Low-Voltage, 6-Ω SPDT Analog Switch

Features

- Latch-up Performance Exceeds 600 mA per JESD 78, Class II
- Supply Voltage: 1.65 V to 5.5 V
- Low on-State Resistance: Typical 4 Ω at V_S = 4.5 V
- Bandwidth: 250 MHz
- Fast Switching Times: t_{ON} = 100 ns, t_{OFF} = 100 ns
- Break-Before-Make Switching
- No Overshoot and Undershoot When Switch Open and Close
- Operation Temperature Range: −40°C to 125°C

Applications

- Industry Control Systems
- Battery-Powered Systems
- Audio Signal Routing
- Portable Instruments and Mobile Device

Description

The TPW3125 is a high performance single-pole/double-throw (SPDT) analog switch. The device features the ultra low R_{ON} of 6 Ω maximum at 4.5-V V_{CC} and operates over the wide V_{CC} range of 1.65 V to 5.5 V.

The TPW3125 features very low quiescent current even when the control voltage is lower than the V_{CC} supply. This feature services the portable applications very well allowing for the direct interface with processor general purpose I/Os, and can tolerate 1.8-V CMOS logic in select input when the V_{CC} supply is in the range of 4.75 V to 5.25 V.

Table of Contents

Revision History

Date	Revision	Notes
2019-11-28	Rev.Pre.0	Pre-released version
2020-02-27	Rev.Pre.1	Added thr VIH specification at 4.5 to 5.5 V_{CC}, 25 to 125 degree
2024-05-29	Rev.A.0	The following updates are all about the new datasheet formats or typo, the actual product remains unchanged Updated to new format of package dimensions Updated tape and reel information

Pin Configuration and Functions

TPW3125
SOT363-6
Top View

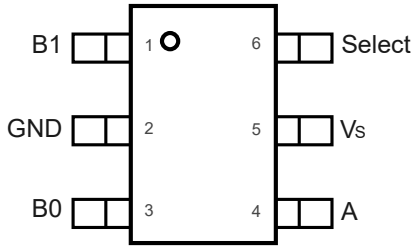


Table 1. Pin Functions

Pin No.	Name	I/O	Description
1	B1		Switch Port 1
2	GND		Ground
3	B0		Switch Port 0
4	A		Common Switch Port
5	V_S		Power Supply
6	Select		Select Pin

Table 2. Function Table

Input: Select Pin	Function
Low	B0 Connected to A
High	B1 Connected to A

Specifications

Absolute Maximum Ratings (1)

Parameter		Min	Max	Unit
	Supply Voltage, V_{CC}	−0.5	6	V
	Select Input Voltage	−0.5	6	V
	Select Input Diode Current	−50		mA
	Switch I/O Port Voltage	−0.5	V_{CC} + 0.5	V
	Switch I/O Port Diode Current	−50	50	mA
	Switch Current		100	mA
T_J	Maximum Operating Junction Temperature		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.

ESD, Electrostatic Discharge Protection

Symbol	Parameter	Condition	Minimum Level	Unit
HBM	Human Body Model ESD	ANSI/ESDA/JEDEC JS-001 (1)	3.5	kV
CDM	Charged Device Model ESD	ANSI/ESDA/JEDEC JS-002 (2)	1.5	kV
LU	Latch Up	JESD 78, 25°C	600	mA
		JESD 78, 125°C	600	mA

(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
SOT363-6	400	100	°C/W

Recommended Operating Conditions (1)

Over operating temperature range.

Parameter		Min	Typ	Max	Unit
	Supply Voltage, V_{CC}	1.65		5.5	V
	Select Input Voltage	0		V_{CC}	V
	Input Transition Rise and Fall Rate of Select Pin			100	ns/V
	Switch I/O Port Voltage	0		V_{CC}	V

Parameter		Min	Typ	Max	Unit
	Operating Temperature Range	−40		125	°C

(1) The select input must be held high or low and it must not float.

Electrical Characteristics

All test conditions: V_{CC} = 4.5 V to 5.5 V, unless otherwise noted.

