PE42440

Document category: Product Specification

UltraCMOS® SP4T RF Switch, 50–3000 MHz

Features

- Low insertion loss:
  - 0.45 dB @ 1000 MHz
  - 0.5 dB @ 2000 MHz
- High Isolation:
  - 34 dB @ 1000 MHz
  - 28 dB @ 2000 MHz
- High ESD tolerance:
  - Class 3 (4.0 kV HBM) on RFC pin
  - Class 2 (2.0 kV HBM) on all pins
- Integrated decoder for 2-pin control accepts 1.8V and 2.75V control logic levels
- Low 4.5Ω series ON resistance
- No blocking capacitors required
- Packaging: 16-lead 3 × 3 × 0.75 mm QFN

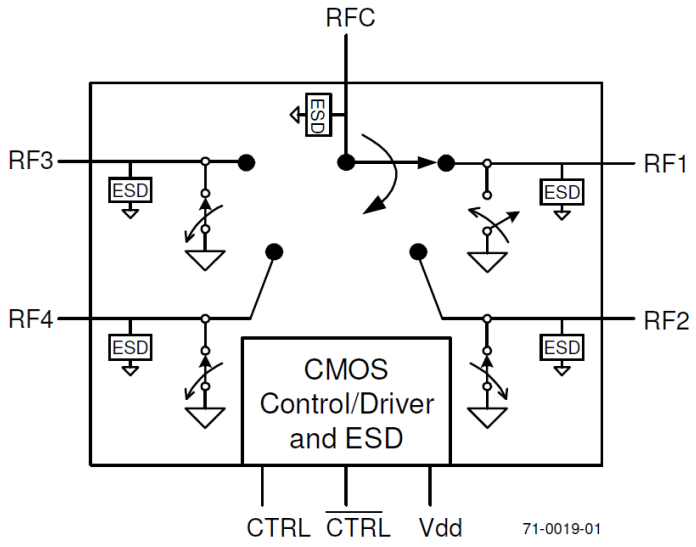

Figure 1. Functional block diagram

Product description

The PE42440 is a HaRP™-enhanced SP4T RF switch developed on the UltraCMOS® process technology. This general-purpose switch contains four identical RF ports and can be used in a multitude of applications up to 3000 MHz. It integrates on-board CMOS control logic with a low voltage CMOS-compatible control interface and requires no DC blocking capacitors. This RoHS-compliant part is available in a standard 16-lead 3 × 3 × 0.75 mm QFN package.

The pSemi HaRP™ technology enhancements deliver high linearity and exceptional harmonics performance. It is an innovative feature of the UltraCMOS® process, providing performance superior to GaAs with the economy and integration of conventional CMOS.

Headquarters: 9369 Carroll Park Dr, San Diego, CA 92121

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. PE42440 absolute maximum ratings

Symbol	Parameter or condition	Min	Max	Unit
V_{DD}	Power supply voltage	-0.3	4.0	V
V_I	Voltage on any DC input	-0.3	VDD + 0.3	V
P_{IN} (50Ω)[1]	RF input power: 50–500 MHz 500–3000 MHz	–	 +28 +33	dBm
V_{ESD}	HBM2 ESD voltage, RFC pin[2]	–	4000	V
	HBM2 ESD voltage, all pins[2]	–	2000	V
	MM ESD voltage, RFC pin	–	300	V
	MM ESD voltage, all pins	–	100	V

1. V_{DD} is within the operating range specified in Table 2.
2. ESD Voltage (HBM, MIL-STD-883 Method 3015.7).

Recommended operating conditions

Table 2 lists the PE42440 recommending operating conditions. Do not operate devices outside the operating conditions listed below.

Table 2. PE42440 operating conditions

Symbol	Parameter	Min	Typ	Max	Unit
V_{DD}	V_{DD} supply voltage	2.65	2.75	3.3	V
I_{DD}	I_{DD} power supply current (V_{DD} = 2.75V)	–	13	50	µA
P_{IN}	RF input power: 50–500 MHz 500–3000 MHz	–	–	 +28 +33	dBm
V_{IH}	Control voltage high	1.4	–	–	V
V_{IL}	Control voltage low	–	–	0.4	V
T_{OP}	Temperature range	-40	+25	+85	°C
T_{ST}	Storage temperature range	-65	+25	+160	°C

Electrical specifications

Table 3 lists the PE42440 key electrical specifications at +25 °C and V_{DD} = 2.75V (Z_S = Z_L = 50Ω), unless otherwise specified.

