PEREGRINE SEMICONDUCTOR

PRODUCT SPECIFICATION

# PE83501

**Military Operating Temperature Range**

## 3.5 GHz Low Power CMOS Divide-by-2 Prescaler

### Features

- High-frequency operation: 400 MHz to 3.5 GHz
- Fixed divide ratio of 2
- Low-power operation: 12 mA typical @ 3 V
- Small package: 8-lead MSOP
- Low cost

## Product Description

*The PE83501 is a high-performance dynamic CMOS prescaler with a fixed divide ratio of 2. Its operating frequency range is 400 MHz to 3.5 GHz. The PE83501 operates on a nominal 3 V supply and draws only 12 mA. It is packaged in a small 8-lead MSOP and is ideal for frequency scaling and microwave PLL synthesis solutions.*

*The PE83501 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 Schematic Diagram**

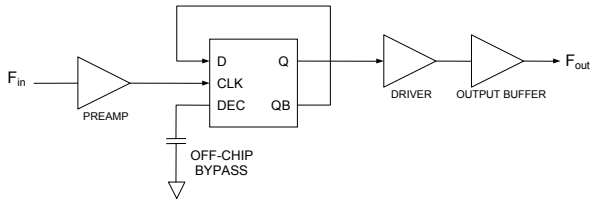



**Figure 2. Package Drawing**

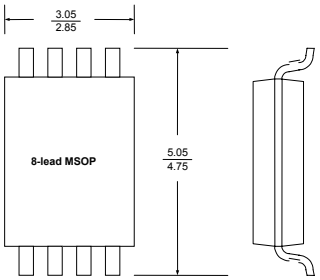
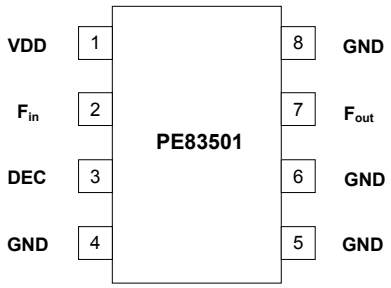



**Table 1. Electrical Specifications** ($Z_S = Z_L = 50\ \Omega$)

2.85V ≤ $V_{DD}$ ≤ 3.15 V; -55° C ≤ $T_A$ ≤ 125° C, unless otherwise specified

| Parameter | Conditions | Minimum | Typical | Maximum | Units |
|---|---|---|---|---|---|
| Supply Voltage | | 2.85 | 3.0 | 3.15 | V |
| Supply Current | | | 13 | 18 | mA |
| Input Frequency ($F_{in}$) | | 400 | | 3500 | MHz |
| Input Power ($P_{in}$) | 400 MHz ≤ $F_{in}$ ≤ 2.0 GHz | -10 | | +10 | dBm |
| | 2.0 GHz < $F_{in}$ ≤ 2.8 GHz | 0 | | +10 | dBm |
| | 2.8 GHz < $F_{in}$ ≤ 3.5 GHz | +5 | | +10 | dBm |
| Output Power ($P_{out}$) | 400 MHz ≤ $F_{in}$ ≤ 3.5 GHz | -15 | | | dBm |

## Figure 3. Pin Configuration




## Table 2. Pin Descriptions

| Pin No. | Pin Name | Description |
|---|---|---|
| 1 | VDD | Power supply pin. Bypassing is required. |
| 2 | $F_{in}$ | Input signal pin. DC blocking capacitor required (15 pF typical) |
| 3 | DEC | Power supply decoupling pin. Place a capacitor as close as possible and connect directly to the ground plane. |
| 4 | GND | Ground pin. Ground pattern on the board should be as wide as possible to reduce ground impedance. |
| 5 | GND | Ground pin. |
| 6 | GND | Ground pin. |
| 7 | $F_{out}$ | Divided frequency output pin. DC blocking capacitor required (47 pF typical) |
| 8 | GND | Ground pin. |

## Table 3. Absolute Maximum Ratings

| Symbol | Parameter/Conditions | Min | Max | Units |
|---|---|---|---|---|
| VDD | Supply voltage | | 4.0 | V |
| $P_{in}$ | Input Power | | 15 | dBm |
| $T_{ST}$ | Storage temperature range | -65 | 150 | °C |
| $T_{OP}$ | Operating temperature range | -55 | 125 | °C |
| VESD | ESD voltage (Human Body Model) | 250 | | V |

## Electrostatic Discharge (ESD) Precautions

When handling this UTSi 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 in Table 3.