Symbol	Parameter	Conditions	V_{CC} (V)	25°C	−40 to 85°C	25 to 125°C	−40 to 125°C	Limit	Unit
Power Supply									
I_{CC}	Quiescent Supply Current	V_{IN} = 0 V or V_{CC}	5.5	0.3	0.5		1.5	Max	μA
ΔI_{CC}	Increase in I_{CC} per Input	Select Input at 1.8 V, others at V_{CC} or GND	5.5	50				Max	μA
Digital Input									
V_{IH}	Input Voltage High		5		1.42	1.35	1.42	Min	V
V_{IL}	Input Voltage Low		5		0.7	0.7	0.7	Max	V
I_{IN}	Control Input Leakage	V_{IN} = 0 V or V_{CC}	5.5	±50	±500		±1000	Max	nA
Analog Switch									
R_{ON} (1)	ON Resistance	I_{OUT} = 50 mA, B_0 or B_1 = 3.5 V	4.5	4				Typ	Ω
R_{ON}	ON Resistance	I_{OUT} = 50 mA, B_0 or B_1 = 3.5 V	4.5	4.8	6		6	Max	Ω
ΔR_{ON}	Maximum ON resistance	I_{OUT} = 50 mA, B_0 or B_1 = 3.5 V	4.5	0.5	0.8		0.8	Max	Ω
$R_{FLAT (ON)}$	On Resistance Flatness	I_{OUT} = 50 mA, B_0 or B_1 = 0 V, 1 V, 3.5 V	4.5	1.2	2		2	Max	Ω
$I_{NO (OFF)}$, $I_{NC (OFF)}$	Switch OFF Leakage Current on B_0, B_1	A = 1 V, 4.5 V, B_0 or B_1 = 4.5 V, 1 V	5.5	±10	±25		±50	Max	nA
$I_{A (OFF)}$	Switch OFF Leakage Current on A	A = 1 V, 4.5V, B_0 or B_1 = 4.5 V, 1 V	5.5	±10	±50		±100	Max	nA
$I_{A (ON)}$	Switch ON Leakage Current on A	A = 1 V, 4.5 V, B_0 or B_1 = 1 V, 4.5 V or Floating	5.5	±10	±50		±100	Max	nA
Dynamic Characteristics									
t_{PHL} (1), t_{PLH} (1)	Switch IN to OUT Time	B_0 or B_1 = 3 V,R_L = 50 Ω, C_L = 100 pF, Figure 4	4.75	5				Typ	ns
t_{ON}	Switch Turn-on Time	B_0 or B_1 = 3 V, R_L = 50 Ω, C_L = 100 pF, Figure 4	4.75	85	100		100	Max	ns
t_{OFF}	Switch Turn-off Time	B_0 or B_1 = 3 V, R_L = 50 Ω, C_L = 100 pF, Figure 4	4.75	85	100		100	Max	ns
t_B (1)	Break Before Make Time	B_0 or B_1 = 3 V, R_L = 50 Ω, C_L = 100 pF, Figure 5	4.75	50				Typ	ns

Symbol	Parameter	Conditions	V_{CC} (V)	25°C	−40 to 85°C	25 to 125°C	−40 to 125°C	Limit	Unit
Q (1)	Charge Injection	C_L = 1.0 nF, V_{GEN} = 0 V, R_{GEN} = 0 Ω, Figure 6	5	20				Typ	pC
	OFF-Isolation (1)	f = 1 MHz, R_L = 50 Ω, Figure 7	5	−65				Typ	dB
	Crosstalk (1)	f = 1 MHz, R_L = 50 Ω, Figure 8	5	−65				Typ	dB
BW (1)	Bandwidth	R_L = 50 Ω	5	250				Typ	MHz
THD (1)	Total Harmonic Distortion	R_L = 600 Ω, V_{IN} = 0.5 V_{PP}, f = 20 Hz to 20 kHz	5	0.004				Typ	%
Capacitance									
C_{IN} (1)	Select Input Capacitance		5	5				Typ	pF
C_{OFF} (1)	B-Port Off Capacitance		5	12				Typ	pF
C_{ON} (1)	ON Capacitance		5	40				Typ	pF

(1) Provided by bench test and design simulation

All test conditions: V_{CC} = 2.7 V to 3.6 V, unless otherwise noted.

