Overview

The GM3085E is a high-speed, half-duplex transceiver for RS-485/RS-422 communication that contains one driver and one receiver. With ±15kV human body model ESD protection and fail-safe circuit, when the receiver input is open or shorted, it ensures that the receiver outputs a logic high level. This means that if all transmitters connected to the terminated bus are disabled (high impedance), the receiver will output a logic high level. GM3085E has a limited slew rate driver, which can reduce EMI and reflections caused by improper cable termination, and achieve error-free data transmission up to 1Mbps. In addition, the receiver of GM3085E has 1/8 unit load input impedance, and up to 256 transceivers can be connected to the bus.

Features

- Low current shutdown mode
- Industry standard 8-pin SOP package
- Allows up to 256 transceivers to be connected to the bus
- The true fail-safe receiver is compatible with EIA/TIA-485
- Powerful slew rate control function helps to achieve error-free data transmission
- Provides enhanced ESD protection for RS-485/RS-422 A/B pins

A/B pin provides enhanced ESD protection

HBM human body model: ±15kV

IEC 61000-4-2:

Contact discharge ±12kV

Air discharge ±15kV

Pin logic diagram and description

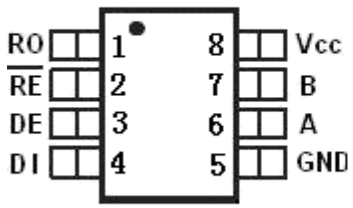


Figure 1: GM3085E pin diagram

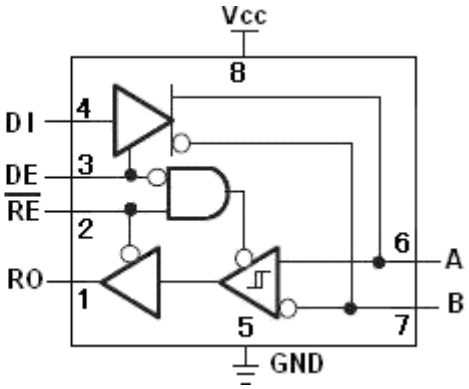


Figure 2: GM3085E logic diagram

Application

- Industrial control
- Electricity meter, water meter, gas meter
- Transceiver applications sensitive to EMI
- Security system
- Lighting system
- Instrumentation

Ordering information

Model	Transfer method	I/O polarity	Temperature range	Package	SPQ
GM3085E	Half duplex	Polar	-40℃ ～ +85℃	SOP8	2500pcs
-					

Pin description

Pin	Name	Features
1	RO	Receiver output. When RE is low, if A-B ≧ -50mV, RO output is high; if A-B ≦ -200mV, RO output is low
2	RE	Receiver output enable. RO output is valid when RE is connected to low level; RO is in high impedance state when RE is connected to high level; When RE is connected to high level and DE is connected to low level, the device enters low-power shutdown mode
3	DE	Driver output enable. When DE is connected to high level, the driver output is valid, when DE is low level, the output is in high impedance state; When RE is connected to high level and DE is connected to low level, the device enters low-power shutdown mode
4	DI	Driver input. When DE is high, the low level on DI forces the non-inverting output low, and the inverting output high. Similarly, a high level on DI will force the non-inverting output to be high, and the inverting output to be low.
5	GND	Ground
6	A	Receiver non-inverting input and driver non-inverting output
7	B	Receiver inverting input and driver inverting output
8	V_{CC}	Power supply: 3.0 ≦ V_{CC} ≦ 5.5V

Absolute maximum ratings

Parameter	Symbol	Value	Unit
Supply voltage	V_{CC}	+7	V
Control input voltage	/RE, DE	-0.3 to V_{CC}+0.3	V
Driver input voltage	DI	-0.3 to V_{CC}+0.3	V
Driver output voltage	A, B	±13	V
Receiver input voltage	A, B	±13	V
Receiver output voltage	RO	-0.3～V_{CC}+0.3	V
Continuous power consumption	SOP8	471	mW
Operating temperature range	GM3085E	-40～+85	℃
Storage temperature		-65～+150	℃
Welding temperature		300	℃

DC electrical characteristics

(If not otherwise stated, V_{CC}=+5V±5%, T_A=T_{MIN}～T_{MAX}, the typical value is V_{CC}=+5V, T_A=25℃) (Note 1)

Parameter	Symbol	Test Conditions		Min	Typ	Max	Unit
Driver							
Supply voltage	V_{CC}			3.0		5.5	V
Differential driver output (no load)	V_{OD1}	Figure 4		1.5		5	V
Differential driver output	V_{OD2}	Figure 4, R=50Ω (RS-422)		2.0		5	V
		Figure 4, R=27Ω (RS-485)		1.5		5	
Amplitude change of differential output voltage (Note 2)	ΔV_{OD}	Figure 4, R=50Ω or R=27Ω				0.2	V
Driver common mode output voltage	V_{OC}	Figure 4, R=50Ω or R=27Ω		1		3	V
Amplitude change of common mode voltage (Note 2)	ΔV_{OC}	Figure 4, R=50Ω or 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}	GM3085E			100		
Input current (A, B) half duplex	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}	-7V≦V_{OUT}≦VCC		-250			mA
		0V≦V_{OUT}≦12V				250	
		0V≦V_{OUT}≦VCC		±25			
Receiver							
Receiver differential threshold voltage	V_{TH}	-7V≦V_{CM}≦12V		-200	-110	-50	mV
Receiver input hysteresis	ΔV_{TH}				30		mV
Receiver output high voltage	V_{OH}	I_O=-4mA, V_{ID}=-50mV		V_{CC}-1.5			V
Receiver output low voltage	V_{OL}	I_O=4mA, V_{ID}=-200mV				0.4	V
Three-state output current at receiver	I_{OZR}	0.4V≦V_O≦2.4V				±1	μA
Receiver input impedance	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=V_{CC}, DE=V_{CC}			140	600	μA
		No load, /RE=DI=GND, DE=GND			110	600	μA
Shutdown mode current	I_{SHDN}	DE=GND, /RE=V_{CC}, DI=V_{CC} or GND			0.1	100	μA
ESD electrostatic protection							
Electrostatic protection (A/B pin)		HBM Human body model		±15			kV
		MM Machine mode		±800			V
		Contact discharge IEC 61000-4-2		±12			kV
		Air discharge IEC 61000-4-2		±15			kV
Electrostatic protection (other pins)		HBM Human body model		±6			kV
		MM Machine mode		±400			V

