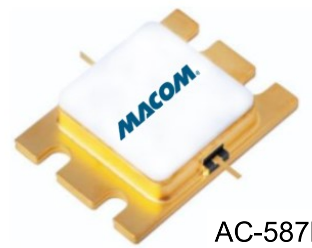
GaN Amplifier 50 V, 630 W, Pulsed
1.2 GHz - 1.4 GHz

MACOM PURE CARBIDE™

CGHV14650F
Rev. V2

Features

- *MACOM PURE CARBIDE*™ Amplifier Series
- Suitable for pulse application
- Pulsed Operation: 630 W Output Power
- 260°C Reflow Compatible
- 50 V Operation
- 100% RF Tested
- RoHS* Compliant



AC-587BH-2

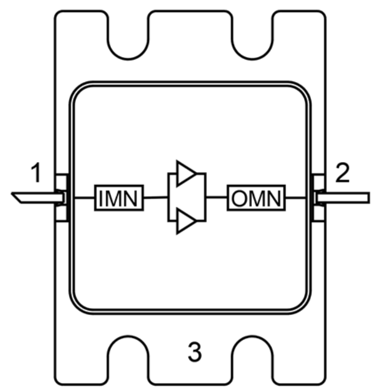
Applications

- L– band pulsed radar application
- Avoinics –TACAN, DEM, IFF
- General purpose amplification

Description

The CGHV14650F is a 630 W packaged amplifier fully matched to 50 Ohms at both input and output ports. Utilizing the high performance, 50 V, GaN on SiC production process, the CGHV14650F operates from 1.2–1.4 GHz, and typically achieves 630 W output power with 15.5 dB large signal gain and 65% drain efficiency under pulsed application.

Functional Schematic



Typical Performance:

Measured under Evaluation Test Fixture[1] at P_{IN} = 42 dBm, 100 µs pulse width, 10% duty cycle.

- V_{DS} = 50 V, I_{DQ} = 500 mA, T_C = 25°C

Frequency (GHz)	Output Power (dBm)	Gain (dB)	η_D (%)
1.2	57.8	15.8	70
1.3	57.9	15.9	68
1.4	57.8	15.8	67

1. Performance values and curves in this data sheet were measured in this fixture.

Pin Configuration

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

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

Ordering Information[2]

Part Number	Package
CGHV14650F	Bulk Quantity
CGHV14650F-AMP	Sample Board

2. Shipped in trays

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

RF Electrical Characteristics: T_C = 25°C, V_{DS} = 50 V, I_{DQ} = 500 mA
Note: Performance in MACOM Evaluation Test Fixture, 50 Ω system

Parameter	Test Conditions	Symbol	Min.	Typ.	Max.	Units
Output Power	Pulsed[5], P_{IN} = 42 dBm 1.2 GHz 1.3 GHz 1.4 GHz	P_{OUT}	57.78 58.00 57.67	58.03 58.27 58.01	—	dBm
Drain Efficiency	Pulsed[5], P_{IN} = 42 dBm 1.2 GHz 1.3 GHz 1.4 GHz	η	66 64 61	70 69 66	—	%
Large Signal Gain	Pulsed[5], P_{IN} = 42 dBm 1.2 GHz 1.3 GHz 1.4 GHz	G_P	15.0 15.0 15.0	15.8 15.9 15.8	—	dB
Small Signal Gain	CW, 1.2 - 1.4 GHz, P_{IN} = -20 dBm	S21	—	18.0	—	dB
Input Return Loss	CW, 1.2 - 1.4 GHz, P_{IN} = -20 dBm	S11	—	-7.8	—	dB
Output Return Loss	CW, 1.2 - 1.4 GHz, P_{IN} = -20 dBm	S22	—	-5.8	—	dB
Ruggedness: Output Mismatch	Pulsed[5], All phase angles	Ψ	VSWR = 2.5:1, No Damage, Stable			

Note: Final testing and screening for all amplifier sales is performed using the CGHV14650F-AMP

5. Pulse details: 100 µs pulse width, 10% Duty Cycle.

DC Electrical Characteristics[6] T_A = 25°C

Parameter	Test Conditions	Min.	Typ.	Max.	Units
Gate Threshold Voltage (V_T)	V_{DS} = 10 V, I_D = 83.6 mA	-3.8	-3.0	-2.3	V
Gate Quiescent Voltage (V_{GSQ})	V_{DS} = 50 V, I_D = 500 mA	—	-2.7	—	V
Saturated Drain Current[6] (I_{DSAT})	V_{DS} = 6 V, V_{GS} = 2 V	62.7	75.5	—	A
Drain-Source Breakdown Voltage (V_{GSQ})	V_{GS} = -8 V, I_D = 83.6 mA	125	—	—	V

6. Measured on wafer prior to packaging
7. Scaled from PCM data

Absolute Maximum Ratings[8,9,10,11]

Parameter	Absolute Maximum
Drain Source Voltage (V_{DS})	150 V
Gate Source Voltage (V_{GS})	-8 to 2 V
Gate Current (I_G)	83.6 mA
Storage Temperature Range	-65°C to +150°C
Case Operating Temperature Range	-40°C to +65°C
DC Drain Current	14 A
Channel Operating Temperature Range (T_{CH})	-40°C to +225°C
Absolute Maximum Channel Temperature	+225°C
Absolute Maximum RF Pulse Width	1000 µs
Absolute Maximum RF Pulse Duty Cycle	10%

8. Exceeding any one or combination of these limits may cause permanent damage to this device.
9. MACOM does not recommend sustained operation above maximum operating conditions.
10. Operating at drain source voltage V_{DS} < 55 V will ensure MTTF > 2 x 10^6 hours.
11. Operating at nominal conditions with T_{CH} ≤ 225°C will ensure MTTF > 2 x 10^6 hours.

Thermal Characteristics

Parameter	Test Conditions	Symbol	Typical	Units
DC Thermal Resistance using Finite Element Analysis[12]	V_{DS} = 50 V, T_C = 85°C 100 µs, 10%, P_{DISS} = 418 W	R_θ(FEA)	0.22	°C/W
Thermal Resistance using Infrared Measurement of Component Body Temperature[13]	V_{DS} = 50 V, I_{DQ} = 500 mA T_C = 65°C, P_{IN} = 42 dBm 1.4 GHz, 100 µs , 10%, P_{DISS} = 320 W	R_θ(IR)	0.20	°C/W
Thermal Resistance using Infrared Measurement of Component Body Temperature[13]	V_{DS} = 50 V, I_{DQ} = 500 mA T_C = 65°C, P_{IN} = 42 dBm 1.4 GHz, 1000 µs , 10%, P_{DISS} = 320 W	R_θ(IR)	0.20	°C/W

12. This information for reference only, at the recommended operation condition, T_{CH} will be less than 150°C.
13. In this product, the thermal limitation is on the maximum body temperature of the components used inside the package.

