

1 FEATURES

- A low-current shutdown mode is provided
- Industry standard SOP8 package available
- Allow Up to 256 Transceivers on the Bus
- True Fail-Safe Receiver While Maintaining EIA/TIA-485 Compatibility
- Enhanced Slew-Rate Limiting Facilitates Error-Free Data Transmission
- Enhanced ESD protection is provided for RS-485/RS-422 A/B pins

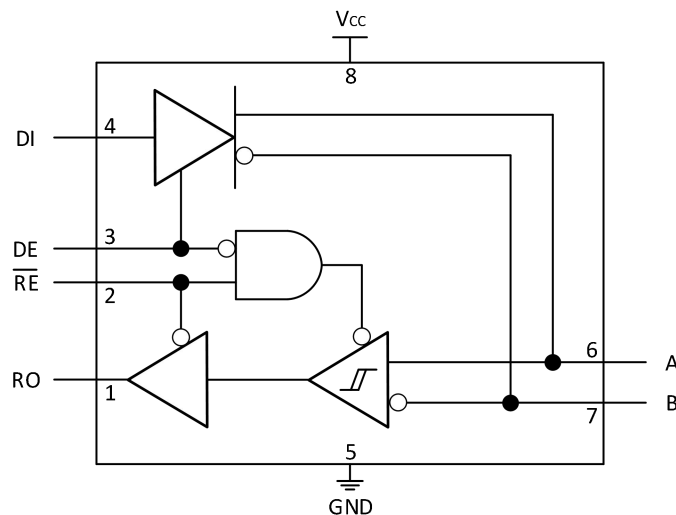
2 APPLICATIONS

- Industrial control
- Electricity meter, water meter, gas meter
- EMI sensitive transceiver applications
- Security system
- Lighting system
- Instrument and meter

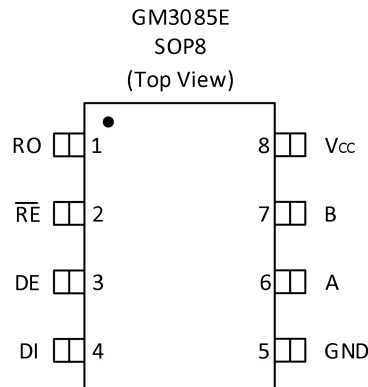
3 DESCRIPTION

The GM3085E are $\pm 8\text{kV}$ electrostatic discharge (ESD)-protected, high-speed transceivers for RS-485/RS-422 communication that contain one driver and one receiver. These devices feature 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 a logic high if all transmitters on a terminated bus are disabled (high impedance). The GM3085E is equipped with reduced slew-rate drivers. These drivers can minimize EMI and reduce reflections caused by improperly terminated cables, enabling error-free data transmission at speeds of up to 1Mbps. In addition, the receivers of the GM3085E have a $1/8$ -unit-load input impedance, which allows up to 256 transceivers to be connected to the bus.

BLOCK DIAGRAM



4 Pin Configuration and Functions



Pin	Name	Description
1	RO	Receiver output. When $\overline{RE}$ is at low level, if $A-B \geq -50mV$, RO outputs a high level; if $A-B \leq -200mV$, RO outputs a low level
2	RE	Receiver output enable. When $\overline{RE}$ is connected to low level, the RO output is valid. When $\overline{RE}$ is connected to high level, RO is in a high - impedance state. When $\overline{RE}$ is connected to high level and DE is connected to low level, the device enters the low-power shutdown mode
3	DE	Driver output enable. When DE is connected to a high level, the driver output is active. When DE is at a low level, the output is in a high - impedance state. When $\overline{RE}$ is connected to a high level and DE is connected to a low level, the device enters the low-power shutdown mode
4	DI	Driver input. When DE is at a high level, a low level on DI forces the in-phase output to be low and the anti-phase output to be high. Similarly, a high level on DI will force the in-phase output to be high and the anti-phase output to be low
5	GND	Ground
6	A	Receiver in-phase input and driver in-phase output
7	B	Receiver inverse-phase input and driver inverse-phase output
8	VCC	Positive supply terminal: $3.0 \leq V_{CC} \leq 5.5V$

5 ABSOLUTE MAXIMUM RATINGS

Parameter	Parameter	Rating	UNIT
Supply Voltage	V_{CC}	+7	V
Control Input Voltage	$\overline{RE}, DE$	-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	-8 to +13	V
Receiver Input Voltage	A, B	-8 to +13	V
Receiver Output Voltage	RO	-0.3 to $V_{CC}+0.3$	V
Continuous Power Dissipation	SOP8	471	mW
Operating Temperature Ranges		-40 to +85	°C
Storage Temperature Range		-65 to +150	°C

