National Semiconductor

DS36954
Quad Differential Bus Transceiver

General Description

The DS36954 is a low power, quad EIA-485 differential bus transceiver especially suited for high speed, parallel, multipoint, I/O bus applications. A compact 20-pin surface mount PLCC or SOIC package provides high transceiver integration and a very small PC board footprint.

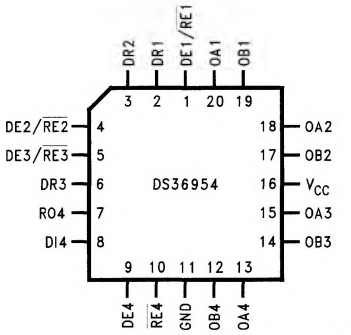
Propagation delay skew between devices is specified to aid in parallel interface designs—limits on maximum and minimum delay times are guaranteed.

Five devices can implement a complete SCSI initiator or target interface. Three transceivers in a package are pinned out for data bus connections. The fourth transceiver, with the flexibility provided by its individual enables, can serve as a control bus transceiver.

Features

- Pinout for SCSI interface
- Compact 20-pin PLCC or SOIC package
- Meets EIA-485 standard for multipoint bus transmission
- Greater than 60 mA source/sink currents
- Thermal shutdown protection
- Glitch-free driver outputs on power up and down

Connection Diagrams



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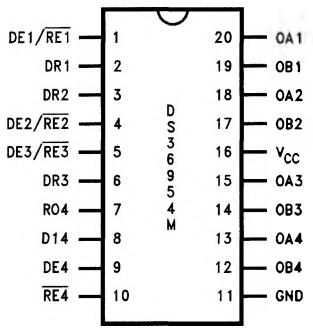
Order Number DS36954V
See NS Package Number V20A



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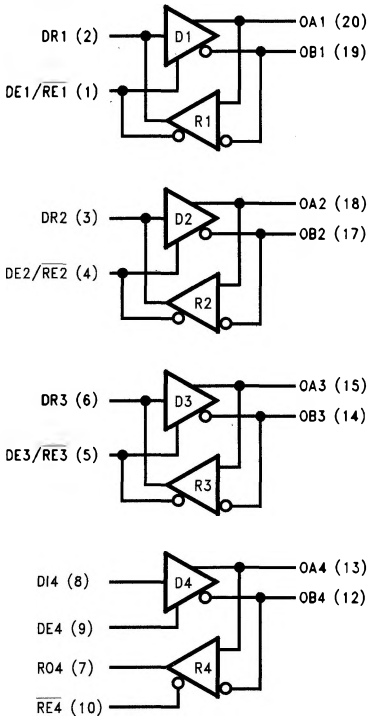
Order Number DS36954M
See NS Package Number M20B

Logic Diagrams



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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	7V
Control Input Voltage	V_{CC} + 0.5V
Driver Input Voltage	V_{CC} + 0.5V
Driver Output Voltage/ Receiver Input Voltage	−10V to +15V
Receiver Output Voltage	5.5V
Continuous Power Dissipation @ +25°C	
V Package	1.73W
M Package	1.73W
Derate V Package	13.9 mW/°C above +25°C
Derate M Package	13.7 mW/°C above +25°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}	4.75	5.25	V
Bus Voltage	−7	+12	V
Operating Free Air Temperature (T_A)	0	+70	°C

