

#### UltraCMOS® SPDT RF Switch 100 – 6000 MHz

#### Product Description

The PE42420 is a HaRP™ technology-enhanced absorptive 50Ω SPDT RF switch developed on the UltraCMOS® process technology.

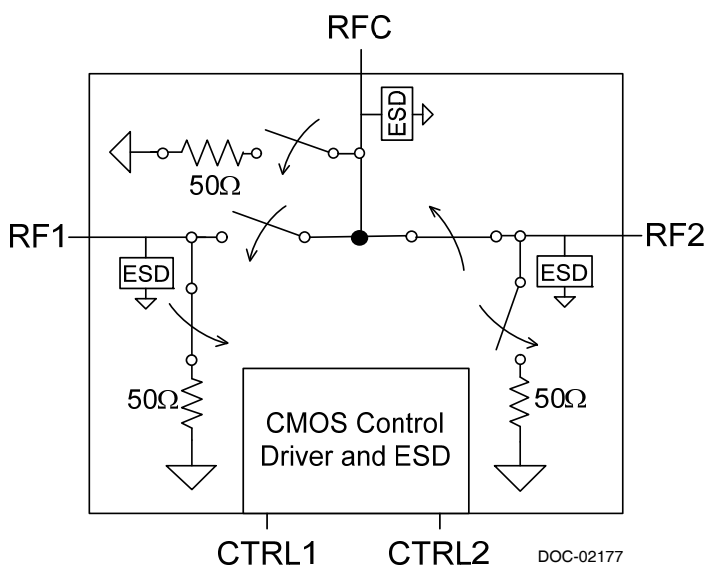
This general purpose switch is comprised of two RF ports and has very high isolation performance. It is ideal for RF and IF transceiver signal switching (signal amplitude adjust), discrete DSA stages, and filter bank switching applications. No blocking capacitors are required if DC voltage is not present on the RF ports.

Peregrine's HaRP™ technology enhancements deliver high linearity and excellent harmonics performance with the economy and integration of conventional CMOS.

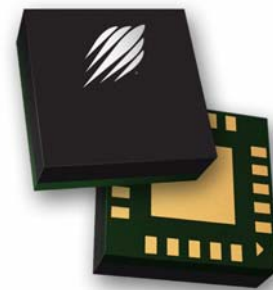
#### Features

- HaRP™ technology enhanced
  - No gate and phase lag
  - No drift in insertion loss and phase
- Supports +1.8V control logic
- High linearity
  - IIP3 of 65 dBm
- High isolation
  - 69 dB @ 1 GHz
  - 62 dB @ 3 GHz
  - 50 dB @ 6 GHz
- High ESD tolerance
  - 4kV HBM on RFC
  - 2kV HBM on all other pins

**Figure 1. Functional Diagram**



**Figure 2. Package Type**  
20-lead 4x4 mm LGA



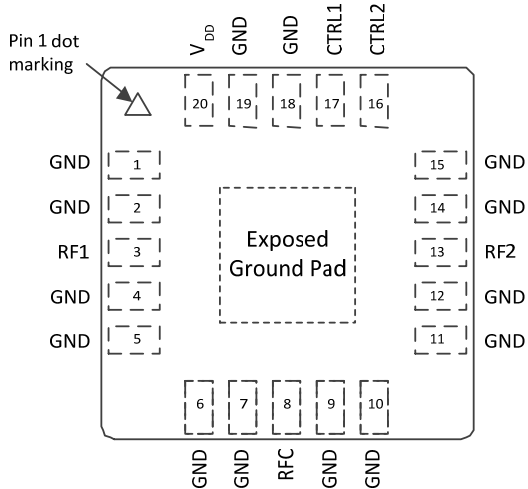
**Table 1. Electrical Specifications Typical @ 25°C, V<sub>DD</sub> = 3.0V (Z<sub>S</sub> = Z<sub>L</sub> = 50Ω )**

