



# 2.5 kV Isolated RS-485 Transceivers with Integrated Transformer Driver

## ADM2482E/ADM2487E

### FEATURES

- Isolated RS-485/RS-422 transceivers, configurable as half duplex or full duplex
- Integrated oscillator driver for external transformer
- ±15 kV ESD protection on RS-485 input/output pins
- Complies with TIA/EIA-485-A-98 and ISO 8482:1987(E)
- Data rate: 500 kbps/16 Mbps
- 5 V or 3.3 V operation ( $V_{DD1}$ )
- 256 nodes on bus
- True fail-safe receiver inputs
- 2500 V rms isolation for 1 minute
- Reinforced insulation 560 V peak
- High common-mode transient immunity: >25 kV/ $\mu$ s
- Thermal shutdown protection
- Operating temperature range: -40°C to +85°C
- Wide-body, 16-lead SOIC package

### APPLICATIONS

- Isolated RS-485/RS-422 interfaces
- Industrial field networks
- Multipoint data transmission systems

### GENERAL DESCRIPTION

The ADM2482E/ADM2487E are isolated data transceivers with ±15 kV ESD protection and are suitable for high speed, half-duplex or full-duplex communication on multipoint transmission lines. For half-duplex operation, the transmitter outputs and receiver inputs share the same transmission line. Transmitter Output Pin Y is linked externally to Receiver Input Pin A, and Transmitter Output Pin Z to Receiver Input Pin B. The parts are designed for balanced transmission lines and comply with TIA/EIA-485-A-98 and ISO 8482:1987(E).

The devices employ the Analog Devices, Inc., *iCoupler*® technology to combine a 3-channel isolator, a three-state differential line driver, and a differential input receiver into a single package. An on-chip oscillator outputs a pair of square waveforms that drive an external transformer to provide isolated

### FUNCTIONAL BLOCK DIAGRAM

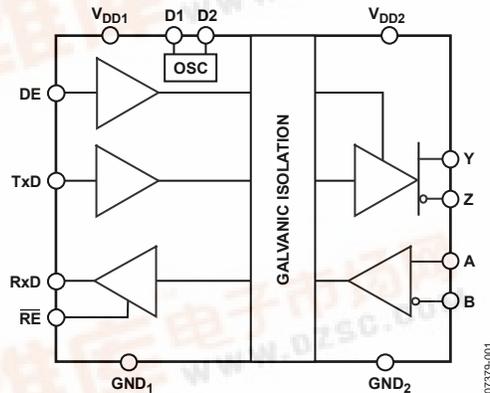


Figure 1.

power. The logic side of the device can be powered with either a 5 V or a 3.3 V supply, and the bus side is powered with an isolated 3.3 V supply.

The ADM2482E/ADM2487E driver has an active high enable, and the receiver has an active low enable. The driver output enters a high impedance state when the driver enable signal is low. The receiver output enters a high impedance state when the receiver enable signal is high.

The device has current-limiting and thermal shutdown features to protect against output short circuits and situations where bus contention might cause excessive power dissipation. The part is fully specified over the industrial temperature range of -40°C to +85°C and is available in a 16-lead, wide-body SOIC package.



# ADM2482E/ADM2487E

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## REVISION HISTORY

5/08—Revision 0: Initial Version

## SPECIFICATIONS

All voltages are relative to their respective ground;  $3.0\text{ V} \leq V_{DD1} \leq 5.5\text{ V}$ ,  $3.0\text{ V} \leq V_{DD2} \leq 3.6\text{ V}$ . All minimum/maximum specifications apply over the entire recommended operation range, unless otherwise noted. All typical specifications are at  $T_A = 25^\circ\text{C}$ ,  $V_{DD1} = 5\text{ V}$ ,  $V_{DD2} = 3.3\text{ V}$ , unless otherwise noted.

**Table 1.**

Parameter	Symbol	Min	Typ	Max	Unit	Test Conditions
<b>SUPPLY CURRENT</b>						
Power-Supply Current, Logic Side						
TxD/RxD Data Rate < 500 kbps	$I_{DD1}$			3.5	mA	Unloaded output
ADM2487E TxD/RxD Data Rate = 500 kbps	$I_{DD1}$			4	mA	Half-duplex configuration, $R_{TERMINATION} = 120\ \Omega$ , see Figure 8
ADM2482E TxD/RxD Data Rate = 16 Mbps	$I_{DD1}$			6.0	mA	Half-duplex configuration, $R_{TERMINATION} = 120\ \Omega$ , see Figure 8
Power-Supply Current, Bus Side						
TxD/RxD Data Rate < 500 kbps	$I_{DD2}$			17	mA	Unloaded output
ADM2487E TxD/RxD Data Rate = 500 kbps	$I_{DD2}$			40	mA	$V_{DD2} = 3.6\text{ V}$ , half-duplex configuration, $R_{TERMINATION} = 120\ \Omega$ , see Figure 8
ADM2482E TxD/RxD Data Rate = 16 Mbps	$I_{DD2}$			50	mA	$V_{DD2} = 3.6\text{ V}$ , half-duplex configuration, $R_{TERMINATION} = 120\ \Omega$ , see Figure 8
<b>DRIVER</b>						
Differential Outputs						
Differential Output Voltage, Loaded	$ V_{OD2} $	2.0		5.0	V	$R_L = 100\ \Omega$ (RS-422), see Figure 2
		1.5		5.0	V	$R_L = 54\ \Omega$ (RS-485), see Figure 2
	$ V_{OD3} $	1.5		5.0	V	$-7\text{ V} \leq V_{TEST} \leq +12\text{ V}$ , see Figure 3
$\Delta V_{OD} $ for Complementary Output States	$\Delta V_{OD} $			0.2	V	$R_L = 54\ \Omega$ or $100\ \Omega$ , see Figure 2
Common-Mode Output Voltage	$V_{OC}$			3.0	V	$R_L = 54\ \Omega$ or $100\ \Omega$ , see Figure 2
$\Delta V_{OC} $ for Complementary Output States	$\Delta V_{OC} $			0.2	V	$R_L = 54\ \Omega$ or $100\ \Omega$ , see Figure 2
Short-Circuit Output Current	$I_{OS}$			250	mA	
Output Leakage Current (Y, Z)	$I_o$			125	$\mu\text{A}$	$DE = 0\text{ V}$ , $\overline{RE} = 0\text{ V}$ , $V_{CC} = 0\text{ V}$ or $3.6\text{ V}$ , $V_{IN} = 12\text{ V}$
		-100			$\mu\text{A}$	$DE = 0\text{ V}$ , $\overline{RE} = 0\text{ V}$ , $V_{CC} = 0\text{ V}$ or $3.6\text{ V}$ , $V_{IN} = -7\text{ V}$
Logic Inputs						
Input Threshold Low	$V_{IL}$	$0.25 \times V_{DD1}$			V	$DE, \overline{RE}, \text{TxD}$
Input Threshold High	$V_{IH}$			$0.7 \times V_{DD1}$	V	$DE, \overline{RE}, \text{TxD}$
Input Current	$I_I$	-10	+0.01	+10	$\mu\text{A}$	$DE, \overline{RE}, \text{TxD}$
<b>RECEIVER</b>						
Differential Inputs						
Differential Input Threshold Voltage	$V_{TH}$	-200	-125	-30	mV	$-7\text{ V} < V_{CM} < +12\text{ V}$
Input Voltage Hysteresis	$V_{HYS}$		15		mV	$V_{OC} = 0\text{ V}$
Input Current (A, B)	$I_I$			125	$\mu\text{A}$	$DE = 0\text{ V}$ , $V_{DD} = 0\text{ V}$ or $3.6\text{ V}$ , $V_{IN} = 12\text{ V}$
				-125	$\mu\text{A}$	$DE = 0\text{ V}$ , $V_{DD} = 0\text{ V}$ or $3.6\text{ V}$ , $V_{IN} = -7\text{ V}$
Line Input Resistance	$R_{IN}$	96			k $\Omega$	$-7\text{ V} < V_{CM} < +12\text{ V}$
Logic Outputs						
Output Voltage Low	$V_{OLRXD}$		0.2	0.4	V	$I_{ORXD} = 1.5\text{ mA}$ , $V_A - V_B = -0.2\text{ V}$
Output Voltage High	$V_{OHRXD}$	$V_{DD1} - 0.3$	$V_{DD1} - 0.2$		V	$I_{ORXD} = -1.5\text{ mA}$ , $V_A - V_B = 0.2\text{ V}$
Short Circuit Current	$I_{OS}$			100	mA	
Tristate Output Leakage Current	$I_{OZR}$			$\pm 1$	$\mu\text{A}$	$V_{DD1} = 5.0\text{ V}$ , $0\text{ V} < V_O < V_{DD1}$

