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DATASHEET

ISL32450E, ISL32452E, ISL32453E, ISL32455E, ISL32457E, ISL32458E, ISL32459E

±60V Fault Protected, 3.3V to 5V, ±20V Common-Mode Range, RS-485/RS-422 Transceivers with Cable Invert and ±15kV ESD

FN7921
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The ISL32450E, ISL32452E, ISL32453E, ISL32455E, ISL32457E, ISL32458E, and ISL32459E are 3.3V to 5V powered, fault protected, extended Common-Mode Range (CMR) differential transceivers for balanced communication. The RS-485 bus pins (driver outputs and receiver inputs) are protected against overvoltages up to ±60V, and against ±15kV ESD strikes. These transceivers operate in environments with common-mode voltages up to ±20V (exceeds the RS-485 requirement), making this RS-485 family one of the most robust on the market.

The transmitters are RS-485 compliant with $V_{CC} \geq 4.5V$ and deliver a 1.1V differential output voltage into the RS-485 specified 54Ω load even with $V_{CC} = 3V$. The receiver (Rx) inputs feature a full fail-safe design that ensures a logic-high Rx output if the Rx inputs are floating, shorted, or on a terminated but undriven (idle) bus. The Rx full fail-safe operation is maintained even when the Rx input polarity is switched (cable invert function on ISL32457E and ISL32459E).

The ISL32457E and ISL32459E include a cable invert function that reverses the polarity of the Rx and Tx bus pins in case the cable is misconnected during installation.

See Table 1 on page 4 for key features and configurations by device number.

Related Literature

- ISL32450E, ISL32452E, ISL32453E, ISL32455E, ISL32457E, ISL32458E, and ISL32459E device pages

Features

- Fault protected RS-485 bus pins . . . . . up to ±60V
- Extended common-mode range . . . . . ±20V larger than required for RS-485
- ±15kV HBM ESD protection on RS-485 bus pins
- Wide supply range . . . . . 3V to 5.5V
- Cable invert pin (ISL32457E and ISL32459E only) corrects for reversed cable connections while maintaining Rx full fail-safe functionality
- 1/4 unit load for up to 128 devices on the bus
- High transient overvoltage tolerance. . . . . ±80V
- Full fail-safe (open, short, terminated) RS-485 receivers
- Choice of RS-485 data rates . . . . . up to 20Mbps
- Low quiescent supply current 2.1mA

Applications

- Utility meters and automated meter reading systems
- Air conditioning systems
- Security camera networks
- Building lighting and environmental control systems
- Industrial and process control networks

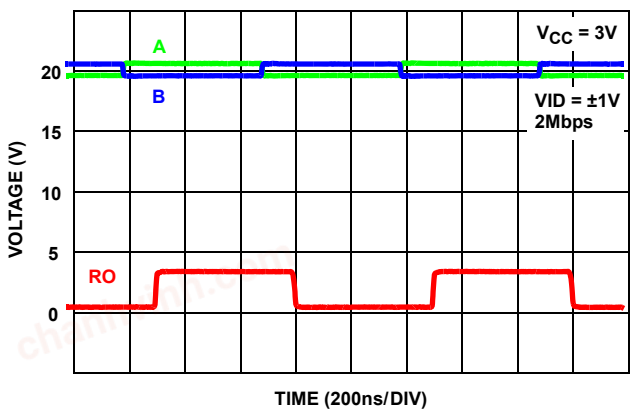


FIGURE 1. EXCEPTIONAL ISL32453E RX OPERATES AT >1Mbps EVEN WITH ±20V COMMON-MODE VOLTAGE

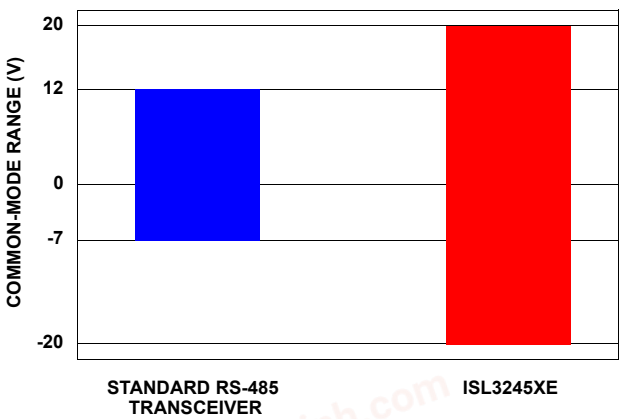


FIGURE 2. TRANSCEIVERS DELIVER SUPERIOR COMMON-MODE RANGE vs STANDARD RS-485 DEVICES

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Typical Operating Circuits

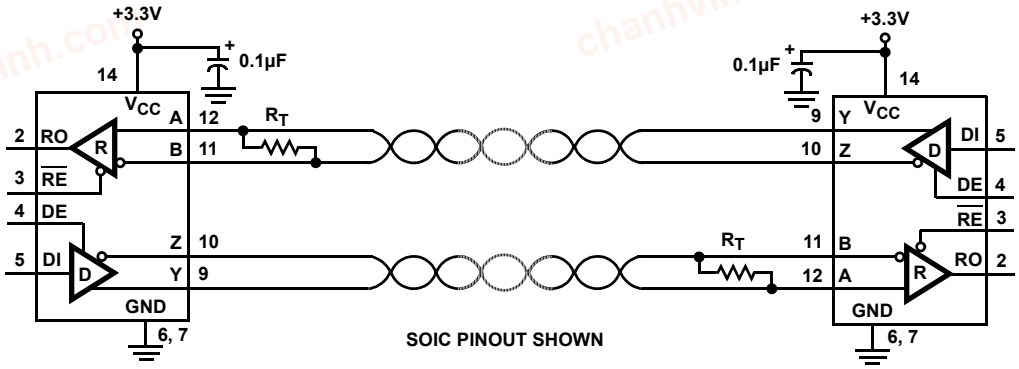


FIGURE 3. ISL32450E, ISL32453E FULL DUPLEX NETWORK

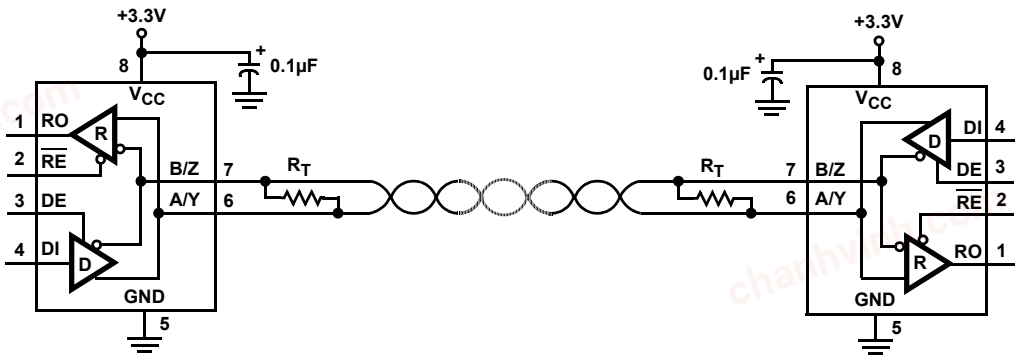


FIGURE 4. ISL32452E, ISL32455E, ISL32458E HALF DUPLEX NETWORK

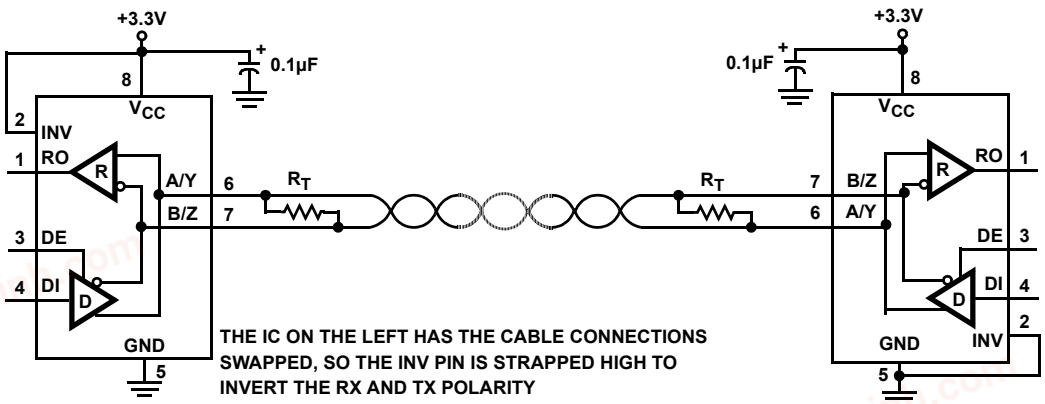


FIGURE 5. ISL32457E, ISL32459E HALF DUPLEX NETWORK USING CABLE INVERT FUNCTION

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Ordering Information

PART NUMBER (Notes 2, 3)	PART MARKING	TEMP. RANGE (°C)	TAPE AND REEL (Units) (Note 1)	PACKAGE (RoHS Compliant)	PKG. DWG. #
ISL32450EIBZ	ISL32450 EIBZ	-40 to +85	-	14 Ld SOIC	M14.15
ISL32450EIBZ-T	ISL32450 EIBZ	-40 to +85	2.5k	14 Ld SOIC	M14.15
ISL32450EIBZ-T7A	ISL32450 EIBZ	-40 to +85	250	14 Ld SOIC	M14.15
ISL32450EIUZ	2450E	-40 to +85	-	10 Ld MSOP	M10.118
ISL32450EIUZ-T	2450E	-40 to +85	2.5k	10 Ld MSOP	M10.118
ISL32450EIUZ-T7A	2450E	-40 to +85	250	10 Ld MSOP	M10.118
ISL32452EIBZ	32452 EIBZ	-40 to +85	-	8 Ld SOIC	M8.15
ISL32452EIBZ-T	32452 EIBZ	-40 to +85	2.5k	8 Ld SOIC	M8.15
ISL32452EIBZ-T7A	32452 EIBZ	-40 to +85	250	8 Ld SOIC	M8.15
ISL32452EIUZ	2452E	-40 to +85	-	8 Ld MSOP	M8.118
ISL32452EIUZ-T	2452E	-40 to +85	2.5k	8 Ld MSOP	M8.118
ISL32452EIUZ-T7A	2452E	-40 to +85	250	8 Ld MSOP	M8.118
ISL32453EIBZ	ISL32453 EIBZ	-40 to +85	-	14 Ld SOIC	M14.15
ISL32453EIBZ-T	ISL32453 EIBZ	-40 to +85	2.5k	14 Ld SOIC	M14.15
ISL32453EIBZ-T7A	ISL32453 EIBZ	-40 to +85	250	14 Ld SOIC	M14.15
ISL32453EIUZ	2453E	-40 to +85	-	10 Ld MSOP	M10.118
ISL32453EIUZ-T	2453E	-40 to +85	2.5k	10 Ld MSOP	M10.118
ISL32453EIUZ-T7A	2453E	-40 to +85	250	10 Ld MSOP	M10.118
ISL32455EIBZ	32455 EIBZ	-40 to +85	-	8 Ld SOIC	M8.15
ISL32455EIBZ-T	32455 EIBZ	-40 to +85	2.5k	8 Ld SOIC	M8.15
ISL32455EIBZ-T7A	32455 EIBZ	-40 to +85	250	8 Ld SOIC	M8.15
ISL32455EIUZ	2455E	-40 to +85	-	8 Ld MSOP	M8.118
ISL32455EIUZ-T	2455E	-40 to +85	2.5k	8 Ld MSOP	M8.118
ISL32455EIUZ-T7A	2455E	-40 to +85	250	8 Ld MSOP	M8.118
ISL32457EIBZ	32457 EIBZ	-40 to +85	-	8 Ld SOIC	M8.15
ISL32457EIBZ-T	32457 EIBZ	-40 to +85	2.5k	8 Ld SOIC	M8.15
ISL32457EIBZ-T7A	32457 EIBZ	-40 to +85	250	8 Ld SOIC	M8.15
ISL32457EIUZ	2457E	-40 to +85	-	8 Ld MSOP	M8.118
ISL32457EIUZ-T	2457E	-40 to +85	2.5k	8 Ld MSOP	M8.118
ISL32457EIUZ-T7A	2457E	-40 to +85	250	8 Ld MSOP	M8.118
ISL32458EIBZ	32458 EIBZ	-40 to +85	-	8 Ld SOIC	M8.15
ISL32458EIBZ-T	32458 EIBZ	-40 to +85	2.5k	8 Ld SOIC	M8.15
ISL32458EIBZ-T7A	32458 EIBZ	-40 to +85	250	8 Ld SOIC	M8.15

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Ordering Information (Continued)

PART NUMBER (Notes 2, 3)	PART MARKING	TEMP. RANGE (°C)	TAPE AND REEL (Units) (Note 1)	PACKAGE (RoHS Compliant)	PKG. DWG. #
ISL32459EIBZ	32459 EIBZ	-40 to +85	-	8 Ld SOIC	M8.15
ISL32459EIBZ-T	32459 EIBZ	-40 to +85	2.5k	8 Ld SOIC	M8.15
ISL32459EIBZ-T7A	32459 EIBZ	-40 to +85	250	8 Ld SOIC	M8.15

NOTES:

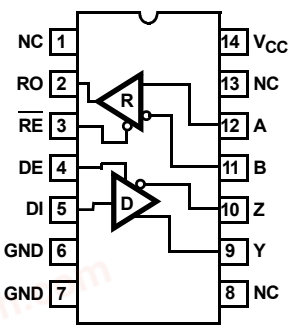
1. See TB347 for details about reel specifications.
2. These Pb-free plastic packaged products employ special Pb-free material sets, molding compounds/die attach materials, and 100% matte tin plate plus anneal (e3 termination finish, which is RoHS compliant and compatible with both SnPb and Pb-free soldering operations). 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 ISL32450E, ISL32452E, ISL32453E, ISL32455E, ISL32457E, ISL32458E, ISL32459E device pages. For more information about MSL, see TB363.

