mmTron
Unleashing the mmWave Frontier

TMC217
27-31 GHz 45 W Linear Power Amplifier

Product Features

- RF frequency: 27 to 31 GHz
- Linear Gain: 23 dB
- P_{sat}: 46.5 dBm
- Linearity: > 23W at 32dBc spectra regrowth
- Die Size: X=4.9, Y=4.0, Z=0.1 mm
- Package Size: X=15.2, Y=15.2, Z=5.2 mm
- DC Bias Point: 28 VDC, 3000 mA
  (VG1 = VG2 = VG3 ~ -4V)

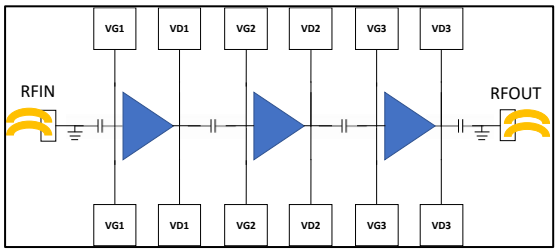
Applications

- SSPA
- SATCOM
- Military Radar, EW

Product Description

The TMC217 is backward compatible in layout and has similar performance to TMC215 but is tailored to cover both Commercial and Miliary bands of Ka band, i.e. 27-31 GHz. TMC217 is an Ultra linear power amplifier die product with high power-added efficiency. TMC217 is designed for use in SATCOM, Instrumentation, Military Radar, and EW applications. The TMC217 is a 50Ω matched design with built-in DC blocking and ESD protection on both input and output RF ports. To ensure rugged and reliable operation and moisture protection, the TMC217 is designed for maximum reliability. TMC217 typical input operating max saturation power is 25dBm but it can handle bursts of pulsed input power levels of 35 dBm. Both bond pad and backside metallization are Au-based that is compatible with ribbon and wedge bonding and high conductivity epoxy and eutectic die attach methods. TMC217 can be biased from 18V to 28V to adjust P1dB output power levels in the 25W to 45W range while maintaining excellent PAE and NPR. TMC217-T is the bare die on a Cu/CuMo/Cu tab. (CuW, CuMo and Diamond-based, optional) shims are available with both silver epoxy and AuSn eutectic die attach. Please contact mmTron for the 15x15 mm packaged version TMC217-P15.

Functional Block Diagram



*Add off chip bypassing for each supply pad 100pF. Decades of capacitance from 100pF to 10uF for best linearity. Device should have DC applied from both top and bottom on all pads.
Number of 1-mil bond wires per pad is as follows:
VG1, VG2 and VG3: 1,
VD1: 1, VD2: 2, VD3: 3.

Ordering Information

Part No.	Description
TMC217-D	Bare Die
TMC217-T1[1]	Bare Die on a Tab
TMC217-P15[2]	Packaged Version

1- Available in Cu/CuMo/Cu shims.

2- Contact mmTron for further information

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For additional information and Application support, please visit https://www.mmTron.com/contact

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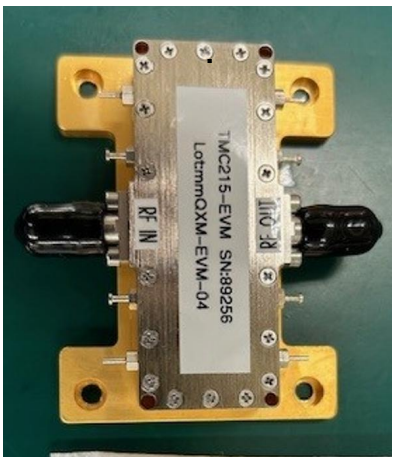
Typical Operating Conditions

	Min	Typ	Max	
Frequency	27		31	GHz
Small Signal Gain		23		dB
Pout @ 19dBc NPR		22		W
Pout @ -32dBc spectral regrowth		23		W
PAE @ P1dB		24		%
Pout @ P1dB		45		W
Return Loss		15		dB
Drain Voltage	18	28	28	V
Drain Bias Current	2000	3000	4000	mA

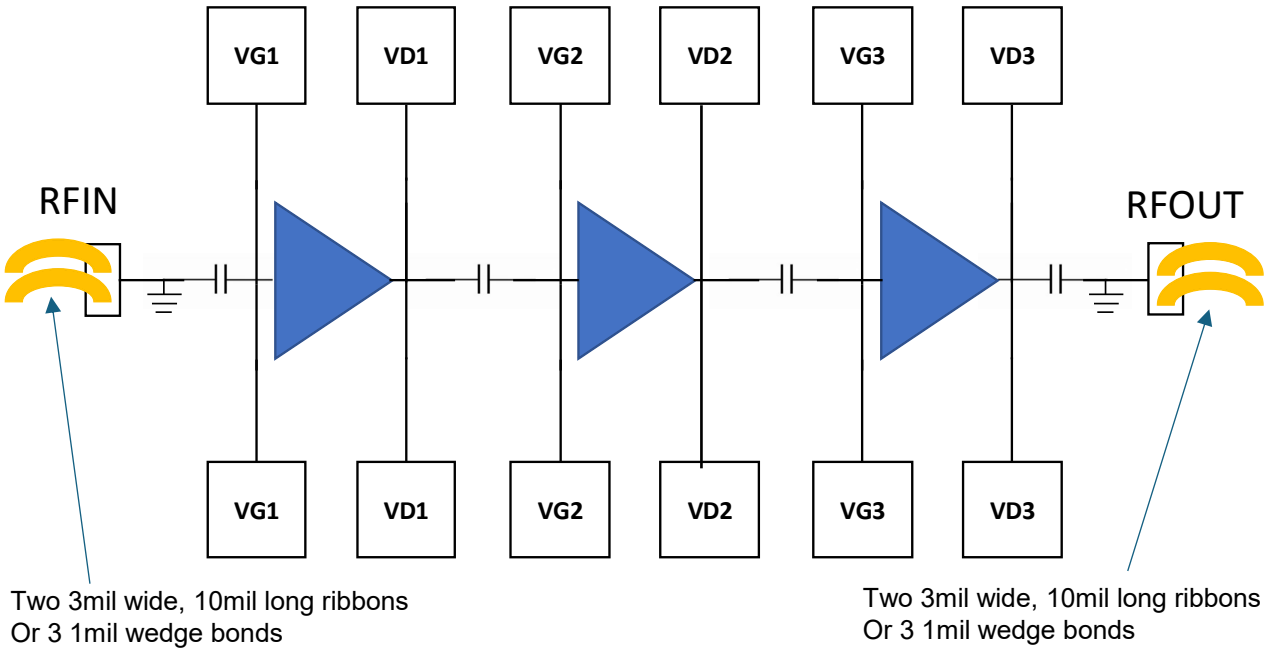
Evaluation Module



1: Contact mmTron, Inc. for mechanical and electrical model information

Connecting Instructions

*Off chip bypassing for each supply pad 100pF to minimize components. Decades of capacitance from 100pF to 10uF for best linearity. Device should have DC applied from both top and bottom on all pads. Minimum number of 1-mil bond wires per DC pad is as follows. VG1, VG2 and VG3: 1 wire, VD1: 1 wire, VD2: 2 wires, VD3: 4 wires per side.

