

High ESD-Protected, Fail-Safe, Slew-Rate-Limited RS-485 Transceivers

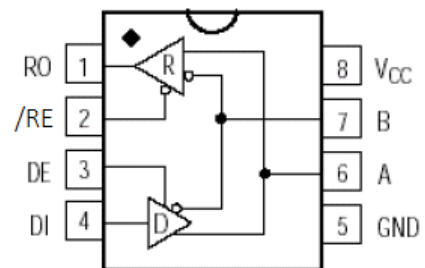
General Description

The BL3085A(H) is a half-duplex RS-485 transceiver with $\pm 15\text{kV}$ IEC 61000-4-2 contact ESD protection. This device contains one driver and one receiver. The BL3085A(H) includes fail-safe circuitry, which guarantees a logic-high receiver output when the receiver inputs are open or shorted. This means that the receiver output will be logic high even if all transmitters on a terminated bus are disabled. The BL3085A(H) features reduced slew-rate driver that minimizes EMI and reduces reflections caused by improperly terminated cables, allowing error-free data transmission up to 250kbps. The BL3085A(H) has a 1/8 unit load receiver input impedance that allows up to 256 transceivers on the bus.

Features

- +3.3V or +5V Operation
- True Fail-Safe Receiver
- Maximum Data Rate: 250kbps
- Allow Up to 256 Transceivers on the Bus
- I/O Pins ESD Protection:
 - $\pm 15\text{kV}$ IEC 61000-4-2, contact Discharge
- Available in SOP8 Package

Functional Block



Applications

- RS-485 Communications
- Level Translators
- Transceivers for EMI-Sensitive Applications
- Industrial Control Local Area Networks
- Energy Meter Networks
- Lighting Systems

Ordering Information

Part Number	Package	Marking
BL3085A(H)	SOP8	BL3085A I47SSSSS

“SSSSS” : Product Trace Code

Pin Function Description

Pin Number	Name	Function
1	RO	Receiver Output.
2	/RE	Receiver Output Enable. /RE is low to enable the Receiver; /RE is high to disable the Receiver.
3	DE	Driver Output Enable. DE is high to enable the Driver; DE is low to disable the Driver.
4	DI	Driver Input
5	GND	Ground.
6	A	Non-inverting Receiver Input and Non-inverting Driver Output.
7	B	Inverting Receiver Input and Inverting Driver Output.
8	V _{CC}	Power Supply.

Function Table (Transmitting)

Inputs			Outputs	
/RE	DE	DI	A	B
X	1	1	1	0
X	1	0	0	1
0	0	X	High-Z	High-Z
1	0	X	Shutdown (High-Z)	

Function Table (Receiving)

Inputs			Outputs
/RE	DE	A-B	RO
0	X	>-50mV	1
0	X	<-200mV	0
0	X	Open/shorted	1
1	1	X	High-Z
1	0	X	Shutdown (High-Z)

Absolute Maximum Ratings

Parameter	Symbol	Rating	Units
Power Supply	V _{CC}	+7	V
Control Input Voltage	/RE, DE	-0.3 to V _{CC} +0.3	V
Transmitter Input Voltage	DI	-0.3 to V _{CC} +0.3	V
Transmitter Output Voltage	A, B	±13	V
Receiver Input Voltage	A, B	±13	V
Receiver Output Voltage	RO	-0.3 to V _{CC} +0.3	V
Operating Temperature		-40 to +85	°C

DC Electrical Characteristics (5V Operation)

(V_{CC}=+5V±5%, TA=-40°C~+85°C, Typical Values are V_{CC}=+5V and TA=25°C) (Note1)