| Parameter                                 | Path      | Condition                  | Min | Typ  | Max  | Unit |
|-------------------------------------------|-----------|----------------------------|-----|------|------|------|
| Operating frequency                       |           |                            | 100 |      | 6000 | MHz  |
| Insertion loss                            | RFC–RFX   | 100–1000 MHz               |     | 0.95 | 1.15 | dB   |
|                                           |           | 1000–2000 MHz              |     | 0.95 | 1.15 | dB   |
|                                           |           | 2000–3000 MHz              |     | 1.00 | 1.2  | dB   |
|                                           |           | 3000–4000 MHz              |     | 1.15 | 1.35 | dB   |
|                                           |           | 4000–5000 MHz <sup>1</sup> |     | 1.25 | 1.55 | dB   |
|                                           |           | 5000–6000 MHz <sup>1</sup> |     | 1.60 | 1.9  | dB   |
| Isolation                                 | RFX–RFX   | 100–1000 MHz               | 67  | 69   |      | dB   |
|                                           |           | 1000–2000 MHz              | 63  | 64   |      | dB   |
|                                           |           | 2000–3000 MHz              | 59  | 62   |      | dB   |
|                                           |           | 3000–4000 MHz              | 60  | 64   |      | dB   |
|                                           |           | 4000–5000 MHz              | 54  | 60   |      | dB   |
|                                           |           | 5000–6000 MHz              | 44  | 50   |      | dB   |
| Isolation                                 | RFC–RFX   | 100–1000 MHz               | 69  | 71   |      | dB   |
|                                           |           | 1000–2000 MHz              | 65  | 67   |      | dB   |
|                                           |           | 2000–3000 MHz              | 63  | 68   |      | dB   |
|                                           |           | 3000–4000 MHz              | 62  | 67   |      | dB   |
|                                           |           | 4000–5000 MHz              | 52  | 57   |      | dB   |
|                                           |           | 5000–6000 MHz              | 44  | 48   |      | dB   |
| Return loss                               | All ports | 100–4000 MHz               |     | 20   |      | dB   |
|                                           |           | 4000–5000 MHz <sup>1</sup> |     | 15   |      | dB   |
|                                           |           | 5000–6000 MHz <sup>1</sup> |     | 13   |      | dB   |
| Input 1 dB compression point <sup>2</sup> | RFC–RFX   | 100–6000 MHz               | 33  |      |      | dBm  |
| Input IP2                                 | RFC–RFX   | 100–6000 MHz               |     | 110  |      | dBm  |
| Input IP3                                 | RFC–RFX   | 100–6000 MHz               | 60  | 65   |      | dBm  |
| Switching time                            |           | 50% CTRL to 90% or 10% RF  |     | 300  | 400  | ns   |

Notes: 1. Insertion loss and return loss can be improved by external matching

2. The input 1dB compression point is a linearity figure of merit. Refer to *Table 3* for the maximum operating power P<sub>IN</sub> (50Ω)

**Figure 3. Pin Configuration (Top View)**



**Table 2. Pin Descriptions**

| Pin #                               | Pin Name         | Description                              |
|-------------------------------------|------------------|------------------------------------------|
| 1, 2, 4-7, 9, 10-12, 14, 15, 18, 19 | GND              | Ground                                   |
| 3                                   | RF1 <sup>1</sup> | RF port                                  |
| 8                                   | RFC <sup>1</sup> | RF common                                |
| 13                                  | RF2 <sup>1</sup> | RF port                                  |
| 16                                  | CTRL2            | Digital control logic input 2            |
| 17                                  | CTRL1            | Digital control logic input 1            |
| 20                                  | V <sub>DD</sub>  | Supply voltage                           |
| Pad                                 | GND              | Exposed pad: ground for proper operation |

Note 1: RF pins 3, 8 and 13 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 <sub>DD</sub>   | 2.7  |     | 5.5 | V    |
| Supply current<br>V <sub>DD</sub> = 2.7 to 5.5V      | I <sub>DD</sub>   |      | 120 | 200 | μA   |
| Digital input high<br>(CTRL1, CTRL2)                 | V <sub>IH</sub>   | 1.17 |     | 3.6 | V    |
| Digital input low<br>(CTRL1, CTRL2)                  | V <sub>IL</sub>   | -0.3 |     | 0.6 | V    |
| Digital input current                                | I <sub>CTRL</sub> |      | 9   | 12  | μA   |
| Maximum operating power<br>(RFC-RFX) <sup>1</sup>    | P <sub>IN</sub>   |      |     | 30  | dBm  |
| Maximum power into<br>termination (RFX) <sup>1</sup> | P <sub>MAX</sub>  |      |     | 20  | dBm  |
| Operating temperature<br>range                       | T <sub>OP</sub>   | -40  |     | +85 | °C   |

Notes: 1. 100% duty cycle, all bands, 50Ω

**Table 4. Absolute Maximum Ratings**

| Parameter/Condition                                   | Symbol            | Min  | Max          | Unit   |
|-------------------------------------------------------|-------------------|------|--------------|--------|
| Supply voltage                                        | V <sub>DD</sub>   | -0.3 | 5.5          | V      |
| Digital input voltage<br>(CTRL1, CTRL2)               | V <sub>CTRL</sub> | -0.3 | 3.6          | V      |
| Operating power<br>(RFC-RFX) <sup>1</sup>             | P <sub>IN</sub>   |      | 30           | dBm    |
| Power into termination (RFX) <sup>1</sup>             | P <sub>MAX</sub>  |      | 20           | dBm    |
| Storage temperature range                             | T <sub>ST</sub>   | -65  | +150         | °C     |
| Maximum die junction temperature                      | T <sub>Jmax</sub> |      | +125         | °C     |
| ESD voltage HBM <sup>2</sup><br>RFC<br>All other pins | V <sub>ESD</sub>  |      | 4000<br>2000 | V<br>V |
| ESD voltage MM <sup>3</sup> , all pins                | V <sub>ESD</sub>  |      | 100          | V      |

Notes: 1. 100% duty cycle, all bands, 50Ω  
2. Human Body Model (MIL-STD 883 Method 3015)  
3. Machine Model (JEDEC JESD22-A115)

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 specified rating.

