Features

- Analog Switch Voltage: 3.3V, 5V, 10V, ±5V

- Low ON-State Resistance:

    typical 50Ω at Vs = ±4.5V or 9V

    typical 60Ω at Vs = 4.5V

    typical 300Ω at Vs = 3V

- Bandwidth: 200 MHz

- Fast switching times: t_{ON} = 60ns, t_{OFF} = 50ns

- 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 TPW4052 is dual SP4T analog switch suitable for use in analog or digital multiplexer/demultiplexer applications. The switch features three digital select inputs (S0, S1), eight independent inputs/outputs (An, Bn), two common input/output (A, B) and a digital enable input (/E). When /E is HIGH, the switches are turned off.

The device is designed on an enhanced process that provides lower power dissipation yet gives high switching speeds. These devices can operate equally well as either multiplexers or de-multiplexers and have an input range that extends to the supplies. All channels exhibit break-before-make switching action, preventing momentary shorting when switching channels.

Switch Selection Guide

Product	Switch Configuration	Supply Voltage(V)	Ron(OHM)	Bandwidth(MHz)	Package
TPW4051	8:1	12	50	200	SOIC-16, TSSOP-16, QFN-16
TPW4052	(4:1)*2	12	50	200	SOIC-16, TSSOP-16
TPW4053	(2:1)*3	12	50	200	SOIC-16, TSSOP-16
TPW3111	1:1	5.5	1	100	SC70-5
TPW3115	1:1	5.5	5	250	SC70-5, SOT23-5
TPW4157	2:1	5.5	1	100	SC70-6
TPW3157A	2:1	5.5	2	100	SC70-6
TPW3221	(2:1)*2	5.5	1	100	MSOP-10
TPW3223	(2:1)*2	5.5	1	100	QFN-10, 1.4*1.8mm

Table of Contents

Revision History

Date	Revision	Notes
2018/8/8	Rev.Pre	Pre-Release Version
2019/3/4	Rev.0	Initial Version
2019/10/2	Rev.0.01	HBM: 2KV -> 1KV
2019/12/25	Rev.0.02	Correct test conditions of RON and switch leakage to follow the product test(Product test is not changed): all of "0V" -> "VEE"; On Resistance Match between Channels at 3 to 3.6V Vcc: -> remove; On Resistance Match between Channels at 9 to 11V Vcc: VIS = 3.5V -> VIS = 1V; On Resistance Match between Channels at 4.5 to 5.5V Vcc, Vee = -4.5V to 5.5V: VIS = 3.5V -> VIS = -3.5V
2020/1/14	Rev.0.03	Correct the "P0" information of TR in Tape and Reel Information

Order Information

Order Number	Operating Temperature Range	Package	Marking Information	MSL	Transport Media, Quantity
TPW4052-SR	-40 to 125°C	16-Pin SOIC	W4052	3	Tape and Reel, 2500
TPW4052-TR	-40 to 125°C	16-Pin TSSOP	W4052	3	Tape and Reel, 3000

Pin Configuration, Description and Functional Table [Note 1]

TPW4052

TPW4052
16-Pin SOIC/TSSOP
(-S and -T Suffixes)

```
        B0 [1]          [16] Vcc
        B2 [2]          [15] A2
         B [3]          [14] A1
        B3 [4]          [13] A
        B1 [5]          [12] A0
        /E [6]          [11] A3
       Vee [7]  LOGIC   [10] S0
       GND [8]          [9] S1
```
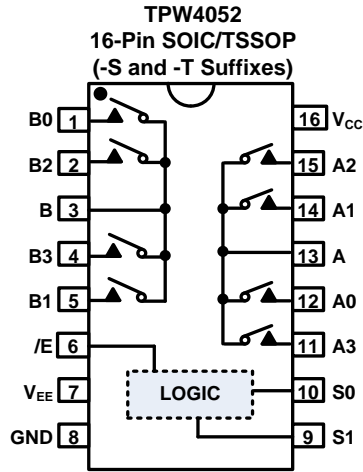
Pin Description