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Parameter	Symbol	Min	Typ	Max	Unit	Test Conditions
TRANSFORMER DRIVER						
Oscillator Frequency	$f_{OSC}$	400	500	600	kHz	$V_{DD1} = 5.0\text{ V}$
Switch-On Resistance	$R_{ON}$	230	330	430	kHz	$V_{DD1} = 3.3\text{ V}$
Start-Up Voltage	$V_{START}$		0.5	1.5	$\Omega$	
COMMON-MODE TRANSIENT IMMUNITY <sup>1</sup>		25	2.2	2.5	V	
					kV/ $\mu\text{s}$	$V_{CM} = 1\text{ kV}$ , transient magnitude = 800V

<sup>1</sup>  $C_M$  is the maximum common-mode voltage slew rate that can be sustained while maintaining specification-compliant operation.  $V_{CM}$  is the common-mode potential difference between the logic and bus sides. The transient magnitude is the range over which the common-mode is slewed. The common-mode voltage slew rates apply to both rising and falling common-mode voltage edges.

## TIMING SPECIFICATIONS

$T_A = -40^\circ\text{C}$  to  $+85^\circ\text{C}$

Table 2. ADM2482E

Parameter	Symbol	Min	Typ	Max	Unit	Test Conditions
DRIVER						
Propagation Delay	$t_{DPLH}, t_{DPHL}$		100		ns	$R_{DIFF} = 54\ \Omega, C_L = 100\text{ pF}$ , see Figure 4 and Figure 9
Output Skew	$t_{DSKEW}$		8		ns	$R_{DIFF} = 54\ \Omega, C_L = 100\text{ pF}$ , see Figure 4 and Figure 9
Rise Time/Fall Time	$t_{DR}, t_{DF}$		15		ns	$R_{DIFF} = 54\ \Omega, C_L = 100\text{ pF}$ , see Figure 4 and Figure 9
Enable Time	$t_{ZL}, t_{ZH}$		120		ns	$R_L = 110\ \Omega, C_L = 50\text{ pF}$ , see Figure 5 and Figure 11
Disable Time	$t_{LZ}, t_{HZ}$		150		ns	$R_L = 110\ \Omega, C_L = 50\text{ pF}$ , see Figure 5 and Figure 11
RECEIVER						
Propagation Delay	$t_{PLH}, t_{PHL}$		110		ns	$C_L = 15\text{ pF}$ , see Figure 6 and Figure 10
Output Skew	$t_{SKEW}$		8		ns	$C_L = 15\text{ pF}$ , see Figure 6 and Figure 10
Enable Time	$t_{ZL}, t_{ZH}$		13		ns	$R_L = 1\text{ k}\Omega, C_L = 15\text{ pF}$ , see Figure 7 and Figure 12
Disable Time	$t_{LZ}, t_{HZ}$		13		ns	$R_L = 1\text{ k}\Omega, C_L = 15\text{ pF}$ , see Figure 7 and Figure 12

Table 3. ADM2487E

Parameter	Symbol	Min	Typ	Max	Unit	Test Conditions
DRIVER						
Propagation Delay	$t_{DPLH}, t_{DPHL}$	250		700	ns	$R_{DIFF} = 54\ \Omega, C_L = 100\text{ pF}$ , see Figure 4 and Figure 9
Output Skew	$t_{DSKEW}$			100	ns	$R_{DIFF} = 54\ \Omega, C_L = 100\text{ pF}$ , see Figure 4 and Figure 9
Rise Time/Fall Time	$t_{DR}, t_{DF}$	200		1100	ns	$R_{DIFF} = 54\ \Omega, C_L = 100\text{ pF}$ , see Figure 4 and Figure 9
Enable Time	$t_{ZL}, t_{ZH}$			2.5	$\mu\text{s}$	$R_L = 110\ \Omega, C_L = 50\text{ pF}$ , see Figure 5 and Figure 11
Disable Time	$t_{LZ}, t_{HZ}$			200	ns	$R_L = 110\ \Omega, C_L = 50\text{ pF}$ , see Figure 5 and Figure 11
RECEIVER						
Propagation Delay	$t_{PLH}, t_{PHL}$			200	ns	$C_L = 15\text{ pF}$ , see Figure 6 and Figure 10
Output Skew	$t_{SKEW}$			30	ns	$C_L = 15\text{ pF}$ , see Figure 6 and Figure 10
Enable Time	$t_{ZL}, t_{ZH}$			13	ns	$R_L = 1\text{ k}\Omega, C_L = 15\text{ pF}$ , see Figure 7 and Figure 12
Disable Time	$t_{LZ}, t_{HZ}$			13	ns	$R_L = 1\text{ k}\Omega, C_L = 15\text{ pF}$ , see Figure 7 and Figure 12

**PACKAGE CHARACTERISTICS**

**Table 4.**

Parameter	Symbol	Min	Typ	Max	Unit	Test Conditions
Resistance (Input-Output) <sup>1</sup>	R <sub>I-O</sub>		10 <sup>12</sup>		Ω	
Capacitance (Input-Output) <sup>1</sup>	C <sub>I-O</sub>		3		pF	f = 1 MHz
Input Capacitance <sup>2</sup>	C <sub>I</sub>		4		pF	
Input IC Junction-to-Case Thermal Resistance	θ <sub>JCI</sub>		33		°C/W	Thermocouple located at center of package underside
Output IC Junction-to-Case Thermal Resistance	θ <sub>JCO</sub>		28		°C/W	Thermocouple located at center of package underside

<sup>1</sup> This device is considered a 2-terminal device: Pin 1 to Pin 8 are shorted together and Pin 9 to Pin 16 are shorted together.

<sup>2</sup> Input capacitance is from any input data pin to ground.

