



# 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, 26.4 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

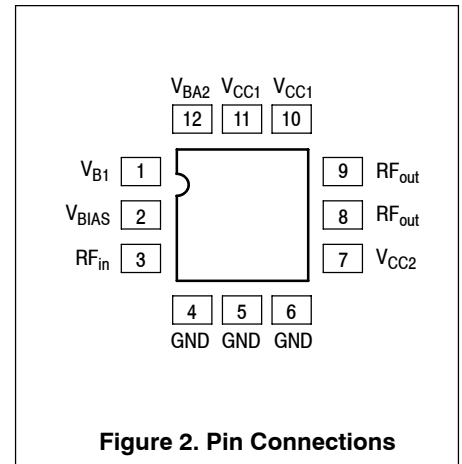
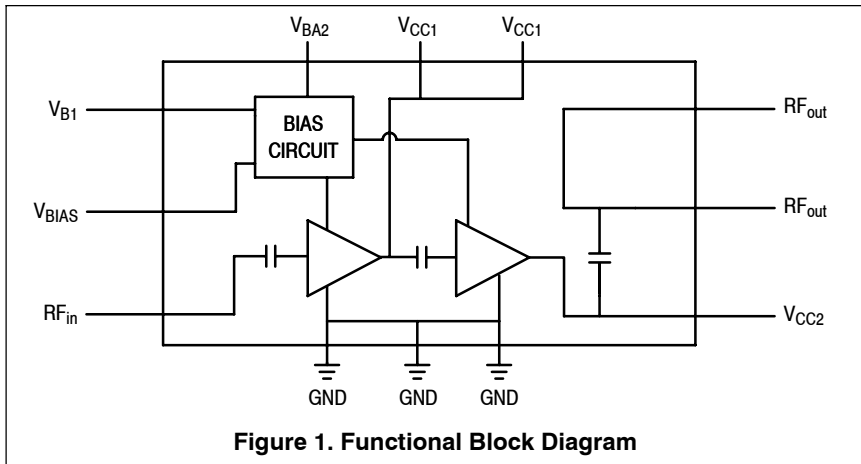
**Table 5. ESD Protection Characteristics**

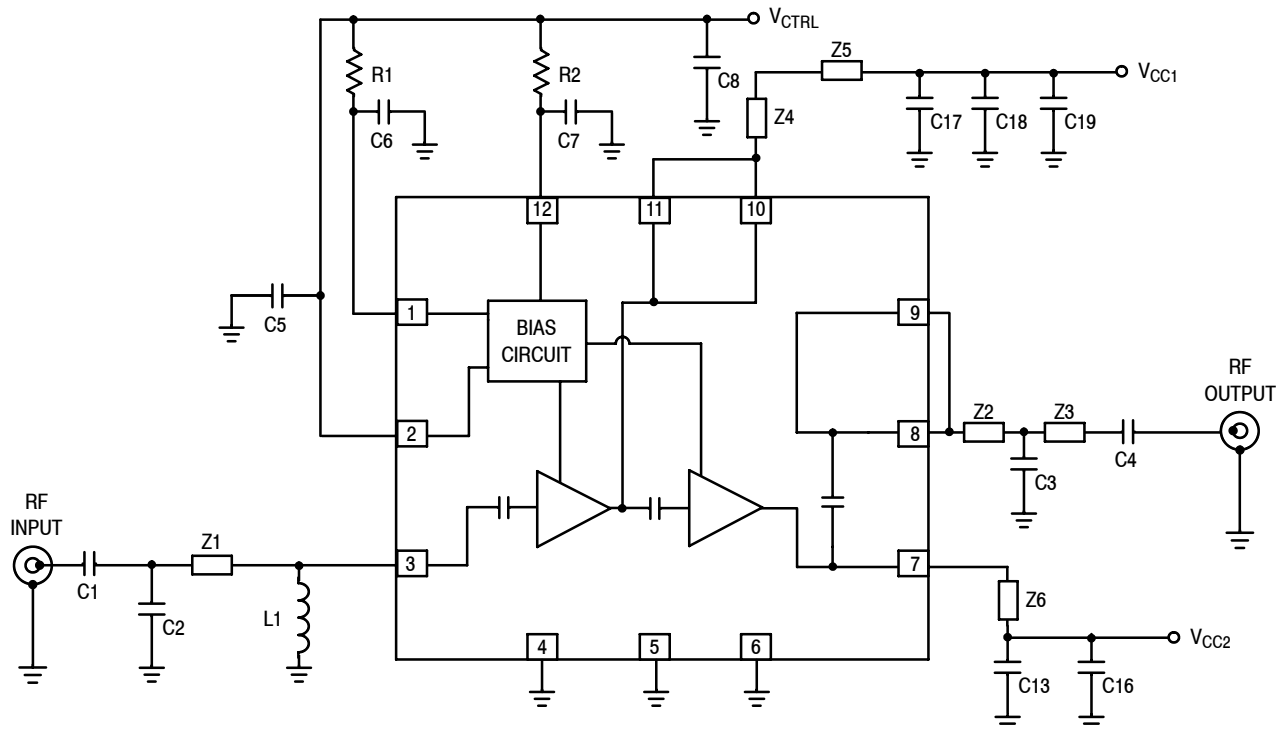
Test Methodology	Class
Human Body Model (per JESD 22-A114)	0 (Minimum), rated to 150 V
Machine Model (per EIA/JESD 22-A115)	A (Minimum)
Charge Device Model (per JESD 22-C101)	III (Minimum)

**Table 6. Moisture Sensitivity Level**

Test Methodology	Rating	Package Peak Temperature	Unit
Per JESD22-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  $150^\circ\text{C}$ .





