MOTOROLA
# SEMICONDUCTOR
TECHNICAL DATA

**MRF430**

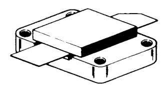
### The RF Line

# NPN Silicon RF Power Transistor

**600 WATTS (LINEAR)**
**30 MHz**
**RF POWER TRANSISTOR**
**NPN SILICON**

. . . designed primarily for high-voltage applications as a high-power linear amplifier from 2 to 30 MHz. Ideal for marine and base station equipment.

- Specified 50 Volt, 30 MHz Characteristics
  - Output Power = 600 W
  - Minimum Gain = 10 dB
  - Efficiency = 40%
- Intermodulation Distortion @ 600 W(PEP) — IMD = −30 dB
- Diffused Emitter Resistors for Superior Ruggedness
- Low Thermal Resistance



CASE 368-01

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**MAXIMUM RATINGS**

| Rating | Symbol | Value | Unit |
|---|---|---|---|
| Collector-Emitter Voltage | $V_{CEO}$ | 50 | Vdc |
| Collector-Base Voltage | $V_{CBO}$ | 110 | Vdc |
| Emitter-Base Voltage | $V_{EBO}$ | 4 | Vdc |
| Collector Current — Continuous | $I_C$ | 60 | Adc |
| Operating Junction Temperature | $T_J$ | 200 | °C |
| Total Device Dissipation @ $T_C$ = 25°C<br>Derate Above 25°C | $P_D$ | 875<br>5 | Watts<br>W/°C |
| Storage Temperature Range | $T_{stg}$ | −65 to +150 | °C |

**THERMAL CHARACTERISTICS**

| Characteristic | Symbol | Max | Unit |
|---|---|---|---|
| Thermal Resistance, Junction to Case | $R_{\theta JC}$ | 0.20 | °C/W |

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

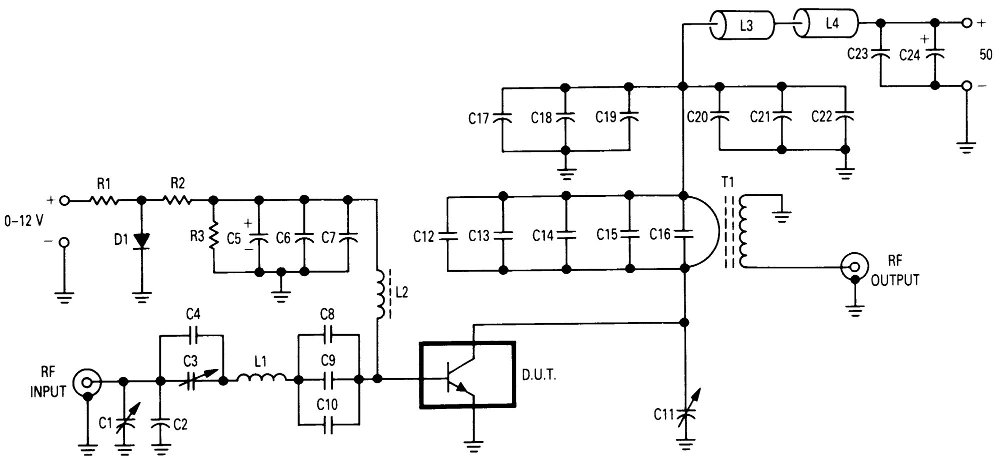
| Characteristic | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| **OFF CHARACTERISTICS** | | | | | |
| Collector-Emitter Breakdown Voltage ($I_C$ = 500 mAdc, $I_B$ = 0) | $V_{(BR)CEO}$ | 50 | — | — | Vdc |
| Collector-Emitter Breakdown Voltage ($I_C$ = 200 mAdc, $V_{BE}$ = 0) | $V_{(BR)CES}$ | 110 | — | — | Vdc |
| Emitter-Base Breakdown Voltage ($I_E$ = 20 mAdc, $I_C$ = 0) | $V_{(BR)EBO}$ | 4 | — | — | Vdc |
| **ON CHARACTERISTICS** | | | | | |
| DC Current Gain ($I_C$ = 20 Adc, $V_{CE}$ = 10 Vdc) | $h_{FE}$ | 10 | 30 | 80 | — |

(continued)

**ELECTRICAL CHARACTERISTICS — continued** ($T_C$ = 25°C unless otherwise noted)

| Characteristic | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| **DYNAMIC CHARACTERISTICS** | | | | | |
| Output Capacitance ($V_{CB}$ = 50 Vdc, $I_E$ = 0, f = 1 MHz) | $C_{ob}$ | — | 900 | 1200 | pF |
| **FUNCTIONAL TEST** | | | | | |
| Common-Emitter Amplifier Power Gain ($V_{CC}$ = 50 Vdc, $P_{out}$ = 600 W (CW), f = 30 MHz, $I_{CQ}$ = 600 mA) | $G_{PE}$ | 10 | 13 | — | dB |
| Collector Efficiency ($V_{CC}$ = 50 Vdc, $P_{out}$ = 600 W, f = 30 MHz, $I_{CQ}$ = 600 mA) (PEP) | $\eta$ | — | 40 | — | % |
| (CW) | | — | 60 | — | % |
| Intermodulation Distortion (1) ($V_{CE}$ = 50 Vdc, $P_{out}$ = 600 W (PEP), $I_{CQ}$ = 600 mA, f = 30 MHz) | IMD | — | −30 | — | dB |

(1) To Mil Std 1311 Version A, Test Method 2204B, Two Tone, Reference Each Tone.




C1, C3, C11 — Arco 469 or equivalent
C2 — 820 pF
C4 — 330 pF
C5 — 1000 μF/3 V Electrolytic
C6, C8, C9, C10, C17, C18, C19 — 0.1 μF
C7, C22, C23 — 0.47 μF, RMC Type 2225C or equivalent
C12, C13, C14 — 470 pF
C15 — 1000 pF
C16 — Two Unencapsulated 1000 pF Mica in Series
C20, C21 — 0.039 μF
C24 — 10 μF/100 V Electrolytic
D1 — 1N4997 or equivalent
R1 — 10 Ohms/10 W
R2 — 0.1 Ohm/½ W
R3 — 2.7 Ohms/2 W

L1 — 2 Turns #14 AWG, ½″ ID, ½″ Long
L2 — Ohmite Z-235 or equivalent
L3, L4 — Ferrite Beads, Fair-Rite Products Corp. #2673000801 or equivalent
T1 — RF Transformer, 1:25 Impedance Ratio. See Motorola Application Note AN749, Figure 4 for details. Ferrite Material: 2 Each, Fair-Rite Product Corp. #2667540001 or equivalent

All capacitors ATC type 100/200 chips or equivalent, unless otherwise noted.

