Watchdog Timer Circuit with EN Control

Features

- Available Watchdog Timeout Periods 10 ms, 100 ms, 0.6 s, 1.6 s and 10 s
- Chip Enable Input
- Open Drain or Push-Pull Active Low $\overline{WDO}$ Output
- Low Power Consumption: 6 μA
- Guaranteed Output Valid to V_{CC} = 1.67 V
- Package
  - SOT23-5: Auto Grade 1 Qualified
  - SC70-5
- Operation Temperature Range: −40°C to +125°C

Applications

- Automotive Cabin
- T-Box
- BMS
- ESS
- Industry Equipment

Description

The TPV710 is a watchdog timer circuit which prevents system failures caused by certain types of hardware errors or software errors.

The TPV710 watchdog timer circuit has an input, WDI, and output $\overline{WDO}$. The input is used to clear the internal watchdog timer periodically within the specified timeout period t_{WD}. While the system operates correctly, it periodically toggles the watchdog input, WDI. If the system fails, the watchdog timer is not reset, and the watchdog output, $\overline{WDO}$, is asserted.

The TPV710 has an enable input, $\overline{EN}$, which can enable or disable the watchdog functionality. The $\overline{EN}$ is connected to the internal pull-down resistor. The device is enabled if the $\overline{EN}$ pin is left floating.

The TPV710 is available in SOT23-5 and SC70-5 packages. The TPV710 with SOT23-5 package is auto-grade 1 qualified. The TPV710 with SC70-5 is industry grade. The operation temperature range is -40℃ to 125℃.

Typical Application Circuit

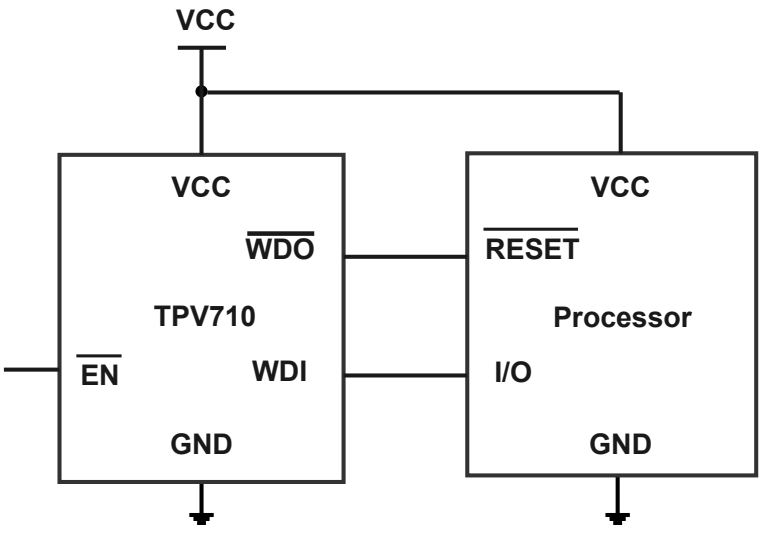


Table of Contents

Product Family Table

Order Number	Watchdog Timer	Open Drain or Push Pull	Marking Information	Package	Quality Grade
TPV710NXQ-S5TR-S (1)	10ms	Open Drain	NXQ	SOT23-5	Automotive
TPV710NWQ-S5TR-S	100ms	Open Drain	NWQ	SOT23-5	Automotive
TPV710NZQ-S5TR-S	0.6s	Open Drain	NZQ	SOT23-5	Automotive
TPV710NYQ-S5TR-S	1.6s	Open Drain	NYQ	SOT23-5	Automotive
TPV710PY-SC5R (1)	1.6s	Push Pull	7PY	SC70-5	Industry
TPV710NV-S5TR (1)	12.8s	Open Drain	7NV	SOT23-5	Industry

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

Revision History

Date	Revision	Notes
2024-04-18	Rev.A.0	Initiation version.

