PE42742

Document category: Product Specification

UltraCMOS® SPDT CATV Switch, 5–2200 MHz

Features

- Meets FCC 15.115 specification of 80 dB isolation @ 216 MHz
- Unpowered operational state
- 3500 V HBM ESD tolerance, all pins
- CTB performance: 90 dBC
- High isolation: 63 dB @ 1000 MHz
- Low insertion loss: 0.5 dB @ 5 MHz and 0.8 dB @ 1000 MHz, typical
- CMOS single-pin control with logic select
- Single +3V supply operation
- Low current consumption: 8 µA
- Packaging: 20-lead 4 × 4 mm QFN

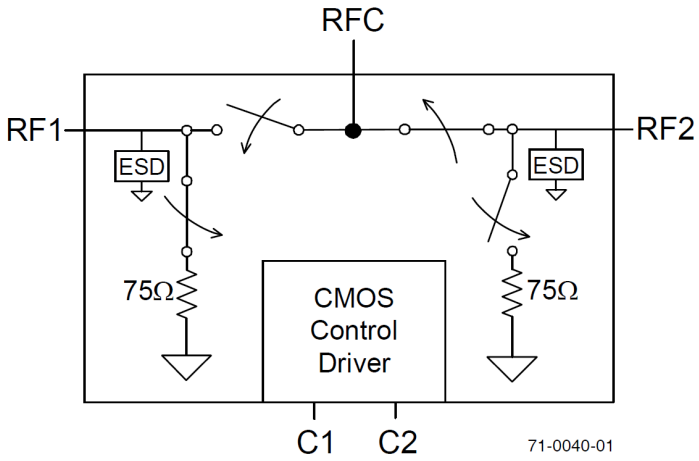

Figure 1. PE42742 functional diagram

Product description

The PE42742 is an SPDT UltraCMOS® switch designed for broadband applications, such as CATV, DTV, multi-tuner digital video recorder (DVR), set-top box, PCTV, and game boxes. It meets the FCC 15.115 specification 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 2200 MHz with a single positive supply and CMOS control. It provides a smaller, cost effective, more reliable, and more manufacturable alternative to the mechanical relays in set-top box applications.

The PE42742 is manufactured using the pSemi 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 listed in Table 1.

Latch-up immunity

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

Table 1. PE42742 absolute maximum ratings

Parameter or condition	Symbol	Min	Max	Unit
Power supply voltage	V_{DD}	-0.3	4.0	V
Voltage on any DC input	V_I	-0.3	VDD + 0.3	V
RF power on RFC, RF1, and RF2 terminated	P_{RF}	–	24	dBm
RF power on RFC, RF1, and RF2 through		–	33	dBm
Storage temperature	T_{ST}	-65	+150	°C
Operating temperature	T_{OP}	-40	+85	°C
HBM ESD voltage RF pins(1)	V_{ESD}	–	3500	V
HBM ESD voltage digital pins(1)		–	3500	
MM ESD voltage all pins(2)		–	150	

1. MIL-STD 883 Method 3015.7.
2. JEDEC JESD22-A114-B.

Recommended operating conditions

Table 2 lists the PE42742 recommended operating conditions. Do not operate devices outside the operating conditions listed below.

Table 2. PE42742 operating conditions at 25 °C

Parameter	Symbol	Min	Typ	Max	Unit
Power supply voltage	V_{DD}	2.7	3.0	3.3	V
Power supply current (V_{DD} = 3V, V_{CNTL} = 3V)	I_{DD}	–	8	–	µA
Control voltage high	–	$0.7 \times V_{DD}$	–	V_{DD}	V
Control voltage low	–	0	–	$0.3 \times V_{DD}$	V

Electrical specifications

Table 3 lists the PE42742 key electrical specifications at +25 °C and V_{DD} = 3V (Z_S = Z_L = 75Ω), unless otherwise specified.

Table 3. PE42742 electrical specifications

Parameter	Condition	Min	Typ	Max	Unit
Operating frequency(1)	–	5	–	2200	MHz
RF1–RFC insertion loss	220 MHz 550 MHz 810 MHz 1000 MHz 2200 MHz	–	0.45 0.55 0.7 0.75 1.7	0.55 0.65 0.8 0.85 1.8	dB
RF2–RFC insertion loss	220 MHz 550 MHz 810 MHz 1000 MHz 2200 MHz	–	0.7 0.8 0.9 1.0 1.8	0.8 0.9 1 1.1 1.9	dB
Isolation RF1 to RF2 (RFC–RF1 ON)	220 MHz 550 MHz 810 MHz 2200 MHz	81 77 71.5 50	94 82 76 53.6	–	dB
Isolation RF1 to RF2 (RFC–RF2 ON)	220 MHz 550 MHz 810 MHz 2200 MHz	81 75 70.5 50	92 79 75 53	–	dB
Isolation RF1 to RFC (RFC–RF2 ON)	220 MHz 550 MHz 810 MHz 2200 MHz	71 64 62 52	74 66 64 57	–	dB
Isolation RF2 to RFC (RFC–RF1 ON)	220 MHz 550 MHz 810 MHz 2200 MHz	70.5 64 61.5 51	73 66 63 55	–	dB
IIP2 RF1(2)	5 MHz–1000 MHz	–	90	–	dBm
IIP2 RF2(2)		–	90	–	
IIP3 RF1(2)	5 MHz–1000 MHz	–	53	–	dBm
IIP3 RF2(2)		–	53	–	
Input 1 dB compression point RF1(2)	1000 MHz	30	32	–	dBm
Input 1 dB compression point RF2(2)		24.5	26.5	–	
CTS/CSO, powered	77 and 110 channels, power out = 44 dBmV	–	-90	–	dBc

Parameter	Condition	Min	Typ	Max	Unit
CTS/CSO, unpowered		–	-77	–	
Switching time[3]	50% CTRL to 10% or 90% of RF	–	3	–	µs
Video feedthrough[4]	5 MHz–1000 MHz	–	20	–	mV_{PP}

1. Device linearity begins to degrade with input signals below 5 MHz.
2. Measured in a 50Ω system.
3. The PE42742 has a maximum 25 kHz switching rate.
4. Measured with a 1 ns risetime, a 0V/3V pulse, and a 500 MHz bandwidth.

