

## General Description

The HG3085E +5V, half-duplex,  $\pm 15\text{kV}$  ESD-protected RS-485/RS-422-compatible transceivers feature one driver and one receiver. The HG3085E include a hot-swap capability to eliminate false transitions on the bus during power-up or live insertion.

The HG3085E features reduced slew-rate drivers that minimize EMI and reduce reflections caused by improperly terminated cables, allowing error-free transmission up to 500kbps.

The HG3085E 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  $\pm 15\text{kV}$  ESD using the Human Body Model.

The HG3085 is available in an 8-pin SO package. The devices operate over the extended  $-40\text{ }^{\circ}\text{C}$  to  $+85\text{ }^{\circ}\text{C}$  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  $\pm 15\text{kV}$  Human Body Model
- 1/8 Unit Load , Allowing Up to 256 Transceivers on the Bus
- 8 Pin-SOP/DIP 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 +6
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 .....	$-40\text{ }^{\circ}\text{C}$ to $+85\text{ }^{\circ}\text{C}$
Junction Temperature.....	$+150\text{ }^{\circ}\text{C}$
Storage Temperature Range .....	$-65\text{ }^{\circ}\text{C}$ to $+150\text{ }^{\circ}\text{C}$
Lead Temperature (soldering 10s) .....	$+300\text{ }^{\circ}\text{C}$

*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.*

## DC ELECTRICAL CHARACTERICS

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

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
<b>DRIVER</b>						
Differential Driver Output (no load)	VOD1	Figure1			5	V
Differential Driver Output	VOD2	Figure1,R = 50Ω (RS-422)		2.0		V
		Figure1,R = 27Ω (RS-485)		1.5		
Change in Magnitude of Differential Output Voltage (Note 2)	ΔVOD	Figure1,R =50Ωor R= 27Ω		0.2		V
Driver Common-Mode Output Voltage	VOC	Figure1,R=50Ωor R = 27Ω		3		V
Change In Magnitude of Common-Mode Voltage (Note 2)	ΔVOC	Figure1,R=50Ωor R = 27Ω		0.2		V
Input High Voltage	VIH1	DE, DI, RE,		2.0		V
Input Low Voltage	VIL1	DE, DI, RE,		0.8		V
DI Input Hysteresis	VHYS	WS3085		100		mV
Input Current	IIN1	DE, DI, RE		±2		μA
Input Current (A and B)	IIN4	DE = GND, VCC=GND or 5.25V	VIN=12V	125		μA
			VIN = -7V	-75		
Driver Short-Circuit Output Current (Note 3)	VOD1	-7V ≤ VOUT ≤ VCC		-250		mV
<b>RECEIVER</b>						
Receiver Differential Threshold Voltage	VTH	-7V ≤ VCM ≤ +12V	-200	-125	-50	mV
Receiver Input Hysteresis	ΔVTH			25		mV
Receiver Output High Voltage	VOH	IO = 4mA, VID = -200mV;		VCC-1.5		V
Receiver Output Low Voltage	VOL	IO = -4mA, VID = -50mV		0.4		V
Three-State Output Current at Receiver	IOZR	0.4V ≤ VO ≤ 2.4V		±1		μA
Receiver Input Resistance	RIN	-7V ≤ VCM ≤ +12V		96		kΩ
Receiver Output Short-Circuit Current	IOSR	0V ≤ VRO ≤ VCC		±7	±95	mA
<b>SUPPLY CURRENT</b>						
Supply Current	ICC	No load, RE=DI=GND or VCC	DE = VCC	530	900	μA
			DE = GND	500	600	