6 DC ELECTRICAL CHARACTERISTICS

(V_{CC} = +5V ±5%, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at V_{CC} = +5V and T_A = +25°C.)⁽¹⁾

Parameter	Symbol	Condition		MIN	TYP	MAX	UNIT
DRIVER							
Supply Voltage	V _{CC}			3.0		5.5	V
Differential Driver Output (No Load)	V _{OD1}	Figure 2		1.5		5	V
Differential Driver Output	V _{OD2}	Figure 2, R=50Ω (RS-422)		2.0		5	V
		Figure 2, R=27Ω (RS-485)		1.5		5	V
Change-in-Magnitude of Differential Output Voltage ⁽²⁾	ΔV _{OD}	Figure 2, R=50Ω or R=27Ω				0.2	V
Driver Common-Mode Output Voltage	V _{OC}	Figure 2, R=50Ω or R=27Ω		1		3	V
Change-in-Magnitude of Common-Mode Voltage ⁽²⁾	ΔV _{OC}	Figure 2, 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}				100		mV
Input Current (A and B)	I _{IN4}	DE = GND, V _{CC} =	V _{IN} =12V			125	μA
		GND or 5.25V	V _{IN} =-7V	-75			
Driver Short-Circuit Output Current	I _{OSD}	-7V≤V _{OUT} ≤V _{CC}		-250			mA
		0V≤V _{OUT} ≤12V				250	
		0V≤V _{OUT} ≤V _{CC}		±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 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=V _{CC} , DE=V _{CC}			150	600	μA
		No load, RE=DI=GND, DE=GND			120	600	μA
Supply Current in Shutdown Mode	I _{SHDN}	DE=GND, RE=V _{CC} ,DI=V _{CC} or GND			0.1	10	μA
ESD ELECTROSTATIC PROTECTION							
Electrostatic Protection (A/B pin)		Human Body Model		±15			kV
		Machine Mode		±800			V
		Contact Discharge IEC 61000-4-2		±12			kV
		Air Discharge IEC 61000-4-2		±15			kV
Electrostatic Protection (other pins)		Human Body Model		±6			kV
		Machine Mode		±400			V

- 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.
- 2: ΔV_{OD} and ΔV_{OC} are the changes in V_{OD} and V_{OC} , respectively, when the DI input changes state.
- 3: The SRL pin is internally biased to $V_{CC}/2$ by a 100k Ω /100k Ω resistor-divider. It is guaranteed to be $V_{CC}/2$ if left unconnected.
- 4: Maximum current level applies to peak current just prior to foldback-current limiting; minimum current level applies during current limiting.

7 SWITCHING CHARACTERISTICS—GM3085E

($V_{CC} = +5V \pm 5\%$, $T_A = T_{MIN}$ to T_{MAX} , unless otherwise noted. Typical values are at $V_{CC} = +5V$ and $T_A = +25^\circ C$.)

