Features

- MACOM PURE CARBIDE® Amplifier Series
- Suitable for Linear & Saturated Applications
- CW & Pulsed Operation
- 50 Ω Input Matched
- 260°C Reflow Compatible
- 28 V Operation
- 100% RF Tested

4 x 4 mm QFN

Applications

- General purpose narrowband to broadband applications in test and measurement, defense communications, land mobile radio and wireless infrastructure.

Description

The MAPC-A1008 is an integrated GaN on SiC power amplifier optimized for 20 - 2700 MHz operation. This amplifier has been designed for saturated and linear operation with output levels to 5 W (37 dBm) assembled in a lead-free 4 x 4 mm 24-lead QFN plastic package.

Typical Circuit Performance:

- V_{DS} = 28 V, I_{DQ} = 90 mA, T_C = 25°C. Measured in sample board circuit under CW operation. Data presented below is at constant P_{OUT} = 37 dBm.

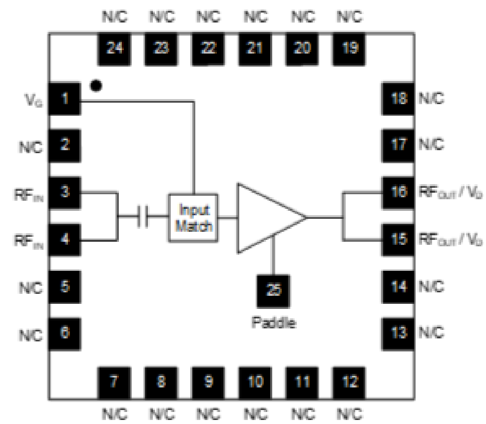
Frequency (MHz)	G_P (dB)	h_D (%)	IRL (dB)
100	13.0	55	-14.2
500	12.0	50	-11.4
900	11.5	47	-10.1
1500	12.0	43	-13.2
1900	14.2	51	-7.7
2400	13.9	47	-7.9
2700	14.1	53	-14.7

Ordering Information[1,2]

Part Number	Package
MAPC-A1008-AQ000	Bulk Quantity
MAPC-A1008-AQTR1	Tape and Reel, 1000 pcs
MAPC-A1008-AQSB1	Sample Board

1. Reference Application Note M513 for reel size information.
2. All sample boards include 5 loose parts.

Functional Schematic



Pin Configuration[3]

Pin #	Pin Name	Function
1	V_G	Gate - DC Bias
2	N/C[1]	No Connection
3,4	RF_{IN}	RF Input
5-14	N/C[1]	No Connection
15,16	RF_{OUT} / V_D	RF Output / Drain
17-24	N/C[1]	No Connection
25	Paddle[4]	Ground / Source

3. MACOM recommends connecting unused package pins to ground.
4. The exposed pad centered on the package bottom must be connected to RF, DC and thermal ground.

* Restrictions on Hazardous Substances, compliant to current RoHS EU directive.

RF Electrical Characteristics: T_C = 25 °C, V_{DS} = 28 V, I_{DQ} = 90 mA
Note: Performance in MACOM Evaluation Test Fixture, 50 Ω system

Parameter	Test Conditions	Symbol	Min.	Typ.	Max.	Units
Small Signal Gain	CW, 2500 MHz	G_{SS}	-	16.4	-	dB
Saturated Power Gain	CW, 2500 MHz	G_{SAT}	-	11.1	-	dB
Saturated Drain Efficiency	CW, 2500 MHz	η_{SAT}	-	64	-	%
Saturated Output Power	CW, 2500 MHz	P_{SAT}	-	40	-	dBm
Gain Variation (-40°C to +85°C)	CW, 2500 MHz, P_{OUT} = 37dBm	ΔG	-	0.02	-	dB/°C
Power Gain	CW, 2500 MHz, P_{OUT} = 37 dBm	G_P	-	14.1	-	dB
Drain Efficiency	CW, 2500 MHz, P_{OUT} = 37 dBm	η	-	47.3	-	%
Input Return Loss	CW, 2500 MHz, P_{OUT} = 37 dBm	IRL	-	-10.5	-	dB
Ruggedness: Output Mismatch	All phase angles	Ψ	VSWR = 15:1, No Damage			

RF Electrical Specifications: T_A = 25°C, V_{DS} = 28 V, I_{DQ} = 90 mA
Note: Performance in MACOM Production Test Fixture, 50 Ω system

Parameter	Test Conditions	Symbol	Min.	Typ.	Max.	Units
Power Gain	CW, 2500 MHz, P_{OUT} = 37 dBm	G_P	13.5	14.2	-	dB
Saturated Drain Efficiency	CW, 2500 MHz, P_{OUT} = 37 dBm	η_P	45	48	-	%

DC Electrical Characteristics: T_A = 25 °C

Parameter	Test Conditions	Symbol	Min.	Typ.	Max.	Units
Drain-Source Leakage Current	V_{GS} = -8 V, V_{DS} = 100 V	I_{DLK}	-	-	2.16	mA
Gate-Source Leakage Current	V_{GS} = -8 V, V_{DS} = 100 V	I_{GLK}	-0.5	-	-	mA
Gate Threshold Voltage	V_{DS} = 28 V, I_D = 2.16 mA	V_T	-3.0	-2.7	-2.0	V
Gate Quiescent Voltage	V_{DS} = 28 V, I_D = 90 mA	V_{GSQ}	-	-2.3	-	V

Absolute Maximum Ratings[5,6,7,8,9]

Parameter	Absolute Maximum
Drain Source Voltage, V_{DS}	120 V
Gate Source Voltage, V_{GS}	-10 to 2 V
Gate Current, I_G	2.16 mA
Storage Temperature Range	-65°C to +150°C
Case Operating Temperature Range	-40°C to +85°C
Channel Operating Temperature Range, T_{CH}	-40°C to +225°C

5. Exceeding any one or combination of these limits may cause permanent damage to this device.
6. MACOM does not recommend sustained operation above maximum operating conditions.
7. Operating at drain source voltage V_{DS} < 28 V will ensure MTTF > 1×10^6 hours.
8. Operating at nominal conditions with $T_{CH} \leq 225°C$ will ensure MTTF > 1×10^6 hours.
9. MTTF may be estimated by the expression MTTF (hours) = A $e^{[B + C/(T+273)]}$ where *T* is the channel temperature in degrees Celsius., *A* = TBD, *B* = TBD, and *C* = TBD.

Thermal Characteristics[10]

Parameter	Test Conditions	Symbol	Typical	Units
Thermal Resistance using Finite Element Analysis	V_{DS} = 28 V T_C = 85°C, T_{CH} = 225°C	R_θ(FEA)	TBD	°C/W
Thermal Resistance using Infrared Measurement of Die Surface Temperature	V_{DS} = 28 V T_C = 85°C, T_{CH} = 225°C	R_θ(IR)	TBD	°C/W

10. Case temperature measured using thermocouple embedded in heat-sink. Contact local applications support team for more details on this measurement.

