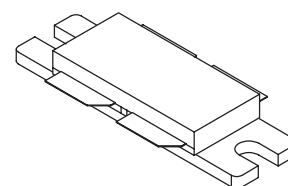


Product Is Not Recommended for New Design.

The next generation of higher performance products are in development. Visit our online Selector Guides (<http://mot-sps.com/rf/sg/sg.html>) for scheduled introduction dates.

MRF186

120 W, 1.0 GHz, 28 V
LATERAL N-CHANNEL
BROADBAND
RF POWER MOSFET



CASE 375B-02, STYLE 2

The RF MOSFET Line

RF Power Field-Effect Transistor N-Channel Enhancement-Mode Lateral MOSFET

Designed for broadband commercial and industrial applications at frequencies from 800 MHz to 1.0 GHz. The high gain and broadband performance of this device makes it ideal for large-signal, common source amplifier applications in 28 volt base station equipment.

- Guaranteed Performance @ 960 MHz, 28 Volts
 - Output Power — 120 Watts (PEP)
 - Power Gain — 11 dB
 - Efficiency — 30%
 - Intermodulation Distortion — -28 dBc
- Excellent Thermal Stability
- 100% Tested for Load Mismatch Stress at all Phase Angles with 5:1 VSWR @ 28 Vdc, 960 MHz, 120 Watts CW

MAXIMUM RATINGS (2)

Rating	Symbol	Value	Unit
Drain-Source Voltage	V_{DS}	65	Vdc
Drain-Gate Voltage ($R_{GS} = 1 \text{ M}\Omega$)	V_{DGR}	65	Vdc
Gate-Source Voltage	V_{GS}	± 20	Vdc
Drain Current — Continuous	I_D	14	Adc
Total Device Dissipation @ $T_C = 70^\circ\text{C}$ Derate above 70°C	P_D	162.5 1.25	Watts W/ $^\circ\text{C}$
Storage Temperature Range	T_{stg}	-65 to +150	$^\circ\text{C}$
Operating Junction Temperature	T_J	200	$^\circ\text{C}$

THERMAL CHARACTERISTICS (2)

