

# The RF MOSFET Line

## RF Power Field Effect Transistors

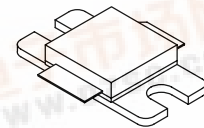
### N-Channel Enhancement-Mode Lateral MOSFETs

**MRF21045LR3**  
**MRF21045LSR3**

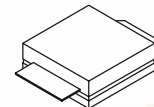
Designed for W-CDMA base station applications with frequencies from 2110 to 2170 MHz. Suitable for TDMA, CDMA and multicarrier amplifier applications. To be used in Class AB for PCN - PCS/cellular radio and WLL applications.

- Typical 2-carrier W-CDMA Performance for  $V_{DD} = 28$  Volts,  $I_{DQ} = 500$  mA,  $f_1 = 2135$  MHz,  $f_2 = 2145$  MHz, Channel Bandwidth = 3.84 MHz, Adjacent Channels measured over 3.84 MHz Bandwidth at  $f_1 - 5$  MHz and  $f_2 + 5$  MHz, Distortion Products measured over a 3.84 MHz Bandwidth at  $f_1 - 10$  MHz and  $f_2 + 10$  MHz, Peak/Avg. = 8.3 dB @ 0.01% Probability on CCDF.
  - Output Power — 10 Watts Avg.
  - Efficiency — 23.5%
  - Gain — 15 dB
  - 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, 45 Watts CW Output Power
- Excellent Thermal Stability
- Characterized with Series Equivalent Large-Signal Impedance Parameters
- Low Gold Plating Thickness on Leads, 40 $\mu$ m Nominal.
- In Tape and Reel. R3 Suffix = 250 Units per 32 mm, 13 Inch Reel.

**2170 MHz, 45 W, 28 V**  
**LATERAL N-CHANNEL**  
**RF POWER MOSFETs**



**CASE 465E-04, STYLE 1**  
**NI-400**  
**MRF21045LR3**



**CASE 465F-04, STYLE 1**  
**NI-400S**  
**MRF21045LSR3**

#### MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Drain-Source Voltage	$V_{DSS}$	65	Vdc
Gate-Source Voltage	$V_{GS}$	-0.5, +15	Vdc
Total Device Dissipation @ $T_C = 25^\circ\text{C}$ Derate above 25 $^\circ\text{C}$	$P_D$	105 0.60	Watts W/ $^\circ\text{C}$
Storage Temperature Range	$T_{stg}$	- 65 to +150	$^\circ\text{C}$
Operating Junction Temperature	$T_J$	200	$^\circ\text{C}$

#### ESD PROTECTION CHARACTERISTICS

Test Conditions	Class
Human Body Model	1 (Minimum)
Machine Model	M2 (Minimum)

#### THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	1.65	$^\circ\text{C}/\text{W}$

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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## ELECTRICAL CHARACTERISTICS (T<sub>C</sub> = 25°C unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
<b>OFF CHARACTERISTICS</b>					
Drain-Source Breakdown Voltage (V <sub>GS</sub> = 0 Vdc, I <sub>D</sub> = 100 μAdc)	V <sub>(BR)DSS</sub>	65	—	—	Vdc
Zero Gate Voltage Drain Current (V <sub>DS</sub> = 28 Vdc, V <sub>GS</sub> = 0 Vdc)	I <sub>DSS</sub>	—	—	10	μAdc
Gate-Source Leakage Current (V <sub>GS</sub> = 5 Vdc, V <sub>DS</sub> = 0 Vdc)	I <sub>GSS</sub>	—	—	1	μAdc
<b>ON CHARACTERISTICS (DC)</b>					
Gate Threshold Voltage (V <sub>DS</sub> = 10 Vdc, I <sub>D</sub> = 100 μAdc)	V <sub>GS(th)</sub>	2	—	4	Vdc
Gate Quiescent Voltage (V <sub>DS</sub> = 28 Vdc, I <sub>D</sub> = 500 mAdc)	V <sub>GS(Q)</sub>	3	3.9	5	Vdc
Drain-Source On-Voltage (V <sub>GS</sub> = 10 Vdc, I <sub>D</sub> = 1 Adc)	V <sub>DS(on)</sub>	—	0.19	0.21	Vdc
Forward Transconductance (V <sub>DS</sub> = 10 Vdc, I <sub>D</sub> = 1 Adc)	g <sub>fs</sub>	—	3	—	S
<b>DYNAMIC CHARACTERISTICS (1)</b>					
Reverse Transfer Capacitance (V <sub>DS</sub> = 28 Vdc, V <sub>GS</sub> = 0, f = 1 MHz)	C <sub>rss</sub>	—	1.8	—	pF
<b>FUNCTIONAL TESTS</b> (In Motorola Test Fixture, 50 ohm system) 2-carrier W-CDMA. Peak/Avg. ratio = 8.3 dB @ 0.01% Probability on CCDF.					
Common-Source Amplifier Power Gain (V <sub>DD</sub> = 28 Vdc, P <sub>out</sub> = 10 W Avg., I <sub>DQ</sub> = 500 mA, f <sub>1</sub> = 2112.5 MHz, f <sub>2</sub> = 2122.5 MHz and f <sub>1</sub> = 2157.5 MHz, f <sub>2</sub> = 2167.5 MHz)	G <sub>ps</sub>	13.5	15	—	dB
Drain Efficiency (V <sub>DD</sub> = 28 Vdc, P <sub>out</sub> = 10 W Avg., I <sub>DQ</sub> = 500 mA, f <sub>1</sub> = 2112.5 MHz, f <sub>2</sub> = 2122.5 MHz and f <sub>1</sub> = 2157.5 MHz, f <sub>2</sub> = 2167.5 MHz)	η	21	23.5	—	%
Third Order Intermodulation Distortion (V <sub>DD</sub> = 28 Vdc, P <sub>out</sub> = 10 W Avg., I <sub>DQ</sub> = 500 mA, f <sub>1</sub> = 2112.5 MHz, f <sub>2</sub> = 2122.5 MHz and f <sub>1</sub> = 2157.5 MHz, f <sub>2</sub> = 2167.5 MHz; IM3 measured over 3.84 MHz Bandwidth at f <sub>1</sub> -10 MHz and f <sub>2</sub> +10 MHz.)	IM3	—	-37.5	-35	dBc
Adjacent Channel Power Ratio (V <sub>DD</sub> = 28 Vdc, P <sub>out</sub> = 10 W Avg., I <sub>DQ</sub> = 500 mA, f <sub>1</sub> = 2112.5 MHz, f <sub>2</sub> = 2122.5 MHz and f <sub>1</sub> = 2157.5 MHz, f <sub>2</sub> = 2167.5 MHz; ACPR measured over 3.84 MHz Bandwidth at f <sub>1</sub> -5 MHz and f <sub>2</sub> +5 MHz.)	ACPR	—	-41	-38	dBc
Input Return Loss (V <sub>DD</sub> = 28 Vdc, P <sub>out</sub> = 10 W Avg., I <sub>DQ</sub> = 500 mA, f <sub>1</sub> = 2112.5 MHz, f <sub>2</sub> = 2122.5 MHz and f <sub>1</sub> = 2157.5 MHz, f <sub>2</sub> = 2167.5 MHz)	IRL	—	-12	-9	dB
Output Mismatch Stress (V <sub>DD</sub> = 28 Vdc, P <sub>out</sub> = 45 W CW, I <sub>DQ</sub> = 500 mA, f = 2170 MHz VSWR = 5:1, All Phase Angles at Frequency of Tests)	Ψ	No Degradation In Output Power Before and After Test			

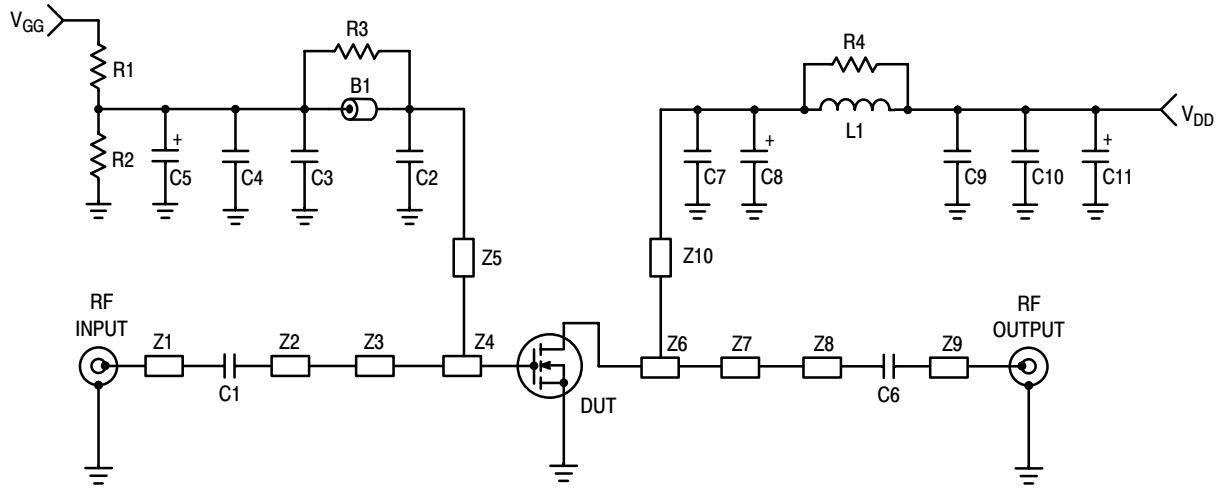
(1) Part is internally matched both on input and output.

