PE42820

Document category: Product Specification

UltraCMOS® SPDT RF Switch, 30–2700 MHz

Features

- High power handling:
  - 45 dBm @ 850 MHz, 32W
  - 44 dBm @ 2 GHz, 25W
- Exceptional linearity:
  - 85 dBm IIP3 @ 850 MHz
  - 81 dBm IIP3 @ 2.7 GHz
- Low insertion loss:
  - 0.25 dB @ 850 MHz
  - 0.40 dB @ 2 GHz
- Wide supply range of 2.3–5.5V
- +1.8V control logic compatible
- ESD performance: 1.5 kV HBM on all pins
- External negative supply option
- Packaging: 32-lead 5 × 5 mm QFN

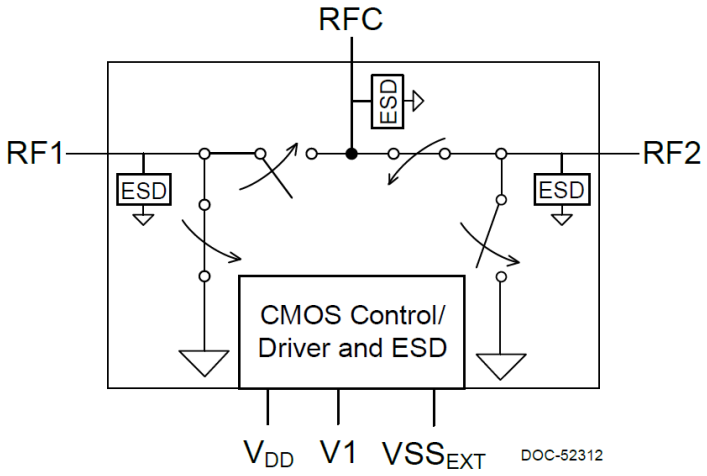

Figure 1. PE42820 functional diagram

Product description

The PE42820 is a HaRP™ technology-enhanced high power reflective SPDT RF switch designed for use in mobile radio, relay replacement, and other high-performance wireless applications.

This switch is a pin-compatible and upgraded version of the pSemi PE42510A with a wider frequency and power supply range, and an external negative supply option. It maintains exceptional linearity and power handling from 30 MHz through 2.7 GHz. The PE42820 also features low insertion loss, high power handling, and is offered in a 32-lead 5 × 5 mm QFN package. In addition, no external blocking capacitors are required if 0 VDC is present on the RF ports.

pSemi manufactured the PE42820 using its UltraCMOS® process, a patented variation of silicon-on-insulator (SOI) technology on a sapphire substrate.

The pSemi 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. PE42820 absolute maximum ratings

Parameter or condition	Symbol	Min	Max	Unit
Supply voltage	V_{DD}	-0.3	5.5	V
Digital input voltage (V1)	V_{CTRL}	-0.3	3.6	V
Maximum input power, 30 MHz–2 GHz	$P_{MAX,ABS}$	–	45.5	dBm
Maximum input power, 2–2.7 GHz		–	44.5	
Storage temperature range	T_{ST}	-65	+150	°C
Maximum case temperature	T_{CASE}	–	+85	°C
Peek maximum junction temperature (10 seconds max)	T_J	–	+200	°C
ESD voltage HBM, all pins(1)	$V_{ESD,HBM}$	–	1500	V
ESD voltage MM, all pins(2)	$V_{ESD,MM}$	–	200	V

1. Human Body Model (MIL-STD 883 Method 3015).
2. Machine Model (JEDEC JESD22-A115).

Recommended operating conditions

Table 2 lists the PE42820 recommended operating conditions. Do not operate devices outside the operating conditions listed below.

Table 2. PE42820 operating conditions

Parameter	Symbol	Min	Typ	Max	Unit
Normal mode[1]					
Supply voltage	V_{DD}	2.3	–	5.5	V
Supply current	I_{DD}	–	130	200	µA
Bypass mode[2]					
Supply voltage	V_{DD}	–	3.3	5.5	V
Supply current	I_{DD}	–	50	80	µA
Negative supply voltage	V_{SS_EXT}	-3.6	–	-3.2	V
Negative supply current	I_{SS}	-40	-16	–	µA
Normal or bypass mode					
Digital input high (V1)[3]	V_{IH}	1.17	–	3.6	V
Digital input low (V1)	V_{IL}	-0.3	–	0.6	V
RF input power, CW, 30 MHz–2 GHz	$P_{MAX,CW}$	–	–	43	dBm
RF input power, CW, 2–2.7 GHz		–	–	42	
RF input power, pulsed, 30 MHz–2 GHz[4]	$P_{MAX,PULSED}$	–	–	45	dBm
RF input power, pulsed, 2–2.7 GHz[4]		–	–	44	
RF input power, unbiased	$P_{MAX,UNB}$	–	–	27	dBm
Operating temperature range, case	T_{OP}	-40	–	+85	°C
Operating junction temperature	T_J	–	–	+140	°C

1. Normal mode: Connect pin 16 to GND to enable the internal negative voltage generator.
2. Bypass mode: Apply a negative voltage to V_{SS_EXT} (pin 16) to bypass and disable the internal negative voltage generator.
3. The maximum V_{IH} voltage is limited to V_{DD} and cannot exceed 3.6V.
4. Pulsed, 10% duty cycle of 4620 µs period, 50Ω.

Electrical specifications

Table 3 lists the PE42820 key electrical specifications at +25 °C (Z_S = Z_L = 50Ω), unless otherwise specified.

