PE42722

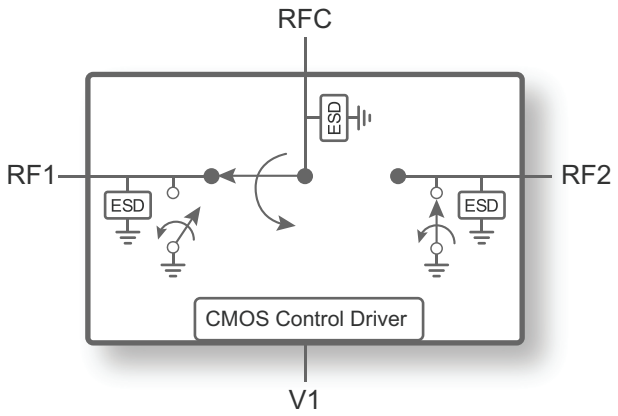
Document Category: Product Specification

UltraCMOS® SPDT RF Switch, 5–1794 MHz

Features

- Supports DOCSIS 3.0/1 requirements
- Exceptional harmonics performance:
  - 2fo of –117 dBc at 170 MHz
  - 3fo of –134 dBc at 170 MHz
- Best in class linearity across frequency band
- Low insertion loss and high isolation performance:
  - Insertion loss of 0.3 dB at 1218 MHz
  - Isolation of 50 dB at 204 MHz
- High ESD performance: 1.5 kV HBM
- Packaging: 32-lead 5 × 5 × 0.85 mm QFN

Figure 1 • PE42722 functional diagram



Applications

- Broadband market (DOCSIS 3.0/1):
  - Cable modems
  - Set-top boxes
- Filter bank switching
- Relay replacement to switch between DOCSIS 3.0 and DOCSIS 3.1 configurations

Product description

The PE42722 is a HaRP™ technology-enhanced reflective SPDT RF switch designed for use in cable applications including DOCSIS 3.0/1 cable modems and set-top boxes. It delivers high linearity and excellent harmonics performance in the 5–1794 MHz band. It also features low insertion loss and high-isolation performance that makes the PE42722 ideal for DOCSIS 3.1 applications.

The PE42722 is manufactured on pSemi's UltraCMOS® process, a patented variation of silicon-on-insulator (SOI) technology on a sapphire substrate, 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 specified in **Table 1**.

Latch-up immunity

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

Table 1 • PE42722 absolute maximum ratings

Parameter or condition	Min	Max	Unit
Supply voltage, V_{DD}	–0.3	5.5	V
Digital input voltage, V1	–0.3	3.6	V
Maximum input power[1]	–	87.5	dBmV
Maximum junction temperature	–	+150	°C
Storage temperature range	–65	+150	°C
ESD voltage HBM, all pins[2]		1500	V
ESD voltage MM, all pins[3]		200	V
ESD voltage CDM, all pins[4]		250	V

Notes:
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 PE42722 recommended operating conditions. Do not operate devices outside the recommended operating conditions listed below.

Table 2 • PE42722 recommended operating conditions

Parameter	Min	Typ	Max	Unit
Supply voltage, V_{DD}	2.3	3.3	5.5	V
Supply current, I_{DD}	–	130	200	µA
Digital input high, V1	1.17	–	3.6(1)	V
Digital input low, V1	–0.3	–	0.6	V
RF input power, CW(2)	–	–	80	dBmV
RF input power, peak(3)	–	–	85	dBmV
Operating temperature range	–40	+25	+85	°C

Notes:
1) Maximum digital input voltage is limited to V_{DD} and cannot exceed 3.6V.
2) 100% duty cycle, 75Ω.
3) OFDMA DOCSIS 3.1, single channel, 75Ω.

Electrical specifications

Table 3 lists the PE42722 key electrical specifications at +25 °C, V_{DD} = 3.3V, and Z_S = Z_L = 75Ω, unless otherwise specified.

Table 3 • PE42722 electrical specifications

Parameter	Path	Condition	Min	Typ	Max	Unit
Operating frequency	–	–	5	–	1794	MHz
Insertion loss(1)	RFC–RFx	5–204 MHz 204–1218 MHz 1218–1700 MHz 1700–1794 MHz	–	0.20 0.30 0.70 0.85	0.35 0.50 1.00 1.25	dB
Isolation(1)	All paths	5–204 MHz 204–612 MHz 612–1218 MHz 1218–1794 MHz	45 36 30 26	50 40 33 29	–	dB
Return loss(1)	RFC–RFx	5–1218 MHz 1218–1794 MHz	–	25 13	–	dB
Second harmonic, 2fo	RFx	170 MHz, average P_{CW} = 65 dBmV 800 MHz, average P_{CW} = 65 dBmV	–	–117 –119	–	dBc
Third harmonic, 3fo	RFx	170 MHz, average P_{CW} = 65 dBmV 800 MHz, average P_{CW} = 65 dBmV	–	–134 –138	–	dBc
Input 0.1-dB compression point(2)	RFC–RFx	5–1218 MHz	–	88	–	dBmV
Switching time	–	50% CTRL to 90% or 10% RF	–	15	–	µs

Notes:
1) Performance specified with external matching. For details, see the evaluation board schematic (**Figure 13**).
2) The input 0.1-dB compression point is a linearity figure of merit. For the operating RF input power (75Ω), see **Table 2**.

Switching frequency

The PE42722 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 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 typical spurious performance of the PE42722 is –137 dBm.

Thermal data

Psi-JT (Ψ_{JT}), the junction top-of-package, is a thermal metric to estimate the junction temperature of a device on the application PCB (JEDEC JESD51-2).