**Figure 1. 30 MHz Test Circuit Schematic**

## TYPICAL CHARACTERISTICS

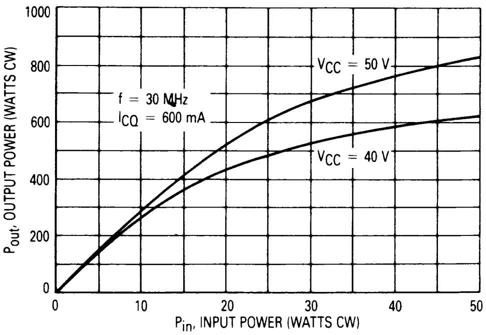



**Figure 2. Output Power versus Input Power**

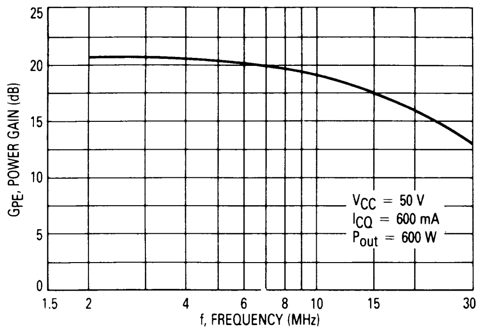



**Figure 3. Power Gain versus Frequency**

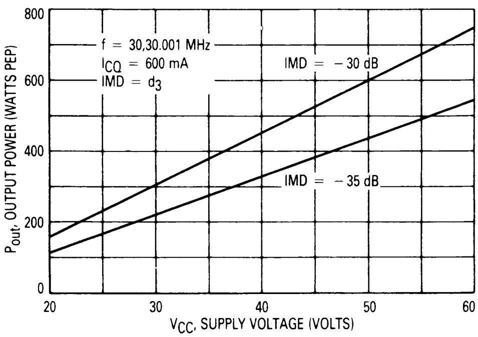



**Figure 4. Output Power versus Supply Voltage**

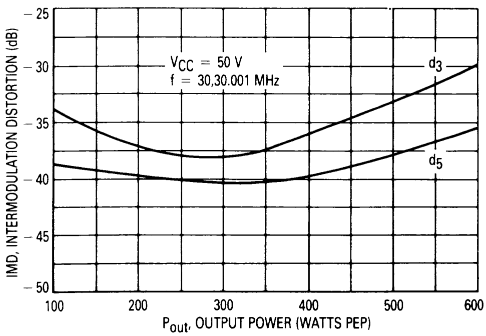



**Figure 5. IMD versus Output Power**

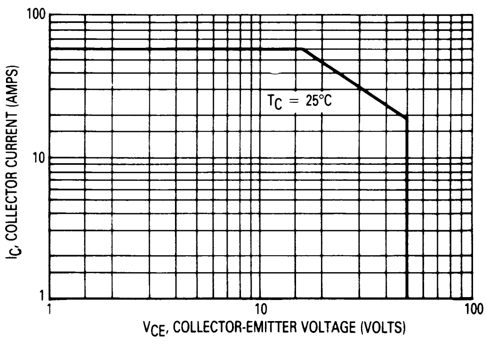



**Figure 6. DC Safe Operating Area**

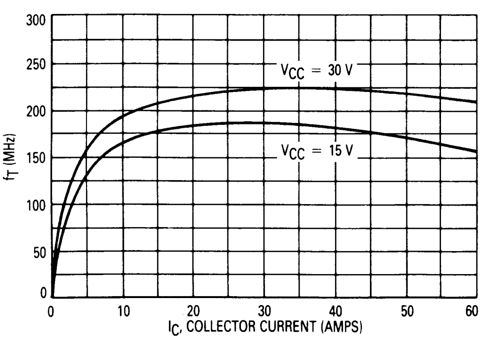



**Figure 7. $f_T$ versus Collector Current**

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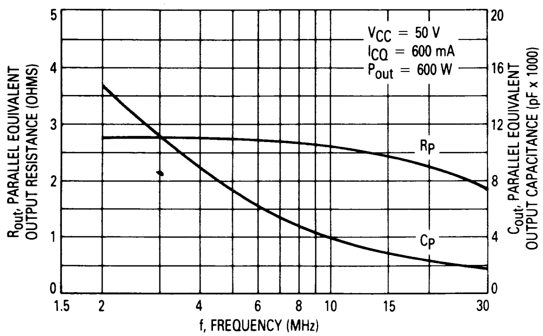


**Figure 8. Output Resistance and Capacitance versus Frequency**

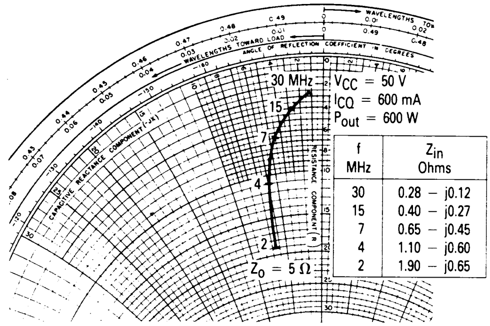


**Figure 9. Series Equivalent Input Impedance**

**MOUNTING OF HIGH POWER RF POWER TRANSISTORS**

The package of this device is designed for conduction cooling. It is extremely important to minimize the thermal resistance between the device flange and the heat dissipator.

Since the device mounting flange is made of soft copper, it may be deformed during various stages of handling or during transportation. It is recommended that the user makes a final inspection on this before the device installation. ±0.0005″ is considered sufficient for the flange bottom.

The same applies to the heat dissipator in the device mounting area. If copper heatsink is not used, a copper head spreader is strongly recommended between the device mounting surfaces and the main heatsink. It should be at least 1/4″ thick and extend at least one inch from the flange edges. A thin layer of thermal compound in all interfaces is, of course, essential. The recommended torque on the 4-40 mounting screws should be in the area of 4–5 lbs.-inch, and spring type lock washers along with flat washers are recommended.

For die temperature calculations, the Δ temperature from a corner mounting screw area to the bottom center of the flange is approximately 5°C and 10°C under normal operating conditions (dissipation 150 W and 300 W respectively).

The main heat dissipator must be sufficiently large and have low $R_\theta$ for moderate air velocity, unless liquid cooling is employed.

**CIRCUIT CONSIDERATIONS**

At high power levels (500 W and up), the circuit layout becomes critical due to the low impedance levels and high RF currents associated with the output matching. Some of the components, such as capacitors and inductors must also withstand these currents. The component losses are directly proportional to the operating frequency. The manufacturers specifications on capacitor ratings should be consulted on these aspects prior to design.

