National Semiconductor

DS92LV090AEP

OBSOLETE
June 15, 2009

9 Channel Bus LVDS Transceiver

General Description

The DS92LV090AEP is one in a series of Bus LVDS transceivers designed specifically for the high speed, low power proprietary backplane or cable interfaces. The device operates from a single 3.3V power supply and includes nine differential line drivers and nine receivers. To minimize bus loading, the driver outputs and receiver inputs are internally connected. The separate I/O of the logic side allows for loop back support. The device also features a flow through pin out which allows easy PCB routing for short stubs between its pins and the connector.

The driver translates 3V TTL levels (single-ended) to differential Bus LVDS (BLVDS) output 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 ±1V.

The receiver threshold is less than ±100 mV over a ±1V common mode range and translates the differential Bus LVDS to standard (TTL/CMOS) levels. (See Applications Information Section for more details.)

ENHANCED PLASTIC

- Extended Temperature Performance of –40°C to +85°C
- Baseline Control - Single Fab & Assembly Site
- Process Change Notification (PCN)
- Qualification & Reliability Data
- Solder (PbSn) Lead Finish is standard
- Enhanced Diminishing Manufacturing Sources (DMS) Support

Features

- Bus LVDS Signaling
- 3.2 nanosecond propagation delay max
- Chip to Chip skew ±800ps
- Low power CMOS design
- High Signaling Rate Capability (above 100 Mbps)
- 0.1V to 2.3V Common Mode Range for V_{ID} = 200mV
- ±100 mV Receiver Sensitivity
- Supports open and terminated failsafe on port pins
- 3.3V operation
- Glitch free power up/down (Driver & Receiver disabled)
- Light Bus Loading (5 pF typical) per Bus LVDS load
- Designed for Double Termination Applications
- Balanced Output Impedance
- Product offered in 64 pin TQFP package
- High impedance Bus pins on power off (V_{CC} = 0V)
- Driver Channel to Channel skew (same device) 230ps typical
- Receiver Channel to Channel skew (same device) 370ps typical

Application

- Selected Military Applications
- Selected Avionics Applications

Ordering Infromation

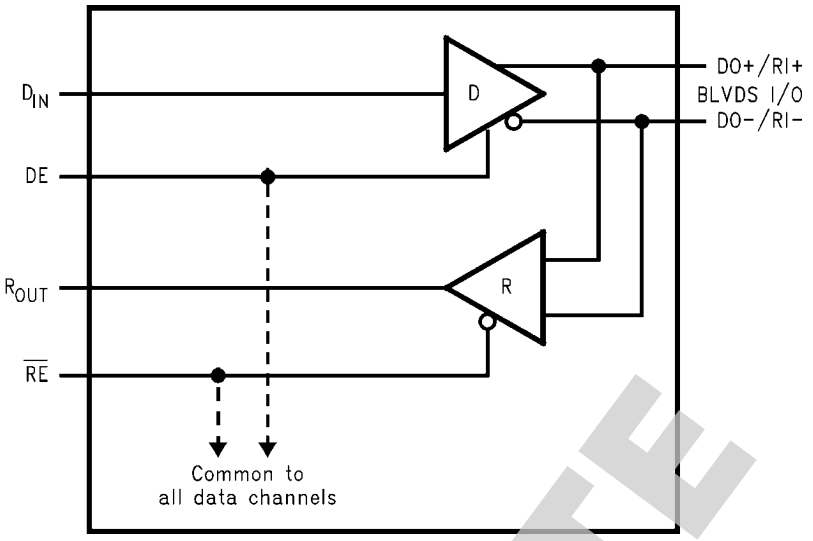
PART NUMBER	VID PART NUMBER	NS PACKAGE NUMBER (Note 3)
DS92LV090ATVEP	V62/04741-01	VEH64A
(Notes 1, 2)	TBD	TBD

Note 1: For the following (Enhanced Plastic) version, check for availability: DS92LV090TVHXEP. Parts listed with an "X" are provided in Tape & Reel and parts without an "X" are in Rails.

