

# ISL32613E, ISL32614E

±16.5kV ESD Protected, +125°C, 1.8V to 3.6V, Low Power, SOT-23,  
RS-485/RS-422 Transmitters

FN7906  
Rev.4.01  
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The [ISL32613E](#) and [ISL32614E](#) are ±16.5kV HBM ESD protected (7kV IEC61000 contact), 1.8V powered, single transmitters for differential communication. These drivers have very low bus currents (±40μA), so they present less than a 1/8 unit load to the bus. The low bus currents allow more than 256 transmitters on the network without violating the RS-485 specification's 32 unit load maximum and without using repeaters.

Hot plug circuitry ensures that the Tx outputs remain in a high impedance state while the power supply stabilizes.

Both ICs use slew rate limited drivers, which reduce EMI and minimize reflections from improperly terminated transmission lines or unterminated stubs in multidrop and multipoint applications. The ISL32613E is more slew rate limited for data rates up to 128kbps, while the less limited ISL32614E is useful for data rates up to 256kbps.

For companion low power single RS-485 receivers, see the [ISL32610E](#) datasheet.

## Related Literature

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

- [ISL32613E](#) and [ISL32614E](#) device pages

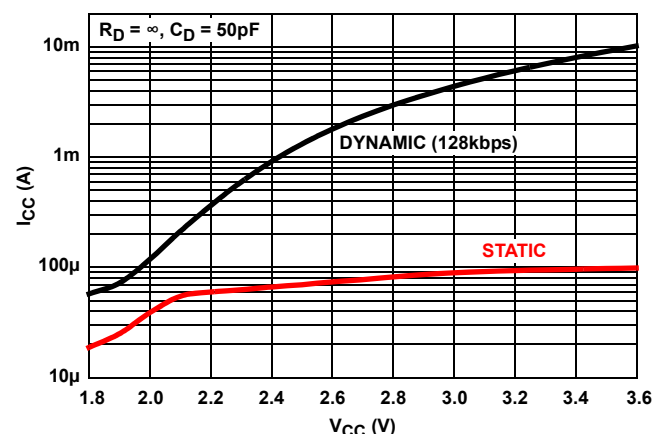


FIGURE 1. ISL32613E WITH  $V_{CC} = 1.8V$  REDUCES OPERATING  $I_{CC}$  BY A FACTOR OF 177 COMPARED WITH  $I_{CC}$  AT  $V_{CC} = 3.6V$

## Features

- Wide supply voltage range . . . . . 1.8V to 3.6V
- Low quiescent supply current . . . . . 80μA (max)
  - Very low shutdown supply current . . . . . 2μA (max)
- High ESD protection on RS-485 outputs . . . . ±16.5kV HBM
  - Class 3 ESD level on all other pins . . . . . >8kV HBM
- Specified for +125°C
- Hot plug - Tx outputs remain three-state during power-up
- Low Tx leakage allows >256 devices on the bus
- Slew rate limited for data rates up to 256kbps
- Current limiting and thermal shutdown for driver overload protection
- 5V tolerant logic inputs
- Pb-Free (RoHS Compliant)

## Applications

- Industrial/process control networks
- Space-constrained systems
- Factory automation
- Building environmental control/lighting systems

## Truth Table

| TRANSMITTING                  |    |          |          |
|-------------------------------|----|----------|----------|
| INPUTS                        |    | OUTPUTS  |          |
| DE ( <a href="#">Note 9</a> ) | DI | Z        | Y        |
| 1                             | 1  | 0        | 1        |
| 1                             | 0  | 1        | 0        |
| 0                             | X  | High-Z * | High-Z * |

