

## The RF MOSFET Line: Broadband Power FET 4W, to 500MHz, 28V

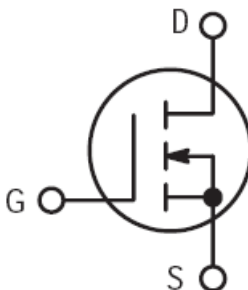
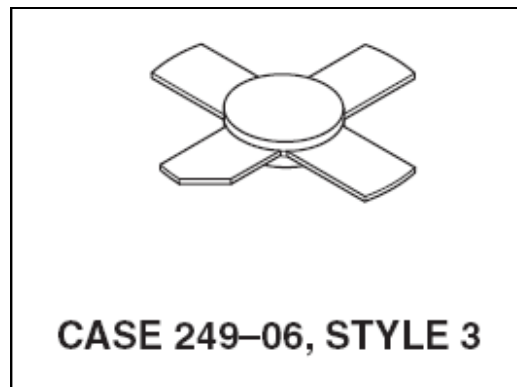
Rev. V1

Designed primarily for wideband large-signal output and driver from 30–500 MHz.

N-Channel enhancement mode MOSFET

- Guaranteed 28 V, 500 MHz performance  
Output power = 4.0 W  
Gain = 16 dB (min.)  
Efficiency = 55% (typ.)
- Excellent thermal stability, ideally suited for Class A operation
- Facilitates manual gain control, ALC and modulation techniques
- 100% Tested for load mismatch at all phase angles with 30:1 VSWR
- Low Crss – 0.8 pF Typical at VDS = 28 V

### Product Image



### MAXIMUM RATINGS ( $T_J = 25^\circ\text{C}$ unless otherwise noted)

Rating	Symbol	Value	Unit
Drain–Gate Voltage	$V_{DSS}$	65	Vdc
Drain–Gate Voltage ( $R_{GS} = 1.0\text{ M}\Omega$ )	$V_{DGR}$	65	Vdc
Gate–Source Voltage	$V_{GS}$	$\pm 20$	Vdc
Drain Current–Continuous	$I_D$	1.0	ADC
Total Device Dissipation @ $T_C = 25^\circ\text{C}$ Derate Above $25^\circ\text{C}$	$P_D$	24 0.14	Watts $\text{W}/^\circ\text{C}$
Storage Temperature Range	$T_{stg}$	– 65 to +150	$^\circ\text{C}$
Operating Junction Temperature	$T_J$	200	$^\circ\text{C}$

### THERMAL CHARACTERISTICS

Thermal Resistance — Junction to Case	$R_{\theta JC}$	7.2	$^\circ\text{C}/\text{W}$
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**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 ( $T_C = 25^\circ\text{C}$ unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
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#### OFF CHARACTERISTICS

Drain–Source Breakdown Voltage ( $V_{DS} = 0\text{ Vdc}$ , $V_{GS} = 0\text{ Vdc}$ , $I_D = 1.0\text{ mA}$ )	$V_{(BR)DSS}$	65	—	—	Vdc
Zero Gate Voltage Drain Current ( $V_{DS} = 28\text{ Vdc}$ , $V_{GS} = 0\text{ V}$ )	$I_{DSS}$	—	—	0.5	mA
Gate–Source Leakage Current ( $V_{GS} = 20\text{ Vdc}$ , $V_{DS} = 0\text{ Vdc}$ )	$I_{GSS}$	—	—	1.0	$\mu\text{A}$

#### ON CHARACTERISTICS

Gate Threshold Voltage ( $V_{DS} = 10\text{ Vdc}$ , $I_D = 10\text{ mA}$ )	$V_{GS(th)}$	1.5	3.0	4.5	Vdc
Drain Source On–Voltage ( $V_{DS(on)}$ , $V_{GS} = 10\text{ Vdc}$ , $I_D = 500\text{ mA}$ )	$V_{DS(on)}$	—	3.8	—	Vdc
Forward Transconductance ( $V_{DS} = 10\text{ Vdc}$ , $I_D = 250\text{ mA}$ )	$g_{fs}$	150	220	—	mS

