

Fault Protected High-Speed CAN FD Transceiver with Standby Mode

Features

- Meets the ISO 11898-2:2016 and SAE J2284-1 to SAE J2284-5 Physical Layer Standards
- Supports CAN FD and Data Rating up to 5 Mbps
- Short Propagation Delay Times and Fast Loop Times
- 5-V Power Supply, I/O Voltage Range Supports 2.8-V to 5.5-V MCU Interface
- Ultra-Low Current Standby Mode with Bus Wake-up Capability
- Ideal Passive Behavior to CAN Bus when Unpowered
- Common-Mode Input Voltage: ± 30 V
- Protection Feature:
 - IEC 61000-4-2 ESD Protection up to ± 15 kV
 - Bus Fault Protection: ± 70 V
 - VCC and VIO (V variants only) Under-Voltage Protection
 - TXD Dominant Time-out Function and Bus-Dominant Time-out Function
 - Thermal Shutdown Protection
- Available in SOP8 Package and Leadless DFN3X3 Package

Applications

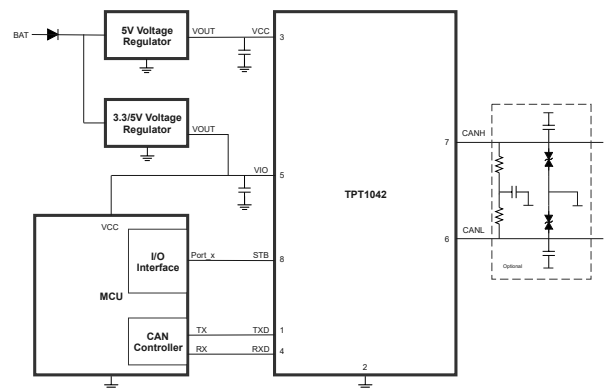
- All Devices Supporting Highly Loaded CAN Networks
- Field Industrial Automation, Sensor and Driver Systems
- Building, Security Control Systems
- Energy Storage Systems
- Telecom Base Station Status and Control

Description

The TPT1042 is a CAN transceiver that meets the ISO11898 high-speed CAN (Controller Area Network) physical layer standard. The device is designed to be used in CAN FD networks up to 5 Mbps, with enhanced timing margin and higher data rates in long and highly loaded networks. As designed, the device features crosswire, overvoltage, and loss of ground protection from -70 V to $+70$ V, over-temperature shutdown, with a -30 V to $+30$ V common-mode input voltage range. The TPT1042V has a secondary power supply input for I/O level shifting the input pin thresholds and RXD output level. This family has a low-current standby mode with CAN BUS waked-up capability. Additionally, all devices include many protection features to enhance the device and network robustness.

The TPT1042 and TPT1042V are available in SOP8 and DFN3X3-8L packages and are characterized from -40°C to $+125^{\circ}\text{C}$.

Typical Application Circuit



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Fault Protected High-Speed CAN FD Transceiver with Standby Mode**Product Family Table**

| Order Number | VCC (V) | VIO (V) | BUS Protection (V) | Package |
|-----------------|------------|------------|--------------------|-----------|
| TPT1042V-SO1R-S | 4.5 to 5.5 | 2.8 to 5.5 | ±70 | SOP8 |
| TPT1042V-DF6R-S | 4.5 to 5.5 | 2.8 to 5.5 | ±70 | DFN3X3-8L |
| TPT1042-SO1R-S | 4.5 to 5.5 | NC | ±70 | SOP8 |
| TPT1042-DF6R-S | 4.5 to 5.5 | NC | ±70 | DFN3X3-8L |

Revision History

| Date | Revision | Notes |
|------------|-----------|------------------|
| 2020-12-05 | Rev.Pre.0 | Initial Version |
| 2022-11-20 | Rev.A.0 | Released Version |

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Pin Configuration and Functions

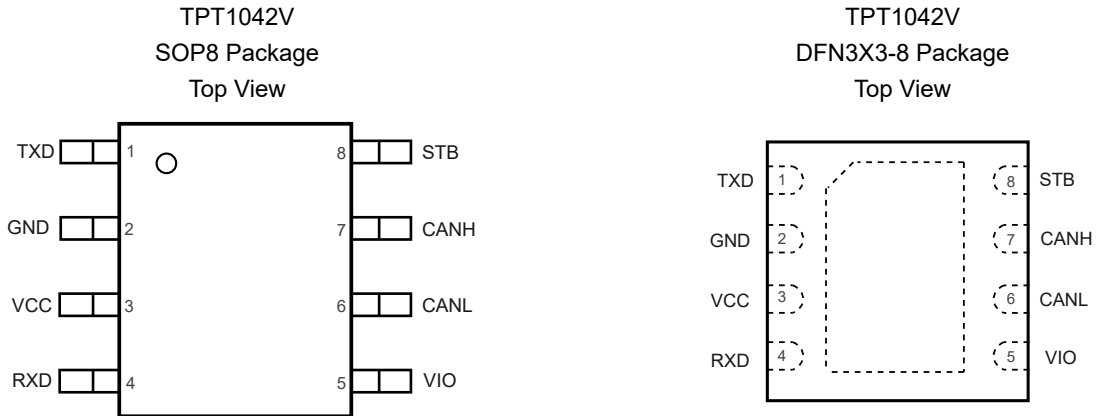


Table 1. Pin Functions: TPT1042VQ

| Pin | | I/O | Description |
|-----|------|---------|--|
| No. | Name | | |
| 1 | TXD | I | CAN transmit data input (LOW for dominant and HIGH for recessive bus states) |
| 2 | GND | GND | Ground |
| 3 | VCC | POWER | Transceiver 5 V supply voltage |
| 4 | RXD | O | CAN receive data output (LOW for dominant and HIGH for recessive bus states) |
| 5 | VIO | POWER | Transceiver I/O level shifting supply voltage |
| 6 | CANL | BUS I/O | Low level CAN bus input/output line |
| 7 | CANH | BUS I/O | High level CAN bus Input/output line |
| 8 | STB | I | Standby Mode control input (active high) |

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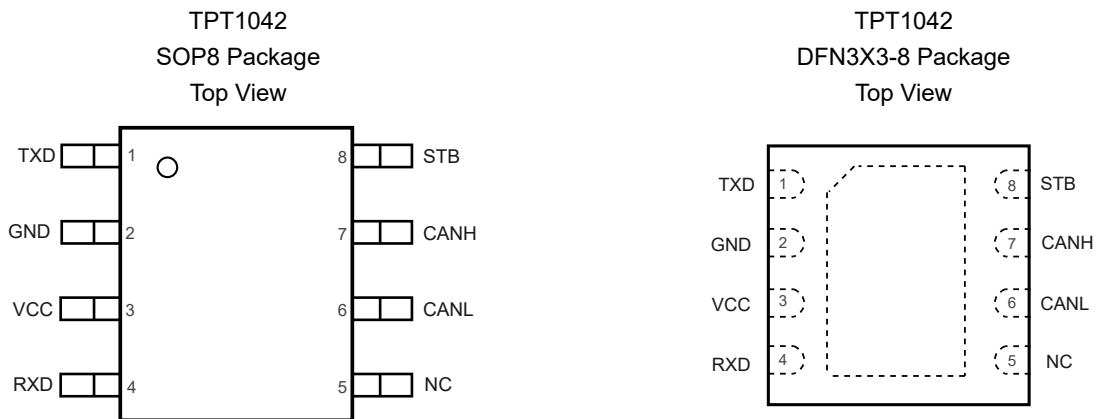


