

## 1. Description

The SN75176B / SN65176B 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.

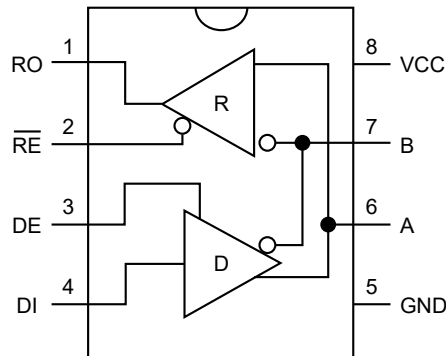
The driver and receiver outputs feature TRI-STATE capability, for the driver outputs over the entire common mode range of +12V to -7V. Bus contention or fault situations that cause excessive power dissipation within the device are handled by a thermal shutdown circuit, which forces the driver outputs into the high impedance state. DC specifications are guaranteed over the -40° to 105°C temperature and 4.75V to 5.25V supply voltage range.

## 2. 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 TRISTATE or with Power Off, Over the Entire Common Mode Range Allows the Unused Devices on the Bus to be Powered Down
- Combined Impedance of a Driver Output and Receiver Input is Less Than One RS485 Unit Load, Allowing up to 32 Transceivers on the Bus
- 70mV Typical Receiver Hysteresis.
- Maximum transmission rate: 10Mbps



### 3. Pinning Information



**SOP-8**

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.

#### Pin Functions

Pin		Type	Description
Name	NO.		
R	1	O	Logic Data Output from RS-485 Receiver
$\overline{\text{RE}}$	2	I	Receive Enable (active low)
DE	3	I	Driver Enable (active high)
D	4	I	Logic Data Input to RS-485 Driver
GND	5	-	Device Ground Pin
A	6	I/O	RS-422 or RS-485 Data Line
B	7	I/O	RS-422 or RS-485 Data Line
V <sub>CC</sub>	8	-	Power Input. Connect to 5-V Power Source



## 4. Absolute Maximum Ratings <sup>(1)(2)</sup>

Parameter	Symbol	Min	Max	Units
Supply voltage	$V_{CC}$		7	V
Voltage range at any bus terminal		-10	15	V
Enable input voltage	$V_I$		5.5	V
Operating virtual junction temperature	$T_J$		150	°C
Storage temperature range	$T_{STG}$	-65	150	°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds			260	°C
ESD Rating (HBM)			500	V

(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 HG 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.

## 5. Recommended Operating Conditions

Parameter	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 $T_A$			
SN75176B	0	70	°C
SN65176B	-40	105	°C
Differential Input Voltage, $V_{ID}$ <sup>(1)</sup>	-12	12	V

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



## 6.1 Electrical Characteristics (Driver)

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

Parameter	Symbol	Conditions <sup>(1)</sup>	Min	Typ <sup>(2)</sup>	Max	Units	
Input clamp voltage	$V_{IK}$	$I_I = -18\text{mA}$			-1.5	V	
Output voltage	$V_O$	$I_O = 0$	0		$V_{CC}$	V	
Differential output voltage	$ V_{OD1} $	$I_O = 0$	1.5	3.6	$V_{CC}$	V	
Differential output voltage	$ V_{OD2} $	$R_L = 100\Omega$	$\frac{1}{2} V_{OD1}$ or 2 <sup>(4)</sup>			V	
		$R_L = 54\Omega$	1.5	2.5	5	V	
Differential output voltage	$V_{OD3}$	See <sup>(5)</sup>	1.5		5	V	
Change in magnitude of differential output voltage <sup>(3)</sup>	$\Delta V_{OD} $	$R_L = 54\Omega$ or $100\Omega$			$\pm 0.2$	V	
Common-mode output voltage	$V_{OC}$	$R_L = 54\Omega$ or $100\Omega$	-1		3	V	
Change in magnitude of common-mode output voltage <sup>(3)</sup>	$\Delta V_{OC} $	$R_L = 54\Omega$ or $100\Omega$			$\pm 0.2$	V	
Output current	$I_O$	Output disabled <sup>(6)</sup>	$V_O = 12\text{V}$		1	mA	
			$V_O = -7\text{V}$		-0.8	mA	
High-level input current	$I_{IH}$	$V_I = 2.4\text{V}$			20	$\mu\text{A}$	
Low-level input current	$I_{IL}$	$V_I = 0.4\text{V}$			-400	$\mu\text{A}$	
Short-circuit output current	$I_{OS}$	$V_O = -7\text{V}$			-250	mA	
		$V_O = 0$			-150	mA	
		$V_O = V_{CC}$			250	mA	
		$V_O = 12\text{V}$			250	mA	
Supply current (total package)	$I_{CC}$	No load	Outputs enabled		42	70	mA
			Outputs disabled		26	35	mA

(1) The power-off measurement in ANSI Standard TIA/EIA-422-B applies to disabled outputs only and is not applied to combined inputs and outputs.

