PE4257

Document category: Product Specification

UltraCMOS® SPDT RF Switch, 10–3000 MHz, Absorptive

Features

- 50Ω characteristic impedance
- Integrated 50Ω terminations
- High input IP3 > +55 dBm
- High isolation 64 dB at 1000 MHz
- Low insertion loss: typically 0.75 dB at 1000 MHz and 0.95 dB at 2000 MHz
- LV CMOS two-pin control
- Single +3V supply operation
- Low current consumption: 8 µA
- Packaging: 20-lead 4 × 4 mm QFN

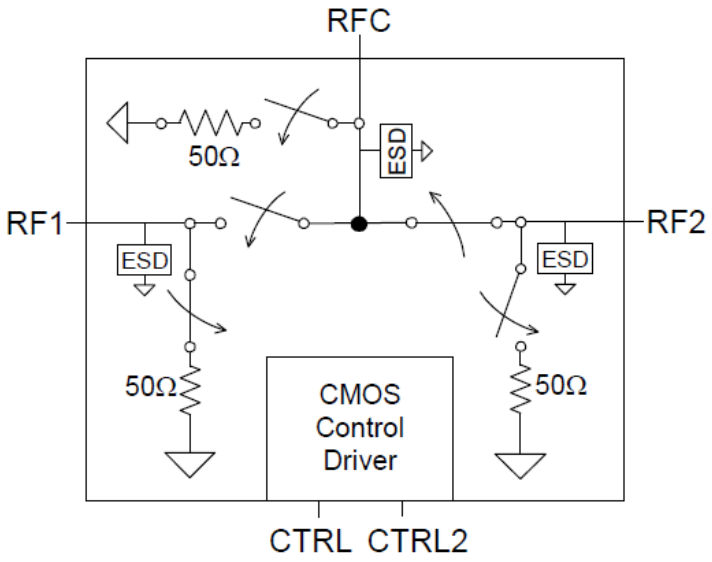


Figure 1. PE4257 functional diagram

Product description

The PE4257 is a high-isolation UltraCMOS® switch designed for wireless applications, covering a broad frequency range from near 10 MHz up to 3000 MHz. 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 +3V supply. In a typical wireless application, the PE4257 provides unprecedented isolation and integration.

The PE4257 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.

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Headquarters: 9369 Carroll Park Dr, San Diego, CA 92121

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. PE4257 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	V_{DD} + 0.3	V
RF power on RFC, RF1, RF2 on port/terminated port	P_{RF}	–	33/24	dBm
Storage temperature	T_{ST}	-65	+150	°C
Operating temperature	T_{OP}	-40	+85	°C
ESD voltage, Human Body Model (HBM)	V_{ESD}	–	1000	V

Recommended operating conditions

Table 2 lists the PE4257 recommended operating conditions. Do not operate devices outside the operating conditions listed below.

Table 2. PE4257 operating conditions @ 25 °C

Parameter	Symbol	Min	Typ	Max	Unit
Power supply	V_{DD}	2.7	3.0	3.3	V
Power supply current (V_{DD} = 3V, V_{CTRL} = 3V)	I_{DD}	–	8	20	µA
Control voltage high	V_{IH}	0.7 × V_{DD}	–	–	V
Control voltage low	V_{IL}	0	–	0.3 × V_{DD}	V

Electrical specifications

Table 3 lists the PE4257 key electrical specifications at +25 °C and V_{DD} = 3.0V (Z_S = Z_L = 50Ω), unless otherwise specified.

Table 3. PE4257 electrical specifications

Parameter	Condition	Min	Typ	Max	Unit
Operating frequency(1)	–	10	–	3000	MHz
Insertion loss	1000 MHz 2000 MHz 3000 MHz	–	0.75 0.95 1.2	0.95 1.15 1.4	dB
Isolation, input to output	1000 MHz 2000 MHz 3000 MHz	61 46 40	64 50 44	–	dB
Isolation, output to input	1000 MHz 2000 MHz 3000 MHz	57 54 42	63 60 48	–	dB
Input IP2	10–1000 MHz	–	80	–	dBm
Input IP3	10–1000 MHz	50	55	–	dBm
Input 1-dB compression point(2)	1000 MHz	29	31	–	dBm
Switching time(3)	50% CTRL to 10%/90% RF	–	2	–	µs
Video feedthrough(4)	10–1000 MHz	–	–	15	mV_{PP}