Parameter	Symbol	conditions	MIN	TYP	MAX	UNITS
Power Supply	V _{CC}		4.5		5.5	V
Driver						
Differential Driver Output(no load)	V _{OD1}	Figure 1			V _{CC}	V
Differential Driver Output	V _{OD2}	Figure 1, R=27Ω	1.5			V
Change in Magnitude of Differential Output Voltage (Note 2)	ΔV _{OD}	Figure 1, R=27Ω			0.2	V
Driver Common-mode Output Voltage	V _{OC}	Figure 1, R=27Ω	1.0		3.0	V
Change in Magnitude of Common-Mode Voltage (Note 2)	ΔV _{OC}	Figure 1, R=27Ω			0.2	V
Input High Voltage	V _{IH}	DE,DI,/RE	2.0			V

Input Low Voltage	V_{IL}	DE,DI,/RE			0.8	V	
DI Input Hysteresis	V_{HYS}			100		mV	
Input Current(A and B)	I_{IN4}	DE=GND $V_{CC}=GND$ or 5.25V	$V_{IN}=12V$		125	μA	
			$V_{IN}=-7V$	-75			
Driver Short-Circuit Output Current	I_{OSD}	A Pin Short to B Pin	-100		100	mA	
Receiver							
Receiver Differential Threshold Voltage	V_{TH}	$-7V \leq V_{CM} \leq 12V$	-200	-125	-50	mV	
Receiver Input Hysteresis	ΔV_{TH}			40		mV	
Receiver Output High Voltage	V_{OH}	$I_{O}=-8mA, V_{ID}=-50mV$	4.0			V	
Receiver Output Low Voltage	V_{OL}	$I_{O}=8mA, V_{ID}=-200mV$			0.4	V	
Three-State Output Current at Receiver	I_{OZR}				± 1	μA	
Receiver Input Resistance	R_{IN}	$-7V \leq V_{CM} \leq 12V$	96			K Ω	
Receiver Output Short-Circuit Current	I_{OSR}	$0V \leq V_{RO} \leq V_{CC}$	± 7		± 95	mA	
Supply Current							
Supply Current	I_{CC}	No load , /RE=DI = GND or V_{CC}	DE= V_{CC}		350	600	μA
			DE=GND		370	600	μA
Supply Current in Shutdown Mode	I_{SHDN}	DE=GND, /RE= V_{CC} , DI= V_{CC} or GND			10	μA	

DC Electrical Characteristics (3.3V Operation)

(VCC=+3.3V±5%, TA=-40°C~+85°C, Typical Values are VCC=+3.3V and TA=25°C) (Note1)

Parameter	Symbol	conditions	MIN	TYP	MAX	UNITS
Power Supply	V _{CC}		3		3.6	V
Driver						
Differential Driver Output(no load)	V _{OD1}	Figure 1			V _{CC}	V
Differential Driver Output	V _{OD2}	Figure 1, R=27Ω	0.8	1.15		V
Change in Magnitude of Differential Output Voltage (Note 2)	ΔV _{OD}	Figure 1, R=27Ω			0.2	V
Driver Common-mode Output Voltage	V _{OC}	Figure 1, R=27Ω	1.0		3.0	V
Change in Magnitude of Common-Mode Voltage (Note 2)	ΔV _{OC}	Figure 1, R=27Ω			0.2	V
Input High Voltage	V _{IH}	DE,DI,/RE	2.0			V
Input Low Voltage	V _{IL}	DE,DI,/RE			0.8	V
DI Input Hysteresis	V _{HYS}			100		mV
Input Current(A and B)	I _{IN4}	DE=GND V _{CC} =GND or 3.6V	V _{IN} =12V		125	μA
			V _{IN} =-7V	-75		
Driver Short-Circuit Output Current	I _{OSD}	A Pin Short to B Pin	-100		100	mA
Receiver						
Receiver Differential Threshold Voltage	V _{TH}	-7V ≦ V _{CM} ≦ 12V	-200	-125	-50	mV
Receiver Input Hysteresis	ΔV _{TH}			40		mV
Receiver Output High Voltage	V _{OH}	I _O =-1.5mA, V _{ID} =-50mV	V _{CC} -0.5			V
Receiver Output Low Voltage	V _{OL}	I _O =2.5mA, V _{ID} =-200mV			0.4	V
Three-State Output Current at Receiver	I _{OZR}				±1	μA
Receiver Input	R _{IN}	-7V ≦ V _{CM} ≦ 12V	96			K Ω