Handling Procedures

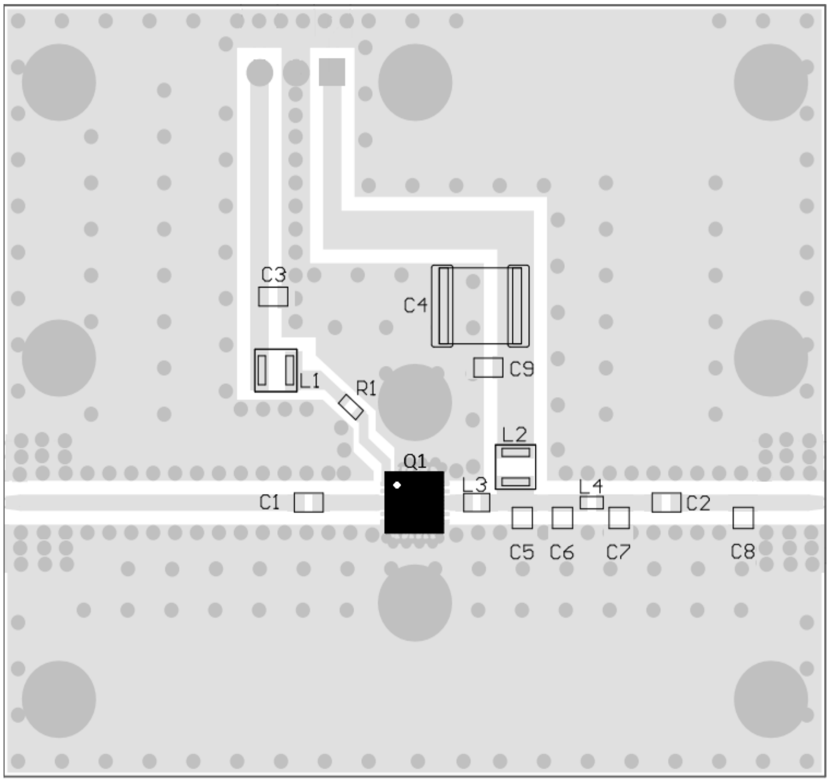
Please observe the following precautions to avoid damage:

Static Sensitivity

These electronic devices are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling these devices.

Evaluation Board and Recommended Tuning Solution

20 - 2700 MHz Broadband Circuit

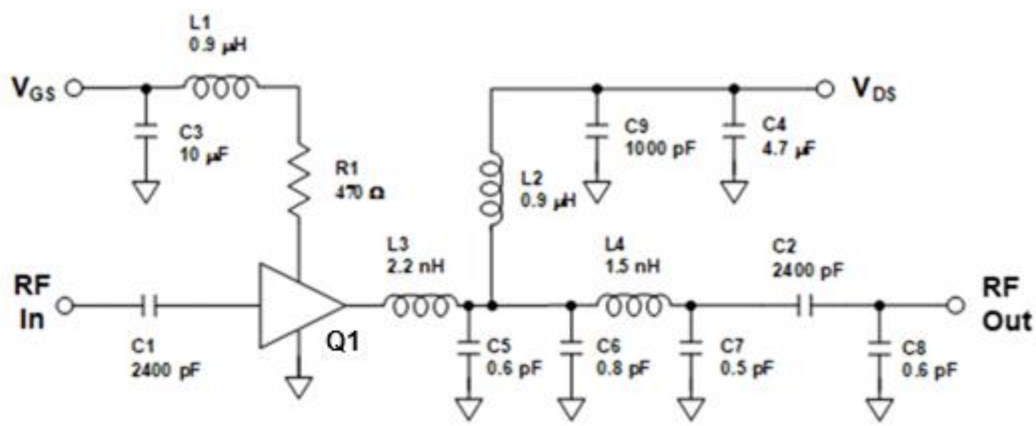


Parts list

Reference	Value	Tolerance	Manufacturer	Part Number
C1, C2	2400 pF	-	Dielectric Labs, Inc.	C08BL242X-5UN-X0
C3	10 µF	10%	TDK	C2012XR1C106M085AC
C4	4.7 µF	10%	TDK	C5750X7R2A475K230KA
C5, C8	0.6 pF	0.1 pF	ATC	800A0R6BT250X
C6	0.8 pF	0.1 pF	ATC	800A0R8BT250X
C7	0.5 pF	0.1 pF	ATC	800A0R5BT250X
C9	1000 pF	10%	Kemet	C0805C102K1RACTU
R1	470 Ω	10%	Panasonic	ERJ-P03F4700V
L1, L2	0.9 µH	10%	Coilcraft	1008AF-901XJLC
L3	2.2 nH	±0.2 nH	AVX	L08052R2CEW
L4	1.5 nH	±0.2 nH	AVX	L06031R5CGS
PCB	Rogers RO4350, e_r=3.5, 0.020”			

Evaluation Board and Recommended Tuning Solution

20 - 2700 MHz Broadband Circuit



Description

Parts measured on evaluation board (20-mil thick RO4350). The PCB's electrical and thermal ground is provided using a standard-plated densely packed via hole array (see recommended via pattern).

Matching is provided using a combination of lumped elements and transmission lines as shown in the simplified schematic above. Recommended tuning solution component placement, transmission lines, and details are shown on the next page.

Bias Sequencing

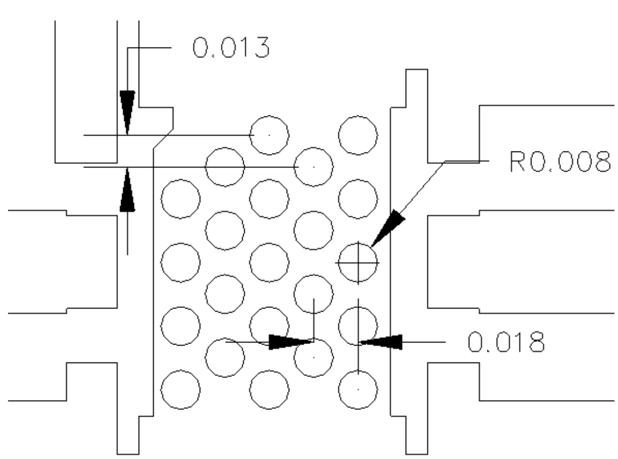
Turning the device ON

1. Set V_{GS} to the pinch-off (V_P), typically -5 V.
2. Turn on V_{DS} to nominal voltage (28 V).
3. Increase V_{GS} until the I_{DS} current is reached.
4. Apply RF power to desired level.

Turning the device OFF

1. Turn the RF power off.
2. Decrease V_{GS} down to V_P.
3. Decrease V_{DS} down to 0 V.
4. Turn off V_{GS}.

Recommended Via Pattern (All dimensions shown as inches)

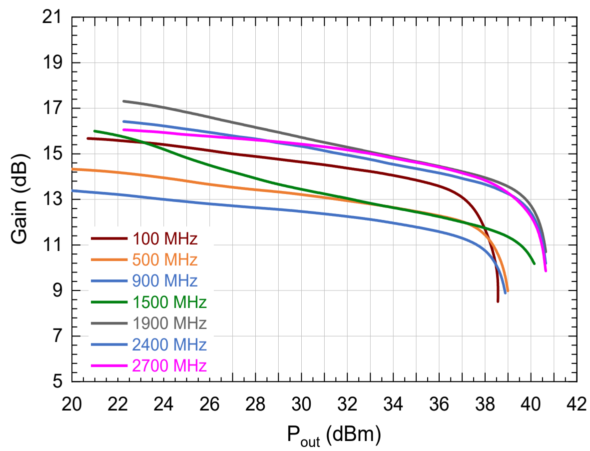


Typical Performance Curves as Measured in the Broadband Evaluation Test Fixture

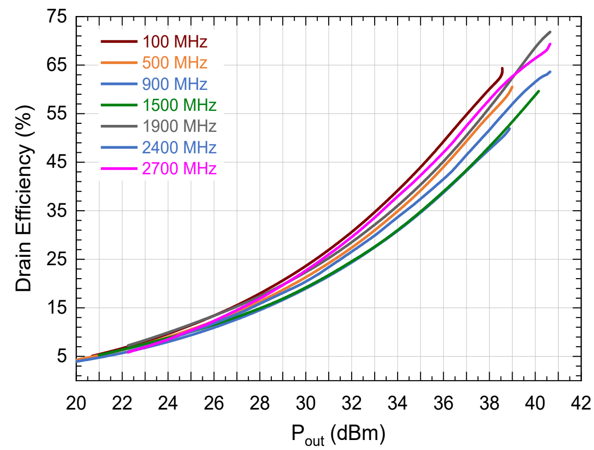
CW, V_{DS} = 28 V, I_{DQ} = 90 mA, Freq = 2500 MHz, T_C = 25°C (Unless Otherwise Noted)

For Engineering Evaluation Only – This data does not Modify MACOM's Datasheet Limits.