Electrical characteristics for unpowered operation

Table 4. PE42742 electrical characteristics for unpowered operation[1]

Parameter	Condition	Min	Typ	Max	Unit
Operating frequency[2]	–	5	–	2200	MHz
Isolation RF1 to RF2[3]	220 MHz 550 MHz 810 MHz 2200 MHz	81 77 70.5 49	90.5 81.5 77 52.5	–	dB

1. For the RFC–RF1 power-off insertion loss, see Figure 3.
2. Device linearity begins to degrade with input signals below 5 MHz.
3. Minimum per the FCC 15.115 specification.

SPDT control logic

pSemi established versatile logic Table 5 to allow C1 or C2 to act as a single pin control in either polarity.

Table 5. PE42742 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

Typical performance data

Figure 2–Figure 11 show the typical performance data at +25 °C and 75Ω, unless otherwise specified.

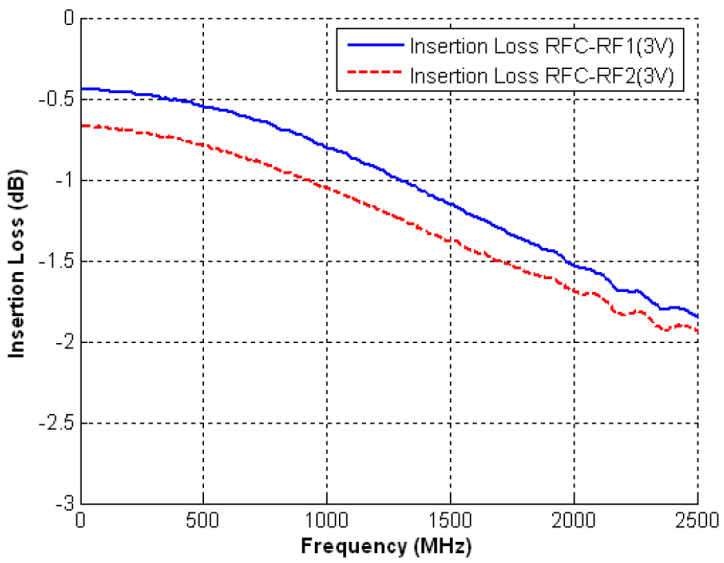


Figure 2. Insertion loss with power on

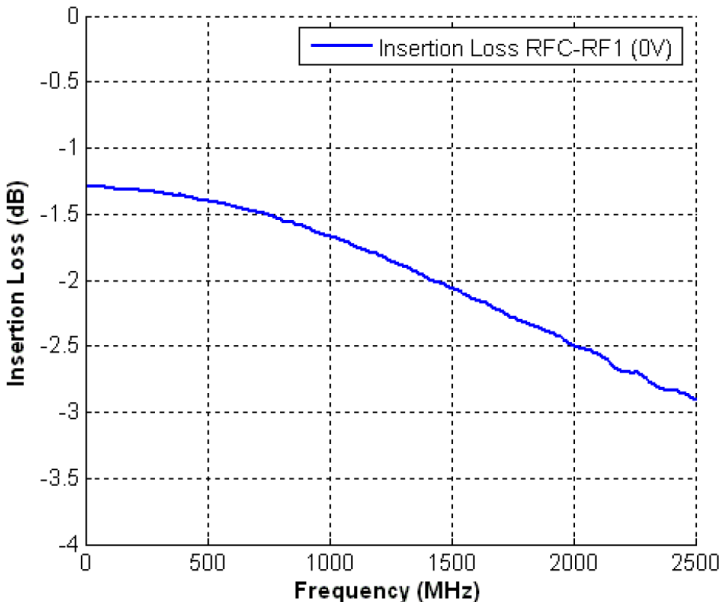


Figure 3. Insertion loss with power off

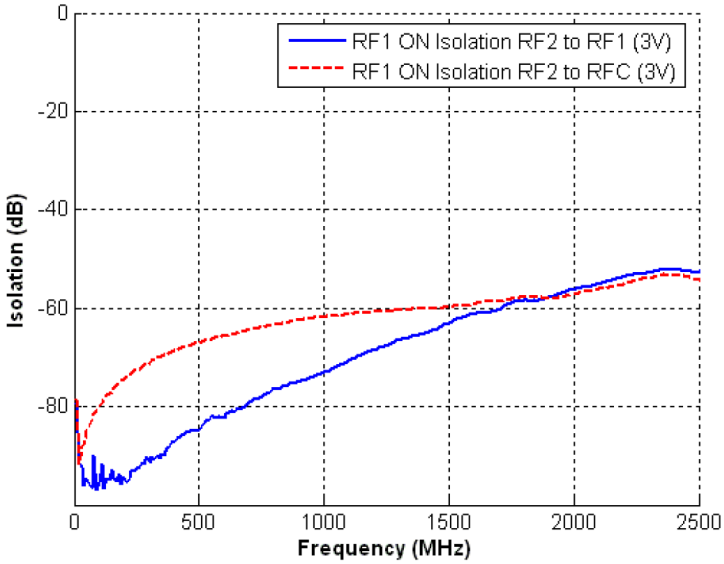


Figure 4. Isolation with power on

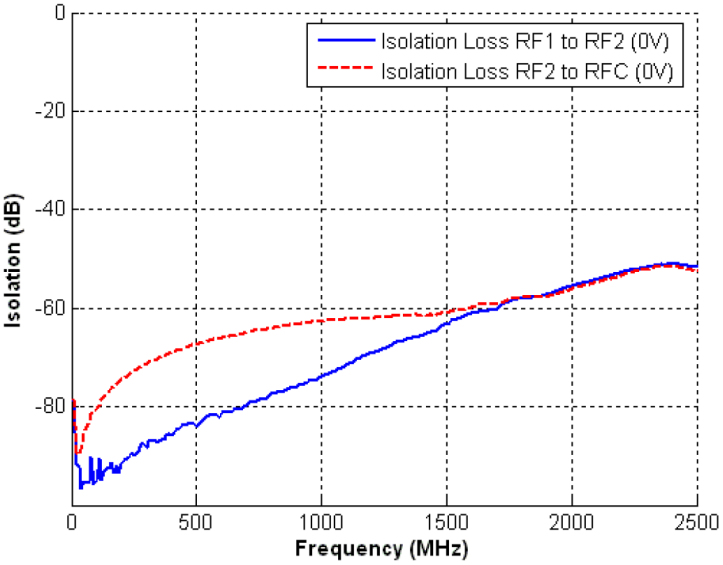


Figure 5. Isolation with power off

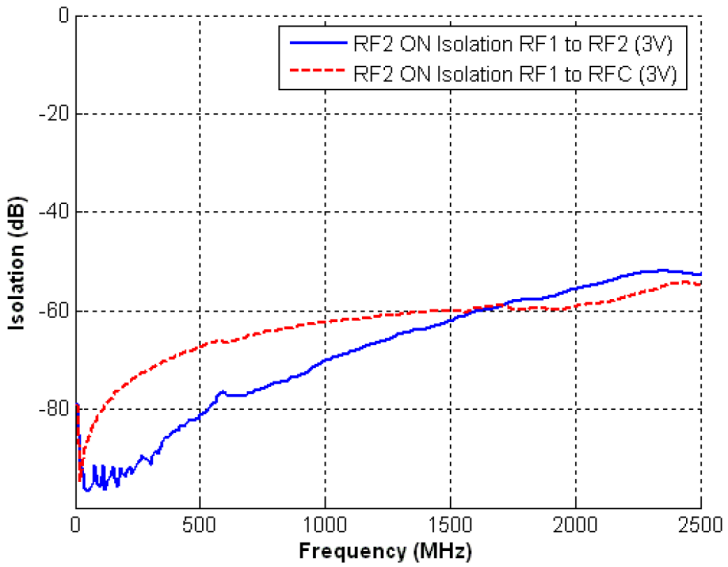


Figure 6. Isolation: RF2 with power on

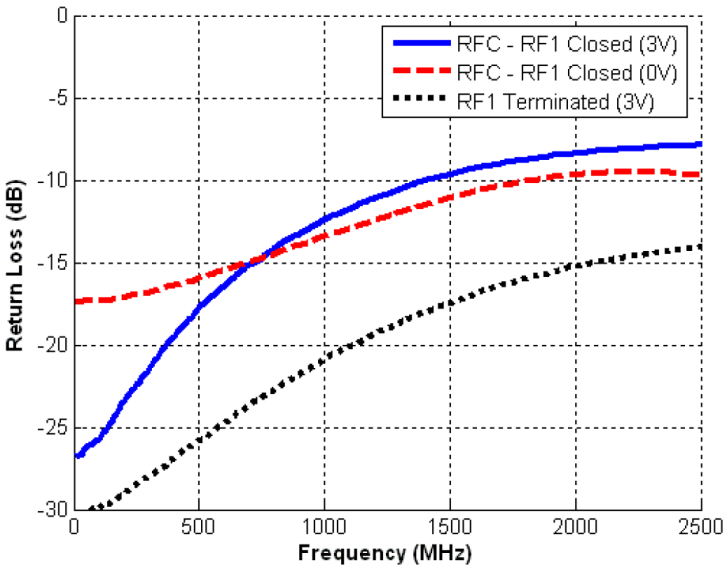


Figure 7. Return loss: RF1

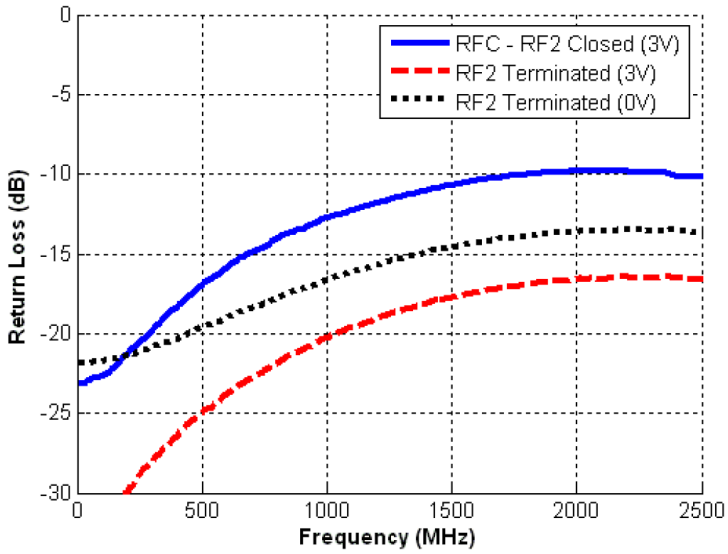


Figure 8. Return loss: RF2

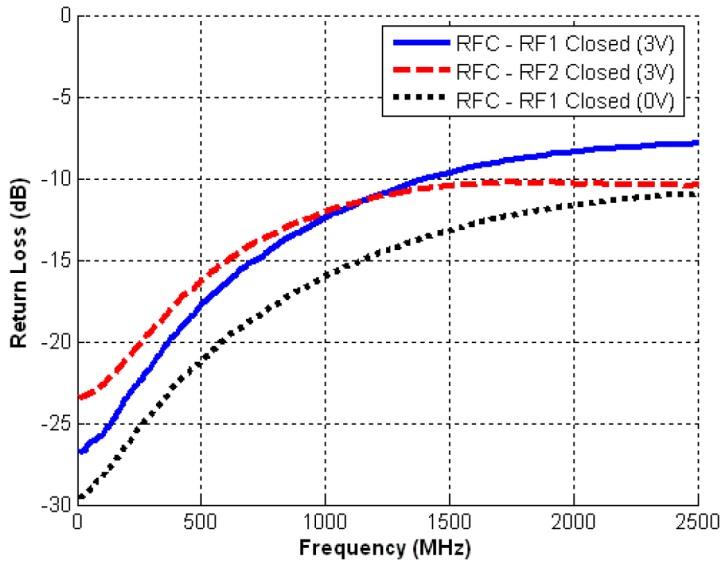


Figure 9. Return loss: RFC

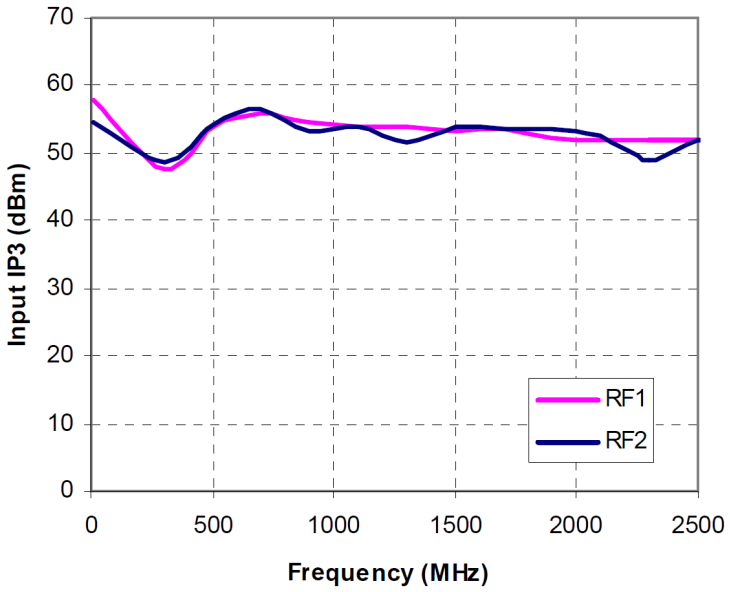


Figure 10. Input IP3: RFC–RF1/RF2

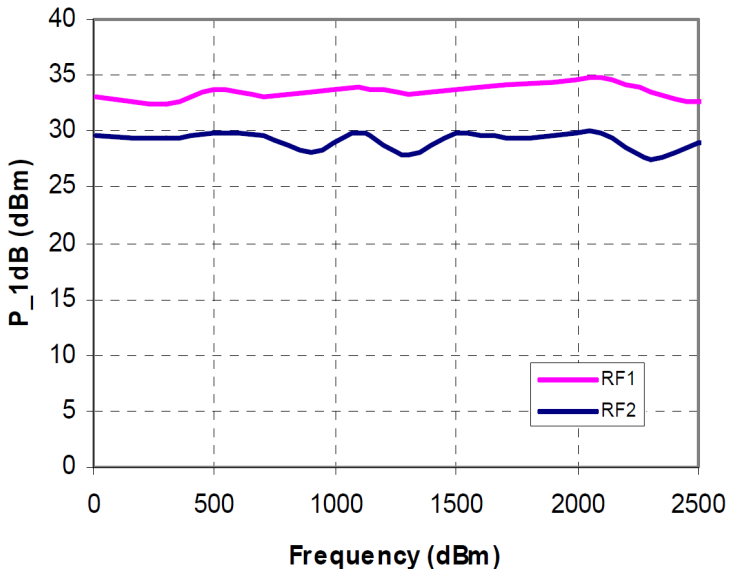


Figure 11. P1dB compression: RFC–RF1/RF2

Evaluation kit

pSemi designed the SPDT evaluation kit to ease your evaluation of the PE42742. The RF common port connects through a 75Ω transmission line to J2. Ports 1 and 2 connect through 75Ω transmission lines to J1 and J3, respectively. A through line connects F connectors J4 and J5. You can use this transmission line to evaluate the PCB loss over environmental conditions. J6 provides DC and digital inputs to the device.

The board consists of 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 jumper short the control pins to ground for logic low. With the jumper removed, the output rises to V_{DD} for logic high through the 1 MΩ pull-up resistor. These resistors draw several microamps from V_{DD} and are not required for normal operation.

