Features

- Meet the ISO 11898 Standard
- Support CAN FD and Data Rates up to 5 Mbps
- Typical Loop Delay: 110 ns
- 5V Power Supply, 3.0 V~5.5 V IO Interface
- Receiver Common-Mode Input Voltage: ±30 V
- Bus Fault Protection: ±42 V
- Up to 110 Nodes in CAN Network
- Junction Temperatures from –40°C to 150°C
- Latch-Up Performance Exceeds 500 mA
- BUS Pin ESD Protection：
  - ±8 kV Human-Body Model
  - ±1.5 kV Charged-Device Model

Applications

- All Devices Support Highly Loaded CAN Networks
- Field Industrial Automation, Sensors, and Drive Systems
- Building, Security Control Systems
- Energy Storage Systems
- Telecom Base Station Status and Control

Description

The TPT1051V is a CAN transceiver that meets the ISO11898 High Speed CAN (Controller Area Network) physical layer standard. The device is designed to use in CAN FD networks up to 5 Mbps, and enhanced timing margin and higher data rates in long and highly loaded networks. As designed, the device features cross-wire, overvoltage, loss of ground protection from –42 V to +42 V, overtemperature shutdown, and a –30V to +30V common-mode range. TPT1051V has a secondary power supply input for I/O level shifting the input pin thresholds and RXD output level, and the device comes with silent mode which is also commonly referred to as listen-only mode, and it includes many protection features to enhance the device and network robustness.

TPT1051V is available in SOP8 and DFN8L packages, and is characterized from –40°C to +125°C.

Typical Application Circuit

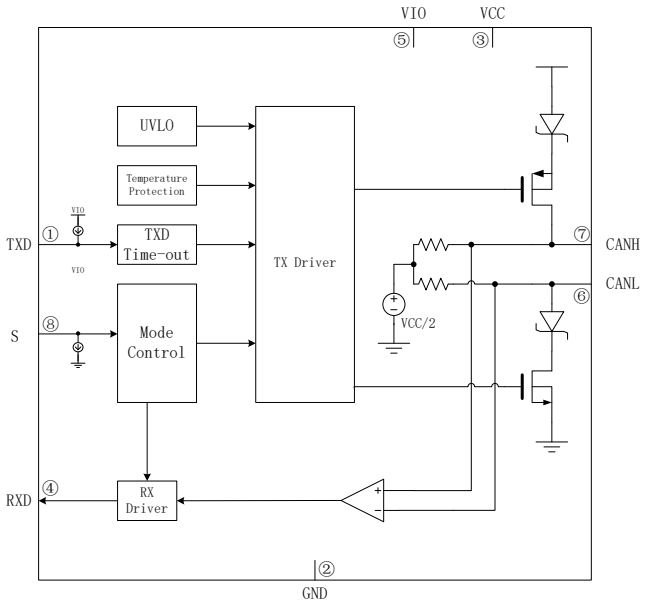


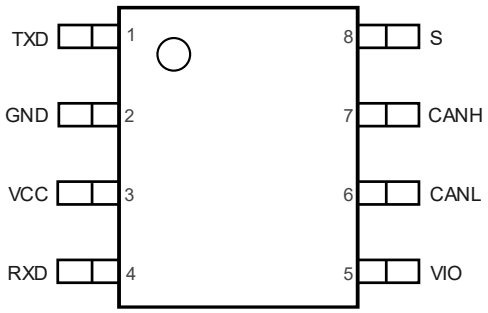
Table of Contents

Revision History

Date	Revision	Notes
2020/2/18	Rev. Pre 0.0	Initial Version
2020/4/24	Rev. Pre 0.1	Updated ESD level
2020/5/18	Rev. Pre 0.2	Updated electrical parameter
2020/6/17	Rev. Pre 0.3	Added DFN3x3-8L package
2020/6/30	Rev.0	Released Version
2020/12/25	Rev.A.0	Updated the notes for Absolute Maximum Ratings
2022/7/25	Rev.A.1	Updated the POD of SOP8 and DFN3X3-8L
2022/9/28	Rev.A.2	Updated the package drawing of DFN3X3-8L

