

Features

- AEC-Q100 Grade 2 certified
- Supports operating temperature up to +105°C
- Low insertion loss
 - 0.25 dB @ 1000 MHz
 - 0.40 dB @ 3000 MHz
 - 0.65 dB @ 5000 MHz
 - 0.90 dB @ 6000 MHz
- High isolation
 - 41 dB @ 1000 MHz
 - 28 dB @ 3000 MHz
 - 20 dB @ 5000 MHz
 - 16 dB @ 6000 MHz
- Excellent linearity
 - IIP2 of 115 dBm
 - IIP3 of 73.5 dBm
- High ESD tolerance
 - 1kV HBM on all pins
 - 200V MM on all pins
 - 1kV CDM on all pins
- Wide supply range of 2.3V to 5.5V

Product Description

The PE423422 is a HaRP™ technology-enhanced reflective SPDT RF switch. It has received AEC-Q100 Grade 2 certification and meets the quality and performance standards that makes it suitable for use in harsh automotive environments. It is designed to cover a wide range of wireless applications from 100 MHz through 6 GHz such as automotive infotainment and traffic safety applications. No blocking capacitors are required if DC voltage is not present on the RF ports.

Peregrine’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.

The PE423422 is manufactured on Peregrine’s UltraCMOS® process, a patented variation of silicon-on-insulator (SOI) technology on a sapphire substrate, offering excellent RF performance.

Figure 1. Functional Diagram

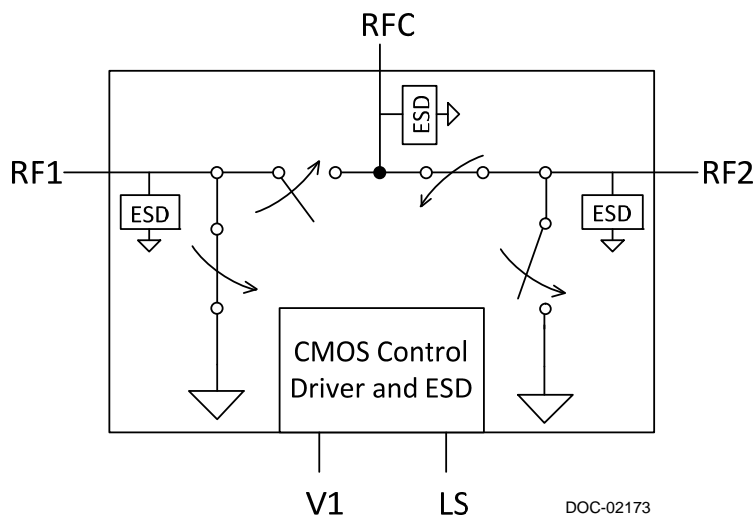


Figure 2. Package Type
12-lead 2x2 mm QFN

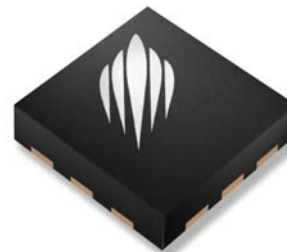


Table 1. Electrical Specifications @ 25°C, V_{DD} = 2.3V to 5.5V (Z_S = Z_L = 50Ω)

| Parameter | Path | Condition | Min | Typ | Max | Unit |
|---|---------|--|-----|-----------------|-------------------|------|
| Operational frequency | | | 100 | | 6000 | MHz |
| Insertion loss | RFC–RFX | 100–1000 MHz | | 0.25 | 0.35 | dB |
| | | 1000–2000 MHz | | 0.30 | 0.40 | dB |
| | | 2000–3000 MHz | | 0.40 | 0.50 | dB |
| | | 3000–4000 MHz | | 0.50 | 0.70 | dB |
| | | 4000–5000 MHz | | 0.65 | 0.90 ¹ | dB |
| | | 5000–6000 MHz | | 0.90 | 1.25 ¹ | dB |
| Isolation | RFX–RFX | 100–1000 MHz | 39 | 41 | | dB |
| | | 1000–2000 MHz | 32 | 33 | | dB |
| | | 2000–3000 MHz | 26 | 28 | | dB |
| | | 3000–4000 MHz | 22 | 24 | | dB |
| | | 4000–5000 MHz | 18 | 20 | | dB |
| | | 5000–6000 MHz | 15 | 16 | | dB |
| Isolation | RFC–RFX | 100–1000 MHz | 41 | 44 | | dB |
| | | 1000–2000 MHz | 33 | 35 | | dB |
| | | 2000–3000 MHz | 27 | 29 | | dB |
| | | 3000–4000 MHz | 22 | 24 | | dB |
| | | 4000–5000 MHz | 18 | 20 | | dB |
| | | 5000–6000 MHz | 15 | 17 | | dB |
| Return loss | RFC–RFX | 100–1000 MHz | | 28 | | dB |
| | | 1000–2000 MHz | | 21 | | dB |
| | | 2000–3000 MHz | | 20 | | dB |
| | | 3000–4000 MHz | | 18 | | dB |
| | | 4000–5000 MHz | | 16 ¹ | | dB |
| | | 5000–6000 MHz | | 13 ¹ | | dB |
| 2nd Harmonic, 2fo | RFC–RFX | +32 dBm output power, 850 / 900 MHz | | -99 | | dBc |
| | | +32 dBm output power, 1800 / 1900 MHz | | -101 | | dBc |
| 3rd Harmonic, 3fo | RFC–RFX | +32 dBm output power, 850 / 900 MHz | | -93 | | dBc |
| | | +32 dBm output power, 1800 / 1900 MHz | | -87 | | dBc |
| IMD3 | | Bands I, II, V, VIII +20 dBm CW @ TX freq at RFC, -15 dBm CW @ 2Tx-Rx at RFC, 50Ω | | -122 | | dBm |
| Input IP2 | RFC–RFX | 100–6000 MHz | | 115 | | dBm |
| Input IP3 | RFC–RFX | 100–6000 MHz | | 73.5 | | dBm |
| Input 0.1 dB compression point ² | RFC–RFX | 100–6000 MHz | | 34 | | dBm |
| Switching time | | 50% CTRL to 90% or 10% RF | | 2 | 4 | μs |

