# Product Specification

# PE42742

**75 Ω Terminated, 5 - 2200 MHz SPDT CATV UltraCMOS™ Switch Featuring Unpowered Operation**

## Product Description

*The PE42742 is an SPDT UltraCMOS™ switch designed for broadband applications such as CATV, DTV, Multi-Tuner DVR (Digital Video Recorder), Set-top Box, PCTV and Game Boxes. It meets FCC 15.115 spec of 80 dB isolation @ 216 MHz and offers high isolation and low insertion loss in both a powered and a unique unpowered default state. The PE42742 covers a broad frequency range from 5 MHz to beyond 2200 MHz with a single positive supply and CMOS control. It provides a smaller, cost effective, more reliable and manufacturable alternative to mechanical relays in set-top box applications.*

*The PE42742 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.*

## Features

- Meets FCC 15.115 spec of 80 dB isolation @ 216 MHz
- Unpowered operational state
- 3500 V HBM ESD tolerance, all pins
- CTB performance of 90 dBc
- High isolation: 63 dB @ 1000 MHz
- Low insertion loss: typically 0.5 dB @ 5 MHz, 0.8 dB @ 1000 MHz
- CMOS single-pin control with logic select
- Single +3 volt supply operation
- Low current consumption: 8 µA

**Figure 1. Functional Diagram**

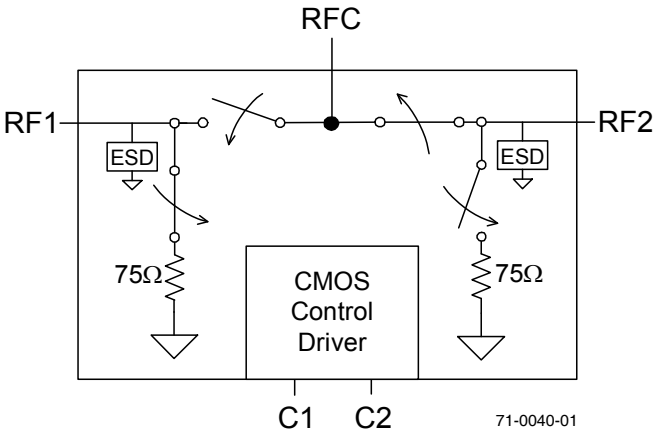



**Figure 2. Package Type**
**20-lead 4x4mm QFN**




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

| Parameter | Condition | Minimum | Typical | Maximum | Units |
|---|---|---|---|---|---|
| Operating Frequency | | 5 | | 2200 | MHz |
| RF1-RFC Insertion Loss | 220 MHz | | 0.45 | 0.55 | dB |
| | 550 MHz | | 0.55 | 0.65 | dB |
| | 810 MHz | | 0.7 | 0.8 | dB |
| | 1000 MHz | | 0.75 | 0.85 | dB |
| | 2200 MHz | | 1.7 | 1.8 | dB |
| RF2-RFC Insertion Loss | 220 MHz | | 0.7 | 0.8 | dB |
| | 550 MHz | | 0.8 | 0.9 | dB |
| | 810 MHz | | 0.9 | 1 | dB |
| | 1000 MHz | | 1.0 | 1.1 | dB |
| | 2200 MHz | | 1.8 | 1.9 | dB |
| Isolation RF1 to RF2 (RFC-RF1 ON) | 220 MHz | 81 | 94 | | dB |
| | 550 MHz | 77 | 82 | | dB |
| | 810 MHz | 71.5 | 76 | | dB |
| | 2200 MHz | 50 | 53.6 | | dB |
| Isolation RF1 to RF2 (RFC-RF2 ON) | 220 MHz | 81 | 92 | | dB |
| | 550 MHz | 75 | 79 | | dB |
| | 810 MHz | 70.5 | 75 | | dB |
| | 2200 MHz | 50 | 53 | | dB |
| Isolation RF1 to RFC (RFC-RF2 ON) | 220 MHz | 71 | 74 | | dB |
| | 550 MHz | 64 | 66 | | dB |
| | 810 MHz | 62 | 64 | | dB |
| | 2200 MHz | 52 | 57 | | dB |
| Isolation RF2 to RFC (RFC-RF1 ON) | 220 MHz | 70.5 | 73 | | dB |
| | 550 MHz | 64 | 66 | | dB |
| | 810 MHz | 61.5 | 63 | | dB |
| | 2200 MHz | 51 | 55 | | dB |
| IP2 RF1/RF2[2] | 5 MHz – 1000 MHz | | 90/90 | | dBm |
| IIP3 RF1/RF2[2] | 5 MHz – 1000 MHz | | 53/53 | | dBm |
| Input 1 dB Compression RF1/RF2[2] | 1000 MHz | 30/24.5 | 32/26.5 | | dBm |
| CTB / CSO (Powered/Unpowered) | 77 & 110 channels; Power Out = 44 dBmV | | -90 / -77 | | dBc |
| Switching time | 50 % CTRL to 10 / 90 RF | | 3 | | µs |
| Video Feedthrough[3] | 5 MHz – 1000 MHz | | 20 | | mVpp |