Resistance							
Receiver Output Short-Circuit Current	I_{OSR}	$0V \leq V_{RO} \leq V_{CC}$	± 7		± 95	mA	
Supply Current							
Supply Current	I_{CC}	No load, $DE=V_{CC}$ $/RE=DI = GND$ or V_{CC}			270	600	μA
		$DE=GND$			290	600	μA
Supply Current in Shutdown Mode	I_{SHDN}	$DE=GND,$ $/RE=V_{CC}, DI=V_{CC}$ or GND				10	μA

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.

Switching Characteristics (5V Operation)

($V_{CC}=+5V \pm 5\%$, $T_A=-40^{\circ}C \sim +85^{\circ}C$, Typical values are at $V_{CC}=+5V$, $T_A=25^{\circ}C$)

Parameter	Symbol	Conditions	MIN	TYP	MAX	UNITS
Driver Input to Output	t_{DPLH}	Figure 3 and 5, $R_{DIFF}=54\Omega$ $C_{L1}=C_{L2}=100pF$		300	800	ns
	t_{DPHL}			300	800	
Driver Output Skew $ T_{DPLH} - T_{DPHL} $	t_{DSKEW}	Figure 3 and 5, $R_{DIFF}=54\Omega$ $C_{L1}=C_{L2}=100pF$			100	ns
Driver Rise or Fall Time	t_{DR}, t_{DF}	Figure 3 and 5, $R_{DIFF}=54\Omega$ $C_{L1}=C_{L2}=100pF$		420	900	ns
Maximum Data Rate	F_{MAX}		250			kbps
Driver Enable to Output High	t_{DZH}	Figure 4 and 6, $C_L=100pF$ S2 Closed			300	ns
Driver Enable to Output Low	t_{DZL}	Figure 4 and 6, $C_L=100pF$ S1 Closed			500	ns

Driver Disable Time from Low	t_{DLZ}	Figure 4 and 6, $C_L=15pF$ S1 Closed			900	ns
Driver Disable Time from High	t_{DHZ}	Figure 4 and 6, $C_L=15pF$ S2 Closed			800	ns
Receiver Input to Output	t_{RPLH} t_{RPHL}	Figure 7 and 9, $ V_{ID} \geq 2.0V$; rise and fall time of $V_{ID} \leq 15ns$		150	300	ns
$ T_{RPLH} - T_{RPHL} $ Differential Receiver Skew	t_{RSKD}	Figure 7 and 9, $ V_{ID} \geq 2.0V$; rise and fall time of $V_{ID} \leq 15ns$		10		ns
Receiver Enable to Output Low	t_{RZL}	Figure 2 and 8, $C_{RL}=15pF$ S1 Closed		20	50	ns
Receiver Enable to Output High	t_{RZH}	Figure 2 and 8, $C_{RL}=15pF$ S2 Closed		20	50	ns
Receiver Disable Time from Low	t_{RLZ}	Figure 2 and 8, $C_{RL}=15pF$ S1 Closed		30	60	ns
Receiver Disable Time from High	t_{RHZ}	Figure 2 and 8, $C_{RL}=15pF$ S2 Closed		30	60	ns
Time to Shutdown	t_{SHDN}			500	1000	ns
Driver Enable from Shutdown to Output High	$t_{DZH(SHDN)}$	Figure 4 and 6, $C_L=100pF$ S2 Closed			2500	ns
Driver Enable from Shutdown to Output Low	$t_{DZL(SHDN)}$	Figure 4 and 6, $C_L=100pF$ S1 Closed			2500	ns
Receiver Enable from Shutdown to Output High	$t_{RZH(SHDN)}$	Figure 2 and 8, $C_{RL}=15pF$ S2 Closed			2500	ns
Receiver Enable from Shutdown to Output Low	$t_{RZL(SHDN)}$	Figure 2 and 8, $C_{RL}=15pF$ S1 Closed			2500	ns