Pin Configuration and Functions

TPT1051V-SO1R
SOP8 Package
Top View



TPT1051VL1-DF6R
DFN3x3-8L
Top View

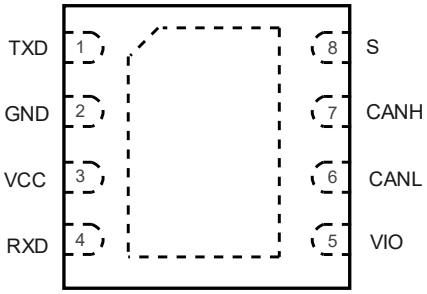


Table 1. Pin Functions: TPT1051V

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 (Devices with "V" suffix only)
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	S	I	Silent Mode control input (active high)

Specifications

Absolute Maximum Ratings(1)

Parameter		Condition	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)		–42	42	V
$V_{(Logic\_Input)}$	Logic Input Terminal Voltage Range (TXD, S)		–0.3	7	V
$V_{(Logic\_Output)}$	Logic Output Terminal Voltage Range (RXD)		–0.3	7	V
IO(RXD)	RXD (Receiver) Output Current		–8	8	mA
$T_{j(max)}$	Maximum Junction Temperature		-40	150	°C
T_{stg}	Storage Temperature Range		–65	150	°C

Note: 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.

(1) This data was taken with the JEDEC low effective thermal conductivity test board.

(2) This data was taken with the JEDEC standard multilayer test boards.

Recommended Operating Conditions

Parameter		Condition	Min	Max	Unit
$V_{I/O}$	Input/output voltage SCL1, SDA1, SCL2, SDA2		3.0	5.5	V
VCC	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

ESD Electrostatic Discharge Protection

Symbol	Parameter	Condition	Minimum Level	Unit
HBM	HBM, per ANSI/ESDA/JEDEC JS-001	Bus Pin	±8	kV
		All Pins Except Bus Pin	±8	kV
CDM	CDM, per ANSI/ESDA/JEDEC JS-002	All Pins	±1.5	kV
LU	LU, per JESD78	All Pins	±500	mA

Thermal Information

Package Type	θ_{JA}	θ_{JC}	Unit
SOIC-8	148	48	°C/W
DFN3x3-8	52	23	°C/W

Power Consumption

Parameter		Test Condition	Value	Unit
P_D	Average Power Dissipation	VCC = 5 V, VIO = 3.3 V (if applicable), Ta = 25°C, RL = 60 Ω, S at 0 V, Input to TXD at 250 kHz, CL_RXD = 15 pF. Typical CAN operating conditions at 500 kbps with 25% transmission (dominant) rate.	65	mW
		VCC = 5.5 V, VIO = 3.6 V (if applicable), Ta = 125°C, RL = 50 Ω, S at 0 V, Input to TXD at 0.5 MHz, CL_RXD = 15 pF. Typical high load CAN operating conditions at 1 Mbps with 50% transmission (dominant) rate and loaded network.	135	mW

Electrical Characteristics

All test condition is V_{CC} = 4.5 V to 5.5 V, V_{IO} = 3.0 V to 5.5 V, T_A = –40°C to 125°C, unless otherwise noted.

