ISL31470E, ISL31472E, ISL31475E, ISL31478E

Fault Protected, Extended Common Mode Range, RS-485/RS-422 Transceivers

FN7639
Rev 1.00
September 3, 2015

The ISL31470E, ISL31472E, ISL31475E, ISL31478E are fault protected, extended common mode range differential transceivers that exceed the RS-485 and RS-422 standards for balanced communication. The RS-485 bus pins (driver outputs and receiver inputs) are protected against overvoltages up to ±60V. Additionally, these transceivers operate in environments with common mode voltages up to ±15V (exceeds the RS-485 requirement), making this RS-485 family one of the more robust on the market.

Transmitters deliver an exceptional 2.5V (typical) differential output voltage into the RS-485 specified 54Ω load. This yields better noise immunity than standard RS-485 ICs, or allows up to six 120Ω terminations in star topologies.

Receiver (Rx) inputs feature a "Full Fail-Safe" design which ensures a logic high Rx output if Rx inputs are floating, shorted, or on a terminated but undriven (idle) bus. Rx outputs feature high drive levels - typically 15mA @ V_{OL} = 1V (to ease the design of opto-coupled isolated interfaces).

Half duplex (Rx inputs and Tx outputs multiplexed together) and full duplex pinouts are available. See Table 1 on page 2 for key features and configurations by device number.

For an RS-485 family with a ±25V extended common mode range, please see the ISL31490E and ISL31480E data sheets.

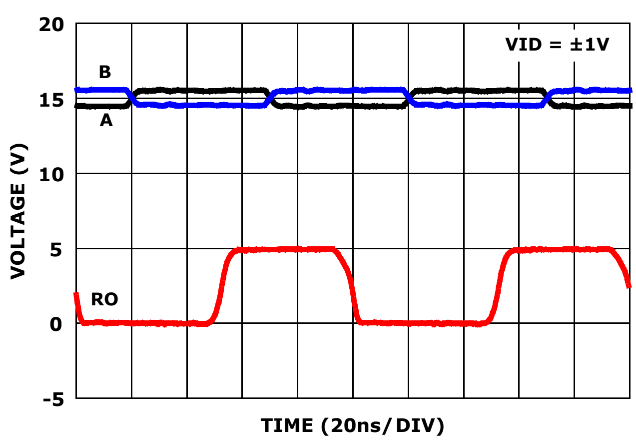
Features

- Fault Protected RS-485 Bus Pinsup to ±60V
- Extended Common Mode Range±15V
  Larger Than Required for RS-485
- 1/4 Unit Load for up to 128 Devices on the Bus
- High Transient Over Voltage Tolerance±80V
- Full Fail-safe (Open, Short, Terminated) RS-485 Receivers
- High Rx I_{OL} for Opto-Couplers in Isolated Designs
- Hot Plug Circuitry - Tx and Rx Outputs Remain Three-State During Power-up/Power-down
- Choice of RS-485 Data Rates250kbps to 15Mbps
- Low Quiescent Supply Current 2.3mA
  Ultra Low Shutdown Supply Current 10µA
- Pb-Free (RoHS Compliant)

Applications

- Utility Meters/Automated Meter Reading Systems
- High Node Count Systems
- PROFIBUS™ and Field Bus Networks, and Factory Automation
- Security Camera Networks
- Building Lighting and Environmental Control Systems
- Industrial/Process Control Networks

Exceptional Rx Operates at >15Mbps Even with ±15V Common Mode Voltage



Transceivers Deliver Superior Common Mode Range vs Standard RS-485 Devices

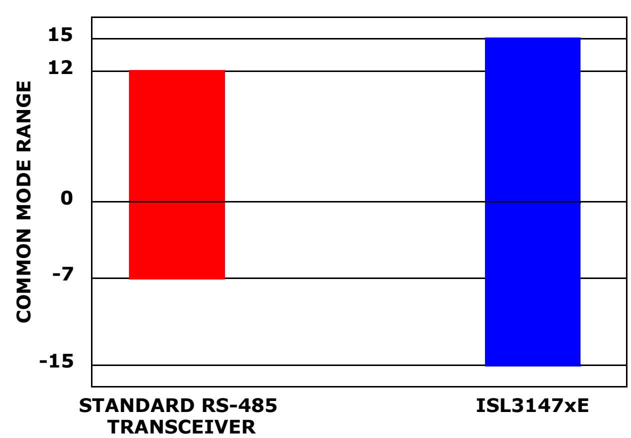


TABLE 1. SUMMARY OF FEATURES

PART NUMBER	HALF/FULL DUPLEX	DATA RATE (Mbps)	SLEW-RATE LIMITED?	EN PINS?	HOT PLUG?	QUIESCENT I_{CC} (mA)	LOW POWER SHDN?	PIN COUNT
ISL31470E	Full	0.25	Yes	Yes	Yes	2.3	Yes	14
ISL31472E	Half	0.25	Yes	Yes	Yes	2.3	Yes	8
ISL31475E	Half	1	Yes	Yes	Yes	2.3	Yes	8
ISL31478E	Half	15	No	Yes	Yes	2.3	Yes	8

Ordering Information

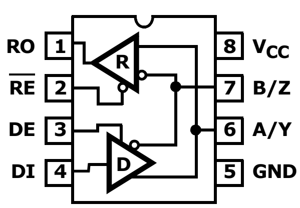
PART NUMBER (Note 3)	PART MARKING	TEMP. RANGE (°C)	PACKAGE (Pb-Free)	PKG. DWG. #
ISL31470EIBZ (Note 1)	ISL31470 EIBZ	-40 to +85	14 Ld SOIC	M14.15
ISL31472EIBZ (Note 1)	31472 EIBZ	-40 to +85	8 Ld SOIC	M8.15
ISL31472EIPZ (Note 2) **(No longer available, recommended replacement:ISL32472EIBZ)**	31472 EIPZ	-40 to +85	8 Ld PDIP	E8.3
ISL31475EIBZ (Note 1)	31475 EIBZ	-40 to +85	8 Ld SOIC	M8.15
ISL31478EIBZ (Note 1)	31478 EIBZ	-40 to +85	8 Ld SOIC	M8.15

NOTES:

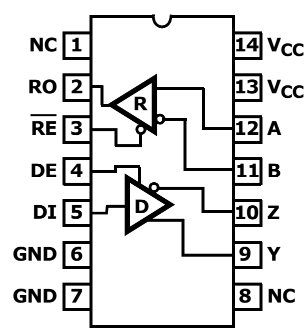
1. Add "-T" suffix for tape and reel. Please refer to TB347 for details on reel specifications.
2. Pb-free PDIPs can be used for through-hole wave solder processing only. They are not intended for use in Reflow solder processing applications.
3. These Intersil Pb-free plastic packaged products employ special Pb-free material sets, molding compounds/die attach materials, and 100% matte tin plate plus anneal (e3 termination finish, which is RoHS compliant and compatible with both SnPb and Pb-free soldering operations). Intersil 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.
4. For Moisture Sensitivity Level (MSL), please see device information pages for ISL31470E, ISL31472E, ISL31475E, ISL31478E. For more information on MSL please see techbrief TB363.

Pin Configurations

ISL31472E, ISL31475E, ISL31478E
(8 LD SOIC, 8 LD PDIP)
TOP VIEW



ISL31470E
(14 LD SOIC)
TOP VIEW



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*	High-Z*

NOTE: *Low Power Shutdown Mode (see Note 13, page 9).

RECEIVING				
INPUTS				OUTPUT
$\overline{RE}$	DE Half Duplex	DE Full Duplex	A-B	RO
0	0	X	≥ -0.01V	1
0	0	X	≤ -0.2V	0
0	0	X	Inputs Open/Shorted	1
1	0	0	X	High-Z*
1	1	1	X	High-Z

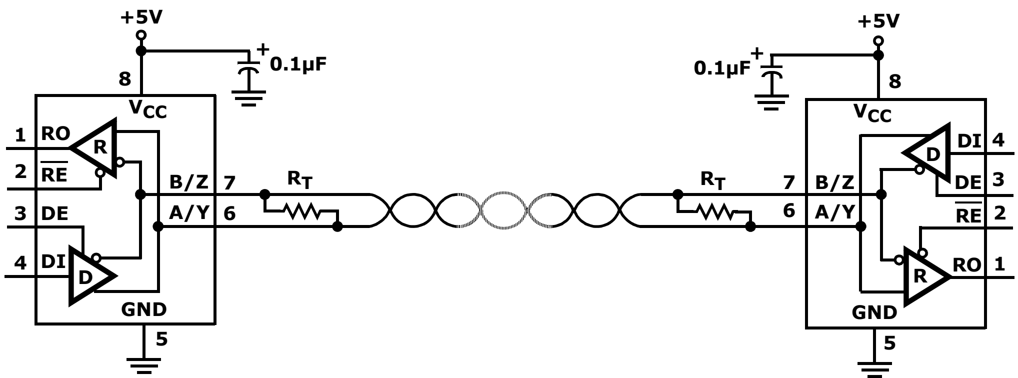
NOTE: *Low Power Shutdown Mode (see Note 13, page 9).

