

## ISL4489E, ISL4491E

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

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The [ISL4489E](#) and [ISL4491E](#) are ESD protected, “fractional” Unit Load (UL), BiCMOS, 5V powered, single transceivers that meet both the RS-485 and RS-422 standards for balanced communication. Each driver output and receiver input is protected against ±15kV ESD strikes without latch-up. Unlike competitive versions, these devices are specified for 10% tolerance supplies (4.5V to 5.5V).

The Rx inputs and Tx outputs present a 1/8 unit load to the RS-485 bus, which allows a total of 256 transmitters and receivers on the network for large node count systems.

These devices are configured for full duplex (separate Rx input and Tx output pins) applications, so they are ideal for RS-422 networks requiring high ESD tolerance on the bus pins.

The ISL4489E uses a slew rate limited driver that reduces EMI and minimizes reflections from improperly terminated transmission lines, or unterminated stubs in multidrop and multipoint applications.

Data rates up to 15Mbps are achievable using the ISL4491E, which features higher slew rates.

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

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

### Features

- Pb-free (RoHS compliant)
- RS-485 I/O pin ESD protection . . . . . ±15kV HBM
  - Class 3 ESD level on all other pins . . . . . >7kV HBM
- 1/8 unit load allows up to 256 devices on the bus
- High data rates (ISL4491E) . . . . . up to 15Mbps
- Slew rate limited version for error free data transmission (ISL4489E)
- Very low quiescent current:
  - 140µA (ISL4489E)
  - 370µA (ISL4491E)
- -7V to +12V common-mode input voltage range
- Tri-statable Rx and Tx outputs
- Full duplex pinout
- Operates from a single +5V supply (10% tolerance)
- Current limiting and thermal shutdown for driver overload protection

### Applications

- Factory automation
- Security networks
- Building environmental control systems
- Industrial/process control networks
- Level translators (for example, RS-232 to RS-422)
- RS-232 “extension cords”

TABLE 1. SUMMARY OF FEATURES

| PART NUMBER | HALF/FULL DUPLEX | HIGH ESD? | NO. OF DEVICES ALLOWED ON BUS | DATA RATE (Mbps) | SLEW-RATE LIMITED? | RECEIVER/ DRIVER ENABLE? | QUIESCENT I <sub>CC</sub> (µA) | PIN COUNT |
|-------------|------------------|-----------|-------------------------------|------------------|--------------------|--------------------------|--------------------------------|-----------|
| ISL4489E    | Full             | Yes       | 256                           | 0.25             | Yes                | Yes                      | 140                            | 14        |
| ISL4491E    | Full             | Yes       | 256                           | 15               | No                 | Yes                      | 370                            | 14        |

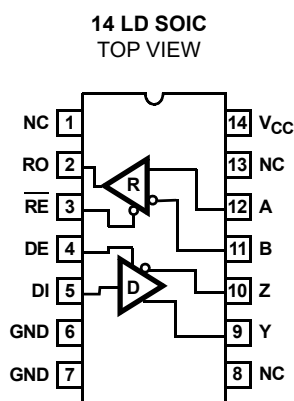
## Ordering Information

| PART NUMBER<br>( <a href="#">Notes 2, 3</a> ) | PART MARKING | PACKAGE DESCRIPTION<br>(RoHS Compliant) | PKG.<br>DWG. # | CARRIER TYPE<br>( <a href="#">Note 1</a> ) | TEMP. RANGE  |
|---|--------------|---|----------------|--|--------------|
| ISL4489EIBZ                                   | 4489EIBZ     | 14 Ld SOIC                              | M14.15         | Tube                                       | -40 to +85°C |
| ISL4489EIBZ-T                                 |              |   |                | Reel, 2.5k                                 |              |
| ISL4491EIBZ                                   | 4491EIBZ     |   |                | Tube                                       |              |
| ISL4491EIBZ-T                                 |              |   |                | Reel, 2.5k                                 |              |

### NOTES:

- Refer to [TB347](#) for details about reel specifications.
- Pb-free plus anneal products employ special Pb-free material sets; molding compounds/die attach materials and 100% matte tin plate termination finish, which are RoHS compliant and compatible with both SnPb and Pb-free soldering operations. Pb-free products are MSL classified at Pb-free peak reflow temperatures that meet or exceed the Pb-free requirements of IPC/JEDEC J-STD-020.
- For Moisture Sensitivity Level (MSL), see the [ISL4489E](#) and [ISL4491E](#) product information pages. For more information on MSL, see [TB363](#).

## Pinout



## Pin Descriptions

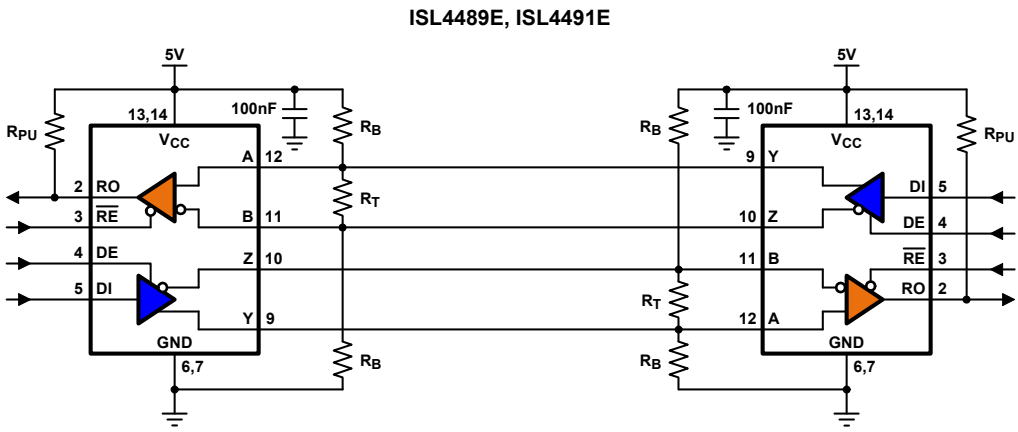
| PIN             | FUNCTION  |
|-----------------|---|
| RO              | Receiver output. RO is high if A > B by at least 0.2V; RO is low if A < B by 0.2V or more; RO = High if A and B are unconnected (floating). |
| $\overline{RE}$ | Receiver output enable. RO is enabled when $\overline{RE}$ is low; RO is high impedance when $\overline{RE}$ is high.                       |
| DE              | Driver output enable. The driver outputs Y and Z are enabled by bringing DE high. They are high impedance when DE is low.                   |
| DI              | Driver input. A low on DI forces output Y low and output Z high. Similarly, a high on DI forces output Y high and output Z low.             |
| GND             | Ground connection.  |
| A               | $\pm 15\text{kV}$ HBM ESD protected, noninverting receiver input.   |
| B               | $\pm 15\text{kV}$ HBM ESD protected, inverting receiver input.  |
| Y               | $\pm 15\text{kV}$ HBM ESD protected, noninverting driver output.  |
| Z               | $\pm 15\text{kV}$ HBM ESD protected, inverting driver output.   |
| V <sub>CC</sub> | System power supply input (4.5V to 5.5V).   |
| NC              | No connection.  |