### Latch-Up Avoidance

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

### Switching Frequency

The PE42420 has a maximum 25 kHz switching frequency.

Switching frequency describes the time duration between switching events. 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. Switching time is provided in *Table 1*.

**Table 5. Truth Table**

| CTRL1 | CTRL2 | RFC – RF1        | RFC – RF2        |
|-------|-------|------------------|------------------|
| Low   | Low   | OFF              | OFF              |
| Low   | High  | OFF              | ON               |
| High  | Low   | ON               | OFF              |
| High  | High  | N/A <sup>1</sup> | N/A <sup>1</sup> |

Note 1: CTRL1 = High and CTRL2 = High are not supported

### Moisture Sensitivity Level

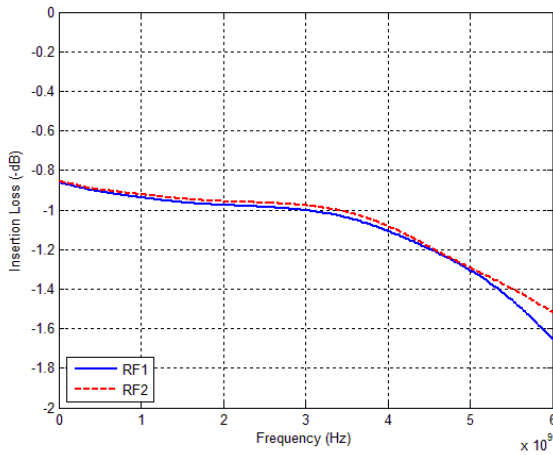
The Moisture Sensitivity Level rating for the PE42420 in the 20-lead 4x4 mm LGA package is MSL3.

### Spurious Performance

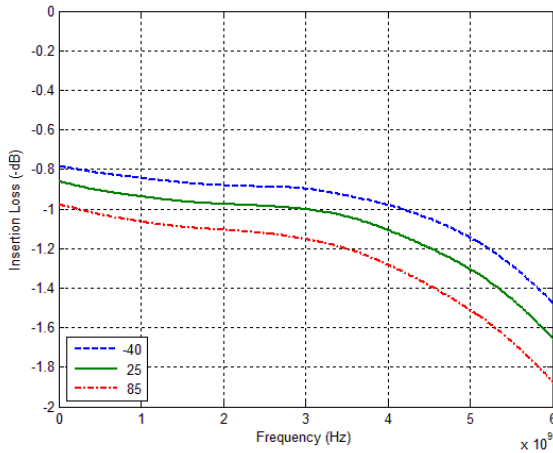
The typical spurious performance of the PE42420 is –155 dBm.

Typical Performance Data @ 25°C and  $V_{DD} = 3.0V$  unless otherwise specified

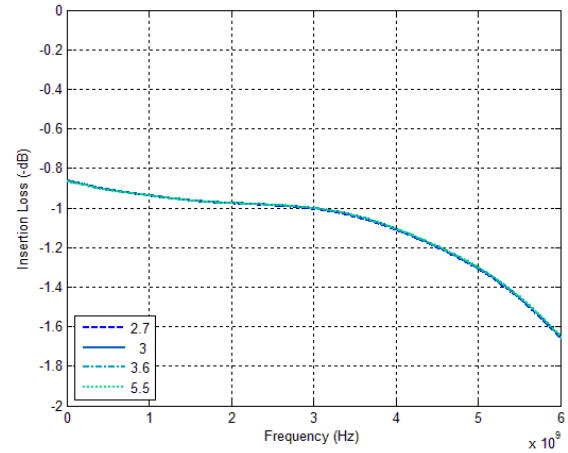
**Figure 4. Insertion Loss (RFC-RFX)**



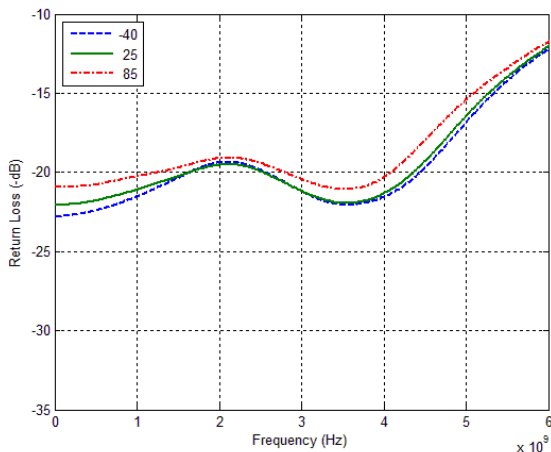
**Figure 5. Insertion Loss vs Temp (RFX-RFC)**