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
ICC	Normal Mode (dominant)	TXD = 0 V, R_L = 60 Ω, C_L = open, R_{CM} = open, S = 0 V		50	70	mA
		TXD = 0 V, R_L = 50 Ω, C_L = open, R_{CM} = open, S = 0 V		52	80	mA
	Normal Mode (dominant – bus fault)	TXD = 0 V, S = 0V, CANH = -12V, R_L = open, C_L = open, R_{CM} = open		74	150	mA
	Normal Mode (recessive)	TXD = V_{CC}, R_L = 50 Ω, C_L = open, R_{CM} = open, S = 0 V		1.3	2.5	mA
	Silent Mode	TXD = V_{CC}, R_L = 50 Ω,C_L = open, R_{CM} = open, S = V_{CC}		1.3	2.5	mA
I_{IO}	Normal and Silent Modes	RXD Floating, TXD = S = 0 or VIO		73	300	μA
UV_{VCC}	Rising Undervoltage Detection on VCC for Protected Mode			4.0	4.4	V
	Falling Undervoltage Detection on VCC for Protected Mode		3.6	3.9	4.15	
$V_{HYS(UVVCC)}$	Hysteresis Voltage on UVVCC			200		mV
UV_{VIO}	Undervoltage Detection on VIO for Protected Mode		1.3		2.75	V
$V_{HYS(UVVIO)}$	Hysteresis Voltage on UVVIO for Protected Mode			150		mV
Pin- S (Mode Select Input)						
V_{IH}	High-level Input Voltage		0.7 x V_{IO}			V
V_{IL}	Low-level Input Voltage				0.3 x V_{IO}	
I_{IH}	High-level Input Leakage Current	S = V_{CC} or V_{IO} = 5.5 V			30	μA
I_{IL}	Low-level Input Leakage Current	S = 0 V, V_{CC} = V_{IO} = 5.5 V	–2	0	2	
$I_{lkg(OFF)}$	Unpowered Leakage Current	S = 5.5 V, V_{CC} = V_{IO} = 0 V	-1	0	1	
Pin- TXD (CAN Transmit Data Input)						
V_{IH}	High-level Input Voltage		0.7 x V_{IO}			V
V_{IL}	Low-level Input Voltage				0.3 x V_{IO}	
I_{IH}	High-level Input Leakage Current	S = V_{CC} or V_{IO} = 5.5 V	–2.5	0	1	μA
I_{IL}	Low-level Input Leakage Current	S = 0 V, V_{CC} = V_{IO} = 5.5 V	–100	-63	–7	
$I_{lkg(OFF)}$	Unpowered Leakage Current	TXD = 5.5 V, V_{CC} = V_{IO} = 0 V	–1	0	1	
C_I	Input Capacitance (1)			4.5		pF

Note: Typ data is based on bench test by LRC meter E4980AL.

Electrical Characteristics (Continued)

All test condition is V_{CC} = 4.5 V to 5.5 V, V_{IO} = 3.0 V to 5.5 V, T_A = –40°C to 125°C, unless otherwise noted.

Symbol	Parameter		Test Conditions	Min	Typ	Max	Unit
Pin- RXD (CAN Receive data output)							
V_{OH}	High-level output voltage		Devices with the "V" suffix (I/O levelshifting), I_O = –2 mA	0.8 × V_{IO}			V
V_{OL}	Low-level output voltage		Devices with the "V" suffix (I/O levelshifting), I_O = +2 mA			0.2 x V_{IO}	
$I_{lkg(OFF)}$	Unpowered leakage current		RXD = 5.5 V, V_{CC} = 0 V, V_{IO} = 0 V	–1	0	1	µA
Driver electrical characteristics							
$V_{O(DOM)}$	Bus output voltage (dominant	CANH	TXD = 0 V, S = 0 V, 50 Ω≤ R_L ≤ 65 Ω, C_L = open, R_{CM} = open	2.75		4.5	V
		CANL		0.5		2.25	V
$V_{O(REC)}$	Bus output voltage (recessive)	CANH CANL	TXD = V_{CC}, V_{IO} = V_{CC}, S = V_{CC} or 0 V (2), R_L = open (no load), R_{CM} = open	2	0.5xVCC	3	V
$V_{OD(DOM)}$	Differential output voltage (dominant)	CANH CANL	TXD = 0 V, S = 0 V, 45 Ω≤ R_L < 50 Ω, C_L = open, R_{CM} = open	1.4		3	V
			TXD = 0 V, S = 0 V, 50 Ω≤ R_L ≤ 65 Ω, C_L = open, R_{CM} = open	1.5		3	V
			TXD = 0 V, S =0 V, R_L = 2240 Ω, C_L = open, R_{CM} = open	1.5		5	V
$V_{OD(REC)}$	$V_{OD(REC)}$	$V_{OD(REC)}$	TXD = VCC, S = 0 V, RL = 60 Ω, CL = open, RCM = open	-120		12	mV
			TXD = VCC, S = 0 V, RL = open (no load), CL = open, RCM = open	-50		50	mV
V_{SYM}	Transient symmetry (dominant or recessive) ($V_{O(CANH)}$ + $V_{O(CANL)}$) / V_{CC} Note1		S at 0 V, R_{term}= 60 Ω, C_{split} = 4.7 nF, C_L = open, R_{CM} = open, T_{XD} = 250 kHz, 1 MHz		1.0		V/V
V_{SYM_DC}	DC Output symmetry (dominant or recessive) (V_{CC} – $V_{O(CANH)}$ – $V_{O(CANL)}$) Note1		S = 0 V,R_L = 60 Ω, C_L = open, R_{CM} = open	-1	0.2	1	V
$I_{OS(SS\_DOM)}$	Short-circuit steady-state output current, dominant		S at 0 V, V_{CANH} = -5 V to 40 V, CANH = open, TXD = 0 V	–100			mA
			S at 0 V, V_{CANL} = -5 V to 40 V, CANH = open, TXD = 0 V			100	
$I_{OS(SS\_REC)}$	Short-circuit steady-state output current, recessive		–27 V ⩽ VBUS ⩽ 32 V, Where VBUS = CANH = CANL, TXD = VCC, all modes	-5		5	mA

