



RFuWEngineeringLtd.

## RFLM-052402QC-290

### Quasi Active 2KW PIN Diode Limiter Module - SMT

#### Features:

- Frequency Range: 50 MHz to 4.0 GHz
- High Average Power Handling: +53 dBm
- High Peak Power Handling: +63 dBm
- Low Insertion Loss: 0.5 dB
- Return Loss: 15 dB
- Low Flat Leakage Power: 17dBm
- Low Spike Energy Leakage: 0.5 ergs
- Surface Mount Limiter Module : 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-052402QC-290 SMT Silicon PIN Diode Limiter Modules offers “Always On” High Power CW and Peak protection in the 50 MHz to 4.0 GHz frequency region. This Limiter Module is based on proven hybrid assembly technique utilized extensively in high reliability, mission critical applications. The RFLM-052402QC-290 offers excellent thermal characteristics in a compact, low profile 8mm x 5mm x 2.5mm package. It is designed for optimal small signal insertion loss permitting extremely low receiver noise figure while simultaneously offering very low Flat Leakage under high power conditions thereby offering excellent receiver protection across the 50 MHz to 4.0 GHz frequency range.

The RFLM-052402QC-290 Limiter Module provide outstanding passive receiver protection (Always on) which protects against High Average Power up to +53 dBm (CW), High Peak Power up to +63 dBm pulsed mode, while maintaining low Flat Leakage to less than 17dBm (typ), and reduces Spike Leakage to less than 0.5 ergs (typ).

#### ESD and Moisture Sensitivity Rating

The RFLM-052402QC-290 Limiter Module carries a Class 0 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 ( $R_{THJA}$ ). The two stage limiter design employs a two stage 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 +53 dBm(CW) and RF Peak Power levels up to +63 dBm (25 usec pulse width @ 5.0% duty cycle) with base plate temperature at +85°C. The RFLM-052402QC-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	$T_{CASE}=+85^\circ\text{C}$ , source and load VSWR < 1.2:1, RF Pulse width = 25 usec, duty cycle = 5%, derated linearly to 0 W at $T_{CASE}=150^\circ\text{C}$ (note 1)	63 dBm
RF CW Incident Power	$T_{CASE}=+85^\circ\text{C}$ , source and load VSWR < 1.2:1, derated linearly to 0 W at $T_{CASE}=150^\circ\text{C}$ (note 1)	53 dBm
RF Input & Output DC Block Capacitor Voltage Breakdown		100 V DC

