

## Features

- Compliant to LIN 2.0, LIN 2.1, LIN 2.2, LIN 2.2A and ISO 17987-4 Electrical Physical Layer (EPL) Specification
- Compliant to SAE J2602-1 LIN Network for Vehicle Applications
- Support LIN Data Rates up to 20 Kbps
- Wide  $V_{BAT}$  Input Voltage Range Supports 5.5 V to 40 V
- Low-current Standby Mode and Sleep Mode with Bus Wake-up and Local Wake-up Capability
- Input Levels Compatible with 3.3-V and 5-V MCU Interface
- Ideal Passive Behavior to LIN Bus when Unpowered
- Integrated Pull-up Resistor for LIN Slave Applications
- Protection Feature :
  - Bus Pin IEC 61000-4-2 ESD Protection  $\pm 10$  kV
  - Bus Fault Tolerant:  $\pm 45$  V
  - $V_{BAT}$  Undervoltage Protection
  - TXD Dominant Time-out Function
  - Thermal Shutdown Protection
- Available in Leadless QFN5.5X3.5-24 Package with Improved Automated Optical Inspection (AOI) Capability
- AEC-Q100 Qualified for Automotive Applications, Grade 1

## Applications

- Automotive and Transportation
- Body Electronics / Lighting
- Power Train / Chassis
- Infotainment / Cluster
- ADAS / Safety

## Description

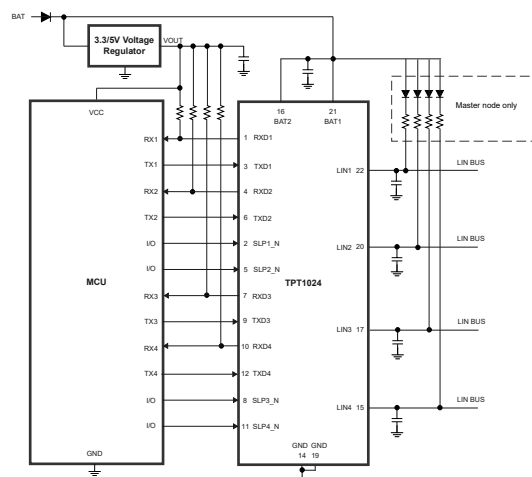
The TPT1024Q is a quad local interconnect network (LIN) physical layer transceiver that is compliant with the ISO 17987-4, SAE J2602-1 and LIN 2.0, LIN 2.1, LIN 2.2, and LIN 2.2-A physical layer standards. LIN is a low-speed universal asynchronous receiver transmitter (UART) communication protocol that supports automotive in-vehicle sub-networks.

The device supports LIN networks up to 20 Kbps with an enhanced timing margin. The device converts the transmitted data received at the TXD with an optimized slew rate to minimize the electro-magnetic emission (EME). It reports the state of the LIN bus at the RXD.

As designed, the device features overvoltage and loss of ground protection from  $-45$  V to  $+45$  V, over-temperature shutdown. The device has low-current standby and sleep mode with LIN BUS wake-up capability. The device integrates a pull high resistor for LIN slave applications and ESD protection which allows applications to operate with a reduced dependence on external components. Additionally, all devices include many protection features to enhance the device and network robustness.

The TPT1024Q is available in the DFN5.5X3.5-24 package and is AEC-Q100 qualified for automotive applications.

## Typical Application Circuit



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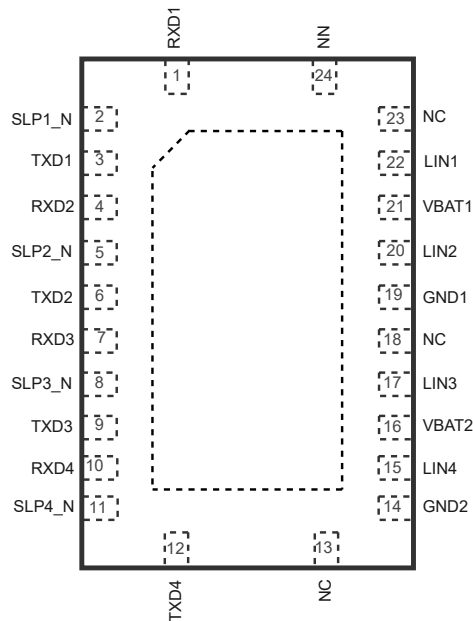
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## Revision History

Date	Revision	Notes
2022-12-05	Rev.Pre.0	Initial version
2024-07-30	Rev.A.0	Released version

## Pin Configuration and Functions

TPT1024Q  
QFN5.5X3.5-24 Package  
Top View



**Table 1. Pin Functions: TPT1024Q**

Pin		I/O	Description
No.	Name		
1	RXD1	Output	LIN1 receives data output, open-drain, active low
2	SLP1_N	Input	LIN1 sleep mode control input, active low
3	TXD1	Input	LIN1 transmits data input
4	RXD2	Output	LIN2 receives data output, open-drain, active low
5	SLP2_N	Input	LIN2 sleep mode control input, active low
6	TXD2	Input	LIN2 transmits data input
7	RXD3	Power	LIN3 receives data output, open-drain, active low
8	SLP3_N	Input	LIN3 sleep mode control input, active low
9	TXD3	Input	LIN3 transmits data input
10	RXD4	Output	LIN4 receives data output, open-drain, active low
11	SLP4_N	Input	LIN4 sleep mode control input, active low
12	TXD4	Input	LIN4 transmits data input
13	NC		Not connected

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**Automotive Quad Fault Protected LIN Transceiver**

Pin		I/O	Description
No.	Name		
14	GND2	Ground	Ground for LIN3 and LIN4
15	LIN4	BUS I/O	LIN4 bus input/output line
16	VBAT2	Power	High voltage power supply from the battery for LIN3 and LIN4
17	LIN3	BUS I/O	LIN3 bus input/output line
18	NC		Not connected
19	GND1	Ground	Ground for LIN1 and LIN2
20	LIN2	BUS I/O	LIN2 bus input/output line
21	VBAT1	Power	High voltage power supply from the battery for LIN1 and LIN2
22	LIN1	BUS I/O	LIN1 bus input/output line
23	NC		Not connected
24	NC		Not connected

