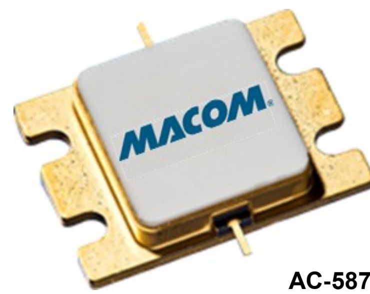
Features

- *MACOM PURE CARBIDE*® Amplifier Series
- Broad Band Internally Matched Amplifier
- High Output Power of 48.4 dBm
- High Linear Gain of 14.3 dB
- Low Intermodulation Distortion with Wide Spacing Tone
- 100% RF Tested
- RoHS* Compliant



AC-587BH-2

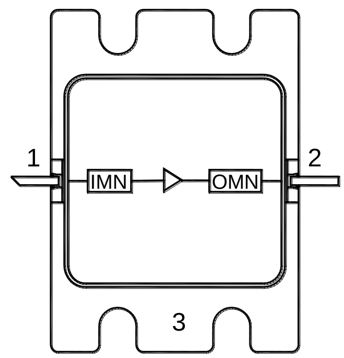
Applications

- Civil Communications
- Military Communications
- Satellite Communications

Description

The MAPC-A4020 is a 60 W packaged amplifier fully matched to 50 Ω at both input and output ports. This amplifier is optimized for 7.7 - 8.5 GHz Satcom applications.

Functional Schematic



Typical Performance:

Measured in Evaluation Test Fixture[1] @
P_{IN} = 38 dBm, CW

- V_{DS} = 40 V, I_{DQ} = 500 mA, T_C = 25°C

Frequency (GHz)	Gain (dB)	η (%)
7.7	10.0	39
8.1	10.8	45
8.5	10.7	40

Two-Tone Test @
P_{OUT} = 41 dBm, Single Carrier Level, CW

- V_{DS} = 40 V, I_{DQ} = 500 mA, T_C = 25°C

Frequency (GHz)	IM3 (dBc) ∆f = 5 MHz	IM3-2 (dBc) ∆f = 150 MHz
7.7	-27	-30
8.1	-28	-30
8.5	-28	-29

1. Performance values and curves in this data sheet were measured in this fixture, de-embedded to the package lead reference planes. (Offset 0.45 dB for both input and output).

Pin Configuration

Pin #	Pin Name	Function
1	RF_{IN} / V_G	RF Input / Gate
2	RF_{OUT} / V_D	RF Output / Drain
3	Flange[2]	Ground / Source

2. The flange on the package bottom must be connected to RF, DC and thermal ground.

Ordering Information

Part Number	Package
MAPC-A4020-AB000	Bulk Quantity
MAPC-A4020-ABSB1	Sample Board

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

RF Electrical Characteristics: Measured in 50 Ω Evaluation Test Fixture[1,3]
Freq. = 7.7 - 8.5 GHz, T_C = 25°C, V_{DS} = 40 V, I_{DQ} = 500 mA

Parameter	Test Conditions	Symbol	Min.	Typ.	Max.	Units
Output Power	CW, P_{IN} = 38 dBm	P_{OUT}	—	48.4	—	dBm
Drain Current	CW, P_{IN} = 38 dBm	IDS1	—	3.8	—	A
Power Added Efficiency	CW, P_{IN} = 38 dBm	η	—	41	—	%
Large Signal Gain	CW, P_{IN} = 38 dBm	G_P	—	10.4	—	dB
Intermodulation Distortion	P_{OUT} = 41 dBm SCL, Δf = 5 MHz Δf = 150 MHz	IM3 IM3-2	—	-27 -30	—	dBc
Drain Current	P_{OUT} = 41 dBm SCL	IDS2	—	1.9	—	A
Small Signal Gain	CW, P_{IN} = 20 dBm	SSG	10.5	14.3	—	dB
SSG Gain Flatness	CW, P_{IN} = 20 dBm	ΔG	—	—	±0.8	dB

RF Electrical Specifications: Measured in 50 Ω Production Test Fixture[1,3]
Pulsed[4], T_C = 25°C, V_{DS} = 40 V, I_{DQ} = 500 mA

Parameter	Test Conditions	Symbol	Min.	Typ.	Max.	Units
Output Power	Pulsed[4], 7.7, 8.1, 8.5 GHz, P_{IN} = 38 dBm	P_{OUT}	47	48.4	—	dBm
Drain Current	Pulsed[4], 7.7, 8.1, 8.5 GHz, P_{IN} = 38 dBm	IDS1	—	4.4	4.9	A
Power Added Efficiency	Pulsed[4], 7.7, 8.1, 8.5 GHz, P_{IN} = 38 dBm	η	27	34	—	%
Intermodulation Distortion	7.7, 8.1, 8.5 GHz, P_{OUT} = 41 dBm SCL, Δf = 5 MHz Δf = 150 MHz	IM3 IM3-2	—	-27 -30	-25 -25	dBc
Drain Current	7.7, 8.1, 8.5 GHz, P_{OUT} = 41 dBm SCL	IDS2	—	2.2	2.5	A
Small Signal Gain	CW, 7.7, 8.1, 8.5 GHz, P_{IN} = 20 dBm	SSG	11	13.5	—	dB
SSG Gain Flatness	CW, 7.7, 8.1, 8.5 GHz, P_{IN} = 20 dBm	ΔG	—	—	±0.8	dB

3. Final testing and screening for all amplifier sales is performed using the MAPC-A4020-ABSB1.
4. Pulse details: 100 µs pulse width, 10% Duty Cycle.

DC Electrical Characteristics, T_C = 25°C

Parameter	Test Conditions	Symbol	Min.	Typ.	Max.	Units
Drain-Source Leakage Current	V_{GS} = -8 V, V_{DS} = 10 V	I_{DS}	—	—	2.0	mA
Gate-Source Leakage Current	V_{GS} = -8 V, V_{DS} = 10 V	I_{DS}	-2.0	—	—	mA
Gate Threshold Voltage	V_{DS} = 10 V, I_D = 14.4 mA	V_T	-3.8	-3.0	-2.3	V
Gate Quiescent Voltage	V_{DS} = 40 V, I_D = 500 mA	$V_{GS,Q}$	—	-2.7	—	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
Forward Gate Current, I_{GMAX}	14.4 mA
Drain Current, I_D	6 A
Storage Temperature Range, T_S	-65°C to +150°C
Case Operating Temperature Range, T_C	-40°C to +85°C
Channel Operating Temperature Range, T_{CH}	-40°C to +225°C
Absolute Maximum Channel Temperature	+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} < 40 V will ensure MTTF > 1 x 10^6 hours.
8. Operating at nominal conditions with $T_{CH} \leq 225°C$ will ensure MTTF > 1 x 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	CW, V_{DS} = 40 V T_C = 85°C, T_{CH} = 225°C	R_θ(FEA)	2.0	°C/W