Pin Configuration and Functions

TPV710
SOT23-5 and SC70-5 Package
Top View

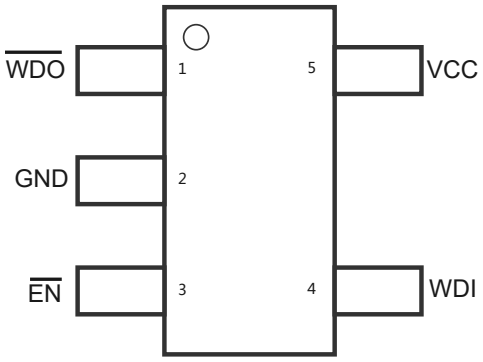


Table 1. Pin Functions

Pin		I/O	Description
NO.	Name		
1	$\overline{WDO}$	O	Watchdog Output. Pulls low for t_{RP} if WDI remains low or high for the duration of the watchdog timeout, and does not go high again until the watchdog is cleared. Whenever VCC is below the reset threshold, $\overline{WDO}$ stays high.
2	GND	-	Ground.
3	$\overline{EN}$	I	Enable pin, enable or disable watchdog. $\overline{EN}$ pin is connected to the internal pull-down resistor. The device is enabled if the $\overline{EN}$ is left floating.
4	WDI	I	Watchdog Input. The timer is cleared if a logic transition occurs on this pin.
5	VCC	–	Power Supply Voltage Monitored.

Specifications

Absolute Maximum Ratings

Parameter		Min	Max	Unit
Input Voltage	VCC, WDI, $\overline{WDO}$, $\overline{EN}$to GND	−0.3	6	V
Output Current	$\overline{WDO}$		20	mA
T_J	Maximum Junction Temperature	−40	150	°C
T_{STG}	Storage Temperature Range	−65	150	°C
T_L	Lead Temperature (Soldering 10 sec)		260	°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
HBM	Human Body Model ESD	ANSI/ESDA/JEDEC JS-001 (1)	±2000	V
CDM	Charged Device Model ESD	ANSI/ESDA/JEDEC JS-002 (2)	±1000	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.

Thermal Information

Package Type	θ_{JA}	θ_{JC}	Unit
SOT23-5	128	67	°C/W

Electrical Characteristics

All test conditions: V_{CC} = 1.67 V to 5.5 V, T_A = −40°C to +125°C, unless otherwise noted.

Parameter		Conditions	Min	Typ	Max	Unit
Supply Voltage and Current						
V_{CC}	V_{CC} Operating Voltage Range		1.67		5.5	V
I_{CC}	Supply Current	WDI and $\overline{EN}$ unconnected (V_{CC} = 5 V)		6	15	μA
V_{START}	Watchdog Timer Startup Voltage			2.19		V
V_{IL}	Input Threshold Voltage Low for WDI, $\overline{EN}$				0.3× V_{CC}	V
V_{IH}	Input Threshold Voltage High for WDI, $\overline{EN}$		0.7× V_{CC}			V
V_{OL}	$\overline{WDO}$ Output Voltage Low	V_{CC} ≥ 1.67 V, I_{SINK} = 1.2 mA			0.3	V
V_{OH}	$\overline{WDO}$ Output Voltage High (Push-Pull Only)	V_{CC} ≥ 1.67 V, I_{SOURCE} = 500 μA	0.8 × V_{CC}			V
t_{PW_EN}	$\overline{EN}$ Input Pulse Width		1			μs
t_{GR_EN}	$\overline{EN}$ Glitch Rejection			250		ns
t_{d_EN}	$\overline{EN}$ to $\overline{WDO}$ Delay			300		ns
R_{PD_EN}	$\overline{EN}$ Pull-Down Resistance			50		kΩ
WDI Pin						
t_{WD}	Watchdog Timeout Period	TPV710xX	7	10	14	ms
		TPV710xW	70	100	140	ms
		TPV710xZ	0.42	0.6	0.84	s
		TPV710xY	1.12	1.6	2.24	s
		TPV710xV	8.9	12.8	17.9	s
t_{RP}	$\overline{WDO}$pull low period when watchdog timeout	TPV710xX	4.2	6	8.4	ms
		TPV710xW	67	96	134	ms
		TPV710xZ	53	75	105	ms
		TPV710xV or TPV710xY	140	200	280	ms
t_{PW_WD}	WDI Pulse Width		50			ns
t_{GR_WD}	WDI Glitch Rejection			20		ns

