PE42721

Document category: Product Specification

UltraCMOS® SPDT RF Switch, 5–2200 MHz

Features

- HaRP™ technology enhanced high linearity:
  - CTB of -99 dBc
  - CSO better than -105 dBc
- Supports +1.8V control logic
- Low insertion loss:
  - 0.40 dB @ 220 MHz
  - 0.50 dB @ 870 MHz
  - 0.65 dB @ 2200 MHz
- High isolation:
  - 85 dB @ 220 MHz
  - 68 dB @ 870 MHz
  - 53 dB @ 2200 MHz
- ESD performance:
  - 3 kV HBM on RF pins to GND
  - 2 kV HBM on all other pins
  - 1 kV CDM on all pins
- Packaging: 12-lead 3 × 3 mm QFN

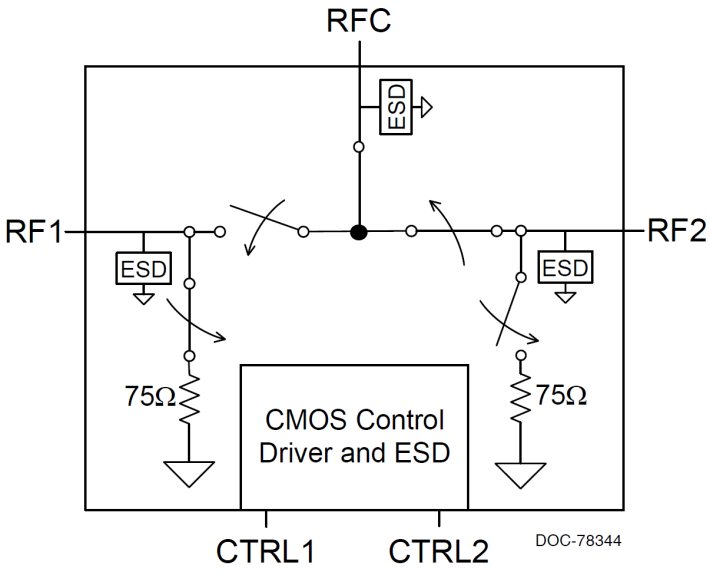


Figure 1. PE42721 functional diagram

Product description

The PE42721 is a HaRP™ technology-enhanced absorptive 75Ω SPDT RF switch developed using pSemi UltraCMOS® process technology.

The PE42721 is a highly linear device delivering high isolation and very low insertion loss performance. It is designed for broadband applications, such as TV tuner modules, CATV signal switching and distribution, DTV, multi-tuner digital video recorders (DVRs) and set-top boxes.

The PE42721 supports +1.8V control logic and offers high ESD protection. The PE42721 is pin compatible with the PE42750. In addition, no blocking capacitors are required if no DC voltage is present on the RF ports.

pSemi's HaRP™ technology enhancement is an innovative feature of the UltraCMOS® process, offering the performance of GaAs with the economy and integration of conventional CMOS.

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. PE42721 absolute maximum ratings

Parameter or condition	Symbol	Min	Max	Unit
Supply voltage	V_{DD}	-0.3	5.5	V
Digital input voltage	V_{CTRL}	-0.3	3.6	V
RF input power (RFC–RFx)[1]: - 5 ≤ 45 MHz - 45 ≤ 2200 MHz	P_{IN}	–	18 22	dBm
RF input power into terminated ports (RFx)[1]: - 5 ≤ 45 MHz - 45 ≤ 2200 MHz	$P_{IN,TERM}$	–	16 16	dBm
Storage temperature range	T_{ST}	-65	+150	°C
ESD voltage HBM[2]: - RF pins to GND - All other pins	$V_{ESD,HBM}$	–	3000 2000	V
ESD voltage MM[3], all pins	$V_{ESD,MM}$	–	100	V
ESD voltage CDM[4], all pins	$V_{ESD,CDM}$	–	1000	V

1. 100% duty cycle, all bands, 75Ω.
2. Human Body Model (MIL-STD-883 Method 3015).
3. Machine Model (JEDEC JESD22-A115).
4. Charged Device Model (JEDEC JESD22-C101).

Recommended operating conditions

Table 2 lists the PE42721 recommended operating conditions. Do not operate devices outside the operating conditions listed below.

Table 2. PE42721 operating conditions

Parameter	Symbol	Min	Typ	Max	Unit
Supply voltage	V_{DD}	2.3	3.3	5.5	V
Supply current	I_{DD}	–	110	200	µA
Digital input high (CTRL1, CTRL2)	V_{IH}	1.17	–	3.6	V
Digital input low (CTRL1, CTRL2)	V_{IL}	-0.3	–	0.6	V
Digital input current	I_{CTRL}	–	–	1	µA
RF input power (RFC–RFx)(*): - 5 ≤ 45 MHz - 45 ≤ 2200 MHz	P_{IN}	–	–	18 22	dBm
RF input power into terminated ports (RFx)(*): - 5 ≤ 45 MHz - 45 ≤ 2200 MHz	$P_{IN,TERM}$	–	–	16 16	dBm
Operating temperature range	T_{OP}	-40	+25	+85	°C

* 100% duty cycle, all bands, 75Ω.

Electrical specifications

Table 3 lists the PE42721 key electrical specifications at +25 °C and V_{DD} = 3.3V (Z_S = Z_L = 75Ω), unless otherwise specified.

