



# Heterojunction Bipolar Transistor Technology (InGaP HBT)

## High Efficiency/Linearity Amplifier

The MMA20312B 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 femto cell or repeater applications. It is suitable for applications with frequencies from 1800 to 2200 MHz such as TD-SCDMA, PCS, UMTS and LTE. The amplifier is housed in a low-cost, surface mount QFN plastic package.

- Typical Performance:  $V_{CC} = 5$  Volts,  $I_{CQ} = 70$  mA,  $P_{out} = 17$  dBm

Frequency	$G_{ps}$ (dB)	ACPR (dBc)	PAE (%)	Test Signal
1880 MHz	29.0	-47.4	9.1	TD-SCDMA
1920 MHz	29.0	-46.7	9.0	TD-SCDMA
2010 MHz	27.4	-52.0	9.3	TD-SCDMA
2025 MHz	26.8	-50.0	9.5	TD-SCDMA
2140 MHz	27.0	-51.7	9.4	W-CDMA

### Features

- Active Bias Control (On-chip)
- Frequency: 1800-2200 MHz
- P1dB: 30.5 dBm @ 2140 MHz (CW Application Circuit)
- Power Gain: 26.4 dB @ 2140 MHz (CW Application Circuit)
- OIP3: 44.5 dBm @ 2140 MHz (W-CDMA Application Circuit)
- Single 5 Volt Supply
- Low Cost QFN Surface Mount Package
- RoHS Compliant
- In Tape and Reel. T1 Suffix = 1000 Units, 12 mm Tape Width, 7 inch Reel.

Table 1. Typical CW Performance <sup>(1)</sup>

Characteristic	Symbol	1800 MHz	2140 MHz	2200 MHz	Unit
Small-Signal Gain (S21)	$G_p$	28.8	26.4	25.5	dB
Input Return Loss (S11)	IRL	-17.6	-10.9	-9.7	dB
Output Return Loss (S22)	ORL	-20.3	-14.7	-13.7	dB
Power Output @1dB Compression	P1db	30.5	30.5	30.5	dBm

1.  $V_{CC1} = V_{CC2} = V_{CTRL} = 5$  Vdc,  $T_A = 25^\circ\text{C}$ , 50 ohm system, CW Application Circuit

Table 3. Thermal Characteristics

Characteristic	Symbol	Value <sup>(3)</sup>	Unit
Thermal Resistance, Junction to Case Case Temperature $86^\circ\text{C}$ , $V_{CC1} = V_{CC2} = V_{CTRL} = 5$ Vdc	$R_{\theta JC}$	52	$^\circ\text{C/W}$

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

**MMA20312BT1**

**1800-2200 MHz, 27.2 dB**  
**30.5 dBm**  
**InGaP HBT**



**CASE 2131-01**  
**QFN 3x3**  
**PLASTIC**

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	$^\circ\text{C}$
Junction Temperature <sup>(2)</sup>	$T_J$	150	$^\circ\text{C}$

2. For reliable operation, the junction temperature should not exceed  $150^\circ\text{C}$ .

**Table 4. Electrical Characteristics** ( $V_{CC1} = V_{CC2} = V_{CTRL} = 5$  Vdc, 2140 MHz,  $T_A = 25^\circ\text{C}$ , 50 ohm system, in Freescale W-CDMA Application Circuit)

Characteristic	Symbol	Min	Typ	Max	Unit
Small-Signal Gain (S21) (1)	$G_p$	23.6	27.2	—	dB
Input Return Loss (S11)	IRL	—	-10.7	—	dB
Output Return Loss (S22)	ORL	—	-15.5	—	dB
Power Output @ 1dB Compression, CW	P1dB	—	28.2	—	dBm
Third Order Output Intercept Point, Two-Tone CW	OIP3	—	44.5	—	dBm
Noise Figure	NF	—	3.3	—	dB
Supply Current (1,2)	$I_{CQ}$	62.5	70	77	mA
Supply Voltage (2)	$V_{CC}$	—	5	—	V

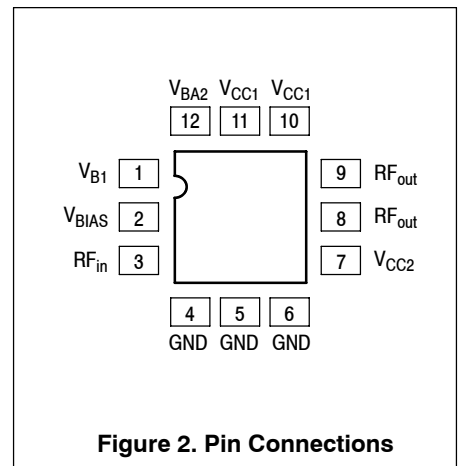
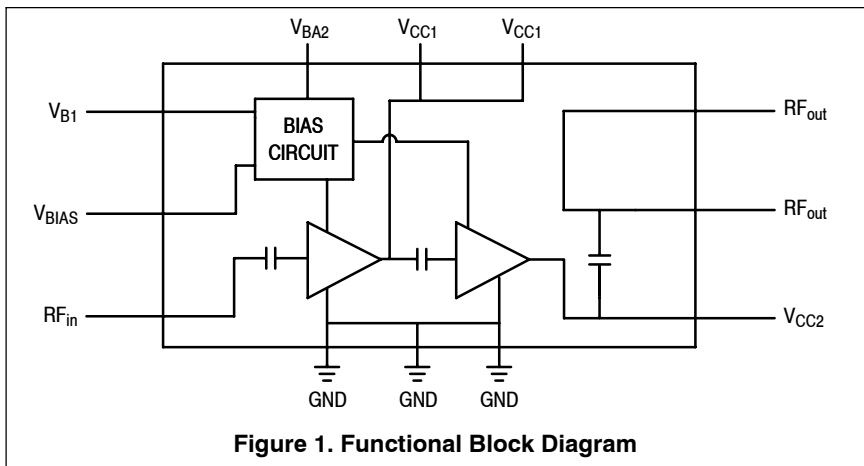
**Table 5. ESD Protection Characteristics**