$\Psi_{JT} = (T_J - T_T)/P$

where:

- Ψ_{JT} = Junction-to-top of package characterization parameter in °C/W
- T_J = Die junction temperature in °C
- T_T = Package temperature (top surface, in the center) in °C
- P = Power dissipated by the device in Watts

Table 4 • PE42722 thermal data

Parameter	Typ	Unit
Ψ_{JT}	73	°C/W
Θ_{JA}, junction-to-ambient thermal resistance	76	°C/W

Control logic

Table 5 lists the PE42722 control logic truth table.

Table 5 • PE42722 truth table

State	V1
RFC–RF1	H
RFC–RF2	L

Typical performance data

Figure 2–Figure 12 show the typical performance data at +25 °C and V_{DD} = 3.3V (Z_S = Z_L = 75Ω), unless otherwise specified.

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

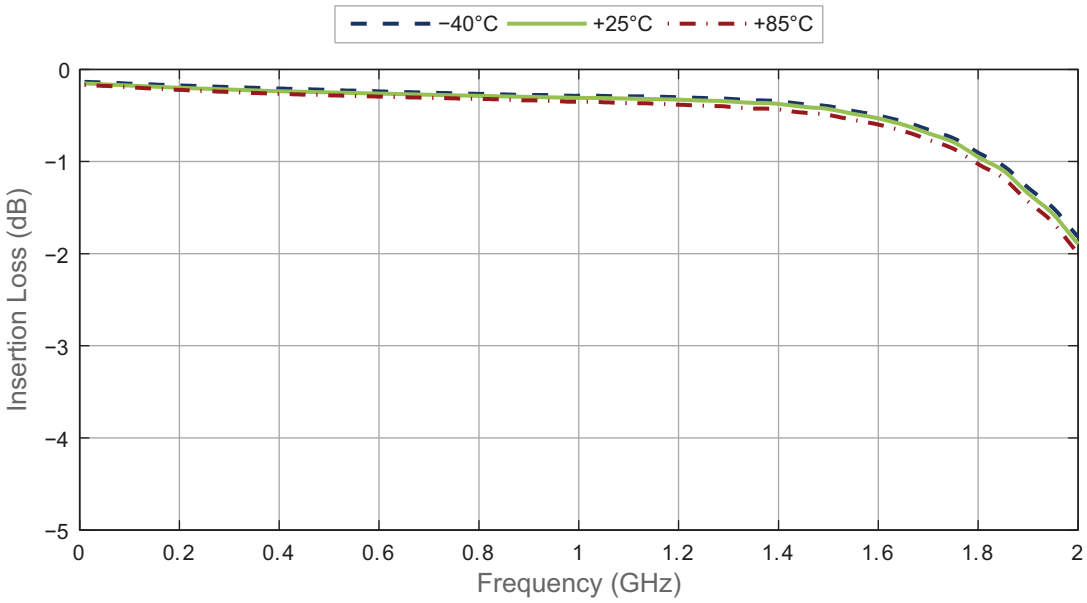


Figure 3 • Insertion loss vs. V_{DD} (RFC–RFx)

