Peregrine Semiconductor

Product Specification

PE4257

50 ΩSPDT Absorptive UltraCMOS™ DC – 3.0 GHz RF Switch

Features

- 50 Ω characteristic impedance
- Integrated 50 Ω 0.25 watt 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 +3 volt supply operation
- Low current consumption: 8 µA

Product Description

The PE4257 is a high-isolation UltraCMOS™ Switch designed for wireless applications, covering a broad frequency range from near DC 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 3-volt supply. In a typical wireless application, the PE4257 provides unprecedented isolation and integration.

The PE4257 is manufactured in Peregrine's patented Ultra Thin Silicon (UTSi®) CMOS process, offering the performance of GaAs with the economy and integration of conventional CMOS.
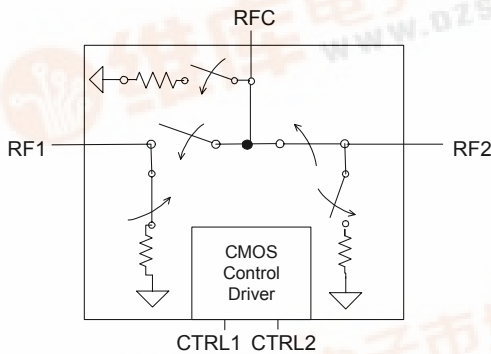
Figure 1. Functional Diagram
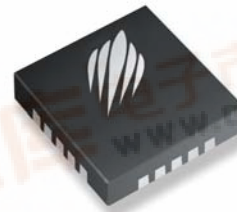

Figure 2. Package Type

4x4mm 20 Lead QFN

Table 1. Electrical Specifications @ +25 °C, V_{DD} = 3.0 V ($Z_S = Z_L = 50\ \Omega$)

Parameter	Condition	Minimum	Typical	Maximum	Units
Operating Frequency[1]		DC		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 Output	1000 MHz 2000 MHz 3000 MHz	57 54 42	63 60 48		dB
Input IP2	5 MHz - 1000 MHz		80		dBm
Input IP3	5 MHz - 1000 MHz	50	55		dBm
Input 1dB Compression[2]	1000 MHz	29	31		dBm
Switching Time	50% CTRL to 10 / 90 RF		2		µs
Video Feedthrough[3]	5 MHz - 1000 MHz			15	mV$_{pp}$

Notes: 1. Device linearity will begin to degrade below 1 MHz.
2. Note Absolute Maximum ratings in Table 3.
3. Measured with a 1 ns risetime, 0/3 V pulse and 500 MHz bandwidth
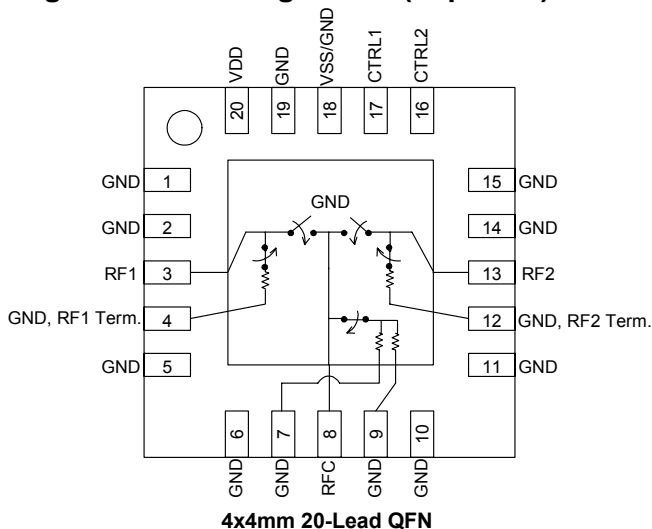
Figure 3. Pin Configuration (Top View)

4x4mm 20-Lead QFN

Table 2. Pin Descriptions

No.	Name	Description
1	GND	RF Ground
2	GND	RF Ground
3[1]	RF1	RF I/O
4	GND	RF Ground
5	GND	RF Ground
6	GND	RF Ground
7	GND	RF Ground
8[1]	RFC	RF Common
9	GND	RF Ground
10	GND	RF Ground
11	GND	RF Ground
12	GND	RF Ground
13[1]	RF2	RF I/O
14	GND	RF Ground
15	GND	RF Ground
16[2]	CTRL2	Control 2
17[2]	CTRL1	Control 1
18[3]	VSS / GND	Negative Supply Option
19	GND	Digital Ground
20	VDD	Supply
Pad	GND	RF Ground Pad

Notes:

1. RF pins 3, 8, and 13 must be at 0 VDC. The RF pins do not require DC blocking capacitors for proper operation if the 0 VDC requirement is met.