Truth Tables

| TRANSMITTING    |    |    |         |        |
|-----------------|----|----|---------|--------|
| INPUTS          |    |    | OUTPUTS |        |
| $\overline{RE}$ | DE | DI | Z       | Y      |
| X               | 1  | 1  | 0       | 1      |
| X               | 1  | 0  | 1       | 0      |
| X               | 0  | X  | High-Z  | High-Z |

| RECEIVING       |    |              |        |
|-----------------|----|--------------|--------|
| INPUTS          |    |              | OUTPUT |
| $\overline{RE}$ | DE | A-B          | RO     |
| 0               | X  | $\geq +0.2V$ | 1      |
| 0               | X  | $\leq -0.2V$ | 0      |
| 0               | X  | Inputs Open  | 1      |
| 1               | X  | X            | High-Z |

Typical Operating Circuit



To calculate the resistor values, refer to [TB509](#)

**Absolute Maximum Ratings**

|                           |   |
|---------------------------|---|
| V <sub>CC</sub> to Ground | 7V  |
| Input Voltages            |   |
| DI, DE, RE                | -0.5V to (V <sub>CC</sub> + 0.5V)               |
| Input/Output Voltages     |   |
| A, B, Y, Z                | -8V to +12.5V                                   |
| RO                        | -0.5V to (V <sub>CC</sub> + 0.5V)               |
| Short-Circuit Duration    |   |
| Y, Z                      | Continuous                                      |
| ESD Rating                | See <a href="#">"ESD PERFORMANCE" on page 5</a> |

**Thermal Information**

|  |                      |
|--|----------------------|
| Thermal Resistance (Typical, <a href="#">Note 4</a> )        | $\theta_{JA}$ (°C/W) |
| 14 Ld SOIC Package   | 128                  |
| Maximum Junction Temperature (Plastic Package)               | +150°C               |
| Maximum Storage Temperature Range                            | -65°C to +150°C      |
| Maximum Lead Temperature (Soldering 10s)<br>(Lead Tips Only) | +300°C               |

**Operating Conditions**

|                   |                |
|-------------------|----------------|
| Temperature Range | -40°C to +85°C |
|-------------------|----------------|

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

**NOTE:**

4.  $\theta_{JA}$  is measured with the component mounted on a low-effective thermal conductivity test board in free air. See [TB379](#) for details.

**Electrical Specifications**

Test Conditions: V<sub>CC</sub> = 4.5V to 5.5V; Unless Otherwise Specified. Typical values are at V<sub>CC</sub> = 5V, T<sub>A</sub> = +25°C,

[Note 5](#)

| PARAMETER   | SYMBOL            | TEST CONDITIONS  | TEMP (°C) | MIN  | TYP  | MAX             | UNIT |
|---|-------------------|--|-----------|------|------|-----------------|------|
| <b>DC CHARACTERISTICS</b>   |                   |  |           |      |      |                 |      |
| Driver Differential V <sub>OUT</sub> (no load)  | V <sub>OD1</sub>  |  | Full      | -    | -    | V <sub>CC</sub> | V    |
| Driver Differential V <sub>OUT</sub> (with load)  | V <sub>OD2</sub>  | R = 50Ω (RS-422) ( <a href="#">Figure 1</a> )  | Full      | 2    | 3    | -               | V    |
|   |                   | R = 27Ω (RS-485) ( <a href="#">Figure 1</a> )  | Full      | 1.5  | 2.3  | 5               | V    |
| Change in Magnitude of Driver Differential V <sub>OUT</sub> for Complementary Output States | ΔV <sub>OD</sub>  | R = 27Ω or 50Ω ( <a href="#">Figure 1</a> )  | Full      | -    | 0.01 | 0.2             | V    |
| Driver Common-Mode V <sub>OUT</sub>   | V <sub>OC</sub>   | R = 27Ω or 50Ω ( <a href="#">Figure 1</a> )  | Full      | -    | -    | 3               | V    |
| Change in Magnitude of Driver Common-Mode V <sub>OUT</sub> for Complementary Output States  | ΔV <sub>OC</sub>  | R = 27Ω or 50Ω ( <a href="#">Figure 1</a> )  | Full      | -    | 0.01 | 0.2             | V    |
| Logic Input High Voltage  | V <sub>IH</sub>   | DE, DI, $\overline{RE}$  | Full      | 2    | -    | -               | V    |
| Logic Input Low Voltage   | V <sub>IL</sub>   | DE, DI, $\overline{RE}$  | Full      | -    | -    | 0.8             | V    |
| Logic Input Current   | I <sub>IN1</sub>  | DI   | Full      | -2   | -    | 2               | μA   |
|   |                   | DE, $\overline{RE}$  | Full      | -40  | -    | 40              | μA   |
| Input Current (A, B) ( <a href="#">Note 8</a> )   | I <sub>IN2</sub>  | DE = 0V, V <sub>CC</sub> = 0V or 4.5 to 5.5V   | Full      | -    | -    | 130             | μA   |
|   |                   | V <sub>IN</sub> = 12V<br>V <sub>IN</sub> = -7V   | Full      | -100 | -    | -               | μA   |
| Driver Tri-State (High Impedance) Output Current (Y, Z)                                     | I <sub>OZD</sub>  | -7V ≤ V <sub>O</sub> ≤ 12V   | Full      | -100 | -    | 100             | μA   |
| Receiver Differential Threshold Voltage   | V <sub>TH</sub>   | -7V ≤ V <sub>CM</sub> ≤ 12V  | Full      | -0.2 | -    | 0.2             | V    |
| Receiver Input Hysteresis   | ΔV <sub>TH</sub>  | V <sub>CM</sub> = 0V   | +25       | -    | 70   | -               | mV   |
| Receiver Output High Voltage  | V <sub>OH</sub>   | I <sub>O</sub> = -4mA, V <sub>ID</sub> = 200mV   | Full      | 3.5  | -    | -               | V    |
| Receiver Output Low Voltage   | V <sub>OL</sub>   | I <sub>O</sub> = -4mA, V <sub>ID</sub> = 200mV   | Full      | -    | -    | 0.4             | V    |
| Tri-State (high impedance) Receiver Output Current  | I <sub>OZR</sub>  | 0.4V ≤ V <sub>O</sub> ≤ 2.4V   | Full      | -    | -    | ±1              | μA   |
| Receiver Input Resistance   | R <sub>IN</sub>   | -7V ≤ V <sub>CM</sub> ≤ 12V  | Full      | 92   | 120  | -               | kΩ   |
| No-Load Supply Current ( <a href="#">Note 6</a> )   | I <sub>CC</sub>   | ISL4489E, DE, DI, $\overline{RE}$ = 0V or V <sub>CC</sub>                                      | Full      | -    | 140  | 190             | μA   |
|   |                   | ISL4491E, DE, DI, $\overline{RE}$ = 0V or V <sub>CC</sub>                                      | Full      | -    | 370  | 460             | μA   |
| Driver Short-Circuit Current, V <sub>O</sub> = High or Low                                  | I <sub>OSD1</sub> | DE = V <sub>CC</sub> , -7V ≤ V <sub>Y</sub> or V <sub>Z</sub> ≤ 12V ( <a href="#">Note 7</a> ) | Full      | 35   | -    | 250             | mA   |
| Receiver Short-Circuit Current  | I <sub>OSR</sub>  | 0V ≤ V <sub>O</sub> ≤ V <sub>CC</sub>  | Full      | 7    | -    | 85              | mA   |