Note 1: All currents into device pins are positive; all currents out of device pins are negative; all voltages are without exception referenced to device ground

Note 2: When DI input changes state, $\triangle V_{OD}$ and $\triangle V_{OC}$ are V_{OD} and V_{OC} changes respectively.

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

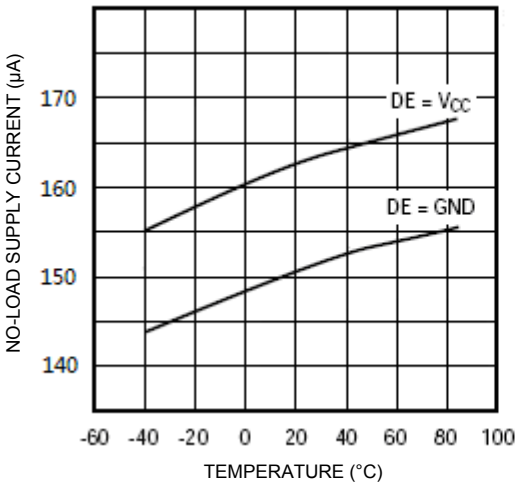
Switching characteristics

(If not otherwise stated, V_{CC}=+5V±5%, T_A=T_{MIN}～T_{MAX}, the typical value is V_{CC}=+5V, T_A=25℃) (Note 1)

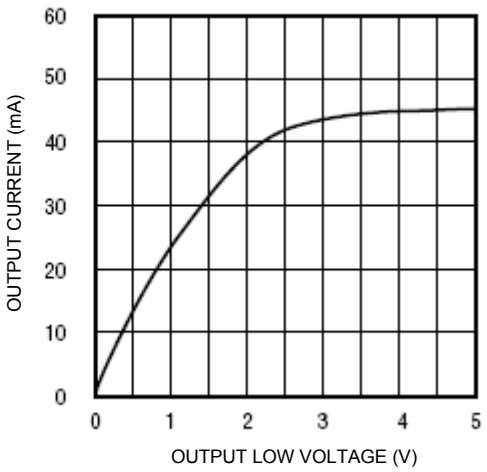
Parameter	Symbol	Condition	Min	Typ	Max	Unit
Driver input to output	T_{DPLH}	Figure 6 and 8, R_{DIFF}=54Ω, C_{L1}=C_{L2}=100pF	250	720	900	ns
	T_{DPHL}		250	720	900	
Driver output skew $\|t_{DPLH} - t_{DPHL}\|$	T_{DSKEW}	Figure 6 and 8, R_{DIFF}=54Ω, C_{L1}=C_{L2}=100pF		-3	±100	ns
Driver rise or fall time	t_{DR}, t_{DF}	Figure 6 and 8, R_{DIFF}=54Ω, C_{L1}=C_{L2}=100pF	200	530	750	ns
Maximum data rate	F_{MAX}				1000	kbps
Driver enable to output high	T_{DZH}	Figure 7 and 9, C_L=100pF, S2 closed			2500	ns
Driver enable to output low	T_{DZL}	Figure 7 and 9, C_L=100pF, S1 closed			2500	ns
Driver disable time from low	T_{DLZ}	Figure 7 and 9, C_L=15pF, S1 closed			100	ns
Driver disable time from high	T_{DHZ}	Figure 7 and 9, C_L=15pF, S2 closed			100	ns
Receiver input to output	T_{RPLH} T_{RPHL}	Figure 10 and 12, $\|V_{ID}\|$≥2.0V, V_{ID}≦15ns rise and fall time		127	200	ns
Differential receiver skew $\|t_{DPLH} - t_{DPHL}\|$	T_{RSKD}	Figure 10 and 12, $\|V_{ID}\|$≥2.0V, V_{ID}≦15ns rise and fall time		3	±30	ns
Receiver enable to output low	T_{RZL}	Figure 5 and 11, C_L=100pF, S1 closed		20	50	ns
Receiver enable to output high	T_{RZH}	Figure 5 and 11, C_L=100pF, S2 closed		20	50	ns
Receiver disable time from low	T_{RLZ}	Figure 5 and 11, C_L=100pF, S1 closed		20	50	ns
Receiver disable time from high	T_{RHZ}	Figure 5 and 11, C_L=100pF, S2 closed		20	50	ns
Time to shutdown	T_{SHDN}		50	200	600	ns
Driver enable from shutdown to output high	$T_{DZH(SHDN)}$	Figure 7 and 9, C_L=15pF, S2 closed			4500	ns
Driver enable from shutdown to output low	$T_{DZL(SHDN)}$	Figure 7 and 9, C_L=15pF, S1 closed			4500	ns
Receiver enable from shutdown to output high	$T_{RZH(SHDN)}$	Figure 5 and 11, C_L=100pF, S2 closed			3500	ns
Receiver enable from shutdown to output low	$T_{RZL(SHDN)}$	Figure 5 and 11, C_L=100pF, S1 closed			3500	ns

