GaN Amplifier, 50 V, 600 W
1.2 - 1.4 GHz

Features
- *MACOM PURE CARBIDE*® Amplifier Series
- Suitable for pulse application
- Pulsed Operation: 600 W Output Power
- 260°C Reflow Compatible
- 50 V Operation
- 100% RF Tested
- RoHS* Compliant

AC-587BH-2

Applications
- L-band pulsed radar application
- Avionics –TACAN, DME, IFF
- General purpose amplification

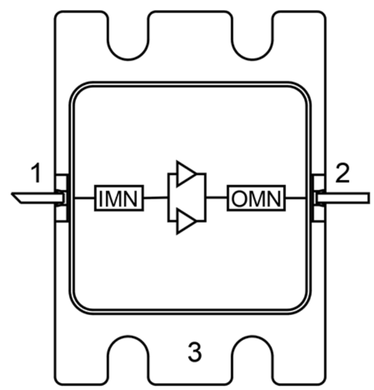
Description
The MAPC-A4027 is a 600 W packaged amplifier fully matched to 50 Ohms at input port. Utilizing the high performance, 50 V, GaN on SiC production process, the MAPC-A4027 operates from 1.2–1.4 GHz, and typically achieves 600 W output power with 14.6 dB large signal gain and 60% drain efficiency under pulsed application.

Typical Performance:
Measured under Evaluation Test Fixture[1] at P_{IN} = 43 dBm, 1 ms pulse width, 10% duty cycle.
- V_{DS} = 50 V, I_{DQ} = 550 mA, T_C = 25°C

Frequency (GHz)	Output Power (dBm)	Gain (dB)	η_D (%)
1.2	57.6	14.6	54
1.3	57.6	14.7	60
1.4	57.5	14.5	61

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

Functional Schematic



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
MAPC-A4027-AB000	Bulk Quantity
MAPC-A4027-ABSB1	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} = 550 mA
Note: Performance in MACOM Evaluation Test Fixture[1], 50 Ω system

Parameter	Test Conditions	Symbol	Min.	Typ.	Max.	Units
Output Power	Pulsed[4], P_{IN} = 43 dBm 1.2 GHz 1.3 GHz 1.4 GHz	P_{OUT}	—	57.6 57.6 57.5	—	dBm
Drain Efficiency	Pulsed[4], P_{IN} = 43 dBm 1.2 GHz 1.3 GHz 1.4 GHz	η	—	54 60 61	—	%
Large Signal Gain	Pulsed[4], P_{IN} = 43 dBm 1.2 GHz 1.3 GHz 1.4 GHz	G_P	—	14.6 14.7 14.5	—	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	—	-15	—	dB
Output Return Loss	CW, 1.2 - 1.4 GHz, P_{IN} = -20 dBm	S22	—	-6	—	dB
Ruggedness: Output Mismatch	Pulsed[4], All phase angles	Ψ	VSWR = 10:1, No Damage, Stable			

Note: Final testing and screening for all amplifier sales is performed using the MAPC-A4027-ABSB1

4. Pulse details: 1ms pulse width, 10% Duty Cycle.

RF Electrical Specifications: T_A = 25°C, V_{DS} = 50 V, I_{DQ} = 550 mA
Note: Performance in MACOM Production Test Fixture, 50 Ω system

Parameter	Test Conditions	Symbol	Min.	Typ.	Max.	Units
Output Power	Pulsed[5], P_{IN} = 43 dBm 1.2 GHz 1.4 GHz	P_{OUT}	57.0 56.8	58.0 57.8	—	dBm
Drain Efficiency	Pulsed[5], P_{IN} = 43 dBm 1.2 GHz 1.4 GHz	η	— 55	47 65	—	%
Large Signal Gain	Pulsed[5], P_{IN} = 43 dBm 1.2 GHz 1.4 GHz	G_P	14.0 13.8	15.0 14.8	—	dB

5. 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_{DLK}	—	—	11.62	mA
Gate-Source Leakage Current	V_{GS} = -8 V, V_{DS} = 10 V	I_{GLK}	-11.62	—	—	mA
Gate Threshold Voltage	V_{DS} = 50 V, I_D = 83.6 mA	V_T	-3.8	-3.0	-2.3	V
Gate Quiescent Voltage	V_{DS} = 50 V, I_D = 550 mA	V_{GSQ}	—	-2.7	—	V

