

Features

- Latch-up Performance Exceeds 800 mA per JESD 78, Class II
- Supply Voltage: 1.65 V to 5.5 V
- Low On-State Resistance: Typical 0.95 Ω at $V_S = 4.5$ V
- Bandwidth: 100 MHz
- Fast Switching Times: $t_{ON} = 40$ ns, $t_{OFF} = 15$ 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

Description

The TPW3221 is a high-performance Single Pole/Double Throw (SPDT) analog switch. The device features ultra-low RON of 1.2- 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 TPW3221 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 a direct interface with processor general purpose I/Os.

The TPW3221 has very excellent channel-to-channel crosstalk performance to fit the applications with high channel-to-channel isolation requirements.

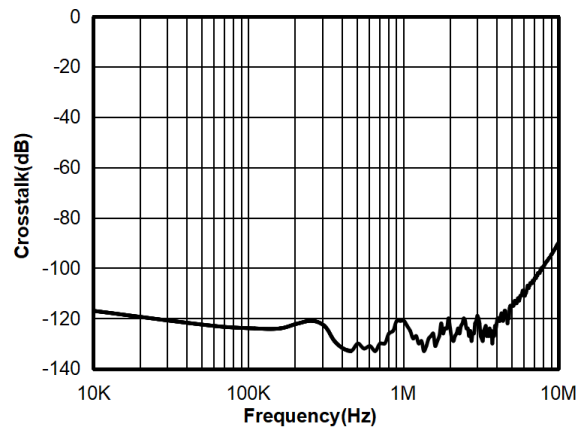


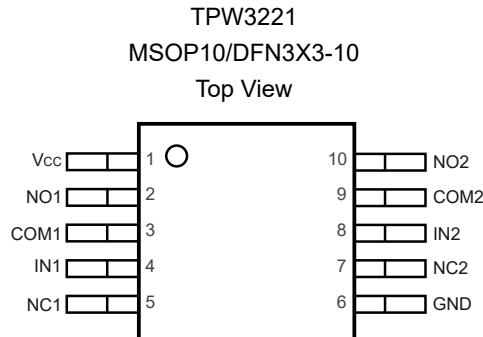
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Revision History

Date	Revision	Notes
2018-06-24	Rev.Pre.0	Pre-release version.
2019-01-28	Rev.A.0	Initial version.
2019-07-24	Rev.A.1	<ul style="list-style-type: none">• Updated the Tape and Reel Information of the TPW3221-FR: from 3000 to 4000.• Removed the data code information.• Corrected the t_{OFF} test condition in figure 6: from 50% of output to 90% of output.• Changed the spec of ΔR_{ON} at 1.65 V_{CC} change: from 2/3/3 ohm to 5/7/7 ohm.• Changed the spec of $t_{ON}/t_{OFF}/t_B$ at 1.65 V_{CC} change: from "max" to "typ".
2024-12-04	Rev.A.2	<p>The following updates are all about the new datasheet formats or typos, and the actual product remains unchanged.</p> <p>Updated to a new datasheet format.</p> <p>Updated the Package Outline Dimensions.</p>

Pin Configuration and Functions



The thermal pad of the DFN package is recommended to be left float.

Table 1. Pin Functions

Pin No.	Name	I/O	Description
1	V _{CC}		Power supply
2	NO1		Switch port 1, normal open
3	COM1		Common switch port 1
4	IN1		Select pin 1
5	NC1		Switch port 1, normal close
6	GND		Ground
7	NC2		Switch port 2, normal close
8	IN2		Select pin 2
9	COM2		Common switch port 2
10	NO2		Switch port 2, normal open

Table 2. Function Table

IN1, IN2	NC1, NC2	NO1, NO2
Low	ON	OFF
High	OFF	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		200	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⁾	4	kV
CDM	Charged Device Model ESD	ANSI/ESDA/JEDEC JS-002 ⁽²⁾	2	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}	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
Operating Temperature Range	-40	125	°C

(1) The select input must be held HIGH or LOW and must not float.