Notes: 1. High frequency performance can be improved by external matching
2. The input 0.1dB compression point is a linearity figure of merit. Refer to *Table 4* for the RF input power P_{MAX,CW} (50Ω)

Table 1A. Electrical Specifications @ -40°C to +105°C, V_{DD} = 2.3V to 5.5V (Z_S = Z_L = 50Ω)

| Parameter | Path | Condition | Min | Typ | Max | Unit |
|---|---------|--|-----|-----------------|-------------------|------|
| Operational frequency | | | 100 | | 6000 | MHz |
| Insertion loss | RFC-RFX | 100–1000 MHz | | 0.25 | 0.55 | dB |
| | | 1000–2000 MHz | | 0.30 | 0.65 | dB |
| | | 2000–3000 MHz | | 0.40 | 0.75 | dB |
| | | 3000–4000 MHz | | 0.50 | 0.85 | dB |
| | | 4000–5000 MHz | | 0.65 | 1.05 ¹ | dB |
| | | 5000–6000 MHz | | 0.90 | 1.45 ¹ | dB |
| Isolation | RFX-RFX | 100–1000 MHz | 38 | 41 | | dB |
| | | 1000–2000 MHz | 31 | 33 | | dB |
| | | 2000–3000 MHz | 25 | 28 | | dB |
| | | 3000–4000 MHz | 21 | 24 | | dB |
| | | 4000–5000 MHz | 17 | 20 | | dB |
| | | 5000–6000 MHz | 14 | 16 | | dB |
| Isolation | RFC-RFX | 100–1000 MHz | 40 | 44 | | dB |
| | | 1000–2000 MHz | 32 | 35 | | dB |
| | | 2000–3000 MHz | 26 | 29 | | dB |
| | | 3000–4000 MHz | 21 | 24 | | dB |
| | | 4000–5000 MHz | 17 | 20 | | dB |
| | | 5000–6000 MHz | 14 | 17 | | dB |
| Return loss | RFC-RFX | 100–1000 MHz | | 28 | | dB |
| | | 1000–2000 MHz | | 21 | | dB |
| | | 2000–3000 MHz | | 20 | | dB |
| | | 3000–4000 MHz | | 18 | | dB |
| | | 4000–5000 MHz | | 16 ¹ | | dB |
| | | 5000–6000 MHz | | 13 ¹ | | dB |
| 2nd Harmonic, 2fo | RFC-RFX | +32 dBm output power, 850 / 900 MHz | | -99 | | dBc |
| | | +32 dBm output power, 1800 / 1900 MHz | | -101 | | dBc |
| 3rd Harmonic, 3fo | RFC-RFX | +32 dBm output power, 850 / 900 MHz | | -93 | | dBc |
| | | +32 dBm output power, 1800 / 1900 MHz | | -87 | | dBc |
| IMD3 | | Bands I, II, V, VIII +20 dBm CW @ TX freq at RFC, -15 dBm CW @ 2Tx-Rx at RFC, 50Ω | | -122 | | dBm |
| Input IP2 | RFC-RFX | 100–6000 MHz | | 115 | | dBm |
| Input IP3 | RFC-RFX | 100–6000 MHz | | 73.5 | | dBm |
| Input 0.1 dB compression point ² | RFC-RFX | 100–6000 MHz | | 34 | | dBm |
| Switching time | | 50% CTRL to 90% or 10% RF | | 2 | 5 | μs |

Notes: 1. High frequency performance can be improved by external matching
2. The input 0.1dB compression point is a linearity figure of merit. Refer to *Table 4* for the RF input power P_{MAX,CW} (50Ω)

Figure 3. Pin Configuration (Top View)

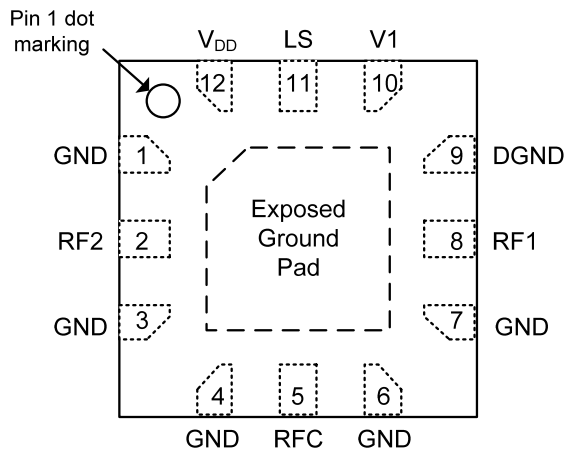


Table 2. Pin Descriptions

| Pin # | Pin Name | Description |
|---------------|------------------|--|
| 1, 3, 4, 6, 7 | GND | Ground |
| 2 | RF2 ¹ | RF port 2 |
| 5 | RFC ¹ | RF common |
| 8 | RF1 ¹ | RF port 1 |
| 9 | DGND | Digital ground |
| 10 | V1 | Digital control logic input 1 |
| 11 | LS | Logic Select |
| 12 | V _{DD} | Supply voltage |
| Pad | GND | Exposed pad: Ground for proper operation |

Note 1: RF pins 2, 5 and 8 must be at 0V DC. The RF pins do not require DC blocking capacitors for proper operation if the 0V DC requirement is met

Table 3. Operating Ranges

| Parameter | Symbol | Min | Typ | Max | Unit |
|---|---------------------|-----|-----|--------|------|
| Supply voltage | V _{DD} | 2.3 | 3.3 | 5.5 | V |
| Supply current | I _{DD} | | 120 | 200 | μA |
| Digital input high (V1, LS) | V _{IH} | 1.2 | 1.5 | 3.3 | V |
| Digital input low (V1,LS) | V _{IL} | 0 | 0 | 0.5 | V |
| RF input power, CW (RFC-RFX) ¹ | P _{MAX,CW} | | | Fig. 4 | dBm |
| Operating temperature range | T _{OP} | -40 | +25 | +105 | °C |