Symbol	Parameter	Conditions	V_{CC} (V)	25°C	−40 to 85°C	−40 to 125°C	Limit	Unit
Power Supply								
I_{CC}	Quiescent Supply Current	V_{IN} = 0 V or V_{CC}	3.6	0.3	0.5	1.5	Max	μA
Digital Input								
V_{IH}	Input Voltage High				1.35	1.35	Min	V
V_{IL}	Input Voltage Low				0.3	0.3	Max	V
I_{IN}	Control Input Leakage	V_{IN} = 0 V or V_{CC}	3.6		±1	±1	Max	μA
Analog Switch								
R_{ON} (1)	ON Resistance	I_{OUT}= 10 mA, B_0 or B_1 = 1.5 V	2.7	10			Typ	Ω
R_{ON}	ON Resistance	I_{OUT}= 10 mA, B_0 or B_1 = 1.5 V	2.7	15	20	20	Max	Ω
ΔR_{ON}	Maximum ON resistance	I_{OUT}= 10 mA, B_0 or B_1 = 1.5 V	2.7	2	4	4	Max	Ω
$R_{FLAT(ON)}$	On Resistance Flatness	I_{OUT} = 10 mA, B_0 or B_1 = 0 V, 0.75 V, 1.5 V	2.7	8	10	10	Max	Ω
$I_{NO(OFF)}$, $I_{NC(OFF)}$	Switch OFF Leakage Current on B_0, B_1	A = 0 V, 3.6 V, B_0 or B_1 = 3.6 V, 0 V	3.6	±10	±25	±50	Max	nA
$I_{A(OFF)}$	Switch OFF Leakage Current on A	A = 0 V, 3.6 V, B_0 or B_1 = 3.6 V, 0 V	3.6	±10	±50	±100	Max	nA
$I_{A(ON)}$	Switch ON Leakage Current on A	A = 0 V, 3.6 V, B_0 or B_1 = 0 V, 3.6 V or Floating	3.6	±10	±50	±100	Max	nA
Dynamic Characteristics								
t_{PHL} (1), t_{PLH} (1)	Switch IN to OUT Time	B_0 or B_1 = 2.5 V, R_L = 50 Ω, C_L = 100 pF, Figure 4	2.7	10			Typ	ns
t_{ON}	Switch Turn-on Time	B_0 or B_1 = 2.5 V, R_L = 50 Ω, C_L = 100 pF, Figure 4	2.7	200	220	220	Max	ns
t_{OFF}	Switch Turn-off Time	B_0 or B_1 = 2.5 V, R_L = 50 Ω, C_L = 100 pF, Figure 4	2.7	200	220	220	Max	ns
t_B (1)	Break Before Make Time	B_0 or B_1 = 2.5 V, R_L = 50 Ω, C_L = 100 pF, Figure 5	2.7	50			Typ	ns
Q (1)	Charge Injection	C_L = 1.0 nF, V_{GEN} = 0 V, R_{GEN} = 0 Ω, Figure 6	3	20			Typ	pC
	OFF-Isolation	f = 1 MHz, R_L = 50 Ω, Figure 7	3	−65			Typ	dB
	Crosstalk	f = 1 MHz, R_L = 50 Ω, Figure 8	3	−65			Typ	dB
BW (1)	Bandwidth	R_L = 50 Ω	3	250			Typ	MHz
THD (1)	Total Harmonic Distortion	R_L = 600 Ω, V_{IN} = 0.5 V_{PP}, f = 20 Hz to 20 kHz	3	0.01			Typ	%

(1) Provided by bench test and design simulation

Typical Performance Characteristics

All test conditions: V_{CC} = 5 V, unless otherwise noted.

