1 FEATURES

- Bus-Pin Fault Protection > ±70V
- Cable Invert Function Allows Correction for Reversed Bus Pins
- Common-Mode Voltage Range (–20V to 30V)More Than Doubles TIA/EIA 485 Requirement
- ±16kV HBM Protection on Bus Pins
- Reduced Unit Load for Up to 256 Nodes
- Failsafe Receiver for Open-Circuit, Short-Circuit,and Idle-Bus Conditions
- Low Power Consumption:
  I_{CC} 0. 5mA Quiescent Current During Operation
- Power-Up, Power-Down Glitch-Free Operation

2 APPLICATIONS

- HAVC Networks
- Security Electronics
- Building Automation
- Telecommunication Equipment
- Motion Control
- Industrial Networks

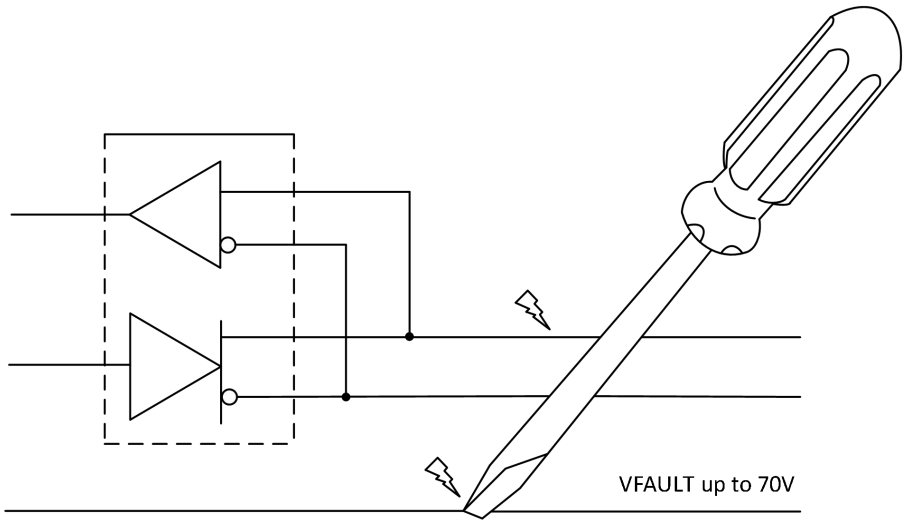
3 DESCRIPTION

These devices are designed to survive overvoltage faults such as direct shorts to power supplies, mis-wiring faults, connector failures, cable crushes, and tool mis-applications. They are also robust to ESD events, with high levels of protection to human-body model specifications.

These devices combine a differential driver and a differential receiver, which operate from a single power supply.The driver differential outputs and the receiver differential inputs are connected internally to for a bus port suitable for half-duplex (two-wire bus) communication. A cable invert pin (INV) allows active correction of mis-wires that may occur during installation. Upon detecting communication errors, the user can apply a logic HIGH to the INV pin, effectively inverting the polarity of the differential bus port, thereby correcting for the reversed bus wires.

These devices feature a wide common-mode voltage range, making them suitable for multi-point applications over long cable runs. These devices are characterized from –40°C to 125°C.

Protection Against Bus Shorts



Device Comparison Table

TRANSCEIVER	SLGNALING RATE	DUPLEX	NODES	CABLE LENGTH
GM1794	1Mbps	HALF	Up to 256	1000m
GM1795	10Mbps	HALF	Up to 256	150m

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4 Pin Configuration and Functions

