RF Power Field Effect Transistors

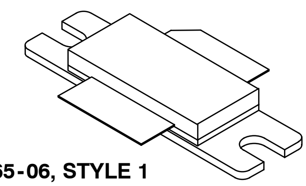
N-Channel Enhancement-Mode Lateral MOSFETs

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.

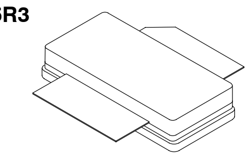
- Typical 2-carrier W-CDMA Performance for V_{DD} = 28 Volts, I_{DQ} = 1000 mA, f1 = 2135 MHz, f2 = 2145 MHz, Channel Bandwidth = 3.84 MHz, Adjacent Channels Measured over 3.84 MHz BW @ f1 -5 MHz and f2 +5 MHz, Distortion Products Measured over a 3.84 MHz BW @ f1 -10 MHz and f2 +10 MHz, Peak/Avg. = 8.3 dB @ 0.01% Probability on CCDF.
  Output Power — 19 Watts Avg.
  Power Gain — 13.6 dB
  Efficiency — 23%
  IM3 — -37.5 dBc
  ACPR — -41 dBc
- Internally Matched, Controlled Q, for Ease of Use
- High Gain, High Efficiency and High Linearity
- Integrated ESD Protection
- Designed for Maximum Gain and Insertion Phase Flatness
- Capable of Handling 5:1 VSWR, @ 28 Vdc, 2170 MHz, 90 Watts CW Output Power
- Excellent Thermal Stability
- Characterized with Series Equivalent Large-Signal Impedance Parameters
- Available with Low Gold Plating Thickness on Leads. L Suffix Indicates 40μ″ Nominal.
- In Tape and Reel. R3 Suffix = 250 Units per 56 mm, 13 inch Reel.

MRF21085R3
MRF21085LSR3

2170 MHz, 90 W, 28 V
LATERAL N-CHANNEL
RF POWER MOSFETs



CASE 465-06, STYLE 1
NI-780
MRF21085R3



CASE 465A-06, STYLE 1
NI-780S
MRF21085LSR3

Table 1. Maximum Ratings

Rating	Symbol	Value	Unit
Drain-Source Voltage	V_{DSS}	-0.5, +65	Vdc
Gate-Source Voltage	V_{GS}	-0.5, +15	Vdc
Total Device Dissipation @ T_C = 25°C Derate above 25°C	P_D	224 1.28	W W/°C
Storage Temperature Range	T_{stg}	- 65 to +150	°C
Operating Junction Temperature	T_J	200	°C

Table 2. Thermal Characteristics

Characteristic	Symbol	Value	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	0.78	°C/W

Table 3. ESD Protection Characteristics

Test Conditions	Class
Human Body Model	1 (Minimum)
Machine Model	M3 (Minimum)

