

# The RF MOSFET Line

## Power Field-Effect Transistor

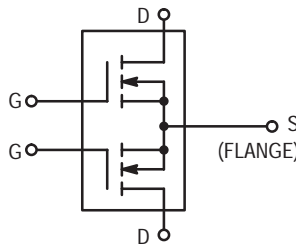
### N-Channel Enhancement-Mode

Designed primarily for wideband large-signal output and driver stages from 100 – 500 MHz.

- Guaranteed Performance @ 500 MHz, 28 Vdc
  - Output Power — 150 Watts
  - Power Gain — 10 dB (Min)
  - Efficiency — 50% (Min)
  - 100% Tested for Load Mismatch at all Phase Angles with VSWR 30:1
- Overall Lower Capacitance @ 28 V
  - C<sub>iss</sub> — 135 pF
  - C<sub>oss</sub> — 140 pF
  - C<sub>rss</sub> — 17 pF
- Simplified AVC, ALC and Modulation

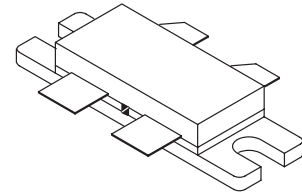
Typical data for power amplifiers in industrial and commercial applications:

- Typical Performance @ 400 MHz, 28 Vdc
  - Output Power — 150 Watts
  - Power Gain — 12.5 dB
  - Efficiency — 60%
- Typical Performance @ 225 MHz, 28 Vdc
  - Output Power — 200 Watts
  - Power Gain — 15 dB
  - Efficiency — 65%



**MRF275G**

**150 W, 28 V, 500 MHz**  
**N-CHANNEL MOS**  
**BROADBAND**  
**100 – 500 MHz**  
**RF POWER FET**



**CASE 375-04, STYLE 2**

#### MAXIMUM RATINGS

| Rating  | Symbol           | Value       | Unit          |
|---|------------------|-------------|---------------|
| Drain-Source Voltage  | V <sub>DSS</sub> | 65          | Vdc           |
| Drain-Gate Voltage<br>(R <sub>GS</sub> = 1.0 MΩ)                      | V <sub>DGR</sub> | 65          | Vdc           |
| Gate-Source Voltage   | V <sub>GS</sub>  | ±40         | Adc           |
| Drain Current — Continuous  | I <sub>D</sub>   | 26          | Adc           |
| Total Device Dissipation @ T <sub>C</sub> = 25°C<br>Derate above 25°C | P <sub>D</sub>   | 400<br>2.27 | Watts<br>W/°C |
| Storage Temperature Range   | T <sub>stg</sub> | -65 to +150 | °C            |
| Operating Junction Temperature  | T <sub>J</sub>   | 200         | °C            |

#### THERMAL CHARACTERISTICS

| Characteristic                       | Symbol           | Max  | Unit |
|--------------------------------------|------------------|------|------|
| Thermal Resistance, Junction to Case | R <sub>θJC</sub> | 0.44 | °C/W |

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

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

| Characteristic | Symbol | Min | Typ | Max | Unit |
|----------------|--------|-----|-----|-----|------|
|----------------|--------|-----|-----|-----|------|

**OFF CHARACTERISTICS (1)**

|  |               |    |   |   |               |
|--|---------------|----|---|---|---------------|
| Drain–Source Breakdown Voltage<br>( $V_{GS} = 0, I_D = 50 \text{ mA}$ )    | $V_{(BR)DSS}$ | 65 | — | — | Vdc           |
| Zero Gate Voltage Drain Current<br>( $V_{DS} = 28 \text{ V}, V_{GS} = 0$ ) | $I_{DSS}$     | —  | — | 1 | mA            |
| Gate–Source Leakage Current<br>( $V_{GS} = 20 \text{ V}, V_{DS} = 0$ )     | $I_{GSS}$     | —  | — | 1 | $\mu\text{A}$ |

**ON CHARACTERISTICS (1)**

|   |              |     |      |     |      |
|---|--------------|-----|------|-----|------|
| Gate Threshold Voltage ( $V_{DS} = 10 \text{ V}, I_D = 100 \text{ mA}$ )  | $V_{GS(th)}$ | 1.5 | 2.5  | 4.5 | Vdc  |
| Drain–Source On–Voltage ( $V_{GS} = 10 \text{ V}, I_D = 5 \text{ A}$ )    | $V_{DS(on)}$ | 0.5 | 0.9  | 1.5 | Vdc  |
| Forward Transconductance ( $V_{DS} = 10 \text{ V}, I_D = 2.5 \text{ A}$ ) | $g_{fs}$     | 3   | 3.75 | —   | mhos |

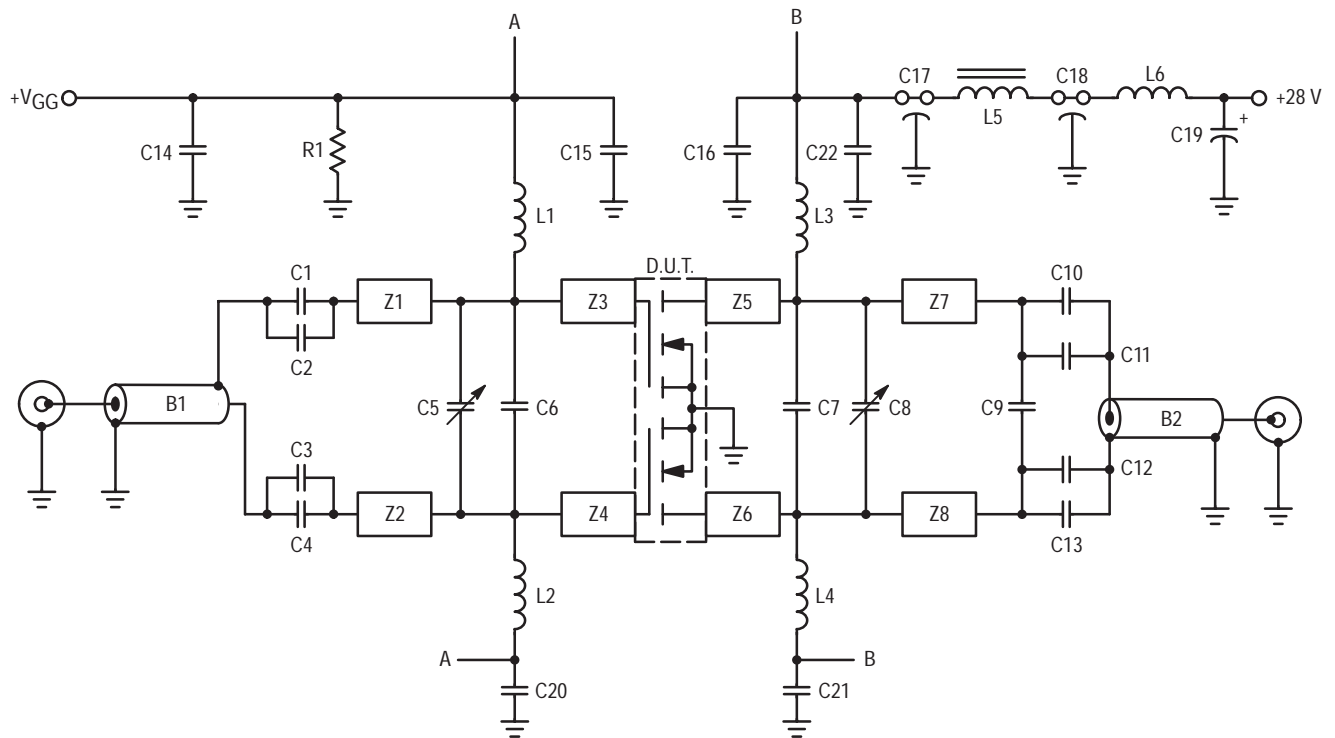
**DYNAMIC CHARACTERISTICS (1)**

|   |           |   |     |   |    |
|---|-----------|---|-----|---|----|
| Input Capacitance ( $V_{DS} = 28 \text{ V}, V_{GS} = 0, f = 1 \text{ MHz}$ )            | $C_{iss}$ | — | 135 | — | pF |
| Output Capacitance ( $V_{DS} = 28 \text{ V}, V_{GS} = 0, f = 1 \text{ MHz}$ )           | $C_{oss}$ | — | 140 | — | pF |
| Reverse Transfer Capacitance ( $V_{DS} = 28 \text{ V}, V_{GS} = 0, f = 1 \text{ MHz}$ ) | $C_{rss}$ | — | 17  | — | pF |