Pin Descriptions

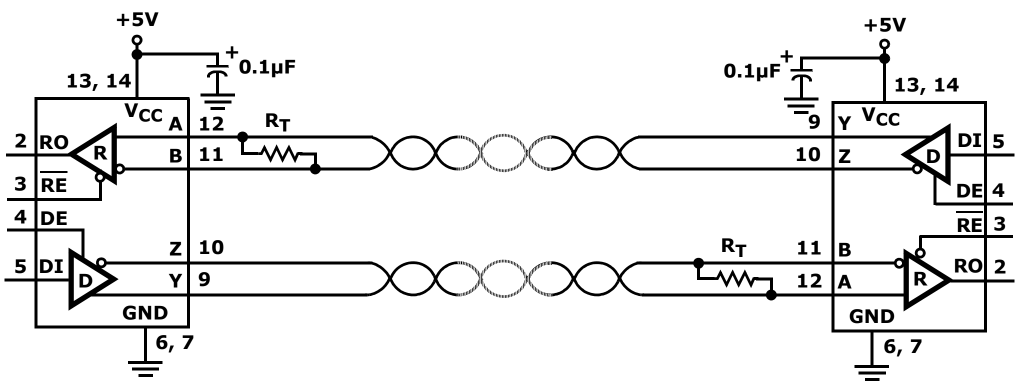
PIN NAME	8 LD PIN #	14 LD PIN #	FUNCTION
RO	1	2	Receiver output: If A-B ≥ -10mV, RO is high; If A-B ≤ -200mV, RO is low; RO = High if A and B are unconnected (floating), shorted together, or connected to an undriven, terminated bus.
$\overline{RE}$	2	3	Receiver output enable. RO is enabled when $\overline{RE}$ is low; RO is high impedance when $\overline{RE}$ is high. Internally pulled low.
DE	3	4	Driver output enable. The driver outputs, Y and Z, are enabled by bringing DE high. They are high impedance when DE is low. Internally pulled high.
DI	4	5	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	5	6, 7	Ground connection.
A/Y	6	-	±60V Fault Protected, RS-485/RS-422 level, non-inverting receiver input and non-inverting driver output. Pin is an input if DE = 0; pin is an output if DE = 1.
B/Z	7	-	±60V Fault Protected, RS-485/RS-422 level, inverting receiver input and inverting driver output. Pin is an input if DE = 0; pin is an output if DE = 1.
A	-	12	±60V Fault Protected, RS-485/RS-422 level, non-inverting receiver input.
B	-	11	±60V Fault Protected, RS-485/RS-422 level, inverting receiver input.
Y	-	9	±60V Fault Protected, RS-485/RS-422 level, non-inverting driver output.
Z	-	10	±60V Fault Protected, RS-485/RS-422 level, inverting driver output.
V_{CC}	8	13, 14	System power supply input (4.5V to 5.5V).
NC	-	1, 8	No Internal Connection.

Typical Operating Circuits

ISL31472E, ISL31475E, ISL31478E



ISL31470E



Absolute Maximum Ratings

V_{CC} to Ground 7V
Input Voltages
DI, DE, $\overline{RE}$ . . . . -0.3V to (V_{CC} + 0.3V)
Input/Output Voltages
A/Y, B/Z, A, B, Y, Z . . . . ±60V
A/Y, B/Z, A, B, Y, Z
(Transient Pulse Through 100Ω, Note 17). . . . . ±80V
RO . . . .-0.3V to (V_{CC} +0.3V)
Short Circuit Duration
Y, Z . . . . Indefinite
ESD Rating . . . . see Specification Table
Latch-up (per JESD78, Level 2, Class A) . . . . +125°C

Recommended Operating Conditions

Supply Voltage (V_{CC}) 5V
Temperature Range . . . .-40°C to +85°C
Bus Pin Common Mode Voltage Range . . . . . . -15V to +15V

Thermal Information

Thermal Resistance (Typical)	θ_{JA} (°C/W)	θ_{JC} (°C/W)
8 Ld PDIP* Package (Notes 5, 7) . . .	105	60
8 Ld SOIC Package (Notes 6, 7). . . .	116	47
14 Ld SOIC Package (Notes 6, 7) . . .	88	39

Maximum Junction Temperature (Plastic Package). . . . .+150°C
Maximum Storage Temperature Range. . . . . -65°C to +150°C
Pb-free Reflow Profile . . . . .see link below
http://www.intersil.com/pbfree/Pb-FreeReflow.asp
*Pb-free PDIPs can be used for through-hole wave solder processing only. They are not intended for use in Reflow solder processing applications.

CAUTION: Do not operate at or near the maximum ratings listed for extended periods of time. Exposure to such conditions may adversely impact product reliability and result in failures not covered by warranty.

NOTES:

5. θ_{JA} is measured with the component mounted on a low effective thermal conductivity test board in free air.
6. θ_{JA} is measured with the component mounted on a high effective thermal conductivity test board in free air. See Tech Brief TB379 for details.
7. For θ_{JC}, the "case temp" location is taken at the package top center.

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 8). **Boldface limits apply over the operating temperature range, -40°C to +85°C.**

PARAMETER	SYMBOL	TEST CONDITIONS	TEMP (°C)	MIN (Note 16)	TYP	MAX (Note 16)	UNITS
DC CHARACTERISTICS							
Driver Differential V_{OUT} (No load)	V_{OD1}		Full	-	-	**V_{CC}**	V
Driver Differential V_{OUT} (Loaded, Figure 1A)	V_{OD2}	R_L = 100Ω (RS-422)	Full	**2.4**	3.2	-	V
		R_L = 54Ω (RS-485)	Full	**1.5**	2.5	**V_{CC}**	V
		R_L = 54Ω (PROFIBUS, V_{CC} ≥ 5V)	Full	**2.0**	2.5	**-**	
		R_L = 21Ω (Six 120Ω terminations for Star Configurations, V_{CC} ≥ 4.75V)	Full	**0.8**	1.3	-	V
Change in Magnitude of Driver Differential V_{OUT} for Complementary Output States	ΔV_{OD}	R_L = 54Ω or 100Ω (Figure 1A)	Full	-	-	**0.2**	V
Driver Differential V_{OUT} with Common Mode Load (Figure 1B)	V_{OD3}	R_L = 60Ω, -7V ≤ V_{CM} ≤ 12V	Full	**1.5**	2.1	**V_{CC}**	V
		R_L = 60Ω, -15V ≤ V_{CM} ≤ 15V (V_{CC} ≥ 4.75V)	Full	**1.7**	2.3	**-**	v
Driver Common-Mode V_{OUT} (Figure 1A)	V_{OC}	R_L = 54Ω or 100Ω	Full	**-1**	-	**3**	V
Change in Magnitude of Driver Common-Mode V_{OUT} for Complementary Output States	ΔV_{OC}	R_L = 54Ω or 100Ω (Figure 1A)	Full	-	-	**0.2**	V
Driver Short-Circuit Current	I_{OSD}	DE = V_{CC}, -15V ≤ V_O ≤ 15V (Note 10)	Full	**-250**	-	**250**	mA
	I_{OSD1}	At First Fold-back, 22V ≤ V_O ≤ -22V	Full	**-83**	-	**83**	mA
	I_{OSD2}	At Second Fold-back, 35V ≤ V_O ≤ -35V	Full	**-13**	-	**13**	mA

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 8). **Boldface limits apply over the operating temperature range, -40°C to +85°C. (Continued)**

PARAMETER	SYMBOL	TEST CONDITIONS		TEMP (°C)	MIN (Note 16)	TYP	MAX (Note 16)	UNITS
Logic Input High Voltage	V_{IH}	DE, DI, $\overline{RE}$		Full	**2.5**	-	-	V
Logic Input Low Voltage	V_{IL}	DE, DI, $\overline{RE}$		Full	-	-	**0.8**	V
Logic Input Current	I_{IN1}	DI		Full	**-1**	-	**1**	µA
		DE, $\overline{RE}$		Full	**-15**	6	**15**	µA
Input/Output Current (A/Y, B/Z)	I_{IN2}	DE = 0V, V_{CC} = 0V or 5.5V	V_{IN} = 12V	Full	-	110	**250**	µA
			V_{IN} = -7V	Full	**-200**	-75	-	µA
			V_{IN} = ±15V	Full	**-800**	±240	**800**	µA
			V_{IN} = ±60V (Note 18)	Full	**-6**	±0.5	**6**	mA
Input Current (A, B) (Full Duplex Versions Only)	I_{IN3}	V_{CC} = 0V or 5.5V	V_{IN} = 12V	Full	-	90	**125**	µA
			V_{IN} = -7V	Full	**-100**	-70	-	µA
			V_{IN} = ±15V	Full	**-500**	±200	**500**	µA
			V_{IN} = ±60V (Note 18)	Full	**-3**	±0.4	**3**	mA
Output Leakage Current (Y, Z) (Full Duplex Versions Only)	I_{OZD}	$\overline{RE}$ = 0V, DE = 0V, V_{CC} = 0V or 5.5V	V_{IN} = 12V	Full	-	20	**200**	µA
			V_{IN} = -7V	Full	**-100**	-5	-	µA
			V_{IN} = ±15V	Full	**-500**	±40	**500**	µA
			V_{IN} = ±60V (Note 18)	Full	**-3**	±0.1	**3**	mA
Receiver Differential Threshold Voltage	V_{TH}	-15V ≤ V_{CM} ≤ 15V		Full	**-200**	-100	**-10**	mV
Receiver Input Hysteresis	ΔV_{TH}	-15V ≤ V_{CM} ≤ 15V		+25	-	25	-	mV
Receiver Output High Voltage	V_{OH}	I_O = -2mA, V_{ID} = -10mV		Full	**V_{CC} - 0.5**	4.75	-	V
		I_O = -8mA, V_{ID} = -10mV		Full	**2.8**	4.2	-	V
Receiver Output Low Voltage	V_{OL}	I_O = 6mA, V_{ID} = -200mV		Full	-	0.27	**0.4**	V
Receiver Output Low Current	I_{OL}	V_O = 1V, V_{ID} = -200mV		Full	**15**	22	-	mA
Three-State (High Impedance) Receiver Output Current	I_{OZR}	0V ≤ V_O ≤ V_{CC}		Full	**-1**	0.01	**1**	µA
Receiver Short-Circuit Current	I_{OSR}	0V ≤ V_O ≤ V_{CC}		Full	**±12**	-	**±110**	mA
SUPPLY CURRENT								
No-Load Supply Current (Note 9)	I_{CC}	DE = V_{CC}, $\overline{RE}$ = 0V or V_{CC}, DI = 0V or V_{CC}		Full	-	2.3	**4.5**	mA
Shutdown Supply Current	I_{SHDN}	DE = 0V, $\overline{RE}$ = V_{CC}, DI = 0V or V_{CC}		Full	-	10	**50**	µA
ESD PERFORMANCE								
All Pins		Human Body Model (Tested per JESD22-A114E)		+25	-	±2	-	kV
		Machine Model (Tested per JESD22-A115-A)		+25	-	±700	-	V
DRIVER SWITCHING CHARACTERISTICS (250kbps Versions; ISL31470E and ISL31472E)								
Driver Differential Output Delay	t_{PLH}, t_{PHL}	R_D = 54Ω, C_D = 50pF (Figure 2)		Full	-	320	**450**	ns
Driver Differential Output Skew	t_{SKEW}	R_D = 54Ω, C_D = 50pF (Figure 2)		Full	-	6	**30**	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 8). **Boldface limits apply over the operating temperature range, -40°C to +85°C. (Continued)**

