

# RF Power Field Effect Transistors

## N-Channel Enhancement-Mode Lateral MOSFETs

Designed for digital and analog cellular PCN and PCS base station applications with frequencies from 1000 to 2500 MHz. Characterized for operation Class A and Class AB at 26 volts in commercial and industrial applications.

- Specified Two-Tone Performance @ 1930 MHz, 26 Volts
  - Output Power — 4 Watts PEP
  - Power Gain — 11 dB
  - Efficiency — 30%
  - Intermodulation Distortion — -29 dBc
- Capable of Handling 10:1 VSWR, @ 26 Vdc, 2000 MHz, 4 Watts CW Output Power

### Features

- Excellent Thermal Stability
- Characterized with Series Equivalent Large-Signal Impedance Parameters
- S-Parameter Characterization at High Bias Levels
- RoHS Compliant
- In Tape and Reel. R1 Suffix = 500 Units per 12 mm, 7 inch Reel.

**MRF281SR1**  
**MRF281ZR1**

**1930-1990 MHz, 4 W, 26 V**  
**LATERAL N-CHANNEL**  
**BROADBAND**  
**RF POWER MOSFETs**

**CASE 458B-03, STYLE 1**  
**NI-200S**  
**MRF281SR1**

**CASE 458C-03, STYLE 1**  
**NI-200Z**  
**MRF281ZR1**

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**Table 1. Maximum Ratings**

Rating	Symbol	Value	Unit
Drain-Source Voltage	$V_{DSS}$	-0.5, +65	Vdc
Gate-Source Voltage	$V_{GS}$	$\pm 20$	Vdc
Total Device Dissipation @ $T_C = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	20 0.115	W W/ $^\circ\text{C}$
Storage Temperature Range	$T_{stg}$	-65 to +150	$^\circ\text{C}$
Case Operating Temperature	$T_C$	150	$^\circ\text{C}$
Operating Junction Temperature	$T_J$	200	$^\circ\text{C}$

**Table 2. Thermal Characteristics**

Characteristic	Symbol	Value	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	5.74	$^\circ\text{C}/\text{W}$

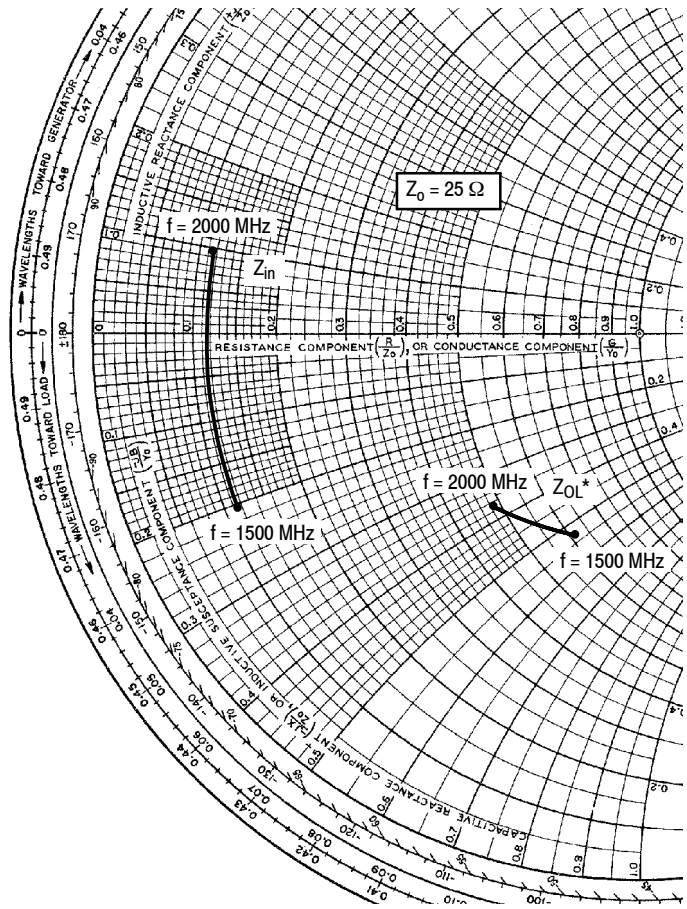
**Table 3. Electrical Characteristics** ( $T_C = 25^\circ\text{C}$  unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
<b>Off Characteristics</b>					
Drain-Source Breakdown Voltage ( $V_{GS} = 0, I_D = 10 \mu\text{Adc}$ )	$V_{(BR)DSS}$	65	74	—	Vdc
Zero Gate Voltage Drain Current ( $V_{DS} = 28 \text{ Vdc}, V_{GS} = 0$ )	$I_{DSS}$	—	—	10	$\mu\text{Adc}$
Gate-Source Leakage Current ( $V_{GS} = 20 \text{ Vdc}, V_{DS} = 0$ )	$I_{GSS}$	—	—	1	$\mu\text{Adc}$

