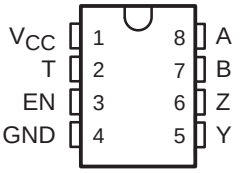
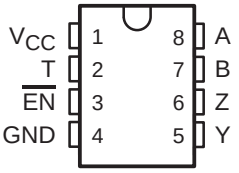
- **Meets EIA Standards RS-422-A and RS-485 and CCITT Recommendations V.11 and X.27**
- **Designed for Multipoint Transmission on Long Bus Lines in Noisy Environments**
- **3-State Outputs**
- **Bus Voltage Range . . . –7 V to 12 V**
- **Positive and Negative Current Limiting**
- **Driver Output Capability . . . 60 mA Max**
- **Driver Thermal Shutdown Protection**
- **Receiver Input Impedance . . . 12 kΩ Min**
- **Receiver Input Sensitivity . . . ±200 mV**
- **Receiver Input Hysteresis . . . 50 mV Typ**
- **Operates From Single 5-V Supply**
- **Low Power Requirements**

SN75177B . . . D OR P PACKAGE
(TOP VIEW)



SN75178B . . . P PACKAGE
(TOP VIEW)



THE SN75177B IS NOT RECOMMENDED FOR NEW DESIGN

description

The SN75177B and SN75178B differential bus repeaters are monolithic integrated devices each designed for one-way data communication on multipoint bus transmission lines. These devices are designed for balanced transmission bus line applications and meet EIA Standard RS-422-A and RS-485 and CCITT Recommendations V.11 and X.27. Each device is designed to improve the performance of the data communication over long bus lines. The SN75177B and SN75178B are identical except for the complementary enable inputs, which allow the devices to be used in pairs for bidirectional communication.

The SN75177B and SN75178B feature positive- and negative-current limiting 3-state outputs for the receiver and driver. The receiver features high input impedance, input hysteresis for increased noise immunity, and input sensitivity of ±200 mV over a common-mode input voltage range of –7 V to 12 V. The driver features thermal shutdown for protection from line fault conditions. Thermal shutdown is designed to occur at a junction temperature of approximately 150°C. The driver is designed to drive current loads up to 60 mA maximum.

The SN75177B and SN75178B are designed for optimum performance when used on transmission buses employing the SN75172 and SN75174 differential line drivers, SN75173 and SN75175 differential line receivers, or SN75176B bus transceiver.

Function Tables

SN75177B

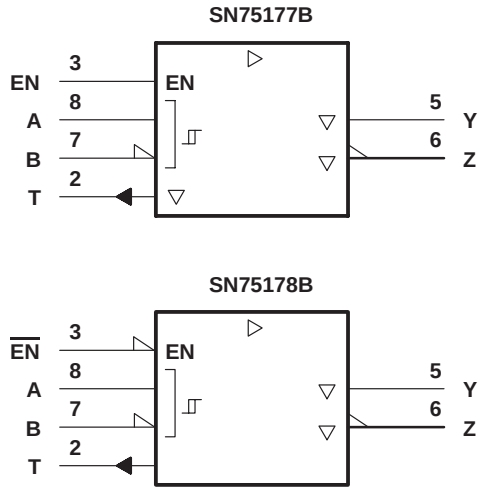
DIFFERENTIAL INPUTS	ENABLE	OUTPUTS		
A – B	EN	T	Y	Z
$V_{ID} \geq 0.2$ V	H	H	H	L
-0.2 V $< V_{ID} < 0.2$ V	H	?	?	?
$V_{ID} \leq 0.2$ V	H	L	L	H
X	L	Z	Z	Z

SN75178B

DIFFERENTIAL INPUTS	ENABLE	OUTPUTS		
A – B	$\overline{EN}$	T	Y	Z
$V_{ID} \geq 0.2$ V	L	H	H	L
-0.2 V $< V_{ID} < 0.2$ V	L	?	?	?
$V_{ID} \leq 0.2$ V	L	L	L	H
X	H	Z	Z	Z

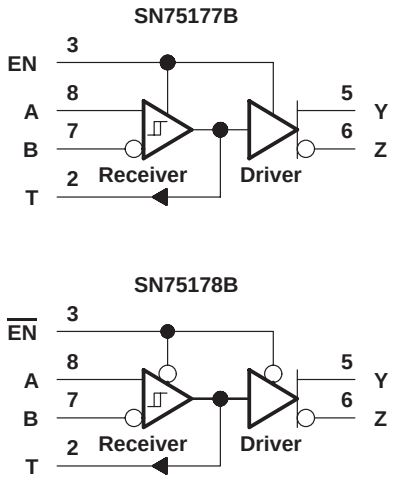
H = high level, L = low level, ? = indeterminate, X = irrelevant, Z = impedance (off)

