DS96174
Top View
See Package Number NFG0016E

These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

Absolute Maximum Ratings(1)(2)

Storage Temperature Range Molded PDIP	−65°C to +150°C
Operating Temperature Range	0°C to +70°C
Lead Temperature Molded PDIP (soldering, 10 sec.)	265°C
Supply Voltage	7V
Enable Input Voltage	5.5V
Maximum Power Dissipation(3)	25°C
PDIP Package	1.98W

(1) Absolute Maximum Ratings are those values beyond which the safety of the device cannot be ensured. They are not meant to imply that the devices should be operated at these limits. The tables of Electrical Characteristics provide conditions for actual device operation.
(2) If Military/Aerospace specified devices are required, please contact the TI Sales Office/ Distributors for availability and specifications.
(3) Derate molded PDIP package 16mW/°C above 25°C.

Recommended OperatingConditions

		Min	Typ	Max	Units
Supply Voltage (V_{CC})		4.75	5	5.25	V
Common Mode	Output Voltage (V_{OC})	−7		+12	V
	Output Current HIGH (I_{OH})			−60	mA
	Output Current LOW (I_{OL})			60	mA
	Operating Temperature (T_A)	0	25	70	°C

Electrical Characteristics (1)(2)

over recommended temperature and supply voltage ranges, unless otherwise specified

Symbol	Parameter	Conditions		Min	Typ	Max	Units
V_{IH}	Input Voltage HIGH			2			V
V_{IL}	Input Voltage LOW					0.8	V
V_{OH}	Output Voltage HIGH	I_{OH} = −20 mA			3.1		V
V_{OL}	Output Voltage LOW	I_{OL} = 20 mA			0.8		V
V_{IC}	Input Clamp Voltage	I_I = −18 mA				−1.5	V
$\|V_{OD1}\|$	Differential Output Voltage	I_O = 0 mA				6	V
$\|V_{OD2}\|$	Differential Output Voltage	R_L = 54Ω,See *Figure 3*		1.5	2		V
		R_L = 100Ω,*See Figure 3*		2	2.3		V
$\Delta\|V_{OD}\|$	Change in Magnitude of Differential Output Voltage (3)	R_L = 54Ω or 100Ω,*See Figure 3*				±0.2	V
V_{OC}	Common Mode Output Voltage (4)	R_L = 54Ω,See *Figure 3*				3	V
$\Delta\|V_{OC}\|$	Change in Magnitude of Common Mode Output Voltage (3)					±0.2	V
I_O	Output Current with Power Off	V_{CC} = 0V, V_O = −7.0V to 12V				±100	µA
I_{OZ}	High Impedance State Output Current	V_O = −7.0V to 12V			±50	±200	µA
I_{IH}	Input Current HIGH	V_I = 2.7V				20	µA
I_{IL}	Input Current LOW	V_I = 0.5V				−100	µA
I_{OS}	Short Circuit Output Current (5)	V_O = −7.0V				−250	mA
		V_O = 0V				−150	
		V_O = V_{CC}				150	
		V_O = 12V				250	
I_{CC}	Supply Current (All Drivers)	No Load	Outputs Enabled		50	70	mA
			Output Disabled		50	60	

(1) Unless otherwise specified min/max limits apply across the 0°C to +70°C range for the DS96172/DS96174. All typicals are given for V_{CC} = 5V and T_A = 25°C.
(2) All currents into the device pins are positive; all currents out of the device pins are negative. All voltages are referenced to ground unless otherwise specified.
(3) Δ $|V_{OD}|$ and Δ$|V_{OC}|$ are the changes in magnitude of V_{OD} and V_{OC} respectively, that occur when the input is changed from a high level to a low level.
(4) In EIA Standards RS-422A and RS-485, $V_{OC,}$ which is the average of the two output voltages with respect to ground, is called output offset voltage, V_{OS}.
(5) Only one output at a time should be shorted.

