

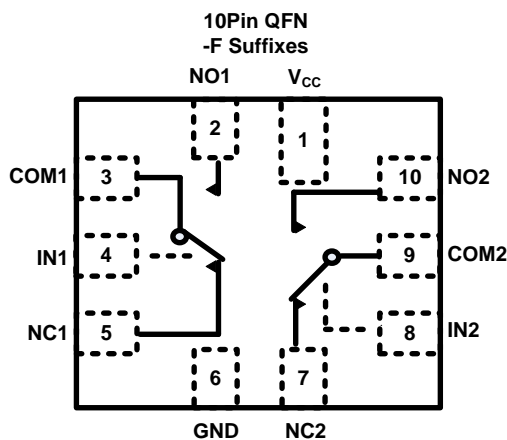
## Features

- Latch-Up Performance Exceeds 800 mA Per JESD 78, Class II
- Supply Voltage: 1.65V to 5.5V
- Low ON-State Resistance: typical 0.95Ω at Vs = 4.5V
- Bandwidth: 100 MHz
- Fast switching times: t<sub>ON</sub> =40 ns, t<sub>OFF</sub> =15 ns
- Break-Before-Make Switching
- Operation Temperature Range: -40°C to 125°C

## Applications

- Industry control systems
- Battery-powered systems
- Audio Signal Routing
- Portable Instruments and Mobile Device

## Pin Configuration(Top View)



## Function Table

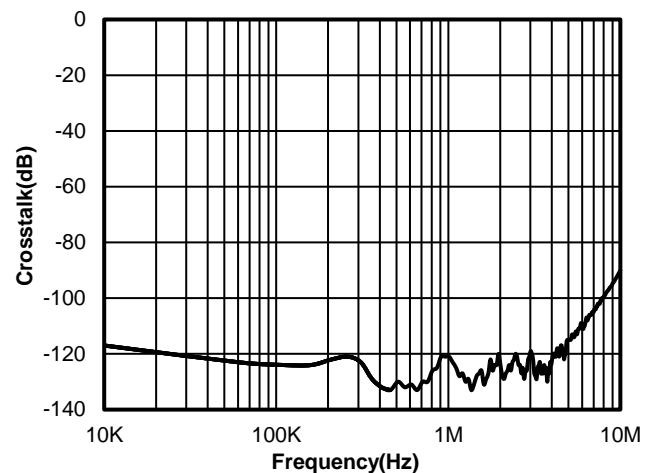
IN1, IN2	NC1, NC2	NO1, NO2
Low	ON	OFF
High	OFF	ON

## Description

TPW3223 is high performance Single Pole/Double Throw (SPDT) analog switches. The devices feature ultra low RON of 1.2Ω maximum at 4.5V V<sub>CC</sub> and will operate over the wide V<sub>CC</sub> range of 1.65V to 5.5V.

The TPW3223 features very low quiescent current even when the control voltage is lower than the V<sub>CC</sub> supply. This feature services the portable applications very well allowing for the direct interface with processor general purpose I/Os.

The TPW3223 has very excellent channel to channel crosstalk performance to fit the application with high channel to channel isolation requirement.



## Pin Description

Pin name	Pin No	Pin function
V <sub>CC</sub>	1	Power supply
NO1	2	Switch Port 1, Normal Open
COM1	3	Common switch port 1
IN1	4	Select pin 1
NC1	5	Switch Port 1, Normal Close
GND	6	Ground
NC2	7	Switch Port 2, Normal Close
IN2	8	Select pin 2
COM2	9	Common switch port 2
NO2	10	Switch Port 2, Normal Open

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## Revision History

Date	Revision	Notes
2018/6/24	Rev.Pre	Pre-Release Version
2019/1/9	Rev.Pre.001	Update Tape and Reel Information
2019/1/28	Rev.0	Initial Version
2019/9/9	Rev.0.01	Update Tape and Reel Information: 3000->4000, remove data code information Correct Toff test condition in figure 6: 50% of output -> 90% of output Spec of ΔRON at 1.65Vcc change: 2/3/3ohm -> 5/7/7ohm Spec of Ton/Toff/Tb at 1.65Vcc change: "max" -> "typ"

## Order Information

Order Number	Operating Temperature Range	Package	Marking Information	MSL	Transport Media, Quantity
TPW3223-FR	-40 to 125°C	10-Pin QFN	W32	3	Tape and Reel, 4000

## Absolute Maximum Ratings <sup>Note 1</sup>

Parameters	Rating
Supply Voltage, $V_{CC}$	-0.5V to 6V
Select Input Voltage	-0.5V to 6V
Select Input Diode Current	-50mA
Switch I/O Port Voltage	-0.5 to $V_{CC} + 0.5$
Switch I/O Port diode current	$\pm 50$ mA
Switch Current	200mA
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	4	kV
CDM	Charged Device Model ESD	ANSI/ESDA/JEDEC JS-002	2	kV

