

Features

- Exceeds Requirements of EIA-485 Standard
- Hot Plug Circuitry – Tx and Rx Outputs Remain Three-State during Power-up/Power-down
- Data Rate: 500 Kbps
- Up to 256 Nodes on a Bus (1/8 Unit Load) at 500 kbps
- Full Fail-Safe Receiver (Open, Short, and Terminated)
- Wide Supply Voltage: 3 V to 5.5 V
- Bus-Pin Protection:
 - ± 18 -kV HBM ESD
 - ± 15 -kV IEC61000-4-2 Contact Discharge
 - ± 18 -kV IEC61000-4-2 Air Discharge
- Operation Temperature Range: -40°C to 125°C

Applications

- Motor Drives
- Industrial Control
- Communication Infrastructure

Description

The TPT487 is a series of IEC 61000 ESD-protected, 3-V to 5.5-V powered transceivers that meet the RS-485 and RS-422 standards for balanced communication.

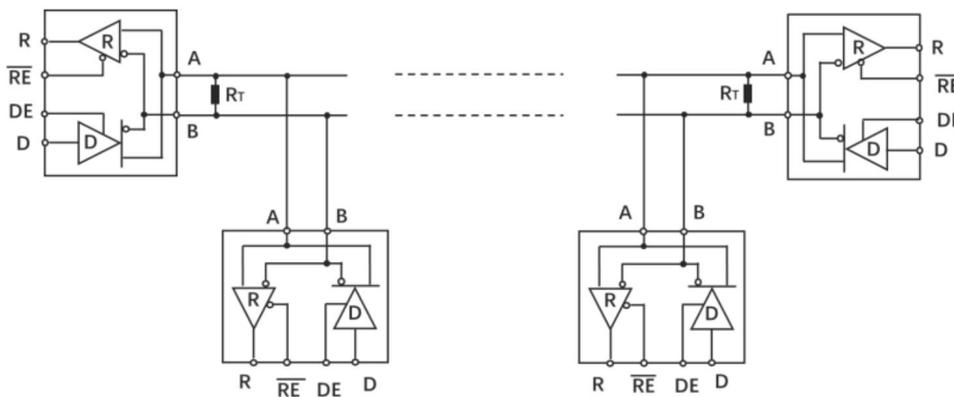
Transmitters in this family deliver exceptional differential output voltages into the RS-485 required $54\text{-}\Omega$ load. These 500-kbps devices have very low bus currents, so they present a true "1/8 unit load" to the RS-485 bus. This allows up to 256 transceivers on the network without using repeaters. Receiver (Rx) inputs feature a "Full Fail-Safe" design, which ensures a logic-high Rx output if Rx inputs are floating, shorted, or on a terminated but undriven bus.

The TPT487 transceivers are designed for half-duplex RS-485, and support the SOP8, MSOP8, and DFN3X3-8 packages, which are characterized from -40°C to 125°C .

Device Table

| Part | Duplex | Enable | Data Rate | Nodes |
|--------|--------|--------|-----------|-------|
| TPT487 | Half | Yes | 500 Kbps | 256 |

Typical Application Circuit



TPT487 Network

Table of Contents

| | |
|---|-----------|
| Features | 1 |
| Applications | 1 |
| Description | 1 |
| Device Table | 1 |
| Typical Application Circuit | 1 |
| Revision History | 3 |
| Pin Configuration and Functions | 4 |
| Functional Table..... | 5 |
| Specifications | 6 |
| Absolute Maximum Ratings ⁽¹⁾ | 6 |
| Recommended Operating Conditions..... | 6 |
| ESD, Electrostatic Discharge Protection..... | 7 |
| Thermal Information..... | 7 |
| Electrical Characteristics..... | 8 |
| Switching Characteristics..... | 10 |
| Test Circuits and Waveforms..... | 11 |
| Detailed Description | 14 |
| Functional Block Diagram..... | 14 |
| Application and Implementation | 15 |
| Typical Application..... | 15 |
| Tape and Reel Information | 16 |
| Package Outline Dimensions | 17 |
| SOP8..... | 17 |
| MSOP8..... | 18 |
| DFN3X3-8..... | 19 |
| Order Information | 20 |
| IMPORTANT NOTICE AND DISCLAIMER | 21 |

Revision History

| Date | Revision | Notes |
|------------|-----------|--|
| 2019-01-14 | Rev.Pre.0 | Initial version. |
| 2019-06-15 | Rev.Pre.1 | Updated the package information. |
| 2019-09-17 | Rev.A.0 | Released version. |
| 2020-03-20 | Rev.A.1 | Updated the Absolute Maximum Ratings. |
| 2023-05-10 | Rev.A.2 | Added the Thermal Information. |
| 2024-12-24 | Rev.A.3 | Updated to a new datasheet format. Updated the POD. Added Tape and Reel Information. |
| 2025-05-29 | Rev.A.4 | Updated E-pad Information. |
| 2025-07-29 | Rev.A.5 | Updated the features description. Updated the functional table description. |

