

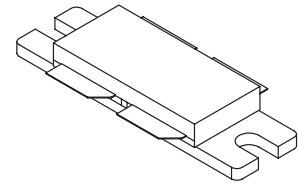
The RF MOSFET Line  
**RF Power Field Effect Transistors**  
N-Channel Enhancement-Mode Lateral MOSFETs

Designed for broadband commercial and industrial applications with frequencies from 865 to 895 MHz. The high gain and broadband performance of these devices make them ideal for large-signal, common source amplifier applications in 26 volt base station equipment.

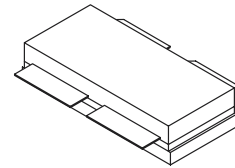
- Typical CDMA Performance @ 880 MHz, 26 Volts,  $I_{DQ} = 2 \times 500$  mA  
IS-97 CDMA Pilot, Sync, Paging, Traffic Codes 8 Through 13  
Output Power — 26 Watts  
Power Gain — 16 dB  
Efficiency — 26%  
Adjacent Channel Power —  
750 kHz: -45 dBc @ 30 kHz BW  
1.98 MHz: -60 dBc @ 30 kHz BW
- Integrated ESD Protection
- Designed for Maximum Gain and Insertion Phase Flatness
- Capable of Handling 10:1 VSWR, @ 26 Vdc, 880 MHz, 120 Watts (CW) Output Power
- Excellent Thermal Stability
- Characterized with Series Equivalent Large-Signal Impedance Parameters

**MRF9120**  
**MRF9120S**

**880 MHz, 120 W, 26 V**  
**LATERAL N-CHANNEL**  
**RF POWER MOSFETs**



**CASE 375B-04, STYLE 1**  
**NI-860**  
**MRF9120**



**CASE 375H-03, STYLE 1**  
**NI-860S**  
**MRF9120S**

**MAXIMUM RATINGS**

| Rating   | Symbol    | Value        | Unit                         |
|--|-----------|--------------|------------------------------|
| Drain-Source Voltage   | $V_{DSS}$ | 65           | Vdc                          |
| Gate-Source Voltage  | $V_{GS}$  | - 0.5, +15   | Vdc                          |
| Total Device Dissipation @ $T_C = 25^\circ\text{C}$<br>Derate above $25^\circ\text{C}$ | $P_D$     | 250<br>1.43  | Watts<br>W/ $^\circ\text{C}$ |
| Storage Temperature Range  | $T_{stg}$ | - 65 to +150 | $^\circ\text{C}$             |
| Operating Junction Temperature   | $T_J$     | 200          | $^\circ\text{C}$             |

**ESD PROTECTION CHARACTERISTICS**

| Test Conditions  | Class        |
|------------------|--------------|
| Human Body Model | 1 (Minimum)  |
| Machine Model    | M1 (Minimum) |

**THERMAL CHARACTERISTICS**

| Characteristic                       | Symbol          | Max  | Unit                      |
|--------------------------------------|-----------------|------|---------------------------|
| Thermal Resistance, Junction to Case | $R_{\theta JC}$ | 0.45 | $^\circ\text{C}/\text{W}$ |

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            |
|---|--------------|-----|------|-----|-----------------|
| <b>OFF CHARACTERISTICS</b> <sup>(1)</sup>   |              |     |      |     |                 |
| Zero Gate Voltage Drain Leakage Current<br>( $V_{DS} = 65\text{ Vdc}$ , $V_{GS} = 0\text{ Vdc}$ )                     | $I_{DSS}$    | —   | —    | 10  | $\mu\text{Adc}$ |
| Zero Gate Voltage Drain Leakage Current<br>( $V_{DS} = 26\text{ Vdc}$ , $V_{GS} = 0\text{ Vdc}$ )                     | $I_{DSS}$    | —   | —    | 1   | $\mu\text{Adc}$ |
| Gate–Source Leakage Current<br>( $V_{GS} = 5\text{ Vdc}$ , $V_{DS} = 0\text{ Vdc}$ )                                  | $I_{GSS}$    | —   | —    | 1   | $\mu\text{Adc}$ |
| <b>ON CHARACTERISTICS</b> <sup>(1)</sup>  |              |     |      |     |                 |
| Gate Threshold Voltage<br>( $V_{DS} = 10\text{ Vdc}$ , $I_D = 200\ \mu\text{Adc}$ )                                   | $V_{GS(th)}$ | 2   | 3    | 4   | Vdc             |
| Gate Quiescent Voltage<br>( $V_{DS} = 26\text{ Vdc}$ , $I_D = 450\text{ mAdc}$ )                                      | $V_{GS(Q)}$  | —   | 3.8  | —   | Vdc             |
| Drain–Source On–Voltage<br>( $V_{GS} = 10\text{ Vdc}$ , $I_D = 1.3\text{ Adc}$ )                                      | $V_{DS(on)}$ | —   | 0.17 | 0.4 | Vdc             |
| Forward Transconductance<br>( $V_{DS} = 10\text{ Vdc}$ , $I_D = 4\text{ Adc}$ )                                       | $g_{fs}$     | —   | 5.3  | —   | S               |
| <b>DYNAMIC CHARACTERISTICS</b> <sup>(1)</sup>   |              |     |      |     |                 |
| Output Capacitance<br>( $V_{DS} = 26\text{ Vdc} \pm 30\text{ mV(rms)ac}$ @ 1 MHz, $V_{GS} = 0\text{ Vdc}$ )           | $C_{oss}$    | —   | 50   | —   | pF              |
| Reverse Transfer Capacitance<br>( $V_{DS} = 26\text{ Vdc} \pm 30\text{ mV(rms)ac}$ @ 1 MHz, $V_{GS} = 0\text{ Vdc}$ ) | $C_{rss}$    | —   | 2    | —   | pF              |

