

Product Description

The PE42641 is a HaRP™-enhanced SP4T RF Switch developed on the UltraCMOS® process technology. This switch contains 4 identical WEDGE/CDMA compliant TX paths and can be used in various GSM and WCDMA mobile applications as well as other wireless applications up to 3000 MHz. It is also suitable for antenna band switching and switchable matching networks for cellular and non-cellular mobile applications. It integrates on-board CMOS control logic with a low voltage CMOS-compatible control interface and requires no DC blocking capacitors. This RoHS-compliant part is available in a standard 3 x 3 x 0.75mm QFN package.

Peregrine's HaRP™ technology enhancements deliver high linearity and exceptional harmonics performance. It is an innovative feature of the UltraCMOS® process, providing performance superior to GaAs with the economy and integration of conventional CMOS.

SP4T UltraCMOS® RF Switch
100 MHz – 3.0 GHz

Features

- Symmetric, High-Power SP4T: All ports WEDGE/CDMA-Compliant
- Very Low Insertion Loss: 0.45 dB @ 1000 MHz, 0.6 dB @ 2000 MHz
- HaRP™ - enhanced Technology for Unparalleled Linearity
 - Low harmonics of $2f_0 = -86$ dBc and $3f_0 = -81$ dBc at +35 dBm
 - IMD3 of -110 dBm at WCDMA Band I
 - IIP3 of +68 dBm
- Very high isolation: 35 dB @ 900 MHz, 29 dB @ 1900 MHz
- Exceptionally high ESD tolerance:
 - Class 3 (4.0 kV HBM) on ANT pin
 - Class 2 (2.0 kV HBM) on all pins
- Integrated decoder for 2-pin control
 - Accepts 1.8V and 2.75V levels
- Low 4.5 ohm series ON resistance
- No blocking capacitors required

Figure 1. Functional Diagram

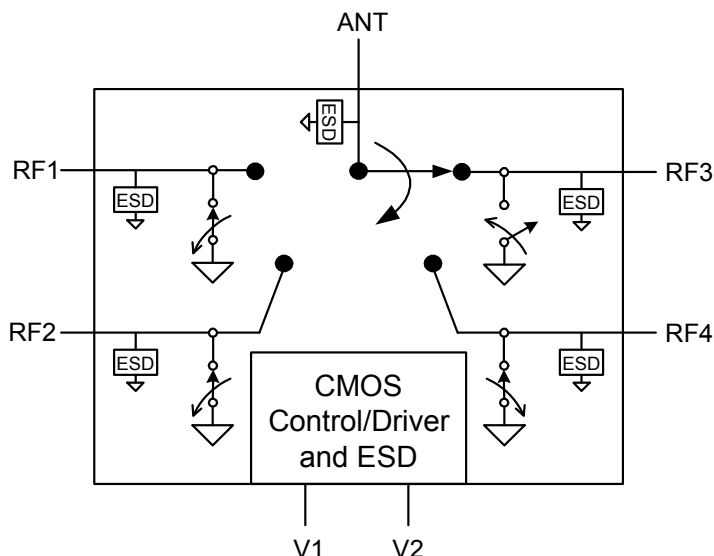


Figure 2. Package Type

16-lead 3x3 mm QFN

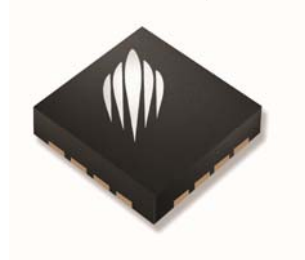


Table 1. Electrical Specifications Temp = 25°C, V_{DD} = 2.75V (Z_S = Z_L = 50 Ω)