Pin Configuration and Functions

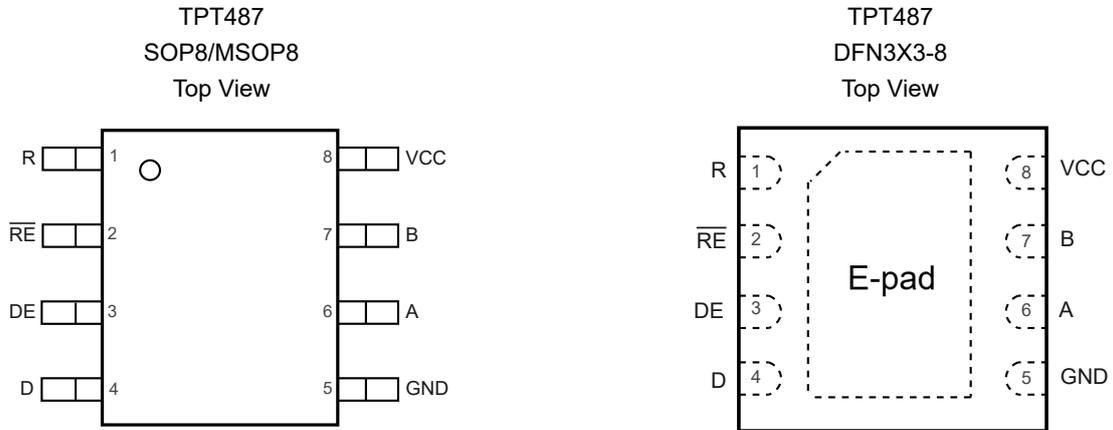


Table 1. Pin Functions

| Pin No. | Name | I/O | Description |
|---------|-----------------|------------------|---|
| 1 | R | Digital Output | Receiver output. |
| 2 | \overline{RE} | Digital Input | Receiver output enable. |
| 3 | DE | Digital Input | Driver output enable. |
| 4 | D | Digital Input | Driver input. |
| 5 | GND | Ground | Ground. |
| 6 | A | Bus Input/Output | Non-inverting receiver input A and non-inverting driver output A. |
| 7 | B | Bus Input/Output | Inverting receiver input B and inverted driver output B. |
| 8 | V _{CC} | Power | Power supply. |
| | E-pad | | Thermal pad, connect to GND for optimal thermal performance |

Functional Table
Driver Function Table

| Input | Enable | Outputs | Outputs | Description |
|-------|--------|---------|---------|------------------------------------|
| D | DE | A | B | |
| H | H | H | L | Actively drive bus High |
| L | H | L | H | Actively drive bus Low |
| X | L | Z | Z | Driver disabled |
| X | OPEN | Z | Z | Driver disabled by default |
| OPEN | H | H | L | Actively drive bus High by default |

Receiver Function Table

| Input | Input | Output | Description |
|------------------------------|-----------------|--------|------------------------------|
| $V_{ID} = V_A - V_B$ | \overline{RE} | R | |
| $V_{ID} > V_{IT+}$ | L | H | Receive valid bus High |
| $V_{IT-} < V_{ID} < V_{IT+}$ | L | ? | Indeterminate bus state |
| $V_{ID} < V_{IT-}$ | L | L | Receive valid bus Low |
| X | H | Z | Receiver disabled |
| X | Open | Z | Receiver disabled by default |
| Open | L | H | Fail-safe high output |
| Short | L | H | Fail-safe high output |
| Idle (Terminated) | L | H | Fail-safe high output |

(1) X = don't care.

(2) Z = high impedance.

Specifications

Absolute Maximum Ratings ⁽¹⁾

| Parameter | | Min | Max | Unit |
|---|--------------------------------------|------|-----------------------|------|
| V _{CC} to GND | | -0.3 | 7 | V |
| Voltage at Logic Pin: D, DE, \overline{RE} , R ⁽²⁾ | | -0.3 | V _{CC} + 0.3 | V |
| Voltage at Bus Pin: A, B as Receiver and Idle | | -15 | 15 | V |
| Voltage at Bus pin: A, B as Driver | | -8 | 13 | V |
| T _A | Operating Temperature Range | -40 | 125 | °C |
| T _{STG} | Storage Temperature Range | -65 | 150 | °C |
| T _J | Maximum Junction Temperature | | 150 | °C |
| T _L | Lead Temperature (Soldering, 10 sec) | | 260 | °C |

(1) Stresses beyond the Absolute Maximum Ratings may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under Recommended Operating Conditions.

Recommended Operating Conditions

All test conditions: over operating free-air temperature range, unless otherwise noted.

| Parameter | | Min | Typ | Max | Unit |
|-----------------|---|-----|-----|-----------------|------|
| V _{CC} | Supply Voltage | 3 | | 5.5 | V |
| V _I | Input Voltage at Any Bus Terminal ⁽¹⁾ | -7 | | 12 | V |
| V _{IH} | High-Level Input Voltage (Driver, Driver Enable, and Receiver Enable Inputs) | 2 | | V _{CC} | V |
| V _{IL} | Low-Level Input Voltage (Driver, Driver Enable, and Receiver Enable Inputs) | 0 | | 0.8 | V |
| V _{ID} | Differential Input Voltage | -7 | | 12 | V |
| R _L | Differential Load Resistance | 54 | | | Ω |
| T _A | Operating Ambient Temperature | -40 | | 125 | °C |
| T _J | Junction Temperature | -40 | | 150 | °C |

(1) The algebraic convention in which the least positive (most negative) limit is designated as the minimum is used in this data sheet.

ESD, Electrostatic Discharge Protection

| Symbol | Parameter | Condition | | Minimum Level | Unit |
|--------|--------------------------|--|-----------------------------|---------------|------|
| | Contact Discharge | IEC-61000-4-2 | Bus Pins | 15 | kV |
| | Air-Gap Discharge | IEC-61000-4-2 | Bus Pins | 18 | kV |
| HBM | Human Body Model ESD | ANSI/ESDA/JEDEC JS-001/ ANSI/ESD STM5.5.1 | Bus Pins | 18 | kV |
| | | | All Pins except Bus Pins | 4 | kV |
| CDM | Charged Device Model ESD | ANSI/ESDA/JEDEC JS-002 ⁽¹⁾ | All Pins | 1.5 | kV |

(1) JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process.

Thermal Information

| Package Type | θ_{JA} | θ_{JC} | Unit |
|--------------|---------------|---------------|------|
| SOP8 | 120 | 64 | °C/W |
| MSOP8 | 135 | 68 | °C/W |
| DFN3X3-8 | 65 | 23 | °C/W |

Electrical Characteristics

All test conditions: $V_{CC} = 5\text{ V}$, over operating free-air temperature range, unless otherwise noted.

