

12-V 4:1 General Purpose Analog Switch

Features

- Analog Switch Voltage: 3.3 V, 5 V, 10 V
- Low On-State Resistance:
 - Typical 50 Ω at Vs = 9 V
 - Typical 60 Ω at Vs = 4.5 V
 - Typical 300 Ω at Vs = 3 V
- Bandwidth: 200 MHz
- Fast Switching Times: t_{ON} = 60 ns, t_{OFF} = 50 ns
- Break-Before-Make Switching
- Operation Temperature Range: -40°C to 125°C

Applications

- Industry Control Systems
- Battery-Powered Systems
- Audio Signal Routing
- Instrumentation

Description

The TPW4054 is a single-pole four-throw (SP4T) analog switch, suitable for use in analog or digital 4:1 multiplexer/demultiplexer applications. The switch features two digital select inputs (S0, S1), four independent inputs/outputs (An), a common input/output (A), and a digital enable input (\bar{E}). When \bar{E} is high, the switch is turned off.

The device is designed on an enhanced process that provides lower power dissipation and high switching speed. The device operates equally well as either a multiplexer or de-multiplexer, and has an input range that extends to the supplies. All channels exhibit break-before-make switching action, preventing momentary shorting when switching channels.

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TPW4054

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Switch Selection Guide

Product	Switch Configuration	Supply Voltage (V)	R _{ON} (Ω)	Bandwidth (MHz)	Package
TPW4051	8:1	12	50	200	SOP16, TSSOP16, QFN16
TPW4052	(4:1) × 2	12	50	200	SOP16, TSSOP16
TPW4053	(2:1) × 3	12	50	200	SOP16, TSSOP16
TPW4054	4:1	12	50	200	MSOP10
TPW4066	(1:1) × 4	12	50	200	SOP14, TSSOP14
TPW3111	1:1	5.5	1	100	SOT353 (SC70-5)
TPW3115	1:1	5.5	5	250	SOT353 (SC70-5), SOT23-5
TPW4157	2:1	5.5	1	100	SOT363 (SC70-6)
TPW3157A	2:1	5.5	2	100	SOT363 (SC70-6)
TPW3221	(2:1) × 2	5.5	1	100	MSOP10
TPW3223	(2:1) × 2	5.5	1	100	QFN1.4X1.8-10

Revision History

Date	Revision	Notes
2019-12-25	Rev.Pre.0	Pre-released version.
2020-03-31	Rev.A.0	Initial version.
2024-12-04	Rev.A.1	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. Updated the Package Outline Dimensions.

Pin Configuration and Functions

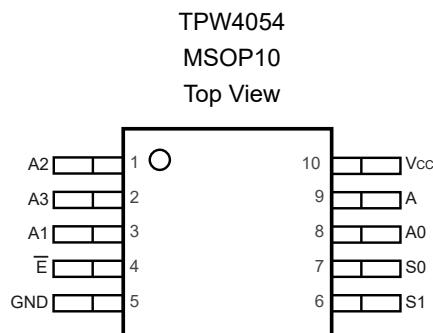


Table 1. Pin Functions: TPW4054

Pin No.	Name	I/O	Description
1	A2	I/O	Channel 2 input or output.
2	A3	I/O	Channel 3 input or output.
3	A1	I/O	Channel 1 input or output.
4	E-bar	I	Enable switch, active low.
5	GND		Ground.
6	S1	I	Control input.
7	S0	I	Control input.
8	A0	I/O	Channel 0 input or output.
9	A	I/O	Common input or output.
10	Vcc		Power input.

Table 2. Functional Table

E-bar, Enable	S1	S0	ON Channel
L	L	L	A0
L	L	H	A1
L	H	L	A2
L	H	H	A3
H	X	X	None

(1) X = Don't care. NA = Not available.

