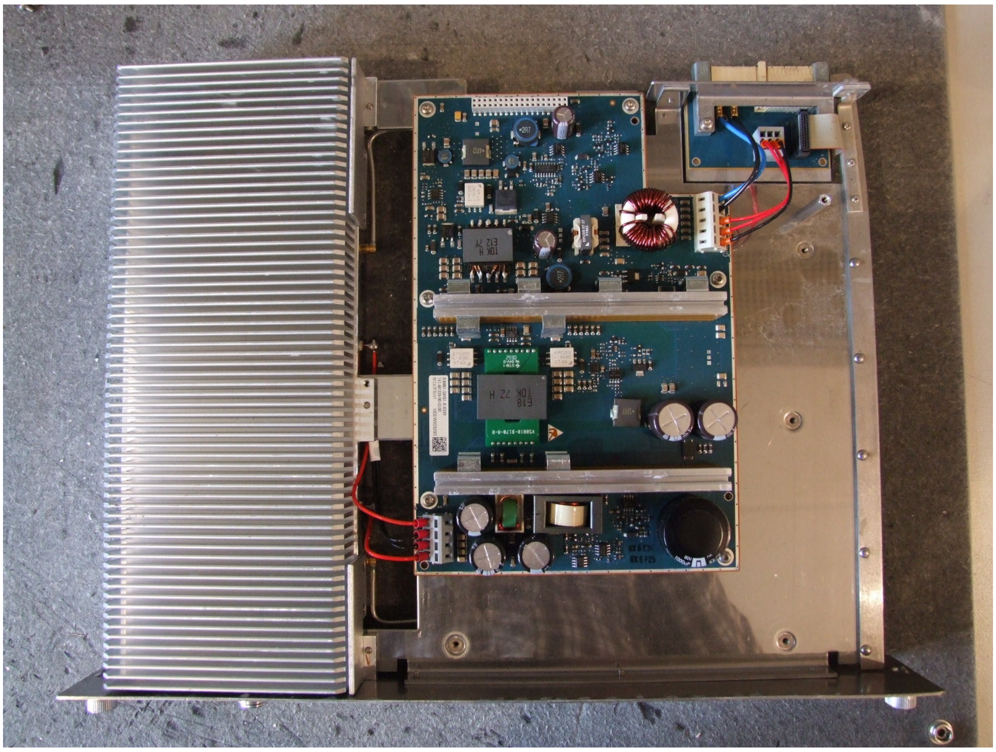
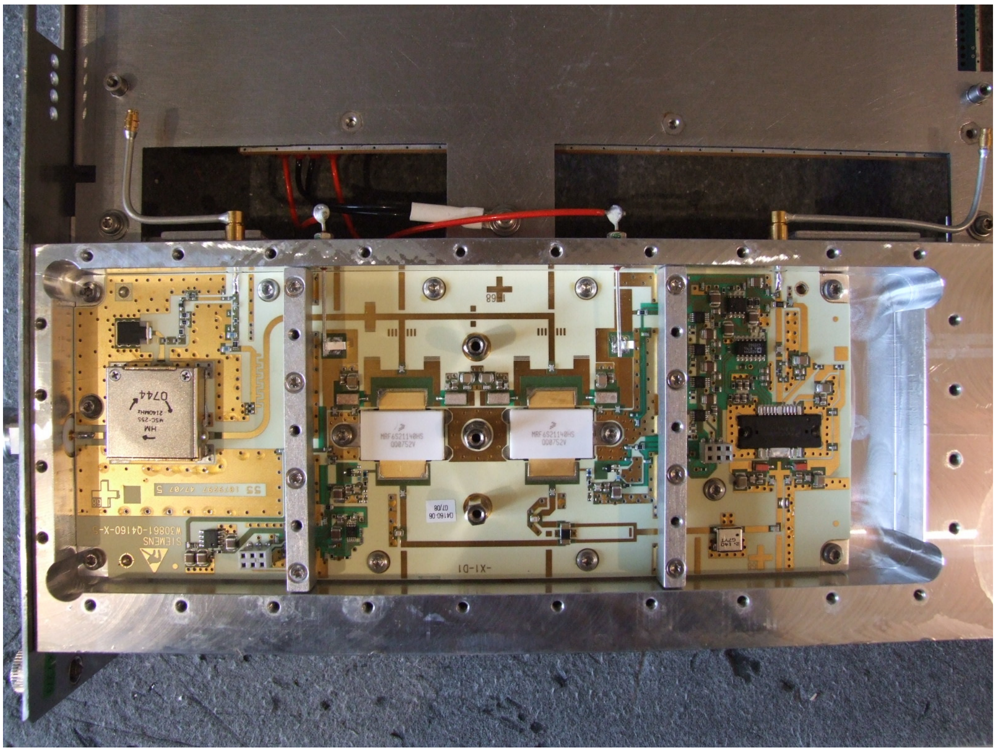
Modificatie Siemens 2140MHz eindtrap voor de 13cm amateurband.

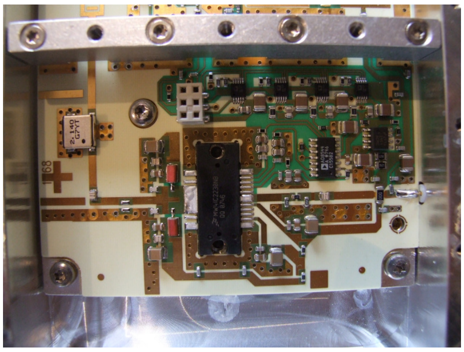
Het betreft dit type eindtrap.

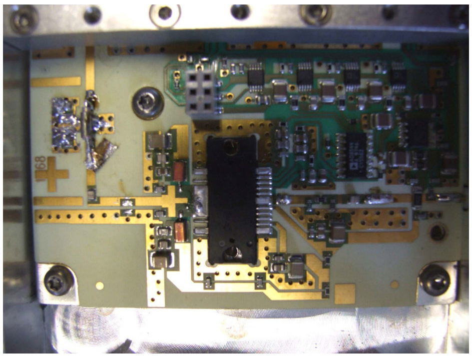




In de rechtse sectie bevindt zich een preamplifier module MW4IC2230NB met onderaan links een selectieve component op 2140MHz.
In de middensectie bevindt zich 2x MRF6S21140HS.
In de linkse sectie bevindt zich de output isolator (2140MHz).

Preamplifier sectie

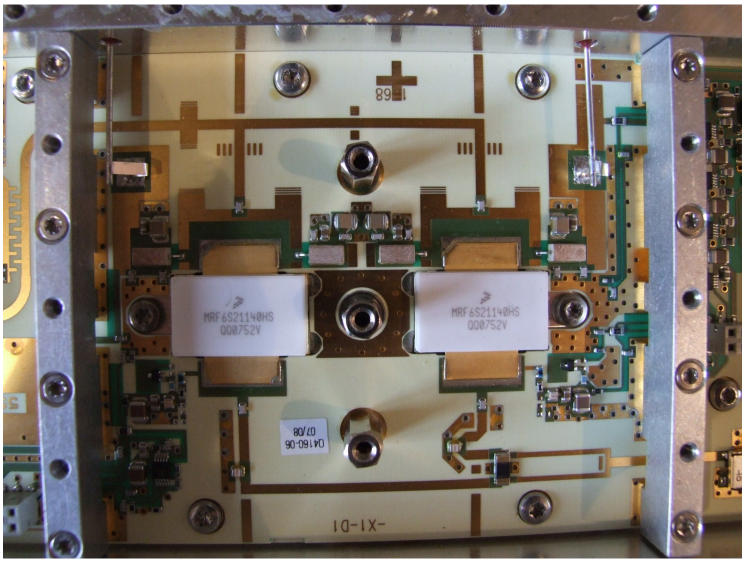




Aan de ingang zit een verzwakker circuit van ongeveer 8dB. Kan desgewenst verwijderd worden. Aan de uitgang zit de selectieve component op 2140MHz. Deze wordt vervangen door een stukje semi-rigid. Er werd een stukje latoenkoper geplaatst om de doorlaatband te optimaliseren.

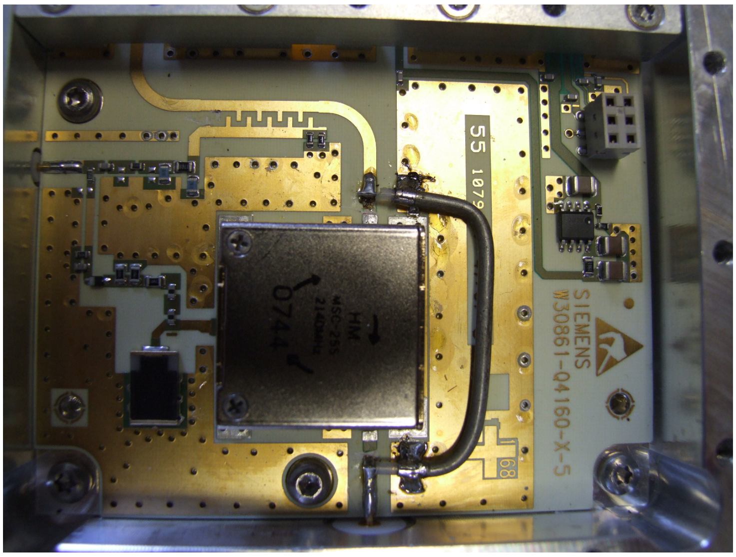
De rechtse foto toont de modificatie. De verzwakker zit er nog in. De metingen zijn gebeurd met de verzwakker eruit.