Typical Performance Characteristics

All test conditions: V_{CC} = 3.3 V, T_A = +25°C, unless otherwise noted.

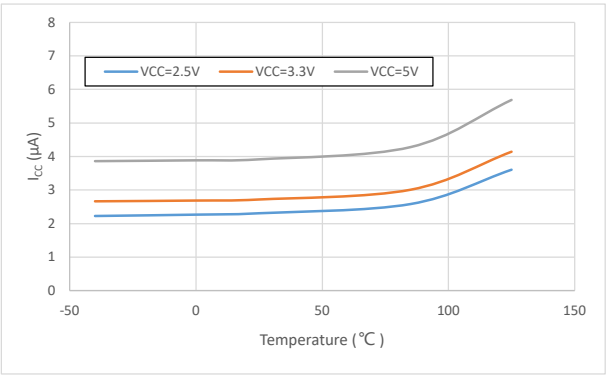


Figure 1. Supply Current vs. Temperature

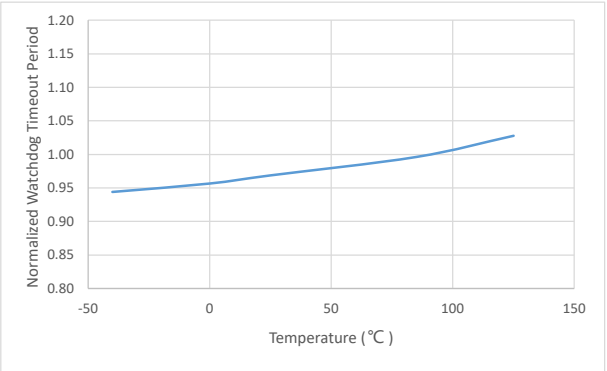


Figure 2. Normalized Watchdog Timeout Period vs. Temperature

Detailed Description

Overview

The TPV710 is a watchdog timer circuit which prevent system failures that are caused by certain types of hardware errors or software errors. The TPV710 watchdog timer circuit has an input, WDI, and output $\overline{WDO}$. The input is used to clear the internal watchdog timer periodically within the specified timerout period t_{WD}. While the system is operating correctly, it periodically toggles the watchdog input, WDI. If the system fails, the watchdog timer is not reset, the watchdog output, $\overline{WDO}$, is asserted. The TPV710 has an enable input, $\overline{EN}$, which can enable or disable the watchdog functionality. The $\overline{EN}$ is connected to the internal pull down resistor. The device is enabled if the $\overline{EN}$ pin is left floating.The TPV710 is available in SOT23-5 and SC70-5 package. The TPV710 with SOT23-5 package is auto grade 1 qualified. The TPV710 with SC70-5 is industry grade. The operation temperature range is -40℃ to 125℃.