**FUNCTIONAL CHARACTERISTICS (2)** (Figure 1)

|   |          |                                |      |   |    |
|---|----------|--------------------------------|------|---|----|
| Common Source Power Gain<br>( $V_{DD} = 28 \text{ V}, P_{out} = 150 \text{ W}, f = 500 \text{ MHz}, I_{DQ} = 2 \times 100 \text{ mA}$ )                               | $G_{ps}$ | 10                             | 11.2 | — | dB |
| Drain Efficiency<br>( $V_{DD} = 28 \text{ V}, P_{out} = 150 \text{ W}, f = 500 \text{ MHz}, I_{DQ} = 2 \times 100 \text{ mA}$ )                                       | $\eta$   | 50                             | 55   | — | %  |
| Electrical Ruggedness<br>( $V_{DD} = 28 \text{ V}, P_{out} = 150 \text{ W}, f = 500 \text{ MHz}, I_{DQ} = 2 \times 100 \text{ mA},$<br>VSWR 30:1 at all Phase Angles) | $\psi$   | No Degradation in Output Power |      |   |    |

1. Each side of device measured separately.
2. Measured in push–pull configuration.



|                    |  |   |   |
|--------------------|--|---|---|
| B1                 | Balun, 50 $\Omega$ , 0.086" O.D. 2" Long, Semi Rigid Coax    | L5                                      | Ferroxcube VK200 20/4B  |
| B2                 | Balun, 50 $\Omega$ , Coax 0.141" O.D. 2" Long, Semi Rigid    | L6                                      | 4 Turns #16, 0.340" I.D., Enameled Wire   |
| C1, C2, C3, C4,    | 270 pF, ATC Chip Capacitor                                   | R1                                      | 1.0 k $\Omega$ , 1/4 W Resistor   |
| C10, C11, C12, C13 | 1.0–20 pF, Trimmer Capacitor, Johanson                       | W1 – W4                                 | 20 x 200 x 250 mils, Wear Pads, Beryllium–Copper, (See Component Location Diagram)    |
| C5, C8             | 22 pF, Mini–Unelco Capacitor                                 | Z1, Z2                                  | 1.10" x 0.245", Microstrip Line   |
| C6                 | 15 pF, Unelco Capacitor                                      | Z3, Z4, Z5, Z6                          | 0.300" x 0.245", Microstrip Line  |
| C7                 | 2.1 pF, ATC Chip Capacitor                                   | Z7, Z8                                  | 1.00" x 0.245", Microstrip Line   |
| C9                 | 0.1 $\mu$ F, Ceramic Capacitor                               | Board material                          | 0.060" Teflon–fiberglass, $\epsilon_r = 2.55$ , copper clad both sides, 2 oz. copper. |
| C14, C15, C16,     | 680 pF, Feedthru Capacitor                                   | Points A are connected together on PCB. |   |
| C20, C21, C22      | 10 $\mu$ F, 50 V, Electrolytic Capacitor, Tantalum           | Points B are connected together on PCB. |   |
| C17, C18           | 10 Turns AWG #24, 0.145" O.D., 106 nH Taylor–Spring Inductor |   |   |
| C19                | 10 Turns AWG #18, 0.340" I.D., Enameled Wire                 |   |   |
| L1, L2             |  |   |   |
| L3, L4             |  |   |   |

Figure 1. 500 MHz Test Circuit

## TYPICAL CHARACTERISTICS

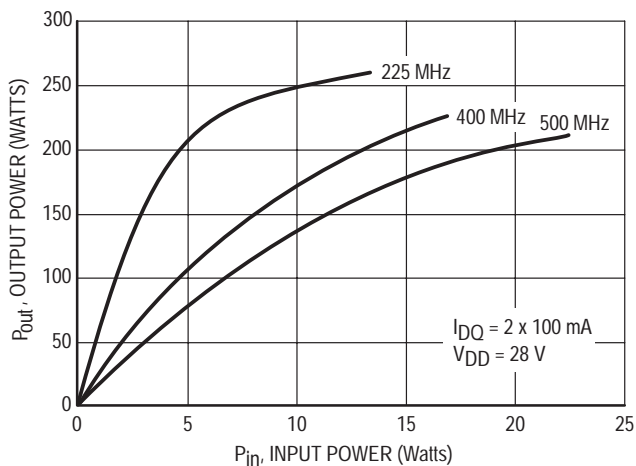


Figure 2. Output Power versus Input Power

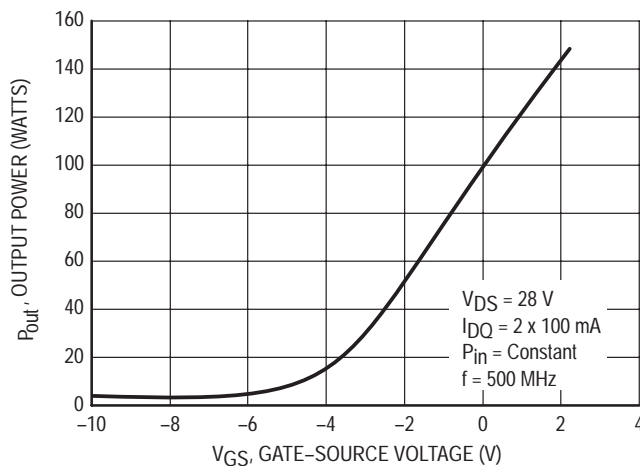


Figure 3. Output Power versus Gate Voltage

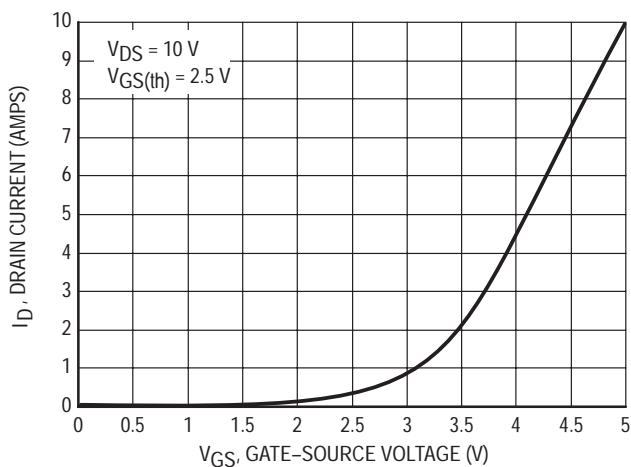


Figure 4. Drain Current versus Gate Voltage (Transfer Characteristics)