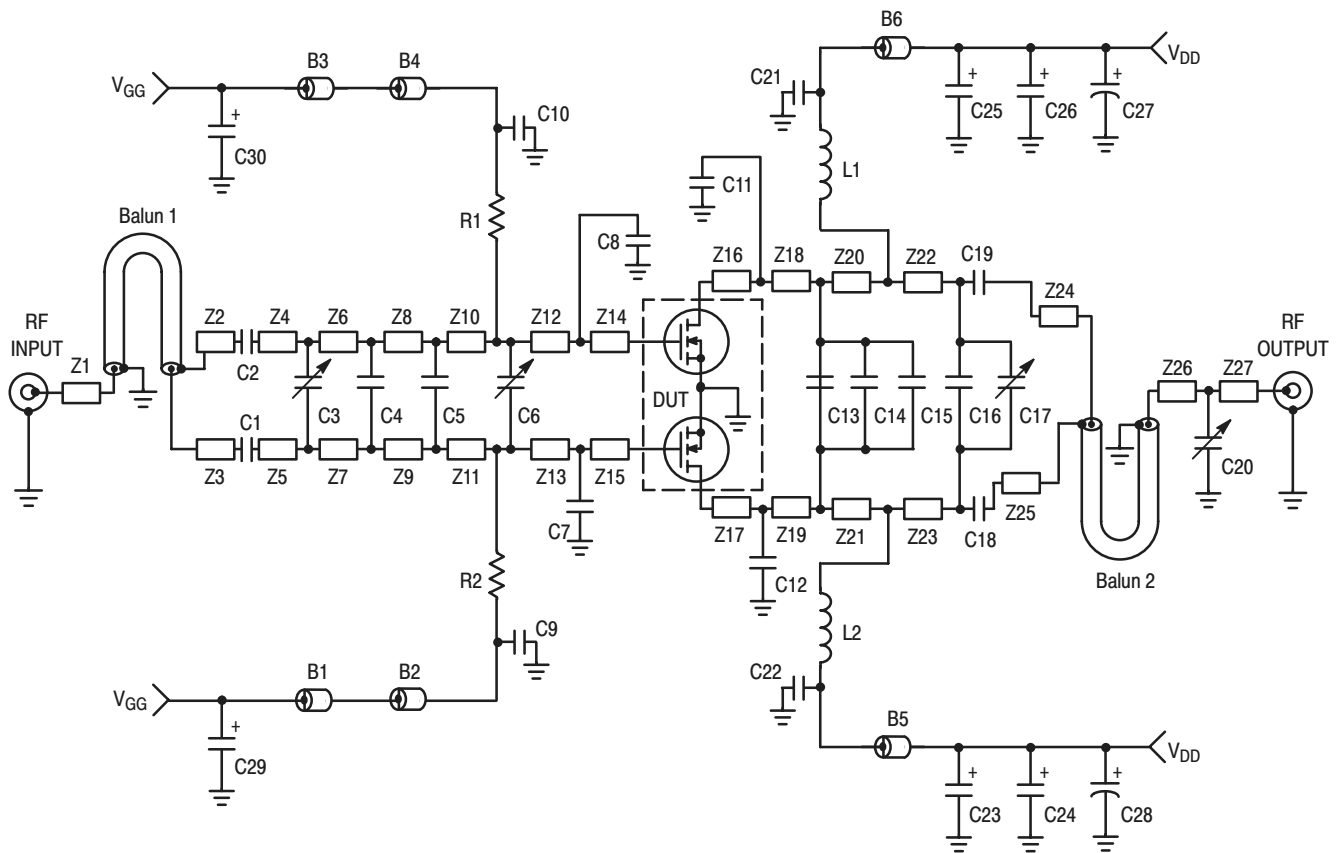
(1) Each side of device measured separately.

(continued)