## Thermal Information

Package Type	$\theta_{JA}$	$\theta_{JC}$	Unit
10-Pin QFN	150	100	°C/W

## Recommended Operating Conditions <sup>Note 1</sup>

Over operating temperature range

Parameters	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	0V	$V_{CC}$	V
Operating Temperature Range	-40	125	°C

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

## Electrical Characteristics

**V<sub>CC</sub> = 4.5 to 5.5V, unless otherwise noted.**

Symbol	Parameter	Conditions	V <sub>CC</sub> (V)	25°C	-40°C to 85°C	-40°C to 125°C	Limit	Unit
<b>Power Supply</b>								
I <sub>CC</sub>	Quiescent Supply Current	V <sub>IN</sub> = 0V or V <sub>CC</sub>	5.5	0.3	0.5	1.5	Max	μA
ΔI <sub>CC</sub>	Increase in I <sub>CC</sub> per Input	Select Input at 2.7V, others at V <sub>CC</sub> or GND	4.3	30	35	35	Max	μA
<b>Digital Input</b>								
V <sub>IH</sub>	Input Voltage High				2.4	2.4	Min	V
V <sub>IL</sub>	Input Voltage Low				0.8	0.8	Max	V
I <sub>IN</sub>	Control Input Leakage	V <sub>IN</sub> = 0V or V <sub>CC</sub>	5.5		±1	±1	Max	μA
<b>Analog Switch</b>								
R <sub>ON</sub>		I <sub>OUT</sub> = 100mA, NCx or NOx = 3.5V	4.5	0.95			Typ	Ω
R <sub>ON</sub>		I <sub>OUT</sub> = 100mA, NCx or NOx = 3.5V	4.5	1.2	1.4	1.5	Max	Ω
ΔR <sub>ON</sub>	Maximum ON resistance	I <sub>OUT</sub> = 100mA, NCx or NOx = 3.5V	4.5	0.12	0.15	0.2	Max	Ω
R <sub>FLAT(ON)</sub>	On Resistance Flatness	I <sub>OUT</sub> = 100mA, NCx or NOx = 0V, 1V, 2V	4.5	0.3	0.4	0.5	Max	Ω
I <sub>NO(OFF)</sub> , I <sub>NC(OFF)</sub>	Switch OFF Leakage Current on B0, B1	COMx = 1V, 4.5V, NCx or NOx = 4.5V, 1V	5.5	±10	±25	±50	Max	nA
I <sub>A(OFF)</sub>	Switch OFF Leakage Current on A	COMx = 1V, 4.5V, NCx or NOx = 4.5V, 1V	5.5	±10	±50	±100	Max	nA
I <sub>A(ON)</sub>	Switch ON Leakage Current on A	COMx = 1V, 4.5V, NCx or NOx = 1V, 4.5V or Floating	5.5	±10	±50	±100	Max	nA
<b>Dynamic Characteristics</b>								
t <sub>PHL</sub> , t <sub>PLH</sub>	Switch IN to OUT time	NCx or NOx = 3V, RL = 50Ω, CL = 35pF, Figure 7	4.5	5			Typ	ns
t <sub>ON</sub>	Switch turn-on time	NCx or NOx = 3V, RL = 50Ω, CL = 35pF, Figure 7	4.5	40	45	45	Max	ns
t <sub>OFF</sub>	Switch turn-off time	NCx or NOx = 3V, RL = 50Ω, CL = 35pF, Figure 7	4.5	15	20	20	Max	ns
t <sub>B</sub>	Break before make time	NCx or NOx = 3V, RL = 50Ω, CL = 35pF, Figure 8	4.5	20	40	40	Typ	ns
Q	Charge Injection	C <sub>L</sub> = 1.0nF, V <sub>GEN</sub> = 0V, R <sub>GEN</sub> = 0Ω, Figure 9	5.5	20			Typ	pC
	OFF-Isolation	f = 1MHz, RL = 50Ω, Figure 10	5	-65			Typ	dB
	Crosstalk	f = 1MHz, RL = 50Ω, Figure 11	5	-65			Typ	dB
	Channel to Channel Crosstalk	f = 1MHz, Figure 12	5	-120			Typ	dB
BW	Bandwidth	R <sub>L</sub> = 50Ω	5	100			Typ	MHz
THD	Total Harmonic Distortion	R <sub>L</sub> = 600Ω, V <sub>IN</sub> = 0.5V <sub>PP</sub> , f = 20Hz to 20kHz	5	0.004			Typ	%
<b>Capacitance</b>								
C <sub>IN</sub>	Select Input capacitance		5	5			Typ	pF
C <sub>OFF</sub>	B-Port Off capacitance		5	12			Typ	pF
C <sub>ON</sub>	ON Capacitance		5	40			Typ	pF

