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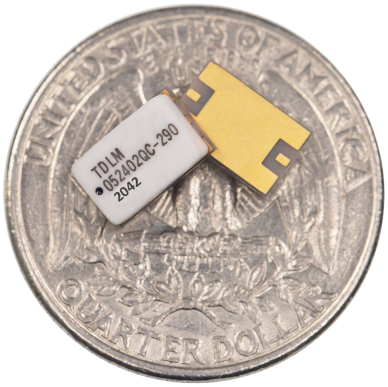
Product Specification

May 2023

TDLM052402QC-290

Quasi Active 2 kW PIN Diode Limiter Module - SMT

Features:



- Frequency Range: 500 MHz to 4.0 GHz
- High Average Power Handling: +53 dBm
- High Peak Power Handling: +63 dBm
- Low Insertion Loss: +0.9 dB
- Return Loss: 13 dB
- Low Flat Leakage Power: 17 dBm
- Low Spike Energy Leakage: 0.5 ergs
- Surface Mount Limiter Module : 8 mm x 5 mm x 2.5 mm
- dc Blocking Capacitors
- “Always On Protection”
  - No external control lines or power supply required
- RoHS Compliant

Description:

The TDLM052402QC-290 SMT Silicon PIN Diode Limiter Modules offers “Always On” High Average Power CW (up to +53dBm) and Peak (up to +63dBm) protection in the 500 MHz to 4.0 GHz frequency region, while maintaining low Flat Leakage to less than 17 dBm (typ) and Spike leakage to less than 0.5 ergs (typ).

This Limiter Module is based on proven hybrid assembly technique utilized extensively in high reliability, mission critical applications. The TDLM052402QC-290 offers excellent thermal characteristics in a compact, low profile 8 mm x 5 mm x 2.5 mm 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 500 MHz to 4.0 GHz frequency range.

ESD and Moisture Sensitivity Rating

The TDLM052402QC-290 Limiter Module carries a Class 0 ESD rating (HBM) and an MSL 1 moisture rating.

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Thermal Management Features

The proprietary design methodology minimizes the thermal resistance from the PIN Diode junction to base plate (RTHJ-A). 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 µsec pulse width @ 5.0% duty cycle) with base plate temperature at +85°C. The TDLM052402QC-290 based substrate has been design to offer superior long term reliability in customers' applications by utilizing ultra-thin, Au plating to combat corrosion.

Absolute Maximum Ratings

@ Z_o = 50 Ω, T_A = +25°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°C, source and load VSWR < 1.2:1, RF Pulse width = 25 µsec, duty cycle = 5%, derated linearly to 0 W at T_{CASE}=150°C (note 1)	63 dBm
RF CW Incident Power	T_{CASE}= +85°C, source and load VSWR < 1.2:1, derated linearly to 0 W at T_{CASE}=150°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.

TDLM052402QC-290 Electrical Specifications

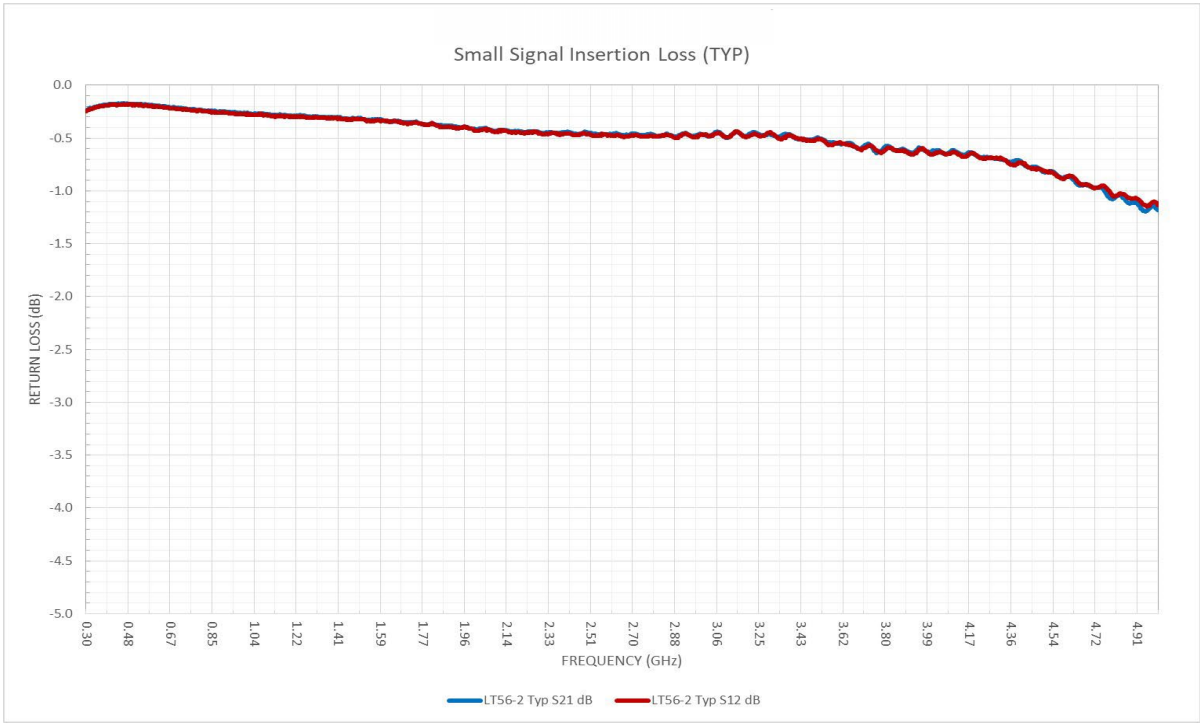
@ Z_o = 50 Ω, TA = +25ºC as measured on the base ground surface of the device.

