

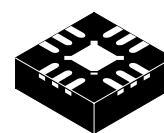
# Indium Gallium Phosphorus HBT WLAN Power Amplifier

Designed for 802.11g and dual mode applications with frequencies from 2400 to 2500 MHz.

- 26.5 dBm P1dB @ 2450 MHz
- Power Gain: 27.5 dB Typ (@ f = 2450 MHz, Class AB)
- High Gain, High Efficiency and High Linearity
- EVM = 3% Typ @ P<sub>out</sub> = +19 dBm, 14% PAE
- RoHS Compliant
- In Tape and Reel. R2 Suffix = 1,500 Units per 12 mm, 7 inch Reel.

**MMG2401NR2**

**2400-2500 MHz, 27.5 dB, 26.5 dBm  
802.11g WLAN POWER AMPLIFIER  
InGaP HBT**



**CASE 1483-01  
QFN 3x3**

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**Table 1. Maximum Ratings**

Rating	Symbol	Value	Unit
Collector Supply	V <sub>CC</sub>	5	V
Base Supply First Stage	V <sub>B1</sub>	5	V
Base Supply Second Stage	V <sub>B2</sub>	5	V
Detector Bias Supply	V <sub>BIAS</sub>	5	V
DC Current	I <sub>DC</sub>	171	mA

**Table 2. Thermal Characteristics**

Characteristic	Symbol	Value	Unit
Thermal Resistance, Junction to Case	R <sub>θJC</sub>	185 (1)	°C/W
Case Operating Temperature Range	T <sub>C</sub>	- 40 to +85	°C
Storage Temperature Range	T <sub>stg</sub>	- 55 to +150	°C

**Table 3. ESD Protection Characteristics**

Test Methodology	Class
Human Body Model (per JESD22-A114)	2 (Minimum)
Machine Model (per EIA/JESD22-A115)	A (Minimum)
Charge Device Model (per JESD22-C101)	II (Minimum)

**Table 4. Moisture Sensitivity Level**

Test Methodology	Rating	Package Peak Temperature	Unit
Per JESD 22-A113, IPC/JEDEC J-STD-020	1	260	°C

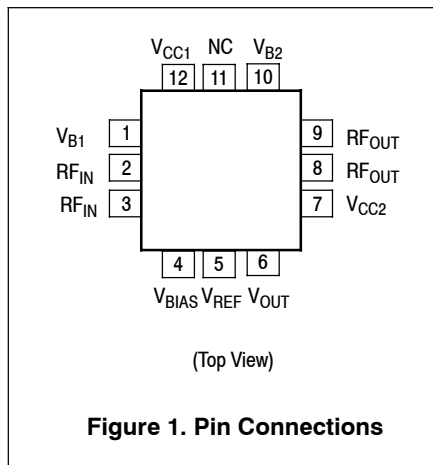
1. Simulated.

**Table 5. Electrical Characteristics** ( $T_A = 25^\circ\text{C}$  unless otherwise noted.)  $V_{CC} = 3.3\text{ Vdc}$ ,  $V_{BIAS} = 3\text{ Vdc}$ ,  $I_{CQ} = 83\text{ mA}$ ,  $f = 2450\text{ MHz}$ 

Characteristic	Symbol	Min	Typ	Max	Unit
Output Power at 1dB Compression	P1dB	24	26.5	—	dBm
Power Gain ( $P_{out} = 19\text{ dBm}$ )	$G_p$	26	27.5	29	dB
Error Vector Magnitude ( $P_{out} = 19\text{ dBm}$ , 64 QAM/54 Mbps)	EVM	—	3	—	%
Total Current ( $P_{out} = 19\text{ dBm}$ )	$I_{Ctotal}$	—	210	—	mA
Quiescent Current	$I_{DCQ}$	—	156	—	mA
Bias Control Reference Current ( $I_{CQ} = 66\text{ mA}$ )	$I_{ref}$	—	8.4	—	mA
Gain Flatness (Over 100 MHz)	$G_F$	—	$\pm 0.2$	—	dB
Gain Variation over Temperature ( $-40$ to $85^\circ\text{C}$ )	—	—	$\pm 1$	—	dB
Input Return Loss	IRL	—	-10	-7.5	dB
Reverse Isolation	—	—	-35	—	dB
Second Harmonic ( $P_{out} = 19\text{ dBm}$ )	—	—	-45	—	dBc
Third Harmonic ( $P_{out} = 19\text{ dBm}$ )	—	—	-35	—	dBc
Ramp-On Time (10-90%)	$t_{ON}$	—	100	—	ns