Typical operating characteristics

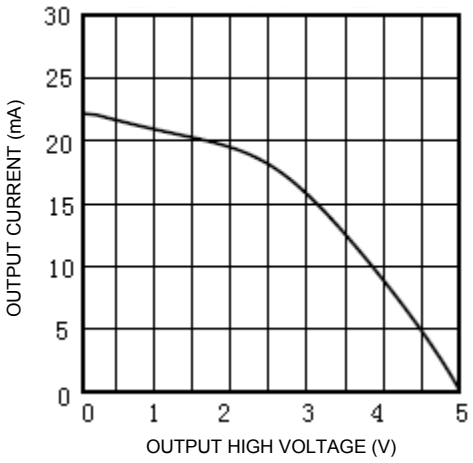
NO LOAD SUPPLY CURRENT
vs. TEMPERATURE



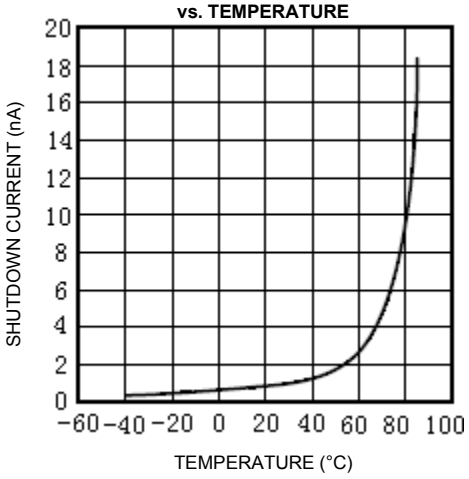
OUTPUT CURRENT
vs. RECEIVER OUTPUT LOW VOLTAGE



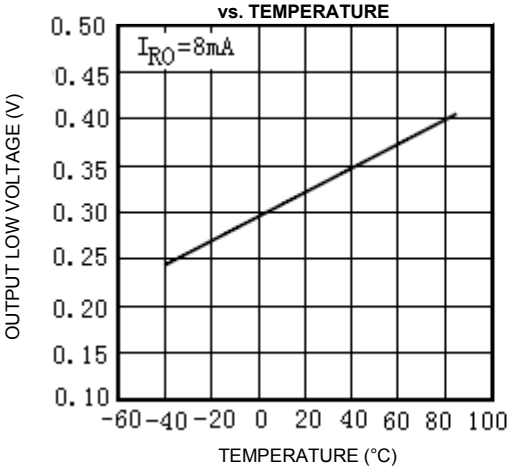
OUTPUT CURRENT
vs. RECEIVER OUTPUT HIGH VOLTAGE



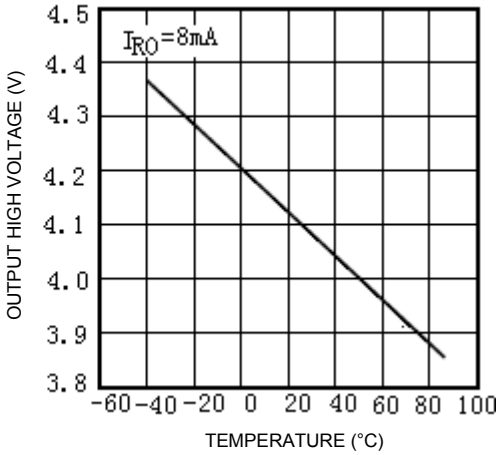
SHUTDOWN CURRENT
vs. TEMPERATURE



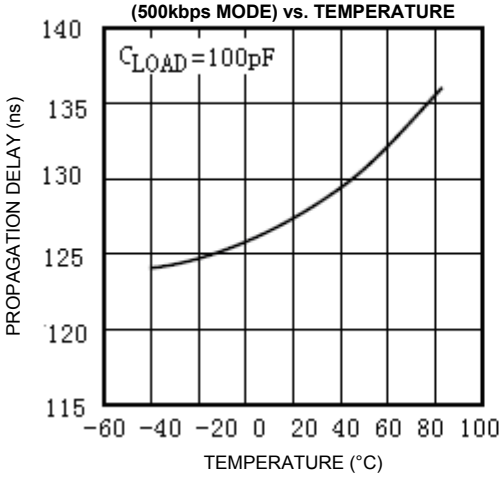
RECEIVER OUTPUT LOW VOLTAGE
vs. TEMPERATURE