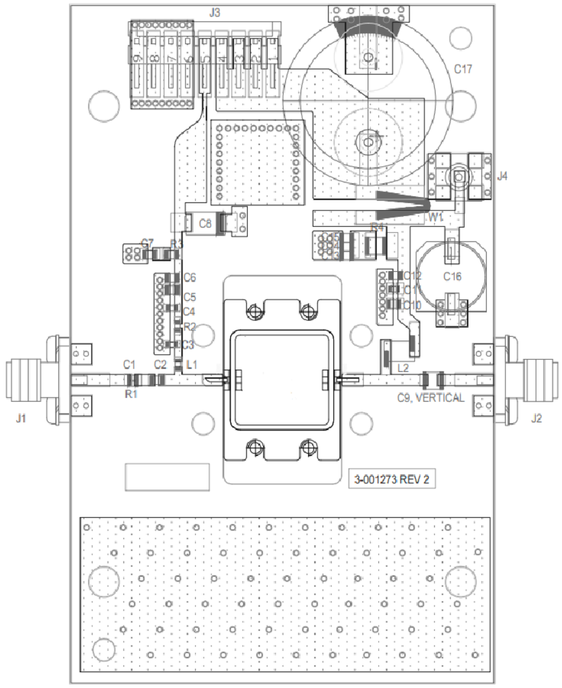
Handling Procedures

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 HBM Class 1B and CDM Class C2a devices.

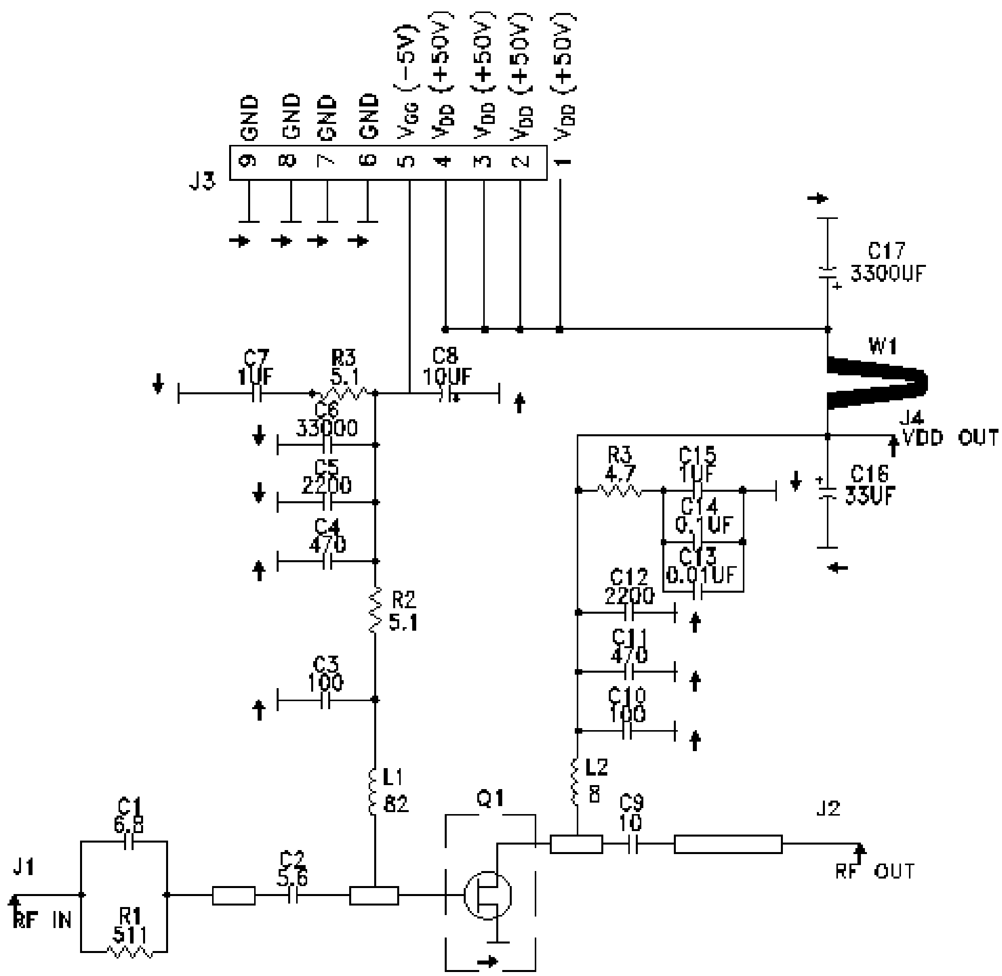
Evaluation Test Fixture[1] and Recommended Tuning Solution 1.2 – 1.4 GHz



Parts List

Reference Designator	Value	Tolerance	Manufacturer	Part Number
C1	6.8 pF	0.25 pF	Kyocera/AVX	ATC600S6R8CW250XT
C2	5.6 pF	0.1 pF	Kyocera/AVX	ATC600F5R6BW250XT
C3,C10	100 pF	5%	Kyocera/AVX	ATC600F100JW250XT
C4, C11	470 pF	5%	Murata	GRM39X7R471J100AD
C5,C12	2200 pF	10%	Murata	GRM155R72A222K01D
C6	33000 pF	10%	Murata	GRM21BR72A333KA01
C7,C15	1 µF	10%	Murata	GCJ21BC72A105KE02L
C8	10 µF	10%	Kemet	T496C106K016ATE2K0
C9	10 pF	0.1 pF	Kyocera/AVX	ACT800B100JW500XT
C13	0.01 µF	10%	Murata	GCJ21BC72A103KE02L
C14	0.1 µF	10%	Murata	GCJ21BC72A104KE02L
C16	33 µF	10%	Panasonic	EEE-2AA330P
C17	3300 µF	20%	Nichicon	UFW2A332MRD
R1	511 Ω	1%	Vishay/Dale	CRCW0603511RFKEC
R2, R3	5.1 Ω	1%	Vishay/Dale	CRCW06035R10FKEAC
R4	4.7 Ω	1%	Vishay/Dale	CRCW12064R70FKEAC
L1	82 nH	5%	Coilcraft	0603CS-82NXJEW
L2	8 nH	2%	Coilcraft	A03T
J1,J2	-	-	Gigalane	PSF-S00-000
J3	-	-	TE Connectivity	640457-9
J4	-	-	Cinch	131-3711-201
W1	-	-	-	18 AWG Black
Q1	MACOM GaN Power Amplifier			CGHV14650F
PCB	RO4350B, 30 mil, 2 oz. Cu (1 oz. CLAD, 1 oz. PLATED), Tin/Lead Finish			

Evaluation Test Fixture and Recommended Tuning Solution 1.2 – 1.4 GHz



Description

Parts measured on the evaluation board (30-mil thick RO4350B). 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 previous page.