2. Pins 16 and 17 are the CMOS controls that set the four operating states.

3. Connect pin 18 to GND to enable the negative voltage generator. Connect pin 18 to V_{SS} (-3 V) to bypass and disable internal -3 V supply generator. See paragraph "Switching Frequency."

Table 3. Absolute Maximum Ratings

Symbol	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 On Port/ Terminated Port		33/24	dBm
T_{ST}	Storage temperature	-65	+150	°C
T_{OP}	Operating temperature	-40	+85	°C
V_{ESD}	ESD voltage (Human Body Model)	1000		V

Absolute Maximum Ratings are those values listed in the above table. Exceeding these values may cause permanent device damage. Functional operation should be restricted to the limits in the DC Electrical Specifications table. Exposure to absolute maximum ratings for extended periods may affect device reliability.

Table 4. DC Electrical Specifications @ 25 °C

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	0.70 V_{DD}			V
Control Voltage Low	0		0.30 V_{DD}	V

Latch-Up Avoidance

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

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.

Switching Frequency

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 -3 V supply is provided at (pin18=V_{SS}).

Table 5. Truth Table

CTRL1	CTRL2	RFC – RF1	RFC – RF2
Low	Low	OFF	OFF
Low	High	OFF	ON
High	Low	ON	OFF
High	High	N/A[1]	N/A[1]

Typical Performance Data @ 25°C (Unless Otherwise Noted)
(50-ohm impedance)
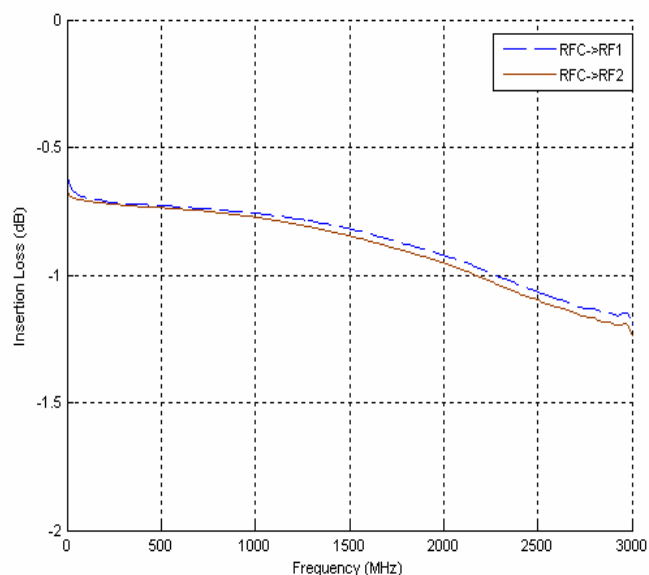
Figure 4. Insertion Loss – Input - Output
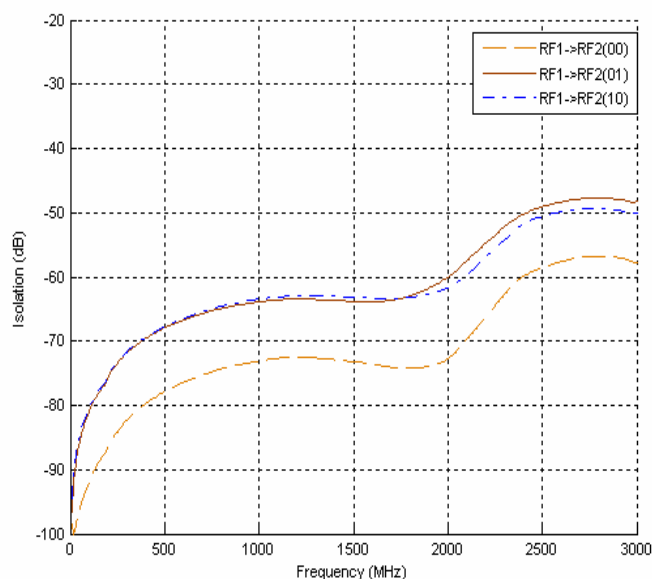