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Specifications

Absolute Maximum Ratings (1)

Parameter		Min	Max	Unit
	Supply Voltage, V _{CC} – GND	-0.5	13	V
	Analog Switch Voltage	-0.5	V _{CC} + 0.5	V
	Analog Switch Current	-25	25	mA
	Analog Switch Diode Current	-20	20	mA
	Digital Input Voltage: Ē, S ₂ , S ₁ , S ₀	GND	V _{CC} + 0.5	V
	Digital Input Diode Current	-20	20	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⁾	1	kV
CDM	Charged Device Model ESD	ANSI/ESDA/JEDEC JS-002 ⁽²⁾	1	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 (1)

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

Parameter		Min	Max	Unit
	Supply Voltage, V _{CC}	3	12	V
	Select Input Voltage	0	V _{CC}	V
	Input Transition Rise-and-Fall Rate		100	ns/V
	Switch I/O Port Voltage	GND	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.

12-V 4:1 General Purpose Analog Switch**Thermal Information**

Package Type	θ_{JA}	θ_{JC}	Unit
SOP16	100	50	°C/W
TSSOP16	150	60	°C/W

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Electrical Characteristics

All test conditions: single supply, $V_{CC} = 4.5\text{ V}$ to 5.5 V , GND = 0 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	$V_{IN} = 0\text{ V}$ or V_{CC}	5.5	4	6	8	Max	μA
Digital Input								
V_{IH}	Input Voltage High				2.0	2.0	Min	V
V_{IL}	Input Voltage Low				0.8	0.8	Max	V
I_{IN}	Control Input Leakage	$V_{IN} = 0\text{ V}$ or V_{CC}	5.5	± 0.4	± 1	± 1	Max	μA
Analog Switch								
R_{ON}		$I_{OUT} = 1\text{ mA}$, $V_{IS} = \text{GND or } V_{CC}$	4.5	60			Typ	Ω
R_{ON}		$I_{OUT} = 1\text{ mA}$, $V_{IS} = \text{GND or } V_{CC}$	4.5	100	130	150	Max	Ω
ΔR_{ON}	On Resistance Match between Channels	$I_{OUT} = 1\text{ mA}$, $V_{IS} = 2.5\text{ V}$	4.5	20	30	35	Max	Ω
$R_{FLAT(ON)}$	On Resistance Flatness	$I_{OUT} = 1\text{ mA}$	4.5	60	80	80	Max	Ω
$I_{CH(OFF)}$	Switch OFF Leakage Current on Channel	$V_{IS} = \text{GND}$, $V_{OS} = V_{CC}$, or $V_{IS} = V_{CC}$, $V_{OS} = \text{GND}$	5.5	± 0.4	± 1	± 1	Max	μA
$I_{COM(OFF)}$	Switch OFF Leakage Current on Common	$V_{IS} = \text{GND}$, $V_{OS} = V_{CC}$, or $V_{IS} = V_{CC}$, $V_{OS} = \text{GND}$	5.5	± 0.4	± 2	± 2	Max	μA
$I_{(ON)}$	Switch ON Leakage Current	$V_{IS} = \text{GND or } V_{CC}$	5.5	± 0.4	± 2	± 2	Max	μA
Dynamic Characteristics								
t_{PHL}, t_{PLH}	Switch IN to OUT Time	$C_L = 50\text{ pF}$	4.5	5			Typ	ns
t_{ON}	Switch Turn-on Time	$C_L = 50\text{ pF}$	4.5	60			Max	ns
t_{OFF}	Switch Turn-off Time	$C_L = 50\text{ pF}$	4.5	50			Max	ns
	OFF-Isolation	$f = 1\text{ MHz}$, $R_L = 50\text{ }\Omega$, $C_L = 10\text{ pF}$	5	-70			Typ	dB
	Crosstalk in Channel	$f = 1\text{ MHz}$, $R_L = 50\text{ }\Omega$, $C_L = 10\text{ pF}$	5	-70			Typ	dB
	Crosstalk in Control	Between control and any switch; $R_L = 600\text{ }\Omega$; $f = 1\text{ MHz}$; E or Sn square wave between V_{CC} and GND	5	110			Typ	mV
BW	Bandwidth	$R_L = 50\text{ }\Omega$	5	200			Typ	MHz
THD	Total Harmonic Distortion	$R_L = 10\text{ k}\Omega$, $f = 1\text{ kHz}$	5	0.05			Typ	%