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

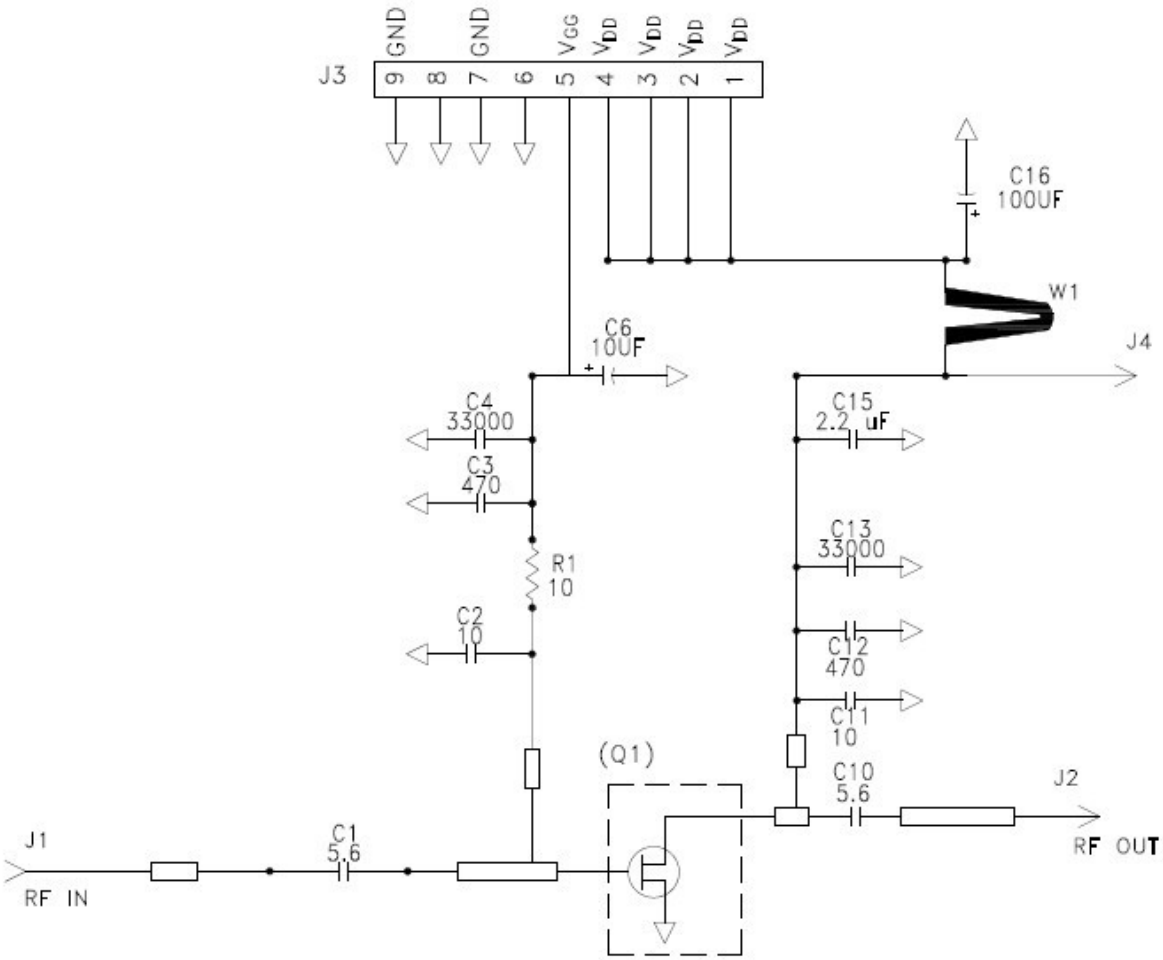
Handling Procedures

Please observe the following precautions to avoid damage:

Static Sensitivity

Gallium Nitride Circuits 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 Test Fixture[1] and Recommended Tuning Solution 7.7-8.5 GHz



Description

Parts measured on evaluation board (20-mil thick RO6035HTC). 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

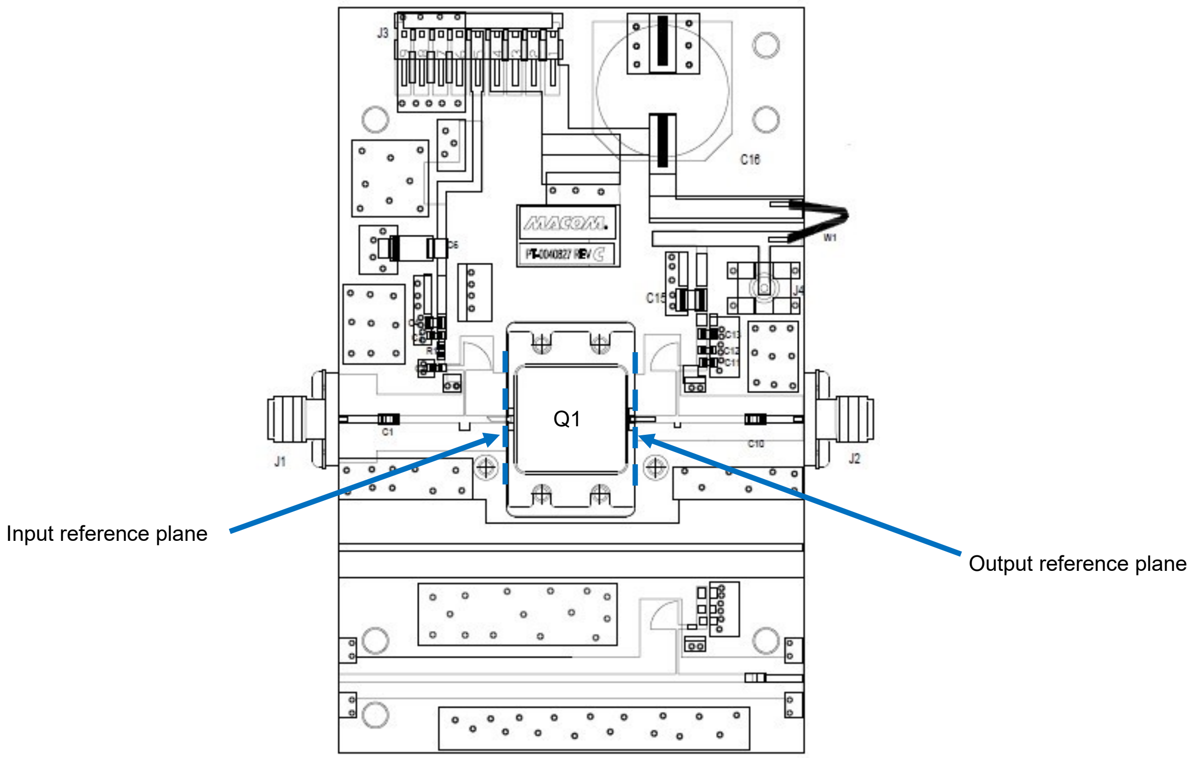
Turning the device ON

1. Set V_{GS} to pinch-off (V_P).
2. Turn on V_{DS} to nominal voltage (40V).
3. Increase V_{GS} until 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 pinch-off.
3. Decrease V_{DS} down to 0 V.
4. Turn off V_{GS}.

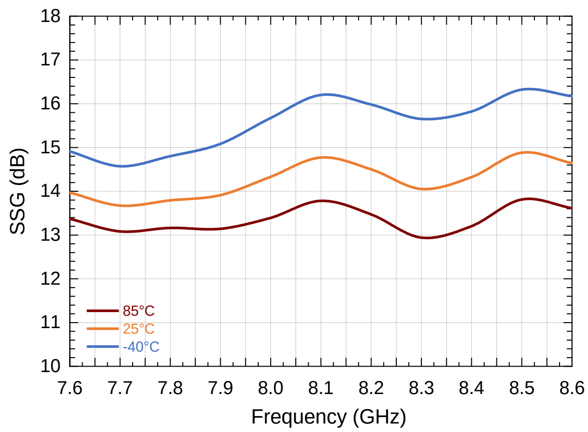
Evaluation Board and Recommended Tuning Solution 7.7 - 8.5 GHz