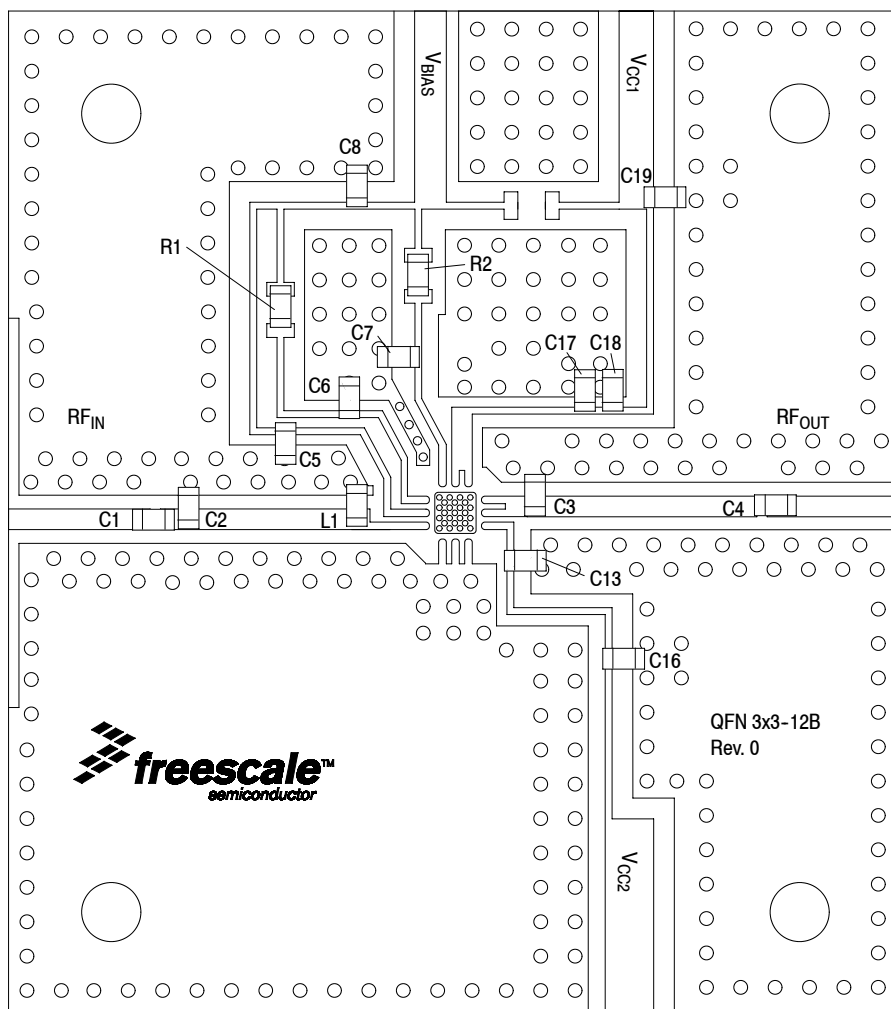
Note: Component numbers C9, C10, C11, C12, C14, and C15 are not used.

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 μF Chip Capacitors	GRM188R61A105KA61	Murata
C16, C19	10 μF Chip Capacitors	GRM188R60J106ME47	Murata
C17	0.1 μF Chip Capacitor	GRM188R71H104KA93	Murata
L1	1.8 nH Chip Inductor	LL1608-FS1N8S	TOKO
R1	120 Ω Chip Resistor	RR0816Q-121-D	Susumu
R2	1300 Ω Chip Resistor	RR0816Q-132-D	Susumu
PCB	0.014", ε <sub>r</sub> = 3.7	FR408	ISOLA



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

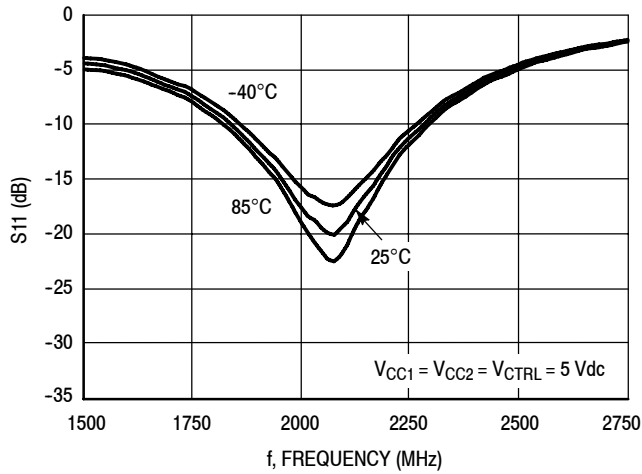
**Figure 4. MMA20312BT1 Test Circuit Component Layout - TD-SCDMA**

