

## ISL81483, ISL81487

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

FN6050  
Rev 9.00  
Sep 6, 2018

These Renesas RS-485/RS-422 devices are “fractional” Unit Load (UL), BiCMOS, 5V powered, single transceivers that meet both the RS-485 and RS-422 standards for balanced communication. Unlike competitive devices, this family is specified for 10% tolerance supplies (4.5V to 5.5V).

The [ISL81483](#) and [ISL81487](#) present a 1/8 unit load to the RS-485 bus, which allows up to 256 transceivers on the network for large node count systems (for example, process automation, remote meter reading systems). In a remote utility meter reading system, individual (apartments for example) utility meter readings are routed to a concentrator through an RS-485 network, so the high allowed node count minimizes the number of repeaters required to network all the meters. Data for all meters is then read out from the concentrator using a single access port, or a wireless link.

The slew rate limited driver on the ISL81483 reduces EMI, and minimizes reflections from improperly terminated transmission lines, or unterminated stubs in multidrop and multipoint applications. Data rates up to 250kbps are achievable with these devices.

Data rates up to 5Mbps are achievable by using the ISL81487, which features higher slew rates.

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

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.

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

### Related Literature

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

- [ISL81483](#), [ISL81487](#) product pages

### Features

- Fractional unit load allows up to 256 devices on the bus
- Specified for 10% tolerance supplies
- Class 3 ESD protection (HBM) on all pins . . . . . >7kV
- High data rate version (ISL81487) . . . . . up to 5Mbps
- Slew rate limited version for error free data transmission (ISL81483) . . . . . up to 250kbps
- Low current shutdown mode (except ISL81487) . . . 0.5µA
- Low quiescent supply current:
  - ISL81483 . . . . . 145µA (Max.)
  - ISL81487 . . . . . 420µA (Max.)
- -7V to +12V common-mode input voltage range
- Three state Rx and Tx outputs
- 30ns propagation delays, 5ns skew (ISL81487)
- Half duplex pinouts
- Operate from a single +5V supply (10% tolerance)
- Current limiting and thermal shutdown for driver overload protection
- Drop-in replacements for: MAX1483 (ISL81483); MAX1487, LMS1487 (ISL81487)
- Pb-free plus anneal available (RoHS compliant)

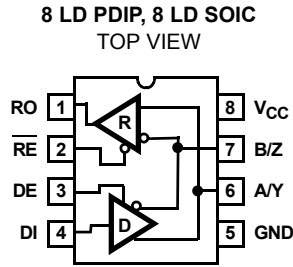
### Applications

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

TABLE 1. SUMMARY OF FEATURES

| PART NUMBER | HALF/FULL DUPLEX | NO. OF DEVICES ALLOWED ON BUS | DATA RATE (Mbps) | SLEW-RATE LIMITED? | RECEIVER/ DRIVER ENABLE? | QUIESCENT I <sub>CC</sub> (µA) | LOW POWER SHUTDOWN? | PIN COUNT |
|-------------|------------------|-------------------------------|------------------|--------------------|--------------------------|--------------------------------|---------------------|-----------|
| ISL81483    | Half             | 256                           | 0.25             | Yes                | Yes                      | 120                            | Yes                 | 8         |
| ISL81487    | Half             | 256                           | 5                | No                 | Yes                      | 350                            | No                  | 8         |

**Pinout**



**Truth Tables**

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

\*Shutdown Mode for ISL81483 (see [Note 10](#))

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

\*Shutdown Mode for ISL81483 (see [Note 10](#))

**Ordering Information**

| PART NUMBER<br>( <a href="#">Notes 2, 3</a> ) | PART MARKING | TEMP. RANGE (°C) | TAPE AND REEL<br>(UNITS) ( <a href="#">Note 1</a> ) | PACKAGE<br>(RoHS Compliant) | PKG. DWG. # |
|---|--------------|------------------|---|-----------------------------|-------------|
| ISL81483IBZ                                   | 81483IBZ     | -40 to +85       | -   | 8 Ld SOIC                   | M8.15       |
| ISL81483IBZ-T                                 | 81483IBZ     | -40 to +85       | 2.5k  | 8 Ld SOIC                   | M8.15       |
| ISL81483IPZ                                   | 81483IPZ     | -40 to +85       | -   | 8 Ld PDIP                   | E8.3        |
| ISL81487IBZ                                   | 81487IBZ     | -40 to +85       | -   | 8 Ld SOIC                   | M8.15       |
| ISL81487IBZ-T                                 | 81487IBZ     | -40 to +85       | 2.5k  | 8 Ld SOIC                   | M8.15       |

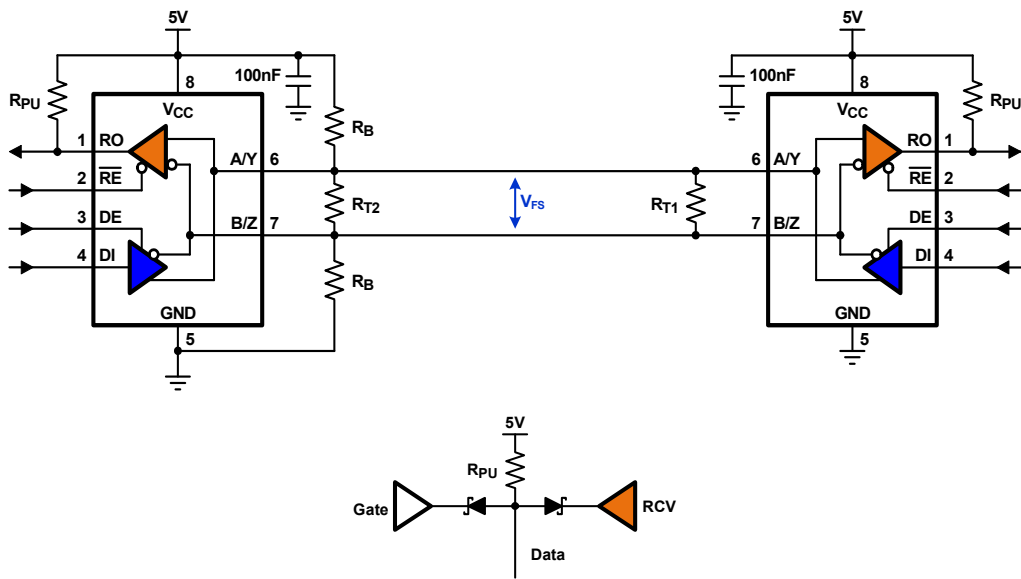
NOTES:

1. Refer to [TB347](#) for details about reel specifications.
2. Pb-free plus anneal products employ special Pb-free material sets; molding compounds/die attach materials and 100% matte tin plate termination finish, which are RoHS compliant and compatible with both SnPb and Pb-free soldering operations. Pb-free products are MSL classified at Pb-free peak reflow temperatures that meet or exceed the Pb-free requirements of IPC/JEDEC J STD-020.
3. For Moisture Sensitivity Level (MSL), see the [ISL81483](#), [ISL81487](#) product information pages. For more information about MSL, see [TB363](#).

