Features

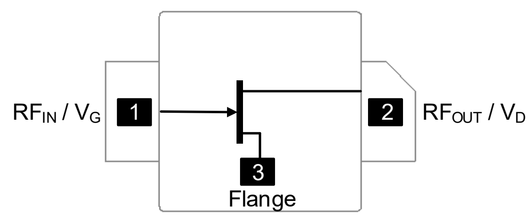
- Optimized for Cellular Base Station Applications
- Designed for Digital Predistortion Error Correction Systems
- High Terminal Impedances for Broadband Performance
- 50 V Operation
- 100% RF Tested
- RoHS* Compliant

AC-400S-2

Description

The MAGB-103638-150B0S is a GaN HEMT D-mode amplifier designed for cellular base station applications with 25 W average power and optimized for 3.6 - 3.8 GHz modulated signal operation. This device supports pulsed and linear operation with peak output power levels to 150 W (51.8 dBm) in an air cavity ceramic package.

Functional Schematic



Typical Performance:

- WCDMA 3GPP TM1 64 DPCH 9.9 dB PAR @ 0.01% CCDF. V_{DS} = 50 V, I_{DQ} = 440 mA, P_{OUT} = 44 dBm

Frequency (GHz)	GP (dB)	η_D (%)	Output PAR (dB)	ACPR (dBc)	IRL (dB)
3.6	15.5	31	7.1	-33	-7
3.7	16.2	34	7.0	-32	-8
3.8	15.5	38	6.8	-31	-9

Pin Configuration

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

1. The exposed pad centered on the package bottom must be connected to RF, DC and thermal ground.

Ordering Information

Part Number	Package
MAGB-103638-150B0S	Bulk Quantity
MAGB-103638-150BTS	Tape and Reel
MAGB-1B3638-150B0S	Class-AB Sample Board

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

RF Electrical Characteristics: T_C = 25°C, V_{DS} = 50 V, I_{DQ} = 440 mA
Note: Performance in MACOM Evaluation Test Fixture, 50 Ω system

Parameter	Test Conditions	Symbol	Min.	Typ.	Max.	Units
Small Signal Gain	Pulsed[2], 3.7 GHz	G_{SS}	-	18	-	dB
Saturated Output Power	Pulsed[2], 3.7 GHz	P_{SAT}	-	52	-	dBm
Drain Efficiency at Saturation	Pulsed[2], 3.7 GHz	η_{SAT}	-	62	-	%
AM/PM	Pulsed[2], 3.7 GHz	Φ	-	-8	-	°
Modulated Peak Power	WCDMA[3], 3.7 GHz	P3dB[4]	-	51.8	-	dBm
VBW Resonance Point	IMD 3rd Order Inflection Point	VBW_{RES}	-	250	-	MHz
Gain Flatness in 60 MHz	WCDMA[3], 3.7 GHz, P_{OUT} = 44 dBm	G_F	-	0.2	-	dB
Gain Variation (-25°C to +105°C)	WCDMA[3], 3.7 GHz, P_{OUT} = 44 dBm	ΔG	-	±0.02	-	dB/°C
Power Variation (-25°C to +105°C)	Pulsed[2], 3.7 GHz	ΔP1dB	-	±0.02	-	dB/°C
Power Gain	WCDMA[3], 3.7 GHz, P_{OUT} = 44 dBm	G_P	-	16.4	-	dB
Drain Efficiency	WCDMA[3], 3.7 GHz, P_{OUT} = 44 dBm	η	-	34	-	%
Output PAR @ 0.01% CCDF	WCDMA[3], 3.7 GHz, P_{OUT} = 44 dBm	PAR	-	6.8	-	dB
Adjacent Channel Power Ratio	WCDMA[3], 3.7 GHzP_{OUT} = 44 dBm	ACPR	-	-32	-	dBc
Input Return Loss	WCDMA[3], 3.7 GHz, P_{OUT} = 44 dBm	IRL	-	-8	-	dB
Ruggedness: Output Mismatch	All phase angles	Ψ	VSWR = 10:1, No Device Damage			

RF Electrical Specifications: T_A = 25°C, V_{DS} = 50 V, I_{DQ} = 440 mA
Note: Performance in MACOM Single-ended Class-AB Production Test Fixture, 50 Ω system

Parameter	Test Conditions	Symbol	Min.	Typ.	Max.	Units
Power Gain	WCDMA[3], 3.7 GHz, P_{OUT} = 43 dBm	G_P	14	15	-	dB
Drain Efficiency	WCDMA[3], 3.7 GHz, P_{OUT} = 43 dBm	η	23.5	26.5	-	%
Output PAR @ 0.01% CCDF	WCDMA[3], 3.7 GHz, P_{OUT} = 43 dBm	PAR	7	7.7	-	dB
Adjacent Channel Power Ratio	WCDMA[3], 3.7 GHz, P_{OUT} = 43 dBm	ACPR		-35	-28	dBc
Input Return Loss	WCDMA[3], 3.7 GHz, P_{OUT} = 43 dBm	IRL	-	-11	-8	dB

2. Pulse details: 100 μs pulse width, 1 ms period, 10% Duty Cycle.
3. Modulated Signal: 3.84 MHz, WCMDA 3 GPP TM1 64 DPCH, 9.9 dB PAR @ 0.01% CCDF.
4. P3dB = P_{OUT} + 7 dB where P_{OUT} is the average output power measured using a modulated signal[3] where the output PAR is compressed to 7 dB @ 0.01% probability CCDF.

