PE42750

Document category: Product Specification

UltraCMOS® SPDT CATV Switch, 5–2200 MHz

Features

- Meets FCC 15.115 isolation specification
- All ports terminated when unpowered
- 2000V HBM ESD tolerance, all ports
- High isolation: 63 dB at 1000 MHz
- Low insertion loss, typical:
  - 0.7 dB at 5 MHz
  - 1.0 dB at 1000 MHz
- CMOS single-pin control with logic select
- Single +3V supply operation
- Low current consumption: 8 µA
- Absorptive switch design
- Packaging: 12-lead 3 × 3 × 0.75 mm QFN

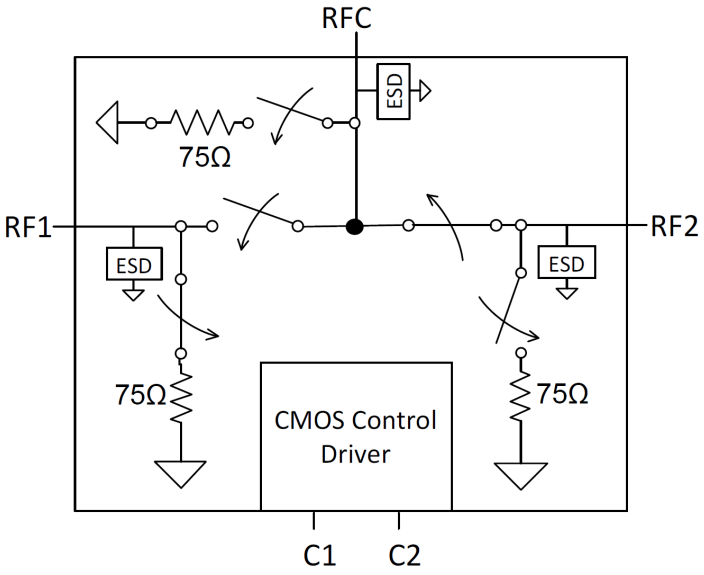

Figure 1. PE42750 functional diagram

Product description

The PE42750 is an UltraCMOS® SPDT switch designed for broadband applications, such as CATV, DTV, multi-tuner digital video recorder (DVR), set-top box, PCTV, and video game consoles. The PE42750 meets the FCC 15.115 specification of 80 dB isolation at 216 MHz in both powered and unpowered states. The PE42750 covers a broad frequency range from 5 MHz to 2200 MHz with a single positive supply and CMOS control. The PE42750 provides a smaller, cost effective, more reliable, and manufacturable alternative to mechanical relays in set-top box applications.

The PE42750 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. PE42750 absolute maximum ratings

Parameter or condition	Symbol	Min	Max	Unit
Supply voltage	V_{DD}	-0.3	–	V
Voltage on CTRL input	V_I	-0.3	VDD + 0.3	V
RF power on RFC, RF1, RF2, terminated	P_{RF}	–	23	dBm
RF power on RFC, RF1, RF2, through 75Ω		–	26	
Storage temperature	T_{ST}	-55	+150	°C
ESD voltage, HBM(1)	V_{ESD}	–	2000	V
ESD voltage, MM, all pins(2)		–	150	
ESD voltage, CDM(3)		–	1000	

1. Human body model (MIL-STD 883, Method 3015.7).
2. Machine model (JEDEC JESD22-A115-A).
3. Charged device model (JEDEC JESD22-C101D).

Recommended operating conditions

Table 2 lists the PE42750 recommended operating conditions. Do not operate devices outside the operating conditions listed below.

Table 2. PE42750 operating conditions

Parameter	Symbol	Min	Typ	Max	Unit
Supply voltage	V_{DD}	2.7	3.0	3.63	V
Supply surrent (V_{DD} = 3V, V_{CNTL} = 3V)	I_{DD}	–	8	–	µA
Control voltage high	–	0.7 × V_{DD}	–	V_{DD}	V
Control voltage low	–	0	–	0.3 × V_{DD}	V
RF power on RFC, RF1, RF2, terminated	P_{RF}	–	–	23	dBm
RF power on RFC, RF1, RF2, through 75Ω		–	–	26	
Operating temperature	T_{OP}	-40	–	+85	°C

Electrical specifications

Table 3 lists the PE42750 key electrical specifications at +25 °C and V_{DD} = 3V (Z_S = Z_L = 75Ω), unless otherwise specified.

Table 3. PE42750 electrical specifications

Parameter	Condition	Min	Typ	Max	Unit
Operating frequency	–	5	–	2200	MHz
Input loss, RFx–RFC	5–220 MHz 221–550 MHz 551–810 MHz 811–870 MHz 871–2200 MHz	–	0.7 0.8 0.9 0.9 1.7	0.8 0.9 1.0 1.0 1.8	dB
Isolation, RFx–RFx[1]	5–220 MHz 221–550 MHz 551–810 MHz 811–870 MHz 871–2200 MHz	80 70 65 65 50	84 76 72 71 57	–	dB
Isolation, RFx–RFC	5–220 MHz 221–550 MHz 551–810 MHz 811–870 MHz 871–2200 MHz	74 67 65 65 51	80 72 70 70 55	–	dB
Return loss, RFx–RFC	5–220 MHz 221–550 MHz 551–810 MHz 811–870 MHz 871–2200 MHz	–	23 20 18 17 10	–	dB
IIP2, RFx[2]	5–2200 MHz	–	100	–	dBm
IIP3, RFx[2][3]	5–2200 MHz	–	47.5	–	dBm
Input 1 dB compression point, RFx or RFC[2]	1000 MHz	21.5	23.5	–	dBm
Switching time[4][5]	50% CTRL to 10 or 90% RF	–	2	3	µs
Video feedthrough[4]	–	–	2	–	mV_{PP}