Table 2. Pin Functions: TPT1042Q

| Pin | | I/O | Description |
|-----|------|---------|--|
| No. | Name | | |
| 1 | TXD | I | CAN transmit data input (LOW for dominant and HIGH for recessive bus states) |
| 2 | GND | GND | Ground |
| 3 | VCC | Power | Transceiver 5 V supply voltage |
| 4 | RXD | O | CAN receive data output (LOW for dominant and HIGH for recessive bus states) |
| 5 | NC | - | Not Connected |
| 6 | CANL | Bus I/O | Low-level CAN bus input/output line |
| 7 | CANH | Bus I/O | High-level CAN bus input/output line |
| 8 | STB | I | Standby Mode control input (active high) |

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Specifications

Absolute Maximum Ratings

| Parameter | | Min | Max | Unit |
|-----------------------|---|------|-----|------|
| V _{CC} | 5-V Bus Supply Voltage Range | -0.3 | 7 | V |
| V _{IO} | I/O Level-Shifting Voltage Range | -0.3 | 7 | V |
| V _{BUS} | CAN Bus I/O Voltage Range (CANH, CANL) | -70 | 70 | V |
| V _{BUS_DIFF} | Differential Voltage of CAN Bus, CANH - CANL | -70 | 70 | V |
| V _{LOGIC} | Logic Input And Output Terminal Voltage Range (TXD, STB, RXD) | -0.3 | 7 | V |
| I _{O_RXD} | RXD (Receiver) Output Current | -8 | 8 | mA |
| T _J | Maximum Junction Temperature | -40 | 150 | °C |
| T _{STG} | Storage Temperature Range | -65 | 150 | °C |
| T _{OTP} | Shutdown Junction Temperature | | 170 | °C |

- (1) Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. Exposure to any Absolute Maximum Rating condition for extended periods may affect device reliability and lifetime.
- (2) This data was taken with the JEDEC low effective thermal conductivity test board.
- (3) This data was taken with the JEDEC standard multilayer test boards.

ESD(Electrostatic Discharge Protection)

| Parameter | | Condition | Minimum Level | Unit |
|-------------------|--|-------------------------------------|---------------|------|
| IEC | IEC Contact Discharge | IEC-61000-4-2, Bus Pin | ±15 | kV |
| | IEC Air-Gap Discharge | IEC-61000-4-2, Bus Pin | ±15 | kV |
| HBM | Human Body Model ESD | ANSI/ESDA/JEDEC JS-001, CAN Bus Pin | ±8 | kV |
| | | ANSI/ESDA/JEDEC JS-001, All Pin | ±7 | kV |
| CDM | Charged Device Model ESD | ANSI/ESDA/JEDEC JS-002, All Pin | ±1.5 | kV |
| LU | Latch up | Latch up per JESD78, All Pin | ±500 | mA |
| V _{tran} | ISO7637-2 transients per IEC 62228-3, CANH, CANL | Pulse 1 | -100 | V |
| | | Pulse 2a | 75 | V |
| | | Pulse 3a | -150 | V |
| | | Pulse 3b | 100 | V |

- (1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.
- (2) JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process.

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Recommended Operating Conditions

| | Parameter | Min | Max | Unit |
|----------------------|--|-----|-----|------|
| V _{IO} | Input/output voltage, TXD, RXD, STB | 2.8 | 5.5 | V |
| V _{CC} | Power Supply | 4.5 | 5.5 | V |
| I _{OH(RXD)} | RXD Terminal High-Level Output Current | -2 | | mA |
| I _{OL(RXD)} | RXD Terminal Low-Level Output Current | | 2 | mA |
| T _A | Operating Ambient Temperature | -40 | 125 | °C |

Thermal Information

| Package Type | θ_{JA} | θ_{JC} | Unit |
|--------------|---------------|---------------|------|
| SOP8 | 118 | 48 | °C/W |
| DFN3x3-8 | 51 | 23 | °C/W |

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Electrical Characteristics

All test conditions: $V_{CC} = 4.5\text{ V to }5.5\text{ V}$, $V_{IO} = 2.8\text{ V to }5.5\text{ V}$, $R_L = 60\ \Omega$, $T = -40^\circ\text{C to }125^\circ\text{C}$, unless otherwise noted.

| Parameter | | Conditions | Min | Typ | Max | Unit |
|--|---|---|-----|-----|-----|---------------|
| Pin V_{CC}, (Power supply) | | | | | | |
| V_{CC} | Supply Voltage | | 4.5 | | 5.5 | V |
| V_{UV_VCC} | Rising Undervoltage Detection on V_{CC} for Protected Mode | | - | 4.1 | 4.5 | V |
| | Falling Undervoltage Detection on V_{CC} for Protected Mode | | 3.6 | 3.9 | - | V |
| V_{HYS_UVVCC} | Hysteresis Voltage on UV_{VCC} ⁽¹⁾ | | - | 200 | - | mV |
| I_{CC} | Standby Mode Supply Current | 1042V, device with the "V" suffix, Standby Mode, $V_{TXD} = V_{CC}$, $R_L = 60\ \Omega$, $C_L = \text{open}$, $V_{STB} = V_{CC}$ | - | 3.5 | 5 | μA |
| | | 1042, device without the "V" suffix, Standby Mode, $V_{TXD} = V_{IO}$, $R_L = 60\ \Omega$, $C_L = \text{open}$, $V_{STB} = V_{IO}$ | - | 10 | 20 | μA |
| | Normal Mode Supply Current | Recessive, $V_{TXD} = V_{CC}$, $R_L = 50\ \Omega$, $C_L = \text{open}$, $V_{STB} = 0\text{ V}$ | 0.5 | 1.3 | 5 | mA |
| | | Dominant, $V_{TXD} = 0\text{ V}$, $R_L = 60\ \Omega$, $C_L = \text{open}$, $V_{STB} = 0\text{ V}$ | 20 | 50 | 80 | mA |
| | | Dominant bus fault, short circuit on bus lines, $V_{TXD} = V_{STB} = 0\text{ V}$, $-3\text{ V} < (V_{CANH} = V_{CANL}) < +18\text{ V}$, $R_L = C_L = \text{open}$ | 2 | 60 | 110 | mA |
| | PIN V_{IO}, (I/O Level Adapter Supply) ⁽²⁾ | | | | | |
| V_{IO} | Supply Voltage on V_{IO} Pin | | 2.8 | - | 5.5 | V |
| V_{UV_VIO} | Rising Undervoltage Detection on V_{IO} For Protected Mode | | - | 2 | 2.7 | V |
| | Falling Undervoltage Detection on V_{IO} For Protected Mode | | 1.3 | 1.9 | - | V |
| V_{HYS_UVVIO} | Hysteresis Voltage on uv_{vio} for Protected Mode | | - | 100 | - | mV |
| I_{IO} | Standby Mode Supply Current on Pin v_{io} | Standby Mode, RXD Floating, $V_{TXD} = V_{STB} = V_{IO}$ | 5 | 10 | 14 | μA |
| | | Recessive, $V_{STB} = 0\text{ V}$, $V_{TXD} = V_{IO}$ | - | 15 | 30 | μA |
| | Normal Mode Supply Current on Pin v_{io} | Dominant, $V_{STB} = 0\text{ V}$, | - | 200 | 600 | μA |

