Surface Mount PIN Diode Limiter
LM202802-M-C-300 Data Sheet

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A passion for performance.

Features

- Surface Mount Limiter in Compact Package:
  - 8 mm L x 5 mm W x 2.5 mm H
- Incorporates NIP and PIN Limiter Diodes
- Broadband Performance (2 to 8 GHz)
- Higher Average Power Handling than Plastic-Packaged Limiter: 45 dBm Average Power
- Low Insertion Loss (1.4 dB)
- Low Flat Leakage Power (20 dBm)
- RoHS Compliant

LEAD FREE
Pb
RoHS
COMPLIANT

Applications

- Receiver protection

Description

The LM202802-M-C-300 Surface Mount PIN Diode Limiter Module is a surface mount, passive two-stage power limiter which operates from 2 GHz to 8 GHz. It is manufactured using Aeroflex Metelics proven hybrid manufacturing process incorporating silicon NIP and PIN diodes integrated onto a ceramic substrate. This low profile, compact (8 mm L x 5 mm W x 2.5 mm H), surface mount component offers superior small and large signal performance. This product is designed to minimize small signal insertion loss for very low receiver noise figure and high isolation for low flat leakage power for effective receiver protection from 20 MHz to 8 GHz.

The design incorporates a silicon NIP coarse limiter diode and a silicon PIN clean-up stage diode to provide broad band microwave performance from 2 GHz – 8 GHz. The NIP and PIN diode configuration eliminates the need to include an RF choke to complete the DC bias return path. The very low thermal resistance (NIP diode: $< 20^{o}C/W$, PIN diode: $< 90\ ^{o}C/W$, junction to the bottom surface of the package) enables the limiter to safely and reliably handle RF CW incident power levels of 45 dBm and RF peak incident power levels of 53 dBm (1 µs RF pulse width, 0.1% duty cycle). The low PIN and NIP diodes' series resistances ($< 1.5\ \Omega$) provide low flat leakage power (< 22 dBm) and the thin I layer of the output stage provides low spike leakage energy (< 0.5 Ergs) for superior LNA protection. No external control signals are required. This product is RoHS compliant.

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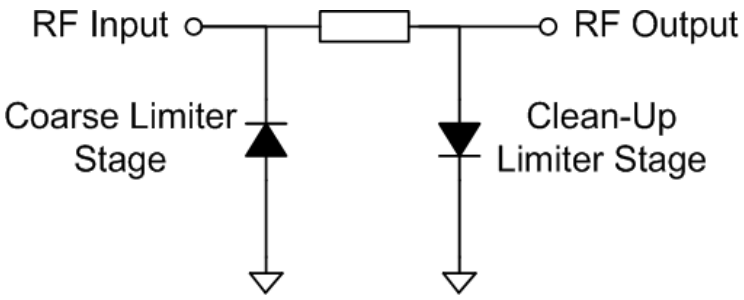
Environmental Capabilities

The LM202802-M-C-300 Limiter Module is compatible with high volume, surface mount, solder re-flow manufacturing methods. This product is durable and capable of reliably operating in military, commercial, and industrial environments. The device is RoHS compliant and is available in tube or tape-reel. The LM202802-M-C-300 Limiter is capable of meeting the environmental requirements of MIL-STD-750 and MIL-STD-202

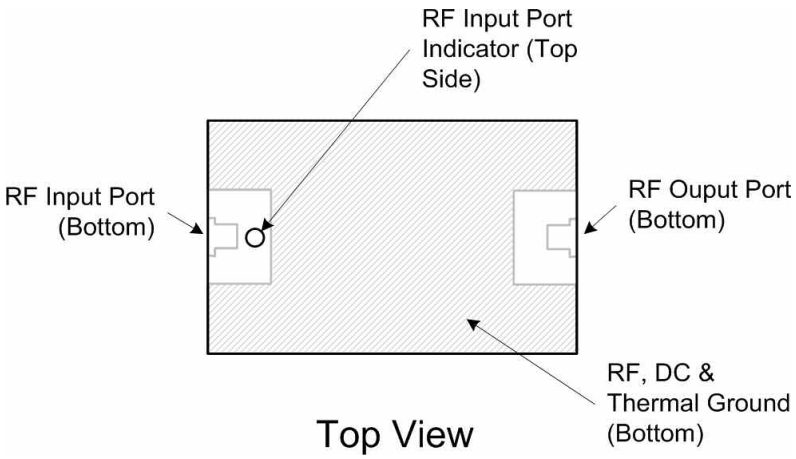
ESD and Moisture Sensitivity Level Rating

