Features

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

7.0 x 6.5 mm DFN

Description

The MAGB-103338-050S0P is a pair of wideband GaN HEMT D-mode amplifier designed for base station applications and optimized for 3.3 - 3.8 GHz modulated signal operation. This device supports pulsed and linear operation with peak output power levels to 50 W (47 dBm) in a 7 x 6.5 mm DFN package.

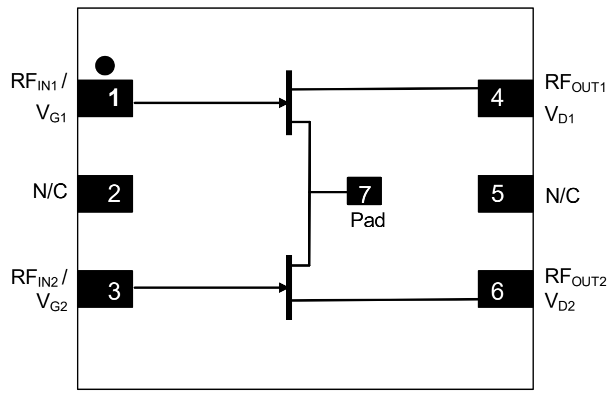
Typical Performance:

- $V_{D1,2}$ = 48 V, $I_{DQ1,2}$ = 65 mA, T_C = 25°C.
  Single channel measured under load-pull at 2.5 dB Compression, 100 µs pulse width, 10% duty cycle.

Frequency (GHz)	Output Power[1] (dBm)	Gain[2] (dB)	η_D[2] (%)
3.3	44.5	18.6	63.1
3.4	44.5	18.0	62.2
3.6	44.4	18.2	62.0
3.8	44.5	16.7	62.2

1. Load impedance tuned for maximum output power.
2. Load impedance tuned for maximum drain efficiency.

Functional Schematic



Pin Configuration[3]

Pin #	Pin Name	Function
1	RF_{IN1}/ V_{G1}	RF Input / Gate
2,5	N/C	No Connection
3	RF_{IN2}/ V_{G2}	RF Input / Gate
4	RF_{OUT1} / V_{D1}	RF Output / Drain
6	RF_{OUT2} / V_{D2}	RF Output / Drain
7	Pad[3]	Ground / Source

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

Ordering Information

Part Number	Package
MAGB-103338-050S0P	Bulk Quantity
MAGB-103338-050STP	Tape and Reel
MAGB-1B3338-050S0P	Class-AB Quad Sample Board

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

RF Electrical Characteristics: T_C = 25°C, $V_{D1,2}$ = 48V, $I_{DQ1,2}$ = 75 mA
Note: Performance in MACOM Quadrature Combined Evaluation Circuit, 50 Ω system.

Parameter	Test Conditions	Symbol	Min.	Typ.	Max.	Units
Small Signal Gain	Pulsed[4], 3.6 GHz	G_{SS}	-	16.3	-	dB
Saturated Output Power	Pulsed[4], 3.6 GHz	P_{SAT}	-	46.3	-	dBm
Drain Efficiency at Saturation	Pulsed[4], 3.6 GHz	η_{SAT}	-	48.7	-	%
AM/PM	Pulsed[4], 3.6 GHz	Φ	-	5	-	°
Modulated Peak Power	WCDMA[5], 3.6 GHz	P2.5dB[6]	-	46.4	-	dBm
Gain Flatness in 60MHz	WCDMA[5], P_{OUT} = 34 dBm	G_F	-	0.5	-	dB
Gain Variation (-25°C to +105°C)	WCDMA[5], 3.6 GHz, P_{OUT} = 34 dBm	ΔG	-	0.02	-	dB/°C
Power Variation (-25°C to +105°C)	Pulsed[4], 3.6 GHz	Δ P2.5dB	-	0.02	-	dBm/°C
Power Gain	WCDMA[5], 3.6 GHz, P_{OUT} = 34 dBm	G_P	-	16.3	-	dB
Drain Efficiency	WCDMA[5], 3.6 GHz, P_{OUT} = 34 dBm	η	-	15.1	-	%
Output CCDF @ 0.01%	WCDMA[5], 3.6 GHz, P_{OUT} = 34 dBm	PAR	-	9.9	-	dB
Adjacent Channel Power	WCDMA[5], 3.6 GHz, P_{OUT} = 34 dBm	ACP	-	-39	-	dBc
Input Return Loss	WCDMA[5], 3.6 GHz, P_{OUT} = 34 dBm	IRL	-	-25	-	dB
Ruggedness: Output Mismatch	All phase angles	Ψ	VSWR = 10:1, No Device Damage			

RF Electrical Characteristics: T_A = 25°C, $V_{D1,2}$ = 48V, $I_{DQ1,2}$ = 65 mA
Note: Performance in MACOM Quadrature Combined Production Test Fixture, 50 Ω system.