**Electrical Specifications** Test Conditions:  $V_{CC} = 4.5V$  to  $5.5V$ ; Unless Otherwise Specified. Typical values are at  $V_{CC} = 5V$ ,  $T_A = +25^{\circ}C$ ,  
[Note 5 \(Continued\)](#)

| PARAMETER                                   | SYMBOL             | TEST CONDITIONS  | TEMP<br>( $^{\circ}C$ ) | MIN | TYP      | MAX  | UNIT |
|---|--------------------|--|-------------------------|-----|----------|------|------|
| <b>SWITCHING CHARACTERISTICS (ISL4489E)</b> |                    |  |                         |     |          |      |      |
| Driver Input to Output Delay                | $t_{PLH}, t_{PHL}$ | $R_{DIFF} = 54\Omega$ , $C_L = 100pF$ ( <a href="#">Figure 2</a> ) | Full                    | 250 | 400      | 2000 | ns   |
| Driver Output Skew                          | $t_{SKEW}$         | $R_{DIFF} = 54\Omega$ , $C_L = 100pF$ ( <a href="#">Figure 2</a> ) | Full                    | -   | 160      | 800  | ns   |
| Driver Differential Rise or Fall Time       | $t_R, t_F$         | $R_{DIFF} = 54\Omega$ , $C_L = 100pF$ ( <a href="#">Figure 2</a> ) | Full                    | 250 | 600      | 2000 | ns   |
| Driver Enable to Output High                | $t_{ZH}$           | $C_L = 100pF$ , SW = GND ( <a href="#">Figure 3</a> )              | Full                    | 250 | 1000     | 2000 | ns   |
| Driver Enable to Output Low                 | $t_{ZL}$           | $C_L = 100pF$ , SW = $V_{CC}$ ( <a href="#">Figure 3</a> )         | Full                    | 250 | 860      | 2000 | ns   |
| Driver Disable from Output High             | $t_{HZ}$           | $C_L = 15pF$ , SW = GND ( <a href="#">Figure 3</a> )               | Full                    | 300 | 660      | 3000 | ns   |
| Driver Disable from Output Low              | $t_{LZ}$           | $C_L = 15pF$ , SW = $V_{CC}$ ( <a href="#">Figure 3</a> )          | Full                    | 300 | 640      | 3000 | ns   |
| Receiver Input to Output Delay              | $t_{PLH}, t_{PHL}$ | <a href="#">Figure 4</a>   | Full                    | 250 | 500      | 2000 | ns   |
| Receiver Skew   $t_{PLH} - t_{PHL}$         | $t_{SKD}$          | <a href="#">Figure 4</a>   | +25                     | -   | 60       | -    | ns   |
| Receiver Enable to Output High              | $t_{ZH}$           | $C_L = 15pF$ , SW = GND ( <a href="#">Figure 5</a> )               | Full                    | -   | 10       | 50   | ns   |
| Receiver Enable to Output Low               | $t_{ZL}$           | $C_L = 15pF$ , SW = $V_{CC}$ ( <a href="#">Figure 5</a> )          | Full                    | -   | 10       | 50   | ns   |
| Receiver Disable from Output High           | $t_{HZ}$           | $C_L = 15pF$ , SW = GND ( <a href="#">Figure 5</a> )               | Full                    | -   | 10       | 50   | ns   |
| Receiver Disable from Output Low            | $t_{LZ}$           | $C_L = 15pF$ , SW = $V_{CC}$ ( <a href="#">Figure 5</a> )          | Full                    | -   | 10       | 50   | ns   |
| Maximum Data Rate                           | $f_{MAX}$          |  | Full                    | 250 | -        | -    | kbps |
| <b>SWITCHING CHARACTERISTICS (ISL4491E)</b> |                    |  |                         |     |          |      |      |
| Driver Input to Output Delay                | $t_{PLH}, t_{PHL}$ | $R_{DIFF} = 54\Omega$ , $C_L = 100pF$ ( <a href="#">Figure 2</a> ) | Full                    | 13  | 24       | 40   | ns   |
| Driver Output Skew                          | $t_{SKEW}$         | $R_{DIFF} = 54\Omega$ , $C_L = 100pF$ ( <a href="#">Figure 2</a> ) | Full                    | -   | 3        | 10   | ns   |
| Driver Differential Rise or Fall Time       | $t_R, t_F$         | $R_{DIFF} = 54\Omega$ , $C_L = 100pF$ ( <a href="#">Figure 2</a> ) | Full                    | 5   | 12       | 20   | ns   |
| Driver Enable to Output High                | $t_{ZH}$           | $C_L = 100pF$ , SW = GND ( <a href="#">Figure 3</a> )              | Full                    | -   | 14       | 70   | ns   |
| Driver Enable to Output Low                 | $t_{ZL}$           | $C_L = 100pF$ , SW = $V_{CC}$ ( <a href="#">Figure 3</a> )         | Full                    | -   | 14       | 70   | ns   |
| Driver Disable from Output High             | $t_{HZ}$           | $C_L = 15pF$ , SW = GND ( <a href="#">Figure 3</a> )               | Full                    | -   | 44       | 70   | ns   |
| Driver Disable from Output Low              | $t_{LZ}$           | $C_L = 15pF$ , SW = $V_{CC}$ ( <a href="#">Figure 3</a> )          | Full                    | -   | 21       | 70   | ns   |
| Receiver Input to Output Delay              | $t_{PLH}, t_{PHL}$ | <a href="#">Figure 4</a>   | Full                    | 30  | 90       | 150  | ns   |
| Receiver Skew   $t_{PLH} - t_{PHL}$         | $t_{SKD}$          | <a href="#">Figure 4</a>   | +25                     | -   | 5        | -    | ns   |
| Receiver Enable to Output High              | $t_{ZH}$           | $C_L = 15pF$ , SW = GND ( <a href="#">Figure 5</a> )               | Full                    | -   | 9        | 50   | ns   |
| Receiver Enable to Output Low               | $t_{ZL}$           | $C_L = 15pF$ , SW = $V_{CC}$ ( <a href="#">Figure 5</a> )          | Full                    | -   | 9        | 50   | ns   |
| Receiver Disable from Output High           | $t_{HZ}$           | $C_L = 15pF$ , SW = GND ( <a href="#">Figure 5</a> )               | Full                    | -   | 9        | 50   | ns   |
| Receiver Disable from Output Low            | $t_{LZ}$           | $C_L = 15pF$ , SW = $V_{CC}$ ( <a href="#">Figure 5</a> )          | Full                    | -   | 9        | 50   | ns   |
| Maximum Data Rate                           | $f_{MAX}$          |  | Full                    | 15  | -        | -    | Mbps |
| <b>ESD PERFORMANCE</b>                      |                    |  |                         |     |          |      |      |
| RS-485 Pins (A, B, Y, Z)                    |                    | Human Body Model   | +25                     | -   | $\pm 15$ | -    | kV   |
| All Other Pins                              |                    |  | +25                     | -   | $>\pm 7$ | -    | kV   |