logic symbols†

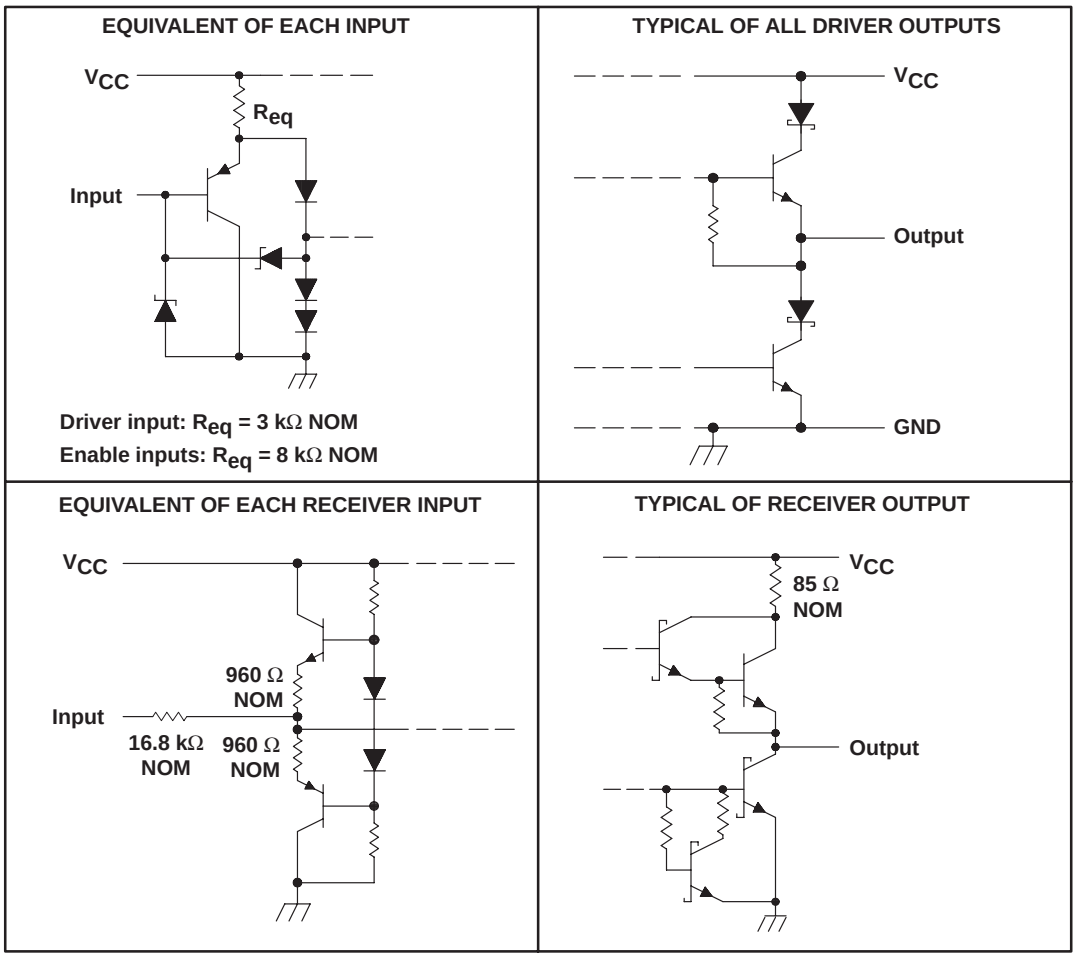


† These symbols are in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

logic diagrams (positive logic)



schematics of inputs and outputs



absolute maximum ratings over operating free-air temperature range (unless otherwise noted)

Supply voltage, V_{CC} (see Note 1) . . . . . 7 V
Voltage range at any bus terminal . . . . . –10 V to 15 V
Differential input voltage (see Note 2) . . . . . ±25 V
Enable input voltage . . . . . 5.5 V
Continuous total dissipation . . . . . See Dissipation Rating Table
Operating free-air temperature range . . . . . 0°C to 70°C
Storage temperature range . . . . . –65°C to 150°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds . . . . . 260°C

NOTES: 1. All voltage values, except differential input voltage, are with respect to network ground terminal.
2. Differential input voltage is measured at the noninverting input with respect to the corresponding inverting input.

DISSIPATION RATING TABLE

PACKAGE	$T_A \le 25°C$ POWER RATING	DERATING FACTOR ABOVE $T_A = 25°C$	$T_A = 70°C$ POWER RATING
D	725 mW	5.8 mW/°C	464 mW
P	1000 mW	8.0 mW/°C	640 mW

recommended operating conditions

		MIN	NOM	MAX	UNIT
Supply voltage, V_{CC}		4.75	5	5.25	V
High-level input voltage, V_{IH}	EN or $\overline{EN}$	2			V
low-level input voltage, V_{IL}	EN or $\overline{EN}$			0.8	V
Common-mode input voltage, V_{IC}		–7†		12	V
Differential input voltage, V_{ID}				±12	V
High-level output current, I_{OH}	Driver			–60	mA
	Receiver			–400	µA
Low-level output current, I_{OL}	Driver			60	mA
	Receiver			8	
Operating free-air temperature, T_A		0		70	°C

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

DRIVER SECTION

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

PARAMETER		TEST CONDITIONS		MIN	TYP†	MAX	UNIT
V_{IK}	Input clamp voltage	I_I = –18 mA				–1.5	V
V_O	Output voltage	I_O = 0		0		6	V
$\|V_{OD1}\|$	Differential output voltage	I_O = 0		1.5		6	V
$\|V_{OD2}\|$	Differential output voltage	R_L = 100 Ω ,	See Figure 1	1/2 V_{OD1} or 2§			V
		R_L = 54 Ω,	See Figure 1	1.5	2.5	5	
$\|V_{OD3}\|$	Differential output voltage	See Note 3		1.5		5	V
$\Delta\|V_{OD}\|$	Change in magnitude of diferential output voltage‡	R_L = 54 Ω or 100 Ω,	See Figure 1			±0.2	V
V_{OC}	Common-mode output voltage					3 –1	V
$\Delta\|V_{OC}\|$	Change in magnitude of common-mode output voltage‡					±0.2	V
I_O	Output current	V_{CC} = 0,	V_O = –7 V to 12 V			±100	µA
I_{OZ}	High-impedance-state output current	V_O = –7 V to 12 V				±100	µA
I_{IH}	High-level input current	V_I = 2.4 V				20	µA
I_{IL}	Low-level input current	V_I = 0.4 V				–400	µA
I_{OS}	Short-circuit output current	V_O = –7 V				–250	mA
		V_O = V_{CC}				250	
		V_O = 12 V				250	
I_{CC}	Supply current (total package)	No load	Outputs enabled		57	70	mA
			Outputs disabled		26	35	

