Freescale Semiconductor
Technical Data

Document Number: MMZ09312B
Rev. 1, 2/2012

RoHS

Heterojunction Bipolar Transistor Technology (InGaP HBT)

High Efficiency/Linearity Amplifier

MMZ09312BT1

400–1000 MHz, 31.7 dB
29.6 dBm
InGaP HBT

CASE 2131-01
QFN 3x3
PLASTIC

The MMZ09312B is a 2–stage high efficiency, Class AB InGaP HBT amplifier designed for use as a linear driver amplifier in wireless base station applications as well as an output stage in femtocell or repeater applications. It is suitable for applications with frequencies from 400 to 1000 MHz such as CDMA, GSM, LTE and ZigBee® at operating voltages from 3 to 5 Volts. The amplifier is housed in a cost–effective, surface mount QFN plastic package.

- Typical Performance: V_{CC1} = V_{CC2} = V_{BIAS} = 5 Volts, I_{CQ} = 74 mA

Frequency	P_{out} (dBm)	G_{ps} (dB)	ACPR (dBc)	PAE (%)	Test Signal
900 MHz	24	31.5	–50.0	26.0	IS–95 CDMA
750 MHz	17.5	32.0	–50.0	15.3	LTE 10/20 MHz
450 MHz	29	33.0	–40.0	57.0	ZigBee

Features

- Frequency: 400–1000 MHz
- P1dB: 29.6 dBm @ 900 MHz
- Power Gain: 31.7 dB @ 900 MHz
- OIP3: 42 dBm @ 900 MHz
- Active Bias Control (adjustable externally)
- Single 3 to 5 Volt Supply
- Performs Well with Digital Predistortion Systems
- Single–ended Power Detector
- Cost–effective QFN Surface Mount Package
- In Tape and Reel. T1 Suffix = 1,000 Units, 12 mm Tape Width, 7 inch Reel.

Table 1. Typical Performance (1)

Characteristic	Symbol	450 MHz	900 MHz	Unit
Small–Signal Gain (S21)	G_p	33.8	31.7	dB
Input Return Loss (S11)	IRL	–22	–15	dB
Output Return Loss (S22)	ORL	–25	–18	dB
Power Output @ 1dB Compression	P1dB	28.8	29.6	dBm

1. V_{CC1} = V_{CC2} = V_{BIAS} = 5 Vdc, T_A = 25°C, 50 ohm system, CW Application Circuit

Table 2. Maximum Ratings

Rating	Symbol	Value	Unit
Supply Voltage	V_{CC}	6	V
Supply Current	I_{CC}	550	mA
RF Input Power	P_{in}	14	dBm
Storage Temperature Range	T_{stg}	–65 to +150	°C
Junction Temperature (2)	T_J	150	°C

2. For reliable operation, the junction temperature should not exceed 150°C.

Table 3. Thermal Characteristics

Characteristic	Symbol	Value (3)	Unit
Thermal Resistance, Junction to Case Case Temperature 84°C, V_{CC1} = V_{CC2} = V_{BIAS} = 5 Vdc	$R_{\theta JC}$	56	°C/W

3. Refer to AN1955, *Thermal Measurement Methodology of RF Power Amplifiers.* Go to http://www.freescale.com/rf. Select Documentation/Application Notes – AN1955.

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Table 4. Electrical Characteristics (V_{CC1} = V_{CC2} = V_{BIAS} = 5 Vdc, 900 MHz, T_A = 25°C, 50 ohm system, in Freescale CW Application Circuit)

Characteristic	Symbol	Min	Typ	Max	Unit
Small-Signal Gain (S21)	G_p	29	31.7	—	dB
Input Return Loss (S11)	IRL	—	-15	—	dB
Output Return Loss (S22)	ORL	—	-18	—	dB
Power Output @ 1dB Compression	P1dB	—	29.6	—	dBm
Third Order Output Intercept Point, Two-Tone CW	OIP3	—	42	—	dBm
Noise Figure	NF	—	4	—	dB
Supply Current (1)	I_{CQ}	69	74	83	mA
Supply Voltage (1)	V_{CC}	—	5	—	V

Table 5. ESD Protection Characteristics

Test Methodology	Class
Human Body Model (per JESD22-A114)	Meets 2000 V for all pins except: Pin 11 meets 400 V Pin 8 meets 200 V Class 0 Rating
Machine Model (per EIA/JESD22-A115)	A
Charge Device Model (per JESD22-C101)	IV

Table 6. Moisture Sensitivity Level

Test Methodology	Rating	Package Peak Temperature	Unit
Per JESD22-A113, IPC/JEDEC J-STD-020	1	260	°C

