

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

Check for Samples: [DS96172](#), [DS96174](#)

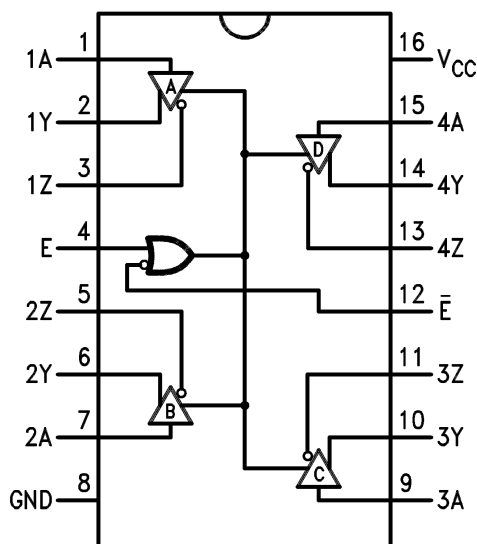
FEATURES

- 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

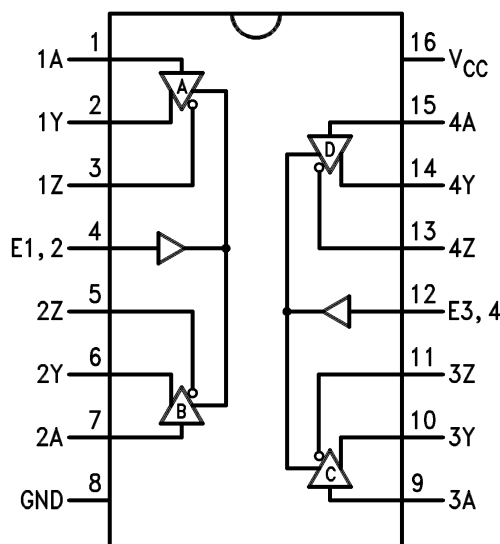
DESCRIPTION

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 $160^{\circ}C$. 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**



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.

All trademarks are the property of their respective owners.

PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of the Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

Copyright © 1998–2013, Texas Instruments Incorporated



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 Operating Conditions

		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	$R_L = 54\Omega$, See Figure 3	1.5	2		V
		$R_L = 100\Omega$, See Figure 3	2	2.3		V
$\Delta V_{OD} $	Change in Magnitude of Differential Output Voltage ⁽³⁾	$R_L = 54\Omega$ or 100Ω , See Figure 3			± 0.2	V
V_{OC}	Common Mode Output Voltage ⁽⁴⁾	$R_L = 54\Omega$, 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	$V_{CC} = 0$ V, $V_O = -7.0$ V to 12 V			± 100	μ A
I_{OZ}	High Impedance State Output Current	$V_O = -7.0$ V to 12 V		± 50	± 200	μ A
I_{IH}	Input Current HIGH	$V_I = 2.7$ V			20	μ A
I_{IL}	Input Current LOW	$V_I = 0.5$ V			-100	μ A
I_{OS}	Short Circuit Output Current ⁽⁵⁾	$V_O = -7.0$ V			-250	mA
		$V_O = 0$ V			-150	
		$V_O = V_{CC}$			150	
		$V_O = 12$ V			250	
I_{CC}	Supply Current (All Drivers)	No Load				mA
		Outputs Enabled		50	70	
		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 $V_{CC} = 5$ V and $T_A = 25^\circ\text{C}$.
- (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) $\Delta|V_{OD}|$ and $\Delta|V_{OC}|$ 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

 $V_{CC} = 5V$, $T_A = 25^\circ C$

Symbol	Parameter	Conditions	Min	Typ	Max	Units
t_{DD}	Differential Output Delay Time	$R_L = 60\Omega$, 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	$R_L = 27\Omega$, 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	$R_L = 110\Omega$, See Figure 6		30	45	ns
t_{PZL}	Output Enable Time to Low Level	$R_L = 110\Omega$, See Figure 7		30	45	ns
t_{PHZ}	Output Disable Time from High Level	$R_L = 110\Omega$, See Figure 6		25	35	ns
t_{PLZ}	Output Disable Time from Low Level	$R_L = 110\Omega$, See Figure 7		30	45	ns