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

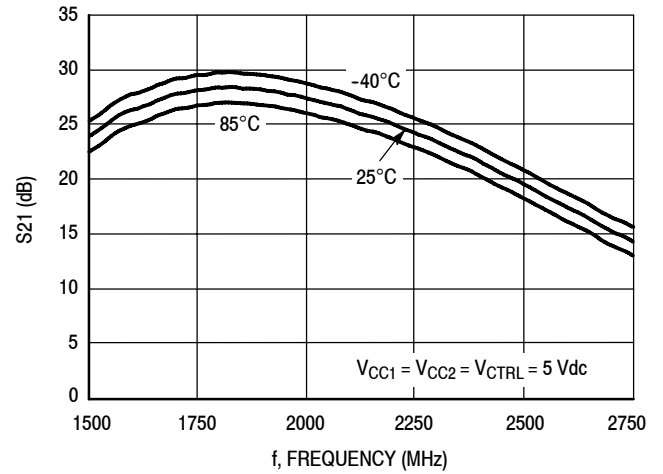
Part	Description	Part Number	Manufacturer
C1, C5	22 pF Chip Capacitors	06033J220GBS	AVX
C2	1.8 pF Chip Capacitor	06035J1R8BBS	AVX
C3	2.2 pF Chip Capacitor	06035J2R2BBS	AVX
C4	5.6 pF Chip Capacitor	06035J5R6BBS	AVX
C6, C7, C13	10 pF Chip Capacitors	06035J100GBS	AVX
C8, C18	1 $\mu$ F Chip Capacitors	GRM188R61A105KA61	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.)