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## ELECTRICAL CHARACTERISTICS — continued ( $T_C = 25^\circ\text{C}$ unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
<b>FUNCTIONAL TESTS</b> (In Motorola Test Fixture, 50 ohm system) — continued					
Two-Tone Common-Source Amplifier Power Gain ( $V_{DD} = 28\text{ Vdc}$ , $P_{out} = 45\text{ W PEP}$ , $I_{DQ} = 500\text{ mA}$ , $f_1 = 2110\text{ MHz}$ , $f_2 = 2120\text{ MHz}$ and $f_1 = 2160\text{ MHz}$ , $f_2 = 2170\text{ MHz}$ )	$G_{ps}$	—	14.9	—	dB
Two-Tone Drain Efficiency ( $V_{DD} = 28\text{ Vdc}$ , $P_{out} = 45\text{ W PEP}$ , $I_{DQ} = 500\text{ mA}$ , $f_1 = 2110\text{ MHz}$ , $f_2 = 2120\text{ MHz}$ and $f_1 = 2160\text{ MHz}$ , $f_2 = 2170\text{ MHz}$ )	$\eta$	—	36	—	%
Intermodulation Distortion ( $V_{DD} = 28\text{ Vdc}$ , $P_{out} = 45\text{ W PEP}$ , $I_{DQ} = 500\text{ mA}$ , $f_1 = 2110\text{ MHz}$ , $f_2 = 2120\text{ MHz}$ and $f_1 = 2160\text{ MHz}$ , $f_2 = 2170\text{ MHz}$ )	IMD	—	-30	—	dBc
Two-Tone Input Return Loss ( $V_{DD} = 28\text{ Vdc}$ , $P_{out} = 45\text{ W PEP}$ , $I_{DQ} = 500\text{ mA}$ , $f_1 = 2110\text{ MHz}$ , $f_2 = 2120\text{ MHz}$ and $f_1 = 2160\text{ MHz}$ , $f_2 = 2170\text{ MHz}$ )	IRL	—	-12	—	dB
$P_{out, 1\text{ dB Compression Point}}$ ( $V_{DD} = 28\text{ Vdc}$ , $I_{DQ} = 500\text{ mA}$ , $f = 2170\text{ MHz}$ )	$P_{1dB}$	—	50	—	W

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Z1, Z9	0.750" x 0.084" Transmission Line	Board	0.030" Glass Teflon <sup>®</sup> ,
Z2	0.160" x 0.084" Transmission Line	PCB	Keene GX-0300-55-22, $\epsilon_r = 2.55$
Z3	1.195" x 0.176" Transmission Line		Etched Circuit Boards
Z4	0.125" x 0.320" Transmission Line		MRF21045 Rev. 3, CMR
Z5	1.100" x 0.045" Transmission Line		
Z6	0.442" x 0.650" Transmission Line		
Z7	0.490" x 0.140" Transmission Line		
Z8	0.540" x 0.084" Transmission Line		
Z10	0.825" x 0.055" Transmission Line		

**Figure 1. MRF21045LR3(LSR3) Test Circuit Schematic**

**Table 1. MRF21045LR3(LSR3) Component Designations and Values**

Designators	Description
B1	Short Ferrite Bead, Fair Rite, #2743019447
C1, C2, C6	43 pF Chip Capacitors, ATC #100B430JCA500X
C7	5.6 pF Chip Capacitor, ATC #100B5R6JCA500X
C3, C9	1000 pF Chip Capacitors, ATC #100B102JCA500X
C4, C10	0.1 $\mu$ F Chip Capacitors, Kemet #CDR33BX104AKWS
C5	1.0 $\mu$ F Tantalum Chip Capacitor, Kemet #T491C105M050
C8	10 $\mu$ F Tantalum Chip Capacitor, Kemet #T495X106K035AS4394
C11	22 $\mu$ F Tantalum Chip Capacitor, Kemet #T491X226K035AS4394
L1	1 Turn, #20 AWG, 0.100" ID, Motorola
N1, N2	Type N Flange Mounts, Omni Spectra #3052-1648-10
R1	1.0 k $\Omega$ , 1/8 W Chip Resistor
R2	180 k $\Omega$ , 1/8 W Chip Resistor
R3, R4	10 $\Omega$ , 1/8 W Chip Resistors