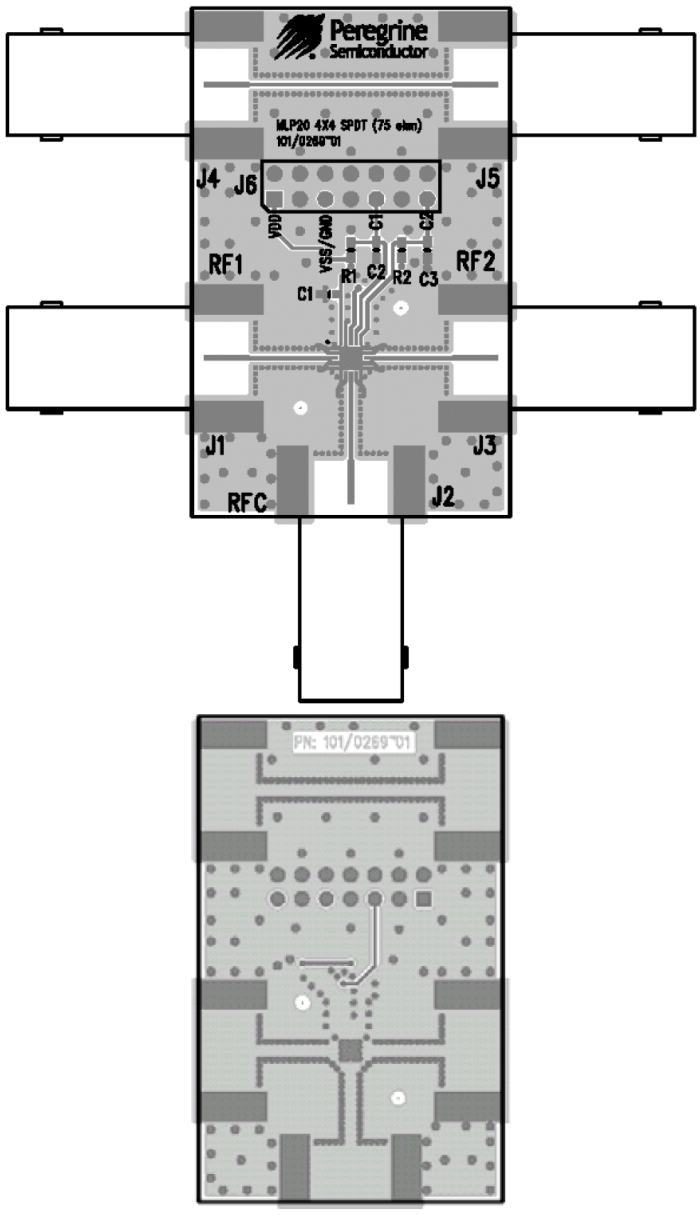


Figure 12. Evaluation board layouts

Evaluation board schematic

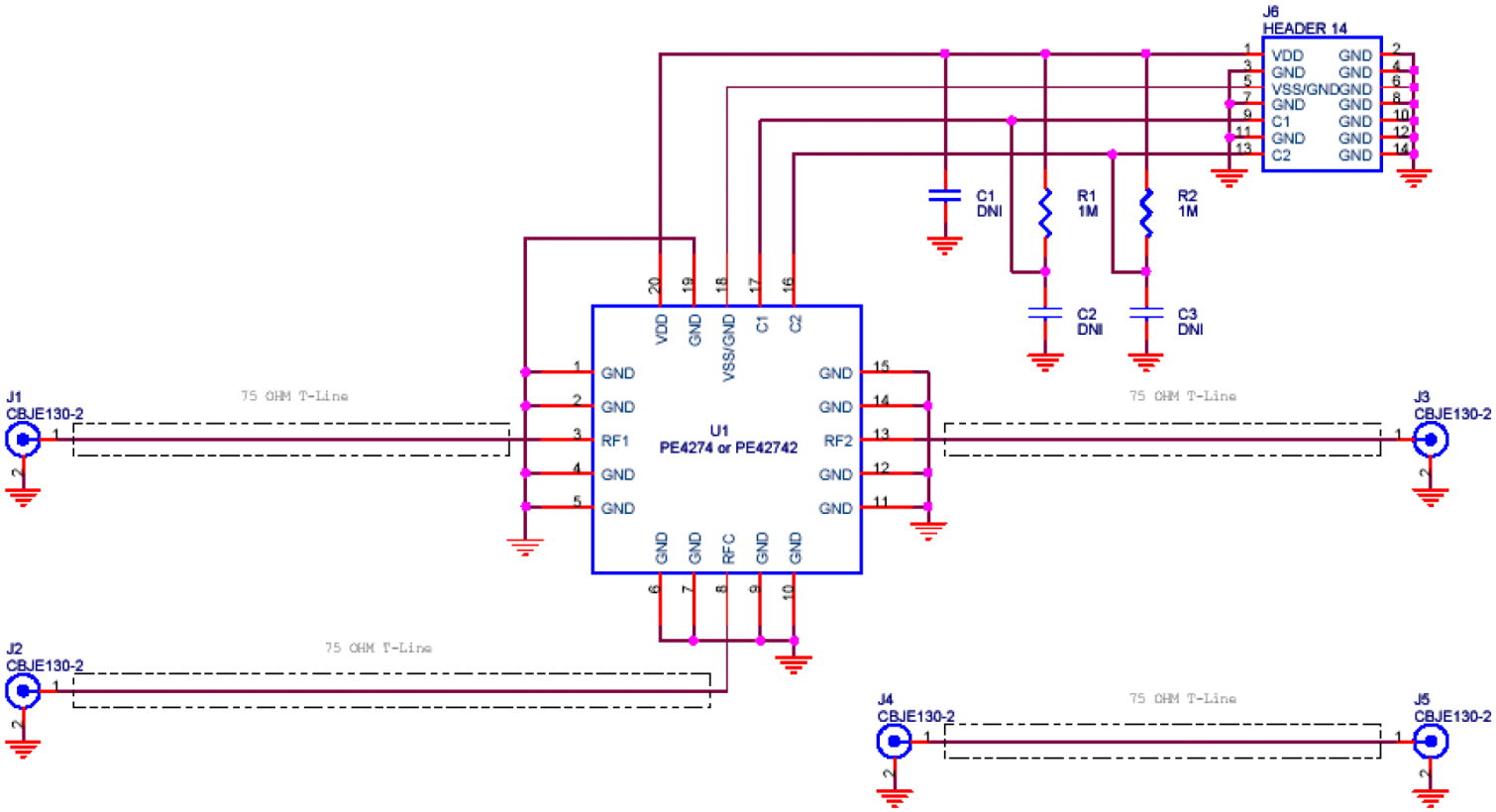


Figure 13. Evaluation board schematic

Typical applications

The PE42742 provides the high isolation required by the FCC part 15.114 regulation between the television antenna and the cable plant. The advantage of the PE42742 is that the device isolation/through 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 the RF1 and RF2 terminations in the unpowered state, like the powered state with C1 = C2 (both high and low).

