

Features

- Latch-Up Performance Exceeds 600 mA Per JESD 78, Class II
- Supply Voltage: 1.65V to 5.5V
- Low ON-State Resistance: typical 0.6Ω at $V_s = 2.7V$
- Bandwidth: 80 MHz
- Break-Before-Make Switching
- Operation Temperature Range: $-40^{\circ}C$ to $85^{\circ}C$

Applications

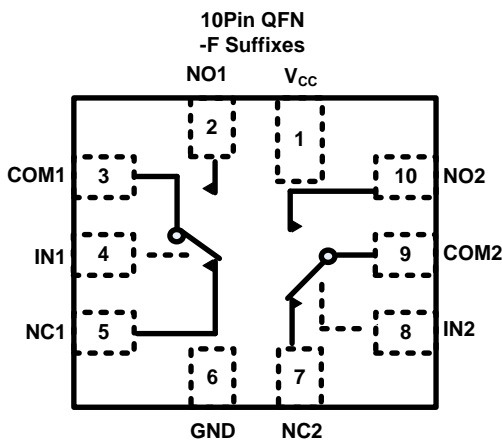
- Industry control systems
- Battery-powered systems
- Audio Signal Routing
- Portable Instruments and Mobile Device

Description

TPW1221 is high performance Single Pole/Double Throw (SPDT) analog switch. The device feature ultra low RON of 0.6 Ω maximum at 2.7V V_{CC} and will operate over the wide V_{CC} range of 1.65V to 5.5V.

The TPW1221 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.

Pin Configuration(Top View)



Pin Description

Pin name	Pin No	Pin function
Vcc	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

Function Table

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

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Revision History

Date	Revision	Notes
2020/6/15	Rev.A	Initial Version
2020/7/13	Rev.A.1	Add Vcc=1.65V to 1.95V spec
2020/8/1	Rev.A.2	Correct typo in Page 7, Vcc=1.65 to 1.95V Spec, condition of timing spec: NCx or NOx = 1.5V -> NCx or NOx = 1V

Order Information

Order Number	Operating Temperature Range	Package	Marking Information	MSL	Transport Media, Quantity
TPW1221-QF2AR	-40 to 85°C	10-Pin QFN	W12	3	Tape and Reel, 4000

Absolute Maximum Ratings ^{Note 1}

Parameters	Rating
Supply Voltage, V_{CC}	-0.5V to 6.9V
Select Input Voltage	-0.5V to 6.9V
Select Input Diode Current	-50mA
Switch I/O Port Voltage	Min: Highest of -3V and $V_{CC} - 6.9V$; Max: $V_{CC} + 0.5$
Switch I/O Port diode current	$\pm 50mA$
Switch Current	250mA
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 and Latch Up Rating

Symbol	Parameter	Condition	Minimum Level	Unit
HBM	Human Body Model ESD	ANSI/ESDA/JEDEC JS-001, Switch Pin	8	kV
		ANSI/ESDA/JEDEC JS-001, Other Pin	4	kV
CDM	Charged Device Model ESD	ANSI/ESDA/JEDEC JS-002	1.5	kV
LU	Latch Up	JESD 78, 25°C	600	mA
		JESD 78, 125°C	400	mA

Thermal Information

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

Recommended Operating Conditions ^{Note 1}

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 ^{Note2}	-2.5V	V_{CC}	V
Operating Temperature Range	-40	85	°C

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

Note 2: The voltage across the switch should be < 5.5 V.

Electrical Characteristics

V_{CC} = 4.5 to 5.5V, unless otherwise noted.