Table 3. PE42721 electrical specifications

Parameter	Path	Condition	Min	Typ	Max	Unit
Operting frequency	–	–	5	–	2200	MHz
Insertion loss	RFC–RFx	5–220 MHz 221–870 MHz 871–2200 MHz	–	0.40 0.50 0.65	0.55 0.70 0.85	dB
Isolation	RFx–RFx	5–220 MHz 221–870 MHz 871–2200 MHz	81 65 52	85 68 53	–	dB
Isolation	RFC–RFx	5–220 MHz 221–870 MHz 871–2200 MHz	68 57 53	70 59 55	–	dB
Return loss	All ports	870 MHz 2200 MHz	–	18 15	–	dB
Input 0.1 dB compression point[1][2]	RFC–RFx	45–1000 MHz	–	27	–	dBm
IIP2[3]	RFx	45–2200 MHz	–	110	–	dBm
IIP3	RFx	5–2200 MHz	–	60	–	dBm
CTB	–	159 channels; 42 dBmV per channel output power	–	-99	–	dBc
CSO	–	159 channels; 42 dBmV per channel output power	–	< -105	–	dBc
Cross-modulation distortion	–	159 channels; 42 dBmV per channel output power	–	-89.5	–	dBc
Video feedthrough	–	DC measurement	–	4	–	mV_{PP}
Switching time[4]	–	50% CTRL to 90% or 10% RF	–	1	1.5	µs

1. The input 0.1 dB compression point (P0.1dB) is a linearity figure of merit. For the RF input power (P_{IN}), see Table 2.
2. P0.1dB = 25 dBm @ 2.2 GHz.
3. IIP2 = 83 dBm @ 5 MHz.
4. The PE42721 has a maximum 25 kHz switching rate. 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.

Spurious performance

The PE42721 typical spurious performance is –124 dBm.

SPDT control logic

Table 4. PE42721 truth table

C1	C2	RFC–RF1	RFC–RF2
Low	Low	ON	OFF
Low	High	OFF	ON
High	Low	OFF	ON
High	High	ON	OFF

Typical performance data

Figure 2–Figure 16 show the typical performance data at +25 °C and V_{DD} = 3.3V, unless otherwise specified.

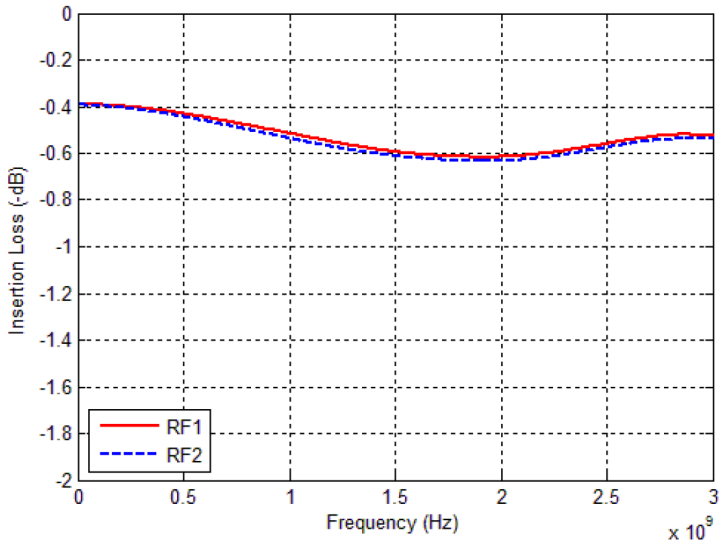


Figure 2. Insertion loss (RFC–RFx)

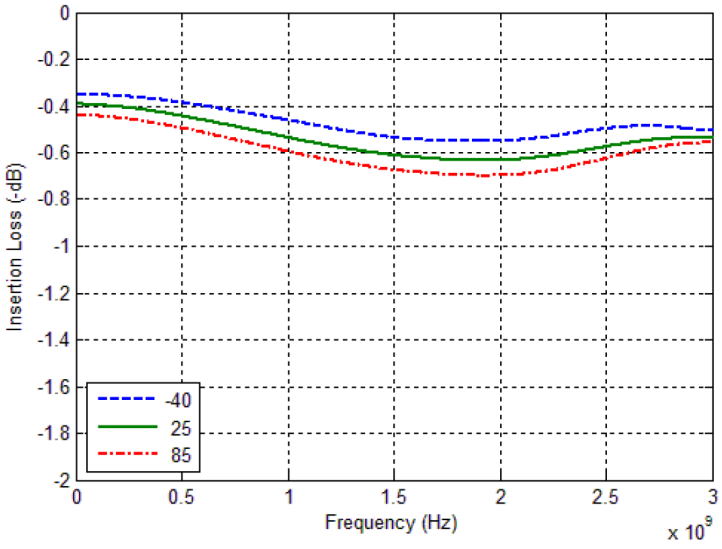


Figure 3. Insertion loss vs. temperature (RFC–RFx)

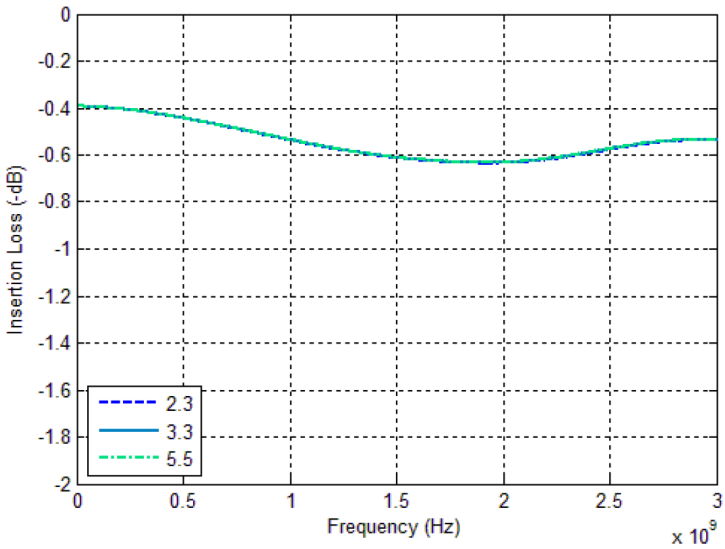


Figure 4. Insertion loss vs. V_{DD} (RFC–RFx)