Note 1: 100% duty cycle, all bands, 50Ω

Table 4. Absolute Maximum Ratings

| Parameter/Condition | Symbol | Min | Max | Unit |
|--|----------------------|------|--------|------|
| Supply voltage | V _{DD} | -0.3 | 5.5 | V |
| Digital input voltage (V1, LS) | V _I | -0.3 | 3.3 | V |
| RF input power, Max | P _{MAX,ABS} | | Fig. 4 | dBm |
| Storage temperature range | T _{ST} | -65 | +150 | °C |
| ESD voltage HBM, all pins ¹ | V _{ESD,HBM} | | 1000 | V |
| ESD voltage MM, all pins ² | V _{ESD,MM} | | 200 | V |
| ESD voltage CDM, all pins ³ | V _{ESD,CDM} | | 1000 | V |

Notes: 1. Human Body Model (MIL-STD-883 Method 3015)
2. Machine Model (JEDEC JESD22-A115)
3. Charged Device Model (JEDEC JESD22-C101)

Exceeding absolute maximum ratings may cause permanent damage. Operation should be restricted to the limits in the Operating Ranges table. Operation between operating range maximum and absolute maximum for extended periods may reduce reliability.

Electrostatic Discharge (ESD) Precautions

When handling this UltraCMOS[®] device, observe the same precautions that you would use with other ESD-sensitive devices. Although this device contains circuitry to protect it from damage due to ESD, precautions should be taken to avoid exceeding the rating specified.

Latch-Up Avoidance

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

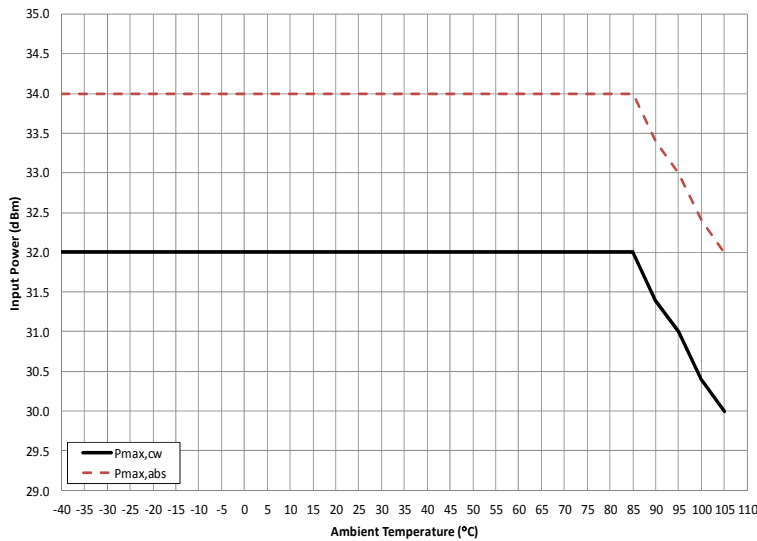
Table 5. Truth Table

| Path | V1 | LS |
|---------|----|----|
| RFC–RF2 | 1 | 1 |
| RFC–RF1 | 0 | 1 |
| RFC–RF1 | 1 | 0 |
| RFC–RF2 | 0 | 0 |

Moisture Sensitivity Level

The Moisture Sensitivity Level rating for the PE423422 in the 12-lead 2x2 mm QFN package is MSL1.

Figure 4. Power De-rating Curve for 100–6000 MHz vs Ambient Temperature (50Ω)



Typical Performance Data @ 25°C and $V_{DD} = 3.3V$ unless otherwise specified

Figure 5. Insertion Loss RFX

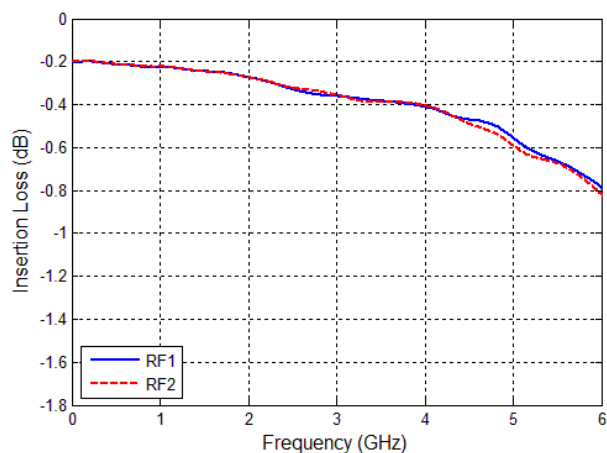


Figure 6. Insertion Loss vs Temp (RFC–RF1)

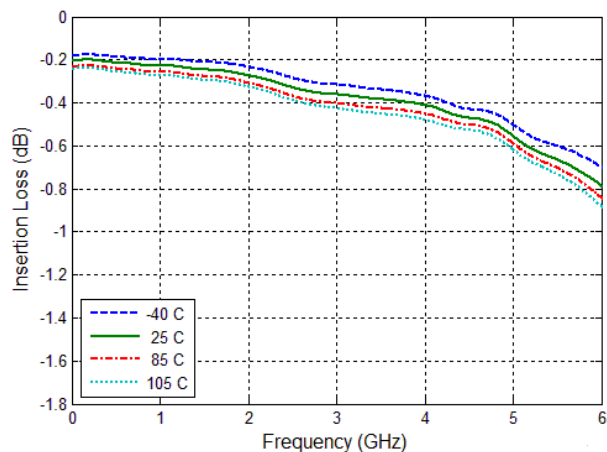


Figure 7. Insertion Loss vs V_{DD} (RFC–RF1)

