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

6x3mm DFN

Description

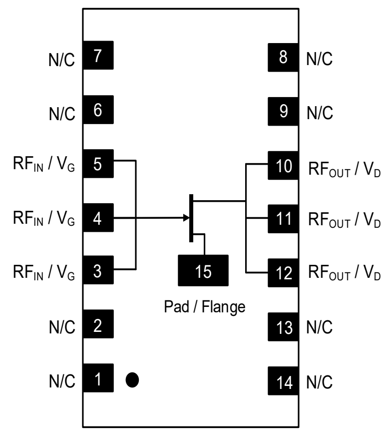
The MAGB-104450-015B0P is a wideband GaN on Si HEMT D-mode transistor designed for cellular base station applications and optimized for 4.4 - 5.0 GHz modulated signal operation. This device supports pulsed and linear operation with peak output power levels to 15W (41.8 dBm) in a 6x3mm DFN package.

Typical Single Ended Performance:

- WCDMA 3GPP TM1 64 DPCH 9.9 dB PAR @ 0.01% CCDF. V_{DS} = 50 V, I_{DQ} = 50 mA, Pout = 34 dBm

Frequency (GHz)	G_P (dB)	η_D (%)	Output PAR (dB)	ACPR (dBc)
4.8	14.7	24	8.0	-40
4.9	15.6	24	8.1	-39
5.0	15.5	26	8.0	-40

Functional Schematic



Pin Configuration

Pin #	Pin Name	Function
1-2	N/C	No Connection
3-5	RF_{IN} / V_G	RF Input / Gate
6-9	N/C	No Connection
10-12	RF_{OUT} / V_D	RF Output / Drain
13-14	N/C	No Connection
15	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-104450-015B0P	Bulk Quantity
MAGB-104450-015BTP	Tape and Reel
MAGB-1B4450-015B0P	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} = 50 mA

Note: Performance in MACOM Evaluation Test Fixture, 50 Ω system

Parameter	Test Conditions	Symbol	Min.	Typ.	Max.	Units
Small Signal Gain	Pulsed[2], 4900 MHz	G_{SS}	-	16	-	dB
Saturated Output Power	Pulsed[2], 4900 MHz	P_{SAT}	-	42	-	dBm
Drain Efficiency at Saturation	Pulsed[2], 4900 MHz	η_{SAT}	-	51	-	%
AM/PM	Pulsed[2], 4900 MHz	Φ	-	-5	-	°
Modulated Peak Power	WCDMA[3], 4900 MHz	P3dB[4]	-	42	-	dBm
VBW Resonance Point	IMD 3rd Order Inflection Point	VBW_{RES}	-	220	-	MHz
Gain Flatness in 60 MHz	WCDMA[3], 4900MHz, P_{OUT} = 34 dBm	G_F	-	0.2	-	dB
Gain Variation (-25°C to +105°C)	WCDMA[3], 4900 MHz, P_{OUT} = 34 dBm	ΔG	-	±0.02	-	dB/°C
Power Variation (-25°C to +105°C)	Pulsed[2], 4900 MHz	ΔP1dB	-	±0.01	-	dB/°C
Power Gain	WCDMA[3], 4900 MHz, P_{OUT} = 34 dBm	G_P	-	15.6	-	dB
Drain Efficiency	WCDMA[3], 4900 MHz, P_{OUT} = 34 dBm	η	-	24	-	%
Output PAR @ 0.01% CCDF	WCDMA[3], 4900 MHz, P_{OUT} = 34 dBm	PAR	-	8.1	-	dB
Adjacent Channel Power	WCDMA[3], 4900 MHz, P_{OUT} = 34 dBm	ACP	-	-39	-	dBc
Input Return Loss	WCDMA[3], 4900 MHz, P_{OUT} = 34 dBm	IRL	-	-5	-	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} = 50 mA

Note: Performance in MACOM Production Test Fixture, 50 Ω system

Parameter	Test Conditions	Symbol	Min.	Typ.	Max.	Units
Power Gain	WCDMA[3], 4900 MHz, P_{OUT} = 34 dBm	G_P	12.3	13.7	-	dB
Drain Efficiency	WCDMA[3], 4900 MHz, P_{OUT} = 34 dBm	η	24.3	28.3	-	%
Output PAR @ 0.01% CCDF	WCDMA[3], 4900 MHz, P_{OUT} = 34 dBm	PAR	6.2	7.1	-	dB
Adjacent Channel Power	WCDMA[3], 4900 MHz, P_{OUT} = 34 dBm	ACP	-	-37	-30	dBc
Input Return Loss	WCDMA[3], 4900 MHz, P_{OUT} = 34 dBm	IRL	-	-10.7	-3	dB