Switching Characteristics (3.3V Operation)

(VCC=+3.3V±5%, TA=-40°C~+85°C, Typical values are at VCC=+3.3V, TA=25°C)

Parameter	Symbol	Conditions	MIN	TYP	MAX	UNITS
Driver Input to Output	t _{DPLH}	Figure 3 and 5, R _{DIFF} =54Ω		280	800	ns
	t _{DPHL}	C _{L1} =C _{L2} =100pF		280	800	
Driver Output Skew T _{DPLH} – T _{DPHL}	t _{DSKEW}	Figure 3 and 5, R _{DIFF} =54Ω C _{L1} =C _{L2} =100pF			100	ns
Driver Rise or Fall Time	t _{DR} , t _{DF}	Figure 3 and 5, R _{DIFF} =54Ω C _{L1} =C _{L2} =100pF		450	900	ns
Maximum Data Rate	F _{MAX}		250			kbps
Driver Enable to Output High	t _{DZH}	Figure 4 and 6, C _L =100pF S2 Closed			300	ns
Driver Enable to Output Low	t _{DZL}	Figure 4 and 6, C _L =100pF S1 Closed			500	ns
Driver Disable Time from Low	t _{DLZ}	Figure 4 and 6, C _L =15pF S1 Closed			900	ns
Driver Disable Time from High	t _{DHZ}	Figure 4 and 6, C _L =15pF S2 Closed			800	ns
Receiver Input to Output	t _{RPLH}	Figure 7 and 9, V _{ID} ≥ 2.0V ; rise and fall time of VID ≤ 15ns		150	300	ns
	t _{RPHL}					
T _{RPLH} – T _{RPHL} Differential Receiver Skew	t _{RSKD}	Figure 7 and 9, V _{ID} ≥ 2.0V ; rise and fall time of VID ≤ 15ns		10		ns
Receiver Enable to Output Low	t _{RZL}	Figure 2 and 8, C _R L=15pF S1 Closed		20	50	ns
Receiver Enable to Output High	t _{RZH}	Figure 2 and 8, C _R L=15pF S2 Closed		20	50	ns

Receiver Disable Time from Low	t_{RLZ}	Figure 2 and 8, $C_{RL}=15pF$ S1 Closed		30	60	ns
Receiver Disable Time from High	t_{RHZ}	Figure 2 and 8, $C_{RL}=15pF$ S2 Closed		30	60	ns
Time to Shutdown	t_{SHDN}			500	1000	ns
Driver Enable from Shutdown to Output High	$t_{DZH(SHDN)}$	Figure 4 and 6, $C_L=100pF$ S2 Closed			2500	ns
Driver Enable from Shutdown to Output Low	$t_{DZL(SHDN)}$	Figure 4 and 6, $C_L=100pF$ S1 Closed			2500	ns
Receiver Enable from Shutdown to Output High	$t_{RZH(SHDN)}$	Figure 2 and 8, $C_{RL}=15pF$ S2 Closed			2500	ns
Receiver Enable from Shutdown to Output Low	$t_{RZL(SHDN)}$	Figure 2 and 8, $C_{RL}=15pF$ S1 Closed			2500	ns