Fault Protected High-Speed CAN FD Transceiver with Standby Mode

| Parameter | | Conditions | Min | Typ | Max | Unit | |
|--|--|--|--|------|---------------------|---------------|---|
| | | $V_{TXD} = 0\text{ V}$ | | | | | |
| Pin STB, (Standby Mode Control Input) | | | | | | | |
| V_{IH} | High-Level Input Voltage | | $0.7 \times V_{IO}$ | - | $V_{IO} + 0.3$ | V | |
| V_{IL} | Low-Level Input Voltage | | -0.3 | - | $0.3 \times V_{IO}$ | V | |
| I_{IH} | High-Level Input Current | $V_{STB} = V_{CC} = V_{IO} = 5.5\text{ V}$ | -2 | 0 | 2 | μA | |
| I_{IL} | Low-Level Input Current | $V_{STB} = 0\text{ V}, V_{CC} = V_{IO} = 5.5\text{ V}$ | -20 | -11 | -2 | μA | |
| $I_{lkg(OFF)}$ | Unpowered Leakage Current | $V_{STB} = 5.5\text{ V}, V_{CC} = V_{IO} = 0\text{ V}$ | -1 | 0 | 1 | μA | |
| Pin TXD, (CAN Transmit Data Input) | | | | | | | |
| V_{IH} | High-Level Input Voltage | | $0.7 \times V_{IO}$ | - | $V_{IO} + 0.3$ | V | |
| V_{IL} | Low-Level Input Voltage | | -0.3 | - | $0.3 \times V_{IO}$ | V | |
| I_{IH} | High-Level Input Current | $V_{TXD} = V_{CC} = V_{IO} = 5.5\text{ V}$ | -2 | 0 | 2 | μA | |
| I_{IL} | Low-Level Input Current | $V_{TXD} = 0\text{ V}, V_{CC} = V_{IO} = 5.5\text{ V}$ | -250 | -160 | -30 | μA | |
| I_{LKG_OFF} | Unpowered Leakage Current | $V_{TXD} = 5.5\text{ V}, V_{CC} = V_{IO} = 5.5\text{ V}$ | -1 | 0 | 1 | μA | |
| C_I | Input Capacitance ⁽¹⁾ | | - | 5 | 10 | pF | |
| Pin RXD, (CAN Receive Data Output) | | | | | | | |
| I_{OH} | High-Level Output Current | $V_{RXD} = V_{IO} - 0.4\text{ V}$ | -8 | -6 | -1 | mA | |
| I_{OL} | Low-Level Output Current | $V_{RXD} = 0.4\text{ V},$ bus dominant | 2 | 5 | 12 | mA | |
| I_{LKG_OFF} | Unpowered Leakage Current | $V_{RXD} = 5.5\text{ V}, V_{CC} = V_{IO} = 0\text{ V}$ | -1 | 0 | 1 | μA | |
| Pins CANH and CANL, (CAN Bus Lines) | | | | | | | |
| V_{O_DOM} | Dominant Bus Output Voltage | CANH | $V_{TXD} = 0\text{ V}, V_{STB} = 0\text{ V}, 50\ \Omega \leq R_L \leq 65\ \Omega, C_L = \text{open}, t < t_{to(dom)TXD}$ | 2.75 | 3.5 | 4.5 | V |
| | | CANL | | 0.5 | 1.5 | 2.25 | V |
| V_{SYM_DC} | DC Output Symmetry (dominant or recessive) ($V_{CC} - V_{O(CANH)} - V_{O(CANL)}$) | $V_{STB} = 0\text{ V}, R_L = 60\ \Omega, C_L = \text{open},$ | -0.4 | - | 0.84 | V | |
| V_{SYM} | Transient Symmetry (dominant or recessive) ($(V_{O(CANH)} + V_{O(CANL)}) / V_{CC}$ ⁽¹⁾) | $4.75\text{ V} \leq V_{CC} \leq 5.25\text{ V}, V_{STB} = 0\text{ V}, R_L = 60\ \Omega, C_{SPLIT} = 4.7\text{ nF}, C_L = \text{open}, T_{XD} = 250\text{ kHz}, 1\text{ MHz}$ | 0.9 | 1 | 1.1 | V/V | |
| V_{OD_DOM} | Differential Output Voltage (dominant) | Normal mode, $t < t_{to(dom)TXD}, V_{TXD} = 0\text{ V}, V_{STB} = 0\text{ V}, 4.75\text{ V} \leq V_{CC} \leq 5.25\text{ V}, 45\ \Omega \leq R_L < 50\ \Omega, C_L = \text{open}$ | 1.5 | - | 3 | V | |

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| Parameter | | Conditions | Min | Typ | Max | Unit |
|---------------------|--|--|------|-----------|------|------|
| | | Normal mode, $t < t_{to(dom)TXD}$, $V_{TXD} = 0\text{ V}$, $V_{STB} = 0\text{ V}$, $4.75\text{ V} \leq V_{CC} \leq 5.25\text{ V}$, $50\ \Omega \leq R_L < 65\ \Omega$, $C_L = \text{open}$ | 1.5 | - | 3 | V |
| | | Normal mode, $t < t_{to(dom)TXD}$, $V_{TXD} = 0\text{ V}$, $V_{STB} = 0\text{ V}$, $4.75\text{ V} \leq V_{CC} \leq 5.25\text{ V}$, $65\ \Omega \leq R_L \leq 70\ \Omega$, $C_L = \text{open}$ | 1.5 | - | 3.3 | V |
| | | Normal mode, $t < t_{to(dom)TXD}$, $V_{TXD} = 0\text{ V}$, $V_{STB} = 0\text{ V}$, $4.75\text{ V} \leq V_{CC} \leq 5.25\text{ V}$, $R_L = 2240\ \Omega$, $C_L = \text{open}$ | 1.5 | - | 5 | V |
| V_{OD_REC} | Differential Output Voltage (recessive) | Normal mode, $V_{TXD} = V_{CC}$, $V_{STB} = 0\text{ V}$, no load | -50 | - | 50 | mV |
| | | Standby mode, $V_{TXD} = V_{STB} = V_{CC}$, no load | -150 | - | 150 | mV |
| V_{O_REC} | Recessive Bus Output Voltage | Normal mode, $V_{TXD} = V_{IO} = V_{CC}$, $V_{STB} = 0\text{ V}$, no load | 2 | 0.5 x VCC | 3 | V |
| | | Standby mode, $V_{TXD} = V_{STB} = V_{IO} = V_{CC}$, no load | -0.1 | - | 0.1 | V |
| V_{CM} | Common Mode Range | $V_{STB} = 0$ or V_{CC} or V_{IO} | -30 | - | 30 | V |
| $V_{TH_RX_DIF}$ | Differential Receiver Threshold Voltage | Normal mode, $V_{STB} = 0\text{ V}$, $-30\text{ V} \leq V_{CANH}/V_{CANL} \leq 30\text{ V}$ | 0.5 | 0.7 | 0.9 | V |
| | | Standby mode, $V_{STB} = V_{IO}$, $-30\text{ V} \leq V_{CANH}/V_{CANL} \leq 30\text{ V}$ | 0.4 | 0.7 | 1.15 | V |
| V_{REC_RX} | Receiver Recessive Voltage, Normal Mode | $-30\text{ V} \leq V_{CANH}/V_{CANL} \leq 30\text{ V}$ | -4 | - | 0.5 | V |
| | Receiver Recessive Voltage, Standby Mode | | -4 | - | 0.4 | V |
| V_{DOM_RX} | Receiver Dominant Voltage, Normal Mode | $-30\text{ V} \leq V_{CANH}/V_{CANL} \leq 30\text{ V}$ | 0.9 | - | 9 | V |
| | Receiver Dominant Voltage, Standby Mode | | 1.15 | - | 9 | V |
| $V_{HYS_RX_DIFF}$ | Differential Receiver Hysteresis Voltage | Normal mode, $-30\text{ V} \leq V_{CANH}/V_{CANL} \leq 30\text{ V}$ | 50 | 120 | 200 | mV |
| | | Standby mode, $-30\text{ V} \leq V_{CANH}/V_{CANL} \leq 30\text{ V}$ | 20 | 70 | 120 | mV |
| $I_{O_SC_DOM}$ | Dominant Short-Circuit Output Current | CANH $V_{STB} = 0\text{ V}$, $V_{CANH} = -15\text{ V}$ to 18 V , CANL = open, $V_{TXD} = 0\text{ V}$ | -115 | - | - | mA |
| | | CANL $V_{STB} = 0\text{ V}$, $V_{CANL} = -15\text{ V}$ to 18 V , CANH = open, $V_{TXD} = 0\text{ V}$ | - | - | 115 | mA |