1. The device linearity can begin to degrade below 5 MHz.
2. See the absolute maximum ratings in Table 1.
3. The PE4257 has a maximum 25-kHz switching rate when the internal negative voltage generator is used (pin 18 = GND). The rate at which the PE4257 can be switched is only limited to the switching time if an external -3V supply is provided at (pin 18 = V_{SS}).
4. Measured with a 1-ns risetime, 0/3 V pulse, and a 500-MHz bandwidth.

SPDT control logic

Table 4. PE4257 truth table

CTRL1	CTRL2	RFC–RF1	RFC–RF2
Low	Low	OFF	OFF
Low	High	OFF	ON
High	Low	ON	OFF
High	High	N/A(*)	N/A(*)

* The operation of the PE4257 is not supported nor characterized in the C1 = V_{DD} and the C2 = V_{DD} state.

Typical performance data

Figure 2–Figure 5 show the typical performance data at +25 °C, unless otherwise specified, and 50Ω impedance.

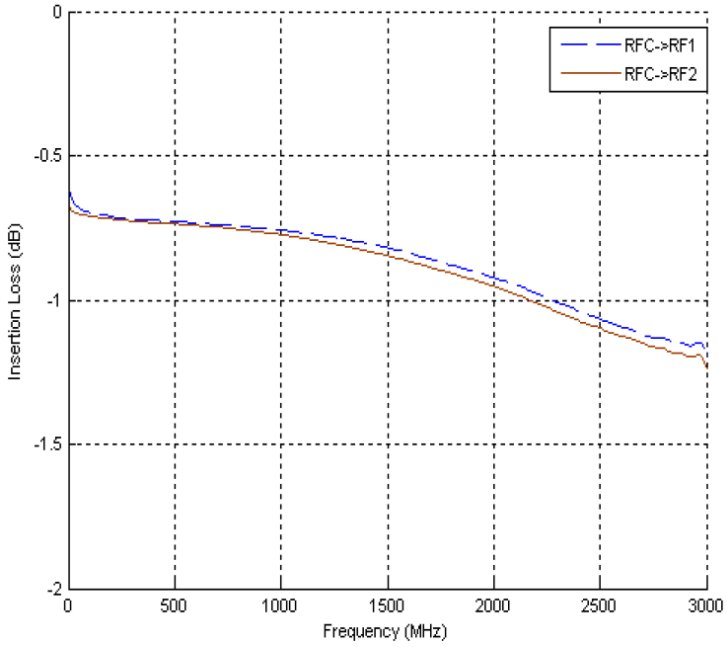


Figure 2. Insertion loss – Input – Output

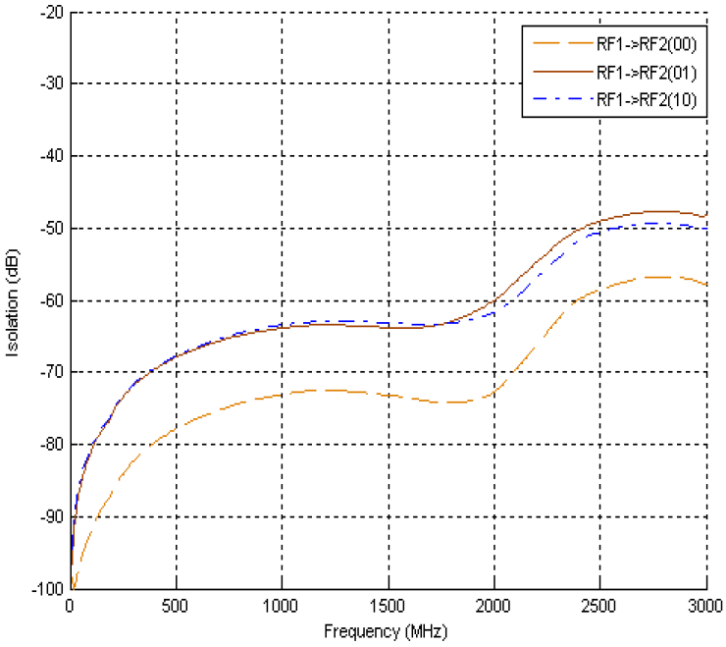


Figure 3. RF1 to RF2 isolation

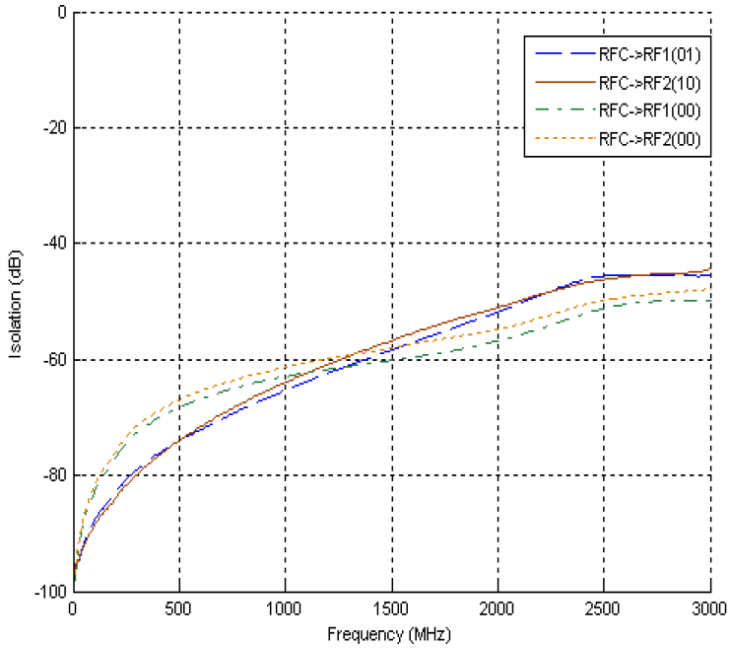


Figure 4. Isolation – RFC to RF1/RF2

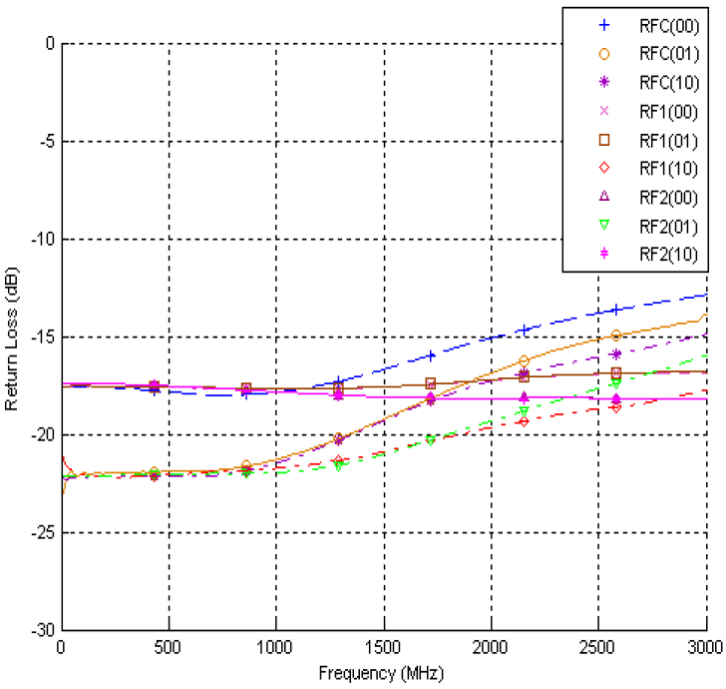


Figure 5. Return loss

Evaluation kit

pSemi designed the SPDT switch evaluation board to ease your evaluation of the PE4257. The RF common port connects through a 50Ω transmission line to J2. Ports 1 and 2 connect through 50Ω transmission lines to J1 and J3. A through transmission line connects SMA connectors J4 and J5. Use this transmission line to estimate the loss of the PCB over the environmental conditions being evaluated.