- Normal mode: V_{DD} = 3.3V, V_{SS_EXT} = 0V, using a single external positive supply.
- Bypass mode: V_{DD} = 3.3V, V_{SS_EXT} = -3.3V, using an external positive supply and an external negative supply.

Table 3. PE42820 electrical specifications

Parameter	Path	Condition	Min	Typ	Max	Unit
Insertion loss(1)	RFC–RFx	30 MHz–1 GHz	–	0.30	0.45	dB
		1–2 GHz	–	0.40	0.60	
		2–2.7 GHz	–	0.70	0.95	
Isolation	RFx–RFx	30 MHz–1 GHz	34	35	–	dB
		1–2 GHz	27	28	–	
		2–2.7 GHz	23	24	–	
Unbiased isolation	RFC–RFx	VDD, V1 = 0V, +27 dBm	–	6	–	dB
Return loss(1)	RFx	30 MHz–1 GHz	–	22	–	dB
		1–2 GHz	–	20	–	
		2–2.7 GHz	–	14	–	
Harmonics	RFC–RFx	2fo: +45 dBm pulsed @ 1 GHz, 50Ω	–	-94	-90	dBc
		3fo: +45 dBm pulsed @ 1 GHz, 50Ω	–	-84	-80	
Input IP3	RFC–RFx	850 MHz	–	85	–	dBm
		2.7 GHz	–	81	–	
Input 0.1 dB compression point(2)	RFC–RFx	30 MHz–2 GHz	–	45.5	–	dBm
		2–2.7 GHz	–	44.5	–	
Switching time(3)	–	50% CTRL to 90% or 10% RF	–	15	25	µs
Settling time(4)	–	50% CTRL to harmonics within specifications	–	30	45	µs

1. The performance is specified with external matching. For more information, see the Evaluation Kit section.
2. The input 0.1 dB compression point is a linearity figure of merit. For the operating RF input power (50Ω), see Table 2.
3. The PE42820 has a maximum 25 kHz switching rate in normal mode (pin 16 = GND). A faster switching rate is available in bypass mode (pin 16 = V_{SS_EXT}). The switching frequency describes the time duration between switching events. The switching time is the time duration between the point the control signal reaches 50% of the final value and the point the output signal reaches within 10% or 90% of its target value.
4. See the harmonics specification above.

Optional external V_{SS} control (V_{SS_EXT})

For applications that require a faster switching rate or spur-free performance, the PE42820 can be operated in bypass mode. Bypass mode requires an external negative voltage in addition to an external V_{DD} supply voltage.

As specified in Table 2, applying the external negative voltage (V_{SS_EXT}) to pin 16 disables and bypasses the internal negative voltage generator.

Spurious performance

The PE42820 typical low-frequency spurious performance in normal mode (pin 16 = GND) is –137 dBm. For spur-free performance, you can disable the internal negative voltage generator by applying an external negative voltage to V_{SS_EXT} (pin 16).

Hot switching capability

The PE42820 typical hot switching capability is +30 dBm. Hot switching occurs when RF power is applied while switching between the RF ports.

Thermal data

Though the insertion loss for this part is very low, when handling high-power RF signals, the junction temperature can rise significantly.

VSWR conditions that present short circuit loads to the part can cause significantly more power dissipation than with proper matching.

Make special consideration in the PCB design to properly dissipate the heat away from the part and maintain the 85 °C maximum case temperature. Use best design practices for high-power QFN packages: multi-layer PCBs with thermal vias in a thermal pad soldered to the slug of the package. Take extreme care to alleviate solder voiding under the part.

Table 4. Theta JC

Parameter	Typ	Unit
Theta JC (+85 °C)	20	°C/W

SPDT control logic

Table 5. PE42820 truth table

Path	CTRL
RFC–RF1	H
RFC–RF2	L

Typical performance data

Figure 2–Figure 11 show the typical performance data at +25 °C, V_{DD} = 3.3V, and V_{SS_EXT} = 0V, unless otherwise specified.

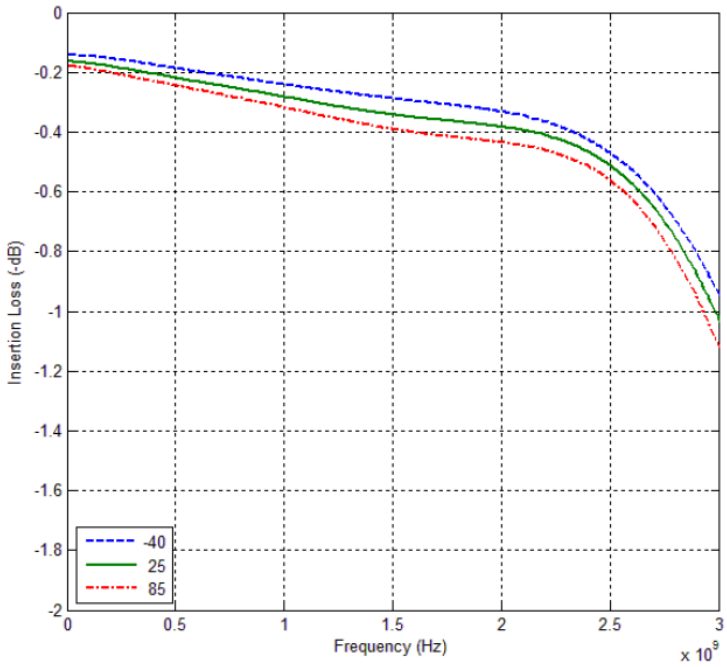


Figure 2. Insertion loss vs. temperature (RFC–RFx)

