# QPC1005

## 0.15 – 2.8 GHz 50 W GaN SPDT Switch

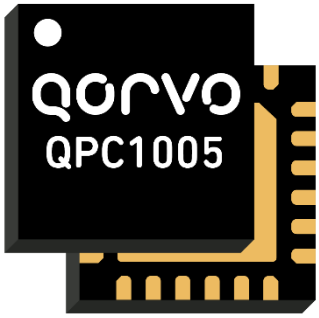
## Product Overview

Qorvo's QPC1005 is a Single-Pole, Double–Throw (SPDT) switch fabricated on Qorvo's QGaN25 0.25um GaN on SiC production process.

Operating from 0.15 to 2.8 GHz, the QPC1005 typically supports 50 W input power handling at control voltages of 0/−40 V for both CW and pulsed RF operations. This switch maintains low insertion loss less than 0.7 dB and greater than 30 dB isolation, making it ideal for high power switching applications across both defense and commercial platforms.

QPC1005 is offered in a 4 x 4 mm plastic overmolded QFN package.

Lead-free and RoHS compliant



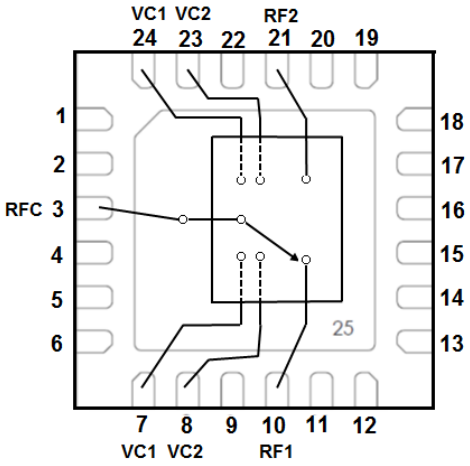

4mm x 4mm 24 Lead OVM QFN

## Key Features

- SPDT
- Frequency Range: 0.15 to 2.8 GHz
- Input Power: 50 W
- Insertion Loss: < 0.7 dB
- Isolation: >30 dB Typical
- Switching Speed: 30 ns
- Control Voltages: 0 V/−40 V
- Redundant Control Lines
- Package Dimensions: 4 x 4 x 0.85 mm

*Performance is typical across frequency. Please reference electrical specification table and data plots for more details.*

## Functional Block Diagram




## Applications

- Commercial and Military Radar
- Land Mobile Radios
- Military Communications Radios
- Electronic Warfare
- Test Instrumentation
- General Purpose

## Ordering Information

| Part No. | Description |
|---|---|
| QPC1005 | 0.5–2.8 GHz 50 W SPDT Switch |
| QPC1005PCB4B01 | QPC1005 Evaluation Board |

## Absolute Maximum Ratings

| Parameter | Rating |
|---|---|
| Control Voltage ($V_C$) | −50 V |
| Control Current ($I_C$) | −1.5 / +1.5 mA |
| Power Dissipation | 12 W |
| RF Input Power, CW, 50 Ω, T = 25 °C | 60 W |
| Mounting Temperature (30 sec) | 260 °C |
| Storage Temperature | −40 to 150 °C |

Exceeding any one or a combination of the Absolute Maximum Rating conditions may cause permanent damage to the device. Extended application of Absolute Maximum Rating conditions to the device may reduce device reliability.

## Recommended Operating Conditions

| Parameter | Min | Typ. | Max | Units |
|---|---|---|---|---|
| $V_{C1}$ | | 0/-40 | | V |
| $V_{C2}$ | | -40/0 | | V |
| Temperature Range | -40 | +25 | +85 | °C |

Electrical specifications are measured at specified test conditions. Specifications are not guaranteed over all recommended operating conditions.

## Thermal and Reliability Information

| Parameter | Test Conditions | Value | Units |
|---|---|---|---|
| Thermal Resistance ($\theta_{JC}$) (1,2) | $T_{BASE}$ = 85 °C, $V_{C1}$ = 0 V, $V_{C2}$ = -40 V, Freq. = 2.8 GHz<br>$P_{IN}$ = 60 W, $P_{DISS}$ (3) = 6.5 W, CW | 5.23 | ºC/W |
| Channel Temperature ($T_{CH}$) (1,2) | | 119 | °C |

Notes:
1. Measured to the back of the package.
2. Refer to the following document: GaN Device Channel Temperature, Thermal Resistance, and Reliability Estimates
3. This is a total $P_{DISS}$ in the FETs.

## Electrical Specifications

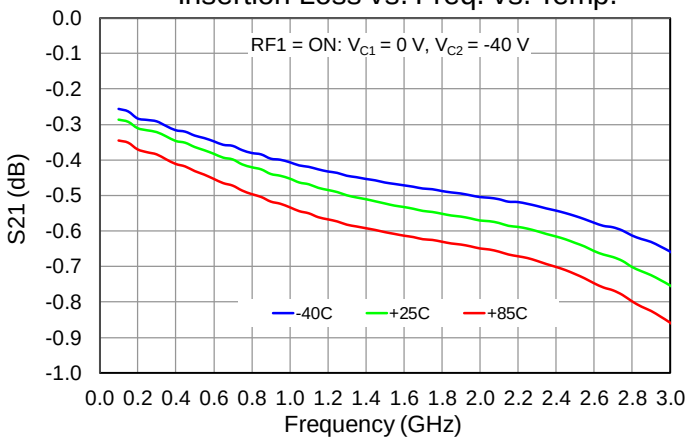
Test conditions unless otherwise noted: 25 °C, $V_{C1}$ = 0 V/-40V, $V_{C2}$ = -40 V/0V, see function table on page 11.

