DS16F95, DS36F95 EIA-485/EIA-422A Differential Bus Transceiver

Check for Samples: DS16F95, DS36F95

FEATURES

- **Meets EIA-485 and EIA-422A**
- **Meets SCSI-1 (5 MHZ) Specifications**
- **Designed for Multipoint Transmission**
- **Wide Positive and Negative Input/Output Bus Voltage Ranges**
- **Thermal Shutdown Protection**
- **Driver Positive and Negative Current-Limiting**
- **High Impedance Receiver Input**
- **Receiver Input Hysteresis of 50 mV Typical**
- **Operates from Single 5.0V Supply**
- **Reduced Power Consumption**
- **Pin Compatible with DS3695 and SN75176A**
- **Military Temperature Range Available**
- **Qualified for MIL-STD 883C**
- **Standard Military Drawings (SMD) Available**
- **Available in 8-Pin CDIP (NAB0008A) or SOIC (D) Package**

DESCRIPTION

The DS16F95/DS36F95 Differential Bus Transceiver is a monolithic integrated circuit designed for bidirectional data communication on balanced multipoint bus transmission lines. The transceiver meets both EIA-485 and EIA-422A standards.

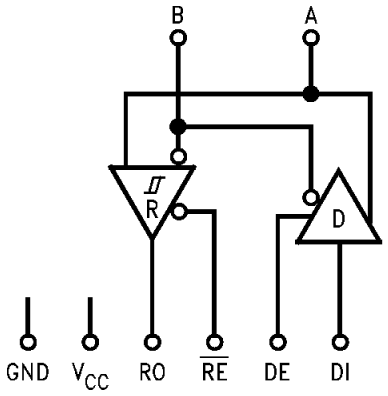
The DS16F95/DS36F95 offers improved performance due to the use of L-FAST bipolar technology. The L-FAST technology allows for higher speeds and lower currents by minimizing gate delay times. Thus, the DS16F95 and DS36F95 consume less power, and feature an extended temperature range as well as improved specifications.

The DS16F95/DS36F95 combines a Tri-state differential line driver and a differential input line receiver, both of which operate from a single 5.0V power supply. The driver and receiver have an active Enable that can be externally connected to function as a direction control. The driver differential outputs and the receiver differential inputs are internally connected to form differential input/output (I/O) bus ports that are designed to offer minimum loading to the bus whenever the driver is disabled or when V_{CC} = 0V. These ports feature wide positive and negative common mode voltage ranges, making the device suitable for multipoint applications in noisy environments.

The driver is designed to accommodate loads of up to 60 mA of sink or source current and features positive and negative current limiting in addition to thermal shutdown for protection from line fault conditions.

The DS16F95/DS36F95 can be used in transmission line applications employing the DS96F172 and the DS96F174 quad differential line drivers and the DS96F173 and DS96F175 quad differential line receivers.

Logic Diagram



Function Tables

Table 1. Driver(1)

Driver Input	Enable	Outputs	
DI	**DE**	**A**	**B**
H	H	H	L
L	H	L	H
X	L	Z	Z

(1) H = High Level
L = Low Level
X = Immaterial
Z = High Impedance (Off)

Table 2. Receiver(1)

Differential Inputs	Enable	Output
A–B	**$\overline{RE}$**	**RO**
$V_{ID} \geq 0.2V$	L	H
$V_{ID} \leq -0.2V$	L	L
X	H	Z

(1) H = High Level
L = Low Level
X = Immaterial
Z = High Impedance (Off)

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.

Absolute Maximum Ratings(1)(2)

Storage Temperature Range		−65°C to +175°C
Lead Temperature (Soldering, 60 sec.)		300°C
Maximum Package Power Dissipation(3) at 25°C	CDIP Package	1300 mW
	SOIC Package	735 mW
Supply Voltage		7.0V
Input Voltage (Bus Terminal)		+15V/−10V
Enable Input Voltage		5.5V

(1) Absolute Maximum Ratings are those values beyond which the safety of the device cannot be ensured. They are not meant to imply that the devices should be operated at these limits. The tables of Electrical Characteristics provide conditions for actual device operation.
(2) Specifications for the 883 version of this product are listed separately on the following pages.
(3) Derate CDIP package 8.7 mW/°C above 25°C.Derate SOIC package 5.88 mW/°C above 25°C.