**NOTES:**

- 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.
- Supply current specification is valid for loaded drivers when DE = 0V.
- Applies to peak current. See ["Typical Performance Curves" on page 9](#) for more information.
- Devices meeting these limits are denoted as "1/8 unit load (1/8 UL)" transceivers. The RS-485 standard allows up to 32 UL on the bus, so there can be 256 1/8 UL devices on a bus.

Test Circuits and Waveforms

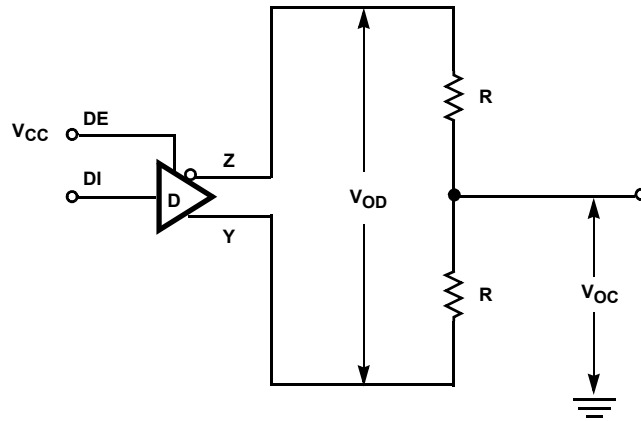


FIGURE 1. DRIVER  $V_{OD}$  AND  $V_{OC}$

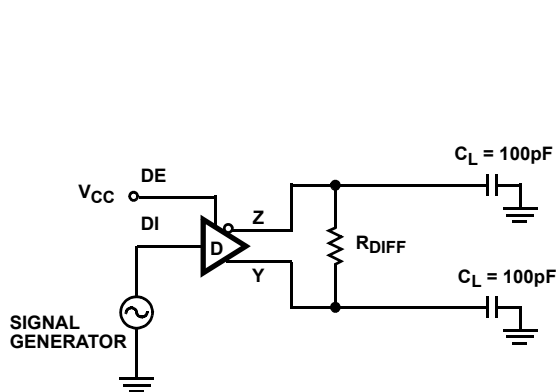


FIGURE 2A. TEST CIRCUIT

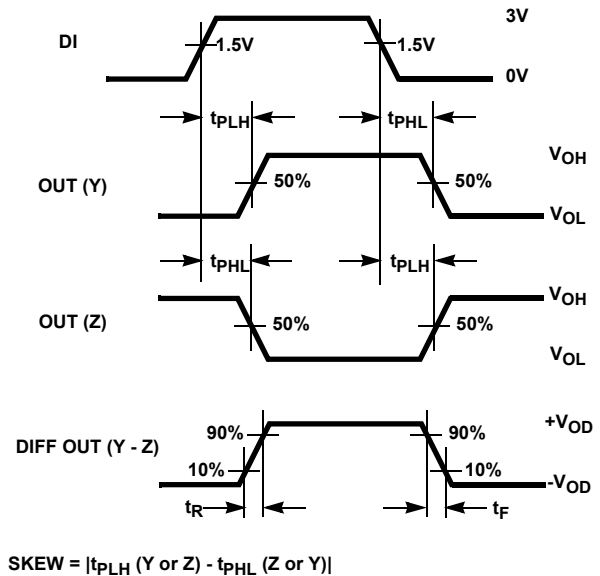


FIGURE 2B. MEASUREMENT POINTS

FIGURE 2. DRIVER PROPAGATION DELAY AND DIFFERENTIAL TRANSITION TIMES

Test Circuits and Waveforms (Continued)