Pin No.	Pin Name	Input / Output	Description	Pin No.	Pin Name	Input / Output	Description
1	B0	Input / Output	Channel B0 input or output	9	S1	Input	Control Input
2	B2	Input / Output	Channel B2 input or output	10	S0	Input	Control Input
3	B	Input / Output	B Common input or output	11	A3	Input / Output	Channel A3 input or output
4	B3	Input / Output	Channel B3 input or output	12	A0	Input / Output	Channel A0 input or output
5	B1	Input / Output	Channel B1 input or output	13	A	Input / Output	A Common input or output
6	/E	Input	Enable switchs, active low	14	A1	Input / Output	Channel A1 input or output
7	V_{EE}		Negative Power Input	15	A2	Input / Output	Channel A2 input or output
8	GND		Ground	16	V_{CC}		Positive Power Input

Functional Table

/E, Enable	S2	S1	S0	ON Channel
L	NA	L	L	A0, B0
L	NA	L	H	A1, B1
L	NA	H	L	A2, B2
L	NA	H	H	A3, B3
H	NA	X	X	None

X = Don't care, NA = Not Available

Absolute Maximum Ratings [Note 1]

Parameters	Rating
Supply Voltage, V_{CC} - V_{EE}	-0.5V to 13V
Supply Voltage, V_{CC} - GND	-0.5V to 13V
Supply Voltage, V_{EE} - GND	-6.5V to 0.5V
Analog Switch Voltage	$V_{EE} - 0.5V$ to $V_{CC} + 0.5V$
Analog Switch Current	$\pm 25mA$
Analog Switch Diode Current	$\pm 20mA$
Digital Input Voltage, /E, S2, S1, S0	GND to $V_{CC} + 0.5V$
Digital Input Diode Current	$\pm 20mA$
Maximum Junction Temperature	150°C
Storage Temperature Range	–65 to 150°C
Lead Temperature (Soldering, 10 sec)	260°C

Note 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 Rating

Symbol	Parameter	Condition	Minimum Level	Unit
HBM	Human Body Model ESD	ANSI/ESDA/JEDEC JS-001	1	kV
CDM	Charged Device Model ESD	ANSI/ESDA/JEDEC JS-002	1	kV

Thermal Information

Package Type	θ_{JA}	θ_{JC}	Unit
16-Pin SOIC	100	50	°C/W
16-Pin TSSOP	150	60	°C/W

Recommended Operating Conditions [Note 1]

Over operating temperature range

Parameters	Min	Max	Unit
Supply Voltage, V_{CC} - V_{EE}	3	12	V
Supply Voltage, V_{CC} – GND[Note2]	3	12	V
Supply Voltage, V_{EE} – GND[Note2]	-6	0	V
Select Input Voltage	0	V_{CC}	V
Input Transition Rise and Fall Rate		100	ns/V
Switch I/O Port Voltage	V_{EE}	V_{CC}	V
Operating Temperature Range	–40	125	°C

Note 1: Select input must be held HIGH or LOW and it must not float.

Note 2: The voltage of V_{CC}, V_{EE} need be in the range of V_{CC}-V_{EE}

Electrical Characteristics

Single Supply, V_{CC} = 4.5 to 5.5V, V_{EE} = 0V, GND = 0V, 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} = 0V 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} = 0V or V_{CC}	5.5	±0.4	±1	±1	Max	µA
Analog Switch								
R_{ON}		I_{OUT} = 1mA, V_{IS} = V_{EE} or V_{CC}	4.5	60			Typ	Ω
R_{ON}		I_{OUT} = 1mA, V_{IS} = V_{EE} or V_{CC}	4.5	100	130	150	Max	Ω
ΔR_{ON}	On Resistance Match between Channels	I_{OUT} = 1mA, V_{IS} = 2.5V	4.5	20	30	35	Max	Ω
$R_{FLAT(ON)}$	On Resistance Flatness	I_{OUT} = 1mA	4.5	60	80	80	Max	Ω
$I_{CH(OFF)}$	Switch OFF Leakage Current on Channel	V_{IS} = V_{EE}, V_{OS} = V_{CC}; or V_{IS} = V_{CC}, V_{OS} = V_{EE}	5.5	±0.4	±1	±1	Max	µA
$I_{COM(OFF)}$	Switch OFF Leakage Current on Common	V_{IS} = V_{EE}, V_{OS} = V_{CC}; or V_{IS} = V_{CC}, V_{OS} = V_{EE},	5.5	±0.4	±2	±2	Max	µA
$I_{(ON)}$	Switch ON Leakage Current	V_{IS} = V_{EE} or V_{CC}	5.5	±0.4	±2	±2	Max	µA
Dynamic Characteristics								
t_{PHL}, t_{PLH}	Switch IN to OUT time	C_L = 50pF	4.5	5			Typ	ns
t_{ON}	Switch turn-on time	C_L = 50pF	4.5	60			Max	ns
t_{OFF}	Switch turn-off time	C_L = 50pF	4.5	50			Max	ns
	OFF-Isolation	f = 1MHz, R_L = 50Ω, C_L = 10pF	5	-70			Typ	dB
	Crosstalk in channel	f = 1MHz, R_L = 50Ω, C_L = 10pF	5	-70			Typ	dB
	Crosstalk in control	Between control and any switch; RL = 600Ω; f = 1 MHz; E or Sn square wave between V_{CC} and GND	5	110			Typ	mV
BW	Bandwidth	R_L = 50Ω	5	200			Typ	MHz
THD	Total Harmonic Distortion	R_L = 10kΩ, f = 1kHz	5	0.05			Typ	%
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