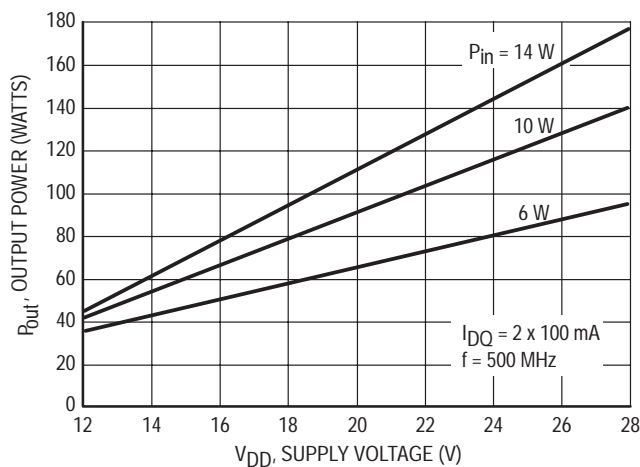


Figure 5. Output Power versus Supply Voltage

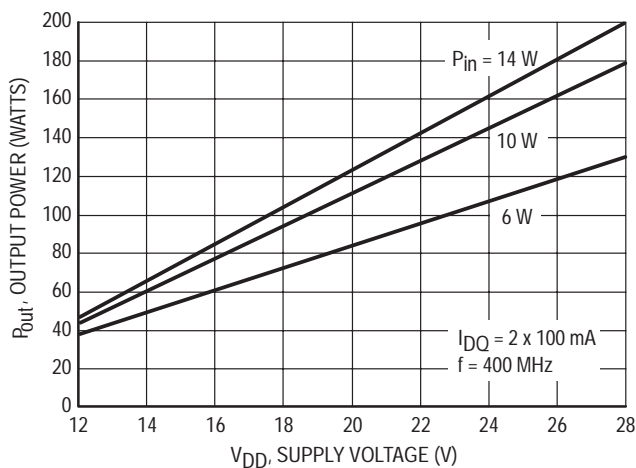


Figure 6. Output Power versus Supply Voltage

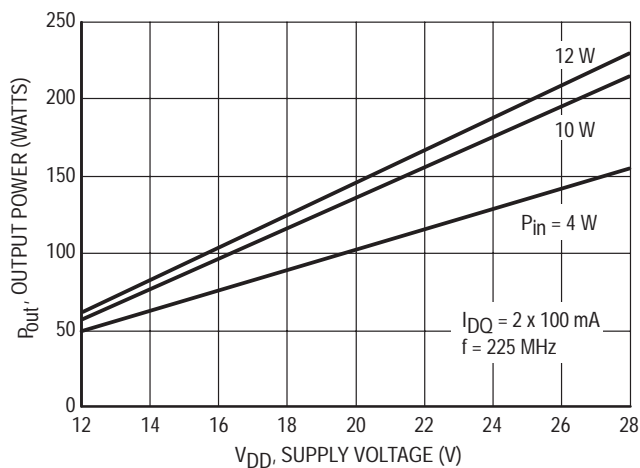
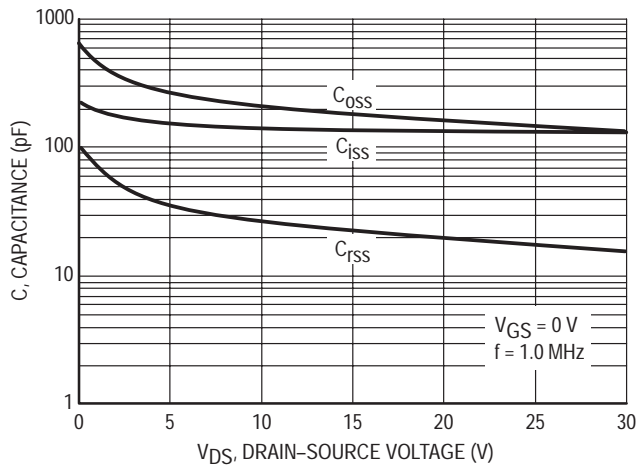
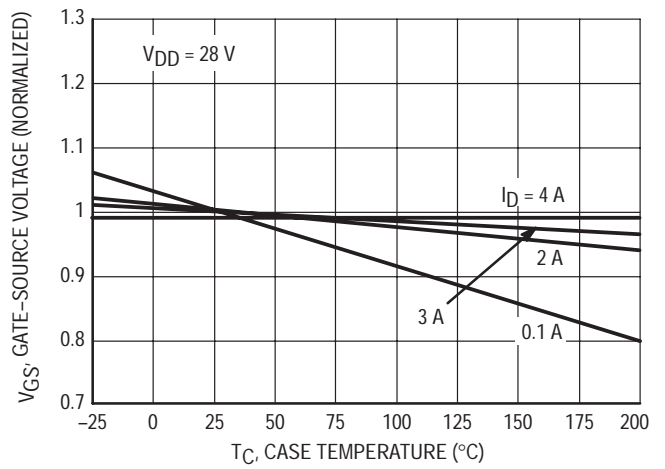


Figure 7. Output Power versus Supply Voltage

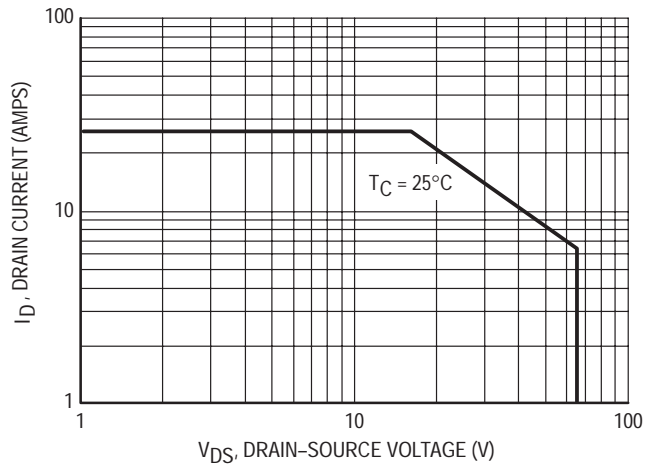
## TYPICAL CHARACTERISTICS



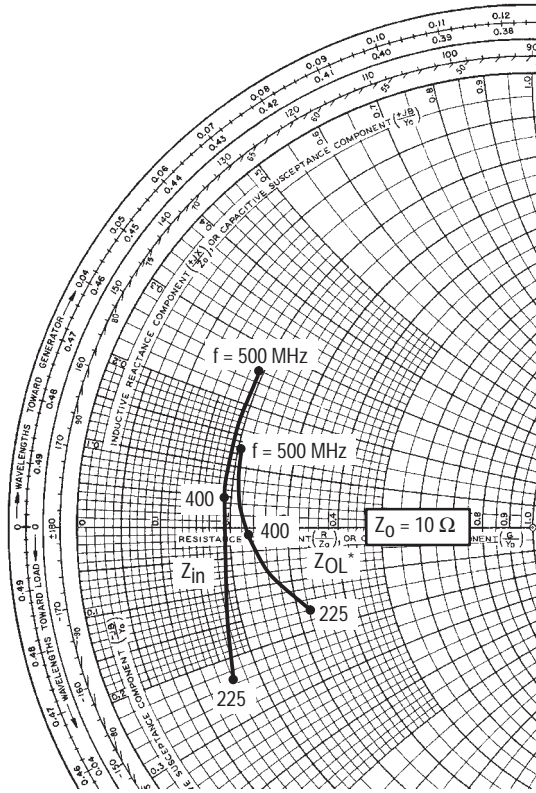
**Figure 8. Capacitance versus Drain-Source Voltage\***  
 \*Data shown applies only to one half of device, MRF275G



**Figure 9. Gate-Source Voltage versus Case Temperature**



**Figure 10. DC Safe Operating Area**



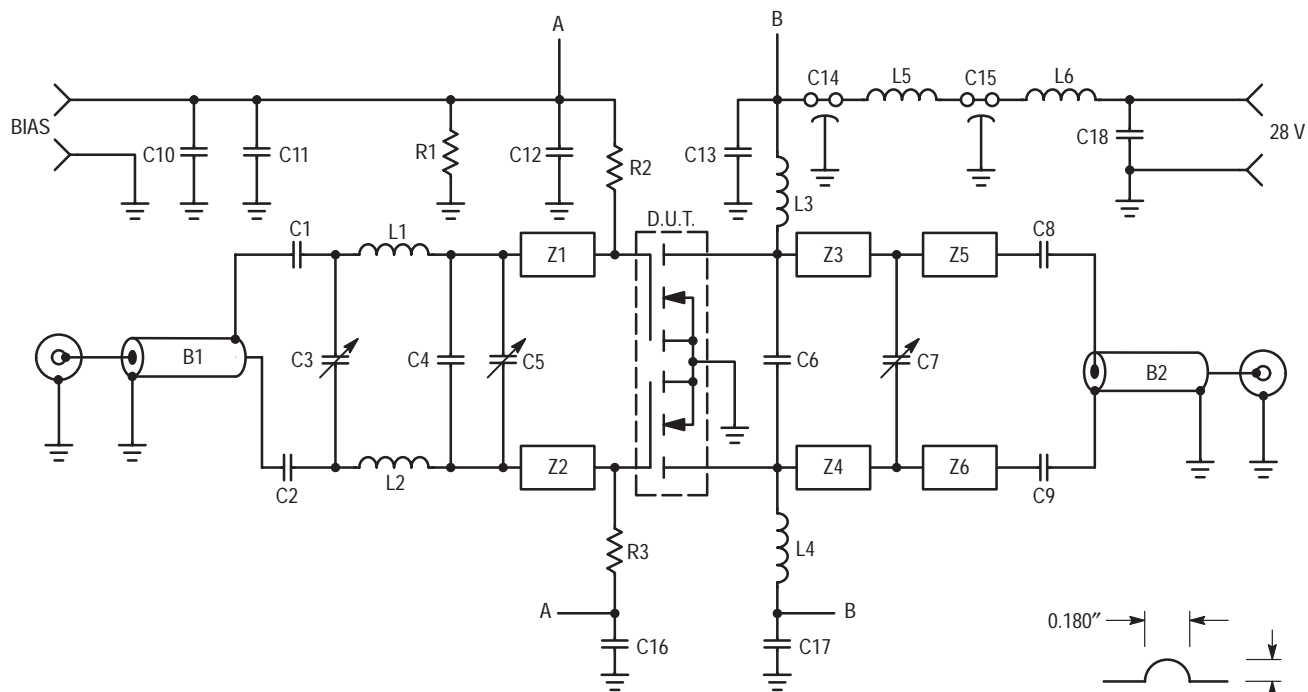
$V_{DD} = 28\text{ V}$ ,  $I_{DQ} = 2 \times 100\text{ mA}$ ,  $P_{Out} = 150\text{ W}$

| f (MHz) | $Z_{in}$ Ohms | $Z_{OL}^*$ Ohms |
|---------|---------------|-----------------|
| 225     | $1.6 - j2.30$ | $3.2 - j1.50$   |
| 400     | $1.9 + j0.48$ | $2.3 - j0.19$   |
| 500     | $1.9 + j2.60$ | $2.0 + j1.30$   |

$Z_{OL}^*$  = Conjugate of the optimum load impedance into which the device operates at a given output power, voltage and frequency.

