

Fail-Safe,Slew-Rate-Limited RS-485/RS-422 Transceivers

■ Description

The TK3087 is interface transceiver of serial data under RS-485 standard with low power consumption. The TK3087 features reduced slew-rate drivers that minimize EMI and reduce reflections caused by improperly terminated cables, allowing error-free data transmission up to 10Mbps. It is intended for full-duplex communications.

The TK3087 is purposed for application in telecom systems under RS485/RS422 standards with low power dissipation, translators of the level, transceiving devices sensitive to electromagnetic radiation, industrial control systems.

■ Features

- Allows up to 256 transceivers on the bus
- Supply voltage range: $5.0V \pm 5\%$
- Operating temperature range: $-40 \sim +85^{\circ}C$
- Data rate: 10Mbps
- Full-duplex communications
- Latch current, min – 300mA at normal climatic condition
- Enhanced ESD Specifications(EC&EE_ only):
 $\pm 15kV$ IEC61000-4-2 Air Discharge
 $\pm 8kV$ IEC61000-4-2 Contact Discharge

■ Ordering Information

| Part Number | Package | Packing | Temperature(TA) | Package Qty | ESD |
|-------------|---------|---------|---------------------------------|-------------|------------|
| TK3087CSA | SOIC-8 | Reel | $0^{\circ}C \sim 70^{\circ}C$ | 2500 | |
| TK3087ESA | SOIC-8 | Reel | $-40^{\circ}C \sim 85^{\circ}C$ | 2500 | |
| TK3087ECSA | SOIC-8 | Reel | $0^{\circ}C \sim 70^{\circ}C$ | 2500 | $\pm 15KV$ |
| TK3087EESA | SOIC-8 | Reel | $-40^{\circ}C \sim 85^{\circ}C$ | 2500 | $\pm 15KV$ |

■ Pin Description

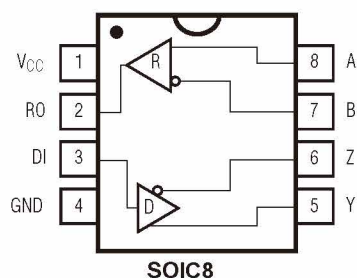


Table 1. Pin Description

| Pin Num | Symbol | Pin Description |
|---------|-----------------|--|
| 01 | V _{CC} | Positive Supply $4.75V \leq V_{CC} \leq 5.25V$ |
| 02 | RO | Receiver Output. When \overline{RE} is low and if $A - B \geq -50mV$, RO will be high; if $A - B \leq -200mV$, RO will be low. |
| 03 | DI | Driver Input. With DE high, a low on DI forces noninverting output low and inverting output high. Similarly, a high on DI forces non-inverting output high and inverting output low. |
| 04 | GND | Ground |
| 05 | Y | Noninverting Driver Output |
| 06 | Z | Inverting Driver Output |
| 07 | B | Inverting Receiver Input |
| 08 | A | Noninverting Receiver Input |

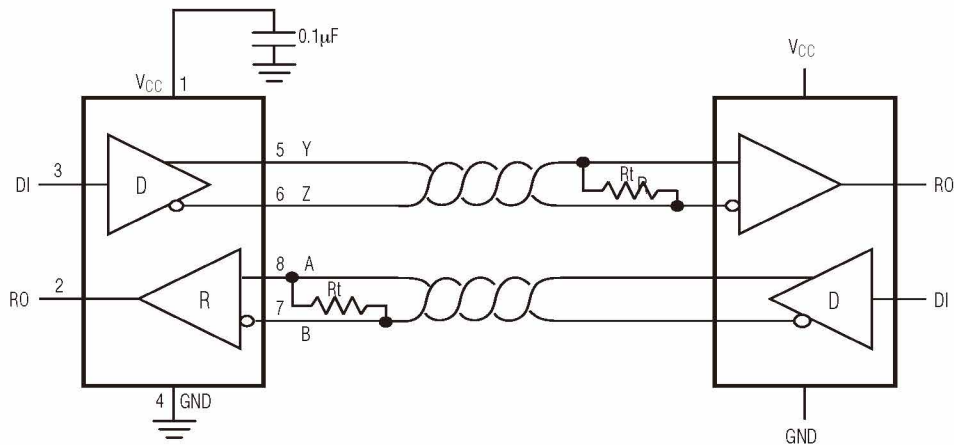
Typical Full-Duplex Operating Circuit


Table 2. Transmitter Truth Table

| TRANSMITTING | | |
|--------------|---------|---|
| INPUT | OUTPUTS | |
| DI | Z | Y |
| H | L | H |
| L | H | L |

Note : H – high level, L – low level , X –don't care

Table 3. Receiver Truth Table

| RECEIVING | |
|---------------|--------|
| INPUTS | OUTPUT |
| A - B | RO |
| $\geq -0.05V$ | H |
| $\leq -0.2V$ | L |
| Open/shorted | H |