**INSULATION AND SAFETY-RELATED SPECIFICATIONS**

**Table 5.**

Parameter	Symbol	Value	Unit	Conditions
Rated Dielectric Insulation Voltage		2500	V rms	1-minute duration
Maximum Working Insulation Voltage		560	V peak	
Minimum External Air Gap (Clearance)	L(I01)	5.7 min	mm	Measured from input terminals to output terminals, shortest distance through air
Minimum External Tracking (Creepage)	L(I02)	6.1 min	mm	Measured from input terminals to output terminals, shortest distance along body
Minimum Internal Gap (Internal Clearance)		0.017 min	mm	Distance through insulation
Tracking Resistance (Comparative Tracking Index)	CTI	>175	V	DIN IEC 112/VDE 0303-1

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## TEST CIRCUITS

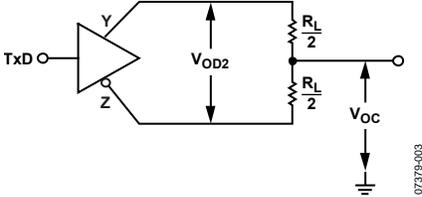


Figure 2. Driver Voltage Measurement

07379-003

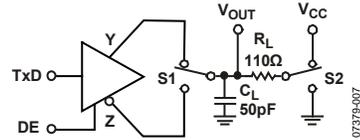


Figure 5. Driver Enable/Disable

07379-007

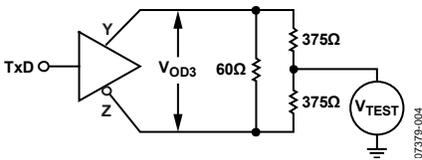


Figure 3. Driver Voltage Measurement

07379-004

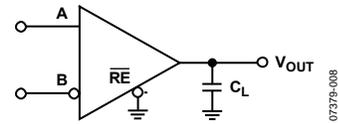


Figure 6. Receiver Propagation Delay

07379-008

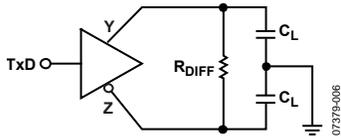


Figure 4. Driver Propagation Delay

07379-006

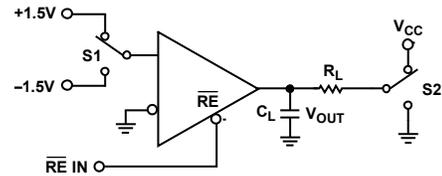


Figure 7. Receiver Enable/Disable

07379-009

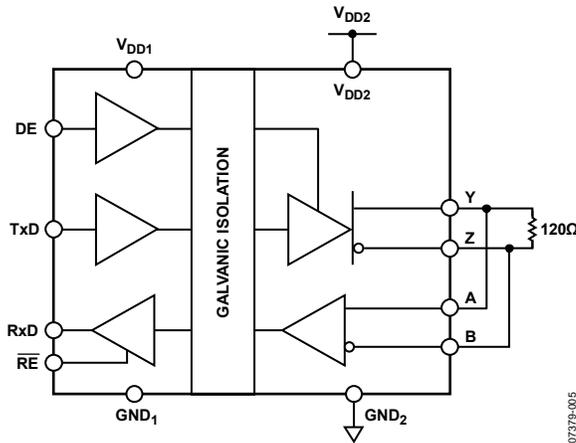
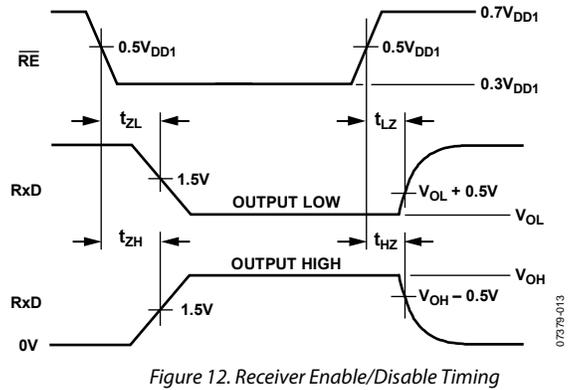
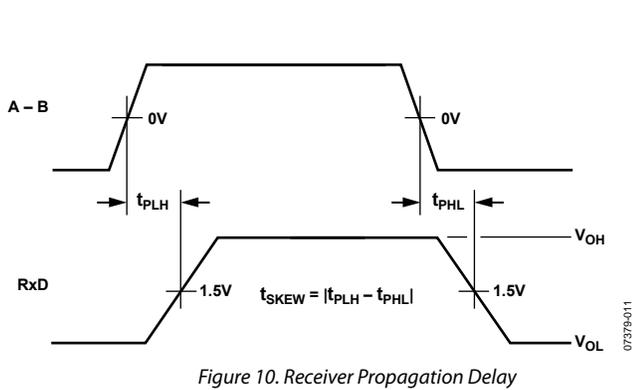
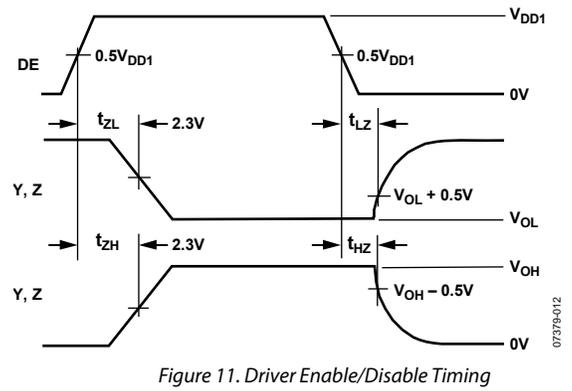
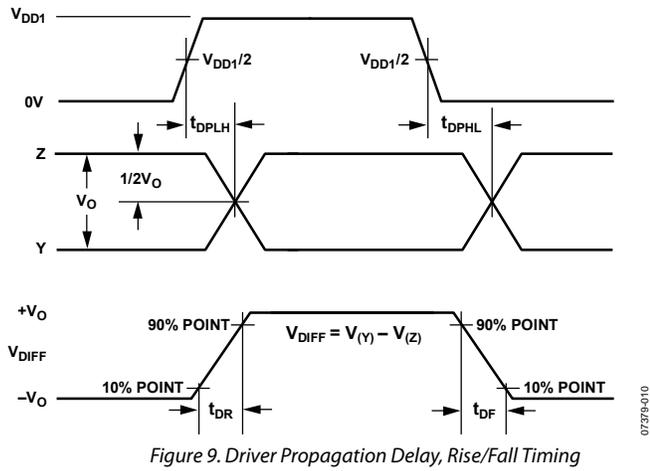


Figure 8. Supply-Current Measurement Test Circuit

07379-005

**SWITCHING CHARACTERISTICS**



# ADM2482E/ADM2487E

## ABSOLUTE MAXIMUM RATINGS

All voltages are relative to their respective ground;  $T_A = 25^\circ\text{C}$ , unless otherwise noted.

Table 6.

Parameter	Rating
$V_{DD1}$	-0.5 V to +6 V
$V_{DD2}$	-0.5 V to +6 V
Digital Input Voltages (DE, $\overline{\text{RE}}$ , TxD)	-0.5 V to $V_{DD1} + 0.5$ V
Digital Output Voltages	
RxD	-0.5 V to $V_{DD1} + 0.5$ V
D1, D2	13 V
Driver Output/Receiver Input Voltage	-9 V to +14 V
Operating Temperature Range	-40°C to +85°C
Storage Temperature Range	-55°C to +150°C
Average Output Current per Pin	-35 mA to +35 mA
ESD (Human Body Model) on A, B, Y and Z pins	$\pm 15$ kV
Lead Temperature	
Soldering (10 sec)	300°C
Vapor Phase (60 sec)	215°C
Infrared (15 sec)	220°C

Stresses above those listed under Absolute Maximum Ratings may cause permanent damage to the device. This is a stress rating only; functional operation of the device at these or any other conditions above those indicated in the operational section of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