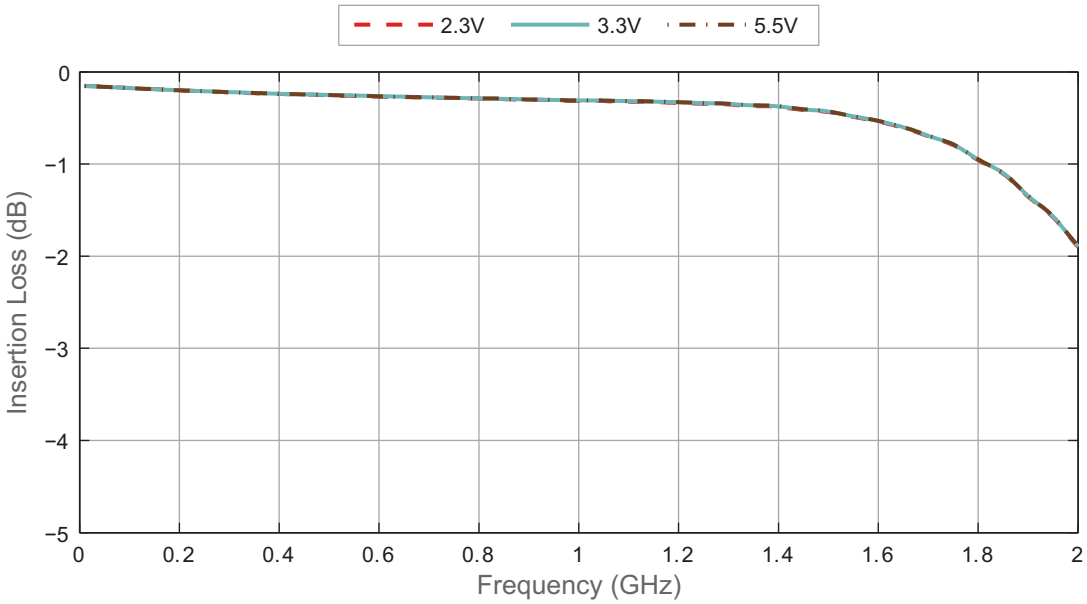


Figure 4 • RFC port return loss vs. temperature

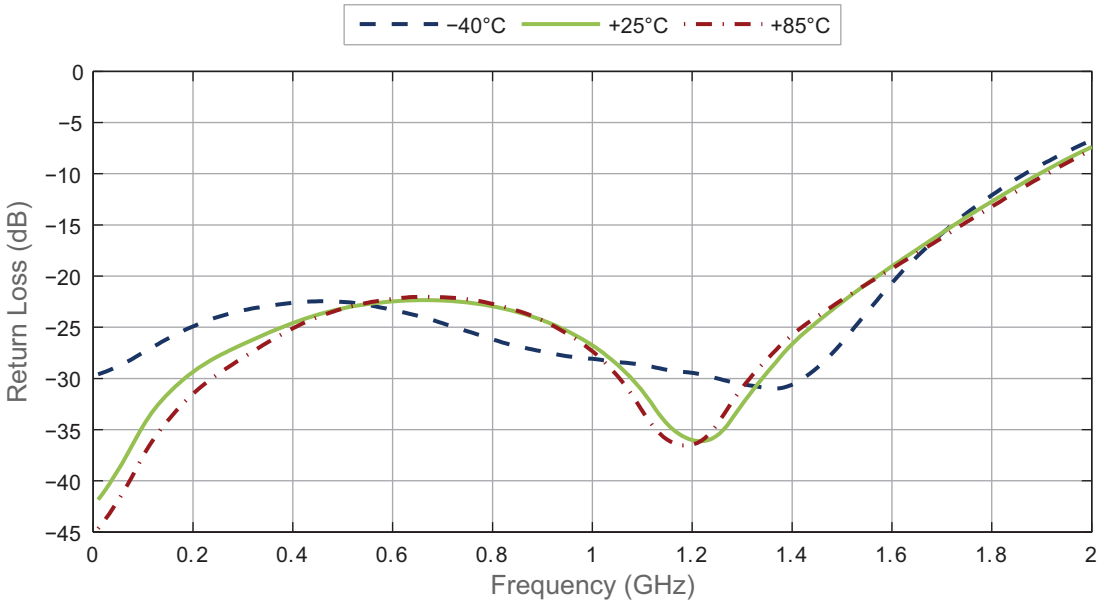


Figure 5 • RFC port return loss vs. V_{DD}

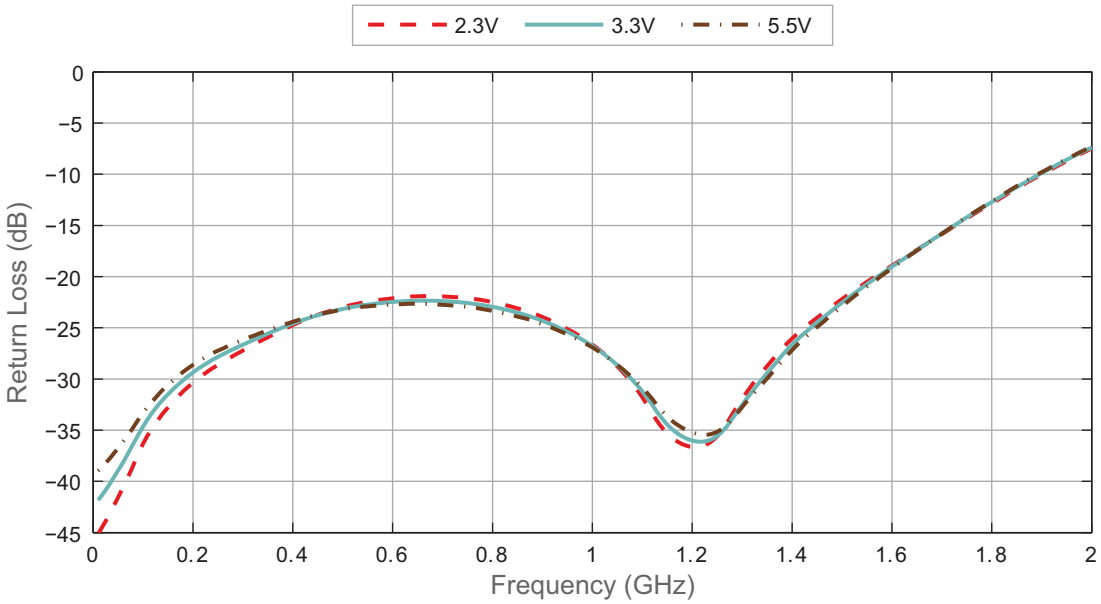


Figure 6 • Active port return loss vs. temperature