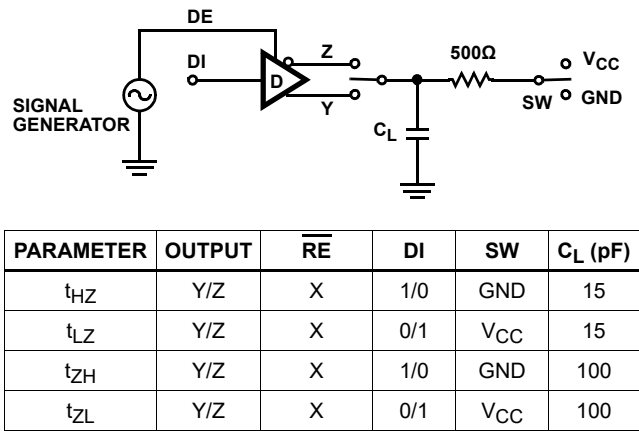


FIGURE 3A. TEST CIRCUIT

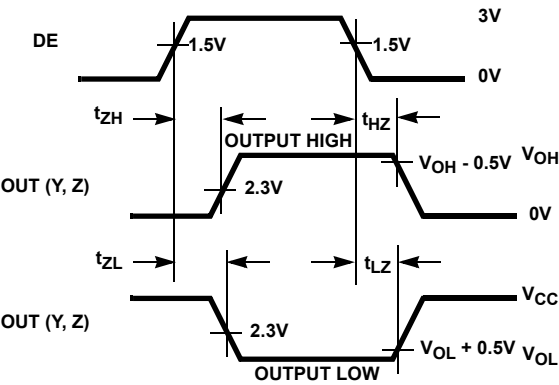


FIGURE 3B. MEASUREMENT POINTS

FIGURE 3. DRIVER ENABLE AND DISABLE TIMES

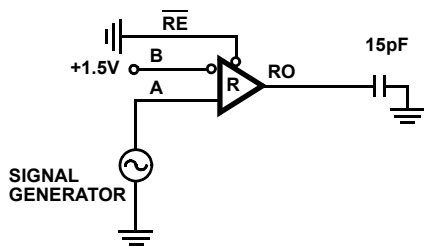


FIGURE 4A. TEST CIRCUIT

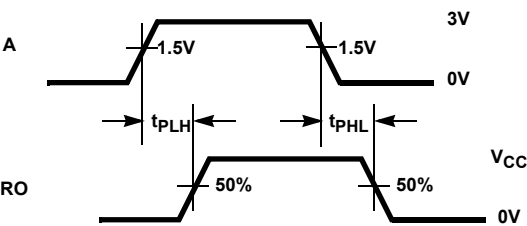


FIGURE 4B. MEASUREMENT POINTS

FIGURE 4. RECEIVER PROPAGATION DELAY

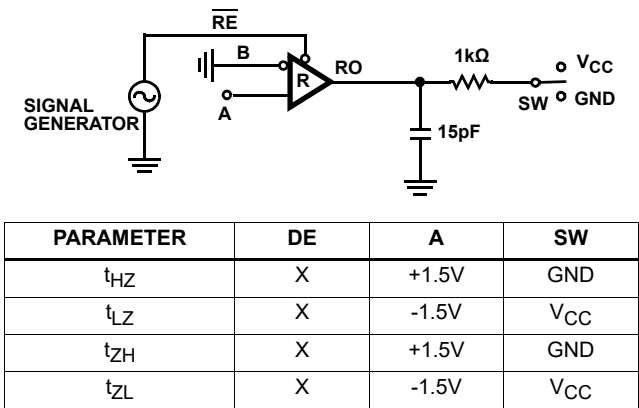


FIGURE 5A. TEST CIRCUIT

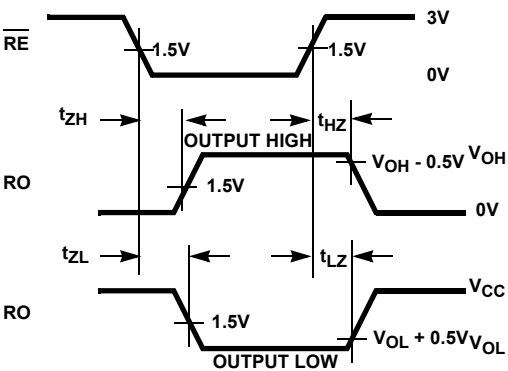


FIGURE 5B. MEASUREMENT POINTS

FIGURE 5. RECEIVER ENABLE AND DISABLE TIMES

## Application Information

RS-485 and RS-422 are differential (balanced) data transmission standards for use in long haul or noisy environments. RS-422 is a subset of RS-485, so RS-485 transceivers are also RS-422 compliant. RS-422 is a point-to-multipoint (multidrop) standard that allows only one driver and up to 10 receivers on each bus, assuming one unit load devices. RS-485 is a true multipoint standard, 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.

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.

### Receiver Features

These devices use a differential input receiver for maximum noise immunity and common-mode rejection. Input sensitivity is  $\pm 200\text{mV}$  as required by the RS-422 and RS-485 specifications.

The receiver input resistance of  $120\text{k}\Omega$  surpasses the RS-422 specification of  $4\text{k}\Omega$ , and is more than eight times the RS-485 "UL" requirement of  $12\text{k}\Omega$ . Thus, these products are known as "one-eighth UL" transceivers. There can be up to 256 of these devices on a network while still complying with the RS-485 loading specification.

Receiver inputs function with common-mode voltages as great as  $\pm 7\text{V}$  outside the power supplies (such as +12V and -7V), making them ideal for long networks in which induced voltages are a realistic concern.

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

Receivers easily meet the data rate supported by the corresponding driver, and the receiver outputs are tri-statable using the active low RE input.

### Driver Features

The RS-485/422 driver is a differential output device that delivers at least 1.5V across a  $54\Omega$  load (RS-485) and at least 2V across a  $100\Omega$  load (RS-422). The drivers feature low propagation delay skew to maximize bit width and to minimize EMI. The driver outputs are tri-statable using the active high DE input.

The ISL4489E driver outputs are slew rate limited to further reduce EMI and to minimize reflections in unterminated or improperly terminated networks. Data rates on these slew

rate limited versions are a maximum of 250kbps. The ISL4491E driver outputs are not limited, so faster output transition times allow data rates of at least 15Mbps.

### Data Rate, Cables, and Terminations

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

RS-485/422 are intended for network lengths up to 4000ft, but the maximum system data rate decreases as the transmission length increases. Devices operating at 15Mbps are limited to lengths of a few hundred feet, while the 250kbps versions can operate at full data rates with lengths in excess of 1000ft.

Proper termination is imperative to minimize reflections when using the 15Mbps devices. Short networks using the 250kbps versions do not need to be terminated, but terminations are recommended unless power dissipation is an overriding concern. In point-to-point or point-to-multipoint (single driver on bus) networks, terminate the main cable in its characteristic impedance (typically  $120\Omega$ ) at the end farthest from the driver. In multi-receiver applications, keep stubs connecting receivers to the main cable as short as possible. In multipoint (multi-driver) systems, terminate the main cable in its characteristic impedance at both ends. Keep stubs connecting a transceiver to the main cable as short as possible.

### Built-In Driver Overload Protection

As stated previously, the RS-485 specification requires that drivers survive worst case bus contentions undamaged. The ISL44xxE devices meet this requirement through driver output short-circuit current limits and on-chip thermal shutdown circuitry.

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

In the event of a major short-circuit condition, the ISL44xxE devices' thermal shutdown feature disables the drivers when the die temperature becomes excessive. This eliminates the power dissipation, allowing the die to cool. The drivers automatically reenables after the die temperature drops about  $15^{\circ}\text{C}$ . If the contention persists, the thermal shutdown/reenable cycle repeats until the fault is cleared. Receivers stay operational during thermal shutdown.



## ESD Protection

All pins on these devices include Class 3 Human Body Model (HBM) ESD protection structures, but the RS-485 pins (driver outputs and receiver inputs) incorporate advanced structures allowing them to survive ESD events in excess of  $\pm 15\text{kV}$  HBM. The RS-485 pins are particularly vulnerable to ESD damage because they typically connect to an exposed port on the exterior of the finished product. Simply touching the port pins or connecting a cable can

cause an ESD event that might destroy unprotected ICs. The ESD structures protect the device whether or not it is powered up, protect without allowing any latchup mechanism to activate, and without degrading the RS-485 common-mode range of  $-7\text{V}$  to  $+12\text{V}$ . This built-in ESD protection eliminates the need for board level protection structures (for example, transient suppression diodes), and the associated undesirable capacitive load they present.