Fault Protected High-Speed CAN FD Transceiver with Standby Mode

| Parameter | | Conditions | Min | Typ | Max | Unit |
|-----------------------|---|---|-----|-----|-----|------|
| I _{O_SC_REC} | Recessive Short-Circuit Output Current | -27 V ≤ V _{CANH} / V _{CANL} ≤ 32 V, V _{TXD} = V _{CC} , normal modes | -5 | - | 5 | mA |
| I _{LKG_OFF} | Power-off (unpowered) Bus Input Leakage Current | V _{CC} = V _{IO} = 0 V or V _{CC} = V _{IO} shorted to ground via 47kΩ, V _{CANH} = 5 V, V _{CANL} = 5 V | -5 | - | 5 | μA |
| R _{IN} | Input Resistance (CANH or CANL) | V _{TXD} = V _{CC} = V _{IO} = 5 V, V _{STB} = 0 V, -30 V ≤ V _{CM} ≤ +30 V | 10 | 23 | 35 | kΩ |
| R _{IN_M} | Input Resistance Matching: $[1 - R_{IN(CANH)} / R_{IN(CANL)}] \times 100\%$ | V _{TXD} = V _{CC} = V _{IO} = 5 V, V _{STB} = 0 V, V _{CANH} = V _{CANL} = 5 V, | -2 | - | 2 | % |
| R _{ID} | Differential Input Resistance | V _{TXD} = V _{CC} = V _{IO} = 5 V, V _{STB} = 0 V, -30 V ≤ V _{CM} ≤ +30 V | 30 | 47 | 60 | kΩ |
| C _I | Input Capacitance to Ground (CANH or CANL) ⁽¹⁾ | | - | - | 20 | pF |
| C _{ID} | Differential Input Capacitance ⁽¹⁾ | | - | - | 10 | pF |

(1) The Typ data is based on bench test and design simulation. The typical data is based on bench test by LRC meter E4980AL.

(2) Only device with V suffix (TPT1042V) have a V_{IO} Pin, device without V suffix (TPT1042) V_{IO} connoted to V_{CC} internally.

AC Timing Requirements

All test conditions: V_{CC} = 4.5 V to 5.5 V, V_{IO} = 2.8 V to 5.5 V, R_L = 60 Ω, T_A = -40°C to 125°C, unless otherwise noted.

| Parameter | | Conditions | Min | Typ | Max | Unit |
|--|--|---|-----|-----|-----|------|
| Transceiver Switching Characteristics | | | | | | |
| t _{pLD} | Propagation delay time, low TXD to driver dominant (recessive to dominant) | Normal mode, V _{STB} = 0 V, R _L = 60 Ω, C _L = 100 pF | - | 60 | 100 | ns |
| t _{pHR} | Propagation delay time, high TXD to driver recessive (dominant to recessive) | | - | 60 | 100 | ns |
| t _{SK_P} | Pulse Skew (t _{pHR} - t _{pLD}) | | - | 10 | 35 | ns |
| t _R | Differential Output Signal Rise Time ⁽¹⁾ | | - | 45 | - | ns |
| t _F | Differential Output Signal Fall Time ⁽¹⁾ | | - | 45 | - | ns |
| t _{PROP_TXDL-RXDL} | Total loop delay, driver input (TXD) low to receiver output (RXD) low, recessive to dominant | Normal mode, V _{STB} = 0 V, R _L = 60 Ω, C _L = 100 pF, C _{L(RXD)} = 15 pF, | - | 110 | 220 | ns |

Fault Protected High-Speed CAN FD Transceiver with Standby Mode

| Parameter | | Conditions | Min | Typ | Max | Unit |
|---------------------------------|---|--|-----|-----|-----|---------------|
| $t_{PROP_TXDH-RXDH}$ | Total loop delay, driver input (TXD) high to receiver output (RXD) high, dominant to recessive | | - | 140 | 220 | ns |
| t_{pRH} | Propagation Delay Time, Bus Recessive Input to RXD High Output (Dominant to Recessive) ⁽¹⁾ | $V_{STB} = 0\text{ V}$, $C_{L(RXD)} = 15\text{ pF}$ | - | 90 | 120 | ns |
| t_{pDL} | Propagation Delay Time, Bus Dominant Input to RXD Low Output (Recessive to Dominant) ⁽¹⁾ | | - | 90 | 120 | ns |
| t_{R_R} | RXD Output Signal Rise Time ⁽¹⁾ | | - | 20 | - | ns |
| t_{R_F} | RXD Output Signal Fall Time ⁽¹⁾ | | - | 20 | - | ns |
| FD Timing Parameters | | | | | | |
| t_{BIT_BUS} | Bit time on CAN bus output pins with $t_{BIT(TXD)} = 500\text{ ns}$ ⁽¹⁾ | $V_{STB} = 0\text{ V}$, $R_L = 60\ \Omega$, $C_L = 100\text{ pF}$, $C_{L(RXD)} = 15\text{ pF}$, $\Delta t_{REC} = t_{BIT(RXD)} - t_{BIT(BUS)}$ | 435 | - | 530 | ns |
| | Bit time on CAN bus output pins with $t_{BIT(TXD)} = 200\text{ ns}$ ⁽¹⁾ | | 155 | - | 210 | ns |
| t_{BIT_RXD} | Bit time on RXD output pins with $t_{BIT(TXD)} = 500\text{ ns}$ | | 400 | - | 550 | ns |
| | Bit time on RXD output pins with $t_{BIT(TXD)} = 200\text{ ns}$ | | 120 | - | 220 | ns |
| Δt_{REC} | Receiver timing symmetry with $t_{BIT(TXD)} = 500\text{ ns}$ ⁽¹⁾ | | -65 | - | 40 | ns |
| | Receiver timing symmetry with $t_{BIT(TXD)} = 200\text{ ns}$ ⁽¹⁾ | | -45 | - | 15 | ns |
| Device Timing Parameters | | | | | | |
| t_{TXD_DTO} | TXD dominant time-out time | normal mode, $V_{STB} = 0\text{ V}$, $R_L = 60\ \Omega$, $C_L = \text{open}$, $V_{TXD} = 0\text{ V}$ | 0.3 | 2 | 5 | ms |
| t_{BUS_DTO} | Bus dominant time-out time | Standby mode | 0.3 | 2 | 5 | ms |
| $t_{BUS_WAKE_FILTER}$ | Bus wake-up filter time | Standby mode | 0.5 | 1.5 | 5 | μs |
| t_{dMODE} | Standby to normal mode delay time | | 3 | 8 | 50 | μs |

(1) The test data is based on bench test and design simulation.