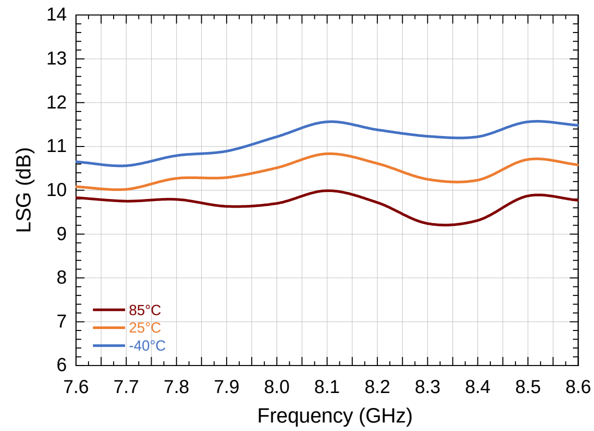
Reference Designator	Value	Tolerance	Manufacturer	Part Number
C1, C10	5.6 pF	+/- 0.1pF	KYOCERA AVX	600F5R6BT250XT
C2, C11	10 pF	+/- 2%	KYOCERA AVX	600S100GW250XT
C3, C12	470 pF	+/- 5%	Murata	06031C471JAT2A
C4, C13	33000 pF	+/- 10%	Murata	GRM21BR72A333KA01
C6	10 µF	+/- 10%	Kemet	T496C106K016ATE2K0
C15	2.2 µF	+/- 10%	KYOCERA AVX	12101C225KAT2A
C16	100 µF	+/- 20%	Nichicon	UVZ2C101MHD1TO
R1	10 Ω	+/- 1%	Vishay Dale	CRCW060310R0FRT
J1, J2	-		GIGALANE	PSF-S01-000
J3	-		TE Connectivity	640457-9
J4	-		Cinch	131-3711-201
W1				CABLE, 18AWG, 4.2”
Q1	MAPC-A4020			
PCB	RO6035HTC, 20mil, 2oz Cu, Au Finish			

Typical Performance Curves as Measured in the Evaluation Test Fixture[1]:
CW, V_{DS} = 40 V, I_{DQ} = 500 mA, P_{IN} = 38 dBm, T_C = 25°C (Unless Otherwise Noted)
For Engineering Evaluation Only - This data does not Modify MACOM's Datasheet Limits.

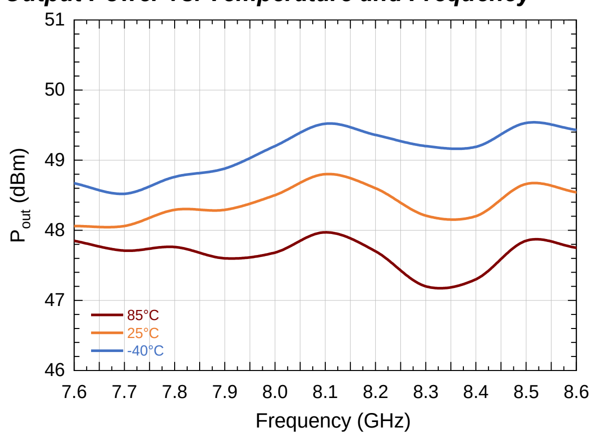
SSG (Pin = 20 dBm) vs. Temperature and Frequency



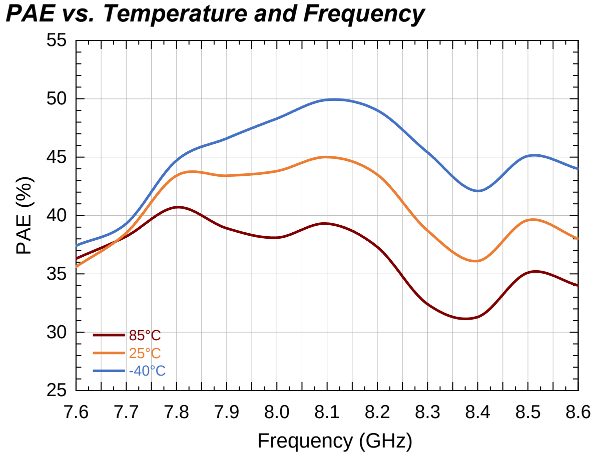
Large Signal Gain vs. Temperature and Frequency



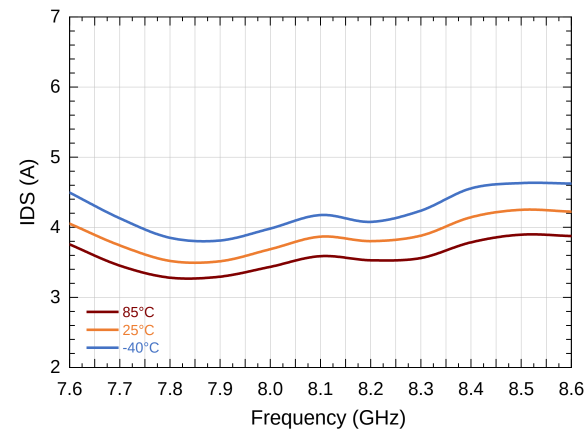
Output Power vs. Temperature and Frequency



PAE vs. Temperature and Frequency

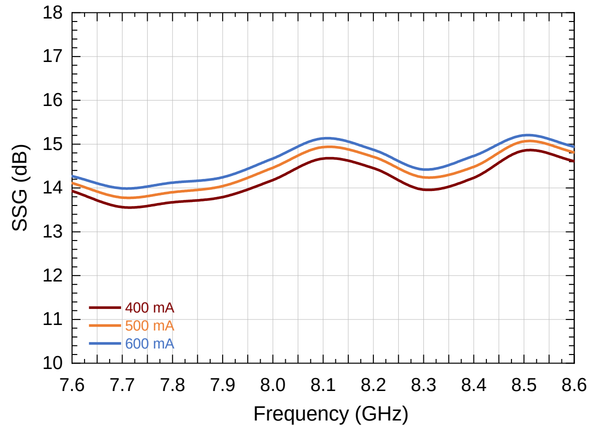


Drain Current vs. Temperature and Frequency

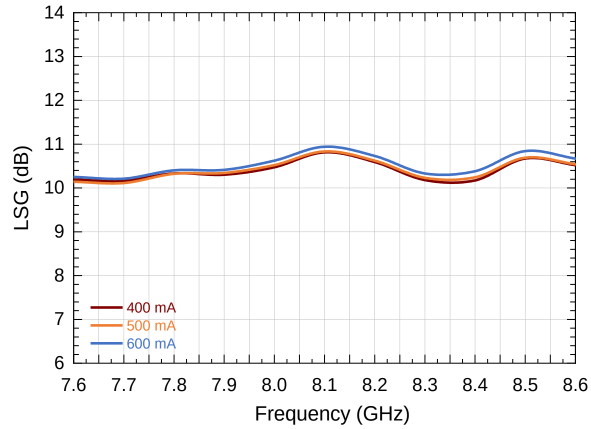


Typical Performance Curves as Measured in the Evaluation Test Fixture[1]:
CW, V_{DS} = 40 V, I_{DQ} = 500 mA, P_{IN} = 38 dBm, T_C = 25°C (Unless Otherwise Noted)
For Engineering Evaluation Only - This data does not Modify MACOM's Datasheet Limits.

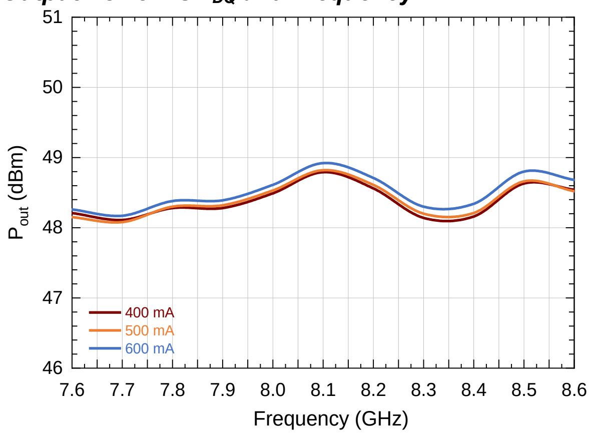
SSG (Pin = 20 dBm) vs. I_{DQ} and Frequency



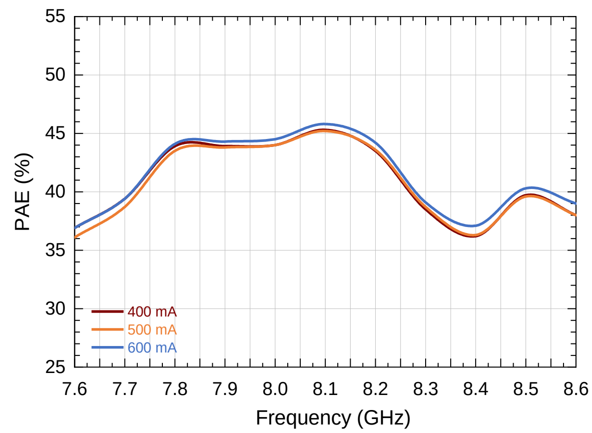
Large Signal Gain vs. I_{DQ} and Frequency



