ISL8487E, ISL81487L, ISL81487E

±15kV ESD Protected, 1/8 Unit Load, 5V, Low Power, High Speed or Slew Rate Limited RS-485/RS-422 Transceivers

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The ISL8487E, ISL81487L, and ISL81487E RS-485/RS-422 devices are ESD protected, fractional unit load (UL), BiCMOS, 5V powered, single transceivers that meet both the RS-485 and RS-422 standards for balanced communication. Each driver output/receiver input is protected against ±15kV ESD strikes without latch-up. Unlike competitive devices, this device family is specified for 10% tolerance supplies (4.5V to 5.5V).

All devices present a 1/8 unit load to the RS-485 bus, which allows up to 256 transceivers on the network for large node count systems (for example, process automation and remote meter reading systems). In a remote utility meter reading system, individual utility meter readings (in apartments, for example) are routed to a concentrator with an RS-485 network, so the high allowed node count minimizes the number of repeaters required to network all the meters. Data for all meters is then read out from the concentrator from a single access port or a wireless link.

Slew rate limited drivers on the ISL8487E and ISL81487L reduce EMI and minimize reflections from improperly terminated transmission lines or unterminated stubs in multidrop and multipoint applications. Data rates up to 250kbps are achievable with these devices.

Data rates up to 5Mbps are achievable by using the ISL81487E, which features higher slew rates.

The receiver (Rx) inputs feature a “fail-safe if open” design, which ensures a logic high Rx output if Rx inputs are floating.

The driver (Tx) outputs are short-circuit protected, even for voltages exceeding the power supply voltage. Additionally, on-chip thermal shutdown circuitry disables the Tx outputs to prevent damage if power dissipation becomes excessive.

The half duplex devices multiplex the Rx inputs and Tx outputs to allow transceivers with Rx and Tx disable functions in 8 lead packages.

Related Literature

For a full list of related documents, visit our website:

- ISL8487E, ISL81487L, and ISL81487E product pages

Features

- RS-485 I/O pin ESD protection . . . . . ±15kV HBM
  - Class 3 ESD level on all other pins . . . . . >7kV HBM
- Fractional unit load allows up to 256 devices on the bus
- Specified for 10% tolerance supplies
- High data rate version (ISL81487E). . . . . up to 5Mbps
- Slew rate limited versions for error free data transmission (ISL8487E, ISL81487L) . . . . .up to 250kbps
- Low current shutdown mode (except ISL81487E) . . . 0.5µA
- Low quiescent supply current:
  - ISL8487E, ISL81487L . . . . . 145µA (maximum)
  - ISL81487E . . . . . 420µA (maximum)
- -7V to +12V common mode input voltage range
- Three state Rx and Tx outputs
- 30ns propagation delays, 5ns skew (ISL81487E)
- Half duplex pinouts
- Operate from a single +5V supply (10% tolerance)
- Current limiting and thermal shutdown for driver overload protection
- Pin compatible replacements for: MAX487E, (ISL8487E); LTC1487, ADM1487 (ISL81487L); MAX1487E, ST485ER (ISL81487E)
- Pb-free plus anneal available (RoHS compliant)

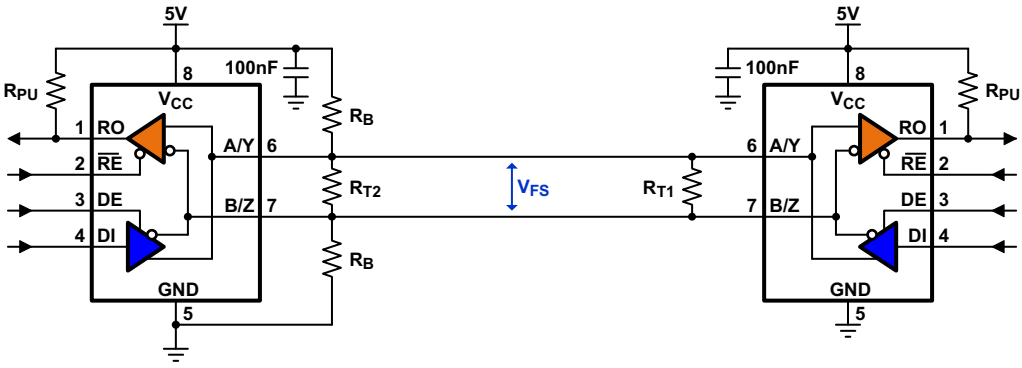
Applications

- High node count networks
- Automated utility meter reading systems
- Factory automation
- Security networks
- Building environmental control systems
- Industrial/process control networks

TABLE 1. SUMMARY OF FEATURES

PART NUMBER	HALF/FULL DUPLEX	NO. OF DEVICES ALLOWED ON BUS	DATA RATE (Mbps)	SLEW RATE LIMITED?	RECEIVER/ DRIVER ENABLE?	QUIESCENT I_{CC} (µA)	LOW POWER SHUTDOWN?	PIN COUNT
ISL8487E	Half	256	0.25	Yes	Yes	120	Yes	8
ISL81487L	Half	256	0.25	Yes	Yes	120	Yes	8
ISL81487E	Half	256	5	No	Yes	350	No	8

Typical Operating Circuits



To calculate the resistor values, refer to TB509.

Ordering Information

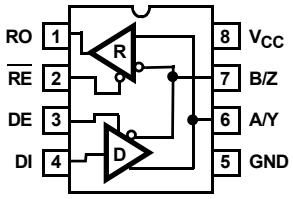
PART NUMBER ()	PART MARKING	TEMP. RANGE (°C)	TAPE AND REEL (UNITS) (Note 1)	PACKAGE	PKG. DWG. #
ISL8487EIBZ	8487EIBZ	-40 to +85	-	8 Ld SOIC (Pb-free)	M8.15
ISL8487EIBZ-T	8487EIBZ	-40 to +85	2.5k	8 Ld SOIC (Pb-free)	M8.15
ISL8487EIPZ **(not recommended for new designs, recommended replacement ISL81487LIPZ)**	8487EIPZ	-40 to +85	-	8 Ld PDIP (Pb-free, Note 4)	E8.3
ISL81487LIBZ	81487LIBZ	-40 to +85	-	8 Ld SOIC (Pb-free)	M8.15
ISL81487LIBZ-T	81487LIBZ	-40 to +85	2.5k	8 Ld SOIC (Pb-free)	M8.15
ISL81487LIPZ	81487LIPZ	-40 to +85	-	8 Ld PDIP (Pb-free, Note 4)	E8.3
ISL81487EIBZ	81487EIBZ	-40 to +85	-	8 Ld SOIC (Pb-free)	M8.15
ISL81487EIBZ-T	81487EIBZ	-40 to +85	2.5k	8 Ld SOIC (Pb-free)	M8.15
ISL81487EIPZ	ISL81487EIPZ	-40 to +85	-	8 Ld PDIP (Pb-free, Note 4)	E8.3

NOTES:

1. Refer to TB347 for details about reel specifications.
2. Pb-free plus anneal products employ special Pb-free material sets; molding compounds/die attach materials and 100% matte tin plate termination finish, which are RoHS compliant and compatible with both SnPb and Pb-free soldering operations. Pb-free products are MSL classified at Pb-free peak reflow temperatures that meet or exceed the Pb-free requirements of IPC/JEDEC J STD-020
3. For Moisture Sensitivity Level (MSL), see the ISL8487E, ISL81487L, and ISL81487E product information pages. For more information about MSL, see TB363.
4. Pb-free PDIPs can be used for through hole wave solder processing only. They are not intended for use in Reflow solder processing applications.