The board is constructed of a four metal layer FR4 material with a total thickness of 0.031”. The transmission lines were designed using a coplanar waveguide with ground plane (28 mil core, 47.6 mil width, 30 mil gap).

Note the number of vias surrounding the device in the layout shown in Figure 6. These vias are critical for obtaining the specified isolation performance for the device shown in this datasheet.

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 will flow through the 1 MΩ pull-up resistor. Do not attribute this extra current to the requirements of the device.

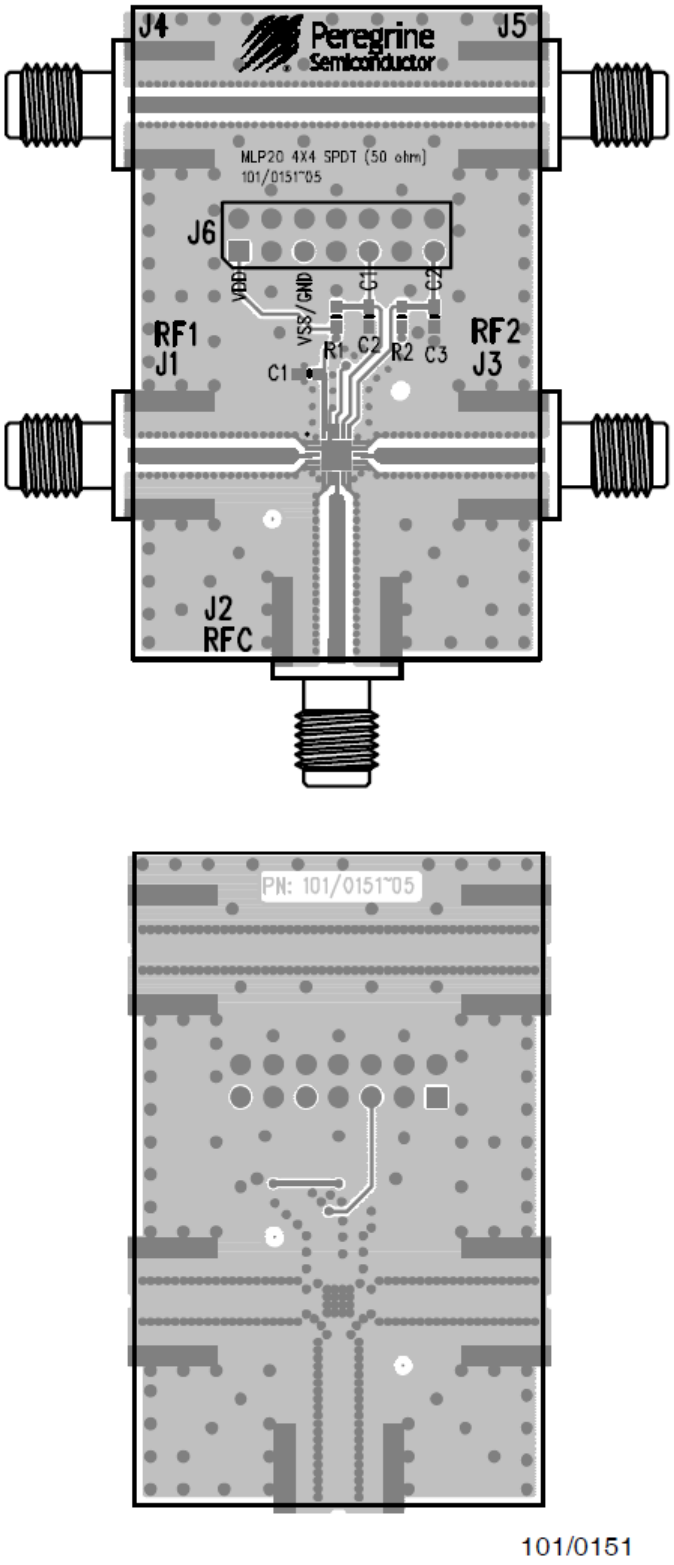


Figure 6. Evaluation board layout

Evaluation board schematic

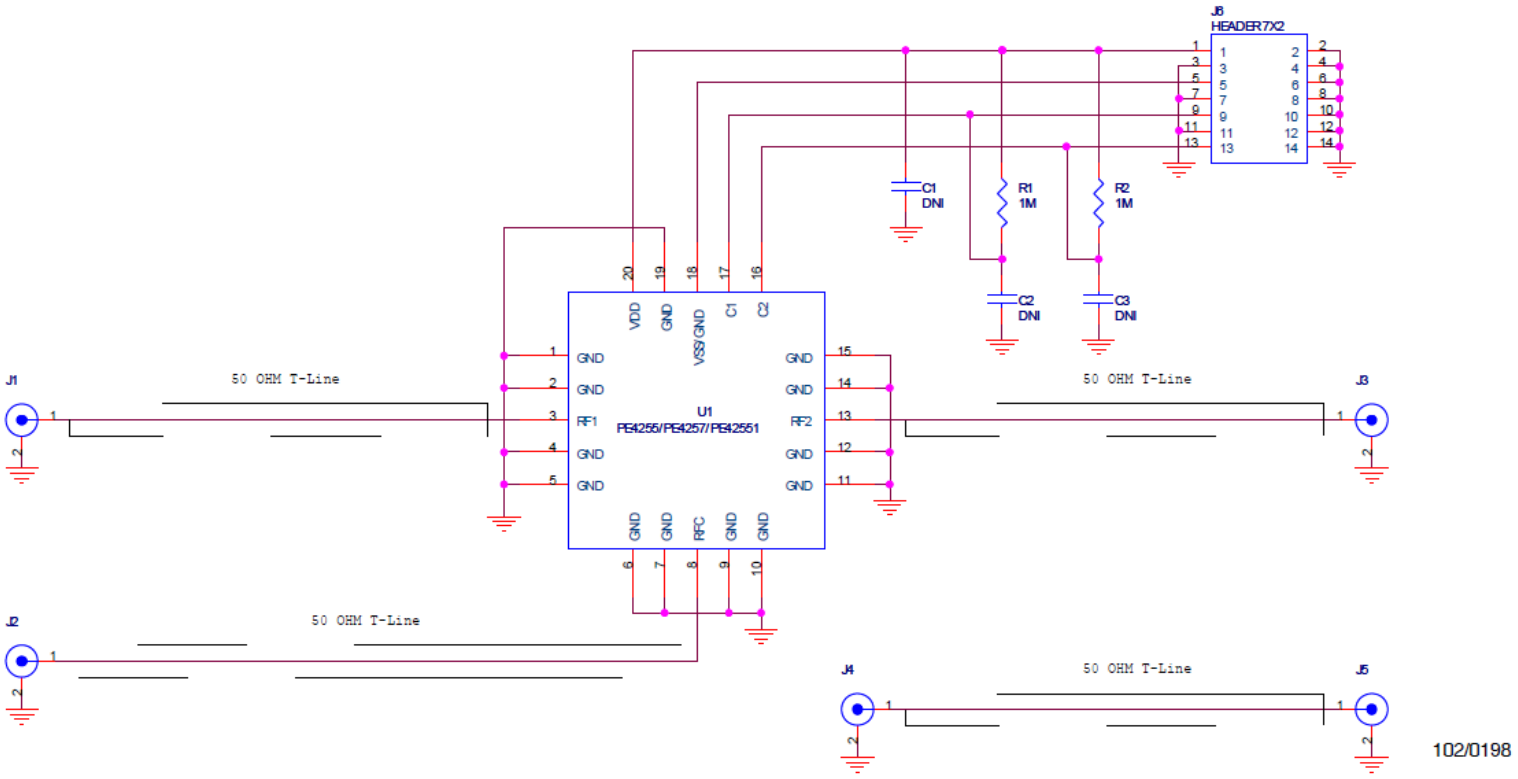


Figure 7. Evaluation board schematic

Pin information

Figure 8 shows the PE4257 pin map for the 20-lead 4 × 4 mm QFN package, and Table 5 lists the description for each pin.

