Document Number: MW4IC2230

Technical Data

Replaced by MW4IC2230NBR1(GNBR1). There are no form, fit or function changes with this part replacement. N suffix added to part number to indicate transition to lead-free terminations.

Rev. 5, 5/2006

RF LDMOS Wideband Integrated Power Amplifiers

The MW4IC2230M wideband integrated circuit is designed for W-CDMA base station applications. It uses Freescale's newest High Voltage (26 to 28 Volts) LDMOS IC technology and integrates a multi-stage structure. Its wideband on-chip design makes it usable from 1600 to 2400 MHz. The linearity performances cover all modulations for cellular applications: GSM, GSM EDGE, TDMA, CDMA and W-CDMA.

Final Application

Typical Single-Carrier W-CDMA Performance: V_{DD} = 28 Volts, I_{DQ1} = 60 mA, I_{DQ2} = 350 mA, P_{out} = 5 Watts Avg., f = 2140 MHz, Channel Bandwidth = 3.84 MHz, PAR = 8.5 dB @ 0.01% Probability on CCDF.

Power Gain — 31 dB

Drain Efficiency — 15%

ACPR @ 5 MHz = -45 dBc in 3.84 MHz Bandwidth

Driver Application

Typical Single-Carrier W-CDMA Performance: V_{DD} = 28 Volts, I_{DQ1} = 60 mA, I_{DQ2} = 350 mA, P_{out} = 0.4 Watts Avg., f = 2140 MHz, Channel Bandwidth = 3.84 MHz, PAR = 8.5 dB @ 0.01% Probability on CCDF. Power Gain — 31.5 dB

ACPR @ 5 MHz = -53.5 dBc in 3.84 MHz Bandwidth

- Capable of Handling 3:1 VSWR, @ 28 Vdc, 2170 MHz, 5 Watts CW Output Power
- Stable into a 3:1 VSWR. All Spurs Below -60 dBc @ 10 mW to 5 W CW Pout.
- Characterized with Series Equivalent Large-Signal Impedance Parameters
- On-Chip Matching (50 Ohm Input, DC Blocked, >5 Ohm Output)
- Integrated Quiescent Current Temperature Compensation with Enable/Disable Function
- On-Chip Current Mirror g_m Reference FET for Self Biasing Application (1)
- Integrated ESD Protection
- 200°C Capable Plastic Package
- In Tape and Reel. R1 Suffix = 500 Units per 44 mm, 13 inch Reel

V_{RD1} V_{RG1} V_{DS2} V_{DS1} V_{DS2} V_{DS1} V_{GS1} V_{GS2} V_{GS3} V_{GS2} V_{GS3} V_{GS3} Figure 1. Functional Block Diagram

MW4IC2230MBR1 MW4IC2230GMBR1

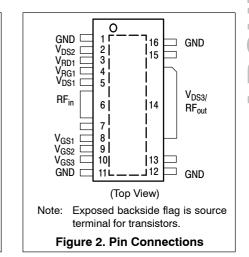
2110-2170 MHz, 30 W, 28 V SINGLE W-CDMA RF LDMOS WIDEBAND INTEGRATED POWER AMPLIFIERS

INTEGRATED FOWER AWIP

CASE 1329-09 TO-272 WB-16 PLASTIC MW4IC2230MBR1



CASE 1329A-03 TO-272 WB-16 GULL PLASTIC MW4IC2230GMBR1



1. Refer to AN1987, *Quiescent Current Control for the RF Integrated Circuit Device Family.* Go to http://www.freescale.com/rf. Select Documentation/Application Notes - AN1987.