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} = 130 V	I_{DLK}	-	-	21.6	mA
Gate-Source Leakage Current	V_{GS} = -8 V, V_{DS} = 0 V	I_{GLK}	-	-	21.6	mA
Gate Threshold Voltage	V_{DS} = 50 V, I_D = 21.6 mA	V_T	-2.6	-2.0	-1.6	V
Gate Quiescent Voltage	V_{DS} = 50 V, I_D = 330 mA	V_{GSQ}	-2.4	-1.8	-1.4	V
On Resistance	V_{GS} = 2 V, I_D = 330 mA	R_{ON}	-	0.23	-	Ω
Maximum Drain Current	V_{DS} = 7 V pulsed, pulse width 300 μs	$I_{D, MAX}$	-	12.5	-	A

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

Parameter	Absolute Maximum
Drain Source Voltage, V_{DS}	130 V
Gate Source Voltage, V_{GS}	-10 to 3 V
Gate Current, I_G	22 mA
Storage Temperature Range	-65°C to +150°C
Case Operating Temperature Range	-40°C to +120°C
Channel Operating Temperature Range, T_{CH}	-40°C to +225°C
Absolute Maximum Channel Temperature	+250°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} < 55 V will ensure MTTF > 1 x 10^7 hours.
8. Operating at nominal conditions with T_{CH} ≤ 225°C will ensure MTTF > 1 x 10^7 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* = 3.686, *B* = -35.00, and *C* = 25,416.

Thermal Characteristics[10]

Parameter	Test Conditions	Symbol	Typical	Units
Thermal Resistance using Finite Element Analysis	V_{DS} = 50 V T_C=105°C, T_{CH} = 225°C	R_θ(FEA)	1.89	°C/W
Thermal Resistance using Infrared Measurement of Die Surface Temperature	V_{DS} = 50 V T_C=105°C, T_{CH} = 225°C	R_θ(IR)	1.50	°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

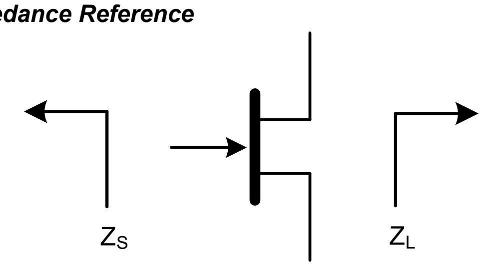
Gallium Nitride Circuits are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling these HBM Class 1B, CDM Class C3 devices.

Pulsed[2] Load-Pull Performance
Reference Plane at Device Leads

Frequency (GHz)	Z_{SOURCE} (Ω)	Maximum Output Power V_{DS} = 50 V, I_{DQ} = 330 mA, T_C = 25°C, P2.5dB					
		Z_{LOAD}[11] (Ω)	Gain (dB)	P_{OUT} (dBm)	P_{OUT} (W)	η_D (%)	AM/PM[13] (°)
3.6	28.8-j22.1	5.6+j2.1	14.9	51.8	151	57	1.9
3.7	33.1-j6.2	4.6+j1.7	14.4	51.6	145	56	1.7
3.8	24.9+j2.7	3.8+j1.5	14.0	51.5	141	57	0.5

Frequency (GHz)	Z_{SOURCE} (Ω)	Maximum Drain Efficiency V_{DS} = 50 V, I_{DQ} = 330 mA, T_C = 25°C, P2.5dB					
		Z_{LOAD}[12] (Ω)	Gain (dB)	P_{OUT} (dBm)	P_{OUT} (W)	η_D (%)	AM/PM[13] (°)
3.6	33.3-j18.6	10.3+j0.9	16.0	50.6	115	61	1.8
3.7	30.6-j1.8	8.1+j2.4	15.5	50.6	115	61	1.8
3.8	21.9+j3.5	5.4+j2.5	14.8	50.9	123	61	1.1