### 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/Y             | RS-485/422 level, noninverting receiver input and noninverting driver output. Pin is an input (A) if DE = 0; pin is an output (Y) if DE = 1. |
| B/Z             | RS-485/422 level, inverting receiver input and inverting driver output. Pin is an input (B) if DE = 0; pin is an output (Z) if DE = 1.       |
| V <sub>CC</sub> | System power supply input (4.5V to 5.5V).  |

### Typical Operating Circuits



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/Y, B/Z                             | -8V to +12.5V                     |
| RO                                   | -0.5V to (V <sub>CC</sub> + 0.5V) |
| Short-Circuit Duration               |                                   |
| Y, Z                                 | Continuous                        |
| ESD Rating                           |                                   |
| HBM (Per MIL-STD-883, Method 3015.7) | >7kV                              |

**Thermal Information**

|   |                                |
|---|--------------------------------|
| Thermal Resistance (Typical, <a href="#">Note 4</a> ) | $\theta_{JA}$ (°C/W)           |
| 8 Ld SOIC Package                                     | 170                            |
| 8 Ld PDIP Package*                                    | 140                            |
| Maximum Junction Temperature (Plastic Package)        | +150°C                         |
| Maximum Storage Temperature Range                     | -65°C to +150°C                |
| Maximum Lead Temperature (Soldering 10s)              | +300°C (SOIC - Lead Tips Only) |

\*Pb-free PDIPs can be used for through hole wave solder processing only. They are not intended for use in Reflow solder processing applications.

**Operating Conditions**

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

**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.

**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. Typicals 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> | DE, DI, $\overline{RE}$                        | Full                  | -2   | -    | 2               | μA   |    |
| Input Current (A/Y, B/Z), ( <a href="#">Note 13</a> )                                       | I <sub>IN2</sub> | DE = 0V, V <sub>CC</sub> = 4.5 to 5.5V         | V <sub>IN</sub> = 12V | Full | -    | -               | 140  | μA |
|   |                  |  | V <sub>IN</sub> = -7V | Full | -    | -               | -120 | μA |
|   | I <sub>IN2</sub> | DE = 0V, V <sub>CC</sub> = 0V                  | V <sub>IN</sub> = 12V | Full | -    | -               | 180  | μA |
|   |                  |  | V <sub>IN</sub> = -7V | Full | -    | -               | -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    |    |
| Three-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                    | ISL81483, ISL81487    | Full | 96   | -               | kΩ   |    |

**Electrical Specifications** Test conditions:  $V_{CC} = 4.5V$  to  $5.5V$ ; unless otherwise specified. Typicals are at  $V_{CC} = 5V$ ,  $T_A = +25^\circ C$ , (Note 5) (Continued)