† All typical values are at V_{CC} = 5 V and T_A = 25°C.
‡ $\Delta|V_{OD}|$ 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.
§ The minimum V_{OD2} with a 100-Ω load is either 1/2 V_{OD1} or 2, whichever is greater.
NOTE 3: See Figure 3.5 of EIA Standard RS-485.

switching characteristics, V_{CC} = 5 V, T_A = 25°C

PARAMETER		TEST CONDITIONS		MIN	TYP	MAX	UNIT
t_{dD}	Differential-output delay time	R_L = 54 Ω,	See Figure 3		15	20	ns
t_{tD}	Differential-output transition time				20	30	ns
t_{PZH}	Output enable time to high level	R_L = 110 Ω,	See Figure 4		85	120	ns
t_{PZL}	Output enable time to low level	R_L = 110 Ω,	See Figure 5		40	60	ns
t_{PHZ}	Output disable time from high level	R_L = 110 Ω,	See Figure 4		150	250	ns
t_{PLZ}	Output disable time from low level	R_L = 110 Ω,	See Figure 5		20	30	ns

SYMBOL EQUIVALENTS

DATA SHEET PARAMETER	RS-422-A	RS-485
V_O	V_{oa}, V_{ob}	V_{oa}, V_{ob}
$\|V_{OD1}\|$	V_o	V_o
$\|V_{OD2}\|$	V_t (R_L = 100 Ω)	V_t (R_L = 54 Ω)
$\|V_{OD3}\|$		V_t (Test Termination) Measurement 2)
$\Delta\|V_{OD}\|$	$\|\|V_t\| - \|\overline{V}_t\|\|$	$\|\|V_t\| - \|\overline{V}_t\|\|$
V_{OC}	$\|V_{OS}\|$	$\|V_{OS}\|$
$\Delta\|V_{OC}\|$	$\|V_{OS} - \overline{V}_{OS}\|$	$\|V_{OS} - \overline{V}_{OS}\|$
I_{OS}	$\|I_{sa}\|$,$\|I_{sb}\|$	
I_O	$\|I_{xa}\|$,$\|I_{xb}\|$	I_{ia},I_{ib}

RECEIVER SECTION

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

PARAMETER		TEST CONDITIONS		MIN	TYP†	MAX	UNIT
V_{T+}	Positive-going input threshold voltage	V_O = 2.7 V, I_O = –0.4 mA				0.2	V
V_{T-}	Negative-going input threshold voltage	V_O = 0.5 V, I_O = 8 mA		–0.2‡			V
V_{hys}	Input hysteresis ($V_{T+} - V_{T-}$)				50		mV
V_{IK}	Input clamp voltage at EN	I_I = –18 mA				–1.5	V
V_{OH}	High-level output voltage	V_{ID} = 200 mV, See Figure 2	I_{OH} = –400 µA,	2.7			V
V_{OL}	Low-level output voltage	V_{ID} = –200 mV, See Figure 2	I_{OL} = 8 mA,			0.45	V
I_{OZ}	High-impedance-state output current	V_O = 0.4 V to 2.4 V				20	µA
						–400	
I_I	Line input current	Other input at 0 V, See Note 4	V_I = 12 V			1	mA
			V_I = –7 V			–0.8	
I_{IH}	High-level enable-input current	V_{IH} = 2.7 V				20	µA
I_{IL}	Low-level enable-input current	V_{IL} = 0.4 V				–200	µA
r_i	Input resistance			12			kΩ
I_{OS}	Short-circuit output current			–15		–85	mA
I_{CC}	Supply current (total package)	No load	Outputs enabled		57	70	mA
			Outputs disabled		26	35	

† All typical values are at V_{CC} = 5 V, T_A = 25°C.
‡ The algebraic convention, where 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.
NOTE 4: Refer to EIA Standard RS-422 for exact conditions.

switching characteristics, V_{CC} = 5 V, T_A = 25°C

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
t_{PLH}	Propagation delay time, low-to-high level output	V_{ID} = –1.5 V to 1.5 V, C_L = 15 pF, See Figure 6		19	35	ns
t_{PHL}	Propagation delay time, high-to-low level output			30	40	
t_{PZH}	Output enable time to high level	C_L = 15 pF, See Figure 7		10	20	ns
t_{PZL}	Output enable time to high level			12	20	
t_{PHZ}	Output disable time from high level	C_L = 15 pF, See Figure 8		25	35	ns
t_{PLZ}	Output disable time from low level			17	25	