Recommended Operating Conditions

		Min	Typ	Max	Units
Supply Voltage (V_{CC})	DS36F95	4.75	5.0	5.25	V
	DS16F95	4.50	5.0	5.50	V
Voltage at Any Bus Terminal (Separately or Common Mode) (V_I or V_{CM})		−7.0		+12	V
Differential Input Voltage (V_{ID})				±12	V
Output Current HIGH (I_{OH})	Driver			−60	mA
	Receiver			−400	µA
Output Current LOW (I_{OL})	Driver			60	mA
	Receiver			16	mA
Operating Temperature (T_A)	DS36F95	0	+25	+70	°C
	DS16F95	−55	+25	+125	°C

Driver Electrical Characteristics[1][2]

Over recommended supply voltage and operating temperature ranges, unless otherwise specified

Symbol	Parameter	Conditions		Min	Typ	Max	Units
V_{IH}	Input Voltage HIGH			2.0			V
V_{IL}	Input Voltage LOW					0.8	V
V_{OH}	Output Voltage HIGH	I_{OH} = −55 mA	0°C to +70°C	3.0			V
V_{OL}	Output Voltage LOW	I_{OL} = 55 mA	0°C to +70°C			2.0	V
V_{IC}	Input Clamp Voltage	I_I = −18 mA				−1.3	V
$\|V_{OD1}\|$	Differential Output Voltage	I_O = 0 mA				6.0	V
$\|V_{OD2}\|$	Differential Output Voltage	R_L = 100Ω, See Figure 1		2.0	2.25		V
		R_L = 54Ω,See Figure 1		1.5	2.0		
$\Delta\|V_{OD}\|$	Change in Magnitude of Differential Output Voltage[3]	R_L = 54Ω or 100Ω, See Figure 1	−40°C to +125°C			±0.2	V
			−55°C to +125°C			±0.4	
V_{OC}	Common Mode Output Voltage[4]					3.0	V
$\Delta\|V_{OC}\|$	Change in Magnitude of Common Mode Output Voltage[3]					±0.2	V
I_O	Output Current[5] (Includes Receiver I_I)	Output Disabled	V_O = +12V			1.0	mA
			V_O = −7.0V			−0.8	
I_{IH}	Input Current HIGH	V_I = 2.4V				20	µA
I_{IL}	Input Current LOW	V_I = 0.4V				−50	µA
I_{OS}	Short Circuit Output Current [6]	V_O = −7.0V				−250	
		V_O = 0V				−150	mA
		V_O = V_{CC}				150	
		V_O = +12V				250	
I_{CC}	Supply Current (Total Package)	No Load, All Inputs Open	DE = 2V, $\overline{RE}$ = 0.8V Outputs Enabled			28	mA
I_{CCX}			DE = 0.8V, $\overline{RE}$ = 2V Outputs Disabled			25	

(1) Unless otherwise specified min/max limits apply across the −55°C to +125°C temperature range for the DS16F95 and across the 0°C to +70°C range for the DS36F95. All typicals are given for V_{CC} = 5V and T_A = 25°C.
(2) All currents into the device pins are positive; all currents out of the device pins are negative. All voltages are referenced to ground unless otherwise specified.
(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) In TIA/EIA-422A and TIA/EIA-485 Standards, V_{OC}, which is the average of the two output voltages with respect to ground, is called output offset voltage, V_{OS}.
(5) Refer to TIA/EIA-485 Standard for exact conditions.
(6) Only one output at a time should be shorted.

Driver Switching Characteristics

V_{CC} = 5.0V, T_A = 25°C

Symbol	Parameter	Conditions	Min	Typ	Max	Units
t_{DD}	Differential Output Delay Time	R_L = 60Ω, See Figure 2	8.0	15	20	ns
t_{TD}	Differential Output Transition Time		8.0	15	22	ns
t_{PLH}	Propagation Delay Time, Low-to-High Level Output	R_L = 27Ω, See Figure 4	6.0	12	16	ns
t_{PHL}	Propagation Delay Time, High-to-Low Level Output		6.0	12	16	ns
t_{ZH}	Output Enable Time to High Level	R_L = 110Ω, See Figure 5		25	32	ns
t_{ZL}	Output Enable Time to Low Level	R_L = 110Ω, See Figure 6		25	32	ns
t_{HZ}	Output Disable Time from High Level	R_L = 110Ω, See Figure 5		20	25	ns
t_{LZ}	Output Disable Time from Low Level	R_L = 110Ω, See Figure 6		20	25	ns
t_{LZL}	Output Disable Time from Low Level with Load Resistor to GND	Load per Figure 5 Timing per Figure 6		300		ns
t_{SKEW}	Skew (Pulse Width Distortion)	R_L = 60Ω, See Figure 2		1.0	4.0	ns