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	0.8	$^\circ\text{C/W}$

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

REV 3

MRF186
5.2-198

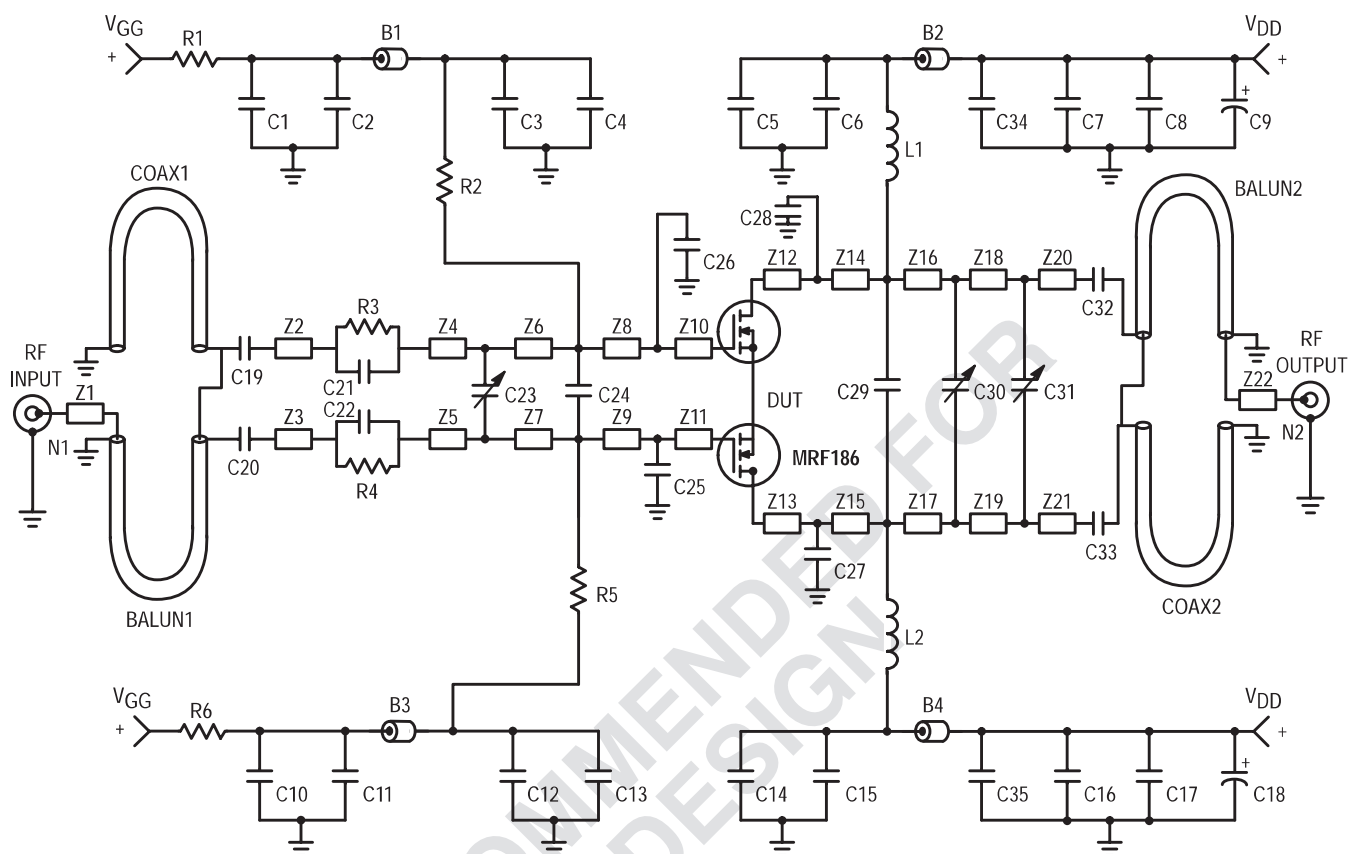
MOTOROLA WIRELESS SEMICONDUCTOR
SOLUTIONS — RF AND IF DEVICE DATA

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

Characteristic	Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS (1)					
Drain–Source Breakdown Voltage ($V_{GS} = 0\text{ Vdc}$, $I_D = 50\text{ }\mu\text{Adc}$)	$V_{(BR)DSS}$	65	—	—	Vdc
Zero Gate Voltage Drain Current ($V_{DS} = 28\text{ Vdc}$, $V_{GS} = 0$)	I_{DSS}	—	—	1	μAdc
Gate–Source Leakage Current ($V_{GS} = 20\text{ Vdc}$, $V_{DS} = 0$)	I_{GSS}	—	—	1	μAdc
ON CHARACTERISTICS (1)					
Gate Quiescent Voltage ($V_{DS} = 26\text{ Vdc}$, $I_D = 300\text{ }\mu\text{Adc}$ Per Side)	$V_{GS(th)}$	2.5	3	4	Vdc
Gate Quiescent Voltage ($V_{DS} = 26\text{ Vdc}$, $I_D = 300\text{ mAdc}$ Per Side)	$V_{GS(Q)}$	3.3	4.2	5	Vdc
Delta Gate Threshold Voltage (Side to Side) ($V_{DS} = 28\text{ V}$, $I_D = 300\text{ mA}$ Per Side)	$\Delta V_{GS(Q)}$	—	—	0.3	Vdc
Drain–Source On–Voltage ($V_{GS} = 10\text{ Vdc}$, $I_D = 3\text{ Adc}$ Per Side)	$V_{DS(on)}$	—	0.58	0.7	Vdc
Forward Transconductance ($V_{DS} = 10\text{ Vdc}$, $I_D = 3\text{ Adc}$ Per Side)	g_{fs}	2.4	2.8	—	S
DYNAMIC CHARACTERISTICS (1)					
Input Capacitance (Per Side) ($V_{DS} = 28\text{ Vdc}$, $V_{GS} = 0$, $f = 1\text{ MHz}$)	C_{iss}	—	177	—	pF
Output Capacitance (Per Side) ($V_{DS} = 28\text{ Vdc}$, $V_{GS} = 0$, $f = 1\text{ MHz}$)	C_{oss}	—	45	—	pF
Reverse Transfer Capacitance (Per Side) ($V_{DS} = 28\text{ Vdc}$, $V_{GS} = 0$, $f = 1\text{ MHz}$)	C_{rss}	—	3.4	—	pF
FUNCTIONAL CHARACTERISTICS (In Motorola Test Fixture) (2)					
Two–Tone Common Source Amplifier Power Gain ($V_{DD} = 28\text{ Vdc}$, $P_{out} = 120\text{ W PEP}$, $I_{DQ} = 2 \times 400\text{ mA}$, $f_1 = 960.0\text{ MHz}$, $f_2 = 960.1\text{ MHz}$)	G_{ps}	11	12.2	—	dB
Two–Tone Drain Efficiency ($V_{DD} = 28\text{ Vdc}$, $P_{out} = 120\text{ W PEP}$, $I_{DQ} = 2 \times 400\text{ mA}$, $f_1 = 960.0\text{ MHz}$, $f_2 = 960.1\text{ MHz}$)	η	30	35	—	%
3rd Order Intermodulation Distortion ($V_{DD} = 28\text{ Vdc}$, $P_{out} = 120\text{ W PEP}$, $I_{DQ} = 2 \times 400\text{ mA}$, $f_1 = 960.0\text{ MHz}$, $f_2 = 960.1\text{ MHz}$)	IMD	—	–32	–28	dBc