Bias Sequencing

Turning the device ON

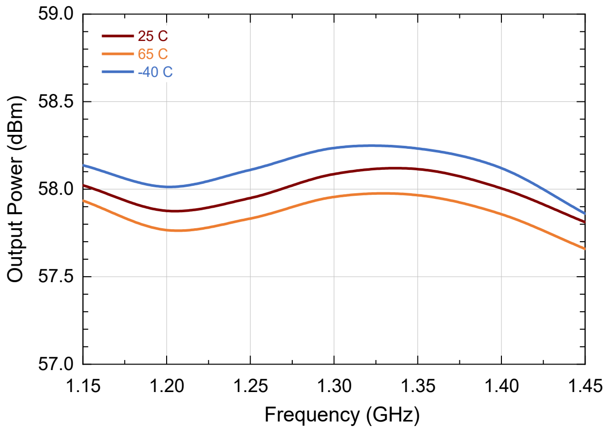
1. Set V_{GS} to pinch-off (V_P, typ. -5 V).
2. Turn on V_{DS} to nominal voltage (50 V).
3. Increase V_{GS} until I_{DS} current is reached.
4. Apply RF power to desired level.

Turning the device OFF

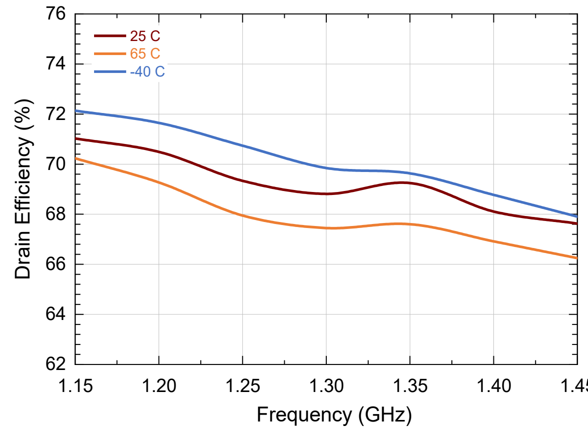
1. Turn the RF power OFF.
2. Decrease V_{GS} down to V_P pinch-off (typ. -5 V).
3. Decrease V_{DS} down to 0 V.
4. Turn off V_{GS}.

Typical Performance Curves as Measured in the Evaluation Test Fixture:
Pulsed 100 µs 10%, V_{DS} = 50 V, I_{DQ} = 500 mA, P_{IN} = 42 dBm (Unless Otherwise Noted)
For Engineering Evaluation Only—This data does not Modify MACOM's Datasheet Limits.

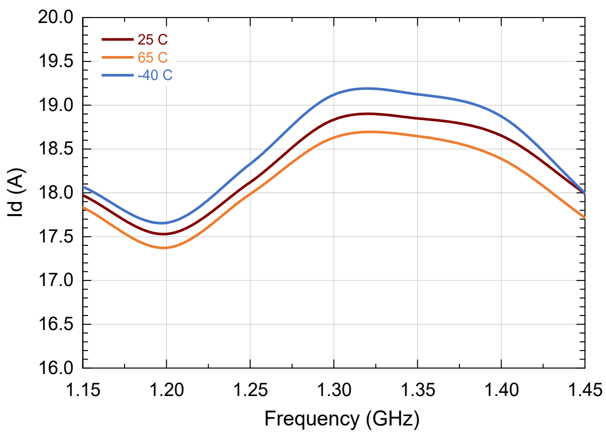
Output Power vs. Temperature and Frequency



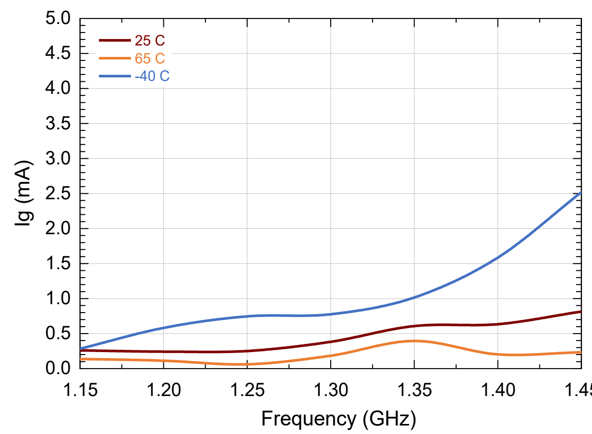
Drain Efficiency vs. Temperature and Frequency



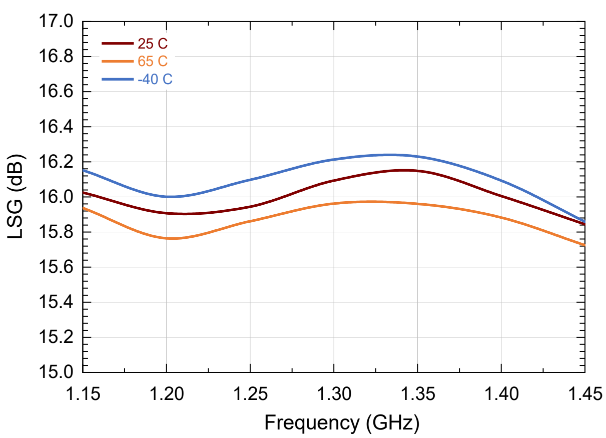
Drain Current vs. Temperature and Frequency



Gate Current vs. Temperature and Frequency



Large Signal Gain vs. Temperature and Frequency



Typical Performance Curves as Measured in the Evaluation Test Fixture:

Pulsed 1000 µs 10%, V_{DS} = 50 V, I_{DQ} = 500 mA, P_{IN} = 42 dBm (Unless Otherwise Noted)
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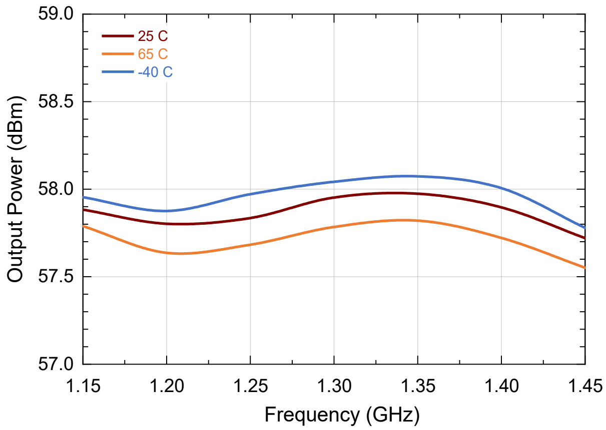
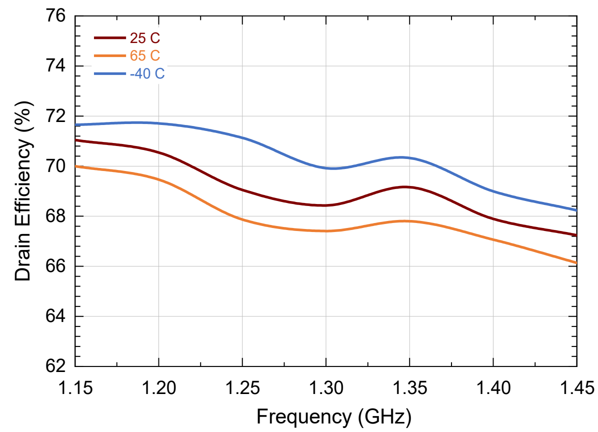
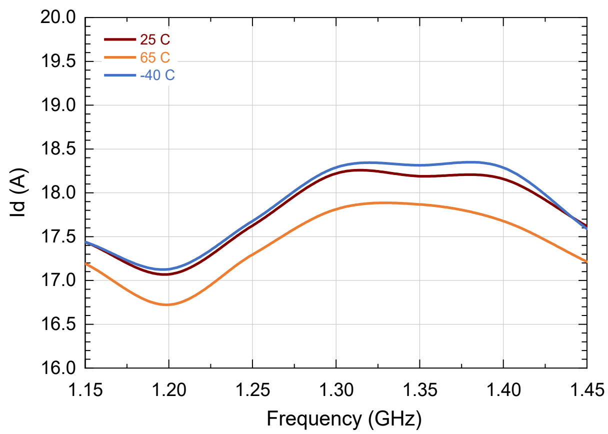
Output Power vs. Temperature and Frequency