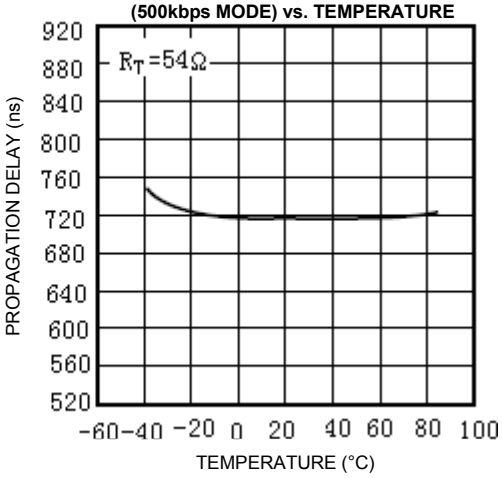
RECEIVER OUTPUT HIGH VOLTAGE
vs. TEMPERATURE



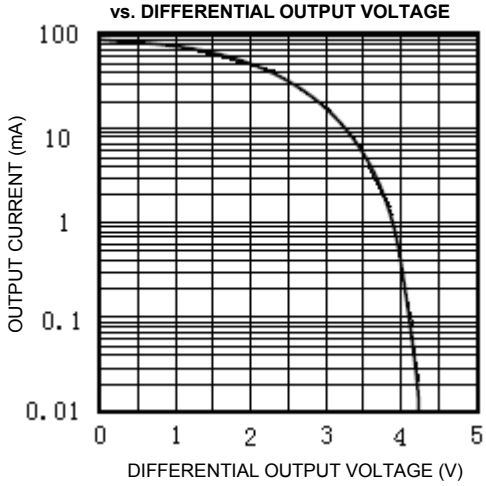
RECEIVER PROPAGATION DELAY
(500kbps MODE) vs. TEMPERATURE



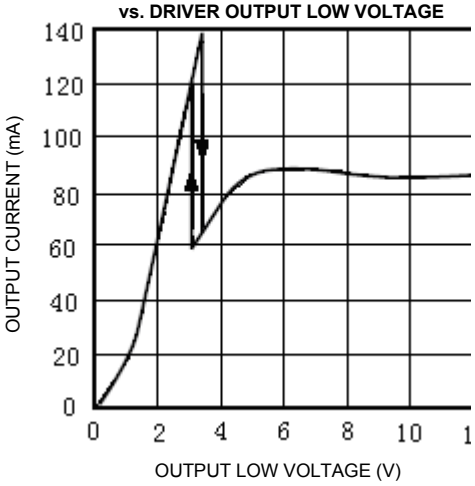
DRIVER PROPAGATION DELAY
(500kbps MODE) vs. TEMPERATURE



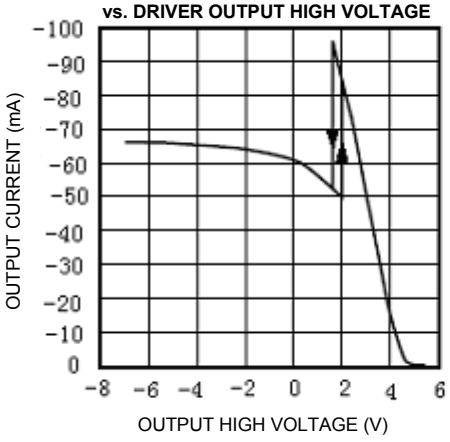
DRIVER OUTPUT CURRENT
vs. DIFFERENTIAL OUTPUT VOLTAGE



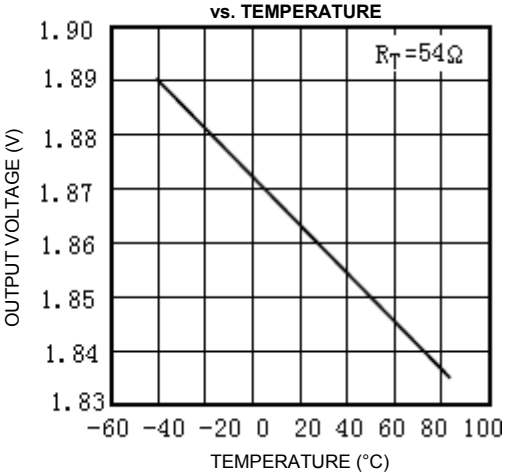
OUTPUT CURRENT
vs. DRIVER OUTPUT LOW VOLTAGE



OUTPUT CURRENT
vs. DRIVER OUTPUT HIGH VOLTAGE



DRIVER DIFFERENTIAL OUTPUT VOLTAGE
vs. TEMPERATURE



Function table

GM3085E

Driver				
Input			Output	
/RE	DE	DI	B	A
X	1	1	0	1
X	1	0	1	0
0	0	X	High-Z	High-Z
1	0	X	Shutdown	

GM3085E

Receiver			
Input		Output	
/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