Thermal Information

Package Type	θ_{JA}	θ_{JC}	Unit
MSOP10	150	100	°C/W

Low-Voltage 1-Ω SPDT Analog Switch

Package Type	θ_{JA}	θ_{JC}	Unit
DFN3X3-10	75	54	°C/W

Low-Voltage 1-Ω SPDT Analog Switch
Electrical Characteristics

 All test conditions: $V_{CC} = 4.5\text{ V to }5.5\text{ V}$, 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	0.3	0.5	1.5	Max	μA
ΔI_{CC}	Increase in I_{CC} per Input	Select input at 2.7 V, others at V_{CC} or GND	4.3	30	35	35	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	$V_{IN} = 0\text{ V or }V_{CC}$	5.5		± 1	± 1	Max	μA
Analog Switch								
R_{ON}		$I_{OUT} = 100\text{ mA}$, NCx or $NOx = 3.5\text{ V}$	4.5	0.95			Typ	Ω
R_{ON}		$I_{OUT} = 100\text{ mA}$, NCx or $NOx = 3.5\text{ V}$	4.5	1.2	1.4	1.5	Max	Ω
ΔR_{ON}	Maximum ON Resistance	$I_{OUT} = 100\text{ mA}$, NCx or $NOx = 3.5\text{ V}$	4.5	0.12	0.15	0.2	Max	Ω
$R_{FLAT(ON)}$	On Resistance Flatness	$I_{OUT} = 100\text{ mA}$, NCx or $NOx = 0\text{ V, }1\text{ V, }2\text{ V}$	4.5	0.3	0.4	0.5	Max	Ω
$I_{NO(OFF)}$, $I_{NC(OFF)}$	Switch OFF Leakage Current on B0, B1	$COMx = 1\text{ V, }4.5\text{ V}$, NCx or $NOx = 4.5\text{ V, }1\text{ V}$	5.5	± 10	± 25	± 50	Max	nA
$I_{A(OFF)}$	Switch OFF Leakage Current on A	$COMx = 1\text{ V, }4.5\text{ V}$, NCx or $NOx = 4.5\text{ V, }1\text{ V}$	5.5	± 10	± 50	± 100	Max	nA
$I_{A(ON)}$	Switch ON Leakage Current on A	$COMx = 1\text{ V, }4.5\text{ V}$, NCx or $NOx = 1\text{ V, }4.5\text{ V or Floating}$	5.5	± 10	± 50	± 100	Max	nA
Dynamic Characteristics								
t_{PHL} , t_{PLH}	Switch IN to OUT Time	NCx or $NOx = 3\text{ V}$, $R_L = 50\ \Omega$, $C_L = 35\text{ pF}$, Figure 7	4.5	5			Typ	ns
t_{ON}	Switch Turn-on Time	NCx or $NOx = 3\text{ V}$, $R_L = 50\ \Omega$, $C_L = 35\text{ pF}$, Figure 7	4.5	40	45	45	Max	ns
t_{OFF}	Switch Turn-off Time	NCx or $NOx = 3\text{ V}$, $R_L = 50\ \Omega$, $C_L = 35\text{ pF}$, Figure 7	4.5	15	20	20	Max	ns
t_B	Break-Before-Make Time	NCx or $NOx = 3\text{ V}$, $R_L = 50\ \Omega$, $C_L = 35\text{ pF}$, Figure 8	4.5	20	40	40	Typ	ns
Q	Charge Injection	$C_L = 1.0\text{ nF}$, $V_{GEN} = 0\text{ V}$, $R_{GEN} = 0\ \Omega$, Figure 9	5.5	20			Typ	pC

Low-Voltage 1-Ω SPDT Analog Switch

Symbol	Parameter	Conditions	V _{CC} (V)	25°C	-40°C to 85°C	-40°C to 125°C	Limit	Unit
	OFF-Isolation	f = 1 MHz, R _L = 50 Ω, Figure 10	5	-65			Typ	dB
	Crosstalk	f = 1 MHz, R _L = 50 Ω, Figure 11	5	-65			Typ	dB
	Channel-to-Channel Crosstalk	f = 1 MHz, Figure 12	5	-120			Typ	dB
BW	Bandwidth	R _L = 50 Ω	5	100			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
C _{ON}	On Capacitance		5	40			Typ	pF

Low-Voltage 1-Ω SPDT Analog Switch
Electrical Characteristics (Continued)

 All test conditions: $V_{CC} = 2.7\text{ V to }3.6\text{ V}$, 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	0.3	0.5	1.5	Max	μA
Digital Input								
V_{IH}	Input Voltage High				1.65	1.65	Min	V
V_{IL}	Input Voltage Low				0.6	0.6	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}		$I_{OUT} = 100\text{ mA}$, $NCx\text{ or }NOx = 1.5\text{ V}$	2.7	2			Typ	Ω
R_{ON}		$I_{OUT} = 100\text{ mA}$ $NCx\text{ or }NOx = 1.5\text{ V}$	2.7	2.1	2.3	2.6	Max	Ω
ΔR_{ON}	Maximum ON resistance	$I_{OUT} = 100\text{ mA}$, $NCx\text{ or }NOx = 1.5\text{ V}$	2.7	0.1	0.15	0.2	Max	Ω
$R_{FLAT(ON)}$	On Resistance Flatness	$I_{OUT} = 100\text{ mA}$, $NCx\text{ or }NOx = 0\text{ V, }0.75\text{ V, }1.5\text{ V}$	2.7	1.2	1.3	1.4	Max	Ω
$I_{NO(OFF)}$, $I_{NC(OFF)}$	Switch OFF Leakage Current on B0, B1	$COMx = 0\text{ V, }3.6\text{ V}$, $NCx\text{ or }NOx = 3.6\text{ V, }0\text{ V}$	3.6	± 10	± 25	± 50	Max	nA
$I_{A(OFF)}$	Switch OFF Leakage Current on A	$COMx = 0\text{ V, }3.6\text{ V}$, $NCx\text{ or }NOx = 3.6\text{ V, }0\text{ V}$	3.6	± 10	± 50	± 100	Max	nA
$I_{A(ON)}$	Switch ON Leakage Current on A	$COMx = 0\text{ V, }3.6\text{ V}$, $NCx\text{ or }NOx = 0\text{ V, }3.6\text{ V or Floating}$	3.6	± 10	± 50	± 100	Max	nA
Dynamic Characteristics								
t_{PHL} , t_{PLH}	Switch IN to OUT Time	$NCx\text{ or }NOx = 1.5\text{ V}$, $R_L = 50\ \Omega$, $C_L = 35\text{ pF}$, Figure 7	2.7	10			Typ	ns
t_{ON}	Switch Turn-on Time	$NCx\text{ or }NOx = 1.5\text{ V}$, $R_L = 50\ \Omega$, $C_L = 35\text{ pF}$, Figure 7	2.7	60	70	70	Max	ns
t_{OFF}	Switch Turn-off Time	$NCx\text{ or }NOx = 1.5\text{ V}$, $R_L = 50\ \Omega$, $C_L = 35\text{ pF}$, Figure 7	2.7	25	30	30	Max	ns
t_B	Break-Before-Make Time	$NCx\text{ or }NOx = 1.5\text{ V}$, $R_L = 50\ \Omega$, $C_L = 35\text{ pF}$, Figure 8	2.7	20			Typ	ns
Q	Charge Injection	$C_L = 1.0\text{ nF}$, $V_{GEN} = 0\text{ V}$, $R_{GEN} = 0\ \Omega$, Figure 9	3	20			Typ	pC

