

# DS92LV010A

## Bus LVDS 3.3/5.0V Single Transceiver

### General Description

The DS92LV010A is one in a series of transceivers designed specifically for the high speed, low power proprietary bus backplane interfaces. The device operates from a single 3.3V or 5.0V power supply and includes one differential line driver and one receiver. To minimize bus loading the driver outputs and receiver inputs are internally connected. The logic interface provides maximum flexibility as 4 separate lines are provided (D<sub>IN</sub>, DE,  $\overline{RE}$ , and R<sub>OUT</sub>). The device also features flow through which allows easy PCB routing for short stubs between the bus pins and the connector. The driver has 10 mA drive capability, allowing it to drive heavily loaded backplanes, with impedance as low as 27 Ohms.

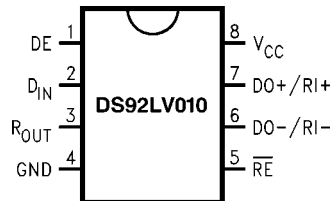
The driver translates between TTL levels (single-ended) to Low Voltage Differential Signaling levels. This allows for high speed operation, while consuming minimal power with reduced EMI. In addition the differential signaling provides common mode noise rejection of  $\pm 1V$ .

The receiver threshold is  $\pm 100mV$  over a  $\pm 1V$  common mode range and translates the low voltage differential levels to standard (CMOS/TTL) levels.

### Features

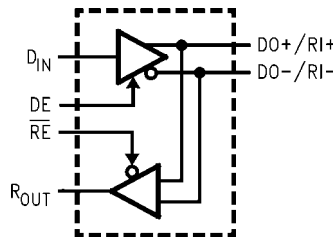
- Bus LVDS Signaling (BLVDS)
- Designed for Double Termination Applications
- Balanced Output Impedance
- Lite Bus Loading 5pF typical
- Glitch free power up/down (Driver disabled)
- 3.3V or 5.0V Operation
- $\pm 1V$  Common Mode Range
- $\pm 100mV$  Receiver Sensitivity
- High Signaling Rate Capability (above 100 Mbps)
- Low Power CMOS design
- Product offered in 8 lead SOIC package
- Industrial Temperature Range Operation

### Connection Diagram



Order Number <sup>10005201</sup> DS92LV010ATM  
See NS Package Number M08A

### Block Diagram



10005202

**Absolute Maximum Ratings** (Notes 1, 2)

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

Supply Voltage ( $V_{CC}$ )	6.0V
Enable Input Voltage (DE, RE)	-0.3V to ( $V_{CC} + 0.3V$ )
Driver Input Voltage (DIN)	-0.3V to ( $V_{CC} + 0.3V$ )
Receiver Output Voltage ( $R_{OUT}$ )	-0.3V to ( $V_{CC} + 0.3V$ )
Bus Pin Voltage (DO/RI±)	-0.3V to +3.9V
Driver Short Circuit Current	Continuous
ESD (HBM 1.5 kΩ, 100 pF)	>2.0 kV
Maximum Package Power Dissipation at 25°C	
SOIC	1025 mW

Derate SOIC Package	8.2 mW/°C
Junction Temperature	+150°C
Storage Temperature Range	-65°C to +150°C
Lead Temperature (Soldering, 4 sec.)	260°C

**Recommended Operating Conditions**

	Min	Max	Units
Supply Voltage ( $V_{CC}$ ), or	3.0	3.6	V
Supply Voltage ( $V_{CC}$ )	4.5	5.5	V
Receiver Input Voltage	0.0	2.9	V
Operating Free Air Temperature	-40	+85	°C

**3.3V DC Electrical Characteristics** (Notes 2, 3)

$T_A = -40^\circ\text{C}$  to  $+85^\circ\text{C}$  unless otherwise noted,  $V_{CC} = 3.3V \pm 0.3V$