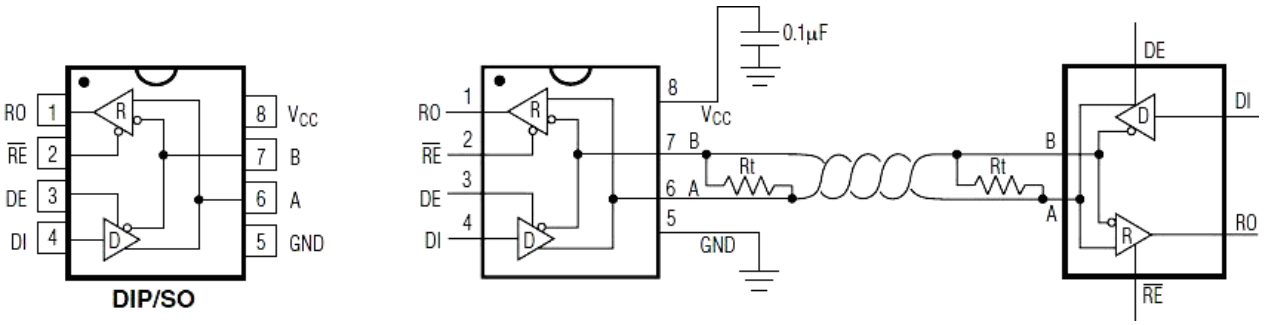


Figure 3: GM3085E typical half-duplex application circuit

1. Description

The GM3085E high-speed transceiver for RS-485/RS-422 communication contains a driver and a receiver. It has a fail-safe circuit to ensure that the receiver outputs a logic high level when the receiver input is open or shorted. This means that if all transmitters connected to the terminated bus are disabled (high impedance), the receiver will output a logic high level. GM3085E has a limited slew rate driver, which can reduce EMI and reflections caused by improper cable termination, and achieve error-free data transmission up to 1Mbps. GM3085E is a half-duplex transceiver.

2. Receiver input filtering

When the GM3085E operates in above 500kbps mode, its receiver not only has input hysteresis, but also includes input filtering function. This filtering function improves the noise immunity with differential signals that have slow rise and fall times. The filter increases receiver propagation delay by 25%.

3. Fail-safe

When the receiver input is short-circuited or open, or when all drivers connected to the terminated transmission line are disabled, GM3085E can ensure that the receiver outputs a logic high level. This is achieved by setting the receiver input threshold to -50mV and -200mV respectively. If the differential receiver input voltage (A-B) is greater than or equal to -50mV, RO is logic-high; if the voltage (A-B) is less than or equal to -200mV, RO is logic-low.

When all transmitters connected to the terminated bus are disabled, the receiver differential input voltage will be pulled to 0V by the termination resistor. Depending on the receiver threshold, a logic high level with a minimum noise margin of 50mV can be achieved. Unlike previous fail-safe devices, the -50mV to -200mV threshold voltage complies with the ±200 mV EIA/TIA-485 standard.

256 transceivers on the bus

The input impedance of the standard RS-485 receiver is 12kΩ (1 unit load), and the standard driver can drive up to 32 unit loads. The receiver of the GM3085E transceiver has 1/8 unit load input impedance (96kΩ), allowing up to 256 transceivers to be connected in parallel on the same communication bus. These devices can be combined arbitrarily, or combined with other RS-485 transceivers, as long as the total load does not exceed 32 unit loads that can be connected to the same bus.

Reduced EMI and reflections

The limited slew rate driver of GM3085E can minimize EMI and reduce reflections caused by improperly terminated cables. Figure 13 shows that the amplitude of high-frequency harmonic components is lower than normal. The rise time of the driver is related to the length of an unterminated stub, and the following equation shows this relationship:

$$Length=t_{RISE}/(10 \times 1.5ns/ft),\ \text{where } t_{RISE} \text{ is the driver's rise time}$$

