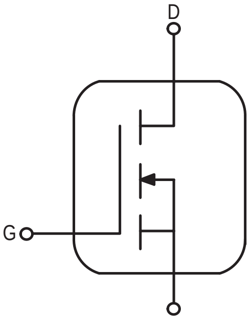
The RF MOSFET Line
RF Power Field Effect Transistors
N–Channel Enhancement–Mode Lateral MOSFETs

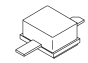
MRF181SR1
MRF181ZR1

Designed for broadband commercial and industrial applications at frequencies to 1.0 GHz. The high gain and broadband performance of these devices make them ideal for large–signal, common source amplifier applications in 12.5 and 28 volt mobile, portable and base station equipment.

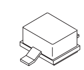
- Guaranteed Performance @ 945 MHz, 28 Volts
  - Output Power = 7.5 Watts
  - Power Gain = 15.5 dB
  - Efficiency = 30%
- Capable of Handling 5:1 VSWR @ 28 Vdc, 945 MHz, 7.5 Watts CW Output Power
- Excellent Thermal Stability
- Characterized with Series Equivalent Large–Signal Impedance Parameters
- S–Parameter Characterization at High Bias Levels
- Suitable for 12.5 Volt Application
- Available in Tape and Reel. R1 Suffix = 500 Units per 12 mm, 7 inch Reel.



1.0 GHz, 7.5 W, 28 V
LATERAL N–CHANNEL
BROADBAND
RF POWER MOSFETs



CASE 458B–02, STYLE 1
(MRF181SR1)



CASE 458C–02, STYLE 1
(MRF181ZR1)

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Drain–Source Voltage	V_{DSS}	65	Vdc
Gate–Source Voltage	V_{GS}	±20	Vdc
Drain Current — Continuous	I_D	2.0	Adc
Total Device Dissipation @ T_C = 70°C Derate above 70°C	P_D	36 0.278	Watts W/°C
Storage Temperature Range	T_{stg}	–65 to +150	°C
Operating Junction Temperature	T_J	200	°C

THERMAL CHARACTERISTICS

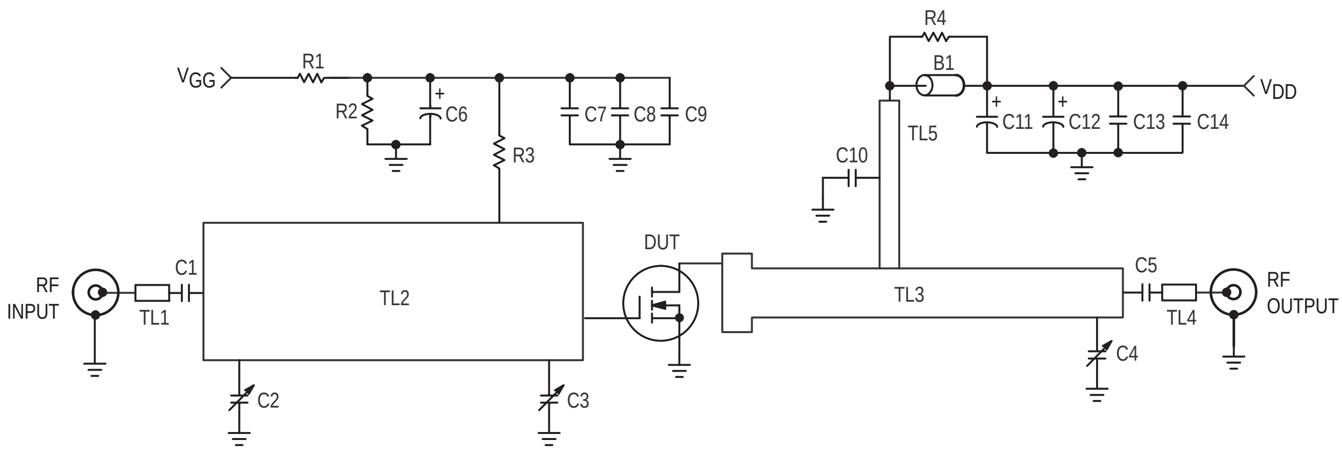
Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	5.42	°C/W