Functional Block Diagram

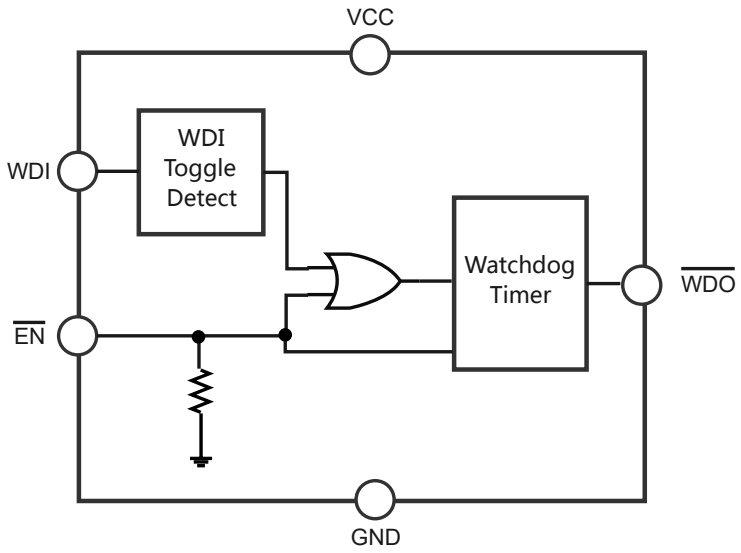


Figure 3. Functional Block Diagram

Feature Description

Watchdog Input

The TPV710 features a watchdog timer, which monitors microprocessor activity. A timer circuit is cleared with every low-to-high or high-to-low logic transition on the watchdog input pin (WDI). If the timer counts through the watchdog timeout period (t_{WD}), $\overline{WDO}$ is asserted. The microprocessor is required to toggle the WDI pin to avoid being reset.

Enable Control

TPV710 has $\overline{EN}$ pin to control the watchdog timer, if $\overline{EN}$ is pull low, the watchdog timer is enabled, if $\overline{EN}$ is pull high, the watchdog timer is disabled and the timer count is cleared. $\overline{EN}$ has internal pull down resistor, which means watchdog timer is enabled if $\overline{EN}$ is not connected. In addition to $\overline{EN}$ control, the watchdog timer is also cleared by an under-voltage condition on V_{CC}. After V_{CC} ramps above V_{UV}, the watchdog timer can be controlled by $\overline{EN}$ control, and the timer starts counting.

Watchdog Output

When watchdog timer out occurs, the $\overline{WDO}$ goes low for t_{PR}, and then goes high. If no WDI toggling, $\overline{WDO}$ goes low again after t_{WD}.

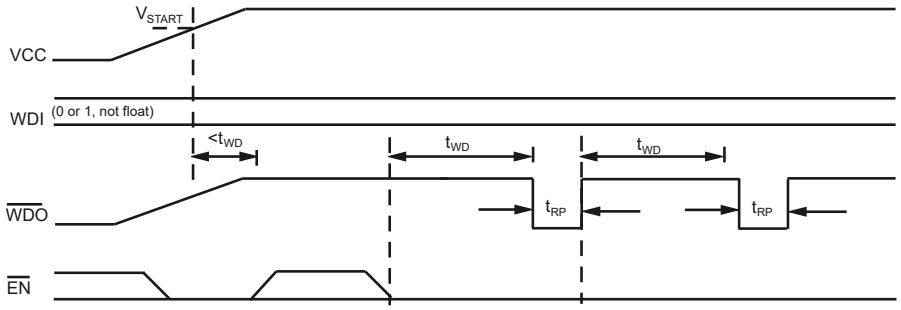


Figure 4. Watchdog Timing Diagram

Application and Implementation

Note

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

Typical Application

The following figure shows the typical application schematic.