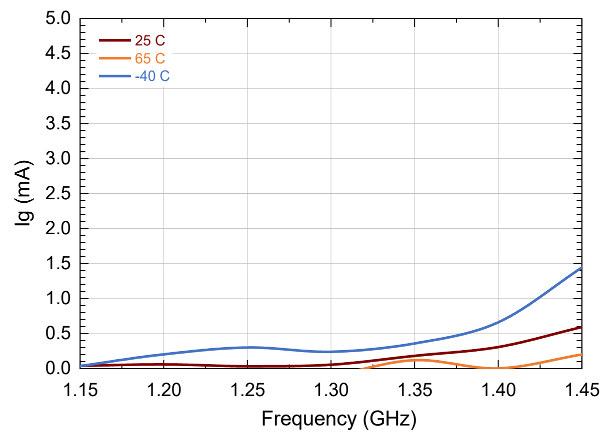
Drain Efficiency vs. Temperature and Frequency



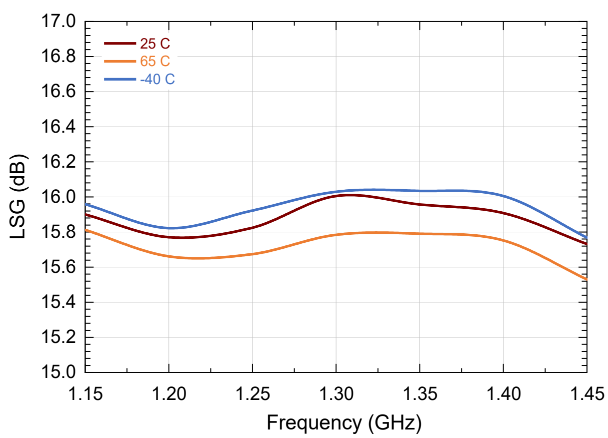
Drain Current vs. Temperature and Frequency



Gate Current vs. Temperature and Frequency



Large Signal Gain vs. Temperature and Frequency



Typical Performance Curves as Measured in the Evaluation Test Fixture:
Pulsed 100 µs 10%, I_{DQ} = 500 mA, Pin = 42 dBm, T_C = 25°C (Unless Otherwise Noted)
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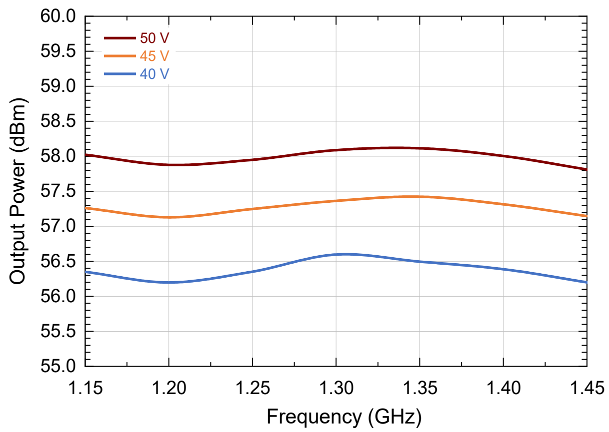
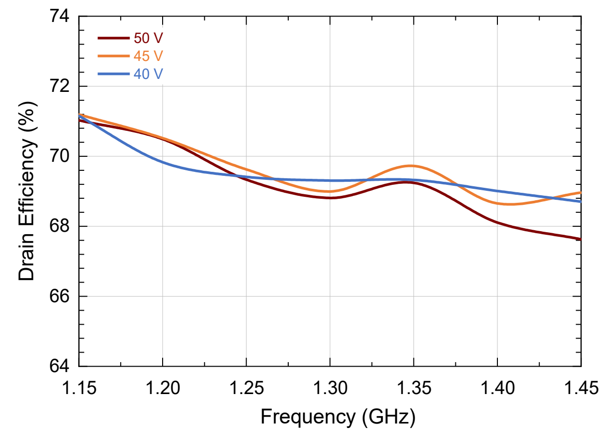
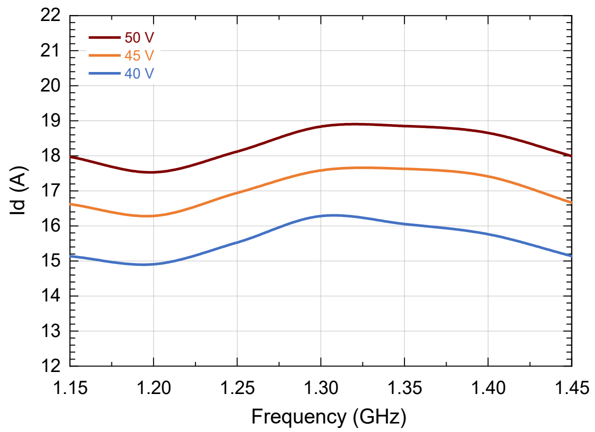
Output Power vs. V_{DS} and Frequency



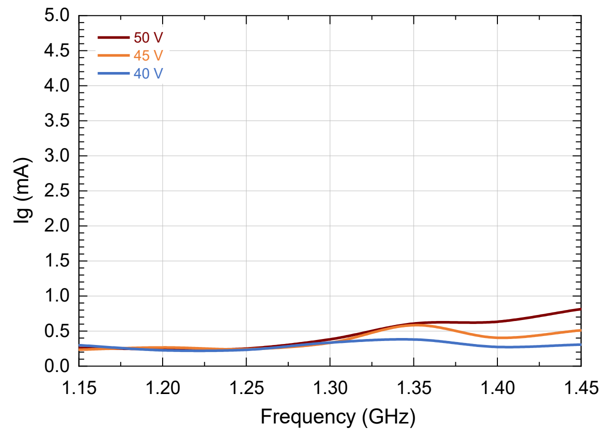
Drain Efficiency vs. V_{DS} and Frequency