1. For reliable operation, the junction temperature should not exceed 150°C.

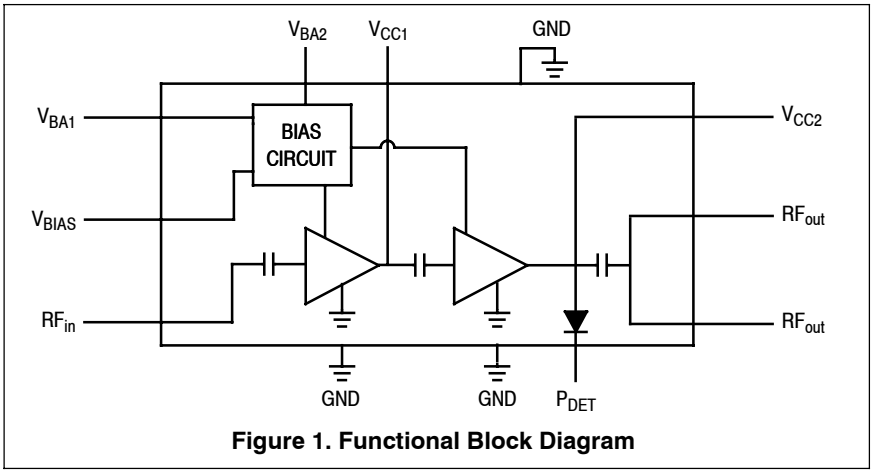


Figure 1. Functional Block Diagram

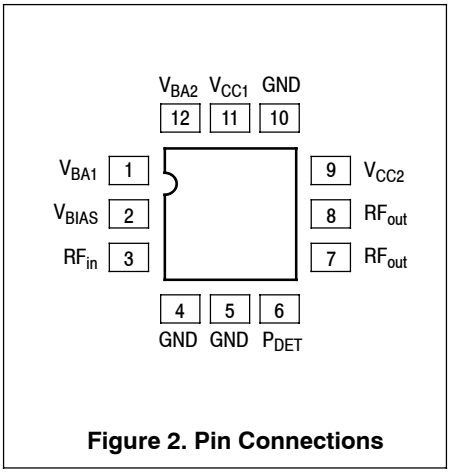


Figure 2. Pin Connections

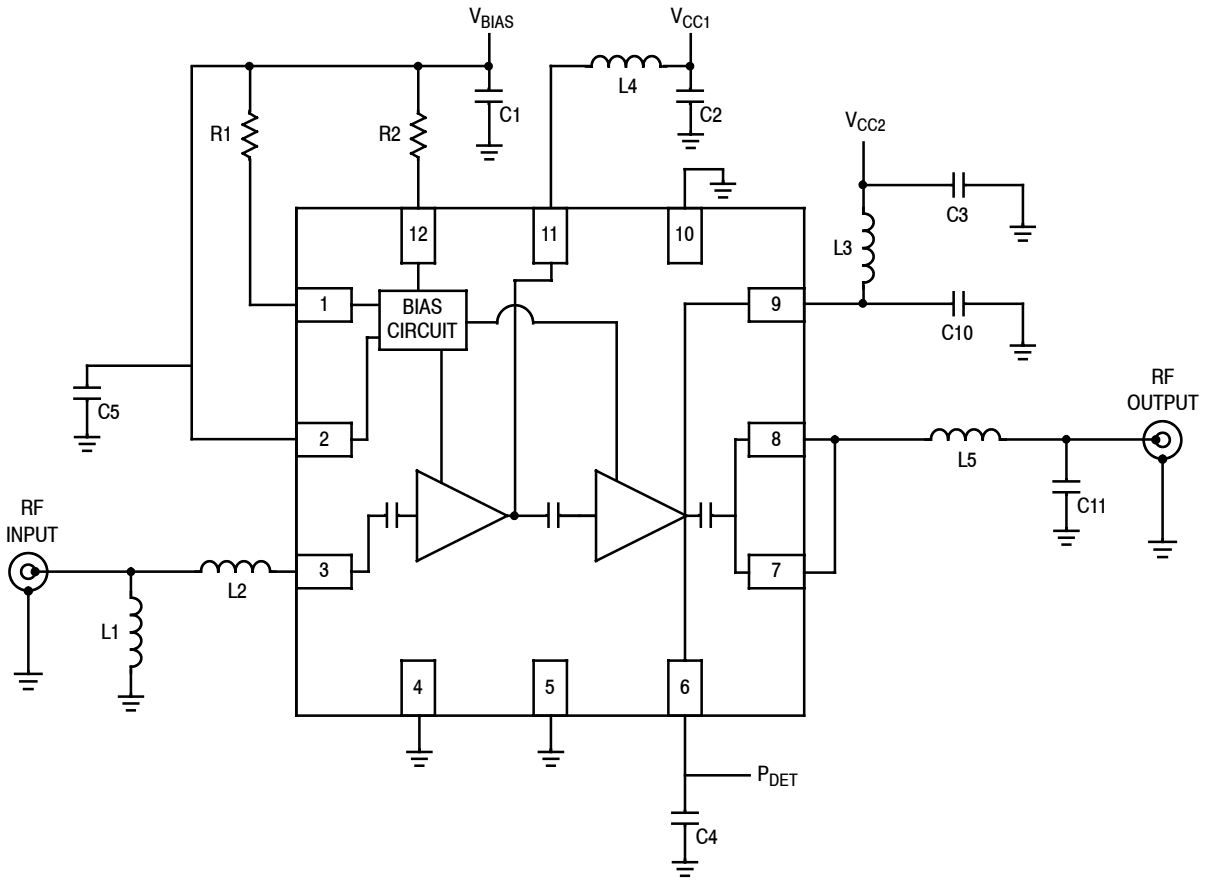
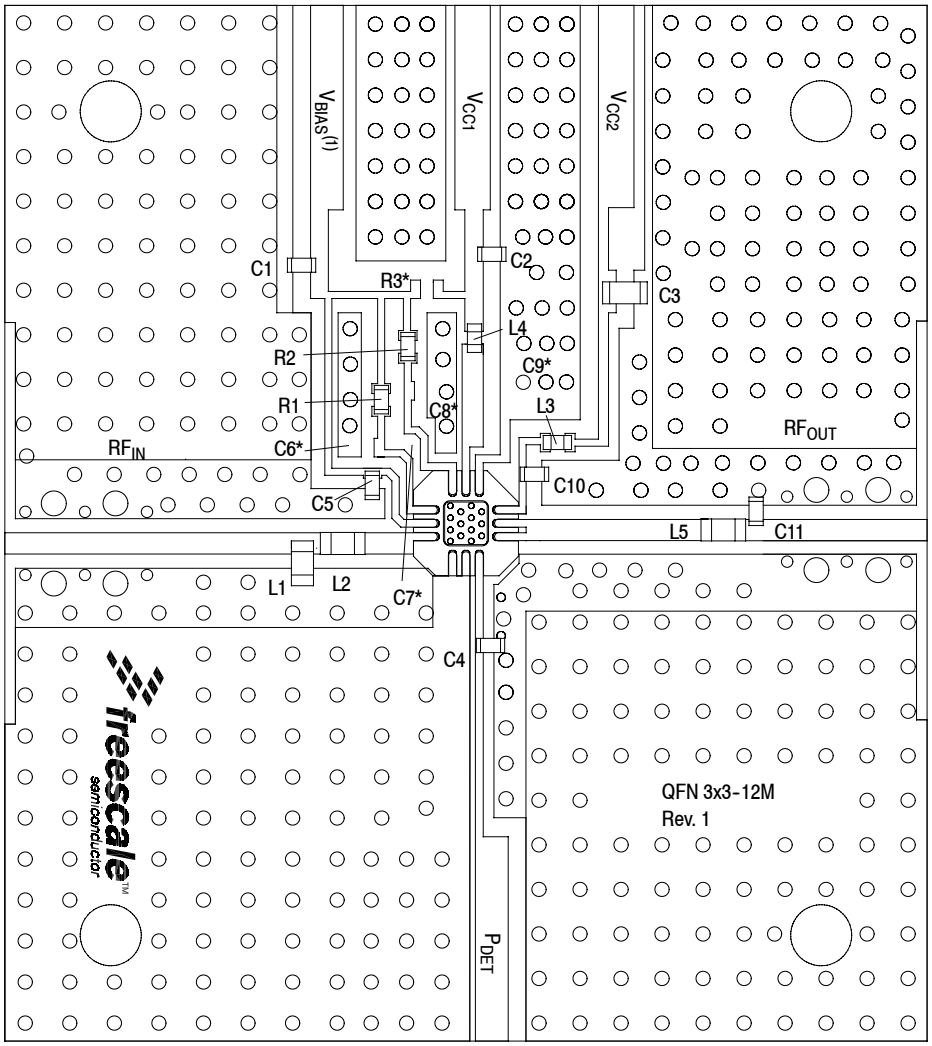


Figure 3. MMZ09312B Test Circuit Schematic — 900 MHz, 5 Volt Operation

Table 7. MMZ09312B Test Circuit Component Designations and Values — 900 MHz, 5 Volt Operation

Part	Description	Part Number	Manufacturer
C1, C2	1 μF Chip Capacitors	GRM155R61A105KE15	Murata
C3	4.7 μF Chip Capacitor	GRM188R60J475KE19	Murata
C4	470 pF Chip Capacitor	GRM1555C1H471JA01	Murata
C5	100 pF Chip Capacitor	GRM1555C1H101JA01	Murata
C6, C7, C8, C9	Components Not Placed		
C10	4.7 pF Chip Capacitor	04023J4R7BBSTR	AVX
C11	6.8 pF Chip Capacitor	04023J6R8BBSTR	AVX
L1	8.2 nH Chip Inductor	LL1608-FSL8N2JL	TOKO
L2	1.2 nH Chip Inductor	LL1608-FSL1N2S	TOKO
L3	33 nH Chip Inductor	0402CS-33NXGLW	Coilcraft
L4	22 nH Chip Inductor	0402CS-22NXGLW	Coilcraft
L5	3.3 nH Chip Inductor	0603CS-3N3XJLW	Coilcraft
R1	330 Ω, 1/16 W Chip Resistor	RC0402JR-07331RL	Yageo
R2	1.5 kΩ, 1/16 W Chip Resistor	RC0402JR-07152RL	Yageo
R3	Component Not Placed		
PCB	0.014″, ε_r = 3.7	FR408	Isola

Note: Component numbers C6, C7, C8, C9 and R3 are labeled on board but not placed.



(1) V_{BIAS} [Board] supplies V_{BA1}, V_{BA2} and V_{BIAS} [Device].
Note: Component numbers C6*, C7*, C8*, C9* and R3* are labeled on board but not placed.

Figure 4. MMZ09312B Test Circuit Component Layout — 900 MHz, 5 Volt Operation

Table 7. MMZ09312B Test Circuit Component Designations and Values — 900 MHz, 5 Volt Operation

Part	Description	Part Number	Manufacturer
C1, C2	1 μF Chip Capacitors	GRM155R61A105KE15	Murata
C3	4.7 μF Chip Capacitor	GRM188R60J475KE19	Murata
C4	470 pF Chip Capacitor	GRM1555C1H471JA01	Murata
C5	100 pF Chip Capacitor	GRM1555C1H101JA01	Murata
C6, C7, C8, C9	Components Not Placed		
C10	4.7 pF Chip Capacitor	04023J4R7BBSTR	AVX
C11	6.8 pF Chip Capacitor	04023J6R8BBSTR	AVX
L1	8.2 nH Chip Inductor	LL1608-FSL8N2JL	TOKO
L2	1.2 nH Chip Inductor	LL1608-FSL1N2S	TOKO
L3	33 nH Chip Inductor	0402CS-33NXGLW	Coilcraft
L4	22 nH Chip Inductor	0402CS-22NXGLW	Coilcraft
L5	3.3 nH Chip Inductor	0603CS-3N3XJLW	Coilcraft
R1	330 Ω, 1/16 W Chip Resistor	RC0402JR-07331RL	Yageo
R2	1.5 kΩ, 1/16 W Chip Resistor	RC0402JR-07152RL	Yageo
R3	Component Not Placed		
PCB	0.014″, ε_r = 3.7	FR408	Isola

(Test Circuit Component Designations and Values table repeated for reference.)

