

RF Reference Design Library

RF Power Amplifier Lineup

InGaP HBT and N-Channel Enhancement-Mode Lateral MOSFET

**MMG3014N
 Driving
 MW7IC2240N
 W-CDMA**

**2110-2170 MHz, 4.0 W AVG., 28 V
 W-CDMA SMART DEMO
 REFERENCE DESIGN**

Amplifier Lineup Characteristics

Designed for W-CDMA and LTE base station applications with frequencies from 2110 to 2170 MHz. This high gain amplifier lineup provides all the necessary 50 ohm impedance matching, temperature compensation and biasing functions needed for a standard commercial amplifier design.

- Typical Single-Carrier W-CDMA Performance: $V_{CC} = 5$ Volts, $I_{CC} = 135$ mA, $V_{DD} = 28$ Volts, $I_{DQ1} = 90$ mA, $I_{DQ2} = 420$ mA, $P_{out} = 4.0$ Watts Avg., IQ Magnitude Clipping, Channel Bandwidth = 3.84 MHz, Input Signal PAR = 7.5 dB @ 0.01% Probability on CCDF.

Frequency	G_{ps} (dB)	η_D (%)	Output PAR (dB)	ACPR (dBc)
2110 MHz	45.8	14.5	7.4	-48.9
2140 MHz	45.4	14.2	7.4	-47.9
2170 MHz	45.6	14.8	7.4	-49.5

- Capable of Handling 5:1 VSWR, @ 28 Vdc, 2140 MHz, 40 Watts CW Output Power
- Stable into a 5:1 VSWR. All Spurs Below -60 dBc @ 100 mW to 10 Watts CW P_{out} .

MMG3014N/MW7IC2240N REFERENCE DESIGN

This reference design is designed to demonstrate the RF performance characteristics of the MMG3014N/MW7IC2240N combination when applied to the 2110- 2170 MHz W- CDMA frequency band. The reference design is tuned for performance at 4.0 watts average output power, $V_{CC} = 5$ volts, $I_{CC} = 135$ mA, $V_{DD} = 28$ volts, $I_{DQ1} = 90$ mA, and $I_{DQ2} = 420$ mA.

product or products, without charge. The reference design contains easy-to-copy, fully functional amplifier designs. Where possible, it consists of “no tune” distributed element matching circuits designed to be as small as possible, includes temperature compensated bias circuitry, and is designed to be used as “building blocks” for our customers.

REFERENCE DESIGN LIBRARY TERMS AND CONDITIONS

Freescale is pleased to make this reference design available for your use in development and testing of your own

HEATSINKING

When operating this fixture please provide adequate heatsinking for the device. Excessive heating of the device will prevent repeating of the included measurements.