Table 1. Maximum Ratings

Rating	Symbol	Value	Unit
Drain-Source Voltage	V _{DSS}	-0.5, +65	Vdc
Gate-Source Voltage	V_{GS}	-0.5, +8	Vdc
Storage Temperature Range	T _{stg}	-65 to +175	°C
Operating Channel Temperature	T _J	200	°C
Input Power	P _{in}	20	dBm

Table 2. Thermal Characteristics

Characteristic	Symbol	Value ⁽¹⁾	Unit
Thermal Resistance, Junction to Case	$R_{ heta JC}$		°C/W
Stage 1		10.5	
Stage 2		5.1	
Stage 3		2.3	

Table 3. ESD Protection Characteristics

Test Conditions	Class
Human Body Model	2 (Minimum)
Machine Model	M3 (Minimum)
Charge Device Model	C5 (Minimum)

Table 4. Moisture Sensitivity Level

Test Methodology	Rating	Package Peak Temperature	Unit
Per JESD 22-A113, IPC/JEDEC J-STD-020	3	260	°C

Table 5. Electrical Characteristics (T_C = 25°C unless otherwise noted)

Characteristic	Symbol	Min	Тур	Max	Unit

Functional Tests (In Freescale Test Fixture, 50 ohm system) V_{DD} = 28 Vdc, I_{DQ1} = 60 mA, I_{DQ2} = 350 mA, I_{DQ3} = 265 mA, P_{out} = 0.4 W Avg., f = 2110 MHz, f = 2170 MHz, Single-carrier W-CDMA. ACPR measured in 3.84 MHz Channel Bandwidth @ \pm 5 MHz Offset. PAR = 8.5 dB @ 0.01% Probability on CCDF.

	Power Gain	G _{ps}	29	31.5	_	dB
	Input Return Loss	IRL	_	-25	-10	dB
Ī	Adjacent Channel Power Ratio	ACPR				dBc
	$P_{out} = 0.4 \text{ W Avg}.$		_	-53.5	-50	
	$P_{out} = 1.26 \text{ W Avg.}$			-52		

Typical Performances (In Freescale Test Fixture tuned for 0.4 W Avg. W-CDMA driver) V_{DD} = 28 Vdc, I_{DQ1} = 60 mA, I_{DQ2} = 350 mA, I_{DQ3} = 265 mA, 2110 MHz

Frequency <2170 MHz

1DQ3 = 200 111 1, 211 0 111 12 11 requestoy 1217 0 111 12					
Saturated Pulsed Output Power (f = 1 kHz, Duty Cycle 10%)	P _{sat}		43		W
Quiescent Current Accuracy over Temperature (-10 to 85°C) (2)	ΔI_{QT}	_	±5	_	%
Gain Flatness in 30 MHz Bandwidth	G _F	_	0.13	_	dB
Deviation from Linear Phase in 30 MHz Bandwidth	Φ	_	±1	_	۰
Delay @ P _{out} = 0.4 W CW Including Output Matching	Delay	_	1.6	_	ns
Part-to-Part Phase Variation	ΔΦ	_	±15	_	٥

- Refer to AN1955, Thermal Measurement Methodology of RF Power Amplifiers. Go to http://www.freescale.com/rf.
 Select Documentation/Application Notes AN1955.
- 2. Refer to AN1977, Quiescent Current Thermal Tracking Circuit in the RF Integrated Circuit Family. Go to http://www.freescale.com/rf. Select Documentation/Application Notes AN1977.

(continued)

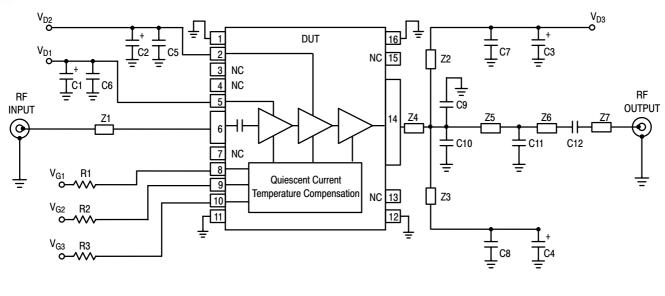


Table 5. Electrical Characteristics (T_C = 25°C unless otherwise noted) (continued)