TYPICAL CHARACTERISTICS — 900 MHz, 5 VOLT OPERATION

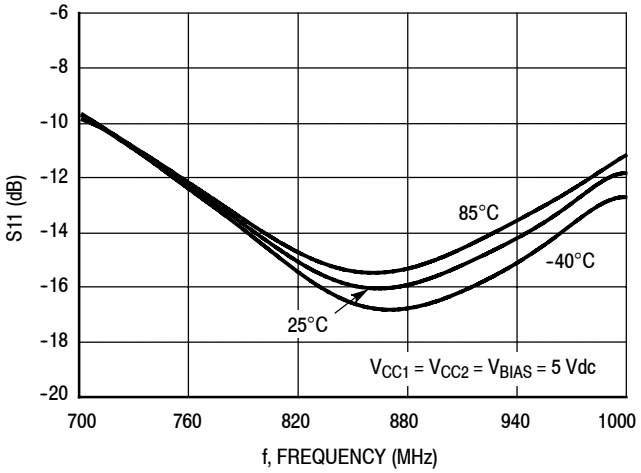


Figure 5. S11 versus Frequency versus Temperature

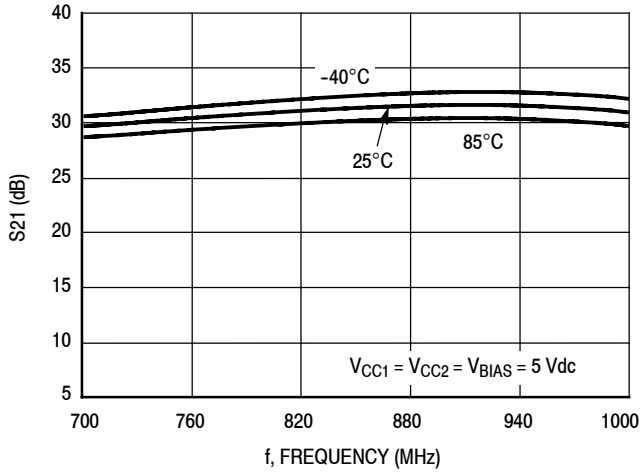


Figure 6. S21 versus Frequency versus Temperature

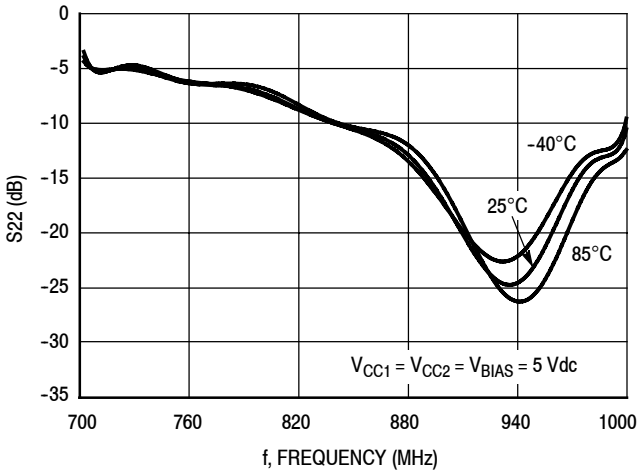


Figure 7. S22 versus Frequency versus Temperature

TYPICAL CHARACTERISTICS — 900 MHz, 5 VOLT OPERATION

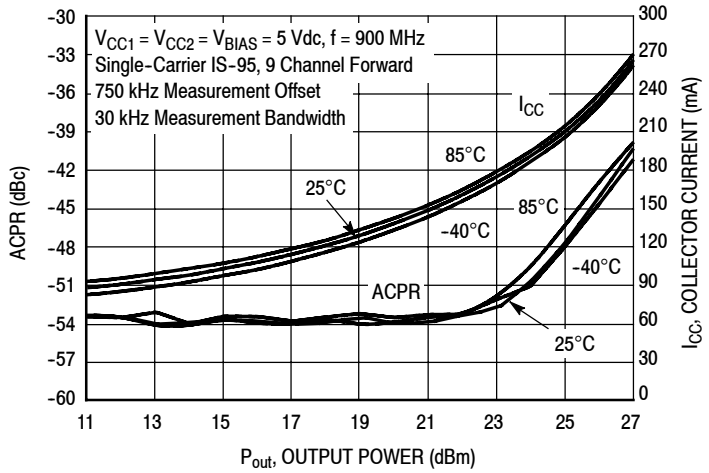


Figure 8. ACPR versus Collector Current versus Output Power versus Temperature

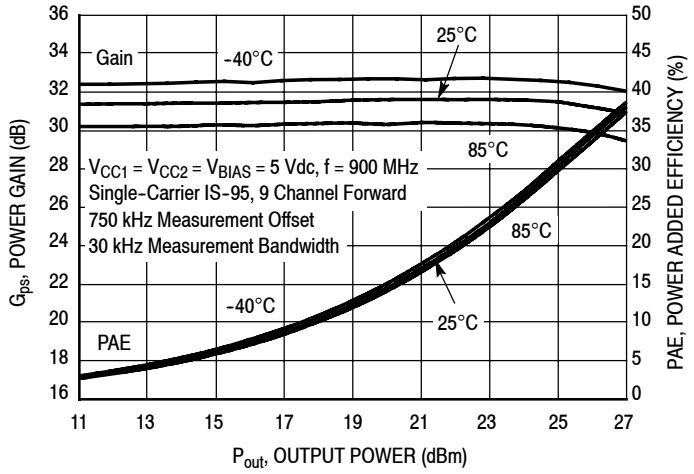


Figure 9. Power Gain versus Power Added Efficiency versus Output Power versus Temperature