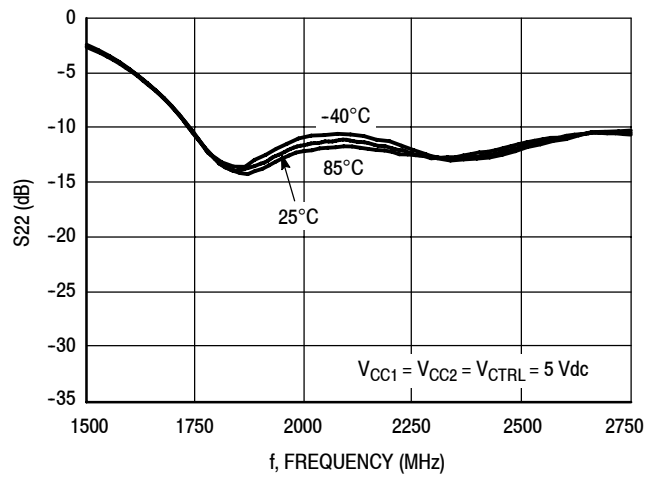
## TYPICAL CHARACTERISTICS — TD-SCDMA



**Figure 5. S11 versus Frequency versus Temperature**

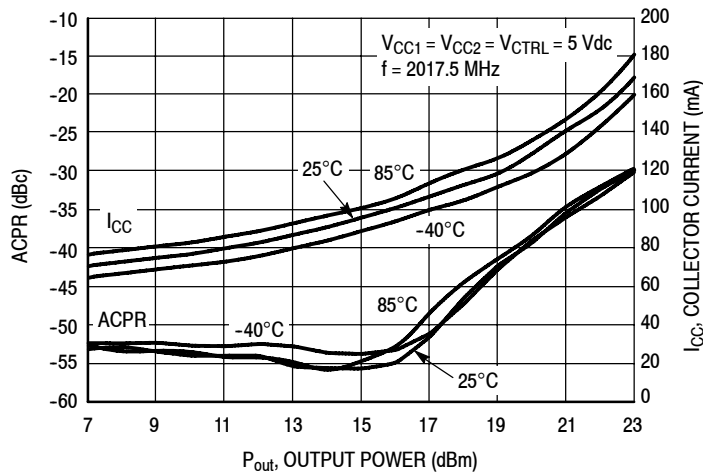


**Figure 6. S21 versus Frequency versus Temperature**

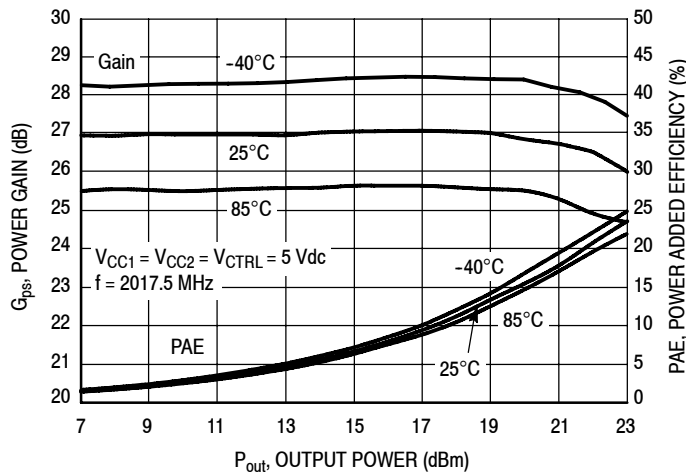


**Figure 7. S22 versus Frequency versus Temperature**

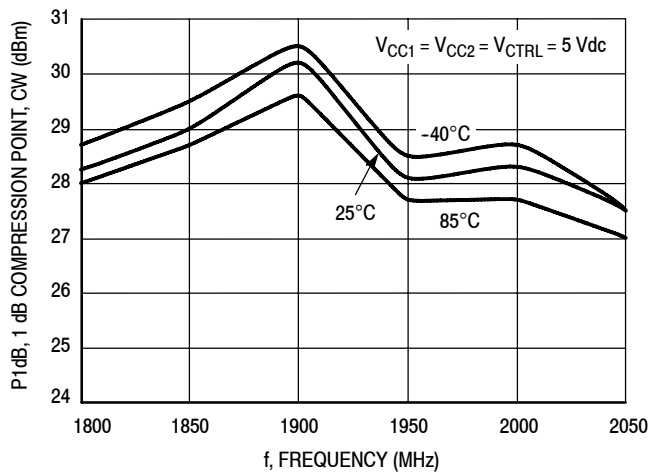
## TYPICAL CHARACTERISTICS — TD-SCDMA



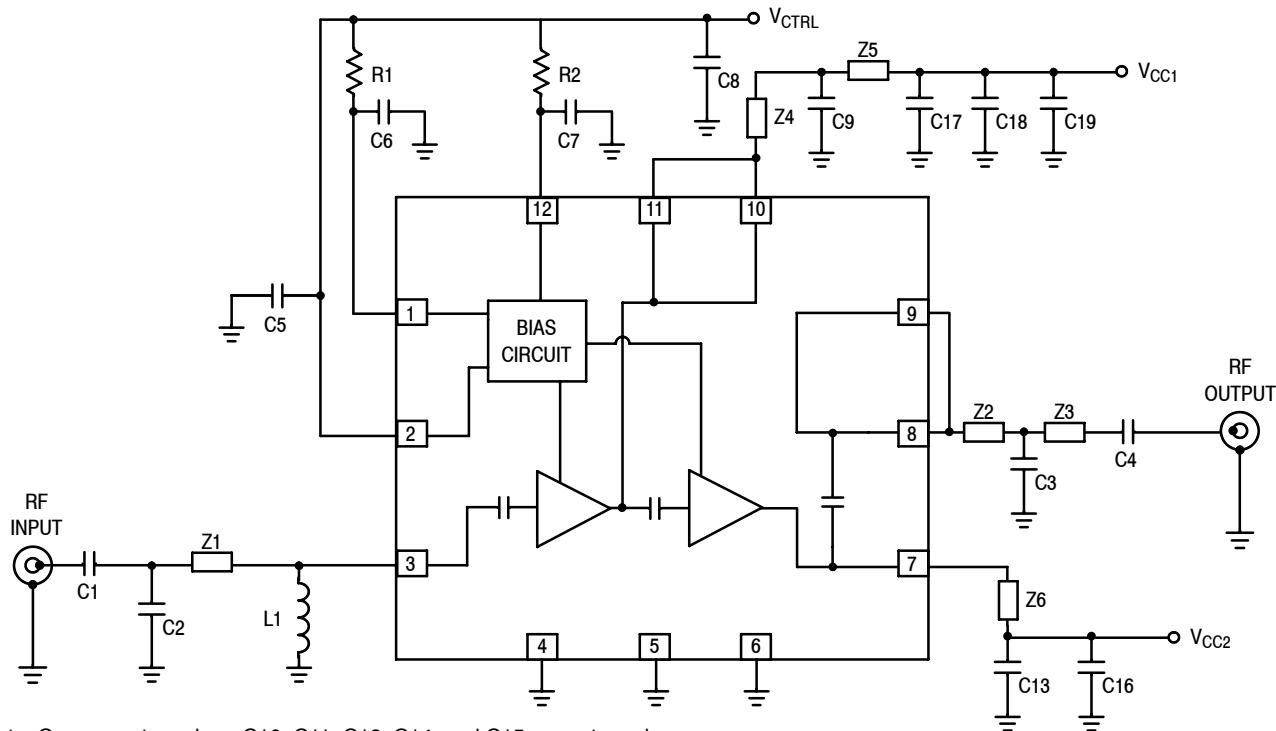
**Figure 8. ACPR versus Collector Current versus Output Power versus Temperature**



