

PE42548

Document Category: Product Specification

UltraCMOS® SP4T RF Switch, 9 kHz–30 GHz



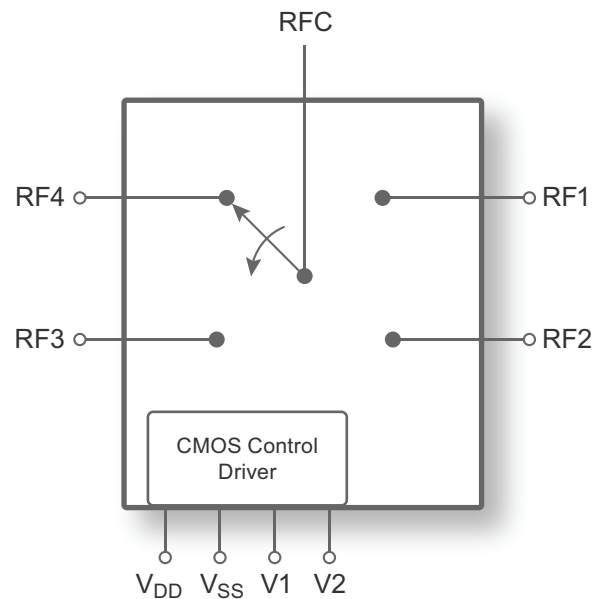
Features

- Wideband support up to 30 GHz
- Low insertion loss of 2.0 dB @ 26.0 GHz
- Fast switching time of 60 ns
- High input P1dB of 33 dBm
- High port-to-port isolation of 41 dB
- -40 °C to +105 °C operating temperature support
- Package: 20-lead 3×3 mm LGA

Applications

- Test and measurement (T&M)
- 5G mmWave
- Microwave backhaul
- Radar
- Satellite communications

Figure 1 ■ PE42548 Functional Diagram



Product Description

The PE42548 is a HaRP™ technology-enhanced reflective SP4T RF switch that supports a wide frequency range from 9 kHz to 30 GHz. It delivers low insertion loss, fast switching time and high isolation performance, making this device ideal for test and measurement (T&M), 5G mmWave, microwave backhaul, radar and satellite communication applications. No blocking capacitors are required if DC voltage is not present on the RF ports.

The PE42548 is manufactured on pSemi's UltraCMOS® process, a patented variation of silicon-on-insulator (SOI) technology.

Revision History

Table 1 ■ Revision History

| Document Revision | Date | Change Description |
|-------------------|-------------|---|
| DOC-117514-1 | July 2024 | Initial release |
| DOC-117514-2 | August 2024 | Table 3, Recommended Operating Conditions Table 8, Order codes |

Absolute Maximum Ratings

Exceeding absolute maximum ratings listed in **Table 2** may cause permanent damage. Operation should be restricted to the limits in **Table 3**. Operation between operating range and absolute maximum for extended periods may reduce reliability.

ESD Precautions

When handling this UltraCMOS device, observe the same precautions as with any 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 2**.

Latch-up Immunity

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

Table 2 ■ Absolute Maximum Ratings for PE42548

| Parameter/Condition | Min | Max | Unit |
|---|------|----------------------|------|
| Input Power ⁽¹⁾ | | 35 | dBm |
| Hot Switching | | 22 | dBm |
| V _{DD} Positive Supply Voltage | -0.3 | 3.6 | V |
| V _{SS} Negative Supply Voltage | -3.6 | 0.3 | V |
| Digital Input Voltage | -0.3 | V _{DD} +0.3 | V |
| Storage Temperature | -65 | 150 | °C |
| ESD voltage HBM, All Pins Except RF ⁽¹⁾ | 2000 | | V |
| ESD voltage HBM, RF Pins ⁽²⁾ | 600 | | V |
| ESD voltages, CDM, All Pins ⁽³⁾ | 1000 | | V |
| Notes: 1) For power de-rating at frequencies less than 2 GHz, see Figure 2 . 2) Human body model (MIL-STD 883 Method 3015). 3) Charged device model (JEDEC JESD22-C101). | | | |

Recommended Operating Conditions

Table 3 lists the recommended operating conditions for the PE42548. Devices should not be operated outside the operating conditions listed below.

Table 3 ■ Recommended Operating Conditions for PE42548

| Parameter | Min | Typ | Max | Unit |
|-------------------------------|-------|------|-------|------|
| VDD Positive Supply Voltage | 3.15 | 3.3 | 3.45 | V |
| VSS Negative Supply Voltage | -3.45 | -3.3 | -3.15 | V |
| IDD Positive Supply Current | | 12 | | μA |
| ISS Negative Supply Current | | -128 | | μA |
| Control Voltage High | 1.3 | | 3.3 | V |
| Control Voltage Low | 0 | | 0.8 | V |
| Digital Input Leakage Current | | | 35 | μA |
| Temperature Range | -40 | 25 | 105 | °C |

Electrical Specifications

Table 4 provides the PE42548 key electrical specifications @ +25 °C, $V_{DD} = 3.3V$, $V_{SS} = -3.3V$ unless otherwise specified.