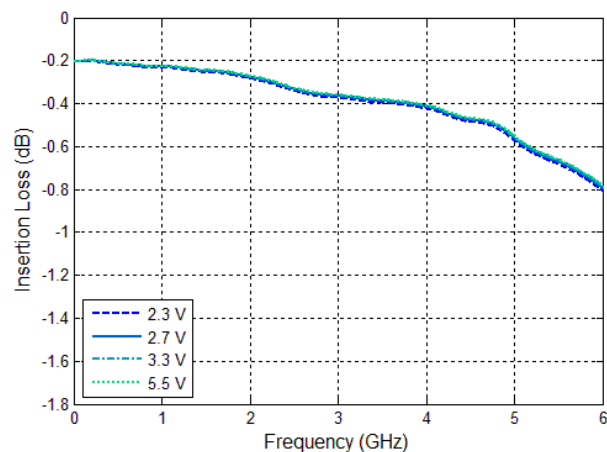


Figure 8. Insertion Loss vs Temp (RFC–RF2)

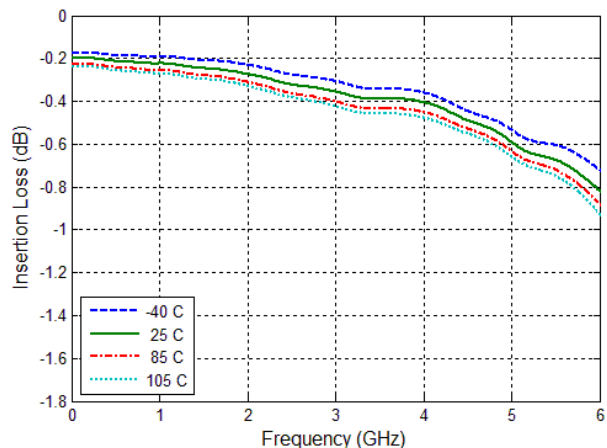
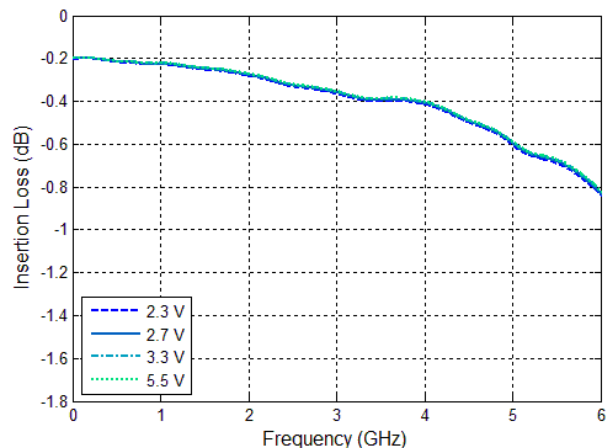


Figure 9. Insertion Loss vs V_{DD} (RFC–RF2)



Typical Performance Data @ 25°C and $V_{DD} = 3.3V$ unless otherwise specified

Figure 10. RFC Port Return Loss vs Temp (RF1 Active)

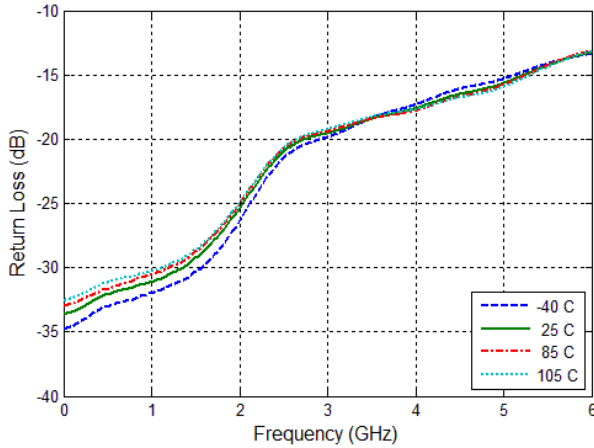


Figure 11. RFC Port Return Loss vs V_{DD} (RF1 Active)

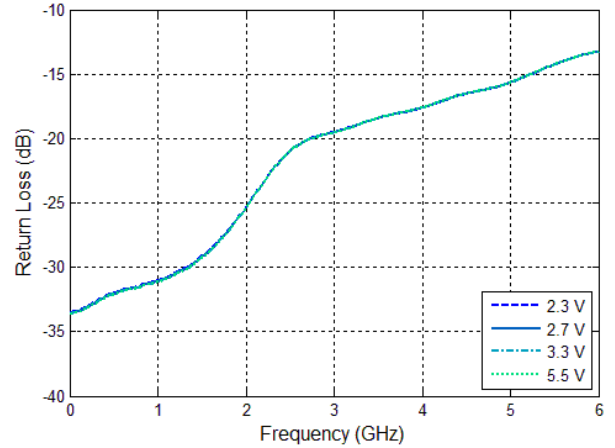


Figure 12. RFC Port Return Loss vs Temp (RF2 Active)

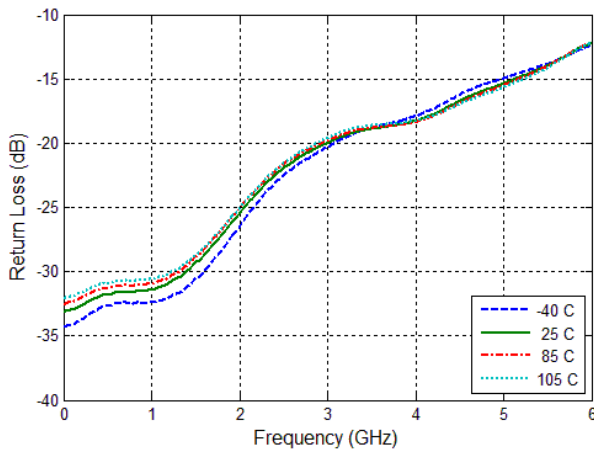
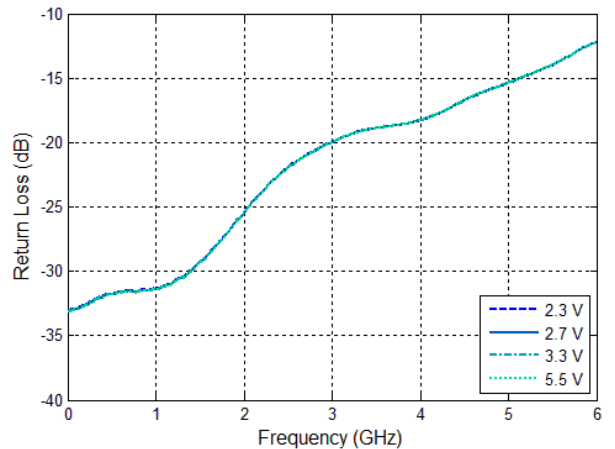