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

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 +85°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	30%

6. Exceeding any one or combination of these limits may cause permanent damage to this device.
7. MACOM does not recommend sustained operation above maximum operating conditions.
8. Operating at drain source voltage V_{DS} < 55 V will ensure MTTF > 2 x 10^6 hours.
9. 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
Thermal Resistance using Finite Element Analysis	Pulsed 1ms, 10%, V_{DS} = 50 V T_C = 85°C, T_{CH} = 225°C	R_θ(FEA)	0.22	°C/W
Thermal Resistance using Infrared Measurement of Die Surface Temperature	Pulsed 1ms, 10%, V_{DS} = 50 V T_C = 85°C, T_{CH} = 225°C	R_θ(IR)	0.18	°C/W

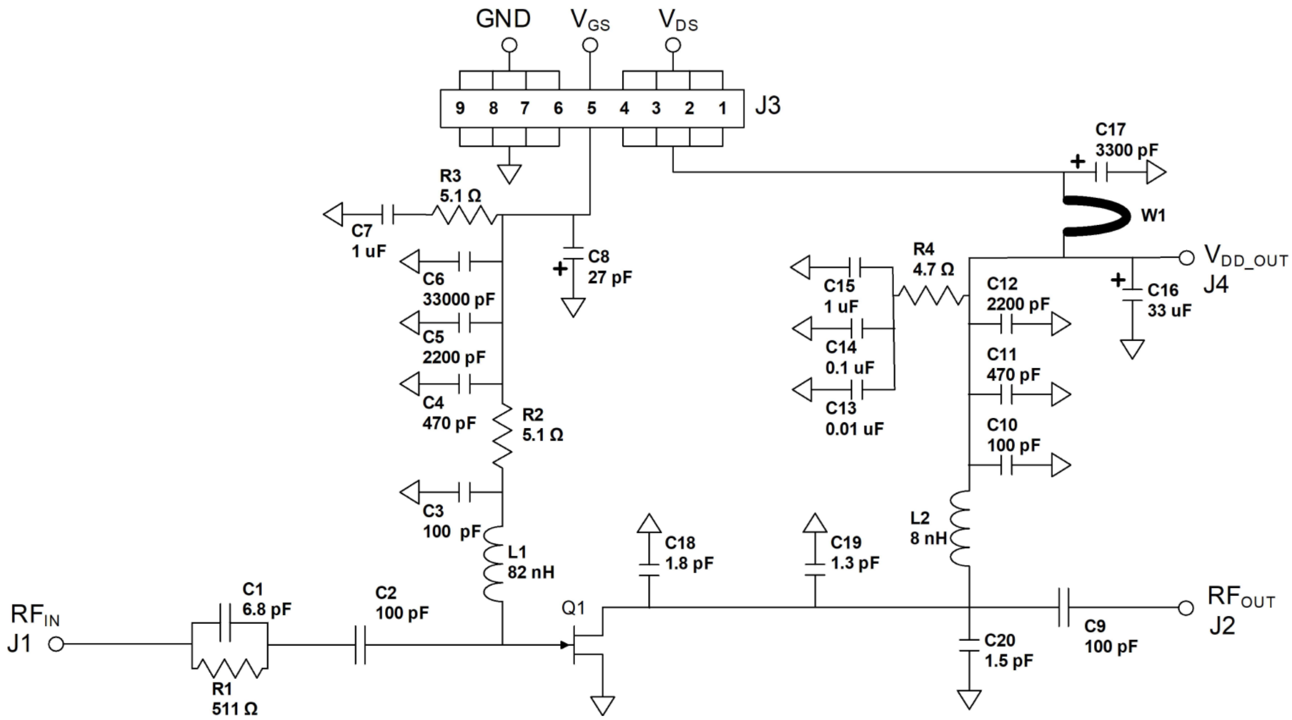
Handling Procedures

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.

Test Fixture and Recommended Tuning Solution 1.2 - 1.4 GHz



Description

Parts measured on 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 next page.