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



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



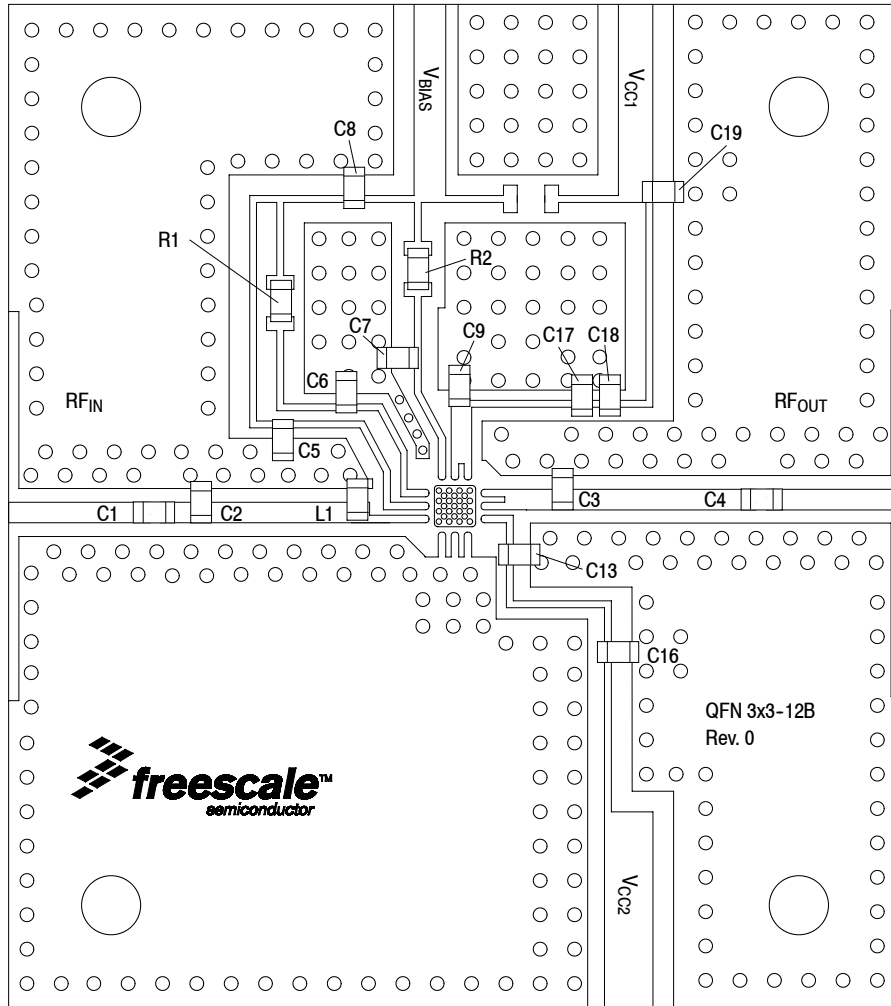
Note: Component numbers C10, C11, C12, C14, and C15 are not used.

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**

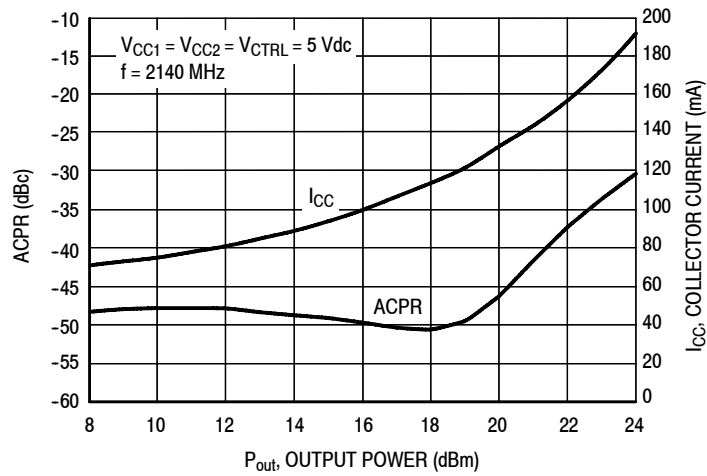
**Table 8. MMA20312BT1 Test Circuit Component Designations and Values - W-CDMA**

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

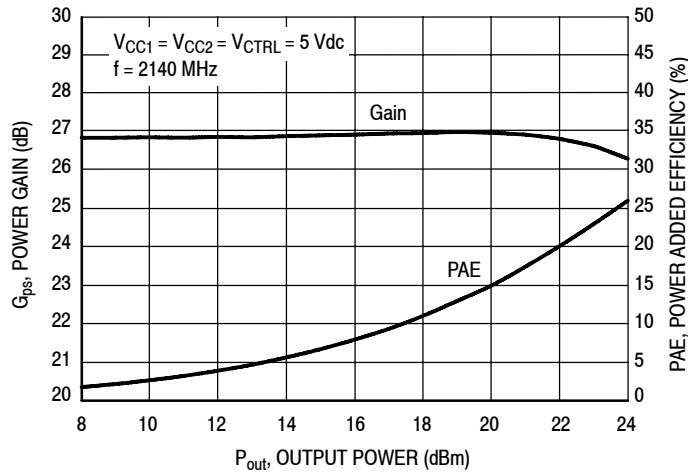
(Component Designations and Values table repeated for reference.)