| Parameter | | Min | Typ. | Max | Units |
|---|---|---|---|---|---|
| Operational Frequency Range | | 0.15 | – | 2.8 | GHz |
| Insertion Loss (On-State) | Frequency = 0.15 GHz | – | 0.30 | – | dB |
| | Frequency = 1.0 GHz | – | 0.45 | – | |
| | Frequency = 2.8 GHz | – | 0.70 | – | |
| Input Return Loss (On-State) Common Port RL | Frequency = 0.15 GHz | – | 37 | – | dB |
| | Frequency = 1.0 GHz | – | 26 | – | |
| | Frequency = 2.8 GHz | – | 18 | – | |
| Output Return Loss (On-State) Switched Port RL | Frequency = 0.15 GHz | – | 34 | – | dB |
| | Frequency = 1.0 GHz | – | 29 | – | |
| | Frequency = 2.8 GHz | – | 18 | – | |
| Isolation (Off-State) | Frequency = 0.15 GHz | – | 57 | – | dB |
| | Frequency = 1.0 GHz | – | 40 | – | |
| | Frequency = 2.8 GHz | – | 29 | – | |
| Output Return Loss Isolated Port | Frequency = 0.15 GHz | – | 2.1 | – | dB |
| | Frequency = 1.0 GHz | – | 2.3 | – | |
| | Frequency = 2.8 GHz | – | 2.2 | – | |
| Insertion Loss @ $P_{IN}$ = 47 dBm (Pulsed RF) PW = 100us; DC = 10% | Frequency = 0.15 GHz | – | 0.30 | – | dB |
| | Frequency = 1.0 GHz | – | 0.50 | – | |
| | Frequency = 2.8 GHz | – | 0.70 | – | |
| Insertion Loss @ $P_{IN}$ = 47 dBm (CW) | Frequency = 0.15 GHz | – | 0.30 | – | dB |
| | Frequency = 1.0 GHz | – | 0.50 | – | |
| | Frequency = 2.8 GHz | – | 0.75 | – | |
| Input Power ($P_{0.1dB}$) | | – | 47 | – | dBm |
| Control Voltage | | | -40 | -50 | V |
| Total Supply Current | | | <3 | | mA |
| Switching Speed | | | 30 | | ns |
| Insertion Loss Temperature Coefficient | | – | -0.0015 | – | dB/°C |

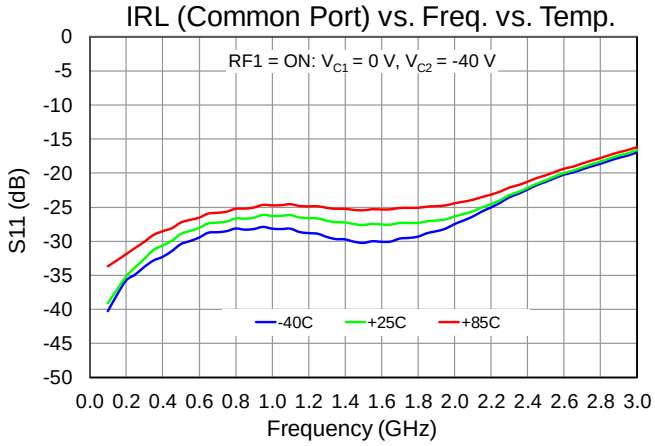
## Performance Plots – Small Signal

**Notes: RFC = Port1; RF1 = Port 2; RF2 = Port 3**

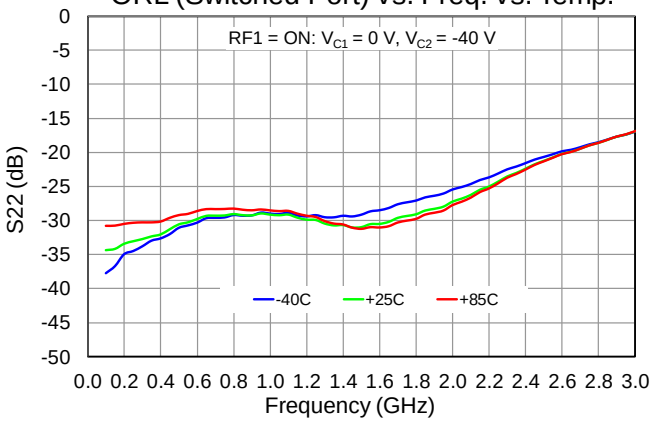
Insertion Loss vs. Freq. vs. Temp.



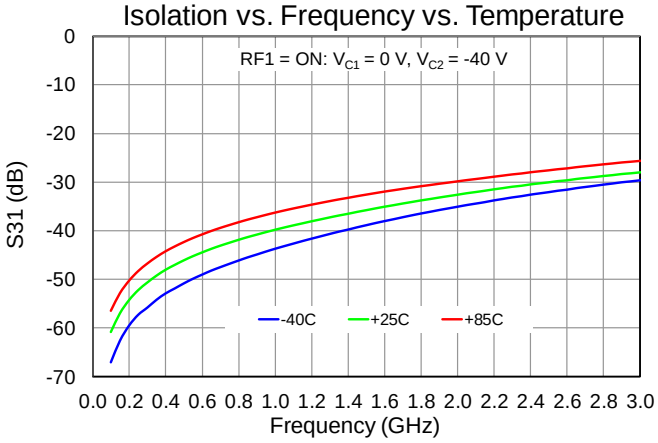

IRL (Common Port) vs. Freq. vs. Temp.



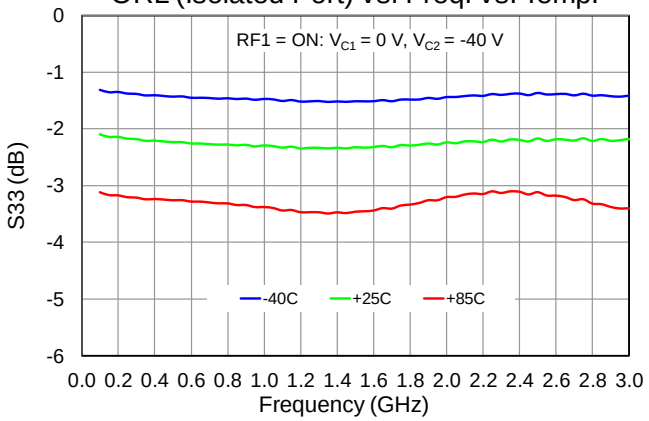

ORL (Switched Port) vs. Freq. vs. Temp.



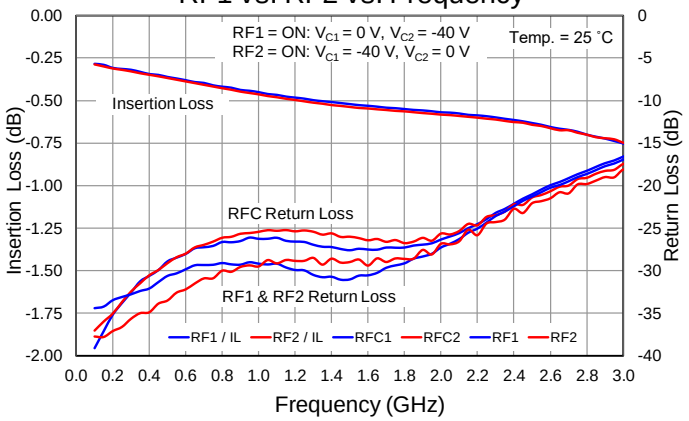

Isolation vs. Frequency vs. Temperature




ORL (Isolated Port) vs. Freq. vs. Temp.