Push-pull circuits are less critical in general, since the ground referenced RF loops are practically eliminated, and the impedance levels are higher for a given power output. High power broadband transformers are also easier to design than comparable LC matching networks.

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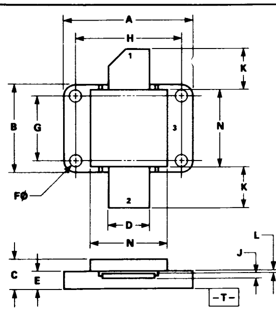
**OUTLINE DIMENSIONS**




NOTES:
1. DIMENSIONS A AND B ARE DATUMS AND T IS BOTH A DATUM AND SEATING PLANE.
2. POSITIONAL TOLERANCE FOR F DIAMETER. ⌖ ϕ 0.25 (.010) Ⓜ T A Ⓜ B Ⓜ
3. DIMENSIONING AND TOLERANCING PER Y14.5M, 1982.
4. CONTROLLING DIMENSION: INCH.

STYLE 1:
PIN 1. COLLECTOR
2. BASE
3. EMITTER

| DIM | MILLIMETERS | | INCHES | |
|---|---|---|---|---|
| | MIN | MAX | MIN | MAX |
| A | 37.85 | 38.35 | 1.490 | 1.510 |
| B | 25.15 | 25.65 | 0.990 | 1.010 |
| C | 8.38 | 8.89 | 0.330 | 0.350 |
| D | 12.45 | 12.95 | 0.490 | 0.510 |
| E | 4.95 | 5.21 | 0.195 | 0.205 |
| F | 3.05 | 3.30 | 0.120 | 0.130 |
| G | 19.05 BSC | | 0.750 BSC | |
| H | 31.75 BSC | | 1.250 BSC | |
| J | 1.14 | 1.39 | 0.045 | 0.055 |
| K | 10.54 | 11.05 | 0.415 | 0.435 |
| L | 0.10 | 0.15 | 0.004 | 0.006 |
| N | 22.87 | 23.11 | 0.890 | 0.910 |

**CASE 368-01**

# MRF433

## The RF Line

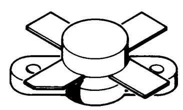
### SILICON RF POWER TRANSISTORS

. . . designed primarily for application as complementary symmetry amplifiers in linear amplifiers from 2.0 to 30 MHz.

- Specified 12.5 Volt, 30 MHz Characterisitcs —
  Output Power = 12.5 W (PEP)
  Minimum Gain = 20 dB
  Efficiency = 50%
- Intermodulation Distortion @ 12.5 W (PEP) —
  IMD = -30 dB (Max)

**12.5 W (PEP) — 30 MHz**
**RF POWER TRANSISTOR**

MRF433 — NPN SILICON



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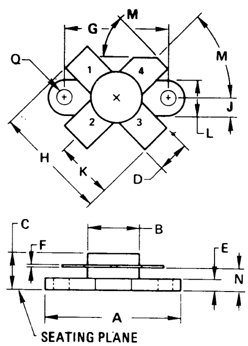
**MAXIMUM RATINGS**

| Rating | Symbol | Value | Unit |
|---|---|---|---|
| Collector-Emitter Voltage | $V_{CEO}$ | 18 | Vdc |
| Collector-Base Voltage | $V_{CBO}$ | 36 | Vdc |
| Emitter-Base Voltage | $V_{EBO}$ | 4.0 | Vdc |
| Collector Current — Continuous | $I_C$ | 2.5 | Adc |
| Total Device Dissipation @ $T_C = 25^oC$<br>Derate above $25^oC$ | $P_D$ | 20<br>114 | Watts<br>$W/^oC$ |
| Storage Temperature Range | $T_{stg}$ | −65 to +150 | $^oC$ |




STYLE 1:
PIN 1. EMITTER
2. BASE
3. EMITTER
4. COLLECTOR

| DIM | MILLIMETERS MIN | MILLIMETERS MAX | INCHES MIN | INCHES MAX |
|---|---|---|---|---|
| A | 24.64 | 24.89 | 0.970 | 0.980 |
| B | 9.40 | 9.91 | 0.370 | 0.390 |
| C | 5.82 | 7.14 | 0.229 | 0.281 |
| D | 5.46 | 5.97 | 0.215 | 0.235 |
| E | 2.16 | 2.67 | 0.085 | 0.105 |
| F | 0.10 | 0.15 | 0.004 | 0.006 |
| G | 18.29 | 18.54 | 0.720 | 0.730 |
| H | 20.07 | 20.57 | 0.790 | 0.810 |
| K | 10.03 | 10.29 | 0.395 | 0.405 |
| L | 6.22 | 6.48 | 0.245 | 0.255 |
| M | 40° | 50° | 40° | 50° |
| N | 3.81 | 4.57 | 0.150 | 0.180 |
| Q | 2.87 | 3.30 | 0.113 | 0.130 |