Parameter	Test Conditions	Symbol	Min.	Typ.	Max.	Units
Power Gain	WCDMA[5], 3.6 GHz, P_{OUT} = 36 dBm	G_P	12	13.3	-	dB
Drain Efficiency	WCDMA[5], 3.6 GHz, P_{OUT} = 36 dBm	η	14	15.3	-	%
Output CCDF @ 0.01%	WCDMA[5], 3.6 GHz, P_{OUT} = 36 dBm	PAR	7.9	8.3	-	dB
Adjacent Channel Power	WCDMA[5], 3.6 GHz, P_{OUT} = 36 dBm	ACP	-	-37	-	dBc
Input Return Loss	WCDMA[5], 3.6 GHz, P_{OUT} = 36 dBm	IRL	-	-17	-	dB

DC Electrical Characteristics: T_C = 25°C (per side of symmetrical device)

Parameter	Test Conditions	Symbol	Min.	Typ.	Max.	Units
Drain-Source Leakage Current	V_{GS} = -8 V, V_{DS} = 130 V	I_{DLK}	-	-	3.3	mA
Gate-Source Leakage Current	V_{GS} = -8 V, V_{DS} = 0 V	I_{GLK}	-	-	-3.3	mA
Gate Threshold Voltage	V_{DS} = 48 V, I_D = 3.31mA	V_T	-2.7	-2.6	-	V
Gate Quiescent Voltage	V_{DS} = 48 V, I_D = 65 mA	V_{GSQ}	-2.0	-1.8	-	V
On Resistance	V_{GS} = 2 V, I_D = 33 mA	R_{ON}	-	1.3	-	Ω
Maximum Drain Current	V_{DS} = 7 V, pulse width 300 μs	$I_{D, MAX}$	-	1.9	-	A

4. Pulse details: 100 μs pulse width, 1 ms period, 10% Duty Cycle
5. Modulated Signal: 3.84 MHz, WCMDA 3GPP TM1 64 DPCH, 9.9 dB PAR @ 0.01% CCDF
6. P2.5dB = P_{OUT} + 7.5 dB where P_{OUT} is the average output power measured using a modulated signal[5] where the output PAR is compressed to 7.5 dB @ 0.01% probability CCDF.

Absolute Maximum Ratings[7,8,9,10,11]

Parameter	Absolute Maximum
Drain Source Voltage, V_{DS}	130 V
Gate Source Voltage, V_{GS}	-10 to 3 V
Gate Current, $I_{G1,2}$	6.6 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 +210°C
Absolute Maximum Channel Temperature	+225°C

7. Exceeding any one or combination of these limits may cause permanent damage to this device.
8. MACOM does not recommend sustained operation above maximum operating conditions.
9. Operating at drain source voltage V_{DS} < 55 V will ensure MTTF > 1 x 10^7 hours.
10. Operating at nominal conditions with $T_{CH} \leq 225°C$ will ensure MTTF > 1 x 10^7 hours.
11. 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[12]

Parameter	Test Conditions	Symbol	Typical	Units
Thermal Resistance using Finite Element Analysis	V_{DS} = 48 V, T_C = 85°C, T_{CH} = 225°C	R_θ(FEA)	4.1	°C/W
Thermal Resistance using Infrared Measurement of Die Surface Temperature	V_{DS} = 48 V, T_C = 85°C, T_{CH} = 225°C	R_θ(IR)	3.0	°C/W

12. 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

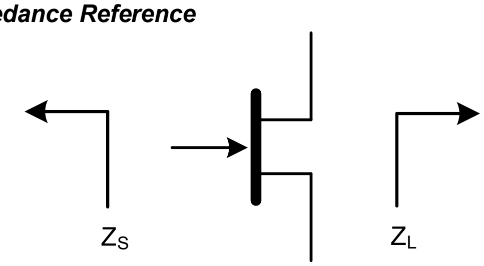
Gallium Nitride Circuits are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling these HBM Class 1A, CDM Class 2A devices.

Pulsed[4] Load-Pull Performance - for one side only (device is symmetrical)
Reference Plane at Device Leads

Frequency (GHz)	Z_{SOURCE} (Ω)	Single Channel: Maximum Output Power					
		V_{D1} = 48 V, I_{DQ1} = 65 mA, T_C = 25°C, P2.5dB					
		Z_{LOAD}[13] (Ω)	Gain (dB)	P_{OUT} (dBm)	P_{OUT} (W)	η_D (%)	AM/PM (°)
3.3	13.2 - j53.4	9.7 + j2.3	16.8	44.5	28.2	56.9	-29.5
3.4	20.6 - j59.5	9.4 + j2.3	16.7	44.5	28.2	56.9	-40.5
3.6	54.4 - j58.2	9.7 + j0.5	16.1	44.4	27.5	53.4	-55.5
3.8	48.2 + j3.1	9.1 + j0.2	15.6	44.5	28.2	54.2	-90.9

Frequency (GHz)	Z_{SOURCE} (Ω)	Single Channel: Maximum Drain Efficiency					
		V_{D1} = 48 V, I_{DQ1} = 65 mA, T_C = 25°C, P2.5dB					
		Z_{LOAD}[14] (Ω)	Gain (dB)	P_{OUT} (dBm)	P_{OUT} (W)	η_D (%)	AM/PM (°)
3.3	1.49 - j58.3	6.0 + j5.2	18.6	43.4	21.9	63.1	-38.0
3.4	27.7 - j66.1	6.0 + j5.3	18.0	43.3	21.4	62.2	-50.7
3.6	102.7 - j24.0	4.5 + j3.8	18.2	42.4	17.4	62.0	-78.8
3.8	38.2 + j3.5	6.1 + j2.3	16.7	43.8	24.0	62.2	-109.2

Impedance Reference

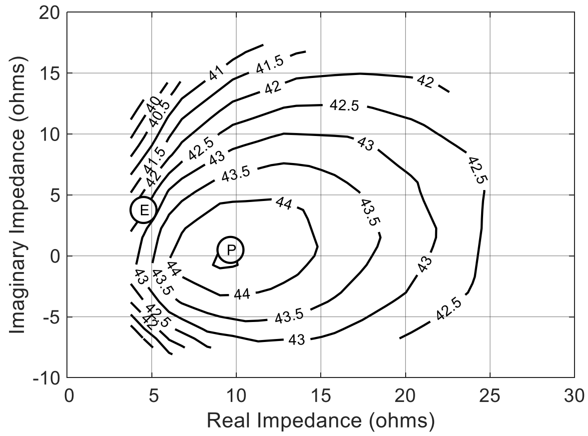


Z_{SOURCE} = Measured impedance presented to the input of the device at package reference plane.
Z_{LOAD} = Measured impedance presented to the output of the device at package reference plane.

