

RF LDMOS Wideband Integrated Power Amplifier

The MW7IC008N wideband integrated circuit is designed with on-chip matching that makes it usable from 100 to 1000 MHz. This multi-stage structure is rated for 24 to 32 Volt operation and covers all typical radio base station modulation formats.

Driver Applications

- Typical CW Performance: $V_{DD} = 28$ Volts, $I_{DQ1} = 25$ mA, $I_{DQ2} = 75$ mA

Frequency	G_{ps} (dB)	PAE (%)
100 MHz @ 11 W CW	23.5	55
400 MHz @ 9 W CW	22.5	41
900 MHz @ 6.5 W CW	23.5	34

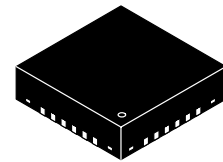
- Capable of Handling 10:1 VSWR, @ 32 Vdc, 900 MHz, $P_{out} = 6.5$ Watts CW (3 dB Input Overdrive from Rated P_{out})
- Stable into a 5:1 VSWR. All Spurs Below -60 dBc @ 1 mW to 8 Watts CW P_{out} @ 900 MHz
- Typical P_{out} @ 1 dB Compression Point \approx 11 Watts CW @ 100 MHz, 9 Watts CW @ 400 MHz, 6.5 Watts CW @ 900 MHz

Features

- Broadband, Single Matching Network from 20 to 1000 MHz
- Integrated Quiescent Current Temperature Compensation with Enable/Disable Function (1)
- Integrated ESD Protection
- 225°C Capable Plastic Package
- RoHS Compliant
- In Tape and Reel. T1 Suffix = 1000 Units per 16 mm, 13 inch Reel.

MW7IC008NT1

100-1000 MHz, 8 W PEAK, 28 V
 RF LDMOS WIDEBAND
 INTEGRATED POWER AMPLIFIER



CASE 1894-01
 PQFN 8x8
 PLASTIC

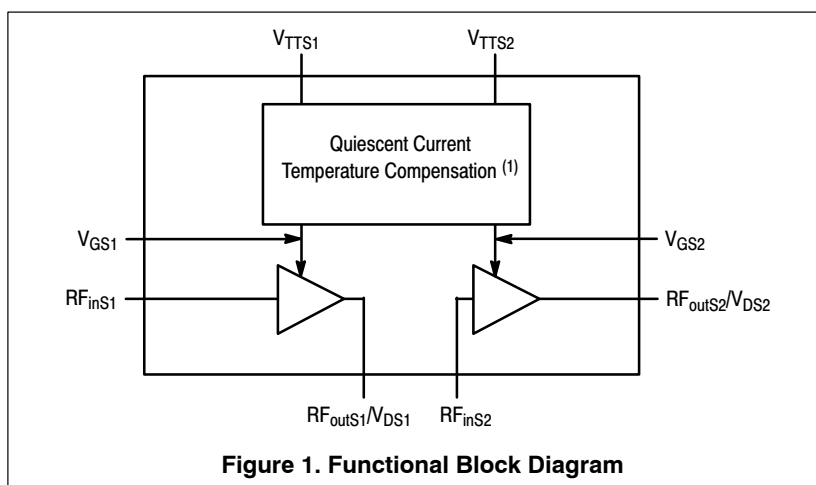


Figure 1. Functional Block Diagram

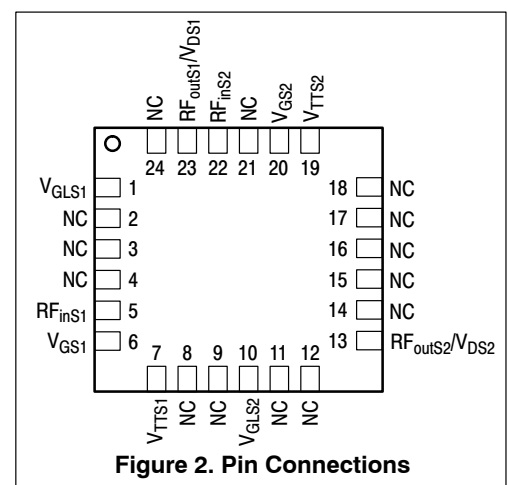


Figure 2. Pin Connections

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.