Pinout

PDIP, SOIC
TOP VIEW



Pin Descriptions

PIN	FUNCTION
RO	Receiver output. RO is high if A > B by at least 0.2V; RO is low if A < B by 0.2V or more; RO is high if A and B are unconnected (floating).
$\overline{RE}$	Receiver output enable. RO is enabled when $\overline{RE}$ is low; RO is high impedance when $\overline{RE}$ is high.
DE	Driver output enable. The driver outputs Y and Z are enabled by bringing DE high. They are high impedance when DE is low.
DI	Driver input. A low on DI forces output Y low and output Z high. Similarly, a high on DI forces output Y high and output Z low.
GND	Ground connection.
A/Y	±15kV HBM ESD protected, RS-485/422 level, noninverting receiver input and noninverting driver output. Pin is an input (A) if DE = 0; pin is an output (Y) if DE = 1.
B/Z	±15kV HBM ESD protected, RS-485/422 level, inverting receiver input and inverting driver output. Pin is an input (B) if DE = 0; pin is an output (Z) if DE = 1.
V_{CC}	System power supply input (4.5V to 5.5V).

Truth Tables

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	High-Z (Note 12)	High-Z (Note 12)

RECEIVING			
INPUTS			OUTPUT
$\overline{RE}$	DE	A-B	RO
0	X	≥ +0.2V	1
0	X	≤ -0.2V	0
0	X	Inputs Open	1
1	X	X	High-Z (Note 12)
1	0	X	High-Z

Absolute Maximum Ratings

V_{CC} to Ground 7V
Input Voltages
DI, DE, $\overline{RE}$ . . . . . -0.5V to (V_{CC} +0.5V)
Input/Output Voltages
A/Y, B/Z . . . . . -8V to +12.5V
RO . . . . . -0.5V to (V_{CC} +0.5V)
Short-Circuit Duration
Y, Z . . . . . Continuous
ESD Rating . . . . . See "Electrical Specifications"

Operating Conditions

Temperature Range
ISL8XXXIX . . . . . -40°C to 85°C

Thermal Information

Thermal Resistance (Typical, Note 5)	θ_{JA} (°C/W)
8 Ld SOIC Package	170
8 Ld PDIP Package (Note 6)	140

Maximum Junction Temperature (Plastic Package) . . . . . 150°C
Maximum Storage Temperature Range . . . . . -65°C to 150°C
Maximum Lead Temperature (Soldering 10s) . . . . . 300°C
(SOIC - Lead Tips Only)

CAUTION: Stresses above those listed in "Absolute Maximum Ratings" can permanently damage the device. This is a stress only rating and operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied.

NOTES:

5. θ_{JA} is measured with the component mounted on a low-effective thermal conductivity test board in free air. See TB379 for details.
6. Pb-free PDIPs can be used for through hole wave solder processing only. They are not intended for use in Reflow solder processing applications.

Electrical Specifications

Test Conditions: V_{CC} = 4.5V to 5.5V; Unless Otherwise Specified. Typicals are at V_{CC} = 5V, T_A = +25°C, Note 7

PARAMETER	SYMBOL	TEST CONDITIONS		TEMP (°C)	MIN	TYP	MAX	UNIT
DC CHARACTERISTICS								
Driver Differential V_{OUT} (No Load)	V_{OD1}			Full	-	-	V_{CC}	V
Driver Differential V_{OUT} (with Load)	V_{OD2}	R = 50Ω (RS-422), (Figure 1)		Full	2	3	-	V
		R = 27Ω (RS-485), (Figure 1)		Full	1.5	2.3	5	V
Change in Magnitude of Driver Differential V_{OUT} for Complementary Output States	ΔV_{OD}	R = 27Ω or 50Ω, (Figure 1)		Full	-	0.01	0.2	V
Driver Common-Mode V_{OUT}	V_{OC}	R = 27Ω or 50Ω, (Figure 1)		Full	-	-	3	V
Change in Magnitude of Driver Common-Mode V_{OUT} for Complementary Output States	ΔV_{OC}	R = 27Ω or 50Ω, (Figure 1)		Full	-	0.01	0.2	V
Logic Input High Voltage	V_{IH}	DE, DI, $\overline{RE}$		Full	2	-	-	V
Logic Input Low Voltage	V_{IL}	DE, DI, $\overline{RE}$		Full	-	-	0.8	V
Logic Input Current	I_{IN1}	DE, DI, $\overline{RE}$		Full	-2	-	2	µA
Input Current (A/Y, B/Z), (Note 15)	I_{IN2}	DE = 0V, V_{CC} = 4.5 to 5.5V	V_{IN} = 12V	Full	-	-	140	µA
			V_{IN} = -7V	Full	-	-	-120	µA
	I_{IN2}	DE = 0V, V_{CC} = 0V	V_{IN} = 12V	Full	-	-	180	µA
			V_{IN} = -7V	Full	-	-	-100	µA
Receiver Differential Threshold Voltage	V_{TH}	-7V ≤ V_{CM} ≤ 12V		Full	-0.2	-	0.2	V
Receiver Input Hysteresis	ΔV_{TH}	V_{CM} = 0V		25	-	70	-	mV
Receiver Output High Voltage	V_{OH}	I_O = -4mA, V_{ID} = 200mV		Full	3.5	-	-	V
Receiver Output Low Voltage	V_{OL}	I_O = -4mA, V_{ID} = 200mV		Full	-	-	0.4	V
Three-State (High Impedance) Receiver Output Current	I_{OZR}	0.4V ≤ V_O ≤ 2.4V		Full	-	-	±1	µA
Receiver Input Resistance	R_{IN}	-7V ≤ V_{CM} ≤ 12V		Full	96	-	-	kΩ

Electrical Specifications

Test Conditions: V_{CC} = 4.5V to 5.5V; Unless Otherwise Specified. Typicals are at V_{CC} = 5V, T_A = +25°C, Note 7 **(Continued)**