Typical Performances (In Freescale Reference Application Circuit tuned for 2-carrier W-CDMA signal) $V_{DD} = 28$ Vdc, $P_{out} = 0.4$ W Avg., $I_{DQ1} = 60$ mA, $I_{DQ2} = 400$ mA, $I_{DQ3} = 245$ mA, f1 = 2112.5 MHz, f2 = 2122.5 MHz and f1 = 2157.5 MHz, f2 = 2167.5 MHz, f2 = 2167.5 MHz, f2 = 2167.5 MHz, f2 = 2167.5 MHz, f3 = 2167.5 MHz, f3

Power Gain	G _{ps}	_	31.5	_	dB
Intermodulation Distortion	IM3	_	-52	_	dBc
Adjacent Channel Power Ratio	ACPR	_	-55	_	dBc
Input Return Loss	IRL	_	-26	_	dB





Z1	2.180" x 0.090" Microstrip	Z6	1.120" x 0.090" Microstrip
Z2, Z3	0.040" x 0.430" Microstrip	Z 7	0.340" x 0.090" Microstrip
Z4	0.350" x 0.240" Microstrip	PCB	Taconic TLX8-0300, 0.030", $\varepsilon_r = 2.55$
Z5	0.420" x 0.090" Microstrip		

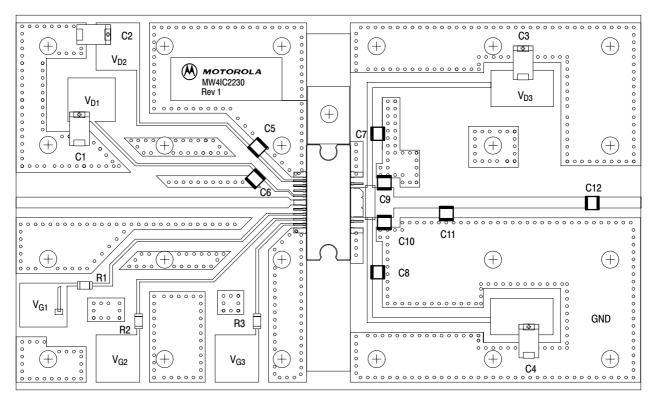
Figure 3. MW4IC2230MBR1(GMBR1) Test Circuit Schematic

Table 6. MW4IC2230MBR1(GMBR1) Test Circuit Component Designations and Values

Part	Description	Part Number	Manufacturer
C1, C2, C3, C4	10 μF, 35 V Tantalum Capacitors	TAJD106K035	AVX
C5, C6, C7, C8, C12	8.2 pF 100B Chip Capacitors	100B8R2CW	ATC
C9, C10	1.8 pF 100B Chip Capacitors	100B1R8BW	ATC
C11	0.3 pF 100B Chip Capacitor	100B0R3BW	ATC
R1, R2, R3	1.8 kΩ Chip Resistors (1206)		



ARCHIVE INFORMATION



Freescale has begun the transition of marking Printed Circuit Boards (PCBs) with the Freescale Semiconductor signature/logo. PCBs may have either Motorola or Freescale markings during the transition period. These changes will have no impact on form, fit or function of the current product.