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

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

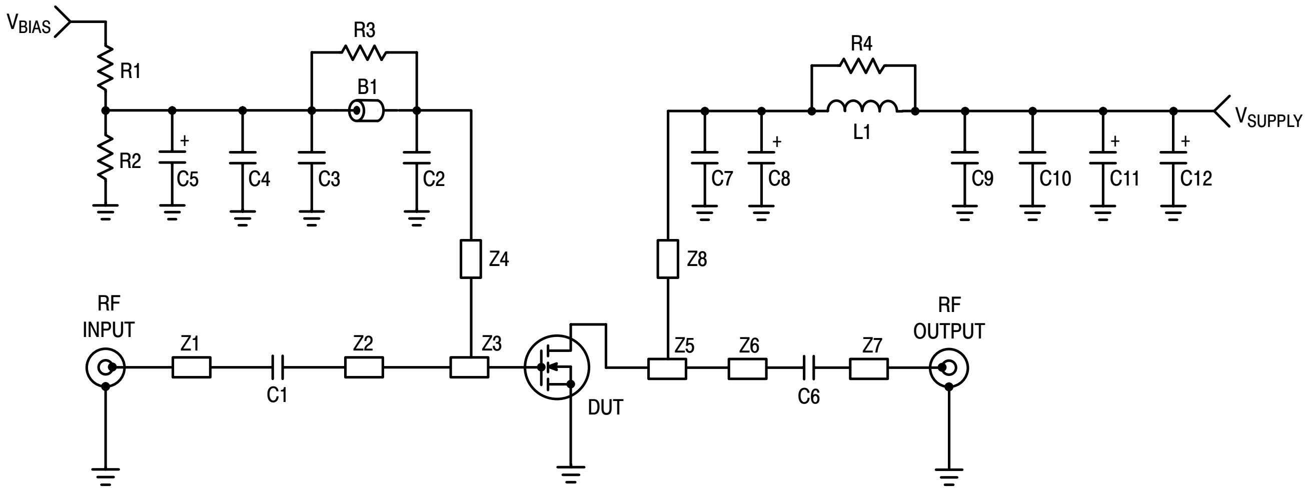
Characteristic	Symbol	Min	Typ	Max	Unit
Off Characteristics					
Drain-Source Breakdown Voltage (V_{GS} = 0 Vdc, I_D = 100 μAdc)	$V_{(BR)DSS}$	65	—	—	Vdc
Zero Gate Voltage Drain Current (V_{DS} = 28 Vdc, V_{GS} = 0 Vdc)	I_{DSS}	—	—	10	μAdc
Gate-Source Leakage Current (V_{GS} = 5 Vdc, V_{DS} = 0 Vdc)	I_{GSS}	—	—	1	μAdc
On Characteristics (DC)					
Gate Threshold Voltage (V_{DS} = 10 Vdc, I_D = 200 μAdc)	$V_{GS(th)}$	2	—	4	Vdc
Gate Quiescent Voltage (V_{DS} = 28 Vdc, I_D = 1000 mAdc)	$V_{GS(Q)}$	3	3.9	5	Vdc
Drain-Source On-Voltage (V_{GS} = 10 Vdc, I_D = 2 Adc)	$V_{DS(on)}$	—	0.18	0.21	Vdc
Forward Transconductance (V_{DS} = 10 Vdc, I_D = 2 Adc)	g_{fs}	—	6	—	S
Dynamic Characteristics [1]					
Reverse Transfer Capacitance (V_{DS} = 28 Vdc, V_{GS} = 0, f = 1.0 MHz)	C_{rss}	—	3.6	—	pF
Functional Tests (In Freescale Test Fixture, 50 ohm system) 2-carrier W-CDMA, 3.84 MHz Channel Bandwidth Carriers, ACPR and IM3 measured in 3.84 MHz Bandwidth. Peak/Avg. = 8.3 dB @ 0.01% Probability on CCDF.					
Common-Source Amplifier Power Gain (V_{DD} = 28 Vdc, P_{out} = 19 W Avg., I_{DQ} = 1000 mA, f1 = 2112.5 MHz, f2 = 2122.5 MHz and f1 = 2157.5 MHz, f2 = 2167.5 MHz)	G_{ps}	12	13.6	—	dB
Drain Efficiency (V_{DD} = 28 Vdc, P_{out} = 19 W Avg., I_{DQ} = 1000 mA, f1 = 2112.5 MHz, f2 = 2122.5 MHz and f1 = 2157.5 MHz, f2 = 2167.5 MHz)	η	20	23	—	%
Third Order Intermodulation Distortion (V_{DD} = 28 Vdc, P_{out} = 19 W Avg., I_{DQ} = 1000 mA, f1 = 2112.5 MHz, f2 = 2122.5 MHz and f1 = 2157.5 MHz, f2 = 2167.5 MHz; IM3 measured over 3.84 MHz BW at f1 -10 MHz and f2 +10 MHz referenced to carrier channel power.)	IM3	—	-37.5	-35	dBc
Adjacent Channel Power Ratio (V_{DD} = 28 Vdc, P_{out} = 19 W Avg., I_{DQ} = 1000 mA, f1 = 2112.5 MHz, f2 = 2122.5 MHz and f1 = 2157.5 MHz, f2 = 2167.5 MHz; ACPR measured over 3.84 MHz at f1 -5 MHz and f2 +5 MHz.)	ACPR	—	-41	-38	dBc
Input Return Loss (V_{DD} = 28 Vdc, P_{out} = 19 W Avg., I_{DQ} = 1000 mA, f1 = 2112.5 MHz, f2 = 2122.5 MHz and f1 = 2157.5 MHz, f2 = 2167.5 MHz)	IRL	—	-12	-9	dB
Output Mismatch Stress (V_{DD} = 28 Vdc, P_{out} = 90 W CW, I_{DQ} = 1000 mA, f = 2170 MHz VSWR = 5:1, All Phase Angles at Frequency of Tests)	Ψ	No Degradation In Output Power Before and After Test			

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

(continued)

