PE42424

Product Specification

UltraCMOS® SPDT RF Switch, 100 MHz–8.5 GHz

Features

- 802.11 a/b/g/n/ac/ax, Wi-Fi® 6E, and Ultra Wideband (UWB) support
- Exceptional isolation:
  - 48 dB at 2.4 GHz
  - 35 dB at 5.8 GHz
- Fast switching:
  - 145 ns switching time
  - 125 kHz switching rate
- High power handling:
  - 39 dBm pulsed
  - 30 dBm CW
- High linearity across supply range:
  - IIP3: 61 dBm
  - IIP2: 125 dBm
- 1.8V control logic compatible
- Operating temperature: 105 °C
- ESD performance: 2500V HBM on RF pins to GND
- Package: 6-lead 1.5 × 1.5 mm DFN

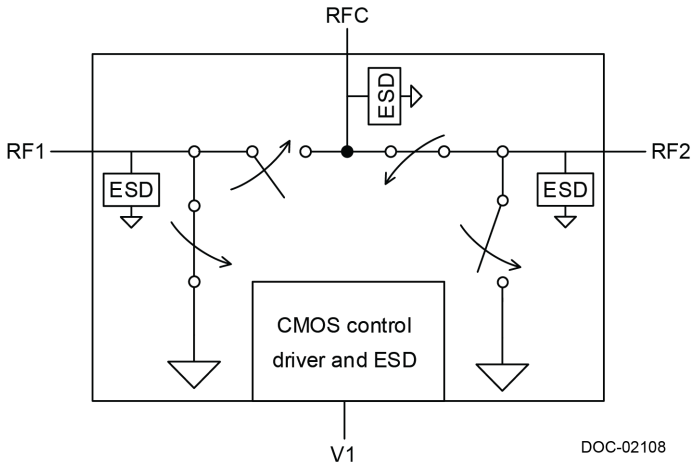

Figure 1. PE42424 functional diagram

Product description

The PE42424 is a HaRP™ technology-enhanced reflective 50Ω SPDT RF switch designed for use in high-power and high-performance WLAN 802.11 a/b/g/n/ac/ax and Wi-Fi 6E applications, such as carrier and enterprise Wi-Fi products and UWB applications supporting bandwidths up to 8.5 GHz.

This switch features exceptional port-to-port isolation, fast switching speed, and high-power handling, all in a compact 1.5 × 1.5 mm package. The PE42424 also features high linearity that remains invariant over the full power supply range. In addition, this device has robust ESD and temperature performance and does not require blocking capacitors or any external matching components.

The PE42424 is manufactured on pSemi's UltraCMOS® process, a patented variation of silicon-on-insulator (SOI) technology on a sapphire substrate.

pSemi's HaRP technology enhancements deliver high linearity and excellent harmonics performance. It is an innovative feature of the UltraCMOS process, offering the performance of GaAs with the economy and integration of conventional CMOS.

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Absolute maximum ratings

Exceeding the absolute maximum ratings listed in Table 1 could cause permanent damage. Restrict operation to the limits in Table 2. Operation between the operating range maximum and the absolute maximum for extended periods could reduce reliability.

ESD precautions

When handling this UltraCMOS device, observe the same precautions as with any other ESD-sensitive devices. Although this device contains circuitry to protect it from damage due to ESD, do not exceed the rating listed in Table 1.

Latch-up immunity

Unlike conventional CMOS devices, UltraCMOS devices are immune to latch-up.

Table 1. Absolute maximum ratings

Parameter or condition	Symbol	Min	Max	Unit
Supply voltage	V_{DD}	-0.3	5.5	V
Digital input, V1	V_{CTRL}	-0.3	3.6	V
RF input power, 100–6000 MHz	$P_{MAX,ABS}$	–	41	dBm
RF input power, 6000–8500 MHz	$P_{MAX,ABS}$	–	40	dBm
Storage temperature range	T_{ST}	-65	150	°C
ESD voltage HBM:(1) - All pins - RF pins to GND	$V_{ESD,HBM}$	–	 1000 2500	V
ESD voltage CDM, all pins(2)	$V_{ESD,CDM}$	–	1000	V

Notes:
1. Human body model (MIL-STD 883 Method 3015)
2. Charged device model (JEDEC JESD22-C101)

Recommended operating conditions

Table 2 lists the PE42424 recommended operating conditions. Do not operate devices outside the operating conditions listed below.

