# Fault Protected, Extended Common Mode Range, RS-485/RS-422 Transceivers with ±16.5kV ESD

## ISL32470E, ISL32472E, ISL32475E, ISL32478E

The ISL32470E, ISL32472E, ISL32475E, ISL32478E 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 fault protected against overvoltages up to ±60V and are protected against ±16.5kV ESD strikes without latch-up. Additionally, these transceivers operate in environments with common mode voltages up to ±15V (exceeds the RS-485 requirement), making this fault-protected RS-485 family one of the more robust on the market.

Transmitters (Tx) 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 a fault-protected RS-485 transceiver with a ±25V extended common mode range, please see the ISL32490E and ISL32483E data sheets.

## Features

- Fault-Protected RS-485 Bus Pins . . . . . . . . . . . . . . Up 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
- ±16.5kV HBM ESD Protection on RS-485 Bus Pins
- 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 Rates . . . . . . . . . . .250kbps to 15Mbps
- Low Quiescent Supply Current . . . . . . . . . . . . . . . . . . . 2.3mA
- Ultra Low Shutdown Supply Current . . . . . . . . . . . . . . . . 10µA

## Applications

- Utility Meters/Automated Meter Reading Systems
- High Node Count RS-485 Systems
- PROFIBUS® and RS-485 Based Field Bus Networks, and Factory Automation
- Security Camera Networks
- Building Lighting and Environmental Control Systems
- Industrial/Process Control Networks

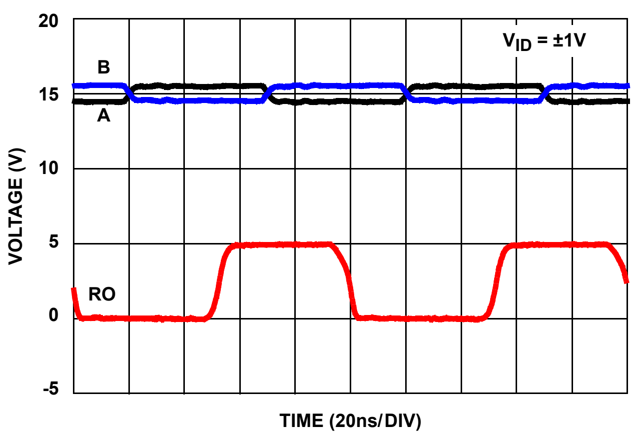



FIGURE 1. EXCEPTIONAL Rx OPERATES AT >15Mbps EVEN WITH ±15V COMMON MODE VOLTAGE

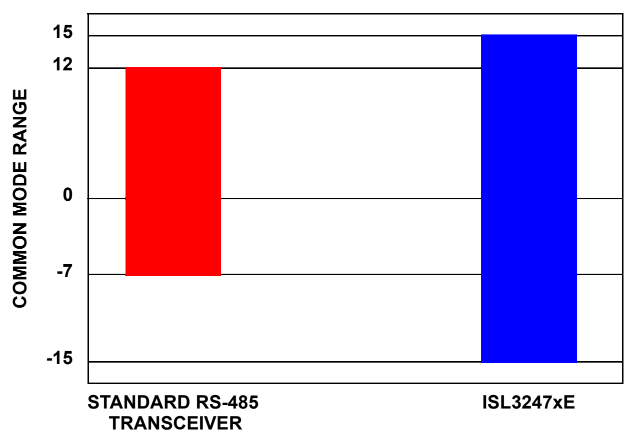



FIGURE 2. TRANSCEIVERS DELIVER SUPERIOR COMMON MODE RANGE vs STANDARD RS-485 DEVICES

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 |
|---|---|---|---|---|---|---|---|---|
| ISL32470E | Full | 0.25 | Yes | Yes | Yes | 2.3 | Yes | 14 |
| ISL32472E | Half | 0.25 | Yes | Yes | Yes | 2.3 | Yes | 8 |
| ISL32475E | Half | 1 | Yes | Yes | Yes | 2.3 | Yes | 8 |
| ISL32478E | Half | 15 | No | Yes | Yes | 2.3 | Yes | 8 |

# Ordering Information

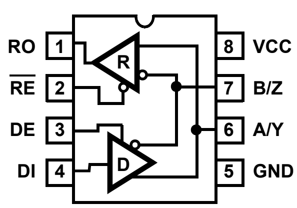
| PART NUMBER (Notes 1, 2, 3) | PART MARKING | TEMP. RANGE (°C) | PACKAGE (Pb-Free) | PKG. DWG. # |
|---|---|---|---|---|
| ISL32470EIBZ | ISL32470 EIBZ | -40 to +85 | 14 Ld SOIC | M14.15 |
| ISL32472EIBZ | 32472 EIBZ | -40 to +85 | 8 Ld SOIC | M8.15 |
| ISL32475EIBZ | 32475 EIBZ | -40 to +85 | 8 Ld SOIC | M8.15 |
| ISL32478EIBZ | 32478 EIBZ | -40 to +85 | 8 Ld SOIC | M8.15 |

NOTES:

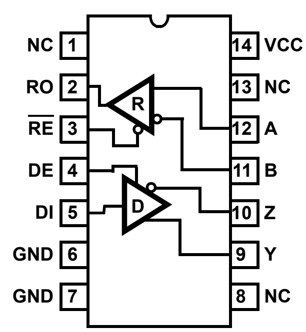
1. Add "-T*" suffix for tape and reel. Please refer to TB347 for details on reel specifications.
2. These Intersil Pb-free plastic packaged products employ special Pb-free material sets, molding compounds/die attach materials, and 100% matte tin plate plus anneal (e3 termination finish, which is RoHS 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.
3. For Moisture Sensitivity Level (MSL), please see device information pages for ISL32470E, ISL32472E, ISL32475E, ISL32478E. For more information on MSL please see techbrief TB363.

# Pin Configurations

ISL32472E, ISL32475E, ISL32478E
(8 LD SOIC)
TOP VIEW




ISL32470E
(14 LD SOIC)
TOP VIEW



## 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 and ±16.5kV HBM ESD 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 and ±16.5kV HBM ESD 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 and ±15kV HBM ESD Protected, RS-485/RS-422 level, non-inverting receiver input. |
| B | - | 11 | ±60V Fault and ±15kV HBM ESD Protected, RS-485/RS-422 level, inverting receiver input. |
| Y | - | 9 | ±60V Fault and ±15kV HBM ESD Protected, RS-485/RS-422 level, non-inverting driver output. |
| Z | - | 10 | ±60V Fault and ±15kV HBM ESD Protected, RS-485/RS-422 level, inverting driver output. |
| VCC | 8 | 14 | System power supply input (4.5V to 5.5V). |
| NC | - | 1, 8, 13 | No Internal Connection. |

## Truth Tables

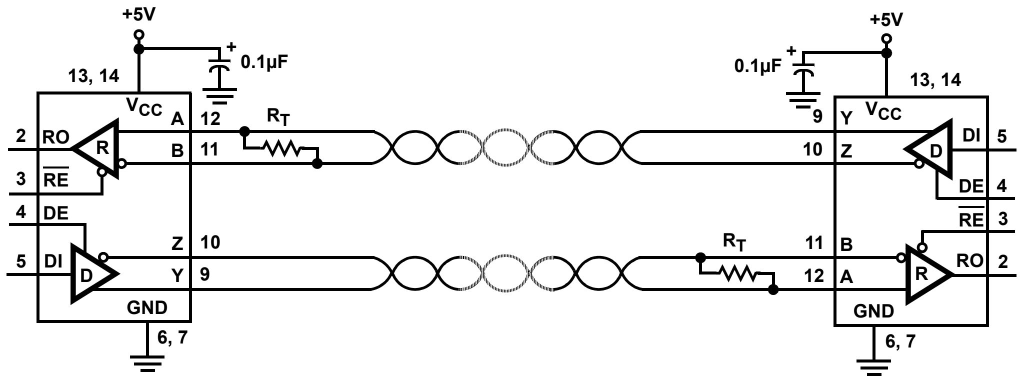
| TRANSMITTING | | | | |
|---|---|---|---|---|
| INPUTS | | | OUTPUTS | |
| RE | DE | DI | Z | Y |
| X | 1 | 1 | 0 | 1 |
| X | 1 | 0 | 1 | 0 |
| 0 | 0 | X | High-Z | High-Z |
| 1 | 0 | X | High-Z (see Note) | High-Z (see Note) |

NOTE: Low Power Shutdown Mode (see Note 11, page 9).