1. Minimum per the FCC 15.115 specification.
2. Measured in a 50Ω system.
3. 10 dBm per tone for 1:3 ratio of fundamental to IMD3 products.
4. 0V/3V on control pin, 1 ns rise time.
5. The PE42750 has a maximum 25 kHz switching rate.

Electrical characterization for unpowered operation

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

Parameter	Condition	Min	Typ	Max	Unit
Operating frequency	–	5	–	2200	MHz
Isolation, RF1–RF2	5–220 MHz 221–550 MHz 551–810 MHz 811–870 MHz 871–2200 MHz	83 77 73 73 65	90 83 79 79 72	–	dB

SPDT control logic

Table 5. PE42750 truth table

V_{DD}	C1[1]	C2[1]	RFC–RF1	RFC–RF2
OFF[2]	Low	Low	OFF	OFF
ON	Low	Low	ON	OFF
ON	Low	High	OFF	ON
ON	High	Low	OFF	ON
ON	High	High	ON	OFF

1. pSemi established a versatile logic table to allow C1 or C2 to act as a single-pin control and in either polarity.
2. V_{DD} = OFF represents and all-terminated state.

Typical performance data

Figure 2–Figure 13 show the typical performance data at +25 °C and V_{DD} = 3V, unless otherwise specified.

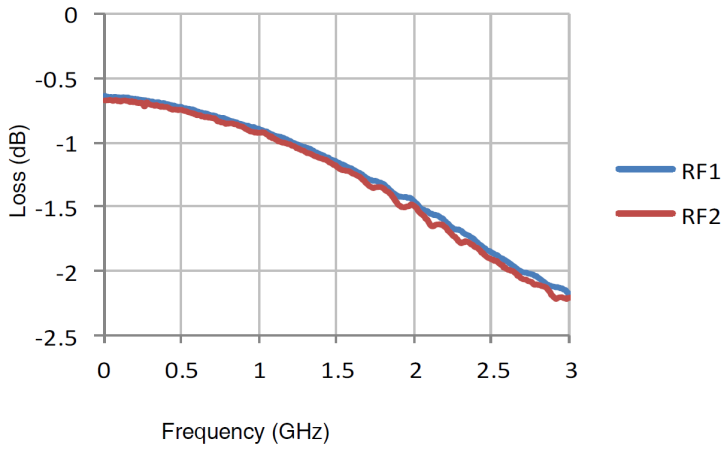


Figure 2. Nominal insertion loss (RFx–RFC)

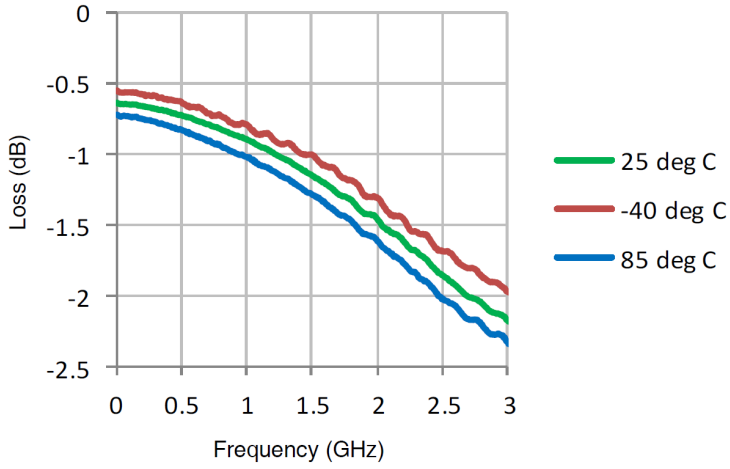


Figure 3. Insertion loss vs. temperature (RFx–RFC)

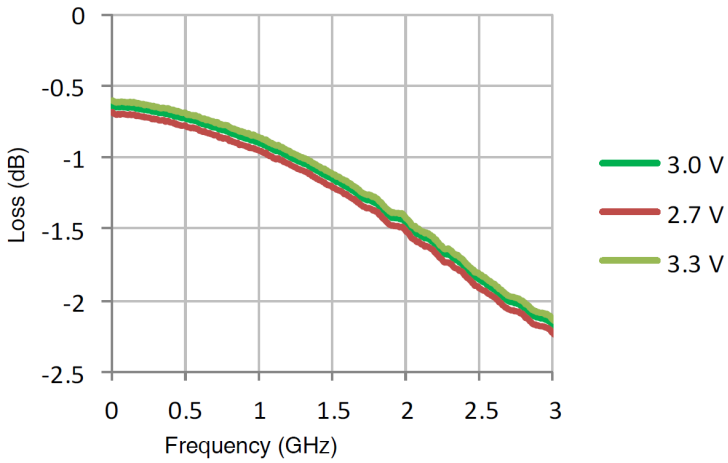


Figure 4. Insertion loss vs. V_{DD} (RFx–RFC)