Input Return Loss ($V_{DD} = 28\text{ Vdc}$, $P_{out} = 120\text{ W PEP}$, $I_{DQ} = 2 \times 400\text{ mA}$, $f_1 = 960.0\text{ MHz}$, $f_2 = 960.1\text{ MHz}$)	IRL	9	16	—	dB
Two–Tone Common Source Amplifier Power Gain ($V_{DD} = 28\text{ Vdc}$, $P_{out} = 120\text{ W PEP}$, $I_{DQ} = 2 \times 400\text{ mA}$, $f_1 = 945.0\text{ MHz}$, $f_2 = 945.1\text{ MHz}$)	G_{ps}	—	12	—	dB
Two–Tone Drain Efficiency ($V_{DD} = 28\text{ Vdc}$, $P_{out} = 120\text{ W PEP}$, $I_{DQ} = 2 \times 400\text{ mA}$, $f_1 = 945.0\text{ MHz}$, $f_2 = 945.1\text{ MHz}$)	η	—	33	—	%
3rd Order Intermodulation Distortion ($V_{DD} = 28\text{ Vdc}$, $P_{out} = 120\text{ W PEP}$, $I_{DQ} = 2 \times 400\text{ mA}$, $f_1 = 945.0\text{ MHz}$, $f_2 = 945.1\text{ MHz}$)	IMD	—	–32	—	dBc
Input Return Loss ($V_{DD} = 28\text{ Vdc}$, $P_{out} = 120\text{ W PEP}$, $I_{DQ} = 2 \times 400\text{ mA}$, $f_1 = 945.0\text{ MHz}$, $f_2 = 945.1\text{ MHz}$)	IRL	—	16	—	dB
Output Mismatch Stress ($V_{DD} = 28\text{ Vdc}$, $P_{out} = 120\text{ W CW}$, $I_{DQ} = 2 \times 400\text{ mA}$, $f = 960\text{ MHz}$, $V_{SWR} = 5:1$, All Phase Angles at Frequency of Tests)	Ψ	No Degradation In Output Power Before and After Test			

(1) Each side of device measured separately.

(2) Device measured in push–pull configuration.



B1 – B4	Fair Rite Products Short Ferrit Bead, 2743021446	C31	0.8 – 8.0 pF, Variable Capacitor, Johanson Gigatrim
C1, C7, C8, C10, C16, C17	10 μ F, 50 V, Tantalum	L1, L2	3 Turns, #20 AWG, IDIA 0.126", 24.7 nH
C2, C11, C34, C35	0.1 μ F, Chip Capacitor	N1, N2	Type N Connectors
C3, C6, C12, C15	330 pF, Chip Capacitor	R1, R6	1 k Ω , 1/4 W, Carbon Resistor
C4, C5, C13, C14, C19, C20, C32, C33	47 pF, Chip Capacitor	R2, R5	1.2 k Ω , 0.1 W, Chip Resistor
C9, C18	250 μ F, 50 V, Electrolytic Capacitor	R3, R4	75 Ω , 0.1 W, Chip Resistor
C21, C22	12 pF, Chip Capacitor	Z1 – Z22	Microstrip (See Component Placement)
C23, C30	0.6 – 4.5 pF, Variable Capacitor, Johanson Gigatrim	Balun1, Balun2,	2.20" 50 Ω , 0.086" OD Semi-Rigid Coax
C24, C25, C26	5.1 pF, Chip Capacitor	Coax1, Coax2	1/32" Glass Teflon [®] , $\epsilon_r = 2.55$
C27, C28	3.9 pF, Chip Capacitor	Board	