## Typical Performance Curves $V_{CC} = 5\text{V}$ , $T_A = 25^\circ\text{C}$ ; Unless Otherwise Specified

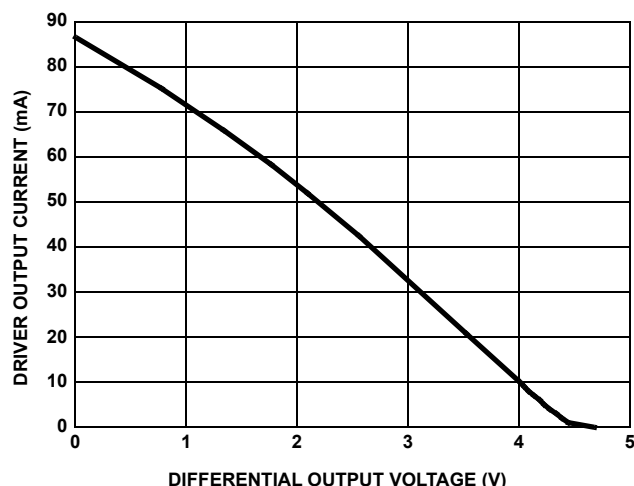


FIGURE 6. DRIVER OUTPUT CURRENT vs DIFFERENTIAL OUTPUT VOLTAGE

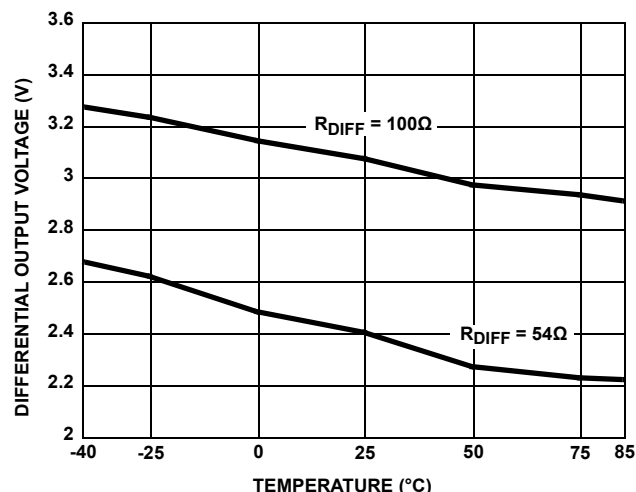


FIGURE 7. DRIVER DIFFERENTIAL OUTPUT VOLTAGE vs TEMPERATURE

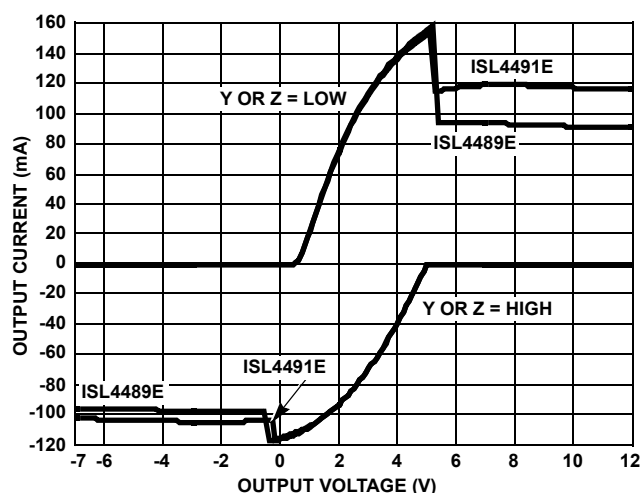


FIGURE 8. DRIVER OUTPUT CURRENT vs SHORT-CIRCUIT VOLTAGE

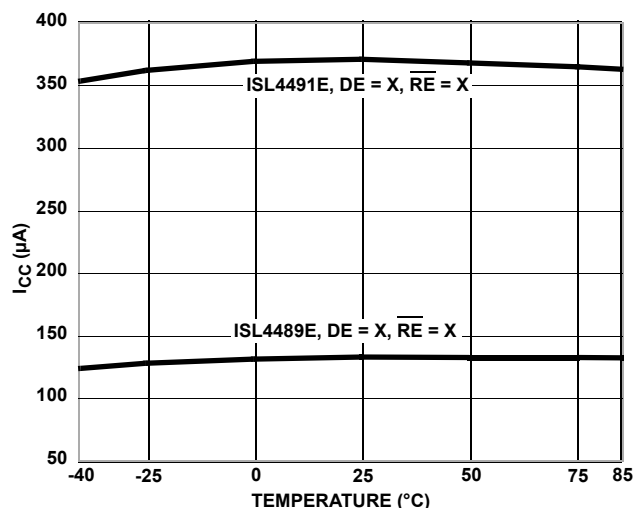


FIGURE 9. SUPPLY CURRENT vs TEMPERATURE

# Typical Performance Curves $V_{CC} = 5V$ , $T_A = 25^\circ C$ ; Unless Otherwise Specified (Continued)

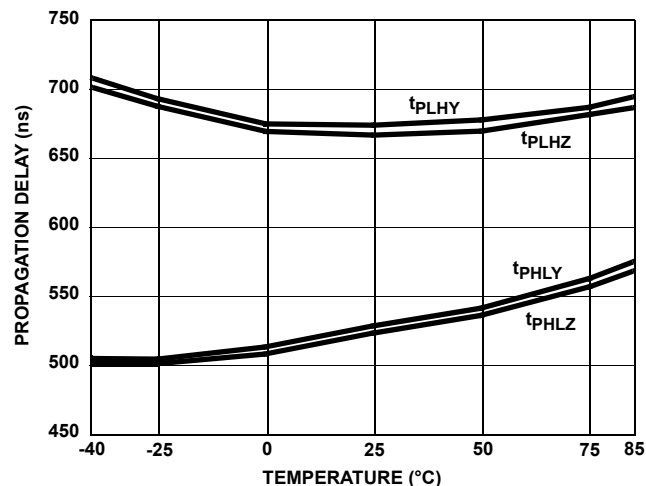


FIGURE 10. DRIVER PROPAGATION DELAY vs TEMPERATURE (ISL4489E)