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

Characteristic	Symbol	Min	Typ	Max	Unit
Functional Tests (In Freescale Test Fixture, 50 ohm system) **(continued)**					
Two-Tone Common-Source Amplifier Power Gain (V_{DD} = 28 Vdc, P_{out} = 90 W PEP, I_{DQ} = 1000 mA, f1 = 2110 MHz, f2 = 2120 MHz and f1 = 2160 MHz, f2 = 2170 MHz)	G_{ps}	—	13.6	—	dB
Two-Tone Drain Efficiency (V_{DD} = 28 Vdc, P_{out} = 90 W PEP, I_{DQ} = 1000 mA, f1 = 2110 MHz, f2 = 2120 MHz and f1 = 2160 MHz, f2 = 2170 MHz)	η	—	36	—	%
Two-Tone Intermodulation Distortion (V_{DD} = 28 Vdc, P_{out} = 90 W PEP, I_{DQ} = 1000 mA, f1 = 2110 MHz, f2 = 2120 MHz and f1 = 2160 MHz, f2 = 2170 MHz)	IMD	—	-31	—	dBc
Input Return Loss (V_{DD} = 28 Vdc, P_{out} = 90 W PEP, I_{DQ} = 1000 mA, f1 = 2110 MHz, f2 = 2120 MHz and f1 = 2160 MHz, f2 = 2170 MHz)	IRL	—	-12	—	dB
P_{out}, 1 dB Compression Point (V_{DD} = 28 Vdc, I_{DQ} = 1000 mA, f = 2170 MHz)	P1dB	—	100	—	W

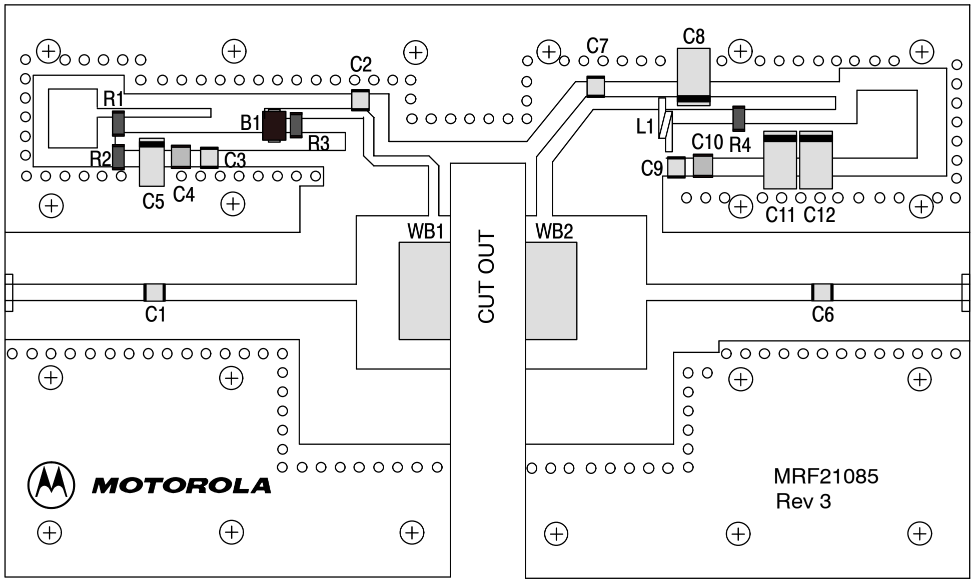


Z1	0.750″ x 0.084″ Microstrip	Board	0.030″ Glass Teflon®, Keene GX-0300-55-22, ε_r = 2.55
Z2	1.015″ x 0.084″ Microstrip	PCB	Etched Circuit Boards MRF21085 Rev. 3, CMR
Z3	0.480″ x 0.800″ Microstrip		
Z4	0.750″ x 0.050″ Microstrip		
Z5	0.610″ x 0.800″ Microstrip		
Z6	0.885″ x 0.084″ Microstrip		
Z7	0.720″ x 0.084″ Microstrip		
Z8	0.800″ x 0.070″ Microstrip		

Figure 1. MRF21085 Test Circuit Schematic

Table 5. MRF21085 Test Circuit Component Designations and Values

Designators	Description
B1	Short Ferrite Bead, Fair Rite, #2743019447
C1, C6	43 pF Chip Capacitors, ATC #100B430JCA500X
C2	10 pF Chip Capacitor, ATC #100B100JCA500X
C3, C9	1000 pF Chip Capacitors, ATC #100B102JCA500X
C4, C10	0.1 μF Chip Capacitors, Kemet #CDR33BX104AKWS
C5	1.0 μF Tantalum Chip Capacitor, Kemet #T491C105M050
C7	2.7 pF Chip Capacitor, ATC #100B2R7JCA500X
C8	10 μF Tantalum Chip Capacitor, Kemet #T495X106K035AS4394
C11, C12	22 μF Tantalum Chip Capacitors, Kemet #T491X226K035AS4394
L1	1 Turn, #20 AWG, 0.100″ ID
N1, N2	Type N Flange Mounts, Omni Spectra #3052-1648-10
R1	1.0 kΩ, 1/8 W Chip Resistor
R2	180 kΩ, 1/8 W Chip Resistor
R3, R4	10 Ω, 1/8 W Chip Resistors