## Specifications

### Absolute Maximum Ratings <sup>(1)</sup>

Parameter		Conditions	Min	Max	Unit
V <sub>BAT</sub>	Battery Supply Voltage Range		-0.3	45	V
V <sub>TXD</sub>	Pin TXD Voltage Range	Pin TXDx	-0.3	7	V
V <sub>RXD</sub>	Pin RXD Voltage Range	Pin RXDx	-0.3	7	V
V <sub>SLP_N</sub>	Pin SLP_N Voltage Range	Pin SLPx_N	-0.3	7	V
V <sub>LIN</sub>	Pin LIN Voltage Range	Pin LINx, with respect to GND and V <sub>BAT</sub>	-45	45	V
ΔV <sub>LIN1-LIN2</sub>	Voltage between Pin LIN1 and LIN2		-	45	V
ΔV <sub>LIN3-LIN4</sub>	Voltage between Pin LIN3 and LIN4		-	45	V
T <sub>J</sub>	Junction Temperature <sup>(2)</sup>		-55	150	°C
T <sub>STG</sub>	Storage Temperature		-55	150	°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 standard multilayer test boards.

### ESD (Electrostatic Discharge Protection)

Parameter		Condition	Min	Max	Unit
V <sub>ESD</sub>	Electrostatics Discharge <sup>(1)(2)</sup>	IEC61000-4-2(150pF, 330Ω discharge circuit), contact discharge on LIN bus LINx pins	-10	10	kV
		Human Body Model (HBM) on LIN bus LINx pins	-10	10	kV
		Human Body Model (HBM) on any other pins	-6	6	kV
		Charged Device Model (CDM) on all pins	-750	750	V
V <sub>TRAN</sub>	Transient Immunity ISO 7637-2 on Bus Pins	Pulse1	-100	-	V
		Pulse2a	-	75	V
		Pulse3a	-150	-	V
		Pulse3b	-	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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**Automotive Quad Fault Protected LIN Transceiver****Recommended Operating Conditions**

	Parameter	Min	Max	Unit
V <sub>BAT</sub>	Battery Power Supply	5.5	40	V
V <sub>LIN</sub>	LIN Bus Input Voltage	0	40	V
V <sub>LOGIC</sub>	Logic Pin Voltage	0	5.25	V
T <sub>J</sub>	Operating Virtual Junction Temperature Range	-40	150	°C

**Thermal Information**

Package Type	$\theta_{JA}$	$\theta_{JC}$	Unit
QFN5.5x3.5-24	31.51	26.84	°C/W

**Electrical Characteristics**

 All test conditions:  $V_{BAT} = 5.5\text{ V to }40\text{ V}$ ,  $R_L = 500\ \Omega$ ,  $T_A = -40^\circ\text{C to }125^\circ\text{C}$ , unless otherwise noted.

Parameter		Conditions	Min	Typ	Max	Unit
<b>Pin VBAT</b>						
$V_{TH\_DET\_POFF}$	Power-off Detection Threshold		1.6	3.1	4.0	V
$V_{TH\_DET\_PON}$	Power-on Detection Threshold		2.3	3.4	4.3	V
$V_{HYS\_DET\_PON}$	Hysteresis Voltage on Power-on Detection <sup>(1)</sup>		50	300	1000	mV
$V_{TH\_VBAT\_L}$	Low-level VBAT Low Threshold Voltage		3.3	4	4.7	V
$V_{TH\_VBAT\_H}$	High-level VBAT Low Threshold Voltage		3.55	4.2	4.9	V
$V_{HYS\_VBAT\_L}$	VBAT Low Hysteresis Voltage <sup>(1)</sup>		15	300	600	mV
$I_{BAT}$	Sleep Mode Supply Current	Recessive; $V_{LINx} = V_{BAT}$ ; $V_{SLPx\_N} = 0\text{ V}$ ; both channels		7	12	$\mu\text{A}$
		Dominant; $V_{LINx} = 0\text{ V}$ ; $V_{BAT} = 12\text{ V}$ ; $V_{SLPx\_N} = 0\text{ V}$ ; both channels		18	30	$\mu\text{A}$
	Standby Mode Supply Current	Recessive; $V_{LINx} = V_{BAT}$ ; $V_{SLPx\_N} = 0\text{ V}$ ; both channels		7	20	$\mu\text{A}$
		Dominant; $V_{LINx} = 0\text{ V}$ ; $V_{BAT} = 12\text{ V}$ ; $V_{SLPx\_N} = 0\text{ V}$ ; both channels		0.8	1	mA
	Normal Mode Supply Current	Recessive; $V_{LINx} = V_{BAT}$ ; $V_{TXD} = 5\text{ V}$ ; $V_{SLP\_N} = 5\text{ V}$		0.3	0.6	mA
		Dominant; $V_{BAT} = 12\text{ V}$ ; $V_{TXD} = 0\text{ V}$ ; $V_{SLP\_N} = 5\text{ V}$		4	10	mA
<b>Pin TXDx</b>						
$V_{IH}$	High-Level Input Voltage		2		7	V
$V_{IL}$	Low-Level Input Voltage		-0.3		0.8	V
$V_{HYS\_TXD}$	Hysteresis Voltage on Pin TXD <sup>(1)</sup>		50	200	450	mV
$R_{PD\_TXD}$	Pin TXD Pull-down Resistance	$V_{TXD} = 5\text{ V}$	50	125	325	k $\Omega$
$I_{IL}$	Low-Level Input Current	$V_{TXD} = 0\text{ V}$	-5		5	$\mu\text{A}$
<b>Pin SLP_Nx</b>						
$V_{IH}$	High-level Input Voltage		2		7	V
$V_{IL}$	Low-level Input Voltage		-0.3		0.8	V
$V_{HYS\_SLP\_N}$	Hysteresis Voltage on Pin SLP_N <sup>(1)</sup>		50	200	450	mV