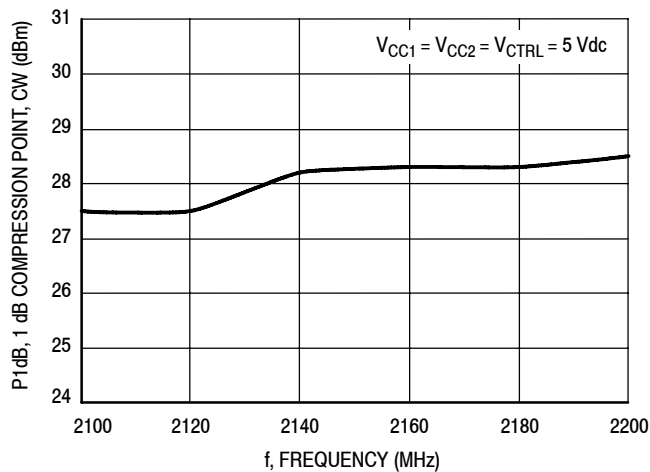
## TYPICAL CHARACTERISTICS — W-CDMA



**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**

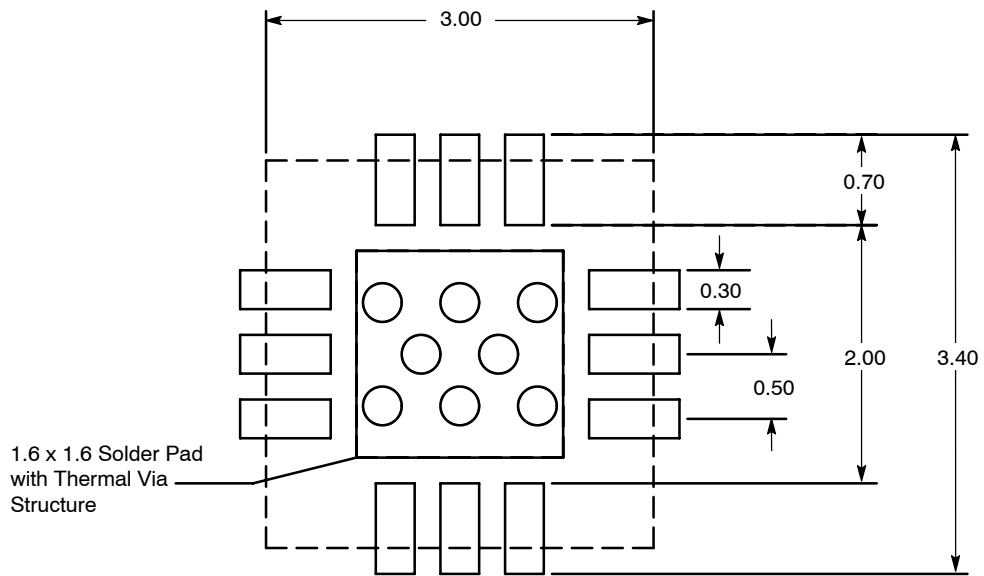
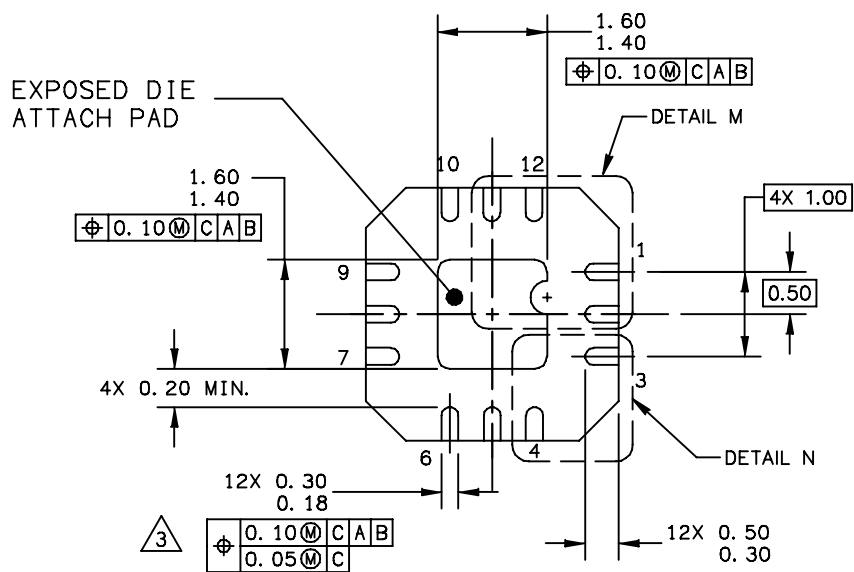
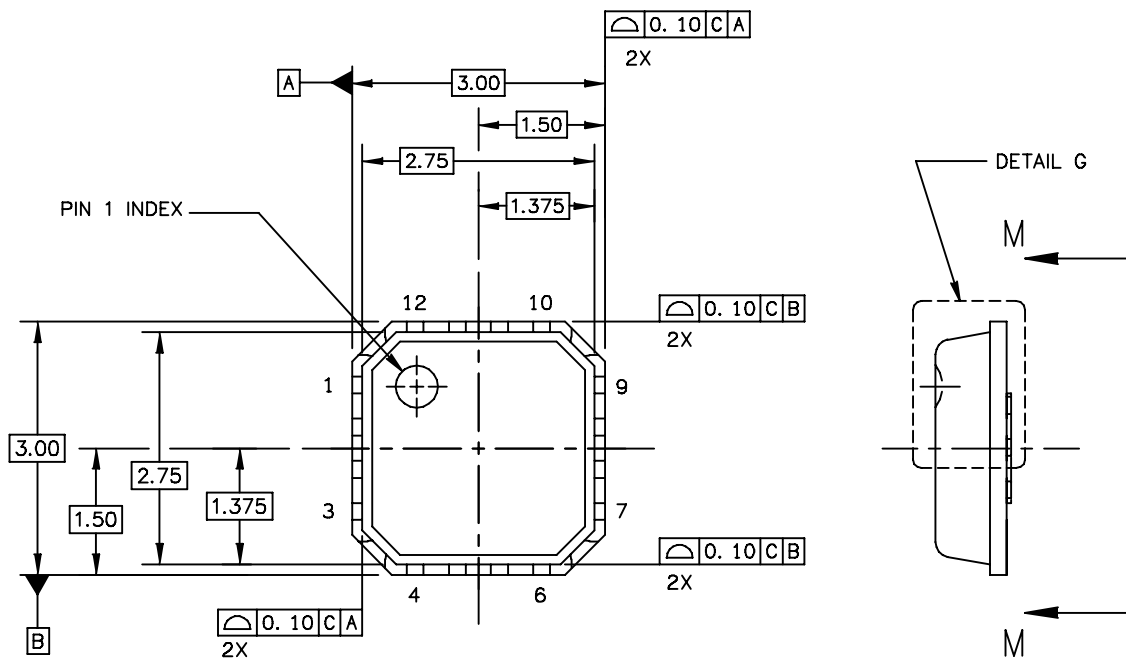