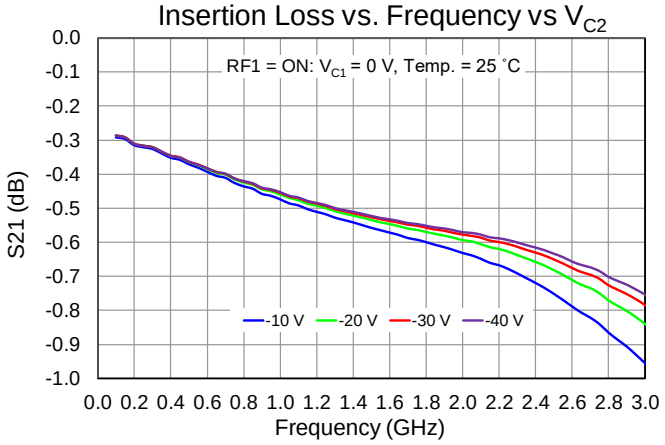



RF1 vs. RF2 vs. Frequency

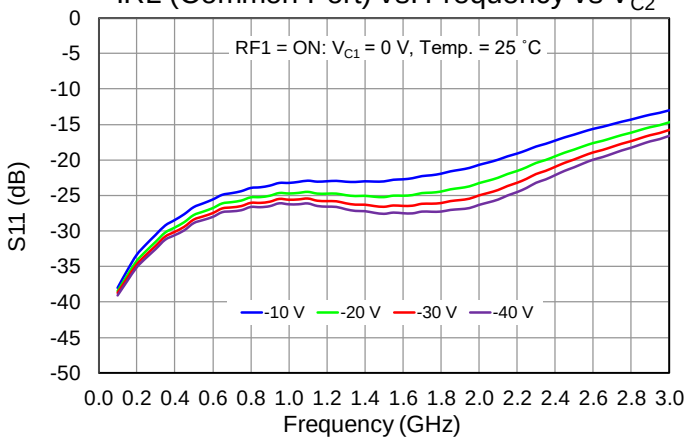


## Performance Plots – Small Signal

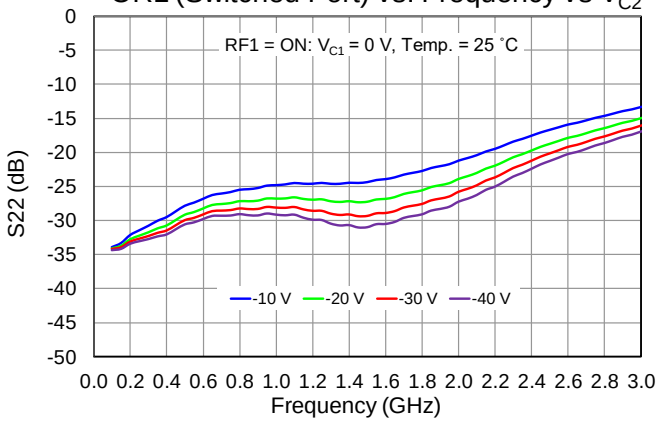
Insertion Loss vs. Frequency vs $V_{C2}$