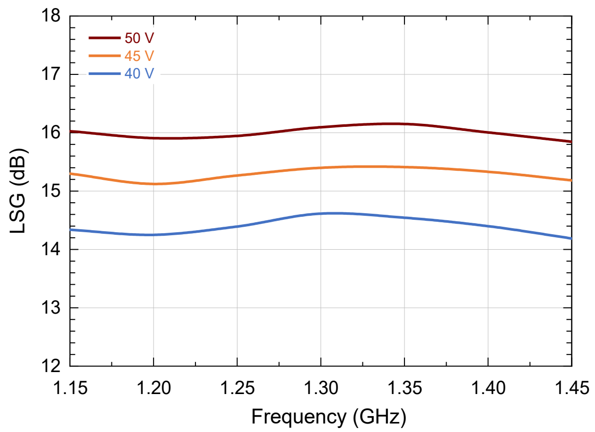
Drain Current vs. V_{DS} and Frequency



Gate Current vs. V_{DS} and Frequency



Large Signal Gain vs. V_{DS} and Frequency



Typical Performance Curves as Measured in the Evaluation Test Fixture:
Pulsed 100 us 10%, V_{DS} = 50 V, P_{IN} = 42 dBm, T_C = 25°C (Unless Otherwise Noted)
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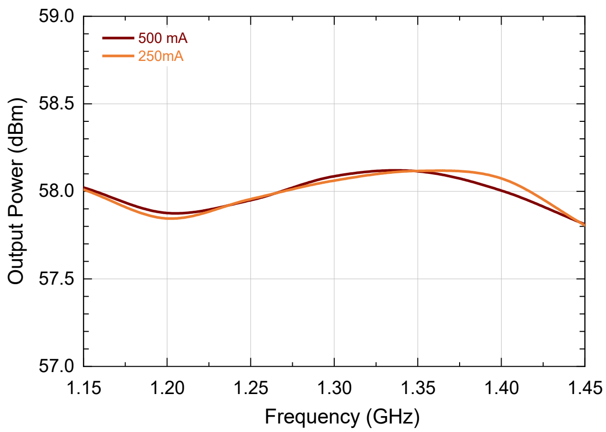
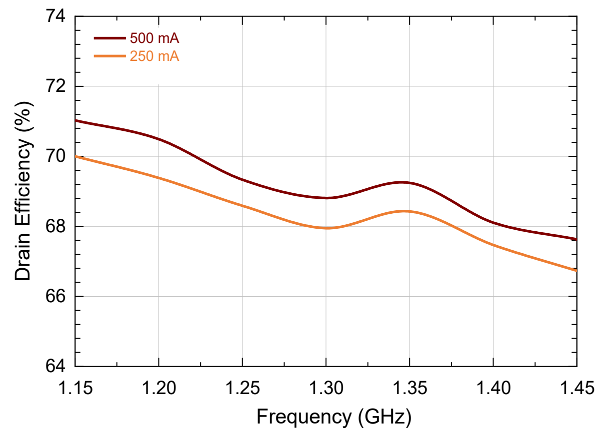
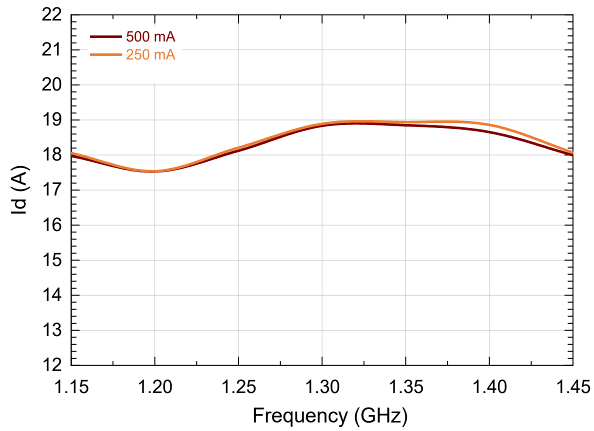
Output Power vs. I_{DQ} and Frequency



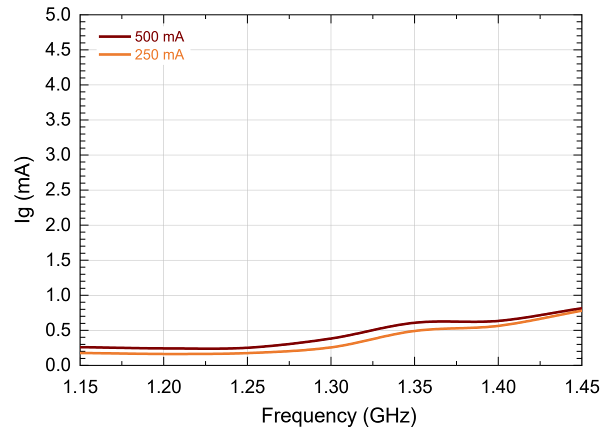
Drain Efficiency vs. I_{DQ} and Frequency



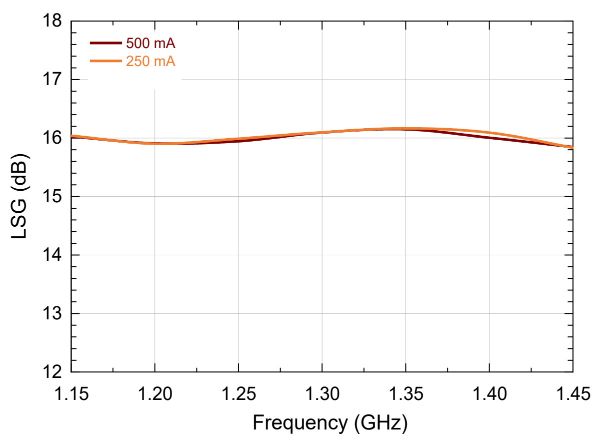
Drain Current vs. I_{DQ} and Frequency



Gate Current vs. I_{DQ} and Frequency

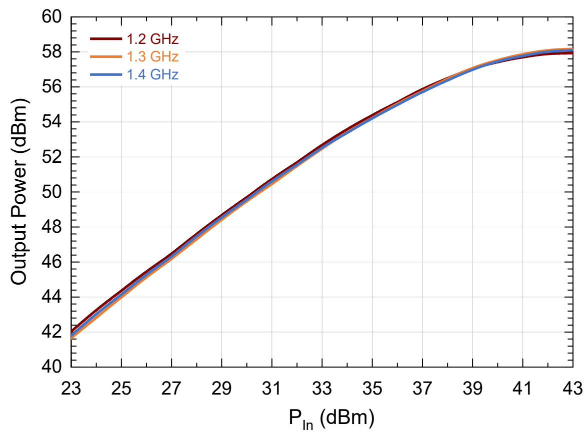


Large Signal Gain vs. I_{DQ} and Frequency

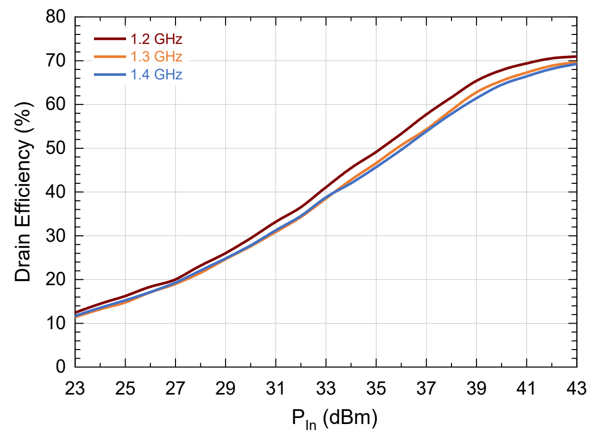


Typical Performance Curves as Measured in the Evaluation Test Fixture:
Pulsed 100 us 10%, V_{DS} = 50 V, I_{DQ} = 500 mA, T_C = 25°C (Unless Otherwise Noted)
For Engineering Evaluation Only—This data does not Modify MACOM's Datasheet Limits.