Figure 14–Figure 17 show typical PE42742 applications.

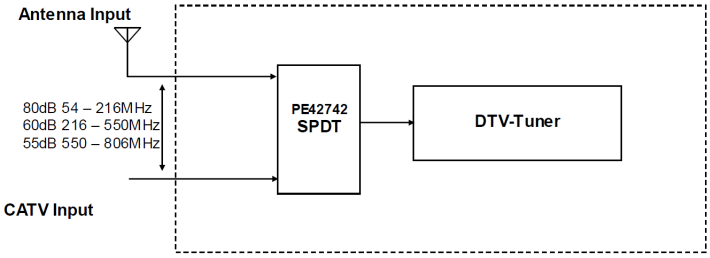


Figure 14. Typical application 1

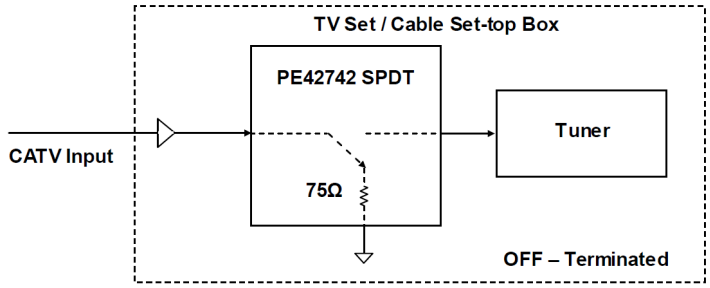


Figure 15. Typical application 2

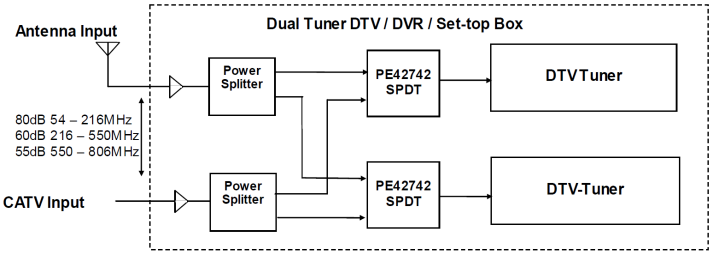


Figure 16. Typical application 3

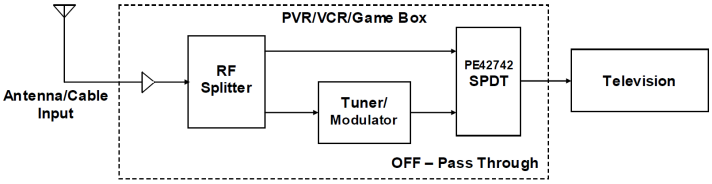


Figure 17. Typical application 4

Pin information

Figure 18 shows the PE42742 pin map for the 20-lead 4 × 4 mm QFN package, and Table 7 lists the description for each pin.

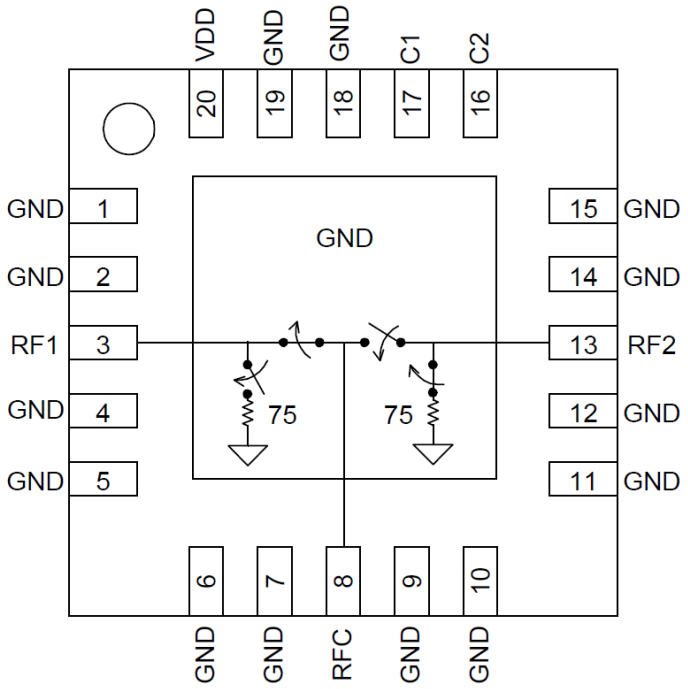


Figure 18. Pin configuration (top view)