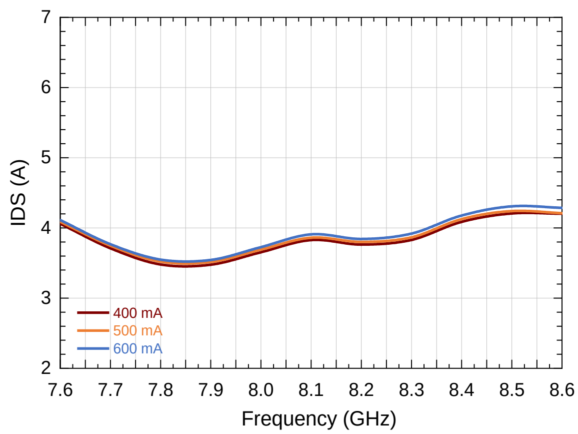
Output Power vs. I_{DQ} and Frequency



PAE vs. I_{DQ} and Frequency

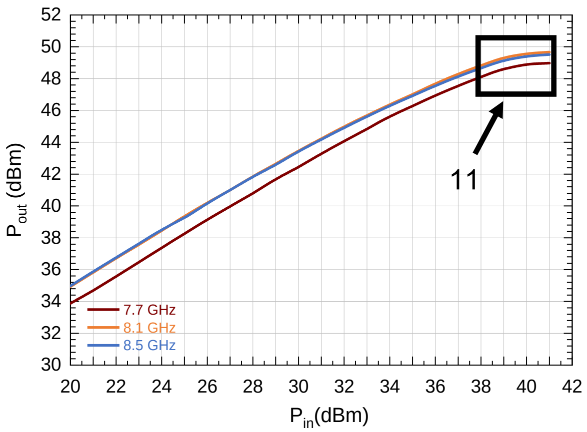


Drain Current vs. I_{DQ} and Frequency

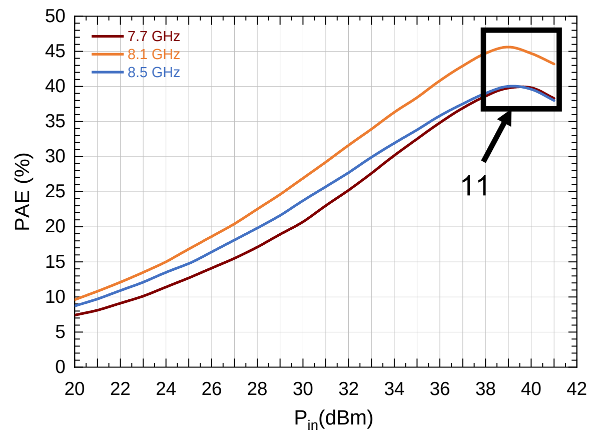


Typical Performance Curves as Measured in the Evaluation Test Fixture[1]:
CW 8.1GHz, V_{DS} = 40 V, I_{DQ} = 500 mA, T_C = 25°C (Unless Otherwise Noted)
For Engineering Evaluation Only - This data does not Modify MACOM's Datasheet Limits.

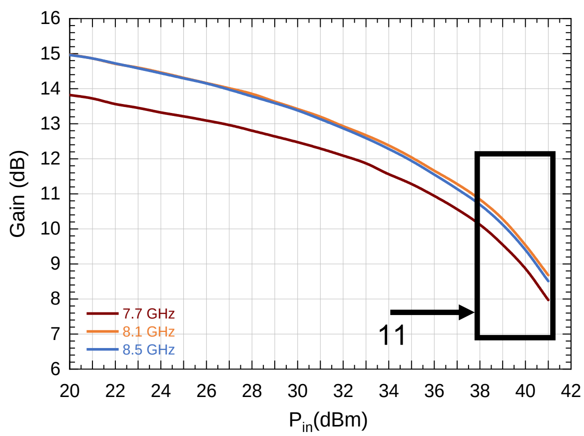
Output Power vs. Frequency and Input Power



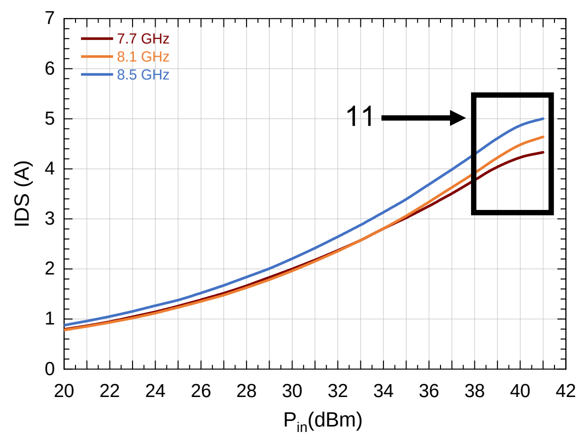
PAE vs. Frequency and Input Power



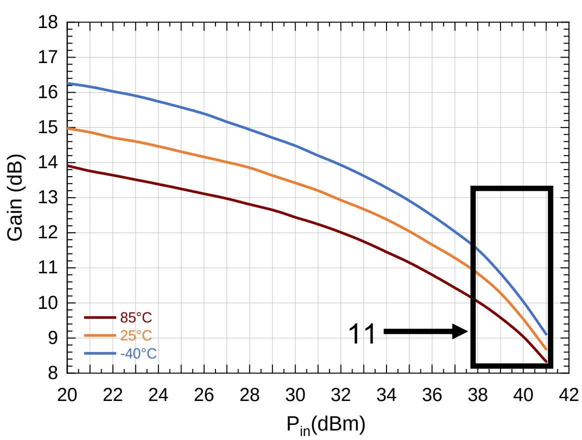
Gain vs. Frequency and Input Power



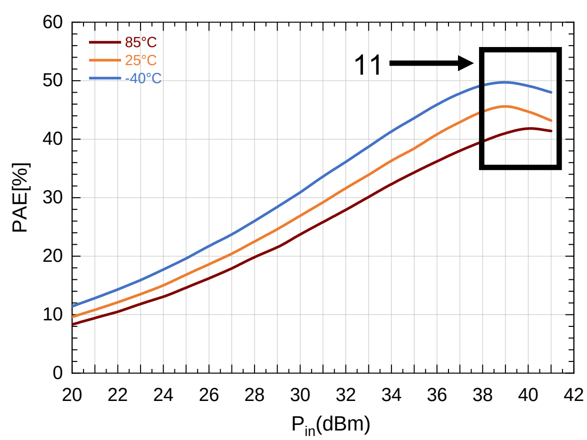
Drain Current vs. Frequency and Input Power



Gain vs. Input Power and Temperature



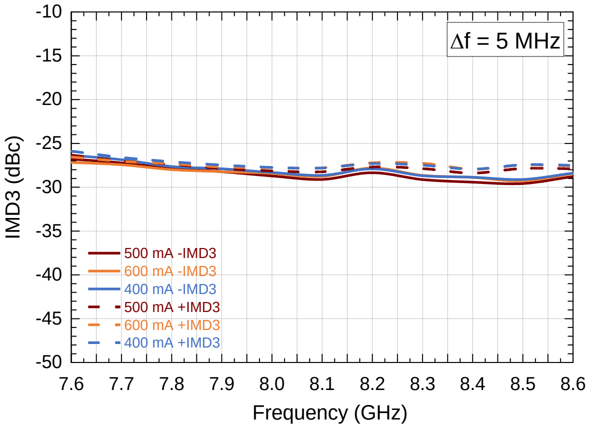
PAE vs. Input Power and Temperature



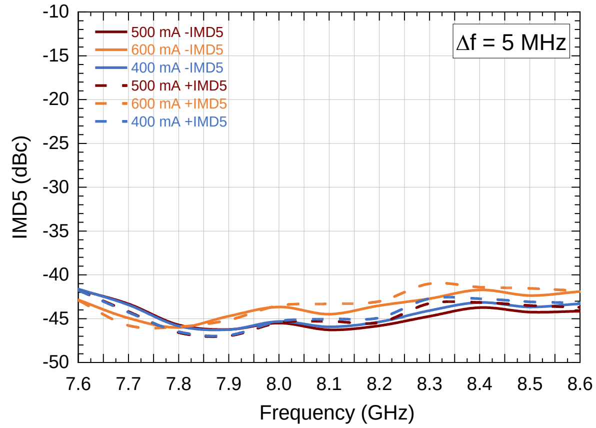
11. Part would exceed maximum reliable channel temperature at 25°C case temperature, if operated in this region.