PARAMETER MEASUREMENT INFORMATION

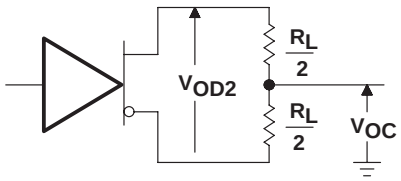


Figure 1. Driver V_{OD} and V_{OC}

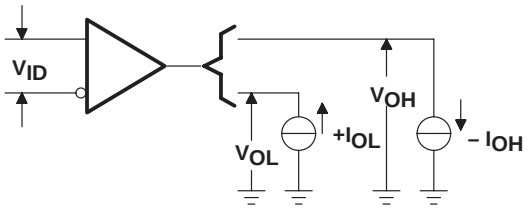


Figure 2. Receiver V_{OH} and V_{OL}

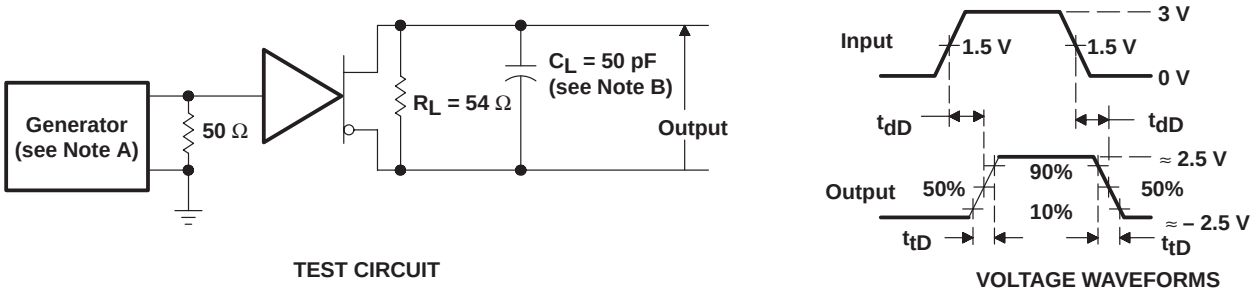


Figure 3. Driver Differential-Output Test Circuit and Voltage Waveforms

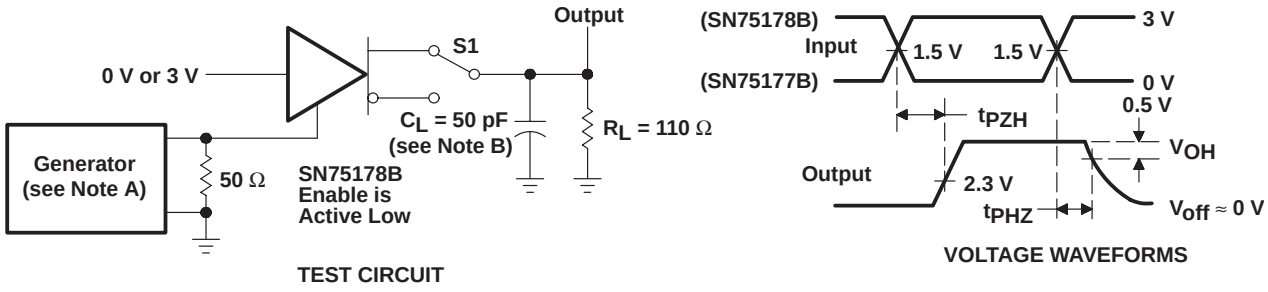


Figure 4. Driver Enable and Disable Times

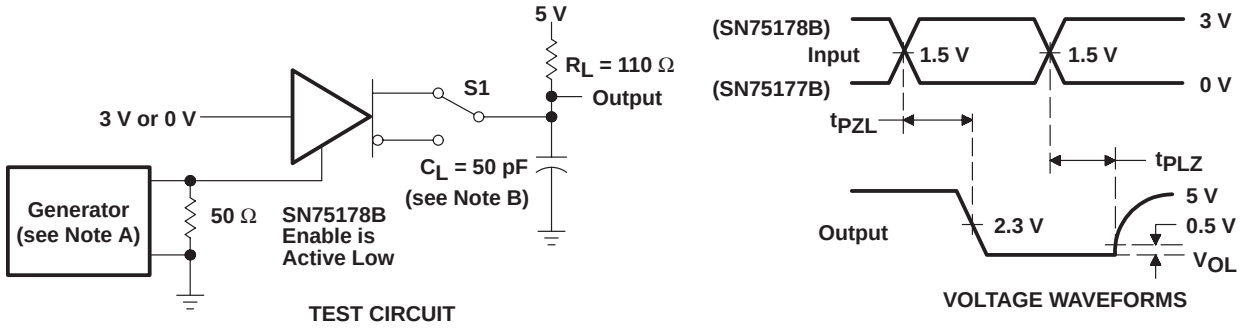


Figure 5. Driver Enable and Disable Times

NOTES: A. The input pulse is supplied by a generator having the following characteristics: PRR ≤ 1 MHz, 50% duty cycle, t_r ≤ 6 ns, t_f ≤ 6 ns, Z_O = 50 Ω.
B. C_L includes probe and jig capacitance.

