Low-Voltage 4-Ω SPST 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 Time: t_{ON} = 85 ns, t_{OFF} = 85 ns
- Break-Before-Make Switching
- Operating Temperature Range: –40°C to 125°C

Applications

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

Description

The TPW3115 is a high-performance Single Pole/Single Throw (SPST) analog switch. The device features low R_{ON} of 4 Ω maximum at 4.5 V V_{CC} and operates over a wide V_{CC} range from 1.65 V to 5.5 V.

The TPW3115 features very low quiescent current even when the control voltage is lower than the V_{CC} supply. This feature serves 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 the select input when the V_{CC} supply is within the range from 4.75 V to 5.25 V.

The TPW3115 is available in the SOT23-5 and SOT353 (SC70-5) packages, and characterized from –40°C to +125°C.

Table of Contents

Revision History

Date	Revision	Notes
2019-05-01	Rev.Pre.0	Initial version.
2019-11-09	Rev.Pre.1	Pre-released version.
2020-06-28	Rev.A.0	Updated the condition of ΔI_{CC} to test setup in Electrical Characteristics on Page 7. Corrected the typo of ΔR_{ON} in Electrical Characteristics (Continued) on Page 9.
2022-08-04	Rev.A.1	Updated the package name from SC70-5 to SOT353.
2024-12-12	Rev.A.2	Updated to a new datasheet format. The following updates are all about the new datasheet formats or typos, and the actual product remains unchanged. Updated to a new datasheet format. Updated the Tape and Reel Information.

Pin Configuration and Functions

TPW3115
SOT353 (SC70-5)/SOT23-5
Top View

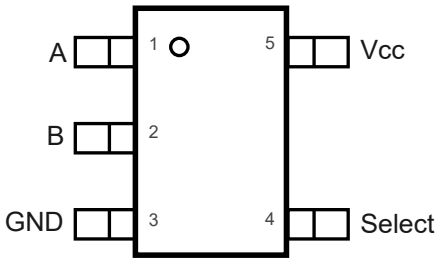


Table 1. Pin Functions: TPW3115

Pin No.	Name	I/O	Description
1	A		Switch port 1
2	B		Switch port 2
3	GND		Ground
4	Select		Select pin
5	V_{CC}		Power supply

Table 2. Function Table

Input: Select Pin	Function
Low	Switch Off
High	Switch On

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 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.

Recommended Operating Conditions (1)

All test conditions: over operating temperature range, unless otherwise noted.

Parameter		Min	Max	Unit
	Supply Voltage, V_{CC}	1.65	5.5	V
	Select Input Voltage	0	V_{CC}	V
	Input Transition Rise-and-Fall Rate		100	ns/V
	Switch I/O Port Voltage	0	V_{CC}	V
T_A	Operating Temperature Range	–40	125	°C

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

Thermal Information

Package Type	θ_{JA}	θ_{JC}	Unit
SOT353 (SC70-5)	400	100	°C/W
SOT23-5	250	81	°C/W

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°C to 85°C	−40°C 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		1.5	1.5	Min	V
V_{IL}	Input Voltage Low		5		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}		I_{OUT} = 50 mA, B = 3.5 V	4.5	4			Typ	Ω
			4.5	4.8	6	6	Max	Ω
$R_{FLAT(ON)}$	On Resistance Flatness	I_{OUT} = 50 mA, B = 0 V, 1 V, 3.5 V	4.5	1.2	2	2	Max	Ω
$I_{(OFF)}$	Switch OFF Leakage Current	A = 1 V, 4.5 V, B = 4.5 V, 1 V	5.5	±10	±50	±100	Max	nA
$I_{(ON)}$	Switch ON Leakage Current	A = 1 V, 4.5 V, B = 1 V, 4.5 V, or floating	5.5	±10	±50	±100	Max	nA
Dynamic Characteristics								
t_{PHL}, t_{PLH}	Switch IN to OUT Time	B = 3 V, R_L = 50 Ω, C_L = 100 pF, Figure 3	4.75	5			Typ	ns
t_{ON}	Switch Turn-on Time	B = 3 V, R_L = 50 Ω, C_L = 100 pF, Figure 3	4.75	85	100	100	Max	ns
t_{OFF}	Switch Turn-off Time	B = 3 V, R_L = 50 Ω, C_L = 100 pF, Figure 3	4.75	85	100	100	Max	ns
Q	Charge Injection	C_L = 1.0 nF, V_{GEN} = 0 V, R_{GEN} = 0 Ω, Figure 4	5	20			Typ	pC
	Off Isolation	f = 1 MHz, R_L = 50 Ω, Figure 5	5	−65			Typ	dB
BW	Bandwidth	R_L = 50 Ω	5	250			Typ	MHz
THD	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}	Select Input capacitance		5	5			Typ	pF
C_{OFF}	B-Port Off capacitance		5	12			Typ	pF

