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## Product Description

The PE64905 is a DuNE™-enhanced Digitally Tunable Capacitor (DTC) based on Peregrine's UltraCMOS® technology. DTC products provide a monolithically integrated impedance tuning solution for demanding RF applications.

The PE64905 offers high RF power handling and ruggedness, while meeting challenging harmonic and linearity requirements.

This highly versatile product can be used in series or shunt configurations to support a wide variety of tuning circuit topologies.

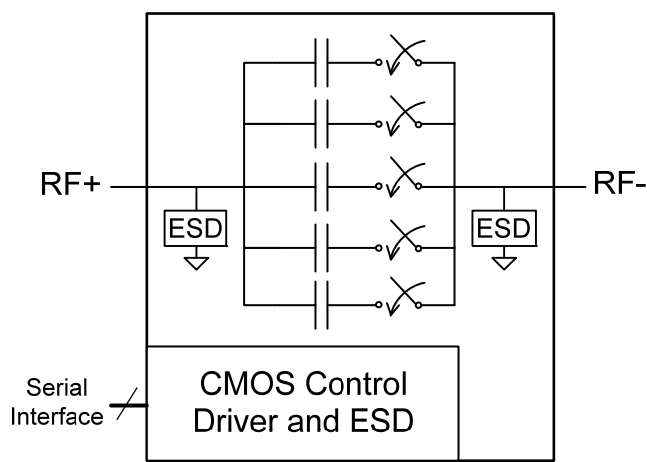
The device is controlled through the widely supported 2-wire (I<sup>2</sup>C compatible) interface and has two selectable addresses for implementations with multiple DTCs. All decoding and biasing is integrated on-chip, and no external bypassing, or filtering components are required.

Peregrine's DuNE™ technology enables excellent linearity and exceptional harmonic performance. DuNE devices deliver performance superior to GaAs devices with the economy and integration of conventional CMOS.

## Features

- 2-wire (I<sup>2</sup>C compatible) Serial Interface with built-in bias voltage generation and ESD protection
- DuNE™-enhanced UltraCMOS® device
- 5-bit 32-state Digitally Tunable Capacitor
- Series configuration C = 0.60 - 4.60 pF (7.7:1 tuning ratio) in discrete 129 fF steps
- Shunt configuration C = 1.10 - 5.10 pF (4.6:1 tuning ratio) in discrete 129 fF steps
- High RF Power Handling (up to 38 dBm, 30 V<sub>pk</sub> RF) and High Linearity
- Wide power supply range (2.3 to 3.6V) and low current consumption (typ. 140 µA at 2.6V)
- Excellent 1.5 kV HBM ESD tolerance on all pins
- 2 x 2 x 0.45 mm QFN package
- Applications include:
  - Tunable Filter Networks
  - Tunable Antennas
  - RFID
  - Tunable Matching Networks
  - Phase Shifters
  - Wireless Communications

