PE4256

Document category: Product Specification

75Ω SPDT CATV UltraCMOS® Switch, 5 MHz–3 GHz

Features

- 75Ω characteristic impedance
- Integrated 75Ω terminations
- CTB performance of –90 dBc
- High isolation: 65 dB at 1000 MHz
- Low insertion loss:
  - 0.5 dB at 5 MHz, typ.
  - 0.9 dB at 1000 MHz, typ.
- High input IP3: >50 dBm
- CMOS two-pin control
- Single +3V supply operation
- Low current consumption: 8 µA
- Unique all-off terminated mode
- Package: 4 x 4 mm QFN

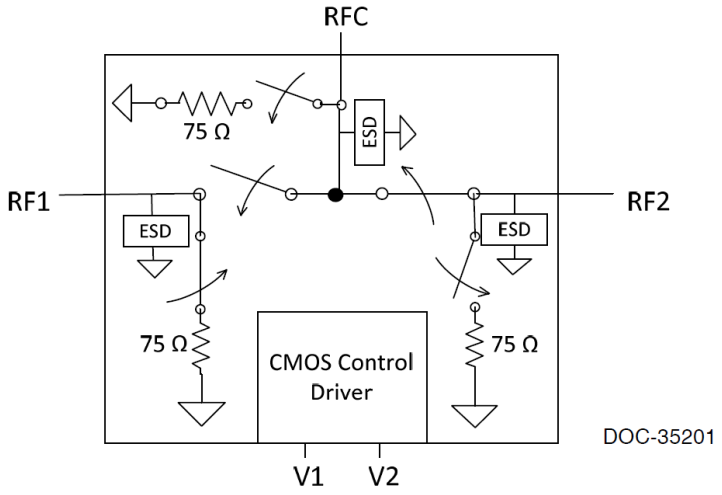


Figure 1. PE4256 functional diagram

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 a cost-effective and manufacturable solution when compared to mechanical relays.

The PE4256 is manufactured on 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.

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. PE4256 absolute maximum ratings

Symbol	Parameter or 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 CW power	–	24	dBm
T_{ST}	Storage temperature	-65	+150	°C
T_{OP}	Operating temperature	-40	+85	°C
V_{ESD}	ESD voltage (Human Body Model)	–	1000	V

Electrical specifications

Table 2 lists the PE4256 key electrical specifications at +25 °C, V_{DD} = +3V (Z_S = Z_L = 75Ω), unless otherwise specified.

Table 2. PE4256 electrical specifications

Parameter	Condition	Min	Typ	Max	Unit
Operating frequency(1)	–	5	–	3000	MHz
Insertion loss	5–250 MHz 250–750 MHz 750–1000 MHz 1000–2200 MHz	–	0.5 0.8 0.9 1.1	0.6 0.95 1.1 1.3	dB
Isolation	5–250 MHz 250–750 MHz 750–1000 MHz 1000–2200 MHz	75 65 62 49	80 70 65 52	–	dB
Input IP2(2)	5–1000 MHz	–	80	–	dBm
Input IP3(2)	5–1000 MHz	50	55	–	dBm
Input 1-dB compression(2)	1000 MHz	29	31	–	dBm
CTB/CSO	77 and 110 channels; Power out = 44 dBmV	–	-90	–	dBc
Switching time	50% CTRL to 10/90% RF	–	2	–	µs
Video feedthrough(3)	51000 MHz	–	–	15	mV_{PP}

1. Device linearity begins to degrade below 5 MHz.
2. Measured in a 50Ω system.
3. Measured with a 1-ns rise time, 0/3V pulse, and 500 MHz bandwidth.

Table 3 lists the PE4256 DC electrical specifications at +25 °C, unless otherwise specified.

Table 3. PE4256 DC electrical specifications

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	20	µA
Control voltage high	70% V_{DD}	–	–	V
Control voltage low	–	–	30% V_{DD}	V

SPDT control logic

Table 4 lists the RF path truth table.

Table 4. RF path truth table

C1	C2	RFc–RF1	RFc–RF2
Low	Low	OFF	OFF
Low	High	OFF	ON
High	Low	ON	OFF
High	Hight	N/A(*)	N/A(*)

* The PE4256 operation is not supported in the C1 = VDD and C2 = VDD state.

Table 5 lists the termination truth table.

Table 5. Termination truth table

C1	C2	RFc–75Ω	RF1–75Ω	RF2–75Ω
Low	Low	X(2)	X(2)	X(2)
Low	High	–	X(2)	–
High	Low	–	–	X(2)
High	High	N/A(1)	N/A(1)	N/A(1)

1. The PE4256 operation is not supported in the C1 = V_{DD} and the C2 = V_{DD} state.
2. “X” denotes termination enabled.