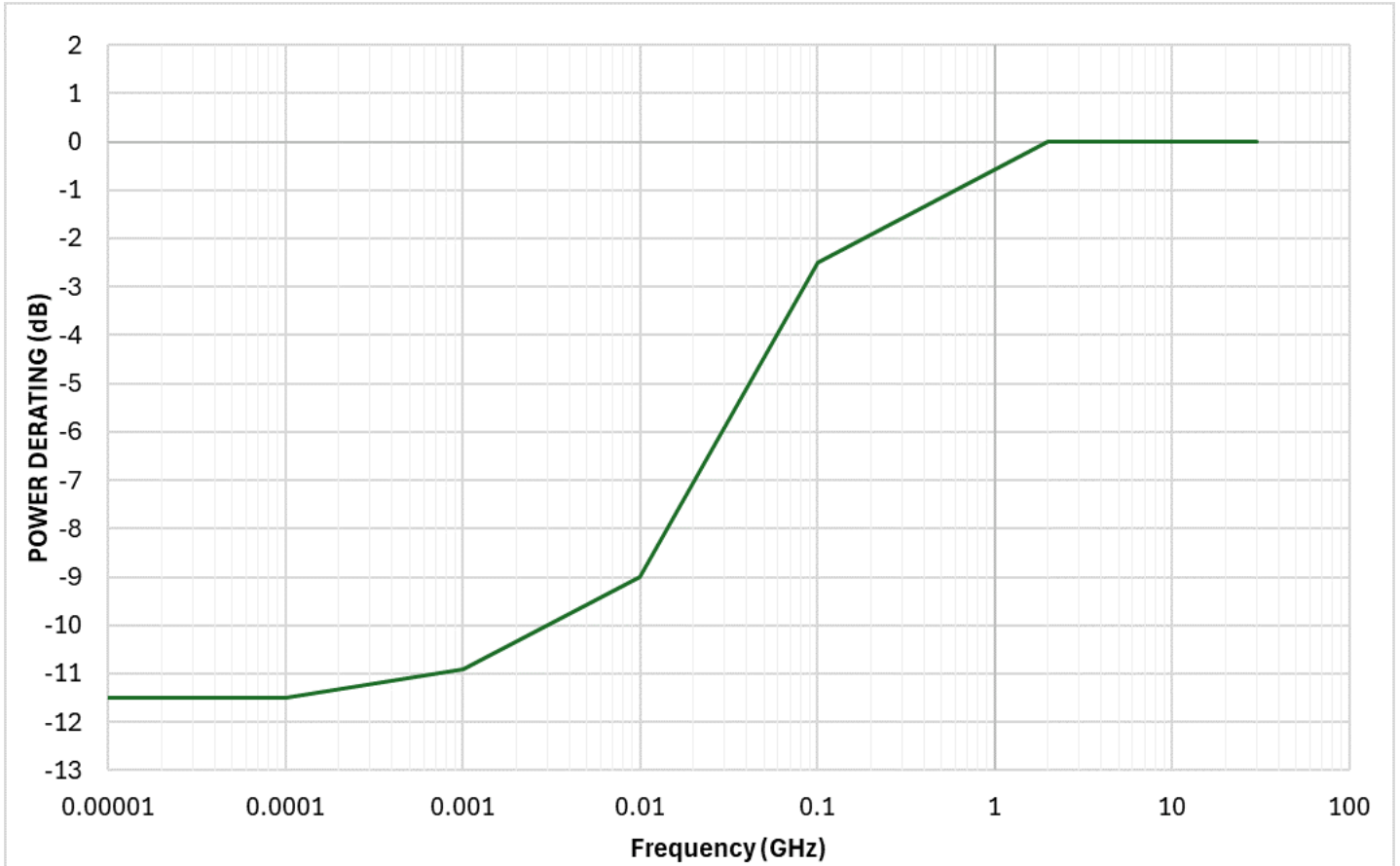
Table 4 ■ Electrical Specifications for PE42548

| Parameter | Description | Frequency (MHz) | Min | Typ | Max | Unit |
|--|-------------------------------------|-----------------|-----|-----|-----|------|
| Insertion Loss | | 10 | | 1.1 | | dB |
| | | 10 to 20000 | | 2.0 | | dB |
| | | 20000 to 30000 | | 2.3 | | dB |
| Isolation | RFC to RFX | 10 to 20000 | | 41 | | dB |
| | | 20000 to 30000 | | 35 | | dB |
| | RFX to RFX | 10 to 20000 | | 37 | | dB |
| | | 20000 to 30000 | | 33 | | dB |
| Return Loss (Common Port) | | 10 to 20000 | | 16 | | dB |
| | | 20000 to 30000 | | 13 | | dB |
| Return Loss (Active Port) | | 10 to 20000 | | 15 | | dB |
| | | 20000 to 30000 | | 13 | | dB |
| 0.1dB Compression ^(*) | | 2–30 GHz | | 31 | | dBm |
| 1 dB Compression ^(*) | | 2–30 GHz | | 33 | | dBm |
| Input IP2 | | 100 | | 103 | | dBm |
| | | 746 | | 105 | | dBm |
| | | 1974 | | 110 | | dBm |
| | | 2635 | | 111 | | dBm |
| Input IP3 | | 746 | | 52 | | dBm |
| | | 1974 | | 53 | | dBm |
| | | 2635 | | 53 | | dBm |
| | | 24900 | | 52 | | dBm |
| Switching Time | 50% VCTL to 10% to 90% of RF output | | | 60 | | nsec |
| Note: * Pulse 100 μ s duty cycle 10%. | | | | | | |

Power De-rating Curve

Figure 2 shows the power de-rating curve for the PE42548 from 10 kHz–30 GHz @ -40°C to +105°C ambient, (50Ω).

Figure 2 ■ Power De-rating Curve for PE42548



Typical Performance Data

Figure 3–Figure 13 show the typical performance data at +25 °C, $V_{DD} = 3.3V$, $V_{SS} = -3.3V$ ($Z_S = Z_L = 50\Omega$), unless otherwise specified.