## Latch-Up Avoidance

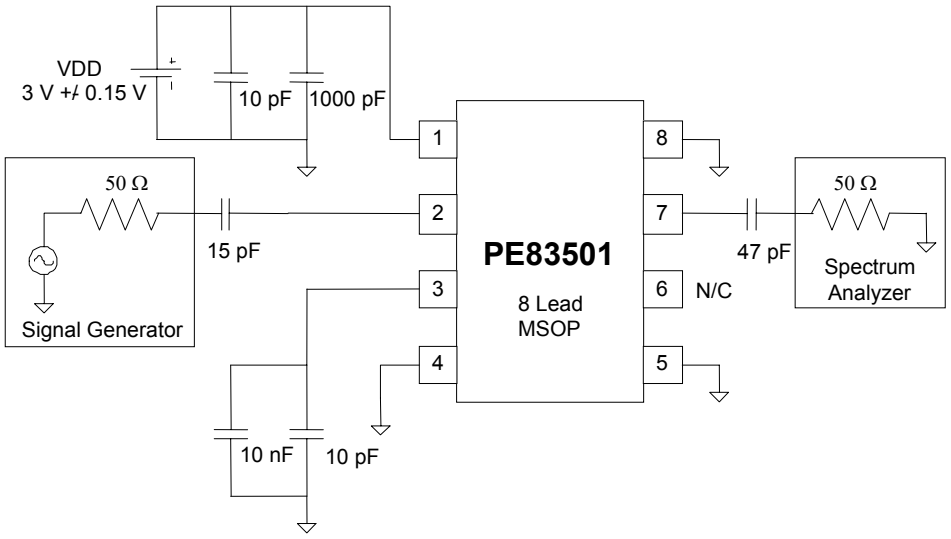
Unlike conventional CMOS devices, UTSi CMOS devices are immune to latch-up.

## Device Functional Considerations

The *PE83501* divides a 400 MHz to 3.5 GHz input signal by two, producing a 200 MHz to 1.75 GHz output signal. To work properly, pin 3 must be supplied with a bypass capacitor to ground. In addition, the input and output signals (pins 2 & 7) must be AC coupled via an external capacitor, as shown in the test circuit in Figure 4.

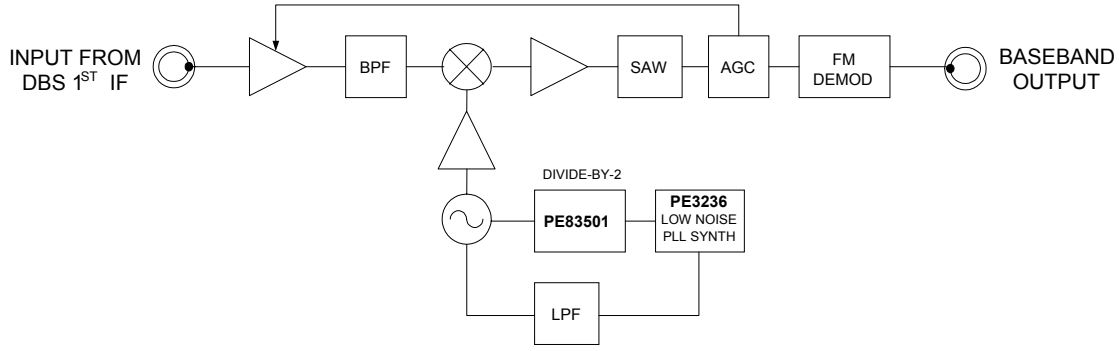
The ground pattern on the board should be made as wide as possible to minimize ground impedance. See Figure 11 for a layout example.