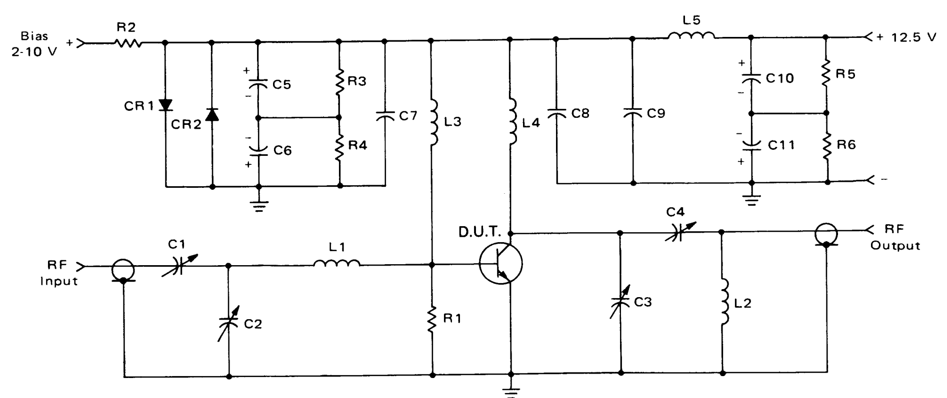
CASE 211-07

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

| Characteristic | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| **OFF CHARACTERISTICS** | | | | | |
| Collector-Emitter Breakdown Voltage ($I_C$ = 20 mAdc, $I_B$ = 0) | $V_{(BR)CEO}$ | 18 | – | – | Vdc |
| Collector-Emitter Breakdown Voltage ($I_C$ = 10 mAdc, $V_{BE}$ = 0) | $V_{(BR)CES}$ | 36 | – | – | Vdc |
| Emitter-Base Breakdown Voltage ($I_E$ = 2.0 mAdc, $I_C$ = 0) | $V_{(BR)EBO}$ | 4.0 | – | – | Vdc |
| Collector Cutoff Current ($V_{CE}$ = 15 Vdc, $V_{BE}$ = 0, $T_C$ = 55°C) | $I_{CES}$ | – | – | 8.0 | mAdc |
| Collector Cutoff Current ($V_{CB}$ = 15 Vdc, $I_E$ = 0) | $I_{CBO}$ | – | – | 0.5 | mAdc |
| **ON CHARACTERISTICS** | | | | | |
| DC Current Gain ($I_C$ = 0.5 Adc, $V_{CE}$ = 5.0 Vdc) | $h_{FE}$ | 15 | – | – | – |
| **DYNAMIC CHARACTERISTICS** | | | | | |
| Output Capacitance ($V_{CB}$ = 15 Vdc, $I_E$ = 0, f = 1.0 MHz) | $C_{ob}$ | – | 70 | 120 | pF |
| **FUNCTIONAL TESTS** | | | | | |
| Common-Emitter Amplifier Power Gain(1) ($V_{CC}$ = 12.5 Vdc, $P_{out}$ = 12.5 W (PEP), $I_{CQ}$ = 100 mAdc, f = 30,30.001 MHz) | $G_{pe}$ | 20 | – | – | dB |
| Collector Efficiency ($V_{CC}$ = 12.5 Vdc, $P_{out}$ = 12.5 W (PEP) (f = 30,30.001 MHz) | $\eta$(1)<br>$\eta$(2) | 45<br>40 | 50<br>45 | – | % |
| Intermodulation Distortion ($V_{CC}$ = 12.5 Vdc, $P_{out}$ = 12.5 W (PEP), $I_{CQ}$ = 100 mAdc, f = 30, 30.001 MHz) | IMD | – | – | -30 | dB |
| Series Equivalent Input Impedance ($V_{CC}$ = 12.5 Vdc, $P_{out}$ = 12.5 W (PEP), $I_{CQ}$ = 100 mAdc, f = 30,30.001 MHz) | $Z_{in}$ | – | 2.50-j2.20 | – | Ohms |
| Series Equivalent Output Impedance ($V_{CC}$ = 12.5 Vdc, $P_{out}$ = 12.5 W (PEP), $I_{CQ}$ = 100 mAdc, f = 30, 30.001 MHz) | $Z_{out}$ | – | 4.80-j3.00 | – | Ohms |

(1) Class AB
(2) Class A

**FIGURE 1 – 30 MHz TEST CIRCUIT SCHEMATIC**




| | | | | | |
|---|---|---|---|---|---|
| C1,C2,C4 | 170–780 pF, ARCO 469 | R2 | 10 Ω, 5 Watt | L3 | 10 μH Molded Choke |
| C3 | 25–280 pF, ARCO 464 | R3,R4 | 1 kΩ, 1/4 Watt | L4 | 15 Turns, #24 AWG Enamaled Wire, Closewound on a 100 Ω, 1 Watt Carbon Resistor. |
| C5,C6 | 500 μF, 3 V, ELECTROLYTIC | R5,R6 | 10 kΩ, 1/4 Watt | | |
| C7,C9 | 0.1 μF, Disc Ceramic | CR1,CR2 | 1N4001 | | |
| C8 | 1000 pF Disc Ceramic | L1 | 3 Turns, #18 AWG, 1/4" I.D., 3/16" Long | L5 | FERROXCUBE VK200 – 20/4B |
| C10,C11 | 100 μF, 15 V, ELECTROLYTIC | L2 | 3 Turns, #16 AWG, 3/8" I.D., 1/4" Long | | |
| R1 | 10 Ω, 1/2 Watt | | | | |

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MOTOROLA
**SEMICONDUCTOR**
TECHNICAL DATA

# MRF448

## The RF Line

250 W — 30 MHz

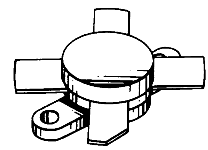
**RF POWER TRANSISTOR**

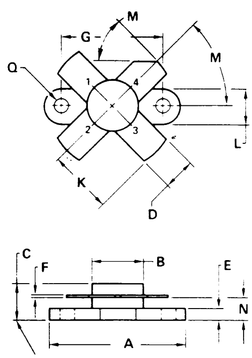
NPN SILICON

### NPN SILICON RF POWER TRANSISTOR

. . . designed primarily for high-voltage applications as a high-power linear amplifier from 2.0 to 30 MHz. Ideal for marine and base station equipment.

- Specified 50 Volt, 30 MHz Characteristics
  Output Power = 250 W
  Minimum Gain = 12 dB
  Efficiency = 45%
- Intermodulation Distortion @ 250 W (PEP) — IMD = −30 dB (Max)
- 100% Tested for Load Mismatch at all Phase Angles with 3:1 VSWR






STYLE 1:
PIN 1. EMITTER
2. BASE
3. EMITTER
4. COLLECTOR

| | MILLIMETERS | | INCHES | |
|---|---|---|---|---|
| DIM | MIN | MAX | MIN | MAX |
| A | 24.38 | 25.15 | 0.960 | 0.990 |
| B | 11.81 | 12.95 | 0.465 | 0.510 |
| C | 5.82 | 6.98 | 0.229 | 0.275 |
| D | 5.46 | 5.97 | 0.216 | 0.235 |
| E | 2.13 | 2.79 | 0.084 | 0.110 |
| F | 0.08 | 0.18 | 0.003 | 0.007 |
| G | 18.29 | 18.54 | 0.720 | 0.730 |
| K | 11.05 | – | 0.435 | – |
| L | 6.22 | 6.48 | 0.246 | 0.255 |
| M | 45° NOM | | 45° NOM | |
| N | 3.66 | 4.52 | 0.144 | 0.178 |
| Q | 2.92 | 3.30 | 0.115 | 0.130 |

**CASE 211-11**

### MAXIMUM RATINGS

| Rating | Symbol | Value | Unit |
|---|---|---|---|
| Collector-Emitter Voltage | $V_{CEO}$ | 50 | Vdc |
| Collector-Base Voltage | $V_{CBO}$ | 100 | Vdc |
| Emitter-Base Voltage | $V_{EBO}$ | 4.0 | Vdc |
| Collector Current — Continuous | $I_C$ | 16 | Adc |
| Withstand Current — 10 s | — | 20 | Adc |
| Total Device Dissipation @ $T_C = 25°C$ (1)<br>Derate Above 25°C | $P_D$ | 400<br>1.67 | Watts<br>W/°C |
| Storage Temperature Range | $T_{stg}$ | −65 to +150 | °C |

### THERMAL CHARACTERISTICS

| Characteristic | Symbol | Max | Unit |
|---|---|---|---|
| Thermal Resistance, Junction to Case | $R_{\theta JC}$ | 0.6 | °C/W |

(1) $P_D$ is a measurement reflecting short term maximum condition. See SOAR curve for operating conditions.