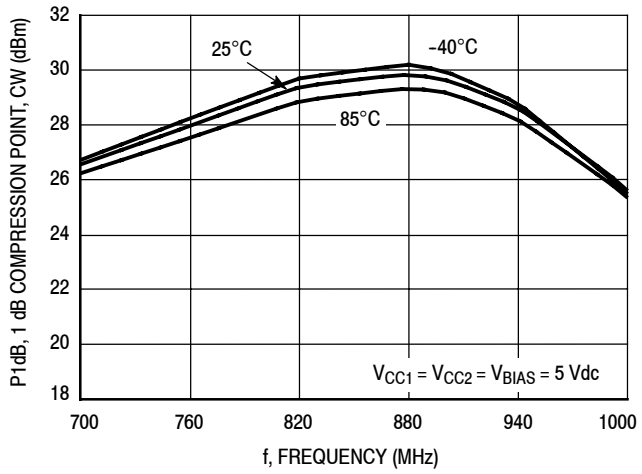


Figure 10. P1dB versus Frequency versus Temperature, CW

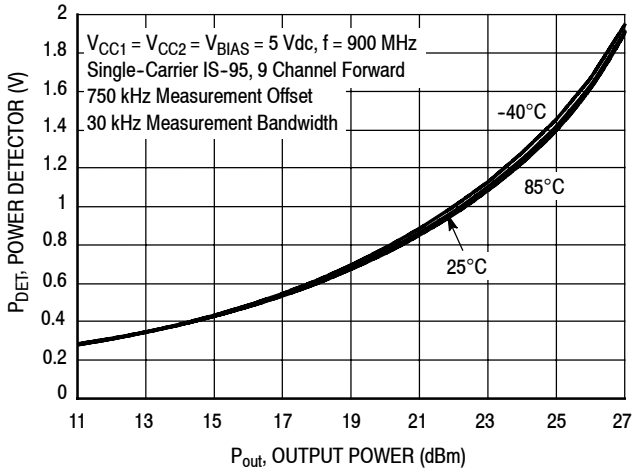


Figure 11. Power Detector versus Output Power versus Temperature

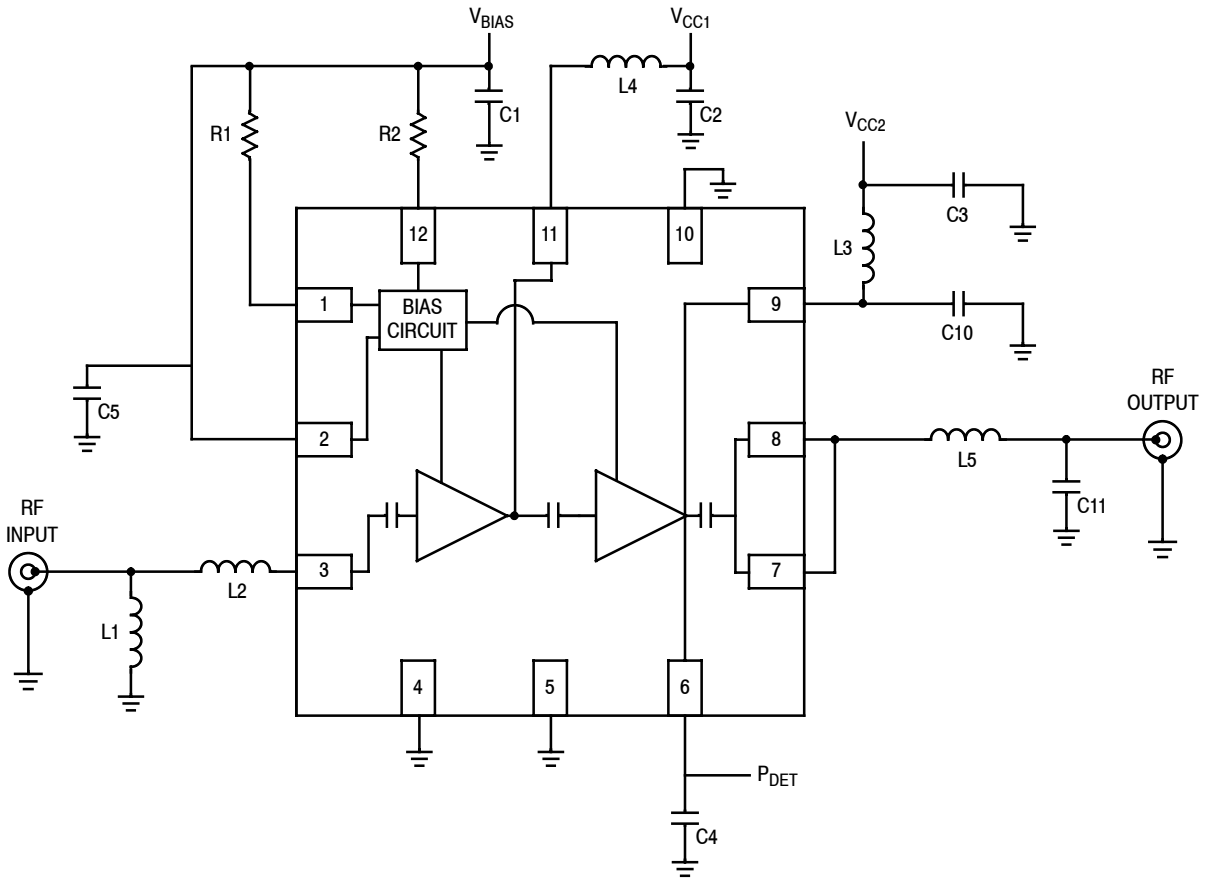
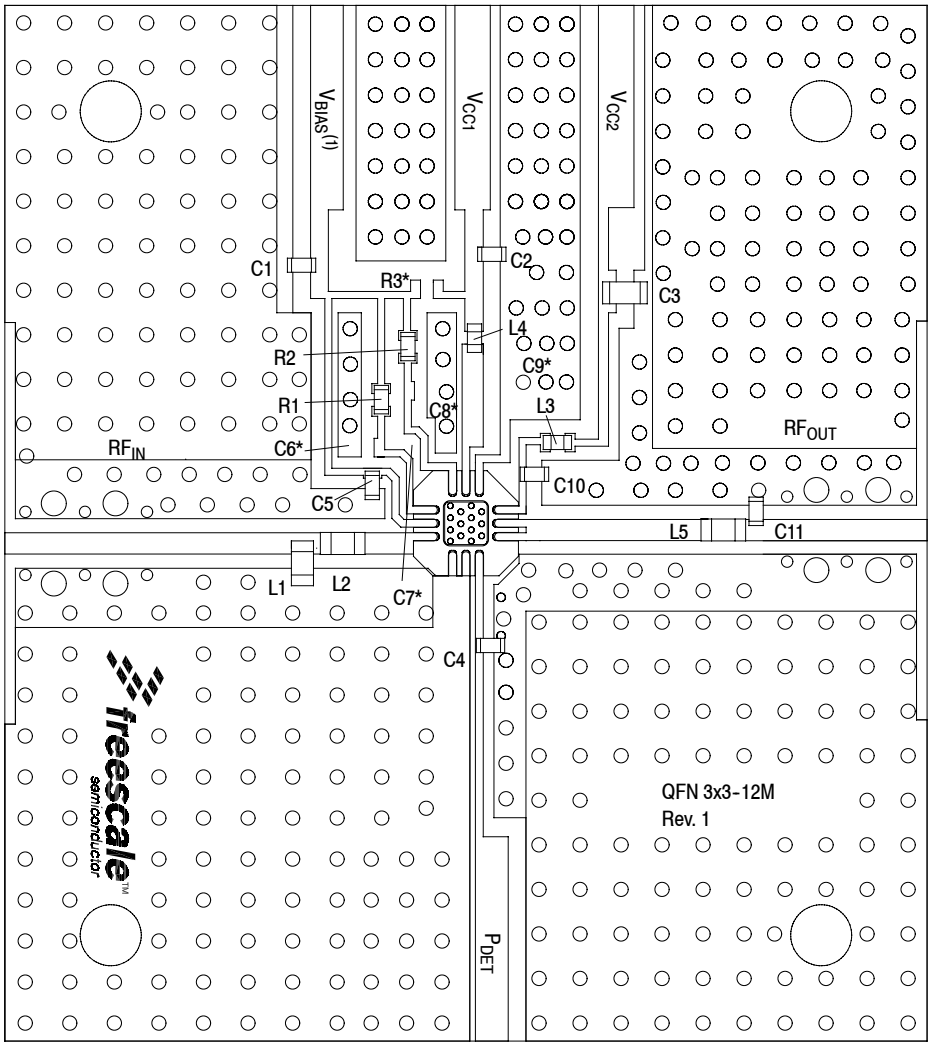


Figure 12. MMZ09312B Test Circuit Schematic — 900 MHz, 3.3 Volt Operation

Table 8. MMZ09312B Test Circuit Component Designations and Values — 900 MHz, 3.3 Volt Operation

Part	Description	Part Number	Manufacturer
C1, C2	1 μF Chip Capacitors	GRM155R61A105KE15	Murata
C3	4.7 μF Chip Capacitor	GRM188R60J475KE19	Murata
C4	470 pF Chip Capacitor	GRM1555C1H471JA01	Murata
C5	100 pF Chip Capacitor	GRM1555C1H101JA01	Murata
C6, C7, C8, C9	Components Not Placed		
C10	4.7 pF Chip Capacitor	04023J4R7BBSTR	AVX
C11	6.8 pF Chip Capacitor	04023J6R8BBSTR	AVX
L1	8.2 nH Chip Inductor	LL1608-FSL8N2JL	TOKO
L2	1.2 nH Chip Inductor	LL1608-FSL1N2S	TOKO
L3	33 nH Chip Inductor	0402CS-33NXGLW	Coilcraft
L4	22 nH Chip Inductor	0402CS-22NXGLW	Coilcraft
L5	3.3 nH Chip Inductor	0603CS-3N3XJLW	Coilcraft
R1	82 Ω, 1/16 W Chip Resistor	RC0402JR-07820RL	Yageo
R2	470 Ω, 1/16 W Chip Resistor	RC0402JR-07471RL	Yageo
R3	Component Not Placed		
PCB	0.014″, ε_r = 3.7	FR408	Isola

Note: Component numbers C6, C7, C8, C9 and R3 are labeled on board but not placed.



(1) V_{BIAS} [Board] supplies V_{BA1}, V_{BA2} and V_{BIAS} [Device].
Note: Component numbers C6*, C7*, C8*, C9* and R3* are labeled on board but not placed.

Figure 13. MMZ09312B Test Circuit Component Layout — 900 MHz, 3.3 Volt Operation

Table 8. MMZ09312B Test Circuit Component Designations and Values — 900 MHz, 3.3 Volt Operation

Part	Description	Part Number	Manufacturer
C1, C2	1 μF Chip Capacitors	GRM155R61A105KE15	Murata
C3	4.7 μF Chip Capacitor	GRM188R60J475KE19	Murata
C4	470 pF Chip Capacitor	GRM1555C1H471JA01	Murata
C5	100 pF Chip Capacitor	GRM1555C1H101JA01	Murata
C6, C7, C8, C9	Components Not Placed		
C10	4.7 pF Chip Capacitor	04023J4R7BBSTR	AVX
C11	6.8 pF Chip Capacitor	04023J6R8BBSTR	AVX
L1	8.2 nH Chip Inductor	LL1608-FSL8N2JL	TOKO
L2	1.2 nH Chip Inductor	LL1608-FSL1N2S	TOKO
L3	33 nH Chip Inductor	0402CS-33NXGLW	Coilcraft
L4	22 nH Chip Inductor	0402CS-22NXGLW	Coilcraft
L5	3.3 nH Chip Inductor	0603CS-3N3XJLW	Coilcraft
R1	82 Ω, 1/16 W Chip Resistor	RC0402JR-07820RL	Yageo
R2	470 Ω, 1/16 W Chip Resistor	RC0402JR-07471RL	Yageo
R3	Component Not Placed		
PCB	0.014″, ε_r = 3.7	FR408	Isola

(Test Circuit Component Designations and Values table repeated for reference.)