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Symbol	Parameter	Conditions	V _{cc} (V)	25°C	-40°C to 85°C	-40°C to 125°C	Limit	Unit
Capacitance								
C _{IN}	Switch Input Capacitance		5	5			Typ	pF
C _{COM}	Common Output Capacitance		5	12			Typ	pF
C _{PD}	Power Dissipation Capacitance		5	50			Typ	pF

12-V 4:1 General Purpose Analog Switch
Electrical Characteristics (Continued)

All test conditions: single supply, $V_{CC} = 3\text{ V}$ to 3.6 V , GND = 0 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	$V_{IN} = 0\text{ V}$ or V_{CC}	3.6	4	6	8	Max	μA
Digital Input								
V_{IH}	Input Voltage High				2.0	2.0	Min	V
V_{IL}	Input Voltage Low				0.8	0.8	Max	V
I_{IN}	Control Input Leakage	$V_{IN} = 0\text{ V}$ or V_{CC}	3.6		± 1	± 1	Max	μA
Analog Switch								
R_{ON}		$I_{OUT} = 1\text{ mA}$, $V_{IS} = \text{GND or } V_{CC}$	3	300			Typ	Ω
$R_{FLAT(ON)}$	On Resistance Flatness	$I_{OUT} = 1\text{ mA}$	3	100			Typ	Ω
$I_{CH(OFF)}$	Switch OFF Leakage Current on Channel	$V_{IS} = \text{GND}$, $V_{OS} = V_{CC}$, or $V_{IS} = V_{CC}$, $V_{OS} = \text{GND}$	3.6	± 0.4	± 1	± 1	Max	μA
$I_{COM(OFF)}$	Switch OFF Leakage Current on Common	$V_{IS} = \text{GND}$, $V_{OS} = V_{CC}$, or $V_{IS} = V_{CC}$, $V_{OS} = \text{GND}$	3.6	± 0.4	± 2	± 2	Max	μA
$I_{(ON)}$	Switch ON Leakage Current	$V_{IS} = \text{GND or } V_{CC}$	3.6	± 0.4	± 2	± 2	Max	μA
Dynamic Characteristics								
t_{PHL}, t_{PLH}	Switch IN to OUT Time	$C_L = 50\text{ pF}$	3	5			Typ	ns
t_{ON}	Switch Turn-on Time	$C_L = 50\text{ pF}$	3	70			Max	ns
t_{OFF}	Switch Turn-off Time	$C_L = 50\text{ pF}$	3	60			Max	ns
	OFF-Isolation	$f = 1\text{ MHz}$, $R_L = 50\text{ }\Omega$, $C_L = 10\text{ pF}$	3.3	-70			Typ	dB
	Crosstalk	$f = 1\text{ MHz}$, $R_L = 50\text{ }\Omega$, $C_L = 10\text{ pF}$	3.3	-70			Typ	dB
	Crosstalk in Control	Between control and any switch; $R_L = 600\text{ }\Omega$; $f = 1\text{ MHz}$; E or Sn square wave between V_{CC} and GND	3.3	110			Typ	mV
BW	Bandwidth	$R_L = 50\text{ }\Omega$	3.3	100			Typ	MHz
THD	Total Harmonic Distortion	$R_L = 10\text{ k}\Omega$, $f = 1\text{ kHz}$	3.3	0.2			Typ	%
Capacitance								
C_{IN}	Switch Input Capacitance		3.3	5			Typ	pF
C_{COM}	Common Output Capacitance		3.3	12			Typ	pF

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Symbol	Parameter	Conditions	V _{cc} (V)	25°C	-40°C to 85°C	-40°C to 125°C	Limit	Unit
C _{PD}	Power Dissipation Capacitance		3.3	50			Typ	pF