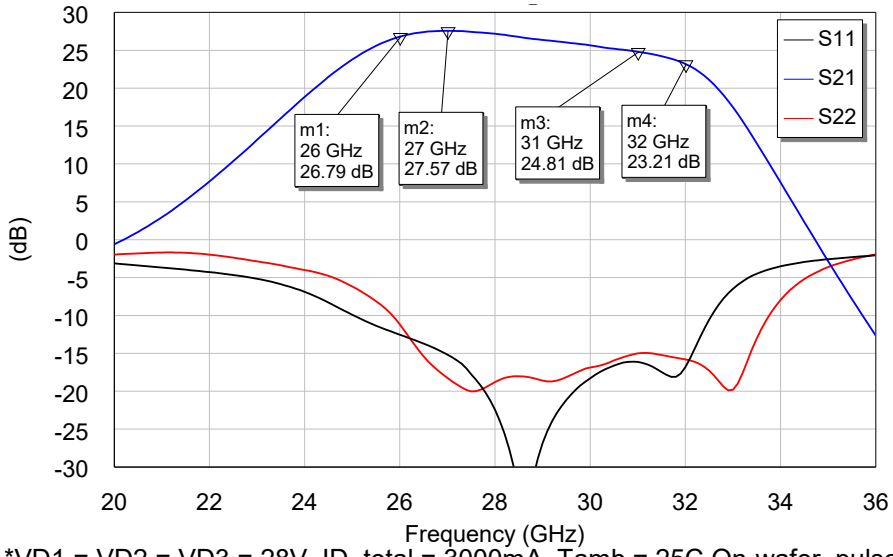


Bias Sequencing: To turn ON the device, VG1, VG2 and VG3 are first set at -6V. Then set VD1, VD2 and VD3 to 28V. Finally, adjust VG1 = VG2 = VG3 to achieve ID_total = 3000mA. To turn OFF the device, you set VG1, VG2 and VG3 to -6V, then turn off the VD1, VD2 and VD3 followed by turning off VG1, VG2 and VG3.

TMC217-D Performance vs. Temperature

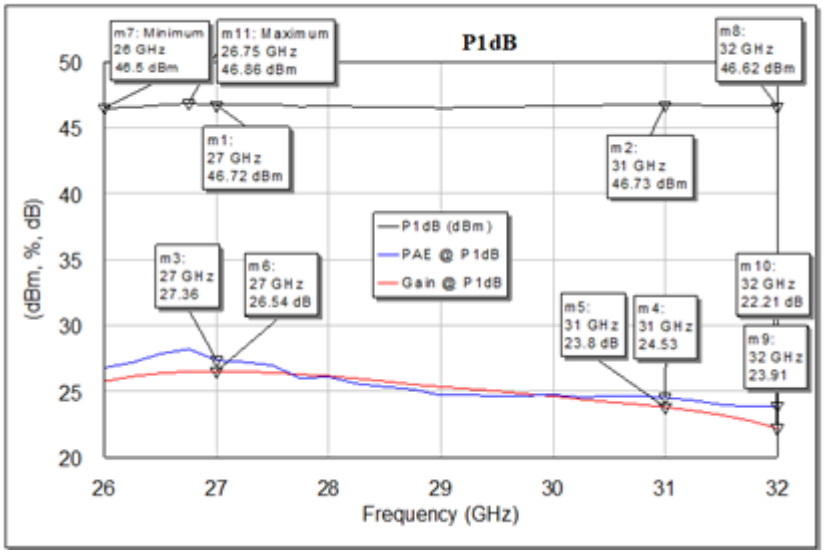
	-55 C	25 C	85 C
Small Signal Gain(dB)	23.9	23	21.6
P1dB (dBm)	45.8	45	44.3
Psat (dBm)	47.5	46.9	46.1

Small-Signal S-Parameters



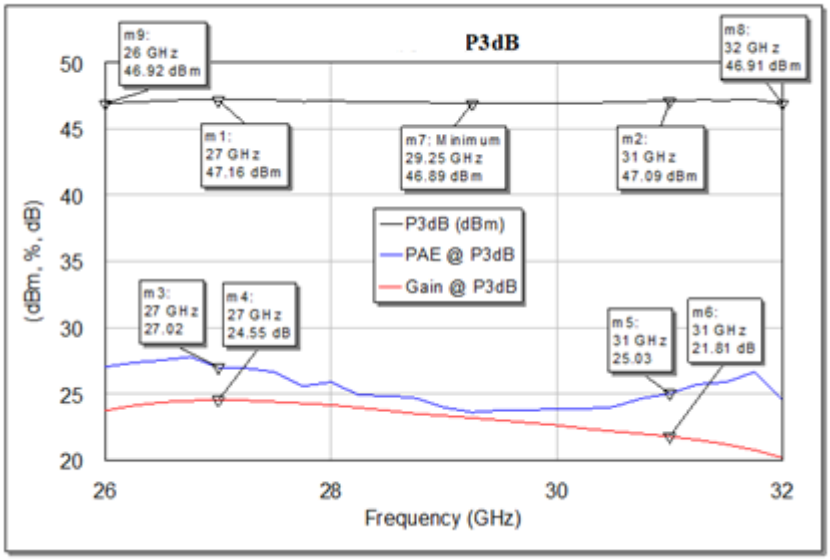
*VD1 = VD2 = VD3 = 28V, ID_total = 3000mA, Tamb = 25C On-wafer, pulsed

P1dB, PAE@P1dB, Gain@P1dB



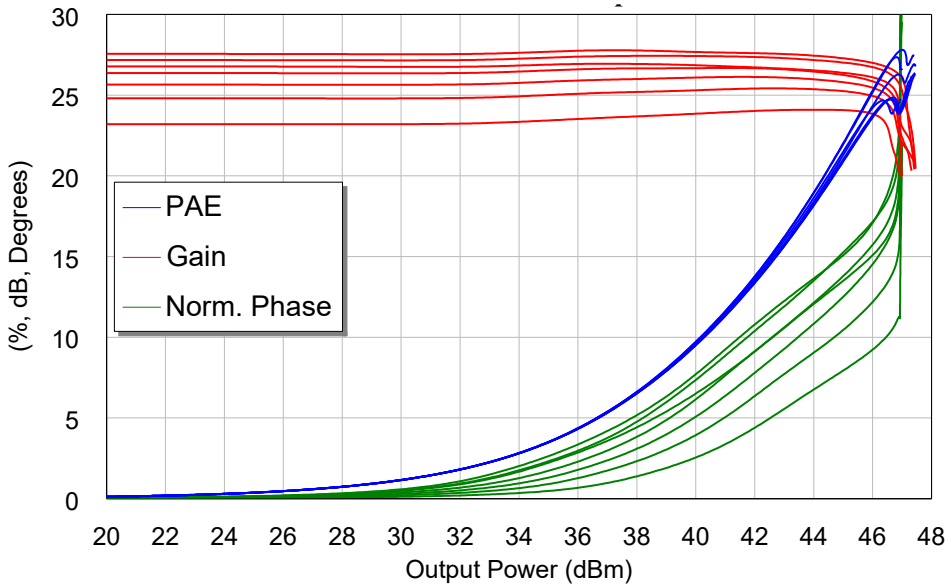
*VD1 = VD2 = VD3 = 28V, ID_total = 3000mA, Tamb = 25C On-wafer, pulsed