2. Pulse details: 100 µs pulse width, 10% Duty Cycle
3. Modulated Signal: 3.84MHz, WCMDA 3GPP TM1 64 DPCH, 9.9dB PAR @ 0.01% CCDF
4. P_{-3dB} = P_{OUT} + 7.0 dB where P_{OUT} is the average output power measured using a modulated signal[3] where the output PAR is compressed to 7.0 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}	-	-	2.0	mA
Gate-Source Leakage Current	V_{GS} = -8 V, V_{DS} = 0 V	I_{GLK}	-	-	2.0	mA
Gate Threshold Voltage	V_{DS} = 50 V, I_D = 2 mA	V_T	-2.6	-2.2	-	V
Gate Quiescent Voltage	V_{DS} = 50 V, I_D = 50 mA	V_{GSQ}	-2.4	-2.0	-1.4	V
On Resistance	V_{GS} = 2 V, I_D = 50 mA	R_{ON}	-	1.7	-	Ω
Maximum Drain Current	V_{DS} = 7 V pulsed, pulse width 300 µs	$I_{D, MAX}$	-	1.3	-	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	0.4 mA
Storage Temperature Range	-65°C to +150°C
Case Operating Temperature Range	-40°C to +85°C
Channel Operating Temperature Range, T_{CH}	-40°C to +210°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} < 55 V will ensure MTTF > 4 x 10^6 hours.
8. Operating at nominal conditions with $T_{CH} \le 210°C$ will ensure MTTF > 4 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* = 1.76, B = -33.83, and C = 23,476.

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)	10.3	°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)	6.8	°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.

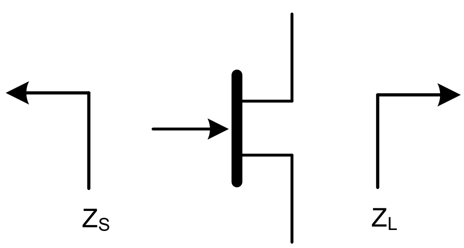
Pulsed[11] Load-Pull Performance

Reference Plane at Device Leads

Frequency (GHz)	Z_{SOURCE} (Ω)	Max Output Power V_{DS} = 50 V, I_{DQ} = 50 mA, T_C = 25°C, P2.5dB					
		Z_{LOAD}[12] (Ω)	Gain (dB)	P_{OUT} (dBm)	P_{OUT} (W)	η_D (%)	AM/PM (°)
4.4	3.2 - j6.5	11.7 + j13.2	14.1	42.7	18.6	54	25.9
4.6	3.5 - j6.9	10.8 + j12.8	14.0	42.5	17.8	54	22.3
4.8	3.5 - j7.7	9.7 + j11.9	14.5	42.5	17.8	54	21
5.0	3.8 - j8.6	9.3 + j12.0	15.3	42.3	17.0	54	18.5

Frequency (GHz)	Z_{SOURCE} (Ω)	Max Drain Efficiency V_{DS} = 50 V, I_{DQ} = 50 mA, T_C = 25°C, P2.5dB					
		Z_{LOAD}[13] (Ω)	Gain (dB)	P_{OUT} (dBm)	P_{OUT} (W)	η_D (%)	AM/PM (°)
4.4	3.2 - j6.5	7.7 + j17.2	14.6	41.7	14.8	61	18.8
4.6	3.5 - j6.9	7.7 + j14.8	14.5	42.1	16.2	60	15.5
4.8	3.5 - j7.7	6.1 + j13.3	15.3	41.8	15.1	61	18.1
5.0	3.8 - j8.6	4.8 + j13.4	15.8	41.4	13.8	60	15.9

Impedance Reference

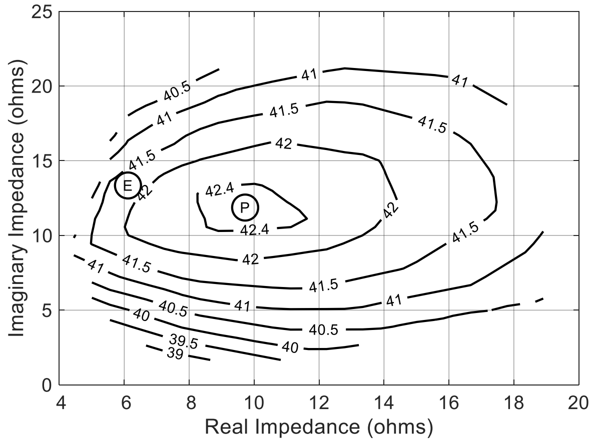


Z_{SOURCE} = Measured impedance presented to the input of the device at package reference plane.
Z_{LOAD} = Measured impedance presented to the output of the device at package reference plane.