## Table 2. Electrical Characterization (Unpowered Operation)[5]

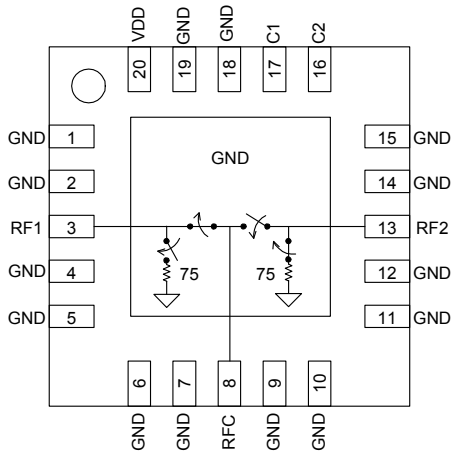
| Parameter | Condition | Minimum | Typical | Maximum | Units |
|---|---|---|---|---|---|
| Operating Frequency[1] | | 5 | | 2200 | MHz |
| Isolation RF1 to RF2[4] | 220 MHz | 81 | 90.5 | - | dB |
| | 550 MHz | 77 | 81.5 | - | dB |
| | 810 MHz | 70.5 | 77 | - | dB |
| | 2200 MHz | 49 | 52.5 | - | dB |

Notes: 1. Device linearity will begin to degrade with input signals below 5 MHz
2. Measured in a 50 Ω system
3. Measured with a 1 ns risetime, 0/3 V pulse and 500 MHz bandwidth
4. Minimum per FCC 15.115 spec
5. See *Figure 9* for Power-Off insertion loss of RFC-RF1

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## Figure 3. Pin Configuration (Top View)




## Table 3. Pin Descriptions

| No. | Name | Description |
|---|---|---|
| 1, 2, 4-7, 9-12, 14, 15, 18, 19 | GND | RF Ground |
| 3 | RF1[1] | RF I/O |
| 8 | RFC[1] | RF Common |
| 13 | RF2[1] | RF I/O |
| 16 | C2[2] | Control 2 (or logic select) |
| 17 | C1[2] | Control 1 (or logic select) |
| 20 | VDD | Supply |
| Pad | GND | RF Ground Pad |

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 0V DC requirement is met.
2. Pins 16 and 17 can be set for single pin or complementary pin control.

### Moisture Sensitivity Level

The Moisture Sensitivity Level rating for the PE42742 in the 20-lead QFN package is MSL1.

## Table 4. Operating Conditions @ 25°C

| Parameter | Min | Typ | Max | Unit |
|---|---|---|---|---|
| $V_{DD}$ Power Supply | 2.7 | 3.0 | 3.3 | V |
| $I_{DD}$ Power Supply Current ($V_{DD}$ = 3V, $V_{CNTL}$ = 3V) | | 8 | | µA |
| Control Voltage High | 0.7 x $V_{DD}$ | | $V_{DD}$ | V |
| Control Voltage Low | 0 | | 0.3 x $V_{DD}$ | V |

## Table 5. Absolute Maximum Ratings

| Symbol | Parameter/Condition | Min | Max | Unit |
|---|---|---|---|---|
| $V_{DD}$ | Power supply voltage | -0.3 | 4.0 | V |
| $V_I$ | Voltage on any DC input | -0.3 | $V_{DD}$ + 0.3 | V |
| $P_{RF}$ | RF power on RFC, RF1, RF2 Terminated/Through | | 24/33 | dBm |
| $T_{ST}$ | Storage temperature | -65 | +150 | °C |
| $T_{OP}$ | Operating temperature | -40 | +85 | °C |
| $V_{ESD}$ | HBM[1] ESD Voltage RF Pins | | 3500 | V |
| | HBM[1] ESD Voltage Digital Pins | | 3500 | |
| | MM[2] ESD Voltage all pins | | 150 | |

Notes: 1. ML_STD 883 Method 3015.7
2. JEDEC JESD22-A114-B

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.

### Switching Frequency

The PE42742 has a maximum 25 kHz switching rate.