Table 3. PE42440 key electrical specifications

Parameter	Condition	Min	Typ	Max	Unit
Operational frequency	–	50	–	3000	MHz
Insertion loss (RFC–RFx)	500–1000 MHz	–	0.45	0.65	dB
	1000–2000 MHz	–	0.5	0.7	
	2000–3000 MHz	–	0.85	1.15	
Return loss (RFC–RFx, active ports)	500–1000 MHz	–	22	–	dB
	1000–2000 MHz	–	15	–	
	2000–3000 MHz	–	11	–	
Isolation (RFC–RFx)	500–1000 MHz	31	34	–	dB
	1000–2000 MHz	25	28	–	
	2000–3000 MHz	20	22	–	
Input IP2	50–3000 MHz, +18 dBm per tone, 1-MHz spacing	–	96	–	dBm
Input IP3	50–3000 MHz, +18 dBm per tone, 1-MHz spacing	–	67	–	dBm
P1dB(*)	50–3000 MHz	–	41.5	–	dBm
Switching time	50% CNTL to 10/90% of RF	–	2	–	µs

* See the maximum operating P_{IN} (50Ω) in Table 2.

Table 4 lists the PE42440 worst-case electrical specifications at +85 °C and V_{DD} = 2.65V (Z_S = Z_L = 50Ω), unless otherwise specified.

Table 4. PE42440 worst-case electrical specifications

Parameter	Condition	Min	Typ	Max	Unit
Operational frequency	–	50	–	3000	MHz
Insertion loss (RFC–RFx)	500–1000 MHz	–	0.5	0.65	dB
	1000–2000 MHz	–	0.65	0.75	
	2000–3000 MHz	–	1.0	1.25	
Return loss (RFC–RFx, active ports)	500–1000 MHz	–	21	–	dB
	1000–2000 MHz	–	15	–	
	2000–3000 MHz	–	10	–	
Isolation (RFC–RFx)	500–1000 MHz	30	32	–	dB
	1000–2000 MHz	24	26	–	
	2000–3000 MHz	20	22	–	
Input IP2	50–3000 MHz, +18 dBm per tone, 1-MHz spacing	–	95	–	dBm
Input IP3	50–3000 MHz, +18 dBm per tone, 1-MHz spacing	–	66	–	dBm
P1dB[(1)]	50–3000 MHz	–	41	–	dBm
Switching time	50% CNTL to 10/90% of RF	–	2	–	µs

* See the maximum operating P_{IN} (50Ω) in Table 2.

SP4T control logic

Table 5. PE42440 truth table

Path	V1	V2
RFC–RF1	0	0
RFC–RF2	1	0
RFC–RF3	0	1
RFC–RF4	1	1

Typical performance data

Figure 2–Figure 8 show the typical performance data at +25 °C and V_{DD} = 2.75V (Z_S = Z_L = 50Ω), unless otherwise specified.