PARAMETER	SYMBOL	TEST CONDITIONS	TEMP (°C)	MIN (Note 16)	TYP	MAX (Note 16)	UNITS
Driver Differential Rise or Fall Time	t_R, t_F	R_D = 54Ω, C_D = 50pF (Figure 2)	Full	**400**	650	**1200**	ns
Maximum Data Rate	f_{MAX}	C_D = 820pF (Figure 4)	Full	**0.25**	1.5	**-**	Mbps
Driver Enable to Output High	t_{ZH}	SW = GND (Figure 3), (Note 11)	Full	-	-	**1200**	ns
Driver Enable to Output Low	t_{ZL}	SW = V_{CC} (Figure 3), (Note 11)	Full	-	-	**1200**	ns
Driver Disable from Output Low	t_{LZ}	SW = V_{CC} (Figure 3)	Full	-	-	**120**	ns
Driver Disable from Output High	t_{HZ}	SW = GND (Figure 3)	Full	-	-	**120**	ns
Time to Shutdown	t_{SHDN}	(Note 13)	Full	**60**	160	**600**	ns
Driver Enable from Shutdown to Output High	$t_{ZH(SHDN)}$	SW = GND (Figure 3), (Notes 13, 14)	Full	-	-	**2500**	ns
Driver Enable from Shutdown to Output Low	$t_{ZL(SHDN)}$	SW = V_{CC} (Figure 3), (Notes 13, 14)	Full	-	-	**2500**	ns
DRIVER SWITCHING CHARACTERISTICS (1Mbps Versions; ISL31475E)							
Driver Differential Output Delay	t_{PLH}, t_{PHL}	R_D = 54Ω, C_D = 50pF (Figure 2)	Full	-	70	**125**	ns
Driver Differential Output Skew	t_{SKEW}	R_D = 54Ω, C_D = 50pF (Figure 2)	Full	-	3	**15**	ns
Driver Differential Rise or Fall Time	t_R, t_F	R_D = 54Ω, C_D = 50pF (Figure 2)	Full	**70**	230	**300**	ns
Maximum Data Rate	f_{MAX}	C_D = 820pF (Figure 4)	Full	**1**	4	**-**	Mbps
Driver Enable to Output High	t_{ZH}	SW = GND (Figure 3), (Note 11)	Full	-	-	**350**	ns
Driver Enable to Output Low	t_{ZL}	SW = V_{CC} (Figure 3), (Note 11)	Full	-	-	**300**	ns
Driver Disable from Output Low	t_{LZ}	SW = V_{CC} (Figure 3)	Full	-	-	**120**	ns
Driver Disable from Output High	t_{HZ}	SW = GND (Figure 3)	Full	-	-	**120**	ns
Time to Shutdown	t_{SHDN}	(Note 13)	Full	**60**	160	**600**	ns
Driver Enable from Shutdown to Output High	$t_{ZH(SHDN)}$	SW = GND (Figure 3), (Notes 13, 14)	Full	-	-	**2000**	ns
Driver Enable from Shutdown to Output Low	$t_{ZL(SHDN)}$	SW = V_{CC} (Figure 3), (Notes 13, 14)	Full	-	-	**2000**	ns
DRIVER SWITCHING CHARACTERISTICS (15Mbps Versions; ISL31478E)							
Driver Differential Output Delay	t_{PLH}, t_{PHL}	R_D = 54Ω, C_D = 50pF (Figure 2)	Full	-	21	**45**	ns
Driver Differential Output Skew	t_{SKEW}	R_D = 54Ω, C_D = 50pF (Figure 2)	Full	-	3	**6**	ns
Driver Differential Rise or Fall Time	t_R, t_F	R_D = 54Ω, C_D = 50pF (Figure 2)	Full	**5**	17	**30**	ns
Maximum Data Rate	f_{MAX}	C_D = 470pF (Figure 4)	Full	**15**	25	**-**	Mbps
Driver Enable to Output High	t_{ZH}	SW = GND (Figure 3), (Note 11)	Full	-	-	**100**	ns
Driver Enable to Output Low	t_{ZL}	SW = V_{CC} (Figure 3), (Note 11)	Full	-	-	**100**	ns
Driver Disable from Output Low	t_{LZ}	SW = V_{CC} (Figure 3)	Full	-	-	**120**	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 8). **Boldface limits apply over the operating temperature range, -40°C to +85°C. (Continued)**

PARAMETER	SYMBOL	TEST CONDITIONS	TEMP (°C)	MIN (Note 16)	TYP	MAX (Note 16)	UNITS
Driver Disable from Output High	t_{HZ}	SW = GND (Figure 3)	Full	-	-	**120**	ns
Time to Shutdown	t_{SHDN}	(Note 13)	Full	**60**	160	**600**	ns
Driver Enable from Shutdown to Output High	$t_{ZH(SHDN)}$	SW = GND (Figure 3), (Notes 13, 14)	Full	-	-	**2000**	ns
Driver Enable from Shutdown to Output Low	$t_{ZL(SHDN)}$	SW = V_{CC} (Figure 3), (Notes 13, 14)	Full	-	-	**2000**	ns
RECEIVER SWITCHING CHARACTERISTICS (250kbps Versions; ISL31470E and ISL31472E)							
Maximum Data Rate	f_{MAX}	(Figure 5)	Full	**0.25**	5	**-**	Mbps
Receiver Input to Output Delay	t_{PLH}, t_{PHL}	(Figure 5)	Full	-	200	**280**	ns
Receiver Skew $\|t_{PLH} - t_{PHL}\|$	t_{SKD}	(Figure 5)	Full	-	4	**10**	ns
Receiver Enable to Output Low	t_{ZL}	R_L = 1kΩ, C_L = 15pF, SW = V_{CC} (Figure 6), (Note 12)	Full	-	-	**50**	ns
Receiver Enable to Output High	t_{ZH}	R_L = 1kΩ, C_L = 15pF, SW = GND (Figure 6), (Note 12)	Full	-	-	**50**	ns
Receiver Disable from Output Low	t_{LZ}	R_L = 1kΩ, C_L = 15pF, SW = V_{CC} (Figure 6)	Full	-	-	**50**	ns
Receiver Disable from Output High	t_{HZ}	R_L = 1kΩ, C_L = 15pF, SW = GND (Figure 6)	Full	-	-	**50**	ns
Time to Shutdown	t_{SHDN}	(Note 13)	Full	**60**	160	**600**	ns
Receiver Enable from Shutdown to Output High	$t_{ZH(SHDN)}$	R_L = 1kΩ, C_L = 15pF, SW = GND (Figure 6), (Notes 13, 15)	Full	-	-	**2000**	ns
Receiver Enable from Shutdown to Output Low	$t_{ZL(SHDN)}$	R_L = 1kΩ, C_L = 15pF, SW = V_{CC} (Figure 6), (Notes 13, 15)	Full	-	-	**2000**	ns
RECEIVER SWITCHING CHARACTERISTICS (1Mbps Versions; ISL31475E)							
Maximum Data Rate	f_{MAX}	(Figure 5)	Full	**1**	15	**-**	Mbps
Receiver Input to Output Delay	t_{PLH}, t_{PHL}	(Figure 5)	Full	-	90	**150**	ns
Receiver Skew $\|t_{PLH} - t_{PH}\|$	t_{SKD}	(Figure 5)	Full	-	4	**10**	ns
Receiver Enable to Output Low	t_{ZL}	R_L = 1kΩ, C_L = 15pF, SW = V_{CC} (Figure 6), (Note 12)	Full	-	-	**50**	ns
Receiver Enable to Output High	t_{ZH}	R_L = 1kΩ, C_L = 15pF, SW = GND (Figure 6), (Note 12)	Full	-	-	**50**	ns
Receiver Disable from Output Low	t_{LZ}	R_L = 1kΩ, C_L = 15pF, SW = V_{CC} (Figure 6)	Full	-	-	**50**	ns
Receiver Disable from Output High	t_{HZ}	R_L = 1kΩ, C_L = 15pF, SW = GND (Figure 6)	Full	-	-	**50**	ns
Time to Shutdown	t_{SHDN}	(Note 13)	Full	**60**	160	**600**	ns
Receiver Enable from Shutdown to Output High	$t_{ZH(SHDN)}$	R_L = 1kΩ, C_L = 15pF, SW = GND (Figure 6), (Notes 13, 15)	Full	-	-	**2000**	ns
Receiver Enable from Shutdown to Output Low	$t_{ZL(SHDN)}$	R_L = 1kΩ, C_L = 15pF, SW = V_{CC} (Figure 6), (Notes 13, 15)	Full	-	-	**2000**	ns
RECEIVER SWITCHING CHARACTERISTICS (15Mbps Versions; ISL31478E)							
Maximum Data Rate	f_{MAX}	(Figure 5)	Full	**15**	25	**-**	Mbps
Receiver Input to Output Delay	t_{PLH}, t_{PHL}	(Figure 5)	Full	-	35	**70**	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 8). **Boldface limits apply over the operating temperature range, -40°C to +85°C. (Continued)**