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 2. MRF21085 Test Circuit Component Layout

TYPICAL CHARACTERISTICS

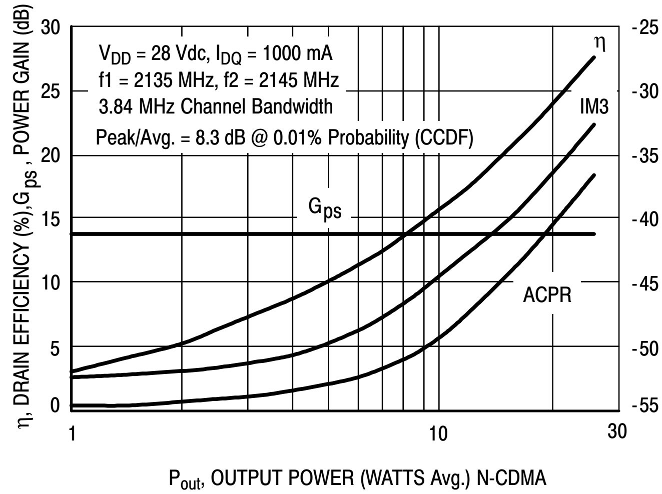


Figure 3. 2-Carrier W-CDMA ACPR, IM3, Power Gain and Drain Efficiency versus Output Power