Parameter Measurement Information

Test Circuit

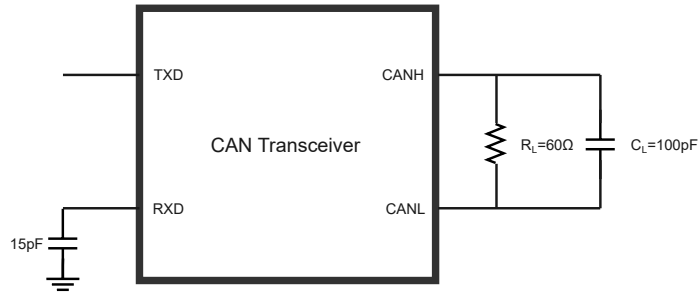


Figure 1. CAN transceiver timing parameter test circuit

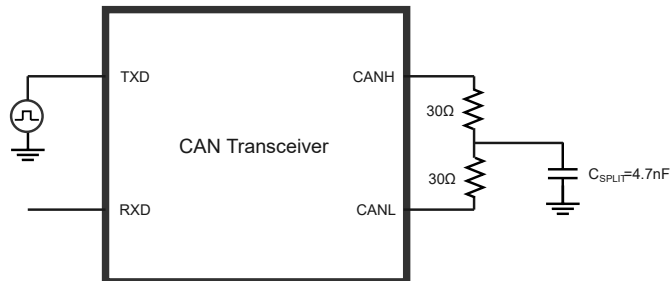


Figure 2. CAN transceiver driver symmetry test circuit

Fault Protected High-Speed CAN FD Transceiver with Standby Mode

Parameter Diagram

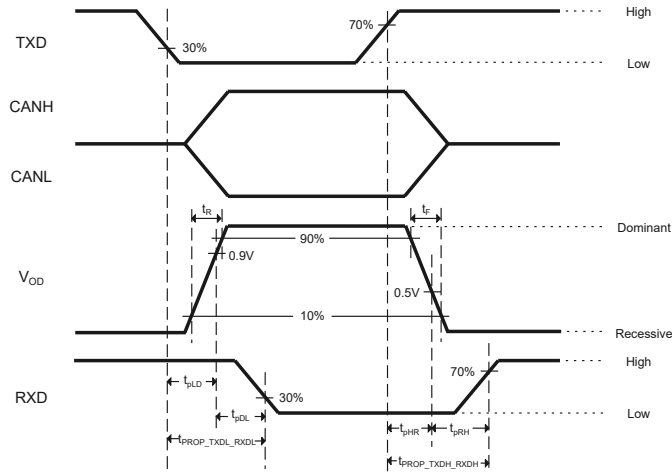


Figure 3. CAN transceiver timing diagram

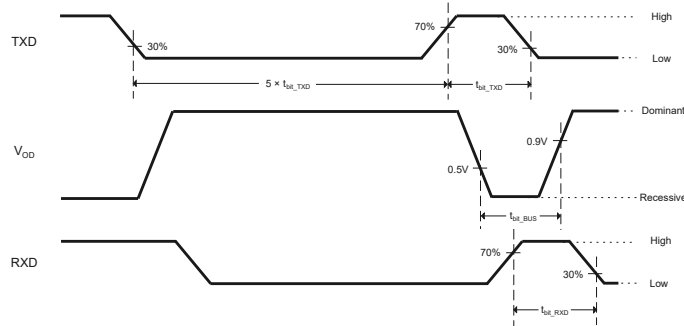


Figure 4. CAN FD timing parameter diagram

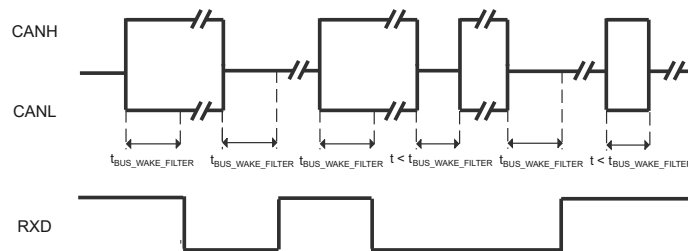


Figure 5. Wake-up timing diagram

Fault Protected High-Speed CAN FD Transceiver with Standby Mode

Detailed Description

Overview

The TPT1042 is a CAN transceiver that meets the ISO11898 high-speed CAN (Controller Area Network) physical layer standard. The device is designed to be used in CAN FD networks up to 5 Mbps, with enhanced timing margin and higher data rates in long and highly loaded networks. As designed, the device features crosswire, overvoltage, and loss of ground protection from -70 V to +70 V, over-temperature shutdown, with a -30 V to +30 V common-mode input voltage range. The TPT1042V has a secondary power supply input for I/O level shifting the input pin thresholds and RXD output level. This family has a low-current standby mode with CAN BUS waked-up capability. Additionally, all devices include many protection features to enhance the device and network robustness.