Note 2: FOR ADDITIONAL ORDERING AND PRODUCT INFORMATION, PLEASE VISIT THE ENHANCED PLASTIC WEB SITE AT: www.national.com/mil

Note 3: Refer to package details under Physical Dimensions

Simplified Functional Diagram



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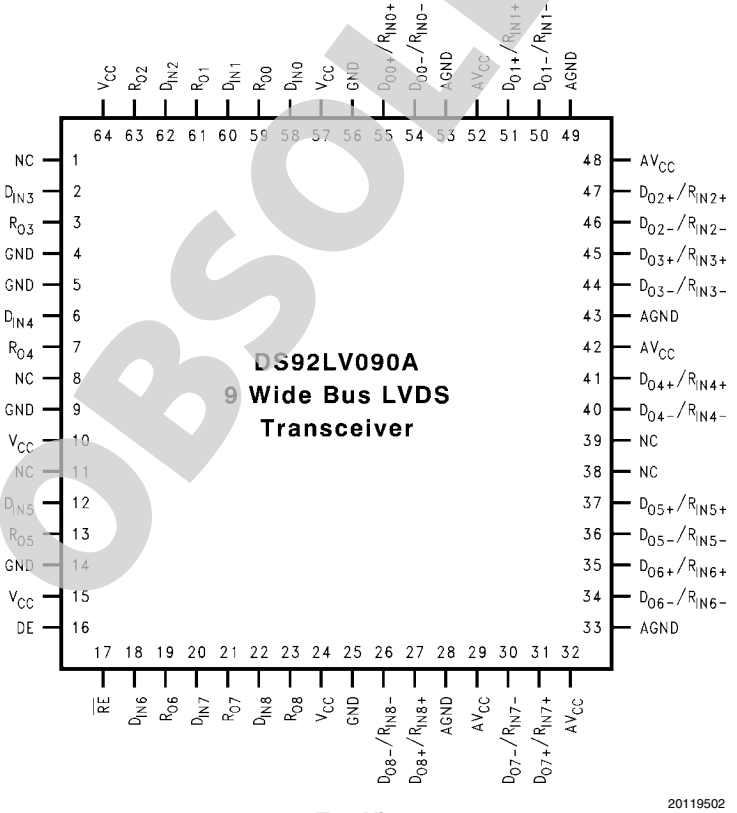
Connection Diagram



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Top View
See NS Package Number VEH064DB

Pin Descriptions

Pin Name	Pin #	Input/Output	Descriptions
DO+/RI+	27, 31, 35, 37, 41, 45, 47, 51, 55	I/O	True Bus LVDS Driver Outputs and Receiver Inputs.
DO−/RI−	26, 30, 34, 36, 40, 44, 46, 50, 54	I/O	Complimentary Bus LVDS Driver Outputs and Receiver Inputs.
D_{IN}	2, 6, 12, 18, 20, 22, 58, 60, 62	I	TTL Driver Input.
RO	3, 7, 13, 19, 21, 23, 59, 61, 63	O	TTL Receiver Output.
$\overline{RE}$	17	I	Receiver Enable TTL Input (Active Low).
DE	16	I	Driver Enable TTL Input (Active High).
GND	4, 5, 9, 14, 25, 56	Power	Ground for digital circuitry (must connect to GND on PC board). These pins connected internally.
V_{CC}	10, 15, 24, 57, 64	Power	V_{CC} for digital circuitry (must connect to V_{CC} on PC board). These pins connected internally.
AGND	28, 33, 43, 49, 53	Power	Ground for analog circuitry (must connect to GND on PC board). These pins connected internally.
AV_{CC}	29, 32, 42, 48, 52	Power	Analog V_{CC} (must connect to V_{CC} on PC board). These pins connected internally.
NC	1, 8, 11, 38, 39	N/A	Leave open circuit, do not connect.

