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Peregrine Semiconductor

Product Specification

PE4220

SPDT UltraCMOS™ RF Switch
DC - 2500 MHz

Features

- Single 3-volt power supply
- Very low insertion loss: 0.25 dB at 1000 MHz
- High isolation: 37 dB at 1.0 GHz
- Typical input 1 dB compression point of +22.5 dBm
- Single-pin CMOS or TTL logic control
- Packaged in a small 8-lead MSOP

Product Description

The PE4220 UltraCMOS™ RF Switch is designed to cover a broad range of applications from near DC to 2500 MHz. This single-supply switch integrates on-board CMOS control logic driven by a simple, single-pin CMOS or TTL compatible control input. Using a nominal +3-volt power supply, a typical input 1 dB compression point of +22 dBm can be achieved. The PE4220 also exhibits input-output isolation of better than 37 dB at 1000 MHz and is offered in a small 8-lead MSOP package.

The PE4220 UltraCMOS™ RF Switch 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

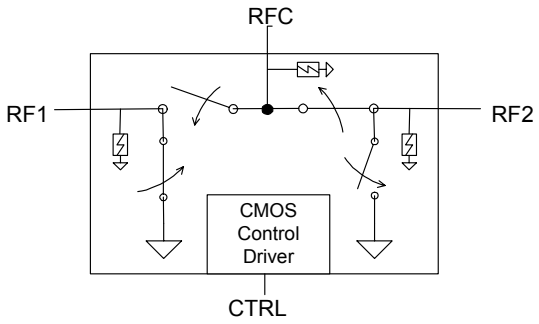

Figure 2. Package Type

8-lead MSOP

Table 1. Electrical Specifications @ +25 °C, V_{DD} = 3 V (Z_S = Z_L = 50 Ω)

Parameter	Conditions	Minimum	Typical	Maximum	Units
Operating Frequency[1]		DC		2500	MHz
Insertion Loss	1000 MHz		0.25	0.35	dB
Isolation – RFC to RF1/RF2	1000 MHz	34.5	37		dB
Isolation – RF1 to RF2	1000 MHz	34	35		dB
Return Loss	1000 MHz	17.5	19		dB
'ON' Switching Time	CTRL to 0.1 dB final value, 2 GHz		200		ns
'OFF' Switching Time	CTRL to 25 dB isolation, 2 GHz		90		ns
Video Feedthrough[2]			5.0		mV_{pp}
Input 1 dB Compression	2000 MHz	20	22.5		dBm
Input IP3	2000 MHz, 8 dBm	42	43.5		dBm

Notes: 1. Device linearity will begin to degrade below 10 MHz.

2. The DC transient at the output of any port of the switch when the control voltage is switched from Low to High or High to Low in a 50Ω test set-up, measured with 1ns risetime pulses and 500 MHz bandwidth.

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Figure 3. Pin Configuration (Top View)

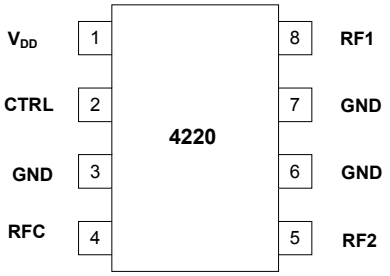

Table 2. Pin Descriptions

Pin No.	Pin Name	Description
1	V_{DD}	Nominal 3 V supply connection. A bypass capacitor (100 pF) to the ground plane should be placed as close as possible to the pin
2	CTRL	CMOS or TTL logic level: High = RFC to RF1 signal path Low = RFC to RF2 signal path
3	GND	Ground connection. Traces should be physically short and connected to ground plane for best performance.
4	RFC	Common RF port for switch (Note 1)
5	RF2	RF2 port (Note 1)
6	GND	Ground connection. Traces should be physically short and connected to ground plane for best performance.
7	GND	Ground connection. Traces should be physically short and connected to ground plane for best performance.
8	RF1	RF1 port (Note 1)

Note 1: All RF pins must be DC blocked with an external series capacitor or held at 0 V_{DC}.

