

# PE4256

**75  $\Omega$  SPDT CATV UltraCMOS™  
Switch 5 MHz - 3 GHz**

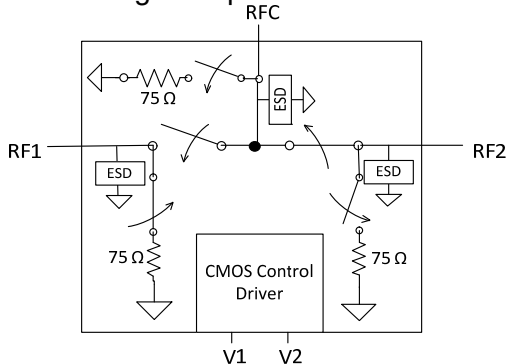
## Product Description

The PE4256 is an UltraCMOS™ Switch designed for CATV applications, covering a broad frequency range from 5 MHz up to 3 GHz. This single-supply SPDT switch integrates a two-pin CMOS control interface. It also provides low insertion loss with extremely low bias requirements while operating on a single 3-volt supply. In a typical CATV application, the PE4256 provides for a cost effective and manufacturable solution when compared to mechanical relays.

The PE4256 is manufactured on Peregrine'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.

**Figure 1. Functional Diagram**

Peregrine Specification 71-0013-01



## Features

- 75  $\Omega$  characteristic impedance
- Integrated 75  $\Omega$  terminations
- CTB performance of -90 dBc
- High isolation 65 dB at 1000 MHz
- Low insertion loss: typically 0.5 dB at 5 MHz, 0.9 dB at 1000 MHz
- High input IP3: >50 dBm
- CMOS two-pin control
- Single +3 volt supply operation
- Low current consumption: 8  $\mu$ A
- Unique all off terminated mode
- 4 x 4 mm QFN package

**Figure 2. Package Type**

20-lead 4 x 4 mm QFN



**Table 1. Electrical Specifications @ +25 °C,  $V_{DD} = +3$  V ( $Z_S = Z_L = 75 \Omega$ )**

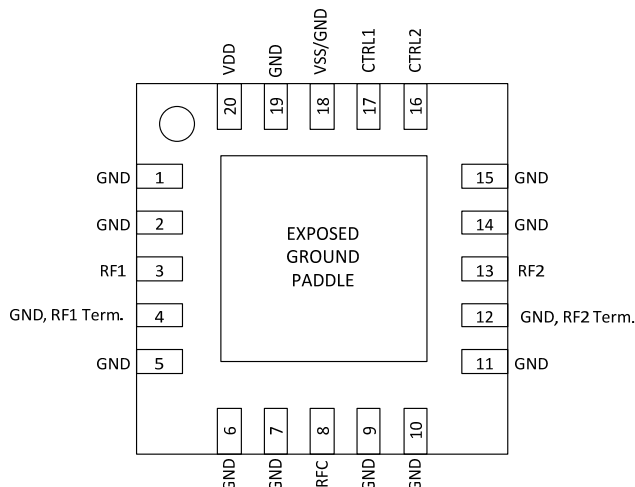
| Parameter                          | Condition                                  | Minimum | Typical | Maximum | Units            |
|------------------------------------|--------------------------------------------|---------|---------|---------|------------------|
| Operating Frequency <sup>1</sup>   |                                            | 5       |         | 3000    | MHz              |
| Insertion Loss                     | 5-250 MHz                                  |         | 0.5     | 0.6     | dB               |
|                                    | 250-750 MHz                                |         | 0.8     | 0.95    |                  |
|                                    | 750-1000 MHz                               |         | 0.9     | 1.1     |                  |
|                                    | 1000-2200 MHz                              |         | 1.1     | 1.3     |                  |
| Isolation                          | 5-250 MHz                                  | 75      | 80      |         | dB               |
|                                    | 250-750 MHz                                | 65      | 70      |         |                  |
|                                    | 750-1000 MHz                               | 62      | 65      |         |                  |
|                                    | 1000-2200 MHz                              | 49      | 52      |         |                  |
| Input IP2 <sup>2</sup>             | 5-1000 MHz                                 |         | 80      |         | dBm              |
| Input IP3 <sup>2</sup>             | 5-1000 MHz                                 | 50      | 55      |         | dBm              |
| Input 1dB Compression <sup>2</sup> | 1000 MHz                                   | 29      | 31      |         | dBm              |
| CTB / CSO                          | 77 & 110 channels;<br>Power Out = 44 dBm V |         | -90     |         | dBc              |
| Switching Time                     | 50% CTRL to 10/90% RF                      |         | 2       |         | $\mu$ s          |
| Video Feedthrough <sup>3</sup>     | 5-1000 MHz                                 |         |         | 15      | mV <sub>pp</sub> |

Notes: 1. Device linearity will begin to degrade below 5 MHz.