Bias Sequencing*

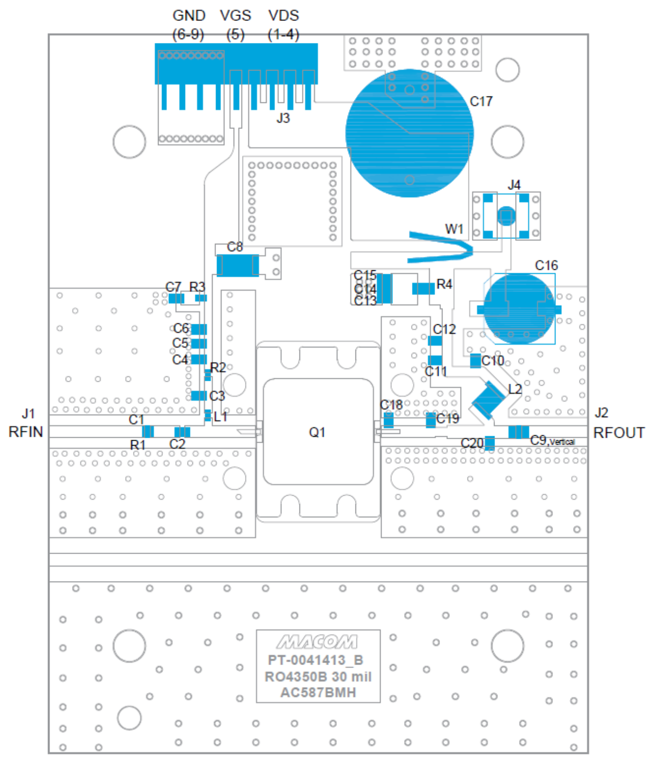
Turning the device ON

1. Set V_{GS} to pinch-off (-4 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 pinch-off voltage.
3. Decrease V_{DS} down to 0 V.
4. Turn off V_{GS}.

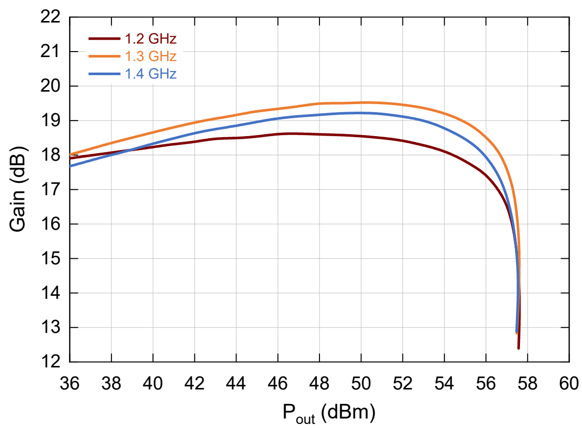
Test Fixture and Recommended Tuning Solution 1.2 - 1.4 GHz



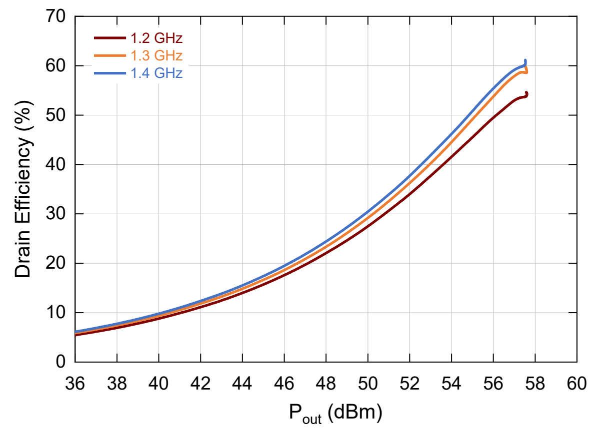
Reference Designator	Value	Tolerance	Manufacturer	Part Number
C1	6.8 pF	+/- 0.25 pF	Kyocera/AVX	ATC600S6R8CW250XT
C2,C3,C10	100 pF	+/- 5 %	Kyocera/AVX	ATC600F100JW250XT
C4, C11	470 pF	+/- 5 %	Murata	GRM2165C2A471JA01D
C5,C12	2200 pF	+/- 10 %	Murata	GRM155R72A222K01D
C6	33000 pF	+/- 10 %	Murata	GRM21BR72A333KA01
C7,C15	1 µF	+/- 10 %	Murata	GCJ21BC72A105KE02L
C8	10 µF	+/- 10 %	Kemet	T496C106K016ATE2K0
C9	100 pF	+/- 5 %	Kyocera/AVX	ATC800B101JW500XT
C13	0.01 µF	+/- 10 %	Murata	GCJ21BC72A103KE02L
C14	0.1 µF	+/- 10 %	Murata	GCJ21BC72A104KE02L
C16	33 µF	+/- 10 %	Panasonic	EEE-2AA330P
C17	3300 µF	+/- 10 %	Nichicon	UFW2A332MRD
C18	1.8 pF	+/- 0.1 pF	Kyocera/AVX	ATC600F1R8BT250XT
C19	1.3 pF	+/- 0.1 pF	Kyocera/AVX	ATC600F1R3BT250XT
C20	1.5 pF	+/- 0.1 pF	Kyocera/AVX	ATC600F1R5BT250XT
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-82NXJRW
L2	8 nH	+/- 5 %	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			MAPC-A4027-AB
PCB	RO4350B, 30 mil, 1 oz. Cu Metal, Au Finish			