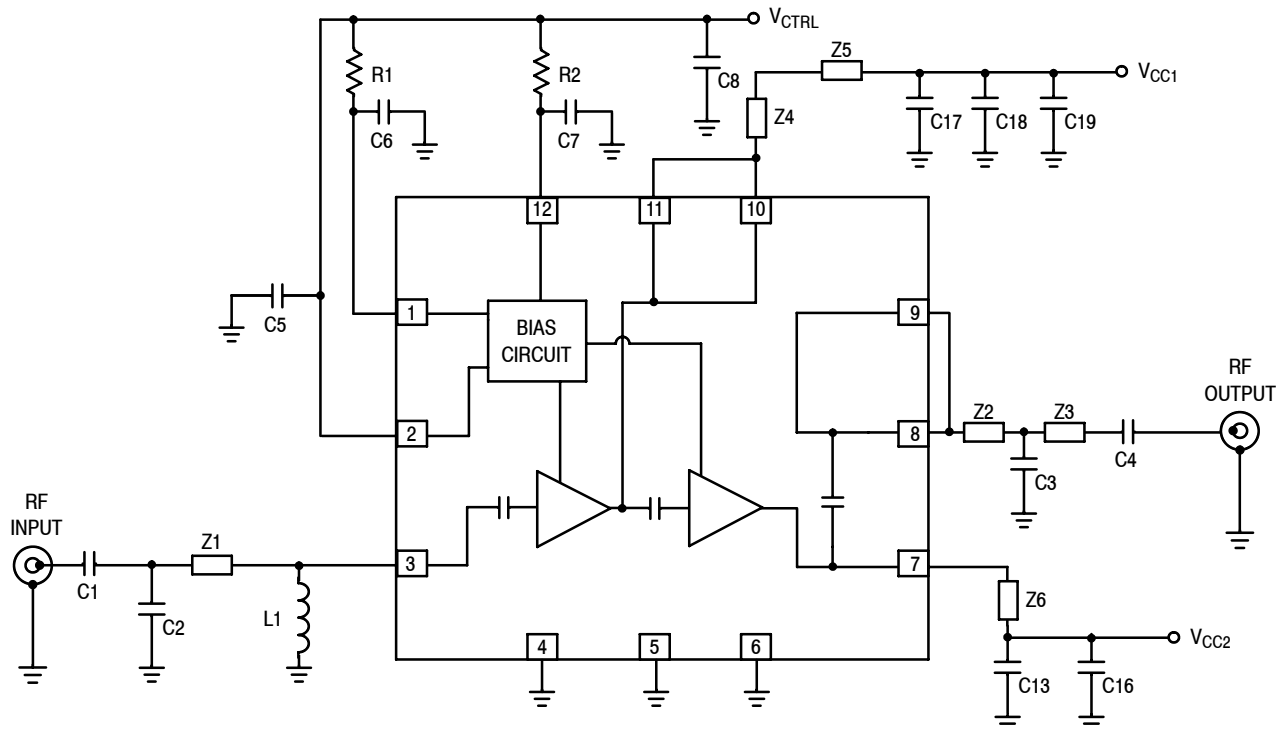
Test Methodology	Class
Human Body Model (per JESD 22-A114)	0 (Minimum), rated to 150 V
Machine Model (per EIA/JESD 22-A115)	A (Minimum)
Charge Device Model (per JESD 22-C101)	III (Minimum)

**Table 6. Moisture Sensitivity Level**

Test Methodology	Rating	Package Peak Temperature	Unit
Per JEDEC22-A113, IPC/JEDEC J-STD-020	3	260	$^\circ\text{C}$

1. Specified data is based on performance of soldered down part in W-CDMA application circuit.
2. For reliable operation, the junction temperature should not exceed  $150^\circ\text{C}$ .





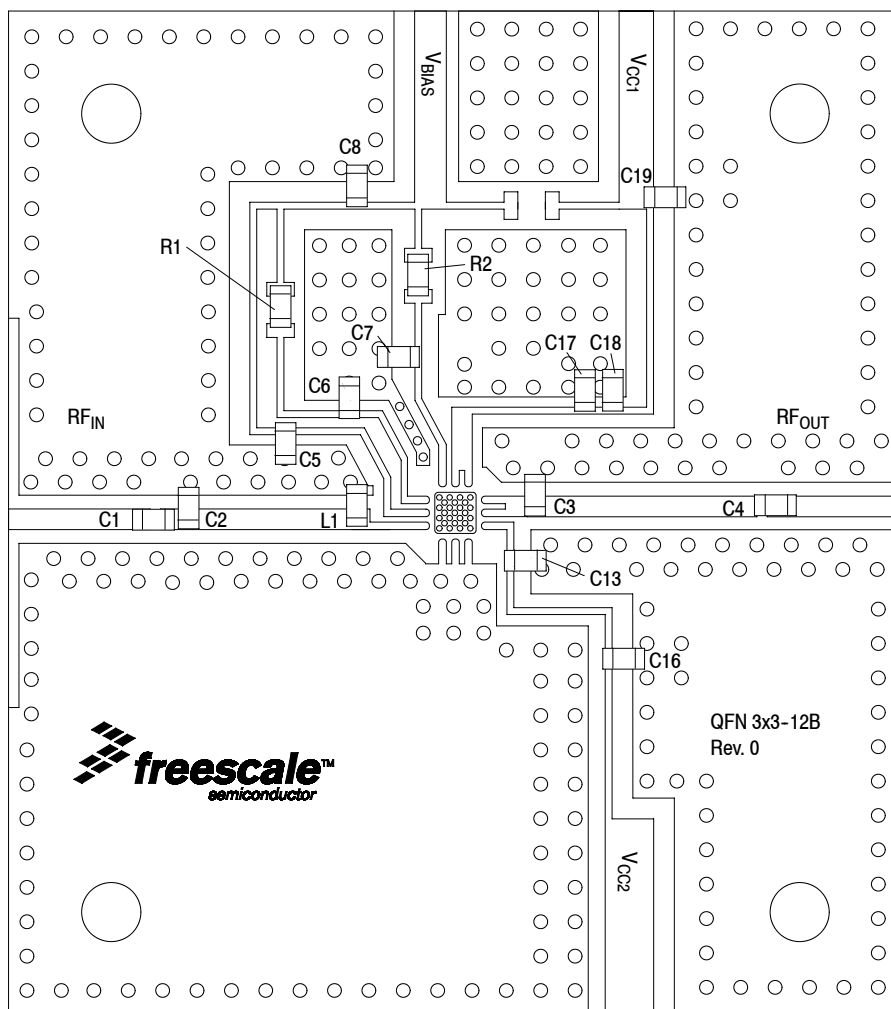
Note: Component numbers C9, C10, C11, C12, C14, and C15 are not used.