2. Measured in a 50  $\Omega$  system.

3. Measured with a 1 ns risetime, 0/3 V pulse and 500 MHz bandwidth

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



**Table 2. Pin Descriptions**

| No.             | Name    | Description            |
|-----------------|---------|------------------------|
| 1               | GND     | Ground                 |
| 2               | GND     | Ground                 |
| 3 <sup>1</sup>  | RF1     | RF I/O                 |
| 4 <sup>4</sup>  | GND     | Ground                 |
| 5               | GND     | Ground                 |
| 6               | GND     | Ground                 |
| 7 <sup>4</sup>  | GND     | Ground                 |
| 8 <sup>1</sup>  | RFC     | Common                 |
| 9 <sup>4</sup>  | GND     | Ground                 |
| 10              | GND     | Ground                 |
| 11              | GND     | Ground                 |
| 12 <sup>4</sup> | GND     | Ground                 |
| 13 <sup>1</sup> | RF2     | RF I/O                 |
| 14              | GND     | Ground                 |
| 15              | GND     | Ground                 |
| 16 <sup>2</sup> | C2      | Control 2              |
| 17 <sup>2</sup> | C1      | Control 1              |
| 18 <sup>3</sup> | VSS/GND | Negative Supply Option |
| 19              | GND     | Ground                 |
| 20              | VDD     | Supply                 |
| Paddle          | GND     | Exposed Ground Paddle  |

- Notes: 1. RF pins 3, 8, and 13 must be at 0 VDC. The RF pins do not require DC blocking capacitors for proper operation if the 0 VDC requirement is met.
2. Pins 16 and 17 are the CMOS controls that set the three operating states.
3. Connect pin 18 to GND to enable the on-chip negative voltage generator. Connect pin 18 to V<sub>SS</sub> (-3 V) to bypass and disable internal -3 V supply generator.
4. Customer can add external resistance to ground to change or modify termination resistance.

**Table 3. Absolute Maximum Ratings**

| Symbol           | Parameter/Condition            | Min  | Max                   | Unit |
|------------------|--------------------------------|------|-----------------------|------|
| V <sub>DD</sub>  | Power supply voltage           | -0.3 | 4.0                   | V    |
| V <sub>I</sub>   | Voltage on CTRL input          | -0.3 | V <sub>DD</sub> + 0.3 | V    |
| P <sub>RF</sub>  | RF CW power                    |      | 24                    | dBm  |
| T <sub>ST</sub>  | Storage temperature            | -65  | 150                   | °C   |
| T <sub>OP</sub>  | Operating temperature          | -40  | 85                    | °C   |
| V <sub>ESD</sub> | ESD voltage (Human Body Model) |      | 1000                  | V    |

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.

**Table 4. DC Electrical Specifications @ 25 °C**

| Parameter                                                                             | Min                 | Typ | Max                 | Unit |
|---------------------------------------------------------------------------------------|---------------------|-----|---------------------|------|
| V <sub>DD</sub> Power Supply                                                          | 2.7                 | 3.0 | 3.3                 | V    |
| I <sub>DD</sub> Power Supply Current (V <sub>DD</sub> = 3 V, V <sub>CNTL</sub> = 3 V) |                     | 8   | 20                  | μA   |
| Control Voltage High                                                                  | 70% V <sub>DD</sub> |     |                     | V    |
| Control Voltage Low                                                                   |                     |     | 30% V <sub>DD</sub> | V    |

### 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.

### Moisture Sensitivity Level

The Moisture Sensitivity Level rating for the PE4256 in the 20-lead 4 x 4 mm QFN package is MSL1.

## Latch-Up Avoidance

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

## Switching Frequency

The PE4256 has a maximum 25 kHz switching rate when the internal negative voltage generator is used (pin 18 = GND).