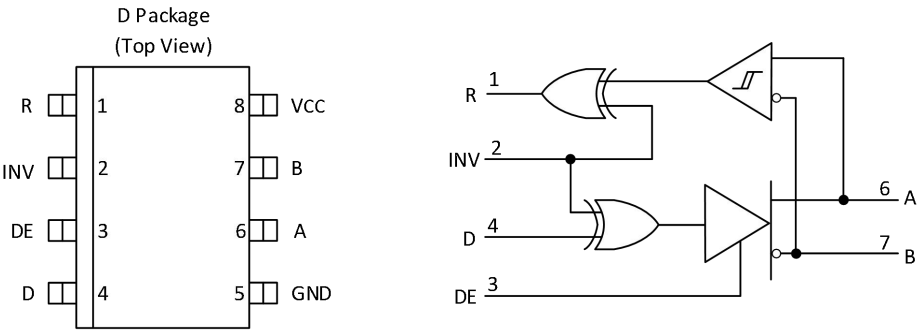


Figure 1. GM17xx With Inverting Feature to Correct for Miswired Cables

5 Specifications

5.1 Absolute Maximum Ratings(1)

	Description	VALUE	UNIT
V_{CC}	Supply voltage	–0.5 to 7	V
	Voltage range at A and B pins with respect to GND	–70 to 70	V
	Voltage range across A and B pins (differential)	–70 to 70	V
	Input voltage range at any logic pin	–0.3 to V_{CC} + 0.3	V
	Receiver output current	–24 to 24	mA
T_J	Junction temperature	170	°C
	IEC 60749-26 ESD (human-body model), bus terminals and GND	±16	kV
	JEDEC Standard 22, human-body model, all pins	±4	kV
	JEDEC Standard 22,charged-device model, all pins	±2	kV
	JEDEC Standard 22, machine model, all pins	±400	V

(1) 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 under Recommended Operating Conditions is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

5.2 Recommended Operating Conditions

Parameter	Description		MIN	NOM	MAX	UNIT
V_{CC}	Supply voltage		4.5	5	5.5	V
V_I	voltage at any bus terminal (separately or common mode)(1)		-30		30	V
V_{IH}	High-level input voltage	driver, driver enable, and invert inputs	2		V_{CC}	V
V_{IL}	Low-level input voltage	driver, driver enable, and invert inputs	0		0.8	V
V_{ID}	Differential input voltage		-25		25	V
I_O	output current	Driver	-60		60	mA
		Receiver	-8		8	mA
R_L	Differential load resistance		54	60		Ω
C_L	Differential load capacitance			50		pF
$1/t_{U1}$	Signaling rate	GM1794			1	Mbps
		GM1795			10	Mbps
T_A	Operating free-air temperature(1)	5V supply	-40		125	°C
T_J	junction temperature		-40		150	°C

(1) By convention, the least positive (most negative) limit is designated as minimum in this data sheet.

5.3 Electrical Characteristics

over operating free-air temperature range (unless otherwise noted)

Parameter	Description	Test Conditions		MIN	TYP	MAX	UNIT
$\|V_{OD(D)}\|$	Driver differential output voltage magnitude	RS-485 with common-mode load, V_{CC}>4.75V,See Figure 2	T_A≤85°C	1.5			V
			T_A≤125°C	1.4			
		R_L = 54Ω,4.75V ≤ V_{CC} ≤ 5.25V		1.5	2		
		R_L = 100Ω,4.75V ≤ V_{CC} ≤ 5.25V		2.5	3.0		
$\Delta\|V_{OD}\|$	Change in magnitude of driver differential output voltage	R_L = 54Ω		-0.2	0	0.2	V
$V_{OC(SS)}$	Steady-state common mode output voltage			1	V_{CC}/2	3	V
ΔV_{OC}	Change in differential driver output common mode voltage			-100	0	100	mV
$V_{OC(PP)}$	Peak-to-peak driver common mode output voltage	Center of two 27Ω load resistors,See Figure 3			500		mV
C_{OO}	Differential output capacitance				23		pF
V_{IT+}	Positive-going receiver differential input voltage threshold	V_{CM} = –20V to 25V			-100	-10	mV
V_{IT-}	Negative-going receiver differential input voltage threshold			-200	-150		mV
V_{hys}	Receiver differential input voltage threshold hysteresis (V_{IT+} – V_{IT-})			30	50		mV
V_{OH}	Receiver high-level output voltage	I_{OH}=-8mA		2.4	V_{CC}-0.3		V
V_{OL}	Receiver low-level output voltage	I_{OL}=8mA	T_A ≤85°C		0.2	0.4	V
			T_A ≤105°C		0.2	0.5	
$I_{I(LOGIC)}$	Driver input, driver enable, and invert input current			-100		100	µA
I_{OS}	Driver short-circuit output current	V_{CC} = 4.5 to 5.5V		-250		250	mA
$I_{I(BUS)}$	Bus input current (disabled driver)	V_{CC} = 4.5 to 5.5V or V_{CC} = 0V,DE at 0V	V_I=12V		75	125	µA
			V_I=-7V	-100	-40		
I_{CC}	Driver enabled	DE = 5V			0.5	0.7	mA
	Driver disabled	DE = GND			0.2	0.4	

