Product Specification

PE42750

75Ω Terminated 5 - 2200 MHz SPDT CATV UltraCMOS® Switch Featuring Unpowered Operation

Product Description

The PE42750 is an SPDT UltraCMOS® 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 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 PSemi'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 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 +3 volt supply operation
- Low current consumption: 8 µA
- Absorptive switch design

Figure 1. Functional Diagram

PSemi Specification 71-0013-02

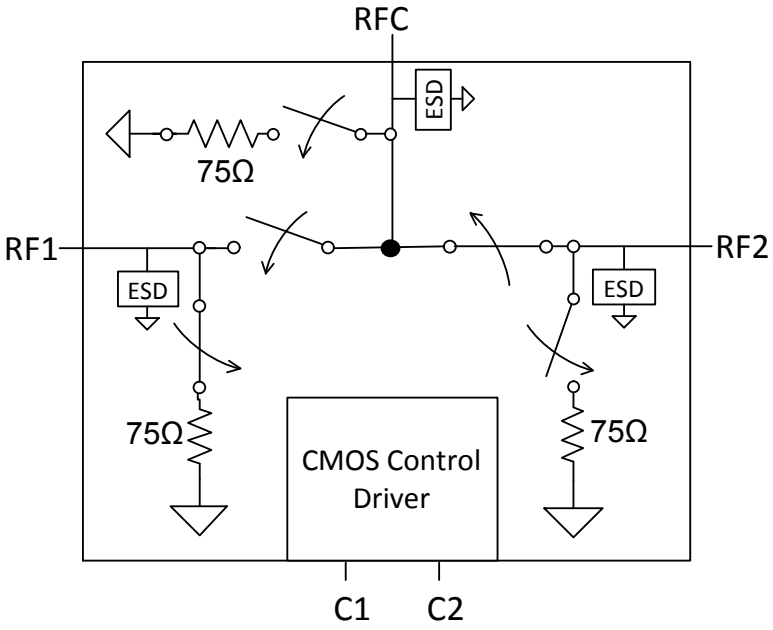


Figure 2. Package Type

12-lead 3 x 3 x 0.75 mm QFN

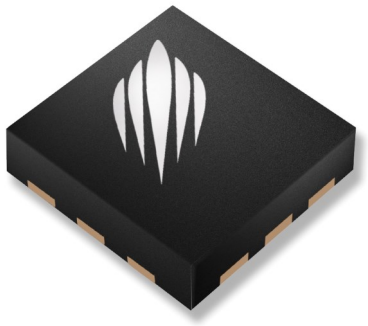


Table 1. Electrical Specifications @ +25°C, V_{DD} = +3V (Z_S = Z_L = 75Ω)

Parameter	Condition	Minimum	Typical	Maximum	Unit
Operating Frequency		5		2200	MHz
Insertion Loss - RFX to RFC	5 to 220 MHz		0.7	0.8	dB
	221 to 550 MHz		0.8	0.9	
	551 to 810 MHz		0.9	1.0	
	811 to 870 MHz		0.9	1.0	
	871 to 2200 MHz		1.7	1.8	
Isolation - RFX to RFX[3]	5 to 220 MHz	80	84		dB
	221 to 550 MHz	70	76		
	551 to 810 MHz	65	72		
	811 to 870 MHz	65	71		
	871 to 2200 MHz	50	57		
Isolation - RFX to RFC	5 to 220 MHz	74	80		dB
	221 to 550 MHz	67	72		
	551 to 810 MHz	65	70		
	811 to 870 MHz	65	70		
	871 to 2200 MHz	51	55		
Return Loss - RFX to RFC	5 to 220 MHz		23		dB
	221 to 550 MHz		20		
	551 to 810 MHz		18		
	811 to 870 MHz		17		
	871 to 2200 MHz		10		
IIP2 - RFX[1]	5-2200 MHz		100		dBm
IIP3 - RFX[1,4]	5-2200 MHz		47.5		dBm
Input 1 dB Compression - RFX or RFC[1]	1000 MHz	21.5	23.5		dBm
Switching time[2]	50% CTRL to 10/90% RF		2	3	µs
Video Feedthough[2]			2		mVpp

Notes: 1. Measured in a 50Ω system
2. 0/3V on control pin, 1 ns rise time
3. Minimum per FCC 15.115 spec
4. 10 dBm per tone for 1:3 ratio of fundamental to IMD3 products

Table 2. Electrical Characterization (Unpowered Operation)