Figure 4. MW4IC2230MBR1(GMBR1) Test Circuit Component Layout



TYPICAL CHARACTERISTICS

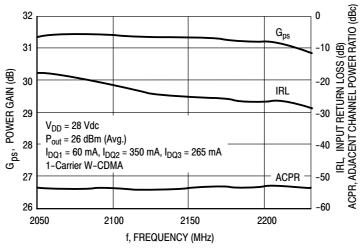


Figure 5. Single-Carrier W-CDMA Wideband Performance @ Pout = 26 dBm

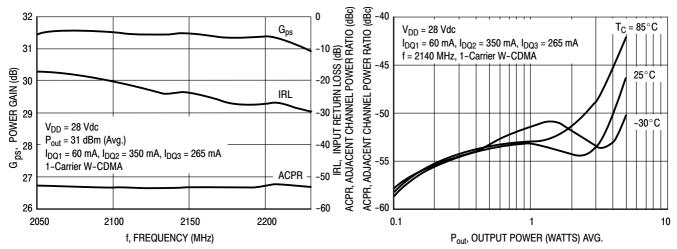


Figure 6. Single-Carrier W-CDMA Wideband Performance @ P_{out} = 31 dBm

Figure 7. Adjacent Channel Power Ratio versus Output Power

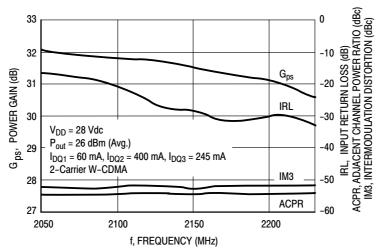
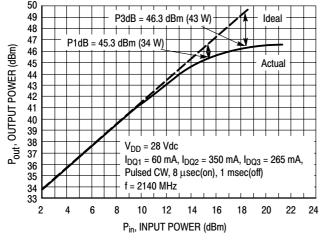


Figure 8. 2-Carrier W-CDMA Wideband Performance



TYPICAL CHARACTERISTICS



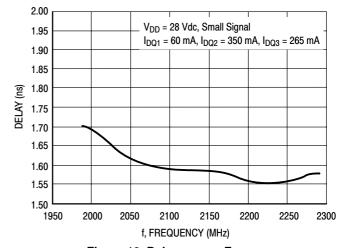
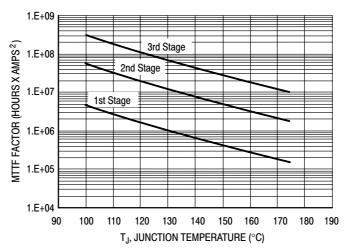


Figure 9. Output Power versus Input Power

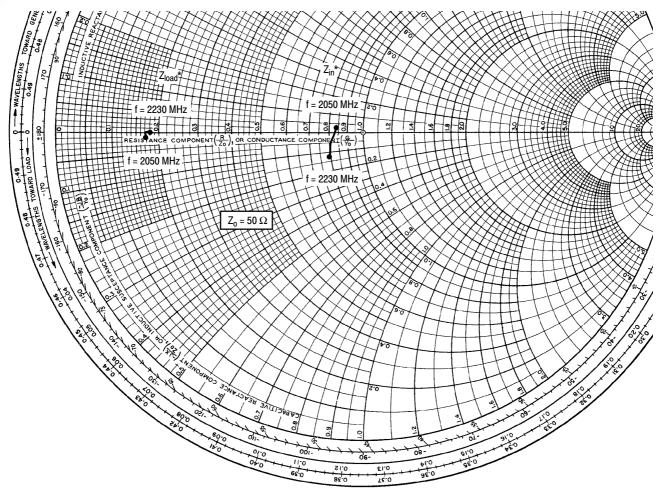
Figure 10. Delay versus Frequency



This above graph displays calculated MTTF in hours x ampere² drain current. Life tests at elevated temperatures have correlated to better than $\pm 10\%$ of the theoretical prediction for metal failure. Divide MTTF factor by $l_D{}^2$ for MTTF in a particular application.

Figure 11. MTTF Factor versus Temperature Junction





 V_{DD} = 28 V, I_{DQ1} = 60 mA, I_{DQ2} = 350 mA, I_{DQ3} = 265 mA, P_{out} = 26 dBm

$oldsymbol{Z_{in}}{\Omega}$	$oldsymbol{Z_{load}}{\Omega}$
42.18 + j1.49	8.52 - j0.46
41.06 - j1.30	8.58 - j0.20
40.49 - j2.42	8.63 - j0.09
40.05 - j3.45	8.69 - j0.01
39.29 - j6.31	8.81 + j0.04
	Ω 42.18 + j1.49 41.06 - j1.30 40.49 - j2.42 40.05 - j3.45