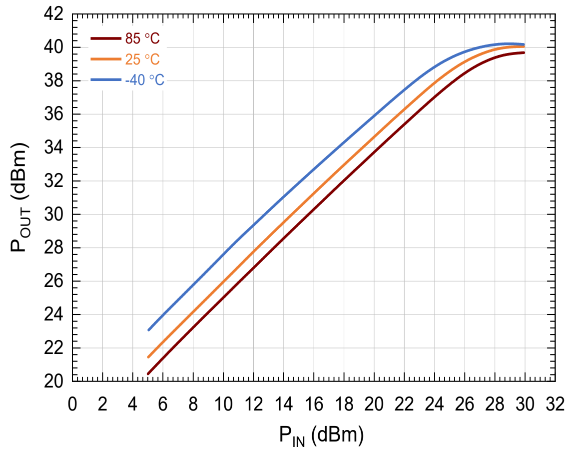
Gain vs. Output Power and Frequency



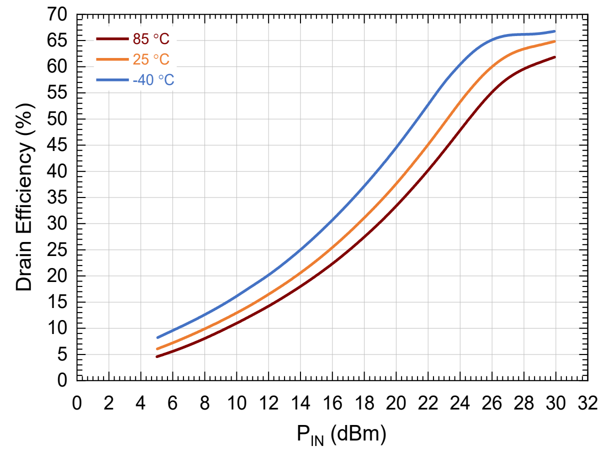
Drain Efficiency vs. Output Power and Frequency



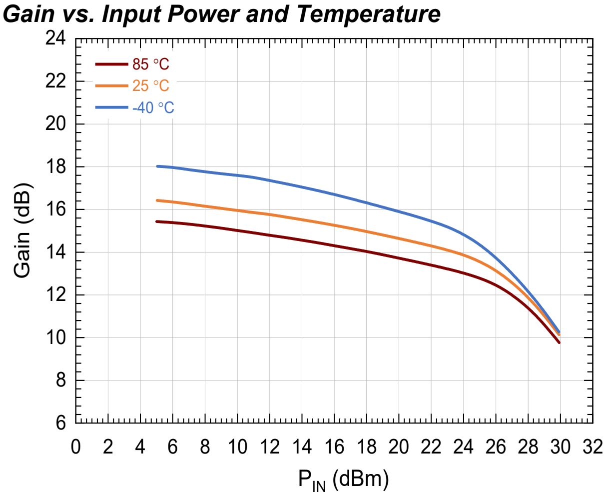
Output Power vs. Input Power and Temperature



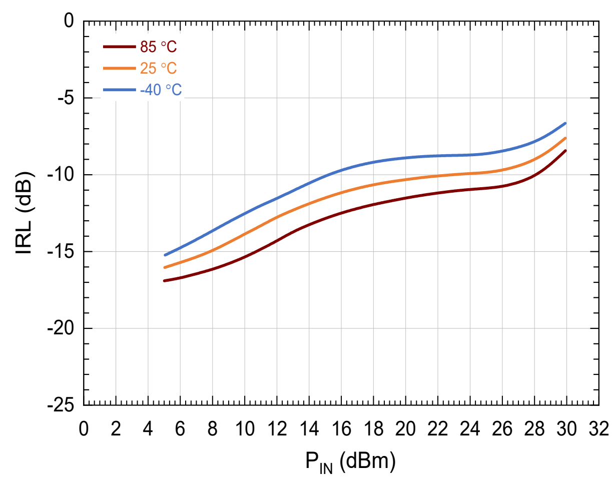
Drain Efficiency vs. Input Power and temperature



Gain vs. Input Power and Temperature



IRL vs. Input Power and temperature



Typical Performance Curves as Measured in the Broadband Evaluation Test Fixture

CW, P_{OUT} = 37 dBm, V_{DS} = 28 V, I_{DQ} = 90 mA, T_C = 25°C (Unless Otherwise Noted)

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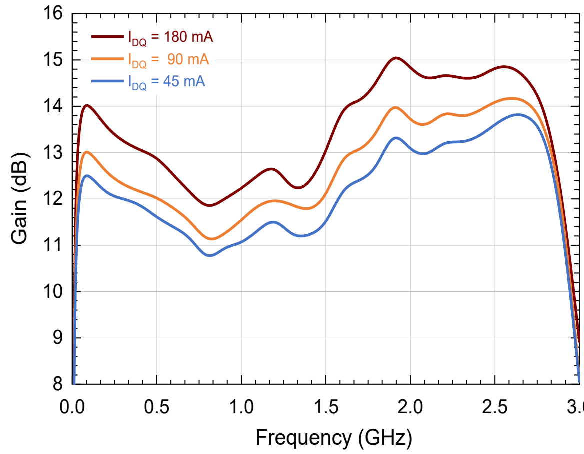
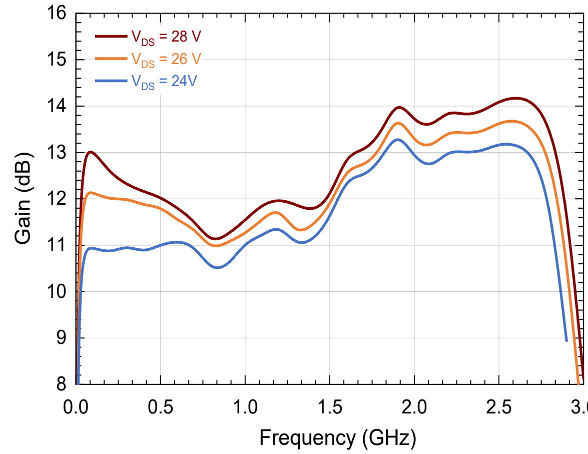
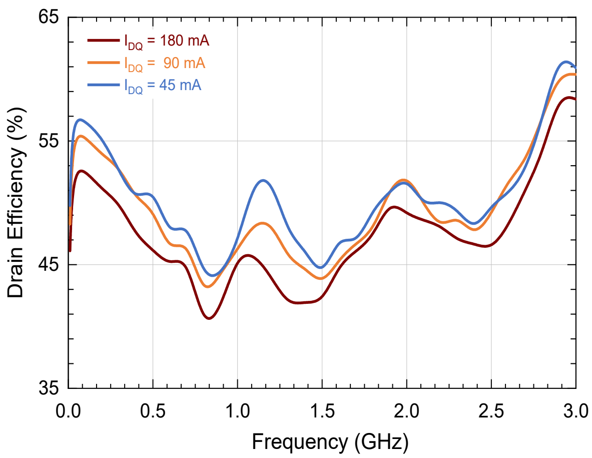
Gain vs. Frequency and I_{DQ}