#### DYNAMIC CHARACTERISTICS

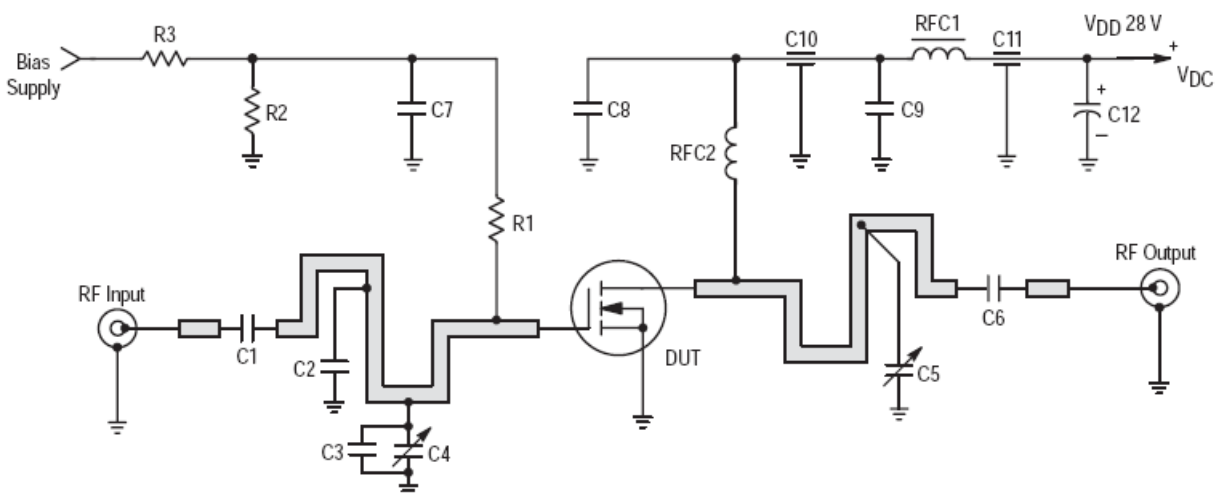
Input Capacitance ( $V_{DS} = 28\text{ Vdc}$ , $V_{GS} = 0\text{ V}$ , $f = 1.0\text{ MHz}$ )	$C_{iss}$	—	6.0	—	pF
Output Capacitance ( $V_{DS} = 28\text{ V}$ , $V_{GS} = 0\text{ Vdc}$ , $f = 1.0\text{ MHz}$ )	$C_{oss}$	—	6.5	—	pF
Reverse Transfer Capacitance ( $V_{DS} = 28\text{ Vdc}$ , $V_{GS} = 0\text{ Vdc}$ , $f = 1.0\text{ MHz}$ )	$C_{rss}$	—	0.8	—	pF

#### FUNCTIONAL CHARACTERISTICS

Common Source Power Gain ( $V_{DD} = 28\text{ Vdc}$ , $P_{out} = 4.0\text{ W}$ , $f = 500\text{ MHz}$ , $I_{DQ} = 50\text{ mA}$ )	$G_{ps}$	16	18	—	dB
Drain Efficiency ( $V_{DD} = 28\text{ Vdc}$ , $P_{out} = 4.0\text{ W}$ , $f = 500\text{ MHz}$ , $I_{DQ} = 50\text{ mA}$ )	$\eta$	50	55	—	%
Electrical Ruggedness ( $V_{DD} = 28\text{ Vdc}$ , $P_{out} = 4.0\text{ W}$ , $f = 500\text{ MHz}$ , $I_{DQ} = 50\text{ mA}$ ) Load VSWR = 30:1 at All Phase Angles at Frequency of Test	$\psi$	No Degradation in Output Power			
Series Equivalent Input Impedance ( $V_{DD} = 28\text{ Vdc}$ , $P_{out} = 4.0\text{ W}$ , $f = 500\text{ MHz}$ , $I_{DQ} = 50\text{ mA}$ )	$Z_{in}$	—	$6.8 - j21$	—	Ohms
Series Equivalent Output Impedance ( $V_{DD} = 28\text{ Vdc}$ , $P_{out} = 4.0\text{ W}$ , $f = 500\text{ MHz}$ , $I_{DQ} = 50\text{ mA}$ )	$Z_{out}$	—	$21 - j28$	—	Ohms