Figure 5. RF1 to RF2 Isolation
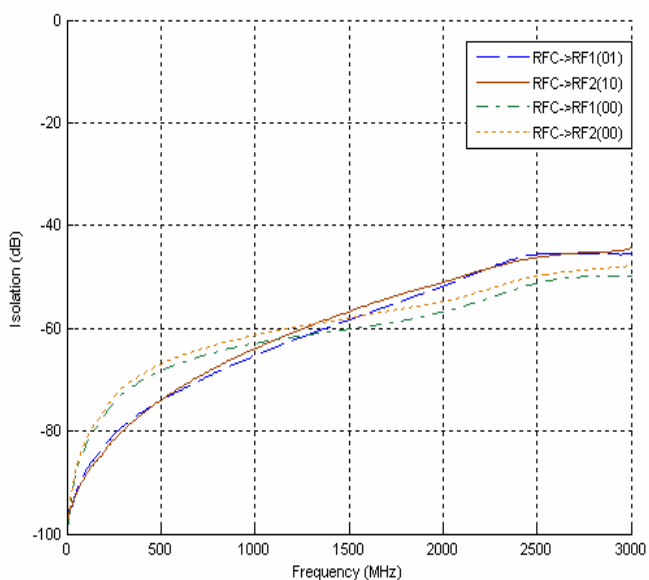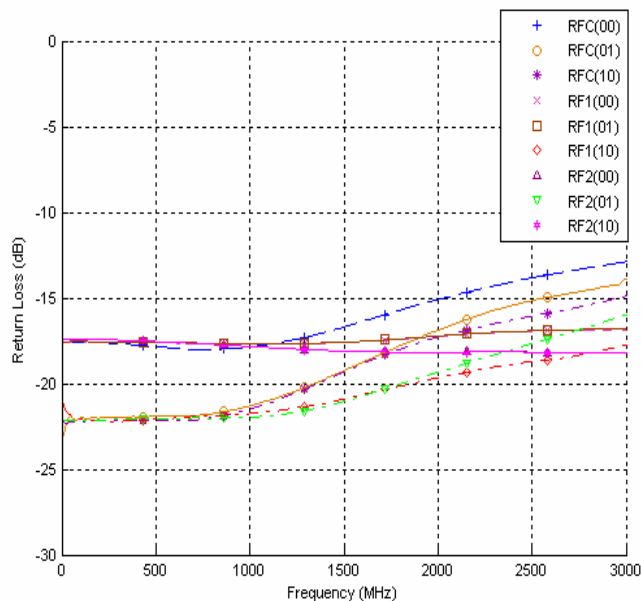

Figure 6. Isolation – RFC to RF1/RF2

Figure 7. Return Loss

Evaluation Kit

The SPDT Switch Evaluation Kit board was designed to ease customer evaluation of the PE4257 SPDT switch. The RF common port is connected through a 50 Ω transmission line to J2. Port 1 and Port 2 are connected through 50 Ω transmission lines to J1 and J3. A through transmission line connects SMA 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 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, 30mil gap).

Note the number of vias surrounding the device in the layout shown in Figure 8. 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 VDD for logic high. When the jumper is in place, 3 µA of current will flow through the 1 MΩ pull up resistor. This extra current should not be attributed to the requirements of the device.

Figure 8. Evaluation Board Layouts
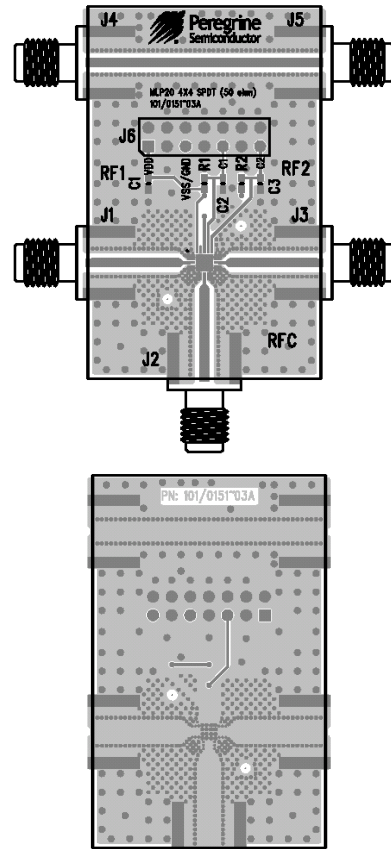Peregrine Specification 101/0151