**Automotive Quad Fault Protected LIN Transceiver**

Parameter		Conditions	Min	Typ	Max	Unit
R <sub>PD_SLP_N</sub>	Pin SLP_N Pull-down Resistance	V <sub>TXD</sub> = 5 V	125	250	650	kΩ
I <sub>IL</sub>	Low-level Input Current	V <sub>TXD</sub> = 0 V	-5		5	μA
<b>Pin RXDx</b>						
I <sub>OL</sub>	Low-level Output Current	Normal mode; V <sub>LIN</sub> = 0 V, V <sub>RXDx</sub> = 0.4 V	2			mA
I <sub>LH</sub>	High-level Leakage Current <sup>(1)</sup>	Normal mode; V <sub>LIN</sub> = V <sub>BAT</sub> , V <sub>RXD</sub> = 5 V	-5	0	5	μA
<b>Pin LIN</b>						
I <sub>BUS_LIN</sub>	Dominant Output Current Limitation	V <sub>BAT</sub> = V <sub>LIN</sub> = 18 V; V <sub>TXDx</sub> = 0 V	40		200	mA
I <sub>PU_SLP</sub>	Pull-up Current	Sleep mode; V <sub>SLP_N</sub> = 0 V	-20		-2	μA
I <sub>BUS_PAS_REC</sub>	Receiver Recessive Input Leakage Current	V <sub>BAT</sub> = 5.5 V; V <sub>LIN</sub> = 40 V; V <sub>TXD</sub> = 5 V		0	20	μA
I <sub>BUS_PAS_DOM</sub>	Receiver Dominant Input Leakage Current	Normal mode; V <sub>BAT</sub> = 12 V; V <sub>LIN</sub> = 0 V; V <sub>TXD</sub> = 5 V	-600			μA
V <sub>SerDiode</sub>	Voltage Drop at the Serial Diode <sup>(1)</sup>	Pull-up path with R <sub>SLAVE</sub> ; I <sub>SerDiode</sub> = 10 μA	0.4		1	V
I <sub>BUS_NO_GND</sub>	Ground Loss Bus Current	V <sub>BAT</sub> = 40 V; V <sub>LIN</sub> = 0 V	-750		10	μA
I <sub>BUS_NO_BAT</sub>	Battery Loss Bus Current	V <sub>BAT</sub> = 0 V; V <sub>LIN</sub> = 40 V			20	μA
V <sub>BUS_PAS_DOM</sub>	Receiver Dominant				0.4 x V <sub>BAT</sub>	V
V <sub>BUS_PAS_REC</sub>	Receiver Recessive		0.6 x V <sub>BAT</sub>			V
V <sub>BUS_CNT</sub>	Receiver Center Voltage		0.475 x V <sub>BAT</sub>	0.5 x V <sub>BAT</sub>	0.525 x V <sub>BAT</sub>	V
V <sub>HYS</sub>	Receiver Hysteresis Voltage				0.175 x V <sub>BAT</sub>	V
R <sub>SLAVE</sub>	Slave Resistance	Between LIN and V <sub>BAT</sub> ; V <sub>BAT</sub> = 12 V; V <sub>LIN</sub> = 0 V	20	30	60	kΩ
C <sub>LIN</sub>	Pin LIN Capacitance <sup>(1)</sup>				20	pF
V <sub>O_DOM</sub>	Dominant Output Voltage	Normal mode; V <sub>TXD</sub> = 0 V			1.4	V
<b>Temperature Detection</b>						
T <sub>J_SD</sub>	Shutdown Junction Temperature <sup>(1)</sup>		160	180	200	°C
T <sub>J_SD_R</sub>	Recover Shutdown Junction Temperature <sup>(1)</sup>		130	145	160	°C

**Automotive Quad Fault Protected LIN Transceiver**
**Duty Cycles**

All test conditions:  $V_{BAT} = 5.5\text{ V to }40\text{ V}$ ,  $R_L = 500\ \Omega$ ,  $T_A = -40^\circ\text{C to }125^\circ\text{C}$ , see [Figure 2](#), unless otherwise noted.

Parameter		Conditions	Min	Typ	Max	Unit
D1	Duty cycle 1; $D1 = t_{BUS\_REC\_MIN} / 2 \times t_{BIT}$	$V_{TH\_REC\_MAX} = 0.744 \times V_{BAT}$ ; $V_{TH\_DOM\_MAX} = 0.581 \times V_{BAT}$ ; 20 kbps; $t_{BIT} = 50\ \mu\text{s}$ ; $7\text{ V} \leq V_{BAT} \leq 40\text{ V}$	0.396			
D1	Duty cycle 1; $D1 = t_{BUS\_REC\_MIN} / 2 \times t_{BIT}$	$V_{TH\_REC\_MAX} = 0.744 \times V_{BAT}$ ; $V_{TH\_DOM\_MAX} = 0.581 \times V_{BAT}$ ; 20 kbps; $t_{BIT} = 50\ \mu\text{s}$ ; $5.5\text{ V} \leq V_{BAT} < 7\text{ V}$	0.396			
D2	Duty cycle 2; $D2 = t_{BUS\_REC\_MAX} / 2 \times t_{BIT}$	$V_{TH\_REC\_MIN} = 0.422 \times V_{BAT}$ ; $V_{TH\_DOM\_MIN} = 0.284 \times V_{BAT}$ ; 20 kbps; $t_{BIT} = 50\ \mu\text{s}$ ; $7.6\text{ V} \leq V_{BAT} \leq 40\text{ V}$			0.581	
D2	Duty cycle 2; $D2 = t_{BUS\_REC\_MAX} / 2 \times t_{BIT}$	$V_{TH\_REC\_MIN} = 0.464 \times V_{BAT}$ ; $V_{TH\_DOM\_MIN} = 0.312 \times V_{BAT}$ ; 20 kbps; $t_{BIT} = 50\ \mu\text{s}$ ; $5.5\text{ V} \leq V_{BAT} < 7.6\text{ V}$			0.581	
D3	Duty cycle 3; $D3 = t_{BUS\_REC\_MIN} / 2 \times t_{BIT}$	$V_{TH\_REC\_MAX} = 0.778 \times V_{BAT}$ ; $V_{TH\_DOM\_MAX} = 0.616 \times V_{BAT}$ ; 10.4 kbps; $t_{BIT} = 96\ \mu\text{s}$ ; $7\text{ V} \leq V_{BAT} \leq 40\text{ V}$	0.417			
D3	Duty cycle 3; $D3 = t_{BUS\_REC\_MIN} / 2 \times t_{BIT}$	$V_{TH\_REC\_MAX} = 0.778 \times V_{BAT}$ ; $V_{TH\_DOM\_MAX} = 0.616 \times V_{BAT}$ ; 10.4 kbps; $t_{BIT} = 96\ \mu\text{s}$ ; $5.5\text{ V} \leq V_{BAT} < 7\text{ V}$	0.417			
D4	Duty cycle 4; $D4 = t_{BUS\_REC\_MAX} / 2 \times t_{BIT}$	$V_{TH\_REC\_MIN} = 0.389 \times V_{BAT}$ ; $V_{TH\_DOM\_MIN} = 0.251 \times V_{BAT}$ ; 10.4 kbps; $t_{BIT} = 96\ \mu\text{s}$ ; $7.6\text{ V} \leq V_{BAT} \leq 40\text{ V}$			0.590	
D4	Duty cycle 4; $D4 = t_{BUS\_REC\_MAX} / 2 \times t_{BIT}$	$V_{TH\_REC\_MIN} = 0.389 \times V_{BAT}$ ; $V_{TH\_DOM\_MIN} = 0.251 \times V_{BAT}$ ; 10.4 kbps; $t_{BIT} = 96\ \mu\text{s}$ ; $5.5\text{ V} \leq V_{BAT} < 7.6\text{ V}$			0.590	