| Parameter | Condition | Min | Typ | Max | Units |
|---|--|------|------|-------|-------|
| Operational Frequency | | 100 | | 3000 | MHz |
| Insertion Loss ¹ (Symmetric Ports) | ANT - RF (850 / 900 MHz) | - | 0.45 | 0.65 | dB |
| | ANT - RF (1800 / 1900 MHz) | - | 0.5 | 0.7 | dB |
| | ANT - RF (1900 / 2200 MHz) | - | 0.55 | 0.75 | dB |
| Return Loss (Active Ports) | 850 / 900 MHz | - | 25 | - | dB |
| | 1800 / 1900 MHz | - | 19 | - | dB |
| | 1900 / 2100 MHz | - | 18 | - | dB |
| Isolation | RF - ANT (850 / 900 MHz) | 31 | 35 | - | dB |
| | RF - ANT (1800 / 1900 MHz) | 25 | 29 | - | dB |
| | RF - ANT (1900 / 2200 MHz) | 23.5 | 27.5 | - | dB |
| 2nd Harmonic | 35 dBm output power, 850 / 900 MHz | | -86 | -80 | dBc |
| | 33 dBm output power, 1800 / 1900 MHz | | -87 | -78 | dBc |
| 3rd Harmonic | 35 dBm output power, 850 / 900 MHz | | -81 | -73.5 | dBc |
| | 33 dBm output power, 1800 / 1900 MHz | | -80 | -72.5 | dBc |
| IMD3 distortion at 2.14 GHz | RF Measured at 2.14 GHz at Ant port, input +20 dBm CW signal at 1.95 GHz and -15 dBm CW signal at 1.76 GHz | | -110 | | dBm |
| Switching time | (10-90%) (90-10%) RF | | 2 | 5 | μs |

Note: 1. The typical ON Resistance value at DC is 4.5 Ω

Table 2. Electrical Specifications, Worst Case Conditions: Temp = 85°C, V_{DD} = 2.65 V (Z_S = Z_L = 50 Ω)

| Parameter | Condition | Min | Typ | Max | Units |
|--|--|------|------|-------|-------|
| Insertion loss (2.65V, 85C) | ANT - RF (850 / 900 MHz) | - | 0.5 | 0.7 | dB |
| | ANT - RF (1800 / 1900 MHz) | - | 0.55 | 0.75 | dB |
| | ANT - RF (1900 / 2200 MHz) | - | 0.6 | 0.8 | dB |
| Return Loss (Active Ports) (2.65V, 85C) | 850 / 900 MHz | - | 25 | - | dB |
| | 1800 / 1900 MHz | - | 19 | - | dB |
| | 1900 / 2100 MHz | - | 18 | - | dB |
| Isolation (2.65V, 85C) | RF - ANT (850 / 900 MHz) | 30.5 | 34.5 | - | dB |
| | RF - ANT (1800 / 1900 MHz) | 24.5 | 28.5 | - | dB |
| | RF - ANT (1900 / 2200 MHz) | 23 | 27 | - | dB |
| 2nd Harmonic (2.65V, 85C) | 35 dBm output power, 850 / 900 MHz | | -84 | -78 | dBc |
| | 33 dBm output power, 1800 / 1900 MHz | | -85 | -76 | dBc |
| 3rd Harmonic (2.65V, 85C) | 35 dBm output power, 850 / 900 MHz | | -79 | -71.5 | dBc |
| | 33 dBm output power, 1800 / 1900 MHz | | -78 | -70.5 | dBc |
| IMD3 distortion at 2.14 GHz (2.65V, 85C) | RF Measured at 2.14 GHz at Ant port, input +20 dBm CW signal at 1.95 GHz and -15 dBm CW signal at 1.76 GHz | | -108 | | dBm |
| Switching time | (10-90%) (90-10%) RF | | 2 | 5 | μs |

Figure 3. Pin Configuration (Top View)

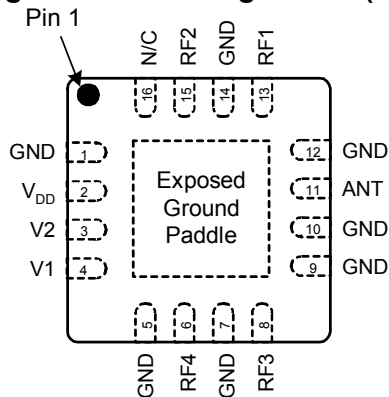


Table 3. Pin Descriptions

| Pin No. | Pin Name | Description |
|---------|------------------|--|
| 1 | GND | Ground |
| 2 | V _{DD} | Supply |
| 3 | V2 | Switch control input, CMOS logic level |
| 4 | V1 | Switch control input, CMOS logic level |
| 5 | GND | Ground |
| 6 | RF4 ² | RF Port 4 |
| 7 | GND | Ground |
| 8 | RF3 ² | RF Port 3 |
| 9 | GND | Ground |
| 10 | GND | Ground |
| 11 | ANT ² | RF Common – Antenna |
| 12 | GND | Ground |
| 13 | RF1 ² | RF Port 1 |
| 14 | GND | Ground |
| 15 | RF2 ² | RF Port 2 |
| 16 | N/C | No Connect |
| Paddle | GND | Ground for proper device operation |