Typical Performance Curves as Measured in the Evaluation Test Fixture[1]:
CW, Two Tone, Po = 41 dBm S.C.L, V_{DS} = 40 V, I_{DQ} = 500 mA, T_C = 25°C (Unless Otherwise Noted)
For Engineering Evaluation Only - This data does not Modify MACOM's Datasheet Limits.

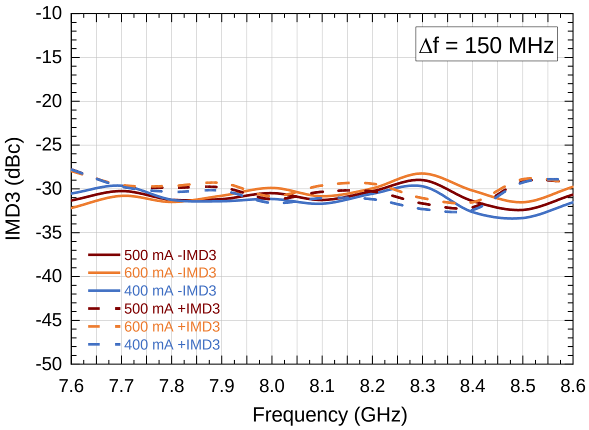
IMD3 vs. I_{DQ} and Frequency



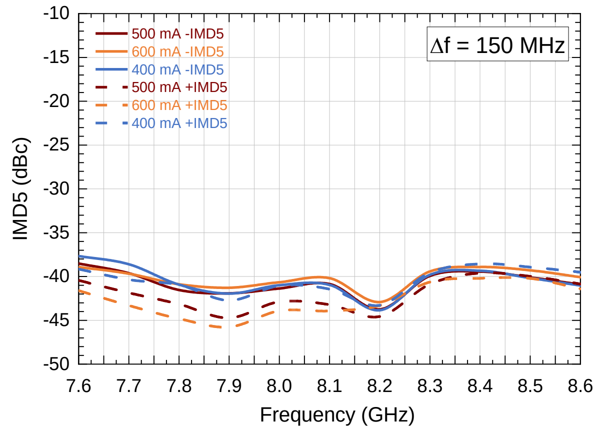
IMD5 vs. I_{DQ} and Frequency



IMD3 vs. I_{DQ} and Frequency



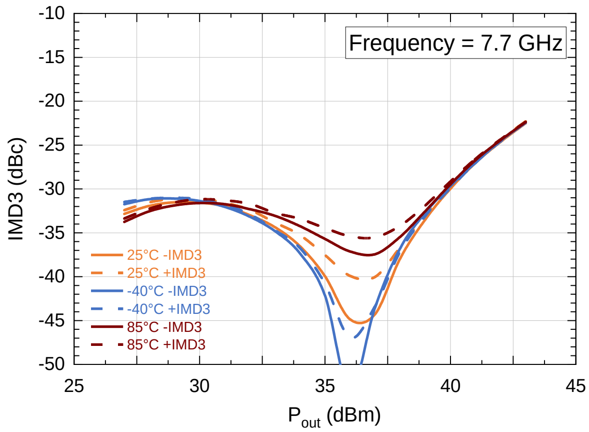
IMD5 vs. I_{DQ} and Frequency



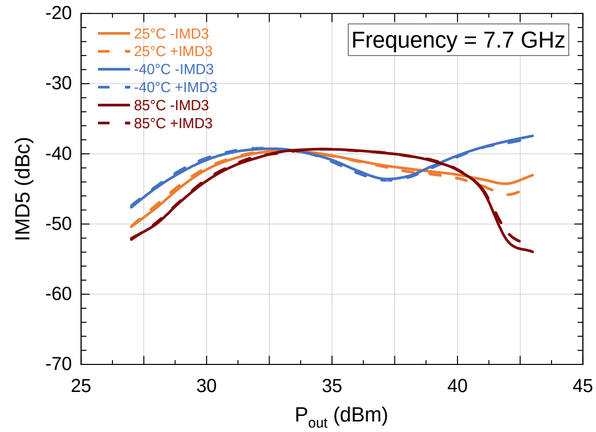
Typical Performance Curves as Measured in the Evaluation Test Fixture[1]:

CW, Two Tone, ΔF = 5 MHz, V_{DS} = 40 V, I_{DQ} = 500 mA, T_C = 25°C (Unless Otherwise Noted)
For Engineering Evaluation Only - This data does not Modify MACOM's Datasheet Limits.

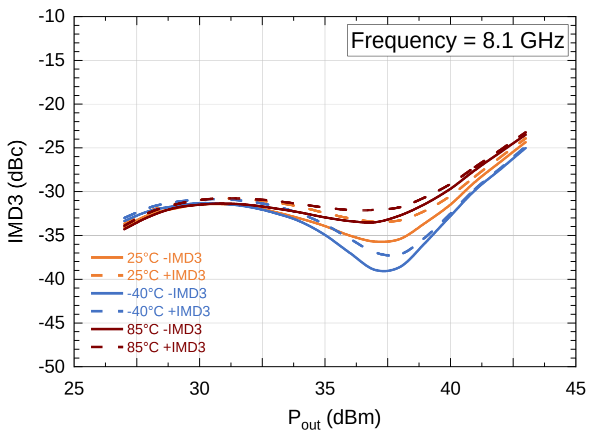
IMD3 vs. Temperature and Output Power @ S.C.L



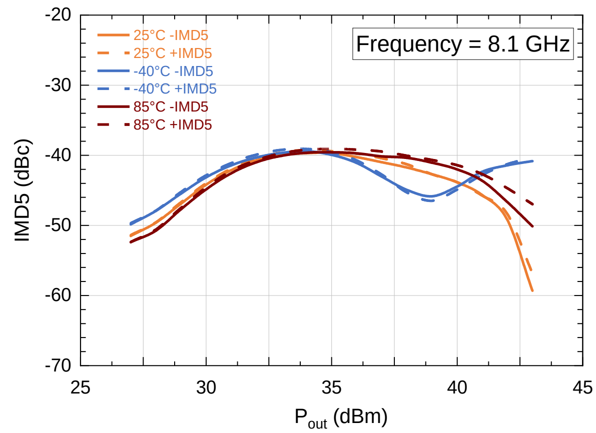
IMD5 vs. Temperature and Output Power @ S.C.L



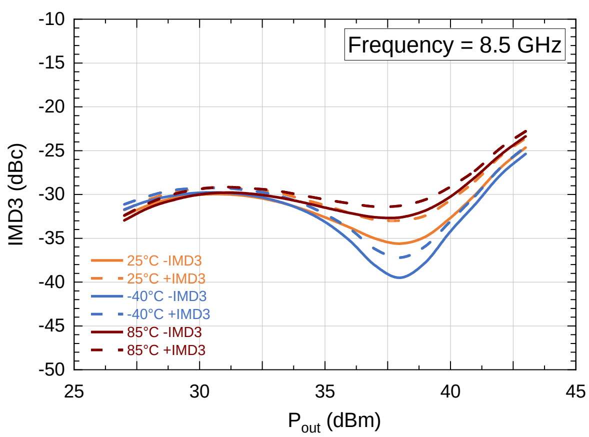
IMD3 vs. Temperature and Output Power @ S.C.L