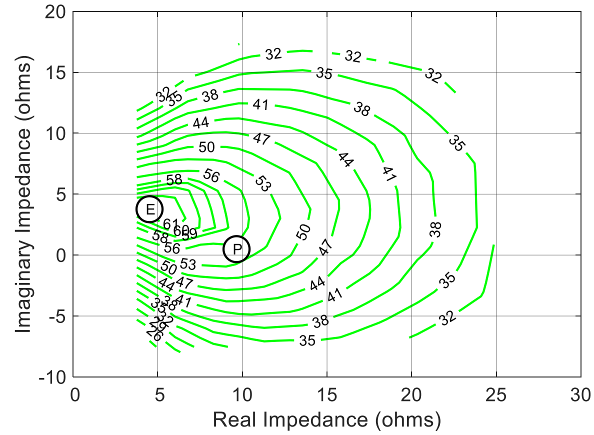
13. Load impedance for optimum output power.
14. Load impedance for optimum efficiency.

Pulsed[4] Load-Pull Performance - for one side only (device is symmetrical) @ 3.6 GHz

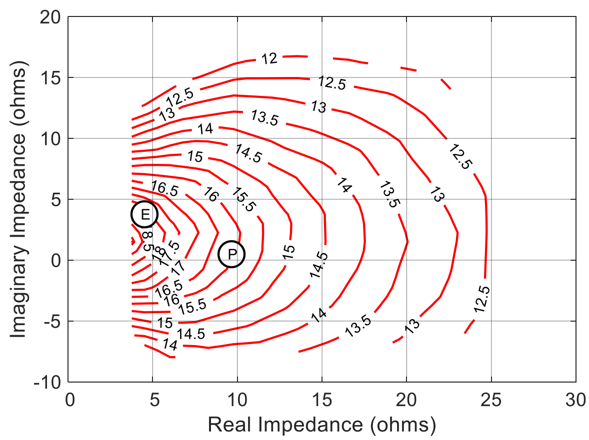
P2.5dB Loadpull Output Power Contours (dBm)



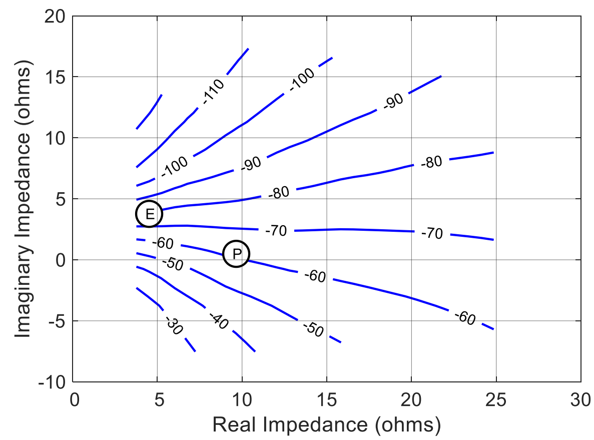
P2.5dB Loadpull Drain Efficiency Contours (%)



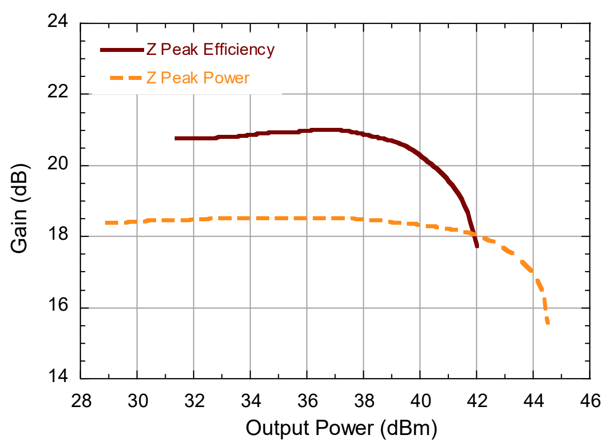
P2.5dB Loadpull Gain Contours (dB)



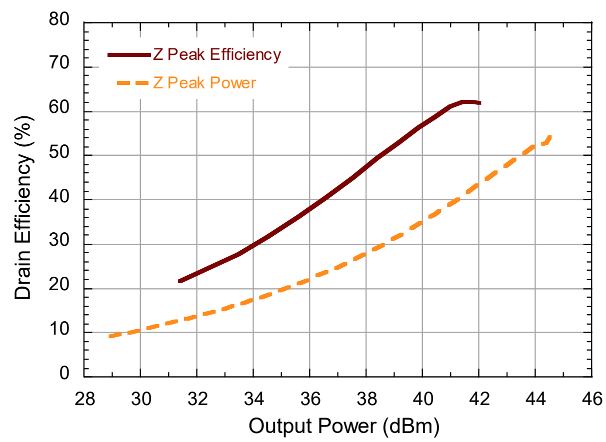
P2.5dB Loadpull AM/PM Contours (°)