Impedance Reference

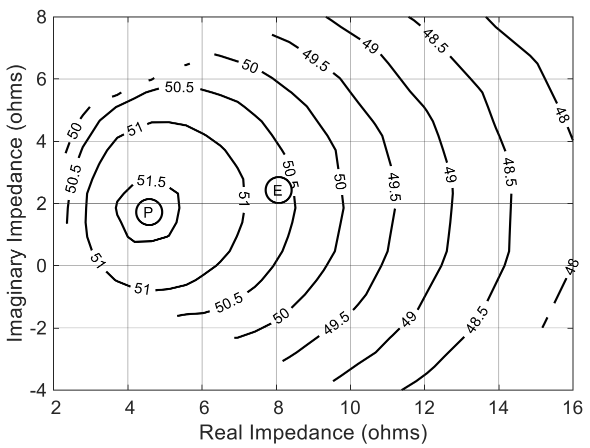


Z_{SOURCE} = Measured impedance presented to the input of the device at package reference plane.
Z_{LOAD} = Measured impedance presented to the output of the device at package reference plane.

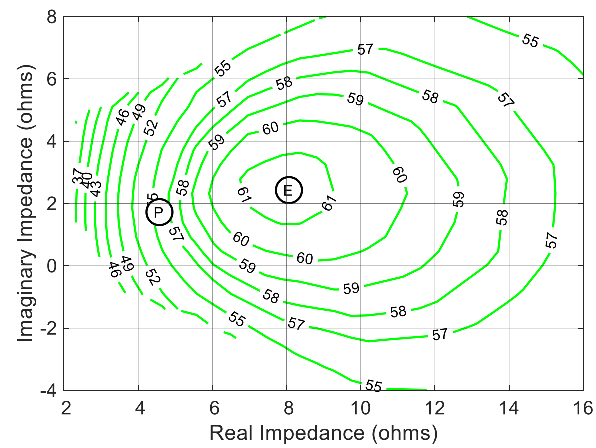
11. Load Impedance for optimum output power.
12. Load Impedance for optimum efficiency.
13. AM/PM listed are relative values.

Pulsed[2] Load-Pull Performance
3.7 GHz

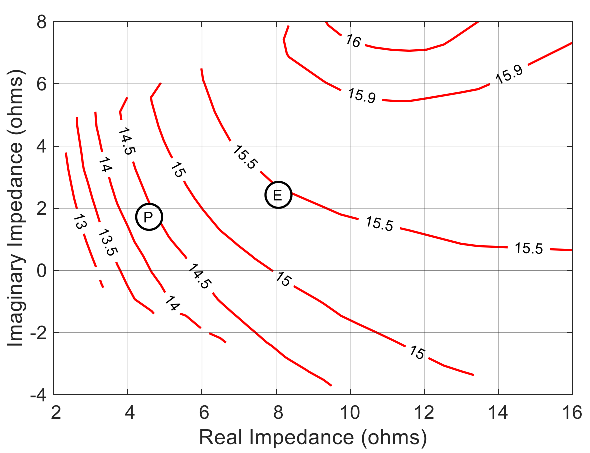
P2.5dB Loadpull Output Power Contours (dBm)



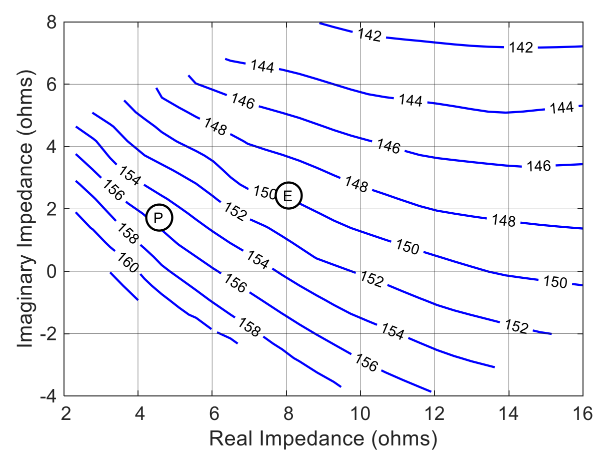
P2.5dB Loadpull Drain Efficiency Contours (%)



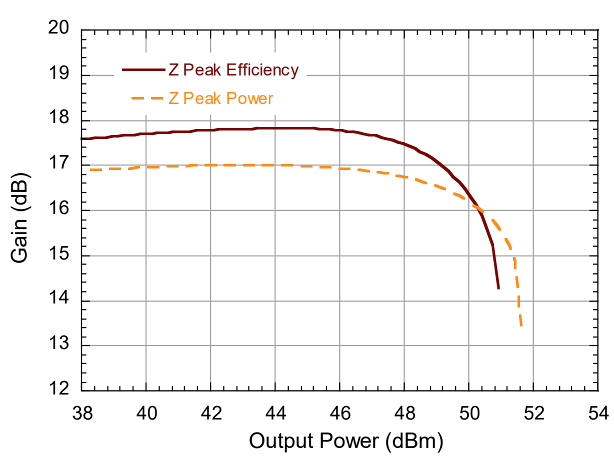
P2.5dB Loadpull Gain Contours (dB)