PARAMETER	SYMBOL	TEST CONDITIONS		TEMP (°C)	MIN	TYP	MAX	UNIT
No-Load Supply Current, (Note 8)	I_{CC}	ISL81487E, DI, $\overline{RE}$ = 0V or V_{CC}	DE = V_{CC}	Full	-	400	500	µA
			DE = 0V	Full	-	350	420	µA
		ISL8487E, ISL81487L, DI, $\overline{RE}$ = 0V or V_{CC}	DE = V_{CC}	Full	-	160	200	µA
			DE = 0V	Full	-	120	145	µA
Shutdown Supply Current	I_{SHDN}	(Note 12), DE = 0V, $\overline{RE}$ = V_{CC}, DI = 0V or V_{CC}		Full	-	0.5	8	µA
Driver Short-Circuit Current, V_O = High or Low	I_{OSD1}	DE = V_{CC}, -7V ≤ V_Y or V_Z ≤ 12V, (Note 9)		Full	35	-	250	mA
Receiver Short-Circuit Current	I_{OSR}	0V ≤ V_O ≤ V_{CC}		Full	7	-	85	mA
SWITCHING CHARACTERISTICS (ISL81487E)								
Driver Input to Output Delay	t_{PLH}, t_{PHL}	R_{DIFF} = 54Ω, C_L = 100pF, (Figure 2)		Full	15	24	50	ns
Driver Output Skew	t_{SKEW}	R_{DIFF} = 54Ω, C_L = 100pF, (Figure 2)		Full	-	3	10	ns
Driver Differential Rise or Fall Time	t_R, t_F	R_{DIFF} = 54Ω, C_L = 100pF, (Figure 2)		Full	3	12	25	ns
Driver Enable to Output High	t_{ZH}	C_L = 100pF, SW = GND, (Figure 2)		Full	-	14	70	ns
Driver Enable to Output Low	t_{ZL}	C_L = 100pF, SW = V_{CC}, (Figure 2)		Full	-	14	70	ns
Driver Disable from Output High	t_{HZ}	C_L = 15pF, SW = GND, (Figure 2)		Full	-	44	70	ns
Driver Disable from Output Low	t_{LZ}	C_L = 15pF, SW = V_{CC}, (Figure 2)		Full	-	21	70	ns
Receiver Input to Output Delay	t_{PLH}, t_{PHL}	(Figure 4)		Full	30	90	150	ns
Receiver Skew | t_{PLH} - t_{PHL} |	t_{SKD}	(Figure 4)		25	-	5	-	ns
Receiver Enable to Output High	t_{ZH}	C_L = 15pF, SW = GND, (Figure 5)		Full	-	9	50	ns
Receiver Enable to Output Low	t_{ZL}	C_L = 15pF, SW = V_{CC}, (Figure 5)		Full	-	9	50	ns
Receiver Disable from Output High	t_{HZ}	C_L = 15pF, SW = GND, (Figure 5)		Full	-	9	50	ns
Receiver Disable from Output Low	t_{LZ}	C_L = 15pF, SW = V_{CC}, (Figure 5)		Full	-	9	50	ns
Maximum Data Rate	f_{MAX}			Full	5	-	-	Mbps
SWITCHING CHARACTERISTICS (ISL8487E)								
Driver Input to Output Delay	t_{PLH}, t_{PHL}	R_{DIFF} = 54Ω, C_L = 100pF, (Figure 2)		Full	250	650	2000	ns
Driver Output Skew	t_{SKEW}	R_{DIFF} = 54Ω, C_L = 100pF, (Figure 2)		Full	-	160	800	ns
Driver Differential Rise or Fall Time	t_R, t_F	R_{DIFF} = 54Ω, C_L = 100pF, (Figure 2)		Full	250	900	2000	ns
Driver Enable to Output High	t_{ZH}	C_L = 100pF, SW = GND, (Figure 3, Note 10)		Full	250	1000	2000	ns
Driver Enable to Output Low	t_{ZL}	C_L = 100pF, SW = V_{CC}, (Figure 3, Note 10)		Full	250	860	2000	ns
Driver Disable from Output High	t_{HZ}	C_L = 15pF, SW = GND, (Figure 3)		Full	300	660	3000	ns
Driver Disable from Output Low	t_{LZ}	C_L = 15pF, SW = V_{CC}, (Figure 3)		Full	300	640	3000	ns
Receiver Input to Output Delay	t_{PLH}, t_{PHL}	(Figure 4)		Full	250	500	2000	ns
Receiver Skew | t_{PLH} - t_{PHL} |	t_{SKD}	(Figure 4)		25	-	60	-	ns
Receiver Enable to Output High	t_{ZH}	C_L = 15pF, SW = GND, (Figure 5, Note 11)		Full	-	10	50	ns
Receiver Enable to Output Low	t_{ZL}	C_L = 15pF, SW = V_{CC}, (Figure 5, Note 11)		Full	-	10	50	ns
Receiver Disable from Output High	t_{HZ}	C_L = 15pF, SW = GND, (Figure 5)		Full	-	10	50	ns
Receiver Disable from Output Low	t_{LZ}	C_L = 15pF, SW = V_{CC}, (Figure 5)		Full	-	10	50	ns
Maximum Data Rate	f_{MAX}			Full	250	-	-	kbps
Time to Shutdown	t_{SHDN}	(Note 12)		Full	50	120	600	ns
Driver Enable from Shutdown to Output High	$t_{ZH(SHDN)}$	C_L = 100pF, SW = GND, (Figure 3, Notes 12 and 13)		Full	-	1000	2000	ns
Driver Enable from Shutdown to Output Low	$t_{ZL(SHDN)}$	C_L = 100pF, SW = V_{CC}, (Figure 3, Notes 12 and 13)		Full	-	1000	2000	ns

Electrical Specifications

Test Conditions: V_{CC} = 4.5V to 5.5V; Unless Otherwise Specified. Typicals are at V_{CC} = 5V, T_A = +25°C, Note 7 **(Continued)**

PARAMETER	SYMBOL	TEST CONDITIONS	TEMP (°C)	MIN	TYP	MAX	UNIT
Receiver Enable from Shutdown to Output High	$t_{ZH(SHDN)}$	C_L = 15pF, SW = GND, (Figure 5, Notes 12 and 14)	Full	-	800	2500	ns
Receiver Enable from Shutdown to Output Low	$t_{ZL(SHDN)}$	C_L = 15pF, SW = V_{CC}, (Figure 5, Notes 12 and 14)	Full	-	800	2500	ns
SWITCHING CHARACTERISTICS (ISL81487L)							
Driver Input to Output Delay	t_{PLH}, t_{PHL}	R_{DIFF} = 54Ω, C_L = 100pF, (Figure 2)	Full	150	650	1200	ns
Driver Output Skew	t_{SKEW}	R_{DIFF} = 54Ω, C_L = 100pF, (Figure 2)	Full	-	160	600	ns
Driver Differential Rise or Fall Time	t_R, t_F	R_{DIFF} = 54Ω, C_L = 100pF, (Figure 2)	Full	250	900	1200	ns
Driver Enable to Output High	t_{ZH}	C_L = 100pF, SW = GND, (Figure 3, Note 10)	Full	100	1000	1500	ns
Driver Enable to Output Low	t_{ZL}	C_L = 100pF, SW = V_{CC}, (Figure 3, Note 10)	Full	100	1000	1500	ns
Driver Disable from Output High	t_{HZ}	C_L = 15pF, SW = GND, (Figure 3)	Full	150	750	1500	ns
Driver Disable from Output Low	t_{LZ}	C_L = 15pF, SW = V_{CC}, (Figure 3)	Full	150	750	1500	ns
Receiver Input to Output Delay	t_{PLH}, t_{PHL}	(Figure 4)	Full	30	175	250	ns
Receiver Skew | t_{PLH} - t_{PHL} |	t_{SKD}	(Figure 4)	25	-	13	-	ns
Receiver Enable to Output High	t_{ZH}	C_L = 15pF, SW = GND, (Figure 5, Note 11)	Full	-	10	50	ns
Receiver Enable to Output Low	t_{ZL}	C_L = 15pF, SW = V_{CC}, (Figure 5, Note 11)	Full	-	10	50	ns
Receiver Disable from Output High	t_{HZ}	C_L = 15pF, SW = GND, (Figure 5)	Full	-	10	50	ns
Receiver Disable from Output Low	t_{LZ}	C_L = 15pF, SW = V_{CC}, (Figure 5)	Full	-	10	50	ns
Maximum Data Rate	f_{MAX}		Full	250	-	-	kbps
Time to Shutdown	t_{SHDN}	(Note 12)	Full	50	140	600	ns
Driver Enable from Shutdown to Output High	$t_{ZH(SHDN)}$	C_L = 100pF, SW = GND, (Figure 3, Notes 12 and 13)	Full	-	1100	2000	ns
Driver Enable from Shutdown to Output Low	$t_{ZL(SHDN)}$	C_L = 100pF, SW = V_{CC}, (Figure 3, Notes 12 and 13)	Full	-	1000	2000	ns
Receiver Enable from Shutdown to Output High	$t_{ZH(SHDN)}$	C_L = 15pF, SW = GND, (Figure 3, Notes 12 and 14)	Full	-	900	2000	ns
Receiver Enable from Shutdown to Output Low	$t_{ZL(SHDN)}$	C_L = 15pF, SW = V_{CC}, (Figure 3, Notes 12 and 14)	Full	-	900	2000	ns
ESD PERFORMANCE							
RS-485 Pins (A/Y, B/Z)		Human Body Model	25	-	±15	-	kV
All Other Pins			25	-	>±7	-	kV

