# Product Specification

# PE42650A

**SP3T High Power UltraCMOS™**
**RF Switch 30 MHz - 1000 MHz**

### Features

- 50 Watt P1dB compression point
- 10 Watts <8:1 VSWR (Normal Operation)
- 38 dB TX-RX Isolation
- $2f_o$ and $3f_o$ < -81 dBc @10 Watts
- ESD rugged to 2.0 kV HBM
- No blocking capacitors required
- 32-lead 5x5 mm QFN package

## Product Description

*The following specification defines an SP3T (single pole three throw) switch for use in cellular and other wireless applications. It has both a standard and attenuated RX mode. The PE42650A uses Peregrine's UltraCMOS™ process and also features HaRP™ technology enhancements to deliver high linearity and exceptional harmonics performance. HaRP™ technology is an innovative feature of the UltraCMOS™ process providing upgraded linearity performance.*

*The PE42650A 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.*



**Figure 1. Functional Diagram**

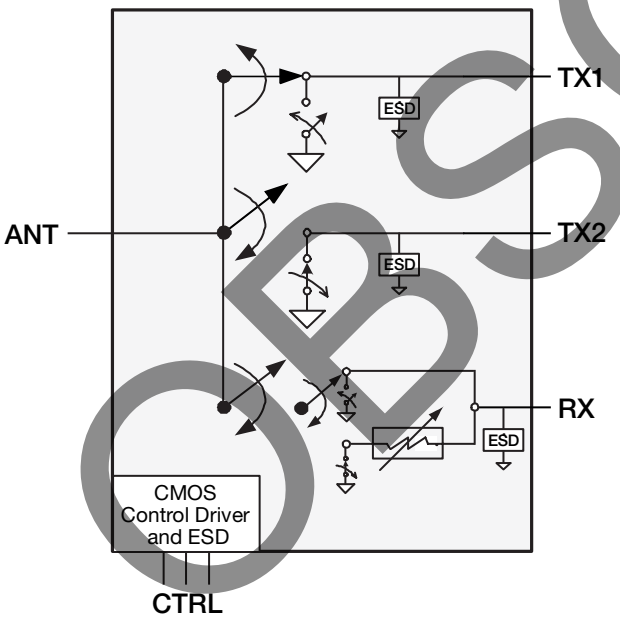
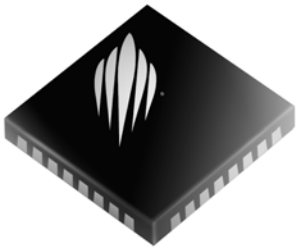



**Figure 2. Package Type**
**32-lead 5x5 mm QFN**



## Table 1: Electrical Specifications @ +25 °C, $V_{DD}$ = 3.3 V ($Z_S$ = $Z_L$ = 50 Ω) unless otherwise noted

| Parameter | Conditions | Min | Typ | Max | Units |
|---|---|---|---|---|---|
| TX Insertion Loss[1] | 30 MHz ≤ 1 GHz | | 0.3 | 0.5 | dB |
| RX Insertion Loss (Un-Attenuated State)[1] | 30 MHz ≤ 1 GHz | | 0.5 | 0.9 | dB |
| RX Insertion Loss (Attenuated State)[1] | 800 MHz | 13 | 14.5 | 16 | dB |
| 0.1 dB Input Compression Point | 800 MHz, 50% duty cycle | | 45.4 | | dBm |
| Isolation (Supply Biased): TX-TX | 800 MHz | 30 | 33 | | dB |
| Isolation (Supply Biased): TX-RX | 800 MHz | 35 | 38 | | dB |
| Unbiased Isolation: ANT - TX, $V_{DD}$, V1, V2, V3=0 V | 800 MHz, +27 dBm | 6 | 10 | | dB |
| Unbiased Isolation: ANT - RX, $V_{DD}$, V1, V2, V3=0 V | 800 MHz, +27 dBm | 14 | 22 | | dB |
| RX Port Return Loss[1] | Un-Attenuated State, 800 MHz | 18 | 22 | | dB |
| | Attenuated State, with external matching inductor optimized without attenuator engaged, 800 MHz | 12 | 18 | | dB |
| TX and ANT Port Return Loss[1] | 800 MHz | 20 | 23 | | dB |
| TX, 2nd Harmonic<br>TX, 3rd Harmonic | 800 MHz @ 42.5 dBm<br>800 MHz @ 42.5 dBm | | -81<br>-81 | -79<br>-79 | dBc<br>dBc |
| RX IIP3 | Un-Attenuated State, 800 MHz, 150 kHz tone separation | 30 | | | dBm |
| Switching Time | 50% of CTRL to 10/90% of RF | | 0.1 | 0.5 | ms |

Note: 1. The device was matched with ~4 nH inductance per RF port. RX port may not need matching inductor.



## Table 2. Operating Ranges

| Parameter | Min | Typ | Max | Units |
|---|---|---|---|---|
| Frequency Range | 30 | | 1000 | MHz |
| TX Input Power[1] (VSWR ≤ 8:1) | | | 40 | dBm |
| RX Input Power[2] (VSWR ≤ 8:1) | | | 27 | dBm |
| $V_{DD}$ Power Supply Voltage | 3.2 | 3.3 | 3.4 | V |
| $I_{DD}$ Power Supply Current | | 90 | 170 | uA |
| Control Voltage High | 1.4 | | | V |
| Control Voltage Low | | | 0.4 | V |
| $T_{OP}$ Operating temperature range (Case) | -40 | | 85 | °C |
| $T_j$ Operating junction temperature | | | 140 | °C |