Single Supply, V$_{CC}$ = 3 to 3.6V, V$_{EE}$ = 0V, GND = 0V, 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$_{IN}$ = 0V 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$_{IN}$ = 0V or V$_{CC}$	3.6		±1	±1	Max	µA
Analog Switch								
R$_{ON}$		I$_{OUT}$ = 1mA, V$_{IS}$ = V$_{EE}$ or V$_{CC}$	3	300			Typ	Ω
R$_{FLAT(ON)}$	On Resistance Flatness	I$_{OUT}$ = 1mA	3	100			Typ	Ω
I$_{CH(OFF)}$	Switch OFF Leakage Current on Channel	V$_{IS}$ = V$_{EE}$, V$_{OS}$ = V$_{CC}$; or V$_{IS}$ = V$_{CC}$, V$_{OS}$ = V$_{EE}$	3.6	±0.4	±1	±1	Max	µA
I$_{COM(OFF)}$	Switch OFF Leakage Current on Common	V$_{IS}$ = V$_{EE}$, V$_{OS}$ = V$_{CC}$; or V$_{IS}$ = V$_{CC}$, V$_{OS}$ = V$_{EE}$,	3.6	±0.4	±2	±2	Max	µA
I$_{(ON)}$	Switch ON Leakage Current	V$_{IS}$ = V$_{EE}$ or V$_{CC}$	3.6	±0.4	±2	±2	Max	µA
Dynamic Characteristics								
t$_{PHL}$, t$_{PLH}$	Switch IN to OUT time	C$_L$ = 50pF	3	5			Typ	ns
t$_{ON}$	Switch turn-on time	C$_L$ = 50pF	3	70			Max	ns
t$_{OFF}$	Switch turn-off time	C$_L$ = 50pF	3	60			Max	ns
	OFF-Isolation	f = 1MHz, R$_L$ = 50Ω, C$_L$ = 10pF	3.3	-70			Typ	dB
	Crosstalk	f = 1MHz, R$_L$ = 50Ω, C$_L$ = 10pF	3.3	-70			Typ	dB
	Crosstalk in control	Between control and any switch; RL = 600Ω; f = 1 MHz; E or Sn square wave between V$_{CC}$ and GND	3.3	110			Typ	mV
BW	Bandwidth	R$_L$ = 50Ω	3.3	200			Typ	MHz
THD	Total Harmonic Distortion	R$_L$ = 10kΩ, f = 1kHz	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
C$_{PD}$	Power Dissipation Capacitance		3.3	50			Typ	pF

