Reinforced High Performance Bidirectional I²C Isolator

Features

- TPT7250: Bidirectional SDA and SCL
- TPT7251: Bidirectional SDA and Unidirectional SCL
- Operation Frequency: up to 1 MHz
- Wide Supply Range: 2.5 V to 5.5 V
- Wide Temperature Range: −40°C to +125°C
- Open-drain Outputs with Sink Current Capability of 3.5 mA Side-A and 35 mA Side-B
- CMTI: Typical ±200 kV/μs (Static), ±150 kV/μs (Dynamic)
- Standout Transient Isolation Voltage: 12000 V_{PK} for WWSOP, 9191 V_{PK} for WSOP (100% Production)
- Standout Surge Immunity: 12000 V_{PK}
- Over 30 years Projected Lifetime under Working Voltage of 2000 V_{RMS} for WWSOP, 1500 V_{RMS} for WSOP
- Wide Creepage and Clearance: Nominal 16.0 mm for WWSOP, 9.5 mm for WSOP, 5.2 mm for SOP and QSOP
- Robust Electromagnetic Compatibility (EMC)
  - Low Emissions, CISPR32 class B Qualified
  - System-level ESD, and EFT Immunity
- Wide Package Range: SOP8, WSOP8, WWSOP8, SOP16, QSOP16, WSOP16, WWSOP16
- Safety-related Certifications:
  - Reinforced Isolation According to DIN VDE V 0884-17 (IEC60747-17)
  - Isolation for 1 Minute per UL 1577: 8000 V_{RMS} (WWSOP), 6500 V_{RMS} (WSOP), 3750 V_{RMS} (SOP, QSOP)
  - CQC Certification per GB 4943.1
  - CSA, TUV, and CB Certifications

Applications

- Isolated I²C Bus
- SMBus and PMBus Interface
- Open-drain Network
- I²C Level Shifting
- Motor Control System
- Battery Management

Description

The TPT725x devices are high-performance, bidirectional I²C-compatible isolators with 8000 V_{RMS} (WWSOP), 6500 V_{RMS} (WSOP), and 3750 V_{RMS} (SOP, QSOP) isolation ratings per UL 1577. These devices are also certified by VDE, UL, CSA, TUV, CQC, and CB.

The TPT725x devices provide high reliability and high performance at low power consumption while isolating logic input and output. Each isolation signal channel is separated by a double capacitive silicon dioxide insulation barrier. The TPT7251 has a bidirectional data channel and a unidirectional clock channel while the TPT7250 device has two isolated bidirectional channels for clock and data. The TPT7251 is suitable for single-master applications while the TPT7250 is suitable for multi-master or slave clock stretching applications.

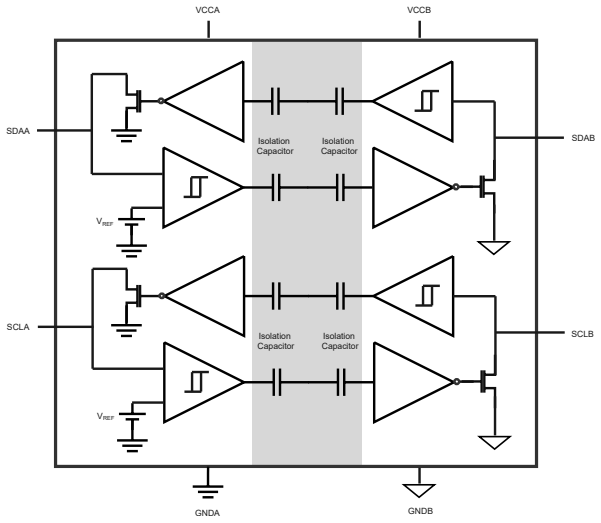
The Common Mode Transient Immunity (CMTI) and Electromagnetic Compatibility (EMC) of the TPT725x devices have been significantly enhanced via innovative circuit design and optimized structure.

The TPT725x family is available in the SOP8, WSOP8, WWSOP8, SOP16, QSOP16, WSOP16, WWSOP16 packages and is characterized from −40°C to +125°C.

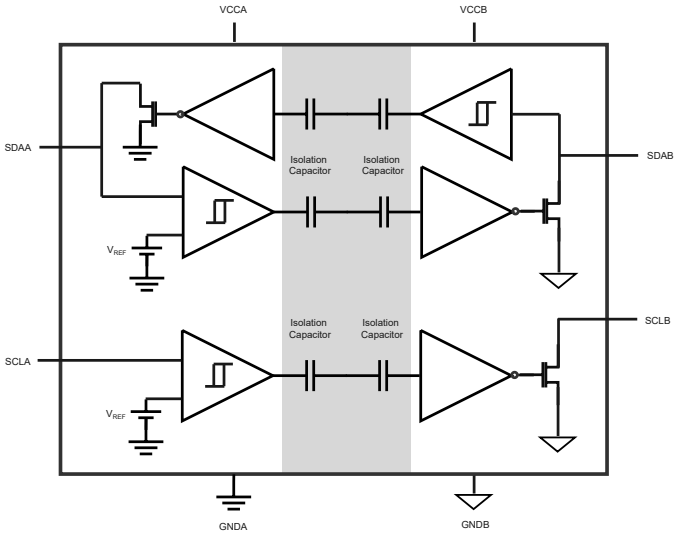
Part Number	Package (1)	Body Size (Nominal)
TPT7250 TPT7251	SOP8	4.90 mm × 3.90 mm
	WSOP8	5.85 mm × 7.50 mm
	WWSOP8	6.40 mm × 14.00 mm
	SOP16	9.90 mm × 3.90 mm
	QSOP16	6.20 mm ×5.30 mm
	WSOP16	10.30 mm × 7.50 mm
	WWSOP16	10.30 mm × 14.00 mm

(1) For all available packages, see Order Information at the end of the datasheet.

Functional Block Diagram



TPT7250



TPT7251

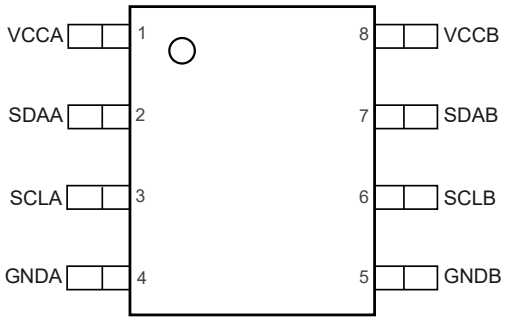
Table of Contents

Revision History

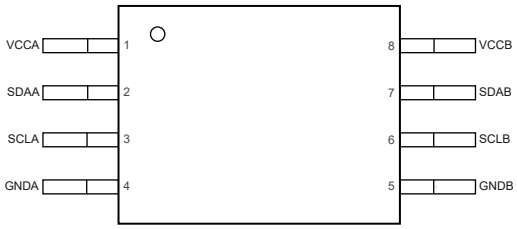
Date	Revision	Notes
2025-04-30	Rev.A.0	Released version.