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

REV 1

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

Characteristic	Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS					
Drain–Source Breakdown Voltage (V_{GS} = 0, I_D = 50 μAdc)	$V_{(BR)DSS}$	65	—	—	Vdc
Zero Gate Voltage Drain Current (V_{DS} = 28 Vdc, V_{GS} = 0)	I_{DSS1}	—	—	1.0	μAdc
Zero Gate Voltage Drain Current (V_{DS} = 65 Vdc, V_{GS} = 0)	I_{DSS2}	—	—	1.0	μAdc
Gate–Source Leakage Current (V_{GS} = 20 Vdc, V_{DS} = 0)	I_{GSS}	—	—	1.0	μAdc
ON CHARACTERISTICS					
Gate Threshold Voltage (V_{DS} = 10 Vdc, I_D = 55 μAdc)	$V_{GS(th)}$	2.0	3.6	4.0	Vdc
Drain–Source On–Voltage (V_{GS} = 10 Vdc, I_D = 0.5 Adc)	$V_{DS(on)}$	0.3	0.66	0.8	Vdc
Gate Quiescent Voltage (V_{DS} = 28 Vdc, I_D = 170 mAdc)	$V_{GS(q)}$	3.5	—	5.5	Vdc
DYNAMIC CHARACTERISTICS					
Input Capacitance (V_{DS} = 28 Vdc, V_{GS} = 0, f = 1.0 MHz)	C_{iss}	—	13	—	pF
Output Capacitance (V_{DS} = 28 Vdc, V_{GS} = 0, f = 1.0 MHz)	C_{oss}	—	6.6	—	pF
Reverse Transfer Capacitance (V_{DS} = 28 Vdc, V_{GS} = 0, f = 1.0 MHz)	C_{rss}	—	0.69	—	pF
FUNCTIONAL TESTS (In Motorola Test Circuit. See Figure 1.)					
Common–Source Power Gain (V_{DD} = 28 Vdc, P_{out} = 7.5 W PEP, I_{DQ} = 170 mA, f1 = 945 MHz, f2 = 945.1 MHz, Min 15.5 dB)	G_{ps}	15.5	17	—	dB
Drain Efficiency (V_{DD} = 28 Vdc, P_{out} = 7.5 W PEP, I_{DQ} = 170 mA, f1 = 945 MHz, f2 = 945.1 MHz)	η	30	32.5	—	%
Input Return Loss (V_{DD} = 28 Vdc, P_{out} = 7.5 W PEP, I_{DQ} = 170 mA, f1 = 945 MHz, f2 = 945.1 MHz)	IRL	—	–12.7	–9	dB
Intermodulation Distortion (V_{DD} = 28 Vdc, P_{out} = 7.5 W PEP, I_{DQ} = 170 mA, f1 = 945 MHz, f2 = 945.1 MHz)	IMD	—	–30	–28.5	dBc
Output Mismatch Stress (V_{DD} = 28 Vdc, P_{out} = 7.5 W CW, I_{DQ} = 170 mA, f1 = 945 MHz, Load VSWR = 5:1, All Phase Angles)	Ψ	No Degradation In Output Power			



B1	Short RF Bead, Fair Rite-2743019447
C1	18 pF Chip Capacitor, ATC 100B180CCA500X
C2, C3	0.8–8.0 pF Variable Capacitor, Johansen Gigatrim
C4	0.4–2.5 pF Variable Capacitor, Johansen Gigatrim
C5	100 pF Chip Capacitor, ATC 100A101CCA150X
C6, C12	10 µF, 50 Vdc Electrolytic Capacitor, Panosonic ECEV1HV100R
C7	43 pF Chip Capacitor, ATC 100B430CCA500X
C8, C13	1000 pF Chip Capacitor, ATC 100B102CCA500X
C9, C14	0.1 µF 50 Vdc Ceramic, Kemet CDR33BX104AKWS
C10	30 pF Chip Capacitor, ATC 100B390CCA500X
C11	250 µF, 50 Vdc Electrolytic Capacitor, Mallory TC50025
N1, N2	Type N Connector
R1	1.2 kΩ, 1/4 W Resistor
R2	47 kΩ, 1/4 W Resistor
R3	10 kΩ, 1/4 W Chip Resistor
R4	4.0 x 39 Ω, 1/8 W Chip Resistor
TL1-TL5	Microstrip Line
Ckt Board	1/32″ Glass Teflon®, ε_r = 2.55, Arlon–GX–0300–55–22

