High-Speed 1:2 Multiplexer and Demultiplexer Analog Switch

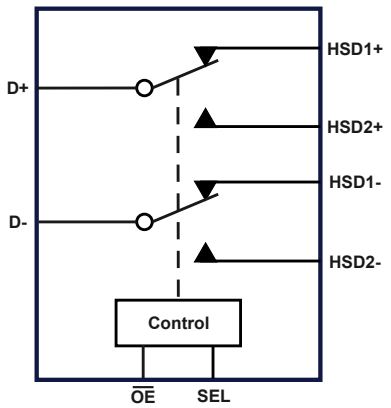
Features

- V_{CC} Supply Voltage: 1.8 V to 5.5 V
- $V_{I/O}$ Accepts Signals up to 5.5 V
- 1.8-V Compatible Control-Pin Inputs (S, $\overline{OE}$)
- Low-Power Mode When OE is Disabled (1 μA)
- R_{ON} = 7.3 Ω Typical at 3 V
- $^{\triangle}R_{ON}$ = 0.8 Ω Typical
- $C_{io(on)}$ = 3.6 pF
- Low Power Consumption (7 μA)
- High Bandwidth: 2.5 GHz
- Break-Before-Make Switching
- Operation Temperature Range: –40°C to 125°C

Applications

- Industry Control Systems
- Mobile Phones
- Routes Signals for USB 1.0, 1.1, and 2.0
- Notebooks
- USB I/O Expansion

Block Diagram and Function Table



$\overline{OE}$	S	HSD1+, HSD1-	HSD2+, HSD2-
Low	Low	ON	OFF
Low	High	OFF	ON
High	X	OFF	OFF

NOTE: Switches shown for logic "0" input.

Description

The TPW3227 is a high-bandwidth analog switch designed for the switching of high-speed USB 2.0 signals in handsets and consumer electronics, such as notebooks and mobile phones, especially those equipped with hubs and controllers featuring limited USB I/Os. The device operates over the wide V_{CC} range from 1.8 V to 5.5 V.

The wide bandwidth (2.5 GHz) of the TPW3227 allows signals to pass with minimum edge, delay, and phase distortion. The device multiplexes differential output from a USB host device to one of two corresponding outputs. The switch is bidirectional and offers little or no attenuation of the high-speed signals at the outputs. The switch consumes very low quiescent current less than 1 μA in a low power mode and is suitable for portable applications with a battery or limited power budget. The device has a very low bit-to-bit skew and excellent channel-to-channel crosstalk to fit applications with high channel-to-channel crosstalk requirements.

The TPW3227 device integrates ESD protection cells on all pins, is available in a tiny UTQFN package (1.4 mm x 1.8 mm), and is characterized over the free air temperature range from −40℃ to 125℃.

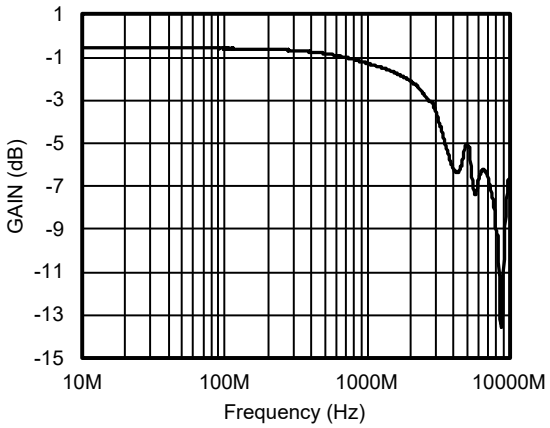


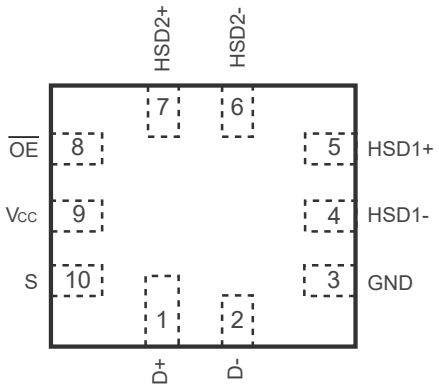
Table of Contents

Revision History

Date	Revision	Notes
2025-07-12	Rev.A.0	Initial Version.
2025-09-08	Rev.A.1	The following updates are all about the new datasheet formats or typos, and the actual product remains unchanged. • Changed the image in the Description. • Added Eye Diagrams and Jitter Images. • Adjusted some description and EC table format.