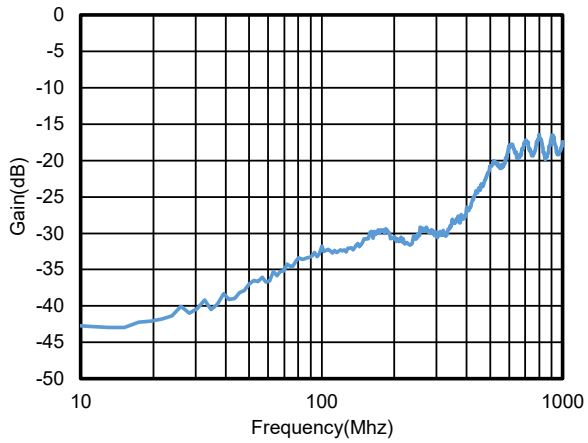


Figure 1. Off-Isolation, V_{CC} = 5 V

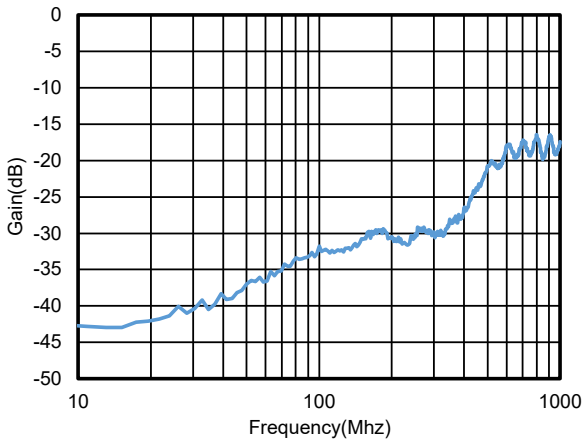


Figure 2. Crosstalk, V_{CC} = 5 V

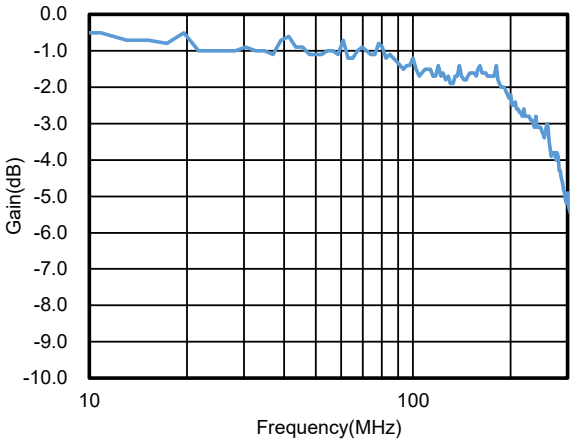


Figure 3. Bandwidth, V_{CC} = 5 V

Test Circuit and Waveforms

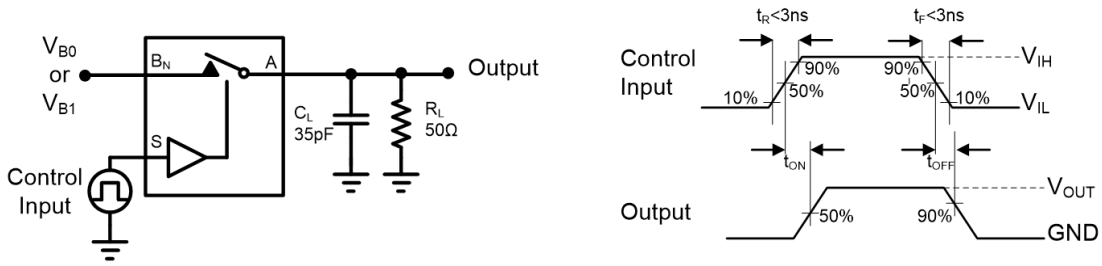


Figure 4. AC Circuit and Test Waveforms

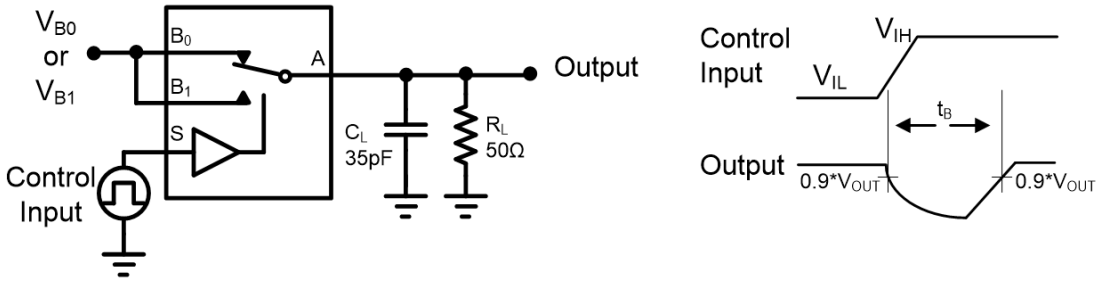


Figure 5. Switch Break Time

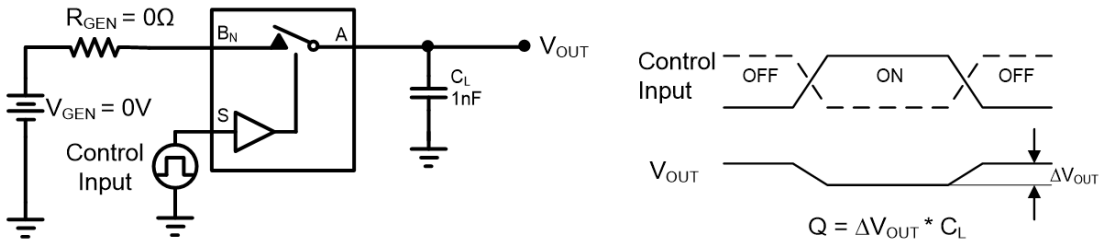


Figure 6. Charge Injection

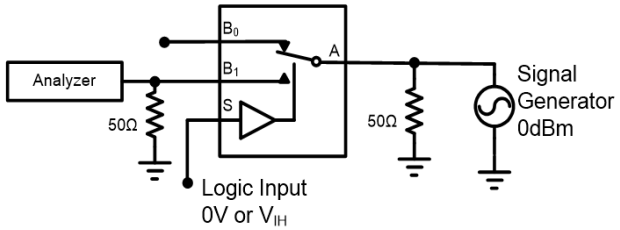


Figure 7. Off Isolation

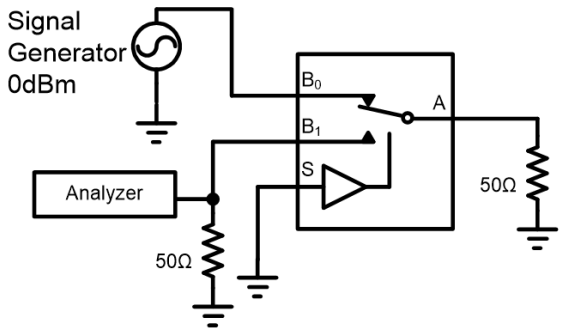


Figure 8. Crosstalk

Application and Implementation