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

| Characteristic | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| **OFF CHARACTERISTICS** | | | | | |
| Collector-Emitter Breakdown Voltage ($I_C$ = 200 mAdc, $I_B$ = 0) | $V_{(BR)CEO}$ | 50 | — | — | Vdc |
| Collector-Emitter Breakdown Voltage ($I_C$ = 100 mAdc, $V_{BE}$ = 0) | $V_{(BR)CES}$ | 100 | — | — | Vdc |
| Collector-Base Breakdown Voltage ($I_C$ = 100 mAdc, $I_E$ = 0) | $V_{(BR)CBO}$ | 100 | — | — | Vdc |
| Emitter-Base Breakdown Voltage ($I_E$ = 10 mAdc, $I_C$ = 0) | $V_{(BR)EBO}$ | 4.0 | — | — | Vdc |
| **ON CHARACTERISTICS** | | | | | |
| DC Current Gain ($I_C$ = 5.0 Adc, $V_{CE}$ = 5.0 Vdc) | $h_{FE}$ | 10 | 30 | — | — |
| **DYNAMIC CHARACTERISTICS** | | | | | |
| Output Capacitance ($V_{CB}$ = 50 Vdc, $I_E$ = 0, f = 1.0 MHz) | $C_{ob}$ | — | 350 | 450 | pF |
| **FUNCTIONAL TEST** | | | | | |
| Common-Emitter Amplifier Power Gain ($V_{CC}$ = 50 Vdc, $P_{out}$ = 250 W CW, f = 30 MHz, $I_{CQ}$ = 250 mA) | $G_{PE}$ | 12 | 14 | — | dB |
| Collector Efficiency ($V_{CC}$ = 50 Vdc, $P_{out}$ = 250 W, f = 30 MHz, $I_{CQ}$ = 250 mA) | $\eta$ | —<br>— | 45<br>65 | —<br>— | % (PEP)<br>% (CW) |
| Intermodulation Distortion (1) ($V_{CE}$ = 50 Vdc, $P_{out}$ = 250 W (PEP), $I_{CQ}$ = 250 mA, f = 30 MHz) | IMD | — | -33 | -30 | dB |
| Electrical Ruggedness ($V_{CC}$ = 50 Vdc, $P_{out}$ = 250 W CW, f = 30 MHz, VSWR 3:1 at all Phase Angles) | No Degradation in Output Power | | | | |

(1) To Mil Std 1311 Version A, Test Method 2204B, Two Tone, Reference Each Tone.

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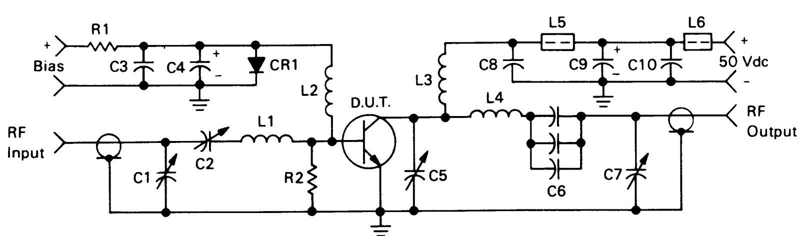
**FIGURE 1 — 30 MHz TEST CIRCUIT SCHEMATIC**




C1, C2, C5, C7 — 170-780 pF, Arco 469
C3, C8, C9 — 0.1 μF, 100 V Erie
C4 — 500 μF @ 6.0 V
C6 — 360 pF, 3 × 120 pF 3.0 kV in parallel
C10 — 10 μF, 100 V
R1 — 10 Ω, 10 Watt
R2 — 10 Ω, 1 Watt

CR1 — 1N4997 or equivalent
L1 — 3 Turns, #16 Wire, 0.4" I.D., 0.3" Long
L2 — 0.8 μH, Ohmite Z-235 or equivalent
L3 — 12 Turns, #16 Enameled Wire Closewound 0.25" I.D.
L4 — 4 Turns, 1/8" Copper Tubing, 0.6" I.D., 1.0" Long
L5, L6 — 2.0 μH, Fair-Rite 2643021801 Ferrite bead each or equivalent.