5.4 Switching Characteristics

over recommended operating conditions (unless otherwise noted)

Parameter	Description	Test Conditions	MIN	TYP(1)	MAX	UNIT
DRIVER(GM1794)						
t_f, t_r	Driver differential output rise or fall time	R_L = 54Ω, C_L = 50pF, See Figure 4	50		300	ns
t_{PHL}, t_{PLH}	Driver propagation delay				200	ns
$t_{sk(p)}$	Driver differential output pulse skew ($\|t_{PHL} - t_{PLH}\|$)				25	ns
t_{PHZ},t_{PLZ}	Driver disable time	See Figure 5 and Figure 6			3	µs
t_{PZH},t_{PZL}	Driver enable time				500	µs
DRIVER(GM1795)						
t_f,t_r	Driver differential output rise or fall time	R_L = 54Ω, C_L = 50pF, See Figure 4	3		30	ns
t_{PHL}, t_{PLH}	Driver propagation delay				50	ns
$t_{sk(p)}$	Driver differential output pulse skew ($\|t_{PHL} - t_{PLH}\|$)				10	ns
t_{PHZ},t_{PLZ}	Driver disable time	See Figure 5 and Figure 6			3	µs
t_{PZH},t_{PZL}	Driver enable time				500	µs
RECEIVER (ALL DEVICES UNLESS OTHERWISE NOTED)						
t_f, t_r	Receiver output rise/fall time	C_L = 15pF, See Figure 7		4	15	ns
t_{PHL}, t_{PLH}	Receiver propagation delay time			100	200	ns
$t_{sk(p)}$	Receiver differential output pulse skew ($\|t_{PHL} - t_{PLH}\|$)			6	20	ns

6 Parameter Measurement Information

Input generator rate is 100kbps, 50% duty cycle, rise or fall time is less than 6ns, output impedance is 50Ω.

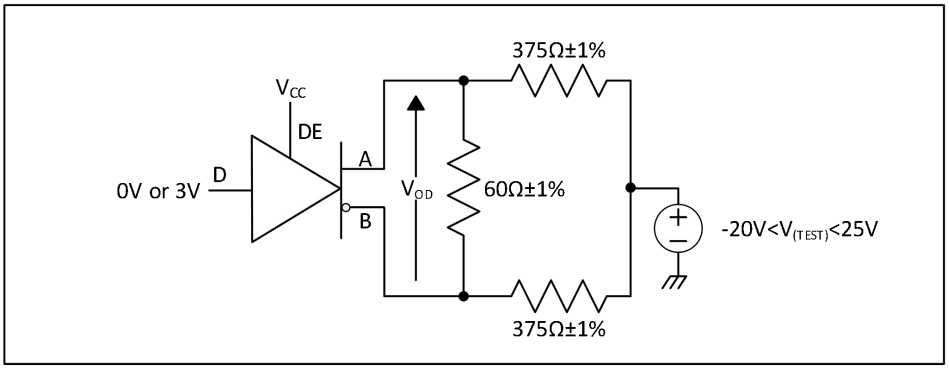


Figure 2. Measurement of Driver Differential Output Voltage With Common-Mode Load

