# Product Specification

# PE83503

**3.5 GHz Low Power UltraCMOS™ Divide-by-8 Prescaler**
**Military Operating Temperature Range**

## Product Description

*The PE83503 is a high-performance monolithic UltraCMOS™ prescaler with a fixed divide ratio of 8. Its operating frequency range is 1.5 GHz to 3.5 GHz. The PE83503 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 microwave PLL synthesis solutions.*

*The PE83503 is manufactured on Peregrine'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.*

## Features

- High-frequency operation: 1.5 GHz to 3.5 GHz
- Fixed divide ratio of 8
- Low-power operation: 12 mA typical @ 3 V across frequency
- Small package: 8-lead MSOP
- Low Cost

**Figure 1. Functional Schematic Diagram**

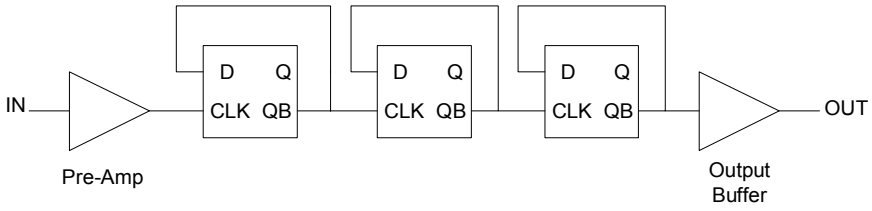



**Figure 2. Package Type**
8-lead MSOP



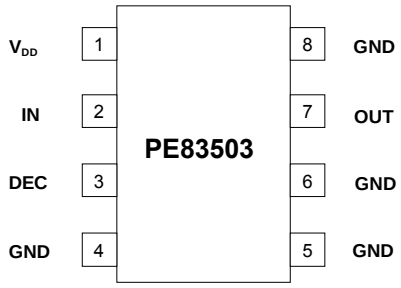
**Table 1. Electrical Specifications** ($Z_S = Z_L = 50\ \Omega$)

2.85 V ≤ $V_{DD}$ ≤ 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 | 19 | mA |
| Input Frequency ($F_{IN}$) | | 1.5 | | 3.5 | GHz |
| Input Power ($P_{IN}$) | 1500 MHz ≤ $F_{in}$ ≤ 2800 MHz | -5 | | +10 | dBm |
| | 2800 MHz < $F_{in}$ ≤ 3500 MHz | 0 | | +10 | dBm |
| Output Power | | 0 | | | dBm |


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### Figure 3. Pin Configuration (Top View)




### Table 2. Pin Descriptions

| Pin No. | Pin Name | Description |
|---|---|---|
| 1 | $V_{DD}$ | Power supply pin. Bypassing is required. |
| 2 | IN | Input signal pin. Should be coupled with a capacitor (eg 15pF) |
| 3 | DEC | Power supply decoupling pin. Place a capacitor as close as possible and connect directly to the ground plane (eg 10 nF and 10 pF). |
| 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 | OUT | Divided frequency output pin. This pin should be coupled with a capacitor (eg 100 pF). |
| 8 | GND | Ground pin. |

### Table 3. Absolute Maximum Ratings

| Symbol | Parameter/Conditions | Min | Max | Units |
|---|---|---|---|---|
| $V_{DD}$ | Supply voltage | | 4.0 | V |
| $T_{ST}$ | Storage temperature range | -65 | 150 | °C |
| $T_{OP}$ | Operating temperature range | -55 | 125 | °C |
| $V_{ESD}$ | ESD voltage (Human Body Model) | | 250 | V |
| $P_{INMAX}$ | Maximum input power | | 15 | dBm |

Absolute Maximum Ratings are those values listed in the above table. Exceeding these values may cause permanent device damage. 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 rating specified in Table 3.