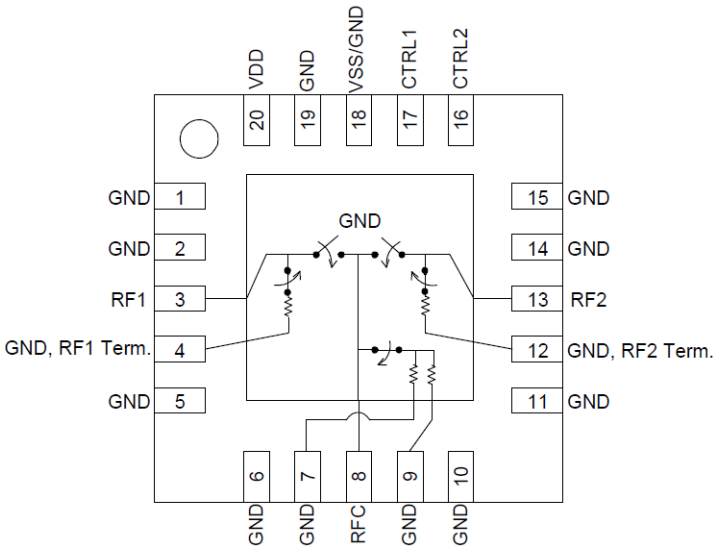


Figure 8. Pin configuration (top view)

Table 5. PE4257 pin descriptions

Pin no.	Pin name	Description
1, 2, 4–7, 9–12, 14, 15	GND	RF ground
3(1)	RF1	RF port 1
8(1)	RFC	RF common
13(1)	RF2	RF port 2
16(2)	CTRL2	Control 2
17(2)	CTRL1	Control 1
18(3)	V_{SS}/GND	Negative supply option
19	GND	Digital ground
20	V_{DD}	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. CMOS control pins 16 and 17 set the four operating states.
3. Connect pin 18 to GND to enable the internal negative voltage generator. Connect pin 18 to V_{SS} (-3V) to bypass and disable the internal -3V supply generator. See the switching time in Table 3.

Packaging information

This section provides the following packaging data:

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

Moisture sensitivity level

The PE4257 moisture sensitivity level rating for the 20-lead 4 × 4 mm QFN package is MSL1.