Notes: 1. Supply biased
2. Supply biased or unbiased

## Table 3. Absolute Maximum Ratings

| Symbol | Parameter/Conditions | Min | Max | Units |
|---|---|---|---|---|
| $V_{DD}$ | Power supply voltage | -0.3 | 4 | V |
| $V_I$ | Voltage on any DC input | -0.3 | $V_{DD}$+ 0.3 | V |
| $T_{ST}$ | Storage temperature range | -65 | 150 | °C |
| $T_{CASE}$ | Maximum case temperature | | 85 | °C |
| $T_j$ | Peak maximum junction temperature (10 seconds max) | | 200 | °C |
| $P_{IN}$ | TX Input Power[1] (VSWR 20:1, 10 seconds) | | 40 | dBm |
| | TX Input Power[1] (50 Ω) | | 45 | dBm |
| | RX Input Power at ANT pin[2] (VSWR 20:1) | | 27 | dBm |
| | RF Input Power on inactive ports or supply unbiased | | 27 | dBm |
| $P_D$ | Maximum Power Dissipation from RF Insertion Loss | | 2.8 | W |
| $V_{ESD}$ | ESD Voltage (HBM, MIL_STD 883 Method 3015.7) | | 2000 | V |

Notes: 1. Supply biased
2. Supply biased or unbiased

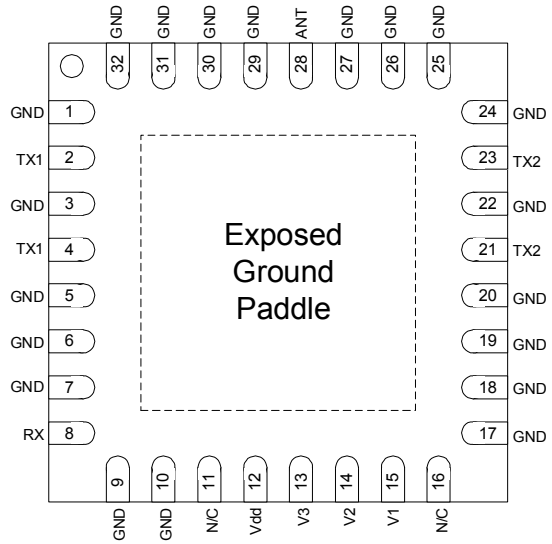
## Moisture Sensitivity Level

The Moisture Sensitivity Level rating for the PE42650A in the 5x5 QFN package is MSL3.

## Absolute Maximum Ratings

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.

## Figure 3. Pin Configuration (Top View)




## Table 4. Pin Descriptions

| Pin No. | Pin Name | Description |
|---|---|---|
| 1 | GND | Ground |
| 2 | TX1 | TX1 port |
| 3 | GND | Ground |
| 4 | TX1[1] | TX1 port |
| 5-7 | GND | Ground |
| 8 | RX | RX port |
| 9-10 | GND | Ground |
| 11 | N/C | No Connect |
| 12 | $V_{DD}$ | Nominal 3.3 V supply connection |
| 13 | V3 | Control |
| 14 | V2 | Control |
| 15 | V1[2] | Control |
| 16 | N/C | Do not connect |
| 17-20 | GND | Ground |
| 21 | TX2 | TX2 port |
| 22 | GND | Ground |
| 23 | TX2[3] | TX2 port |
| 24-27 | GND | Ground |
| 28 | ANT | Antenna Port |
| 29-32 | GND | Ground |
| Paddle | GND | Exposed ground paddle |

Note: 1. Must be tied to pin 2
2. Must be tied to V2
3. Must be tied to pin 21

## 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.

### Latch-Up Avoidance

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

## Table 5. Control Logic Truth Table

| Path | V3 | V2 | V1 |
|---|---|---|---|
| ANT – RX Attenuated | L | L | L |
| Unsupported mode | L | L | H |
| Unsupported mode | L | H | L |
| ANT – TX1 | L | H | H |
| ANT – RX | H | L | L |
| Unsupported mode | H | L | H |
| Unsupported mode | H | H | L |
| ANT – TX2 | H | H | H |

## Evaluation Kit

The PE42650A Evaluation Kit board was designed to ease customer evaluation of the PE42650A RF switch.

DC power is supplied through J10, with $V_{DD}$ on pin 9, and GND on the entire lower row of even numbered pins. To evaluate a switch path, add or remove jumpers on V1 (pin 3), V2 (pin 5), and V3 (pin 7) using Table 5 (adding a jumper pulls the CMOS control pin low and removing it allows the on-board pull-up resistor to set the CMOS control pin high). J10 pins 1, 11, and 13 are N/C.

The RF common port (ANT) is connected through a 50 Ohm transmission line via the top SMA connector, J1. RX and TX paths are also connected through 50 Ohm transmission lines via SMA connectors. A 50 Ohm through transmission line is available via SMA connectors J8 and J9. This transmission line can be used to estimate the loss of the PCB over the environmental conditions being evaluated. An open-ended 50 Ohm transmission line is also provided at J7 for calibration if needed.

Narrow trace widths are used near each part to improve impedance matching.