P3dB, PAE@P3dB, Gain@P3dB

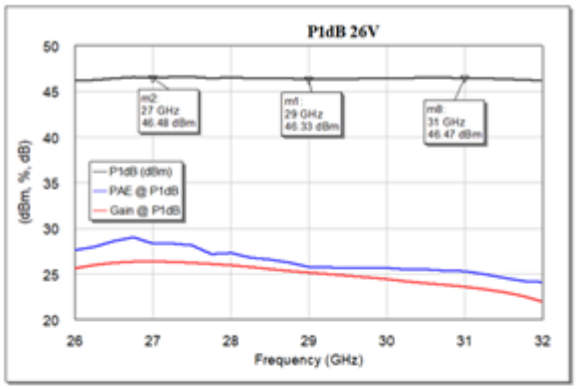


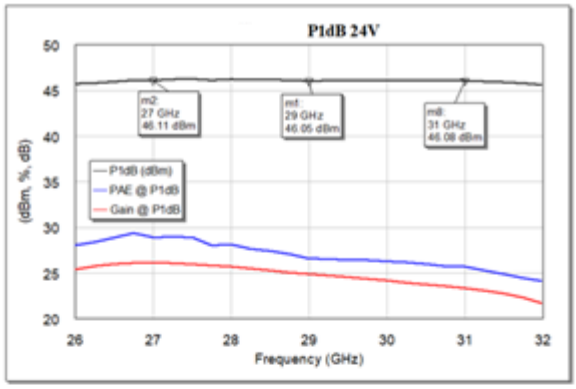
*VD1 = VD2 = VD3 = 28V, ID_total = 3000mA, Tamb = 25C, On-wafer, pulsed