Receiver Electrical Characteristics

Over recommended supply voltage and operating temperature ranges, unless otherwise specified

Symbol	Parameter	Conditions		Min	Typ	Max	Units
V_{TH}	Differential Input High Threshold Voltage	V_O = 2.7V, I_O = −0.4 mA				0.2	V
V_{TL}	Differential Input Low Threshold Voltage See (1)	V_O = 0.5V, I_O = 8.0 mA		−0.2			V
$V_{T+}-V_{T-}$	Hysteresis See (2)	V_{CM} = 0V		35	50		mV
V_{IH}	Enable Input Voltage HIGH			2.0			V
V_{IL}	Enable Input Voltage LOW					0.8	V
V_{IC}	Enable Input Clamp Voltage	I_I = −18 mA				−1.3	V
V_{OH}	Output Voltage HIGH	V_{ID} = 200 mV,	0°C to +70°C	2.8			V
		I_{OH} = −400 µA, See Figure 2	−55°C to +125°C	2.5			
V_{OL}	Output Voltage LOW	V_{ID} = −200 mV, See Figure 2	I_{OL} = 8.0 mA			0.45	V
			I_{OL} = 16 mA			0.50	
I_{OZ}	High Impedance State Output	V_O = 0.4V to 2.4V				±20	µA
I_I	Line Input Current See (3)	Other Input = 0V	V_I = +12V			1.0	mA
			V_I = −7.0V			0.8	
I_{IH}	Enable Input Current HIGH	V_{IH} = 2.7V				20	µA
I_{IL}	Enable Input Current LOW	V_{IL} = 0.4V				−50	µA
R_I	Input Resistance			14	18	22	kΩ
I_{OS}	Short Circuit Output Current	See (3)		−15		−85	mA
I_{CC}	Supply Current (Total Package)	No Load, All Inputs Open	DE = 2V, $\overline{RE}$ = 0.8V Outputs Enabled			28	mA
I_{CCX}			DE = 0.8V, $\overline{RE}$ = 2V Outputs Disabled			25	

(1) 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.
(2) Hysteresis is the difference between the positive-going input threshold voltage, V_T+, and the negative-going input threshold voltage, V_T-.
(3) Refer to TIA/EIA-485 Standard for exact conditions.

Receiver Switching Characteristics

V_{CC} = 5.0V, T_A = 25°C

Symbol	Parameter	Conditions	Min	Typ	Max	Units
t_{PLH}	Propagation Delay Time, Low-to-High Level Output	V_{ID} = 0V to +3.0VC_L = 15 pF, See Figure 7	14	19	24	ns
t_{PHL}	Propagation Delay Time, High-to-Low Level Output		14	19	24	ns
t_{ZH}	Output Enable Time to High Level	C_L = 15 pF, See Figure 8		10	16	ns
t_{ZL}	Output Enable Time to Low Level			12	18	ns
t_{HZ}	Output Disable Time from High Level	C_L = 5.0 pF, See Figure 8		12	20	ns
t_{LZ}	Output Disable Time from Low Level			12	18	ns
$\lvert t_{PLH} - t_{PHL} \rvert$	Pulse Width Distortion (SKEW)	See Figure 7		1.0	4.0	ns

Parameter Measurement Information

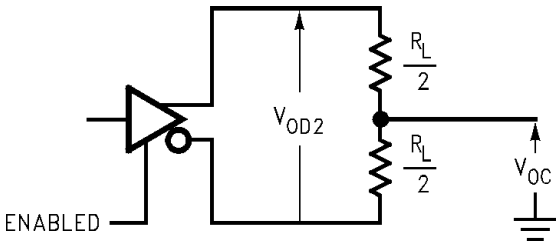


Figure 1. Driver V_{OD} and V_{OC} (1)