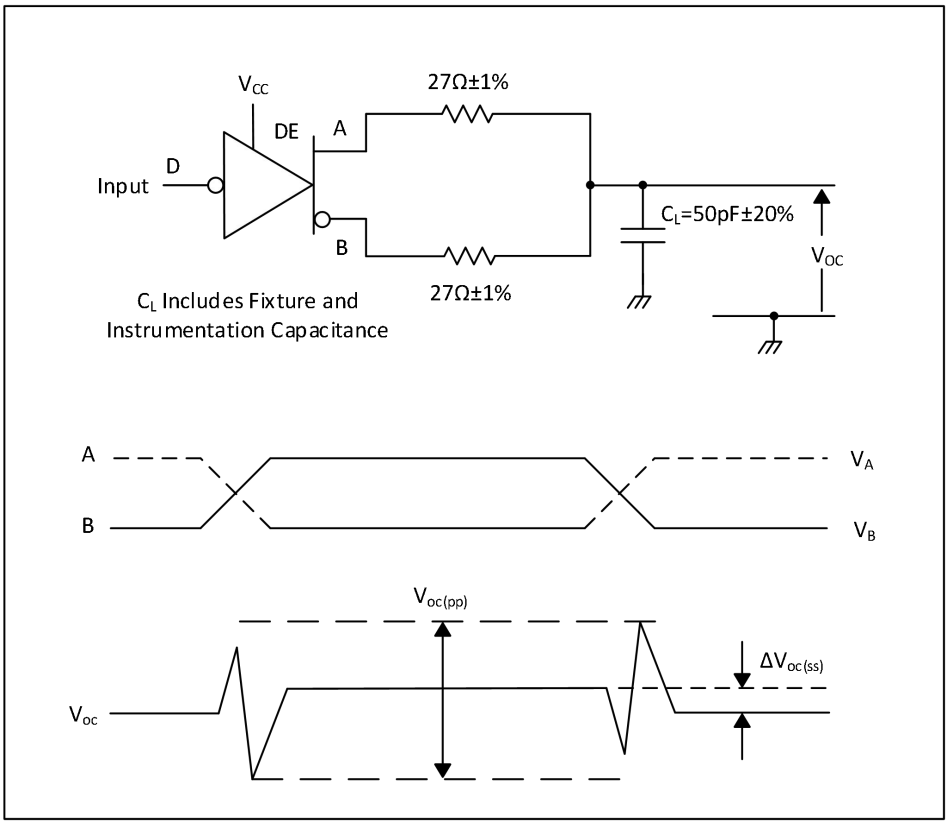


Figure 3. Measurement of Driver Differential and Common-Mode Output With RS-485 Load