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit | |
|------------------|--|---|-------------------------------|----------------|------------|------|----|
| Driver | | | | | | | |
| $ V_{OD} $ | Driver Differential-Output Voltage Magnitude, $V_{CC} = 3.3\text{ V}$ | $R_L = 60\ \Omega$, $-7\text{ V} \leq V_{\text{test}} \leq +12\text{ V}$ | See Figure 1B | 1.5 | 2.3 | | V |
| | | $R_L = 54\ \Omega$ (RS-485) | See Figure 1A | 1.5 | 2.2 | | |
| | | $R_L = 100\ \Omega$ (RS-485) | | 2.0 | 2.6 | | |
| | Driver Differential-Output Voltage Magnitude, $V_{CC} = 5.0\text{ V}$ | $R_L = 60\ \Omega$, $-7\text{ V} \leq V_{\text{test}} \leq +12\text{ V}$ | See Figure 1B | 2.0 | 3.5 | | |
| | | $R_L = 54\ \Omega$ (RS-485) | See Figure 1A | 2.0 | 3.4 | | |
| | | $R_L = 100\ \Omega$ (RS-485) | | 2.7 | 3.9 | | |
| $\Delta V_{OD} $ | Change in Magnitude of Driver Differential-Output Voltage | $R_L = 54\ \Omega$, $C_L = 50\text{ pF}$ | See Figure 1A | -50 | | 50 | mV |
| | | $R_L = 100\ \Omega$, $C_L = 50\text{ pF}$ | See Figure 1A | -50 | | 50 | |
| $V_{OC(SS)}$ | Steady-State Common-Mode Output Voltage | Center of two 27- Ω load resistors | See Figure 1A | 1 | $V_{CC}/2$ | 3 | V |
| ΔV_{OC} | Change in Differential Driver Common-Mode Output Voltage | | | -65 | | 65 | mV |
| $V_{OC(PP)}$ | Peak-to-Peak Driver Common-Mode Output Voltage | | | | 600 | | |
| $ I_{OS} $ | Driver Short-Circuit Output Current | $ I_{OS} $ with A shorted to B | | 86 | 110 | mA | |
| | | $ I_{OS} $ with -7 V to +12 V | -220 | | 220 | | |
| Receiver | | | | | | | |
| V_{IT+} | Positive-Going Receiver Differential-Input Voltage Threshold | | | -100 | -15 | mV | |
| V_{IT-} | Negative-Going Receiver Differential-Input Voltage Threshold | | -240 | -150 | | mV | |
| $V_{HYS}^{(1)}$ | Receiver Differential-Input Voltage Threshold Hysteresis ($V_{IT+} - V_{IT-}$) | | | 60 | | mV | |
| V_{IH} | Logic Input High Voltage | DI, DE, \overline{RE} | 2 | | | V | |
| V_{IL} | Logic Input Low Voltage | DI, DE, \overline{RE} | | | 0.8 | V | |
| V_{OH} | Receiver High-Level Output Voltage | $I_{OH} = -8\text{ mA}$ | 4 | $V_{CC} - 0.3$ | | V | |
| V_{OL} | Receiver Low-Level Output Voltage | $I_{OL} = 8\text{ mA}$ | | 0.2 | 0.4 | V | |

3-V to 5.5-V RS-485 Transceivers

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit | |
|---------------|---|--|---|-----|-----|------------|---------|
| I_{in} | DE = 0, $V_{CC} = 0$ or $V_{CC} = 5.5$ V (A, B) | $V_I = 12$ V | | 30 | 120 | μ A | |
| | | $V_I = -7$ V | -100 | -50 | | μ A | |
| R_A, R_B | Bus Input Impedance | $V_A = -7$ V, $V_B = 12$ V or $V_A = 12$ V, $V_B = -7$ V | 96 | | | k Ω | |
| I_{OZ} | Receiver High-Impedance Output Current | $V_O = 0$ V or V_{CC} , \overline{RE} at V_{CC} | -1 | | 1 | μ A | |
| I_{OSR} | Receiver Output Short to Ground Current | $\overline{RE} = 0$, DE = V_{CC} | | 78 | 95 | mA | |
| Logic | | | | | | | |
| I_{in} | Input current (\overline{RE} , DE, D) | 4.5 V < V_{CC} < 5.5 V | -5 | | 5 | μ A | |
| Supply | | | | | | | |
| I_{CC} | Supply Current (Quiescent) | Driver and Receiver enabled | DE = V_{CC} , $\overline{RE} = GND$, no load | | 650 | 750 | μ A |
| | | Driver enabled, Receiver disabled | DE = $\overline{RE} = V_{CC}$, no load | | 450 | 600 | |
| | | Driver disabled, Receiver enabled | DE = $\overline{RE} = GND$, no load | | 450 | 600 | |
| | | Driver and Receiver disabled | DE = GND, $\overline{RE} = D = V_{CC}$, no load | | 0.5 | 2 | |

(1) Parameter is provided by lab bench test and design simulation

Switching Characteristics

| Symbol | Parameter | Conditions | Min | Typ | Max | Units |
|--------------------|---|---|-----|------|------|-------|
| Driver | | | | | | |
| t_r, t_f | Driver Differential-Output Rise and Fall Time | | | 300 | | |
| t_{PHL}, t_{PLH} | Driver Propagation Delay | $R_L = 54 \Omega, C_L = 50 \text{ pF}$ | 230 | 280 | 410 | ns |
| $t_{SK(P)}$ | Driver Pulse Skew, $ t_{PHL} - t_{PLH} $ | | | | 20 | |
| t_{PHZ}, t_{PLZ} | Driver Disable Time | $\overline{RE} = 0, \overline{RE} = V_{CC}$ | | 50 | 90 | ns |
| t_{PZH}, t_{PZL} | Driver Enable Time | $\overline{RE} = 0$ | | 200 | 450 | ns |
| | | $\overline{RE} = V_{CC}$ | | 2750 | 3200 | |
| Receiver | | | | | | |
| t_r, t_f | Receiver Rise and Fall Time | | | 28 | | |
| t_{PHL}, t_{PLH} | Receiver Propagation Delay Time | $C_L = 15 \text{ pF}$ | | 100 | 150 | ns |
| $t_{SK(P)}$ | Receiver Pulse Skew, $ t_{PHL} - t_{PLH} $ | | | | | |
| t_{PHZ}, t_{PLZ} | Driver Disable Time | $\overline{RE} = 0, \overline{RE} = V_{CC}$ | | 20 | 65 | ns |
| t_{PZL} | Receiver Enable Time | $DE = V_{CC}$ | | 20 | 50 | ns |
| t_{PZH} | Receiver Enable Time | $DE = V_{CC}$ | | 127 | 200 | ns |
| t_{PZH}, t_{PZL} | Receiver Enable Time | $DE = 0$ | | 2600 | 3200 | ns |