## The RF MOSFET Line: Broadband Power FET 4W, to 500MHz, 28V

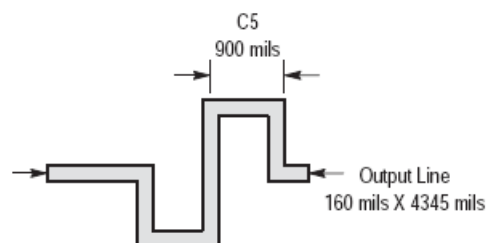
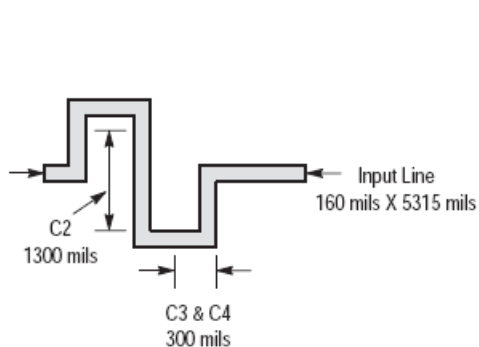
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C1, C6 240 pF, 100 mil Chip Capacitors  
C2 15 pF, 100 mil ATC Chip Capacitor  
C4, C5 1 – 10 pF, Johanson Trimmer Capacitors  
C3 24 pF, 100 mil ATC Chip Capacitor  
C7, C9 0.1  $\mu$ F, 100 mil Chip Capacitors  
C8 220 pF, 100 mil ATC Chip Capacitor  
C10, C11 680 pF, Feed Through Capacitors  
C12 50  $\mu$ F, 50 V Electrolytic Capacitor

R1 200  $\Omega$ , 1/2 Watt  
R2 10 k $\Omega$ , 1/2 Watt  
R3 1 k $\Omega$ , 1/2 Watt  
RFC1 Ferroxcube VK200-19/4B  
RFC2 8 Turns, #20 AWG, Enameled, ID 110 mils

Board Material — 0.062", Teflon® Fiberglass, 1 oz.,  
Copper clad both sides,  $\epsilon_r = 2.55$



NOTE: Due to variation in Chip Capacitor values and board material, these are approximate positions.