Table 7. PE42742 pin descriptions

Pin no.	Pin name	Description
1, 2, 4–7, 9–12, 14, 15, 18, 19	GND	RF ground
3[1]	RF1	RF I/O
8[1]	RFC	RF common
13[1]	RF2	RF I/O
16[2]	C2	Control 2, or logic select
17[2]	C1	Control 1, or logic select
20	VDD	Voltage supply
Pad	GND	RF ground pad

1. RF pins 3, 8, and 13 must be at 0 VDC. These RF pins do not require DC blocking capacitors for proper operation if the 0 VDC requirement is met.
2. Pins 16 and 17 can be set for single pin or complementary pin control

Packaging information

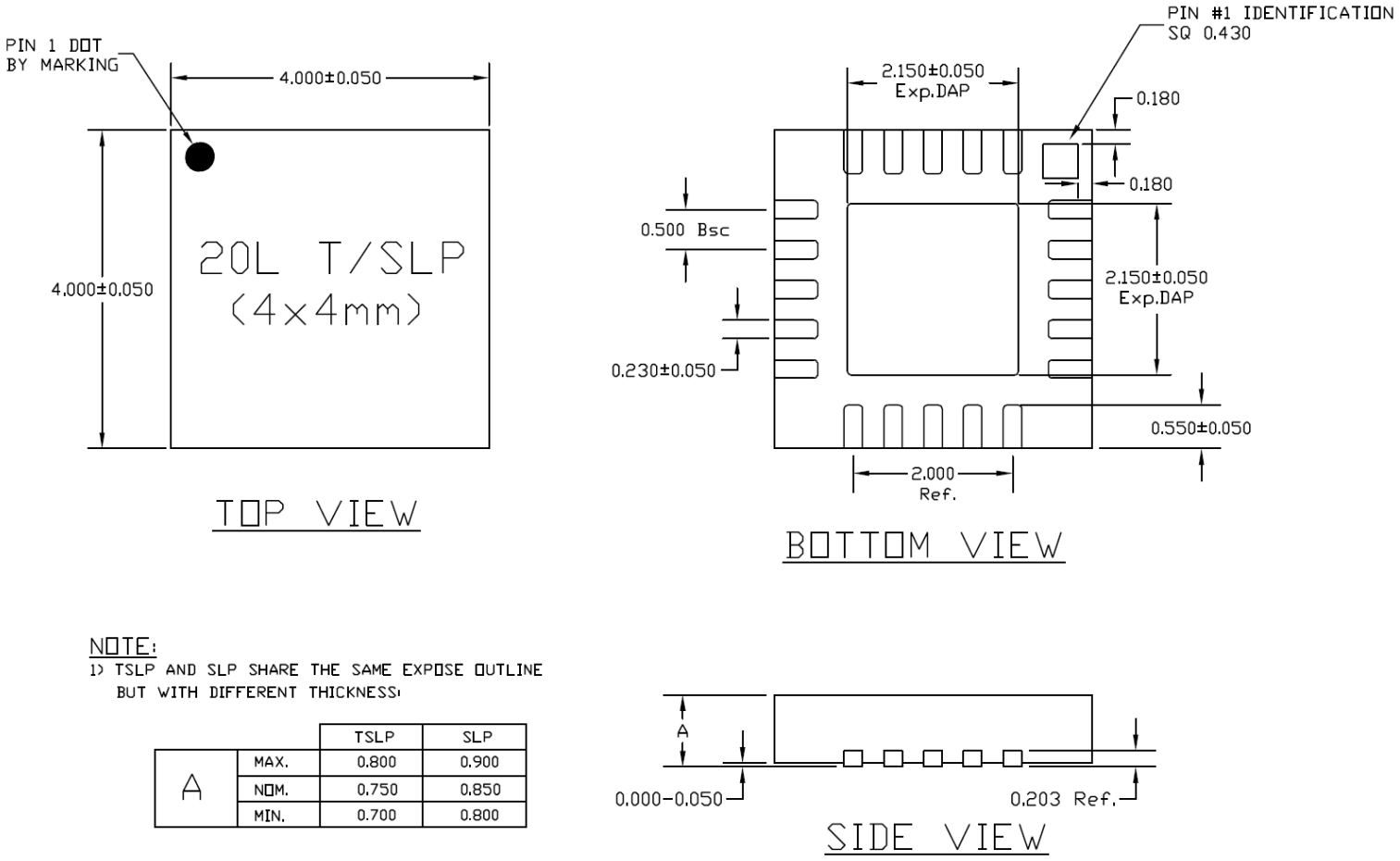
This section provides the following packaging data:

- Moisture sensitivity level
- Package drawing
- Package marking
- Tape-and-reel information

Moisture sensitivity level

The PE42742 moisture sensitivity level rating for the 20-lead 4 × 4 mm QFN package is MSL1.