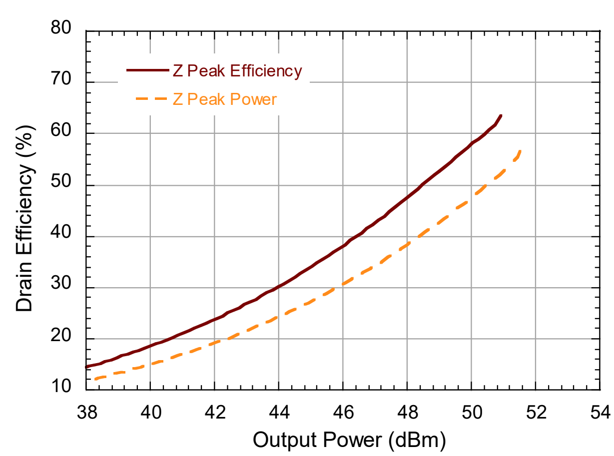
P2.5dB Loadpull AM/PM Contours (°)



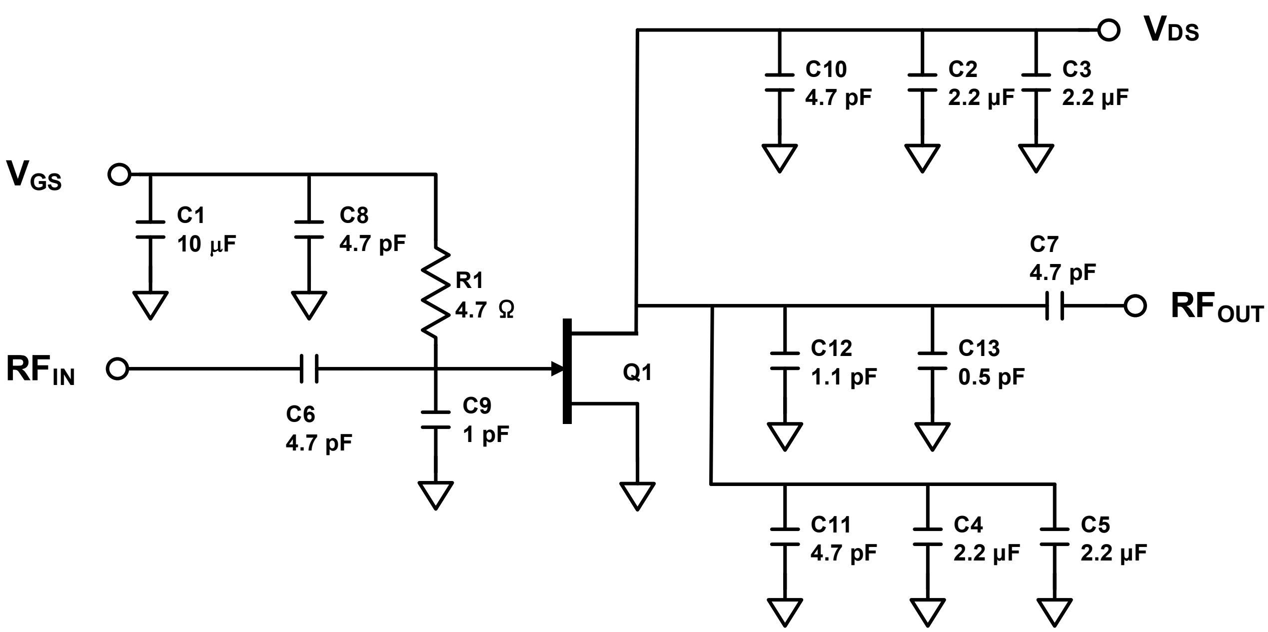
Gain vs. Output Power



Drain Efficiency vs. Output Power



Evaluation Test Fixture and Recommended Tuning Solution 3.6 - 3.8 GHz



Description

Parts measured on evaluation board (20-mil thick RO4350). 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

