

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

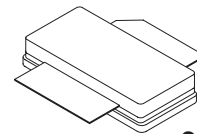
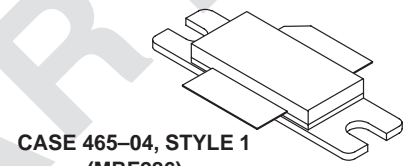
Designed for PCN and PCS base station applications at frequencies from 1000 to 2400 MHz. Suitable for FM, TDMA, CDMA, and multicarrier amplifier applications. To be used in class A and class AB for PCN-PCS/cellular radio and WLL applications.

- Specified Two-Tone Performance @ 2000 MHz, 26 Volts
Output Power — 60 Watts (PEP)
Power Gain — 9.5 dB
Intermodulation Distortion — -28 dBc
- Typical Two-Tone Performance at 2000 MHz, 26 Volts
Output Power — 60 Watts (PEP)
Power Gain — 10.5 dB
Efficiency — 32%
Intermodulation Distortion — -30 dBc
- S-Parameter Characterization at High Bias Levels
- Capable of Handling 10:1 VSWR, @ 26 Vdc, 2000 MHz, 60 Watts (CW) Output Power
- Excellent Thermal Stability
- Characterized with Series Equivalent Large-Signal Impedance Parameters

MRF286
MRF286S

Order sample parts by XRF286,S
PILOT PRODUCTION PROTOTYPE

2000 MHz, 60 W, 26 V
LATERAL N-CHANNEL
BROADBAND
RF POWER MOSFETs



MAXIMUM RATINGS

| Rating | Symbol | Value | Unit |
|---|------------------|-------------|---------------|
| Drain-Source Voltage | V _{DSS} | 65 | Vdc |
| Gate-Source Voltage | V _{GS} | ±20 | Vdc |
| Total Device Dissipation @ T _C = 25°C Derate above 25°C | P _D | 240 1.37 | 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 _{θJC} | 0.73 | °C/W |

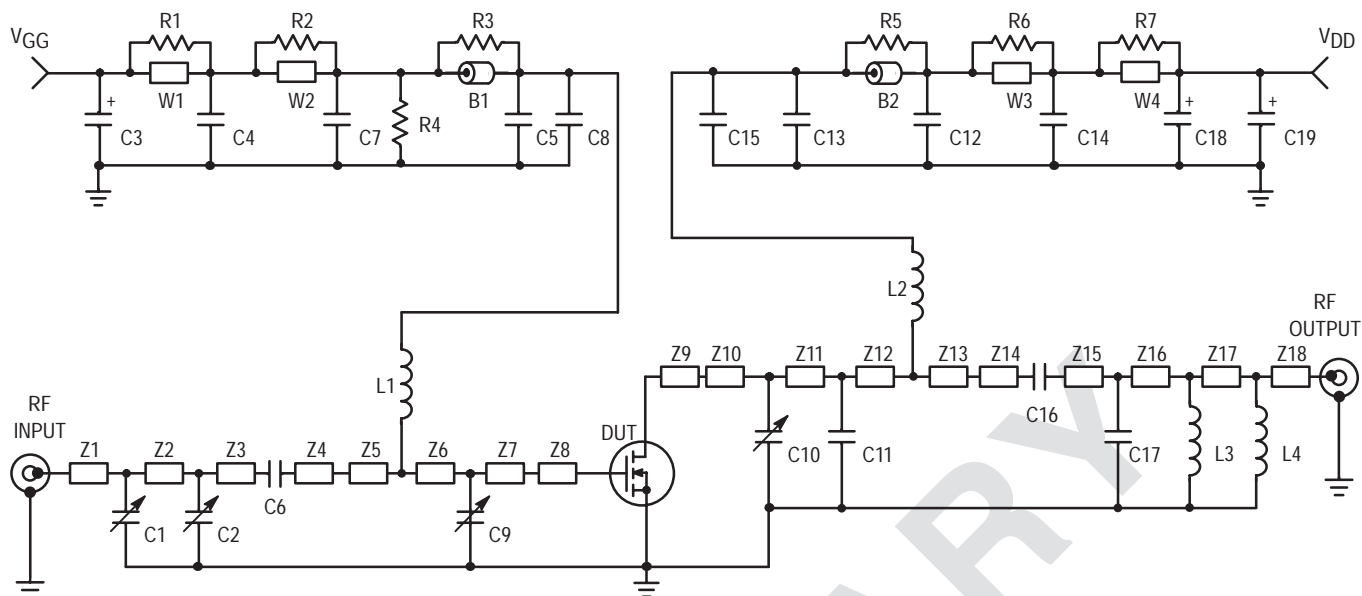
NOTE – **CAUTION** – MOS devices are susceptible to damage from electrostatic charge. Reasonable precautions in handling and packaging MOS devices should be observed.