Figure 13. RFC Port Return Loss vs V_{DD} (RF2 Active)



Typical Performance Data @ 25°C and V_{DD} = 3.3V unless otherwise specified

Figure 14. Active Port Return Loss vs Temp (RF1 Active)

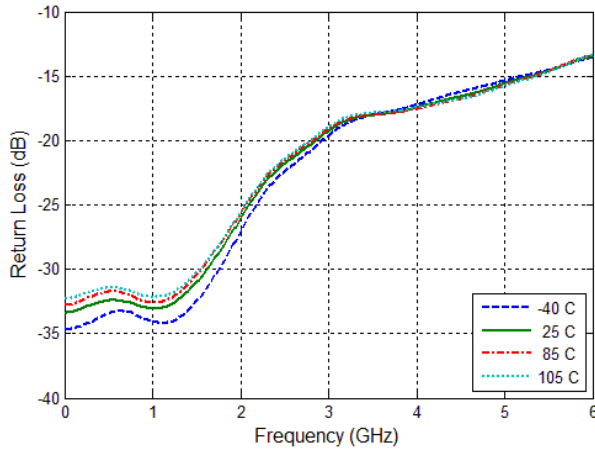


Figure 15. Active Port Return Loss vs V_{DD} (RF1 Active)

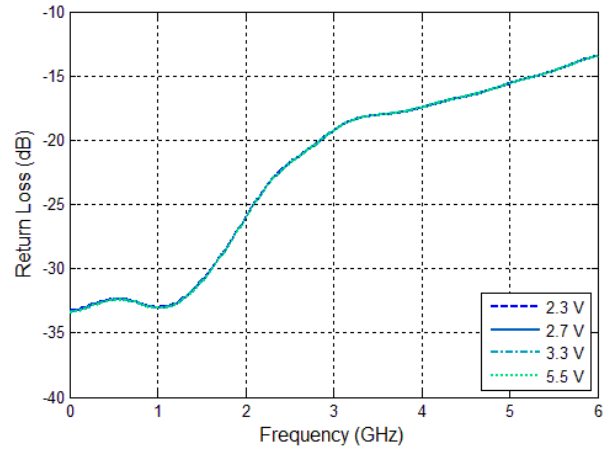


Figure 16. Active Port Return Loss vs Temp (RF2 Active)

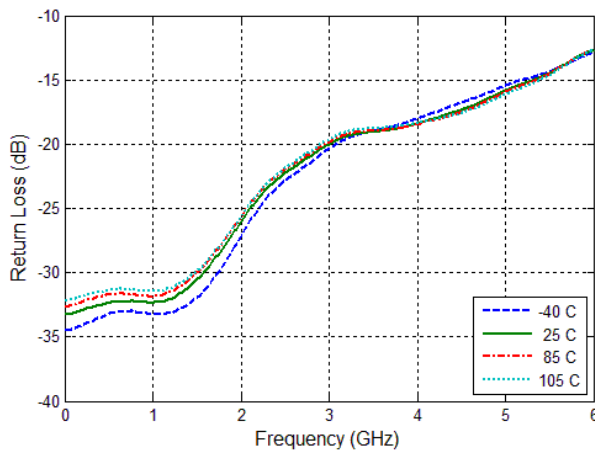
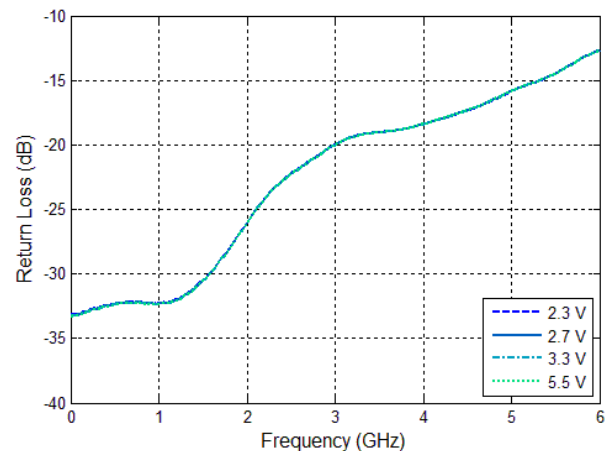


Figure 17. Active Port Return Loss vs V_{DD} (RF2 Active)



Typical Performance Data @ 25°C and $V_{DD} = 3.3V$ unless otherwise specified

Figure 18. Isolation vs Temp
(RF1–RF2, RF1 Active)

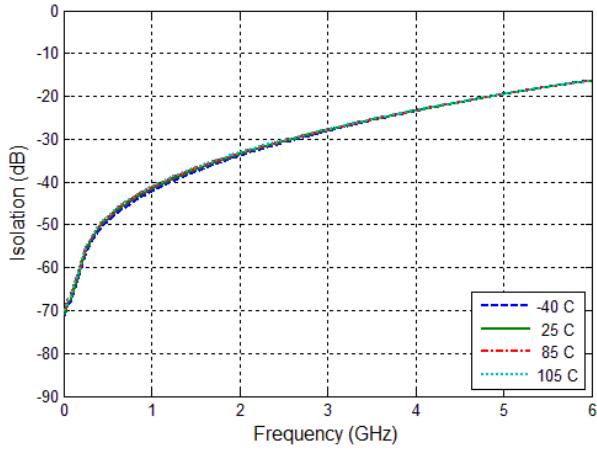


Figure 19. Isolation vs V_{DD}
(RF1–RF2, RF1 Active)