## AC Timing Requirements

All test conditions:  $V_{BAT} = 5.5\text{ V to }40\text{ V}$ ,  $R_L = 500\ \Omega$ ,  $T_A = -40^\circ\text{C to }125^\circ\text{C}$ , unless otherwise noted.

Parameter		Conditions	Min	Typ	Max	Unit
$t_{RX\_PD}$	Receiver Propagation Delay	Rising and falling			6	$\mu\text{s}$
$t_{RX\_SYM}$	Receiver Propagation Delay Symmetry	Rising edge with respect to falling edge	-2		2	$\mu\text{s}$
$t_{WAKE\_DOM\_LIN}$	LIN Dominant Wake-up Time	Sleep mode	30	80	150	$\mu\text{s}$
$t_{GOTONORM}$	Go-to-Normal Time	Mode change time from Sleep, Standby mode to Normal mode	2	5	10	$\mu\text{s}$
$t_{INITNORM}$	Normal Mode Initialization Time		7	12	20	$\mu\text{s}$
$t_{GOTOSLEEP}$	Go-to-Sleep Time	Mode change time from Normal to Sleep mode	2	5	10	$\mu\text{s}$
$t_{TO\_DOM\_TXD}$	TXD dominant time-out time	$V_{TXD} = 0\text{ V}$	17	30	50	ms