**V<sub>CC</sub> = 2.7 to 3.6V, unless otherwise noted.**

Symbol	Parameter	Conditions	V <sub>CC</sub> (V)	25°C	-40°C to 85°C	-40°C to 125°C	Limit	Unit
<b>Power Supply</b>								
I <sub>CC</sub>	Quiescent Supply Current	V <sub>IN</sub> = 0V or V <sub>CC</sub>	3.6	0.3	0.5	1.5	Max	μA
<b>Digital Input</b>								
V <sub>IH</sub>	Input Voltage High				1.65	1.65	Min	V
V <sub>IL</sub>	Input Voltage Low				0.6	0.6	Max	V
I <sub>IN</sub>	Control Input Leakage	V <sub>IN</sub> = 0V or V <sub>CC</sub>	3.6		±1	±1	Max	μA
<b>Analog Switch</b>								
R <sub>ON</sub>		I <sub>OUT</sub> = 100mA, NCx or NOx = 1.5V	2.7	2			Typ	Ω
R <sub>ON</sub>		I <sub>OUT</sub> = 100mA, NCx or NOx = 1.5V	2.7	2.1	2.3	2.6	Max	Ω
ΔR <sub>ON</sub>	Maximum ON resistance	I <sub>OUT</sub> = 100mA, NCx or NOx = 1.5V	2.7	0.1	0.15	0.2	Max	Ω
R <sub>FLAT(ON)</sub>	On Resistance Flatness	I <sub>OUT</sub> = 100mA, NCx or NOx = 0V, 0.75V, 1.5V	2.7	1.2	1.3	1.4	Max	Ω
I <sub>NO(OFF)</sub> , I <sub>NC(OFF)</sub>	Switch OFF Leakage Current on B0, B1	COMx = 0V, 3.6V, NCx or NOx = 3.6V, 0V	3.6	±10	±25	±50	Max	nA
I <sub>A(OFF)</sub>	Switch OFF Leakage Current on A	COMx = 0V, 3.6V, NCx or NOx = 3.6V, 0V	3.6	±10	±50	±100	Max	nA
I <sub>A(ON)</sub>	Switch ON Leakage Current on A	COMx = 0V, 3.6V, NCx or NOx = 0V, 3.6V or Floating	3.6	±10	±50	±100	Max	nA
<b>Dynamic Characteristics</b>								
t <sub>PHL</sub> , t <sub>PLH</sub>	Switch IN to OUT time	NCx or NOx = 1.5V, R <sub>L</sub> = 50Ω, C <sub>L</sub> = 35pF, Figure 7	2.7	10			Typ	ns
t <sub>ON</sub>	Switch turn-on time	NCx or NOx = 1.5V, R <sub>L</sub> = 50Ω, C <sub>L</sub> = 35pF, Figure 7	2.7	60	70	70	Max	ns
t <sub>OFF</sub>	Switch turn-off time	NCx or NOx = 1.5V, R <sub>L</sub> = 50Ω, C <sub>L</sub> = 35pF, Figure 7	2.7	25	30	30	Max	ns
t <sub>B</sub>	Break before make time	NCx or NOx = 1.5V, R <sub>L</sub> = 50Ω, C <sub>L</sub> = 35pF, Figure 8	2.7	20			Typ	ns
Q	Charge Injection	C <sub>L</sub> = 1.0nF, V <sub>GEN</sub> = 0V, R <sub>GEN</sub> = 0Ω, Figure 9	3	20			Typ	pC
	OFF-Isolation	f = 1MHz, R <sub>L</sub> = 50Ω, Figure 10	3	-65			Typ	dB
	Crosstalk	f = 1MHz, R <sub>L</sub> = 50Ω, Figure 11	3	-65			Typ	dB
	Channel to Channel Crosstalk	f = 1MHz, Figure 12	3	-120			Typ	dB
BW	Bandwidth	R <sub>L</sub> = 50Ω	3	100			Typ	MHz
THD	Total Harmonic Distortion	R <sub>L</sub> = 600Ω, V <sub>IN</sub> = 0.5V <sub>PP</sub> , f = 20Hz to 20kHz	3	0.01			Typ	%

