



RFuWEngineeringLtd.

RFLM-011015QF-290

S Band Quasi-Active PIN Diode Limiter Module - SMT

Features:

- Frequency Range: 2.0 to 4.0 GHz
- Peak Power: +56 dBm
- Average Power: +50 dBm
- Insertion Loss: <0.5 dB
- Return Loss: >22 dB
- Low Flat Leakage Power: <14 dBm
- Low Spike Energy Leakage: <0.5 ergs
- Package: 8mm x 5mm x 2.5mm
- DC Blocking Capacitors
- “Always On Protection”
 - - No external control lines or power supply required
- RoHS Compliant

Description:

The RFLM-011015QF-290 SMT Silicon PIN Diode Limiter Module offers “Always On” High Power CW and Peak protection in the S-Band region. This Limiter Module is based on proven hybrid assembly technique utilized extensively in high reliability, mission critical applications for decades. The RFLM-011015QF-290 offers excellent thermal characteristics in a compact, low profile 8mm x 5mm x 2.5mm package. It was designed for optimal small signal insertion loss permitting extremely low receiver noise figure while simultaneously offering exceptional Flat Leakage for effective receiver protection in the S Band frequency range.

The RFLM-011015QF-290 Limiter Module provide outstanding passive receiver protection (Always On) which protects against High Peak Power up to +56 dBm pulsed, High Average Power up to +50 dBm while maintaining low Flat Leakage to less than +14dBm (typ), and reduces Spike Leakage to less than 0.5 ergs (typ).

ESD and Moisture Sensitivity Rating

The RFLM-011015QF-290 Limiter Module carries a Class 1A ESD rating (HBM) and an MSL 1 moisture rating.

Thermal Management Features

The proprietary design methodology minimizes the thermal resistance from the PIN Diode junction to base plate. The two stage limiter design employs a detector circuit which enables ultra-fast turn on of the High Power PIN Diodes. This circuit topology coupled with the thermal characteristic of the substrate design enables the Limiter Module to reliably handling High Input RF Power up to +50 dBm CW and RF Peak Power levels up to +56 dBm (1 msec pulse width @ 10% duty cycle) with base plate temperature at +85°C. The RFLM-011015QF-290 based substrate has been design to offer superior long term reliability in the customer's application by utilizing ultra-thin Au plating to combat Au embrittlement concerns.

Absolute Maximum Ratings

@ $Z_0=50\Omega$, $T_A= +25^\circ\text{C}$ as measured on the base ground surface of the device.

| Parameter | Conditions | Absolute Maximum Value |
|--|--|------------------------|
| Operating Temperature | | -65°C to 125°C |
| Storage Temperature | | -65°C to 150°C |
| Junction Temperature | | 175°C |
| Assembly Temperature | T = 30 seconds | 260°C |
| RF Peak Incident Power | $T_{\text{CASE}}=+55^\circ\text{C}$, source and load VSWR < 1.2:1, RF Pulse width = 1 msec, duty cycle = 10%, derated linearly to 0 W at $T_{\text{CASE}}=150^\circ\text{C}$ (note 1) | +56 dBm |
| RF CW Incident Power | $T_{\text{CASE}}=+55^\circ\text{C}$, source and load VSWR < 1.2:1, derated linearly to 0 W at $T_{\text{CASE}}=150^\circ\text{C}$ (note 1) | +51 dBm |
| RF Input & Output DC Block Capacitor Voltage Breakdown | | 100V DC |

Note 1: T_{CASE} is defined as the temperature of the bottom ground surface of the device.

RFLM011015QF-290 Electrical Specifications

@ $Z_0=50\Omega$, $T_A=+25^\circ\text{C}$ as measured on the base ground surface of the device.