Table 1. Maximum Ratings

Rating	Symbol	Value	Unit
Drain-Source Voltage	V_{DSS}	-0.5, +65	Vdc
Gate-Source Voltage	V_{GS}	-6.0, +12	Vdc
Operating Voltage	V_{DD}	32, +0	Vdc
Storage Temperature Range	T_{stg}	-65 to +150	°C
Operating Junction Temperature	T_J	150	°C
100 MHz CW Operation @ $T_A = 25^\circ\text{C}$ (3)	CW	11	W
400 MHz CW Operation @ $T_A = 25^\circ\text{C}$ (3)		6	W
900 MHz CW Operation @ $T_A = 25^\circ\text{C}$ (3)		5	W
Input Power	P_{in}	100 MHz 400 MHz 900 MHz	27 23 38
			dBm

Table 2. Thermal Characteristics

Characteristic	Symbol	Value (1,2)	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$		°C/W
(CW Signal @ 100 MHz) (Case Temperature 82°C, $P_{out} = 11$ W CW)		Stage 1, 28 Vdc, $I_{DQ1} = 25$ mA Stage 2, 28 Vdc, $I_{DQ2} = 75$ mA	5.3 4.9
(CW Signal @ 400 MHz) (Case Temperature 87°C, $P_{out} = 9$ W CW)		Stage 1, 28 Vdc, $I_{DQ1} = 25$ mA Stage 2, 28 Vdc, $I_{DQ2} = 75$ mA	4.4 2.7
(CW Signal @ 900 MHz) (Case Temperature 86°C, $P_{out} = 6.5$ W CW)		Stage 1, 28 Vdc, $I_{DQ1} = 25$ mA Stage 2, 28 Vdc, $I_{DQ2} = 75$ mA	3.5 3.2

Table 3. ESD Protection Characteristics

Test Methodology	Class
Human Body Model (per JESD22-A114)	1B (Minimum)
Machine Model (per EIA/JESD22-A115)	A (Minimum)
Charge Device Model (per JESD22-C101)	III (Minimum)

Table 4. Moisture Sensitivity Level

Test Methodology	Rating	Package Peak Temperature	Unit
Per JESD22-A113, IPC/JEDEC J-STD-020	3	260	°C

1. MTTF calculator available at <http://www.freescale.com/rf>. Select Software & Tools/Development Tools/Calculators to access MTTF calculators by product.
2. Refer to AN1955, *Thermal Measurement Methodology of RF Power Amplifiers*. Go to <http://www.freescale.com/rf>. Select Documentation/Application Notes - AN1955.
3. CW Ratings at the individual frequencies are limited by a 100 year MTTF requirement. See MTTF calculator (referenced in Note 1).

(continued)

Table 5. Electrical Characteristics ($T_A = 25^\circ\text{C}$ unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
Stage 1 — Off Characteristics					
Zero Gate Voltage Drain Leakage Current ($V_{DS} = 65\text{ Vdc}$, $V_{GS} = 0\text{ Vdc}$)	I_{DSS}	—	—	10	μAdc
Zero Gate Voltage Drain Leakage Current ($V_{DS} = 28\text{ Vdc}$, $V_{GS} = 0\text{ Vdc}$)	I_{DSS}	—	—	1	μAdc
Gate-Source Leakage Current ($V_{GS} = 1.5\text{ Vdc}$, $V_{DS} = 0\text{ Vdc}$)	I_{GSS}	—	—	10	μAdc

Stage 1 — On Characteristics

Gate Threshold Voltage ($V_{DS} = 10\text{ Vdc}$, $I_D = 5.3\ \mu\text{Adc}$)	$V_{GS(th)}$	1.3	2	2.8	Vdc
Gate Quiescent Voltage ($V_{DD} = 28\text{ Vdc}$, $I_D = 25\text{ mAdc}$, Measured in Functional Test)	$V_{GS(Q)}$	2	2.8	3.5	Vdc

Stage 2 — Off Characteristics

Zero Gate Voltage Drain Leakage Current ($V_{DS} = 65\text{ Vdc}$, $V_{GS} = 0\text{ Vdc}$)	I_{DSS}	—	—	10	μAdc
Zero Gate Voltage Drain Leakage Current ($V_{DS} = 28\text{ Vdc}$, $V_{GS} = 0\text{ Vdc}$)	I_{DSS}	—	—	1	μAdc
Gate-Source Leakage Current ($V_{GS} = 1.5\text{ Vdc}$, $V_{DS} = 0\text{ Vdc}$)	I_{GSS}	—	—	10	μAdc

Stage 2 — On Characteristics

Gate Threshold Voltage ($V_{DS} = 10\text{ Vdc}$, $I_D = 23\ \mu\text{Adc}$)	$V_{GS(th)}$	1.3	2	2.8	Vdc
Gate Quiescent Voltage ($V_{DD} = 28\text{ Vdc}$, $I_D = 75\text{ mAdc}$, Measured in Functional Test)	$V_{GS(Q)}$	2	2.7	3.5	Vdc
Drain-Source On-Voltage ($V_{GS} = 10\text{ Vdc}$, $I_D = 3.6\text{ Adc}$)	$V_{DS(on)}$	0.1	0.3	1	Vdc

Functional Tests ⁽¹⁾ (In Freescale Test Fixture, 50 ohm system) $V_{DD} = 28\text{ Vdc}$, $I_{DQ1} = 25\text{ mA}$, $I_{DQ2} = 75\text{ mA}$, $P_{out} = 6.5\text{ W CW}$, $f = 900\text{ MHz}$