Switching Characteristics

V_{CC} = 5V, T_A = 25°C

Symbol	Parameter	Conditions	Min	Typ	Max	Units
t_{DD}	Differential Output Delay Time	R_L = 60Ω,See *Figure 4*		15	25	ns
t_{TD}	Differential Output Transition Time			15	25	ns
t_{PLH}	Propagation Delay Time, Low-to-High Level Output	R_L = 27Ω,See *Figure 5*		12	20	ns
t_{PHL}	Propagation Delay Time, High-to-Low Level Output			12	20	ns
t_{PZH}	Output Enable Time to High Level	R_L = 110Ω,*See Figure 6*		30	45	ns
t_{PZL}	Output Enable Time to Low Level	R_L = 110Ω, *See Figure 7*		30	45	ns
t_{PHZ}	Output Disable Time from High Level	R_L = 110Ω, See *Figure 6*		25	35	ns
t_{PLZ}	Output Disable Time from Low Level	R_L = 110Ω, See *Figure 7*		30	45	ns

Parameter Measurement Information (1) (2) (3) (4)

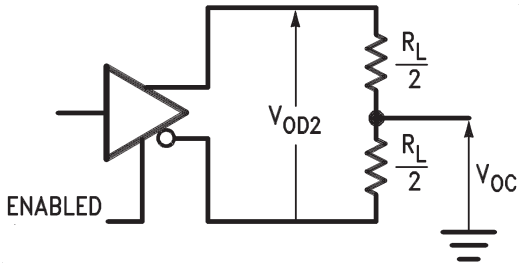


Figure 3. Differential and Common Mode Output Voltage

(1) The input pulse is supplied by a generator having the following characteristics: PRR = 1.0 MHz, duty cycle = 50%, $t_r \le 5.0$ ns, $t_f \le 5.0$ ns, Z_O = 50Ω.
(2) C_L includes probe and jig capacitance.
(3) DS96172 with active high and active low Enables is shown here. DS96174 has active high Enable only.
(4) To test the active low Enable $\overline{E}$ of DS96172, ground E and apply an inverted waveform to $\overline{E}$. DS96174 has active high Enable only.