Functional Block Diagram

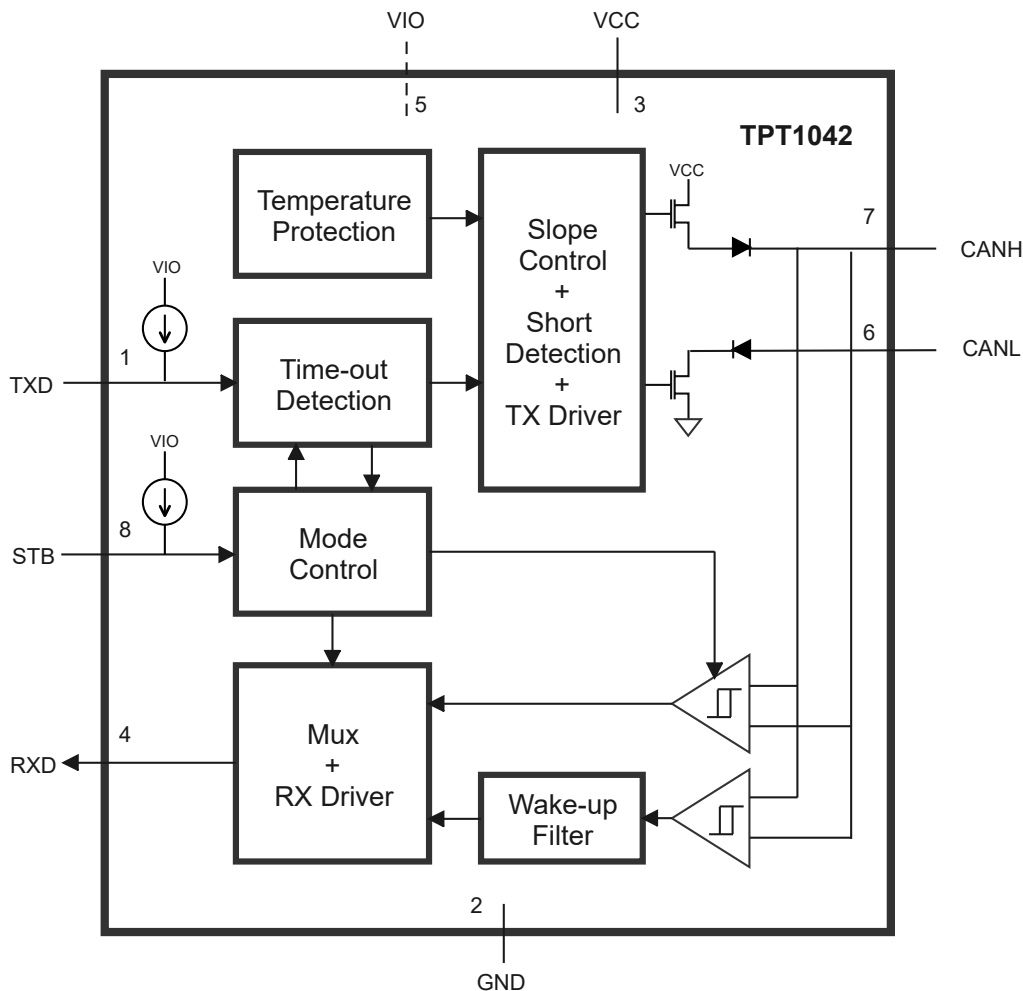


Figure 6. Functional Block Diagram

Fault Protected High-Speed CAN FD Transceiver with Standby Mode

Feature Description

Table 3. Driver Function Table

| Device | Inputs | | Outputs | | Driven BUS State |
|-------------|-----------|-----------|---------|------|------------------|
| | STB | TXD | CANH | CANL | |
| All Devices | L | L | H | L | Dominant |
| | | H or Open | Z | Z | Recessive |
| | H or Open | X | Z | Z | Recessive |

Table 4. Receiver Function Table

| Device Mode | CAN Differential Inputs V_{ID} $= V_{CANH} - V_{CANL}$ | Bus State | RXD Terminal |
|-------------------|---|---------------|---------------|
| Normal or Standby | $V_{ID} \geq V_{IT+(MAX)}$ | Dominant | L |
| | $V_{IT-(MIN)} < V_{ID} < V_{IT+(MAX)}$ | Indeterminate | Indeterminate |
| | $V_{ID} \leq V_{IT-(MIN)}$ | Recessive | H |
| | Open ($V_{ID} \approx 0$ V) | Open | H |

Device Operating Modes

Normal Mode

A low level on the STB pin selects the normal mode. In this mode, the transceiver will transmit and receive data via the bus lines CANH and CANL. The differential receiver converts the analog data on the bus lines into digital data, which is output to the RXD pin. The slopes of the output signals on the bus lines are controlled internally and optimized to guarantee the lowest possibility for Electro Magnetic Emission (EME).

Standby Mode

Activate the low-power standby mode by setting the STB terminal high. In this mode, the bus transmitter will not send data, nor will the normal mode receiver accept data as the bus lines are biased to ground minimizing the system supply current. Only the low-power receiver will be actively monitoring the bus for activity. RXD indicates a valid wake-up event after a valid wake-up signal has been detected on the Bus. The low-power receiver is powered using the VIO pin only. This allows V_{CC} to be removed reducing power consumption further.

Device Local Faults

TXD Dominant Time-out

The device will detect TXD dominant time-out and prevents a permanent low on the TXD pin drive CAN bus into permanent dominant blocking the CAN bus network. If the TXD remains low for longer than t_{TXD_DTO} , the transmitter will be disabled until the fault flag has been cleared. The TXD dominant time-out time also defines that the data rate should be faster than 40 kbit/s.

Bus Dominant Time-out

The device will detect Bus dominant time-out and prevent a permanent dominant on the CAN bus blocking the CAN bus network. The fault flag is set if the CAN bus remains dominant for longer than t_{BUS_DTO} , and is released as soon as the bus returns to recessive.

Fault Protected High-Speed CAN FD Transceiver with Standby Mode**Under-Voltage Lockout (UVLO)**

The device integrated under-voltage detect and lockout circuit of the supply terminal to keep the device in the protected mode if the supply voltage drops below the threshold until the supply voltage is higher than the UVLO threshold. This protects the device and system during the under-voltage event on supply terminals.

Over-Temperature Protection (OTP)

The output drivers are protected against over-temperature conditions. If the virtual junction temperature exceeds the shutdown junction temperature T_{OTP} , the output drivers will be disabled until the virtual junction temperature falls below T_{OTP} and TXD becomes recessive again. Including the TXD condition minimizes output driver oscillation due to temperature drift.

Fault Protected High-Speed CAN FD Transceiver with Standby Mode

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.

Application Information

The TPT1042 is a CAN transceiver to support CAN FD function up to 5 Mbps, with BUS protection voltage from -70 V to +70 V, overtemperature shutdown, a -30 V to +30 V common-mode range. The VIO of TPT1042 can support the voltage level of TXD and RXD from 2.8 V to 5.5 V. The following sections show a typical application of the TPT1042.

Typical Application

Figure 7 shows the typical application schematic of the TPT1042.