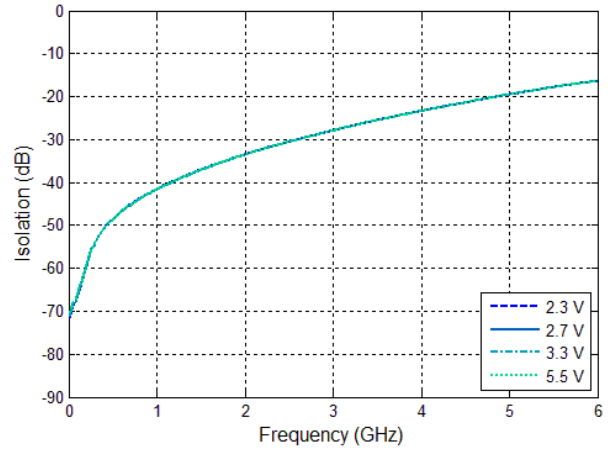


Figure 20. Isolation vs Temp
(RFC–RF2, RF1 Active)

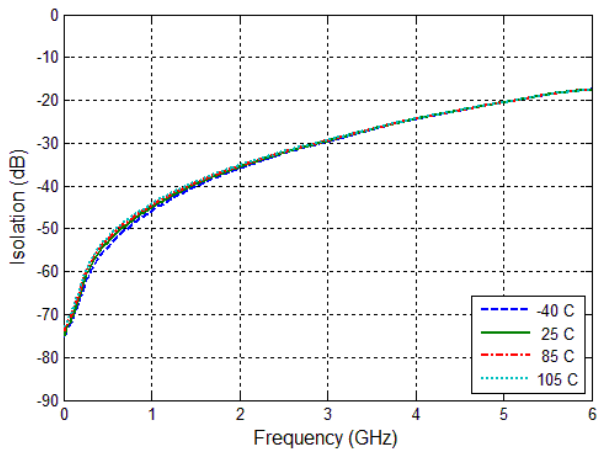
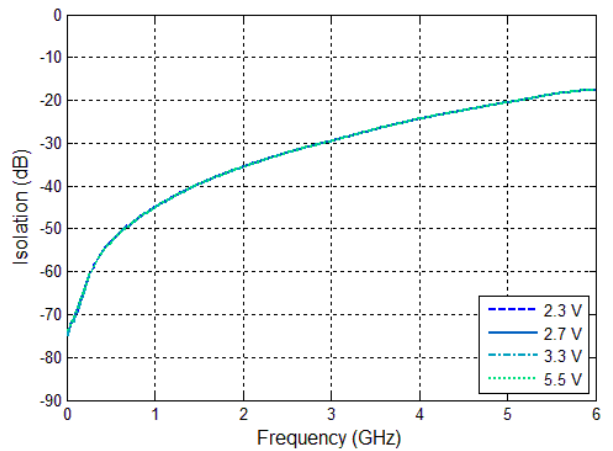


Figure 21. Isolation vs V_{DD}
(RFC–RF2, RF1 Active)

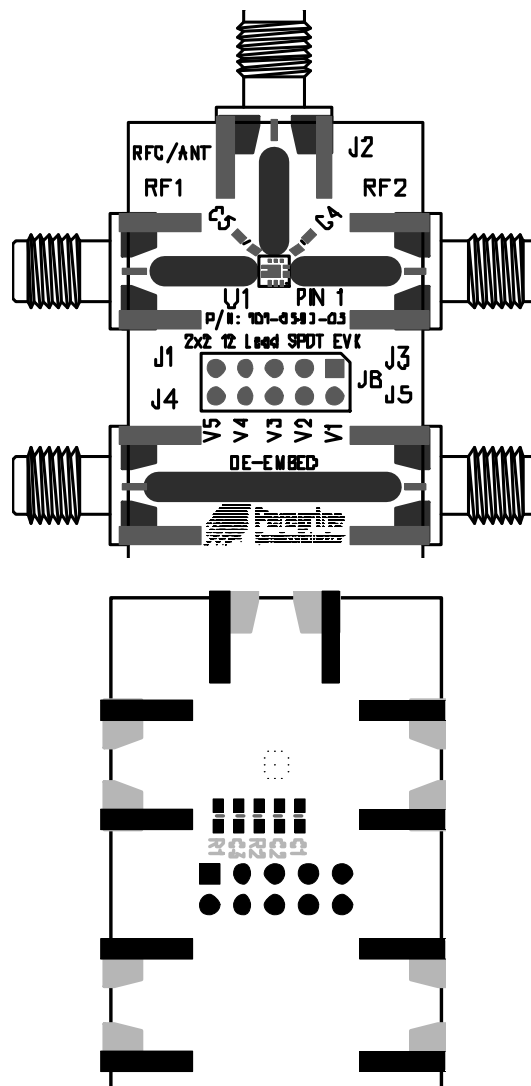


Evaluation Board

The SPDT switch evaluation board was designed to ease customer evaluation of Peregrine's PE423422. The RF common port is connected through a 50Ω transmission line via the top SMA connector, J2. RF1 and RF2 ports are connected through 50Ω transmission lines via SMA connectors J1 and J3, respectively. A through 50Ω transmission is available via SMA connectors J4 and J5. This transmission line can be used to estimate the loss of the PCB over the environmental conditions being evaluated. J8 provides DC and digital inputs to the device.