**Table 5. RF Path Truth Table**

| C1   | C2   | 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> |

**Table 6. Termination Truth Table**

| C1   | C2   | RFC – 75 $\Omega$ | RF1 – 75 $\Omega$ | RF2 – 75 $\Omega$ |
|------|------|-------------------|-------------------|-------------------|
| Low  | Low  | X <sup>2</sup>    | X <sup>2</sup>    | X <sup>2</sup>    |
| Low  | High |                   | X <sup>2</sup>    |                   |
| High | Low  |                   |                   | X <sup>2</sup>    |
| High | High | N/A <sup>1</sup>  | N/A <sup>1</sup>  | N/A <sup>1</sup>  |

Notes: 1. The operation of the PE4256 is not supported or characterized in the C1 = V<sub>DD</sub> and C2 = V<sub>DD</sub> state.  
2. "X" denotes termination enabled.

## Evaluation Kit

The SPDT Switch Evaluation Kit was designed to ease customer evaluation of the PE4256 SPDT switch. The RF common port (RFC) is connected through a 75  $\Omega$  transmission line to J2. Port 1 and Port 2 are connected through 75  $\Omega$  transmission lines to J1 and J3. A through transmission line connects F connectors J4 and J5. This transmission line can be used to estimate the loss of the PCB over the environmental conditions being evaluated.

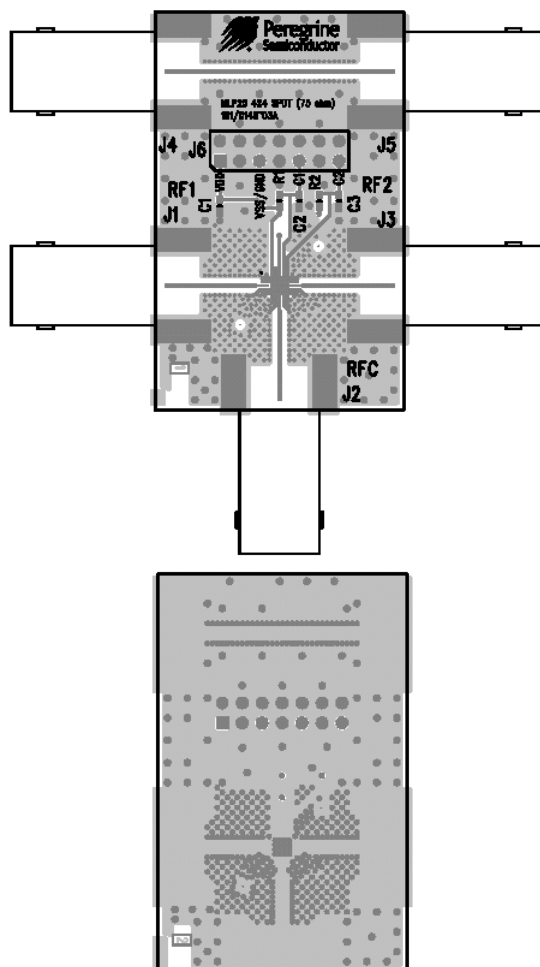
The board is constructed with four metal layers in FR4 material with a total thickness of 0.062". The transmission lines were designed using a coplanar waveguide with ground plane (28 mil core, 21 mil width, 30 mil gap).

J6 provides a means for controlling DC and digital inputs to the device. The provided jumpers short the package pin to ground for logic low. When the jumper is removed, the pin is pulled up to  $V_{DD}$  for logic high.