Typical performance data

Figure 2–Figure 9 show the typical performance data from -40 °C to +85 °C, 75Ω impedance, unless otherwise specified.

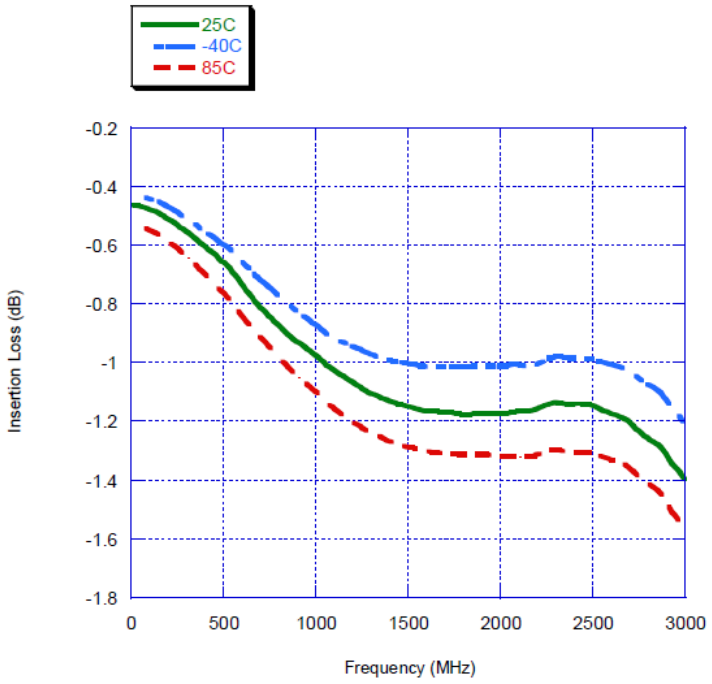


Figure 2. Insertion loss (RFc to RF1 or RF2)

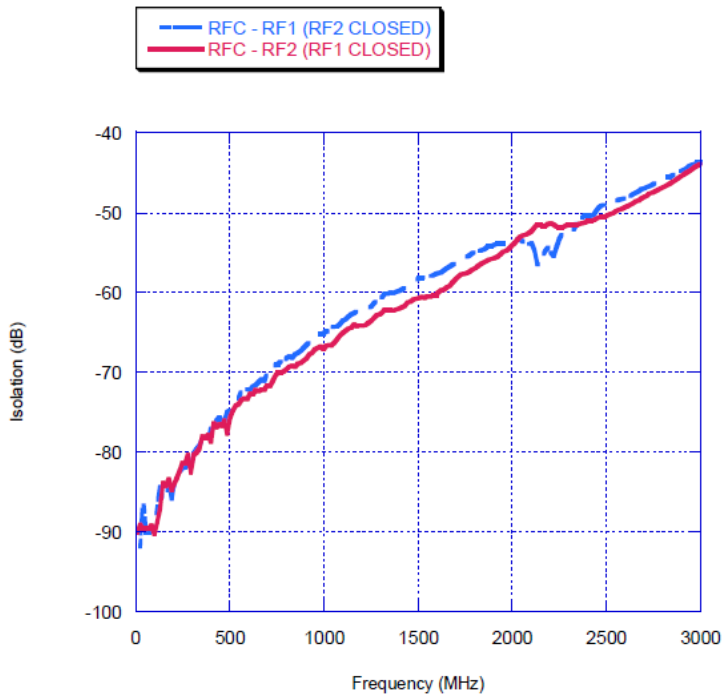


Figure 3. Input-to-output isolation (closed)