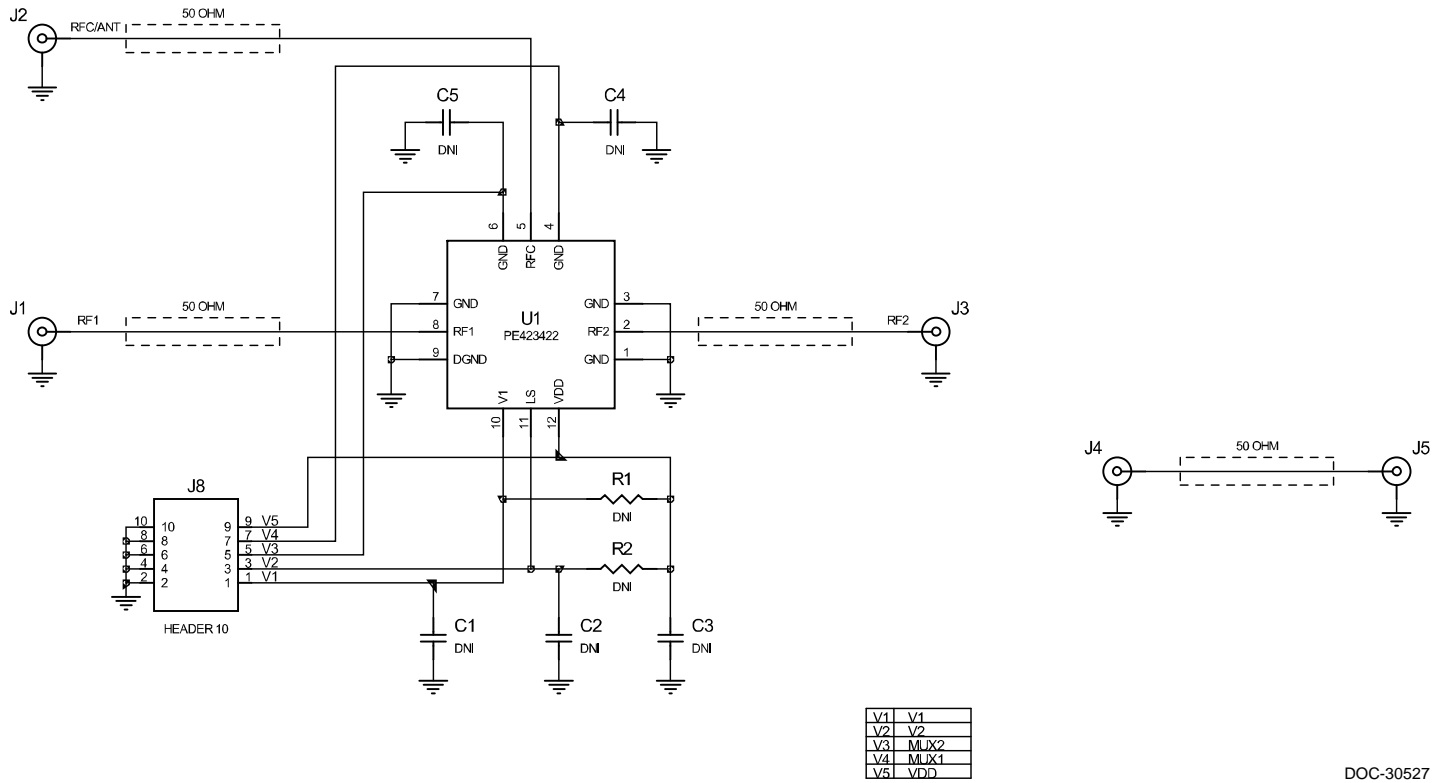
The board is constructed of a four metal layer material with a total thickness of 62 mils. The top and bottom RF layers are Rogers RO4350 material with a 10 mil RF core. The middle layers provide ground for the transmission lines. The transmission lines were designed using a coplanar waveguide with ground plane model using a trace width of 22 mils, trace gaps of 7 mils, and metal thickness of 2.1 mils.

Figure 22. Evaluation Board Layout



PRT-29005

Figure 23. Evaluation Board Schematic



DOC-30527

Figure 24. Package Drawing
12-lead 2x2 mm QFN

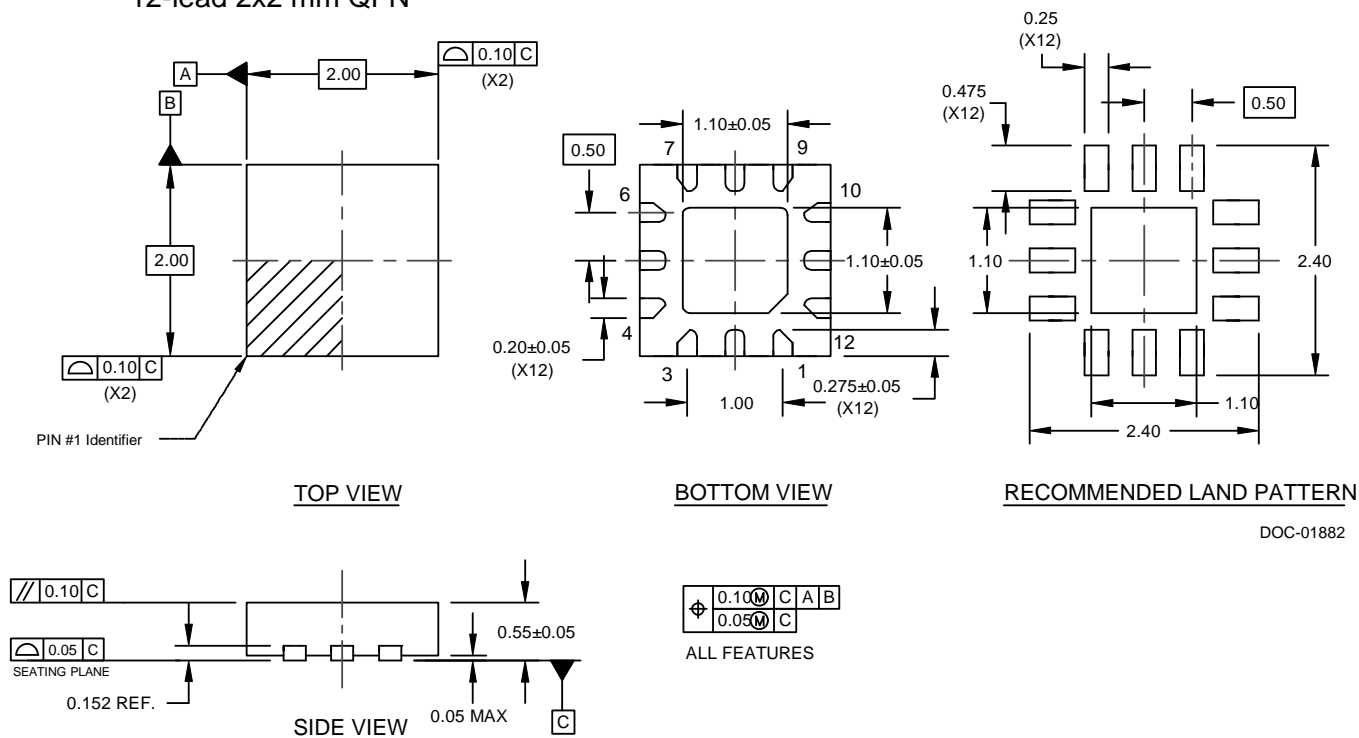
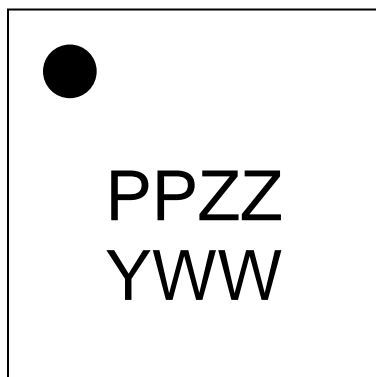