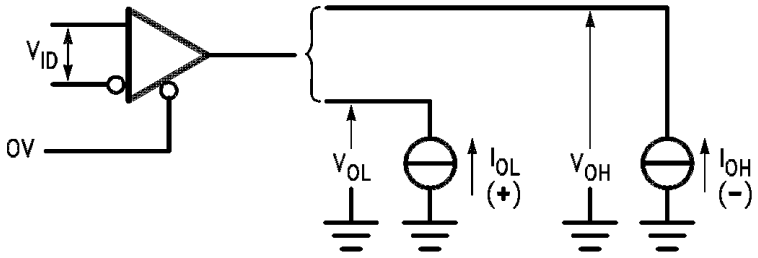
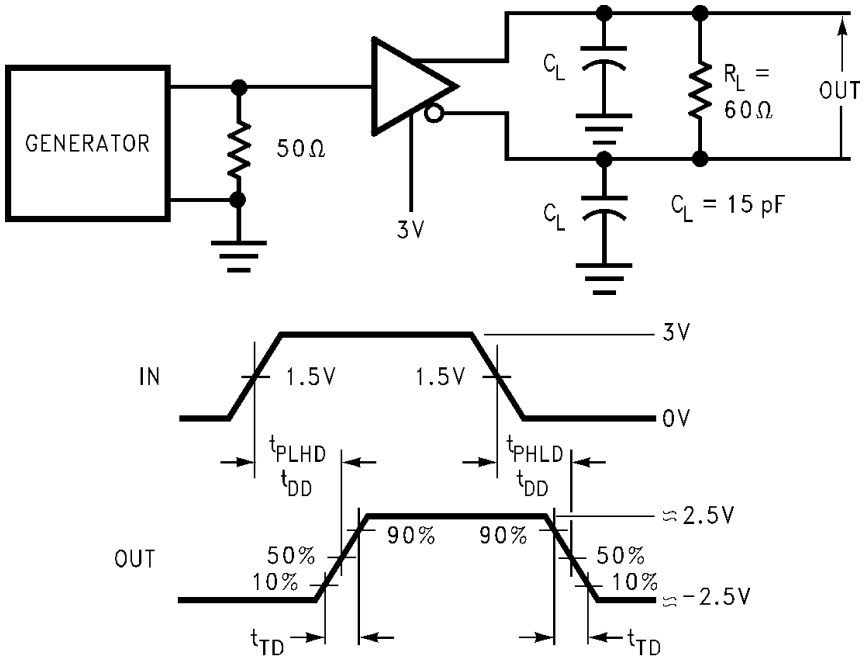


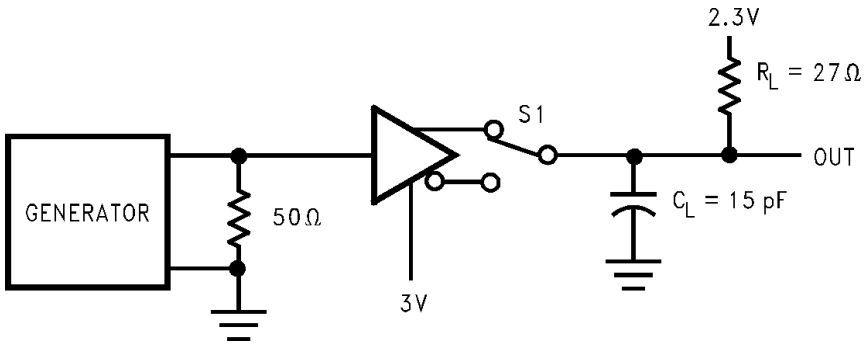
Figure 2. Receiver V_{OH} and V_{OL}

(1) All diodes are 1N916 or equivalent.



$t_{SKEW} = |t_{PLHD} - t_{PHLD}|$

Figure 3. Driver Differential Output Delay and Transition Times(2)(3)



(2) The input pulse is supplied by a generator having the following characteristics: PRR = 1.0 MHz, 50% duty cycle, tr ≤ 6.0 ns, tf ≤ 6.0 ns, ZO = 50Ω.

(3) DS16F95/DS36F95 Driver enable is Active-High

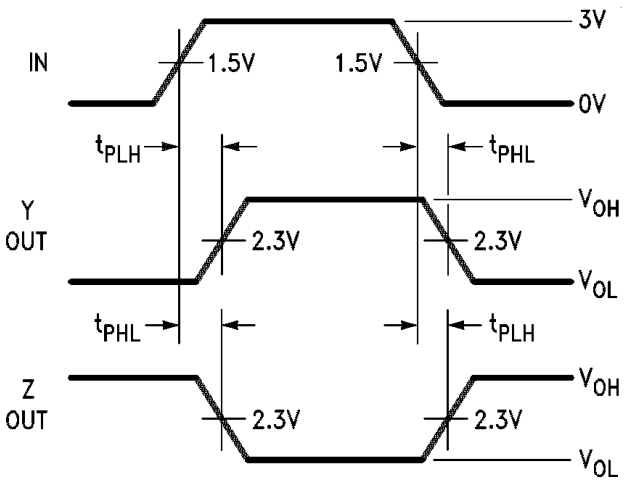


Figure 4. Driver Propagation Times[2][4]

