

DS75176B/DS75176BT Multipoint RS-485/RS-422 Transceivers

Check for Samples: [DS75176B](#), [DS75176BT](#)

FEATURES

- Meets EIA Standard RS485 for Multipoint Bus Transmission and is Compatible with RS-422.
- Small Outline (SOIC) Package Option Available for Minimum Board Space.
- 22 ns Driver Propagation Delays.
- Single +5V Supply.
- -7V to +12V Bus Common Mode Range Permits $\pm 7V$ Ground Difference Between Devices on the Bus.
- Thermal Shutdown Protection.
- High Impedance to Bus with Driver in TRI-STATE or with Power Off, Over the Entire Common Mode Range Allows the Unused Devices on the Bus to be Powered Down.
- Pin Out Compatible with DS3695/A and SN75176A/B.
- Combined Impedance of a Driver Output and Receiver Input is Less Than One RS485 Unit Load, Allowing up to 32 Transceivers on the Bus.
- 70 mV Typical Receiver Hysteresis.

DESCRIPTION

The DS75176B is a high speed differential TRI-STATE[®] bus/line transceiver designed to meet the requirements of EIA standard RS485 with extended common mode range (+12V to -7V), for multipoint data transmission. In addition, it is compatible with RS-422.

The driver and receiver outputs feature TRI-STATE capability, for the driver outputs over the entire common mode range of +12V to -7V. Bus contention or fault situations that cause excessive power dissipation within the device are handled by a thermal shutdown circuit, which forces the driver outputs into the high impedance state.

DC specifications are guaranteed over the 0 to 70°C temperature and 4.75V to 5.25V supply voltage range.

Connection and Logic Diagram

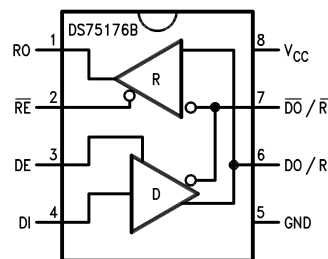


Figure 1. Top View
See Package Number P0008E or D0008A



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.



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.

TRI-STATE is a registered trademark of Texas Instruments.
All other trademarks are the property of their respective owners.

Absolute Maximum Ratings ⁽¹⁾⁽²⁾

Supply Voltage, V_{CC}		7V
Control Input Voltages		7V
Driver Input Voltage		7V
Driver Output Voltages		+15V/ -10V
Receiver Input Voltages (DS75176B)		+15V/ -10V
Receiver Output Voltage		5.5V
Continuous Power Dissipation @ 25°C	for SOIC Package	675 mW ⁽³⁾
	for PDIP Package	900 mW ⁽⁴⁾
Storage Temperature Range		-65°C to +150°C
Lead Temperature (Soldering, 4 seconds)		260°C
ESD Rating (HBM)		500V

- (1) "Absolute Maximum Ratings" are those beyond which the safety of the device cannot be verified. They are not meant to imply that the device 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 linearly @ 6.11 mW/°C to 400 mW at 70°C.
- (4) Derate linearly at 5.56 mW/°C to 650 mW at 70°C.

Recommended Operating Conditions

	Min	Max	Units
Supply Voltage, V_{CC}	4.75	5.25	V
Voltage at Any Bus Terminal (Separate or Common Mode)	-7	+12	V
Operating Free Air Temperature T_A			
DS75176B	0	+70	°C
DS75176BT	-40	+85	°C
Differential Input Voltage, VID ⁽¹⁾	-12	+12	V

- (1) Differential - Input/Output bus voltage is measured at the noninverting terminal A with respect to the inverting terminal B.

Electrical Characteristics ^{(1) (2)}

0°C ≤ T_A ≤ 70°C, 4.75V < V_{CC} < 5.25V unless otherwise specified

Symbol	Parameter	Conditions	Min	Typ	Max	Units					
V_{OD1}	Differential Driver Output Voltage (Unloaded)	$I_O = 0$			5	V					
V_{OD2}	Differential Driver Output Voltage (with Load)	See (Figure 2)									
			R = 50Ω; (RS-422) ⁽³⁾	2		V					
					1.5	V					
ΔV_{OD}	Change in Magnitude of Driver Differential Output Voltage For Complementary Output States	See (Figure 2)			0.2	V					
V_{OC}	Driver Common Mode Output Voltage						R = 27Ω			3.0	V
$\Delta V_{OC} $	Change in Magnitude of Driver Common Mode Output Voltage For Complementary Output States									0.2	V

- (1) All currents into device pins are positive; all currents out of device pins are negative. All voltages are referenced to device ground unless otherwise specified.
- (2) All typicals are given for $V_{CC} = 5V$ and $T_A = 25°C$.
- (3) All worst case parameters for which this note is applied, must be increased by 10% for DS75176BT. The other parameters remain valid for -40°C < T_A < +85°C.

