WuXi Silicon Technology Co., Ltd

WS3085

ESD Enhanced, Fail-Safe, Slew-Rate-limited RS-485/RS-422 Transceivers

WST

2015.07.20

General Description

The WS3085 5V, half-duplex, ±20kV ESD-protected RS-485/RS-422 compatible transceivers feature one driver and one receiver.

The WS3085 features enhanced slew-rate drivers that minimize EMI and reduce reflections caused by improperly terminated cables, allowing error-free transmission up to 500kbps.

The WS3085 feature a 1/8-unit load receiver input impedance, allowing up to 256 transceivers on the bus. These devices are intended for half-duplex communications. All driver outputs are protected to ±20kV ESD using the Human Body Model and ±15kV ESD using the IEC 61000-4-2 Contact Discharge Method.

TheWS3085 is available in an 8-pin SO package. The devices operate over the extended -40℃ to +125℃ temperature range.

Features

- 5V Operation
- Hot-Swappable for Telecom Applications
- Enhanced Slew-Rate Limiting Facilitates Error-Free Data Transmission
- Extended ESD Protection for RS-485 I/O Pins ±20kV HBM
- 1/8Unit Load , Allowing Up to 256Transceivers on the Bus
- 8 Pin-SO Package

Applications

- Isolated RS-485 Interfaces
- Utility Meters
- Industrial Controls
- Industrial Motor Drives
- Automated HVAC Systems

ABSOLUTE MAXIMUM RATINGS
(All voltages referenced to GND.)

Supply Voltage VCC.....+6V

DE, RE-, DI.....-0.3V to +6V

A, B..... -8V to +13V

Short-Circuit Duration (RO, A, B) to GND .....Continuous

Continuous Power Dissipation (TA = +70°C)

8-Pin SO (derate 5.9mW/°C above +70°C).....471mW

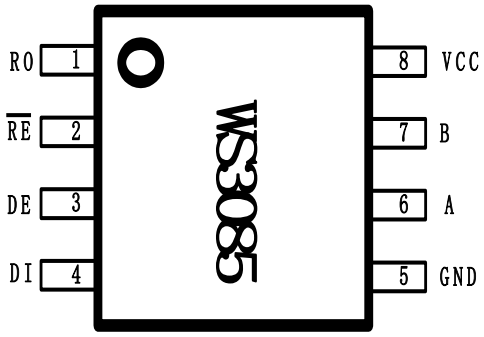
Operating Temperature Range .....-40°C to +125°C

Junction Temperature.....+150°C

Storage Temperature Range .....-65°C to +150°C

Lead Temperature (soldering 10s) .....+300°C

Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.



Package： SOIC8

PACKAGE INFORMATON

DC ELECTRICAL CHARACTERICS

(VCC = +5V ±5%, TA = TMIN to TMAX, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
DRIVER						
Differential Driver Output (no load)	V_{OD1}	Figure1		5		V
Differential Driver Output	V_{OD2}	Figure1,R = 50Ω (RS-422)	2			V
		Figure1,R = 27Ω (RS-485)	1.5			
Change in Magnitude of Differential Output Voltage (Note 2)	ΔV_{OD}	Figure1,R =50Ωor R= 27Ω			0.2	V
Driver Common-Mode Output Voltage	V_{OC}	Figure1,R=50Ωor R = 27Ω			2	V
Change In Magnitude of Common-Mode Voltage (Note 2)	ΔV_{OC}	Figure1,R=50Ωor R = 27Ω			0.2	V
Input High Voltage	V_{IH1}	DE , DI ,RE- ,	2.0			V
Input Low Voltage	V_{IL1}	DE, DI, RE-,			0.8	V
DI Input Hysteresis	V_{HYS}	WS3085		100		mV
Input Current	I_{IN1}	DE, DI, RE-,			±2	μA
Input Current (A and B)	I_{IN4}	DE = GND, VCC=5V, V_{IN}=12V			125	μA
		DE = GND, VCC=5V, V_{IN} = -7V	-75			
Driver Short-Circuit Output Current (Note 3)	I_{OD1}	-7V ≤ V_{OUT} ≤ V_{CC}	-250			mA
		0V ≤ V_{OUT} ≤ 12V			250	mA
		0V ≤ V_{OUT} ≤ V_{CC}	±25			mA
RECEIVER						
Receiver Differential Threshold Voltage	V_{TH}	-7V ≤ V_{CM} ≤ +12V	-200		-50	mV
Receiver Input Hysteresis	ΔV_{TH}			60		mV
Receiver Output High Voltage	V_{OH}	I_O = 4mA, V_{ID} = -200mV;	Vcc-1.5			V
Receiver Output Low Voltage	V_{OL}	I_O = -4mA, V_{ID} = -50mV			0.4	V
Three-State Output Current at Receiver	I_{OZR}	0.4V ≤ V_O ≤ 2.4V			±1	μA
Receiver Input Resistance	R_{IN}	-7V ≤ V_{CM} ≤ +12V	96			kΩ
Receiver Output Short-Circuit Current	I_{OSR}	0V ≤ V_{RO} ≤ V_{CC}	±7		±95	mA