NOTE: \*Shutdown Mode

## Typical Operating Circuits

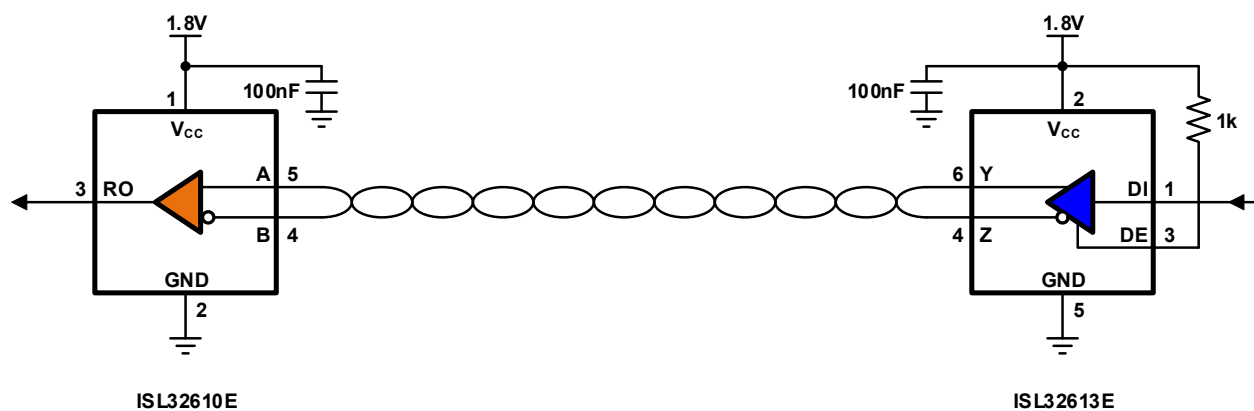


FIGURE 2. POINT-TO-POINT LINK WITH FIXED ENABLE-PINS

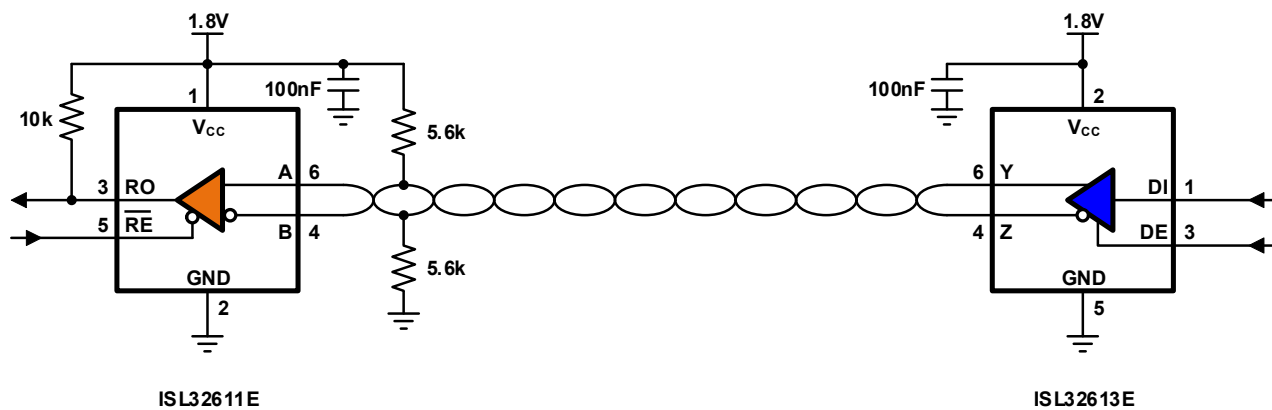


FIGURE 3. POINT-TO-POINT LINK WITH PROGRAMMABLE ENABLE-PINS

## Ordering Information

| PART NUMBER<br>(Notes 2, 3) | PART MARKING<br>(Note 4) | TEMP RANGE<br>(°C) | TAPE AND REEL<br>(UNITS) (Note 1) | PACKAGE<br>(RoHS Compliant) | PKG.<br>DWG. # |
|-----------------------------|--------------------------|--------------------|-----------------------------------|-----------------------------|----------------|
| ISL32613EFHZ-T              | 613F                     | -40 to +125        | 3k                                | 6 Ld SOT-23                 | P6.064         |
| ISL32613EFHZ-T7A            | 613F                     | -40 to +125        | 250                               | 6 Ld SOT-23                 | P6.064         |
| ISL32614EFHZ-T              | 614F                     | -40 to +125        | 3k                                | 6 Ld SOT-23                 | P6.064         |
| ISL32614EFHZ-T7A            | 614F                     | -40 to +125        | 250                               | 6 Ld SOT-23                 | P6.064         |

### NOTES:

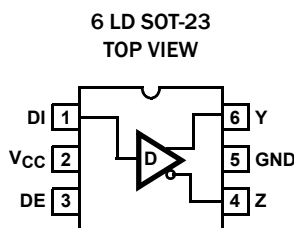
1. See [TB347](#) for details about reel specifications.
2. These Pb-free plastic packaged products employ special Pb-free material sets, molding compounds/die attach materials, and 100% matte tin plate plus anneal (e3 termination finish, which is RoHS compliant and compatible with both SnPb and Pb-free soldering operations). Pb-free products are MSL classified at Pb-free peak reflow temperatures that meet or exceed the Pb-free requirements of IPC/JEDEC J STD-020.
3. For Moisture Sensitivity Level (MSL), see the [ISL32613E](#) and [ISL32614E](#) device pages. For more information about MSL, see [TB363](#).
4. SOT-23 "PART MARKING" is branded on the bottom side.

### NOTES:

TABLE 1. SUMMARY OF FEATURES AT  $V_{CC} = 1.8V$

| PART NUMBER | FUNCTION | DATA RATE<br>(kbps) | SLEW-RATE<br>LIMITED? | HOT<br>PLUG? | TX ENABLED?<br>(Note 9) | MAXIMUM QUIESCENT<br>$I_{CC}$ ( $\mu A$ ) | LOW POWER<br>SHUTDOWN? | PIN<br>COUNT |
|-------------|----------|---------------------|-----------------------|--------------|-------------------------|-------------------------------------------|------------------------|--------------|
| ISL32613E   | 1 Tx     | 128                 | Yes                   | Yes          | Yes                     | 80                                        | Yes                    | 6 Ld SOT     |
| ISL32614E   | 1 Tx     | 256                 | Yes                   | Yes          | Yes                     | 80                                        | Yes                    | 6 Ld SOT     |

## Pin Configuration



## Pin Descriptions

| PIN # | PIN NAME | FUNCTION                                                                                                                                                                                                                                      |
|-------|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1     | 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.                                                                                                               |
| 2     | $V_{CC}$ | System power supply input (1.8V to 3.6V).                                                                                                                                                                                                     |
| 3     | DE       | Driver output enable. The driver outputs, Y and Z, are enabled by bringing DE high, and are high impedance when DE is low. If the driver enable function is not needed, connect DE to $V_{CC}$ through a 1k $\Omega$ to 2k $\Omega$ resistor. |
| 4     | Z        | $\pm 16.5kV$ HBM, $\pm 7kV$ IEC61000 (contact method) ESD protected inverting differential transmitter output.                                                                                                                                |
| 5     | GND      | Ground connection.                                                                                                                                                                                                                            |
| 6     | Y        | $\pm 16.5kV$ HBM, $\pm 7kV$ IEC61000 (contact method) ESD protected noninverting differential transmitter output.                                                                                                                             |

## Absolute Maximum Ratings

|                                                |                                       |
|------------------------------------------------|---------------------------------------|
| V <sub>CC</sub> to GND                         | -0.3V to 7V                           |
| Input Voltages                                 |                                       |
| DI, DE                                         | -0.3V to 7V                           |
| Output Voltages                                |                                       |
| Y, Z (V <sub>CC</sub> = 0V or ≥ 2.7V)          | -8V to +13V                           |
| Y, Z (V <sub>CC</sub> = 1.8V, Output Enabled)  | -8V to +3V                            |
| Y, Z (V <sub>CC</sub> = 1.8V, Output Disabled) | -8V to +8V                            |
| Short Circuit Duration                         |                                       |
| Y, Z                                           | Indefinite                            |
| ESD Rating                                     | see <a href="#">"ESD PERFORMANCE"</a> |
| Latch-Up (per JESD78, Level 2, Class A)        | +125°C                                |

## Thermal Information

|                                                    |                           |                      |
|----------------------------------------------------|---------------------------|----------------------|
| Thermal Resistance (Typical)                       | $\theta_{JA}$ (°C/W)      | $\theta_{JC}$ (°C/W) |
| 6 Ld SOT-23 Package ( <a href="#">Notes 5, 6</a> ) | 177                       | 95                   |
| Maximum Junction Temperature (Plastic Package)     | +150°C                    |                      |
| Maximum Storage Temperature Range                  | -65°C to +150°C           |                      |
| Pb-Free Reflow Profile                             | see <a href="#">TB493</a> |                      |

## Recommended Operating Conditions

|                                                             |                 |
|-------------------------------------------------------------|-----------------|
| Supply Voltage Range                                        | 1.8V to 3.3V    |
| Common-Mode Range; V <sub>CC</sub> = 1.8V                   | ±2V             |
| V <sub>CC</sub> ≥ 2.7V                                      | -7V to +12V     |
| Temperature Range (F Suffix)                                | -40°C to +125°C |
| Differential Load (R <sub>D</sub> ); V <sub>CC</sub> = 1.8V | ≥10kΩ           |
| V <sub>CC</sub> ≥ 2.7V                                      | ≥60Ω            |

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

### NOTES:

5.  $\theta_{JA}$  is measured with the component mounted on a high-effective thermal conductivity test board in free air. See [TB379](#) for details.
6. For  $\theta_{JC}$ , the "case temp" location is taken at the package top center.