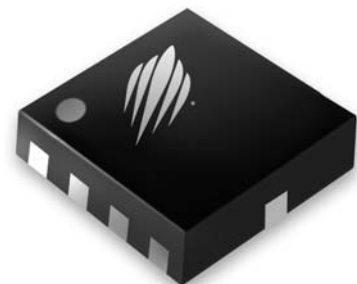
**Figure 1. Functional Block Diagram**



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**Figure 2. Package Type**

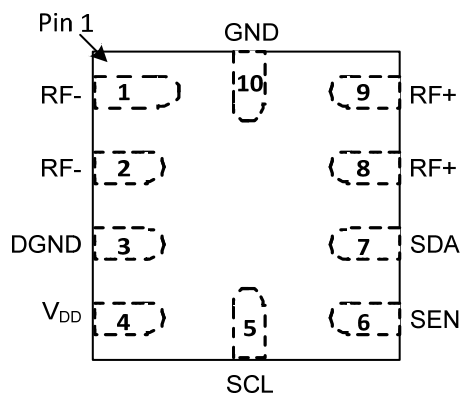
10L 2 x 2 x 0.45 mm QFN package



**Table 1. Electrical Specifications @ 25°C, V<sub>DD</sub> = 2.6V**

| Parameter                          | Configuration | Condition  | Min  | Typ   | Max  | Unit |
|------------------------------------|---------------|--|------|-------|------|------|
| Operating Frequency Range          | Both          |  | 100  |       | 3000 | MHz  |
| Minimum Capacitance                | Series        | State = 00000, 100 MHz (RF+ to RF-)              | 0.49 | 0.60  | 0.71 | pF   |
|                                    | Shunt         | State = 00000, 100 MHz (RF+ to Grounded RF-)     | 0.99 | 1.10  | 1.21 |      |
| Maximum Capacitance                | Series        | State = 11111, 100 MHz (RF+ to RF-)              | 4.09 | 4.60  | 5.11 | pF   |
|                                    | Shunt         | State = 11111, 100 MHz (RF+ to Grounded RF-)     | 4.59 | 5.10  | 5.61 |      |
| Parasitic Capacitance              | Series        | All States, 100 MHz (RF+ to GND, RF- to GND)     |      | 0.5   |      | pF   |
| Tuning Ratio                       | Series        | 100 MHz  |      | 7.7:1 |      |      |
|                                    | Shunt         | 100 MHz  |      | 4.6:1 |      |      |
| Step Size                          | Both          | 5 bits (32 states), constant step size (100 MHz) |      | 0.129 |      | pF   |
| Equivalent Series Resistance       | Series        | State = 00000                                    |      | 1.40  |      | Ω    |
|                                    |               | State = 11111                                    |      | 1.33  |      |      |
| Quality Factor (C <sub>min</sub> ) | Shunt         | 1 GHz  |      | 35    |      |      |
| Quality Factor (C <sub>max</sub> ) | Shunt         | 1 GHz  |      | 25    |      |      |
| Harmonics (2fo)                    | Series        | 100 MHz-3 GHz                                    |      |       | -36  | dBm  |
| Harmonics (3fo)                    |               | 100 MHz-3 GHz                                    |      |       | -36  |      |

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



**Table 2. Pin Descriptions**

| Pin # | Pin Name        | Description                    |
|-------|-----------------|--------------------------------|
| 1     | RF-             | Negative RF Port <sup>1</sup>  |
| 2     | RF-             | Negative RF Port <sup>1</sup>  |
| 3     | DGND            | Ground                         |
| 4     | V <sub>DD</sub> | Power supply pin               |
| 5     | SCL             | Serial Interface Clock Input   |
| 6     | ADDR            | Serial Interface Address Input |
| 7     | SDA             | Serial interface Data input    |
| 8     | RF+             | Positive RF Port <sup>1</sup>  |
| 9     | RF+             | Positive RF Port <sup>1</sup>  |
| 10    | GND             | RF Ground                      |

Note: 1. Pins 1-2 and 8-9 must be tied together on PCB for optimal performance

**Latch-Up Avoidance**

Unlike conventional CMOS devices, UltraCMOS<sup>®</sup> devices are immune to latch-up.

**Moisture Sensitivity Level**

The Moisture Sensitivity Level rating for the PE64905 in the 10-lead 2 x 2 x 0.45 mm QFN package is MSL1.

**Table 3. Operating Ranges**

| Parameter  | Min | Typ | Max  | Units           |
|--|-----|-----|------|-----------------|
| V <sub>DD</sub> Supply Voltage                                 | 2.3 | 2.6 | 3.6  | V               |
| I <sub>DD</sub> Power Supply Current (V <sub>DD</sub> = 2.6 V) |     | 140 | 200  | μA              |
| V <sub>IH</sub> Control Voltage High                           | 1.2 | 1.8 | 3.6  | V               |
| V <sub>IL</sub> Control Voltage Low                            | 0   | 0   | 0.57 | V               |
| Peak Operating RF Voltage @ 100 MHz <sup>1</sup>               |     |     | 30   | V <sub>pk</sub> |
| RF+ to RF-   |     |     | 30   | V <sub>pk</sub> |
| RF+ and/or RF- to Ground                                       |     |     |      |                 |
| T <sub>OP</sub> Operating Temperature Range                    | -40 |     | +85  | °C              |
| T <sub>ST</sub> Storage Temperature Range                      | -65 |     | +150 | °C              |