Symbol	Parameter	Conditions	V _{CC} (V)	25°C	-40°C to 85°C	Limit	Unit
I _{CC}	Quiescent Supply Current	V _{IN} = 0V or V _{CC}	5.5	1	2	Max	μA
ΔI _{CC}	Increase in I _{CC} per Input	Select Input at 2.7V, others at V _{CC} or GND	4.3	10	20	Max	μA
V _{IH}	Input Voltage High		5		1.6	Min	V
V _{IL}	Input Voltage Low		5		0.6	Max	V
I _{IN}	Control Input Leakage	V _{IN} = 0V or V _{CC}	5.5	±100	±1	Max	μA
R _{ON}		I _{OUT} = 100mA, NCx or NOx = 3.5V	4.5	0.6		Typ	Ω
R _{ON}		I _{OUT} = 100mA, NCx or NOx = 3.5V	4.5	0.7	1	Max	Ω
ΔR _{ON}	ON resistance match	I _{OUT} = 100mA, NCx or NOx = 3.5V	4.5	0.1	0.15	Max	Ω
R _{FLAT(ON)}	On Resistance Flatness	I _{OUT} = 100mA, NCx or NOx = 0V, 1V, 2V	4.5	0.2	0.25	Max	Ω
I _{NO(OFF)} , I _{NC(OFF)}	Switch OFF Leakage Current on B0, B1	COMx = 1V, 4.5V, NCx or NOx = 4.5V, 1V	5.5	±100	±1000	Max	nA
I _{A(OFF)}	Switch OFF Leakage Current on A	COMx = 1V, 4.5V, NCx or NOx = 4.5V, 1V	5.5	±100	±1000	Max	nA
I _{A(ON)}	Switch ON Leakage Current on A	COMx = 1V, 4.5V, NCx or NOx = Floating	5.5	±100	±1000	Max	nA
t _{PHL} , t _{PLH}	Switch IN to OUT time	NCx or NOx = 3V, RL = 50Ω, CL = 35pF, Figure 7	4.5	5		Typ	ns
t _{ON}	Switch turn-on time	NCx or NOx = 3V, RL = 50Ω, CL = 35pF, Figure 7	4.5	120	130	Max	ns
t _{OFF}	Switch turn-off time	NCx or NOx = 3V, RL = 50Ω, CL = 35pF, Figure 7	4.5	80	90	Max	ns
t _B	Break before make time	NCx or NOx = 3V, RL = 50Ω, CL = 35pF, Figure 8	4.5	40		Typ	ns
Q	Charge Injection	C _L = 1.0nF, V _{GEN} = 0V, R _{GEN} = 0Ω, Figure 9	5.5	20		Typ	pC
	OFF-Isolation	f = 100kHz, RL = 50Ω, Figure 10	5	-65		Typ	dB
	Crosstalk	f = 100kHz, RL = 50Ω, Figure 11	5	-65		Typ	dB
	Channel to Channel Crosstalk	f = 100kHz, Figure 12	5	-120		Typ	dB
BW	Bandwidth	R _L = 50Ω	5	80		Typ	MHz
THD	Total Harmonic Distortion	R _L = 600Ω, V _{IN} = 0.5V _{PP} , f = 20Hz to 20kHz	5	-70		Typ	dB
C _{IN}	Select Input capacitance		5	5		Typ	pF
C _{OFF}	Off capacitance		5	25		Typ	pF
C _{ON}	ON Capacitance		5	75		Typ	pF

V_{CC} = 2.7 to 3.6V, unless otherwise noted.