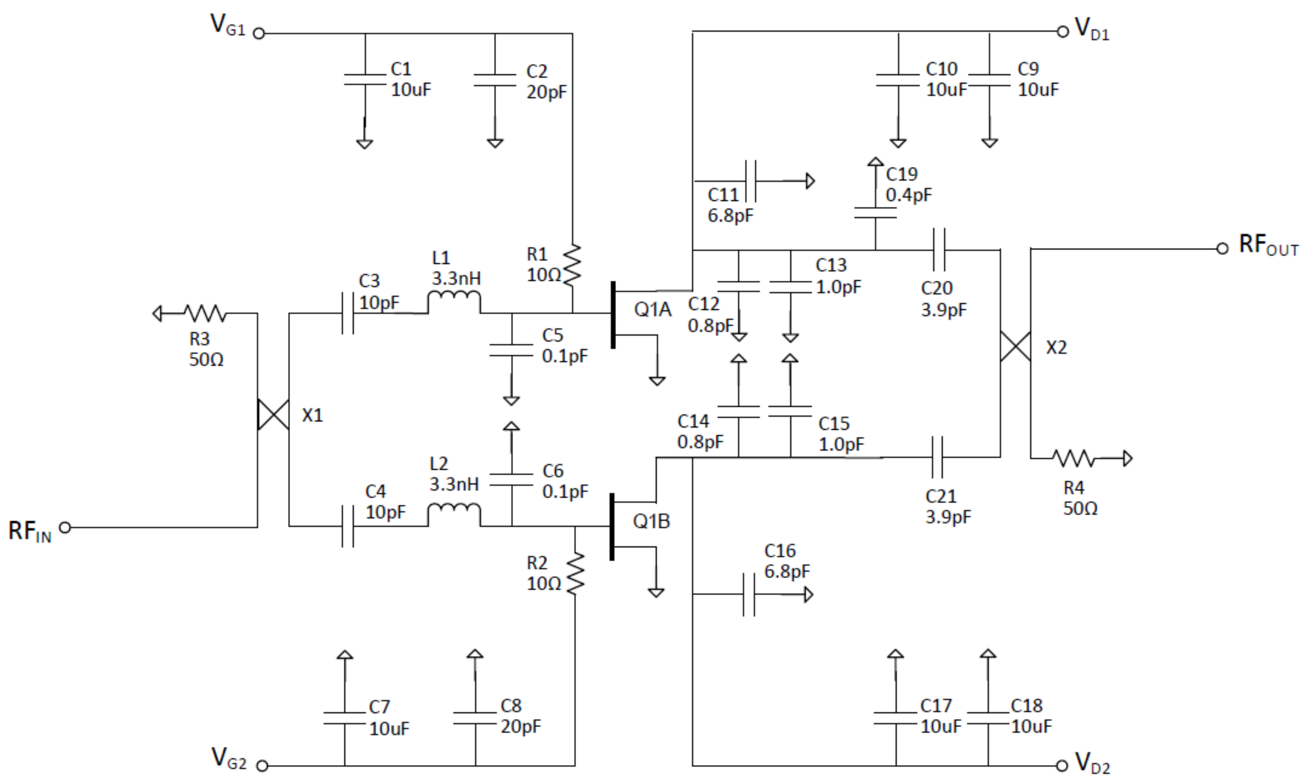
Gain vs. Output Power



Drain Efficiency vs. Output Power



Evaluation Board and Recommended Tuning Solution 3.3 - 3.6 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

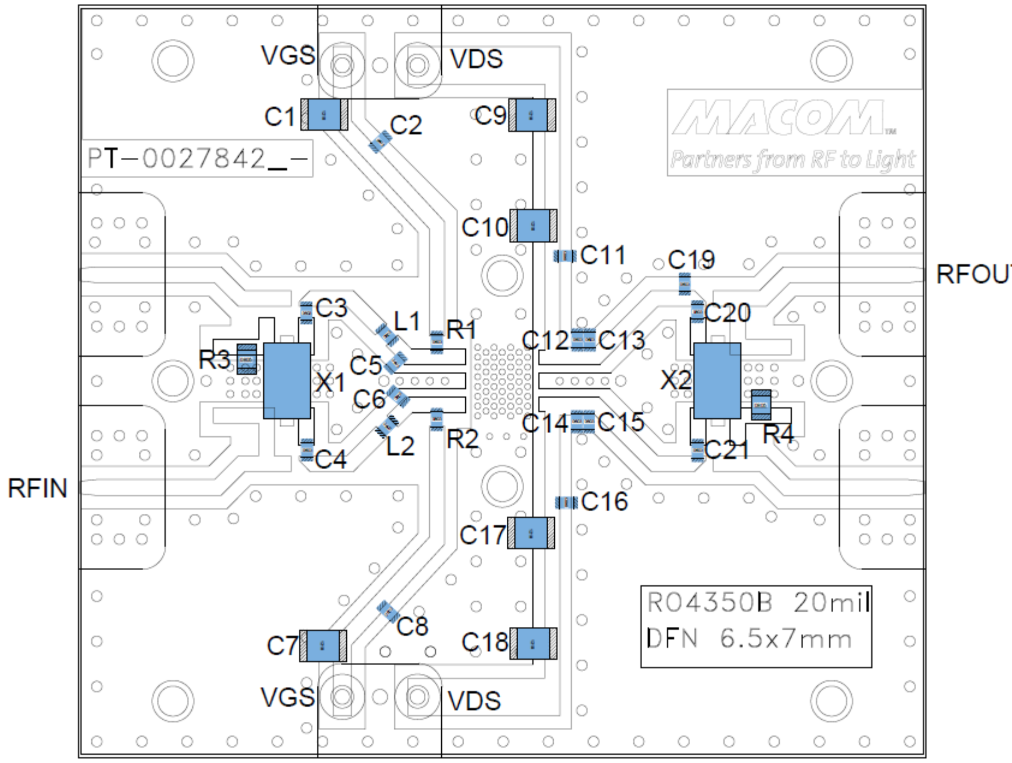
Turning the device ON

1. Set V_{G1} and V_{G2} to the pinch-off Voltage (V_P), typically -3 V.
2. Turn on V_{D1} and V_{D2} to nominal Voltage (48 V).
3. Increase V_{G1} until I_{D1} current is reached.
4. Increase V_{G2} until I_{D2} current is reached.
5. Apply RF power to desired level.