2x MRF6S21140HS sectie



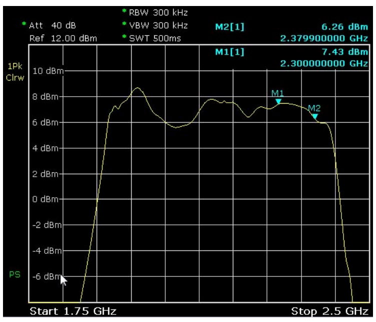
Deze is ongewijzigd gebleven.

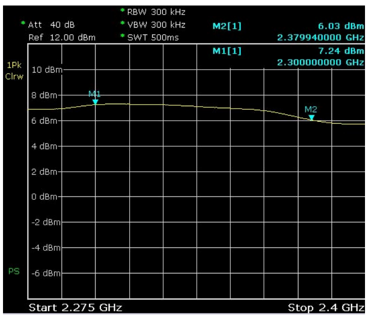
Output sectie
In en out van de isolator werden onderbroken en overbrugd met een stukje semi-rigid coax.

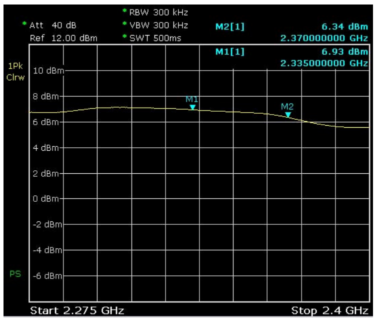


Metingen
Eindtrap wordt gevoed door een Ericsson voeding 28V/25A. Deze geeft 27.3V en er werd een max stroom van 9.7A genoteerd.

Op de output van de versterker zit een directional coupler afgesloten met een dummyload.
Op de forward power poort zit een verzwakker. De totale verzwakking voor de spectrum analyser is 37.5dB. Een gemeten waarde van 7dBm is in werkelijkheid 44.5dBm.
Het aangeboden signaal van de tracking generator is 0dBm (maximum).
De versterker doet dus +/- 44dB.

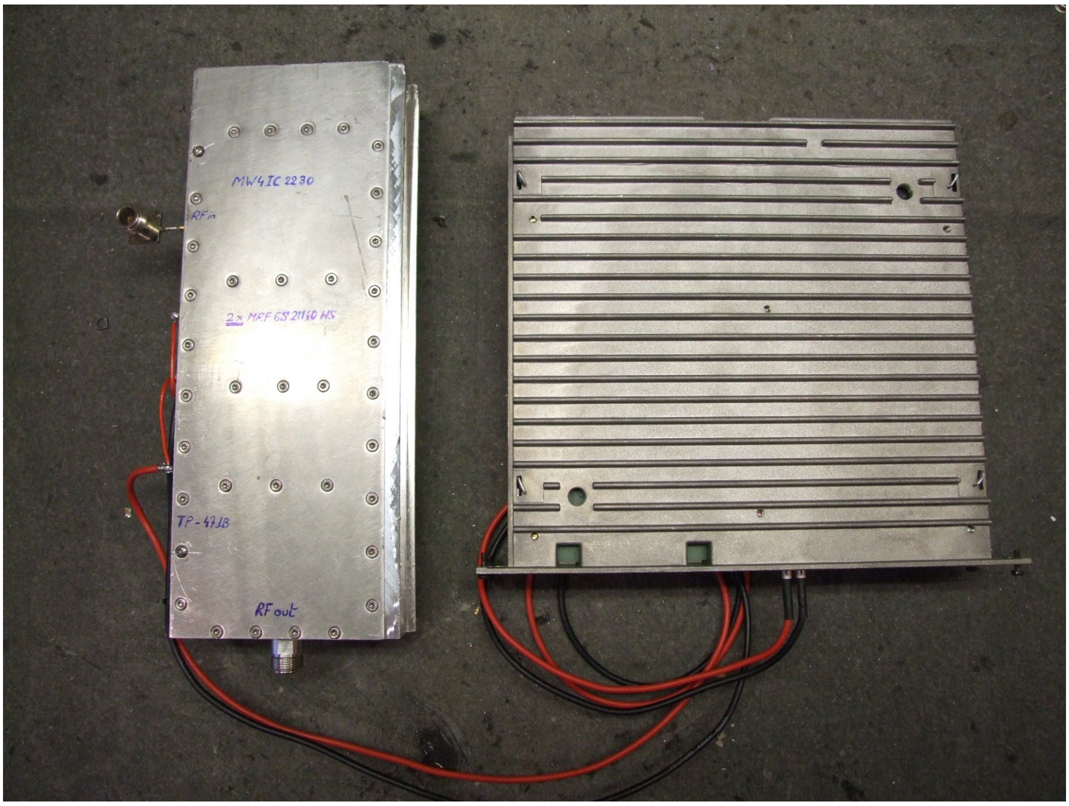


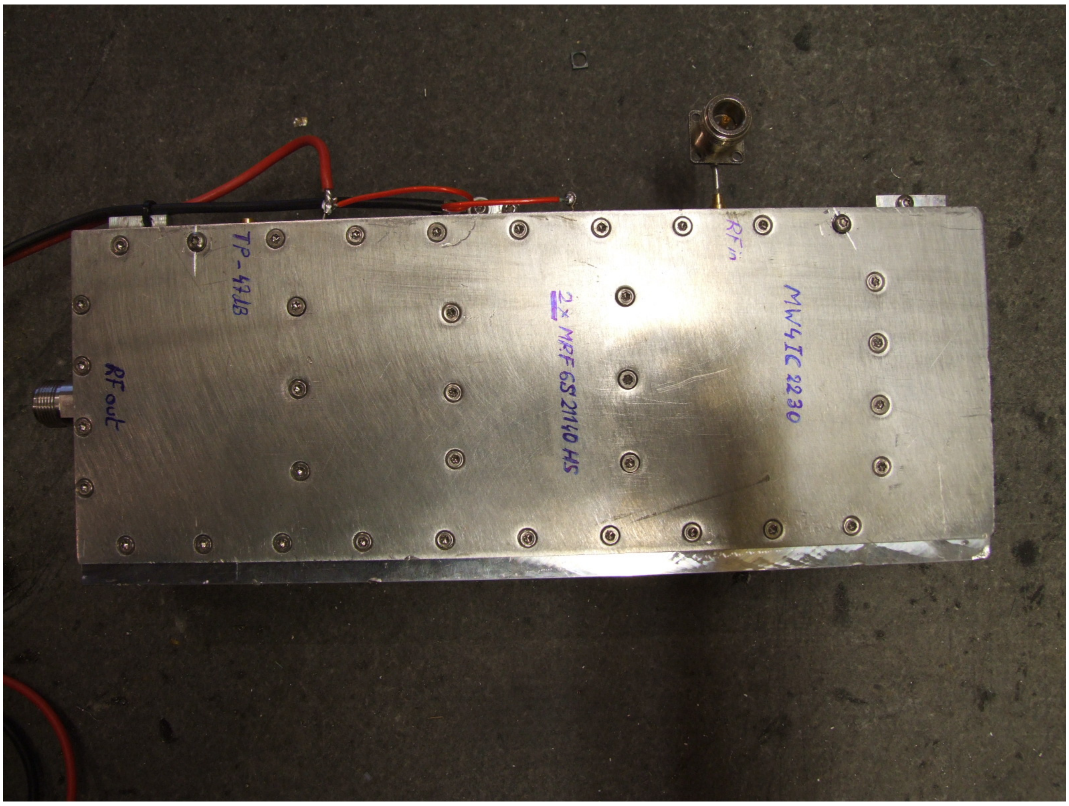




Tevens werd de eindtrap vollledig in saturatie gestuurd door een 17dBm FM TV signaal aan de ingang aan te bieden.
2300MHz → 80W ; 2330MHz → 60W ; 2365MHz → 60W ; 2380MHz → 50W.

De eindtrap + de voeding



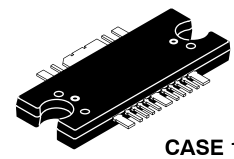


The Wideband IC Line

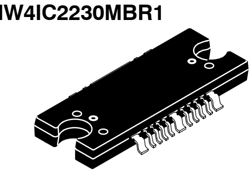
RF LDMOS Wideband Integrated Power Amplifiers

MW4IC2230MBR1
MW4IC2230GMBR1

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



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



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

The MW4IC2230 wideband integrated circuit is designed for W-CDMA base station applications. It uses Motorola'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, Peak/Avg. = 8.5 dB @ 0.01% Probability on CCDF.