SUPPLY CURRENT							
Supply Current	I_{CC}	No load, RE- =DI=GND or V_{CC}	DE = V_{CC}		450	900	μA
			DE = GND		450	600	
Supply Current in Shutdown Mode	I_{SHDN}	DE = GND, V_{RE-} = V_{CC}			1.8	10	μA
ESD Protection							
ESD Protection(A,B)		IEC 61000-4-2 Contact model		±15			KV
		Human Body Model		±20			
ESD Protection(all other pins)		Human Body Model		±4			KV

Note 1: All currents into the device are positive; all currents out of the device are negative. All voltages are referred to device ground unless otherwise noted.

Note 2: ΔVOD and ΔVOC are the changes in VOD and VOC, respectively, when the DI input changes state.

Note 3: Maximum current level applies to peak current just prior to fold-back-current limiting; minimum current level applies during current limiting.

SWITCHING CHARACTERISTICS

(VCC = +5V ±5%, TA = TMIN to TMAX, unless otherwise noted. Typical values are at TA = +25℃.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Driver Input to Output	t_{DPLH}	Figures3 and 5, R_{DIFF} = 54Ω, C_{L1} = C_{L2} = 100pF	250	720	1000	ns
	t_{DPHL}		250	720	1000	
Driver Output Skew | t_{DPLH} - t_{DPHL} |	t_{DSKEW}	Figures 3 and 5, R_{DIFF} = 54Ω, C_{L1} = C_{L2} = 100pF		-3	±100	ns
Driver Rise or Fall Time	t_{DR}, t_{DF}	Figures 3 and 5, R_{DIFF} = 54Ω, C_{L1} = C_{L2} = 100pF	400	700	1200	ns
Maximum Data Rate	f_{MAX}			500		kbps
Driver Enable to Output High	t_{DZH}	Figures4 and 6, C_L = 100pF, S2 closed			2500	ns
Driver Enable to Output Low	t_{DZL}	Figures4 and 6,C_L= 100pF, S1 closed			2500	ns
Driver Disable Time from Low	t_{DLZ}	Figures 4 and 6, C_L = 15pF, S1 closed			500	ns
Driver Disable Time from High	t_{DHZ}	Figures 4 and 6, C_L = 15pF, S2 closed			500	ns
Receiver Input to Output	t_{RPLH}, t_{RPHL}	Figures 7 and 9; | V_{ID} | ≥ 2.0V;rise and fall time of V_{ID} ≤ 15ns		127	250	ns
| t_{RPLH} - t_{RPHL} | Differential Receiver Skew	t_{RSKD}	Figures 7 and 9; | V_{ID} | ≥ 2.0V;rise and fall time of V_{ID} ≤ 15ns		10	±50	ns
Receiver Enable to Output Low	t_{RZL}	Figures 2 and 8, C_L = 100pF, S1 closed		20	120	ns
Receiver Enable to Output High	t_{RZH}	Figures 2 and 8, C_L = 100pF, S2 closed		20	120	ns
Receiver Disable Time from Low	t_{RLZ}	Figures 2 and 8 , C_L = 100pF, S1 closed		20	120	ns
Receiver Disable Time from High	t_{RHZ}	Figures 2 and 8, C_L = 100pF, S2 closed		20	120	ns
Time to Shutdown	t_{SHDN}	(Note 4)	50	200	600	ns
Driver Enable from Shutdown to Output High	$t_{DZH(SHDN)}$	Figures 4 and 6, C_L = 15pF, S2 closed			4500	ns