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### Table 6. Truth Table

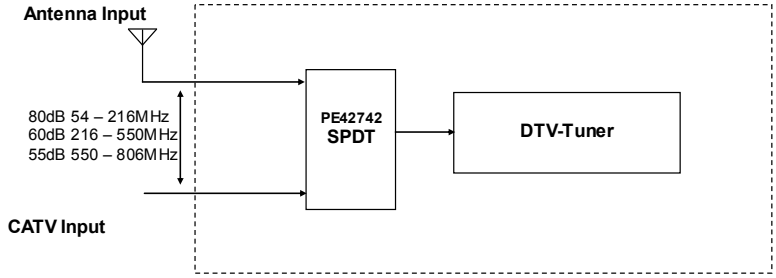
| $V_{DD}$ | C1 (pin 17) | C2 (pin 16) | RFC – RF1 | RFC – RF2 |
|---|---|---|---|---|
| OFF | Low | Low | ON | OFF |
| ON | Low | Low | ON | OFF |
| ON | Low | High | OFF | ON |
| ON | High | Low | OFF | ON |
| ON | High | High | ON | OFF |

Note: A versatile logic table has been established to allow either C1 or C2 act as a single pin control and in either polarity.

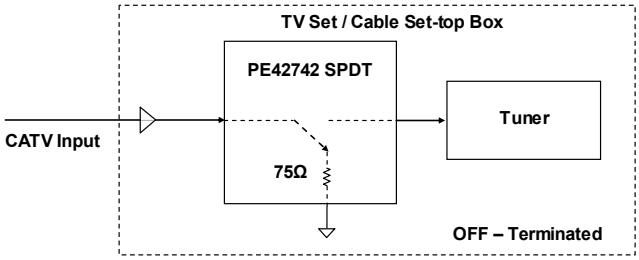
## Typical Applications

The PE42742 provides the high isolation required by FCC part 15.115 regulation between the television antenna and the cable plant. The advantage of the PE42742 is that device isolation / thru performance is maintained when power is removed. This unique feature makes the PE42742 ideal for set-top box and VCR applications. The PE42742 supports signal flow from RFC to RF1 and RF2 termination in the unpowered state; similar to the powered state with C1=C2 (both high or low).

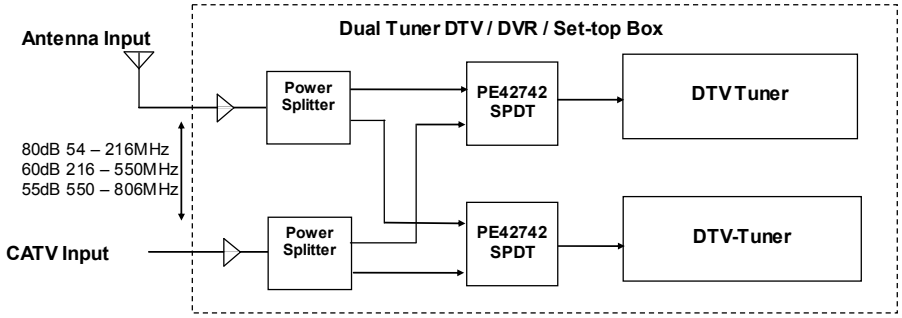
### Figure 4. Typical Application (1 of 4)