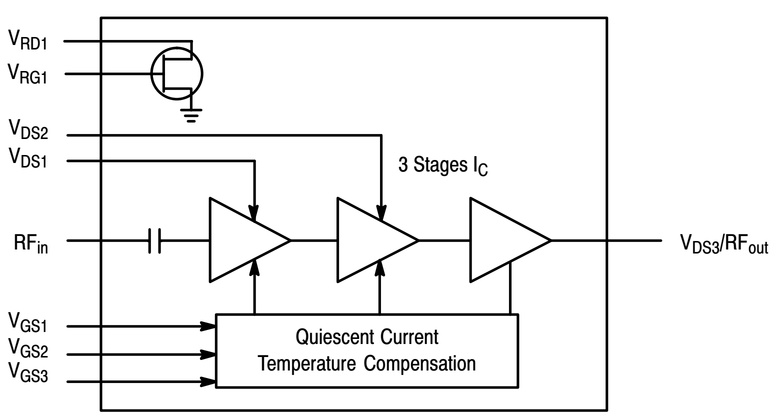
Power Gain — 31 dB
Drain Efficiency — 15%
ACPR @ 5 MHz = -45 dBc @ 3.84 MHz Bandwidth

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, Peak/Avg. = 8.5 dB @ 0.01% Probability on CCDF.

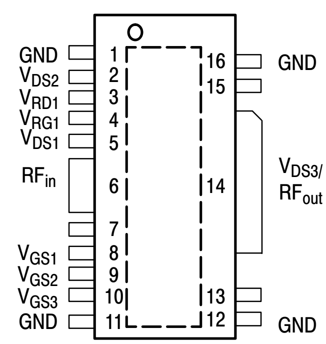
Power Gain — 31.5 dB
ACPR @ 5 MHz = -53.5 dBc @ 3.84 MHz Bandwidth

- Capable of Handling 3:1 VSWR, @ 28 Vdc, 2170 MHz, 5 Watts CW Output Power
- Characterized with Series Equivalent Large-Signal Impedance Parameters
- On-Chip Matching (50 Ohm Input, DC Blocked, >5 Ohm Output)
- Integrated Temperature Compensation with Enable/Disable Function
- On-Chip Current Mirror g_m Reference FET for Self Biasing Application (1)
- Integrated ESD Protection
- Also Available in Gull Wing for Surface Mount
- In Tape and Reel. R1 Suffix = 500 Units per 44 mm, 13 inch Reel



Functional Block Diagram

PIN CONNECTIONS



(Top View)

NOTE: Exposed backside flag is source terminal for transistors.

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

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Drain-Source Voltage	V_{DSS}	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	175	°C
Input Power	P_{in}	20	dBm

THERMAL CHARACTERISTICS

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

ESD PROTECTION CHARACTERISTICS

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

MOISTURE SENSITIVITY LEVEL

Test Methodology	Rating
Per JESD 22-A113	3

ELECTRICAL CHARACTERISTICS (T_C = 25°C unless otherwise noted)

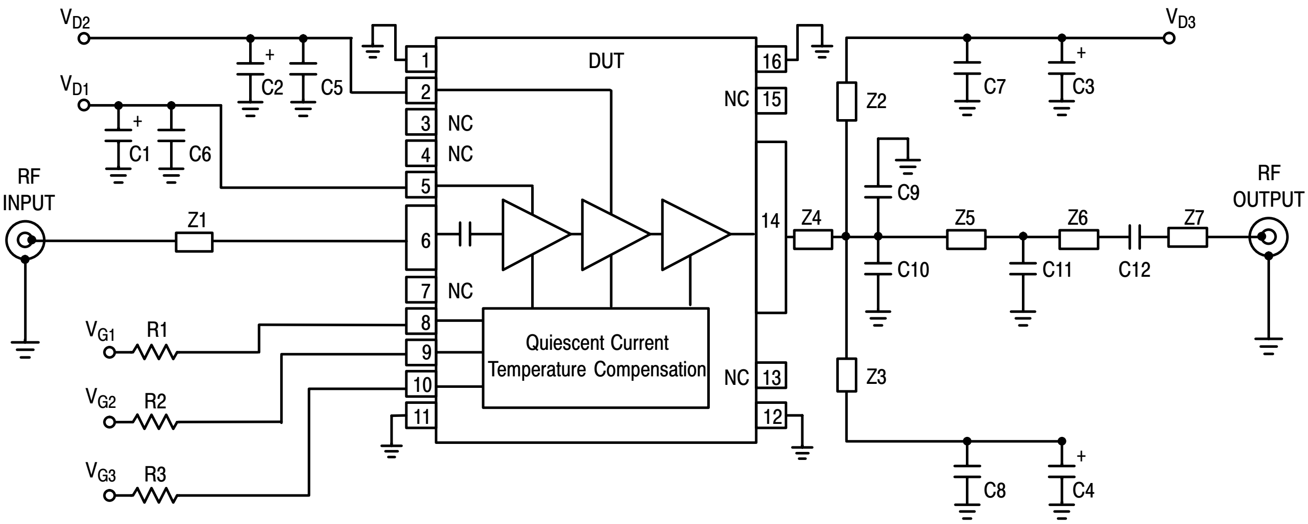
Characteristic	Symbol	Min	Typ	Max	Unit
FUNCTIONAL TESTS (In Motorola Test Fixture, 50 ohm system) V_{DD} = 28 Vdc, I_{DQ1} = 60 mA, I_{DQ2} = 350 mA, I_{DQ3} = 265 mA, P_{out} = 0.4 W Avg., f = 2110 MHz, f = 2170 MHz, Single-carrier W-CDMA. ACPR measured in 3.84 MHz Channel Bandwidth @ ±5 MHz Offset. Peak/Avg. Ratio = 8.5 dB @ 0.01% Probability on CCDF.					
Power Gain	G_{ps}	29	31.5	—	dB
Input Return Loss	IRL	—	-25	-10	dB
Adjacent Channel Power Ratio P_{out} = 0.4 W Avg. P_{out} = 1.26 W Avg.	ACPR	 — —	 -53.5 -52	 -50 —	dBc
Stability (10 mW<P_{out}<5 W CW, Load VSWR = 3:1, All Phase Angles, 24 V<Vds<28 V)		No Spurious > -60 dBc			
TYPICAL PERFORMANCES (In Motorola 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					
Saturated Pulsed Output Power (f = 1 kHz, Duty Cycle 10%)	P_{sat}	—	43	—	Watts
Quiescent Current Accuracy over Temperature (-10 to 85°C)	ΔI_{QT}	—	±5	—	%
Gain Flatness in 30 MHz Bandwidth	G_F	—	0.13	—	dB
Deviation from Linear Phase in 30 MHz Bandwidth	Φ	—	±1	—	°
Delay @ P_{out} = 0.4 W CW Including Output Matching	Delay	—	1.6	—	ns
Part to Part Phase Variation	$\Phi\Delta$	—	±15	—	°

(1) MTTF calculator available at http://www.motorola.com/semiconductors/rf. Select Tools/Software/Application Software/Calculators to access the MTTF calculators by product.

(continued)

ELECTRICAL CHARACTERISTICS — continued (T_C = 25°C unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
TYPICAL PERFORMANCES (In Motorola 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, 2-carrier W-CDMA, 3.84 MHz Channel Bandwidth Carriers. ACPR measured in 3.84 MHz Channel Bandwidth @ ±5 MHz Offset. IM3 measured in 3.84 MHz Channel Bandwidth @ ±10 MHz Offset. Peak/Avg. = 8.5 dB @ 0.01% Probability on CCDF.					
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	Z7	0.340″ x 0.090″ Microstrip
Z4	0.350″ x 0.240″ Microstrip	PCB	Taconic TLX8-0300, 0.030″, ε_r = 2.55
Z5	0.420″ x 0.090″ Microstrip		

Figure 1. MW4IC2230MBR1(GMBR1) Test Circuit Schematic

Table 1. 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)		