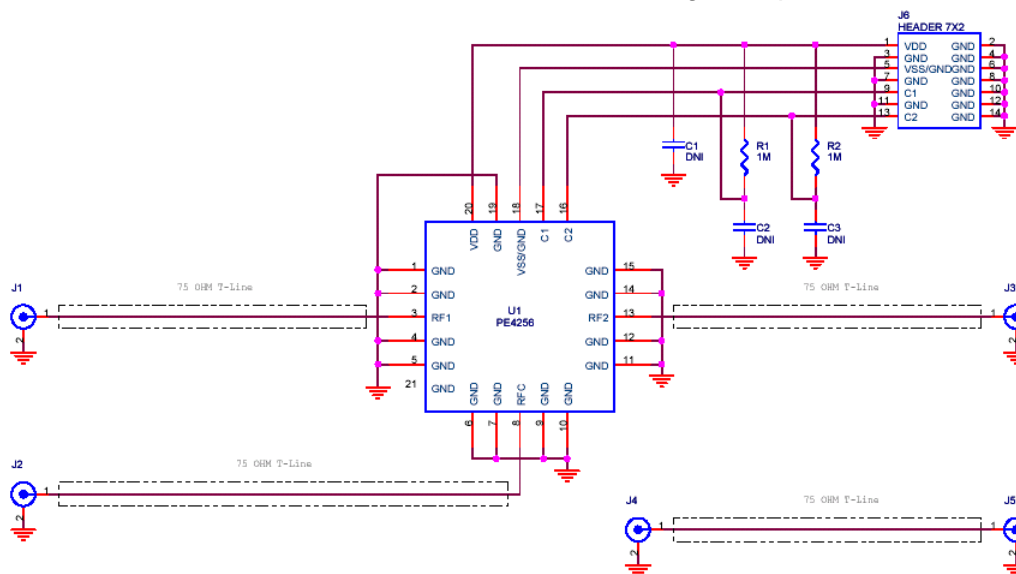
When the jumper is in place, 3  $\mu A$  of current will flow through the 1 M $\Omega$  pull-up resistor. This extra current should not be attributed to the device.

Proper PCB design is essential for full isolation performance. This evaluation board demonstrates good trace and ground management for minimum coupling and radiation.