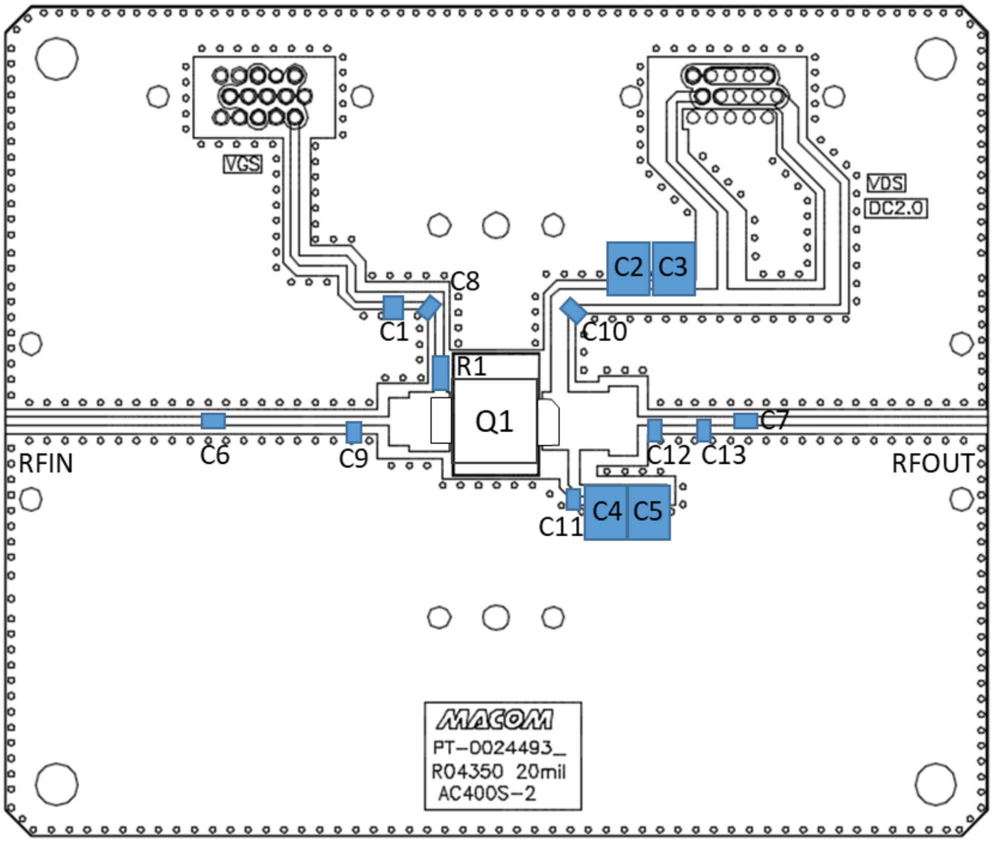
Turning the device ON

1. Set V_{GS} to the pinch-off (V_p).
2. Turn on V_{DS} to nominal Voltage (50 V).
3. Increase V_{GS} until I_{DSQ} 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}.

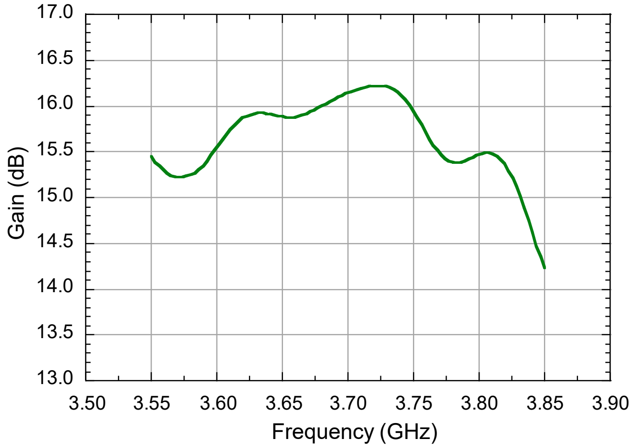
Evaluation Test Fixture and Recommended Tuning Solution 3.6 - 3.8 GHz



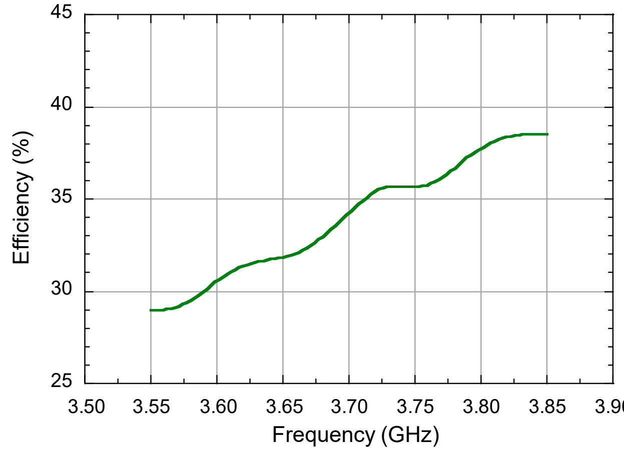
Reference Designator	Value	Tolerance	Manufacturer	Part Number
C1	10 µF	+/- 10%	Murata	GRM21BZ71C106KE15L
C2, C3, C4, C5	2.2 µF	+/- 10%	Murata	KRM55TR72E225MH01L
C6, C7, C8, C10, C11	4.7 pF	+/- 0.1 pF	Murata	GQM2195G2H4R7BB15
C9	1 pF	+/- 0.1 pF	Murata	GQM2195G2H1R0BB15
C12	1.1pF	+/- 0.1 pF	Murata	GQM2195G2H1R1BB15
C13	0.5pF	+/- 0.1 pF	Murata	GQM2195G2HR50BB15
R1	4.7 Ω	+/- 1%	Panasonic	ERJ-8RQF4R7V
PCB	RO4350, 20 mil, 1 oz Cu, Au Finish			