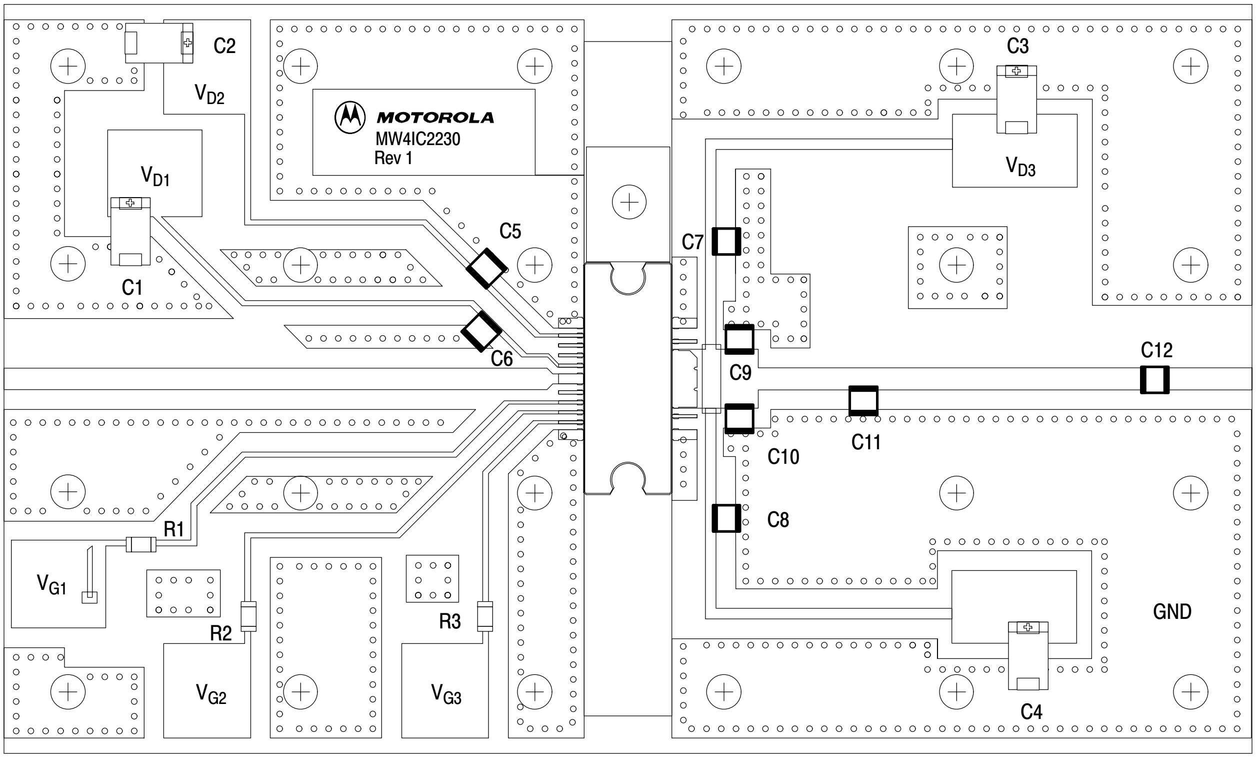


Figure 2. MW4IC2230MBR1(GMBR1) Test Circuit Component Layout

TYPICAL CHARACTERISTICS

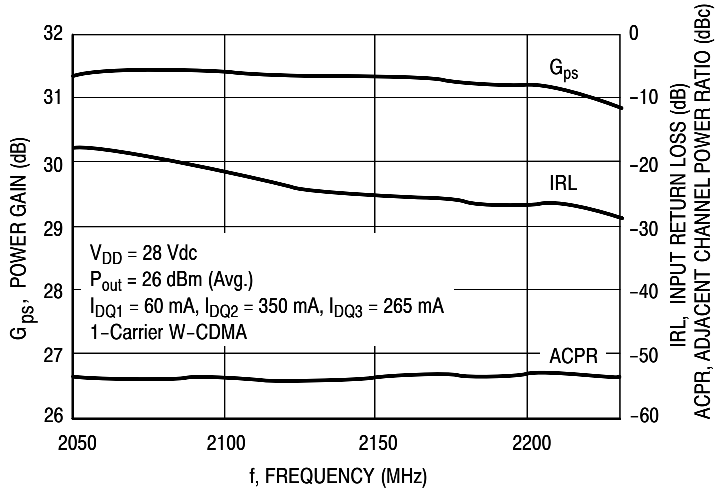


Figure 3. Single-Carrier W-CDMA Wideband Performance

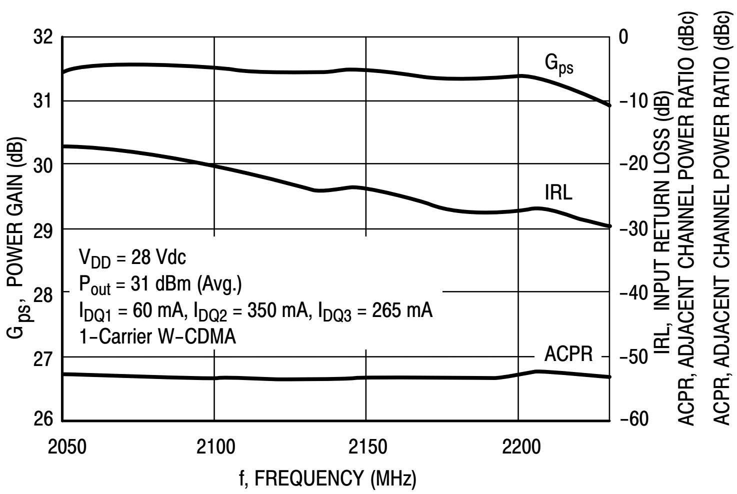


Figure 4. Single-Carrier W-CDMA Wideband Performance

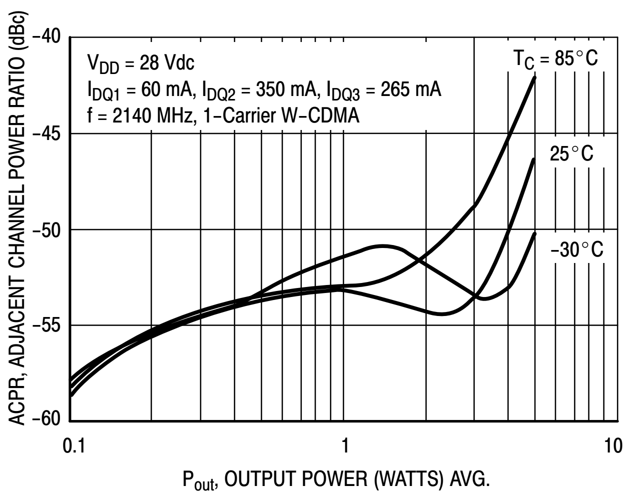


Figure 5. Adjacent Channel Power Ratio versus Output Power

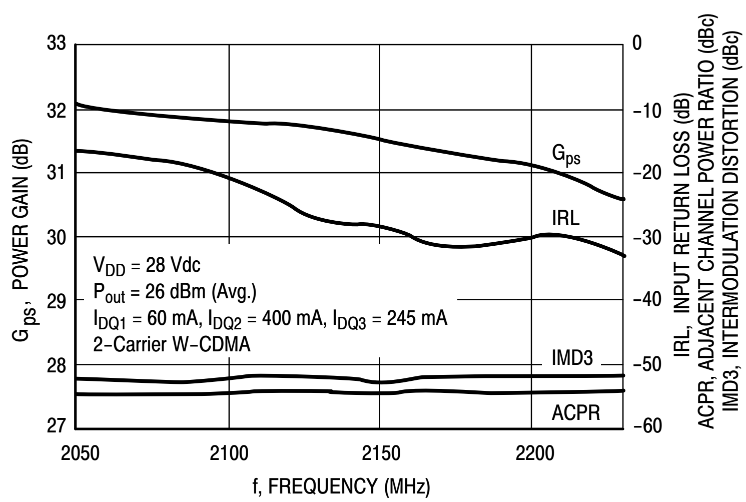


Figure 6. 2-Carrier W-CDMA Wideband Performance

TYPICAL CHARACTERISTICS

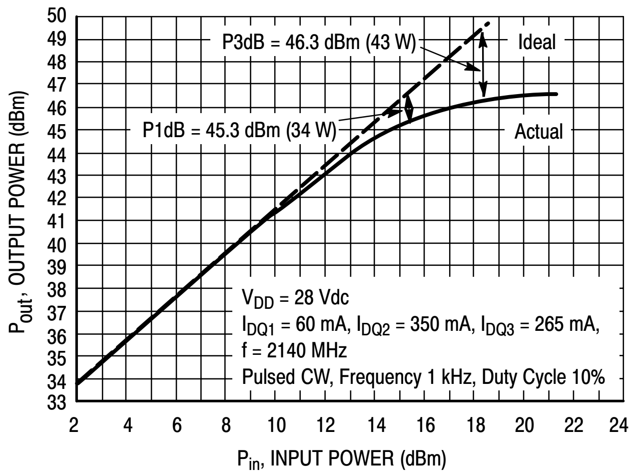


Figure 7. Output Power versus Input Power

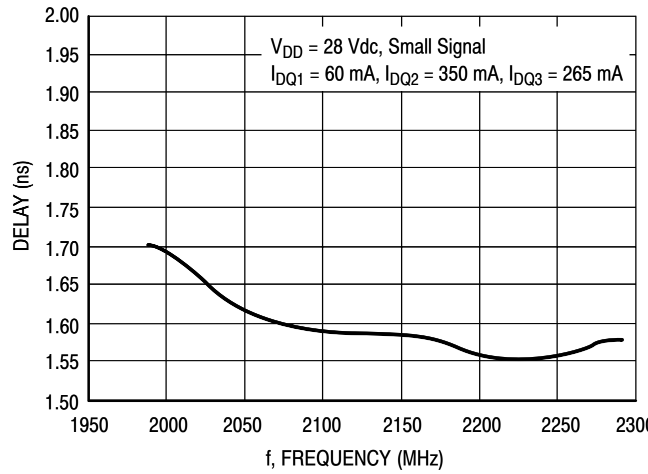
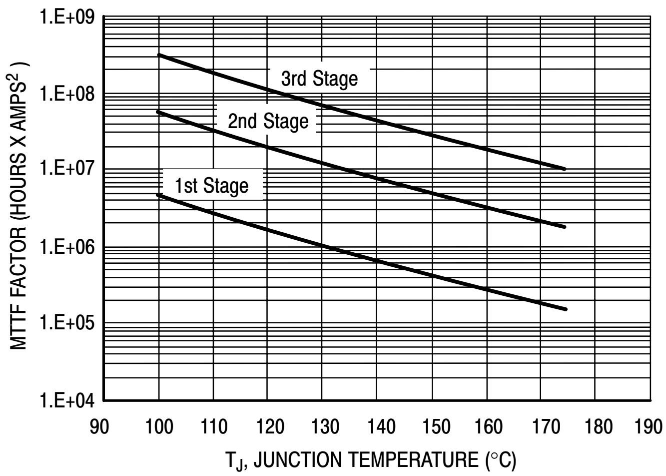
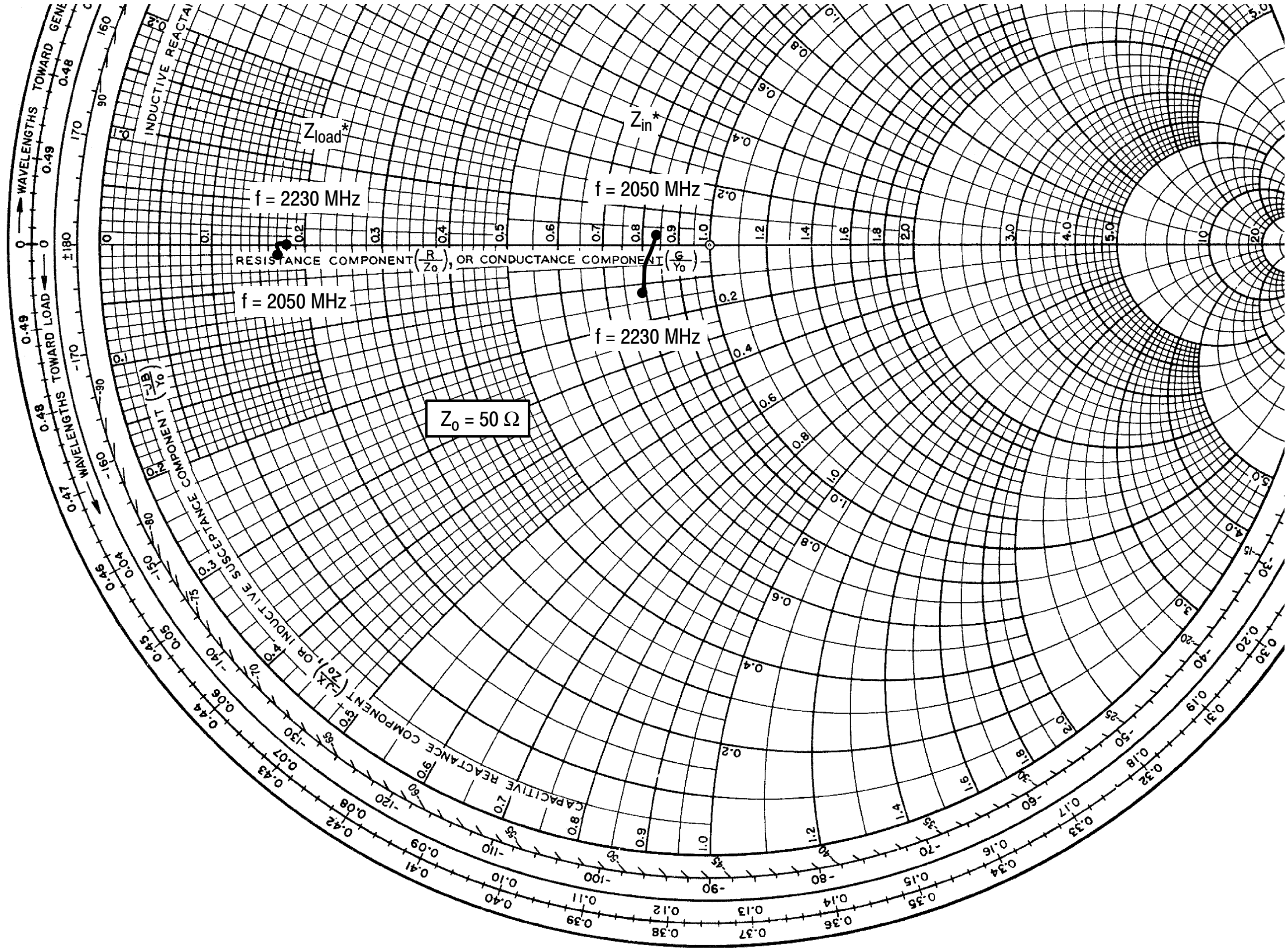


Figure 8. Delay versus Frequency



This above graph displays calculated MTTF in hours x ampere^2 drain current. Life tests at elevated temperatures have correlated to better than ±10% of the theoretical prediction for metal failure. Divide MTTF factor by I_D^2 for MTTF in a particular application.

Figure 9. 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

f MHz	Z_{in} Ω	Z_{load} Ω
2050	42.18 + j1.49	8.52 - j0.46
2110	41.06 - j1.30	8.58 - j0.20
2140	40.49 - j2.42	8.63 - j0.09
2170	40.05 - j3.45	8.69 - j0.01
2230	39.29 - j6.31	8.81 + j0.04

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

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

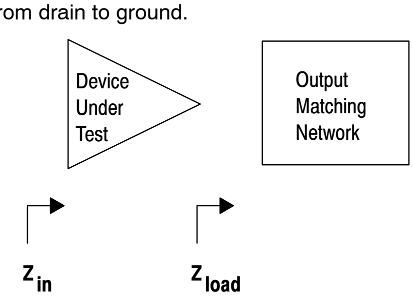


Figure 10. Series Equivalent Input and Load Impedance

Freescale Semiconductor
Technical Data

MRF6S21140H
Rev. 2, 1/2005

RF Power Field Effect Transistors

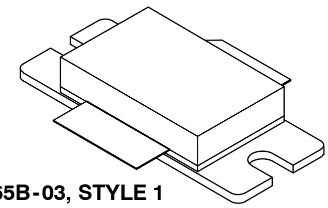
N-Channel Enhancement-Mode Lateral MOSFETs

Designed for W-CDMA base station applications with frequencies from 2110 to 2170 MHz. Suitable for TDMA, CDMA and multicarrier amplifier applications. To be used in Class AB for PCN-PCS/cellular radio and WLL applications.

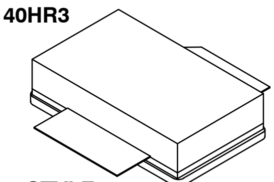