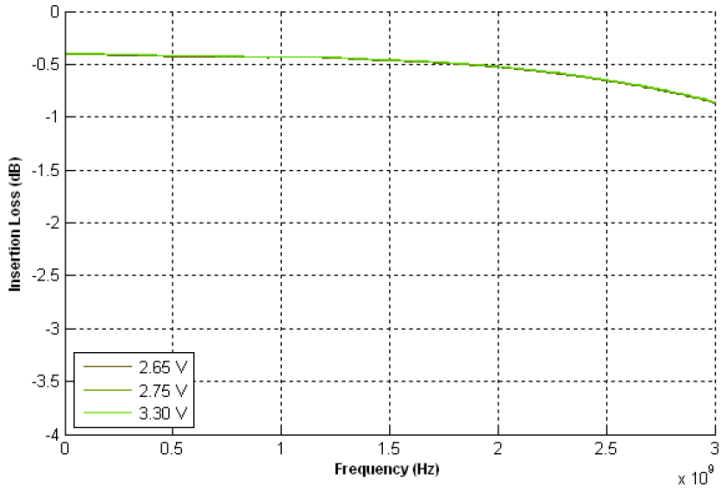

Figure 2. Insertion loss: RFC–RF @ 25 °C

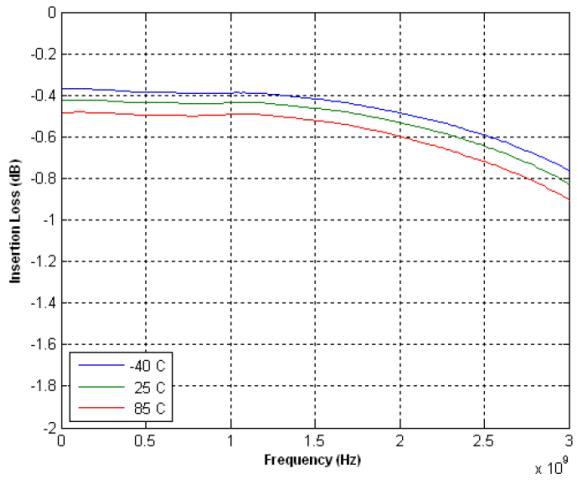

Figure 3. Insertion loss: RFC–RF @ 2.75V

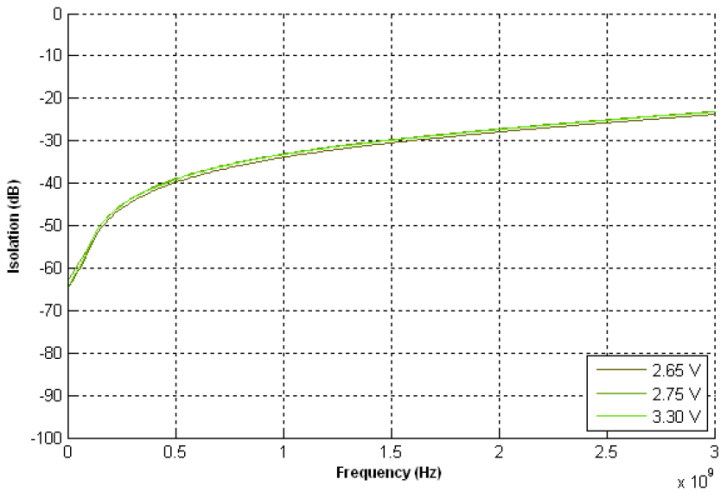

Figure 4. Isolation: RFC–RF @ 25 °C

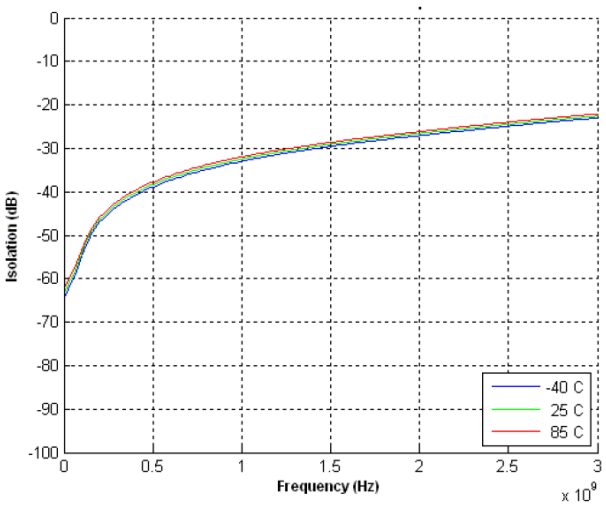

Figure 5. Isolation: RFC–RF @ 2.75V

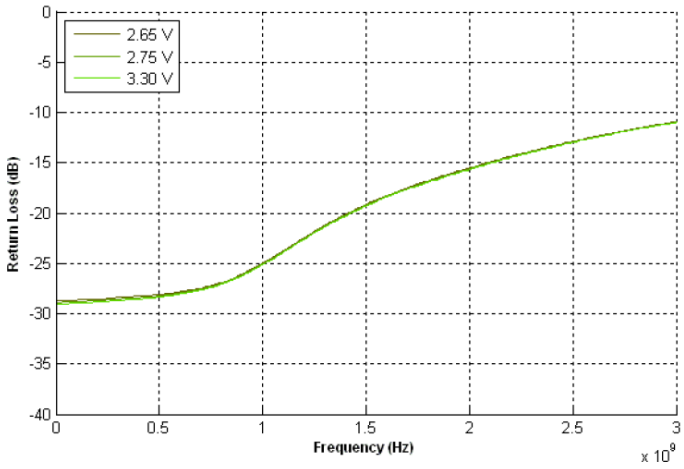

Figure 6. Return loss at active port @ 25 °C

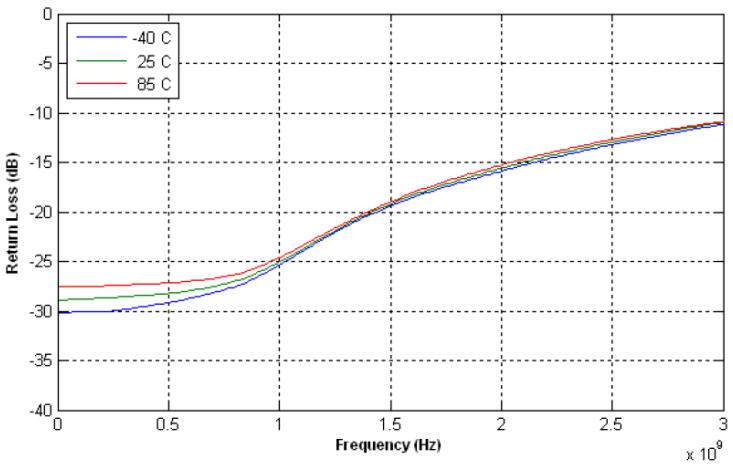

Figure 7. Return loss at active port @ 2.75V

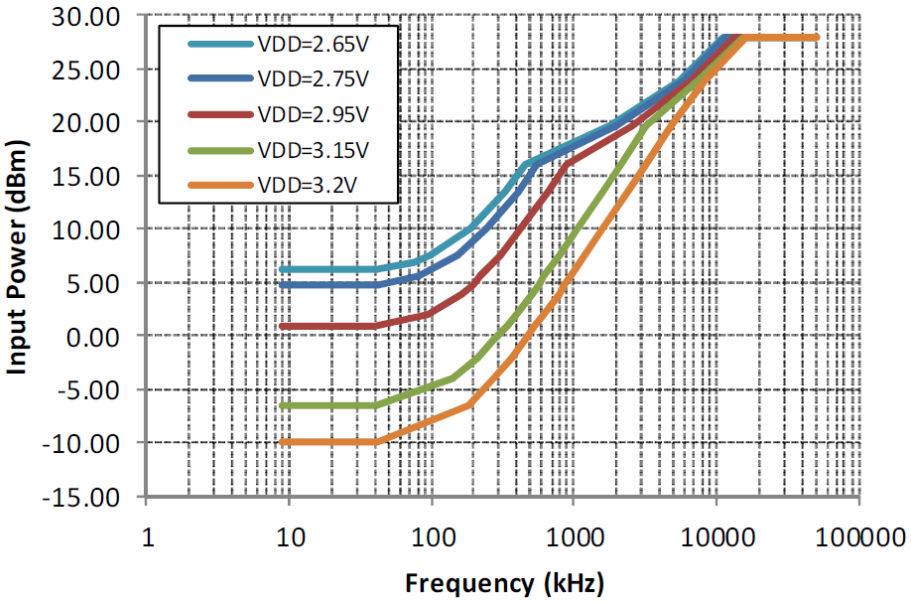

Figure 8. Maximum operating power vs. frequency

Evaluation kit

pSemi designed the SP4T switch evaluation board to ease your evaluation of the PE42440. The RF common port is connected through a 50Ω transmission line via the top SMA connector, J1. RF1, RF2, RF3, and RF4 are connected through 50Ω transmission lines via SMA connectors J3, J5, J2 and J4, respectively. A through 50Ω transmission is available via SMA connectors J6 and J7. You can use this transmission line to estimate the loss of the PCB over the environmental conditions being evaluated.

The board is constructed of a four-layer metal FR4 material with a total thickness of 62 mils. The middle layers provide ground for the transmission lines. The transmission lines were designed using a coplanar waveguide with ground plane model using a trace width of 32 mils, trace gaps of 25 mils, and a metal thickness of 2.1 mils.