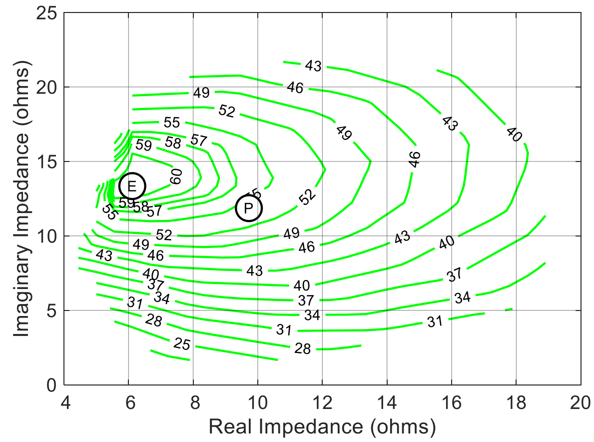
11. Pulse details: 100 µs pulse width, 10% Duty Cycle
12. Load Impedance for optimum output power.
13. Load Impedance for optimum efficiency.

Pulsed[11] Load-Pull Performance @ 4.8 GHz

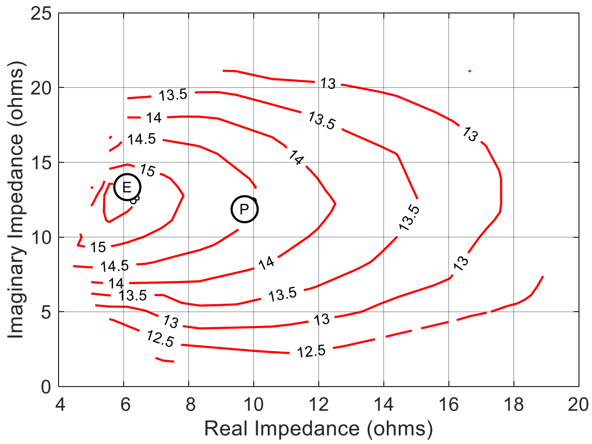
P2.5dB Loadpull Output Power Contours (dBm)



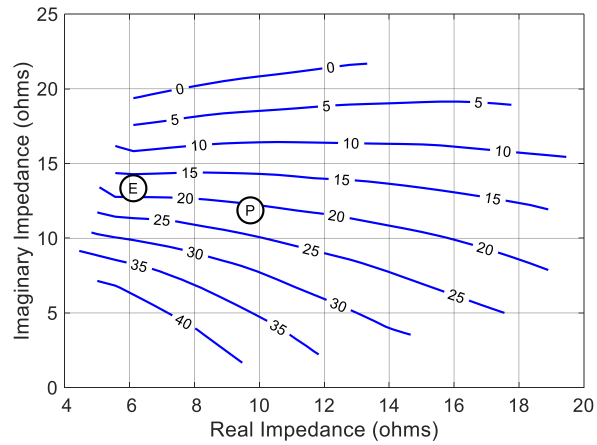
P2.5dB Loadpull Drain Efficiency Contours (%)



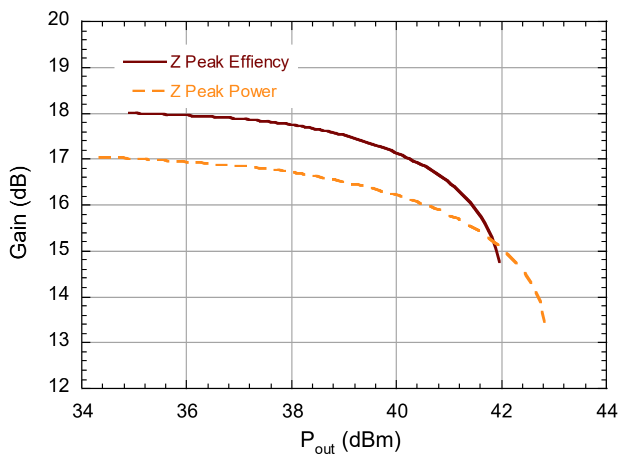
P2.5dB Loadpull Gain Contours (dB)