Low-Voltage 1-Ω SPDT Analog Switch

Symbol	Parameter	Conditions	V _{CC} (V)	25°C	-40°C to 85°C	-40°C to 125°C	Limit	Unit
	OFF-Isolation	f = 1 MHz, R _L = 50 Ω, Figure 10	3	-65			Typ	dB
	Crosstalk	f = 1 MHz, R _L = 50 Ω, Figure 11	3	-65			Typ	dB
	Channel-to-Channel Crosstalk	f = 1 MHz, Figure 12	3	-120			Typ	dB
BW	Bandwidth	R _L = 50 Ω	3	100			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	%

Electrical Characteristics (Continued)

 All test conditions: $V_{CC} = 1.65\text{ V to }1.95\text{ V}$, 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	$V_{IN} = 0\text{ V or }V_{CC}$	1.95	0.3	0.5	1.5	Max	μA
Digital Input								
V_{IH}	Input Voltage High				1.4	1.4	Min	V
V_{IL}	Input Voltage Low				0.4	0.4	Max	V
I_{IN}	Control Input Leakage	$V_{IN} = 0\text{ V or }V_{CC}$	1.95		± 1	± 1	Max	μA
Analog Switch								
R_{ON}		$I_{OUT} = 10\text{ mA}$, $NCx\text{ or }NOx = 0.9\text{ V}$	1.65	10			Typ	Ω
R_{ON}		$I_{OUT} = 10\text{ mA}$, $NCx\text{ or }NOx = 0.9\text{ V}$	1.65	15	18	18	Max	Ω
ΔR_{ON}	Maximum ON resistance	$I_{OUT} = 10\text{ mA}$, $NCx\text{ or }NOx = 0.9\text{ V}$	1.65	5	7	7	Max	Ω
$I_{NO(OFF)}$, $I_{NC(OFF)}$	Switch OFF Leakage Current on B0, B1	$COMx = 0\text{ V, }1.95\text{ V}$, $NCx\text{ or }NOx = 1.95\text{ V, }0\text{ V}$	1.95	± 10	± 25	± 50	Max	nA
$I_{A(OFF)}$	Switch OFF Leakage Current on A	$COMx = 0\text{ V, }1.95\text{ V}$, $NCx\text{ or }NOx = 1.95\text{ V, }0\text{ V}$	1.95	± 10	± 50	± 100	Max	nA
$I_{A(ON)}$	Switch ON Leakage Current on A	$COMx = 0\text{ V, }1.95\text{ V}$, $NCx\text{ or }NOx = 0\text{ V, }1.95\text{ V}$ or Floating	1.95	± 10	± 50	± 100	Max	nA
Dynamic Characteristics								
t_{PHL} , t_{PLH}	Switch IN to OUT time	$NCx\text{ or }NOx = 1.0\text{ V}$, $R_L = 50\ \Omega$, $C_L = 35\text{ pF}$, Figure 7	1.65	10			Typ	ns
t_{ON}	Switch Turn-on Time	$NCx\text{ or }NOx = 1.0\text{ V}$, $R_L = 50\ \Omega$, $C_L = 35\text{ pF}$, Figure 7	1.65	80			Typ	ns
t_{OFF}	Switch Turn-off Time	$NCx\text{ or }NOx = 1.0\text{ V}$, $R_L = 50\ \Omega$, $C_L = 35\text{ pF}$, Figure 7	1.65	55			Typ	ns
t_B	Break-Before-Make Time	$NCx\text{ or }NOx = 1.0\text{ V}$, $R_L = 50\ \Omega$, $C_L = 35\text{ pF}$, Figure 8	1.65	20			Typ	ns
Q	Charge Injection	$C_L = 1.0\text{ nF}$, $V_{GEN} = 0\text{ V}$, $R_{GEN} = 0\ \Omega$, Figure 9	1.8	20			Typ	pC
	OFF-Isolation	$f = 1\text{ MHz}$, $R_L = 50\ \Omega$, Figure 10	1.8	-65			Typ	dB
	Crosstalk	$f = 1\text{ MHz}$, $R_L = 50\ \Omega$, Figure 11	1.8	-65			Typ	dB