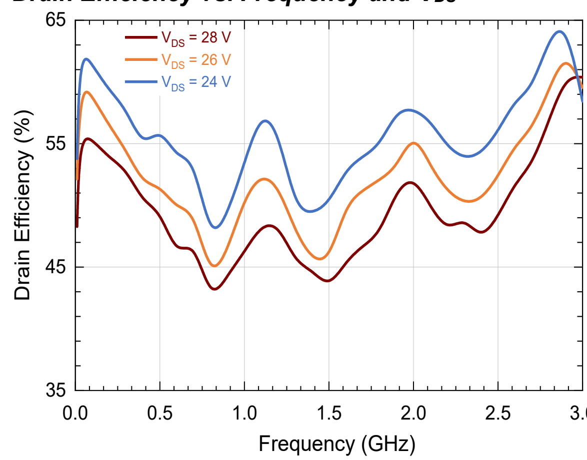
Gain vs. Frequency and V_{DS}



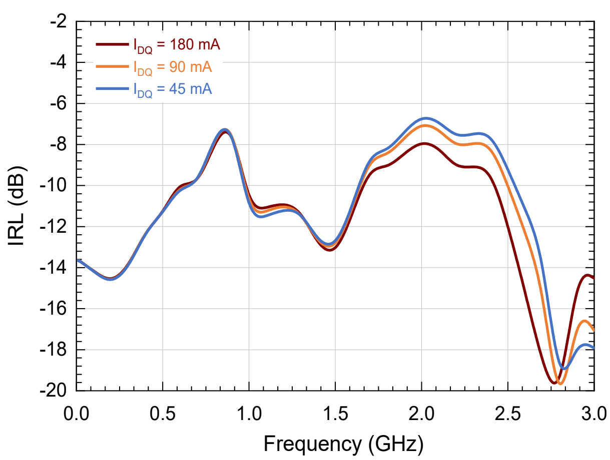
Drain Efficiency vs. Frequency and I_{DQ}



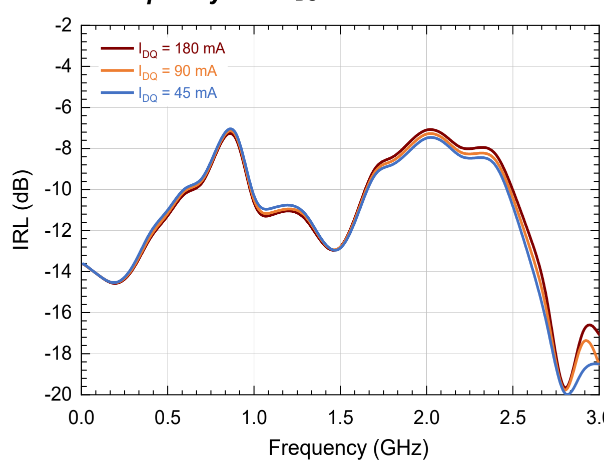
Drain Efficiency vs. Frequency and V_{DS}



IRL vs. Frequency and I_{DQ}



IRL vs. Frequency and V_{DS}



Typical Performance Curves as Measured in the Broadband Evaluation Test Fixture

CW, P_{OUT} = 37 dBm, V_{DS} = 28 V, I_{DQ} = 90 mA, T_C = 25°C (Unless Otherwise Noted)

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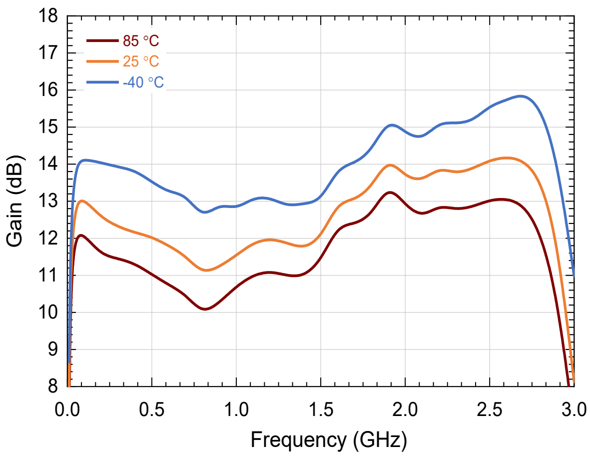
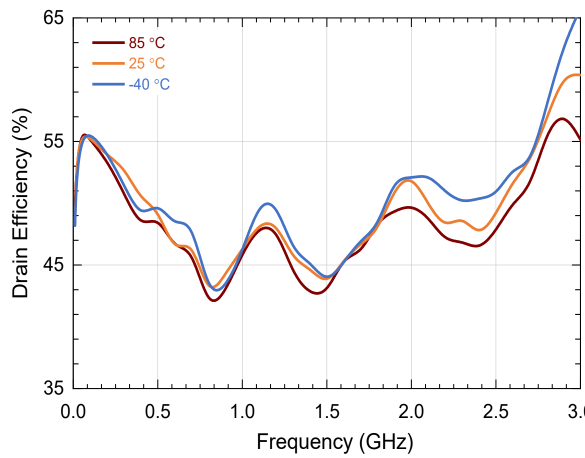
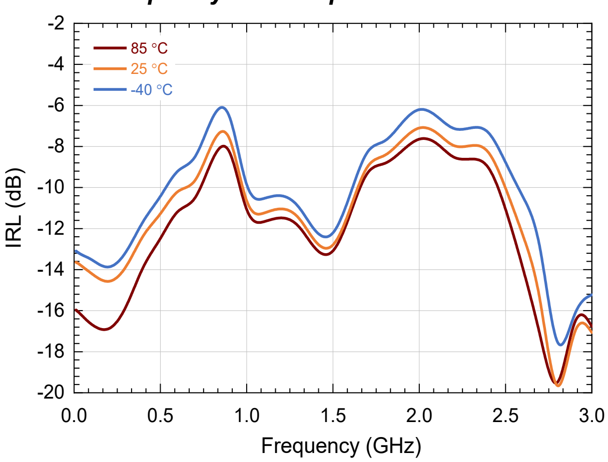
Gain vs. Frequency and Temperature



Drain Efficiency vs. Frequency and Temperature



IRL vs. Frequency and Temperature

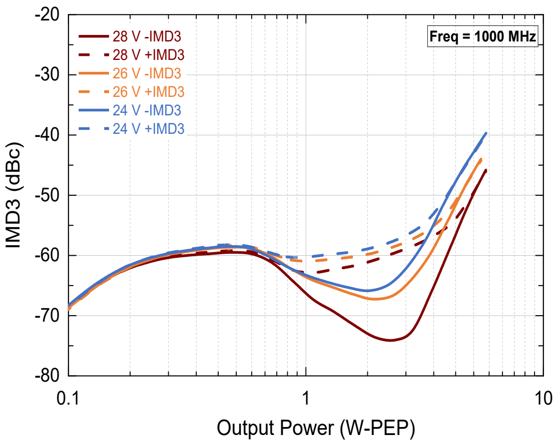


Typical Performance Curves as Measured in the Broadband Evaluation Test Fixture:

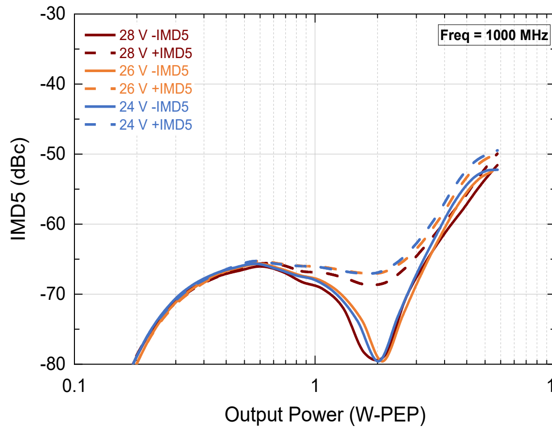
CW, Two Tone, ΔF = 1 MHz, V_{DS} = 28 V, I_{DQ} = 90 mA, T_C = 25°C (Unless Otherwise Noted)

For Engineering Evaluation Only - This data does not Modify MACOM's Datasheet Limits.