Driver Enable from Shutdown to Output Low	$t_{DZL(SHDN)}$	Figures 4 and 6, C_L = 15pF, S1 closed	4500	ns
Receiver Enable from Shutdown to Output High	$t_{RZH(SHDN)}$	Figures 2 and 8, C_L = 100pF, S2 closed	3500	ns
Receiver Enable from Shutdown to Output Low	$t_{RZL(SHDN)}$	Figures 2 and 8, C_L = 100pF, S1 closed	3500	ns

Note 4: The device is put into shutdown by bringing RE- high and DE low. If the enable inputs are in this state for less than 50ns, the device is guaranteed not to enter shutdown. If the enable inputs are in this state for at least 600ns, the device is guaranteed to have entered shutdown.

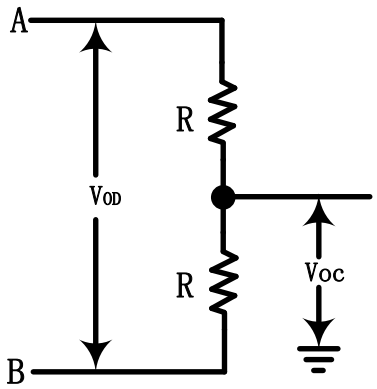


Figure 1 Driver DC Test Load

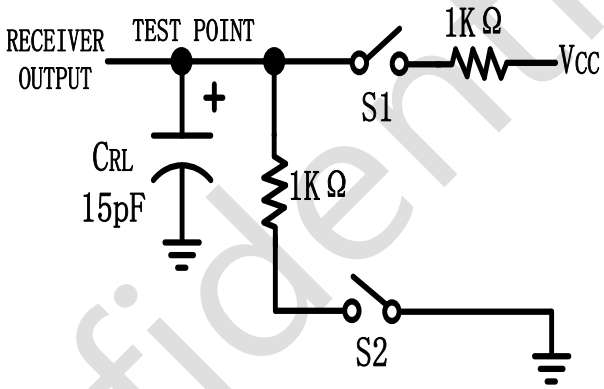


Figure 2 Receiver Enable/Disable Timing Test Load

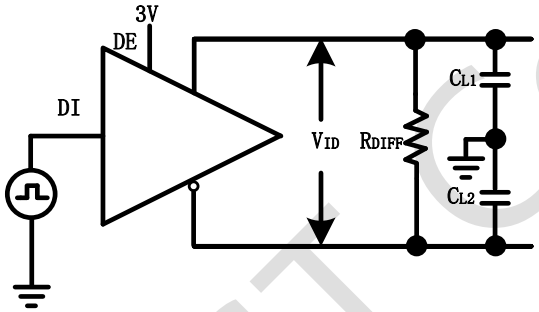


Figure 3 Driver Timing Test Circuit

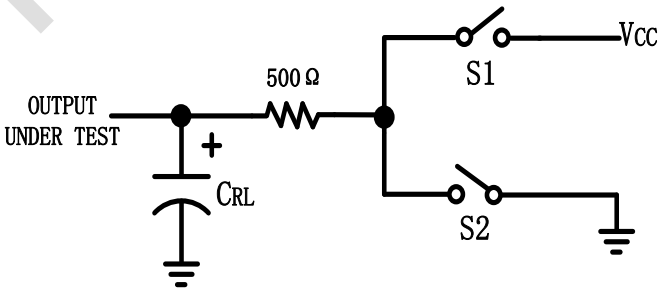


Figure 4 Driver Enable/Disable Timing Test Load

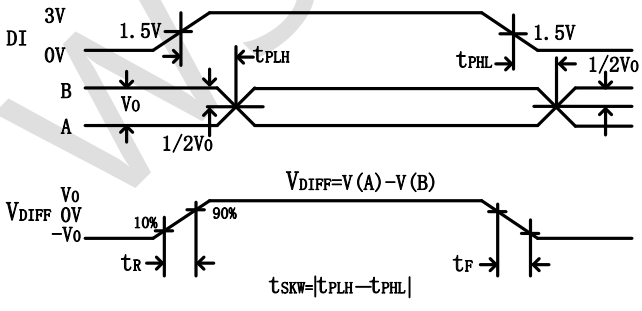


Figure 5 Driver Propagation Delays

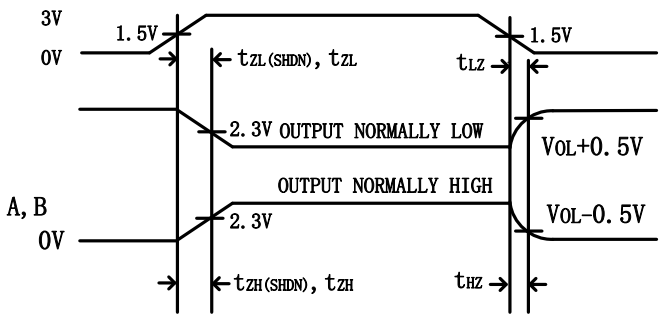


Figure 6 Driver Enable and Disable Times

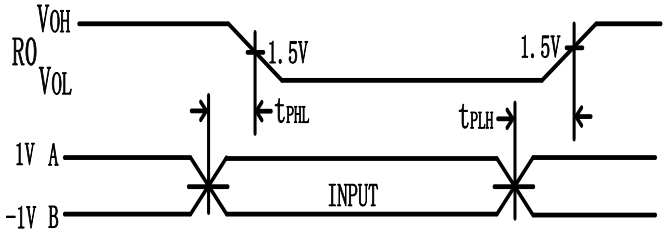


Figure 7 Receiver Propagation Delays

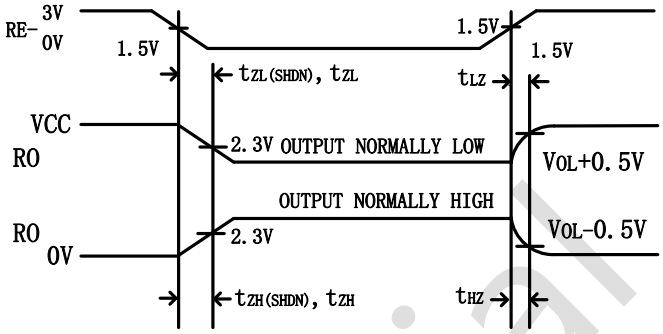


Figure 8 Receiver Enable and Disable Times

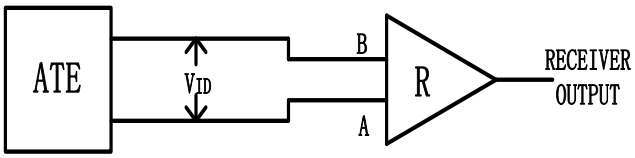


Figure 9 Receiver Propagation Delay Test Circuit

Pin Description

PIN	NAME	FUNCTION
1	RO	Receiver Output. When RE is low and if A - B ≥ -50mV, RO will be high; if A - B ≤ -200mV, RO will be low.