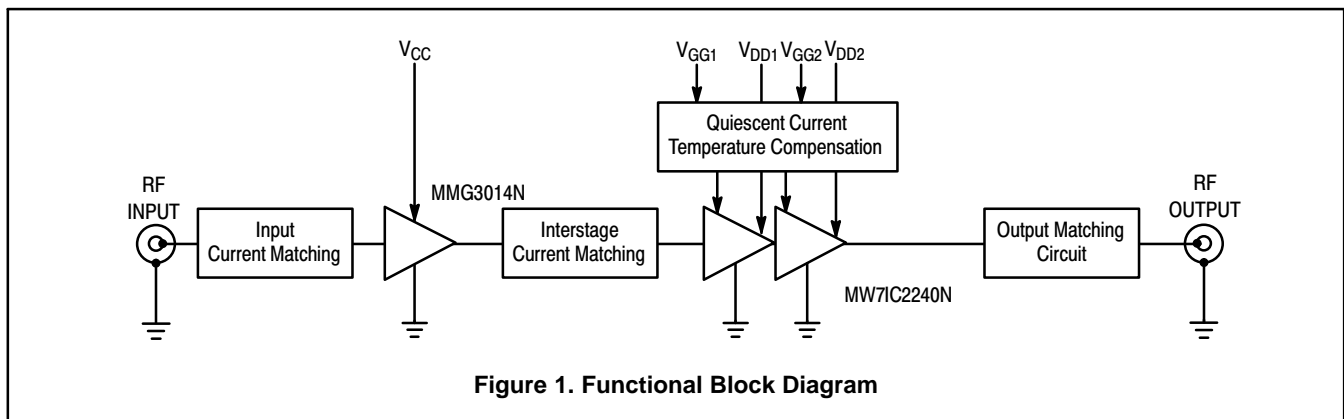


Figure 1. Functional Block Diagram

Amplifier Lineup Alternate Characteristics

- Typical Single-Carrier W-CDMA Performance: $V_{CC} = 5$ Volts, $I_{CC} = 135$ mA, $V_{DD} = 28$ Volts, $I_{DQ1} = 90$ mA, $I_{DQ2} = 420$ mA, $P_{out} = 4.0$ Watts Avg., IQ Magnitude Clipping, Channel Bandwidth = 3.84 MHz, Input Signal PAR = 9.9 dB @ 0.01% Probability on CCDF.

Frequency	G_{ps} (dB)	η_D (%)	Output PAR (dB)	ACPR (dBc)
2110 MHz	45.7	14.8	9.5	-47.5
2140 MHz	45.2	14.4	9.4	-48.1
2170 MHz	45.5	15.0	9.5	-48.9

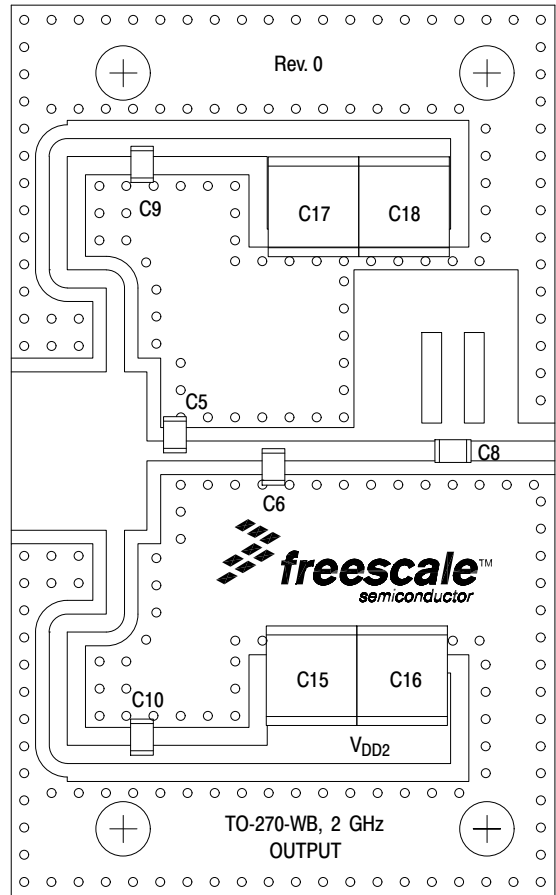
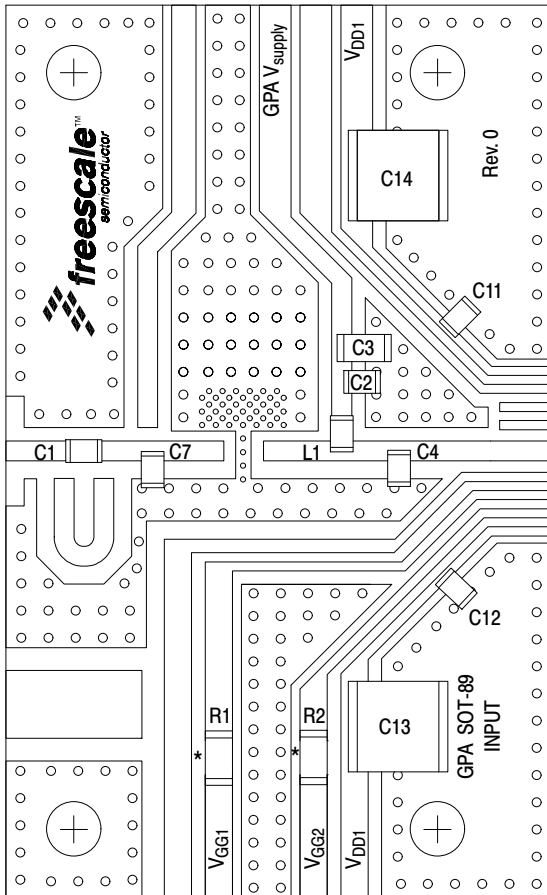
MMG3014N Device Features