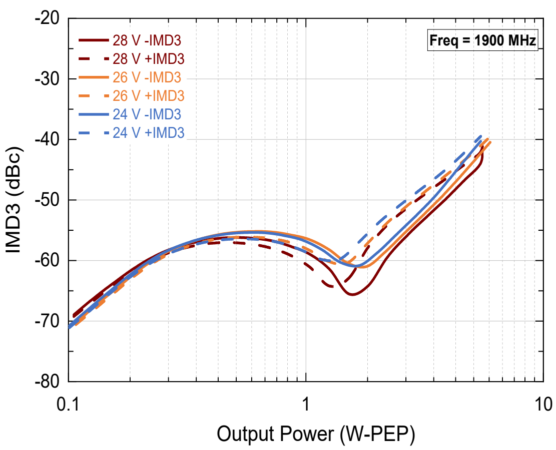
IMD3 vs. Output Power(W-PEP) and V_{DS}



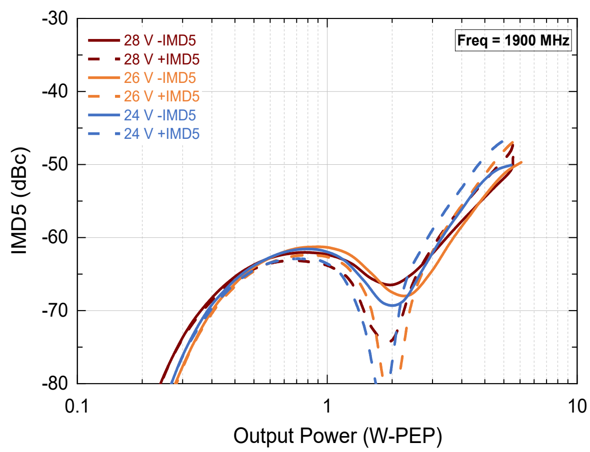
IMD5 vs. Output Power(W-PEP) and V_{DS}



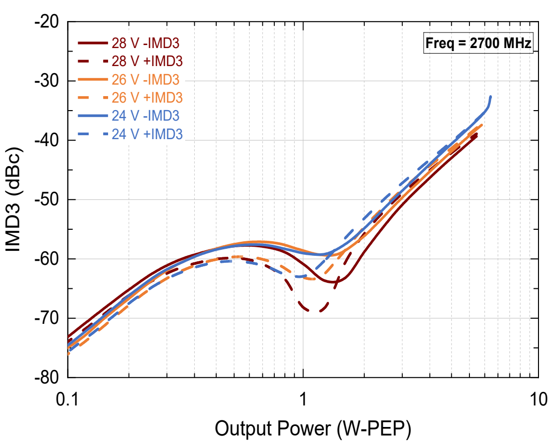
IMD3 vs. Output Power(W-PEP) and V_{DS}



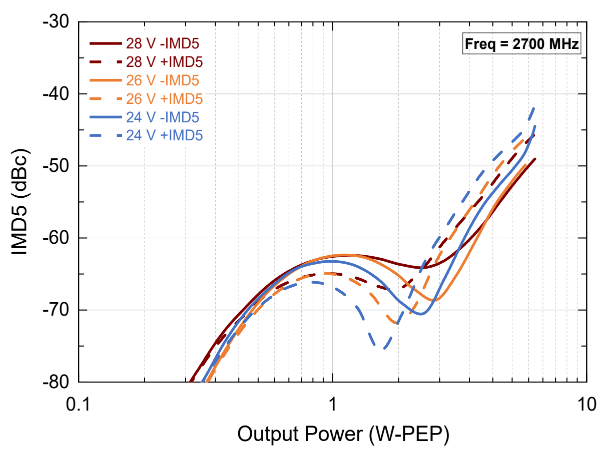
IMD5 vs. Output Power(W-PEP) and V_{DS}



IMD3 vs. Output Power(W-PEP) and V_{DS}



IMD5 vs. Output Power(W-PEP) and V_{DS}



Typical Performance Curves as Measured in the Broadband Evaluation Test Fixture:

CW, Two Tone, ∆F = 1 MHz, V_{DS} = 28 V, I_{DQ} = 90 mA, T_C = 25°C (Unless Otherwise Noted)
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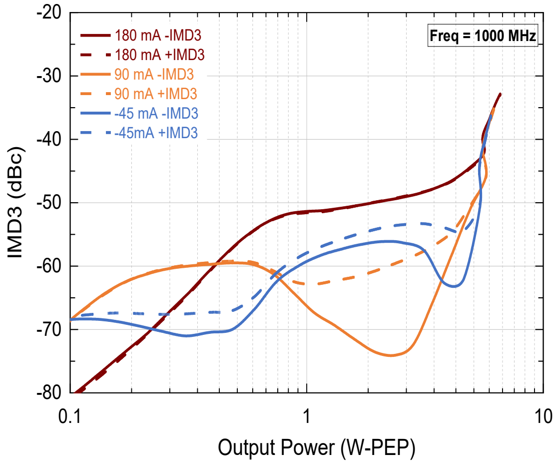
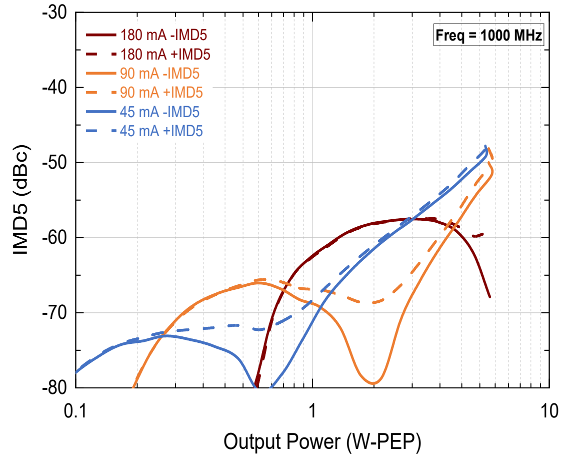
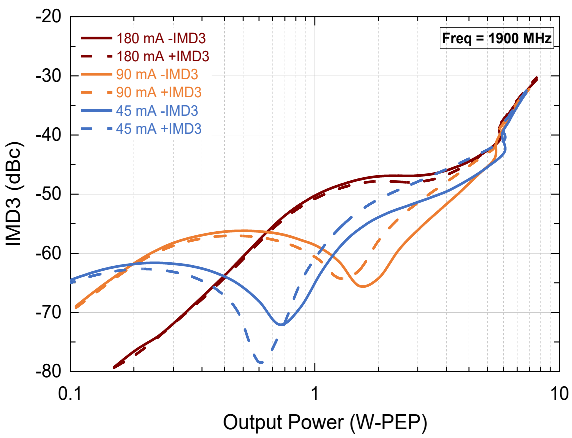
IMD3 vs. Output Power(W-PEP) and I_{DQ}