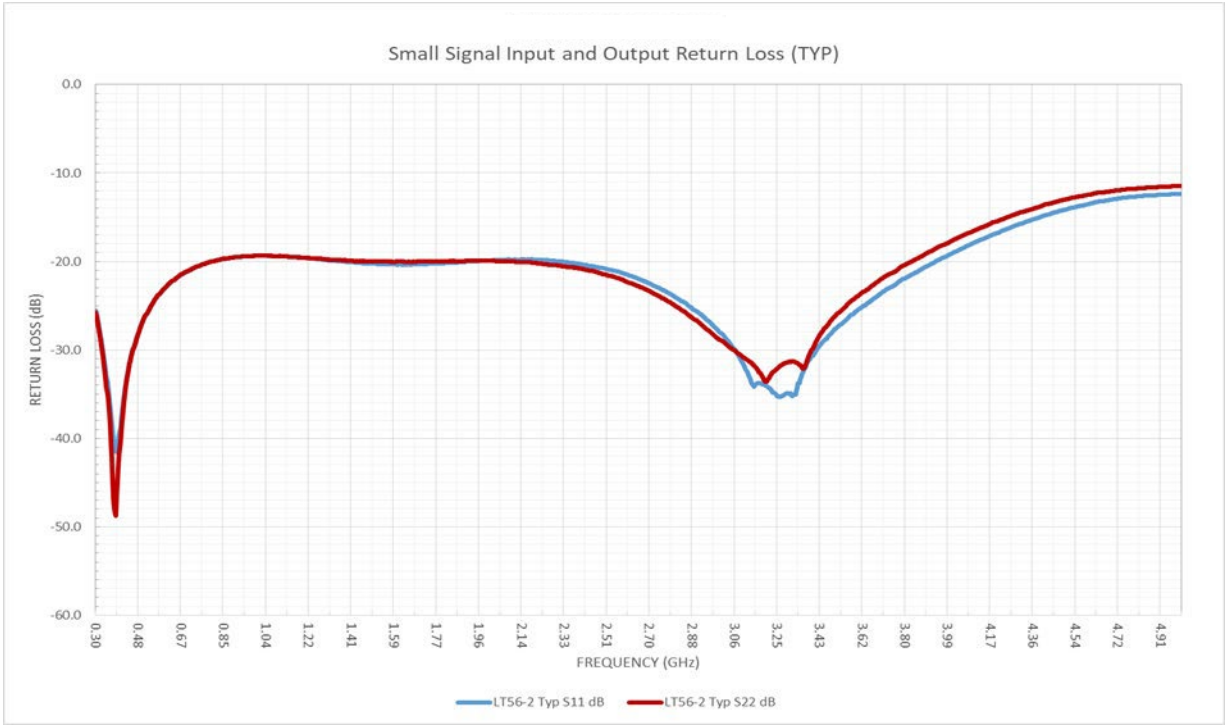
Parameters	Symbol	Test Conditions	Min Value	Typ Value	Max Value	Units
Frequency	F	500 MHz ≤ F ≤ 4 GHz	0.05		4.0	GHz
Insertion Loss	IL	500 MHz ≤ F ≤ 4 GHz, P_{in}= -20 dBm		0.7	0.9	dB
Insertion Loss Rate of Change vs Operating Temperature /1	ΔIL	500 MHz ≤ F ≤ 4 GHz, Pin ≤ -20 dBm		0.005		dB/ºC
Return Loss	RL	500 MHz ≤ F ≤ 4 GHz, Pin= -20 dBm	13			dB
Input 1 dB Compression Point	IP_{1dB}	500 MHz ≤ F ≤ 4 GHz	7	10		dBm
2nd Harmonic	$2F_o$	P_{in}= -10 dBm, F_o= 2.0 GHz		-40	-35	dBc
Peak Incident Power /1	$P_{inc\ (PK)}$	RF Pulse = 25 µsec, duty cycle = 5%, t_{rise} ≤ 3µs, t_{fall} ≤ 3µsec			63	dBm
CW Incident Power /1	$P_{inc(CW)}$	500 MHz ≤ F ≤ 4 GHz			53	dBm
Flat Leakage /1	FL	P_{in} = +63 dBm, RF Pulse Width = 25 µs, Duty Cycle = 5%, t_{rise}≤ 3 µs, t_{fall}≤ 3 µs			17	dBm
Spike Leakage /1	SL	Pin = +63 dBm, RF Pulse Width = 25 µs, Duty Cycle = 5%			0.5	erg
Recovery Time /1	T_R	50% falling edge of RF Pulse to 1 dB IL, Pin = +63 dBm peak, RF PW = 25 µs, Duty Cycle = 5%, trise ≤ 3µs, t_{fall} ≤ 3µsec			1.5	µsec