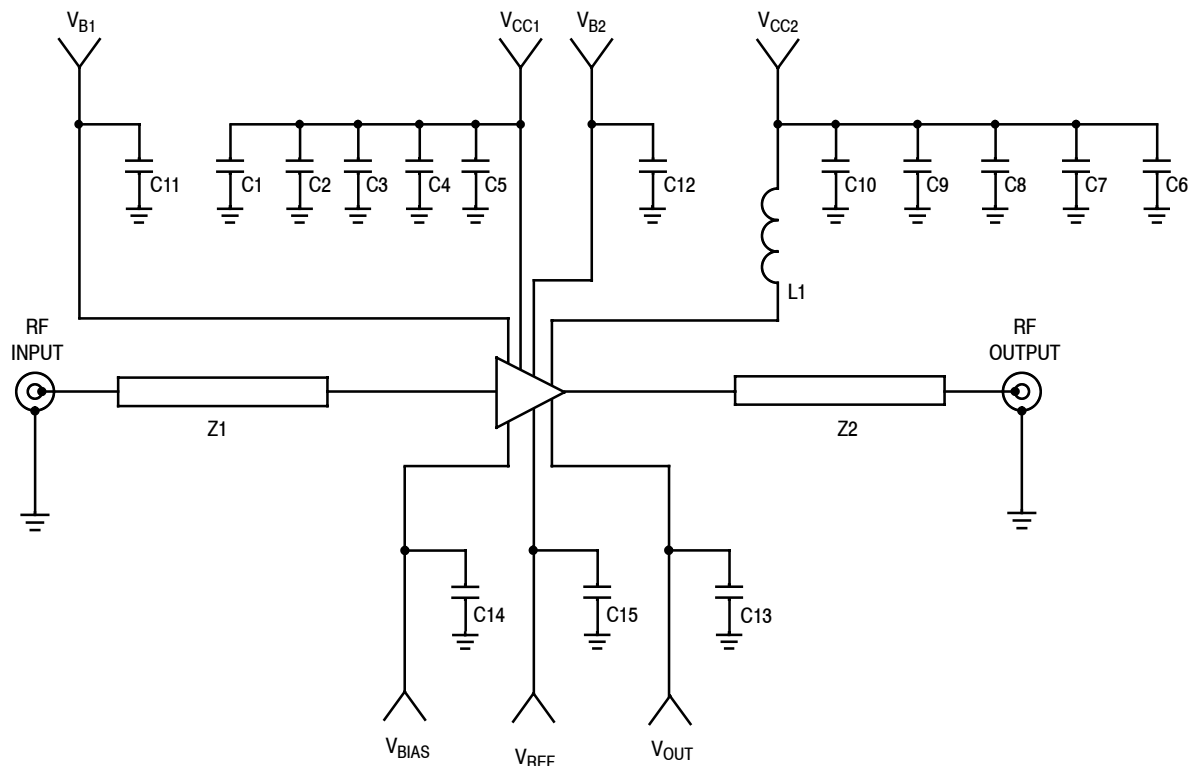
**Table 6. Functional Pin Description**

Name	Pin Number	Description
V <sub>B1</sub>	1	Base power supply for first stage amplifier.
RF <sub>IN</sub>	2, 3	RF input for the power amplifier. This pin is DC-shortened to GND and AC-coupled to the transistor base of the first stage.
V <sub>BIAS</sub>	4	Detector bias voltage supply.
V <sub>REF</sub>	5	Detector output voltage reference. V <sub>out</sub> - V <sub>REF</sub> is useful for tracking detector performance over temperature.
V <sub>OUT</sub>	6	Detector output voltage.
V <sub>CC2</sub>	7	Collector power supply for second stage amplifier.
RF <sub>OUT</sub>	8, 9	RF output for the power amplifier. This pin is DC-coupled and requires a DC-blocking series capacitor.
V <sub>B2</sub>	10	Base power supply for second stage amplifier.
NC	11	Not connected.
V <sub>CC1</sub>	12	Collector power supply for first stage amplifier.
GND	Backside Center Metal	The center metal base of the QFN 3x3 package provides both DC and RF ground as well as heat sink contact for the power amplifier.