Note: 2. Blocking capacitors needed only when non-zero DC voltage present

Table 4. Operating Ranges

| Parameter | Symbol | Min | Typ | Max | Units |
|--|-----------------|------|------|------|-------|
| Temperature range | T _{OP} | -40 | | +85 | °C |
| V _{DD} Supply Voltage | V _{DD} | 2.65 | 2.75 | 2.85 | V |
| I _{DD} Power Supply Current (V _{DD} = 2.75V) | I _{DD} | | 13 | 50 | µA |
| RF input power ³ (VSWR ≤ 3:1) 824-915 MHz | P _{IN} | | | +35 | dBm |
| RF input power ³ (VSWR ≤ 3:1) 1710-1910 MHz | | | | +33 | |
| Control Voltage High | V _{IH} | 1.4 | | | V |
| Control Voltage Low | V _{IL} | | | 0.4 | V |

Note: 3. Assumes RF input period of 4620 µs and duty cycle of 50%

Table 5. Absolute Maximum Ratings

| Symbol | Parameter/Conditions | Min | Max | Units |
|-------------------------------|--|------|-----------------------|-------|
| V _{DD} | Power supply voltage | -0.3 | 4.0 | V |
| V _I | Voltage on any DC input | -0.3 | V _{DD} + 0.3 | V |
| T _{ST} | Storage temperature range | -65 | +150 | °C |
| P _{IN} (50 Ω) | RF input power (50 Ω) ^{4,5} 824-915 MHz | | +38 | dBm |
| | RF input power (50 Ω) ^{4,5} 1710-1910 MHz | | +36 | |
| P _{IN} (∞:1) | RF input power (VSWR = ∞:1) ^{4,5} 824-915 MHz | | +35 | dBm |
| | RF input power (VSWR = ∞:1) ^{4,5} 1710-1910 MHz | | +33 | |
| V _{ESD} ⁶ | ESD Voltage, ANT pin | | 4000 | V |
| | ESD Voltage, all pins | | 2000 | V |

Notes: 4. Assumes RF input period of 4620 µs and duty cycle of 50%
5. V_{DD} within operating range specified in Table 4
6. ESD Voltage (HBM, MIL-STD-883 Method 3015.7)

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.

Table 6. Truth Table

| Path | V2 | V1 |
|-----------|----|----|
| ANT – RF1 | 0 | 0 |
| ANT – RF2 | 1 | 0 |
| ANT – RF3 | 0 | 1 |
| ANT – RF4 | 1 | 1 |

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.

Latch-Up Avoidance

Unlike conventional CMOS devices, UltraCMOS[®] devices are immune to latch-up.

Moisture Sensitivity Level

The Moisture Sensitivity Level rating for the PE42641 in the 16-lead 3x3 QFN package is MSL1.

Evaluation Kit

The SP4T switch EK Board was designed to ease customer evaluation of Peregrine’s PE42641. The RF common port is connected through a 50 Ω transmission line via the top SMA connector, J1. RF1, RF2, RF3 and RF4 are connected through 50 Ω transmission lines via SMA connectors J3, J5, J2 and J4, respectively. A through 50 Ω transmission is available via SMA connectors J6 and J7. 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 four metal layer FR4 material with a total thickness of 62 mils. The middle layers provide ground for the transmission lines. The transmission lines were designed using a coplanar waveguide with ground plane model using a trace width of 32 mils, trace gaps of 25 mils, and metal thickness of 2.1 mils.