NOTES:

7. Currents into device pins are positive; currents out of device pins are negative. Voltages are referenced to ground unless otherwise specified.
8. Supply current specification is valid for loaded drivers when DE = 0V.
9. Applies to peak current. See "Typical Performance Curves" for more information.
10. When testing the ISL8487E and ISL81487L, keep $\overline{RE}$ = 0 to prevent the device from entering shutdown (SHDN).
11. When testing the ISL8487E and ISL81487L, the $\overline{RE}$ signal high time must be short enough (typically <200ns) to prevent the device from entering SHDN.
12. The ISL8487E and ISL81487L go into SHDN by bringing $\overline{RE}$ high and DE low. If the inputs are in this state for less than 50ns, the parts are specified not to enter SHDN. If the inputs are in this state for at least 600ns, the parts are specified to enter SHDN. See "Low Power Shutdown Mode (Excluding ISL81487E)" for more information.
13. Keep $\overline{RE}$ = V_{CC} and set the DE signal low time >600ns to ensure that the device enters SHDN.
14. Set the $\overline{RE}$ signal high time >600ns to ensure that the device enters SHDN.
15. Devices meeting these limits are denoted as 1/8 unit load (1/8 UL) transceivers. The RS-485 standard allows up to 32 UL on the bus, so there can be 256 1/8 UL devices on a bus.

Test Circuits and Waveforms

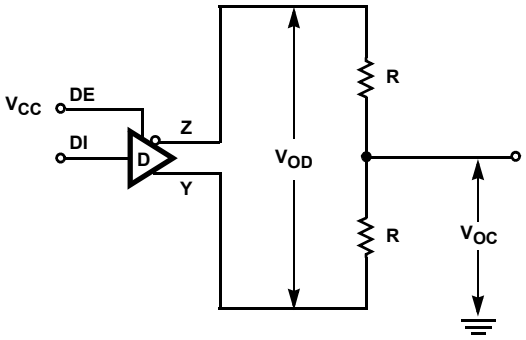


FIGURE 1. DRIVER V_{OD} AND V_{OC}

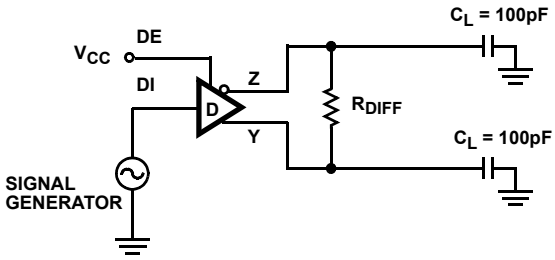
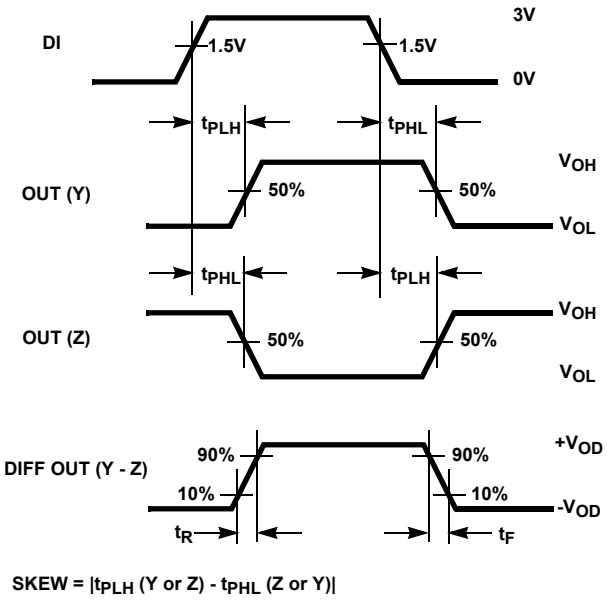


FIGURE 2A. TEST CIRCUIT

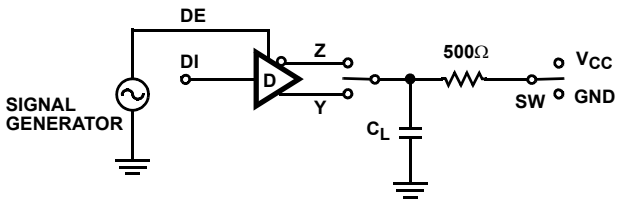


SKEW = $|t_{PLH}$ (Y or Z) - t_{PHL} (Z or Y)|

FIGURE 2B. MEASUREMENT POINTS

FIGURE 2. DRIVER PROPAGATION DELAY AND DIFFERENTIAL TRANSITION TIMES

Test Circuits and Waveforms (Continued)



(SHDN) for ISL8487E and ISL81487L only.

PARAMETER	OUTPUT	$\overline{RE}$	DI	SW	C_L (pF)
t_{HZ}	Y/Z	X	1/0	GND	15
t_{LZ}	Y/Z	X	0/1	V_{CC}	15
t_{ZH}	Y/Z	0 (Note 10)	1/0	GND	100
t_{ZL}	Y/Z	0 (Note 10)	0/1	V_{CC}	100
$t_{ZH(SHDN)}$	Y/Z	1 (Note 12)	1/0	GND	100
$t_{ZLSHDN)}$	Y/Z	1 (Note 12)	0/1	V_{CC}	100

FIGURE 3A. TEST CIRCUIT

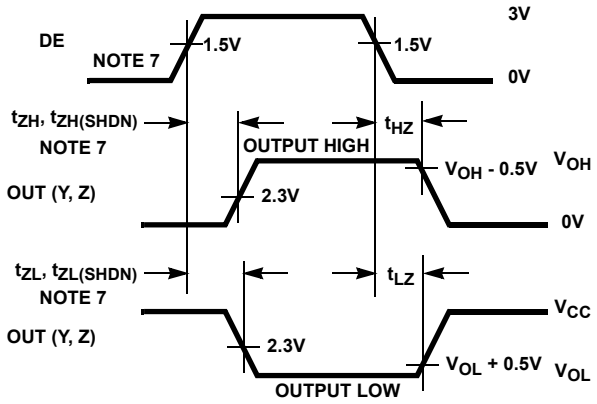


FIGURE 3B. MEASUREMENT POINTS

FIGURE 3. DRIVER ENABLE AND DISABLE TIMES

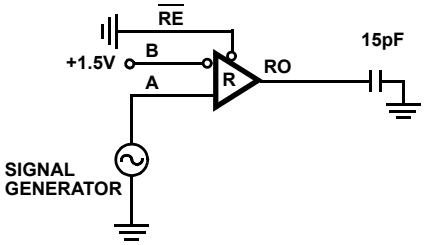


FIGURE 4A. TEST CIRCUIT

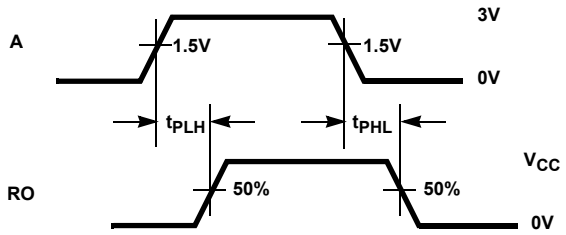
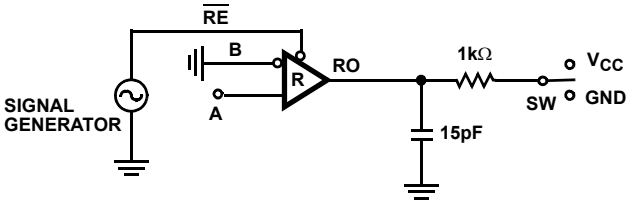


FIGURE 4B. MEASUREMENT POINTS

FIGURE 4. RECEIVER PROPAGATION DELAY



(SHDN) for ISL8487E and ISL81487L only.