Note : H – high level, L – low level , BH – inputs not used, X –don't care

Table 4. Maximum Ratings

| Parameter | Limit | | Unit |
|---|-------|-----------------------|------|
| | min | max | |
| Supply Voltage (V _{CC}) | | 7.0 | V |
| Driver Input Voltage (DI) | 0.3 | V _{CC} + 0.3 | V |
| Driver Output Voltage (A, B, Y, Z) | -13 | 13 | V |
| Receiver Input Voltage, Full Duplex (A, B) | -25 | 25 | V |
| Receiver Output Voltage (RO) | 0.3 | V _{CC} + 0.3 | V |
| Continuous Power Dissipation (T _A = +70°C) | | 471 | mW |

Table 5. Electrical Parameters
 $(V_{CC} = 5V \pm 5\%)$

| PARAMETER | SYMBOL | CONDITIONS | | MIN | TYP | MAX | UNITS |
|--|-----------------|--|----------------|----------------|------|--------------|-------|
| DRIVER | | | | | | | |
| Differential Driver Output (no load) | V_{OD1} | Fig 1 | | | | 5 | V |
| Differential Driver Output | V_{OD2} | Fig 1, R = 50Ω (RS-422) | | 2.0 | | | V |
| | | Fig 1, R = 27Ω (RS-485) | | 1.5 | | | |
| Change in Magnitude of Differential Output Voltage | ΔV_{OD} | Fig 1, R = 50Ω or R = 27Ω | | | | 0.2 | V |
| Driver Common-Mode Output Voltage | V_{OC} | Fig 1, R = 50Ω or R = 27Ω | | | | 3 | V |
| Change In Magnitude of Common-Mode Voltage) | ΔV_{OC} | Fig 1, R = 50Ω or R = 27Ω | | | | 0.2 | V |
| Input High Voltage | V_{IH1} | DE, DI, \overline{RE} , H/ \overline{F} , TXP, RXP | | 2.0 | | | V |
| Input Low Voltage | V_{IL1} | DE, DI, \overline{RE} , H/ \overline{F} , TXP, RXP | | | | 0.8 | V |
| DI Input Hysteresis | V_{HYS} | MAX3080–MAX3085, and MAX3089 with SRL = V_{CC} or unconnected | | | 100 | | mV |
| SRL Input Current | I_{IN1} | DE, DI, \overline{RE} | | | | ±2 | μA |
| | I_{IN2} | H/ \overline{F} , TXP, RXP, internal pulldown | | 10 | | 40 | |
| Input High Voltage | V_{IH2} | SRL | | $V_{CC} - 0.8$ | | | V |
| Input Middle Voltage | V_{IM2} | SRL | | 0.4 V_{CC} | | 0.6 V_{CC} | V |
| Input Low Voltage | V_{IL2} | SRL | | | | 0.8 | V |
| SRL Input Current | I_{IN3} | SRL = V_{CC} | | | | 75 | μA |
| | | SRL = GND | | -75 | | | |
| Input Current (A and B) Full Duplex | I_{IN4} | DE = GND, $V_{CC} = GND$ or 5.25V | $V_{IN} = 12V$ | | | 125 | μA |
| | | | $V_{IN} = -7V$ | | | -75 | |
| Output Leakage (Y and Z) Full Duplex | I_O | DE = GND, $V_{CC} = GND$ or 5.25V | $V_{IN} = 12V$ | | | 125 | μA |
| | | | $V_{IN} = -7V$ | -100 | | | |
| Driver Short-Circuit Output Current | V_{OD1} | $-7V \leq V_{OUT} \leq V_{CC}$ | | -250 | | | mA |
| | | $0V \leq V_{OUT} \leq 12V$ | | | | 250 | |
| | | $0V \leq V_{OUT} \leq V_{CC}$ | | ±25 | | | |
| RECEIVER | | | | | | | |
| Receiver Differential Threshold Voltage | V_{TH} | $-7V \leq V_{CM} \leq +12V$ | | -200 | -125 | -50 | mV |
| Receiver Input Hysteresis | ΔV_{TH} | | | | 25 | | mV |
| Receiver Output High Voltage | V_{OH} | $I_O = -4mA, V_{ID} = -50mV$ | | $V_{CC} - 1.5$ | | | V |
| Receiver Output Low Voltage | V_{OL} | $I_O = 4mA, V_{ID} = -200mV$ | | | | 0.4 | V |
| Three-State Output Current at Receiver | I_{OZR} | $0.4V \leq V_O \leq 2.4V$ | | | | ±1 | μA |
| | R_{IN} | | | 96 | | | kΩ |
| Receiver Output Short-Circuit Current | I_{OSR} | $0V \leq V_{RO} \leq V_{CC}$ | | ±7 | | ±95 | mA |
| SUPPLY CURRENT | | | | | | | |
| Supply Current | I_{CC} | No load, $\overline{RE} = DI = GND$ or V_{CC} , SRL = V_{CC} | DE = V_{CC} | | 430 | 900 | μA |
| | | | DE = GND | | 375 | 600 | |
| | | No load, $\overline{RE} = DI = GND$ or V_{CC} , SRL = GND | DE = V_{CC} | | 475 | 1000 | μA |
| | | | DE = GND | | 420 | 800 | |
| Supply Current in Shutdown Mode | I_{SHDN} | DE = GND, $V_{\overline{RE}} = V_{CC}$ | | 0.001 | | 10 | μA |
| ESD Protection for Y, Z, A, B | | Human Body Model (TK3086E_) | | | ±15 | | kV |