TABLE 1. SUMMARY OF FEATURES

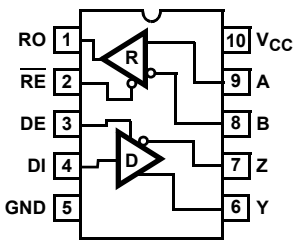
PART NUMBER	HALF/FULL DUPLEX	DATA RATE (Mbps)	SLEW-RATE LIMITED?	EN PINS?	HOT PLUG	CABLE INVERT (INV) PIN?	QUIESCENT I_{CC} (mA)	LOW POWER SHUTDOWN?	PIN COUNT
ISL32450E	Full	0.25	Yes	Yes	No	No	2.1	Yes	10, 14
ISL32452E	Half	0.25	Yes	Yes	No	No	2.1	Yes	8
ISL32453E	Full	1	Yes	Yes	No	No	2.1	Yes	10, 14
ISL32455E	Half	1	Yes	Yes	No	No	2.1	Yes	8
ISL32457E	Half	0.25	Yes	Tx Only	No	Yes	2.1	No	8
ISL32458E	Half	20	No	Yes	No	No	2.1	Yes	8
ISL32459E	Half	20	No	Tx Only	No	Yes	2.1	No	8

Pin Configurations

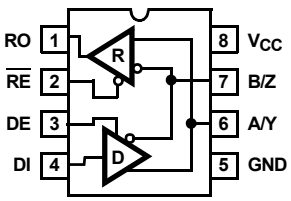
ISL32450E, ISL32453E
(14 LD SOIC)
TOP VIEW



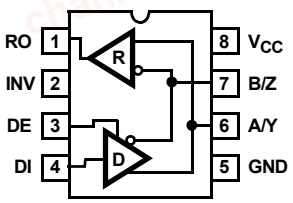
ISL32450E, ISL32453E
(10 LD MSOP)
TOP VIEW



ISL32452E, ISL32455E, ISL32458E
(8 LD SOIC, 8 LD MSOP)
TOP VIEW



ISL32457E, ISL32459E
(8 LD SOIC, 8 LD MSOP)
TOP VIEW



NOTE: Evaluate creepage and clearance requirements at your maximum fault voltage before using small pitch packages, such as MSOP.

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Pin Descriptions

PIN NAME	ISL32450E, ISL32453E, (14 LD SOIC) PIN #	ISL32450E, ISL32453E, (10 LD MSOP) PIN #	ISL32452E, ISL32455E, ISL32458E (8 LD SOIC, 8 LD MSOP) PIN #	ISL32457E, ISL32459E (8 LD SOIC, 8 LD MSOP) PIN #	FUNCTION
RO	2	1	1	1	Receiver output. For parts without the cable invert function - or if INV is low - then: If A - B ≥ -10mV, RO is high; if A - B ≤ -200mV, RO is low. If INV is high, then: If B - A ≥ -10mV, RO is high; if B - A ≤ -200mV, RO is low. In all cases, RO = High if A and B are unconnected (floating), or shorted together, or connected to an undriven, terminated bus (that is, Rx is always fail-safe open, shorted and idle, even if polarity is inverted).
$\overline{RE}$	3	2	2	N/A	Receiver output enable. RO is enabled when $\overline{RE}$ is low; RO is high impedance when $\overline{RE}$ is high. Internally pulled low.
DE	4	3	3	3	Driver output enable. The driver outputs, Y and Z, are enabled by bringing DE high and they are high impedance when DE is low. Internally pulled high.
DI	5	4	4	4	Driver input. For parts without the cable invert function - or if INV is low - a low on DI forces output Y low and output Z high, while a high on DI forces output Y high and output Z low. The output states, relative to DI, invert if INV is high.
GND	6, 7	5	5	5	Ground connection.
A/Y	N/A	N/A	6	6	±60V fault protected and ±16.5kV ESD protected RS-485/RS-422 I/O pin. For parts without the cable invert function - or if INV is low - A/Y is the noninverting receiver input and noninverting driver output. If INV is high, A/Y is the inverting receiver input and the inverting driver output. Pin is an input if DE = 0; pin is an output if DE = 1.
B/Z	N/A	N/A	7	7	±60V fault protected and ±16.5kV ESD protected RS-485/RS-422 I/O pin. For parts without the cable invert function - or if INV is low - B/Z is the inverting receiver input and inverting driver output. If INV is high, B/Z is the noninverting receiver input and the noninverting driver output. Pin is an input if DE = 0; pin is an output if DE = 1.
A	12	9	N/A	N/A	±60V fault protected and ±15kV ESD protected RS-485/RS-422 noninverting receiver input.
B	11	8	N/A	N/A	±60V fault protected and ±15kV ESD protected RS-485/RS-422 inverting receiver input.
Y	9	6	N/A	N/A	±60V fault protected and ±15kV ESD protected RS-485/RS-422 noninverting driver output.
Z	10	7	N/A	N/A	±60V fault protected and ±15kV ESD protected RS-485/RS-422 inverting driver output.
V_{CC}	14	10	8	8	System power supply input (3V to 5.5V).
INV	N/A	N/A	N/A	2	Receiver and driver cable invert (polarity selection) input. When driven high this pin swaps the polarity of the driver output and receiver input pins. If unconnected (floating) or connected low, normal RS-485 polarity conventions apply. Internally pulled low.
NC	1, 8, 13	N/A	N/A	N/A	No internal connection.

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Truth Tables

TRANSMITTING					
INPUTS				OUTPUTS	
$\overline{RE}$	DE	DI	INV (Note 4)	Y	Z
X	1	1	0	1	0
X	1	0	0	0	1
X	1	1	1	0	1
X	1	0	1	1	0
0	0	X	X	High-Z	High-Z
1	0	X	X	High-Z (Note 5)	High-Z (Note 5)

NOTES:

4. Parts without the INV pin follow the rows with INV = “0” and “X”.
5. Low Power Shutdown mode (see Notes 14 and 19).

RECEIVING					
INPUTS					OUTPUT
$\overline{RE}$ (Note 19)	DE Half Duplex	DE Full Duplex	A-B	INV (Note 4)	RO
0	0	X	$V_{AB} \geq -0.01V$	0	1
0	0	X	$-0.01V > V_{AB} > -0.2V$	0	Undetermined
0	0	X	$V_{AB} \leq -0.2V$	0	0
0	0	X	$V_{AB} \leq 0.01V$	1	1
0	0	X	$0.01V < V_{AB} < 0.2V$	1	Undetermined
0	0	X	$\geq 0.2V$	1	0
0	0	X	Inputs Open or Shorted	X	1
1	0	0	X	X	High-Z (Note 5)
1	1	1	X	X	High-Z

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Absolute Maximum Ratings

V_{CC} to Ground 7V
Input Voltages
DI, DE, $\overline{RE}$, INV. . . . . -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 6) . . . . . ±80V
RO. . . . . -0.3V to (V_{CC} +0.3V)
Short-Circuit Duration
Y, Z . . . . . Indefinite
ESD Rating . . . . . see "ESD PERFORMANCE" on page 8
Latch-Up (per JESD78, Level 2, Class A) . . . . . +125°C

Thermal Information

Thermal Resistance (Typical)	θ_{JA} (°C/W)	θ_{JC} (°C/W)
8 Ld SOIC Package (Notes 7, 8)	108	47
8 Ld MSOP Package (Notes 7, 8)	140	40
10 Ld MSOP Package (Notes 7, 8)	135	50
14 Ld SOIC Package (Notes 7, 8)	88	39

Maximum Junction Temperature (Plastic Package). . . . . +150°C
Maximum Storage Temperature Range . . . . . -65°C to +150°C
Pb-Free Reflow Profile . . . . . see TB493

Recommended Operating Conditions

Supply Voltage (V_{CC}). . . . . 3.3V or 5V
Temperature Range . . . . . -40°C to +85°C
Bus Pin Common-Mode Voltage Range. . . . . -20V to +20V

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

NOTES:

6. Tested according to TIA/EIA-485-A, Section 4.2.6 (±80V for 15µs at a 1% duty cycle).
7. θ_{JA} is measured with the component mounted on a high-effective thermal conductivity test board in free air. See TB379 for details.
8. For θ_{JC}, the "case temp" location is taken at the package top center.

Electrical Specifications

Test Conditions: V_{CC} = 3V to 3.6V and 4.5V to 5.5V, unless otherwise specified. Typicals are at the worst case of V_{CC} = 5V or V_{CC} = 3.3V, T_A = +25°C (Note 9). **Boldface limits apply across the operating temperature range, -40°C to +85°C.**

PARAMETER	SYMBOL	TEST CONDITIONS	TEMP (°C)	MIN (Note 17)	TYP	MAX (Note 17)	UNIT
DC CHARACTERISTICS							
Driver Differential V_{OUT} (No load)	V_{OD1}		Full	-	-	**V_{CC}**	V
Driver Differential V_{OUT} (Loaded, Figure 6A)	V_{OD2}	R_L = 100Ω (RS-422), V_{CC} ≥ 4.5V	Full	**2**	3	-	V
		R_L = 54Ω (RS-485), V_{CC} ≥ 4.5V	Full	**1.7**	2.3	**V_{CC}**	V
		R_L = 54Ω (RS-485), V_{CC} ≥ 3V	Full	**1.1**	1.3	**V_{CC}**	V
Change in Magnitude of Driver Differential V_{OUT} for Complementary Output States	ΔV_{OD}	R_L = 54Ω or 100Ω (Figure 6A)	Full	-	-	**0.2**	V
Driver Differential V_{OUT} with Common-Mode Load (Figure 6B)	V_{OD3}	R_L = 60Ω, -20V ≤ V_{CM} ≤ 20V, V_{CC} ≥ 4.5V	Full	**1.5**	-	-	V
Driver Common-Mode V_{OUT} (Figure 6A)	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 6A)	Full	-	-	**0.2**	V
Driver Short-Circuit Current	I_{OSD}	DE = V_{CC}, -20V ≤ V_O ≤ 20V (Note 11)	Full	**-250**	-	**250**	mA
	I_{OSD1}	At first foldback, 24V ≤ V_O ≤ -24V	Full	**-83**	-	**83**	mA
	I_{OSD2}	At second foldback, 35V ≤ V_O ≤ -35V	Full	**-13**	-	**13**	mA
Logic Input High Voltage	V_{IH}	DE, DI, $\overline{RE}$, INV (See Figure 33)	Full	**2.35**	-	-	V
Logic Input Low Voltage	V_{IL}	DE, DI, $\overline{RE}$, INV	Full	-	-	**0.8**	V
Logic Input Current	I_{IN1}	DI	Full	**-1**	-	**1**	µA
		DE, $\overline{RE}$, INV	Full	**-15**	6	**15**	µA