2	$\overline{RE}$	Receiver Output Enable. Drive $\overline{RE}$ low to enable RO; RO is high impedance when $\overline{RE}$ is high. Drive $\overline{RE}$ high and DE low to enter low-power shutdown mode.
3	DE	Driver Output Enable. Drive DE high to enable driver outputs. These outputs are high impedance when DE is low. Drive RE high and DE low to enter low-power shutdown mode.
4	DI	Driver Input. With DE high, a low on DI forces non-inverting output low and inverting output high. Similarly, a high on DI forces non-inverting output high and inverting output low.
5	GND	Ground
6	A	Non-inverting Receiver Input and Non-inverting Driver Output
7	B	Inverting Receiver Input and Inverting Driver Output
8	Vcc	Positive Supply, V_{CC} = +5V ±5%. Bypass V_{CC} to GND with a 0.1μF capacitor.

Function Table

TRANSMITTING				
INPUTS			OUTPUTS	
RE-	DE	DI	B/Z	A/Y
X	1	1	0	1
X	1	0	1	0
0	0	X	High-Z	High-Z
1	0	X	Shutdown	

RECEIVING			
INPUTS			OUTPUTS
RE-	DE	A-B	RO
0	X	≥ -0.05V	1
0	X	≤ -0.2V	0
0	X	Open/shorted	1
1	1	X	High-Z
1	0	X	Shutdown

Applications Information

256 Transceivers on the Bus

The standard RS-485 receiver input impedance is 12kΩ (one-unit load), and the standard driver can drive up to 32 unit loads. The WS3085 family of transceivers have a 1/8-unit-load receiver input impedance (96kΩ), allowing up to 256 transceivers to be connected in parallel on one communication line. Any combination of these devices and/or other RS-485 transceivers with a total of 32 unit loads or less can be connected to the line.