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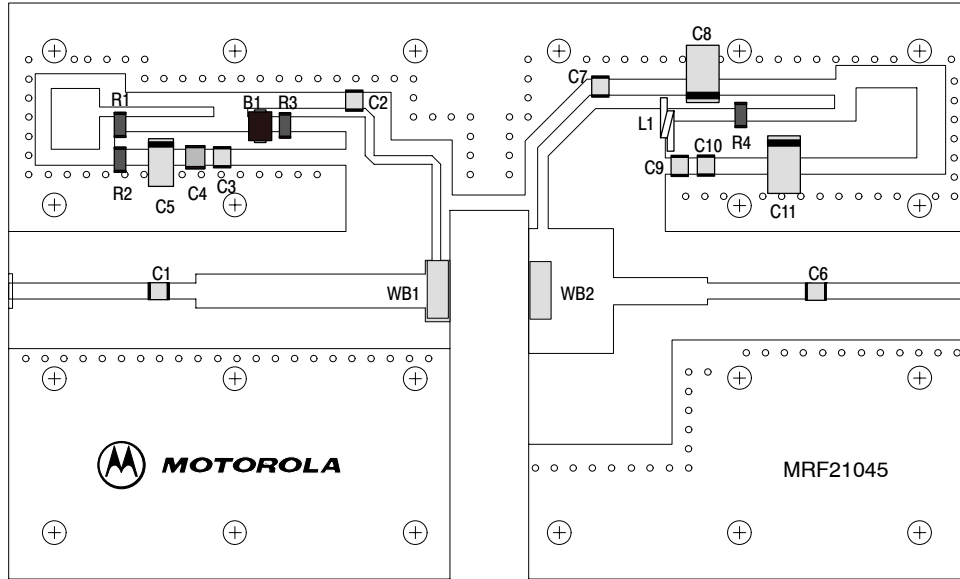
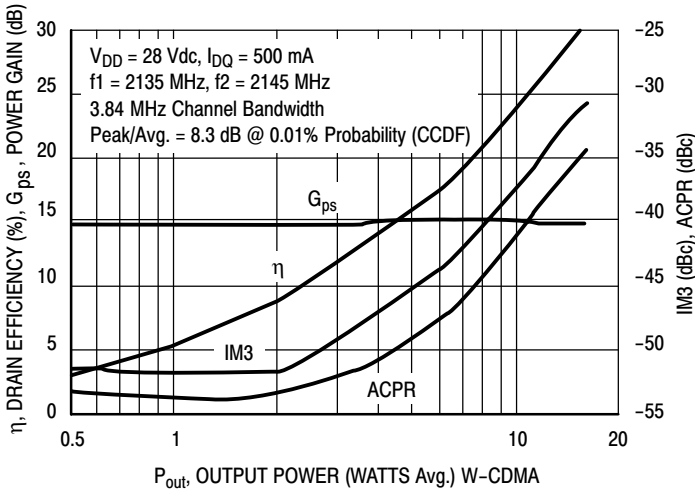


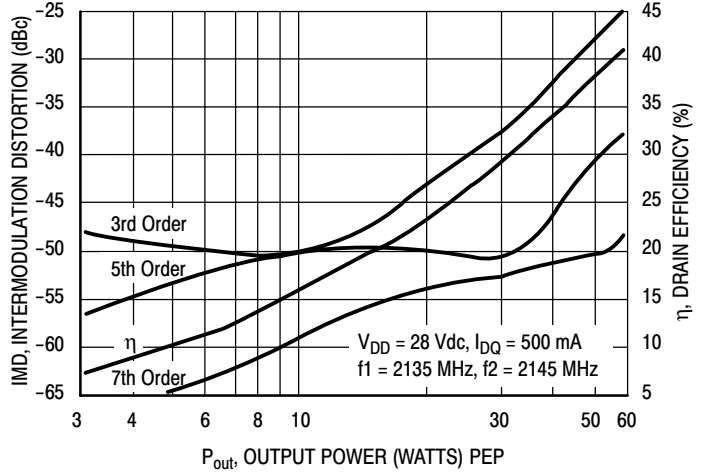
Figure 2. MRF21045LR3(LSR3) Test Circuit Component Layout

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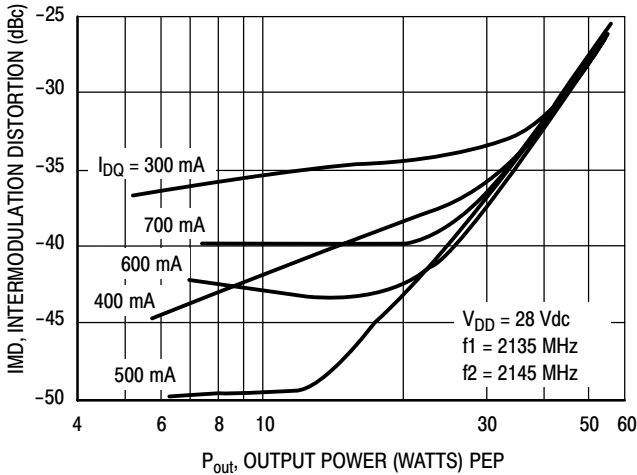
## TYPICAL CHARACTERISTICS