Figure 1. MRF160 500 MHz Test Circuit

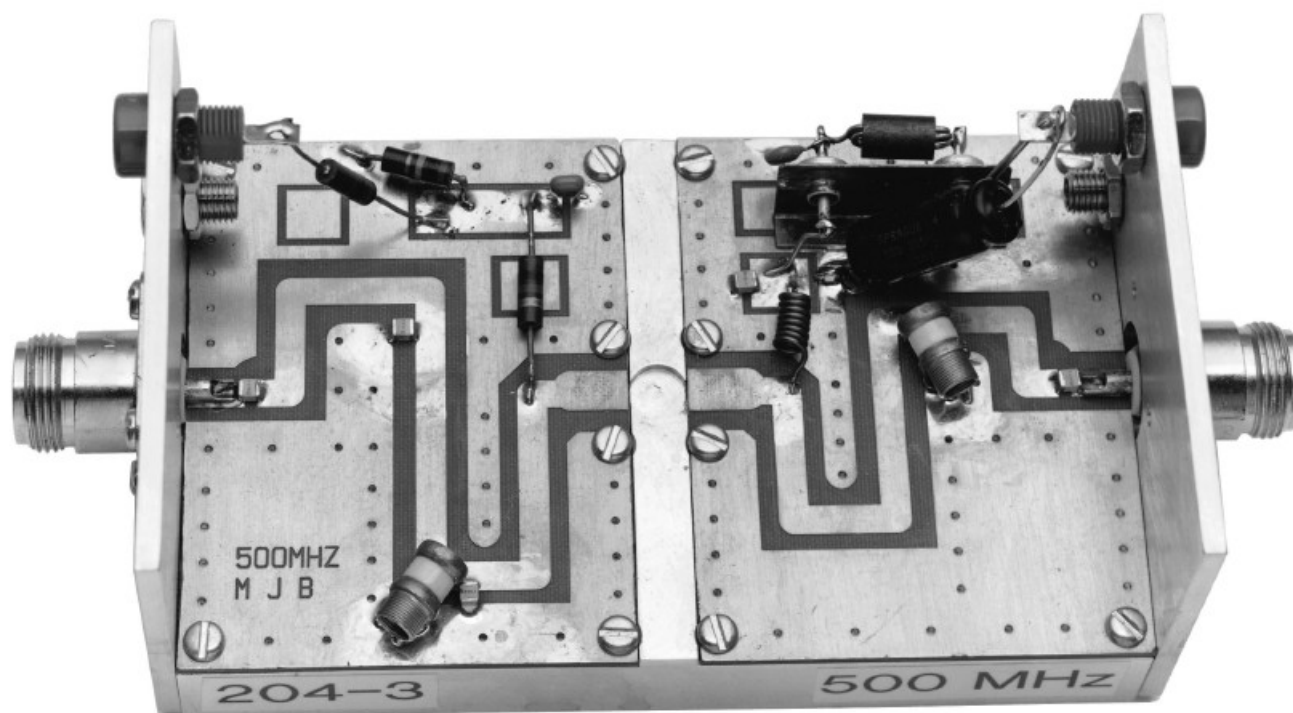


Figure 2. MRF160 Broadband Test Fixture

## TYPICAL CHARACTERISTICS

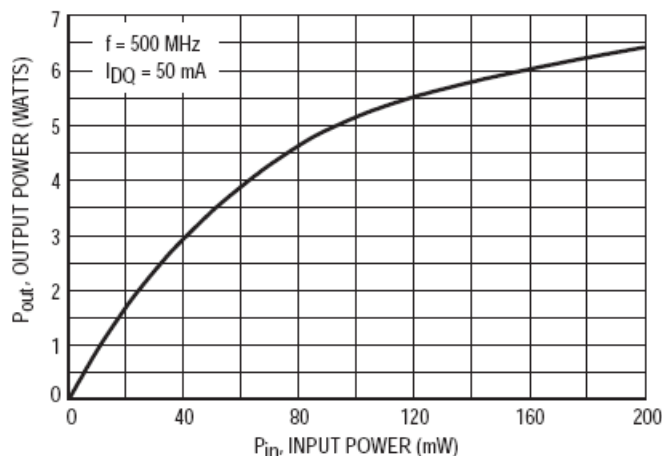


Figure 3. Output Power versus Input Power

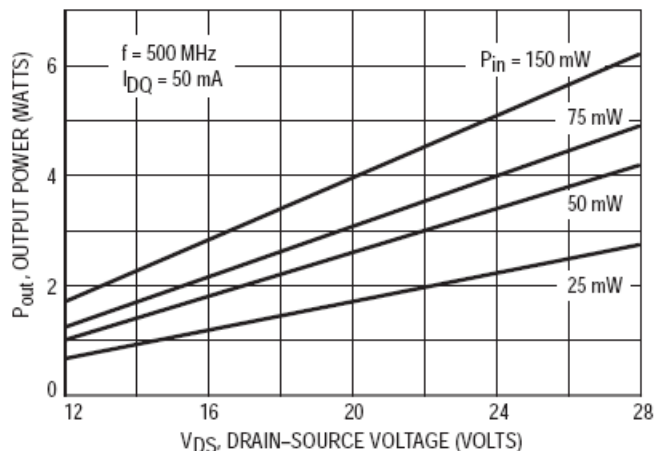


Figure 4. Output Power versus Voltage

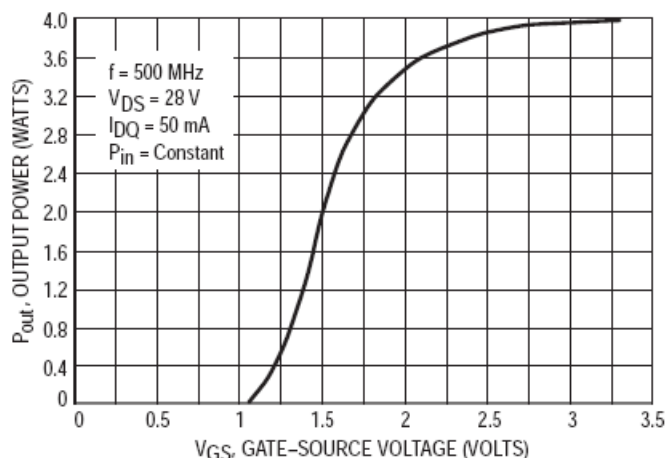


Figure 5. Output Power versus Gate Voltage

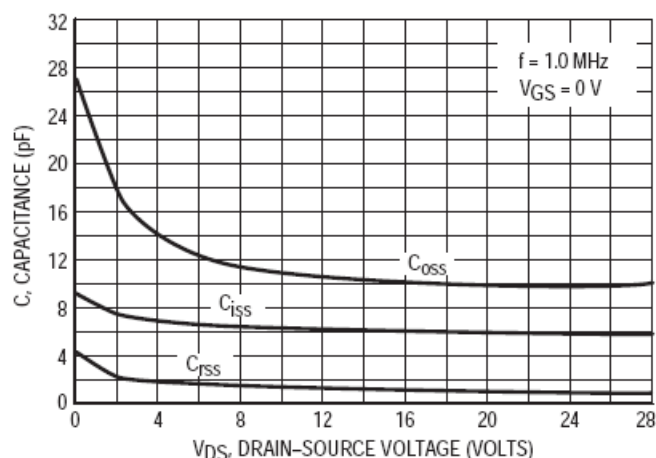


Figure 6. Capacitance versus Drain-Source Voltage

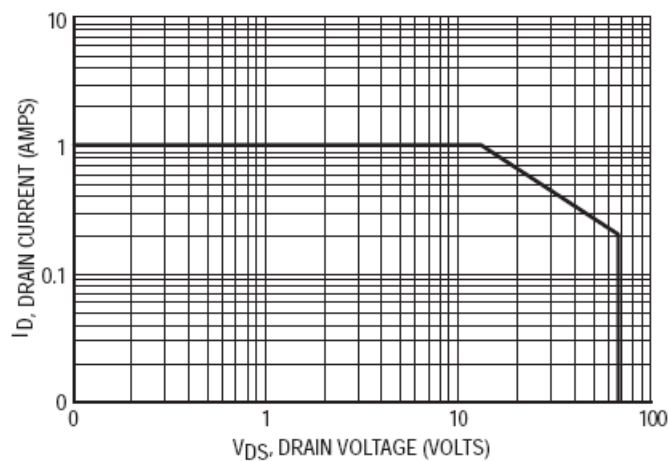


Figure 7. DC Safe Operating Area

**The RF MOSFET Line: Broadband Power FET**  
**4W, to 500MHz, 28V**

Rev. V1

Table 1. Common Source S-Parameters ( $V_{DS} = 12.5\text{ V}$ ,  $I_D = 120\text{ mA}$ )

f MHz	S <sub>11</sub>		S <sub>21</sub>		S <sub>12</sub>		S <sub>22</sub>	
	S <sub>11</sub>	∠	S <sub>21</sub>	∠	S <sub>12</sub>	∠	S <sub>22</sub>	∠
30	0.991	-19	15.80	166	0.019	77	0.938	-19
40	0.970	-25	15.50	161	0.025	72	0.933	-25
50	0.959	-31	15.20	156	0.030	67	0.918	-31
60	0.943	-37	14.80	151	0.035	63	0.900	-37
70	0.925	-42	14.30	147	0.040	59	0.880	-42
80	0.912	-48	13.90	143	0.044	56	0.863	-47
85	0.903	-51	13.70	141	0.046	54	0.857	-49
90	0.896	-53	13.50	139	0.048	52	0.851	-52
100	0.872	-58	12.90	135	0.051	48	0.830	-57
110	0.853	-63	12.40	131	0.054	46	0.812	-60