TYPICAL CHARACTERISTICS — 900 MHz, 3.3 VOLT OPERATION

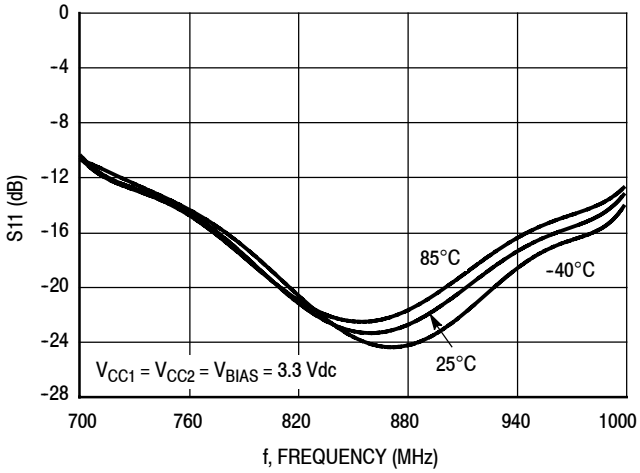


Figure 14. S11 versus Frequency versus Temperature

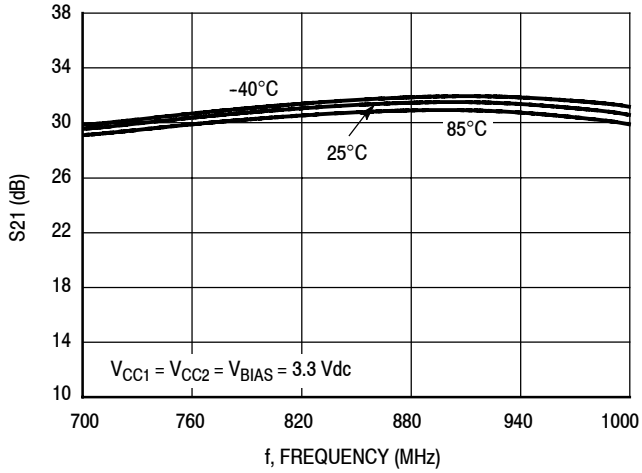


Figure 15. S21 versus Frequency versus Temperature

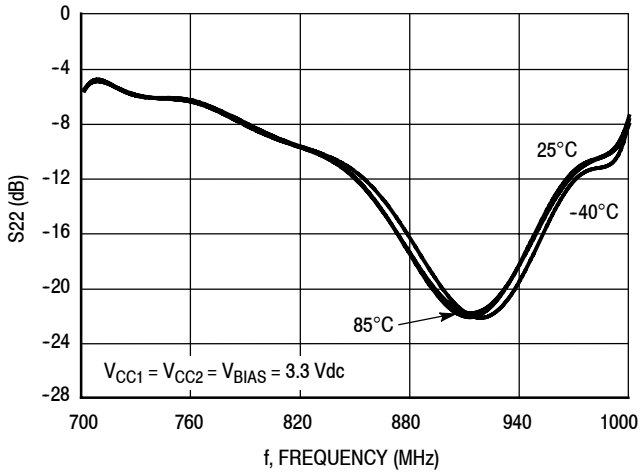


Figure 16. S22 versus Frequency versus Temperature

TYPICAL CHARACTERISTICS — 900 MHz, 3.3 VOLT OPERATION

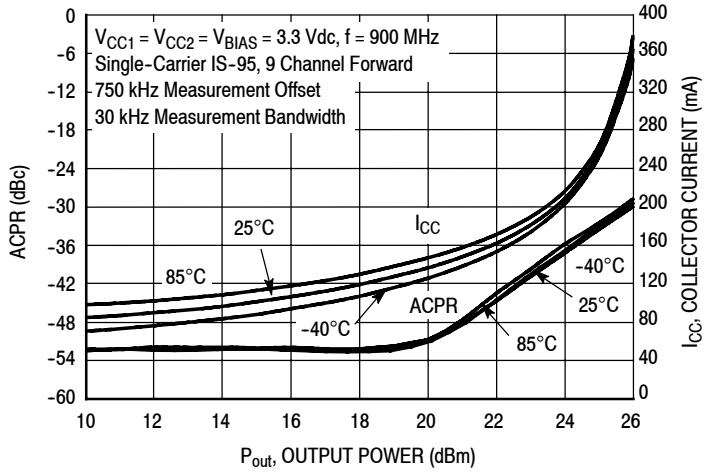


Figure 17. ACPR versus Collector Current versus Output Power versus Temperature

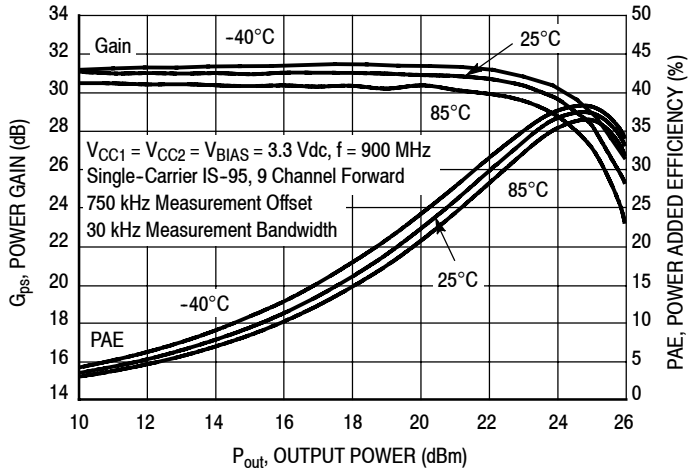


Figure 18. Power Gain versus Power Added Efficiency versus Output Power versus Temperature