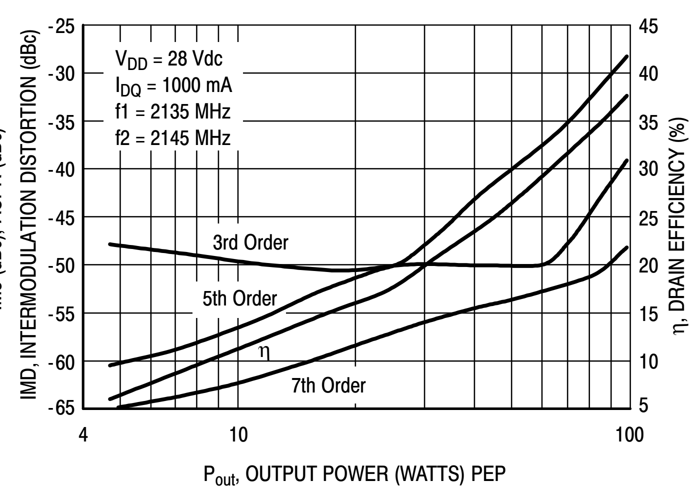


Figure 4. Intermodulation Distortion Products versus Output Power

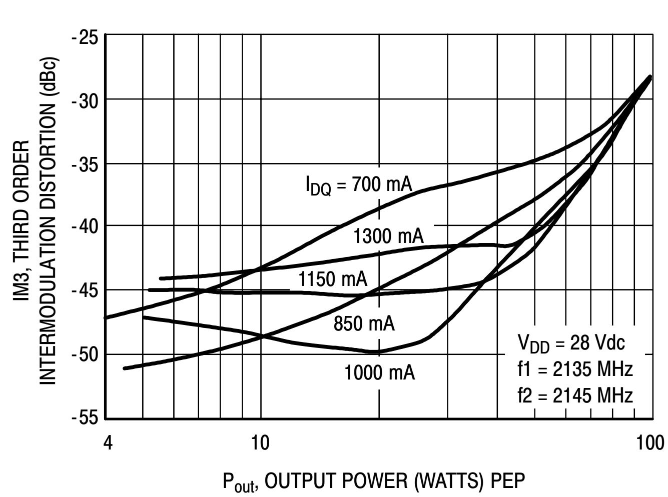


Figure 5. Third Order Intermodulation Distortion versus Output Power

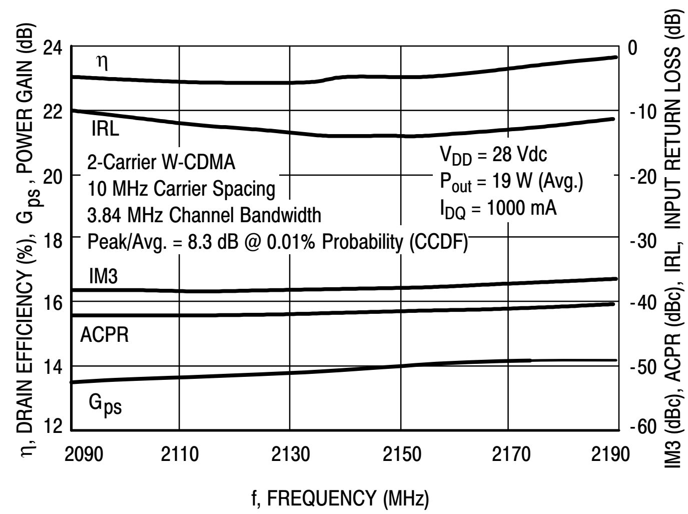


Figure 6. 2-Carrier W-CDMA Broadband Performance

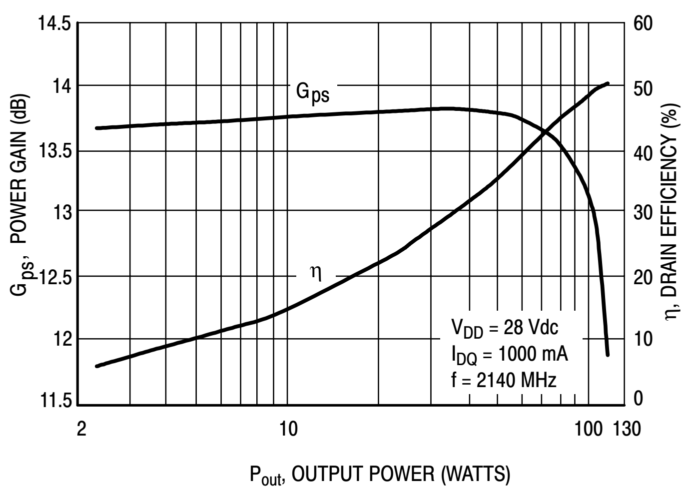


Figure 7. CW Performance

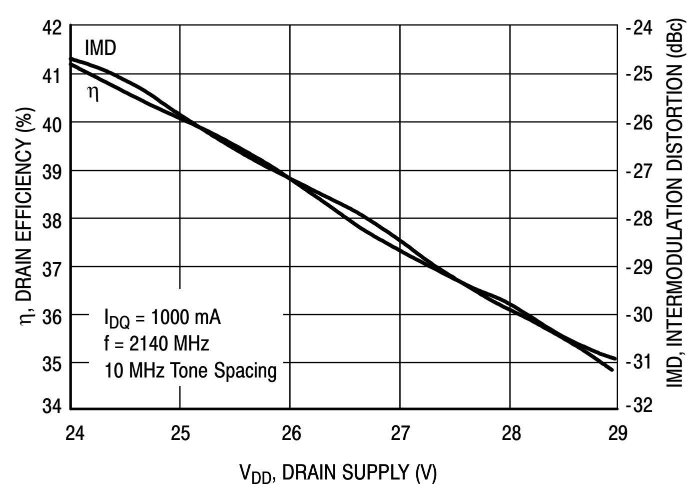


Figure 8. Two-Tone Intermodulation Distortion and Drain Efficiency versus Drain Supply