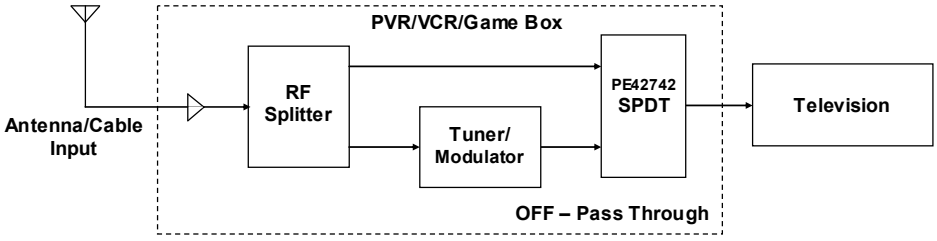

### Figure 5. Typical Application (2 of 4)




### Figure 6. Typical Application (3 of 4)




### Figure 7. Typical Application (4 of 4)

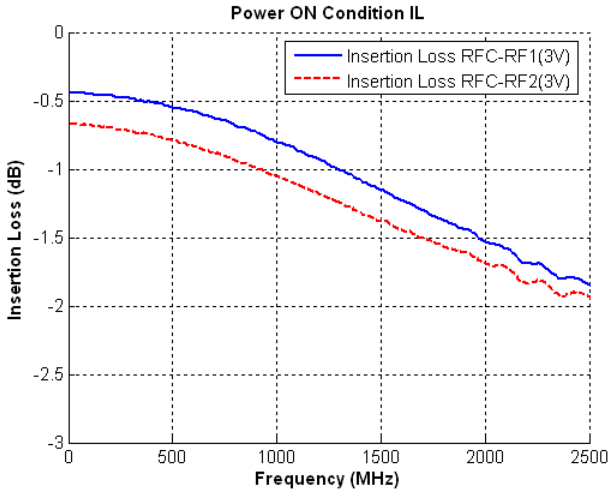



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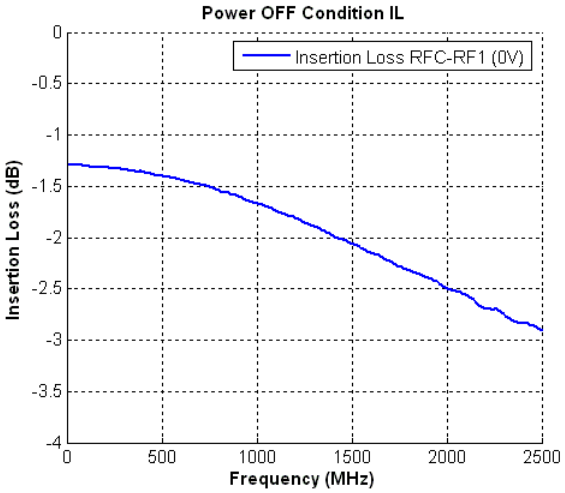

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## Typical Performance Data @ 25°C, 75 Ω