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Absolute Maximum Ratings (Notes 4, 5)

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

Supply Voltage (V_{CC})	4.0V
Enable Input Voltage (DE, $\overline{RE}$)	−0.3V to (V_{CC} +0.3V)
Driver Input Voltage (D_{IN})	−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
ESD (HBM 1.5 kΩ, 100 pF)	>4.5 kV
Driver Short Circuit Duration	momentary
Receiver Short Circuit Duration	momentary
Maximum Package Power Dissipation at 25°C	
TQFP	1.74 W
Derate TQFP Package	13.9 mW/°C
θ_{ja}	71.7°C/W
θ_{jc}	10.9°C/W
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})	3.0	3.6	V
Receiver Input Voltage	0.0	2.4	V
Operating Free Air Temperature	−40	+85	°C
Maximum Input Edge Rate (Note 9)(20% to 80%)			Δt/ΔV
Data		1.0	ns/V
Control		3.0	ns/V

DC Electrical Characteristics

Over recommended operating supply voltage and temperature ranges unless otherwise specified (Notes 5, 6, 17)

Symbol	Parameter	Conditions		Pin	Min	Typ	Max	Units
V_{OD}	Output Differential Voltage	R_L = 27Ω, *Figure 1*		DO+/RI+, DO−/RI−	240	300	460	mV
ΔV_{OD}	V_{OD} Magnitude Change						27	mV
V_{OS}	Offset Voltage				1.1	1.3	1.5	V
ΔV_{OS}	Offset Magnitude Change					5	10	mV
V_{OH}	Driver Output High Voltage	R_L = 27Ω				1.4	1.65	V
V_{OL}	Driver Output Low Voltage	R_L = 27Ω			0.95	1.1		V
I_{OSD}	Output Short Circuit Current (Note 13)	V_{OD} = 0V, DE = V_{CC}, Driver outputs shorted together				|36|	|65|	mA
V_{OH}	Voltage Output High (Note 14)	V_{ID} = +300 mV	I_{OH} = −400 µA	R_{OUT}	V_{CC}−0.2			V
		Inputs Open			V_{CC}−0.2			V
		Inputs Terminated, R_L = 27Ω			V_{CC}−0.2			V
V_{OL}	Voltage Output Low	I_{OL} = 2.0 mA, V_{ID} = −300 mV				0.05	0.075	V
I_{OD}	Receiver Output Dynamic Current (Note 13)	V_{ID} = 300mV, V_{OUT} = V_{CC}−1.0V			−110	|75|		mA
		V_{ID} = −300mV, V_{OUT} = 1.0V				|75|	110	mA
V_{TH}	Input Threshold High	DE = 0V, V_{CM} = 1.5V		DO+/RI+, DO−/RI−			+100	mV
V_{TL}	Input Threshold Low				−100			mV
V_{CMR}	Receiver Common Mode Range				|V_{ID}|/2		2.4 − |V_{ID}|/2	V
I_{IN}	Input Current	DE = 0V, $\overline{RE}$ = 2.4V, V_{IN} = +2.4V or 0V			−20	±1	+20	µA
		V_{CC} = 0V, V_{IN} = +2.4V or 0V			−20	±1	+20	µA
V_{IH}	Minimum Input High Voltage			D_{IN}, DE, $\overline{RE}$	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			−20	±10	+20	µA
I_{IL}	Input Low Current	V_{IN} = GND or 0.4V			−20	±10	+20	µA
V_{CL}	Input Diode Clamp Voltage	I_{CLAMP} = −18 mA			−1.5	−0.8		V

Symbol	Parameter	Conditions	Pin	Min	Typ	Max	Units
I_{CCD}	Power Supply Current Drivers Enabled, Receivers Disabled	No Load, DE = $\overline{RE}$ = V_{CC}, DIN = V_{CC} or GND	V_{CC}		55	80	mA
I_{CCR}	Power Supply Current Drivers Disabled, Receivers Enabled	DE = $\overline{RE}$ = 0V, V_{ID} = ±300mV			73	80	mA
I_{CCZ}	Power Supply Current, Drivers and Receivers TRI-STATE®	DE = 0V; $\overline{RE}$ = V_{CC}, DIN = V_{CC} or GND			35	80	mA
I_{CC}	Power Supply Current, Drivers and Receivers Enabled	DE = V_{CC}; $\overline{RE}$ = 0V, DIN = V_{CC} or GND, R_L = 27Ω			170	210	mA
I_{OFF}	Power Off Leakage Current	V_{CC} = 0V or OPEN, D_{IN}, DE, $\overline{RE}$ = 0V or OPEN, $V_{APPLIED}$ = 3.6V (Port Pins)	DO+/RI+, DO−/RI−	−20		+20	µA
C_{OUTPUT}	Capacitance @ Bus Pins		DO+/RI+, DO−/RI−		5		pF
c_{OUTPUT}	Capacitance @ R_{OUT}		R_{OUT}		7		pF

