GaN Amplifier 40 V, 130 W
5.85 - 6.75 GHz

MACOM PURE CARBIDE

MAPC-A4017
Rev. V2

Features

- *MACOM PURE CARBIDE*® Amplifier Series
- Broad Band Internally Matched Amplifier
- High Output Power of 52 dBm
- High Linear Gain of 13 dB
- Low Intermodulation Distortion with Wide Spacing Tone
- 100% RF Tested
- RoHS* Compliant

AC-587BH-2

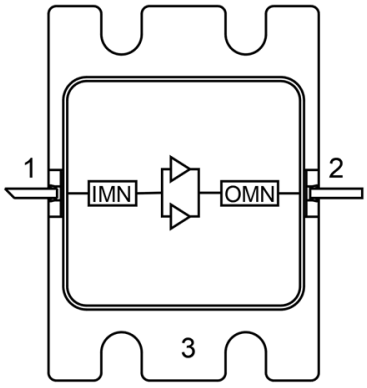
Applications

- Civil Communications
- Military Communications
- Satellite Communications

Description

The MAPC-A4017 is a 130 W package amplifier fully matched to 50 Ω at both input and output ports. This amplifier is optimized for 5.85 - 6.75 GHz Satcom applications.

Functional Schematic



Typical Performance:

Measured in Evaluation Test Fixture[1] @
P_{IN} = 43 dBm, 100 µs pulse width, 10% duty cycle.

- V_{DS} = 40 V, I_{DQ} = 800 mA, T_C = 25°C

Frequency (GHz)	G_P (dB)	η (%)
5.85	9.3	46
6.3	9.7	48
6.75	9.6	44

Two-Tone Test @
P_{OUT} = 44 dBm (Single Carrier Level), CW

- V_{DS} = 40 V, I_{DQ} = 800 mA, T_C = 25°C

Frequency (GHz)	IM3 (dBc) Δf = 5 MHz	IM3-2 (dBc) Δf = 150 MHz
5.85	-29	-32
6.3	-30	-32
6.75	-30	-34

1. Performance values and curves in this data sheet were measured in this fixture, de-embedded to the package lead reference planes.

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-A4017-AB000	Bulk Quantity
MAPC-A4017-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. = 5.85 - 6.75 GHz, T_C = 25°C, V_{DS} = 40 V, I_{DQ} = 800 mA

Parameter	Test Conditions	Symbol	Min.	Typ.	Max.	Units
Output Power	Pulsed[4], P_{IN} = 43 dBm	P_{OUT}	—	52.5	—	dBm
Drain Current	Pulsed[4], P_{IN} = 43 dBm	IDS1	—	9.5	—	A
Power Added Efficiency	Pulsed[4], P_{IN} = 43 dBm	η	—	45	—	%
Large Signal Gain	Pulsed[4], P_{IN} = 43 dBm	G_P	—	9.5	—	dB
Intermodulation Distortion	P_{OUT} = 44 dBm SCL, Δf = 5 MHz Δf = 150 MHz	IM3 IM3-2	—	-28 -30	—	dBc
Drain Current	P_{OUT} = 44 dBm SCL Δf = 5 MHz, Δf = 150 MHz	IDS2	—	3.8	—	A
Small Signal Gain	CW, P_{IN} = 20 dBm	SSG	11.5	13	—	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]
T_C = 25°C, V_{DS} = 40 V, I_{DQ} = 800 mA

Parameter	Test Conditions	Symbol	Min.	Typ.	Max.	Units
Output Power	Pulsed[4], 5.85,6.45,6.75 GHz, P_{IN} = 43 dBm	P_{OUT}	50	52.5	—	dBm
Drain Current	Pulsed[4], 5.85,6.45,6.75 GHz, P_{IN} = 43 dBm	IDS1	—	9.5	—	A
Power Added Efficiency	Pulsed[4], 5.85,6.45,6.75 GHz, P_{IN} = 43 dBm	η	—	45	—	%
Intermodulation Distortion	5.85, 6.3, 6.75 GHz, P_{OUT} = 44 dBm SCL, Δf = 5 MHz Δf = 150 MHz	IM3 IM3-2	—	-28 -30	-25 -25	dBc
Drain Current	5.85, 6.3 ,6.75 GHz, P_{OUT} = 44 dBm SCL Δf = 5 MHz, Δf = 150 MHz	IDS2	—	3.8	5	A
Small Signal Gain	5.85, 6.25, 6.55 & 6.75 GHz, Pin = 20 dBm	SSG	11.5	13	—	dB
SSG Gain Flatness	5.85, 6.25, 6.55 & 6.75 GHz, Pin = 20 dBm	ΔG	—	—	±0.8	dB

3. Final testing and screening for all amplifier sales is performed using the MAPC-A4019-SBPPR.
4. Pulse details: 100 µs pulse width, 10% Duty Cycle.

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} = 10 V	I_{DS}	—	—	4.0	mA
Gate-Source Leakage Current	V_{GS} = -8 V, V_{DS} = 10 V	I_{GS}	-4.0	—	—	mA
Gate Threshold Voltage	V_{DS} = 10 V, I_D = 28.8 mA	V_T	-3.8	-3.0	-2.3	V
Gate Quiescent Voltage	V_{DS} = 40 V, I_D = 800 mA	V_{GSQ}	—	-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}	28.8 mA
Drain Current, I_D	12 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)	1	°C/W

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

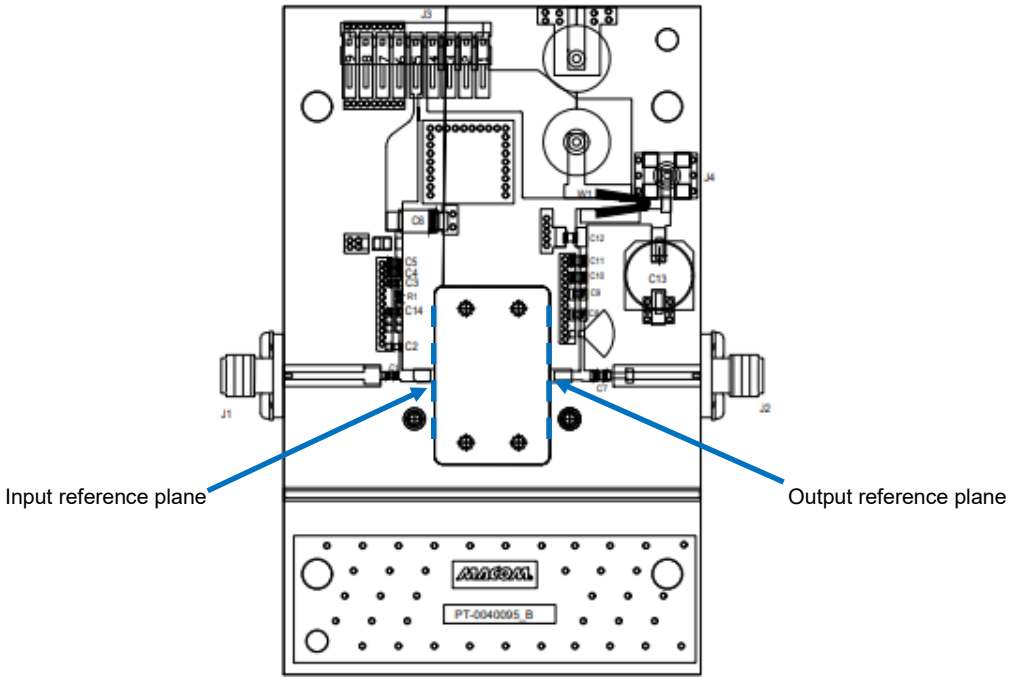
Handling Procedures

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.