Figure 16. PCB Pad Layout for QFN 3x3



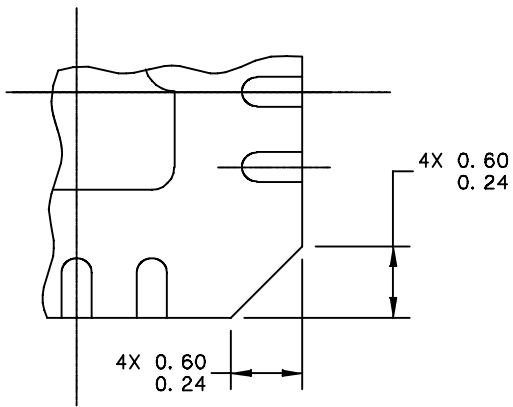
Figure 17. Product Marking

### PACKAGE DIMENSIONS

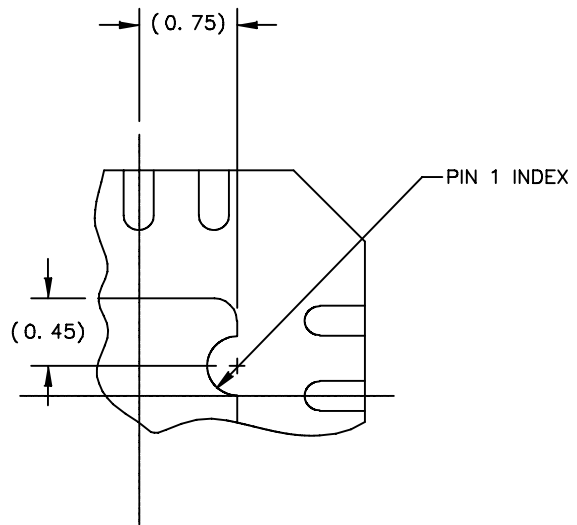


VIEW M-M

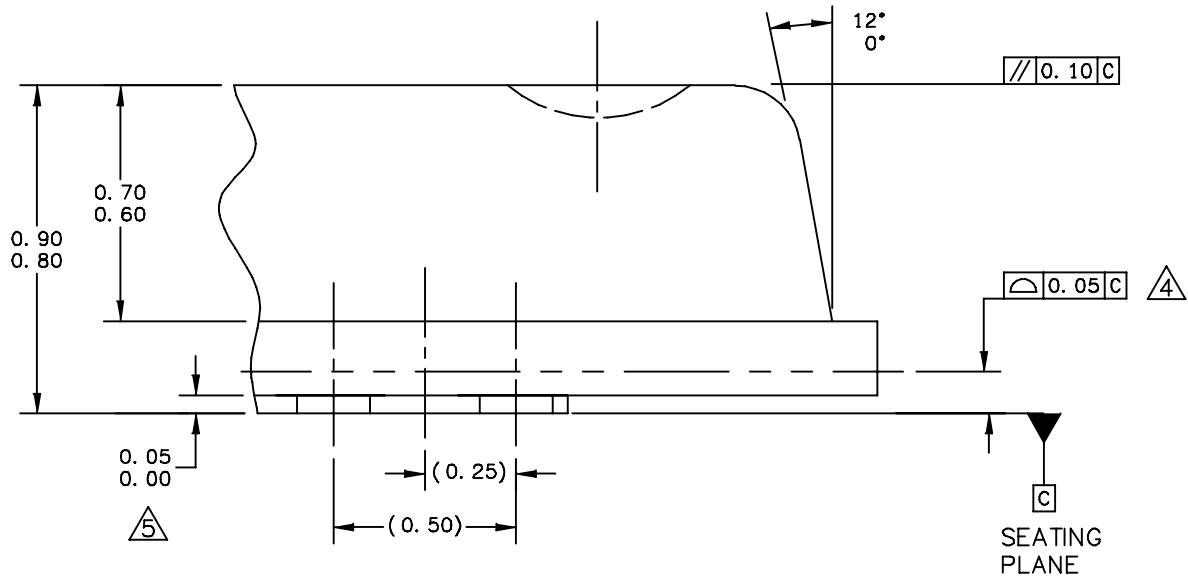
© FREESCALE SEMICONDUCTOR, INC. ALL RIGHTS RESERVED.	MECHANICAL OUTLINE	PRINT VERSION NOT TO SCALE	
TITLE: THERMALLY ENHANCED QUAD FLAT NON-LEADED PACKAGE (QFN) 12 TERMINAL, 0.5 PITCH (3X3X0.85)	DOCUMENT NO: 98ASA00227D	REV: 0	
	CASE NUMBER: 2131-01	14 MAY 2010	
	STANDARD: NON-JEDEC		