Typical Performance Curves as Measured in the 1.2 - 1.4 GHz Test Fixture: Pulse Width = 1ms, Duty Cycle = 10%, 1.3 GHz, V_{DS} = 50 V, I_{DQ} = 550 mA, T_C = 25°C (Unless Otherwise Noted)

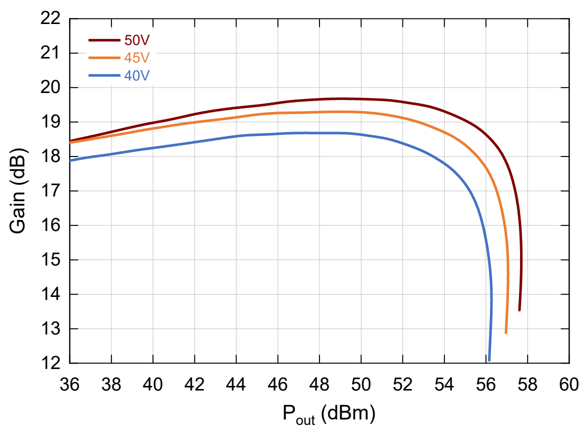
Gain vs. Output Power and Frequency



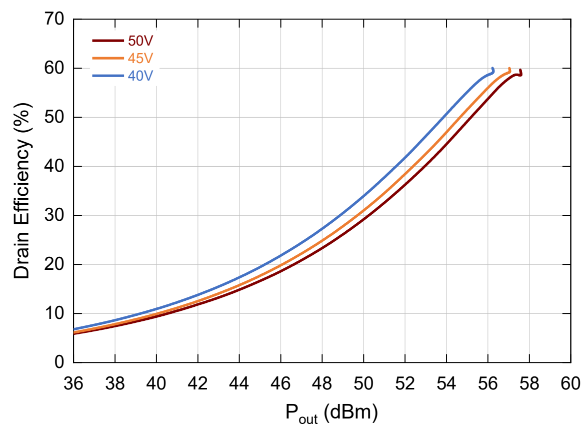
Drain Efficiency vs. Output Power and Frequency