Z1	0.250" x 0.030" Microstrip	Z4	0.080" x 0.030" Microstrip
Z2	0.035" x 0.030" Microstrip	Z5	0.155" x 0.010" Microstrip
Z3	0.283" x 0.030" Microstrip	Z6	0.045" x 0.010" Microstrip

**Figure 3. MMA20312BT1 Test Circuit Schematic - TD-SCDMA**

**Table 7. MMA20312BT1 Test Circuit Component Designations and Values - TD-SCDMA**

Part	Description	Part Number	Manufacturer
C1, C5	22 pF Chip Capacitors	06033J220GBS	AVX
C2	1.8 pF Chip Capacitor	06035J1R8BBS	AVX
C3	2.2 pF Chip Capacitor	06035J2R2BBS	AVX
C4	5.6 pF Chip Capacitor	06035J5R6BBS	AVX
C6, C7, C13	10 pF Chip Capacitors	06035J100GBS	AVX
C8, C18	1 $\mu$ F Chip Capacitors	GRM188R61A105KA61	Murata
C16, C19	10 $\mu$ F Chip Capacitors	GRM188R60J106ME47	Murata
C17	0.1 $\mu$ F Chip Capacitor	GRM188R71H104KA93	Murata
L1	1.8 nH Chip Inductor	LL1608-FS1N8S	TOKO
R1	120 $\Omega$ Chip Resistor	RR0816Q-121-D	Susumu
R2	1300 $\Omega$ Chip Resistor	RR0816Q-132-D	Susumu
PCB	0.014", $\epsilon_r = 3.7$	FR408	ISOLA



Note: Component numbers C9, C10, C11, C12, C14, and C15 are not used.

**Figure 4. MMA20312BT1 Test Circuit Component Layout - TD-SCDMA**

**Table 7. MMA20312BT1 Test Circuit Component Designations and Values - TD-SCDMA**

Part	Description	Part Number	Manufacturer
C1, C5	22 pF Chip Capacitors	06033J220GBS	AVX
C2	1.8 pF Chip Capacitor	06035J1R8BBS	AVX
C3	2.2 pF Chip Capacitor	06035J2R2BBS	AVX
C4	5.6 pF Chip Capacitor	06035J5R6BBS	AVX
C6, C7, C13	10 pF Chip Capacitors	06035J100GBS	AVX
C8, C18	1 $\mu$ F Chip Capacitors	GRM188R61A105KA61	Murata
C16, C19	10 $\mu$ F Chip Capacitors	GRM188R60J106ME47	Murata
C17	0.1 $\mu$ F Chip Capacitor	GRM188R71H104KA93	Murata
L1	1.8 nH Chip Inductor	LL1608-FS1N8S	TOKO
R1	120 $\Omega$ Chip Resistor	RR0816Q-121-D	Susumu
R2	1300 $\Omega$ Chip Resistor	RR0816Q-132-D	Susumu
PCB	0.014", $\epsilon_r = 3.7$	FR408	ISOLA

(Component Designations and Values table repeated for reference.)