Electrical Characteristics ⁽¹⁾ ⁽²⁾ (continued)
 $0^{\circ}\text{C} \leq T_A \leq 70^{\circ}\text{C}$, $4.75\text{V} < V_{CC} < 5.25\text{V}$ unless otherwise specified

Symbol	Parameter	Conditions	Min	Typ	Max	Units	
V_{IH}	Input High Voltage	DI, DE, RE, E	2			V	
V_{IL}	Input Low Voltage				0.8		
V_{CL}	Input Clamp Voltage		$I_{IN} = -18\text{ mA}$			-1.5	
I_{IL}	Input Low Current		$V_{IL} = 0.4\text{V}$			-200	μA
I_{IH}	Input High Current		$V_{IH} = 2.4\text{V}$			20	μA
I_{IN}	Input Current	DO/RI, $\overline{\text{DO}}/\overline{\text{RI}}$ $V_{CC} = 0\text{V}$ or 5.25V $\text{DE} = 0\text{V}$			+1.0	mA	
					-0.8	mA	
V_{TH}	Differential Input Threshold Voltage for Receiver	$-7\text{V} \leq V_{CM} \leq +12\text{V}$	-0.2		+0.2	V	
ΔV_{TH}	Receiver Input Hysteresis	$V_{CM} = 0\text{V}$		70		mV	
V_{OH}	Receiver Output High Voltage	$I_{OH} = -400\ \mu\text{A}$	2.7			V	
V_{OL}	Output Low Voltage	RO $I_{OL} = 16\ \text{mA}^{(3)}$			0.5	V	
I_{OZR}	OFF-State (High Impedance) Output Current at Receiver	$V_{CC} = \text{Max}$ $0.4\text{V} \leq V_O \leq 2.4\text{V}$			± 20	μA	
R_{IN}	Receiver Input Resistance	$-7\text{V} \leq V_{CM} \leq +12\text{V}$	12			k Ω	
I_{CC}	Supply Current	No Load ⁽³⁾			55	mA	
		Driver Outputs Enabled			35	mA	
		Driver Outputs Disabled					
I_{OSD}	Driver Short-Circuit Output Current	$V_O = -7\text{V}^{(3)}$			-250	mA	
		$V_O = +12\text{V}^{(3)}$			+250	mA	
I_{OSR}	Receiver Short-Circuit Output Current	$V_O = 0\text{V}$	-15		-85	mA	

Switching Characteristics
 $V_{CC} = 5.0\text{V}$, $T_A = 25^{\circ}\text{C}$

Symbol	Parameter	Conditions	Min	Typ	Max	Units
t_{PLH}	Driver Input to Output	$R_{L\text{DIFF}} = 60\ \Omega$		12	22	ns
t_{PHL}	Driver Input to Output	$C_{L1} = C_{L2} = 100\ \text{pF}$		17	22	ns
t_r	Driver Rise Time	$R_{L\text{DIFF}} = 60\ \Omega$			18	ns
t_f	Driver Fall Time	$C_{L1} = C_{L2} = 100\ \text{pF}$ (Figure 4 and Figure 6)			18	ns
t_{ZH}	Driver Enable to Output High	$C_L = 100\ \text{pF}$ (Figure 5 and Figure 7) S1 Open		29	100	ns
t_{ZL}	Driver Enable to Output Low	$C_L = 100\ \text{pF}$ (Figure 5 and Figure 7) S2 Open		31	60	ns
t_{LZ}	Driver Disable Time from Low	$C_L = 15\ \text{pF}$ (Figure 5 and Figure 7) S2 Open		13	30	ns
t_{HZ}	Driver Disable Time from High	$C_L = 15\ \text{pF}$ (Figure 5 and Figure 7) S1 Open		19	200	ns
t_{PLH}	Receiver Input to Output	$C_L = 15\ \text{pF}$ (Figure 3 and Figure 8) S1 and S2 Closed		30	37	ns
t_{PHL}	Receiver Input to Output			32	37	ns
t_{ZL}	Receiver Enable to Output Low	$C_L = 15\ \text{pF}$ (Figure 3 and Figure 9) S2 Open		15	20	ns
t_{ZH}	Receiver Enable to Output High	$C_L = 15\ \text{pF}$ (Figure 3 and Figure 9) S1 Open		11	20	ns
t_{LZ}	Receiver Disable from Low	$C_L = 15\ \text{pF}$ (Figure 3 and Figure 9) S2 Open		28	32	ns
t_{HZ}	Receiver Disable from High	$C_L = 15\ \text{pF}$ (Figure 3 and Figure 9) S1 Open		13	35	ns