Test Circuits and Waveforms

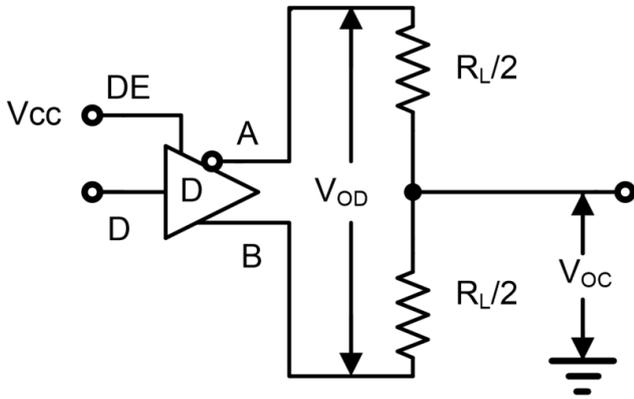


Figure 1A. V_{OD} and V_{OC}

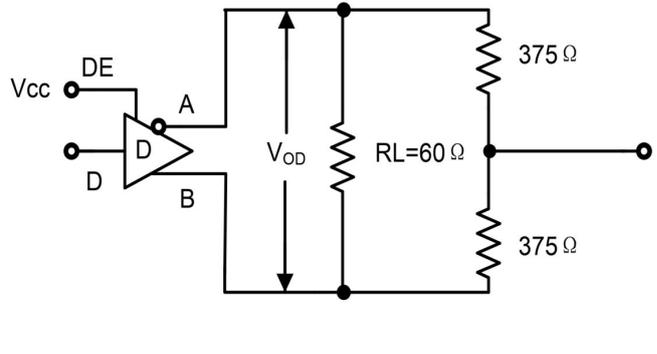


Figure 1B. V_{OD} with Common-Mode Load

Figure 1. DC Driver Test Circuits

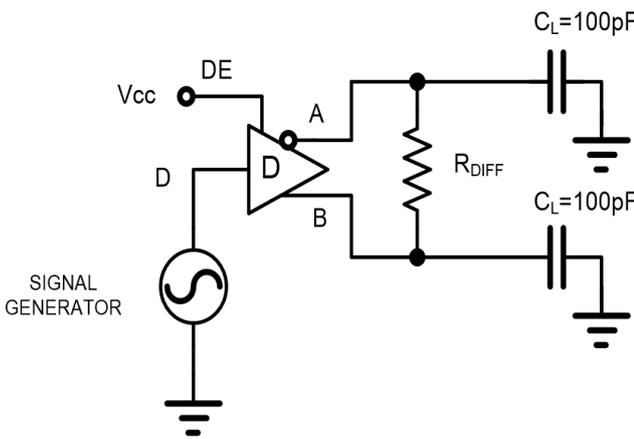


Figure 2A. Test Circuit

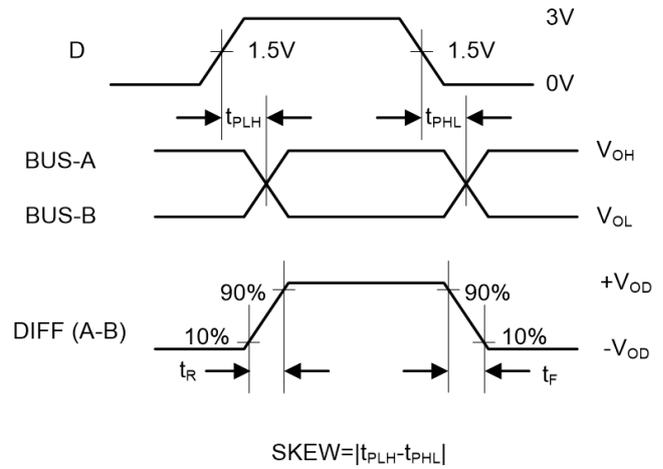
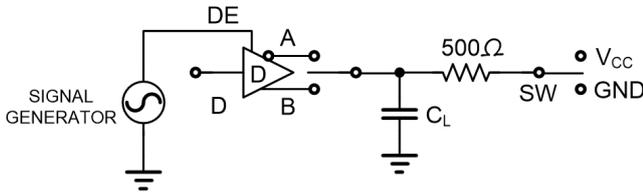


Figure 2B. Measurement Points

Figure 2. Driver Propagation Delay and Differential Transition Times

3-V to 5.5-V RS-485 Transceivers



| PARAMETER | OUTPUT | RE | DI | SW | CL (pF) |
|------------|--------|----|-----|-----|---------|
| tPHZ | A/B | X | 1/0 | GND | 15 |
| tPLZ | A/B | X | 0/1 | VCC | 15 |
| tPZH | A/B | 0 | 1/0 | GND | 100 |
| tPZL | A/B | 0 | 0/1 | VCC | 100 |
| tPZH(SHDN) | A/B | 1 | 1/0 | GND | 100 |
| tPZL(SHDN) | A/B | 1 | 0/1 | VCC | 100 |