TYPICAL CHARACTERISTICS

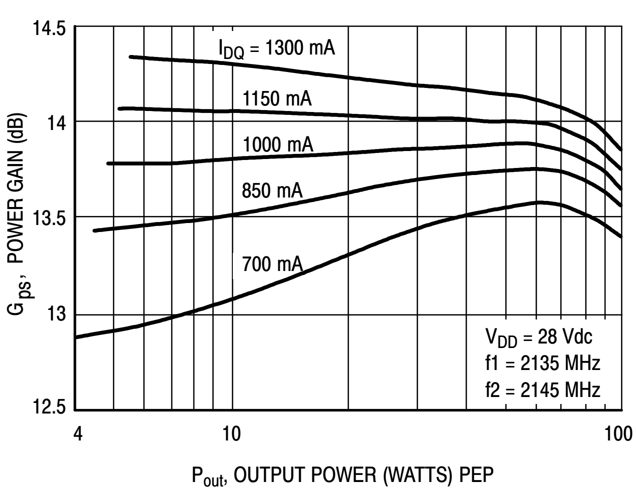


Figure 9. Two-Tone Power Gain versus Output Power

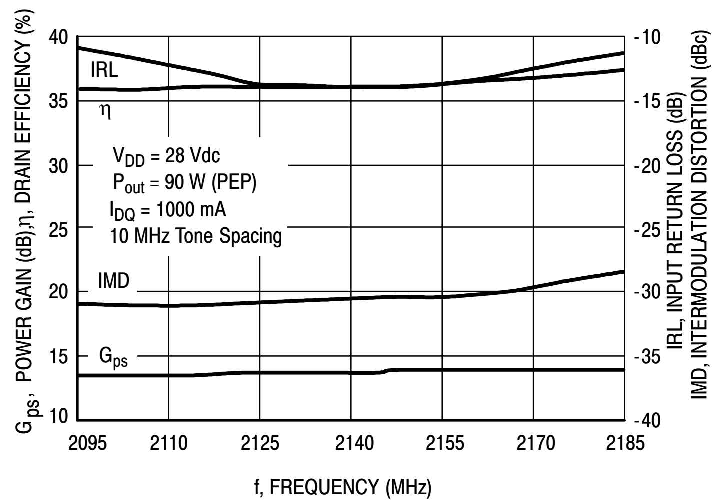


Figure 10. Two-Tone Broadband Performance

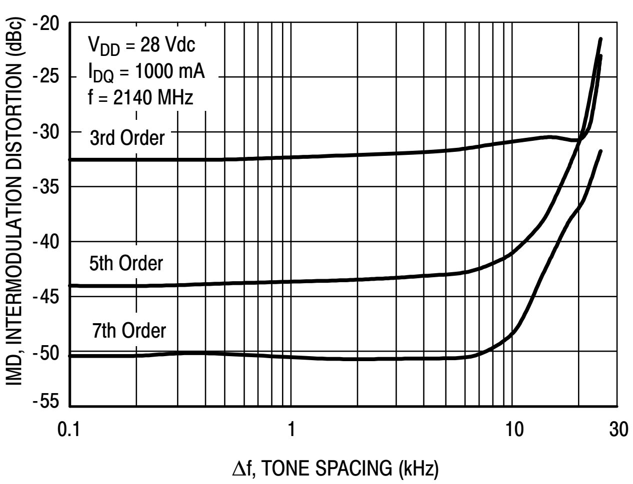


Figure 11. Intermodulation Distortion Products versus Two-Tone Spacing

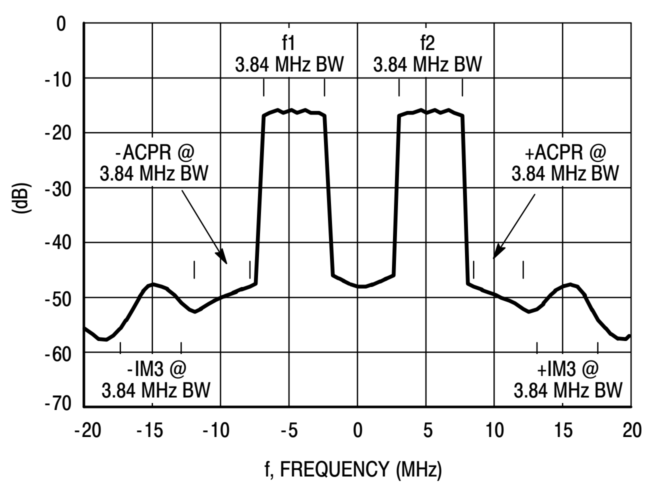
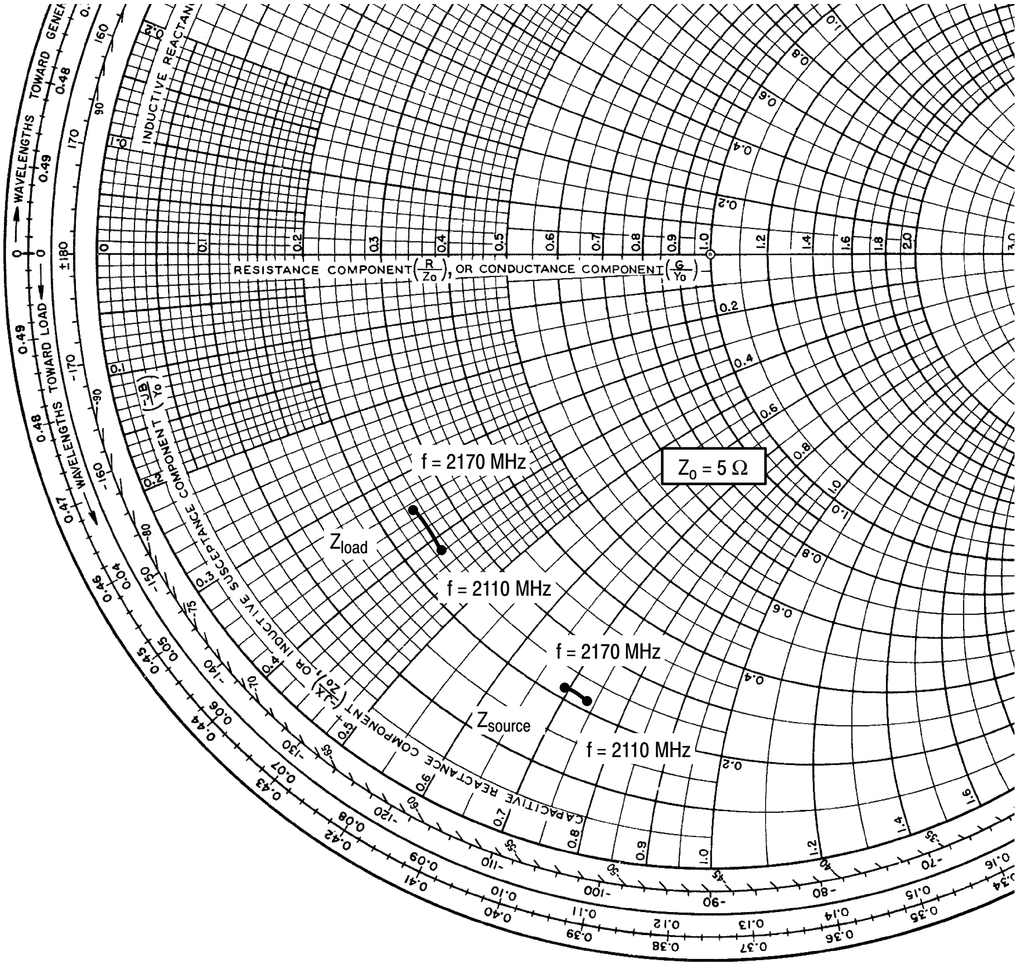