(2) All typical values are at  $V_{CC} = 5\text{V}$  and  $T_A = 25^\circ\text{C}$ .

(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) The minimum  $V_{OD2}$  with a 100- $\Omega$  load is either  $\frac{1}{2} V_{OD1}$  or 2 V, whichever is greater.

(5) See ANSI Standard TIA/EIA-485-A, Figure 3.5, Test Termination Measurement 2.

(6) This applies for both power on and off; refer to ANSI Standard TIA/EIA-485-A for exact conditions. The TIA/EIA-422-B limit does not apply for a combined driver and receiver terminal.



## 6.2 Electrical Characteristics (Receiver)

Over recommended ranges of common-mode input voltage, supply voltage, and operating free-air temperature (unless otherwise noted)

Parameter	Symbol	Conditions	Min	Typ <sup>(2)</sup>	Max	Units	
Positive-going input threshold voltage	$V_{IT+}$	$V_O=2.7V, I_O=-0.4mA$			0.2	V	
Negative-going input threshold voltage	$V_{IT-}$	$V_O=0.5V, I_O=8mA$	0.2 <sup>(2)</sup>			V	
Input hysteresis voltage ( $V_{IT+} - V_{IT-}$ )	$V_{hys}$			50		mV	
Enable Input clamp voltage	$V_{IK}$	$I_I=-18mA$			-1.5	V	
High-level output voltage	$V_{OH}$	$V_{ID}=200mV, I_{OH}=-400\mu A$	2.7			V	
Low-level output voltage	$V_{OL}$	$V_{ID}=-200mV, I_{OL}=8mA$			0.45	V	
High-impedance-state output current	$I_{OZ}$	$V_O=0.4V$ to 2.4V			$\pm 20$	$\mu A$	
Line input current	$I_I$	Other	$V_I=12V$		1	mA	
		input=0V <sup>(3)</sup>	$V_I=-7V$		-0.8	mA	
High-level enable input current	$I_{IH}$	$V_{IH}=2.7V$			20	$\mu A$	
Low-level enable input current	$I_{IL}$	$V_{IL}=0.4V$			-100	$\mu A$	
Input resistance	$R_I$	$V_I=12V$	12			k $\Omega$	
Short-circuit output current	$I_{OS}$		-15		-85	mA	
Supply current (total package)	$I_{CC}$	No load	Outputs enabled		42	55	mA
			Outputs disabled		26	35	mA

(1) All typical values are at  $V_{CC}=5V, T_A=25^\circ C$ .

(2) The algebraic convention, in which the less positive (more negative) limit is designated minimum, is used in this data sheet for common-mode input voltage and threshold voltage levels only.

(3) This applies for both power on and power off. Refer to EIA Standard TIA/EIA-485-A for exact conditions.



## 7. Switching Characteristics

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

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



### 8.AC Test Circuits

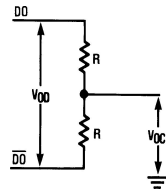


Figure 2.

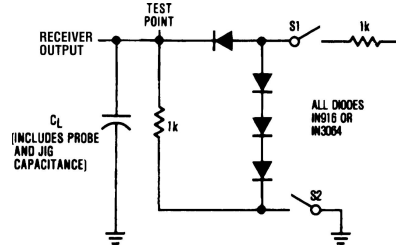


Figure 3.

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

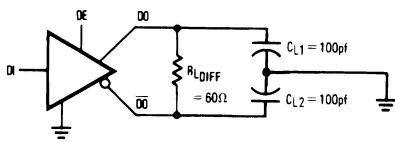


Figure 4.

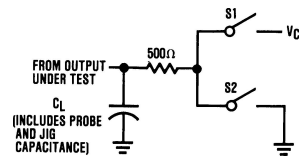


Figure 5.