Pin Configuration and Functions

TPT7250
SOP8
Top View

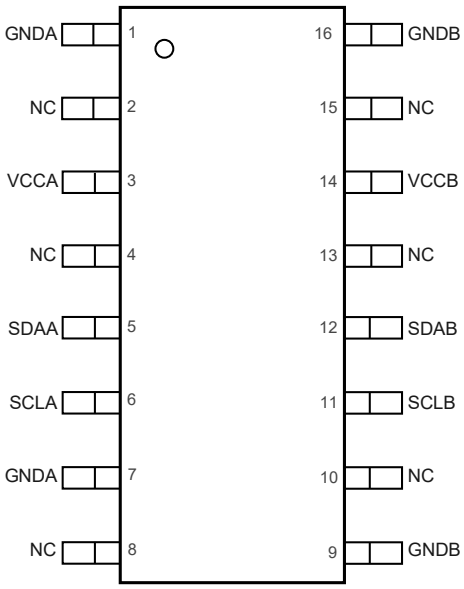


TPT7250
WSOP8
Top View

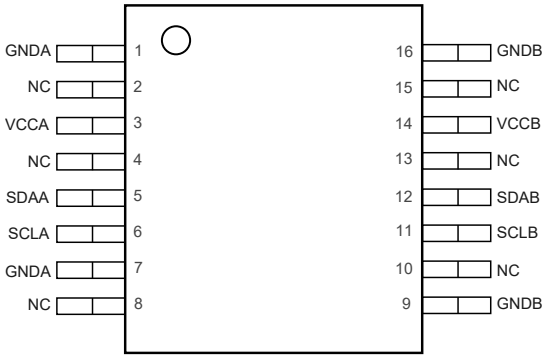


TPT7250
WWSOP8
Top View

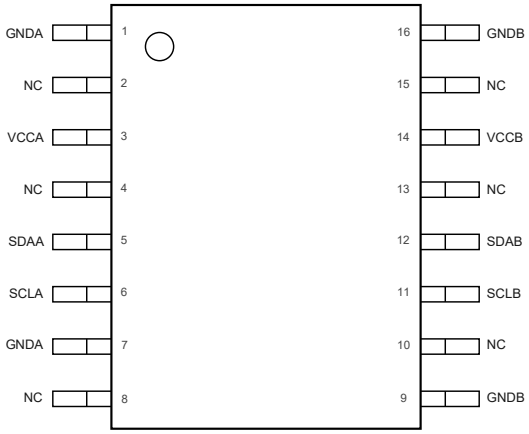
TPT7250
SOP16
Top View



TPT7250
QSOP16
Top View

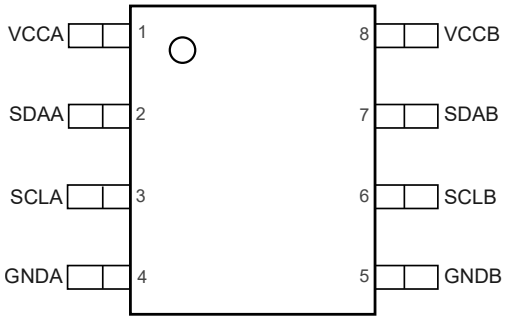


TPT7250
WSOP16
Top View

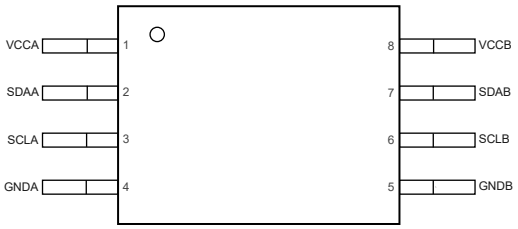


TPT7250
WWSOP16
Top View

TPT7251
SOP8
Top View

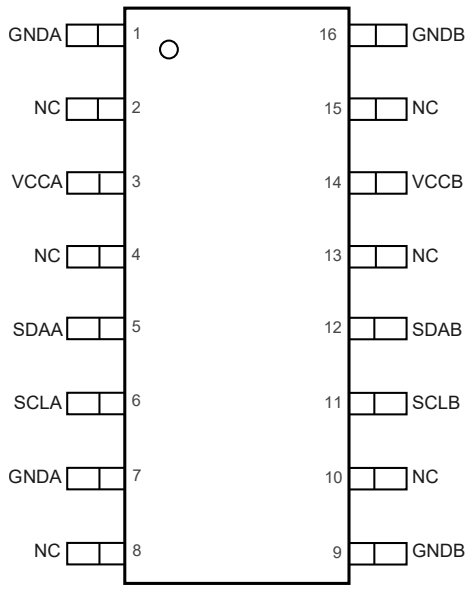


TPT7251
WSOP8
Top View

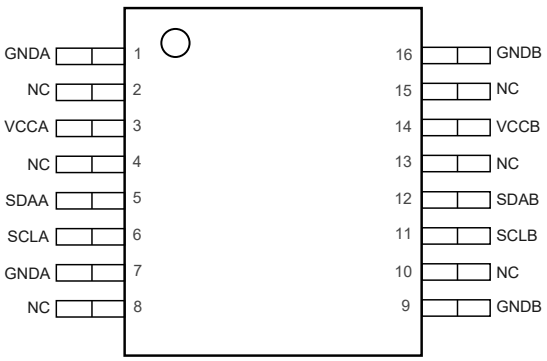


TPT7251
WWSOP8
Top View

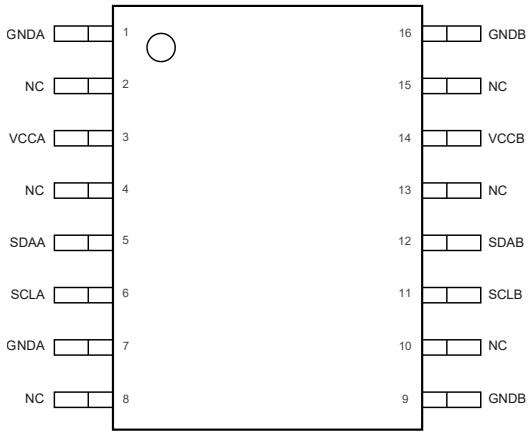
TPT7251
SOP16
Top View



TPT7251
QSOP16
Top View



TPT7251
WSOP16
Top View



TPT7251
WWSOP16
Top View

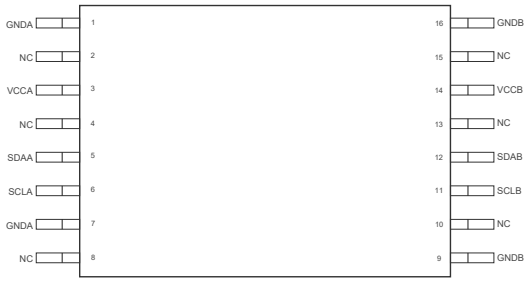


Table 1. Pin Functions: TPT725x

8-Pin Pin No.	16-Pin Pin No.	Name	I/O	Description
1	3	VCCA	−	Power supply, VCCA
2	5	SDAA	I/O	Serial data input/output, side A
3	6	SCLA	I/O	Serial clock input/output, side A
4	1, 7	GNDA	−	Ground connection for VCCA
5	9, 16	GNDB	−	Ground connection for VCCB
6	11	SCLB	I/O	Serial clock input/output, side B
7	12	SDAB	I/O	Serial data input/output, side B
8	14	VCCB	−	Power supply, VCCB
−	2, 4, 8, 10, 13, 15	NC	−	No connection

Specifications

Absolute Maximum Ratings (1)

Parameter			Min	Max	Unit
V_{CC}	Supply Voltage, V_{CCA}, V_{CCB}		−0.5	6	V
V_{IO}	Voltage at SDAA, SCLA, SDAB, SCLB		−0.5	V_{CC} + 0.5	V
I_O	Output Current	SDAA, SCLA	−20	20	mA
		SDAB, SCLB	−100	100	mA
T_J	Operating Virtual Junction Temperature		-	150	°C
T_{stg}	Storage Temperature		−65	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.

ESD, Electrostatic Discharge Protection

Parameter		Condition	Value	Unit
HBM	HBM, per ANSI/ESDA/JEDEC JS-001/ANSI/ESD STM5.5.1 (1)	All pins	±8	kV
CDM	CDM, per ANSI/ESDA/JEDEC JS-002 (2)	All pins	±2	kV

(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.

Recommended Operating Conditions

Parameter		Min	Max	Unit
V_{CCA}, V_{CCB}	Supply Voltage	2.5	5.5	V
V_{SDAA}, V_{SCLB}	Input and Output Signal Voltages, Side 1	0	V_{CCA}	V
V_{SDAA}, V_{SCLB}	Input and Output Signal Voltages, Side 2	0	V_{CCB}	V
V_{IL1}	Low-level Input Voltage, Side 1	0	0.4	V
V_{IH1}	High-level Input Voltage, Side 1	0.7 × V_{CCA}	V_{CCA}	V
V_{IL2}	Low-level Input Voltage, Side 2	0	0.3 × V_{CCB}	V
V_{IH2}	High-level Input Voltage, Side 2	0.7 × V_{CCB}	V_{CCB}	V
I_{OLA}	Output Current, Side A	0.5	3.5	mA
I_{OLB}	Output Current, Side B	0.5	35	mA
C_{LA}	Capacitive Load, Side A	-	40	pF
C_{LB}	Capacitive Load, Side B	-	400	pF
f_{MAX}	Operating Frequency	-	1	MHz
T_A	Ambient Temperature	–40	125	°C
T_J	Junction Temperature	–40	136	°C

Thermal Information

Package Type	θ_{JA}	θ_{JC}	Unit
SOP8	92.25	32.55	°C/W
WSOP8	79.37	27.90	°C/W
WWSOP8	62.68	20.68	°C/W
SOP16	58.79	27.28	°C/W
QSOP16	76.74	35.60	°C/W
WSOP16	59.58	22.62	°C/W
WWSOP16	50.24	18.77	°C/W

Insulation Specifications

Parameter		Test Conditions	Value			Unit
			SOP8 SOP16 QSOP16	WSOP8 WSOP16	WWSOP8 WWSOP16	
IEC 60664-1						
CLR	External clearance (1)	Shortest terminal-to-terminal distance through air, nominal	5.2	9.5	16.0	mm
CPG	External creepage (1)	Shortest terminal-to-terminal distance across the package surface, nominal	5.2	9.5	16.0	mm
DTI	Distance through the insulation	Minimum internal gap (internal clearance)	> 22	> 22	> 22	μm
DTC	Distance through the Molding compound	Minimum internal distance across the conductors inside the package	0.45	0.8	0.8	mm
CTI	Comparative tracking index	IEC 60112	> 600	> 600	> 600	V
	Material group	According to IEC 60664-1	I	I	I	
	Overvoltage category per IEC 60664-1	Rated mains voltage ≤ 150 V_{RMS}	I-IV	I-IV	I-IV	
		Rated mains voltage ≤ 300 V_{RMS}	I-III	I-IV	I-IV	
		Rated mains voltage ≤ 600 V_{RMS}	I-II	I-IV	I-IV	
		Rated mains voltage ≤ 1000 V_{RMS}	I	I-III	I-IV	
DIN EN IEC 60747-17 (VDE 0884-17) (2)						
V_{IORM}	Maximum repetitive peak isolation voltage	AC voltage (bipolar)	707	2121	2828	V_{PK}
V_{IOWM}	Maximum working isolation voltage	AC voltage; Time dependent dielectric breakdown (TDDB) Test	500	1500	2000	V_{RMS}