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

| Characteristic   | Symbol    | Min                            | Typ  | Max | Unit |
|--|-----------|--------------------------------|------|-----|------|
| <b>FUNCTIONAL TESTS</b> (In Motorola Test Fixture, 50 ohm system) (2)  |           |                                |      |     |      |
| Two-Tone Common-Source Amplifier Power Gain<br>( $V_{DD} = 26\text{ Vdc}$ , $P_{out} = 120\text{ W PEP}$ , $I_{DQ} = 2 \times 500\text{ mA}$ ,<br>$f_1 = 880.0\text{ MHz}$ , $f_2 = 880.1\text{ MHz}$ )      | $G_{ps}$  | 15                             | 16.5 | —   | dB   |
| Two-Tone Drain Efficiency<br>( $V_{DD} = 26\text{ Vdc}$ , $P_{out} = 120\text{ W PEP}$ , $I_{DQ} = 2 \times 500\text{ mA}$ ,<br>$f_1 = 880.0\text{ MHz}$ , $f_2 = 880.1\text{ MHz}$ )                        | $\eta$    | 36                             | 39   | —   | %    |
| 3rd Order Intermodulation Distortion<br>( $V_{DD} = 26\text{ Vdc}$ , $P_{out} = 120\text{ W PEP}$ , $I_{DQ} = 2 \times 500\text{ mA}$ ,<br>$f_1 = 880.0\text{ MHz}$ , $f_2 = 880.1\text{ MHz}$ )             | IMD       | —                              | -31  | -28 | dBc  |
| Input Return Loss<br>( $V_{DD} = 26\text{ Vdc}$ , $P_{out} = 120\text{ W PEP}$ , $I_{DQ} = 2 \times 500\text{ mA}$ ,<br>$f_1 = 880.0\text{ MHz}$ , $f_2 = 880.1\text{ MHz}$ )                                | IRL       | —                              | -16  | -9  | dB   |
| Two-Tone Common-Source Amplifier Power Gain<br>( $V_{DD} = 26\text{ Vdc}$ , $P_{out} = 120\text{ W PEP}$ , $I_{DQ} = 2 \times 500\text{ mA}$ ,<br>$f_1 = 895.0\text{ MHz}$ , $f_2 = 895.1\text{ MHz}$ )      | $G_{ps}$  | —                              | 16.5 | —   | dB   |
| Two-Tone Drain Efficiency<br>( $V_{DD} = 26\text{ Vdc}$ , $P_{out} = 120\text{ W PEP}$ , $I_{DQ} = 2 \times 500\text{ mA}$ ,<br>$f_1 = 895.0\text{ MHz}$ , $f_2 = 895.1\text{ MHz}$ )                        | $\eta$    | —                              | 40.5 | —   | %    |
| 3rd Order Intermodulation Distortion<br>( $V_{DD} = 26\text{ Vdc}$ , $P_{out} = 120\text{ W PEP}$ , $I_{DQ} = 2 \times 500\text{ mA}$ ,<br>$f_1 = 895.0\text{ MHz}$ , $f_2 = 895.1\text{ MHz}$ )             | IMD       | —                              | -30  | —   | dBc  |
| Input Return Loss<br>( $V_{DD} = 26\text{ Vdc}$ , $P_{out} = 120\text{ W PEP}$ , $I_{DQ} = 2 \times 500\text{ mA}$ ,<br>$f_1 = 895.0\text{ MHz}$ , $f_2 = 895.1\text{ MHz}$ )                                | IRL       | —                              | -13  | —   | dB   |
| Power Output, 1 dB Compression Point<br>( $V_{DD} = 26\text{ Vdc}$ , $P_{out} = 120\text{ W CW}$ , $I_{DQ} = 2 \times 500\text{ mA}$ ,<br>$f_1 = 880.0\text{ MHz}$ )   | $P_{1dB}$ | —                              | 120  | —   | W    |
| Common-Source Amplifier Power Gain<br>( $V_{DD} = 26\text{ Vdc}$ , $P_{out} = 120\text{ W CW}$ , $I_{DQ} = 2 \times 500\text{ mA}$ ,<br>$f_1 = 880.0\text{ MHz}$ )   | $G_{ps}$  | —                              | 16   | —   | dB   |
| Drain Efficiency<br>( $V_{DD} = 26\text{ Vdc}$ , $P_{out} = 120\text{ W CW}$ , $I_{DQ} = 2 \times 500\text{ mA}$ ,<br>$f_1 = 880.0\text{ MHz}$ )   | $\eta$    | —                              | 51   | —   | %    |
| Output Mismatch Stress<br>( $V_{DD} = 26\text{ Vdc}$ , $P_{out} = 120\text{ W CW}$ , $I_{DQ} = 2 \times 500\text{ mA}$ ,<br>$f = 880.0\text{ MHz}$ , $VSWR = 10:1$ , All Phase Angles at Frequency of Tests) | $\Psi$    | No Degradation In Output Power |      |     |      |

(2) Device measured in push-pull configuration.