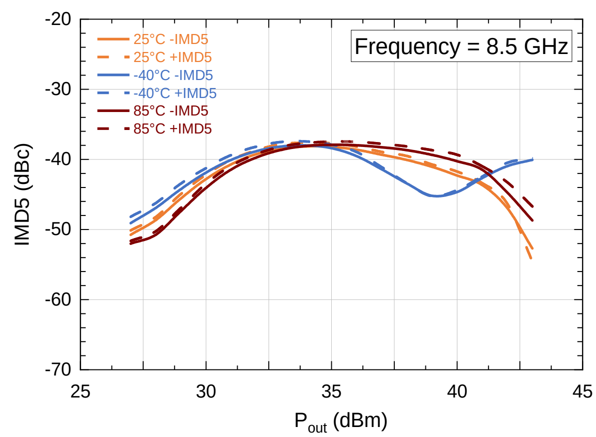
IMD5 vs. Temperature and Output Power @ S.C.L



IMD3 vs. Temperature and Output Power @ S.C.L



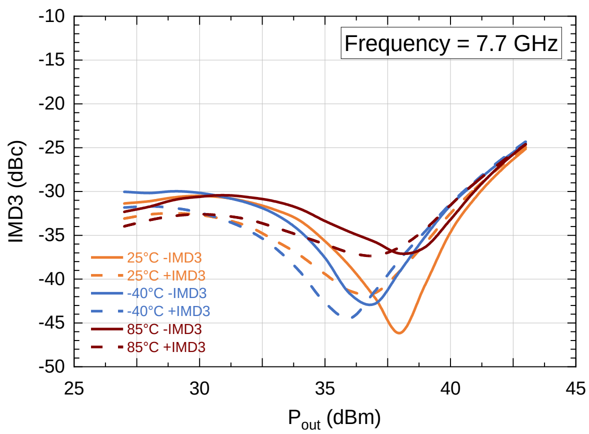
IMD5 vs. Temperature and Output Power @ S.C.L



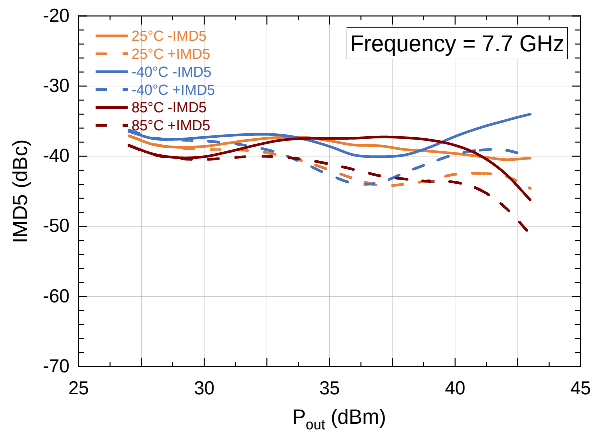
Typical Performance Curves as Measured in the Evaluation Test Fixture[1]:

CW, Two Tone, ΔF = 150 MHz, V_{DS} = 40 V, I_{DQ} = 500 mA, T_C = 25°C (Unless Otherwise Noted)
For Engineering Evaluation Only - This data does not Modify MACOM's Datasheet Limits.

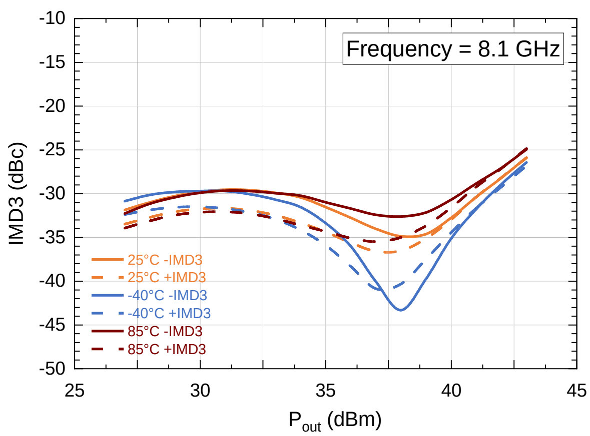
IMD3-2 vs. Temperature and Output Power @ S.C.L



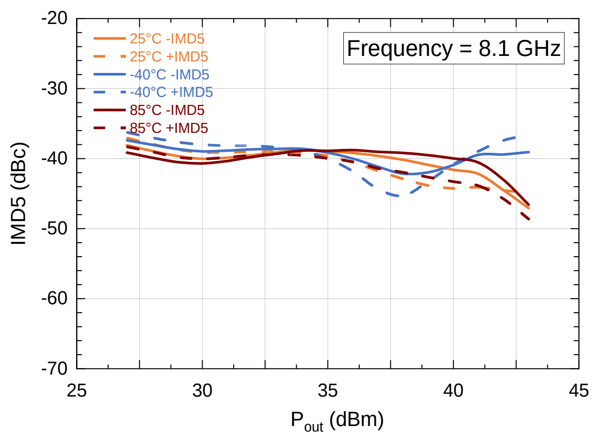
IMD5-2 vs. Temperature and Output Power @ S.C.L



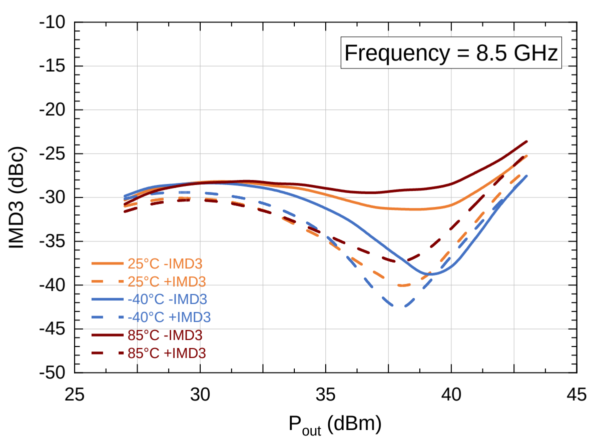
IMD3-2 vs. Temperature and Output Power @ S.C.L



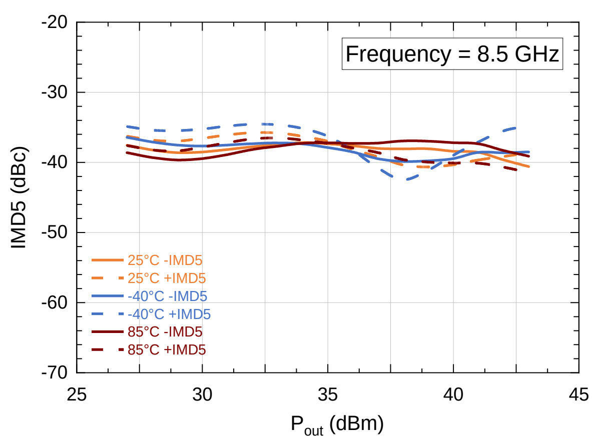
IMD5-2 vs. Temperature and Output Power @ S.C.L