### ESD CAUTION



**ESD (electrostatic discharge) sensitive device.** Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

## PIN CONFIGURATION AND FUNCTION DESCRIPTIONS

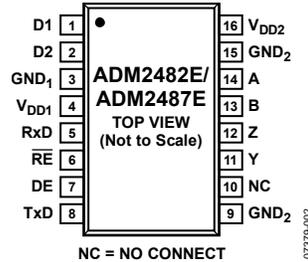


Figure 13. Pin Configuration

Table 7. Pin Function Descriptions

Pin No.	Mnemonic	Description
1	D1	Transformer Driver Terminal 1.
2	D2	Transformer Driver Terminal 2.
3	GND <sub>1</sub>	Ground, Logic Side.
4	V <sub>DD1</sub>	Power Supply, Logic Side (3.3 V or 5 V). Decoupling capacitor to GND <sub>1</sub> required; capacitor value should be between 0.01 $\mu$ F and 0.1 $\mu$ F.
5	RxD	Receiver Output Data. This output is high when $(A - B) > +200$ mV and low when $(A - B) < -200$ mV. The output is tristated when the receiver is disabled, that is, when $\overline{RE}$ is driven high.
6	$\overline{RE}$	Receiver Enable Input. This is an active-low input. Driving this input low enables the receiver; driving it high disables the receiver.
7	DE	Driver Enable Input. Driving this input high enables the driver; driving it low disables the driver.
8	TxD	Transmit Data.
9	GND <sub>2</sub>	Ground, Bus Side.
10	NC	No Connect. This pin must be left floating.
11	Y	Driver Noninverting Output.
12	Z	Driver Inverting Output.
13	B	Receiver Inverting Input.
14	A	Receiver Noninverting Input.
15	GND <sub>2</sub>	Ground, Bus Side.
16	V <sub>DD2</sub>	Power Supply, Bus Side (Isolated 3.3 V Supply). Decoupling capacitor to GND <sub>2</sub> required; capacitor value should be between 0.01 $\mu$ F and 0.1 $\mu$ F.

# ADM2482E/ADM2487E

## TYPICAL PERFORMANCE CHARACTERISTICS

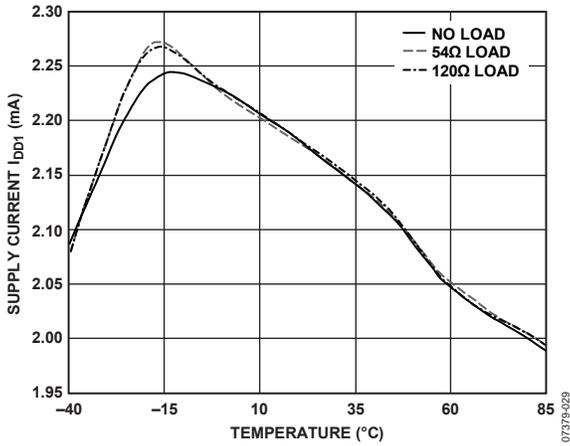


Figure 14. ADM2487E  $I_{DD1}$  Supply Current vs. Temperature (Data Rate = 500 kbps,  $V_{DD1} = 5\text{ V}$ ,  $V_{DD2} = 3.3\text{ V}$ ,  $DE = 1\text{ V}$ ,  $\overline{RE} = 0\text{ V}$ )

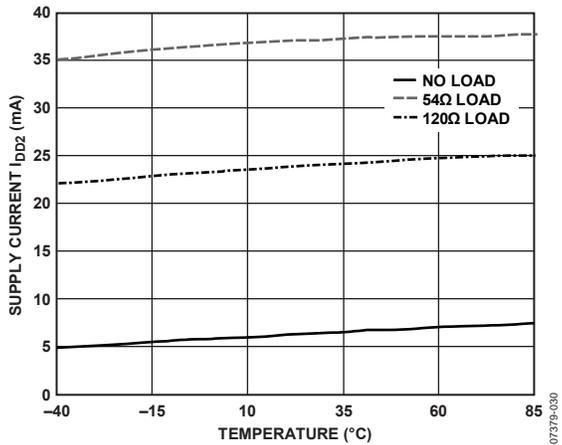


Figure 15. ADM2487E  $I_{DD2}$  Supply Current vs. Temperature (See Figure 8) (Data Rate = 500 kbps,  $V_{DD1} = 5\text{ V}$ ,  $V_{DD2} = 3.3\text{ V}$ ,  $DE = 1\text{ V}$ ,  $\overline{RE} = 0\text{ V}$ )

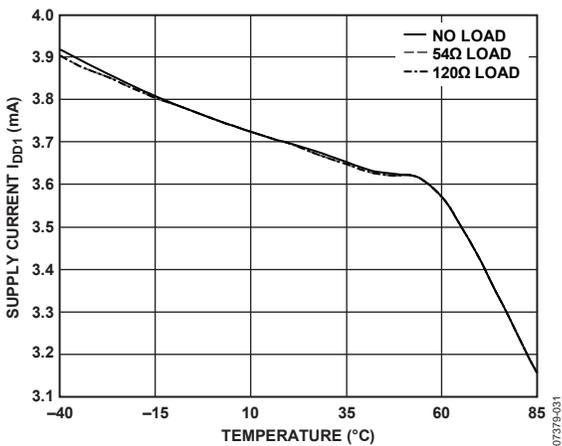


Figure 16. ADM2482E  $I_{DD1}$  Supply Current vs. Temperature (Data Rate = 16 Mbps,  $V_{DD1} = 5\text{ V}$ ,  $V_{DD2} = 3.3\text{ V}$ ,  $DE = 1\text{ V}$ ,  $\overline{RE} = 0\text{ V}$ )

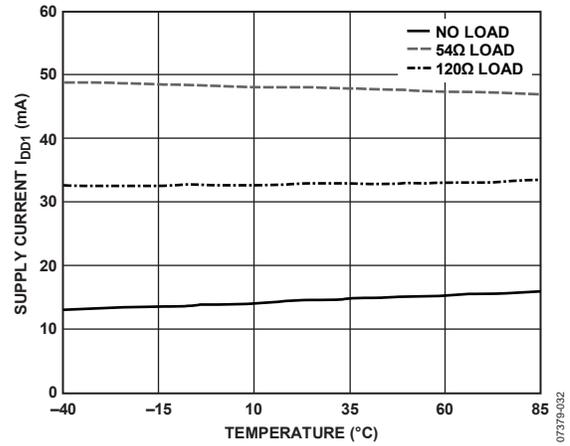


Figure 17. ADM2482E Supply Current vs. Temperature (See Figure 8) (Data Rate = 16 Mbps,  $V_{DD1} = 5\text{ V}$ ,  $V_{DD2} = 3.3\text{ V}$ ,  $DE = 1$ ,  $\overline{RE} = 0\text{ V}$ )