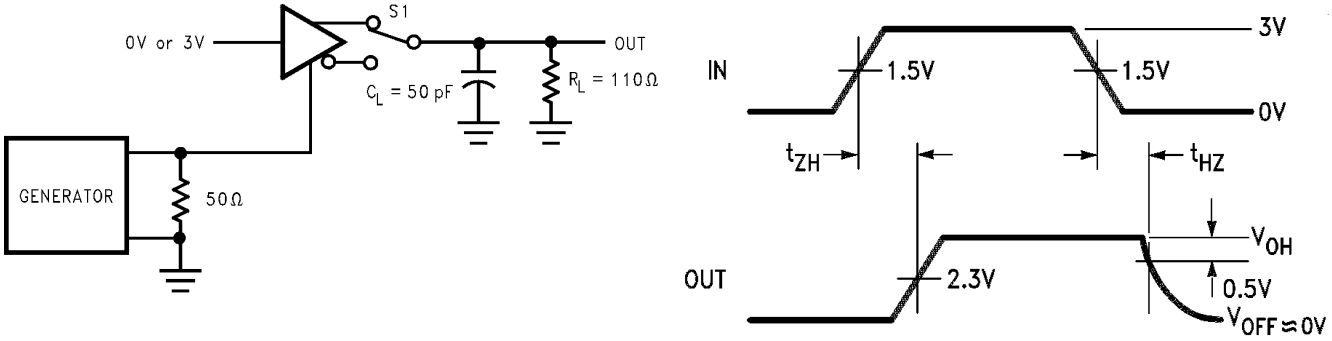


Figure 5. Driver Enable and Disable Times (t_{ZH}, t_{HZ})[2][4][3]

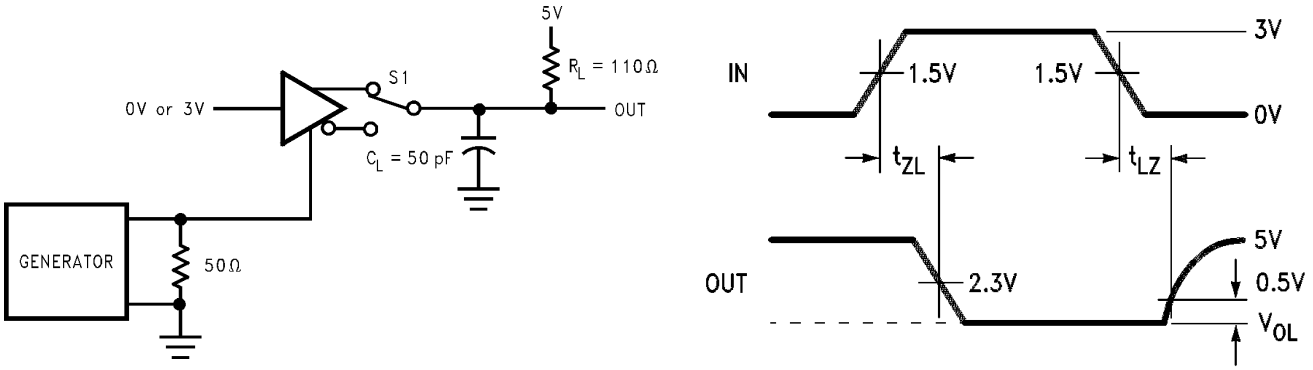


Figure 6. Driver Enable and Disable Times (t_{ZL}, t_{LZ}, t_{LZL}) [5][6][7]

(4) CL includes probe and stray capacitance
(5) The input pulse is supplied by a generator having the following characteristics: PRR = 1.0 MHz, 50% duty cycle, tr ≤ 6.0 ns, tf ≤ 6.0 ns, ZO = 50Ω.
(6) CL includes probe and stray capacitance
(7) DS16F95/DS36F95 Driver enable is Active-High