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AC Electrical Characteristics

Over recommended operating supply voltage and temperature ranges unless otherwise specified (Notes 9, 17)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
DIFFERENTIAL DRIVER TIMING REQUIREMENTS						
t_{PHLD}	Differential Prop. Delay High to Low (Note 11)	R_L = 27Ω, *Figures 2*, *3*, C_L = 10 pF	0.6	1.4	2.2	ns
t_{PLHD}	Differential Prop. Delay Low to High (Note 11)		0.6	1.4	2.2	ns
t_{SKD1}	Differential Skew $\|t_{PHLD}–t_{PLHD}\|$ (Note 12)			80		ps
t_{SKD2}	Chip to Chip Skew (Note 15)				1.6	ns
t_{SKD3}	Channel to Channel Skew (Note 16)			0.25	0.45	ns
t_{TLH}	Transition Time Low to High			0.6	1.2	ns
t_{THL}	Transition Time High to Low			0.5	1.2	ns
t_{PHZ}	Disable Time High to Z	R_L = 27Ω, *Figures 4*, *5*, C_L = 10 pF		3	8	ns
t_{PLZ}	Disable Time Low to Z			3	8	ns
t_{PZH}	Enable Time Z to High			3	8	ns
t_{PZL}	Enable Time Z to Low			3	8	ns
DIFFERENTIAL RECEIVER TIMING REQUIREMENTS						
t_{PHLD}	Differential Prop. Delay High to Low (Note 11)	*Figures 6*, *7*, C_L = 35 pF	1.6	2.4	3.2	ns
t_{PLHD}	Differential Prop Delay Low to High (Note 11)		1.6	2.4	3.2	ns
t_{SDK1}	Differential Skew $\|t_{PHLD}–t_{PLHD}\|$ (Note 12)			80		ps
t_{SDK2}	Chip to Chip Skew (Note 15)				1.6	ns
t_{SDK3}	Channel to Channel Skew (Note 16)			0.35	0.60	ns
t_{TLH}	Transition Time Low to High			1.5	2.5	ns
t_{THL}	Transition Time High to Low			1.5	2.5	ns
t_{PHZ}	Disable Time High to Z	R_L = 500Ω, *Figures 8*, *9*, C_L = 35 pF		4.5	10	ns
t_{PLZ}	Disable Time Low to Z			3.5	8	ns
t_{PZH}	Enable Time Z to High			3.5	8	ns
t_{PZL}	Enable Time Z to Low			3.5	8	ns

Note 4: "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed. They are not meant to imply that the devices should be operated at these limits. The table of "Electrical Characteristics" provides conditions for actual device operation.

Note 5: All currents into device pins are positive; all currents out of device pins are negative. All voltages are referenced to ground unless otherwise specified except V_{OD}, ΔV_{OD} and V_{ID}.

Note 6: All typicals are given for V_{CC} = +3.3V and T_A = +25°C, unless otherwise stated.

Note 7: ESD Rating: HBM (1.5 kΩ, 100 pF) > 4.5 kV EIAJ (0Ω, 200 pF) > 300V.

Note 8: C_L includes probe and fixture capacitance.

Note 9: Generator waveforms for all tests unless otherwise specified: f = 25 MHz, Z_O = 50Ω, t_r, t_f = <1.0 ns (0%–100%). To ensure fastest propagation delay and minimum skew, data input edge rates should be equal to or faster than 1ns/V; control signals equal to or faster than 3ns/V. In general, the faster the input edge rate, the better the AC performance.

Note 10: The DS92LV090AEP functions within datasheet specification when a resistive load is applied to the driver outputs.

Note 11: Propagation delays are guaranteed by design and characterization.