Figure 3 ■ Insertion Loss RFC to RFX vs. Frequency

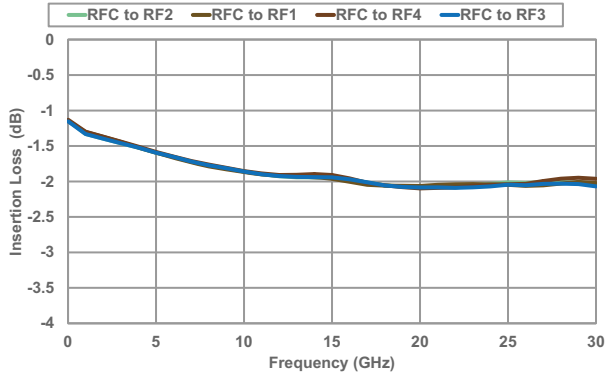


Figure 4 ■ Insertion Loss vs. Temperature (RFC–RF1)

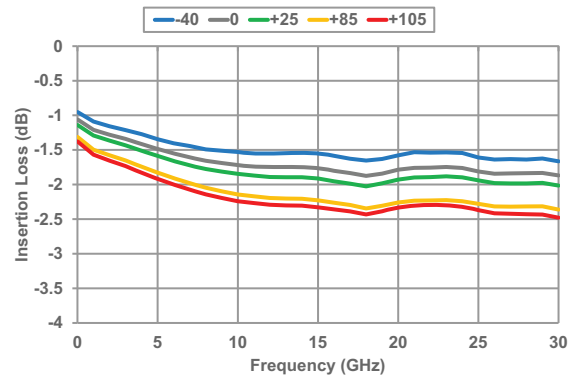


Figure 5 ■ Insertion Loss vs. Temperature (RFC–RF2)

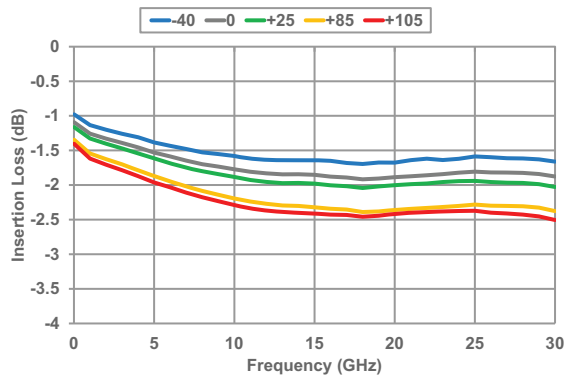


Figure 6 ■ Isolation (RFC–RFX)

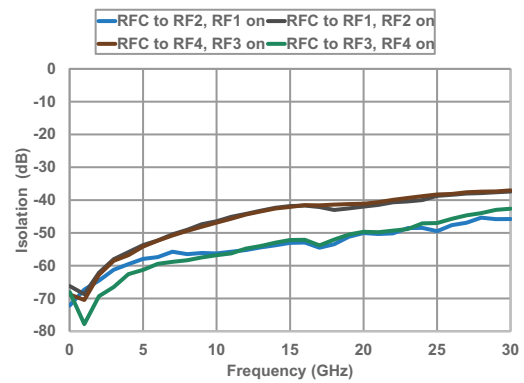


Figure 7 ■ Isolation (RFX–RFX)

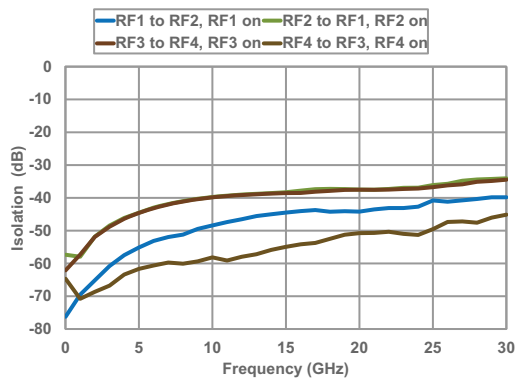


Figure 8 ■ Isolation vs. Temperature (RF1–RF2, RF1 On)

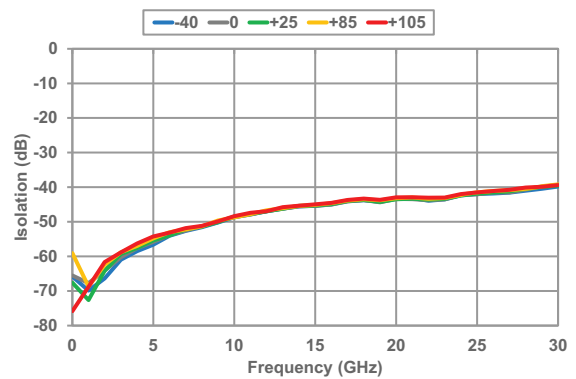


Figure 9 ■ Isolation vs. Temperature (RF1–RF2, RF2 On)

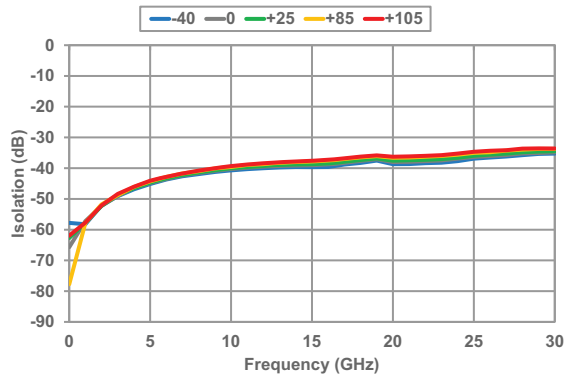


Figure 10 ■ Isolation vs. Temperature (RFC–RF1, RF2 On)