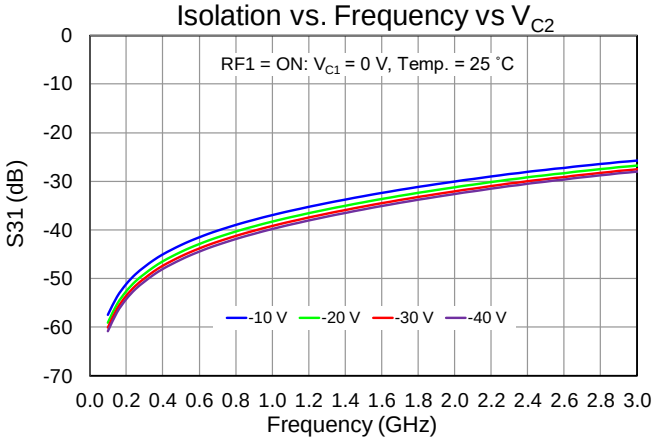

IRL (Common Port) vs. Frequency vs $V_{C2}$



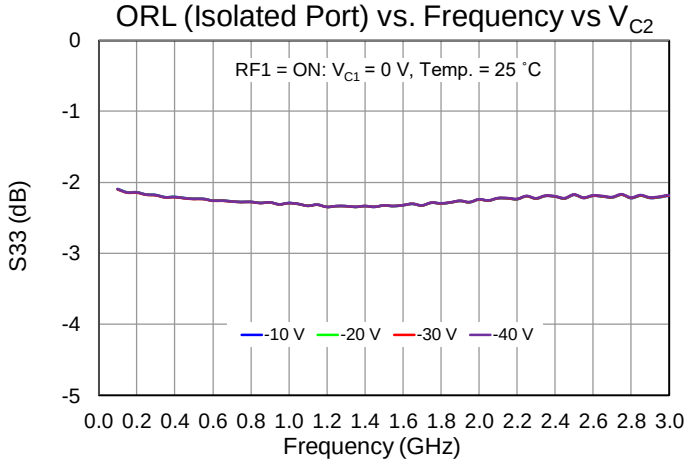

ORL (Switched Port) vs. Frequency vs $V_{C2}$



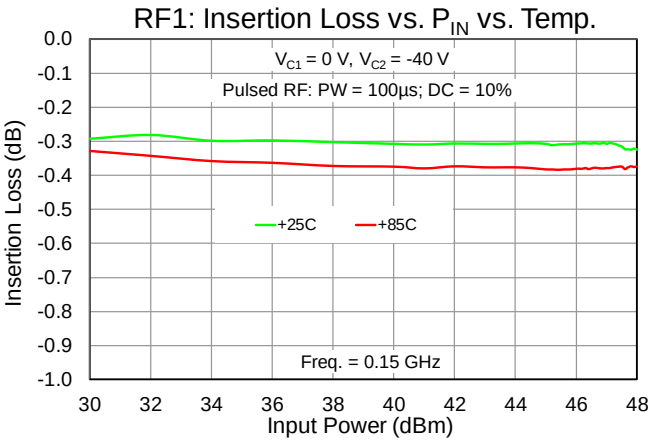

Isolation vs. Frequency vs $V_{C2}$

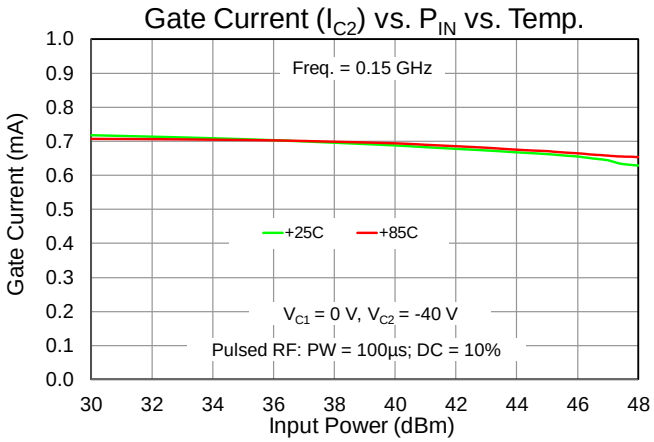


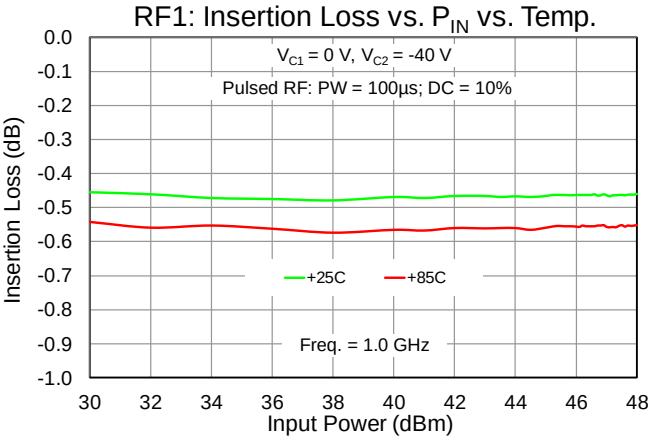

ORL (Isolated Port) vs. Frequency vs $V_{C2}$

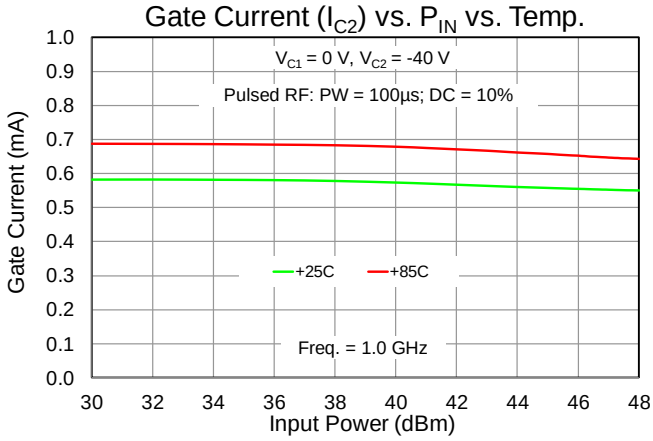


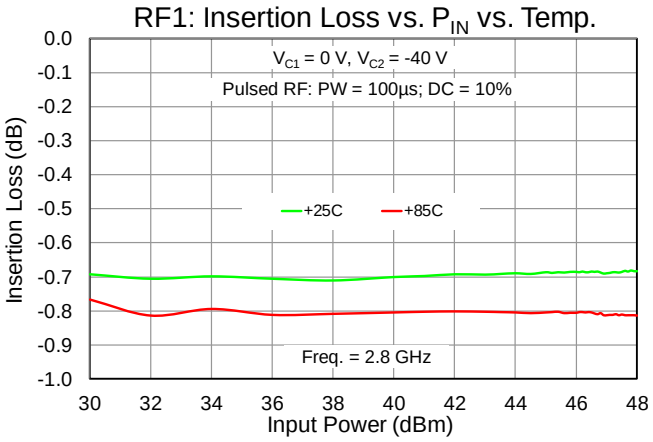
## Performance Plots – Compression (Pulsed)

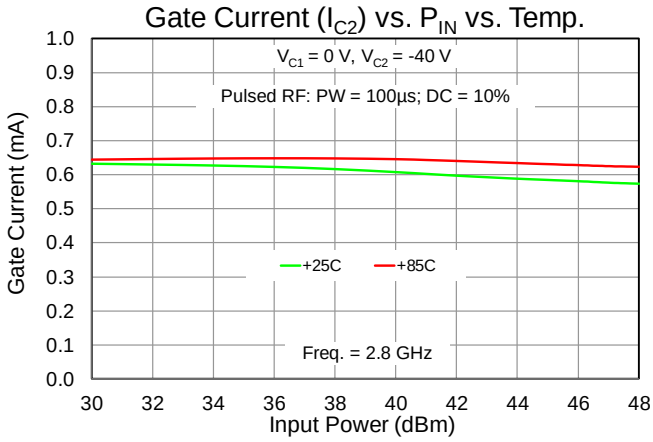


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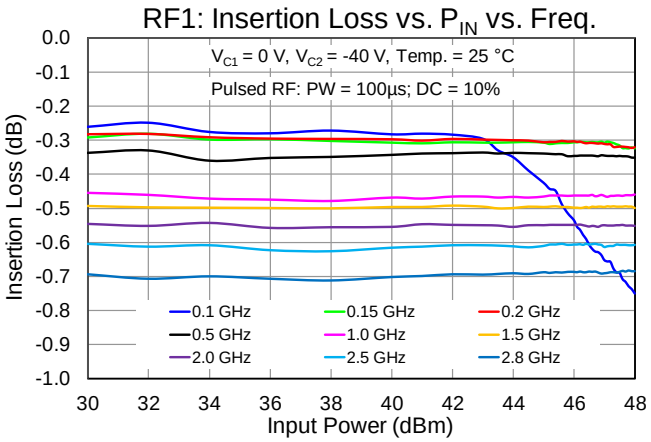
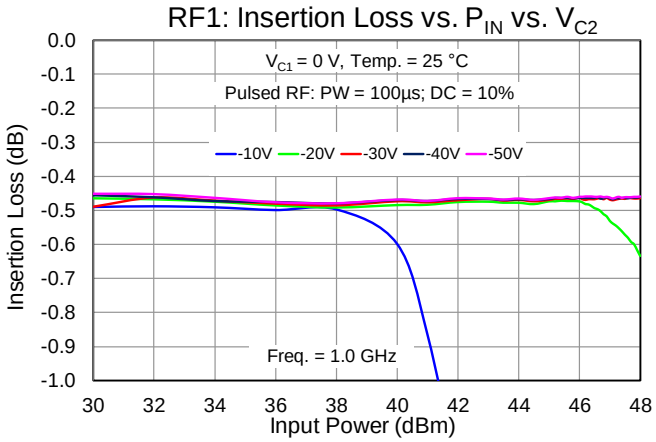
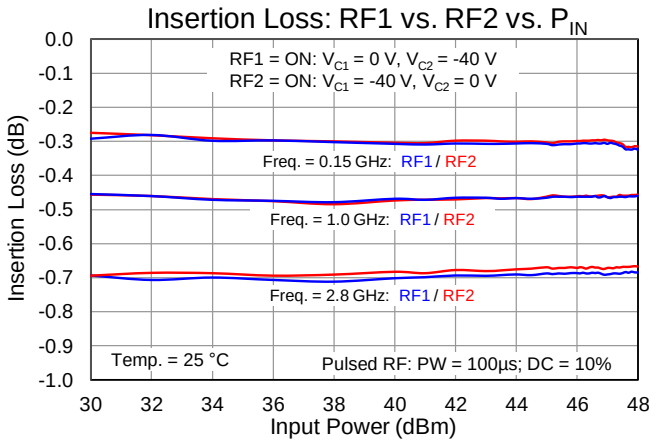
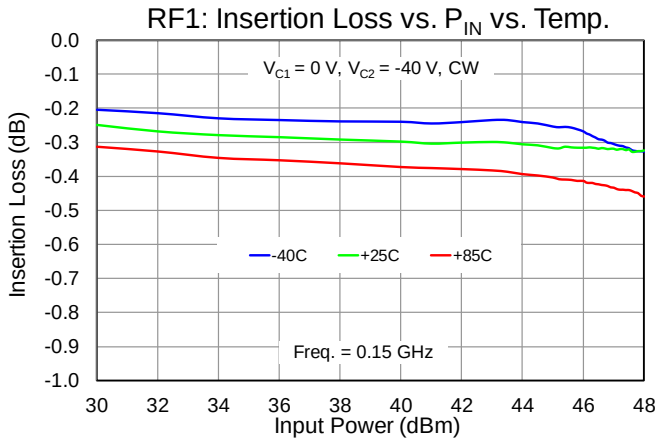
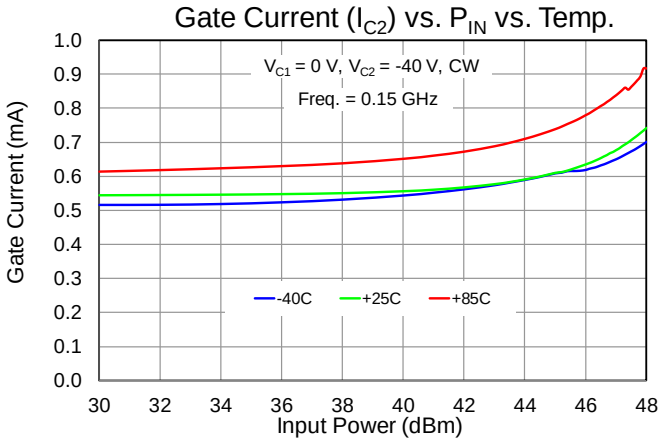