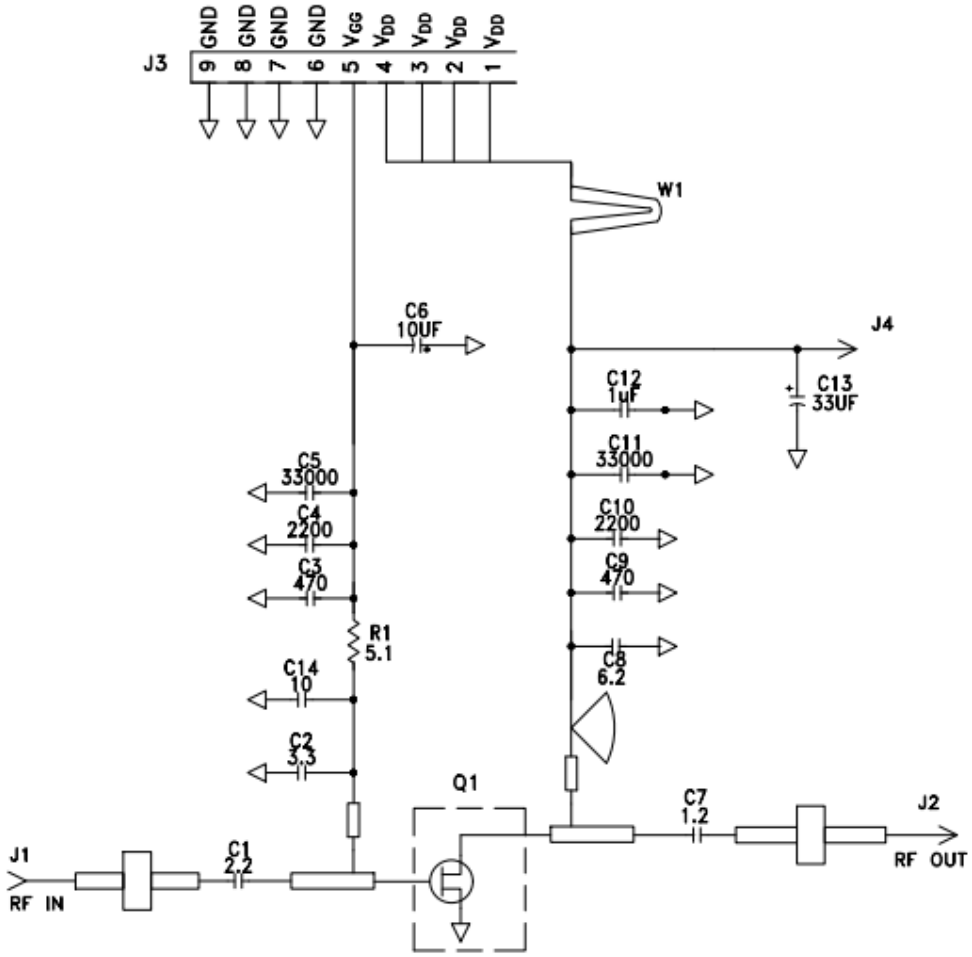
Evaluation Board and Recommended Tuning Solution 5.85 - 6.75 GHz



Applications Board Parts List

Reference Designator	Value	Tolerance	Manufacturer	Manufacturer Part #
C1	2.2 pF	0.1 pF	Kyocera/AVX	ATC600S2R2BT250XT
C3	3.3 pF	0.1 pF	Kyocera/AVX	ATC600S3R3BT250XT
C3, C9	470 pF	5%	Murata	GRM39X7R471J100AD
C4, C10	2200 pF	10%	Murata	GRM188R72A222K01D
C5, C11	33000 pF	10%	Murata	GRM21BR72A333KA01
C6	10 µF	10%	Kemet	T496C106K016ATE2K0
C7	1.2 pF	0.1 pF	Kyocera/AVX	ATC600F1R2BW500XT
C8	6.2 pF	0.1 pF	Kyocera/AVX	ATC600S6R2BT250XT
C12	1 µF	10%	Murata	GCJ21BC72A105KE02L
C13	33 µF	20%	Panasonic	EEE-2AA330P
C14	10 pF	0.1 pF	Kyocera/AVX	ATC600S100BT250XT
R1	5.1 Ω	1%	Vishay/Dale	CRCW06035R10FKEAC
J1, J2	—	—	GIGALANE	PSF-S00-000
J3	—	—	TE Connectivity	640457-9
J4	—	—	Cinch	131-3711-201
T1	0.040” x 0.100” x 0.005”	—		tinned copper tab
W1	CABLE, 18 AWG, 4.2”	—		18 AWG Black
Baseplate	Copper, Baseplate, 4.0” x 2.5” x 0.5”	—	MACOM	4-001940, Rev C
Test Board	PCB, Test Board, 0.020 thk.	—	MACOM	PT-0040095, Rev B

Evaluation Test Fixture[1] and Recommended Tuning Solution 5.85 - 6.75 GHz



Description

Parts measured on evaluation board (20-mil thick RO635HTC). 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

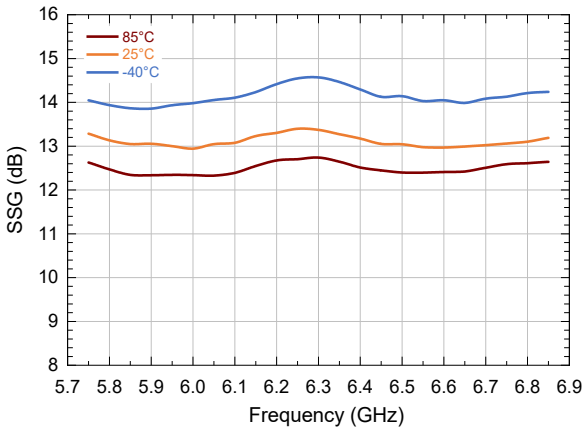
1. Set V_{GS} to pinch-off (V_P).
2. Turn on V_{DS} to nominal voltage (40 V).
3. Increase V_{GS} until I_{DS} current is reached.
4. Apply RF power to desired level.

Turning the device OFF

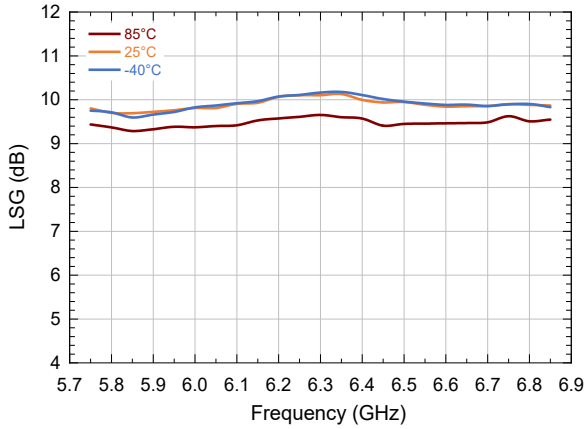
1. Turn the RF power OFF.
2. Decrease V_{GS} down to V_P pinch-off.
3. Decrease V_{DS} down to 0 V.
4. Turn off V_{GS}.