Symbol	Parameter	Conditions	Pin	Min	Typ	Max	Units	
$V_{OD}$	Output Differential Voltage	$R_L = 27\Omega$ , Figure 1	DO+/RI+, DO-/RI-	140	250	360	mV	
$\Delta V_{OD}$	$V_{OD}$ Magnitude Change				3	30	mV	
$V_{OS}$	Offset Voltage			1	1.25	1.65	V	
$\Delta V_{OS}$	Offset Magnitude Change				5	50	mV	
$I_{OSD}$	Output Short Circuit Current	$V_O = 0V$ , $DE = V_{CC}$			-12	-20	mA	
$V_{OH}$	Voltage Output High	$V_{ID} = +100$ mV	$R_{OUT}$				V	
		Inputs Open						$I_{OH} = -400$ $\mu\text{A}$
		Inputs Shorted						
		Inputs Terminated, $R_L = 27\Omega$						
$V_{OL}$	Voltage Output Low	$I_{OL} = 2.0$ mA, $V_{ID} = -100$ mV			0.1	0.4	V	
$I_{OS}$	Output Short Circuit Current	$V_{OUT} = 0V$ , $V_{ID} = +100$ mV		-5	-35	-85	mA	
$V_{TH}$	Input Threshold High	$DE = 0V$	DO+/RI+, DO-/RI-			+100	mV	
$V_{TL}$	Input Threshold Low			-100			mV	
$I_{IN}$	Input Current	$DE = 0V$ , $V_{IN} = +2.4V$ , or $0V$		-20	$\pm 1$	+20	$\mu\text{A}$	
		$V_{CC} = 0V$ , $V_{IN} = +2.4V$ , or $0V$		-20	$\pm 1$	+20	$\mu\text{A}$	
$V_{IH}$	Minimum Input High Voltage		DIN, DE, RE	2.0		$V_{CC}$	V	
$V_{IL}$	Maximum Input Low Voltage			GND		0.8	V	
$I_{IH}$	Input High Current	$V_{IN} = V_{CC}$ or 2.4V			$\pm 1$	$\pm 10$	$\mu\text{A}$	
$I_{IL}$	Input Low Current	$V_{IN} = \text{GND}$ or 0.4V			$\pm 1$	$\pm 10$	$\mu\text{A}$	
$V_{CL}$	Input Diode Clamp Voltage	$I_{CLAMP} = -18$ mA		-1.5	-0.8		V	
$I_{CCD}$	Power Supply Current	$DE = \overline{RE} = V_{CC}$ , $R_L = 27\Omega$	$V_{CC}$		13	20	mA	
$I_{CCR}$		$DE = \overline{RE} = 0V$			5	8	mA	
$I_{CCZ}$		$DE = 0V$ , $\overline{RE} = V_{CC}$			3	7.5	mA	
$I_{CC}$		$DE = V_{CC}$ , $\overline{RE} = 0V$ , $R_L = 27\Omega$			16	22	mA	
$C_{output}$	Capacitance @ BUS Pins		DO+/RI+, DO-/RI-		5		pF	

## 5V DC Electrical Characteristics (Notes 2, 3)

$T_A = -40^\circ\text{C}$  to  $+85^\circ\text{C}$  unless otherwise noted,  $V_{CC} = 5.0\text{V} \pm 0.5\text{V}$