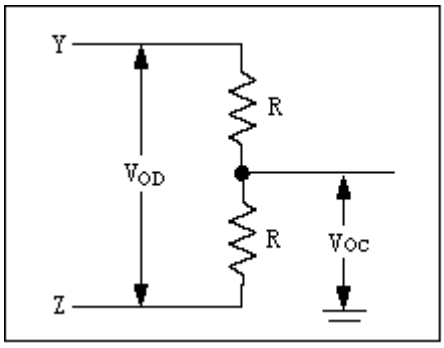


Figure 4: Driver DC test load

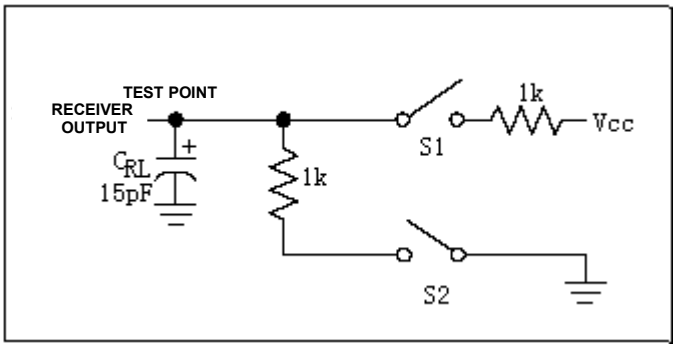


Figure 5: Receiver enable/disable timing test load

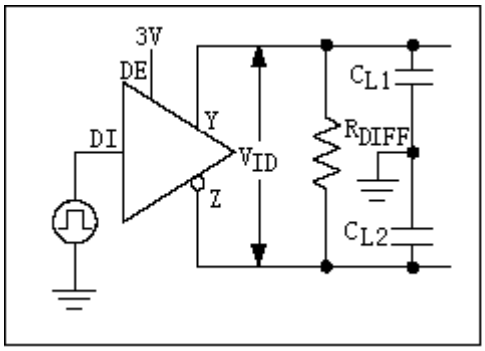


Figure 6: Driver timing test load

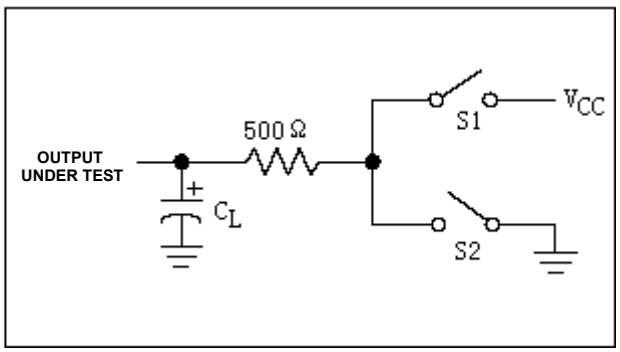


Figure 7: Driver enable/disable timing test load

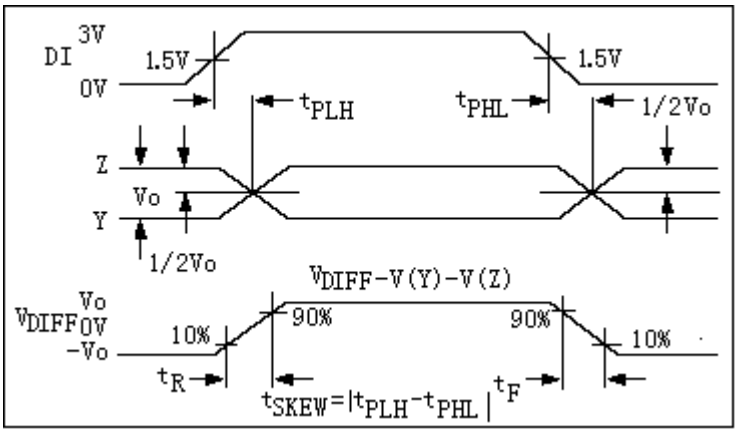


Figure 8: Driver propagation delays

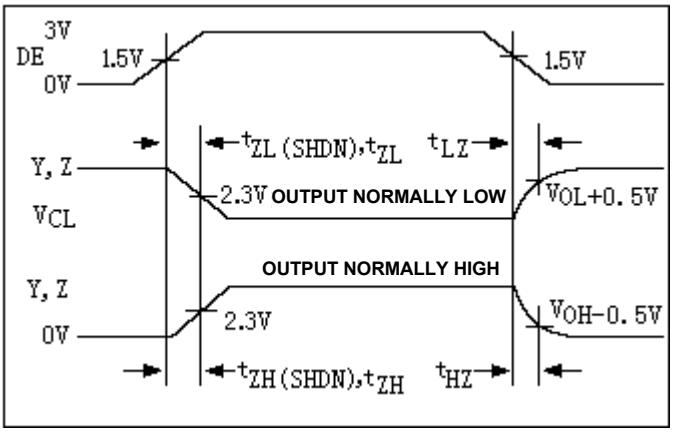


Figure 9: Driver enable and disable times

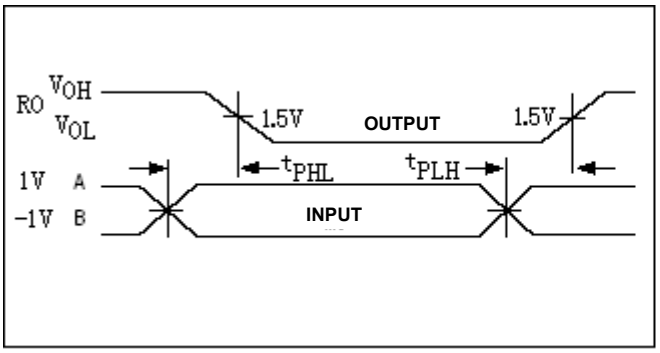


Figure 10: Receiver propagation delays

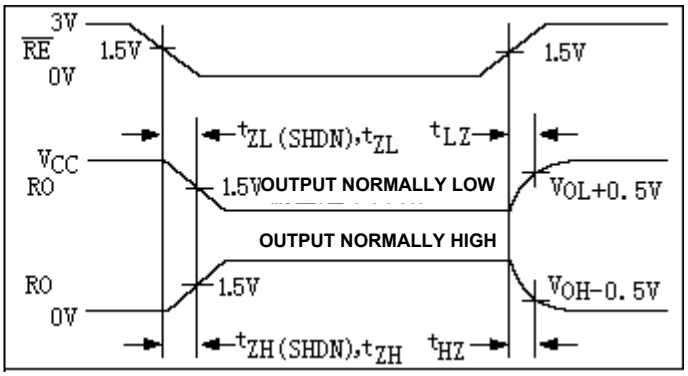


Figure 11: Receiver enable and disable times

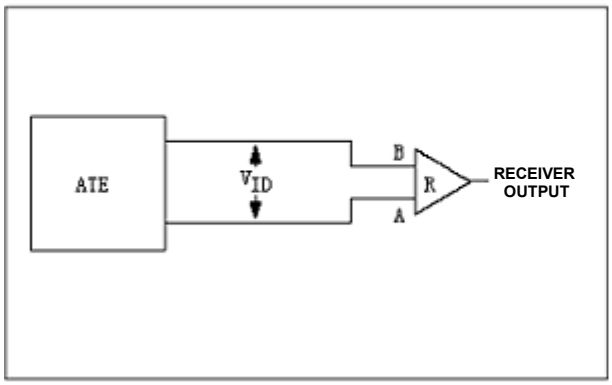


Figure 12: Receiver propagation delay test circuit

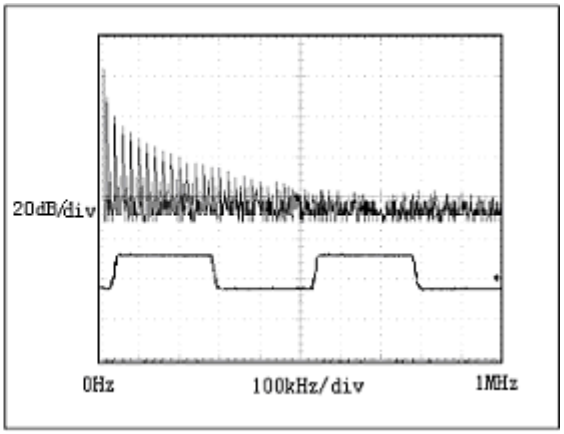


Figure 13: GM3085E driver output waveform and FFT diagram when transmitting a 20kHz signal