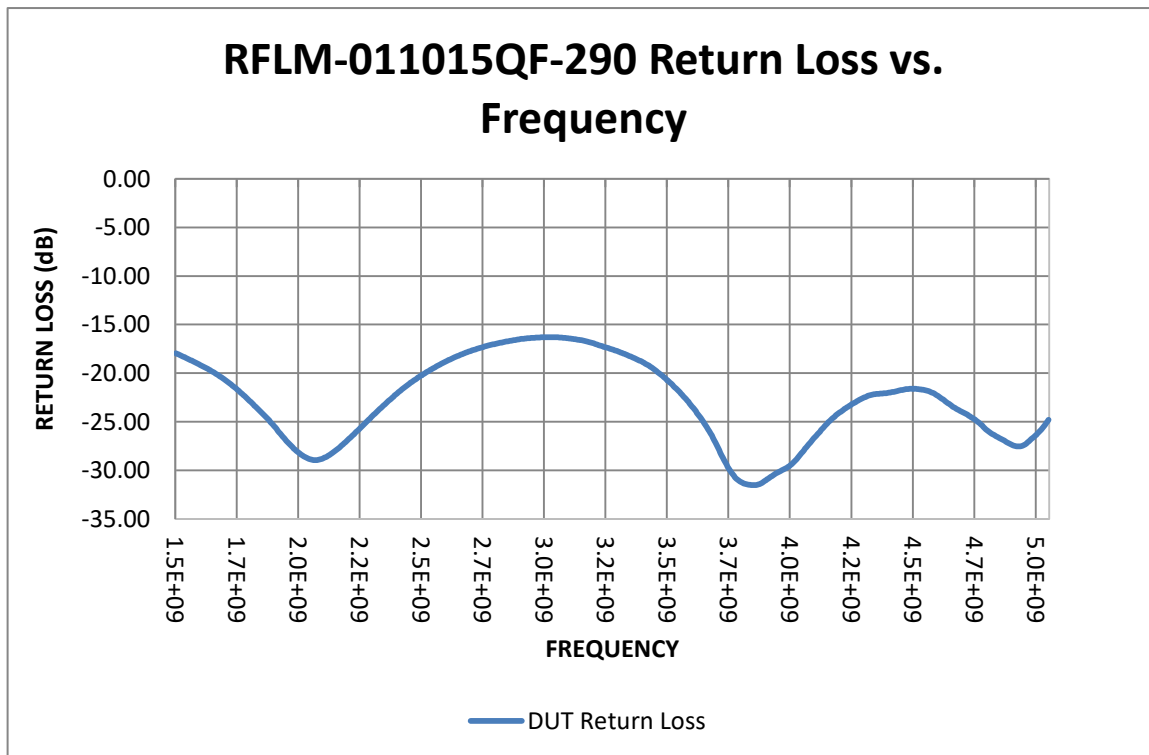
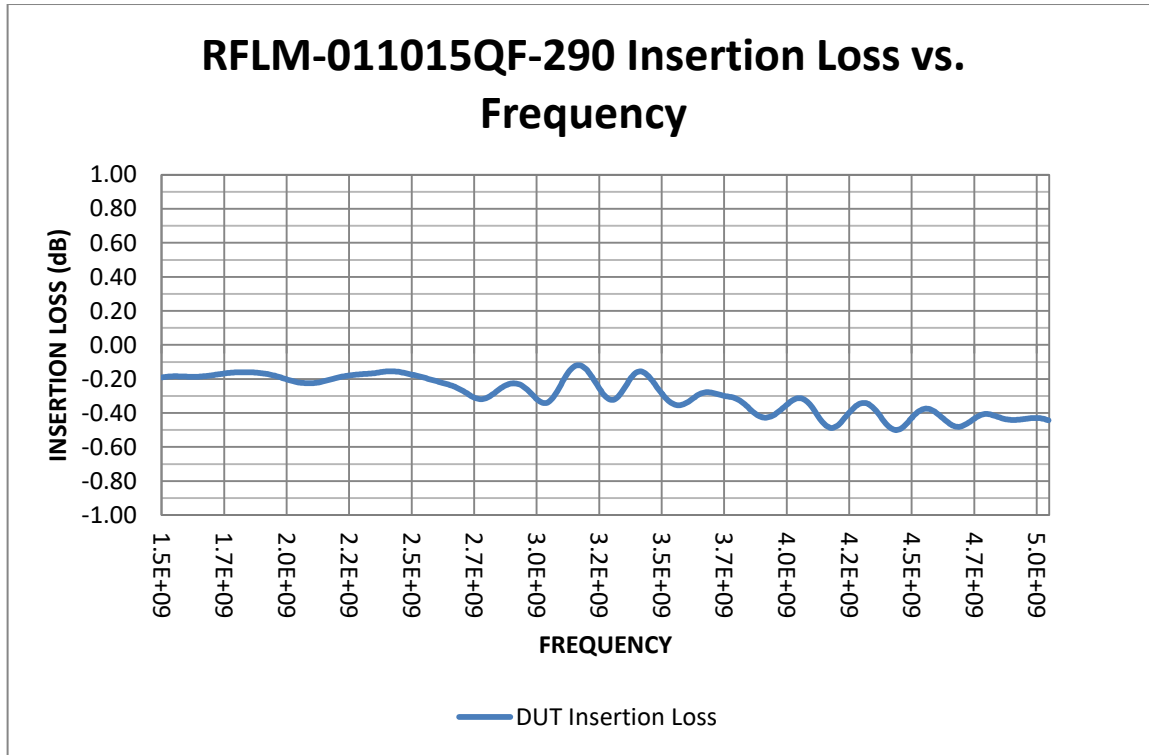
| Parameters | Symbol | Test Conditions | Min Value | Typ Value | Max Value | Units |
|--|--------------------------|--|-----------|-------------------|-----------|----------------------|
| Frequency | F | $2\text{ GHz} \leq F \leq 4\text{ GHz}$ | 2.0 | | 4.0 | GHz |
| Insertion Loss | IL | $P_{in} = -20\text{dBm}$, $F = 2.0\text{ GHz}$ $P_{in} = -20\text{dBm}$, $F = 3.5\text{ GHz}$ $P_{in} = -20\text{dBm}$, $F = 4.0\text{ GHz}$ | | 0.2 0.4 0.5 | 0.7 | dB |
| Insertion Loss Rate of Change vs Operating Temperature | ΔIL | $2\text{ GHz} \leq F \leq 4\text{ GHz}$, $P_{in} \leq -20\text{ dBm}$ | | 0.005 | | dB/ $^\circ\text{C}$ |
| Return Loss | RL | $P_{in} = -20\text{dBm}$, $F = 2.0\text{ GHz}$ $P_{in} = -20\text{dBm}$, $F = 3.5\text{ GHz}$ $P_{in} = -20\text{dBm}$, $F = 4.0\text{ GHz}$ | | 27 22 29 | | dB |