Table 3. DC Electrical Specifications

Parameter	Min	Typ	Max	Units
V_{DD} Power Supply Voltage	2.7	3.0	3.3	V
I_{DD} Power Supply Current (V_{DD} = 3V, V_{CNTL} = 3)		30	40	µA
Control Voltage High	0.7x V_{DD}			V
Control Voltage Low			0.3x V_{DD}	V

Table 4. Absolute Maximum Ratings

Symbol	Parameter/Conditions	Min	Max	Units
V_{DD}	Power supply voltage	-0.3	4.0	V
V_I	Voltage on any input	-0.3	V_{DD} + 0.3	V
T_{ST}	Storage temperature range	-65	150	°C
T_{OP}	Operating temperature range	-40	85	°C
P_{IN}	Input power (50Ω)		25	dBm
V_{ESD}	ESD voltage (Human Body Model)		250	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.

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 specified rating in Table 4.

Latch-Up Avoidance

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

Table 5. Control Logic Truth Table

Control Voltage	Signal Path
CTRL = CMOS or TTL High	RFC to RF1
CTRL = CMOS or TTL Low	RFC to RF2

Control Logic

The control logic input pin (CTRL) is typically driven by a 3-volt CMOS logic level signal, and has a threshold of 50% of V_{DD}. For flexibility to support systems that have 5-volt control logic drivers, the control logic input has been designed to handle a 5-volt logic HIGH signal. (A minimal current will be sourced out of the V_{DD} pin when the control logic input voltage level exceeds V_{DD}.)

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Evaluation Kit

The SPDT Switch Evaluation Kit board was designed to ease customer evaluation of the PE4220 SPDT switch. The RF common port is connected through a 50 Ω transmission line to the top left SMA connector, J1. Port 1 and Port 2 are connected through 50 Ω transmission lines to the top two SMA connectors on the right side of the board, J3 and J4. A through transmission line connects SMA connectors J6 and J8. 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 two metal layer FR4 material with a total thickness of 0.031". The bottom layer provides ground for the RF transmission lines. The transmission lines were designed using a coplanar waveguide model with a trace width of 0.030", trace gaps of 0.007", dielectric thickness of 0.028", metal thickness of 0.0014" and ε_r of 4.4. Note that the predominate mode for these transmission lines is coplanar waveguide with a ground plane.

J2 provides a means for controlling DC and digital inputs to the device. Starting from the lower left pin, the second pin to the right (J2-3) is connected to the device CTRL input. The fourth pin to the right (J2-7) is connected to the device V_{DD} input. A decoupling capacitor (100 pF) is provided on both CTRL and V_{DD} traces. It is the responsibility of the customer to determine proper supply decoupling for their design application. Removing these components from the evaluation board has not been shown to degrade RF performance.