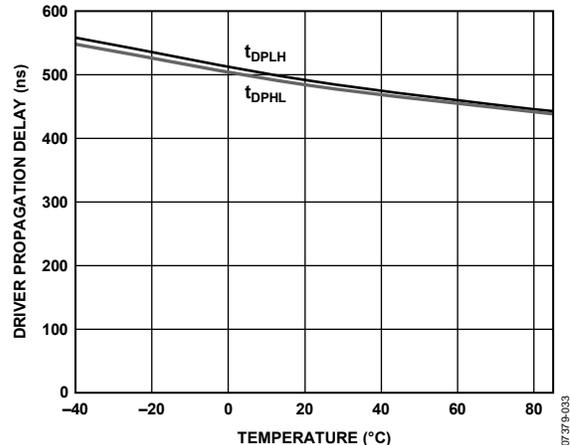


Figure 18. ADM2487E Driver Propagation Delay vs. Temperature

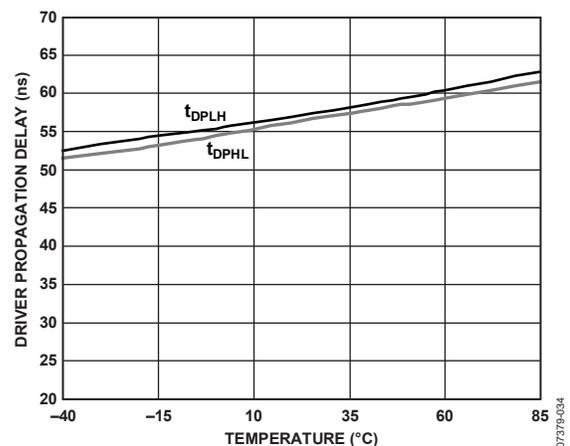


Figure 19. ADM2482E Driver Propagation Delay vs. Temperature

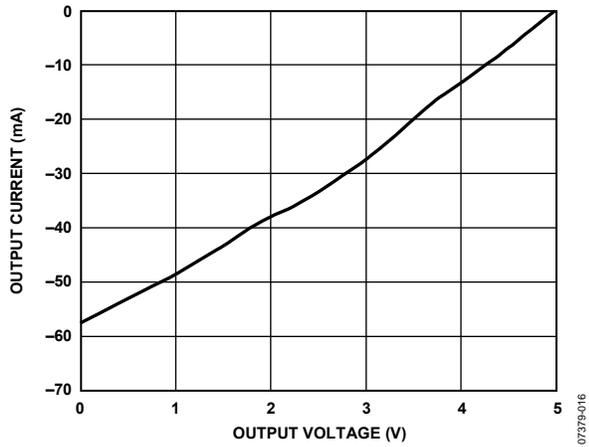


Figure 20. Output Current vs. Receiver Output High Voltage

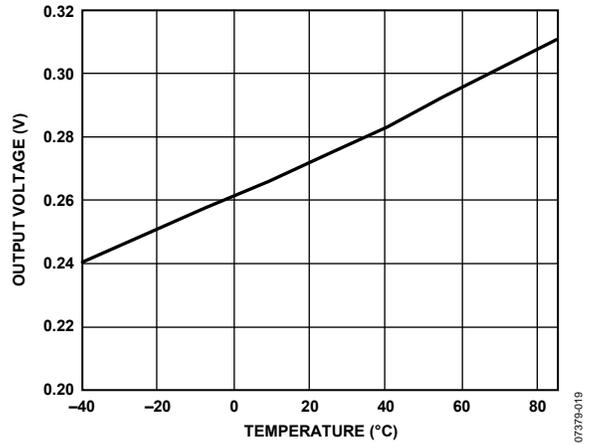


Figure 23. Receiver Output Low Voltage vs. Temperature ( $I_{DD2} = 4 \text{ mA}$ )

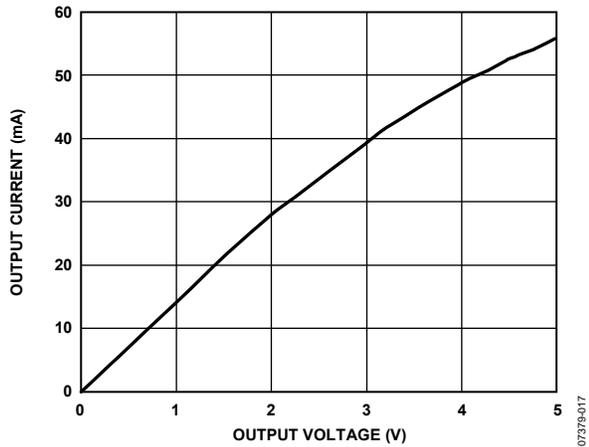


Figure 21. Output Current vs. Receiver Output Low Voltage

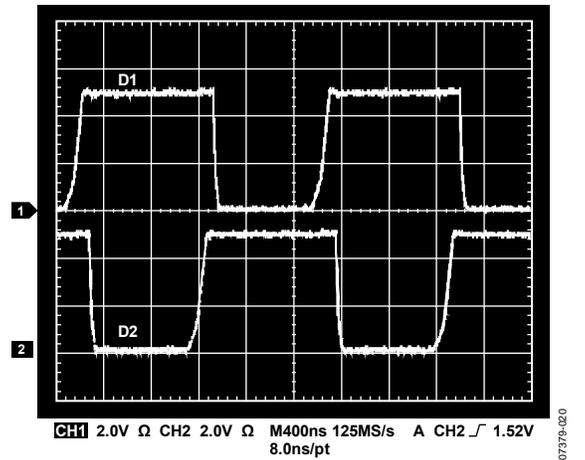


Figure 24. Switching Waveforms (50 Ω Pull-Up to  $V_{DD1}$  on D1 and D2)

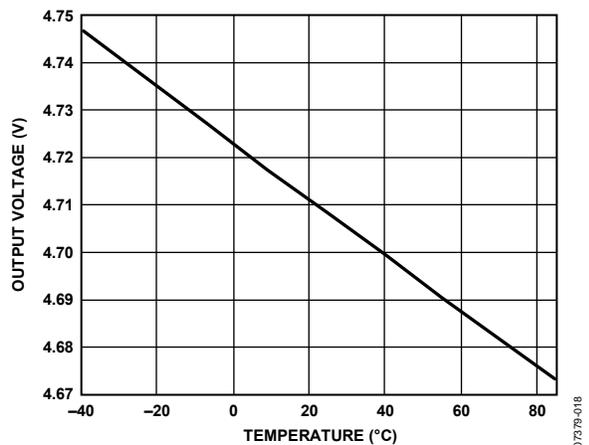


Figure 22. Receiver Output High Voltage vs. Temperature ( $I_{DD2} = -4 \text{ mA}$ )

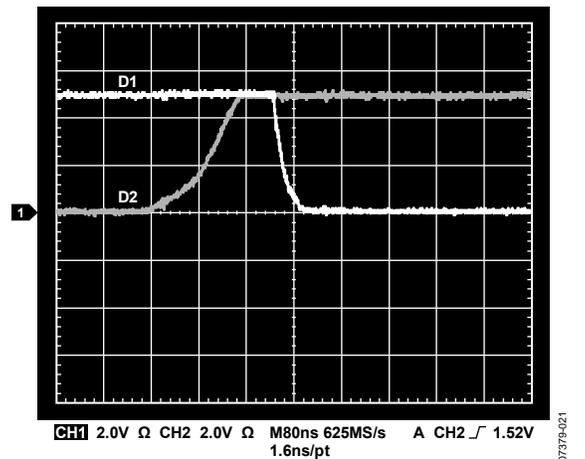


Figure 25. Switching Waveforms (Break-Before-Make, 50 Ω Pull-Up to  $V_{DD1}$  on D1 and D2)

# ADM2482E/ADM2487E

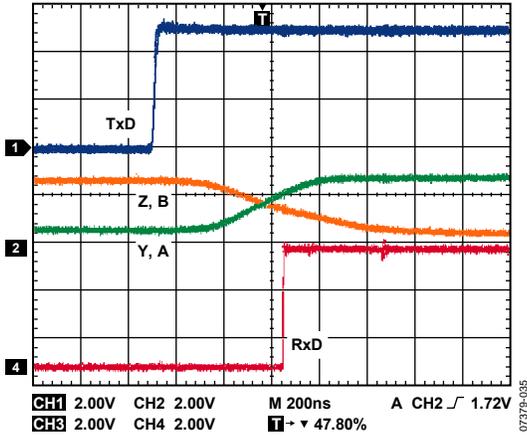


Figure 26. ADM2487E Driver/Receiver Propagation Delay, Low to High  
 ( $R_{DIFF} = 54 \Omega$ ,  $C_{L1} = C_{L2} = 100 \text{ pF}$ )