Table 6. SWITCHING CHARACTERISTICS

 (V_{CC} = +5V ±5%, T_A = T_{MIN} to T_{MAX}, Typical values are at V_{CC} = +5V and T_A = +25°C.)

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS |
|--|--|---|-----|------|------|-------|
| Driver Input-to-Output | t _{DPLH} | Fig 3 and 5, R _{DIFF} = 54Ω, C _{L1} = C _{L2} = 100pF | | 34 | 60 | ns |
| | t _{DPHL} | | | 34 | 60 | |
| Driver Output Skew t _{DPLH} - t _{DPHL} | t _{DSKEW} | Fig 3 and 5, R _{DIFF} = 54Ω, C _{L1} = C _{L2} = 100pF | | -2.5 | ±10 | ns |
| Driver Rise or Fall Time | t _{DR} , t _{DF} | Fig 3 and 5, R _{DIFF} = 54Ω, C _{L1} = C _{L2} = 100pF | | 14 | 25 | ns |
| Maximum Data Rate | f _{MAX} | | 10 | | | Mbps |
| Driver Enable to Output High | t _{DZH} | Fig 4 and 6, C _L = 100pF, S2 closed | | | 150 | ns |
| Driver Enable to Output Low | t _{DZL} | Fig 4 and 6, C _L = 100pF, S1 closed | | | 150 | ns |
| Driver Disable Time from Low | t _{DLZ} | Fig 4 and 6, C _L = 15pF, S1 closed | | | 100 | ns |
| Driver Disable Time from High | t _{DHZ} | Fig 4 and 6, C _L = 15pF, S2 closed | | | 100 | ns |
| Receiver Input to Output | t _{RPLH} , t _{RPHL} | Fig 7 and 9; V _{ID} ≥ 2.0V; rise and fall time of V _{ID} ≤ 15ns | | 106 | 150 | ns |
| t _{RPLH} - t _{RPHL} Differential Receiver Skew | t _{RSKD} | Fig 7 and 9; V _{ID} ≥ 2.0V; rise and fall time of V _{ID} ≤ 15ns | | 0 | ±10 | ns |
| | | | | | | |
| | t _{RZL} | Fig 2 and 8, C _L = 100pF, S1 closed | | 20 | 50 | ns |
| Receiver Enable to Output High | t _{RZH} | Fig 2 and 8, C _L = 100pF, S2 closed | | 20 | 50 | ns |
| Receiver Disable Time from Low | t _{RLZ} | Fig 2 and 8, C _L = 100pF, S1 closed | | 20 | 50 | ns |
| Receiver Disable Time from High | t _{RHZ} | Fig 2 and 8, C _L = 100pF, S2 closed | | 20 | 50 | ns |
| Time to Shutdown | t _{SHDN} | (Note 5) | 50 | 200 | 600 | ns |
| Driver Enable from Shutdown-to-Output High | t _{DZH(SHDN)} | Fig 4 and 6, C _L = 15pF, S2 closed | | | 250 | ns |
| Driver Enable from Shutdown-to-Output Low | t _{DZL(SHDN)} | Fig 4 and 6, C _L = 15pF, S1 closed | | | 250 | ns |
| Receiver Enable from Shutdown-to-Output High | t _{RZH(SHDN)} | Fig 2 and 8, C _L = 100pF, S2 closed | | | 3500 | ns |
| Receiver Enable from Shutdown-to-Output Low | t _{RZL(SHDN)} | Fig 2 and 8, C _L = 100pF, S1 closed | | | 3500 | ns |