Note 12: t_{SKD1} $|t_{PHLD}–t_{PLHD}|$ is the worse case skew between any channel and any device over recommended operation conditions.

Note 13: Only one output at a time should be shorted, do not exceed maximum package power dissipation capacity.

Note 14: V_{OH} failsafe terminated test performed with 27Ω connected between RI+ and RI– inputs. No external voltage is applied.

Note 15: Chip to Chip skew is the difference in differential propagation delay between any channels of any devices, either edge.

Note 16: Channel to Channel skew is the difference in driver output or receiver output propagation delay between any channels within a device, either edge.

Note 17: "Testing and other quality control techniques are used to the extent deemed necessary to ensure product performance over the specified temperature range. Product may not necessarily be tested across the full temperature range and all parameters may not necessarily be tested. In the absence of specific PARAMETRIC testing, product performance is assured by characterization and/or design."

Applications Information

General application guidelines and hints may be found in the following application notes: AN-808, AN-903, AN-971, AN-977, and AN-1108.

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

- Use at least 4 PCB board layer (Bus LVDS signals, ground, power and TTL signals).
- Keep drivers and receivers as close to the (Bus LVDS port side) connector as possible.
- Bypass each Bus LVDS device and also use distributed bulk capacitance between power planes. Surface mount capacitors placed close to power and ground pins work best. Two or three high frequency, multi-layer ceramic (MLC) surface mount (0.1 µF, 0.01 µF, 0.001 µF) in parallel should be used between each V_{CC} and ground. The capacitors should be as close as possible to the V_{CC} pin. Multiple vias should be used to connect V_{CC} and Ground planes to the pads of the by-pass capacitors.
  In addition, randomly distributed by-pass capacitors should be used.
- Use the termination resistor which best matches the differential impedance of your transmission line.
- Leave unused Bus LVDS receiver inputs open (floating). Limit traces on unused inputs to <0.5 inches.
- Isolate TTL signals from Bus LVDS signals

MEDIA (CONNECTOR or BACKPLANE) SELECTION:

- Use controlled impedance media. The backplane and connectors should have a matched differential impedance.

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 2. Transmitter Mode

INPUTS		OUTPUTS	
DE	**D_{IN}**	**DO+**	**DO–**
H	L	L	H
H	H	H	L
H	0.8V< D_{IN} <2.0V	X	X
L	X	Z	Z

TABLE 3. Receiver Mode

INPUTS		OUTPUT
$\overline{RE}$	**(RI+) – (RI–)**	
L	L (< –100 mV)	L
L	H (> +100 mV)	H
L	–100 mV < V_{ID} < +100 mV	X
H	X	Z