120	0.841	-67	11.90	128	0.056	43	0.796	-63
130	0.831	-71	11.50	126	0.059	40	0.788	-67
140	0.814	-75	11.10	122	0.061	37	0.777	-70
150	0.797	-79	10.70	119	0.063	34	0.760	-74
160	0.782	-82	10.20	117	0.064	32	0.739	-78
170	0.776	-85	9.81	115	0.066	32	0.740	-79
180	0.769	-89	9.55	112	0.068	28	0.737	-83
190	0.754	-92	9.24	109	0.069	25	0.725	-87
200	0.737	-94	8.83	107	0.068	23	0.707	-90
210	0.731	-96	8.47	105	0.068	22	0.692	-92
220	0.730	-99	8.20	103	0.069	21	0.692	-94
230	0.724	-101	7.94	101	0.071	20	0.697	-95
240	0.713	-104	7.69	99	0.072	16	0.696	-99
250	0.705	-106	7.44	97	0.070	15	0.676	-100
260	0.699	-108	7.18	96	0.070	15	0.673	-102
270	0.697	-109	6.91	94	0.070	14	0.661	-103
280	0.697	-111	6.70	93	0.071	13	0.654	-104
290	0.693	-113	6.54	92	0.071	11	0.658	-106
300	0.686	-115	6.36	90	0.072	9	0.664	-108
310	0.679	-116	6.12	88	0.069	7	0.639	-111
320	0.679	-117	5.96	87	0.070	9	0.642	-110
330	0.679	-119	5.80	86	0.070	8	0.648	-112
340	0.679	-121	5.63	84	0.071	7	0.648	-114
350	0.674	-122	5.47	83	0.070	5	0.645	-114
360	0.669	-123	5.33	82	0.070	4	0.650	-116
370	0.667	-124	5.18	80	0.068	3	0.644	-118
380	0.672	-125	5.02	80	0.066	3	0.614	-119
390	0.675	-127	4.96	78	0.071	4	0.655	-116
400	0.672	-129	4.83	77	0.070	2	0.655	-119
410	0.668	-130	4.70	75	0.069	0	0.654	-121
420	0.666	-131	4.56	74	0.067	-1	0.644	-122
430	0.667	-131	4.48	74	0.066	-1	0.646	-122