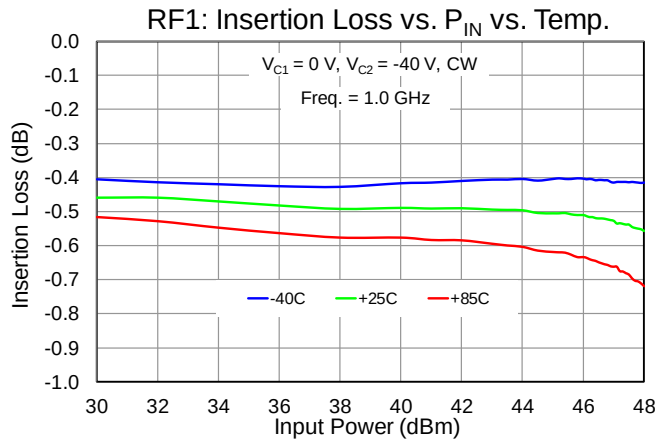



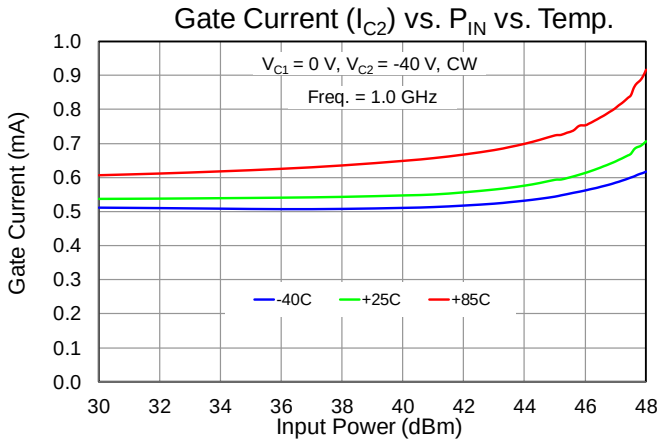



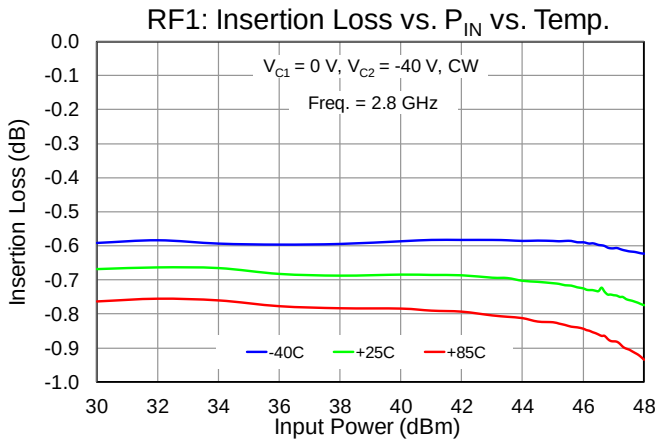
## Performance Plots – Compression (CW)