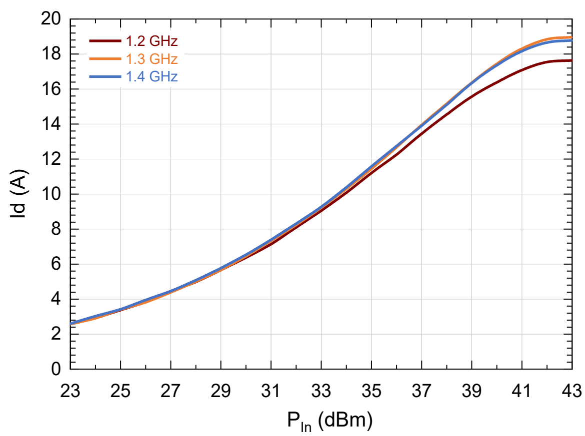
Output Power vs. Frequency and P_{IN}



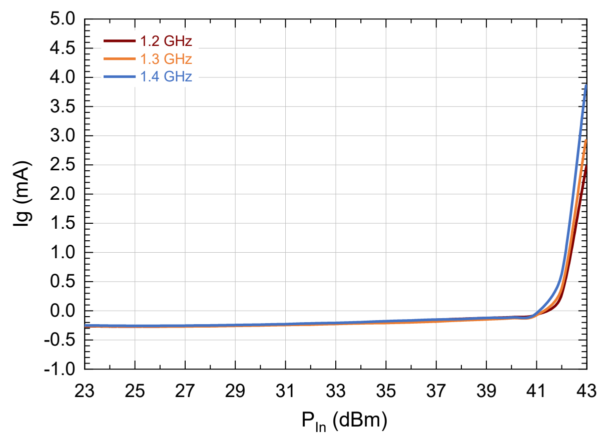
Drain Efficiency vs. Frequency and P_{IN}



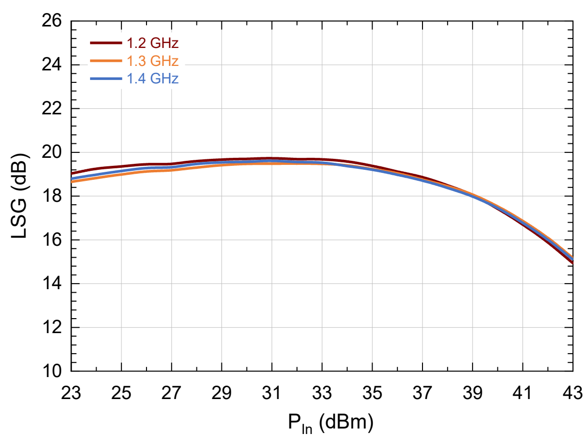
Drain Current vs. Frequency and P_{IN}



Gate Current vs. Frequency and P_{IN}

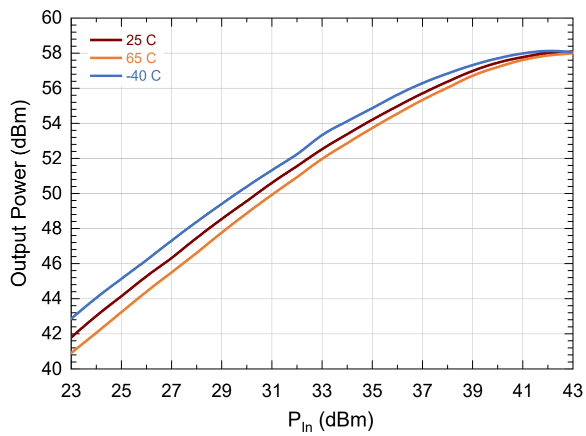


Large Signal Gain vs. Frequency and P_{IN}

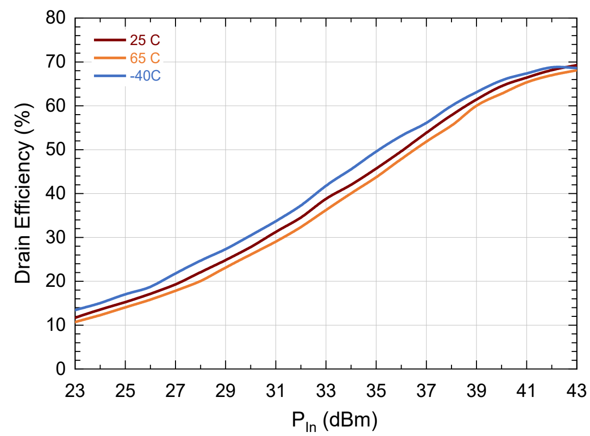


Typical Performance Curves as Measured in the Evaluation Test Fixture:
Pulsed 100 us 10%, V_{DS} = 50 V, I_{DQ} = 500 mA, Frequency = 1.4 GHz (Unless Otherwise Noted)
For Engineering Evaluation Only—This data does not Modify MACOM's Datasheet Limits.

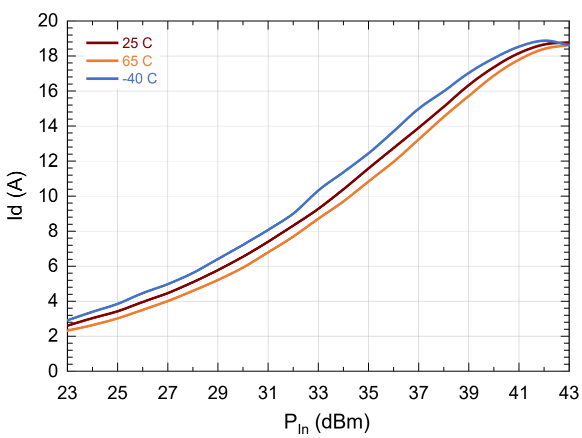
Output Power vs. Temperature and P_{IN}



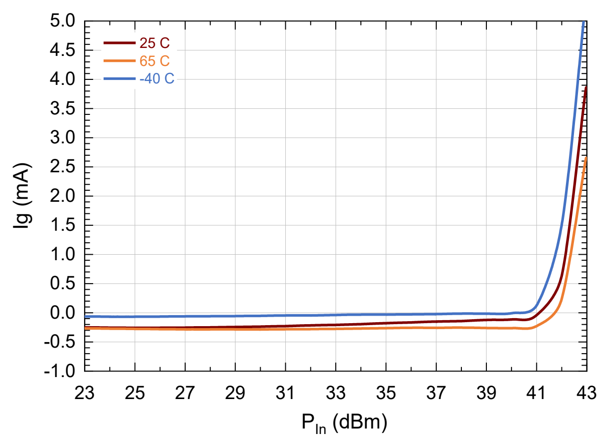
Drain Efficiency vs. Temperature and P_{IN}