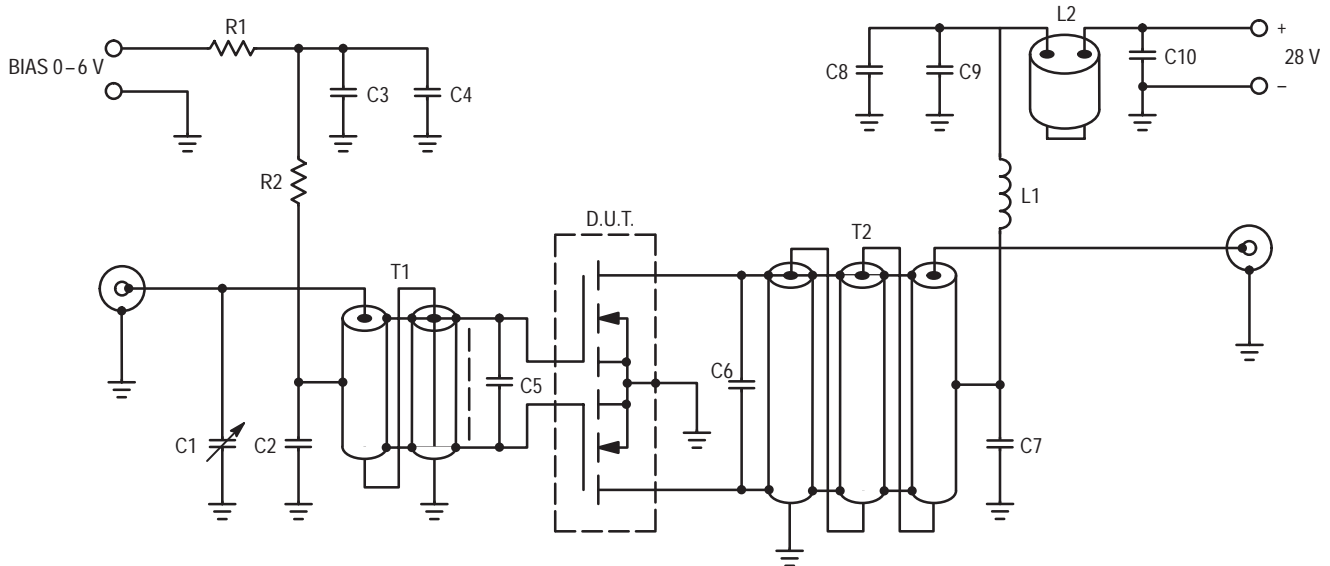
Note: Input and output impedance values given are measured from gate to gate and drain to drain respectively.

Figure 11. Series Equivalent Input/Output Impedance



|                |  |                |  |
|----------------|--|----------------|--|
| B1             | Balun, 50 $\Omega$ , 0.086" O.D. 2" Long,<br>Semi Rigid Coax | L1, L2         | #18 Wire, Hairpin Inductor   |
| B2             | Balun, 50 $\Omega$ , 0.141" O.D. 2" Long,<br>Semi Rigid Coax | L3, L4         | 12 Turns #18, 0.340" I.D.,<br>Enameled Wire  |
| C1, C2, C8, C9 | 270 pF, ATC Chip Capacitor                                   | L5             | Ferroxcube VK200 20/4B   |
| C3, C5, C7     | 1.0–20 pF, Trimmer Capacitor                                 | L6             | 3 Turns #16, 0.340" I.D.,<br>Enameled Wire   |
| C4             | 15 pF, ATC Chip Capacitor                                    | R1             | 1.0 k $\Omega$ , 1/4 W Resistor  |
| C6             | 33 pF, ATC Chip Capacitor                                    | R2, R3         | 10 k $\Omega$ , 1/4 W Resistor   |
| C10, C12, C13, | 0.01 $\mu$ F, Ceramic Capacitor                              | Z1, Z2         | 0.400" x 0.250", Microstrip Line   |
| C16, C17       |  | Z3, Z4         | 0.870" x 0.250", Microstrip Line   |
| C11            | 1.0 $\mu$ F, 50 V, Tantalum                                  | Z5, Z6         | 0.500" x 0.250", Microstrip Line   |
| C14, C15       | 680 pF, Feedthru Capacitor                                   | Board material | 0.060" Teflon–fiberglass,<br>$\epsilon_r = 2.55$ , copper clad both sides, 2 oz. copper. |
| C18            | 20 $\mu$ F, 50 V, Tantalum                                   |                |  |

Figure 12. 400 MHz Test Circuit



|                |  |    |   |
|----------------|--|----|---|
| C1             | 8.0–60 pF, Arco 404  | R1 | 100 $\Omega$ , 1/2 W  |
| C2, C3, C7, C8 | 1000 pF, Chip Capacitor                                    | R2 | 1.0 k $\Omega$ , 1/2 W  |
| C4, C9         | 0.1 $\mu$ F, Chip Capacitor                                | T1 | 4:1 Impedance Ratio, RF Transformer<br>Can Be Made of 25 $\Omega$ , Semi Rigid Coax,<br>47–52 Mils O.D.     |
| C5             | 180 pF, Chip Capacitor                                     | T2 | 1:9 Impedance Ratio, RF Transformer.<br>Can Be Made of 15–18 $\Omega$ , Semi Rigid<br>Coax, 62–90 Mils O.D. |
| C6             | 100 pF and 130 pF,<br>Chips in Parallel                    |    |   |
| C10            | 0.47 $\mu$ F, Chip Capacitor, 1215 or<br>Equivalent, Kemet |    |   |

L1  
10 Turns AWG #16, 1/4" I.D.,  
Enamel Wire, Close Wound

L2  
Ferrite Beads of Suitable Material  
for 1.5–2.0  $\mu$ H Total Inductance

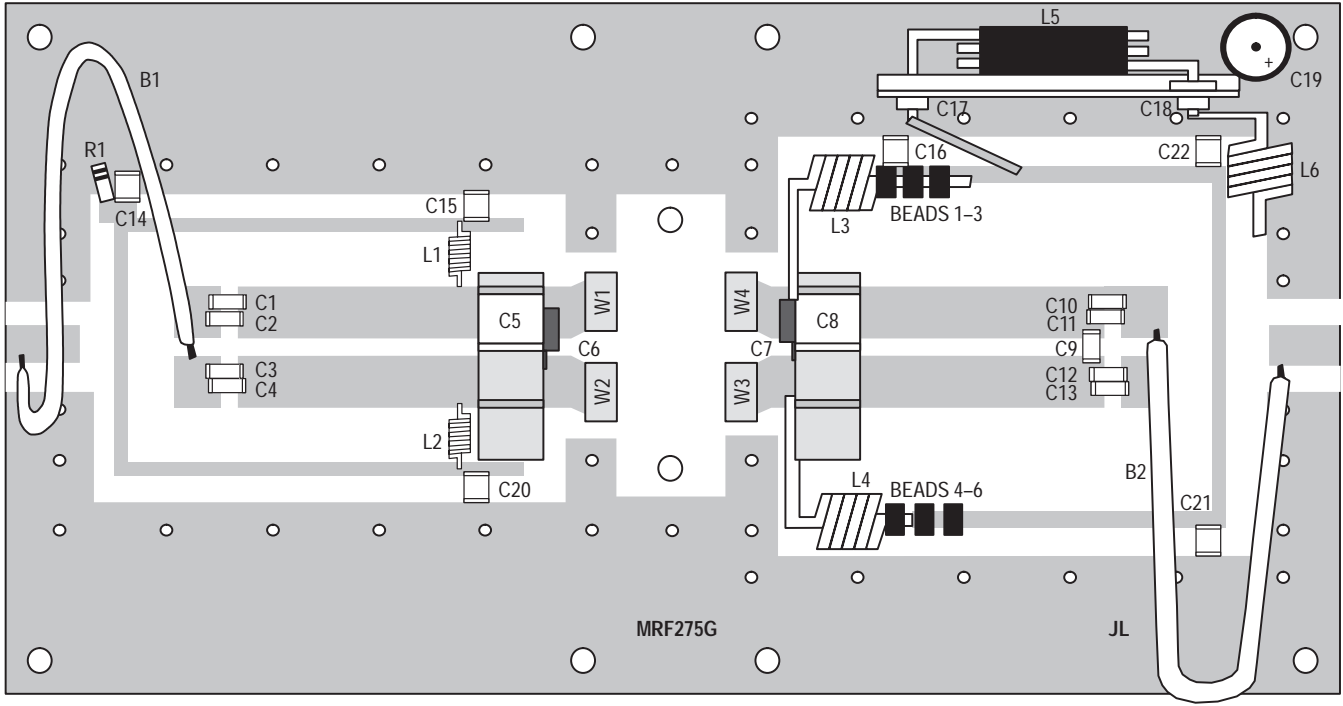
Board material 062" fiberglass (G10),  
 $\epsilon_r \approx 5$ , Two sided, 1 oz. Copper.