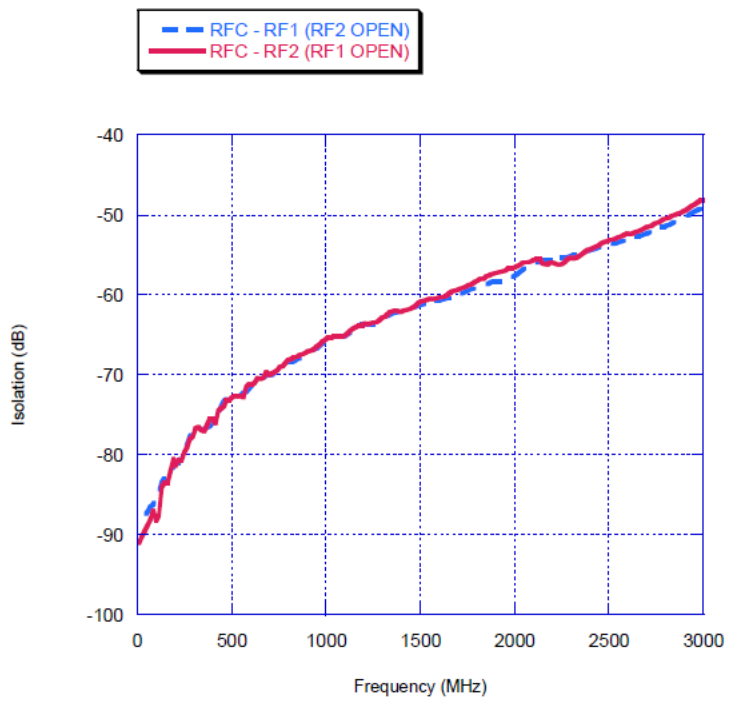


Figure 4. Input-to-output isolation (open)