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

## Parameter Measurement Information

### Test Circuit

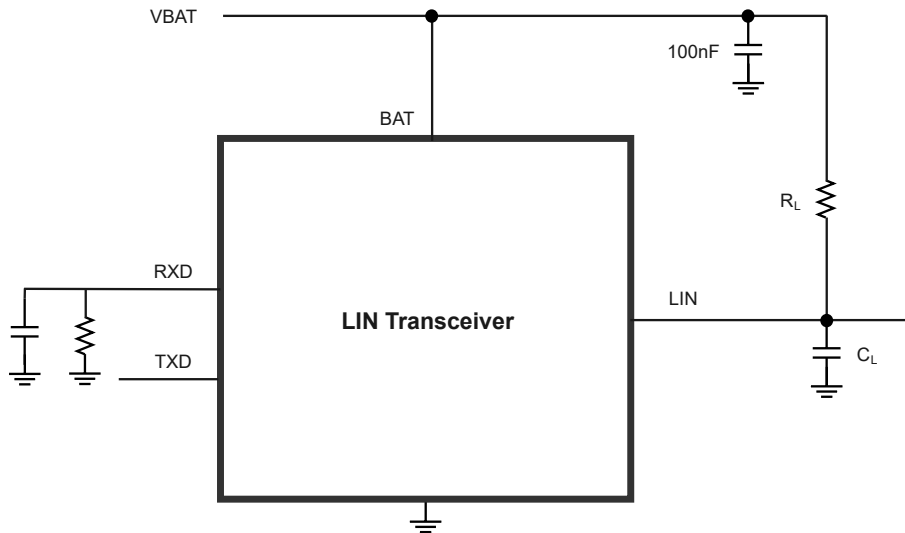


Figure 1. LIN Transceiver Timing Parameter Test Circuit

### Parameter Diagram

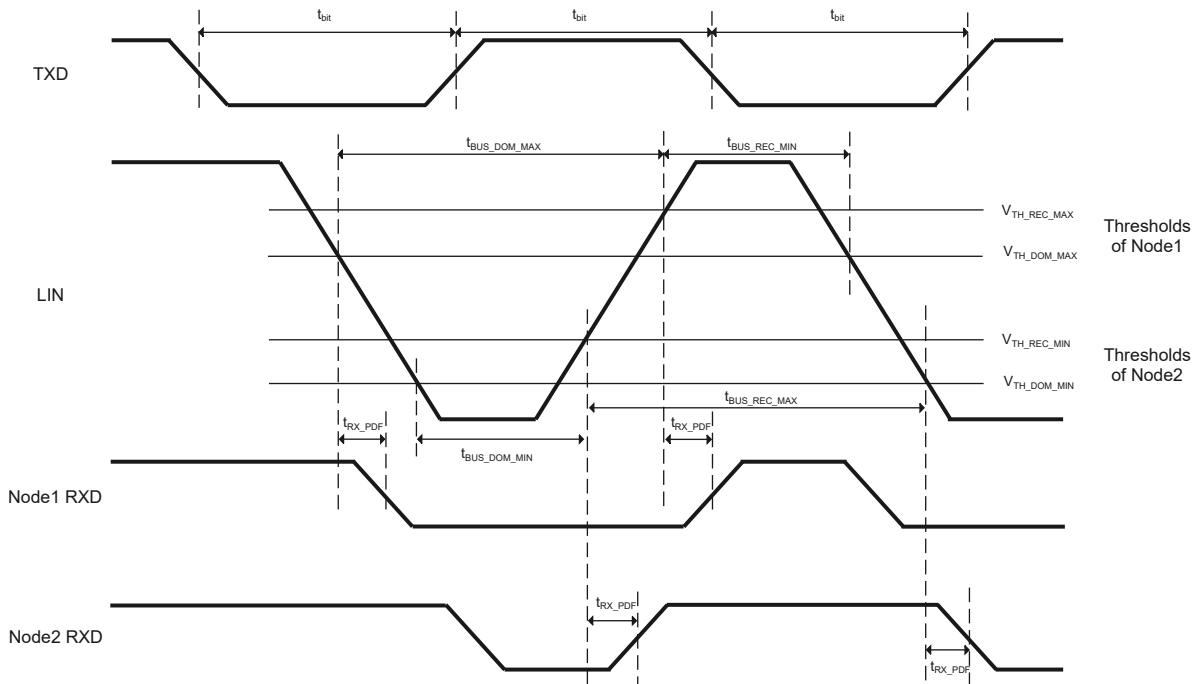
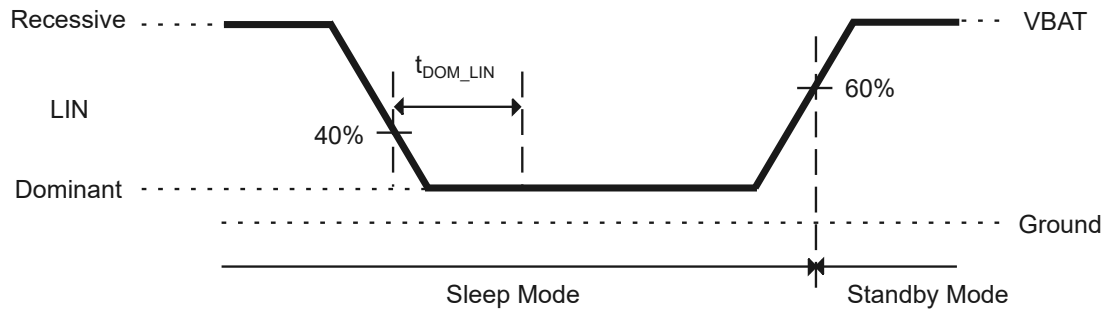


Figure 2. LIN Transceiver Timing Diagram

**Automotive Quad Fault Protected LIN Transceiver**



**Figure 3. Remote Wake-up Diagram**

## Detailed Description

### Overview

The TPT1024Q is a quad local interconnect network (LIN) physical layer transceiver that is compliant with the ISO 17987-4, SAE J2602 and LIN 2.0, LIN 2.1, LIN 2.2, and LIN 2.2-A physical layer standards. LIN is a low-speed universal asynchronous receiver transmitter (UART) communication protocol that supports automotive in-vehicle sub-networks. The device supports LIN networks up to 20 Kbps with an enhanced timing margin. The device converts the transmitted data received at the TXD with an optimized slew rate to minimize the electromagnetic emission (EME) and reports the state of the LIN bus at the RXD. As designed, the device features overvoltage and loss of ground protection from -45 V to +45 V, over-temperature shutdown. The device has low-current standby and sleep mode with LIN BUS wake-up capability. The device integrates a pull high resistor for LIN slave applications and ESD protection which allows applications to operate with a reduced dependence on external components. Additionally, all devices include many protection features to enhance the device and network robustness. The TPT1024Q is available in the QFN5.5X3.5-24 package and is AEC-Q100 qualified for automotive applications.