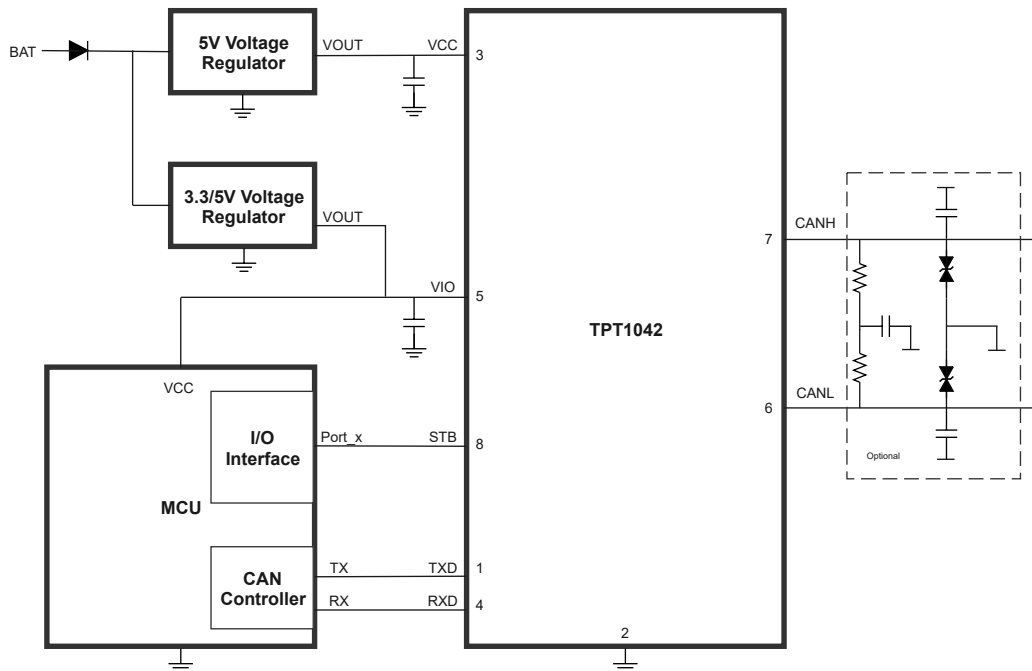
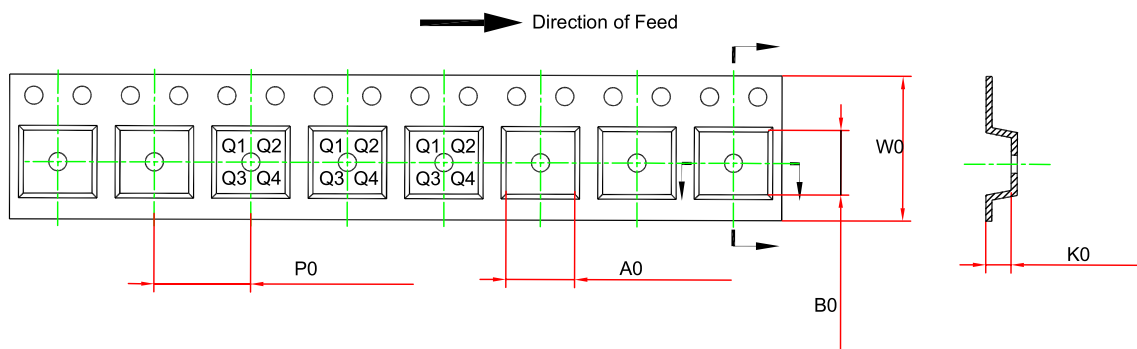
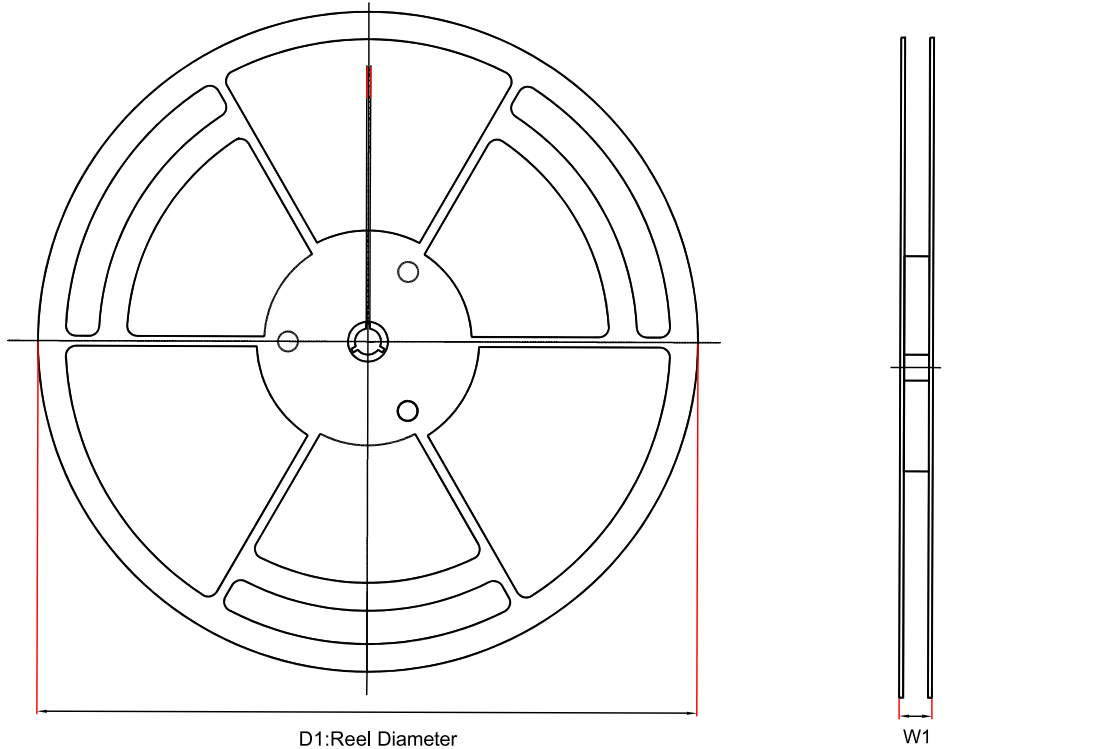