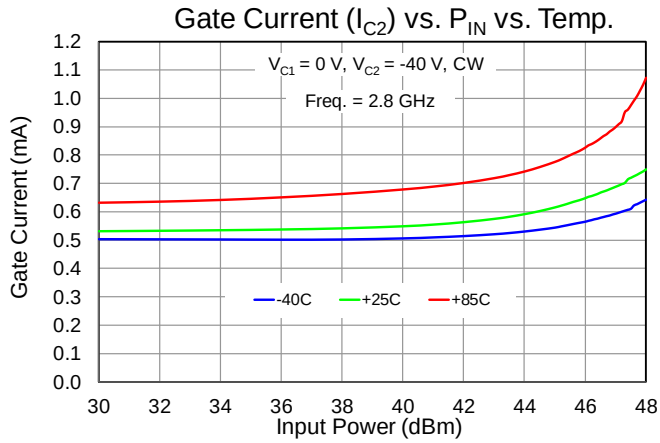


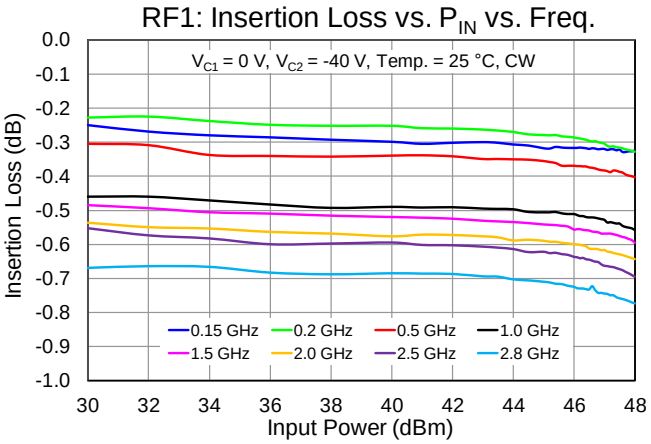



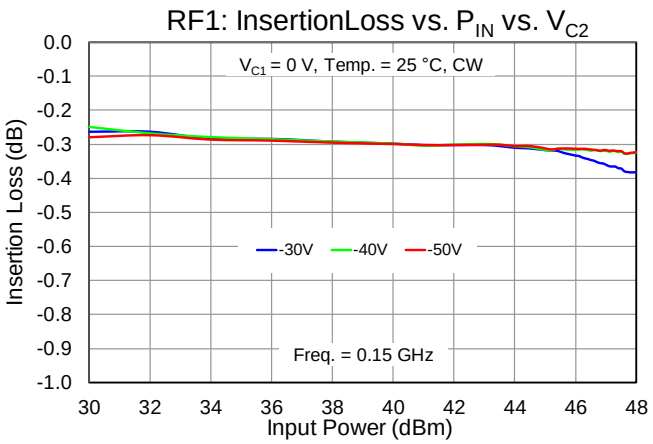



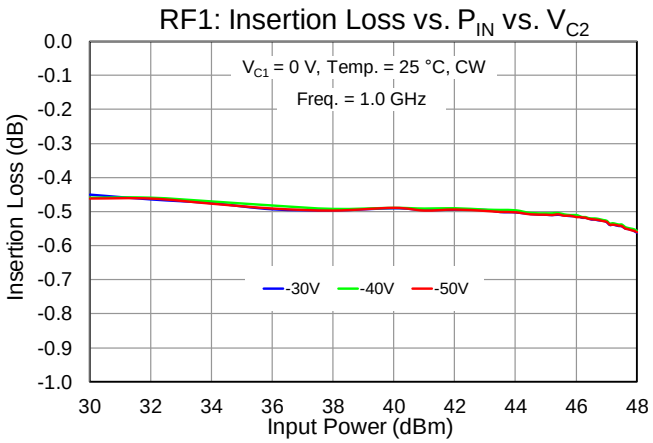



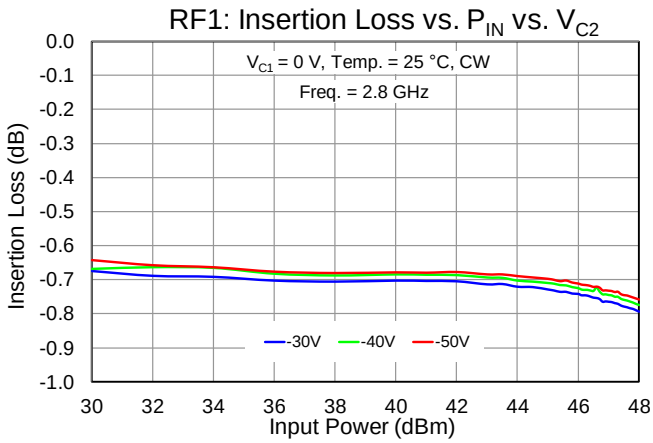



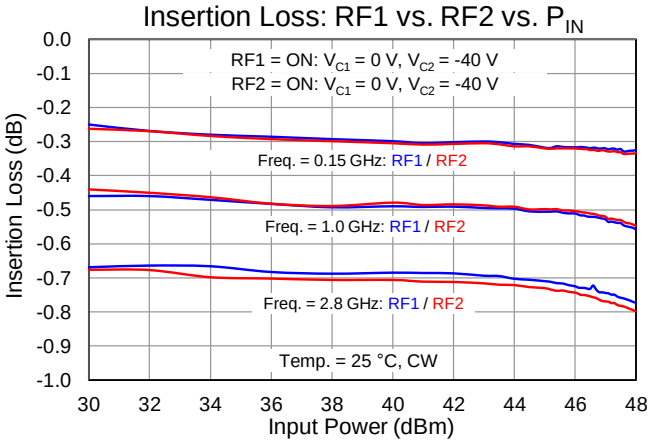
## Performance Plots – Compression (CW)