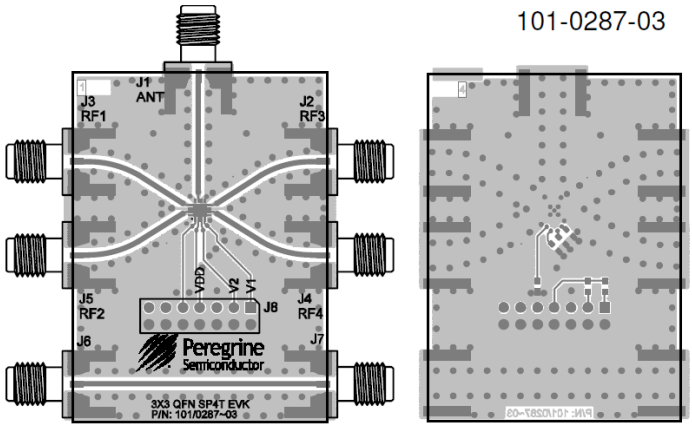

Figure 9. Evaluation board layouts

Evaluation board schematic

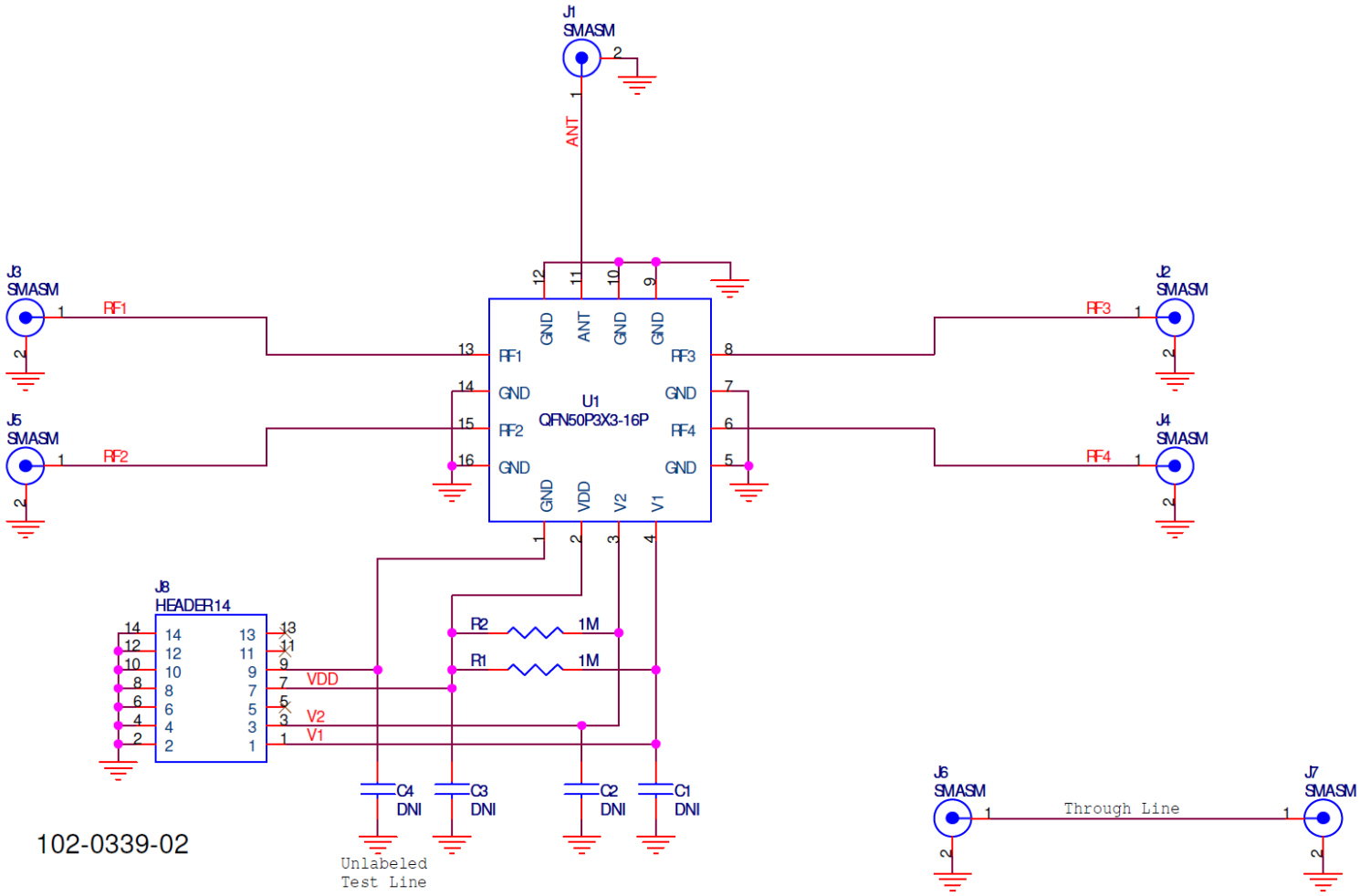

Figure 10. Evaluation board schematic

Pin information

Figure 11 shows the PE42440 pin map for the 16-lead 3 × 3 × 0.75 mm QFN package, and Table 6 lists the description for each pin.