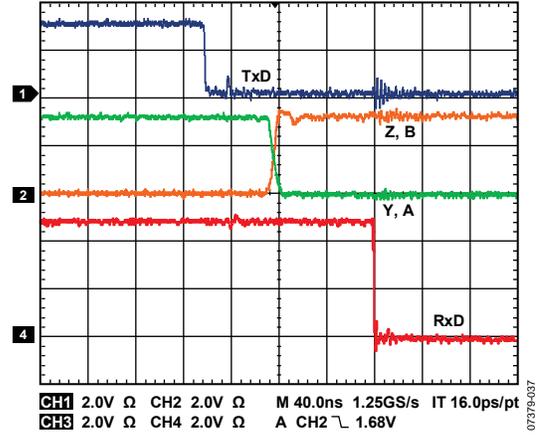


Figure 28. ADM2482E Driver/Receiver Propagation Delay, High to Low  
 ( $R_{DIFF} = 54 \Omega$ ,  $C_{L1} = C_{L2} = 100 \text{ pF}$ )

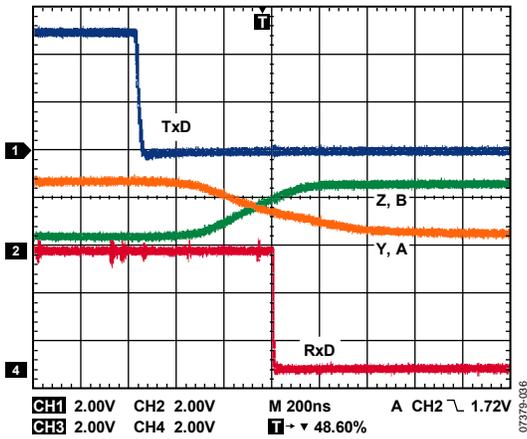


Figure 27. ADM2487E Driver/Receiver Propagation Delay, High to Low  
 ( $R_{DIFF} = 54 \Omega$ ,  $C_{L1} = C_{L2} = 100 \text{ pF}$ )

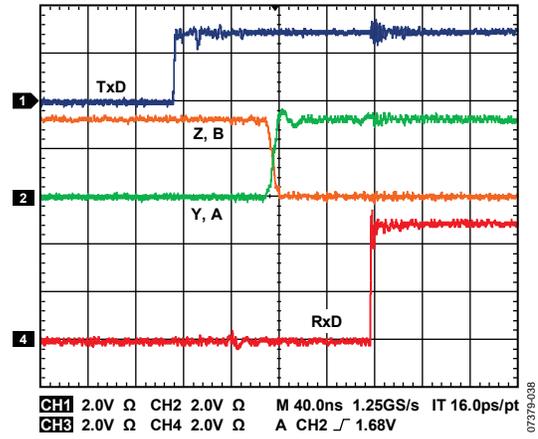


Figure 29. ADM2482E Driver/Receiver Propagation Delay, Low to High  
 ( $R_{DIFF} = 54 \Omega$ ,  $C_{L1} = C_{L2} = 100 \text{ pF}$ )

## CIRCUIT DESCRIPTION

### ELECTRICAL ISOLATION

In the ADM2482E/ADM2487E, electrical isolation is implemented on the logic side of the interface. Therefore, the part has two main sections: a digital isolation section and a transceiver section (see Figure 30). Driver input and data enable applied to the TxD and DE pins, respectively, and referenced to logic ground (GND<sub>1</sub>) are coupled across an isolation barrier to appear at the transceiver section referenced to isolated ground (GND<sub>2</sub>). Similarly, the receiver output, referenced to isolated ground in the transceiver section, is coupled across the isolation barrier to appear at the RxD pin referenced to logic ground.

### iCoupler Technology

The digital signals transmit across the isolation barrier using iCoupler technology. This technique uses chip scale transformer windings to couple the digital signals magnetically from one side of the barrier to the other. Digital inputs are encoded into waveforms that are capable of exciting the primary transformer winding. At the secondary winding, the induced waveforms are decoded into the binary value that was originally transmitted.

Positive and negative logic transitions at the input cause narrow pulses (~1 ns) to be sent to the decoder, via the transformer.

The decoder is bistable and is, therefore, either set or reset by the pulses, indicating input logic transitions. In the absence of logic transitions at the input for more than ~1 μs, a periodic set of refresh pulses indicative of the correct input state are sent to ensure dc correctness at the output. If the decoder receives no internal pulses for more than about 5 μs, then the input side is assumed to be unpowered or nonfunctional, in which case the output is forced to a default state (see Table 8).

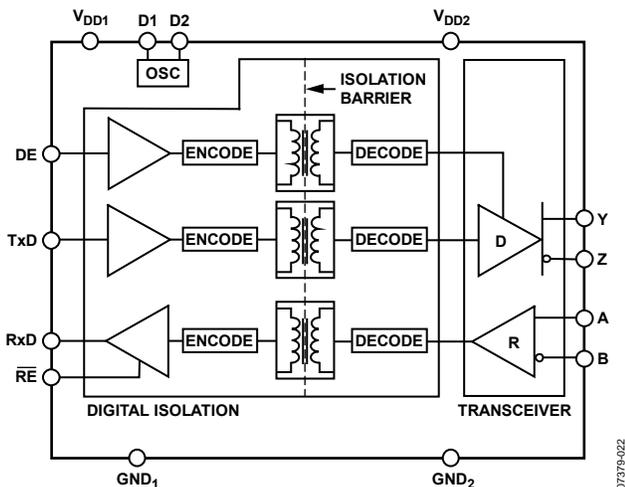


Figure 30. ADM2482E/ADM2487E Digital Isolation and Transceiver Sections

### TRUTH TABLES

The truth tables in this section use the abbreviations found in Table 8.

Table 8. Truth Table Abbreviations

Letter	Description
H	High level
I	Indeterminate
L	Low level
X	Irrelevant
Z	High impedance (off)
NC	Disconnected

Table 9. Transmitting

Supply Status		Inputs		Outputs	
V <sub>DD1</sub>	V <sub>DD2</sub>	DE	TxD	Y	Z
On	On	H	H	H	L
On	On	H	L	L	H
On	On	L	X	Z	Z
On	Off	X	X	Z	Z
Off	On	L	X	Z	Z
Off	Off	X	X	Z	Z

Table 10. Receiving

Supply Status		Inputs		Outputs
V <sub>DD1</sub>	V <sub>DD2</sub>	A – B	RE	RxD
On	On	>–0.03 V	L or NC	H
On	On	<–0.2 V	L or NC	L
On	On	–0.2 V < A – B < –0.03 V	L or NC	I
On	On	Inputs open	L or NC	H
On	On	X	H	Z
On	Off	X	L or NC	H
Off	Off	X	L or NC	L

# ADM2482E/ADM2487E

## THERMAL SHUTDOWN

The ADM2482E/ADM2487E contain thermal shutdown circuitry that protects the part from excessive power dissipation during fault conditions. Shorting the driver outputs to a low impedance source can result in high driver currents. The thermal sensing circuitry detects the increase in die temperature under this condition and disables the driver outputs. This circuitry is designed to disable the driver outputs when a die temperature of 150°C is reached. As the device cools, the drivers are re-enabled at a temperature of 140°C.

## TRUE FAIL-SAFE RECEIVER INPUTS

The receiver inputs have a true fail-safe feature that ensures that the receiver output is high when the inputs are open or shorted. During line-idle conditions, when no driver on the bus is enabled, the voltage across a terminating resistance at the receiver input decays to 0 V. With traditional transceivers, receiver input thresholds specified between -200 mV and +200 mV mean that external bias resistors are required on the A and B pins to ensure that the receiver outputs are in a known state. The true fail-safe receiver input feature eliminates the need for bias resistors by specifying the receiver input threshold between -30 mV and -200 mV. The guaranteed negative threshold means that when the voltage between A and B decays to 0 V, the receiver output is guaranteed to be high.