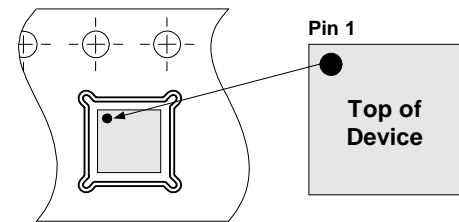
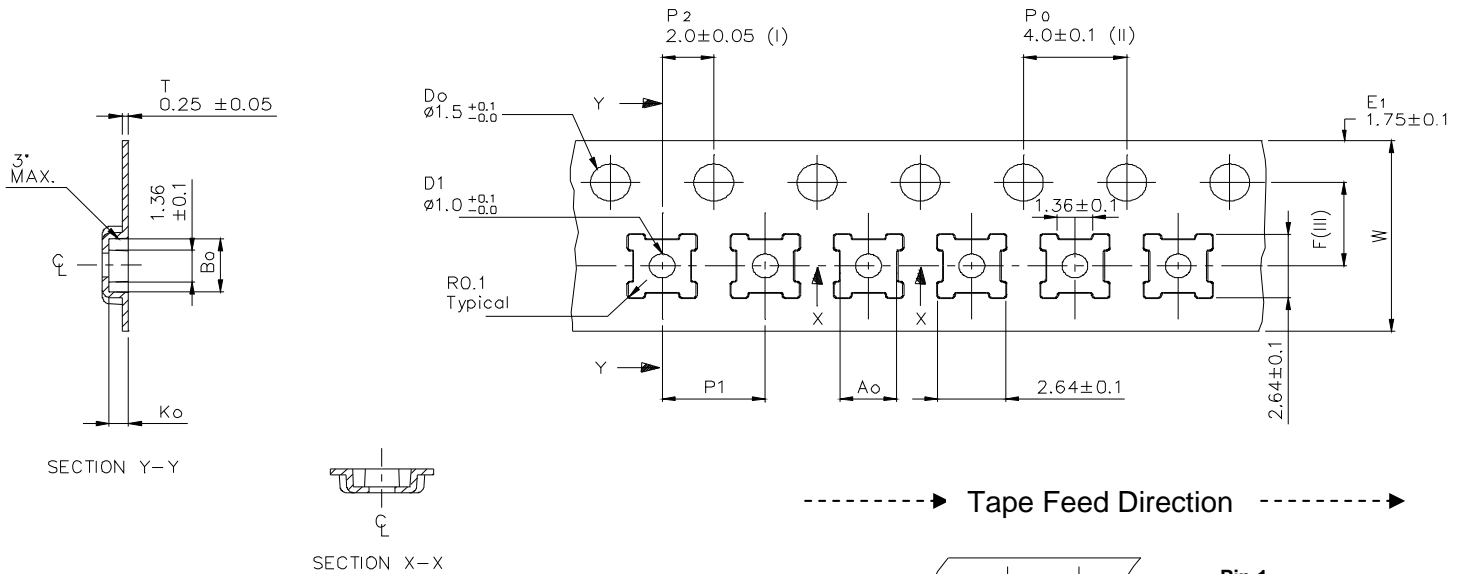
Figure 25. Top Marking Specifications



DOC-51207

| Marking Spec Symbol | Package Marking | Definition |
|---------------------|-----------------|--|
| PP | DJ | Part number marking for PE423422 |
| ZZ | 00-99 | Last two digits of lot code |
| Y | 0-9 | Last digit of year, starting from 2009 (0 for 2010, 1 for 2011, etc) |
| WW | 01-53 | Work week |

Figure 26. Tape and Reel Specifications



Device Orientation in Tape

Note: All dimensions in millimeters unless otherwise specified

| | Nominal | Tolerance |
|-----------|---------|-----------|
| Ao | 2.20 | ±0.10 |
| Bo | 2.20 | ±0.10 |
| Ko | 0.75 | ±0.10 |
| F | 3.50 | ±0.05 |
| P1 | 4.00 | ±0.10 |
| W | 8.00 | ±0.30 |

- (I) Measured from centreline of sprocket hole to centreline of pocket.
- (II) Cumulative tolerance of 10 sprocket holes is ± 0.10 .
- (III) Measured from centreline of sprocket hole to centreline of pocket.
- (IV) Other material available.

This part shall not contain any banned substance as Sony standard SS-00259

Table 6. Ordering Information

| Order Code | Description | Package | Shipping Method |
|-------------|-------------------------|--------------------------|-----------------|
| PE423422A-Z | PE423422 SPDT RF switch | Green 12-lead 2x2 mm QFN | 3000 units T/R |
| EK423422-01 | PE423422 Evaluation kit | Evaluation kit | 1/Box |

Sales Contact and Information

For Sales and contact information please visit www.psemi.com.

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