**V<sub>CC</sub> = 1.65 to 1.95V, unless otherwise noted.**

Symbol	Parameter	Conditions	V <sub>CC</sub> (V)	25°C	-40°C to 85°C	-40°C to 125°C	Limit	Unit
<b>Power Supply</b>								
I <sub>CC</sub>	Quiescent Supply Current	V <sub>IN</sub> = 0V or V <sub>CC</sub>	1.95	0.3	0.5	1.5	Max	μA
<b>Digital Input</b>								
V <sub>IH</sub>	Input Voltage High				1.4	1.4	Min	V
V <sub>IL</sub>	Input Voltage Low				0.4	0.4	Max	V
I <sub>IN</sub>	Control Input Leakage	V <sub>IN</sub> = 0V or V <sub>CC</sub>	1.95		±1	±1	Max	μA
<b>Analog Switch</b>								
R <sub>ON</sub>		I <sub>OUT</sub> = 10mA, NCx or NOx = 0.9V	1.65	10			Typ	Ω
R <sub>ON</sub>		I <sub>OUT</sub> = 10mA, NCx or NOx = 0.9V	1.65	15	18	18	Max	Ω
ΔR <sub>ON</sub>	Maximum ON resistance	I <sub>OUT</sub> = 10mA, NCx or NOx = 0.9V	1.65	5	7	7	Max	Ω
I <sub>NO(OFF)</sub> , I <sub>NC(OFF)</sub>	Switch OFF Leakage Current on B0, B1	COMx = 0V, 1.95V, NCx or NOx = 1.95V, 0V	1.95	±10	±25	±50	Max	nA
I <sub>A(OFF)</sub>	Switch OFF Leakage Current on A	COMx = 0V, 1.95V, NCx or NOx = 1.95V, 0V	1.95	±10	±50	±100	Max	nA
I <sub>A(ON)</sub>	Switch ON Leakage Current on A	COMx = 0V, 1.95V, NCx or NOx = 0V, 1.95V or Floating	1.95	±10	±50	±100	Max	nA
<b>Dynamic Characteristics</b>								
t <sub>PHL</sub> , t <sub>PLH</sub>	Switch IN to OUT time	NCx or NOx = 1.0V, R <sub>L</sub> = 50Ω, CL = 35pF, Figure 7	1.65	10			Typ	ns
t <sub>ON</sub>	Switch turn-on time	NCx or NOx = 1.0V, R <sub>L</sub> = 50Ω, CL = 35pF, Figure 7	1.65	80			Typ	ns
t <sub>OFF</sub>	Switch turn-off time	NCx or NOx = 1.0V, R <sub>L</sub> = 50Ω, CL = 35pF, Figure 7	1.65	55			Typ	ns
t <sub>B</sub>	Break before make time	NCx or NOx = 1.0V, R <sub>L</sub> = 50Ω, CL = 35pF, Figure 8	1.65	20			Typ	ns
Q	Charge Injection	C <sub>L</sub> = 1.0nF, V <sub>GEN</sub> = 0V, R <sub>GEN</sub> = 0Ω, Figure 9	1.8	20			Typ	pC
	OFF-Isolation	f = 1MHz, R <sub>L</sub> = 50Ω, Figure 10	1.8	-65			Typ	dB
	Crosstalk	f = 1MHz, R <sub>L</sub> = 50Ω, Figure 11	1.8	-65			Typ	dB
	Channel to Channel Crosstalk	f = 1MHz, Figure 12	1.8	-120			Typ	dB
BW	Bandwidth	R <sub>L</sub> = 50Ω	1.8	100			Typ	MHz
THD	Total Harmonic Distortion	R <sub>L</sub> = 600Ω, V <sub>IN</sub> = 0.5V <sub>PP</sub> , f = 20Hz to 20kHz	1.8	0.01			Typ	%

**T<sub>COMx</sub> = 0°C to 50°C, unless otherwise noted.**

Symbol	Parameter	Conditions	V <sub>CC</sub> (V)	Spec	Limit	Unit
I <sub>NO(OFF)</sub> , I <sub>NC(OFF)</sub>	Switch OFF Leakage Current on B0, B1	COMx = 1V, 4.5V, NCx or NOx = 4.5V, 1V	3.6	±10	Max	nA
I <sub>A(OFF)</sub>	Switch OFF Leakage Current on A	COMx = 1V, 4.5V, NCx or NOx = 4.5V, 1V	3.6	±20	Max	nA
I <sub>A(ON)</sub>	Switch ON Leakage Current on A	COMx = 1V, 4.5V, NCx or NOx = 1V, 4.5V or Floating	3.6	±20	Max	nA
I <sub>NO(OFF)</sub> , I <sub>NC(OFF)</sub>	Switch OFF Leakage Current on B0, B1	COMx = 1V, 4.5V, NCx or NOx = 4.5V, 1V	5.5	±10	Max	nA
I <sub>A(OFF)</sub>	Switch OFF Leakage Current on A	COMx = 1V, 4.5V, NCx or NOx = 4.5V, 1V	5.5	±20	Max	nA
I <sub>A(ON)</sub>	Switch ON Leakage Current on A	COMx = 1V, 4.5V, NCx or NOx = 1V, 4.5V or Floating	5.5	±20	Max	nA