## Figure 4. Test Circuit Block Diagram



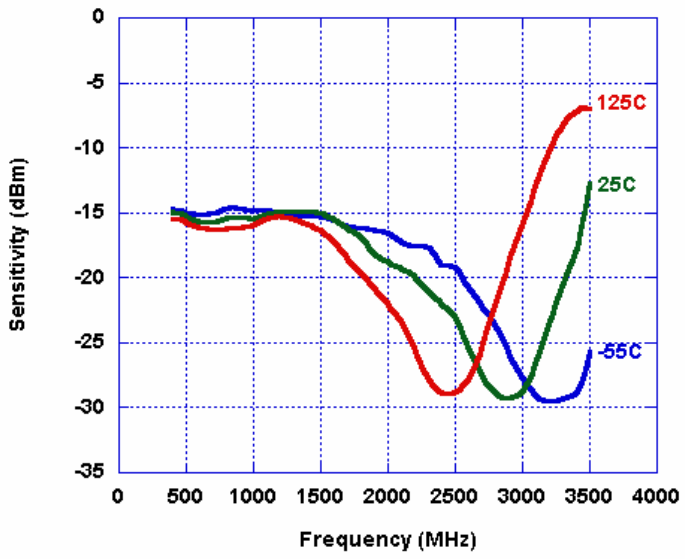

## Figure 5. High Frequency System Application

The wideband frequency of operation of the *PE83501* makes it an ideal part for use in a DBS downconverter system.