Note1: Test data based on bench test and design simulation

Electrical Characteristics (Continued)

All test condition is V_{CC} = 4.5 V to 5.5 V, V_{IO} = 3.0 V to 5.5 V, T_A = –40°C to 125°C, unless otherwise noted.

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
Receiver Electrical Characteristics						
V_{CM}	Common Mode Range, Normal Mode	S = 0 or V_{CC} or V_{IO}	-30		+30	V
V_{IT+}	Positive-going Input Threshold Voltage, all modes	S = 0 or V_{CC} or V_{IO}, -20 V ≤ V_{CM} ≤ +20 V			900	mV
V_{IT-}	Negative-going Input Threshold Voltage, all modes		400			
V_{IT+}	Positive-going Input Threshold Voltage, all modes	S = 0 or V_{CC} or V_{IO}, -30 V ≤ V_{CM} ≤ +30 V			1000	mV
V_{IT-}	Negative-going Input Threshold Voltage, all modes		400			
V_{HYS}	Hysteresis Voltage (V_{IT+} - V_{IT-}) (1)	S = 0 or V_{CC} or V_{IO}		115		mV
$I_{lkg(IOFF)}$	Power-off (unpowered) Bus Input Leakage Current	CANH = CANL = 5 V, V_{CC} = V_{IO} = 0 V			4.8	µA
C_I	Input Capacitance to Ground (CANH or CANL) (2)			35		pF
C_{ID}	Differential Input Capacitance (3)			20		pF
R_{ID}	Differential Input Resistance	TXD = V_{CC} = V_{IO} = 5 V, S = 0 V, -30 V ≤ V_{CM} ≤ +30 V	30		80	kΩ
R_{IN}	Input Resistance (CANH or CANL)		15		40	kΩ
$R_{IN(M)}$	Input Resistance Matching: [1 – $R_{IN(CANH)}$ / $R_{IN(CANL)}$] × 100%	V_{CANH} = V_{CANL} = 5 V	–2%		+2%	

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

(2) Typ data is based on the bench test by LRC meter E4980AL.

(3) Typ data is based on the bench test by LRC meter E4980AL.

AC Timing Requirements

All test condition is V_{CC} = 4.5 V to 5.5 V, V_{IO} = 3.0 V to 5.5 V, T_A = –40°C to 125°C, unless otherwise noted.