| PARAMETER   | SYMBOL             | TEST CONDITIONS  | TEMP (°C)     | MIN  | TYP  | MAX  | UNIT    |         |
|---|--------------------|--|---------------|------|------|------|---------|---------|
| No-Load Supply Current, (Note 6)                  | $I_{CC}$           | ISL81487, DI, $\overline{RE} = 0V$ or $V_{CC}$                     | DE = $V_{CC}$ | Full | -    | 400  | 500     | $\mu A$ |
|   |                    |  | DE = 0V       | Full | -    | 350  | 420     | $\mu A$ |
|   |                    | ISL81483, DI, $\overline{RE} = 0V$ or $V_{CC}$                     | DE = $V_{CC}$ | Full | -    | 160  | 200     | $\mu A$ |
|   |                    |  | DE = 0V       | Full | -    | 120  | 145     | $\mu A$ |
| Shutdown Supply Current                           | $I_{SHDN}$         | (Note 10), DE = 0V, $\overline{RE} = V_{CC}$ , DI = 0V or $V_{CC}$ | Full          | -    | 0.5  | 8    | $\mu A$ |         |
| Driver Short-Circuit Current, $V_O =$ High or Low | $I_{OSD1}$         | DE = $V_{CC}$ , $-7V \leq V_Y$ or $V_Z \leq 12V$ , (Note 7)        | Full          | 35   | -    | 250  | mA      |         |
| Receiver Short-Circuit Current                    | $I_{OSR}$          | $0V \leq V_O \leq V_{CC}$  | Full          | 7    | -    | 85   | mA      |         |
| <b>SWITCHING CHARACTERISTICS (ISL81487)</b>       |                    |  |               |      |      |      |         |         |
| Driver Input to Output Delay                      | $t_{PLH}, t_{PHL}$ | $R_{DIFF} = 54\Omega$ , $C_L = 100pF$ , (Figure 2)                 | Full          | 15   | 24   | 50   | ns      |         |
| Driver Output Skew                                | $t_{SKEW}$         | $R_{DIFF} = 54\Omega$ , $C_L = 100pF$ , (Figure 2)                 | Full          | -    | 2    | 10   | ns      |         |
| Driver Differential Rise or Fall Time             | $t_R, t_F$         | $R_{DIFF} = 54\Omega$ , $C_L = 100pF$ , (Figure 2)                 | Full          | 3    | 12   | 25   | ns      |         |
| Driver Enable to Output High                      | $t_{ZH}$           | $C_L = 100pF$ , SW = GND, (Figure 3)                               | Full          | -    | 14   | 70   | ns      |         |
| Driver Enable to Output Low                       | $t_{ZL}$           | $C_L = 100pF$ , SW = $V_{CC}$ , (Figure 3)                         | Full          | -    | 14   | 70   | ns      |         |
| Driver Disable from Output High                   | $t_{HZ}$           | $C_L = 15pF$ , SW = GND, (Figure 3)                                | Full          | -    | 44   | 70   | ns      |         |
| Driver Disable from Output Low                    | $t_{LZ}$           | $C_L = 15pF$ , SW = $V_{CC}$ , (Figure 3)                          | Full          | -    | 21   | 70   | ns      |         |
| Receiver Input to Output Delay                    | $t_{PLH}, t_{PHL}$ | (Figure 4)   | Full          | 30   | 90   | 150  | ns      |         |
| Receiver Skew   $t_{PLH} - t_{PHL}$               | $t_{SKD}$          | (Figure 4)   | +25           | -    | 5    | -    | ns      |         |
| Receiver Enable to Output High                    | $t_{ZH}$           | $C_L = 15pF$ , SW = GND, (Figure 5)                                | Full          | -    | 9    | 50   | ns      |         |
| Receiver Enable to Output Low                     | $t_{ZL}$           | $C_L = 15pF$ , SW = $V_{CC}$ , (Figure 5)                          | Full          | -    | 9    | 50   | ns      |         |
| Receiver Disable from Output High                 | $t_{HZ}$           | $C_L = 15pF$ , SW = GND, (Figure 5)                                | Full          | -    | 9    | 50   | ns      |         |
| Receiver Disable from Output Low                  | $t_{LZ}$           | $C_L = 15pF$ , SW = $V_{CC}$ , (Figure 5)                          | Full          | -    | 9    | 50   | ns      |         |
| Maximum Data Rate                                 | $f_{MAX}$          |  | Full          | 5    | -    | -    | Mbps    |         |
| <b>SWITCHING CHARACTERISTICS (ISL81483)</b>       |                    |  |               |      |      |      |         |         |
| Driver Input to Output Delay                      | $t_{PLH}, t_{PHL}$ | $R_{DIFF} = 54\Omega$ , $C_L = 100pF$ , (Figure 2)                 | Full          | 250  | 650  | 2000 | ns      |         |
| Driver Output Skew                                | $t_{SKEW}$         | $R_{DIFF} = 54\Omega$ , $C_L = 100pF$ , (Figure 2)                 | Full          | -    | 160  | 800  | ns      |         |
| Driver Differential Rise or Fall Time             | $t_R, t_F$         | $R_{DIFF} = 54\Omega$ , $C_L = 100pF$ , (Figure 2)                 | Full          | 250  | 900  | 2000 | ns      |         |
| Driver Enable to Output High                      | $t_{ZH}$           | $C_L = 100pF$ , SW = GND, (Figure 3, Note 8)                       | Full          | 250  | 1000 | 2000 | ns      |         |
| Driver Enable to Output Low                       | $t_{ZL}$           | $C_L = 100pF$ , SW = $V_{CC}$ , (Figure 3, Note 8)                 | Full          | 250  | 860  | 2000 | ns      |         |
| Driver Disable from Output High                   | $t_{HZ}$           | $C_L = 15pF$ , SW = GND, (Figure 3)                                | Full          | 300  | 660  | 3000 | ns      |         |
| Driver Disable from Output Low                    | $t_{LZ}$           | $C_L = 15pF$ , SW = $V_{CC}$ , (Figure 3)                          | Full          | 300  | 640  | 3000 | ns      |         |
| Receiver Input to Output Delay                    | $t_{PLH}, t_{PHL}$ | (Figure 4)   | Full          | 250  | 500  | 2000 | ns      |         |
| Receiver Skew   $t_{PLH} - t_{PHL}$               | $t_{SKD}$          | (Figure 4)   | +25           | -    | 60   | -    | ns      |         |
| Receiver Enable to Output High                    | $t_{ZH}$           | $C_L = 15pF$ , SW = GND, (Figure 5, Note 9)                        | Full          | -    | 10   | 50   | ns      |         |
| Receiver Enable to Output Low                     | $t_{ZL}$           | $C_L = 15pF$ , SW = $V_{CC}$ , (Figure 5, Note 9)                  | Full          | -    | 10   | 50   | ns      |         |
| Receiver Disable from Output High                 | $t_{HZ}$           | $C_L = 15pF$ , SW = GND, (Figure 5)                                | Full          | -    | 10   | 50   | ns      |         |
| Receiver Disable from Output Low                  | $t_{LZ}$           | $C_L = 15pF$ , SW = $V_{CC}$ , (Figure 5)                          | Full          | -    | 10   | 50   | ns      |         |
| Maximum Data Rate                                 | $f_{MAX}$          |  | Full          | 250  | -    | -    | kbps    |         |
| Time to Shutdown                                  | $t_{SHDN}$         | (Note 10)  | Full          | 50   | 120  | 600  | ns      |         |
| Driver Enable from Shutdown to Output High        | $t_{ZH}(SHDN)$     | $C_L = 100pF$ , SW = GND, (Figure 3, Notes 10, 11)                 | Full          | -    | 1000 | 2000 | ns      |         |

**Electrical Specifications** Test conditions:  $V_{CC} = 4.5V$  to  $5.5V$ ; unless otherwise specified. Typicals are at  $V_{CC} = 5V$ ,  $T_A = +25^{\circ}C$ , (Note 5) (Continued)

| PARAMETER                                    | SYMBOL         | TEST CONDITIONS                                       | TEMP (°C) | MIN | TYP  | MAX  | UNIT |
|--|----------------|---|-----------|-----|------|------|------|
| Driver Enable from Shutdown to Output Low    | $t_{ZL}(SHDN)$ | $C_L = 100pF, SW = V_{CC}$ , (Figure 3, Notes 10, 11) | Full      | -   | 1000 | 2000 | ns   |
| Receiver Enable from Shutdown to Output High | $t_{ZH}(SHDN)$ | $C_L = 15pF, SW = GND$ , (Figure 5, Notes 10, 12)     | Full      | -   | 800  | 2500 | ns   |
| Receiver Enable from Shutdown to Output Low  | $t_{ZL}(SHDN)$ | $C_L = 15pF, SW = V_{CC}$ , (Figure 5, Notes 10, 12)  | Full      | -   | 800  | 2500 | ns   |

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.
- When testing the ISL81483, keep  $\overline{RE} = 0$  to prevent the device from entering SHDN.
- When testing the ISL81483, the  $\overline{RE}$  signal high time must be short enough (typically <200ns) to prevent the device from entering SHDN.
- The ISL81483 is put into shutdown by bringing  $\overline{RE}$  high and  $DE$  low. If the inputs are in this state for less than 50ns, 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 (Excluding ISL81487)" on page 9.
- Keep  $\overline{RE} = V_{CC}$ , and set the  $DE$  signal low time >600ns to ensure that the device enters SHDN.
- Set the  $\overline{RE}$  signal high time >600ns to ensure that the device enters SHDN.
- Devices meeting these limits are denoted as "1/8 unit load (1/8 UL)" transceivers. The RS-485 standard allows up to 32 Unit Loads on the bus, so there can be 256 1/8 UL devices on a bus.