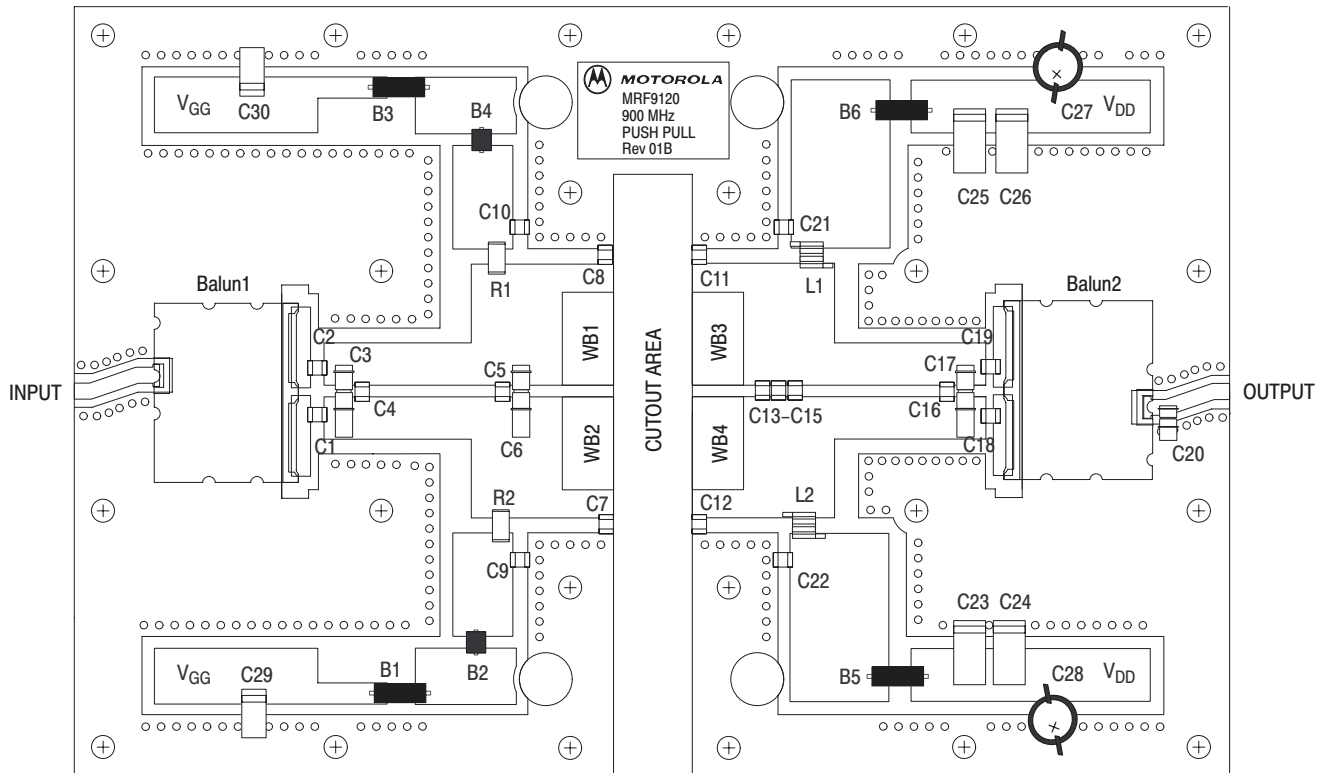


|          |                            |          |                            |
|----------|----------------------------|----------|----------------------------|
| Z1       | 0.420" x 0.080" Microstrip | Z14, Z15 | 0.040" x 0.630" Microstrip |
| Z2, Z3   | 0.090" x 0.420" Microstrip | Z16, Z17 | 0.040" x 0.630" Microstrip |
| Z4, Z5   | 0.125" x 0.220" Microstrip | Z18, Z19 | 0.330" x 0.630" Microstrip |
| Z6, Z7   | 0.095" x 0.220" Microstrip | Z20, Z21 | 0.450" x 0.630" Microstrip |
| Z8, Z9   | 0.600" x 0.220" Microstrip | Z22, Z23 | 0.750" x 0.220" Microstrip |
| Z10, Z11 | 0.200" x 0.630" Microstrip | Z24, Z25 | 0.115" x 0.420" Microstrip |
| Z12, Z13 | 0.500" x 0.630" Microstrip | Z26      | 0.130" x 0.080" Microstrip |
|          |                            | Z27      | 0.350" x 0.080" Microstrip |

Figure 1. 880 MHz Broadband Test Circuit Schematic

**Table 1. 880 MHz Broadband Test Circuit Component Designations and Values**

| Part               | Description   | Value, P/N or DWG         | Manufacturer |
|--------------------|---|---------------------------|--------------|
| B1, B3, B5, B6     | Long Ferrite Beads, Surface Mount   | 95F787                    | Newark       |
| B2, B4             | Short Ferrite Beads, Surface Mount  | 95F786                    | Newark       |
| C1, C2             | 68 pF Chip Capacitors, B Case   | 100B680JP500X             | ATC          |
| C3, C6             | 0.8 – 8.0 pF Variable Capacitors  | 44F3360                   | Newark       |
| C4                 | 7.5 pF Chip Capacitor, B Case   | 100B7R5JP150X             | ATC          |
| C5                 | 3.3 pF Chip Capacitor, B Case   | 100B3R3CP150X             | ATC          |
| C7, C8             | 11 pF Chip Capacitors, B Case   | 100B110BCA500X            | ATC          |
| C9, C10, C21, C22  | 51 pF Chip Capacitors, B Case   | 100B510JP500X             | ATC          |
| C11, C12           | 6.2 pF Chip Capacitors, B Case  | 100B6R2BCA150X            | ATC          |
| C13                | 4.7 pF Chip Capacitor, B Case   | 100B4R7BCA150X            | ATC          |
| C14                | 5.1 pF Chip Capacitor, B Case   | 100B5R1BCA150X            | ATC          |
| C15                | 3.0 pF Chip Capacitor, B Case   | 100B2R7BCA150X            | ATC          |
| C16                | 2.7 pF Chip Capacitor, B Case   | 100B3R0BCA150X            | ATC          |
| C17                | 0.6 – 4.5 pF Variable Capacitor   | 44F3358                   | Newark       |
| C18, C19           | 47 pF Chip Capacitors, B Case   | 100B470JP500X             | ATC          |
| C20                | 0.4 – 2.5 pF Variable Capacitor   | 44F3367                   | Newark       |
| C29, C30           | 10 $\mu$ F, 35 V Tantalum Chip Capacitors                                   | 93F2975                   | Newark       |
| C23, C24, C25, C26 | 22 $\mu$ F, 35 V Tantalum Chip Capacitors                                   | 92F1853                   | Newark       |
| C27, C28           | 220 $\mu$ F, 50 V Electrolytic Capacitors                                   | 14F185                    | Newark       |
| Balun 1, Balun 2   | Xinger Surface Mount Balun Transformers                                     | 3A412                     | Anaren       |
| L1, L2             | 12.5 nH Mini Spring Inductors   | A04T-5                    | Coilcraft    |
| R1, R2             | 510 $\Omega$ , 1/4 W Chip Resistors   |                           | Garret       |
| WB1, WB2, WB3, WB4 | 10 mil Brass Wear Blocks  |                           |              |
| Board Material     | 30 mil Glass Teflon <sup>®</sup> , $\epsilon_r = 2.55$ Copper Clad, 2 oz Cu | 900 MHz Push-Pull Rev 01B | CMR          |
| PCB                | Etched Circuit Board  | 900 MHz Push-Pull Rev 01B | CMR          |