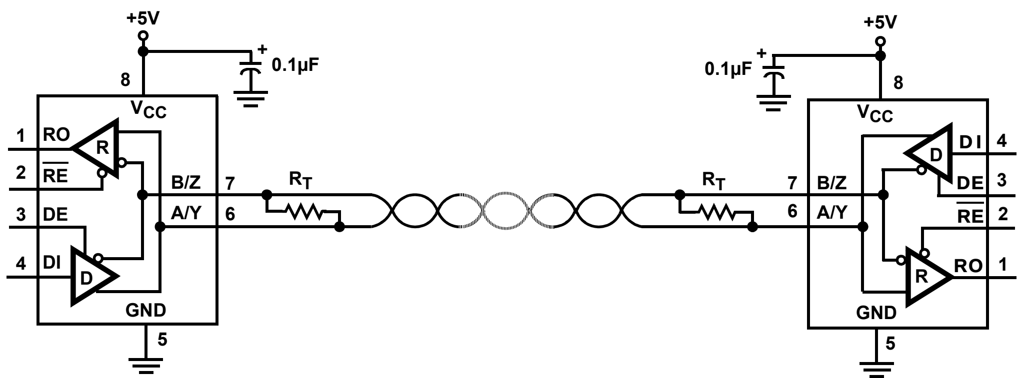
| RECEIVING | | | | |
|---|---|---|---|---|
| INPUTS | | | | OUTPUT |
| RE | DE Half Duplex | DE Full Duplex | A-B | RO |
| 0 | 0 | X | ≥ -0.01V | 1 |
| 0 | 0 | X | ≤ -0.2V | 0 |
| 0 | 0 | X | Inputs Open/Shorted | 1 |
| 1 | 0 | 0 | X | High-Z (see Note) |
| 1 | 1 | 1 | X | High-Z |

NOTE: Low Power Shutdown Mode (see Note 11, page 9).

## Typical Operating Circuits




ISL32470E FULL DUPLEX EXAMPLE




ISL32472E, ISL32475E, ISL32478E HALF DUPLEX EXAMPLE

## 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 15). . . . . . . . . ±80V
RO . . . . . . . . . -0.3V to ($V_{CC}$ +0.3V)
Short Circuit Duration
Y, Z . . . . . . . . . Indefinite
ESD Rating . . . . . . . . . see "ESD PERFORMANCE" on page 6
Latch-up (per JESD78, Level 2, Class A) . . . . . . . . . +125°C

## Thermal Information

| Thermal Resistance (Typical) | $\theta_{JA}$ (°C/W) | $\theta_{JC}$ (°C/W) |
|---|---|---|
| 8 Ld SOIC Package (Notes 4, 5) | 108 | 47 |
| 14 Ld SOIC Package (Notes 4, 5) | 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

## Recommended Operating Conditions

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

*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:

4. $\theta_{JA}$ is measured with the component mounted on a high effective thermal conductivity test board in free air. See Tech Brief TB379 for details.
5. For $\theta_{JC}$, 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 $V_{CC}$ = 5V, $T_A$ = +25°C (Note 6). **Boldface limits apply over the operating temperature range, -40°C to +85°C.**

| PARAMETER | SYMBOL | TEST CONDITIONS | TEMP (°C) | MIN (Note 14) | TYP | MAX (Note 14) | UNITS |
|---|---|---|---|---|---|---|---|
| **DC CHARACTERISTICS** | | | | | | | |
| Driver Differential $V_{OUT}$ (No load) | $V_{OD1}$ | | Full | - | - | **$V_{CC}$** | V |
| Driver Differential $V_{OUT}$ (Loaded, Figure 3A) | $V_{OD2}$ | $R_L$ = 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 | $\Delta V_{OD}$ | $R_L$ = 54Ω or 100Ω (Figure 3A) | Full | - | - | **0.2** | V |
| Driver Differential $V_{OUT}$ with Common Mode Load (Figure 3B) | $V_{OD3}$ | $R_L$ = 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 3A) | $V_{OC}$ | $R_L$ = 54Ω or 100Ω | Full | **-1** | - | **3** | V |
| Change in Magnitude of Driver Common-Mode $V_{OUT}$ for Complementary Output States | $\Delta V_{OC}$ | $R_L$ = 54Ω or 100Ω (Figure 3A) | Full | - | - | **0.2** | V |
| Driver Short-Circuit Current | $I_{OSD}$ | DE = $V_{CC}$, -15V ≤ $V_O$ ≤ 15V (Note 8) | Full | **-250** | - | **250** | mA |
| | $I_{OSD1}$ | At First Foldback, 22V ≤ $V_O$ ≤ -22V | 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, $\overline{RE}$ | 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 |

**Electrical Specifications** Test Conditions: $V_{CC}$ = 4.5V to 5.5V; Unless Otherwise Specified. Typicals are $V_{CC}$ = 5V, $T_A$ = +25°C (Note 6). **Boldface limits apply over the operating temperature range, -40°C to +85°C. (Continued)**

| PARAMETER | SYMBOL | TEST CONDITIONS | | TEMP (°C) | MIN (Note 14) | TYP | MAX (Note 14) | UNITS |
|---|---|---|---|---|---|---|---|---|
| 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 16) | 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 16) | 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 16) | Full | **-3** | ±0.1 | **3** | mA |
| Receiver Differential Threshold Voltage | $V_{TH}$ | $-15V \le V_{CM} \le 15V$ | | Full | **-200** | -100 | **-10** | mV |
| Receiver Input Hysteresis | $\Delta V_{TH}$ | $-15V \le V_{CM} \le 15V$ | | 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 | $I_{OZR}$ | $0V \le V_O \le V_{CC}$ | | Full | **-1** | 0.01 | **1** | µA |
| Receiver Short-Circuit Current | $I_{OSR}$ | $0V \le V_O \le V_{CC}$ | | Full | **±12** | - | **±110** | mA |
| **SUPPLY CURRENT** | | | | | | | | |
| No-Load Supply Current (Note 7) | $I_{CC}$ | 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** | | | | | | | | |
| RS-485 Pins (A, Y, B, Z, A/Y, B/Z) | | Human Body Model, From Bus Pins to GND | 1/2 Duplex | 25 | - | ±16.5 | - | kV |
| | | | Full Duplex | 25 | - | ±15 | - | kV |
| All Pins | | Human Body Model, per JEDEC | | 25 | - | ±8 | - | kV |
| | | Machine Model | | 25 | - | ±700 | - | V |
| **DRIVER SWITCHING CHARACTERISTICS (250kbps Versions; ISL32470E and ISL32472E)** | | | | | | | | |
| Driver Differential Output Delay | $t_{PLH}$, $t_{PHL}$ | $R_D$ = 54Ω, $C_D$ = 50pF (Figure 4) | | Full | - | 320 | **450** | ns |
| Driver Differential Output Skew | $t_{SKEW}$ | $R_D$ = 54Ω, $C_D$ = 50pF (Figure 4) | | Full | - | 6 | **30** | ns |
| Driver Differential Rise or Fall Time | $t_R$, $t_F$ | $R_D$ = 54Ω, $C_D$ = 50pF (Figure 4) | | Full | **400** | 650 | **1200** | ns |

**Electrical Specifications** Test Conditions: $V_{CC}$ = 4.5V to 5.5V; Unless Otherwise Specified. Typicals are $V_{CC}$ = 5V, $T_A$ = +25°C (Note 6). **Boldface limits apply over the operating temperature range, -40°C to +85°C. (Continued)**