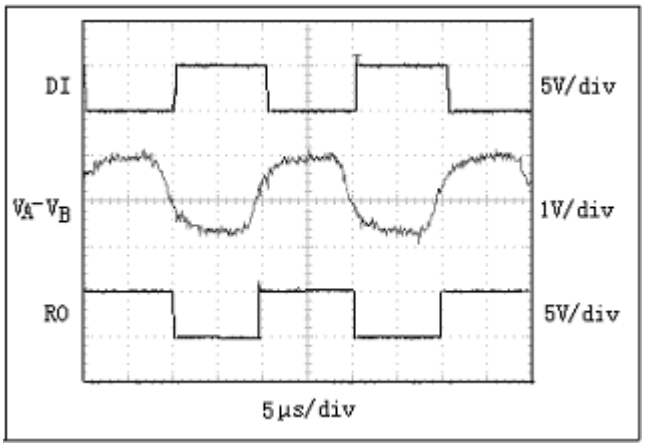


Figure 14: System differential voltage at 50kHz driving 4000 feet of cable

Drive output protection

A foldback current limit mechanism on the output stage prevents excessive output current and high power dissipation caused by faults or by bus contention. The output stage foldback current limiting provides immediate short-circuit protection over the entire common-mode voltage range (refer to the typical operating characteristics).

Typical application

The GM3085E transceiver is designed for two-way data communication on a multipoint bus transmission line. Figure 15 shows a typical network application circuit. These devices can also be used as linear transponders with cables longer than 4000 feet, as shown in Figure 14. In order to reduce reflections, terminal matching should be performed at both ends of the transmission line with the characteristic impedance of the wire used, and the length of the branch wires outside the main line should be as short as possible

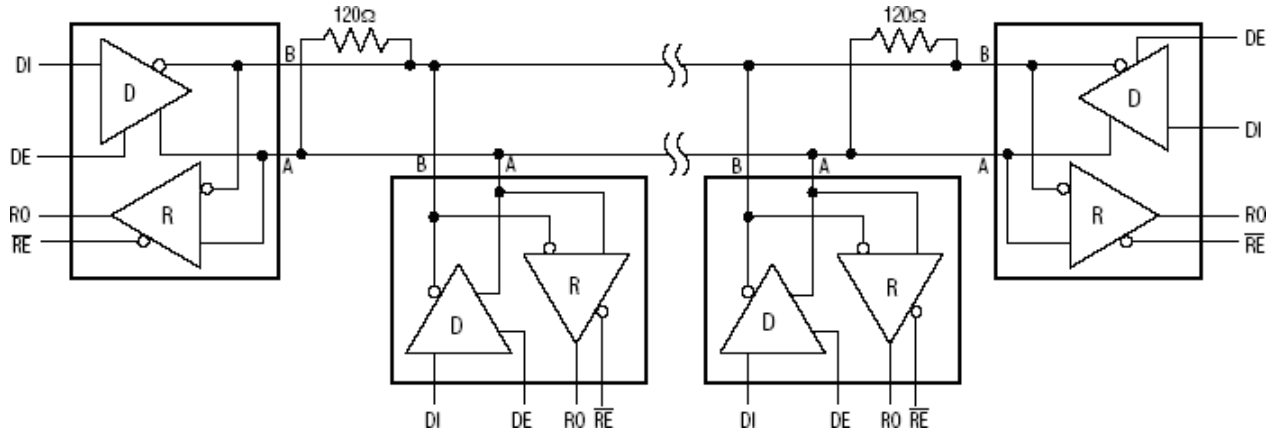


Figure 15: Typical half-duplex RS-485 network

Product information

1. Internal structure and materials

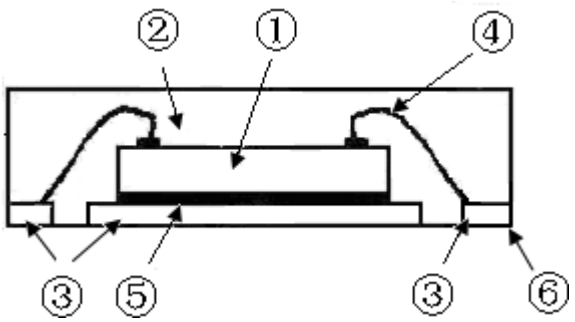


Figure 16: Typical IC internal structure diagram

NO	Item	Materials
1	Die	Silicon
2	Molding	Silica Fused
3	Lead frame	Cu-Alloy
4	Wire	Au or Cu
5	Die attach	Ag paste
6	Plating	Sn

2. Storage conditions

Operating temperature range: -40℃～+85℃
Storage temperature range: -65℃～+150℃
The recommended storage conditions are as follows:
——Temperature: +5℃～+30℃
——Humidity: 40%～70%RH