| Input 1 dB Compression Point | $\text{IP}_{1\text{dB}}$ | $2\text{ GHz} \leq F \leq 4\text{ GHz}$ | | 14 | | dBm |
| Peak Incident Power ^{note 1} | $P_{inc(PK)}$ | RF Pulse = 1 msec, duty cycle = 10%, $t_{rise} \leq 3\mu\text{s}$, $t_{fall} \leq 3\mu\text{sec}$ | | | 56 | dBm |
| CW Incident Power ^{note 1} | $P_{inc(CW)}$ | $2\text{ GHz} \leq F \leq 4\text{ GHz}$ | | | 50 | dBm |
| Flat Leakage Power | FL | $P_{in} = +56\text{ dBm}$, RF Pulse width = 1 msec, duty cycle = 10%, $t_{rise} \leq 3\text{ us}$, $t_{fall} \leq 3\text{ us}$ | | 14 | 15 | dBm |
| Spike Leakage Power | SLP | $P_{in} = +56\text{ dBm}$, RF Pulse width = 1 msec, duty cycle = 10% | | | 30 | dBm |
| Spike Leakage | SL | $P_{in} = +56\text{ dBm}$, RF Pulse width = 1 msec, duty cycle = 10% | | | 0.3 | erg |
| Recovery Time | T_R | 50% falling edge of RF Pulse to 1 dB IL, $P_{in} = +56\text{ dBm}$ peak, RF PW = 1 ms, duty cycle = 10%, $t_{rise} \leq 3\mu\text{s}$, $t_{fall} \leq 3\mu\text{sec}$ | | | 750 | nsec |