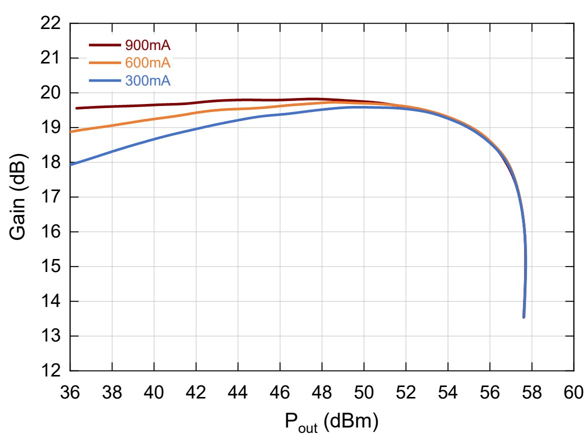
Gain vs. Output Power and V_{DS}



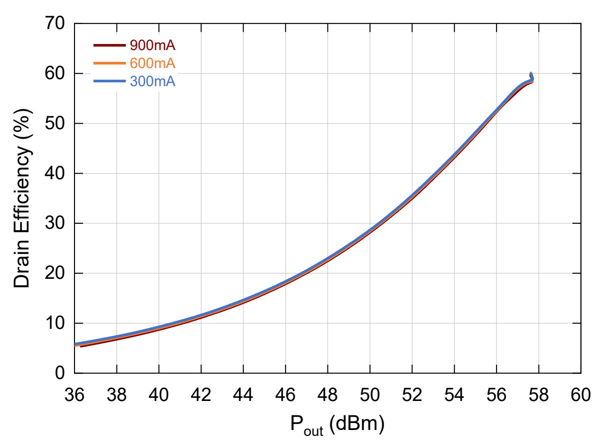
Drain Efficiency vs. Output Power and V_{DS}



Gain vs. Output Power and I_{DQ}

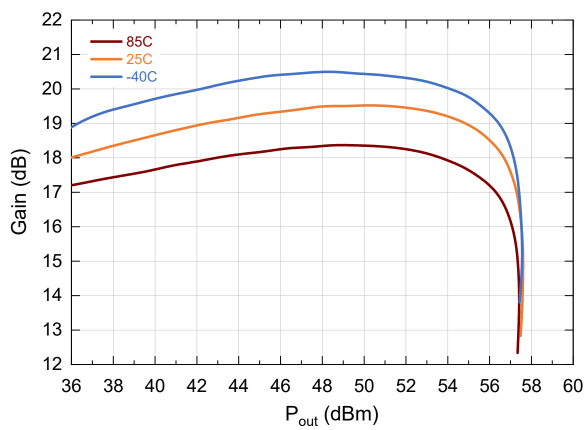


Drain Efficiency vs. Output Power and I_{DQ}

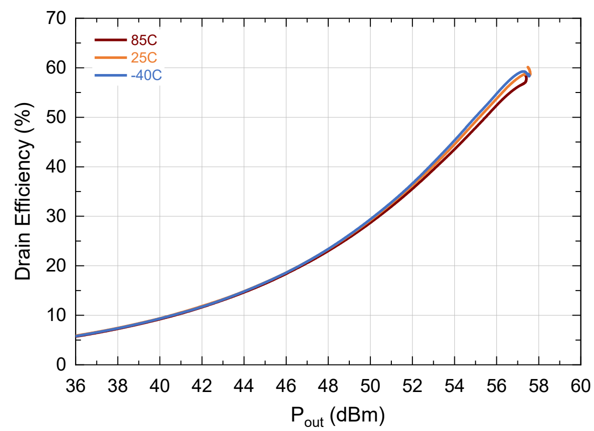


Typical Performance Curves as Measured in the 1.2 - 1.4 GHz Test Fixture: Pulse Width = 1ms, Duty Cycle = 10%, 1.3 GHz, V_{DS} = 50 V, I_{DQ} = 550 mA, T_C = 25°C (Unless Otherwise Noted)