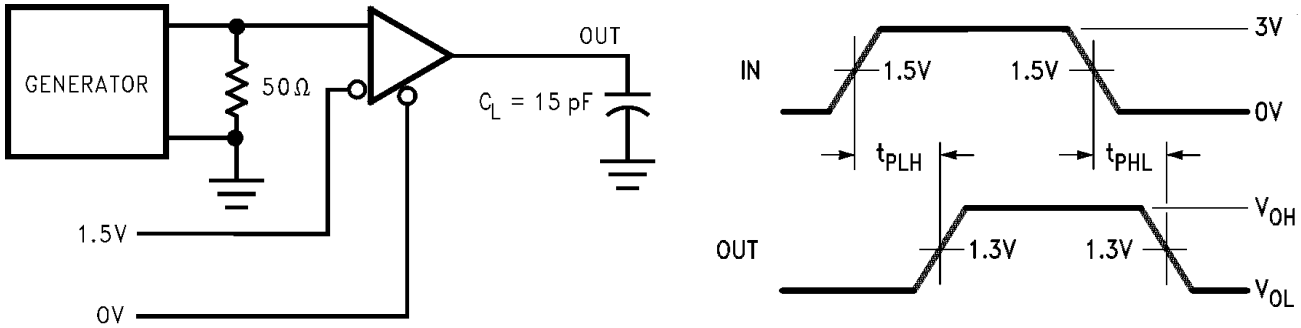


Figure 7. Receiver Propagation Delay Times(5)(6)

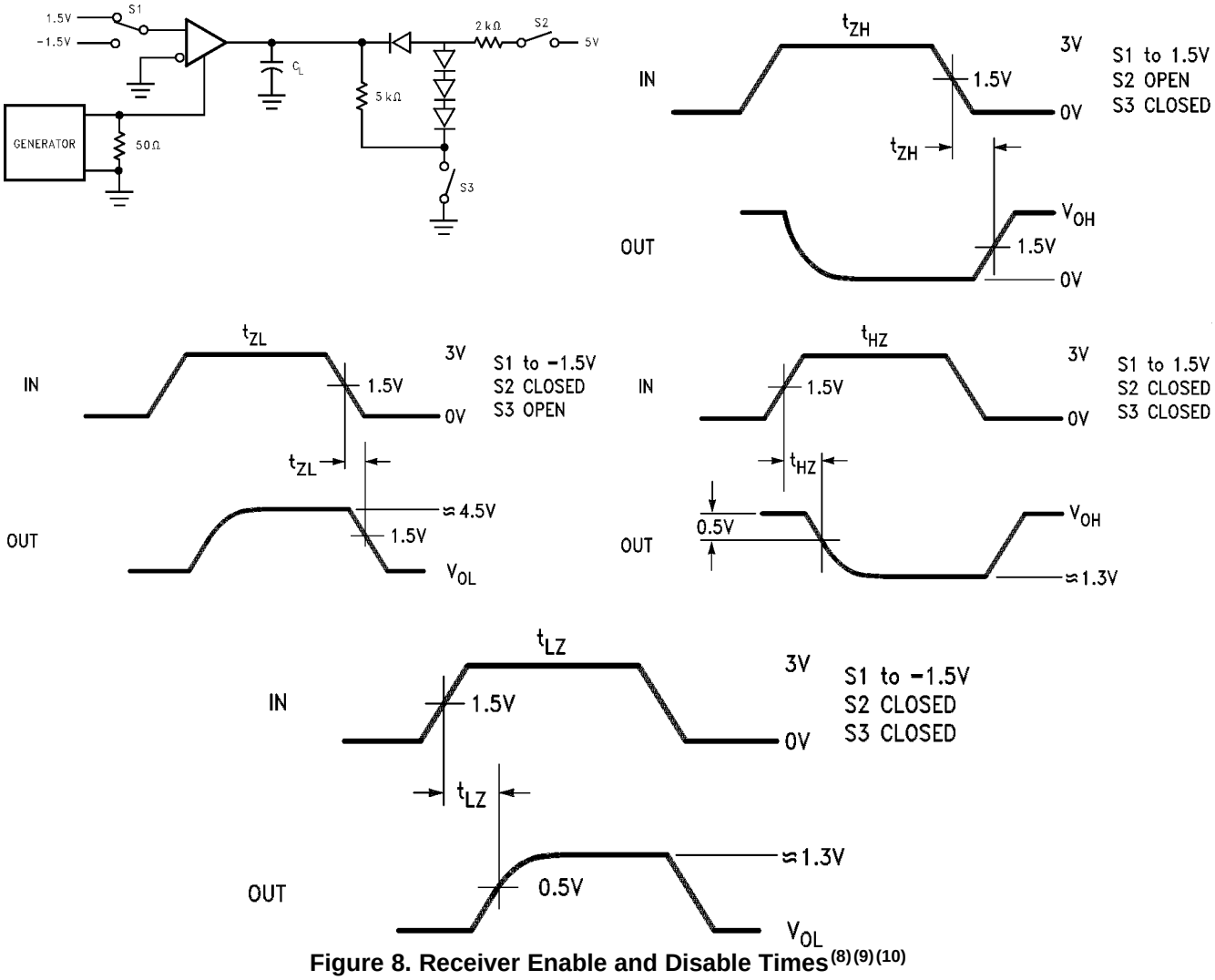
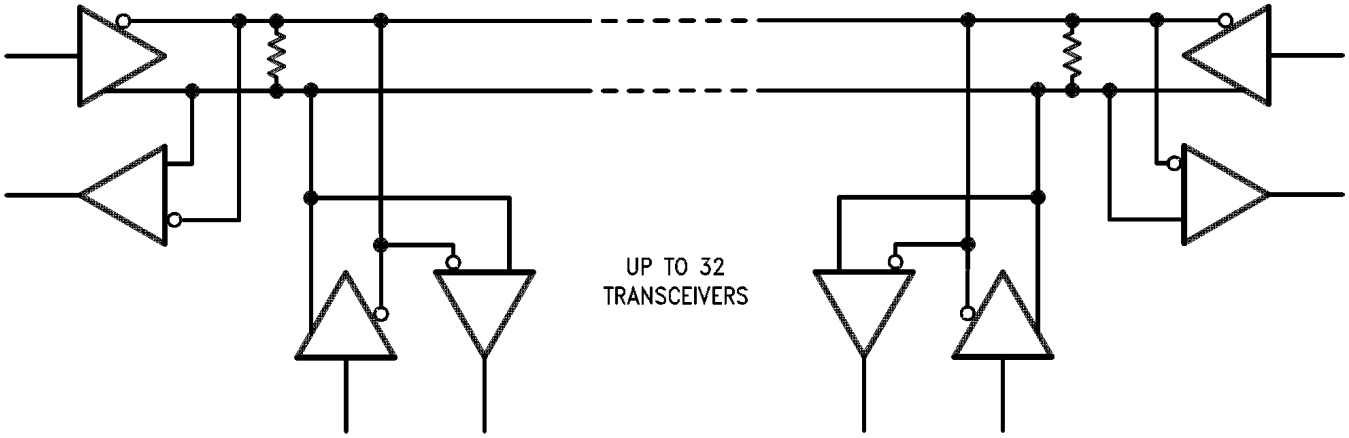