Table 2. Recommended operating conditions

Parameter	Symbol	Min	Typ	Max	Unit
Supply voltage	V_{DD}	2.3	3.3	5.5	V
Supply current	I_{DD}	–	130(1) 200(2)	200 300	µA
Digital input high, V1	V_{IH}	1.4	–	3.6	V
Digital input low, V1	V_{IL}	-0.3	–	0.6	V
RF input power, CW, 100-6000 MHz	$P_{MAX,CW}$	–	–	30	dBm
RF input power, CW, 6000-8500 MHz	$P_{MAX,CW}$	–	–	29	dBm
RF input power, pulsed, 100-6000 MHz(3)	$P_{MAX,PULSED}$	–	–	39	dBm
RF input power, pulsed, 6000-8500 MHz(3)	$P_{MAX,PULSED}$	–	–	38	dBm
Operating temperature range	T_{OP}	-40	25	105	°C

Notes:
1. $V_{IH} > 1.7V$
2. $1.4V < V_{IH} < 1.7V$
3. Pulsed, 5% duty cycle of 4620-µs period, 50Ω

Electrical specifications

Table 3 lists the PE42424 key electrical specifications at +25 °C and V_{DD} = 3.3V (Z_S = Z_L = 50Ω), unless otherwise specified.

Table 3. Electrical specifications

Parameter	Symbol	Path	Condition	Min	Typ	Max	Unit
Operating frequency	–	–	–	0.1	–	8.5	GHz
Insertion loss	IL	RFC-RFx	0.1–2.5 GHz 2.5–5.825 GHz 5.825–6.0 GHz 6.0-8.5 GHz	–	0.8 0.9 0.95 1.08	0.95 1.15 1.2 1.6	dB
Isolation	ISO	RFC-RFx	0.1–2.5 GHz 2.5–5.825 GHz 5.825–6.0 GHz 6.0-8.5 GHz	45 33 33 27	47 35 34 29	–	dB
		RFx-RFx	0.1–2.5 GHz 2.5–5.825 GHz 5.825–6.0 GHz 6.0-8.5 GHz	37 29 29 24	39 30 30 26	–	
Return loss (common and active port)	RL	RFx	0.1–6.0 GHz 6.0-8.5 GHz	–	21 21	–	dB
Input 1-dB compression point(1)	P1dB	RFC-RFx	0.1–6.0 GHz 6.0-8.5 GHz	–	41 40	–	dBm
Third order input intercept point(2)	IIP3	RFC-RFx	1900 MHz	–	60	–	dBm
Third harmonic	3fo	RFC-RFx	P_{IN} = +30 dBm at 1900 MHz	–	74	–	dBc
Second order input intercept point(2)	IIP2	RFC-RFx	1900 MHz	–	125	–	dBm
Second harmonic	2fo	RFC-RFx	P_{IN} = +30 dBm at 1900 MHz	–	85	–	dBc
Switching time	T_{SW}	–	50% CTRL to 90% or 10% of final value	–	145	230	ns

Notes:
1. The input P1dB compression point is a linearity figure of merit. For the operating RF input power (50Ω), see Table 2.
2. The input intercept point remains invariant over the full supply range as defined above.

Switching capability

The PE42424 has a maximum 125 kHz switching rate with a control pin input capacitance of 2 pF. The switching rate describes the time duration between switching events. The switching time is the time duration between the point that the control signal reaches 50% of the final value and the point that the output signal reaches within 10% or 90% of its target value.

Spurious performance

The PE42424 typical spurious performance is –126 dBm.

Control logic

Table 4. Truth table

V1	RFC–RF1	RFC–RF2
0	OFF	ON
1	ON	OFF

Typical performance data

Figures 2–10 show the typical performance data at +25 °C and V_{DD} = 3.3V, unless otherwise specified.