## Electrical Specifications

V<sub>CC</sub> = 1.8V; typical values are at T<sub>A</sub> = +25°C; unless otherwise specified. **Boldface limits apply across the operating temperature range.** ([Note 7](#))

| PARAMETER                                                                                   | SYMBOL           | TEST CONDITIONS                                                                  |                                                | TEMP<br>(°C) | MIN<br>( <a href="#">Note 10</a> ) | TYP  | MAX<br>( <a href="#">Note 10</a> ) | UNIT |
|---------------------------------------------------------------------------------------------|------------------|----------------------------------------------------------------------------------|------------------------------------------------|--------------|------------------------------------|------|------------------------------------|------|
| DC CHARACTERISTICS                                                                          |                  |                                                                                  |                                                |              |                                    |      |                                    |      |
| Driver Differential V <sub>OUT</sub>                                                        | V <sub>OD</sub>  | R <sub>L</sub> = 100Ω ( <a href="#">Figure 4</a> )                               | V <sub>CC</sub> = 1.8V                         | Full         | <b>0.8</b>                         | 0.92 | -                                  | V    |
|                                                                                             |                  |                                                                                  | V <sub>CC</sub> ≥ 3.15V                        | Full         | <b>2</b>                           | -    | -                                  | V    |
|                                                                                             |                  | R <sub>L</sub> = 54Ω ( <a href="#">Figure 4</a> ), V <sub>CC</sub> ≥ 3V          |                                                | Full         | <b>1.5</b>                         | -    | -                                  | V    |
|                                                                                             |                  | No Load                                                                          |                                                | Full         | <b>1.1</b>                         | 1.45 | <b>V<sub>CC</sub></b>              | V    |
| Change in Magnitude of Driver Differential V <sub>OUT</sub> for Complementary Output States | ΔV <sub>OD</sub> | R <sub>L</sub> = 100Ω ( <a href="#">Figure 4</a> )                               |                                                | Full         | -                                  | 0.01 | <b>0.2</b>                         | V    |
| Driver Common-Mode V <sub>OUT</sub>                                                         | V <sub>OC</sub>  | R <sub>L</sub> = 100Ω ( <a href="#">Figure 4</a> )                               |                                                | Full         | -                                  | 1.1  | <b>1.4</b>                         | V    |
| Change in Magnitude of Driver Common-Mode V <sub>OUT</sub> for Complementary Output States  | ΔV <sub>OC</sub> | R <sub>L</sub> = 100Ω ( <a href="#">Figure 4</a> )                               |                                                | Full         | -                                  | 0.01 | <b>0.2</b>                         | V    |
| Logic Input High Voltage (DI, DE)                                                           | V <sub>IH</sub>  | V <sub>CC</sub> = 1.8V                                                           |                                                | Full         | <b>1.26</b>                        | -    | -                                  | V    |
|                                                                                             |                  | 2.7V ≤ V <sub>CC</sub> ≤ 3.6V                                                    |                                                | Full         | <b>2.2</b>                         | -    | -                                  | V    |
| Logic Input Low Voltage (DI, DE)                                                            | V <sub>IL</sub>  | V <sub>CC</sub> = 1.8V                                                           |                                                | Full         | -                                  | -    | <b>0.4</b>                         | V    |
|                                                                                             |                  | 2.7V ≤ V <sub>CC</sub> ≤ 3.6V                                                    |                                                | Full         | -                                  | -    | <b>0.8</b>                         | V    |
| Logic Input Current                                                                         | I <sub>IN</sub>  | DI = DE = 0V or V <sub>CC</sub> ( <a href="#">Note 9</a> )                       |                                                | Full         | <b>-2</b>                          | -    | <b>2</b>                           | μA   |
| Output Leakage Current (Y, Z, <a href="#">Note 9</a> )                                      | I <sub>OZ</sub>  | DE = 0V, V <sub>CC</sub> = 0V or 1.8V, or 3.6V                                   | V <sub>O</sub> = 7V at V <sub>CC</sub> = 1.8V  | Full         | -                                  | 0.1  | <b>30</b>                          | μA   |
|                                                                                             |                  |                                                                                  | V <sub>O</sub> = 12V at V <sub>CC</sub> = 3.6V | Full         | -                                  | 0.1  | <b>40</b>                          | μA   |
|                                                                                             |                  |                                                                                  | V <sub>O</sub> = -7V                           | Full         | <b>-40</b>                         | -8   | -                                  | μA   |
| Driver Short-Circuit Current, V <sub>O</sub> = High or Low ( <a href="#">Note 8</a> )       | I <sub>OS</sub>  | V <sub>CC</sub> = 1.8V, DE = V <sub>CC</sub> , -2V ≤ V <sub>O</sub> ≤ 2V         |                                                | Full         | -                                  | -    | <b>±250</b>                        | mA   |
|                                                                                             |                  | V <sub>CC</sub> ≥ 2.7V, DE = V <sub>CC</sub> , -7V ≤ V <sub>O</sub> ≤ 12V        |                                                | Full         | -                                  | ±150 | -                                  | mA   |
| SUPPLY CURRENT                                                                              |                  |                                                                                  |                                                |              |                                    |      |                                    |      |
| No-Load Supply Current                                                                      | I <sub>CC</sub>  | DE = V <sub>CC</sub> = 1.8V, DI = 0V or V <sub>CC</sub>                          |                                                | Full         | -                                  | 20   | <b>80</b>                          | μA   |
|                                                                                             |                  | DE = V <sub>CC</sub> , 2.7V ≤ V <sub>CC</sub> ≤ 3.6V, DI = 0V or V <sub>CC</sub> |                                                | Full         | -                                  | 100  | <b>150</b>                         | μA   |