Parameter	Symbol	Condition	MIN	TYP	MAX	UNIT
Driver Input-to-Output	T_{DPLH}	Figures 4 and 6, $R_{DIFF}=54\Omega$, $C_{L1}=C_{L2}=100pF$	250	720	900	ns
	T_{DPHL}		250	720	900	
Driver Output Skew $t_{DPLH} - t_{DPHL}$	T_{DSKEW}	Figures 4 and 6, $R_{DIFF}=54\Omega$, $C_{L1}=C_{L2}=100pF$		-3	± 100	ns
Driver Rise or Fall Time	T_{DR}, T_{DF}	Figures 4 and 6, $R_{DIFF}=54\Omega$, $C_{L1}=C_{L2}=100pF$	200	530	750	ns
Maximum Data Rate	F_{MAX}				500	kbps
Driver Enable to Output High	T_{DZH}	Figures 5 and 7, $C_L=100pF$, S2 closed			2500	ns
Driver Enable to Output Low	T_{DZL}	Figures 5 and 7, $C_L=100pF$, S1 closed			2500	ns
Driver Disable Time from Low	T_{DLZ}	Figures 5 and 7, $C_L=15pF$, S1 closed			100	ns
Driver Disable Time from High	T_{DHZ}	Figures 5 and 7, $C_L=15pF$, S2 closed			100	ns
Receiver Input to Output	T_{RPLH}, T_{RPHL}	Figures 8 and 10; V_{ID} $\geq 2.0V$; rise and fall time of $V_{ID} \leq 15ns$		127	200	ns
$t_{RPLH} - t_{RPHL}$ Differential Receiver Skew	T_{RSKD}	Figures 8 and 10; V_{ID} $\geq 2.0V$; rise and fall time of $V_{ID} \leq 15ns$		3	± 30	ns
Receiver Enable to Output Low	T_{RZL}	Figures 3 and 9, $C_L=100pF$, S1 closed		20	50	ns
Receiver Enable to Output High	T_{RZH}	Figures 3 and 9, $C_L=100pF$, S2 closed		20	50	ns
Receiver Disable Time from Low	T_{RLZ}	Figures 3 and 9, $C_L=100pF$, S1 closed		20	50	ns
Receiver Disable Time from High	T_{RHZ}	Figures 3 and 9, $C_L=100pF$, S2 closed		20	50	ns
Time to Shutdown	T_{SHDN}	(5)	50	200	600	ns
Driver Enable from Shutdown to Output High	$T_{DZH(SHDN)}$	Figures 5 and 7, $C_L=15pF$, S2 closed			4500	ns
Driver Enable from Shutdown to Output Low	$T_{DZL(SHDN)}$	Figures 5 and 7, $C_L=15pF$, S1 closed			4500	ns
Receiver Enable from Shutdown to Output High	$T_{RZH(SHDN)}$	Figures 3 and 9, $C_L=100pF$, S2 closed			3500	ns
Receiver Enable from Shutdown to Output Low	$T_{RZL(SHDN)}$	Figures 3 and 9, $C_L=100pF$, S1 closed			3500	ns

5: The device is put into shutdown by bringing $\overline{RE}$ 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.

8 FUNCTION TABLES

GM3085E

TRANSMITTING				
INPUTS			OUTPUTS	
$\overline{RE}$	DE	DI	Z	Y
X	1	1	0	1
X	1	0	1	0
0	0	X	High-Z	High-Z
1	0	X	Shutdown	

GM3085E

RECEIVING			
INPUTS			OUTPUTS
$\overline{RE}$	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

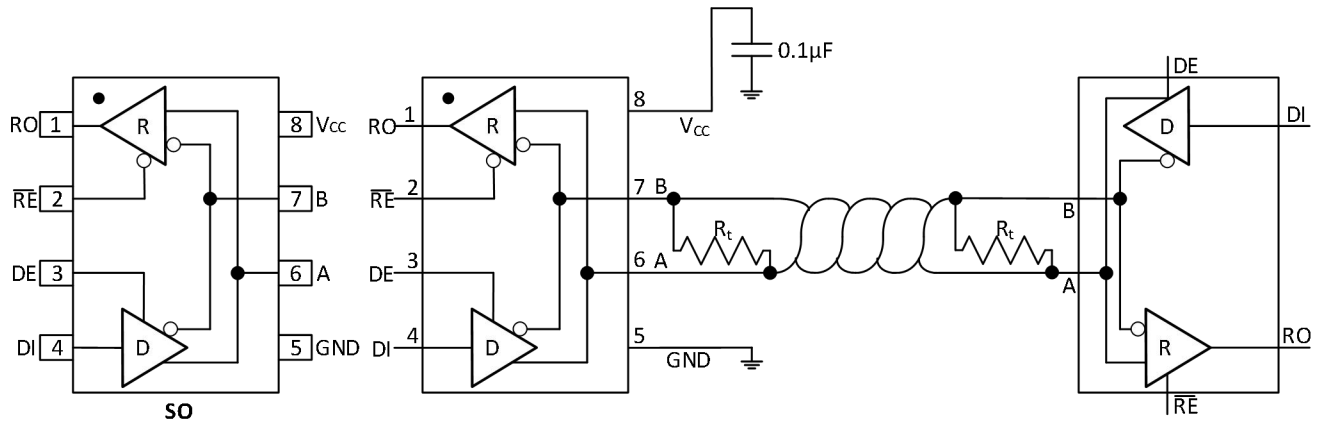


Figure 1. GM3085E Typical Half-Duplex Operating Circuit

8.1 Detailed Description

The GM3085E high-speed transceiver for RS-485/RS-422 communication contains a driver and a receiver. It has a fail-safe circuit that ensures the receiver outputs a logic high level when the receiver inputs are open-circuited or short-circuited. If all transmitters connected to the terminated bus are disabled (in a high-impedance state), the receiver will output a logic high level. The GM3085E is equipped with a low-slew-rate driver, which can reduce EMI and reflections caused by improper cable termination, enabling error-free data transmission at speeds of up to 1Mbps. The GM3085E is a half-duplex transceiver.