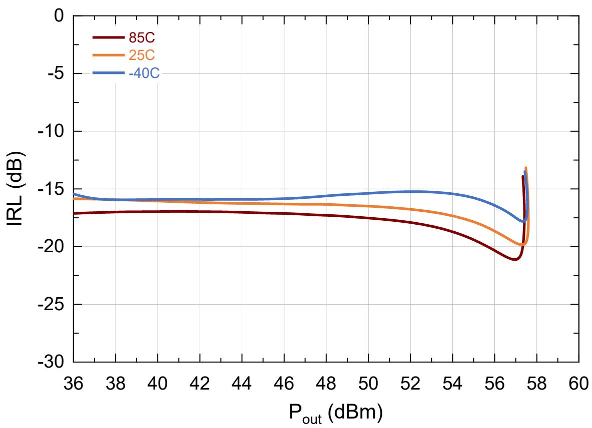
Gain vs. Output Power and T_C



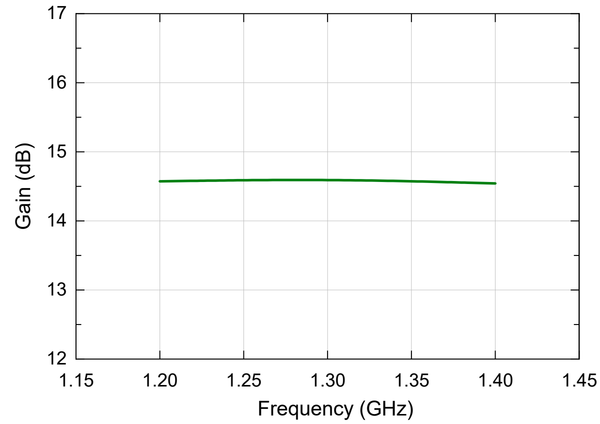
Drain Efficiency vs. Output Power and T_C



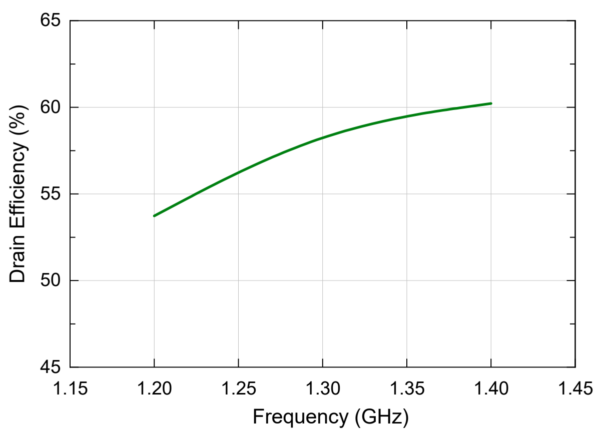
Input Return Loss vs. Output Power and T_C