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Electrical Specifications

Test Conditions: V_{CC} = 3V to 3.6V and 4.5V to 5.5V, unless otherwise specified. Typicals are at the worst case of V_{CC} = 5V or V_{CC} = 3.3V, T_A = +25°C (Note 9). **Boldface limits apply across the operating temperature range, -40°C to +85°C. (Continued)**

PARAMETER	SYMBOL	TEST CONDITIONS		TEMP (°C)	MIN (Note 17)	TYP	MAX (Note 17)	UNIT
Input/Output Current (A/Y, B/Z)	I_{IN2}	DE = 0V, V_{CC} = 0V or 3.6V or 5.5V	V_{IN} = 12V	Full	-	-	**250**	µA
			V_{IN} = -7V	Full	**-200**	-	-	µA
			V_{IN} = ±20V	Full	**-800**	-	**850**	µA
			V_{IN} = ±60V, (Note 18)	Full	**-6**	-	**6**	mA
Input Current (A, B) (Full Duplex Versions Only)	I_{IN3}	V_{CC} = 0V or 3.6V or 5.5V	V_{IN} = 12V	Full	-	-	**125**	µA
			V_{IN} = -7V	Full	**-100**	-	-	µA
			V_{IN} = ±20V	Full	**-500**	-	**500**	µA
			V_{IN} = ±60V, (Note 18)	Full	**-3**	-	**3**	mA
Output Leakage Current (Y, Z) (Full Duplex Versions Only)	I_{OZD}	$\overline{RE}$ = 0V, DE = 0V, V_{CC} = 0V or 3.6V or 5.5V	V_{IN} = 12V	Full	-	-	**200**	µA
			V_{IN} = -7V	Full	**-100**	-	-	µA
			V_{IN} = ±20V	Full	**-500**	-	**500**	µA
			V_{IN} = ±60V, (Note 18)	Full	**-3**	-	**3**	mA
Receiver Differential Threshold Voltage	V_{TH}	-20V ≤ V_{CM} ≤ 20V, (For ISL32457E and ISL32459E only, A-B if INV = 0; B-A if INV = 1)	V_{CC} ≤ 3.6V	Full	**-200**	-120	**-10**	mV
			V_{CC} ≥ 4.5V	Full	**-250**	-180	**-10**	mV
Receiver Input Hysteresis	ΔV_{TH}	-20V ≤ V_{CM} ≤ 20V		+25	-	30	-	mV
Receiver Output High Voltage	V_{OH1}	V_{ID} = -10mV	I_O = -4mA, V_{CC} ≥ 3V	Full	**2.4**	-	-	V
	V_{OH2}		I_O = -8mA, V_{CC} ≥ 4.5V	Full	**2.4**	-	-	V
Receiver Output Low Voltage	V_{OL}	I_O = 4mA, V_{CC} ≥ 3V, V_{ID} = -200mV		Full	-	-	**0.4**	V
		I_O = 5mA, V_{CC} ≥ 4.5V, V_{ID} = -250mV		Full	-	-	**0.4**	V
Three-State (High Impedance) Receiver Output Current (Note 19)	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	-	-	**±115**	mA
SUPPLY CURRENT								
No-Load Supply Current (Note 10)	I_{CC}	DE = V_{CC}, $\overline{RE}$ = 0V or V_{CC}, DI = 0V or V_{CC}		Full	-	2.1	**4.5**	mA
Shutdown Supply Current (Note 19)	I_{SHDN}	DE = 0V, $\overline{RE}$ = V_{CC}, DI = 0V or V_{CC}		Full	-	10	**35**	µA
ESD PERFORMANCE								
All Pins		Human Body Model (ISL32450E, ISL32452E, ISL32453E, ISL32455E, ISL32457E; Tested per JESD22-A114E)		+25	-	±8	-	kV
		Human Body Model (ISL32458E, ISL32459E; Tested per JESD22-A114E)		+25	-	±3	-	kV
		Machine Model (Tested per JESD22-A115-A)		+25	-	±700	-	V
RS-485 Pins (A, B, Y, Z, A/Y, B/Z)		Human Body Model, from Bus Pins to GND	Full Duplex	+25	-	±15	-	kV
			Half Duplex	+25	-	±16.5	-	kV

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Electrical Specifications

Test Conditions: V_{CC} = 3V to 3.6V and 4.5V to 5.5V, unless otherwise specified. Typicals are at the worst case of V_{CC} = 5V or V_{CC} = 3.3V, T_A = +25°C (Note 9). **Boldface limits apply across the operating temperature range, -40°C to +85°C. (Continued)**

PARAMETER	SYMBOL	TEST CONDITIONS	TEMP (°C)	MIN (Note 17)	TYP	MAX (Note 17)	UNIT
DRIVER SWITCHING CHARACTERISTICS (250kbps VERSIONS; ISL32450E, ISL32452E, ISL32457E)							
Driver Differential Output Delay	t_{PLH}, t_{PHL}	R_D = 54Ω, C_D = 50pF (Figure 7)	Full	-	280	**1000**	ns
Driver Differential Output Skew	t_{SKEW}	R_D = 54Ω, C_D = 50pF (Figure 7)	Full	-	4	**100**	ns
Driver Differential Rise or Fall Time	t_R, t_F	R_D = 54Ω, C_D = 50pF (Figure 7)	Full	**250**	650	**1500**	ns
Maximum Data Rate	f_{MAX}	C_D = 820pF (Figure 9)	Full	**250**	-	**-**	kbps
Driver Enable to Output High	t_{ZH}	SW = GND (Figure 8), (Note 12)	Full	-	-	**1600**	ns
Driver Enable to Output Low	t_{ZL}	SW = V_{CC} (Figure 8), (Note 12)	Full	-	-	**1600**	ns
Driver Disable from Output Low	t_{LZ}	SW = V_{CC} (Figure 8)	Full	-	-	**300**	ns
Driver Disable from Output High	t_{HZ}	SW = GND (Figure 8)	Full	-	-	**300**	ns
Time to Shutdown	t_{SHDN}	(Notes 14, 19)	Full	**60**	160	**600**	ns
Driver Enable from Shutdown to Output High	$t_{ZH(SHDN)}$	SW = GND (Figure 8), (Notes 14, 15, 19)	Full	-	-	**3000**	ns
Driver Enable from Shutdown to Output Low	$t_{ZL(SHDN)}$	SW = V_{CC} (Figure 8), (Notes 14, 15, 19)	Full	-	-	**3000**	ns
DRIVER SWITCHING CHARACTERISTICS (1Mbps VERSIONS; ISL32453E, ISL32455E)							
Driver Differential Output Delay	t_{PLH}, t_{PHL}	R_D = 54Ω, C_D = 50pF (Figure 7)	Full	-	70	**200**	ns
Driver Differential Output Skew	t_{SKEW}	R_D = 54Ω, C_D = 50pF (Figure 7)	Full	-	4	**25**	ns
Driver Differential Rise or Fall Time	t_R, t_F	R_D = 54Ω, C_D = 50pF (Figure 7)	Full	**50**	130	**300**	ns
Maximum Data Rate	f_{MAX}	C_D = 820pF (Figure 9)	Full	**1**	-	-	Mbps
Driver Enable to Output High	t_{ZH}	SW = GND (Figure 8), (Note 12)	Full	-	-	**300**	ns
Driver Enable to Output Low	t_{ZL}	SW = V_{CC} (Figure 8), (Note 12)	Full	-	-	**300**	ns
Driver Disable from Output Low	t_{LZ}	SW = V_{CC} (Figure 8)	Full	-	-	**300**	ns
Driver Disable from Output High	t_{HZ}	SW = GND (Figure 8)	Full	-	-	**300**	ns
Time to Shutdown	t_{SHDN}	(Note 14)	Full	**60**	160	**600**	ns
Driver Enable from Shutdown to Output High	$t_{ZH(SHDN)}$	SW = GND (Figure 8), (Notes 14, 15)	Full	-	-	**3000**	ns
Driver Enable from Shutdown to Output Low	$t_{ZL(SHDN)}$	SW = V_{CC} (Figure 8), (Notes 14, 15)	Full	-	-	**3000**	ns
DRIVER SWITCHING CHARACTERISTICS (20Mbps VERSIONS; ISL32458E, ISL32459E)							
Driver Differential Output Delay	t_{PLH}, t_{PHL}	R_D = 54Ω, C_D = 50pF (Figure 7)	Full	-	28	**45**	ns
Driver Differential Output Skew	t_{SKEW}	R_D = 54Ω, C_D = 50pF (Figure 7)	Full	-	3	**9**	ns
Driver Differential Rise or Fall Time	t_R, t_F	R_D = 54Ω, C_D = 50pF (Figure 7)	Full	-	17	**35**	ns
Maximum Data Rate	f_{MAX}	C_D = 470pF (Figure 9)	Full	**20**	-	-	Mbps
Driver Enable to Output High	t_{ZH}	SW = GND (Figure 8), (Note 12)	Full	-	-	**180**	ns
Driver Enable to Output Low	t_{ZL}	SW = V_{CC} (Figure 8), (Note 12)	Full	-	-	**180**	ns
Driver Disable from Output Low	t_{LZ}	SW = V_{CC} (Figure 8)	Full	-	-	**300**	ns
Driver Disable from Output High	t_{HZ}	SW = GND (Figure 8)	Full	-	-	**300**	ns
Time to Shutdown	t_{SHDN}	(Notes 14, 19)	Full	**60**	160	**600**	ns
Driver Enable from Shutdown to Output High	$t_{ZH(SHDN)}$	SW = GND (Figure 8), (Notes 14, 15, 19)	Full	-	-	**3000**	ns

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Electrical Specifications Test Conditions: V_{CC} = 3V to 3.6V and 4.5V to 5.5V, unless otherwise specified. Typicals are at the worst case of V_{CC} = 5V or V_{CC} = 3.3V, T_A = +25°C (Note 9). **Boldface limits apply across the operating temperature range, -40°C to +85°C. (Continued)**