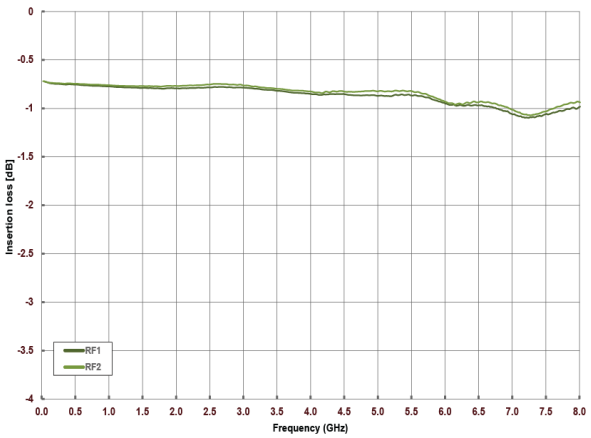


Figure 2. Insertion loss RFC–RFx

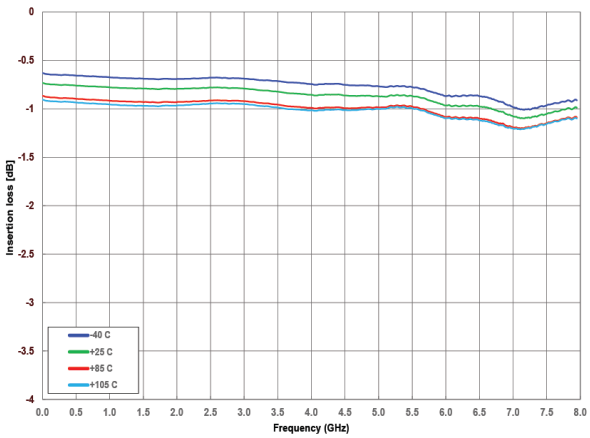


Figure 3. Insertion loss vs. temperature, RFC–RFx

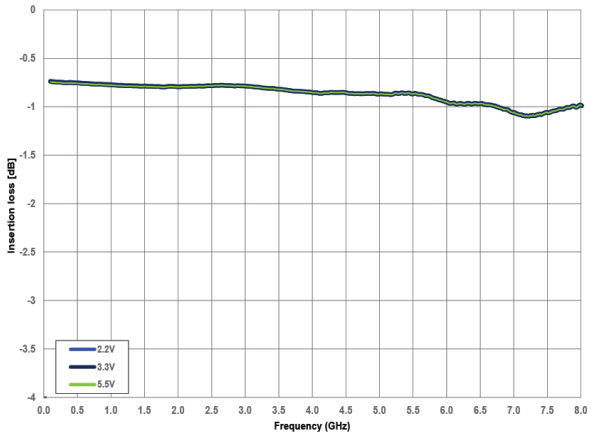


Figure 4. Insertion loss vs. V_{DD}, RFC–RFx

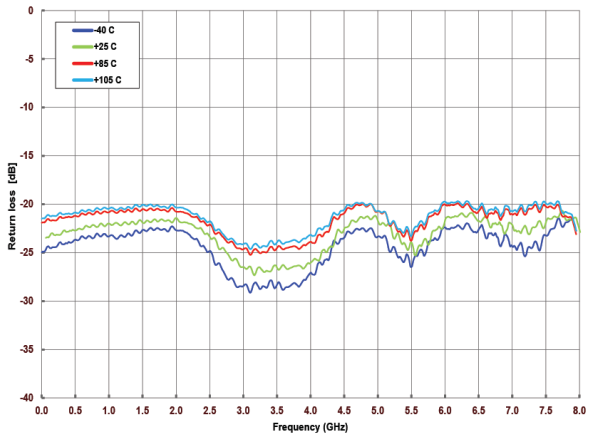


Figure 5. Return loss vs. temperature, RFC–RFx

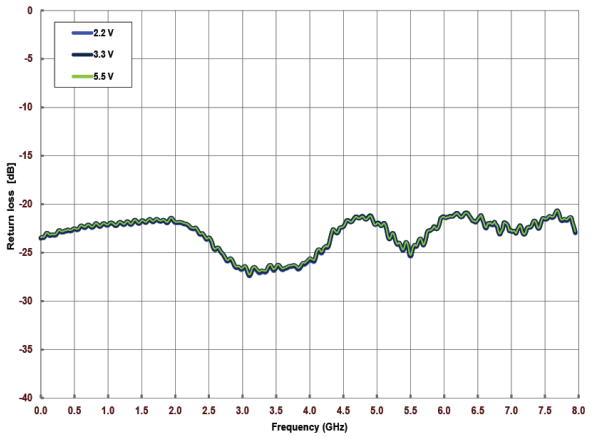


Figure 6. Return loss vs. V_{DD}, RFC–RFx

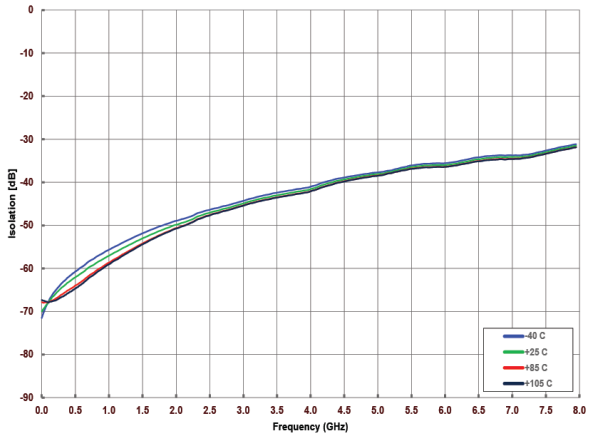


Figure 7. Isolation vs. temperature, RFC–RFx

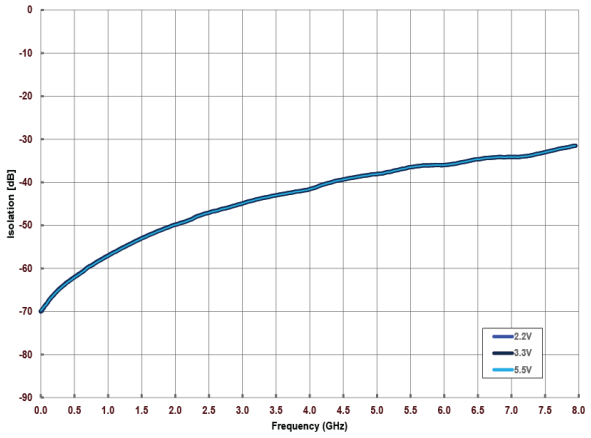


Figure 8. Isolation vs. V_{DD}, RFC–RFx

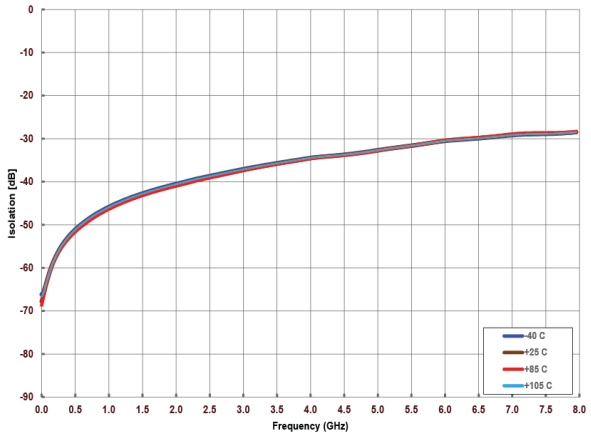


Figure 9. Isolation vs. temperature, RFx–RFx

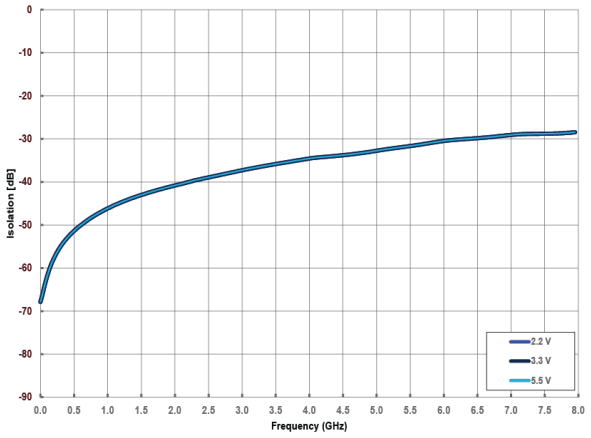


Figure 10. Isolation vs. V_{DD}, RFx–RFx

Evaluation kit

pSemi designed the SPDT switch evaluation board to ease your evaluation of the PE42424 RF switch. The RF common port connects to the device through a 50Ω transmission line via SMA connector J3. The RF1 and RF2 ports connect to the device through 50Ω transmission lines via SMA connectors J1 and J2, respectively. A transmission line has been included on the reverse side of the PCB, accessible via SMA connectors J4 and J5. This transmission line provides an equivalent length to de-embed PCB trace losses. DC and digital inputs are provided to the device via J6.

This PCB is constructed of a four metal layer material with total thickness of 62 mils. The top and bottom RF layers are Rogers RO4003 material with an 8-mil RF core. The middle layers provide ground for the RF transmission lines. The transmission lines were designed using a coplanar waveguide with ground plane model using a trace width of 16 mils and 10 mil trace gap, with 2.1 mils of metal thickness.

To realize the true performance of the PE42424, design your PCB so that the RF transmission lines and sensitive DC I/O traces are heavily isolated from one another.