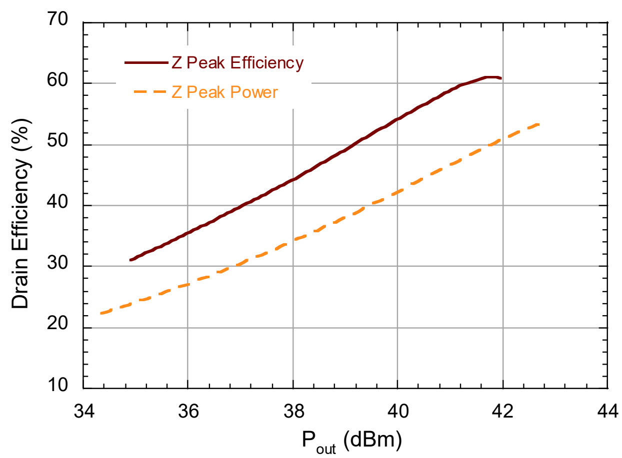
P2.5dB Loadpull AM/PM Contours (°)



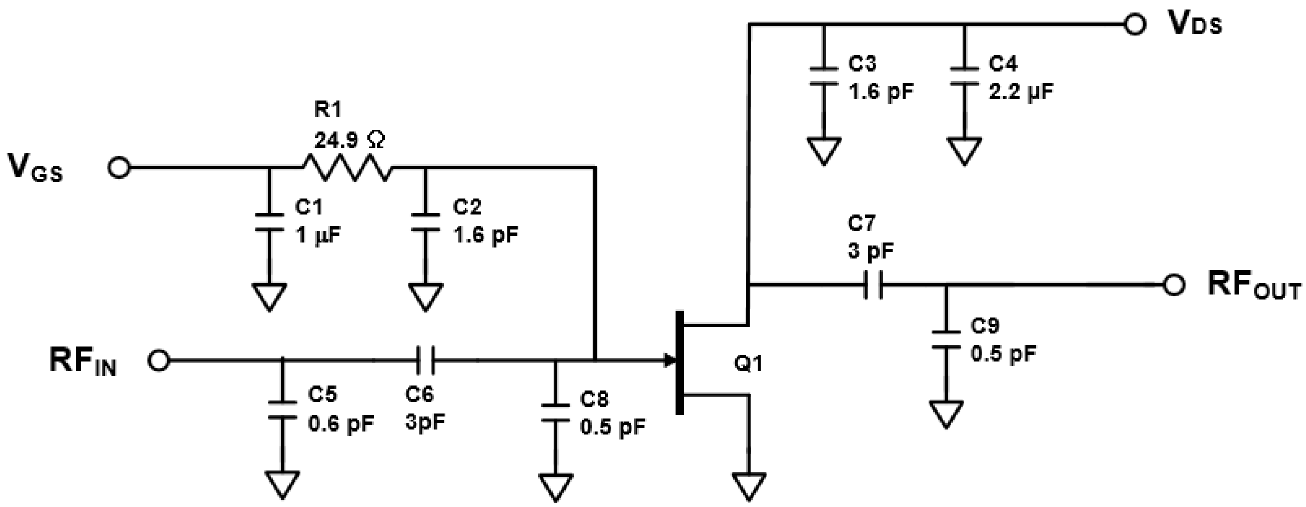
Gain vs. Output Power



Drain Efficiency vs. Output Power



Evaluation Test Fixture and Recommended Tuning Solution 4.8 - 5.0 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