**Figure 4. Evaluation Board Layouts**  
Peregrine Specification 101/0148~03A

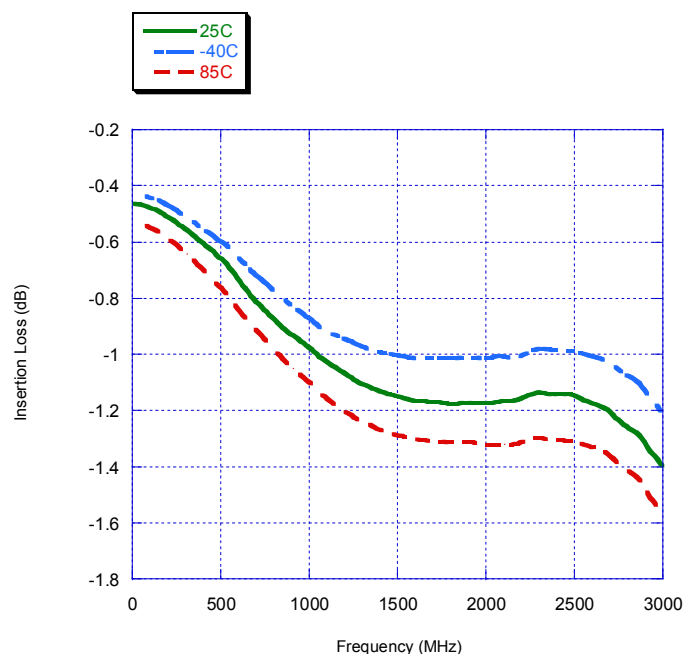


**Figure 5. Evaluation Board Schematic**  
Peregrine Specification 102/0195~02A

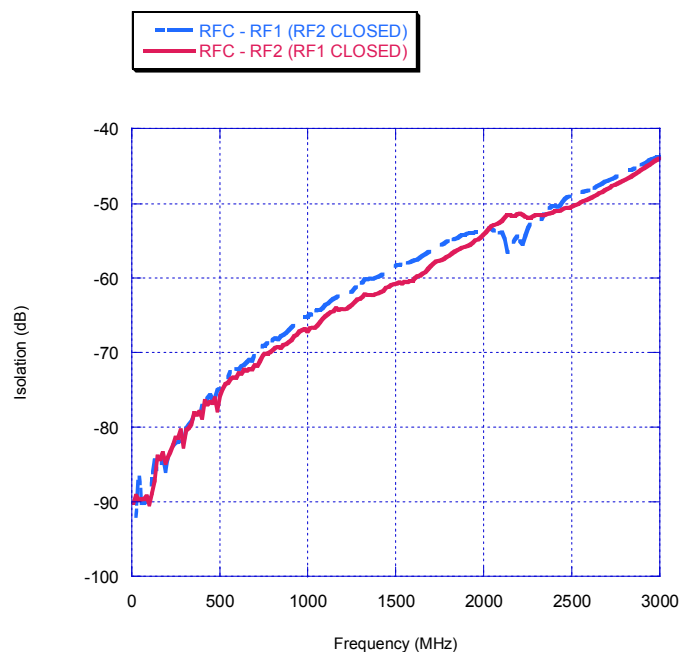


**Typical Performance Data from -40 °C to +85 °C, 75  $\Omega$  Impedance**

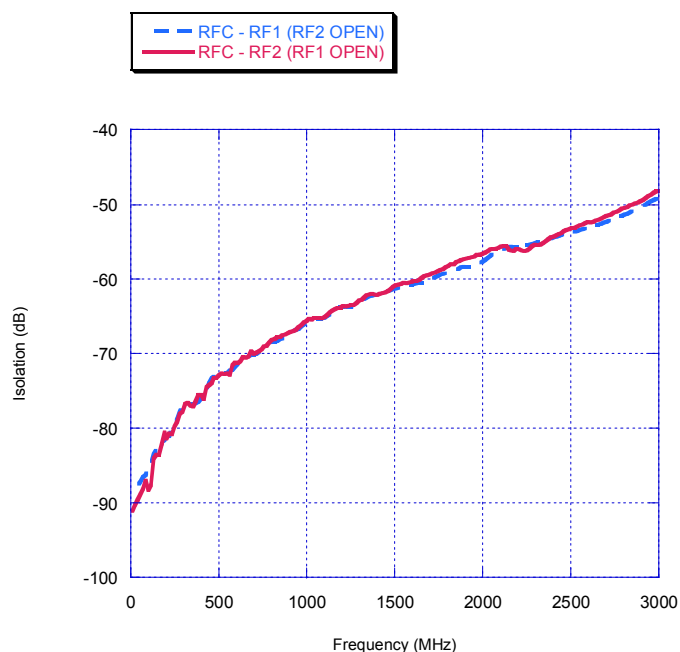
**Figure 6. Insertion Loss (RFC to RF1 or RF2)**



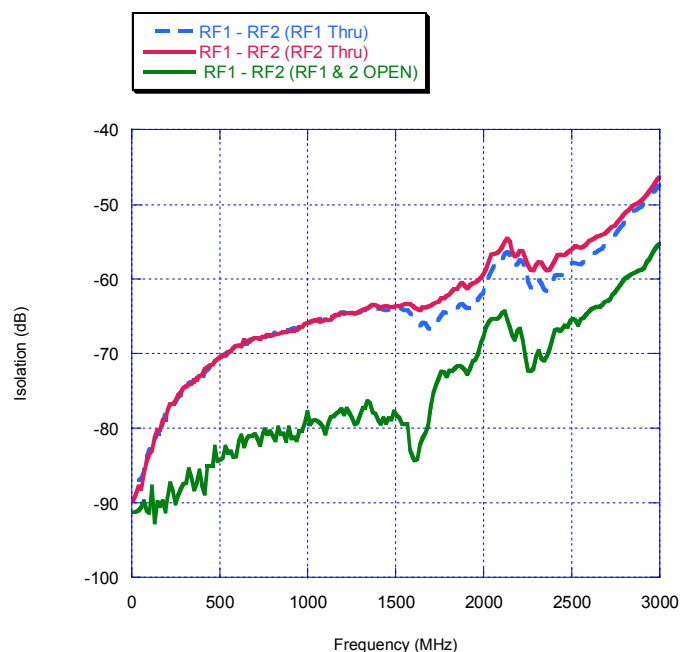
**Figure 7. Input to Output Isolation (Closed)**