8.2 Receiver Input Filtering

The receivers of the GM3085E when operating in 1Mbps mode, incorporate input filtering in addition to input hysteresis. This filtering enhances noise immunity with differential signals that have very slow rise and fall times. Receiver propagation delay increases by 25% due to this filtering.

8.3 Fail-Safe

The GM3085E 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 the GM3085E, 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.

8.4 256 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 GM3085E 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.

8.5 Reduced EMI and Reflections

The low slew rate driver of GM3085N can reduce EMI and decrease reflections caused by improper cable termination. The rise time of the driver is related to the length of the terminal, and the following equation represents their relationship: $\text{Length} = T_{\text{RISE}} / (10 \times 1.5\text{ns} / F_t)$, where T_{RISE} is the rise time of the driver.

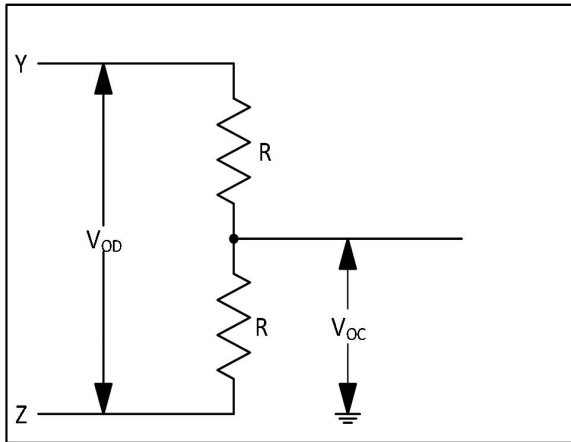


Figure 2. Driver DC Test Load

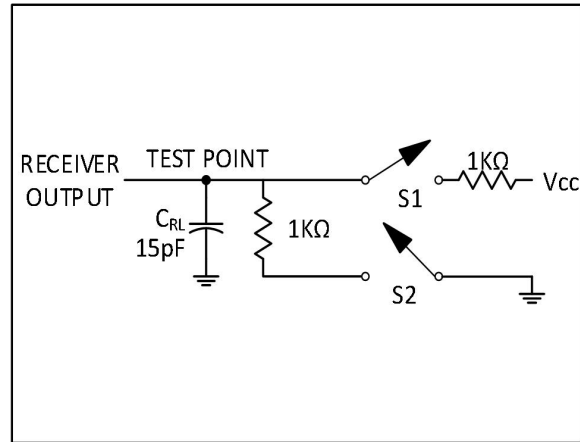


Figure 3. Receiver enable/disable timing test load

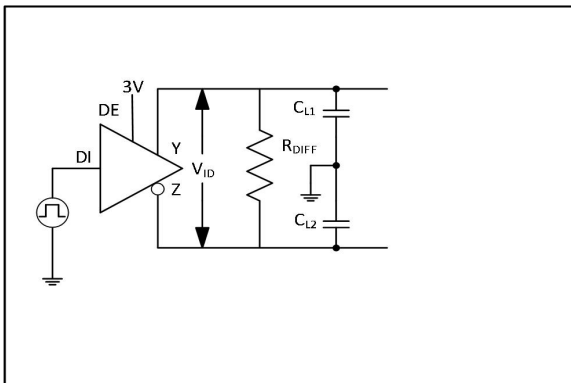


Figure 4. Transmitter timing test load

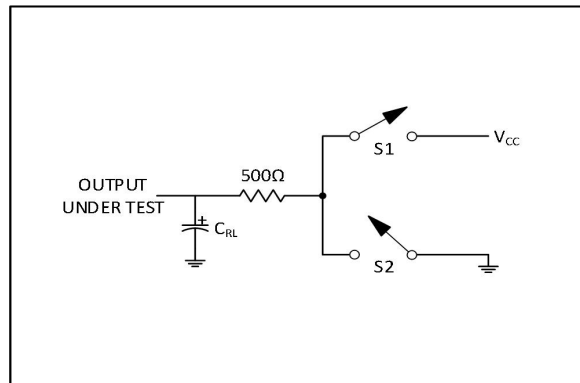


Figure 5. Transmitter enable/disable timing test load

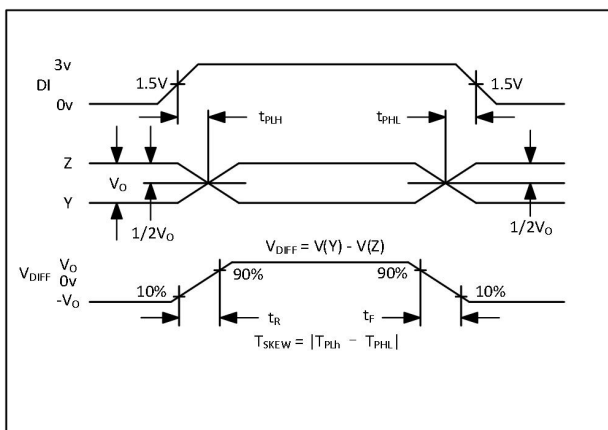


Figure 6. Transmitter propagation delays

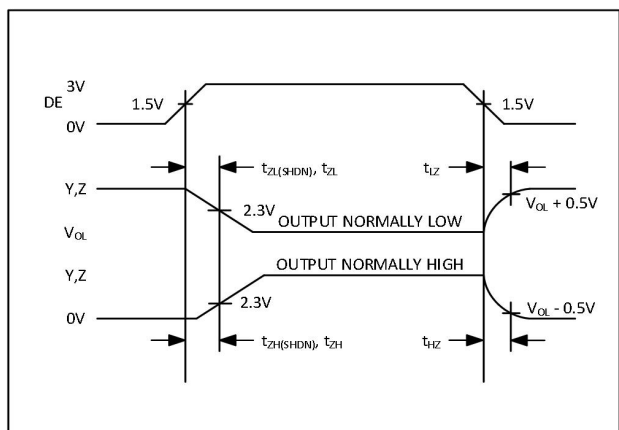


Figure 7. Transmitter enable and disable time

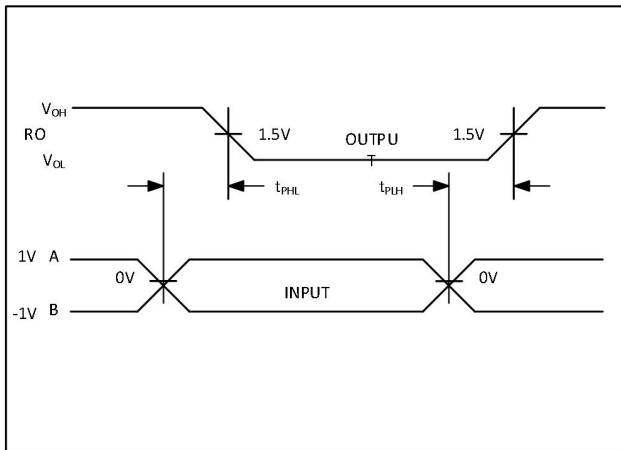