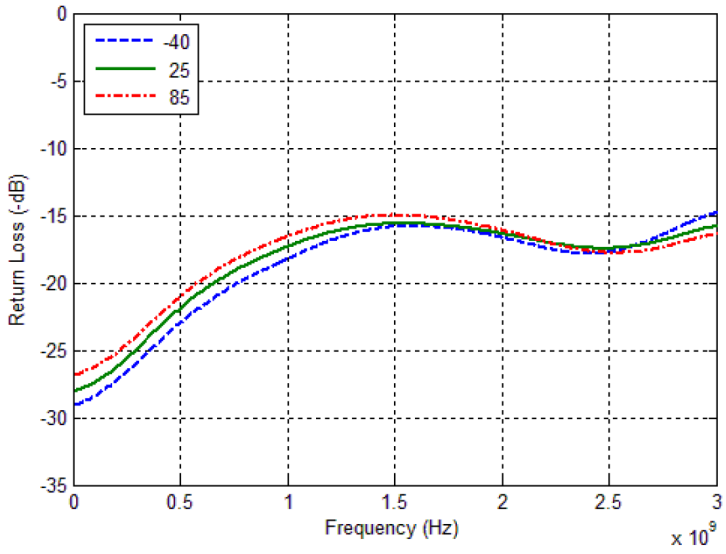


Figure 5. RFC port return loss vs. temperature (RF1 active)

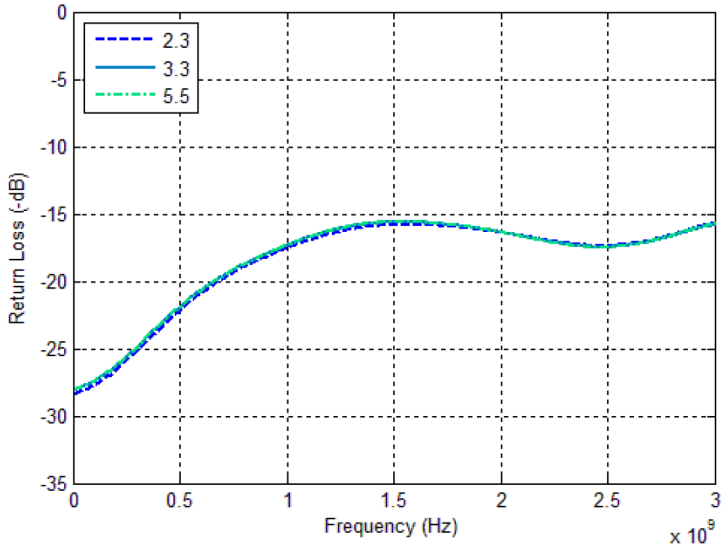


Figure 6. RFC port return loss vs. V_{DD} (RF1 active)

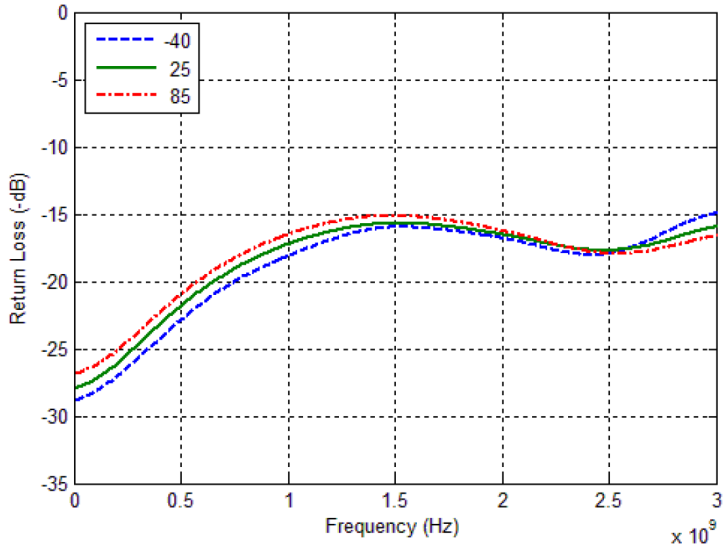


Figure 7. RFC port return loss vs. temperature (RF2 active)

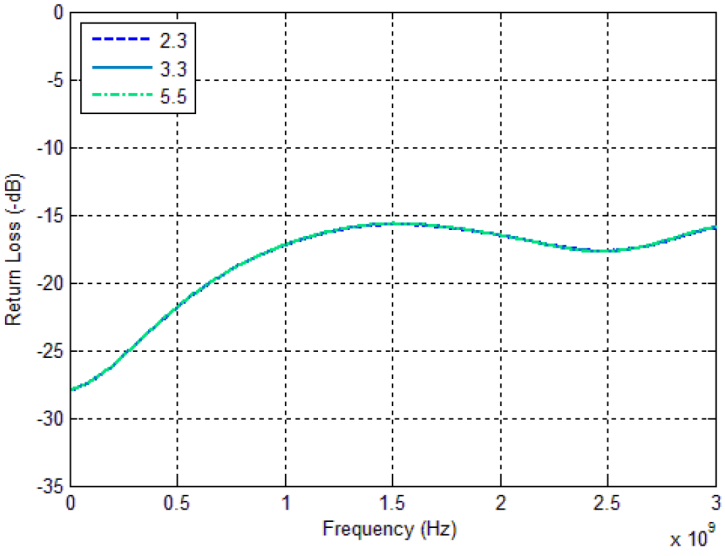


Figure 8. RFC port return loss vs. V_{DD} (RF2 active)