Power Gain	G_{ps}	21.5	23.5	31.5	dB
Power Added Efficiency	PAE	30	34	—	%
Input Return Loss	IRL	—	-15	-11	dB

Typical Broadband Performance (In Freescale Test Fixture, 50 ohm system) $V_{DD} = 28\text{ Vdc}$, $I_{DQ1} = 25\text{ mA}$, $I_{DQ2} = 75\text{ mA}$

Frequency	G_{ps} (dB)	PAE (%)	IRL (dB)
100 MHz @ 11 W CW	23.5	55	-20
400 MHz @ 9 W CW	22.5	41	-17
900 MHz @ 6.5 W CW	23.5	34	-15

1. Part internally matched both on input and output.

(continued)

Table 5. Electrical Characteristics ($T_A = 25^\circ\text{C}$ unless otherwise noted) (continued)

Characteristic	Symbol	Min	Typ	Max	Unit
Typical Performances (In Freescale Test Fixture, 50 ohm system) $V_{DD} = 28\text{ Vdc}$, $I_{DQ1} = 25\text{ mA}$, $I_{DQ2} = 75\text{ mA}$, 100-1000 MHz Bandwidth					
Characteristic	Symbol	Min	Typ	Max	Unit
IMD Symmetry @ 6.8 W PEP, P_{out} where IMD Third Order Intermodulation $\cong 30\text{ dBc}$ (Delta IMD Third Order Intermodulation between Upper and Lower Sidebands $> 2\text{ dB}$)	IMD_{sym}	—	180	—	MHz
VBW Resonance Point ⁽¹⁾ (IMD Third Order Intermodulation Inflection Point)	VBW_{res}	—	210	—	MHz
Gain Flatness in 500-1000 MHz Bandwidth @ $P_{out} = 6\text{ W Avg.}$	G_F	—	1.35	—	dB
Gain Variation over Temperature (-30°C to $+85^\circ\text{C}$)	ΔG	—	0.024	—	dB/ $^\circ\text{C}$
Output Power Variation over Temperature (-30°C to $+85^\circ\text{C}$)	$\Delta P1\text{dB}$	—	0.005	—	dBm/ $^\circ\text{C}$

Typical CW Performances — 100 MHz (In Freescale Test Fixture, 50 ohm system) $V_{DD} = 28\text{ Vdc}$, $I_{DQ1} = 25\text{ mA}$, $I_{DQ2} = 75\text{ mA}$, $P_{out} = 11\text{ W}$ CW, $f = 100\text{ MHz}$

Power Gain	G_{ps}	—	23.5	—	dB
Power Added Efficiency	PAE	—	55	—	%
Input Return Loss	IRL	—	-20	—	dB
P_{out} @ 1 dB Compression Point, CW	P1dB	—	11	—	W

Typical CW Performances — 400 MHz (In Freescale Test Fixture, 50 ohm system) $V_{DD} = 28\text{ Vdc}$, $I_{DQ1} = 25\text{ mA}$, $I_{DQ2} = 75\text{ mA}$, $P_{out} = 9\text{ W}$ CW, $f = 400\text{ MHz}$

Power Gain	G_{ps}	—	22.5	—	dB
Power Added Efficiency	PAE	—	41	—	%
Input Return Loss	IRL	—	-17	—	dB
P_{out} @ 1 dB Compression Point, CW	P1dB	—	9	—	W

Typical CW Performances — 900 MHz (In Freescale Test Fixture, 50 ohm system) $V_{DD} = 28\text{ Vdc}$, $I_{DQ1} = 25\text{ mA}$, $I_{DQ2} = 75\text{ mA}$, $P_{out} = 6.5\text{ W}$ CW, $f = 900\text{ MHz}$

Power Gain	G_{ps}	—	23.5	—	dB
Power Added Efficiency	PAE	—	34	—	%
Input Return Loss	IRL	—	-15	—	dB
P_{out} @ 1 dB Compression Point, CW	P1dB	—	6.5	—	W