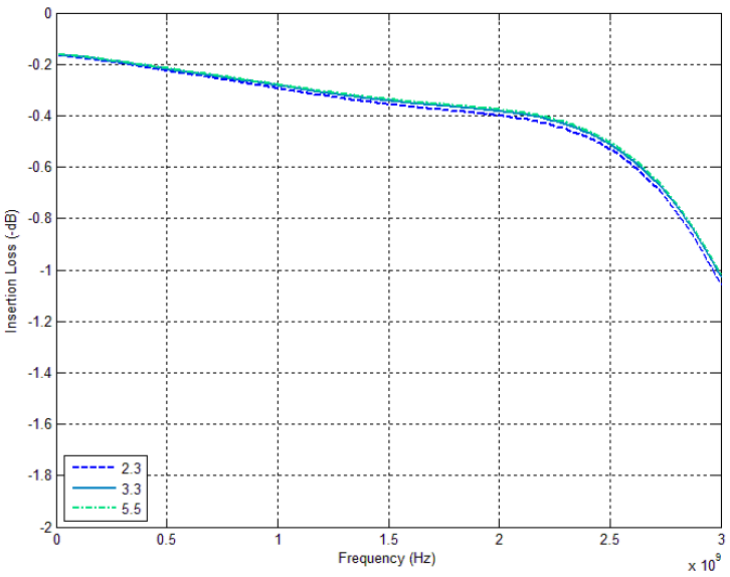


Figure 3. Insertion loss vs. V_{DD} (RFC–RFx)

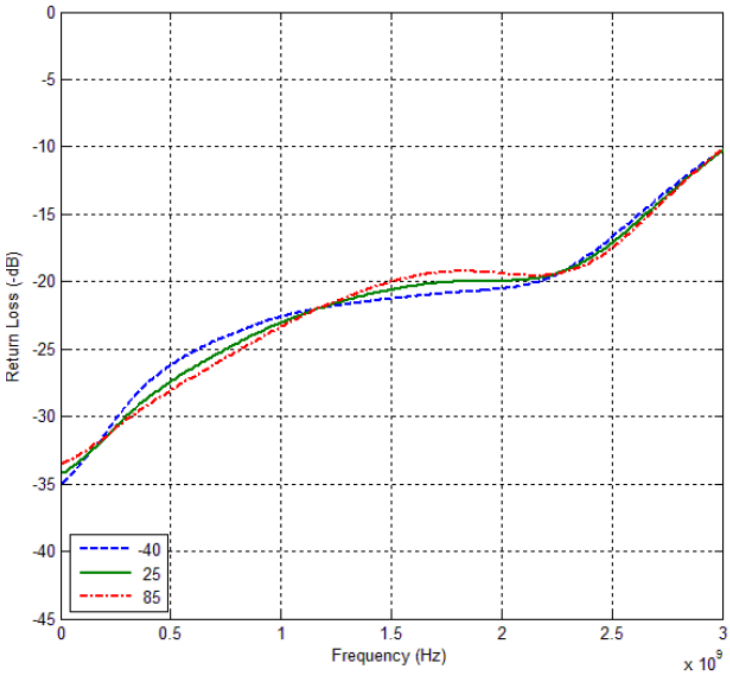


Figure 4. RFC port return loss vs. temperature (RF1 active)

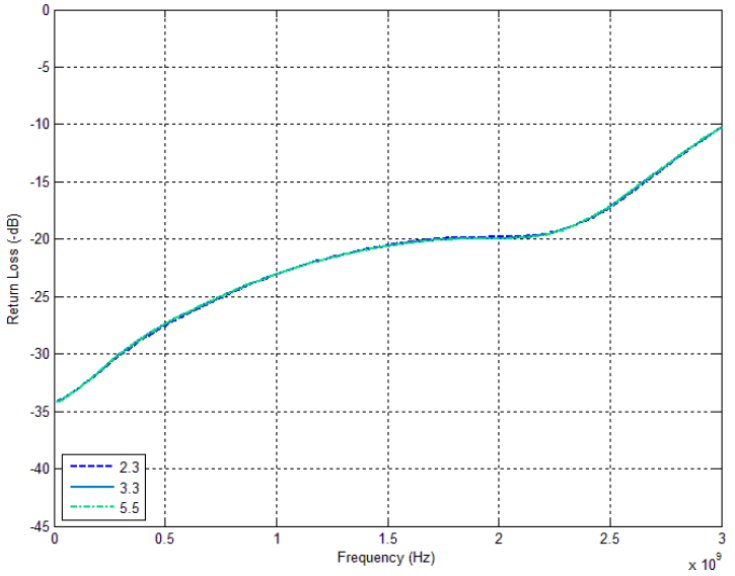


Figure 5. RFC port return loss vs. V_{DD} (RF1 active)

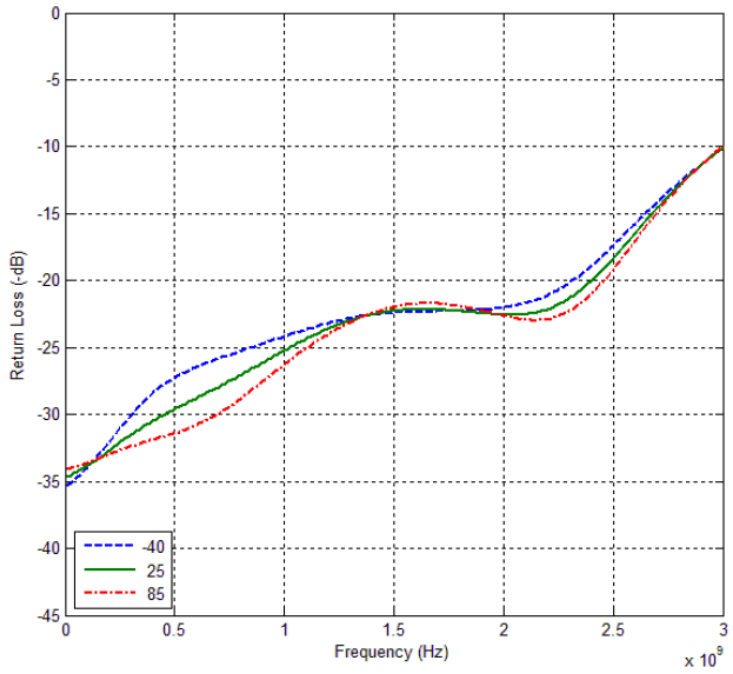


Figure 6. Active port return loss vs. temperature (RF1 active)