“PILOT PRODUCTION PROTOTYPE (“X” Status)” devices are preproduction products and may not be released or produced in volume. “X” status devices are for engineering evaluation and should not be used for production. Specifications are subject to change without notice.

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

| Characteristic | Symbol | Min | Typ | Max | Unit |
|---|---------------|--------------------------------|------|-----|-----------------|
| OFF CHARACTERISTICS | | | | | |
| Drain–Source Breakdown Voltage ($V_{GS} = 0, I_D = 20 \mu\text{Adc}$) | $V_{(BR)DSS}$ | 65 | — | — | Vdc |
| Gate–Source Leakage Current ($V_{GS} = 20 \text{ Vdc}, V_{DS} = 0 \text{ Vdc}$) | I_{GSS} | — | — | 1 | μAdc |
| Zero Gate Voltage Drain Leakage Current ($V_{DS} = 28 \text{ Vdc}, V_{GS} = 0$) | I_{DSS} | — | — | 10 | μAdc |
| ON CHARACTERISTICS | | | | | |
| Forward Transconductance ($V_{DS} = 10 \text{ Vdc}, I_D = 2 \text{ Adc}$) | g_{fs} | — | 3 | — | S |
| Gate Threshold Voltage ($V_{DS} = 10 \text{ V}, I_D = 300 \mu\text{A}$) | $V_{GS(th)}$ | 2 | 3.2 | 4 | Vdc |
| Gate Quiescent Voltage ($V_{DS} = 26 \text{ V}, I_D = 500 \text{ mA}$) | $V_{GS(Q)}$ | 3 | 4.15 | 5 | Vdc |
| Drain–Source On–Voltage ($V_{GS} = 10 \text{ V}, I_D = 1 \text{ A}$) | $V_{DS(on)}$ | — | 0.16 | 0.6 | Vdc |
| DYNAMIC CHARACTERISTICS | | | | | |
| Reverse Transfer Capacitance ($V_{DS} = 26 \text{ Vdc}, V_{GS} = 0, f = 1 \text{ MHz}$) | C_{rss} | — | 3 | — | pF |
| Input Capacitance ⁽¹⁾ ($V_{DS} = 26 \text{ Vdc}, V_{GS} = 0, f = 1 \text{ MHz}$) | C_{iss} | — | 145 | — | pF |
| Output Capacitance ($V_{DS} = 26 \text{ Vdc}, V_{GS} = 0, f = 1 \text{ MHz}$) | C_{oss} | — | 51 | — | pF |
| FUNCTIONAL TESTS (In Motorola Test Fixture) | | | | | |
| Common–Source Amplifier Power Gain ($V_{DD} = 26 \text{ Vdc}, P_{out} = 60 \text{ W PEP}, I_{DQ} = 500 \text{ mA}, f_1 = 2000.0 \text{ MHz}, f_2 = 2000.1 \text{ MHz}$) | G_{ps} | 9.5 | 10.5 | — | dB |
| Drain Efficiency ($V_{DD} = 26 \text{ Vdc}, P_{out} = 60 \text{ W PEP}, I_{DQ} = 500 \text{ mA}, f_1 = 2000.0 \text{ MHz}, f_2 = 2000.1 \text{ MHz}$) | η | 28 | 32 | — | % |
| Intermodulation Distortion ($V_{DD} = 26 \text{ Vdc}, P_{out} = 60 \text{ W PEP}, I_{DQ} = 500 \text{ mA}, f_1 = 2000.0 \text{ MHz}, f_2 = 2000.1 \text{ MHz}$) | IMD | — | 30 | –28 | dBc |
| Input Return Loss ($V_{DD} = 26 \text{ Vdc}, P_{out} = 60 \text{ W PEP}, I_{DQ} = 500 \text{ mA}, f_1 = 2000.0 \text{ MHz}, f_2 = 2000.1 \text{ MHz}$) | IRL | — | –12 | –9 | dB |
| Output Mismatch Stress ($V_{DD} = 26 \text{ Vdc}, P_{out} = 60 \text{ W CW}, I_{DQ} = 500 \text{ mA}, f = 2 \text{ GHz}, \text{VSWR} = 10:1, \text{All Phase Angles at Frequency of Tests}$) | Ψ | No Degradation In Output Power | | | |