Single Supply, V$_{CC}$ = 9V to 11V, V$_{EE}$ = 0V, GND = 0V, 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$_{IN}$ = 0V 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$_{IN}$ = 0V or V$_{CC}$	11	±0.4	±1	±1	Max	µA
Analog Switch								
R$_{ON}$		I$_{OUT}$ = 1mA, V$_{IS}$ = V$_{EE}$ or V$_{CC}$	9	50			Typ	Ω
R$_{ON}$		I$_{OUT}$ = 1mA, V$_{IS}$ = V$_{EE}$ or V$_{CC}$	9	80	95	105	Max	Ω
ΔR$_{ON}$	On Resistance Match between Channels	I$_{OUT}$ = 1mA, V$_{IS}$ = 1V	9	15	25	30	Max	Ω
R$_{FLAT(ON)}$	On Resistance Flatness	I$_{OUT}$ = 1mA	9	30	40	40	Max	Ω
I$_{CH(OFF)}$	Switch OFF Leakage Current on Channel	V$_{IS}$ = V$_{EE}$, V$_{OS}$ = V$_{CC}$; or V$_{IS}$ = V$_{CC}$, V$_{OS}$ = V$_{EE}$	11	±0.4	±1	±1	Max	µA
I$_{COM(OFF)}$	Switch OFF Leakage Current on Common	V$_{IS}$ = V$_{EE}$, V$_{OS}$ = V$_{CC}$; or V$_{IS}$ = V$_{CC}$, V$_{OS}$ = V$_{EE}$,	11	±0.4	±2	±2	Max	µA
I$_{(ON)}$	Switch ON Leakage Current	V$_{IS}$ = V$_{EE}$ or V$_{CC}$	11	±0.4	±2	±2	Max	µA
Dynamic Characteristics								
t$_{PHL}$, t$_{PLH}$	Switch IN to OUT time	C$_L$ = 50pF	9	5			Typ	ns
t$_{ON}$	Switch turn-on time	C$_L$ = 50pF	9	60			Max	ns
t$_{OFF}$	Switch turn-off time	C$_L$ = 50pF	9	50			Max	ns
	OFF-Isolation	f = 1MHz, R$_L$ = 50Ω, C$_L$ = 10pF	10	-70			Typ	dB
	Crosstalk	f = 1MHz, R$_L$ = 50Ω, C$_L$ = 10pF	10	-70			Typ	dB
	Crosstalk in control	Between control and any switch; RL = 600Ω; f = 1 MHz; E or Sn square wave between V$_{CC}$ and GND	10	220			Typ	mV
BW	Bandwidth	R$_L$ = 50Ω	10	200			Typ	MHz
THD	Total Harmonic Distortion	R$_L$ = 10kΩ, f = 1kHz	10	0.03			Typ	%
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

Dual Supply, V_{CC} = 4.5 to 5.5V, V_{EE} = -4.5 to 5.5V, GND = 0V, unless otherwise noted.

Symbol	Parameter	Conditions	V_{CC} /V_{EE}(V)	25°C	-40°C to 85°C	-40°C to 125°C	Limit	Unit
Power Supply								
I_{CC}	Quiescent Supply Current	V_{IN} = 0V or V_{CC}	5.5/-5.5	8	12	16	Max	µA
Digital Input								
V_{IH}	Input Voltage High				70%* V_{CC}	70%* V_{CC}	Min	V
V_{IL}	Input Voltage Low				30%* V_{CC}	30%* V_{CC}	Max	V
I_{IN}	Control Input Leakage	V_{IN} = 0V or V_{CC}	5.5/-5.5	±0.4	±1	±1	Max	µA
Analog Switch								
R_{ON}		I_{OUT} = 1mA, V_{IS} = V_{EE} or V_{CC}	4.5/-4.5	50			Typ	Ω
R_{ON}		I_{OUT} = 1mA, V_{IS} = V_{EE} or V_{CC}	4.5/-4.5	80	95	105	Max	Ω
ΔR_{ON}	On Resistance Match between Channels	I_{OUT} = 1mA, V_{IS} = -3.5V	4.5/-4.5	15	25	30	Max	Ω
$R_{FLAT(ON)}$	On Resistance Flatness	I_{OUT} = 1mA	4.5/-4.5	30	40	40	Max	Ω
$I_{CH(OFF)}$	Switch OFF Leakage Current on Channel	V_{IS} = V_{EE}, V_{OS} = V_{CC}; or V_{IS} = V_{CC}, V_{OS} = V_{EE}	5.5/-5.5	±0.4	±1	±1	Max	µA
$I_{COM(OFF)}$	Switch OFF Leakage Current on Common	V_{IS} = V_{EE}, V_{OS} = V_{CC}; or V_{IS} = V_{CC}, V_{OS} = V_{EE},	5.5/-5.5	±0.4	±2	±2	Max	µA
$I_{(ON)}$	Switch ON Leakage Current	V_{IS} = V_{EE} or V_{CC}	5.5/-5.5	±0.4	±2	±2	Max	µA
Dynamic Characteristics								
t_{PHL}, t_{PLH}	Switch IN to OUT time	C_L = 50pF	4.5/-4.5	5			Typ	ns
t_{ON}	Switch turn-on time	C_L = 50pF	4.5/-4.5	60			Max	ns
t_{OFF}	Switch turn-off time	C_L = 50pF	4.5/-4.5	50			Max	ns
	OFF-Isolation	f = 1MHz, R_L = 50Ω, C_L = 10pF	5/-5	-70			Typ	dB
	Crosstalk	f = 1MHz, R_L = 50Ω, C_L = 10pF	5/-5	-70			Typ	dB
	Crosstalk in control	Between control and any switch; RL = 600Ω; f = 1 MHz; E or Sn square wave between V_{CC} and GND	5/-5	220			Typ	mV
BW	Bandwidth	R_L = 50Ω	5/-5	100			Typ	MHz
THD	Total Harmonic Distortion	R_L = 10kΩ, f = 1kHz	5/-5	0.03			Typ	%
Capacitance								
C_{IN}	Switch Input Capacitance		5/-5	5			Typ	pF
C_{COM}	Common Output Capacitance		5/-5	12			Typ	pF
C_{PD}	Power Dissipation Capacitance		5/-5	50			Typ	pF