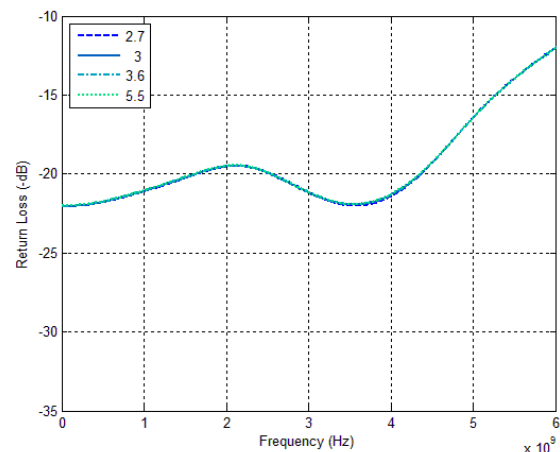
**Figure 6. Insertion Loss vs  $V_{DD}$  (RFX-RFC)**



**Figure 7. RFC Port Return Loss vs Temp (RF1 Active)**

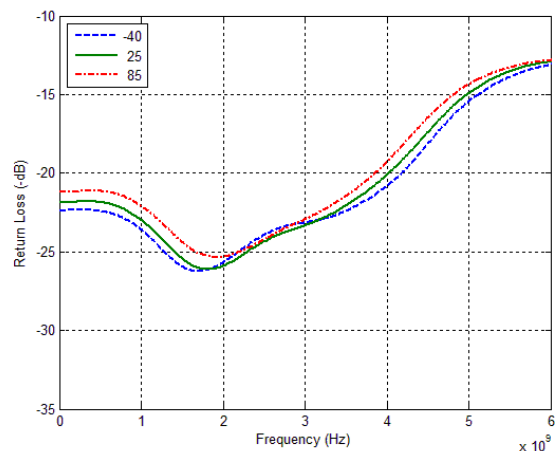


**Figure 8. RFC Port Return Loss vs  $V_{DD}$  (RF1 Active)**

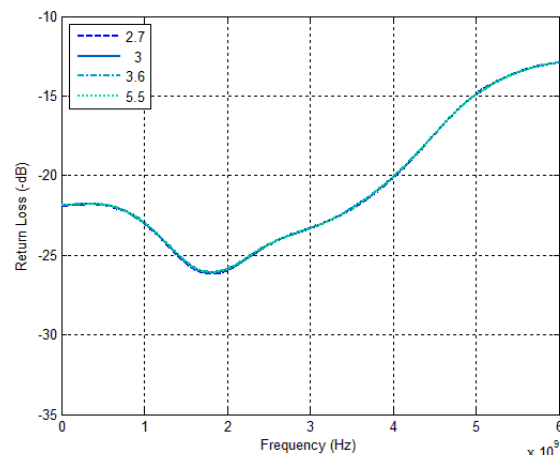


**Typical Performance Data@ 25°C and  $V_{DD} = 3.0V$  unless otherwise specified**

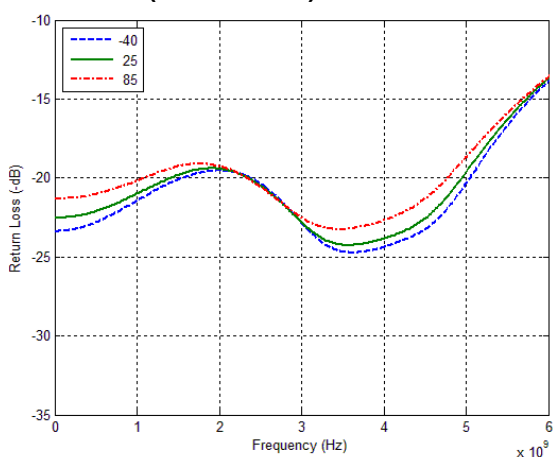
**Figure 9. RFC Port Return Loss vs Temp (RF2 Active)**



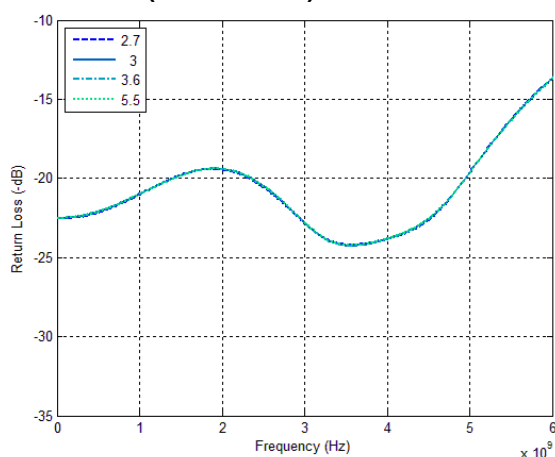
**Figure 10. RFC Port Return Loss vs  $V_{DD}$  (RF2 Active)**