Package drawing

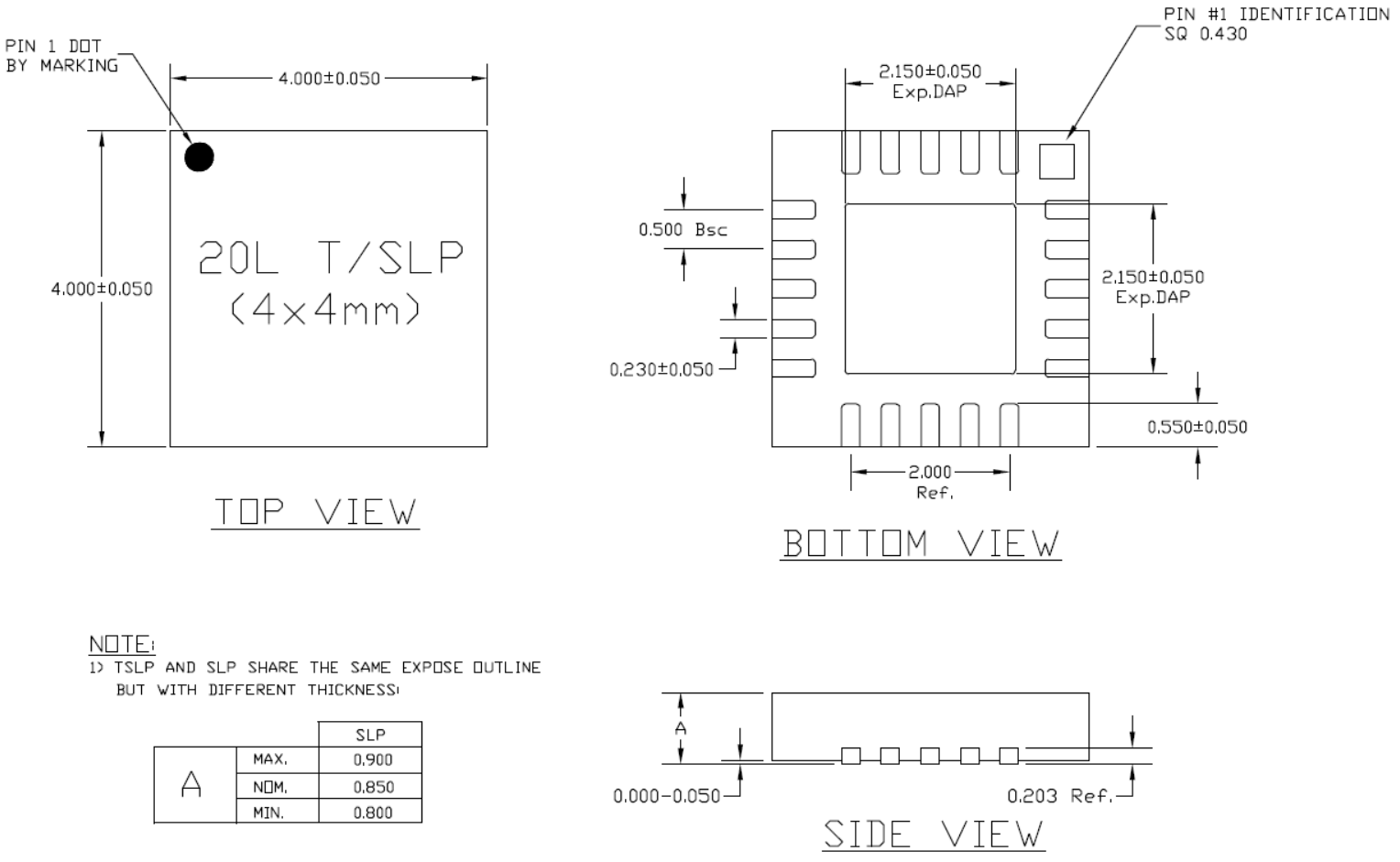


Figure 9. Package mechanical drawing for the 20-lead 4 × 4 mm QFN package

Top-marking specification

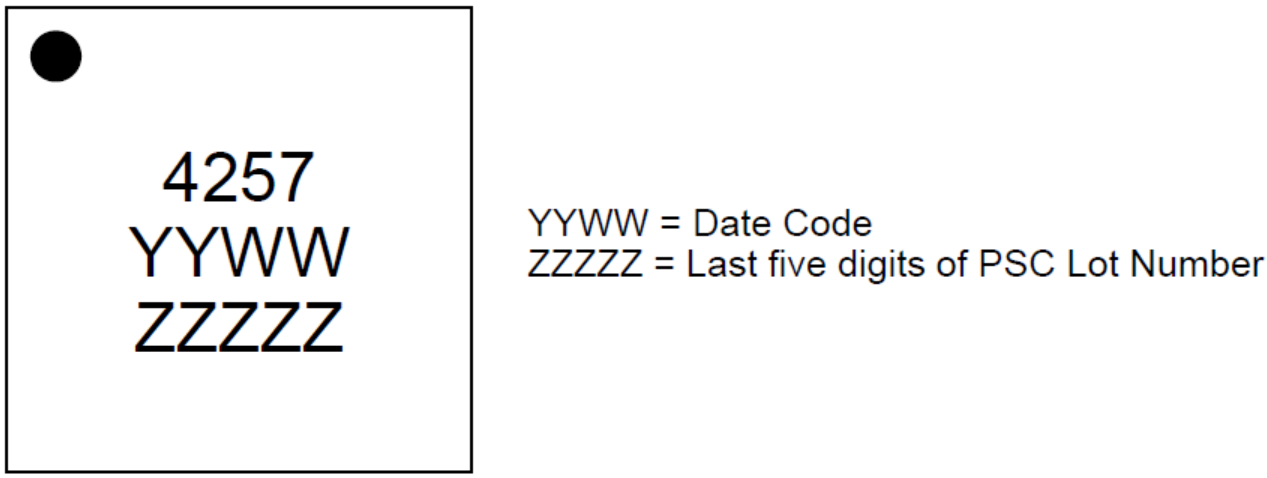
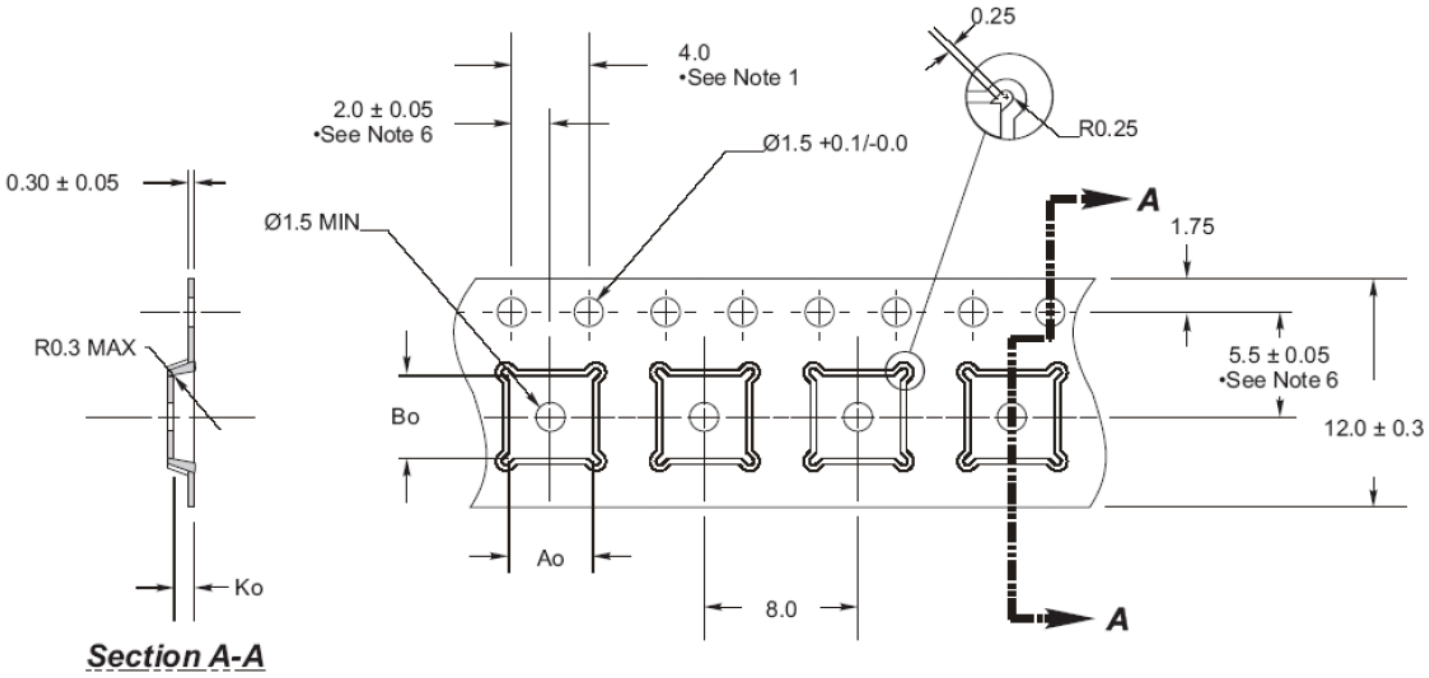
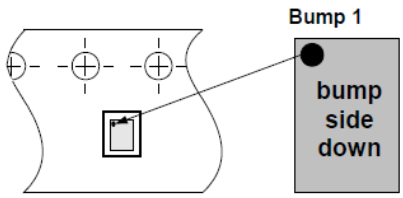


Figure 10. PE4257 package marking specification

Tape and reel specification



	Nominal	Tolerance
Ao	4.35	±0.05
Bo	4.35	±0.05
Ko	1.10	±0.05



Device Orientation in Tape

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

Ordering information

Order code	Description	Packaging	Shipping method
4257-52	PE4257 SPDT RF switch	Green 20-lead 4 × 4 mm QFN	3000 units/T&R
4257-00	PE4257 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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