PARAMETER	DE	A	SW
t_{HZ}	0	+1.5V	GND
t_{LZ}	0	-1.5V	V_{CC}
t_{ZH} (Note 11)	0	+1.5V	GND
t_{ZL} (Note 11)	0	-1.5V	V_{CC}
$t_{ZH(SHDN)}$ (Note 12)	0	+1.5V	GND
$t_{ZL(SHDN)}$ (Note 12)	0	-1.5V	V_{CC}

FIGURE 5A. TEST CIRCUIT

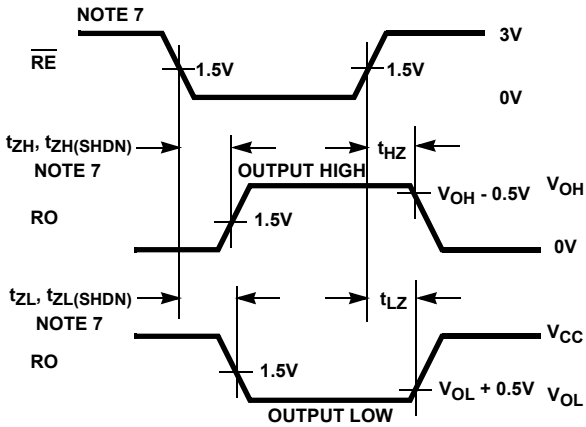


FIGURE 5B. MEASUREMENT POINTS

FIGURE 5. RECEIVER ENABLE AND DISABLE TIMES

Application Information

RS-485 and RS-422 are differential (balanced) data transmission standards for use in long haul or noisy environments. RS-422 is a subset of RS-485, so RS-485 transceivers are also RS-422 compliant. RS-422 is a point-to-multipoint (multidrop) standard that allows only one driver and up to 10 receivers on each bus (assuming one unit load devices). RS-485 is a true multipoint standard that allows up to 32 one unit load devices (any combination of drivers and receivers) on each bus. To allow for multipoint operation, the RS-485 specification requires that drivers handle bus contention without sustaining any damage.

An important advantage of RS-485 is the extended Common-Mode Range (CMR), which specifies that the driver outputs and receiver inputs withstand signals ranging from +12V to -7V. RS-422 and RS-485 are intended for runs as long as 4000ft, so the wide CMR is necessary to handle ground potential differences and voltages induced in the cable by external fields.

Receiver Features

These devices use a differential input receiver for maximum noise immunity and common-mode rejection. Input sensitivity is ±200mV, as required by the RS-422 and RS-485 specifications.

The receiver input resistance of 96kΩ surpasses the RS-422 specification of 4kΩ and is eight times the RS-485 Unit Load (UL) requirement of 12kΩ minimum. Thus, these products are known as one-eighth UL transceivers. A network can host up to 256 of these devices still complying with the RS-485 loading specification.

The receiver inputs function with common-mode voltages as great as ±7V outside the power supplies (that is, +12V and -7V), making them ideal for long networks in which induced voltages are a realistic concern.

All the receivers include a “fail-safe if open” function that guarantees a high level receiver output if the receiver inputs are unconnected (floating).

Receivers easily meet the data rates supported by the corresponding driver. The receiver outputs are three-statable using the active low $\overline{RE}$ input.

Driver Features

The RS-485/422 driver is a differential output device that delivers at least 1.5V across a 54Ω load (RS-485) and at least 2V across a 100Ω load (RS-422). The drivers feature low propagation delay skew to maximize bit width and to minimize EMI.

Driver outputs are three-statable using the active high DE input.

The ISL8487E and ISL81487L driver outputs are slew rate limited to minimize EMI and to minimize reflections in unterminated or improperly terminated networks. The maximum data rate on these slew rate limited versions is 250kbps. The ISL81487E drivers are not limited, so faster output transition times allow data rates of at least 5Mbps.

Data Rate, Cables, and Terminations

RS-485/422 are intended for network lengths up to 4000ft, but the maximum system data rate decreases as the transmission length increases. Devices operating at 5Mbps are limited to lengths less than a few hundred feet, while the 250kbps versions can operate at full data rates with lengths in excess of 1000ft.

Twisted pair cable is the cable of choice for RS-485/422 networks. Twisted pair cables tend to pick up noise and other electromagnetically induced voltages as common-mode signals that are effectively rejected by the differential receivers in these ICs.

Proper termination is imperative to minimize reflections when using the 5Mbps device. Short networks using the 250kbps versions do not need to be terminated, but terminations are recommended unless power dissipation is an overriding concern.

In point-to-point or point-to-multipoint (single driver on bus) networks, terminate the main cable in its characteristic impedance (typically 120Ω) at the end farthest from the driver. In multi-receiver applications, keep stubs connecting receivers to the main cable as short as possible. In multipoint (multi-driver) systems, terminate the main cable in its characteristic impedance at both ends. Keep stubs connecting a transceiver to the main cable as short as possible.

Built-In Driver Overload Protection

The RS-485 specification requires that drivers survive worst case bus contentions undamaged. These devices meet this requirement with driver output short-circuit current limits and on-chip thermal shutdown circuitry.

The driver output stages incorporate short-circuit current limiting circuitry that ensures the output current never exceeds the RS-485 specification, even at the common-mode voltage range extremes. These devices also use a foldback circuit that reduces the short-circuit current and as a result, the power dissipation when the contending voltage exceeds either supply.

In the event of a major short-circuit condition, the thermal shutdown feature disables the drivers when the die temperature becomes excessive. This eliminates the power dissipation, allowing the die to cool. The drivers automatically re-enable after the die temperature drops about 15°C. If the condition persists, the thermal shutdown/re-enable cycle repeats until the fault is cleared. Receivers stay operational during thermal shutdown.

Low Power Shutdown Mode (Excluding ISL81487E)

These CMOS transceivers all use a fraction of the power required by their bipolar counterparts, but the ISL8487E and ISL81487L include a shutdown feature that reduces the already low quiescent I_{CC} to a 500nA trickle. They enter shutdown whenever the receiver and driver are simultaneously disabled ($\overline{RE}$ = V_{CC} and DE = GND) for a period of at least 600ns. Disabling both the driver and the receiver for less than 50ns guarantees that shutdown is not entered.

Note that receiver and driver enable times increase when enabling from shutdown. Refer to Note 10 through 14 at the end of the "Electrical Specifications" table for more information.

ESD Protection

All pins on the interface devices include Class 3 Human Body Model (HBM) ESD protection structures, but the RS-485 pins (driver outputs and receiver inputs) incorporate advanced structures allowing them to survive ESD events in excess of ±15kV HBM. The RS-485 pins are particularly vulnerable to ESD damage because they typically connect to an exposed port on the exterior of the finished product. Touching the port pins or connecting a cable can cause an ESD event that destroys unprotected ICs. The ESD structures protect the device whether or not it is powered up, protect without allowing any latchup mechanism to activate, and without degrading the RS-485 common-mode range of -7V to +12V. This built-in ESD protection eliminates the need for board level protection structures (for example, transient suppression diodes), and the associated undesirable capacitive load they present.

Human Body Model Testing

This test method emulates the ESD event delivered to an IC during human handling. The tester delivers the charge stored on a 100pF capacitor through a 1.5kΩ current limiting resistor into the pin under test. The HBM method determines an IC's ability to withstand the ESD events typically present during handling and manufacturing. The RS-485 pin survivability on this high ESD family has been characterized to be in excess of ±15kV for discharges to GND.