Figure 1. MRF181 Test Circuit Schematic

TYPICAL CHARACTERISTICS

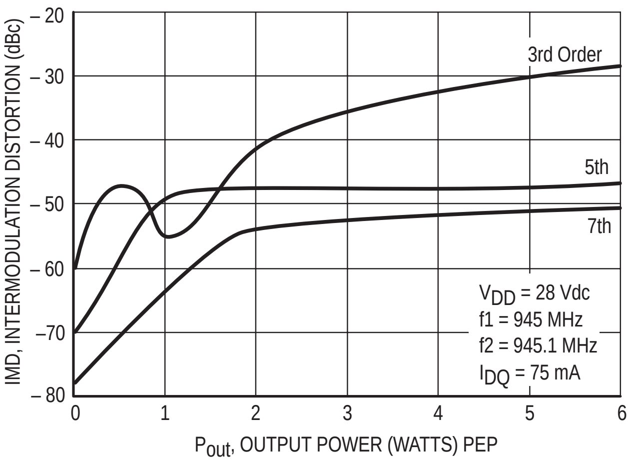


Figure 2. Intermodulation Distortion Products versus Output Power

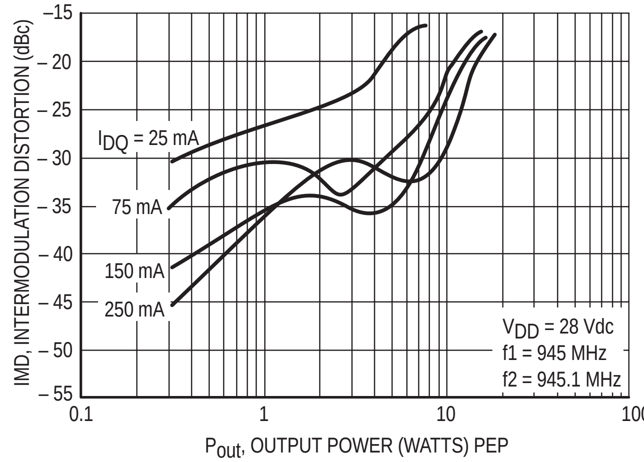


Figure 3. Intermodulation Distortion versus Output Power

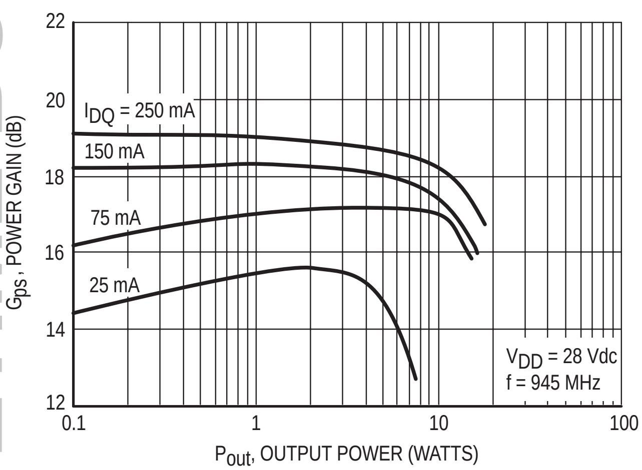