- Typical 2-carrier W-CDMA Performance: V_{DD} = 28 Volts, I_{DQ} = 1200 mA, P_{out} = 30 Watts Avg., Full Frequency Band, Channel Bandwidth = 3.84 MHz, Peak/Avg. = 8.5 dB @ 0.01% Probability on CCDF.
  Power Gain — 15.5 dB
  Drain Efficiency — 27.5%
  IM3 @ 10 MHz Offset — -37 dBc @ 3.84 MHz Channel Bandwidth
  ACPR @ 5 MHz Offset — -41 dBc @ 3.84 MHz Channel Bandwidth
- Capable of Handling 10:1 VSWR, @ 28 Vdc, 2140 MHz, 140 Watts CW Output Power
- Characterized with Series Equivalent Large-Signal Impedance Parameters
- Internally Matched, Controlled Q, for Ease of Use
- Qualified Up to a Maximum of 32 V_{DD} Operation
- Integrated ESD Protection
- Lower Thermal Resistance Package
- Designed for Lower Memory Effects and Wide Instantaneous Bandwidth Applications
- Low Gold Plating Thickness on Leads, 40μ″ Nominal.
- In Tape and Reel. R3 Suffix = 250 Units per 56 mm, 13 inch Reel.

MRF6S21140HR3
MRF6S21140HSR3

2170 MHz, 30 W AVG., 28 V
2 x W-CDMA
LATERAL N-CHANNEL
RF POWER MOSFETs



CASE 465B-03, STYLE 1
NI-880
MRF6S21140HR3



CASE 465C-02, STYLE 1
NI-880S
MRF6S21140HSR3

Table 1. Maximum Ratings

Rating	Symbol	Value	Unit
Drain-Source Voltage	V_{DSS}	-0.5, +68	Vdc
Gate-Source Voltage	V_{GS}	-0.5, +12	Vdc
Total Device Dissipation @ T_C = 25°C Derate above 25°C	P_D	500 2.9	W W/°C
Storage Temperature Range	T_{stg}	- 65 to +150	°C
Operating Junction Temperature	T_J	200	°C
CW Operation	CW	140	W

Table 2. Thermal Characteristics

Characteristic	Symbol	Value (1,2)	Unit
Thermal Resistance, Junction to Case Case Temperature 80°C, 140 W CW Case Temperature 75°C, 30 W CW	$R_{\theta JC}$	 0.35 0.38	°C/W

1. MTTF calculator available at http://www.freescale.com/rf. Select Tools/Software/Application Software/Calculators to access the MTTF calculators by product.
2. Refer to AN1955/D, *Thermal Measurement Methodology of RF Power Amplifiers.* Go to http://www.freescale.com/rf. Select Documentation/Application Notes - AN1955.

NOTE - **CAUTION** - MOS devices are susceptible to damage from electrostatic charge. Reasonable precautions in handling and packaging MOS devices should be observed.