Figure 3A. Test Circuit

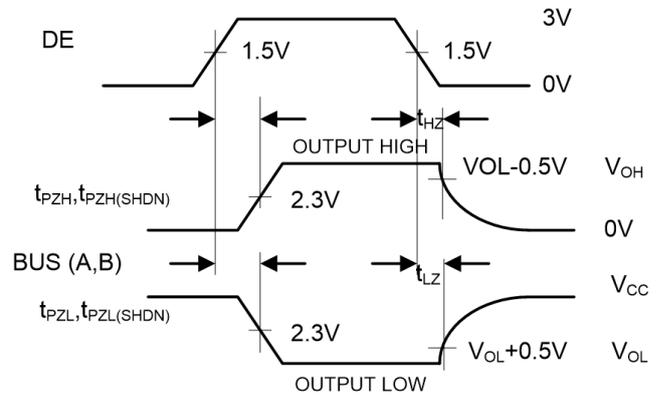


Figure 3B. Measurement Points

Figure 3. Driver Enable and Disable Times

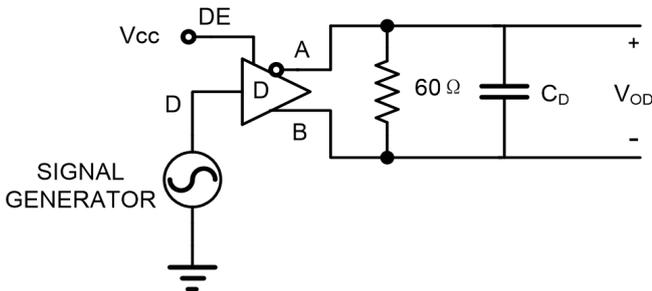


Figure 4A. Test Circuit

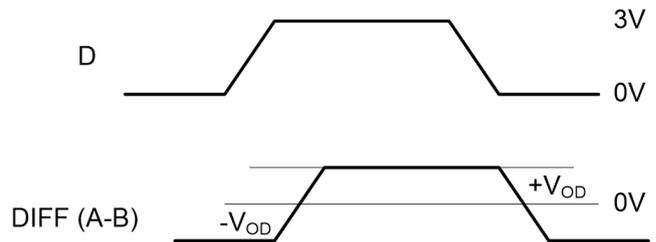


Figure 4B. Measurement Points

Figure 4. Driver Data Rate

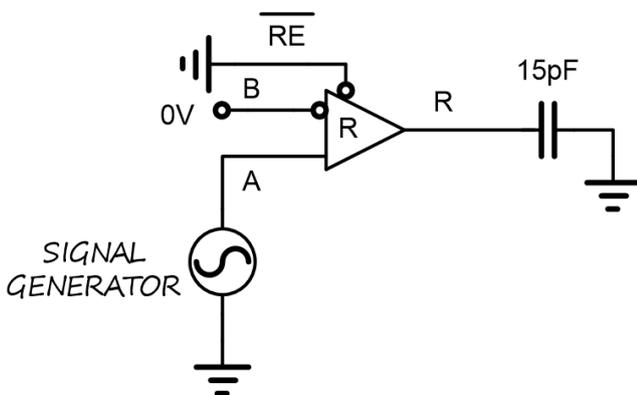


Figure 5A. Test Circuit

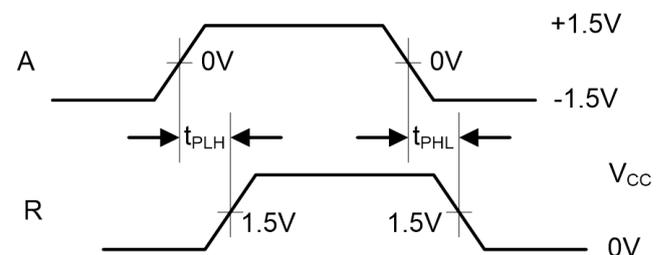
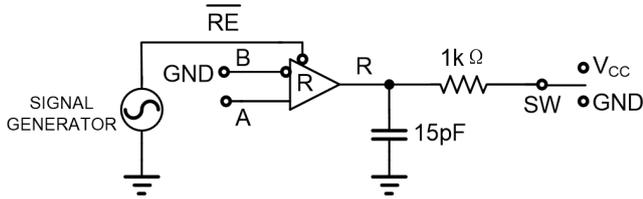


Figure 5B. Measurement Points

Figure 5. Receiver Propagation Delay and Data Rate



| PARAMETER | DE | A | SW |
|------------|----|-------|-----------------|
| tPHZ | 1 | +1.5V | GND |
| tPLZ | 1 | -1.5V | V _{CC} |
| tPZH | 1 | +1.5V | GND |
| tPZL | 1 | -1.5V | V _{CC} |
| tPZH(SHDN) | 0 | +1.5V | GND |
| tPZL(SHDN) | 0 | -1.5V | V _{CC} |

Figure 6A. Test Circuit

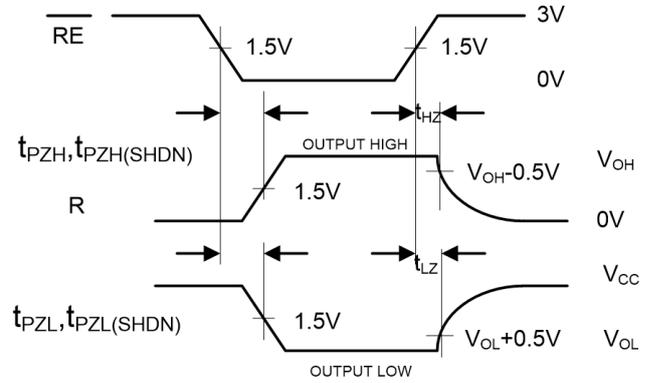
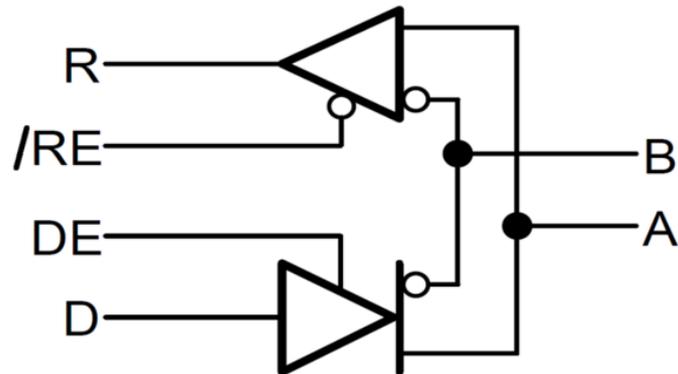


Figure 6B. Measurement Points

Figure 6. Receiver Enable and Disable Times

Detailed Description**Functional Block Diagram****TPT487 Block Diagram**

Application and Implementation

Note

Information in the following application sections is not part of the 3PEAK's component specification and 3PEAK does not warrant its accuracy or completeness. 3PEAK's customers are responsible for determining suitability of components for their purposes. Customers should validate and test their design implementation to confirm system functionality.

Typical Application

Figure 7 shows the typical application schematic.