Unless otherwise noted, all chip capacitors  
are ATC Type 100 or Equivalent.

NOTE: For stability, the input transformer T1 should be loaded  
with ferrite toroids or beads to increase the common  
mode inductance. For operation below 100 MHz. The  
same is required for the output transformer.

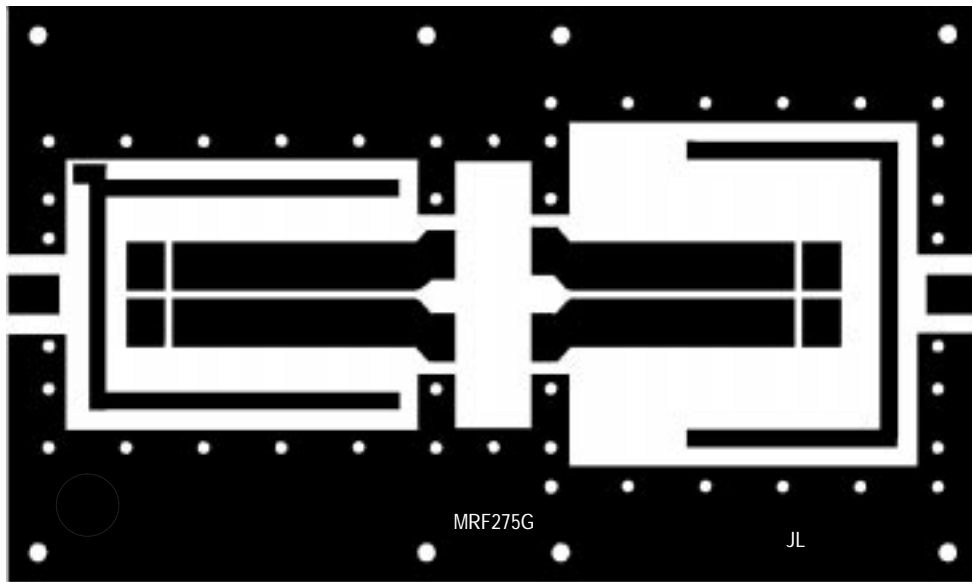
**Figure 13. 225 MHz Test Circuit**





(Not to Scale)

Figure 14. MRF275G Component Location (500 MHz)



(Scale 1:1)

Figure 15. MRF275G Circuit Board Photo Master (500 MHz)

NOTE: S-Parameter data represents measurements taken from one chip only.

Table 1. Common Source S-Parameters ( $V_{DS} = 12\text{ V}$ ,  $I_D = 4.5\text{ A}$ )

| f<br>MHz | S <sub>11</sub> |      | S <sub>21</sub> |    | S <sub>12</sub> |     | S <sub>22</sub> |      |
|----------|-----------------|------|-----------------|----|-----------------|-----|-----------------|------|
|          | S <sub>11</sub> | φ    | S <sub>21</sub> | φ  | S <sub>12</sub> | φ   | S <sub>22</sub> | φ    |
| 30       | 0.822           | -172 | 6.34            | 91 | 0.027           | 3   | 0.946           | -173 |
| 40       | 0.846           | -173 | 4.32            | 81 | 0.027           | -6  | 0.859           | -172 |
| 50       | 0.842           | -174 | 3.62            | 79 | 0.027           | -8  | 0.863           | -175 |
| 60       | 0.838           | -175 | 3.03            | 79 | 0.027           | -5  | 0.923           | -177 |
| 70       | 0.836           | -175 | 2.76            | 80 | 0.028           | -3  | 1.010           | -178 |
| 80       | 0.841           | -176 | 2.43            | 78 | 0.029           | -4  | 1.080           | -178 |
| 90       | 0.849           | -176 | 2.19            | 74 | 0.029           | -7  | 1.150           | -176 |
| 100      | 0.857           | -176 | 1.89            | 68 | 0.028           | -13 | 1.110           | -176 |
| 110      | 0.864           | -176 | 1.66            | 63 | 0.026           | -19 | 1.050           | -177 |
| 120      | 0.868           | -176 | 1.43            | 60 | 0.024           | -19 | 0.958           | -175 |
| 130      | 0.871           | -176 | 1.25            | 59 | 0.023           | -19 | 0.905           | -176 |
| 140      | 0.874           | -176 | 1.15            | 59 | 0.023           | -17 | 0.914           | -177 |
| 150      | 0.876           | -176 | 1.11            | 59 | 0.023           | -16 | 0.969           | -178 |
| 160      | 0.880           | -176 | 1.06            | 59 | 0.023           | -17 | 1.060           | -178 |
| 170      | 0.885           | -177 | 1.01            | 55 | 0.023           | -18 | 1.130           | -177 |
| 180      | 0.891           | -177 | 0.96            | 51 | 0.023           | -23 | 1.190           | -178 |
| 190      | 0.896           | -177 | 0.87            | 45 | 0.022           | -26 | 1.140           | -179 |
| 200      | 0.900           | -177 | 0.77            | 43 | 0.020           | -26 | 1.050           | -177 |
| 210      | 0.904           | -177 | 0.69            | 42 | 0.018           | -25 | 0.958           | -176 |
| 220      | 0.907           | -177 | 0.63            | 43 | 0.017           | -23 | 0.924           | -175 |
| 230      | 0.909           | -177 | 0.60            | 43 | 0.018           | -23 | 0.981           | -178 |
| 240      | 0.912           | -178 | 0.58            | 44 | 0.017           | -22 | 0.981           | -180 |
| 250      | 0.915           | -178 | 0.58            | 42 | 0.017           | -20 | 1.040           | -179 |
| 260      | 0.918           | -178 | 0.56            | 40 | 0.016           | -20 | 1.150           | -180 |
| 270      | 0.922           | -178 | 0.54            | 34 | 0.015           | -24 | 1.170           | 179  |
| 280      | 0.925           | -179 | 0.49            | 32 | 0.014           | -27 | 1.130           | -180 |
| 290      | 0.927           | -179 | 0.43            | 28 | 0.013           | -27 | 1.010           | -178 |
| 300      | 0.930           | -179 | 0.41            | 30 | 0.013           | -23 | 0.964           | -178 |
| 310      | 0.932           | -179 | 0.40            | 32 | 0.013           | -14 | 0.936           | -178 |
| 320      | 0.934           | -180 | 0.39            | 31 | 0.012           | -9  | 0.948           | 180  |
| 330      | 0.936           | -180 | 0.35            | 32 | 0.011           | -9  | 1.000           | 180  |
| 340      | 0.938           | 180  | 0.38            | 31 | 0.011           | -12 | 1.070           | 178  |
| 350      | 0.941           | 180  | 0.35            | 28 | 0.011           | -12 | 1.100           | 180  |
| 360      | 0.943           | 179  | 0.33            | 23 | 0.011           | -10 | 1.120           | -180 |
| 370      | 0.944           | 179  | 0.30            | 21 | 0.011           | -4  | 1.080           | 180  |
| 380      | 0.945           | 179  | 0.29            | 21 | 0.009           | 1   | 1.020           | 180  |
| 390      | 0.947           | 179  | 0.28            | 22 | 0.008           | 3   | 0.966           | -180 |
| 400      | 0.948           | 179  | 0.26            | 25 | 0.008           | 4   | 0.936           | -179 |
| 410      | 0.949           | 178  | 0.26            | 24 | 0.010           | 5   | 1.010           | 179  |
| 420      | 0.951           | 178  | 0.25            | 25 | 0.010           | 11  | 1.040           | 178  |