Figure 4. Evaluation Board Layouts
Peregrine Specification 101/0287

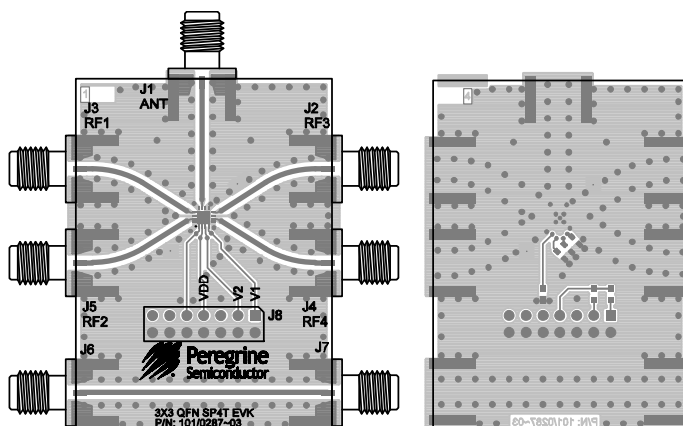


Figure 5. Evaluation Board Schematic
Peregrine Specification 102/0339

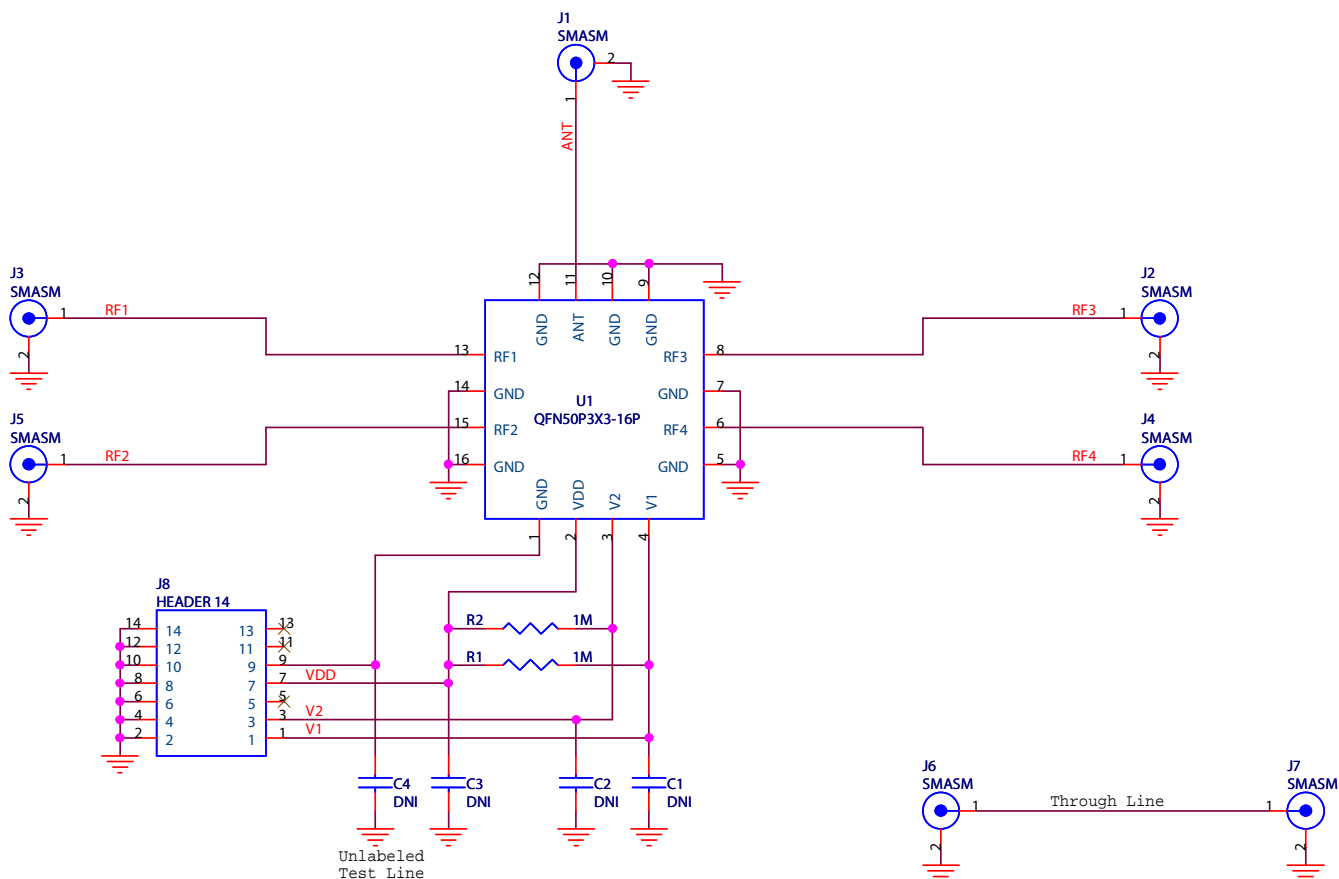


Figure 6. Insertion Loss: ANT-RF @ 25°C