TYPICAL CHARACTERISTICS — TD-SCDMA

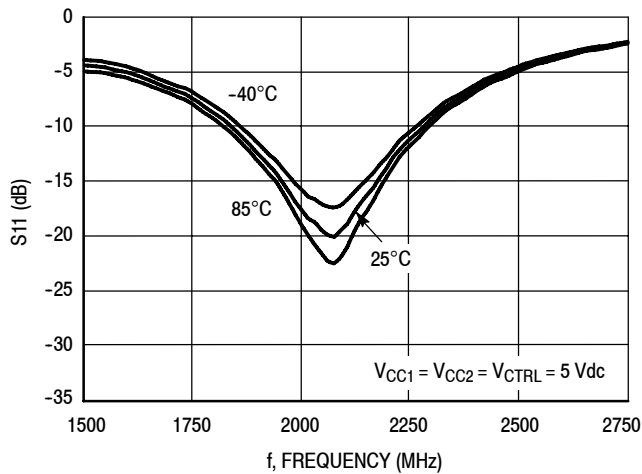


Figure 5. S11 versus Frequency versus Temperature

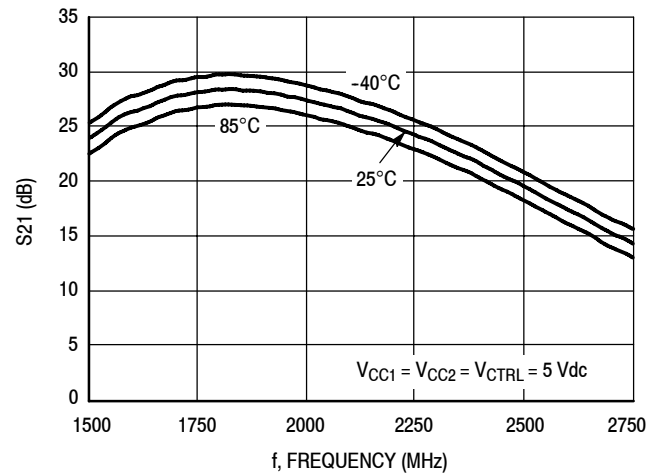


Figure 6. S21 versus Frequency versus Temperature

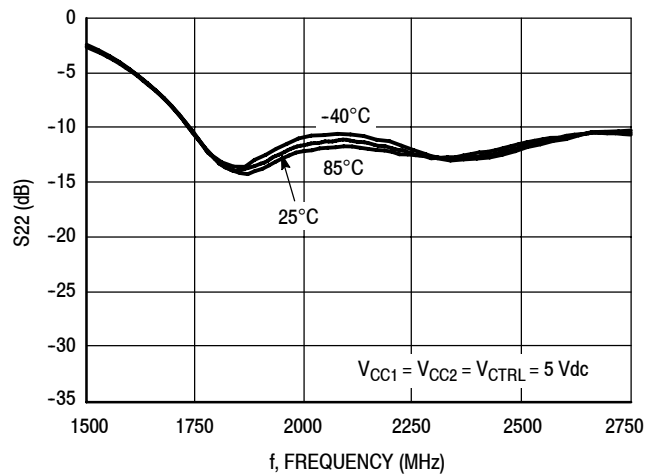
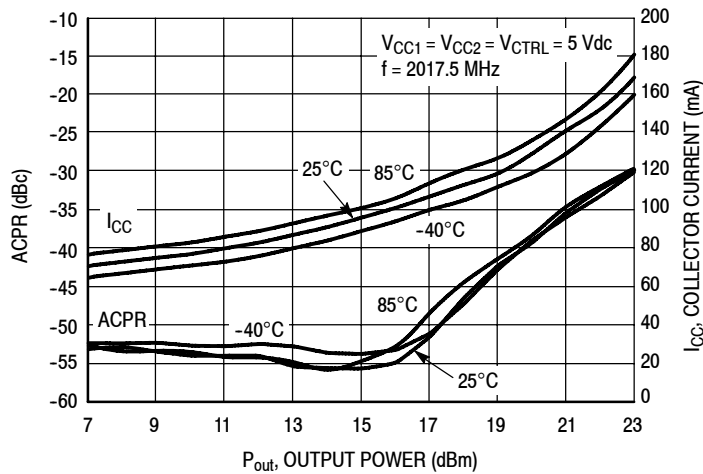
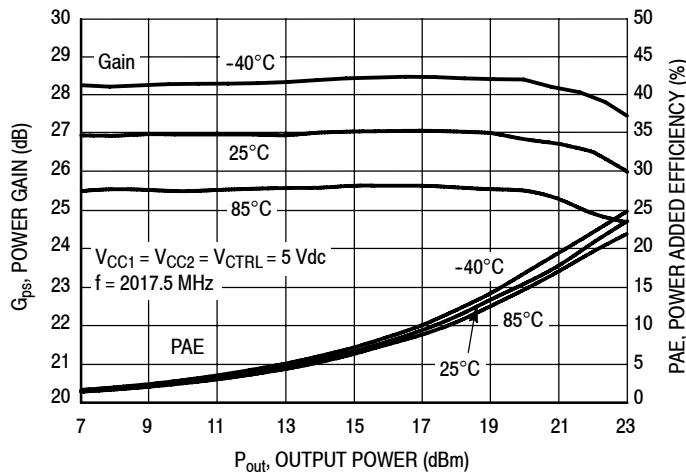