PARAMETER MEASUREMENT INFORMATION

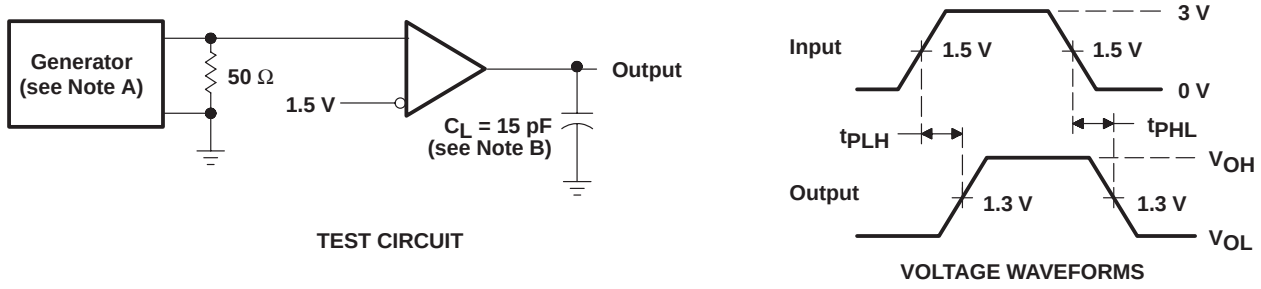


Figure 6. Receiver Propagation Delay Times

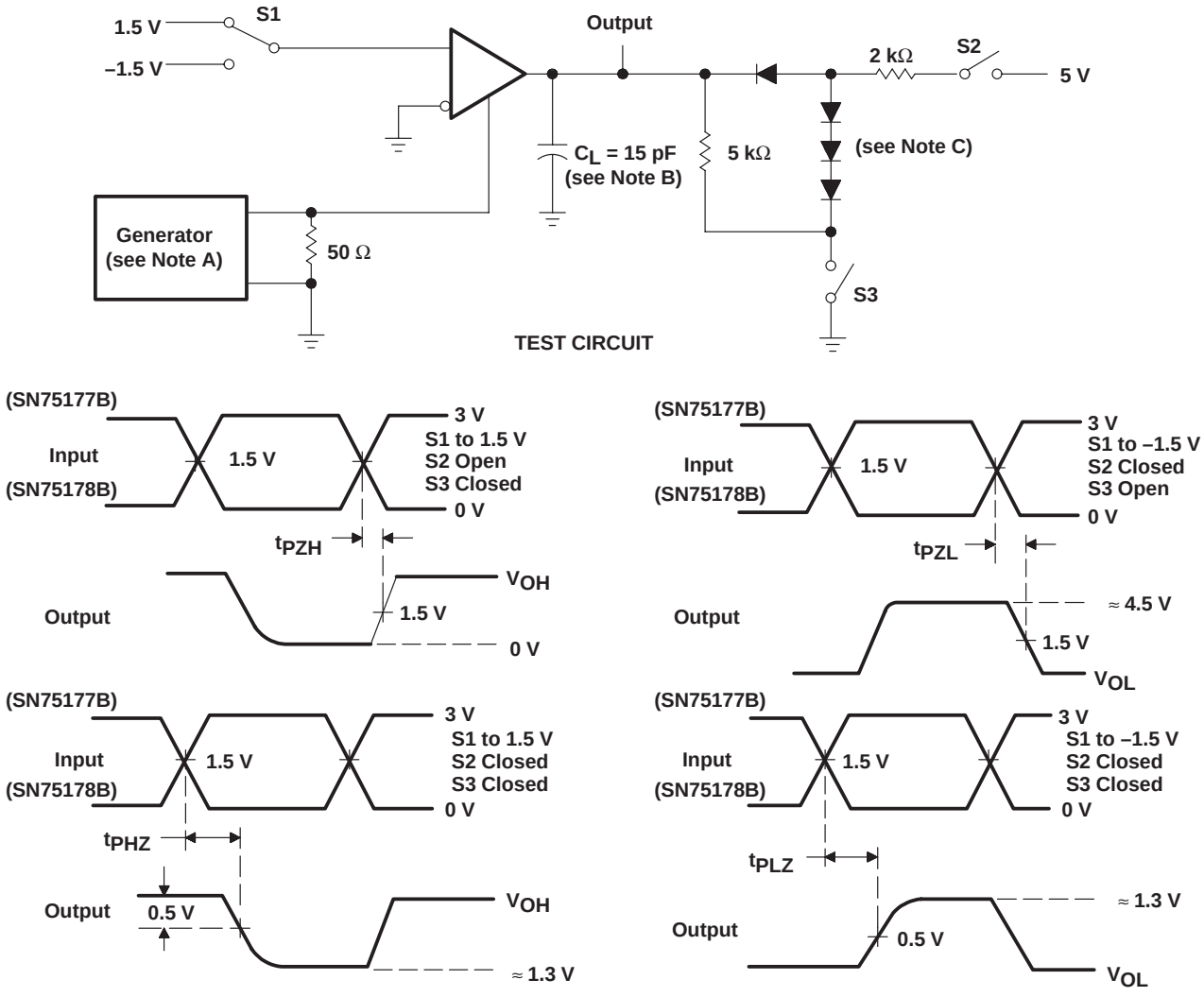


Figure 7. Receiver Output Enable and Disable Times

NOTES: A. The input pulse is supplied by a generator having the following characteristics: PRR ≤ 1 MHz, 50% duty cycle, t_r ≤ 6 ns, t_f ≤ 6 ns, Z_O = 50 Ω.
B. C_L includes probe and jig capacitance.
C. All diodes are 1N916 or equivalent.