Pin Configuration and Functions

TPW3227R
QFN1.4X1.8-10
Top View



TPW3227S
QFN1.4X1.8-10
Top View

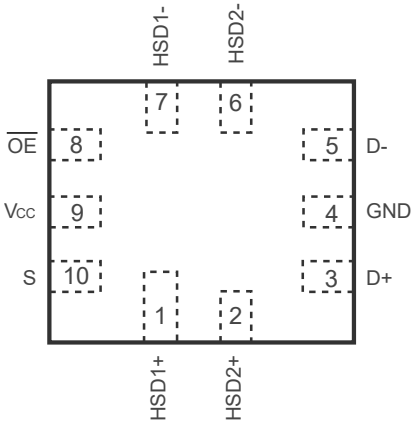


Table 1. Pin Functions： TPW3227

Pin No.		Name	I/O	Description
TPW3227R	TPW3227S			
1	3	D+	I/O	Common port
2	5	D-	I/O	Common Port
3	4	GND		Ground
4	7	HSD1-	I/O	Switch port 1
5	1	HSD1+	I/O	Switch port 1
6	6	HSD2-	I/O	Switch port 2
7	2	HSD2+	I/O	Switch port 2
8	8	$\overline{OE}$	I	Bus-switch enable
9	9	V_{CC}		Power supply
10	10	S	I	Select input

Table 2. Function Table

$\overline{OE}$	S	HSD1+, HSD1-	HSD2+, HSD2-
Low	Low	ON	OFF
Low	High	OFF	ON
High	X	OFF	OFF

Specifications

Absolute Maximum Ratings (1)

Parameter		Min	Max	Unit
	Supply Voltage, V_{CC}	0	6.5	V
	Control Input Voltage, V_S, $V_{\overline{OE}}$	−0.3	6.5	V
	Switch I/O Port Voltage	−0.3	6.5	V
	On-state Switch Continuous Current	−50	+50	mA
	On-state Switch Peak Current	−100	+100	mA
T_J	Maximum Junction Temperature		125	°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)	±1.5	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 the operating temperature range, unless otherwise noted.

Parameter	Min	Max	Unit
Supply Voltage, V_{CC}	1.8	5.5	V
Control Input Voltage, V_S, $V_{\overline{OE}}$	0	5.5	V
Switch I/O Port Voltage	0	V_{CC}	V
Operating Temperature Range	–40	125	°C