Symbol	Parameter	Conditions	V _{CC} (V)	25°C	-40°C to 85°C	Limit	Unit
I _{CC}	Quiescent Supply Current	V _{IN} = 0V or V _{CC}	3.6	1	2	Max	μA
ΔI _{CC}	Increase in I _{CC} per Input	Select Input at 1.8V, others at V _{CC} or GND	3.6	10	15	Max	μA
V _{IH}	Input Voltage High				1.3	Min	V
V _{IL}	Input Voltage Low				0.6	Max	V
I _{IN}	Control Input Leakage	V _{IN} = 0V or V _{CC}	3.6		±1	Max	μA
R _{ON}		I _{OUT} = 100mA, NCx or NOx = (V _{CC} -4.5V), -1V, 0V, 1V, 2V, V _{CC}	2.7	0.6		Typ	Ω
			2.7	1.05	1.3	Max	Ω
ΔR _{ON}	ON resistance match	I _{OUT} = 100mA, NCx or NOx = (V _{CC} -4.5V), -1V, 0V, 1V, 2V, V _{CC}	2.7	0.05		Typ	Ω
			2.7	0.1	0.15	Max	Ω
R _{FLAT(ON)}	On Resistance Flatness	I _{OUT} = 100mA, NCx or NOx = (V _{CC} -4.5V), -1V, 0V, 1V, 2V, V _{CC}	2.7	0.3		Typ	Ω
			2.7	0.37	0.45	Max	Ω
I _{NO(OFF)} , I _{NC(OFF)}	Switch OFF Leakage Current on B0, B1	COMx = -2.5V, 2.5V, NCx or NOx = 2.5V, -2.5V	2.7	±100	±1000	Max	nA
I _{A(OFF)}	Switch OFF Leakage Current on A	COMx = -2.5V, 2.5V, NCx or NOx = 2.5V, -2.5V	2.7	±100	±1000	Max	nA
I _{A(ON)}	Switch ON Leakage Current on A	COMx = -2.5V, 2.5V, NCx or NOx = Floating	2.7	±100	±1000	Max	nA
t _{PHL} , t _{PLH}	Switch IN to OUT time	NCx or NOx = 1.5V, RL = 50Ω, CL = 35pF, Figure 7	2.7	5		Typ	ns
t _{ON}	Switch turn-on time	NCx or NOx = 1.5V, RL = 50Ω, CL = 35pF, Figure 7	2.7	130	150	Max	ns
t _{OFF}	Switch turn-off time	NCx or NOx = 1.5V, RL = 50Ω, CL = 35pF, Figure 7	2.7	120	140	Max	ns
t _B	Break before make time	NCx or NOx = 1.5V, RL = 50Ω, CL = 35pF, Figure 8	2.7	50		Typ	ns
Q	Charge Injection	C _L = 1.0nF, V _{GEN} = 0V, R _{GEN} = 0Ω, Figure 9	3	10		Typ	pC
	OFF-Isolation	f = 100kHz, RL = 50Ω, Figure 10	5	-65		Typ	dB
	Crosstalk	f = 100kHz, RL = 50Ω, Figure 11	5	-65		Typ	dB
	Channel to Channel Crosstalk	f = 100kHz, Figure 12	5	-120		Typ	dB
BW	Bandwidth	R _L = 50Ω	3	80		Typ	MHz
THD	Total Harmonic Distortion	R _L = 32Ω, V _{IN} = 1V _{RMS} , f = 20Hz to 20kHz	3.3	-69		Typ	dB

V_{CC} = 1.65 to 1.95V, unless otherwise noted.

Symbol	Parameter	Conditions	V _{CC} (V)	25°C	-40°C to 85°C	Limit	Unit
I _{CC}	Quiescent Supply Current	V _{IN} = 0V or V _{CC}	1.95	1	2	Max	μA
V _{IH}	Input Voltage High				1.2	Min	V
V _{IL}	Input Voltage Low				0.4	Max	V
I _{IN}	Control Input Leakage	V _{IN} = 0V or V _{CC}	1.95		±1	Max	μA
R _{ON}		I _{OUT} = 10mA, NCx or NOx = 0V, 0.8V, 1V	1.65	2		Typ	Ω
			1.65	6	10	Max	Ω
ΔR _{ON}	ON resistance match	I _{OUT} = 10mA, NCx or NOx = 0V, 0.8V, 1V	1.65	0.2		Typ	Ω
			1.65	1	1.5	Max	Ω
t _{PHL} , t _{PLH}	Switch IN to OUT time	NCx or NOx = 1V, RL = 50Ω, CL = 35pF, Figure 7	1.65	10		Typ	ns
t _{ON}	Switch turn-on time	NCx or NOx = 1V, RL = 50Ω, CL = 35pF, Figure 7	1.65	240	300	Max	ns
t _{OFF}	Switch turn-off time	NCx or NOx = 1V, RL = 50Ω, CL = 35pF, Figure 7	1.65	240	300	Max	ns
t _B	Break before make time	NCx or NOx = 1V, RL = 50Ω, CL = 35pF, Figure 8	1.65	50		Typ	ns