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

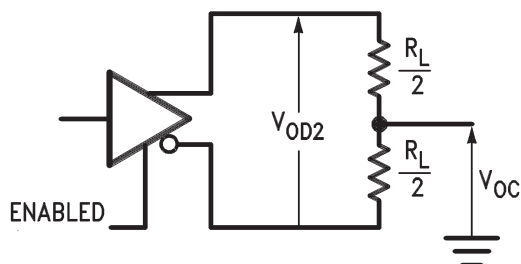


Figure 3. Differential and Common Mode Output Voltage

- (1) The input pulse is supplied by a generator having the following characteristics: PRR = 1.0 MHz, duty cycle = 50%, $t_r \leq 5.0$ ns, $t_f \leq 5.0$ ns, $Z_O = 50\Omega$.
- (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 \bar{E} of DS96172, ground E and apply an inverted waveform to \bar{E} . DS96174 has active high Enable only.

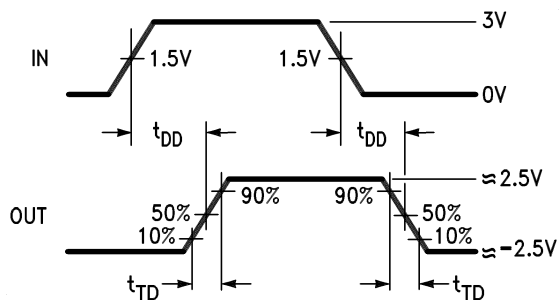
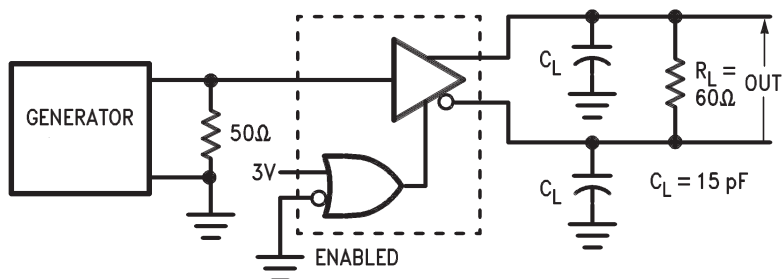


Figure 4. Differential Output Delay and Transition Times

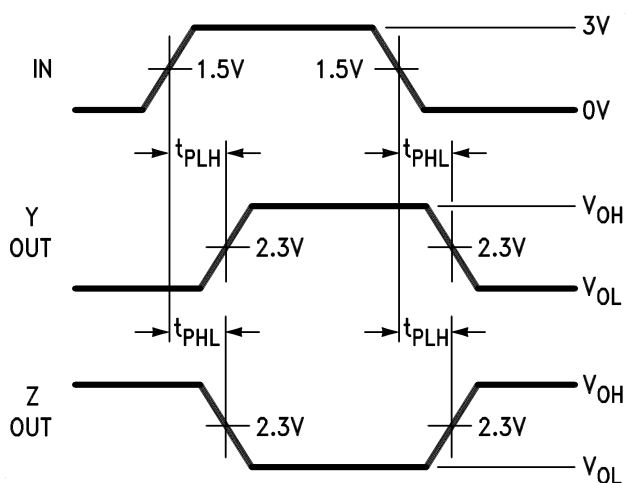
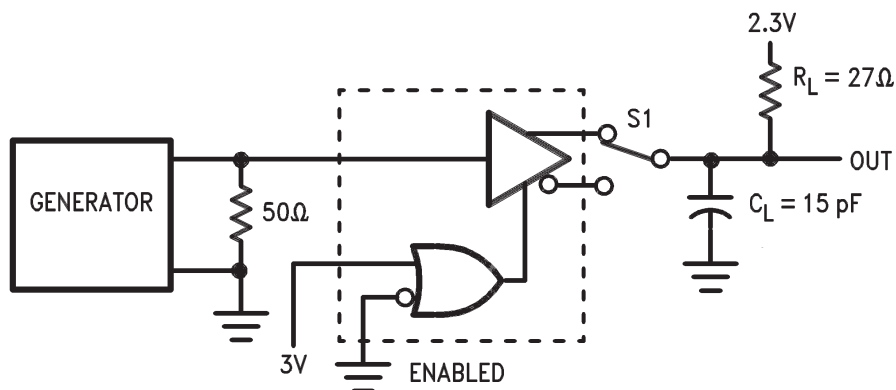