**Figure 2. 865–895 MHz Broadband Test Circuit Component Layout**

## TYPICAL CHARACTERISTICS

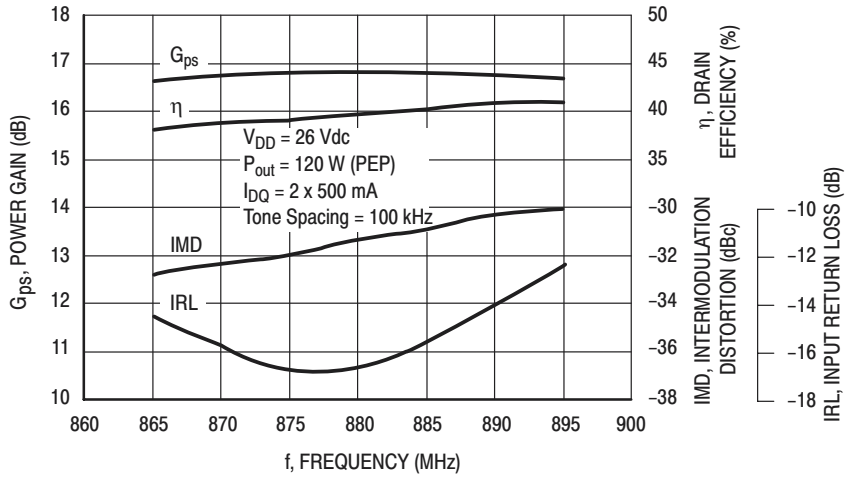


Figure 3. Class AB Broadband Circuit Performance

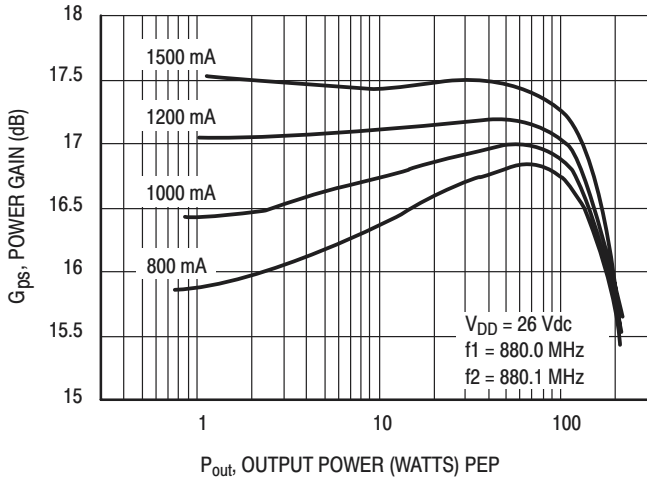


Figure 4. Power Gain versus Output Power

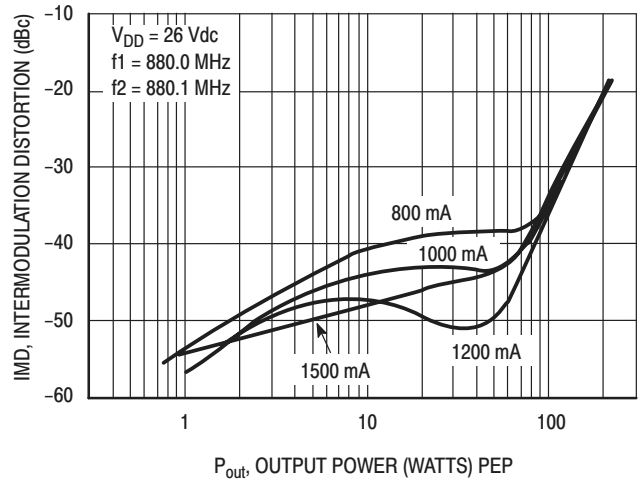


Figure 5. Intermodulation Distortion versus Output Power

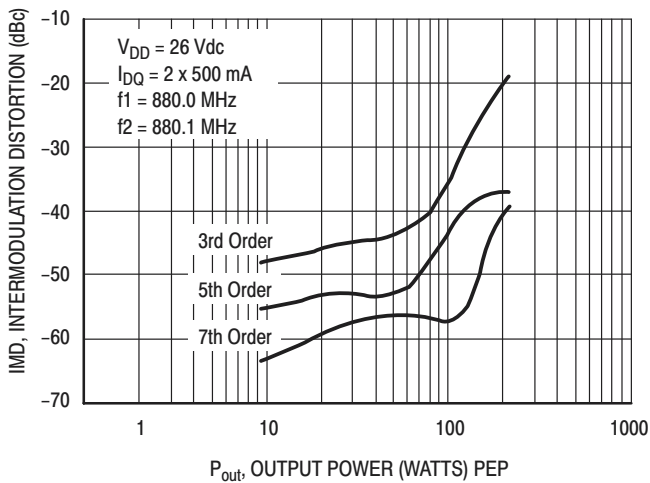


Figure 6. Intermodulation Distortion Products versus Output Power

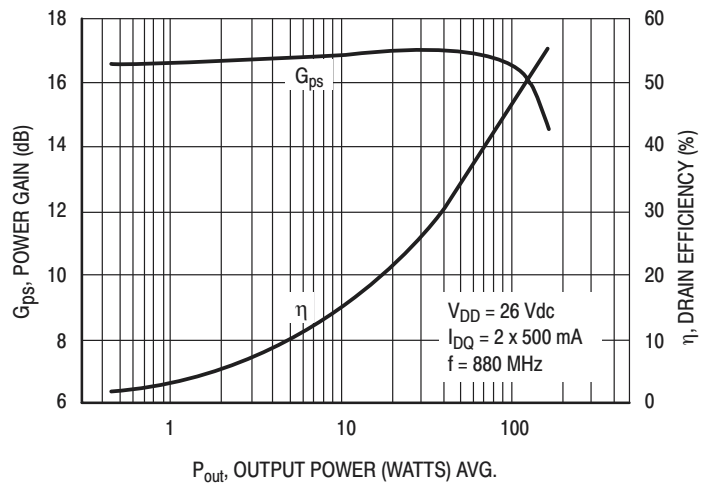
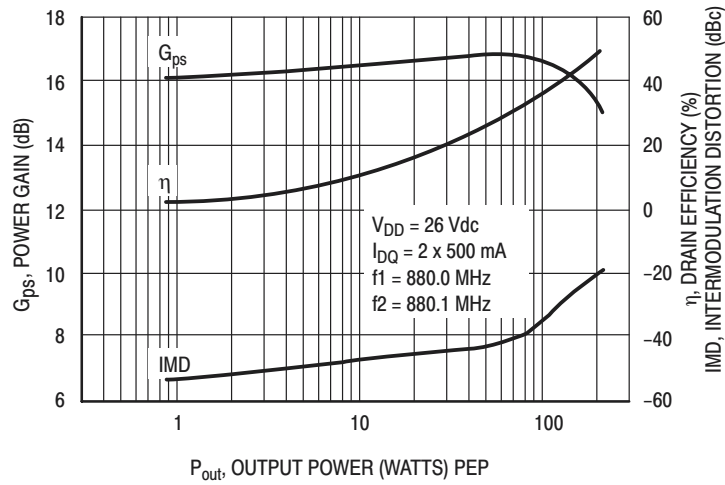
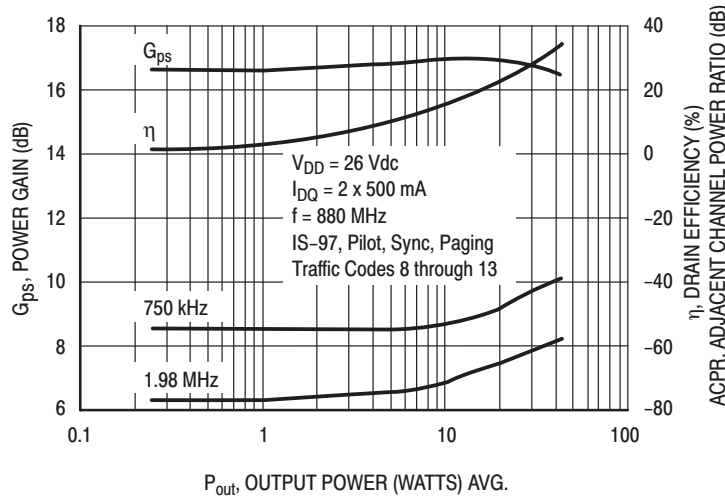


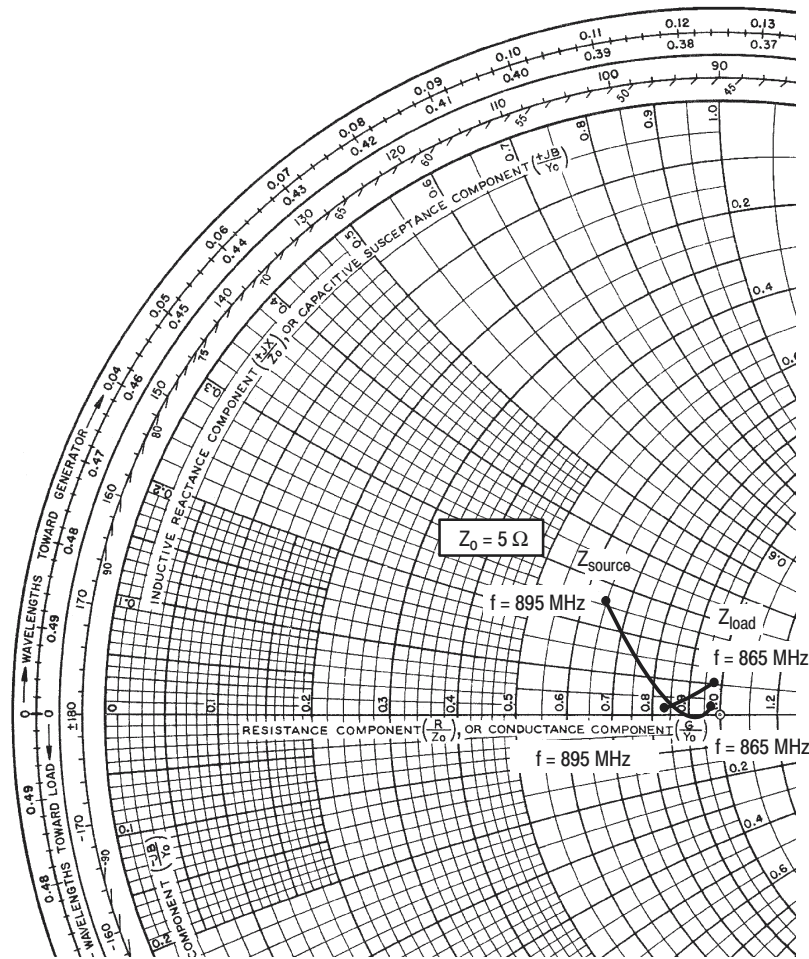
Figure 7. Power Gain and Efficiency versus Output Power



**Figure 8. Power Gain, Efficiency and IMD versus Output Power**



**Figure 9. Power Gain, Efficiency and ACPR versus Output Power**



$V_{DD} = 26 \text{ V}$ ,  $I_{DQ} = 2 \times 500 \text{ mA}$ ,  $P_{out} = 120 \text{ W PEP}$

| f<br>MHz | $Z_{source}$<br>$\Omega$ | $Z_{load}$<br>$\Omega$ |
|----------|--------------------------|------------------------|
| 865      | $4.89 + j0.2$            | $4.9 + j0.5$           |
| 880      | $4.54 - j0.07$           | $4.6 + j0.32$          |
| 895      | $3.29 + j1.3$            | $4.2 + j0.04$          |

$Z_{source}$  = Test circuit impedance as measured from gate to gate, balanced configuration.