Typical Performance Characteristics

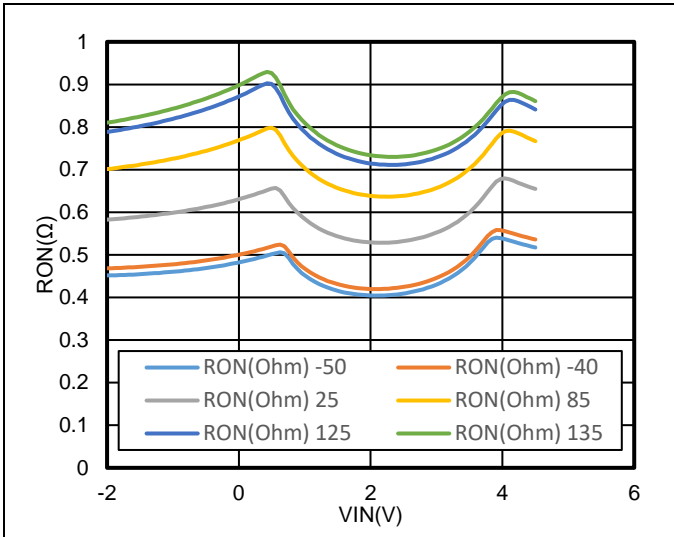


Figure 1. RON, V_{CC} = 4.5V, Temp = -40, 25, 85, 125°C

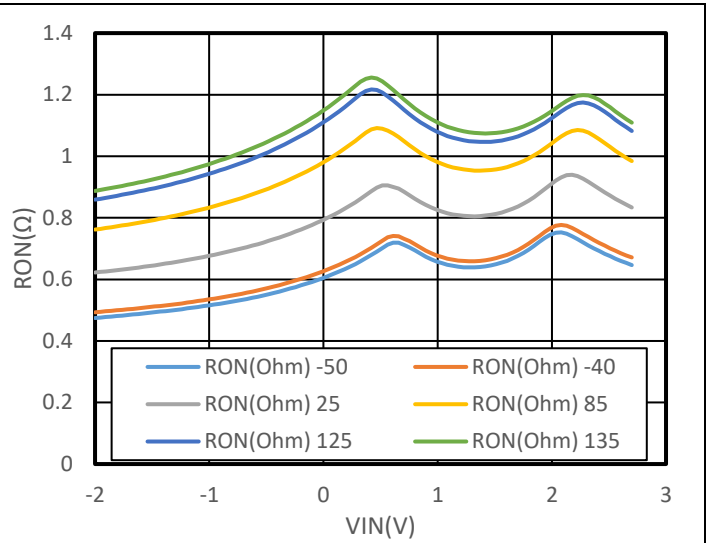


Figure 2. RON, V_{CC} = 2.7V, Temp = -40, 25, 85, 125°C