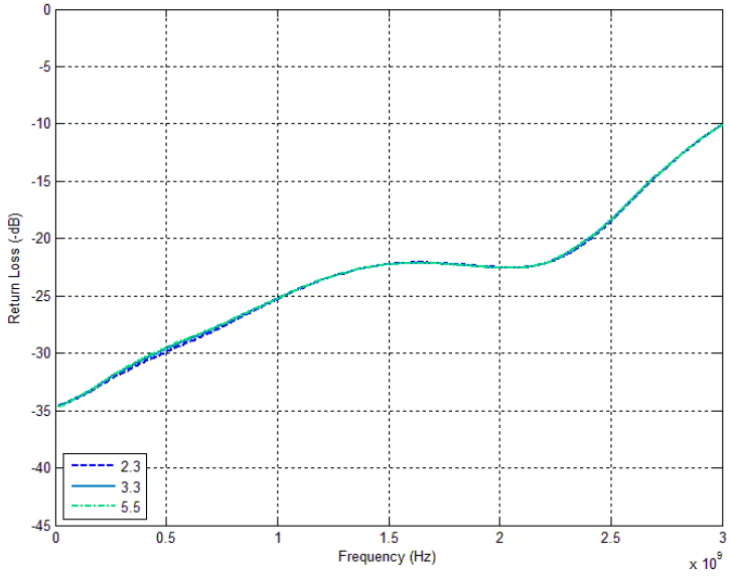


Figure 7. Active port return loss vs. V_{DD} (RF1 active)

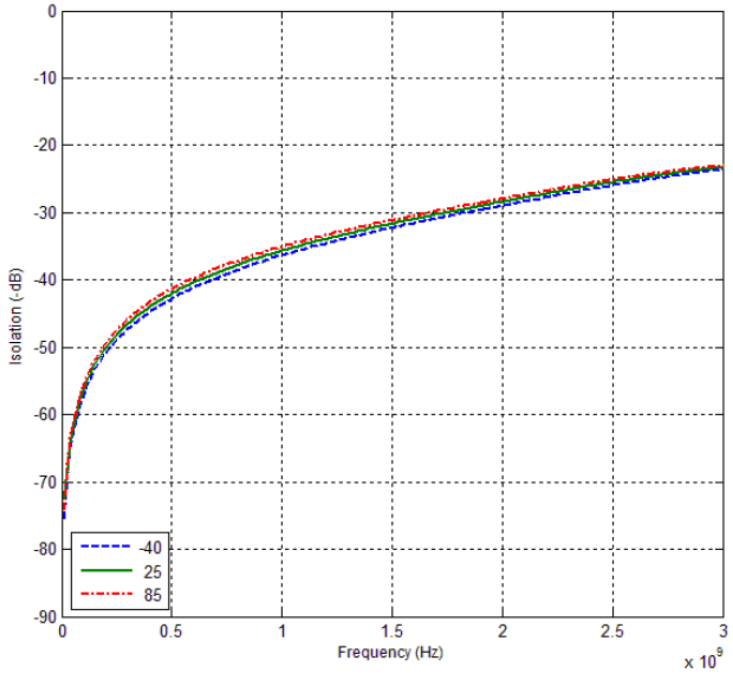


Figure 8. Isolation vs. temperature (RFC–RFx, RFx active)

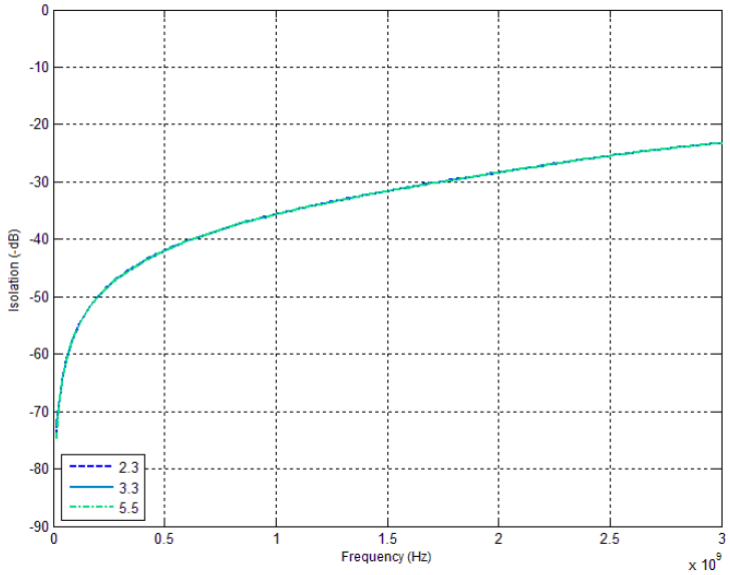


Figure 9. Isolation vs. V_{DD} (RFC–RFx, RFx active)