DETAIL N  
CORNER CONFIGURATION



DETAIL M  
PIN 1 BACKSIDE INDEX



DETAIL G  
VIEW ROTATED 90° CW

© FREESCALE SEMICONDUCTOR, INC. ALL RIGHTS RESERVED.	MECHANICAL OUTLINE	PRINT VERSION NOT TO SCALE	
TITLE: THERMALLY ENHANCED QUAD FLAT NON-LEADED PACKAGE (QFN) 12 TERMINAL, 0.5 PITCH (3X3X0.85)	DOCUMENT NO: 98ASA00227D	REV: 0	
	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.

© FREESCALE SEMICONDUCTOR, INC. ALL RIGHTS RESERVED.	MECHANICAL OUTLINE	PRINT VERSION NOT TO SCALE	
TITLE: THERMALLY ENHANCED QUAD FLAT NON-LEADED PACKAGE (QFN) 12 TERMINAL, 0.5 PITCH (3X3X0.85)	DOCUMENT NO: 98ASA00227D	REV: 0	
	CASE NUMBER: 2131-01	14 MAY 2010	
	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>

## ***How to Reach Us:***

### **Home Page:**

[www.freescale.com](http://www.freescale.com)

### **Web Support:**

<http://www.freescale.com/support>

### **USA/Europe or Locations Not Listed:**

Freescale Semiconductor, Inc.  
Technical Information Center, EL516  
2100 East Elliot Road  
Tempe, Arizona 85284  
1-800-521-6274 or +1-480-768-2130  
[www.freescale.com/support](http://www.freescale.com/support)

### **Europe, Middle East, and Africa:**

Freescale Halbleiter Deutschland GmbH  
Technical Information Center  
Schatzbogen 7  
81829 Muenchen, Germany  
+44 1296 380 456 (English)  
+46 8 52200080 (English)  
+49 89 92103 559 (German)  
+33 1 69 35 48 48 (French)  
[www.freescale.com/support](http://www.freescale.com/support)

### **Japan:**

Freescale Semiconductor Japan Ltd.  
Headquarters  
ARCO Tower 15F  
1-8-1, Shimo-Meguro, Meguro-ku,  
Tokyo 153-0064  
Japan  
0120 191014 or +81 3 5437 9125  
[support.japan@freescale.com](mailto:support.japan@freescale.com)

### **Asia/Pacific:**

Freescale Semiconductor China Ltd.  
Exchange Building 23F  
No. 118 Jianguo Road  
Chaoyang District  
Beijing 100022  
China  
+86 10 5879 8000  
[support.asia@freescale.com](mailto:support.asia@freescale.com)

### **For Literature Requests Only:**

Freescale Semiconductor Literature Distribution Center  
1-800-441-2447 or +1-303-675-2140  
Fax: +1-303-675-2150  
[LDCForFreescaleSemiconductor@hibbertgroup.com](mailto:LDCForFreescaleSemiconductor@hibbertgroup.com)

Information in this document is provided solely to enable system and software implementers to use Freescale Semiconductor products. There are no express or implied copyright licenses granted hereunder to design or fabricate any integrated circuits or integrated circuits based on the information in this document.

Freescale Semiconductor reserves the right to make changes without further notice to any products herein. Freescale Semiconductor makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does Freescale Semiconductor assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation consequential or incidental damages. "Typical" parameters that may be provided in Freescale Semiconductor data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals", must be validated for each customer application by customer's technical experts. Freescale Semiconductor does not convey any license under its patent rights nor the rights of others. Freescale Semiconductor products are not designed, intended, or authorized for use as components in systems intended for surgical implant into the body, or other applications intended to support or sustain life, or for any other application in which the failure of the Freescale Semiconductor product could create a situation where personal injury or death may occur. Should Buyer purchase or use Freescale Semiconductor products for any such unintended or unauthorized application, Buyer shall indemnify and hold Freescale Semiconductor and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that Freescale Semiconductor was negligent regarding the design or manufacture of the part.

Freescale™ and the Freescale logo are trademarks of Freescale Semiconductor, Inc. All other product or service names are the property of their respective owners.

© Freescale Semiconductor, Inc. 2010-2011. All rights reserved.