Typical Performance Curves as Measured in the Evaluation Test Fixture[1]:
Pulsed[4], V_{DS} = 40 V, I_{DQ} = 800 mA, P_{IN} = 43 dBm, T_C = 25°C (Unless Otherwise Noted)
For Engineering Evaluation Only - This data does not Modify MACOM's Datasheet Limits.

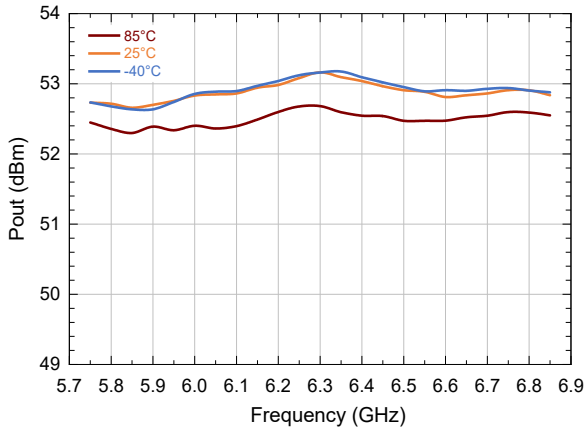
SSG (CW Pin = 20 dBm) vs. Frequency and Temperature



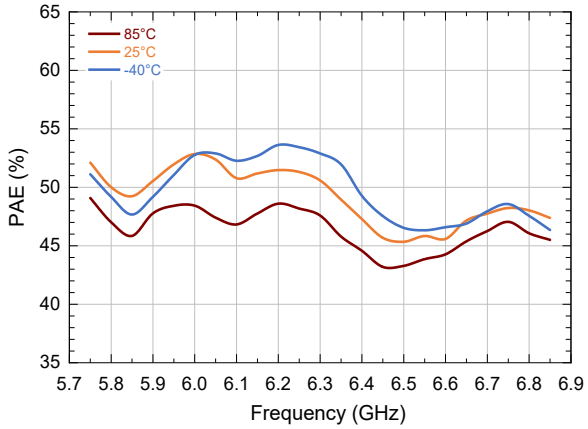
Large Signal Gain vs. Frequency and Temperature



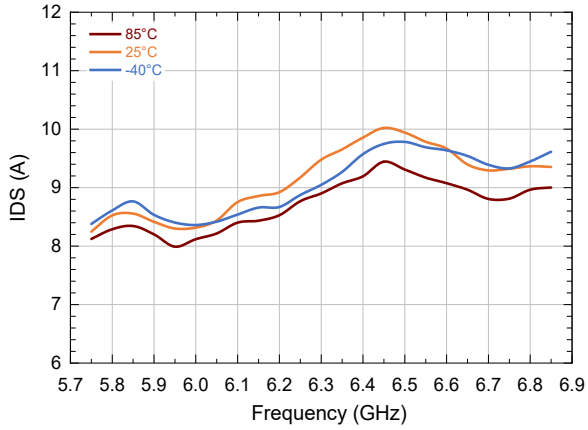
Output Power vs. Frequency and Temperature



PAE vs. Frequency and Temperature



Drain Current vs. Frequency and Temperature



Typical Performance Curves as Measured in the Evaluation Test Fixture[1]:
Pulsed[4], V_{DS} = 40 V, I_{DQ} = 800 mA, P_{IN} = 43 dBm, T_C = 25°C (Unless Otherwise Noted)
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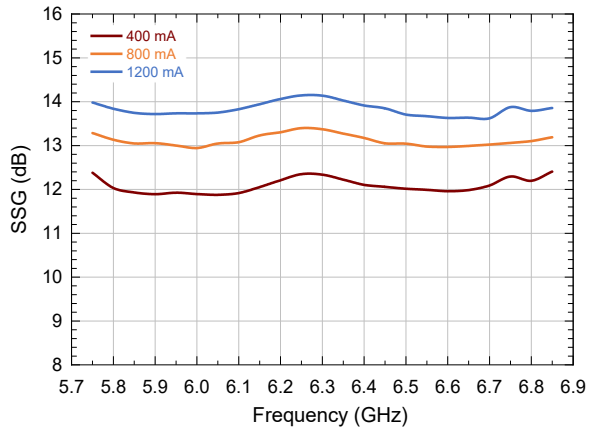
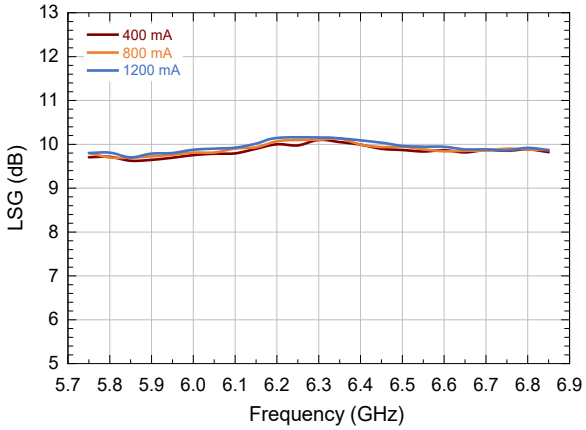
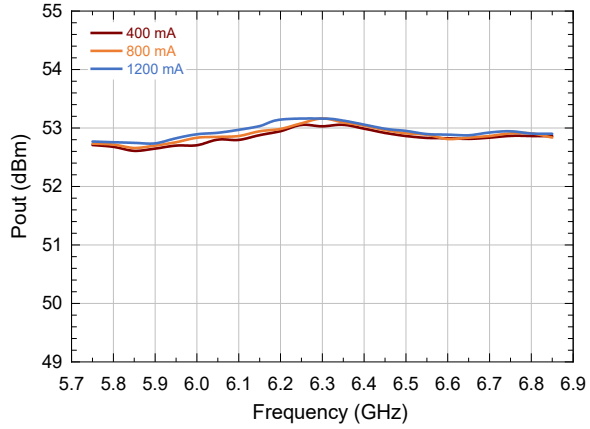
SSG (CW Pin = 20 dBm) vs. Frequency and I_{DQ}



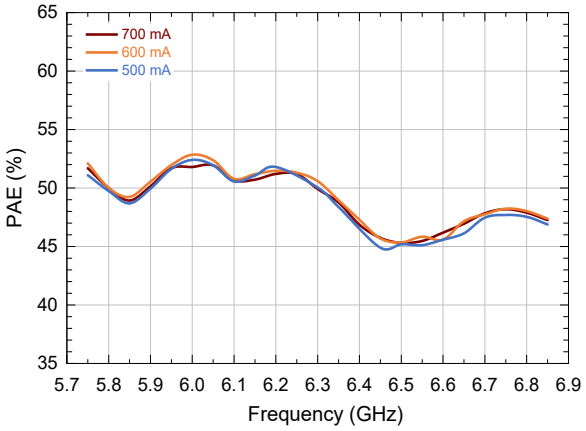
Large Signal Gain vs. Frequency and I_{DQ}