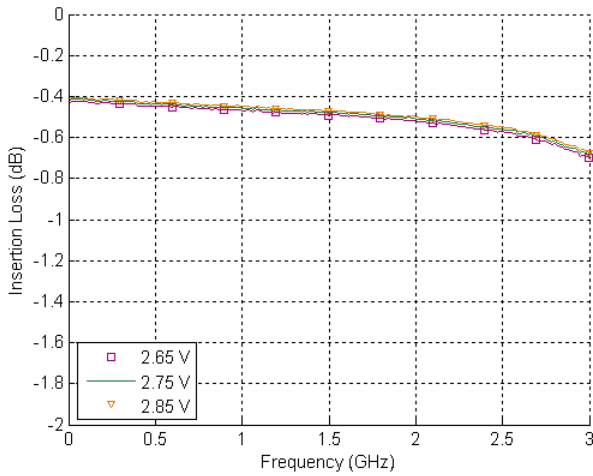


Figure 7. Insertion Loss: ANT-RF @ 2.75V

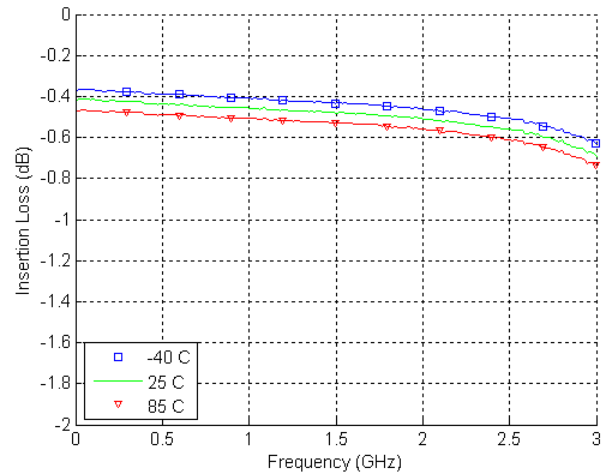


Figure 8. Isolation: ANT-RF @ 25°C

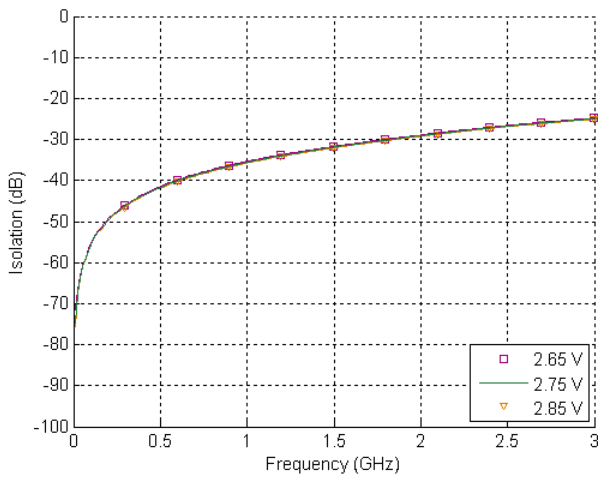


Figure 9. Isolation: ANT-RF @ 2.75V

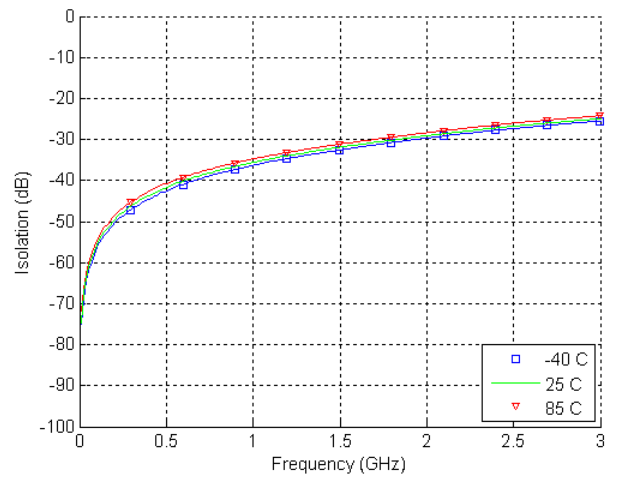