Typical Performance Curves

V_{CC} = 5V, T_A = +25°C, ISL8487E, ISL81487L, and ISL81487E; unless otherwise specified

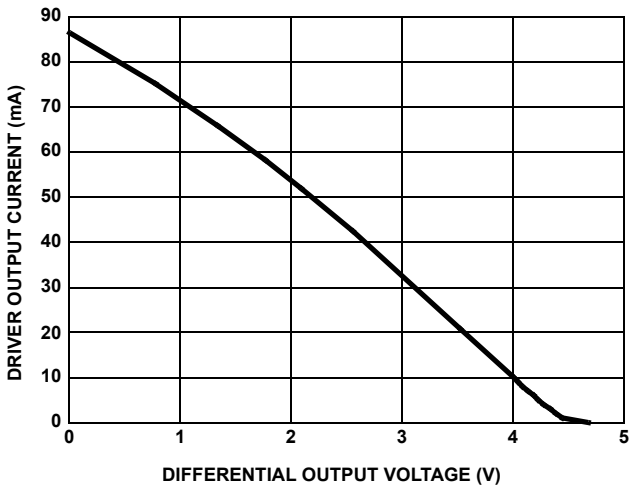


FIGURE 6. DRIVER OUTPUT CURRENT vs DIFFERENTIAL OUTPUT VOLTAGE

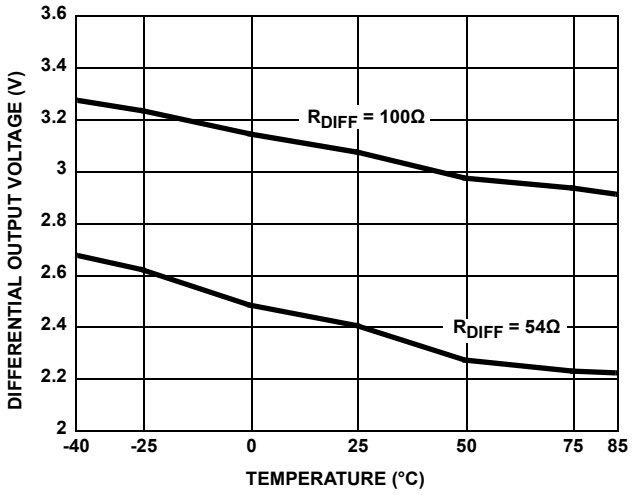


FIGURE 7. DRIVER DIFFERENTIAL OUTPUT VOLTAGE vs TEMPERATURE

Typical Performance Curves V_{CC} = 5V, T_A = +25°C, ISL8487E, ISL81487L, and ISL81487E; unless otherwise specified

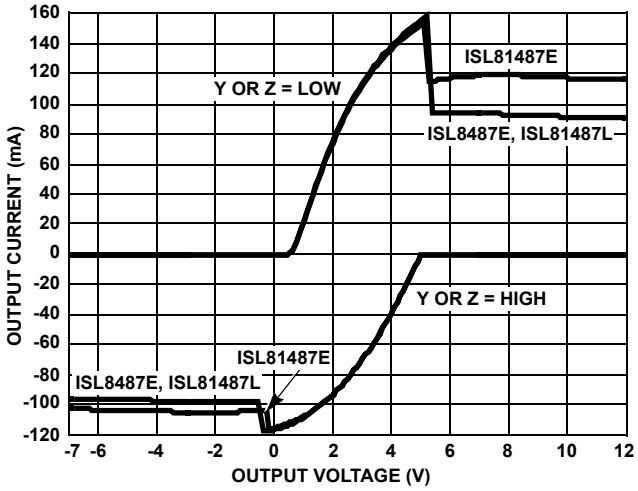


FIGURE 8. DRIVER OUTPUT CURRENT vs SHORT-CIRCUIT VOLTAGE

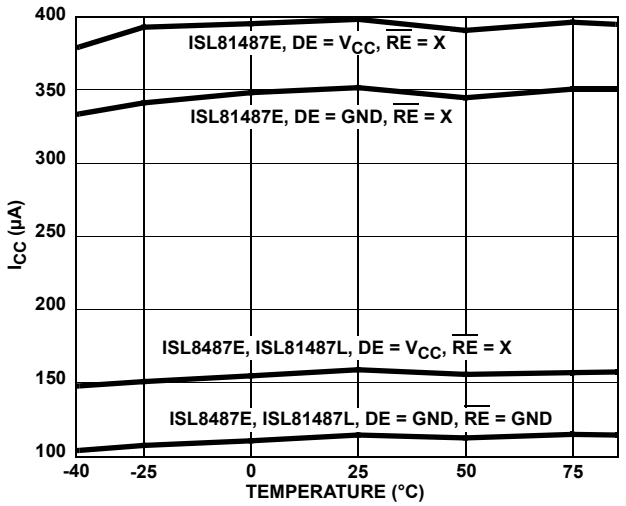


FIGURE 9. SUPPLY CURRENT vs TEMPERATURE

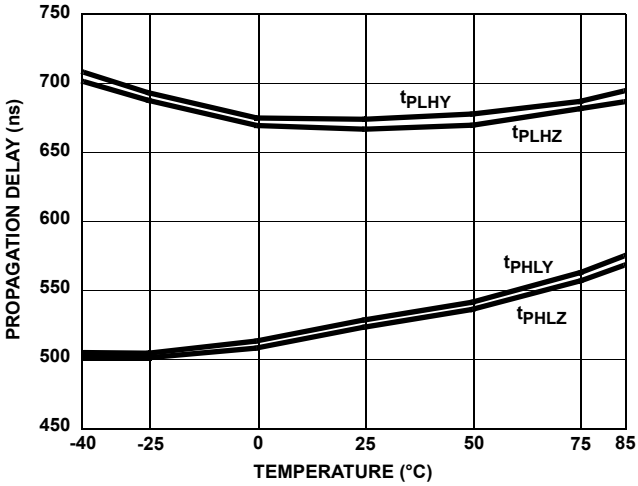


FIGURE 10. DRIVER PROPAGATION DELAY vs TEMPERATURE (ISL8487E and ISL81487L)

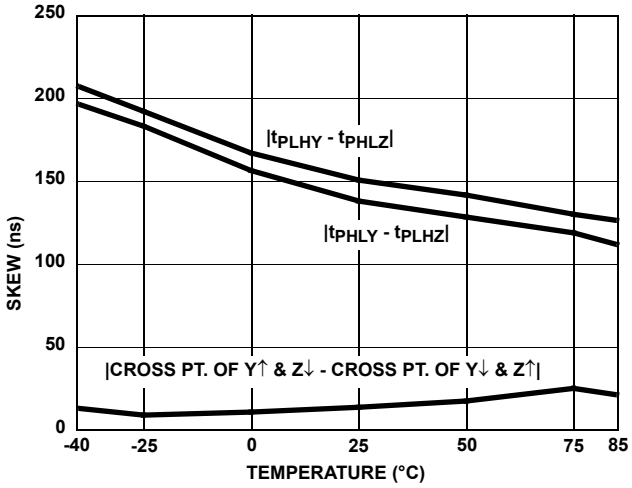


FIGURE 11. DRIVER SKEW vs TEMPERATURE (ISL8487E and ISL81487L)

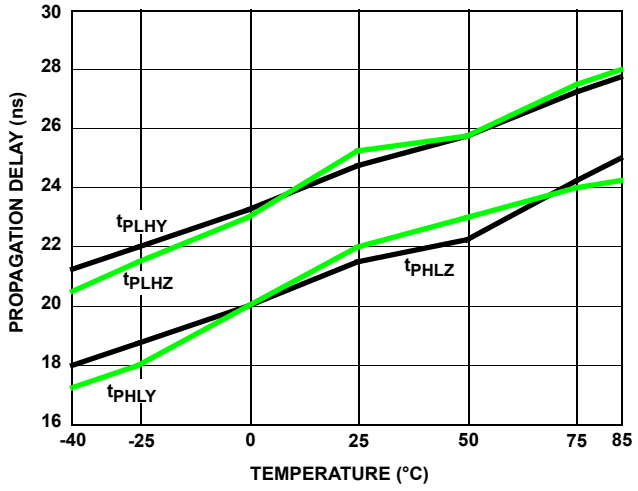


FIGURE 12. DRIVER PROPAGATION DELAY vs TEMPERATURE (ISL81487E)