AC TEST CIRCUITS

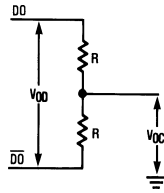
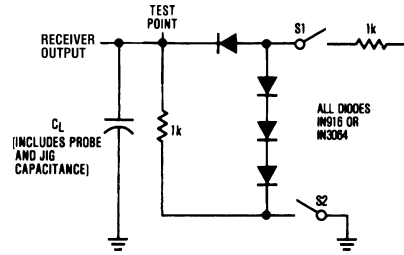


Figure 2.



Note: S1 and S2 of load circuit are closed except as otherwise mentioned.

Figure 3.

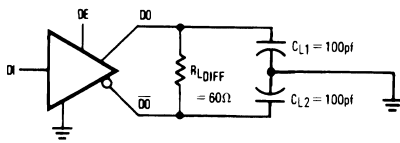
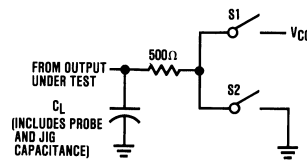


Figure 4.



Note: Unless otherwise specified the switches are closed.

Figure 5.

Switching Time Waveforms

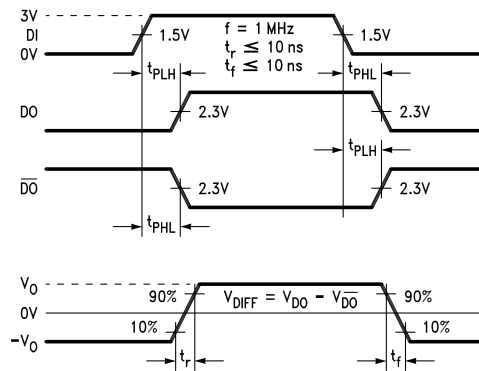


Figure 6. Driver Propagation Delays and Transition Times

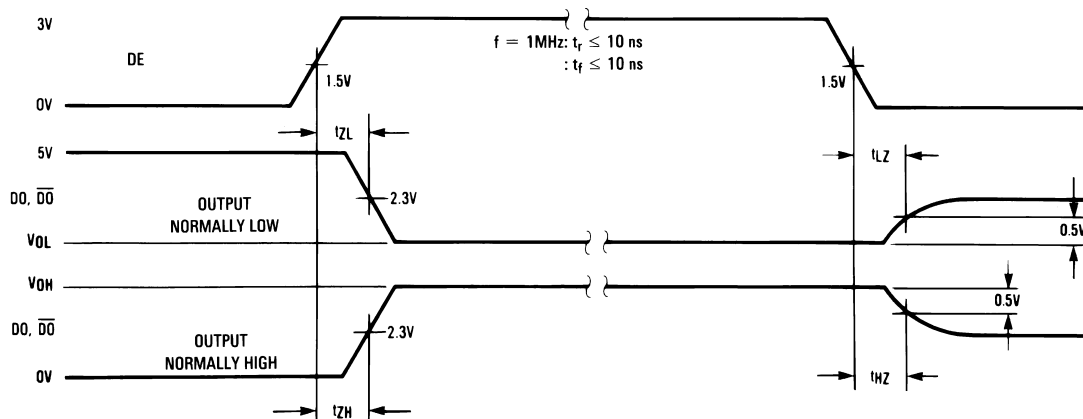
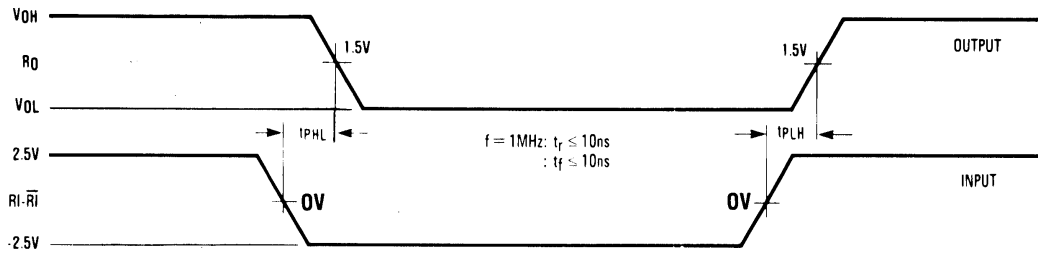