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

Thermal Information

Package Type	θ_{JA}	θ_{JC}	Unit
QFN1.4X1.8-10	150	100	°C/W

Electrical Characteristics

All test conditions: over operating temperature range, typical at T_A = 25℃, unless otherwise noted.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Power Supply						
I_{CC}	Active Supply Current	V_{CC} = 5.5 V, $\overline{OE}$ = 0 V, S = 0 V or V_{CC}, $V_{I/O}$ = 0 V or floating		4.5	7	μA
I_{STDN}	Shutdown Supply Current (low power mode)	V_{CC} = 5.5 V, $\overline{OE}$ = V_{CC}, S = 0 V or V_{CC}, $V_{I/O}$ = 0 V or floating			1	μA
ΔI_{CC}	Increase in I_{CC} per Input	V_{CC} = 5.5 V, One input at 1.8 V, others at V_{CC} or GND			12	μA
Digital Input						
V_{IH}	Input Voltage High, control pin ($\overline{OE}$, S)		1.5			V
V_{IL}	Input Voltage Low, control pin ($\overline{OE}$, S)				0.5	V
I_{IN}	Control Input Leakage	V_{CC} = 5.5 V, V_{IN} = 0 V or V_{CC}	−1		1	μA
Analog Switch						
R_{ON}	ON-state Resistance	V_{CC} = 3 V, I_{OUT} = 8 mA,V_{IN} = 0 V to 0.4 V		7.3	11	Ω
		V_{CC} = 5 V, I_{OUT} = 8 mA,V_{IN} = 0 V to 0.4 V		5.6	8	Ω
ΔR_{ON}	ON-state Resistance Match between Channels	V_{CC} = 3 V, I_{OUT} = 8 mA,V_{IN} = 0 V to 0.4 V		0.8	1	Ω
		V_{CC} = 5 V, I_{OUT} = 8 mA,V_{IN} = 0 V to 0.4 V		0.8	1	Ω
$R_{FLAT(ON)}$	On-state Resistance Flatness	V_{CC} = 3 V, I_{OUT} = 8 mA,V_{IN} = 0 V to 1 V		0.04	0.2	Ω
		V_{CC} = 5 V, I_{OUT} = 8 mA,V_{IN} = 0 V to 1 V		0.04	0.2	Ω
$I_{D(OFF)}$	Power OFF Leakage Current on D	V_{CC} = 0 V, $\overline{OE}$, S = 0 V or 3.6 V, V_D = 0 V to 3.6 V, HSDn floating	−1		1	μA
		V_{CC} = 0 V, $\overline{OE}$, S = 0 V or 5.5 V, V_D = 0 V to 5.5 V, HSDn floating	−1		1	μA
$I_{HSD(OFF)}$	Switch OFF Leakage Current on HSDn	V_{CC} = 3.6 V, $\overline{OE}$ = V_{CC}, S = 0 V or V_{CC}, V_D = 3.3 V, 0.3 V, V_{HSDn} = 0.3 V, 3.3 V	−1		1	μA
		V_{CC} = 5.5 V, $\overline{OE}$ = V_{CC}, S = 0 V or V_{CC}, V_D = 4.5 V, 1 V, V_{HSDn} = 1 V, 4.5 V	−1		1	μA

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$I_{HSD(ON)}$	Switch ON Leakage Current on HSDn	V_{CC} = 3.6 V, $\overline{OE}$ = 0 V, S = 0 V or V_{CC}, D floating, V_{HSDn} = 0.3 V or 3.3 V	−1		1	μA
		V_{CC} = 5.5 V, $\overline{OE}$ = 0 V, S = 0 V or V_{CC}, D floating, V_{HSDn} = 1 V or 4.5 V	−1		1	μA
Dynamic Characteristics						
t_{PD}	Propagation Delay	V_{CC} = 3.3 V, R_L = 50 Ω, C_L = 10 pF, Figure 17		50		ps
		V_{CC} = 5 V, R_L = 50 Ω, C_L = 10 pF, Figure 17		50		ps
skew	Output Skew Between Channels	V_{CC} = 3.3 V, R_L = 50 Ω, C_L = 10 pF		10		ps
		V_{CC} = 5 V, R_L = 50 Ω, C_L = 10 pF		10		ps
t_{ON}	Switch Turn-on Time	V_{CC} = 3.3 V, V_{IN} = 0.8 V, R_L = 50 Ω, C_L = 10 pF, Figure 11		40		ns
		V_{CC} = 5 V, V_{IN} = 0.8 V, R_L = 50 Ω, C_L = 10 pF, Figure 11		30		ns
t_{OFF}	Switch Turn-off Time	V_{CC} = 3.3 V, V_{IN} = 0.8 V, R_L = 50 Ω, C_L = 10 pF, Figure 11		15		ns
		V_{CC} = 5 V, V_{IN} = 0.8 V, R_L = 50 Ω, C_L = 10 pF, Figure 11		15		ns
t_B	Break-Before-Make Time	V_{CC} = 3.3 V, V_{IN} = 0.8 V, R_L = 50 Ω, C_L = 10 pF, Figure 12		30		ns
		V_{CC} = 5 V, V_{IN} = 0.8 V, R_L = 50 Ω, C_L = 10 pF, Figure 12		22		ns
Q	Charge Injection	V_{CC} = 3.3 V, C_L = 1.0 nF, V_{GEN} = 0 V, R_{GEN} = 0 Ω, Figure 13		4		pC
		V_{CC} = 5 V, C_L = 1.0 nF, V_{GEN} = 0 V, R_{GEN} = 0 Ω, Figure 13		5.5		pC
OISO	OFF-Isolation	V_{CC} = 3.3 V, f = 250 MHz, R_L = 50 Ω, Figure 14		−24		dB
		V_{CC} = 5 V, f = 250 MHz, R_L = 50 Ω, Figure 14		−24		dB
XTALK	Crosstalk	V_{CC} = 3.3 V, f = 250 MHz, R_L = 50 Ω, Figure 15		−40		dB
		V_{CC} = 5 V, f = 250 MHz, R_L = 50 Ω, Figure 15		−40		dB
BW	Bandwidth	V_{CC} = 3.3 V, R_L = 50 Ω, Figure 16		2500		MHz
		V_{CC} = 5 V, R_L = 50 Ω, Figure 16		2500		MHz
Capacitance						