Note /1: Guaranteed by characterization.

TDLM052402QC-290 Typical Performance

Z_o = 50 Ω, T_{CASE} = 25°C, PIN = -20 dBm as measured on the Ground Plane of the device.



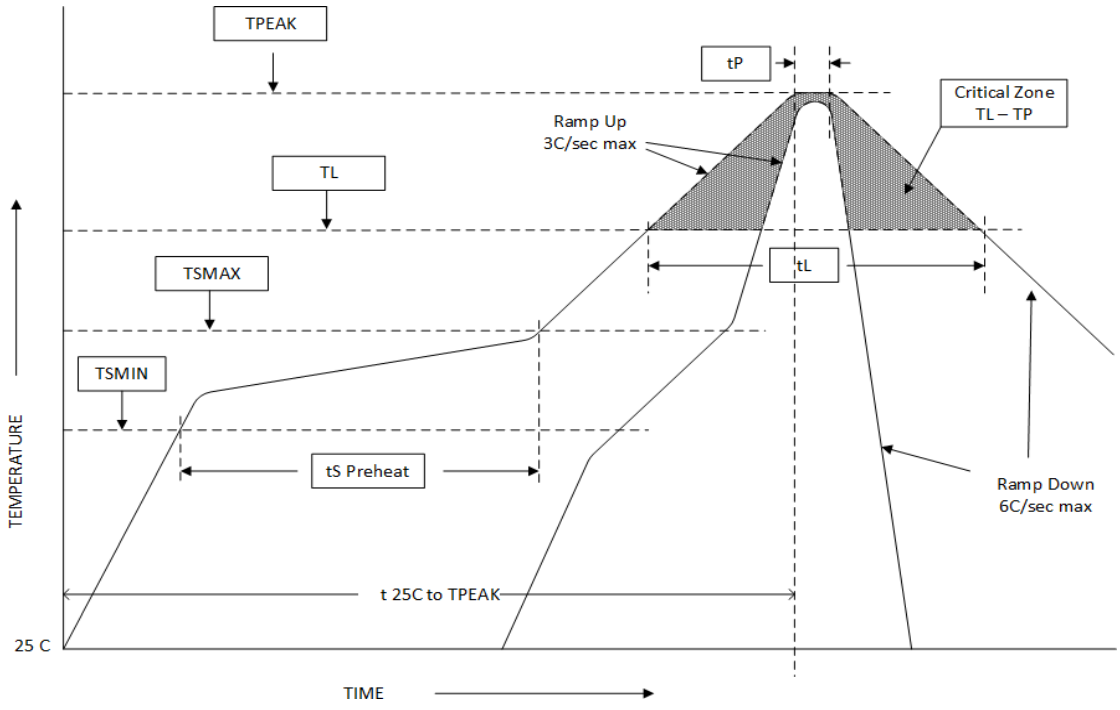


Assembly Instructions

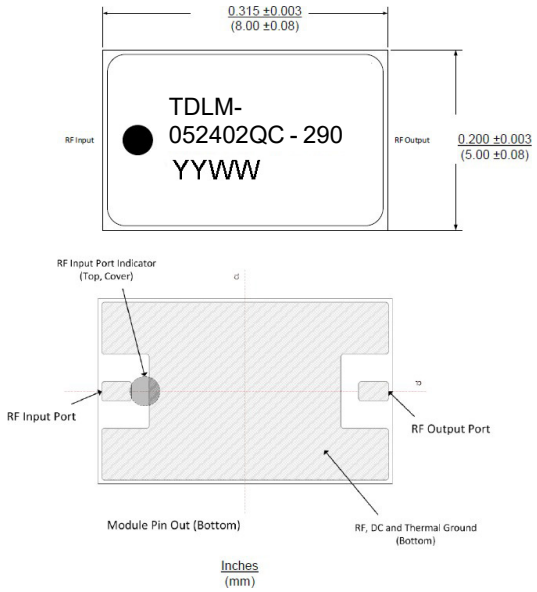
The TDLM052402QC-290 may be attached to the printed circuit card using solder reflow procedures using either RoHS or Sn63/ Pb37 type