Parameter		Test Conditions	Value			Unit
			SOP8 SOP16 QSOP16	WSOP8 WSOP16	WWSOP8 WWSOP16	
		DC voltage	707	2121	2828	V_{DC}
V_{IOTM}	Maximum transient isolation voltage	V_{TEST} = V_{IOTM}, t = 60 s (qualification); V_{TEST} = 1.2 × V_{IOTM}, t = 1 s (100% production)	5300	9191	12000	V_{PK}
V_{IMP}	Maximum impulse voltage (3)	Tested in air, 1.2/50 μs waveform per IEC 62368-1	8000	9000	9000	V_{PK}
V_{IOSM}	Maximum surge isolation voltage (4)	V_{IOSM} ≥ 1.3 × V_{IMP}; tested in oil (qualification test), 1.2/50 μs waveform per IEC 62368-1	12000	12000	12000	V_{PK}
q_{pd}	Apparent charge (5)	Method a, After input-output safety test subgroup 2/3, V_{ini} = V_{IOTM}, t_{ini} = 60 s; $V_{pd(m)}$ = 1.2 × V_{IORM}, t_m = 10 s	≤ 5	≤ 5	≤ 5	pC
		Method a, After environmental tests subgroup 1, V_{ini} = V_{IOTM}, t_{ini} = 60 s; $V_{pd(m)}$ = 1.6 × V_{IORM}, t_m = 10 s	≤ 5	≤ 5	≤ 5	
		Method b: At routine test (100% production); V_{ini} = 1.2 × V_{IOTM}, t_{ini} = 1 s; $V_{pd(m)}$ = 1.875 × V_{IORM}, t_m = 1 s (method b1) or $V_{pd(m)}$ = V_{ini}, t_m = t_{ini} (method b2)	≤ 5	≤ 5	≤ 5	
C_{IO}	Barrier capacitance, input to output (6)	V_{IO} = 0.4 × sin (2πft), f = 1 MHz	~0.5	~0.5	~0.5	pF
R_{IO}	Isolation resistance, input to output (6)	V_{IO} = 500 V, T_A = 25 °C	> 10^{12}	> 10^{12}	> 10^{12}	Ω
		V_{IO} = 500 V, 100°C ≤ T_A ≤ 125 °C	> 10^{11}	> 10^{11}	> 10^{11}	Ω
		V_{IO} = 500 V at T_S = 150 °C	> 10^9	> 10^9	> 10^9	Ω
	Pollution degree		2	2	2	
	Climatic category		-40/125/21	-40/125/21	-40/125/21	
UL 1577						
V_{ISO}	Withstand isolation voltage	V_{TEST}= V_{ISO}, t = 60 s (qualification); V_{TEST}= 1.2 × V_{ISO}, t = 1 s (100% production)	3750	6500	8000	V_{RMS}

(1) Creepage and clearance requirements should be applied according to the specific equipment isolation standards of an application. Care should be taken to maintain the creepage and clearance distance of a board design to ensure that the mounting pads of the isolator on the printed-circuit board do not reduce this distance. Creepage and clearance on a printed-circuit board become equal in certain cases. Techniques such as inserting grooves, ribs, or both on a printed circuit board are used to help increase these specifications.
(2) This coupler is suitable for safe electrical insulation only within the safety ratings. Compliance with the safety ratings shall be ensured by means of suitable protective circuits.
(3) Testing is carried out in air to determine the surge immunity of the package.
(4) Testing is carried out in oil to determine the intrinsic surge immunity of the isolation barrier.
(5) Apparent charge is an electrical discharge caused by a partial discharge (pd).
(6) All pins on each side of the barrier are tied together creating a two-pin device.

Safety-Related Certifications

VDE	UL	TUV	CQC	CSA	CB
According to DIN VDE V 0884-17	According to UL 1577 Component Recognition Program	According to EN IEC 62368-1 and EN IEC 61010-1	According to GB 4943.1	According to IEC 62368-1, IEC 61010-1 and IEC 60601	According to EN IEC 62368-1
Certificate planned	Certificate planned	Certificate planned	Certificate planned	Certificate planned	Certificate planned

Safety Limiting Values

Safety limiting (1) intends to minimize potential damage to the isolation barrier upon failure of input or output circuitry.

Parameter	Conditions	Min	Typ	Max	Unit
Safety Supply Current	$R_{\theta JA}$ = 92.25°C/W, V_I = 5 V, T_J = 150°C, T_A = 25°C (SOP8)	-	-	271.00	mA
	$R_{\theta JA}$ = 79.37°C/W, V_I = 5 V, T_J = 150°C, T_A = 25°C (WSOP8)	-	-	314.98	mA
	$R_{\theta JA}$ = 62.68°C/W, V_I = 5 V, T_J = 150°C, T_A = 25°C (WWSOP8)	-	-	398.85	mA
	$R_{\theta JA}$ = 58.79°C/W, V_I = 5 V, T_J = 150°C, T_A = 25°C (SOP16)	-	-	425.24	mA
	$R_{\theta JA}$ = 76.74°C/W, V_I = 5 V, T_J = 150°C, T_A = 25°C (QSOP16)	-	-	325.78	mA
	$R_{\theta JA}$ = 59.58°C/W, V_I = 5 V, T_J = 150°C, T_A = 25°C (WSOP16)	-	-	419.60	mA
	$R_{\theta JA}$ = 50.24°C/W, V_I = 5 V, T_J = 150°C, T_A = 25°C (WWSOP16)	-	-	497.61	mA
Safety Total Power	$R_{\theta JA}$ = 92.25°C/W, T_J = 150°C, T_A = 25°C (SOP8)	-	-	1355.01	mW
	$R_{\theta JA}$ = 79.37°C/W, T_J = 150°C, T_A = 25°C (WSOP8)	-	-	1574.90	mW
	$R_{\theta JA}$ = 62.68°C/W, T_J = 150°C, T_A = 25°C (WWSOP8)	-	-	1994.26	mW
	$R_{\theta JA}$ = 58.79°C/W, T_J = 150°C, T_A = 25°C (SOP16)	-	-	2126.21	mW
	$R_{\theta JA}$ = 76.74°C/W, T_J = 150°C, T_A = 25°C (QSOP16)	-	-	1628.88	mW
	$R_{\theta JA}$ = 59.58°C/W, T_J = 150°C, T_A = 25°C (WSOP16)	-	-	2098.02	mW
	$R_{\theta JA}$ = 50.24°C/W, T_J = 150°C, T_A = 25°C (WWSOP16)	-	-	2488.06	mW
Maximum Safety Temperature		-	-	150	°C

(1) The maximum safety temperature, T_S, has the same value as the maximum junction temperature, T_J, specified for the device. The I_S and P_S parameters represent the safety current and safety power respectively. The maximum limits of I_S and P_S must not be exceeded. These limits vary with the ambient temperature, T_A.

The junction-to-air thermal resistance, $R_{\theta JA}$, in the table is that of a device installed on a high-K test board for leaded surface-mount packages. Use these equations to calculate the value for each parameter:

$T_J = T_A + R_{\theta JA} \times P$, where P is the power dissipated in the device.

$T_{J(max)} = T_S = T_A + R_{\theta JA} \times P_S$, where $T_{J(max)}$ is the maximum allowed junction temperature.

$P_S = I_S \times V_I$, where V_I is the maximum input voltage.

Electrical Characteristics

All test conditions: V_{CCA} = V_{CCB} = 2.25 V to 5.5 V, T_A = −40°C to +125°C, Typical values are at V_{CC} = 3.3 V, T_A = +25°C, unless otherwise noted.

Parameter		Conditions	Min	Typ	Max	Unit
Side A						
V_{IHA}	Voltage Input Threshold High, SDAA and SCLA		450	570	650	mV
V_{ILA}	Voltage Input Threshold Low, SDAA and SCLA		400	470	550	mV
V_{HYSA}	Voltage Input Hysteresis	V_{IHA} – V_{ILA}	-	100	-	mV
V_{OLA}	Low-level Output Voltage, SDAA and SCLA (1)	0.5 mA ≤ (I_{SDAA} and I_{SCLA}) ≤ 3.5 mA	-	700	780	mV
ΔV_{OIA}	Low-level Output Voltage to High-level Input Voltage Threshold Difference, SDAA and SCLA (1)(2)(3)	0.5 mA ≤ (I_{SDAA} and I_{SCLA}) ≤ 3.5 mA	50	130	-	mV
Side B						
V_{IHB}	Voltage Input Threshold High, SDAB and SCLB		0.3 × V_{CCB}	1.5	0.5 × V_{CCB}	V
V_{ILB}	Voltage Input Threshold Low, SDAB and SCLB		0.3 × V_{CCB}	1.3	0.5 × V_{CCB}	V
V_{HYSB}	Voltage Input Hysteresis Low-level Output Voltage, SDAB and SCLB (1)(2)	V_{IHB} – V_{ILB}	-	210	-	mV
V_{OLB}	Low-level Output Voltage, SDAB and SCLB	0.5 mA ≤ (I_{SDAB} and I_{SCLB}) ≤ 3.5 mA	-	-	390	mV
Both Sides						
$\|I_I\|$	Input Leakage Currents, SDAA, SCLA, SDAB, and SCLB	V_{SDAA}, V_{SCLA} = V_{CCA}; V_{SDAB}, V_{SCLB} = V_{CCB}	-	0.1	2	μA
C_I	Input Capacitance, SDAA, SCLA, SDAB, and SCLB (1)	V_I = 0.4 × sin(2e6×πt) + 2.5 V	-	7	-	pF
CMTI	Common-mode Transient Immunity	Static CMTI	-	200	-	kV/μs
		Dynamic CMTI	-	150	-	kV/μs
$V_{CC\ (UVLO+)}$	VCC Undervoltage Lockout Threshold when the Supply Voltage is Rising (4)		1.75	2.0	2.2	V
$V_{CC\ (UVLO-)}$	VCC Undervoltage Lockout Threshold when the Supply Voltage is Falling (4)		1.75	1.9	2.2	V
$V_{HYS(UVLO)}$	Supply Voltage UVLO Hysteresis		-	140	-	mV

(1) This parameter does not apply to the TPT7251 SCLA line as it is unidirectional.

(2) Provided by bench test and design simulation.

(3) $\Delta V_{OIA} = V_{OL1} – V_{IH1}$. This represents the minimum difference between a Low-Level Output Voltage and a High-Level Input Voltage Threshold to prevent a permanent latch condition that would otherwise occur with bidirectional communication.

(4) Any VCC voltages, on either side, less than the minimum will ensure device lockout. Both VCC voltages greater than the maximum will prevent device lockout.

Timing Specifications − 5-V Supply

All test conditions: V_{CCA} = V_{CCB} = 5 V, T_A = −40°C ~ +125°C. Typical values are at V_{CC} = 5 V, T_A = +25°C, C_L = 15 pF to GND, unless otherwise noted.

