



## RFLM-200802MA-299

### Two Stage Passive Limiter Module - SMT

#### Features:

- Frequency Range: 20 MHz to 8 GHz
- High Average Power Handling : +44 dBm
- High Peak Power Handling: +51 dBm
- Insertion Loss: <1.0 dB
- Return Loss: >13 dB
- Low Flat Leakage Power : <20dBm
- Low Spike Energy Leakage: 0.2 ergs
- Surface Mount Limiter Module: 8mm x 5mm x 2.5mm
- No external control lines or power supply required
- RoHS Compliant

#### Description:

The RFLM-200802MA-299 SMT Silicon PIN Diode Limiter Module offer both High Power CW and Peak Power protection in the 20 MHz to 8.0 GHz frequency range. It is based on a proven hybrid assembly technique utilized extensively in high reliability, mission critical applications. The RFLM200802MA-299 offers excellent thermal characteristics in a compact, low profile 8mm x 5mm x 2.5mm package. The RFLM-200802MA-299 is designed for optimal small signal insertion loss permitting extremely low receiver noise figure while simultaneously offering excellent large input signal Flat Leakage for effective receiver protection in the 20 MHz to 8 GHz frequency range.

The limiter RF circuit characteristics provide outstanding passive receiver protection (always on) which protects against High Average Power up to +44 dBm, High Peak Power up to +51 dBm pulsed (pulse width = 1 usec, duty cycle = 0.1%), maintains low flat leakage to less than 20 dBm (typical) and reduces Spike Leakage to less than 0.2 ergs.

#### ESD and Moisture Sensitivity Rating

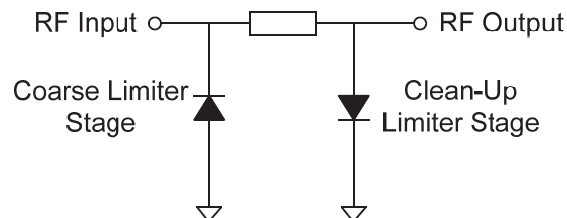
The RFLM200802MA-299 Limiter Module carries a Class 1C ESD rating (HBM) and an MSL 1 moisture rating.

#### Thermal Management Features

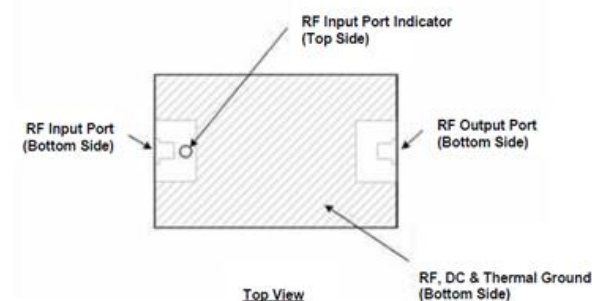
The RFLM-200802MA-299 based substrate has been design to offer superior long term reliability in the customer's application by utilizing ultra-thin Au plating to combat Au embrittlement concerns. Also, a proprietary design methodology has minimized the thermal resistance from the PIN Diode junction to base plate ( $R_{THJ-A}$ ).

The two stage limiter design employs a second stage limiter and quarter wavelength spacer detector circuit which permits ultra-fast turn on of the High Power PIN Diodes. This circuit topology coupled with the thermal characteristic of the substrate design enables reliably handling High Input RF Power up to +44 dBm CW and RF Peak Power levels up to +51dBm (1 uSec pulse width @ 0.1% duty cycle with base plate temperature at +85°C).

### RFLM-200802MA-299 Limiter Module Schematic - No RF Coupling Capacitors



### Pin Out



### 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 | $T_{\text{CASE}}=+85^\circ\text{C}$ , source and load VSWR < 1.2, RF Pulse width = 1 uSec, duty cycle = 0.1%, derated linearly to 0 W at $T_{\text{CASE}}=150^\circ\text{C}$ (See note 1) | + 51 dBm               |
| RF CW Incident Power   |                                                                                                                                                                                           | +44 dBm                |
| Assembly Temperature   |                                                                                                                                                                                           | 260°C for 30 seconds   |