Typical Performance Curves as Measured in the 3.6 - 3.8 GHz Evaluation Test Fixture:
WCMDA 3GPP TM1 64 DPCH 9.9 dB PAR @ 0.01% CCDF
V_{DS} = 50 V, I_{DQ} = 440 mA, T_C = 25°C

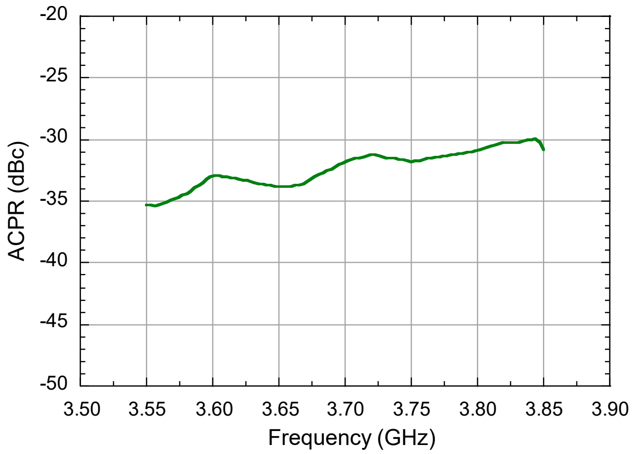
Gain vs. Frequency at P_{OUT} = 44 dBm



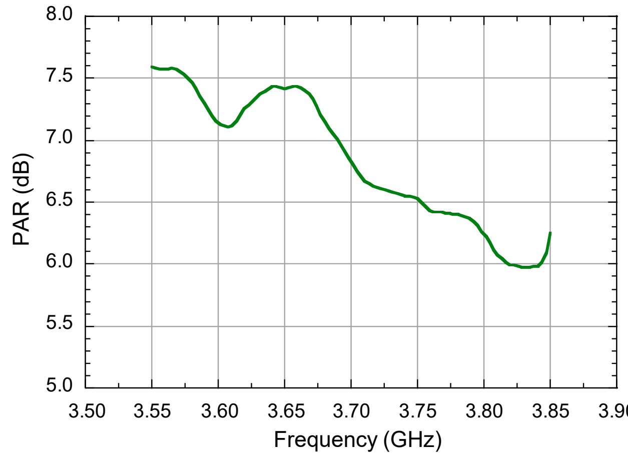
Efficiency vs. Frequency at P_{OUT} = 44 dBm



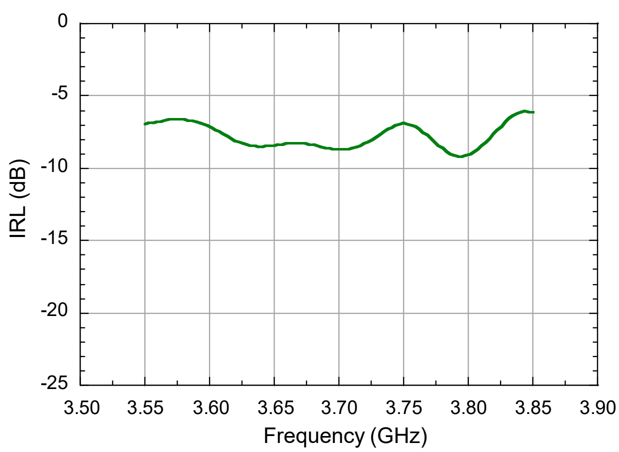
ACPR (Max ±5 MHz) vs. Frequency at P_{OUT} = 44 dBm