1. Estimated data.

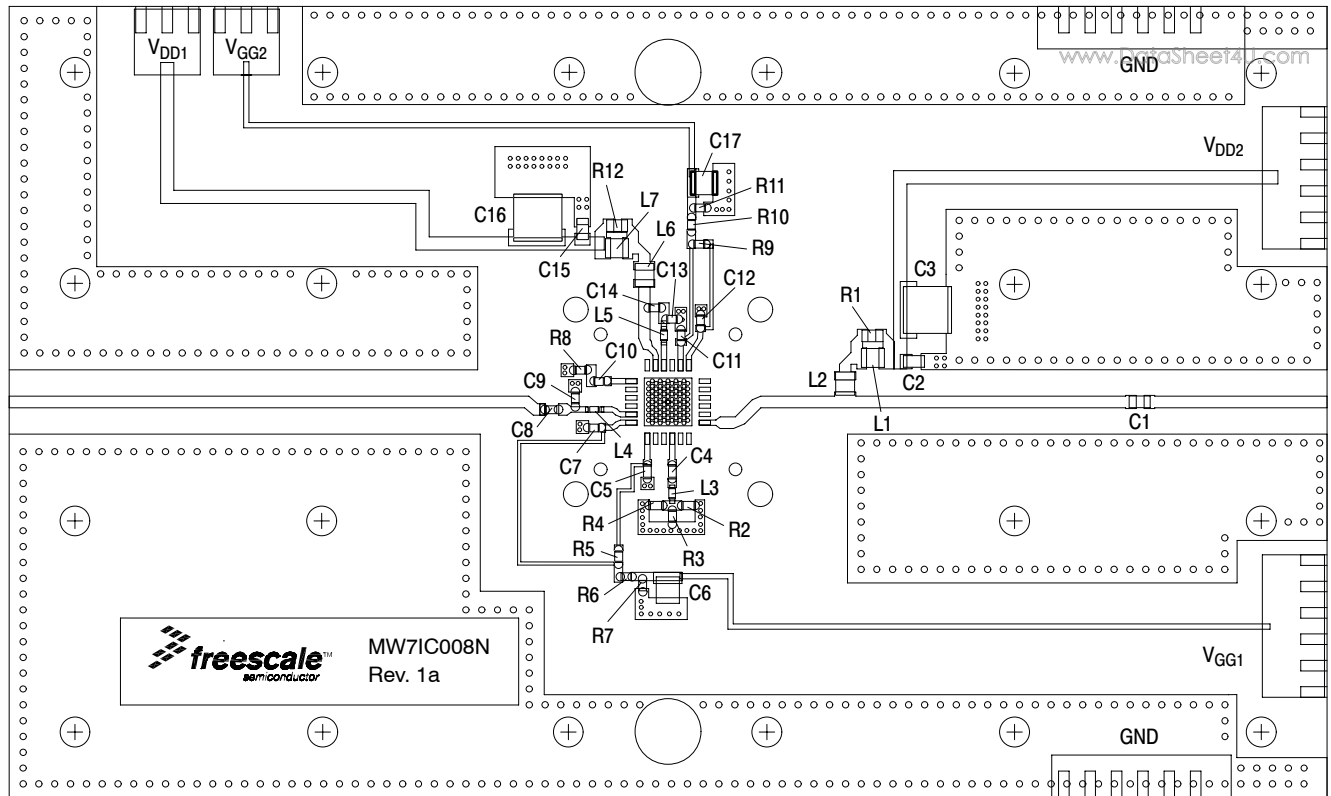


Figure 3. MW7IC008NT1 Test Circuit Component Layout

Table 6. MW7IC008NT1 Test Circuit Component Designations and Values

Part	Description	Part Number	Manufacturer
C1	0.01 μ F Chip Capacitor	GRM3195C1E103JA01	Murata
C2, C15	0.1 μ F Chip Capacitors	GRM219F51H104ZA01	Murata
C3, C16	10 μ F Chip Capacitors	GRM55DR61H106KA88L	Murata
C4, C5, C7, C8, C10, C11, C12, C14	0.01 μ F Chip Capacitors	C0805C103K5RAC	Kemet
C6, C17	1 μ F, 35 V Tantalum Capacitors	TAJA105K035R	AVX
C9	2.2 pF Chip Capacitor	ATC600S2R2CT250XT	ATC
C13	3.3 pF Chip Capacitor	ATC600S3R3BT250XT	ATC
L1, L7	150 nH Ceramic Chip Inductors	LL2012-FHLR15J	Toko
L2, L6	180 nH Ceramic Chip Inductors	LL2012-FHLR18J	Toko
L3	1.6 nH Inductor	0603HC-1N6XJLW	Coilcraft
L4, L5	5.1 nH Inductors	0603HP-5N1XJLW	Coilcraft
R1, R12	510 Ω , 1/10 W Chip Resistors	RR1220P-511-B-T5	Susumu
R2, R3, R4	91 Ω , 1/8 W Chip Resistors	CRCW080591R0FKEA	Vishay
R5*, R9*	0 Ω , 2.5 A Chip Resistors	CRCW08050000Z0EA	Vishay
R6	10 K Ω , 1/8 W Chip Resistor	CRCW080510K0JNEA	Vishay
R7, R11	12 K Ω , 1/8 W Chip Resistors	CRCW080512K0JNEA	Vishay
R8	43 Ω , 1/8 W Chip Resistor	CRCW080543R0FKEA	Vishay
R10	15 K Ω , 1/8 W Chip Resistor	CRCW080515K0JNEA	Vishay
PCB	0.020", $\epsilon_r = 3.5$	RO4350	Rogers