Typical Performance Characteristics

Figure 1. R_{ON} vs. V_{IS}

Figure 2. Bandwidth
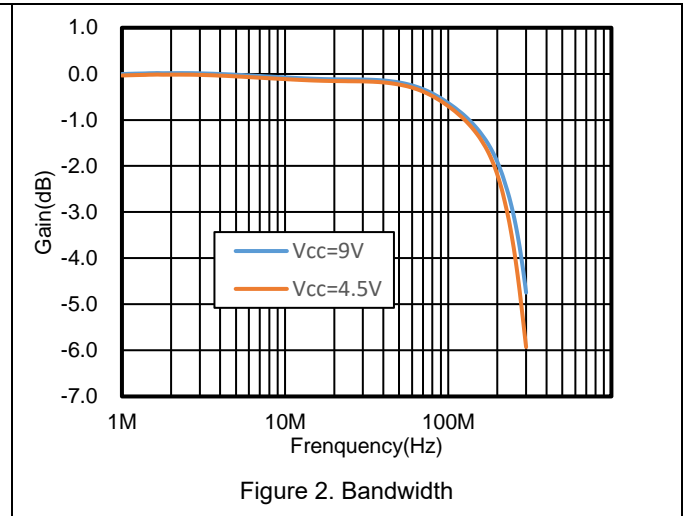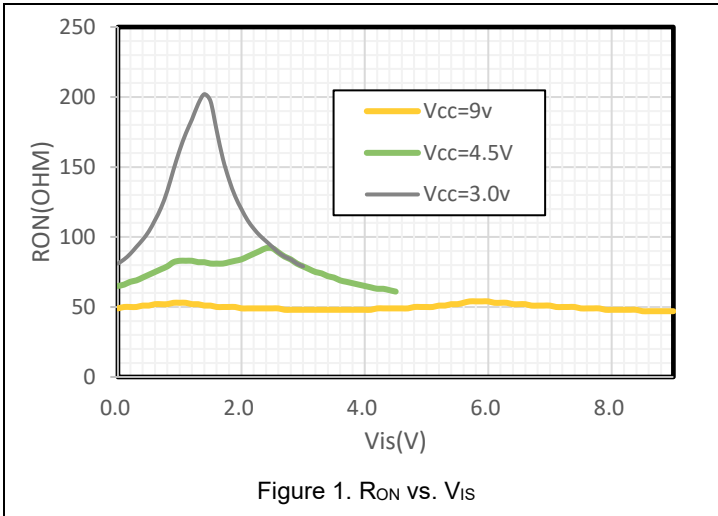
Test Circuit and Waveforms
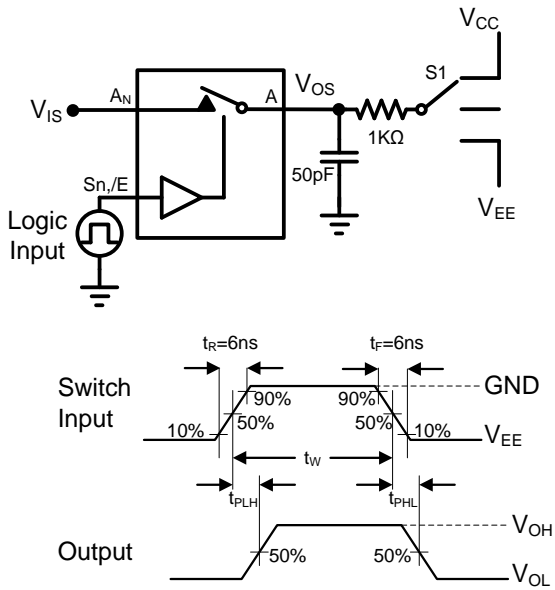
Parameter	Vis	S1 Position
t_{PHL}, t_{PLH}	Pulse	Open
t_{PZH}, t_{PHZ}	V_{CC}	V_{EE}
t_{PZL}, t_{PLZ}	V_{EE}	V_{CC}