PAR (CCDF @ 0.01%) vs. Frequency at P_{OUT} = 44 dBm

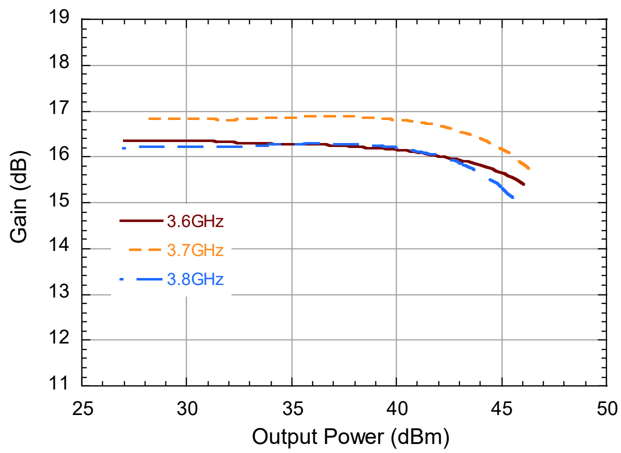


Input Return Loss vs. Frequency at P_{OUT} = 44 dBm

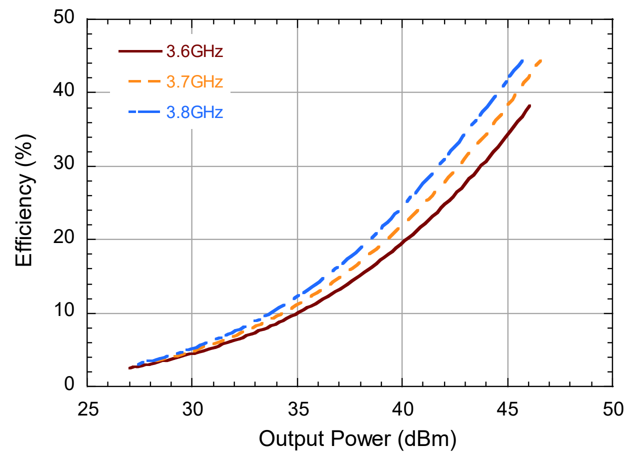


Typical Performance Curves as Measured in the 3.6 - 3.8 GHz Evaluation Test Fixture:
WCMDA 3GPP TM1 64 DPCH 9.9 dB PAR @ 0.01% CCDF
V_{DS} = 50 V, I_{DQ} = 440 mA, T_C = 25°C