As are all semiconductor devices, PIN diode limiters are susceptible to damage from ESD events. The ESD rating for this device is Class 0 (HBM). The moisture sensitivity level rating for this device is MSL 1.

Limiter Schematic



Pinout



Absolute Maximum Ratings

@ Z_0 = 50 Ω, T_A= +25ºC as measured in Aeroflex evaluation board (Unless Otherwise Defined)

Parameter	Conditions	Absolute Maximum Value
Operating Temperature		-65ºC to 150ºC
Storage Temperature		-65ºC to 150ºC
Junction Temperature		175ºC
Assembly Temperature	t = 30 s	260ºC
RF Peak Incident Power Handling	T_{CASE} = 85 ºC, source and load VSWR < 1.2:1, RF pulse width = 1 µs, duty cycle = 0.1%, derate linearly to 0 W at T_{CASE} = 150ºC (note 1)	53 dBm
RF CW Incident Power Handling	T_{CASE} = 85 ºC, source and load VSWR < 1.2:1, derate linearly to 0 W at T_{CASE} = 150 ºC (note 1)	45 dBm
Θ_{JC} Thermal Resistance	Junction to bottom surface of package	25ºC/W

Notes:

1 T_{CASE} is defined as the temperature of the bottom surface of the package

LM202802-M-C-300 Electrical Specifications

Z_0 = 50 Ω, T_A= 25ºC as measured in Aeroflex evaluation board (Unless Otherwise Defined)

Parameter	Symbol	Test Conditions	Min. Value	Typ. Value	Max. Value	Units
Frequency	F		2		8	GHz
Insertion Loss	IL	20 MHz ≤ F ≤ 8 GHz, P_{IN} = 0 dBm		1.2	1.4	dB
Return Loss	RL	20 MHz ≤ F ≤ 8 GHz, P_{IN} = 0 dBm	13	15		dB
Input 1 dB Compression Point	IP_{1dB}	20 MHz ≤ F ≤ 8 GHz	7	8	10	dBm
2ND Harmonic	$2F_0$	P_{IN} = 0 dBm, F_0 = 2.0 GHz		-50	-45	dBc
Peak Incident Power	P_{inc}(Pk)	RF Pulse Width = 1 µs, duty cycle = 0.001			53	dBm
CW Incident Power	P_{inc}(CW)	20 MHz ≤ F ≤ 8 GHz			45	dBm
Flat Leakage Power	FL	P_{IN} = 50 dBm peak, RF pulse width = 1 µs, duty cycle = 0.1%		20	22	dBm
Spike Leakage Energy	SL	P_{IN} = 50 dBm peak, RF pulse width = 1 µs, duty cycle = 0.1%		0.3	0.5	erg
Recovery Time	T_R	50% falling edge of RF pulse to 1 dB IL, P_{IN} = 50 dBm peak, RF pulse width = 1 µs, duty cycle = 0.1%,		1500	2000	ns

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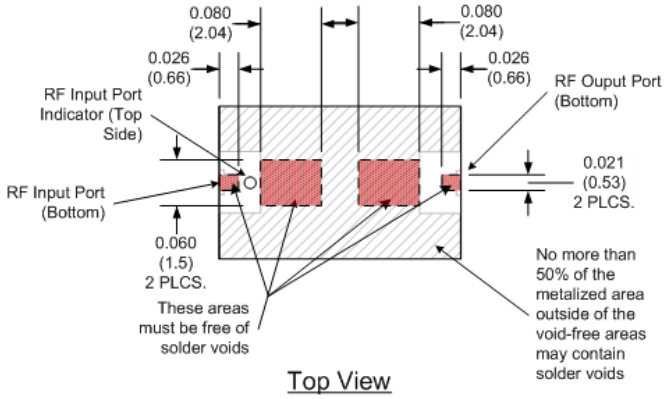
Evaluation Board