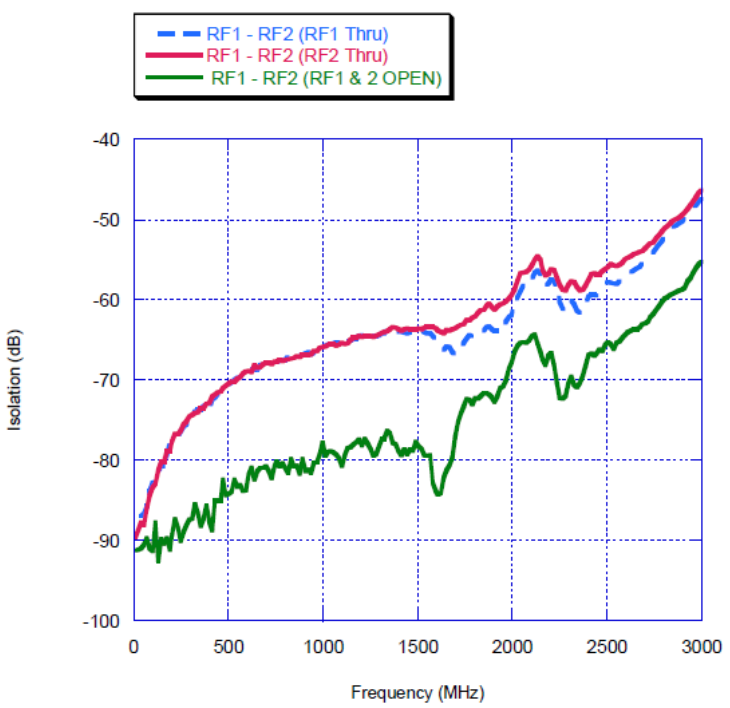


Figure 5. Isolation — RF1 to RF2

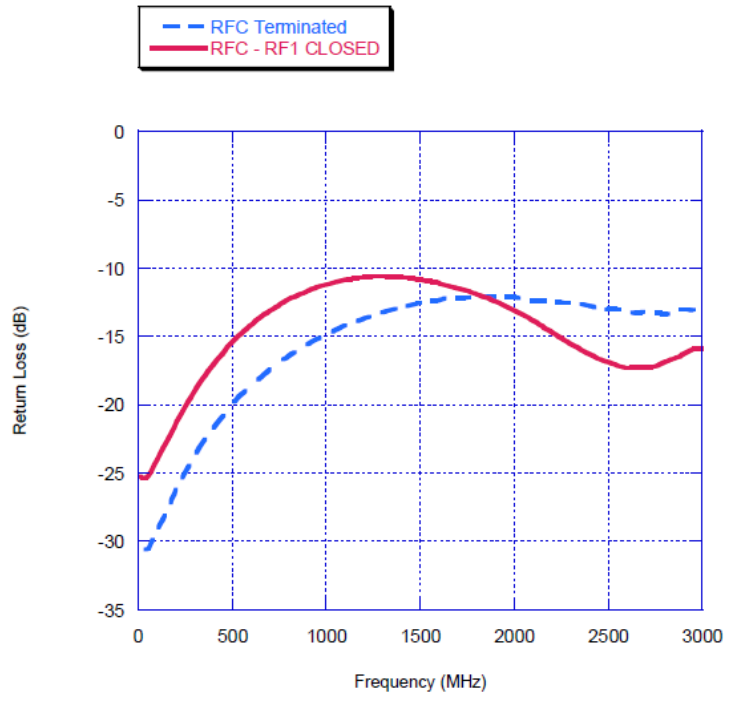


Figure 6. RFc return loss

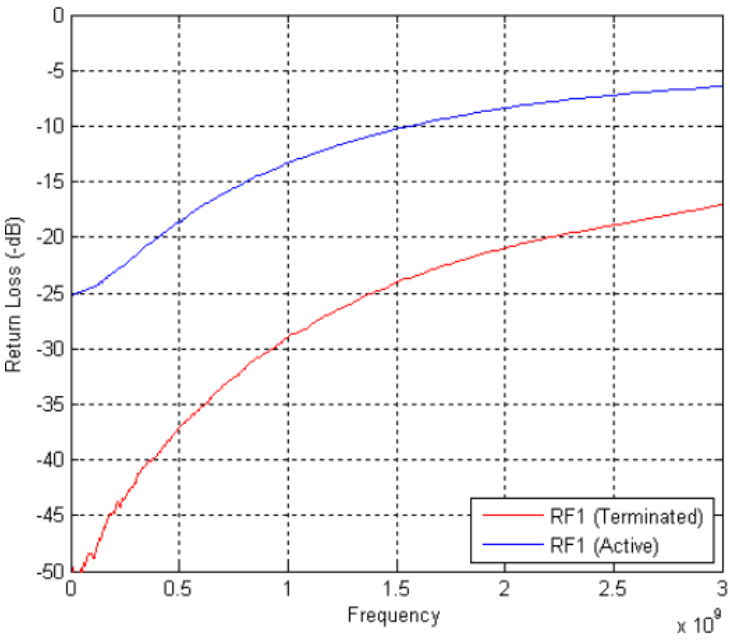


Figure 7. RF1 return loss

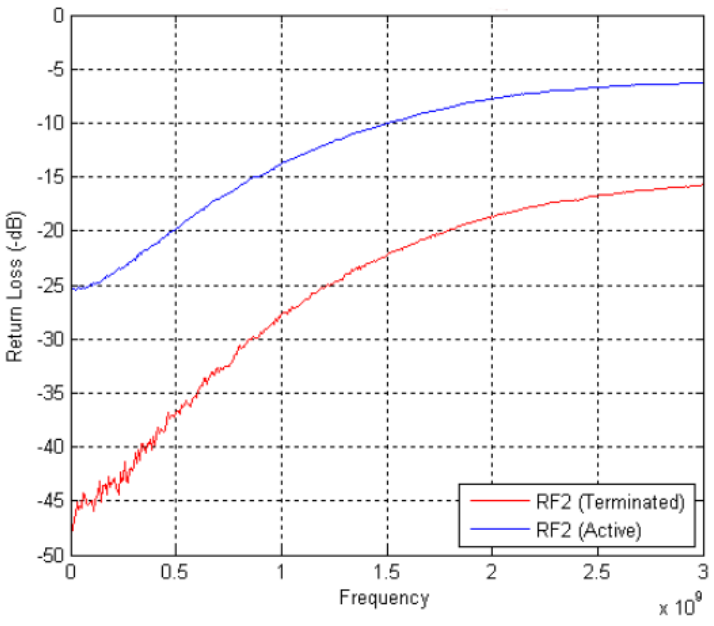


Figure 8. RF2 return loss

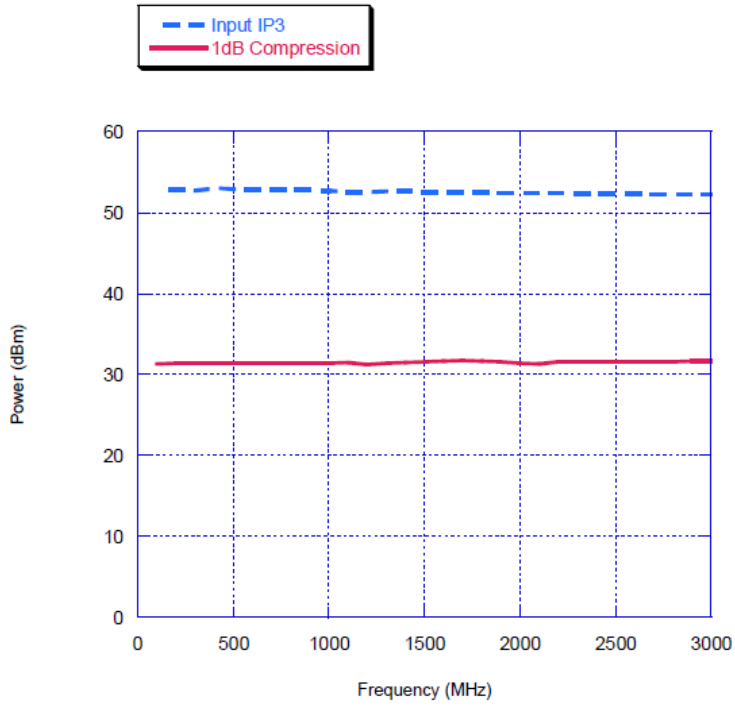


Figure 9. Linearity (50Ω system impedance)