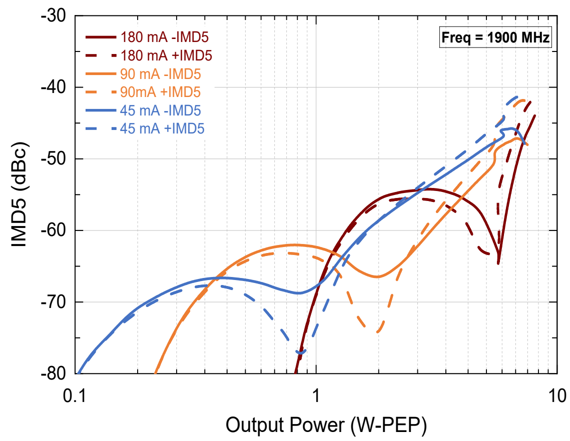
IMD5 vs. Output Power(W-PEP) and I_{DQ}



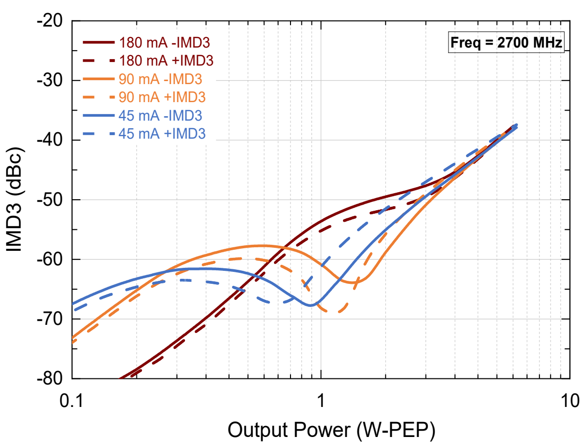
IMD3 vs. Output Power(W-PEP) and I_{DQ}



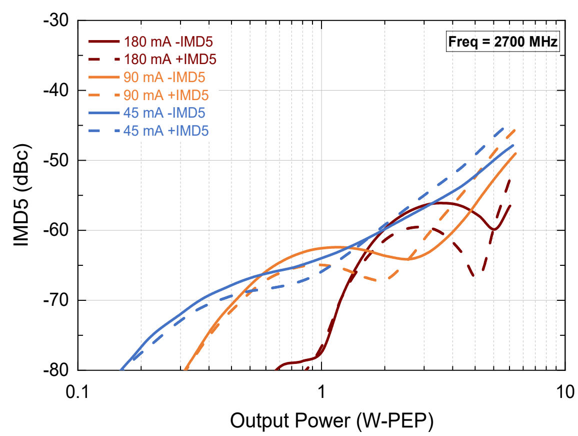
IMD5 vs. Output Power(W-PEP) and I_{DQ}



IMD3 vs. Output Power(W-PEP) and I_{DQ}



IMD5 vs. Output Power(W-PEP) and I_{DQ}



Typical Performance Curves as Measured in the Broadband Evaluation Test Fixture:
CW, Two Tone, ∆F = 1 MHz, V_{DS} = 28 V, I_{DQ} = 90 mA, T_C = 25°C (Unless Otherwise Noted)
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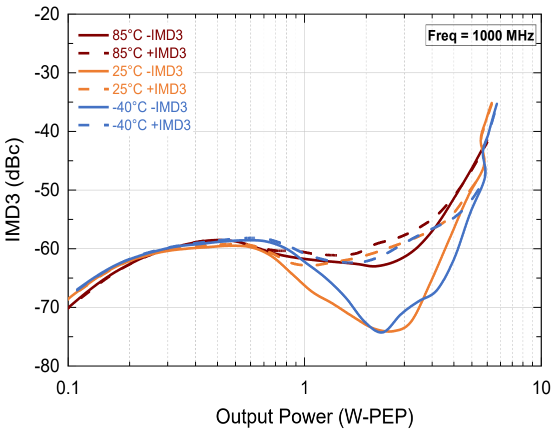
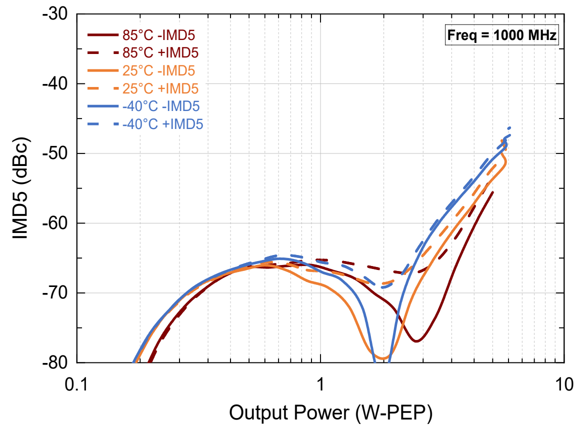
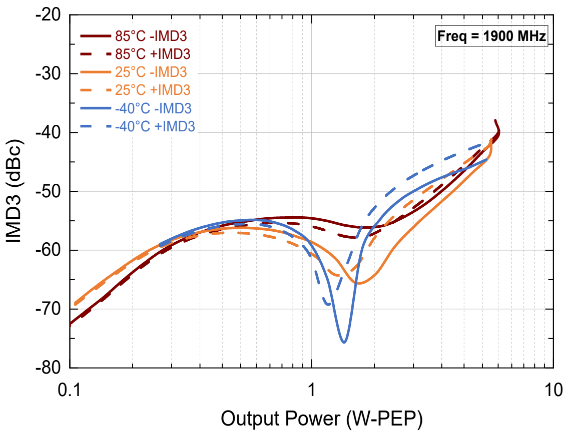
IMD3 vs. Output Power(W-PEP) and Temperature



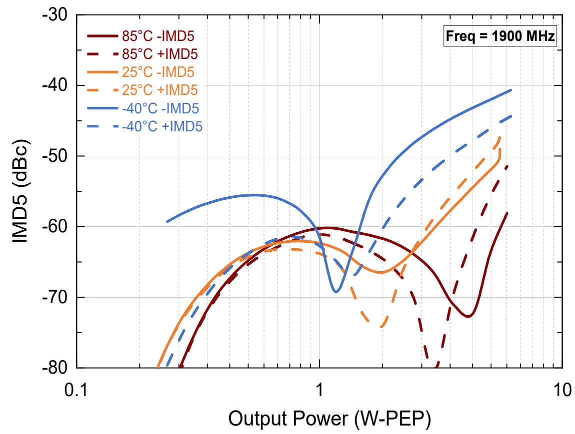
IMD5 vs. Output Power(W-PEP) and Temperature



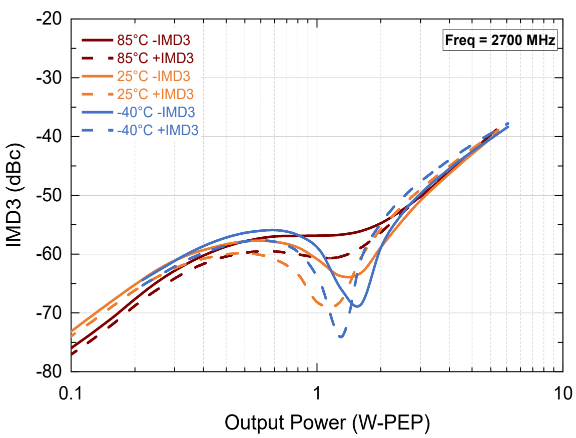
IMD3 vs. Output Power(W-PEP) and Temperature