Test Circuits and Timing Diagrams

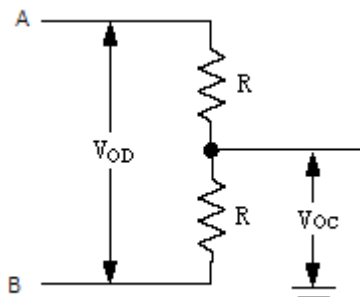


Figure 1: Driver DC Test Load

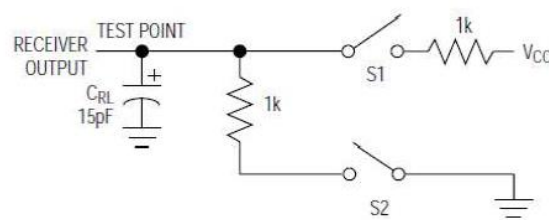


Figure 2: Receiver Enable/Disable Timing Test Load

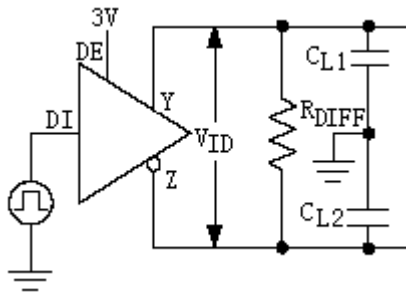


Figure 3: Driver Timing Test Circuit

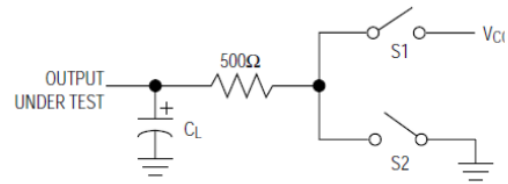


Figure 4: Driver Enable/Disable Timing Test Load

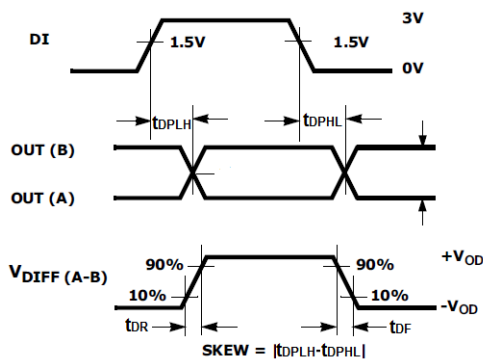


Figure 5: Driver Propagation Delays

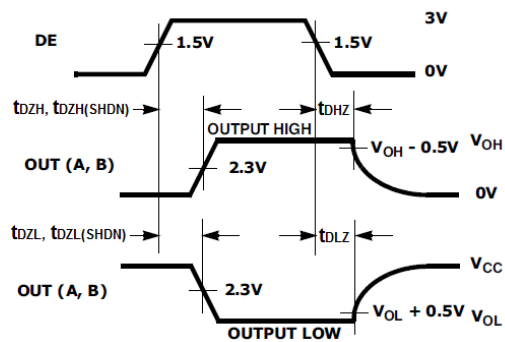


Figure 6: Driver Enable and Disable Times

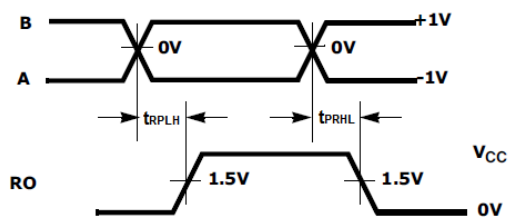


Figure 7: Receiver Propagation Delays

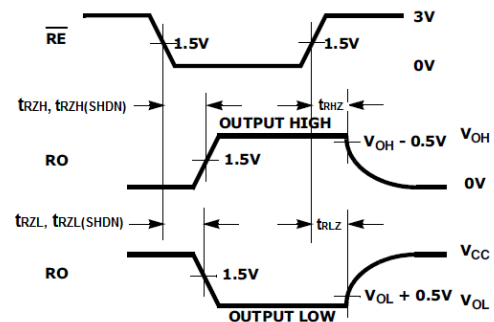