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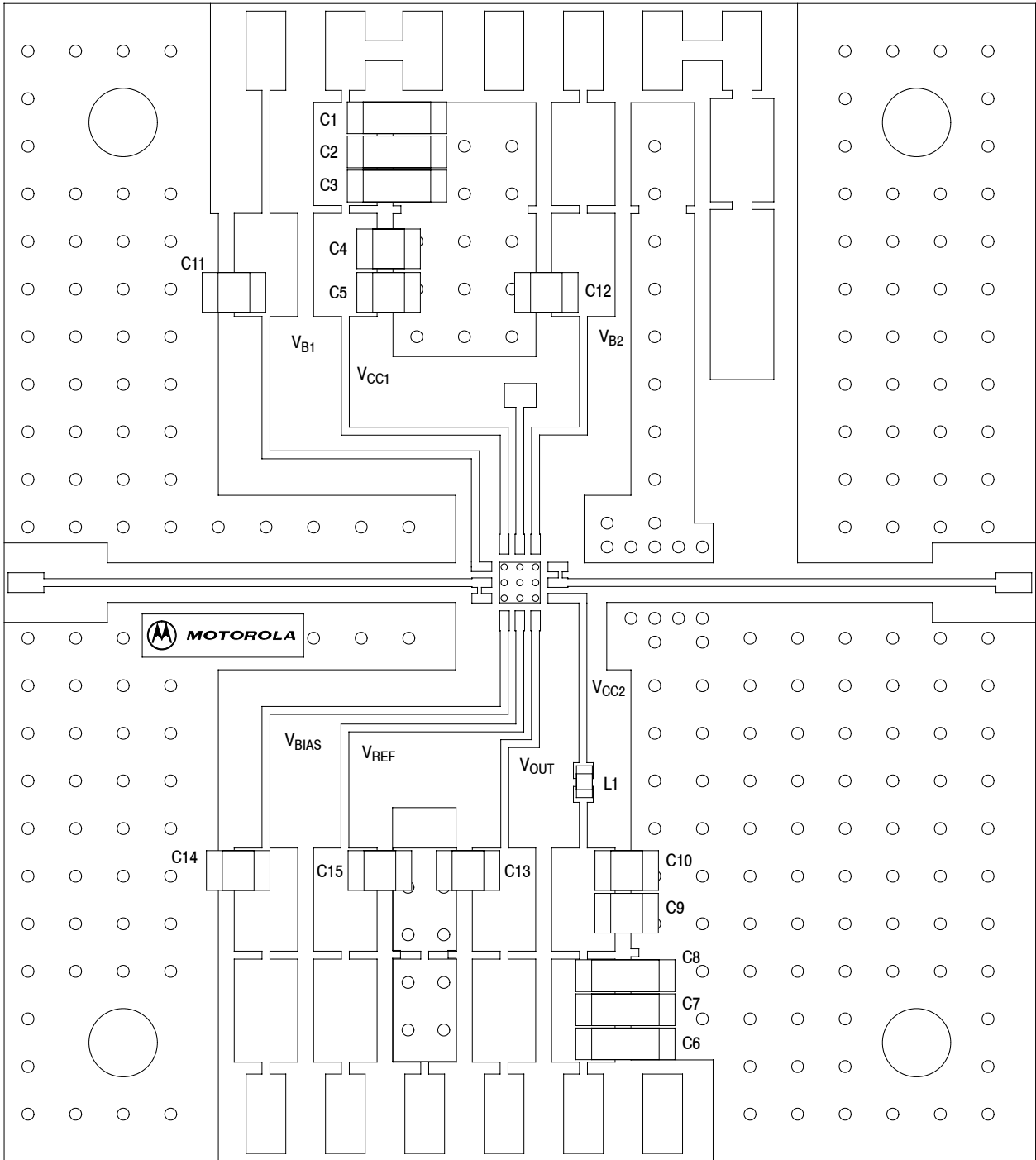


Z1, Z2      0.10" x 0.5395" Microstrip  
PCB          Getek ML200M, 0.005",  $\epsilon_r = 3.8$

**Figure 2. MMG2401NR2 Test Circuit Schematic**

**Table 7. MMG2401NR2 Test Circuit Component Designations and Values**

Part	Description	Part Number	Manufacturer
C1, C6	1 $\mu$ F Chip Capacitor	12065A105JAT2A	AVX
C2, C7	0.1 $\mu$ F Chip Capacitor	12065A104JAT2A	AVX
C3, C8	0.01 $\mu$ F Chip Capacitor	12065A103JAT2A	AVX
C4, C9, C11, C12	100 pF Chip Capacitor	08055A101FAT2A	AVX
C5, C10, C13, C14, C15	20 pF Chip Capacitor	12065A200CAT2A	AVX
L1	7.5 nH Chip Inductor	0402CS-7N5XJBC	Coilcraft



Freescle has begun the transition of marking Printed Circuit Boards (PCBs) with the Freescle Semiconductor signature/logo. PCBs may have either Motorola or Freescle markings during the transition period. These changes will have no impact on form, fit or function of the current product.