### Latch-Up Avoidance

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

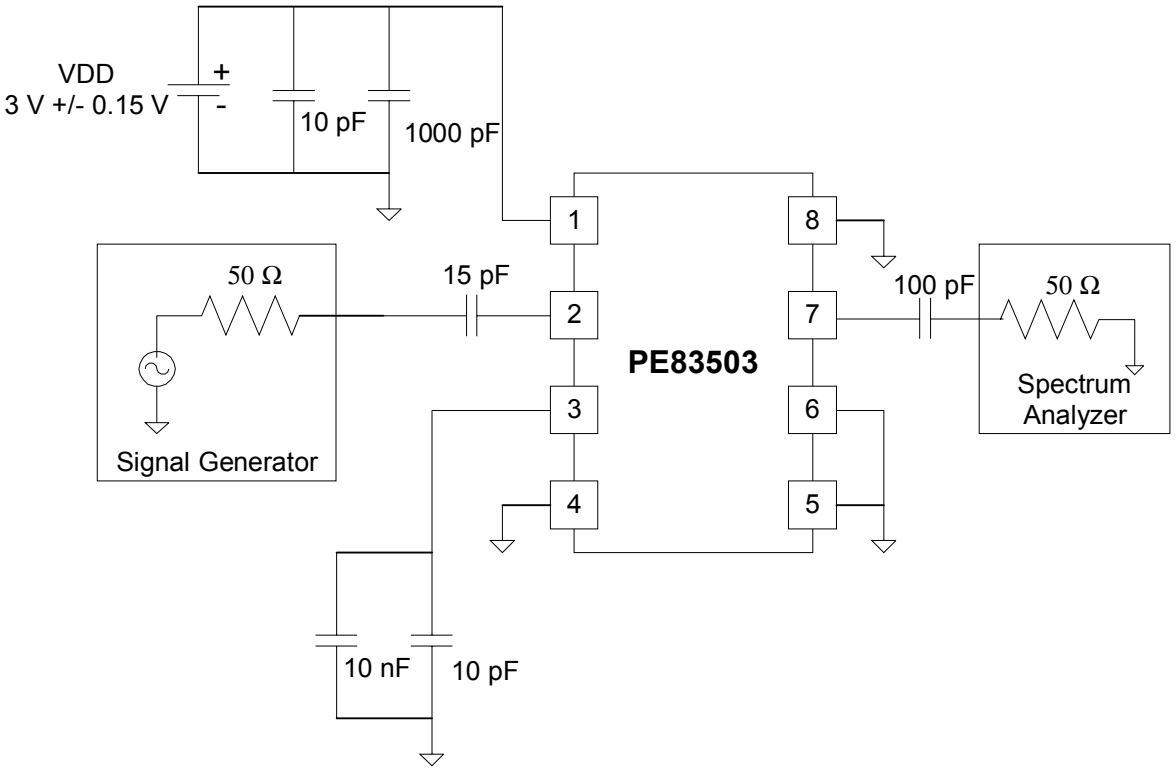
### Device Functional Considerations

The *PE83503* takes an input signal frequency from 1.5 GHz to 3.5 GHz and produces an output signal frequency one-eighth that of the supplied input. In order for the prescaler to work properly, several conditions need to be adhered to. It is crucial that pin 3 be supplied with a bypass capacitor to ground. In addition, the input and output signals (pins 2 & 7, respectively) need to be AC coupled via an external capacitor as shown in the test circuit in Figure 7.

The ground pattern on the board should be made as wide as possible to minimize ground impedance.