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

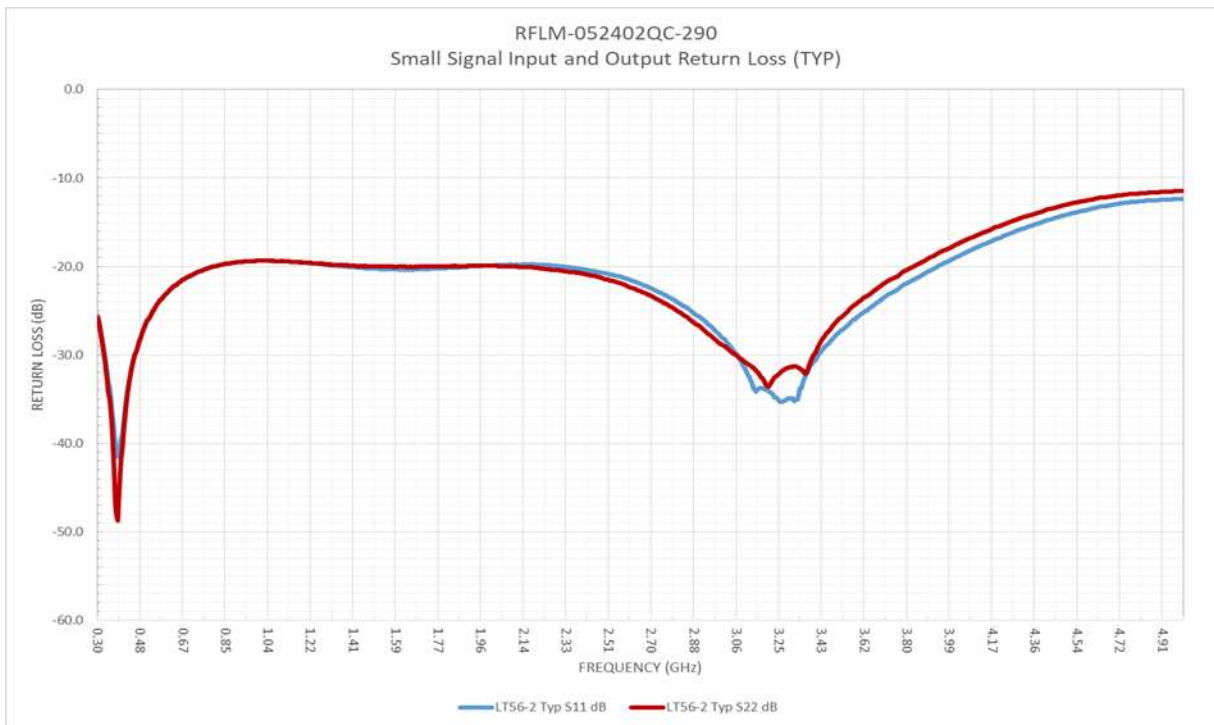
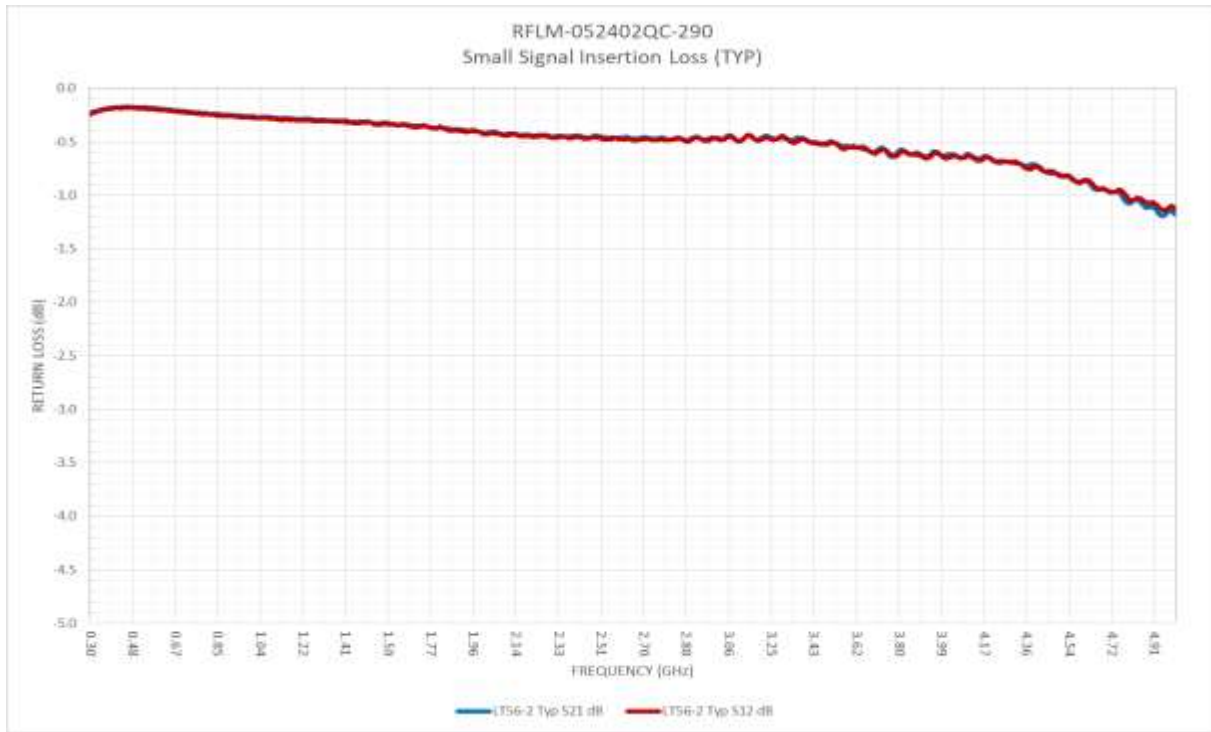
## RFLM-052402QC-290 Electrical Specifications