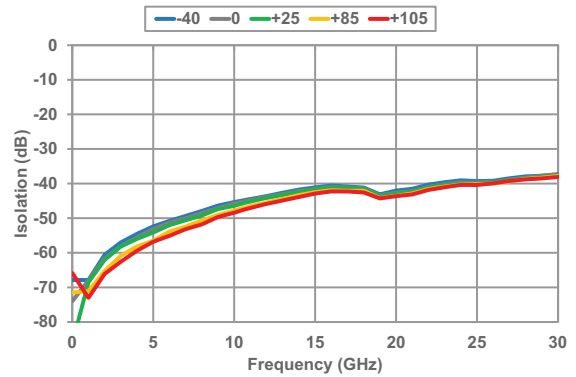


Figure 11 ■ Isolation vs. Temperature (RFC–RF2, RF1 On)

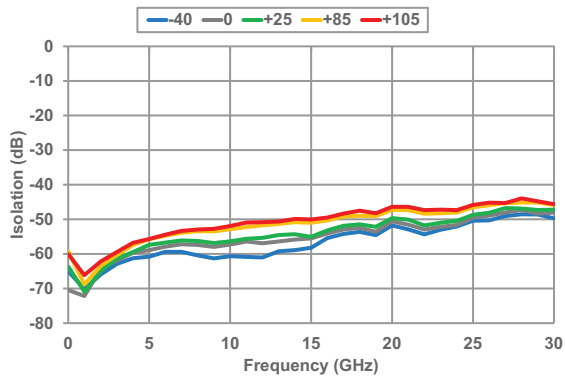


Figure 12 ■ Return Loss Active Port (RFX On)

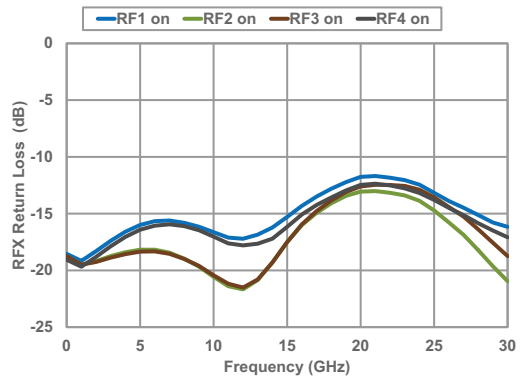
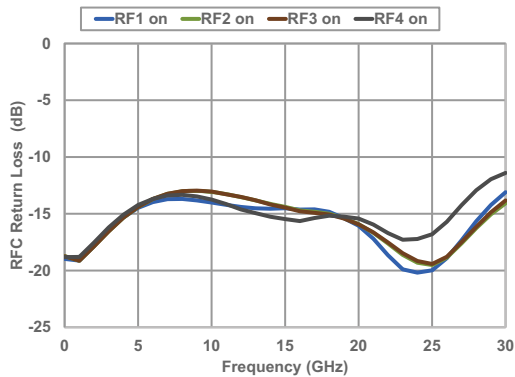


Figure 13 ■ Return Loss Common Port (RFX On)



Evaluation Kit

The SP4T switch evaluation kit was designed to ease customer evaluation of pSemi's PE42548. The RF common port is connected through a 50Ω transmission line via the top SMA connector, J6. RF1, RF2, RF3 and RF4 are connected through 50Ω transmission lines via SMA connectors J1, J3, J5 and J4, respectively. A through 50Ω transmission is available via SMA connectors J7 and J8. 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 material with a total thickness of 62 mils. The dual-clad top RF layer is Astra MT77 material with a 2.5 mil prepreg and $\epsilon_r = 3.00$. 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 4.75 mils, trace gaps of 4 mils, and metal with 2 mil thickness.

Figure 14 ■ Evaluation Board Layout, Assembly Primary and Secondary Sides for PE42548