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 75Ω transmission line to J2. Ports 1 and 2 connect through 75Ω 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 µA of current flows through the 1 MΩ pull-up resistor. Do not attribute this extra current 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.

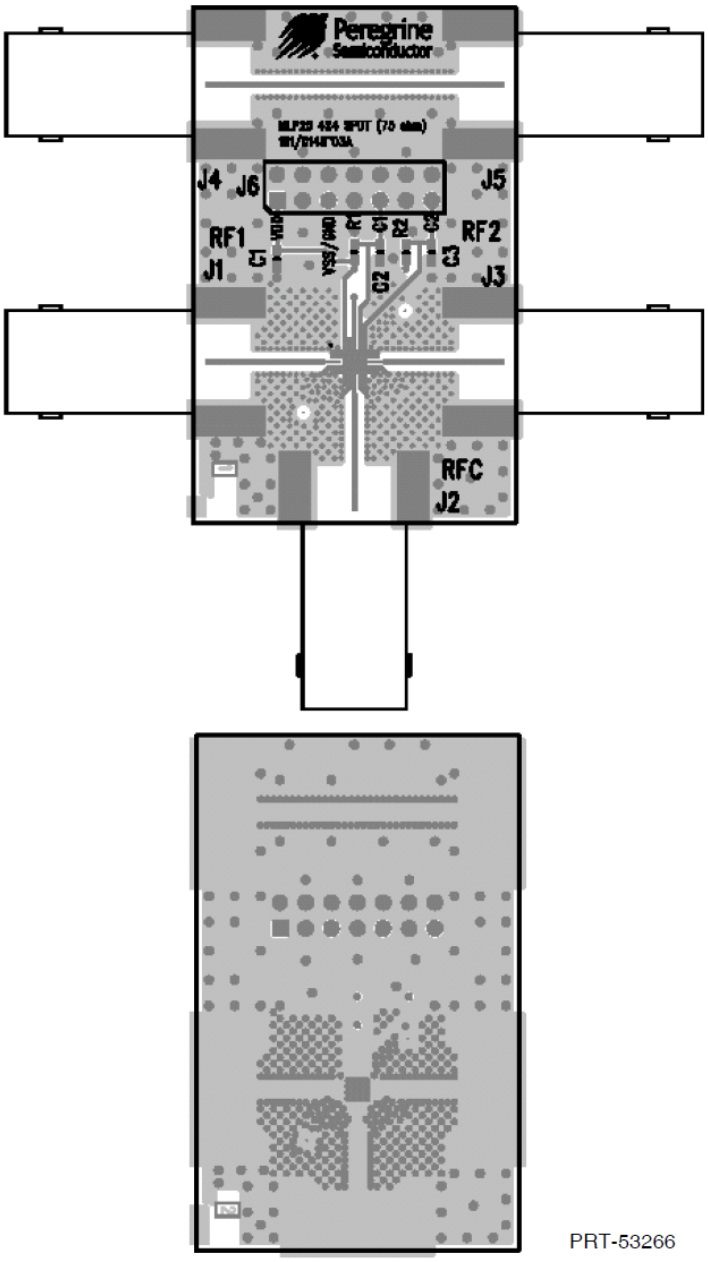


Figure 10. Evaluation board layouts

Evaluation board schematic

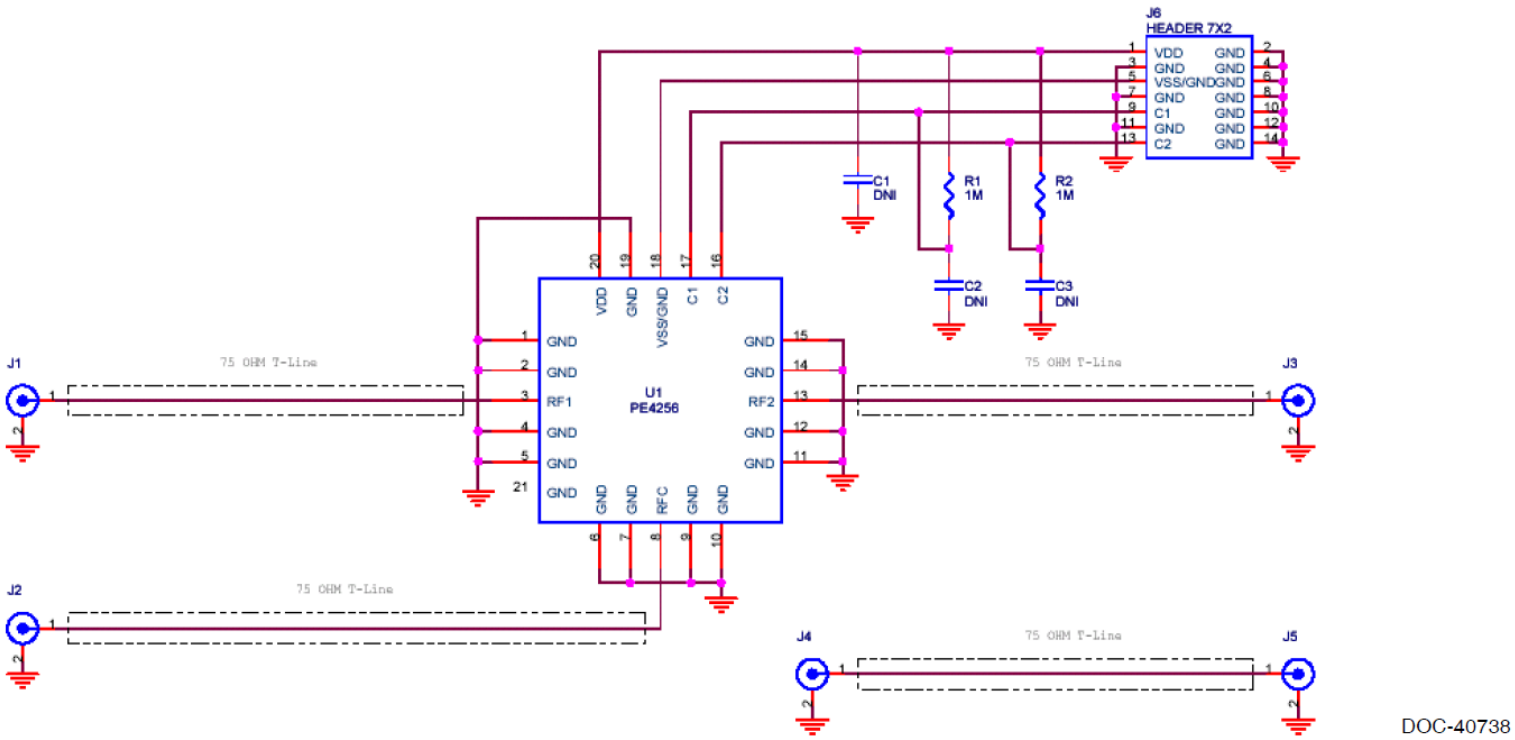


Figure 11. Evaluation board schematic

Pin information

Figure 12 shows the PE4256 pin map for the 20-lead 4 x 4 mm QFN package, and Table 6 lists the description for each pin.