**Figure 4. Evaluation Board Layout**

Peregrine Specification 101-0315

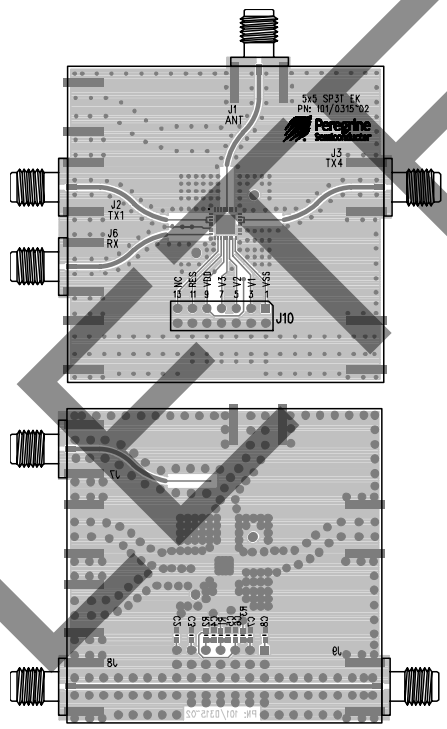
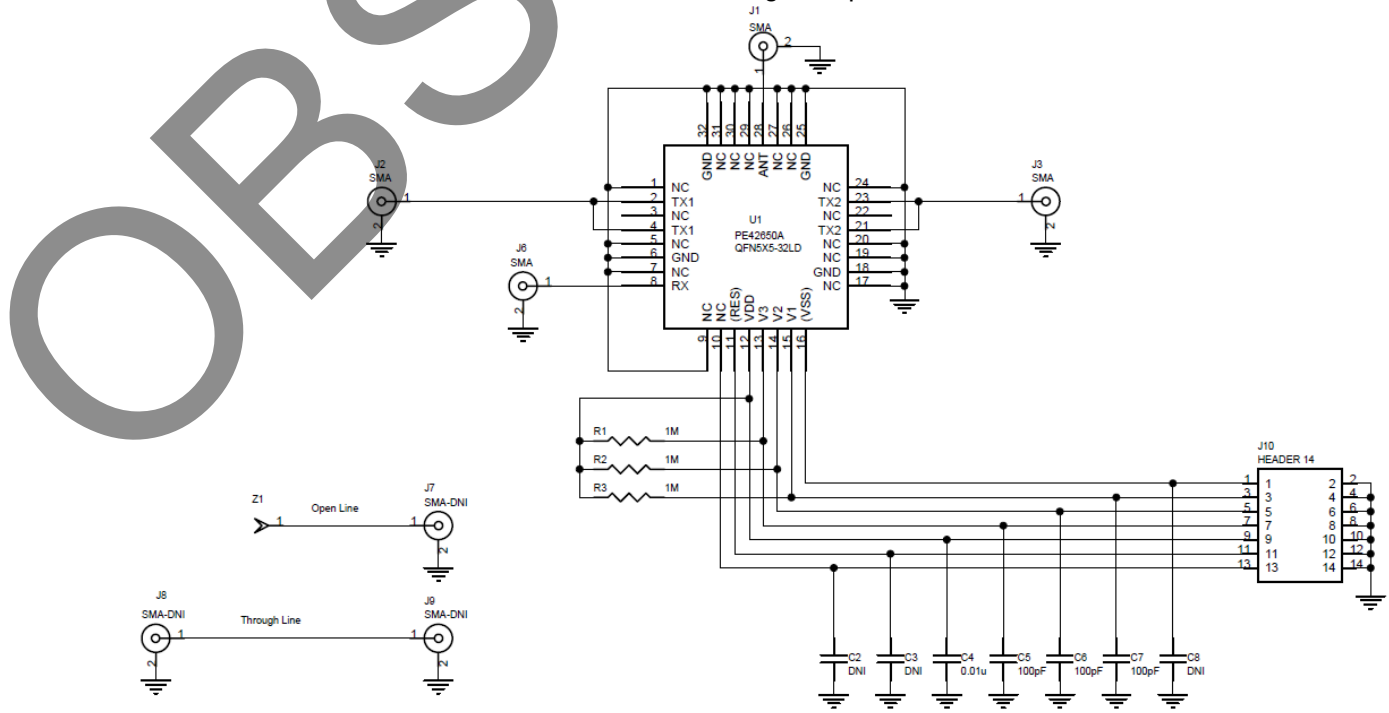


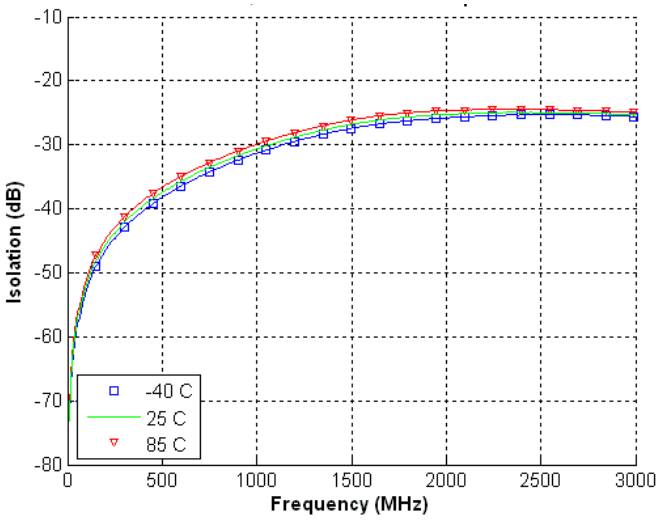

**Figure 5. Evaluation Board Schematic**

Peregrine Specification 102-0535

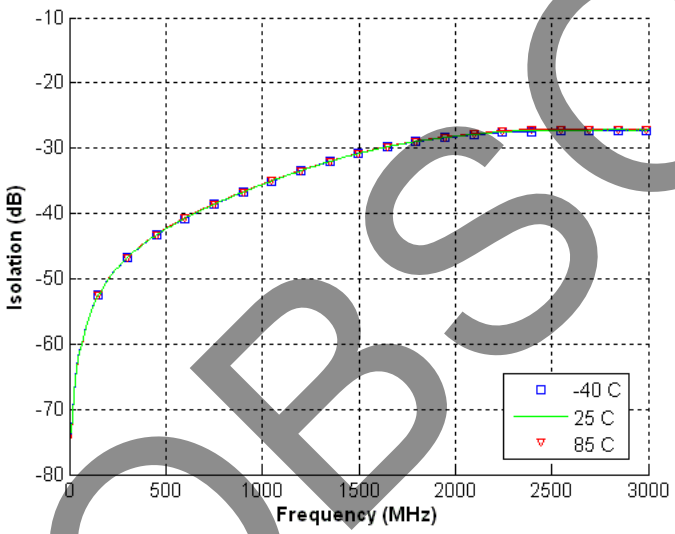


## Performance Plots

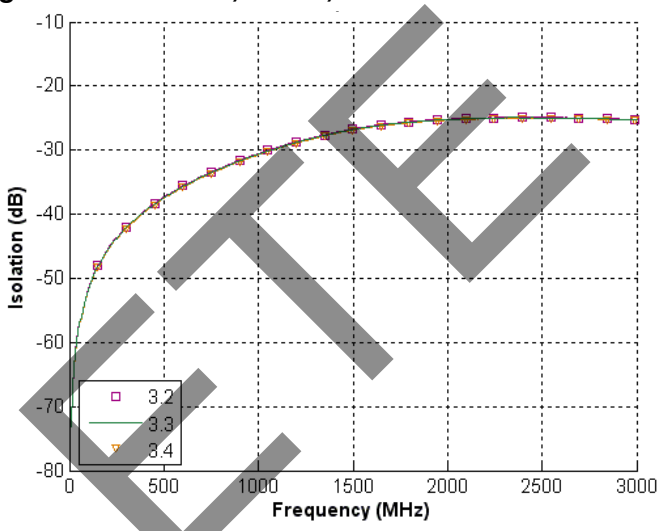
### Figure 6. Isolation, Tx-Tx, $V_{DD}$=3.3V