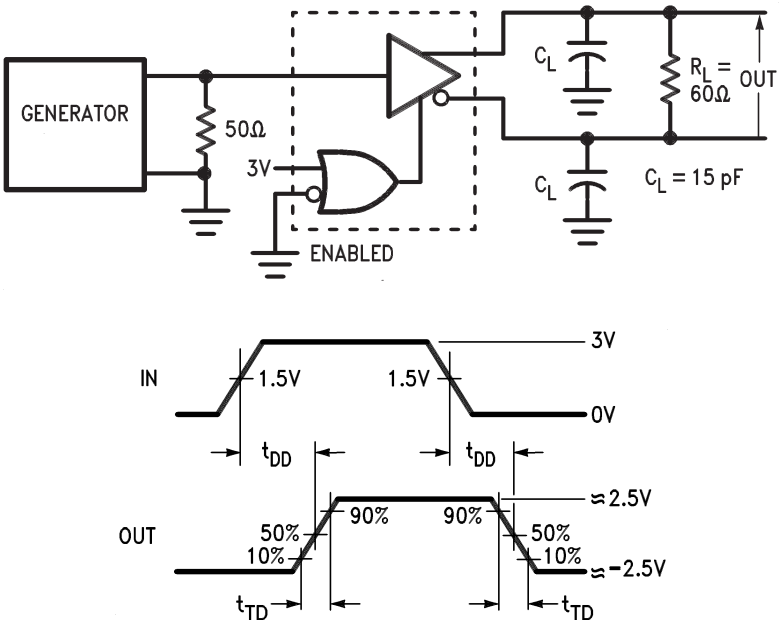


Figure 4. Differential Output Delay and Transition Times

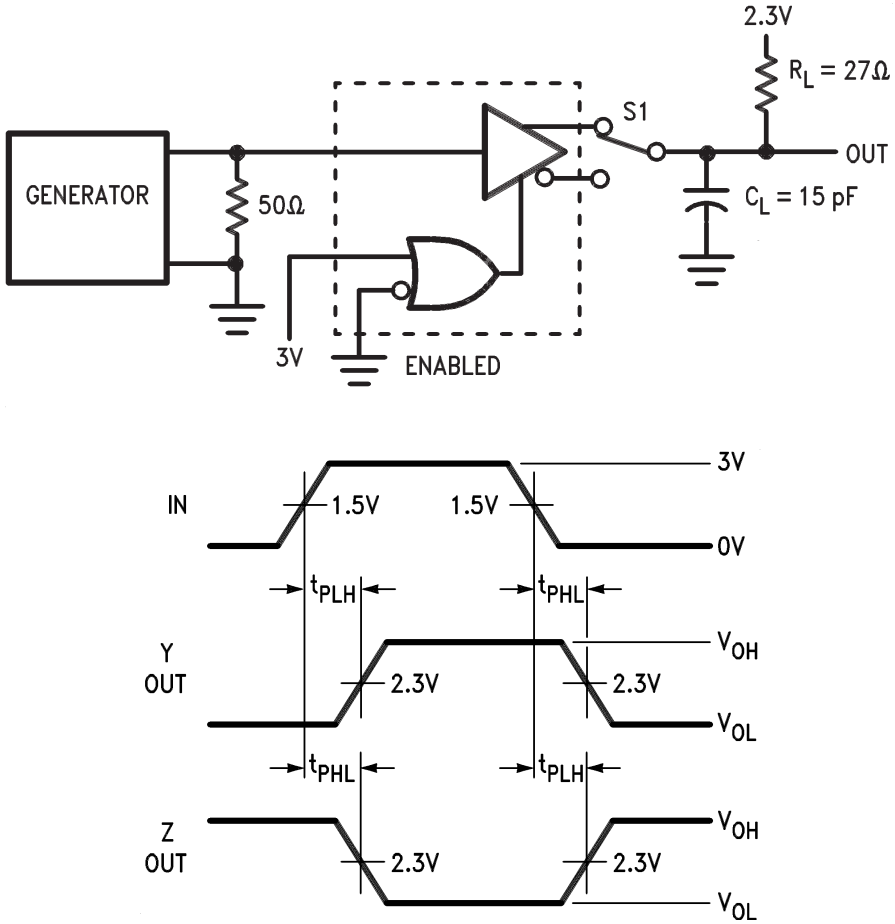


Figure 5. Propagation Delay Times

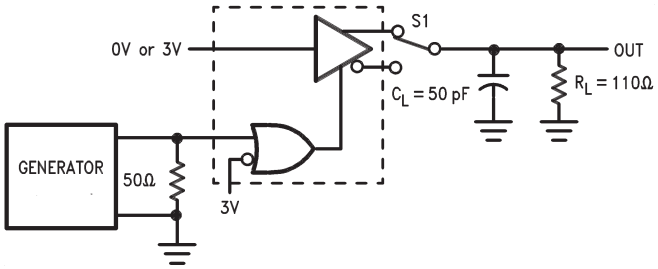


Figure .