solders per the Table and Temperature Profile Graph shown below:

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}) Temp Max (T_{smax}) Time (min to max) (t_s)	100°C 150°C 60 – 120 sec	100°C 150°C 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) 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



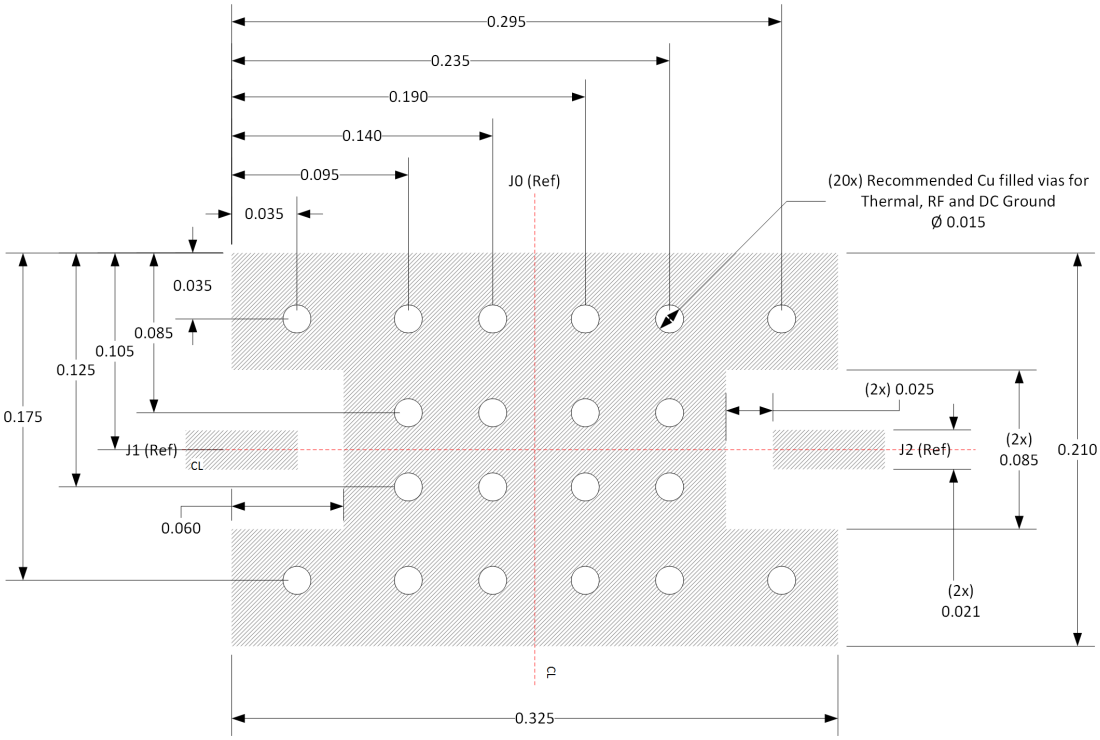
TDLM052402QC-290 Limiter Module Package Outline Drawing