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

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

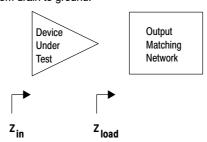


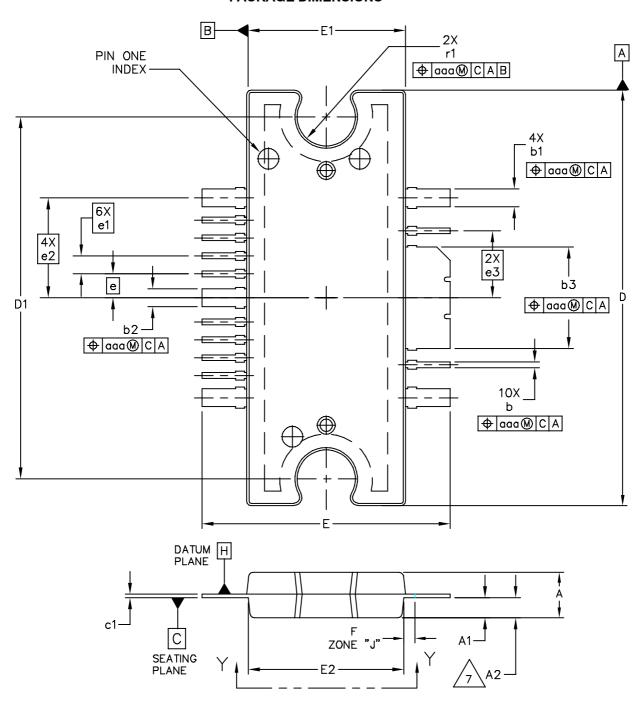
Figure 12. Series Equivalent Input and Load Impedance



NOTES

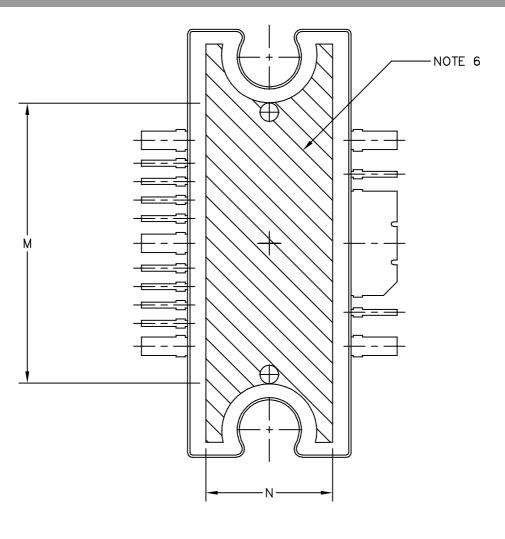


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- 7. DIM A2 APPLIES WITHIN ZONE "J" ONLY.

	IN	СН	MILL	IMETER		INCH		MILLI	METER
DIM	MIN	MAX	MIN	MAX	DIM	MIN	MAX	MIN	MAX
A	.100	.104	2.54	2.64	b	.011	.017	0.28	0.43
A1	.038	.044	0.96	1.12	b1	.037	.043	0.94	1.09
A2	.040	.042	1.02	1.07	b2	.037	.043	0.94	1.09
D	.928	.932	23.57	23.67	b3	.225	.231	5.72	5.87
D1	.810	BSC	20.5	7 BSC	c1	.007	.011	.18	.28
E	.551	.559	14.00	14.20	е	.054 BSC		1.37 BSC	
E1	.353	.357	8.97	9.07	e1	.040 BSC		1.02 BSC	
E2	.346	.350	8.79	8.89	e2	.224 BSC		5.69 BSC	
F	.025 BSC 0.64 BSC		4 BSC	e3	.1	50 BSC	3.81	BSC	
М	.600		15.24		r1	.063	.068	1.6	1.73
N	.270		6.86						
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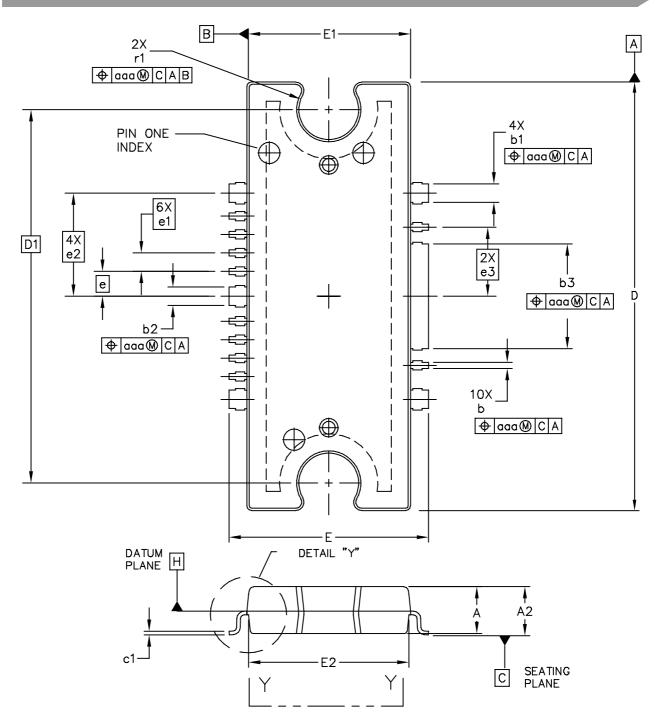
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 CASE NUMBER: 1329-09
 13 MAR 2006