Figure 7. S22 versus Frequency versus Temperature

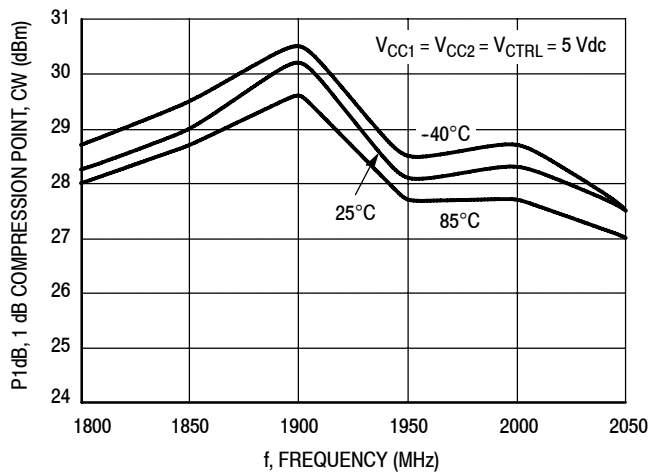
## TYPICAL CHARACTERISTICS — TD-SCDMA



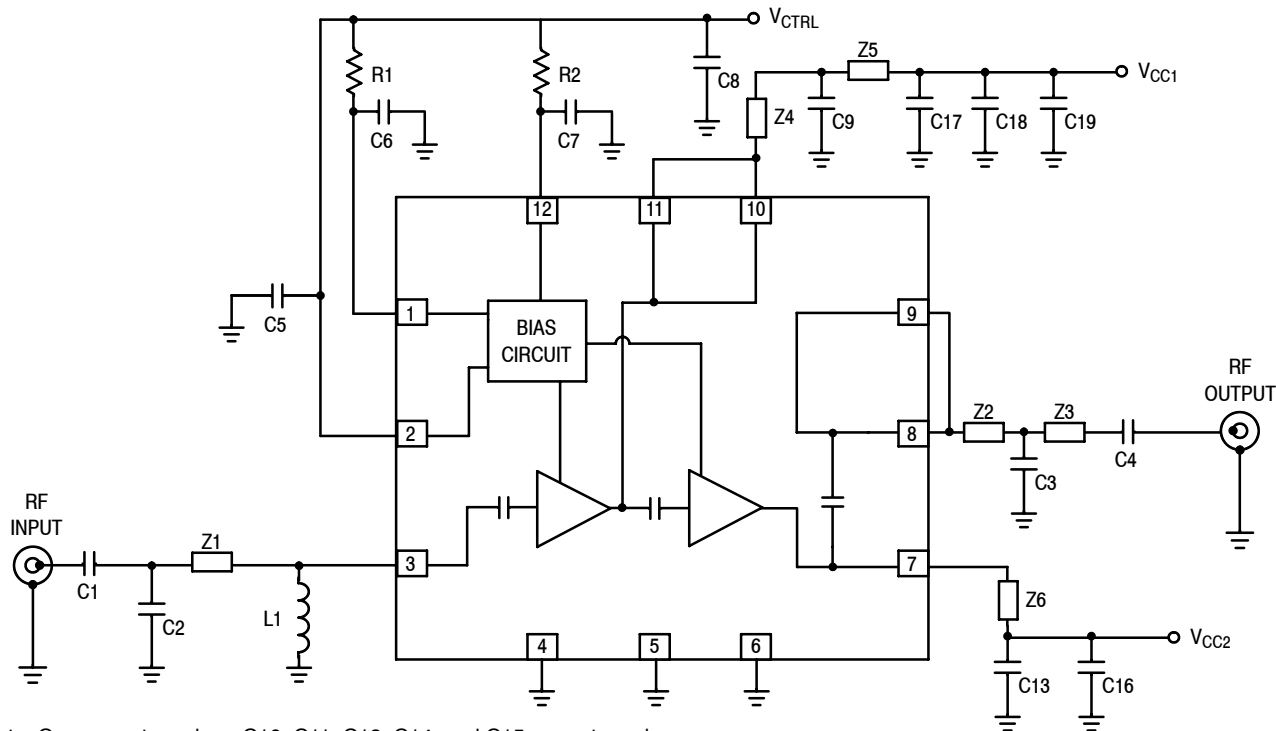
**Figure 8. ACPR versus Collector Current versus Output Power versus Temperature**



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



**Figure 10. P1dB versus Frequency versus Temperature, CW**



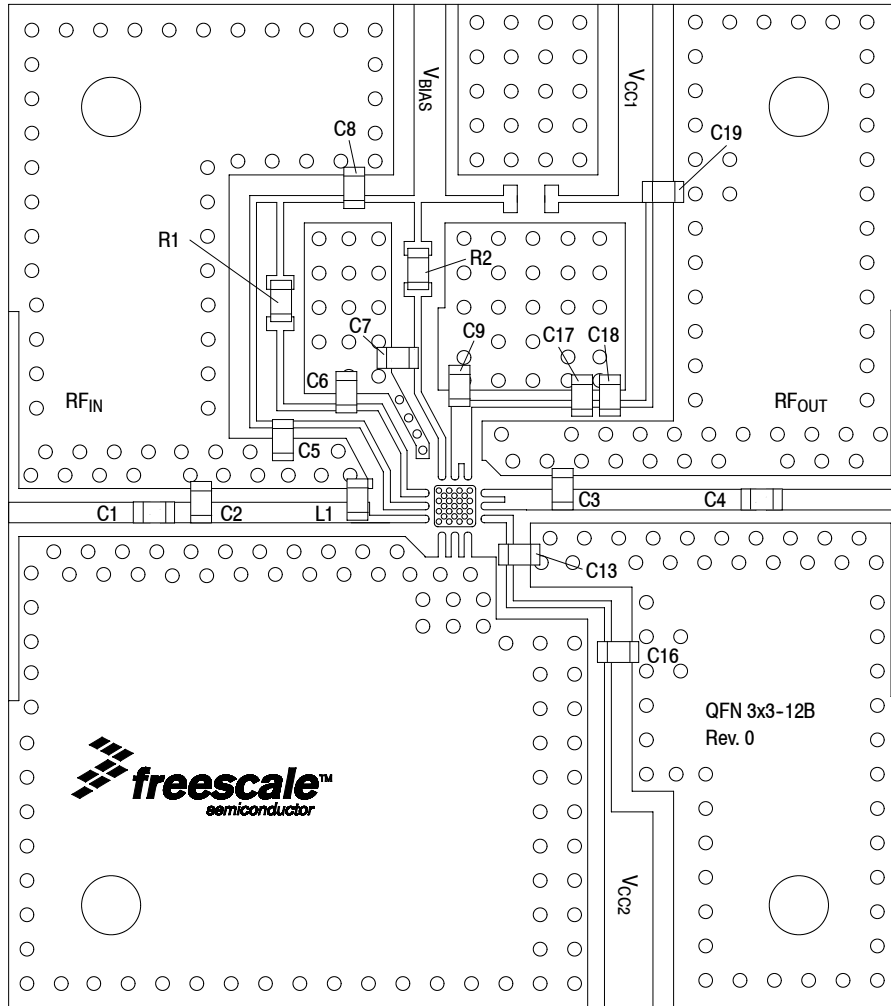
Note: Component numbers C10, C11, C12, C14, and C15 are not used.