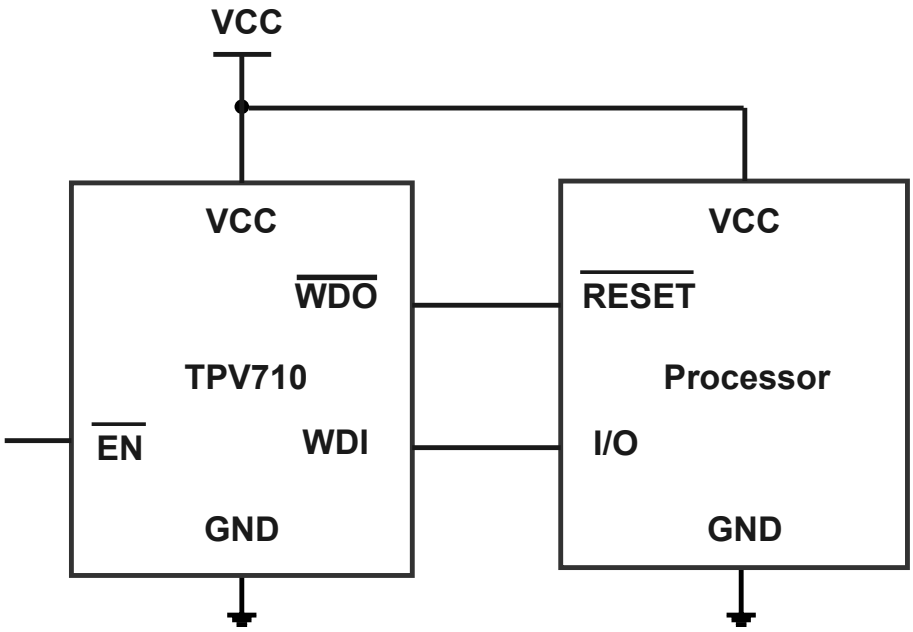
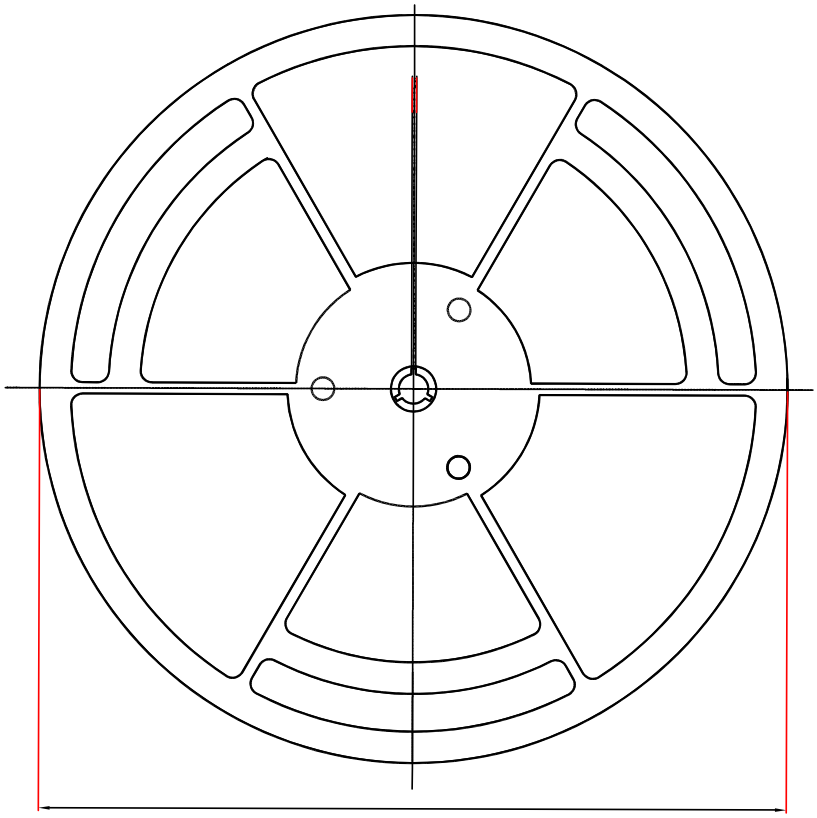
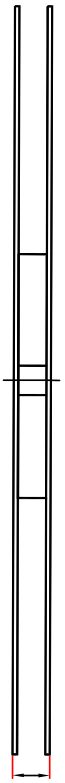
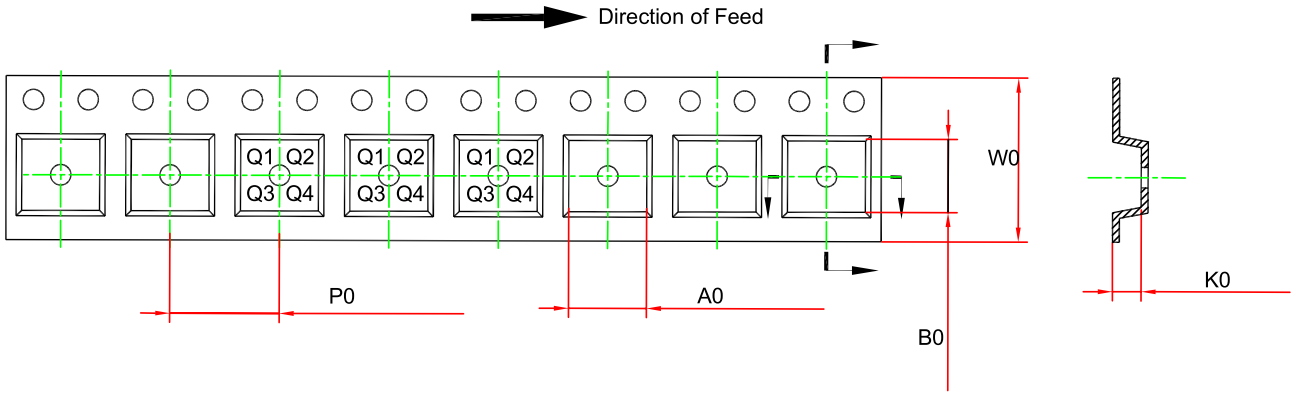