**Test Circuits and Waveforms**

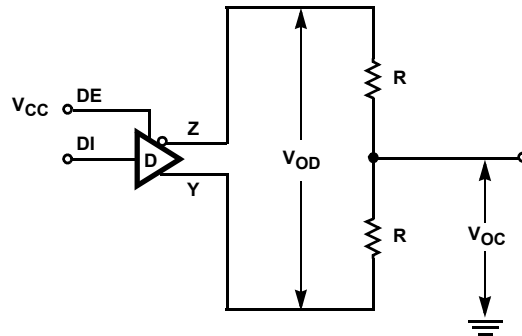


FIGURE 1. DRIVER  $V_{OD}$  AND  $V_{OC}$

**Test Circuits and Waveforms** (Continued)

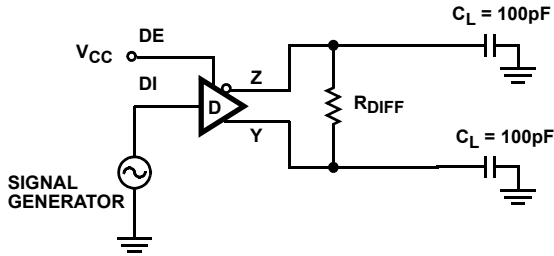
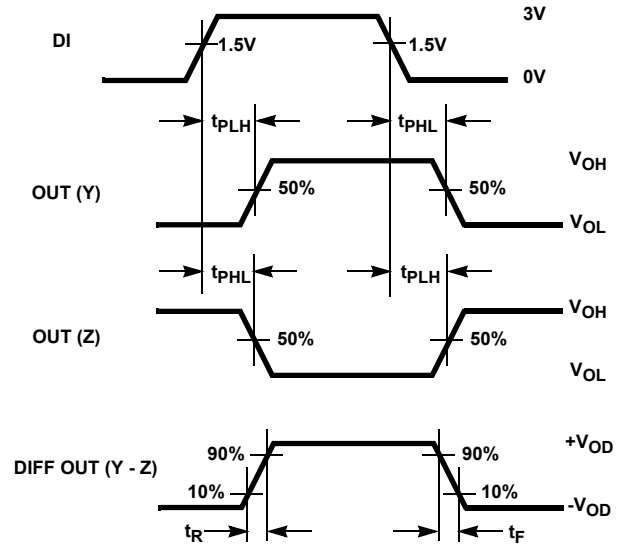


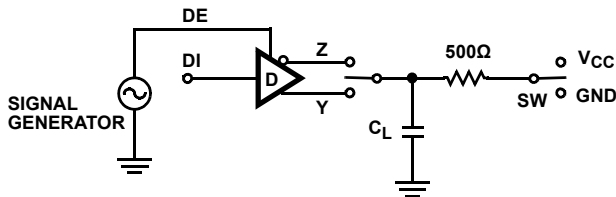
FIGURE 2A. TEST CIRCUIT



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

FIGURE 2B. MEASUREMENT POINTS

FIGURE 2. DRIVER PROPAGATION DELAY AND DIFFERENTIAL TRANSITION TIMES



(SHDN) for ISL81483 only.

| PARAMETER             | OUTPUT | RE          | DI  | SW  | CL (pF) |
|-----------------------|--------|-------------|-----|-----|---------|
| $t_{HZ}$              | Y/Z    | X           | 1/0 | GND | 15      |
| $t_{LZ}$              | Y/Z    | X           | 0/1 | VCC | 15      |
| $t_{ZH}$              | Y/Z    | 0 (Note 8)  | 1/0 | GND | 100     |
| $t_{ZL}$              | Y/Z    | 0 (Note 8)  | 0/1 | VCC | 100     |
| $t_{ZH}(\text{SHDN})$ | Y/Z    | 1 (Note 10) | 1/0 | GND | 100     |
| $t_{ZL}(\text{SHDN})$ | Y/Z    | 1 (Note 10) | 0/1 | VCC | 100     |

FIGURE 3A. TEST CIRCUIT

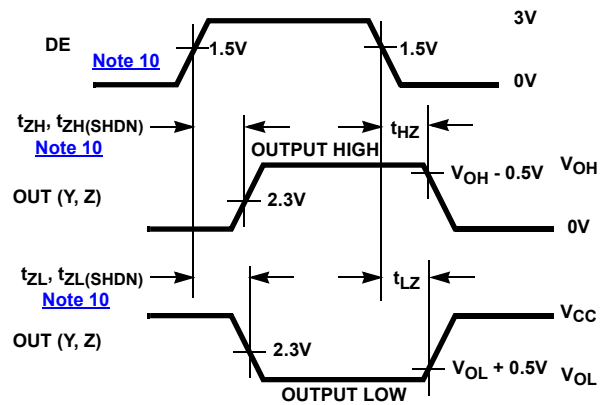


FIGURE 3B. MEASUREMENT POINTS

FIGURE 3. DRIVER ENABLE AND DISABLE TIMES

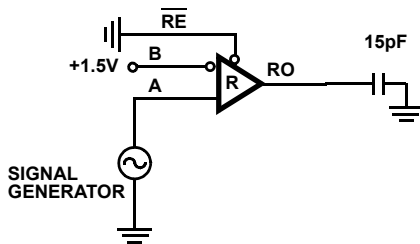


FIGURE 4A. TEST CIRCUIT

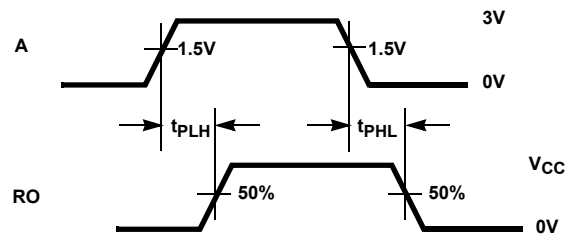
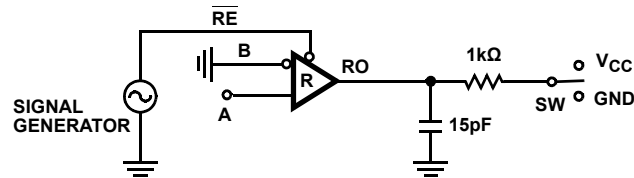


FIGURE 4B. MEASUREMENT POINTS

FIGURE 4. RECEIVER PROPAGATION DELAY

**Test Circuits and Waveforms** (Continued)

(SHDN) for ISL81483 only.

| PARAMETER               | DE | A     | SW       |
|-------------------------|----|-------|----------|
| $t_{HZ}$                | 0  | +1.5V | GND      |
| $t_{LZ}$                | 0  | -1.5V | $V_{CC}$ |
| $t_{ZH}$ (Note 6)       | 0  | +1.5V | GND      |
| $t_{ZL}$ (Note 6)       | 0  | -1.5V | $V_{CC}$ |
| $t_{ZH}(SHDN)$ (Note 7) | 0  | +1.5V | GND      |
| $t_{ZL}(SHDN)$ (Note 7) | 0  | -1.5V | $V_{CC}$ |