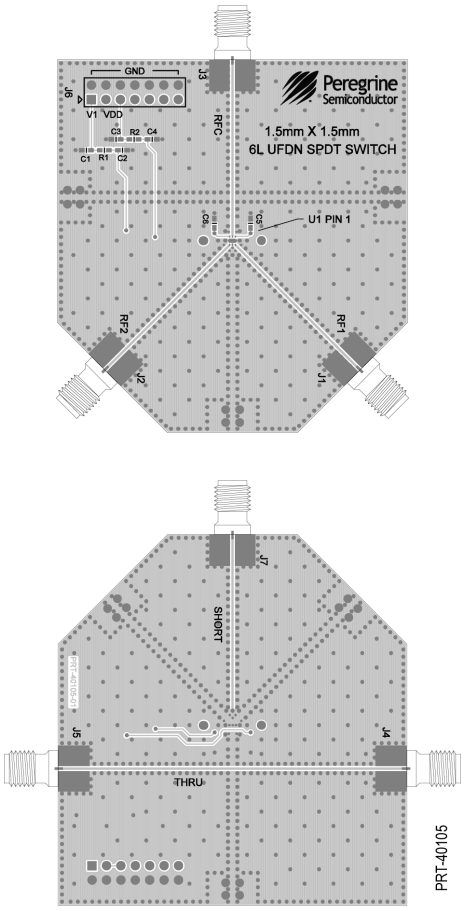


Figure 11. PE42424 evaluation board layout

Evaluation board schematic

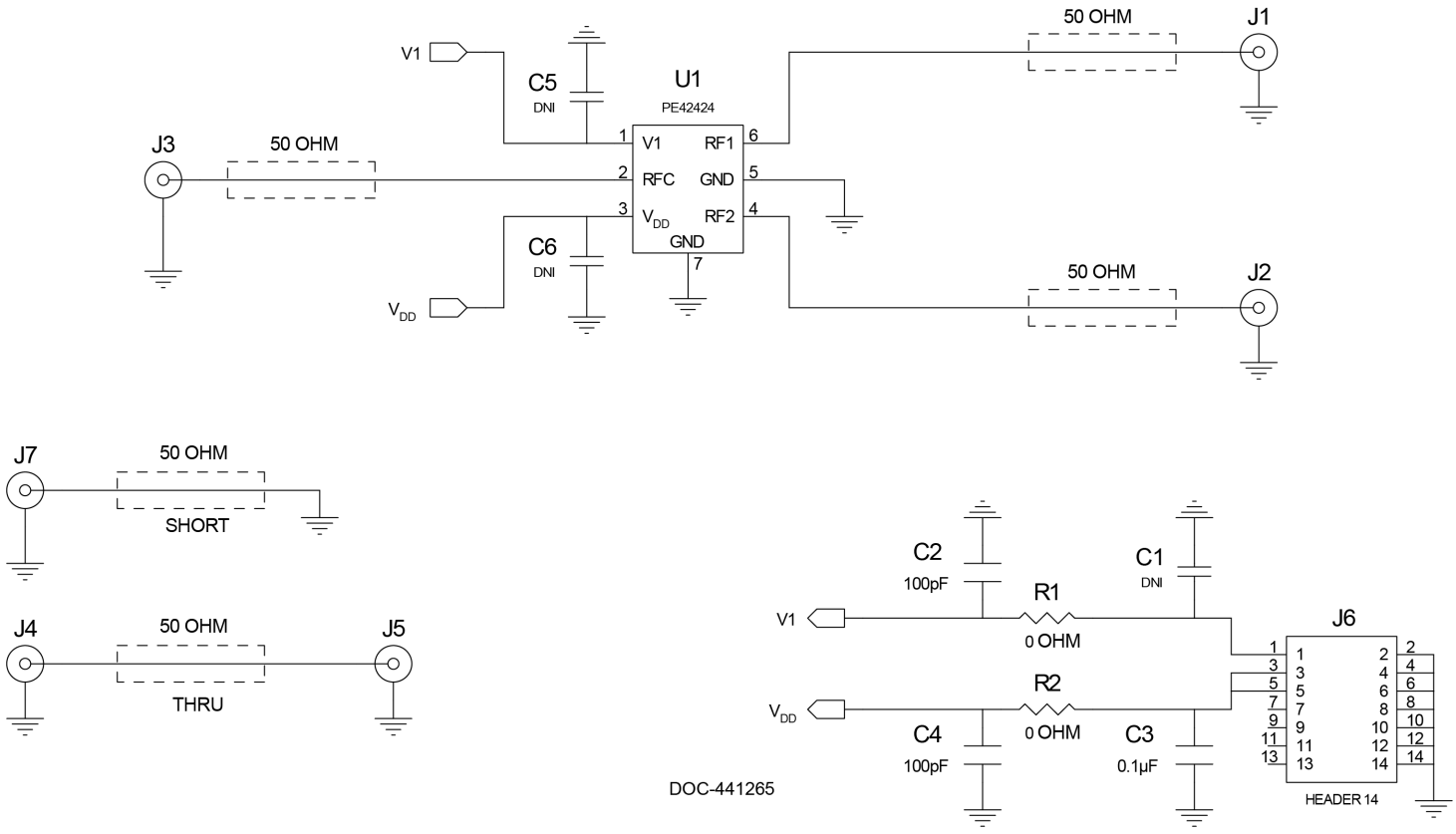


Figure 12. PE42424 evaluation board schematic

Pin configuration

Figure 13 shows the PE42424 pin configuration for the 6-lead 1.5 × 1.5 mm DFN package, and Table 5 lists the description for each pin.