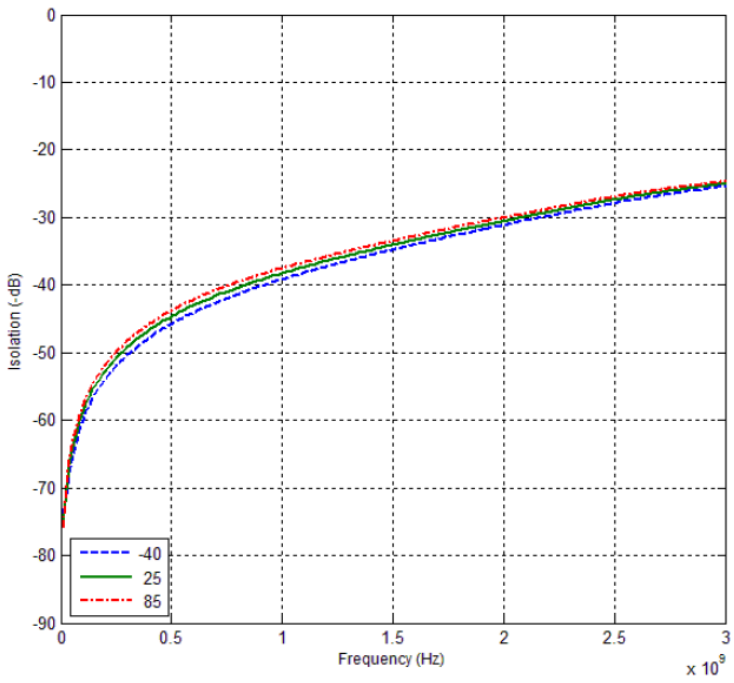


Figure 10. Isolation vs. temperature (RFx–RFx, RFx active)

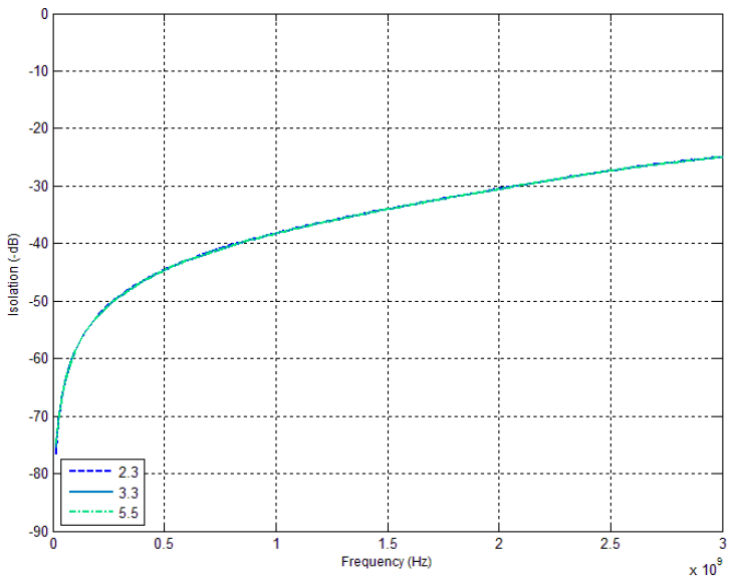


Figure 11. Isolation vs. V_{DD} (RFC–RFx, RFx active)

Evaluation kit

pSemi designed the PE42820 evaluation board to ease your evaluation of the PE42820 RF switch.

DC power is supplied through J10, with VDD on pin 9, and GND on the entire lower row of even-numbered pins. To evaluate a switch path, add or remove jumpers on V1 (pin 3), as listed in Table 5.

The ANT/RFC port connects through a 50Ω transmission line via the top SMA connector, J1. The RF1 and RF2 paths also connect through 50Ω transmission lines via SMA connectors as J2 and J3, respectively. A 50Ω through transmission line is available via SMA connectors J5 and J6. Use this transmission line to estimate the loss of the PCB over the environmental conditions being evaluated. An open-ended 50Ω transmission line is also provided for calibration at J4, if needed.

pSemi used narrow trace widths near each part to improve the impedance matching. The shunt capacitor (C1) on the RFC port provides high-frequency impedance matching.