Figure 4. Evaluation Board Layout
Peregrine specification 101/0037

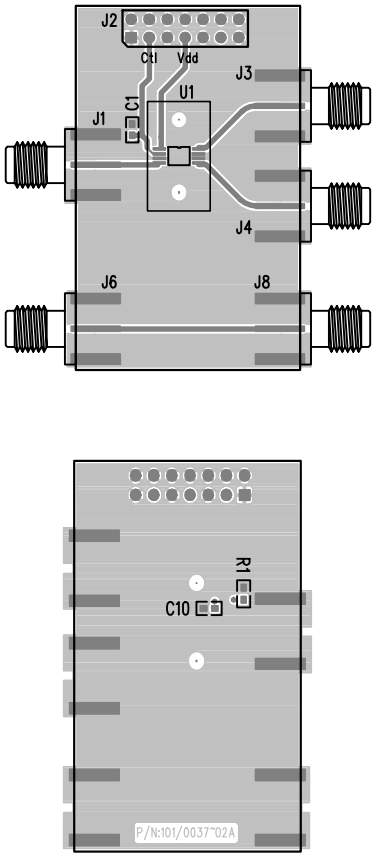
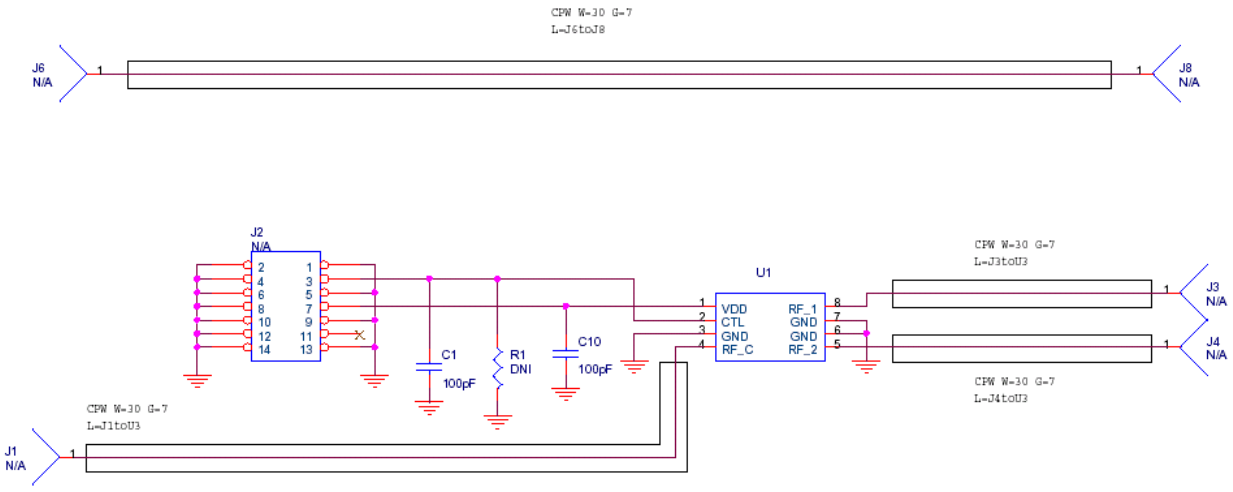


Figure 5. Evaluation Board Schematic
Peregrine specification 102/0035



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Typical Performance Data @ -40 °C to 85 °C (Unless otherwise noted)