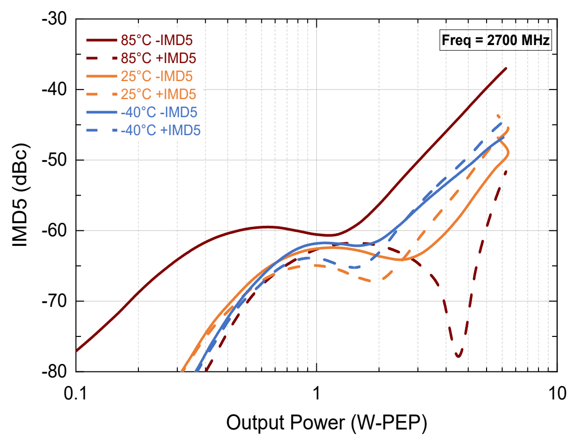
IMD5 vs. Output Power(W-PEP) and Temperature



IMD3 vs. Output Power(W-PEP) and Temperature



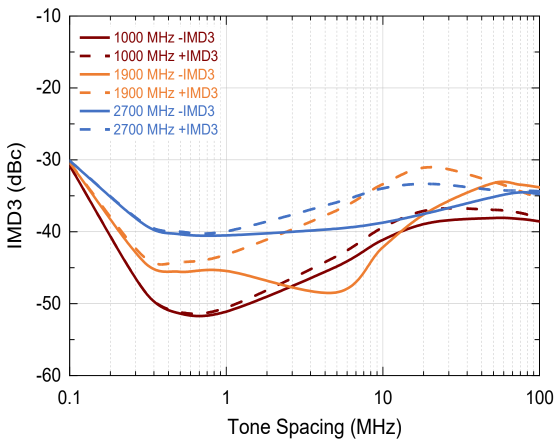
IMD5 vs. Output Power(W-PEP) and Temperature



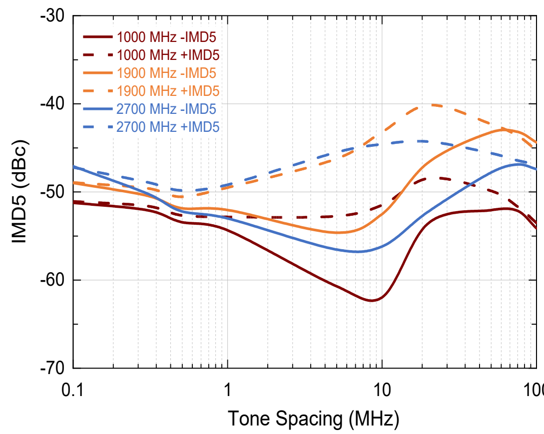
Typical Performance Curves as Measured in the Broadband Evaluation Test Fixture:

CW, Two Tone, P_{OUT} = 37 dBm_PEP, V_{DS} = 28 V, I_{DQ} = 90 mA, T_C = 25°C (Unless Otherwise Noted)
For Engineering Evaluation Only - This data does not Modify MACOM's Datasheet Limits.

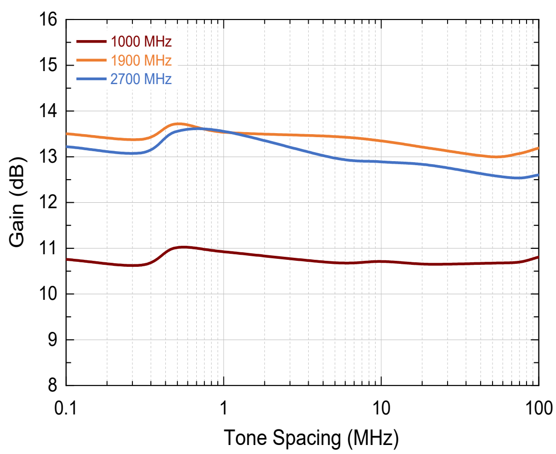
IMD3 vs. 2-Tone Spacing and Frequency



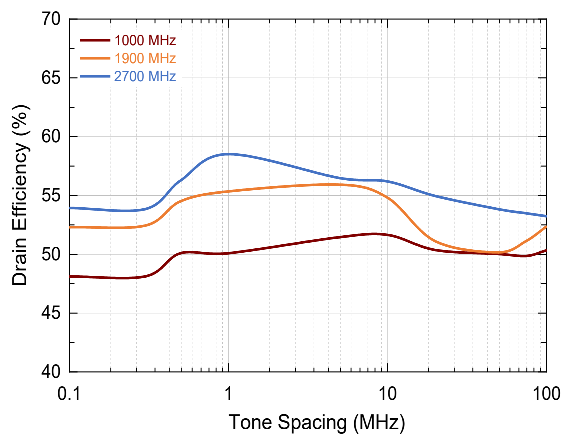
IMD5 vs. 2-Tone Spacing and Frequency



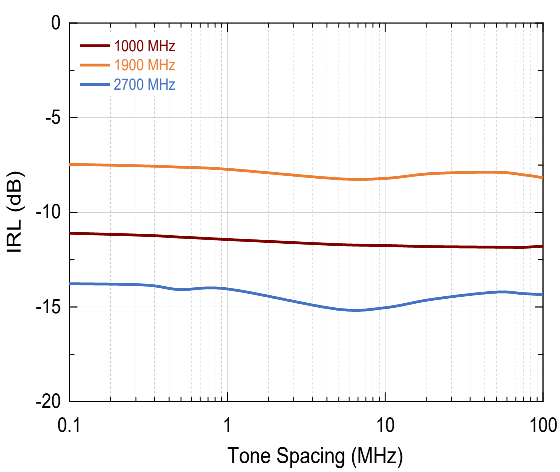
Gain vs. 2-Tone Spacing and Frequency



Drain Efficiency vs. 2-Tone Spacing and Frequency

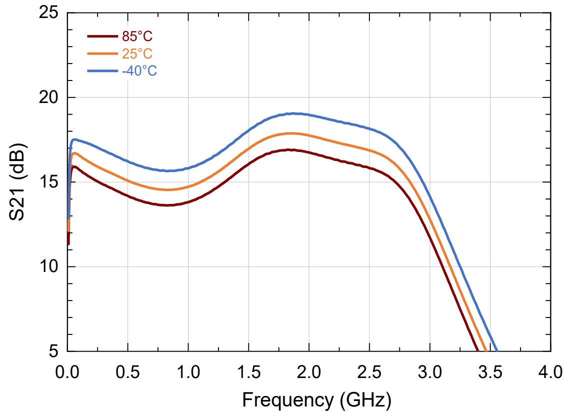


IRL vs. 2-Tone Spacing and Frequency

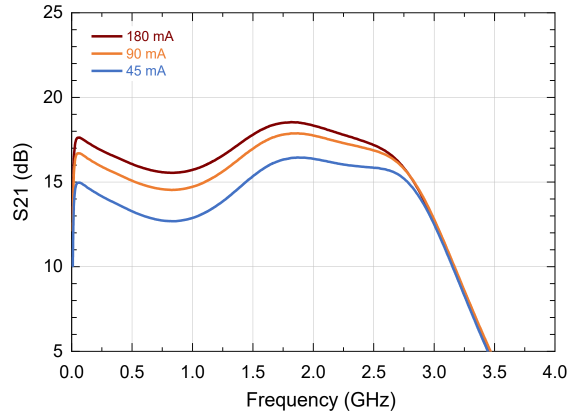


Typical Performance Curves as Measured in the Evaluation Test Fixture[1]:
V_{DS} = 28 V, I_{DQ} = 90 mA, T_C = 25°C (Unless Otherwise Noted)
For Engineering Evaluation Only—This data does not Modify MACOM's Datasheet Limits.