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

Parameters	Symbol	Test Conditions	Min Value	Typ Value	Max Value	Units
Frequency	F	$50\text{ MHz} \leq F \leq 4\text{ GHz}$	0.05		4.0	GHz
Insertion Loss	IL	$50\text{ MHz} \leq F \leq 4\text{ GHz}$ , $P_{in} = -20\text{ dBm}$			0.5	dB
Insertion Loss Rate of Change vs Operating Temperature	$\Delta\text{IL}$	$50\text{ MHz} \leq F \leq 4\text{ GHz}$ , $P_{in} \leq -20\text{ dBm}$		0.005		dB/ $^\circ\text{C}$
Return Loss	RL	$50\text{ MHz} \leq F \leq 4\text{ GHz}$ , $P_{in} = -20\text{ dBm}$	15			dB
Input 1 dB Compression Point	$\text{IP}_{1\text{dB}}$	$50\text{ MHz} \leq F \leq 4\text{ GHz}$		10		dBm
2 <sup>nd</sup> Harmonic	$2F_0$	$P_{in} = -10\text{ dBm}$ , $F_0 = 2.0\text{ GHz}$		-40		dBc
Peak Incident Power	$P_{inc(PK)}$	RF Pulse = 25 usec, duty cycle = 5%, $t_{rise} \leq 3\text{ us}$ , $t_{fall} \leq 3\text{ usec}$			63	dBm
CW Incident Power	$P_{inc(CW)}$	$50\text{ MHz} \leq F \leq 4\text{ GHz}$			53	dBm
Flat Leakage	FL	$P_{in} = +63\text{ dBm}$ , RF Pulse Width = 25 us, Duty Cycle = 5%, $t_{rise} \leq 3\text{ us}$ , $t_{fall} \leq 3\text{ us}$			17	dBm
Spike Leakage	SL	$P_{in} = +63\text{ dBm}$ , RF Pulse Width = 25 us, Duty Cycle = 5%			0.5	erg
Recovery Time	$T_R$	50% falling edge of RF Pulse to 1 dB IL, $P_{in} = +63\text{ dBm}$ peak, RF PW = 25 us, Duty Cycle = 5%, $t_{rise} \leq 3\text{ us}$ , $t_{fall} \leq 3\text{ usec}$			1.5	usec