*Add for temperature compensation

TYPICAL CHARACTERISTICS

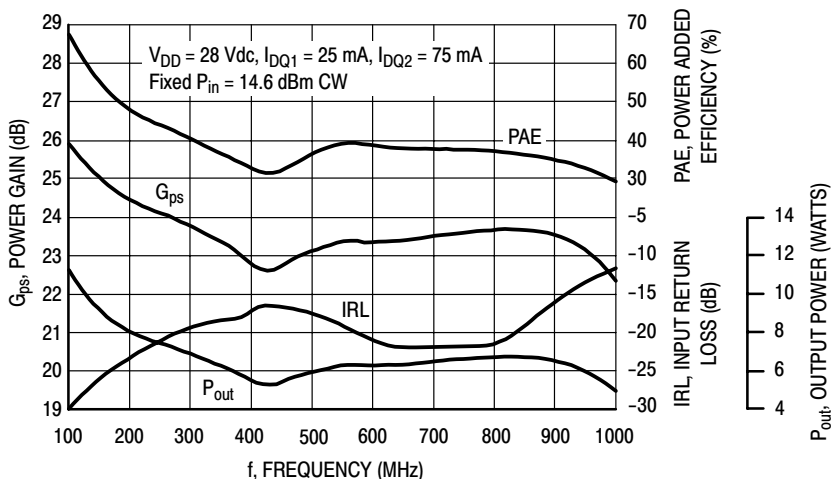


Figure 4. Broadband Performance @ $P_{in} = 14.6$ dBm CW

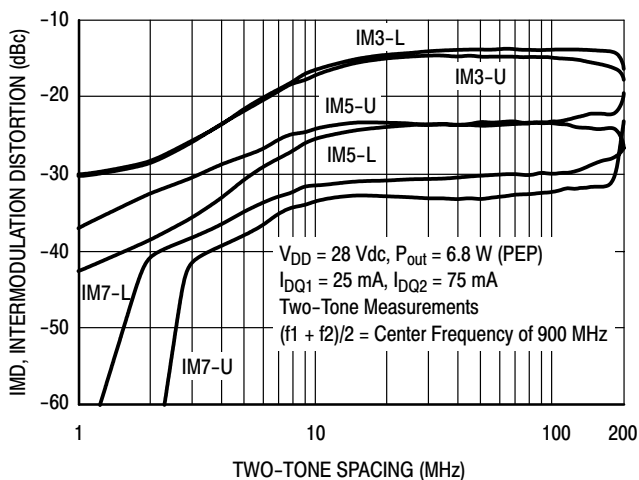


Figure 5. Intermodulation Distortion Products versus Two-Tone Spacing

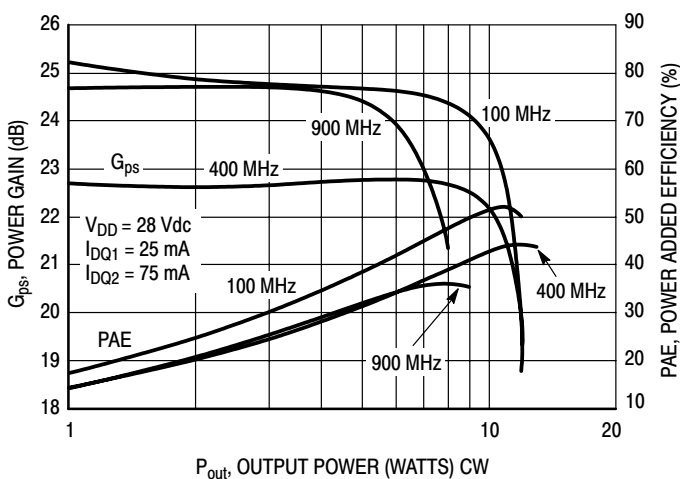


Figure 6. Power Gain and Power Added Efficiency versus Output Power

TYPICAL CHARACTERISTICS

www.DataSheet4U.com

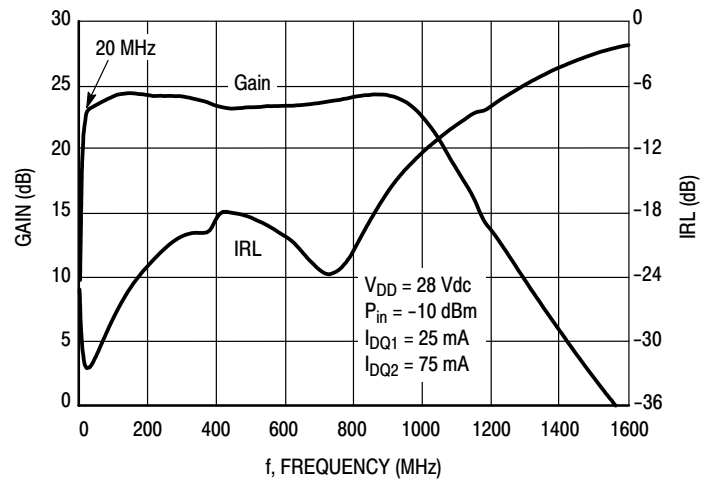


Figure 7. Broadband Frequency Response

$V_{DD} = 28 \text{ Vdc}$, $I_{DQ1} = 25 \text{ mA}$, $I_{DQ2} = 75 \text{ mA}$
 $P_{out} = 11 \text{ W @ 100 MHz}$, 9 W @ 400 MHz , 6.5 W @ 900 MHz

f MHz	Z_{in} Ω	Z_{load} Ω
100	49.78 + j1.07	47.87 - j9.85
150	48.96 + j1.44	49.12 - j5.44
200	48.00 + j1.54	49.09 - j2.66
250	46.67 + j1.36	48.63 - j0.79
300	45.30 + j0.91	47.73 + j0.49
350	43.93 + j0.11	46.60 + j1.22
400	42.53 - j0.86	45.63 + j1.43
450	41.38 - j2.16	44.97 + j1.13