Low-Voltage 1- Ω SPDT Analog Switch

Symbol	Parameter	Conditions	V _{CC} (V)	25°C	-40°C to 85°C	-40°C to 125°C	Limit	Unit
	Channel-to-Channel Crosstalk	f = 1 MHz, Figure 12	1.8	-120			Typ	dB
BW	Bandwidth	R _L = 50 Ω	1.8	100			Typ	MHz
THD	Total Harmonic Distortion	R _L = 600 Ω , V _{IN} = 0.5 V _{PP} , f = 20 Hz to 20 kHz	1.8	0.01			Typ	%

Electrical Characteristics (Continued)

All test conditions: $T_{COMx} = 0^{\circ}\text{C}$ to 50°C , unless otherwise noted.

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

Typical Performance Characteristics

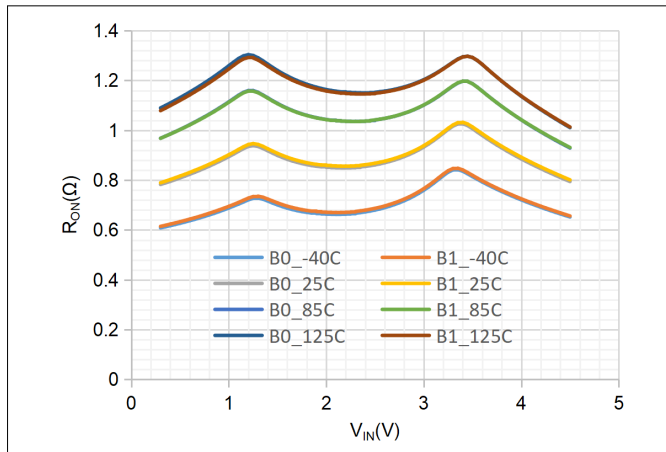


Figure 1. R_{ON} , $V_{CC} = 4.5\text{ V}$, Temp = $-40, 25, 85, 125^{\circ}\text{C}$

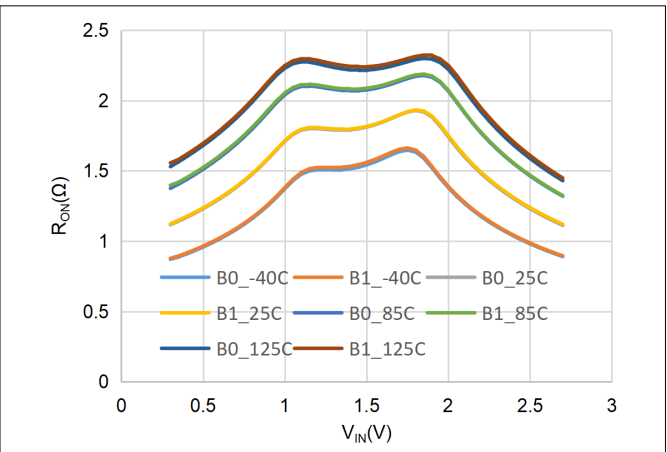


Figure 2. R_{ON} , $V_{CC} = 2.7\text{ V}$, Temp = $-40, 25, 85, 125^{\circ}\text{C}$