Figure 7. Driver Enable and Disable Times



Note: Differential input voltage may be realized by grounding $\overline{R1}$ and pulsing $R1$ between +2.5V and -2.5V

Figure 8. Receiver Propagation Delays

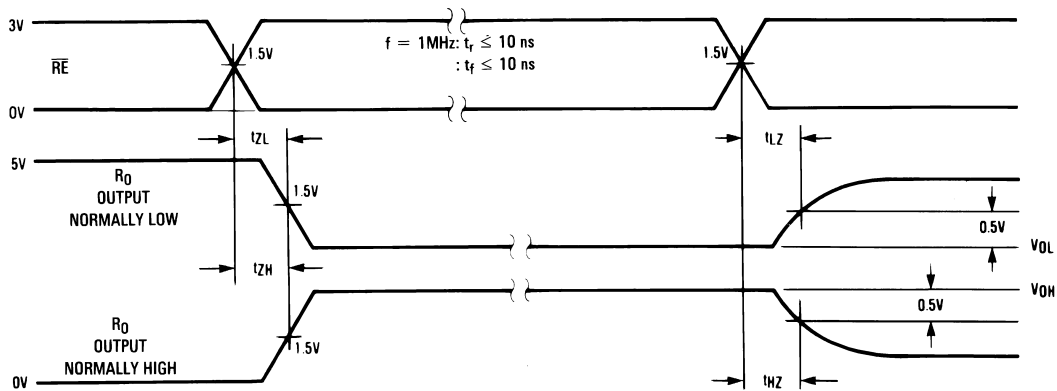


Figure 9. Receiver Enable and Disable Times

Function Tables

Table 1. DS75176B Transmitting⁽¹⁾

Inputs			Line Condition	Outputs	
\overline{RE}	DE	DI		\overline{DO}	DO
X	1	1	No Fault	0	1
X	1	0	No Fault	1	0
X	0	X	X	Z	Z
X	1	X	Fault	Z	Z

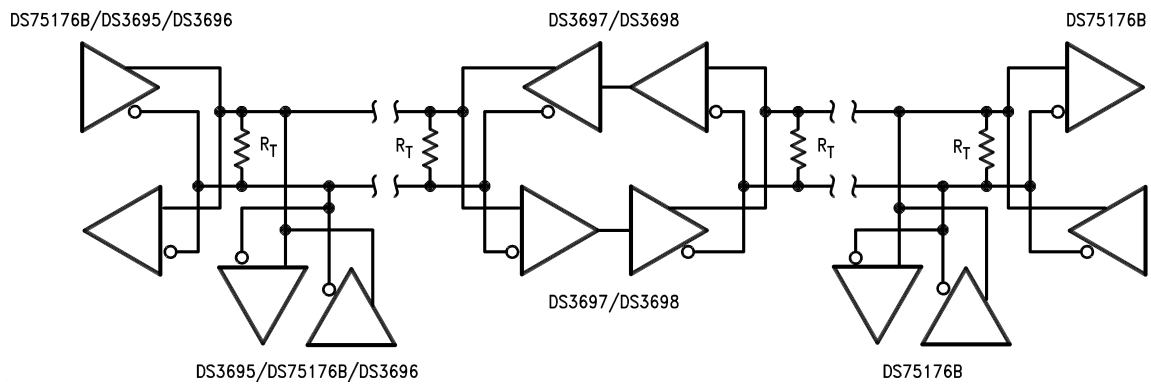
(1) X — Don't care condition
 Z — High impedance state
 Fault — Improper line conditions causing excessive power dissipation in the driver, such as shorts or bus contention situations
 **This is a fail safe condition