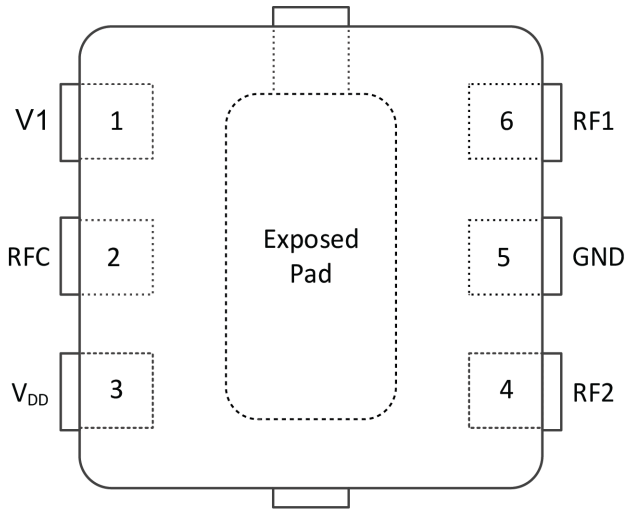


Figure 13. Pin configuration, top view

Table 5. Pin descriptions

Pin no.	Pin name	Description
1	V1	Digital control logic input 1
2	RFC(*)	RF common
3	V_{DD}	Supply voltage (nominal 3.3V)
4	RF2(*)	RF port 2
5	GND	Ground
6	RF1(*)	RF port 1
Pad	GND	Ground
Note: * RF pins 2, 4, and 6 must be at 0 VDC. These RF pins do not require DC blocking capacitors for proper operation if the 0 VDC requirement is met.		

Packaging information

This section provides the following packaging data:

- Moisture sensitivity level
- Package drawing
- Package marking
- Tape-and-reel information

Moisture sensitivity level

The PE42424 moisture sensitivity level rating for the 6-lead 1.5 × 1.5 mm DFN package is MSL1.