Parameter	Condition	Minimum	Typical	Maximum	Unit
Operating Frequency		5		2200	MHz
Isolation - F1 to RF2	5 to 220 MHz	83	90		dB
	221 to 550 MHz	77	83		
	551 to 810 MHz	73	79		
	811 to 870 MHz	73	79		
	871 to 2200 MHz	65	72		

Figure 3. Pin Configuration (Top View)

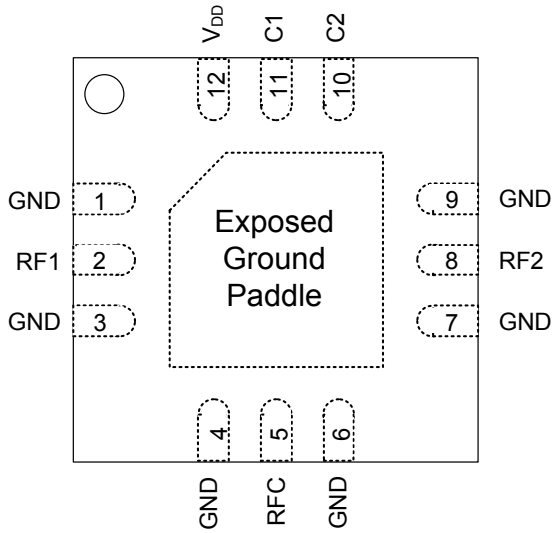


Table 3. Pin Descriptions

No.	Name	Description
1	GND	RF Ground
2	RF1[1]	RF I/O
3	GND	RF Ground
4	GND	RF Ground
5	RFC[1]	RF Common
6	GND	RF Ground
7	GND	RF Ground
8	RF2[1]	RF I/O
9	GND	RF Ground
10	C2[2]	Control 2 (or logic select)
11	C1[2]	Control 1 (or logic select)
12	V_{DD}	Supply
Pad	GND	Exposed Ground Paddle

Notes: 1. RF pins 2, 5, and 8 must be at 0V DC. The RF pins do not require DC blocking capacitors for proper operation if the 0V DC requirement is met
2. Pins 10 and 11 can be set for single pin control
3. GND must be connected to exposed ground paddle to ensure good isolation

Moisture Sensitivity Level

The Moisture Sensitivity Level rating for the PE42750 in the 12-lead 3 x 3 x 0.75 mm QFN package is MSL1.

Switching Frequency

The PE42750 has a maximum 25 kHz switching rate.

Latch-Up Avoidance

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

Table 4. Operating Conditions @ 25°C

Parameter	Min	Typ	Max	Unit
V_{DD} Power Supply	2.7	3.0	3.63	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
P_{RF} RF power on RFC, RF1, RF2 Terminated/ Through 75Ω			23/26	dBm
T_{OP} Operating Temperature	-40		+85	°C

Operation should be restricted to the limits in the Operating Ranges table.

Table 5. Absolute Maximum Ratings

Parameter/Condition	Min	Max	Unit
V_{DD} Power supply voltage	-0.3	4.0	V
V_I Voltage on CTRL input	-0.3	V_{DD} + 0.3	V
P_{RF} RF power on RFC, RF1, RF2 Terminated/Through 75Ω		23/26	dBm
T_{ST} Storage temperature	-55	+150	°C
V_{ESD} ESD Voltage, HBM, MIL_STD 883, Method 3015.7		2000	V
V_{ESD} MM ESD Voltage all pins JEDEC JESD22-A115-A		150	
V_{ESD} CDM ESD Voltage JEDEC JESD22-C101D		1000	

Exceeding absolute maximum ratings may cause permanent damage. 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.

Table 6. Truth Table[1]

V_{DD}	C1	C2	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

Note: 1. A versatile logic table has been established to allow either C1 or C2 to act as a single pin control and in either polarity
2. V_{DD} at "OFF" represents an all terminated state

Performance Plots @ 25°C and 3.0V unless otherwise specified.