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
C_{ON}	On Capacitance	V_{CC} = 3.3 V, f = 1 MHz, f = 30 MHz		3.6		pF
C_{ON}	On Capacitance	V_{CC} = 3.3 V, f = 250 MHz		1.8		pF

(1) C_{ON} is guaranteed by simulation.

Typical Performance Characteristics

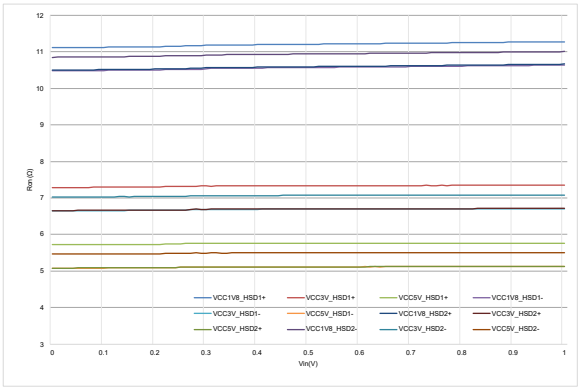


Figure 1. R_{ON}, V_{CC} = 1.8 V, 3 V, 5 V, Temp = 25°C

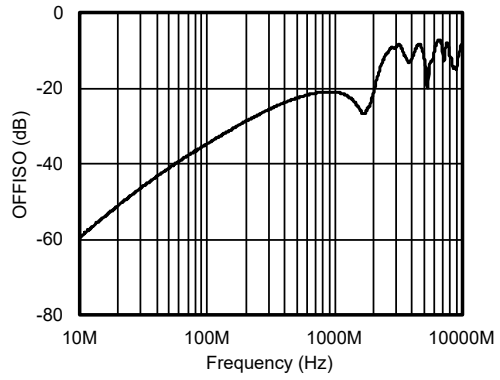


Figure 2. Off-Isolation, V_{CC} = 3.3 V

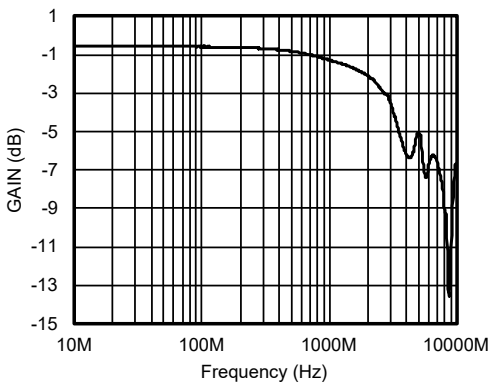


Figure 3. Bandwidth, V_{CC} = 3.3 V

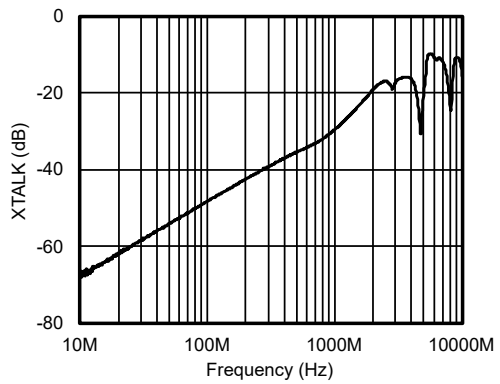


Figure 4. Crosstalk, V_{CC} = 3.3 V

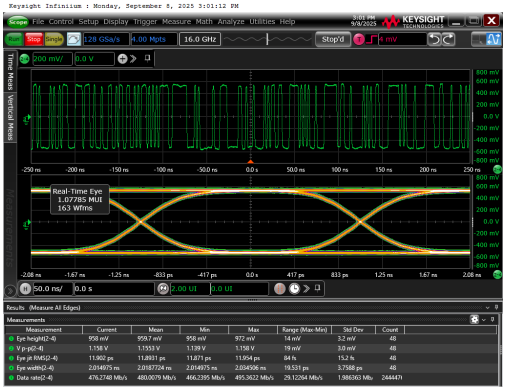


Figure 5. 480 Mbps Eye Diagram

Figure 6. 480 Mbps Jitter

Figure 7. 3 Gbps Eye Diagram

Figure 8. 3 Gbps Jitter

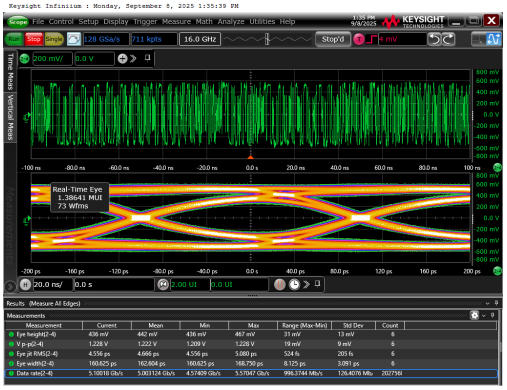


