DS75176B,DS75176BT

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

TEXAS INSTRUMENTS

Literature Number: SNLS381B

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

General 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.

Features

- Meets EIA standard RS485 for multipoint bus transmission and is compatible with RS-422.
- Small Outline (SO) Package option available for minimum board space.
- 22 ns driver propagation delays.
- Single +5V supply.
- –7V to +12V bus common mode range permits ±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.

Connection and Logic Diagram
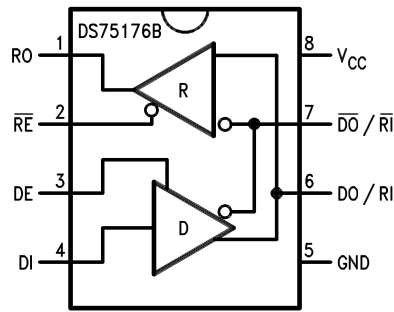
00875901

Top View
Order Number DS75176BN, DS75176BTN, DS75176BM or DS75176BTM
See NS Package Number N08E or M08A

Absolute Maximum Ratings (Note 1)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

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 M Package	675 mW (Note 5)
for N Package	900 mW (Note 4)
Storage Temperature Range	−65˚C to +150˚C
Lead Temperature (Soldering, 4 seconds)	260˚C

ESD Rating (HBM)   500V

Recommended Operating Conditions

	Min	Max	Units
Supply Voltage, V_{CC}	4.75	5.25	V
Voltage at Any Bus Terminal	−7	+12	V
(Separate or Common Mode)			
Operating Free Air Temperature T_A			
DS75176B	0	+70	˚C
DS75176BT	−40	+85	˚C
Differential Input Voltage,			
VID (Note 6)	−12	+12	V

Electrical Characteristics (Notes 2, 3)

$0°C \leq T_A \leq 70°C$, $4.75V < V_{CC} < 5.25V$ 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)		(*Figure 1*)	$R = 50\Omega$; (RS-422) (Note 7)	2			V
				$R = 27\Omega$; (RS-485)	1.5			V
ΔV_{OD}	Change in Magnitude of Driver Differential Output Voltage For Complementary Output States		(*Figure 1*)	$R = 27\Omega$			0.2	V
V_{OC}	Driver Common Mode Output Voltage						3.0	V
$\Delta|V_{OC}|$	Change in Magnitude of Driver Common Mode Output Voltage For Complementary Output States						0.2	V
V_{IH}	Input High Voltage				2			V
V_{IL}	Input Low Voltage	DI, DE, $\overline{RE}$, E					0.8	
V_{CL}	Input Clamp Voltage		$I_{IN} = -18$ mA				−1.5	
I_{IL}	Input Low Current		$V_{IL} = 0.4V$				−200	µA
I_{IH}	Input High Current		$V_{IH} = 2.4V$				20	µA
I_{IN}	Input Current	DO/RI, $\overline{DO}/\overline{RI}$ $V_{CC} = 0V$ or 5.25V DE = 0V	$V_{IN} = 12V$				+1.0	mA
			$V_{IN} = -7V$				−0.8	mA
V_{TH}	Differential Input Threshold Voltage for Receiver		$-7V \leq V_{CM} \leq +12V$		−0.2		+0.2	V
ΔV_{TH}	Receiver Input Hysteresis		$V_{CM} = 0V$			70		mV
V_{OH}	Receiver Output High Voltage		$I_{OH} = -400$ µA		2.7			V
V_{OL}	Output Low Voltage	RO	$I_{OL} = 16$ mA (Note 7)				0.5	V
I_{OZR}	OFF-State (High Impedance) Output Current at Receiver		$V_{CC} = $ Max $0.4V \leq V_O \leq 2.4V$				±20	µA
R_{IN}	Receiver Input Resistance		$-7V \leq V_{CM} \leq +12V$		12			kΩ
I_{CC}	Supply Current		No Load (Note 7)	Driver Outputs Enabled			55	mA
				Driver Outputs Disabled			35	mA

Electrical Characteristics (Notes 2, 3) (Continued)

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

Symbol	Parameter	Conditions	Min	Typ	Max	Units
I_{OSD}	Driver Short-Circuit	$V_O = -7V$ (Note 7)			−250	mA
	Output Current	$V_O = +12V$ (Note 7)			+250	mA
I_{OSR}	Receiver Short-Circuit	$V_O = 0V$	−15		−85	mA
	Output Current					

Note 1: "Absolute Maximum Ratings" are those beyond which the safety of the device cannot be guaranteed. 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.