Note:

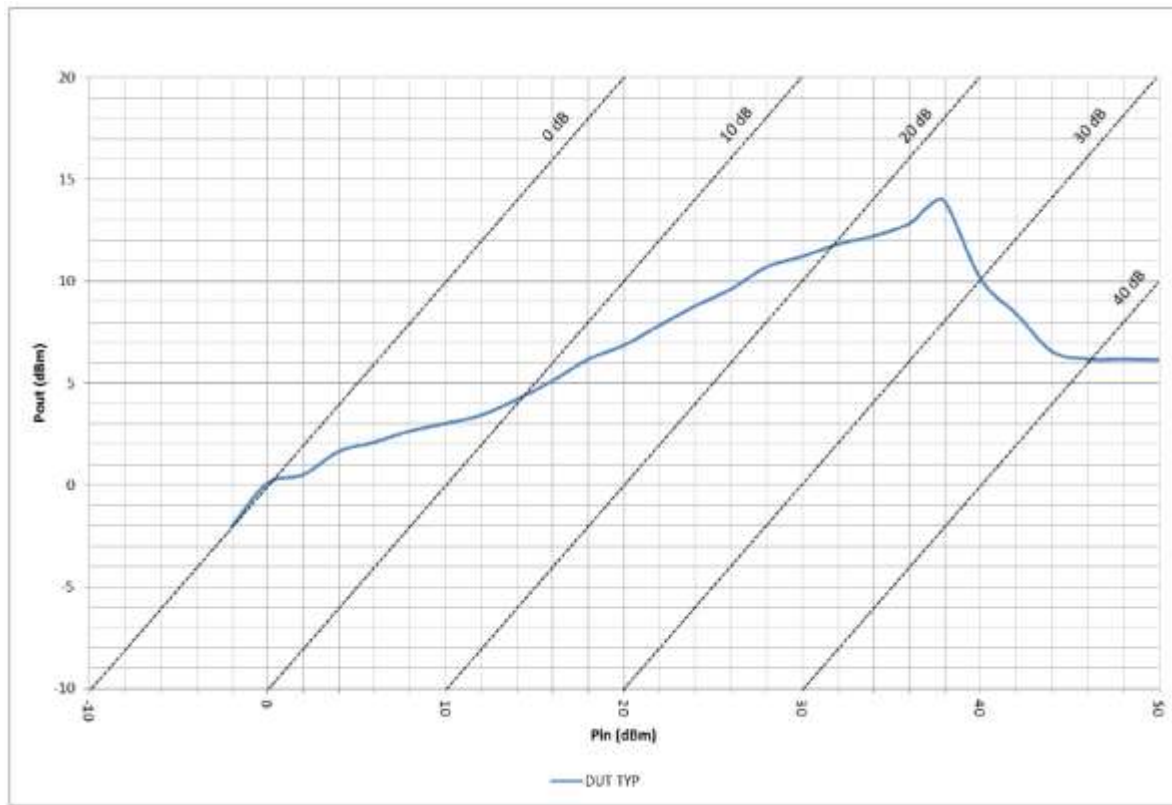
1. Incident Power rating defined to be 1.2:1 maximum source VSWR and 1.2:1 maximum load VSWR.
2. Defined to be the period between peak power leakage and -3 dB less than peak.

RFLM-011015QF-290 Typical Performance

$Z_0 = 50\Omega$, $T_{CASE} = +25^\circ C$, $PIN = -20\text{ dBm}$ as measured on the Ground Plane of the device.