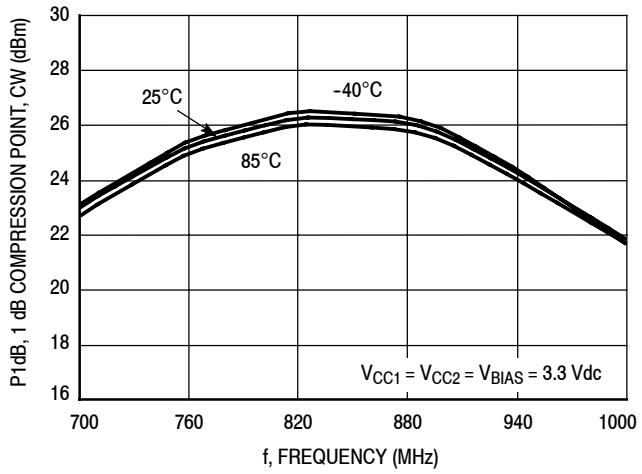


Figure 19. P1dB versus Frequency versus Temperature, CW

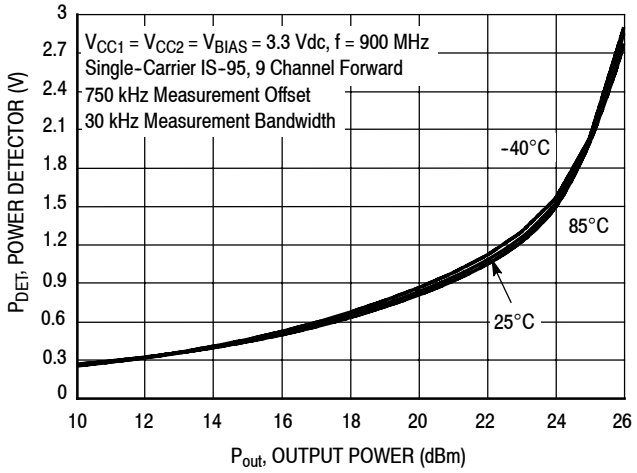


Figure 20. Power Detector versus Output Power versus Temperature

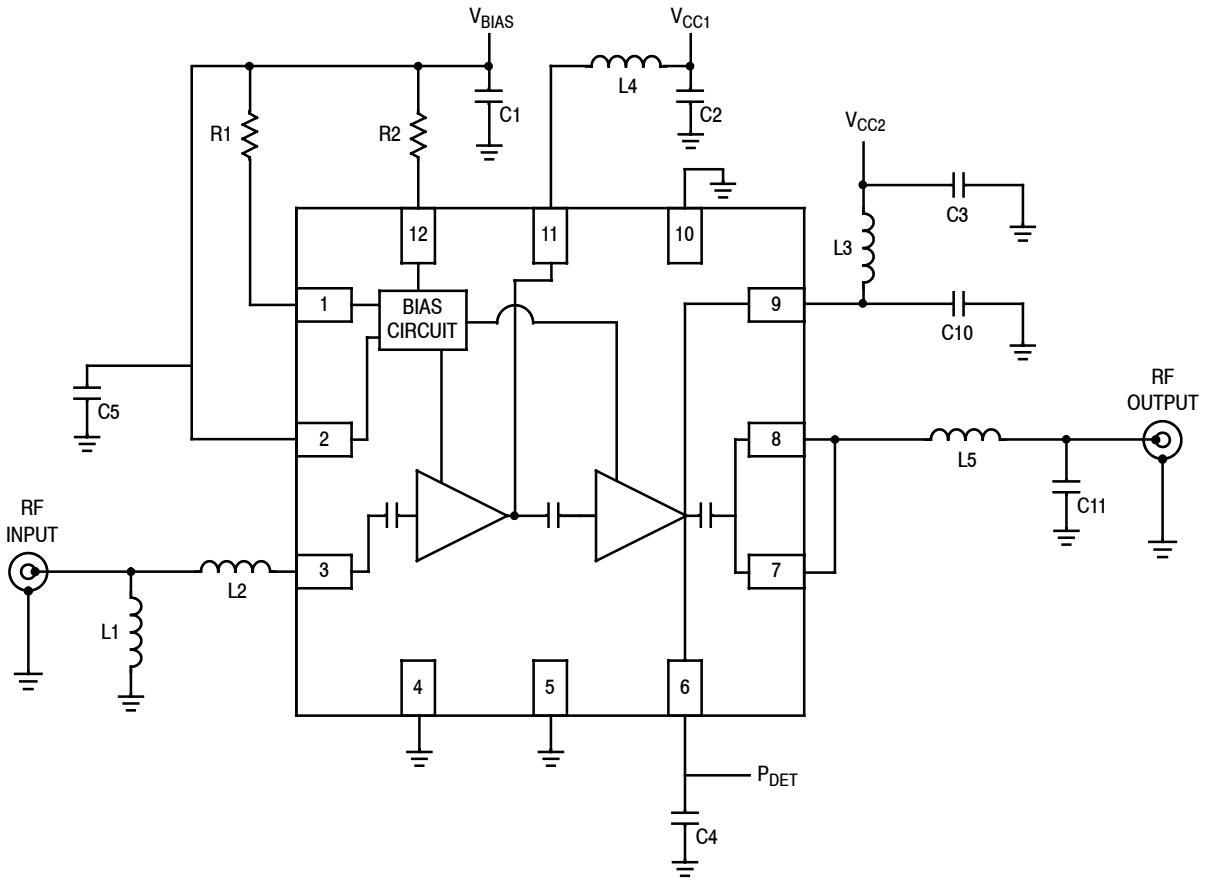
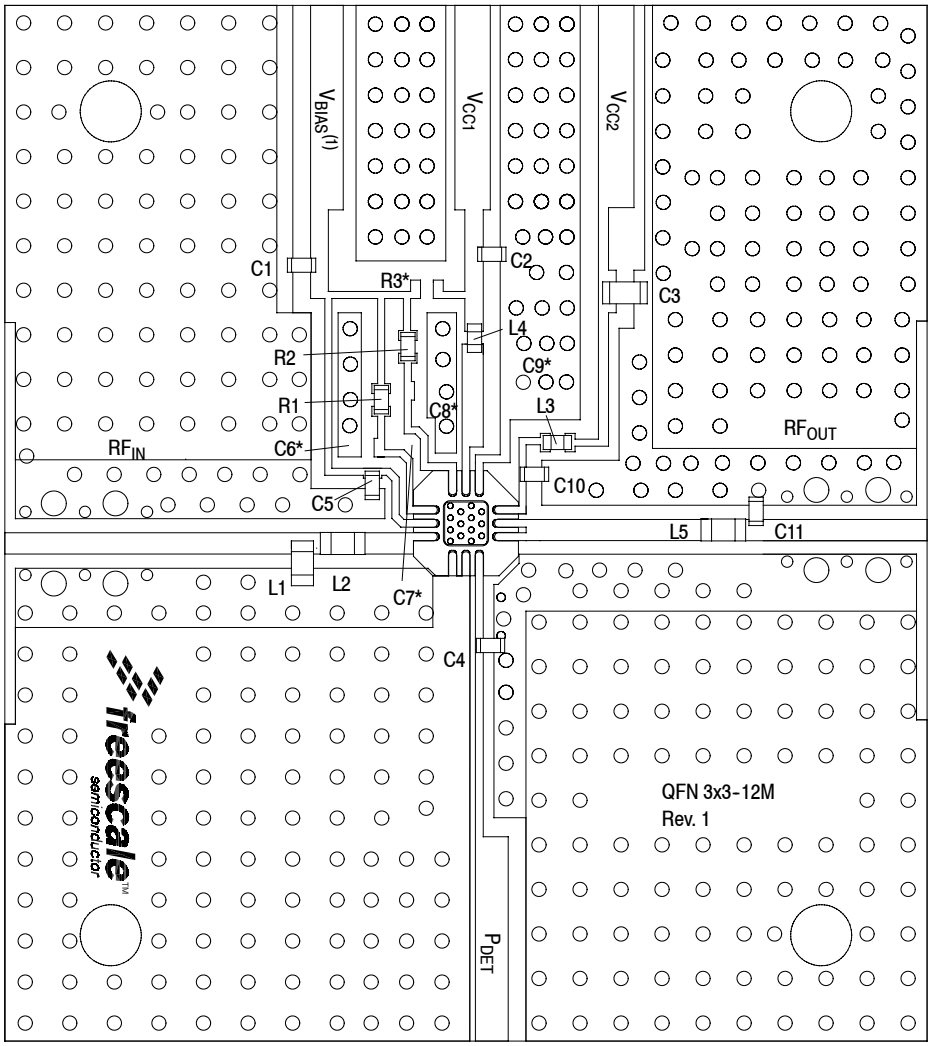


Figure 21. MMZ09312B Test Circuit Schematic — 450 MHz, 5 Volt Operation

Table 9. MMZ09312B Test Circuit Component Designations and Values — 450 MHz, 5 Volt Operation

Part	Description	Part Number	Manufacturer
C1, C2	1 μF Chip Capacitors	GRM155R61A105KE15	Murata
C3	4.7 μF Chip Capacitor	GRM188R60J475KE19	Murata
C4	470 pF Chip Capacitor	GRM1555C1H471JA01	Murata
C5	100 pF Chip Capacitor	GRM1555C1H101JA01	Murata
C6, C7, C8, C9	Components Not Placed		
C10	3.9 pF Chip Capacitor	04023J3R9BBSTR	AVX
C11	10 pF Chip Capacitor	04023J10R0BBSTR	AVX
L1	18 nH Chip Inductor	LL1608-FSL18N0S	TOKO
L2	1.2 nH Chip Inductor	LL1608-FSL1N2S	TOKO
L3	3.9 nH Chip Inductor	LL1608-FSL3N9S	TOKO
L4	12 nH Chip Inductor	LL1608-FSL12N0S	TOKO
L5	12 nH Chip Inductor	0603CS-12NXJL	Coilcraft
R1	330 Ω, 1/16 W Chip Resistor	RC0402JR-07331RL	Yageo
R2	1.5 kΩ, 1/16 W Chip Resistor	RC0402JR-07152RL	Yageo
R3	Component Not Placed		
PCB	0.014″, ε_r = 3.7	FR408	Isola

Note: Component numbers C6, C7, C8, C9 and R3 are labeled on board but not placed.



(1) V_{BIAS} [Board] supplies V_{BA1}, V_{BA2} and V_{BIAS} [Device].
Note: Component numbers C6*, C7*, C8*, C9* and R3* are labeled on board but not placed.

Figure 22. MMZ09312B Test Circuit Component Layout — 450 MHz, 5 Volt Operation

Table 9. MMZ09312B Test Circuit Component Designations and Values — 450 MHz, 5 Volt Operation

Part	Description	Part Number	Manufacturer
C1, C2	1 μF Chip Capacitors	GRM155R61A105KE15	Murata
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C4	470 pF Chip Capacitor	GRM1555C1H471JA01	Murata
C5	100 pF Chip Capacitor	GRM1555C1H101JA01	Murata
C6, C7, C8, C9	Components Not Placed		
C10	3.9 pF Chip Capacitor	04023J3R9BBSTR	AVX
C11	10 pF Chip Capacitor	04023J10R0BBSTR	AVX
L1	18 nH Chip Inductor	LL1608-FSL18N0S	TOKO
L2	1.2 nH Chip Inductor	LL1608-FSL1N2S	TOKO
L3	3.9 nH Chip Inductor	LL1608-FSL3N9S	TOKO
L4	12 nH Chip Inductor	LL1608-FSL12N0S	TOKO
L5	12 nH Chip Inductor	0603CS-12NXJL	Coilcraft
R1	330 Ω, 1/16 W Chip Resistor	RC0402JR-07331RL	Yageo
R2	1.5 kΩ, 1/16 W Chip Resistor	RC0402JR-07152RL	Yageo
R3	Component Not Placed		
PCB	0.014″, ε_r = 3.7	FR408	Isola

(Test Circuit Component Designations and Values table repeated for reference.)