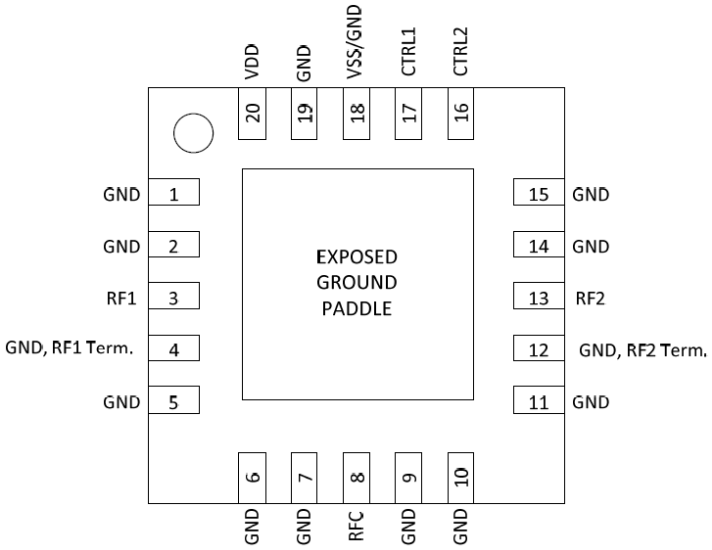


Figure 12. Pin configuration (top view)

1. Pins 3, 8, and 13 must be at 0 VDC. The RF pins do not required blocking capacitors if the 0 VDC requirement is met.
2. Pins 16 and 17 are the CMOS controls that set the three operating states.
3. To enable the internal negative voltage generator, connect pin 18 to GND (the PE4256 has a maximum 25 kHz switching rate when the internal negative voltage generator is used). To bypass and disable the internal negative voltage generator, connect pin 18 to V_{SS} (-3V).
4. You can add external resistance to ground to change the termination resistance.