**Figure 3. MMG2401NR2 Test Circuit Component Layout**

### TYPICAL CHARACTERISTICS

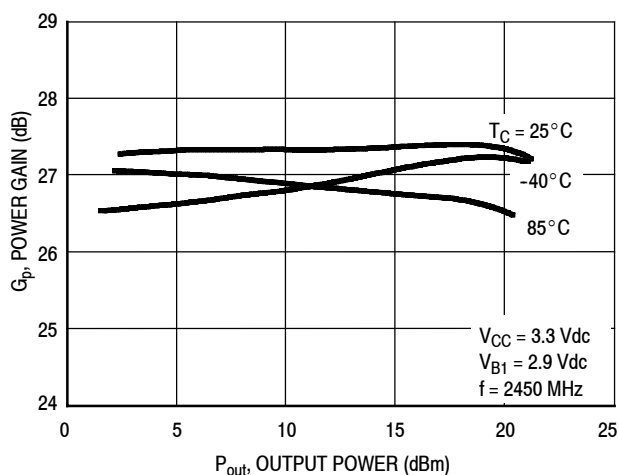


Figure 4. Power Gain versus Output Power

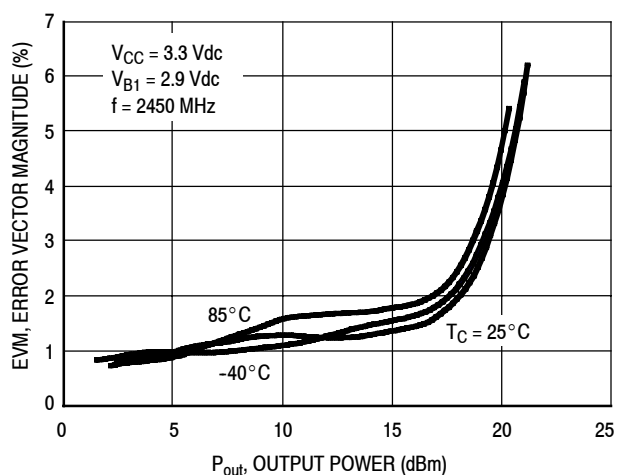


Figure 5. Error Vector Magnitude versus Output Power

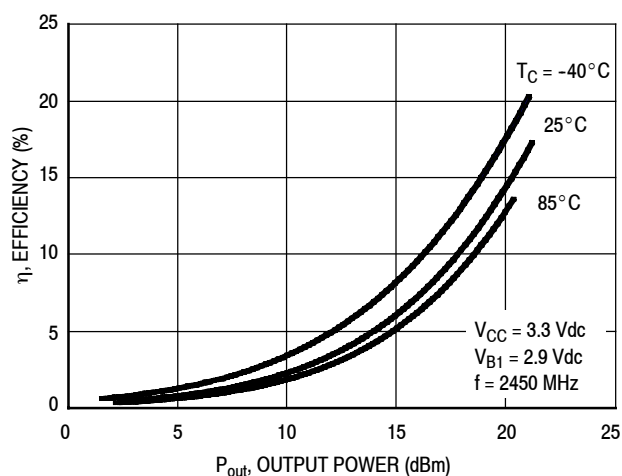


Figure 6. Efficiency versus Output Power

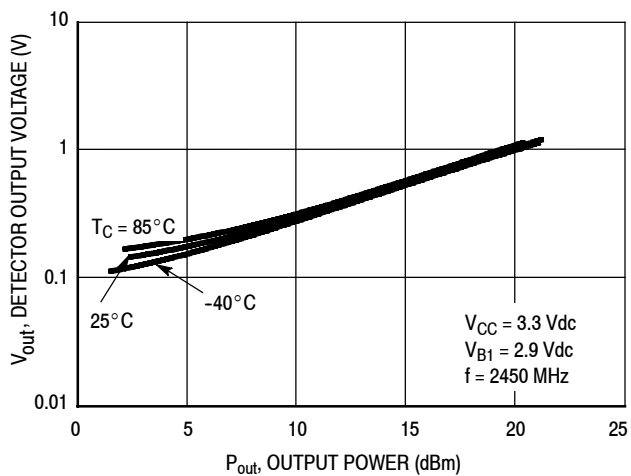


Figure 7. Detector Output Voltage versus Output Power

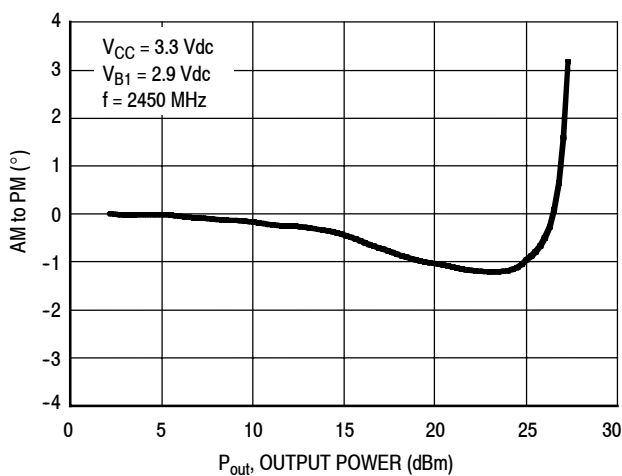


Figure 8. AM to PM versus Output Power

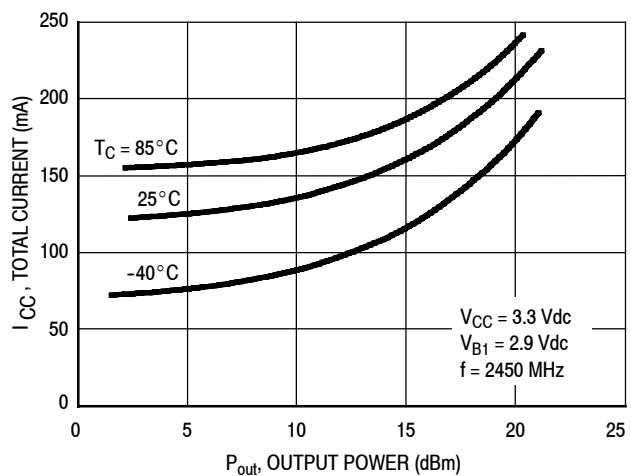
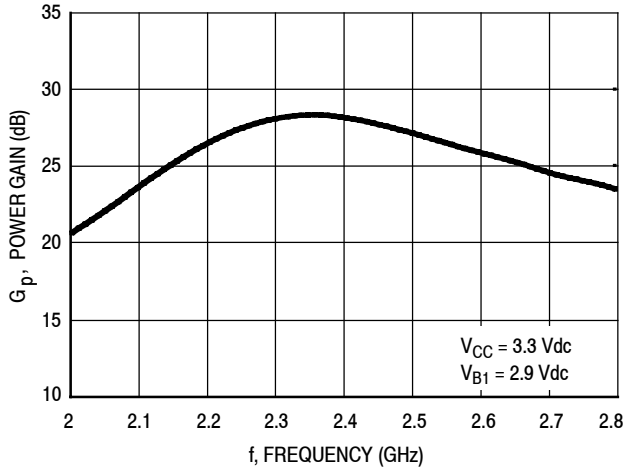