Figure 4. Nominal Insertion Loss (RFX-RFC)

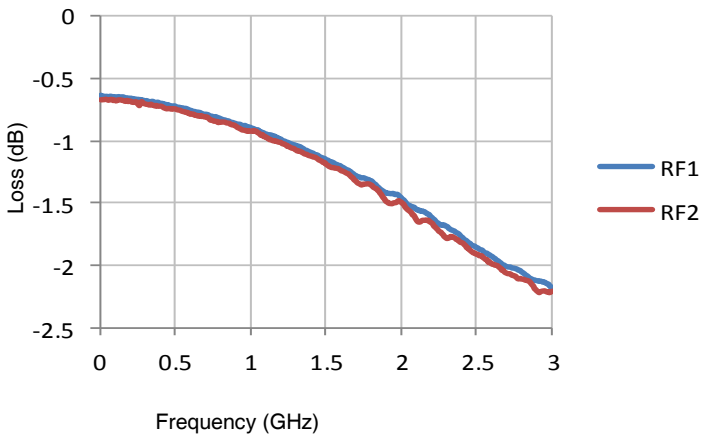


Figure 5. Insertion Loss vs Temperature (RFX-RFC)

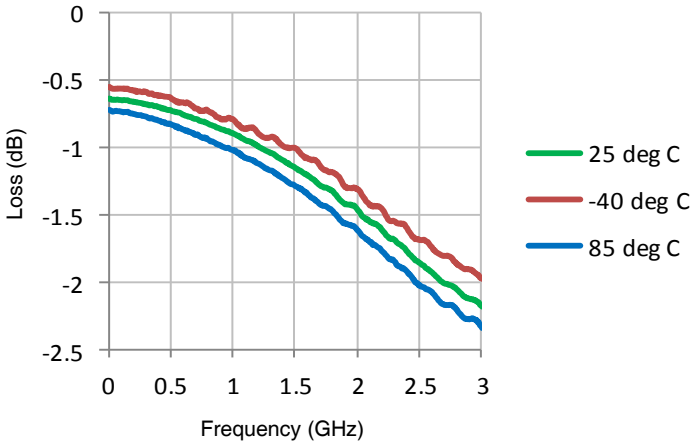


Figure 6. Insertion Loss vs V_{DD} (RFX-RFC)

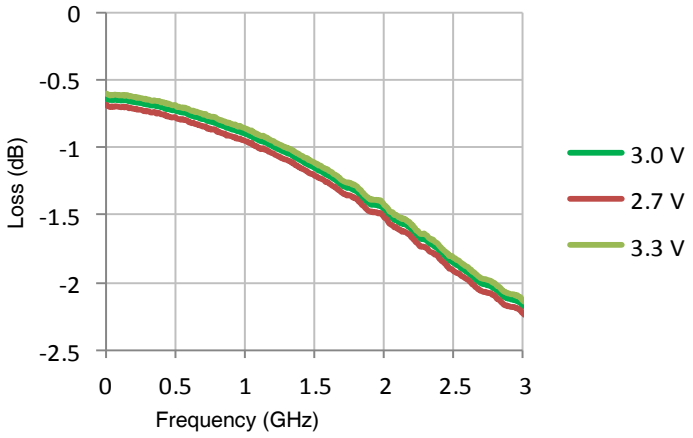


Figure 7. Active Port Return Loss vs Temperature (RFX)

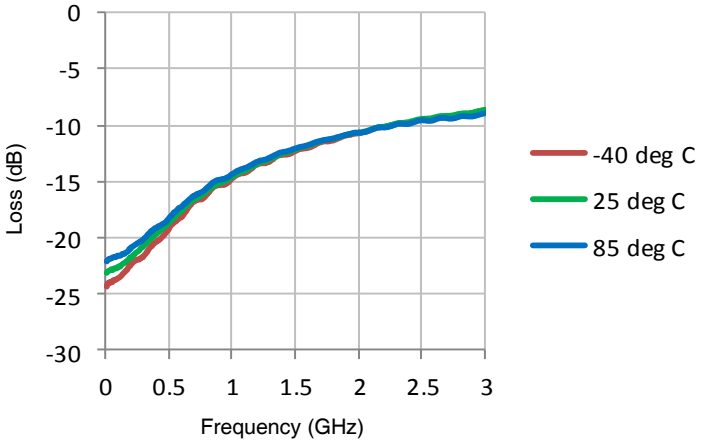


Figure 8. Active Port Return Loss vs V_{DD} (RFX)