TPT487 Network

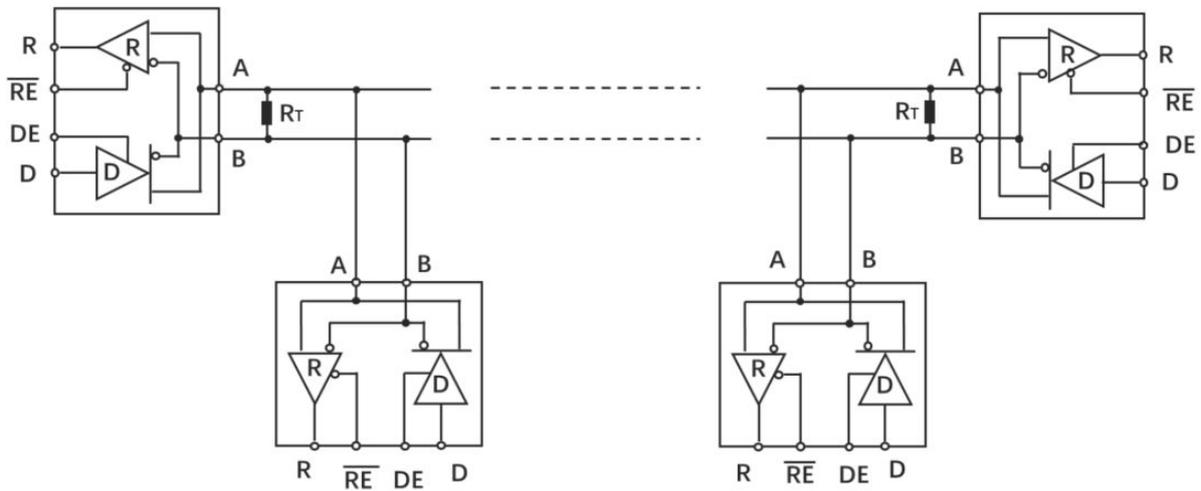
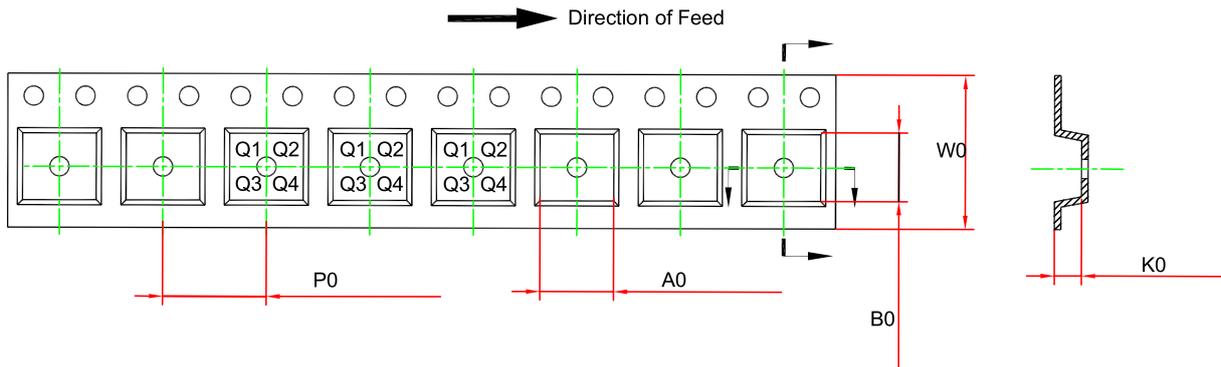
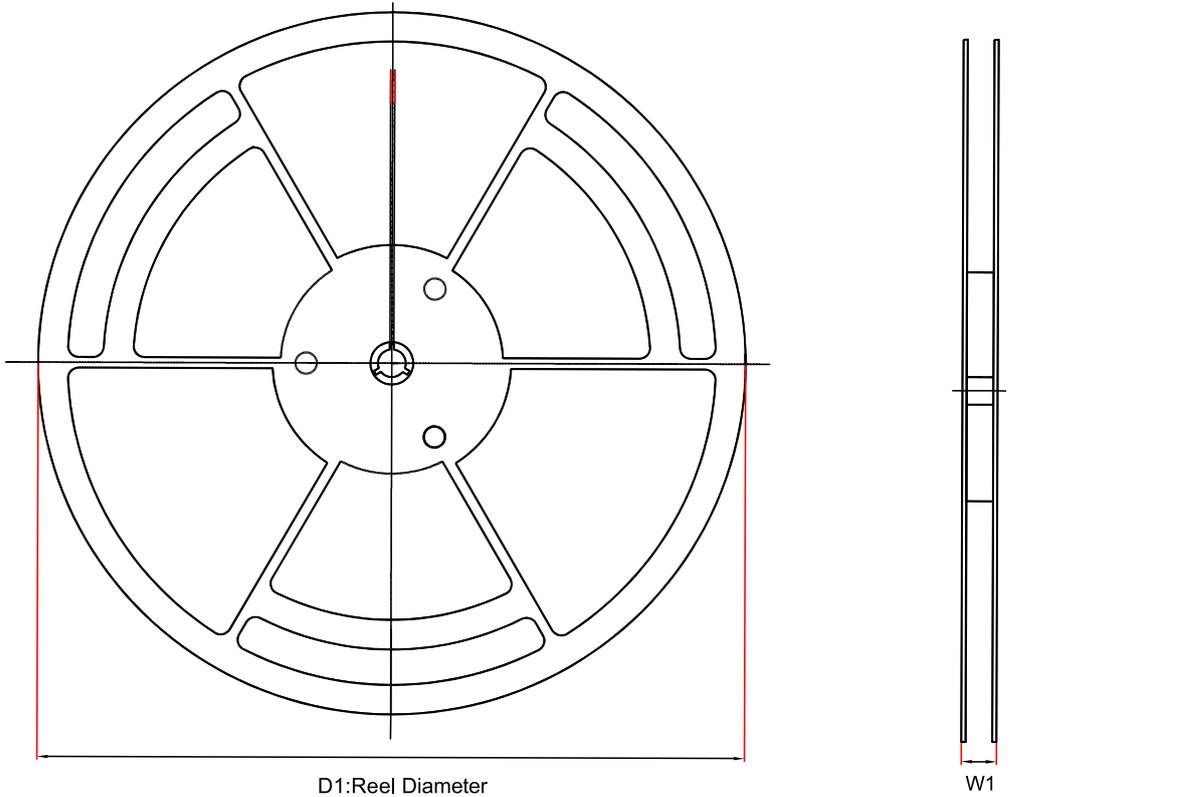