(1) Part is internally matched both on input and output.



| | | | |
|-----|----------------------------|------------------|--|
| Z1 | 0.436" x 0.080" Microstrip | Z13 | 0.025" x 0.325" Microstrip |
| Z2 | 0.248" x 0.080" Microstrip | Z14 | 0.544" x 0.080" Microstrip |
| Z3 | 0.610" x 0.080" Microstrip | Z15 | 0.108" x 0.080" Microstrip |
| Z4 | 0.529" x 0.080" Microstrip | Z16 | 0.095" x 0.080" Microstrip |
| Z5 | 0.024" x 0.325" Microstrip | Z17 | 0.996" x 0.080" Microstrip |
| Z6 | 0.144" x 0.325" Microstrip | Z18 | 0.077" x 0.080" Microstrip |
| Z7 | 0.098" x 0.325" Microstrip | Board | 0.030" Glass Teflon®, 2 oz Copper, 3" x 5" Dimensions, Arlon GX0300-55-22, $\epsilon_r = 2.55$ |
| Z8 | 0.215" x 0.515" Microstrip | RF Circuit Board | 3" x 5" Copper Clad PCB, Glass Teflon®, $\epsilon_r = 2.55$ |
| Z9 | 0.215" x 0.515" Microstrip | | |
| Z10 | 0.044" x 0.325" Microstrip | | |
| Z11 | 0.060" x 0.325" Microstrip | | |
| Z12 | 0.141" x 0.325" Microstrip | | |

Figure 1. 1.93 – 2.0 GHz Broadband Test Circuit Schematic

Table 1. 1.93 – 2.0 GHz Broadband Component Designations and Values

| Designators | Description |
|------------------------|---|
| B1, B2 | Ferrite Bead, Round, Newark #95F769 |
| C1, C2, C9 | 0.8–8.0 pF, Variable Capacitors, Gigatrim Johanson, Newark #44F3360 |
| C3, C18 | 22 μ F, 35 V Tantalum Surface Mount Chip Capacitors, Kemet #T491X226K035AS4394 |
| C4, C14 | 0.1 μ F, Chip Capacitors, Kemet #CDR33BX104AKWS |
| C5, C15 | 91 pF, RF Chip Capacitors, B Case, ATC #100B910JP500X |
| C6 | 8.2 pF, RF Chip Capacitor, B Case, ATC #100B8R2CP500X |
| C7, C12 | 1000 pF, RF Chip Capacitors, B Case, ATC #100B102JP50X |
| C8, C13 | 5.1 pF, RF Chip Capacitors, B Case, ATC #100B5R1CP500X |
| C10 | 0.4–2.5 pF, Variable Capacitor, Gigatrim Johanson, Newark #44F3367 |
| C11 | 2.2 pF, RF Chip Capacitor, B Case, ATC #100B2R2JP500X |
| C16 | 200 pF, RF Chip Capacitor, B Case, ATC #100B201JP500X |
| C17 | 0.1 pF, RF Chip Capacitor, B Case, ATC #100B0R1BP500X |
| C19 | 10 μ F, 35 V Tantalum Surface Mount Chip Capacitor, Kemet #T495X106K035AS4394 |
| L1 | 8 Turns, #24 AWG, 0.120" OD, 0.270" Long (28.0 nH), CoilCraft #B08T-5 |
| L2 | 6 Turns, #24 AWG, 0.195" OD, 0.150" Long (47.0 nH), CoilCraft #1812SMS-47NJ |
| L3 | 2 Turns, #24 AWG, 0.120" OD, 0.145" Long (5.0 nH), CoilCraft #A02T-5 |
| L4 | 3 Turns, #24 AWG, 0.120" OD, 0.145" Long (8.0 nH), CoilCraft #A03T-5 |
| R1, R2, R3, R5, R6, R7 | 12 Ω , 1/4 W Chip Resistors (0.08" x 0.13"), Garrett Instruments #RM73B2B120JT |
| R4 | 560 k Ω , 1/4 W Chip Resistor (0.08" x 0.13") |
| W1, W2, W3, W4 | Solid Copper Buss Wire, #16 AWG |
| WS1, WS2 | Beryllium Copper Wear Blocks (0.005" x 0.210" x 0.520") Nominal |