Turning the device OFF

1. Turn the RF power off.
2. Decrease both V_{G1} and V_{G2} down to V_P.
3. Decrease V_{D1} and V_{D2} down to 0 V.
4. Turn off V_{G1} and V_{G2}.

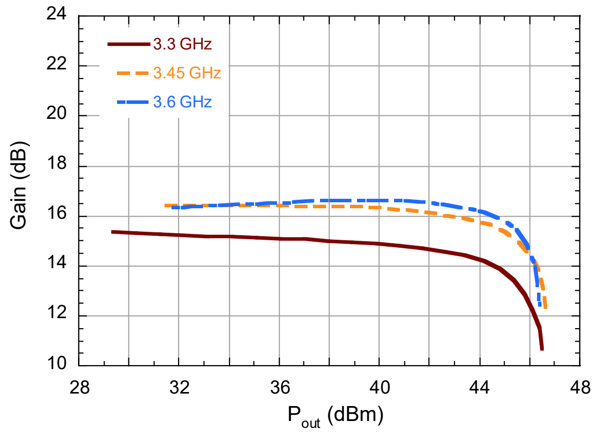
Evaluation Board and Recommended Tuning Solution 3.3 - 3.6 GHz



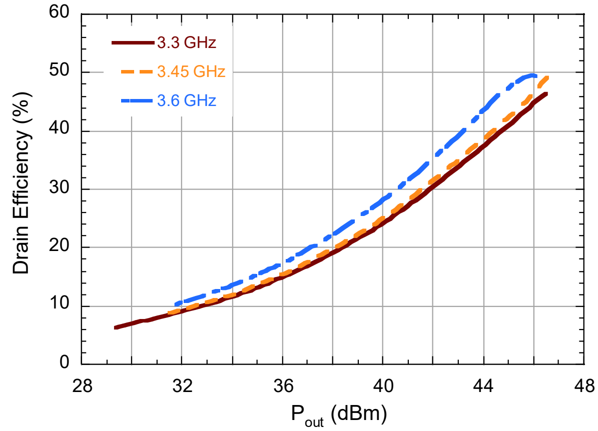
Reference Designator	Value	Tolerance	Manufacturer	Part Number
C1, C7, C9, C10, C17, C18	10 µF	+/- 10%	Murata	GRM32EC72A106KE05
C2, C8	20 pF	+/- 1%	Murata	GQM2195C2E200FB12
C3, C4	10 pF	+/- 1%	Murata	GQM2195C2E100FB12
C5, C6	0.1 pF	+/- 0.1 pF	Murata	GQM1875C2ER10BB12
C11, C16	6.8 pF	+/- 0.1 pF	Murata	GQM2195C2E6R8BB12
C12, C14	0.8 pF	+/- 0.1 pF	Murata	GQM2195C2ER30BB12
C13, C15	1.0 pF	+/- 0.1 pF	Murata	GQM2195C2E1R0BB12
C19	0.4 pF	+/- 0.1 pF	Murata	GQM2195C2ER40BB12
C20, C21	3.9 pF	+/- 0.1 pF	Murata	GQM2195C2E3R9BB12
L1, L2	3.3 nH	+/- 5%	Coilcraft	0603CS-3N3XJEU
R1, R2	10 Ω	+/- 0.5%	Yageo	RT0603DRE0710RL
R3, R4	50 Ω	+/- 2%	Anaren	C8A50Z4B
X1, X2	3dB Coupler		Anaren	X3C35F1-03S
PCB	RO4350, 20 mil, 1 oz Cu, Au Finish			

Typical Performance Curves as Measured in the 3.3 - 3.6 GHz Evaluation Board:
Pulsed[4] 3.45 GHz, $V_{D1,2}$ = 48 V, $I_{DQ1,2}$ = 75 mA, T_C = 25°C (unless otherwise noted)