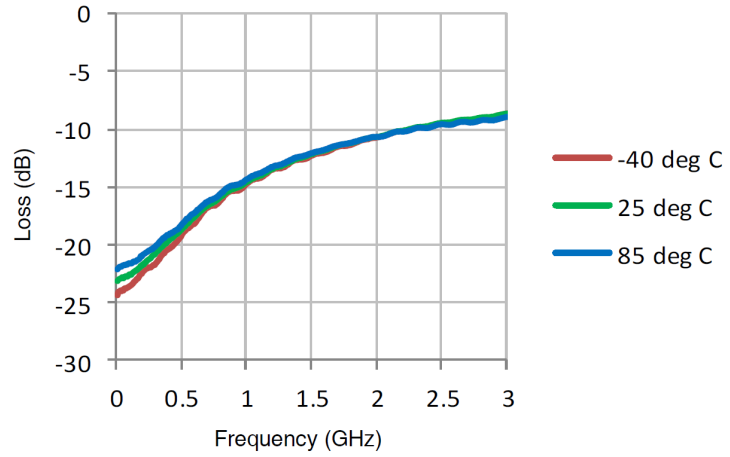


Figure 5. Active port return loss vs. temperature (RFx)

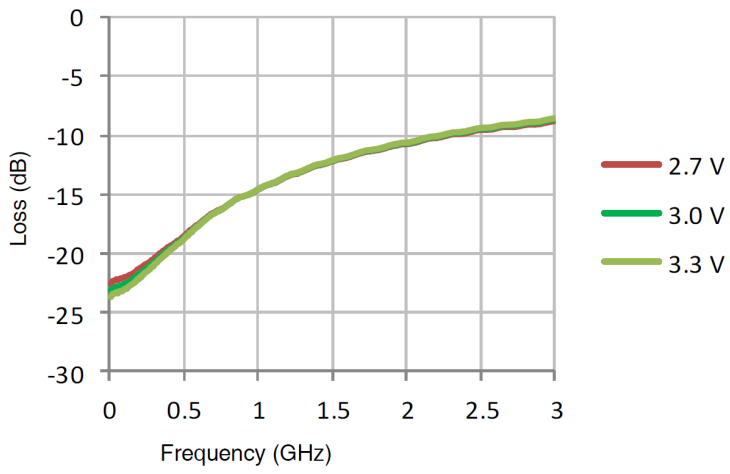


Figure 6. Active port return loss vs. V_{DD} (RFx)