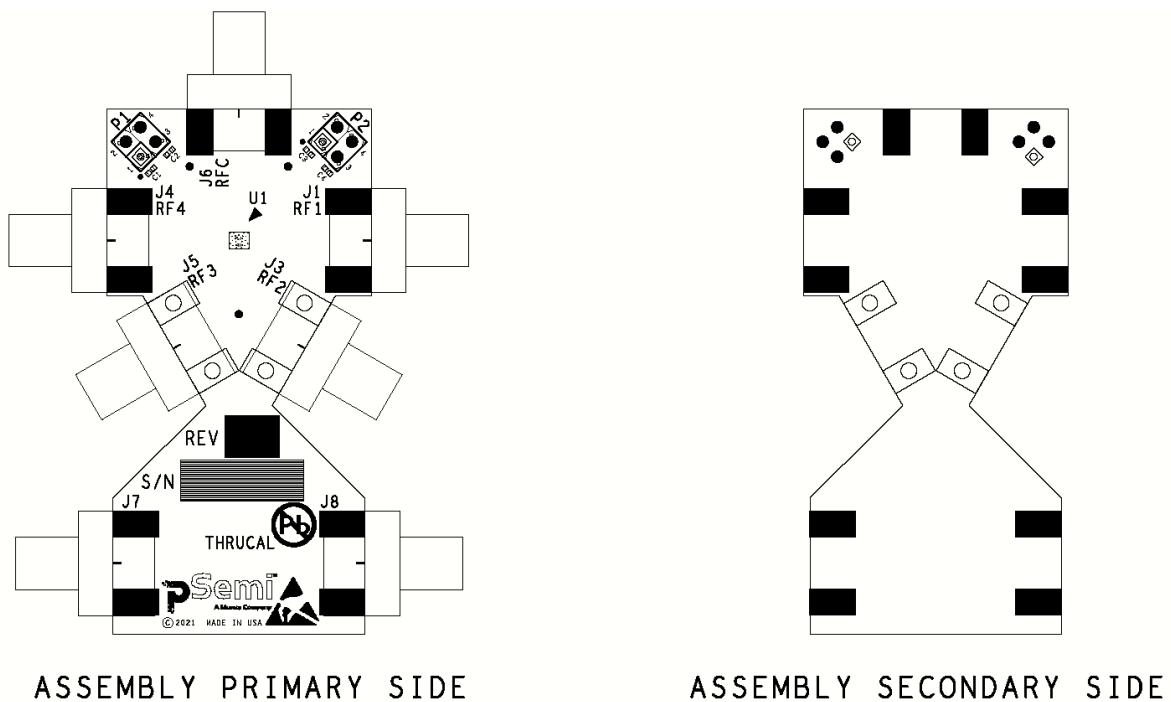


Figure 15 ▪ Evaluation Board Layout, Top Layer for PE42548

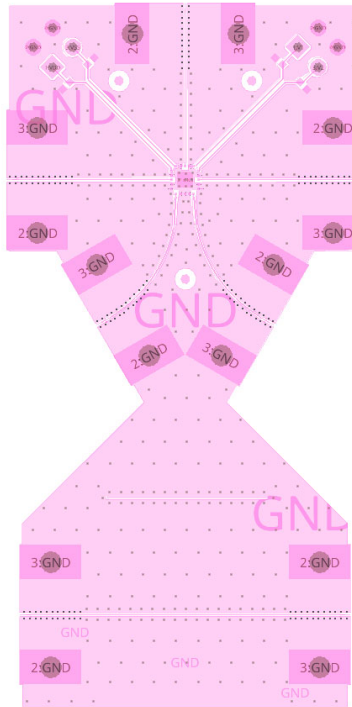
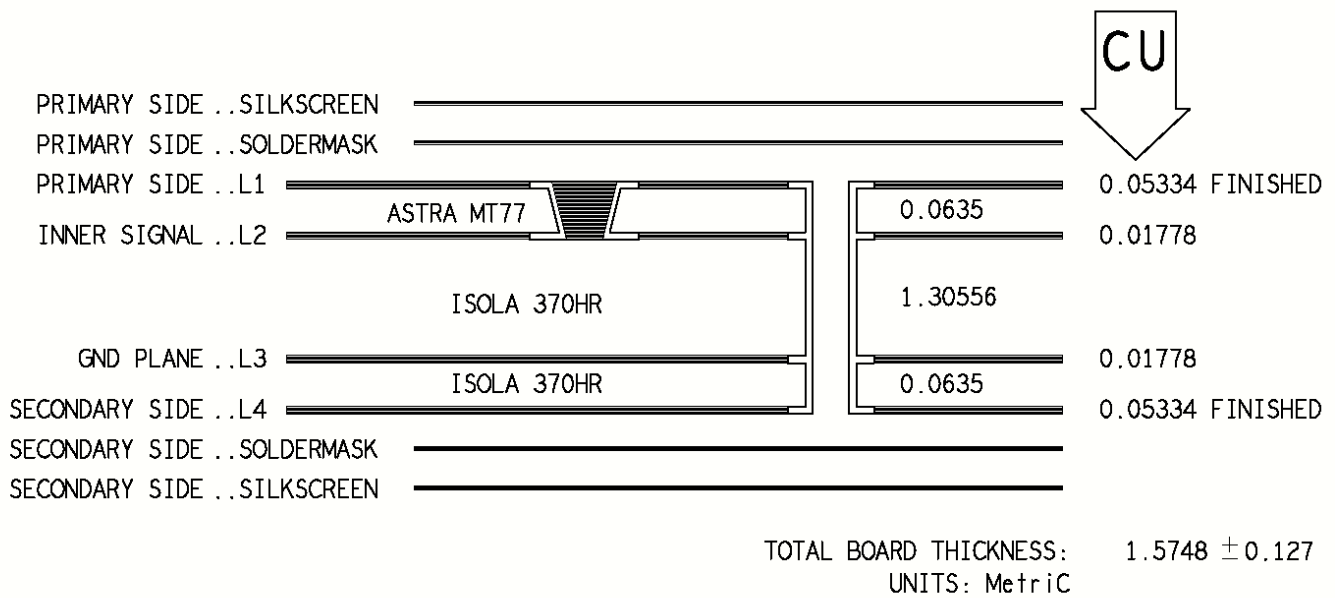