Figure 7. Typical Application Circuit

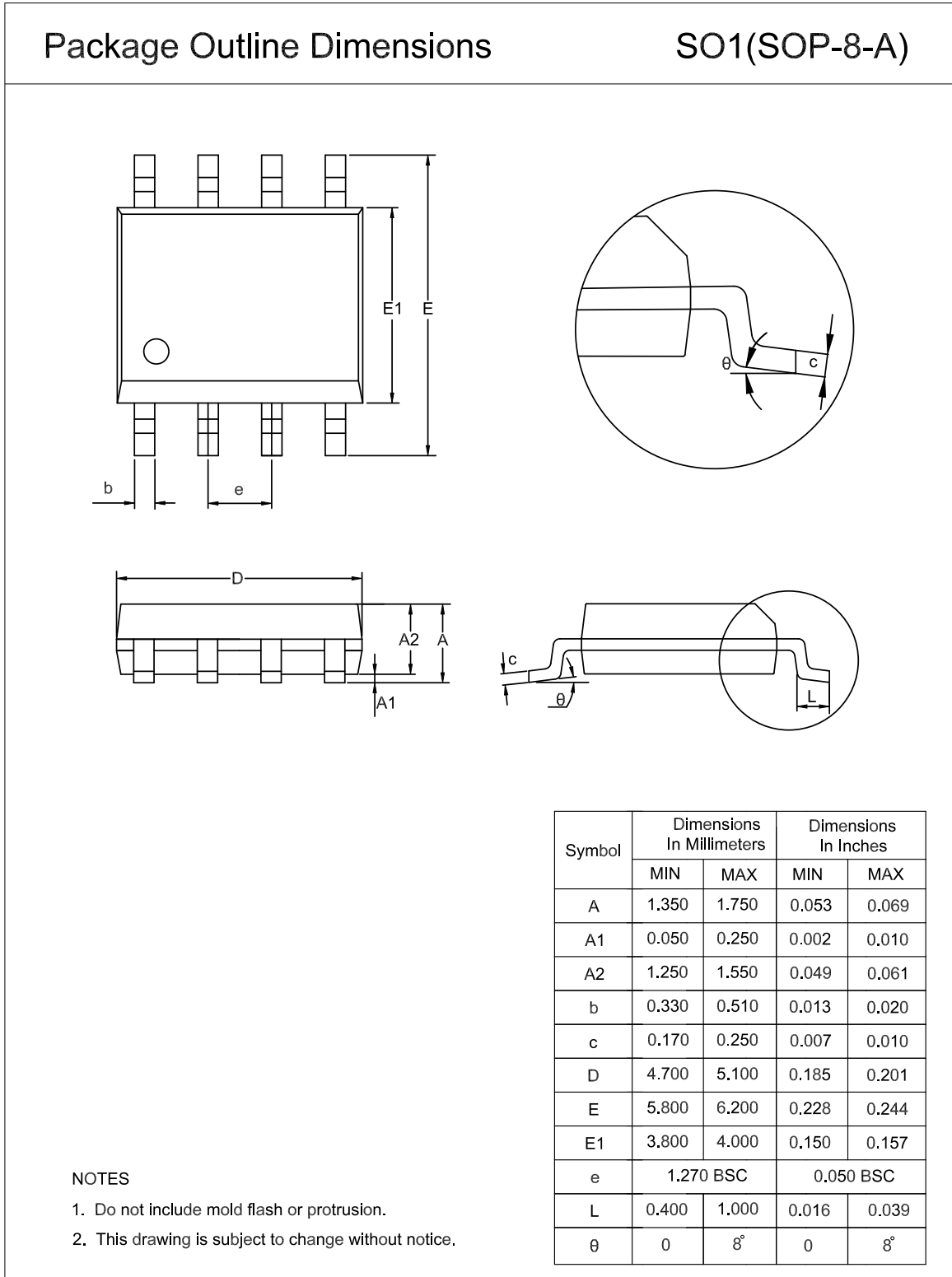
Tape and Reel Information



| Order Number | Package | D1 (mm) | W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P0 (mm) | W0 (mm) | Pin1 Quadrant |
|-----------------|----------|---------|---------|---------|---------|---------|---------|---------|---------------|
| TPT1042V-SO1R-S | SOP8 | 330 | 17.6 | 6.5 | 5.4 | 2.0 | 8.0 | 12.0 | Q1 |
| TPT1042V-DF6R-S | DFN3x3-8 | 330 | 17.6 | 3.3 | 3.3 | 1.1 | 8.0 | 12.0 | Q1 |
| TPT1042-SO1R-S | SOP8 | 330 | 17.6 | 6.5 | 5.4 | 2.0 | 8.0 | 12.0 | Q1 |
| TPT1042-DF6R-S | DFN3x3-8 | 330 | 17.6 | 3.3 | 3.3 | 1.1 | 8.0 | 12.0 | Q1 |

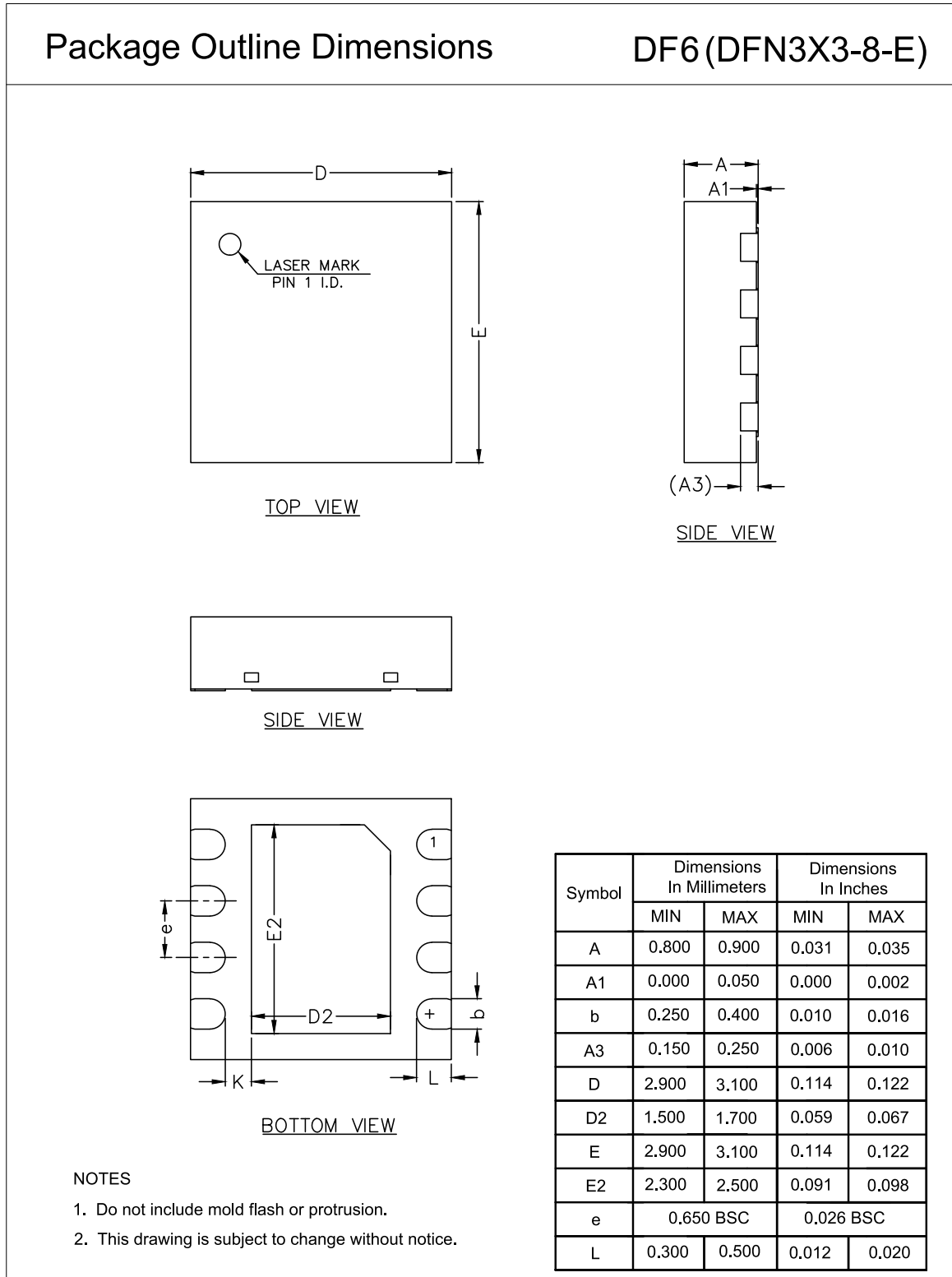
Package Outline Dimensions

SOP-8



Fault Protected High-Speed CAN FD Transceiver with Standby Mode

DFN3X3-8



Fault Protected High-Speed CAN FD Transceiver with Standby Mode**Order Information**

| Order Number | Operating Temperature Range | Package | Marking Information | MSL | Transport Media, Quantity | Eco Plan |
|-----------------|-----------------------------|----------|---------------------|------|---------------------------|----------|
| TPT1042V-SO1R-S | -40 to 125°C | SOP8 | 1042V | MSL3 | Tape and Reel, 4000 | Green |
| TPT1042V-DF6R-S | -40 to 125°C | DFN3x3-8 | 1042V | MSL3 | Tape and Reel, 4000 | Green |
| TPT1042-SO1R-S | -40 to 125°C | SOP8 | T1042 | MSL3 | Tape and Reel, 4000 | Green |
| TPT1042-DF6R-S | -40 to 125°C | DFN3x3-8 | T1042 | MSL3 | Tape and Reel, 4000 | Green |

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

Fault Protected High-Speed CAN FD Transceiver with Standby Mode

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