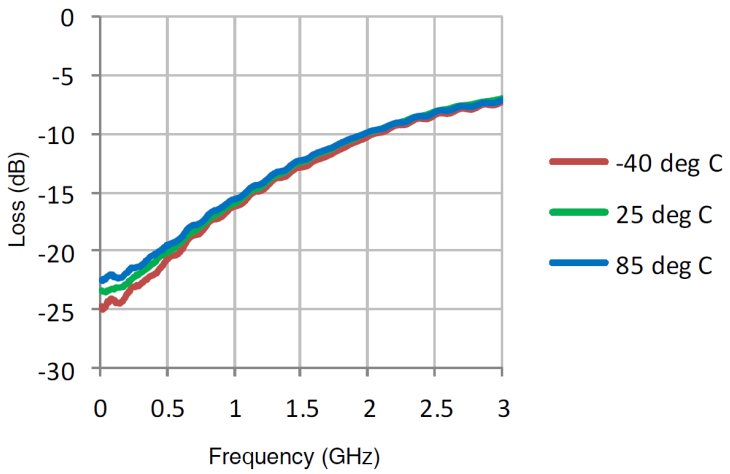


Figure 7. RFC port return loss vs. temperature

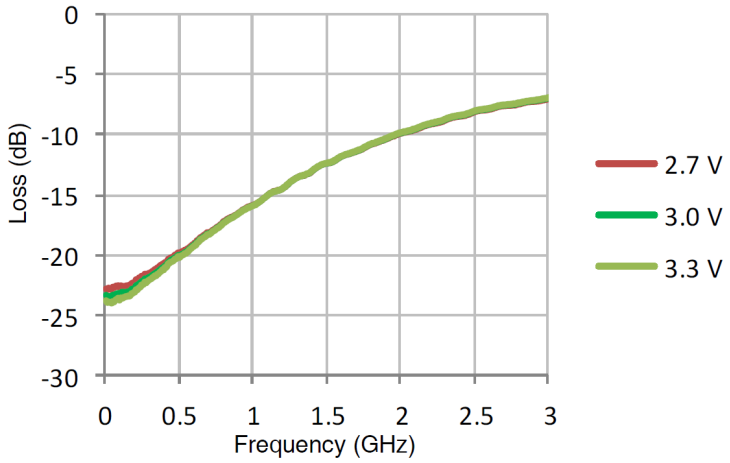


Figure 8. RFC port return loss vs. V_{DD}

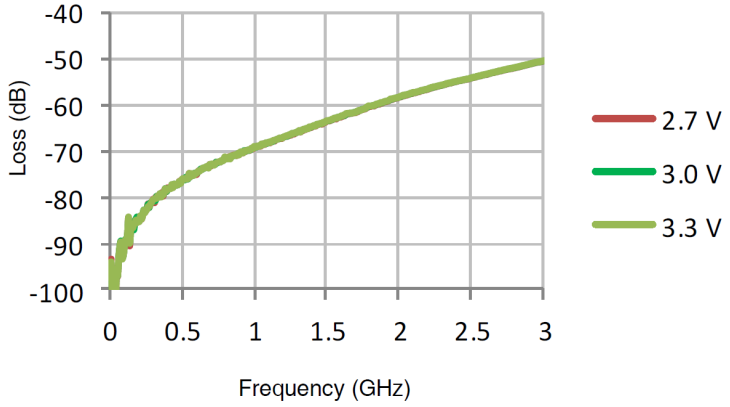


Figure 9. RF1–RF2 isolation vs. V_{DD}

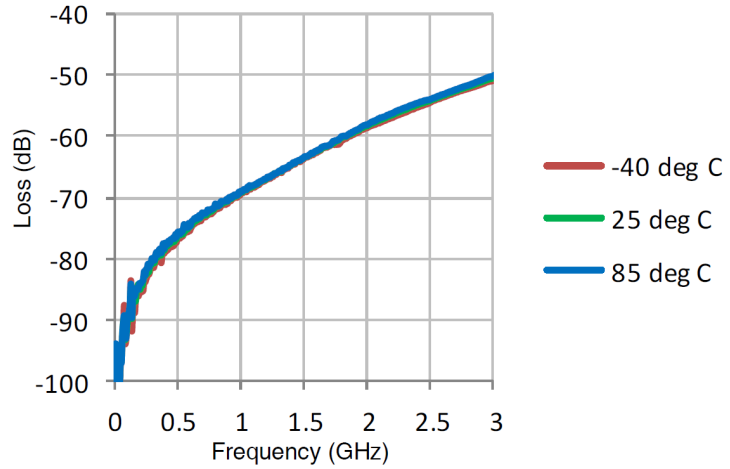


Figure 10. RF1–RF2 isolation vs. temperature

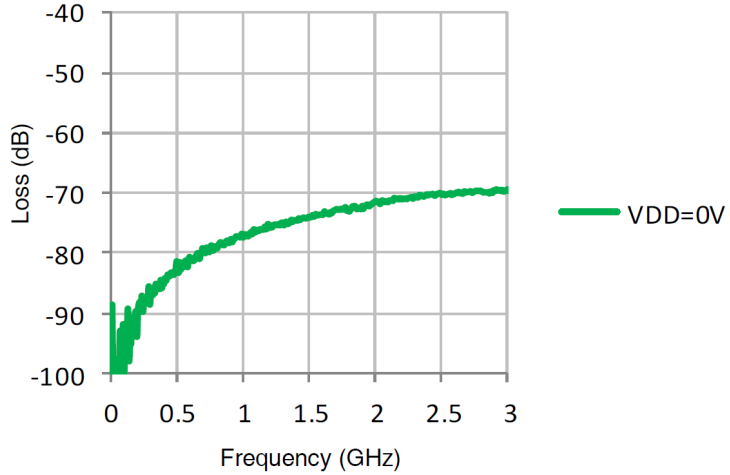


Figure 11. Unpowered RF1–RF2 isolation

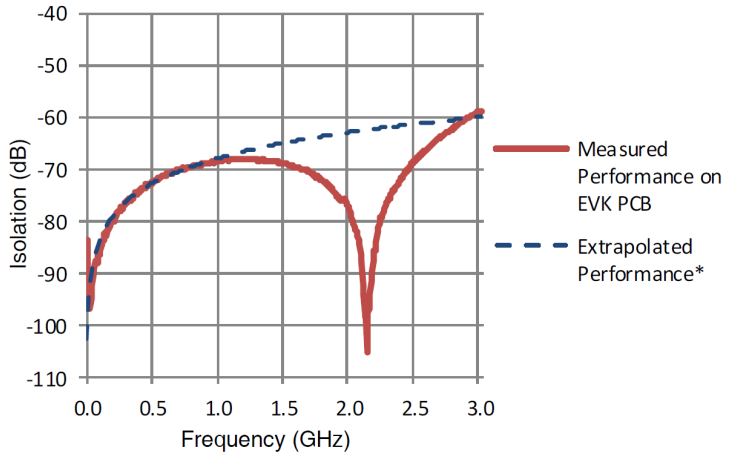


Figure 12. RFx–RFC isolation

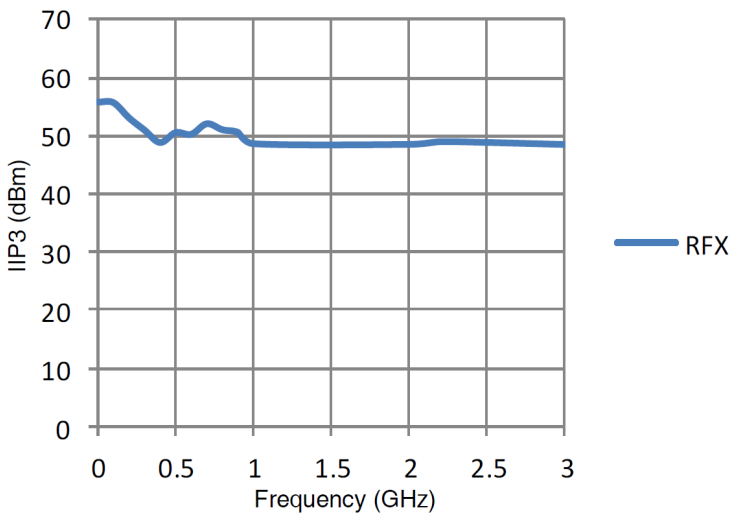


Figure 13. Input IIP3, RFC–RFx

* EVK-PCB-related resonance removed from the dataset. The extrapolated performance in Figure 12 represents the PE42750 true performance.

Evaluation kit

pSemi designed the evaluation kit to ease your evaluation of the PE42750. The RF common port is connected 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. Use this transmission line to estimate the PCB loss over the environmental conditions. J6 provides DC and digital inputs to the device.

The board consists 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 draw several microamps from V_{DD} and are not required for normal operation.