FIGURE 2 — OUTPUT POWER versus INPUT POWER

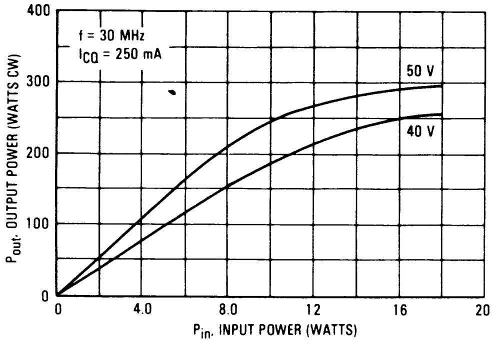



FIGURE 3 — OUTPUT POWER versus SUPPLY VOLTAGE

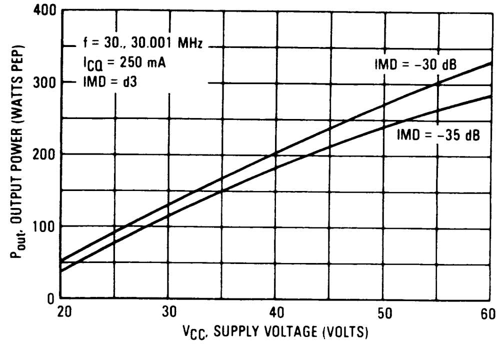



FIGURE 4 — POWER GAIN versus FREQUENCY

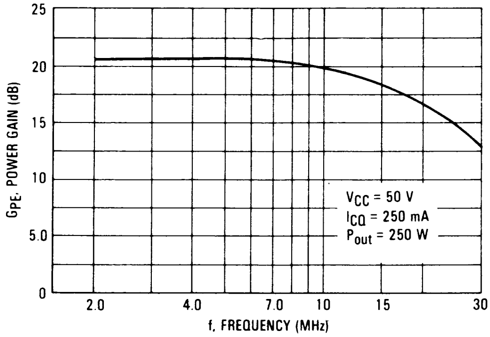



FIGURE 5 — RF SOAR (CLASS AB) $P_{out}$ versus OUTPUT VSWR

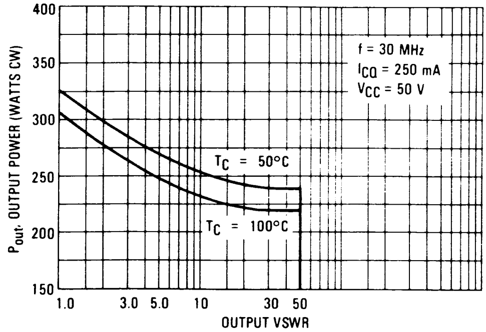



FIGURE 6 — $f_T$ versus COLLECTOR CURRENT

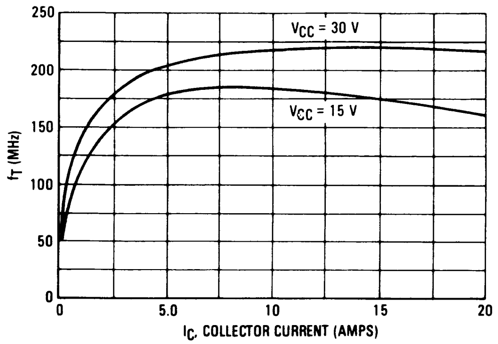



FIGURE 7 — IMD versus $P_{out}$

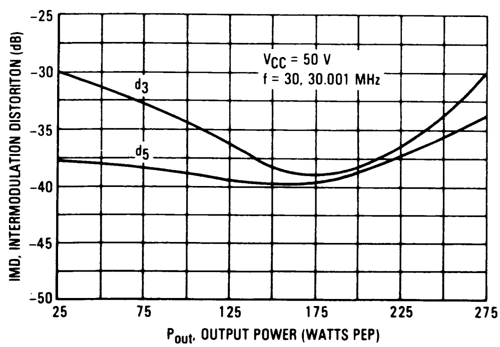


**FIGURE 8 — OUTPUT RESISTANCE AND CAPACITANCE versus FREQUENCY**

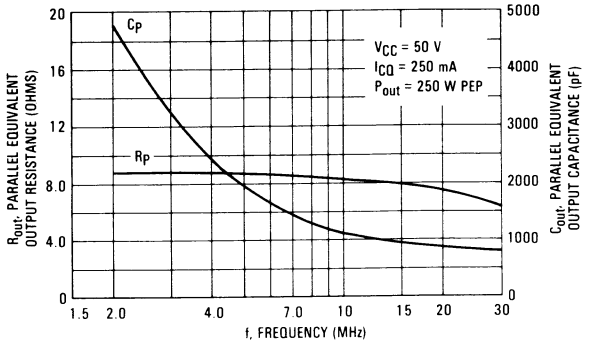
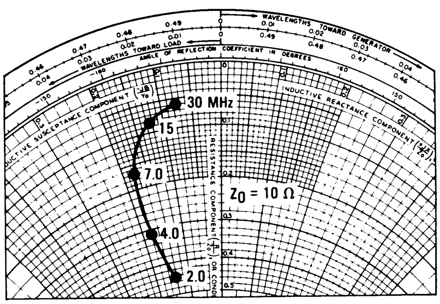



**FIGURE 9—SERIES EQUIVALENT IMPEDANCE**




$V_{CC}$ = 50 V
$I_{CQ}$ = 150 mA
$P_{out}$ = 250 W PEP

| f MHz | $Z_{in}$ Ohms |
|---|---|
| 30 | 0.60 -J0.75 |
| 15 | 0.80 -J1.25 |
| 7.0 | 1.70 -J1.75 |
| 4.0 | 3.10 -J1.80 |
| 2.0 | 4.50 -J1.40 |

MOTOROLA
# SEMICONDUCTOR
TECHNICAL DATA

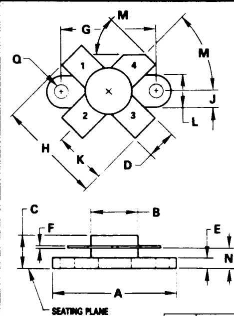
# MRF449
# MRF449A

## The RF Line

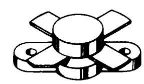
**30 W — 30 MHz**

**RF POWER TRANSISTORS**

**NPN SILICON**

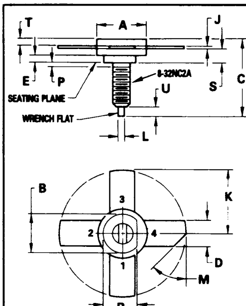



**CASE 211-07**
**MRF449**

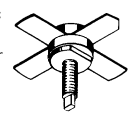


STYLE 1:
PIN 1. EMITTER
2. BASE
3. EMITTER
4. COLLECTOR

| DIM | MILLIMETERS | | INCHES | |
|---|---|---|---|---|
| | MIN | MAX | MIN | MAX |
| A | 24.38 | 25.15 | 0.960 | 0.990 |
| B | 9.40 | 9.91 | 0.370 | 0.390 |
| C | 5.82 | 7.14 | 0.229 | 0.281 |
| D | 5.46 | 5.97 | 0.215 | 0.235 |
| E | 2.16 | 2.67 | 0.085 | 0.105 |
| F | 0.10 | 0.15 | 0.004 | 0.006 |
| G | 18.29 | 18.54 | 0.720 | 0.730 |
| H | 20.07 | 20.57 | 0.790 | 0.810 |
| K | 10.03 | 10.29 | 0.395 | 0.405 |
| L | 6.22 | 6.48 | 0.245 | 0.255 |
| M | 40° | 50° | 40° | 50° |
| N | 3.81 | 4.57 | 0.150 | 0.180 |
| Q | 2.87 | 3.30 | 0.113 | 0.130 |




**CASE 145A-09**
**MRF449A**



STYLE 1:
PIN 1. EMITTER
2. BASE
3. EMITTER
4. COLLECTOR

| DIM | MILLIMETERS | | INCHES | |
|---|---|---|---|---|
| | MIN | MAX | MIN | MAX |
| A | 9.40 | 9.78 | 0.370 | 0.385 |
| B | 8.13 | 8.38 | 0.320 | 0.330 |
| C | 17.02 | 20.07 | 0.670 | 0.790 |
| D | 5.46 | 5.97 | 0.215 | 0.235 |
| E | 1.78 | — | 0.070 | — |
| J | 0.08 | 0.18 | 0.003 | 0.007 |
| K | 12.45 | — | 0.490 | — |
| L | 1.40 | 1.78 | 0.055 | 0.070 |
| M | 45° NOM | | 45° NOM | |
| P | — | 1.27 | — | 0.050 |
| R | 7.59 | 7.80 | 0.299 | 0.307 |
| S | 4.01 | 4.52 | 0.158 | 0.178 |
| T | 2.11 | 2.54 | 0.083 | 0.100 |
| U | 2.49 | 3.35 | 0.098 | 0.132 |

### NPN SILICON RF POWER TRANSISTORS

. . . designed for power amplifier application in industrial, commercial and amateur radio equipment to 30 MHz.