Figure 8: Receiver Enable and Disable Times

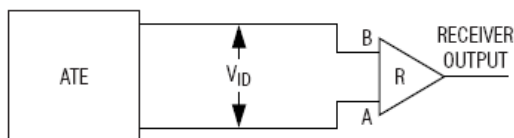


Figure 9: Receiver Propagation Delay Test Circuit

Typical Application

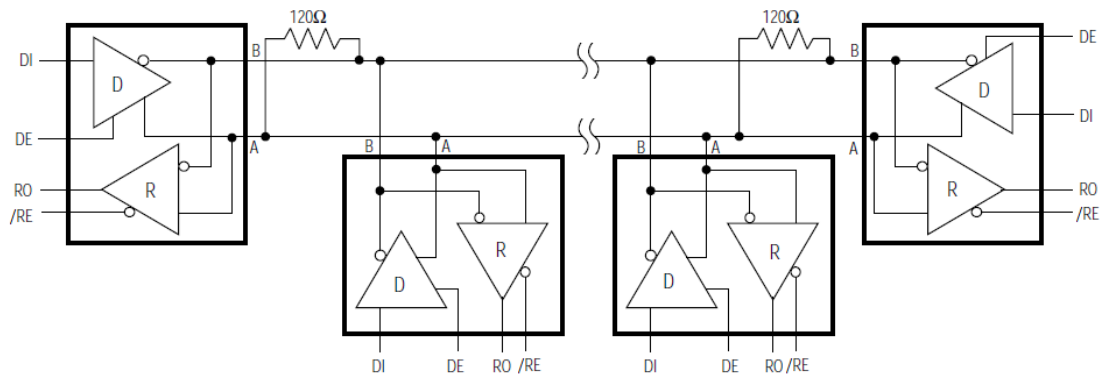
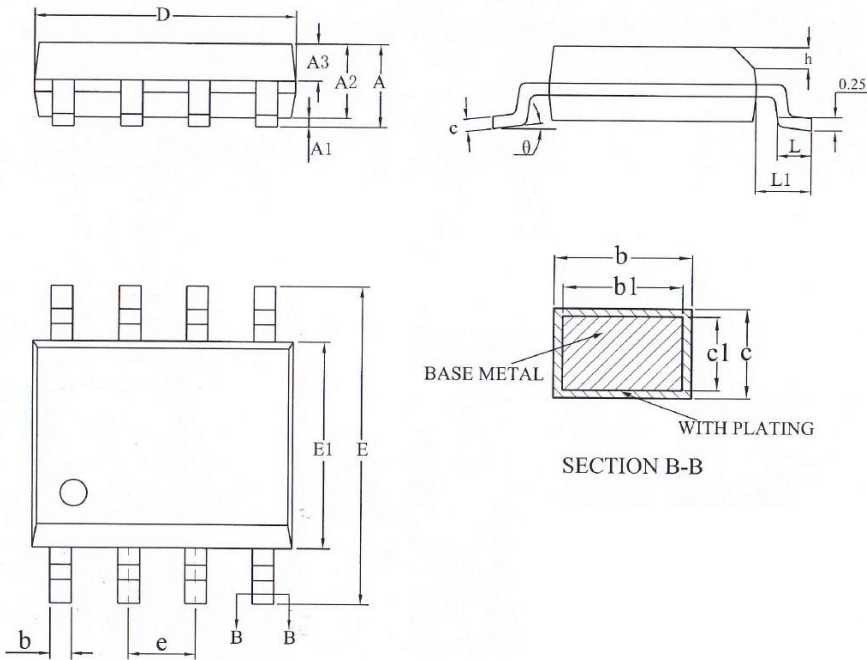


Figure10 Typical Half-Duplex RS-485 Network

Package Information (SOP8)



SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	—	—	1.77
A1	0.08	0.18	0.28
A2	1.20	1.40	1.60
A3	0.55	0.65	0.75
b	0.39	—	0.48
b1	0.38	0.41	0.44
c	0.20	—	0.26
c1	0.19	0.20	0.21
D	4.70	4.90	5.10
E	5.80	6.00	6.20
E1	3.70	3.90	4.10
e	1.27BSC		
h	0.25	—	0.50
L	0.50	—	0.80
L1	1.05REF		
θ	0	—	8°

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