TYPICAL CHARACTERISTICS — 450 MHz, 5 VOLT OPERATION

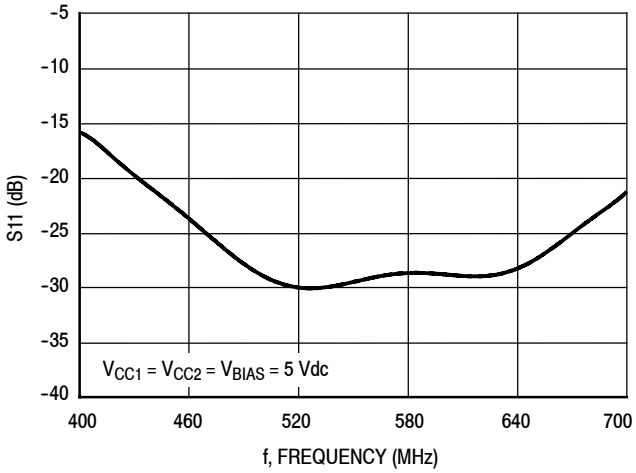


Figure 23. S11 versus Frequency

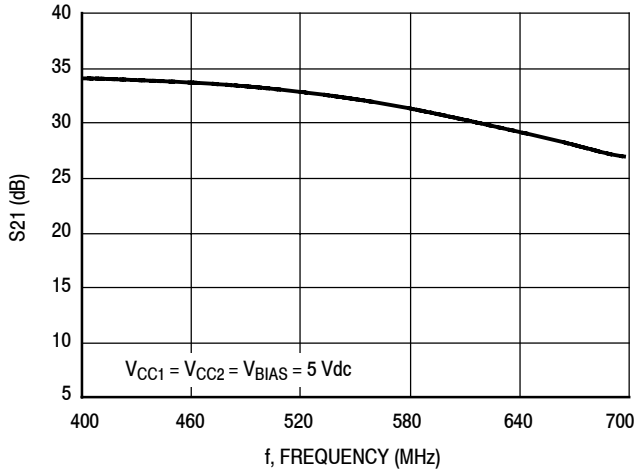


Figure 24. S21 versus Frequency

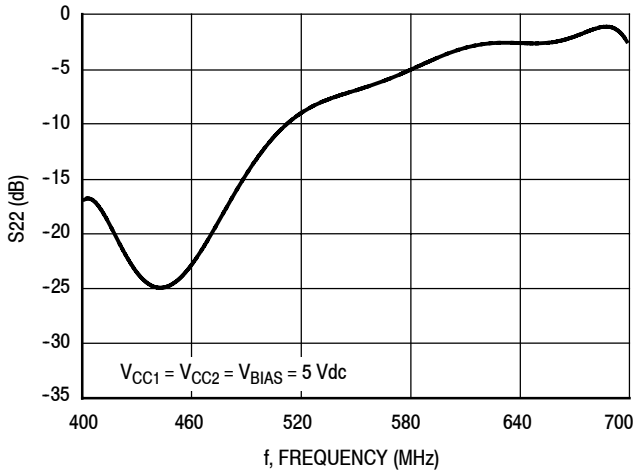


Figure 25. S22 versus Frequency

TYPICAL CHARACTERISTICS — 450 MHz, 5 VOLT OPERATION

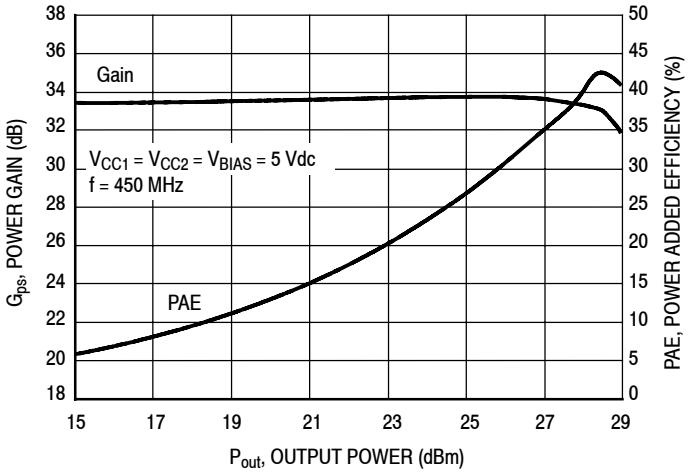


Figure 26. Power Gain versus Power Added Efficiency versus Output Power, CW

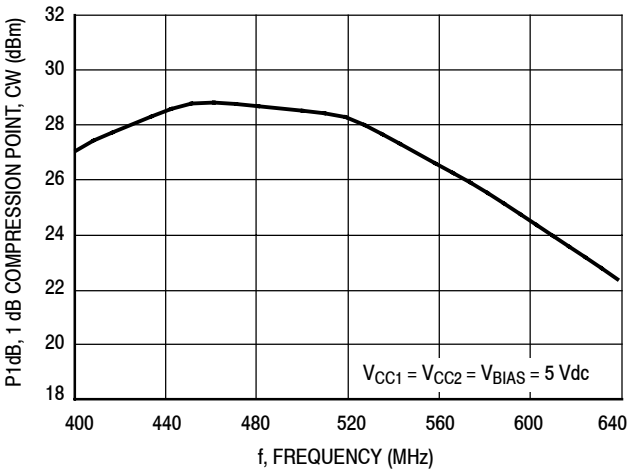


Figure 27. P1dB versus Frequency, CW

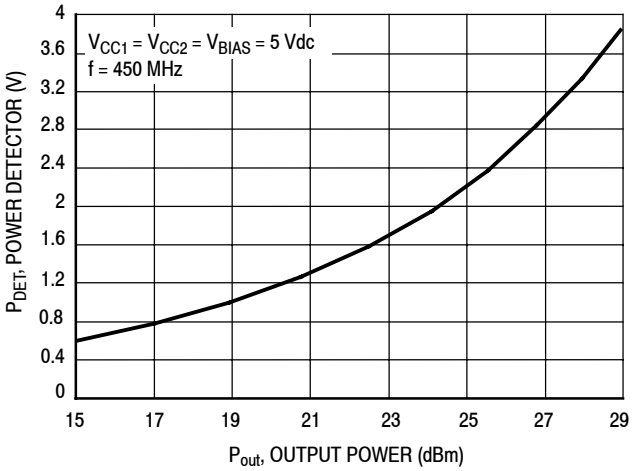


Figure 28. Power Detector versus Output Power, CW

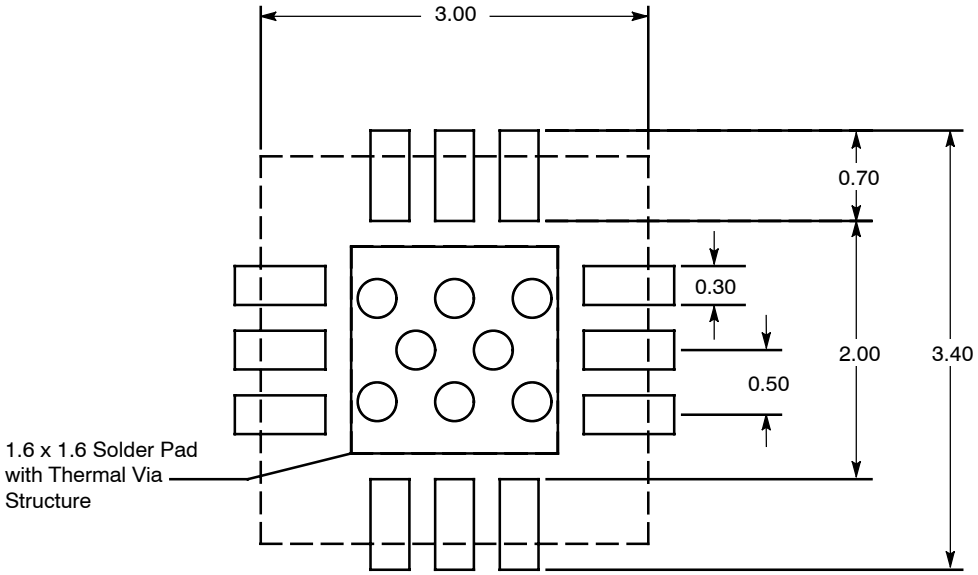
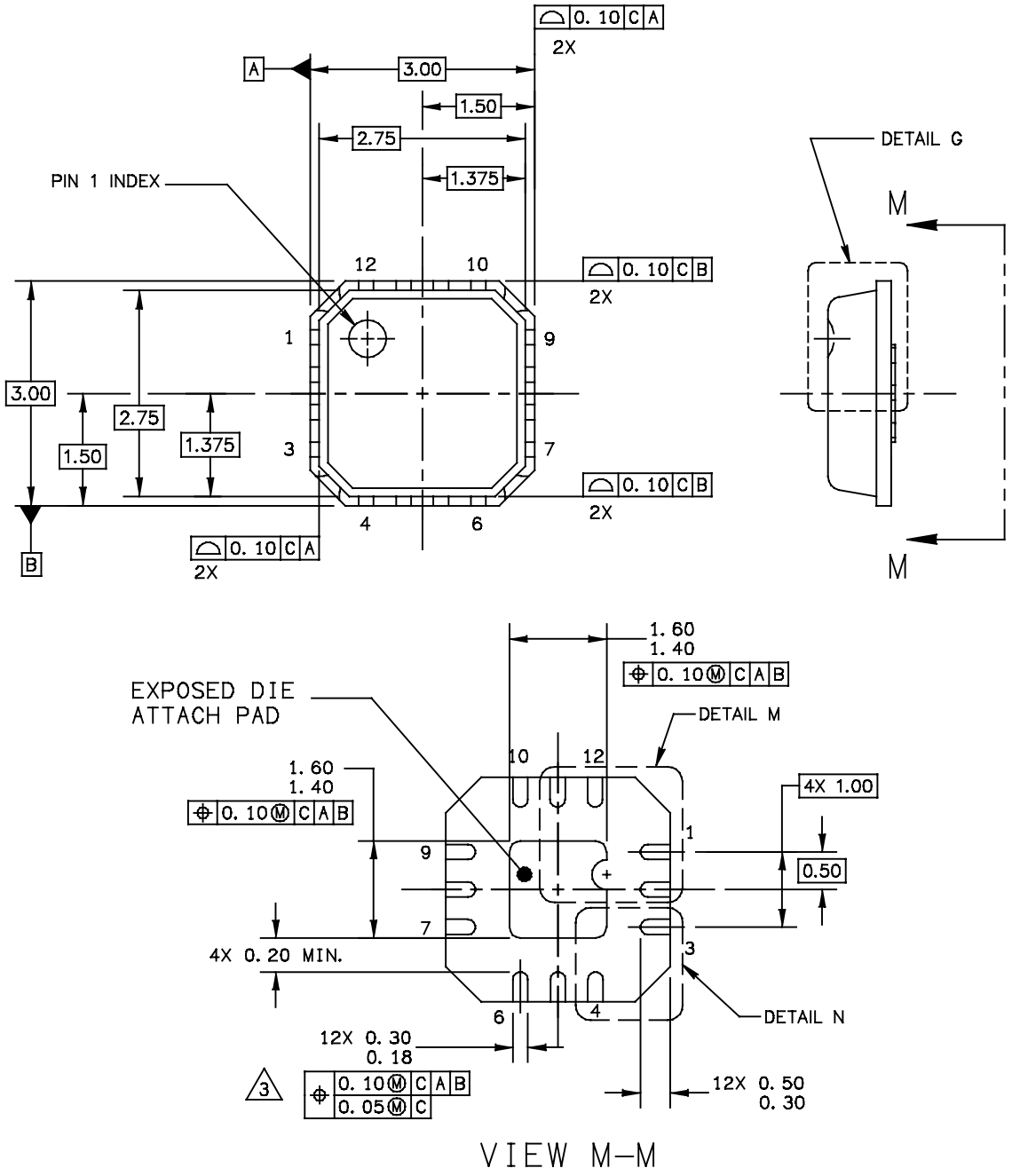