PARAMETER	SYMBOL	TEST CONDITIONS	TEMP (°C)	MIN (Note 16)	TYP	MAX (Note 16)	UNITS
Receiver Skew $\|t_{PLH} - t_{PHL}\|$	t_{SKD}	(Figure 5)	Full	-	4	**10**	ns
Receiver Enable to Output Low	t_{ZL}	R_L = 1kΩ, C_L = 15pF, SW = V_{CC} (Figure 6), (Note 12)	Full	-	-	**50**	ns
Receiver Enable to Output High	t_{ZH}	R_L = 1kΩ, C_L = 15pF, SW = GND (Figure 6), (Note 12)	Full	-	-	**50**	ns
Receiver Disable from Output Low	t_{LZ}	R_L = 1kΩ, C_L = 15pF, SW = V_{CC} (Figure 6)	Full	-	-	**50**	ns
Receiver Disable from Output High	t_{HZ}	R_L = 1kΩ, C_L = 15pF, SW = GND (Figure 6)	Full	-	-	**50**	ns
Time to Shutdown	t_{SHDN}	(Note 13)	Full	**60**	160	**600**	ns
Receiver Enable from Shutdown to Output High	$t_{ZH(SHDN)}$	R_L = 1kΩ, C_L = 15pF, SW = GND (Figure 6), (Notes 13, 15)	Full	-	-	**2000**	ns
Receiver Enable from Shutdown to Output Low	$t_{ZL(SHDN)}$	R_L = 1kΩ, C_L = 15pF, SW = V_{CC} (Figure 6), (Notes 13, 15)	Full	-	-	**2000**	ns

NOTES:

8. All currents into device pins are positive; all currents out of device pins are negative. All voltages are referenced to device ground unless otherwise specified.
9. Supply current specification is valid for loaded drivers when DE = 0V.
10. Applies to peak current. See "Typical Performance Curves" beginning on page 14 for more information.
11. Keep $\overline{RE}$ = 0 to prevent the device from entering SHDN.
12. The $\overline{RE}$ signal high time must be short enough (typically <100ns) to prevent the device from entering SHDN.
13. Transceivers are put into shutdown by bringing $\overline{RE}$ high and DE low. If the inputs are in this state for less than 60ns, the parts are guaranteed not to enter shutdown. If the inputs are in this state for at least 600ns, the parts are guaranteed to have entered shutdown. See "Low Power Shutdown Mode" on page 14.
14. Keep $\overline{RE}$ = VCC, and set the DE signal low time >600ns to ensure that the device enters SHDN.
15. Set the $\overline{RE}$ signal high time >600ns to ensure that the device enters SHDN.
16. Parameters with MIN and/or MAX limits are 100% tested at +25°C, unless otherwise specified. Temperature limits established by characterization and are not production tested.
17. Tested according to TIA/EIA-485-A, Section 4.2.6 (±80V for 15µs at a 1% duty cycle).
18. See "Caution" statement below the "Recommended Operating Conditions" section on page 5.

Test Circuits and Waveforms

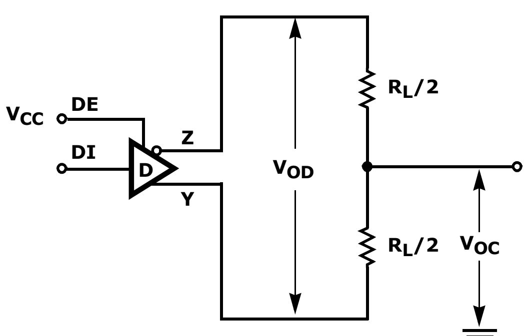


FIGURE 1A. V_{OD} AND V_{OC}

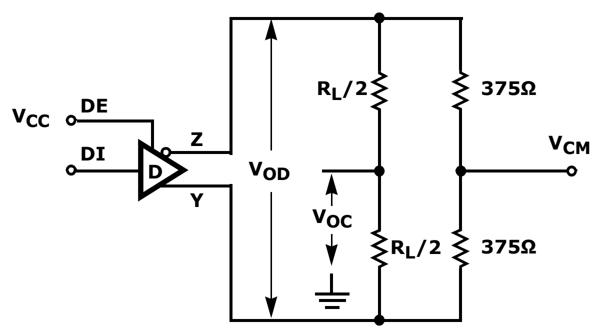


FIGURE 1B. V_{OD} AND V_{OC} WITH COMMON MODE LOAD

FIGURE 1. DC DRIVER TEST CIRCUITS

Test Circuits and Waveforms (Continued)

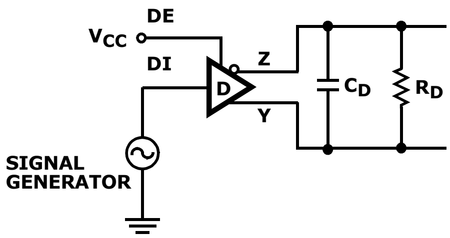


FIGURE 2A. TEST CIRCUIT

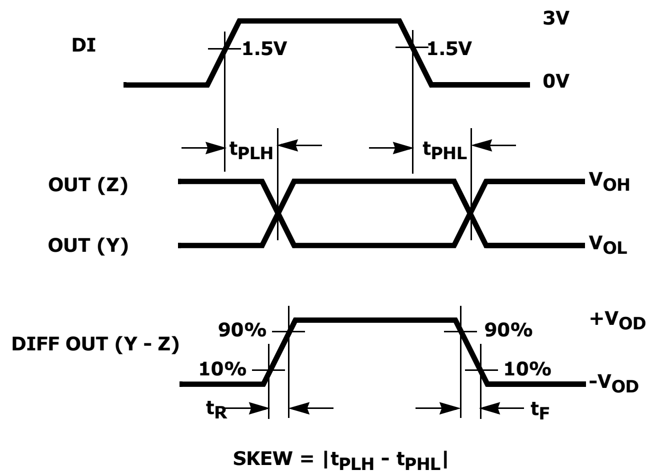
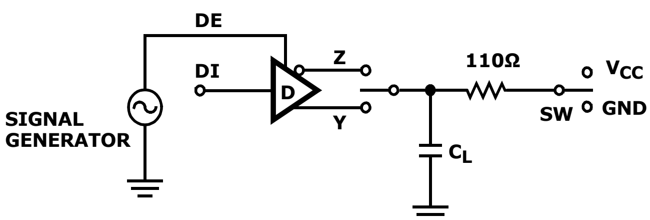


FIGURE 2B. MEASUREMENT POINTS

FIGURE 2. DRIVER PROPAGATION DELAY AND DIFFERENTIAL TRANSITION TIMES



PARAMETER	OUTPUT	$\overline{RE}$	DI	SW	C_L (pF)
t_{HZ}	Y/Z	X	1/0	GND	50
t_{LZ}	Y/Z	X	0/1	V_{CC}	50
t_{ZH}	Y/Z	0 (Note 11)	1/0	GND	100
t_{ZL}	Y/Z	0 (Note 11)	0/1	V_{CC}	100
$t_{ZH(SHDN)}$	Y/Z	1 (Note 14)	1/0	GND	100
$t_{ZL(SHDN)}$	Y/Z	1 (Note 14)	0/1	V_{CC}	100

FIGURE 3A. TEST CIRCUIT

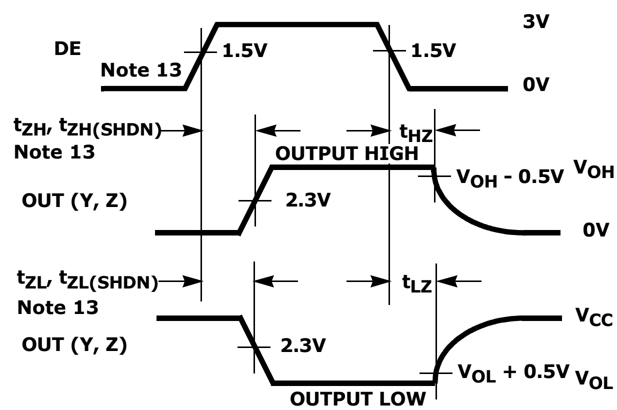


FIGURE 3B. MEASUREMENT POINTS

FIGURE 3. DRIVER ENABLE AND DISABLE TIMES

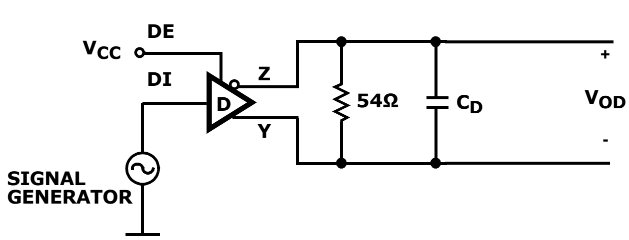


FIGURE 4A. TEST CIRCUIT

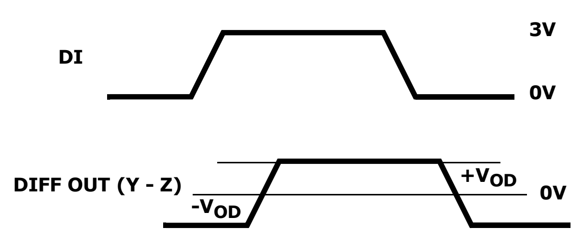


FIGURE 4B. MEASUREMENT POINTS

FIGURE 4. DRIVER DATA RATE

Test Circuits and Waveforms (Continued)

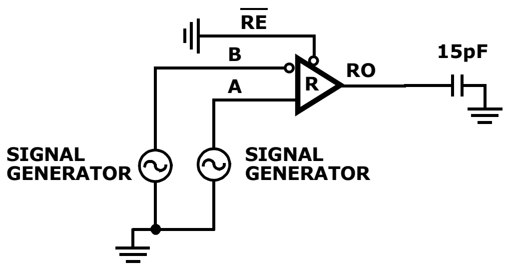


FIGURE 5A. TEST CIRCUIT

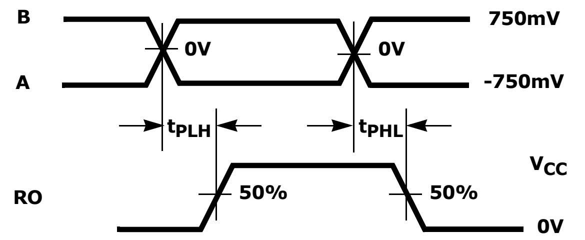
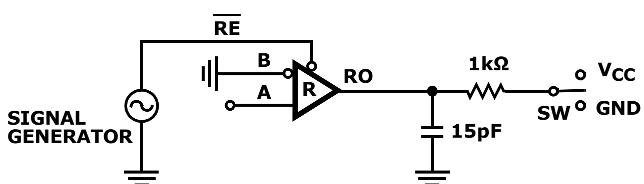