PARAMETER	SYMBOL	TEST CONDITIONS	TEMP (°C)	MIN (Note 17)	TYP	MAX (Note 17)	UNIT
Driver Enable from Shutdown to Output Low	$t_{ZL(SHDN)}$	SW = V_{CC} (Figure 8), (Notes 14, 15, 19)	Full	-	-	**3000**	ns
RECEIVER SWITCHING CHARACTERISTICS (250kbps VERSIONS; ISL32450E, ISL32452E, ISL32457E)							
Maximum Data Rate	f_{MAX}	(Figure 10)	Full	**250**	-	-	kbps
Receiver Input to Output Delay	t_{PLH}, t_{PHL}	(Figure 10)	Full	-	240	**325**	ns
Receiver Skew $\lvert t_{PLH} - t_{PHL} \rvert$	t_{SKD}	(Figure 10)	Full	-	6	**25**	ns
Receiver Enable to Output Low	t_{ZL}	R_L = 1kΩ, C_L = 15pF, SW = V_{CC} (Figure 11), (Notes 13, 19)	Full	-	-	**80**	ns
Receiver Enable to Output High	t_{ZH}	R_L = 1kΩ, C_L = 15pF, SW = GND (Figure 11), (Notes 13, 19)	Full	-	-	**80**	ns
Receiver Disable from Output Low	t_{LZ}	R_L = 1kΩ, C_L = 15pF, SW = V_{CC} (Figure 11), (Note 19)	Full	-	-	**80**	ns
Receiver Disable from Output High	t_{HZ}	R_L = 1kΩ, C_L = 15pF, SW = GND (Figure 11), (Note 19)	Full	-	-	**80**	ns
Time to Shutdown	t_{SHDN}	(Notes 14, 19)	Full	**60**	160	**600**	ns
Receiver Enable from Shutdown to Output High	$t_{ZH(SHDN)}$	R_L = 1kΩ, C_L = 15pF, SW = GND (Figure 11), (Notes 14, 16, 19)	Full	-	-	**2500**	ns
Receiver Enable from Shutdown to Output Low	$t_{ZL(SHDN)}$	R_L = 1kΩ, C_L = 15pF, SW = V_{CC} (Figure 11), (Notes 14, 16, 19)	Full	-	-	**2500**	ns
RECEIVER SWITCHING CHARACTERISTICS (1Mbps VERSIONS; ISL32453E, ISL32455E)							
Maximum Data Rate	f_{MAX}	(Figure 10)	Full	**1**	-	-	Mbps
Receiver Input to Output Delay	t_{PLH}, t_{PHL}	(Figure 10)	Full	-	115	**200**	ns
Receiver Skew $\lvert t_{PLH} - t_{PHL} \rvert$	t_{SKD}	(Figure 10)	Full	-	4	**20**	ns
Receiver Enable to Output Low	t_{ZL}	R_L = 1kΩ, C_L = 15pF, SW = V_{CC} (Figure 11), (Note 13)	Full	-	-	**80**	ns
Receiver Enable to Output High	t_{ZH}	R_L = 1kΩ, C_L = 15pF, SW = GND (Figure 11), (Note 13)	Full	-	-	**80**	ns
Receiver Disable from Output Low	t_{LZ}	R_L = 1kΩ, C_L = 15pF, SW = V_{CC} (Figure 11)	Full	-	-	**80**	ns
Receiver Disable from Output High	t_{HZ}	R_L = 1kΩ, C_L = 15pF, SW = GND (Figure 11)	Full	-	-	**80**	ns
Time to Shutdown	t_{SHDN}	(Note 14)	Full	**60**	160	**600**	ns
Receiver Enable from Shutdown to Output High	$t_{ZH(SHDN)}$	R_L = 1kΩ, C_L = 15pF, SW = GND (Figure 11), (Notes 14, 16)	Full	-	-	**2500**	ns
Receiver Enable from Shutdown to Output Low	$t_{ZL(SHDN)}$	R_L = 1kΩ, C_L = 15pF, SW = V_{CC} (Figure 11), (Notes 14, 16)	Full	-	-	**2500**	ns
RECEIVER SWITCHING CHARACTERISTICS (20Mbps VERSIONS; ISL32458E, ISL32459E)							
Maximum Data Rate	f_{MAX}	(Figure 10)	Full	**20**	-	-	Mbps
Receiver Input to Output Delay	t_{PLH}, t_{PHL}	(Figure 10)	Full	-	40	**80**	ns
Receiver Skew $\lvert t_{PLH} - t_{PHL} \rvert$	t_{SKD}	(Figure 10)	Full	-	3	**9**	ns
Receiver Enable to Output Low	t_{ZL}	R_L = 1kΩ, C_L = 15pF, SW = V_{CC} (Figure 11), (Notes 13, 19)	Full	-	-	**80**	ns
Receiver Enable to Output High	t_{ZH}	R_L = 1kΩ, C_L = 15pF, SW = GND (Figure 11), (Notes 13, 19)	Full	-	-	**80**	ns
Receiver Disable from Output Low	t_{LZ}	R_L = 1kΩ, C_L = 15pF, SW = V_{CC} (Figure 11), (Note 19)	Full	-	-	**80**	ns

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Electrical Specifications Test Conditions: V_{CC} = 3V to 3.6V and 4.5V to 5.5V, unless otherwise specified. Typicals are at the worst case of V_{CC} = 5V or V_{CC} = 3.3V, T_A = +25°C (Note 9). **Boldface limits apply across the operating temperature range, -40°C to +85°C. (Continued)**

PARAMETER	SYMBOL	TEST CONDITIONS	TEMP (°C)	MIN (Note 17)	TYP	MAX (Note 17)	UNIT
Receiver Disable from Output High	t_{HZ}	R_L = 1kΩ, C_L = 15pF, SW = GND (Figure 11), (Note 19)	Full	-	-	**80**	ns
Time to Shutdown	t_{SHDN}	(Notes 14, 19)	Full	**60**	160	**600**	ns
Receiver Enable from Shutdown to Output High	$t_{ZH(SHDN)}$	R_L = 1kΩ, C_L = 15pF, SW = GND (Figure 11), (Notes 14, 16, 19)	Full	-	-	**2500**	ns
Receiver Enable from Shutdown to Output Low	$t_{ZL(SHDN)}$	R_L = 1kΩ, C_L = 15pF, SW = V_{CC} (Figure 11), (Notes 14, 16, 19)	Full	-	-	**2500**	ns

NOTES:

9. 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.
10. Supply current specification is valid for loaded drivers when DE = 0V.
11. Applies to peak current. See “Typical Performance Curves” beginning on page 13 for more information.
12. Keep $\overline{RE}$ = 0 to prevent the device from entering shutdown (does not apply to the ISL32457E and ISL32459E).
13. The $\overline{RE}$ signal high time must be short enough (typically <100ns) to prevent the device from entering shutdown.
14. 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 ensured not to enter shutdown. If the inputs are in this state for at least 600ns, the parts are ensured to have entered shutdown. See “Low Power Shutdown Mode” on page 19
15. Keep $\overline{RE}$ = VCC, and set the DE signal low time >600ns to ensure that the device enters shutdown.
16. Set the $\overline{RE}$ signal high time >600ns to ensure that the device enters shutdown.
17. Compliance to data sheet limits is assured by one or more methods: production test, characterization and/or design.
18. See “Caution” statement following “Absolute Maximum Ratings” on page 7.
19. Does not apply to the ISL32457E and ISL32459E. These transceivers have no Rx enable function, and thus no shutdown function.

Test Circuits and Waveforms

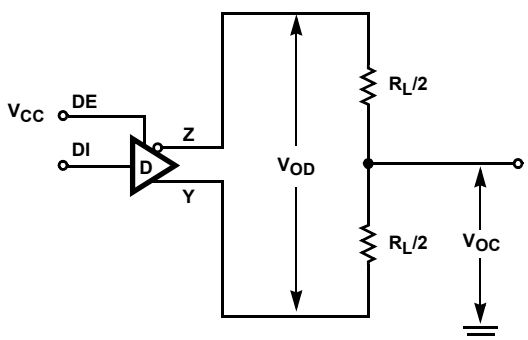


FIGURE 6A. V_{OD} AND V_{OC}

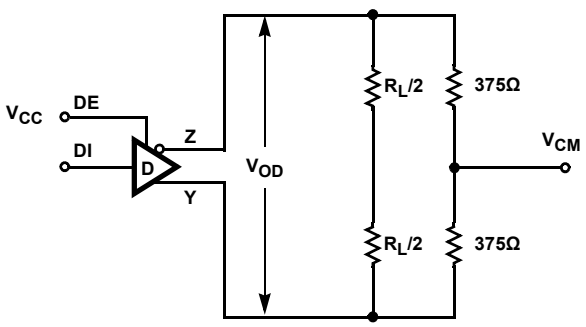


FIGURE 6B. V_{OD} WITH COMMON-MODE LOAD

FIGURE 6. DC DRIVER TEST CIRCUITS

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Test Circuits and Waveforms (Continued)

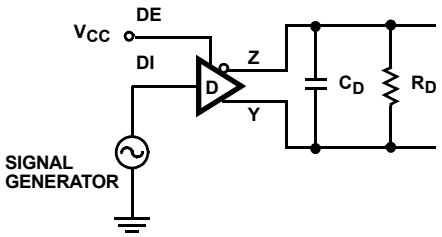


FIGURE 7A. TEST CIRCUIT

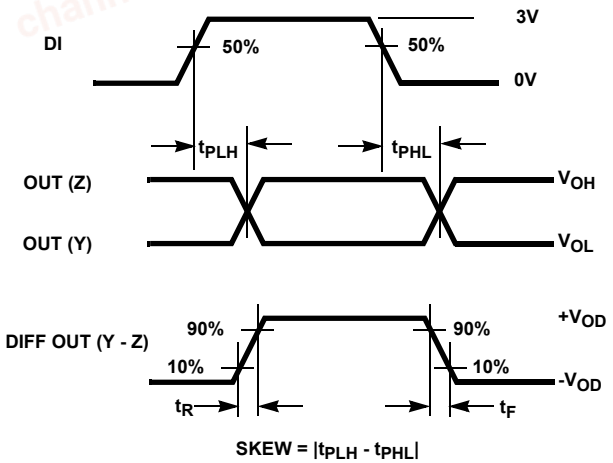
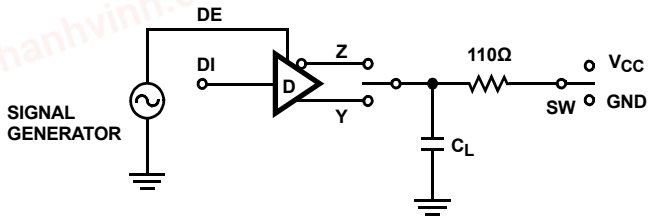


FIGURE 7B. MEASUREMENT POINTS

FIGURE 7. 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 12)	1/0	GND	100
t_{ZL}	Y/Z	0 (Note 12)	0/1	V_{CC}	100
$t_{ZH(SHDN)}$	Y/Z	1 (Note 15)	1/0	GND	100
$t_{ZL(SHDN)}$	Y/Z	1 (Note 15)	0/1	V_{CC}	100

FIGURE 8A. TEST CIRCUIT

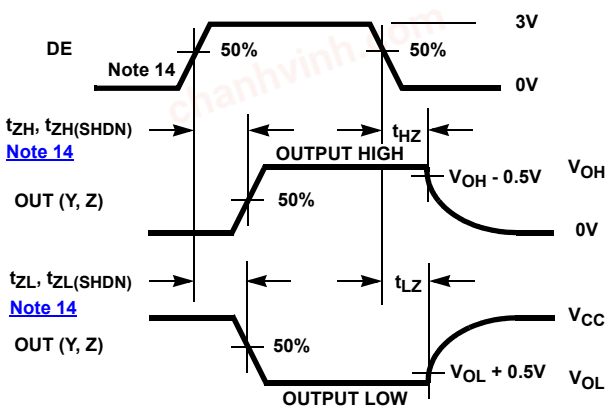


FIGURE 8B. MEASUREMENT POINTS

FIGURE 8. DRIVER ENABLE AND DISABLE TIMES

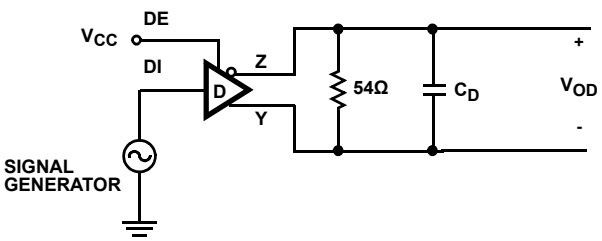


FIGURE 9A. TEST CIRCUIT

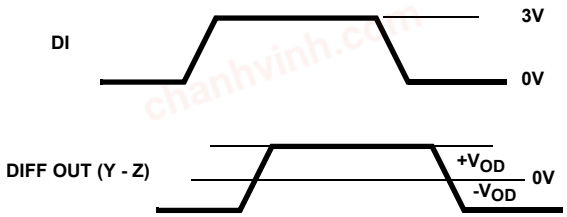


FIGURE 9B. MEASUREMENT POINTS

FIGURE 9. DRIVER DATA RATE

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Test Circuits and Waveforms (Continued)

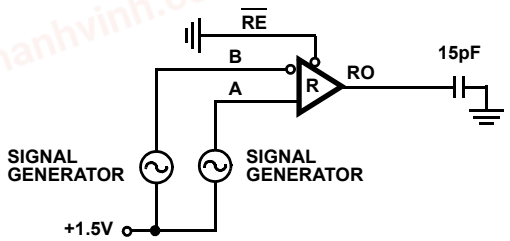


FIGURE 10A. TEST CIRCUIT

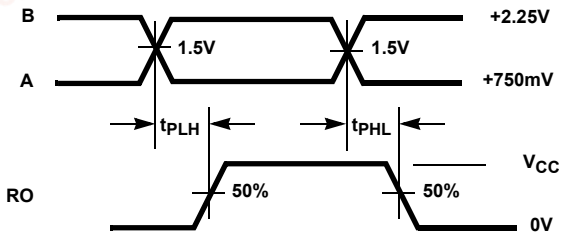
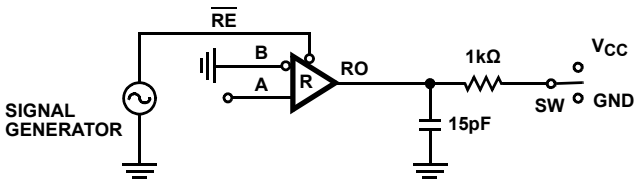


FIGURE 10B. MEASUREMENT POINTS

FIGURE 10. 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 13)	0	+1.5V	GND
t_{ZL} (Note 13)	0	-1.5V	V_{CC}
$t_{ZH(SHDN)}$ (Note 16)	0	+1.5V	GND
$t_{ZL(SHDN)}$ (Note 16)	0	-1.5V	V_{CC}

FIGURE 11A. TEST CIRCUIT

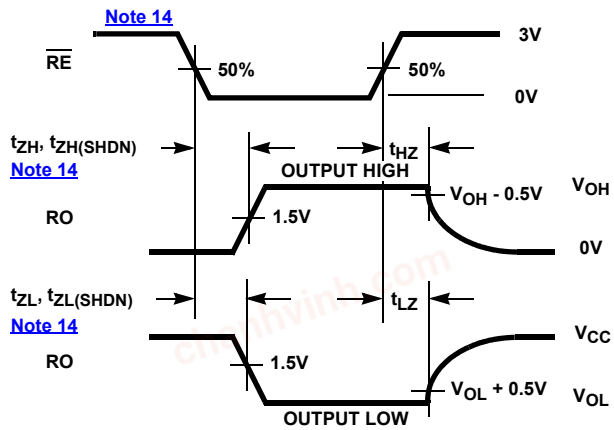


FIGURE 11B. MEASUREMENT POINTS

FIGURE 11. RECEIVER ENABLE AND DISABLE TIMES

Typical Performance Curves

T_A = +25°C; unless otherwise specified.