Figure 10. Return Loss at active port @ 25°C

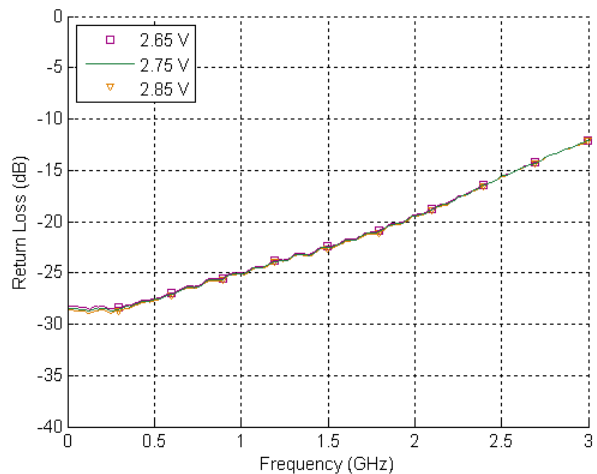


Figure 11. Return Loss at active port @ 2.75V

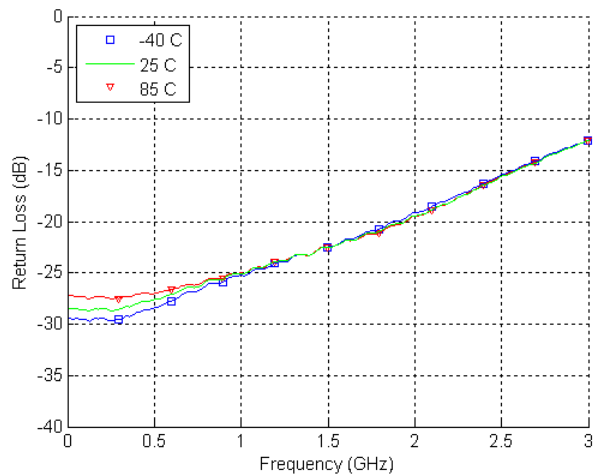
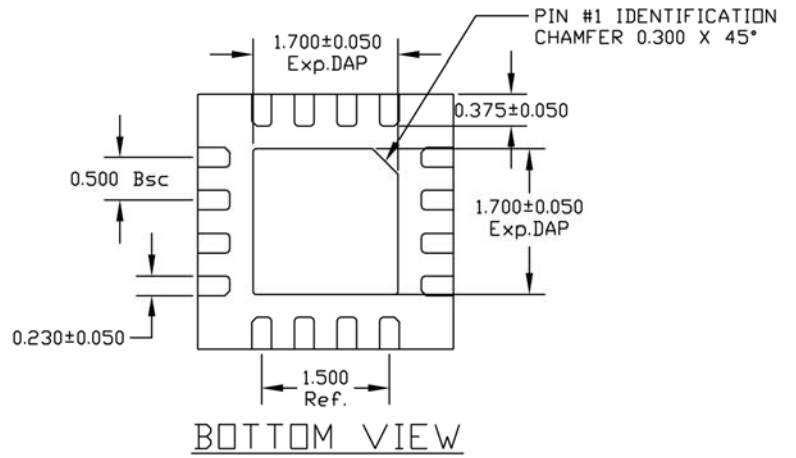
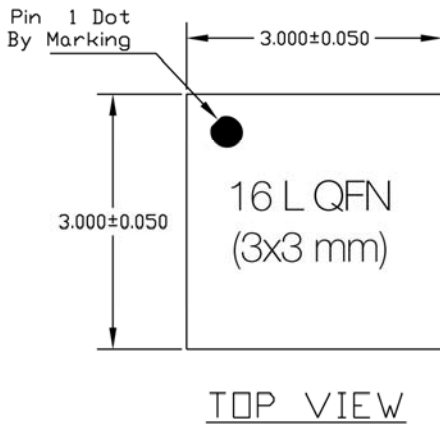