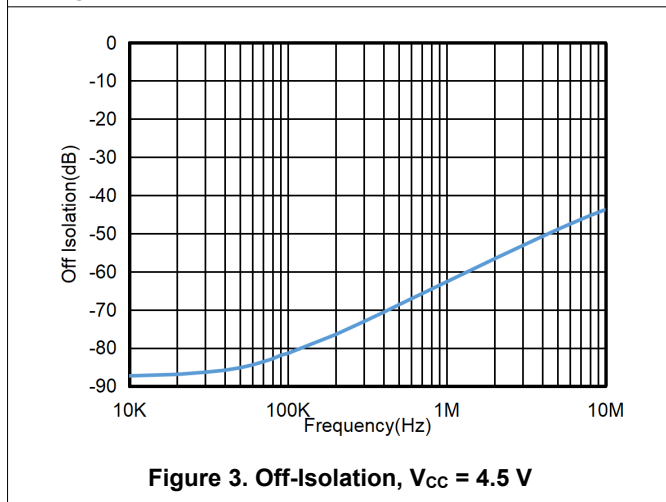


Figure 3. Off-Isolation, $V_{CC} = 4.5\text{ V}$

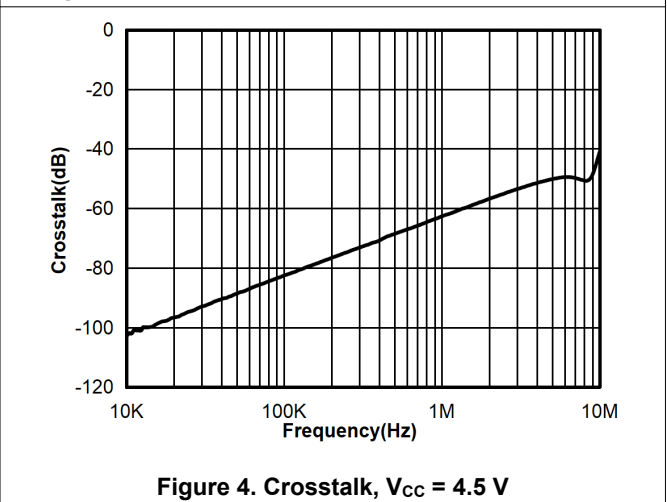


Figure 4. Crosstalk, $V_{CC} = 4.5\text{ V}$

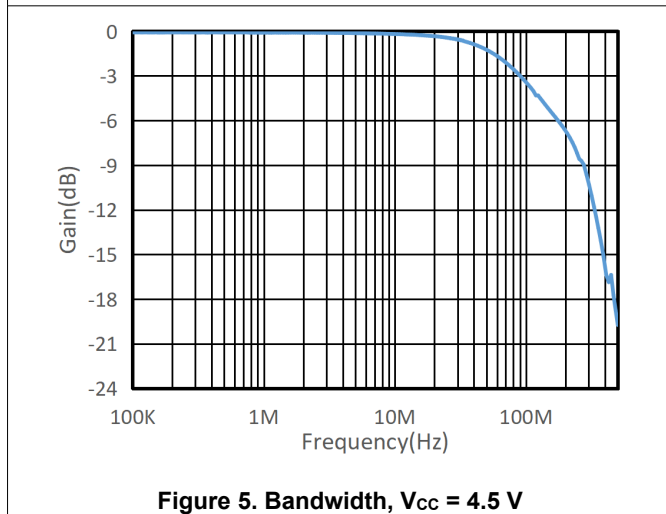


Figure 5. Bandwidth, $V_{CC} = 4.5\text{ V}$

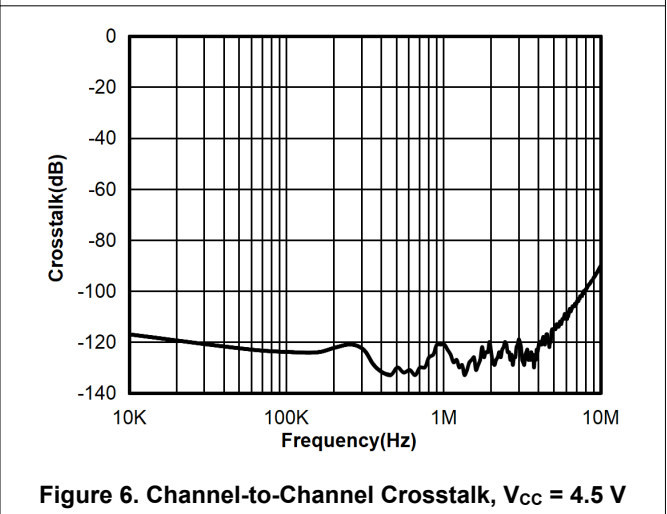


Figure 6. Channel-to-Channel Crosstalk, $V_{CC} = 4.5\text{ V}$