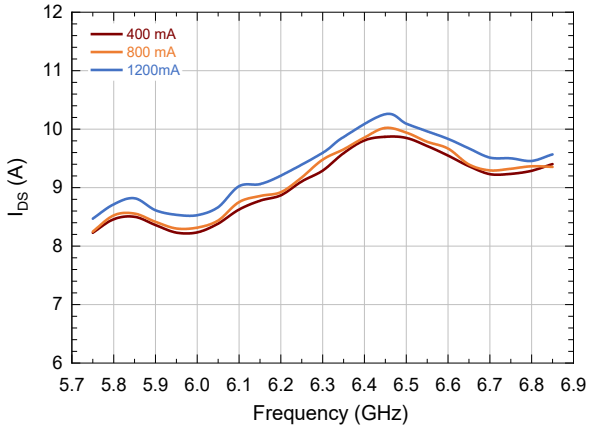
Output Power vs. Frequency and I_{DQ}



PAE vs. Frequency and I_{DQ}

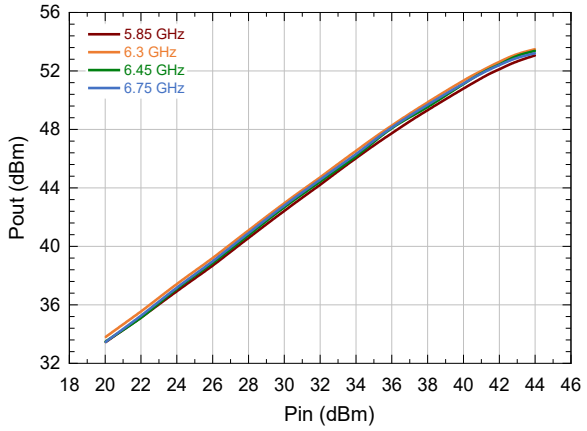


Drain Current vs. Frequency and I_{DQ}

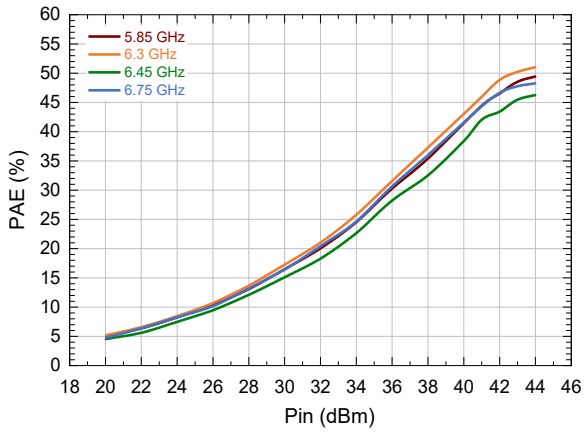


Typical Performance Curves as Measured in the Evaluation Test Fixture[1]:
Pulsed[4] 6.3 GHz, V_{DS} = 40 V, I_{DQ} = 800 mA, T_C = 25°C (Unless Otherwise Noted)
For Engineering Evaluation Only - This data does not Modify MACOM's Datasheet Limits.

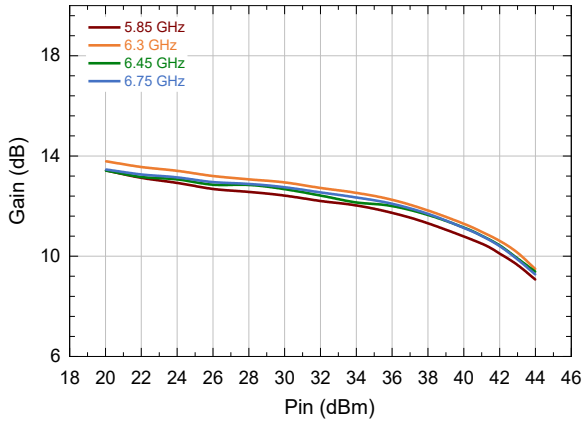
Output Power vs. Input Power and Frequency



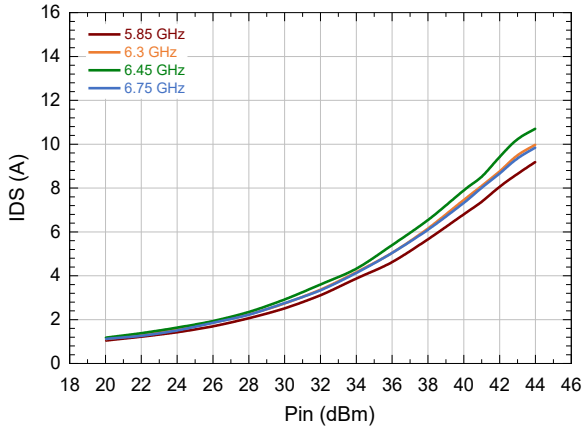
PAE vs. Input Power and Frequency



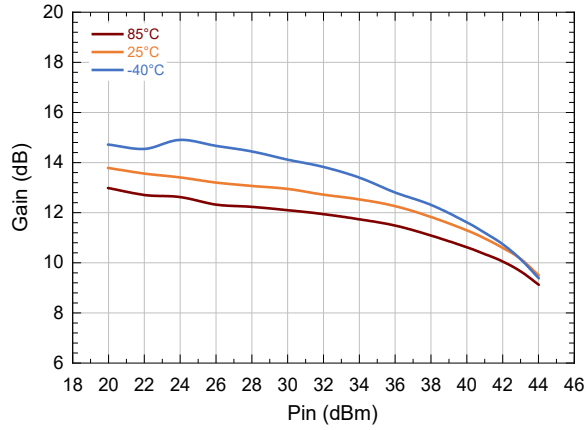
Gain vs. Input Power and Frequency



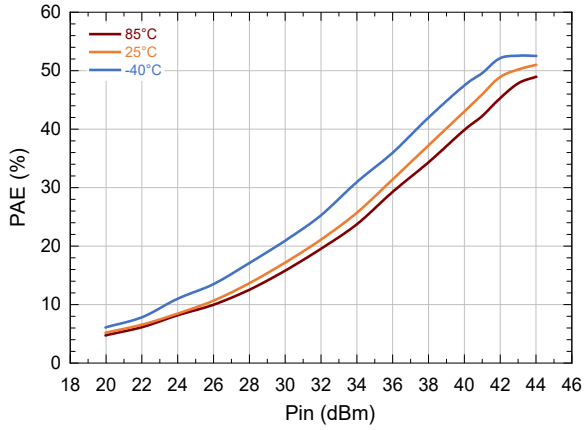
Drain Current vs. Input Power and Frequency



Gain vs. Input Power and Temperature

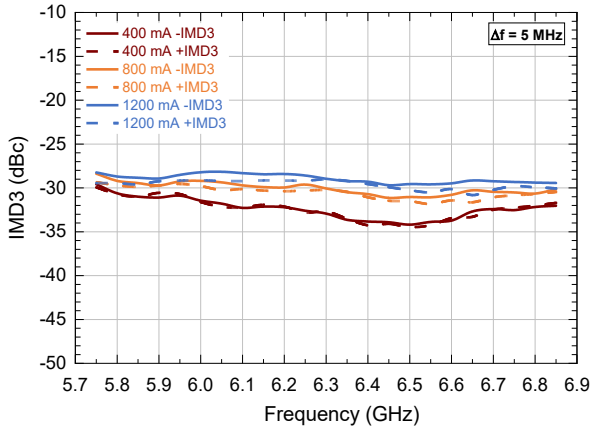


PAE vs. Input Power and Temperature

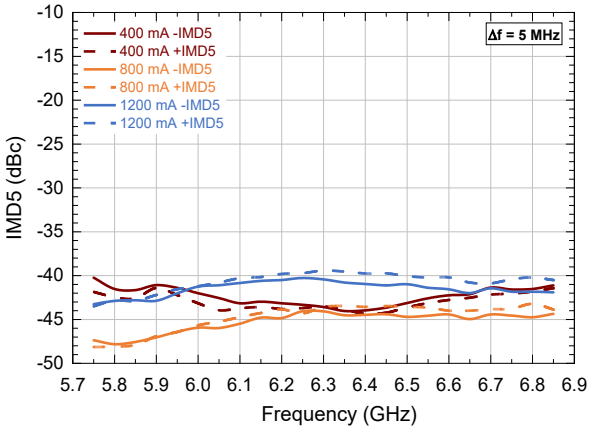


Typical Performance Curves as Measured in the Evaluation Test Fixture[1]:
CW, Two Tone, Po = 44 dBm S.C.L, V_{DS} = 40 V, I_{DQ} = 800 mA, T_C = 25°C (Unless Otherwise Noted)
For Engineering Evaluation Only - This data does not Modify MACOM's Datasheet Limits.