Figure 1. 930 – 960 MHz Test Circuit Schematic

TYPICAL CHARACTERISTICS

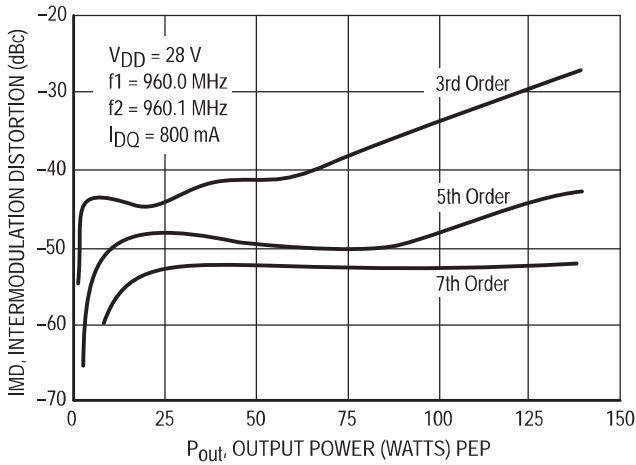


Figure 2. Intermodulation Distortion Products versus Output Power

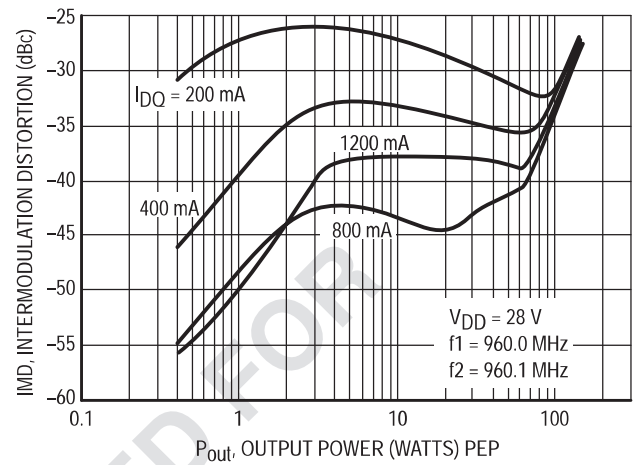


Figure 3. Intermodulation Distortion versus Output Power

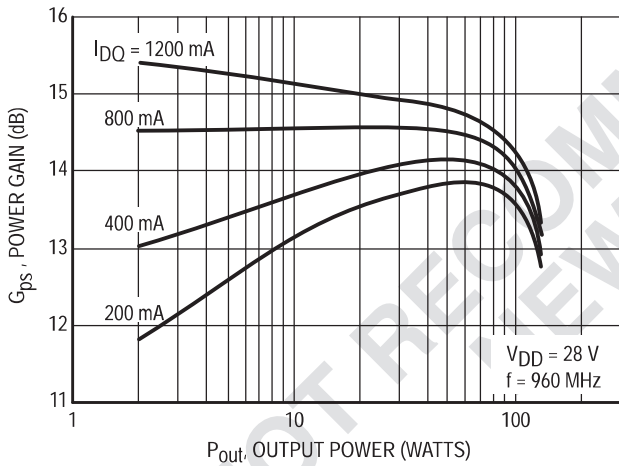


Figure 4. Power Gain versus Output Power

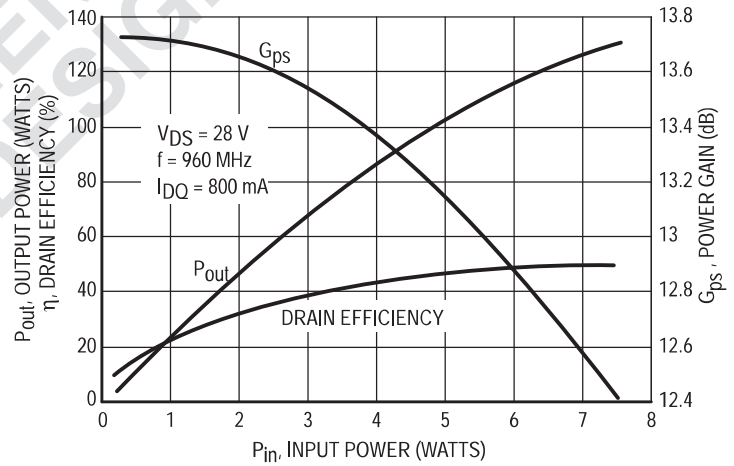