Table 2. DS75176B Receiving⁽¹⁾

Inputs			Outputs
\overline{RE}	DE	RI- \overline{RI}	RO
0	0	$\geq +0.2V$	1
0	0	$\leq -0.2V$	0
0	0	Inputs Open**	1
1	0	X	Z

- (1) X — Don't care condition
 Z — High impedance state
 Fault — Improper line conditions causing excessive power dissipation in the driver, such as shorts or bus contention situations
 **This is a fail safe condition

TYPICAL APPLICATION



REVISION HISTORY

Changes from Revision B (April 2013) to Revision C	Page
• Changed layout of National Data Sheet to TI format	6

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
DS75176BM	LIFEBUY	SOIC	D	8	95	TBD	Call TI	Call TI	0 to 70	DS75176BM	
DS75176BM/NOPB	LIFEBUY	SOIC	D	8	95	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	0 to 70	DS75176BM	
DS75176BMX	LIFEBUY	SOIC	D	8	2500	TBD	Call TI	Call TI	0 to 70	DS75176BM	
DS75176BMX/NOPB	LIFEBUY	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	0 to 70	DS75176BM	
DS75176BN/NOPB	LIFEBUY	PDIP	P	8	40	Green (RoHS & no Sb/Br)	CU SN	Level-1-NA-UNLIM	0 to 70	DS75176BN	
DS75176BTM	LIFEBUY	SOIC	D	8	95	TBD	Call TI	Call TI	-40 to 85	DS75176BTM	
DS75176BTM/NOPB	LIFEBUY	SOIC	D	8	95	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 85	DS75176BTM	
DS75176BTMX	LIFEBUY	SOIC	D	8	2500	TBD	Call TI	Call TI	-40 to 85	DS75176BTM	
DS75176BTMX/NOPB	LIFEBUY	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 85	DS75176BTM	
DS75176BTN/NOPB	LIFEBUY	PDIP	P	8	40	Green (RoHS & no Sb/Br)	CU SN	Level-1-NA-UNLIM	-40 to 85	DS75176BTN	

(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) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

RoHS Exempt: TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.

Green: TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

(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.

D (R-PDSO-G8)

PLASTIC SMALL OUTLINE



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.

IMPORTANT NOTICE

Texas Instruments Incorporated (TI) reserves 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.

TI's published terms of sale for semiconductor products (<http://www.ti.com/sc/docs/stdterms.htm>) apply to the sale of packaged integrated circuit products that TI has qualified and released to market. Additional terms may apply to the use or sale of other types of TI products and services.

Reproduction of significant portions of TI information in TI 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 reproduced documentation. Information of third parties may be subject to additional restrictions. Resale of TI products or services with statements different from or beyond the parameters stated by TI for that product or service voids all express and any implied warranties for the associated TI product or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Buyers and others who are developing systems that incorporate TI products (collectively, "Designers") understand and agree that Designers remain responsible for using their independent analysis, evaluation and judgment in designing their applications and that Designers have full and exclusive responsibility to assure the safety of Designers' applications and compliance of their applications (and of all TI products used in or for Designers' applications) with all applicable regulations, laws and other applicable requirements. Designer represents that, with respect to their applications, Designer has all the necessary expertise to create and implement safeguards that (1) anticipate dangerous consequences of failures, (2) monitor failures and their consequences, and (3) lessen the likelihood of failures that might cause harm and take appropriate actions. Designer agrees that prior to using or distributing any applications that include TI products, Designer will thoroughly test such applications and the functionality of such TI products as used in such applications.

TI's provision of technical, application or other design advice, quality characterization, reliability data or other services or information, including, but not limited to, reference designs and materials relating to evaluation modules, (collectively, "TI Resources") are intended to assist designers who are developing applications that incorporate TI products; by downloading, accessing or using TI Resources in any way, Designer (individually or, if Designer is acting on behalf of a company, Designer's company) agrees to use any particular TI Resource solely for this purpose and subject to the terms of this Notice.