Package drawing

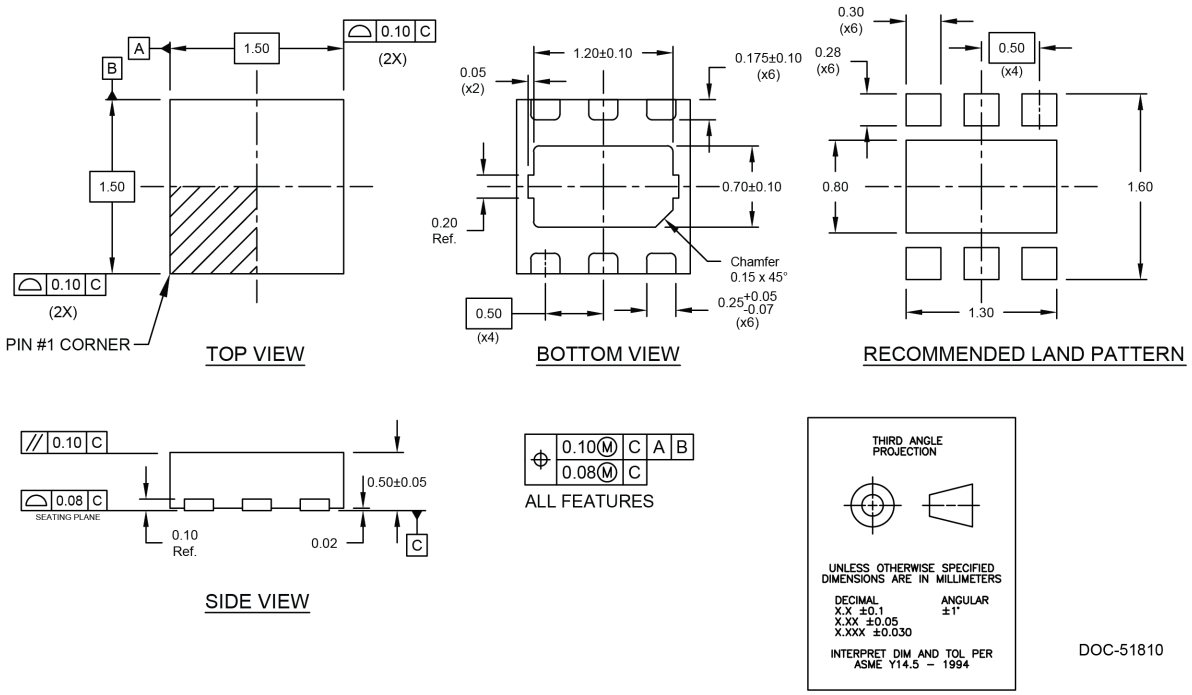


Figure 14. Package mechanical drawing for the 6-lead 1.5 × 1.5 mm DFN package

Top-marking specification

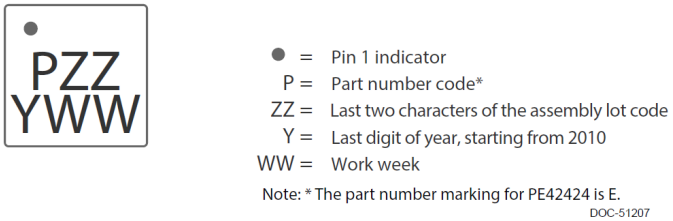
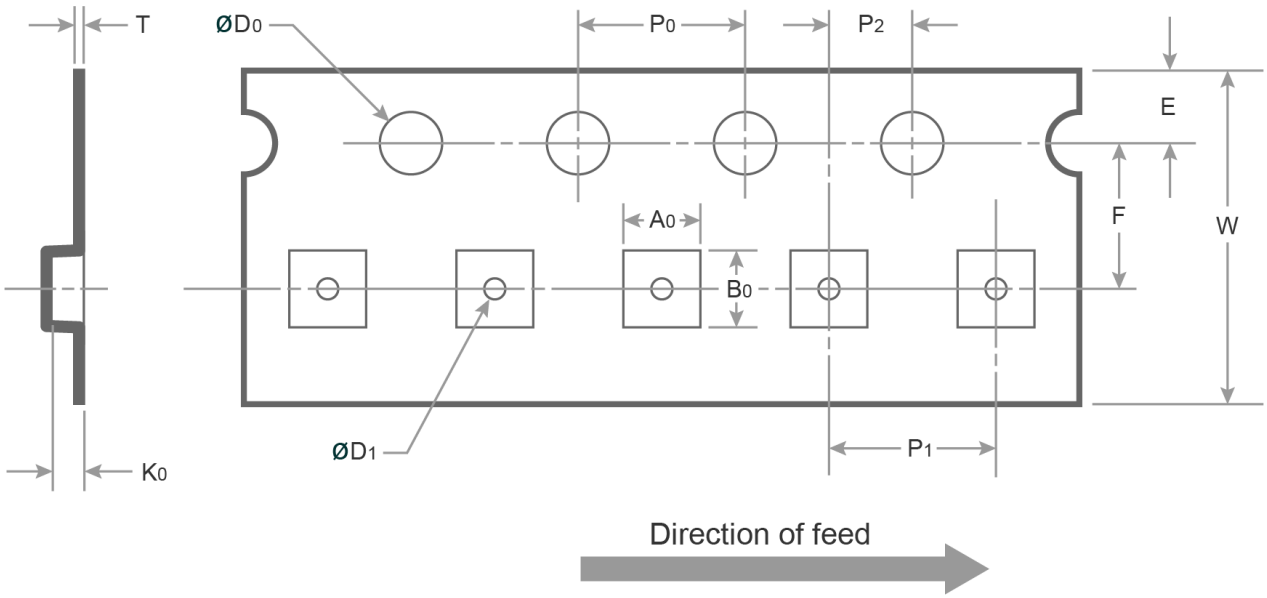


Figure 15. Package marking specification

Tape and reel specification



Notes:

Not drawn to scale.
Dimensions are in millimeters.
Maximum cavity angle 5 degrees.
Bumped die are oriented active side down.

Carrier tape dimensions					
Pocket	Nominal	Tolerance	Pocket	Nominal	Tolerance
A_0	1.70	+/- 0.05	D_1	0.5	+ 0.5 - 0.1
B_0	1.70	+/- 0.05	D_0	1.5	+ 0.1
K_0	0.76	+/- 0.05	E	1.75	+/- 0.1
P_1	4.00	+/- 0.1	P_0	4.0	+/- 0.1
W	8.00	+ 0.3 - 0.1	P_2	2.0	+/- 0.05
F	3.50	+/- 0.5	T	0.25	+/- 0.02

Figure 16. Tape and reel specification for the 6-lead 1.5 × 1.5 mm DFN package

Ordering information

Order code	Description	Packaging	Shipping method
PE42424A-Z	PE42424 SPDT RF switch	Green 6-lead 1.5 × 1.5 mm DFN	3000 units/T&R
EK42424-01	PE42424 evaluation kit	Evaluation kit	1/box

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