- Small-Signal Gain: 15 dB @ 2140 MHz
- Third Order Output Intercept Point: 40.5 dBm @ 2140 MHz
- Single 5 Volt Supply
- Active Self Bias
- Low Cost SOT-89 Surface Mount Package

MW7IC2240N Device Features

- Characterized with Series Equivalent Large-Signal Impedance Parameters and Common Source S-Parameters
- On-Chip Matching (50 Ohm Input, DC Blocked, >3 Ohm Output)
- Integrated Quiescent Current Temperature Compensation with Enable/ Disable Function (1)
- Integrated ESD Protection

1. Refer to AN1977, *Quiescent Current Thermal Tracking Circuit in the RF Integrated Circuit Family* and to AN1987, *Quiescent Current Control for the RF Integrated Circuit Device Family*. Go to <http://www.freescale.com/rf>. Select Documentation/Application Notes - AN1977 or AN1987.



*Trace will need to be cut under the resistors.

Figure 2. MMG3014N Driving MW7IC2240N Board Layout

Table 1. MMG3014N Driving MW7IC2240N Test Circuit Component Designations and Values

Part	Description	Part Number	Manufacturer
C1	22 pF Chip Capacitor	ATC600F220JT250XT	ATC
C2	0.1 μ F Chip Capacitor	C0603C104J5RAC	Kemet
C3	2.2 μ F Chip Capacitor	C0805C225J4RAC	Kemet
C4, C5	0.5 pF Chip Capacitors	ATC600F0R5BT250XT	ATC
C6	1.0 pF Chip Capacitor	ATC600F1R0BT250XT	ATC
C7	1.5 pF Chip Capacitor	ATC600F1R5BT250XT	ATC
C8, C9, C10	33 pF Chip Capacitors	ATC600F330JT250XT	ATC
C11, C12	5.6 pF Chip Capacitors	ATC600F5R6BT250XT	ATC
C13, C14, C15, C16, C17, C18	10 μ F Chip Capacitors	GRM55DR61H106KA88L	Murata
L1	15 nH Chip Capacitor	HK160815NJ-T	Taiyo Yuden
R1, R2	10 k Ω , 1/4 W Chip Resistor	CRCW120610K0FKEA	Vishay
PCB	0.020", $\epsilon_r = 3.5$	RO4350B	Rogers

Note: See Appendix A for Tuning Tips.