Note: Unless otherwise specified the switches are closed.

### 9.Switching Time Waveforms

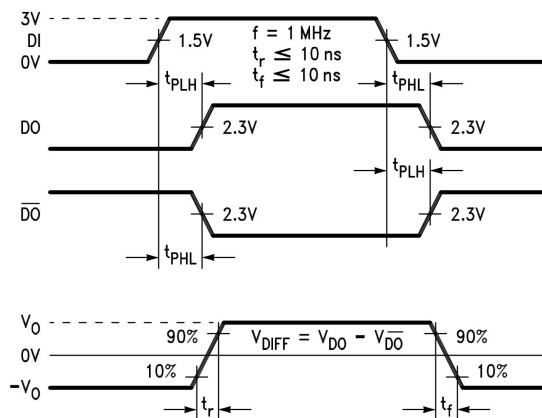


Figure 6. Driver Propagation Delays and Transition Time

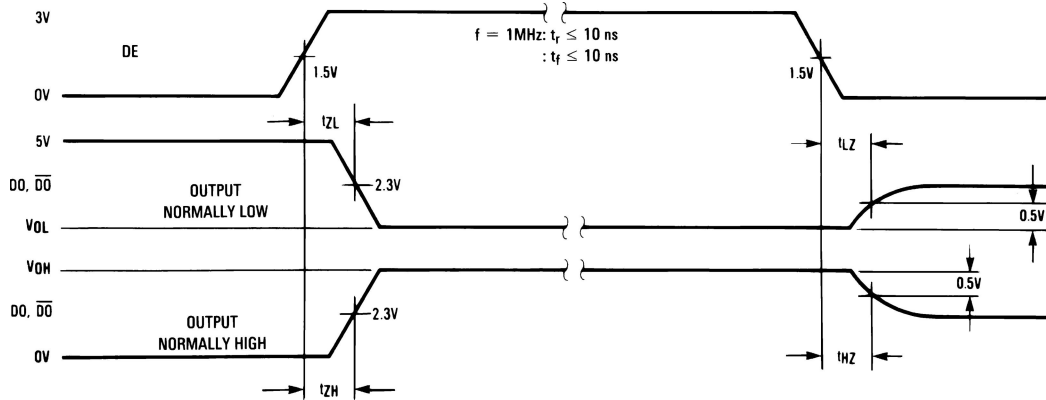
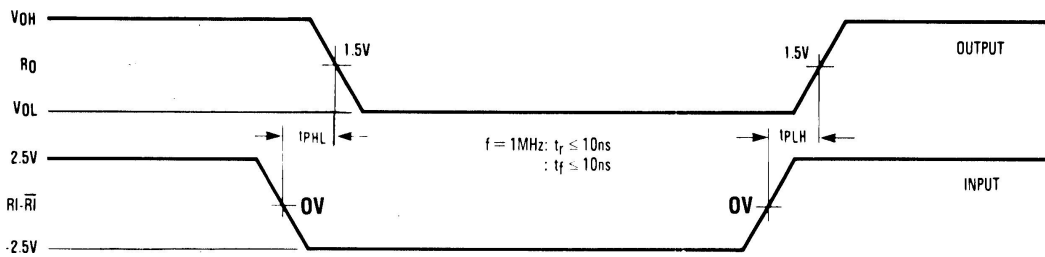


Figure 7. Driver Enable and Disable Times



Note: Differential input voltage may be realized by grounding RI and pulsing RI between +2.5V and -2.5V