Table 1. Common Source S-Parameters ( $V_{DS} = 12\text{ V}$ ,  $I_D = 4.5\text{ A}$ ) continued

| f<br>MHz | S <sub>11</sub> |     | S <sub>21</sub> |    | S <sub>12</sub> |    | S <sub>22</sub> |     |
|----------|-----------------|-----|-----------------|----|-----------------|----|-----------------|-----|
|          | S <sub>11</sub> | φ   | S <sub>21</sub> | φ  | S <sub>12</sub> | φ  | S <sub>22</sub> | φ   |
| 430      | 0.952           | 178 | 0.25            | 22 | 0.010           | 19 | 1.080           | 177 |
| 440      | 0.953           | 177 | 0.24            | 19 | 0.009           | 22 | 1.100           | 178 |
| 450      | 0.955           | 177 | 0.24            | 16 | 0.008           | 21 | 1.100           | 179 |
| 460      | 0.956           | 177 | 0.21            | 15 | 0.008           | 11 | 1.080           | 177 |
| 470      | 0.956           | 177 | 0.20            | 16 | 0.009           | 16 | 0.992           | 178 |
| 480      | 0.957           | 176 | 0.19            | 18 | 0.010           | 27 | 0.975           | 179 |
| 490      | 0.958           | 176 | 0.19            | 18 | 0.010           | 40 | 0.974           | 178 |
| 500      | 0.960           | 176 | 0.19            | 19 | 0.010           | 46 | 1.010           | 177 |
| 600      | 0.956           | 175 | 0.18            | 12 | 0.007           | 49 | 0.940           | 175 |
| 700      | 0.958           | 172 | 0.11            | 14 | 0.018           | 61 | 0.989           | 173 |
| 800      | 0.962           | 170 | 0.10            | 12 | 0.029           | 51 | 0.967           | 172 |
| 900      | 0.965           | 168 | 0.08            | 16 | 0.021           | 72 | 0.973           | 170 |
| 1000     | 0.964           | 165 | 0.07            | 12 | 0.021           | 57 | 1.010           | 168 |

Table 2. Common Source S-Parameters ( $V_{DS} = 24\text{ V}$ ,  $I_D = 0.35\text{ mA}$ )

| f<br>MHz | S <sub>11</sub> |      | S <sub>21</sub> |    | S <sub>12</sub> |     | S <sub>22</sub> |      |
|----------|-----------------|------|-----------------|----|-----------------|-----|-----------------|------|
|          | S <sub>11</sub> | φ    | S <sub>21</sub> | φ  | S <sub>12</sub> | φ   | S <sub>22</sub> | φ    |
| 30       | 0.829           | -170 | 9.20            | 92 | 0.023           | 4   | 0.915           | -171 |
| 40       | 0.858           | -172 | 6.30            | 83 | 0.022           | -4  | 0.834           | -170 |
| 50       | 0.852           | -173 | 5.28            | 80 | 0.023           | -6  | 0.836           | -174 |
| 60       | 0.846           | -174 | 4.42            | 80 | 0.023           | -3  | 0.892           | -175 |
| 70       | 0.843           | -175 | 4.01            | 81 | 0.024           | -1  | 0.978           | -177 |
| 80       | 0.847           | -175 | 3.53            | 80 | 0.024           | -2  | 1.050           | -177 |
| 90       | 0.855           | -175 | 3.18            | 76 | 0.024           | -5  | 1.110           | -176 |
| 100      | 0.865           | -176 | 2.75            | 70 | 0.023           | -10 | 1.080           | -175 |
| 110      | 0.872           | -176 | 2.43            | 65 | 0.022           | -16 | 1.020           | -176 |
| 120      | 0.874           | -176 | 2.10            | 62 | 0.020           | -16 | 0.932           | -174 |
| 130      | 0.876           | -176 | 1.84            | 61 | 0.019           | -15 | 0.882           | -175 |
| 140      | 0.878           | -176 | 1.70            | 61 | 0.019           | -14 | 0.889           | -176 |
| 150      | 0.880           | -176 | 1.63            | 61 | 0.019           | -13 | 0.943           | -177 |
| 160      | 0.883           | -176 | 1.56            | 61 | 0.019           | -13 | 1.030           | -177 |
| 170      | 0.888           | -177 | 1.49            | 58 | 0.019           | -14 | 1.100           | -176 |
| 180      | 0.894           | -177 | 1.42            | 53 | 0.019           | -18 | 1.160           | -176 |
| 190      | 0.899           | -177 | 1.29            | 47 | 0.018           | -22 | 1.120           | -177 |
| 200      | 0.902           | -177 | 1.14            | 45 | 0.017           | -24 | 1.030           | -176 |
| 210      | 0.905           | -177 | 1.02            | 44 | 0.015           | -23 | 0.941           | -175 |
| 220      | 0.907           | -177 | 0.94            | 46 | 0.015           | -19 | 0.903           | -174 |
| 230      | 0.909           | -178 | 0.89            | 45 | 0.015           | -16 | 0.957           | -177 |
| 240      | 0.912           | -178 | 0.87            | 46 | 0.014           | -15 | 0.961           | -179 |
| 250      | 0.915           | -178 | 0.86            | 44 | 0.014           | -15 | 1.020           | -178 |
| 260      | 0.918           | -178 | 0.83            | 42 | 0.014           | -17 | 1.120           | -178 |
| 270      | 0.922           | -178 | 0.80            | 36 | 0.013           | -19 | 1.140           | -180 |

Table 2. Common Source S-Parameters ( $V_{DS} = 24\text{ V}$ ,  $I_D = 0.35\text{ mA}$ ) continued

| f<br>MHz | S <sub>11</sub> |      | S <sub>21</sub> |    | S <sub>12</sub> |     | S <sub>22</sub> |      |
|----------|-----------------|------|-----------------|----|-----------------|-----|-----------------|------|
|          | S <sub>11</sub> | φ    | S <sub>21</sub> | φ  | S <sub>12</sub> | φ   | S <sub>22</sub> | φ    |
| 280      | 0.925           | -179 | 0.73            | 34 | 0.013           | -20 | 1.110           | -179 |
| 290      | 0.927           | -179 | 0.65            | 32 | 0.011           | -18 | 0.994           | -177 |
| 300      | 0.929           | -179 | 0.62            | 32 | 0.011           | -15 | 0.948           | -177 |
| 310      | 0.931           | -179 | 0.60            | 34 | 0.010           | -9  | 0.916           | -177 |
| 320      | 0.932           | -180 | 0.57            | 33 | 0.010           | -6  | 0.934           | -180 |
| 330      | 0.934           | -180 | 0.53            | 34 | 0.010           | -4  | 0.985           | -180 |
| 340      | 0.937           | 180  | 0.56            | 33 | 0.010           | -2  | 1.050           | 179  |
| 350      | 0.939           | 180  | 0.53            | 30 | 0.010           | 0   | 1.090           | -179 |
| 360      | 0.941           | 179  | 0.50            | 25 | 0.010           | 0   | 1.110           | -178 |
| 370      | 0.943           | 179  | 0.46            | 23 | 0.009           | 0   | 1.080           | -179 |
| 380      | 0.944           | 179  | 0.44            | 22 | 0.009           | 2   | 1.010           | -179 |
| 390      | 0.945           | 179  | 0.41            | 24 | 0.008           | 8   | 0.956           | -179 |
| 400      | 0.946           | 178  | 0.40            | 27 | 0.008           | 16  | 0.926           | -178 |
| 410      | 0.947           | 178  | 0.38            | 26 | 0.009           | 20  | 1.000           | -180 |
| 420      | 0.949           | 178  | 0.38            | 26 | 0.009           | 22  | 1.040           | 179  |
| 430      | 0.950           | 178  | 0.37            | 23 | 0.009           | 25  | 1.070           | 179  |
| 440      | 0.952           | 177  | 0.36            | 21 | 0.009           | 26  | 1.090           | 180  |
| 450      | 0.953           | 177  | 0.36            | 18 | 0.009           | 28  | 1.090           | -180 |
| 460      | 0.954           | 177  | 0.31            | 17 | 0.009           | 24  | 1.070           | 178  |
| 470      | 0.955           | 177  | 0.30            | 17 | 0.009           | 29  | 0.990           | 179  |
| 480      | 0.956           | 176  | 0.29            | 19 | 0.009           | 36  | 0.963           | -179 |
| 490      | 0.957           | 176  | 0.29            | 20 | 0.010           | 45  | 0.959           | 180  |
| 500      | 0.958           | 176  | 0.28            | 20 | 0.010           | 50  | 0.996           | 178  |
| 600      | 0.956           | 175  | 0.24            | 12 | 0.006           | 90  | 0.924           | 176  |
| 700      | 0.959           | 172  | 0.16            | 13 | 0.019           | 63  | 0.986           | 174  |
| 800      | 0.963           | 170  | 0.14            | 10 | 0.023           | 63  | 0.963           | 173  |
| 900      | 0.968           | 168  | 0.12            | 11 | 0.026           | 84  | 0.967           | 171  |
| 1000     | 0.969           | 165  | 0.09            | 7  | 0.025           | 70  | 1.000           | 169  |