FIGURE 5B. MEASUREMENT POINTS

FIGURE 5. RECEIVER PROPAGATION DELAY AND DATA RATE



PARAMETER	DE	A	SW
t_{HZ}	0	+1.5V	GND
t_{LZ}	0	-1.5V	V_{CC}
t_{ZH} (Note 12)	0	+1.5V	GND
t_{ZL} (Note 12)	0	-1.5V	V_{CC}
$t_{ZH(SHDN)}$ (Note 15)	0	+1.5V	GND
$t_{ZL(SHDN)}$ (Note 15)	0	-1.5V	V_{CC}

FIGURE 6A. TEST CIRCUIT

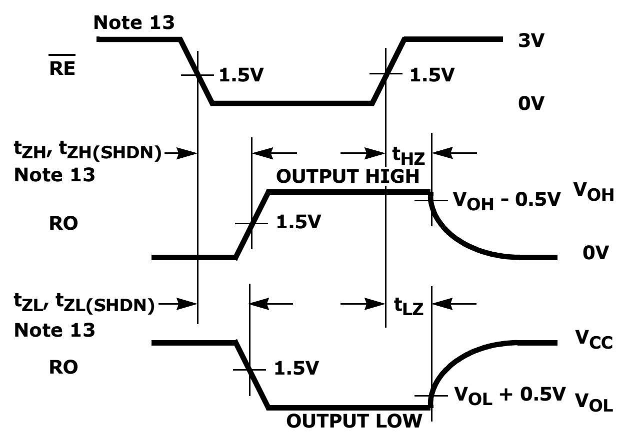


FIGURE 6B. MEASUREMENT POINTS

FIGURE 6. RECEIVER ENABLE AND DISABLE TIMES

Application Information

RS-485 and RS-422 are differential (balanced) data transmission standards used for 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, which allows only one driver and up to 10 (assuming one unit load devices) receivers on each bus. RS-485 is a true multipoint standard, which 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 must handle bus contention without sustaining any damage.

Another important advantage of RS-485 is the extended common mode range (CMR), which specifies that the driver outputs and receiver inputs withstand signals that range from +12V to -7V. RS-422 and RS-485 are intended for runs as long as 4000′, thus the wide CMR is necessary to handle ground potential differences, as well as voltages induced in the cable by external fields.

The ISL31470E, ISL31472E, ISL31475E, ISL31478E is a family of ruggedized RS-485 transceivers that improves on the RS-485 basic requirements, and therefore increases system reliability. The CMR increases to ±15V, while the RS-485 bus pins (receiver inputs and driver outputs) include fault protection against voltages and transients up to ±60V. Additionally, larger than required differential output voltages (V_{OD}) increase noise immunity.

Receiver (Rx) Features

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

Receiver input (load) current surpasses the RS-422 specification of 3mA, and is four times lower than the RS-485 “Unit Load (UL)” requirement of 1mA maximum. Thus, these products are known as “one-quarter UL” transceivers, and there can be up to 128 of these devices on a network while still complying with the RS-485 loading specification.

The Rx functions with common mode voltages as great as ±15V, making them ideal for industrial, or long networks where induced voltages are a realistic concern.

All the receivers include a “full fail-safe” function that guarantees a high level receiver output if the receiver inputs are unconnected (floating), shorted together, or connected to a terminated bus with all the transmitters disabled (i.e., an idle bus).

Rx outputs feature high drive levels (typically 22mA @ V_{OL} = 1V) to ease the design of optically-coupled isolated interfaces.

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

The Rx in the 250kbps and 1Mbps versions include noise filtering circuitry to reject high frequency signals. The 1Mbps version typically rejects pulses narrower than 50ns (equivalent to 20Mbps), while the 250kbps Rx rejects pulses below 150ns (6.7Mbps).

Driver (Tx) Features

The RS-485/RS-422 driver is a differential output device that delivers at least 1.5V across a 54Ω load (RS-485), and at least 2.4V across a 100Ω load (RS-422). The drivers feature low propagation delay skew to maximize bit width, and to minimize EMI, and all drivers are three-statable via the active high DE input.

The 250kbps and 1Mbps driver outputs are slew rate limited to minimize EMI, and to minimize reflections in unterminated or improperly terminated networks. Outputs of the ISL31478E drivers are not limited, thus, faster output transition times allow data rates of at least 15Mbps.

High Overvoltage (Fault) Protection Increases ruggedness

The ±60V (referenced to the IC GND) fault protection on the RS-485 pins, makes these transceivers some of the most rugged on the market. This level of protection makes the ISL31470E, ISL31472E, ISL31475E, ISL31478E perfect for applications where power (e.g., 24V and 48V supplies) must be routed in the conduit with the data lines, or for outdoor applications where large transients are likely to occur. When power is routed with the data lines, even a momentary short between the supply and data lines will destroy an unprotected device. The ±60V fault levels of this family are at least **five times higher** than the levels specified for standard RS-485 ICs. The ISL31470E, ISL31472E, ISL31475E, ISL31478E protection is active whether the Tx is enabled or disabled, and even if the IC is powered down.

If transients or voltages (including overshoots and ringing) greater than ±60V are possible, then additional external protection is required.

Wide Common Mode Voltage (CMV) Tolerance Improves Operating Range

RS-485 networks operating in industrial complexes, or over long distances, are susceptible to large CMV variations. Either of these operating environments may suffer from large node-to-node ground potential differences, or CMV pickup from external electromagnetic sources, and devices with only the minimum required +12V to -7V CMR may malfunction. The ISL31470E, ISL31472E, ISL31475E, ISL31478E’s extended ±15V CMR allows for operation in environments that would overwhelm lesser transceivers. Additionally, the Rx will not phase invert (erroneously change state) even with CMVs of ±40V, or differential voltages as large as 40V.

High V_{OD} Improves Noise Immunity and Flexibility

The ISL31470E, ISL31472E, ISL31475E, ISL31478E driver design delivers larger differential output voltages (V_{OD}) than the RS-485 standard requires, or than most RS-485 transmitters can deliver. The typical ±2.5V V_{OD} provides more noise immunity than networks built using many other transceivers.

Another advantage of the large V_{OD} is the ability to drive more than two bus terminations, which allows for utilizing the ISL31470E, ISL31472E, ISL31475E, ISL31478E in "star" and other multi-terminated, nonstandard network topologies. Figure 8, details the transmitter's V_{OD} vs I_{OUT} characteristic, and includes load lines for four (30Ω) and six (20Ω) 120Ω terminations. Figure 8 shows that the driver typically delivers ±1.3V into six terminations, and the "Electrical Specification" table guarantees a V_{OD} of ±0.8V at 21Ω over the full temperature range. The RS-485 standard requires a minimum 1.5V V_{OD} into two terminations, but the ISL31470E, ISL31472E, ISL31475E, ISL31478E deliver RS-485 voltage levels with 2x to 3x the number of terminations.

Hot Plug Function

When a piece of equipment powers up, there is a period of time where the processor or ASIC driving the RS-485 control lines (DE, $\overline{RE}$) is unable to ensure that the RS-485 Tx and Rx outputs are kept disabled. If the equipment is connected to the bus, a driver activating prematurely during power-up may crash the bus. To avoid this scenario, the ISL31470E, ISL31472E, ISL31475E, ISL31478E devices incorporate a "Hot Plug" function. Circuitry monitoring V_{CC} ensures that, during power-up and power-down, the Tx and Rx outputs remain disabled, regardless of the state of DE and $\overline{RE}$, if V_{CC} is less than ≈3.5V. This gives the processor/ASIC a chance to stabilize and drive the RS-485 control lines to the proper states. Figure 7 illustrates the power-up and power-down performance of the ISL31470E, ISL31472E, ISL31475E, ISL31478E compared to an RS-485 IC without the Hot Plug feature.

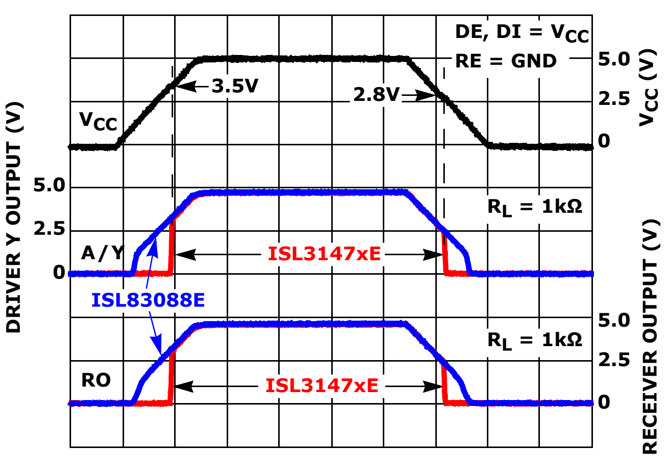


FIGURE 7. HOT PLUG PERFORMANCE (ISL3147xE) vs ISL83088E WITHOUT HOT PLUG CIRCUITRY

Data Rate, Cables, and Terminations

RS-485/RS-422 are intended for network lengths up to 4000', but the maximum system data rate decreases as the transmission length increases. Devices operating at 15Mbps may be used at lengths up to 150' (46m), but the distance can be increased to 328' (100m) by operating at 10Mbps. The 1Mbps versions can operate at full data rates with lengths up to 800' (244m). Jitter is the limiting parameter at these faster data rates, so employing encoded data streams (e.g., Manchester coded or Return-to-Zero) may allow increased transmission distances. The slow versions can operate at 115kbps, or less, at the full 4000' (1220m) distance, or at 250kbps for lengths up to 3000' (915m). DC cable attenuation is the limiting parameter, so using better quality cables (e.g., 22 AWG) may allow increased transmission distance.

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

Proper termination is imperative, when using the 15Mbps devices, to minimize reflections. Short networks using the 250kbps versions need not be terminated, however, terminations are recommended unless power dissipation is an overriding concern.