Package drawing

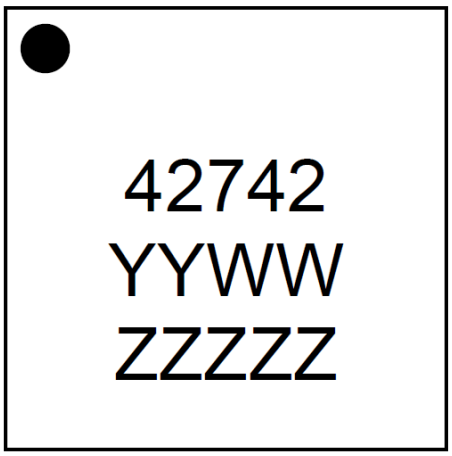


		TSLP	SLP
A	MAX.	0.800	0.900
	NOM.	0.750	0.850
	MIN.	0.700	0.800

Note: PE42742 uses the SLP dimensions.

Figure 19. Package mechanical drawing for the 20-lead 4 × 4 mm QFN package

Top-marking specification



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

Figure 20. PE42742 package marking specification

Tape and reel specification

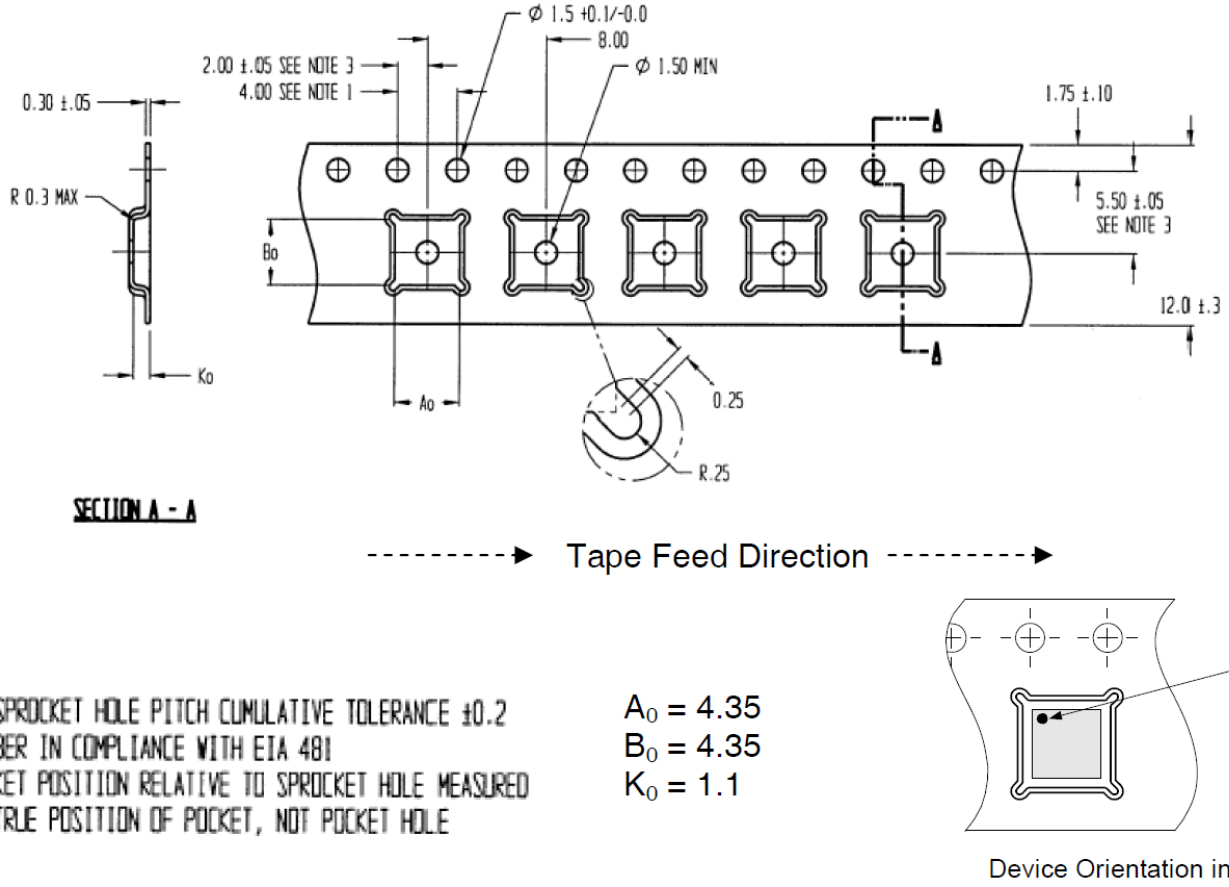


Figure 21. Tape and reel specification for the 20-lead 4 × 4 mm QFN package

- The diagram is not drawn to scale.
- The units are in millimeters (mm).
- The maximum cavity angle is five degrees.
- The bumped die are oriented active side down.

Ordering information

Order code	Description	Packaging	Shipping method
PE42742MLIBB	PE42742 SPDT RF switch	Green 20-lead 4 × 4 mm QFN	Cut tape or loose
PE42742MLIBB-Z	PE42742 SPDT RF switch	Green 20-lead 4 × 4 mm QFN	3000 units/T&R
EK42742-03	PE42742 evaluation kit	Evaluation kit	1/box

Document categories

Advance Information	The product is in a formative or design stage. The data sheet contains design target specifications for product development. Specifications and features may change in any manner without notice.
Preliminary Specification	The data sheet contains preliminary data. Additional data may be added at a later date. pSemi reserves the right to change specifications at any time without notice to supply the best possible product.
Product Specification	The data sheet contains final data. In the event that pSemi decides to change the specifications, pSemi will notify customers of the intended changes by issuing a Customer Notification Form (CNF).
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