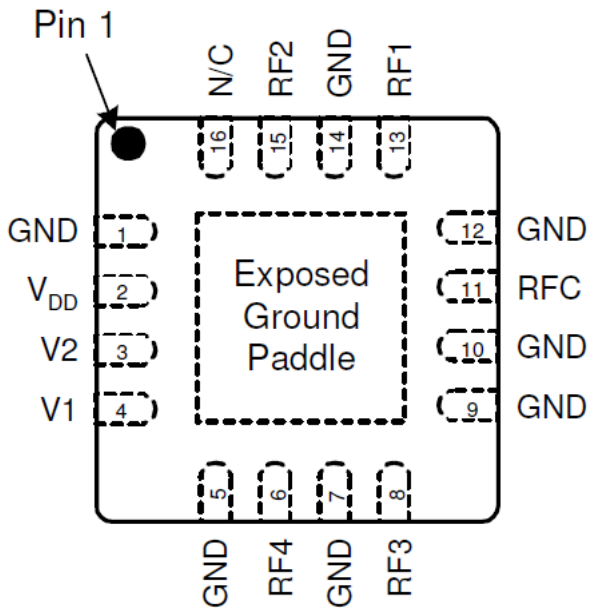

Figure 11. Pin configuration (top view)

* RF pins 6, 8, 11, 13, and 15 must be DC blocked with an external series capacitor or held at 0 VDC.

Table 6. PE42440 pin descriptions

Pin no.	Pin name	Description
1	GND	Ground
2	V_{DD}	Supply voltage
3	V2	Switch control input, CMOS logic level
4	V1	Switch control input, CMOS logic level
5	GND	Ground
6(*)	RF4	RF port 4
7	GND	Ground
8(*)	RF3	RF port 3
9	GND	Ground
10	GND	Ground
11(*)	RFC	RF common
12	GND	Ground
13(*)	RF1	RF port 1
14	GND	Ground
15(*)	RF2	RF port 2
16	N/C	No connect
Paddle	GND	Exposed paddle. Ground for proper operation.

Packaging information

This section provides the following packaging data:

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

Moisture sensitivity level

The PE42440 moisture sensitivity level rating for the 16-lead 3 × 3 × 0.75 mm QFN package is MSL1.