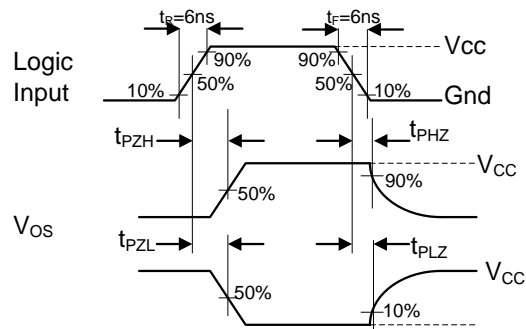t_{ON}: t_{PZH} or t_{PZL}

t_{OFF}: t_{PHZ} or t_{PLZ}

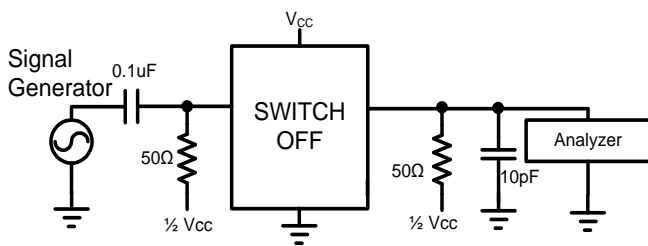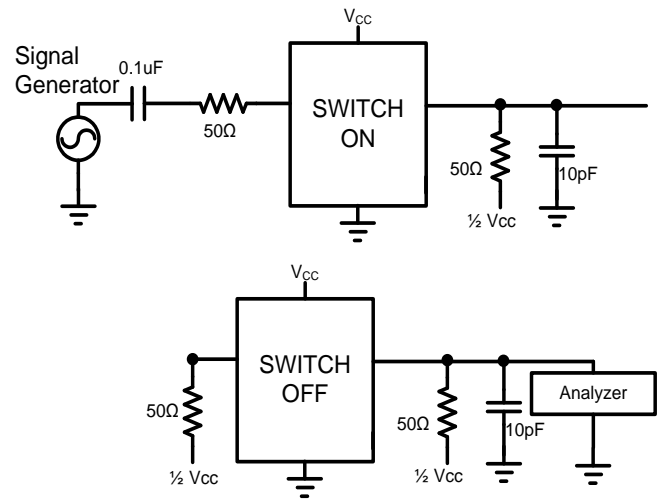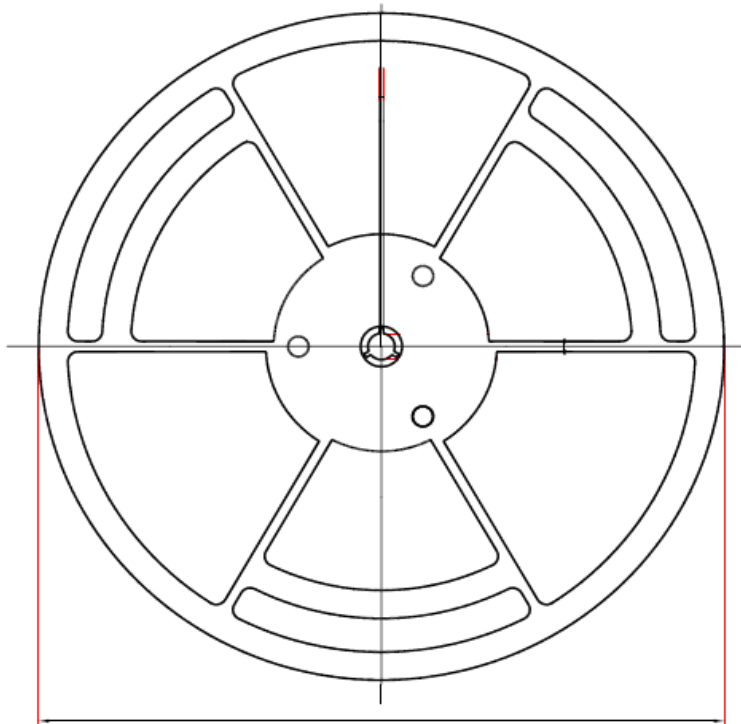Figure 3 AC Test Circuit and Test Waveforms