Figure 4. Power Gain versus Output Power

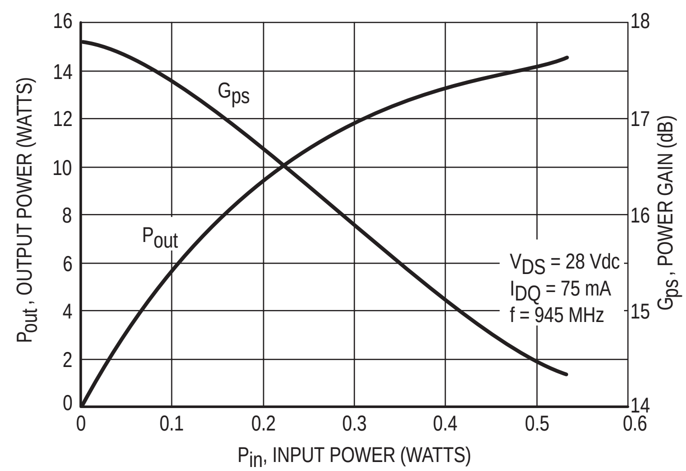


Figure 5. Output Power versus Input Power

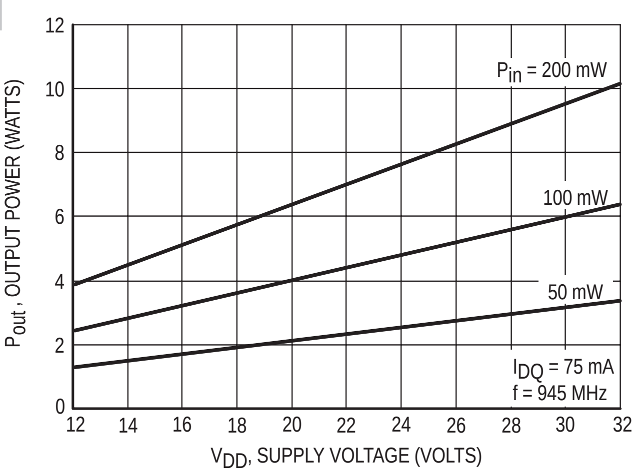


Figure 6. Output Power versus Supply Voltage

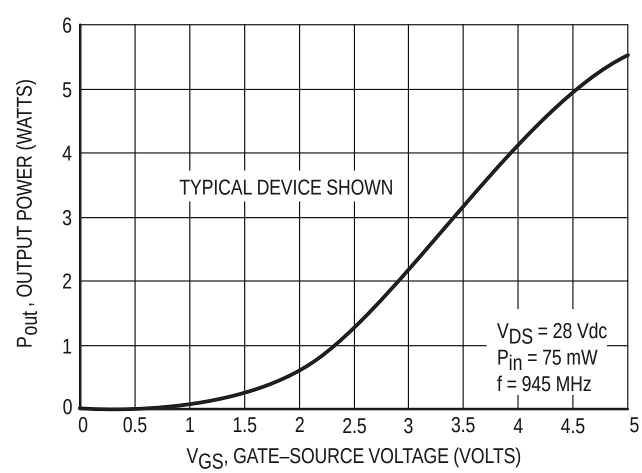


Figure 7. Output Power versus Gate Voltage

TYPICAL CHARACTERISTICS