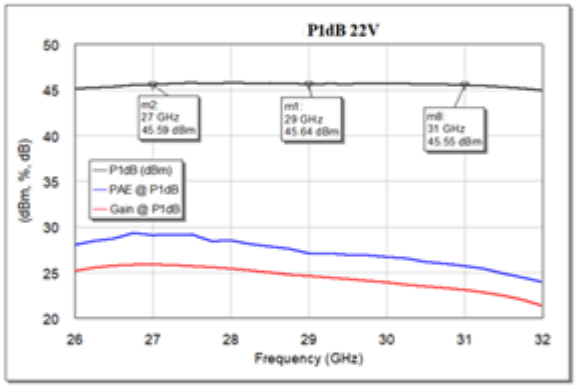
PAE, Gain, Norm. Phase vs. P_{OUT}

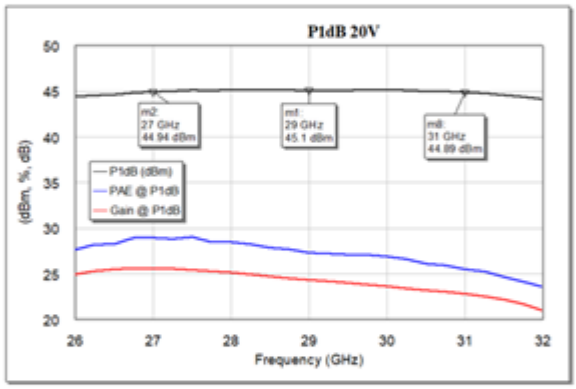


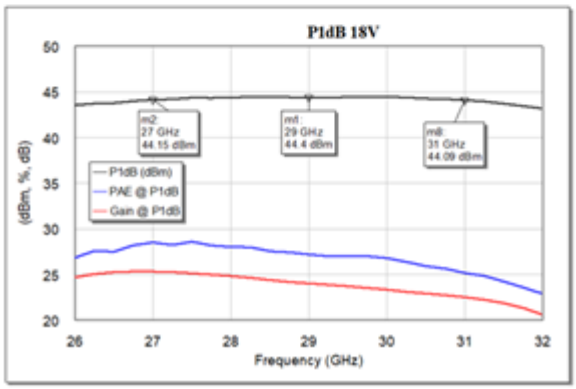
P1dB, PAE, Gain vs. V_D charts

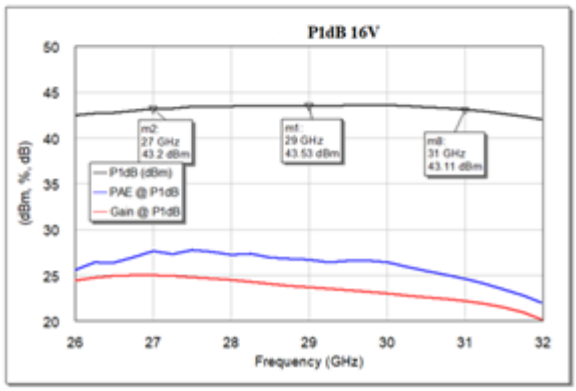




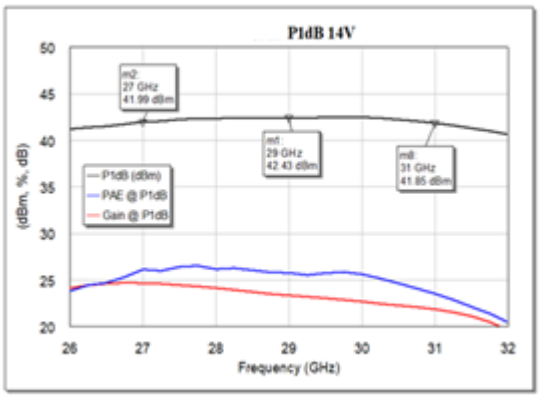


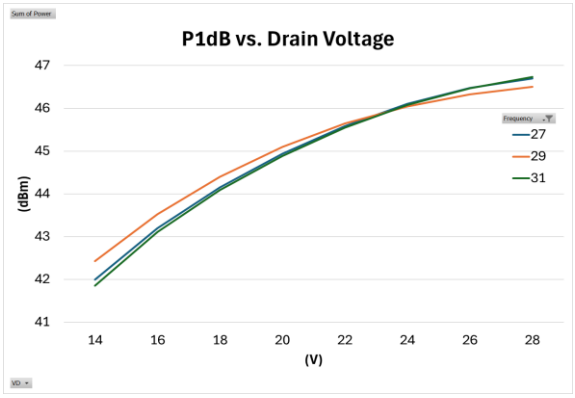


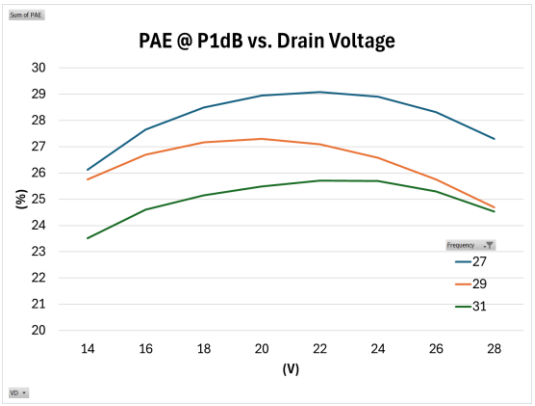


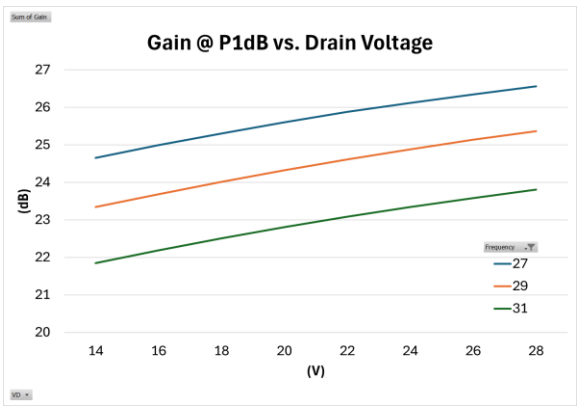


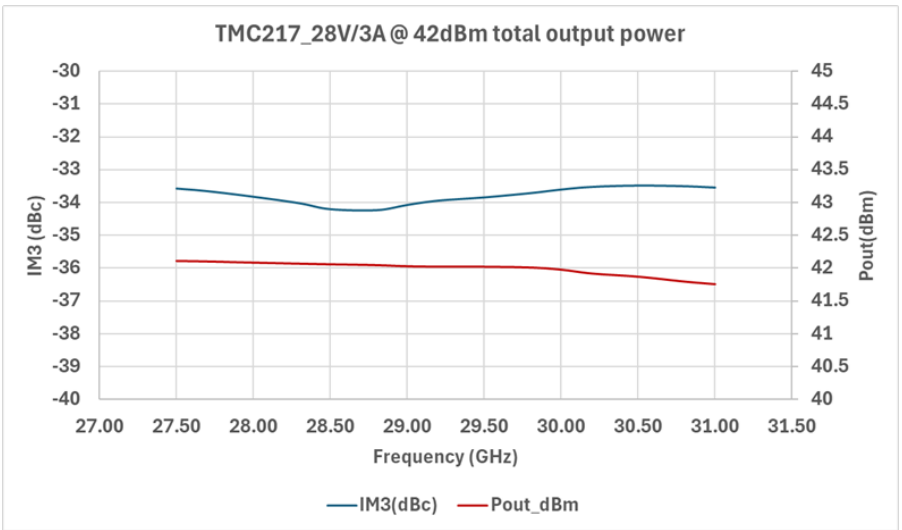
P1dB, PAE@P1dB, Gain vs. V_D charts

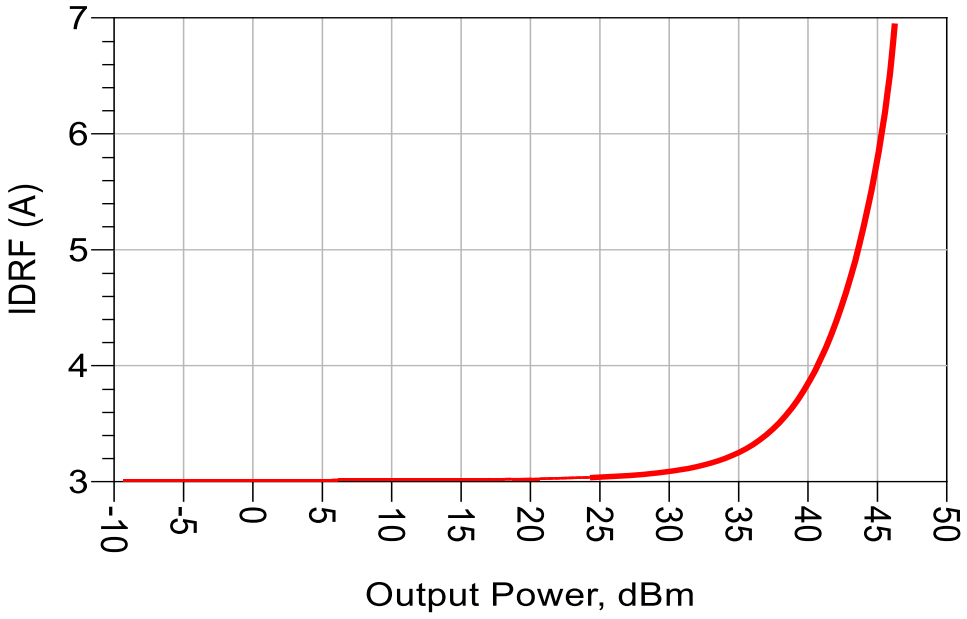


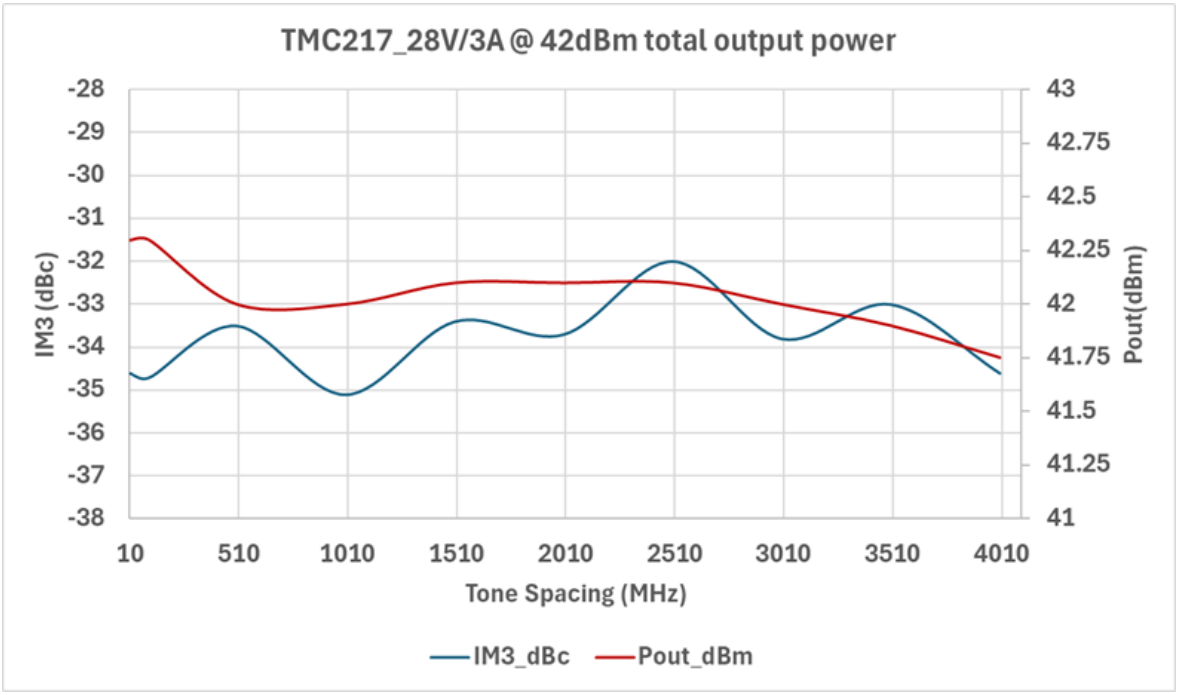




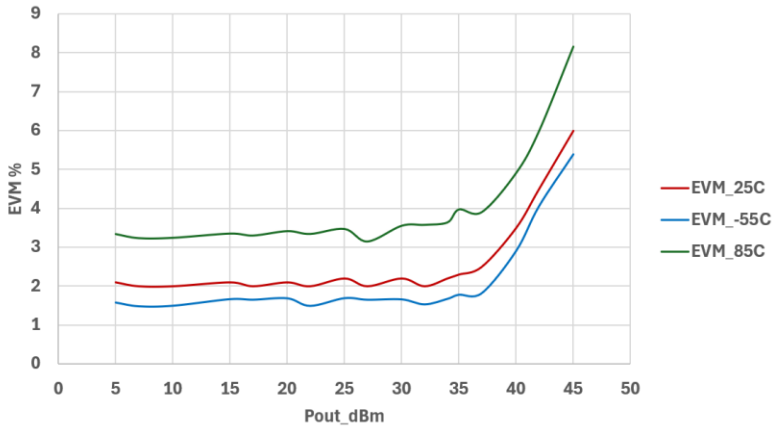