Figure 5. Output Power versus Input Power

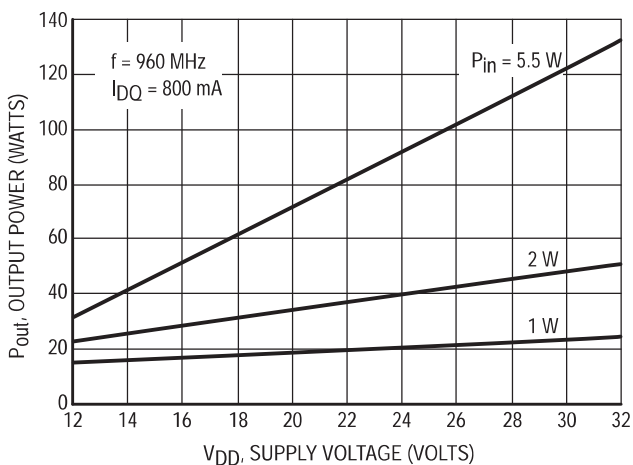


Figure 6. Output Power versus Supply Voltage

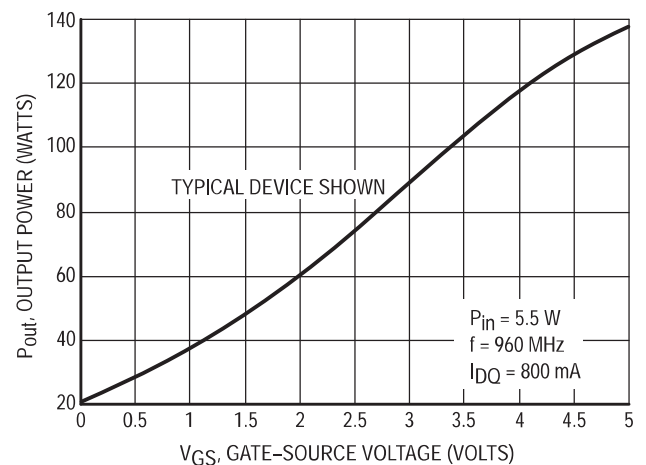


Figure 7. Output Power versus Gate Voltage

TYPICAL CHARACTERISTICS

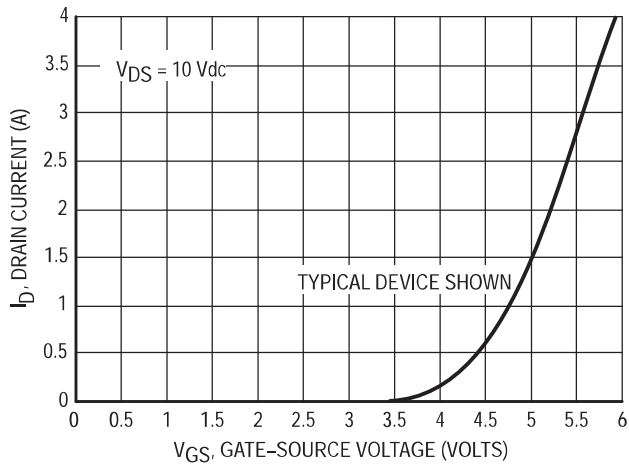


Figure 8. Drain Current versus Gate Voltage

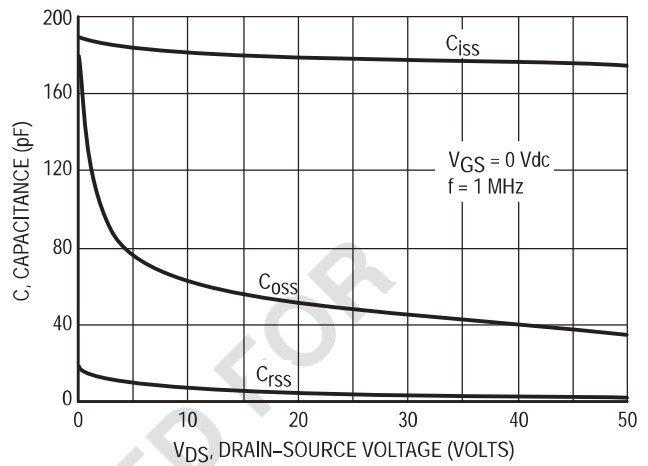


Figure 9. Capacitance versus Voltage

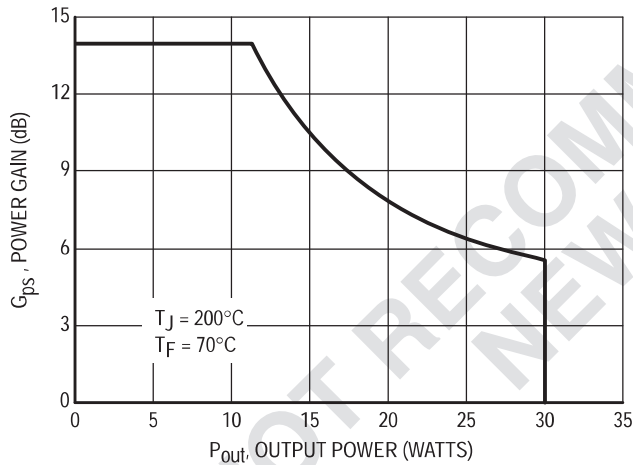