Parameter		Conditions	Min	Typ	Max	Unit
tf_A	Output Signal Fall Time (SDAA, SCLA)		-	22	40	ns
tf_B	Output Signal Fall Time (SDAB, SCLB)		-	10	40	ns
t_{pLHA-B}	Low-to-High Propagation Delay, Side A to Side B	0.55 V to 0.7 × V_{CCB}	30	51	75	ns
t_{PHLA-B}	High-to-Low Propagation Delay, Side A to Side B	0.7 V to 0.4 V	30	45	75	ns
PWD_{A-B}	Pulse Width Distortion |tpHLA-B – tpLHA-B|		-	6	40	ns
t_{pLHB-A}	Low-to-High Propagation Delay, Side B to Side A	0.4 × V_{CCB} to 0.7 × V_{CCA}	30	61	85	ns
t_{pHLB-A}	High-to-Low Propagation Delay, Side B to Side A	0.4 × V_{CCB} to 0.9 V	30	57	85	ns
PWD_{B-A}	Pulse Width Distortion |tpHLB-A – tpLHB-A|		-	4	20	ns
t_{LOOPA}	Round-trip Propagation Delay on Side A	0.4 V to 0.3 × V_{CCA}	30	124	180	ns

Supply Current Characteristics − 5-V Supply

All test conditions: V_{CCA} = V_{CCB} = 5 V, T_A = −40°C ~ +125°C. Typical values are at V_{CC} = 5 V, T_A = +25°C, C_L = 15 pF to GND, unless otherwise noted.

Parameter	Description	Test Condition	Min	Typ	Max	Unit
Supply Current, Side A	TPT7250	V_{SDAA}, V_{SCLA} = GNDA; V_{SDAB}, V_{SCLB} = GNDB	1	5.5	7.8	mA
		V_{SDAA}, V_{SCLA}= VCCA; V_{SDAB}, V_{SCLB} = VCCB	1	2.8	4.8	
	TPT7251	V_{SDAA}, V_{SCLA} = GNDA; V_{SDAB}, V_{SCLB} = GNDB	-	5.5	8.5	
		V_{SDAA}, V_{SCLA}= VCCA; V_{SDAB}, V_{SCLB} = VCCB	-	2.5	4.5	
Supply Current, Side B	TPT7251 and TPT7250	V_{SDAA}, V_{SCLA} = GNDA; V_{SDAB}, V_{SCLB} = GNDB	1	5.3	7.3	
		V_{SDAA}, V_{SCLA}= VCCA; V_{SDAB}, V_{SCLB} = VCCB	1	2.9	5	

Timing Specifications − 3.3-V Supply

All test conditions: V_{CCA} = V_{CCB} = 3.3 V, T_A = −40°C ~ +125°C. Typical values are at V_{CC} = 3.3 V, T_A = +25°C, C_L = 15 pF to GND, unless otherwise noted.

Parameter		Conditions	Min	Typ	Max	Unit
tf_A	Output Signal Fall Time (SDAA, SCLA)		-	14	40	ns
tf_B	Output Signal Fall Time (SDAB, SCLB)		-	14	40	ns
t_{pLHA-B}	Low-to-High Propagation Delay, Side A to Side B	0.55 V to 0.7 × V_{CCB}	30	51	75	ns
t_{pHLA-B}	High-to-Low Propagation Delay, Side A to Side B	0.7 V to 0.4 V	30	53	75	ns
PWD_{A-B}	Pulse Width Distortion $\lvert t_{pHLA-B} - t_{pLHA-B} \rvert$		-	2	40	ns
t_{pLHB-A}	Low-to-High Propagation Delay, Side B to Side A	0.4 × V_{CCB} to 0.7 × V_{CCA}	30	58	80	ns
t_{pHLB-A}	High-to-Low Propagation Delay, Side B to Side A	0.4 × V_{CCB} to 0.9 V	30	56	85	ns
PWD_{B-A}	Pulse Width Distortion $\lvert t_{pHLB-A} - t_{pLHB-A} \rvert$		-	2	20	ns
t_{LOOPA}	Round-trip Propagation Delay on Side A	0.4 V to 0.3 × V_{CCA}	30	116	165	ns

Supply Current Characteristics − 3.3-V Supply

All test conditions: V_{CCA} = V_{CCB} = 3.3 V, T_A = −40°C ~ +125°C. Typical values are at V_{CC} = 3.3 V, T_A = +25°C, C_L = 15 pF to GND, unless otherwise noted.

Parameter	Description	Test Condition	Min	Typ	Max	Unit
Supply Current, Side A	TPT7250	V_{SDAA}, V_{SCLA} = GNDA; V_{SDAB}, V_{SCLB} = GNDB	1	5.4	7.6	mA
		V_{SDAA}, V_{SCLA} = VCCA; V_{SDAB}, V_{SCLB} = VCCB	1	2.7	4.6	
	TPT7251	V_{SDAA}, V_{SCLA} = GNDA; V_{SDAB}, V_{SCLB} = GNDB	-	5.5	8.5	
		V_{SDAA}, V_{SCLA} = VCCA; V_{SDAB}, V_{SCLB} = VCCB	-	2.5	4.5	
Supply Current, Side B	TPT7251 and TPT7250	V_{SDAA}, V_{SCLA} = GNDA; V_{SDAB}, V_{SCLB} = GNDB	1	5.2	7	
		V_{SDAA}, V_{SCLA} = VCCA; V_{SDAB}, V_{SCLB} = VCCB	1	2.8	4.7	

Timing Specifications − 2.5-V Supply

All test conditions: V_{CCA} = V_{CCB} = 2.5 V, T_A = −40°C ~ +125°C. Typical values are at V_{CC} = 2.5 V, T_A = +25°C, C_L = 15 pF to GND, unless otherwise noted.

Parameter		Conditions	Min	Typ	Max	Unit
tf_A	Output Signal Fall Time (SDAA, SCLA)		-	12	40	ns
tf_B	Output Signal Fall Time (SDAB, SCLB)		-	19	40	ns
t_{pLHA-B}	Low-to-High Propagation Delay, Side A to Side B	0.55 V to 0.7 × V_{CCB}	30	51	75	ns
t_{pHLA-B}	High-to-Low Propagation Delay, Side A to Side B	0.7 V to 0.4 V	30	63	85	ns
PWD_{A-B}	Pulse Width Distortion $\lvert t_{pHLA-B} - t_{pLHA-B} \rvert$		-	12	60	ns
t_{pLHB-A}	Low-to-High Propagation Delay, Side B to Side A	0.4 × V_{CCB} to 0.7 × V_{CCA}	30	55	80	ns
t_{pHLB-A}	High-to-Low Propagation Delay, Side B to Side A	0.4 × V_{CCB} to 0.9 V	30	63	85	ns
PWD_{B-A}	Pulse Width Distortion $\lvert t_{pHLB-A} - t_{pLHB-A} \rvert$		-	8	60	ns
t_{LOOPA}	Round-trip Propagation Delay on Side A	0.4 V to 0.3 × V_{CCA}	30	110	150	ns

Supply Current Characteristics − 2.5-V Supply

All test conditions: V_{CCA} = V_{CCB} = 2.5 V, T_A = −40°C ~ +125°C. Typical values are at V_{CC} = 2.5 V, T_A = +25°C, C_L = 15 pF to GND, unless otherwise noted.

Parameter	Description	Test Condition	Min	Typ	Max	Unit
Supply Current, Side A	TPT7250	V_{SDAA}, V_{SCLA} = GNDA; V_{SDAB}, V_{SCLB} = GNDB	1	5.4	7.5	mA
		V_{SDAA}, V_{SCLA} = VCCA; V_{SDAB}, V_{SCLB} = VCCB	1	2.7	4.6	
	TPT7251	V_{SDAA}, V_{SCLA} = GNDA; V_{SDAB}, V_{SCLB} = GNDB	-	5.5	8.5	
		V_{SDAA}, V_{SCLA} = VCCA; V_{SDAB}, V_{SCLB} = VCCB	-	2.5	4.5	
Supply Current, Side B	TPT7251 and TPT7250	V_{SDAA}, V_{SCLA} = GNDA; V_{SDAB}, V_{SCLB} = GNDB	1	5.2	7	
		V_{SDAA}, V_{SCLA} = VCCA; V_{SDAB}, V_{SCLB} = VCCB	1	2.7	4.6	