Figure 5. Typical Application Circuit

Tape and Reel Information





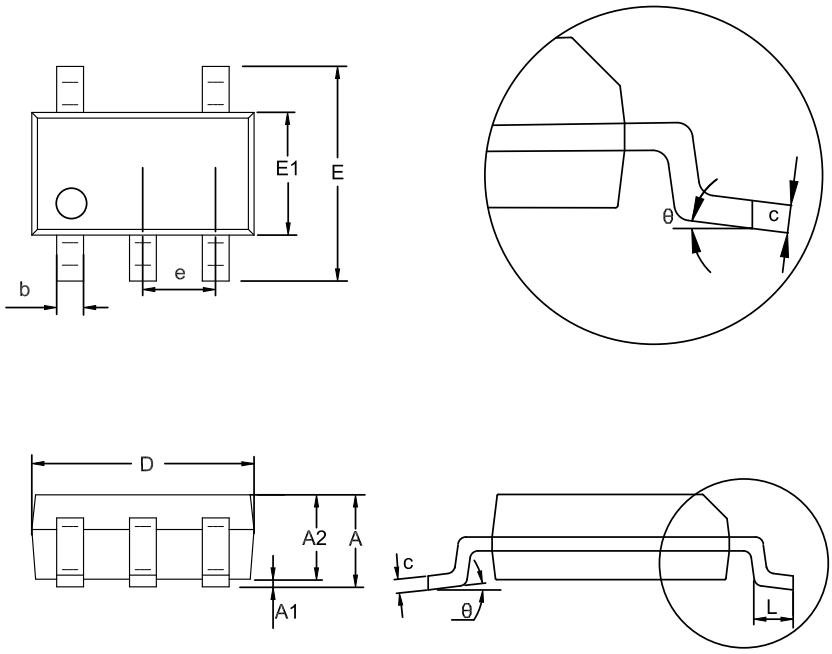


Order Number	Package	D1 (mm)	W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	W0 (mm)	Pin1 Quadrant
TPV710xxQ-S5TR-S	SOT23-5	179	12	3.3	3.25	1.4	4	8	Q3
TPV710xx-SC5R	SOT353-5	178	12.1	2.4	2.5	1.2	4	8	Q3