Typical Performance Characteristics

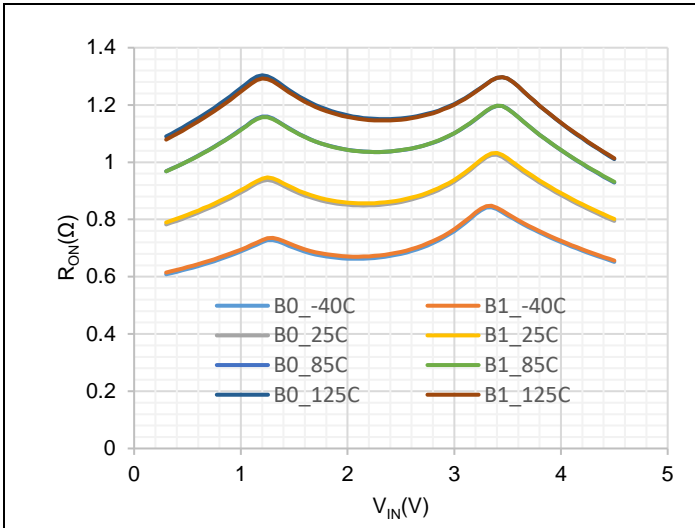


Figure 1.  $R_{ON}$ ,  $V_{CC} = 4.5V$ , Temp = -40, 25, 85, 125°C

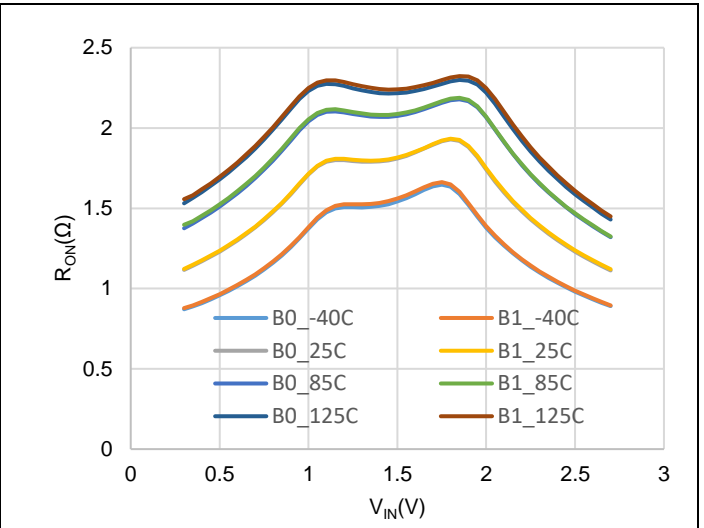


Figure 2.  $R_{ON}$ ,  $V_{CC} = 2.7V$ , Temp = -40, 25, 85, 125°C

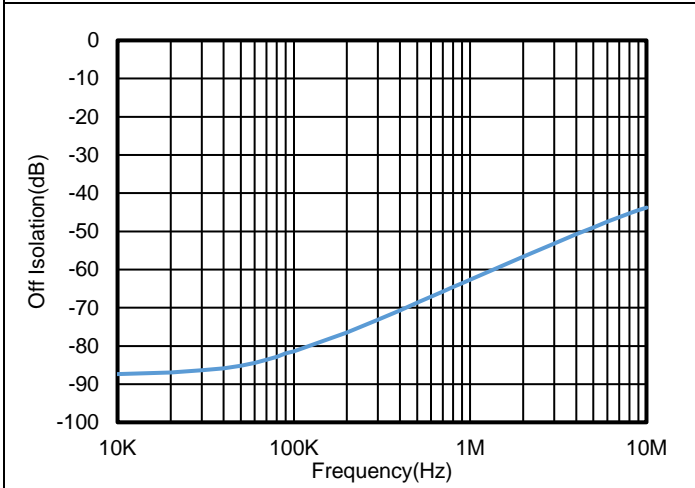


Figure 3. Off-Isolation,  $V_{CC} = 4.5V$