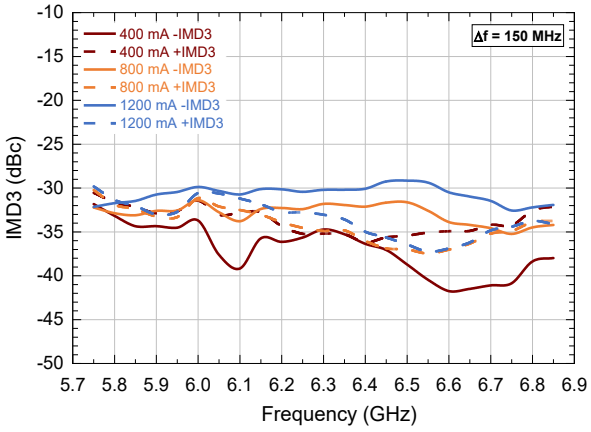
IMD3 vs. Frequency and I_{DQ}



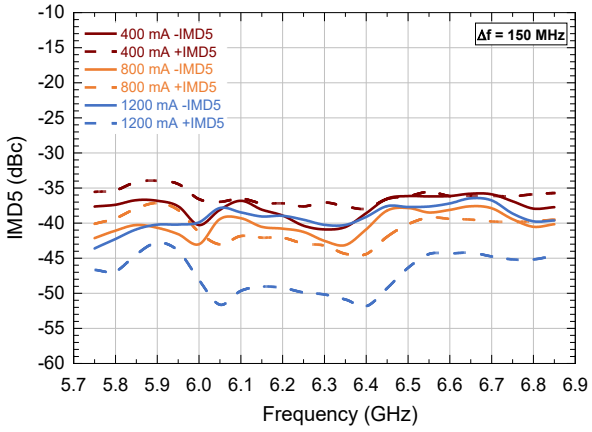
IMD5 vs. Frequency and I_{DQ}



IMD3 vs. Frequency and I_{DQ}



IMD5 vs. Frequency and I_{DQ}



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

CW, Two Tone, ΔF = 5 MHz, V_{DS} = 40 V, I_{DQ} = 800 mA, T_C = 25°C (Unless Otherwise Noted)
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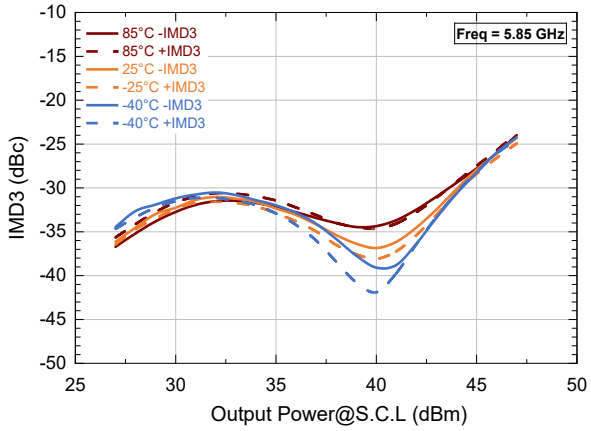
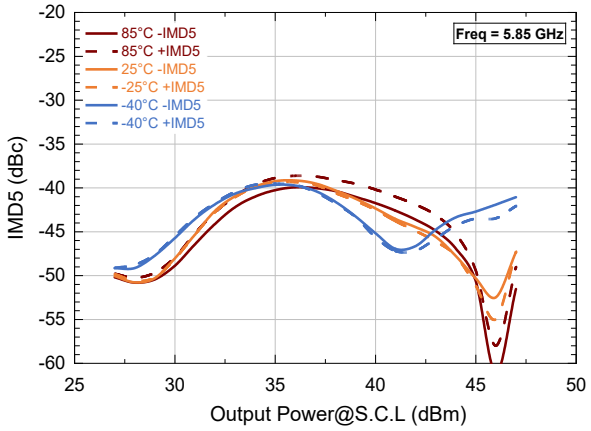
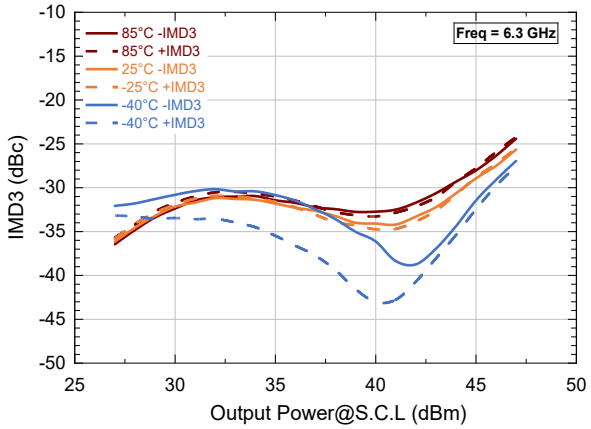
IMD3 vs. Output Power @ S.C.L and Temperature



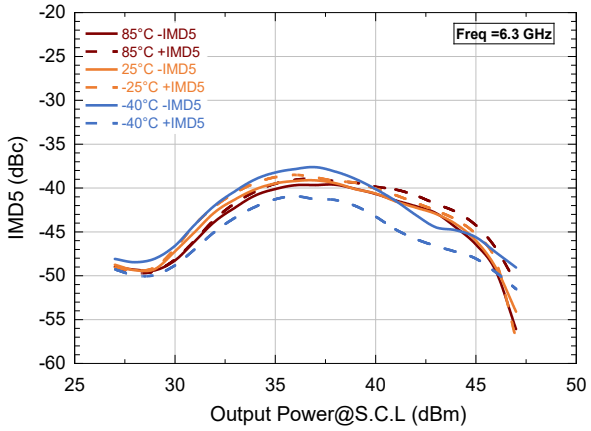
IMD5 vs. Output Power @ S.C.L and Temperature



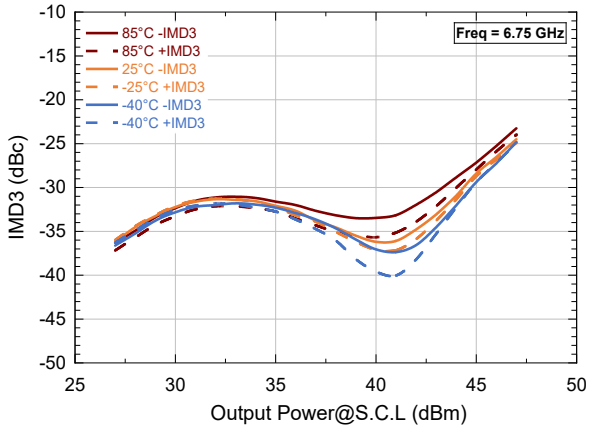
IMD3 vs. Output Power @ S.C.L and Temperature