Low-Voltage 1-Ω SPDT Analog Switch

Test Circuit and Waveforms

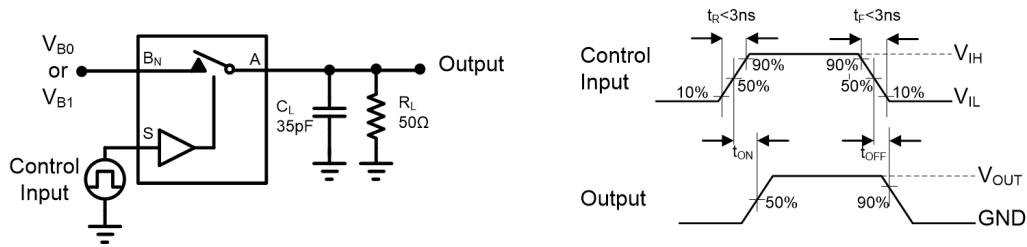


Figure 7. AC Test Circuit and Test Waveforms

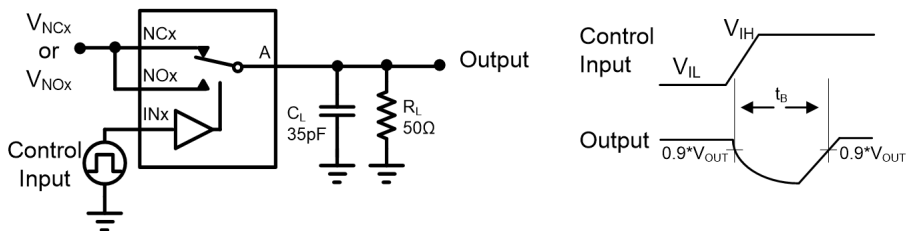


Figure 8. Switch Break Time

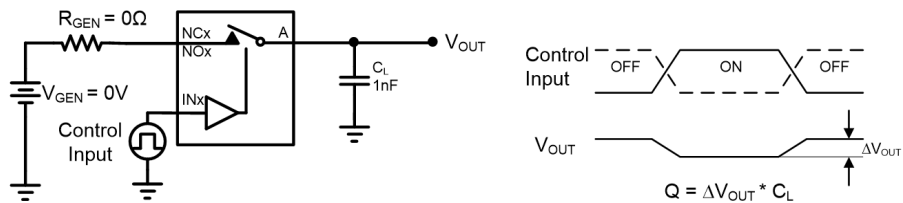


Figure 9. Charge Injection

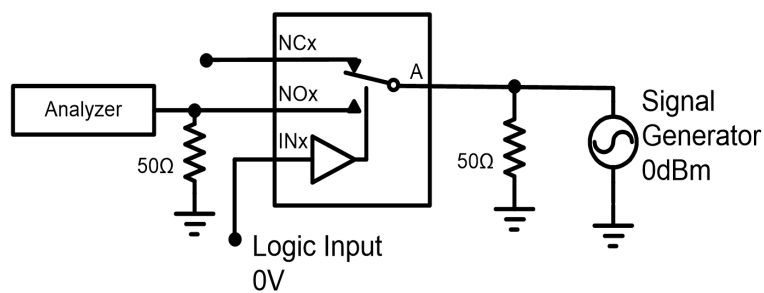