- Specified 12.5 Volt, 30 MHz Characteristics —
  Output Power = 30 Watts
  Minimum Gain = 12 dB
  Efficiency = 50%

### MAXIMUM RATINGS

| Rating | Symbol | Value | Unit |
|---|---|---|---|
| Collector-Emitter Voltage | $V_{CEO}$ | 20 | Vdc |
| Collector-Base Voltage | $V_{CBO}$ | 40 | Vdc |
| Emitter-Base Voltage | $V_{EBO}$ | 4.0 | Vdc |
| Total Device Dissipation @ $T_C = 25°C$<br>Derate above 25°C | $P_D$ | 60<br>343 | Watts<br>mW/°C |
| Storage Temperature Range | $T_{stg}$ | −65 to +150 | °C |

### THERMAL CHARACTERISTICS

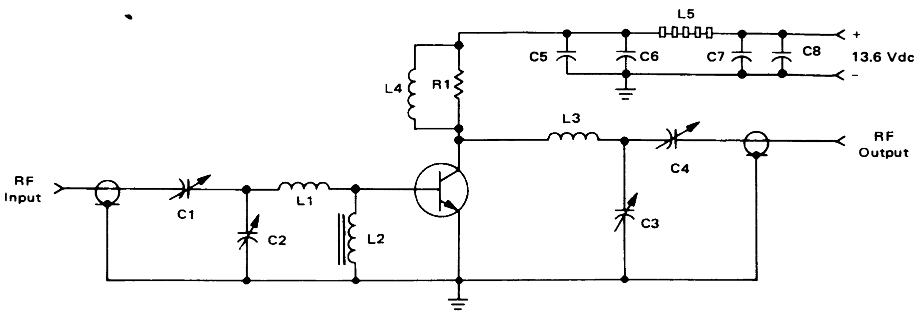
| Characteristic | Symbol | Max | Unit |
|---|---|---|---|
| Thermal Resistance, Junction to Case | $R_{\theta JC}$ | 2.9 | °C/W |

3

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

| Characteristic | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| **OFF CHARACTERISTICS** | | | | | |
| Collector-Emitter Breakdown Voltage ($I_C$ = 100 mAdc, $I_B$ = 0) | $V_{(BR)CEO}$ | 20 | – | – | Vdc |
| Collector-Emitter Breakdown Voltage ($I_C$ = 50 mAdc, $V_{BE}$ = 0) | $V_{(BR)CES}$ | 40 | 50 | – | Vdc |
| Collector-Base Breakdown Voltage ($I_C$ = 20 mAdc, $I_E$ = 0) | $V_{(BR)CBO}$ | 40 | – | – | Vdc |
| Emitter-Base Breakdown Voltage ($I_E$ = 5.0 mAdc, $I_C$ = 0) | $V_{(BR)EBO}$ | 4.0 | – | – | Vdc |
| **ON CHARACTERISTICS** | | | | | |
| DC Current Gain ($I_C$ = 1.0 Adc, $V_{CE}$ = 5.0 Vdc) | $h_{FE}$ | 10 | – | – | – |
| **DYNAMIC CHARACTERISTICS** | | | | | |
| Output Capacitance ($V_{CB}$ = 12.5 Vdc, $I_E$ = 0, f = 1.0 MHz) | $C_{ob}$ | – | – | 140 | pF |
| **FUNCTIONAL TESTS (Figure 1)** | | | | | |
| Common-Emitter Amplifier Power Gain ($V_{CC}$ = 13.6 Vdc, $P_{out}$ = 30 W, $I_C(max)$ = 4.0 Adc, f = 30 MHz) | $G_{PE}$ | 12 | 14 | – | dB |
| Collector Efficiency ($V_{CC}$ = 13.6 Vdc, $P_{out}$ = 30 W, $I_C(max)$ = 4.0 Adc, f = 30 MHz) | $\eta$ | 50 | – | – | % |
| Series Equivalent Input Impedance ($V_{CC}$ = 12.5 Vdc, $P_{out}$ = 30 W, f = 30 MHz) | $Z_{in}$ | – | 2.13-j1.15 | – | Ohms |
| Series Equivalent Output Impedance ($V_{CC}$ = 12.5 Vdc, $P_{out}$ = 30 W, f = 30 MHz) | $Z_{out}$ | – | 2.47-j0.37 | – | Ohms |

FIGURE 1 — 30 MHz TEST CIRCUIT SCHEMATIC




| | |
|---|---|
| C1 — | 14-150 pF, ARCO 424 |
| C2,C3,C4 — | 170-780 pF, ARCO 469 |
| C5,C8 — | ERIE 0.1 μF @ 100 V RED CAPS |
| C6 — | 1000 pF UNELCO, 350 Vdc |
| C7 — | 10 μF, 35 Vdc |
| R1 — | 100 Ω, 2 W Carbon |
| L1 — | 0.15 μH Molded Choke MILLER |
| L2 — | FERROXCUBE, VK200-20-4B |
| L3 — | 3 Turns, #14 Bare Tinned Wire, 0.3" (0.79) I.D. x 0.38" (0.97) Long |
| L4 — | 9 Turns, #20 Enamal Wire, Close Wound on R1 |
| L5 — | FERROXCUBE #56-570-65/3B, 5 Ferrite Beads, on 1" Long #20 Wire |
| Input/Output Connectors — | Type N |
| Board — | Glass Teflon Mounted on a 4" x 4" x 2" SEEZAK Box |

FIGURE 2 — POWER OUTPUT versus POWER INPUT

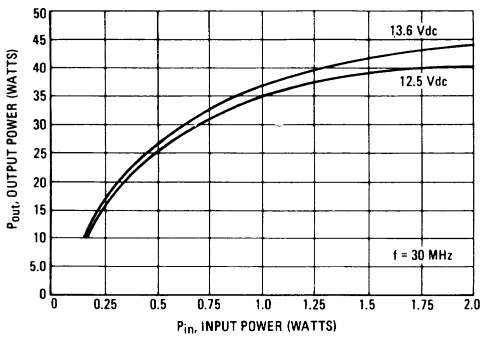
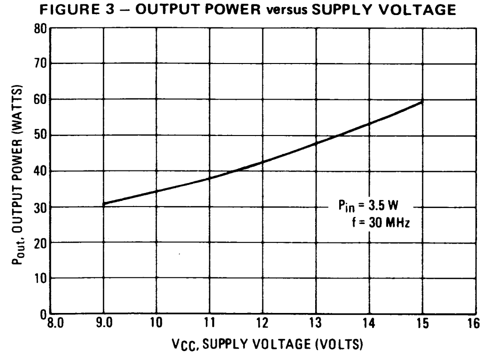



FIGURE 3 — OUTPUT POWER versus SUPPLY VOLTAGE




3

# MRF450
# MRF450A

## The RF Line

50 W – 30 MHz
RF POWER
TRANSISTORS
NPN SILICON

### NPN SILICON RF POWER TRANSISTORS

. . . designed for power amplifier applications in industrial, commercial and amateur radio equipment to 30 MHz.