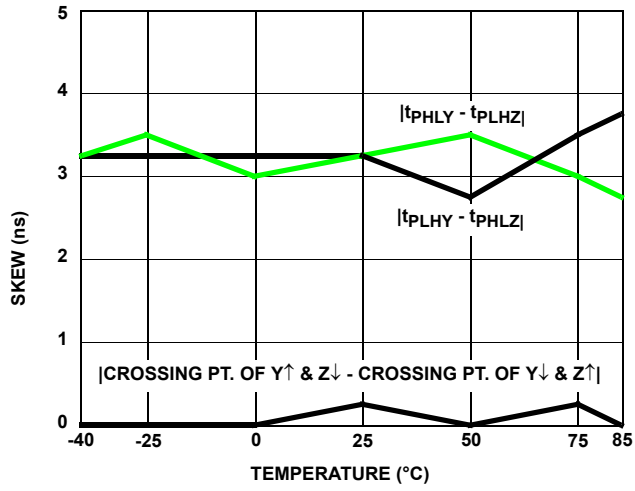


FIGURE 13. DRIVER SKEW vs TEMPERATURE (ISL81487E)

Typical Performance Curves V_{CC} = 5V, T_A = +25°C, ISL8487E, ISL81487L, and ISL81487E; unless otherwise specified

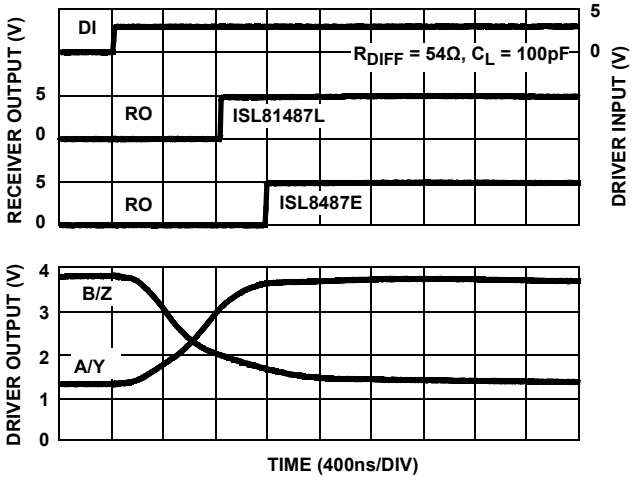


FIGURE 14. DRIVER AND RECEIVER WAVEFORMS, LOW TO HIGH (ISL8487E and ISL81487L)

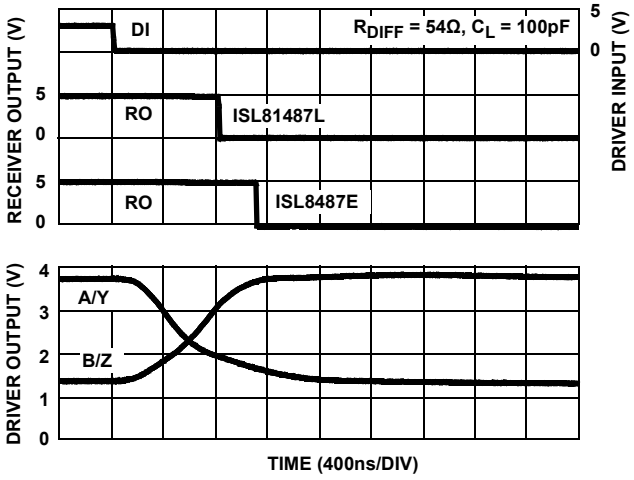


FIGURE 15. DRIVER AND RECEIVER WAVEFORMS, HIGH TO LOW (ISL8487E and ISL81487L)

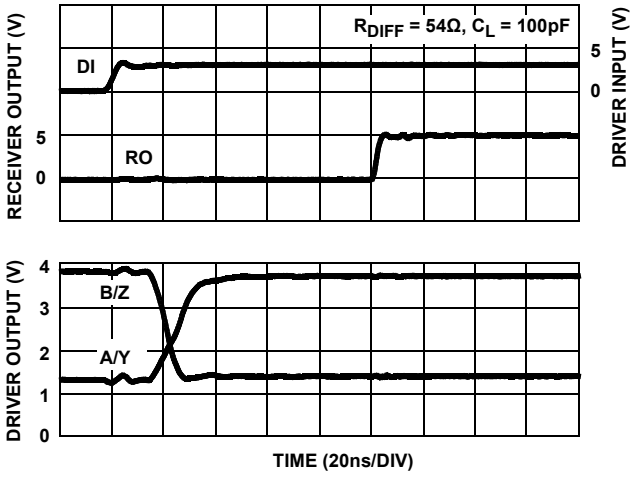


FIGURE 16. DRIVER AND RECEIVER WAVEFORMS, LOW TO HIGH (ISL81487E)

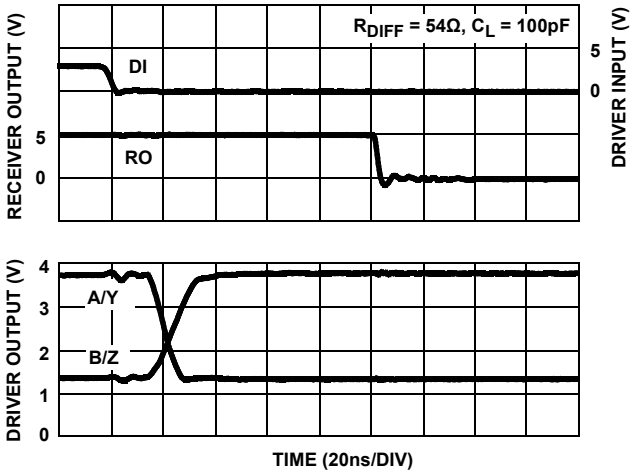


FIGURE 17. DRIVER AND RECEIVER WAVEFORMS, HIGH TO LOW (ISL81487E)

Die Characteristics

SUBSTRATE POTENTIAL (POWERED UP):

GND

TRANSISTOR COUNT:

518

PROCESS:

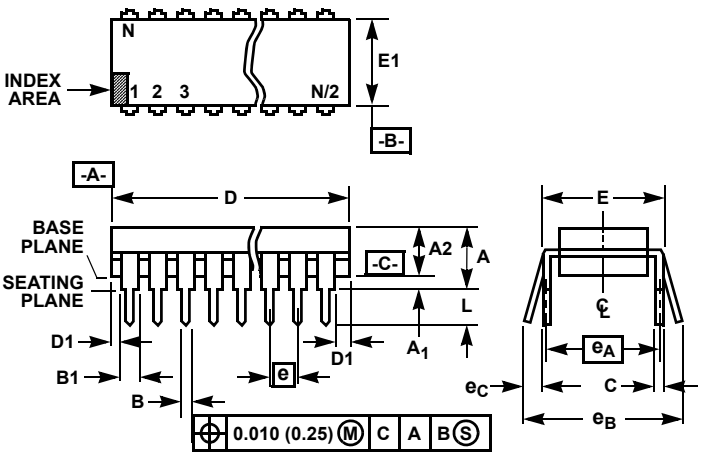
Si Gate CMOS

Revision History

The revision history provided is for informational purposes only and is believed to be accurate, but not warranted. Please visit our website to make sure you have the latest revision.