CHARACTERISTICS — 7.5 dB Input PAR Test Signal

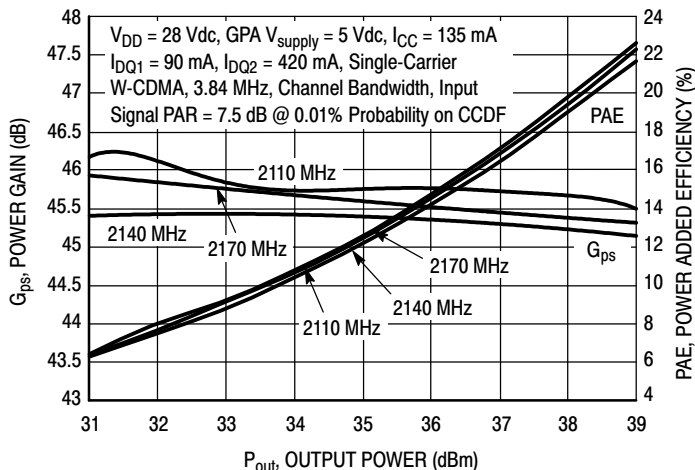


Figure 3. Power Gain and Power Added Efficiency versus Output Power

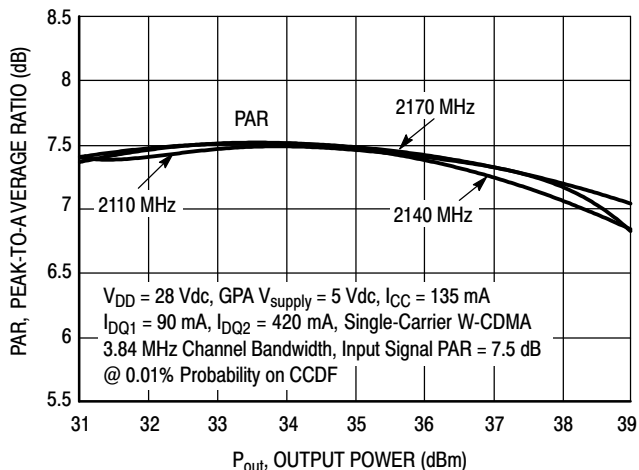


Figure 4. Output Peak-to-Average Ratio (PAR) versus Output Power

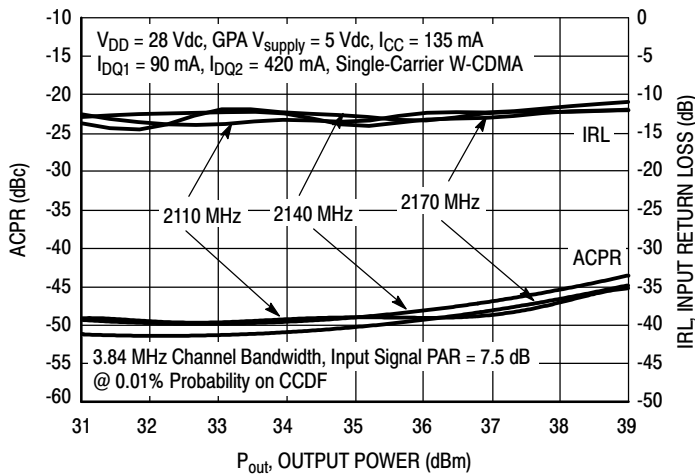


Figure 5. ACPR and Input Return Loss versus Output Power

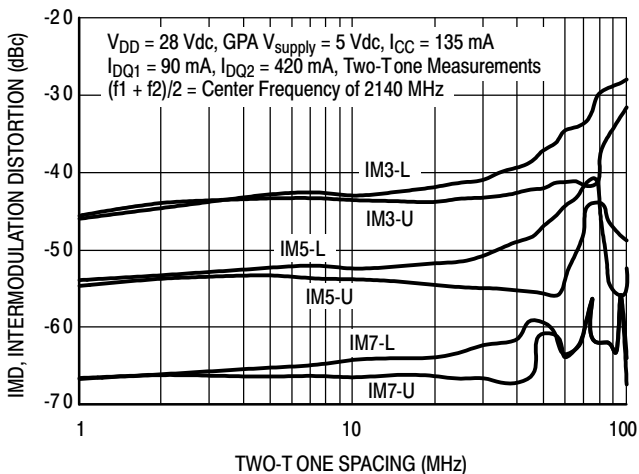


Figure 6. Intermodulation Distortion Products versus Two-Tone Spacing

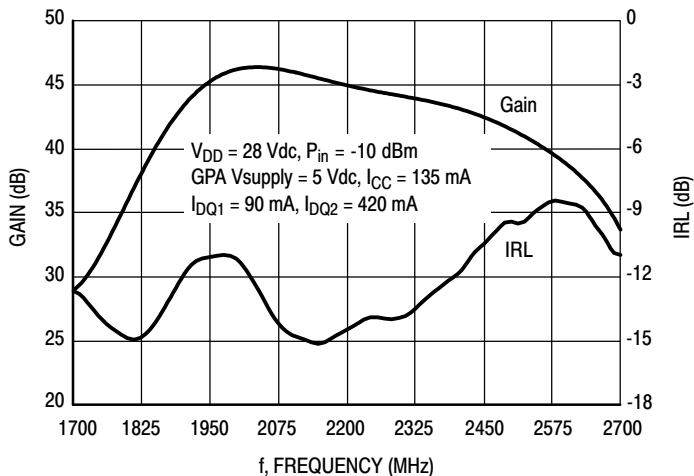


Figure 7. Broadband Frequency Response

W-CDMA TEST SIGNAL

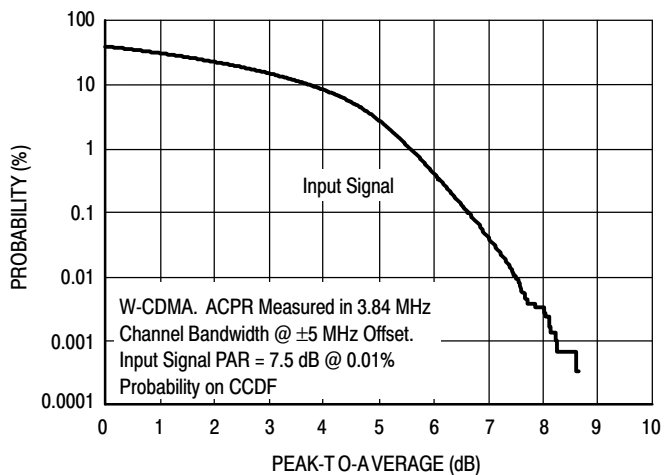


Figure 8. CCDF W-CDMA IQ Magnitude Clipping, Single-Carrier Test Signal

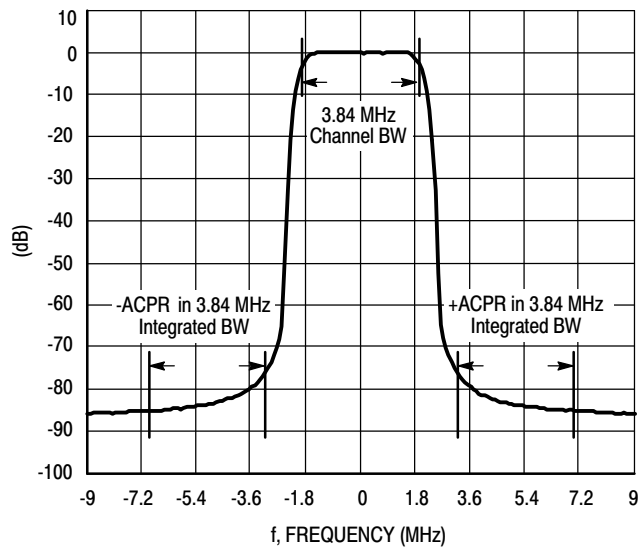


Figure 9. Single-Carrier W-CDMA Spectrum

CHARACTERISTICS — 9.9 dB Input PAR Test Signal