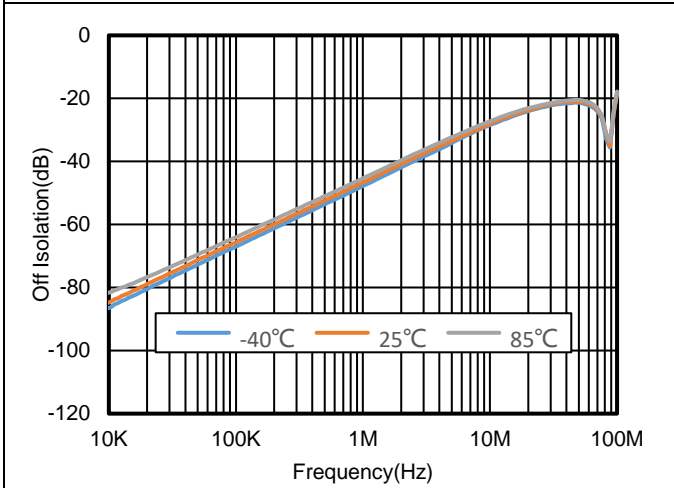


Figure 3. Off-Isolation, V_{CC} = 2.7V

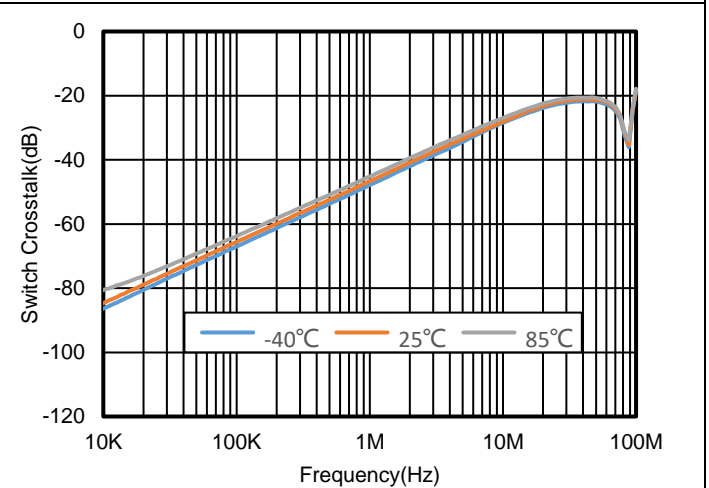


Figure 4. Crosstalk, V_{CC} = 2.7V

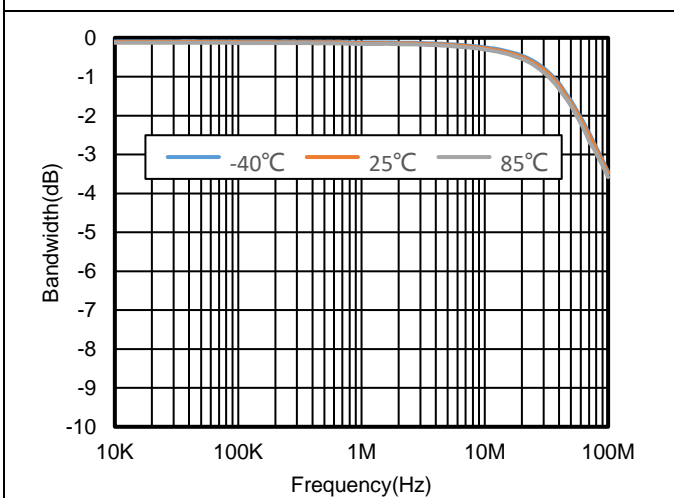


Figure 5. Bandwidth, V_{CC} = 2.7V

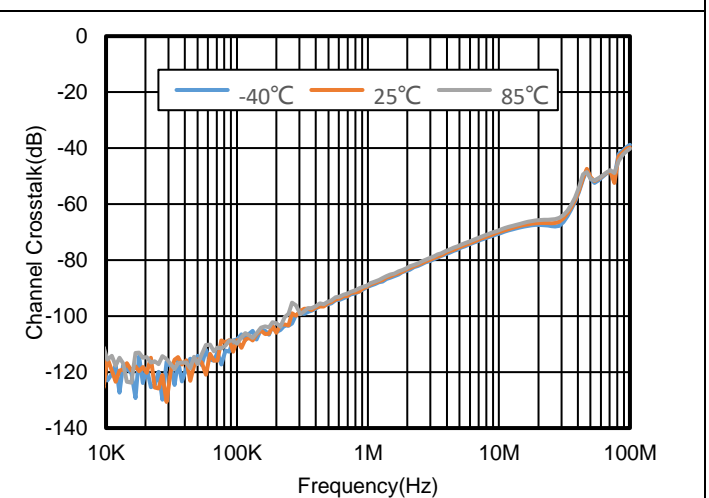