FIGURE 5A. TEST CIRCUIT

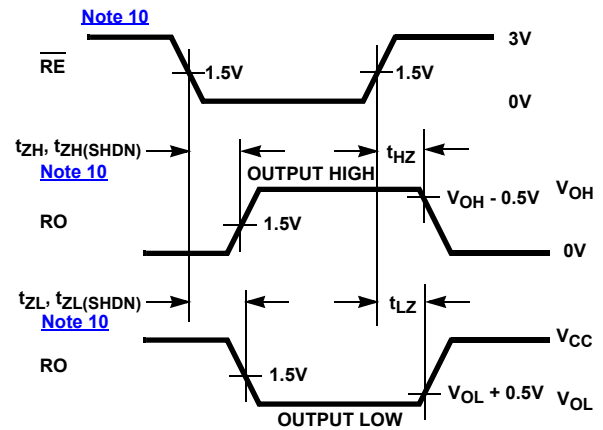


FIGURE 5B. MEASUREMENT POINTS

FIGURE 5. RECEIVER ENABLE AND DISABLE TIMES

**Application Information**

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

Another important advantage of RS-485 is the extended Common-Mode Range (CMR). The CMR 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.

Receiver input resistance of  $96\text{k}\Omega$  surpasses the RS-422 specification of  $4\text{k}\Omega$  and is eight times the RS-485 "Unit Load (UL)" requirement of  $12\text{k}\Omega$  minimum. The products are known as "one-eighth UL" transceivers, and there can be up to 256 of the 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 rates supported by the corresponding driver, and receiver outputs are three-statable using the active low  $\overline{\text{RE}}$  input.

**Driver Features**

The RS-485 and RS-422 drivers are differential output devices that deliver 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 a low propagation delay skew to maximize bit width and to minimize EMI.

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

The ISL81483 driver outputs are slew rate limited to minimize EMI and to minimize reflections in unterminated or improperly terminated networks. Data rate on these slew rate limited versions is a maximum of 250kbps. ISL81487 drivers are not limited, so faster output transition times allow data rates of at least 5Mbps.

**Data Rate, Cables, and Terminations**

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

Twisted pair cable is the cable of choice for the RS-485 and RS-422 networks. Twisted pair cables pick up noise and other electromagnetically induced voltages as



common-mode signals, which are effectively rejected by the differential receivers in these ICs.

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

In point-to-point or point-to-multipoint (single driver on bus) networks, terminate the main cable in its characteristic impedance (typically 120Ω) at the end farthest from the driver. In multi-receiver applications, keep stubs connecting receivers to the main cable as short as possible. In multipoint (multi-driver) systems, terminate the main cable in its characteristic impedance at both ends. Keep stubs that are 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. These devices meet this requirement through the driver output short-circuit current limits and on-chip thermal shutdown circuitry.

The driver output stages incorporate short-circuit current limiting circuitry that 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 the power dissipation when the contending voltage exceeds either supply.

In the event of a major short-circuit condition, the devices' thermal shutdown feature disables the drivers whenever the die temperature becomes excessive. This eliminates the power dissipation allowing the die to cool. The drivers automatically re-enable after the die temperature drops about 15°. 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 (Excluding ISL81487)**

These CMOS transceivers all use a fraction of the power required by their bipolar counterparts. However, the ISL81483 includes a shutdown feature that reduces the already low quiescent I<sub>CC</sub> to a 500nA trickle. They enter shutdown whenever the receiver and driver are **simultaneously** disabled (RE = V<sub>CC</sub> and DE = GND) for a period of at least 600ns. Disabling both the driver and the receiver for less than 50ns ensures that shutdown is not entered.

Note that receiver and driver enable times increase when enabling from shutdown. Refer to [Notes 5](#) through [13](#) on [page 6](#) at the end of the Electrical Specification table for more information.

**Typical Performance Curves** V<sub>CC</sub> = 5V, T<sub>A</sub> = +25°C, ISL81483 and ISL81487; unless otherwise specified

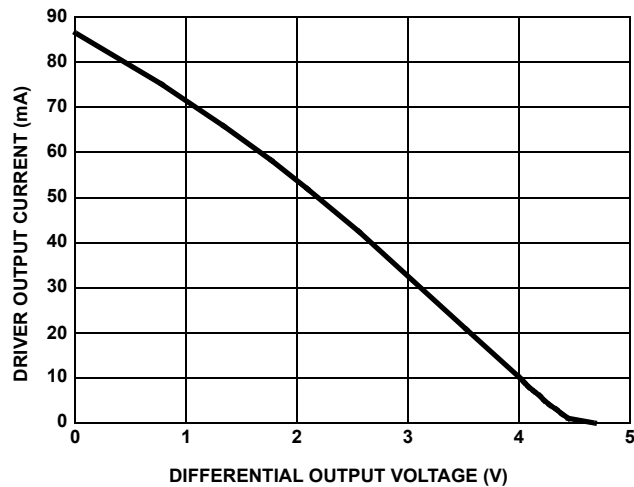


FIGURE 6. DRIVER OUTPUT CURRENT vs DIFFERENTIAL OUTPUT VOLTAGE

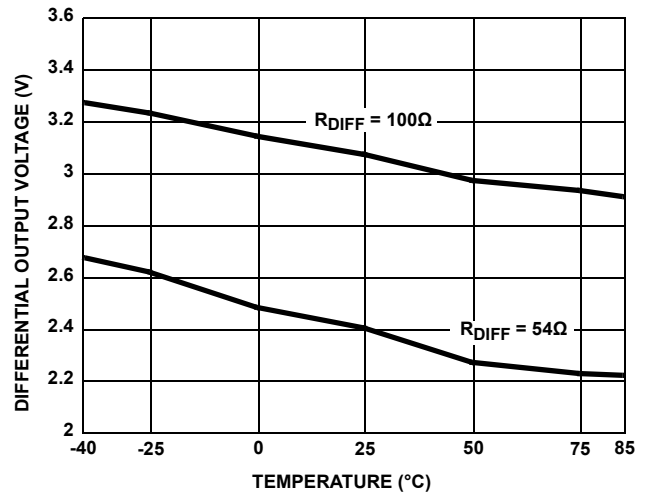


FIGURE 7. DRIVER DIFFERENTIAL OUTPUT VOLTAGE vs TEMPERATURE

**Typical Performance Curves**  $V_{CC} = 5V, T_A = +25^{\circ}C$ , ISL81483 and ISL81487; unless otherwise specified (Continued)