500	40.30 - j3.71	45.04 + j0.70
550	39.38 - j5.44	45.23 + j0.77
600	38.43 - j7.11	44.80 + j1.29
650	37.94 - j8.71	44.32 + j1.48
700	37.49 - j10.52	43.57 + j1.51
750	37.31 - j12.42	43.19 + j1.32
800	37.00 - j14.03	42.61 + j0.77
850	36.74 - j15.64	42.25 + j0.39
900	36.57 - j17.09	41.90 + j0.03
950	36.37 - j18.59	41.67 - j0.41
1000	36.12 - j20.06	41.77 - j1.10
1050	35.58 - j21.43	41.82 - j1.60
1100	35.00 - j22.79	41.90 - j2.01
1150	34.53 - j24.39	42.26 - j2.43
1200	33.53 - j25.97	42.51 - j2.80
1250	32.67 - j27.84	42.74 - j2.99
1300	31.61 - j29.89	43.10 - j3.11
1350	30.61 - j32.34	43.52 - j3.19
1400	29.55 - j34.81	43.86 - j3.13
1450	28.23 - j37.61	44.03 - j3.03
1500	27.34 - j40.59	44.33 - j2.67

Z_{in} = Device input impedance as measured from gate to ground.

Z_{load} = Test circuit impedance as measured from drain to ground.

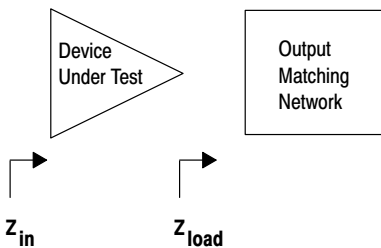
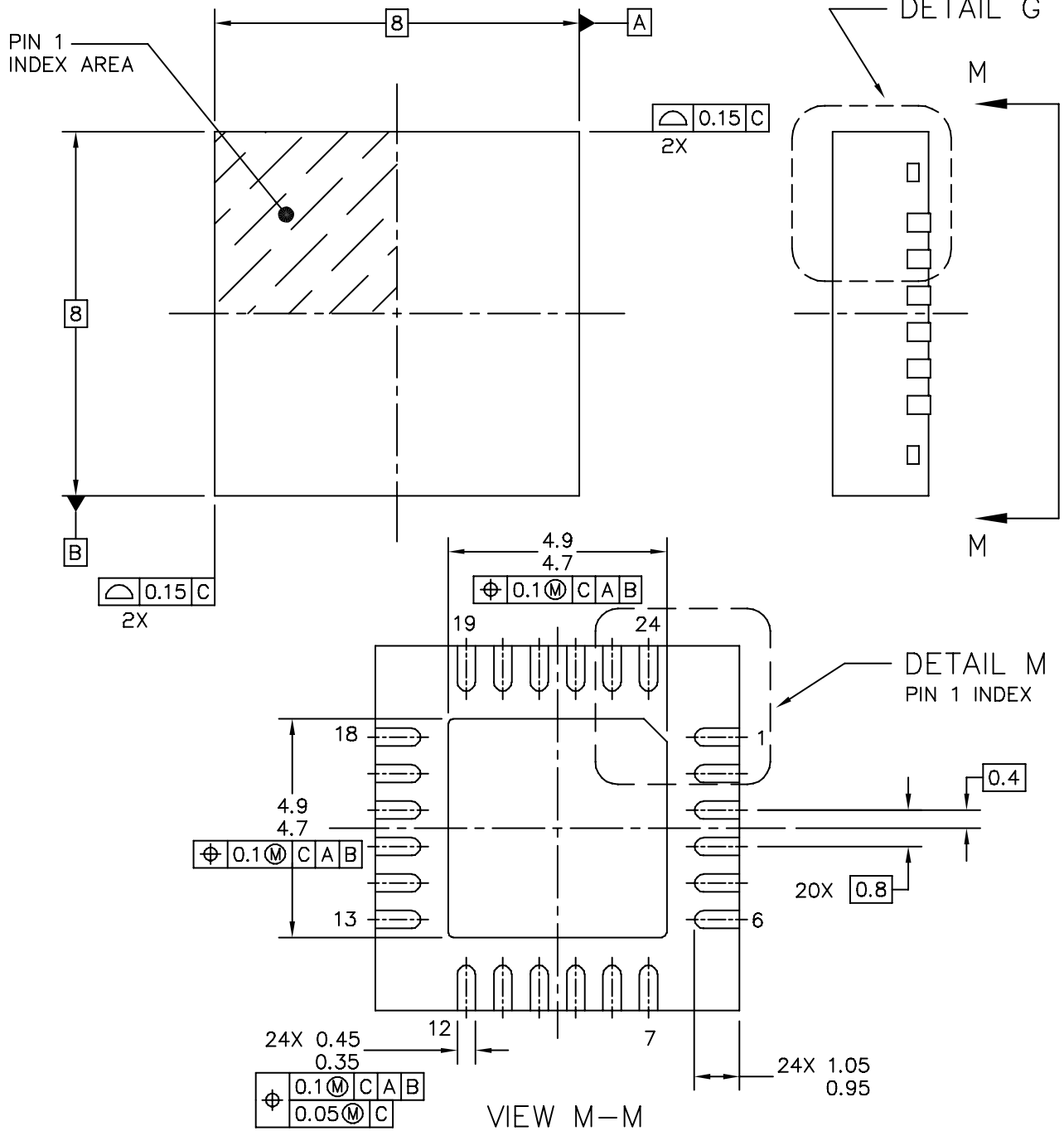