Launched by Motorola
freescale™ semiconductor

Table 3. ESD Protection Characteristics

Test Methodology	Class
Human Body Model (per JESD22-A114)	2 (Minimum)
Machine Model (per EIA/JESD22-A115)	A (Minimum)
Charge Device Model (per JESD22-C101)	IV (Minimum)

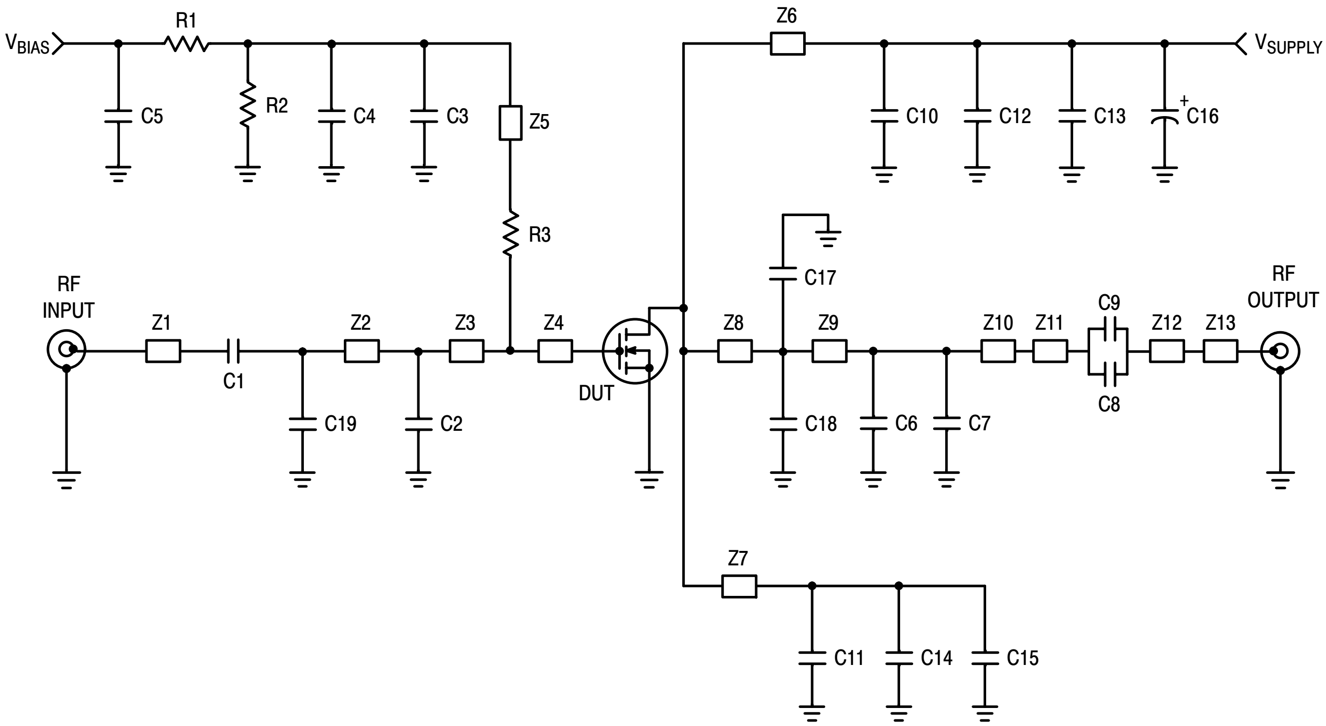
Table 4. Electrical Characteristics (T_C = 25°C unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
Off Characteristics					
Zero Gate Voltage Drain Leakage Current (V_{DS} = 68 Vdc, V_{GS} = 0 Vdc)	I_{DSS}	—	—	10	μAdc
Zero Gate Voltage Drain Leakage Current (V_{DS} = 28 Vdc, V_{GS} = 0 Vdc)	I_{DSS}	—	—	1	μAdc
Gate-Source Leakage Current (V_{GS} = 5 Vdc, V_{DS} = 0 Vdc)	I_{GSS}	—	—	1	μAdc
On Characteristics					
Gate Threshold Voltage (V_{DS} = 10 Vdc, I_D = 300 μAdc)	$V_{GS(th)}$	1	2	3	Vdc
Gate Quiescent Voltage (V_{DS} = 28 Vdc, I_D = 1200 mAdc)	$V_{GS(Q)}$	2	2.8	4	Vdc
Drain-Source On-Voltage (V_{GS} = 10 Vdc, I_D = 3 Adc)	$V_{DS(on)}$	—	0.21	0.3	Vdc
Forward Transconductance (V_{DS} = 10 Vdc, I_D = 3 Adc)	g_{fs}	—	7.2	—	S
Dynamic Characteristics (1)					
Reverse Transfer Capacitance (V_{DS} = 28 Vdc ± 30 mV(rms)ac @ 1 MHz, V_{GS} = 0 Vdc)	C_{rss}	—	2	—	pF

Functional Tests (In Freescale Test Fixture, 50 ohm system) V_{DD} = 28 Vdc, I_{DQ} = 1200 mA, P_{out} = 30 W Avg., f1 = 2112.5 MHz, f2 = 2122.5 MHz and f1 = 2157.5 MHz, f2 = 2167.5 MHz, 2-carrier W-CDMA, 3.84 MHz Channel Bandwidth Carriers. ACPR measured in 3.84 MHz Channel Bandwidth @ ±5 MHz Offset. IM3 measured in 3.84 MHz Channel Bandwidth @ ±10 MHz Offset. Peak/Avg. = 8.5 dB @ 0.01% Probability on CCDF.

Characteristic	Symbol	Min	Typ	Max	Unit
Power Gain	G_{ps}	14.5	15.5	17.5	dB
Drain Efficiency	η_D	26	27.5	—	%
Intermodulation Distortion	IM3	—	-37	-35	dBc
Adjacent Channel Power Ratio	ACPR	—	-41	-38	dBc
Input Return Loss	IRL	—	-15	-9	dB

1. Part is internally matched both on input and output.



Z1	0.250″ x 0.083″ Microstrip	Z8	0.531″ x 1.000″ Microstrip
Z2	1.177″ x 0.083″ Microstrip	Z9	0.308″ x 0.083″ Microstrip
Z3	0.443″ x 0.083″ Microstrip	Z10	0.987″ x 0.083″ Microstrip
Z4	0.276″ x 0.787″ Microstrip	Z11, Z12	0.070″ x 0.220″ Microstrip
Z5	0.786″ x 0.083″ Microstrip (quarter wave length for bias purpose)	Z13	0.160″ x 0.083″ Microstrip
Z6, Z7	0.833″ x 0.083″ Microstrip (quarter wave length for supply purpose)	PCB	Taconic TLX8-0300, 0.030″, ε_r = 2.55

Figure 1. MRF6S21140HR3(HSR3) Test Circuit Schematic

Table 5. MRF6S21140HR3(HSR3) Test Circuit Component Designations and Values

Part	Description	Part Number	Manufacturer
C1, C3, C8, C9, C10, C11	6.8 pF 100B Chip Capacitors	100B6R8CW	ATC
C2	0.8 pF 100B Chip Capacitor	100B0R8BW	ATC
C4	220 nF Chip Capacitor (1812)	1812Y224KXA	Vishay-Vitramon
C5, C12, C13, C14, C15	10 μF Chip Capacitors (2220)	C5750X5R1H106MT	TDK
C6, C19	0.2 pF 100B Chip Capacitors	100B0R2BW	ATC
C7	0.5 pF 100B Chip Capacitor	100B0R5BW	ATC
C16	220 μF, 63 V Electrolytic Capacitor, Radial	13668221	Philips
C17, C18	0.1 pF 100B Chip Capacitors	100B0R1BW	ATC
R1, R2	10 kΩ, 1/4 W Chip Resistors (1206)		
R3	10 Ω, 1/4 W Chip Resistor (1206)		