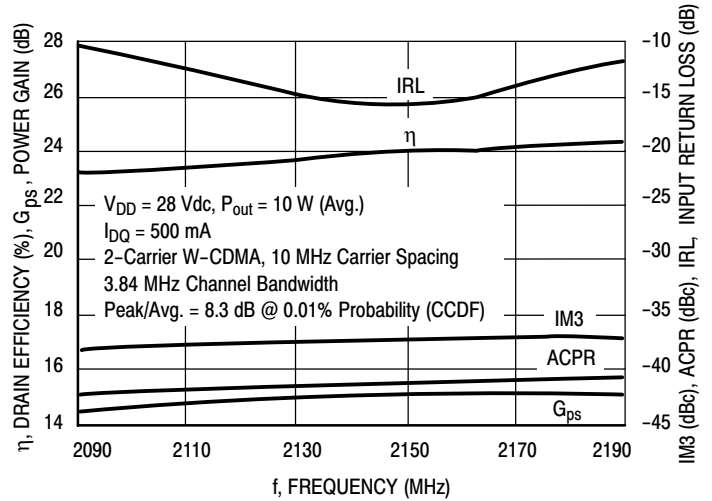
**Figure 3. 2-Carrier W-CDMA ACPR, IM3, Power Gain and Drain Efficiency versus Output Power**



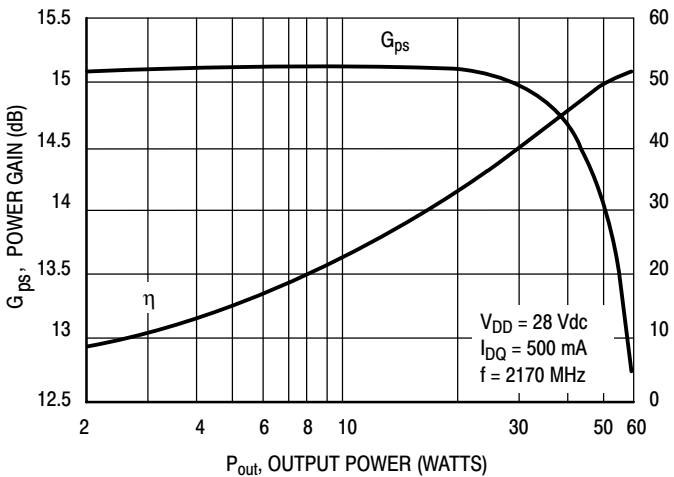
**Figure 4. Intermodulation Distortion Products versus Output Power**



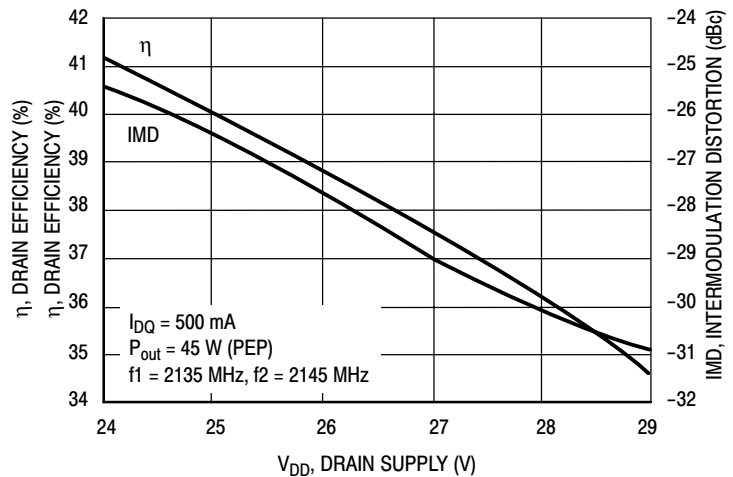
**Figure 5. Intermodulation Distortion versus Output Power**