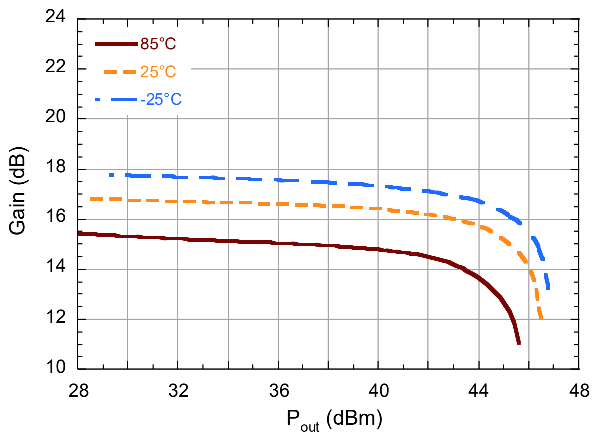
Gain vs. Output Power and Frequency



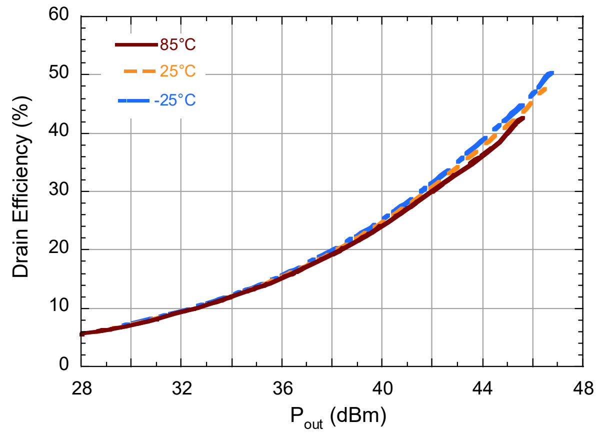
Drain Efficiency vs. Output Power and Frequency



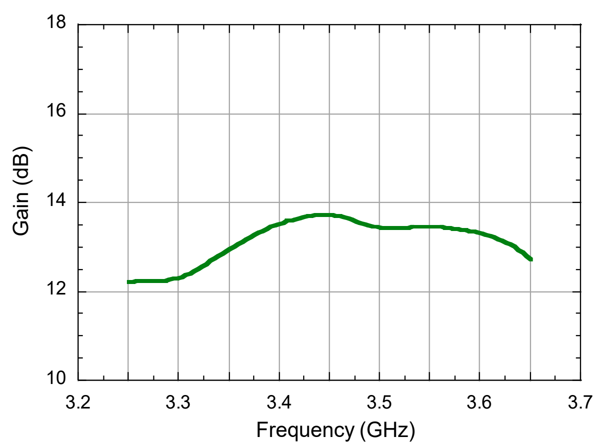
Gain vs. Output Power and T_C



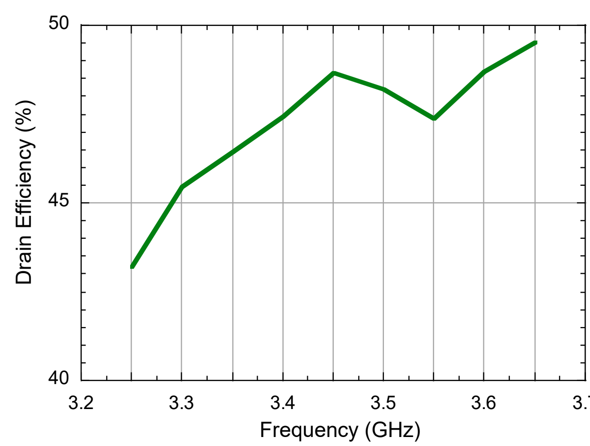
Drain Efficiency vs. Output Power and T_C



Gain vs. Frequency, 2.5dB Gain Compression

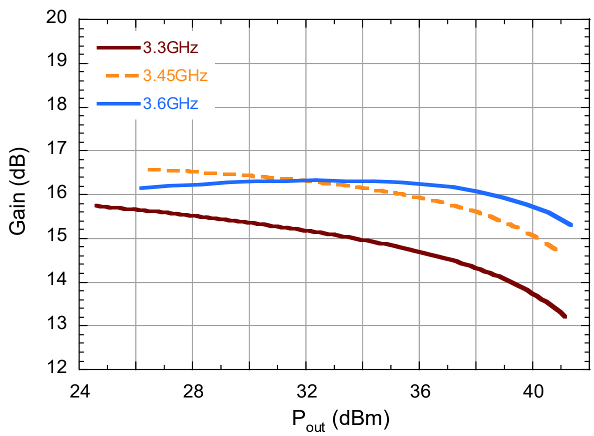


Drain Efficiency vs. Frequency, 2.5dB Gain Compression

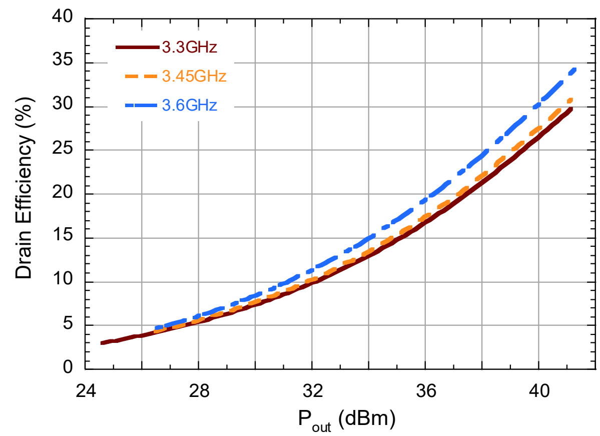


Typical Performance as Measured in the 3.3 - 3.6 GHz Evaluation Board:
WCMDA 3GPP TM1 64 DPCH 9.9 dB PAR @ 0.01% CCDF, $V_{D1,2}$ = 48 V, $I_{DQ1,2}$ = 75 mA, T_C = 25°C