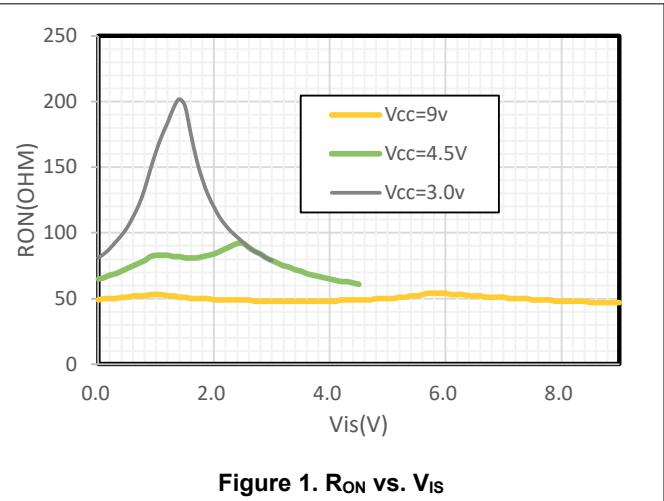
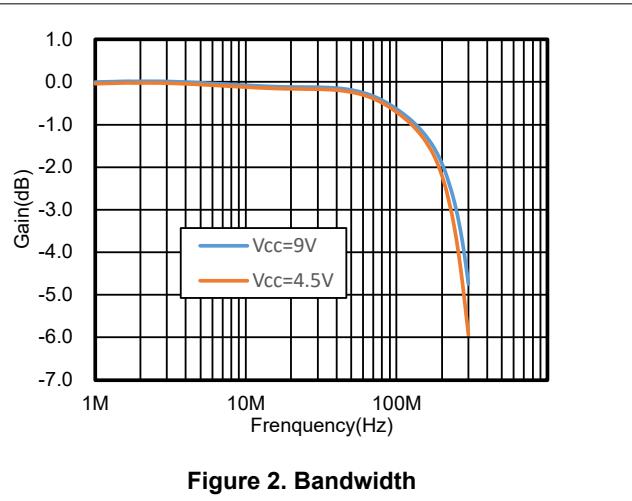
12-V 4:1 General Purpose Analog Switch
Electrical Characteristics (Continued)

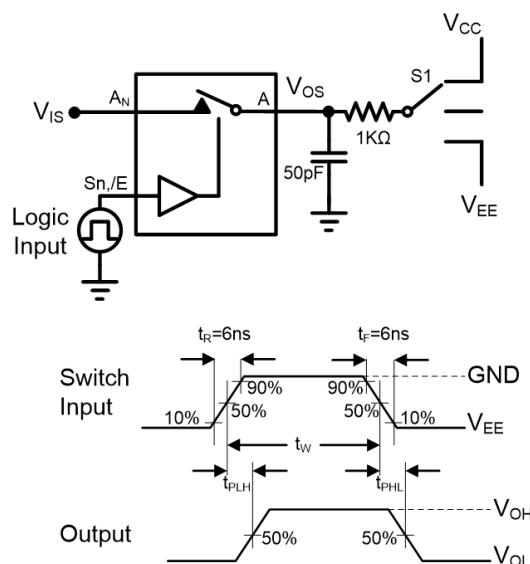
All test conditions: single supply, $V_{CC} = 9\text{ V}$ to 11 V , GND = 0 V, unless otherwise noted.