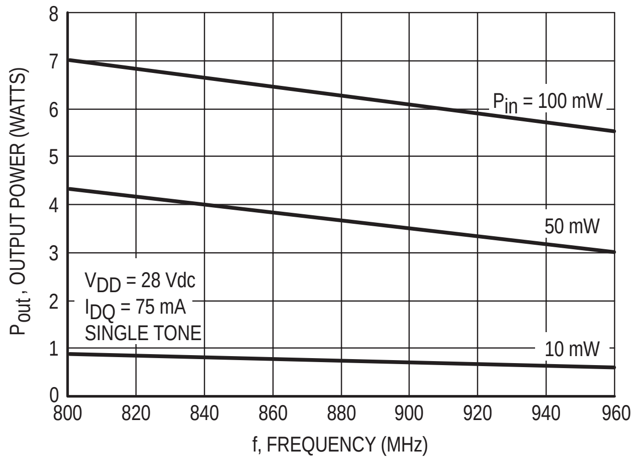


Figure 8. Output Power versus Frequency

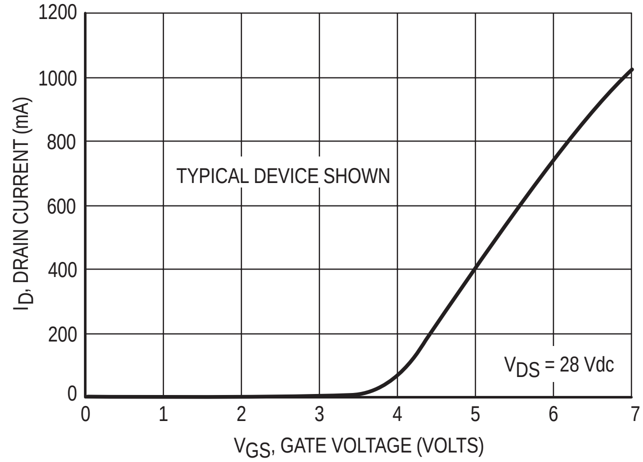


Figure 9. Drain Current versus Gate Voltage

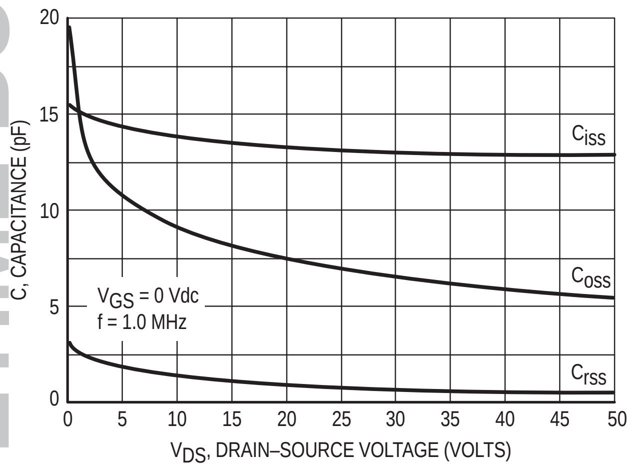


Figure 10. Capacitance versus Voltage

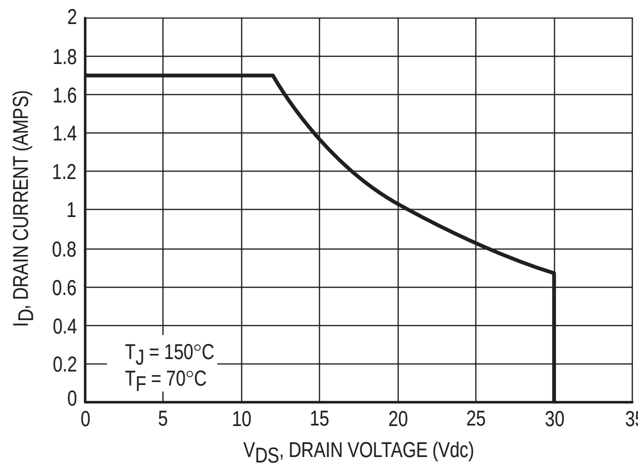


Figure 11. DC Safe Operating Area

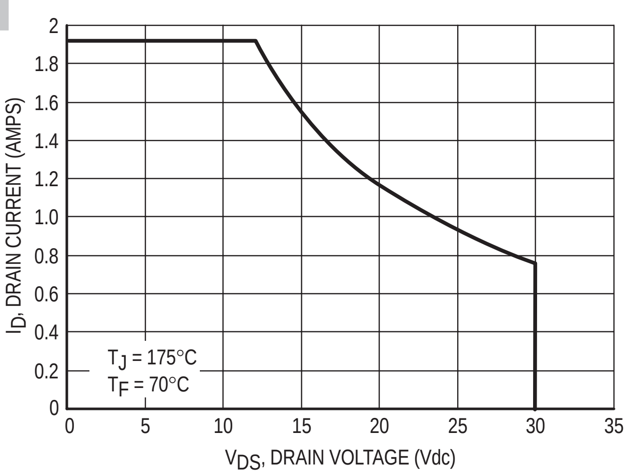