Figure 9. Total Current versus Output Power

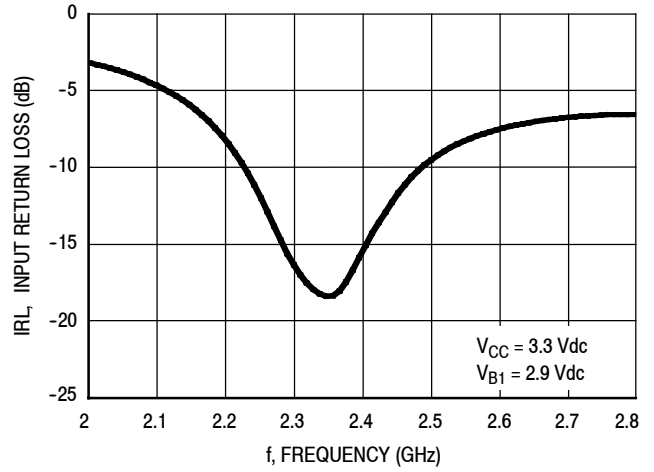
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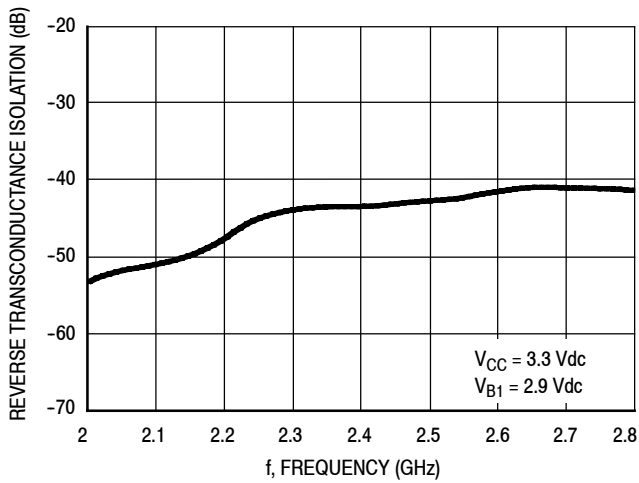
## TYPICAL CHARACTERISTICS



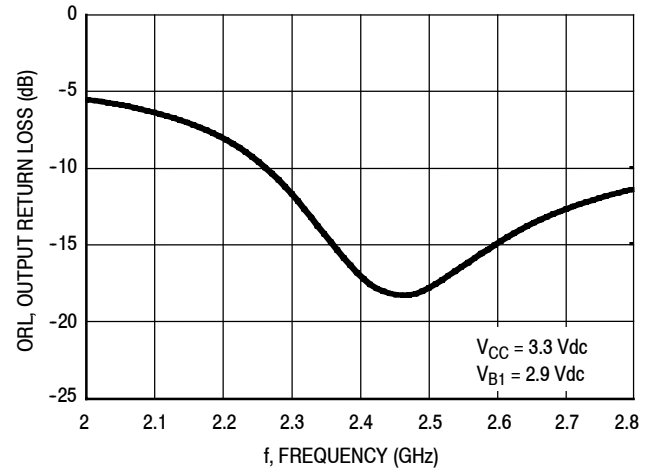
**Figure 10. Power Gain (S21) versus Frequency**