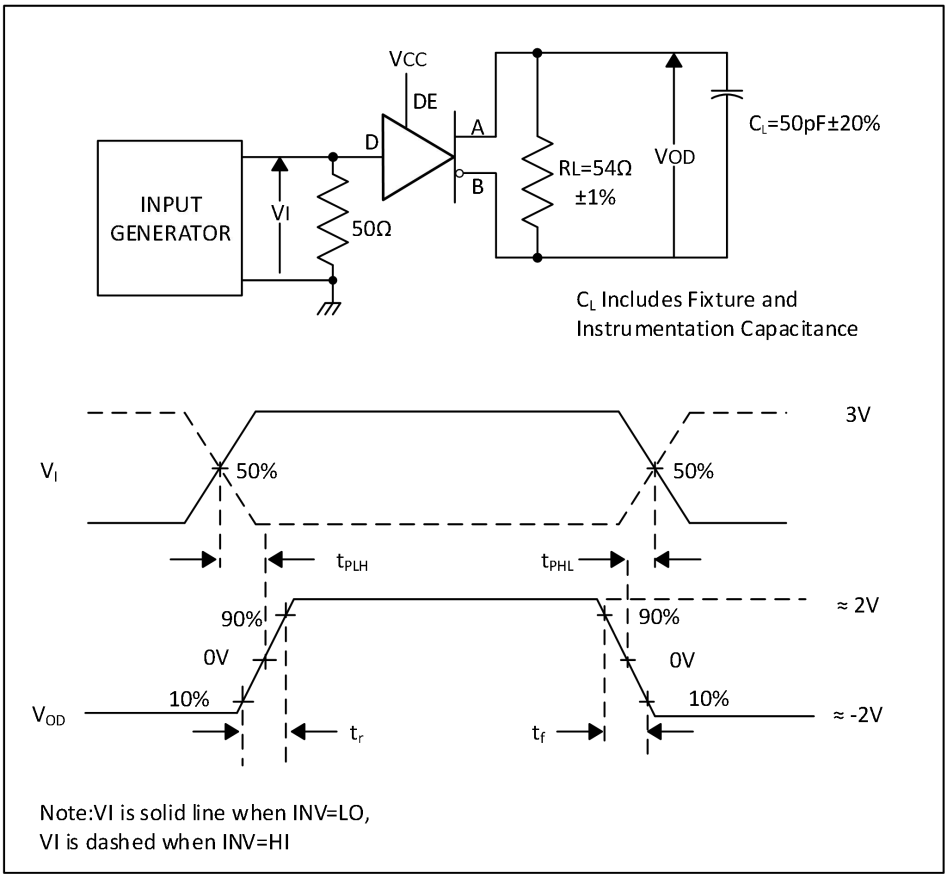


Figure 4. Measurement of Driver Differential Output Rise and Fall Times and Propagation Delays