TYPICAL CHARACTERISTICS

DRIVER HIGH-LEVEL OUTPUT VOLTAGE vs HIGH-LEVEL OUTPUT CURRENT

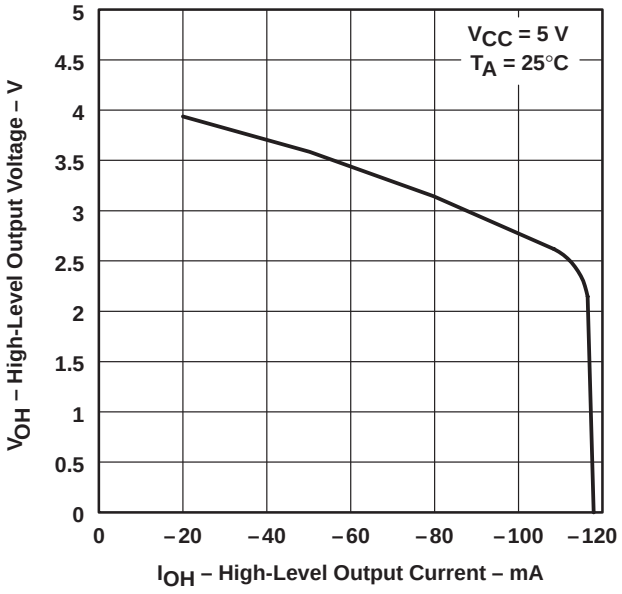


Figure 8

DRIVER LOW-LEVEL OUTPUT VOLTAGE vs LOW-LEVEL OUTPUT CURRENT

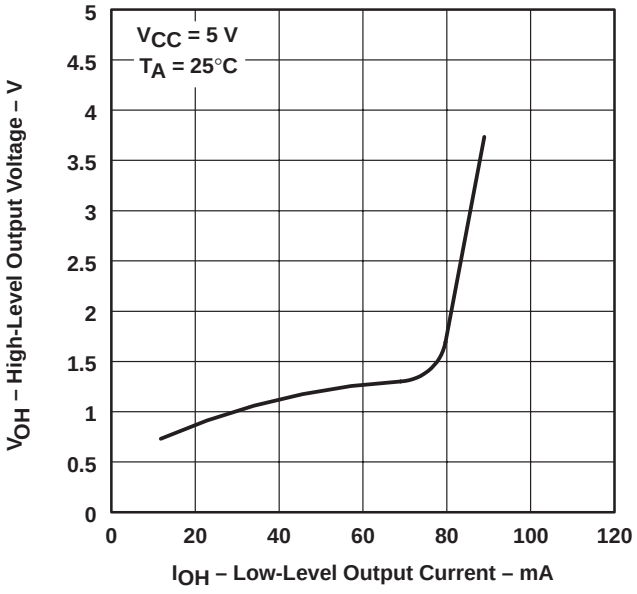


Figure 9

DRIVER DIFFERENTIAL OUTPUT VOLTAGE vs DRIVER OUTPUT CURRENT

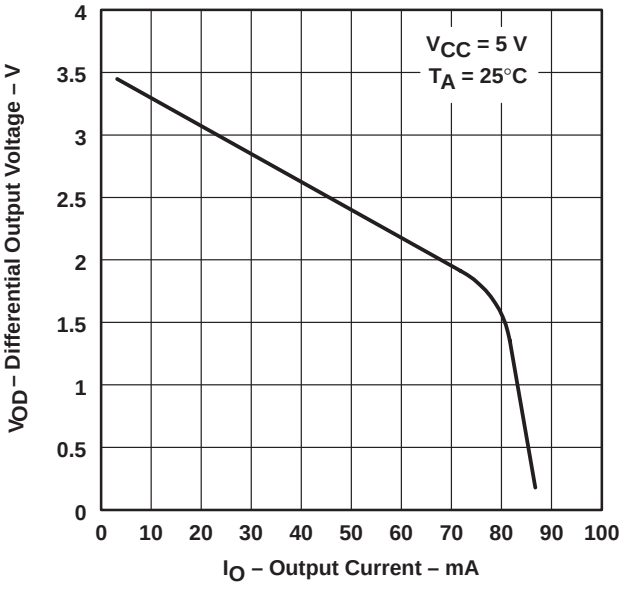


Figure 10

RECEIVER OUTPUT VOLTAGE vs DIFFERENTIAL INPUT VOLTAGE

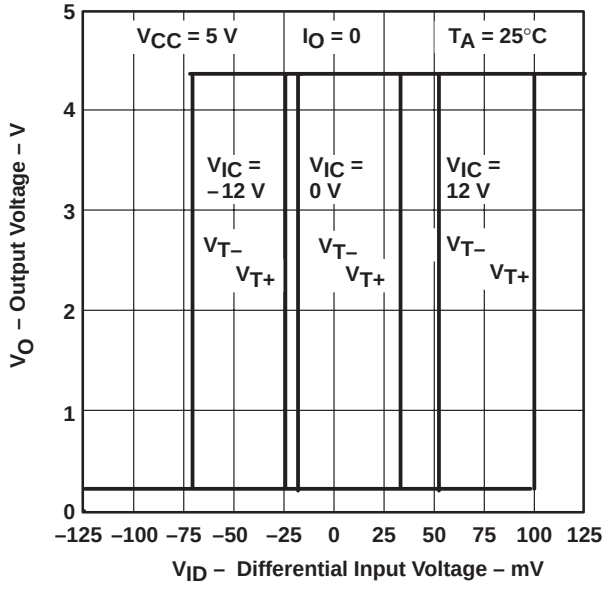


Figure 11

TYPICAL CHARACTERISTICS