**Electrical Specifications**  $V_{CC} = 1.8V$ ; typical values are at  $T_A = +25^\circ C$ ; unless otherwise specified. **Boldface limits apply across the operating temperature range. (Note 7) (Continued)**

| PARAMETER                                                     | SYMBOL                          | TEST CONDITIONS                                                                                 | TEMP<br>(°C)                | MIN<br>( <a href="#">Note 10</a> ) | TYP        | MAX<br>( <a href="#">Note 10</a> ) | UNIT        |      |
|---------------------------------------------------------------|---------------------------------|-------------------------------------------------------------------------------------------------|-----------------------------|------------------------------------|------------|------------------------------------|-------------|------|
| Shutdown Supply Current                                       | I <sub>SHDN</sub>               | 1.8V ≤ V <sub>CC</sub> ≤ 3.6V, DE = 0V, DI = 0V or V <sub>CC</sub>                              | Full                        | -                                  | 0.01       | <b>2</b>                           | μA          |      |
| ESD PERFORMANCE                                               |                                 |                                                                                                 |                             |                                    |            |                                    |             |      |
| RS-485 Pins (Y, Z)                                            |                                 | Human Body Model, from bus pins to GND                                                          | 25                          | -                                  | ±16.5      | -                                  | kV          |      |
|                                                               |                                 | IEC61000 Contact, from bus pins to GND                                                          | 25                          | -                                  | ±7         | -                                  | kV          |      |
| All Pins                                                      |                                 | HBM, per MIL-STD-883 Method 3015                                                                | 25                          | -                                  | ±8         | -                                  | kV          |      |
|                                                               |                                 | Machine Model                                                                                   | 25                          | -                                  | ±400       | -                                  | V           |      |
| DRIVER SWITCHING CHARACTERISTICS (ISL32613E, 128kbps Version) |                                 |                                                                                                 |                             |                                    |            |                                    |             |      |
| Maximum Data Rate                                             | f <sub>MAX</sub>                |                                                                                                 | V <sub>CC</sub> = 1.8V      | Full                               | <b>128</b> | -                                  | -           | kbps |
|                                                               |                                 |                                                                                                 | 3V ≤ V <sub>CC</sub> ≤ 3.6V | Full                               | <b>256</b> | -                                  | -           | kbps |
| Driver Differential Output Delay                              | t <sub>DD</sub>                 | C <sub>D</sub> = 50pF ( <a href="#">Figure 5</a> )                                              | V <sub>CC</sub> = 1.8V      | Full                               | -          | 1700                               | <b>2600</b> | ns   |
|                                                               |                                 |                                                                                                 | 3V ≤ V <sub>CC</sub> ≤ 3.6V | Full                               | -          | 1100                               | <b>1500</b> | ns   |
| Driver Differential Output Skew                               | t <sub>DSK</sub>                | C <sub>D</sub> = 50pF ( <a href="#">Figure 5</a> )                                              | V <sub>CC</sub> = 1.8V      | Full                               | -          | 30                                 | <b>200</b>  | ns   |
|                                                               |                                 |                                                                                                 | 3V ≤ V <sub>CC</sub> ≤ 3.6V | Full                               | -          | 2                                  | <b>30</b>   | ns   |
| Driver Differential Rise or Fall Time                         | t <sub>R</sub> , t <sub>F</sub> | C <sub>D</sub> = 50pF ( <a href="#">Figure 5</a> )                                              | V <sub>CC</sub> = 1.8V      | Full                               | -          | 1600                               | <b>2600</b> | ns   |
|                                                               |                                 |                                                                                                 | 3V ≤ V <sub>CC</sub> ≤ 3.6V | Full                               | <b>400</b> | 960                                | <b>1500</b> | ns   |
| Driver Enable to Output High                                  | t <sub>ZH</sub>                 | R <sub>L</sub> = 500Ω, C <sub>L</sub> = 50pF, SW = GND ( <a href="#">Figure 6</a> )             | Full                        | -                                  | 460        | <b>800</b>                         | ns          |      |
| Driver Enable to Output Low                                   | t <sub>ZL</sub>                 | R <sub>L</sub> = 500Ω, C <sub>L</sub> = 50pF, SW = V <sub>CC</sub> ( <a href="#">Figure 6</a> ) | Full                        | -                                  | 460        | <b>800</b>                         | ns          |      |
| Driver Disable from Output High                               | t <sub>HZ</sub>                 | R <sub>L</sub> = 500Ω, C <sub>L</sub> = 50pF, SW = GND ( <a href="#">Figure 6</a> )             | Full                        | -                                  | 60         | <b>250</b>                         | ns          |      |
| Driver Disable from Output Low                                | t <sub>LZ</sub>                 | R <sub>L</sub> = 500Ω, C <sub>L</sub> = 50pF, SW = V <sub>CC</sub> ( <a href="#">Figure 6</a> ) | Full                        | -                                  | 60         | <b>250</b>                         | ns          |      |
| DRIVER SWITCHING CHARACTERISTICS (ISL32614E, 256kbps Version) |                                 |                                                                                                 |                             |                                    |            |                                    |             |      |
| Maximum Data Rate                                             | f <sub>MAX</sub>                | R <sub>D</sub> = ∞, C <sub>D</sub> = 50pF                                                       | V <sub>CC</sub> = 1.8V      | Full                               | <b>256</b> | -                                  | -           | kbps |
|                                                               |                                 |                                                                                                 | 3V ≤ V <sub>CC</sub> ≤ 3.6V | Full                               | <b>500</b> | -                                  | -           | kbps |
| Driver Differential Output Delay                              | t <sub>DD</sub>                 | R <sub>D</sub> = ∞, C <sub>D</sub> = 50pF ( <a href="#">Figure 5</a> )                          | V <sub>CC</sub> = 1.8V      | Full                               | -          | 700                                | <b>2000</b> | ns   |
|                                                               |                                 |                                                                                                 | 3V ≤ V <sub>CC</sub> ≤ 3.6V | Full                               | -          | 350                                | <b>500</b>  | ns   |
| Driver Differential Output Skew                               | t <sub>DSK</sub>                | R <sub>D</sub> = ∞, C <sub>D</sub> = 50pF ( <a href="#">Figure 5</a> )                          | V <sub>CC</sub> = 1.8V      | Full                               | -          | 30                                 | <b>200</b>  | ns   |
|                                                               |                                 |                                                                                                 | 3V ≤ V <sub>CC</sub> ≤ 3.6V | Full                               | -          | 2                                  | <b>30</b>   | ns   |
| Driver Differential Rise or Fall Time                         | t <sub>R</sub> , t <sub>F</sub> | R <sub>D</sub> = ∞, C <sub>D</sub> = 50pF ( <a href="#">Figure 5</a> )                          | V <sub>CC</sub> = 1.8V      | Full                               | -          | 1700                               | <b>2600</b> | ns   |
|                                                               |                                 |                                                                                                 | 3V ≤ V <sub>CC</sub> ≤ 3.6V | Full                               | <b>200</b> | 350                                | <b>800</b>  | ns   |
| Driver Enable to Output High                                  | t <sub>ZH</sub>                 | R <sub>L</sub> = 500Ω, C <sub>L</sub> = 50pF, SW = GND ( <a href="#">Figure 6</a> )             | Full                        | -                                  | 460        | <b>800</b>                         | ns          |      |
| Driver Enable to Output Low                                   | t <sub>ZL</sub>                 | R <sub>L</sub> = 500Ω, C <sub>L</sub> = 50pF, SW = V <sub>CC</sub> ( <a href="#">Figure 6</a> ) | Full                        | -                                  | 460        | <b>800</b>                         | ns          |      |
| Driver Disable from Output High                               | t <sub>HZ</sub>                 | R <sub>L</sub> = 500Ω, C <sub>L</sub> = 50pF, SW = GND ( <a href="#">Figure 6</a> )             | Full                        | -                                  | 60         | <b>250</b>                         | ns          |      |
| Driver Disable from Output Low                                | t <sub>LZ</sub>                 | R <sub>L</sub> = 500Ω, C <sub>L</sub> = 50pF, SW = V <sub>CC</sub> ( <a href="#">Figure 6</a> ) | Full                        | -                                  | 60         | <b>250</b>                         | 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.
- Applies to peak current. See "Typical Performance Curves" on page 7 for more information.
- If the Driver Enable function is not needed, connect DE to  $V_{CC}$  through a 1k $\Omega$  to 2k $\Omega$  resistor.
- Compliance to datasheet limits is assured by one or more methods: production test, characterization, and/or design.