Table 3. Common Source S-Parameters ( $V_{DS} = 28\text{ V}$ ,  $I_D = 0.39\text{ mA}$ )

| f<br>MHz | S <sub>11</sub> |      | S <sub>21</sub> |    | S <sub>12</sub> |     | S <sub>22</sub> |      |
|----------|-----------------|------|-----------------|----|-----------------|-----|-----------------|------|
|          | S <sub>11</sub> | φ    | S <sub>21</sub> | φ  | S <sub>12</sub> | φ   | S <sub>22</sub> | φ    |
| 30       | 0.834           | -169 | 10.08           | 93 | 0.021           | 4   | 0.807           | -171 |
| 40       | 0.863           | -172 | 6.91            | 83 | 0.021           | -4  | 0.828           | -170 |
| 50       | 0.857           | -173 | 5.79            | 81 | 0.021           | -5  | 0.830           | -173 |
| 60       | 0.851           | -174 | 4.86            | 81 | 0.022           | -3  | 0.883           | -175 |
| 70       | 0.848           | -175 | 4.41            | 82 | 0.022           | -1  | 0.970           | -177 |
| 80       | 0.852           | -175 | 3.87            | 80 | 0.022           | -1  | 1.040           | -177 |
| 90       | 0.860           | -175 | 3.49            | 77 | 0.023           | -5  | 1.100           | -176 |
| 100      | 0.869           | -176 | 3.03            | 71 | 0.022           | -9  | 1.070           | -175 |
| 110      | 0.876           | -176 | 2.68            | 66 | 0.021           | -14 | 1.010           | -176 |
| 120      | 0.878           | -176 | 2.31            | 63 | 0.019           | -14 | 0.923           | -174 |
| 130      | 0.879           | -176 | 2.03            | 62 | 0.018           | -15 | 0.876           | -175 |

Table 3. Common Source S-Parameters ( $V_{DS} = 28\text{ V}$ ,  $I_D = 0.39\text{ mA}$ ) continued

| f<br>MHz | S <sub>11</sub> |      | S <sub>21</sub> |    | S <sub>12</sub> |     | S <sub>22</sub> |      |
|----------|-----------------|------|-----------------|----|-----------------|-----|-----------------|------|
|          | S <sub>11</sub> | φ    | S <sub>21</sub> | φ  | S <sub>12</sub> | φ   | S <sub>22</sub> | φ    |
| 140      | 0.881           | -176 | 1.87            | 62 | 0.018           | -13 | 0.884           | -176 |
| 150      | 0.883           | -176 | 1.79            | 62 | 0.018           | -11 | 0.934           | -177 |
| 160      | 0.886           | -177 | 1.72            | 62 | 0.018           | -11 | 1.020           | -177 |
| 170      | 0.890           | -177 | 1.64            | 58 | 0.018           | -12 | 1.090           | -176 |
| 180      | 0.896           | -177 | 1.56            | 54 | 0.018           | -16 | 1.150           | -176 |
| 190      | 0.901           | -177 | 1.42            | 48 | 0.018           | -21 | 1.110           | -177 |
| 200      | 0.904           | -177 | 1.26            | 46 | 0.017           | -19 | 1.030           | -176 |
| 210      | 0.907           | -177 | 1.13            | 45 | 0.015           | -14 | 0.938           | -175 |
| 220      | 0.908           | -177 | 1.03            | 47 | 0.013           | -13 | 0.897           | -174 |
| 230      | 0.910           | -178 | 0.99            | 46 | 0.014           | -15 | 0.948           | -176 |
| 240      | 0.912           | -178 | 0.96            | 47 | 0.014           | -13 | 0.956           | -179 |
| 250      | 0.916           | -178 | 0.95            | 45 | 0.014           | -10 | 1.020           | -178 |
| 260      | 0.919           | -178 | 0.93            | 42 | 0.013           | -12 | 1.120           | -178 |
| 270      | 0.922           | -179 | 0.89            | 37 | 0.012           | -15 | 1.140           | -179 |
| 280      | 0.925           | -179 | 0.81            | 35 | 0.012           | -16 | 1.110           | -178 |
| 290      | 0.927           | -179 | 0.72            | 33 | 0.011           | -16 | 0.988           | -176 |
| 300      | 0.929           | -179 | 0.69            | 33 | 0.011           | -10 | 0.944           | -177 |
| 310      | 0.931           | -179 | 0.66            | 35 | 0.012           | 5   | 0.920           | -177 |
| 320      | 0.933           | -180 | 0.63            | 34 | 0.011           | 16  | 0.936           | -180 |
| 330      | 0.934           | -180 | 0.59            | 35 | 0.009           | 14  | 0.989           | -180 |
| 340      | 0.937           | 180  | 0.62            | 34 | 0.009           | 3   | 1.050           | 180  |
| 350      | 0.939           | 180  | 0.59            | 31 | 0.010           | 4   | 1.080           | -179 |
| 360      | 0.941           | 179  | 0.55            | 26 | 0.010           | 8   | 1.110           | -178 |
| 370      | 0.943           | 179  | 0.51            | 24 | 0.009           | 11  | 1.070           | -179 |
| 380      | 0.944           | 179  | 0.49            | 23 | 0.008           | 17  | 1.010           | -178 |
| 390      | 0.945           | 179  | 0.46            | 25 | 0.008           | 24  | 0.949           | -178 |
| 400      | 0.946           | 178  | 0.44            | 27 | 0.007           | 20  | 0.922           | -178 |
| 410      | 0.947           | 178  | 0.43            | 26 | 0.010           | 19  | 0.995           | -180 |
| 420      | 0.949           | 178  | 0.42            | 27 | 0.012           | 29  | 1.030           | 179  |
| 430      | 0.950           | 178  | 0.41            | 24 | 0.010           | 41  | 1.060           | 179  |
| 440      | 0.951           | 177  | 0.40            | 21 | 0.008           | 40  | 1.090           | 180  |
| 450      | 0.953           | 177  | 0.39            | 19 | 0.008           | 34  | 1.090           | -180 |
| 460      | 0.953           | 177  | 0.35            | 17 | 0.009           | 26  | 1.070           | 178  |
| 470      | 0.954           | 177  | 0.33            | 18 | 0.010           | 30  | 0.983           | 179  |
| 480      | 0.955           | 176  | 0.32            | 19 | 0.012           | 43  | 0.964           | -180 |
| 490      | 0.956           | 176  | 0.32            | 20 | 0.012           | 60  | 0.956           | 179  |
| 500      | 0.957           | 176  | 0.31            | 21 | 0.010           | 65  | 0.993           | 178  |
| 600      | 0.955           | 174  | 0.26            | 13 | 0.012           | 67  | 0.926           | 176  |
| 700      | 0.958           | 172  | 0.18            | 12 | 0.018           | 64  | 0.984           | 174  |
| 800      | 0.963           | 170  | 0.15            | 9  | 0.020           | 89  | 0.961           | 173  |
| 900      | 0.966           | 168  | 0.13            | 9  | 0.028           | 81  | 0.967           | 171  |
| 1000     | 0.968           | 165  | 0.10            | 6  | 0.033           | 73  | 0.997           | 169  |