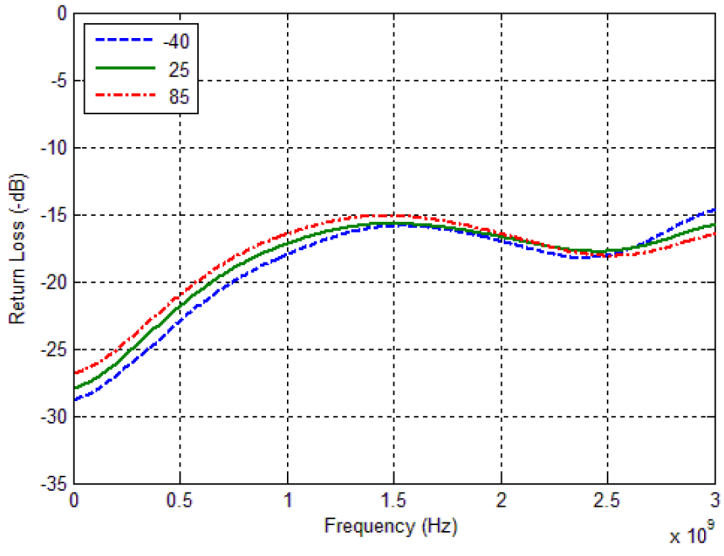


Figure 9. Active port return loss vs. temperature (RF1 active)

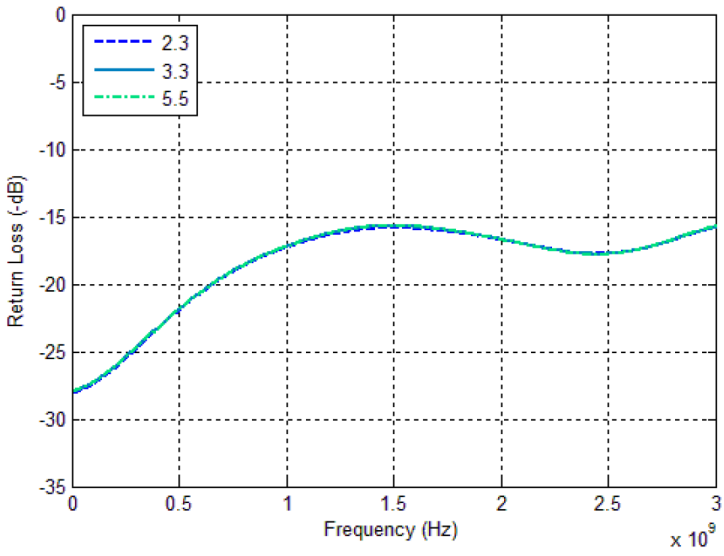


Figure 10. Active port return loss vs. V_{DD} (RF1 active)

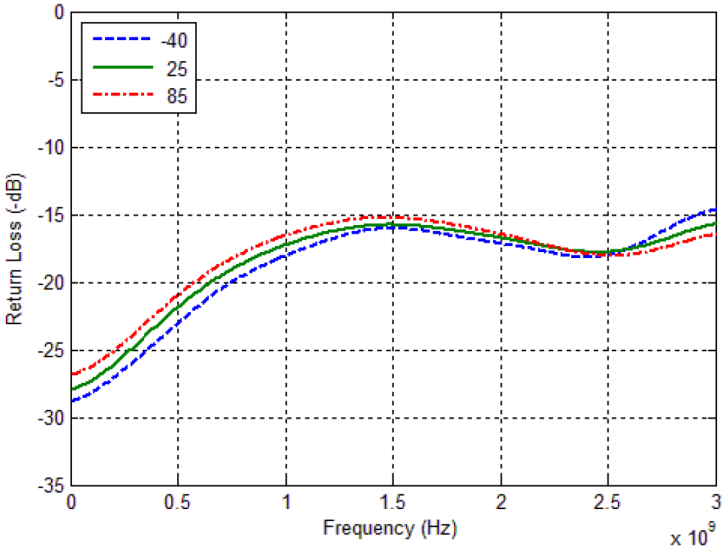


Figure 11. Active port return loss vs. temperature (RF2 active)

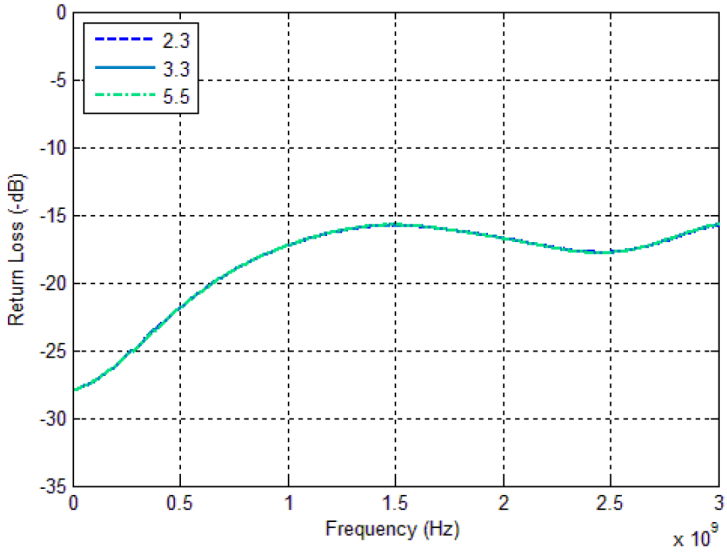


Figure 12. Active port return loss vs. V_{DD} (RF2 active)