$Z_{load}$  = Test circuit impedance as measured from drain to drain, balanced configuration.

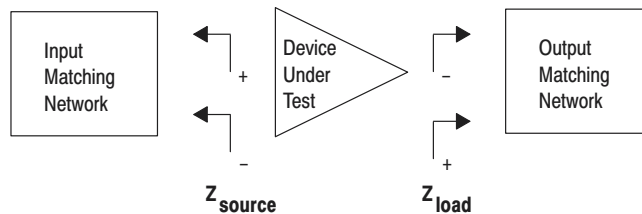


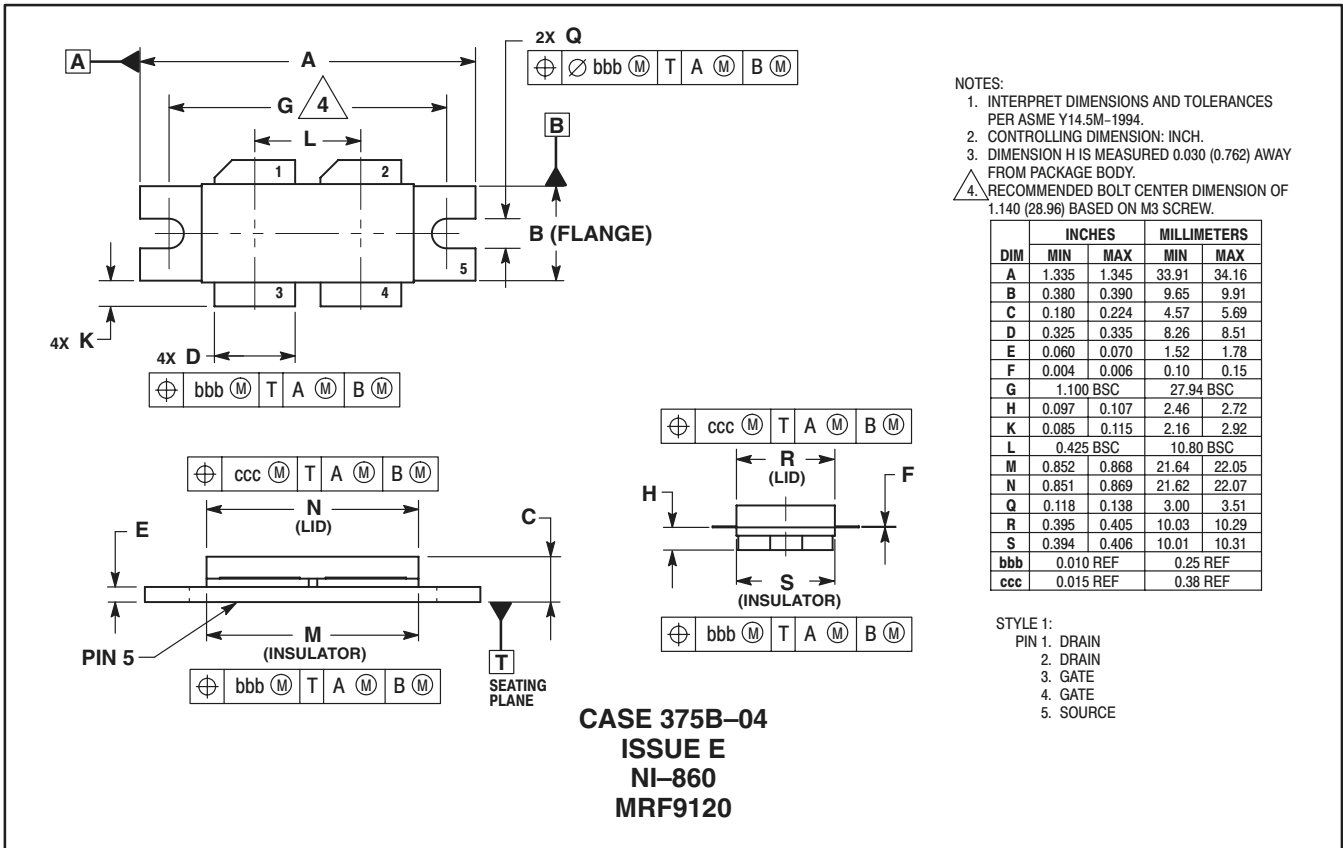
Figure 10. Series Equivalent Input and Output Impedance