3. Welding temperature

3.1 Recommended reflow soldering temperature

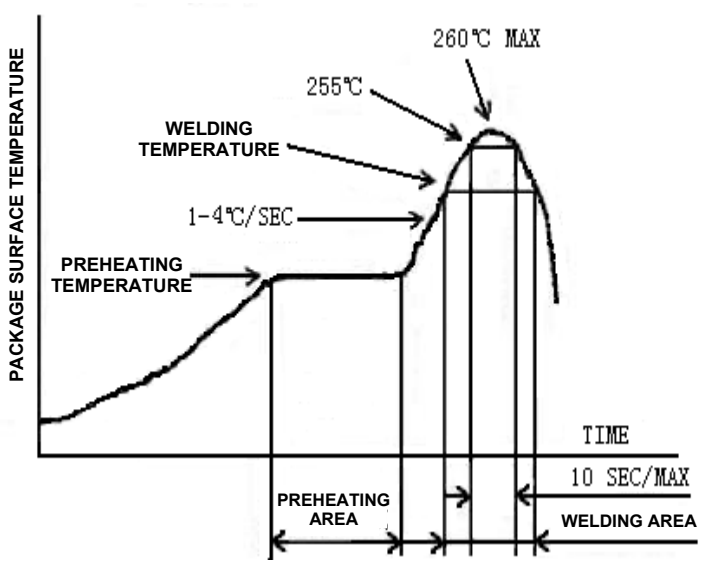


Figure 17: IC reflow soldering temperature curve

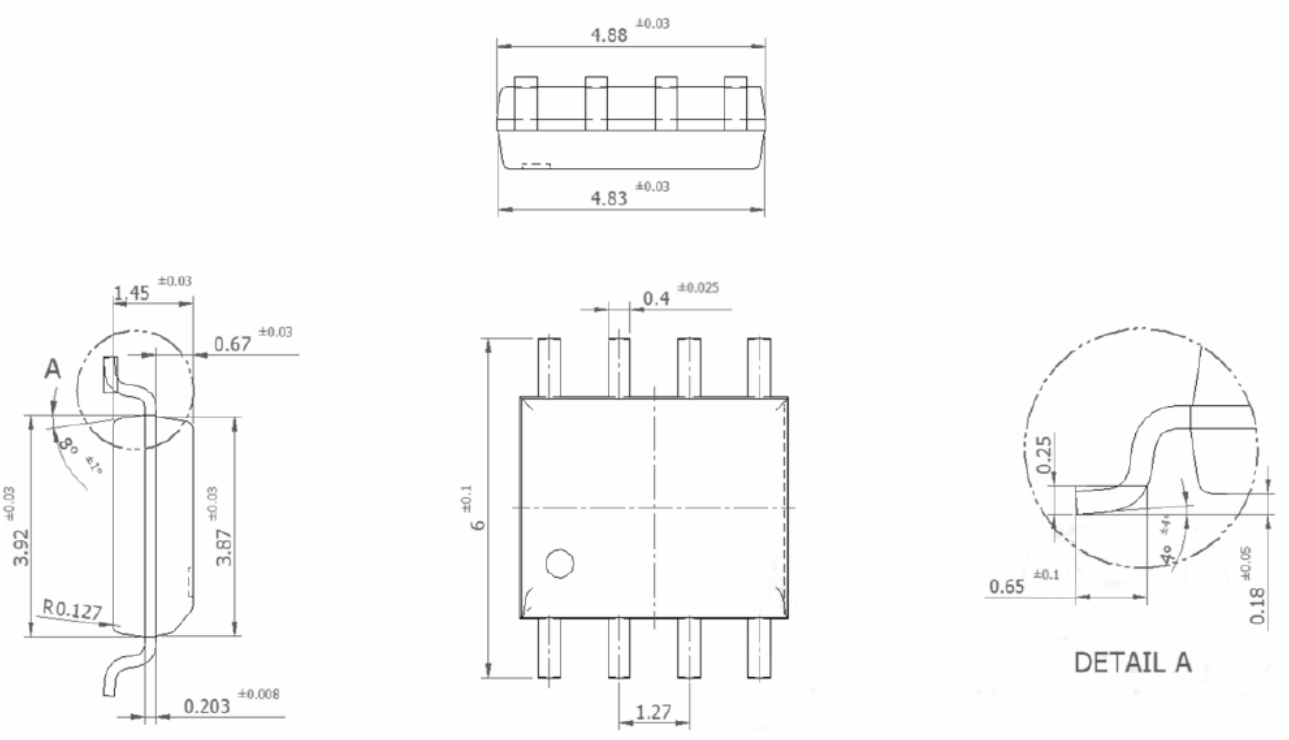
Preheating temperature: 130℃～190℃
Preheating area: 120sec max
Welding temperature: 200℃～230℃
Welding area: 60sec max

(Note) Number of maximum reflow cycles: twice

3.2 DIP8 products are suitable for wave soldering, and the soldering temperature is 235℃～260℃.

4. Package information

8-pin plastic SOIC8, package code: SOP8



Note: All dimensions are in millimeters.

Version information

Version	Content	Modify page	Date	Modifier
2.0	1. Modify and optimize layout style of the content of the manual; 2. Modify and optimize ordering information; 3. Added ESD electrostatic protection features; 4. Update package information chart.	1 3 12	2017-08-08	Andy
…				