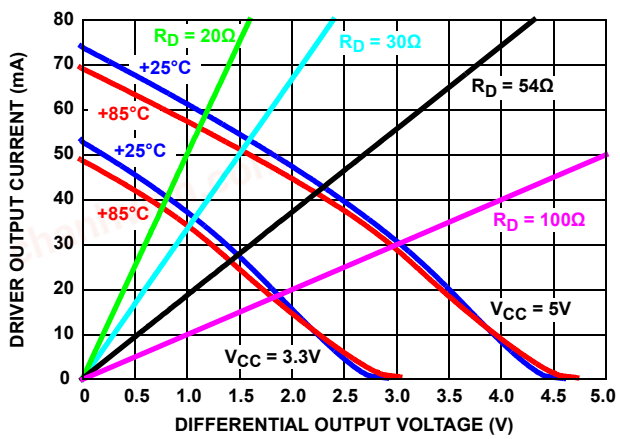


FIGURE 12. DRIVER OUTPUT CURRENT vs DIFFERENTIAL OUTPUT VOLTAGE

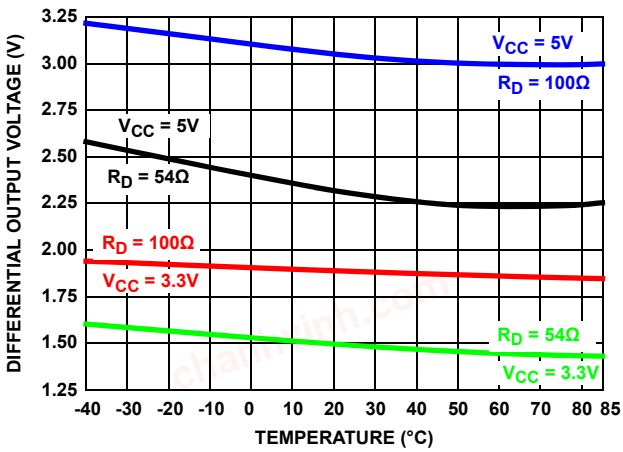


FIGURE 13. DRIVER DIFFERENTIAL OUTPUT VOLTAGE vs TEMPERATURE

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Typical Performance Curves

T_A = +25°C; unless otherwise specified. **(Continued)**

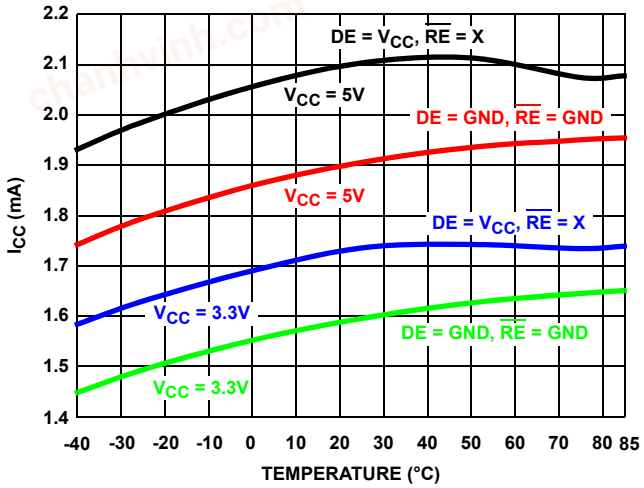


FIGURE 14. SUPPLY CURRENT vs TEMPERATURE

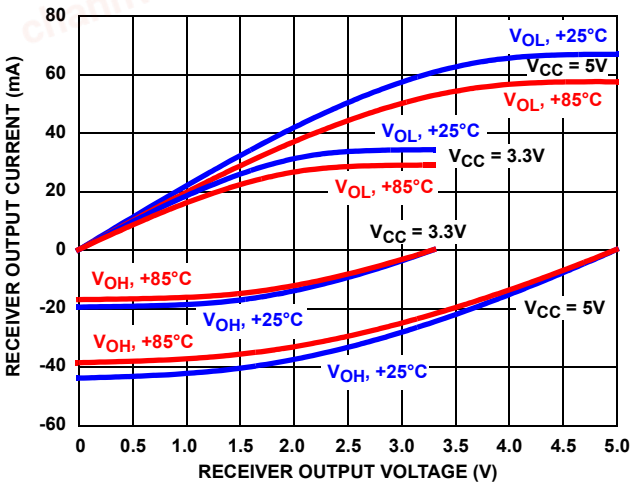


FIGURE 15. RECEIVER OUTPUT CURRENT vs RECEIVER OUTPUT VOLTAGE

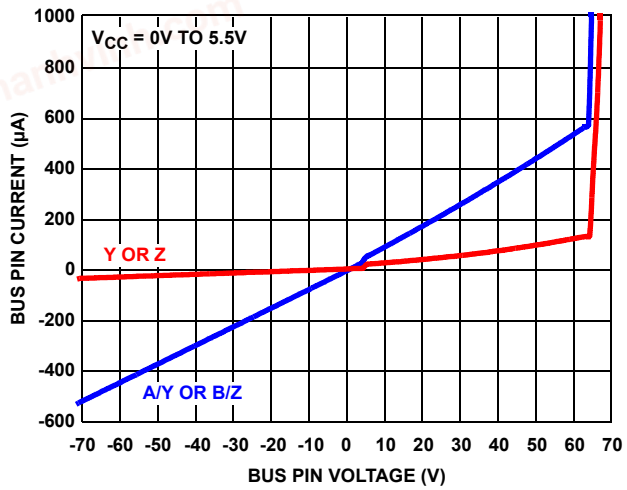


FIGURE 16. BUS PIN CURRENT vs BUS PIN VOLTAGE

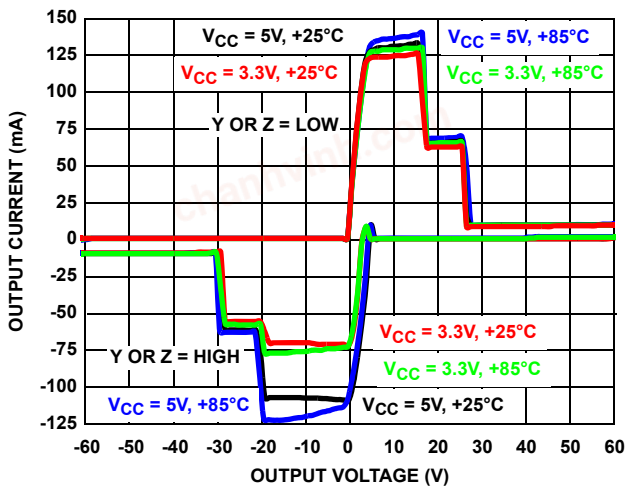


FIGURE 17. DRIVER OUTPUT CURRENT vs SHORT-CIRCUIT VOLTAGE

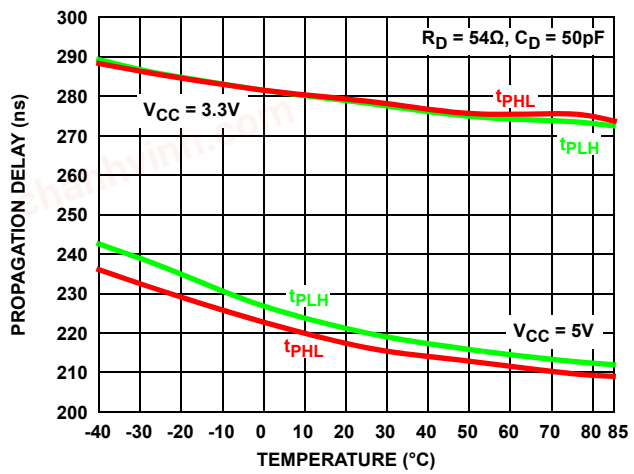


FIGURE 18. DRIVER DIFFERENTIAL PROPAGATION DELAY vs TEMPERATURE (ISL32450E, ISL32452E, ISL32457E)

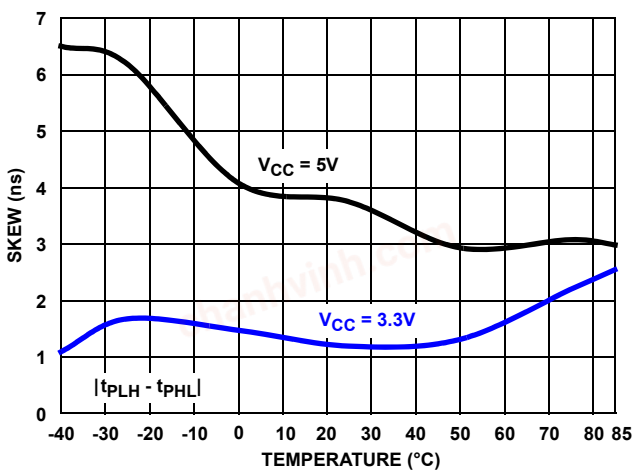


FIGURE 19. DRIVER DIFFERENTIAL SKEW vs TEMPERATURE (ISL32450E, ISL32452E, ISL32457E)

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Typical Performance Curves

T_A = +25°C; unless otherwise specified. **(Continued)**

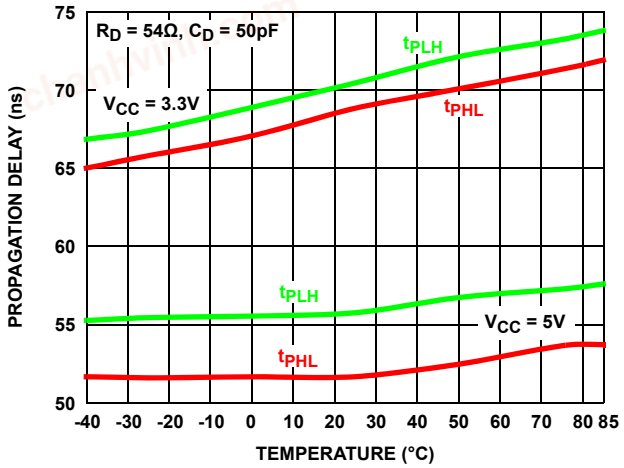


FIGURE 20. DRIVER DIFFERENTIAL PROPAGATION DELAY vs TEMPERATURE (ISL32453E, ISL32455E)

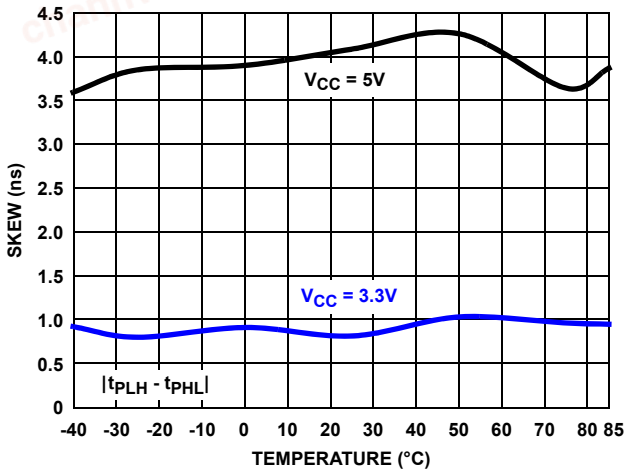


FIGURE 21. DRIVER DIFFERENTIAL SKEW vs TEMPERATURE (ISL32453E, ISL32455E)