Note: 1. De-rated over frequency

**Table 4. Absolute Maximum Ratings**

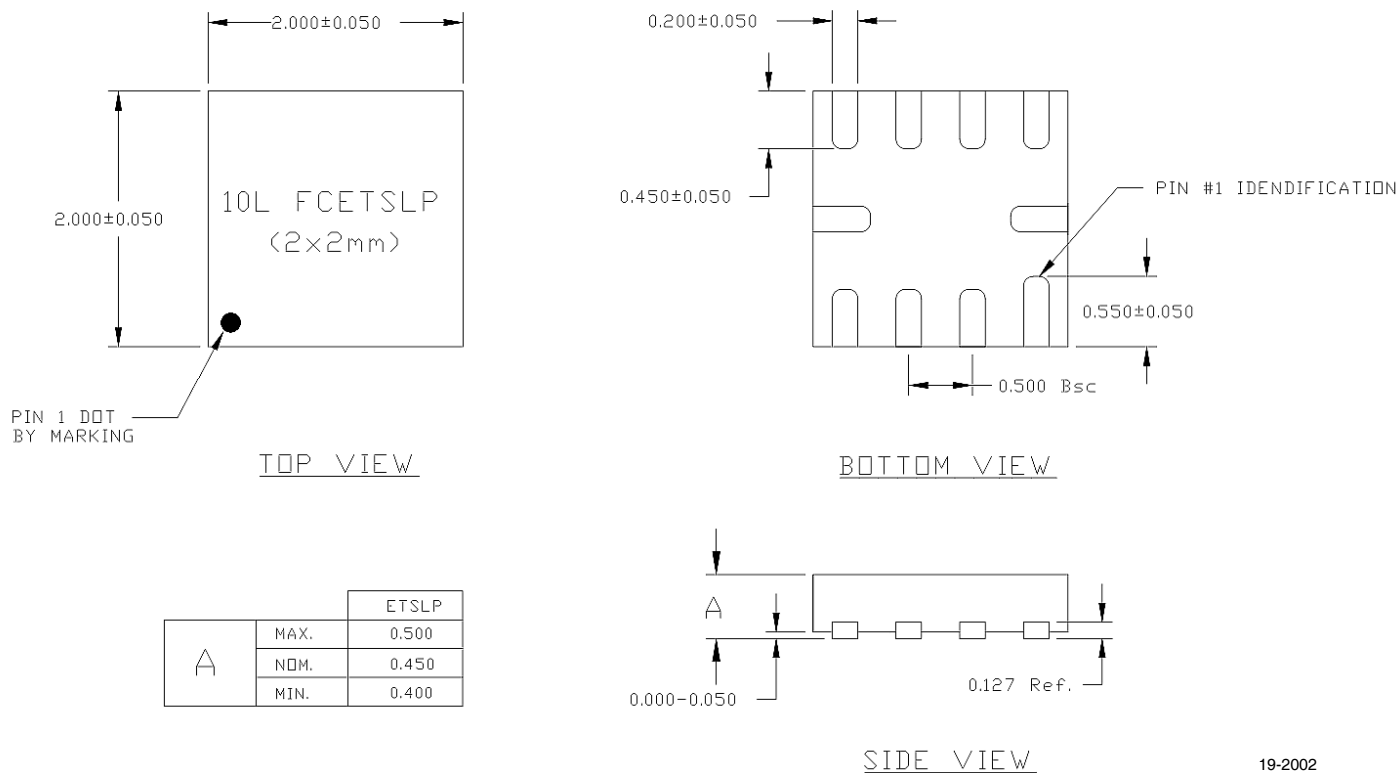
| Symbol           | Parameter/Conditions                         | Min  | Max  | Units |
|------------------|--|------|------|-------|
| V <sub>DD</sub>  | Power supply voltage                         | -0.3 | 4.0  | V     |
| V <sub>I</sub>   | Voltage on any DC input                      | -0.3 | 4.0  | V     |
| V <sub>ESD</sub> | ESD Voltage (HBM, MIL_STD 883 Method 3015.7) |      | 1500 | V     |

Exceeding absolute maximum ratings may cause permanent damage. Operation should be restricted to the limits in the Operating Ranges table. Operation between operating range maximum and absolute maximum for extended periods may reduce reliability.

**Electrostatic Discharge (ESD) Precautions**

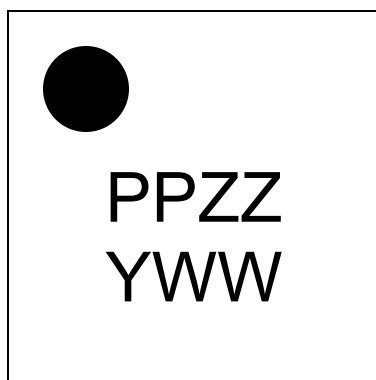
When handling this UltraCMOS<sup>®</sup> device, observe the same precautions that you would use with other ESD-sensitive devices. Although this device contains circuitry to protect it from damage due to ESD, precautions should be taken to avoid exceeding the specified rating.