Figure 7. Typical Application Circuit

Tape and Reel Information

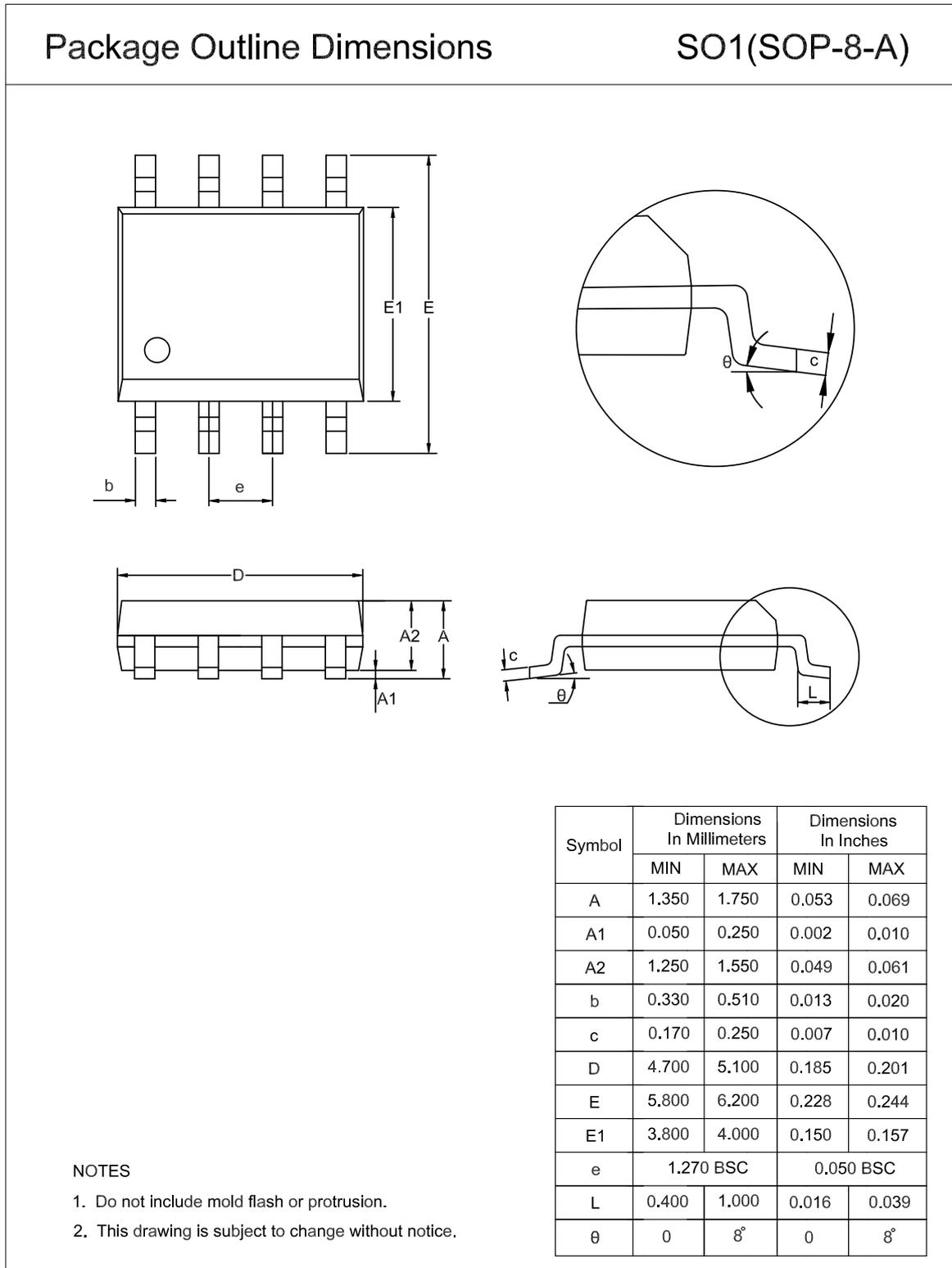


| Order Number | Package | D1 (mm) | W1 (mm) | A0 (mm) ⁽¹⁾ | B0 (mm) ⁽¹⁾ | K0 (mm) ⁽¹⁾ | P0 (mm) | W0 (mm) | Pin1 Quadrant |
|---------------|----------|---------|---------|------------------------|------------------------|------------------------|---------|---------|---------------|
| TPT487L1-SO1R | SOP8 | 330.0 | 17.6 | 6.5 | 5.4 | 2.0 | 8.0 | 12.0 | Q1 |
| TPT487-VS1R | MSOP8 | 330.0 | 17.6 | 5.3 | 3.4 | 1.3 | 8.0 | 12.0 | Q1 |
| TPT487L1-DF6R | DFN3X3-8 | 330.0 | 17.6 | 3.3 | 3.3 | 1.1 | 8.0 | 12.0 | Q1 |

(1) The value is for reference only. Contact the 3PEAK factory for more information.

Package Outline Dimensions

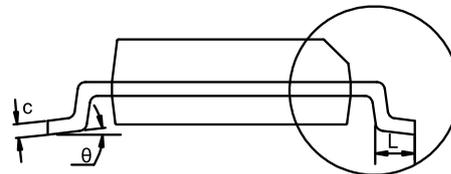
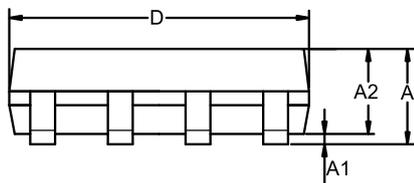
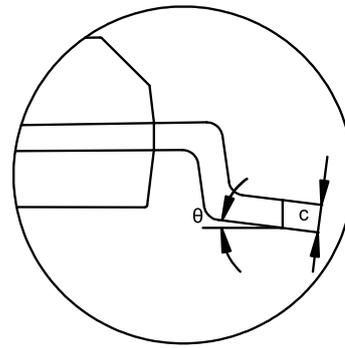
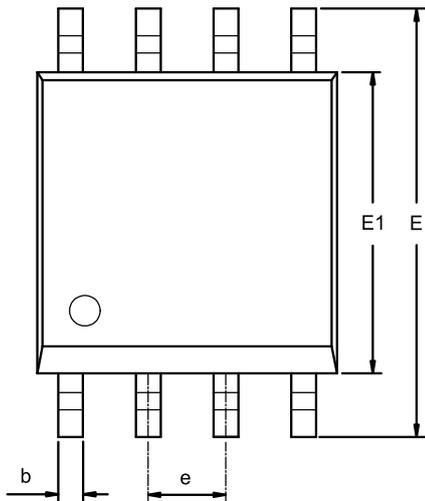
SOP8