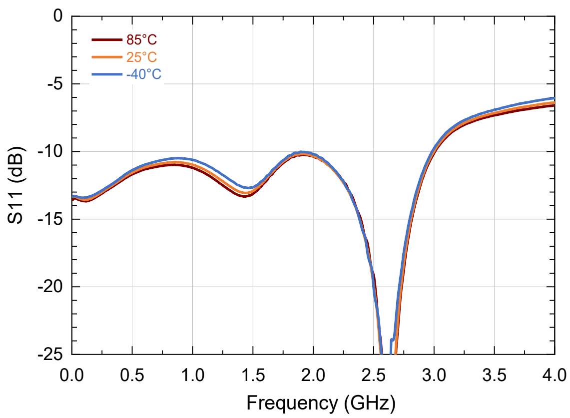
S21 vs Frequency and Temperature



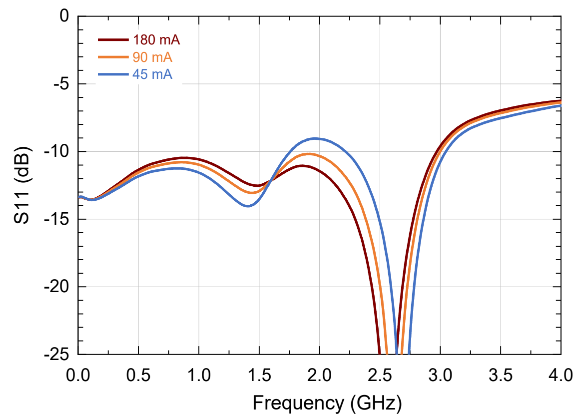
S21 vs Frequency and I_{DQ}



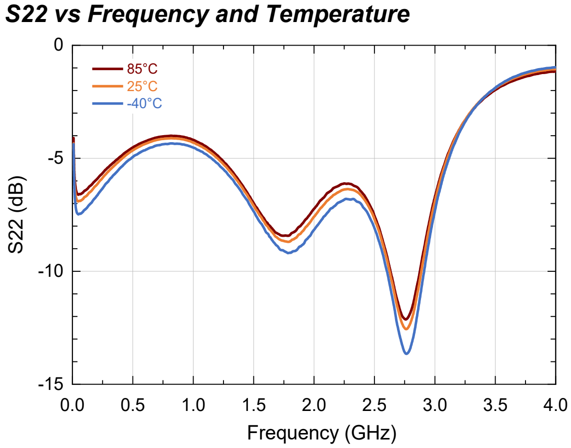
S11 vs Frequency and Temperature



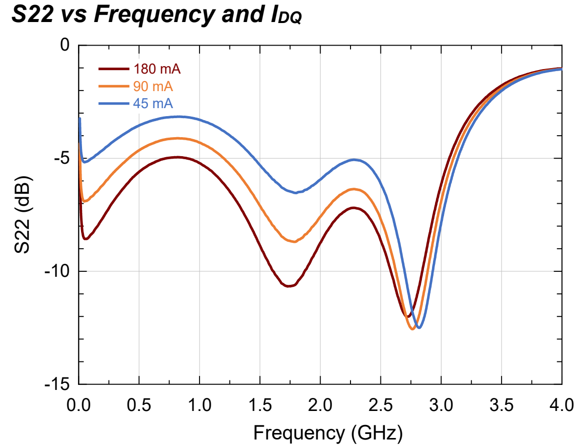
S11 vs Frequency and I_{DQ}



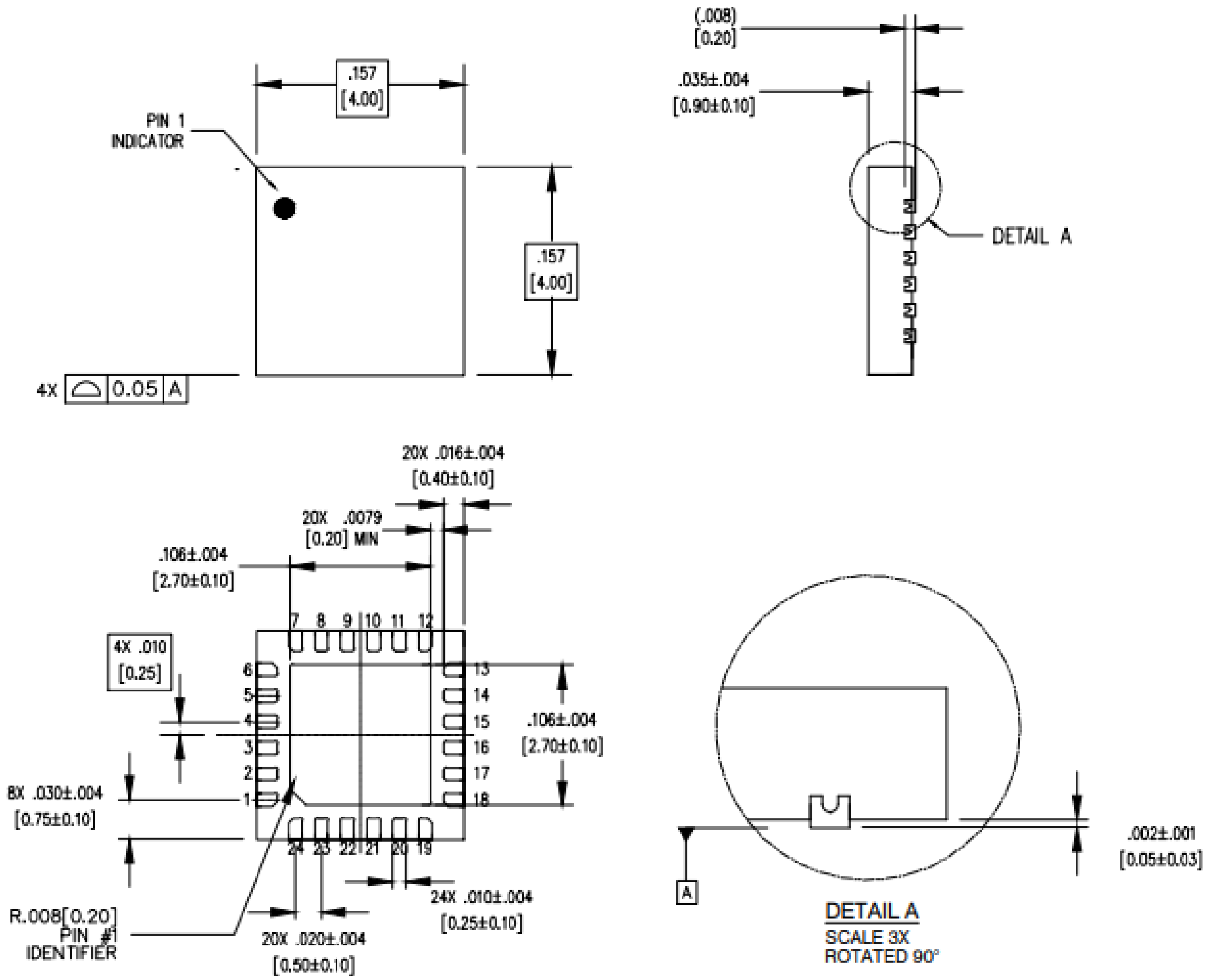
S22 vs Frequency and Temperature



S22 vs Frequency and I_{DQ}



Lead-Free 4 mm 24-Lead QFN Plastic Package†



NOTES:
1. ALL DIMENSIONS SHOWN AS in[mm]. CONTROLLING DIMENSIONS ARE IN in.
   CONVERTED mm DIMENSIONS ARE NOT NECESSARILY EXACT.
2. EXPOSED LEADS: NiPdAu

† Reference Application Note S2083 for lead-free solder reflow recommendations.
Meets JEDEC moisture sensitivity level x requirements.
Plating is NiPdAu