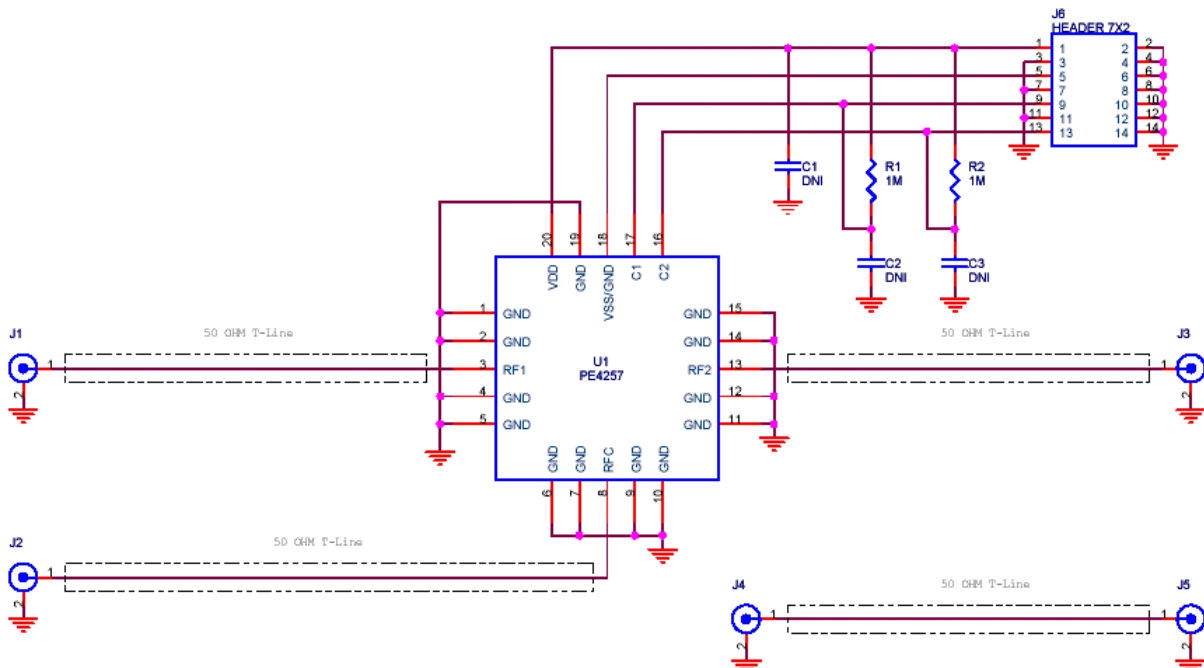## Figure 9. Evaluation Board Schematic
Peregrine Specification 102/0198