Note 2: 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.

Note 3: All typicals are given for $V_{CC} = 5V$ and $T_A = 25°C$.

Note 4: Derate linearly at 5.56 mW/°C to 650 mW at 70°C.

**Note 5:** Derate linearly @ 6.11 mW/°C to 400 mW at 70°C.

Note 6: Differential - Input/Output bus voltage is measured at the noninverting terminal A with respect to the inverting terminal B.

Note 7: All worst case parameters for which note 7 is applied, must be increased by 10% for DS75176BT. The other parameters remain valid for $-40°C < T_A < +85°C$.

Switching Characteristics

$V_{CC} = 5.0V$, $T_A = 25°C$

Symbol	Parameter	Conditions	Min	Typ	Max	Units
t_{PLH}	Driver Input to Output	$R_{LDIFF} = 60\Omega$		12	22	ns
t_{PHL}	Driver Input to Output	$C_{L1} = C_{L2} = 100$ pF		17	22	ns
t_r	Driver Rise Time	$R_{LDIFF} = 60\Omega$			18	ns
t_f	Driver Fall Time	$C_{L1} = C_{L2} = 100$ pF (*Figure 3* and *Figure 5*)			18	ns
t_{ZH}	Driver Enable to Output High	$C_L = 100$ pF (*Figure 4* and *Figure 6*) S1 Open		29	100	ns
t_{ZL}	Driver Enable to Output Low	$C_L = 100$ pF (*Figure 4* and *Figure 6*) S2 Open		31	60	ns
t_{LZ}	Driver Disable Time from Low	$C_L = 15$ pF (*Figure 4* and *Figure 6*) S2 Open		13	30	ns
t_{HZ}	Driver Disable Time from High	$C_L = 15$ pF (*Figure 4* and *Figure 6*) S1 Open		19	200	ns
t_{PLH}	Receiver Input to Output	$C_L = 15$ pF (*Figure 2* and *Figure 7*)		30	37	ns
t_{PHL}	Receiver Input to Output	S1 and S2 Closed		32	37	ns
t_{ZL}	Receiver Enable to Output Low	$C_L = 15$ pF (*Figure 2* and *Figure 8*) S2 Open		15	20	ns
t_{ZH}	Receiver Enable to Output High	$C_L = 15$ pF (*Figure 2* and *Figure 8*) S1 Open		11	20	ns
t_{LZ}	Receiver Disable from Low	$C_L = 15$ pF (*Figure 2* and *Figure 8*) S2 Open		28	32	ns
t_{HZ}	Receiver Disable from High	$C_L = 15$ pF (*Figure 2* and *Figure 8*) S1 Open		13	35	ns

AC Test Circuits
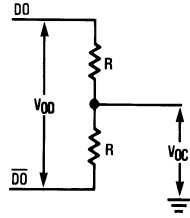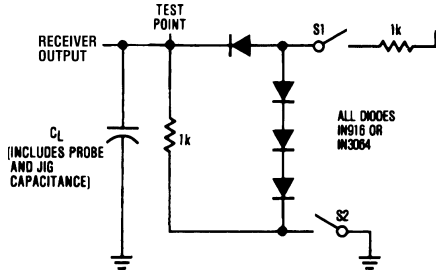
FIGURE 1.

Note: S1 and S2 of load circuit are closed except as otherwise mentioned.
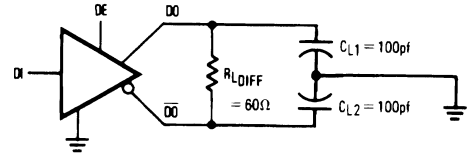
FIGURE 2.

FIGURE 3.

Note: Unless otherwise specified the switches are closed.