Symbol	Parameter	Conditions	Pin	Min	Typ	Max	Units
$V_{OD}$	Output Differential Voltage	$R_L = 27\Omega$ , Figure 1	DO+/RI+, DO-/RI-	145	270	390	mV
$\Delta V_{OD}$	$V_{OD}$ Magnitude Change				3	30	mV
$V_{OS}$	Offset Voltage			1	1.35	1.65	V
$\Delta V_{OS}$	Offset Magnitude Change				5	50	mV
$I_{OSD}$	Output Short Circuit Current			$V_O = 0\text{V}$ , $DE = V_{CC}$		-12	-20
$V_{OH}$	Voltage Output High	$V_{ID} = +100\text{ mV}$	$I_{OH} = -400\ \mu\text{A}$	$R_{OUT}$	4.3	5.0	V
		Inputs Open			4.3	5.0	V
		Inputs Shorted			4.3	5.0	V
		Inputs Terminated, $R_L = 27\Omega$			4.3	5.0	V
$V_{OL}$	Voltage Output Low	$I_{OL} = 2.0\text{ mA}$ , $V_{ID} = -100\text{ mV}$		0.1	0.4	V	
$I_{OS}$	Output Short Circuit Current	$V_{OUT} = 0\text{V}$ , $V_{ID} = +100\text{ mV}$		-35	-90	-130	mA
$V_{TH}$	Input Threshold High	$DE = 0\text{V}$	DO+/RI+, DO-/RI-			+100	mV
$V_{TL}$	Input Threshold Low			-100			mV
$I_{IN}$	Input Current	$DE = 0\text{V}$ , $V_{IN} = +2.4\text{V}$ , or $0\text{V}$		-20	$\pm 1$	+20	$\mu\text{A}$
		$V_{CC} = 0\text{V}$ , $V_{IN} = +2.4\text{V}$ , or $0\text{V}$		-20	$\pm 1$	+20	$\mu\text{A}$
$V_{IH}$	Minimum Input High Voltage		DIN, DE, RE	2.0		$V_{CC}$	V
$V_{IL}$	Maximum Input Low Voltage			GND		0.8	V
$I_{IH}$	Input High Current	$V_{IN} = V_{CC}$ or $2.4\text{V}$			$\pm 1$	$\pm 10$	$\mu\text{A}$
$I_{IL}$	Input Low Current	$V_{IN} = \text{GND}$ or $0.4\text{V}$			$\pm 1$	$\pm 10$	$\mu\text{A}$
$V_{CL}$	Input Diode Clamp Voltage	$I_{CLAMP} = -18\text{ mA}$		-1.5	-0.8		V
$I_{CCD}$	Power Supply Current	$DE = \overline{RE} = V_{CC}$ , $R_L = 27\Omega$	$V_{CC}$		17	25	mA
$I_{CCR}$		$DE = \overline{RE} = 0\text{V}$			6	10	mA
$I_{CCZ}$		$DE = 0\text{V}$ , $\overline{RE} = V_{CC}$			3	8	mA
$I_{CC}$		$DE = V_{CC}$ , $\overline{RE} = 0\text{V}$ , $R_L = 27\Omega$			20	25	mA
$C_{output}$	Capacitance @ BUS Pins		DO+/RI+, DO-/RI-		5		pF

**Note 1:** "Absolute Maximum Ratings" are these 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 table of "Electrical Characteristics" provides 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 except  $V_{OD}$ ,  $V_{ID}$ ,  $V_{TH}$  and  $V_{TL}$  unless otherwise specified.

**Note 3:** All typicals are given for  $V_{CC} = +3.3\text{V}$  or  $5.0\text{V}$  and  $T_A = +25^\circ\text{C}$ , unless otherwise stated.

**Note 4:** ESD Rating: HBM (1.5 k $\Omega$ , 100 pF) > 2.0 kV EAT (0 $\Omega$ , 200 pF) > 300V.

**Note 5:**  $C_L$  includes probe and fixture capacitance.

**Note 6:** Generator waveforms for all tests unless otherwise specified:  $f = 1\text{MHz}$ ,  $Z_O = 50\Omega$ ,  $t_r$ ,  $t_f \leq 6.0\text{ns}$  (0%–100%) on control pins and  $\leq 1.0\text{ns}$  for RI inputs.

**Note 7:** The DS92LV010A is a current mode device and only function with datasheet specification when a resistive load is applied between the driver outputs.

**Note 8:** For receiver TRI-STATE<sup>®</sup> delays, the switch is set to  $V_{CC}$  for  $t_{PZL}$  and  $t_{PLZ}$  and to GND for  $t_{PZH}$  and  $t_{PHZ}$ .