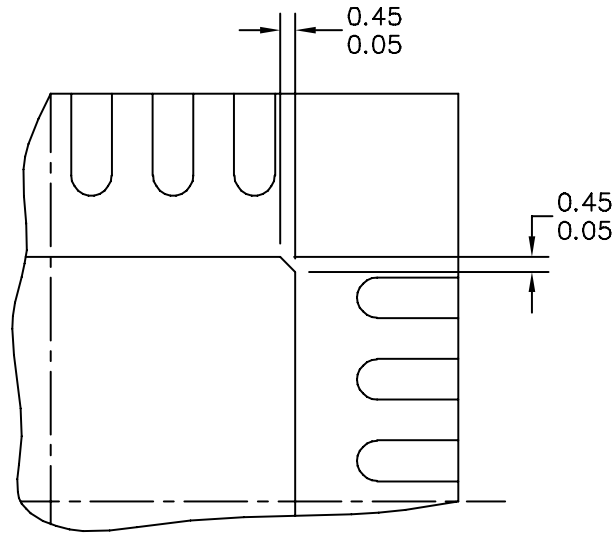
Figure 8. Series Equivalent Input and Load Impedance

PACKAGE DIMENSIONS

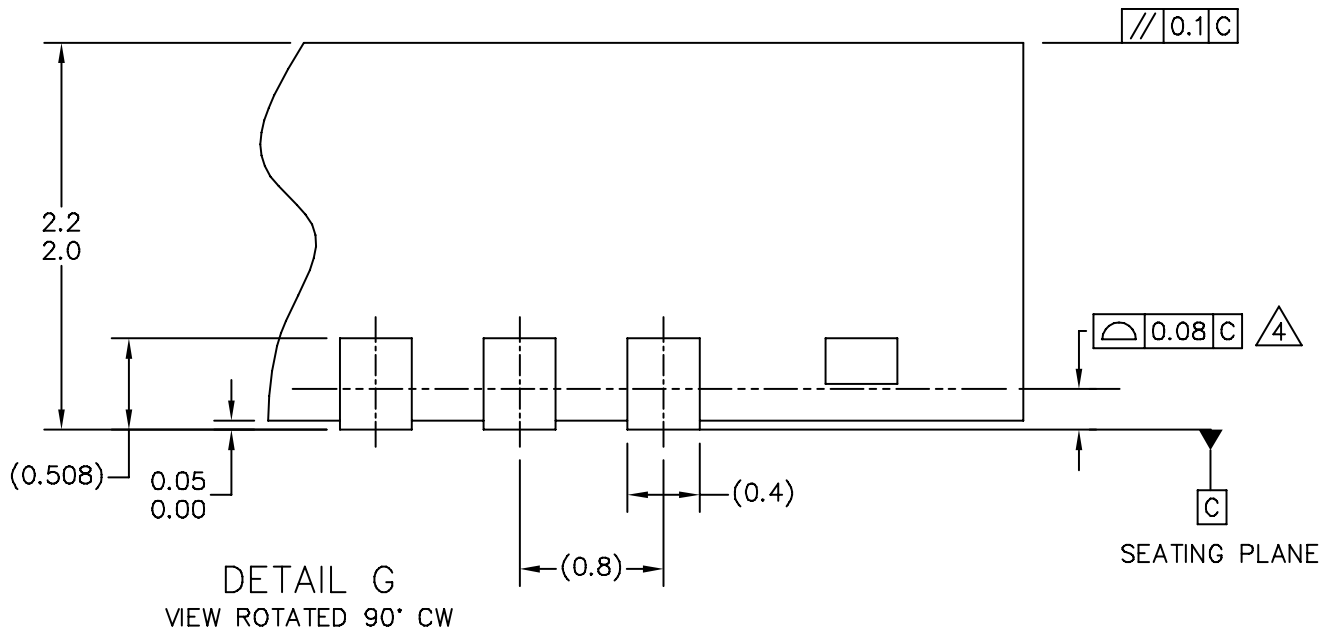
www.DataSheet4U.com



© FREESCALE SEMICONDUCTOR, INC. ALL RIGHTS RESERVED.	MECHANICAL OUTLINE	PRINT VERSION NOT TO SCALE	
TITLE: THERMALLY ENHANCED POWER QUAD FLAT NON-LEADED PACKAGE (PQFN) 24 TERMINAL, 0.8 PITCH, (8X8X2.1) CASE OUTLINE	DOCUMENT NO: 98ASA10760D	REV: 0	
	CASE NUMBER: 1894-01	05 SEP 2006	
	STANDARD: NON-JEDEC		




DETAIL M
BACKSIDE PIN 1 INDEX



DETAIL G
VIEW ROTATED 90° CW

© FREESCALE SEMICONDUCTOR, INC. ALL RIGHTS RESERVED.	MECHANICAL OUTLINE	PRINT VERSION NOT TO SCALE	
TITLE: THERMALLY ENHANCED POWER QUAD FLAT NON-LEADED PACKAGE (PQFN) 24 TERMINAL, 0.8 PITCH, (8X8X2.1) CASE OUTLINE	DOCUMENT NO: 98ASA10760D	REV: 0	
	CASE NUMBER: 1894-01	05 SEP 2006	
	STANDARD: NON-JEDEC		

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. DIMENSIONING AND TOLERANCING PER ASME Y14.5M-1994.
3. THE COMPLETE JEDEC DESIGNATOR FOR THIS PACKAGE IS: HF-PQFN.
4.  COPLANARITY APPLIES TO LEADS AND DIE ATTACH PAD.
5. MINIMUM METAL GAP SHOULD BE 0.25MM.

© FREESCALE SEMICONDUCTOR, INC. ALL RIGHTS RESERVED.	MECHANICAL OUTLINE	PRINT VERSION NOT TO SCALE	
TITLE: THERMALLY ENHANCED POWER QUAD FLAT NON-LEADED PACKAGE (PQFN) 24 TERMINAL, 0.8 PITCH, (8X8X2.1) CASE OUTLINE	DOCUMENT NO: 98ASA10760D	REV: 0	
	CASE NUMBER: 1894-01	05 SEP 2006	
	STANDARD: NON-JEDEC		