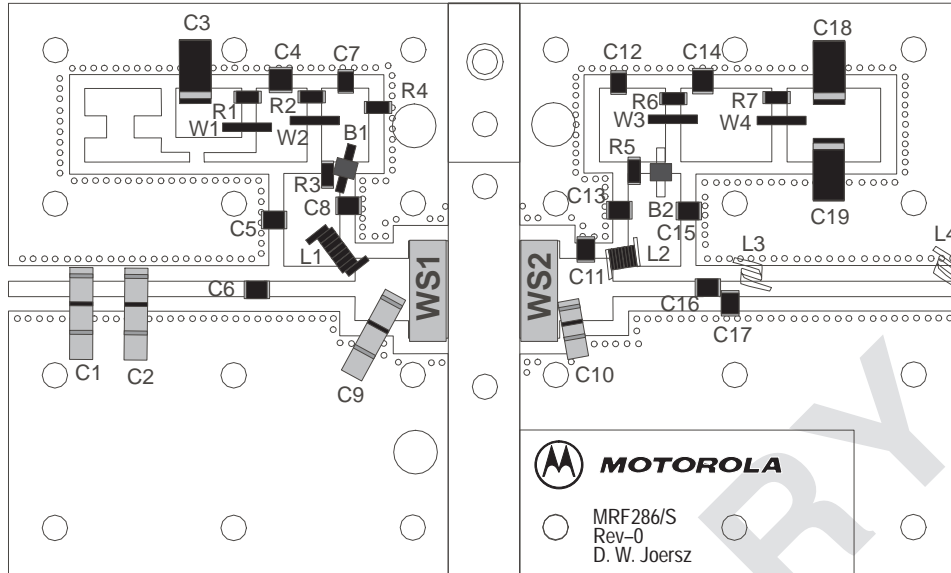
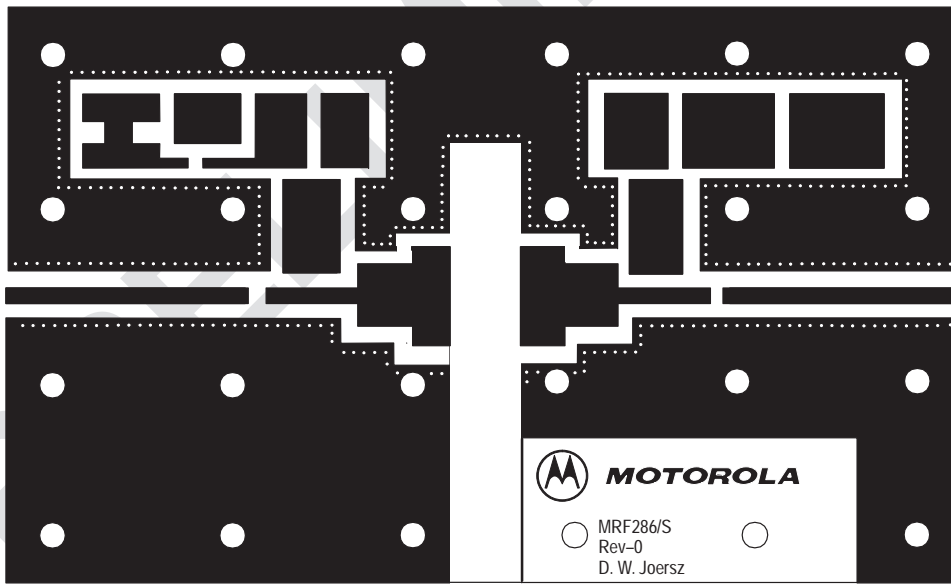