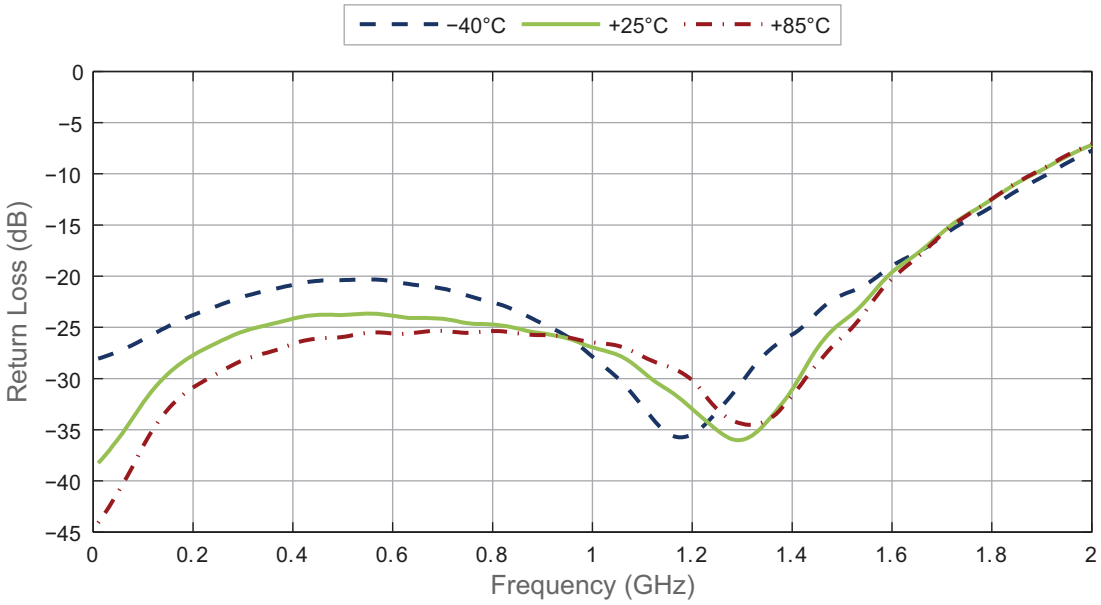


Figure 7 • Active port return loss vs. V_{DD}

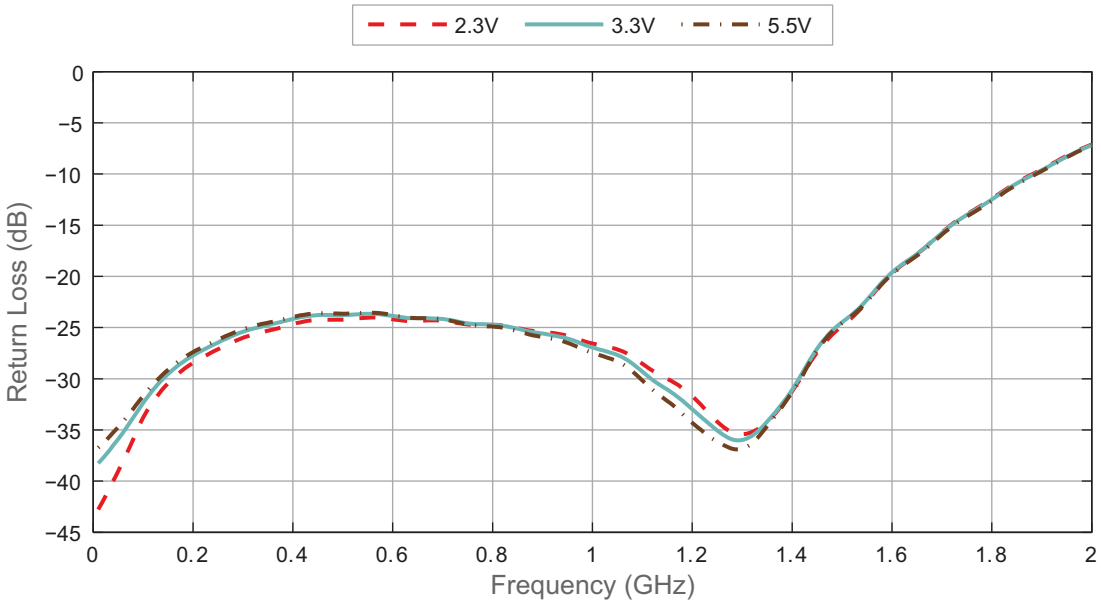


Figure 8 • Isolation vs. temperature (RFx–RFx)

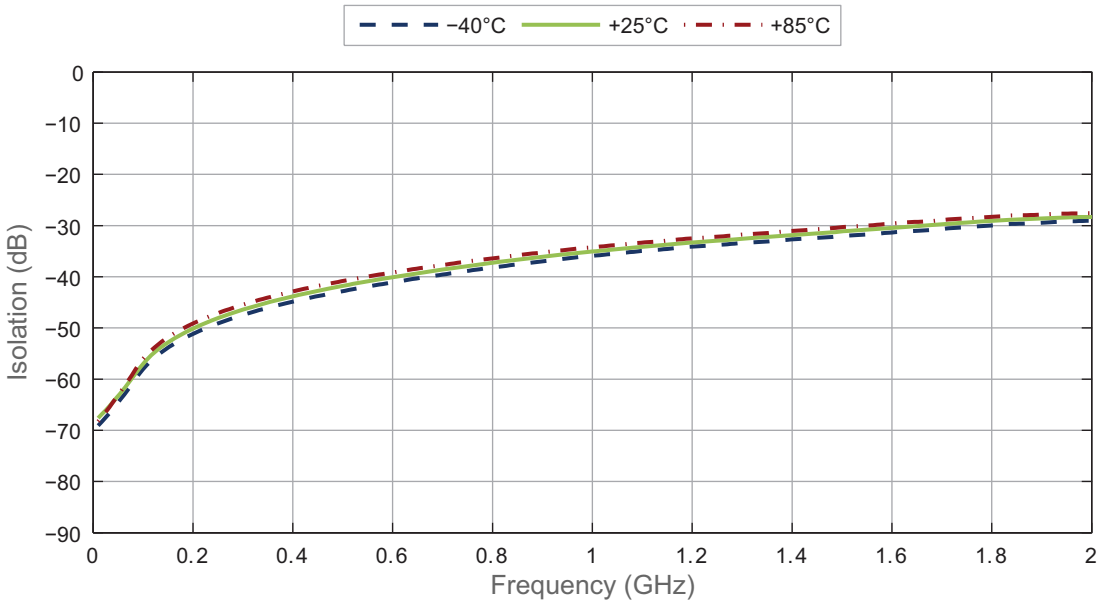


Figure 9 • Isolation vs. V_{DD} (RFx–RFx)