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Rev. V1

Table 1. Common Source S-Parameters ( $V_{DS} = 12.5\text{ V}$ ,  $I_D = 120\text{ mA}$ ) (continued)

f MHz	S <sub>11</sub>		S <sub>21</sub>		S <sub>12</sub>		S <sub>22</sub>	
	S <sub>11</sub>	∠	S <sub>21</sub>	∠	S <sub>12</sub>	∠	S <sub>22</sub>	∠
440	0.671	-132	4.39	72	0.066	-1	0.651	-123
450	0.670	-134	4.29	71	0.068	-1	0.663	-123
460	0.662	-135	4.15	70	0.067	-6	0.677	-127
470	0.663	-135	4.05	69	0.065	-5	0.664	-127
480	0.666	-136	3.95	68	0.064	-5	0.663	-128
490	0.670	-137	3.88	67	0.064	-5	0.663	-128
500	0.670	-138	3.81	66	0.063	-6	0.670	-128
600	0.693	-147	3.06	55	0.053	-17	0.689	-136
700	0.708	-152	2.61	46	0.044	-14	0.723	-142
800	0.731	-158	2.22	40	0.037	-15	0.733	-146
900	0.724	-165	1.93	32	0.037	-32	0.760	-151
1000	0.748	-169	1.73	28	0.027	-6	0.778	-153

**The RF MOSFET Line: Broadband Power FET**  
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Table 2. Common Source S-Parameters ( $V_{DS} = 28\text{ V}$ ,  $I_D = 250\text{ mA}$ )

f MHz	S <sub>11</sub>		S <sub>21</sub>		S <sub>12</sub>		S <sub>22</sub>	
	S <sub>11</sub>	∠	S <sub>21</sub>	∠	S <sub>12</sub>	∠	S <sub>22</sub>	∠
30	0.995	-18	15.00	167	0.014	78	0.919	-15
40	0.978	-24	14.70	162	0.018	73	0.913	-19
50	0.971	-30	14.50	158	0.022	69	0.900	-23
60	0.961	-36	14.20	153	0.026	65	0.885	-28
70	0.947	-41	13.80	149	0.029	62	0.867	-32
80	0.938	-46	13.40	145	0.033	58	0.851	-35
85	0.932	-49	13.30	143	0.034	56	0.845	-37
90	0.927	-51	13.10	141	0.036	55	0.839	-39
100	0.908	-56	12.70	138	0.038	51	0.825	-43
110	0.893	-61	12.20	134	0.040	49	0.802	-46
120	0.884	-65	11.80	131	0.043	46	0.788	-48
130	0.875	-69	11.40	128	0.045	44	0.781	-51
140	0.862	-74	11.10	125	0.047	40	0.772	-54
150	0.848	-78	10.70	122	0.048	37	0.754	-57
160	0.836	-81	10.30	119	0.049	35	0.733	-60
170	0.830	-84	9.86	117	0.050	35	0.718	-60
180	0.824	-88	9.64	115	0.053	31	0.729	-64
190	0.813	-91	9.38	112	0.053	29	0.719	-67
200	0.798	-94	9.00	109	0.053	26	0.701	-70
210	0.792	-96	8.63	107	0.053	25	0.682	-72
220	0.790	-98	8.36	105	0.054	24	0.677	-73
230	0.785	-101	8.10	104	0.055	22	0.677	-75
240	0.777	-104	7.92	101	0.057	19	0.694	-78
250	0.769	-106	7.65	99	0.055	18	0.663	-80
260	0.764	-108	7.40	97	0.055	18	0.662	-81
270	0.761	-109	7.13	96	0.055	17	0.649	-82
280	0.760	-111	6.91	95	0.055	16	0.640	-82