Package drawing

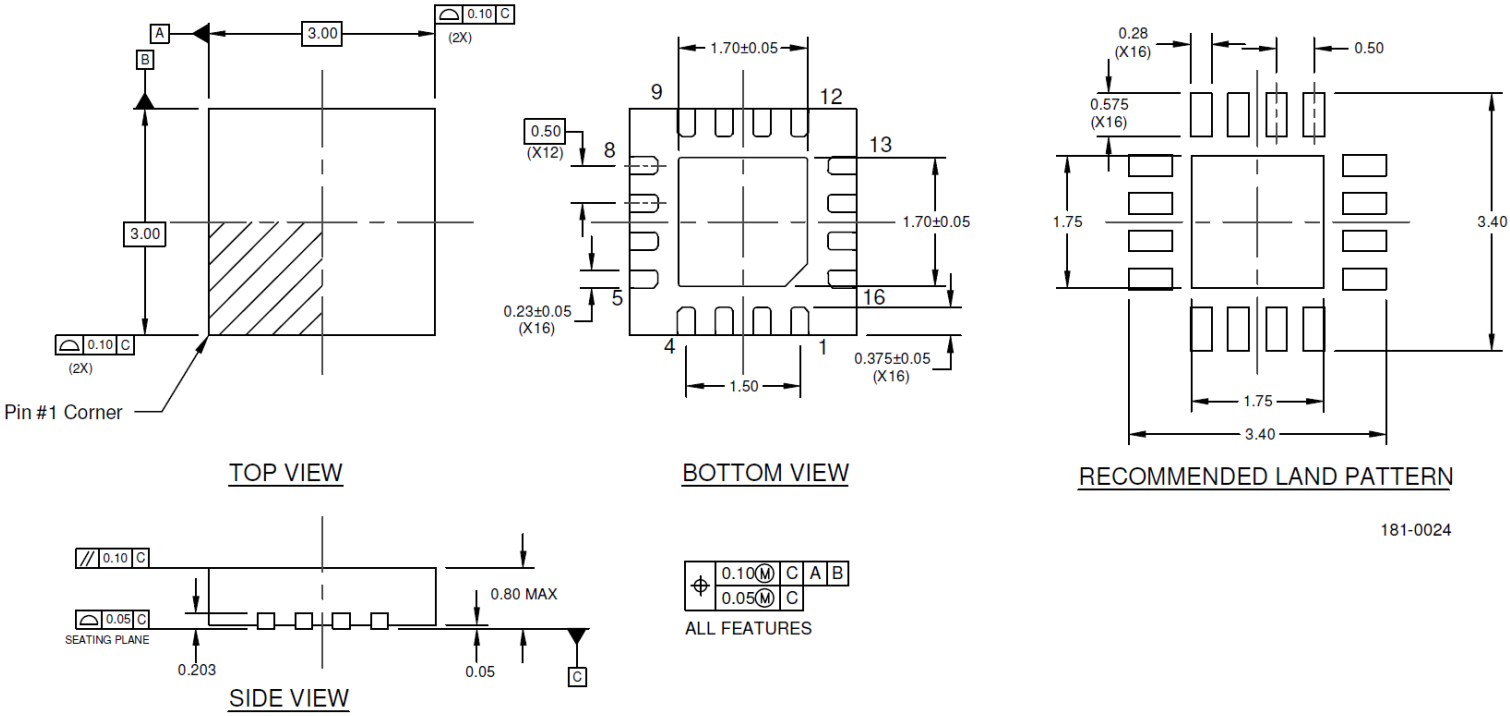

Figure 12. Package mechanical drawing for the 16-lead 3 × 3 × 0.75 mm QFN package