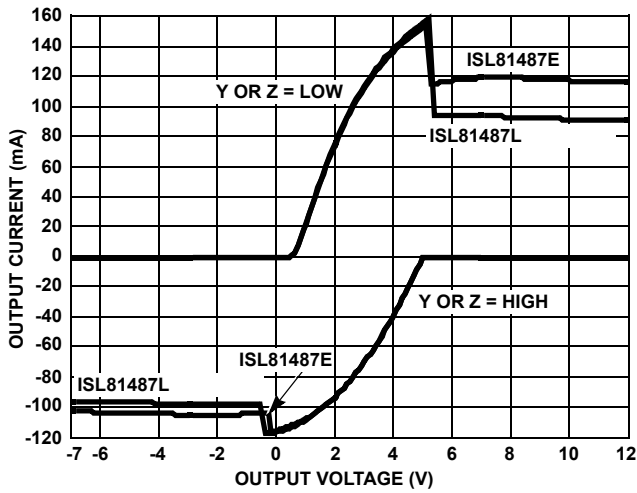


FIGURE 8. DRIVER OUTPUT CURRENT vs SHORT CIRCUIT VOLTAGE

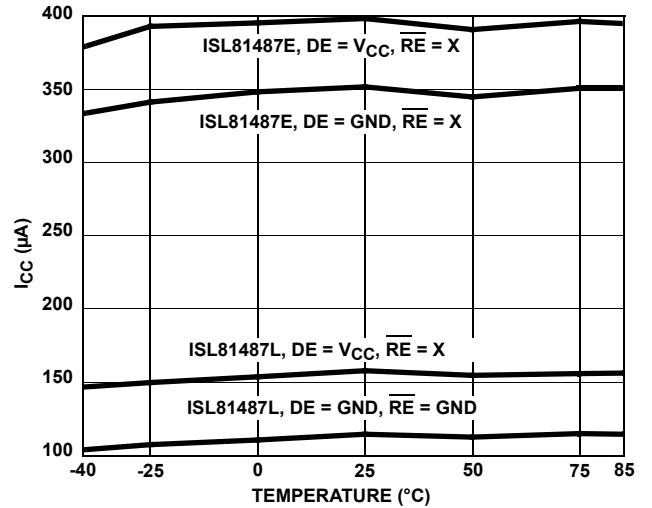


FIGURE 9. SUPPLY CURRENT vs TEMPERATURE

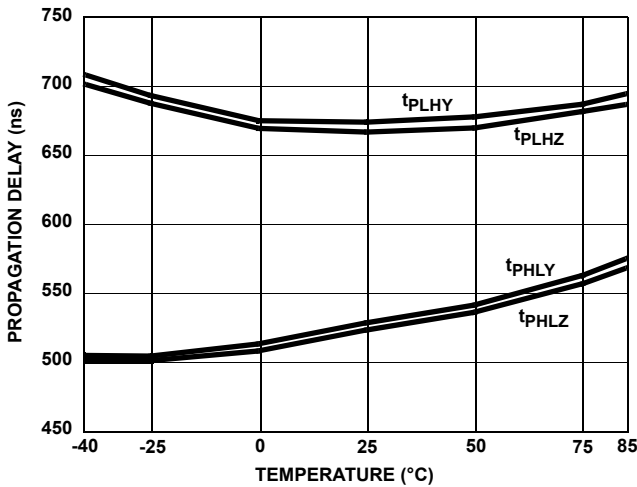


FIGURE 10. DRIVER PROPAGATION DELAY vs TEMPERATURE (ISL81483)

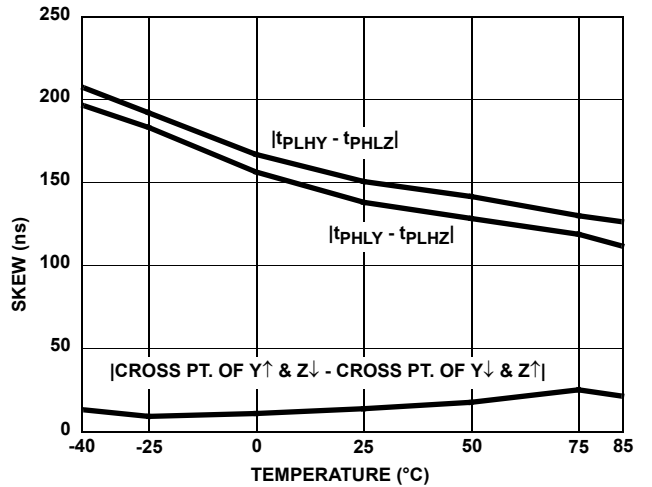


FIGURE 11. DRIVER SKEW vs TEMPERATURE (ISL81483)

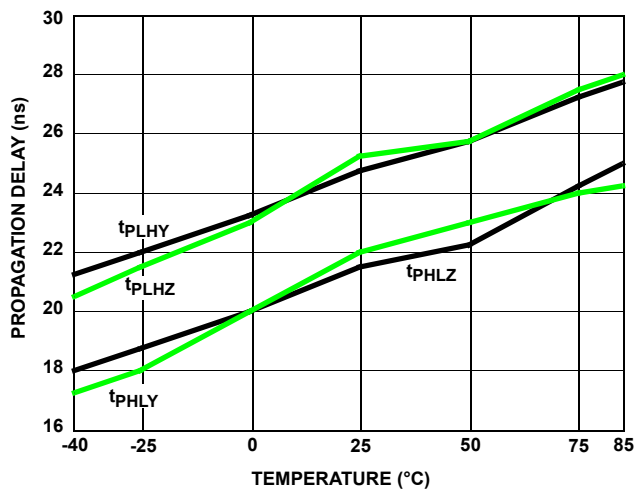


FIGURE 12. DRIVER PROPAGATION DELAY vs TEMPERATURE (ISL81487)

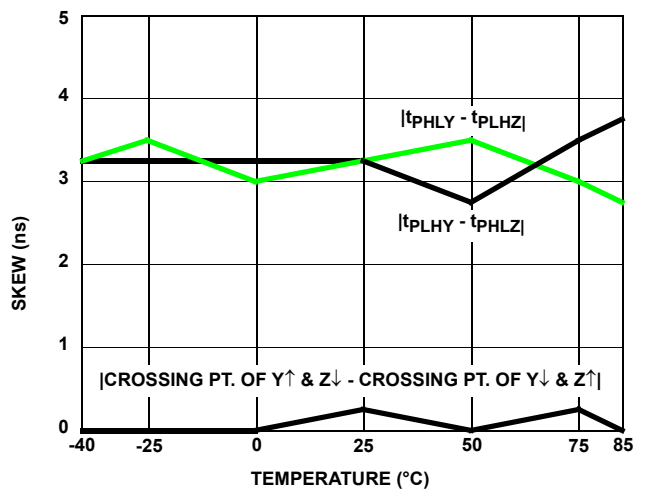


FIGURE 13. DRIVER SKEW vs TEMPERATURE (ISL81487)