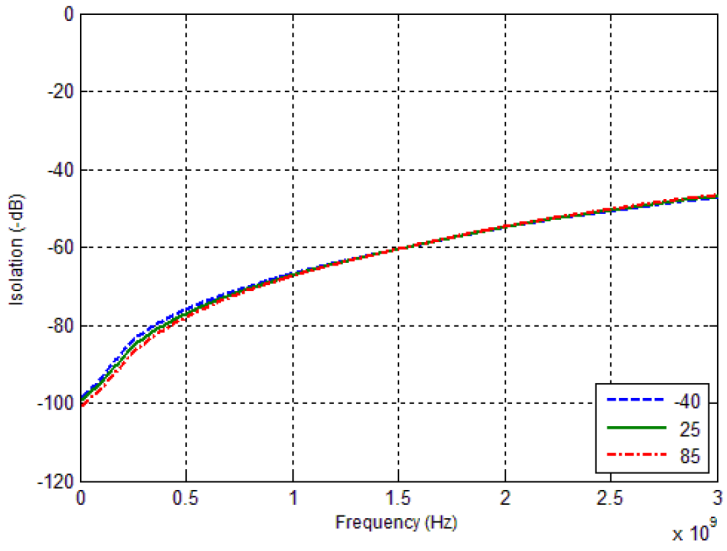


Figure 13. Isolation vs. temperature (RFx–RFx)

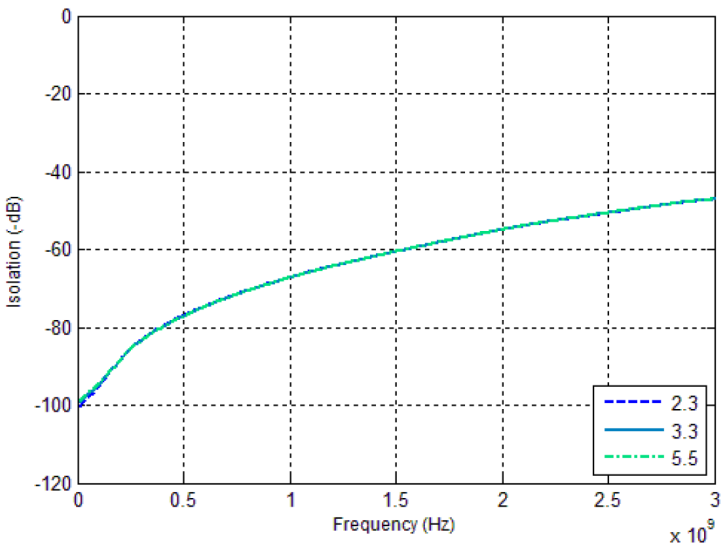


Figure 14. Isolation vs. V_{DD} (RFx–RFx)

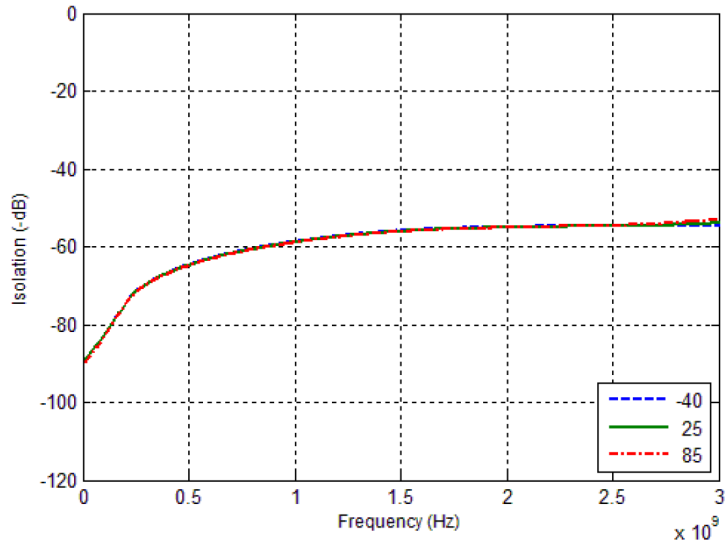


Figure 15. Isolation vs. temperature (RFC–RFx)

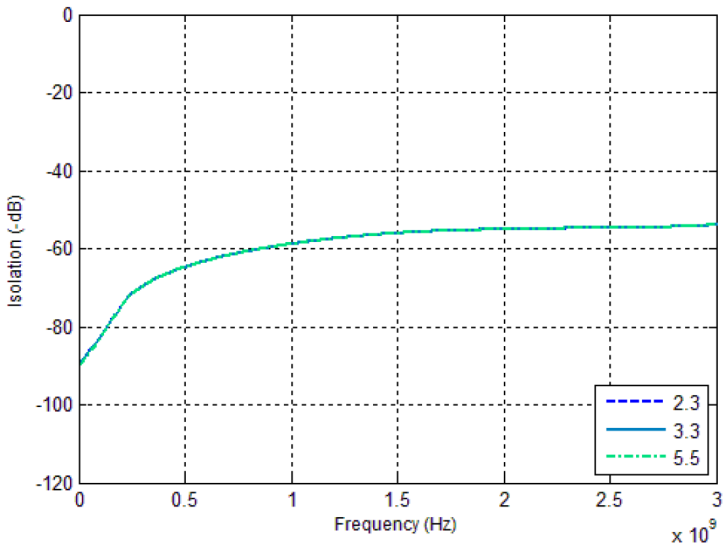


Figure 16. Isolation vs. V_{DD} (RFC–RFx)

Evaluation kit

pSemi designed the SPDT switch evaluation board to ease your evaluation of the pSemi PE42721. The RF common port is connected through a 75Ω transmission line via the F-Type connector, J2. Ports RF1 and RF2 connect through 75Ω transmission lines via F-type connectors J1 and J3, respectively. A 75Ω through transmission line is available via F-type connectors J4 and J5, which you can use to de-embed the loss of the PCB. J6 provides DC and digital inputs to the device.