Figure 16 ▪ Evaluation Board Layout, Stack Up for PE42548

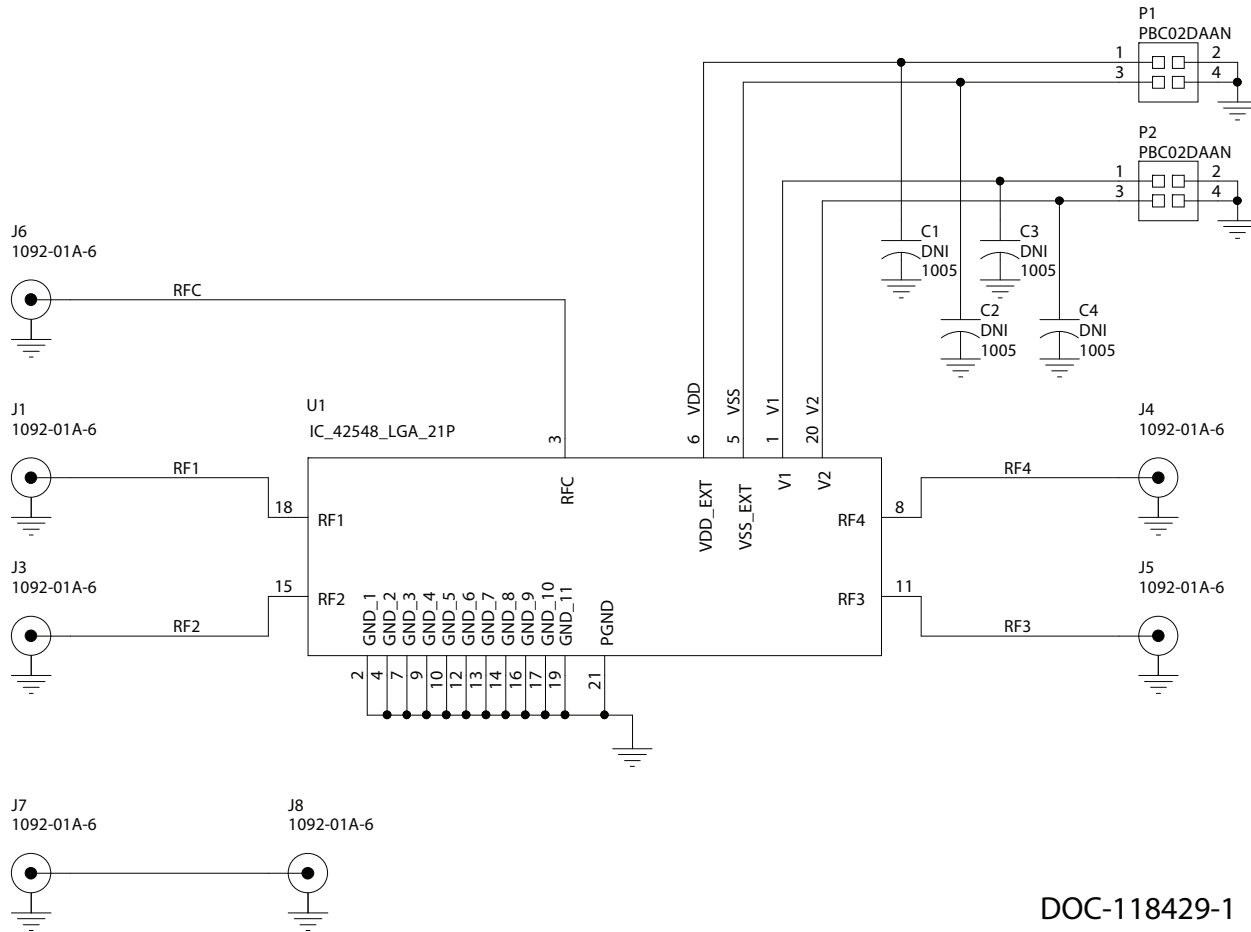
4 LAYER - STACK UP



Evaluation Board Schematic and BOM

Figure 17 shows the evaluation board schematic. Table 5 shows the evaluation board bill of materials.

Figure 17 ■ PE42548 Evaluation Board Schematic



DOC-118429-1

Table 5 ■ PE42548 Evaluation Board BOM Components

| Reference | Value | Description | Manufacturer | Mfg. Part Number |
|----------------------|-------------------|--|-----------------------------|------------------|
| C1,C2,C3,C4 | DNI | CAP, SMD, CER, DNI, n/a, n/a, n/a, 0402 (1005 Metric) | | |
| J1,J3,J4,J5,J6,J7,J8 | CN_1492-04A-6 | CONN, Coaxial Connectors (RF), SMA, SMD, Jack, Female Socket, 40GHz | Southwest Microwave | 1092-01A-6 |
| P1,P2 | PBC02DAAN | CONN, Rectangular Connectors - Headers, Male Pins, Header Unshrouded Breakaway, TH, Male, 2.54mmX2.54mm, 4 POS | Sullins Connector Solutions | PBC02DAAN |
| U1 | IC_42548_L-GA_21P | IC, 42548 LGA | pSemi Corporation | |

Pin Information

This section provides pinout information for the PE42548. **Figure 18** shows the pin map of this device for the available package. **Table 6** provides a description for each pin.

Figure 18 ▪ Pin Configuration (Top View)