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

**Table 3. Electrical Characteristics** ( $T_C = 25^\circ\text{C}$  unless otherwise noted) (continued)

Characteristic	Symbol	Min	Typ	Max	Unit
<b>On Characteristics</b>					
Gate Threshold Voltage ( $V_{DS} = 10\text{ Vdc}$ , $I_D = 20\ \mu\text{Adc}$ )	$V_{GS(th)}$	2.4	3.2	4	Vdc
Gate Quiescent Voltage ( $V_{DS} = 26\text{ Vdc}$ , $I_D = 25\text{ mA}$ )	$V_{GS(q)}$	3	4.1	5	Vdc
Drain-Source On-Voltage ( $V_{GS} = 10\text{ Vdc}$ , $I_D = 0.1\text{ A}$ )	$V_{DS(on)}$	0.18	0.24	0.30	Vdc
<b>Dynamic Characteristics</b>					
Input Capacitance ( $V_{DS} = 26\text{ Vdc}$ , $V_{GS} = 0$ , $f = 1.0\text{ MHz}$ )	$C_{iss}$	—	5.5	—	pF
Output Capacitance ( $V_{DS} = 26\text{ Vdc}$ , $V_{GS} = 0$ , $f = 1.0\text{ MHz}$ )	$C_{oss}$	—	3.3	—	pF
Reverse Transfer Capacitance ( $V_{DS} = 26\text{ Vdc}$ , $V_{GS} = 0$ , $f = 1.0\text{ MHz}$ )	$C_{rss}$	—	0.17	—	pF
<b>Functional Tests</b> (In Freescale Test Fixture)					
Common-Source Amplifier Power Gain ( $V_{DD} = 26\text{ Vdc}$ , $P_{out} = 4\text{ W PEP}$ , $I_{DQ} = 25\text{ mA}$ , $f_1 = 1930.0\text{ MHz}$ , $f_2 = 1930.1\text{ MHz}$ )	$G_{ps}$	11	12.5	—	dB
Drain Efficiency ( $V_{DD} = 26\text{ Vdc}$ , $P_{out} = 4\text{ W}$ , $I_{DQ} = 25\text{ mA}$ , $f_1 = 1930.0\text{ MHz}$ , $f_2 = 1930.1\text{ MHz}$ )	$\eta$	30	—	—	%
Input Return Loss ( $V_{DD} = 26\text{ Vdc}$ , $P_{out} = 4\text{ W PEP}$ , $I_{DQ} = 25\text{ mA}$ , $f_1 = 1930.0\text{ MHz}$ , $f_2 = 1930.1\text{ MHz}$ )	IRL	—	-16	-10	dB
Intermodulation Distortion ( $V_{DD} = 26\text{ Vdc}$ , $P_{out} = 4\text{ W PEP}$ , $I_{DQ} = 25\text{ mA}$ , $f_1 = 1930.0\text{ MHz}$ , $f_2 = 1930.1\text{ MHz}$ )	IMD	—	-31	—	dBc



$V_{DD} = 26 \text{ V}$ ,  $I_{DQ} = 25 \text{ mA}$ ,  $P_{out} = 4 \text{ W (PEP)}$

f MHz	$Z_{in}$ $\Omega$	$Z_{OL}^*$ $\Omega$
1500	$3.15 - j5.3$	$15.5 - j13.6$
1600	$3.1 - j3.8$	$14.7 - j12.5$
1700	$3.1 - j2.3$	$14.0 - j11.7$
1800	$3.1 - j0.7$	$13.4 - j11.0$
1900	$3.1 + j0.9$	$12.8 - j10.1$
2000	$3.1 + j2.4$	$12.2 - j9.2$

$Z_{in}$  = Complex conjugate of source impedance.  
 $Z_{OL}^*$  = Complex conjugate of the optimum load impedance at given output power, voltage, IMD, bias current and frequency.