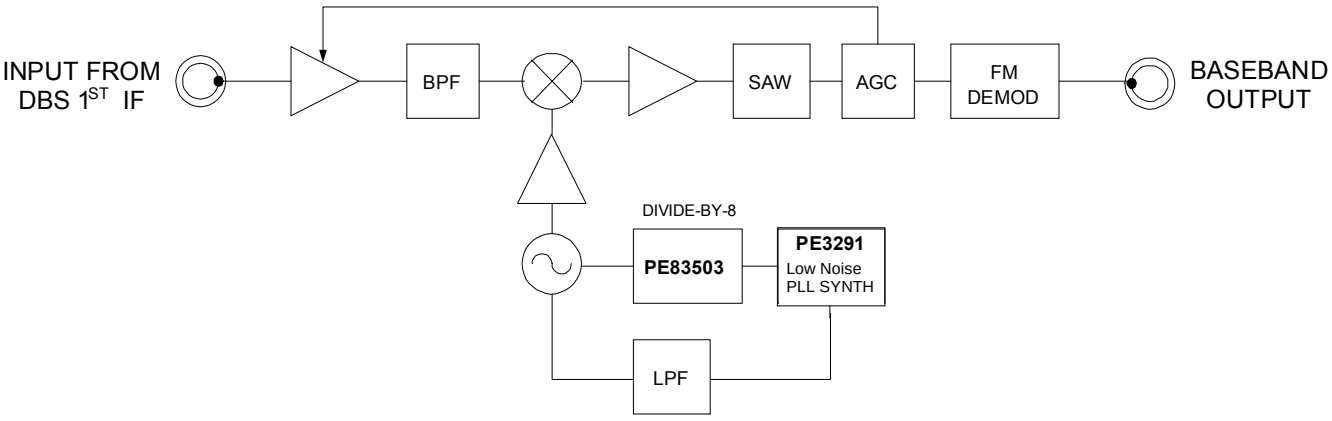
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### Figure 4. Test Circuit Block Diagram




### Figure 5. High Frequency System Application

The wideband frequency of operation of the *PE83503* makes it an ideal part for use in a DBS downconverter system.

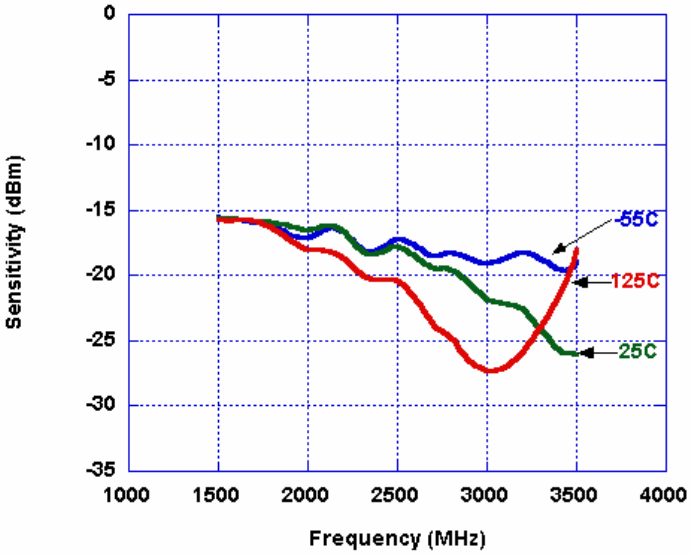




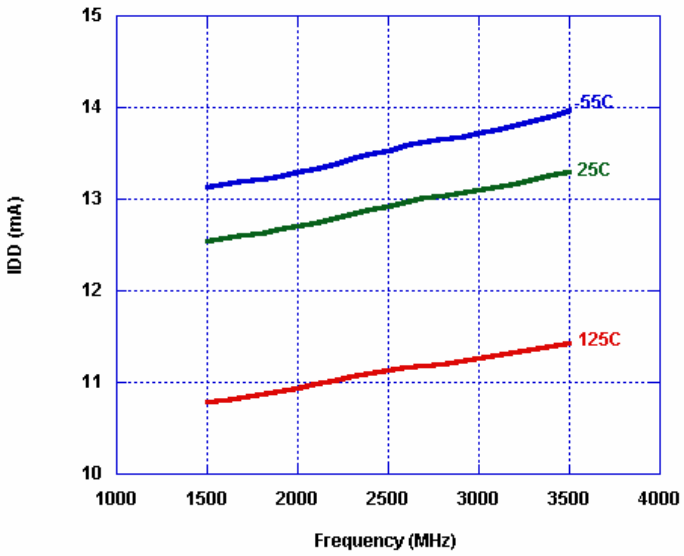
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## Typical Performance Data: $V_{DD}$ = 3.0 V