## MAGNETIC FIELD IMMUNITY

The limitation on the magnetic field immunity of the iCoupler is set by the condition in which an induced voltage in the receiving coil of the transformer is large enough to either falsely set or reset the decoder. The following analysis defines the conditions under which this may occur. The 3 V operating condition of the ADM2482E/ADM2487E is examined because it represents the most susceptible mode of operation.

The pulses at the transformer output have an amplitude greater than 1 V. The decoder has a sensing threshold of about 0.5 V, thus establishing a 0.5 V margin in which induced voltages can be tolerated.

The voltage induced across the receiving coil is given by

$$V = \left( \frac{-d\beta}{dt} \right) \sum \pi r_n^2; n = 1, 2, \dots, N$$

where:

$\beta$  is the magnetic flux density (gauss).

$N$  is the number of turns in the receiving coil.

$r_n$  is the radius of the  $n^{\text{th}}$  turn in the receiving coil (cm).

Given the geometry of the receiving coil and an imposed requirement that the induced voltage is, at most, 50% of the 0.5 V margin at the decoder, a maximum allowable magnetic field can be determined using Figure 31.

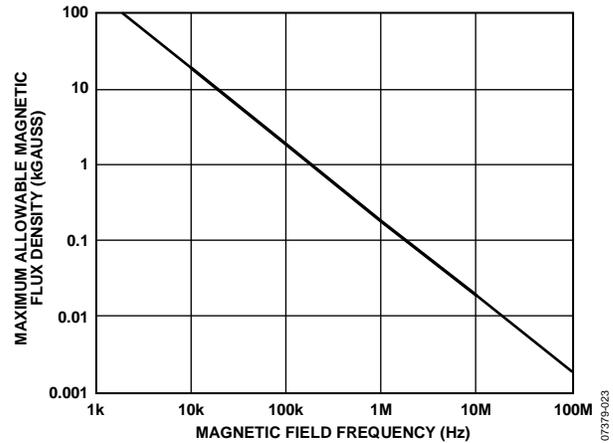


Figure 31. Maximum Allowable External Magnetic Flux Density

For example, at a magnetic field frequency of 1 MHz, the maximum allowable magnetic field of 0.2 kgauss induces a voltage of 0.25 V at the receiving coil. This is about 50% of the sensing threshold and does not cause a faulty output transition. Similarly, if such an event occurs during a transmitted pulse and is the worst-case polarity, it reduces the received pulse from >1.0 V to 0.75 V, still well above the 0.5 V sensing threshold of the decoder.

Figure 32 shows the magnetic flux density values in terms of more familiar quantities, such as maximum allowable current flow at given distances away from the ADM2482E/ADM2487E transformers.

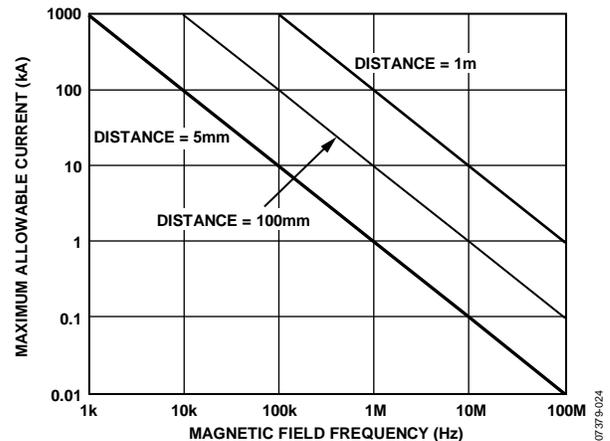


Figure 32. Maximum Allowable Current for Various Current-to-ADM2482E/ADM2487E Spacings

With combinations of strong magnetic field and high frequency, any loops formed by PCB traces could induce error voltages large enough to trigger the thresholds of succeeding circuitry. Care should be taken in the layout of such traces to avoid this possibility.

## APPLICATIONS INFORMATION

### PRINTED CIRCUIT BOARD LAYOUT

The isolated RS-485 transceiver of the ADM2482E/ADM2487E requires no external interface circuitry for the logic interfaces. Power supply bypassing is required at the input and output supply pins (see Figure 33).

Bypass capacitors are most conveniently connected between Pin 3 and Pin 4 for  $V_{DD1}$  and between Pin 15 and Pin 16 for  $V_{DD2}$ . The capacitor value must be between 0.01  $\mu\text{F}$  and 0.1  $\mu\text{F}$ . The total lead length between both ends of the capacitor and the input power supply pin must not exceed 20 mm.

Bypassing Pin 9 and Pin 16 is also recommended unless the ground pair on each package side is connected close to the package.

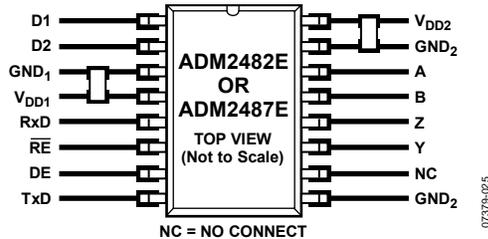


Figure 33. Recommended Printed Circuit Board Layout

In applications involving high common-mode transients, care must be taken to ensure that board coupling across the isolation barrier is minimized. Furthermore, the board layout must be designed such that any coupling that does occur equally affects all pins on a given component side.

Failure to ensure this can cause voltage differentials between pins exceeding the absolute maximum ratings of the device, thereby leading to latch-up or permanent damage.

### ISOLATED POWER SUPPLY CIRCUIT

The ADM2482E/ADM2487E integrate a transformer driver that, when used with an external transformer and linear voltage regulator (LDO), generates an isolated 3.3 V power supply to be supplied between  $V_{DD2}$  and  $GND_2$ , as shown in Figure 34.

Pin D1 and Pin D2 of the ADM2482E/ADM2487E drive a center-tapped Transformer T1. A pair of Schottky diodes and a smoothing capacitor are used to create a rectified signal from the secondary winding. The ADP1710 LDO provides a regulated 3.3 V power supply to the ADM2482E/ADM2487E bus-side circuitry ( $V_{DD2}$ ).

When the ADM2482E/ADM2487E are powered by 3.3 V on the logic side, a step-up transformer is required to compensate for the forward voltage drop of the Schottky diodes and the voltage drop across the regulator. The transformer turns ratio should be chosen to ensure just enough headroom for the ADP1710 LDO to output a regulated 3.3 V output under all operating conditions.

If the ADM2482E/ADM2487E are powered by 5 V on the logic side, then a step-down transformer should be used. For optimum efficiency, the transformer turns ratio should be chosen to ensure just enough headroom for the ADP1710 LDO to output a regulated 3.3 V output under all operating conditions.