| PARAMETER | SYMBOL | TEST CONDITIONS | TEMP (°C) | MIN (Note 14) | TYP | MAX (Note 14) | UNITS |
|---|---|---|---|---|---|---|---|
| Maximum Data Rate | $f_{MAX}$ | $C_D$ = 820pF (Figure 6) | Full | **0.25** | 1.5 | - | Mbps |
| Driver Enable to Output High | $t_{ZH}$ | SW = GND (Figure 5), (Note 9) | Full | - | - | **1200** | ns |
| Driver Enable to Output Low | $t_{ZL}$ | SW = $V_{CC}$ (Figure 5), (Note 9) | Full | - | - | **1200** | ns |
| Driver Disable from Output Low | $t_{LZ}$ | SW = $V_{CC}$ (Figure 5) | Full | - | - | **120** | ns |
| Driver Disable from Output High | $t_{HZ}$ | SW = GND (Figure 5) | Full | - | - | **120** | ns |
| Time to Shutdown | $t_{SHDN}$ | (Note 11) | Full | **60** | 160 | **600** | ns |
| Driver Enable from Shutdown to Output High | $t_{ZH(SHDN)}$ | SW = GND (Figure 5), (Notes 11, 12) | Full | - | - | **2500** | ns |
| Driver Enable from Shutdown to Output Low | $t_{ZL(SHDN)}$ | SW = $V_{CC}$ (Figure 5), (Notes 11, 12) | Full | - | - | **2500** | ns |
| **DRIVER SWITCHING CHARACTERISTICS (1Mbps Versions; ISL32475E)** | | | | | | | |
| Driver Differential Output Delay | $t_{PLH}$, $t_{PHL}$ | $R_D$ = 54Ω, $C_D$ = 50pF (Figure 4) | Full | - | 70 | **125** | ns |
| Driver Differential Output Skew | $t_{SKEW}$ | $R_D$ = 54Ω, $C_D$ = 50pF (Figure 4) | Full | - | 4.5 | **15** | ns |
| Driver Differential Rise or Fall Time | $t_R$, $t_F$ | $R_D$ = 54Ω, $C_D$ = 50pF (Figure 4) | Full | **70** | 170 | **300** | ns |
| Maximum Data Rate | $f_{MAX}$ | $C_D$ = 820pF (Figure 6) | Full | **1** | 4 | - | Mbps |
| Driver Enable to Output High | $t_{ZH}$ | SW = GND (Figure 5), (Note 9) | Full | - | - | **350** | ns |
| Driver Enable to Output Low | $t_{ZL}$ | SW = $V_{CC}$ (Figure 5), (Note 9) | Full | - | - | **300** | ns |
| Driver Disable from Output Low | $t_{LZ}$ | SW = $V_{CC}$ (Figure 5) | Full | - | - | **120** | ns |
| Driver Disable from Output High | $t_{HZ}$ | SW = GND (Figure 5) | Full | - | - | **120** | ns |
| Time to Shutdown | $t_{SHDN}$ | (Note 11) | Full | **60** | 160 | **600** | ns |
| Driver Enable from Shutdown to Output High | $t_{ZH(SHDN)}$ | SW = GND (Figure 5), (Notes 11, 12) | Full | - | - | **2000** | ns |
| Driver Enable from Shutdown to Output Low | $t_{ZL(SHDN)}$ | SW = $V_{CC}$ (Figure 5), (Notes 11, 12) | Full | - | - | **2000** | ns |
| **DRIVER SWITCHING CHARACTERISTICS (15Mbps Versions; ISL32478E)** | | | | | | | |
| Driver Differential Output Delay | $t_{PLH}$, $t_{PHL}$ | $R_D$ = 54Ω, $C_D$ = 50pF (Figure 4) | Full | - | 21 | **45** | ns |
| Driver Differential Output Skew | $t_{SKEW}$ | $R_D$ = 54Ω, $C_D$ = 50pF (Figure 4) | Full | - | 3 | **6** | ns |
| Driver Differential Rise or Fall Time | $t_R$, $t_F$ | $R_D$ = 54Ω, $C_D$ = 50pF (Figure 4) | Full | **5** | 17 | **30** | ns |
| Maximum Data Rate | $f_{MAX}$ | $C_D$ = 470pF (Figure 6) | Full | **15** | 25 | - | Mbps |
| Driver Enable to Output High | $t_{ZH}$ | SW = GND (Figure 5), (Note 9) | Full | - | - | **100** | ns |
| Driver Enable to Output Low | $t_{ZL}$ | SW = $V_{CC}$ (Figure 5), (Note 9) | Full | - | - | **100** | ns |
| Driver Disable from Output Low | $t_{LZ}$ | SW = $V_{CC}$ (Figure 5) | Full | - | - | **120** | ns |
| Driver Disable from Output High | $t_{HZ}$ | SW = GND (Figure 5) | Full | - | - | **120** | ns |
| Time to Shutdown | $t_{SHDN}$ | (Note 11) | Full | **60** | 160 | **600** | ns |
| Driver Enable from Shutdown to Output High | $t_{ZH(SHDN)}$ | SW = GND (Figure 5), (Notes 11, 12) | Full | - | - | **2000** | ns |
| Driver Enable from Shutdown to Output Low | $t_{ZL(SHDN)}$ | SW = $V_{CC}$ (Figure 5), (Notes 11, 12) | Full | - | - | **2000** | ns |

**Electrical Specifications** Test Conditions: $V_{CC}$ = 4.5V to 5.5V; Unless Otherwise Specified. Typicals are $V_{CC}$ = 5V, $T_A$ = +25°C (Note 6). **Boldface limits apply over the operating temperature range, -40°C to +85°C. (Continued)**

| PARAMETER | SYMBOL | TEST CONDITIONS | TEMP (°C) | MIN (Note 14) | TYP | MAX (Note 14) | UNITS |
|---|---|---|---|---|---|---|---|
| **RECEIVER SWITCHING CHARACTERISTICS (250kbps Versions; ISL32470E and ISL32472E)** | | | | | | | |
| Maximum Data Rate | $f_{MAX}$ | (Figure 7) | Full | **0.25** | 5 | - | Mbps |
| Receiver Input to Output Delay | $t_{PLH}$, $t_{PHL}$ | (Figure 7) | Full | - | 200 | **280** | ns |
| Receiver Skew \| tPLH - tPHL \| | $t_{SKD}$ | (Figure 7) | Full | - | 4 | **10** | ns |
| Receiver Enable to Output Low | $t_{ZL}$ | $R_L$ = 1kΩ, $C_L$ = 15pF, SW = $V_{CC}$ (Figure 8), (Note 10) | Full | - | - | **50** | ns |
| Receiver Enable to Output High | $t_{ZH}$ | $R_L$ = 1kΩ, $C_L$ = 15pF, SW = GND (Figure 8), (Note 10) | Full | - | - | **50** | ns |
| Receiver Disable from Output Low | $t_{LZ}$ | $R_L$ = 1kΩ, $C_L$ = 15pF, SW = $V_{CC}$ (Figure 8) | Full | - | - | **50** | ns |
| Receiver Disable from Output High | $t_{HZ}$ | $R_L$ = 1kΩ, $C_L$ = 15pF, SW = GND (Figure 8) | Full | - | - | **50** | ns |
| Time to Shutdown | $t_{SHDN}$ | (Note 11) | Full | **60** | 160 | **600** | ns |
| Receiver Enable from Shutdown to Output High | $t_{ZH(SHDN)}$ | $R_L$ = 1kΩ, $C_L$ = 15pF, SW = GND (Figure 8), (Notes 11, 13) | Full | - | - | **2000** | ns |
| Receiver Enable from Shutdown to Output Low | $t_{ZL(SHDN)}$ | $R_L$ = 1kΩ, $C_L$ = 15pF, SW = $V_{CC}$ (Figure 8), (Notes 11, 13) | Full | - | - | **2000** | ns |
| **RECEIVER SWITCHING CHARACTERISTICS (1Mbps Versions; ISL32475E)** | | | | | | | |
| Maximum Data Rate | $f_{MAX}$ | (Figure 7) | Full | **1** | 15 | - | Mbps |
| Receiver Input to Output Delay | $t_{PLH}$, $t_{PHL}$ | (Figure 7) | Full | - | 90 | **150** | ns |
| Receiver Skew \| $t_{PLH}$ - tPH \| | $t_{SKD}$ | (Figure 7) | Full | - | 4 | **10** | ns |
| Receiver Enable to Output Low | $t_{ZL}$ | $R_L$ = 1kΩ, $C_L$ = 15pF, SW = $V_{CC}$ (Figure 8), (Note 10) | Full | - | - | **50** | ns |
| Receiver Enable to Output High | $t_{ZH}$ | $R_L$ = 1kΩ, $C_L$ = 15pF, SW = GND (Figure 8), (Note 10) | Full | - | - | **50** | ns |
| Receiver Disable from Output Low | $t_{LZ}$ | $R_L$ = 1kΩ, $C_L$ = 15pF, SW = $V_{CC}$ (Figure 8) | Full | - | - | **50** | ns |
| Receiver Disable from Output High | $t_{HZ}$ | $R_L$ = 1kΩ, $C_L$ = 15pF, SW = GND (Figure 8) | Full | - | - | **50** | ns |
| Time to Shutdown | $t_{SHDN}$ | (Note 11) | Full | **60** | 160 | **600** | ns |
| Receiver Enable from Shutdown to Output High | $t_{ZH(SHDN)}$ | $R_L$ = 1kΩ, $C_L$ = 15pF, SW = GND (Figure 8), (Notes 11, 13) | Full | - | - | **2000** | ns |
| Receiver Enable from Shutdown to Output Low | $t_{ZL(SHDN)}$ | $R_L$ = 1kΩ, $C_L$ = 15pF, SW = $V_{CC}$ (Figure 8), (Notes 11, 13) | Full | - | - | **2000** | ns |
| **RECEIVER SWITCHING CHARACTERISTICS (15Mbps Versions; ISL32478E)** | | | | | | | |
| Maximum Data Rate | $f_{MAX}$ | (Figure 7) | Full | **15** | 25 | - | Mbps |
| Receiver Input to Output Delay | $t_{PLH}$, $t_{PHL}$ | (Figure 7) | Full | - | 35 | **70** | ns |
| Receiver Skew \| $t_{PLH}$ - $t_{PHL}$ \| | $t_{SKD}$ | (Figure 7) | Full | - | 4 | **10** | ns |
| Receiver Enable to Output Low | $t_{ZL}$ | $R_L$ = 1kΩ, $C_L$ = 15pF, SW = $V_{CC}$ (Figure 8), (Note 10) | Full | - | - | **50** | ns |
| Receiver Enable to Output High | $t_{ZH}$ | $R_L$ = 1kΩ, $C_L$ = 15pF, SW = GND (Figure 8), (Note 10) | Full | - | - | **50** | ns |
| Receiver Disable from Output Low | $t_{LZ}$ | $R_L$ = 1kΩ, $C_L$ = 15pF, SW = $V_{CC}$ (Figure 8) | Full | - | - | **50** | ns |
| Receiver Disable from Output High | $t_{HZ}$ | $R_L$ = 1kΩ, $C_L$ = 15pF, SW = GND (Figure 8) | Full | - | - | **50** | ns |