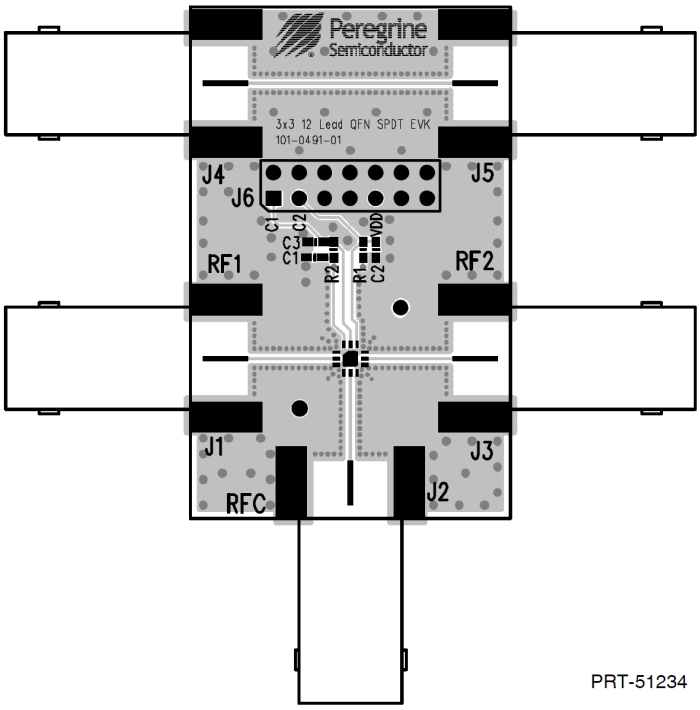


Figure 17. Evaluation board layout

Evaluation board schematic

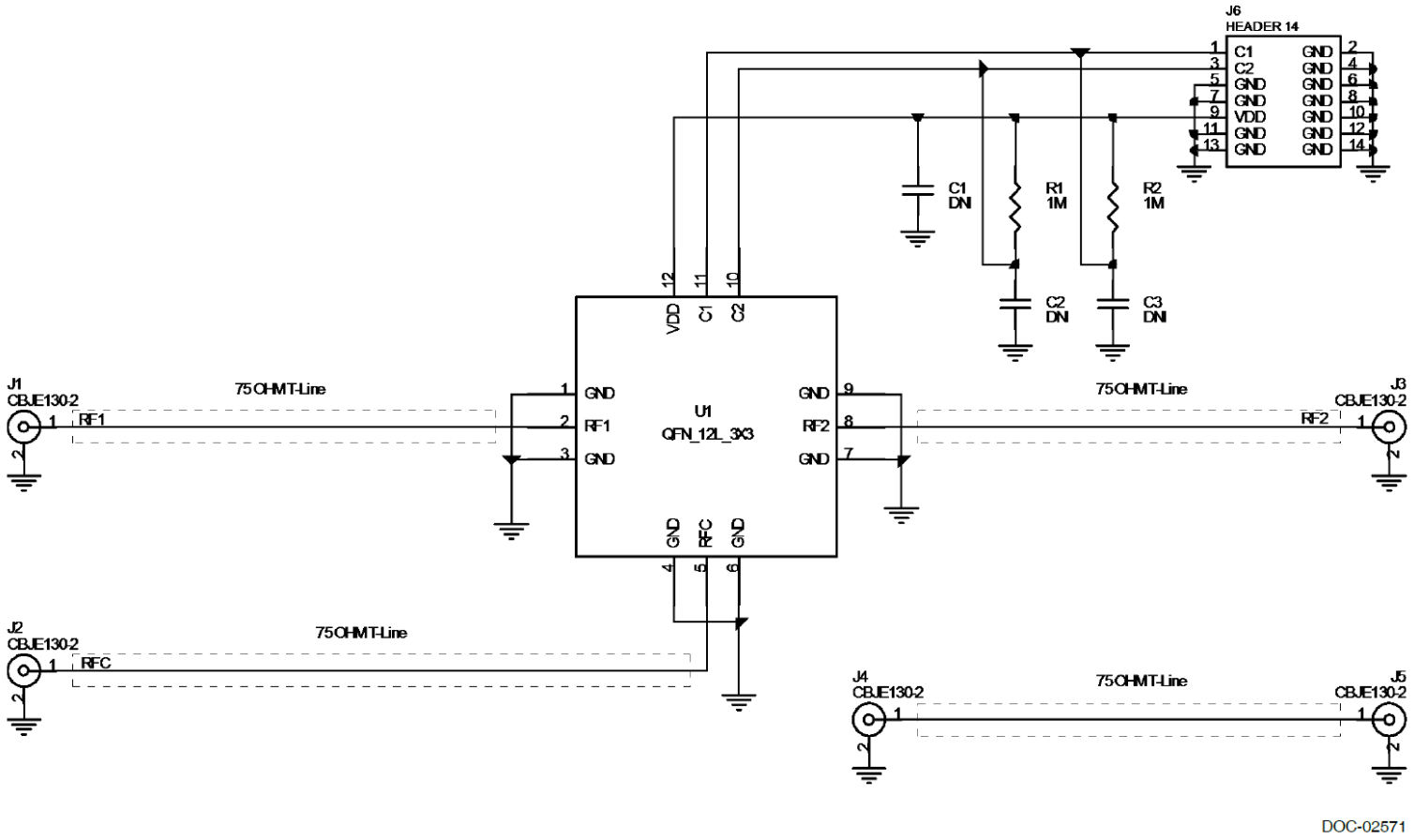


Figure 18. Evaluation board schematic

Pin information

Figure 19 shows the PE42721 pin map for the 12-lead 3 × 3 mm QFN package, and Table 5 lists the description for each pin.