In point-to-point, or point-to-multipoint (single driver on bus like RS-422) networks, the main cable should be terminated in its characteristic impedance (typically 120Ω) at the end farthest from the driver. In multi-receiver applications, stubs connecting receivers to the main cable should be kept as short as possible. Multipoint (multi-driver) systems require that the main cable be terminated in its characteristic impedance at both ends. Stubs connecting a transceiver to the main cable should be kept as short as possible.

Built-In Driver Overload Protection

As stated previously, the RS-485 specification requires that drivers survive worst case bus contentions undamaged. These transceivers meet this requirement via driver output short circuit current limits, and on-chip thermal shutdown circuitry.

The driver output stages incorporate a double fold-back short circuit current limiting scheme which ensures that the output current never exceeds the RS-485 specification, even at the common mode and fault condition voltage range extremes. The first fold-back current level (≈70mA) is set to ensure that the driver never folds back when driving loads with common mode voltages up to ±15V. The very low second fold-back current setting (≈9mA) minimizes power dissipation if the Tx is enabled when a fault occurs.

In the event of a major short circuit condition, devices also include a thermal shutdown feature that disables the drivers whenever 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 contention persists, the thermal shutdown/re-enable cycle repeats until the fault is cleared. Receivers stay operational during thermal shutdown.

Low Power Shutdown Mode

These CMOS transceivers all use a fraction of the power required by competitive devices, but they also include a shutdown feature that reduces the already low quiescent I_{CC} to a 10µA trickle. These devices 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 60ns guarantees that the transceiver will not enter shutdown.

Note that receiver and driver enable times increase when the transceiver enables from shutdown. Refer to Notes 11, 12, 13, 14 and 15, at the end of the "Electrical Specification" table on page 9, for more information.

Typical Performance Curves V_{CC} = 5V, T_A = +25°C; Unless Otherwise Specified.

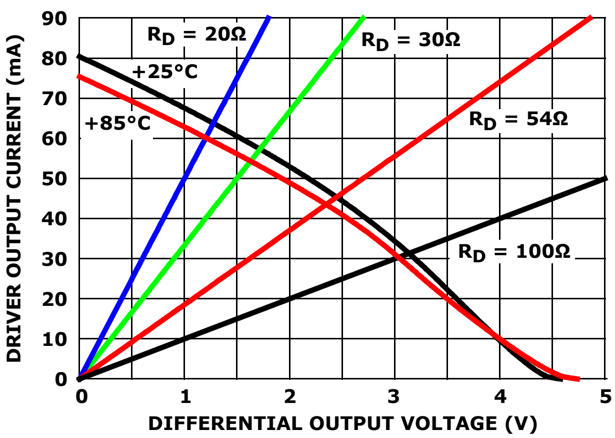


FIGURE 8. DRIVER OUTPUT CURRENT vs DIFFERENTIAL OUTPUT VOLTAGE

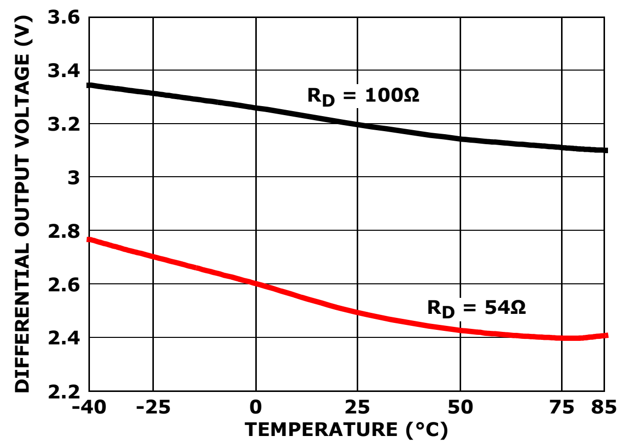


FIGURE 9. DRIVER DIFFERENTIAL OUTPUT VOLTAGE vs TEMPERATURE

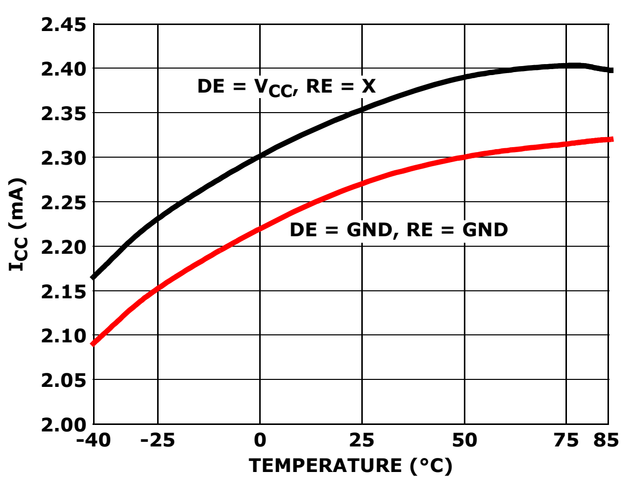


FIGURE 10. SUPPLY CURRENT vs TEMPERATURE

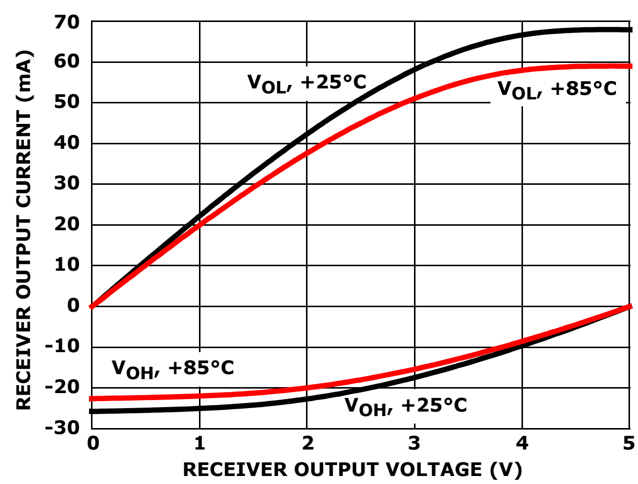


FIGURE 11. RECEIVER OUTPUT CURRENT vs RECEIVER OUTPUT VOLTAGE

Typical Performance Curves V_{CC} = 5V, T_A = +25°C; Unless Otherwise Specified. **(Continued)**

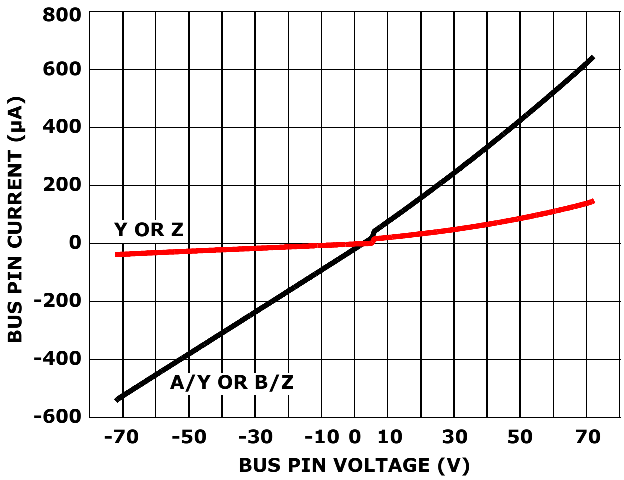


FIGURE 12. BUS PIN CURRENT vs BUS PIN VOLTAGE

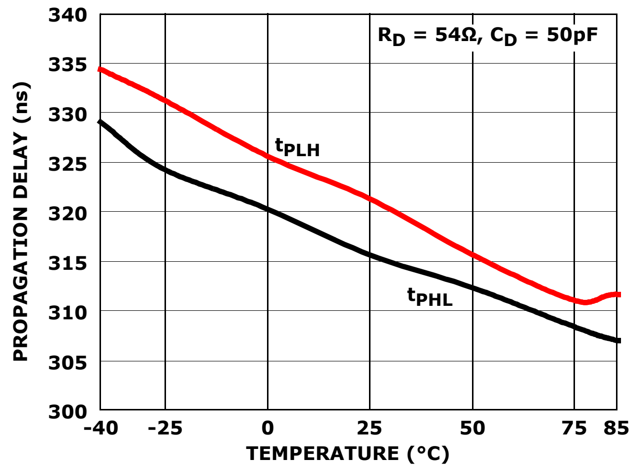


FIGURE 13. DRIVER DIFFERENTIAL PROPAGATION DELAY vs TEMPERATURE (ISL31470E, ISL31472E)

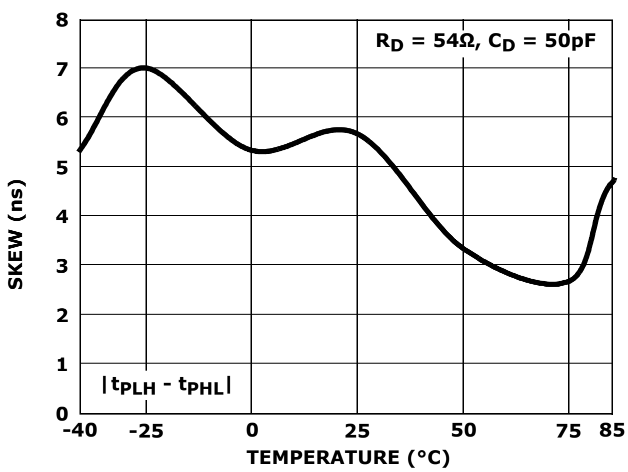


FIGURE 14. DRIVER DIFFERENTIAL SKEW vs TEMPERATURE (ISL31470E, ISL31472E)