Figure 12. 2-Carrier W-CDMA Spectrum



V_{DD} = 28 V, I_{DQ} = 1000 mA, P_{out} = 19 W Avg.

f MHz	Z_{source} Ω	Z_{load} Ω
2110	1.10 - j3.71	1.23 - j2.10
2140	1.11 - j3.57	1.26 - j1.92
2170	1.12 - j3.40	1.25 - j1.76

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

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

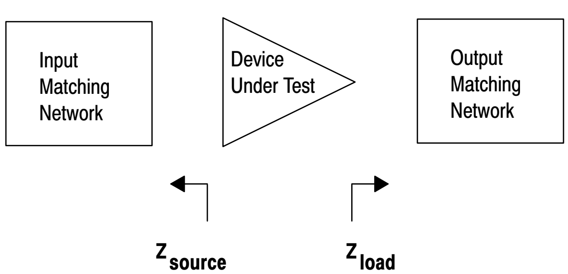
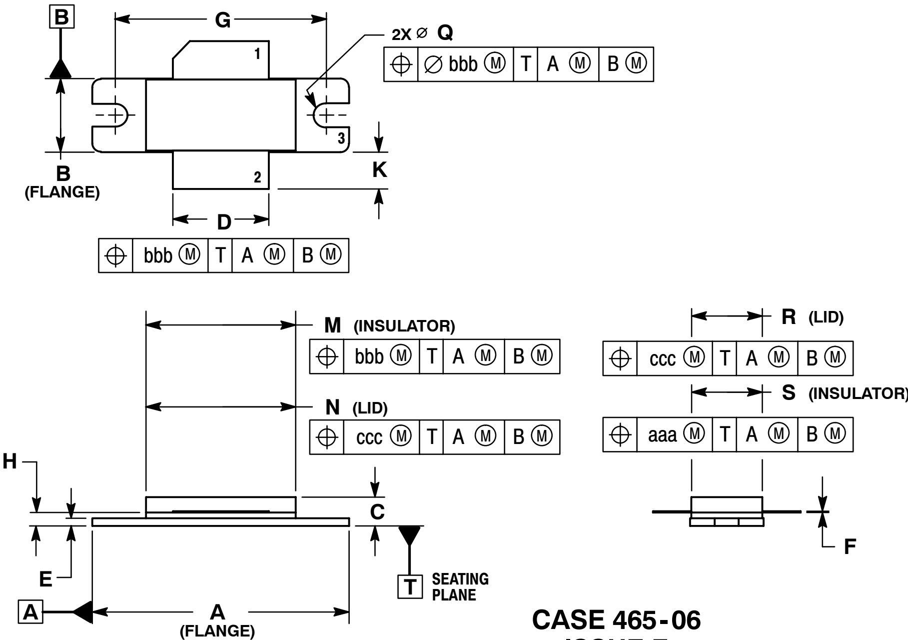