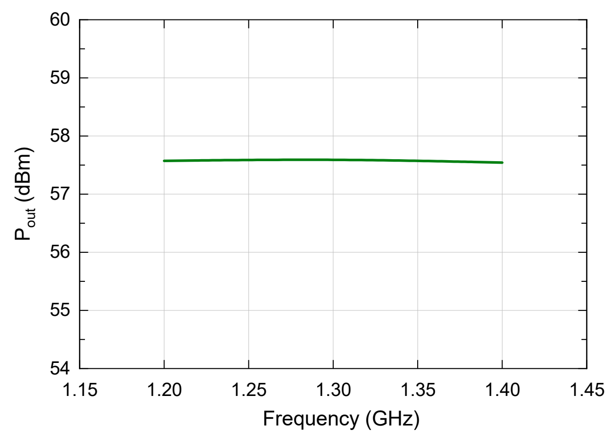
Gain vs. Frequency and RF_{IN} = 43dBm



Drain Efficiency vs. Frequency and RF_{IN} = 43dBm

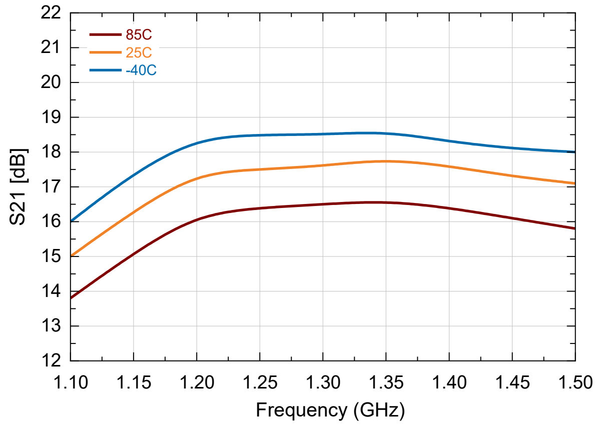


Output Power vs. Frequency and RF_{IN} = 43dBm

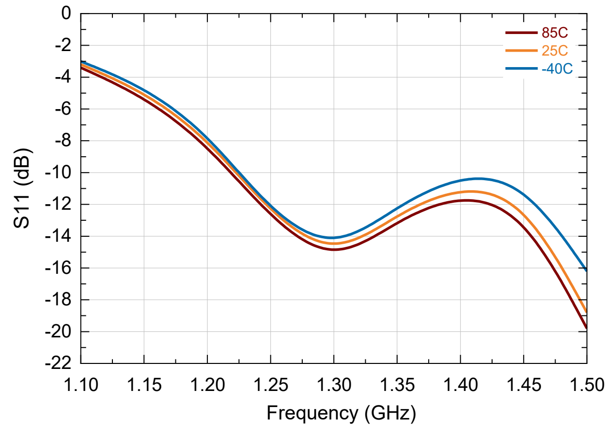


Typical Performance Curves as Measured in the 1.2 - 1.4 GHz Test Fixture:
CW, V_{DS} = 50 V, I_{DQ} = 550 mA, P_{IN}=-20 dBm, T_C = 25°C (Unless Otherwise Noted)