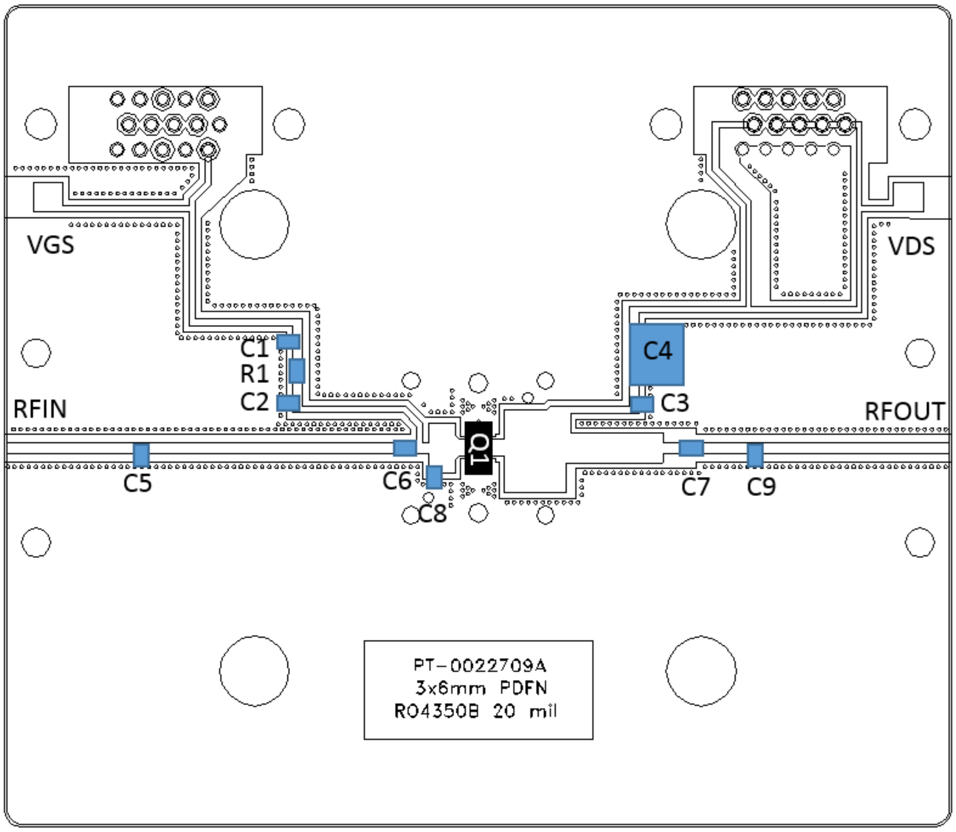
Turning the device ON

1. Set V_{GS} to the pinch-off (V_p), typically –2.2V
2. Turn on V_{DS} to nominal Voltage (50 V).
3. Increase V_{GS} until I_{DQ} 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}.

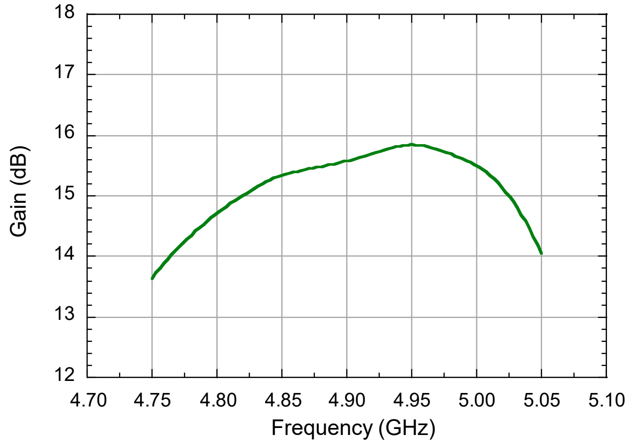
Evaluation Test Fixture and Recommended Tuning Solution 4.8 - 5.0 GHz



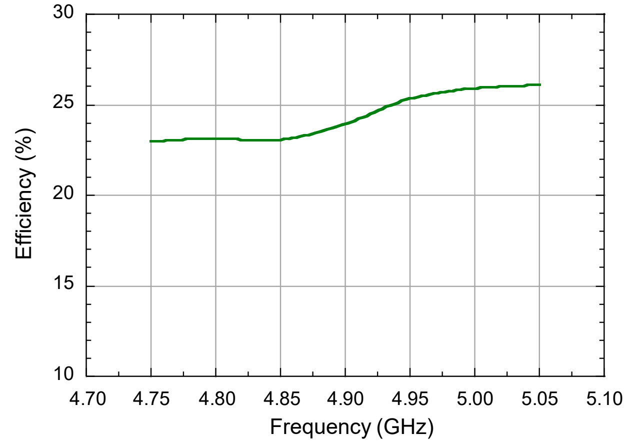
Reference Designator	Value	Tolerance	Manufacturer	Part Number
C1	1 µF	±10%	Murata	GRM21BC72A105KE01L
C2, C3	1.6 pF	±0.1 pF	Murata	GQM2195C2E1R6BB12D
C4	2.2 µF	±20%	Murata	KRM55TR72E225MH01K
C5	0.6 pF	±0.1 pF	Murata	GQM2195C2ER60BB12D
C6, C7	3.0 pF	±0.1 pF	Murata	GQM2195C2E3R0BB12D
C8, C9	0.5 pF	±0.1 pF	Murata	GQM2195C2ER20BB12D
R1	24.9 Ω	±1%	Panasonic	ERJ-3EKF24R9V
PCB	RO4350, 20 mil, 1 oz. Cu, Au Finish			