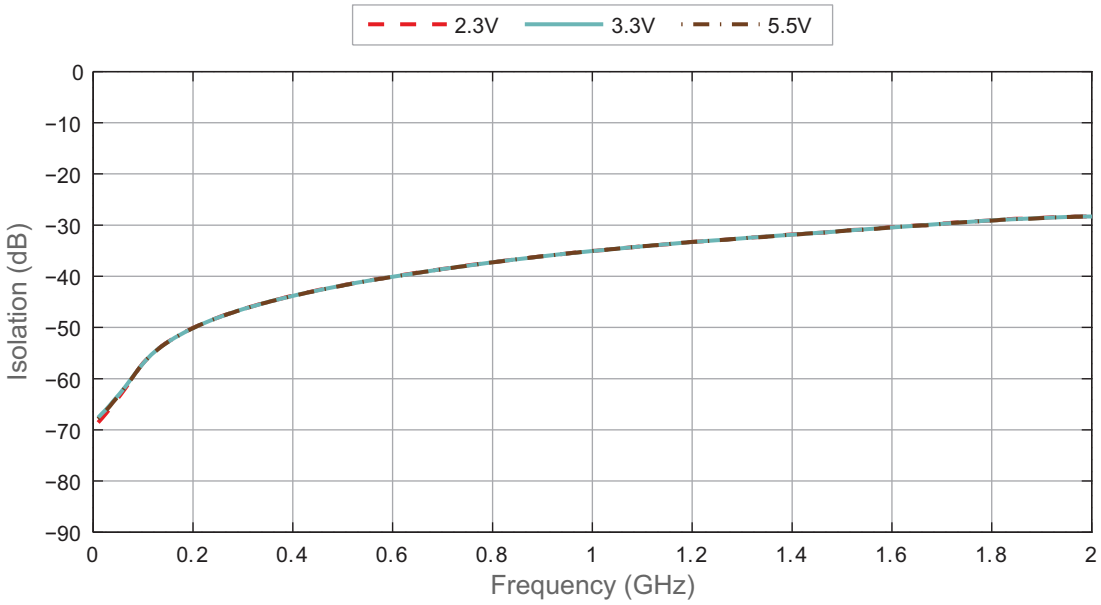


Figure 10 • Isolation vs. temperature (RFC–RFx)

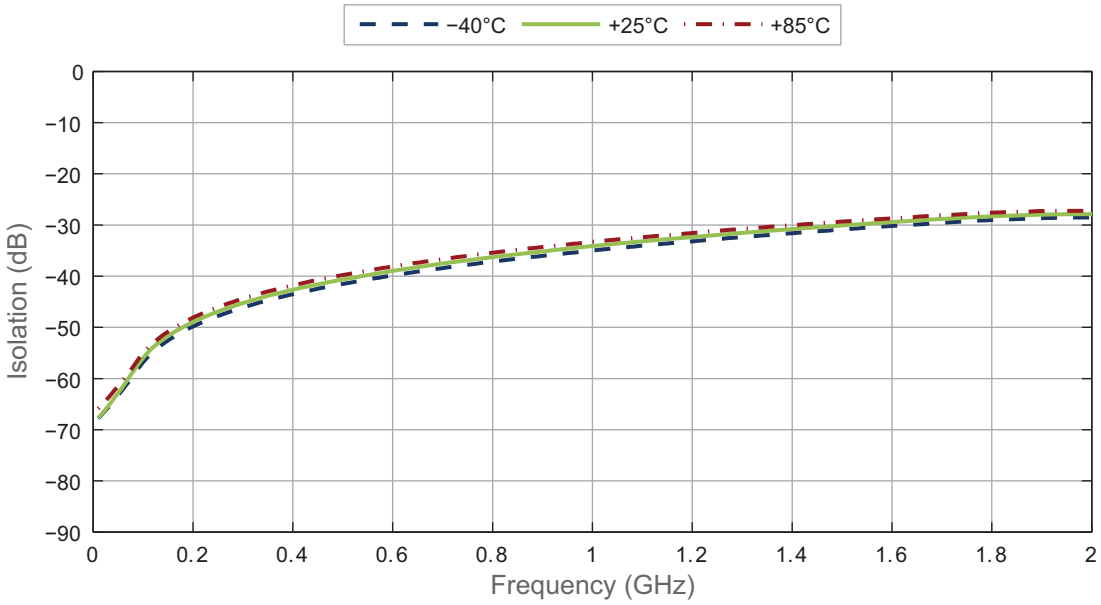


Figure 11 • Isolation vs. V_{DD} (RFC–RFx)