**Figure 6. 2-Carrier W-CDMA Broadband Performance**



**Figure 7. CW Performance**

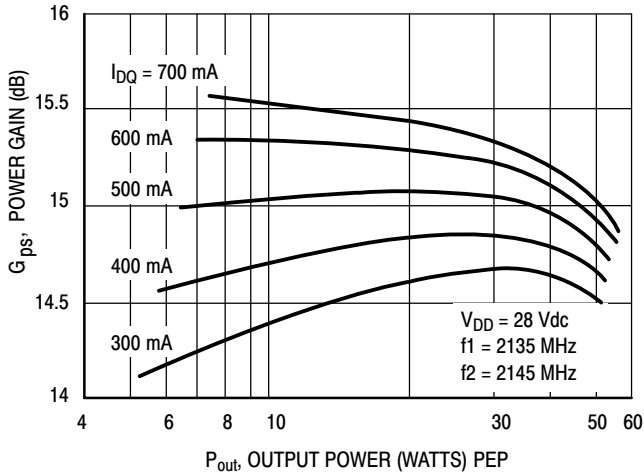


**Figure 8. Two-Tone Intermodulation Distortion and Drain Efficiency versus Drain Supply**

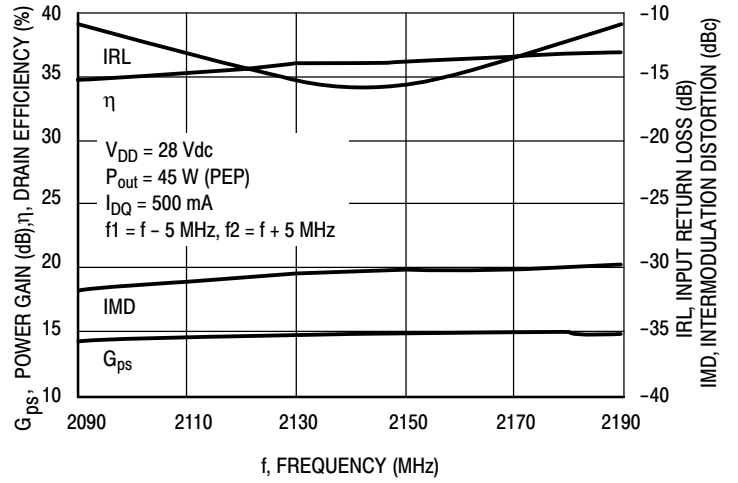
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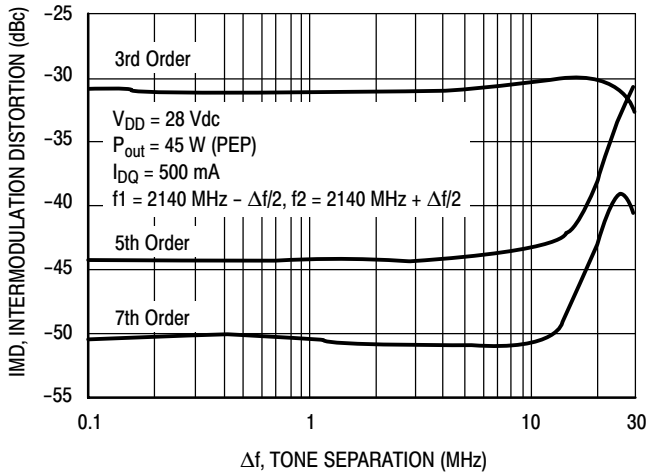
## TYPICAL CHARACTERISTICS



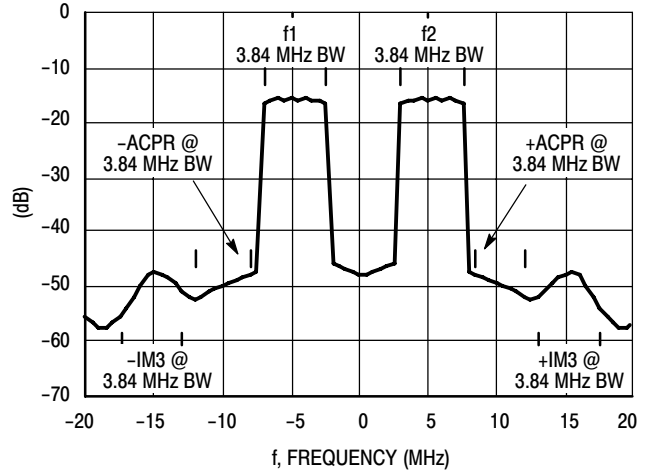
**Figure 9. Two-Tone Power Gain versus Output Power**



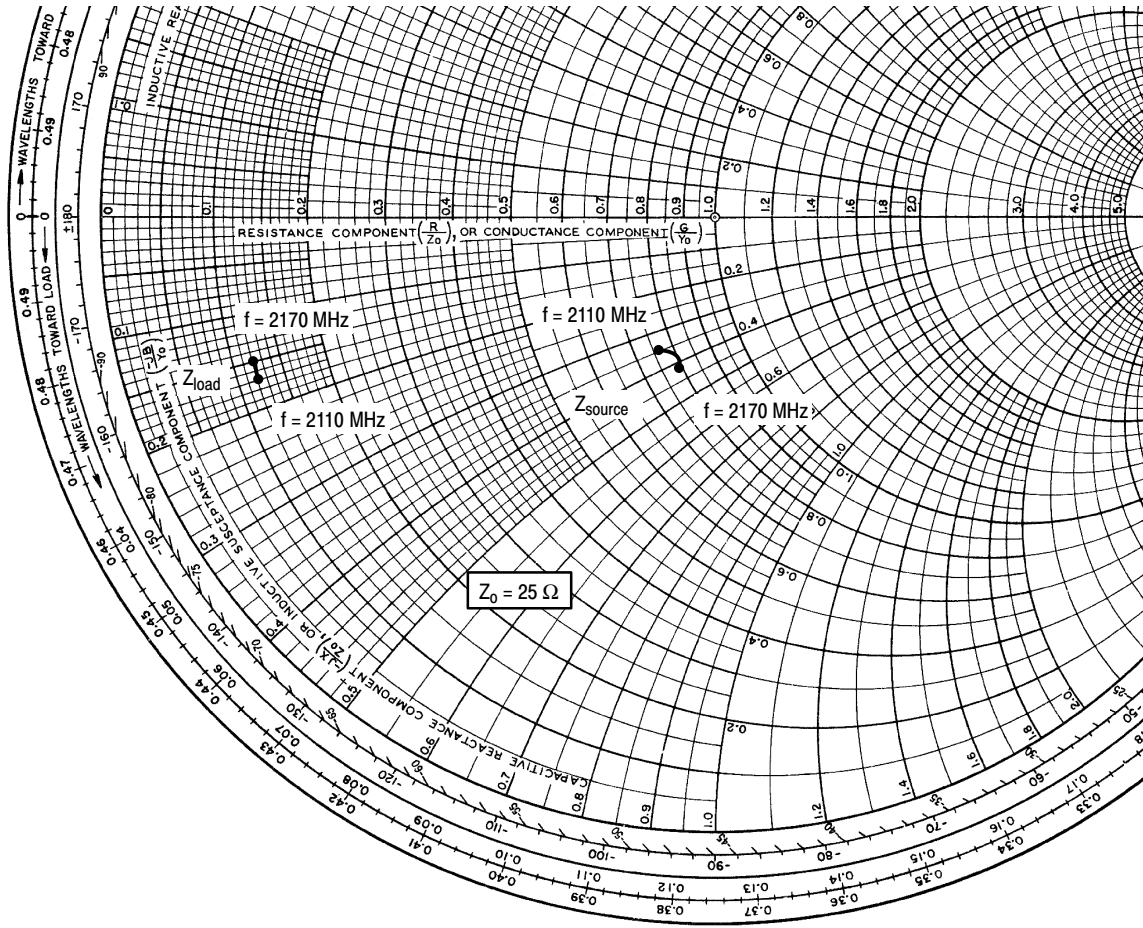
**Figure 10. Two-Tone Broadband Performance**