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
Device Switching Characteristics						
$t_{PROP(LOOP1)}$	Total loop delay, driver input (TXD) to receiver output (RXD), recessive to dominant	S = 0 V, RL = 60 Ω, CL = 100 pF, CL(RXD) = 15 pF		100	160	ns
$t_{PROP(LOOP2)}$	Total loop delay, driver input (TXD) to receiver output (RXD), dominant to recessive			110	175	
t_{MODE}	Mode change time, from Normal to Silent or from Silent to Normal			0.15	10	µs
Driver Switching Characteristics						
t_{pHR}	Propagation delay time, high TXD to driver recessive (dominant to recessive) Note1	S = 0 V, R_L = 60 Ω, C_L = 100 pF, R_{CM} = open		70		ns
t_{pLD}	Propagation delay time, low TXD to driver dominant (recessive to dominant) Note1			42		
$t_{sk(p)}$	Pulse Skew ($\lvert t_{pHR} - t_{pLD} \rvert$) (1)			20		
t_R	Differential Output Signal Rise Time (1)			45		
t_F	Differential Output Signal Fall Time (1)			45		
t_{TXD_DTO}	Dominant Timeout	S = 0 V, R_L = 60 Ω, C_L = open	1.2		3.8	ms
Receiver Switching Characteristics						
t_{pRH}	Propagation delay time, bus recessive input to high output (Dominant to Recessive) (1)	S = 0 V, $C_{L(RXD)}$ = 15 pF		76		ns
t_{pDL}	Propagation delay time, bus dominant input to low output (Recessive to Dominant) (1)			59		
t_R	RXD Output Signal Rise Time Note1			10		
t_F	RXD Output Signal Fall Time Note1			10		
FD Timing Parameters						
$t_{BIT(BUS)}$	Bit time on CAN bus output pins with $t_{BIT(TXD)}$ = 500 ns, all devices	S = 0 V, R_L = 60 Ω, C_L = 100 pF, $C_{L(RXD)}$ = 15 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 ns, G device variants only		155		210	
$t_{BIT(RXD)}$	Bit time on RXD output pins with $t_{BIT(TXD)}$ = 500 ns, all devices		400		550	
	Bit time on RXD output pins with $t_{BIT(TXD)}$ = 200 ns, G device variants only		120		220	
Δt_{REC}	Receiver timing symmetry with $t_{BIT(TXD)}$ = 500 ns, all devices		-65		40	
	Receiver timing symmetry with $t_{BIT(TXD)}$ = 200 ns, G device variants only		-45		15	

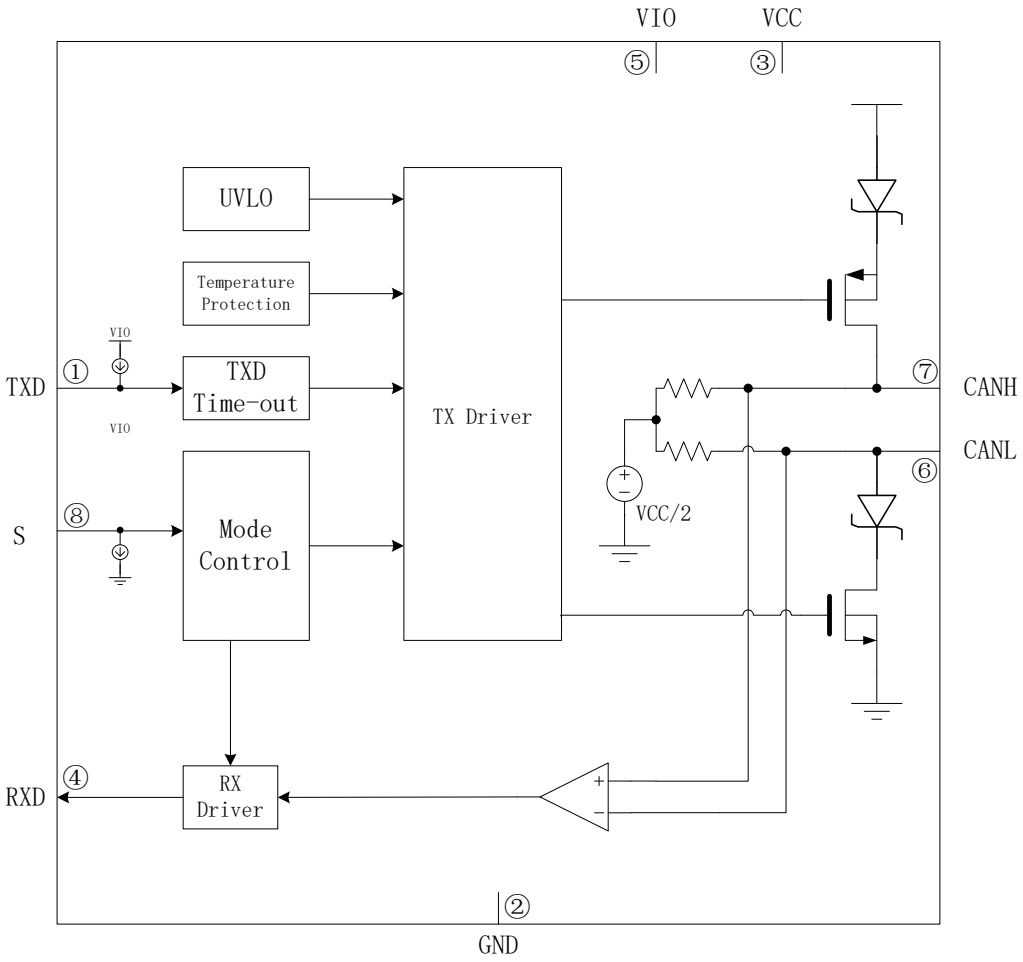
Note1: Test data based on bench test and design simulation