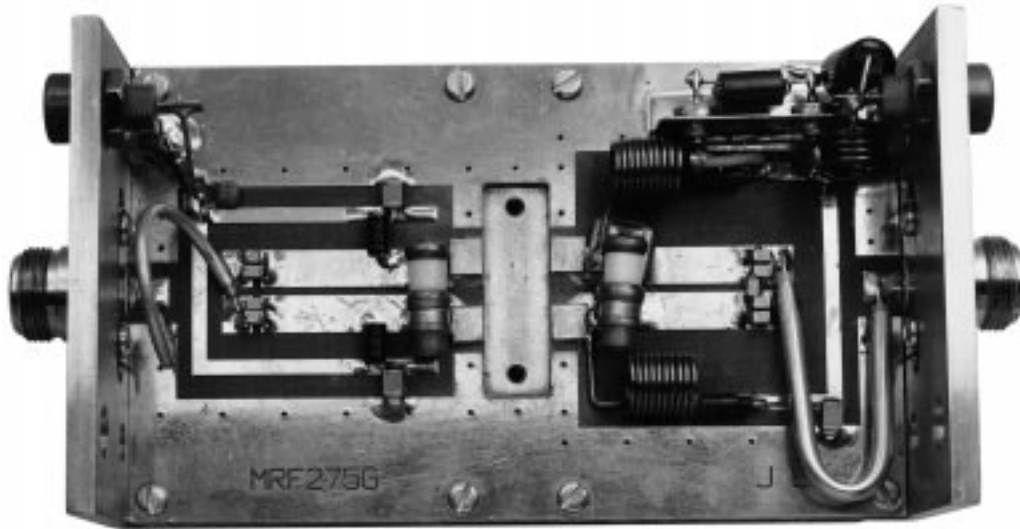


Figure 16. MRF275G Test Fixture

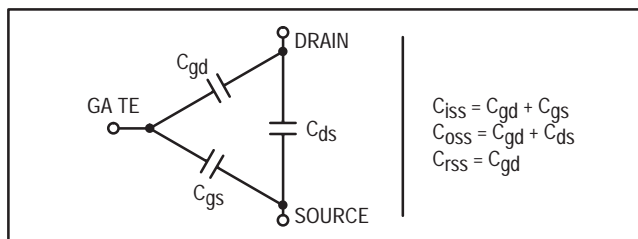
## RF POWER MOSFET CONSIDERATIONS

### MOSFET CAPACITANCES

The physical structure of a MOSFET results in capacitors between the terminals. The metal oxide gate structure determines the capacitors from gate-to-drain ( $C_{gd}$ ), and gate-to-source ( $C_{gs}$ ). The PN junction formed during the fabrication of the MOSFET results in a junction capacitance from drain-to-source ( $C_{ds}$ ).

These capacitances are characterized as input ( $C_{iSS}$ ), output ( $C_{oSS}$ ) and reverse transfer ( $C_{rSS}$ ) capacitances on data sheets. The relationships between the inter-terminal capacitances and those given on data sheets are shown below. The  $C_{iSS}$  can be specified in two ways:

1. Drain shorted to source and positive voltage at the gate.
2. Positive voltage of the drain in respect to source and zero volts at the gate. In the latter case the numbers are lower. However, neither method represents the actual operating conditions in RF applications.



The  $C_{iSS}$  given in the electrical characteristics table was measured using method 2 above. It should be noted that  $C_{iSS}$ ,  $C_{oSS}$ ,  $C_{rSS}$  are measured at zero drain current and are provided for general information about the device. They are not RF design parameters and no attempt should be made to use them as such.

### DRAIN CHARACTERISTICS

One figure of merit for a FET is its static resistance in the full-on condition. This on-resistance,  $V_{DS(on)}$ , occurs in the linear region of the output characteristic and is specified under specific test conditions for gate-source voltage and drain current. For MOSFETs,  $V_{DS(on)}$  has a positive temperature coefficient and constitutes an important design consideration at high temperatures, because it contributes to the power dissipation within the device.

### GATE CHARACTERISTICS

The gate of the MOSFET is a polysilicon material, and is electrically isolated from the source by a layer of oxide. The input resistance is very high — on the order of  $10^9$  ohms — resulting in a leakage current of a few nanoamperes.

Gate control is achieved by applying a positive voltage slightly in excess of the gate-to-source threshold voltage,  $V_{GS(th)}$ .

**Gate Voltage Rating** — Never exceed the gate voltage rating (or any of the maximum ratings on the front page). Exceeding the rated  $V_{GS}$  can result in permanent damage to the oxide layer in the gate region.

**Gate Termination** — The gates of this device are essentially capacitors. Circuits that leave the gate open-circuited or floating should be avoided. These conditions can result in turn-on of the devices due to voltage build-up on the input capacitor due to leakage currents or pickup.

**Gate Protection** — These devices do not have an internal monolithic zener diode from gate-to-source. If gate protection is required, an external zener diode is recommended.

Using a resistor to keep the gate-to-source impedance low also helps damp transients and serves another important function. Voltage transients on the drain can be coupled to the gate through the parasitic gate-drain capacitance. If the gate-to-source impedance and the rate of voltage change on the drain are both high, then the signal coupled to the gate

may be large enough to exceed the gate–threshold voltage and turn the device on.

### HANDLING CONSIDERATIONS

When shipping, the devices should be transported only in antistatic bags or conductive foam. Upon removal from the packaging, careful handling procedures should be adhered to. Those handling the devices should wear grounding straps and devices not in the antistatic packaging should be kept in metal tote bins. MOSFETs should be handled by the case and not by the leads, and when testing the device, all leads should make good electrical contact before voltage is applied. As a final note, when placing the FET into the system it is designed for, soldering should be done with grounded equipment.

### DESIGN CONSIDERATIONS

The MRF275G is a RF power N–channel enhancement mode field–effect transistor (FETs) designed for HF, VHF and UHF power amplifier applications. M/A-COM RF MOSFETs feature a vertical structure with a planar design.

M/A-COM Application Note AN211A, FETs in Theory and Practice, is suggested reading for those not familiar with the construction and characteristics of FETs.

The major advantages of RF power FETs include high gain, low noise, simple bias systems, relative immunity from

thermal runaway, and the ability to withstand severely mismatched loads without suffering damage. Power output can be varied over a wide range with a low power dc control signal.

### DC BIAS

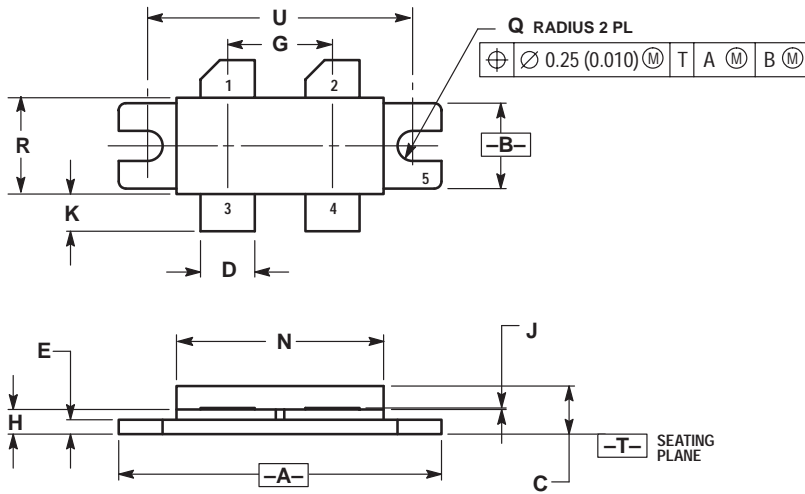
The MRF275G is an enhancement mode FET and, therefore, does not conduct when drain voltage is applied. Drain current flows when a positive voltage is applied to the gate. RF power FETs require forward bias for optimum performance. The value of quiescent drain current ( $I_{DQ}$ ) is not critical for many applications. The MRF275G was characterized at  $I_{DQ} = 100$  mA, each side, which is the suggested minimum value of  $I_{DQ}$ . For special applications such as linear amplification,  $I_{DQ}$  may have to be selected to optimize the critical parameters.

The gate is a dc open circuit and draws no current. Therefore, the gate bias circuit may be just a simple resistive divider network. Some applications may require a more elaborate bias system.

### GAIN CONTROL

Power output of the MRF275G may be controlled from its rated value down to zero (negative gain) by varying the dc gate voltage. This feature facilitates the design of manual gain control, AGC/ALC and modulation systems.

## PACKAGE DIMENSIONS



- NOTES:  
 1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.  
 2. CONTROLLING DIMENSION: INCH.

| DIM | INCHES    |       | MILLIMETERS |       |
|-----|-----------|-------|-------------|-------|
|     | MIN       | MAX   | MIN         | MAX   |
| A   | 1.330     | 1.350 | 33.79       | 34.29 |
| B   | 0.370     | 0.410 | 9.40        | 10.41 |
| C   | 0.190     | 0.230 | 4.83        | 5.84  |
| D   | 0.215     | 0.235 | 5.47        | 5.96  |
| E   | 0.050     | 0.070 | 1.27        | 1.77  |
| G   | 0.430     | 0.440 | 10.92       | 11.18 |
| H   | 0.102     | 0.112 | 2.59        | 2.84  |
| J   | 0.004     | 0.006 | 0.11        | 0.15  |
| K   | 0.185     | 0.215 | 4.83        | 5.33  |
| N   | 0.845     | 0.875 | 21.46       | 22.23 |
| Q   | 0.060     | 0.070 | 1.52        | 1.78  |
| R   | 0.390     | 0.410 | 9.91        | 10.41 |
| U   | 1.100 BSC |       | 27.94 BSC   |       |

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

**CASE 375-04  
 ISSUE D**

*Specifications subject to change without notice.*

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Visit [www.macom.com](http://www.macom.com) for additional data sheets and product information.

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