IMD3-2 vs. Temperature and Output Power @ S.C.L

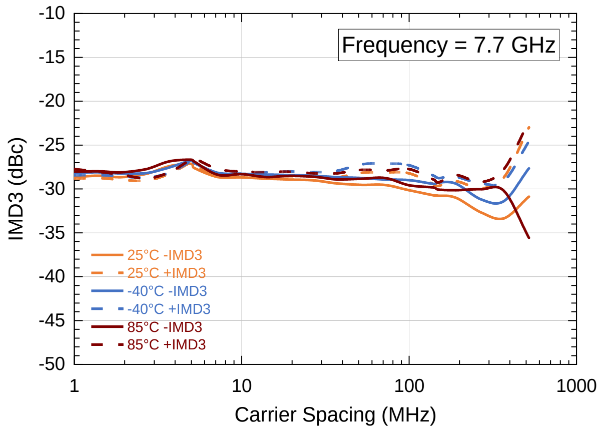


IMD5-2 vs. Temperature and Output Power @ S.C.L

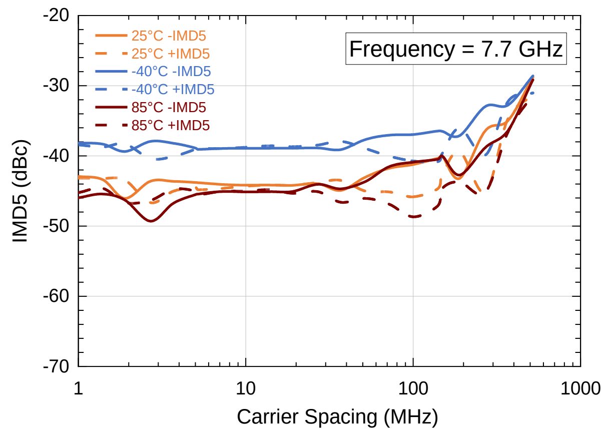


Typical Performance Curves as Measured in the Evaluation Test Fixture[1]:
CW, Two Tone, Po = 41 dBm S.C.L, V_{DS} = 40 V, I_{DQ} = 500 mA (Unless Otherwise Noted)
For Engineering Evaluation Only - This data does not Modify MACOM's Datasheet Limits.

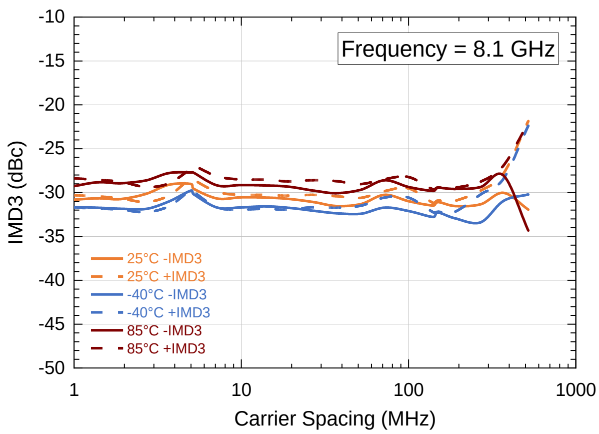
IMD3 vs. Temperature and Two-Tone Spacing



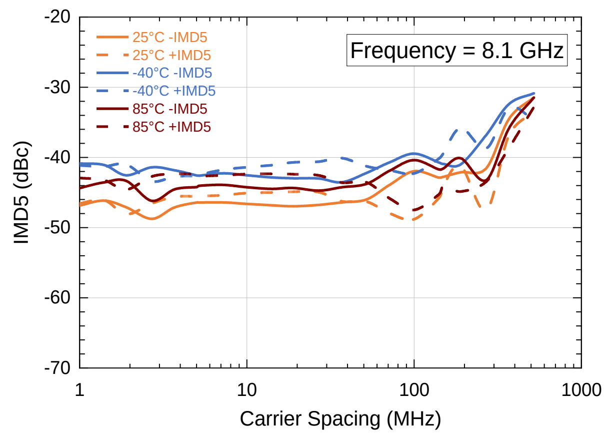
IMD5 vs. Temperature and Two-Tone Spacing



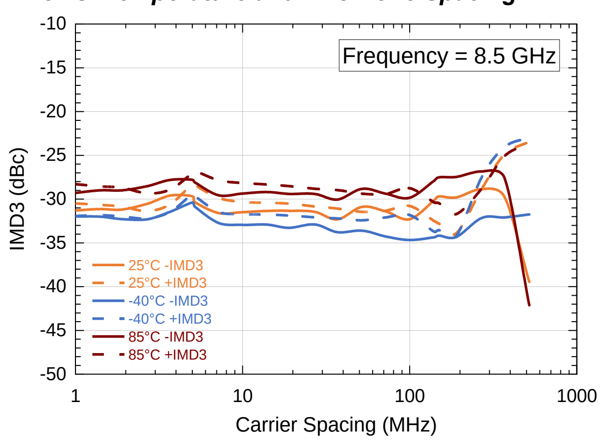
IMD3 vs. Temperature and Two-Tone Spacing



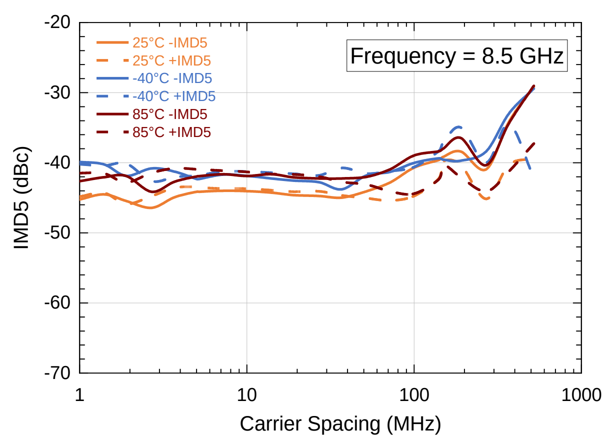
IMD5 vs. Temperature and Two-Tone Spacing



IMD3 vs. Temperature and Two-Tone Spacing

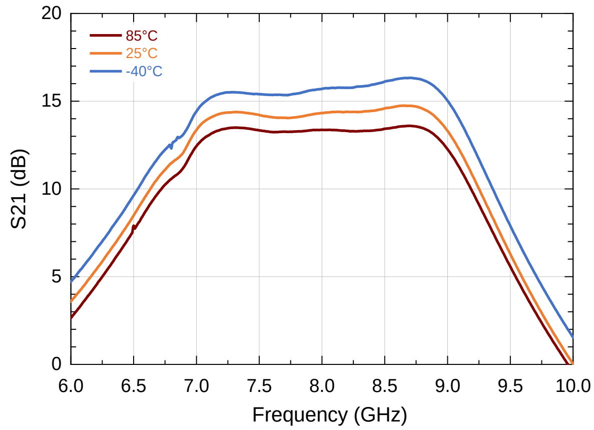


IMD5 vs. Temperature and Two-Tone Spacing

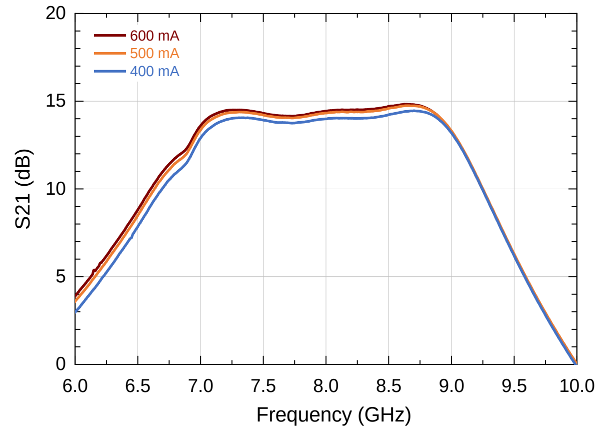


Typical Performance Curves as Measured in the Evaluation Test Fixture[1]:
V_{DS} = 40 V, I_{DQ} = 500 mA, T_C = 25°C (Unless Otherwise Noted)
For Engineering Evaluation Only—This data does not Modify MACOM's Datasheet Limits.