Figure 12. Package Drawing



| | | QFN 3x3 mm |
|---|-----|------------|
| A | MAX | 0.800 |
| | NOM | 0.750 |
| | MIN | 0.700 |

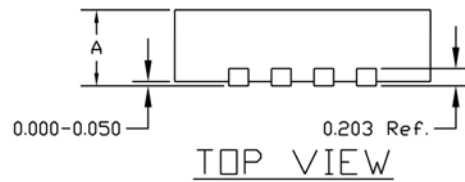
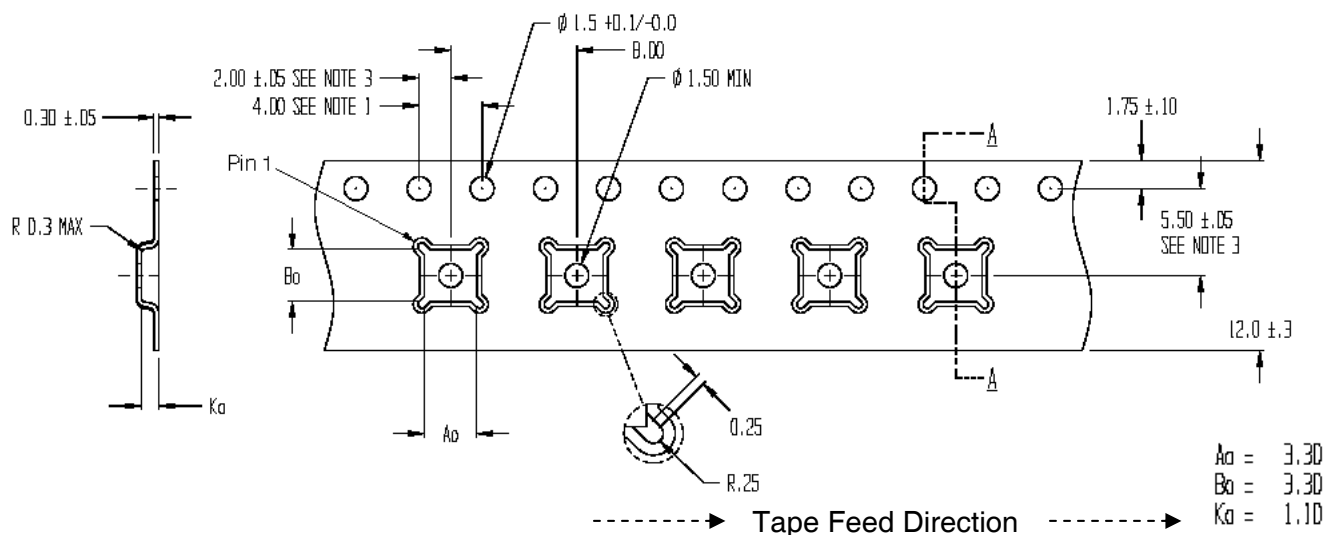


Figure 13. Tape and Reel Specifications

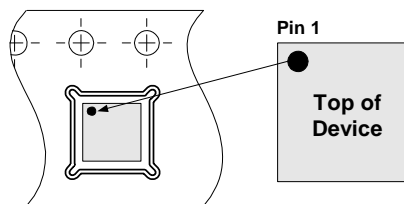
16-lead 3x3 mm QFN



SECTION A - A

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



Device Orientation in Tape

Table 7. Ordering Information

| Order Code | Part Marking | Description | Package | Shipping Method |
|-----------------------------|--------------|----------------------------|-------------------------|------------------|
| EK42641-02 ¹ | PE42641-EK | PE42641-16QFN 3x3mm-EK | Evaluation Kit | 1 / Box |
| EK42641-03 ¹ | PE42641-EK | PE42641-16QFN 3x3mm-EK | Evaluation Kit | 1 / Box |
| PE42641MLIBB-Z ¹ | 42641 | PE42641G-16QFN 3x3mm-3000C | Green 16-lead 3x3mm QFN | 3000 units / T&R |
| PE42641MLBC-Z ² | 42641 | PE42641G-16QFN 3x3mm-3000C | Green 16-lead 3x3mm QFN | 3000 units / T&R |

Notes: 1. Hana – AYT (Thailand) assembly house. Please contact factory for assembly house details.
2. Unisem assembly house. Please contact factory for assembly house details.

Sales Contact and Information

For sales and contact information please visit www.psemi.com.

Advance Information: The product is in a formative or design stage. The datasheet contains design target specifications for product development. Specifications and features may change in any manner without notice.
Preliminary Specification: The datasheet 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.
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