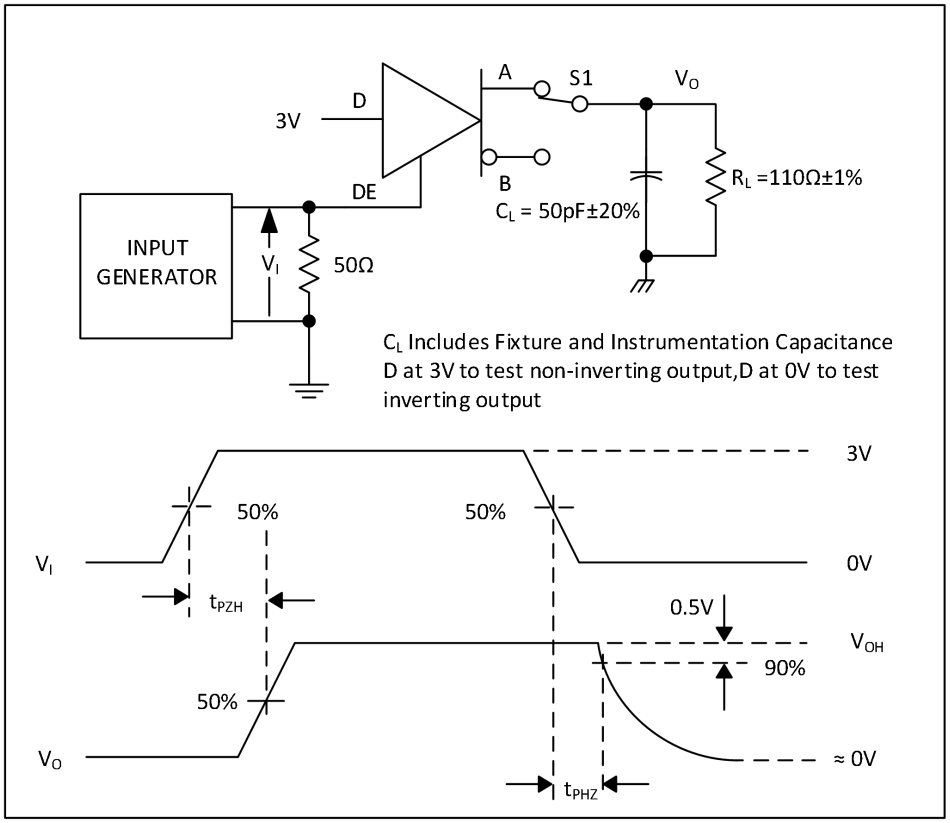


Figure 5. Measurement of Driver Enable and Disable Times With Active High Output and Pulldown Load

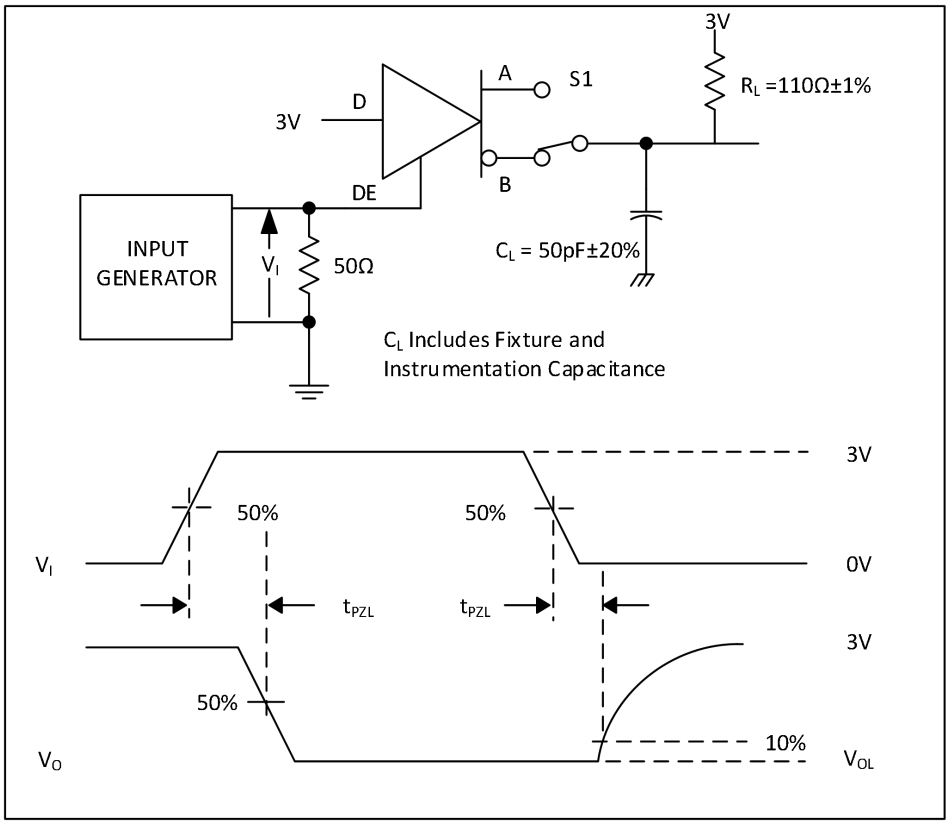


Figure 6. Measurement of Driver Enable and Disable Times With Active-Low Output and Pullup Load