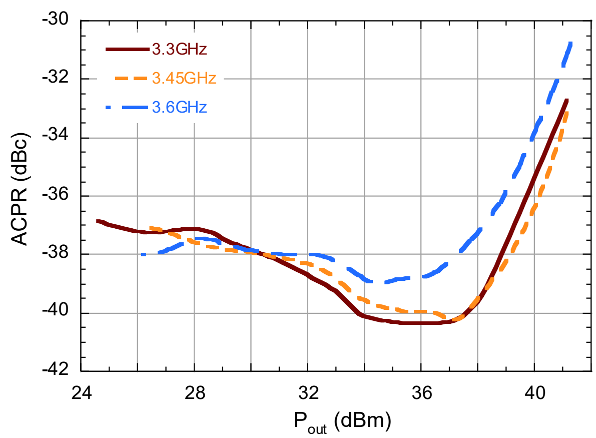
Gain vs. Output Power and Frequency



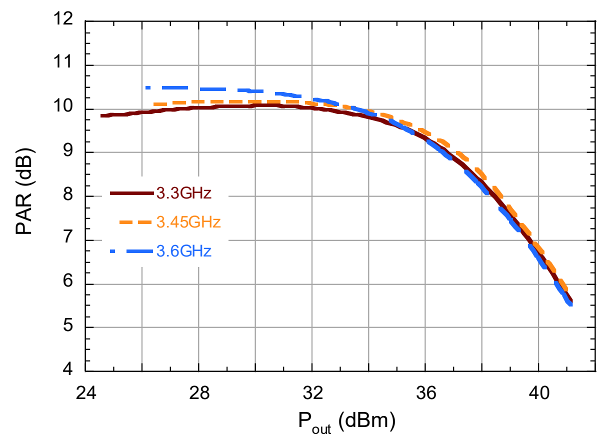
Drain Efficiency vs. Output Power and Frequency



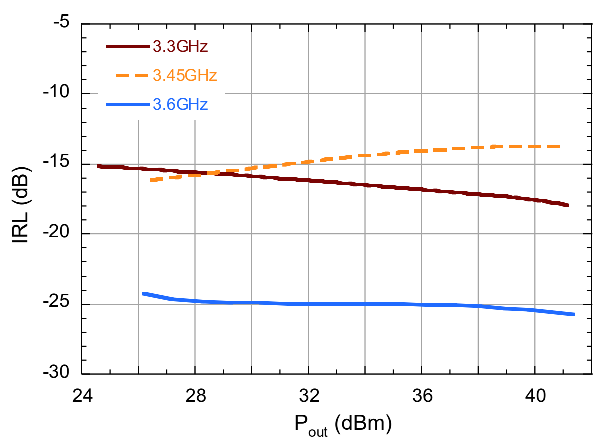
ACPR (Max ±5 MHz) vs. Output Power and Frequency



PAR (CCDF @ 0.01%) vs. Output Power and Frequency

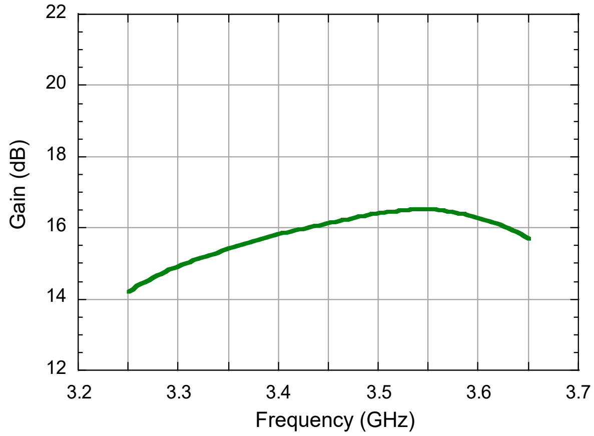


Input Return Loss vs. Output Power and Frequency

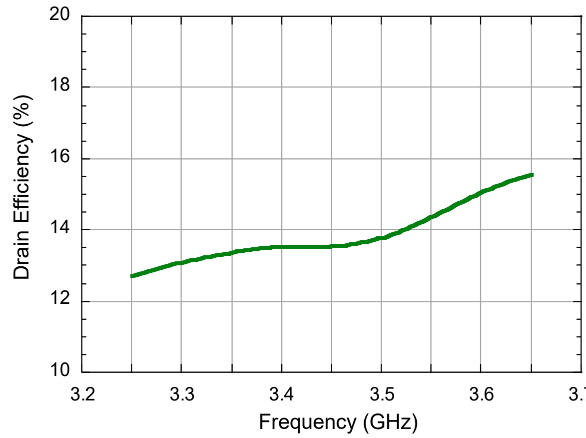


Typical Performance as Measured in the 3.3 - 3.6 GHz Evaluation Board:
WCMDA 3GPP TM1 64 DPCH 9.9 dB PAR @ 0.01% CCDF, $V_{D1,2}$ = 48 V, $I_{DQ1,2}$ = 75 mA, T_C = 25°C

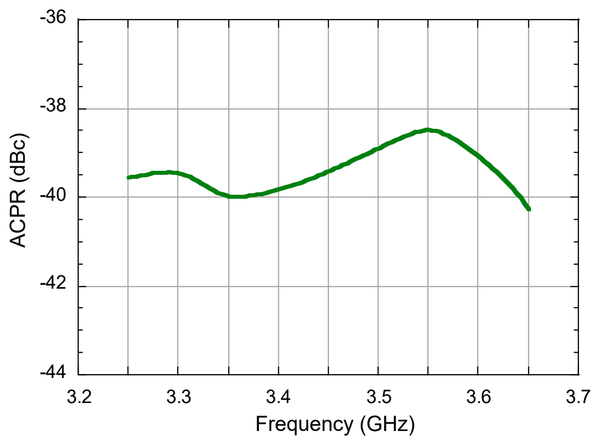
Gain vs. Frequency at P_{OUT} = 34 dBm



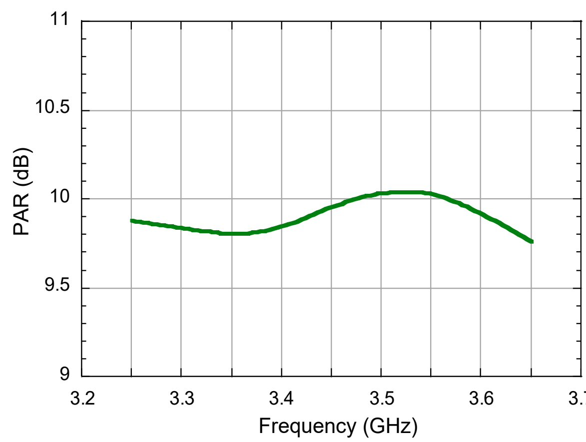
Drain Efficiency vs. Frequency at P_{OUT} = 34 dBm