Figure 8. Receiver Enable and Disable Times(8)(9)(10)

(8) The input pulse is supplied by a generator having the following characteristics: PRR = 1.0 MHz, 50% duty cycle, tr ≤ 6.0 ns, tf ≤ 6.0 ns, ZO = 50Ω.
(9) CL includes probe and stray capacitance
(10) All diodes are 1N916 or equivalent.

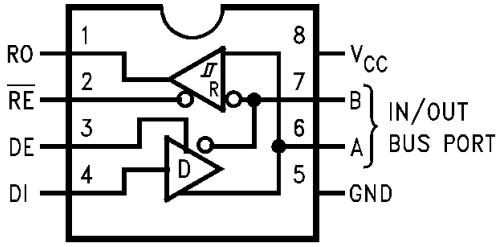
Typical Application



NOTE

The line should be terminated at both ends in its characteristic impedance, typically 120Ω. Stub lengths off the main line should be kept as short as possible.

Connection Diagram



8-Lead Dual-In-Line Package or Small Outline Molded Package
See Package Number J08A, or M08

REVISION HISTORY

Changes from Revision C (April 2013) to Revision D	Page
• Changed layout of National Data Sheet to TI format	12

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead finish/ Ball material (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
DS16F95 MDA	ACTIVE	DIESALE	Y	0	221	RoHS & Green	Call TI	Level-1-NA-UNLIM	-40 to 85		Samples

(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) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".
RoHS Exempt: TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.
Green: TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

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

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

(6) Lead finish/Ball material - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

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