Z1	0.218" x 0.030" Microstrip	Z4	0.080" x 0.030" Microstrip
Z2	0.068" x 0.030" Microstrip	Z5	0.155" x 0.010" Microstrip
Z3	0.250" x 0.030" Microstrip	Z6	0.045" x 0.010" Microstrip

Figure 11. MMA20312BT1 Test Circuit Schematic - W-CDMA

Table 8. MMA20312BT1 Test Circuit Component Designations and Values - W-CDMA

Part	Description	Part Number	Manufacturer
C1, C5, C9	22 pF Chip Capacitors	06033J220GBS	AVX
C2, C3	1.8 pF Chip Capacitors	06035J1R8BBS	AVX
C4	5.6 pF Chip Capacitor	06035J5R6BBS	AVX
C6, C7, C13	10 pF Chip Capacitors	06035J100GBS	AVX
C8, C18	1 $\mu$ F Chip Capacitors	GRM188R61A105KA61	Murata
C16, C19	10 $\mu$ F Chip Capacitors	GRM188R60J106ME47	Murata
C17	0.1 $\mu$ F Chip Capacitor	GRM188R71H104KA93	Murata
L1	1.8 nH Chip Inductor	LL1608-FS1N8S	TOKO
R1	120 $\Omega$ Chip Resistor	RR0816Q-121-D	Susumu
R2	1500 $\Omega$ Chip Resistor	RR0816Q-152-D	Susumu
PCB	0.014", $\epsilon_r = 3.7$	FR408	ISOLA



Note: Component numbers C10, C11, C12, C14, and C15 are not used.

**Figure 12. MMA20312BT1 Test Circuit Component Layout - W-CDMA**

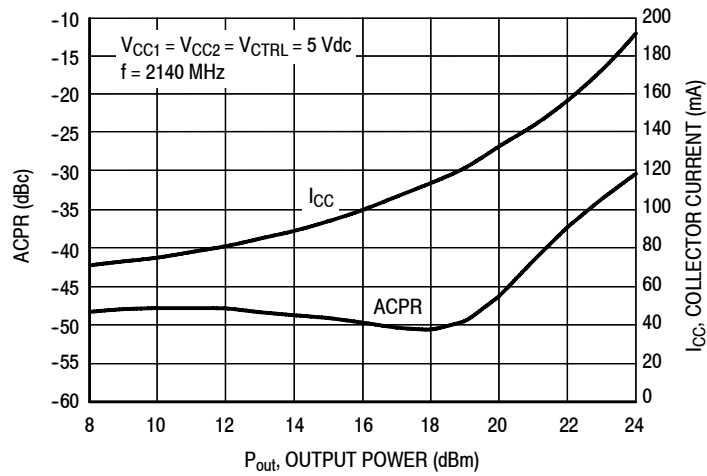
**Table 8. MMA20312BT1 Test Circuit Component Designations and Values - W-CDMA**

Part	Description	Part Number	Manufacturer
C1, C5, C9	22 pF Chip Capacitors	06033J220GBS	AVX
C2, C3	1.8 pF Chip Capacitors	06035J1R8BBS	AVX
C4	5.6 pF Chip Capacitor	06035J5R6BBS	AVX
C6, C7, C13	10 pF Chip Capacitors	06035J100GBS	AVX
C8, C18	1 $\mu$ F Chip Capacitors	GRM188R61A105KA61	Murata
C16, C19	10 $\mu$ F Chip Capacitors	GRM188R60J106ME47	Murata
C17	0.1 $\mu$ F Chip Capacitor	GRM188R71H104KA93	Murata
L1	1.8 nH Chip Inductor	LL1608-FS1N8S	TOKO
R1	120 $\Omega$ Chip Resistor	RR0816Q-121-D	Susumu
R2	1500 $\Omega$ Chip Resistor	RR0816Q-152-D	Susumu
PCB	0.014", $\epsilon_r = 3.7$	FR408	ISOLA

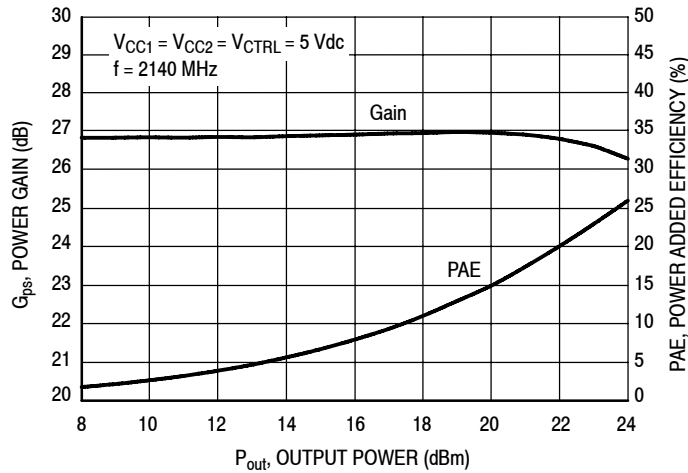
(Component Designations and Values table repeated for reference.)