Automotive Quad Fault Protected LIN Transceiver

Functional Block Diagram

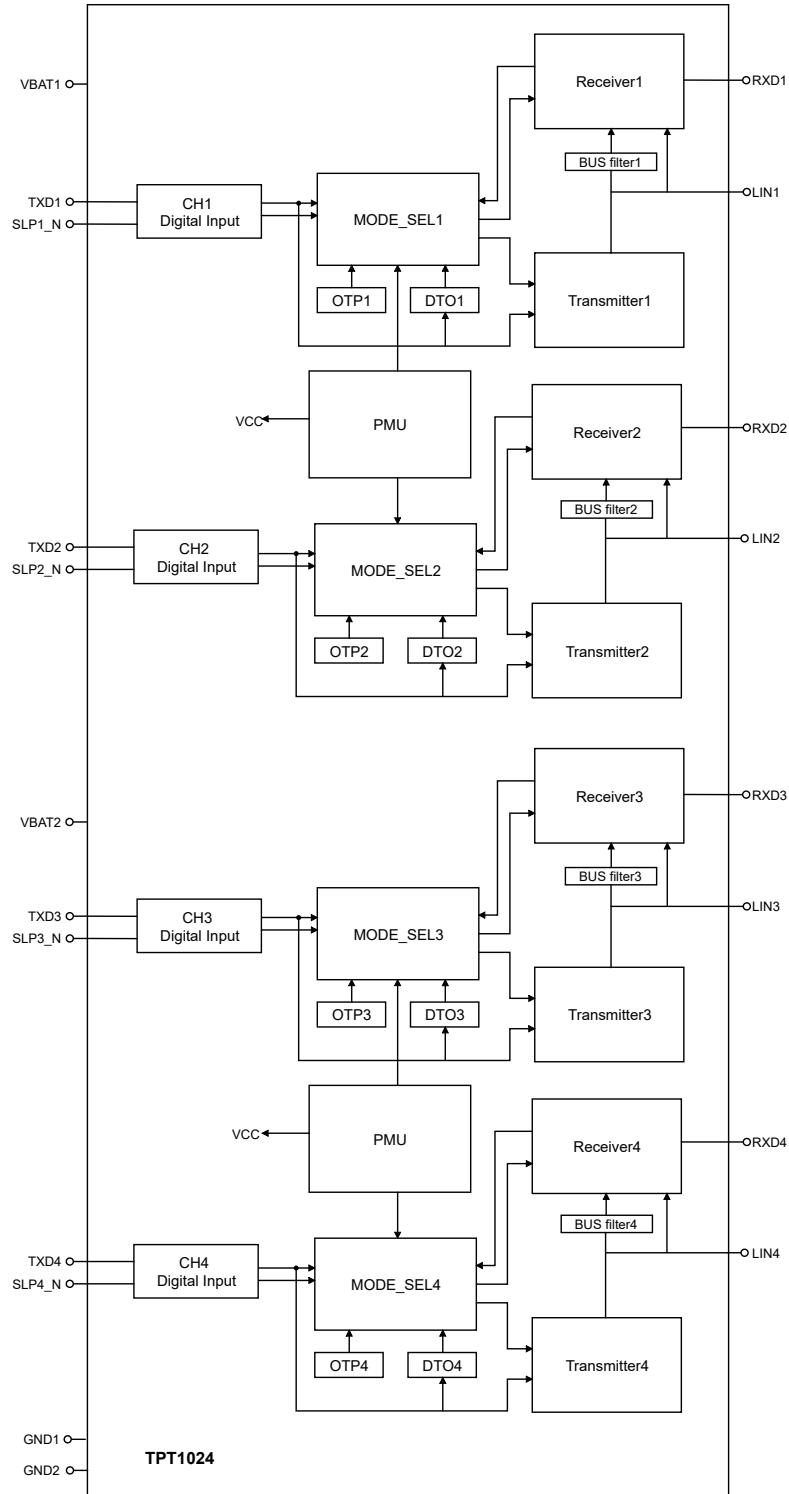


Figure 4. Functional Block Diagram

## Feature Description

### Device Operating Modes

The TPT1024Q supports modes for normal mode, power-on mode, standby mode, and sleep mode. The figure below shows the state diagram.

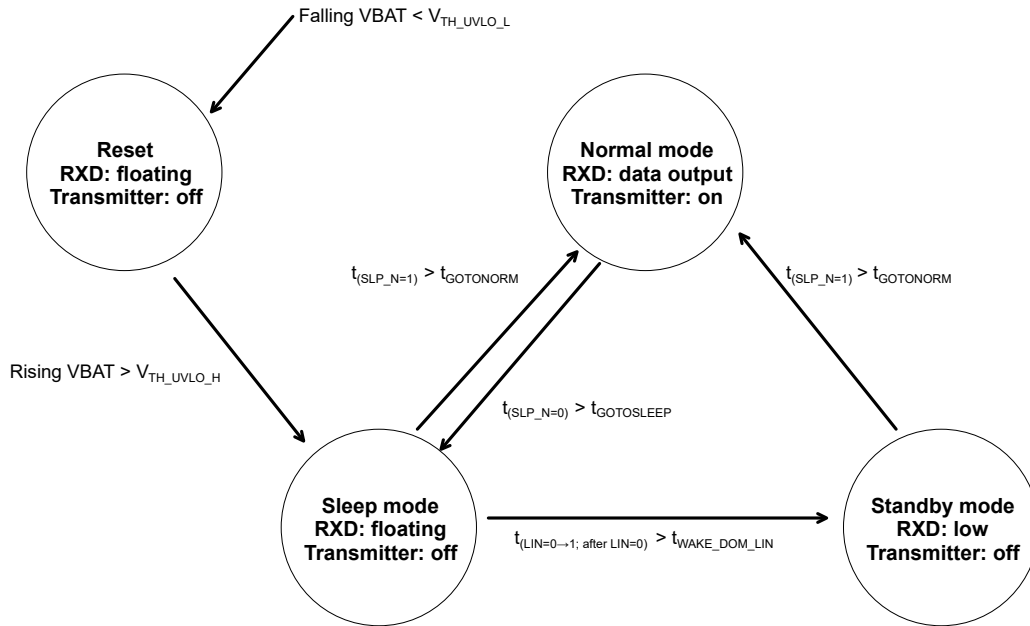


Figure 5. State Diagram

Table 2. Operation Mode Table

Mode	SLP_Nx	TXDx	RXDx	Transmitter	Comments
Normal	High	High: recessive state Low: dominant state	High: recessive state Low: dominant state	Normal	
Sleep	Low	Weak pull-down	Floating	Off	No wake-up event detected
Standby	Low	Weak pull-down	Low	Off	Wake-up event detected

### Normal Mode

In Normal mode, the device can transmit and receive data through the LIN bus line. The receiver detects the data stream at the LIN bus input pin and transfers it to the microcontroller via the RXD pin. On the bus, a HIGH level corresponds to a recessive state, while a LOW level represents a dominant state. The receiver incorporates a voltage-dependent threshold with hysteresis and an integrated filter to suppress noise on the bus.

The transmit data stream from the protocol controller at the TXD input is converted by the transmitter into a bus signal with optimized slew rate and wave shaping, aiming to minimize electromagnetic emissions (EME). The LIN bus output pin is pulled HIGH through an internal slave termination resistor. For master applications, an external resistor in series with a diode should be connected between pin VBAT and pin LIN.



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## Automotive Quad Fault Protected LIN Transceiver

### Sleep Mode

The device offers an energy-efficient mode known as the power-saving mode. Despite its extremely low current consumption, the device retains the capability to be remotely awakened via the LIN pin or directly activated through the SLP\_N pin. Input filters are incorporated at the receiver (LIN), and SLP\_N pin to prevent undesired wake-up events caused by automotive transients or electromagnetic interference (EMI).

To initiate Sleep mode from Normal mode, a falling edge on the SLP\_N pin is required. In order to successfully enter Sleep mode, the sleep command (SLP\_N pin set to LOW) must be sustained for a minimum duration of  $t_{\text{gotosleep}}$ .

During Sleep mode, the internal slave termination between the LIN and VBAT pins is disabled to minimize power dissipation if the LIN pin is short-circuited to ground. Only a weak pull-up is present between the LIN and VBAT pins.

When VBAT voltage drops below the undervoltage threshold, the device transitions into Sleep mode.

### Standby Mode

Whenever a local or remote wake-up occurs while the device is in Sleep mode, Standby mode is automatically activated. These wake-up events enable the slave termination resistor at the LIN pin.

Standby mode is indicated by a low level on the RXD pin, which can serve as an interrupt for the microcontroller.

### Wake-up

When VBAT voltage exceeds the undervoltage threshold voltage, the device transitions into Sleep mode. In this mode, both the transmitter and receiver remain inactive. If SLP\_N is HIGH for a duration greater than  $t_{\text{gotonorm}}$ , the device enters Normal mode.