# RFLM-052402QC-290 Typical Performance

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

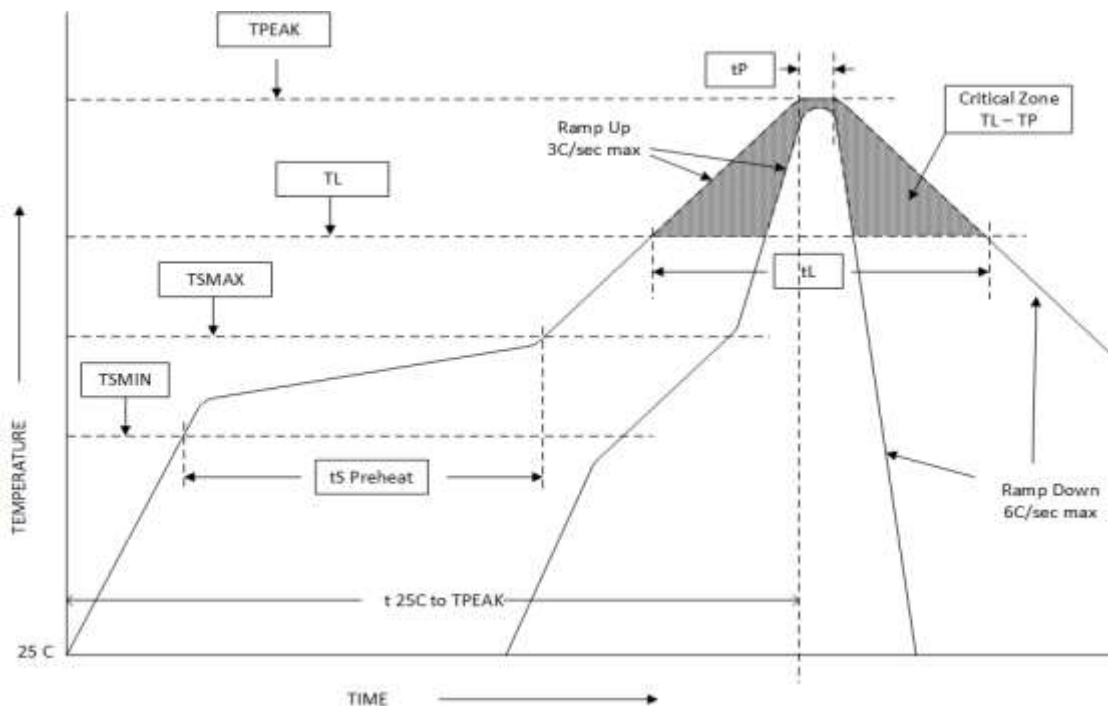


## Assembly Instructions

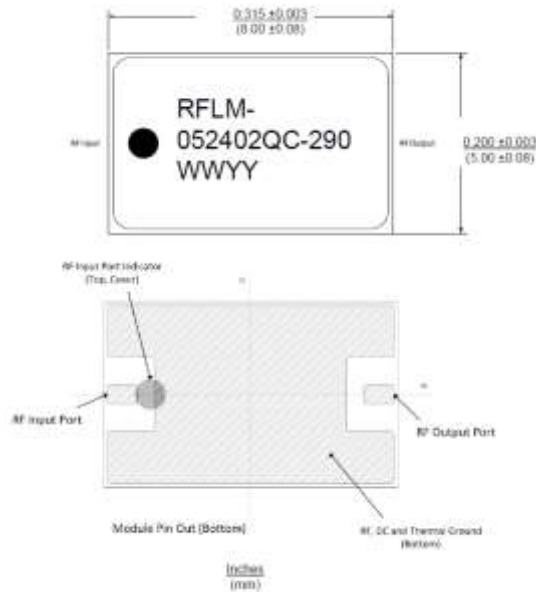
The RFLM-052402QC-290 may be attached to the printed circuit card using solder reflow procedures using either RoHS or Sn63/ Pb37 type solders per the Table and Temperature Profile Graph shown below:

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)
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 ( $T_L$ )	183°C	217°C
Time ( $t_L$ )	60 to 150 sec	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



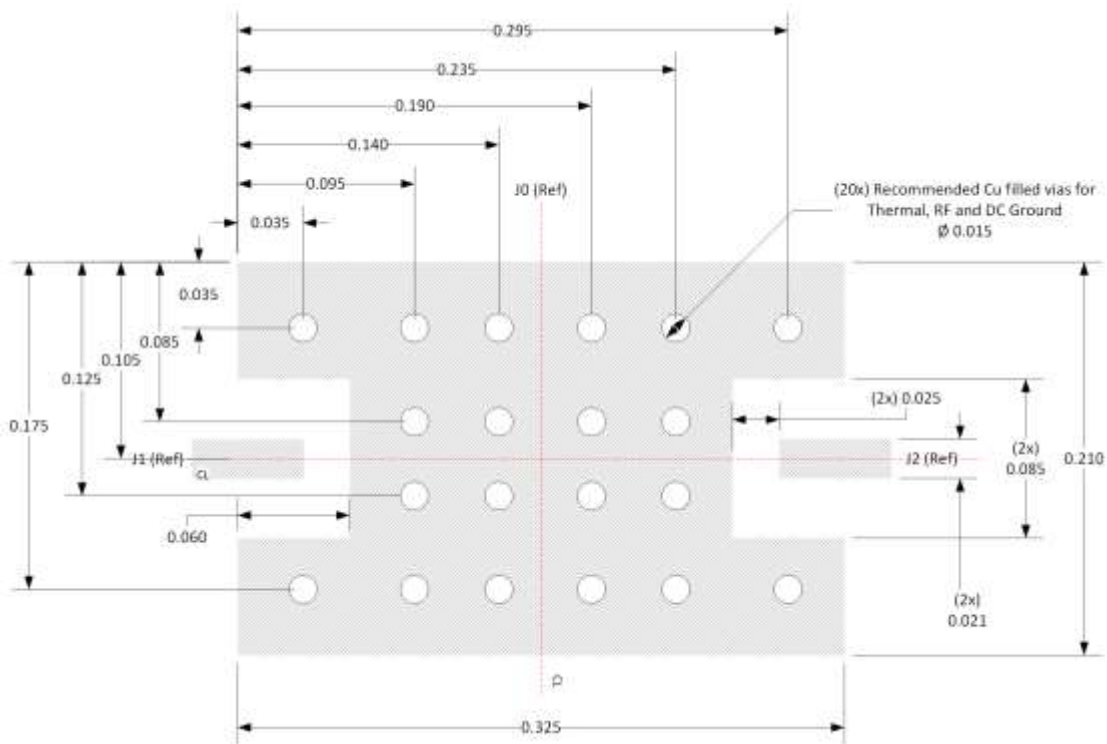
# RFLM-052402QC-290 Limiter Module Package Outline Drawing