FIGURE 4.
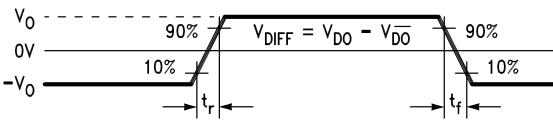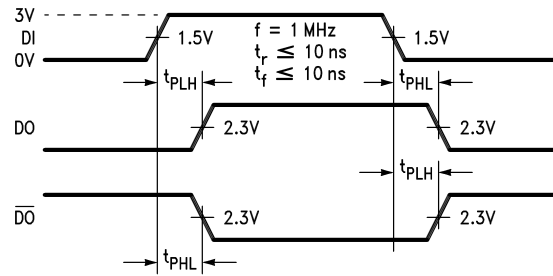
Switching Time Waveforms
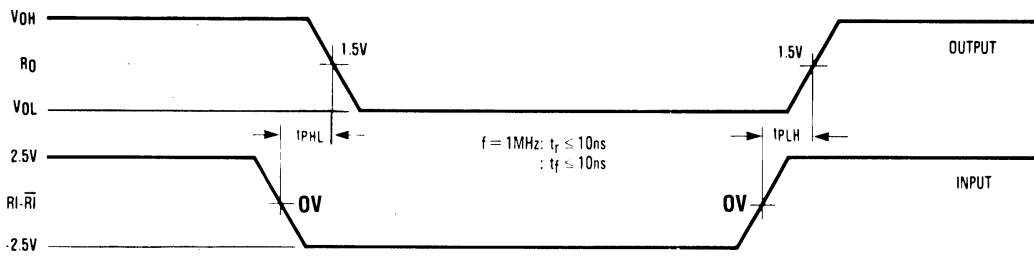

FIGURE 5. Driver Propagation Delays and Transition Times
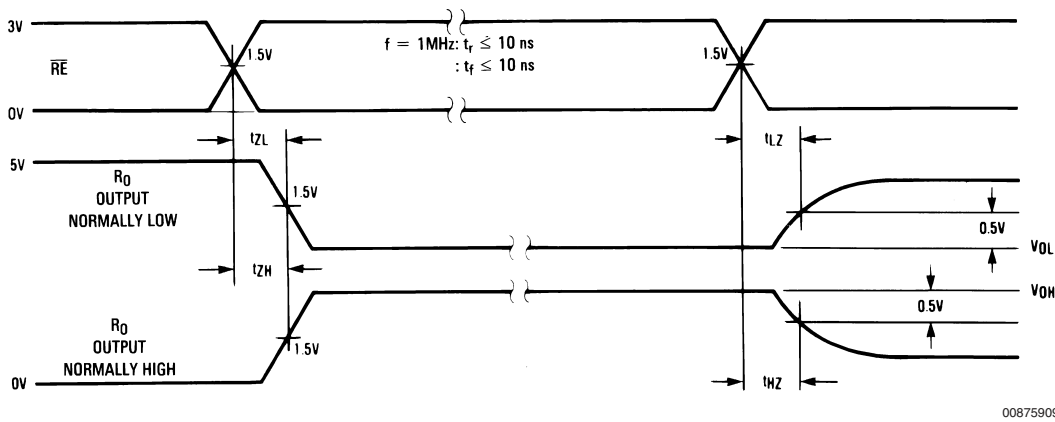
Switching Time Waveforms (Continued)
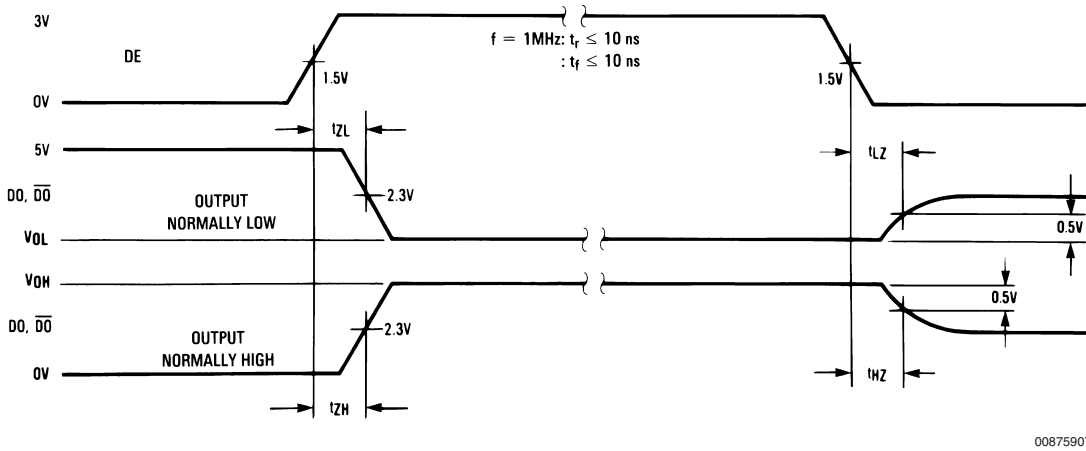
FIGURE 6. Driver Enable and Disable Times