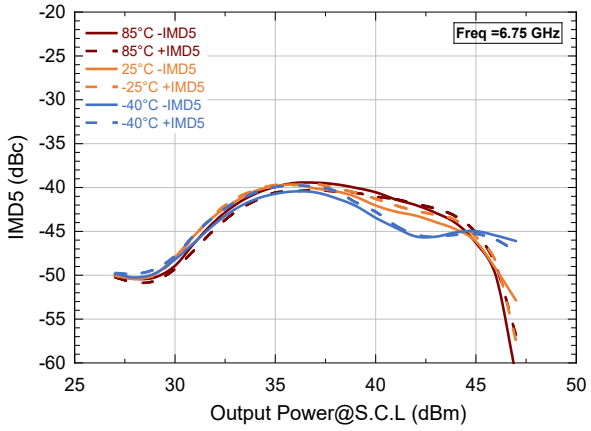
IMD5 vs. Output Power @ S.C.L and Temperature



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



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



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

CW, Two Tone, ΔF = 150 MHz, V_{DS} = 40 V, I_{DQ} = 800 mA, T_C = 25°C (Unless Otherwise Noted)
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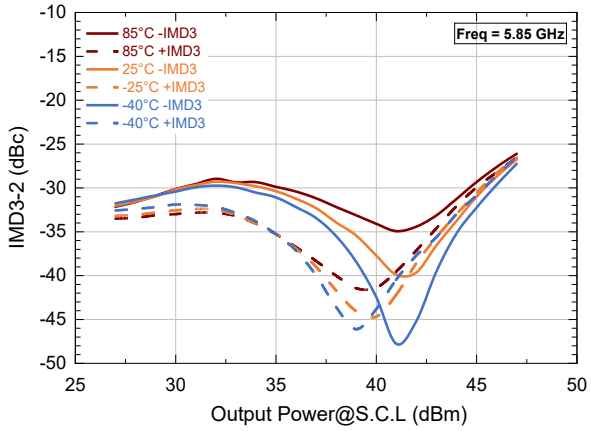
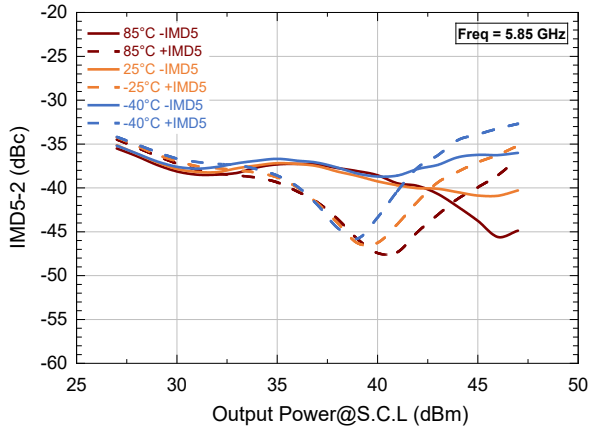
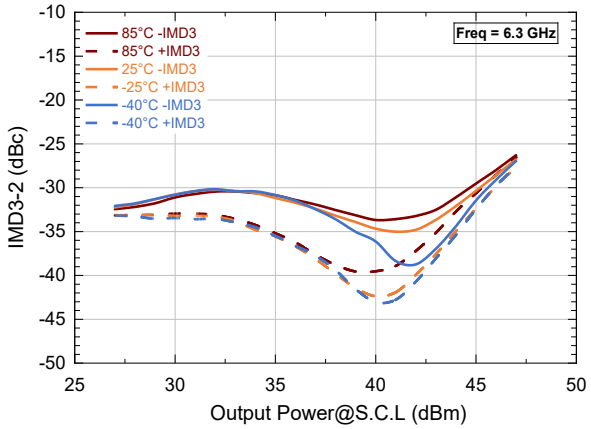
IMD3-2 vs. Output Power @ S.C.L and Temperature



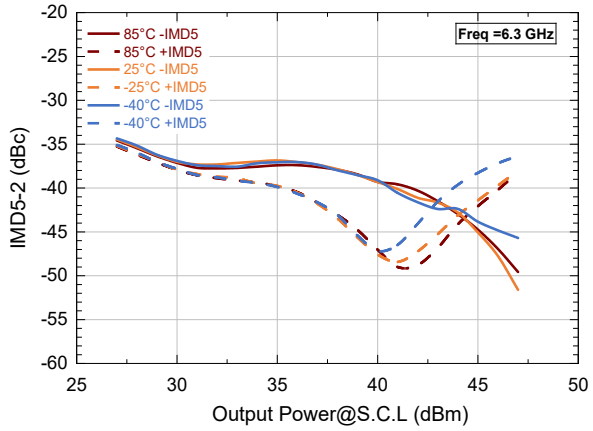
IMD5-2 vs. Output Power @ S.C.L and Temperature



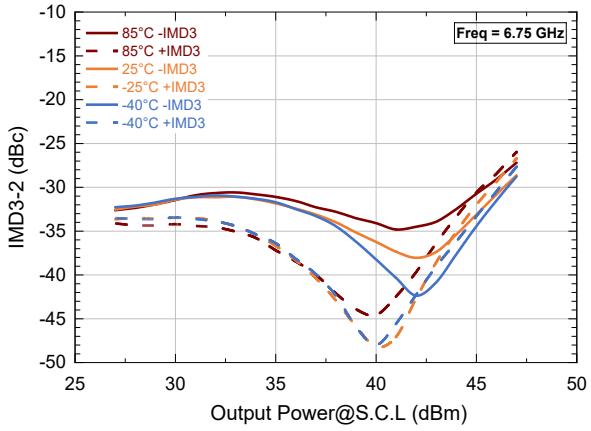
IMD3-2 vs. Output Power @ S.C.L and Temperature



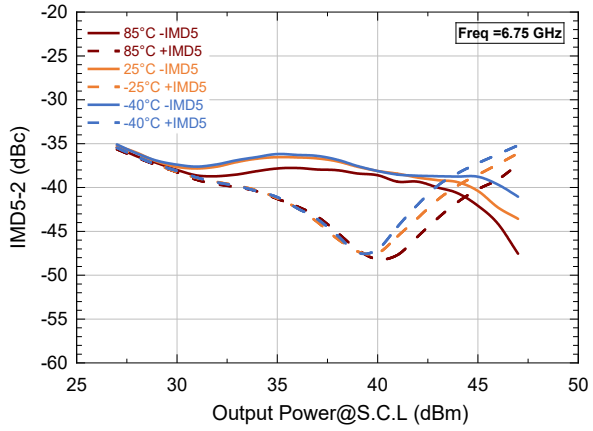
IMD5-2 vs. Output Power @ S.C.L and Temperature