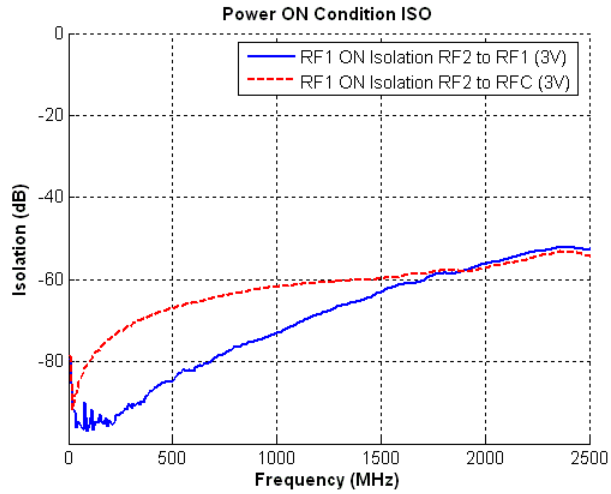
### Figure 8. Insertion Loss – Power On



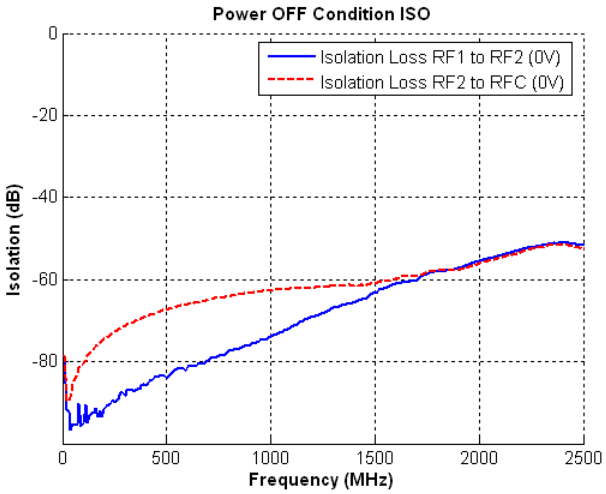

### Figure 9. Insertion Loss – Power Off




### Figure 10. Isolation - Power On




### Figure 11. Isolation - Power Off



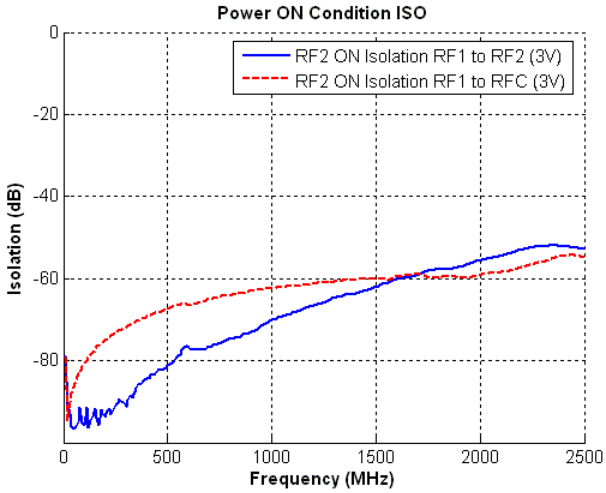


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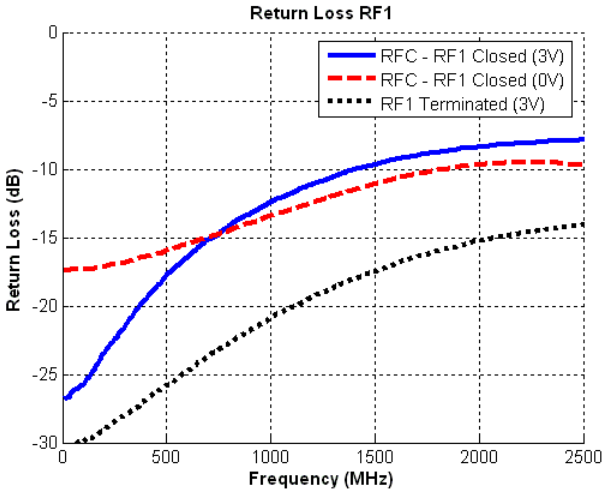
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## Typical Performance Data @ 25°C, 75 Ω

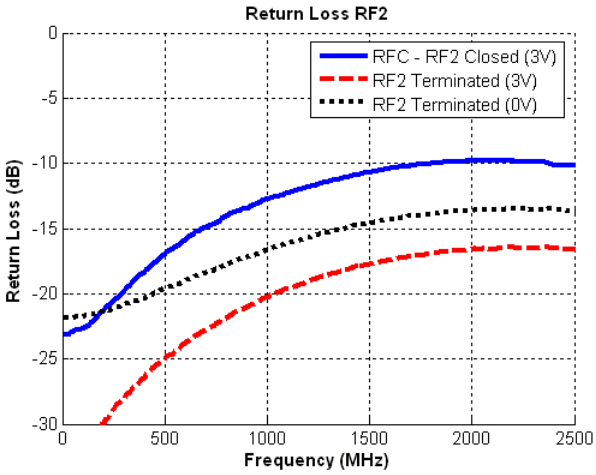
### Figure 12. Isolation: RF2 – Power On



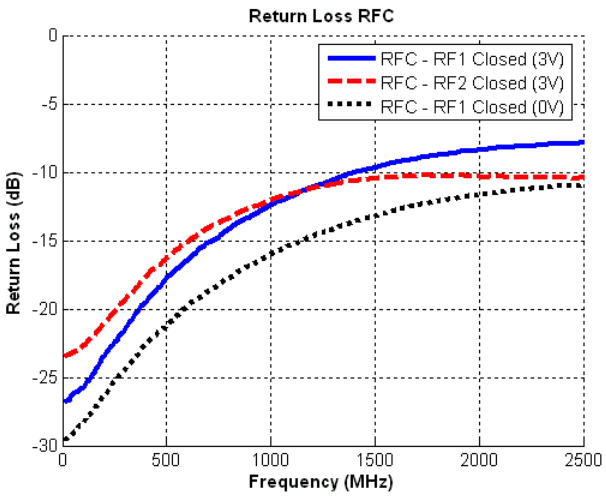

### Figure 13. Return Loss: RF1




### Figure 14. Return Loss: RF2




### Figure 15. Return Loss: RFC




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## Typical Performance Data @ 25°C, 75 Ω