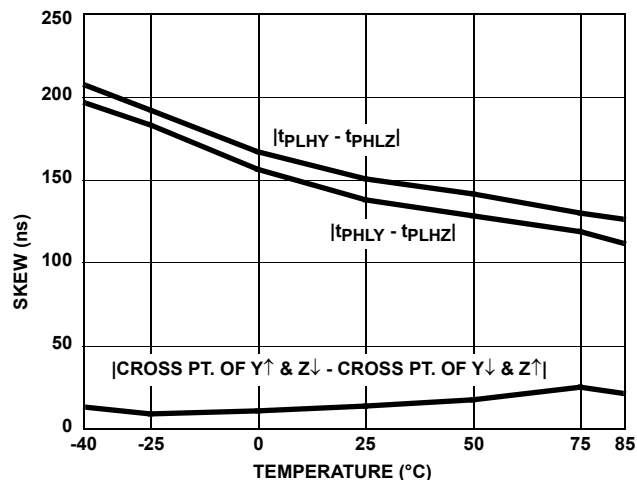


FIGURE 11. DRIVER SKEW vs TEMPERATURE (ISL4489E)

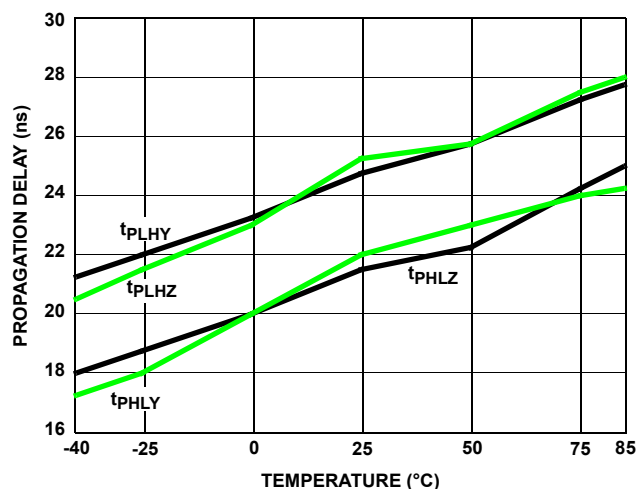


FIGURE 12. DRIVER PROPAGATION DELAY vs TEMPERATURE (ISL4491E)

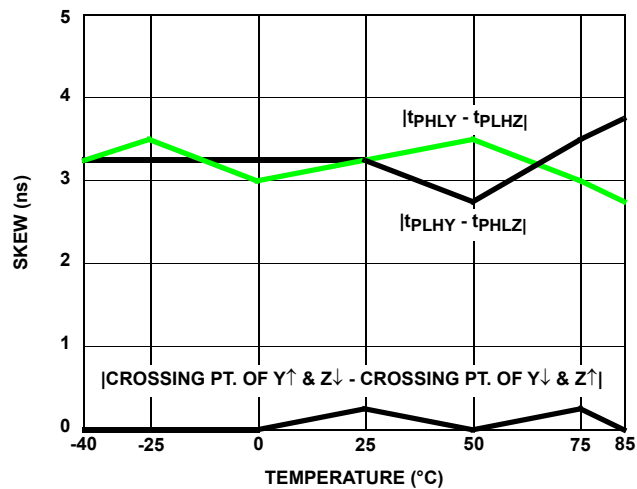


FIGURE 13. DRIVER SKEW vs TEMPERATURE (ISL4491E)

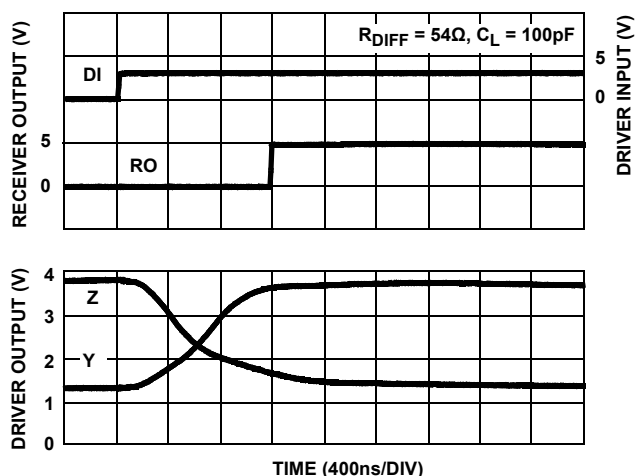


FIGURE 14. DRIVER AND RECEIVER WAVEFORMS, LOW TO HIGH (ISL4489E)

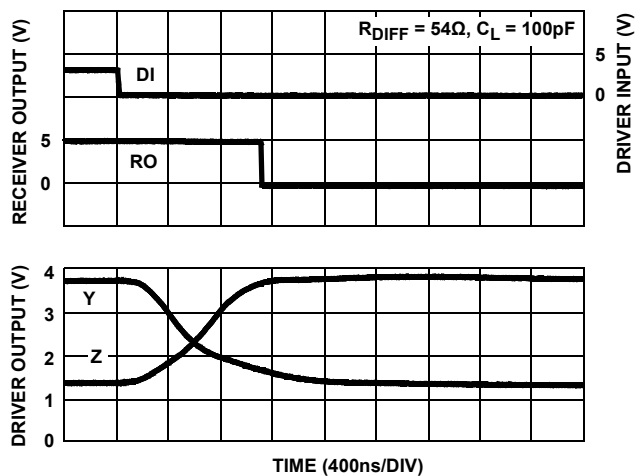


FIGURE 15. DRIVER AND RECEIVER WAVEFORMS, HIGH TO LOW (ISL4489E)

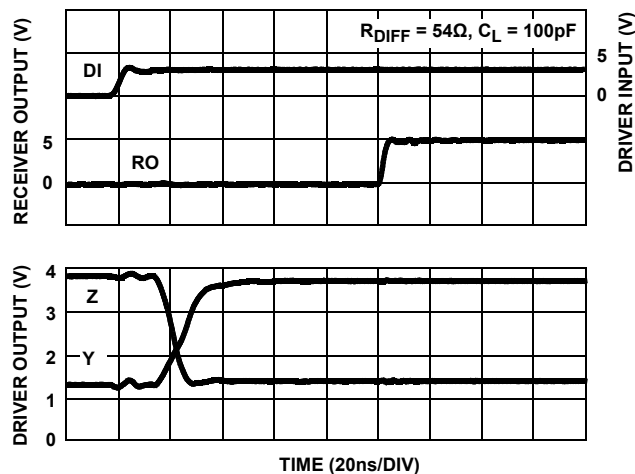
**Typical Performance Curves**  $V_{CC} = 5V$ ,  $T_A = 25^\circ C$ ; Unless Otherwise Specified (Continued)

FIGURE 16. DRIVER AND RECEIVER WAVEFORMS, LOW TO HIGH (ISL4491E)