### Figure 7. Isolation, Tx-Rx, $V_{DD}$=3.3V




### Figure 8. Isolation, Tx-Tx, +25°C




### Figure 9. Isolation, Tx-Rx, +25°C

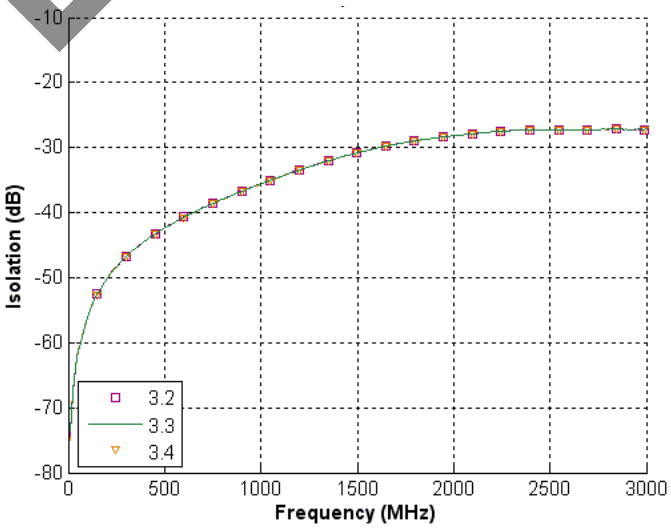


**Figure 10. Tx Insertion Loss, $V_{DD}$=3.3V**

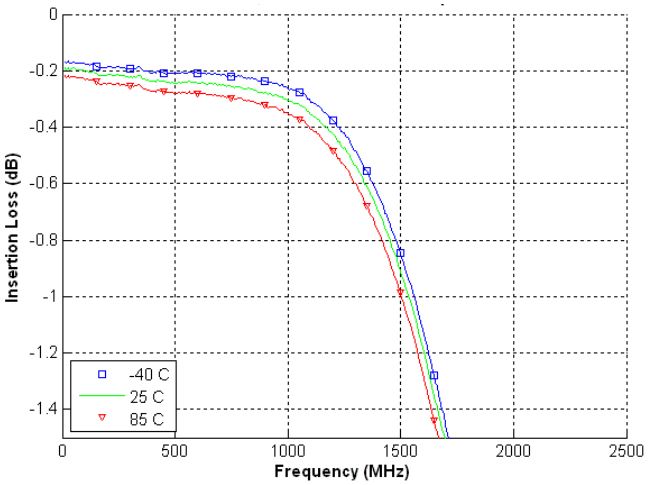



**Figure 11. Rx Insertion Loss Un-Attenuated, $V_{DD}$=3.3V**

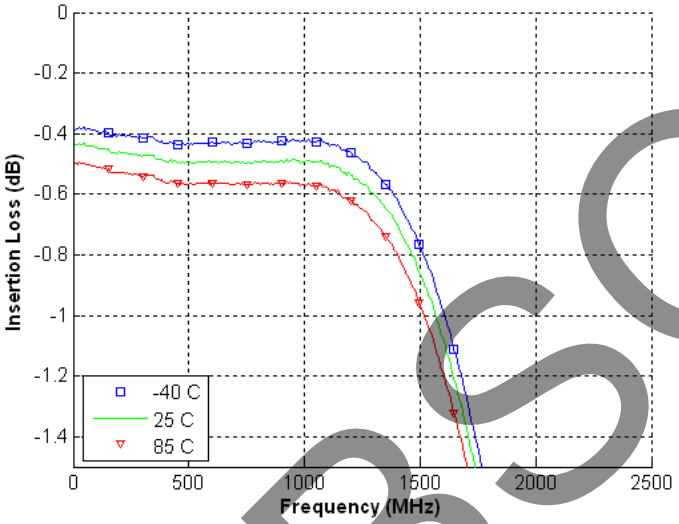



**Figure 12. Rx Insertion Loss Attenuated, $V_{DD}$=3.3V**

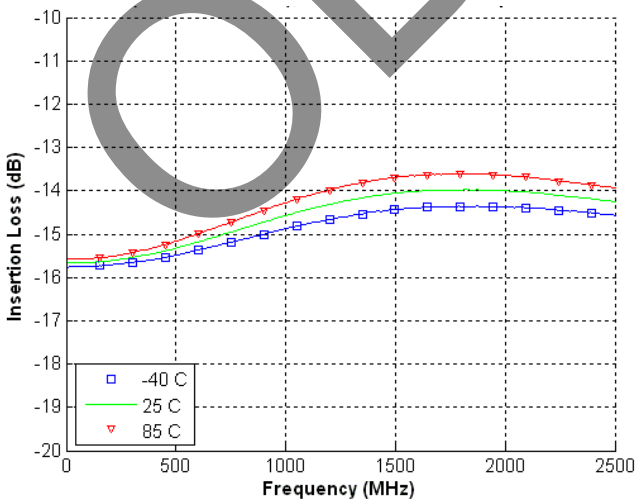