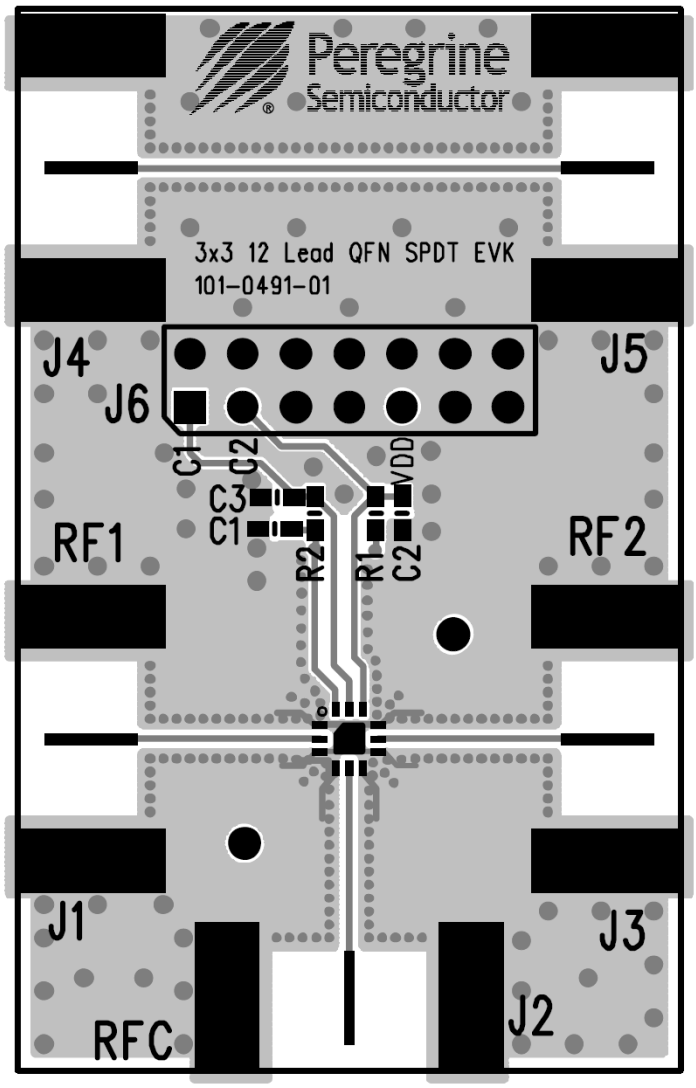


Figure 14. Evaluation board layout

Evaluation board schematic

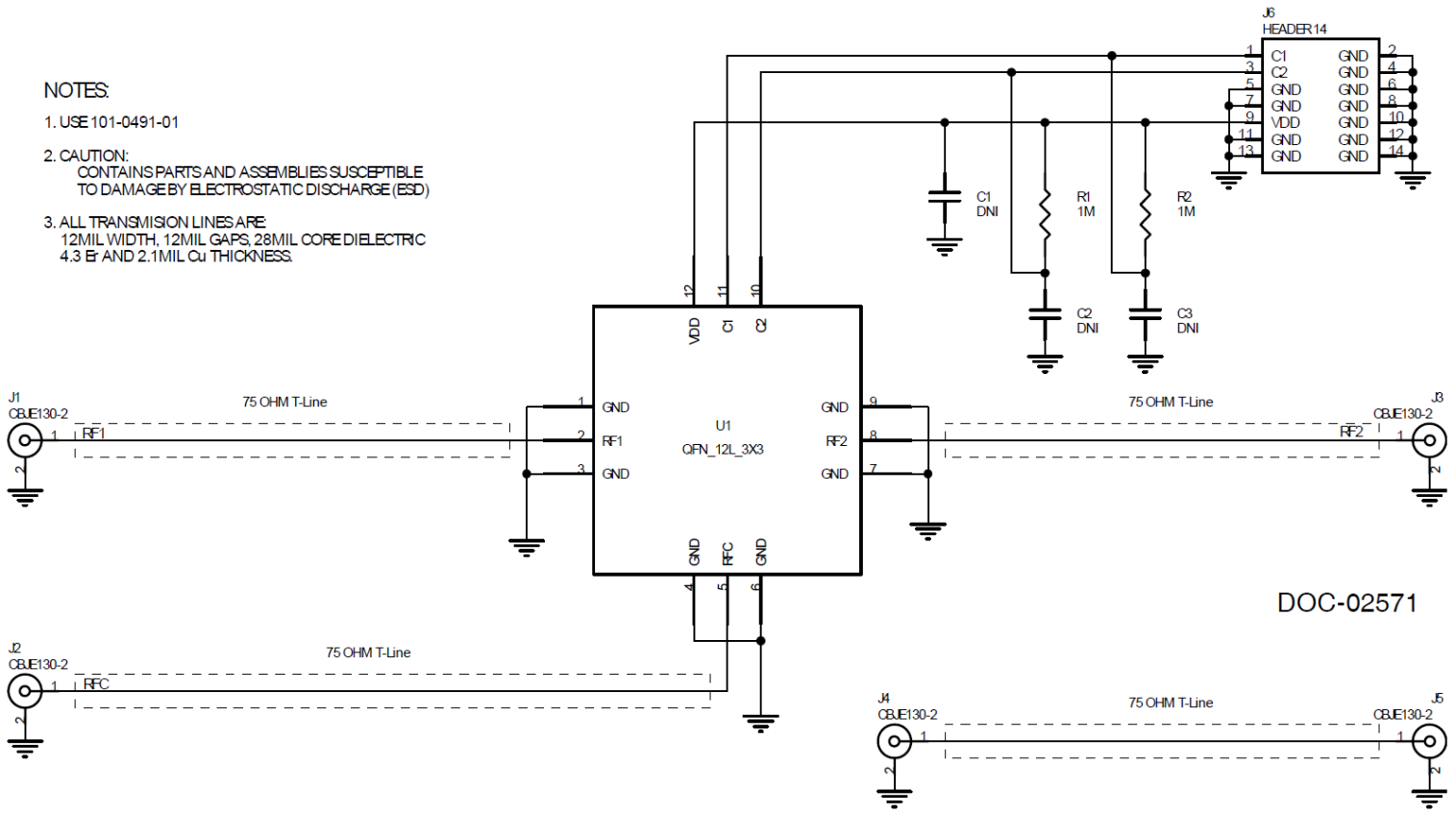


Figure 15. Evaluation board schematic

Applications

The PE42750 provides the high isolation required by the FCC 15.115 specification between the television antenna and the cable plant. The PE42750 advantage is that it maintains its device isolation performance when the power is removed. When the PE42750 is unpowered, all ports are terminated.