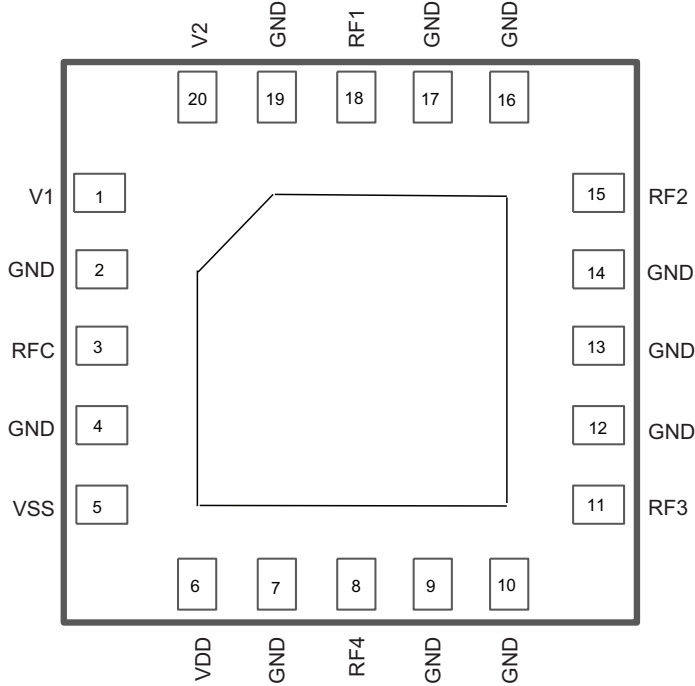


Table 6 ▪ Pin Descriptions for PE42548

| Pin No. | Pin Name | Description |
|---------|----------|-------------------------|
| 1 | V1 | Control input 1 |
| 2 | GND | Ground |
| 3 | RFC | RF common port |
| 4 | GND | Ground |
| 5 | VSS | Negative supply voltage |
| 6 | VDD | Positive supply voltage |
| 7 | GND | Ground |
| 8 | RF4 | RF throw port 4 |
| 9 | GND | Ground |
| 10 | GND | Ground |
| 11 | RF3 | RF throw port 3 |
| 12 | GND | Ground |
| 13 | GND | Ground |
| 14 | GND | Ground |
| 15 | RF2 | RF throw port 2 |
| 16 | GND | Ground |
| 17 | GND | Ground |
| 18 | RF1 | RF throw port 1 |
| 19 | GND | Ground |
| 20 | V2 | Control input 2 |

Control Logic

Table 7 provides the control logic truth table for the PE42548, where 0 = Low (0–0.8V) and 1 = High (1.2–3.3V).

Table 7 ▪ *Truth Table for PE42548*

| V1 | V2 | RF1 | RF2 | RF3 | RF4 |
|----|----|-----------|-----------|-----------|-----------|
| 0 | 0 | ON | Isolation | Isolation | Isolation |
| 1 | 0 | Isolation | ON | Isolation | Isolation |
| 0 | 1 | Isolation | Isolation | ON | Isolation |
| 1 | 1 | Isolation | Isolation | Isolation | ON |

Packaging Information

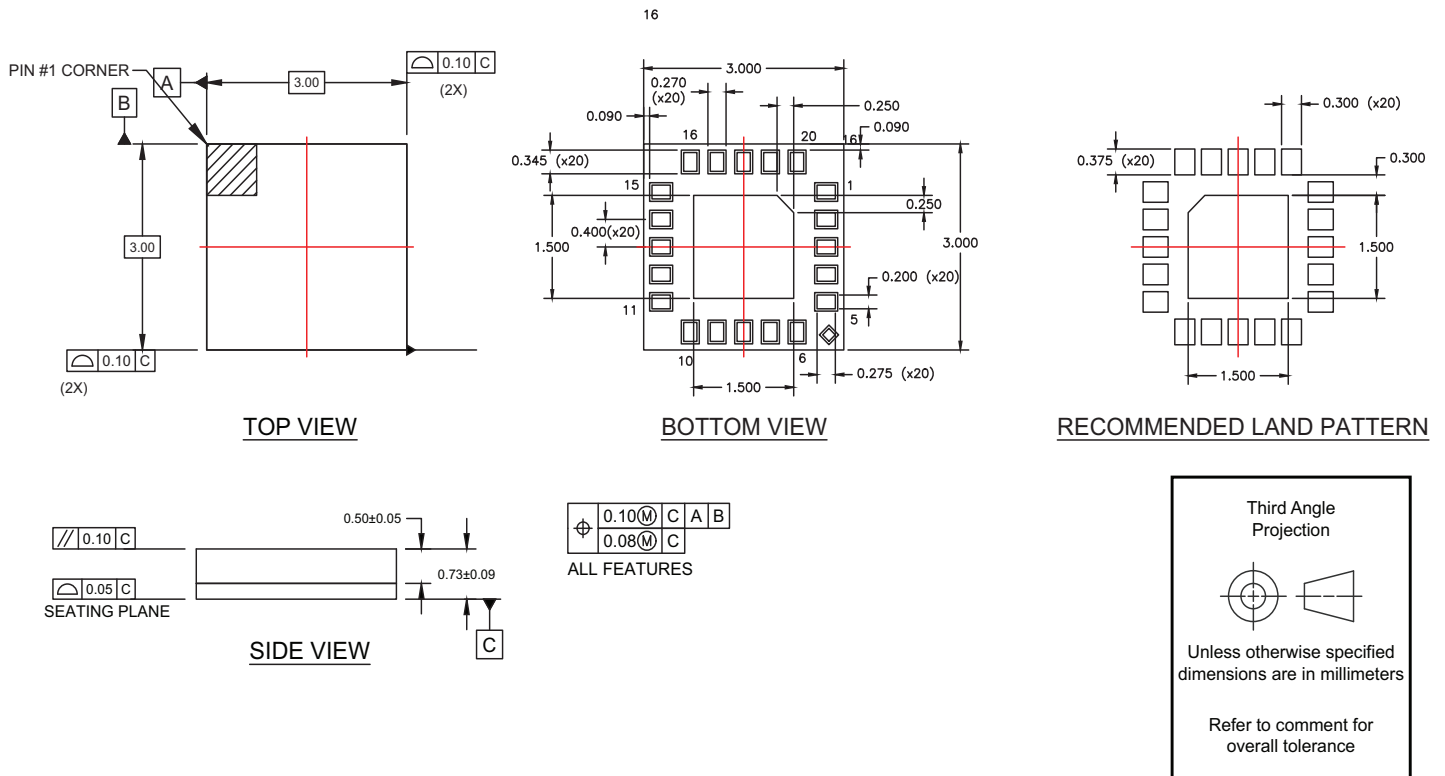
This section provides packaging data including the moisture sensitivity level, package drawing, package marking and tape-and-reel information.

Moisture Sensitivity Level

The moisture sensitivity level rating for the PE42548 in the 20-lead 3×3 mm LGA package is MSL 3.