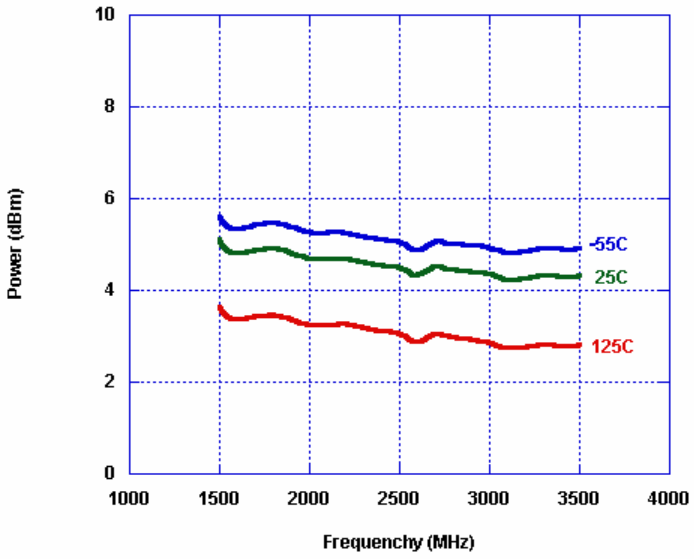
### Figure 6. Input Sensitivity




### Figure 7. Device Current




### Figure 8. Output Power




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## Evaluation Kit

### Evaluation Kit Operation

The MSOP Prescaler Evaluation Board was designed to help customers evaluate the *PE83503* Divide-by-8 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 15pF 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 100pF 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) 731-9400 and ask for applications support. You may also contact us by fax or e-mail:
**Fax:** (858) 731-9499
**E-Mail:** help@psemi.com

**Figure 9. Evaluation Board Layouts**
Peregrine Specification 101/0035

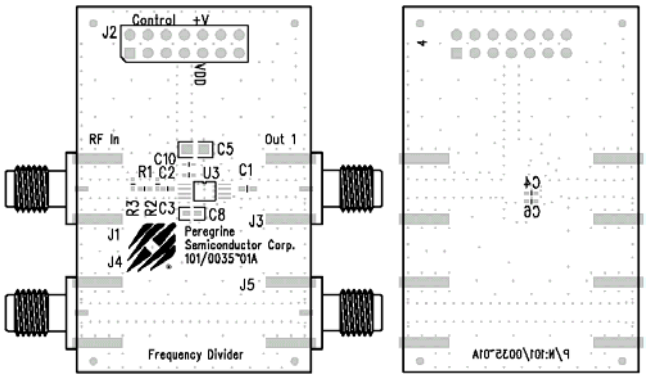
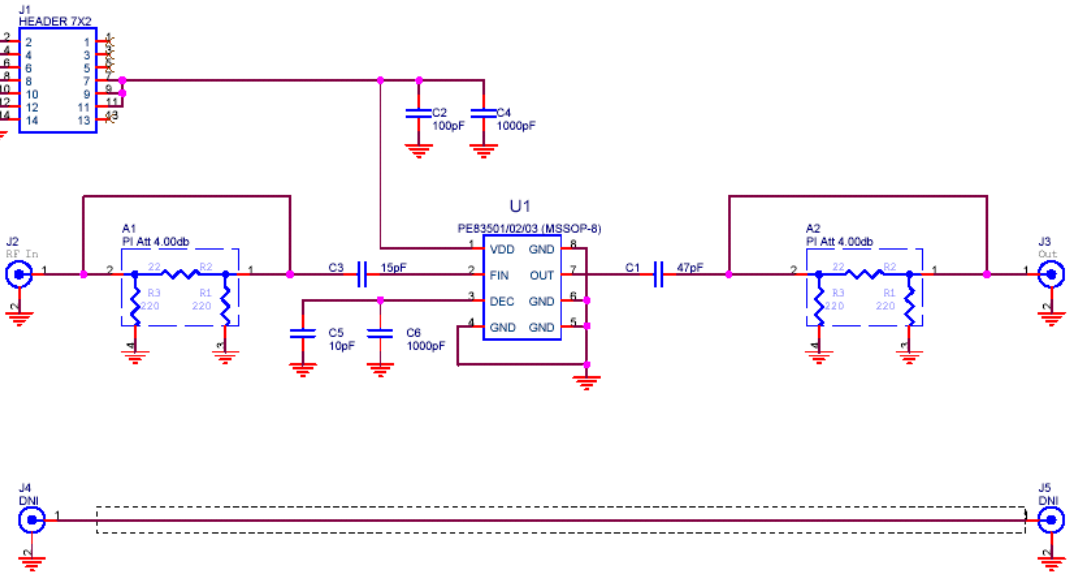