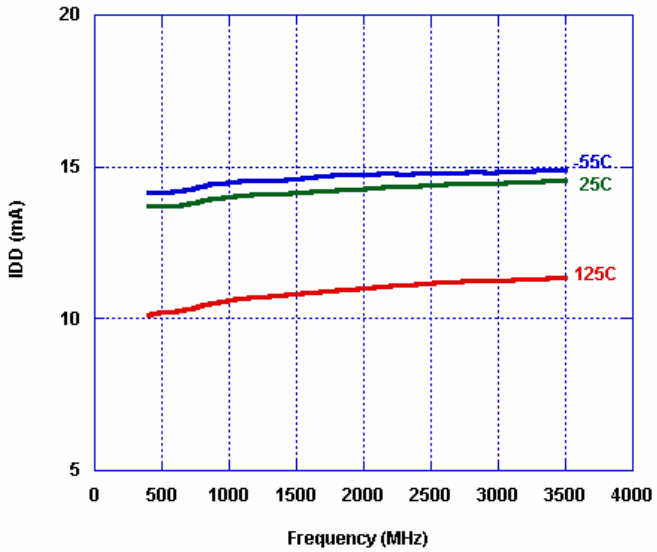


## Typical Performance Data: $V_{DD}$ = 3.0V

### Figure 6. Input Sensitivity




### Figure 7. Device Current




### Figure 8. Output Power

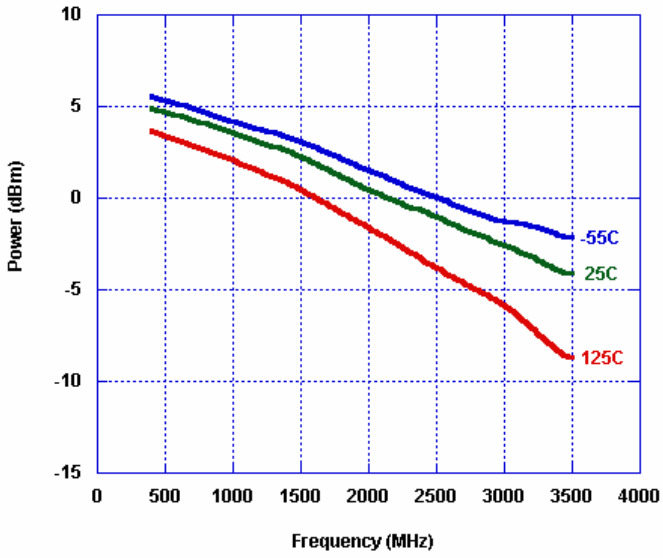


**Figure 10. Evaluation Board Schematic Diagram**

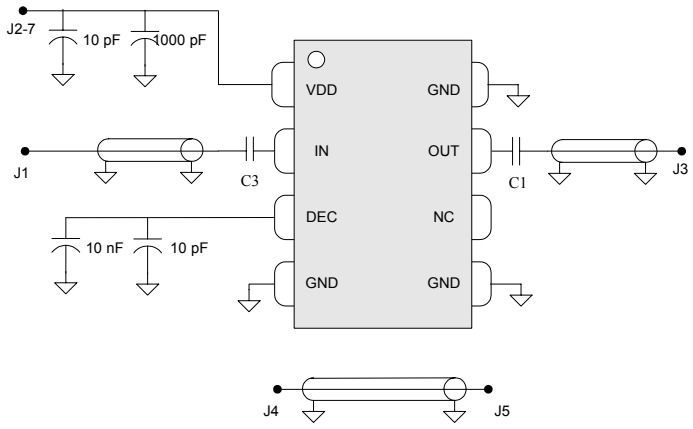
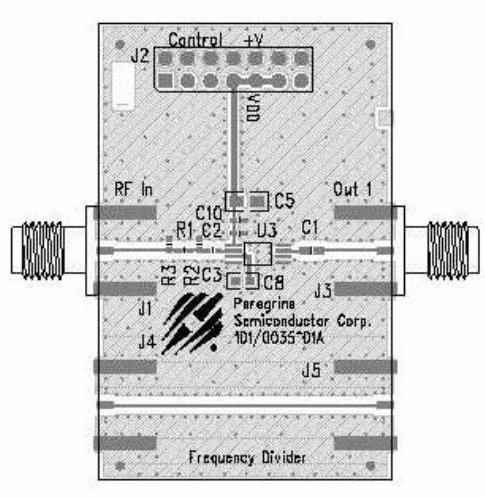



**Figure 11. Evaluation Board Layout**




## Evaluation Kit Operation

The MSOP Prescaler Evaluation Board was designed to help customers evaluate the *PE83501* Divide-by-2 Prescaler. On this board, the device input (pin 2) is connected to connector J1 through a 50 Ω transmission line. A series capacitor (C3) provides the necessary DC block for the device input. It is important to note that the value of this capacitance will impact the performance of the device. A value of 15 pF was found to be optimal for this board layout; other applications may require a different value.

The device output (pin 7) is connected to connector J3 through a 50 Ω transmission line. A series capacitor (C1) provides the necessary DC block for the device output. Note that this capacitor must be chosen to have a low impedance at the desired output frequency the device. The value of 47 pF was chosen to provide a wide operating range for the evaluation board.

The board is constructed of a two-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 above ground plane model with trace width of 0.030", trace gaps of 0.007", dielectric thickness of 0.028", metal thickness of 0.0014" and $\varepsilon_r$ of 4.4. Note that the predominate mode for these transmission lines is coplanar waveguide.

J2 provides DC power to the device. Starting from the lower left pin, the second pin to the right (J2-3) is connected to the device VDD pin (1). Two decoupling capacitors (10 pF, 1000 pF) are included on this trace. It is the responsibility of the customer to determine proper supply decoupling for their design application.

The DEC pin (3) must be connected to a low impedance AC ground for proper device operation. On the board, two decoupling capacitors (C6 = 10 nF, C4 = 10 pF), located on the back of the board, perform this function.