Note 1: The device is put into shutdown by bringing \overline{RE} high and DE low. If the enable inputs are in this state for less than 50ns, The device is guaranteed not to enter shutdown. If the enable inputs are in this state for at least 600ns, the device is guaranteed to have entered shutdown.

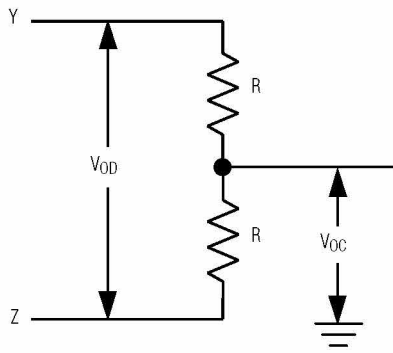


Fig 1. Driver DC Test Load

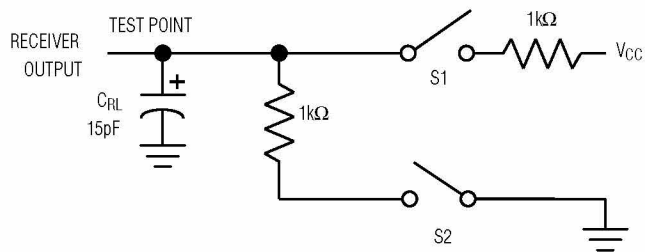


Fig 2. Receiver Enable/Disable Timing Test Load