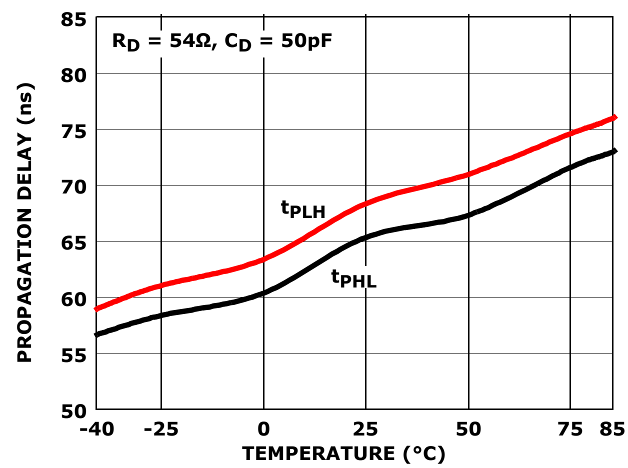


FIGURE 15. DRIVER DIFFERENTIAL PROPAGATION DELAY vs TEMPERATURE (ISL31475E)

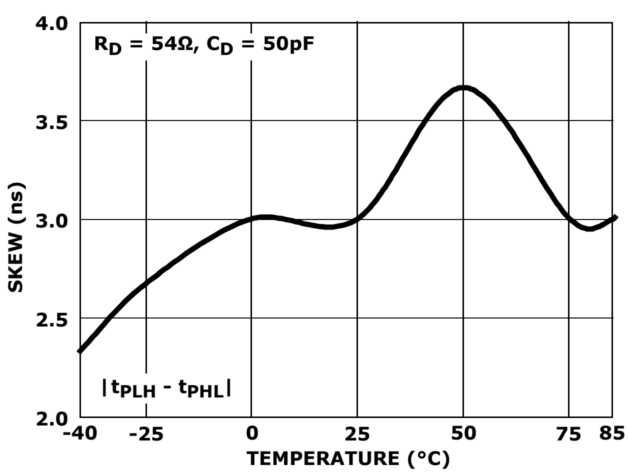


FIGURE 16. DRIVER DIFFERENTIAL SKEW vs TEMPERATURE (ISL31475E)

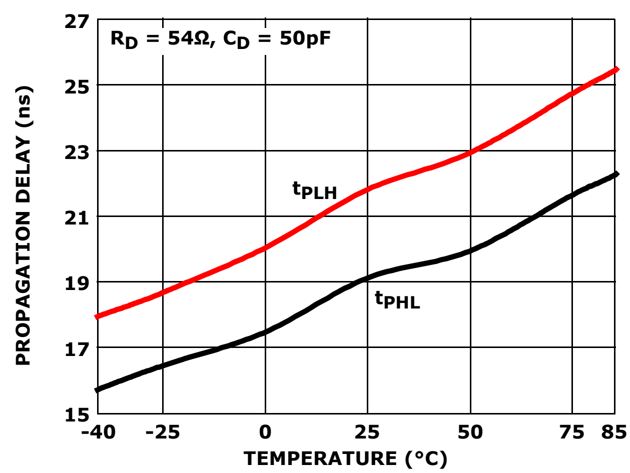


FIGURE 17. DRIVER DIFFERENTIAL PROPAGATION DELAY vs TEMPERATURE (ISL31478E)

Typical Performance Curves V_{CC} = 5V, T_A = +25°C; Unless Otherwise Specified. **(Continued)**

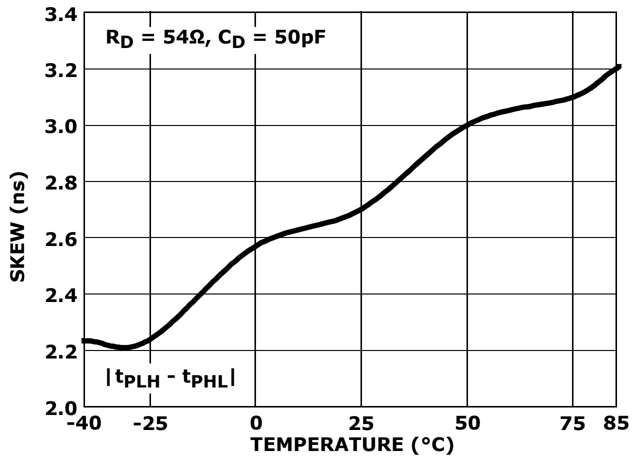


FIGURE 18. DRIVER DIFFERENTIAL SKEW vs TEMPERATURE (ISL31478E)

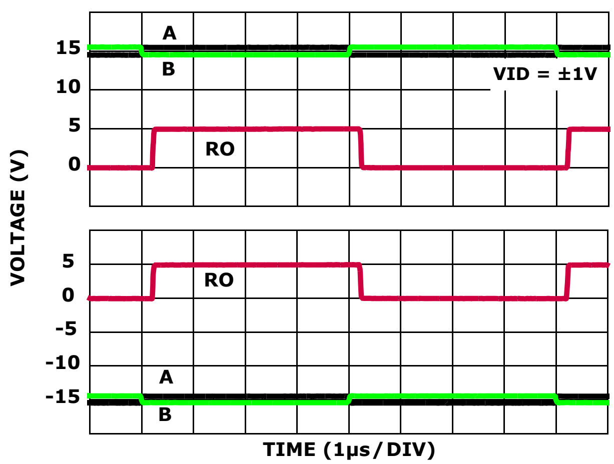


FIGURE 19. ±15V RECEIVER PERFORMANCE (ISL31470E, ISL31472E)

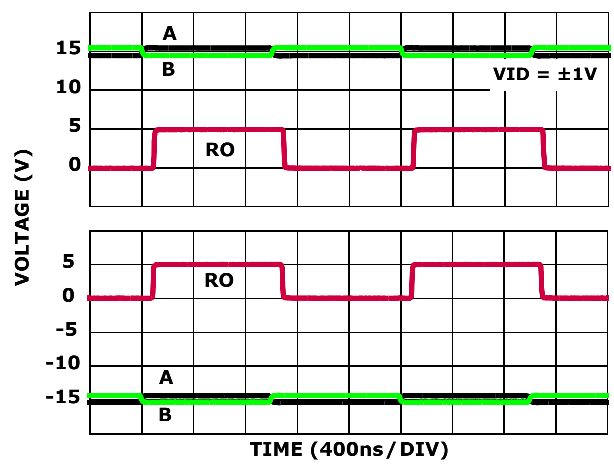


FIGURE 20. ±15V RECEIVER PERFORMANCE (ISL31475E)

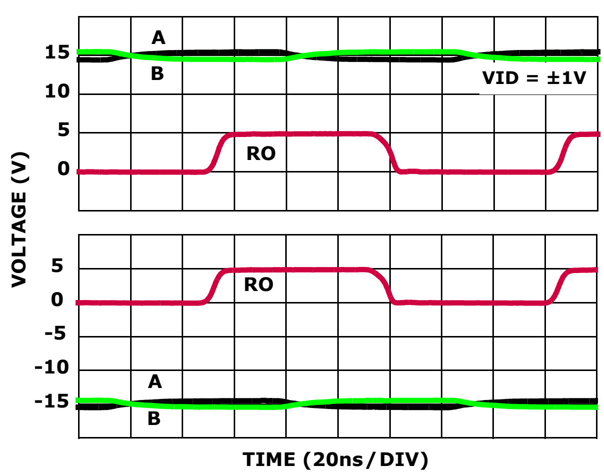


FIGURE 21. ±15V RECEIVER PERFORMANCE (ISL31478E)

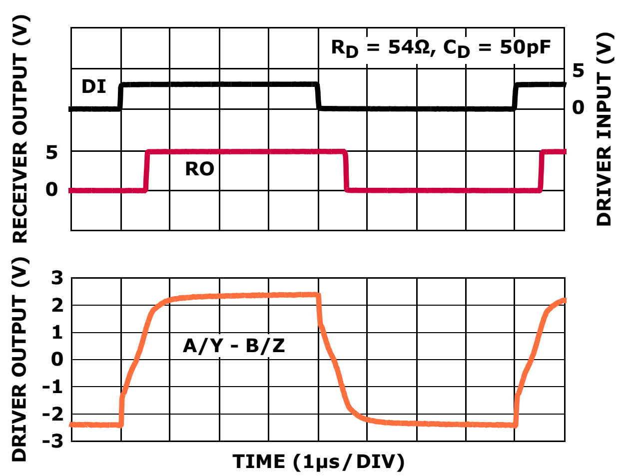


FIGURE 22. DRIVER AND RECEIVER WAVEFORMS (ISL31470E, ISL31472E)

Typical Performance Curves V_{CC} = 5V, T_A = +25°C; Unless Otherwise Specified. **(Continued)**

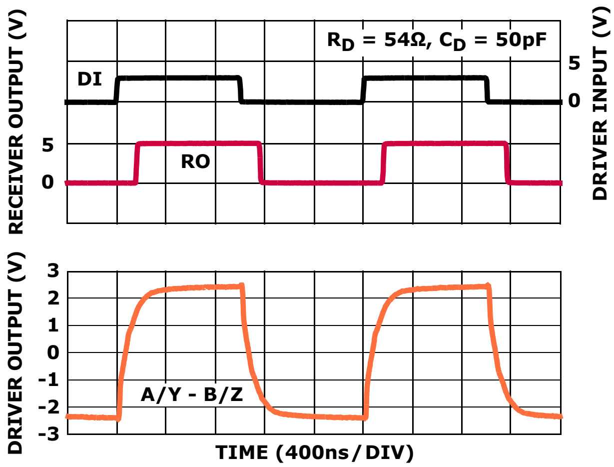


FIGURE 23. DRIVER AND RECEIVER WAVEFORMS (ISL31475E)

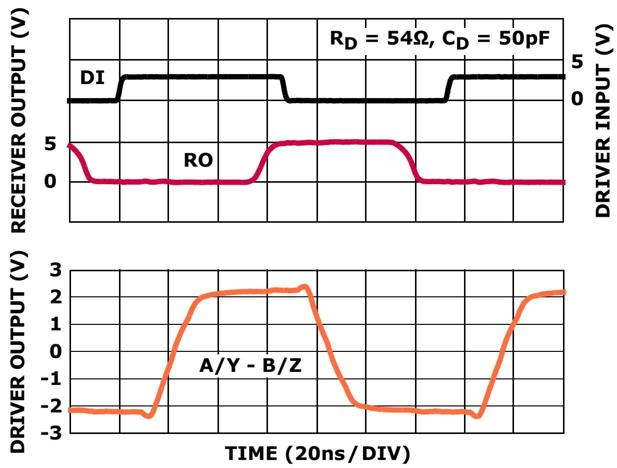


FIGURE 24. DRIVER AND RECEIVER WAVEFORMS (ISL31478E)

Die Characteristics

SUBSTRATE POTENTIAL (POWERED UP):

GND

PROCESS:

Si Gate BiCMOS

Revision History

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

DATE	REVISION	CHANGE
September 3, 2015	FN7639.1	- Updated Ordering Information Table on page 2. - Added About Intersil Verbiage.
June 17, 2010	FN7639.0	Initial Release

About Intersil

Intersil Corporation is a leading provider of innovative power management and precision analog solutions. The company's products address some of the largest markets within the industrial and infrastructure, mobile computing and high-end consumer markets.