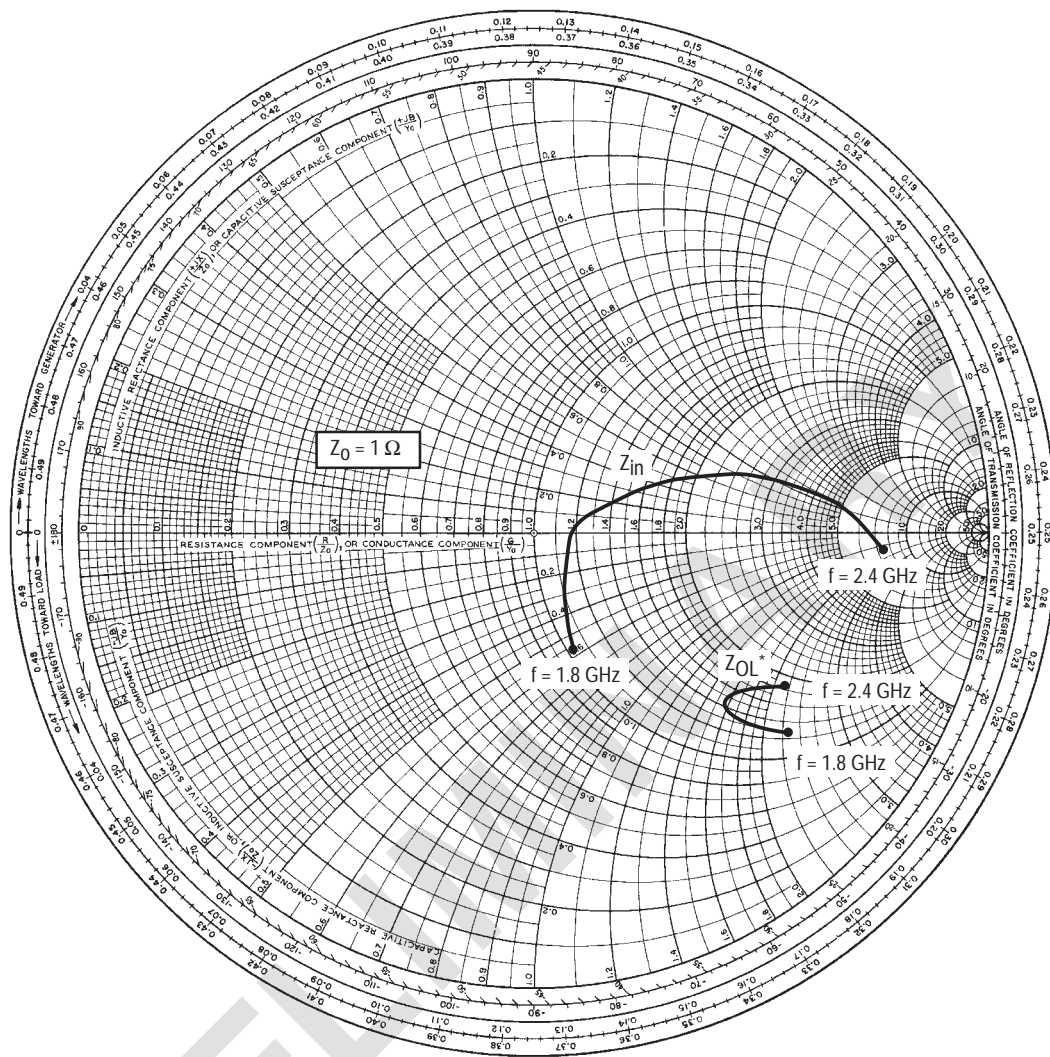