Figure 12. DC Safe Operating Area

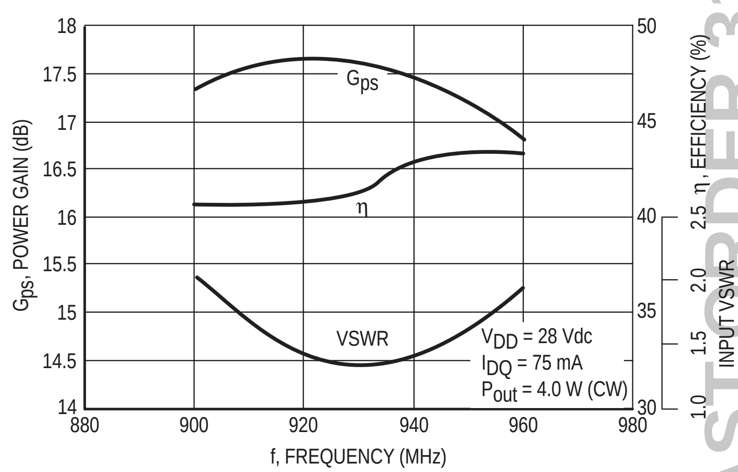


Figure 13. Performance in Broadband Circuit

TYPICAL CHARACTERISTICS

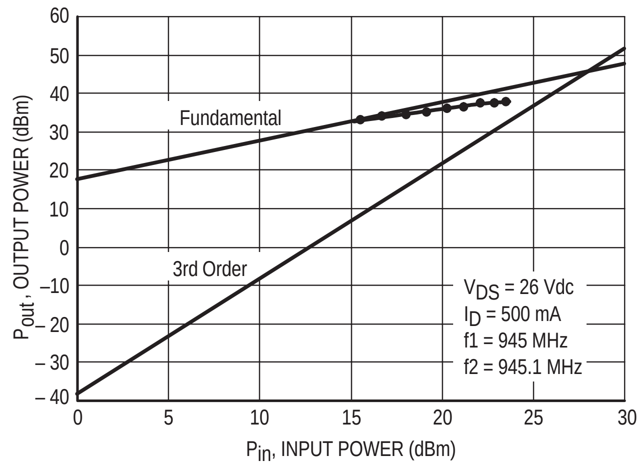


Figure 14. Class A Third Order Intercept Point

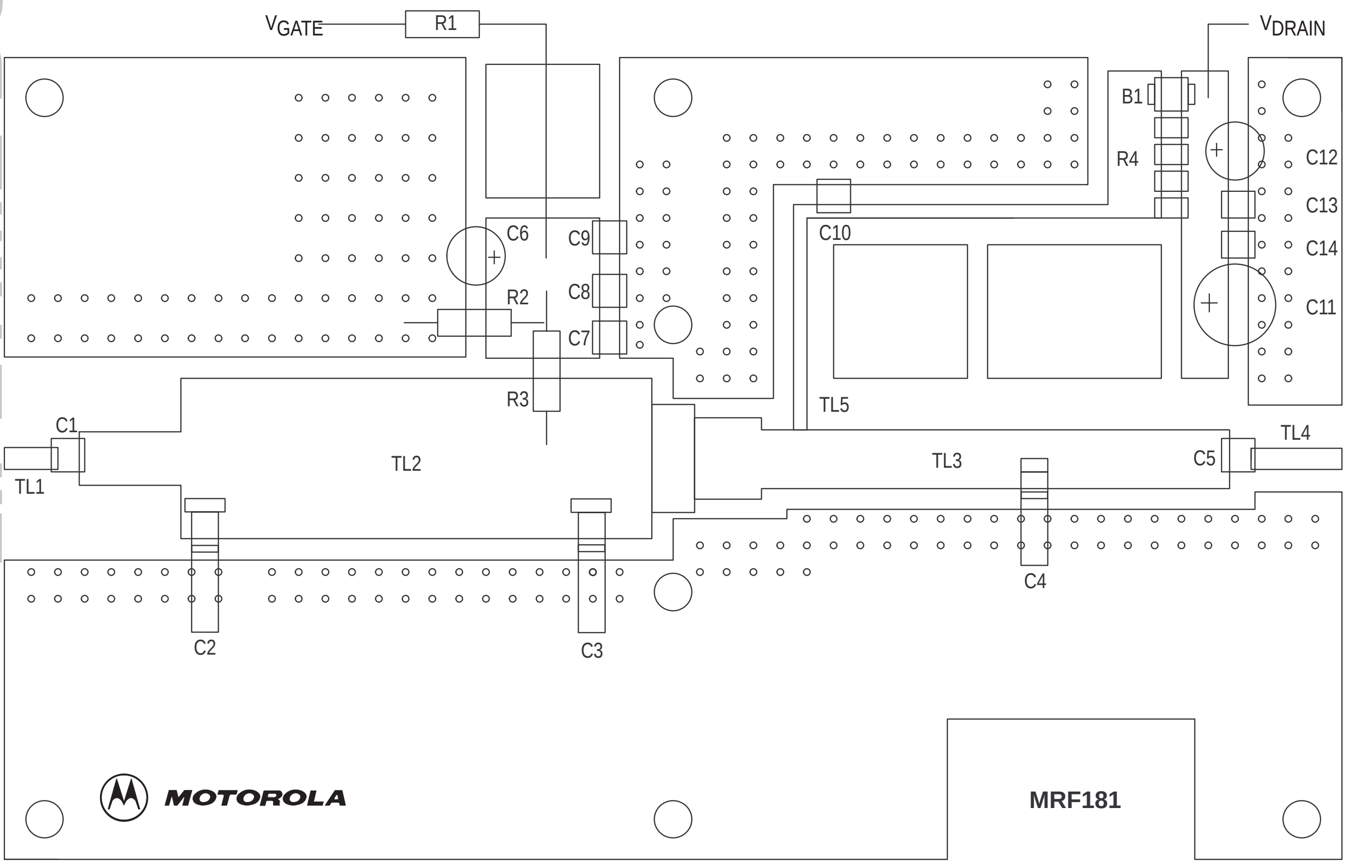
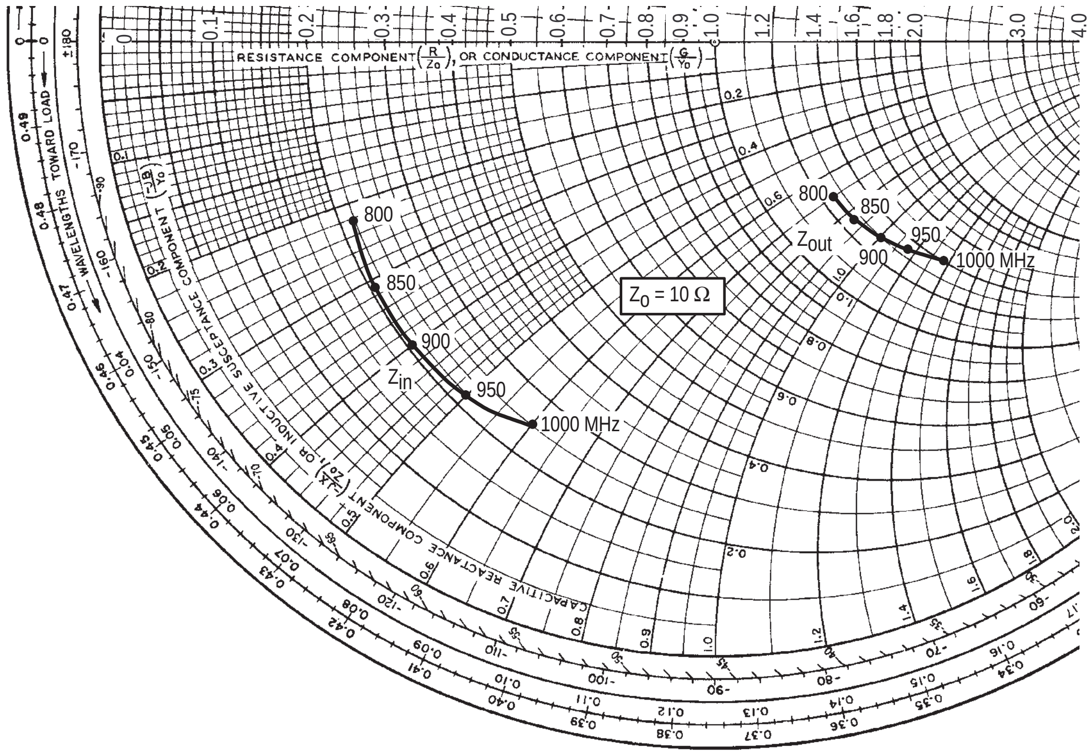


Figure 15. Component Parts Layout



V_{DD} = 28 Vdc, I_{DQ} = 170 mA, P_{out} = 7.5 W (PEP)

f MHz	Z_{in} Ohms	Z_{OL}* Ohms
800	2.15 – j2.2	12.45 – j7.0
850	2.11 – j3.5	12.65 – j8.5
900	2.14 – j4.0	12.95 – j10.0
950	2.20 – j5.0	13.52 – j11.5
1000	2.35 – j5.8	14.11 – j13.7

Z_{in} = Complex conjugate of source impedance.