Electrical Characteristics

Over Supply Voltage and Operating Temperature ranges, unless otherwise specified (Note 2)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
DRIVER CHARACTERISTICS						
V_{ODL}	Differential Driver Output Voltage (Full Load)	I_L = 60 mA, V_{CM} = 0V	1.5	1.9		V
V_{OD}	Differential Driver Output Voltage (Termination Load)	R_L = 100Ω (EIA-422)	2.0	2.25		V
		R_L = 54Ω (EIA-485)	1.5	2.0		V
$\Delta\lvert V_{OD}\rvert$	Change in Magnitude of Driver Differential Output Voltage for Complementary Output States	R_L = 54 or 100Ω (Note 4) *(Figure 1)* (EIA-422/485)			0.2	V
V_{OC}	Driver Common Mode Output Voltage (Note 5)	R_L = 54Ω *(Figure 1)* (EIA-485)			3.0	V
$\Delta\lvert V_{OC}\rvert$	Change in Magnitude of Common Mode Output Voltage	(Note 4) *(Figure 1)* (EIA-422/485)			0.2	V
V_{OH}	Output Voltage High	I_{OH} = −55 mA	2.7	3.2		V
V_{OL}	Output Voltage Low	I_{OL} = 55 mA		1.4	1.7	V
V_{IH}	Input Voltage High		2.0			V
V_{IL}	Input Voltage Low				0.8	V
V_{CL}	Input Clamp Voltage	I_{CL} = −18 mA			−1.5	V
I_{IH}	Input High Current	V_{IN} = 2.4V (Note 3)			20	μA
I_{IL}	Input Low Current	V_{IN} = 0.4V (Note 3)			−20	μA
I_{OSC}	Driver Short-Circuit Output Current (Note 9)	V_O = −7V (EIA-485)		−130	−250	mA
		V_O = 0V (EIA-422)		−90	−150	mA
		V_O = +12V (EIA-485)		130	250	mA

Electrical Characteristics

Over Supply Voltage and Operating Temperature ranges, unless otherwise specified (Note 2) (Continued)

Symbol	Parameter	Conditions		Min	Typ	Max	Units
RECEIVER CHARACTERISTICS							
I_{OSR}	Short Circuit Output Current	V_O = 0V (Note 9)		−15	−28	−75	mA
I_{OZ}	TRI-STATE® Output Current	V_O = 0.4V to 2.4V				20	μA
V_{OH}	Output Voltage High	V_{ID} = 0.2V, I_{OH} = 0.4 mA		2.4	3.0		V
V_{OL}	Output Voltage Low	V_{ID} = −0.2V, I_{OL} = 4 mA			0.35	0.5	V
V_{TH}	Differential Input High Threshold Voltage	V_O = V_{OH}, I_O = −0.4 mA (EIA-422/485)			0.03	0.2	V
V_{TL}	Differential Input Low Threshold Voltage (Note 6)	V_O = V_{OL}, I_O = 4.0 mA (EIA-422/485)		−0.20	−0.03		V
V_{HST}	Hysteresis (Note 7)	V_{CM} = 0V		35	60		mV
DRIVER AND RECEIVER CHARACTERISTICS							
V_{IH}	Enable Input Voltage High			2.0			V
V_{IL}	Enable Input Voltage Low					0.8	V
V_{CL}	Enable Input Clamp Voltage	I_{CL} = −18 mA				−1.5	V
I_{IN}	Line Input Current (Note 8)	Other Input = 0V, DE/$\overline{RE}$ = 0.8V, DE4 = 0.8V	V_I = +12V		0.5	1.0	mA
			V_I = −7V		−0.45	−0.8	mA
I_{ING}	Line Input Current (Note 8)	Other Input = 0V, DE/$\overline{RE}$ and DE4 = 2V, V_{CC} = 3.0V, T_A = +25°C	V_I = +12V			1.0	mA
			V_I = −7V			−0.8	mA
I_{IH}	Enable Input Current High	V_{IN} = 2.4V, DE/$\overline{RE}$	V_{CC} = 3.0V		1	40	μA
			V_{CC} = 4.75V		1		μA
			V_{CC} = 5.25V		1	40	μA
		V_{IN} = 2.4V, DE4 or $\overline{RE4}$	V_{CC} = 3.0V		1	20	μA
			V_{CC} = 5.25V		1	20	μA
I_{IL}	Enable Input Current Low	V_{IN} = 0.8V, DE/$\overline{RE}$	V_{CC} = 3.0V		−6	−40	μA
			V_{CC} = 4.75V		−12		μA
			V_{CC} = 5.25V		−14	−40	μA
		V_{IN} = 0.8V, DE4 or $\overline{RE4}$	V_{CC} = 3.0V		−3	−20	μA
			V_{CC} = 5.25V		−7	−20	μA
I_{CCD}	Supply Current (Note 10)	No Load, DE/$\overline{RE}$ and DE4 = 2.0V			75	90	mA
I_{CCR}	Supply Current (Note 10)	No Load, DE/$\overline{RE}$ and $\overline{RE4}$ = 0.8V			50	70	mA