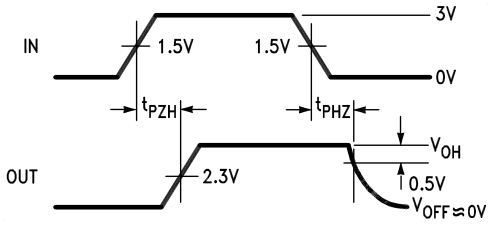
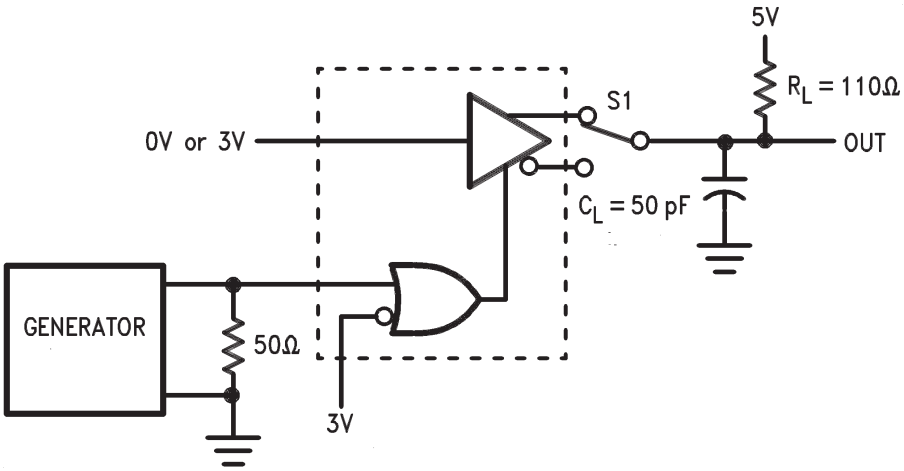


Figure 6. t_{PZH} and t_{PHZ}



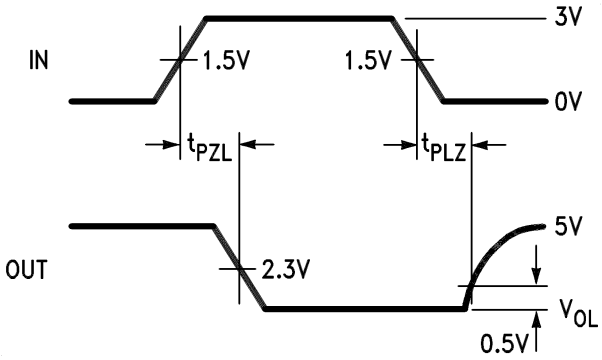


Figure 7. t_{PZL} and t_{PLZ}

Function Tables

Table 1. DS96172

Input	Enables		Outputs	
A	E	$\overline{E}$	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

Table 2. DS96174 (1)

Input	Enable	Outputs	
		Y	Z
H	H	H	L
L	H	L	H
X	L	Z	Z

(1) H = High Level
X = Immaterial
L = Low Level
Z = High Impedance (off)

Typical Application

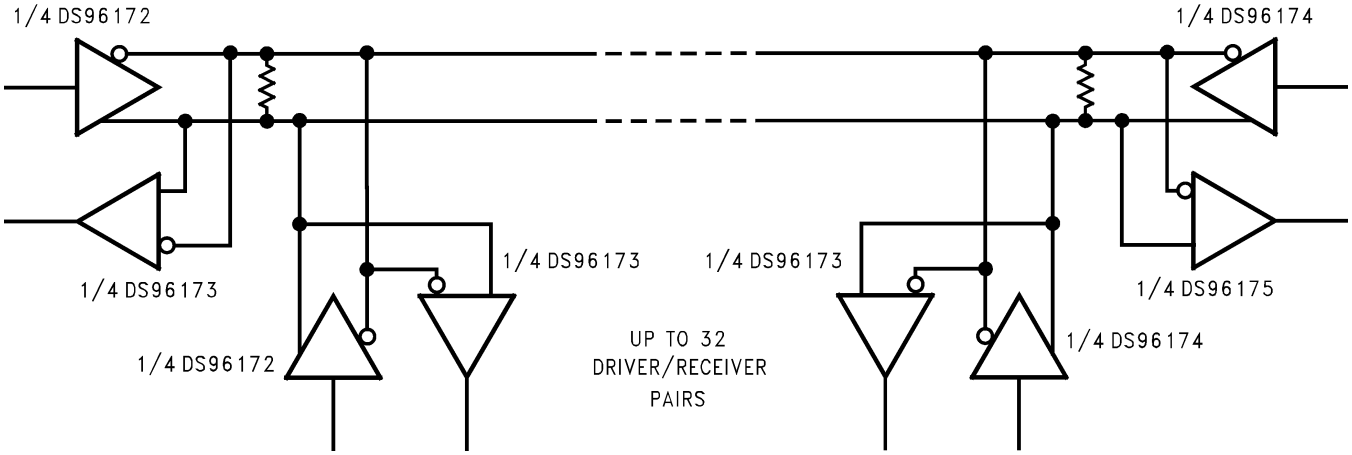


Figure 8.