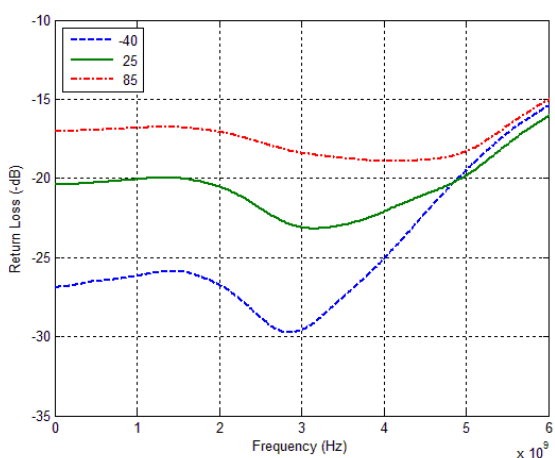
**Figure 11. Active Port Return Loss vs Temp (RF1 Active)**



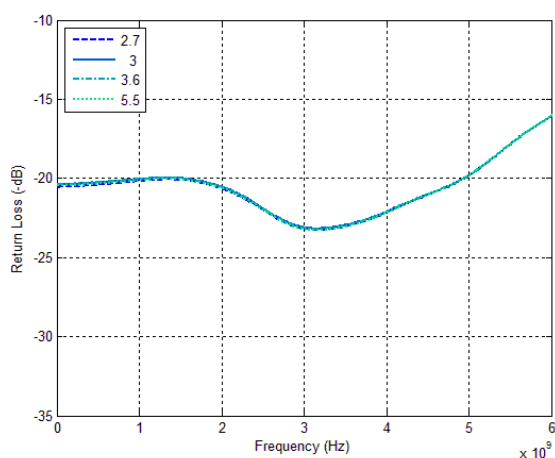
**Figure 12. Active Port Return Loss vs  $V_{DD}$  (RF1 Active)**



**Figure 13. Terminated Port Return Loss vs Temp (RF1 Active)**



**Figure 14. Terminated Port Return Loss vs  $V_{DD}$  (RF1 Active)**



Typical Performance Data@ 25°C and  $V_{DD} = 3.0V$  unless otherwise specified

Figure 15. Isolation vs Temp (RFX-RFX)

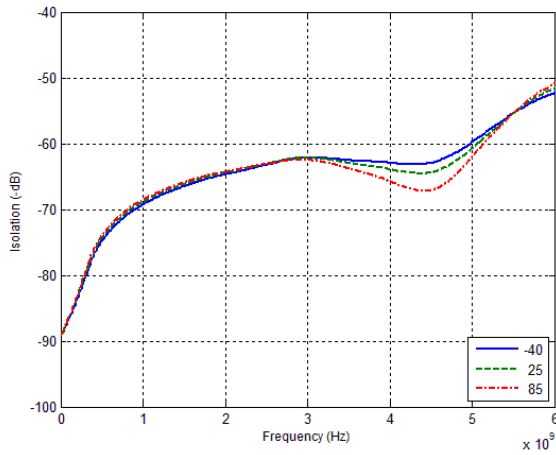


Figure 16. Isolation vs  $V_{DD}$  (RFX-RFX)

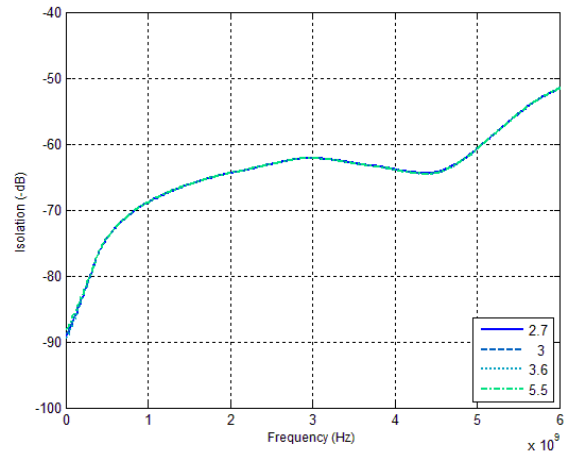


Figure 17. Isolation vs Temp (RFC-RFX)