Figure 10. DC Safe Operating Area

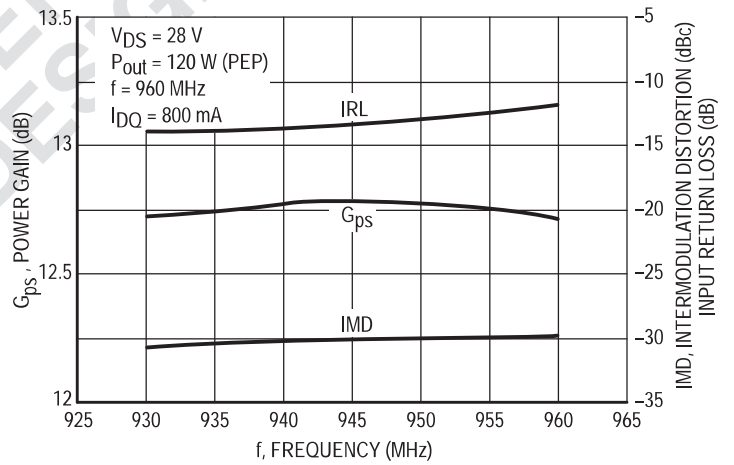
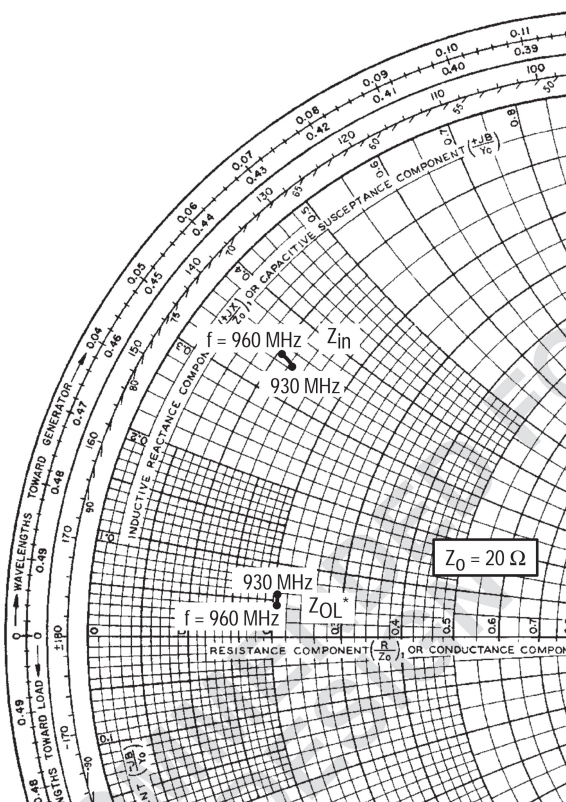


Figure 11. Broadband Circuit Performance



$V_{CC} = 28 \text{ V}$, $I_{DQ} = 2 \times 400 \text{ mA}$, $P_{out} = 120 \text{ Watts (PEP)}$

f MHz	Z_{in} Ω	Z_{OL}^* Ω
930	$2.5 + j6.9$	$4.3 + j1.2$
945	$2.5 + j7.0$	$4.3 + j1.0$
960	$2.2 + j7.1$	$4.3 + j0.9$

Z_{in} = Complex conjugate of source impedance.