Typical Performance as Measured in the 4.8 - 5.0 GHz Evaluation Test Fixture: WCDMA 3GPP TM1 64 DPCH 9.9 dB PAR @ 0.01% CCDF, V_{DS} = 50 V, I_{DQ} = 50 mA, T_C = 25°C

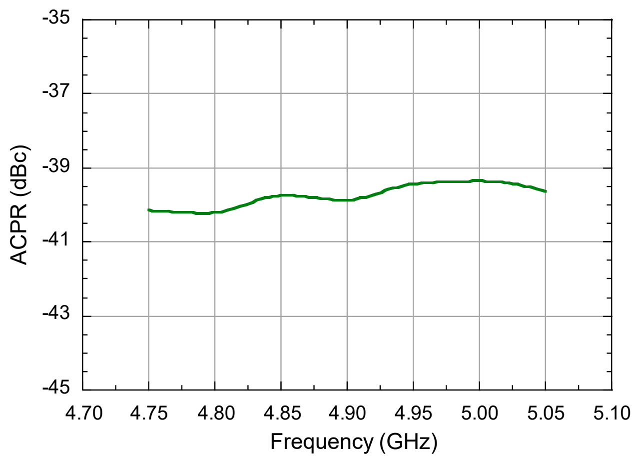
Gain vs. Frequency at P_{OUT} = 34 dBm



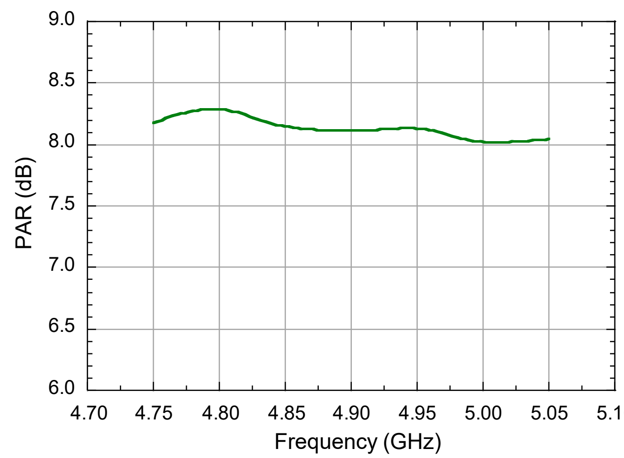
Efficiency vs. Frequency at P_{OUT} = 34 dBm



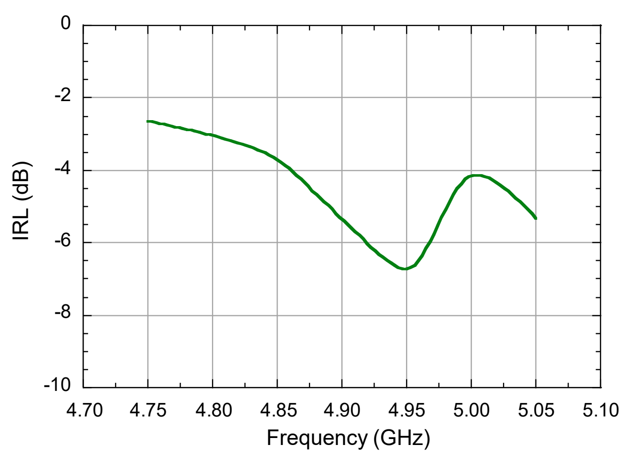
ACPR (Max ±5 MHz) vs. Frequency at P_{OUT} = 34 dBm