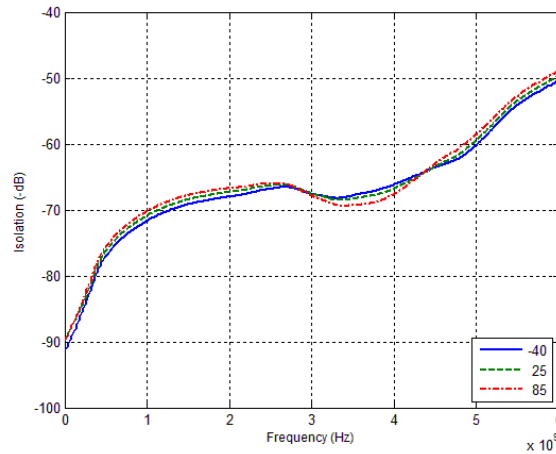
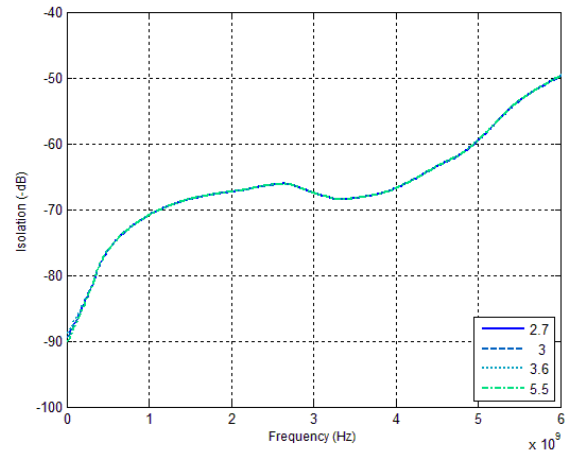


Figure 18. Isolation vs  $V_{DD}$  (RFC-RFX)



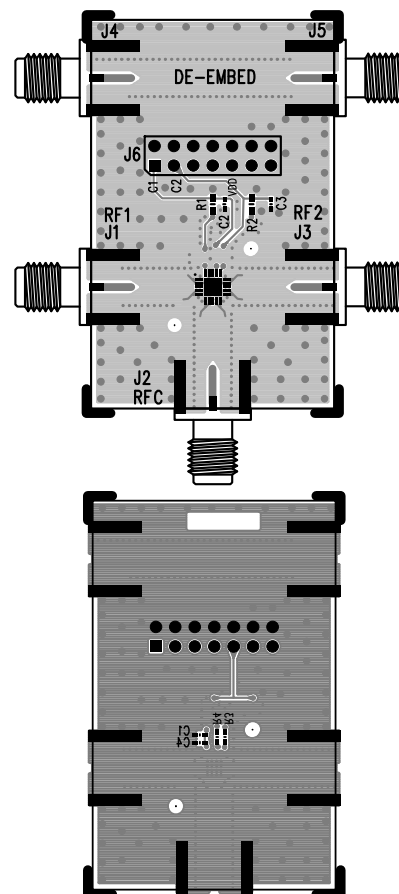
## Evaluation Kit

The SPDT switch evaluation board was designed to ease customer evaluation of Peregrine's PE42420. The RF common port is connected through a 50 $\Omega$  transmission line via the top SMA connector, J2. RF1 and RF2 ports are connected through 50 $\Omega$  transmission lines via SMA connectors J1 and J3, respectively. A 50 $\Omega$  through transmission line is available via SMA connectors J4 and J5, which can be used to calculate the loss of the PCB. J6 provides DC and digital inputs to the device.

The board is constructed of a four metal layer material with a total thickness of 36 mils. To achieve high isolation, the 50 $\Omega$  transmission lines are designed in layer 2 using a stripline waveguide design. The board stack up for 50 $\Omega$  transmission lines has 10 mil thickness of Rogers 4350 between layer 1 and layer 2, and 10 mil thickness of Rogers 4350 between layer 2 and layer 3.

For the true performance of the PE42420 to be realized, the PCB should be designed in such a way that RF transmission lines and sensitive DC I/O traces are heavily isolated from one another.