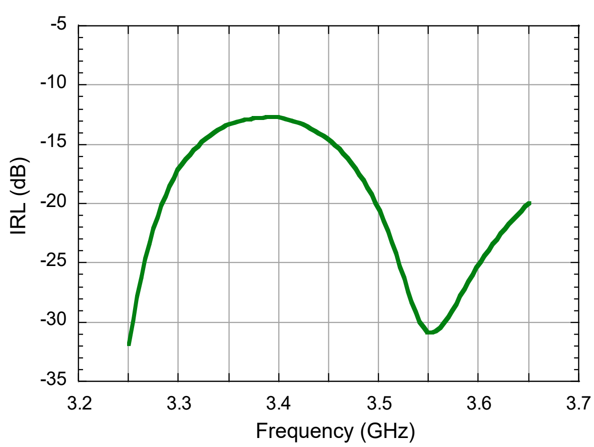
ACPR (Max ±5 MHz) vs. Frequency at P_{OUT} = 34 dBm



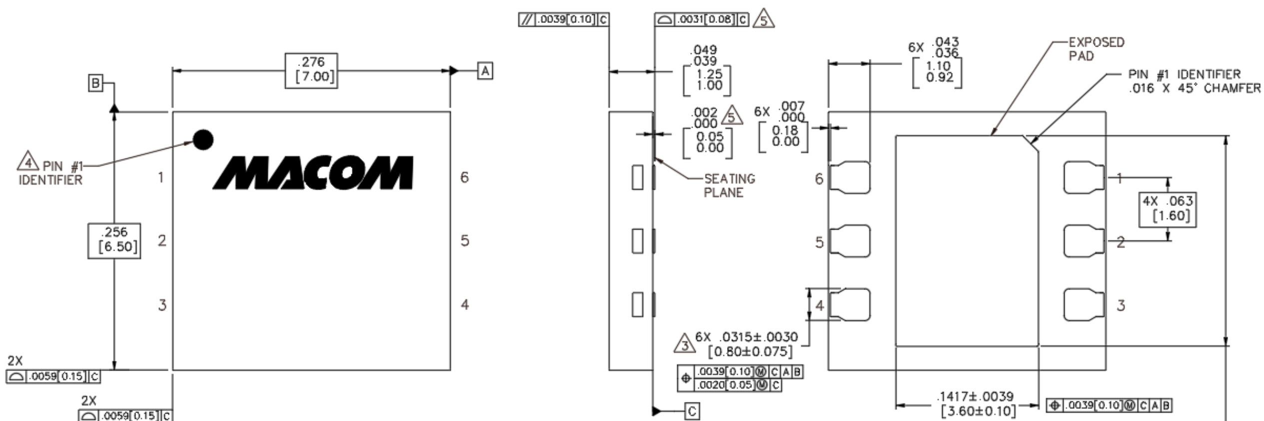
PAR (CCDF @ 0.01%) vs. Frequency at P_{OUT} = 34 dBm



Input Return Loss vs. Frequency at P_{OUT} = 34 dBm



Lead-Free 7.0 x 6.5 mm 6-Lead Package Dimensions†



NOTES:
1. ALL DIMENSIONS AND TOLERANCES ARE BASED ON JEDEC MO-220, VAR WITH SAW SINGULATION. ALL DIMENSIONS SHOWN AS in[mm]. CONTROLLING DIMENSIONS ARE IN mm AND CONVERTED in DIMENSIONS ARE NOT NECESSARILY EXACT.
2. ELECTROSTATIC DISCHARGE CONTROL PROGRAM FOR THE PROTECTION OF ELECTRICAL AND ELECTRONIC PARTS, ASSEMBLIES AND EQUIPMENT SHALL BE IN ACCORANCE WITH ANSI/ESD 20.20.
3. INDICATED DIMENSIONS/TOLERANCES APPLY TO THE PLATED LEAD AND IS MEASURED BETWEEN .0059[0.15] AND .0118[0.30] FROM THE LEAD END. LEAD NECK DOWN FEATURE IS OPTIONAL.
4. EXACT SIZE AND SHAPE OF THIS FEATURE IS OPTIONAL.
5. INDICATED DIMENSIONS/TOLERANCES APPLY TO LEADS AND EXPOSED PAD.
6. ALL MATERIALS DESCRIBED IN THIS DOCUMENT/DRAWING SHALL BE IN COMPLIANCE WITH AND CONTAIN NO SUBSTANCES RESTRICTED OR REQUIRING SPECIAL RECLAMATION UNDER THE LATEST ROHS, WEEE OR ELV DIRECTIVES.

† Reference Application Note S2083 for lead-free solder reflow recommendations.
Meets JEDEC moisture sensitivity level (MSL) 3 requirements.
Plating is NiPdAu.