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

Test Circuits and Timing Waveforms

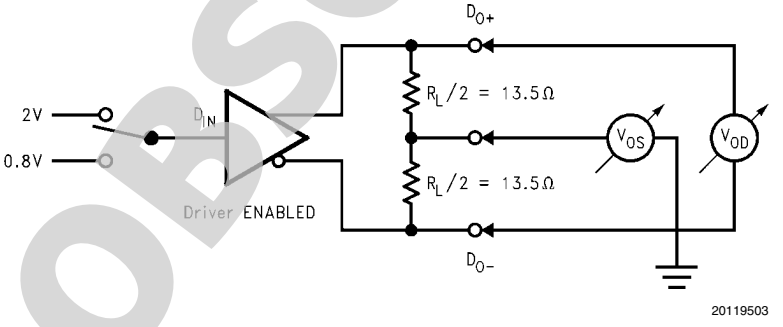


FIGURE 1. Differential Driver DC Test Circuit

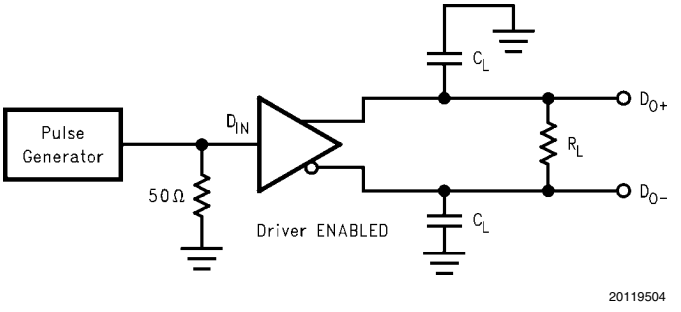


FIGURE 2. Differential Driver Propagation Delay and Transition Time Test Circuit

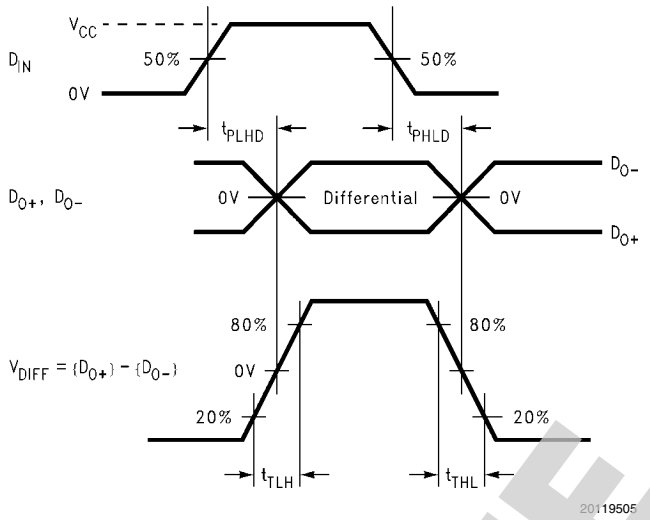


FIGURE 3. Differential Driver Propagation Delay and Transition Time Waveforms

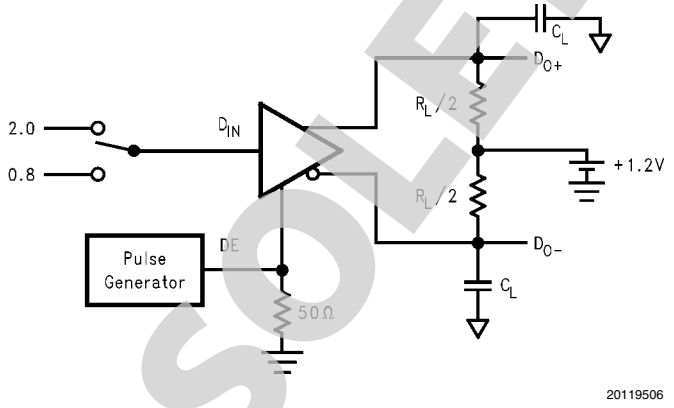


FIGURE 4. Driver TRI-STATE Delay Test Circuit