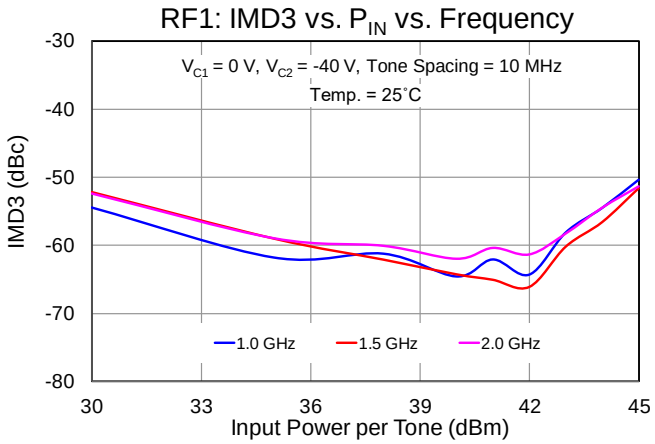



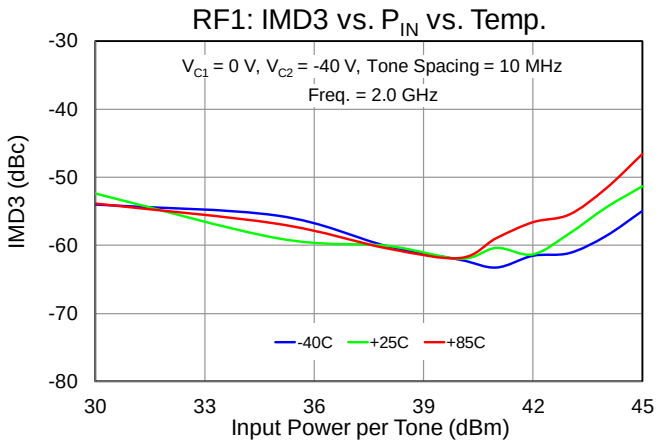



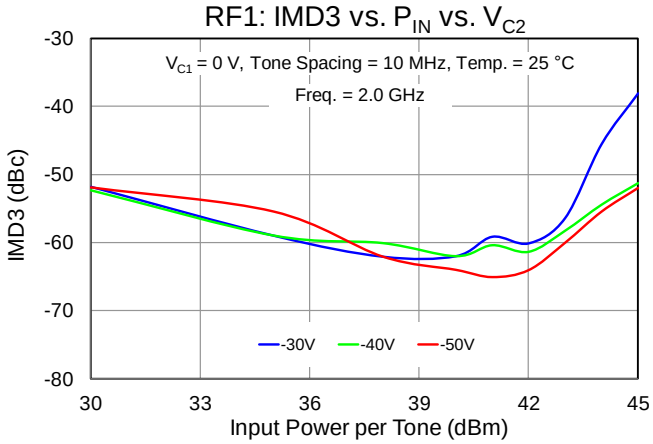



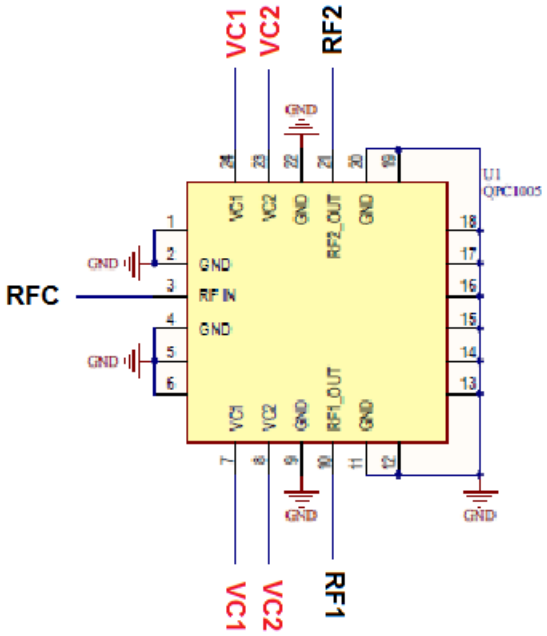
## Performance Plots – Linearity



## Application Circuit




Notes:

1. This switch can be configured as a Single Pole, Single Throw (SPST) by terminating one unused RF switched port with a 50 Ohm load.
2. $V_{C1}$ can be biased from either pin 7 or 24 and the non-biased pin can be left open.
3. $V_{C2}$ can be biased from either pin 8 or 23 and the non-biased pin can be left open.
4. External components are not required

## Bias Up Procedure

1. $V_{C1}$ or $V_{C2}$ set to 0 V (see Function Table for RF Path)
2. $V_{C2}$ or $V_{C1}$ set to -40 V (see Function Table for RF Path)
3. Apply RF signal to RF Input

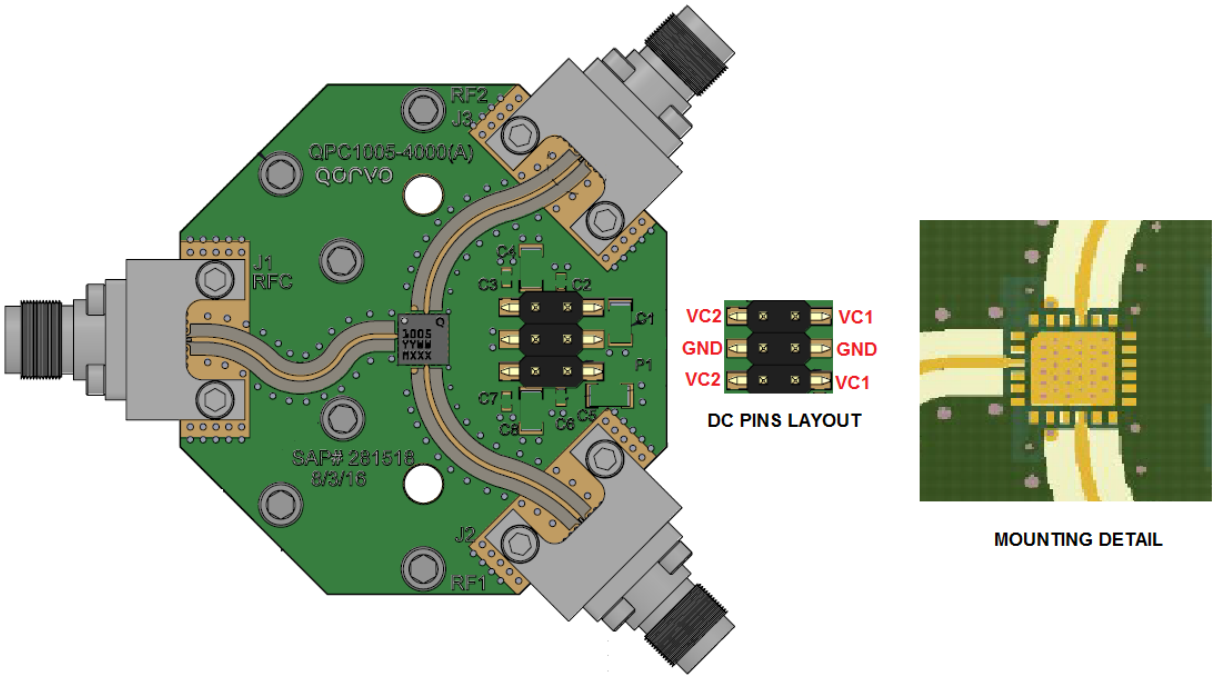
## Bias Up Down

1. Turn off RF supply
2. Turn $V_{C2}$ or $V_{C1}$ to 0 V
3. Turn $V_{C1}$ or $V_{C2}$ to 0 V

## Function Table

| RF Path | State | $V_{C1}$ | $V_{C2}$ |
|---|---|---|---|
| RFC to RF1 ON | On-State (Insertion Loss) | 0 V | −40 V |
| | Off-State (Isolation) | −40 V | 0 V |
| RFC to RF2 ON | On-State (Insertion Loss) | −40 V | 0 V |
| | Off-State (Isolation) | 0 V | −40 V |