## SWITCHING CHARACTERISTICS

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

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Driver Input to Output	tDPLH	Figures 3 and 5, RDIFF = 54Ω, CL1 = CL2 = 100pF	250	720	1000	ns
	tDPHL		250	720	1000	
Driver Output Skew  tDPLH - tDPHL	tDSKEW	Figures 3 and 5, RDIFF = 54Ω, CL1 = CL2 = 100pF	-3	±100		ns
Driver Rise or Fall Time	tDR, tDF	Figures 3 and 5, RDIFF = 54Ω, CL1 = CL2 = 100pF	200	530	750	ns
Maximum Data Rate	fMAX			500		kbps
Driver Enable to Output High	tDZH	Figures 4 and 6, CL = 100pF, S2 closed		2500		ns
Driver Enable to Output Low	tDZL	Figures 4 and 6, CL = 100pF, S1 closed		2500		ns
Driver Disable Time from Low	tDLZ	Figures 4 and 6, CL = 15pF, S1 closed		100		ns
Driver Disable Time from High	tDHZ	Figures 4 and 6, CL = 15pF, S2 closed		100		ns
Receiver Input to Output	tRPLH, tRPHL	Figures 7 and 9;  VID  ≥ 2.0V; rise and fall time of VID ≤ 15ns	127	200		ns
tRPLH - tRPHL  Differential Receiver Skew	tRSKD	Figures 7 and 9;  VID  ≥ 2.0V; rise and fall time of VID ≤ 15ns	3	±30		ns
Receiver Enable to Output Low	tRZL	Figures 2 and 8, CL = 100pF, S1 closed	20	50		ns
Receiver Enable to Output High	tRZH	Figures 2 and 8, CL = 100pF, S2 closed	20	50		ns
Receiver Disable Time from Low	tRLZ	Figures 2 and 8, CL = 100pF, S1 closed	20	50		ns
Receiver Disable Time from High	tRHZ	Figures 2 and 8, CL = 100pF, S2 closed	20	50		ns
Time to Shutdown	tSHDN	(Note 4)	50	200	600	ns
Driver Enable from Shutdown to Output High	tDZH(SHD N)	Figures 4 and 6, CL = 15pF, S2 closed		4500		ns
Driver Enable from Shutdown to Output Low	tDZL(SHDN )	Figures 4 and 6, CL = 15pF, S1 closed		4500		ns
Receiver Enable from Shutdown to Output High	tRZH(SHD N)	Figures 2 and 8, CL = 100pF, S2 closed		3500		ns
Receiver Enable from Shutdown to Output Low	tRZL(SHDN )	Figures 2 and 8, CL = 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