Figure 8. Receiver propagation delays

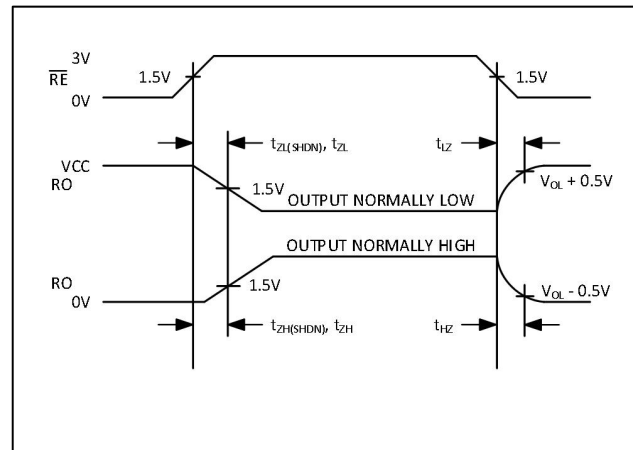


Figure 9. Receiver enable and disable time

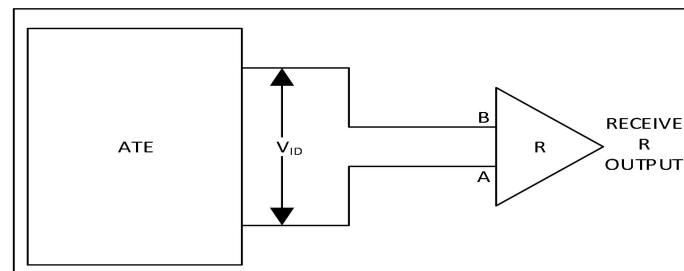


Figure 10. Receiver-Propagation-Delay Test Circuit

8.6 Typical Application

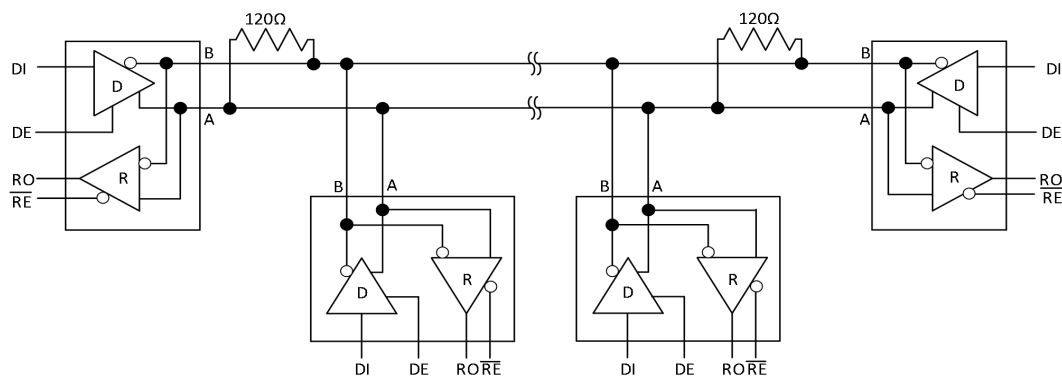
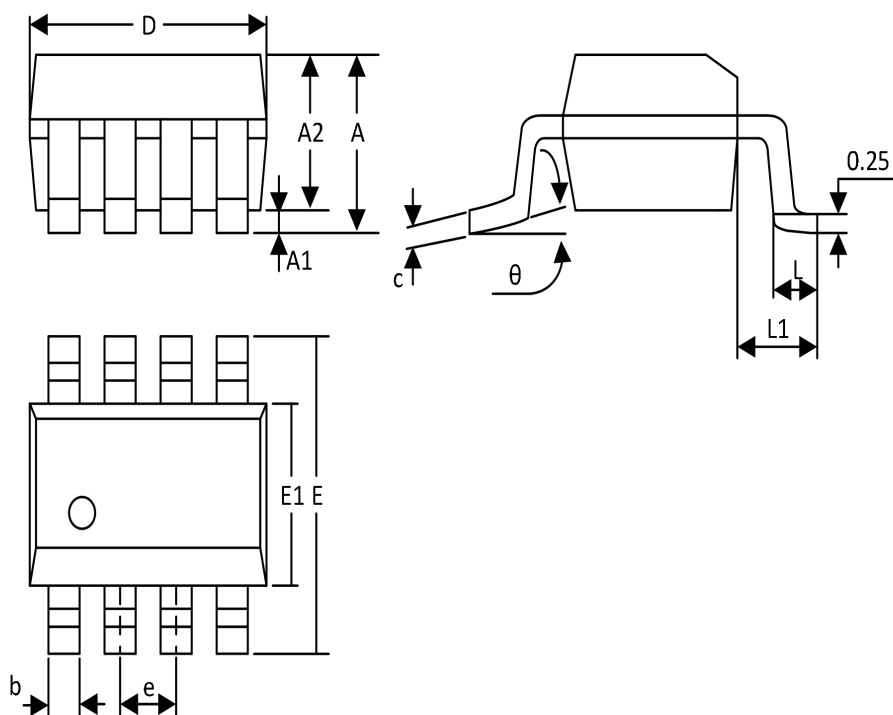


Figure11. Typical Polarity-Adaptive RS-485 Network Application Diagram

PACKAGE DIMENSION

SOP8



SYMBOLS	MILLIMETER		
	MIN	NOM	MAX
A	1.5	-	1.7
A1	0.1	-	0.25
A2	1.3	1.4	1.5
b	0.33	0.4	0.47
C	0.2	-	0.25
D	4.7	4.9	5.1
E	5.9	6	6.1
E1	3.8	3.9	4
e	1.27(BSC)		
L	0.55	0.6	0.75
L1	1.05(BSC)		
θ	0°	4°	8°

Order Information

Order number	Package	Marking information	Operation Temperature Range	MSL Grade	Ship, Quantity	Green
GM3085E	SOP8	GM3085E	-40 to 85°C	3	T&R, 2500	Rohs