Switching Characteristics

Over Supply Voltage and Operating Temperature ranges, unless otherwise specified.

Symbol	Parameter	Conditions		Min	Typ	Max	Units
DRIVER SINGLE-ENDED CHARACTERISTICS							
t_{PZH}	Output Enable Time to High Level	R_L = 110Ω	*(Figure 5)*		35	40	ns
t_{PZL}	Output Enable Time to Low Level		*(Figure 6)*		25	40	ns
t_{PHZ}	Output Disable Time to High Level		*(Figure 5)*		15	25	ns
t_{PLZ}	Output Disable Time to Low Level		*(Figure 6)*		35	40	ns
DRIVER DIFFERENTIAL CHARACTERISTICS							
t_r, t_f	Rise and Fall Time	R_L = 54Ω C_L = 50 pF C_D = 15 pF *(Figures 3, 4,* and *9)*			13	16	ns
t_{PLHD}	Differential Propagation Delays (Note 15)			9	15	19	ns
t_{PHLD}				9	12	19	ns
t_{SKD}	$\lvert t_{PLHD} - t_{PHLD} \rvert$ Diff. Skew				3	6	ns
RECEIVER CHARACTERISTICS							
t_{PLHD}	Differential Propagation Delays	C_L = 15 pF V_{CM} = 2.0V *(Figure 7)*		9	14	19	ns
t_{PHLD}				9	13	19	ns
t_{SKD}	$\lvert t_{PLHD} - t_{PHLD} \rvert$ Diff. Receiver Skew				1	3	ns
t_{PZH}	Output Enable Time to High Level	C_L = 15 pF *(Figure 8)*			15	22	ns
t_{PZL}	Output Enable Time to Low Level				20	30	ns
t_{PHZ}	Output Disable Time from High Level				20	30	ns
t_{PLZ}	Output Disable Time from Low Level				17	25	ns

Note 1: "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 tables of "Electrical Characteristics" specify conditions for device operation.

Note 2: Current into device pins is defined as positive. Current out of device pins is defined as negative. All voltages are referenced to ground unless otherwise specified.

Note 3: I_{IH} and I_{IL} include driver input current and receiver TRI-STATE leakage current on DR(1–3).

Note 4: Δ IVODI and Δ IVOCI are changes in magnitude of V_{OD} and V_{OC}, respectively, that occur when the input changes state.

Note 5: In EIA Standards EIA-422 and EIA-485, V_{OC}, which is the average of the two output voltages with respect to ground, is called output offset voltage, V_{OS}.

Note 6: Threshold parameter limits specified as an algebraic value rather than by magnitude.

Note 7: Hysteresis defined as $V_{HST} = V_{TH} - V_{TL}$.

Note 8: I_{IN} includes the receiver input current and driver TRI-STATE leakage current.

Note 9: Short one output at a time.

Note 10: Total package supply current.

Note 11: All typicals are given for V_{CC} = 5.0V and T_A = +25°C.