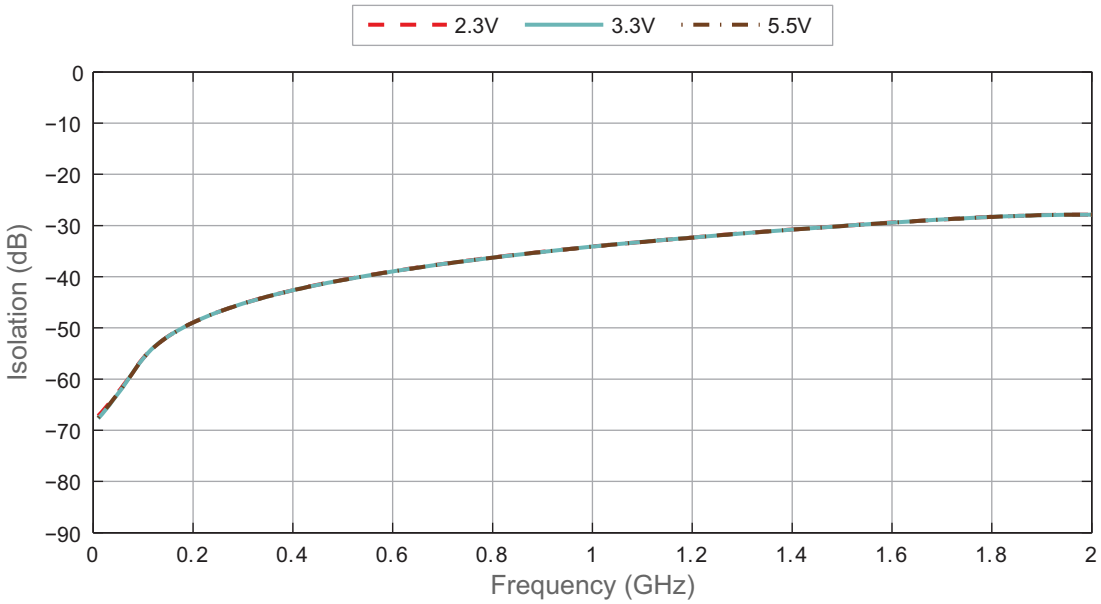
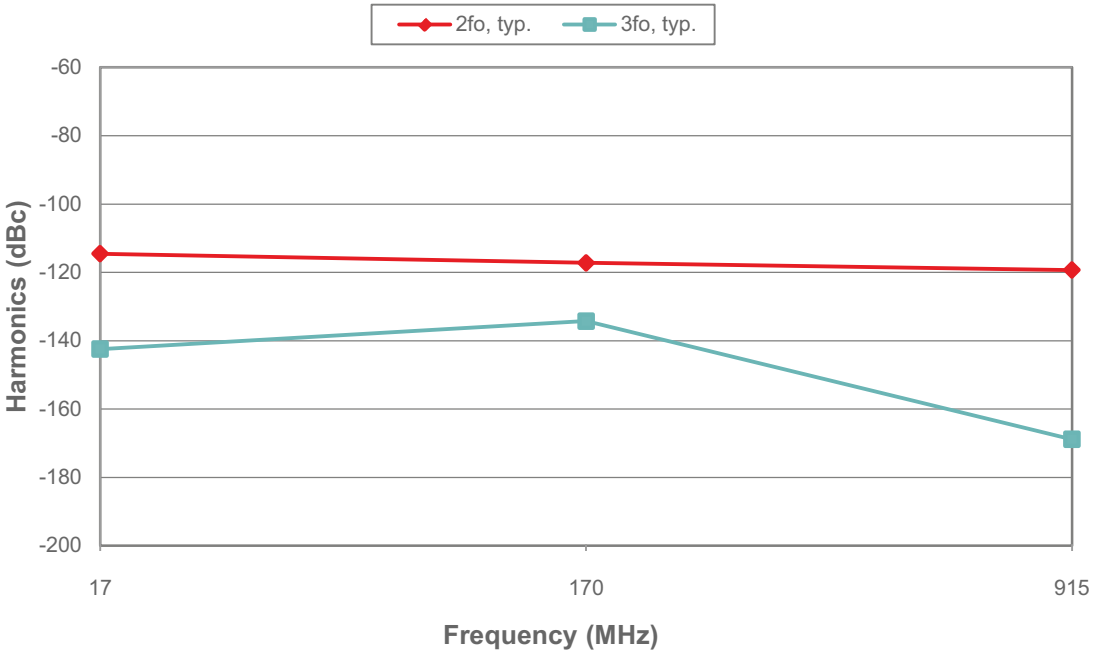


Figure 12 • Second and third harmonics (P_{IN} = 65 dBmV)