## 3.3V AC Electrical Characteristics (Note 6)

$T_A = -40^\circ\text{C}$  to  $+85^\circ\text{C}$ ,  $V_{CC} = 3.3\text{V} \pm 0.3\text{V}$

Symbol	Parameter	Conditions	Min	Typ	Max	Units	
<b>DIFFERENTIAL DRIVER TIMING REQUIREMENTS</b>							
$t_{PHLD}$	Differential Prop. Delay High to Low	$R_L = 27\Omega$ , Figures 2, 3 $C_L = 10\text{ pF}$	1.0	3.0	5.0	ns	
$t_{PLHD}$	Differential Prop. Delay Low to High		1.0	2.8	5.0	ns	
$t_{SKD}$	Differential SKEW $ t_{PHLD} - t_{PLHD} $			0.2	1.0	ns	
$t_{TLH}$	Transition Time Low to High				0.3	2.0	ns
$t_{THL}$	Transition Time High to Low				0.3	2.0	ns

Symbol	Parameter	Conditions	Min	Typ	Max	Units	
$t_{PHZ}$	Disable Time High to Z	$R_L = 27\Omega$ , Figures 4, 5 $C_L = 10$ pF	0.5	4.5	9.0	ns	
$t_{PLZ}$	Disable Time Low to Z		0.5	5.0	10.0	ns	
$t_{PZH}$	Enable Time Z to High		2.0	5.0	7.0	ns	
$t_{PZL}$	Enable Time Z to Low		1.0	4.5	9.0	ns	
<b>DIFFERENTIAL RECEIVER TIMING REQUIREMENTS</b>							
$t_{PHLD}$	Differential Prop. Delay High to Low	Figures 6, 7 $C_L = 10$ pF	2.5	5.0	12.0	ns	
$t_{PLHD}$	Differential Prop. Delay Low to High		2.5	5.5	10.0	ns	
$t_{SKD}$	Differential SKEW $ t_{PHLD} - t_{PLHD} $			0.5	2.0	ns	
$t_r$	Rise Time				1.5	4.0	ns
$t_f$	Fall Time				1.5	4.0	ns
$t_{PHZ}$	Disable Time High to Z	$R_L = 500\Omega$ , Figures 8, 9 $C_L = 10$ pF (Note 8)	2.0	4.0	6.0	ns	
$t_{PLZ}$	Disable Time Low to Z		2.0	5.0	7.0	ns	
$t_{PZH}$	Enable Time Z to High		2.0	7.0	13.0	ns	
$t_{PZL}$	Enable Time Z to Low		2.0	6.0	10.0	ns	

### 5V AC Electrical Characteristics (Note 6)

$T_A = -40^\circ\text{C}$  to  $+85^\circ\text{C}$ ,  $V_{CC} = 5.0\text{V} \pm 0.5\text{V}$

Symbol	Parameter	Conditions	Min	Typ	Max	Units	
<b>DIFFERENTIAL DRIVER TIMING REQUIREMENTS</b>							
$t_{PHLD}$	Differential Prop. Delay High to Low	$R_L = 27\Omega$ , Figures 2, 3 $C_L = 10$ pF	0.5	2.7	4.5	ns	
$t_{PLHD}$	Differential Prop. Delay Low to High		0.5	2.5	4.5	ns	
$t_{SKD}$	Differential SKEW $ t_{PHLD} - t_{PLHD} $			0.2	1.0	ns	
$t_{TLH}$	Transition Time Low to High				0.3	2.0	ns
$t_{THL}$	Transition Time High to Low				0.3	2.0	ns
$t_{PHZ}$	Disable Time High to Z	$R_L = 27\Omega$ , Figures 4, 5 $C_L = 10$ pF	0.5	3.0	7.0	ns	
$t_{PLZ}$	Disable Time Low to Z		0.5	5.0	10.0	ns	
$t_{PZH}$	Enable Time Z to High		2.0	4.0	7.0	ns	
$t_{PZL}$	Enable Time Z to Low		1.0	4.0	9.0	ns	
<b>DIFFERENTIAL RECEIVER TIMING REQUIREMENTS</b>							
$t_{PHLD}$	Differential Prop. Delay High to Low	Figures 6, 7 $C_L = 10$ pF	2.5	5.0	12.0	ns	
$t_{PLHD}$	Differential Prop. Delay Low to High		2.5	4.6	10.0	ns	
$t_{SKD}$	Differential SKEW $ t_{PHLD} - t_{PLHD} $			0.4	2.0	ns	
$t_r$	Rise Time				1.2	2.5	ns
$t_f$	Fall Time				1.2	2.5	ns
$t_{PHZ}$	Disable Time High to Z	$R_L = 500\Omega$ , Figures 8, 9 $C_L = 10$ pF (Note 8)	2.0	4.0	6.0	ns	
$t_{PLZ}$	Disable Time Low to Z		2.0	4.0	6.0	ns	
$t_{PZH}$	Enable Time Z to High		2.0	5.0	9.0	ns	
$t_{PZL}$	Enable Time Z to Low		2.0	5.0	7.0	ns	