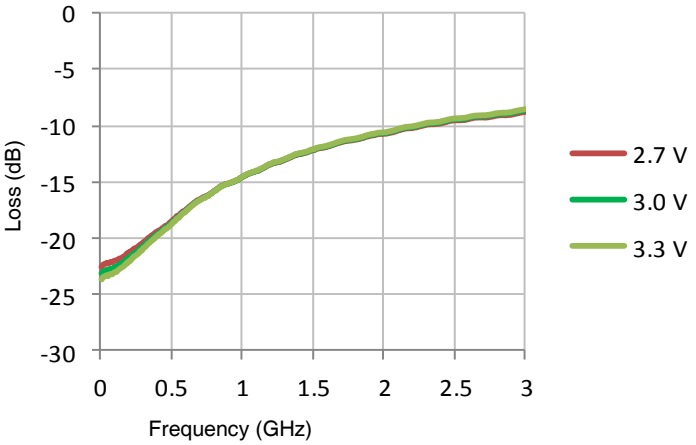


Figure 9. RFC Port Return Loss vs Temperature

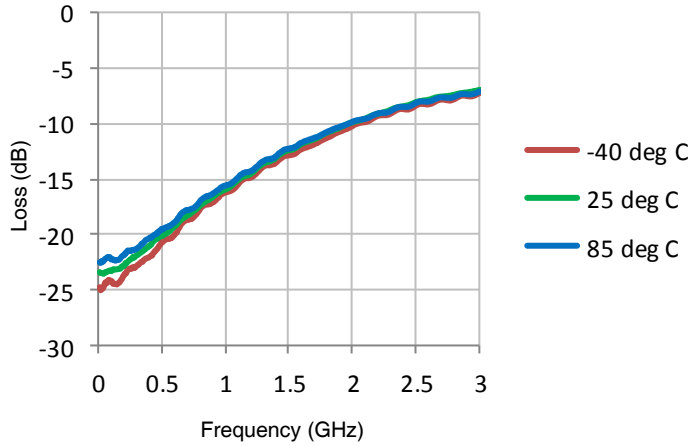


Figure 10. RFC Port Return Loss vs V_{DD}

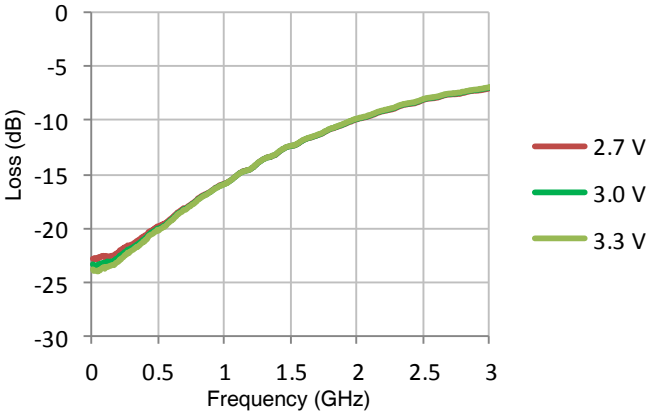


Figure 11. RF1-RF2 Isolation vs V_{DD}

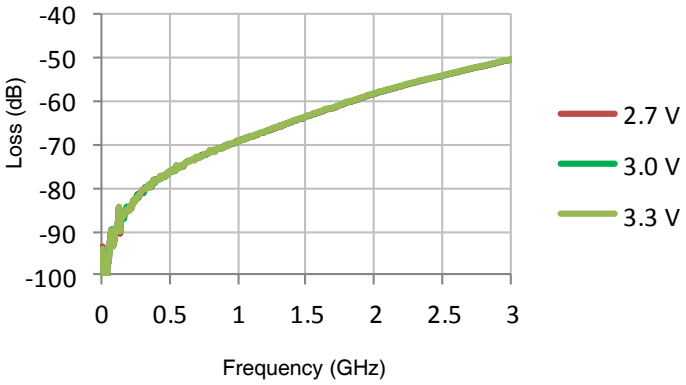


Figure 12. RF1-RF2 Isolation vs Temperature

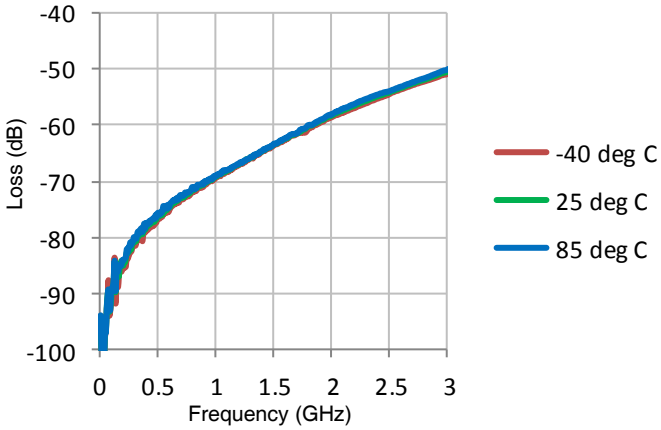


Figure 13. Unpowered RF1-RF2 Isolation

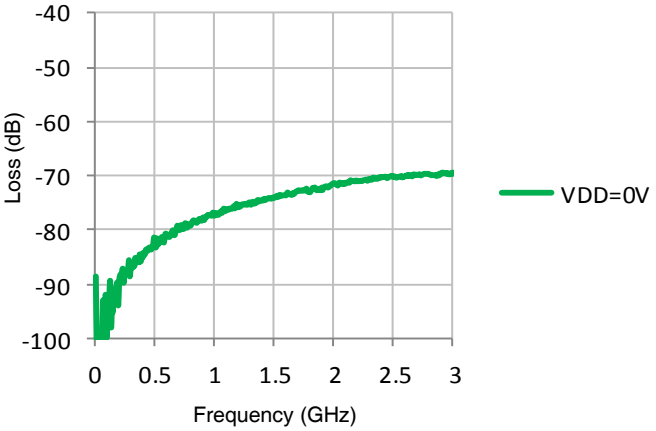
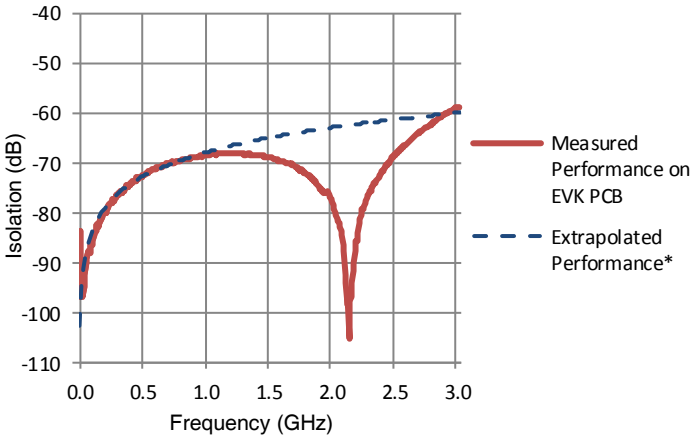
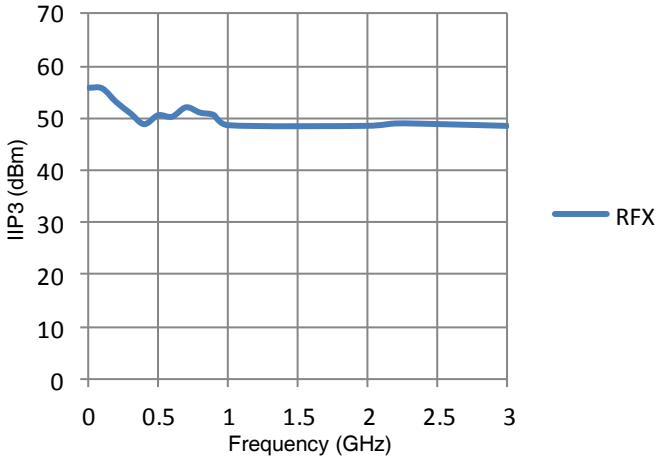


Figure 14. RFX-RFC Isolation