**Typical Performance Curves**  $V_{CC} = 5V$ ,  $T_A = +25^\circ C$ , ISL81483 and ISL81487; unless otherwise specified (Continued)

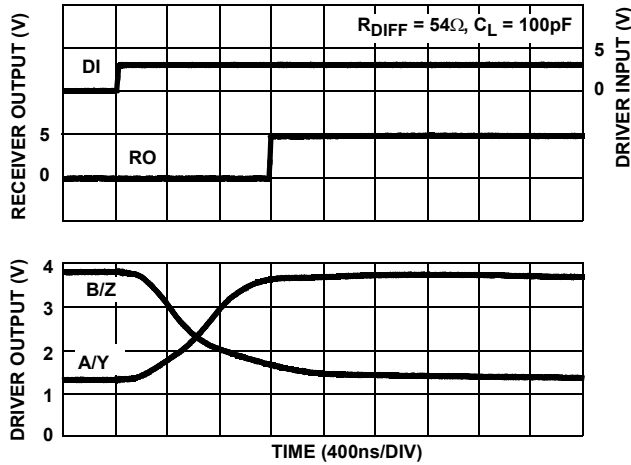


FIGURE 14. DRIVER AND RECEIVER WAVEFORMS, LOW TO HIGH (ISL81483)

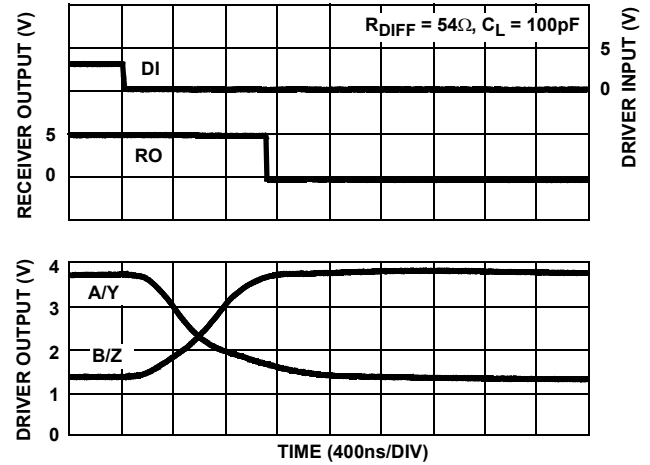


FIGURE 15. DRIVER AND RECEIVER WAVEFORMS, HIGH TO LOW (ISL81483)

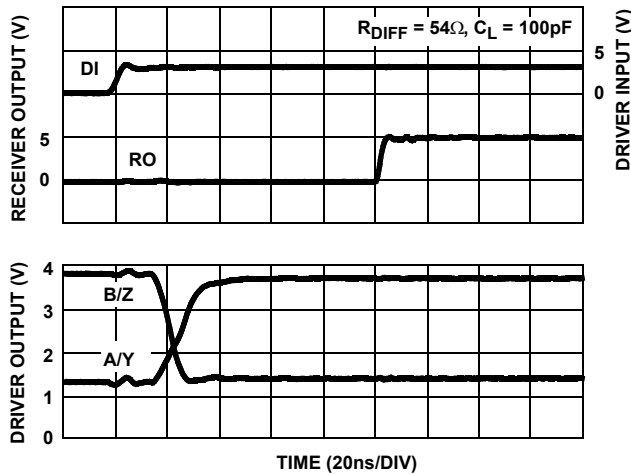


FIGURE 16. DRIVER AND RECEIVER WAVEFORMS, LOW TO HIGH (ISL81487)

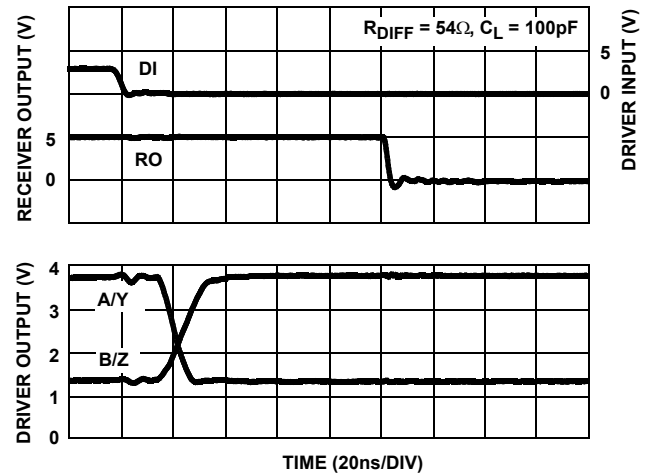


FIGURE 17. DRIVER AND RECEIVER WAVEFORMS, HIGH TO LOW (ISL81487)

**Die Characteristics**

**SUBSTRATE POTENTIAL (POWERED UP):**

GND

**TRANSISTOR COUNT:**

518

**PROCESS:**

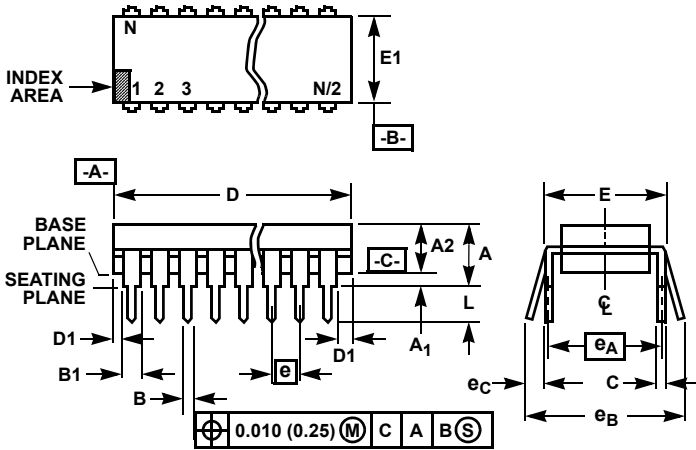
Si Gate CMOS

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

| DATE           | REVISION | CHANGE  |
|----------------|----------|---|
| Sep 6, 2018    | FN6050.9 | Added Related Literature section.<br>Removed ISL8487 information from datasheet.<br>Updated Typical Operating Circuits on page 3.<br>Updated the Ordering Information table by adding tape and reel information, adding Notes 1 and 3.<br>Removed Note 11.<br>Removed About Intersil section and updated disclaimer.  |
| March 14, 2016 | FN6050.8 | Added Rev History and About Intersil Verbiage.<br>Updated "Ordering Information" table on page 2.<br>Updated M8.15 to current revision. POD revision changes are as follows:<br>Note 1 "1982" to "1994"<br>Changed in Typical Recommended Land Pattern the following:<br>2.41(0.095) to 2.20(0.087)<br>0.76 (0.030) to 0.60(0.023)<br>0.200 to 5.20(0.205)<br>Updated to new POD format by removing table and moving dimensions onto drawing and adding land pattern. |

**Package Outline Drawings**

For the most recent package outline drawing, see [E8.3](#).