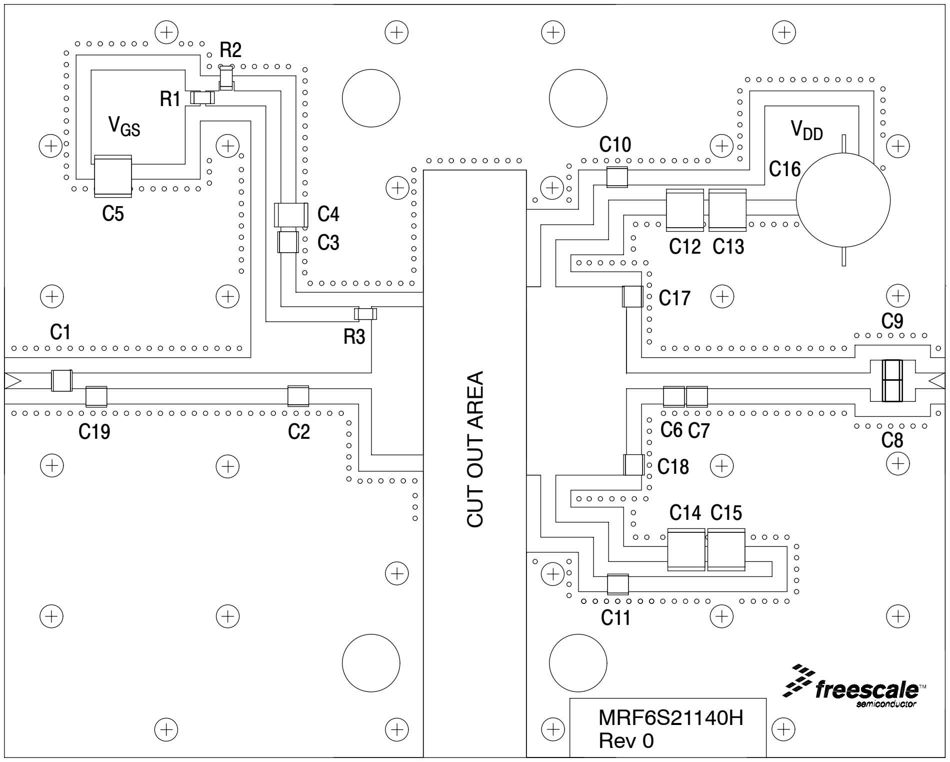


Figure 2. MRF6S21140HR3(HSR3) Test Circuit Component Layout

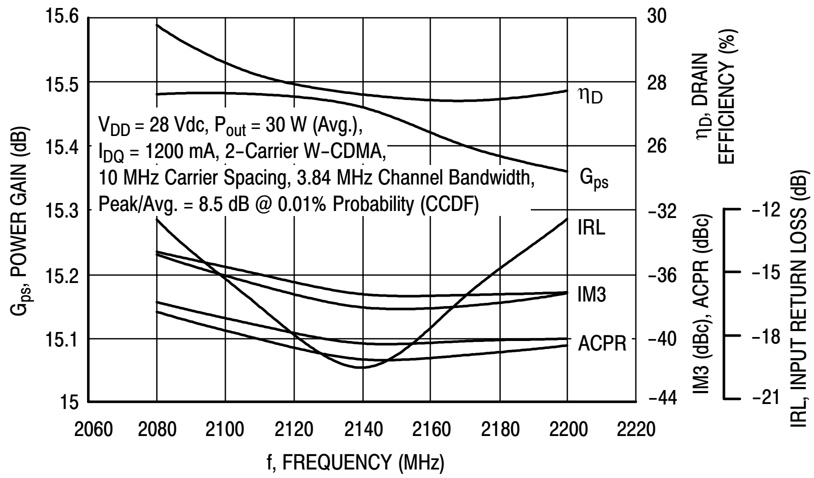


Figure 3. 2-Carrier W-CDMA Broadband Performance @ P_{out} = 30 Watts Avg.

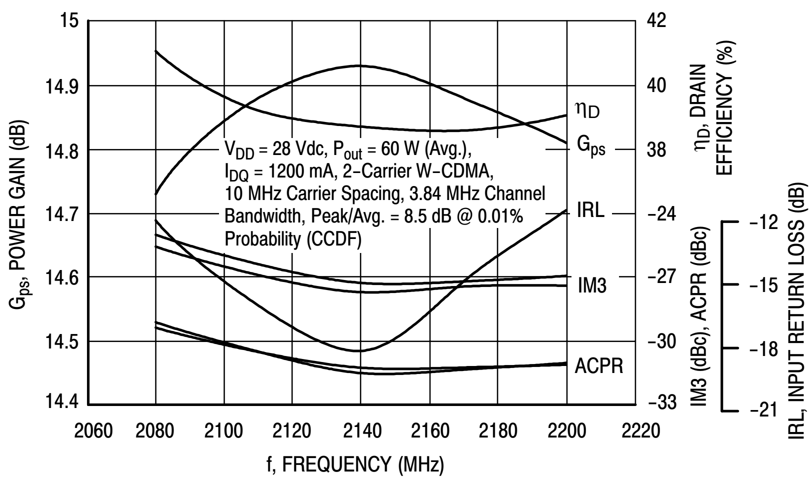


Figure 4. 2-Carrier W-CDMA Broadband Performance @ P_{out} = 60 Watts Avg.

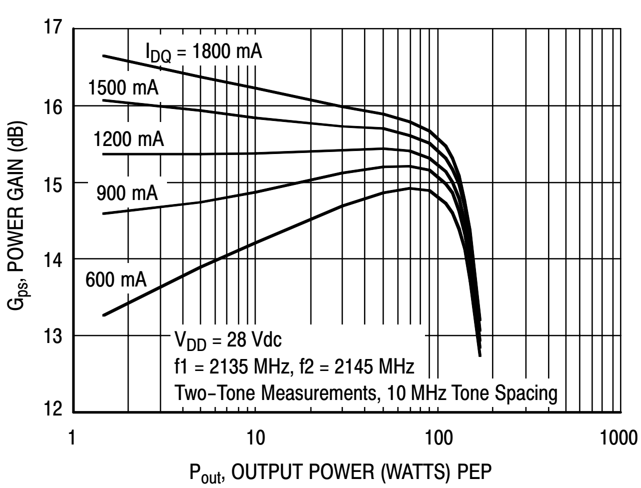


Figure 5. Two-Tone Power Gain versus Output Power

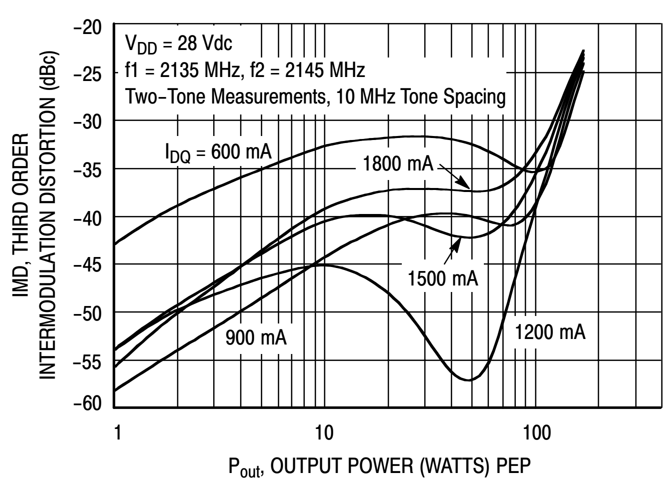


Figure 6. Third Order Intermodulation Distortion versus Output Power

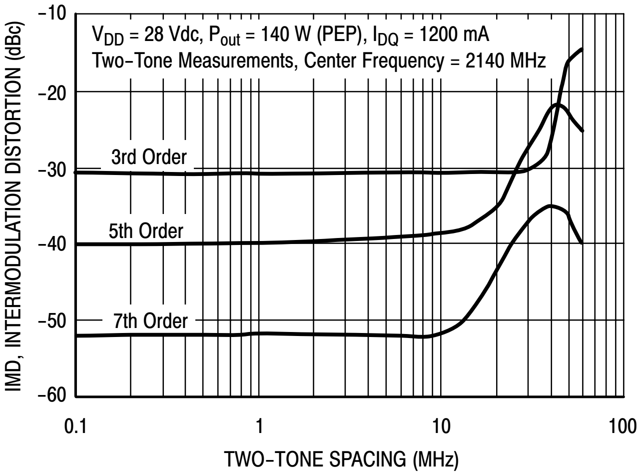


Figure 7. Intermodulation Distortion Products versus Tone Spacing

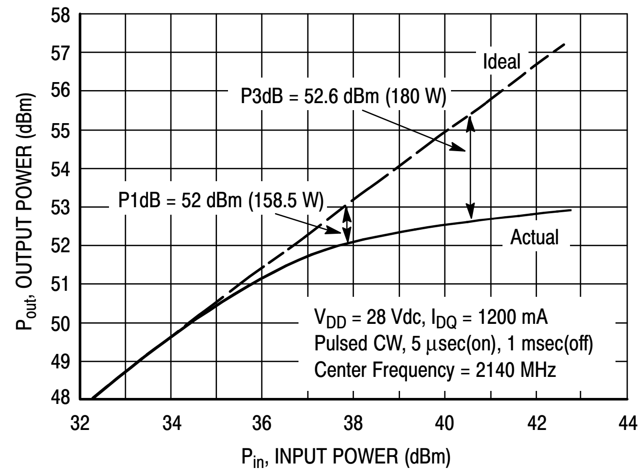


Figure 8. Pulse CW Output Power versus Input Power

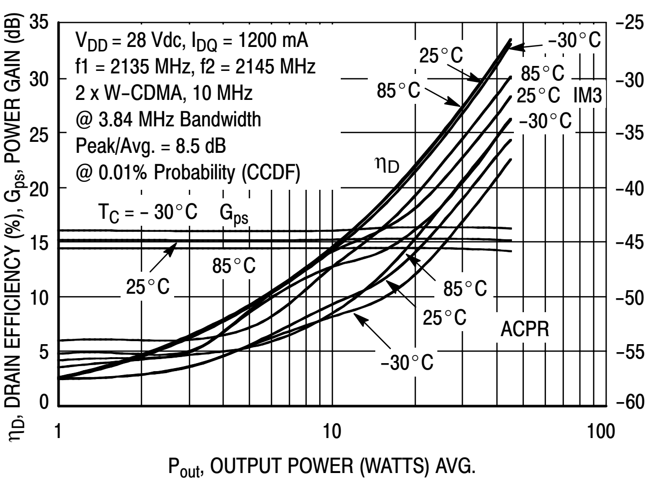


Figure 9. 2-Carrier W-CDMA ACPR, IM3, Power Gain and Drain Efficiency versus Output Power