When a large signal is incident upon the input of the LM202802-M-C-300, the impedance of the coarse limiter diodes is forced to a low value by the charge which is injected into these diodes by the large RF voltage initially present across the internal diodes. As the impedance of these diodes decreases, an increasingly large impedance mismatch with the impedance of the transmission line to which the limiter is connected is created. Ultimately, the impedance of the coarse limiter diodes is reduced to a few ohms. This mismatch creates a standing wave, with a current maximum located ideally at the position of the coarse limiter diode. While the large majority of the input signal power is reflected back to its source due to the impedance mismatch, the significant RF current that flows at the current maximum causes Joule heating to occur in the coarse limiter diode, so there must be a path with minimal thermal resistance from the coarse diode to the external system heat sink. Also, there must be a minimal electrical resistance and inductance between the underside of the limiter module package and the system ground in order to achieve maximum RF isolation between the input and the output of the limiter module.



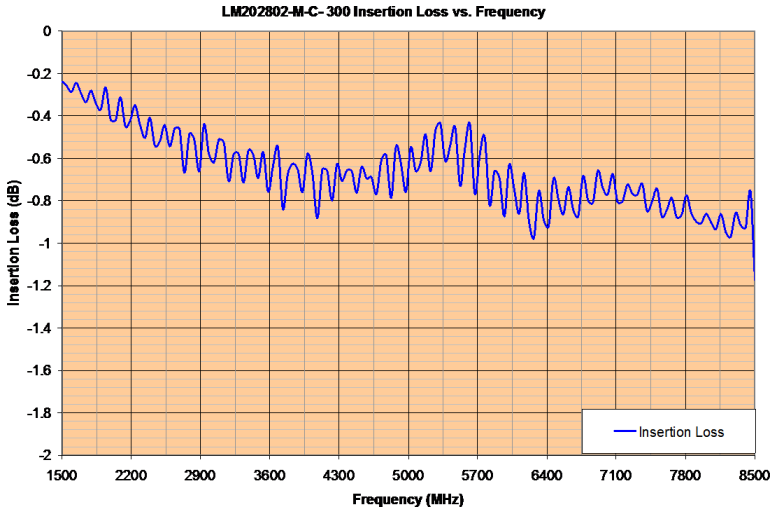
Dimensions in inches (mm).

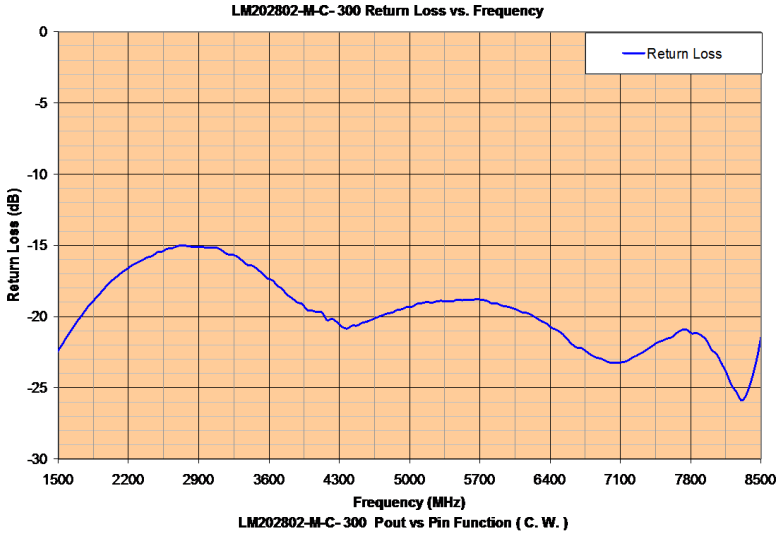
For these reasons, it is imperative that there are no voids in the electrical and thermal paths directly under the coarse limiter diode. Care must be taken when mounting the LM202802-M-C-300 to avoid voids in the solder joint in the area along the lengthwise axis of the package, under and between the filled vias in the AlN substrate of the module, which are shown in the diagram (above). It is also important to ensure no solder voids exist between the limiter module RF ports and the PCB to which the limiter module is attached.