Figure 2. 1.93–2.0 GHz Broadband Test Circuit Component Layout



(Scale 1:1)

Figure 3. MRF286 Test Circuit Photomaster
(Reduced 18% in printed data book, DL110/D)



$V_{DD} = 26 \text{ V}$, $I_{DQ} = 500 \text{ mA}$, $P_{out} = 60 \text{ Watts (PEP)}$

| f MHz | Z_{in} Ω | Z_{OL}^* Ω |
|----------|----------------------|------------------------|
| 1800 | $1.0 - j0.57$ | $1.25 - j2.31$ |
| 1900 | $1.19 - j0.005$ | $1.35 - j2.0$ |
| 2000 | $1.38 + j0.20$ | $1.40 - j1.6$ |
| 2100 | $1.75 + j0.47$ | $1.60 - j1.7$ |
| 2200 | $2.40 + j0.80$ | $1.80 - j2.0$ |
| 2300 | $4.90 + j1.20$ | $1.85 - j2.1$ |
| 2400 | $7.50 - j1.85$ | $1.90 - j2.18$ |

Z_{in} = Complex conjugate of source impedance.

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

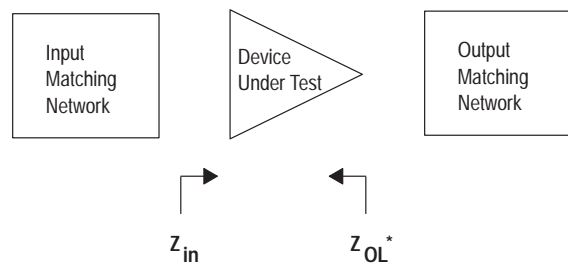


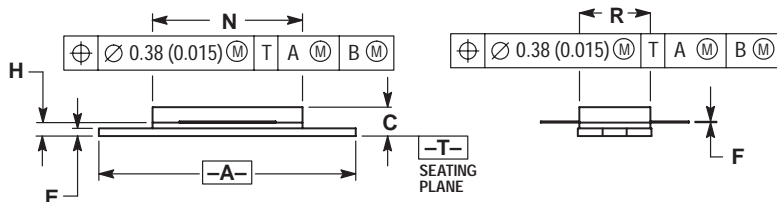
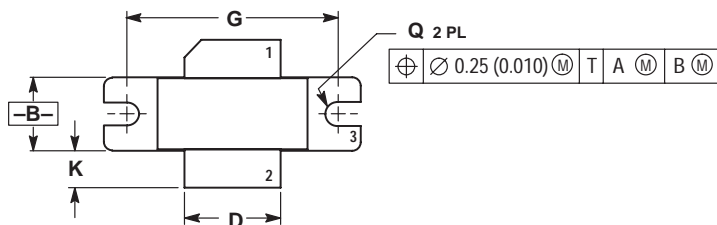
Figure 4. Series Large-Signal Device Impedances

Table 2. High Bias Small-Signal S-Parameters

$I_D = 3.6 \text{ A}$

| f GHz | S ₁₁ | | S ₂₁ | | S ₁₂ | | S ₂₂ | |
|----------|-----------------|------|-----------------|------|-----------------|-----|-----------------|------|
| | S ₁₁ | φ | S ₂₁ | φ | S ₁₂ | φ | S ₂₂ | φ |
| 1.0 | 0.945 | -180 | 0.458 | 8 | 0.02 | 105 | 0.905 | -179 |
| 1.1 | 0.949 | -180 | 0.406 | 5 | 0.02 | 93 | 0.900 | -180 |
| 1.2 | 0.954 | 178 | 0.357 | 1 | 0.03 | 79 | 0.885 | 180 |
| 1.3 | 0.961 | 178 | 0.324 | -1 | 0.03 | 73 | 0.874 | -179 |
| 1.4 | 0.957 | 177 | 0.301 | -3 | 0.03 | 74 | 0.889 | -178 |
| 1.5 | 0.953 | 176 | 0.290 | -6 | 0.02 | 59 | 0.899 | -178 |
| 1.6 | 0.950 | 175 | 0.275 | -9 | 0.02 | 75 | 0.921 | -178 |
| 1.7 | 0.946 | 175 | 0.271 | -12 | 0.02 | 79 | 0.927 | -180 |
| 1.8 | 0.942 | 174 | 0.275 | -16 | 0.03 | 80 | 0.934 | 180 |
| 1.9 | 0.936 | 174 | 0.286 | -21 | 0.03 | 81 | 0.939 | 179 |
| 2.0 | 0.945 | 173 | 0.310 | -27 | 0.03 | 83 | 0.943 | 177 |
| 2.1 | 0.952 | 171 | 0.354 | -36 | 0.03 | 75 | 0.940 | 177 |
| 2.2 | 0.954 | 170 | 0.427 | -51 | 0.04 | 81 | 0.944 | 176 |
| 2.3 | 0.915 | 167 | 0.513 | -76 | 0.04 | 71 | 0.957 | 175 |
| 2.4 | 0.851 | 169 | 0.507 | -112 | 0.04 | 72 | 0.970 | 174 |
| 2.5 | 0.916 | 172 | 0.417 | -148 | 0.05 | 88 | 0.983 | 172 |
| 2.6 | 0.936 | 169 | 0.260 | -180 | 0.08 | 66 | 0.977 | 170 |
| 2.7 | 0.953 | 168 | 0.172 | 164 | 0.08 | 54 | 0.980 | 170 |