**Figure 10. Evaluation Board Schematic**
Peregrine Specification 102/0200

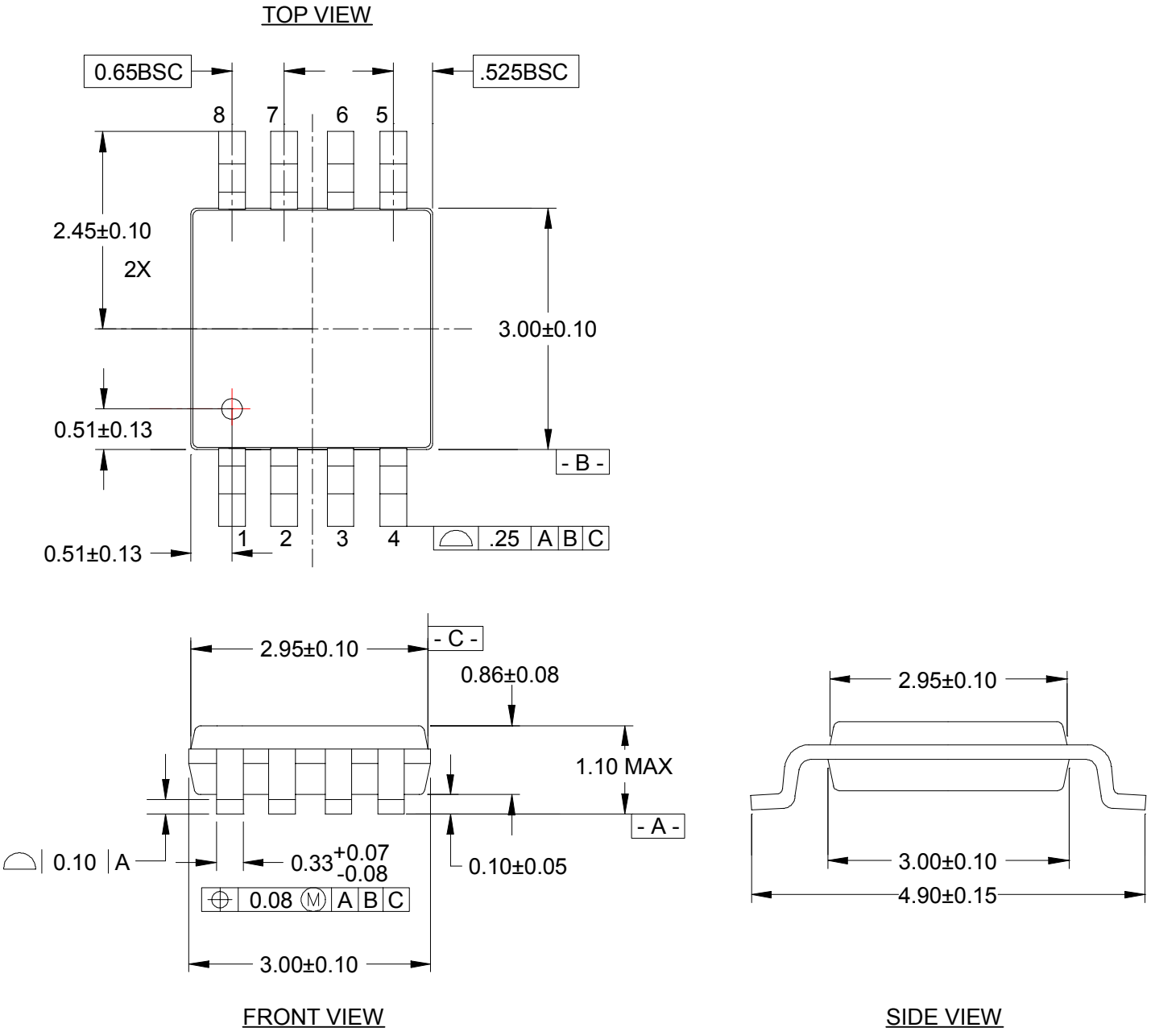




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## Figure 11. Package Drawing

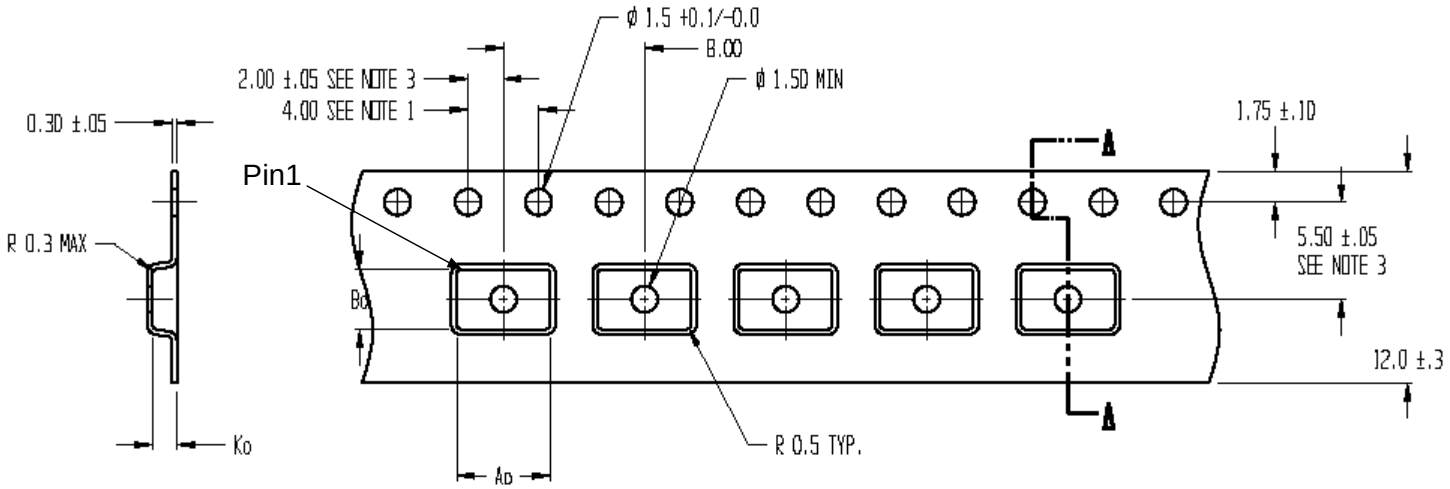
8-lead MSOP




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## Figure 12. Tape and Reel Specifications

8-lead MSOP




Ao = 5.30
Bo = 3.40
Ko = 1.40

NOTES:
1. 10 SPROCKET HOLE PITCH CUMULATIVE TOLERANCE ±0.2
2. CAMBER IN COMPLIANCE WITH EIA 481
3. POCKET POSITION RELATIVE TO SPROCKET HOLE MEASURED AS TRUE POSITION OF POCKET, NOT POCKET HOLE

## Table 4. Ordering Information

| Order Code | Part Marking | Description | Package | Shipping Method |
|---|---|---|---|---|
| 83503-21 | 83503 | PE83503-08MSOP-100A | 8-lead MSOP | 50 pcs. / Tube |
| 83503-22 | 83503 | PE83503-08MSOP-2000C | 8-lead MSOP | 2000 pcs. / T&R |
| 83503-00 | PE83503-EK | PE83503-08MSOP-EK | Evaluation Board | 1 / Box |


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