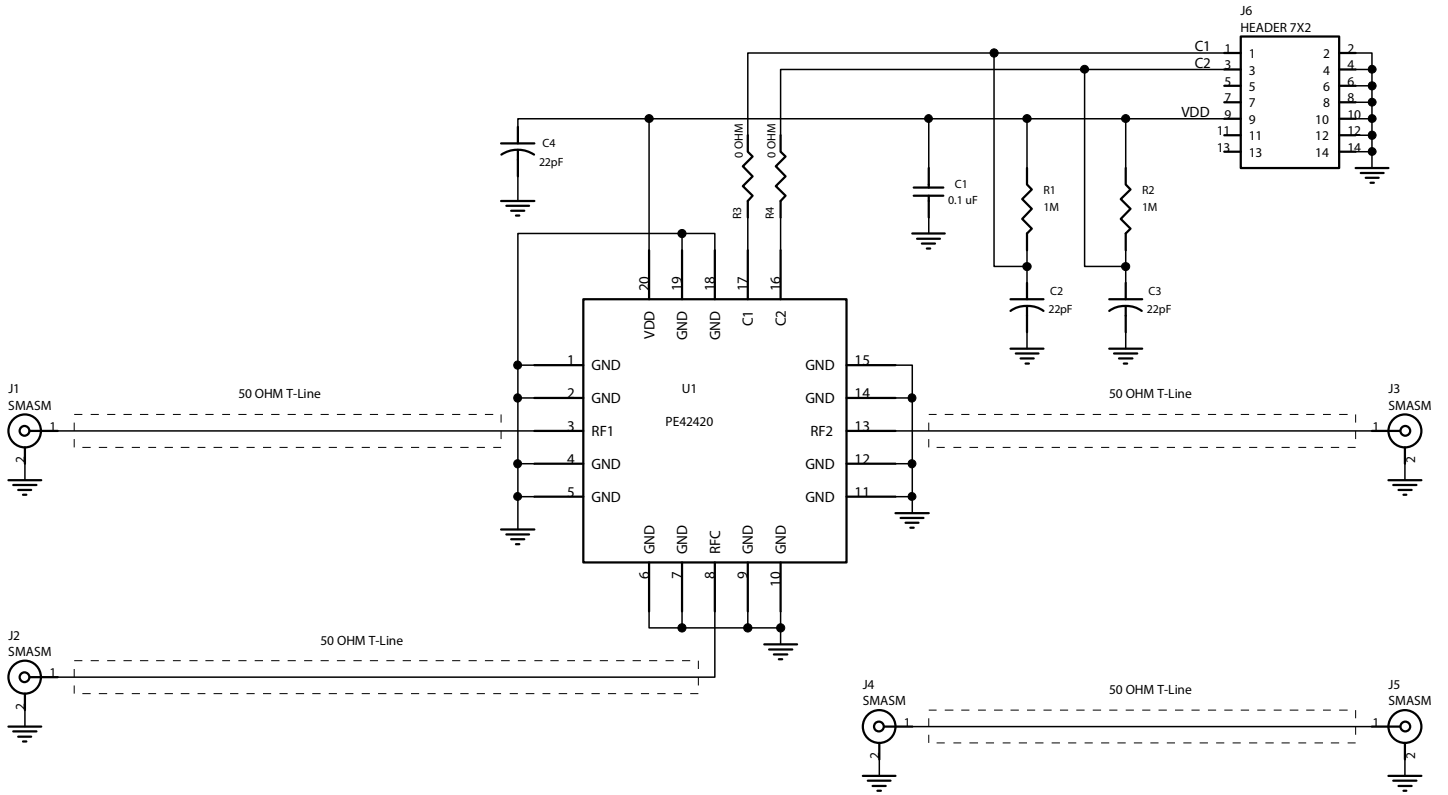
**Figure 19. Evaluation Board Layouts**



101-0551

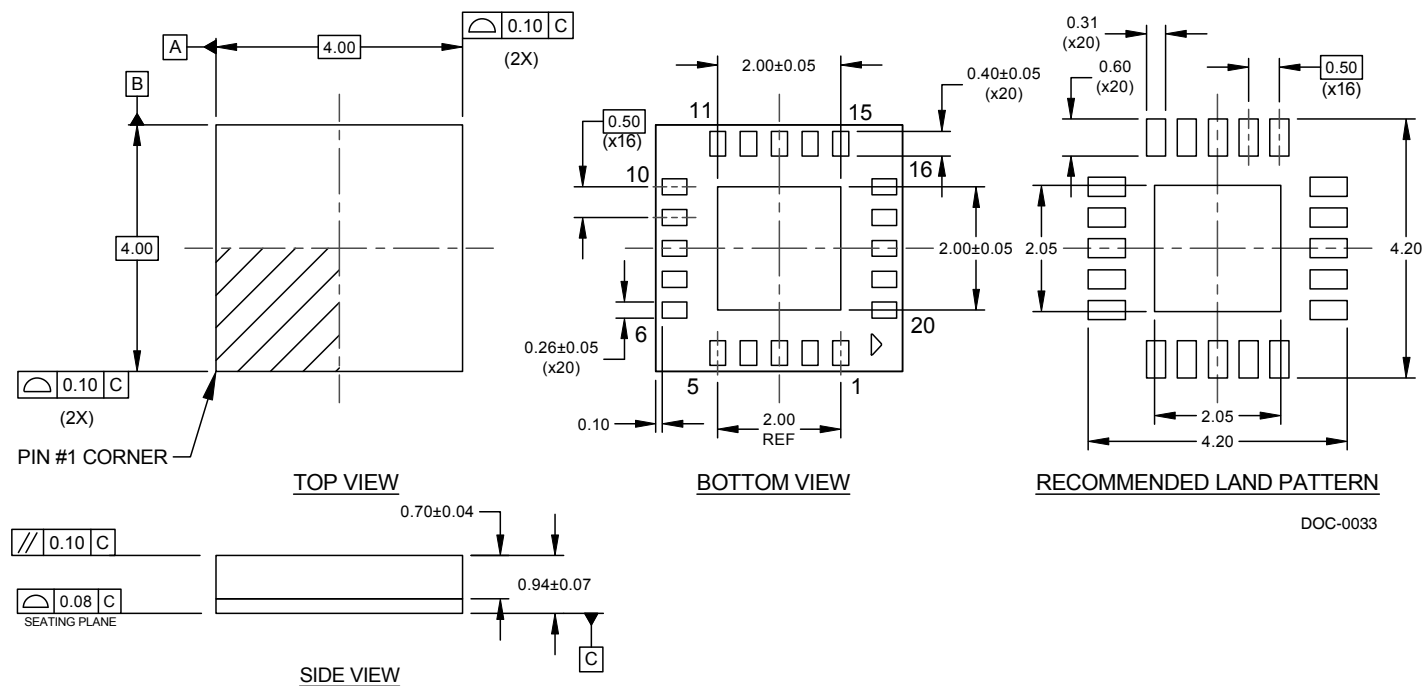


**Figure 20. Evaluation Board Schematic**

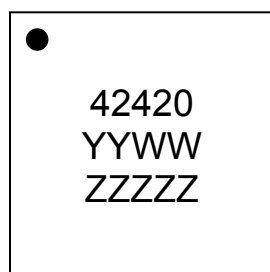


DOC-14527

**Figure 21. Package Drawing**  
20-lead 4x4 mm LGA



**Figure 22. Top Marking Specifications**

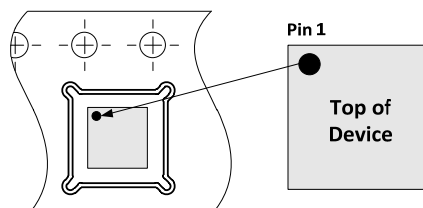


● = Pin 1 designator  
YYWW = Date Code  
ZZZZZ = Last five digits of Lot Number

DOC-01641

[illegible]

- $A_o = 4.35 \text{ mm}$   
 $B_o = 4.35 \text{ mm}$   
 $K_o = 1.1 \text{ mm}$



### Table 6. Ordering Information

| Order Code    | Description            | Package                  | Shipping Method  |
|---------------|------------------------|--------------------------|------------------|
| PE42420LGBB-Z | PE42420 SPDT RF switch | Green 20-lead 4x4 mm LGA | 3000 units / T&R |
| EK42420-02    | PE42420 Evaluation kit | Evaluation kit           | 1 / Box          |

For sales and contact information please visit [www.psemi.com](http://www.psemi.com).

No patent rights or licenses to any circuits described in this datasheet are implied or granted to any third party. Peregrine's products are not designed or intended for use in devices or systems intended for surgical implant, or in other applications intended to support or sustain life, or in any application in which the failure of the Peregrine product could create a situation in which personal injury or death might occur. Peregrine assumes no liability for damages, including consequential or incidental damages, arising out of the use of its products in such applications.