PACKAGE DIMENSIONS

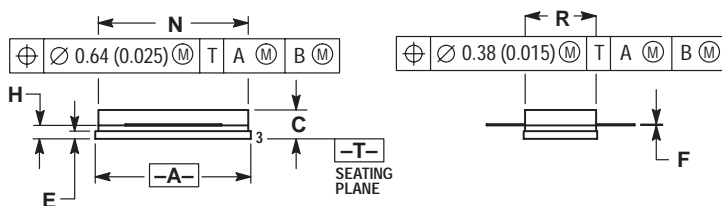
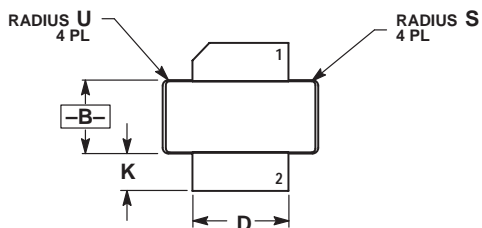


**CASE 465-04
ISSUE D
(MRF286)**

- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
 2. CONTROLLING DIMENSION: INCH.
 3. 465-01, -02 AND -03 OBSOLETE, NEW STANDARD 465-04.
 4. DIMENSION H IS MEASURED 0.030" AWAY FROM FLANGE.

| 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 | 0.125 | 0.170 | 3.18 | 4.32 |
| D | 0.495 | 0.505 | 12.57 | 12.83 |
| E | 0.035 | 0.045 | 0.89 | 1.14 |
| F | 0.003 | 0.006 | 0.08 | 0.15 |
| G | 1.100 BSC | | 27.94 BSC | |
| H | 0.055 | 0.065 | 1.40 | 1.65 |
| K | 0.170 | 0.210 | 4.32 | 5.33 |
| N | 0.772 | 0.788 | 19.60 | 20.00 |
| Q | 0.118 | 0.138 | 3.00 | 3.51 |
| R | 0.365 | 0.375 | 9.27 | 9.53 |

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




**CASE 465A-04
ISSUE D
(MRF286S)**

- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
 2. CONTROLLING DIMENSION: INCH.
 3. DIMENSION H IS MEASURED 0.030" AWAY FROM FLANGE.

| DIM | INCHES | | MILLIMETERS | |
|-----|-----------|-------|-------------|-------|
| | MIN | MAX | MIN | MAX |
| A | 0.805 | 0.815 | 20.45 | 20.70 |
| B | 0.380 | 0.390 | 9.65 | 9.91 |
| C | 0.125 | 0.170 | 3.18 | 4.32 |
| D | 0.495 | 0.505 | 12.57 | 12.83 |
| E | 0.035 | 0.045 | 0.89 | 1.14 |
| F | 0.003 | 0.006 | 0.08 | 0.15 |
| H | 0.055 | 0.065 | 1.40 | 1.65 |
| K | 0.170 | 0.210 | 4.32 | 5.33 |
| N | 0.775 | 0.785 | 19.69 | 19.94 |
| R | 0.365 | 0.375 | 9.27 | 9.53 |
| S | 0.020 REF | | 0.51 REF | |
| U | 0.030 REF | | 0.76 REF | |

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

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