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

Application Notes

- AN1955: Thermal Measurement Methodology of RF Power Amplifiers
- AN1977 Quiescent Current Thermal Tracking Circuit in the RF Integrated Circuit Family
- AN1987 Quiescent Current Control for the RF Integrated Circuit Device Family

Engineering Bulletins

- EB212: Using Data Sheet Impedances for RF LDMOS Devices

Software

- Electromigration MTTF Calculator
- RF High Power Model
- .s2p File

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	Aug. 2009	<ul style="list-style-type: none"> • Initial Release of Data Sheet
1	Sept. 2009	<ul style="list-style-type: none"> • Modified Fig. 3, Test Circuit Component Layout and Table 6, Test Circuit Component Designations and Values to include temperature compensation options, p. 5 • Fig. 3, Test Circuit Component Layout, corrected V_{DD1} to V_{GG1}, p. 5 • Table 6, Test Circuit Component Designations and Values, C6, C17: updated description from “1 μF Tantalum Capacitors” to “1 μF, 35 V Tantalum Capacitors”; L1, L7, L2, L6: corrected manufacturer from Coilcraft to Toko; L3: corrected part number from “0603HC-1N6XJLC” to “0603HC-1N6XJLW”; L4, L5: corrected part number from “100B100JT500XT” to “0603HP-5N1XJLW”; R1, R12: updated description from “510 Ω Chip Resistors” to “510 Ω, 1/10 W Chip Resistors”, p. 5

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. 2009. All rights reserved.