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

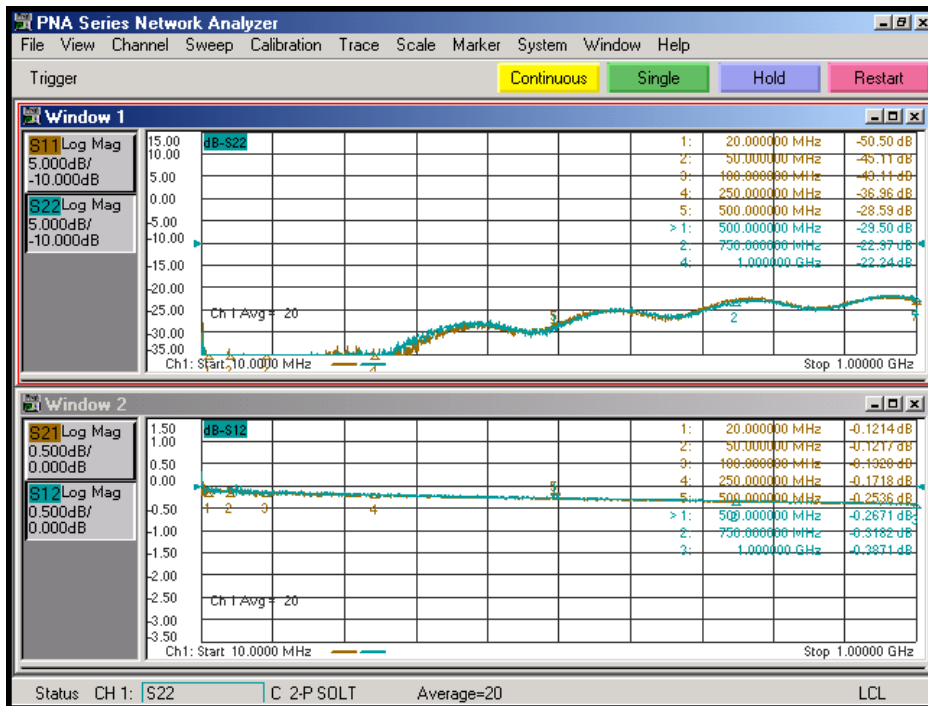
## RFLM200802MA-299 Electrical Specifications

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

| Parameters                                             | Symbol        | Test Conditions                                                                                                                                                      | Min Value | Typ Value | Max Value | Units                |
|--------------------------------------------------------|---------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|-----------|-----------|----------------------|
| Frequency                                              | F             |                                                                                                                                                                      | 0.020     |           | 8.0       | GHz                  |
| Insertion Loss                                         | IL            | $20\text{ MHz} \leq F \leq 8\text{ GHz}$ , $P_{in} = -20\text{ dBm}$                                                                                                 |           |           | 1.0       | dB                   |
| Insertion Loss Rate of Change vs Operating Temperature | $\Delta IL$   | $20\text{ MHz} \leq F \leq 8\text{ GHz}$ , $P_{in} \leq -20\text{ dBm}$                                                                                              |           | 0.005     |           | dB/ $^\circ\text{C}$ |
| Return Loss                                            | RL            | $20\text{ MHz} \leq F \leq 8\text{ GHz}$ , $P_{in} = -20\text{ dBm}$                                                                                                 | 13        |           |           | dB                   |
| Input 1 dB Compression Point                           | $IP_{1dB}$    | $20\text{ MHz} \leq F \leq 8\text{ GHz}$                                                                                                                             |           | 8         |           | dBm                  |
| 2 <sup>nd</sup> Harmonic                               | $2F_0$        | $P_{in} = 0\text{ dBm}$ , $F_0 = 2.0\text{ GHz}$                                                                                                                     |           | -50       | -40       | dBc                  |
| Peak Incident Power                                    | $P_{inc(PK)}$ | RF Pulse = 1 usec, duty cycle = 0.1%, $t_{rise} \leq 2\text{ us}$ , $t_{fall} \leq 2\text{ usec}$                                                                    |           | 50        | 51        | dBm                  |
| CW Incident Power                                      | $P_{inc(CW)}$ | $20\text{ MHz} \leq F \leq 8\text{ GHz}$                                                                                                                             |           | 43        | 44        | dBm                  |
| Flat Leakage                                           | FL            | $P_{in} = 50\text{ dBm}$ , RF Pulse width = 1 us, duty cycle = 0.1%, $t_{rise} \leq 2\text{ us}$ , $t_{fall} \leq 2\text{ us}$                                       |           | 20        | 23        | dBm                  |
| Spike Leakage                                          | SL            | $P_{in} = 50\text{ dBm}$ , RF Pulse width = 1 us, duty cycle = 0.1%                                                                                                  |           | 0.2       | 0.3       | erg                  |
| Recovery Time                                          | $T_R$         | 50% falling edge of RF Pulse to 1 dB IL, $P_{in} = 50\text{ dBm}$ peak, RF PW = 1 us, duty cycle = 0.1%, $t_{rise} \leq 2\text{ us}$ , $t_{fall} \leq 1\text{ usec}$ |           | 500       | 800       | nsec                 |