**Figure 11. Input Return Loss (S11) versus Frequency**



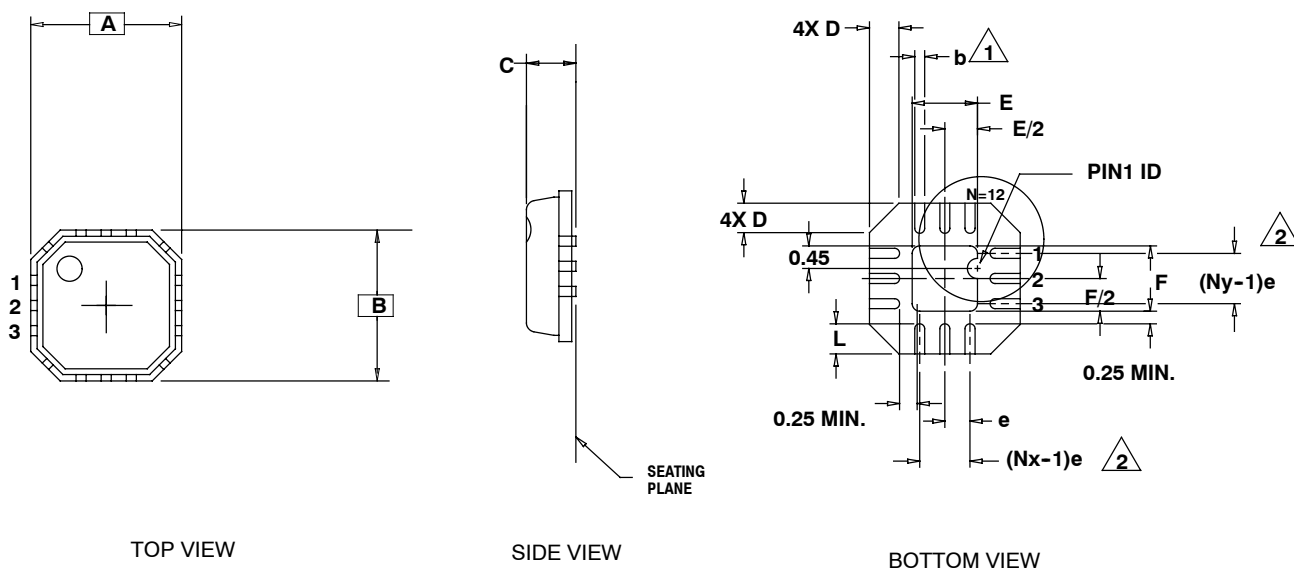
**Figure 12. Reverse Transconductance Isolation (S12) versus Frequency**



**Figure 13. Output Return Loss (S22) versus Frequency**

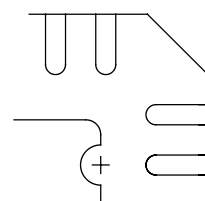
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- NOTES:
- 1. DIMENSION b APPLIES TO PLATED TERMINAL AND IS MEASURED BETWEEN 0.20 AND 0.25 MM FROM TERMINAL TIP.
  - 2. N IS THE NUMBER OF TERMINALS (12). Nx IS THE NUMBER OF TERMINALS IN X-DIRECTION AND Ny IS THE NUMBER OF TERMINALS IN Y-DIRECTION.
  - 3. ALL DIMENSIONS ARE IN MILLIMETERS.

DIM	MIN	NOM	MAX
A		3.00 BSC	
B		3.00 BSC	
C	-	0.85	1.00
D	0.24	0.42	0.60
E	SEE EXPOSED PAD		
F	SEE EXPOSED PAD		
b	0.18	0.23	0.30
e	0.50 BSC		
Nx	3		
Ny	3		