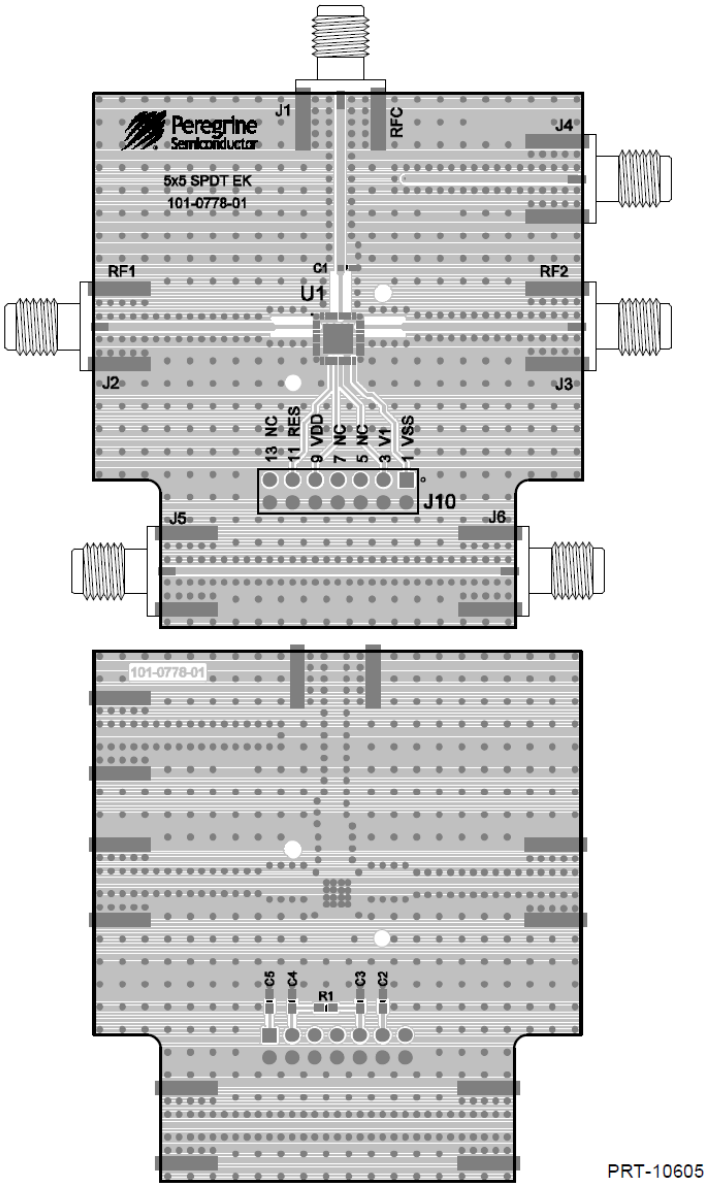


Figure 12. Evaluation board layout

Evaluation board schematic

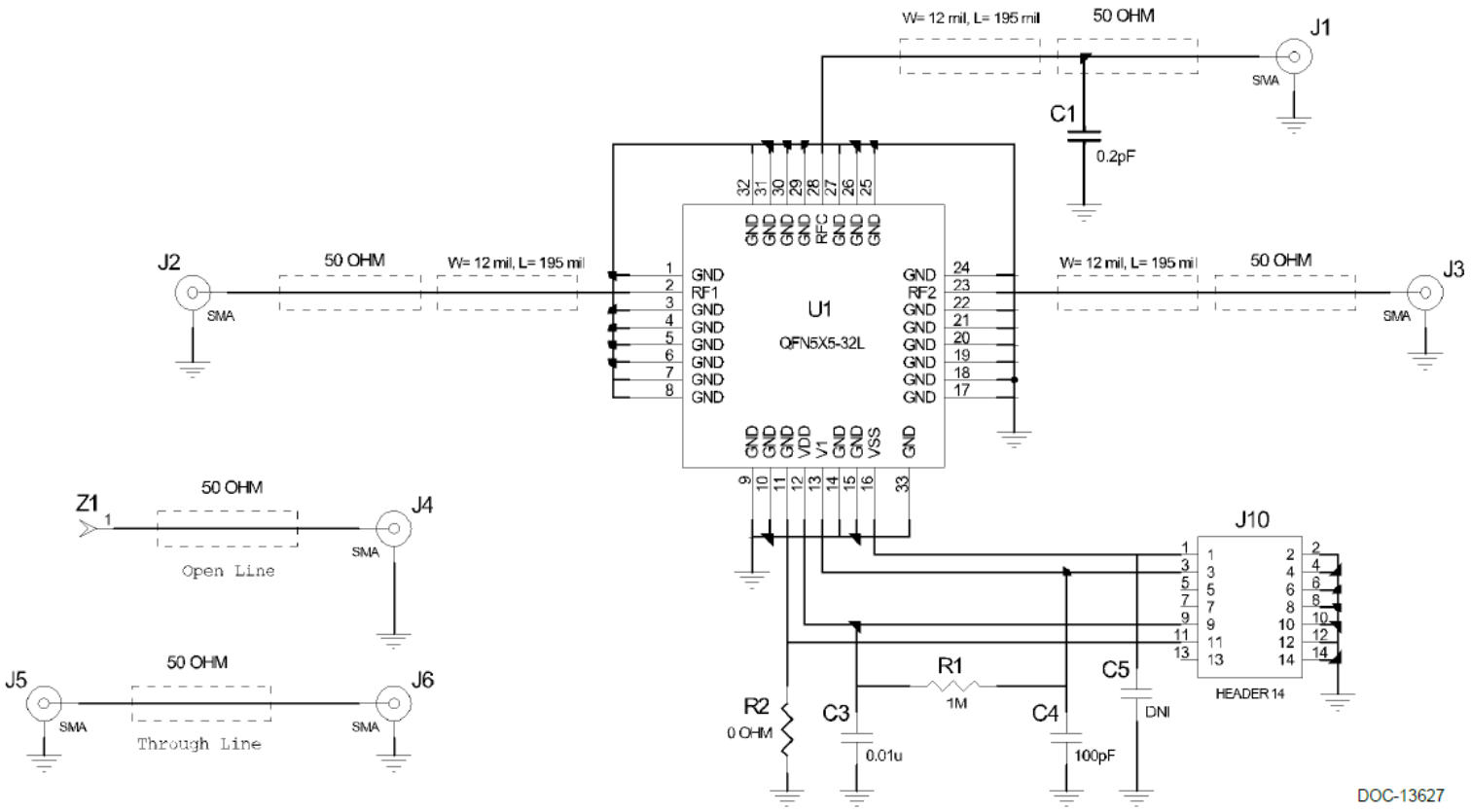


Figure 13. Evaluation board schematic

Pin information

Figure 14 shows the PE42820 pin map for the 32-lead 5 × 5 mm QFN package, and Table 6 lists the description for each pin.