Symbol	Parameter	Conditions	V_{CC} (V)	25°C	−40°C to 85°C	−40°C to 125°C	Limit	Unit
C_{ON}	On Capacitance		5	40			Typ	pF

Electrical Characteristics (Continued)

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

Symbol	Parameter	Conditions	V_{CC} (V)	25°C	−40°C to 85°C	−40°C 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}		I_{OUT} = 10 mA, B = 1.5 V	2.7	10			Typ	Ω
			2.7	15	20	20	Max	Ω
ΔR_{ON}	Maximum On Resistance	I_{OUT} = 10 mA, B = 1.5 V	2.7	2	4	4	Max	Ω
$R_{FLAT(ON)}$	On Resistance Flatness	I_{OUT} = 10 mA, B = 0 V, 0.75 V, 1.5 V	2.7	8	10	10	Max	Ω
$I_{(OFF)}$	Switch OFF Leakage Current	A = 0 V, 3.6 V, B = 3.6 V, 0 V	3.6	±10	±50	±100	Max	nA
$I_{(ON)}$	Switch ON Leakage Current	A = 0 V, 3.6 V, B = 0 V, 3.6 V, or floating	3.6	±10	±50	±100	Max	nA
Dynamic Characteristics								
t_{PHL}, t_{PLH}	Switch IN to OUT Time	B = 2.5 V, R_L = 50 Ω, C_L = 100 pF, Figure 3	2.7	10			Typ	ns
t_{ON}	Switch Turn-on Time	B = 2.5 V, R_L = 50 Ω, C_L = 100 pF, Figure 3	2.7	200	220	220	Max	ns
t_{OFF}	Switch Turn-off Time	B = 2.5 V, R_L = 50 Ω, C_L = 100 pF, Figure 3	2.7	200	220	220	Max	ns
Q	Charge Injection	C_L = 1.0 nF, V_{GEN} = 0 V, R_{GEN} = 0 Ω, Figure 4	3	20			Typ	pC
	Off Isolation	f = 1 MHz, R = 50 Ω, Figure 5	3	−65			Typ	dB
BW	Bandwidth	R_L = 50 Ω	3	250			Typ	MHz
THD	Total Harmonic Distortion	R_L = 600 Ω, V_{IN} = 0.5 V_{PP}, f = 20 Hz to 20 kHz	3	0.01			Typ	%