STANDARD

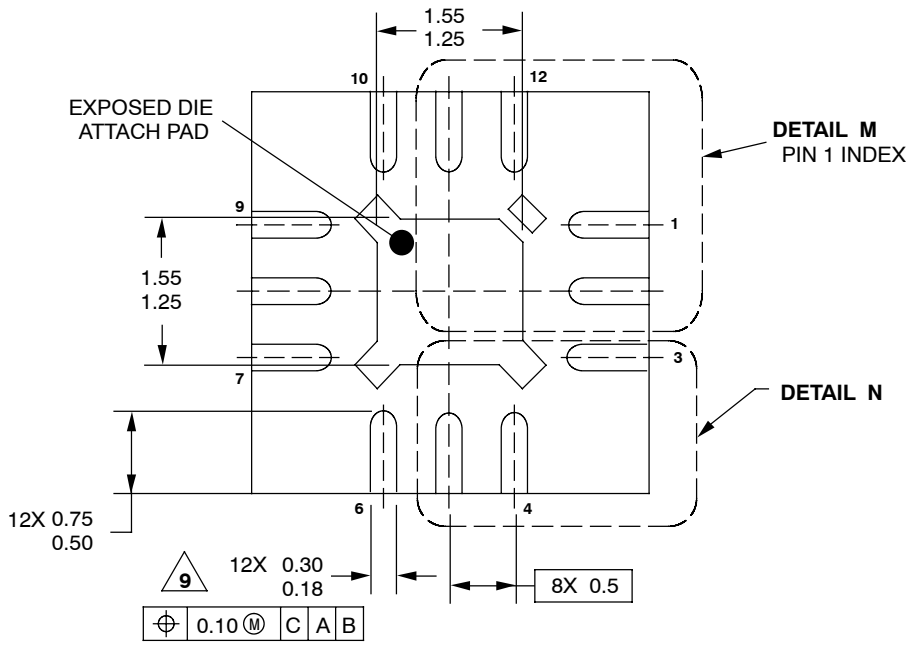
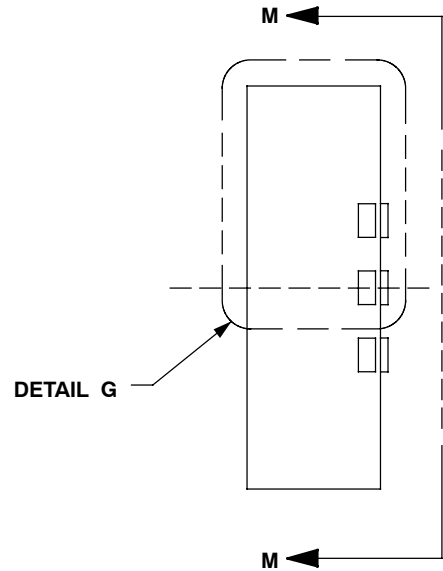
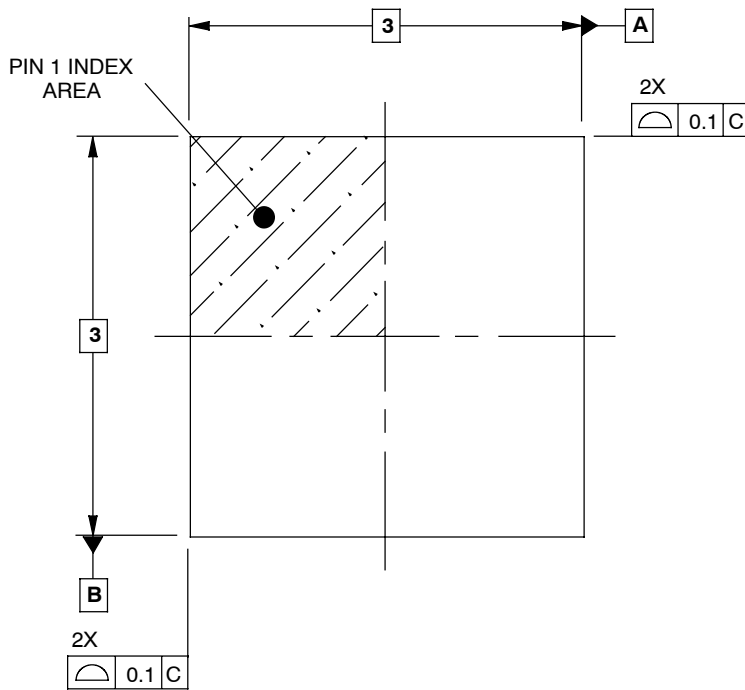
DETAIL "A" - PIN #1 ID AND TIE BAR MARK OPTION

SYMBOLS	E			F		
	MIN	NOM	MAX	MIN	NOM	MAX
EXPOSED PAD	1.15	1.30	1.45	1.15	1.30	1.45

Figure 14. MMG2401NR2 Specific Mechanical Outline Information



### PACKAGE DIMENSIONS

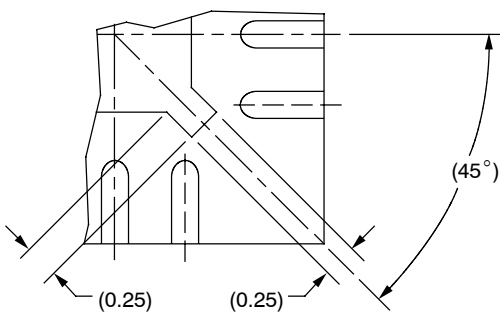


VIEW M - M

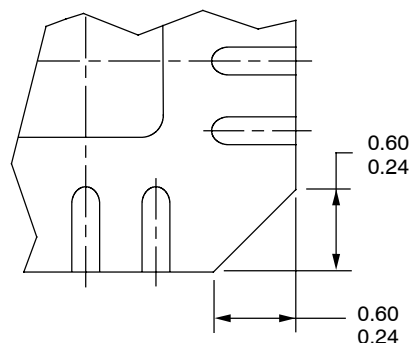
NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1994.
3. THE COMPLETE JEDEC DESIGNATOR FOR THIS PACKAGE IS: HF-PQFP-N.
4. FOR ANVIL SINGULATED QFN PACKAGES, MAXIMUM DRAFT ANGLE IS 12°.
5. PACKAGE WARPAGE MAX 0.05 MM.
6. CORNER CHAMFER MAY NOT BE PRESENT. DIMENSIONS OF OPTIONAL FEATURES ARE FOR REFERENCE ONLY.
7. CORNER LEADS CAN BE USED FOR THERMAL OR GROUND AND ARE TIED TO THE DIE ATTACH PAD. THESE LEADS ARE NOT INCLUDED IN THE LEAD COUNT.
8. COPLANARITY APPLIES TO LEAD, CORNER LEADS, AND DIE ATTACH PAD.
9. THIS DIMENSION APPLIES TO PLATED TERMINAL AND IS MEASURED BETWEEN 0.20 MM AND 0.25 MM FROM TERMINAL TIP.