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 TDLM052402QC-290



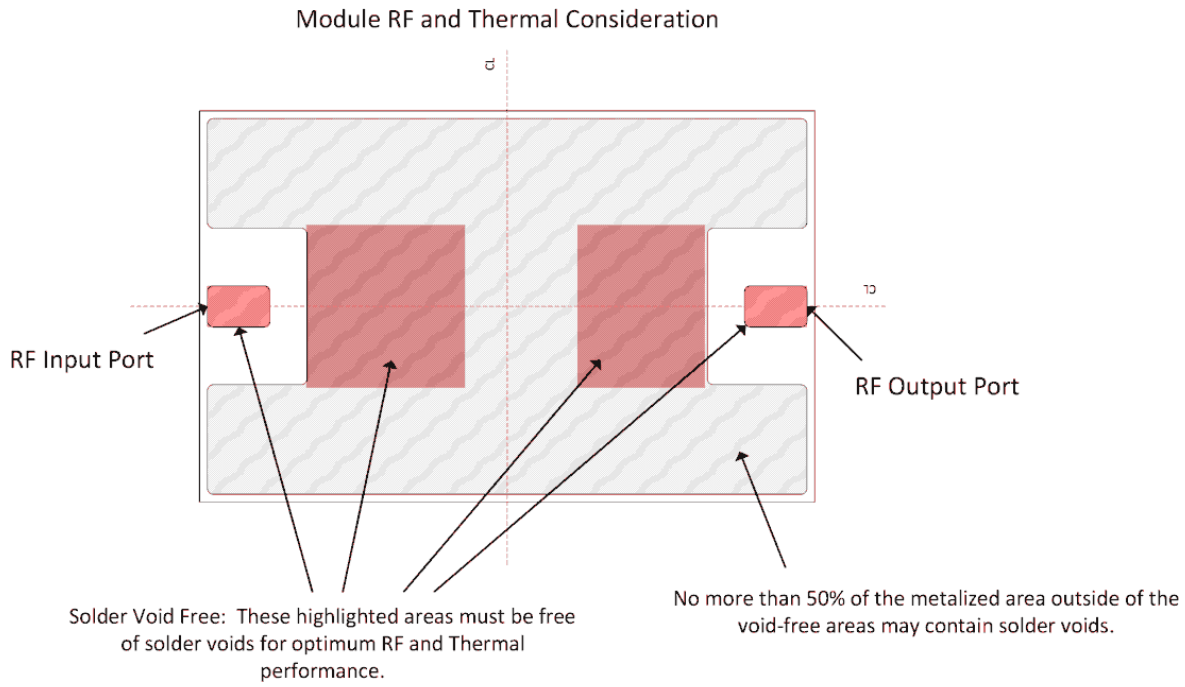
Notes:

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 TDLM052402QC-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 Tjc 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 TDLM052402QC-290 Limiter Module is available in the following shipping formats:

Part Number	Description	Packaging
TDLM052402QC-290-EVK[1]	TDLM052402QC Evaluation Kit	1/box
TDLM052402QC-290[1]	500 MHz to 4.0 GHz Limiter with Input & Output dc Blocking Caps	Gel Packs

1 : Products are available to US/Domestic markets only

Document Change Control:

Document Number	Item or Change	Date
TDLM052402QC 042023 Rev 1a	Initial Release	03/17/2021
TDLM052402QC 052023 Rev 1b	Changed date code to standard **YYWW** fomat on Package Outline Drawing page 6	5/12/2023

Document Categories

Definitions

Advance Information

The product is in a formative or design stage. The datasheet contains design target specifications for product development. Specifications and features may change in any manner without notice.

Preliminary Specification

The datasheet contains preliminary data. Additional data may be added at a later date. Peregrine reserves the right to change specifications at any time without notice in order to supply the best possible product.

Product Specification

The datasheet contains final data. In the event Peregrine decides to change the specifications, Peregrine will notify customers of the intended changes by issuing a CNF (Customer Notification Form).

Sales Contact

For additional information, contact us via email: tdemarketing@teledyne.com / **www.tdehirel.com**

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