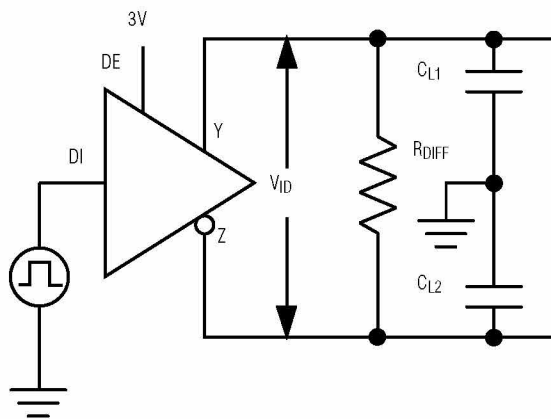


Fig 3. Driver Timing Test Circuit

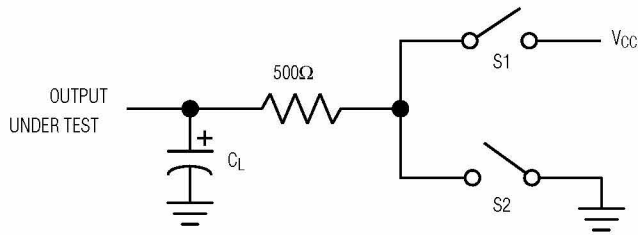


Fig 4 Driver Enable/Disable Timing Test Load

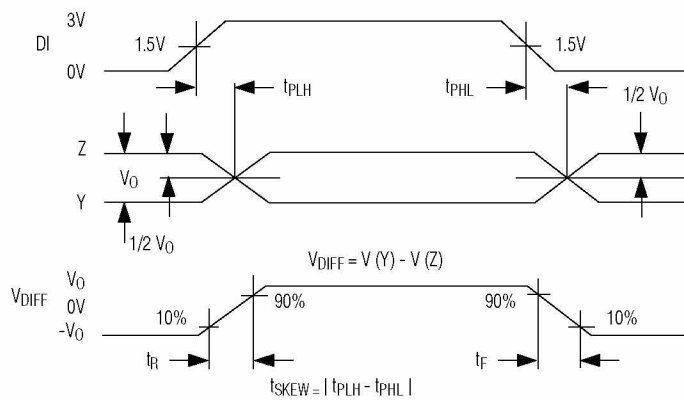


Fig 5. Driver Propagation Delays

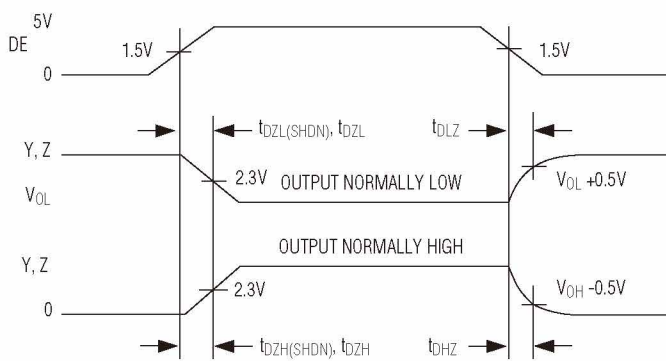


Fig 6. Driver Enable and Disable Times

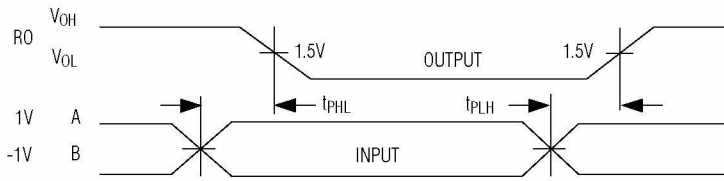


Fig 7. Receiver Propagation Delays

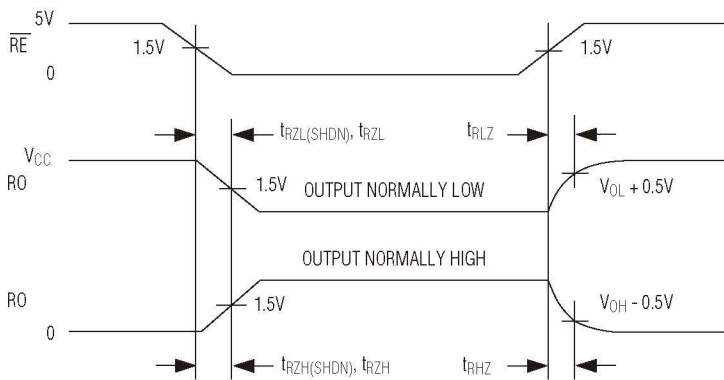