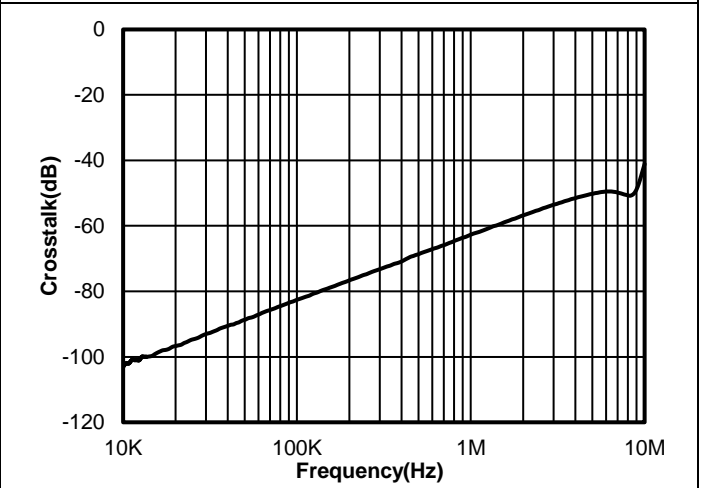


Figure 4. Crosstalk,  $V_{CC} = 4.5V$

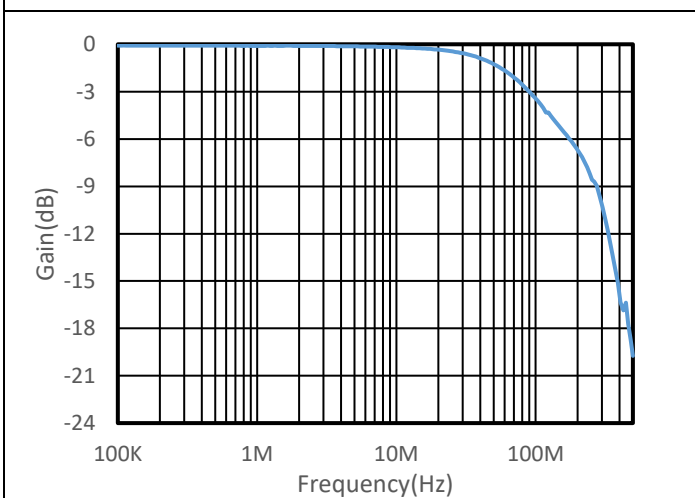


Figure 5. Bandwidth,  $V_{CC} = 4.5V$

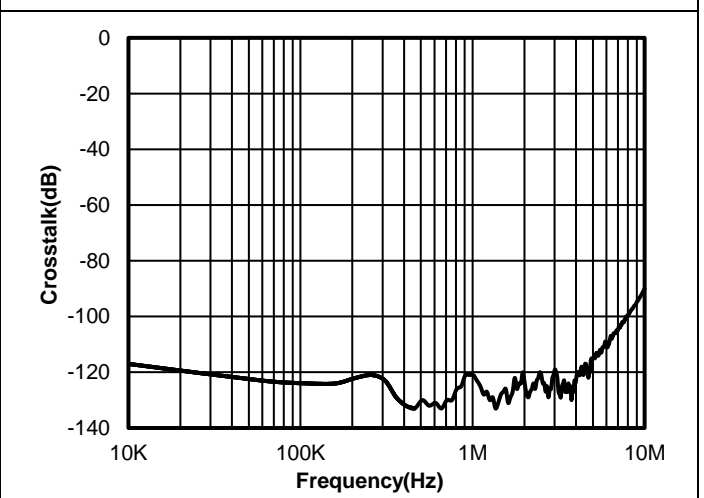


Figure 6. Channel to Channel Crosstalk,  $V_{CC} = 4.5V$

**Test Circuit and Waveforms**

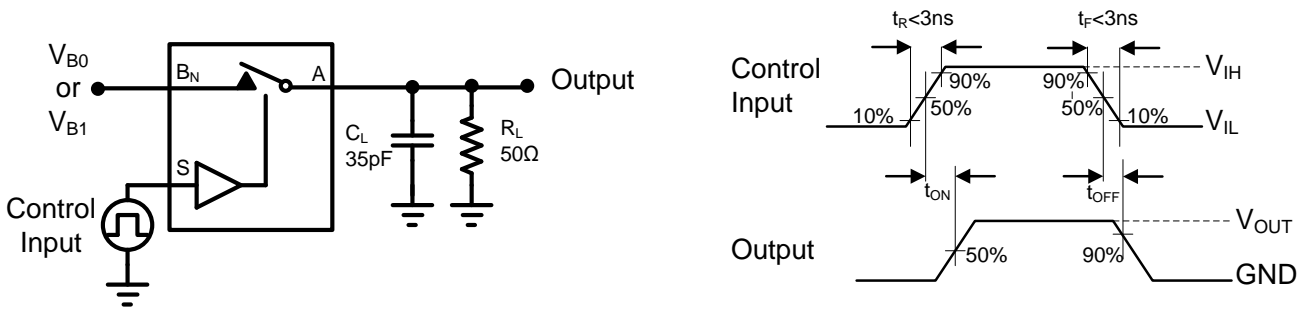