**Electrical Specifications** Test Conditions: $V_{CC}$ = 4.5V to 5.5V; Unless Otherwise Specified. Typicals are $V_{CC}$ = 5V, $T_A$ = +25°C (Note 6). **Boldface limits apply over the operating temperature range, -40°C to +85°C. (Continued)**

| PARAMETER | SYMBOL | TEST CONDITIONS | TEMP (°C) | MIN (Note 14) | TYP | MAX (Note 14) | UNITS |
|---|---|---|---|---|---|---|---|
| Time to Shutdown | $t_{SHDN}$ | (Note 11) | Full | **60** | 160 | **600** | ns |
| Receiver Enable from Shutdown to Output High | $t_{ZH(SHDN)}$ | $R_L$ = 1kΩ, $C_L$ = 15pF, SW = GND (Figure 8), (Notes 11, 13) | Full | - | - | **2000** | ns |
| Receiver Enable from Shutdown to Output Low | $t_{ZL(SHDN)}$ | $R_L$ = 1kΩ, $C_L$ = 15pF, SW = $V_{CC}$ (Figure 8), (Notes 11, 13) | Full | - | - | **2000** | ns |

NOTES:

6. 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.
7. Supply current specification is valid for loaded drivers when DE = 0V.
8. Applies to peak current. See “Typical Performance Curves” beginning on page 13 for more information.
9. Keep $\overline{RE}$ = 0 to prevent the device from entering SHDN.
10. The $\overline{RE}$ signal high time must be short enough (typically <100ns) to prevent the device from entering SHDN.
11. 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 13.
12. Keep $\overline{RE}$ = $V_{CC}$, and set the DE signal low time >600ns to ensure that the device enters SHDN.
13. Set the $\overline{RE}$ signal high time >600ns to ensure that the device enters SHDN.
14. Compliance to data sheet limits is assured by one or more methods: production test, characterization and/or design.
15. Tested according to TIA/EIA-485-A, Section 4.2.6 (±80V for 15µs at a 1% duty cycle).
16. See “Caution” statement below the “Recommended Operating Conditions” section on page 5.

# Test Circuits and Waveforms

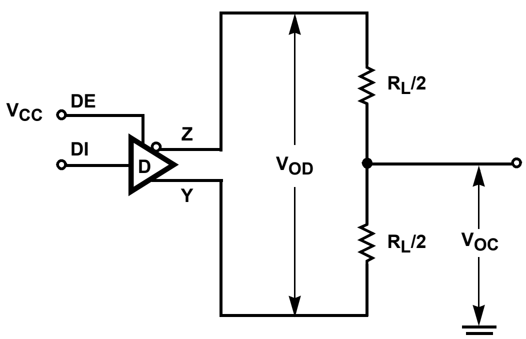



FIGURE 3A. $V_{OD}$ AND $V_{OC}$

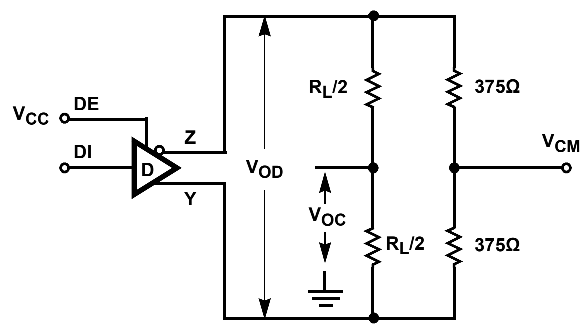



FIGURE 3B. $V_{OD}$ AND $V_{OC}$ WITH COMMON MODE LOAD

FIGURE 3. DC DRIVER TEST CIRCUITS

## Test Circuits and Waveforms (Continued)

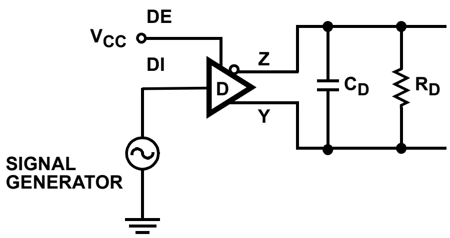



FIGURE 4A. TEST CIRCUIT

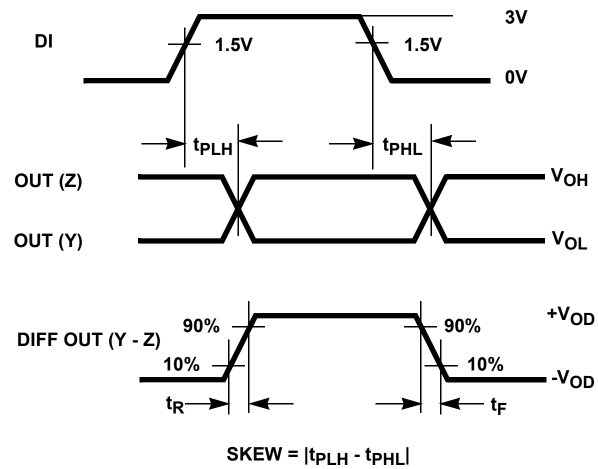
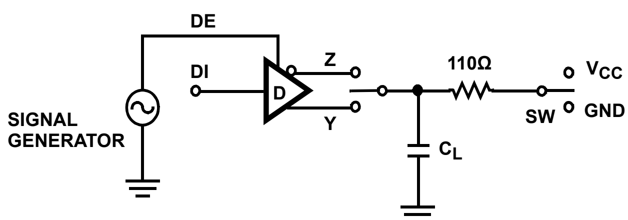



FIGURE 4B. MEASUREMENT POINTS

FIGURE 4. DRIVER PROPAGATION DELAY AND DIFFERENTIAL TRANSITION TIMES




| PARAMETER | OUTPUT | 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 9) | 1/0 | GND | 100 |
| $t_{ZL}$ | Y/Z | 0 (Note 9) | 0/1 | $V_{CC}$ | 100 |
| $t_{ZH(SHDN)}$ | Y/Z | 1 (Note 12) | 1/0 | GND | 100 |
| $t_{ZL(SHDN)}$ | Y/Z | 1 (Note 12) | 0/1 | $V_{CC}$ | 100 |