**Figure 13. Tx Insertion Loss, +25°C**

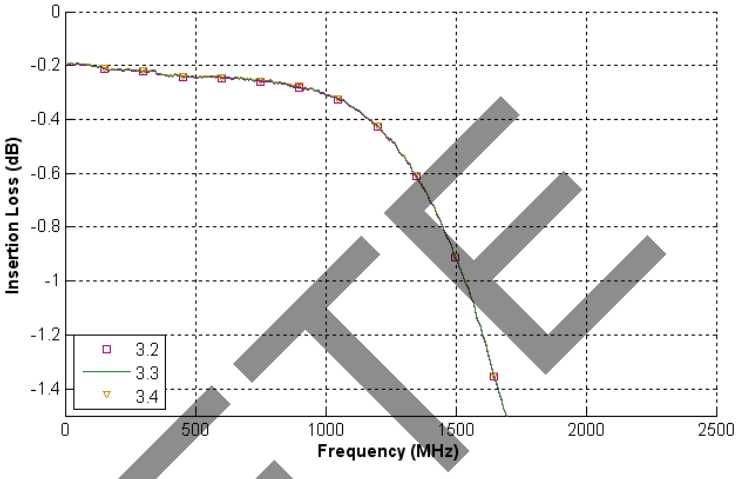



**Figure 14. Rx Insertion Loss Un-Attenuated, +25°C**

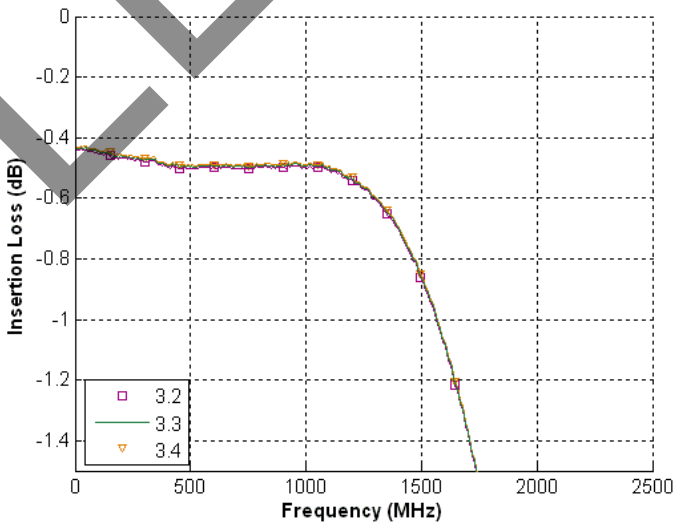



**Figure 15. Rx Insertion Loss Attenuated, +25°C**

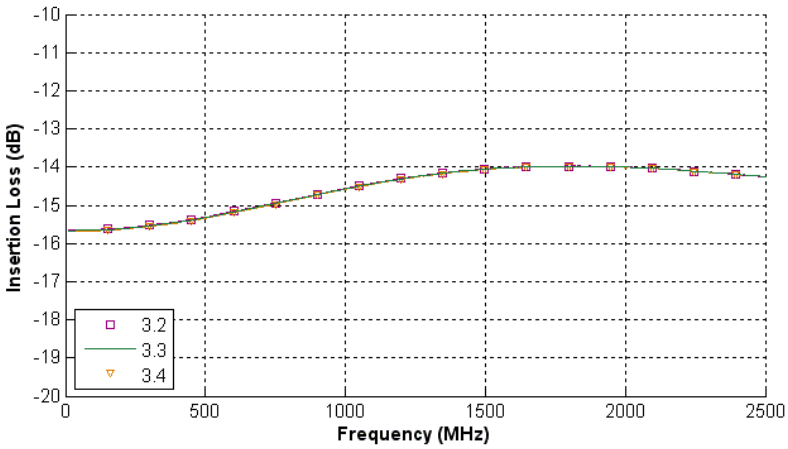


**Figure 16. Return Loss, $V_{DD}$=3.3V**

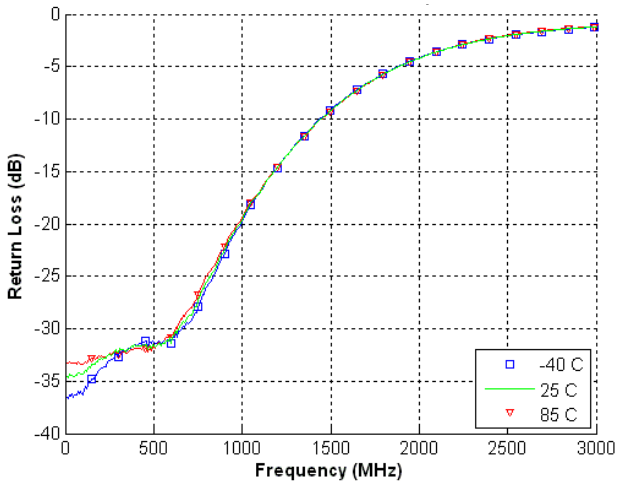



**Figure 17. Tx Return Loss, $V_{DD}$=3.3V**

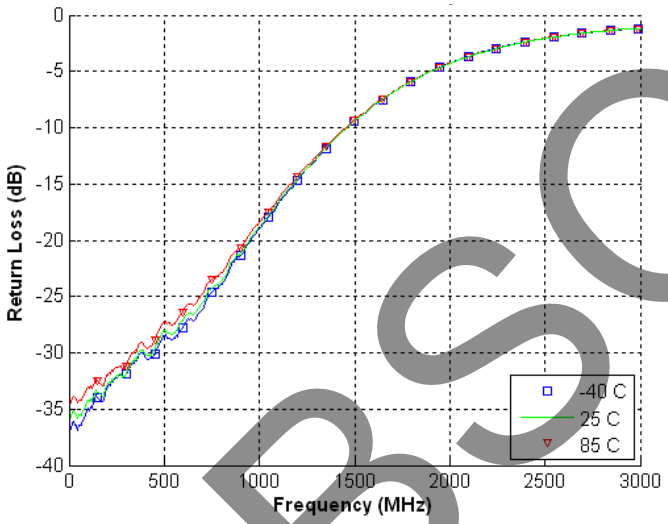