Detailed Description

Overview

The TPT1051V is a CAN transceiver that meets the ISO11898 High Speed CAN (Controller Area Network) physical layer standard. The device is designed to use in CAN FD networks up to 5 Mbps, and enhanced timing margin and higher data rates in long and highly loaded networks. As designed, the device features cross-wire, overvoltage, loss of ground protection from –42 V to +42 V, overtemperature shutdown, and a –30V to +30V common-mode range. TPT1051V has a secondary power supply input for I/O level shifting the input pin thresholds and RXD output level, and the device comes with silent mode which is also commonly referred to as listen-only mode, and it includes many protection features to enhance the device and network robustness.

Functional Block Diagram



Feature Description

Driver Function Table

Device	Inputs		Outputs		Driven BUS State
	S	TXD	CANH	CANL	
All Devices	L or open	L	H	L	Dominant
		H or Open	Z	Z	Recessive
	H	X	Z	Z	Recessive

Receiver Function Table

Device Mode	CAN Differential Inputs $V_{ID} = V_{CANH} – V_{CANL}$	BUS State	RXD Terminal
Normal or Silent	$V_{ID} \geq V_{IT+(MAX)}$	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

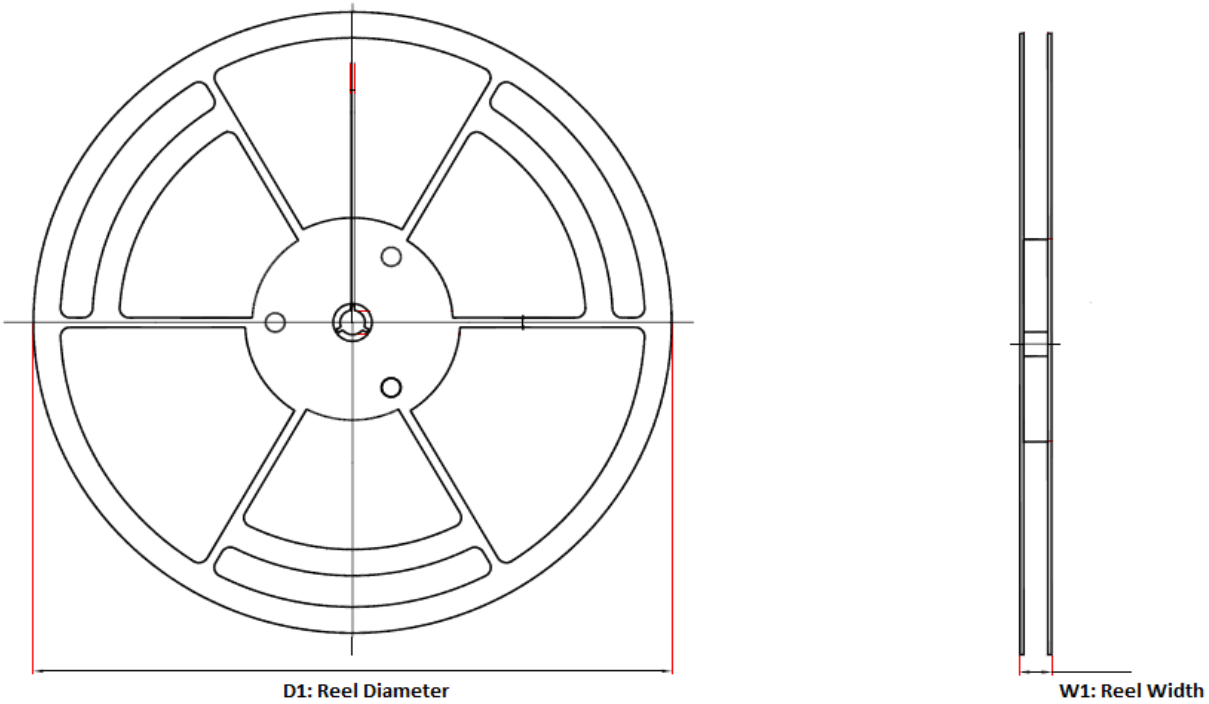
Normal Mode

A Low level on pin S selects the normal mode. In normal mode, the transceiver transmits and receives 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 pin RXD. The slopes of the output signals on the bus lines are controlled internally and optimized to guarantee the lowest possible Electro Magnetic Emission (EME).

Silent Mode

A High level on pin S selects the silent mode. In silent mode, the transmitter is disabled, releasing the bus pins to a recessive state. All other IC functions, including the receiver, continue to operate as in the normal mode, just like listen-only mode. Silent mode can be used to prevent a faulty CAN controller from disrupting all network communications.

Tape and Reel Information

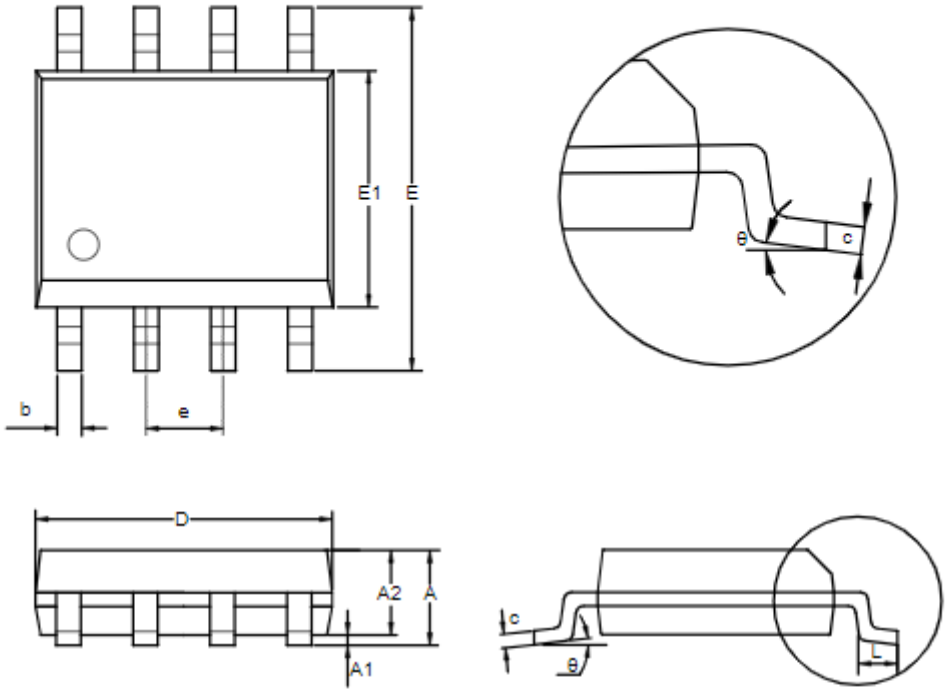


Order Number	Package	D1 (mm)	W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	W0 (mm)	Pin1 Quadrant
TPT1051V-SO1R	SOP8	330.0	17.6	6.4	5.4	2.1	8.0	12.0	Q1
TPT1051V-DF6R	DFN3X3-8L	330.0	17.6	3.3	3.3	1.1	8.0	12.0	Q1