Figure 8. Receiver Propagation Delays

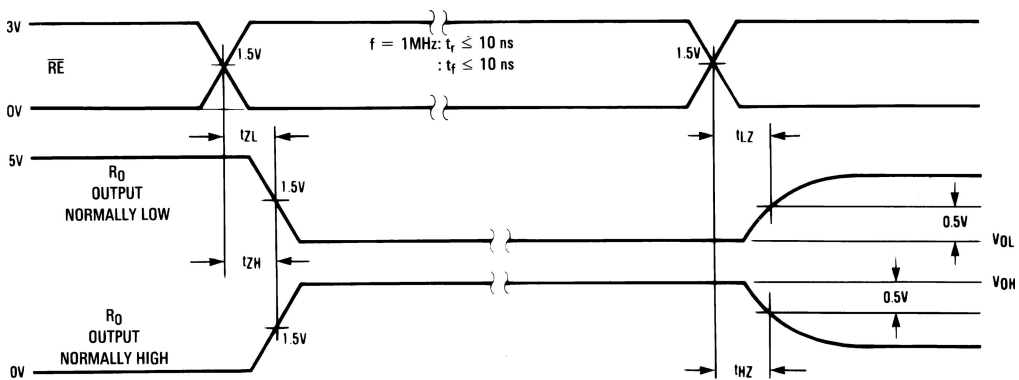


Figure 9. Receiver Enable and Disable Times



## 10.Function Tables

Table 1. SN75176B Transmitting<sup>(1)</sup>

Inputs			Line Condition	Outputs	
$\overline{\text{RE}}$	DE	DI		B	A
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

Table 2. SN75176B Receiving<sup>(1)</sup>

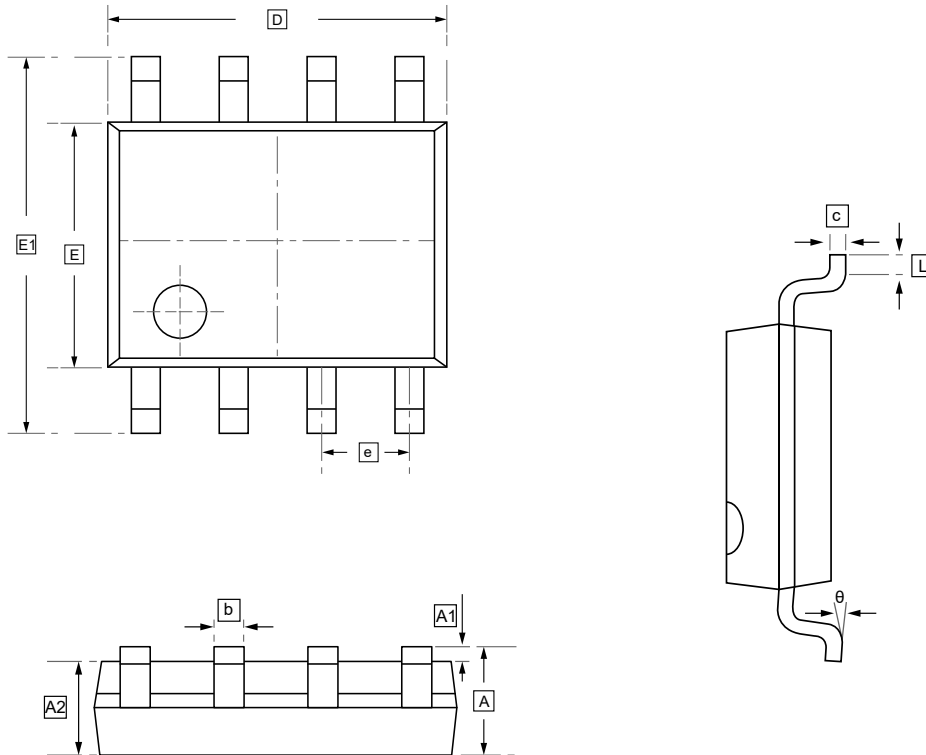
Inputs			Outputs
$\overline{\text{RE}}$	DE	A-B	RO
0	0	$\geq +0.2\text{V}$	1
0	0	$\leq -0.2\text{V}$	0
0	0	Inputs Open**	Z
1	0	X	Z

(1) 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.



### 11.SOP-8 Package Outline Dimensions

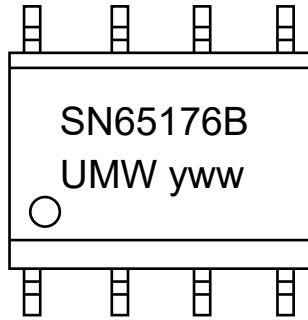


**DIMENSIONS (mm are the original dimensions)**

Symbol	A	A1	A2	b	c	D	E	E1	e	L	θ
Min	1.350	0.000	1.350	0.330	0.170	4.700	3.800	5.800	1.270	0.400	0°
Max	1.750	0.100	1.550	0.510	0.250	5.100	4.000	6.200	BSC	1.270	8°



## 12. Ordering Information



yww: Batch Code

Order Code	Marking	Package	Base QTY	Delivery Mode
UMW SN65176BDR	SN65176B	SOP-8	2500	Tape and reel
UMW SN75176BDR	SN75176B	SOP-8	2500	Tape and reel



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