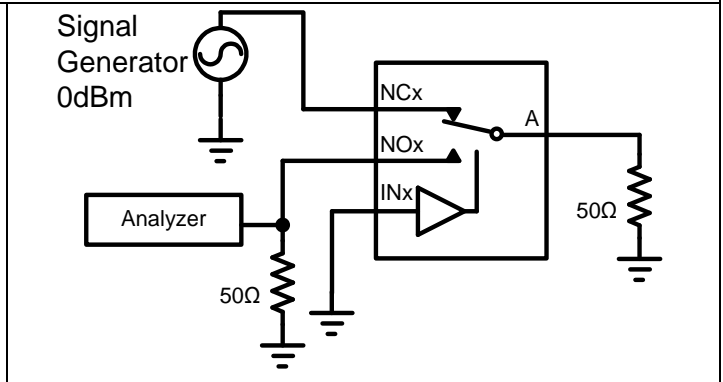
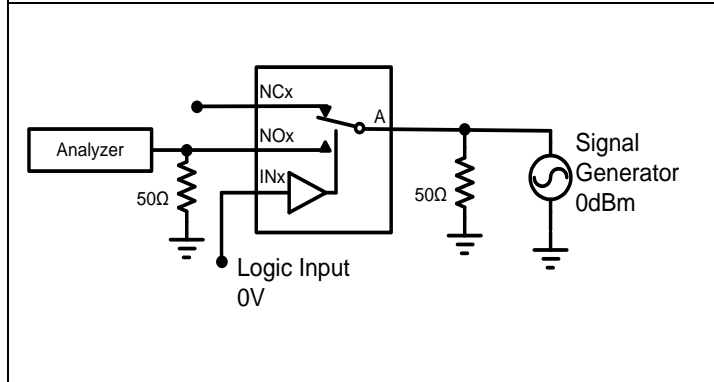
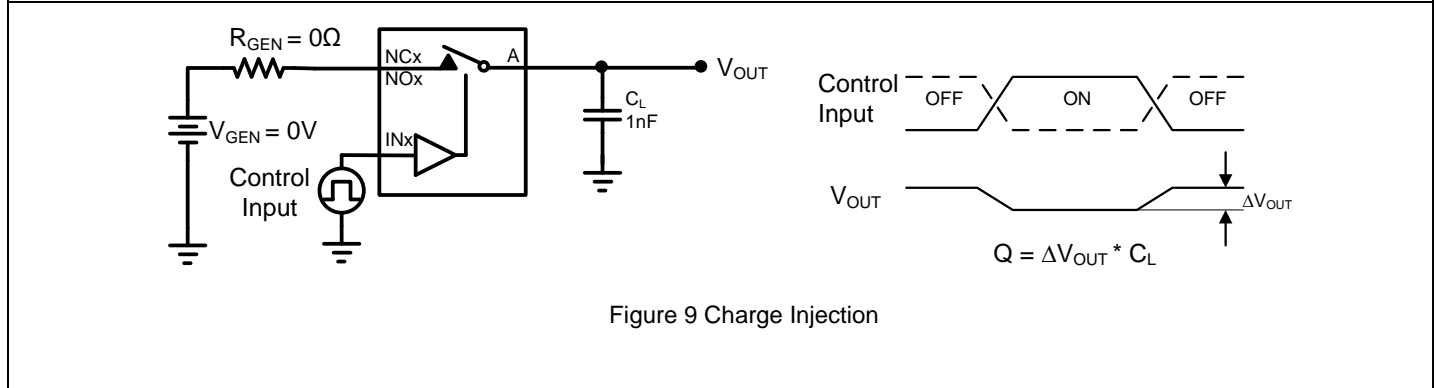
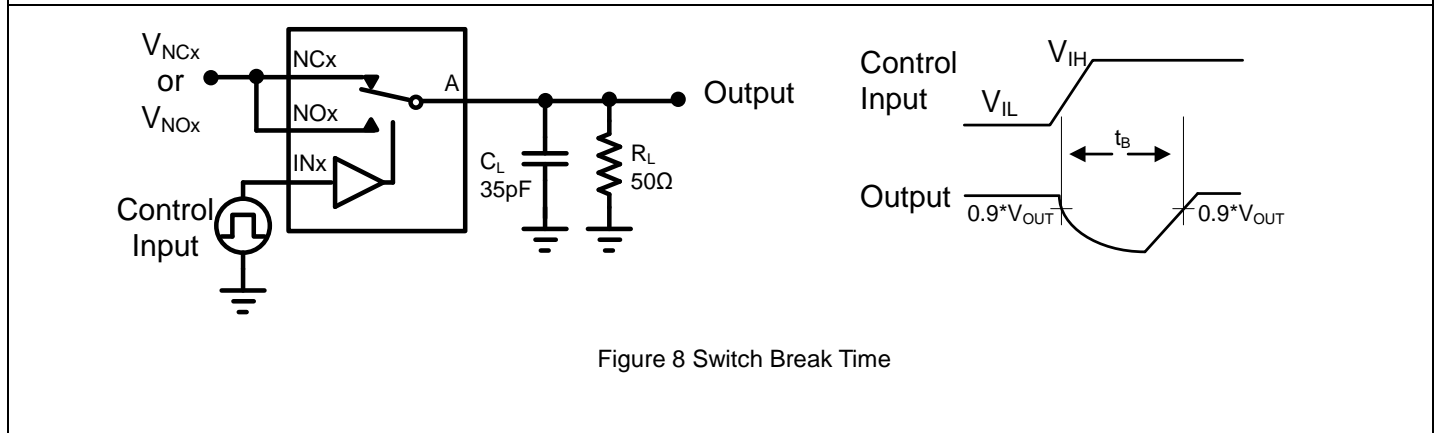
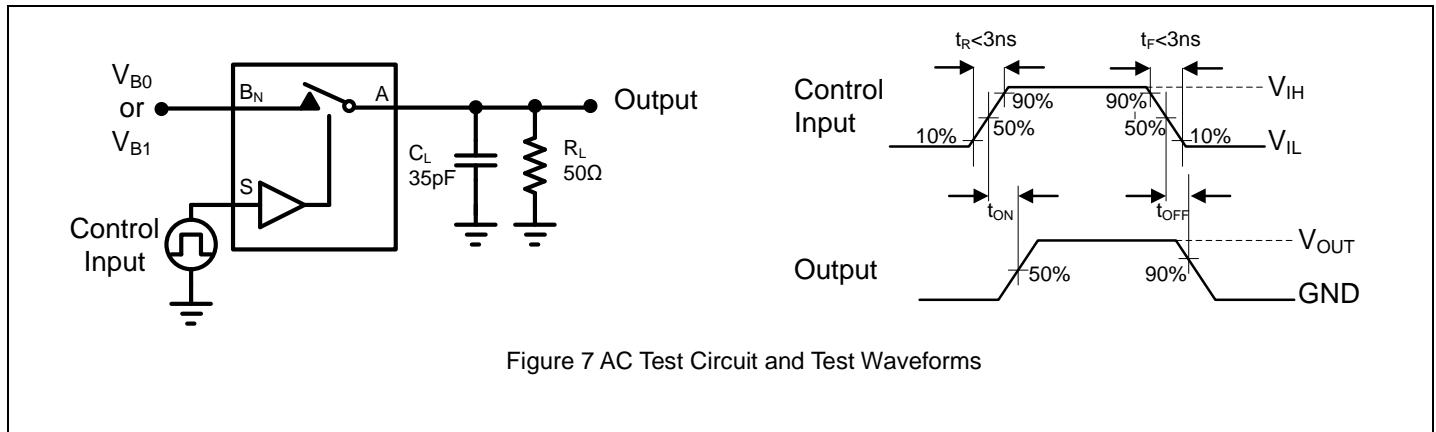
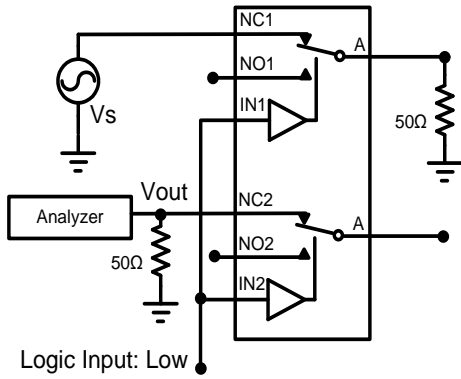