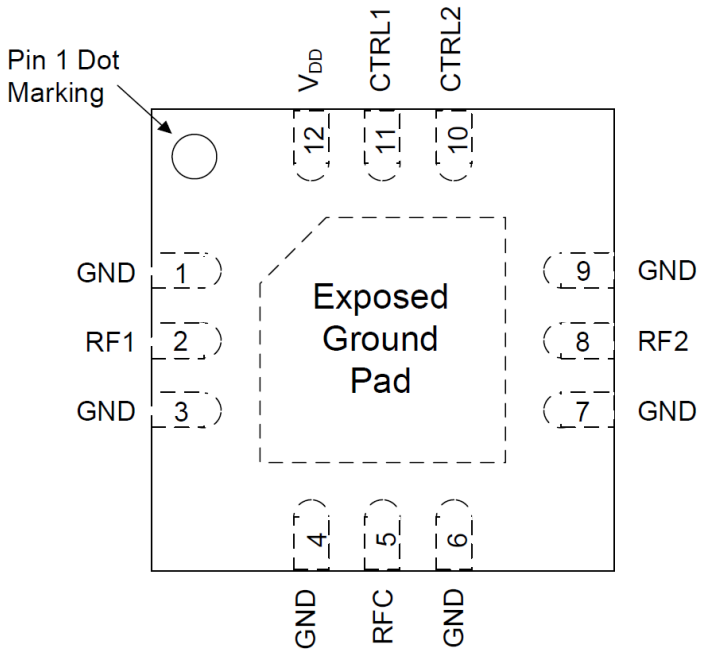


Figure 19. Pin configuration (top view)

Table 5. PE42721 pin descriptions

Pin no.	Pin name	Description
1, 3, 4, 6, 7, 9	GND	Ground
2(*)	RF1	RF port 1
5(*)	RFC	RF common
8(*)	RF2	RF port 2
10	CTRL2	Digital control logic input 2
11	CTRL1	Digital control logic input 1
12	V_{DD}	Supply voltage
Pad	GND	Exposed pad. Ground for proper operation.

* RF pins 2, 5, and 8 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 PE42721 moisture sensitivity level rating for the 12-lead 3 × 3 mm QFN package is MSL1.

Package drawing

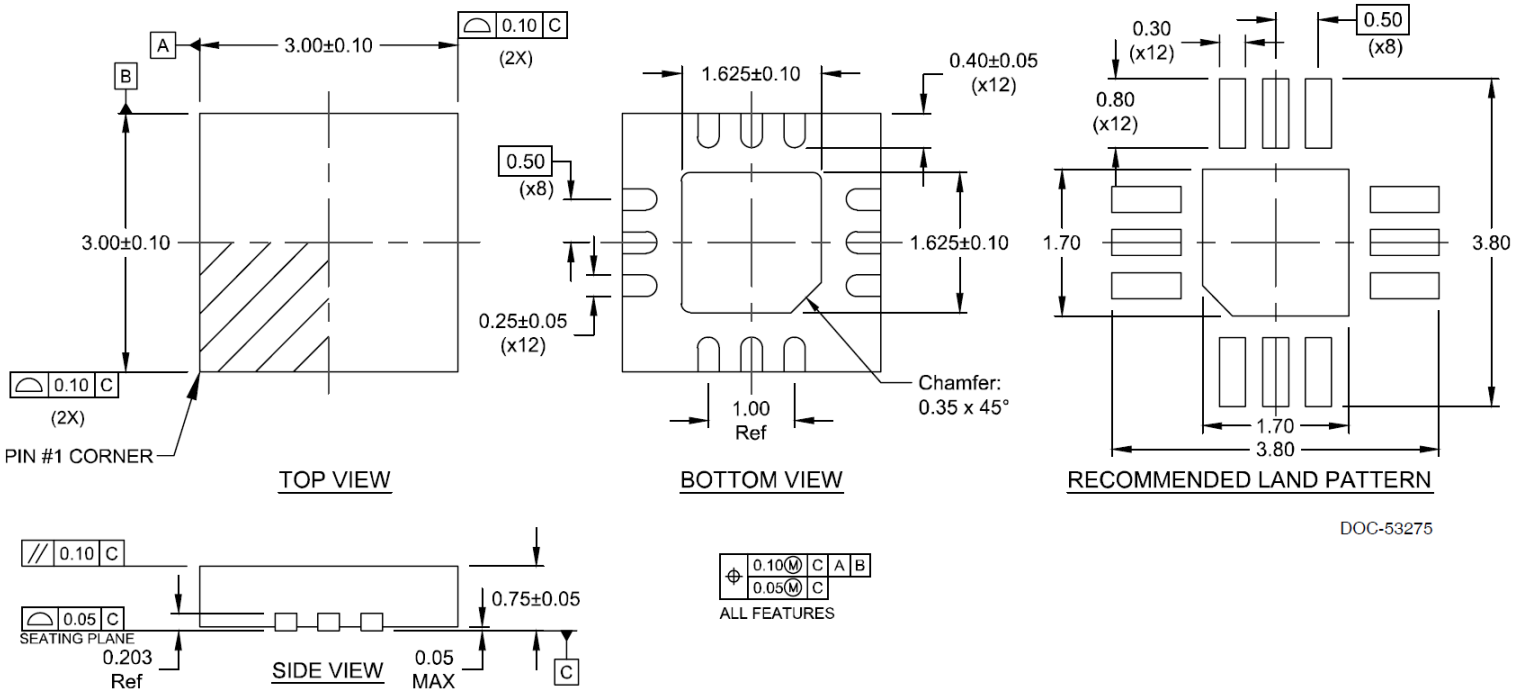
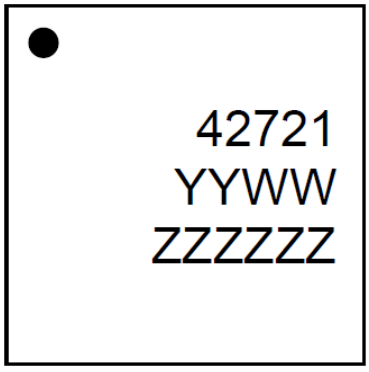