Typical Performance Characteristics

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

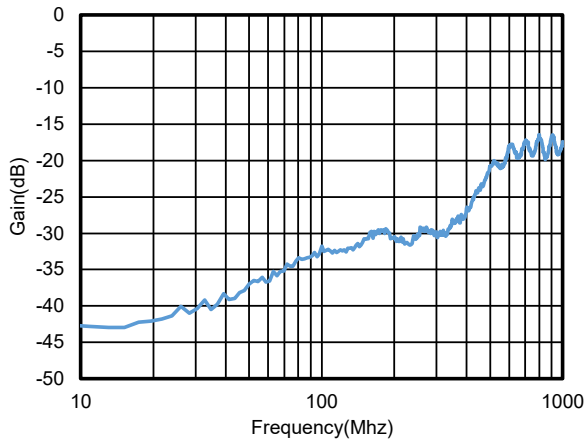


Figure 1. Off Isolation, V_{CC} = 5 V

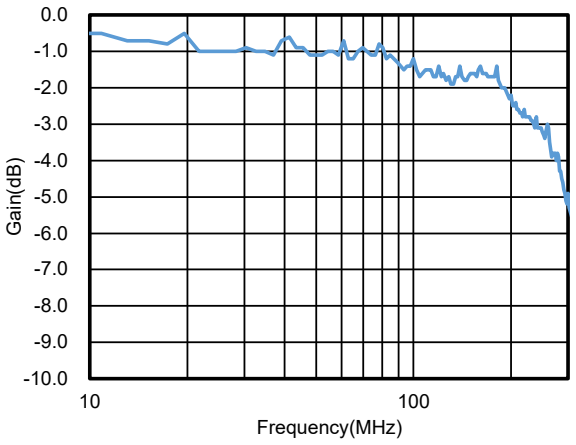


Figure 2. Bandwidth, V_{CC} = 5 V

Test Circuit and Waveforms

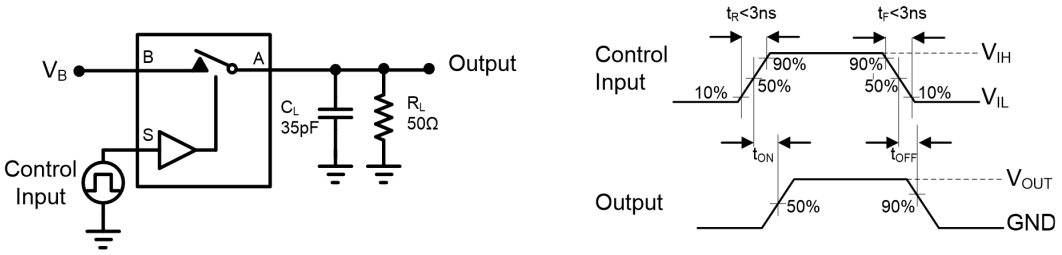


Figure 3. AC Test Circuit and Test Waveforms

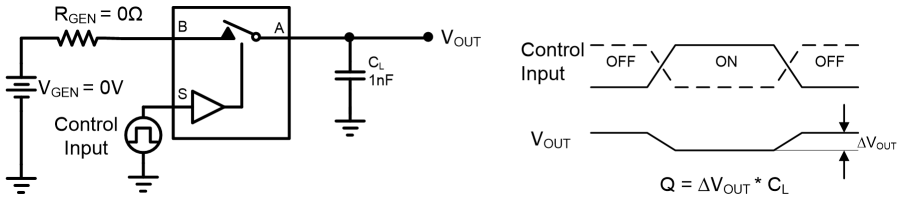


Figure 4. Charge Injection

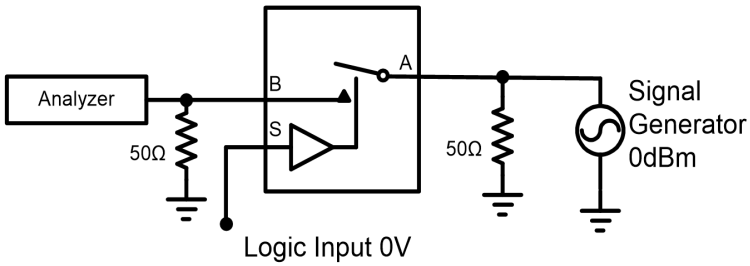