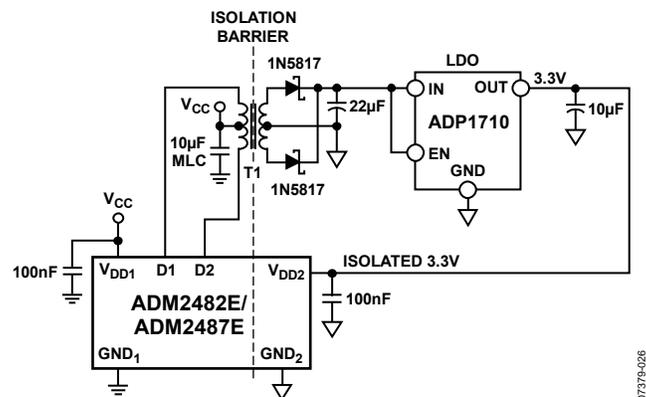


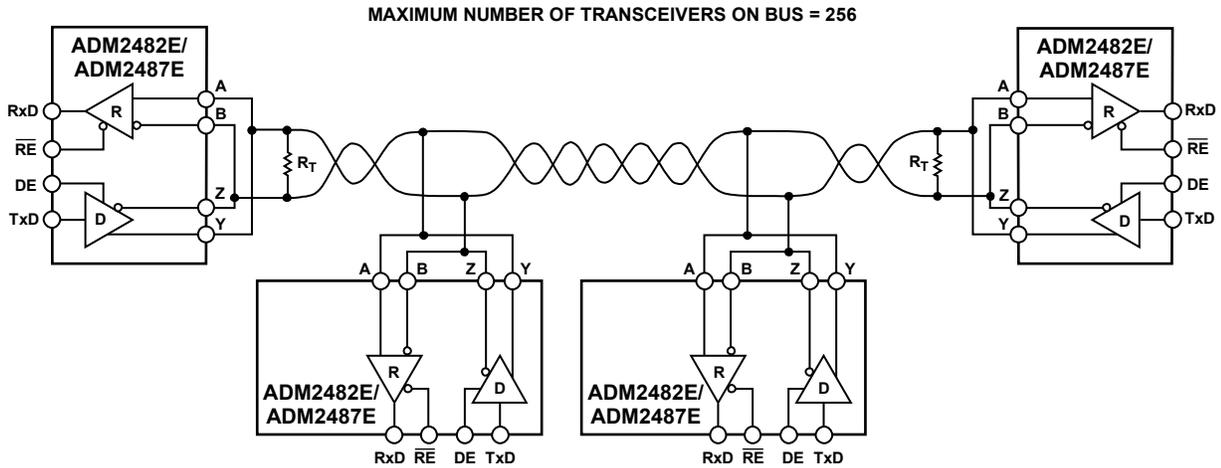
Figure 34. Applications Diagram

# ADM2482E/ADM2487E

## TYPICAL APPLICATIONS

Figure 35 and Figure 36 show typical applications of the ADM2482E/ADM2487E in half-duplex and full-duplex RS-485 network configurations. Up to 256 transceivers can be connected to the RS-485 bus. To minimize reflections, the

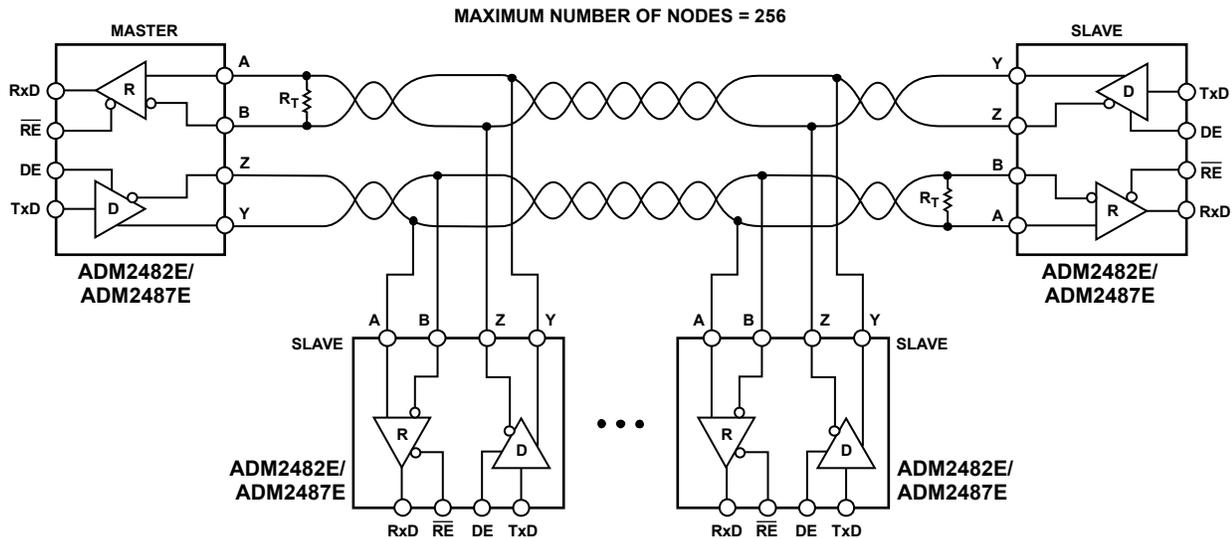
line must be terminated at the receiving end in its characteristic impedance, and stub lengths off the main line must be kept as short as possible. For half-duplex operation, this means that both ends of the line must be terminated, because either end can be the receiving end.



- NOTES**
1.  $R_T$  IS EQUAL TO THE CHARACTERISTIC IMPEDANCE OF THE CABLE.
  2. ISOLATION NOT SHOWN.

Figure 35. ADM2482E/ADM2487E Typical Half-Duplex RS-485 Network

07379-027

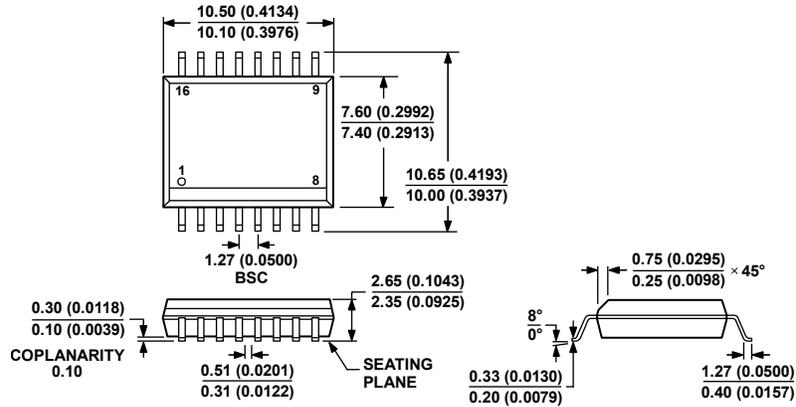


- NOTES**
1.  $R_T$  IS EQUAL TO THE CHARACTERISTIC IMPEDANCE OF THE CABLE.

Figure 36. ADM2482E/ADM2487E Typical Full-Duplex RS-485 Network

07379-028

## OUTLINE DIMENSIONS



COMPLIANT TO JEDEC STANDARDS MS-013-AA  
 CONTROLLING DIMENSIONS ARE IN MILLIMETERS; INCH DIMENSIONS  
 (IN PARENTHESES) ARE ROUNDED-OFF MILLIMETER EQUIVALENTS FOR  
 REFERENCE ONLY AND ARE NOT APPROPRIATE FOR USE IN DESIGN.

Figure 37. 16-Lead Standard Small Outline Package [SOIC\_W]  
 Wide Body  
 (RW-16)

Dimensions shown in millimeters and (inches)

0.32707-B

## ORDERING GUIDE

Model	Data Rate (Mbps)	Temperature Range	Package Description	Package Option
ADM2482EBRWZ <sup>1</sup>	16	-40°C to +85°C	16-Lead SOIC_W	RW-16
ADM2482EBRWZ-REEL7 <sup>1</sup>	16	-40°C to +85°C	16-Lead SOIC_W	RW-16
ADM2487EBRWZ <sup>1</sup>	0.5	-40°C to +85°C	16-Lead SOIC_W	RW-16
ADM2487EBRWZ-REEL7 <sup>1</sup>	0.5	-40°C to +85°C	16-Lead SOIC_W	RW-16

<sup>1</sup> Z = RoHS Compliant Part.

**ADM2482E/ADM2487E**

**NOTES**

**NOTES**

**ADM2482E/ADM2487E**

**NOTES**