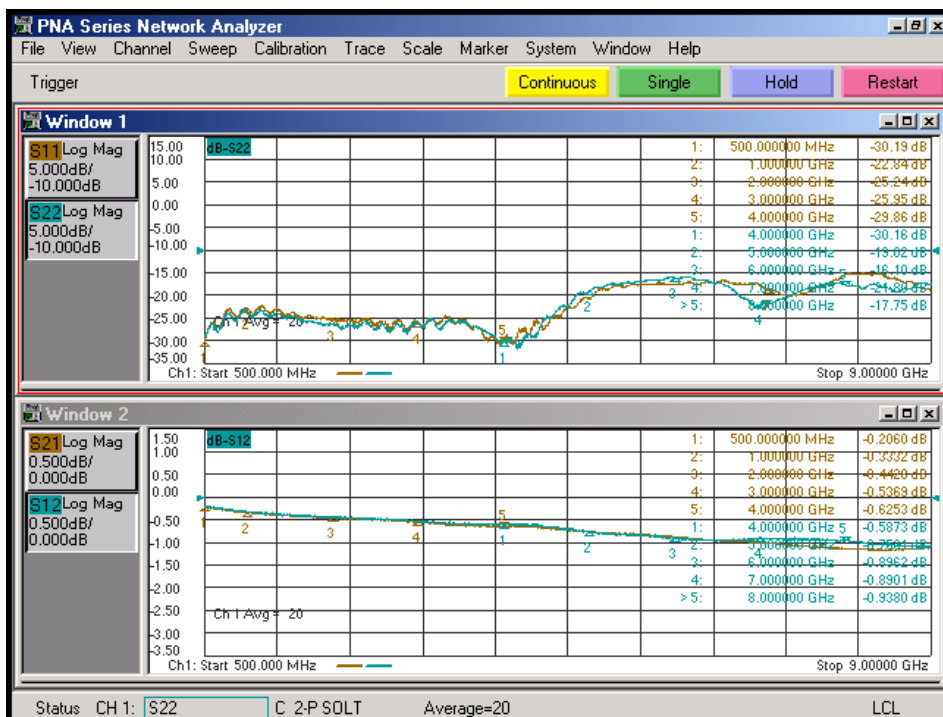
## RFLM-200802MA-299 Typical Performance: Insertion Loss & return Loss from 20 MHz to 1.0 GHz