Top-marking specification

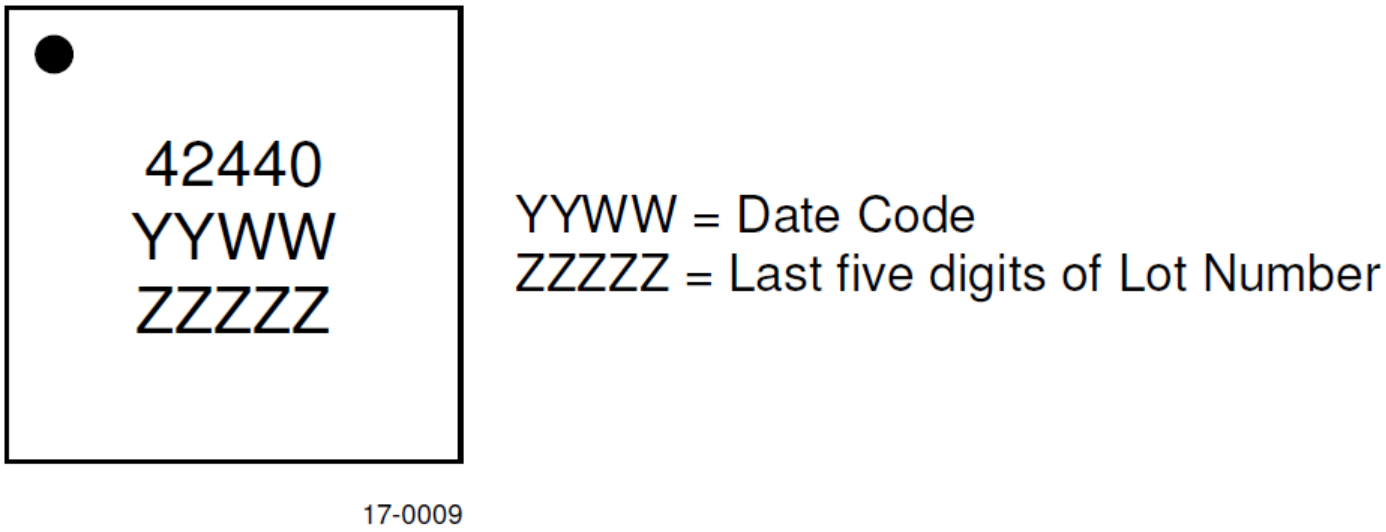

Figure 13. PE42440 package marking specification

Tape and reel specification

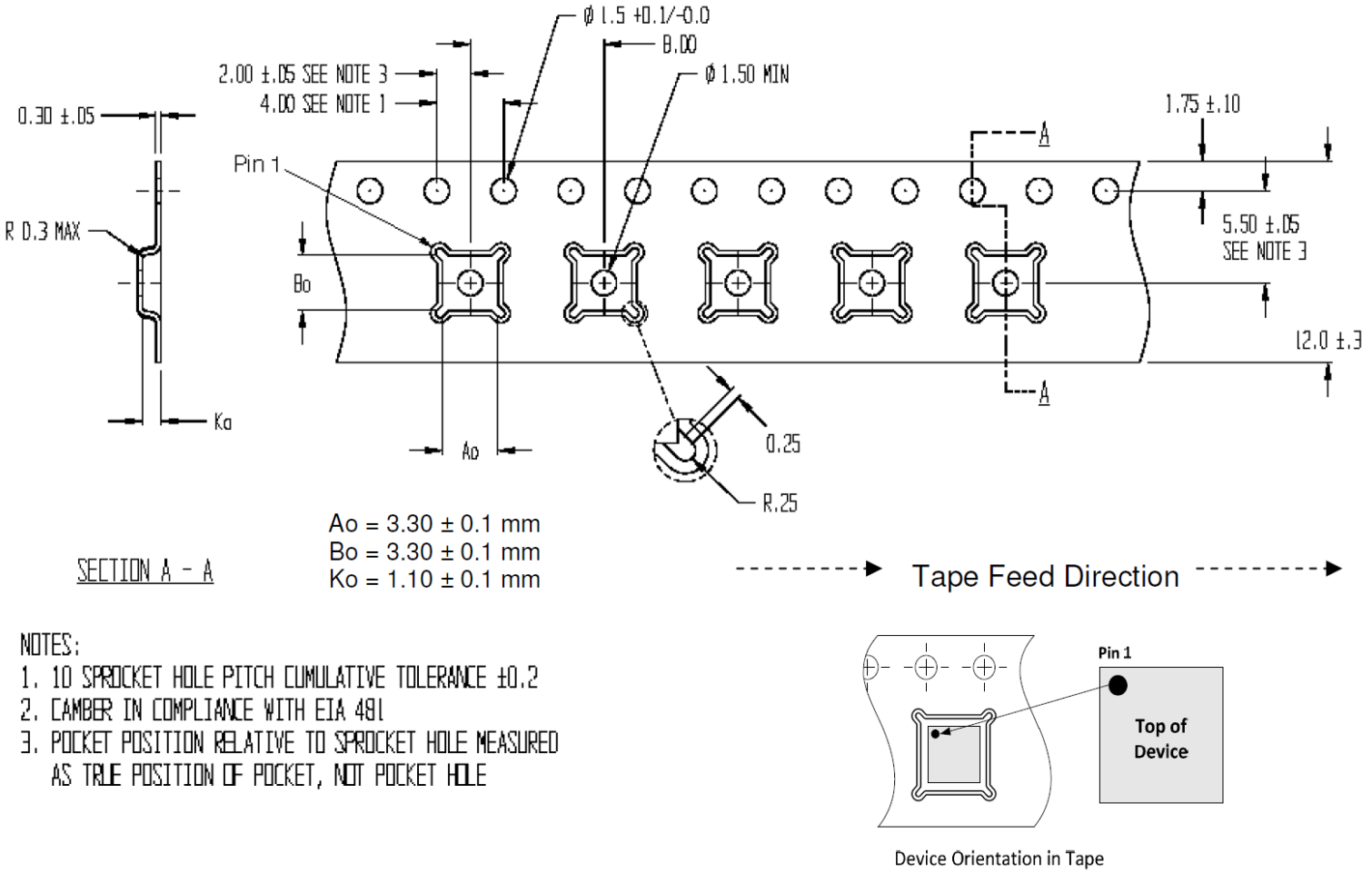

Figure 14. Tape and reel specification for the 16-lead 3 × 3 × 0.75 mm QFN package

- The diagram is not drawn to scale.
- The units are in millimeters (mm).
- The maximum cavity angle is five degrees.
- The bumped die are oriented active side down.

Ordering information

Table 7. PE42440 ordering codes and shipping methods

Order code	Description	Packaging	Shipping method
PE42440MLBB-Z	PE42440G-16QFN 3 x 3 mm-3000C	Green 16-lead 3 × 3 × 0.75 mm QFN	3000 units/T&R
EK42440-02	PE42440-16QFN 3 x 3 mm-EK	Evaluation kit	1/box

Document categories

Advance Information	The product is in a formative or design stage. The data sheet contains design target specifications for product development. Specifications and features may change in any manner without notice.
Preliminary Specification	The data sheet contains preliminary data. Additional data may be added at a later date. pSemi reserves the right to change specifications at any time without notice to supply the best possible product.
Product Specification	The data sheet contains final data. In the event that pSemi decides to change the specifications, pSemi will notify customers of the intended changes by issuing a Customer Notification Form (CNF).
Product Brief	This document contains a shortened version of the data sheet. For the full data sheet, contact sales@psemi.com.

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