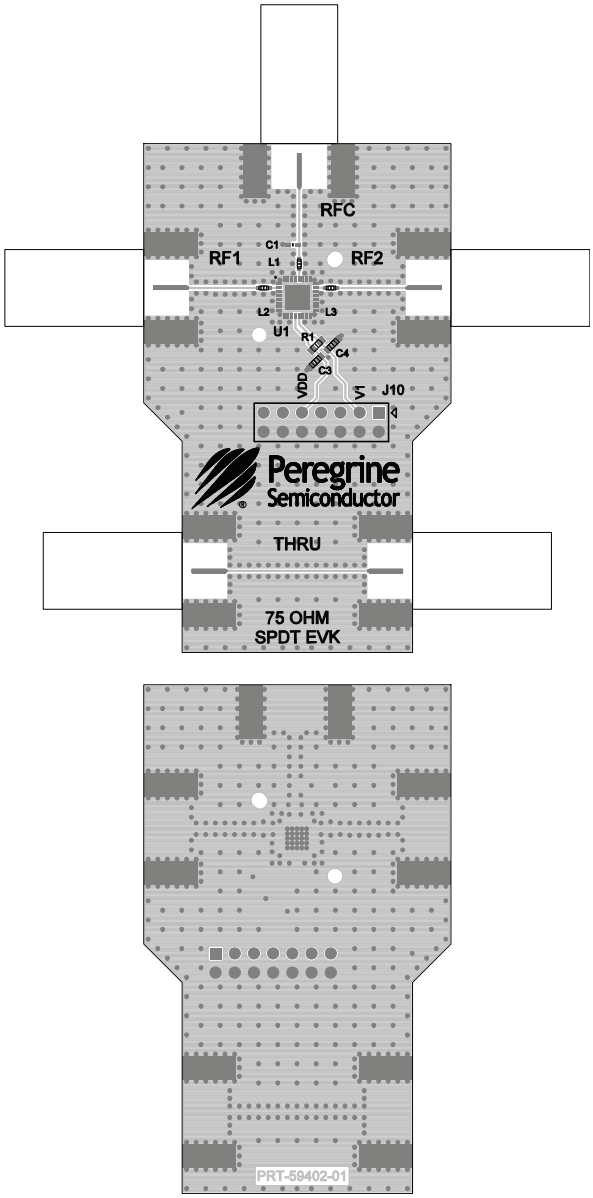


Evaluation kit

pSemi designed the PE42722 evaluation board to ease your evaluation of the PE42722 RF switch. The RF common port connects through a 75Ω transmission line via the F-Type connector, J1. The RF1 and RF2 ports connect through 75Ω transmission lines via F-type connectors J2 and J3, respectively. A 75Ω through transmission line is available via F-Type connectors J5 (THRU left) and J6 (THRU right), which you can use to de-embed the loss of the PCB. DC power is supplied through J10, with V_{DD} on pin 9, and GND on the entire lower row of the even-numbered pins. To evaluate a switch path, add or remove jumpers on V1 (pin 3) as listed in **Table 5**.

Series 6.2-nH inductors are used on the three RF ports to provide impedance matching.

Figure 13 • PE42722 evaluation board layout



Pin configuration

Figure 14 shows the PE42722 pin map for the 32-lead 5 × 5 × 0.85 mm QFN package, and **Table 6** lists the description for each pin.

Figure 14 • Pin configuration, top view

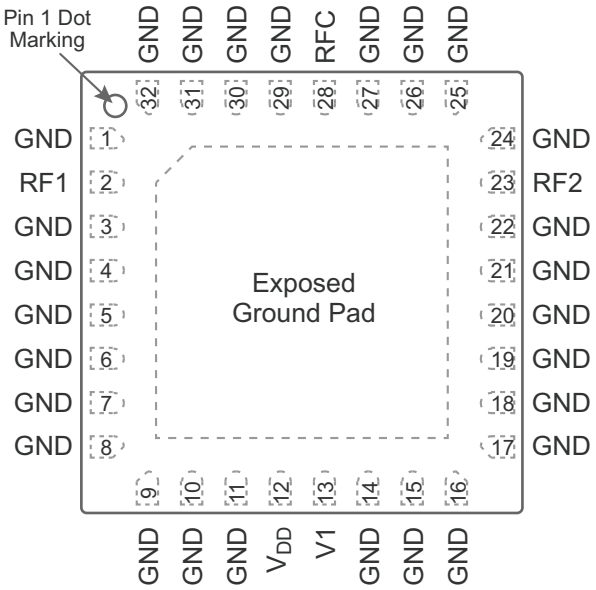


Table 6 • PE42722 pin descriptions

Pin no.	Pin name	Description
1, 3–11, 14–22, 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
23	RF2(*)	RF port 2
28	RFC(*)	RF common
Pad	GND	Exposed pad. Ground for proper operation

Note: * RF pins 2, 23, and 28 must be at 0 VDC. The RF pins do not require DC blocking capacitors for proper operation if the 0 VDC requirement is met.

Packaging information

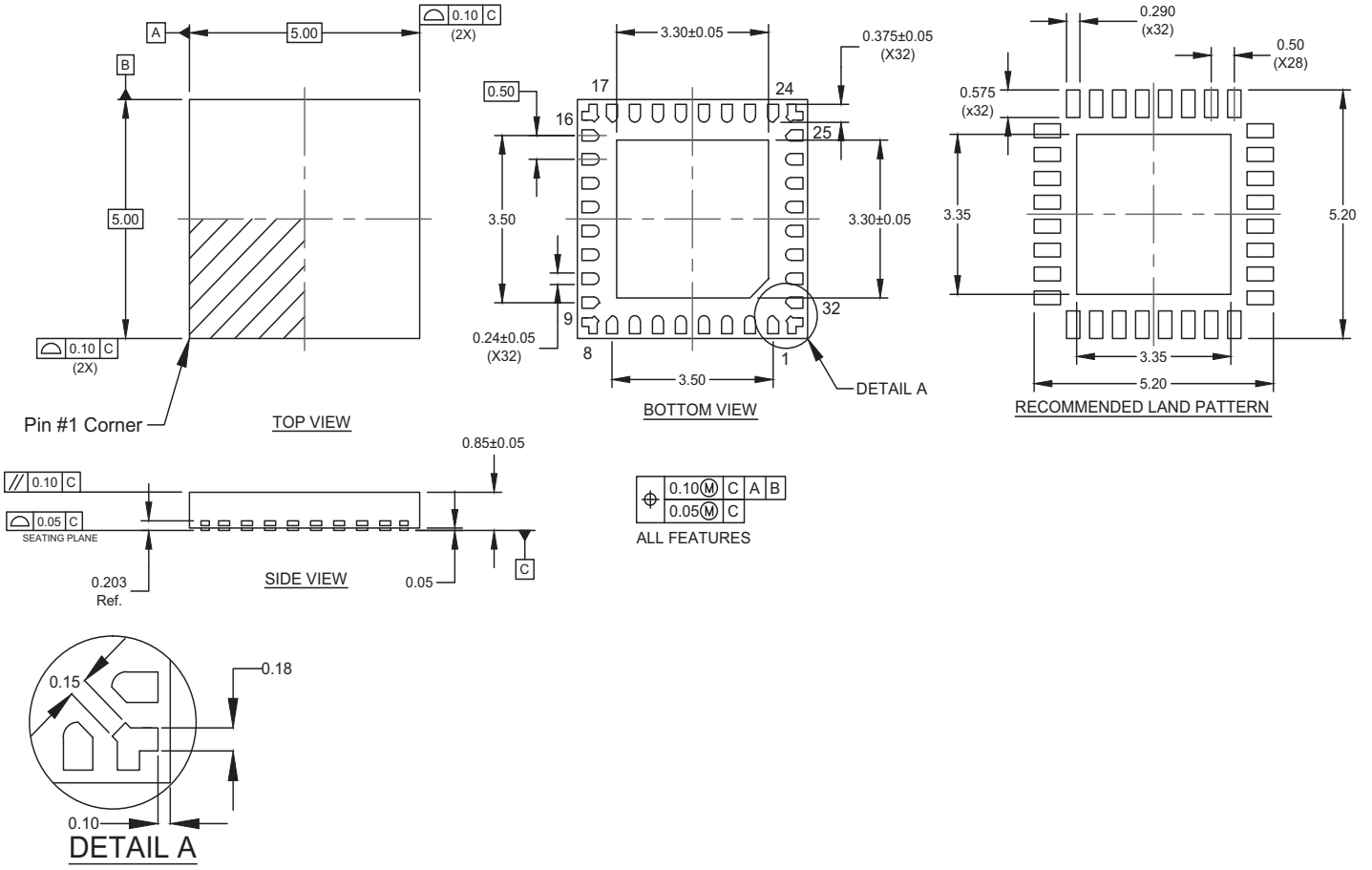
This section provides PE42722 packaging data, including the moisture sensitivity level, package drawing, package marking, and tape-and-reel information.