FIGURE 5A. TEST CIRCUIT

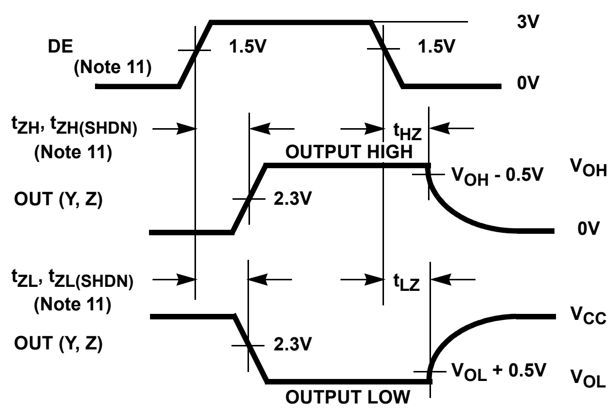



FIGURE 5B. MEASUREMENT POINTS

FIGURE 5. DRIVER ENABLE AND DISABLE TIMES

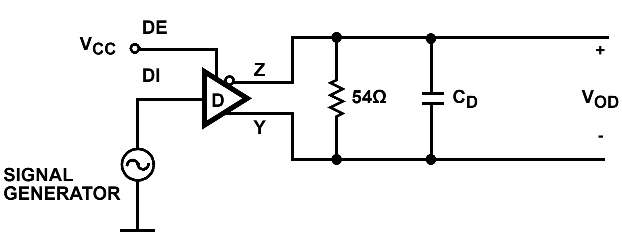



FIGURE 6A. TEST CIRCUIT

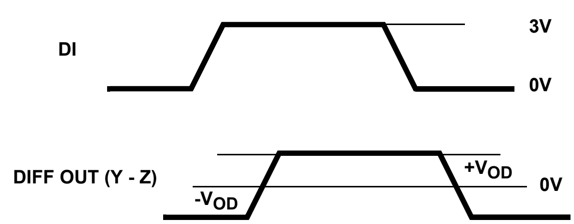



FIGURE 6B. MEASUREMENT POINTS

FIGURE 6. DRIVER DATA RATE

## Test Circuits and Waveforms (Continued)

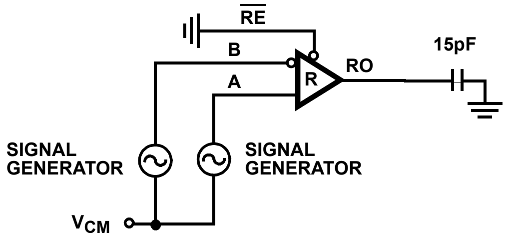



FIGURE 7A. TEST CIRCUIT

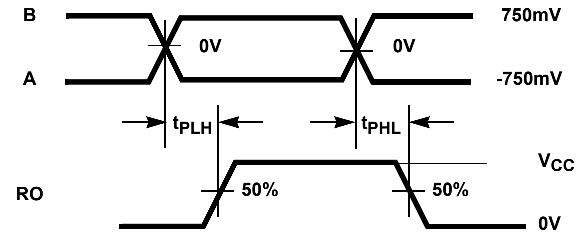
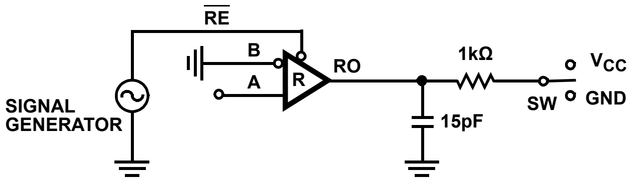



FIGURE 7B. MEASUREMENT POINTS

FIGURE 7. 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 10) | 0 | +1.5V | GND |
| $t_{ZL}$ (Note 10) | 0 | -1.5V | $V_{CC}$ |
| $t_{ZH(SHDN)}$ (Note 13) | 0 | +1.5V | GND |
| $t_{ZL(SHDN)}$ (Note 13) | 0 | -1.5V | $V_{CC}$ |

FIGURE 8A. TEST CIRCUIT

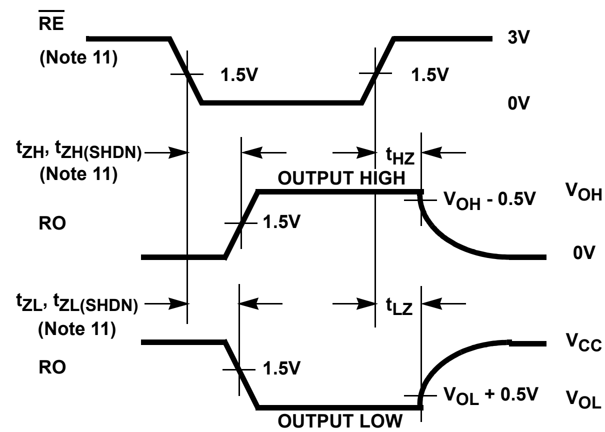



FIGURE 8B. MEASUREMENT POINTS

FIGURE 8. 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 feet; thus, the wide CMR is necessary to handle ground potential differences, as well as voltages induced in the cable by external fields.

The ISL32470E, ISL32472E, ISL32475E, ISL32478E 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, while the ±16.5kV built-in ESD protection complements the fault protection.

### 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 @ VOL = 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 ISL32478E 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 ISL32470E, ISL32472E, ISL32475E, ISL32478E 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 ISL32470E, ISL32472E, ISL32475E, ISL32478E 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 ISL32470E, ISL32472E, ISL32475E, ISL32478E has extended ±15V CMR, which 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 ISL32470E, ISL32472E, ISL32475E, ISL32478E 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 ISL32470E, ISL32472E, ISL32475E, ISL32478E in “star” and other multi-terminated, nonstandard network topologies. Figure 10 details the transmitter’s $V_{OD}$ vs $I_{OUT}$ characteristic and includes load lines for four (30Ω) and six (20Ω) 120Ω terminations. Figure 10 shows that the driver typically delivers ±1.3V into six terminations, and the “Electrical Specifications” 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 ISL32470E, ISL32472E, ISL32475E, ISL32478E delivers RS-485 voltage levels with two to three times the number of terminations.

## Hot Plug Function

When a piece of equipment powers up, there is a period of time in which 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 ISL32470E, ISL32472E, ISL32475E, ISL32478E 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 9 illustrates the power-up and power-down performance of the ISL32470E, ISL32472E, ISL32475E, ISL32478E compared to an RS-485 IC without the Hot Plug feature.

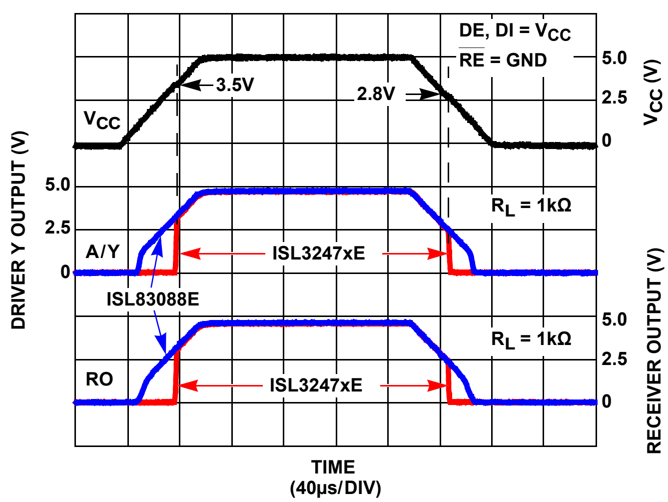



FIGURE 9. HOT PLUG PERFORMANCE (ISL3247xE) vs ISL83088E WITHOUT HOT PLUG CIRCUITRY

## ESD Protection

All pins on these devices include class 3 (>8kV) Human Body Model (HBM) ESD protection structures that are good enough to survive ESD events commonly seen during manufacturing. Even so, the RS-485 pins (driver outputs and receiver inputs) incorporate more advanced structures, which allows them to survive ESD events in excess of ±16.5kV HBM (±15kV for full-duplex versions). The RS-485 pins are particularly vulnerable to ESD strikes because they typically connect to an exposed port on the exterior of the finished product. Simply touching the port pins, or connecting a cable, can cause an ESD event that might destroy unprotected ICs. These new ESD structures protect the device whether or not it is powered up, and without interfering with the exceptional ±15V CMR. This built-in ESD protection minimizes the need for board-level protection structures (e.g., transient suppression diodes) and the associated, undesirable capacitive load they present.

## Data Rate, Cables, and Terminations

RS-485/RS-422 are intended for network lengths up to 4000 feet, but the maximum system data rate decreases as the transmission length increases. Devices operating at 15Mbps may be used at lengths up to 150 feet (46m), but the distance can be increased to 328 feet (100m) by operating at 10Mbps. The 1Mbps versions can operate at full data rates with lengths up to 800 feet (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-foot (1220m) distance, or at 250kbps for lengths up to 3000 feet (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 foldback 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 foldback 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 foldback 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 by 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 BiCMOS 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 9, 10, 11, 12 and 13 on page 9, at the end of the “Electrical Specifications” table, for more information.