Z_{OL}^* = Conjugate of the optimum load impedance at a given output power, voltage, IMD, bias current, efficiency and frequency.

Note: Z_{OL}^* was chosen based on tradeoffs between gain, output power, drain efficiency and intermodulation performance. Impedances shown represent a single channel (1/2 of MRF186) impedance measurement.

Figure 12. Series Equivalent Input and Output Impedance

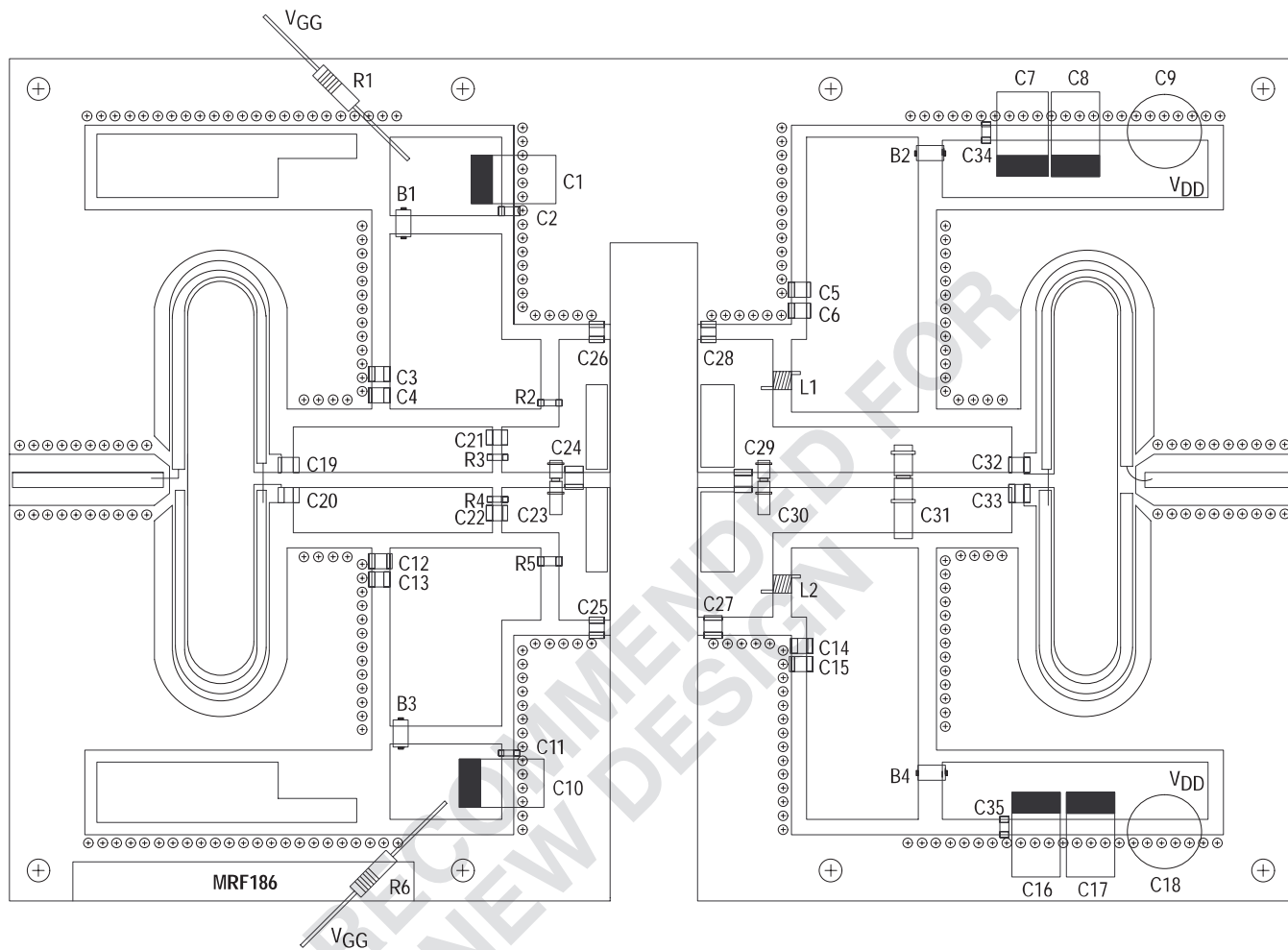


Figure 13. Component Placement Diagram of 930 – 960 MHz Broadband Test Fixture