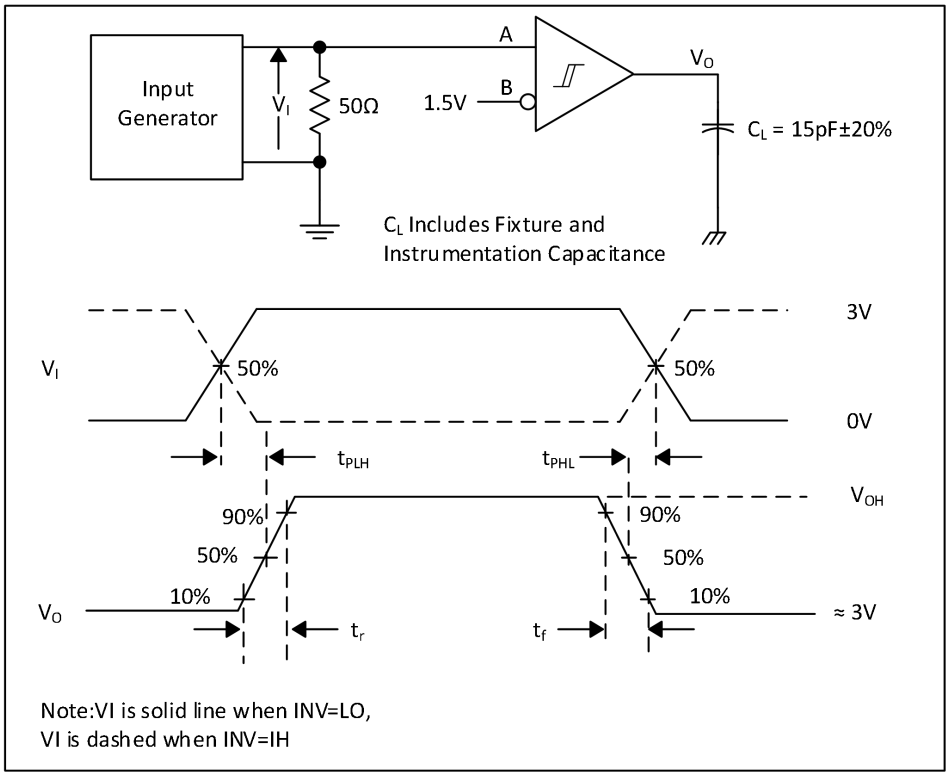


Figure 7. Measurement of Receiver Output Rise and Fall Times and Propagation Delays

7 Detailed Description

7.1 Hot-Plugging

These devices are designed to operate in "hot swap" or "hot pluggable" applications. Key features for hot pluggable applications are power-up, power-down glitch free operation, default disabled input/output pins, and receiver failsafe. An internal Power-On Reset circuit keeps the driver outputs in a high impedance state until the supply voltage has reached a level at which the device will reliably operate. This ensures that no spurious transitions (glitches) will occur on the bus pin outputs as the power supply turns on or turns off.

As shown in the device FUNCTION TABLE, the ENABLE inputs have the feature of default disable on both the driver enable and receiver enable. This ensures that the device will neither drive the bus nor report data on the R pin until the associated controller actively drives the enable pins.

Likewise, the receiver output is "failsafe" to open-circuit, short-circuit, or idle (terminated only) bus conditions. This eliminates false transitions on the receiver output until a valid RS-485 signal is applied to the receiver input pins.

7.2 Cable Invert

For many RS-485 applications, wiring of data cables takes place during equipment installation, and the possibility of miss-wiring is a significant issue. When the twisted-pair wires are reversed due to installation mistakes, normal RS-485 communication is not possible. The Cable Invert (INV) pin allows designers to compensate for this installation mistake. Under normal circumstances, the INV pin can be set to logic LOW, and the transceiver operates with normal polarity. If, after initial network start-up, a node cannot communicate properly, the local controller can set the INV pin high, which will invert the polarity of the A and B differential bus pins. This will compensate for a reversal of the bus wires, allowing proper communication.

7.3 Receiver Failsafe

The differential receiver is “failsafe” to invalid bus states caused by open bus conditions such as a disconnected connector, shorted bus conditions such as cable damage shorting the twisted-pair together or idle bus conditions that occur when no driver is actively driving a valid RS-485 bus state on the network. In any of these cases, the differential receiver outputs a failsafe state, so that small noise signals do not cause spurious transitions at the receiver output. When INV is logic Low or Open (normal operation), the receiver output will be failsafe High. When INV is logic High to correct for a twisted-pair reversal, the receiver output will be failsafe Low under those fault conditions.