Test Circuits and Waveforms

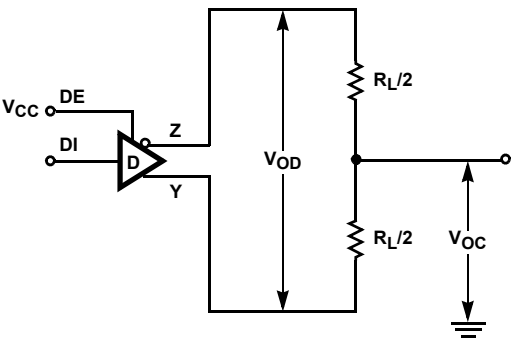


FIGURE 4. DC DRIVER TEST CIRCUITS

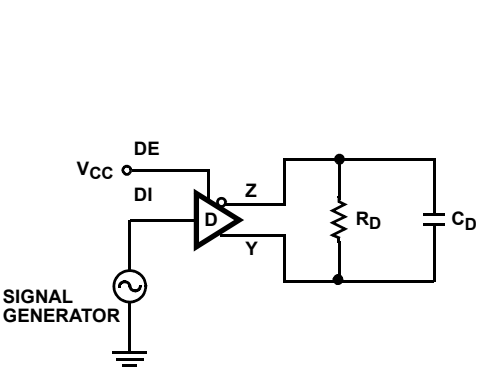


FIGURE 5A. TEST CIRCUIT

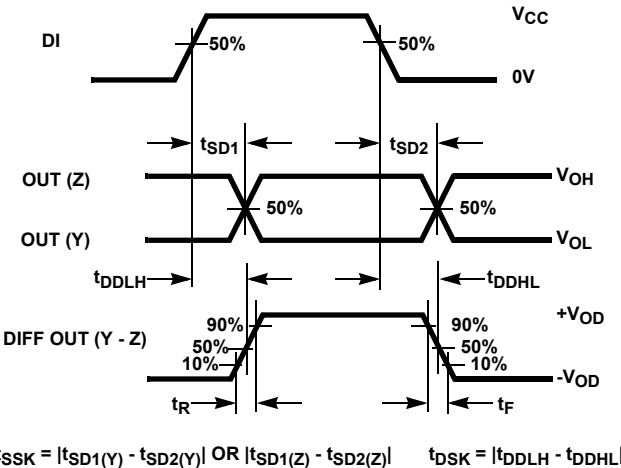
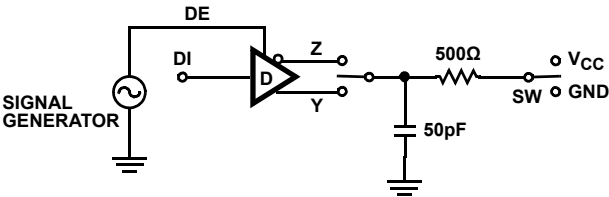


FIGURE 5B. MEASUREMENT POINTS

FIGURE 5. DRIVER PROPAGATION DELAY AND DIFFERENTIAL TRANSITION TIMES



| PARAMETER       | OUTPUT | DI  | SW              |
|-----------------|--------|-----|-----------------|
| t <sub>HZ</sub> | Y/Z    | 1/0 | GND             |
| t <sub>LZ</sub> | Y/Z    | 0/1 | V <sub>CC</sub> |
| t <sub>ZH</sub> | Y/Z    | 1/0 | GND             |
| t <sub>ZL</sub> | Y/Z    | 0/1 | V <sub>CC</sub> |