# Typical Performance Curves

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

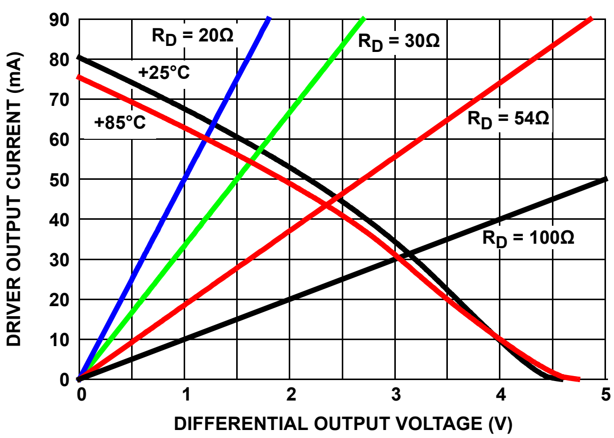



FIGURE 10. DRIVER OUTPUT CURRENT vs DIFFERENTIAL OUTPUT VOLTAGE

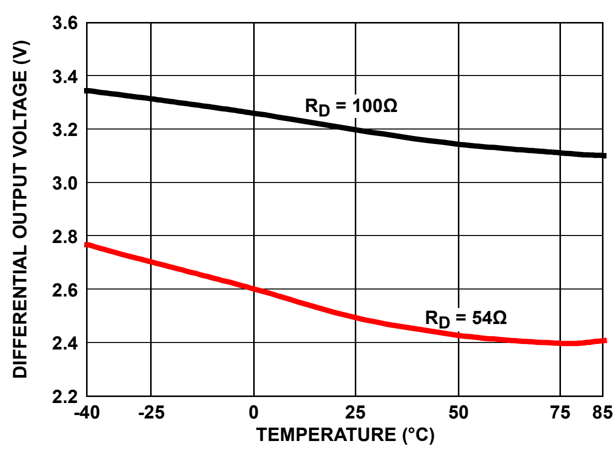



FIGURE 11. DRIVER DIFFERENTIAL OUTPUT VOLTAGE vs TEMPERATURE

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

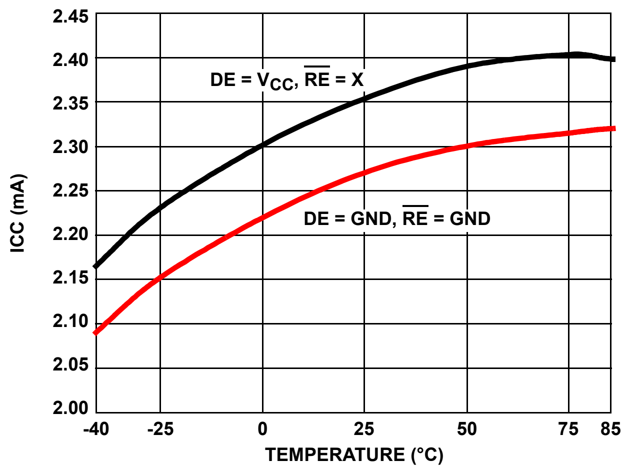



FIGURE 12. SUPPLY CURRENT vs TEMPERATURE

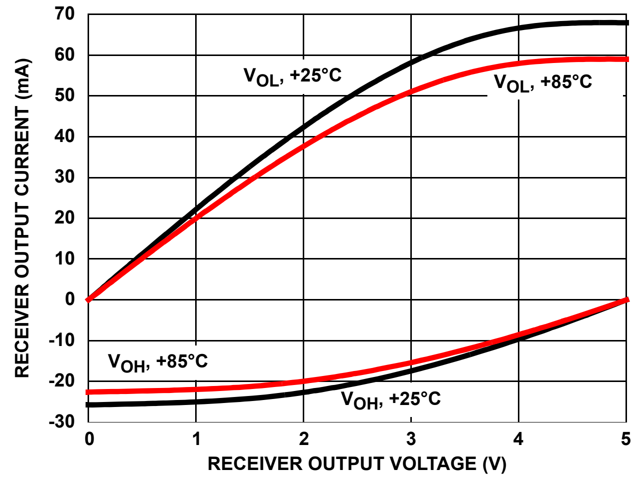



FIGURE 13. RECEIVER OUTPUT CURRENT vs RECEIVER OUTPUT VOLTAGE

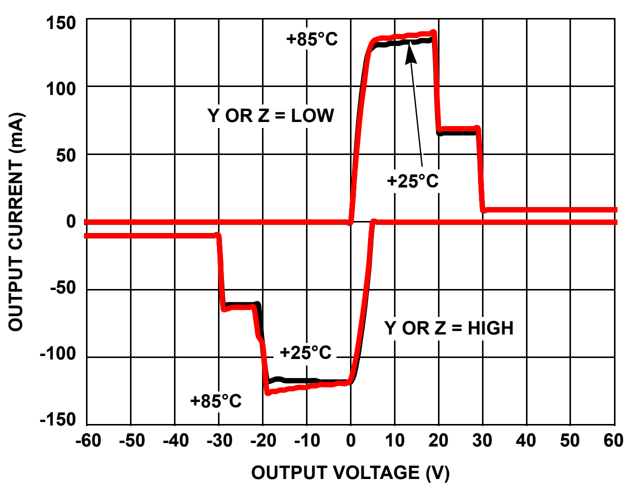



FIGURE 14. DRIVER OUTPUT CURRENT vs SHORT CIRCUIT VOLTAGE

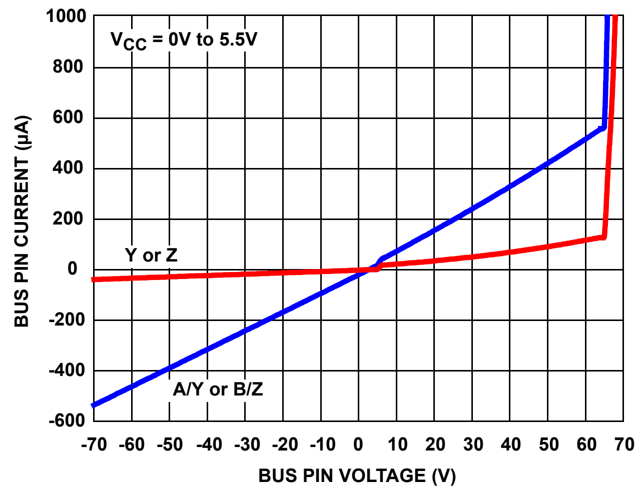



FIGURE 15. BUS PIN CURRENT vs BUS PIN VOLTAGE

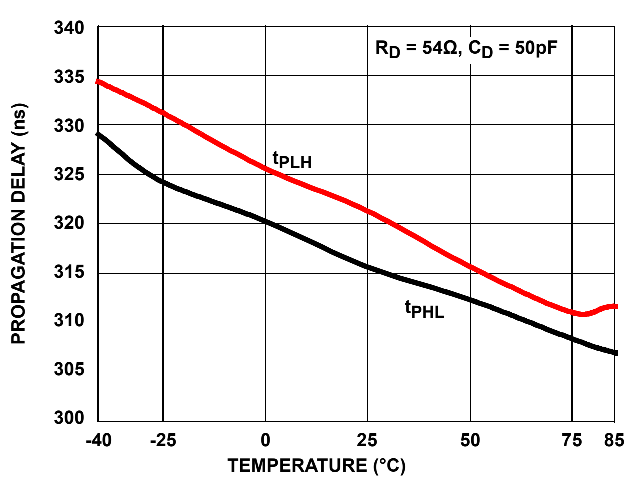



FIGURE 16. DRIVER DIFFERENTIAL PROPAGATION DELAY vs TEMPERATURE (ISL32470E, ISL32472E)

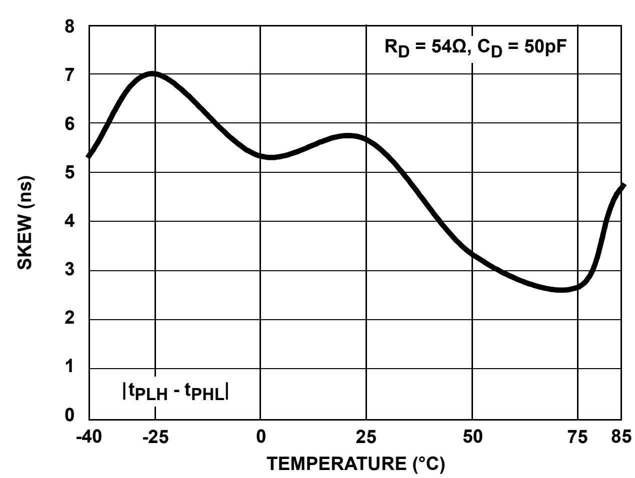



FIGURE 17. DRIVER DIFFERENTIAL SKEW vs TEMPERATURE (ISL32470E, ISL32472E)

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

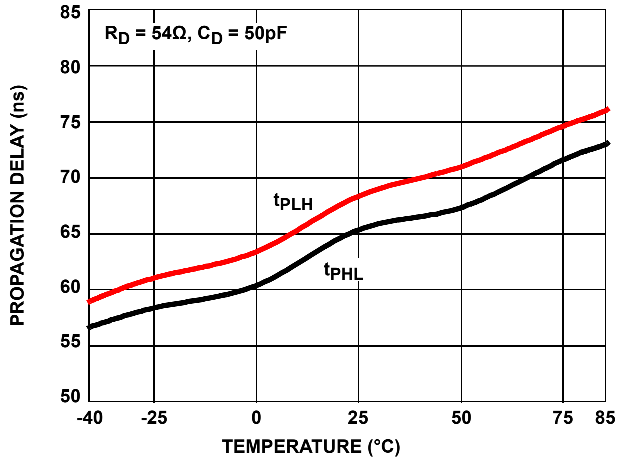



FIGURE 18. DRIVER DIFFERENTIAL PROPAGATION DELAY vs TEMPERATURE (ISL32475E)

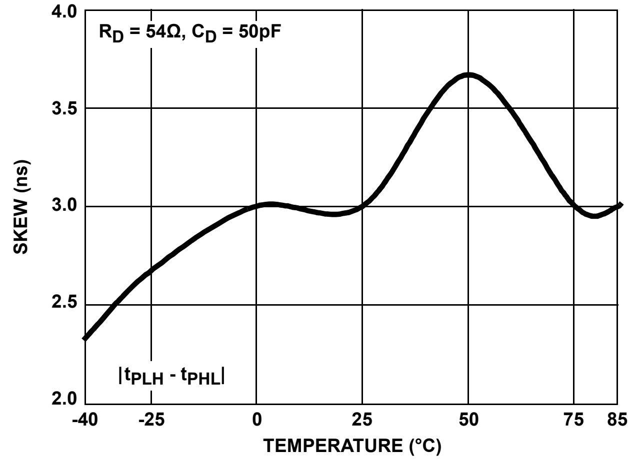



FIGURE 19. DRIVER DIFFERENTIAL SKEW vs TEMPERATURE (ISL32475E)