**Figure 8. Input to Output Isolation (Open)**

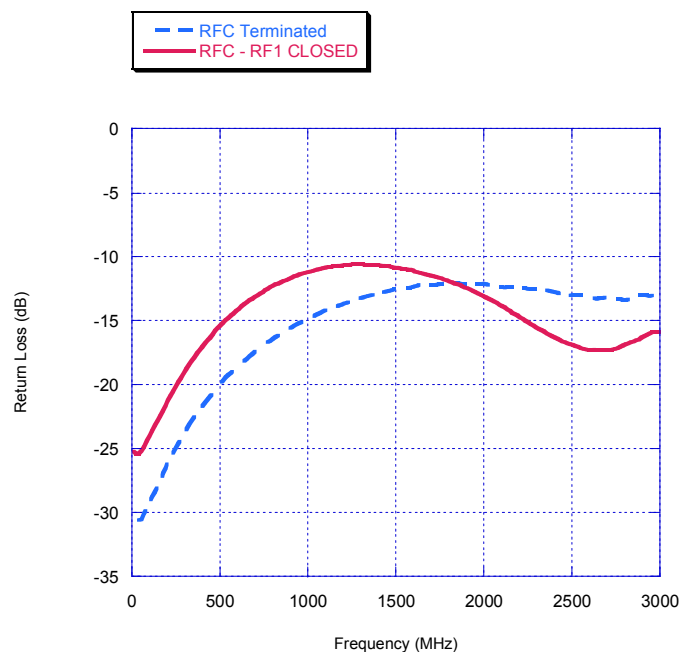


**Figure 9. Isolation – RF1 To RF2**

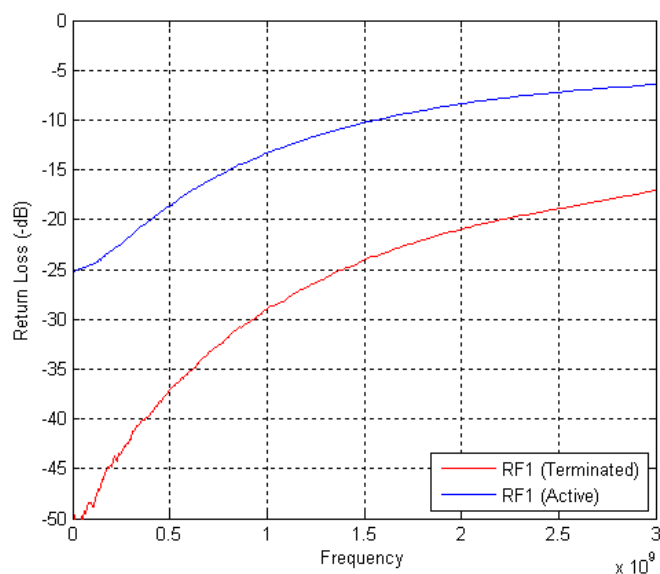


Typical Performance Data @ +25 °C, 75  $\Omega$  Impedance (unless otherwise noted)