Figure 7 AC Test Circuit and Test Waveforms

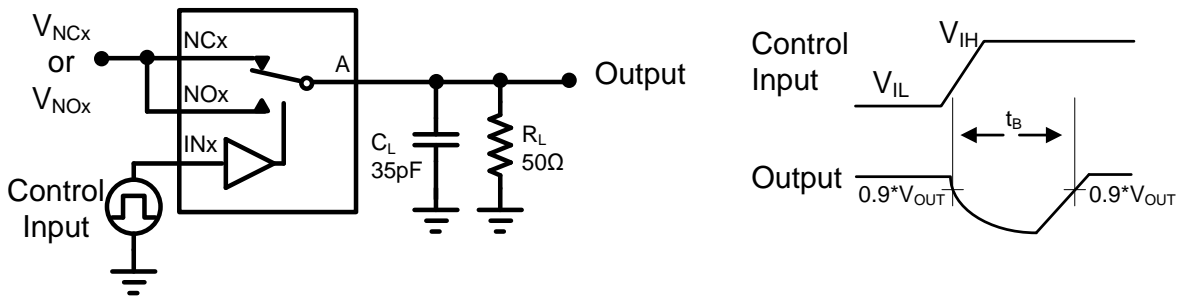


Figure 8 Switch Break Time

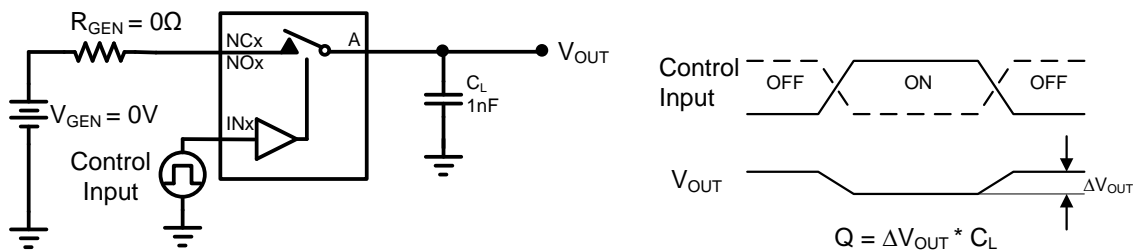


Figure 9 Charge Injection

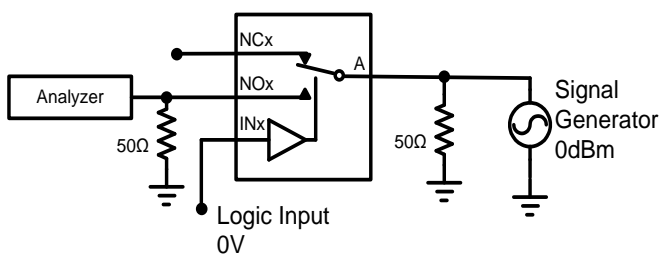


Figure 10 Off Isolation

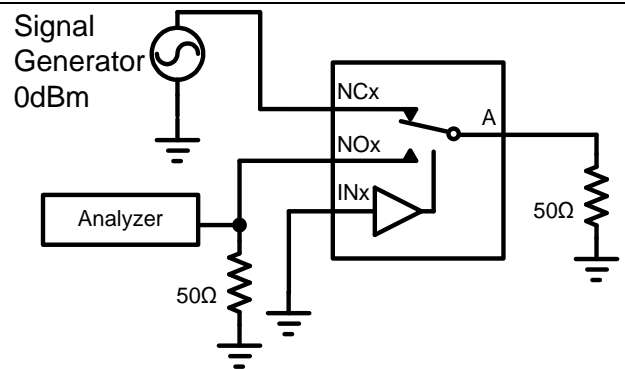
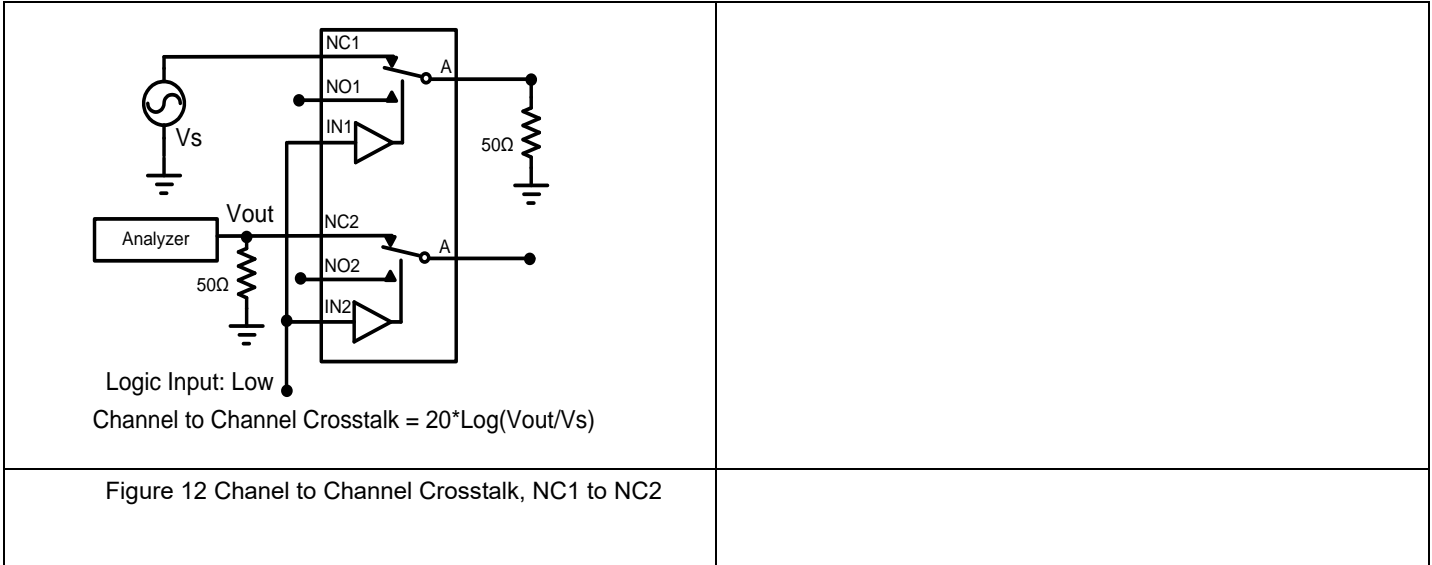