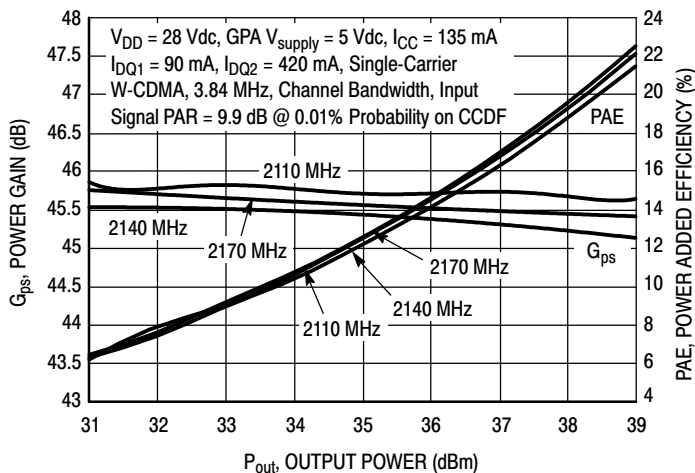


Figure 10. Power Gain and Power Added Efficiency versus Output Power

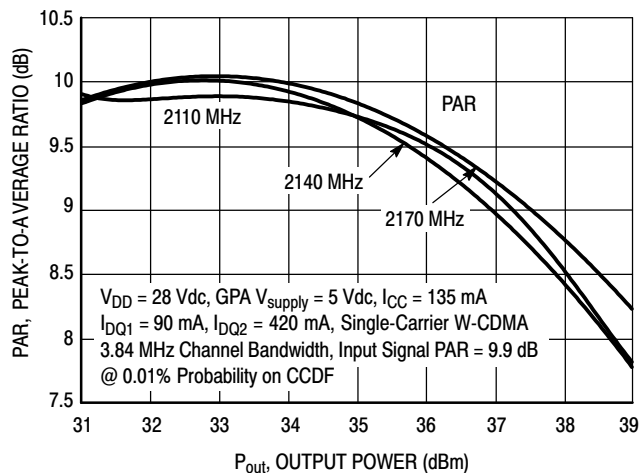


Figure 11. Output Peak-to-Average Ratio (PAR) versus Output Power

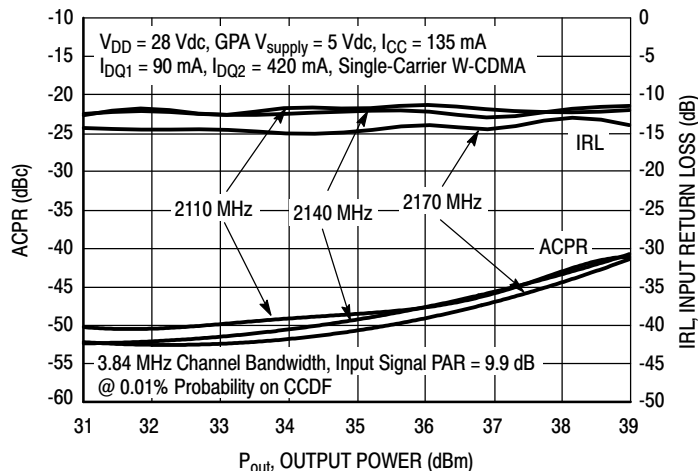


Figure 12. ACPR and Input Return Loss versus Output Power

W-CDMA TEST SIGNAL

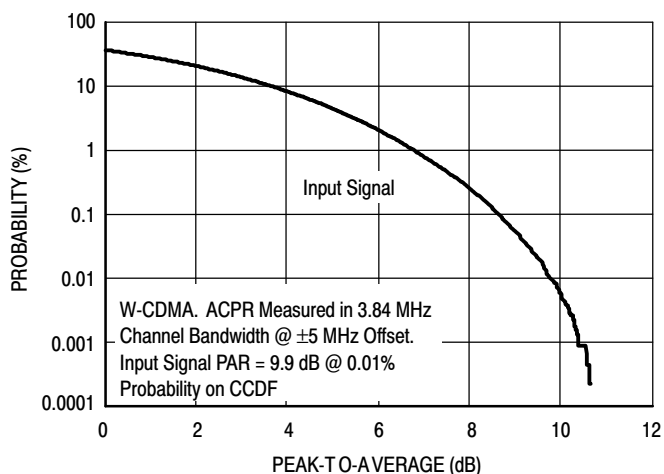


Figure 13. CCDF W-CDMA IQ Magnitude Clipping, Single-Carrier Test Signal

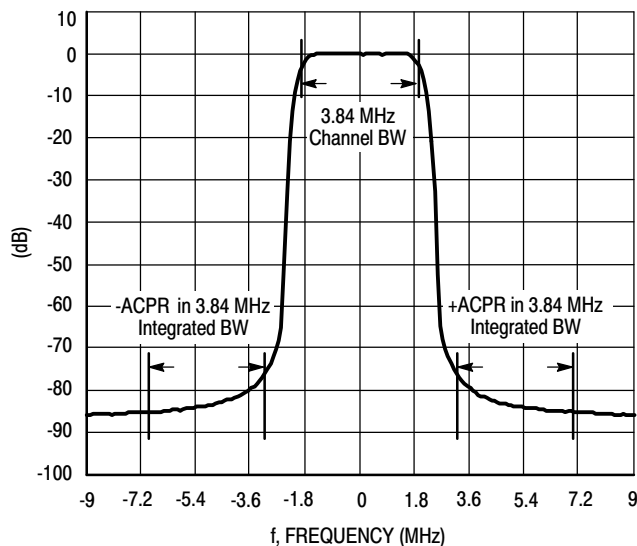


Figure 14. Single-Carrier W-CDMA Spectrum

APPENDIX A

MMG3014N Driving MW7IC2240N Tuning Tips

- Cut traces to insert R1 and R2 as indicated in Fig. 2, MMG3014N Driving MW7IC2240N Board Layout, p. 2.
- Install MW7IC2240N with Delrin hold-down clamp.
- Apply Drain 2 power on MW7IC2240N, adjust V_{DD2} to 28 Vdc.
- Adjust I_{CQ2} to 420 mA, V_{GG2} range from 7-12.5 Vdc.
- Apply Drain 1 power on MW7IC2240N, adjust V_{DD1} to 28 Vdc.
- Adjust I_{CQ1} to 90 mA, V_{GG2} range from 9.5-16.5 Vdc.
- Power on MMG3014N to 5 Vdc. I_{CC} should be around 135 mA.
- Turn on W-CDMA for initial RF test, adjust the output power to 36 dBm or 4.0 watt. Gain should be around 45 dB.
- Move C7 left and right to optimize the return loss.
- Move C5 and C6 to adjust gain flatness and efficiency.

How to Reach Us:

Home Page:

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

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

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

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

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

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. All rights reserved.