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



## RFLM-200802MA-299 Typical Performance: Insertion Loss & return Loss from 500 MHz to 9.0 GHz

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

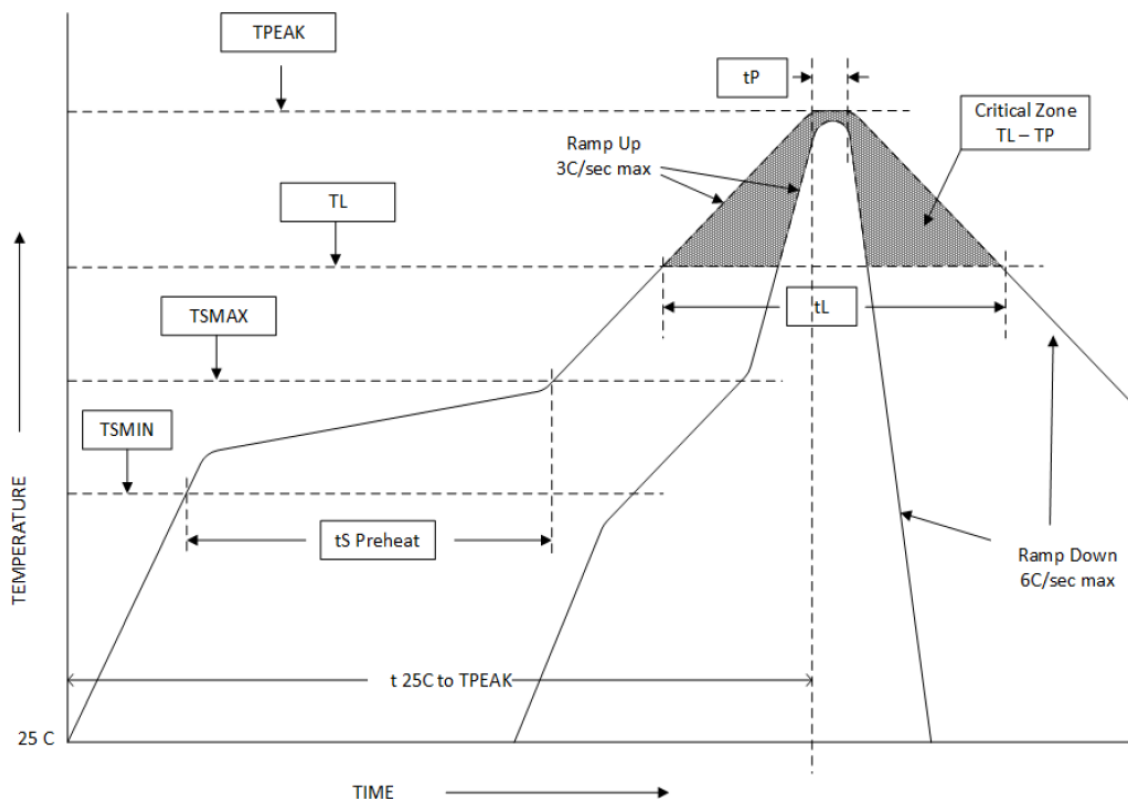


## Assembly Instructions

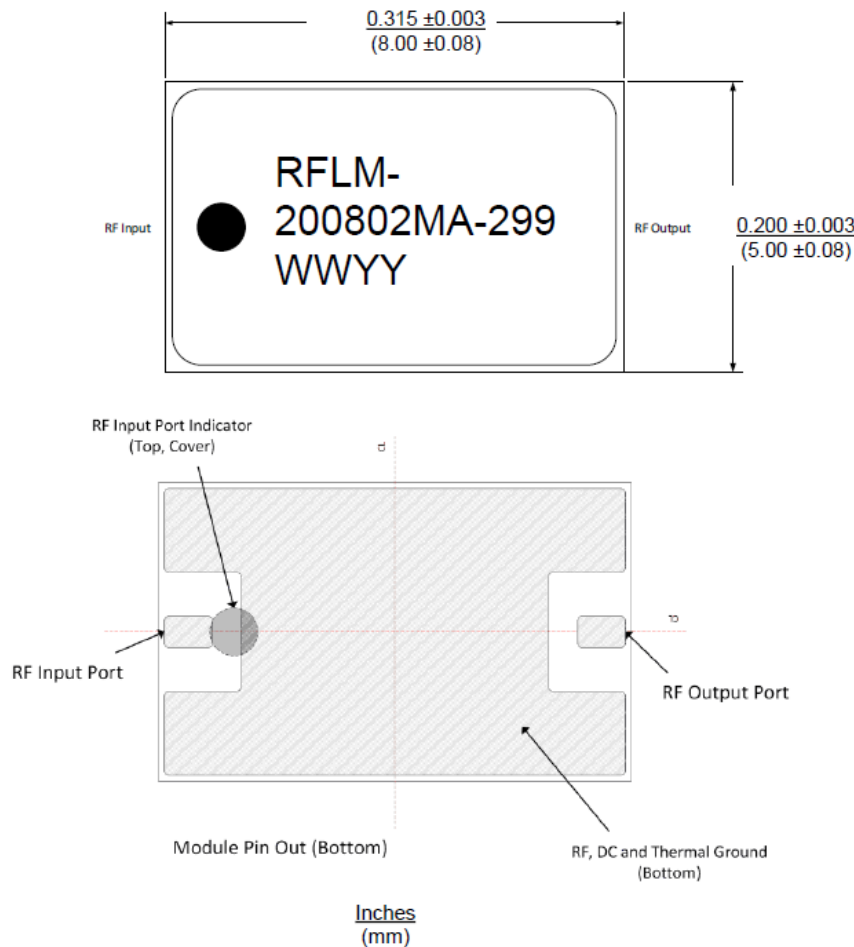
The RFLM-200802MA-299 may be attached to the printed circuit card using solder reflow procedures using either RoHS or Sn63/ Pb37 type solders per the Table and Temperature Profile Graph shown below:

| 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 – 120 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:<br>Temp ( $T_L$ )<br>Time ( $t_L$ ) | 183°C<br>60 to 150 sec   | 217°C<br>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-200802MA-299 Limiter Module Package Outline Drawing



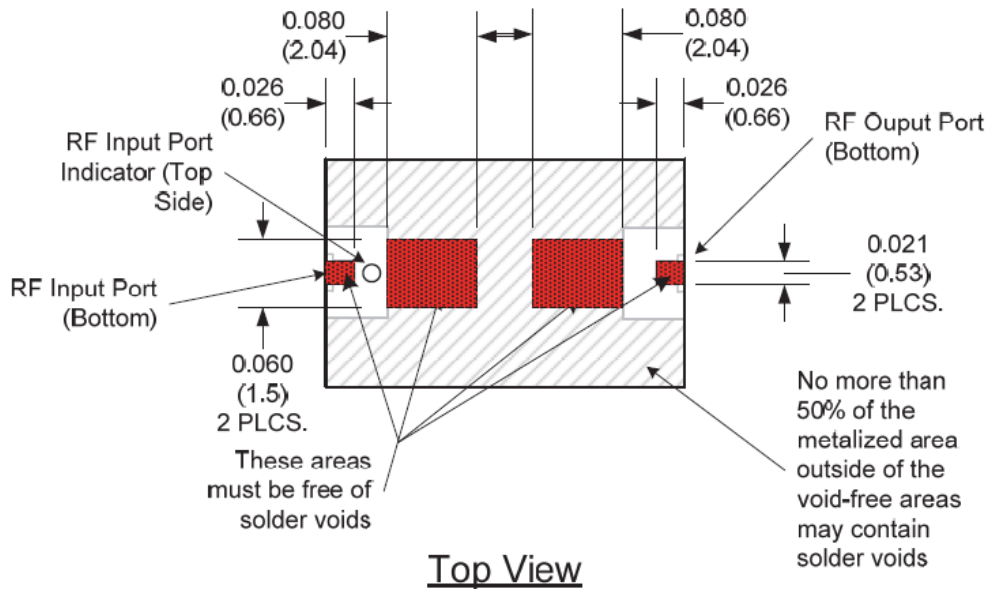
### Notes:

- 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 (15 u in typ Au plated over Ti-Pd).