Figure 13. Series Equivalent Source and Load Impedance

NOTES

NOTES

PACKAGE DIMENSIONS

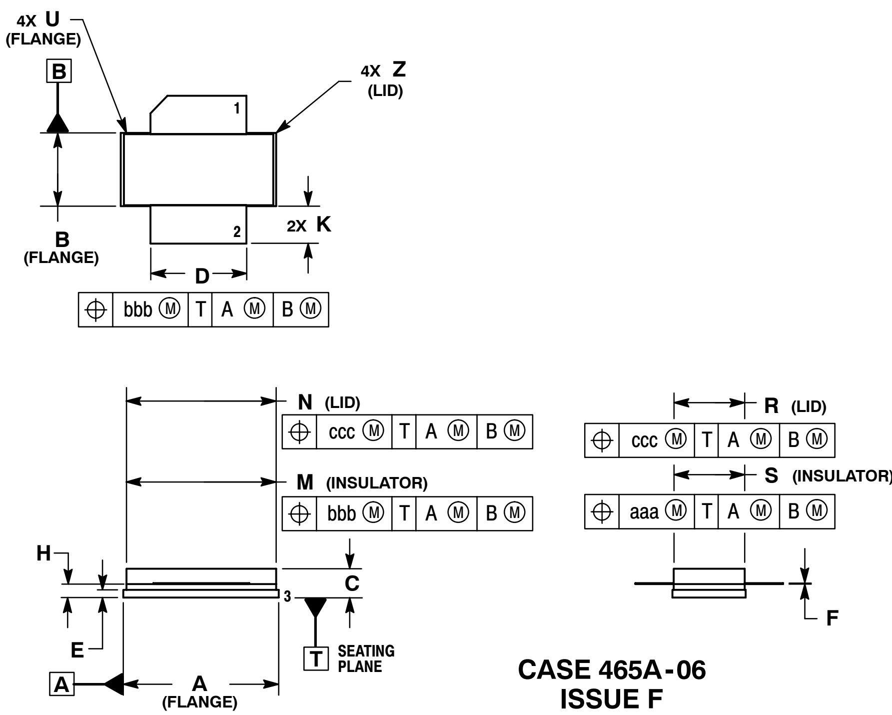


CASE 465-06
ISSUE F
NI-780
MRF21085R3

NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M-1994.
2. CONTROLLING DIMENSION: INCH.
3. DELETED
4. DIMENSION H IS MEASURED 0.030 (0.762) AWAY FROM PACKAGE BODY.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	1.335	1.345	33.91	34.16
B	0.380	0.390	9.65	9.91
C	0.125	0.170	3.18	4.32
D	0.495	0.505	12.57	12.83
E	0.035	0.045	0.89	1.14
F	0.003	0.006	0.08	0.15
G	1.100 BSC		27.94 BSC	
H	0.057	0.067	1.45	1.70
K	0.170	0.210	4.32	5.33
M	0.774	0.786	19.66	19.96
N	0.772	0.788	19.60	20.00
Q	⌀.118	⌀.138	⌀3.00	⌀3.51
R	0.365	0.375	9.27	9.53
S	0.365	0.375	9.27	9.52
aaa	0.005 REF		0.127 REF	
bbb	0.010 REF		0.254 REF	
ccc	0.015 REF		0.381 REF	

STYLE 1:
PIN 1. DRAIN
2. GATE
3. SOURCE



CASE 465A-06
ISSUE F
NI-780S
MRF21085LSR3

NOTES:
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2. CONTROLLING DIMENSION: INCH.
3. DELETED
4. DIMENSION H IS MEASURED 0.030 (0.762) AWAY FROM PACKAGE BODY.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.805	0.815	20.45	20.70
B	0.380	0.390	9.65	9.91
C	0.125	0.170	3.18	4.32
D	0.495	0.505	12.57	12.83
E	0.035	0.045	0.89	1.14
F	0.003	0.006	0.08	0.15
H	0.057	0.067	1.45	1.70
K	0.170	0.210	4.32	5.33
M	0.774	0.786	19.61	20.02
N	0.772	0.788	19.61	20.02
R	0.365	0.375	9.27	9.53
S	0.365	0.375	9.27	9.52
U	---	0.040	---	1.02
Z	---	0.030	---	0.76
aaa	0.005 REF		0.127 REF	
bbb	0.010 REF		0.254 REF	
ccc	0.015 REF		0.381 REF	

STYLE 1:
PIN 1. DRAIN
2. GATE
5. SOURCE

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