**NOTES:**

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

**E8.3 (JEDEC MS-001-BA ISSUE D)  
8 LEAD DUAL-IN-LINE PLASTIC PACKAGE**

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

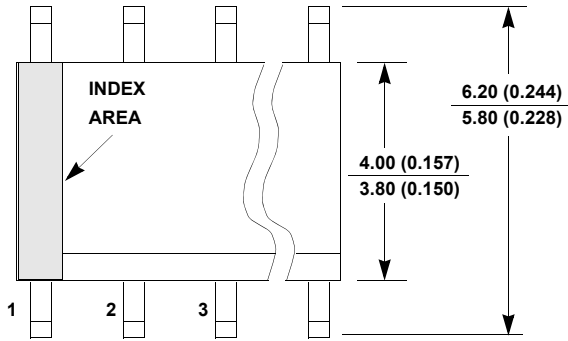
Rev. 0 12/93

**M8.15**

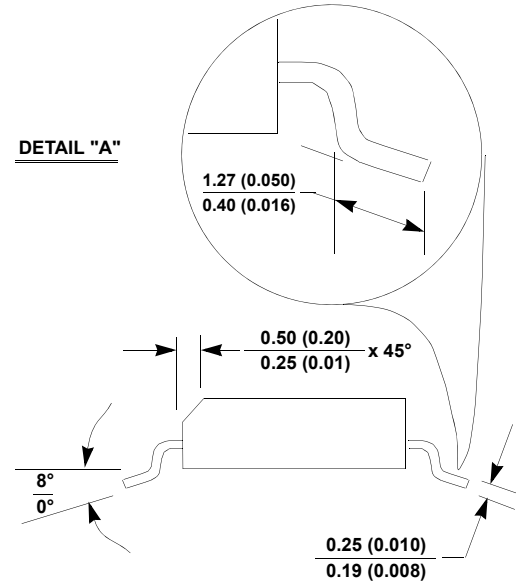
**8 LEAD NARROW BODY SMALL OUTLINE PLASTIC PACKAGE**

Rev 4, 1/12

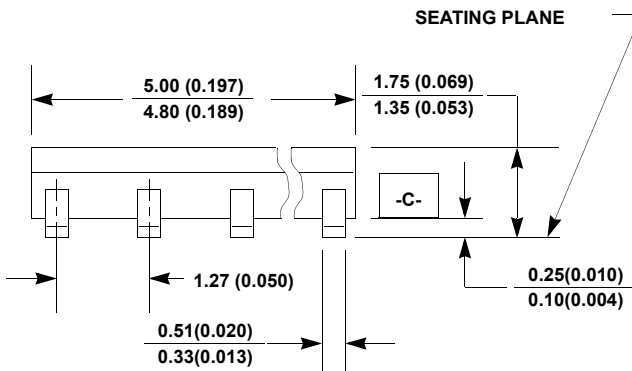
For the most recent package outline drawing, see [M8.15](#).



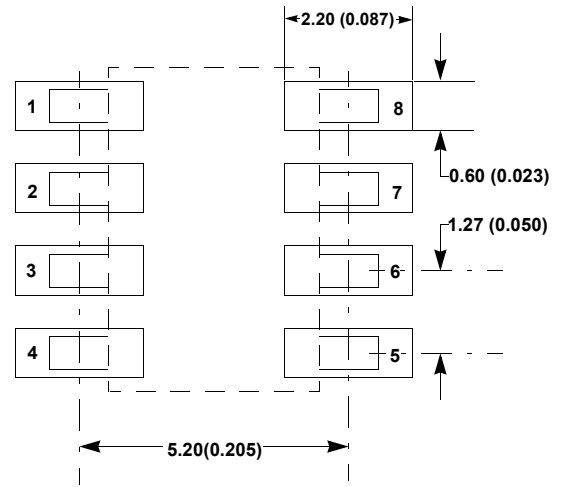
**TOP VIEW**



**SIDE VIEW "B"**



**SIDE VIEW "A"**



**TYPICAL RECOMMENDED LAND PATTERN**

**NOTES:**

24. Dimensioning and tolerancing per ANSI Y14.5M-1994.
25. 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.
26. Package width does not include interlead flash or protrusions. Interlead flash and protrusions shall not exceed 0.25mm (0.010 inch) per side.
27. The chamfer on the body is optional. If it is not present, a visual index feature must be located within the crosshatched area.
28. Terminal numbers are shown for reference only.
29. 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).
30. Controlling dimension: MILLIMETER. Converted inch dimensions are not necessarily exact.
31. This outline conforms to JEDEC publication MS-012-AA ISSUE C.

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(Rev.4.0-1 November 2017)



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4590 Patrick Henry Drive, Santa Clara, California 95054-1817, U.S.A.  
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**Renesas Electronics Canada Limited**  
9251 Yonge Street, Suite 8309 Richmond Hill, Ontario Canada L4C 9T3  
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Dukes Meadow, Millboard Road, Bourne End, Buckinghamshire, SL8 5FH, U.K  
Tel: +44-1628-651-700

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Arcadiastrasse 10, 40472 Düsseldorf, Germany  
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Room 1709 Quantum Plaza, No.27 ZhichunLu, Haidian District, Beijing, 100191 P. R. China  
Tel: +86-10-8235-1155, Fax: +86-10-8235-7679

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Unit 301, Tower A, Central Towers, 555 Langao Road, Putuo District, Shanghai, 200333 P. R. China  
Tel: +86-21-2226-0888, Fax: +86-21-2226-0999

**Renesas Electronics Hong Kong Limited**  
Unit 1601-1611, 16/F., Tower 2, Grand Century Place, 193 Prince Edward Road West, Mongkok, Kowloon, Hong Kong  
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