Table 6. PE4256 pin descriptions

Pin no.	Pin name	Description
1	GND	Ground
2	GND	Ground
3[1]	RF1	RF I/O
4[4]	GND	Ground
5	GND	Ground
6	GND	Ground
7[4]	GND	Ground
8[1]	RFC	RF common
9[4]	GND	Ground
10	GND	Ground
11	GND	Ground
12[4]	GND	Ground
13[1]	RF2	RF I/O
14	GND	Ground
15	GND	Ground
16[2]	C2	Control 2
17[2]	C1	Control 1
18[3]	VSS/GND	Negative supply option
19	GND	Ground
20	VDD	Supply
Paddle	GND	Exposed ground paddle

Packaging information

This section provides the following packaging data:

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

Moisture sensitivity level

The PE4256 moisture sensitivity level rating for the 20-lead 4 x 4 mm QFN package is MSL1.

Package drawing

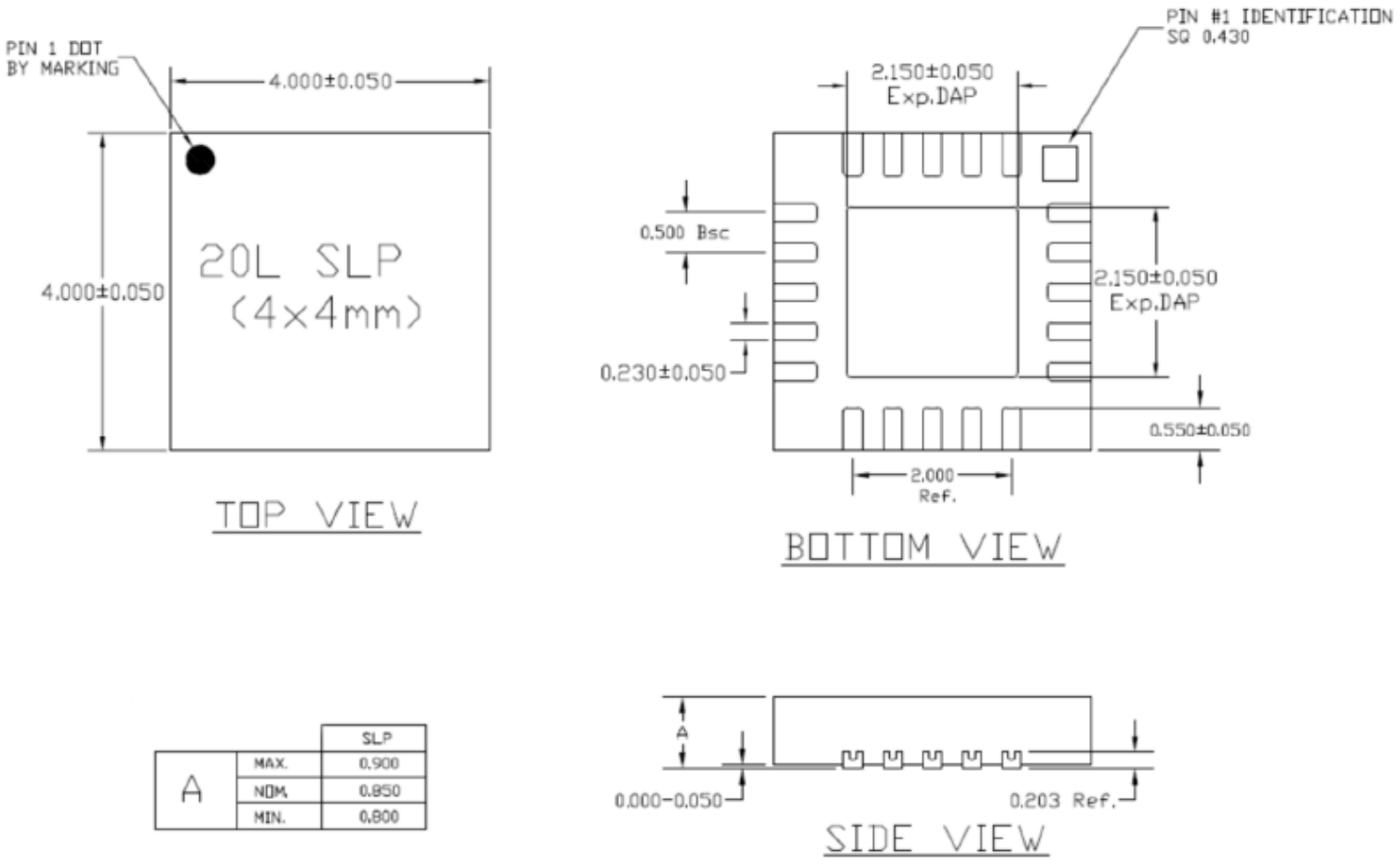
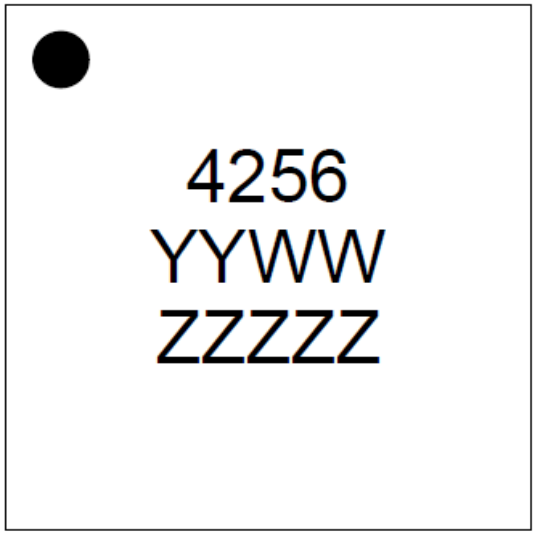