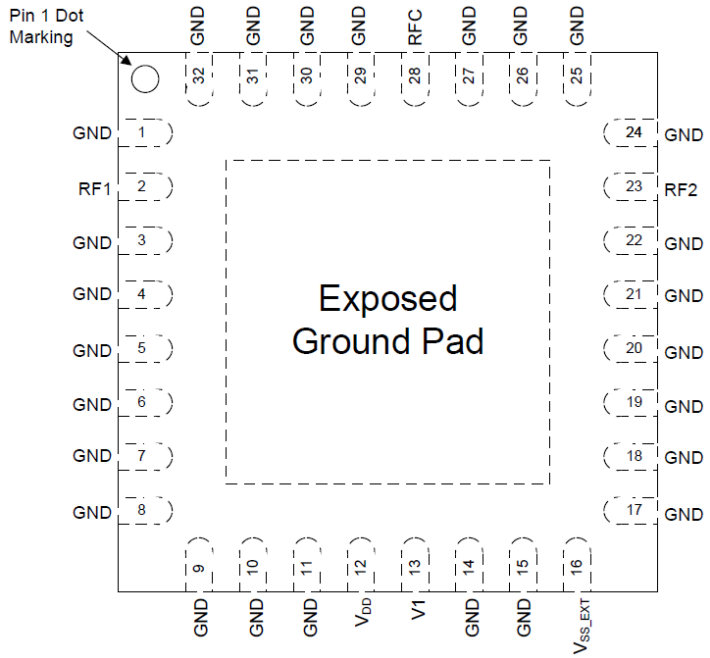


Figure 14. Pin configuration (top view)

Table 6. PE42820 pin descriptions

Pin no.	Pin name	Description
1, 3–11, 14, 15, 17–22, 24–27, 29–32	GND	Ground
2	RF1	RF port 1
12	V_{DD}	Supply voltage (nominal 3.3V)
13	V1	Digital control logic input 1
16	V_{SS_EXT}	External V_{SS} negative voltage control
23	RF2	RF port 2
28	RFC	RF common
Pad	GND	Exposed pad. Ground for proper operation.

1. RF pins 2, 23, and 28 must be at 0 VDC. These RF pins do not require DC blocking capacitors for proper operation if the 0 VDC requirement is met.
2. Use V_{SS_EXT} (pin 16, V_{SS_EXT} = $-V_{DD}$) to bypass and disable internal negative voltage generator. Connect V_{SS_EXT} (pin 16, V_{SS_EXT} = GND) to enable the internal negative voltage generator.

Packaging information

This section provides the following packaging data:

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

Moisture sensitivity level

The PE42820 moisture sensitivity level rating for the 32-lead 5 × 5 mm QFN package is MSL3.