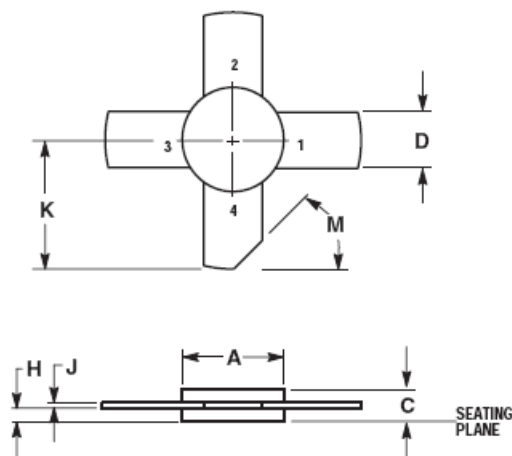
**The RF MOSFET Line: Broadband Power FET**  
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Table 2. Common Source S-Parameters ( $V_{DS} = 28\text{ V}$ ,  $I_D = 250\text{ mA}$ ) (continued)

f MHz	S <sub>11</sub>		S <sub>21</sub>		S <sub>12</sub>		S <sub>22</sub>	
	S <sub>11</sub>	∠	S <sub>21</sub>	∠	S <sub>12</sub>	∠	S <sub>22</sub>	∠
290	0.757	-113	6.75	93	0.055	14	0.641	-84
300	0.751	-115	6.59	91	0.056	12	0.645	-86
310	0.743	-117	6.37	89	0.055	9	0.635	-90
320	0.744	-118	6.17	88	0.054	11	0.619	-89
330	0.744	-120	6.01	87	0.055	11	0.628	-90
340	0.743	-121	5.85	85	0.055	10	0.629	-92
350	0.738	-123	5.70	84	0.055	8	0.629	-92
360	0.733	-124	5.55	82	0.054	6	0.631	-94
370	0.730	-126	5.40	81	0.054	4	0.623	-96
380	0.732	-127	5.21	80	0.052	4	0.593	-98
390	0.737	-129	5.17	79	0.055	7	0.627	-93
400	0.734	-130	5.04	77	0.055	4	0.639	-97
410	0.731	-131	4.92	76	0.054	3	0.641	-99
420	0.728	-132	4.78	75	0.052	1	0.630	-100
430	0.729	-133	4.67	74	0.051	0	0.628	-101
440	0.731	-134	4.57	72	0.051	1	0.626	-102
450	0.731	-136	4.47	71	0.053	1	0.630	-102
460	0.723	-137	4.37	69	0.054	-4	0.673	-106
470	0.724	-137	4.24	68	0.050	-3	0.647	-107
480	0.727	-138	4.13	68	0.049	-3	0.642	-108
490	0.730	-139	4.05	67	0.048	-3	0.641	-107
500	0.730	-140	3.99	66	0.048	-4	0.647	-108
600	0.736	-150	3.54	56	0.037	-14	0.657	-118
700	0.745	-156	2.99	46	0.029	-9	0.699	-126
800	0.765	-161	2.54	39	0.025	-5	0.713	-131
900	0.759	-168	2.20	31	0.022	-34	0.742	-136
1000	0.769	-173	1.98	27	0.018	19	0.756	-139

## PACKAGE DIMENSIONS



- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  2. CONTROLLING DIMENSION: INCH.
  3. SEATING PLANE = GROUND AND IS CONNECTED TO PIN 1 AND 3.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.271	0.286	6.88	7.26
C	0.112	0.136	2.84	3.45
D	0.215	0.235	5.46	5.97
H	0.065	0.065	1.40	1.65
J	0.003	0.007	0.08	0.18
K	0.435	—	11.05	—
M	45° REF		45° REF	

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

CASE 249-06  
ISSUE H

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