Figure 16–Figure 18 show typical PE42750 applications.

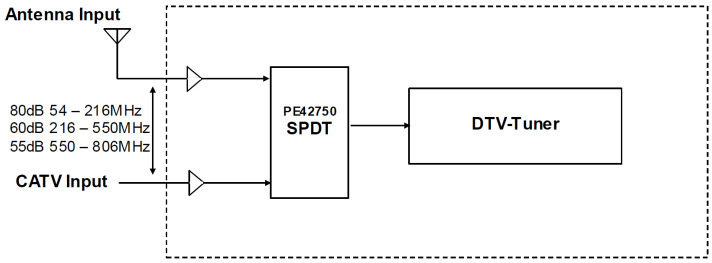


Figure 16. Typical application 1

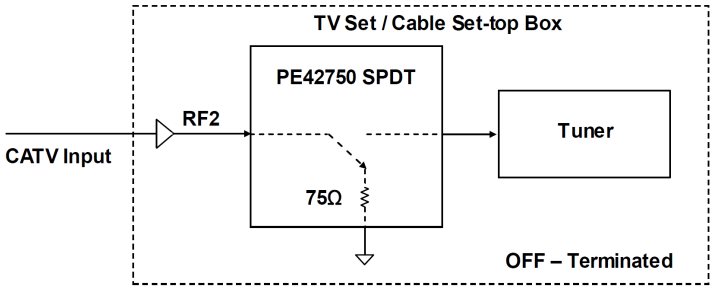


Figure 17. Typical application 2

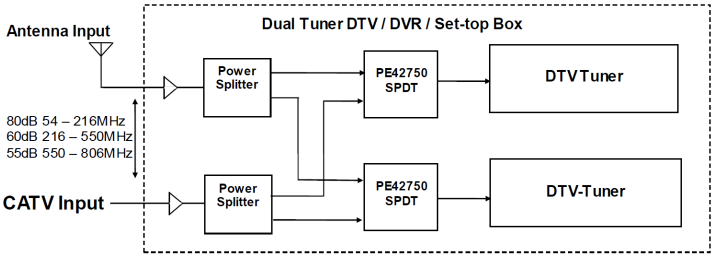


Figure 18. Typical application 3

Pin information

Figure 19 shows the PE42750 pin map for the 12-lead 3 × 3 × 0.75 mm QFN package, and Table 6 lists the description for each pin.