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

FIGURE 7. Receiver Propagation Delays

FIGURE 8. Receiver Enable and Disable Times

Function Tables
DS75176B Transmitting

Inputs			Line	Outputs	
$\overline{RE}$	DE	DI	Condition	$\overline{DO}$	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

DS75176B Receiving

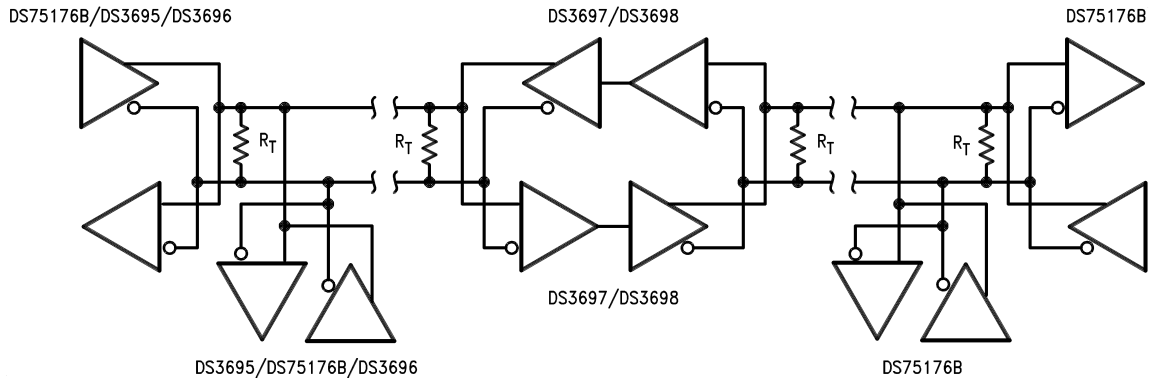| Inputs			Outputs
$\overline{RE}$	DE	RI-$\overline{RI}$	RO
0	0	≥ +0.2V	1
0	0	≤ −0.2V	0
0	0	Inputs Open**	1
1	0	X	Z

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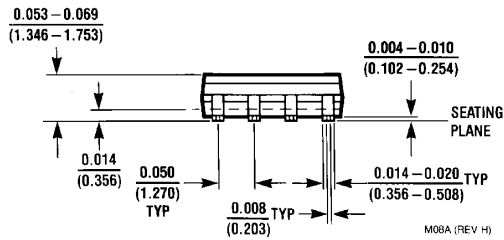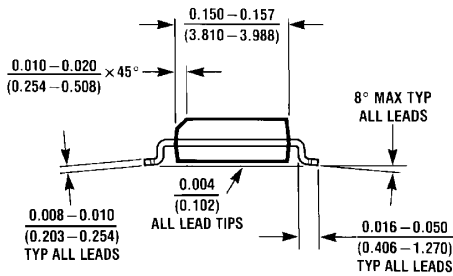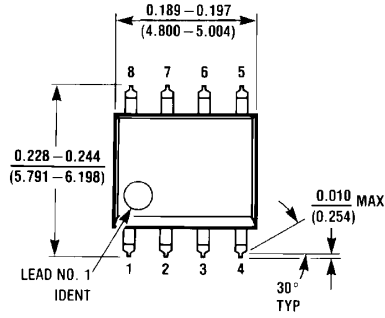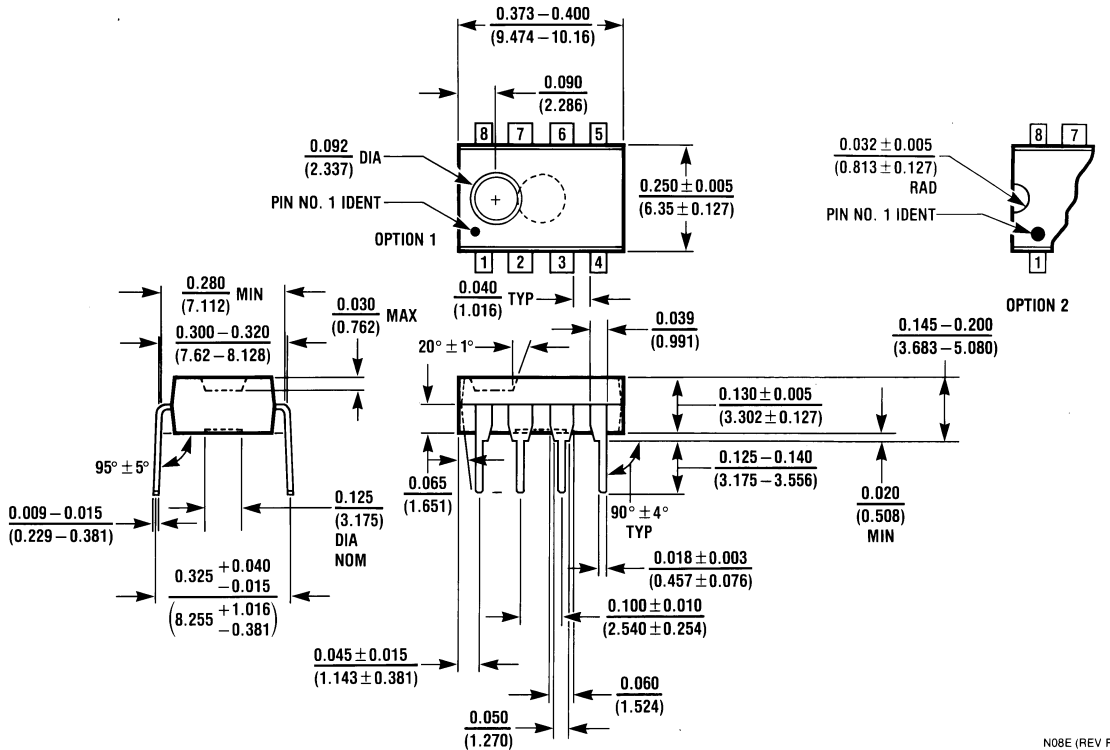**This is a fail safe condition