Low-Power Shutdown Mode

Low-power shutdown mode is initiated by bringing both RE- high and DE low. In shutdown, the devices typically draw only 1.8uA of supply current.

$\overline{RE}$ and DE may be driven simultaneously; the parts are guaranteed not to enter shutdown if $\overline{RE}$ is high and DE is low for less than 50ns. If the inputs are in this state for at least 600ns, the parts are guaranteed to enter shutdown.

Reduced EMI and Reflections

WS3085 is slew-rate limited, minimizing EMI and reducing reflections caused by improperly terminated cables.

Driver Output Protection

Two mechanisms prevent excessive output current and power dissipation caused by faults or by bus contention. The first, a fold-back current limit on the output stage, provides immediate protection against short circuits over the whole common-mode voltage range (see Typical Operating Characteristics). The second, a thermal shutdown circuit, forces the driver outputs into a high-impedance state if the die temperature becomes excessive.

Fail-Safe

The WS3085 guarantees a logic-high receiver output when the receiver inputs are shorted or open, or when they are connected to a terminated transmission line with all drivers disabled. This is done by setting the receiver threshold between -50mV and -200mV. If the differential receiver input voltage (A-B) is greater than or equal to -50mV, RO is logic high. If A-B is less than or equal to -200mV, RO is logic low. In the case of a terminated bus with all transmitters disabled, the receiver's differential input voltage is pulled to 0V by the termination. With the receiver thresholds of WS3085, this results in a logic high with a 50mV minimum noise margin. Unlike previous fail-safe devices, the -50mV to -200mV threshold complies with the ±200mV EIA/TIA-485 standard.

ESD Protection

As with all WST devices, ESD-protection structures are incorporated on all pins to protect against electrostatic discharges encountered during handing and assembly. The driver outputs and receiver inputs of WS3085 have extra protection against static electricity. WST's engineers have developed state-of-the-art structures to protect these pins against ESD of ±20kV HBM without damage. The ESD structures withstand high ESD in all states: normal operation shutdown, and powered down. After an ESD event the WS3085 keep working without latch-up or damage.

ESD protection can be tested in various ways. The transmitter outputs and receiver inputs of the WS3085 are characterized for protection to the following limits:

- ±20kV using the Human Body Model
- ±15kV using the Contact Discharge Method specified in IEC61000-4-2

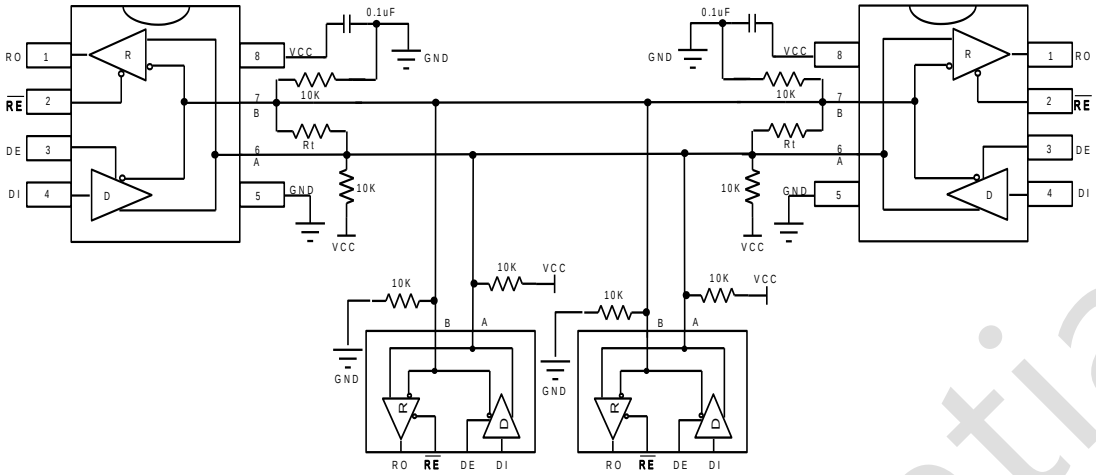


Figure 100 Typical Half-Duplex RS-485 Network