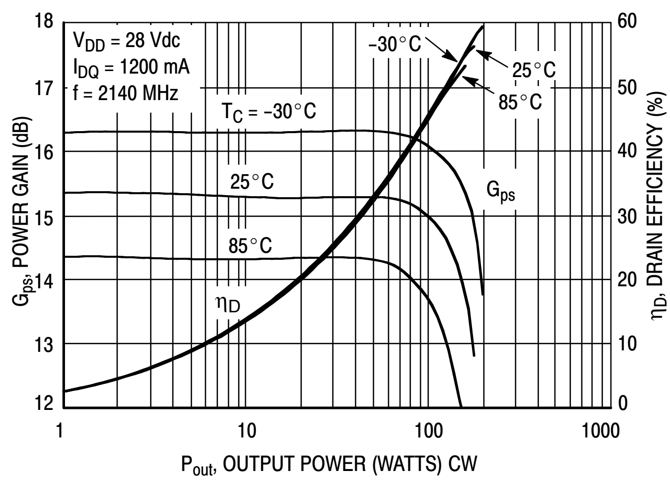


Figure 10. Power Gain and Drain Efficiency versus CW Output Power

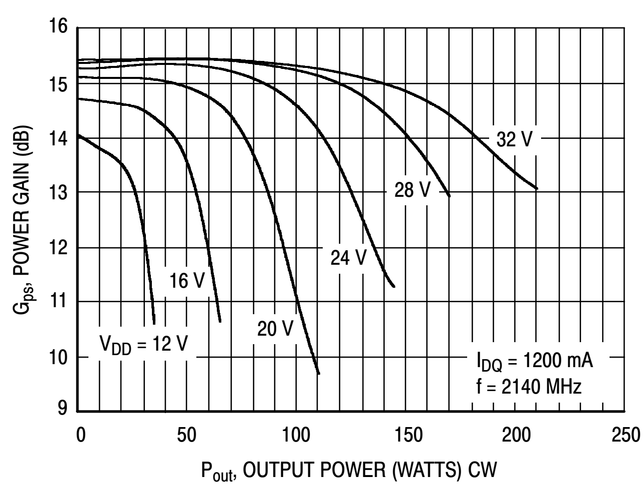
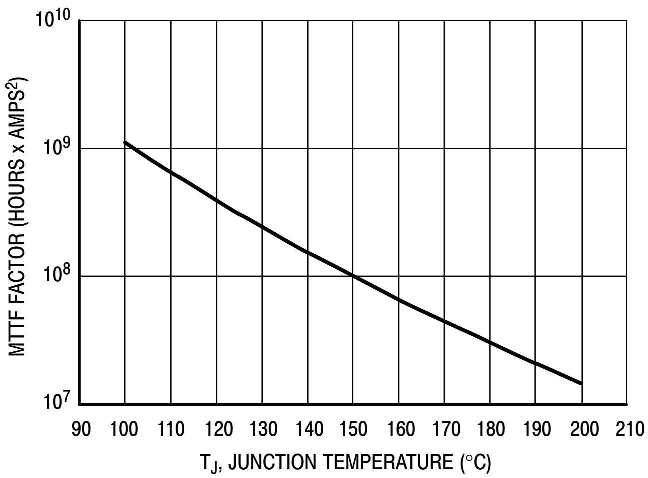


Figure 11. Power Gain versus Output Power

TYPICAL CHARACTERISTICS



This above graph displays calculated MTTF in hours x ampere^2 drain current. Life tests at elevated temperatures have correlated to better than ±10% of the theoretical prediction for metal failure. Divide MTTF factor by I_D^2 for MTTF in a particular application.

Figure 12. MTTF Factor versus Junction Temperature

TYPICAL CHARACTERISTICS
W-CDMA TEST SIGNAL

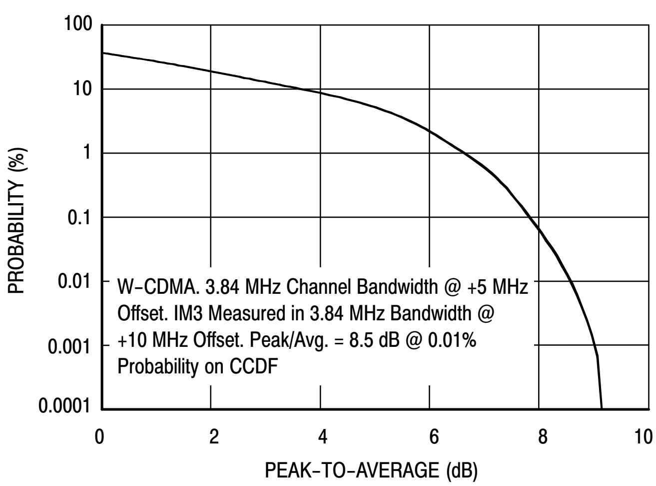


Figure 13. CCDF W-CDMA 3GPP, Test Model 1, 64 DPCH, 67% Clipping, Single-Carrier Test Signal

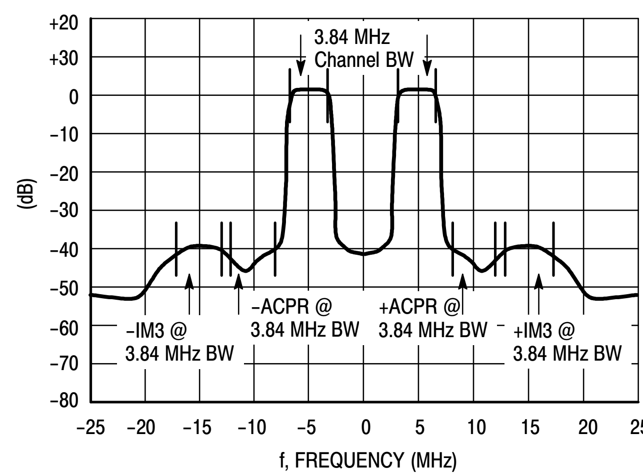
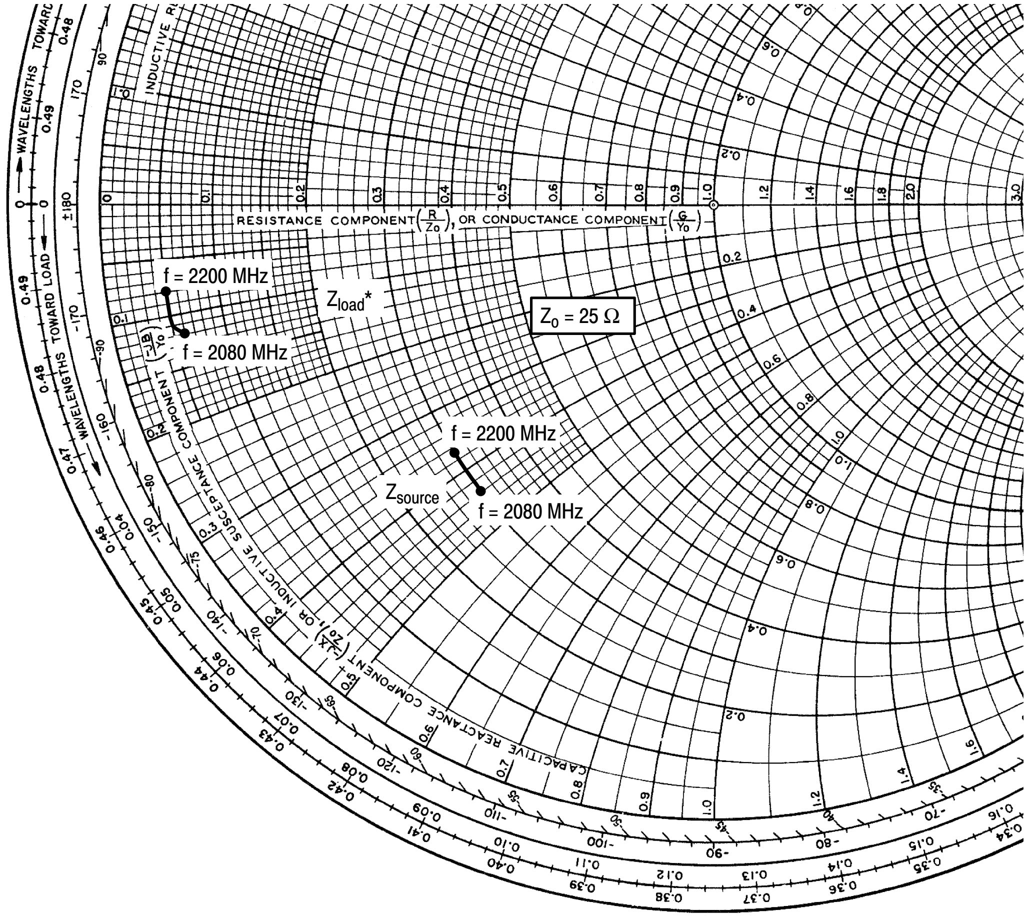


Figure 14. 2-Carrier W-CDMA Spectrum



V_{DD} = 28 Vdc, I_{DQ} = 1200 mA, P_{out} = 30 W Avg.

f MHz	Z_{source} Ω	Z_{load} Ω
2080	7.53 - j10.99	1.40 - j3.03
2110	7.57 - j10.67	1.37 - j2.78
2140	7.58 - j10.23	1.34 - j2.52
2170	7.51 - j9.73	1.32 - j2.28
2200	7.44 - j9.32	1.31 - j2.06

Z_{source} = Test circuit impedance as measured from gate to ground.

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

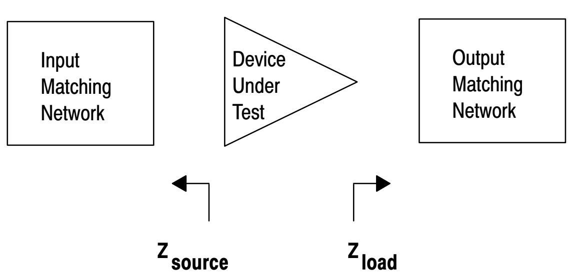


Figure 15. Series Equivalent Source and Load Impedance