Note: EVK-PCB-related resonance removed from dataset. Extrapolated performance shown represents true performance of part.

Figure 15. Input IIP3 RFC-RFX



Typical Applications

The PE42750 provides the high isolation required by FCC part 15.115 regulation between the television antenna and the cable plant. The advantage of the PE42750 is that device isolation performance is maintained when power is removed. When the PE42750 is unpowered all ports are terminated.

Figure 16. Typical Application (1 of 3)

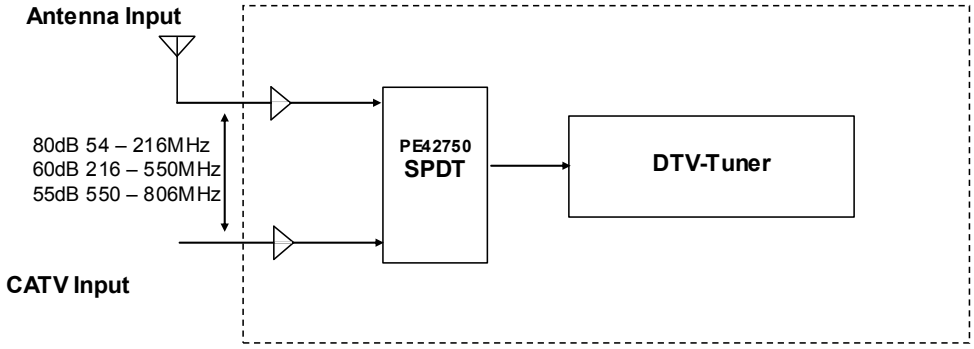


Figure 17. Typical Application (2 of 3)