7.4 Device Information

Table 1. DRIVER FUNCTION TABLE

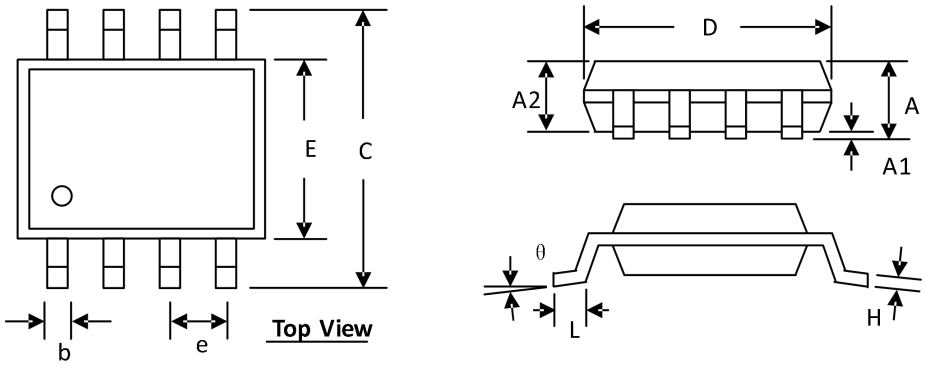
INPUT	ENABLE	INVERT	OUTPUTS		
D	**DE**	**INV**	**A**	**B**	
H	H	L	H	L	Actively drive normal bus High
L	H	L	L	H	Actively drive normal bus Low
H	H	H	L	H	Actively drive inverted bus High (drive normal bus Low)
L	H	H	H	L	Actively drive inverted bus Low (drive normal bus High)
X	L	X	Z	Z	Driver disabled
X	OPEN	X	Z	Z	Driver disabled by default
OPEN	H	L	H	L	Actively drive bus High by default
OPEN	H	H	L	H	Actively drive bus Low by default (inverted cable)

Table 2. RECEIVER FUNCTION TABLE

DIFFERENTIAL INPUT	ENABLE	OUTPUT	FUNCTION
$V_{ID} = V_A - V_B$	**INV**	**R**	
$V_{IT+} < V_{ID}$	L or OPEN	H	Receive valid bus high
	H	L	
$V_{IT-} < V_{ID} < V_{IT+}$	X	?	Indeterminate bus state
$V_{ID} < V_{IT-}$	L or OPEN	L	Receive valid bus low
	H	H	
Open-circuit bus	L or OPEN	H	Fail-safe high output
	H	L	
Short-circuit bus	L or OPEN	H	Fail-safe high output
	H	L	
Idle (terminated) bus	L or OPEN	H	Fail-safe high output
	H	L	

(1) When both the driver and receiver are disabled, the device enters a low-power standby mode.

PACKAGE DIMENSION SOP8-L



SYMBOLS	DIMENSION (MM)		DIMENSION (INCH)	
	MIN	MAX	MIN	MAX
A	1.300	1.752	0.051	0.069
A1	0.000	0.203	0.000	0.008
A2	1.350	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
C	5.790	6.200	0.228	0.244
D	4.700	5.110	0.185	0.201
E	3.800	4.000	0.150	0.157
e	1.270 BSC		0.050 BSC	
H	0.170	0.254	0.007	0.010
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°

Order Information

Order number	Package	Marking information	Operation Temperature Range	MSL Grade	Ship, Quantity	Green
GM1794E	SOP8-L	GM1794E	-40 to 125°C	3	T&R, 2500	Rohs
GM1795E	SOP8-L	GM1795E	-40 to 125°C	3	T&R, 2500	Rohs