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

## Recommended RF Circuit Solder Footprint for the RFLM-052402QC-290



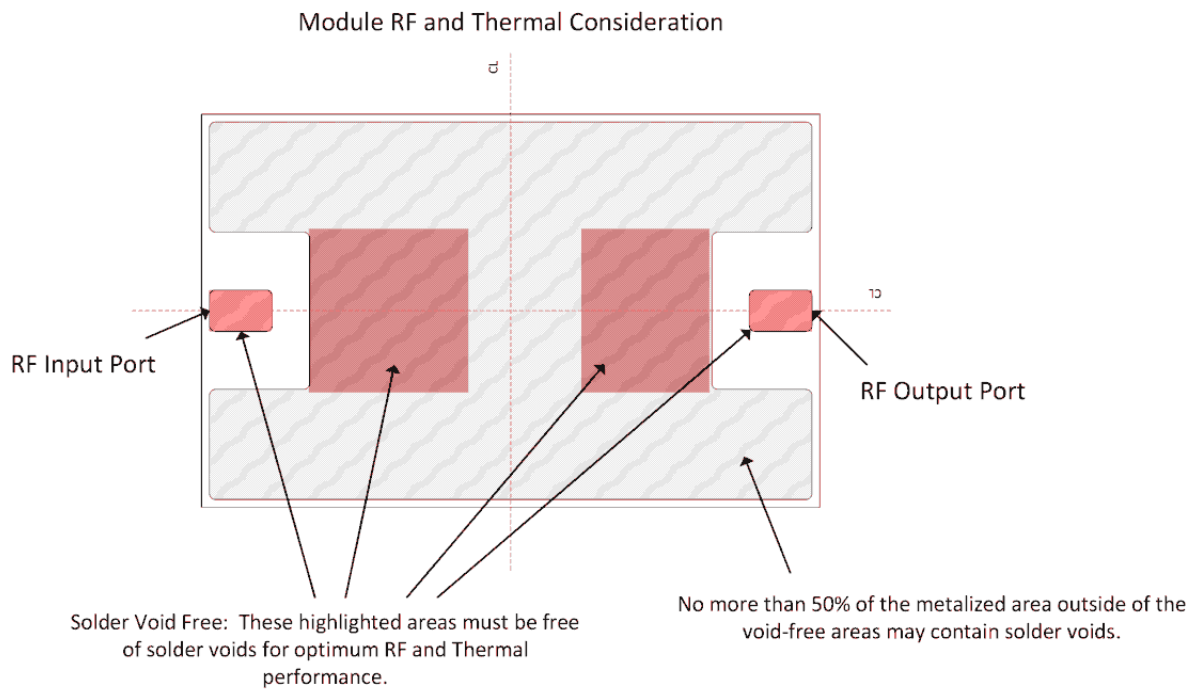
Notes:

- 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

**Thermal Design Considerations:**

The design of the RFLM-052402QC-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<sub>jc</sub> 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.



**Part Number Ordering Detail:**

The RFLM-052402QC-290 Limiter Module is available in the following shipping formats:

Part Number	Description	Packaging
RFLM-052402QC-290	50 MHz to 4.0 GHz Limiter with Input & Output DC Blocking Caps	Gel-Pack