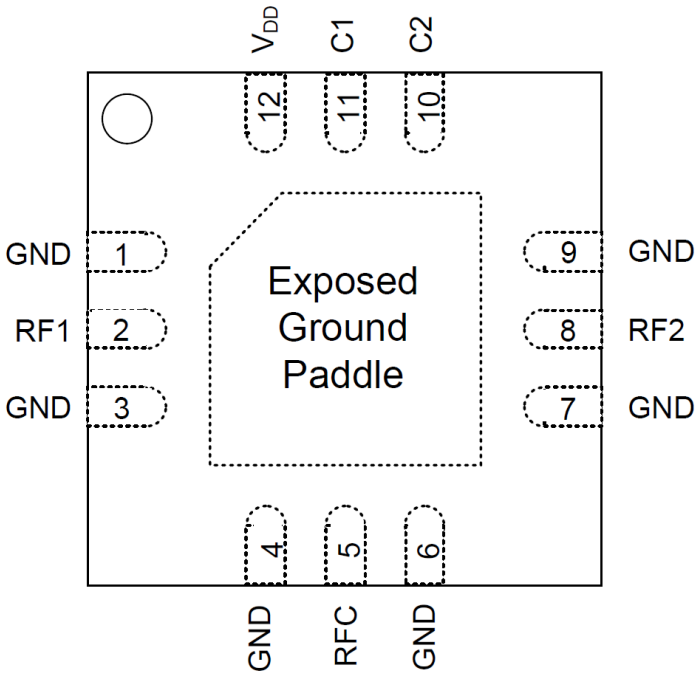


Figure 19. Pin configuration (top view)

Table 6. PE42750 pin descriptions

Pin no.	Pin name	Description
1, 3, 4, 6, 7, 9	GND	Ground
2	RF1	RF port 1
5	RFC	RF common
8	RF2	RF port 2
10	C2	Control 2, or logic select
11	C1	Control 1, or logic select
12	V_{DD}	Supply voltage
Pad	GND	Exposed pad. Ground for proper operation.

1. RF pins 2, 5, and 8 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 10 and 11 can be set for single-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 PE42750 moisture sensitivity level rating for the 12-lead 3 × 3 × 0.75 mm QFN package is MSL1.

Package drawing

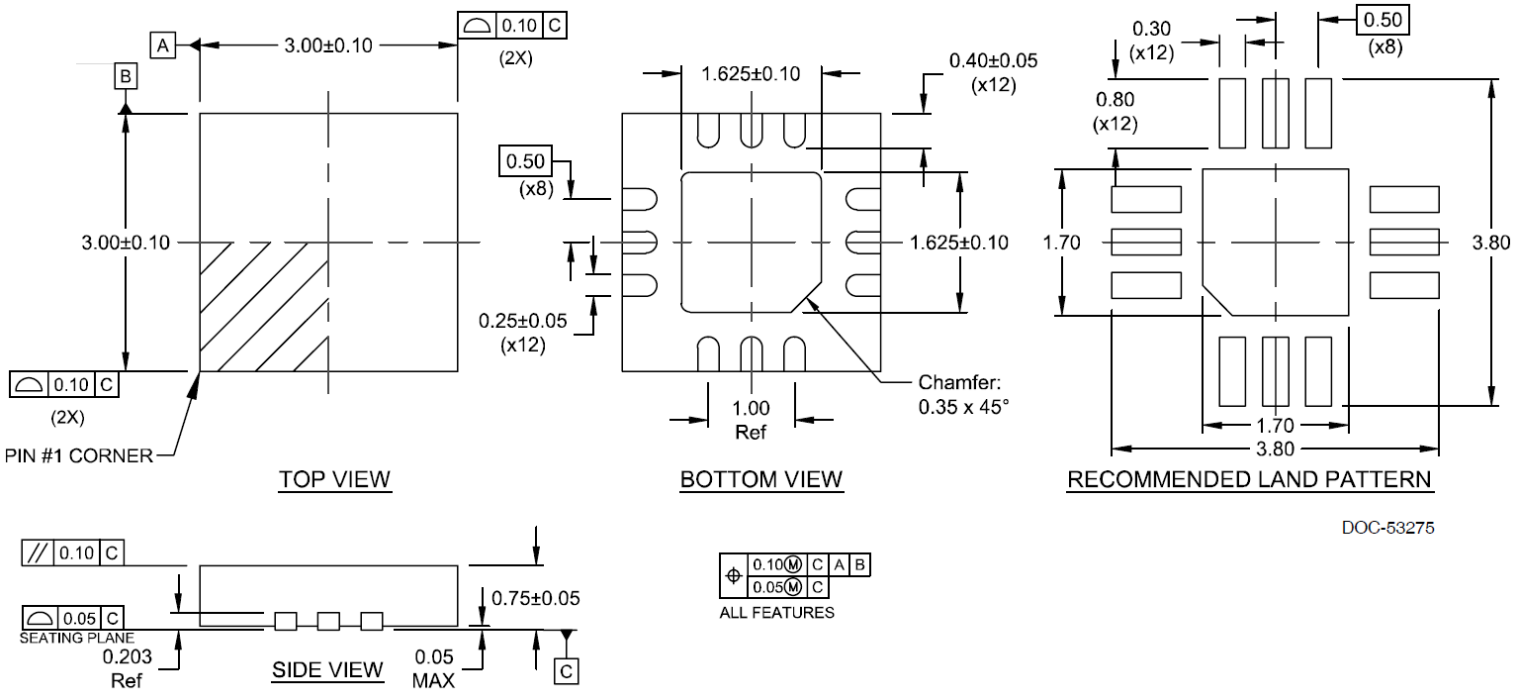
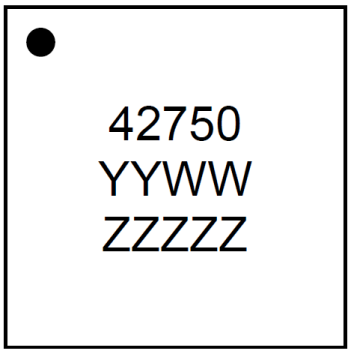