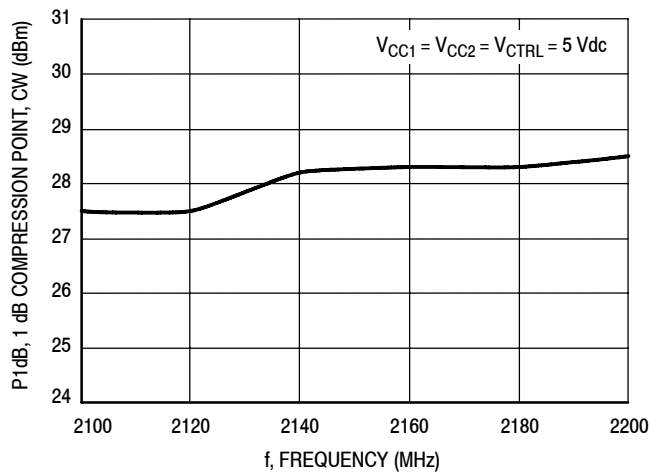
## TYPICAL CHARACTERISTICS — W-CDMA



**Figure 13. ACPR versus Collector Current versus Output Power**



**Figure 14. Power Gain versus Power Added Efficiency versus Output Power**



**Figure 15. P1dB versus Frequency, CW**

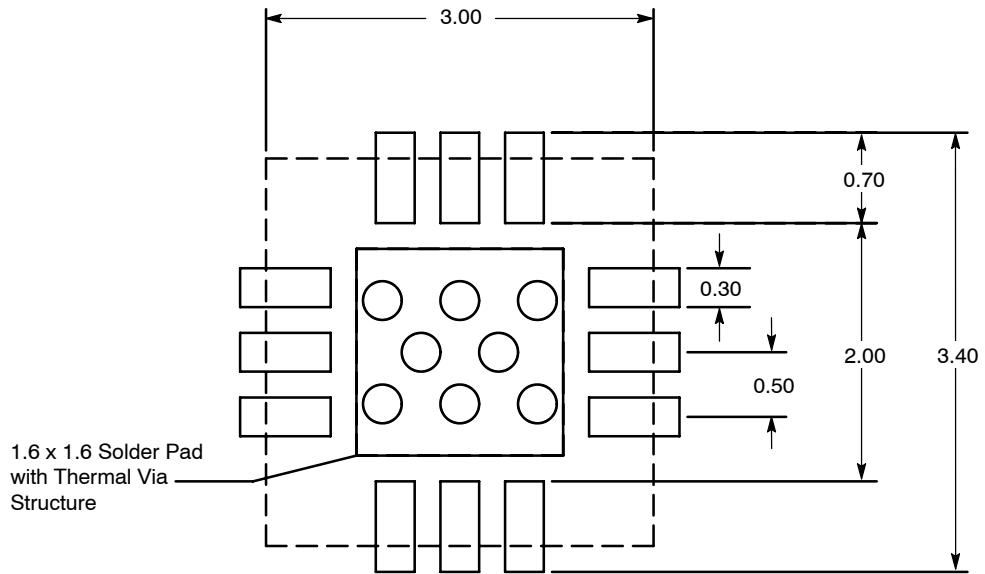


Figure 16. PCB Pad Layout for QFN 3x3

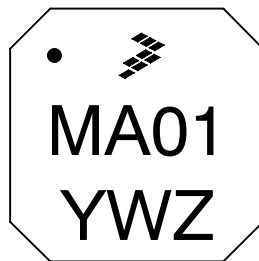
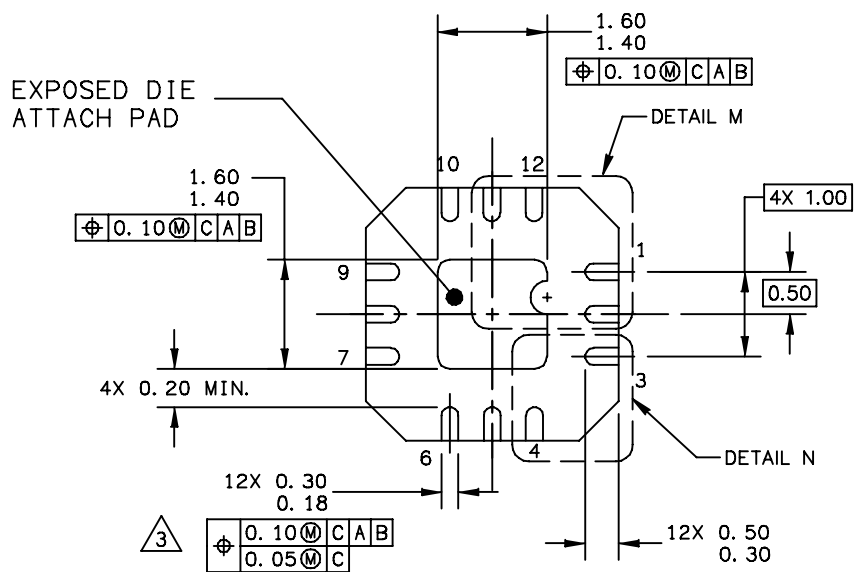
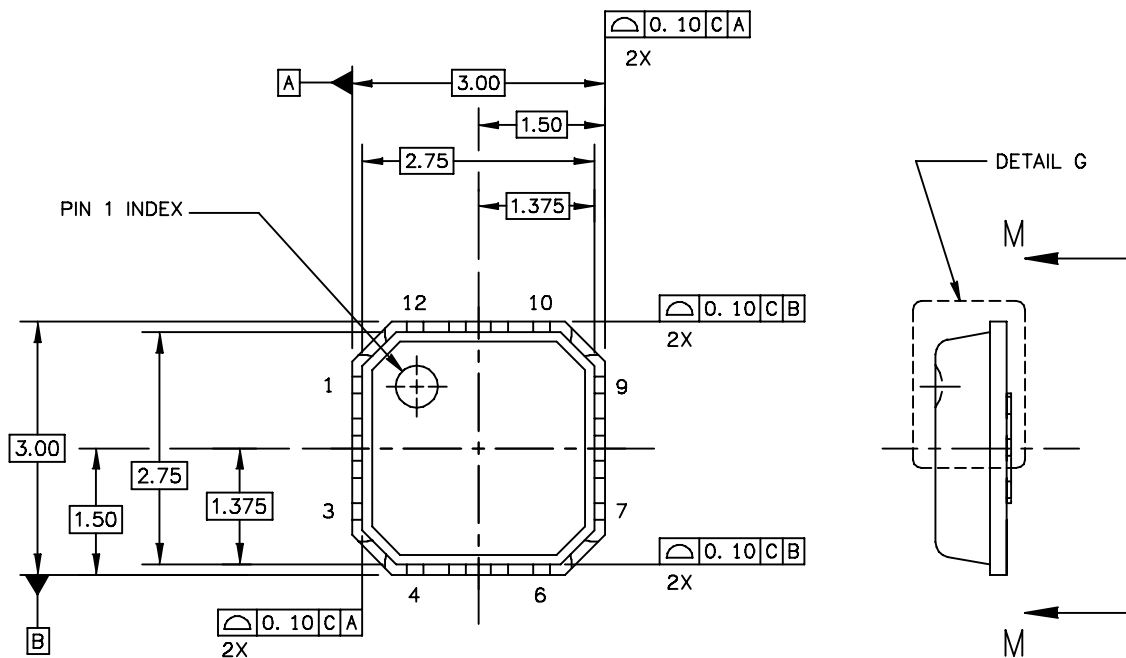