Parameter Measurement Information

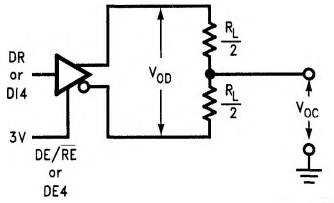

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FIGURE 1. Driver V_{OD} and V_{OC} (Note 13)

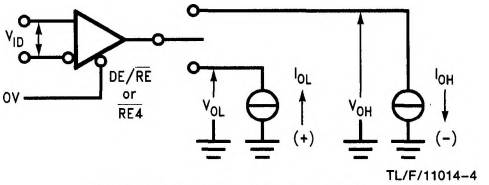

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FIGURE 2. Receiver V_{OH} and V_{OL}

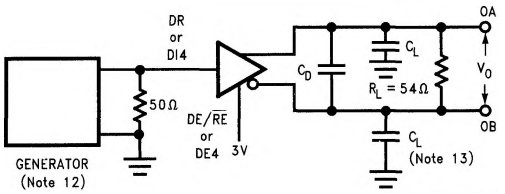

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FIGURE 3. Driver Differential Propagation Delay Load Circuit

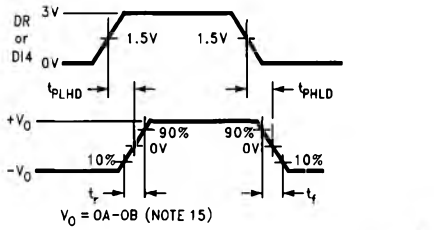

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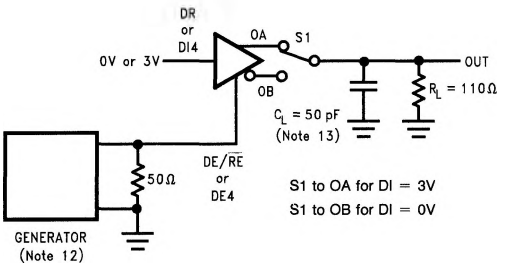
FIGURE 4. Driver Differential Propagation Delays and Transition Times



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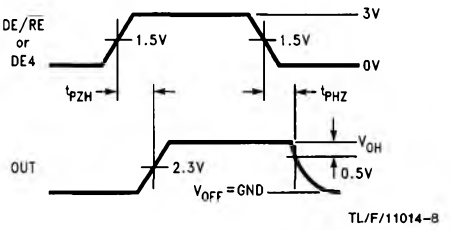

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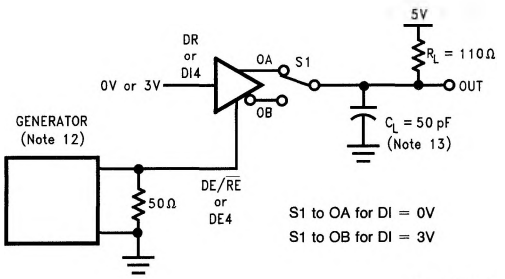
FIGURE 5. Driver Enable and Disable Timing (t_{PZH}, t_{PHZ})



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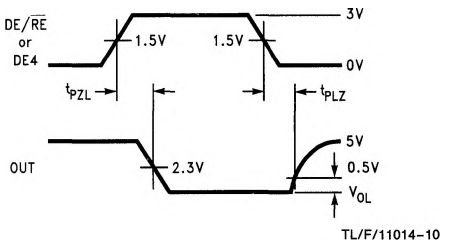

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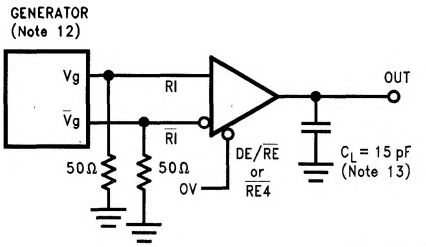
FIGURE 6. Driver Enable and Disable Timing (t_{PZL}, t_{PLZ})

Parameter Measurement Information (Continued)



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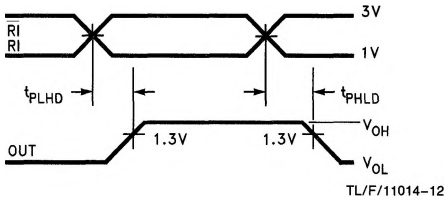