RECEIVER HIGH-LEVEL OUTPUT VOLTAGE vs HIGH-LEVEL OUTPUT CURRENT

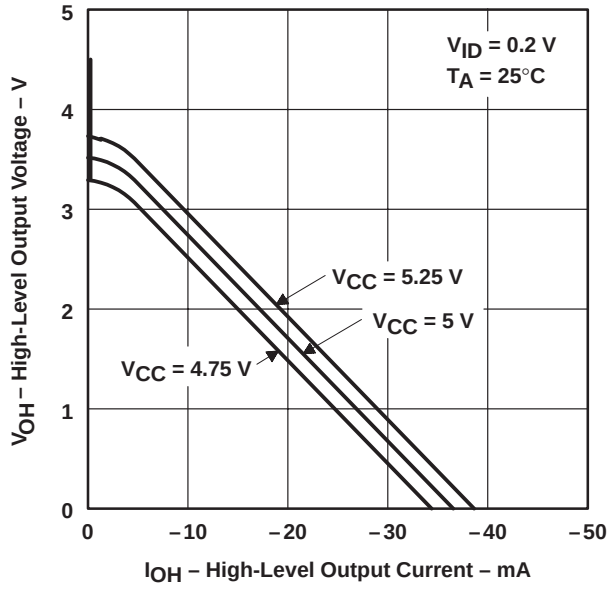


Figure 12

RECEIVER HIGH-LEVEL OUTPUT VOLTAGE vs FREE-AIR TEMPERATURE

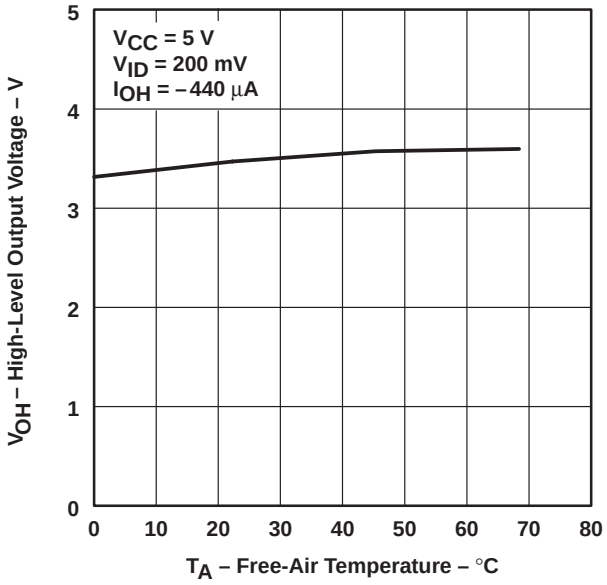


Figure 13

RECEIVER LOW-LEVEL OUTPUT VOLTAGE vs LOW-LEVEL OUTPUT CURRENT

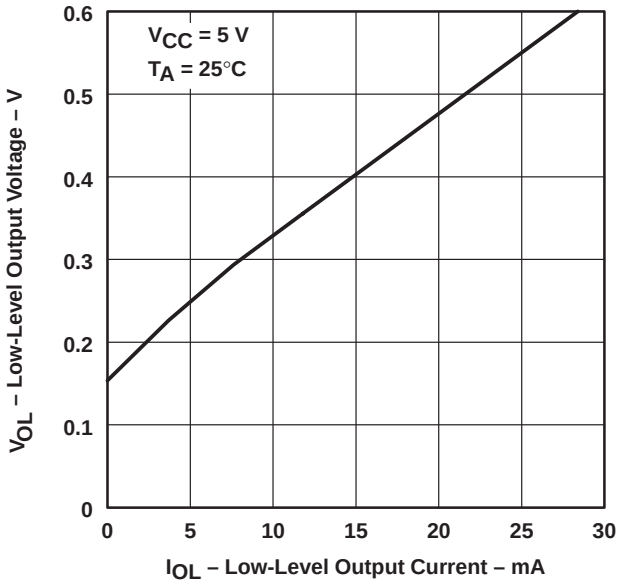


Figure 14

RECEIVER LOW-LEVEL OUTPUT VOLTAGE vs FREE-AIR TEMPERATURE

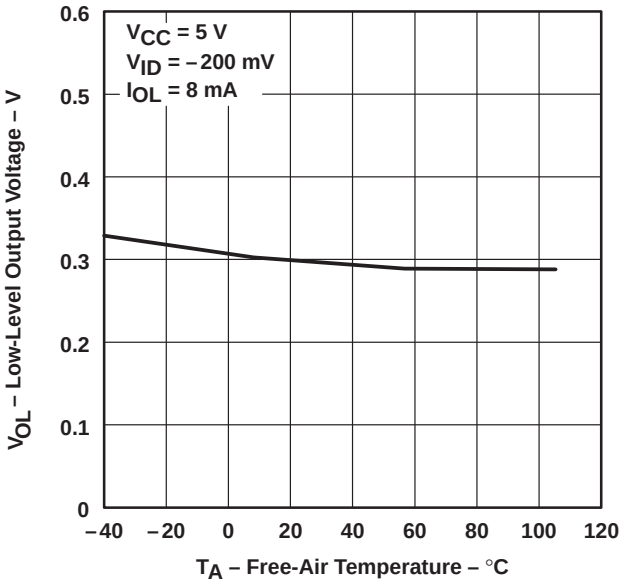
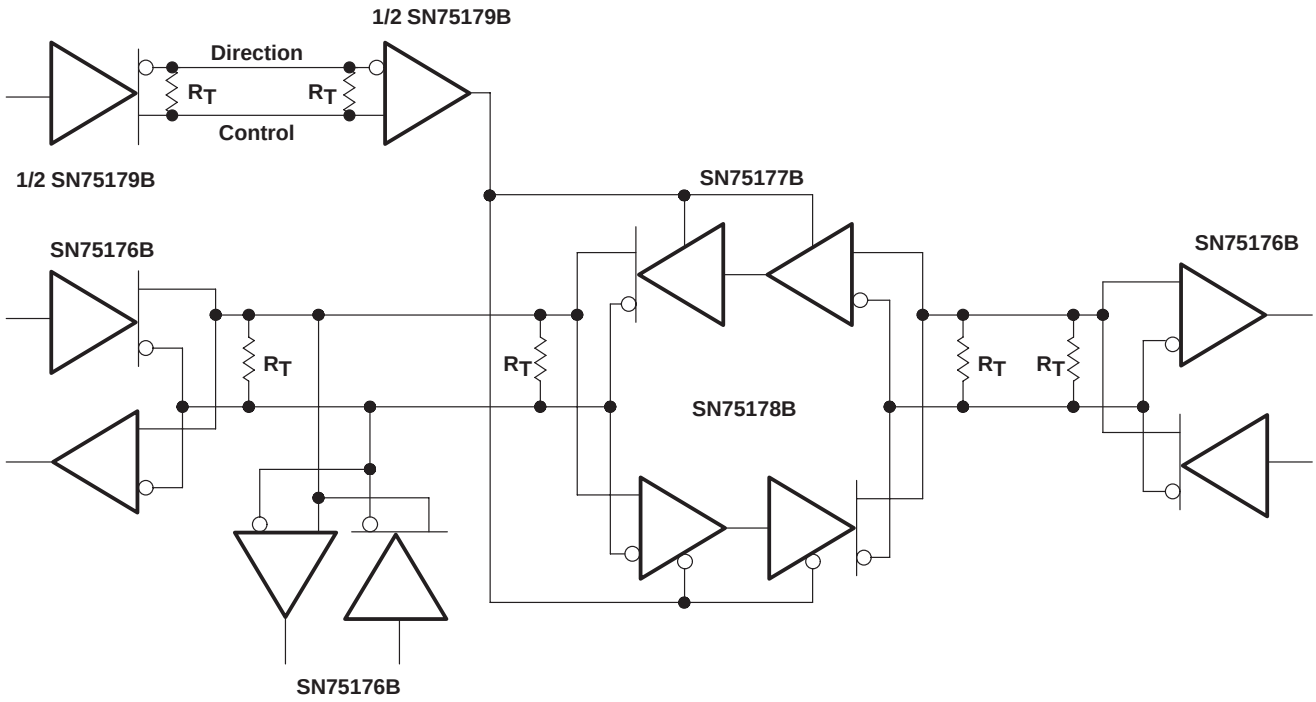