Figure 5. Off Isolation

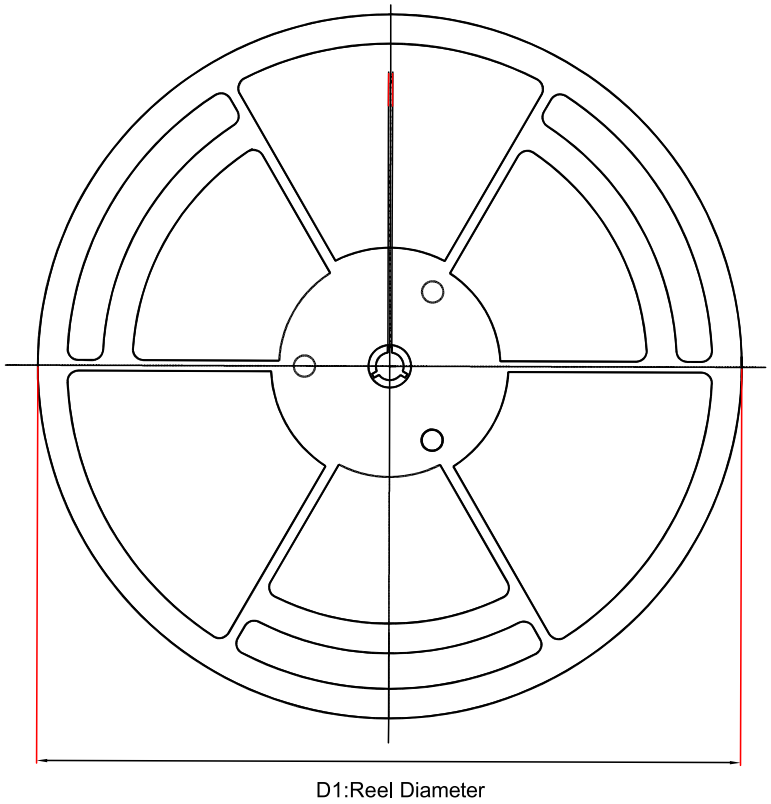
Application and Implementation

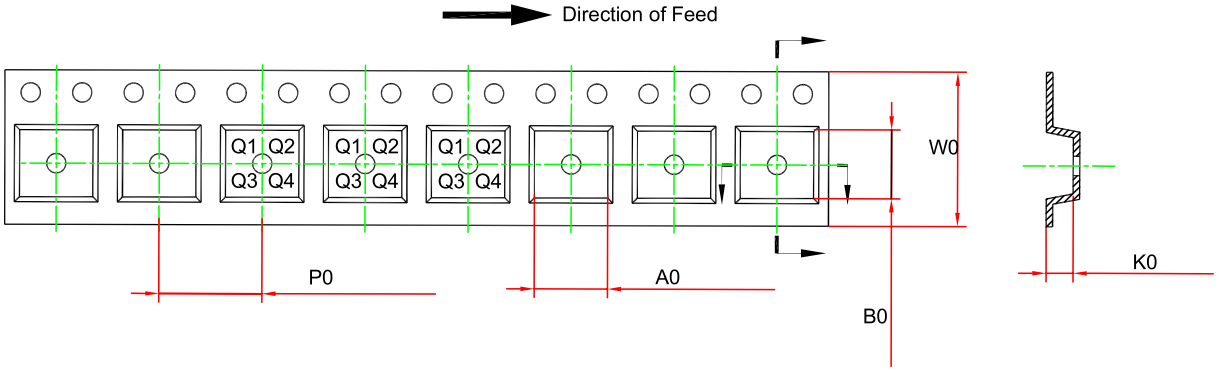
> Note
>
> Information in the following application sections is not part of the 3PEAK's component specification and 3PEAK does not warrant its accuracy or completeness. 3PEAK's customers are responsible for determining suitability of components for their purposes. Customers should validate and test their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