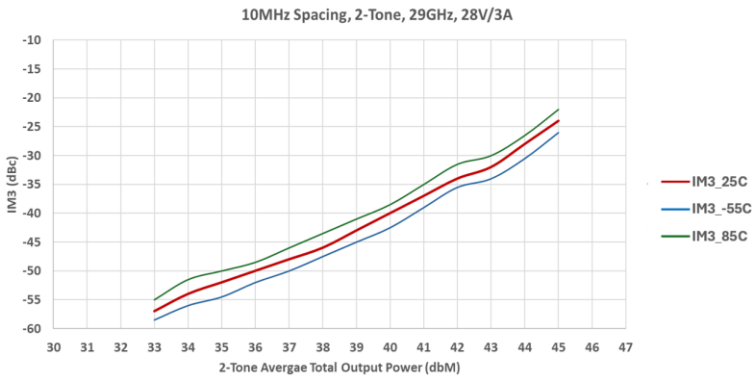



IDRF (A)
7
6
5
4
3
-10
-5
0
5
10
15
20
25
30
35
40
45
50
Output Power, dBm

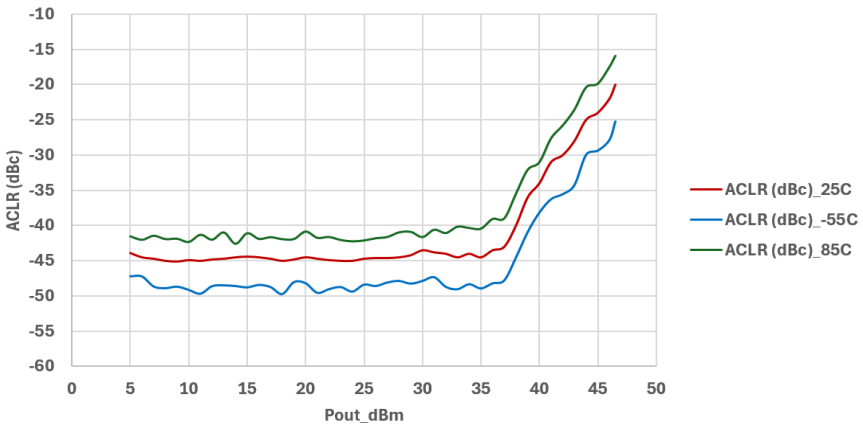

TMC217_28V/3A @ 42dBm total output power
IM3 (dBc)
-28
-29
-30
-31
-32
-33
-34
-35
-36
-37
-38
Pout(dBm)
43
42.75
42.5
42.25
42
41.75
41.5
41.25
41
10
510
1010
1510
2010
2510
3010
3510
4010
Tone Spacing (MHz)
IM3_dBc
Pout_dBm

EVM vs. P_{OUT} , 5GNR (29GHz)

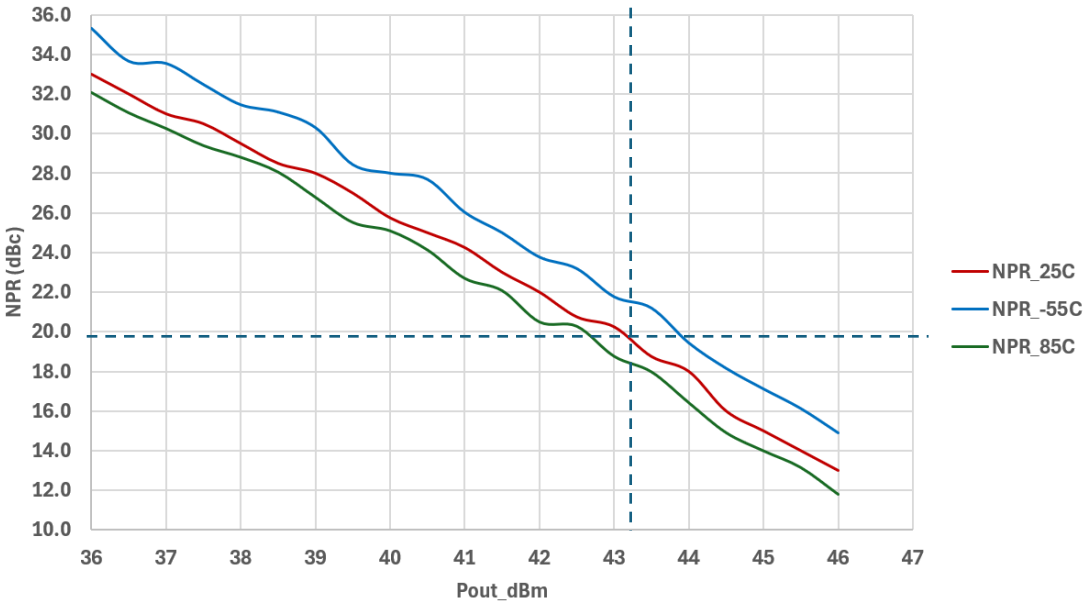


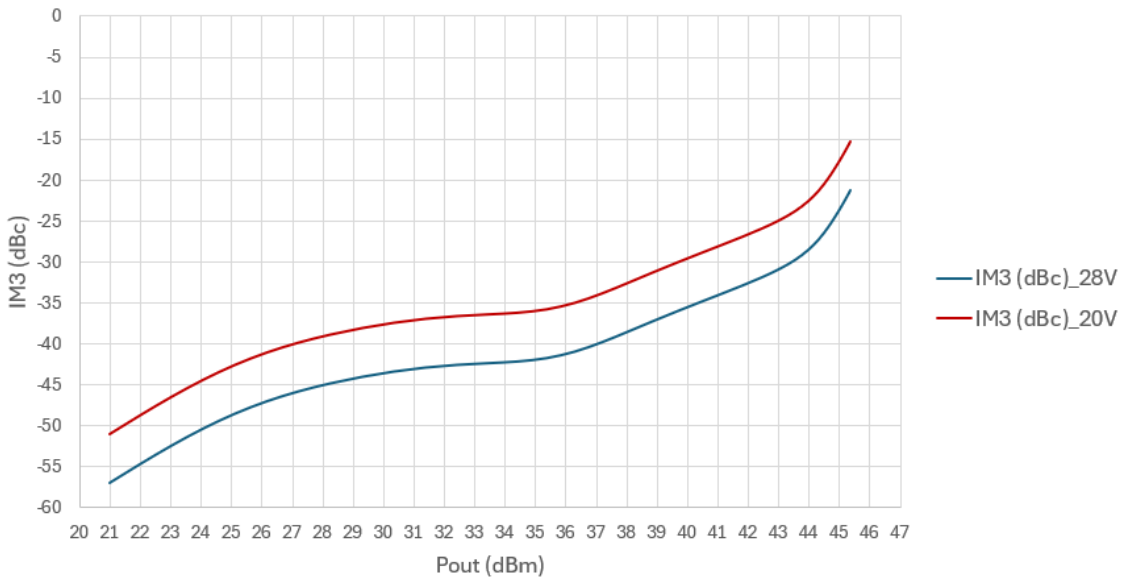


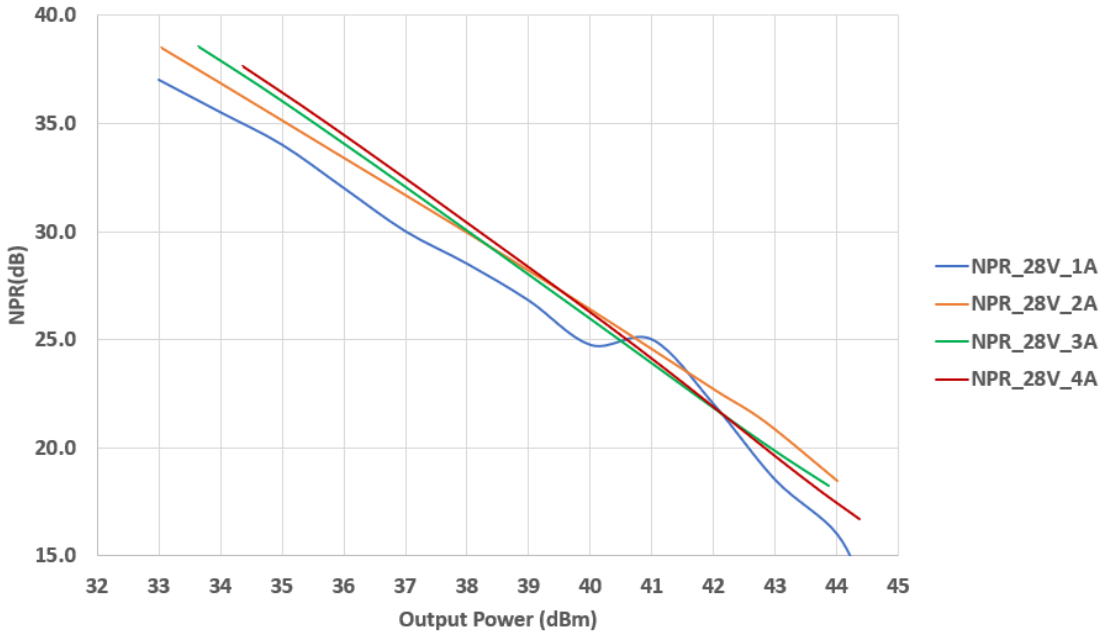
ACLR vs. P_{OUT} , 5GNR (29 GHz)