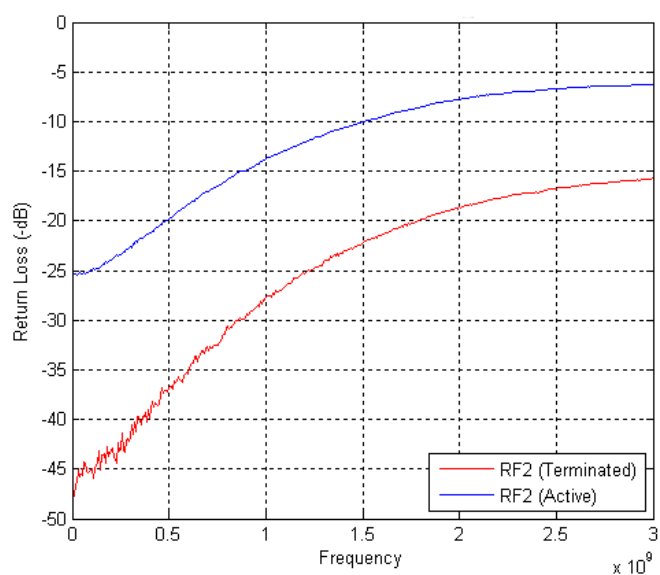
**Figure 10. RFC Return Loss**



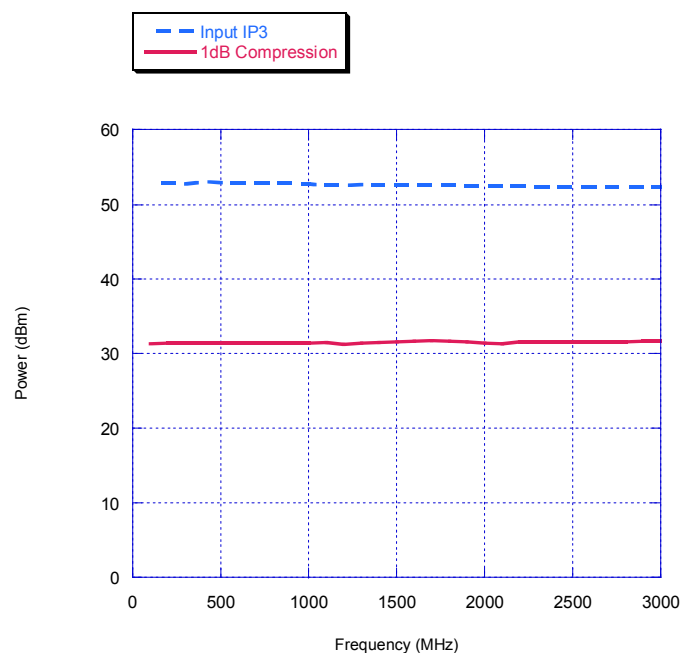
**Figure 11. RF1 Return Loss**



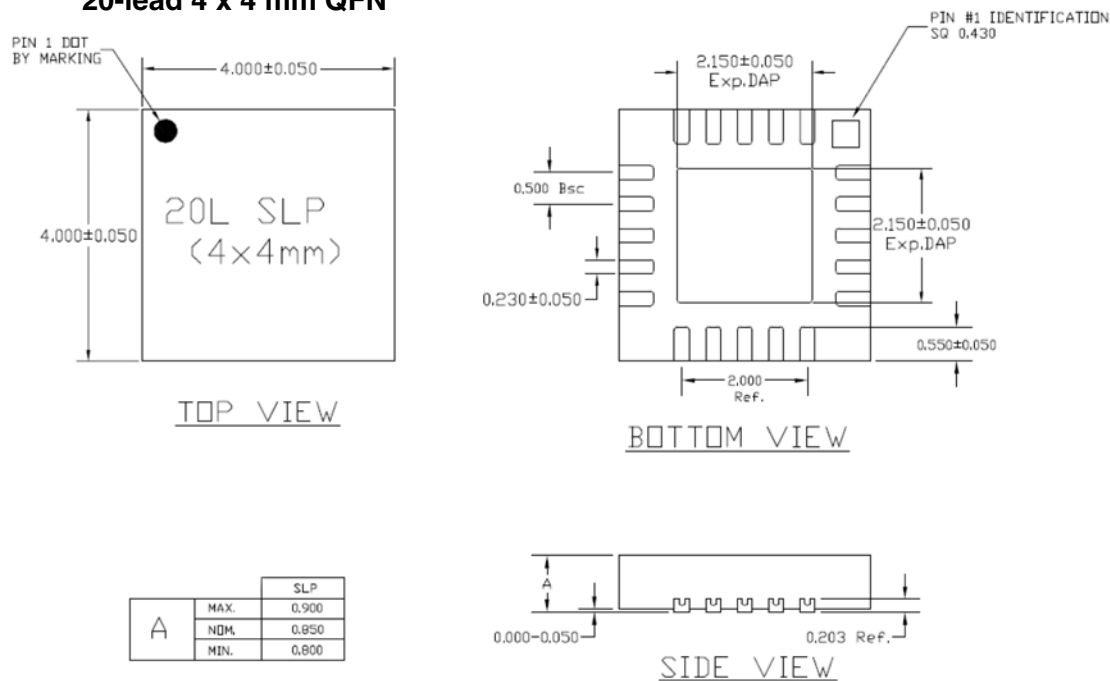
**Figure 12. RF2 Return Loss**



**Figure 13. Linearity (50  $\Omega$  System Impedance)**



**Figure 14. Package Drawing (mm)**  
**20-lead 4 x 4 mm QFN**

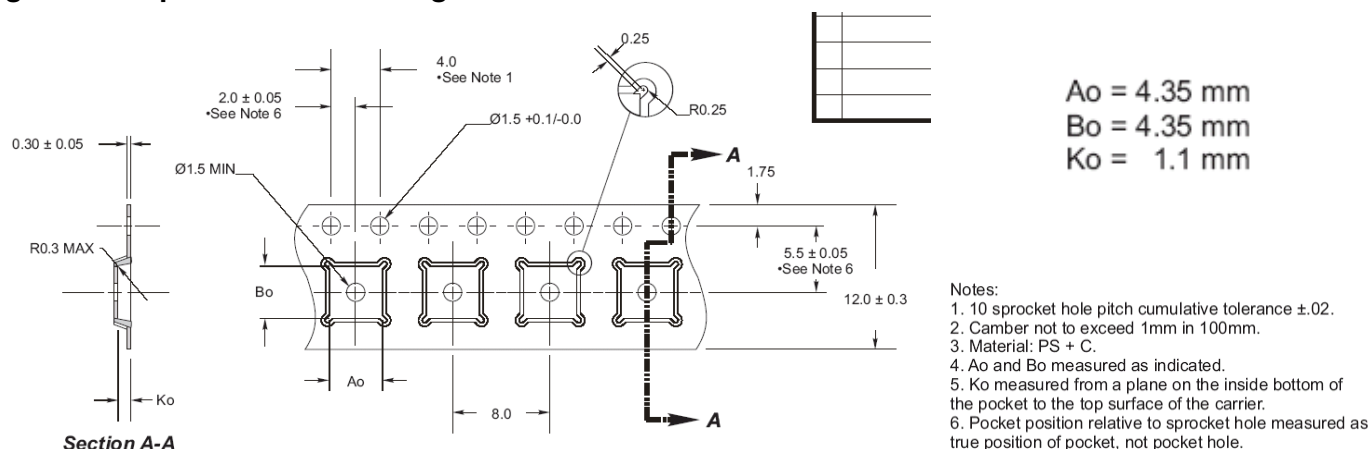


**Figure 15. Marking Specifications**



YYWW = Date Code  
ZZZZZ = Last five digits of PSC Lot Number

**Figure 15. Tape and Reel Drawing**



**Table 7. Ordering Information**

| Order Code    | Part Marking | Description                  | Package                                           | Shipping Method  |
|---------------|--------------|------------------------------|---------------------------------------------------|------------------|
| 4256-00       | PE4256-EK    | PE4256-20QFN 4 x 4 mm-EK     | Evaluation Kit                                    | 1 / Box          |
| PE4256MLIAA   | 4256         | PE4256-20QFN 4 x 4 mm-75     | Green 20-lead 4 x 4 mm QFN, NiPdAu Lead Finish    | 75 units / Tube  |
| PE4256MLIAA-Z | 4256         | PE4256-20QFN 4 x 4 mm-3000   | Green 20-lead 4 x 4 mm QFN, NiPdAu Lead Finish    | 3000 units / T&R |
| EK4256-01     | PE4256-EK    | PE4256-20QFN 4 x 4 mm-EK     | Evaluation Kit                                    | 1 / Box          |
| 4256-52       | 4256         | PE4256G-20QFN 4 x 4 mm-3000C | Green 20-lead 4 x 4 mm QFN, Matte Tin Lead Finish | 3000 units / T&R |

## Sales Contact and Information

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