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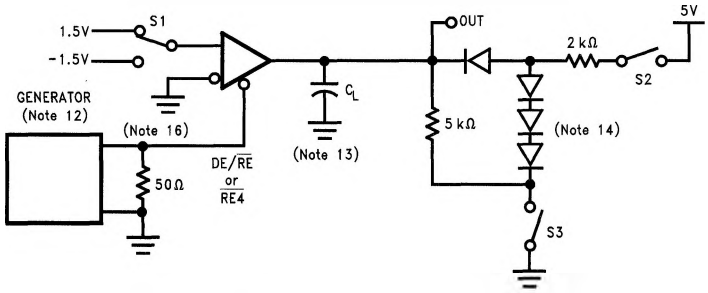
FIGURE 7. Receiver Differential Propagation Delay Timing



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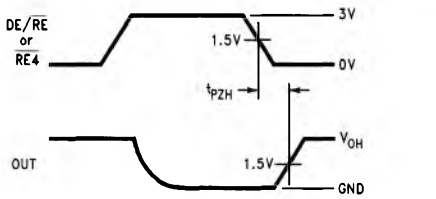

S1 1.5V
S2 Open
S3 Closed

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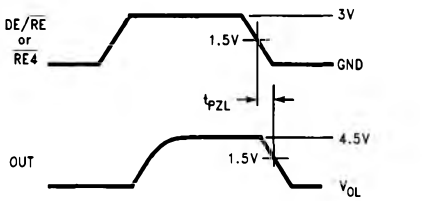

S1 −1.5V
S2 Closed
C3 Open

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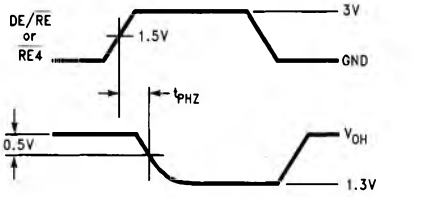

S1 1.5V
S2 Closed
C3 Closed

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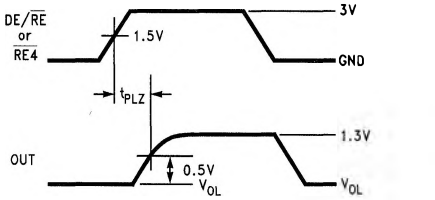

S1 −1.5V
S2 Closed
C3 Closed

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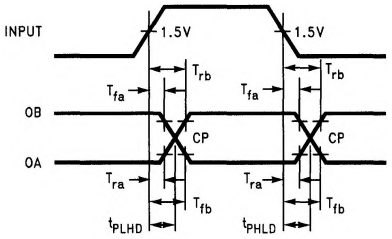
FIGURE 8. Receiver Enable and Disable Timing

Parameter Measurement Information (Continued)



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$$T_{CP} = \frac{(T_{fb} \times T_{rb}) - (T_{ra} \times T_{fa})}{T_{rb} - T_{ra} - T_{fa} + T_{fb}}$$

T_{ra}, T_{rb}, T_{fa} and T_{fb} are propagation delay measurements to the 20% and 80% levels.

T_{CP} = Crossing Point

FIGURE 9. Propagation Delay Timing for Calculations of Driver Differential Propagation Delays

Note 12: The input pulse is supplied by a generator having the following characteristics: f = 1.0 MHz, 50% duty cycle, t_r and t_f < 6.0 ns, Z_O = 50Ω.

Note 13: C_L includes probe and stray capacitance.

Note 14: Diodes are 1N916 or equivalent.

Note 15: Differential propagation delays are calculated from single-ended propagation delays measured from driver input to the 20% and 80% levels on the driver outputs *(Figure 9)*.

Note 16: On transceivers 1–3 the driver is loaded with receiver input conditions when DE/$\overline{RE}$ is high. Do not exceed the package power dissipation limit when testing.