**Figure 11. Intermodulation Distortion Products versus Two-Tone Spacing**



**Figure 12. 2-Carrier W-CDMA Spectrum**



$V_{DD} = 28$  Vdc,  $I_{DQ} = 500$  mA,  $P_{out} = 10$  W Avg.

f MHz	$Z_{source}$ $\Omega$	$Z_{load}$ $\Omega$
2110	18.88 - j8.86	3.11 - j4.18
2140	19.80 - j9.93	3.09 - j3.87
2170	19.68 - j10.44	3.12 - j3.72

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

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

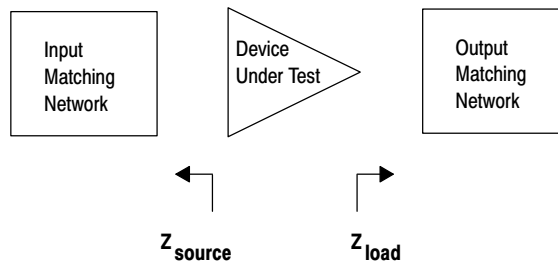


Figure 13. Series Equivalent Source and Load Impedance



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**NOTES**

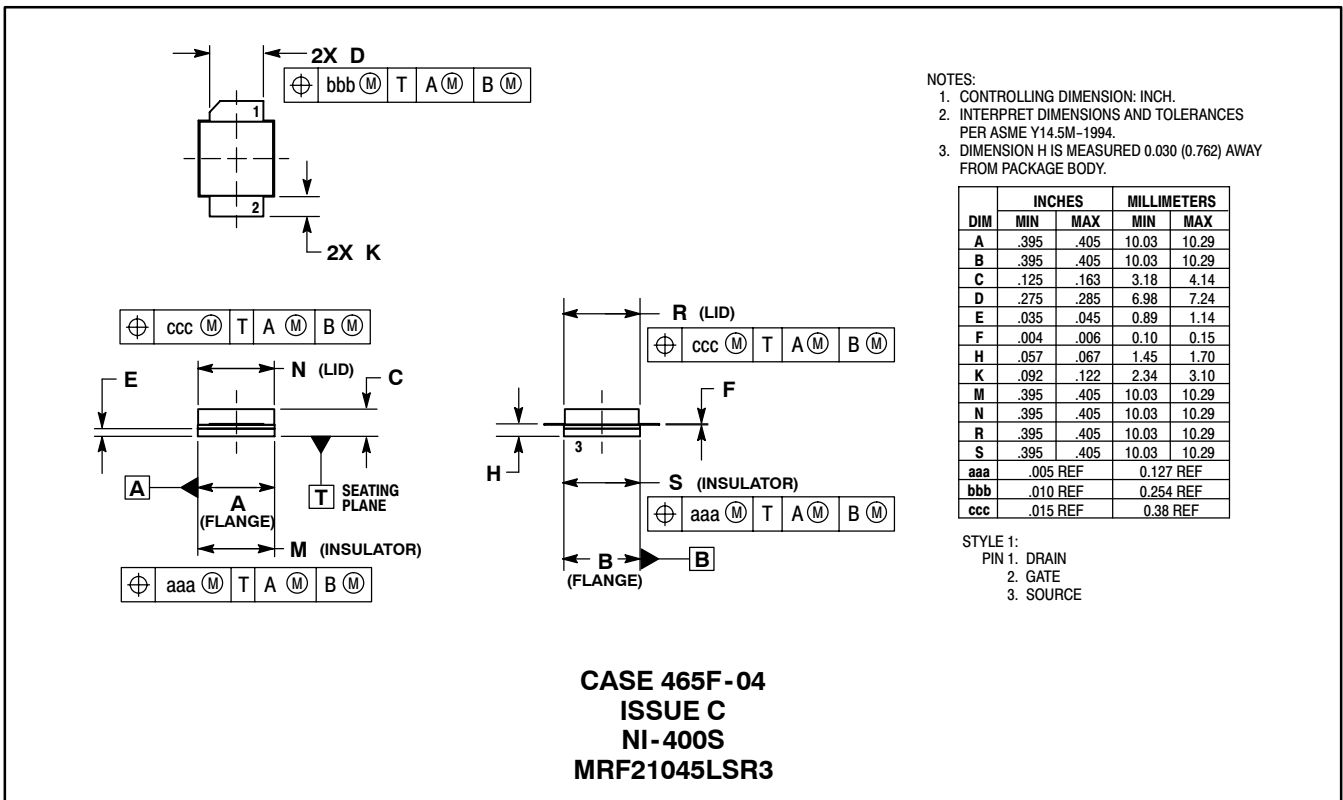
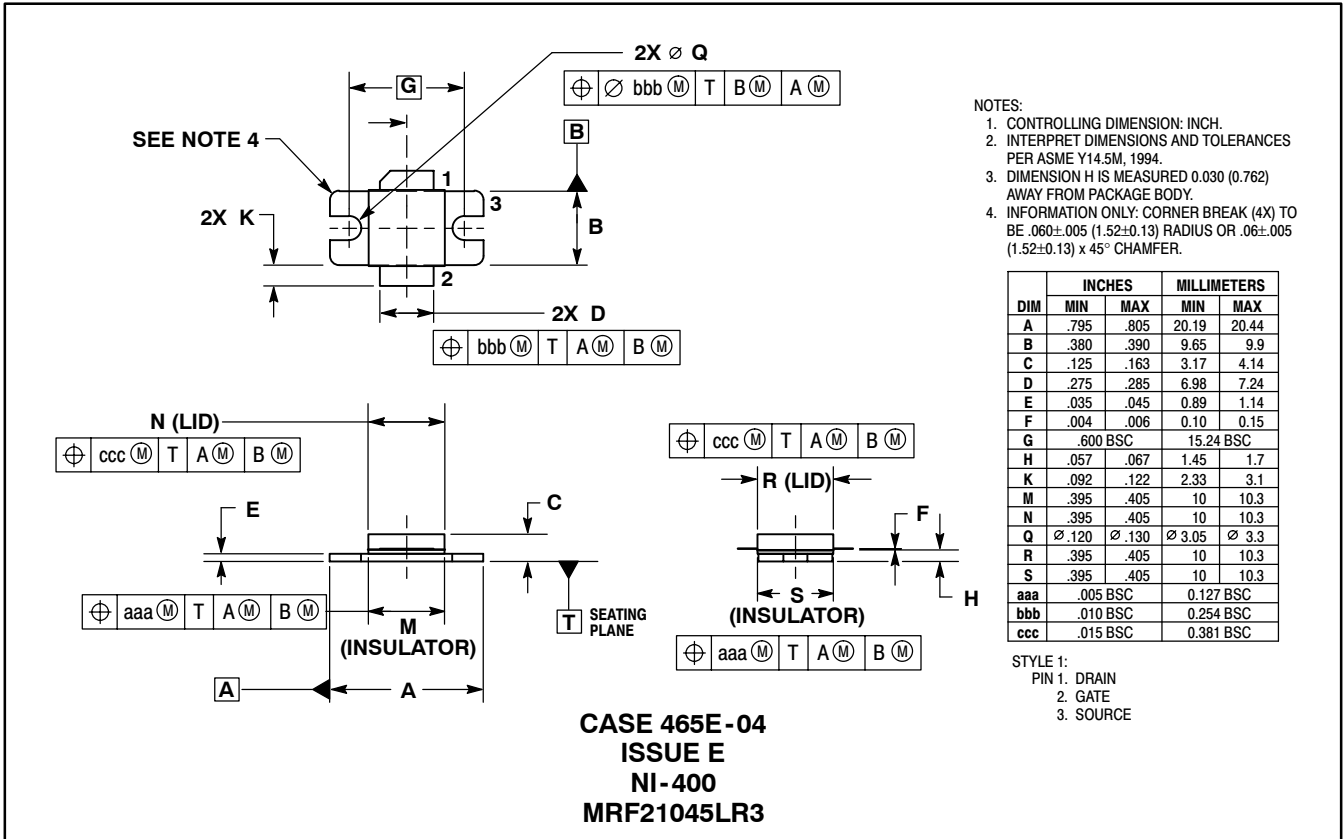
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