Figure 9. 5 Gbps Eye Diagram

Figure 10. 5 Gbps Jitter

Test Circuit and Waveforms

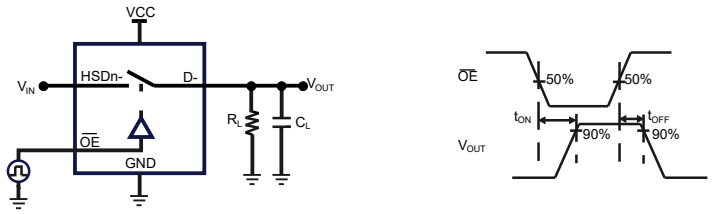


Figure 11. AC Test Circuit and Test Waveforms

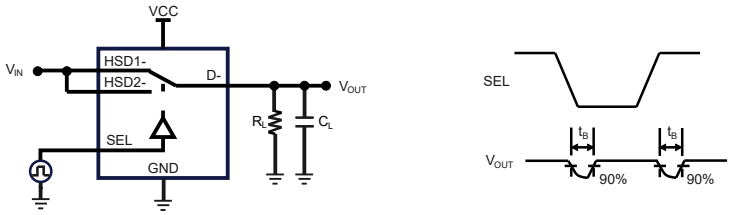


Figure 12. Switch Break Time

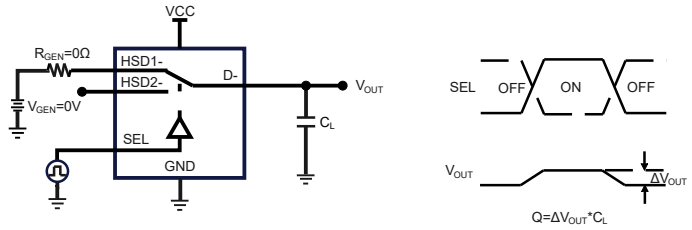


Figure 13. Charge Injection

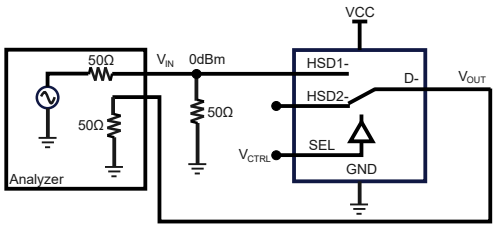


Figure 14. Off Isolation

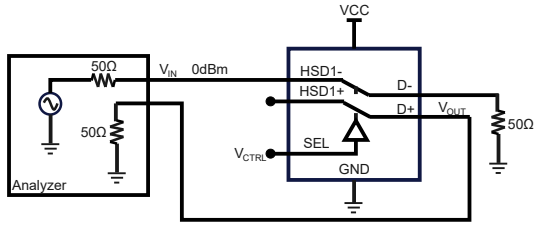


Figure 15. Crosstalk

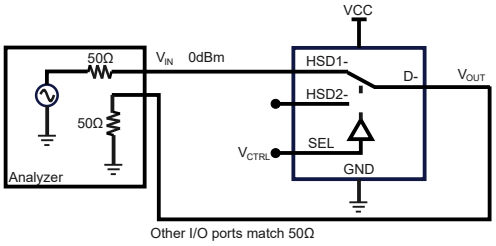


Figure 16. Bandwidth

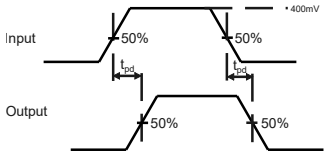


Figure 17. Propagation Delay

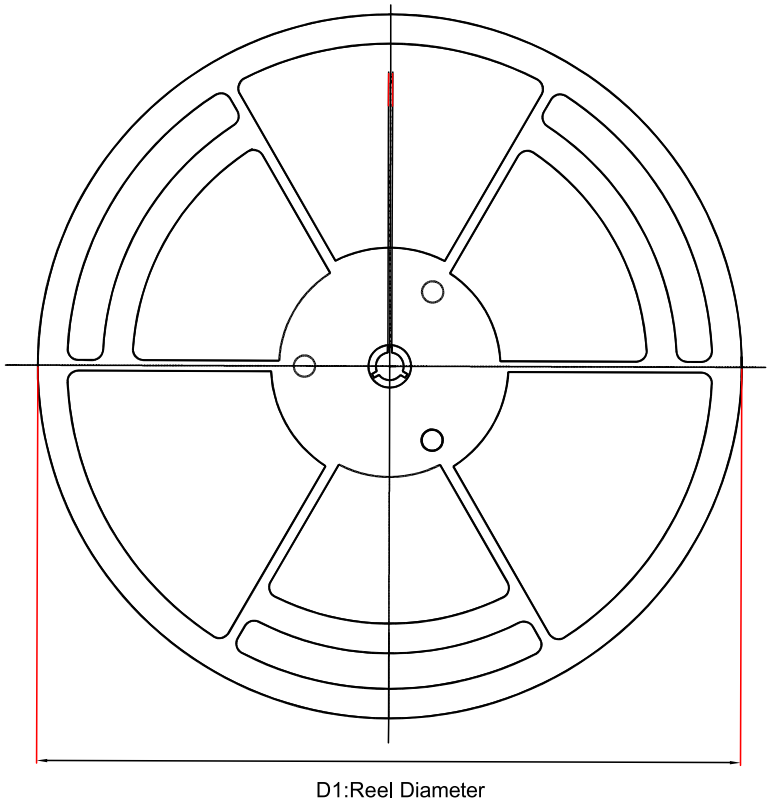
Application and Implementation

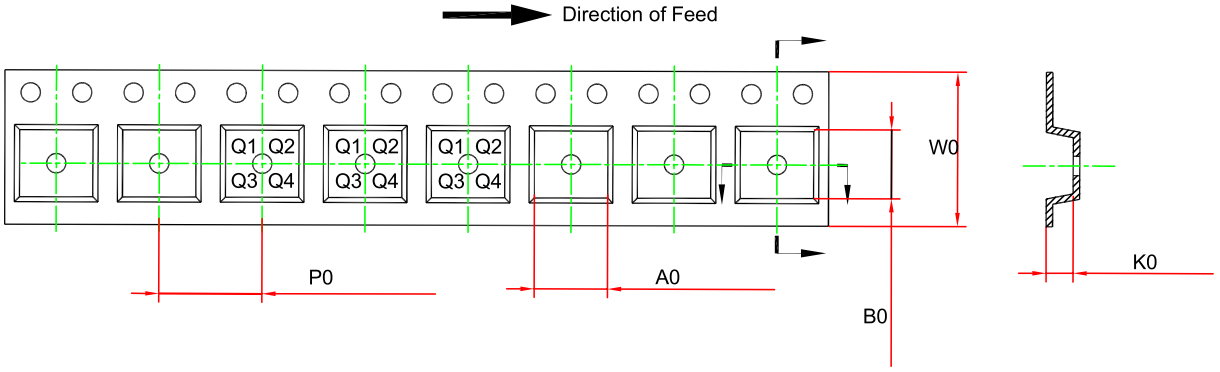
> Note
>