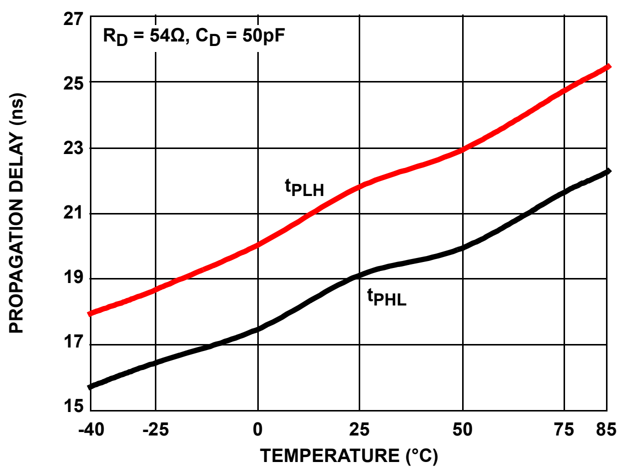



FIGURE 20. DRIVER DIFFERENTIAL PROPAGATION DELAY vs TEMPERATURE (ISL32478E)

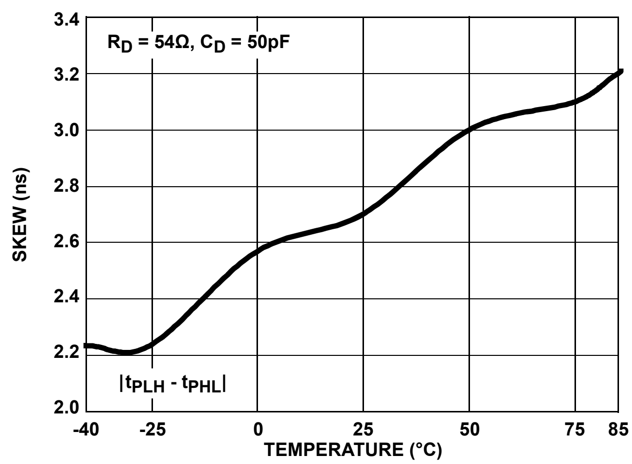



FIGURE 21. DRIVER DIFFERENTIAL SKEW vs TEMPERATURE (ISL32478E)

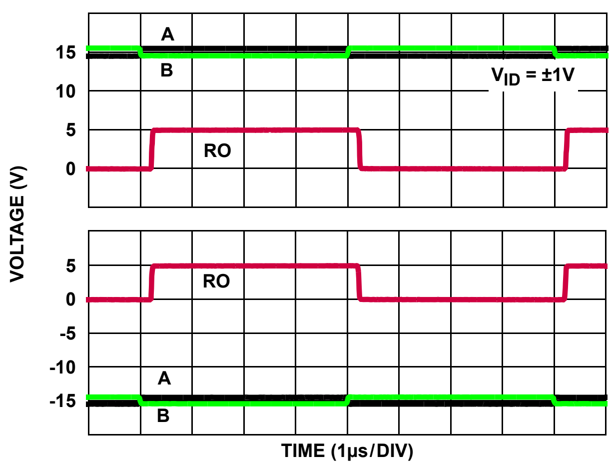



FIGURE 22. RECEIVER PERFORMANCE WITH ±15V CMV (ISL32470E, ISL32472E)

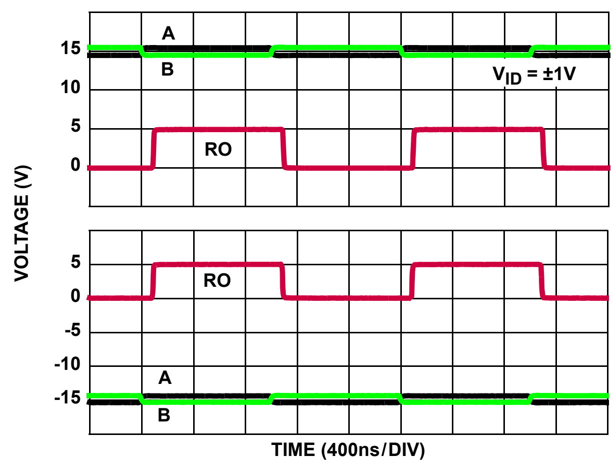



FIGURE 23. RECEIVER PERFORMANCE WITH ±15V CMV (ISL32475E)

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

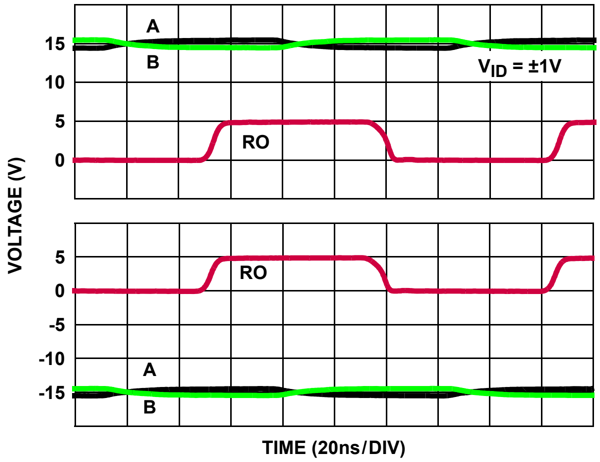



FIGURE 24. RECEIVER PERFORMANCE WITH ±15V CMV (ISL32478E)

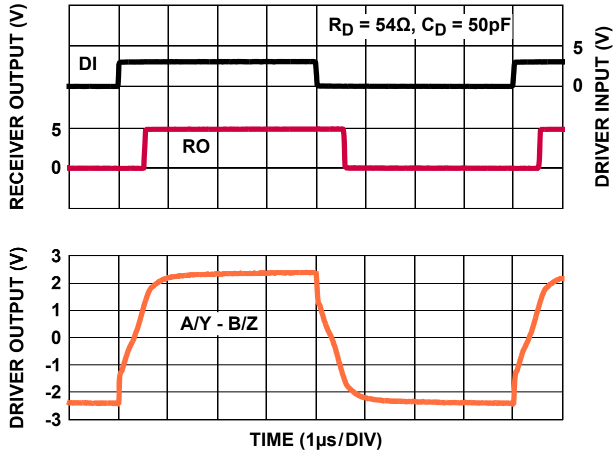



FIGURE 25. DRIVER AND RECEIVER WAVEFORMS (ISL32470E, ISL32472E)

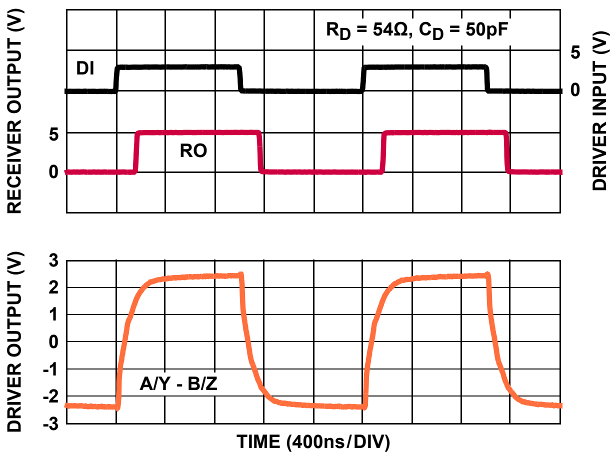



FIGURE 26. DRIVER AND RECEIVER WAVEFORMS (ISL32475E)

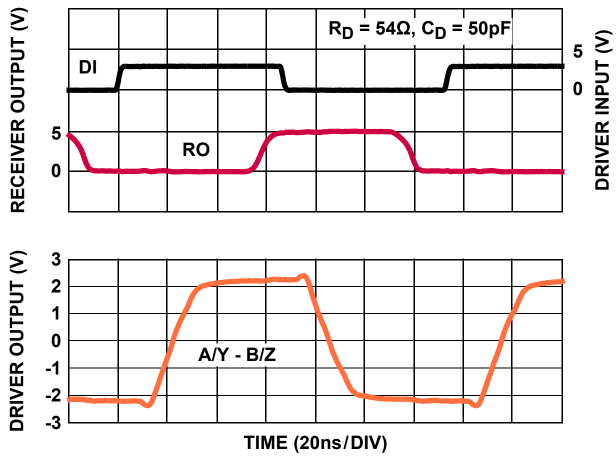



FIGURE 27. DRIVER AND RECEIVER WAVEFORMS (ISL32478E)

# 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 |
|---|---|---|
| March 9, 2012 | FN7784.1 | Page 5 - Thermal Information, Thermal Resistance:<br>8 Ld SOIC Package Theta JA changed from 116 to 108<br>Page 14 - Updated Figure 15 to show Pos breakdown between 60V and 70V.<br>Page 19 - Updated Package Outline Drawing M8.15 to newest revision. |
| January 21, 2011 | FN7784.0 | Initial Release |

## Products

Intersil Corporation is a leader in the design and manufacture of high-performance analog semiconductors. The Company's products address some of the industry's fastest growing markets, such as, flat panel displays, cell phones, handheld products, and notebooks. Intersil's product families address power management and analog signal processing functions. Go to www.intersil.com/products for a complete list of Intersil product families.