Figure 29. PCB Pad Layout for QFN 3x3

Figure 30. Product Marking

PACKAGE DIMENSIONS



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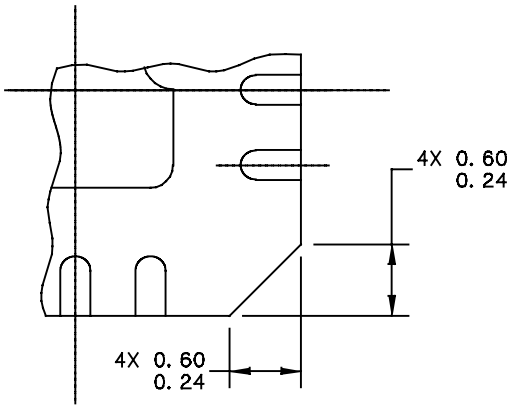
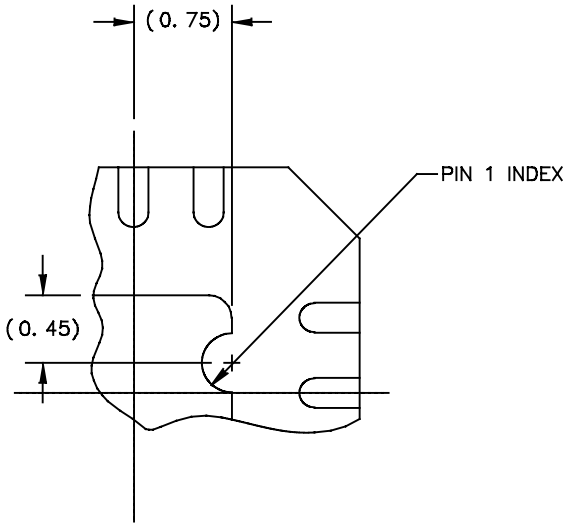
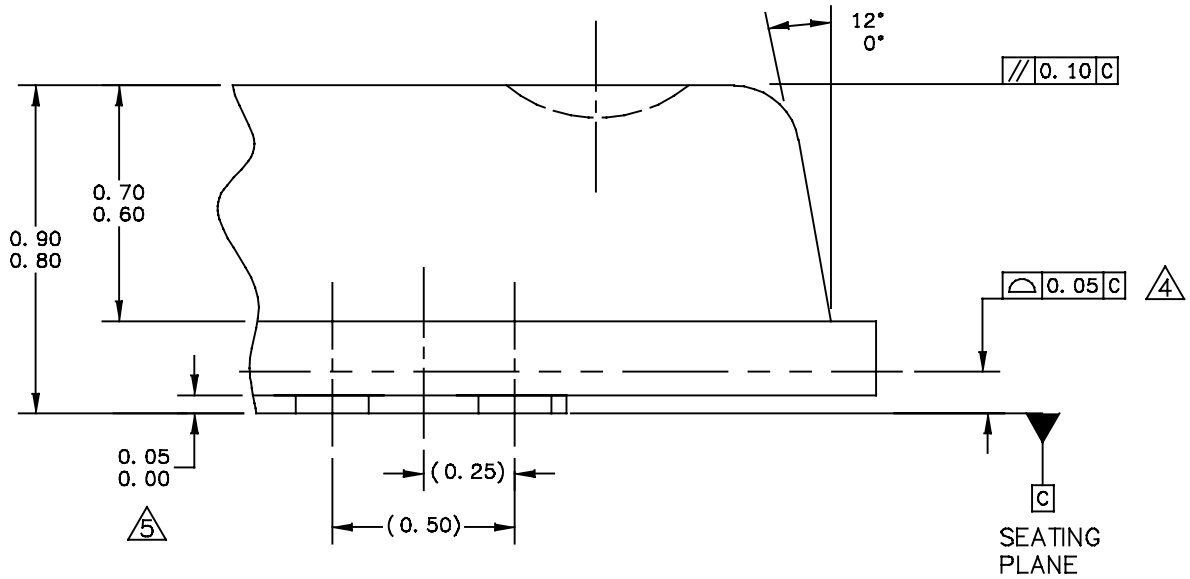
	CASE NUMBER: 2131–01	14 MAY 2010
	STANDARD: NON–JEDEC	



DETAIL N
CORNER CONFIGURATION



DETAIL M
PIN 1 BACKSIDE INDEX



DETAIL G
VIEW ROTATED 90° CW

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	CASE NUMBER: 2131-01	14 MAY 2010
	STANDARD: NON-JEDEC	

NOTE:

1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. DIMENSIONING & TOLERANCING PER ASME Y14.5 – 2009.
3. THIS DIMENSION APPLIES TO PLATED TERMINAL AND IS MEASURED BETWEEN 0.15 AND 0.30 MM FROM TERMINAL TIP.
4. BILATERAL COPLANARITY ZONE APPLIES TO THE EXPOSED PAD AS WELL AS THE TERMINALS.
5. THIS DIMENSION APPLIED ONLY FOR TERMINALS.

MECHANICAL OUTLINE	PRINT VERSION NOT TO SCALE

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THERMALLY ENHANCED QUAD FLAT NON–LEADED PACKAGE (QFN) 12 TERMINAL, 0.5 PITCH (3X3X0.85)	CASE NUMBER: 2131–01	14 MAY 2010
	STANDARD: NON–JEDEC	

PRODUCT DOCUMENTATION, SOFTWARE AND TOOLS

Refer to the following documents, software and tools to aid your design process.

Application Notes

- AN1955: Thermal Measurement Methodology of RF Power Amplifiers

Software

- .s2p File

Development Tools

- Printed Circuit Boards

For Software and Tools, do a Part Number search at http://www.freescale.com, and select the “Part Number” link. Go to the Software & Tools tab on the part’s Product Summary page to download the respective tool.

REVISION HISTORY

The following table summarizes revisions to this document.

Revision	Date	Description
0	Nov. 2011	• Initial Release of Data Sheet
1	Feb. 2012	• Typical Performance table: changed P_{out} at 750 MHz from 19.5 to 17.5 dBm to reflect recent performance measurements, p. 1 • Figs. 3, 12 and 21, MMZ09312B Test Circuit Schematic: corrected L1 inductor label in test circuit schematics, p. 3, 7 and 11

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Rev. 1, 2/2012