# NOTES

# NOTES

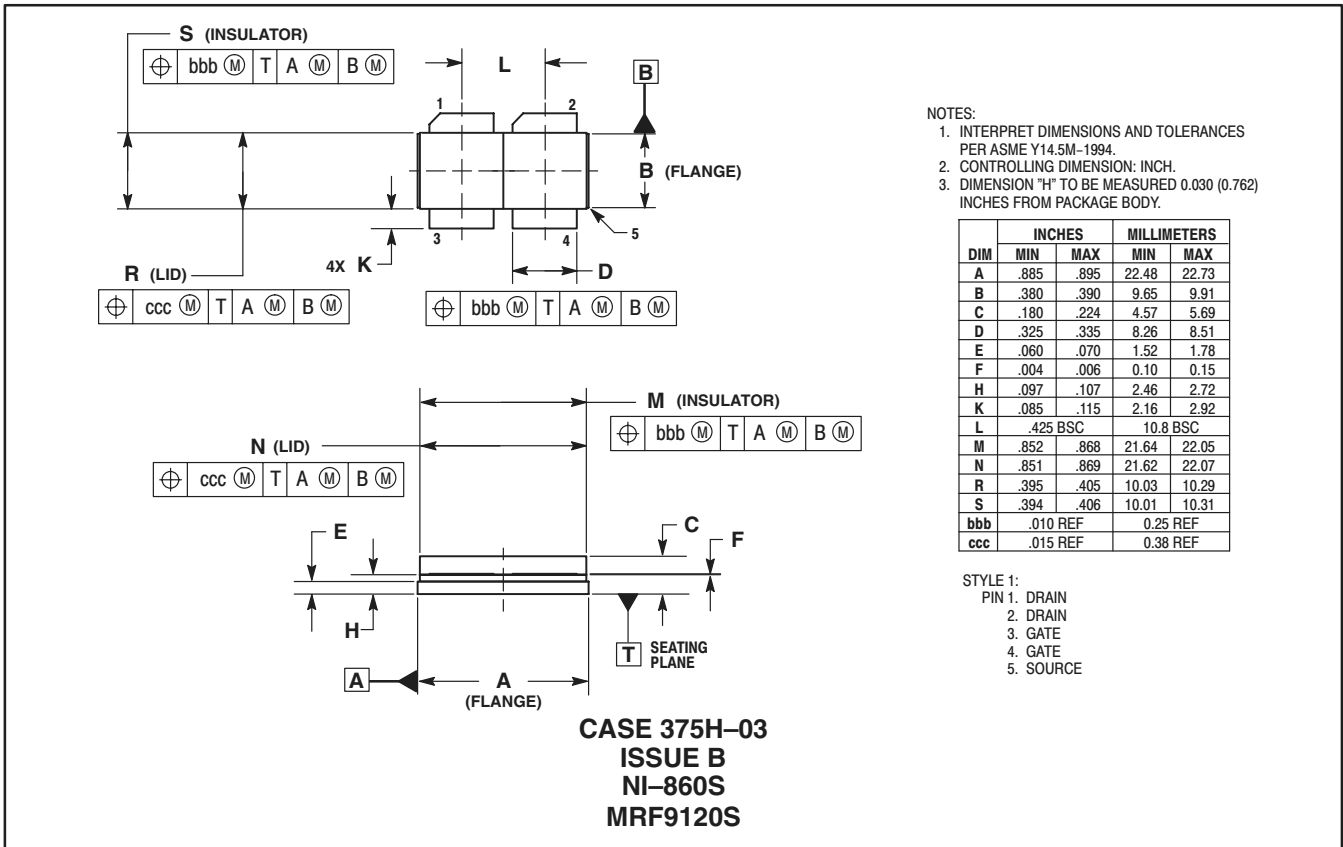
## PACKAGE DIMENSIONS



- NOTES:  
 1. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M-1994.  
 2. CONTROLLING DIMENSION: INCH.  
 3. DIMENSION H IS MEASURED 0.030 (0.762) AWAY FROM PACKAGE BODY.  
 4. RECOMMENDED BOLT CENTER DIMENSION OF 1.140 (28.96) BASED ON M3 SCREW.

| DIM | INCHES    |       | MILLIMETERS |       |
|-----|-----------|-------|-------------|-------|
|     | MIN       | MAX   | MIN         | MAX   |
| A   | 1.335     | 1.345 | 33.91       | 34.16 |
| B   | 0.380     | 0.390 | 9.65        | 9.91  |
| C   | 0.180     | 0.224 | 4.57        | 5.69  |
| D   | 0.325     | 0.335 | 8.26        | 8.51  |
| E   | 0.060     | 0.070 | 1.52        | 1.78  |
| F   | 0.004     | 0.006 | 0.10        | 0.15  |
| G   | 1.100 BSC |       | 27.94 BSC   |       |
| H   | 0.097     | 0.107 | 2.46        | 2.72  |
| K   | 0.085     | 0.115 | 2.16        | 2.92  |
| L   | .425 BSC  |       | 10.80 BSC   |       |
| M   | 0.852     | 0.868 | 21.64       | 22.05 |
| N   | 0.851     | 0.869 | 21.62       | 22.07 |
| Q   | 0.118     | 0.138 | 3.00        | 3.51  |
| R   | 0.395     | 0.405 | 10.03       | 10.29 |
| S   | 0.394     | 0.406 | 10.01       | 10.31 |
| bbb | 0.010 REF |       | 0.25 REF    |       |
| ccc | 0.015 REF |       | 0.38 REF    |       |


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



- NOTES:  
 1. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M-1994.  
 2. CONTROLLING DIMENSION: INCH.  
 3. DIMENSION "H" TO BE MEASURED 0.030 (0.762) INCHES FROM PACKAGE BODY.

| DIM | INCHES   |      | MILLIMETERS |       |
|-----|----------|------|-------------|-------|
|     | MIN      | MAX  | MIN         | MAX   |
| A   | .885     | .895 | 22.48       | 22.73 |
| B   | .380     | .390 | 9.65        | 9.91  |
| C   | .180     | .224 | 4.57        | 5.69  |
| D   | .325     | .335 | 8.26        | 8.51  |
| E   | .060     | .070 | 1.52        | 1.78  |
| F   | .004     | .006 | 0.10        | 0.15  |
| H   | .097     | .107 | 2.46        | 2.72  |
| K   | .085     | .115 | 2.16        | 2.92  |
| L   | .425 BSC |      | 10.8 BSC    |       |
| M   | .852     | .868 | 21.64       | 22.05 |
| N   | .851     | .869 | 21.62       | 22.07 |
| R   | .395     | .405 | 10.03       | 10.29 |
| S   | .394     | .406 | 10.01       | 10.31 |
| bbb | .010 REF |      | 0.25 REF    |       |
| ccc | .015 REF |      | 0.38 REF    |       |

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

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