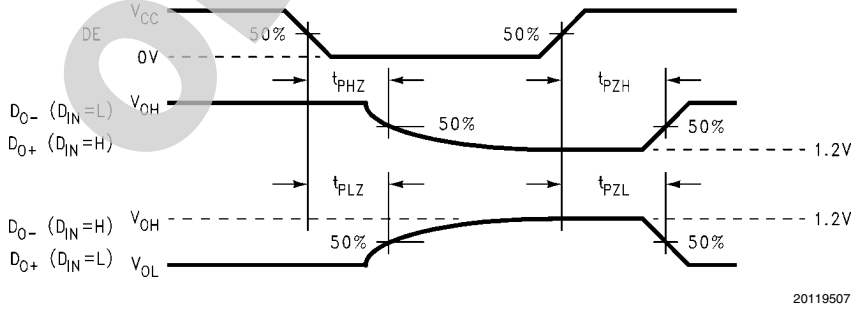


FIGURE 5. Driver TRI-STATE Delay Waveforms

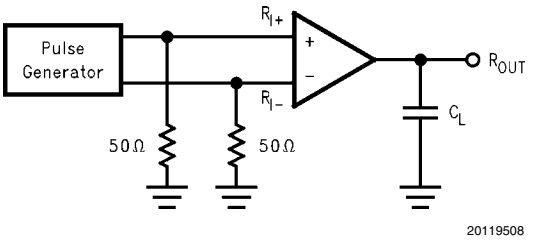


FIGURE 6. Receiver Propagation Delay and Transition Time Test Circuit

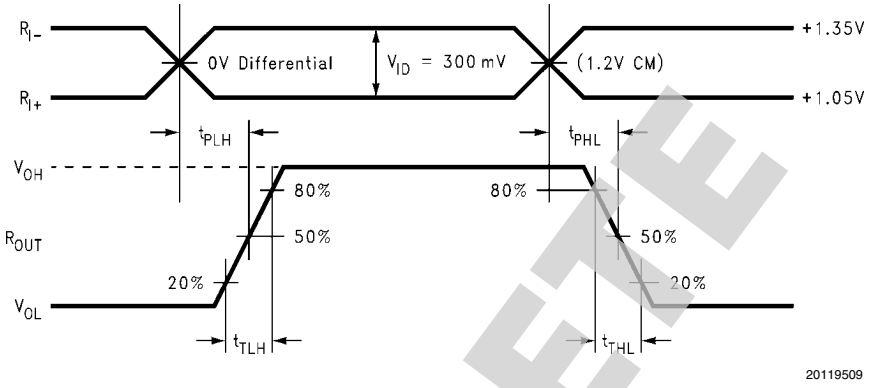


FIGURE 7. Receiver Propagation Delay and Transition Time Waveforms

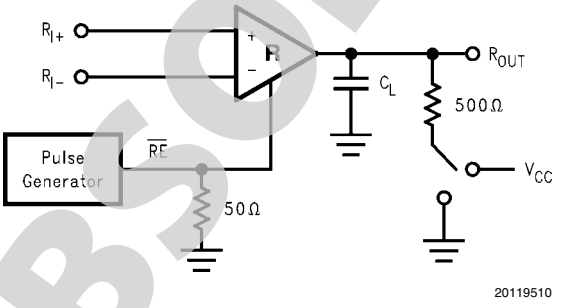


FIGURE 8. Receiver TRI-STATE Delay Test Circuit

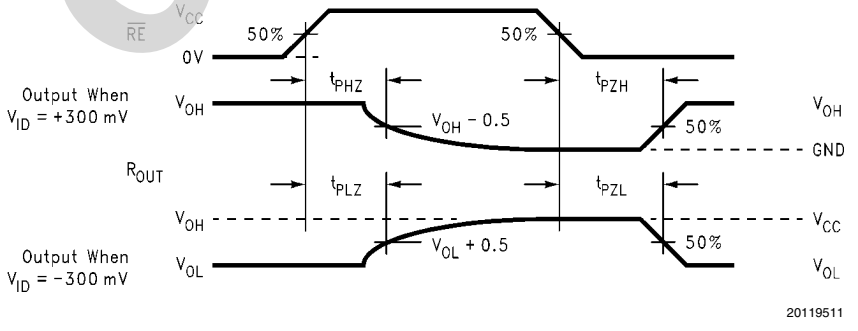
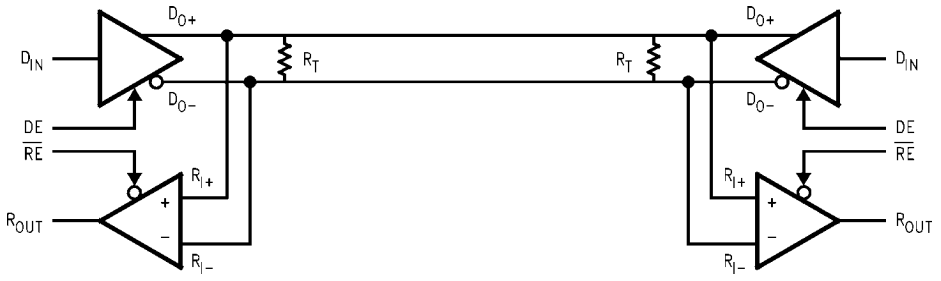
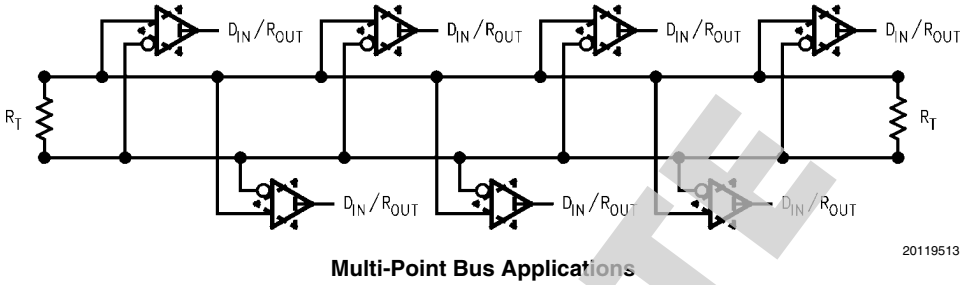