Figure 6. Insertion Loss – RFC to RF1

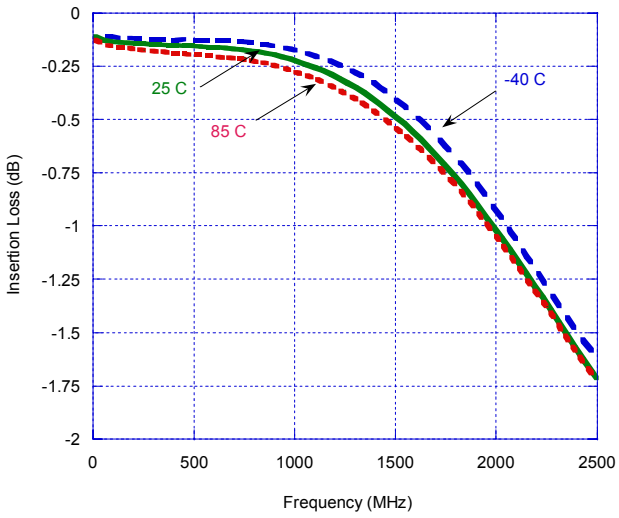


Figure 7. Input 1 dB Compression Point & IIP3

T = 25 °C

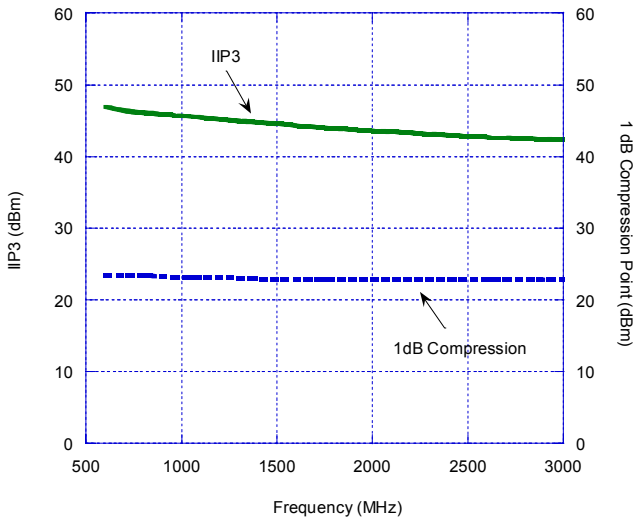


Figure 8. Insertion Loss – RFC to RF2

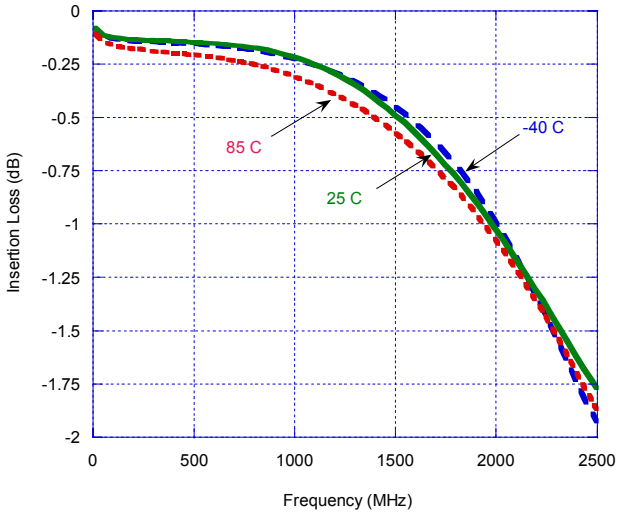
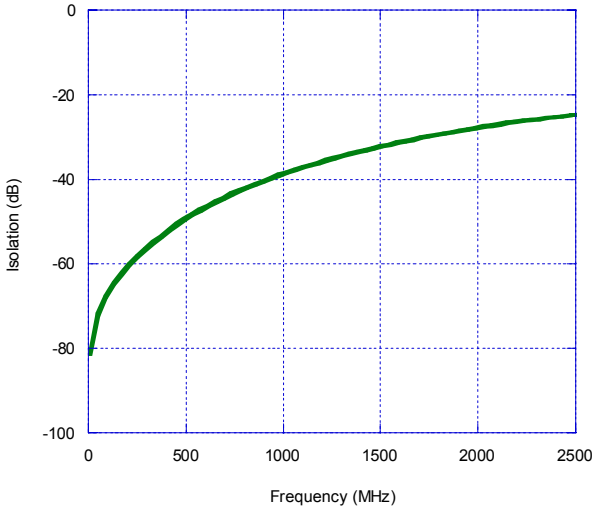


Figure 9. Isolation – RFC to RF1

T = 25 °C



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Typical Performance Data @ 25 °C