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	$V_{IN} = 0\text{ V}$ or V_{CC}	9	8	12	16	Max	μA
Digital Input								
V_{IH}	Input Voltage High				2.4	2.4	Min	V
V_{IL}	Input Voltage Low				0.8	0.8	Max	V
I_{IN}	Control Input Leakage	$V_{IN} = 0\text{ V}$ or V_{CC}	11	± 0.4	± 1	± 1	Max	μA
Analog Switch								
R_{ON}		$I_{OUT} = 1\text{ mA}$, $V_{IS} = \text{GND or } V_{CC}$	9	50			Typ	Ω
R_{ON}		$I_{OUT} = 1\text{ mA}$, $V_{IS} = \text{GND or } V_{CC}$	9	80	95	105	Max	Ω
ΔR_{ON}	On Resistance Match between Channels	$I_{OUT} = 1\text{ mA}$, $V_{IS} = 1\text{ V}$	9	15	25	30	Max	Ω
$R_{FLAT(ON)}$	On Resistance Flatness	$I_{OUT} = 1\text{ mA}$	9	30	40	40	Max	Ω
$I_{CH(OFF)}$	Switch OFF Leakage Current on Channel	$V_{IS} = \text{GND}$, $V_{OS} = V_{CC}$, or $V_{IS} = V_{CC}$, $V_{OS} = \text{GND}$	11	± 0.4	± 1	± 1	Max	μA
$I_{COM(OFF)}$	Switch OFF Leakage Current on Common	$V_{IS} = \text{GND}$, $V_{OS} = V_{CC}$, or $V_{IS} = V_{CC}$, $V_{OS} = \text{GND}$	11	± 0.4	± 2	± 2	Max	μA
$I_{(ON)}$	Switch ON Leakage Current	$V_{IS} = \text{GND or } V_{CC}$	11	± 0.4	± 2	± 2	Max	μA
Dynamic Characteristics								
t_{PHL}, t_{PLH}	Switch IN to OUT Time	$C_L = 50\text{ pF}$	9	5			Typ	ns
t_{ON}	Switch Turn-on Time	$C_L = 50\text{ pF}$	9	60			Max	ns
t_{OFF}	Switch Turn-off Time	$C_L = 50\text{ pF}$	9	50			Max	ns
	OFF-Isolation	$f = 1\text{ MHz}$, $R_L = 50\text{ }\Omega$, $C_L = 10\text{ pF}$	10	-70			Typ	dB
	Crosstalk	$f = 1\text{ MHz}$, $R_L = 50\text{ }\Omega$, $C_L = 10\text{ pF}$	10	-70			Typ	dB
	Crosstalk in Control	Between control and any switch; $R_L = 600\text{ }\Omega$; $f = 1\text{ MHz}$; E or Sn square wave between V_{CC} and GND	10	220			Typ	mV
BW	Bandwidth	$R_L = 50\text{ }\Omega$	10	200			Typ	MHz
THD	Total Harmonic Distortion	$R_L = 10\text{ k}\Omega$, $f = 1\text{ kHz}$	10	0.03			Typ	%

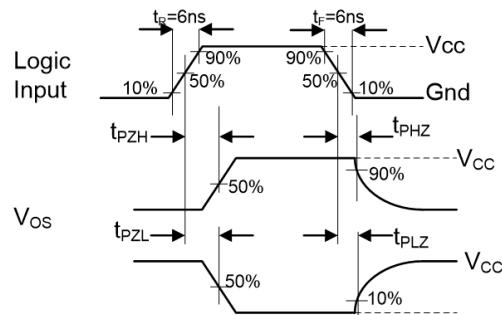
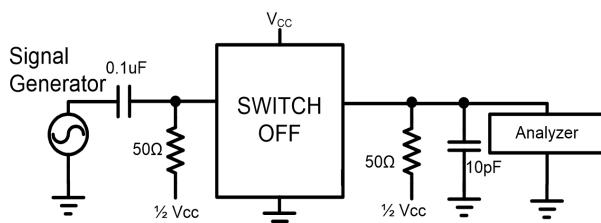
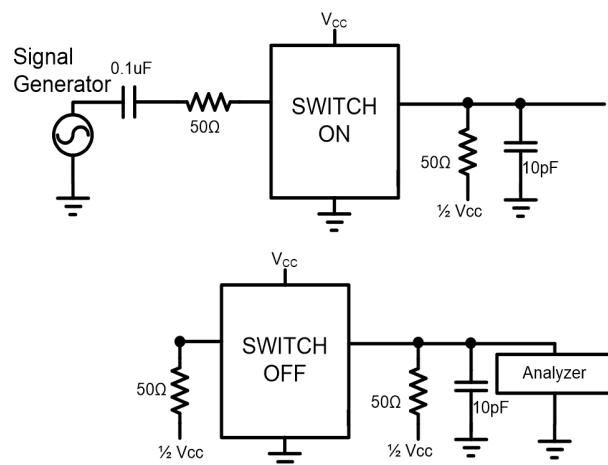
12-V 4:1 General Purpose Analog Switch

Symbol	Parameter	Conditions	V _{cc} (V)	25°C	-40°C to 85°C	-40°C to 125°C	Limit	Unit
Capacitance								
C _{IN}	Switch Input Capacitance		10	5			Typ	pF
C _{COM}	Common Output Capacitance		10	12			Typ	pF
C _{PD}	Power Dissipation Capacitance		10	50			Typ	pF