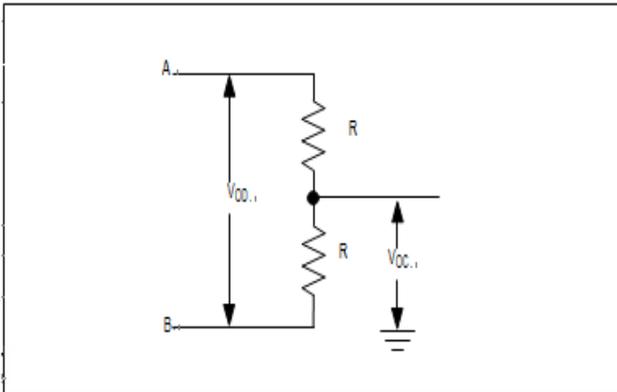


Figure 1. Driver DC Test Load

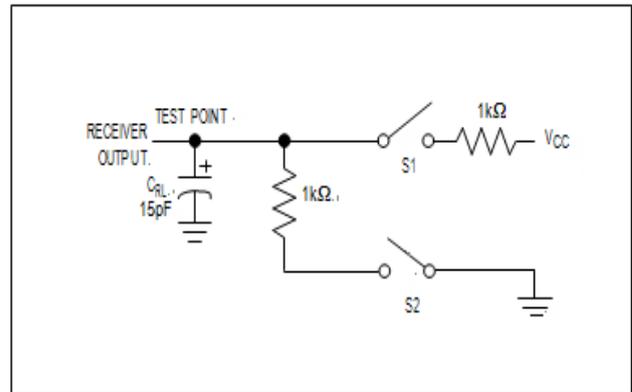


Figure 2. Receiver Enable/Disable Timing Test Load

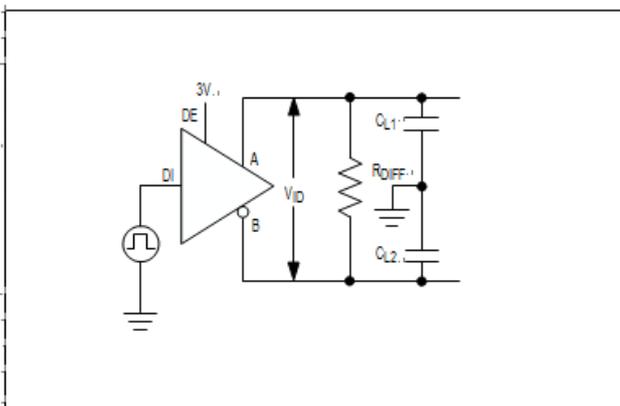


Figure 3 Driver Timing Test Circuit

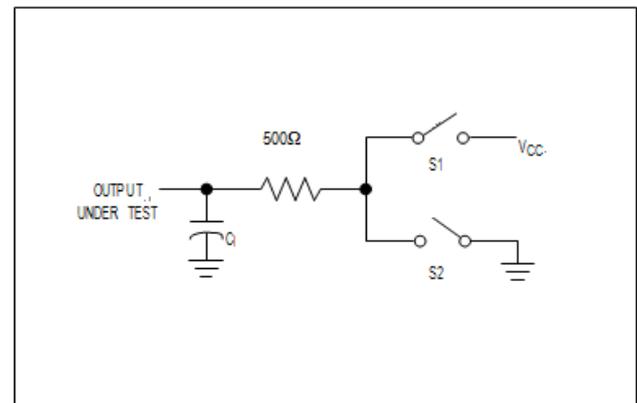


Figure 4 Driver Enable/Disable Timing Test Load

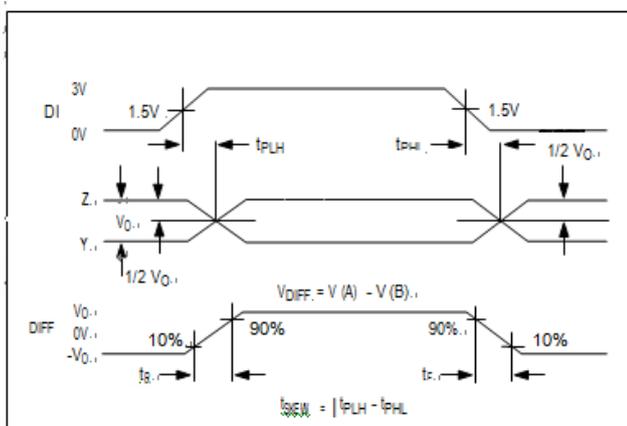


Figure 5 Driver Propagation Delays

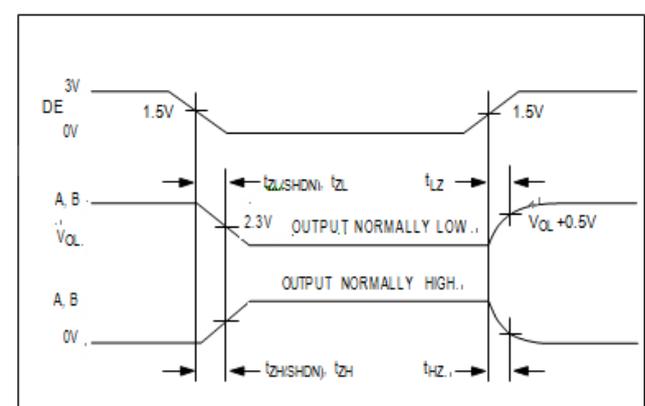


Figure 6. Driver Enable and Disable Times

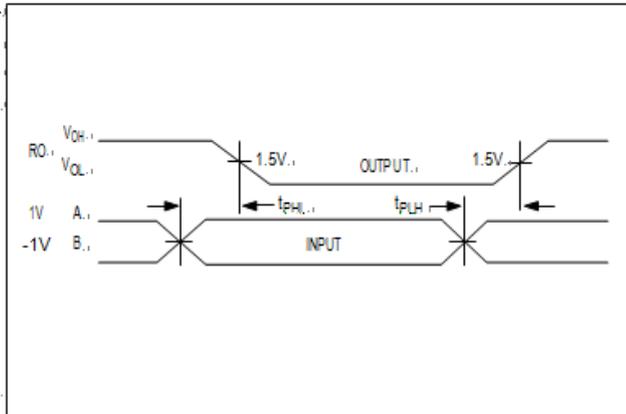


Figure 7. Receiver Propagation Delays

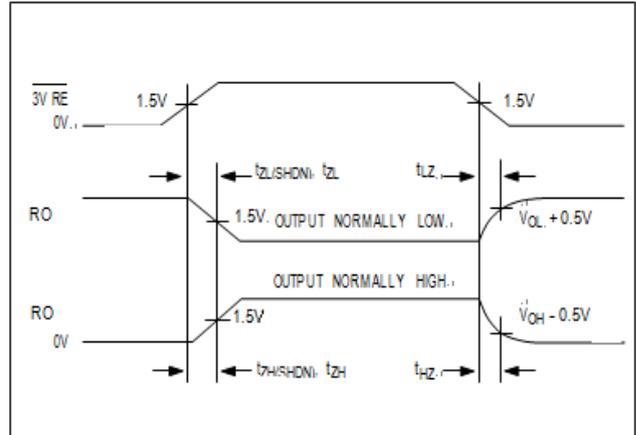


Figure 8. Receiver Enable and Disable Times

## Pin Description

PIN	NAME	FUNCTION
1	RO	Receiver Output. When RE is low and if A - B $\geq$ -50mV, RO will be high; if A - B $\leq$ -200mV, RO will be low.
2	RE	Receiver Output Enable. Drive RE low to enable RO; RO is high impedance when RE is high. Drive RE high and DE low to enter low-power shutdown mode. RE is a hot-swap input (see the <i>Hot-Swap Capability</i> section for more details).
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. DE is a hot-swap input (see the <i>Hot-Swap Capability</i> section for more details).