**Figure 18. Return Loss, +25°C**

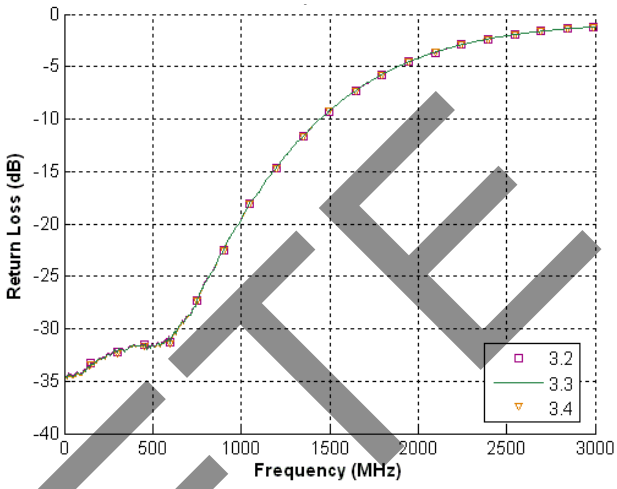



**Figure 19. Tx Return Loss, +25°C**

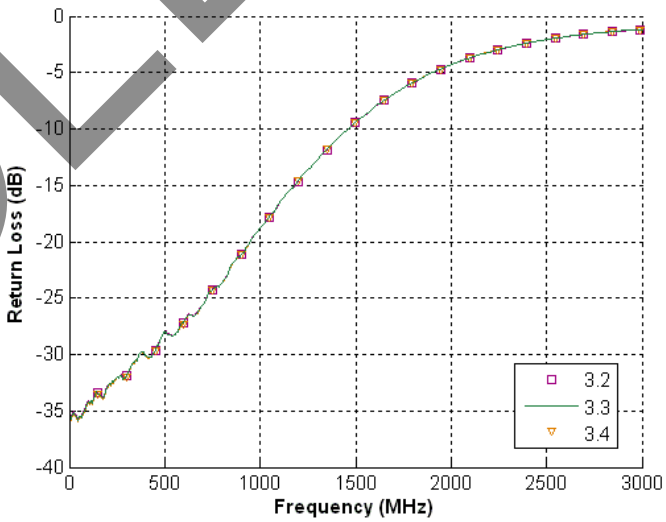


**Figure 20. Rx Return Loss Attenuated, $V_{DD}$=3.3V**

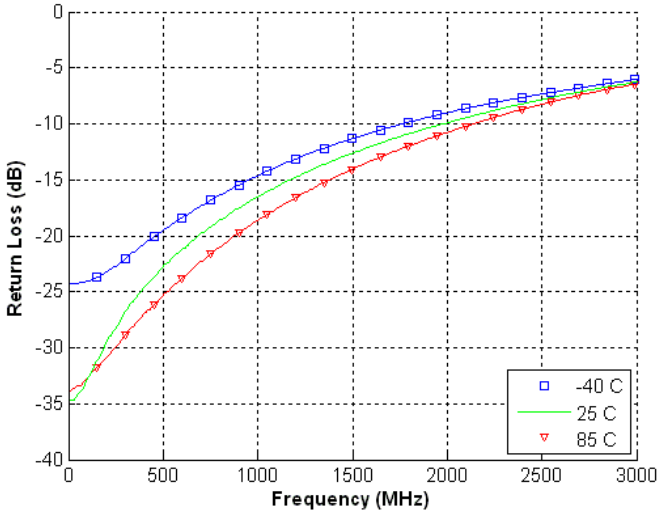



**Figure 21. Rx Return Loss Un-Attenuated, $V_{DD}$=3.3V**

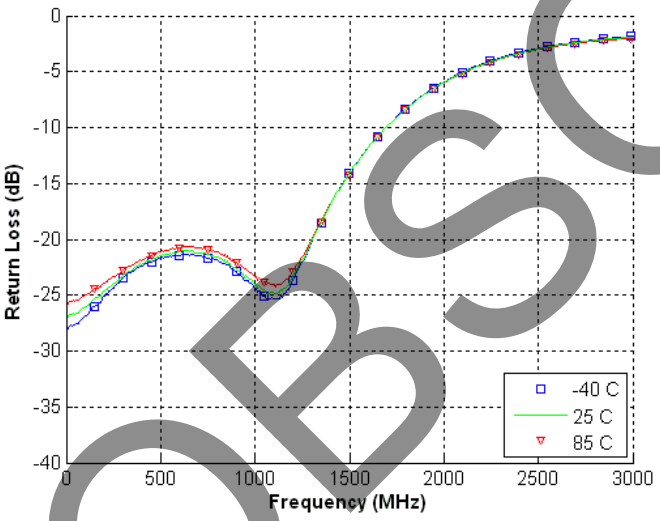



**Figure 22. Rx Return Loss Attenuated, +25°C**

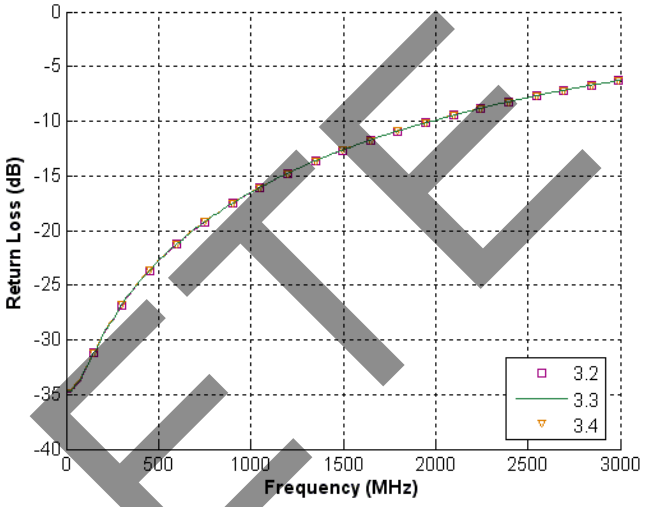
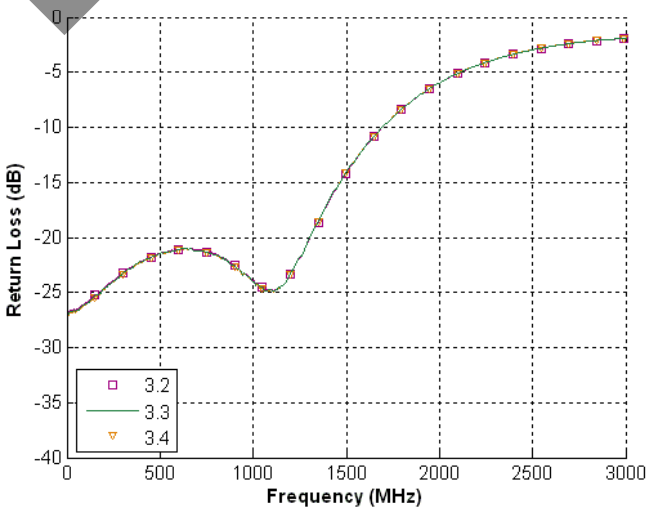