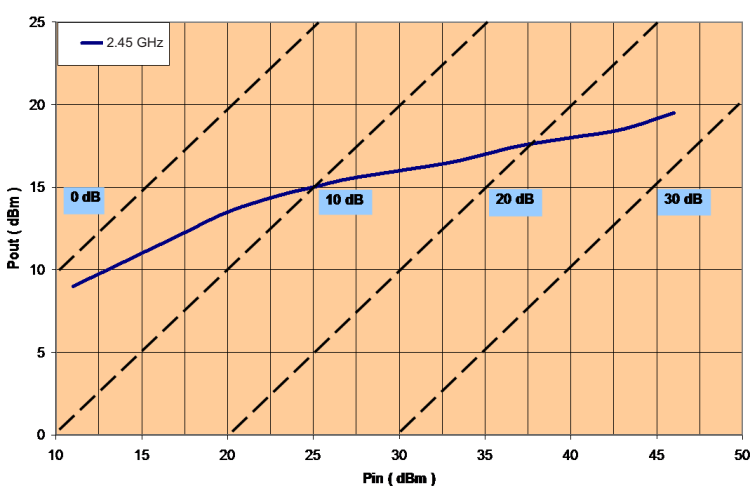
No greater than 50% of the remaining metalized area on the bottom of the package may contain solder voids.

LM202802-M-C-300 Typical Performance

Z_0 = 50 Ω, T_A= 25°C, P_{IN} = 0 dBm as measured in the Aeroflex Metelics evaluation board (Unless Otherwise Defined)







Output Power vs. Input Power, f = 2.45 GHz

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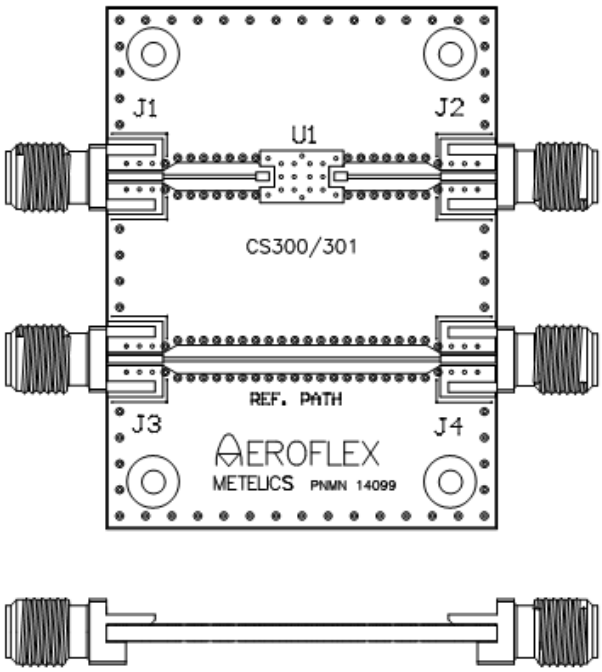
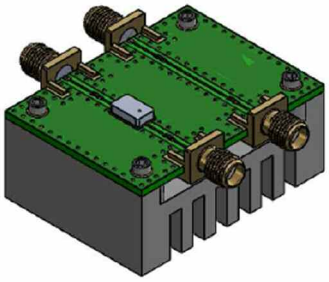
SP2T Switch Evaluation Board Layout



The evaluation board for the LM202802-M-C-300 is shown above. This evaluation board comprises two sections: the evaluation circuit for the LM202802-M-C-300 limiter module (U1); and, a reference path transmission line.

The limiter module is mounted in position U1. Its RF input is connected to J1 and its output port is connected to J2, via two 50Ω microstrip transmission lines.

The reference path 50Ω microstrip transmission line structure can be utilized to determine the insertion loss of the transmission line structures connected between J1 and the limiter module input, as well as between the limiter module output and J2, so that their respective insertion losses may be subtracted from the total insertion loss measured between J1 and J2. This enables the resolution of the insertion loss of the limiter module only.