MSOP8

Package Outline Dimensions

VS1(MSOP-8-A)

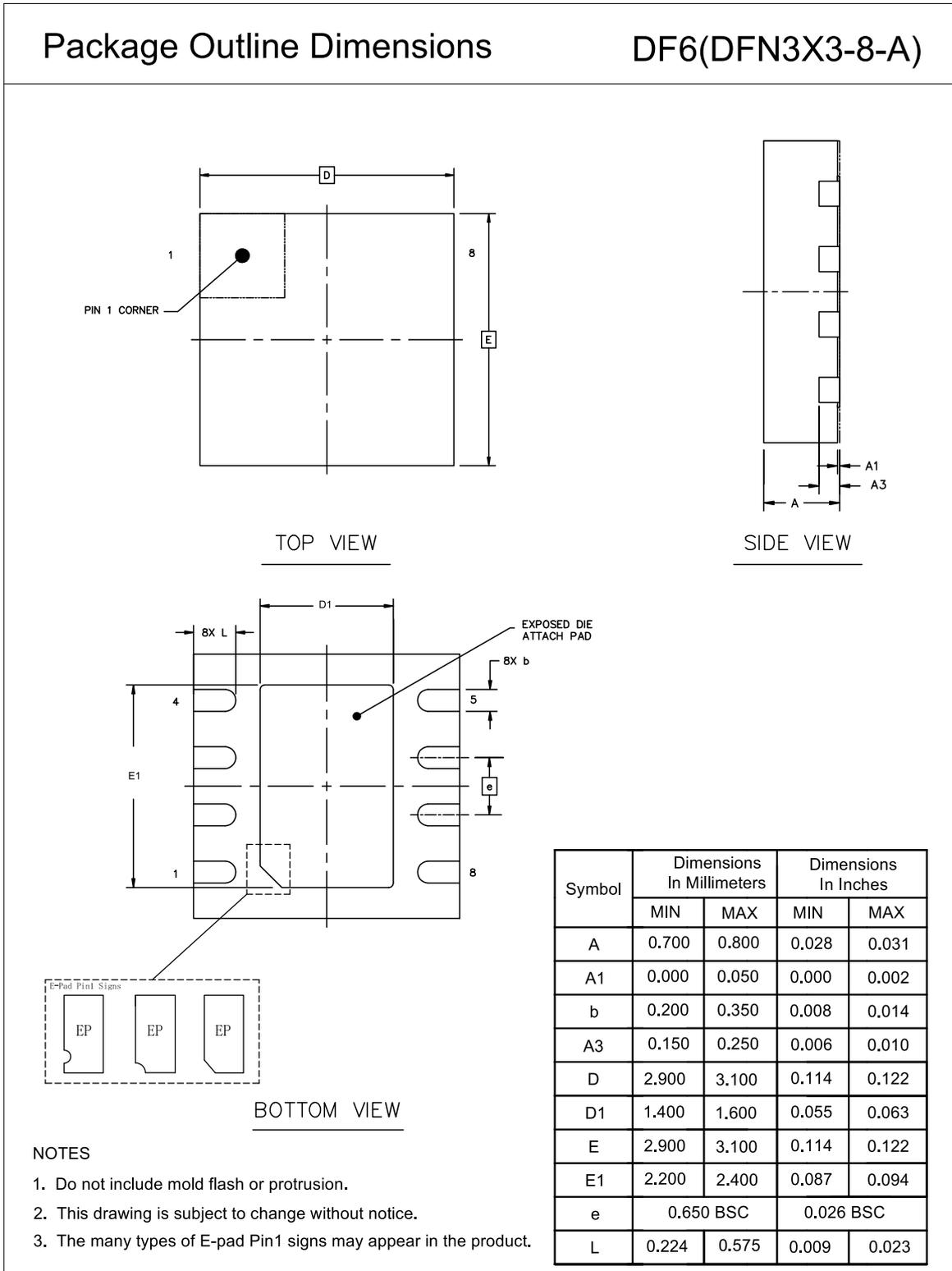


| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|----------|------------------------------|-------|-------------------------|-------|
| | MIN | MAX | MIN | MAX |
| A | 0.800 | 1.100 | 0.031 | 0.043 |
| A1 | 0.020 | 0.150 | 0.001 | 0.006 |
| A2 | 0.750 | 0.950 | 0.030 | 0.037 |
| b | 0.250 | 0.380 | 0.010 | 0.015 |
| c | 0.090 | 0.230 | 0.004 | 0.009 |
| D | 2.900 | 3.100 | 0.114 | 0.122 |
| E | 4.700 | 5.100 | 0.185 | 0.201 |
| E1 | 2.900 | 3.100 | 0.114 | 0.122 |
| e | 0.650 BSC | | 0.026 BSC | |
| L | 0.400 | 0.800 | 0.016 | 0.031 |
| θ | 0 | 8° | 0 | 8° |

NOTES

1. Do not include mold flash or protrusion.
2. This drawing is subject to change without notice.

DFN3X3-8



Order Information

| Order Number | Operating Temperature Range | Package | Marking Information | MSL | Transport Media, Quantity | Eco Plan |
|---------------|-----------------------------|----------|---------------------|-----|---------------------------|----------|
| TPT487L1-SO1R | -40 to 125°C | SOP8 | T487 | 1 | Tape and Reel, 4000 | Green |
| TPT487-VS1R | -40 to 125°C | MSOP8 | T487 | 3 | Tape and Reel, 3000 | Green |
| TPT487L1-DF6R | -40 to 125°C | DFN3X3-8 | T487 | 1 | Tape and Reel, 4000 | Green |

Green: 3PEAK defines "Green" to mean RoHS compatible and free of halogen substances.

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