Figure 5. Propagation Delay Times

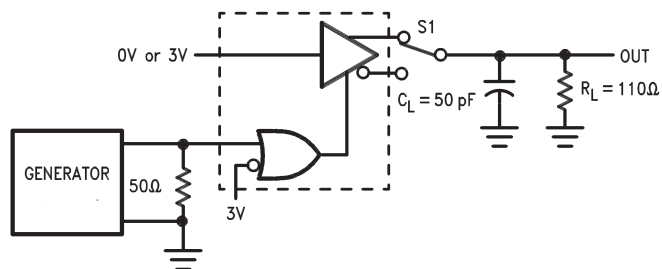
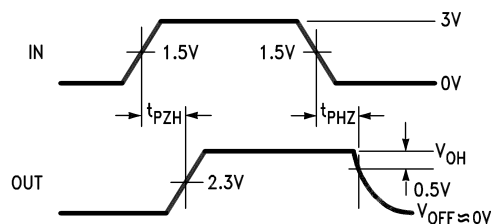
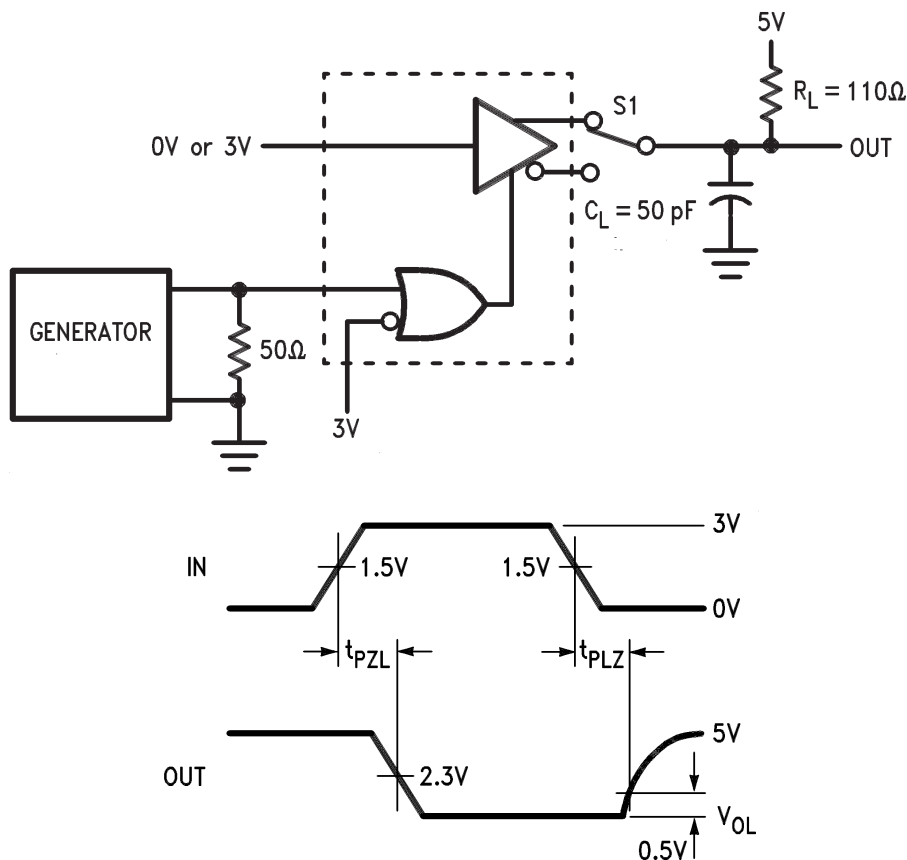