Figure 20. Package mechanical drawing for the 12-lead 3 × 3 × 0.75 mm QFN package

Top-marking specification



● = Pin 1 designator
AAAAA = Five digit part number
YYWW = Date Code, last two digits of the year and work week
ZZZZZ = Five digits of the lot number

Figure 21. PE42750 package marking specification

Tape and reel specification

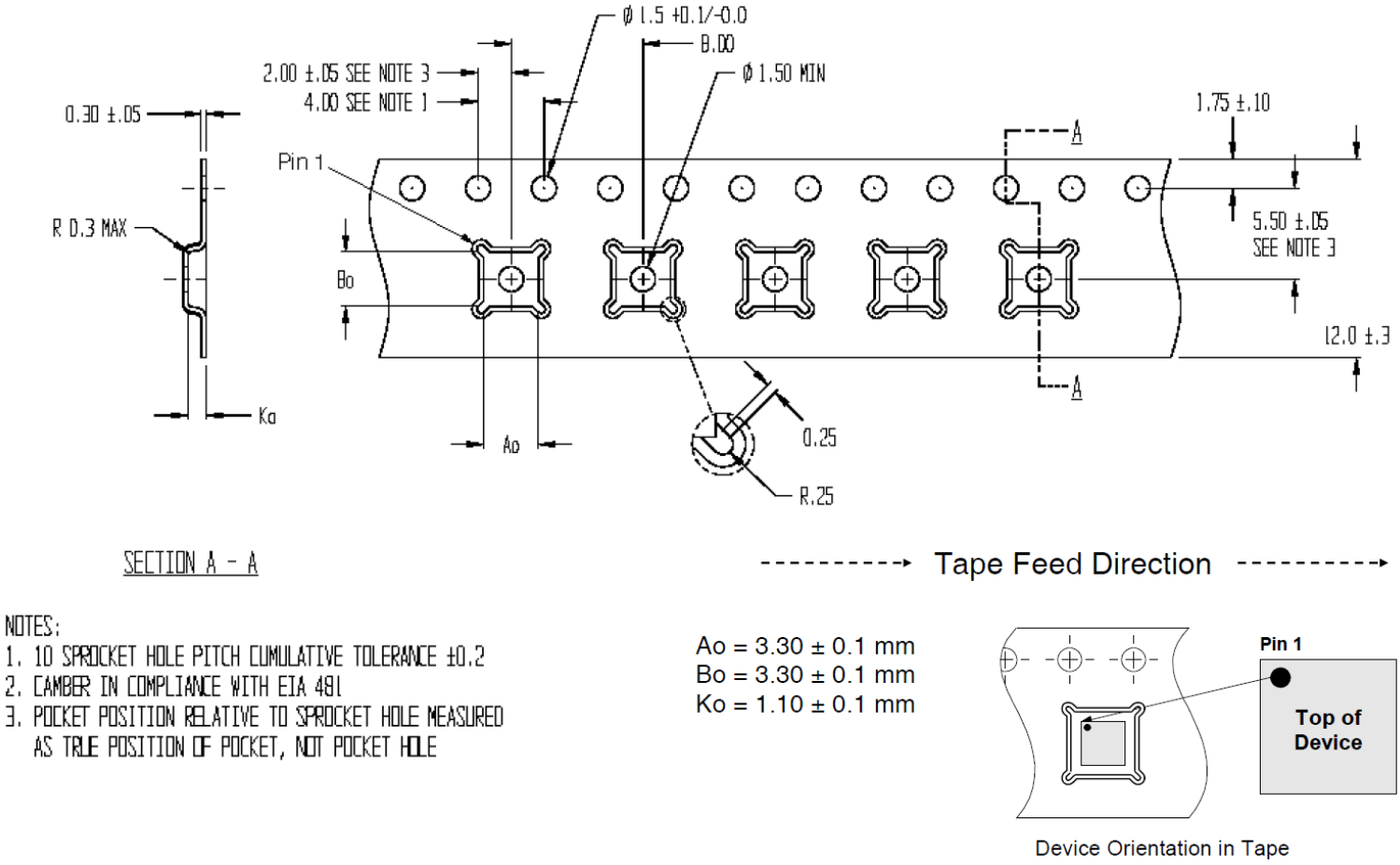


Figure 22. Tape and reel specification for the 12-lead 3 × 3 × 0.75 mm QFN package

- 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
PE42750MLAA-Z	PE42750 SPDT RF switch	Green 12-lead 3 × 3 × 0.75 mm QFN	3000 units/T&R
EK42750-01	PE42750 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.
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