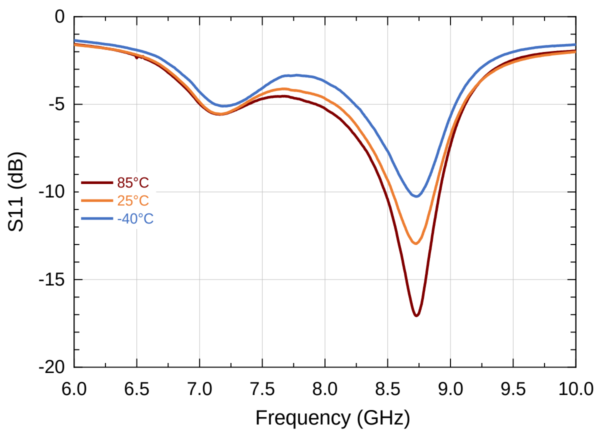
S21 vs Frequency and Temperature



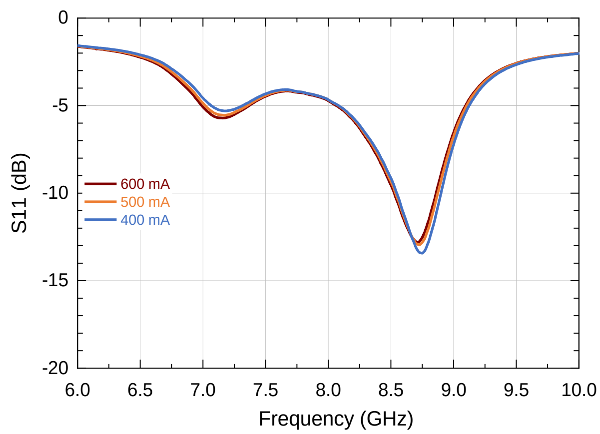
S21 vs Frequency and I_{DQ}



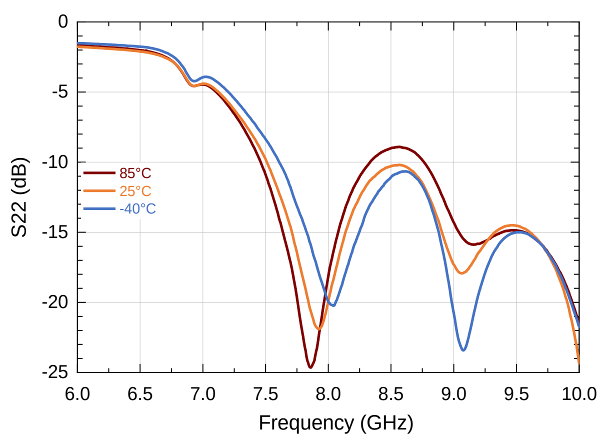
S11 vs Frequency and Temperature



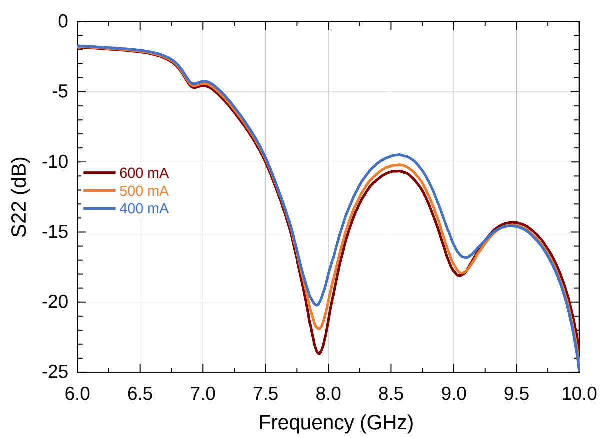
S11 vs Frequency and I_{DQ}



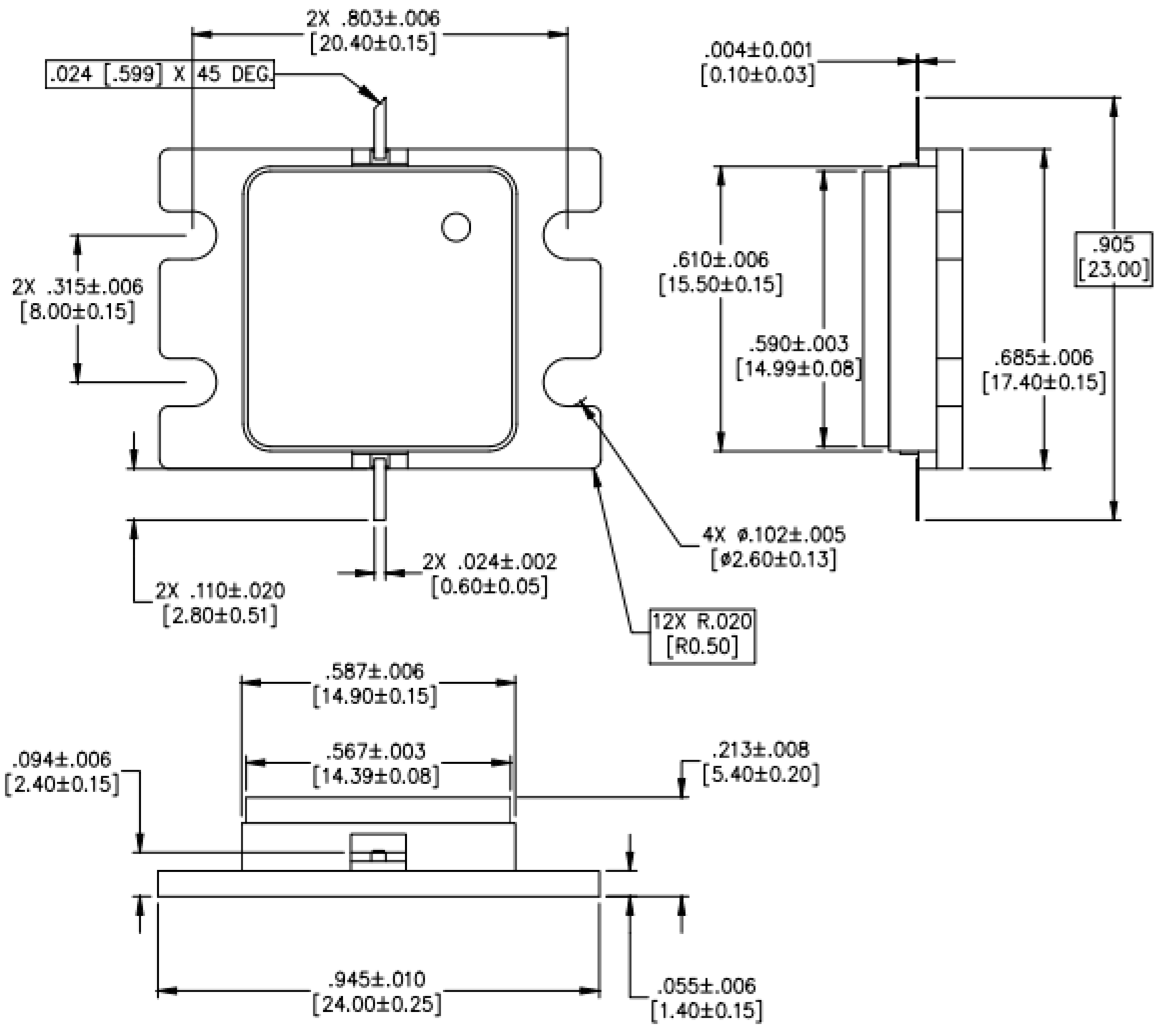
S22 vs Frequency and Temperature



S22 vs Frequency and I_{DQ}



Lead-Free Package Dimensions†



NOTES:
1. ALL DIMENSIONS SHOWN AS in[mm]. CONTROLLING DIMENSIONS ARE IN in AND CONVERTED mm DIMENSIONS ARE NOT NECESSARILY EXACT.
2. ALL TOLERANCES ARE ±.005 [0.13] UNLESS OTHERWISE NOTED
3. LEAD FINISH: AU
   FLANGE FINISH: AU
   LID MATERIAL: LCP
4. LID SEAL EPOXY MAY FLOW OUT A MAXIMUM OF .020 [0.51] FROM EDGE OF LID
5. LID MAY BE MIS-ALIGNED UP TO .010 [0.25] FROM PACKAGE IN ANY DIRECTION

† Reference Application Note AN-0004363 for lead-free solder reflow recommendations.
Meets JEDEC moisture sensitivity level 3 requirements.
Plating is Au.