To wake up a device that is in Sleep mode, there are two methods:

Remote wake-up through the LIN bus by receiving a dominant bus state that is sustained for a duration of at least  $t_{\text{WAKE\_DOM\_LIN}}$  then followed by a rising edge.

Mode change by setting the SLP\_N pin to a HIGH level. This change in pin state signals the device to exit Sleep mode and enter Normal mode.

## Protection Features

### TXD Dominant Time-out

The device detects TXD dominant time-out and prevents a permanent low on pin TXD driving the LIN bus into permanent dominant blocking the LIN bus network. If the TXD remains low for longer than  $t_{\text{TXD\_DTO}}$ , the transmitter is disabled until the fault flag has been cleared.

### Under-voltage Lockout (UVLO)

The device integrates under-voltage to detect and lockout the circuit of the supply terminal to keep the device in 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 undervoltage events on supply terminals.

### Over-Temperature Protection (OTP)

The output drivers are protected against overtemperature conditions. If the virtual junction temperature exceeds the shutdown junction temperature  $T_{\text{J\_SD}}$ , the output drivers is disabled until the virtual junction temperature falls below  $T_{\text{J\_SD\_R}}$ , and TXD becomes recessive again. Including the TXD condition ensures that output driver oscillation due to temperature drift is avoided.

### Fail-safe Features

An internal pull-down to GND on the TXD pin to establish a predetermined level in case the TXD pin is disconnected.

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**Automotive Quad Fault Protected LIN Transceiver**

An internal pull-down to GND on the SLP\_N pin to establish a predetermined level in case the SLP\_N pin is disconnected.

The RXD pin is set to floating when the VBAT pin is unpowered.

The current limit is applied to LIN transmitter output to protect LIN bus short circuits to VBAT or GND.

VBAT and GND loss does not impact the LIN bus or the MCU. No reverse current flows from the bus into pin LIN. The internal integrated LIN slave termination resistor remains to keep the current path from VBAT to LIN. Disconnecting the LIN transceiver from the power supply does not affect the LIN bus.

## 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

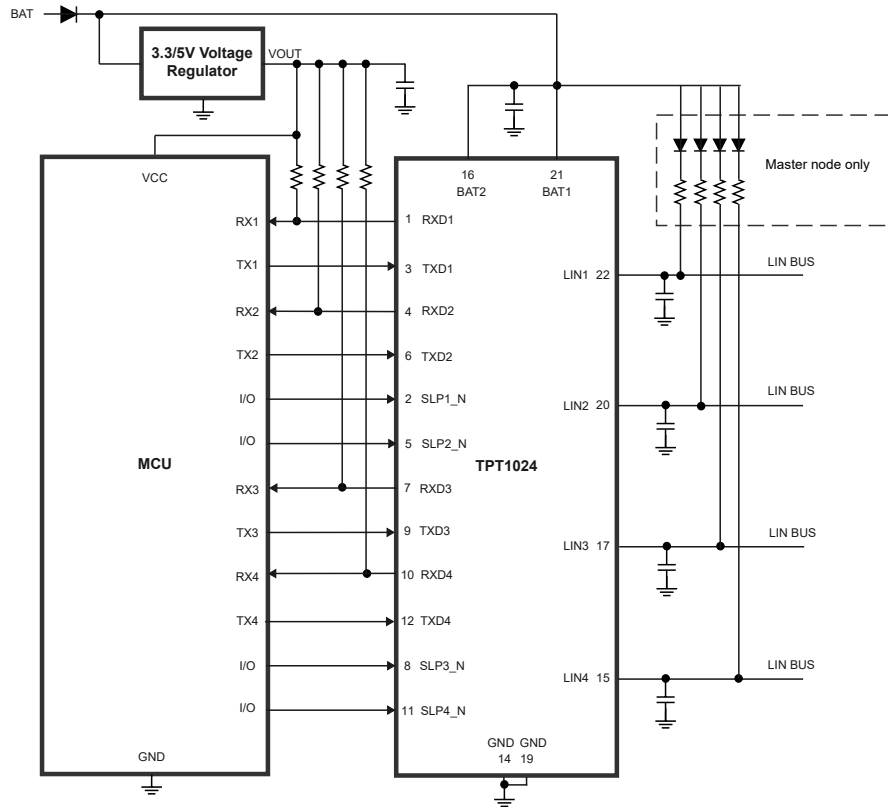
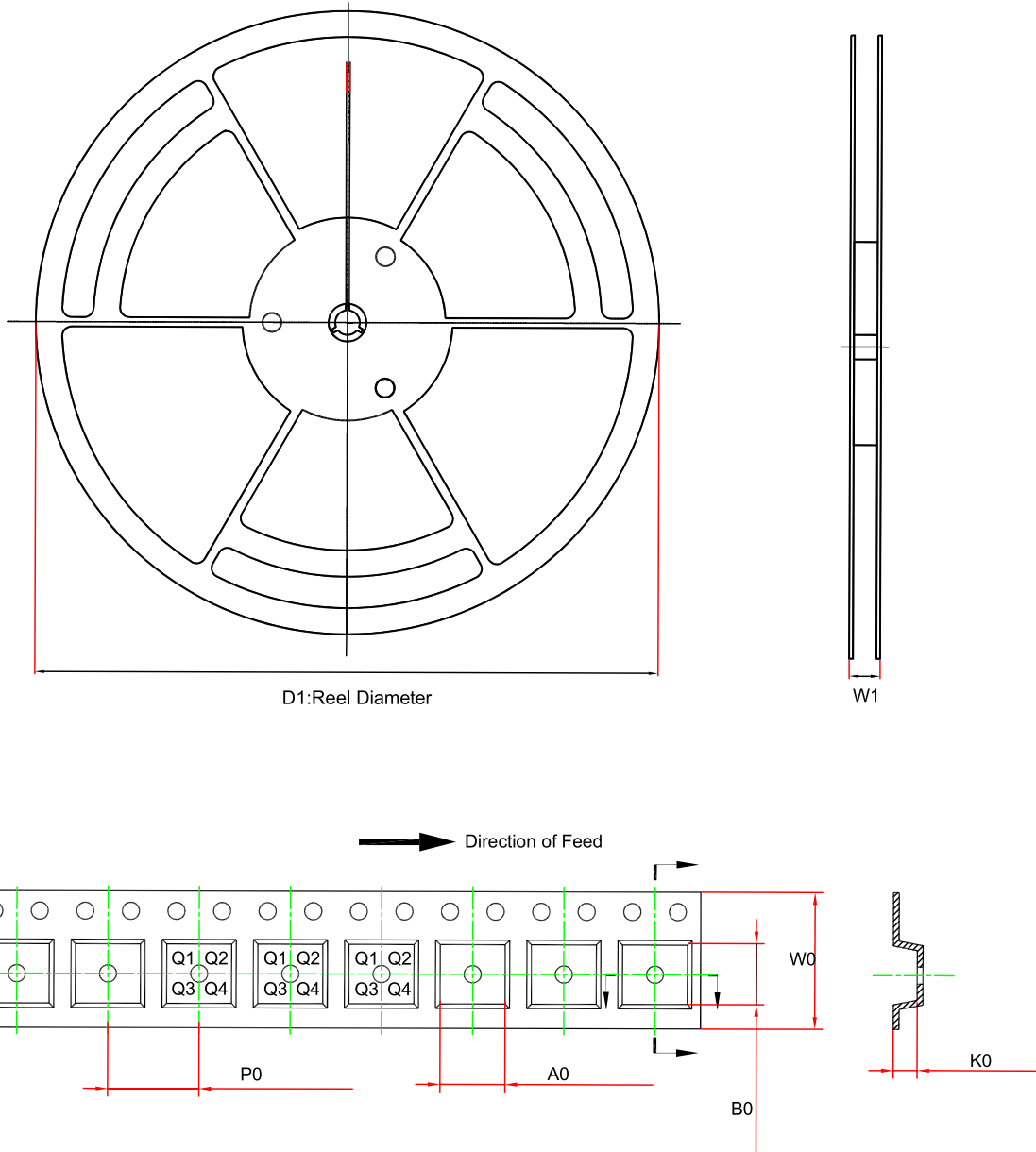