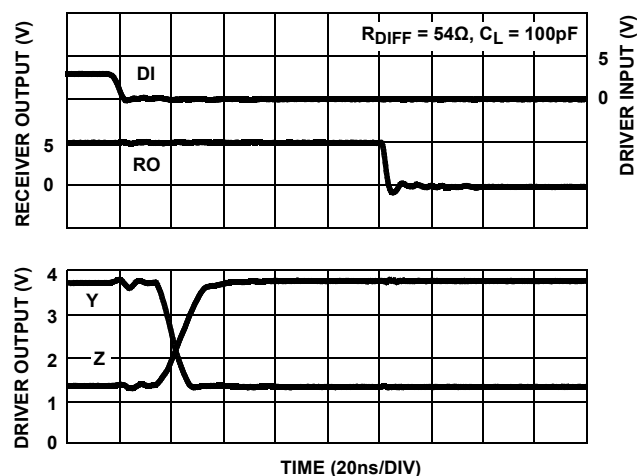


FIGURE 17. DRIVER AND RECEIVER WAVEFORMS, HIGH TO LOW (ISL4491E)

**Die Characteristics****SUBSTRATE POTENTIAL (POWERED UP):**

GND

**TRANSISTOR COUNT:**

518

**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 visit our website to make sure you have the latest revision.

| DATE         | REVISION | CHANGE   |
|--------------|----------|--|
| Jan 24, 2022 | 5.00     | Removed Related Literature section.<br>Updated Ordering Information table formatting.<br>Corrected error by moving the VIL value of 0.8V from the MIN column to the MAX column on page 4.<br>Updated POD M14.15 to the latest version, changes are as follows: <ul style="list-style-type: none"><li>• In Side View B and Detail A:<ul style="list-style-type: none"><li>- Added lead length dimension (1.27 – 0.40)</li><li>- Changed angle of the lead to 0-8 degrees.</li></ul></li></ul> |
| Sep 14, 2018 | 4.00     | Added Related Literature section.<br>Updated first features bullet.<br>Updated Ordering Information table by removing retired parts, adding Notes 1 and 3, added tape and reel parts and column.<br>Updated the Typical Operating Circuit diagram on page 3.<br>Added Revision History section.<br>Updated POD M14.15 to the latest revision. Changes are as follows: <ul style="list-style-type: none"><li>- Add land pattern and moved dimensions from table onto drawing</li></ul>        |

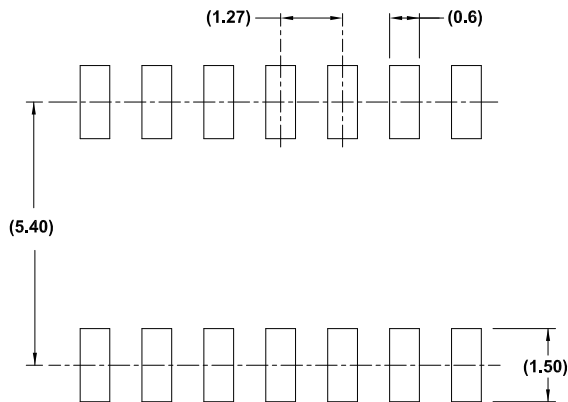
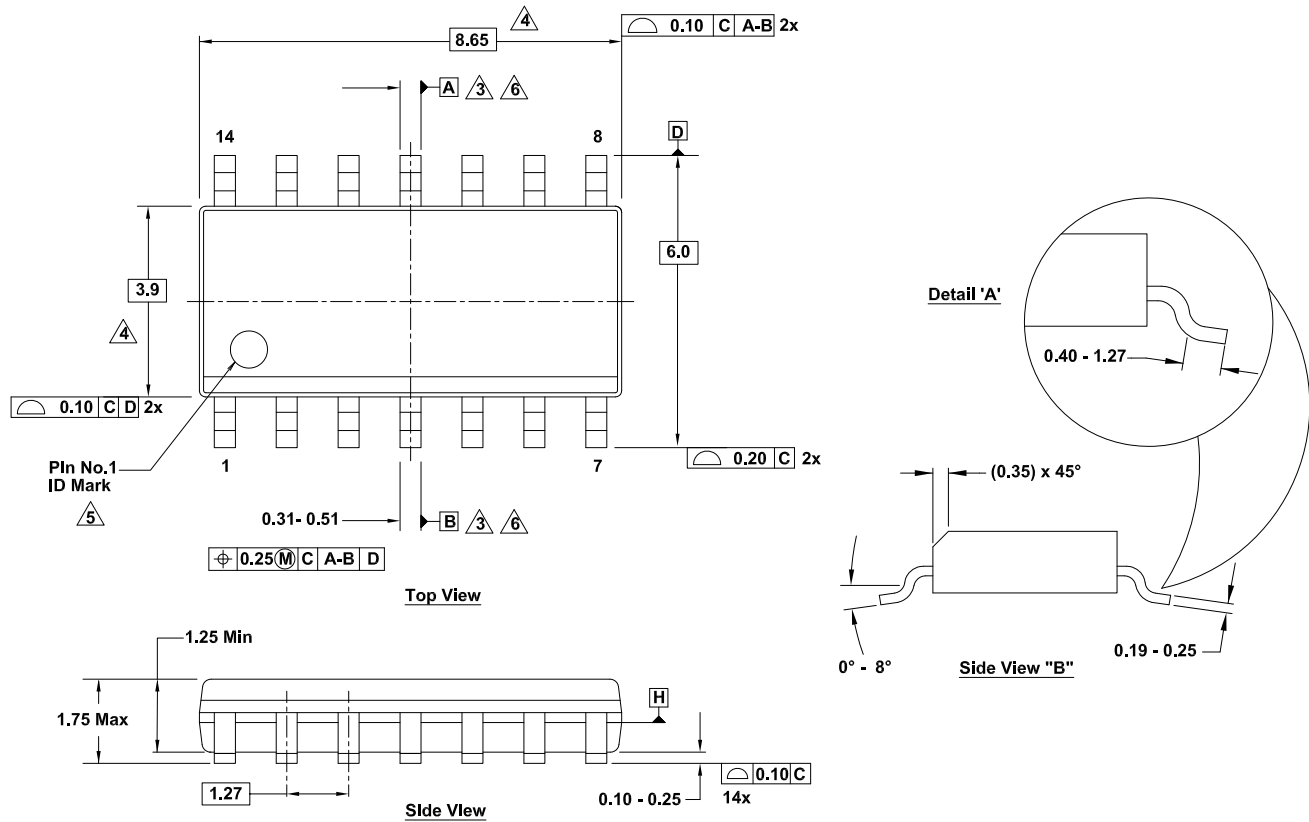
## Package Outline Drawing

For the most recent package outline drawing, see [M14.15](#).

M14.15

14 Lead Narrow Body Small Outline Plastic Package

Rev 2, 6/20



Typical Recommended Land Pattern

### Notes:

1. Dimensions are in millimeters.  
Dimensions in ( ) for reference only.
2. Dimensioning and tolerancing conform to ASME Y14.5m-1994.
3. Datums A and B are 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 identifier can 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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