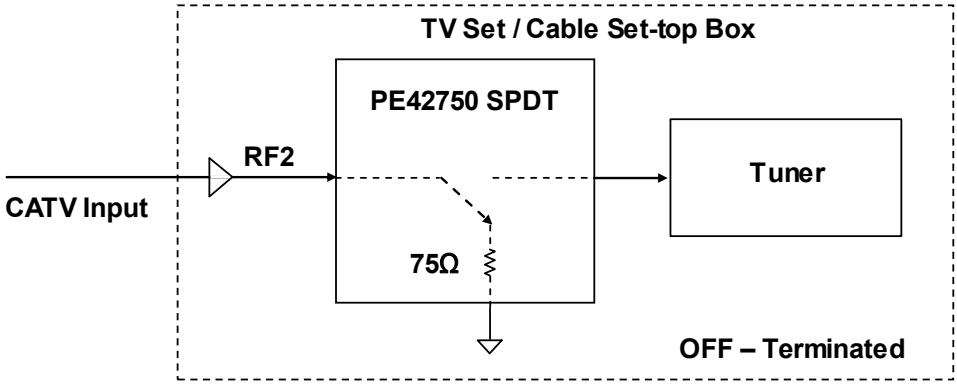
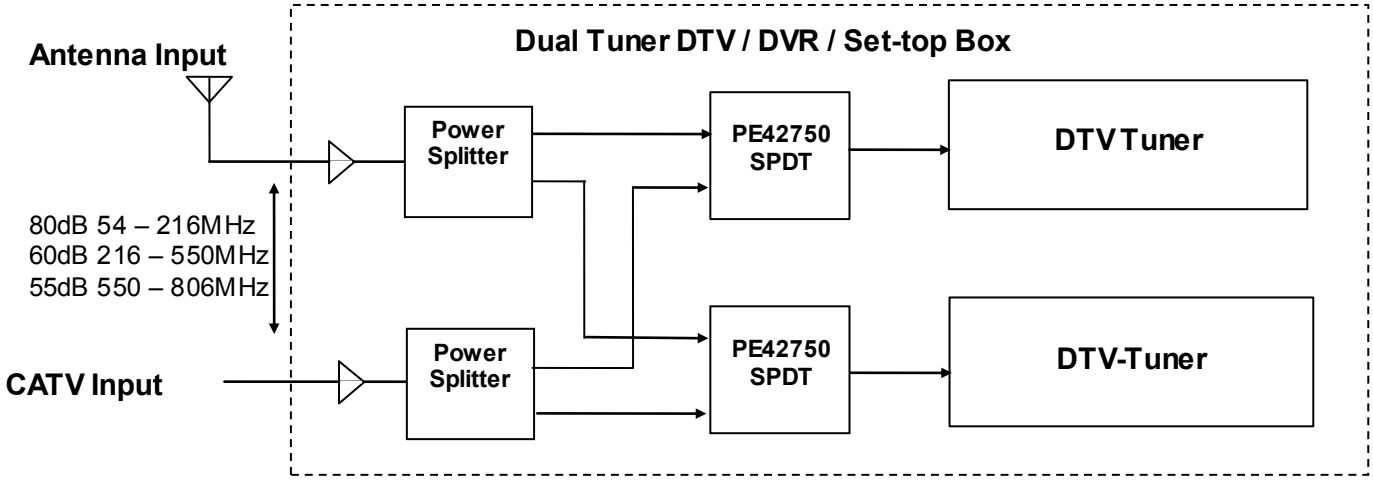


Figure 18. Typical Application (3 of 3)



Evaluation Kit Information

The SPDT Switch Evaluation Kit facilitates customer evaluation of the PE42750 SPDT switch. The RF common port is connected through a 75Ω transmission line to J2. Ports 1 and 2 are connected through 75Ω 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 20. Evaluation Board Layouts