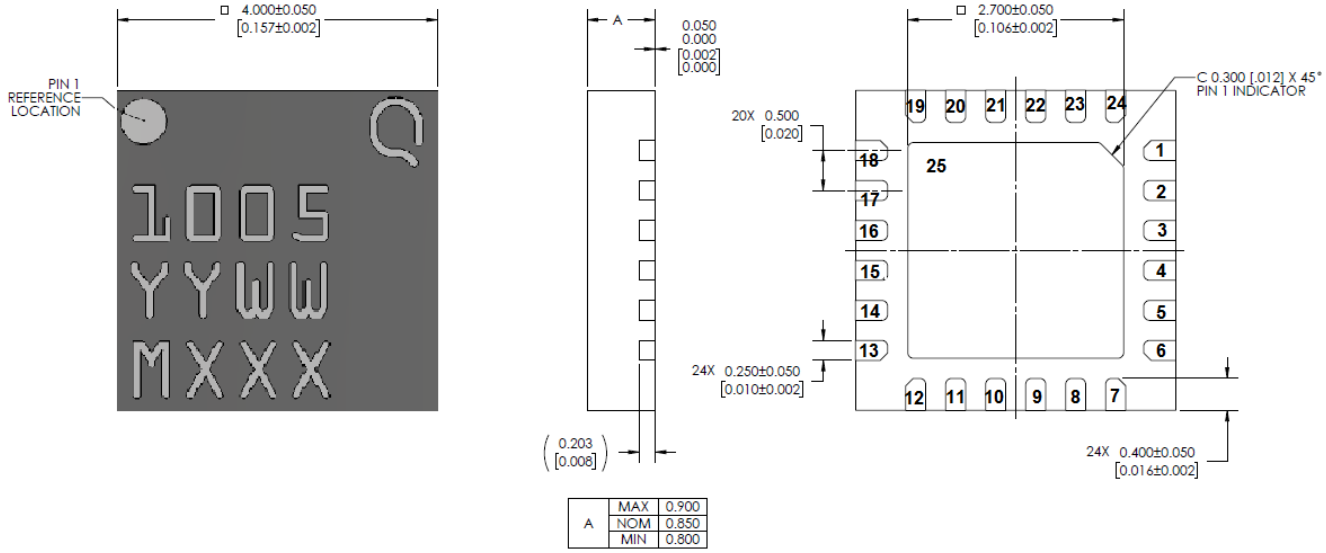
## Evaluation Board (EVB) Assembly Layout.




Notes:

1. This switch can be configured as a Single Pole, Single Throw (SPST) by terminating one unused RF switched port with a 50 Ohm load.
2. $V_{C1}$ can be biased from either pin and the non-biased pin can be left open.
3. $V_{C2}$ can be biased from either pin and the non-biased pin can be left open.
4. External components are not required

## Mechanical Information




Units: millimeters
Tolerances: unless specified
x.xx = ± 0.25
x.xxx = ± 0.100
Materials:
Base: Cu Alloy
Packaged Exposed Metallization is gold plated
Marking:
QPC1005: Part number
YY: Part Assembly year
WW: Part Assembly week
MXXX: Batch ID

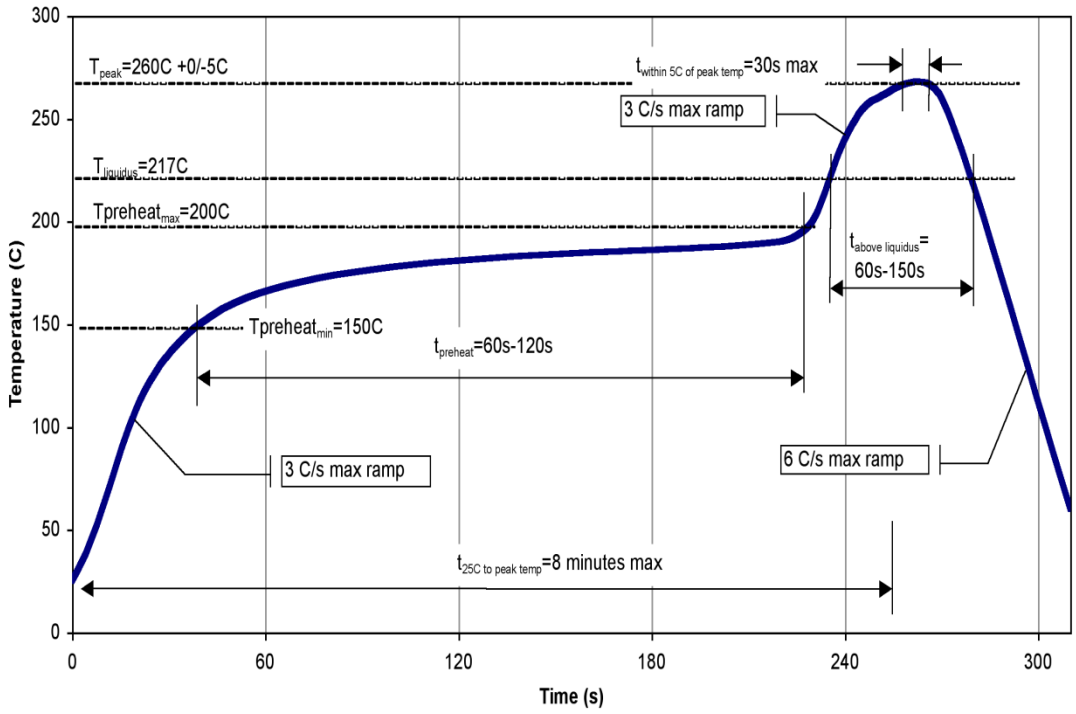
## Pin Description

| Pad No. | Symbol | Description |
|---|---|---|
| 1, 5, 6, 11-20, | N/C | Not connected internally. Recommended to be grounded at EVB level |
| 2, 4, 9, 22 | GND | Ground. Connected to GND paddle (pin 25); should be grounded on PCB to improve isolation |
| 3 | RFC | RF common port (port 1); matched to 50 Ω; DC coupled |
| 7, 24 | $V_{C1}$ | Control voltage #1; External components are not required |
| 8, 23 | $V_{C2}$ | Control voltage #2; External components are not required |
| 10 | RF1 | RF switched port 2; matched to 50 Ω; DC coupled |
| 21 | RF2 | RF switched port 3; matched to 50 Ω; DC coupled |
| 25 | GND | Backside Paddle. Multiple vias should be employed to minimize inductance and thermal resistance. |

## Solderability

1. Compatible with the latest version of J-STD-020, Lead-free solder, 260° C soldering process.
2. The use of no-clean solder to avoid washing after soldering is recommended.
3. Contact plating: Ni-Pd-Au.

## Recommended Soldering Profile



## Handling Precautions

| Parameter | Rating | Standard |
|---|---|---|
| ESD – Human Body Model (HBM) | Class 1A | ESDA / JEDEC JS-001-2012 |
| ESD – Charged Device Model (CDM) | TBD | ESDA / JEDEC JS-002-2014 |
| MSL – Convection Reflow 260 °C | Level 3 | JEDEC standard IPC/JEDEC J-STD-020 |

Caution!
ESD-Sensitive Device

## RoHS Compliance

This part is compliant with 2011/65/EU RoHS directive (Restrictions on the Use of Certain Hazardous Substances in Electrical and Electronic Equipment) as amended by Directive 2015/863/EU.

This product also has the following attributes:

- Lead Free
- Halogen Free (Chlorine, Bromine)
- Antimony Free
- TBBP-A ($C_{15}H_{12}Br_40_2$) Free
- PFOS Free
- SVHC Free

## Contact Information

For the latest specifications, additional product information, worldwide sales and distribution locations:

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