The evaluation board is supplied mounted on a heat sink. The maximum RF input power specified in the absolute maximum ratings table must not be exceeded.

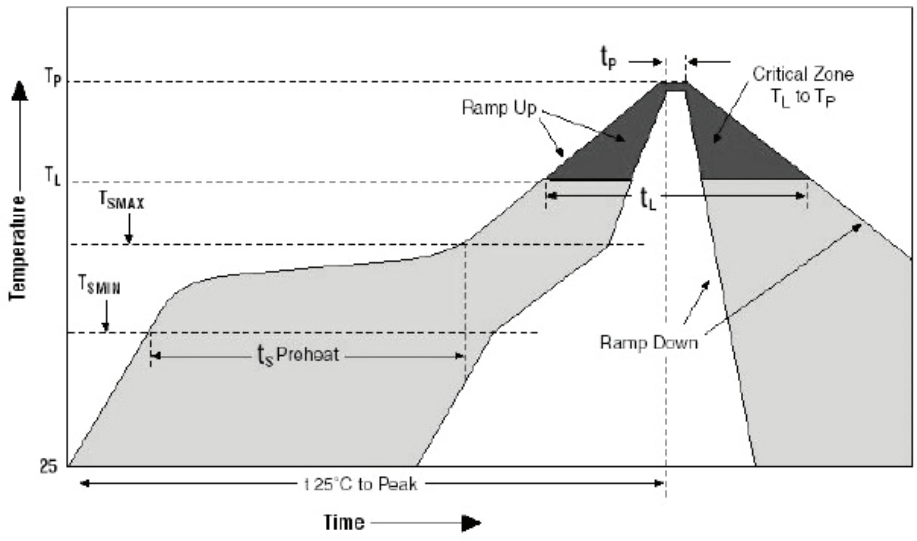
Assembly Instructions

The LM202802-M-C-300 limiter is capable of being placed onto a circuit board by pick-and-place manufacturing equipment from tube or tape-reel dispensing. The device is attached to the circuit board using conventional solder re-flow or wave soldering procedures with RoHS type or Sn60/Pb40 type solders per the recommended time-temperature profile shown below.

Table 1. Time-Temperature Profile for Sn60/Pb40 or RoHS Type Solders

Profile Feature	SnPb Solder Assembly	Pb-Free Solder Assembly
Average Ramp-Up Rate (T_L to T_P)	3°C /second maximum	3°C /second maximum
Preheat: - Temperature Min (T_{SMIN}) - Temperature Max (T_{SMAX}) - Time (min to max)(t_S)	 100°C 150°C 60-120 s	 150°C 200°C 60-180 s
T_{SMAX} to T_L - Ramp-Up Rate		 3°C/s maximum
Time Maintained Above: - Temperature (T_L) - Time (t_L)	 183°C 60-150 s	 217°C 60-150 s
Peak temperature (T_P)	225 +0/-5°C	260 +0/-5°C
Time Within 5°C of Actual Peak Temperature (t_P)	10 – 30 s	20 – 40 s
Ramp-Down Rate	6°C /s maximum	6°C /s maximum
Time 25°C to Peak Temperature	6 minutes maximum	8 minutes maximum