12-V 4:1 General Purpose Analog Switch**Typical Performance Characteristics****Figure 1. R_{ON} vs. V_{IS}** **Figure 2. Bandwidth**

12-V 4:1 General Purpose Analog Switch
Test Circuit and Waveforms


Parameter	Vis	S1 Position
t_{PHL}, t_{PLH}	Pulse	Open
t_{PZH}, t_{PHZ}	V_{CC}	V_{EE}
t_{PZL}, t_{PLZ}	V_{EE}	V_{CC}

 $t_{ON}: t_{PZH} \text{ or } t_{PZL}$
 $t_{OFF}: t_{PHZ} \text{ or } t_{PLZ}$

Figure 3. AC Test Circuit and Test Waveforms

Figure 4. Off Isolation

Figure 5. Crosstalk

12-V 4:1 General Purpose Analog Switch

Application and Implementation

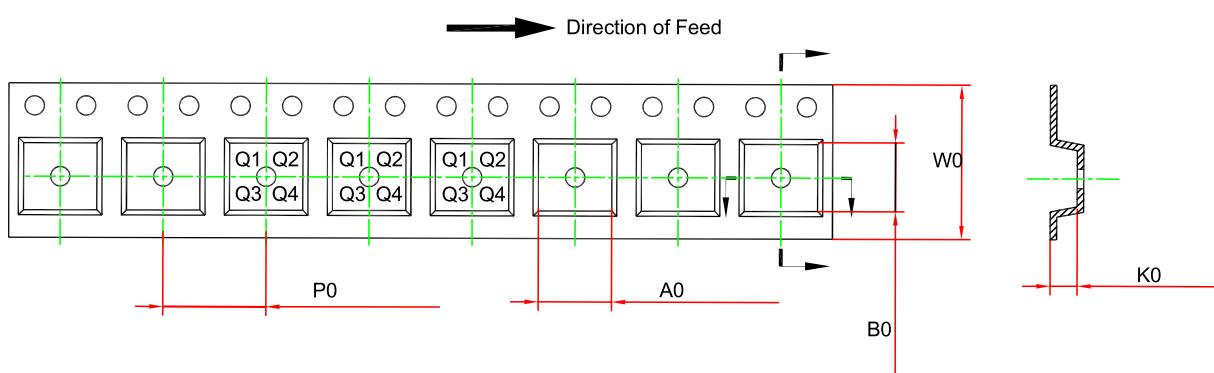
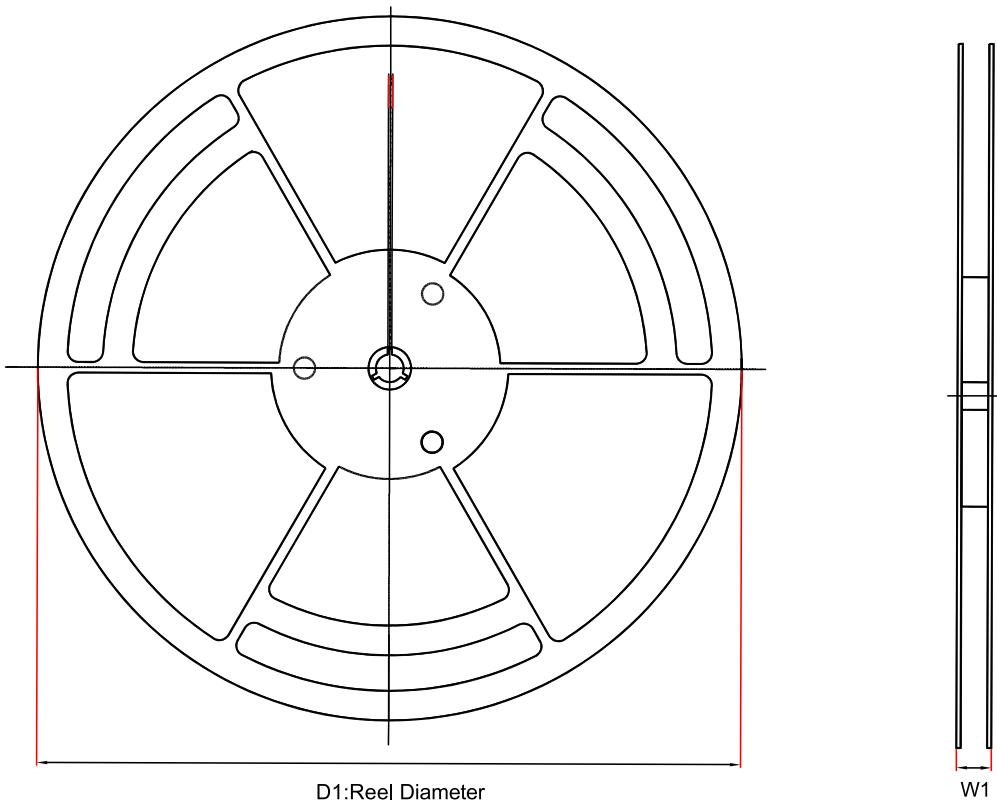
Note