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, Vcc = +5V $\pm$ 5%. Bypass Vcc to GND with a 0.1 $\mu$ F 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	$\geq -0.05V$	1
0	X	$\leq -0.2V$	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 12k $\Omega$  (one-unit load), and the standard driver can drive up to 32 unit loads. The HG3085 E family of transceivers have a 1/8-unit-load receiver input impedance (96k $\Omega$ ), 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.

### 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.

### 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 2 $\mu$ A of supply current.

RE and DE may be driven simultaneously; the parts are guaranteed not to enter shutdown if 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

HG3085E is slew-rate limited, minimizing EMI and reducing reflections caused by improperly terminated cables.

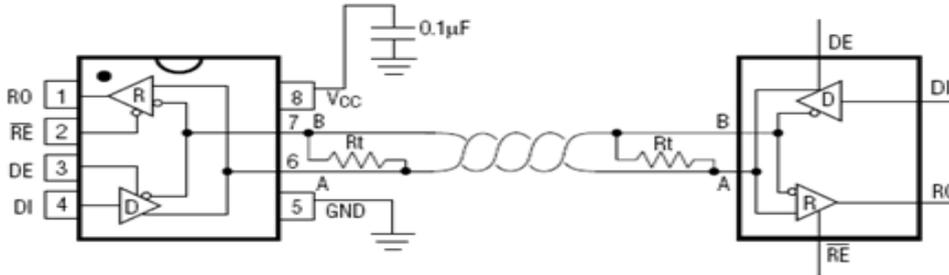


Figure 9 3085 Pin Configuration and Typical Half-Duplex Operating Circuit

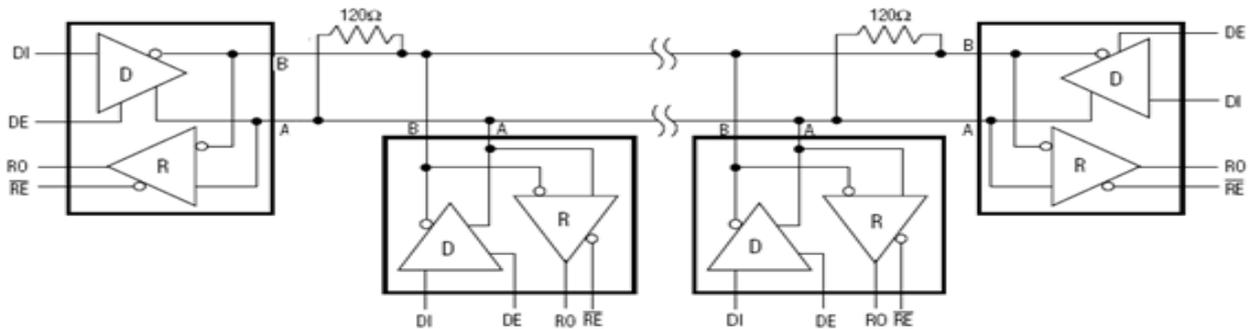


Figure 10 Typical Half-Duplex RS-485 Network