> Information in the following application sections is not part of the 3PEAK's component specification and 3PEAK does not warrant its accuracy or completeness. 3PEAK's customers are responsible for determining suitability of components for their purposes. Customers should validate and test their design implementation to confirm system functionality.

Application Information

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

Tape and Reel Information





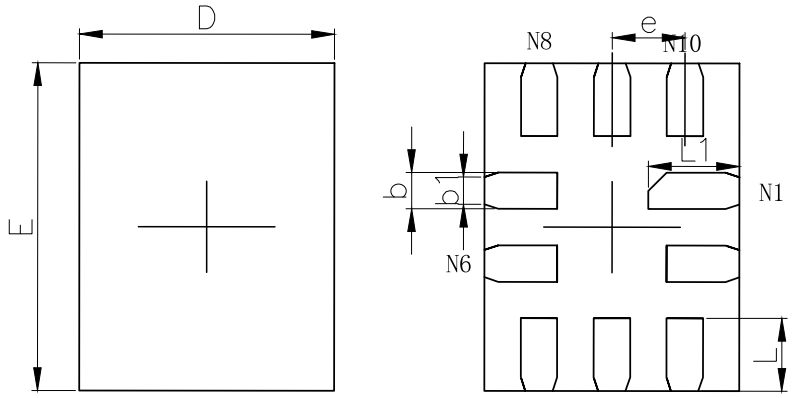
Order Number	Package	D1 (mm)	W1 (mm)	A0 (mm) (1)	B0 (mm) (1)	K0 (mm) (1)	P0 (mm)	W0 (mm)	Pin1 Quadrant
TPW3227R-QFQR	QFN1.4X1.8-10	180.0	13.1	1.6	2	0.85	4.00	8.00	Q1
TPW3227S-QFQR	QFN1.4X1.8-10	180.0	13.1	1.6	2	0.85	4.00	8.00	Q1

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

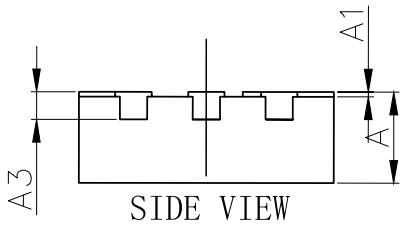
Package Outline Dimensions

QFN1.4X1.8-10

Package Outline Dimensions QFQ(QFN1.4X1.8-10-A)



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
b	0.150	0.250	0.006	0.010
b1	0.100	0.200	0.004	0.008
A3	0.152 REF		0.006 REF	
D	1.350	1.450	0.053	0.057
E	1.750	1.850	0.069	0.073
e	0.400 BSC		0.016 BSC	
L	0.350	0.450	0.014	0.018
L1	0.450	0.550	0.018	0.022

NOTES

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

Order Information

Order Number	Operating Temperature Range	Package	Marking Information	MSL	Transport Media, Quantity	Eco Plan
TPW3227R-QFQR	−40 to 125°C	QFN1.4X1.8-10	AAF	MSL3	Tape and Reel,4000	Green
TPW3227S-QFQR (1)	−40 to 125°C	QFN1.4X1.8-10	AAG	MSL3	Tape and Reel,4000	Green

(1) For future products, contact the 3PEAK factory for more information and samples.

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

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