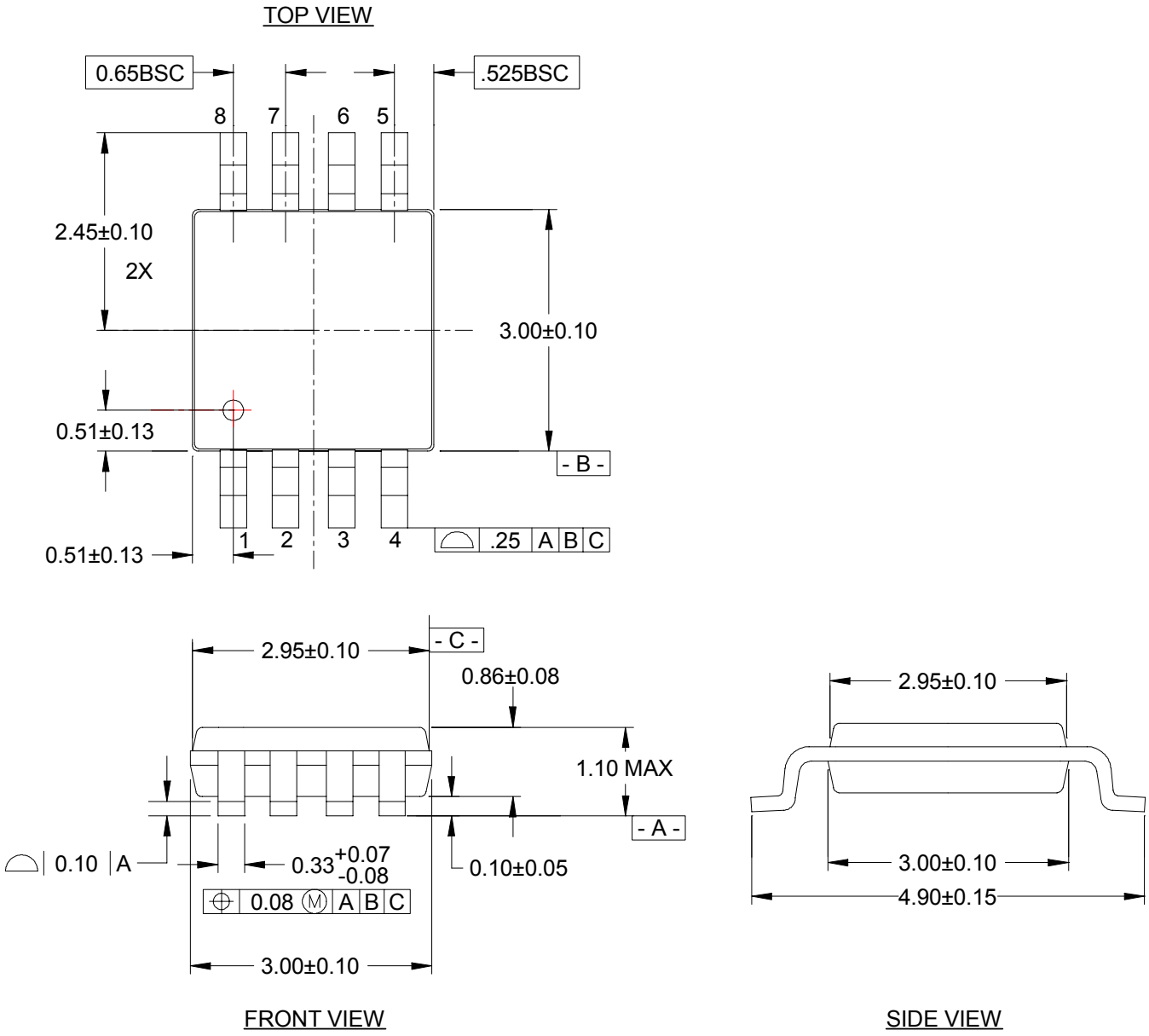
## Applications Support

If you have a problem with your evaluation kit or if you have applications questions call (858) 455-0660 and ask for applications support. You may also contact us by fax or e-mail:

**Fax:** (858) 455-0770
**E-Mail:** help@peregrine-semi.com

## Figure 10. Package Drawing

8-Lead MSOP




## Table 6. Ordering Information

| Order Code | Part Marking | Description | Package | Shipping Method |
|---|---|---|---|---|
| 83501-11 | PE83501 | PE83501-08MSOP-100A | 8-lead MSOP | 50 pcs. / Tube |
| 83501-12 | PE83501 | PE83501-08MSOP-2000C | 8-lead MSOP | 2000 pcs. / T&R |
| 83501-00 | PE83501-EK | PE83501-08MSOP-EK | Evaluation Board | 1 / Box |

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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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