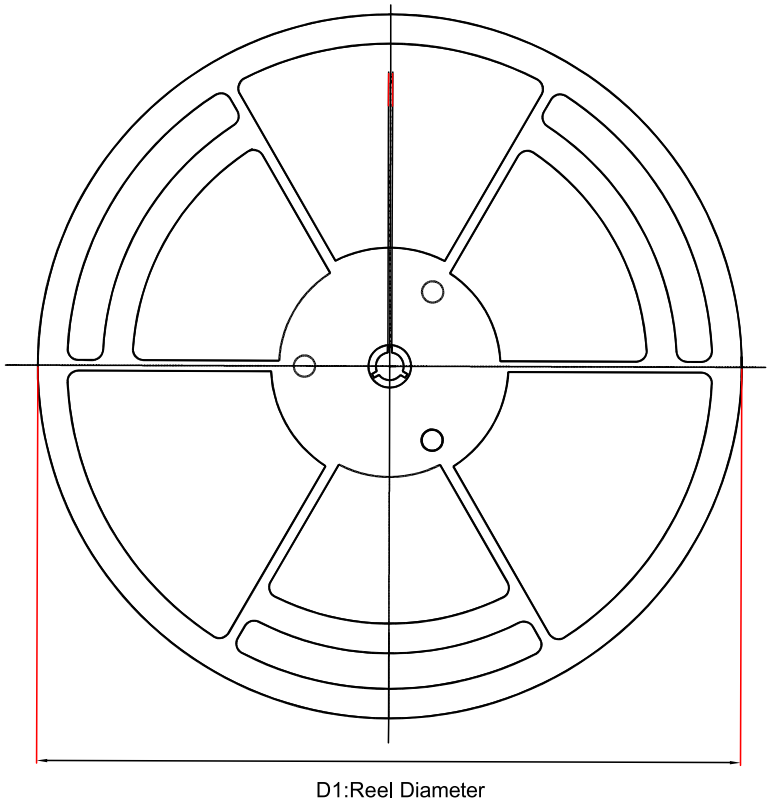
Note

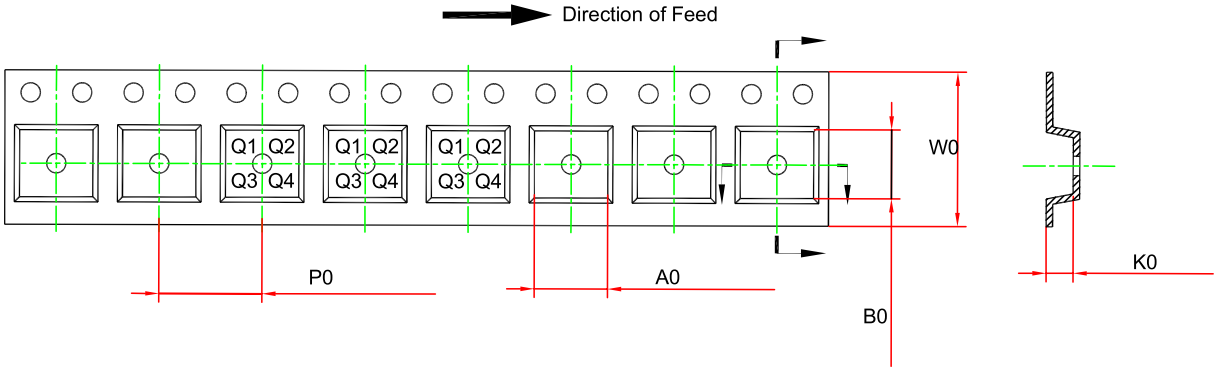
Information in the following application sections is not part of the 3PEAK's component specification and 3PEAK does not warrant its accuracy or completeness. 3PEAK's customers are responsible for determining suitability of components for their purposes. Customers should validate and test their design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

Application Information

A 0.1-μF bypass capacitor on V_{CC} and GND is recommended to prevent power disturbance.

Tape and Reel Information



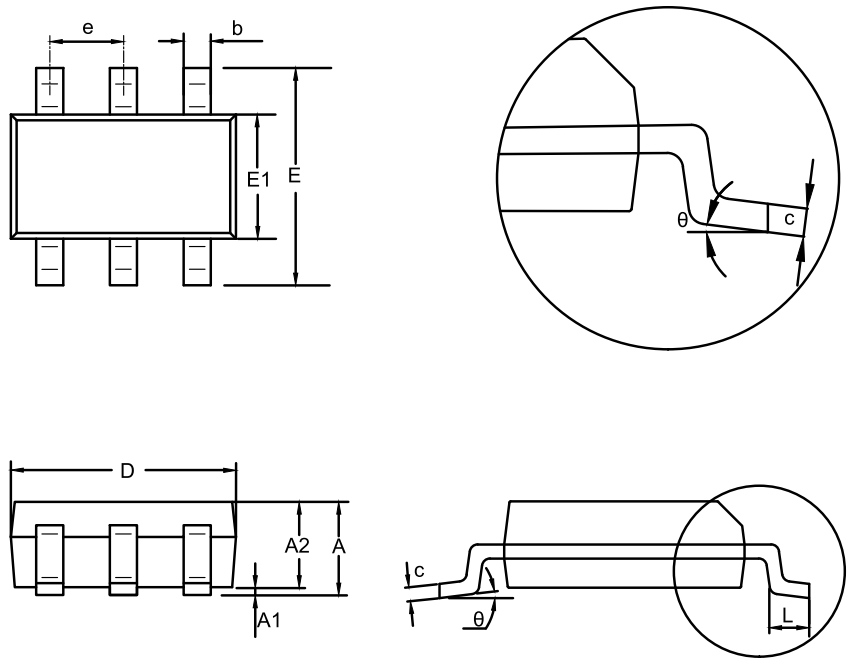


Order Number	Package	D1 (mm)	W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	W0 (mm)	Pin1 Quadrant
TPW3125L1-SC6R-S	SOT363-6	178.0	12.1	2.4	2.5	1.2	4.0	8.0	Q3

Package Outline Dimensions

SOT363-6

Package Outline Dimensions SC6(SOT363-6-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	0.080	0.230	0.003	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
TPW3125L1-SC6R-S	−40 to 125°C	SOT363-6	W25	1	Tape and Reel, 3000	Green

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

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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.

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