Figure 4 Off Isolation

Figure 5 Crosstalk

Application Information

A 0.1-μF bypass capacitor on V_{CC} and GND is recommended to prevent power disturbance, another 0.1-μF bypass capacitor on V_{EE} and GND is also recommended if the V_{EE} is not connected to GND.

Tape and Reel Information

D1: Reel Diameter

W1: Reel Width

Direction of Feed
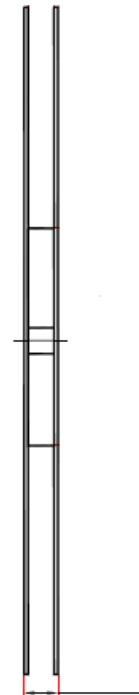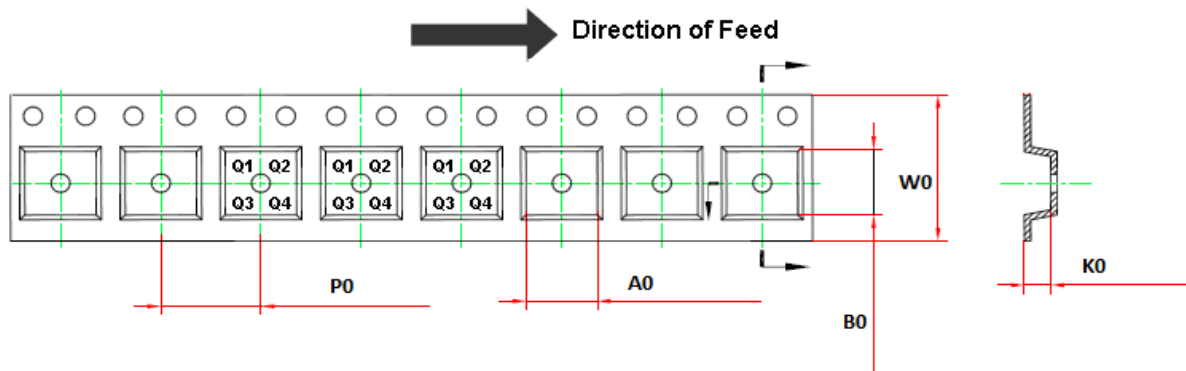
Order Number	Package	D1	W1	A0	B0	K0	P0	W0	Pin1 Quadrant
TPW4052-SR	SOIC-16	330	21.6	6.7±0.1	10.4±0.1	2.1±0.1	8.0±0.1	16.0±0.3	Q1
TPW4052-TR	TSSOP-16	330	17.6	6.8±0.1	5.4±0.1	1.3±0.1	8.0±0.1	12.0±0.1	Q1