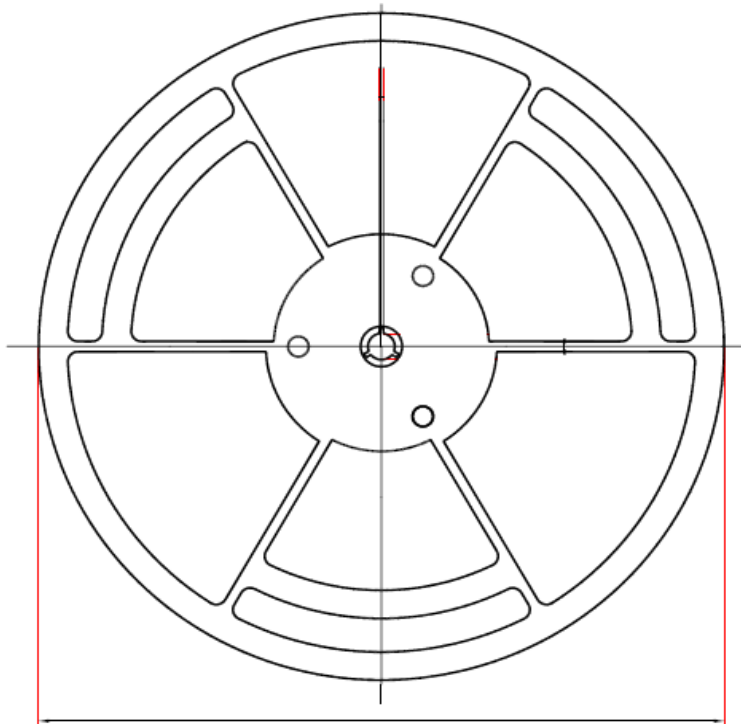
Figure 11 Crosstalk



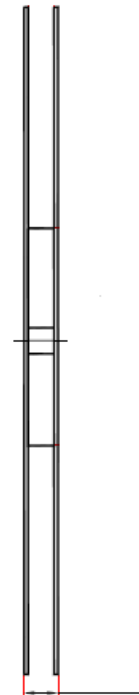
## Application Information

A 0.1-μF bypass capacitor on V<sub>CC</sub> and GND is recommended to prevent power disturbance.

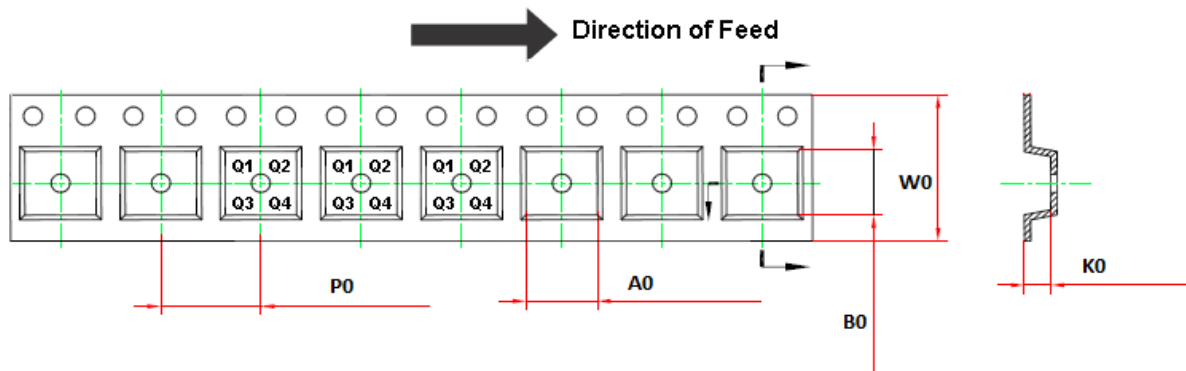
### Tape and Reel Information



D1: Reel Diameter



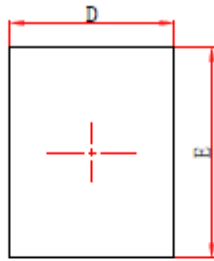
W1: Reel Width



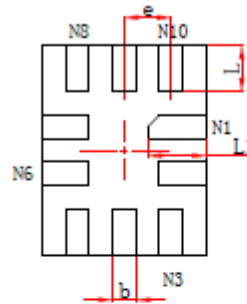
Order Number	Package	D1	W1	A0	B0	K0	P0	W0	Pin1 Quadrant
TPW3223-FR	10-Pin QFN	180	13.1	1.6	2.0	0.85	4	8	Q1

### Package Outline Dimensions

#### QFN-10



Top View



Bottom View



Side View

Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	0.500	0.600	0.020	0.024
A1	0.000	0.050	0.000	0.002
A3	0.152REF.		0.006REF.	
D	1.350	1.450	0.053	0.057
E	1.750	1.850	0.069	0.073
D1	—	—	—	—
E1	—	—	—	—
k	—		—	
b	0.150	0.250	0.006	0.010
e	0.400TYP.		0.016TYP.	
L	0.350	0.450	0.014	0.018
L1	0.450	0.550	0.018	0.022

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