For the most updated datasheet, application notes, related documentation and related parts, please see the respective product information page found at www.intersil.com.

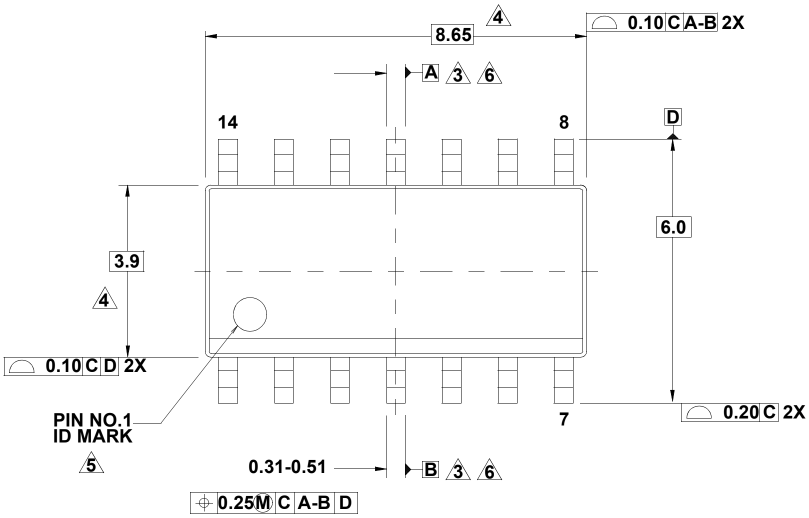
You may report errors or suggestions for improving this datasheet by visiting www.intersil.com/ask.

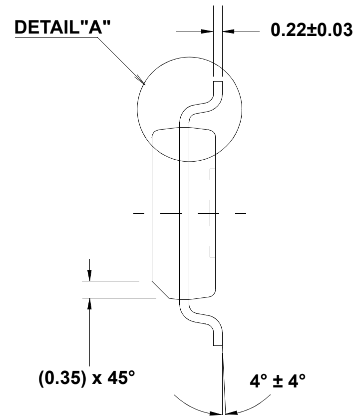
Reliability reports are also available from our website at www.intersil.com/support.

Package Outline Drawing

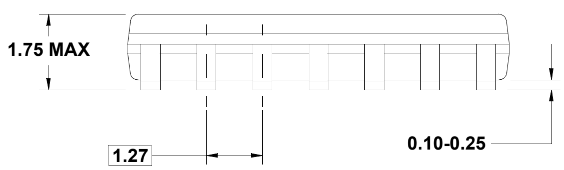
M14.15

14 LEAD NARROW BODY SMALL OUTLINE PLASTIC PACKAGE
Rev 1, 10/09

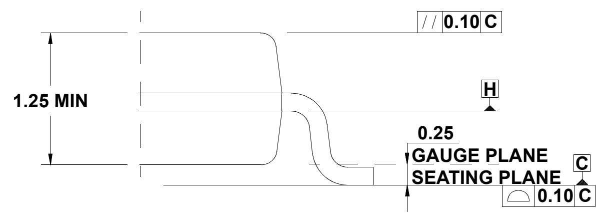




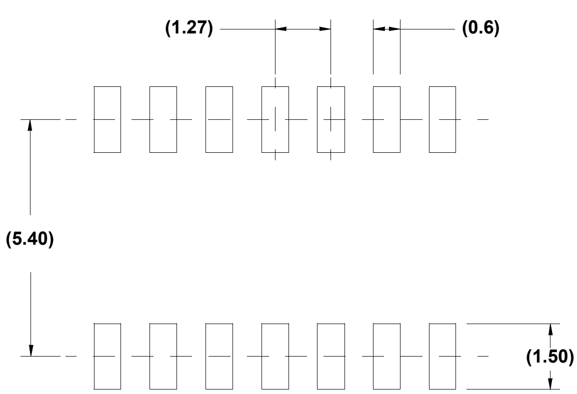
TOP VIEW



SIDE VIEW



DETAIL "A"

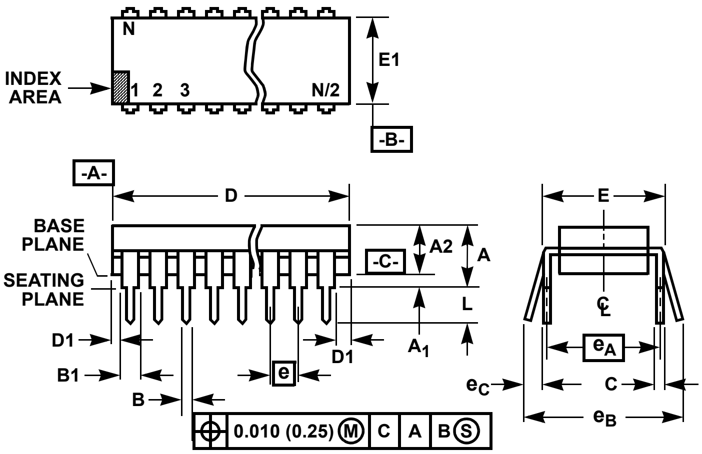


TYPICAL RECOMMENDED LAND PATTERN

NOTES:

1. Dimensions are in millimeters.
   Dimensions in ( ) for Reference Only.
2. Dimensioning and tolerancing conform to AMSEY14.5m-1994.
3. Datums A and B to be determined at Datum H.
4. Dimension does not include interlead flash or protrusions.
   Interlead flash or protrusions shall not exceed 0.25mm per side.
5. The pin #1 indentifier may be either a mold or mark feature.
6. Does not include dambar protrusion. Allowable dambar protrusion shall be 0.10mm total in excess of lead width at maximum condition.
7. Reference to JEDEC MS-012-AB.

Dual-In-Line Plastic Packages (PDIP)



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

8 LEAD DUAL-IN-LINE PLASTIC PACKAGE

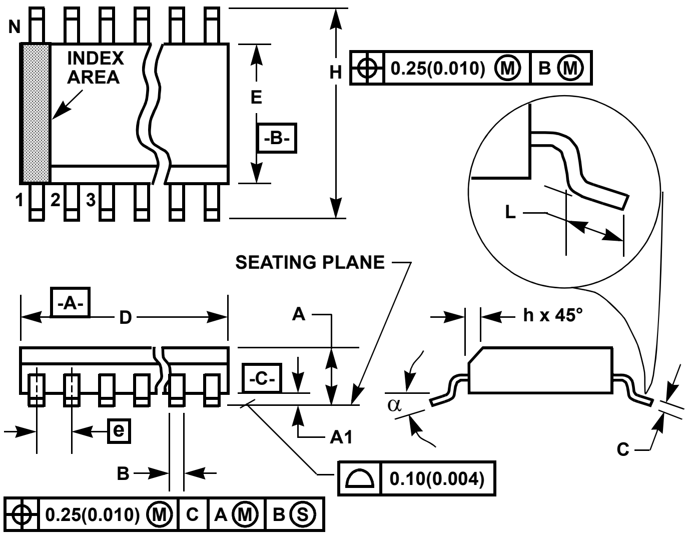
SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN	MAX	MIN	MAX	
A	-	0.210	-	5.33	4
A1	0.015	-	0.39	-	4
A2	0.115	0.195	2.93	4.95	-
B	0.014	0.022	0.356	0.558	-
B1	0.045	0.070	1.15	1.77	8, 10
C	0.008	0.014	0.204	0.355	-
D	0.355	0.400	9.01	10.16	5
D1	0.005	-	0.13	-	5
E	0.300	0.325	7.62	8.25	6
E1	0.240	0.280	6.10	7.11	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

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).

Small Outline Plastic Packages (SOIC)



M8.15 (JEDEC MS-012-AA ISSUE C)

8 LEAD NARROW BODY SMALL OUTLINE PLASTIC PACKAGE

SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN	MAX	MIN	MAX	
A	0.0532	0.0688	1.35	1.75	-
A1	0.0040	0.0098	0.10	0.25	-
B	0.013	0.020	0.33	0.51	9
C	0.0075	0.0098	0.19	0.25	-
D	0.1890	0.1968	4.80	5.00	3
E	0.1497	0.1574	3.80	4.00	4
e	0.050 BSC		1.27 BSC		-
H	0.2284	0.2440	5.80	6.20	-
h	0.0099	0.0196	0.25	0.50	5
L	0.016	0.050	0.40	1.27	6
N	8		8		7
α	0°	8°	0°	8°	-

Rev. 1 6/05

NOTES:

1. Symbols are defined in the “MO Series Symbol List” in Section 2.2 of Publication Number 95.
2. Dimensioning and tolerancing per ANSI Y14.5M-1982.
3. Dimension “D” 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.
4. Dimension “E” does not include interlead flash or protrusions. Interlead flash and protrusions shall not exceed 0.25mm (0.010 inch) per side.
5. The chamfer on the body is optional. If it is not present, a visual index feature must be located within the crosshatched area.
6. “L” is the length of terminal for soldering to a substrate.
7. “N” is the number of terminal positions.
8. Terminal numbers are shown for reference only.
9. The lead width “B”, 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).
10. Controlling dimension: MILLIMETER. Converted inch dimensions are not necessarily exact.