Package Drawing

Figure 19 ■ Package Mechanical Drawing for 20-lead 3×3 mm LGA



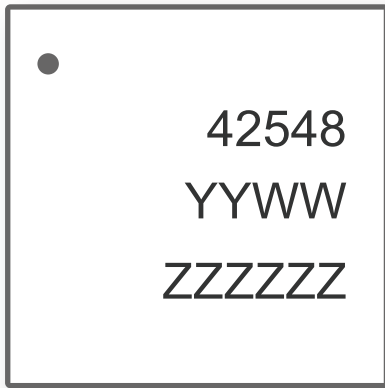
Third Angle Projection

Unless otherwise specified dimensions are in millimeters

Refer to comment for overall tolerance

Top-Marking Specification

Figure 20 ▪ Package Marking Specifications for PE42548

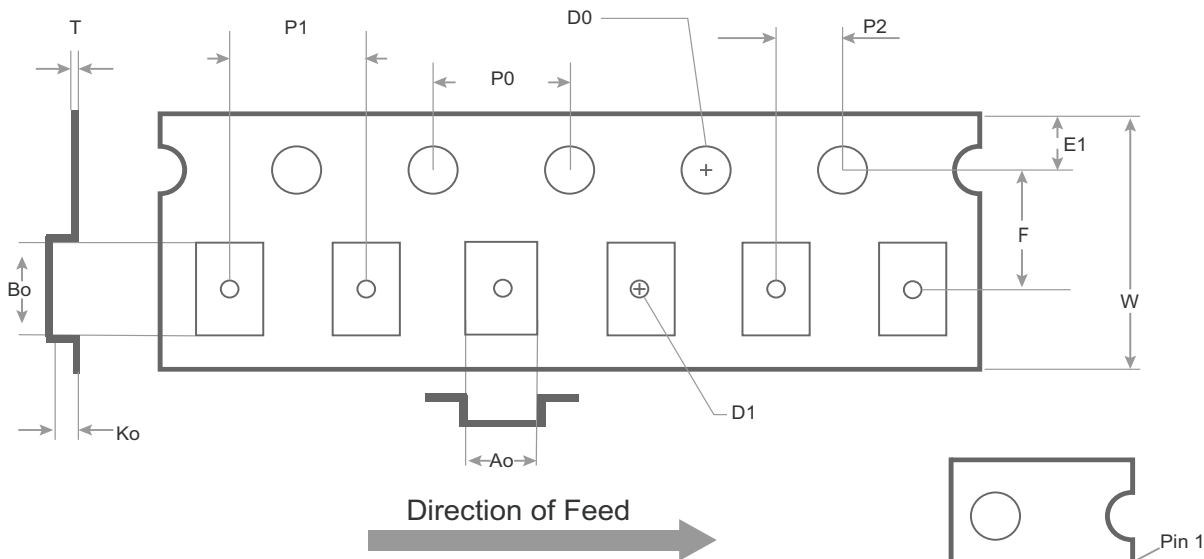


- = Pin 1 indicator
- 42548 = Product part number
- YY = Last two digits of assembly year (2022 = 22)
- WW = Work week of assembly lot start date (01, ..., 52)
- ZZZZZZ = Assembly lot code (max six characters)

Tape and Reel Specification

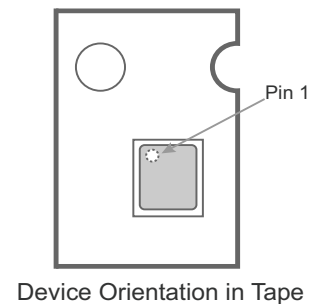
This section provides the tape and reel specifications for the PE42548.

Figure 21 ▪ Tape and Reel Specifications for PE42548



Notes:
Not drawn to scale.
Dimensions are in millimeters.
Maximum cavity angle 5 degrees.
Bumped die are oriented active side down.

| Carrier Tape Dimension Table | | | | | |
|------------------------------|---------|---------------|--------|---------|-----------|
| Pocket | Nominal | Tolerance | Pocket | Nominal | Tolerance |
| Ao | 3.30 | +/- 0.1 | D1 | 1.5 | Min. |
| Bo | 3.30 | +/- 0.1 | D0 | 1.55 | +/- 0.05 |
| Ko | 1.10 | +/- 0.1 | E1 | 1.75 | +/- 0.1 |
| P1 | 8.00 | +/- 0.1 | P0 | 4.0 | +/- 0.1 |
| W | 12.00 | + 0.3 / - 0.3 | P2 | 2.0 | +/- 0.05 |
| F | 5.5 | +/- 0.05 | T | 0.2 | +/- 0.05 |



DOC-101540

Ordering Information

Table 8 lists the available ordering codes for the PE42548 as well as available shipping methods.

Table 8 ■ Order Codes for PE42548

| Order Codes | Description | Packaging | Shipping Method |
|-------------|--|--------------------|-----------------|
| PE42548A-X | PE42548 SP4T RF Switch | 20-lead 3×3 mm LGA | 500 IC/T&R |
| PE42548A-Z | PE42548 SP4T RF Switch | 20-lead 3×3 mm LGA | 3000 IC/T&R |
| EK42548-01 | PE42548 SP4T RF Switch Connectorized EVK | Evaluation Kit | 1/Box |

Document Categories

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. pSemi reserves the right to change specifications at any time without notice in order to supply the best possible product.

Product Specification

The datasheet contains final data. In the event pSemi decides to change the specifications, pSemi will notify customers of the intended changes by issuing a CNF (Customer Notification Form).

Sales Contact

For additional information, contact Sales at sales@psemi.com.

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