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

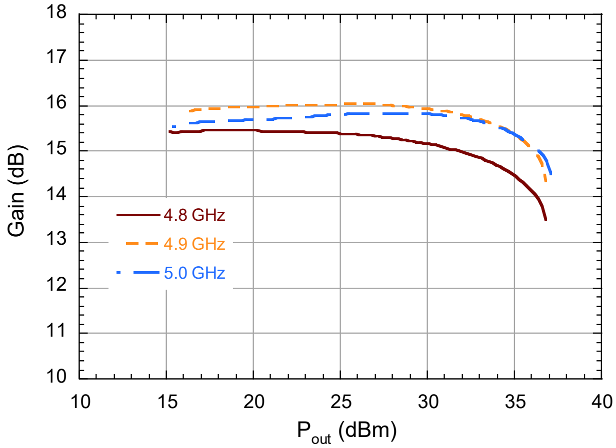


Input Return Loss vs. Frequency at P_{OUT} = 34 dBm

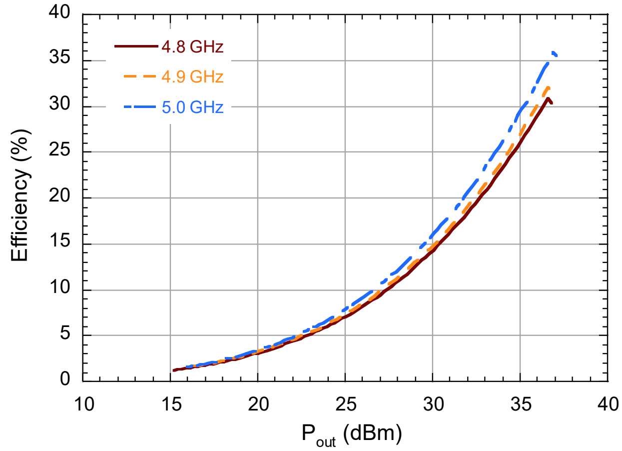


Typical Performance as Measured in the 4.8 - 5.0 GHz Evaluation Test Fixture: WCMDA 3GPP TM1 64 DPCH 9.9 dB PAR @ 0.01% CCDF V_{DS} = 50 V, I_{DQ} = 50 mA, T_C = 25°C