Test Circuits and Waveforms

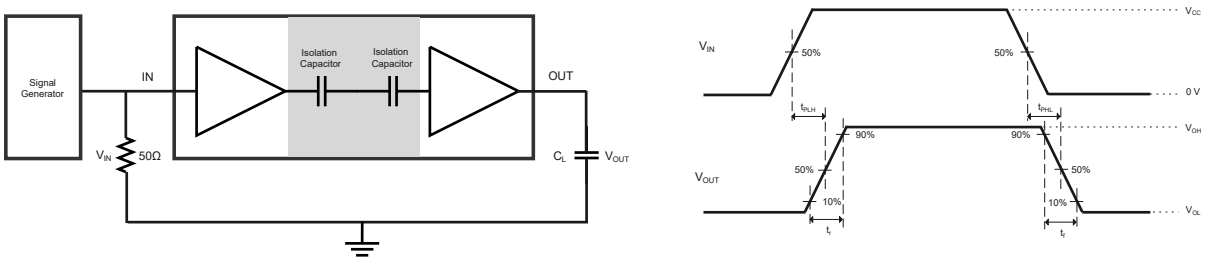


Figure 1. Switching Characteristics Test Circuit and Waveforms

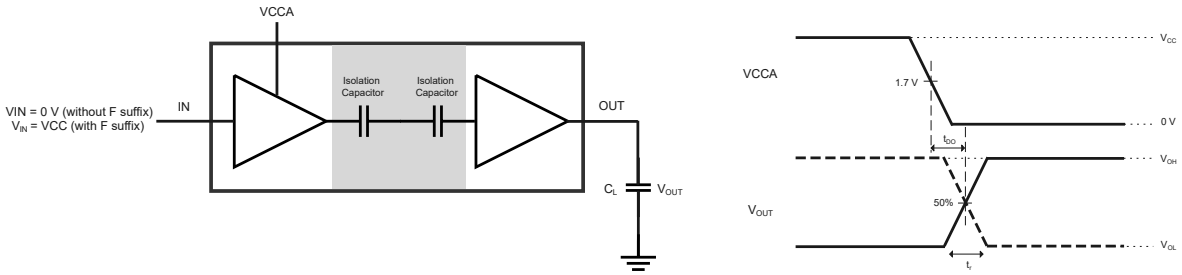


Figure 2. Default Output Delay Time Test Circuit and Voltage Waveforms

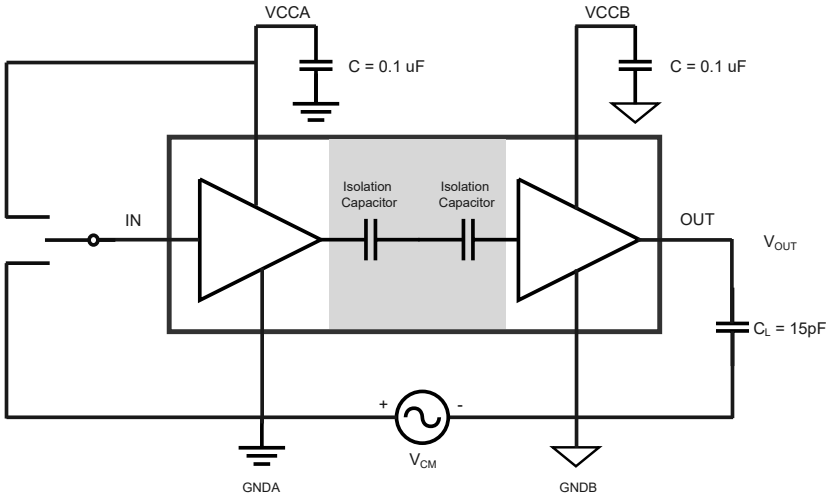


Figure 3. Common-Mode Transient Immunity Test Circuit

Detailed Description

Overview

The TPT725x device utilizes an ON-OFF Keying (OOK) modulation circuit to transmit the digital data through the isolation barrier. The transmitter sends an HF carrier to represent the digital state One and sends no signal to represent digital state Zero. Once the modulated signal passes through the barrier, the receiver demodulates the signal following the process of signal conditioning and brings the output via a buffer stage. The device also utilizes advanced circuit design to maximize the CMTI performance and minimize the radiated emissions due to the HF carrier and IO buffer switching. The block diagram below shows a functional block diagram of a typical channel.

Functional Block Diagram

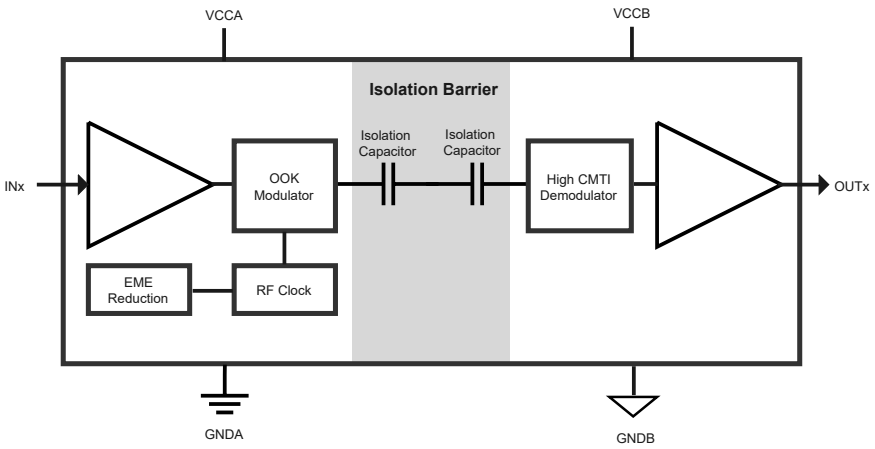


Figure 4. Block Diagram of Digital Capacitive Isolator

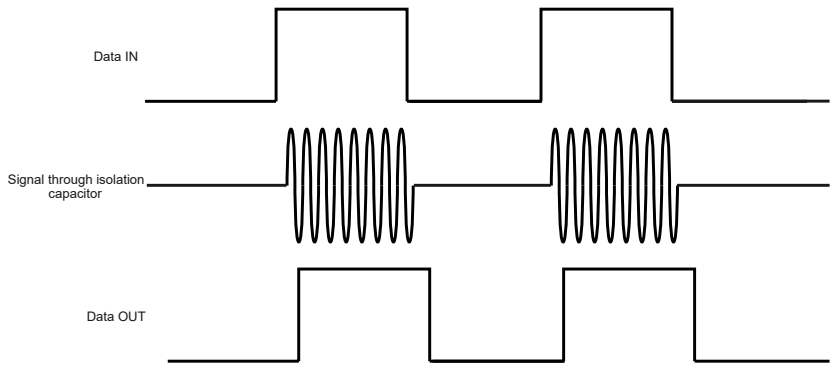


Figure 5. On-Off Keying (OOK) based Modulation Scheme

Feature Description

The following table lists the device features of the TPT725x devices.

Part Number	Max Data Rate	Channel Direction	Package	Isolation Rating
TPT7250	1 MHz	Bidirectional SCL Bidirectional SDA	SOP8	3750 V_{RMS}/ 5300 V_{PK}
			WSOP8	6500 V_{RMS}/ 9191 V_{PK}
			WWSOP8	8000 V_{RMS}/ 12000 V_{PK}
			SOP16	3750 V_{RMS}/ 5300 V_{PK}
			QSOP16	3750 V_{RMS}/ 5300 V_{PK}
			WSOP16	6500 V_{RMS}/ 9191 V_{PK}
			WWSOP16	8000 V_{RMS}/ 12000 V_{PK}
TPT7251	1 MHz	Unidirectional SCL Bidirectional SDA	SOP8	3750 V_{RMS}/ 5300 V_{PK}
			WSOP8	6500 V_{RMS}/ 9191 V_{PK}
			WWSOP8	8000 V_{RMS}/ 12000 V_{PK}
			SOP16	3750 V_{RMS}/ 5300 V_{PK}
			QSOP16	3750 V_{RMS}/ 5300 V_{PK}
			WSOP16	6500 V_{RMS}/ 9191 V_{PK}
			WWSOP16	8000 V_{RMS}/ 12000 V_{PK}

Device Functional Modes

The table below lists the functional modes for the TPT725x devices.

Power State	Input	Output
VCCA or VCCB < 2.1 V	X	Z
VCCA and VCCB > 2.8 V	Low	Low
	High	Z
	Z	Undetermined

(1) X = Irrelevant; Z = High impedance

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

The two external bypass capacitors need to be close to the VCC power pin. The maximum distance is 2 mm.