Figure 20. Package mechanical drawing for the 12-lead 3 × 3 mm QFN package

Top-marking specification



● = Pin 1 designator
YY = Last two digits of assembly year
WW = Assembly work week
ZZZZZZ = Assembly lot code (maximum six characters)

Figure 21. PE42721 package marking specification

Tape and reel specification

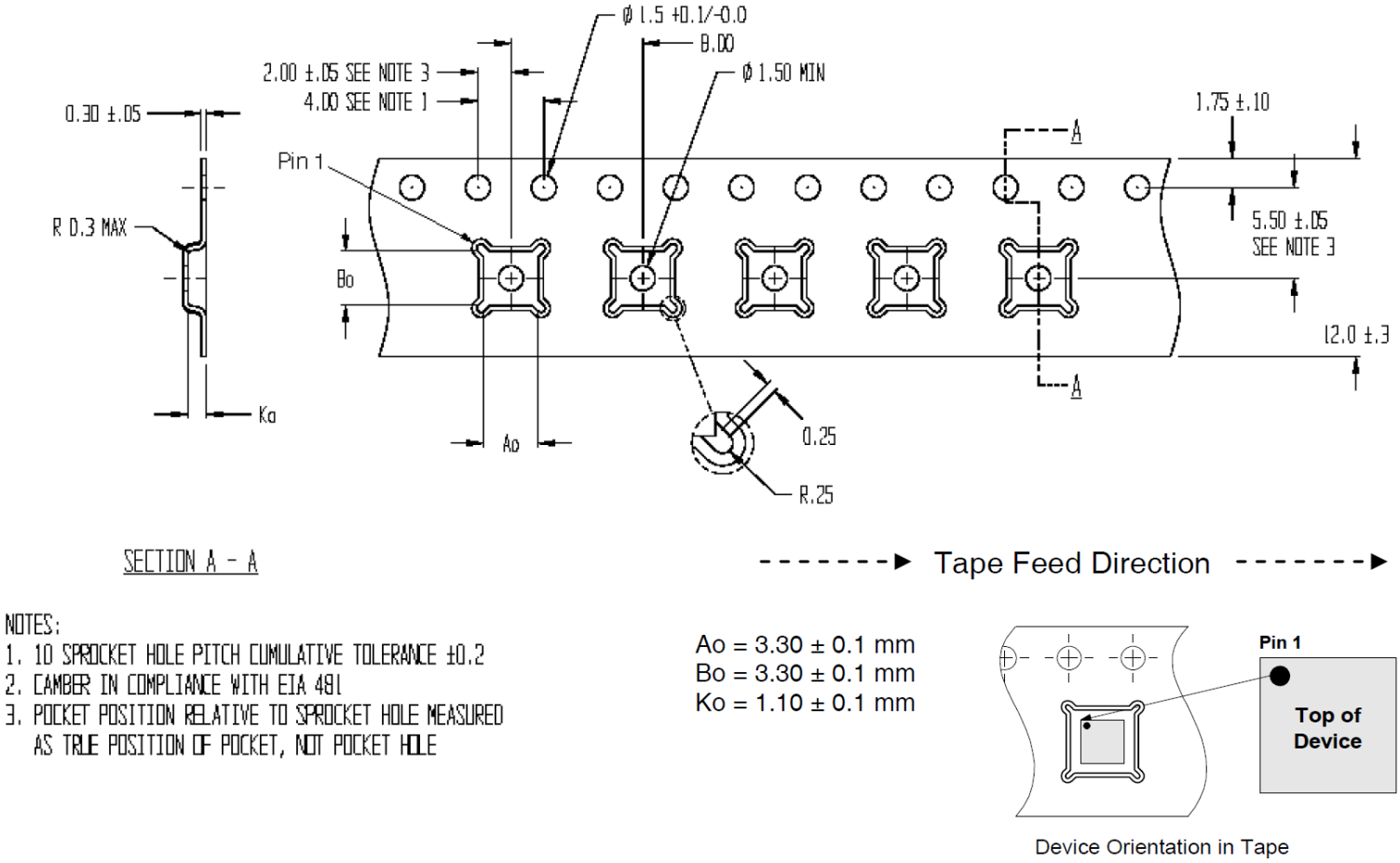


Figure 22. Tape and reel specification for the 12-lead 3 × 3 mm QFN package

- 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
PE42721MLBA-Z	PE42721 SPDT RF switch	Green 12-lead 3 × 3 mm QFN	3000 units/T&R
EK42721-02	PE42721 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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