**Figure 4. Package Drawing**  
10L 2 x 2 x 0.45 mm



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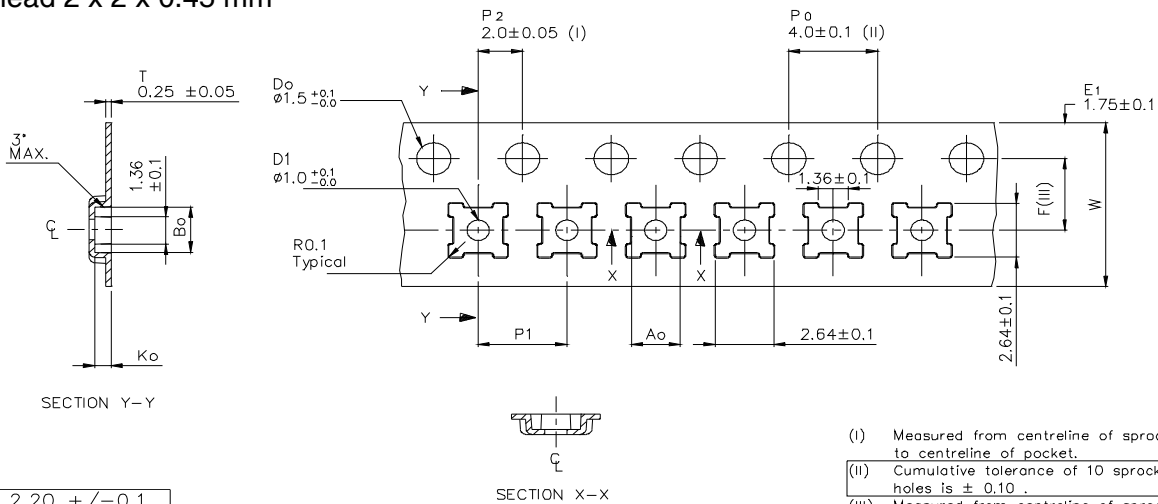
**Figure 5. Marking Specifications**



17-0112

| Marking Spec Symbol | Package Marking | Definition   |
|---------------------|-----------------|--|
| PP                  | CF              | Part number marking for PE64905                                      |
| ZZ                  | 00-99           | Last two digits of lot code  |
| Y                   | 0-9             | Last digit of year, starting from 2009 (0 for 2010, 1 for 2011, etc) |
| WW                  | 01-53           | Work week  |

**Figure 24. Tape and Reel Specifications**  
10-lead 2 x 2 x 0.45 mm



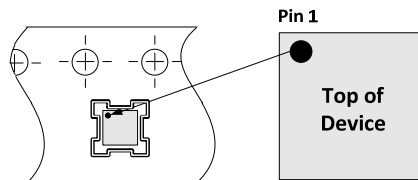
|    |              |
|----|--------------|
| Ao | 2.20 +/−0.1  |
| Bo | 2.20 +/−0.1  |
| Ko | 0.75 +/−0.1  |
| F  | 3.50 +/−0.05 |
| P1 | 4.00 +/−0.1  |
| W  | 8.00 +/−0.3  |

- (I) Measured from centreline of sprocket hole to centreline of pocket.
- (II) Cumulative tolerance of 10 sprocket holes is ± 0.10 .
- (III) Measured from centreline of sprocket hole to centreline of pocket.
- (IV) Other material available.

This part shall not contain any banned substance as Sony standard SS-00259

ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE STATED.

-----> Tape Feed Direction ----->



Device Orientation in Tape

**Table 9. Ordering Information**

| Order Code    | Package                     | Description                   | Shipping Method |
|---------------|-----------------------------|-------------------------------|-----------------|
| PE64905MLBB-Z | 10-lead QFN 2 x 2 x 0.45 mm | Package Part in Tape and Reel | 3000 units/T&R  |
| EK64905-12    | Evaluation Kit              | Evaluation Kit                | 1 Set/Box       |

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