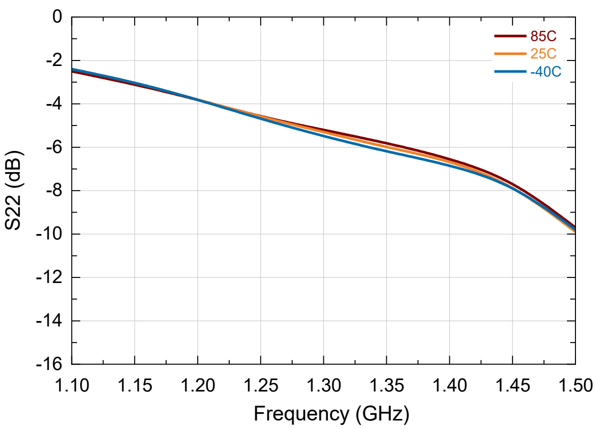
S21 vs. Frequency and T_C



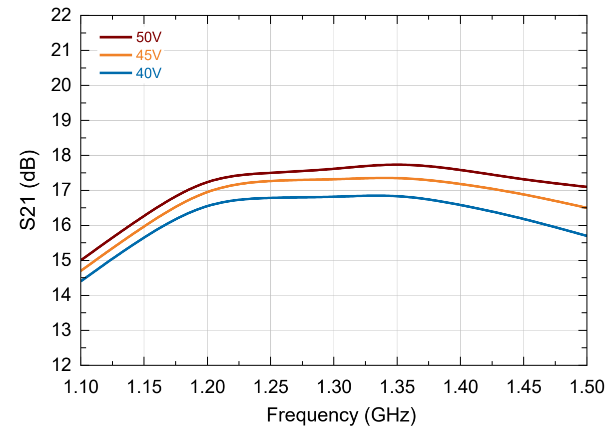
S11 vs. Frequency and T_C



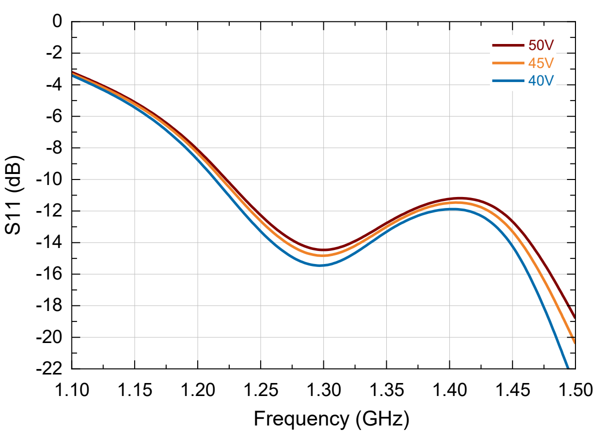
S22 vs. Frequency and T_C



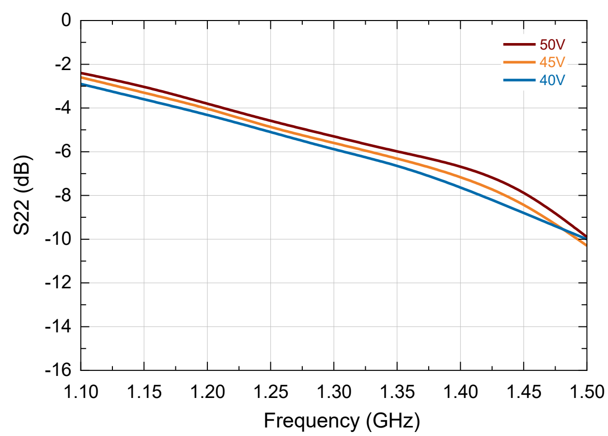
S21 vs. Frequency and V_{DS}



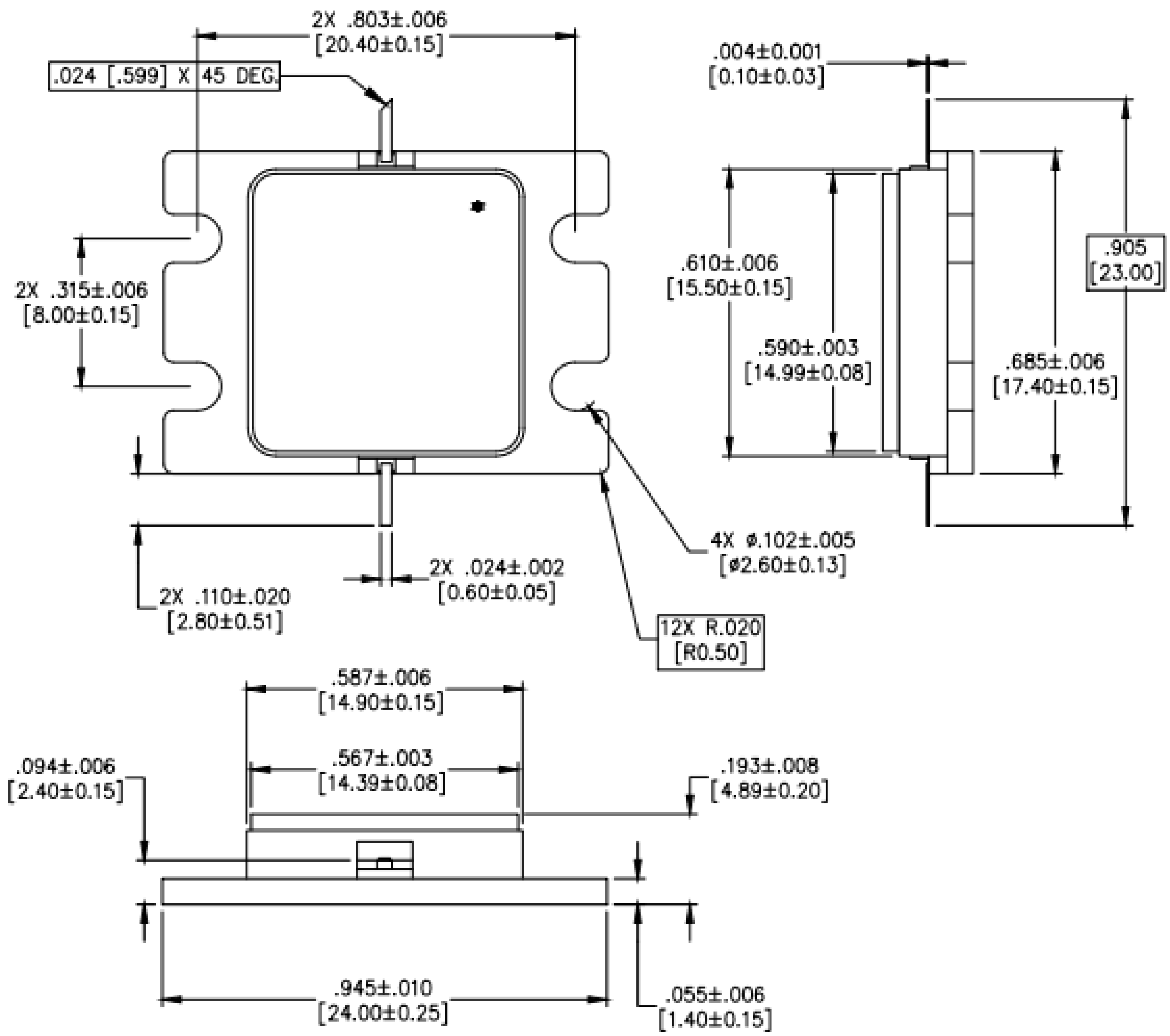
S11 vs. Frequency and V_{DS}



S22 vs. Frequency and V_{DS}



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.