PSemi Specification PRT-51234

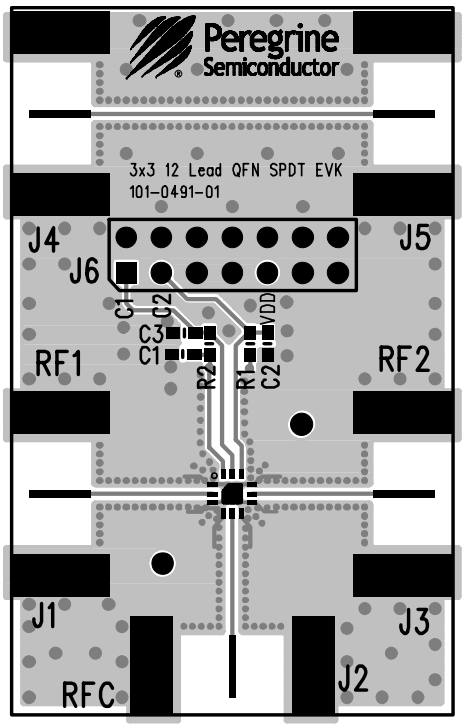


Figure 19. Evaluation Board Schematic

PSemi Specification DOC-02571

NOTES:

1. USE 101-0491-01
2. CAUTION:
   CONTAINS PARTS AND ASSEMBLIES SUSCEPTIBLE TO DAMAGE BY ELECTROSTATIC DISCHARGE (ESD)
3. ALL TRANSMISION LINES ARE:
   12MIL WIDTH, 12MIL GAPS, 28MIL CORE DIELECTRIC 4.3 Er AND 2.1MIL Cu THICKNESS.