Figure 5.

Figure 6. t_{PZH} and t_{PHZ} Figure 7. t_{PZL} and t_{PLZ}

Function Tables

Table 1. DS96172

Input	Enables		Outputs	
A	E	\bar{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

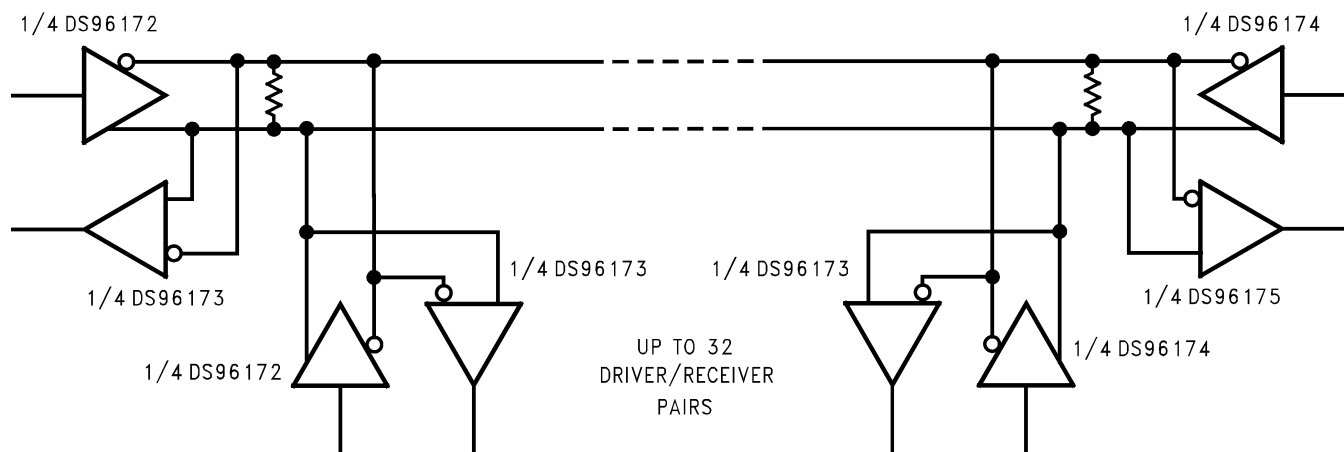


Figure 8.

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	OBSOLETE	PDIP	NFG	16		TBD	Call TI	Call TI	0 to 70	DS96174CN	
DS96174CN/NOPB	OBSOLETE	PDIP	NFG	16		TBD	Call TI	Call TI	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.

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.