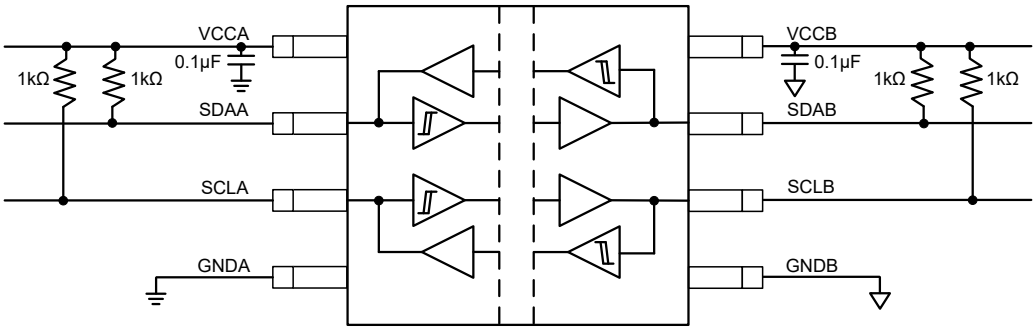


Figure 6. TPT7250 SOP8, WSOP8, WWSOP8

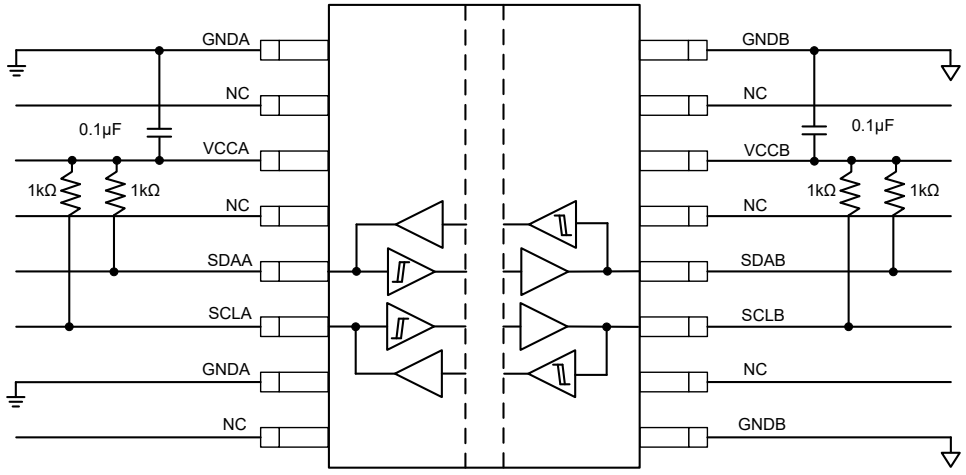


Figure 7. TPT7250 SOP16, QSOP16, WSOP16, WWSOP16

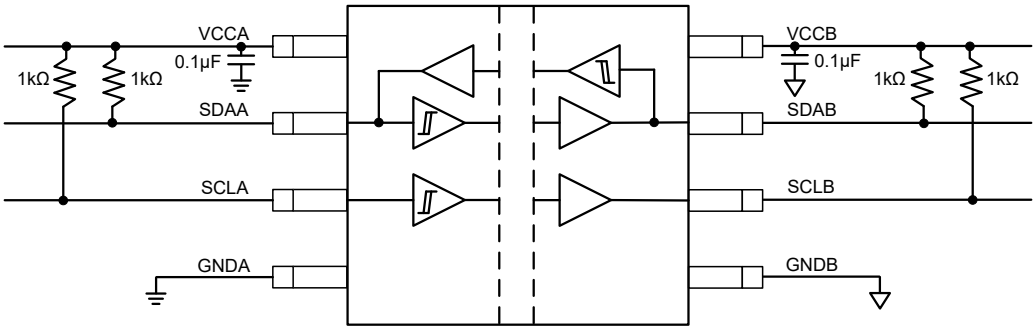


Figure 8. TPT7251 SOP8, WSOP8, WWSOP8

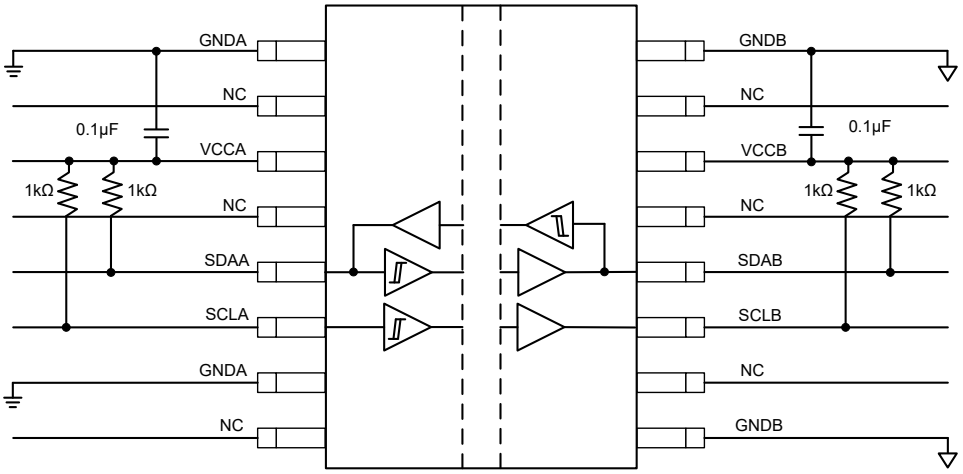
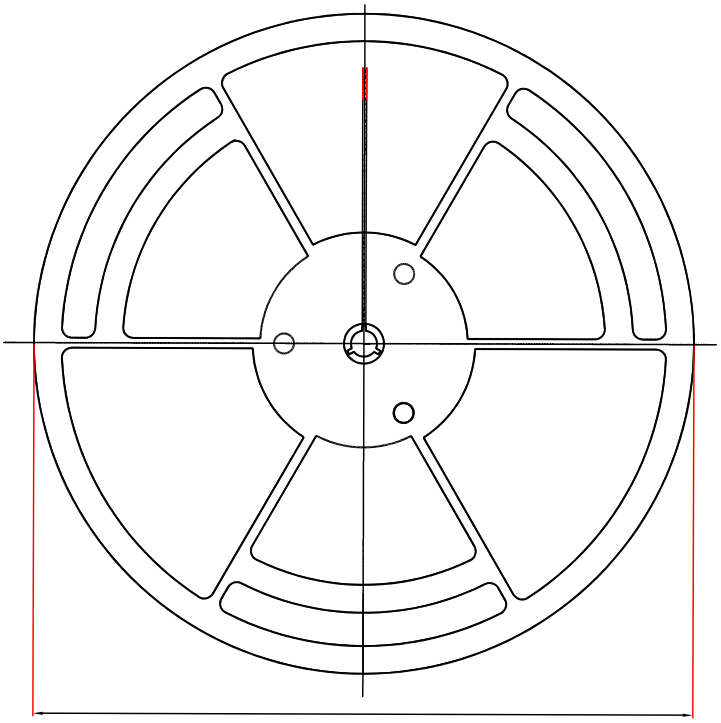
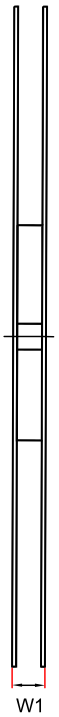
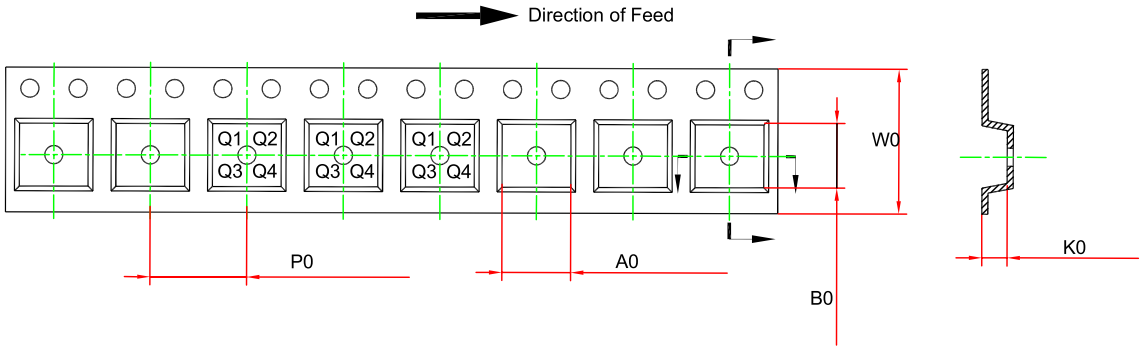


Figure 9. TPT7251 SOP16, QSOP16, WSOP16, WWSOP16

Tape and Reel Information





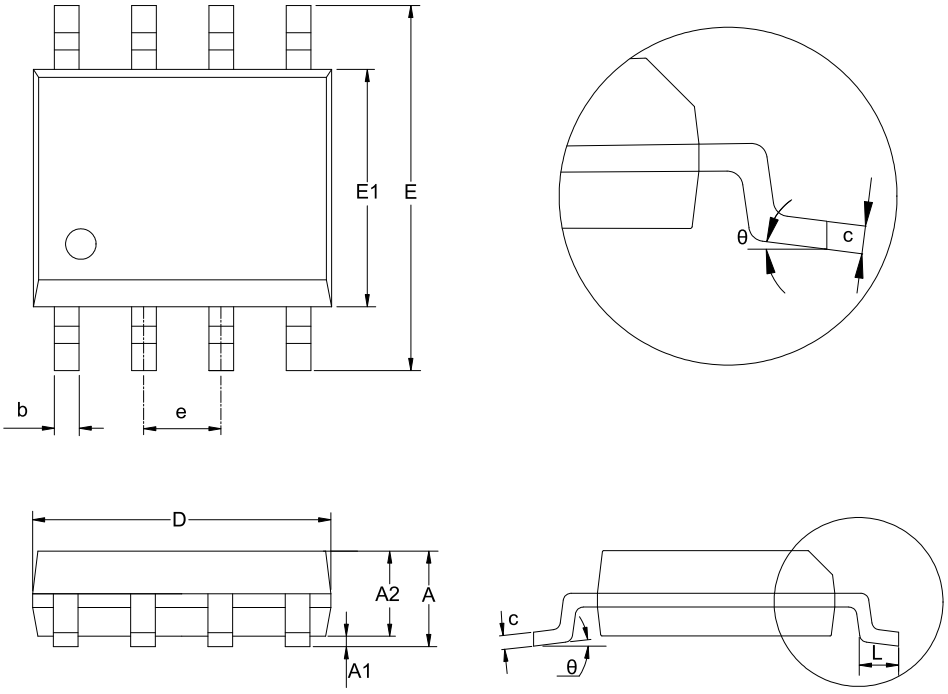


Order Number	Package	D1 (mm)	W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	W0 (mm)	Pin1 Quadrant
TPT7250-SO1R	SOP8	330.0	17.6	6.5	5.4	2.0	8.0	12.0	Q1
TPT7250-SOAR	WSOP8	330.0	21.6	11.95	6.2	3.1	16.0	16.0	Q1
TPT7250-SOKR	WWSOP8	330.0	21.6	17.7	6.8	2.8	24.0	16.0	Q1
TPT7250-SO3R	SOP16	330.0	21.6	6.6	10.4	2.1	8.0	16.0	Q1
TPT7250-SS3R	QSOP16	330.0	17.6	6.6	5.3	1.9	8.0	12.0	Q1
TPT7250-SOBR	WSOP16	330.0	21.6	10.9	10.8	3.1	12.0	16.0	Q1
TPT7250-SOFR	WWSOP16	330.0	29.0	17.6	10.8	3.0	20.0	24.0	Q1
TPT7251-SO1R	SOP8	330.0	17.6	6.5	5.4	2.0	8.0	12.0	Q1
TPT7251-SOAR	WSOP8	330.0	21.6	11.95	6.2	3.1	16.0	16.0	Q1
TPT7251-SOKR	WWSOP8	330.0	21.6	17.7	6.8	2.8	24.0	16.0	Q1
TPT7251-SO3R	SOP16	330.0	21.6	6.6	10.4	2.1	8.0	16.0	Q1
TPT7251-SS3R	QSOP16	330.0	17.6	6.6	5.3	1.9	8.0	12.0	Q1
TPT7251-SOBR	WSOP16	330.0	21.6	10.9	10.8	3.1	12.0	16.0	Q1
TPT7251-SOFR	WWSOP16	330.0	29.0	17.6	10.8	3.0	20.0	24.0	Q1

Package Outline Dimensions

SOP8

Package Outline Dimensions SO1(SOP-8-B)