**Figure 23. Rx Return Loss Un-Attenuated, +25°C**



## Thermal Data

Though the insertion loss for this part is very low, when handling high power RF signals, the part can get quite hot.

Figure 24 shows the estimated power dissipation for a given incident RF power level. Multiple curves are presented to show the effect of poor VSWR conditions. VSWR conditions that present short circuit loads to the part can cause significantly more power dissipation than with proper matching.

Figure 25 shows the estimated maximum junction temperature of the part for similar conditions.

Note that both of these charts assume that the case (GND slug) temperature is held at 85C. Special consideration needs to be made in the design of the PCB to properly dissipate the heat away from the part and maintain the 85C maximum case temperature. It is recommended to use best design practices for high power QFN packages: multi-layer PCBs with thermal vias in a thermal pad soldered to the slug of the package. Special care also needs to be made to alleviate solder voiding under the part.

**Table 6. Theta JC**

| Parameter | Min | Typ | Max | Units |
|---|---|---|---|---|
| Theta JC (+85°C) | | 15 | | C/W |

**Figure 24. Power Dissipation**

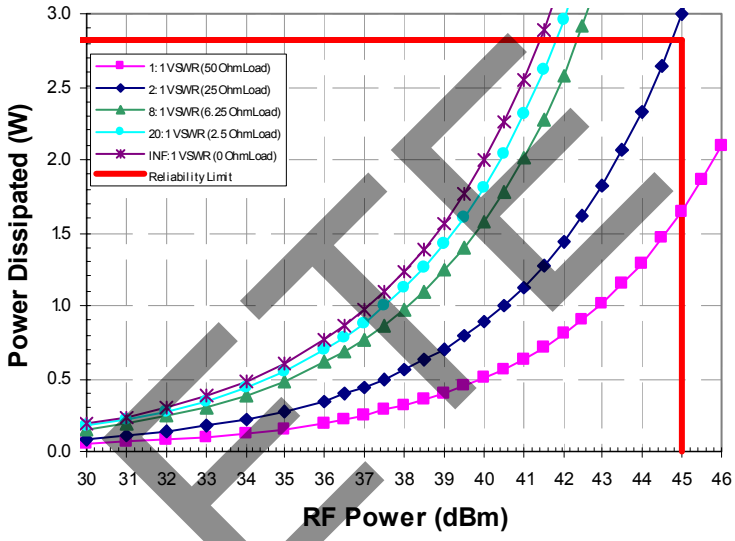
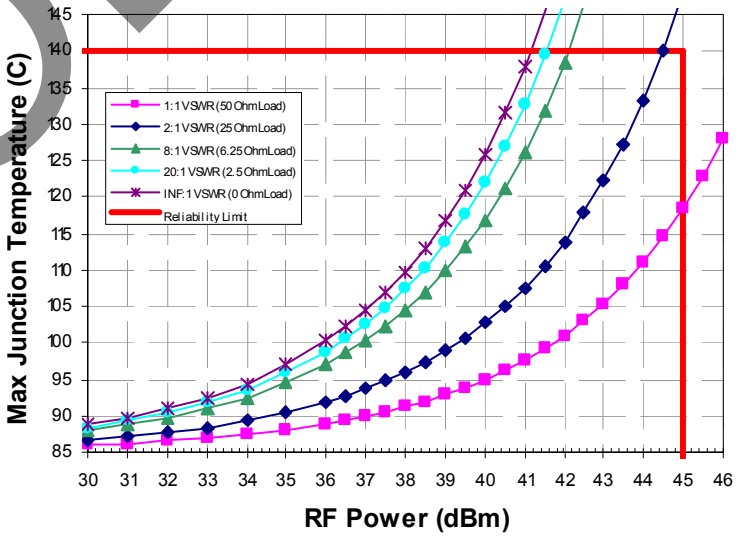
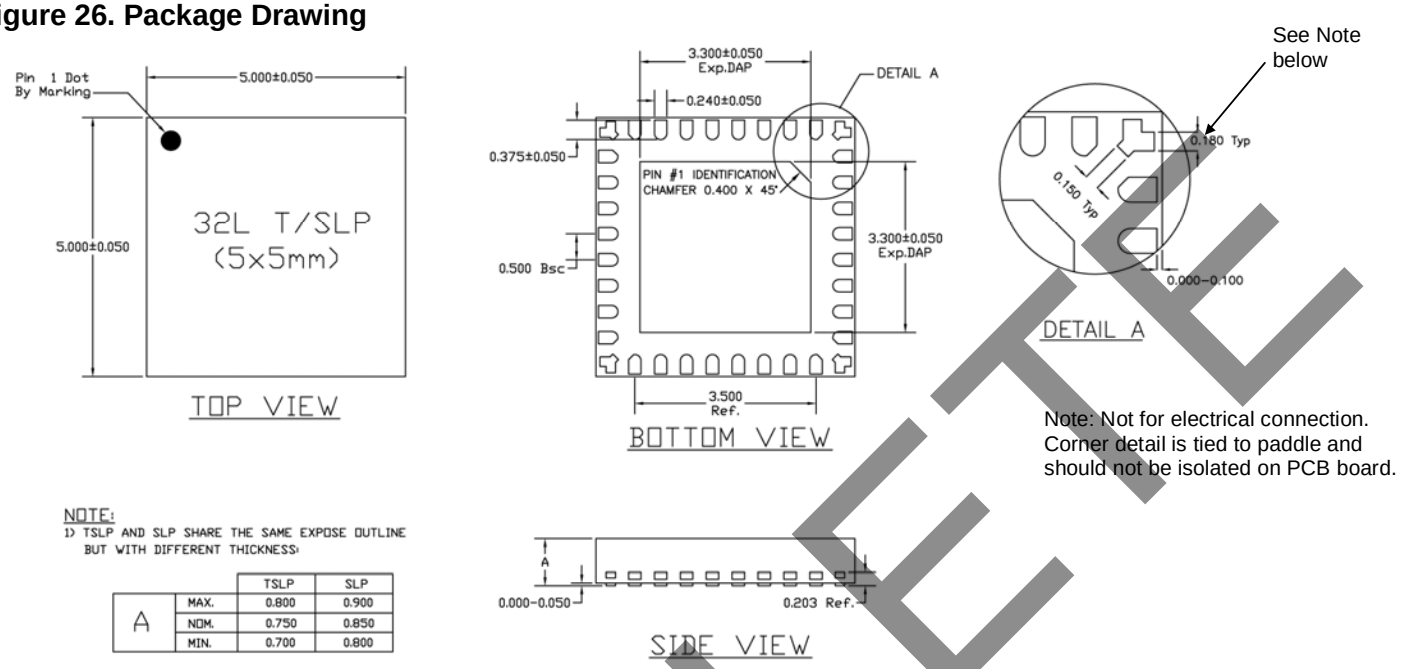