# Test Circuits and Timing Waveforms

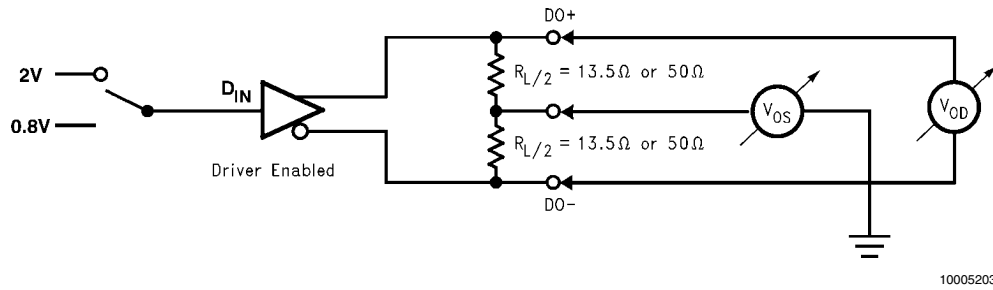


FIGURE 1. Differential Driver DC Test Circuit

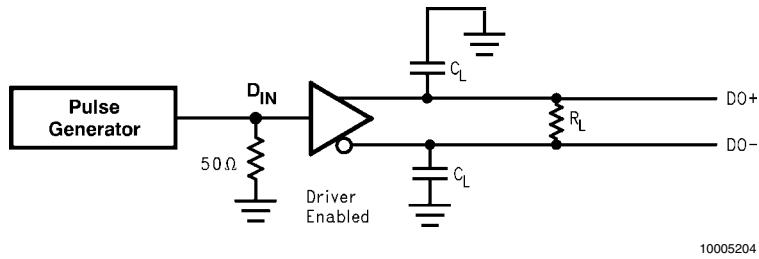


FIGURE 2. Differential Driver Propagation Delay and Transition Time Test Circuit

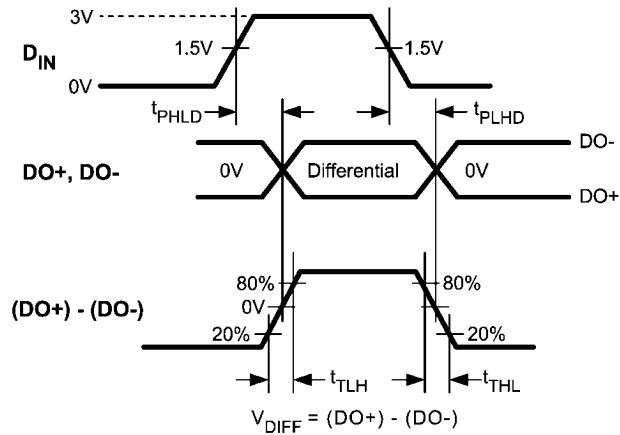
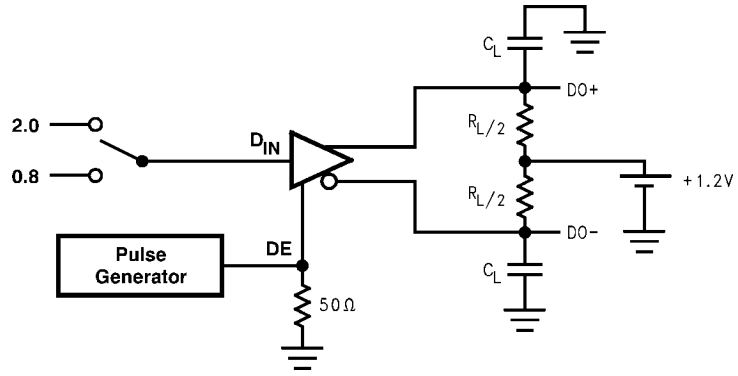
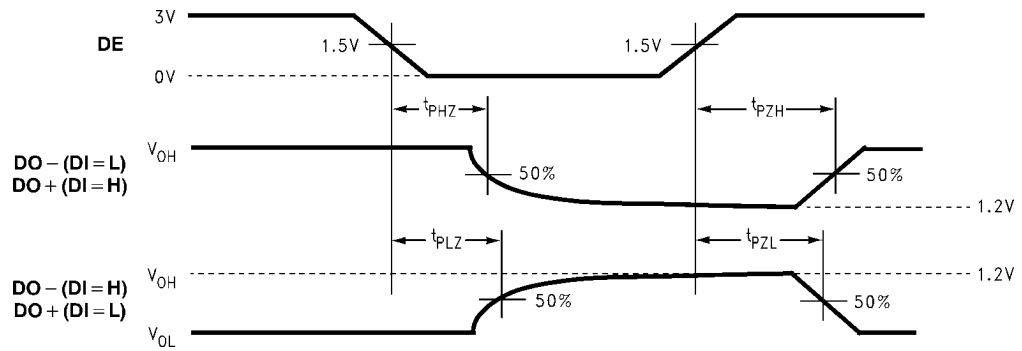