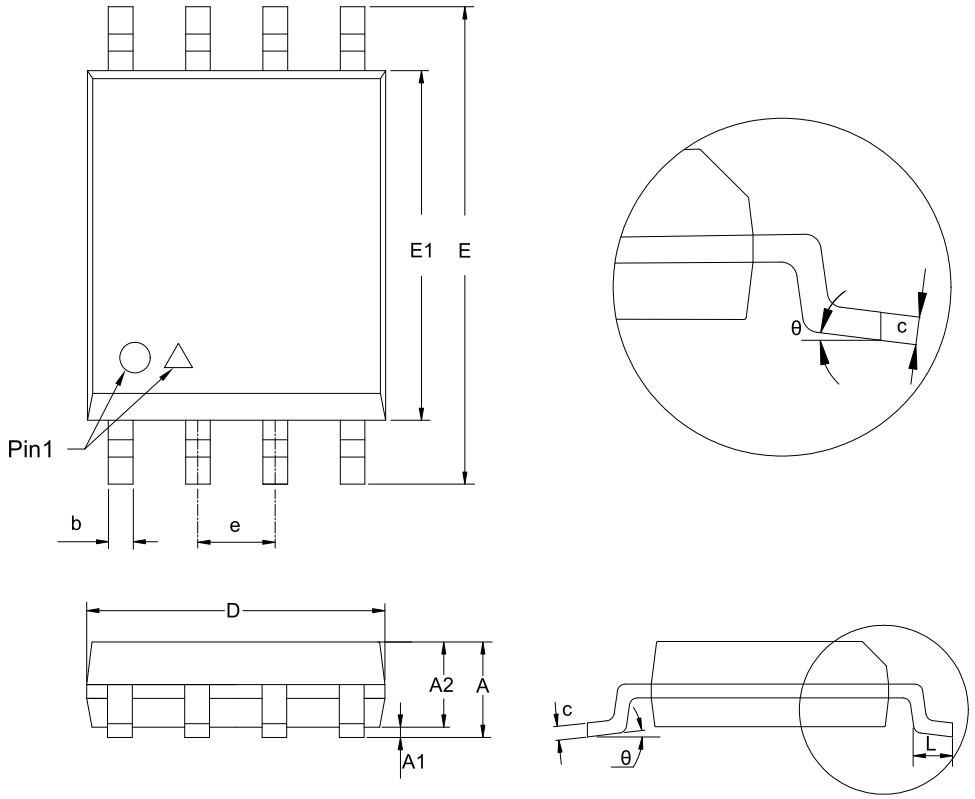
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.250	1.550	0.049	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.007	0.010
D	4.700	5.100	0.185	0.201
E	5.800	6.200	0.228	0.244
E1	3.800	4.000	0.150	0.157
e	1.270 BSC		0.050 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.

WSOP8

Package Outline Dimensions SOA(WSOP-8-A)



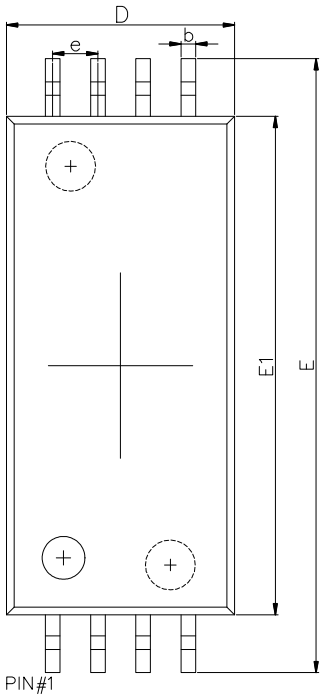
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	2.550	2.800	0.100	0.110
A1	0.360	0.460	0.014	0.018
A2	2.190	2.390	0.086	0.094
b	0.310	0.510	0.012	0.020
c	0.150	0.300	0.006	0.012
D	5.750	5.950	0.226	0.234
E	11.250	11.750	0.443	0.463
E1	7.400	7.600	0.291	0.299
e	1.270 BSC		0.050 BSC	
L	0.500	1.000	0.020	0.039
θ	0	8°	0	8°

NOTES

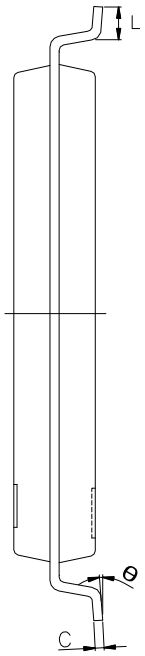
1. Do not include mold flash or protrusion.
2. This drawing is subject to change without notice.

WWSOP8

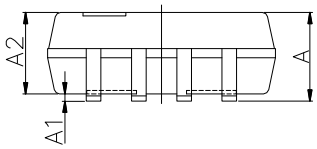
Package Outline Dimensions SOK(WWSOP-8-A)



TOP VIEW



SIDE VIEW



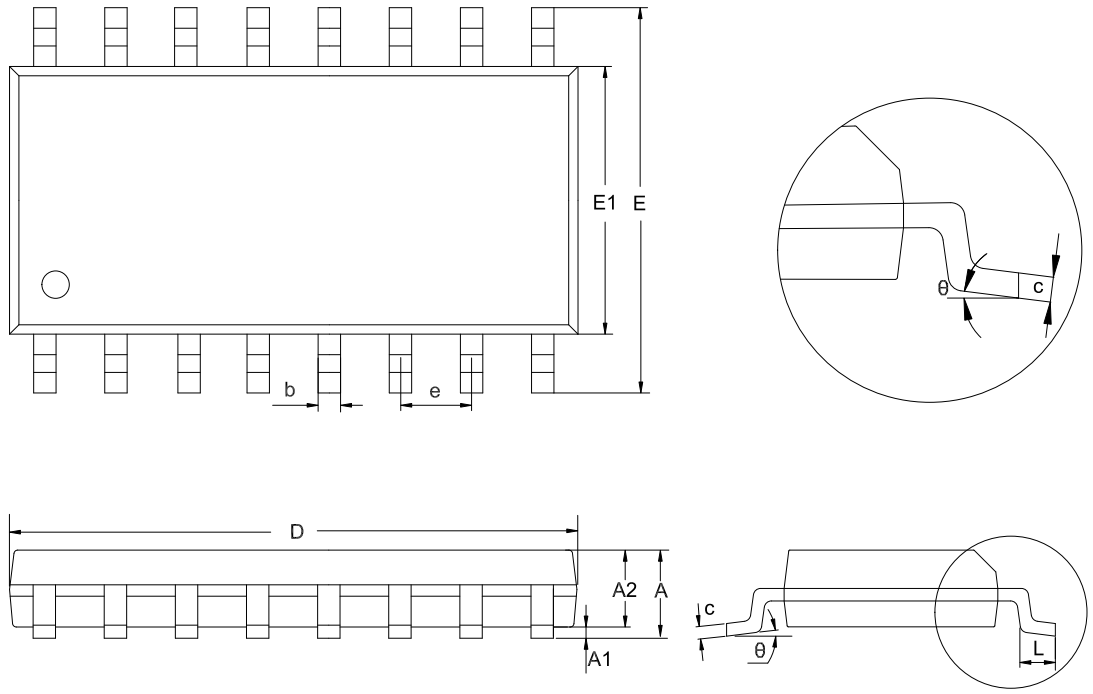
SIDE VIEW

Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	---	2.650	---	0.104
A1	0.100	0.300	0.004	0.012
A2	2.250	2.336	0.089	0.092
b	0.310	0.510	0.012	0.020
c	0.220	0.280	0.009	0.011
D	6.300	6.500	0.248	0.256
e	1.270 BSC		0.050 BSC	
E	17.100	17.400	0.673	0.685
E1	13.900	14.100	0.547	0.555
L	0.600	1.100	0.024	0.043
θ	0°	8°	0°	8°

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

SOP16

Package Outline Dimensions SO3(SOP-16-A)



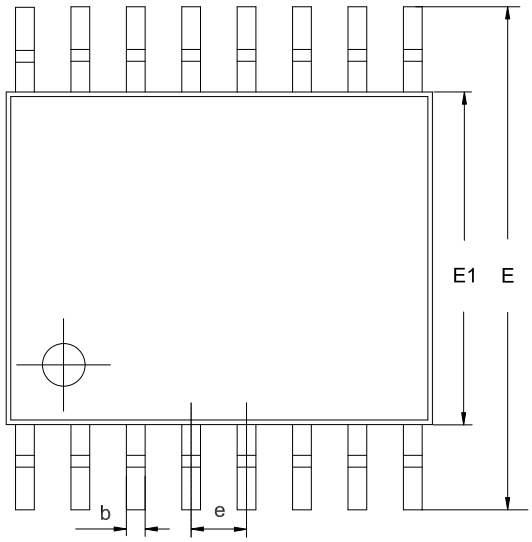
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.350	1.750	0.053	0.069
A1	0.050	0.250	0.002	0.010
A2	1.300	1.600	0.051	0.063
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.007	0.010
D	9.800	10.000	0.386	0.394
E	5.800	6.200	0.228	0.244
E1	3.800	4.000	0.150	0.157
e	1.270 BSC		0.050 BSC	
L	0.400	1.000	0.016	0.039
θ	0	8°	0	8°

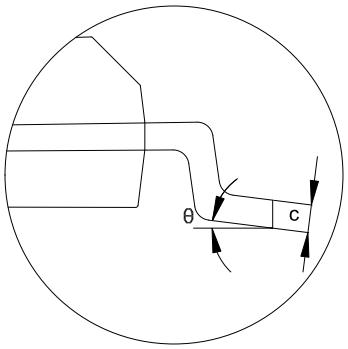
NOTES

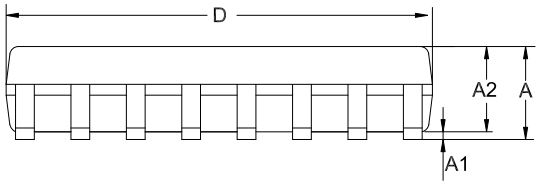
1. Do not include mold flash or protrusion.
2. This drawing is subject to change without notice.