Figure 1. Solder Re-Flow Time-Temperature Profile



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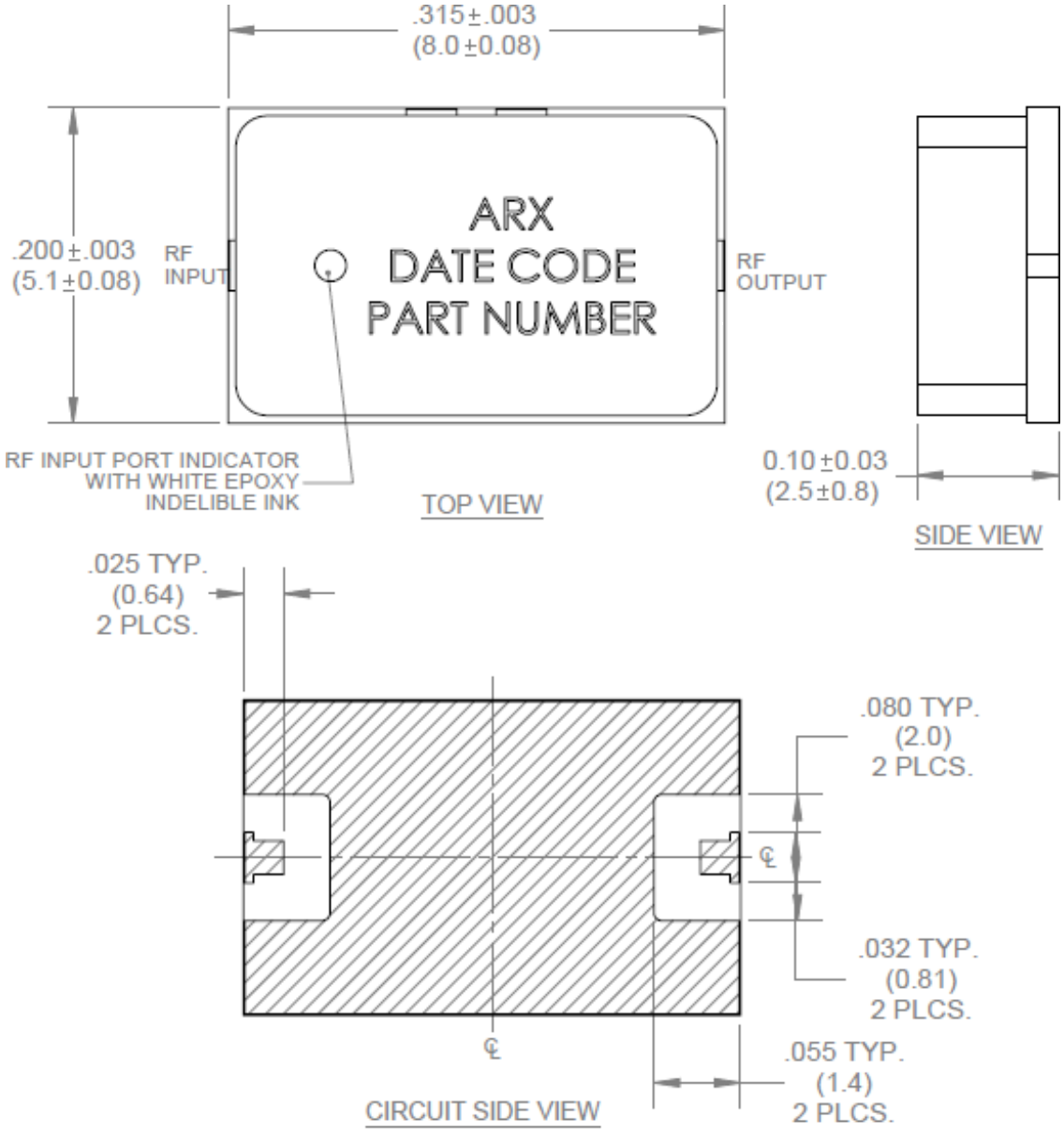
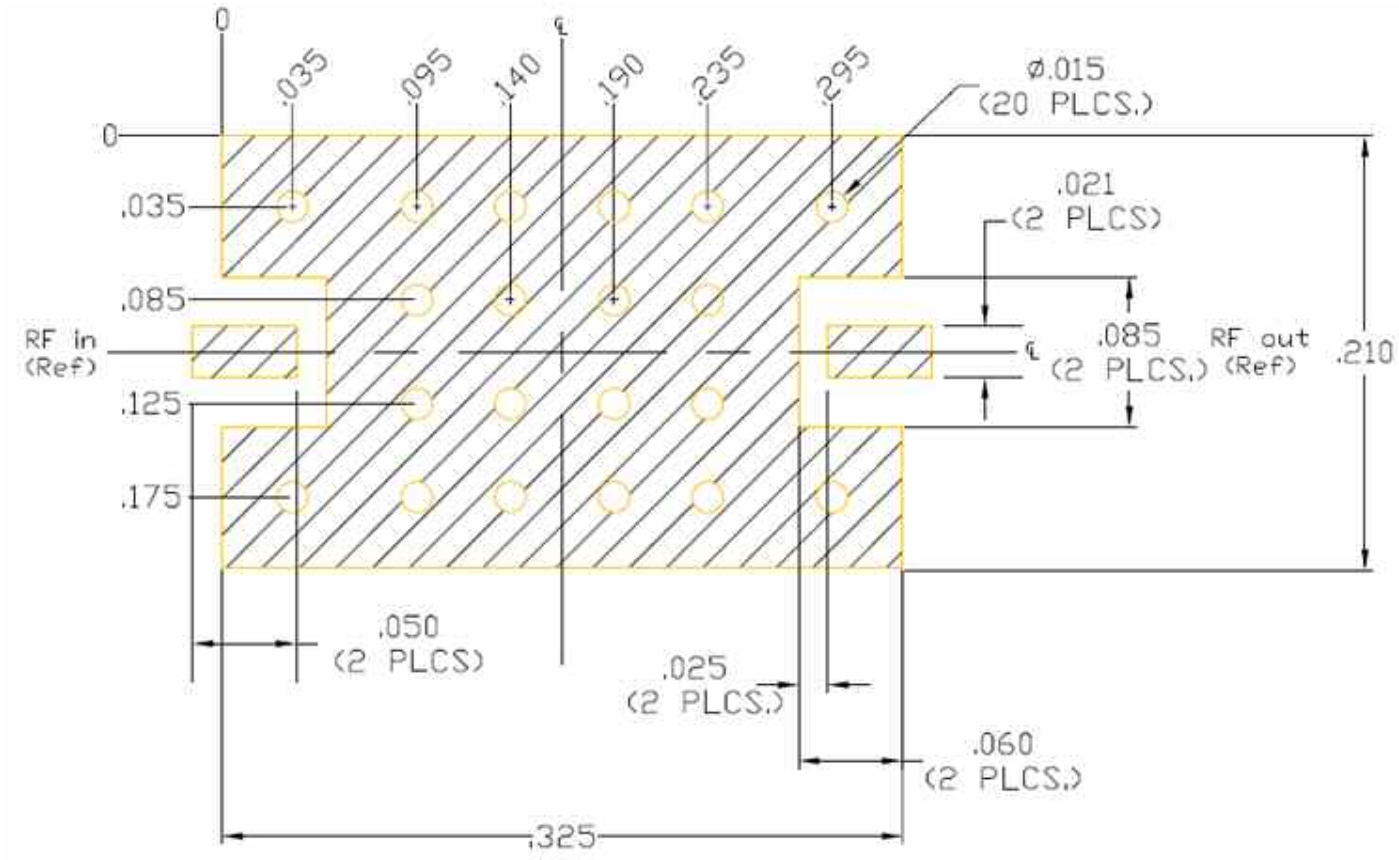
LM202802-M-C-300 Limiter Outline (CS300)



NOTES:
1. SUBSTRATE MATERIAL: 20 MIL THICK ALUMINUM NITRIDE (AIN) RF COVER: BLACK CERAMIC.
2. TOP SIDE AND BACKSIDE METALLIZATION: REF: PNLB 12892.
3. DIMENSION IN PARENTHESIS ARE IN MM.

RF Circuit Solder Footprint for Case Style 300 (CS300)



Notes:

1 Recommended PCB material is Rogers 4350, 10 mils THK.

2 Hatched area is RF, DC, and thermal ground. Vias should be solid copper filled and gold plated for optimum heat transfer from backside of limiter module through circuit vias to thermal ground.

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Part Number Ordering Information

Part Number	Description	Packaging
LM202802-M-C-300-T		Tube
LM202802-M-C-300-R		Tape-Reel (Quantities of 250 or 500)
LM202802-M-C-300-W		Waffle Pack
LM202802-M-C-300-E		RF Evaluation Board with Heat Sink

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