Typical Application

00875911

Physical Dimensions inches (millimeters)
unless otherwise noted

0.189 − 0.197
(4.800 − 5.004)

0.228 − 0.244
(5.791 − 6.198)

8 7 6 5

1 2 3 4

0.010 MAX
(0.254)

30°
TYP

LEAD NO. 1
IDENT

0.150 − 0.157
(3.810 − 3.988)

0.010 − 0.020 × 45°
(0.254 − 0.508)

8° MAX TYP
ALL LEADS

0.008 − 0.010
(0.203 − 0.254)
TYP ALL LEADS

0.004
(0.102)
ALL LEAD TIPS

0.016 − 0.050
(0.406 − 1.270)
TYP ALL LEADS

0.053 − 0.069
(1.346 − 1.753)

0.004 − 0.010
(0.102 − 0.254)

SEATING
PLANE

0.014
(0.356)

0.050
(1.270)
TYP

0.008 TYP
(0.203)

0.014 − 0.020 TYP
(0.356 − 0.508)

M08A (REV H)

Lit. # 103669

0.373 − 0.400
(9.474 − 10.16)

0.090
(2.286)

0.092
(2.337) DIA

PIN NO. 1 IDENT

OPTION 1

8 7 6 5

1 2 3 4

0.250 ± 0.005
(6.35 ± 0.127)

0.040 TYP
(1.016)

0.039
(0.991)

0.032 ± 0.005
(0.813 ± 0.127)
RAD

PIN NO. 1 IDENT

OPTION 2

8 7

1

0.280 MIN
(7.112)

0.300 − 0.320
(7.62 − 8.128)

0.030 MAX
(0.762)

95° ± 5°

0.009 − 0.015
(0.229 − 0.381)

0.325 +0.040
−0.015
(8.255 +1.016
−0.381)

0.125
(3.175)
DIA
NOM

0.045 ± 0.015
(1.143 ± 0.381)

0.050
(1.270)

20° ± 1°

0.065
(1.651)

90° ± 4°
TYP

0.018 ± 0.003
(0.457 ± 0.076)

0.100 ± 0.010
(2.540 ± 0.254)

0.060
(1.524)

0.130 ± 0.005
(3.302 ± 0.127)

0.125 − 0.140
(3.175 − 3.556)

0.145 − 0.200
(3.683 − 5.080)

0.020
(0.508)
MIN

N08E (REV F)

Molded Dual-In-Line Package (N)
Order Number DS75176BN or DS75176BTN
NS Package Number N08E

Notes

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