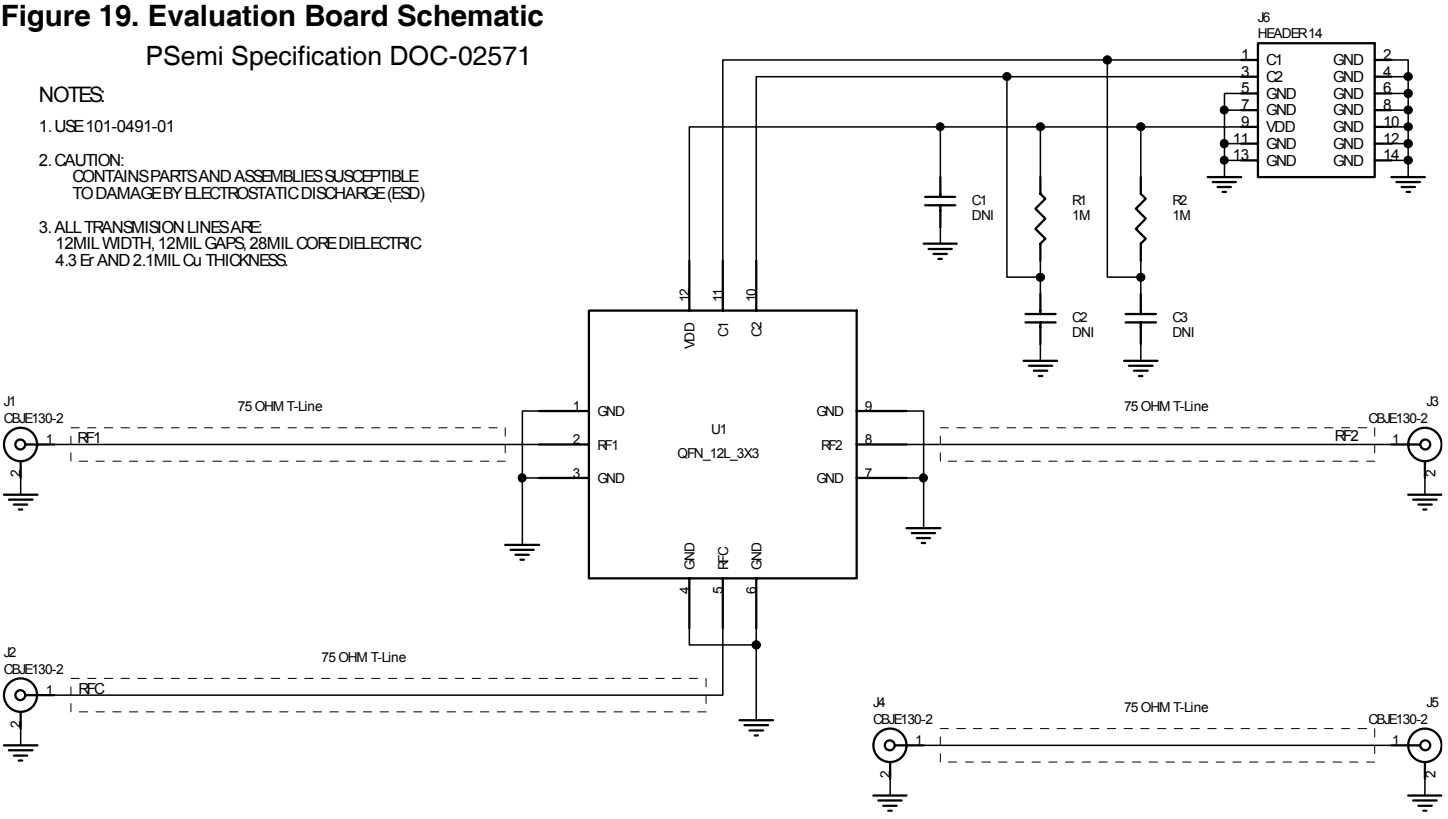


Figure 21. Package Drawing
12-lead 3x3 mm QFN

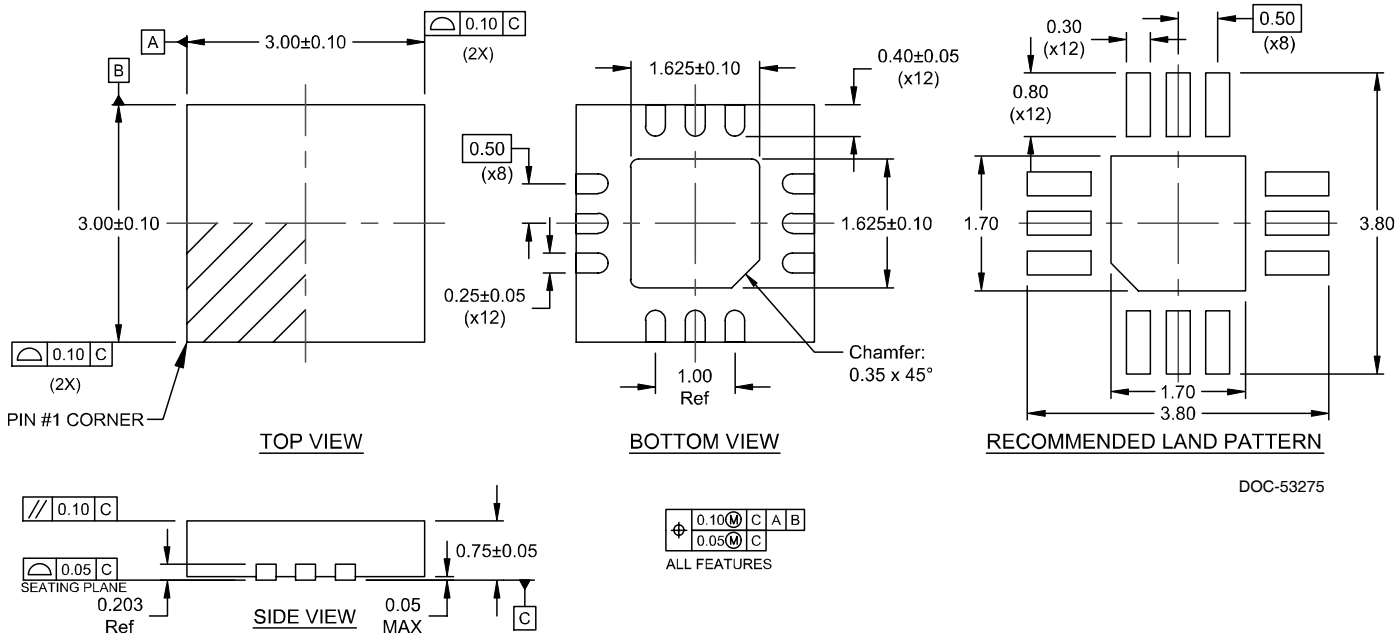
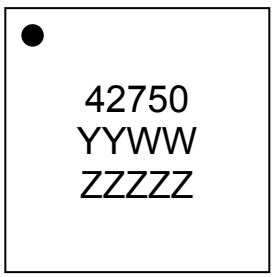


Figure 22. Marking Specifications



DOC-51207

● = 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