FIGURE 3. Differential Driver Propagation Delay and Transition Time Waveforms



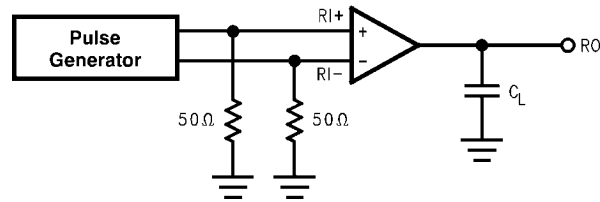
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FIGURE 4. Driver TRI-STATE Delay Test Circuit



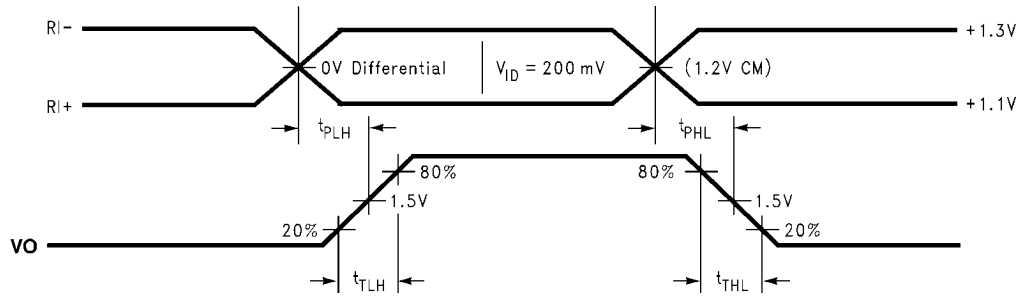
10005207

FIGURE 5. Driver TRI-STATE Delay Waveforms



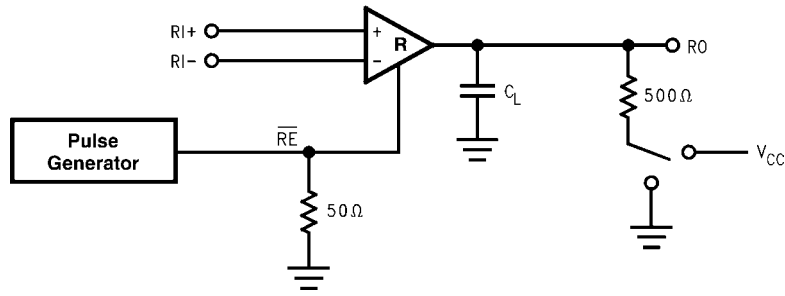
10005208

FIGURE 6. Receiver Propagation Delay and Transition Time Test Circuit



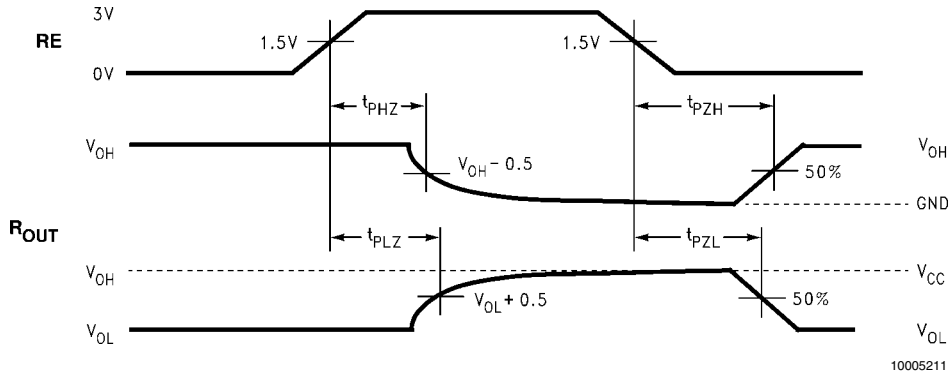
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FIGURE 7. Receiver Propagation Delay and Transition Time Waveforms



10005210

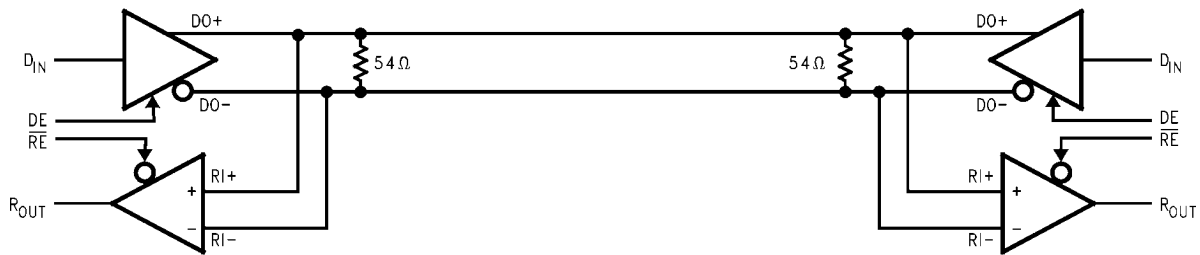
FIGURE 8. Receiver TRI-STATE Delay Test Circuit



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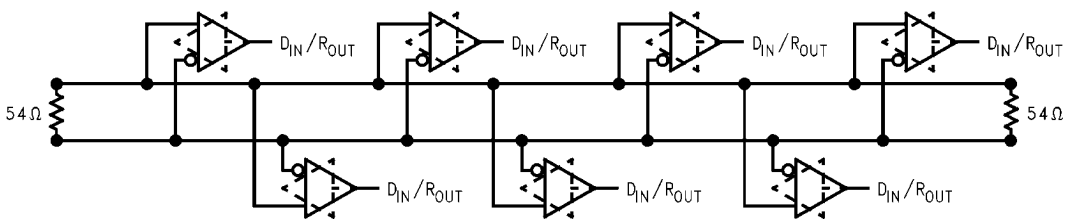
FIGURE 9. Receiver TRI-STATE Delay Waveforms

## Typical Bus Application Configurations



10005212

Bi-Directional Half-Duplex Point-to-Point Applications



10005213

Multi-Point Bus Applications

## Application Information

There are a few common practices which should be implied when designing PCB for BLVDS signaling. Recommended practices are:

- Use at least 4 layer PCB board (BLVDS signals, ground, power and TTL signals).
- Keep drivers and receivers as close to the (BLVDS port side) connector as possible.
- Bypass each BLVDS device and also use distributed bulk capacitance. Surface mount capacitors placed close to power and ground pins work best. Two or three multi-layer ceramic (MLC) surface mount capacitors (0.1  $\mu$ F, and 0.01  $\mu$ F in parallel should be used between each  $V_{CC}$  and ground. The capacitors should be as close as possible to the  $V_{CC}$  pin.
- Use the termination resistor which best matches the differential impedance of your transmission line.
- Leave unused LVDS receiver inputs open (floating)