### Thermal Design Considerations:

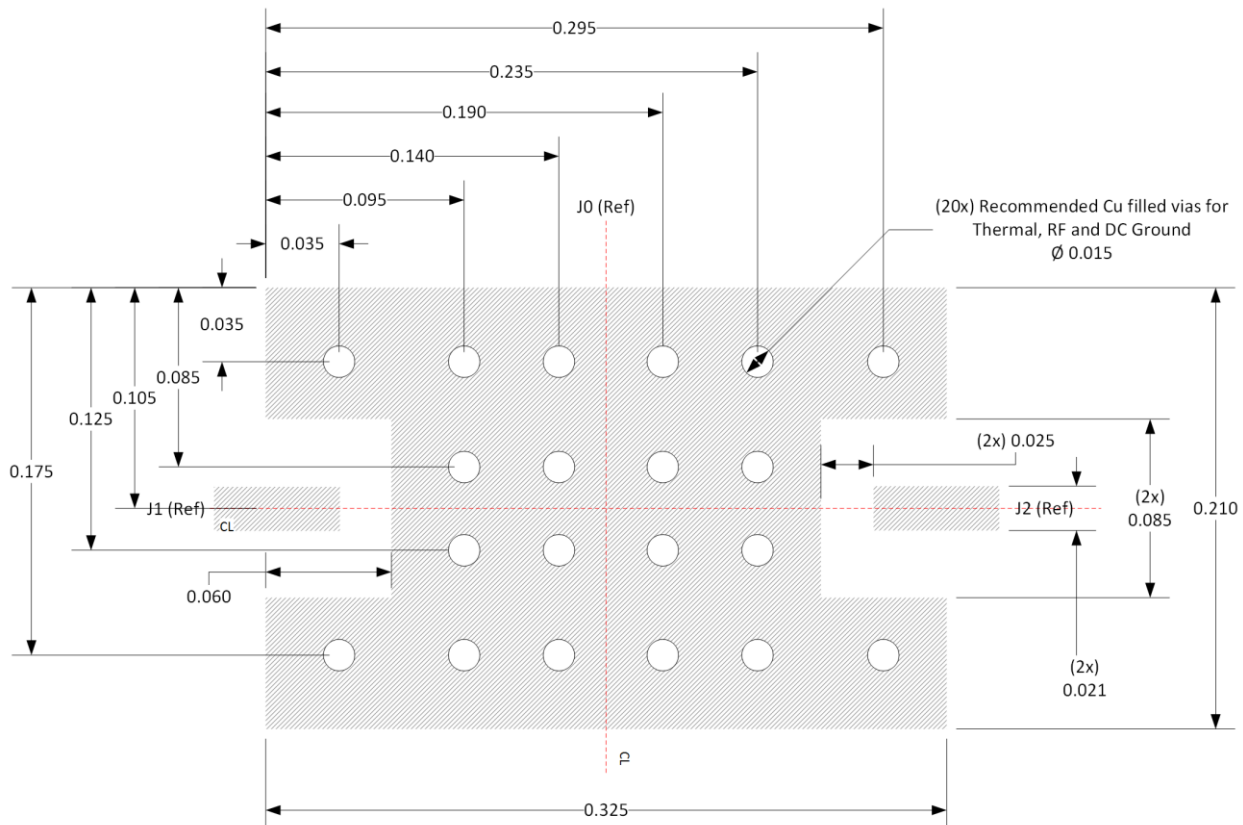
The design of the RFLM-200802MA-299 family of Limiter Modules permits the maximum efficiency in thermal management of the PIN Diodes while maintaining extremely high reliability. Optimum Limiter performance and reliability of the device can be achieved by the maintaining the base ground surface temperature of less than +85°C.

There must a minimal thermal and electrical resistance between the limiter and ground. Adequate thermal management is required to maintain a  $T_{jc}$  at less than +175°C and therefore will not adversely affect 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.



Dimensions in inches (mm).

## Recommended RF Circuit Solder Footprint for the RFLM200802MA-299



Notes:

- 1) Recommended PCB material is rogers 4350, 10 mils thick.
- 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.

## Part Number Ordering Detail:

The RFLM-200802MA-299 Limiter Module is available in the following format:

| Part Number                 | Description                                          | Packaging |
|-----------------------------|------------------------------------------------------|-----------|
| RFLM-200802MA-299           | 20 MHz to 8 GHz Band Limiter,<br>No DC Blocking Caps | Gel-Pack  |
| RFLM-200802MA-299 SS<br>EVB | RFLM-200802MA-299 Small Signal Evaluation<br>Board   | Box       |
| RFLM-200802MA-299<br>HP EVB | RFLM-200802MA-299 High Power Evaluation<br>Board     | Box       |