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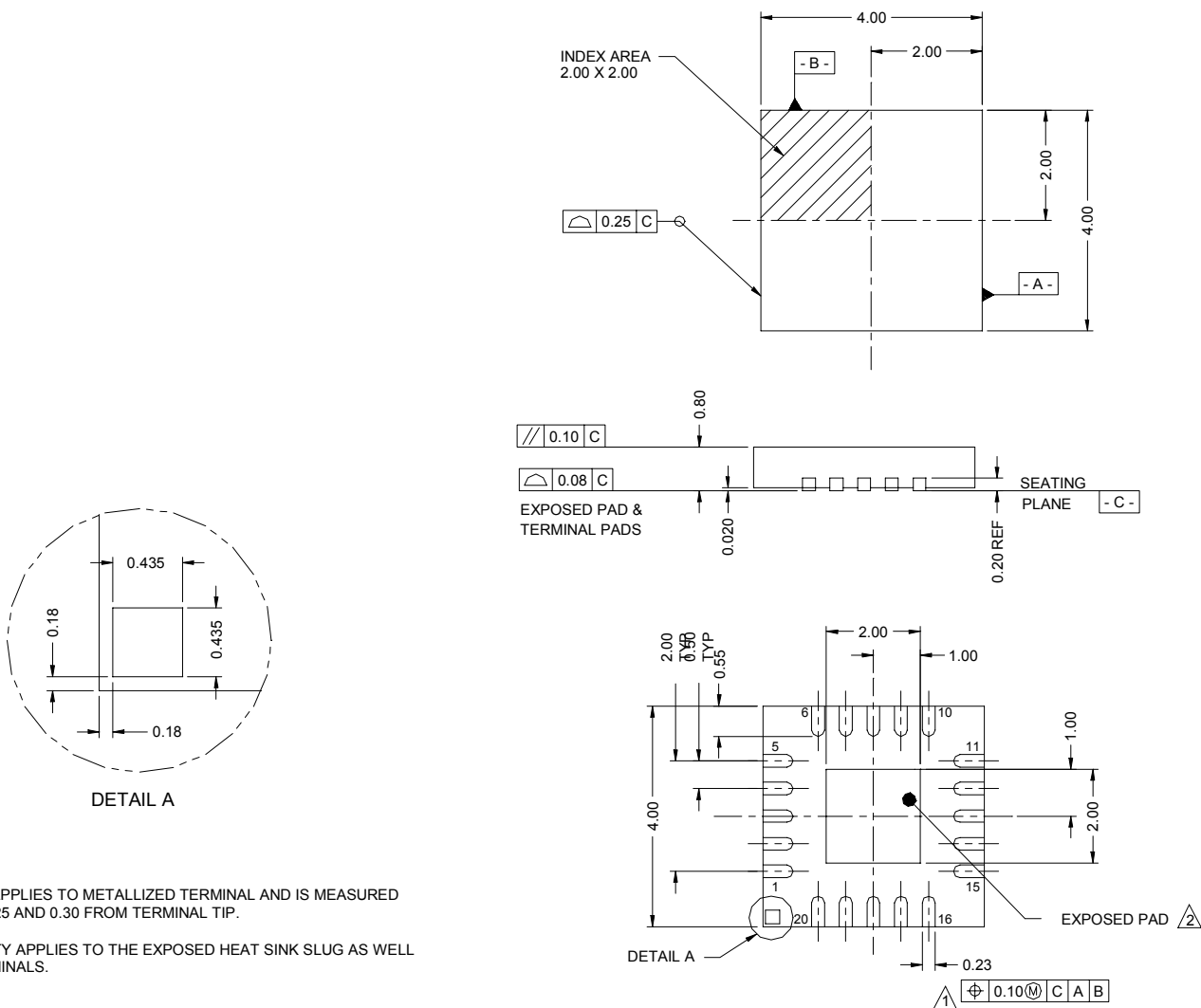## Figure 10. Package Drawing

20-Lead 4x4 QFN

DETAIL A

1. DIMENSION APPLIES TO METALLIZED TERMINAL AND IS MEASURED BETWEEN 0.25 AND 0.30 FROM TERMINAL TIP.

2. COPLANARITY APPLIES TO THE EXPOSED HEAT SINK SLUG AS WELL AS THE TERMINALS.

Table 6. Ordering Information

Order Code	Part Marking	Description	Package	Shipping Method
4257-01	4257	PE4257-20QFN 4x4mm-75A	20-lead 4x4mm QFN	75 units / Tube
4257-02	4257	PE4257-20QFN 4x4mm-3000C	20-lead 4x4mm QFN	3000 units / T&R
4257-00	PE4257-EK	PE4257-20QFN 4x4mm-EK	Evaluation Kit	1 / Box
4257-51	4257	PE4257G-20QFN 4x4mm-75A	Green 20-lead 4x4mm QFN	75 units / Tube
4257-52	4257	PE4257G-20QFN 4x4mm-3000C	Green 20-lead 4x4mm QFN	3000 units / T&R

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Data Sheet Identification

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. Peregrine reserves the right to change specifications at any time without notice in order to supply the best possible product.

Product Specification

The data sheet contains final data. In the event Peregrine decides to change the specifications, Peregrine will notify customers of the intended changes by issuing a DCN (Document Change Notice).