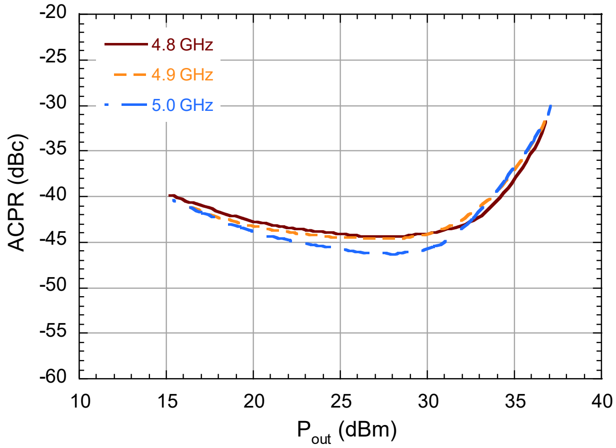
Gain vs. Output Power



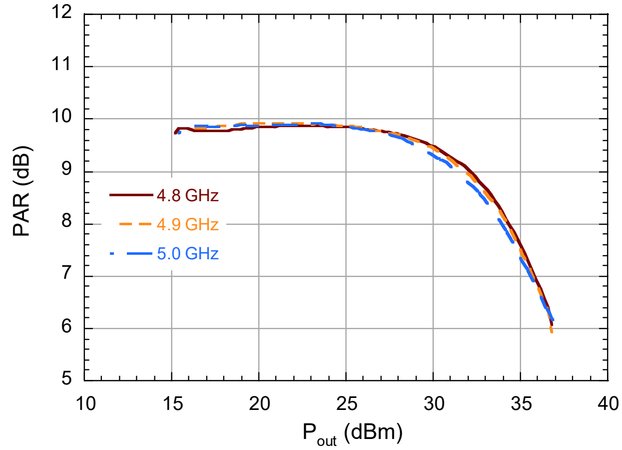
Efficiency vs. Output Power



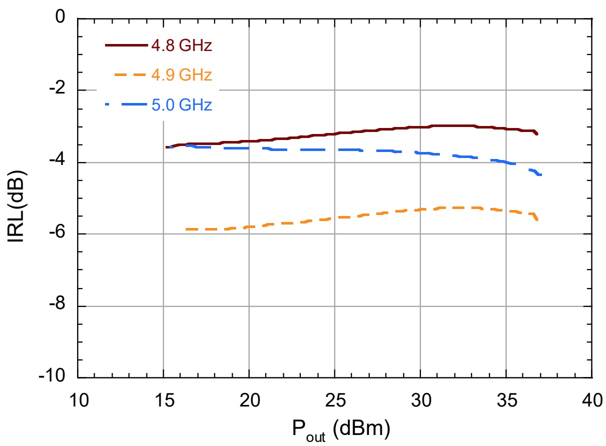
ACPR (Max ±5 MHz) vs. Output Power



PAR (CCDF @ 0.01%) vs. Output Power

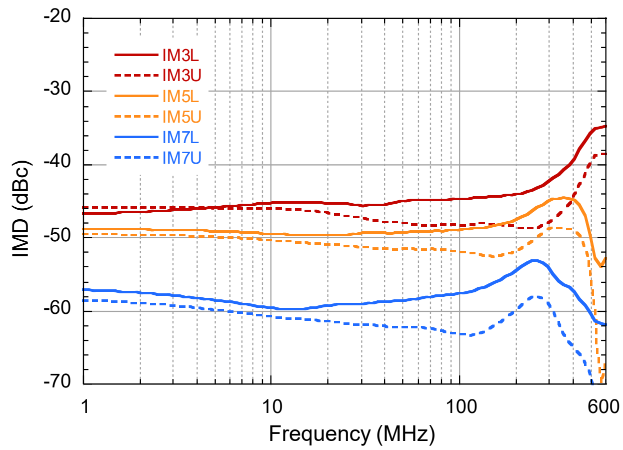


Input Return Loss vs. Output Power

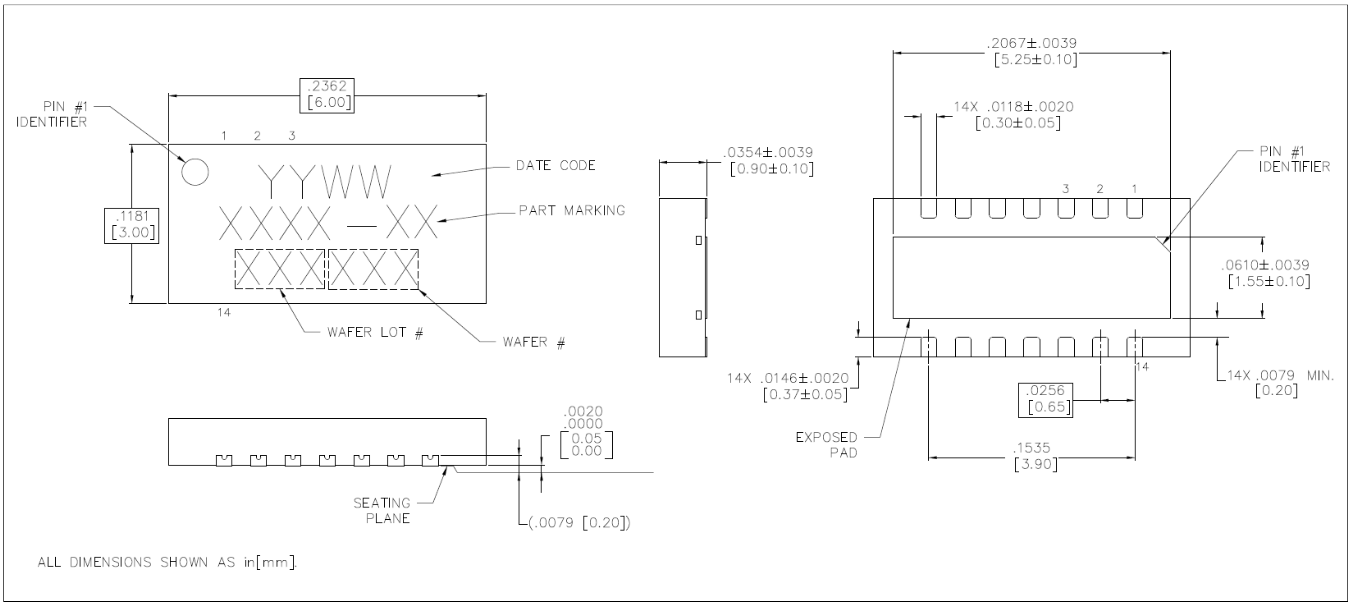


Typical Performance as Measured in the 4.8—5.0 GHz Evaluation Test Fixture: 2-Tone Video Bandwidth Performance, V_{DS} = 50 V, I_{DQ} = 50 mA, P_{OUT} = 34 dBm Avg.

IMD vs. Tone Spacing (MHz) at 4.9 GHz



Lead-Free 6 x 3 mm DFN Package Dimensions†



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