The Peregrine name, logo, UltraCMOS and UTSi are registered trademarks and HaRP, MultiSwitch and DuNE are trademarks of Peregrine Semiconductor Corp.



Компания «ЭлектроПласт» предлагает заключение долгосрочных отношений при поставках импортных электронных компонентов на взаимовыгодных условиях!

Наши преимущества:

- Оперативные поставки широкого спектра электронных компонентов отечественного и импортного производства напрямую от производителей и с крупнейших мировых складов;
- Поставка более 17-ти миллионов наименований электронных компонентов;
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- Лицензия ФСБ на осуществление работ с использованием сведений, составляющих государственную тайну;
- Поставка специализированных компонентов (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Aeroflex, Peregrine, Syfer, Eurofarad, Texas Instrument, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

Помимо этого, одним из направлений компании «ЭлектроПласт» является направление «Источники питания». Мы предлагаем Вам помощь Конструкторского отдела:

- Подбор оптимального решения, техническое обоснование при выборе компонента;
- Подбор аналогов;
- Консультации по применению компонента;
- Поставка образцов и прототипов;
- Техническая поддержка проекта;
- Защита от снятия компонента с производства.



#### Как с нами связаться

**Телефон:** 8 (812) 309 58 32 (многоканальный)

**Факс:** 8 (812) 320-02-42

**Электронная почта:** [org@eplast1.ru](mailto:org@eplast1.ru)

**Адрес:** 198099, г. Санкт-Петербург, ул. Калинина, дом 2, корпус 4, литера А.