Moisture sensitivity level

The PE42722 moisture sensitivity level rating for the 32-lead 5 × 5 × 0.85 mm QFN package is MSL3.

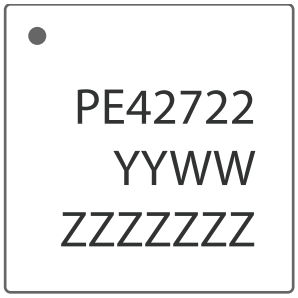
Package drawing

Figure 15 • Package mechanical drawing for the 32-lead 5 × 5 × 0.85 mm QFN package



Top-marking specification

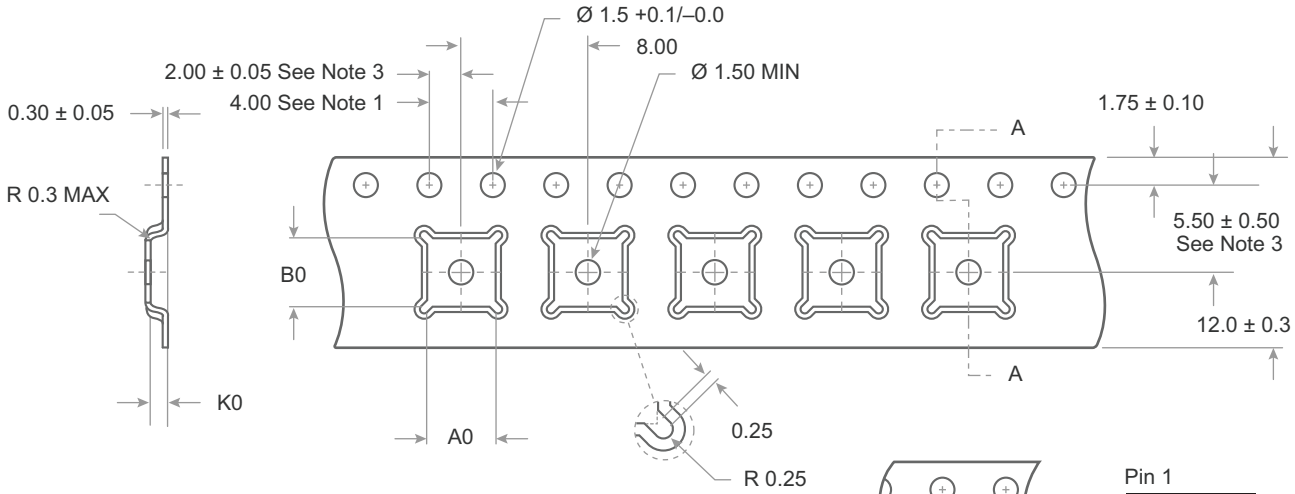
Figure 16 • PE42722 package marking specification



● = Pin 1 indicator
YY = Last 2 digits of assembly year
WW = Work Week of assembly lot molding
ZZZZZZZ = Maximum 7 characters of the assembly lot code

Tape and reel specification

Figure 17 • Tape and reel specification for the 32-lead 5 × 5 × 0.85 mm QFN package



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.

A0 = 5.25 ± 0.01 mm
B0 = 5.25 ± 0.01 mm
K0 = 1.10 ± 0.01 mm

Device Orientation in Tape

Ordering information

Table 7 lists the PE42722 ordering codes and shipping methods.

Table 7 • PE42722 order codes and shipping methods

Order code	Description	Packaging	Shipping method
PE42722B-Z	PE42722 SPDT RF Switch	Green 32-lead 5 × 5 mm QFN	3000 units/T&R
EK42722-02	PE42722 evaluation kit	Evaluation kit	1/box

Document categories

Advance Information

The product is in a formative or design stage. The datasheet contains design target specifications for product development. Specifications and features may change in any manner without notice.

Preliminary Specification

The datasheet contains preliminary data. Additional data may be added at a later date. pSemi reserves the right to change specifications at any time without notice in order to supply the best possible product.

Product Specification

The datasheet contains final data. In the event pSemi decides to change the specifications, pSemi will notify customers of the intended changes by issuing a CNF (Customer Notification Form).

Product Brief

This document contains a shortened version of the datasheet. For the full datasheet, contact sales@psemi.com.

Sales contact

For additional information, contact Sales at sales@psemi.com.

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