RFLM-011015QF-290: Pin vs Pout

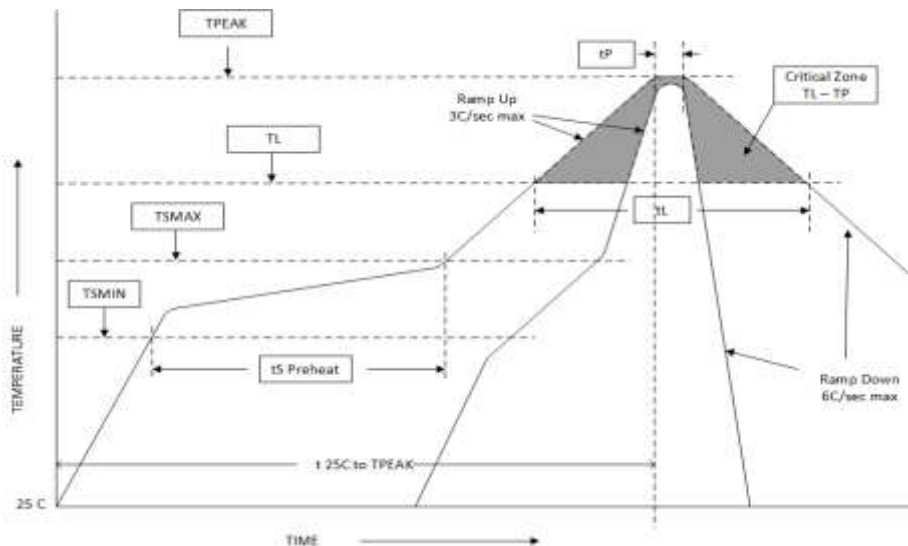


Assembly Instructions

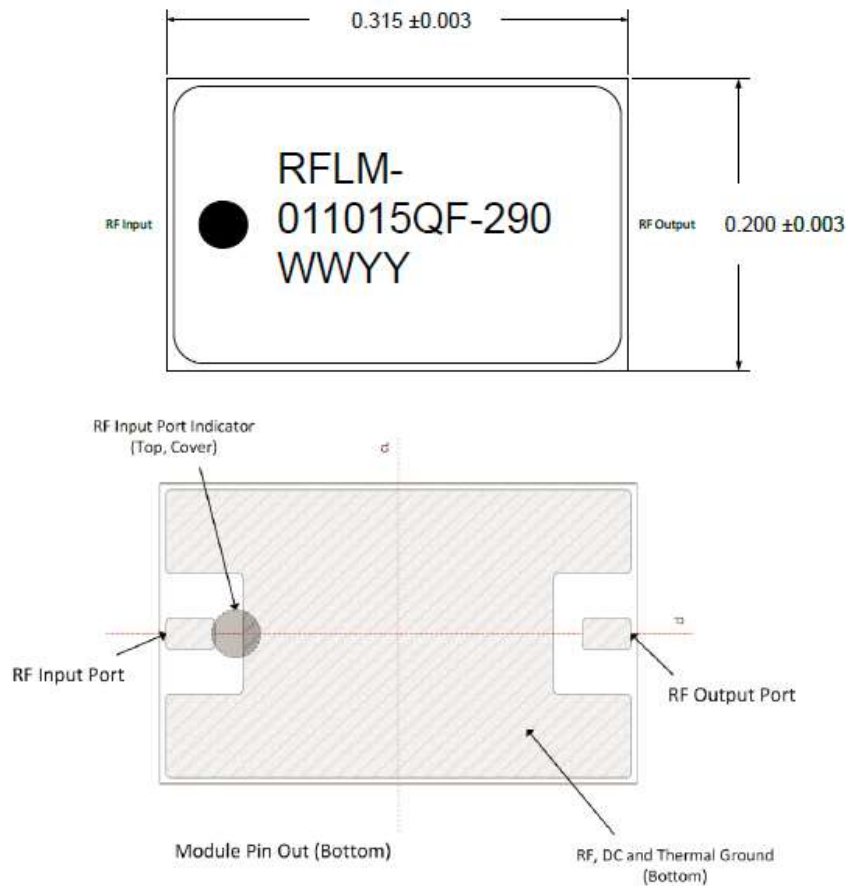
The RFLM-011015QF-290 may be attached to the printed circuit card using solder reflow procedures using either RoHS or Sn63/ Pb37 type solders per the Table and Temperature Profile Graph shown below:

| Profile Parameter | Sn-Pb Assembly Technique | RoHS Assembly Technique |
|--|--------------------------|-------------------------|
| Average ramp-up rate (T_L to T_P) | 3°C/sec (max) | 3°C/sec (max) |
| Preheat | | |
| Temp Min (T_{smin}) | 100°C | 100°C |
| Temp Max (T_{smax}) | 150°C | 150°C |
| Time (min to max) (t_s) | 60 – 120 sec | 60 – 180 sec |
| T_{smax} to T_L Ramp up Rate | 3°C/sec (max) | 3°C/sec (max) |
| Peak Temp (T_P) | 225°C +0°C / -5°C | 260°C +0°C / -5°C |
| Time within 5°C of Actual Peak Temp (T_P) | 10 to 30 sec | 20 to 40 sec |
| Time Maintained Above: Temp (T_L) Time (t_L) | 183°C 60 to 150 sec | 217°C 60 to 150 sec |
| Ramp Down Rate | 6°C/sec (max) | 6°C/sec (max) |
| Time 25°C to T_P | 6 minutes (max) | 8 minutes (max) |

Solder Re-Flow Time-Temperature Profile



RFLM-011015QF-290 Limiter Module Package Outline Drawing



Notes:

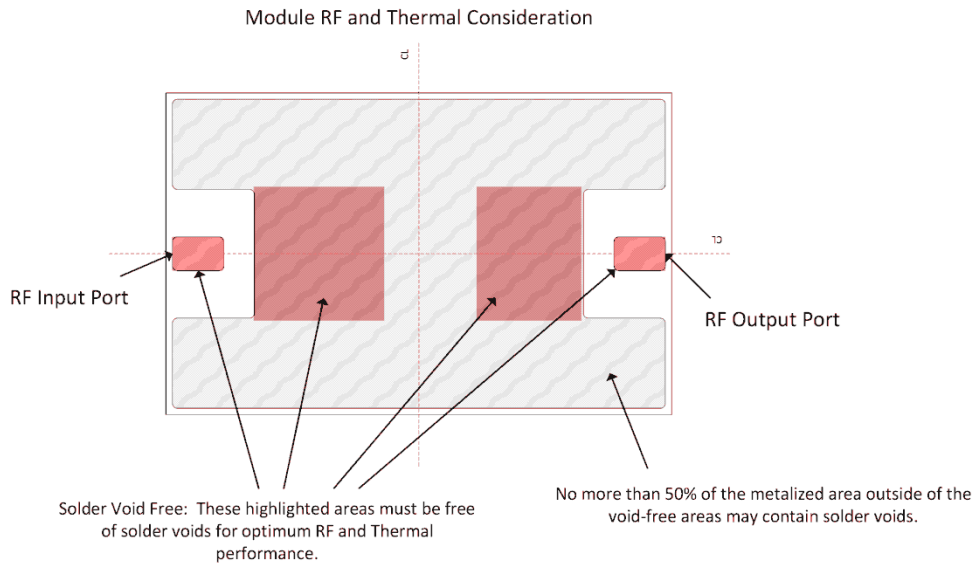
- 1) Metalized area on backside is the RF, DC and Thermal ground. In user's end application this surface temperature must be managed to meet the power handling requirements.
- 2) Back side metallization is thin Au termination plating to combat Au embrittlement (Au plated over Cu).
- 3) Unit = mils

Thermal Design Considerations:

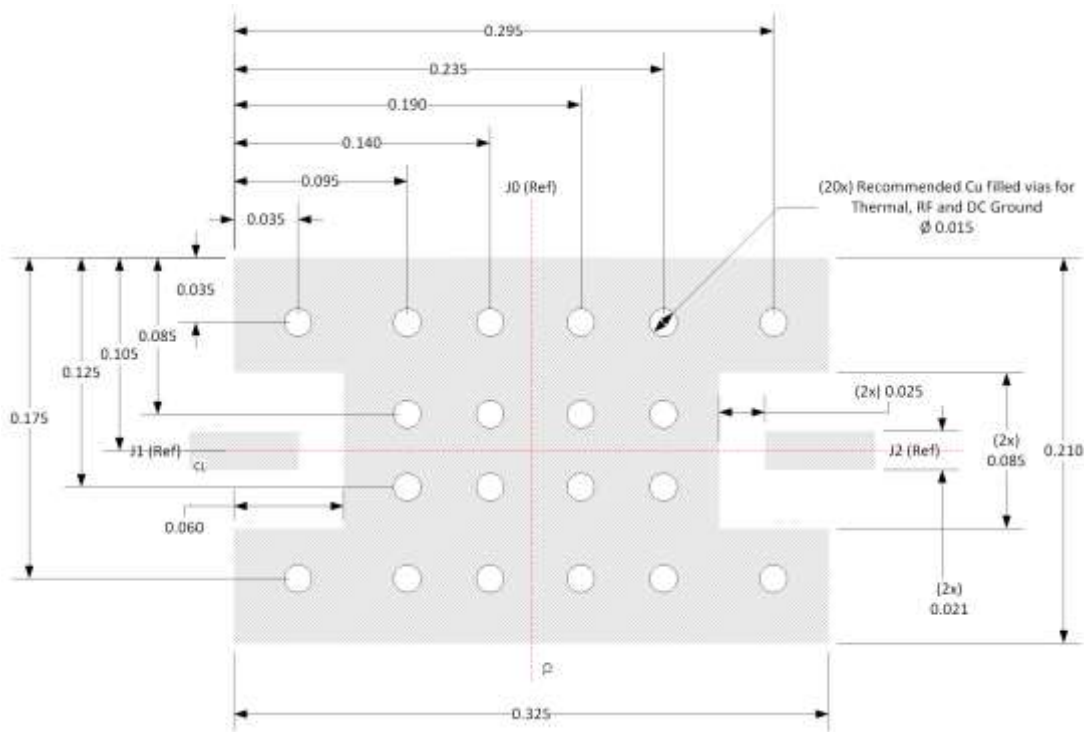
The design of the RFLM-011015QF-290 Limiter Module permits the maximum efficiency in thermal management of the PIN Diodes while maintaining extremely high reliability. Optimum Limiter performance and reliability of the device can be achieved by the maintaining the base ground surface temperature of less than +85°C.

There must be a minimal thermal and electrical resistance between the limiter module and ground. Adequate thermal management is required to maintain a T_{jc} at less than +175°C and thereby avoid adversely affecting the

semiconductor reliability. Special care must be taken to assure that minimal voiding occurs in the solder connection in the areas shade in red in the figure shown below.



Recommended RF Circuit Solder Footprint for the RFLM-011015QF-290



Notes:

- 1) Recommended PCB material is Rogers 4350B, 10 mils thick (RF Input and Output trace width needs to be adjusted from the recommended footprint.)
- 2) Hatched area is RF, DC and Thermal Ground. Vias should be solid Cu filled and Au plated for optimal heat transfer from backside of Limiter Module through circuit vias to thermal ground.
- 3) Unit = mils

Part Number Ordering Detail:

The RFLM-011015QF-290 Limiter Module is available in following format:

| Part Number | Description | Packaging |
|-------------------|---|-----------|
| RFLM-011015QF-290 | S-Band Limiter with Input & Output DC Blocking Caps | Gel-Pack |