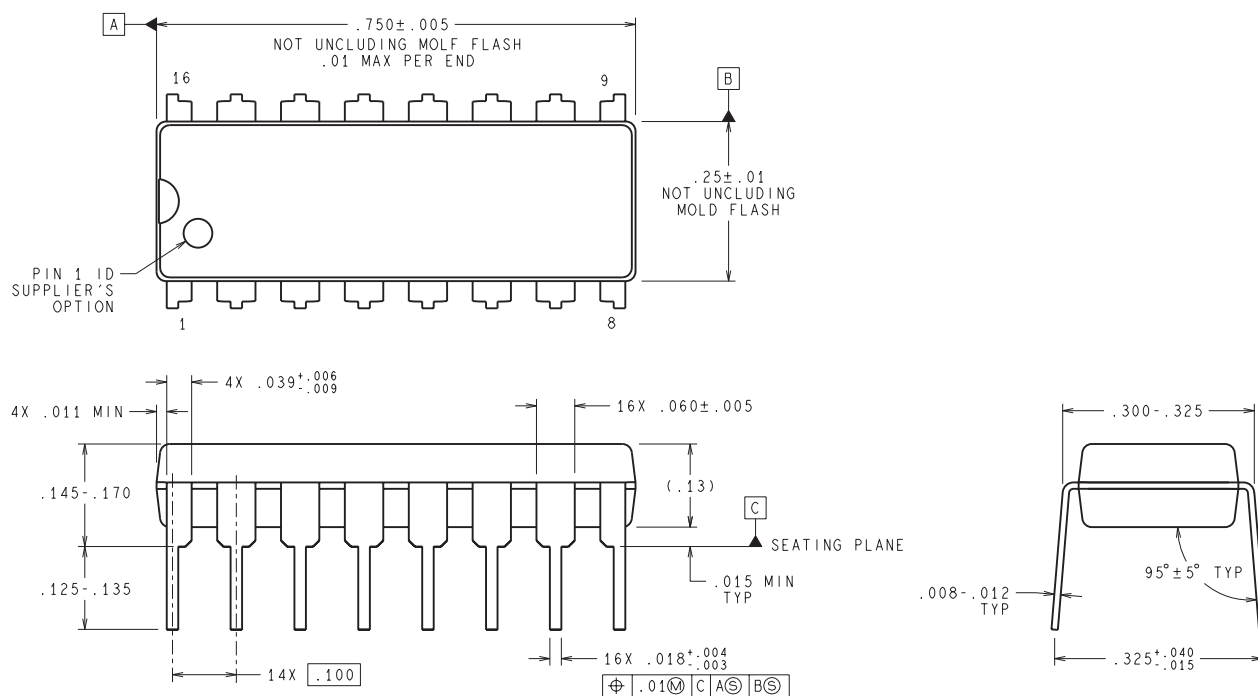
(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

(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.

NFG0016E



DIMENSIONS ARE IN INCHES
DIMENSIONS IN () FOR REFERENCE ONLY

N16E (Rev G)

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as "components") are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its components to the specifications applicable at the time of sale, in accordance with the warranty in TI's terms and conditions of sale of semiconductor products. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by applicable law, testing of all parameters of each component is not necessarily performed.

TI assumes no liability for applications assistance or the design of Buyers' products. Buyers are responsible for their products and applications using TI components. To minimize the risks associated with Buyers' products and applications, Buyers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of significant portions of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI components or services with statements different from or beyond the parameters stated by TI for that component or service voids all express and any implied warranties for the associated TI component or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI's goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or "enhanced plastic" are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have **not** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

Products

Audio	www.ti.com/audio
Amplifiers	amplifier.ti.com
Data Converters	dataconverter.ti.com
DLP® Products	www.dlp.com
DSP	dsp.ti.com
Clocks and Timers	www.ti.com/clocks
Interface	interface.ti.com
Logic	logic.ti.com
Power Mgmt	power.ti.com
Microcontrollers	microcontroller.ti.com
RFID	www.ti-rfid.com
OMAP Applications Processors	www.ti.com/omap
Wireless Connectivity	www.ti.com/wirelessconnectivity

Applications

Automotive and Transportation	www.ti.com/automotive
Communications and Telecom	www.ti.com/communications
Computers and Peripherals	www.ti.com/computers
Consumer Electronics	www.ti.com/consumer-apps
Energy and Lighting	www.ti.com/energy
Industrial	www.ti.com/industrial
Medical	www.ti.com/medical
Security	www.ti.com/security
Space, Avionics and Defense	www.ti.com/space-avionics-defense
Video and Imaging	www.ti.com/video

TI E2E Community

e2e.ti.com