Figure 10. Isolation – RFC to RF2

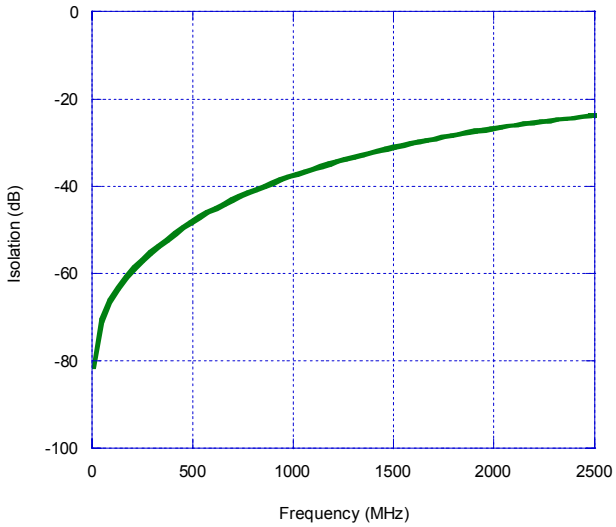

Figure 11. Isolation – RF1/RF2 to RF2/RF1

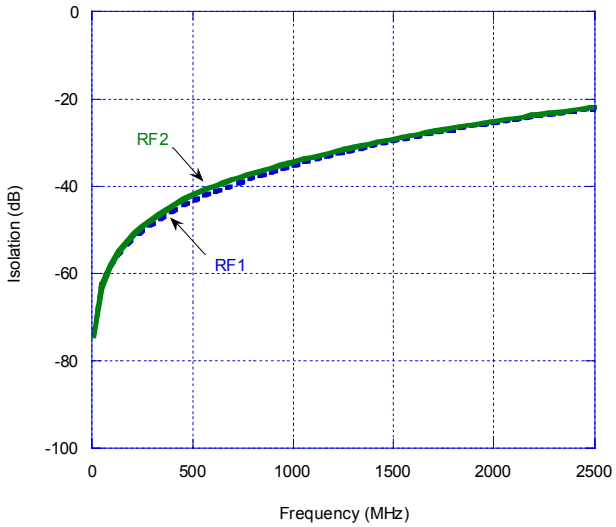

Figure 12. Return Loss – RFC

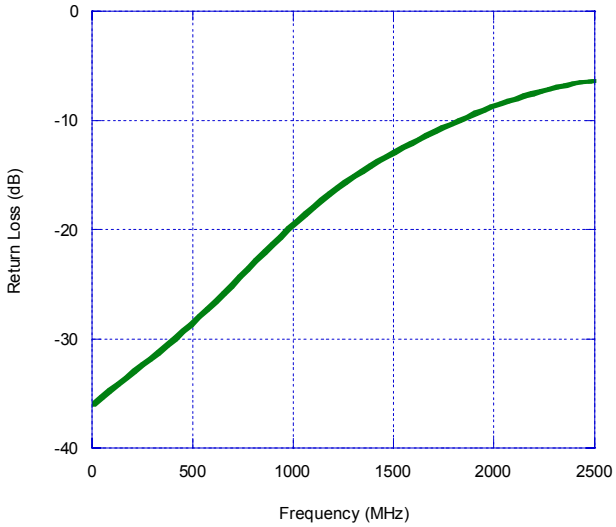

Figure 13. Return Loss – RF1, RF2

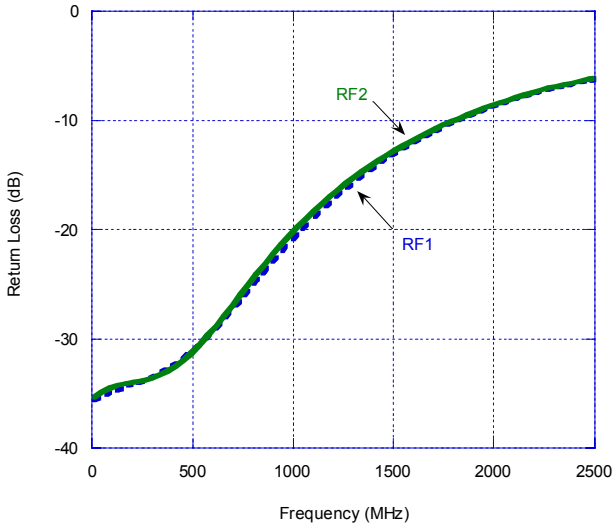

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Figure 14. Package Drawing

8-lead MSOP

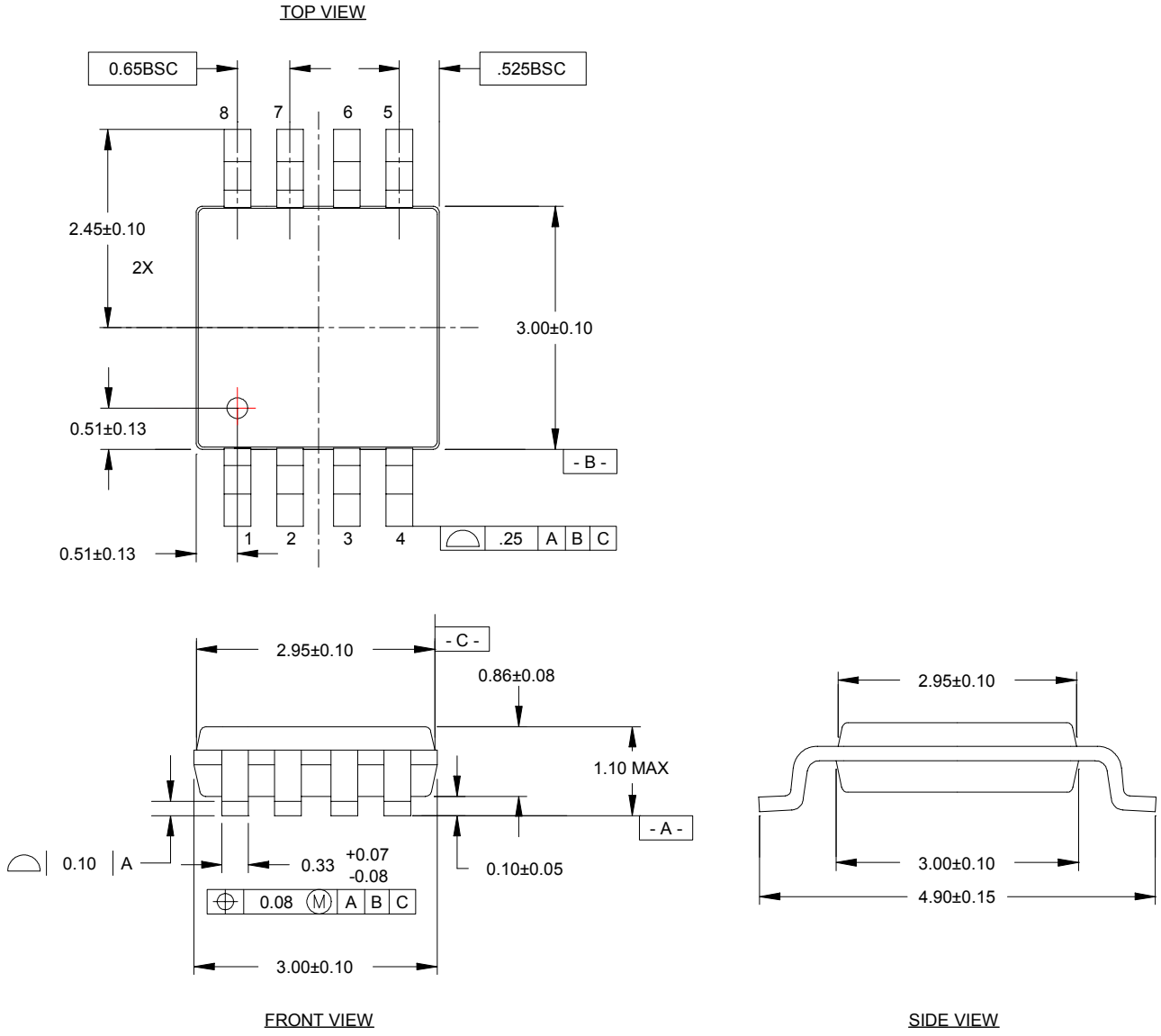

Table 6. Ordering Information

Order Code	Part Marking	Description	Package	Shipping Method
4220-21	4220	PE4220-08MSOP-50A	8-lead MSOP	50 units / Tube
4220-22	4220	PE4220-08MSOP-2000C	8-lead MSOP	2000 units / T&R
4220-00	PE4220-EK	PE4220-08MSOP-EK	Evaluation Kit	1 / Box
4220-51	4220	PE4220G-08MSOP-50A	Green 8-lead MSOP	50 units / Tube
4220-52	4220	PE4220G-08MSOP-2000C	Green 8-lead MSOP	2000 units / T&R

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Data Sheet Identification

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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

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