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

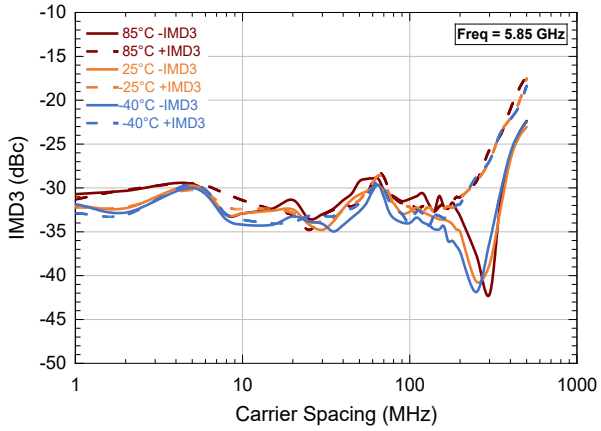


IMD5-2 vs. Output Power @ S.C.L and Temperature

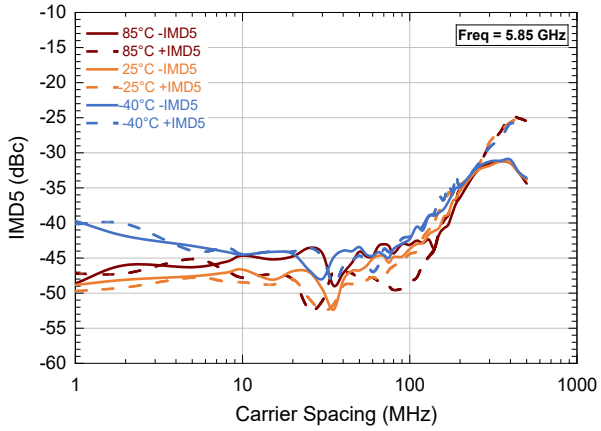


Typical Performance Curves as Measured in the Evaluation Test Fixture[1]:
CW, Two Tone, Po = 44 dBm S.C.L, V_{DS} = 40 V, I_{DQ} = 800 mA (Unless Otherwise Noted)
For Engineering Evaluation Only - This data does not Modify MACOM's Datasheet Limits.

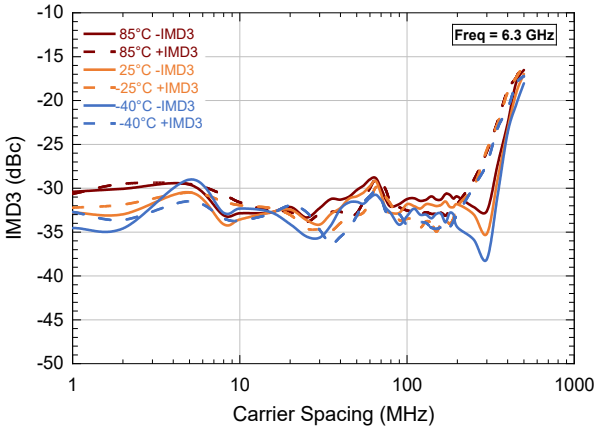
IMD3 vs. Two-Tone Spacing and Temperature



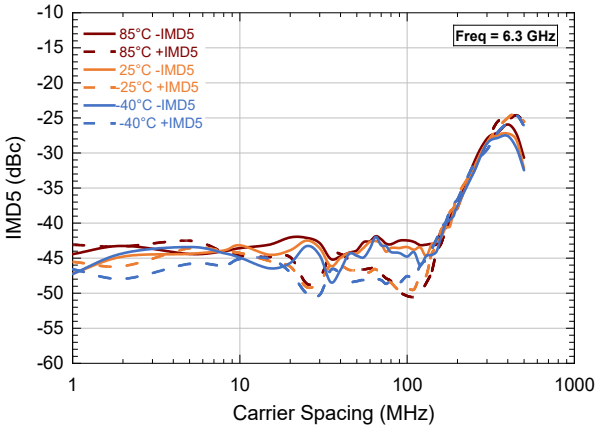
IMD5 vs. Two-Tone Spacing and Temperature



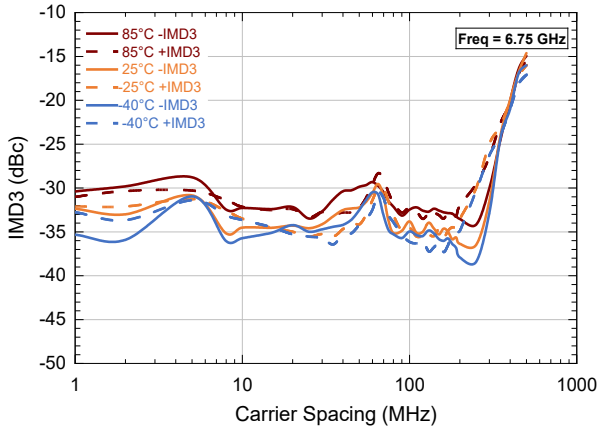
IMD3 vs. Two-Tone Spacing and Temperature



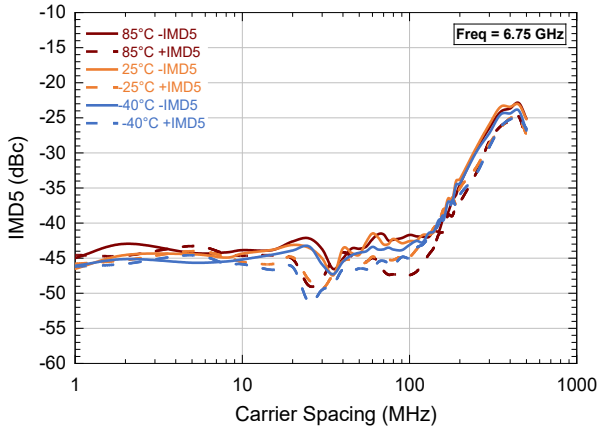
IMD5 vs. Two-Tone Spacing and Temperature



IMD3 vs. Two-Tone Spacing and Temperature



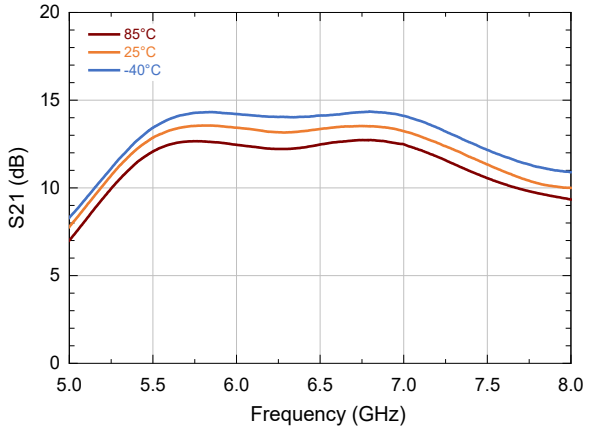
IMD5 vs. Two-Tone Spacing and Temperature



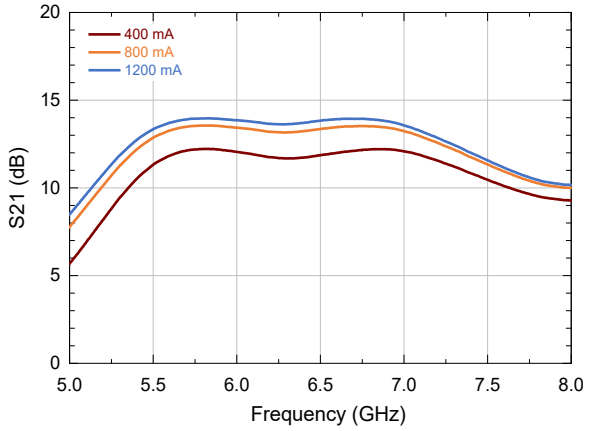
Typical Performance Curves as Measured in the Evaluation Test Fixture[1]:

V_{DS} = 40 V, I_{DQ} = 600 mA, T_C = 25°C (Unless Otherwise Noted)
For Engineering Evaluation Only—This data does not Modify MACOM's Datasheet Limits.