Figure 15

APPLICATION INFORMATION



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

Figure 16. Typical Application Circuit

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)
SN75177BD	OBSOLETE	SOIC	D	8		TBD	Call TI	Call TI
SN75177BP	OBSOLETE	PDIP	P	8		TBD	Call TI	Call TI
SN75178BD	OBSOLETE	SOIC	D	8		TBD	Call TI	Call TI
SN75178BDR	OBSOLETE	SOIC	D	8		TBD	Call TI	Call TI
SN75178BP	ACTIVE	PDIP	P	8	50	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
SN75178BPE4	ACTIVE	PDIP	P	8	50	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
SN75178BPSR	ACTIVE	SO	PS	8	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN75178BPSRE4	ACTIVE	SO	PS	8	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN75178BPSRG4	ACTIVE	SO	PS	8	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM

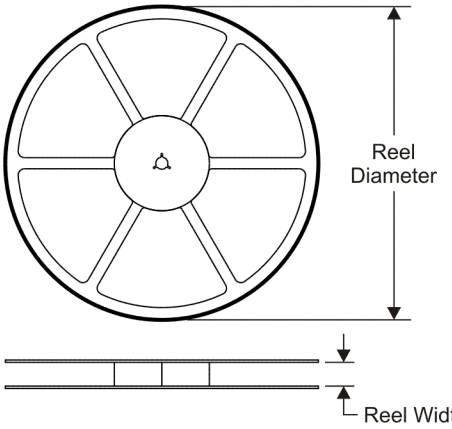
(1) The marketing status values are defined as follows:
ACTIVE: Product device recommended for new designs.
LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.
NRND: Not recommended for new designs. Device is in production to support existing customers, 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)

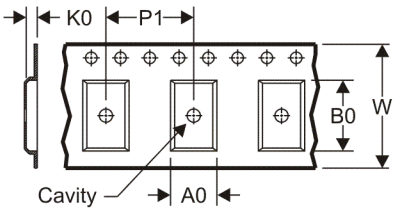
(3) MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

TAPE AND REEL INFORMATION

REEL DIMENSIONS

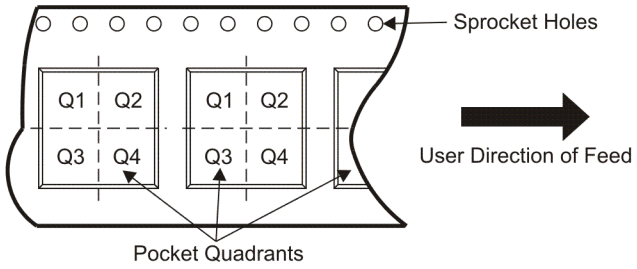


TAPE DIMENSIONS



A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

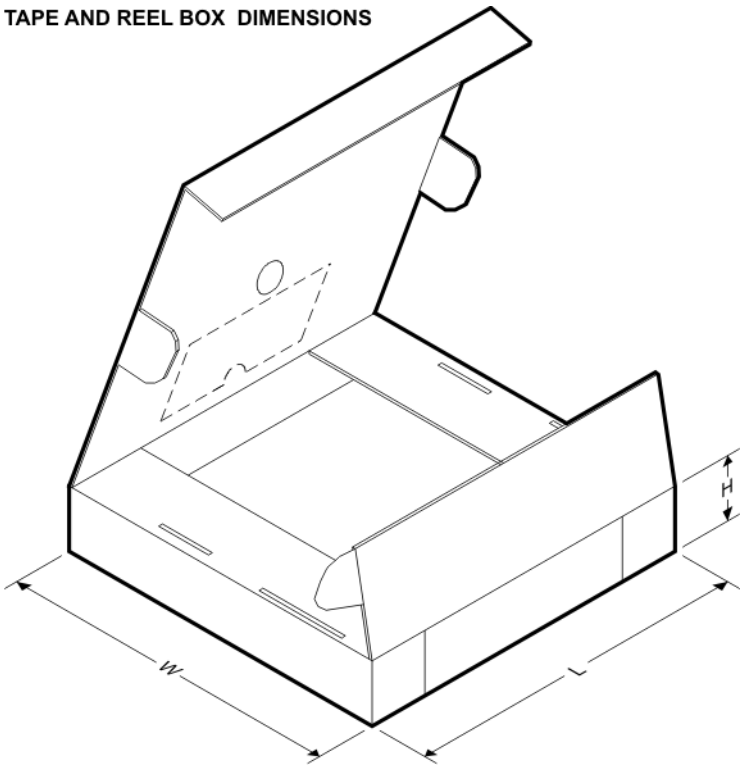
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
SN75178BPSR	SO	PS	8	2000	330.0	16.4	8.2	6.6	2.5	12.0	16.0	Q1

TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN75178BPSR	SO	PS	8	2000	346.0	346.0	33.0

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