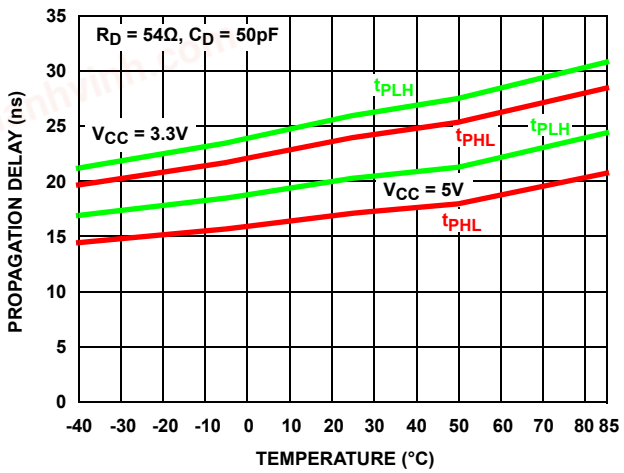


FIGURE 22. DRIVER DIFFERENTIAL PROPAGATION DELAY vs TEMPERATURE (ISL32458E, ISL32459E)

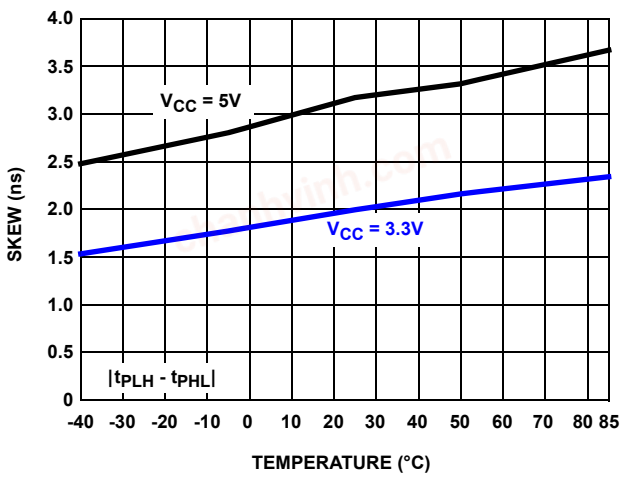


FIGURE 23. DRIVER DIFFERENTIAL SKEW vs TEMPERATURE (ISL32458E, ISL32459E)

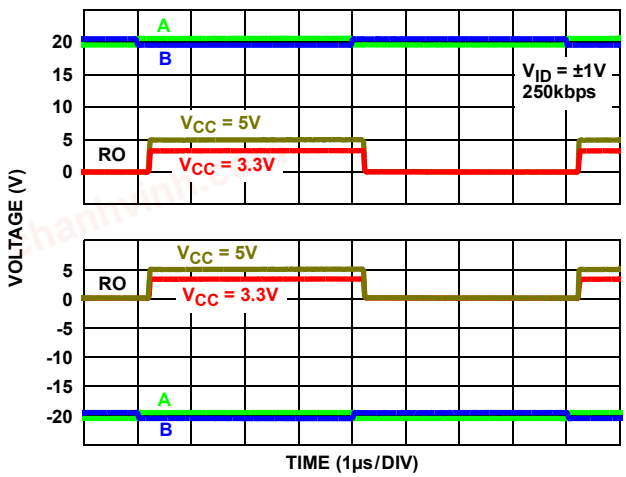


FIGURE 24. ±20V RECEIVER PERFORMANCE (ISL32450E, ISL32452E, ISL32457E)

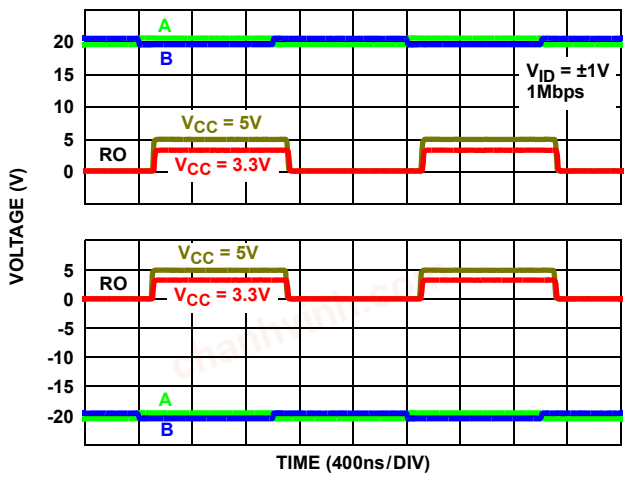


FIGURE 25. ±20V RECEIVER PERFORMANCE (ISL32453E, ISL32455E)

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Typical Performance Curves

T_A = +25°C; unless otherwise specified. **(Continued)**

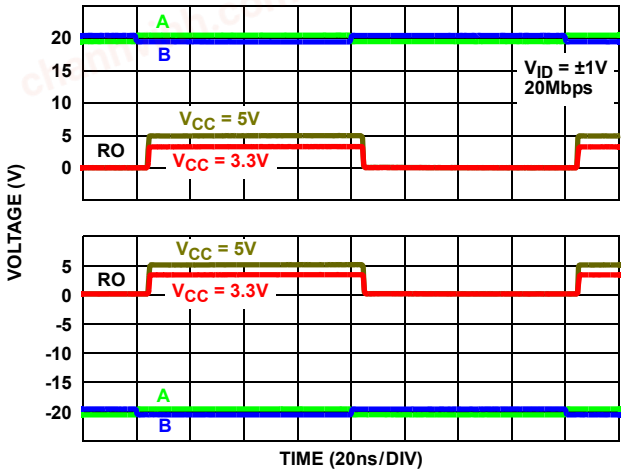


FIGURE 26. ±20V RECEIVER PERFORMANCE (ISL32458E, ISL32459E)

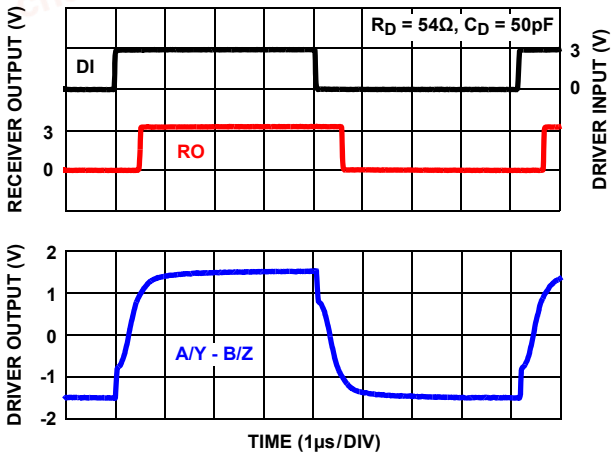


FIGURE 27. V_{CC} = 3.3V, DRIVER AND RECEIVER WAVEFORMS (ISL32450E, ISL32452E, ISL32457E)

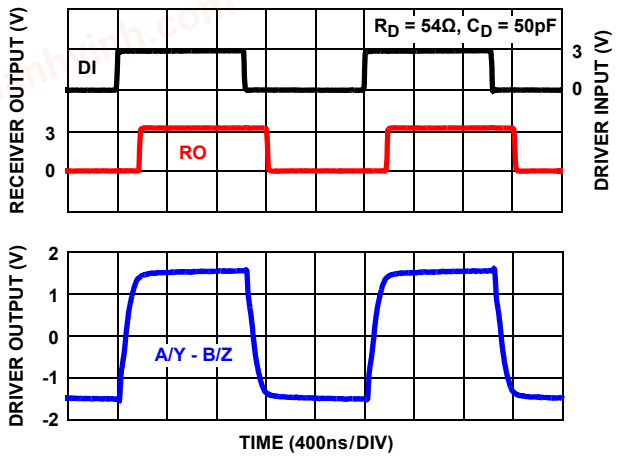


FIGURE 28. V_{CC} = 3.3V, DRIVER AND RECEIVER WAVEFORMS (ISL32453E, ISL32455E)

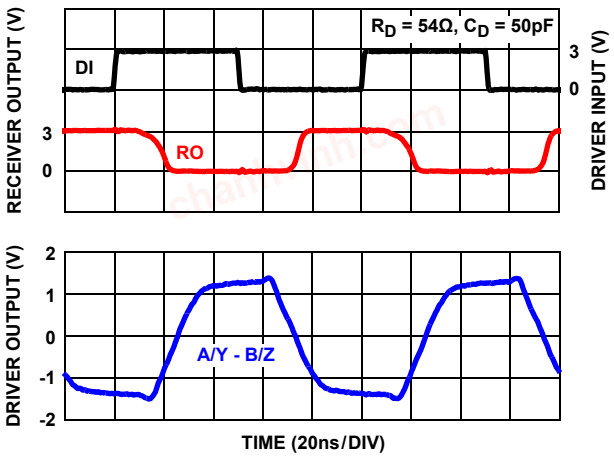


FIGURE 29. V_{CC} = 3.3V, DRIVER AND RECEIVER WAVEFORMS (ISL32458E, ISL32459E)

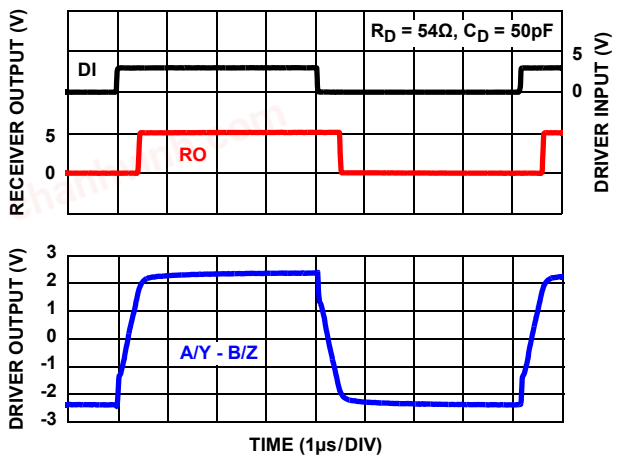


FIGURE 30. V_{CC} = 5V, DRIVER AND RECEIVER WAVEFORMS (ISL32450E, ISL32452E, ISL32457E)

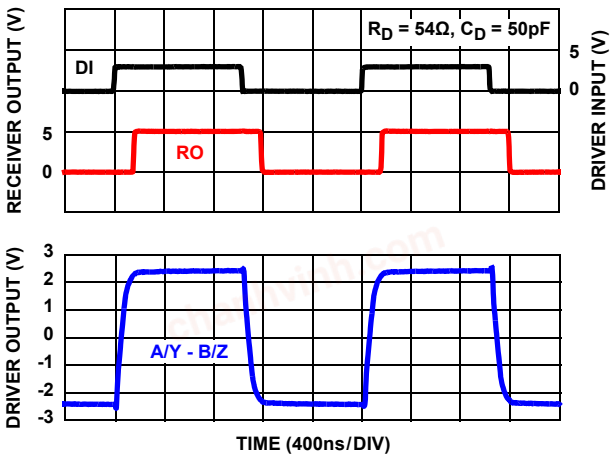


FIGURE 31. V_{CC} = 5V, DRIVER AND RECEIVER WAVEFORMS (ISL32453E, ISL32455E)

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Typical Performance Curves

T_A = +25°C; unless otherwise specified. **(Continued)**

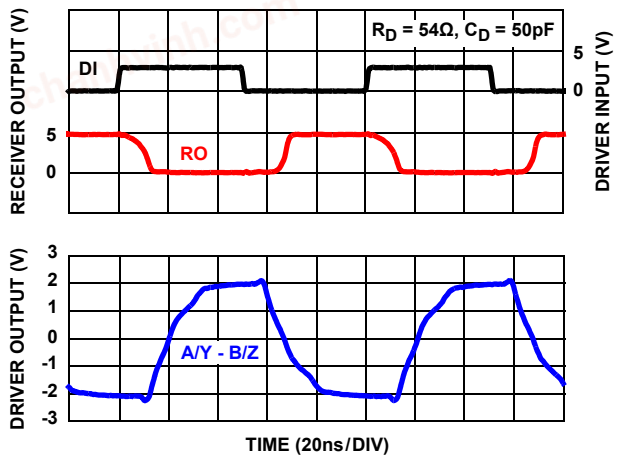


FIGURE 32. V_{CC} = 5V, DRIVER AND RECEIVER WAVEFORMS (ISL32458E, ISL32459E)

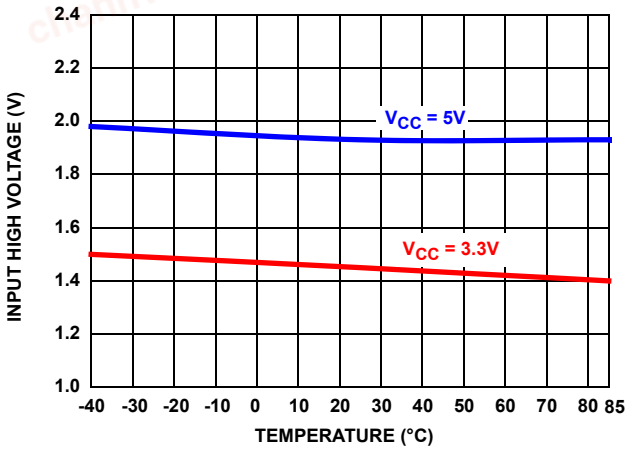


FIGURE 33. LOGIC INPUT HIGH VOLTAGE vs TEMPERATURE

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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 that allows only one driver and up to 10 receivers (assuming one unit load devices) on each bus. 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 must 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 that range 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.