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- μ F bypass capacitor on Vcc and GND is recommended to prevent power disturbance.

Tape and Reel Information

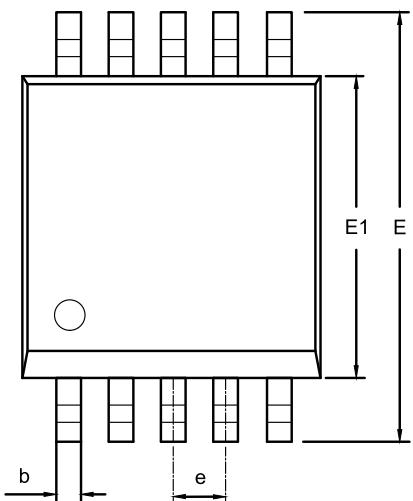
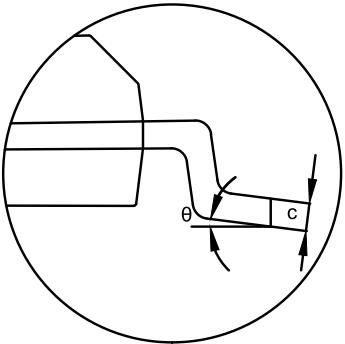
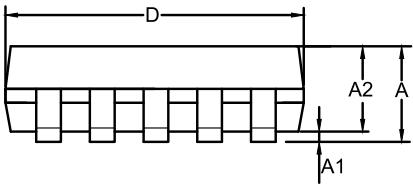
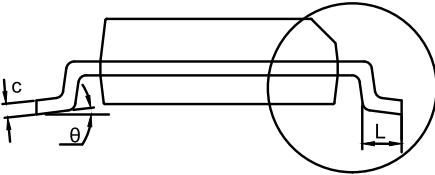


Order Number	Package	D1 (mm)	W1 (mm)	A0 (mm) ⁽¹⁾	B0 (mm) ⁽¹⁾	K0 (mm) ⁽¹⁾	P0 (mm)	W0 (mm)	Pin1 Quadrant
TPW4054-VR	MSOP10	330	17.6	5.3	3.4	1.4	8	12	Q1

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

Package Outline Dimensions

MSOP10

Package Outline Dimensions		VS2(MSOP-10-A)			
					
					
Symbol	Dimensions In Millimeters		Dimensions In Inches		
	MIN	MAX	MIN	MAX	
A	0.800	1.100	0.031	0.043	
A1	0.050	0.150	0.002	0.006	
A2	0.750	0.950	0.030	0.037	
b	0.180	0.280	0.007	0.011	
c	0.090	0.230	0.004	0.009	
D	2.900	3.100	0.114	0.122	
E	4.700	5.100	0.185	0.201	
E1	2.900	3.100	0.114	0.122	
e	0.500 BSC		0.020 BSC		
L	0.400	0.800	0.016	0.031	
θ	0	8°	0	8°	

NOTES

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

12-V 4:1 General Purpose Analog Switch**Order Information**

Order Number	Operating Temperature Range	Package	Marking Information	MSL	Transport Media, Quantity	Eco Plan
TPW4054-VR	-40 to 125°C	MSOP10	W4054	3	Tape and Reel, 3000	Green

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

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