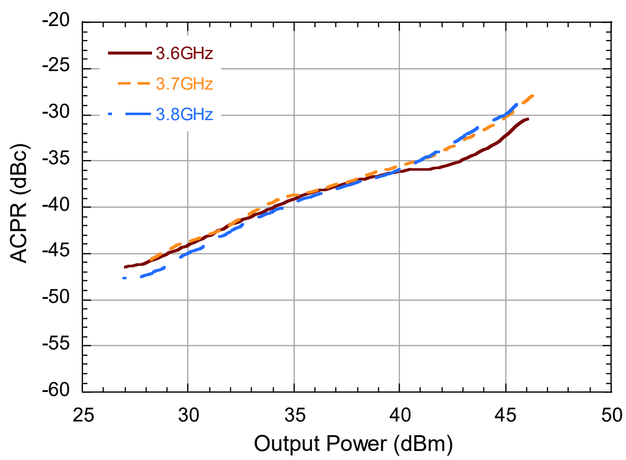
Gain vs. Output Power



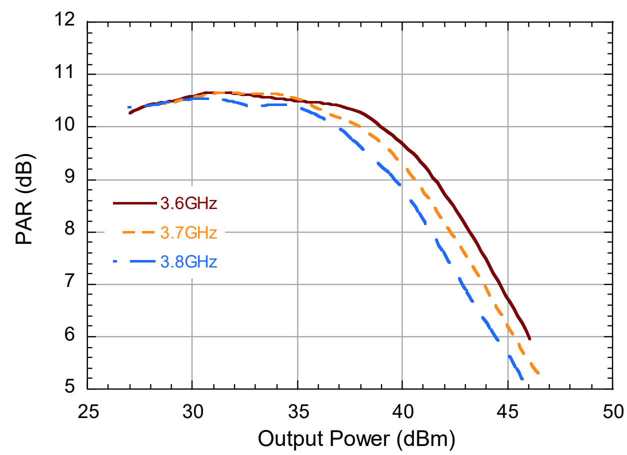
Efficiency vs. Output Power



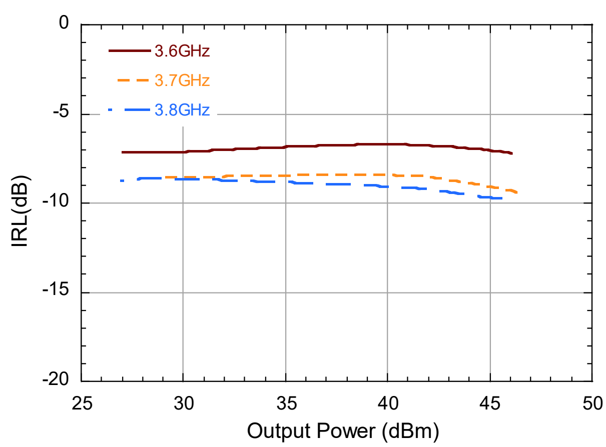
ACPR (Max ±5 MHz) vs. Output Power



PAR (CCDF @ 0.01%) vs. Output Power



Input Return Loss vs. Output Power

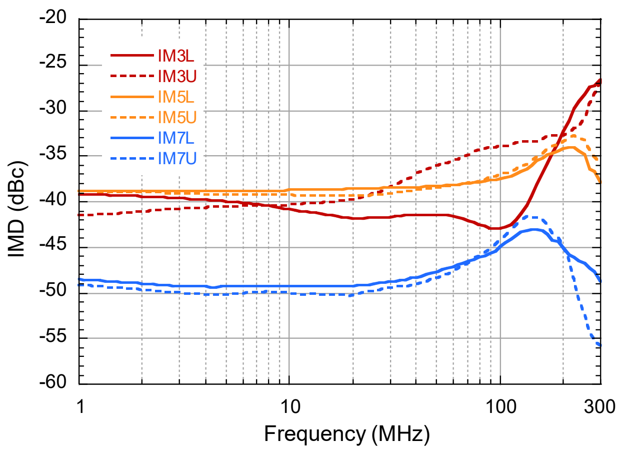


Typical Performance Curves as Measured in the 3.6 - 3.8 GHz Applications Circuit:

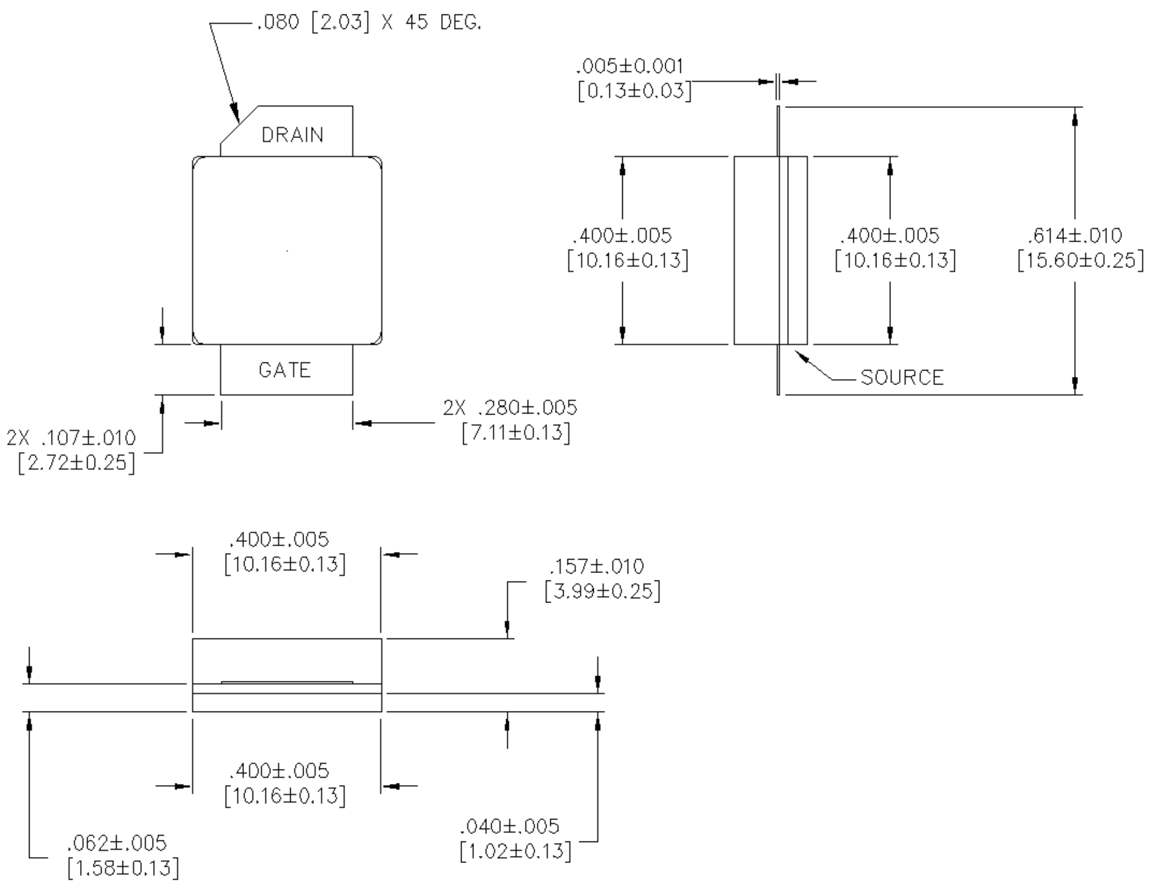
2-Tone Video Bandwidth Performance

V_{DS} = 50 V, I_{DQ} = 440 mA, P_{OUT} = 44 dBm Avg.

IMD vs. Tone Spacing (MHz) at 3.7 GHz



Lead-Free AC-400S-2 Package Dimensions†



† Reference Application Note AN0004363 for lead-free solder reflow recommendations.
Meets JEDEC moisture sensitivity level (MSL) 3 requirements.
Plating is Au