**TABLE 1. Functional Table**

MODE SELECTED	DE	$\overline{RE}$
DRIVER MODE	H	H
RECEIVER MODE	L	L
TRI-STATE MODE	L	H
LOOP BACK MODE	H	L

**TABLE 4. Device Pin Descriptions**

Pin Name	Pin #	Input/Output	Description
DIN	2	I	TTL Driver Input
$DO_{\pm}/RI_{\pm}$	6, 7	I/O	LVDS Driver Outputs/LVDS Receiver Inputs
$R_{OUT}$	3	O	TTL Receiver Output
$\overline{RE}$	5	I	Receiver Enable TTL Input (Active Low)
DE	1	I	Driver Enable TTL Input (Active High)
GND	4	NA	Ground
$V_{CC}$	8	NA	Power Supply

**TABLE 2. Transmitter Mode**

INPUTS		OUTPUTS	
DE	DI	DO+	DO-
H	L	L	H
H	H	H	L
H	$2 > \& > 0.8$	X	X
L	X	Z	Z

L = Low state  
H = High state

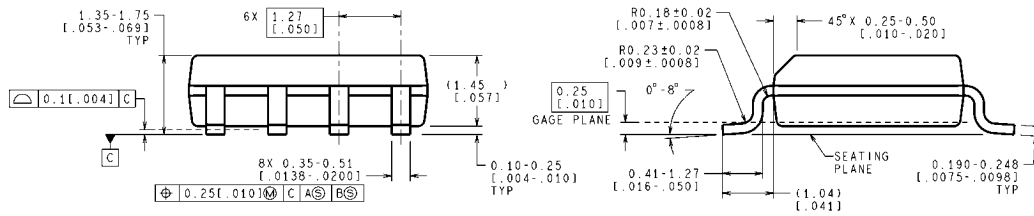
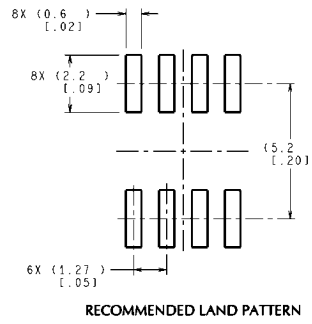
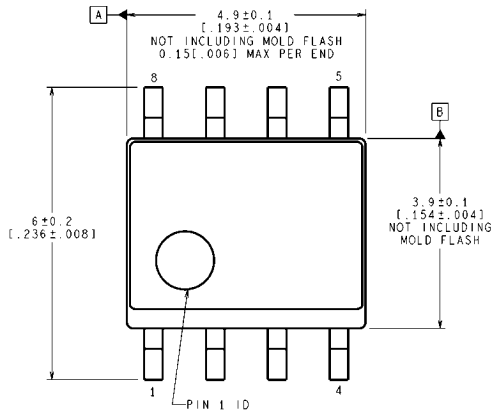
**TABLE 3. Receiver Mode**

INPUTS		OUTPUT
$\overline{RE}$	(RI+)-(RI-)	
L	L (< -100 mV)	L
L	H (> +100 mV)	H
L	100 mV > & > -100 mV	X
H	X	Z

X = High or Low logic state  
Z = High impedance state  
L = Low state  
H = High state



**Physical Dimensions** inches (millimeters) unless otherwise noted



CONTROLLING DIMENSION IS MILLIMETER  
VALUES IN [ ] ARE INCHES  
DIMENSIONS IN ( ) FOR REFERENCE ONLY

**Order Number DS92LV010ATM**  
**See NS Package Number M08A**

M08A (Rev L)

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Data Converters	<a href="http://www.national.com/adc">www.national.com/adc</a>	Distributors	<a href="http://www.national.com/contacts">www.national.com/contacts</a>
Displays	<a href="http://www.national.com/displays">www.national.com/displays</a>	Green Compliance	<a href="http://www.national.com/quality/green">www.national.com/quality/green</a>
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Interface	<a href="http://www.national.com/interface">www.national.com/interface</a>	Quality and Reliability	<a href="http://www.national.com/quality">www.national.com/quality</a>
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Temperature Sensors	<a href="http://www.national.com/tempsensors">www.national.com/tempsensors</a>		
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