**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. Peregrine 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 Peregrine decides to change the specifications, Peregrine will notify customers of the intended changes by issuing a CNF (Customer Notification Form).

The information in this datasheet is believed to be reliable. However, Peregrine assumes no liability for the use of this information. Use shall be entirely at the user's own risk.

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





**Стандарт  
Электрон  
Связь**

Мы молодая и активно развивающаяся компания в области поставок электронных компонентов. Мы поставляем электронные компоненты отечественного и импортного производства напрямую от производителей и с крупнейших складов мира.

Благодаря сотрудничеству с мировыми поставщиками мы осуществляем комплексные и плановые поставки широчайшего спектра электронных компонентов.

Собственная эффективная логистика и склад в обеспечивает надежную поставку продукции в точно указанные сроки по всей России.

Мы осуществляем техническую поддержку нашим клиентам и предпродажную проверку качества продукции. На все поставляемые продукты мы предоставляем гарантию .

Осуществляем поставки продукции под контролем ВП МО РФ на предприятия военно-промышленного комплекса России , а также работаем в рамках 275 ФЗ с открытием отдельных счетов в уполномоченном банке. Система менеджмента качества компании соответствует требованиям ГОСТ ISO 9001.

Минимальные сроки поставки, гибкие цены, неограниченный ассортимент и индивидуальный подход к клиентам являются основой для выстраивания долгосрочного и эффективного сотрудничества с предприятиями радиоэлектронной промышленности, предприятиями ВПК и научно-исследовательскими институтами России.

С нами вы становитесь еще успешнее!

**Наши контакты:**

**Телефон:** +7 812 627 14 35

**Электронная почта:** [sales@st-electron.ru](mailto:sales@st-electron.ru)

**Адрес:** 198099, Санкт-Петербург,  
Промышленная ул, дом № 19, литера Н,  
помещение 100-Н Офис 331