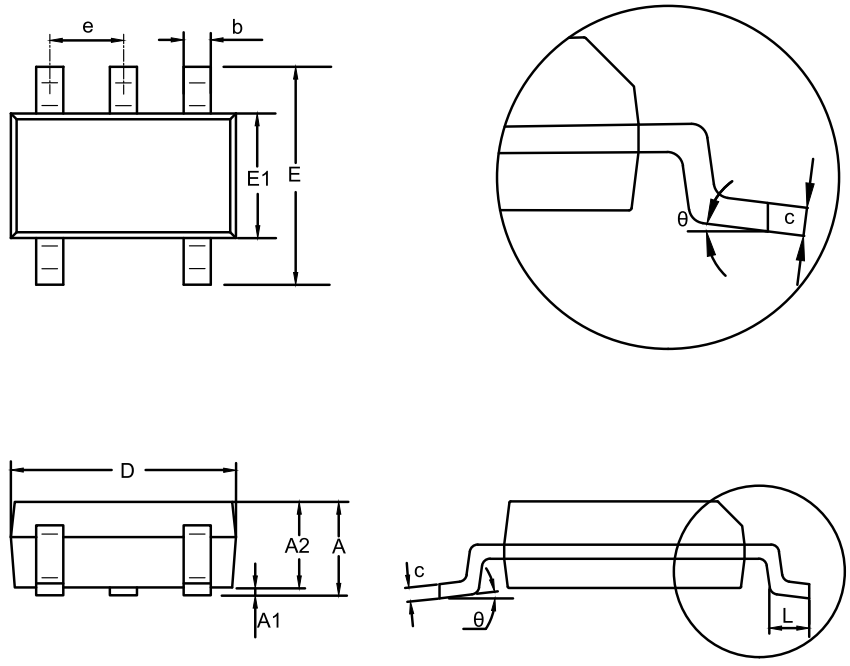
Order Number	Package	D1 (mm)	W1 (mm)	A0 (mm) (1)	B0 (mm) (1)	K0 (mm) (1)	P0 (mm)	W0 (mm)	Pin1 Quadrant
TPW3115-SC5R	SOT353 (SC70-5)	178	12.1	2.4	2.5	1.2	4	8	Q3
TPW3115-S5TR	SOT23-5	180	12	3.3	3.25	1.4	4	8	Q3

(1) The value is for reference only. Contact the 3PEAK factory for more information.

Package Outline Dimensions

SOT353 (SC70-5)

Package Outline Dimensions SC5(SOT353-5-A)



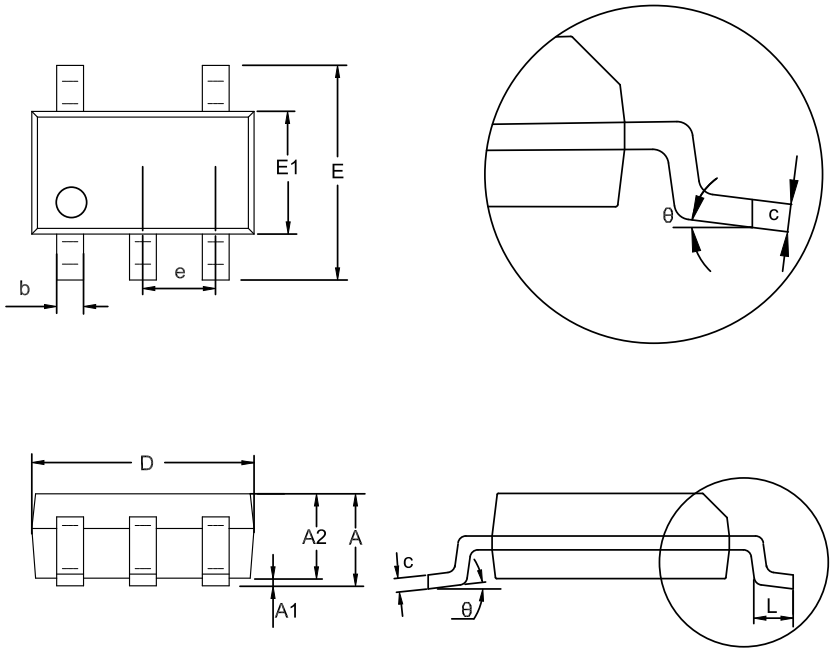
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.850	1.100	0.033	0.043
A1	0.000	0.100	0.000	0.004
A2	0.800	1.000	0.031	0.039
b	0.150	0.350	0.006	0.014
c	0.110	0.230	0.004	0.009
D	2.000	2.200	0.079	0.087
E	2.150	2.450	0.085	0.096
E1	1.150	1.350	0.045	0.053
e	0.650 BSC		0.026 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.

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.

Order Information

Order Number	Operating Temperature Range	Package	Marking Information	MSL	Transport Media, Quantity	Eco Plan
TPW3115-S5TR	−40 to 125°C	SOT23-5	W15XX (1)	3	Tape and Reel, 3000	Green
TPW3115-SC5R	−40 to 125°C	SOT353 (SC70-5)	W15XX (1)	3	Tape and Reel, 3000	Green

(1) "XX" identifies the manufacturing information.

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

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