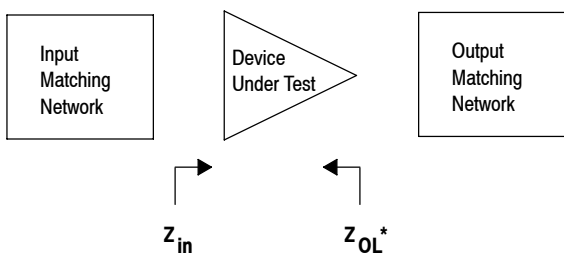


Figure 1. Series Equivalent Input and Output Impedance

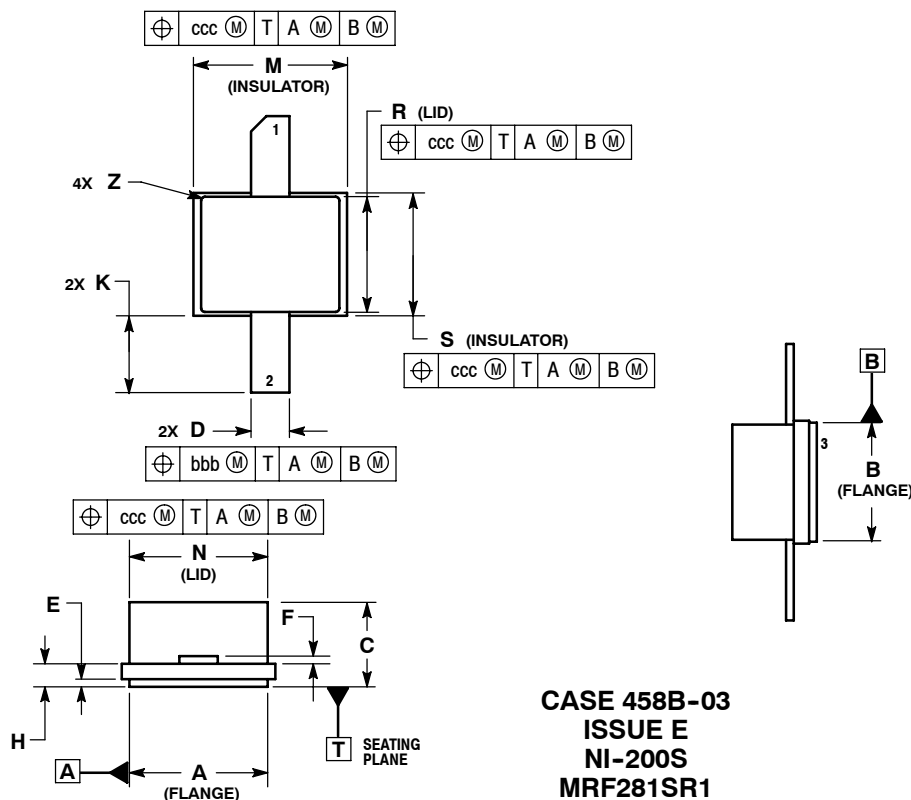
**Table 4. Common Source S-Parameters at  $V_{DS} = 26$  Vdc,  $I_D = 250$  mAdc**

f GHz	S <sub>11</sub>		S <sub>21</sub>		S <sub>12</sub>		S <sub>22</sub>	
	S <sub>11</sub>	∠ φ	dB	∠ φ	S <sub>12</sub>	∠ φ	S <sub>22</sub>	∠ φ
0.1	.982	-28	18.9	160	.008	73	.851	-13
0.2	.947	-52	17.0	143	.015	58	.811	-25
0.3	.912	-73	15.0	129	.019	45	.770	-33
0.4	.886	-90	12.9	117	.022	36	.741	-42
0.5	.859	-103	11.1	108	.022	28	.719	-47
0.6	.854	-114	9.69	100	.023	23	.718	-51
0.7	.841	-123	8.54	93	.022	18	.709	-56
0.8	.837	-131	7.57	87	.021	15	.714	-59
0.9	.838	-138	6.69	81	.019	12	.719	-62
1.0	.841	-143	6.01	76	.018	11	.728	-64
1.1	.840	-149	5.41	72	.015	12	.742	-66
1.2	.849	-153	4.91	68	.013	13	.745	-68
1.3	.848	-158	4.51	64	.012	18	.758	-69
1.4	.856	-162	4.12	60	.010	26	.769	-70
1.5	.858	-167	3.78	57	.009	36	.786	-70
1.6	.871	-170	3.50	54	.008	54	.797	-72
1.7	.868	-173	3.22	51	.009	69	.808	-71
1.8	.870	-176	3.00	49	.009	82	.823	-72
1.9	.872	-180	2.80	46	.011	95	.828	-72
2.0	.877	178	2.63	44	.013	104	.845	-72
2.1	.876	174	2.47	41	.015	109	.843	-72
2.2	.880	171	2.36	39	.018	111	.859	-71
2.3	.882	168	2.21	36	.021	114	.858	-72
2.4	.886	165	2.12	34	.024	114	.872	-70
2.5	.896	162	1.97	32	.027	115	.863	-70
2.6	.897	158	1.89	29	.029	117	.873	-69