Figure 13. Package mechanical drawing for the 20-lead 4 x 4 mm QFN package

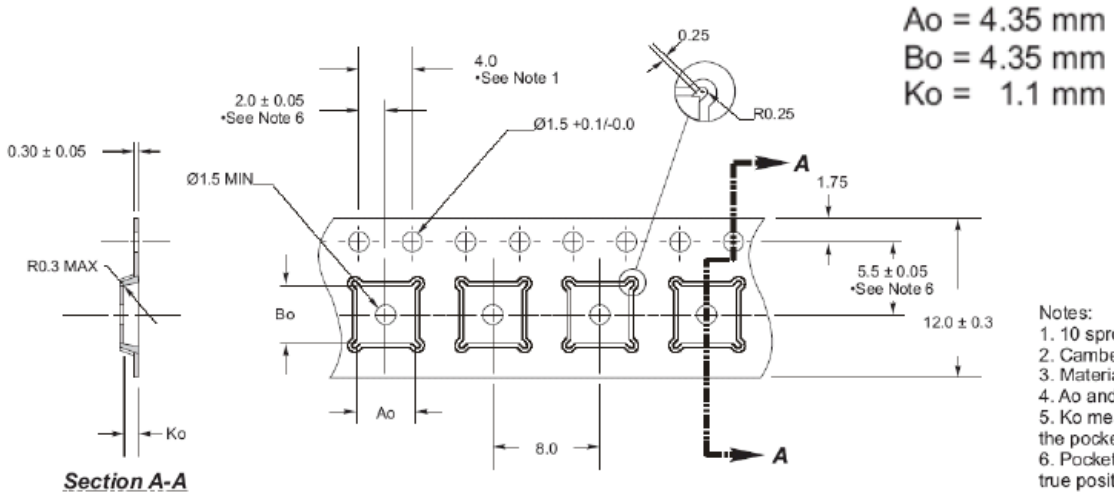
Top-marking specification



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

Figure 14. PE4256 package marking specification

Tape and reel specification



Notes:
1. 10 sprocket hole pitch cumulative tolerance ±.02.
2. Camber not to exceed 1mm in 100mm.
3. Material: PS + C.
4. Ao and Bo measured as indicated.
5. Ko measured from a plane on the inside bottom of the pocket to the top surface of the carrier.
6. Pocket position relative to sprocket hole measured as true position of pocket, not pocket hole.

Figure 15. Tape and reel specification for the 20-lead 4 x 4 mm QFN package

Ordering information

Order code	Description	Packaging	Shipping method
PE4256MLIAA-Z	PE4256-20QFN 4 x 4 mm-3000	Green 20-lead 4 x 4 mm QFN, NiPdAu Lead Finish	3000 units/T&R
EK4256-01	PE4256-20QFN 4 x 4 mm-EK	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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