**Figure 25. Maximum Junction Temperature**

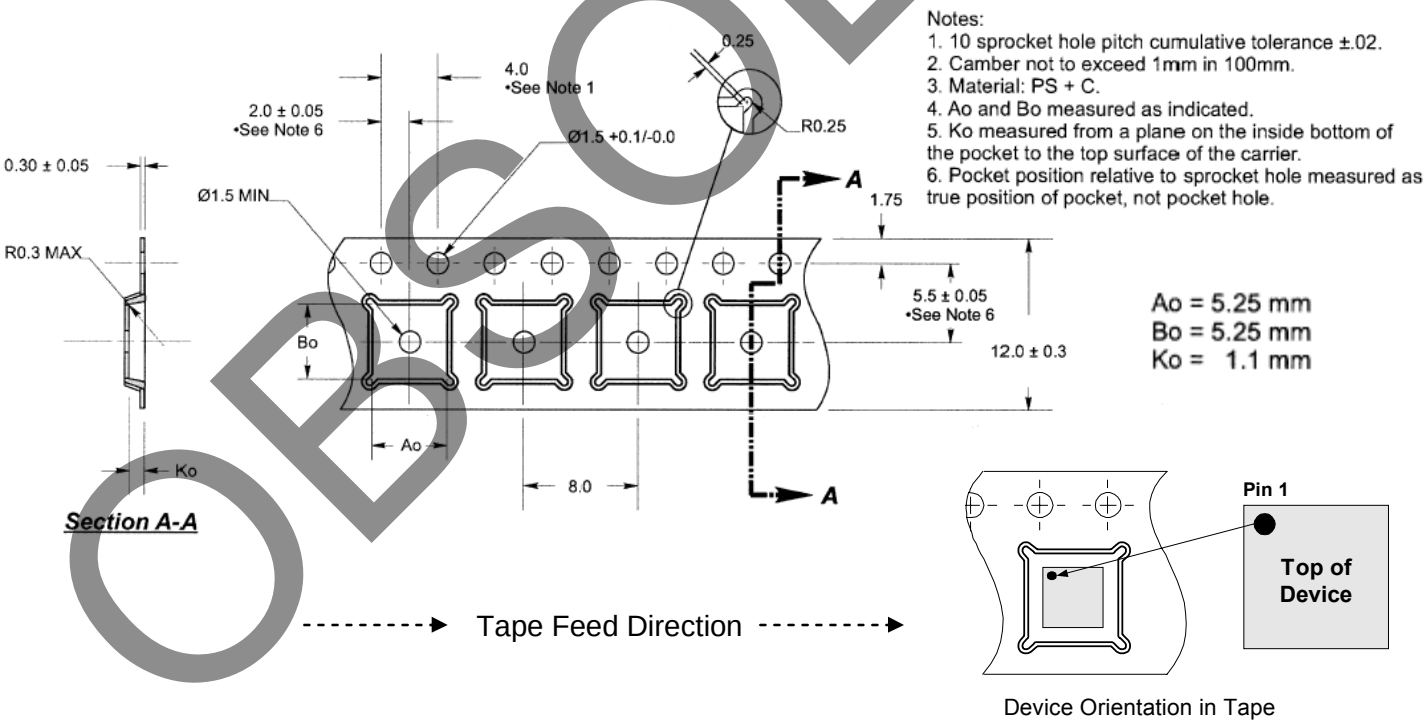


## Figure 26. Package Drawing




| | | TSLP | SLP |
|---|---|---|---|
| A | MAX. | 0.800 | 0.900 |
| | NOM. | 0.750 | 0.850 |
| | MIN. | 0.700 | 0.800 |

## Figure 27. Tape and Reel Specs




## Table 7. Ordering Information

| Order Code | Part Marking | Description | Package | Shipping Method |
|---|---|---|---|---|
| PE42650AMLI-Z | 42650A | Parts on Tape and Reel | Green 32-lead 5x5mm QFN | 3000 units / T&R |
| PE42650AMLI | 42650A | Parts in Tubes or Cut Tape | Green 32-lead 5x5mm QFN | 73 units / Tube |
| EK42650A-01 | 42650A | Evaluation Kit | Evaluation Kit | 1 / Box |

## Sales Offices

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Fax: +81-3-3502-5213

For a list of representatives in your area, please refer to our Web site at: ***www.psemi.com***

## 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).

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