Fig 8. Receiver Enable and Disable Times

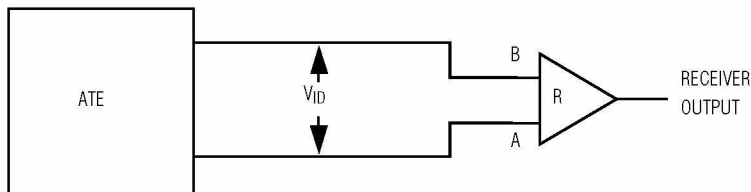


Fig 9. Receiver Propagation Delay Test Circuit

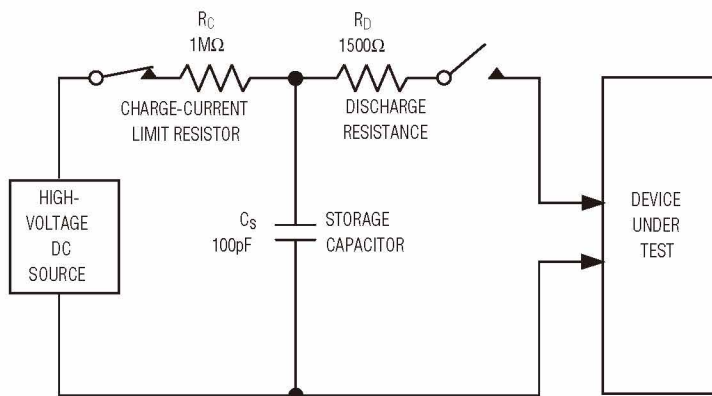
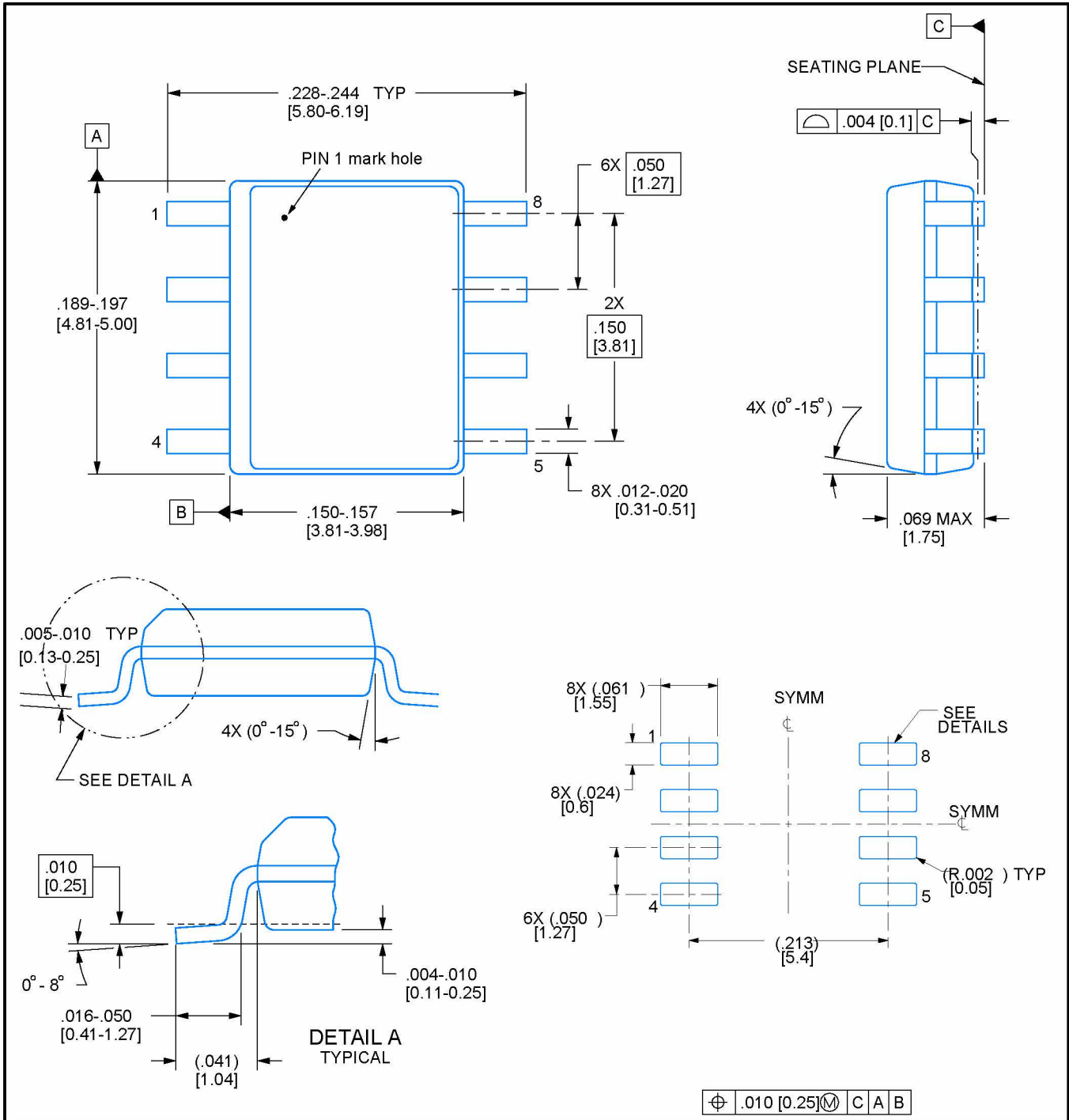


Fig 10. Human Body ESD Test Model

PACKAGE OUTLINE SOIC - 8, 1.75 mm max height



NOTES: Linear dimensions are in inches [millimeters]. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed .006 [0.15] per side.