Figure 6. Channel to Channel Crosstalk, V_{CC} = 2.7V

Test Circuit and Waveforms





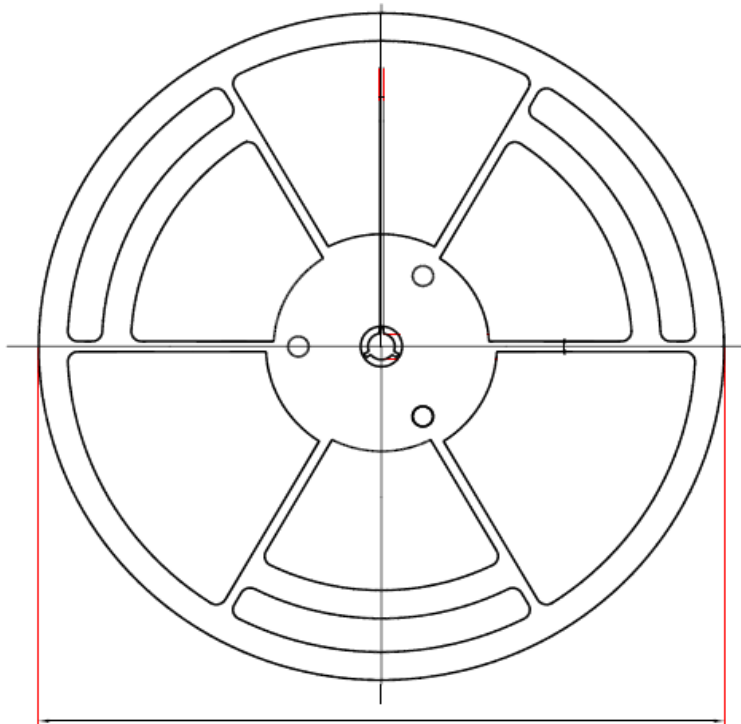
Channel to Channel Crosstalk = $20 \cdot \log(V_{out}/V_s)$