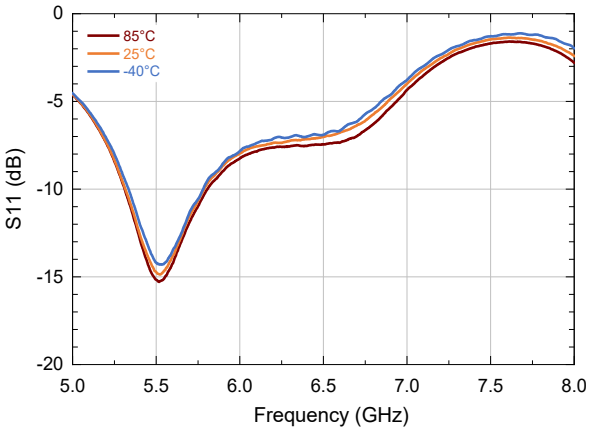
S21 vs Frequency and Temperature



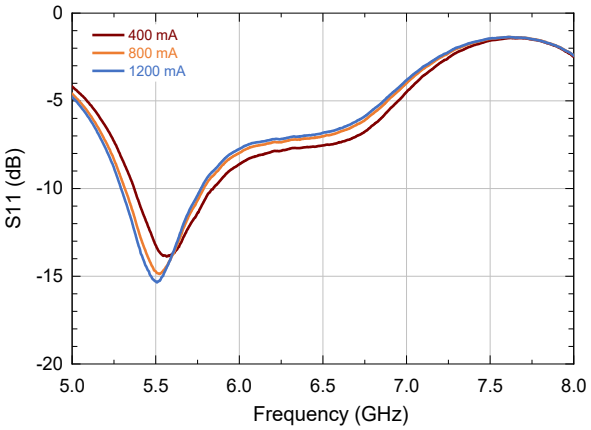
S21 vs Frequency and I_{DQ}



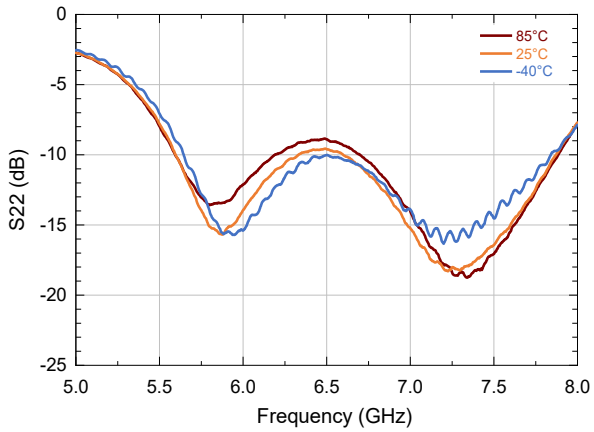
S11 vs Frequency and Temperature



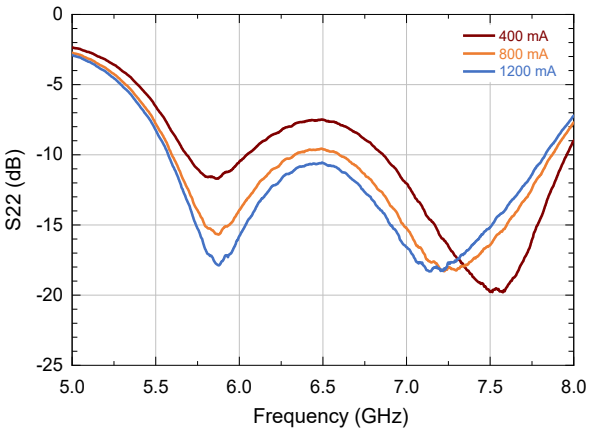
S11 vs Frequency and I_{DQ}



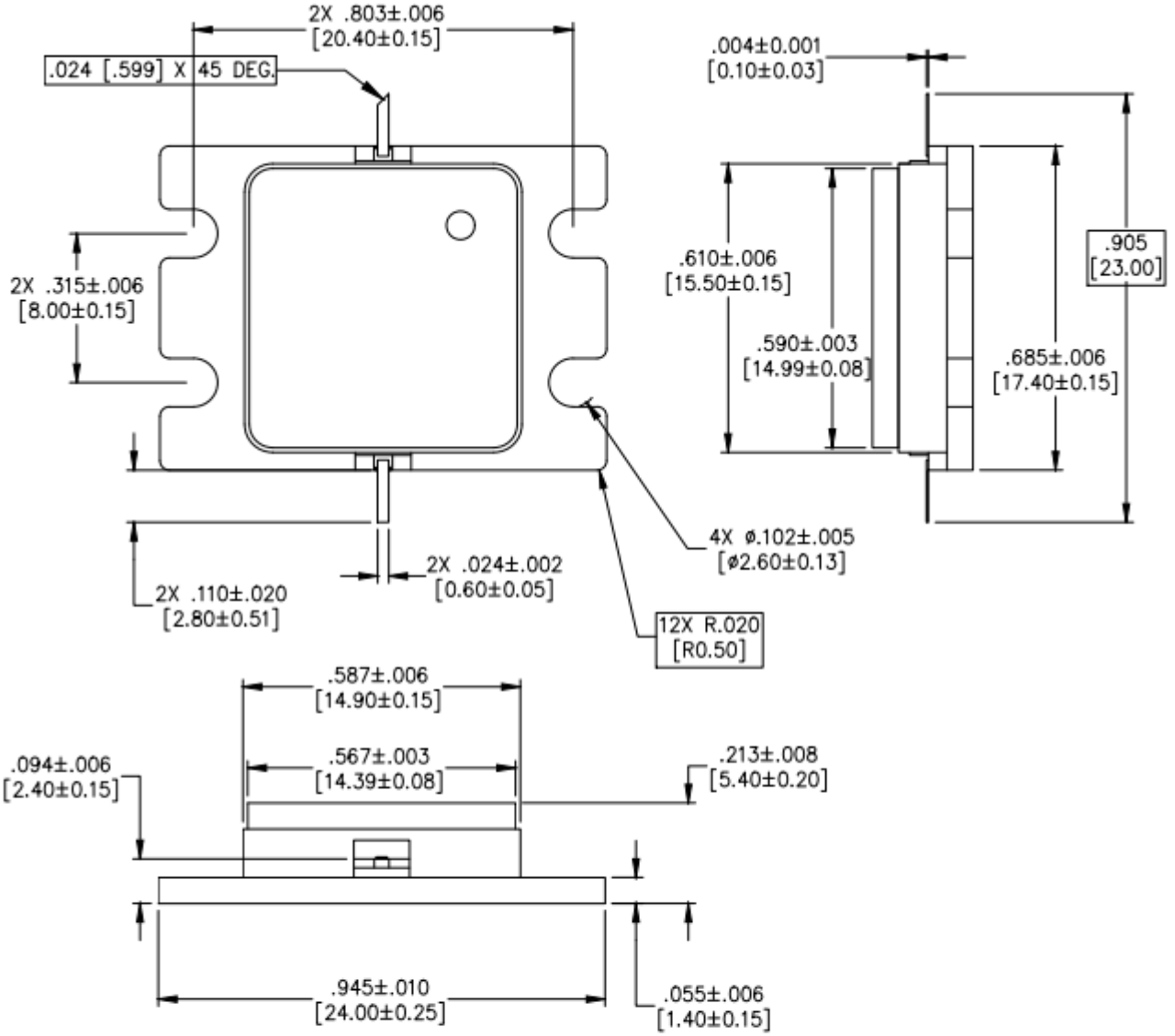
S22 vs Frequency and Temperature



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.