Package Outline Dimensions

SOT23-5

Package Outline Dimensions S5T(SOT23-5-A)



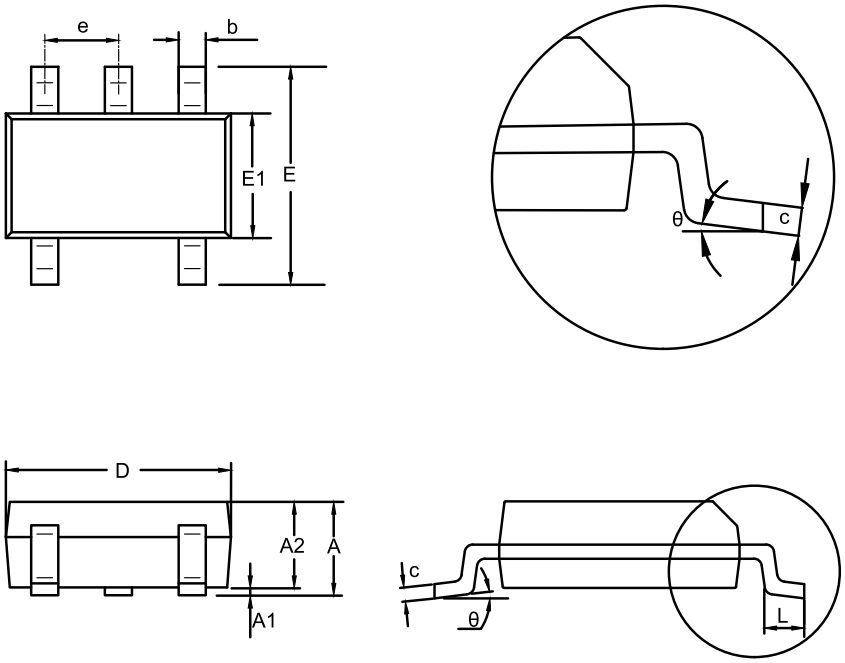
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.050	1.250	0.041	0.049
A1	0.000	0.150	0.000	0.006
A2	1.000	1.200	0.039	0.047
b	0.280	0.500	0.011	0.020
c	0.100	0.230	0.004	0.009
D	2.820	3.020	0.111	0.119
E	2.600	3.000	0.102	0.118
E1	1.500	1.720	0.059	0.068
e	0.950 BSC		0.037 BSC	
L	0.300	0.600	0.012	0.024
θ	0	8°	0	8°

NOTES

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

SOT353-5

Package Outline Dimensions SC5(SOT353-5-A)



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.850	1.100	0.033	0.043
A1	0.000	0.100	0.000	0.004
A2	0.800	1.000	0.031	0.039
b	0.150	0.350	0.006	0.014
c	0.110	0.230	0.004	0.009
D	2.000	2.200	0.079	0.087
E	2.150	2.450	0.085	0.096
E1	1.150	1.350	0.045	0.053
e	0.650 BSC		0.026 BSC	
L	0.260	0.460	0.010	0.018
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
TPV710NXQ-S5TR-S (1)	−40°C to 125°C	SOT23-5	NXQ	1	Tape and Reel, 3,000	Green
TPV710NWQ-S5TR-S	−40°C to 125°C	SOT23-5	NWQ	1	Tape and Reel, 3,000	Green
TPV710NZQ-S5TR-S	−40°C to 125°C	SOT23-5	NZQ	1	Tape and Reel, 3,000	Green
TPV710NYQ-S5TR-S	−40°C to 125°C	SOT23-5	NYQ	1	Tape and Reel, 3,000	Green
TPV710PY-SC5R (1)	−40°C to 125°C	SOT353-5	7PY	1	Tape and Reel, 3,000	Green
TPV710NV-S5TR (1)	−40°C to 125°C	SOT23-5	7NV	1	Tape and Reel, 3,000	Green

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

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

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