Package Outline Dimensions

SOP8

Package Outline Dimensions SO1(SOP-8-A)



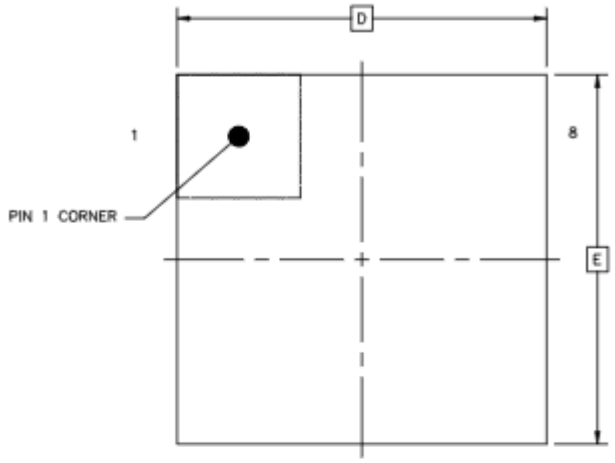
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.350	1.750	0.053	0.069
A1	0.050	0.250	0.002	0.010
A2	1.250	1.550	0.049	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.007	0.010
D	4.700	5.100	0.185	0.201
E	5.800	6.200	0.228	0.244
E1	3.800	4.000	0.150	0.157
e	1.270 BSC		0.050 BSC	
L	0.400	1.000	0.016	0.039
θ	0	8°	0	8°

NOTES

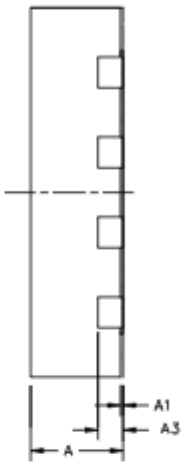
1. Do not include mold flash or protrusion.
2. This drawing is subject to change without notice.

DFN3x3-8L

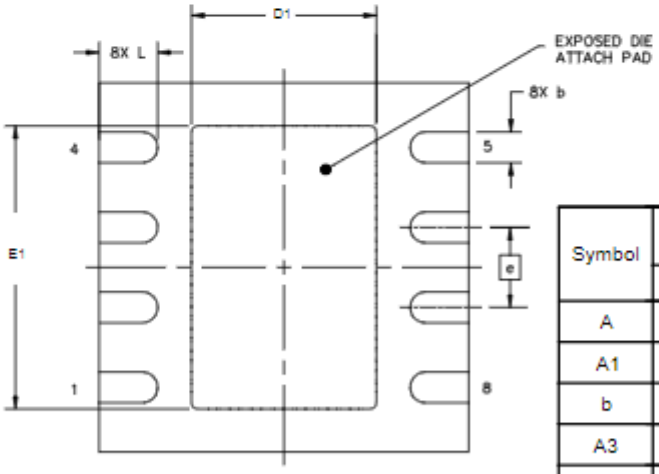
Package Outline Dimensions DF6(DFN3X3-8-A)



TOP VIEW



SIDE VIEW



BOTTOM VIEW

NOTES

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

Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.700	0.800	0.028	0.031
A1	0.000	0.050	0.000	0.002
b	0.200	0.330	0.008	0.013
A3	0.150	0.250	0.006	0.010
D	2.900	3.100	0.114	0.122
D1	1.400	1.600	0.055	0.063
E	2.900	3.100	0.114	0.122
E1	2.200	2.400	0.087	0.094
e	0.650 BSC		0.026 BSC	
L	0.250	0.575	0.010	0.023

Order Information

Order Number	Operating Temperature Range	Package	Marking Information	MSL	Transport Media, Quantity	Eco Plan
TPT1051V-SO1R	-40 to 125°C	SOP8	T1051V	3	Tape and Reel, 4000	Green
TPT1051V-DF6R	-40 to 125°C	DFN3x3-8	1051V	3	Tape and Reel, 4000	Green

(1) For Future products, contact the 3PEAK factory for more information and sample.

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

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