Package Outline Dimensions

SOIC-16
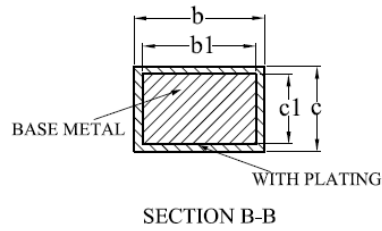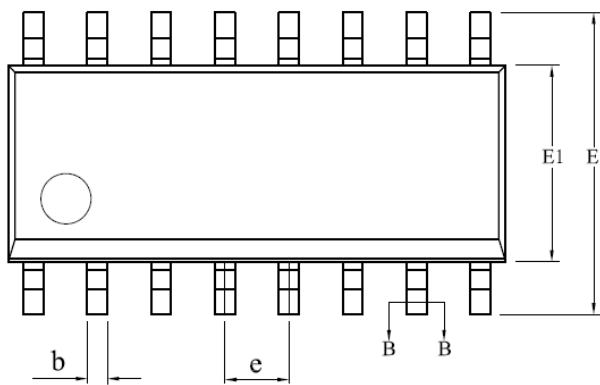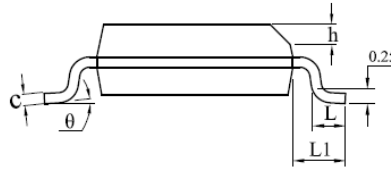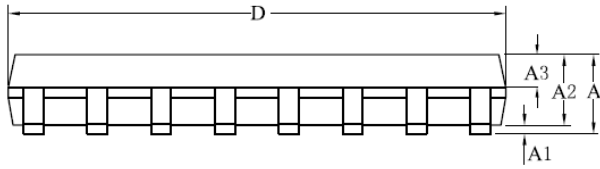
SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	–	–	1.75
A1	0.10	–	0.225
A2	1.30	1.40	1.50
A3	0.60	0.65	0.70
b	0.39	–	0.47
b1	0.38	0.41	0.44
c	0.20	–	0.24
c1	0.19	0.20	0.21
D	9.80	9.90	10.00
E	5.80	6.00	6.20
E1	3.80	3.90	4.00
e	1.27BSC		
h	0.25	—	0.50
L	0.50	—	0.80
L1	1.05REF		
θ	0		8°

TSSOP-16
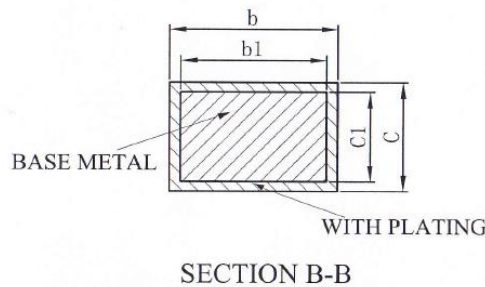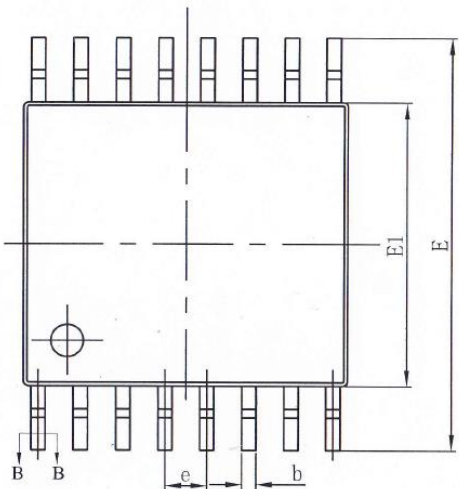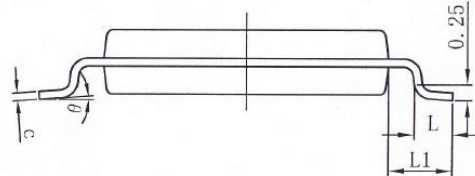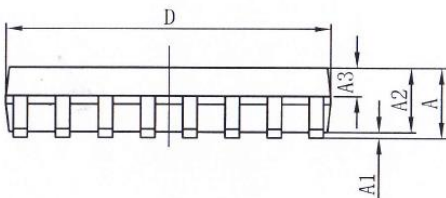
SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	—	—	1.20
A1	0.05	—	0.15
A2	0.90	1.00	1.05
A3	0.39	0.44	0.49
b	0.20	—	0.28
b1	0.19	0.22	0.25
c	0.13	—	0.17
c1	0.12	0.13	0.14
D	4.90	5.00	5.10
E	6.20	6.40	6.60
E1	4.30	4.40	4.50
e	0.65BSC		
L	0.45	0.60	0.75
L1	1.00BSC		
θ	0	—	8°

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