**Figure 16. Input IP3: RFC-RF1/RF2**

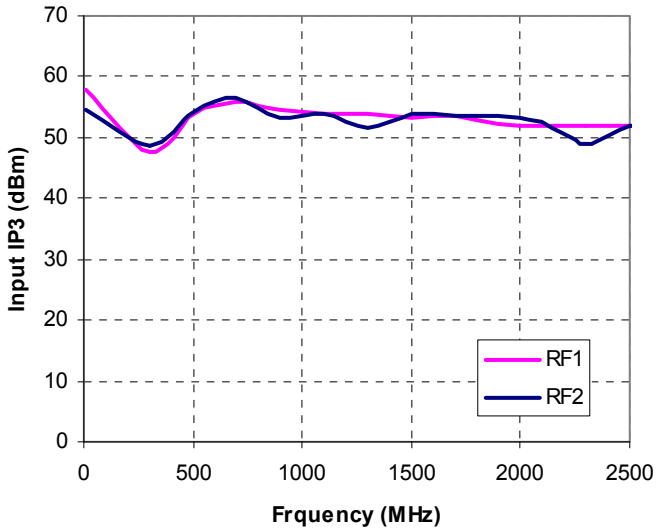
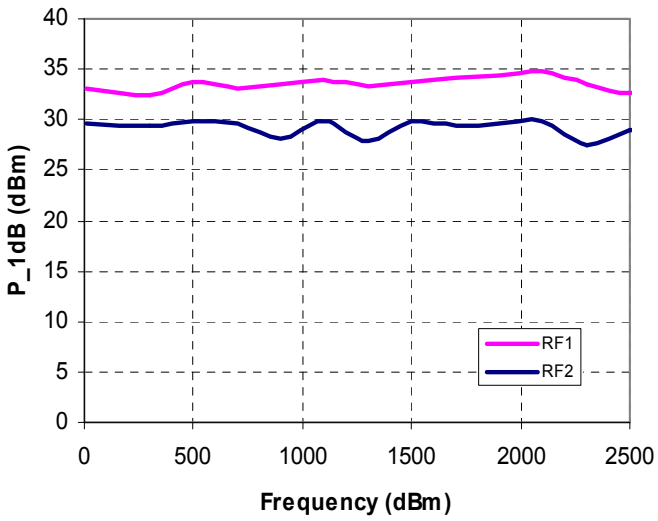



**Figure 17. P_1dB Compression: RFC-RF1/RF2**





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## Evaluation Kit

The SPDT Switch Evaluation Kit facilitates customer evaluation of the PE42742 SPDT switch. The RF common port is connected through a 75 Ω transmission line to J2. Ports 1 and 2 are connected through 75 Ω transmission lines to J1 and J3. A through line connects F connectors J4 and J5. This transmission line can be used to estimate the PCB loss over the environmental conditions. J6 provides DC and digital inputs to the device.

The board is composed of a two metal layer FR4 material with a total thickness of 0.032". The transmission lines are hybrid microstrip/coplanar waveguide with ground plane (28 mil core, 12 mil width, 12 mil gap).

The provided jumpers short the control pins to ground for logic low. With the jumper removed the control input rises to $V_{DD}$ for logic high through the 1 MΩ pull up resistor. These resistors will draw several microamps from $V_{DD}$. They are not required for normal operation.

**Figure 18. Evaluation Board Layouts**

Peregrine Specification 101/0269

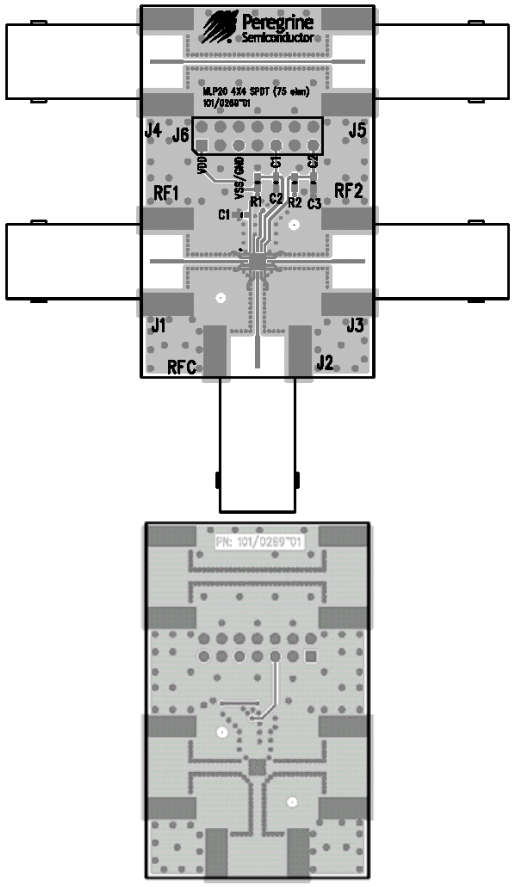
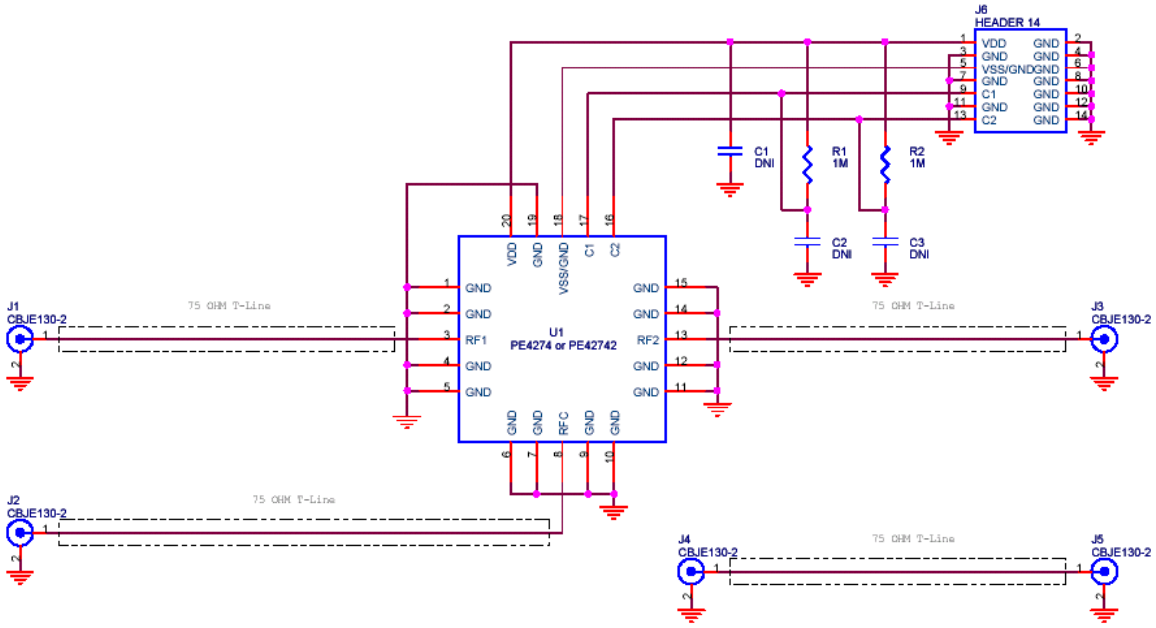