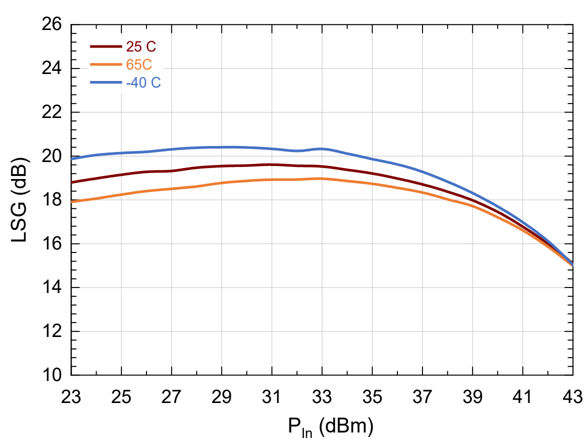
Drain Current vs. Temperature and P_{IN}



Gate Current vs. Temperature and P_{IN}

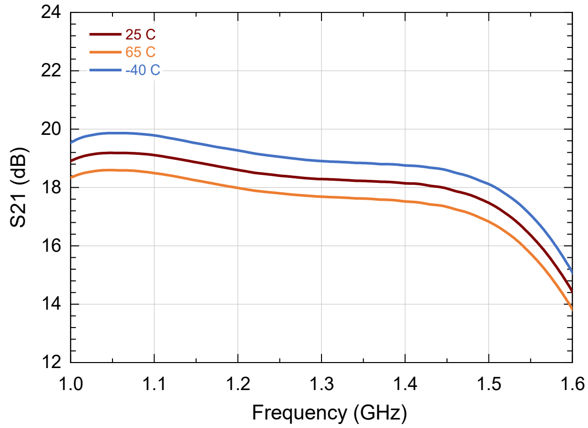


Large Signal Gain vs. Temperature and P_{IN}

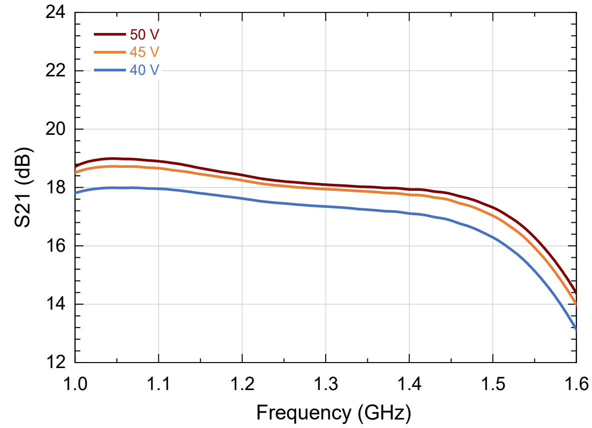


Typical Performance Curves as Measured in the Evaluation Test Fixture:
CW, V_{DS} = 50 V, I_{DQ} = 500 mA, P_{IN} = -20 dBm (Unless Otherwise Noted)
For Engineering Evaluation Only—This data does not Modify MACOM's Datasheet Limits.