*For a complete listing of Applications, Related Documentation and Related Parts, please see the respective device information page on intersil.com: ISL32470E, ISL32472E, ISL32475E, ISL32478E.

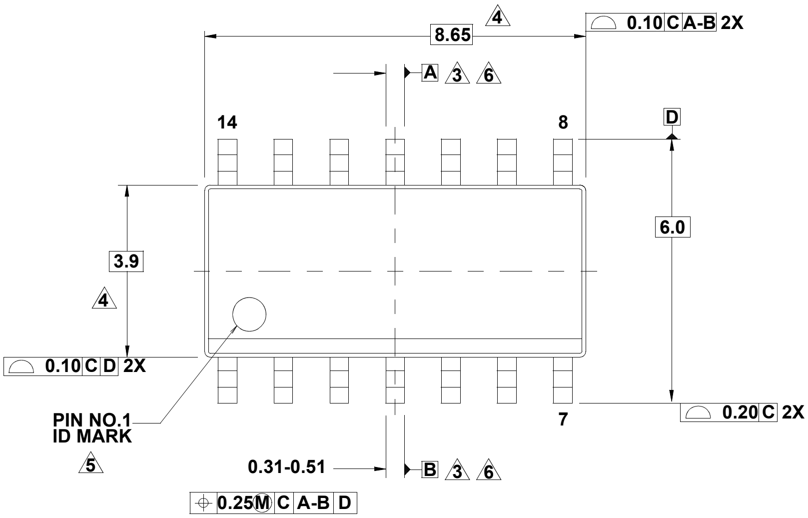
To report errors or suggestions for this data sheet, please go to www.intersil.com/ask our staff

FITs are available from our web site at http://rel.intersil.com/reports/search.php

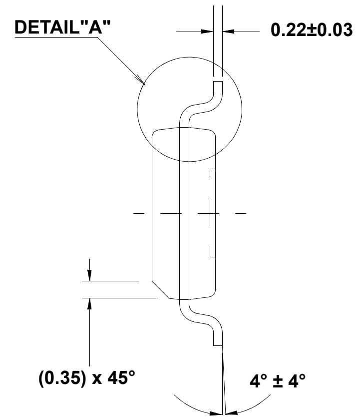
# Package Outline Drawing

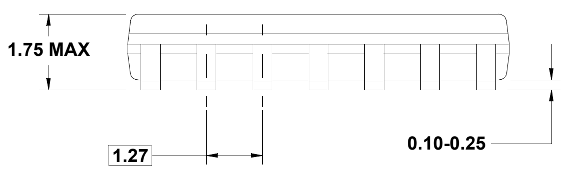
## M14.15

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

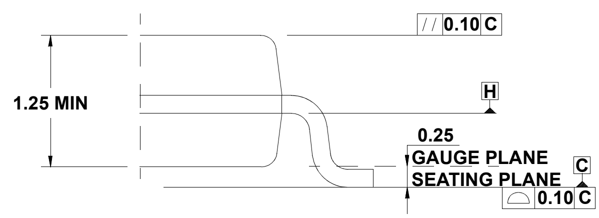



TOP VIEW

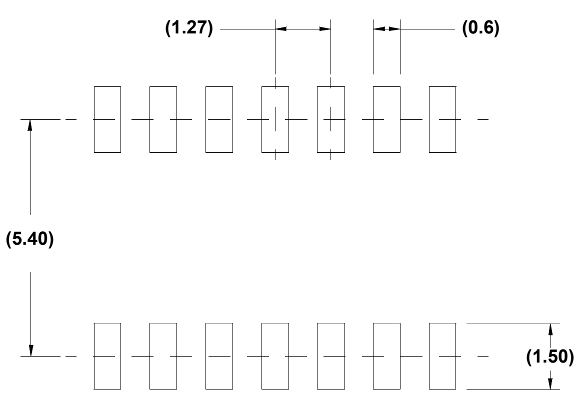



SIDE VIEW




DETAIL "A"




TYPICAL RECOMMENDED LAND PATTERN

**NOTES:**

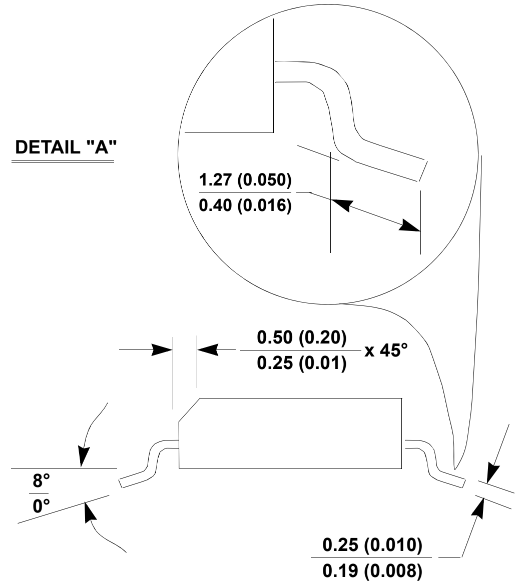
1. Dimensions are in millimeters.
   Dimensions in ( ) for Reference Only.
2. Dimensioning and tolerancing conform to AMSEY14.5m-1994.
3. Datums A and B to be determined at Datum H.
4. Dimension does not include interlead flash or protrusions.
   Interlead flash or protrusions shall not exceed 0.25mm 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.

# Package Outline Drawing

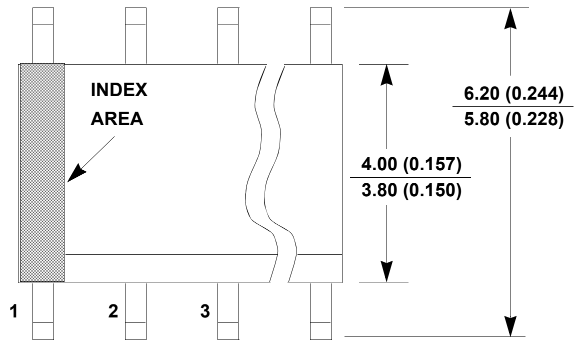
## M8.15

**8 LEAD NARROW BODY SMALL OUTLINE PLASTIC PACKAGE**

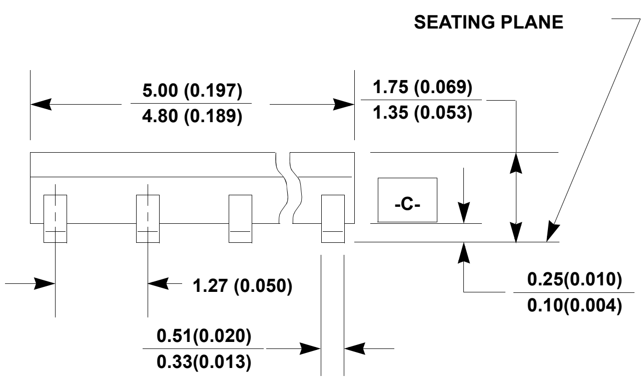
**Rev 4, 1/12**



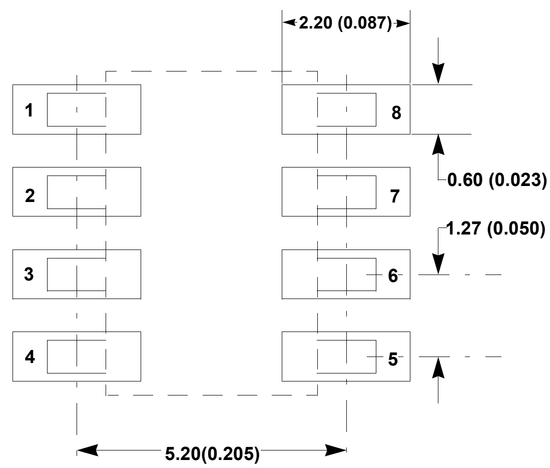

SIDE VIEW "B"




TOP VIEW




SIDE VIEW "A




TYPICAL RECOMMENDED LAND PATTERN

**NOTES:**

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