**Figure 19. Evaluation Board Schematic**

Peregrine Specification 102/0352

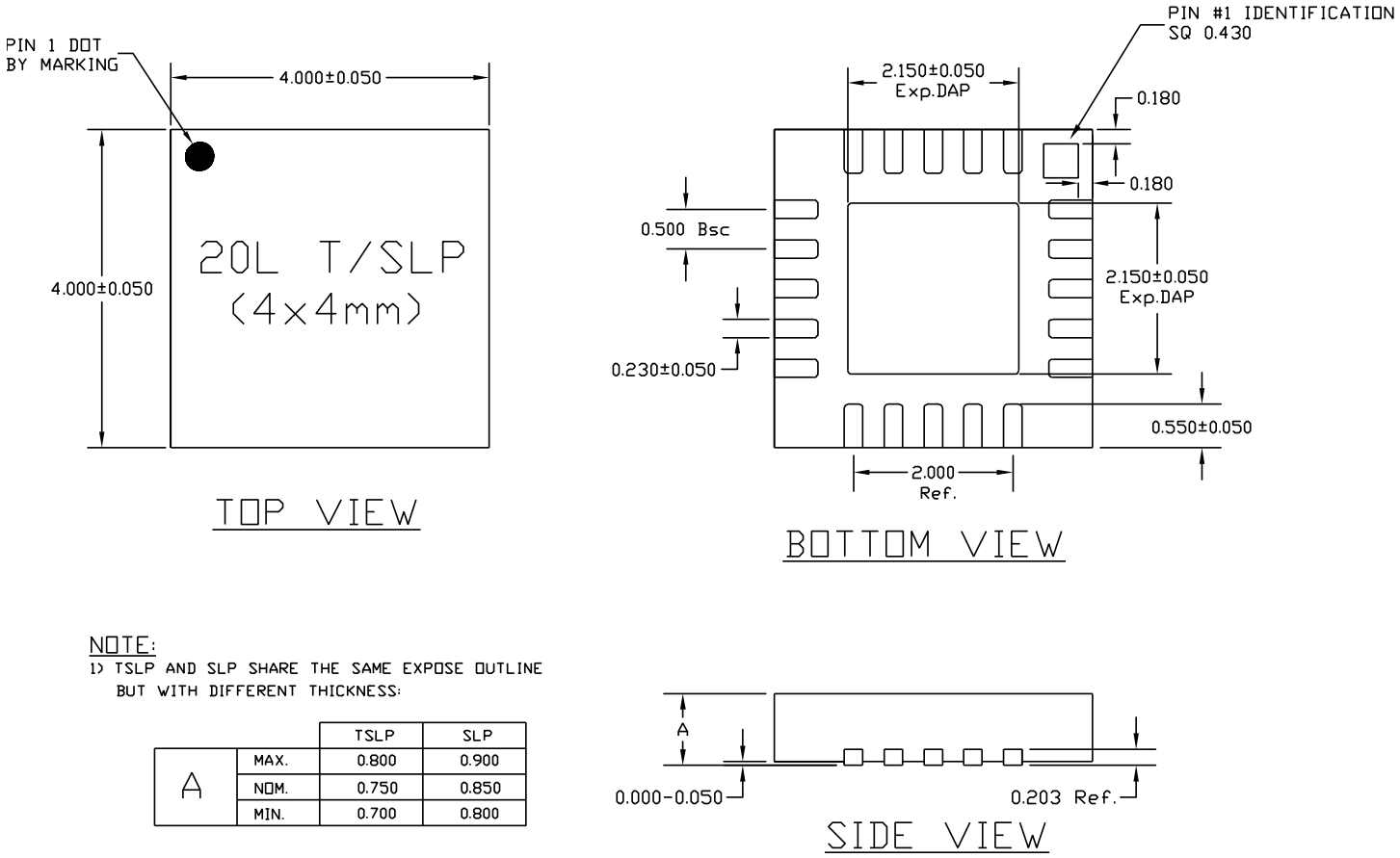



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## Figure 20. Package Drawing

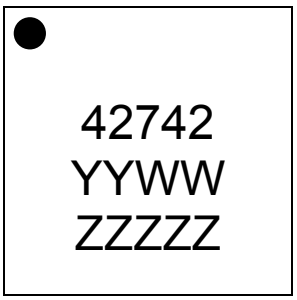
**4x4 mm 20-lead QFN, BOM 19/0106**




| | | TSLP | SLP |
|---|---|---|---|
| A | MAX. | 0.800 | 0.900 |
| | NOM. | 0.750 | 0.850 |
| | MIN. | 0.700 | 0.800 |

Note: PE42742 uses the SLP dimensions.

## Figure 21. Marking Specification

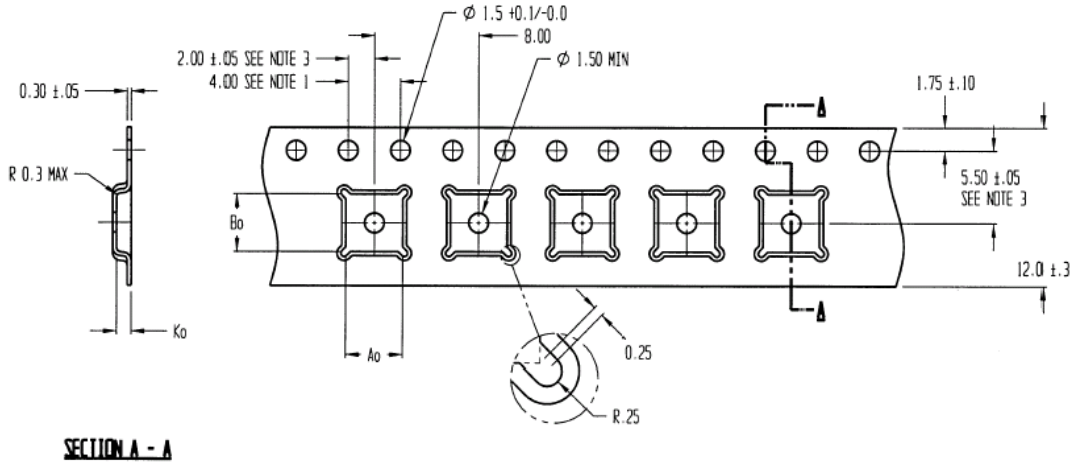



YYWW = Date Code (Year, Work Week)
ZZZZZ = Last five digits of PSC Lot Number


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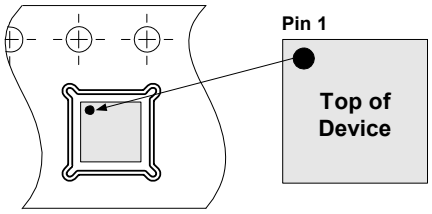
## Figure 22. Tape and Reel Drawing




Tape Feed Direction

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

$A_0$ = 4.35
$B_0$ = 4.35
$K_0$ = 1.1




Device Orientation in Tape

## Table 7. Ordering Information

| Order Code | Part Marking | Description | Package | Shipping Method |
|---|---|---|---|---|
| PE42742MLIBB | 42742 | PE42742G-20 QFN 4x4mm-cut off tape and reel | Green 20-lead 4x4mm QFN | Cut tape or loose |
| PE42742MLIBB-Z | 42742 | PE42742G-20 QFN 4x4mm-3000C | Green 20-lead 4x4mm QFN | 3000 units / T&R |
| EK42742-03 | PE42742-EK | PE42742-20 QFN 4x4mm-EK | Evaluation Kit | 1 / Box |

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