FIGURE 6A. TEST CIRCUIT

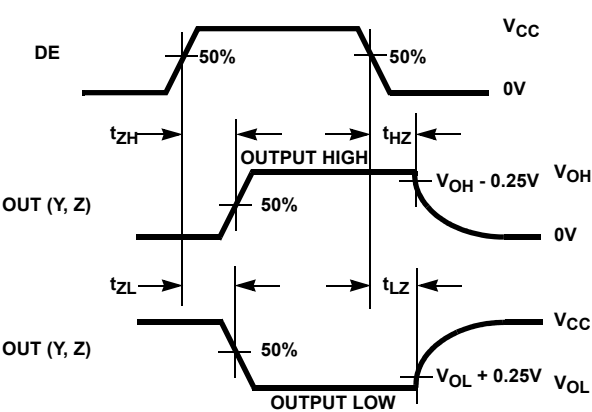


FIGURE 6B. MEASUREMENT POINTS

FIGURE 6. DRIVER ENABLE AND DISABLE TIMES

## Typical Performance Curves $V_{CC} = 1.8V$ , $T_A = +25^\circ C$ ; unless otherwise specified.

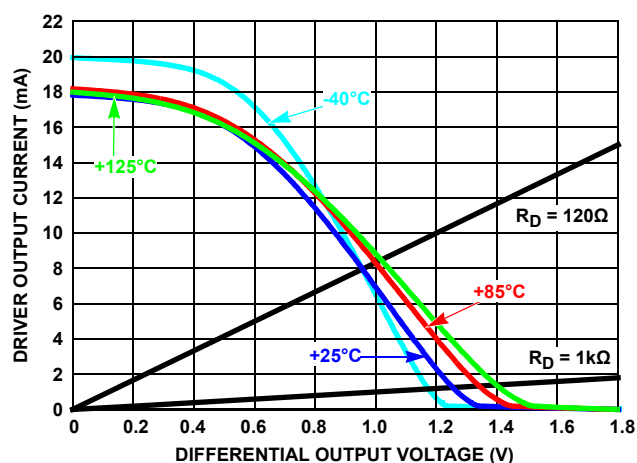


FIGURE 7. DRIVER OUTPUT CURRENT vs DIFFERENTIAL OUTPUT VOLTAGE

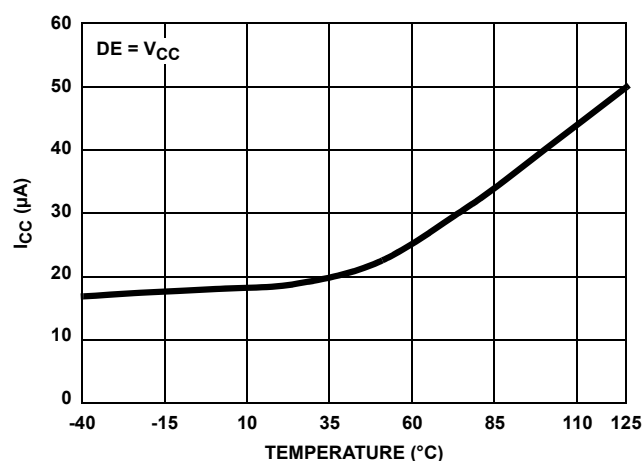


FIGURE 8. STATIC SUPPLY CURRENT vs TEMPERATURE

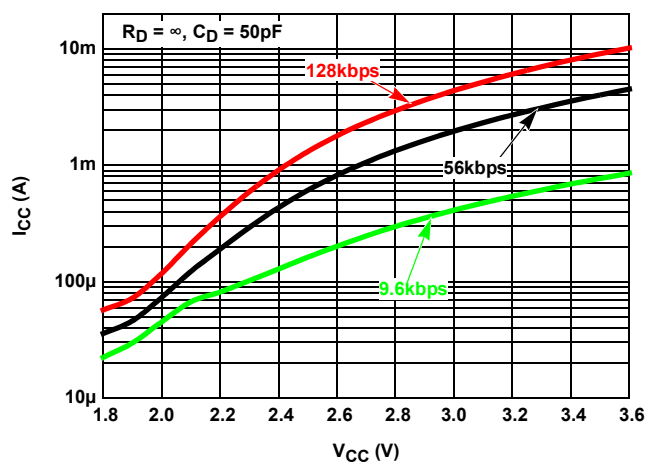


FIGURE 9. ISL32613E DYNAMIC SUPPLY CURRENT vs SUPPLY VOLTAGE AT DIFFERENT DATA RATES

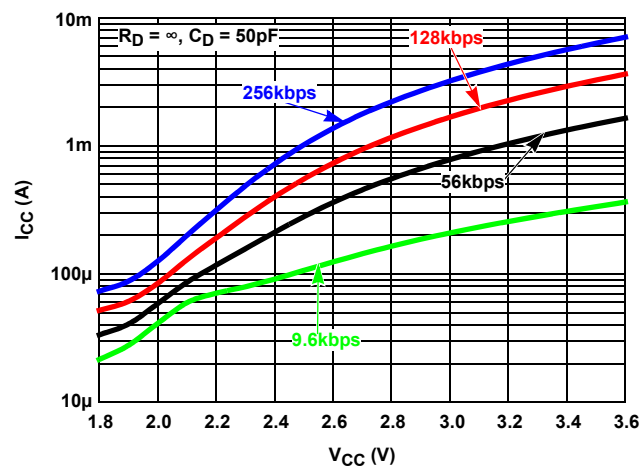


FIGURE 10. ISL32614E DYNAMIC SUPPLY CURRENT vs SUPPLY VOLTAGE AT DIFFERENT DATA RATES

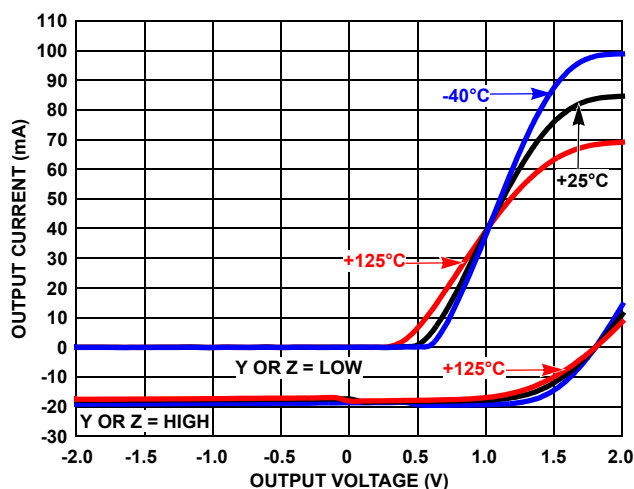


FIGURE 11. DRIVER OUTPUT CURRENT vs SHORT-CIRCUIT VOLTAGE

## Typical Performance Curves $V_{CC} = 1.8V$ , $T_A = +25^\circ C$ ; unless otherwise specified. (Continued)

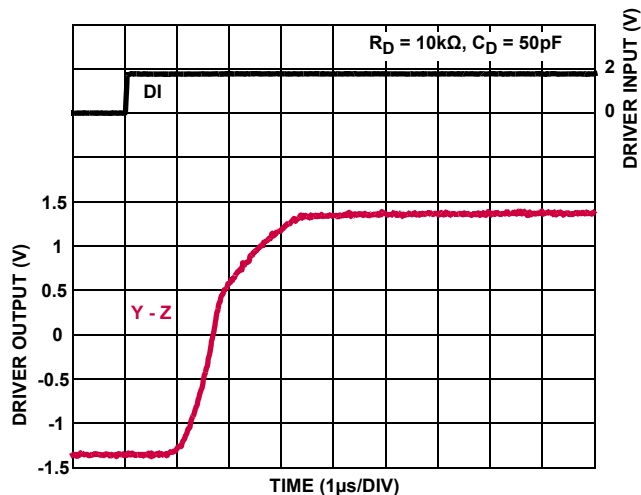


FIGURE 12. ISL32613E DRIVER WAVEFORMS, LOW-TO-HIGH

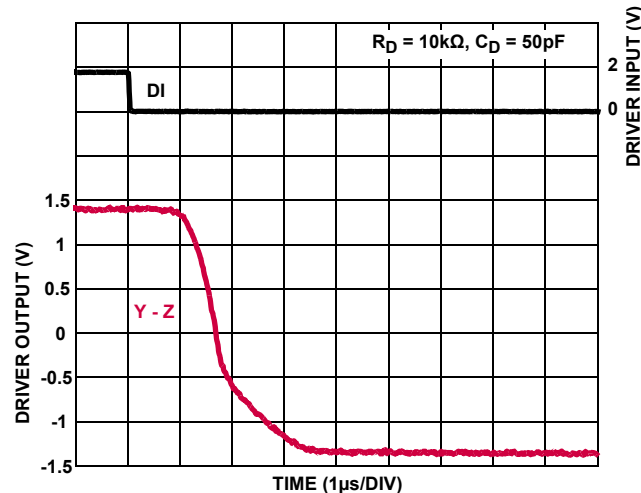


FIGURE 13. ISL32614E DRIVER WAVEFORMS, HIGH-TO-LOW

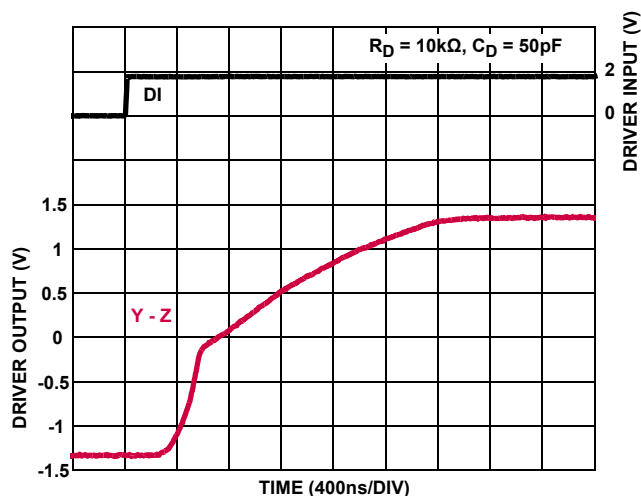


FIGURE 14. ISL32614E DRIVER WAVEFORMS, LOW-TO-HIGH

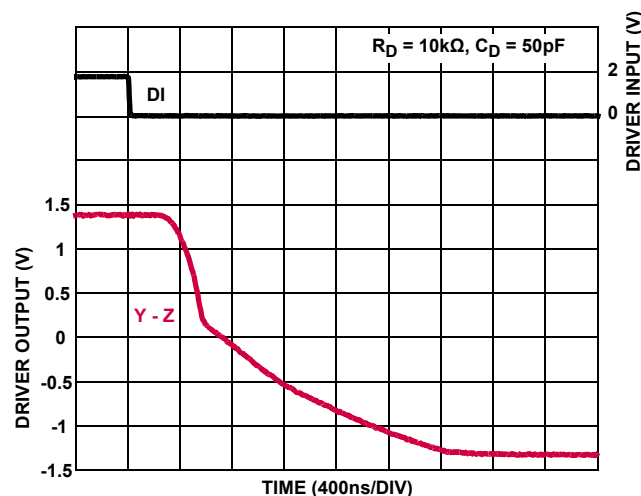


FIGURE 15. ISL32614E DRIVER WAVEFORMS, HIGH-TO-LOW

## Application Information

### Driver Features

The ISL32613E and ISL32614E transmitters are differential output devices that operate with  $V_{CC}$  as low as 1.8V and up to 3.6V. The devices are RS-485 compliant with  $V_{CC} \geq 3V$ , but significant power savings are obtained by operating at  $V_{CC} = 1.8V$ .

The transmitter outputs are tri-statable with the active high DE input. If the Tx enable function is not needed, tie DE to  $V_{CC}$  through a 1kΩ to 2kΩ resistor. Outputs are slew rate limited to minimize EMI and to reduce reflections in unterminated or improperly terminated networks.

### 1.8V Operation

The ISL32613E and ISL32614E operate with  $V_{CC}$  as low as 1.8V. When coupled with the ISL32610E or ISL32611E 1.8V receivers, they provide a differential communication link optimized for very low power and for slow data rates. Figures 9 and 10 illustrate the static and dynamic power savings from using these transmitters at low supply voltages. With  $V_{CC} = 1.8V$  rather than 3.3V, using the ISL32613E at 128kbps reduces the operating supply current from 9.9mA to 56μA (a factor of 177).