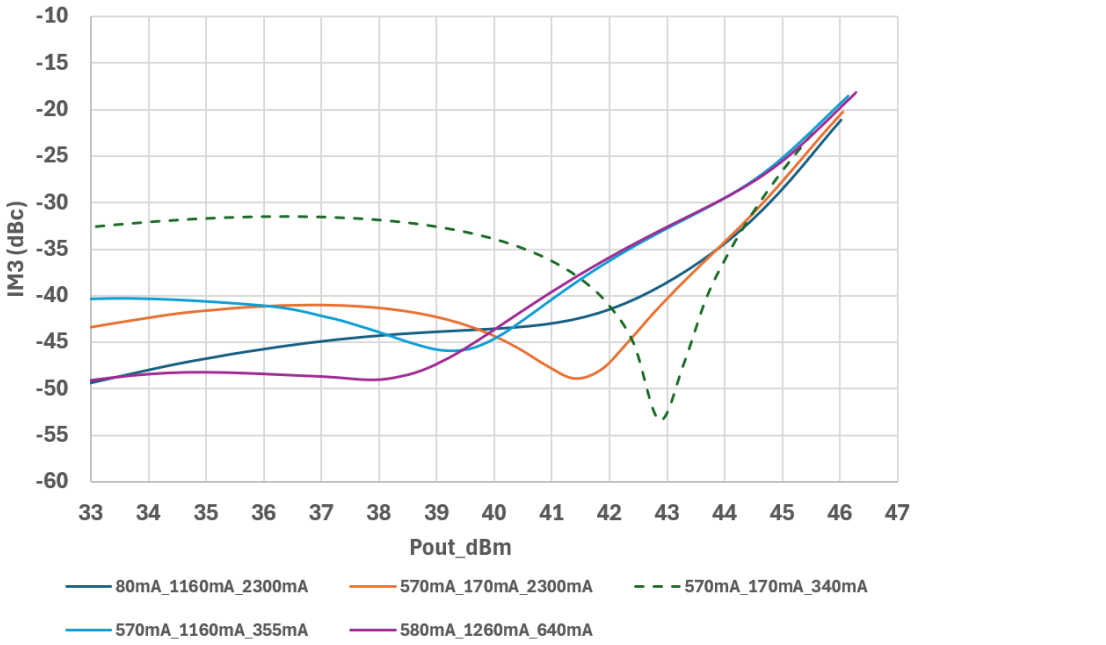


NPR (1GHz BW, 10% Notch) and IM3 charts, 29 GHz

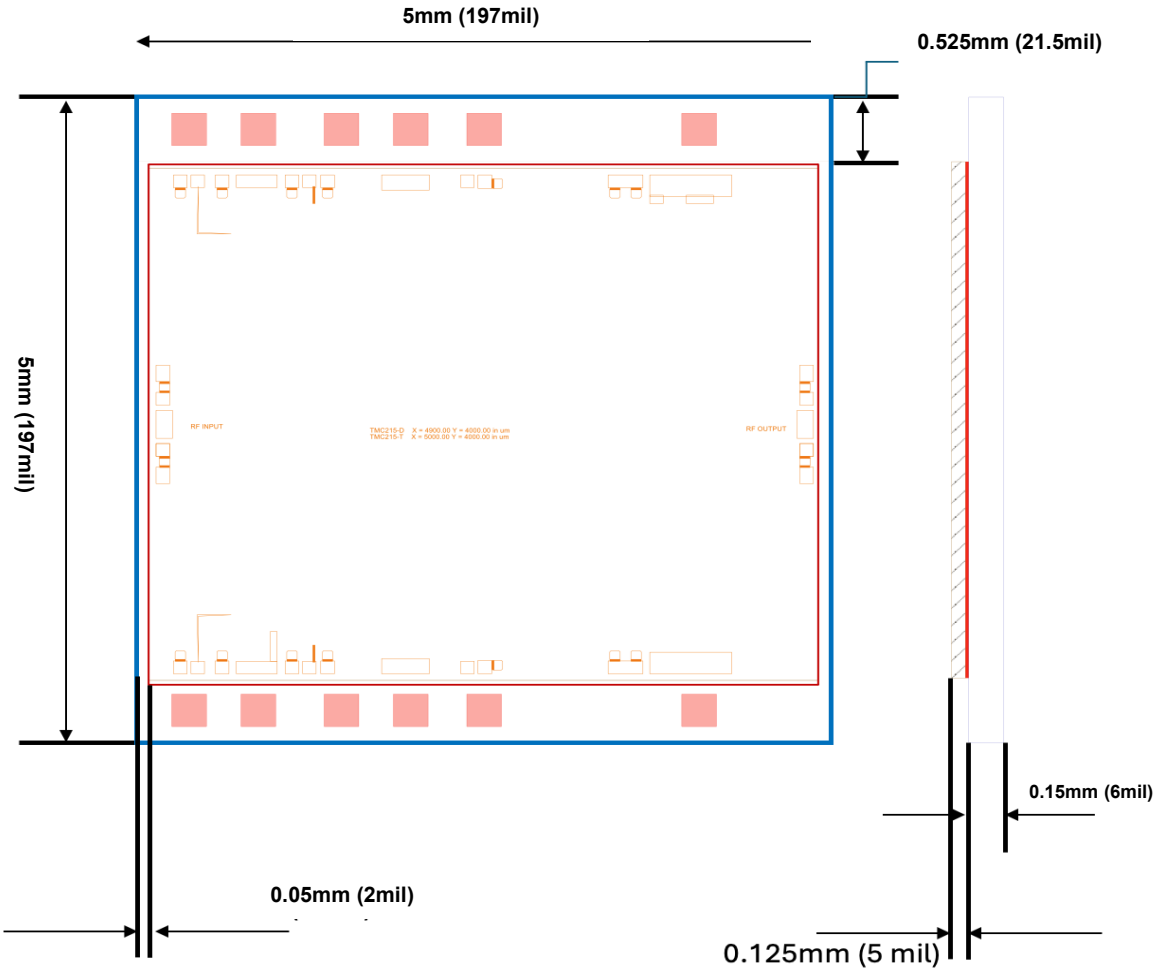





40.0
35.0
30.0
25.0
20.0
15.0
NPR(dB)
32
33
34
35
36
37
38
39
40
41
42
43
44
45
Output Power (dBm)
NPR_28V_1A
NPR_28V_2A
NPR_28V_3A
NPR_28V_4A


-10
-15
-20
-25
-30
-35
-40
-45
-50
-55
-60
IM3 (dBc)
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
Pout_dBm
80mA_1160mA_2300mA
570mA_170mA_2300mA
570mA_170mA_340mA
570mA_1160mA_355mA
580mA_1260mA_640mA