Figure 6. Typical Application Circuit

### Tape and Reel Information

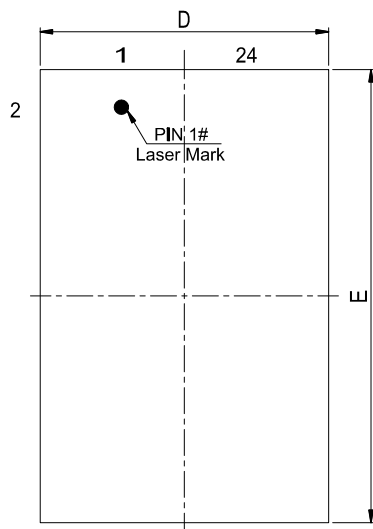


Order Number	Package	D1 (mm)	W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	W0 (mm)	Pin1 Quadrant
TPT1024Q-QFXR-S	QFN 5.5X3.5-24	330	17.6	3.8	5.8	1.05	8	12	Q1

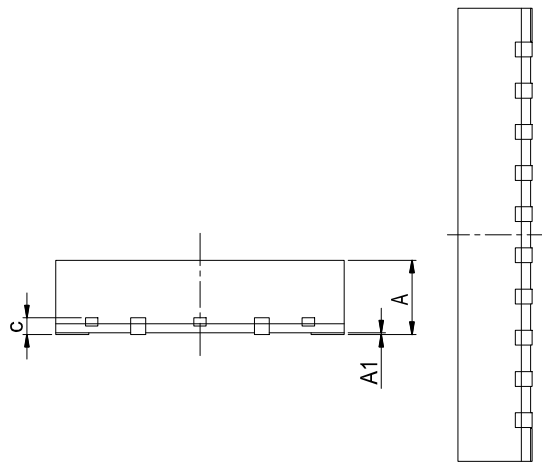
Package Outline Dimensions

QFN5.5X3.5-24

Package Outline Dimensions QFX(QFN5.5X3.5-24-WET-A)

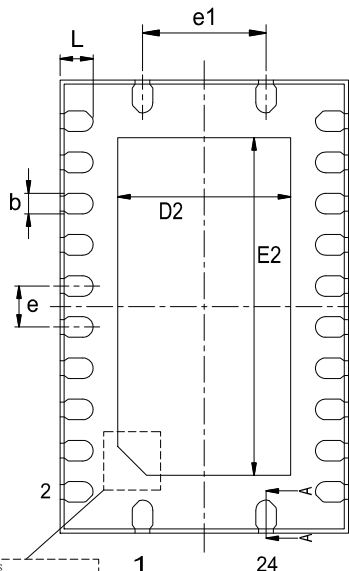


TOP VIEW

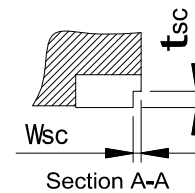


SIDE VIEW

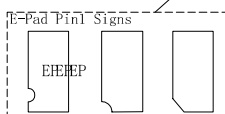
SIDE VIEW



BOTTOM VIEW



Section A-A



NOTES

1. Do not include mold flash or protrusion.
2. This drawing is subject to change without notice.
3. The many types of E-pad Pin1 signs may appear in the product.

Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.800	0.900	0.031	0.035
A1	0.000	0.050	0.000	0.002
b	0.200	0.300	0.008	0.012
C	0.203 REF		0.008 BSC	
D	3.400	3.600	0.134	0.142
E	5.400	5.600	0.213	0.220
e	0.500 BSC		0.020 BSC	
e1	1.500 BSC		0.060 BSC	
L	0.350	0.450	0.014	0.018
D2	2.000	2.200	0.079	0.087
E2	4.000	4.200	0.157	0.165
Wsc	0.010	0.090	0.000	0.004
tsc	0.080	0.180	0.003	0.007

**Order Information**

Order Number	Operating Temperature Range	Package	Marking Information	MSL	Transport Media, Quantity	Eco Plan
TPT1024Q-QFXR-S	-40 to 125°C	QFN5.5X3.5-24	1024Q	MSL1	Tape and Reel,3000	Green

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

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