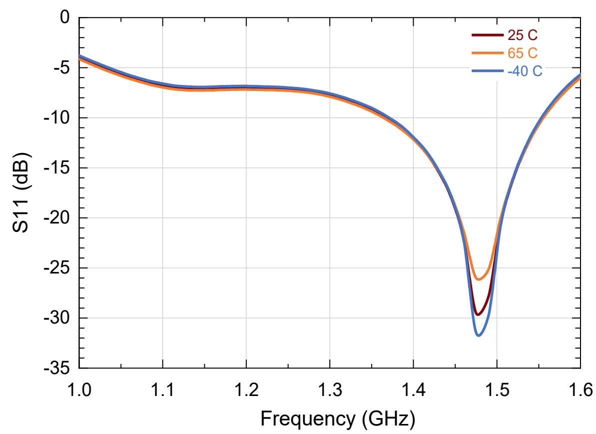
S21 vs Frequency and Temperature



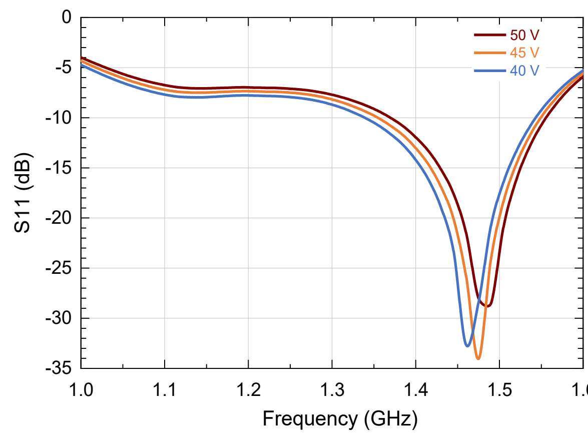
S21 vs Frequency and V_{DS}



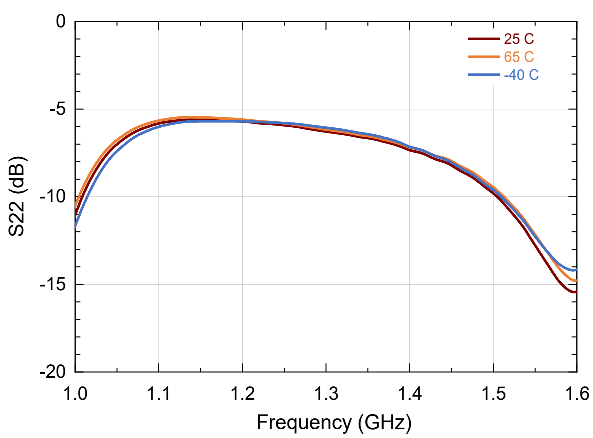
S11 vs Frequency and Temperature



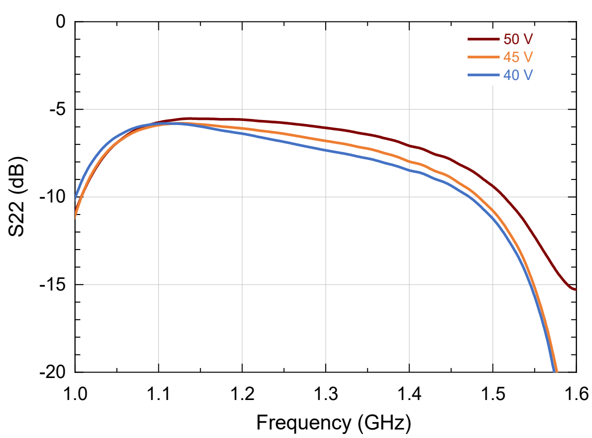
S11 vs Frequency and V_{DS}



S22 vs Frequency and Temperature

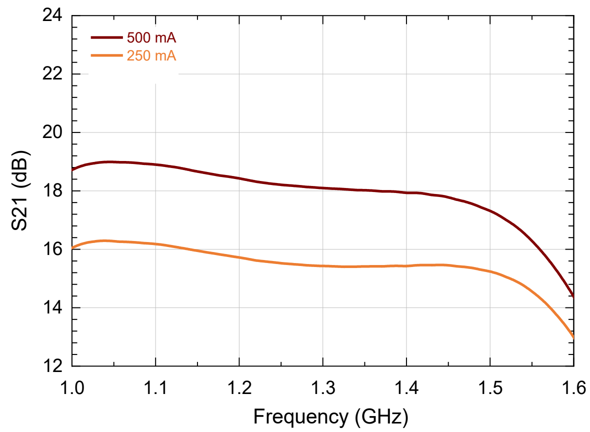


S22 vs Frequency and V_{DS}

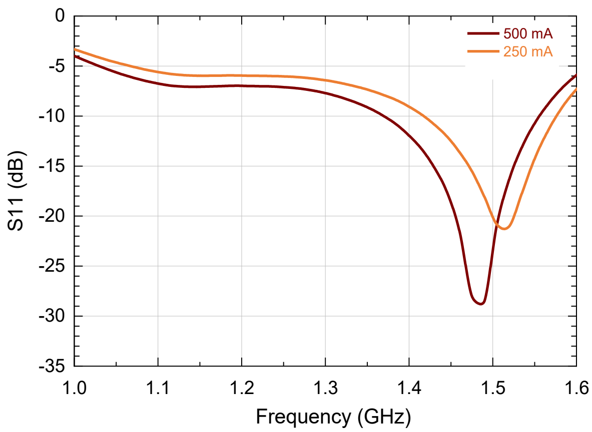


Typical Performance Curves as Measured in the Evaluation Test Fixture:
CW, V_{DS} = 50 V, I_{DQ} = 500 mA, P_{IN} = -20 dBm (Unless Otherwise Noted)
For Engineering Evaluation Only—This data does not Modify MACOM's Datasheet Limits.

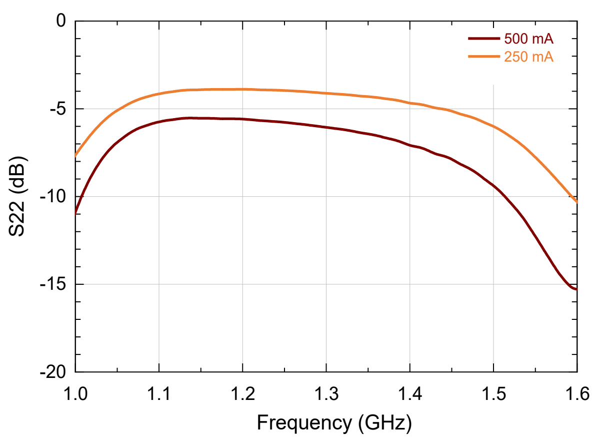
S21 vs Frequency and I_{DQ}



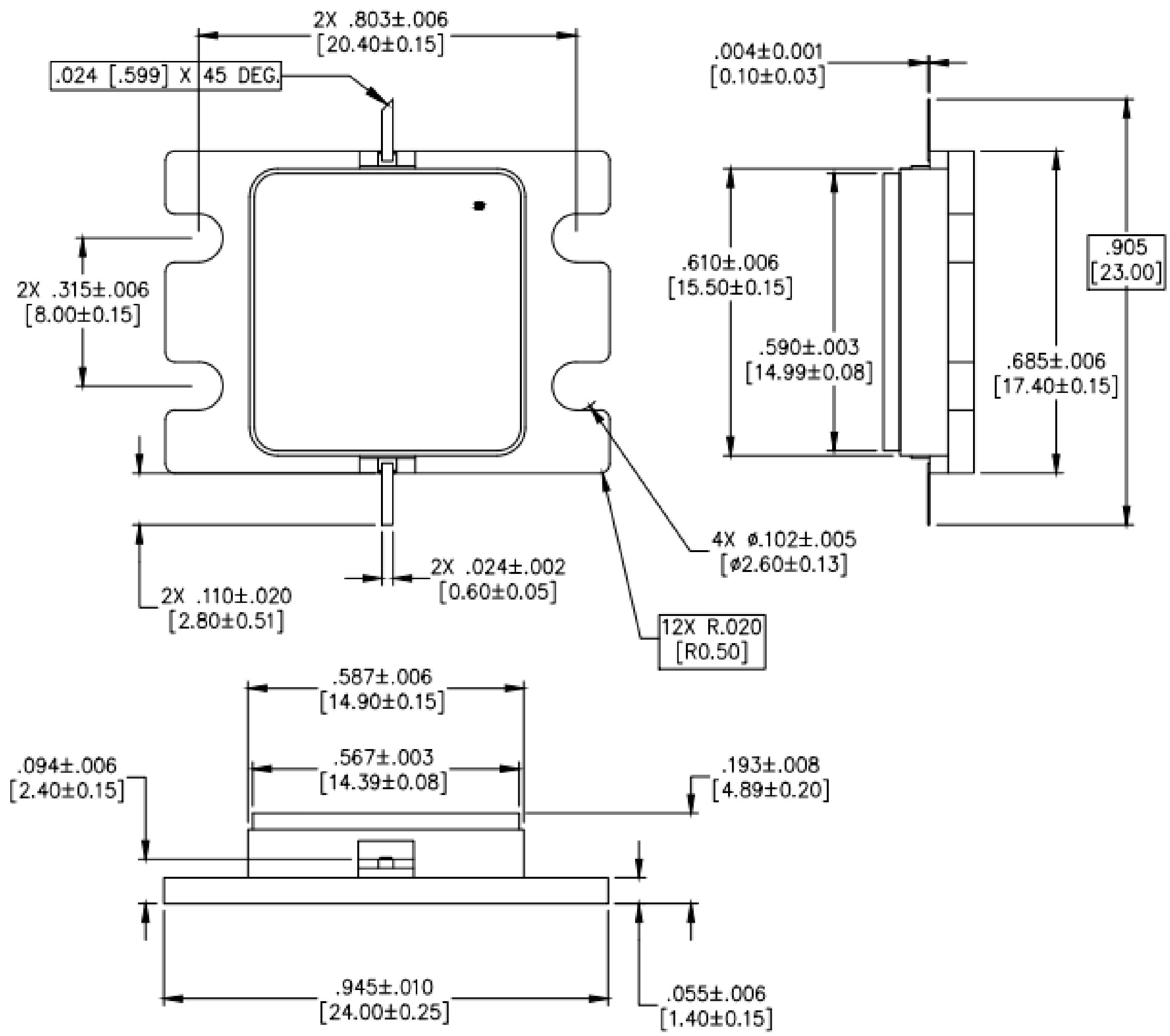
S11 vs Frequency and I_{DQ}



S22 vs Frequency and I_{DQ}



Lead-Free AC-587BH-2 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
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.
Plating is Au.