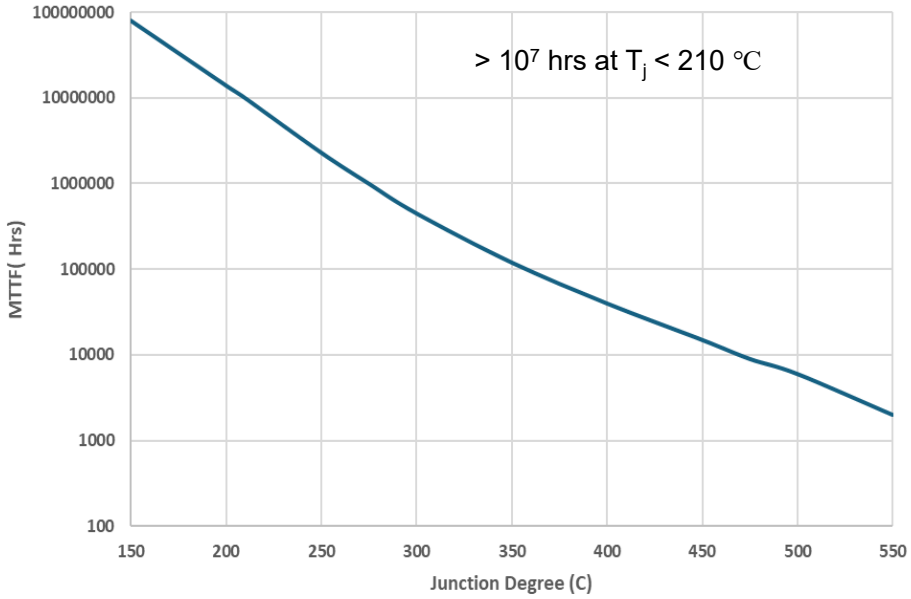
Die Attach Drawing



1. Dimensions are in mm(mil), +/- 1mil X-Y Tolerance
2. Three-sigma Placement Tolerance including AuSn reflow is +/- 3mil
2. Thermal spreader TAB material: CuMoCu
3. Plating: Ni/Gold
4. AuSn Vacuum die attach
5. AutoCAD drawings and PCB layout are available upon request

* Contact mmTron for further information

MTTF vs. Junction Temperature



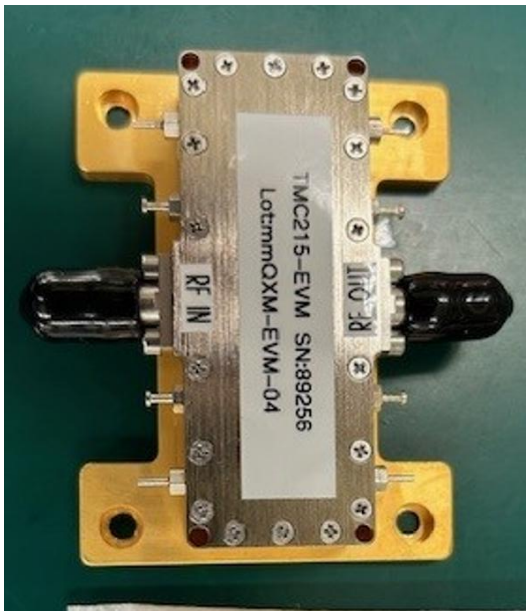
Thermal Profile and Power Derating

Parameter	Condition (Bare Die)	Value	Unit
Thermal Resistance	Pout=45.3dBm (34W), Frequency=27 GHz VDD=28 V, IDQ=3A → IDRF=4.86A	0.81	°C/W
Junction Temperature	$T_{backside}$=85 °C, P_{diss}=102 W	167.8	°C

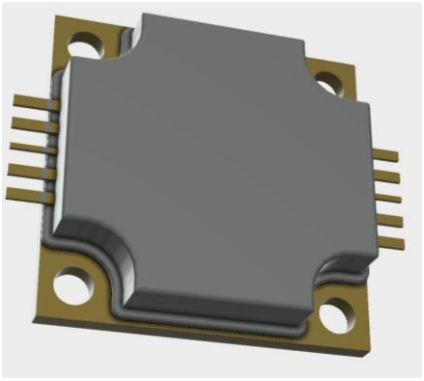
Parameter	Condition (Bare Die)	Value	Unit
Thermal Resistance	Pout=47.2dBm (52W), Frequency=27 GHz VDD=28 V, IDQ=3A → IDRF=6.69A	0.83	°C/W
Junction Temperature	$T_{backside}$=85 °C, P_{diss}=135.6 W	197.5	°C

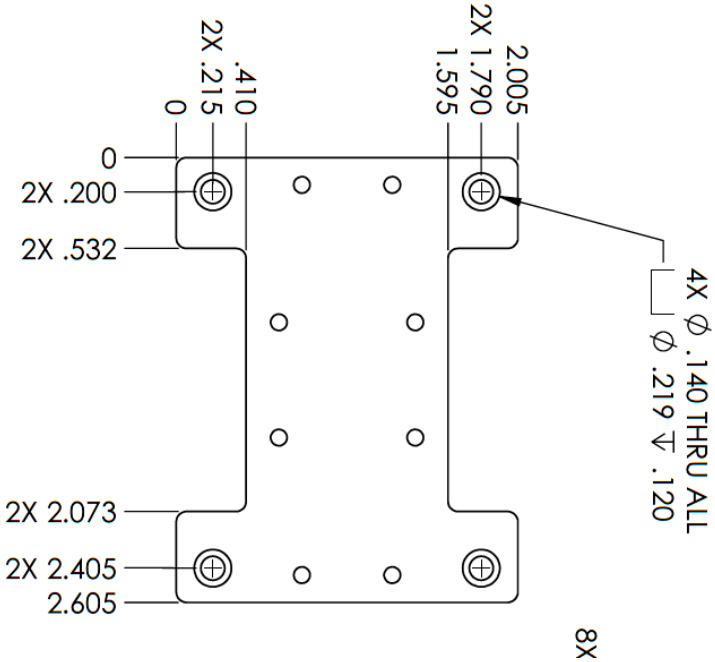
	Value	Unit
TMC217-D (Bare Die)	0.83	°C/W
TMC217-T (CuMoCu)	0.90	°C/W
TMC217-P15 (CuMoCu)	0.95	°C/W