Figure 10. Off Isolation

Low-Voltage 1-Ω SPDT Analog Switch

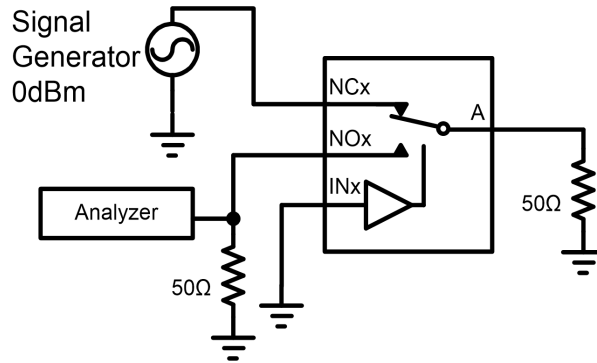


Figure 11. Crosstalk

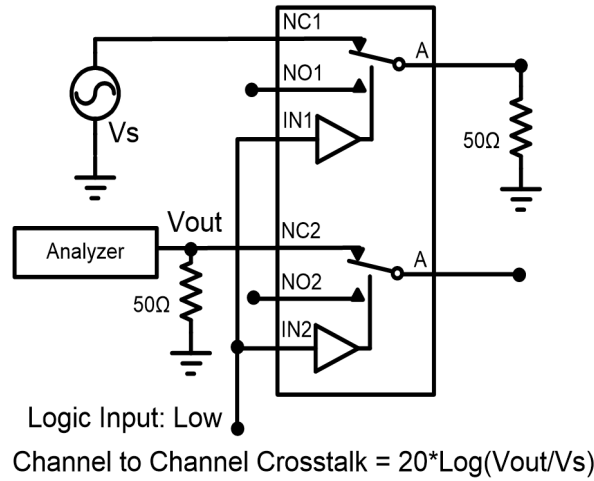


Figure 12. Channel-to-Channel Crosstalk, NC1 to NC2

Application and Implementation

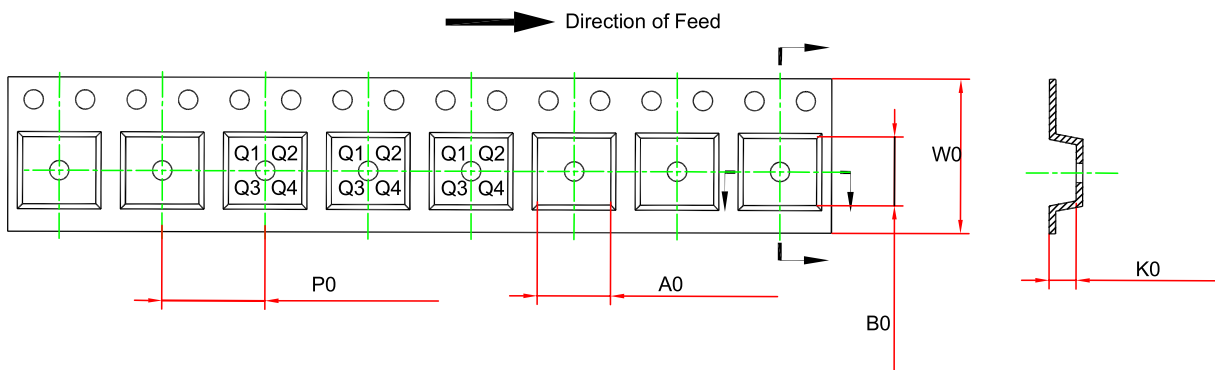
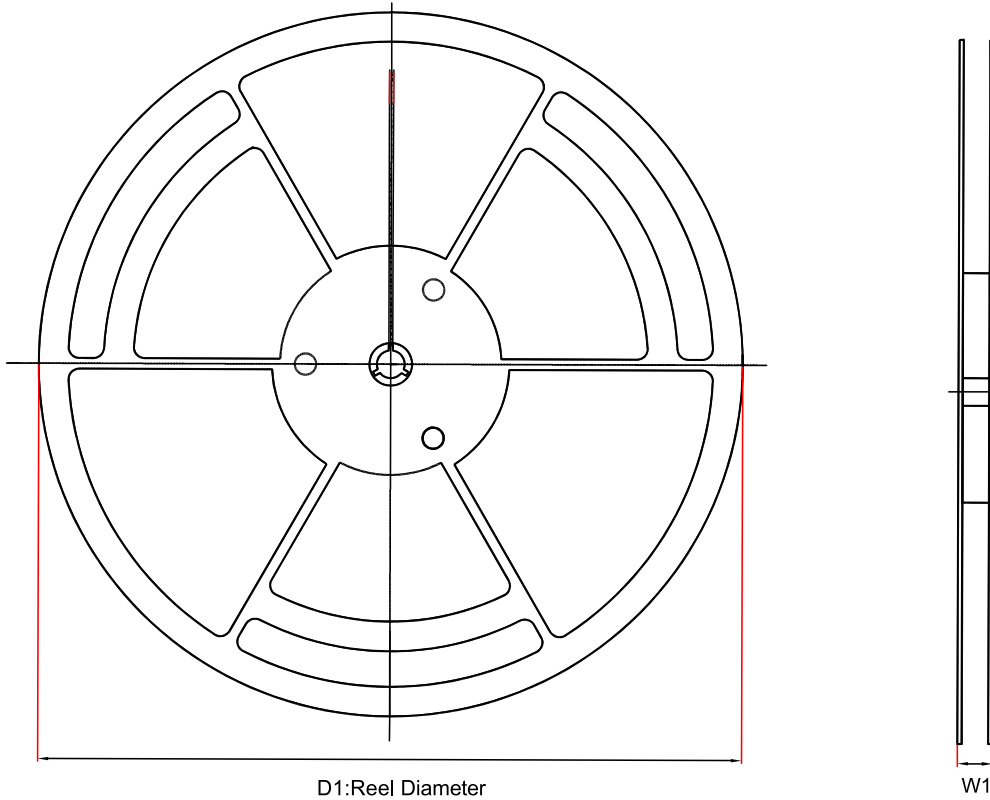
Note