TI's provision of TI Resources does not expand or otherwise alter TI's applicable published warranties or warranty disclaimers for TI products, and no additional obligations or liabilities arise from TI providing such TI Resources. TI reserves the right to make corrections, enhancements, improvements and other changes to its TI Resources. TI has not conducted any testing other than that specifically described in the published documentation for a particular TI Resource.

Designer is authorized to use, copy and modify any individual TI Resource only in connection with the development of applications that include the TI product(s) identified in such TI Resource. NO OTHER LICENSE, EXPRESS OR IMPLIED, BY ESTOPPEL OR OTHERWISE TO ANY OTHER TI INTELLECTUAL PROPERTY RIGHT, AND NO LICENSE TO ANY TECHNOLOGY OR INTELLECTUAL PROPERTY RIGHT OF TI OR ANY THIRD PARTY IS GRANTED HEREIN, including but not limited to any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information regarding or referencing third-party products or services does not constitute a license to use such products or services, or a warranty or endorsement thereof. Use of TI Resources 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.

TI RESOURCES ARE PROVIDED "AS IS" AND WITH ALL FAULTS. TI DISCLAIMS ALL OTHER WARRANTIES OR REPRESENTATIONS, EXPRESS OR IMPLIED, REGARDING RESOURCES OR USE THEREOF, INCLUDING BUT NOT LIMITED TO ACCURACY OR COMPLETENESS, TITLE, ANY EPIDEMIC FAILURE WARRANTY AND ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, AND NON-INFRINGEMENT OF ANY THIRD PARTY INTELLECTUAL PROPERTY RIGHTS. TI SHALL NOT BE LIABLE FOR AND SHALL NOT DEFEND OR INDEMNIFY DESIGNER AGAINST ANY CLAIM, INCLUDING BUT NOT LIMITED TO ANY INFRINGEMENT CLAIM THAT RELATES TO OR IS BASED ON ANY COMBINATION OF PRODUCTS EVEN IF DESCRIBED IN TI RESOURCES OR OTHERWISE. IN NO EVENT SHALL TI BE LIABLE FOR ANY ACTUAL, DIRECT, SPECIAL, COLLATERAL, INDIRECT, PUNITIVE, INCIDENTAL, CONSEQUENTIAL OR EXEMPLARY DAMAGES IN CONNECTION WITH OR ARISING OUT OF TI RESOURCES OR USE THEREOF, AND REGARDLESS OF WHETHER TI HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

Unless TI has explicitly designated an individual product as meeting the requirements of a particular industry standard (e.g., ISO/TS 16949 and ISO 26262), TI is not responsible for any failure to meet such industry standard requirements.

Where TI specifically promotes products as facilitating functional safety or as compliant with industry functional safety standards, such products are intended to help enable customers to design and create their own applications that meet applicable functional safety standards and requirements. Using products in an application does not by itself establish any safety features in the application. Designers must ensure compliance with safety-related requirements and standards applicable to their applications. Designer may not use any TI products in life-critical medical equipment unless authorized officers of the parties have executed a special contract specifically governing such use. Life-critical medical equipment is medical equipment where failure of such equipment would cause serious bodily injury or death (e.g., life support, pacemakers, defibrillators, heart pumps, neurostimulators, and implantables). Such equipment includes, without limitation, all medical devices identified by the U.S. Food and Drug Administration as Class III devices and equivalent classifications outside the U.S.

TI may expressly designate certain products as completing a particular qualification (e.g., Q100, Military Grade, or Enhanced Product). Designers agree that it has the necessary expertise to select the product with the appropriate qualification designation for their applications and that proper product selection is at Designers' own risk. Designers are solely responsible for compliance with all legal and regulatory requirements in connection with such selection.

Designer will fully indemnify TI and its representatives against any damages, costs, losses, and/or liabilities arising out of Designer's non-compliance with the terms and provisions of this Notice.

Mouser Electronics

Authorized Distributor

Click to View Pricing, Inventory, Delivery & Lifecycle Information:

[Texas Instruments:](#)

[DS75176BN](#) [DS75176BTN](#)