### 5.5V Tolerant Logic Pins

The logic input pins (DI and DE) contain no ESD or parasitic diodes to  $V_{CC}$ , so they withstand input voltages exceeding 5.5V, regardless of the  $V_{CC}$  voltage.

## Hot Plug Function

When a piece of equipment powers up, there is a period of time during when the processor or ASIC driving the RS-485 control line (DE) is unable to ensure that the RS-485 Tx 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 crashes, these transmitters incorporate a hot plug function. During power-up, circuitry monitoring  $V_{CC}$  ensures that the Tx outputs remain disabled for a period of time, regardless of the state of DE. The disabled Tx outputs allow the processor/ASIC a chance to stabilize and drive the control lines to the proper states.

## ESD Protection

All pins on these devices include Class 3 (8kV) Human Body Model (HBM) ESD protection structures, but the driver outputs incorporate advanced structures that allow them to survive ESD events in excess of  $\pm 16.5\text{kV}$  HBM and  $\pm 7\text{kV}$  to the IEC61000 contact test method. 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. Touching the port pins or connecting a cable can cause an ESD event that destroy unprotected ICs. The new ESD structures protect the device whether it is powered up or not, and without degrading the common-mode range. 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.

## Driver Overload Protection

The driver output stages incorporate short-circuit, current-limiting circuitry that ensures that the output current never exceeds the RS-485 specification over a  $\pm 2\text{V}$  ( $-7\text{V}$  to  $+12\text{V}$  for  $V_{CC} \geq 2.7\text{V}$ ) common mode voltage range.

The ISL32613E and ISL32614E's thermal shutdown feature disables the drivers whenever the die temperature becomes excessive in the event of a major short-circuit condition. Thermal shutdown eliminates power dissipation, allowing the die to cool. The drivers automatically reenables after the die temperature drops by about  $+20^\circ\text{C}$ . If the condition persists, the thermal shutdown/reenable cycle repeats until the fault is cleared.