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 V_{CC} and GND is recommended to prevent power disturbance.

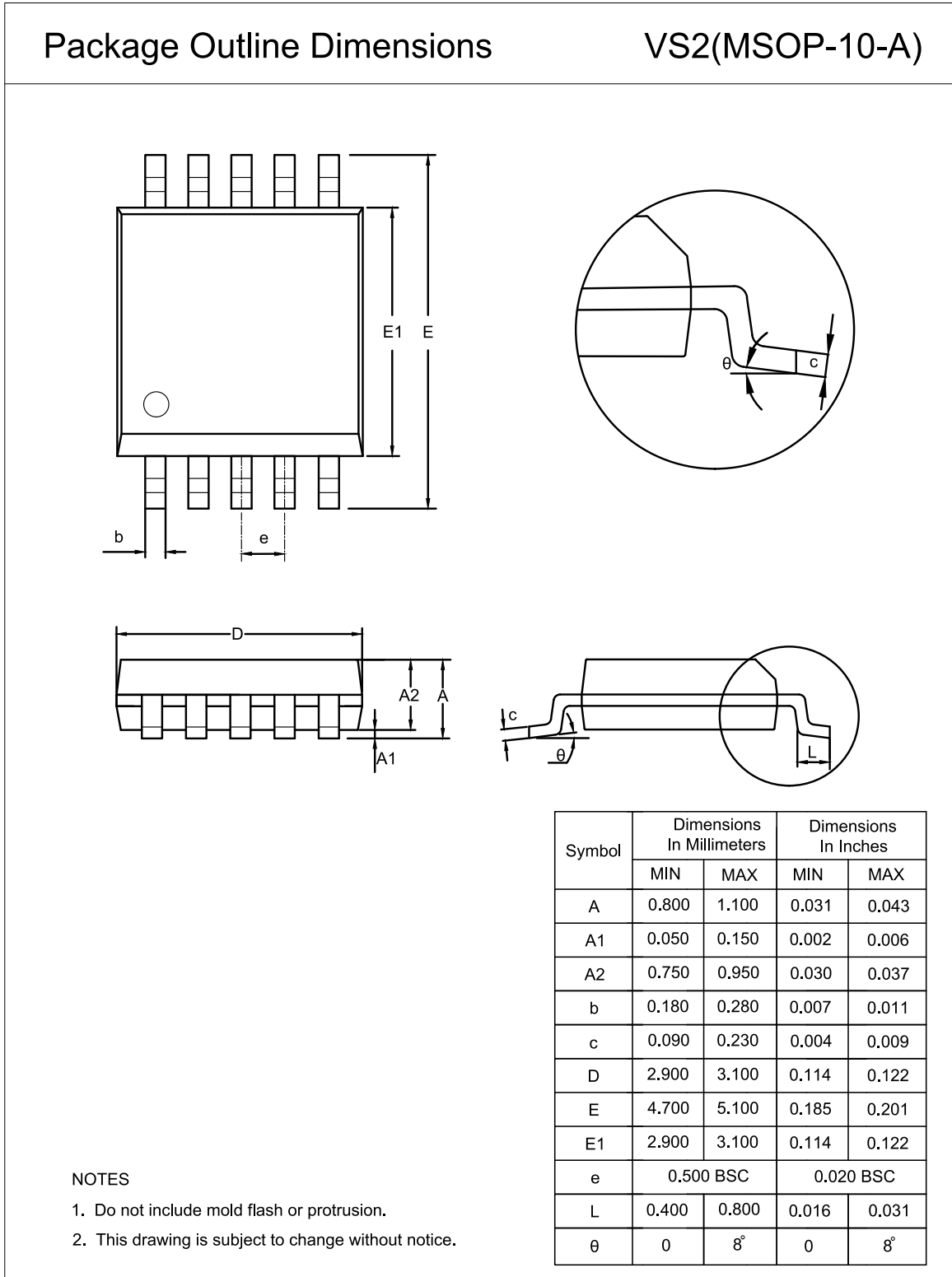
Tape and Reel Information



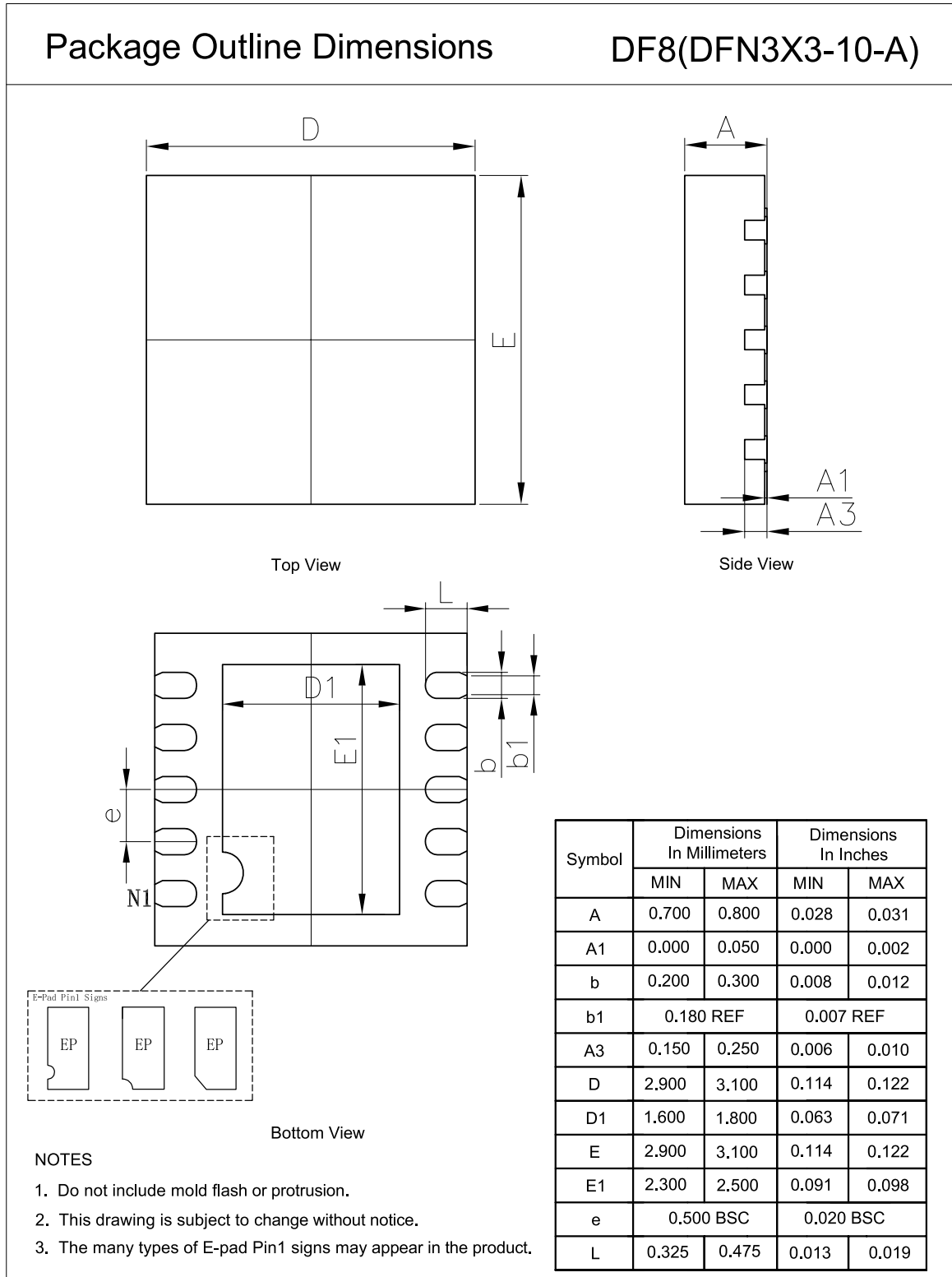
Order Number	Package	D1 (mm)	W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	W0 (mm)	Pin1 Quadrant
TPW3221-VR	MSOP10	330.0	17.6	5.20	3.30	1.50	8.00	12.00	Q1
TPW3221-FR	DFN3X3-10	330.0	17.6	3.35	3.35	1.13	8.00	12.00	Q1

Package Outline Dimensions

MSOP10



DFN3X3-10



Order Information

Order Number	Operating Temperature Range	Package	Marking Information	MSL	Transport Media, Quantity	Eco Plan
TPW3221-VR	-40 to 125°C	MSOP10	W3221	3	Tape and Reel, 3000	Green
TPW3221-FR	-40 to 125°C	DFN3X3-10	W3221	3	Tape and Reel, 4000	Green

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

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