Package drawing

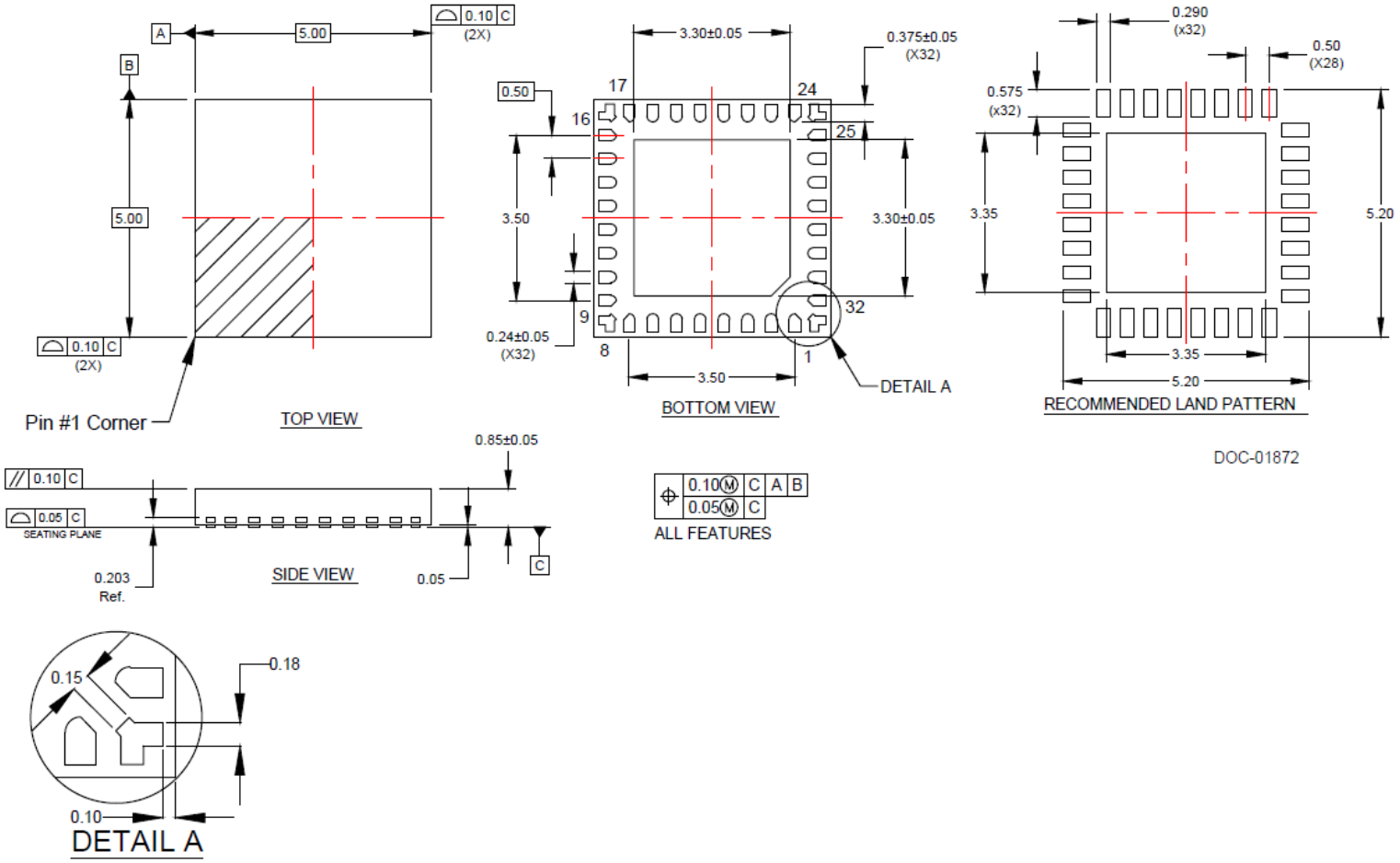


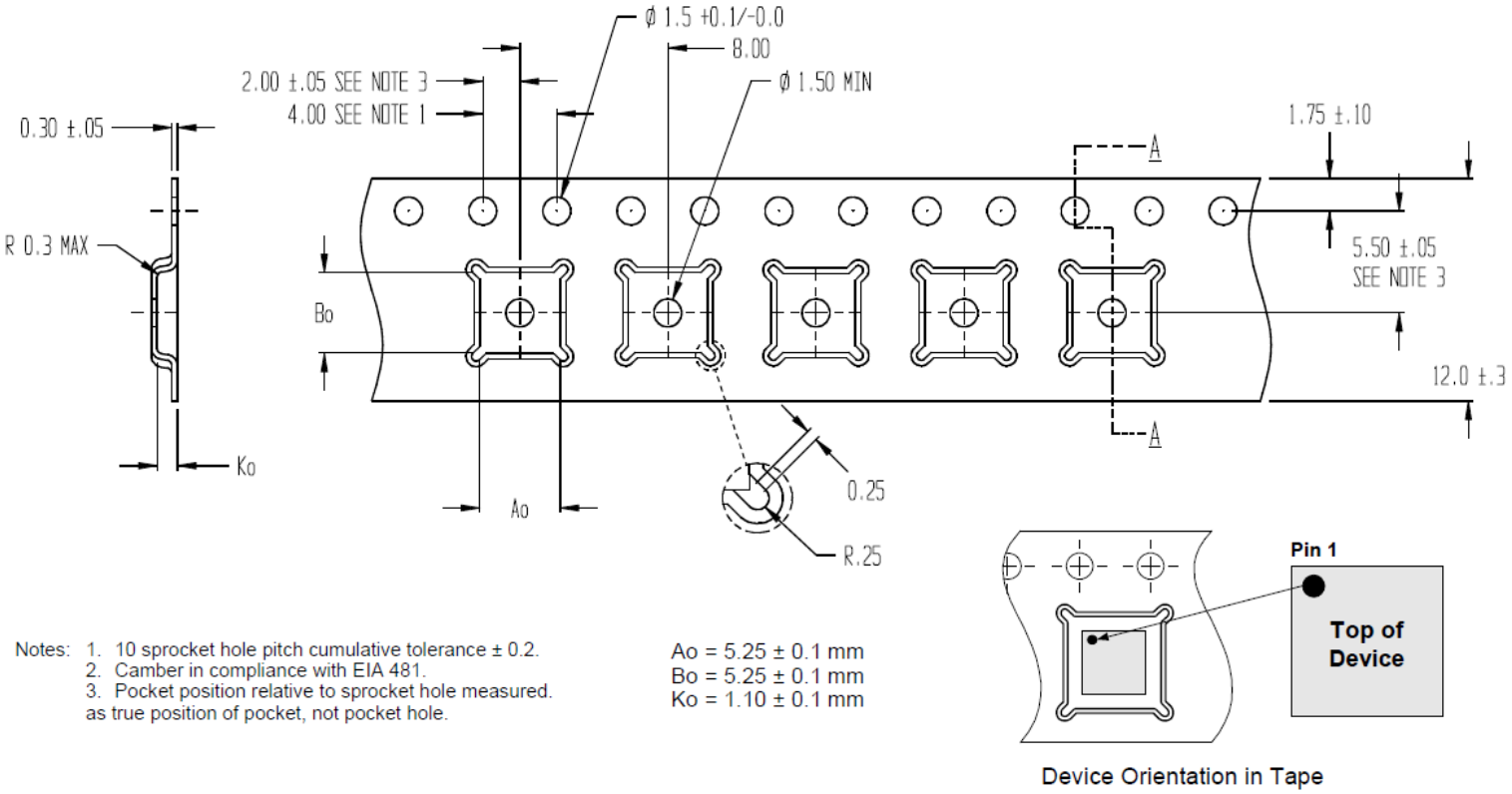
Figure 15. Package mechanical drawing for the 32-lead 5 × 5 mm QFN package

Top-marking specification

● = Pin 1 indicator
YYWW = Date code, last two digits of the year and work week
ZZZZZZ = Six digits of the lot number

Figure 16. PE42820 package marking specification

Tape and reel specification



Notes: 1. 10 sprocket hole pitch cumulative tolerance ± 0.2.
2. Camber in compliance with EIA 481.
3. Pocket position relative to sprocket hole measured as true position of pocket, not pocket hole.

Ao = 5.25 ± 0.1 mm
Bo = 5.25 ± 0.1 mm
Ko = 1.10 ± 0.1 mm

Figure 17. Tape and reel specification for the 32-lead 5 × 5 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

Order code	Description	Packaging	Shipping method
PE42820B-X	PE42820 SPDT RF switch	Green 32-lead 5 × 5 mm QFN	500 units/T&R
EK42820-03	PE42820 evaluation kit	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).
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