## Low Power Shutdown Mode

Th BiCMOS transmitters use a fraction of the power required by its bipolar counterparts, but they also include a shutdown feature that reduces the already low quiescent  $I_{CC}$  to a 10nA trickle. These devices enter shutdown whenever the driver disables ( $DE = \text{GND}$ ).

## 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 visit our website to ensure you have the latest revision.

| DATE         | REVISION    | CHANGE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|--------------|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Sep 27, 2019 | FN7906.4.01 | Replaced Figures 2 and 3.<br>Removed Note on page 2.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Feb 14, 2019 | FN7906.4    | Updated both Typical Operating Circuits.<br>Updated links throughout document.<br>Updated disclaimer.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Jun 12, 2018 | FN7906.3    | Added Related Literature section on page 1.<br>Updated Ordering information table by switching Notes 1 and 2 and adding the tape and reel units column.<br>Removed military temperature range from Features on page 1.<br>Removed 55 °C curves from Figures 7 and 11 on page 8.<br>Removed About Intersil section and added Renesas disclaimer.                                                                                                                                                                                                                                                                                                                             |
| Jul 27, 2015 | FN7906.2    | Ordering Information Table on page 3: Removed part numbers ISL32614EMHZ-T and ISL32614EMHZ-T7A.<br>Recommended Operating Conditions table on page 4: Removed the line referencing "M Suffix".<br>Replaced "Product" section with "About Intersil" on page 10.                                                                                                                                                                                                                                                                                                                                                                                                               |
| May 2, 2012  | FN7906.1    | Page 1, "Features" - changed "Specified for +125 °C Operation" to "Specified for +125 °C or Full Mil Temperature Operation". Also changed Figure 1 title.<br>Page 2, added new part "ISL32614EMHZ-T" to the "Ordering Information".<br>Page 4, changed "Y, Z (V <sub>CC</sub> = 1.8V)" to "Y, Z (V <sub>CC</sub> = 1.8V, Output Enabled)" and added "Y, Z (V <sub>CC</sub> = 1.8V, Output Disabled)... -8V to +8V" under the "Absolute Maximum Rating". Also added "(F Suffix)" and "(M Suffix)...-55 °C to +125 °C" under the "Recommended Operating Conditions".<br>Page 8, replaced Figure 7 and added -55 °C curve to Figure 11 under the "Typical Performance Curves". |
| Aug 30, 2011 | FN7906.0    | Initial Release                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |

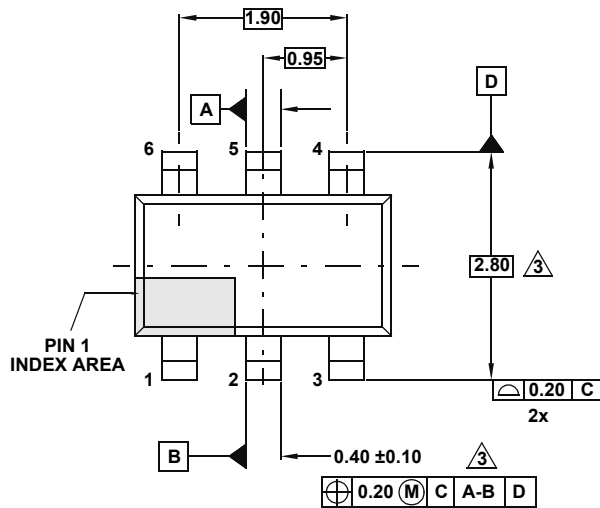
# Package Outline Drawing

For the most recent package outline drawing, see [P6.064](#).

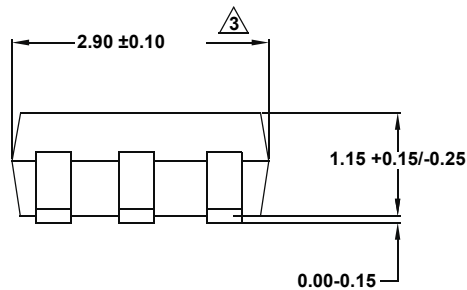
## P6.064

### 6 LEAD SMALL OUTLINE TRANSISTOR PLASTIC PACKAGE

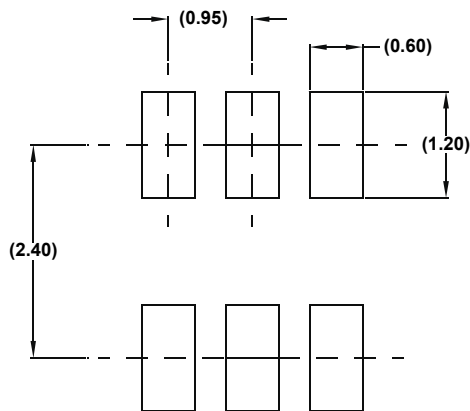
Rev 4, 2/10



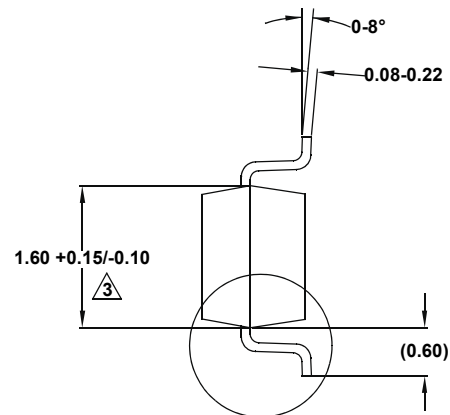
TOP VIEW



SIDE VIEW

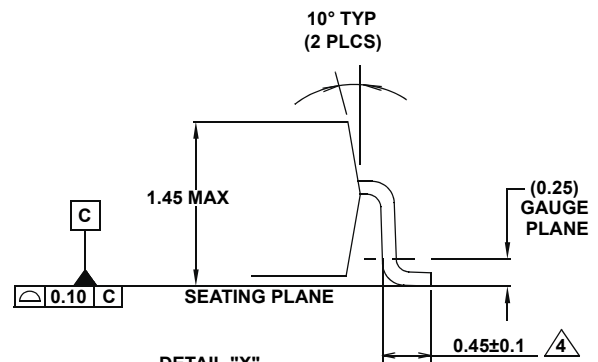


TYPICAL RECOMMENDED LAND PATTERN



SEE DETAIL X

END VIEW



DETAIL "X"

#### NOTES:

1. Dimensions are in millimeters.  
Dimensions in ( ) for Reference Only.
2. Dimensioning and tolerancing conform to ASME Y14.5M-1994.
3. Dimension is exclusive of mold flash, protrusions or gate burrs.
4. Foot length is measured at reference to gauge plane.
5. Package conforms to JEDEC MO-178AB.

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