The ISL3245xE are a family of ruggedized RS-485 transceivers that improve on the RS-485 basic requirements and increases system reliability. The CMR increases to ±20V that the RS-485 bus pins (receiver inputs and driver outputs) include fault protection against voltages and transients up to ±60V. Additionally, the ±15kV to ±16.5kV built-in ESD protection complements the fault protection.

Receiver (Rx) Features

These devices use a differential input receiver for maximum noise immunity and common-mode rejection. Input sensitivity is better than ±200mV (3.3V operation), as required by the RS-422 and RS-485 specifications.

The 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. Therefore, 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 receiver (Rx) functions, with common-mode voltages as great as ±20V, make them ideal for industrial or long networks where induced voltages are a realistic concern.

All the receivers include a full fail-safe function that ensures 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 (an idle bus).

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

The Rx in the 250kbps (ISL32450E, ISL32452E, and ISL32457E) and 1Mbps (ISL32453E and ISL32455E) versions include noise filtering circuitry to reject high frequency signals. The ISL32453E and ISL32455E typically reject pulses narrower than 50ns (equivalent to 20Mbps), while the ISL32450E, ISL32452E, and ISL32457E Rx reject pulses below 150ns (6.7Mbps). The ISL32450E, ISL32452E, and ISL32457E have no Rx noise filtering.

Driver (Tx) Features

The RS-485/RS-422 driver is a differential output device that delivers at least 1.7V across a 54Ω load (RS-485), and at least 2V across a 100Ω load (RS-422) with $V_{CC} \geq 4.5V$. The drivers feature low propagation delay skew to maximize bit width and to minimize EMI. All drivers are tri-statable through the active high DE input.

The 250kbps and 1Mbps driver outputs are slew rate limited to minimize EMI and reflections in unterminated or improperly terminated networks. The ISL32458E and ISL32459E driver outputs are not limited, so faster output transition times allow data rates of at least 20Mbps.

High Overvoltage (Fault) Protection Increases Ruggedness

Note: The available smaller pitch package (MSOP) may not meet the Creepage and Clearance (C&C) requirements for ±60V levels. Determine C&C requirements before selecting a package type.

The ±60V fault protection (referenced to the IC GND) on the RS-485 pins makes these transceivers some of the most rugged on the market. This level of protection makes the ISL3245xE family ideal for applications where power (such as 24V and 48V supplies) must be routed in the conduit with the data lines and 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 destroys an unprotected device. The ±60V fault levels of this family are at least four times higher than the levels specified for standard RS-485 ICs. The ISL3245xE's protection is active whether the Tx is enabled or disabled, and even if the IC is powered down or VCC and Ground are floating.

If transients or voltages (including overshoots and ringing) greater than ±60V are possible, additional external protection is required. Use a protection device with the lowest clamping voltage acceptable for the application. Note, TVS type devices typically clamp 5V to 10V above the designated stand-off voltage (for example, a "54V TVS" clamps between 60V and 66V).

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 can 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 can malfunction. The ISL3245xE's extended ±20V CMR allows for operation in environments that would overwhelm lesser transceivers. Additionally, the Rx does not phase invert (erroneously change state) even with CMVs of ±25V or differential voltages as large as 40V.

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Cable Invert (Polarity Reversal) Function

Large node count RS-485 networks are commonly wired backwards during installation. When this happens, the node is unable to communicate over the network. When a technician finds the miswired node, they must then rewire the connector, which is time consuming.

The ISL32457E and ISL32459E simplify this task by including a cable invert pin (INV) that allows the technician to invert the polarity of the Rx input and the Tx output pins simply by moving a jumper to change the state of the invert pin. When the invert pin is low, the IC operates like any standard RS-485 transceiver, and the bus pins have their normal polarity definition of A and Y as noninverting and B and Z as inverting. With the invert pin high, the corresponding bus pins reverse their polarity, so B and Z become noninverting, and A and Y become inverting.

This unique cable invert function is superior to that found on competing devices, because the Rx full fail-safe function is maintained, even when the Rx polarity is reversed. Competitor devices implement the Rx invert function simply by inverting the Rx output. This means that with the Rx inputs floating or shorted together, the Rx appropriately delivers a logic 1 in normal polarity, but outputs a logic low when the IC is operated in the inverted mode. The innovative Renesas Rx design ensures that the Rx output remains high with the Rx inputs floating or shorted together (V_{ID} = 0V), regardless of the state of the invert pin.

Data Rate, Cables, and Terminations

RS-485/RS-422 are intended for network lengths up to 4000ft, but the maximum system data rate decreases as the transmission length increases. High speed versions operating at 20Mbps can be used at lengths up to 150ft (46m), but the distance can be increased to 328ft (100m) by operating them at 5Mbps. The ISL32453E and ISL32455E can operate at the full data rate of 1Mbps with lengths up to 800ft (244m). Jitter is the limiting parameter at faster data rates and may limit the network to shorter lengths, so employing encoded data streams (such as Manchester coded or Return-to-Zero) may allow increased transmission distances. The ISL32450E, ISL32452E, and ISL32457E can operate at 115kbps or less at the full 4000ft (1220m) distance, or at 250kbps for lengths up to 3000ft (915m). DC cable attenuation is the limiting parameter, so using better quality cables (such as 22 AWG) may allow increased transmission distance.

Use twisted pair cables for RS-485/RS-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.

Note: Proper termination is imperative to minimize reflections when using the 20Mbps ISL32458E and ISL32459E devices. Short networks using the 250kbps ISL32450E, ISL32452E, and ISL32457E versions do not need to be terminated; however, terminations are recommended unless power dissipation is an overriding concern.

In point-to-point or point-to-multireceiver networks (single driver on bus like RS-422), terminate the main cable in its characteristic impedance (typically 120Ω) at the end farthest from the driver. In multireceiver applications, keep stubs connecting receivers to the main cable as short as possible. Multipoint (multidriver) systems require that the main cable is terminated 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 transceivers meet this requirement through driver output short-circuit current limits and on-chip thermal shutdown circuitry.

The driver output stages incorporate a double foldback short-circuit current limiting scheme that ensures that the output current never exceeds the RS-485 specification, even at the common-mode and fault condition voltage range extremes. The first foldback current level (≈83mA) is set to ensure that the driver never folds back when driving loads with common-mode voltages up to ±20V. The very low second foldback current setting (≈13mA) minimizes power dissipation if the Tx is enabled when a fault occurs.

In the event of a major short-circuit condition, the ISL3245xE's thermal shutdown feature disables the drivers whenever the die temperature becomes excessive. Thermal shutdown 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. The receivers stay operational during thermal shutdown.

Low Power Shutdown Mode

These BiCMOS transceivers all use a fraction of the power required by competitive devices, but they (excluding ISL32457E and ISL32459E) 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 ensures that the transceiver does not enter shutdown.

Note: The receiver and driver enable times increase when the transceiver enables from shutdown. See Notes 12 through 16 on page 11 for more information.

Die Characteristics

SUBSTRATE POTENTIAL (POWERED UP):

GND

PROCESS:

Si Gate BiCMOS

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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
Feb 14, 2019	FN7921.3	Updated links throughout document. Updated ordering information table by adding all tape and reel information and updating notes. Updated last sentence in second paragraph in “High Overvoltage (Fault) Protection Increases Ruggedness” on page 18 Removed About Intersil section. Updated disclaimer.
August 31, 2017	FN7921.2	Updated the receiving truth table on page 3.
December 1, 2015	FN7921.1	Added 20Mbps versions (ISL32458E and ISL32459E) to datasheet. Replaced Products section with About Intersil verbiage. Updated Package Outline Drawing M10.118 to the latest version. Changes are as follows: -Updated to new POD template. Added land pattern.
February 20, 2012	FN7921.0	Initial release

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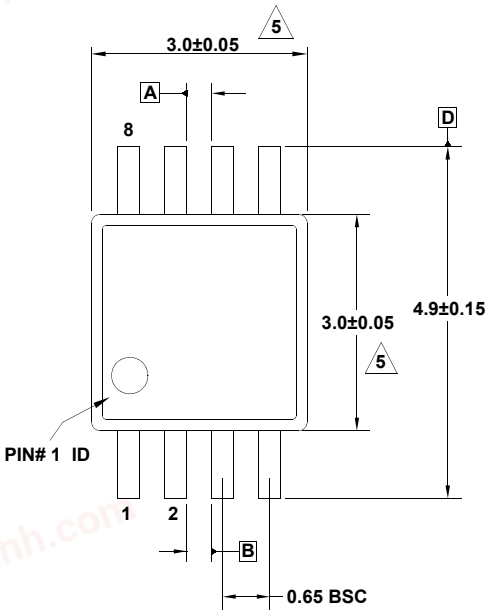
Package Outline Drawings

For the most recent package outline drawing, see M8.118.

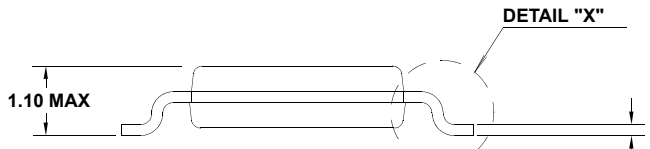
M8.118

8 LEAD MINI SMALL OUTLINE PLASTIC PACKAGE

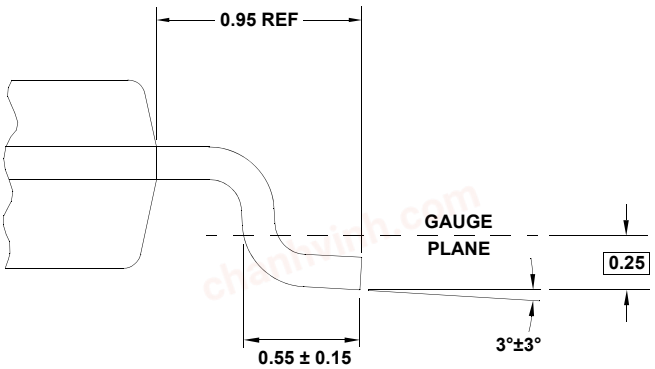
Rev 4, 7/11



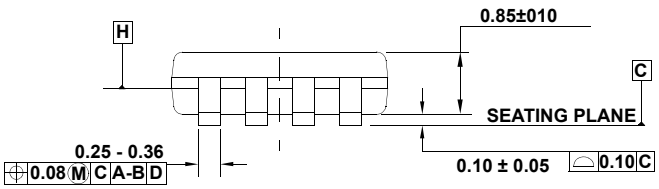
TOP VIEW



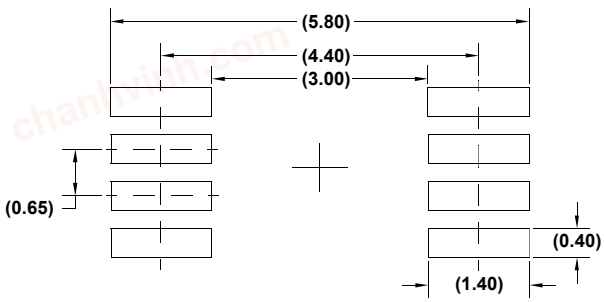
SIDE VIEW 2



DETAIL "X"



SIDE VIEW 1



TYPICAL RECOMMENDED LAND PATTERN

NOTES:

1. Dimensions are in millimeters.
2. Dimensioning and tolerancing conform to JEDEC MO-187-AA and AMSEY14.5m-1994.
3. Plastic or metal protrusions of 0.15mm max per side are not included.
4. Plastic interlead protrusions of 0.15mm max per side are not included.
5. Dimensions are measured at Datum Plane "H".
6. Dimensions in ( ) are for reference only.