Figure 12 Channel to Channel Crosstalk, NC1 to NC2

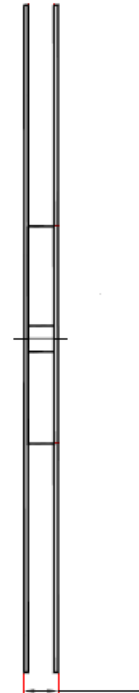
Application Information

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

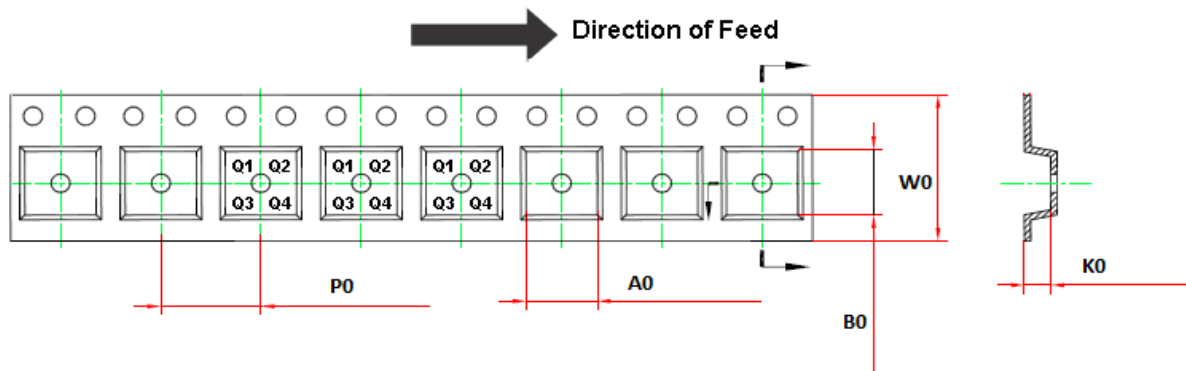
Tape and Reel Information



D1: Reel Diameter



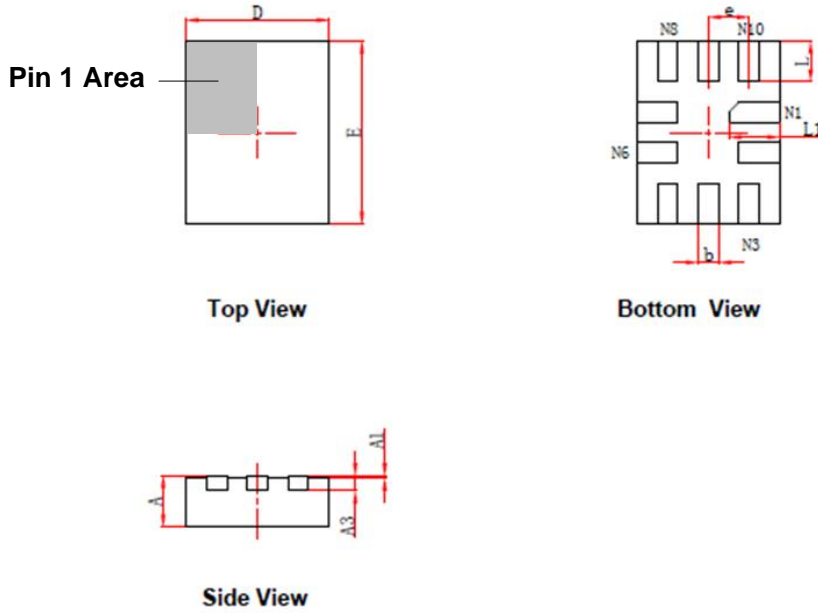
W1: Reel Width



Order Number	Package	D1	W1	A0	B0	K0	P0	W0	Pin1 Quadrant
TPW1221-QF2AR	10-Pin QFN	180	13.1	1.6	2.0	0.85	4	8	Q1

Package Outline Dimensions

QFN-10



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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