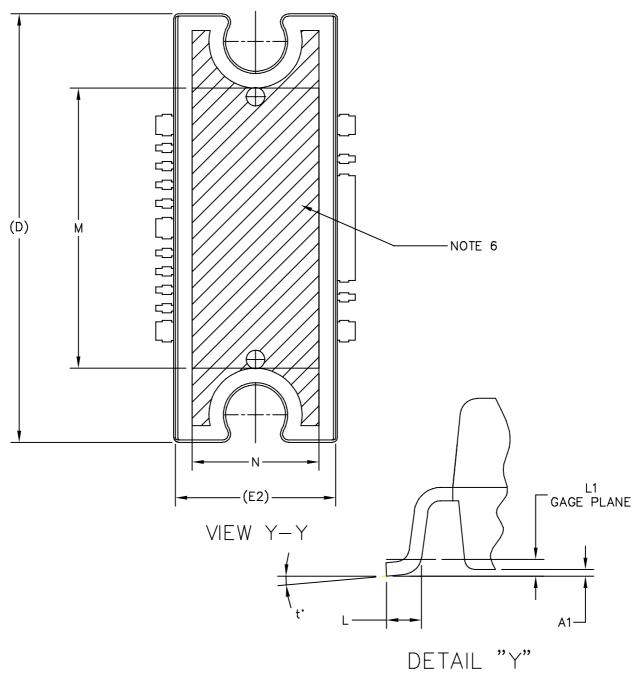
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	INCH		МІГ	LIMETER		INCH		МІ	LLIMETER	
DIM	MIN	MAX	MIN	MAX	DIM	MIN	MAX	MIN	MAX	
Α	.100	.104	2.54	2.64	Ь	.011	.017	0.28	0.43	
A1	.001	.004	0.02	0.10	b1	.037	.043	0.94	1.09	
A2	.099	.110	2.51	2.79	b2	.037	.043	0.94	1.09	
D	.928	.932	23.57	23.67	b3	.225	.231	5.72	5.87	
D1	.810	BSC	20.	57 BSC	BSC c1 .		.011	.18	.28	
Е	.429	.437	10.9	11.1	е	.054 BSC		1.37 BSC		
E1	.353	.357	8.97	9.07	e1	.04	.040 BSC		1.02 BSC	
E2	.346	.350	8.79	8.89	e2	.224 BSC		5.69 BSC		
L	.018	.024	4.90	5.06	e3	.150 BSC		3.81 BSC		
L1	.01	.01 BSC .025 BSC		25 BSC	r1	.063	.068	1.6	1.73	
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How to Reach Us:

Home Page:

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USA/Europe or Locations Not Listed: Freescale Semiconductor

Freescale Semiconductor
Technical Information Center, CH370
1300 N. Alma School Road
Chandler, Arizona 85224
+1-800-521-6274 or +1-480-768-2130
support@freescale.com

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) support@freescale.com

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 Hong Kong Ltd. Technical Information Center 2 Dai King Street
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