FIGURE 9. Receiver TRI-STATE Delay Waveforms

Typical Bus Application Configurations



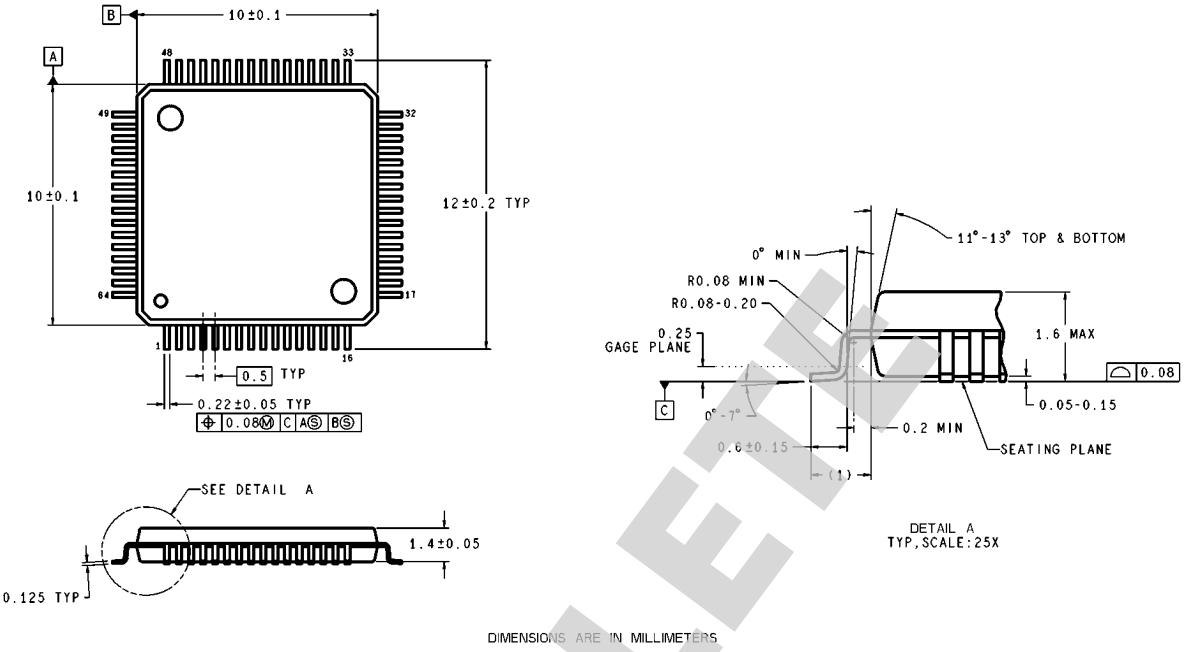
Bi-Directional Half-Duplex Point-to-Point Applications



Multi-Point Bus Applications

Physical Dimensions

Physical Dimensions inches (millimeters) unless otherwise noted



64-Lead Molded TQFP Package
NS Package Number VEH064DBAII

Notes

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Switching Regulators	www.national.com/switchers	Distributors	www.national.com/contacts
LDOs	www.national.com/ldo	Quality and Reliability	www.national.com/quality
LED Lighting	www.national.com/led	Feedback/Support	www.national.com/feedback
Voltage Reference	www.national.com/vref	Design Made Easy	www.national.com/easy
PowerWise® Solutions	www.national.com/powerwise	Solutions	www.national.com/solutions
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