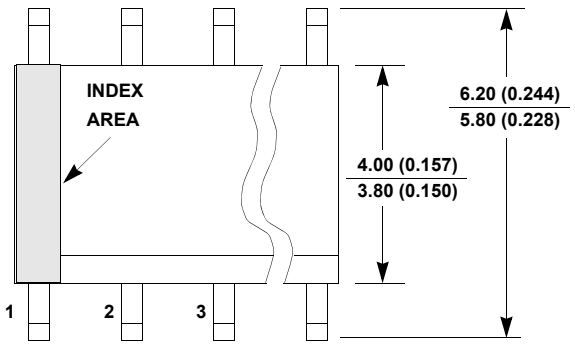
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M8.15

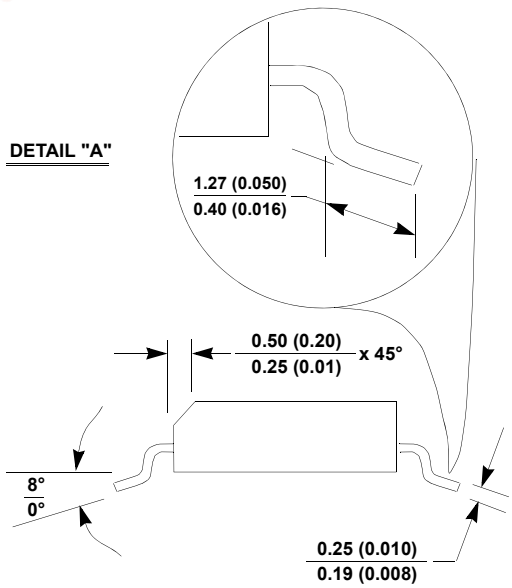
8 LEAD NARROW BODY SMALL OUTLINE PLASTIC PACKAGE

Rev 4, 1/12

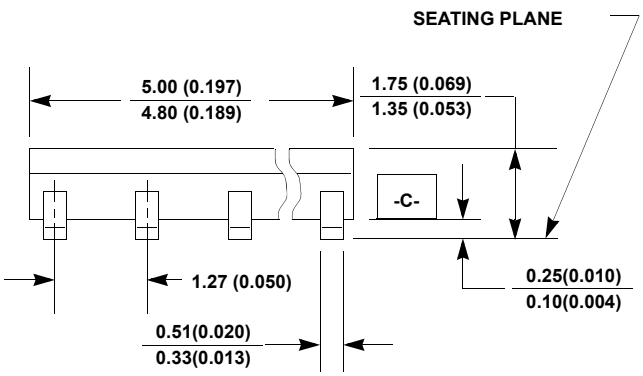
For the most recent package outline drawing, see M8.15.



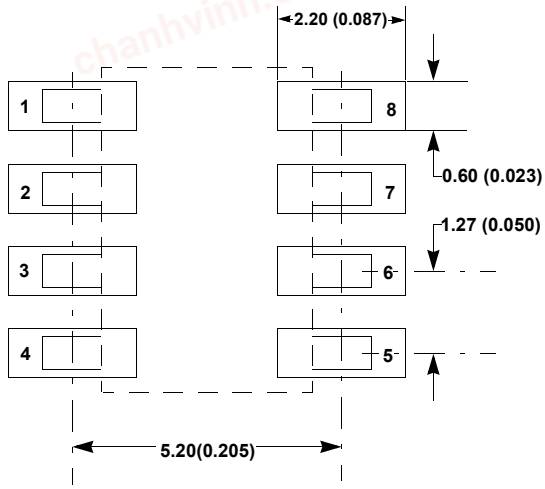
TOP VIEW



SIDE VIEW "B"



SIDE VIEW "A"



TYPICAL RECOMMENDED LAND PATTERN

NOTES:

20. Dimensioning and tolerancing per ANSI Y14.5M-1994.
21. 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.
22. Package width does not include interlead flash or protrusions. Interlead flash and protrusions shall not exceed 0.25mm (0.010 inch) per side.
23. The chamfer on the body is optional. If it is not present, a visual index feature must be located within the crosshatched area.
24. Terminal numbers are shown for reference only.
25. 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).
26. Controlling dimension: MILLIMETER. Converted inch dimensions are not necessarily exact.
27. This outline conforms to JEDEC publication MS-012-AA ISSUE C.

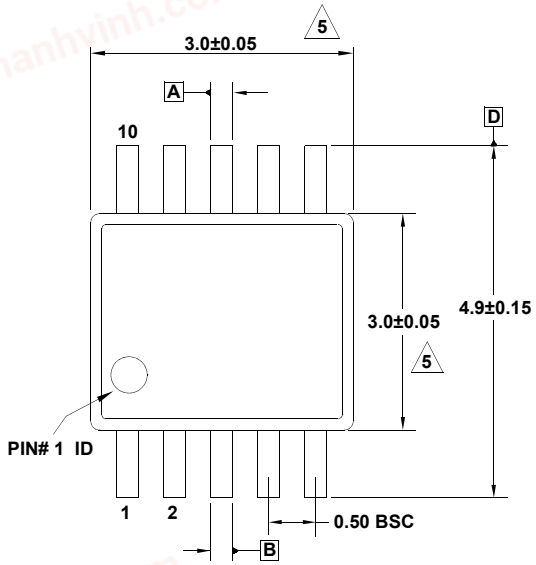
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M10.118

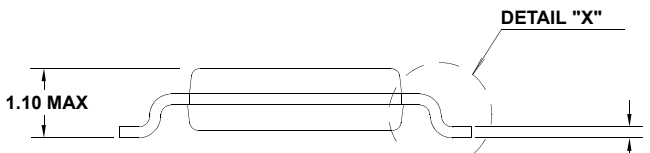
10 LEAD MINI SMALL OUTLINE PLASTIC PACKAGE

Rev 1, 4/12

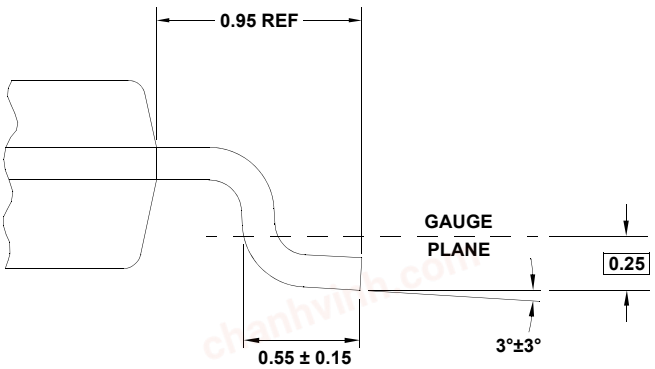
For the most recent package outline drawing, see M10.118.



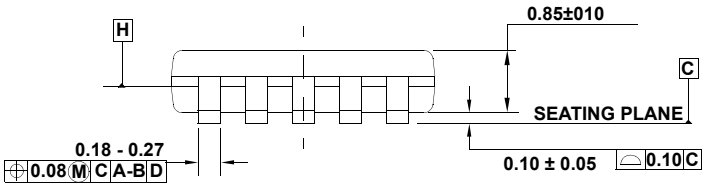
TOP VIEW



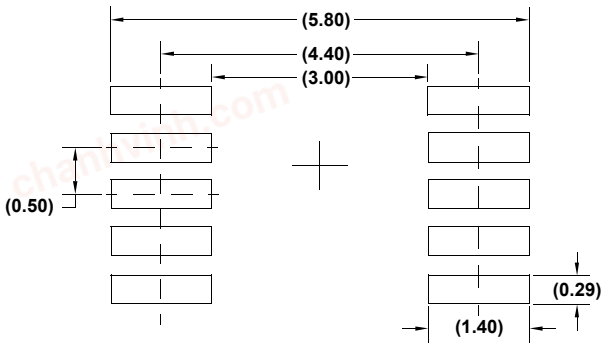
SIDE VIEW 2



DETAIL "X"



SIDE VIEW 1



TYPICAL RECOMMENDED LAND PATTERN

NOTES:

1. Dimensions are in millimeters.
2. Dimensioning and tolerancing conform to JEDEC MO-187-BA and AMSEY14.5m-1994.
3. Plastic or metal protrusions of 0.15mm max per side are not included.
4. Plastic interlead protrusions of 0.15mm max per side are not included.
5. Dimensions are measured at Datum Plane "H".
6. Dimensions in ( ) are for reference only.

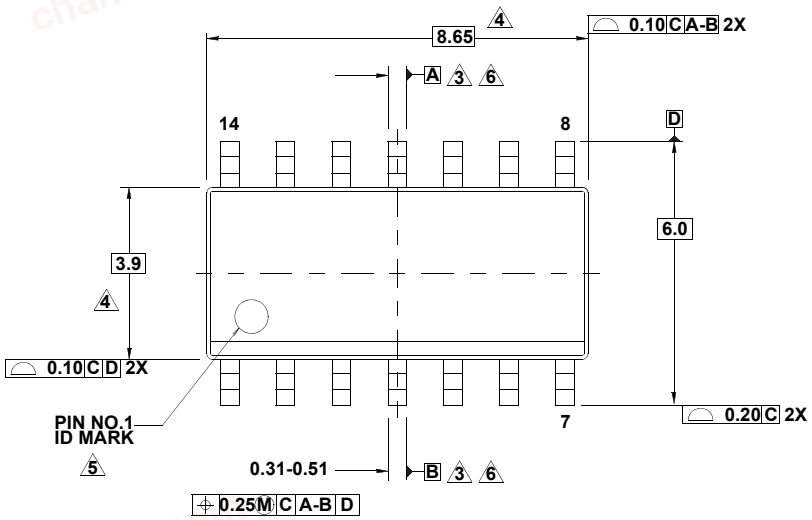
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M14.15

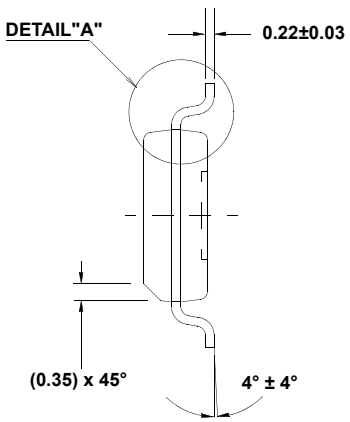
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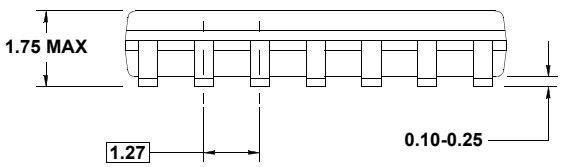
14 LEAD NARROW BODY SMALL OUTLINE PLASTIC PACKAGE

Rev 1, 10/09

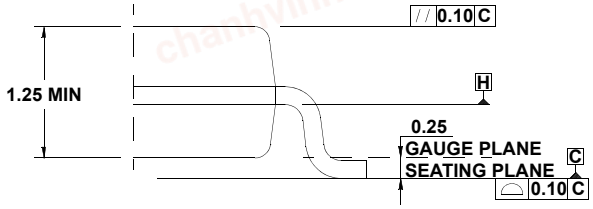


TOP VIEW

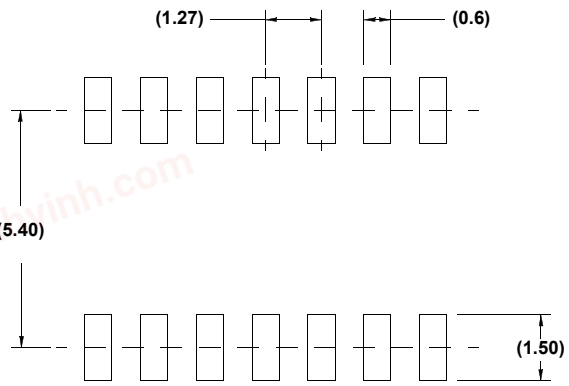




SIDE VIEW



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.

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