Figure 17. Product Marking

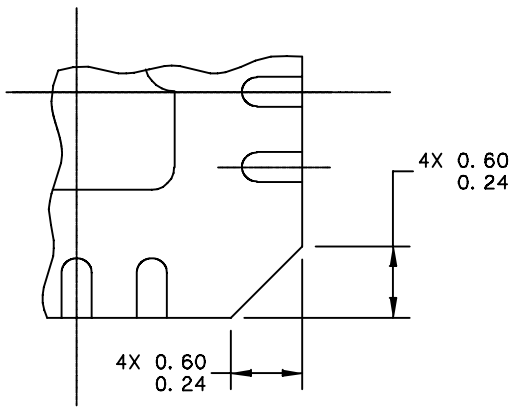
### PACKAGE DIMENSIONS



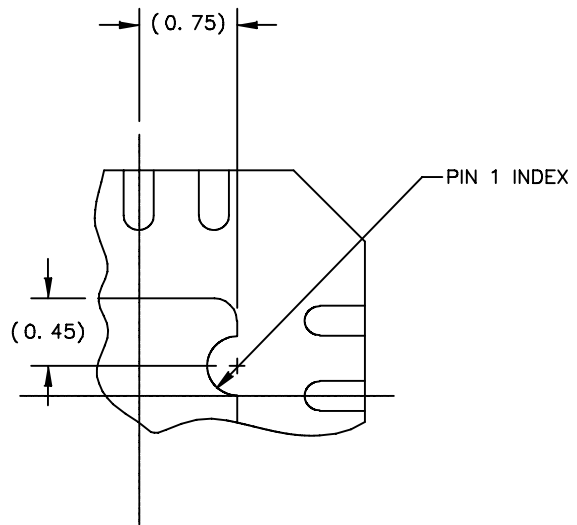
VIEW M-M

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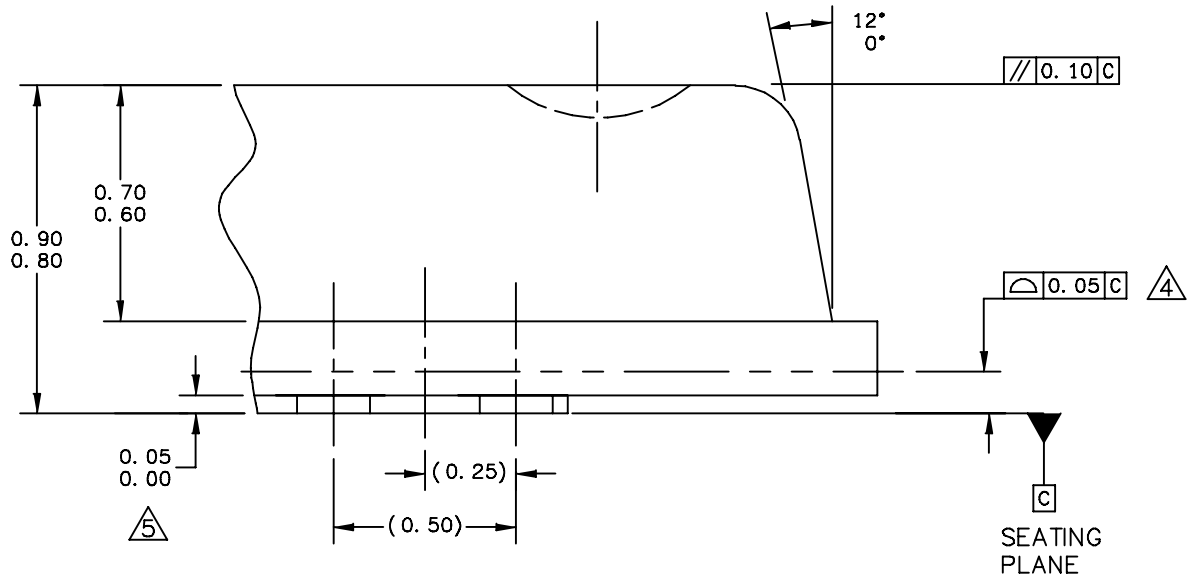
MMA20312BT1



DETAIL N  
CORNER CONFIGURATION



DETAIL M  
PIN 1 BACKSIDE INDEX



DETAIL G  
VIEW ROTATED 90° CW

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	STANDARD: NON-JEDEC		

## PRODUCT DOCUMENTATION, SOFTWARE AND TOOLS

Refer to the following documents, tools and software 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	Oct. 2010	<ul style="list-style-type: none"><li>• Initial Release of Data Sheet</li></ul>
1	Mar. 2011	<ul style="list-style-type: none"><li>• Added “OIP3: 44.5 dBm @ 2140 MHz (W-CDMA Application Circuit)” to Features list, p. 1</li><li>• Typical CW Performance table: removed OIP3, p. 1</li><li>• Figs. 4 and 12, Test Circuit Component Layout, updated component part layout identifier to reflect package type. Changed from MMA20312B to QFN 3x3-12B, p. 4, 8</li></ul>
1.1	Mar. 2011	<ul style="list-style-type: none"><li>• Updated device descriptor box to reflect W-CDMA application circuit small-signal gain value, p. 1</li></ul>

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