TMC217-EVM Evaluation Module



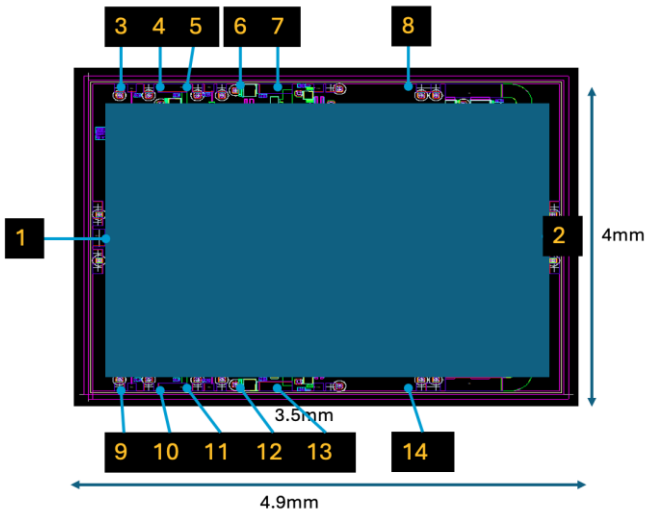
TMC217-P15*





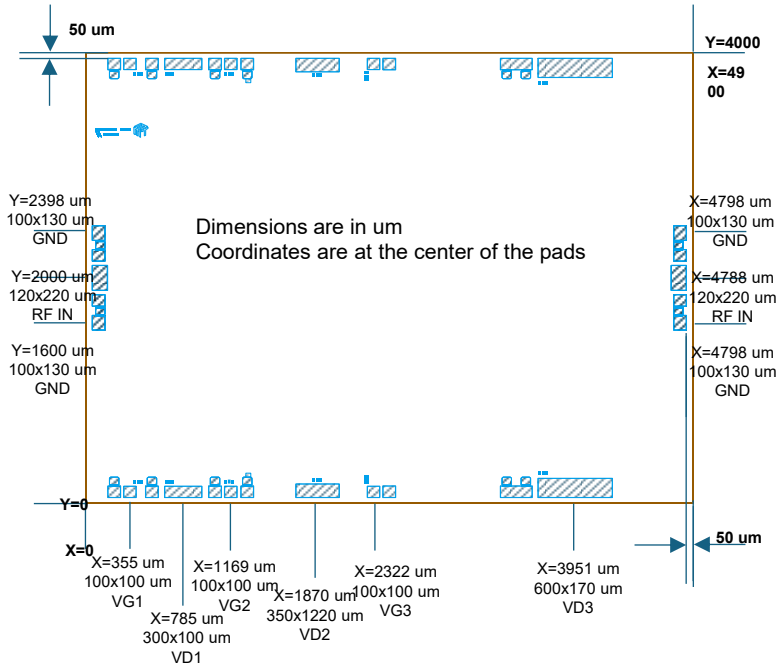
Heatsink top-side (mounting details):
Material is 0.160 +/- 0.002 thick made of copper.

Pad Location and Description

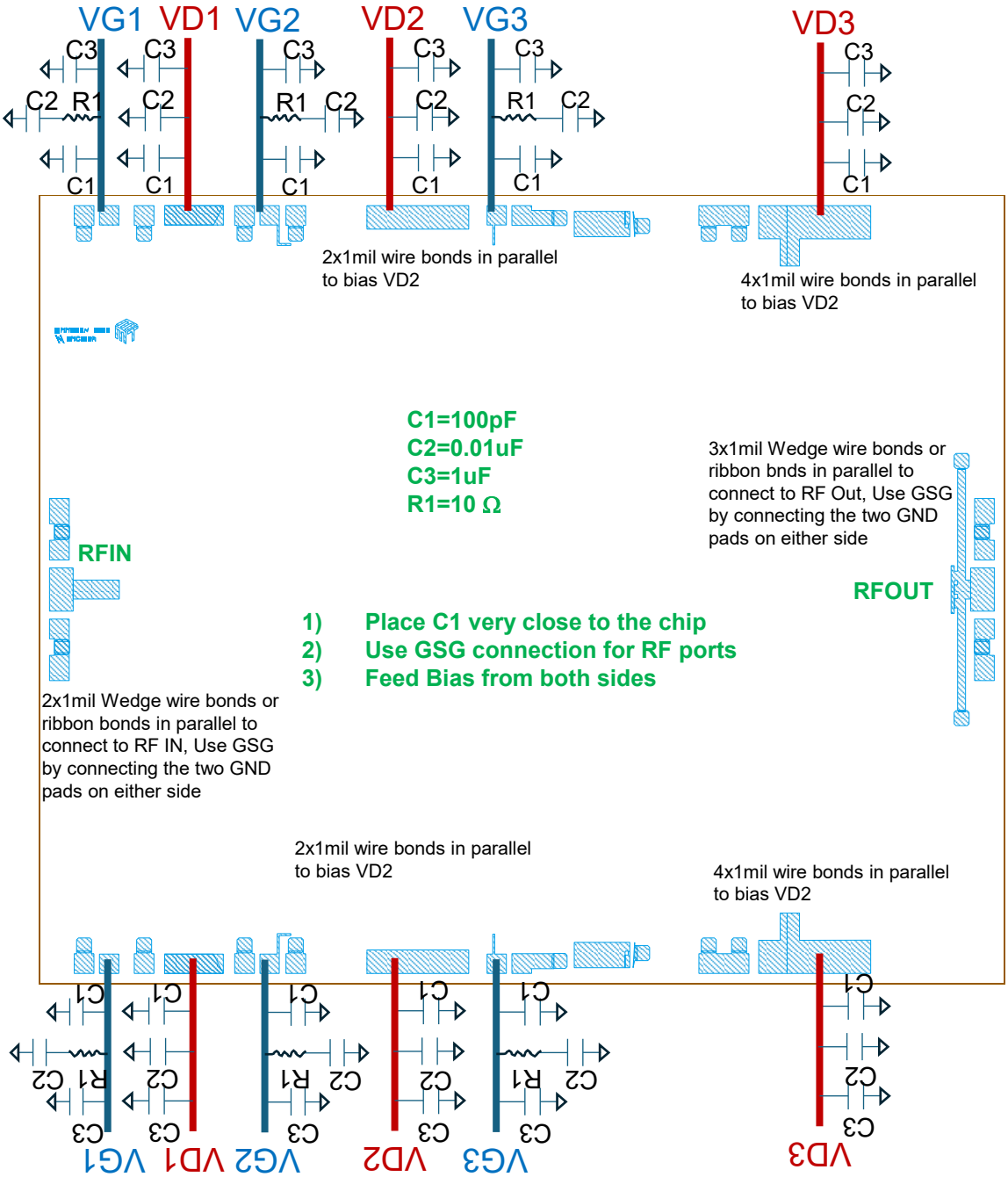


Pad #	Function
1	RFIN
2	RFOUT
3, 9	VG1
4, 10	VD1
5, 11	VG2
6, 12	VD2
7, 13	VG3
8, 14	VD3

Layout Drawing



Recommended Biasing



Recommended Biasing

The TMC217-D is operated with one positive supply VDD (VD1=VD2=VD3) and one negative supply VGG (VG1 = VG2 = VG3). The positive supply must be connected to the VD1, VD2 and VD3 pads on the die. The negative supply must be connected to the VG1, VG2 and VG3 pads on the die. VGG is biased to -6V first, then VDD is gradually biased to +28V and finally, VGG is adjusted to around -4V for ID_total = 3000mA DC current.

Reverse the sequence during power down, i.e. bring VGG to -6V, lower VDD to 0V, and then VGG to 0V.

Note that VG1, VG2 and VG3 can be separated and controlled independently in order to further improve linearity.

Assembly Techniques

The TMC217 is fabricated using a GaN-based semiconductor material structure and may be packaged in a flange-mount package or used as a die. The die is designed to allow either high conductivity epoxy or AuSn eutectic attach.

A High-Density Polysynthetic Silver Thermal Compound such as Arctic Silver® 5 can be used for thermal interface of the package to the housing floor.



Electrostatic Discharge Caution

This integrated circuit can be damaged by ESD. mmTron Inc. recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage. ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications. III-V MMICs are ESD-sensitive. Preventative ESD measures must be employed in all aspects of storage, handling, and assembly. MMIC ESD precautions, handling considerations, and die-attach and bonding methods are critical factors in successful III-V MMIC performance and reliability.



RoHS Compliant

This part is RoHS compliant, meeting the requirements of the EU Restriction of Hazardous Substances Directive 2002/95/EC, commonly known as RoHS. Six substances are regulated: lead, mercury, cadmium, chromium VI (hexavalent chromium), polybrominated biphenyls (PBB), and polybrominated biphenyl ethers (PBDE). RoHS compliance requires that any residual concentration of these substances is below the Directive's maximum concentration values (MCV): cadmium 100ppm by weight and all others 1000ppm by weight.

Disclaimer and Warranty Statement

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