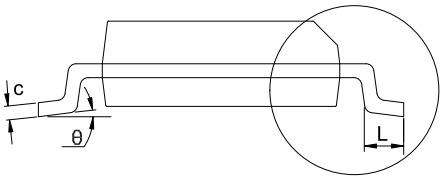
QSOP16

Package Outline Dimensions SS3(SSOP-16-A)









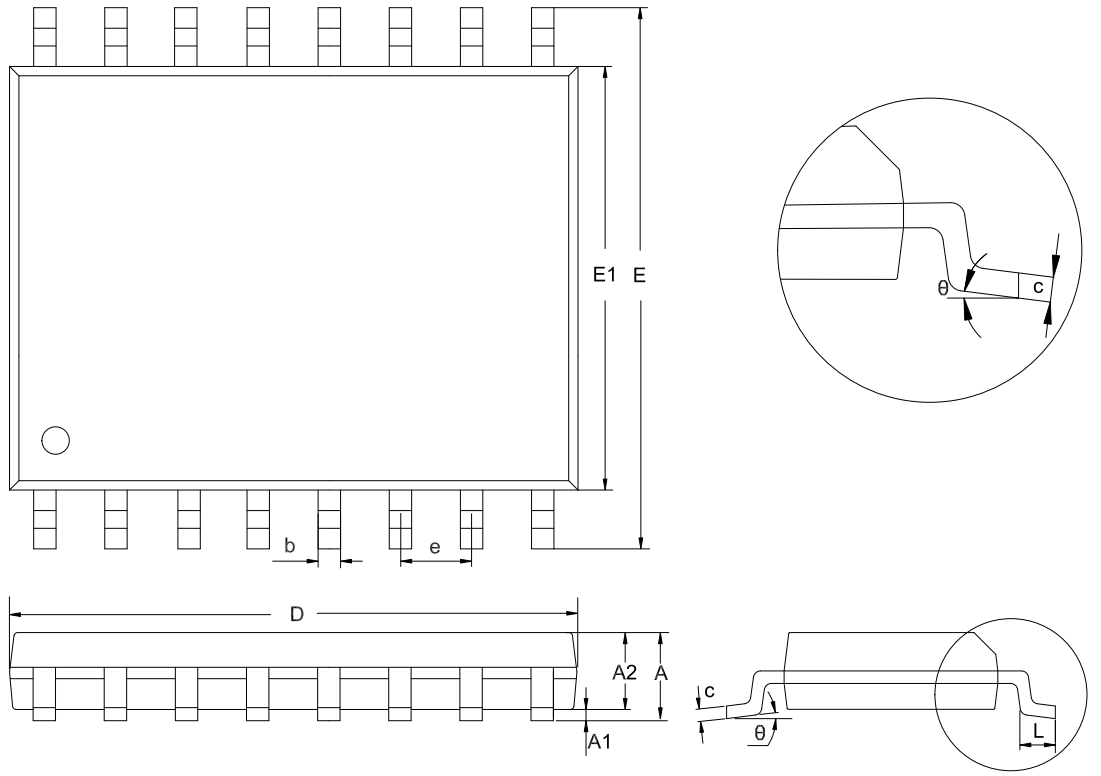
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.500	2.000	0.059	0.079
A1	0.050	0.250	0.002	0.010
A2	1.400	1.850	0.055	0.073
b	0.220	0.380	0.009	0.015
c	0.090	0.250	0.004	0.010
D	5.900	6.500	0.232	0.256
E	7.400	8.200	0.291	0.323
E1	5.000	5.600	0.197	0.220
e	0.650 BSC		0.026 BSC	
L	0.550	1.050	0.022	0.041
θ	0	8°	0	8°

NOTES

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

WSOP16

Package Outline Dimensions SOB(WSOP-16-A)



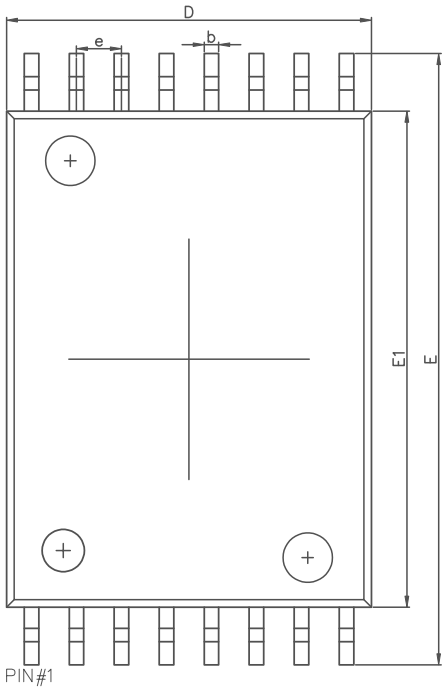
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	2.350	2.650	0.093	0.104
A1	0.100	0.300	0.004	0.012
A2	2.250	2.350	0.089	0.093
b	0.350	0.450	0.014	0.018
c	0.200	0.290	0.008	0.011
D	10.100	10.500	0.398	0.413
E	10.100	10.600	0.398	0.417
E1	7.300	7.700	0.287	0.303
e	1.270 BSC		0.050 BSC	
L	0.500	0.850	0.020	0.033
θ	0	8°	0	8°

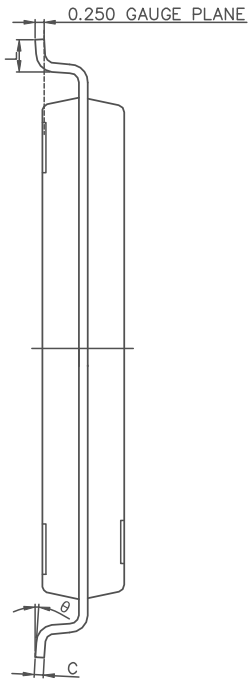
NOTES

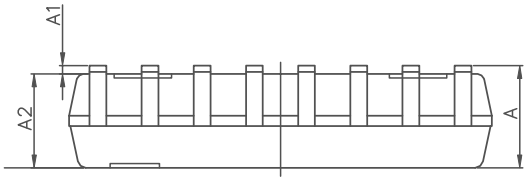
1. Do not include mold flash or protrusion.
2. This drawing is subject to change without notice.

WWSOP16

Package Outline Dimensions SOF(WWSOP-16-A)







Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	---	2.650	---	0.104
A1	0.100	0.300	0.004	0.012
A2	2.236	2.336	0.088	0.092
b	0.310	0.510	0.012	0.020
c	0.220	0.280	0.009	0.011
D	10.200	10.400	0.402	0.409
E	17.100	17.400	0.673	0.685
E1	13.900	14.100	0.547	0.555
e	1.270 BSC		0.050 BSC	
L	0.600	1.100	0.024	0.043
θ	0	8°	0	8°

NOTES

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

Order Information

Order Number	Operating Temperature Range	Package	Marking Information	MSL	Transport Media, Quantity	Eco Plan
TPT7250-SO1R	−40 to 125°C	SOP8	T7250	MSL3	Tape and Reel, 4000	Green
TPT7250-SOAR	−40 to 125°C	WSOP8	T7250	MSL3	Tape and Reel, 1000	Green
TPT7250-SOKR	−40 to 125°C	WWSOP8	T7250	MSL3	Tape and Reel, 500	Green
TPT7250-SO3R	−40 to 125°C	SOP16	T7250	MSL3	Tape and Reel, 2500	Green
TPT7250-SS3R	−40 to 125°C	QSOP16	T7250	MSL3	Tape and Reel, 2000	Green
TPT7250-SOBR	−40 to 125°C	WSOP16	T7250	MSL3	Tape and Reel, 1500	Green
TPT7250-SOFR	−40 to 125°C	WWSOP16	T7250	MSL3	Tape and Reel, 1000	Green
TPT7251-SO1R	−40 to 125°C	SOP8	T7251	MSL3	Tape and Reel, 4000	Green
TPT7251-SOAR	−40 to 125°C	WSOP8	T7251	MSL3	Tape and Reel, 1000	Green
TPT7251-SOKR (1)	−40 to 125°C	WWSOP8	T7251	MSL3	Tape and Reel, 500	Green
TPT7251-SO3R (1)	−40 to 125°C	SOP16	T7251	MSL3	Tape and Reel, 2500	Green
TPT7251-SS3R (1)	−40 to 125°C	QSOP16	T7251	MSL3	Tape and Reel, 2000	Green
TPT7251-SOBR (1)	−40 to 125°C	WSOP16	T7251	MSL3	Tape and Reel, 1500	Green
TPT7251-SOFR (1)	−40 to 125°C	WWSOP16	T7251	MSL3	Tape and Reel, 1000	Green

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

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

IMPORTANT NOTICE AND DISCLAIMER

Trademarks. Any of the 思瑞浦 or 3PEAK trade names, trademarks, graphic marks, and domain names contained in this document /material are the property of 3PEAK. You may NOT reproduce, modify, publish, transmit or distribute any Trademark without the prior written consent of 3PEAK.

Performance Information. Performance tests or performance range contained in this document/material are either results of design simulation or actual tests conducted under designated testing environment. Any variation in testing environment or simulation environment, including but not limited to testing method, testing process or testing temperature, may affect actual performance of the product.

Disclaimer. 3PEAK provides technical and reliability data (including data sheets), design resources (including reference designs), application or other design recommendations, networking tools, security information and other resources "As Is". 3PEAK makes no warranty as to the absence of defects, and makes no warranties of any kind, express or implied, including without limitation, implied warranties as to merchantability, fitness for a particular purpose or non-infringement of any third-party's intellectual property rights. Unless otherwise specified in writing, products supplied by 3PEAK are not designed to be used in any life-threatening scenarios, including critical medical applications, automotive safety-critical systems, aviation, aerospace, or any situations where failure could result in bodily harm, loss of life, or significant property damage. 3PEAK disclaims all liability for any such unauthorized use.