CASE 1483-01  
ISSUE A  
QFN 3x3



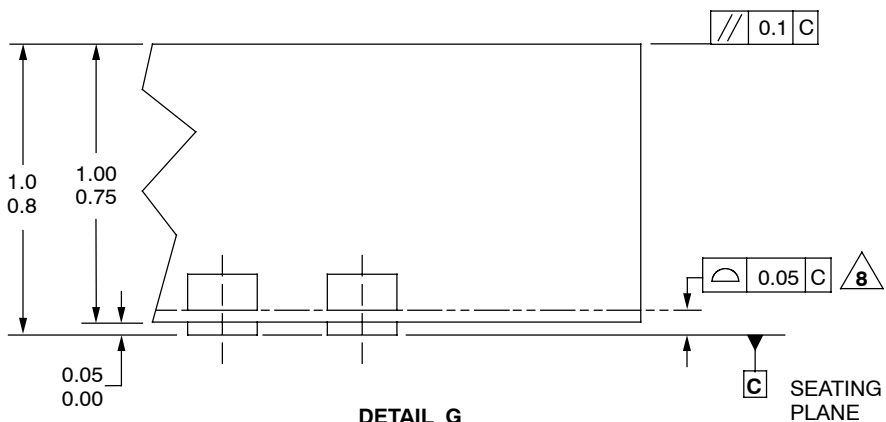
**DETAIL N**  
PREFERRED CORNER CONFIGURATION



**DETAIL N**  
CORNER CONFIGURATION



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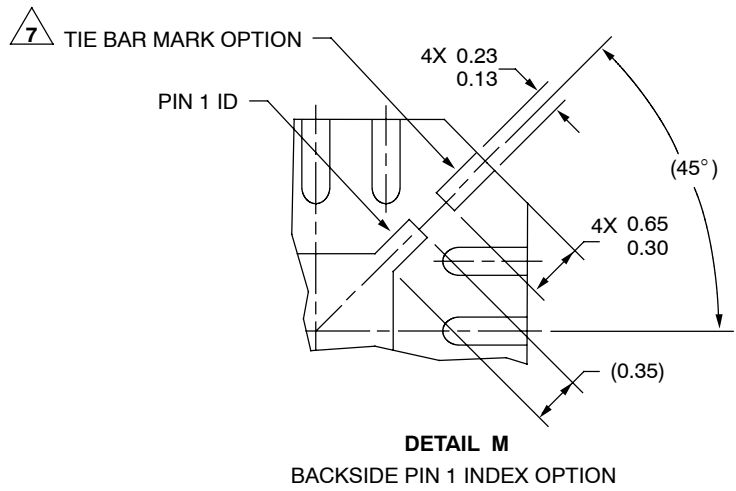
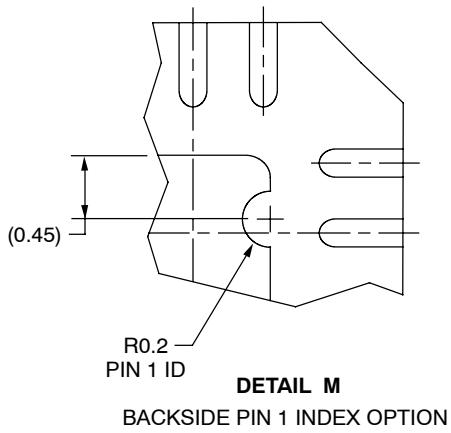
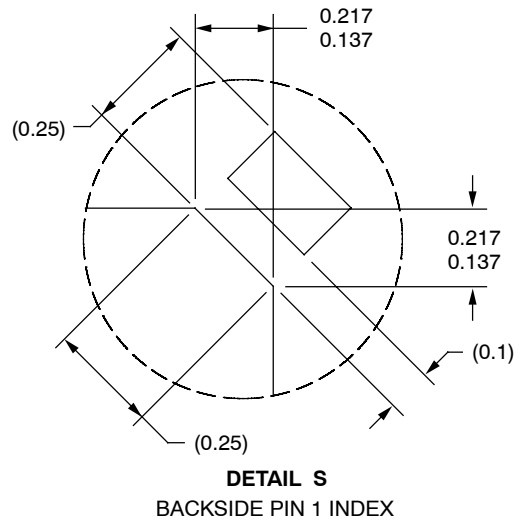
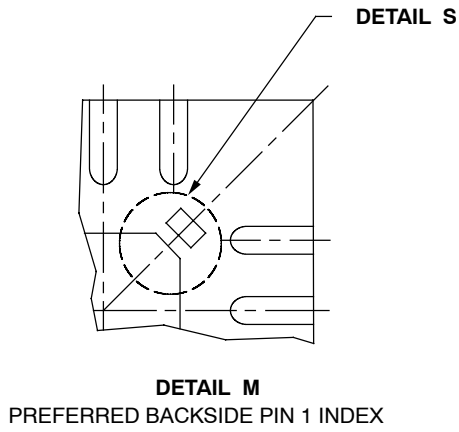


**DETAIL G**  
VIEW ROTATED 90° CW

**C** SEATING PLANE

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**CASE 1483-01**  
**ISSUE A**  
**QFN 3x3**



**CASE 1483-01**  
**ISSUE A**  
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