DATE	REVISION	CHANGE
Sep 20, 2018	FN6051.8	Applied Renesas Header/Footer. Added Related Literature section. Updated Ordering Information table by removing retired parts ISL8487EIB, ISL81487LIB, ISL81487LIP, and ISL81487EIP, adding Notes 1 and 3, and adding tape and reel parts and column. Updated the Typical Operating Circuit diagram on page 2. Added Revision History section. Updated POD M8.15 to the latest revision. Changes are as follows: -Revision 1: Initial revision -Revision 1 to revision 2: Updated to new package outline drawing format by removing table, moving dimensions onto drawing, and adding land pattern -Revision 2 to revision 3: Changed the following values in Typical Recommended Landing Pattern: 2.41(0.095) to 2.20 (0.087) 0.76(0.030) to 0.60(0.023) 0.200 to 5.20(0.205) -Revision 3 to revision 4: Changed text in Note 1 from “1982” to “1994”

Package Outline Drawings



NOTES:

1. Controlling Dimensions: INCH. In case of conflict between English and Metric dimensions, the inch dimensions control.
2. Dimensioning and tolerancing per ANSI Y14.5M-1982.
3. Symbols are defined in the “MO Series Symbol List” in Section 2.2 of Publication No. 95.
4. Dimensions A, A1 and L are measured with the package seated in JEDEC seating plane gauge GS-3.
5. D, D1, and E1 dimensions do not include mold flash or protrusions. Mold flash or protrusions shall not exceed 0.010 inch (0.25mm).
6. E and e_A are measured with the leads constrained to be perpendicular to datum -C-.
7. e_B and e_C are measured at the lead tips with the leads unconstrained. e_C must be zero or greater.
8. B1 maximum dimensions do not include dambar protrusions. Dambar protrusions shall not exceed 0.010 inch (0.25mm).
9. N is the maximum number of terminal positions.
10. Corner leads (1, N, N/2 and N/2 + 1) for E8.3, E16.3, E18.3, E28.3, E42.6 will have a B1 dimension of 0.030 - 0.045 inch (0.76 - 1.14mm).

E8.3 (JEDEC MS-001-BA ISSUE D)

8 LEAD DUAL-IN-LINE PLASTIC PACKAGE

SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN	MAX	MIN	MAX	
A	-	0.210	-	5.33	4
A1	0.015	-	0.39	-	4
A2	0.115	0.195	2.93	4.95	-
B	0.014	0.022	0.356	0.558	-
B1	0.045	0.070	1.15	1.77	8, 10
C	0.008	0.014	0.204	0.355	-
D	0.355	0.400	9.01	10.16	5
D1	0.005	-	0.13	-	5
E	0.300	0.325	7.62	8.25	6
E1	0.240	0.280	6.10	7.11	5
e	0.100 BSC		2.54 BSC		-
e_A	0.300 BSC		7.62 BSC		6
e_B	-	0.430	-	10.92	7
L	0.115	0.150	2.93	3.81	4
N	8		8		9

Rev. 0 12/93

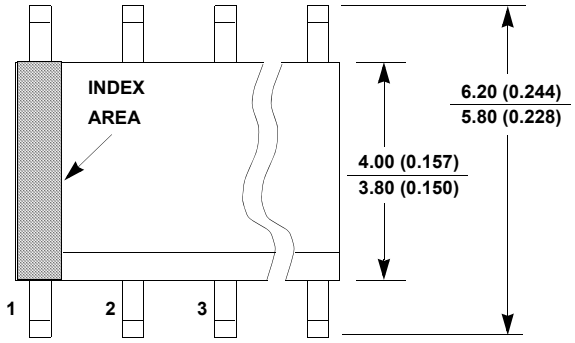
For the most recent package outline drawing, see E8.3.

M8.15

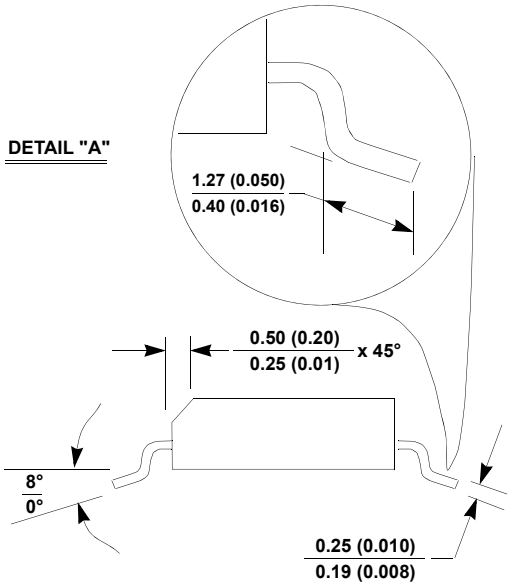
For the most recent package outline drawing, see M8.15.

8 LEAD NARROW BODY SMALL OUTLINE PLASTIC PACKAGE

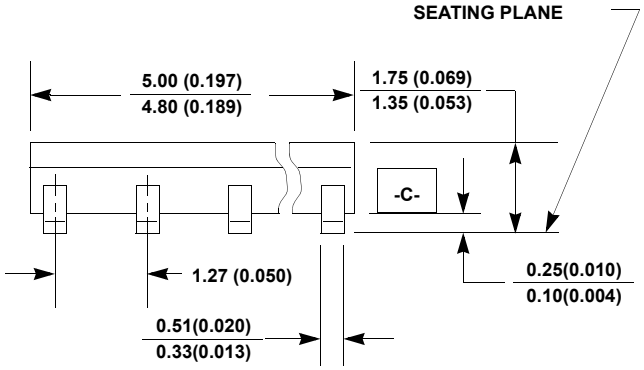
Rev 4, 1/12



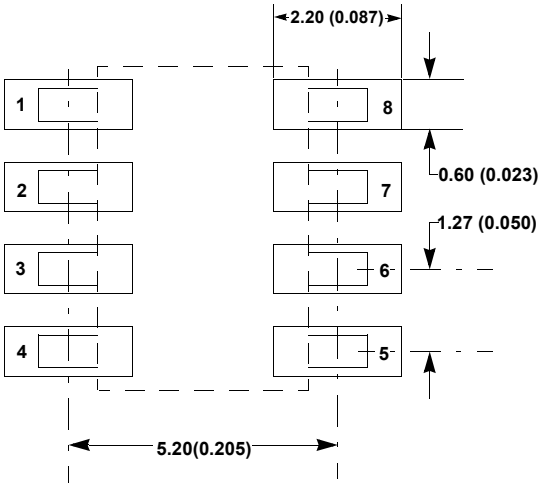
TOP VIEW



SIDE VIEW "B"



SIDE VIEW "A



TYPICAL RECOMMENDED LAND PATTERN

NOTES:

1. Dimensioning and tolerancing per ANSI Y14.5M-1994.
2. Package length does not include mold flash, protrusions or gate burrs. Mold flash, protrusion and gate burrs shall not exceed 0.15mm (0.006 inch) per side.
3. Package width does not include interlead flash or protrusions. Interlead flash and protrusions shall not exceed 0.25mm (0.010 inch) per side.
4. The chamfer on the body is optional. If it is not present, a visual index feature must be located within the crosshatched area.
5. Terminal numbers are shown for reference only.
6. The lead width as measured 0.36mm (0.014 inch) or greater above the seating plane, shall not exceed a maximum value of 0.61mm (0.024 inch).
7. Controlling dimension: MILLIMETER. Converted inch dimensions are not necessarily exact.
8. This outline conforms to JEDEC publication MS-012-AA ISSUE C.