NOTE

The line length should be terminated at both ends in its characteristic impedance. Stub lengths off the main line should be kept as short as possible.

REVISION HISTORY

Changes from Revision C (April 2013) to Revision D	Page
• Changed layout of National Data Sheet to TI format	8

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
DS96174CN	LIFEBUY	PDIP	NFG	16	25	TBD	Call TI	Call TI	0 to 70	DS96174CN	
DS96174CN/NOPB	LIFEBUY	PDIP	NFG	16	25	Green (RoHS & no Sb/Br)	CU SN	Level-1-NA-UNLIM	0 to 70	DS96174CN	

(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.
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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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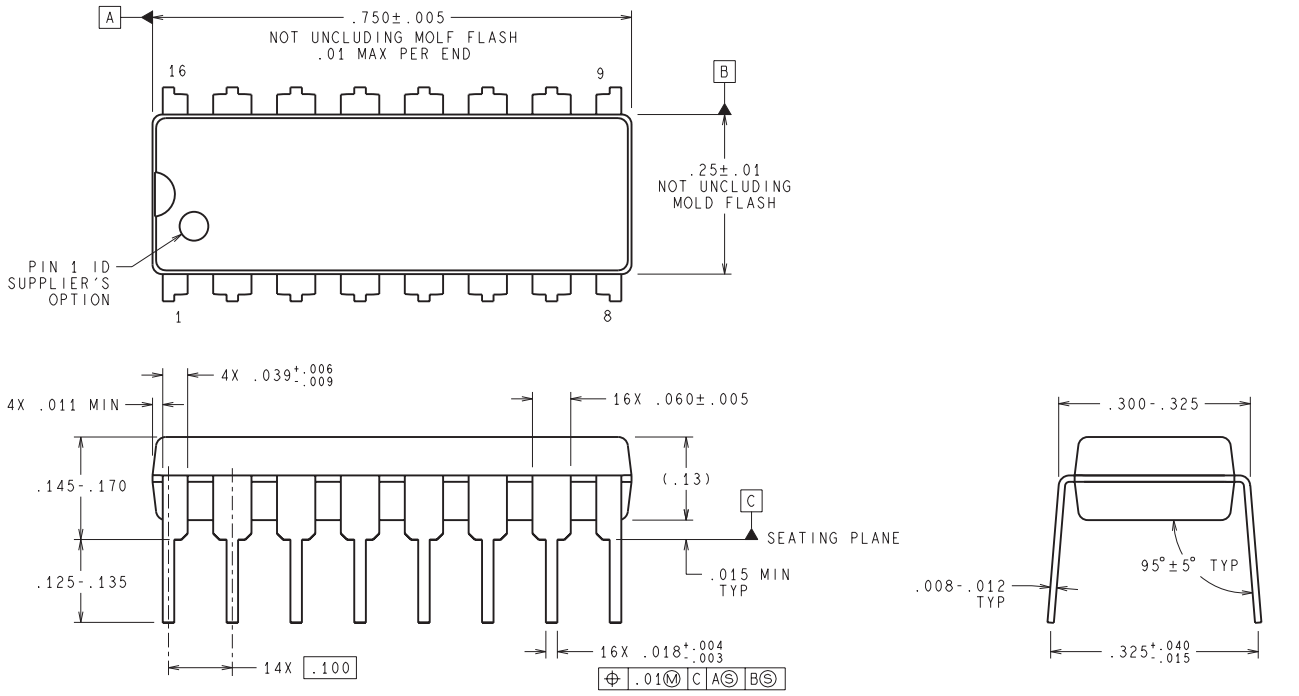

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N16E (Rev G)

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