Z_{OL}* = Complex conjugate of the load impedance at given output power, voltage, frequency and efficiency.

Note: Z_{OL}* was chosen based on tradeoffs between gain, drain efficiency, and device stability.

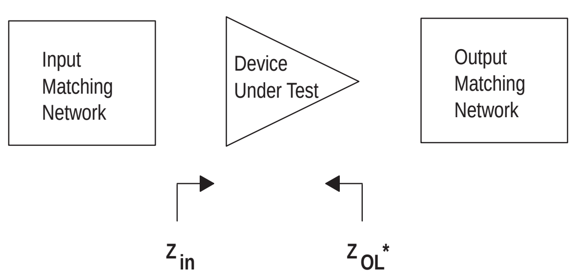


Figure 16. Series Equivalent Input and Output Impedance

Table 1. Common Emitter S–Parameters (V_{DS} = 26 Vdc)

I_D = 500 mA

f MHz	S_{11}		S_{21}		S_{12}		S_{22}	
	$\|S_{11}\|$	∠ φ	$\|S_{21}\|$	∠ φ	$\|S_{12}\|$	∠ φ	$\|S_{22}\|$	∠ φ
10	0.944	–10	31.66	174	0.004	84	0.772	–7
20	0.940	–20	31.23	168	0.008	78	0.765	–14
30	0.934	–30	30.54	162	0.011	73	0.752	–21
40	0.927	–39	29.66	156	0.015	67	0.736	–28
50	0.918	–48	28.62	151	0.018	62	0.718	–34
100	0.873	–83	22.81	129	0.028	41	0.620	–60
150	0.843	–106	17.94	114	0.033	28	0.549	–78
200	0.827	–121	14.44	103	0.035	18	0.509	–90
250	0.820	–131	11.94	95	0.036	11	0.490	–99
300	0.817	–139	10.09	88	0.036	6	0.484	–105
350	0.817	–145	8.69	82	0.036	1	0.487	–111
400	0.820	–149	7.59	77	0.035	–3	0.496	–115
450	0.823	–153	6.71	72	0.034	–7	0.508	–118
500	0.828	–156	5.99	68	0.033	–10	0.523	–122
550	0.833	–159	5.39	64	0.032	–12	0.538	–125
600	0.839	–161	4.88	60	0.031	–15	0.555	–127
650	0.845	–163	4.44	56	0.029	–17	0.572	–130
700	0.851	–165	4.06	52	0.028	–19	0.589	–132
750	0.857	–167	3.73	49	0.026	–20	0.606	–134
800	0.864	–169	3.44	45	0.025	–22	0.622	–137
850	0.870	–171	3.18	42	0.023	–23	0.638	–139
900	0.876	–172	2.95	39	0.022	–23	0.654	–141
950	0.882	–174	2.74	36	0.020	–24	0.669	–143
1000	0.888	–175	2.55	33	0.018	–24	0.683	–144
1050	0.893	–176	2.38	30	0.017	–23	0.697	–146
1100	0.899	–178	2.23	28	0.015	–22	0.710	–148
1150	0.904	–179	2.09	25	0.014	–20	0.722	–150
1200	0.909	180	1.96	22	0.012	–16	0.734	–151
1250	0.914	179	1.85	20	0.011	–12	0.745	–153
1300	0.918	177	1.74	17	0.010	–6	0.756	–155
1350	0.922	176	1.64	15	0.009	1	0.766	–156
1400	0.927	175	1.55	13	0.009	10	0.775	–158
1450	0.931	174	1.47	10	0.008	20	0.784	–159
1500	0.934	173	1.39	8	0.008	30	0.793	–161