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### PACKAGE DIMENSIONS



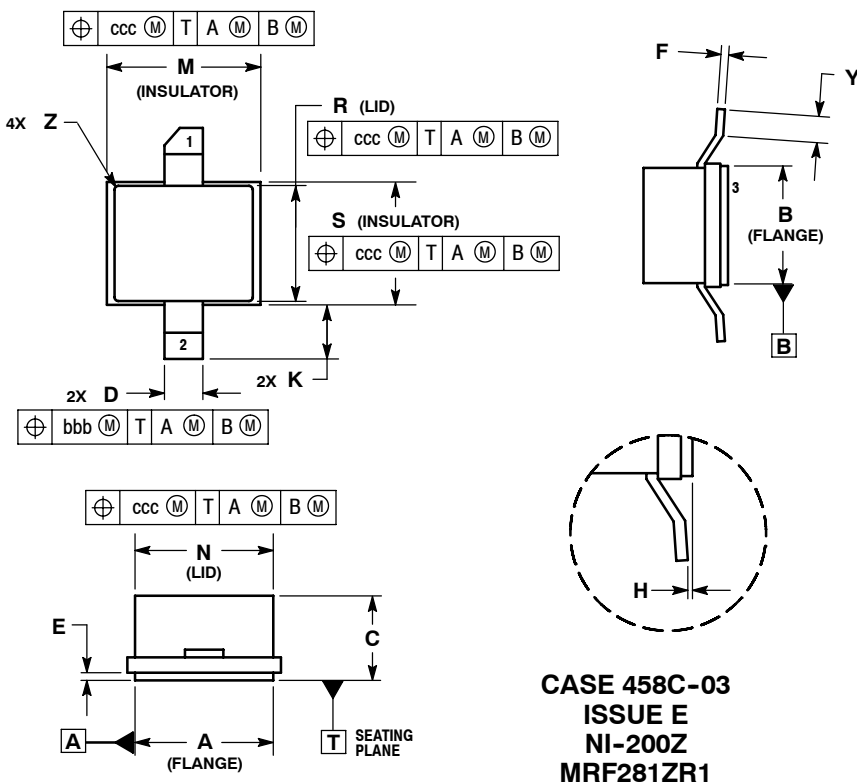
- NOTES:
1. CONTROLLING DIMENSIONS: INCHES.
  2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1994.
  3. ALL DIMENSIONS ARE SYMMETRICAL ABOUT CENTERLINE UNLESS OTHERWISE NOTED.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.180	0.190	4.572	4.83
B	0.140	0.150	3.556	3.81
C	0.082	0.116	2.083	2.946
D	0.047	0.053	1.194	1.346
E	0.004	0.010	0.102	0.254
F	0.004	0.006	0.102	0.152
H	0.025	0.031	0.635	0.787
K	0.060	0.110	1.524	2.794
M	0.197	0.203	5.004	5.156
N	0.177	0.183	4.496	4.648
R	0.147	0.153	3.734	3.886
S	0.157	0.163	3.988	4.14
Z	---	0.020	---	0.508
bbb	.010 REF		0.254 REF	
ccc	.015 REF		0.381 REF	

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

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- NOTES:
1. CONTROLLING DIMENSIONS: INCHES.
  2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1994.
  3. DIMENSION H (PACKAGE COPLANARITY): THE BOTTOM OF LEADS AND REFERENCE PLANE T MUST BE COPLANAR WITHIN DIMENSION H.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.180	0.190	4.572	4.830
B	0.140	0.150	3.556	3.810
C	0.082	0.116	2.083	2.946
D	0.047	0.053	1.194	1.346
E	0.004	0.010	0.102	0.254
F	0.004	0.006	0.102	0.152
H	0.000	0.004	0.000	0.102
K	0.050	0.090	1.270	2.286
M	0.197	0.203	5.004	5.156
N	0.177	0.183	4.496	4.648
R	0.147	0.153	3.734	3.886
S	0.157	0.163	3.988	4.140
Y	0.020	0.040	0.508	1.016
Z	---	R.020	---	R.508
bbb	.010 REF		0.254 REF	
ccc	.015 REF		0.381 REF	

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

## PRODUCT DOCUMENTATION

Refer to the following documents to aid your design process.

### Engineering Bulletins

- EB212: Using Data Sheet Impedances for RF LDMOS Devices

## REVISION HISTORY

The following table summarizes revisions to this document.

Revision	Date	Description
6	Oct. 2008	<ul style="list-style-type: none"> <li>• Modified data sheet to reflect RF Test Reduction described in Product and Process Change Notification number, PCN13232, p. 1, 2, and Product Discontinuance Notification number, PCN13420, adding applicable overlay</li> <li>• Added Product Documentation and Revision History, p. 6</li> </ul>
	Dec. 2010	<ul style="list-style-type: none"> <li>• Data sheet archived. Parts no longer manufactured.</li> </ul>

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