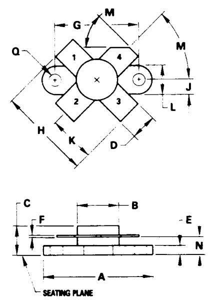
- Specified 12.5 Volt, 30 MHz Characteristics –
  Output Power = 50 Watts
  Minimum Gain = 11 dB
  Efficiency = 50%

### MAXIMUM RATINGS

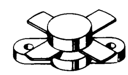
| Rating | Symbol | Value | Unit |
|---|---|---|---|
| Collector-Emitter Voltage | $V_{CEO}$ | 20 | Vdc |
| Collector-Base Voltage | $V_{CBO}$ | 40 | Vdc |
| Emitter-Base Voltage | $V_{EBO}$ | 4.0 | Vdc |
| Collector Current – Continuous | $I_C$ | 7.5 | Adc |
| Total Device Dissipation @ $T_C = 25°C$<br>Derate above 25°C | $P_D$ | 115<br>0.66 | Watts<br>W/°C |
| Storage Temperature Range | $T_{stg}$ | −65 to +150 | °C |

### THERMAL CHARACTERISTICS

| Characteristic | Symbol | Max | Unit |
|---|---|---|---|
| Thermal Resistance, Junction to Case | $R_{\theta JC}$ | 1.53 | °C/W |

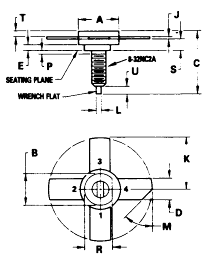



CASE 211-07
MRF450

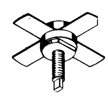


STYLE 1:
PIN 1. EMITTER
2. BASE
3. EMITTER
4. COLLECTOR

| DIM | MILLIMETERS MIN | MILLIMETERS MAX | INCHES MIN | INCHES MAX |
|---|---|---|---|---|
| A | 24.38 | 25.15 | 0.960 | 0.990 |
| B | 9.40 | 9.91 | 0.370 | 0.390 |
| C | 5.82 | 7.14 | 0.229 | 0.281 |
| D | 5.46 | 5.97 | 0.215 | 0.235 |
| E | 2.16 | 2.67 | 0.085 | 0.105 |
| F | 0.10 | 0.15 | 0.004 | 0.006 |
| G | 18.29 | 18.54 | 0.720 | 0.730 |
| H | 20.07 | 20.57 | 0.790 | 0.810 |
| K | 10.03 | 10.29 | 0.395 | 0.405 |
| L | 6.22 | 6.48 | 0.245 | 0.255 |
| M | 40° | 50° | 40° | 50° |
| N | 3.81 | 4.57 | 0.150 | 0.180 |
| Q | 2.87 | 3.30 | 0.113 | 0.130 |




CASE 145A-09
MRF450A



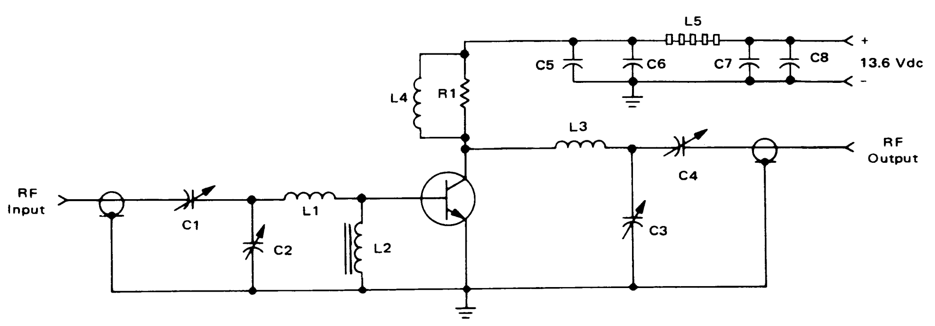
STYLE 1:
PIN 1. EMITTER
2. BASE
3. EMITTER
4. COLLECTOR

| DIM | MILLIMETERS MIN | MILLIMETERS MAX | INCHES MIN | INCHES MAX |
|---|---|---|---|---|
| A | 9.40 | 9.78 | 0.370 | 0.385 |
| B | 8.13 | 8.38 | 0.320 | 0.330 |
| C | 17.02 | 20.07 | 0.670 | 0.790 |
| D | 5.46 | 5.97 | 0.215 | 0.235 |
| E | 1.78 | — | 0.070 | — |
| J | 0.08 | 0.18 | 0.003 | 0.007 |
| K | 12.45 | — | 0.490 | — |
| L | 1.40 | 1.78 | 0.055 | 0.070 |
| M | 45° NOM | | 45° NOM | |
| P | — | 1.27 | — | 0.050 |
| R | 7.59 | 7.80 | 0.299 | 0.307 |
| S | 4.01 | 4.52 | 0.158 | 0.178 |
| T | 2.11 | 2.54 | 0.083 | 0.100 |
| U | 2.49 | 3.35 | 0.098 | 0.132 |

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

| Characteristic | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| **OFF CHARACTERISTICS** | | | | | |
| Collector-Emitter Breakdown Voltage ($I_C$ = 100 mAdc, $I_B$ = 0) | $V_{(BR)CEO}$ | 20 | – | – | Vdc |
| Collector-Emitter Breakdown Voltage ($I_C$ = 20 mAdc, $V_{BE}$ = 0) | $V_{(BR)CES}$ | 40 | – | – | Vdc |
| Collector-Base Breakdown Voltage ($I_C$ = 20 mAdc, $I_E$ = 0) | $V_{(BR)CBO}$ | 40 | – | – | Vdc |
| Emitter-Base Breakdown Voltage ($I_E$ = 10 mAdc, $I_C$ = 0) | $V_{(BR)EBO}$ | 4.0 | – | – | Vdc |
| **ON CHARACTERISTICS** | | | | | |
| DC Current Gain ($I_C$ = 1.0 Adc, $V_{CE}$ = 5.0 Vdc) | $h_{FE}$ | 10 | – | – | – |
| **DYNAMIC CHARACTERISTICS** | | | | | |
| Output Capacitance ($V_{CB}$ = 15 Vdc, $I_E$ = 0, f = 1.0 MHz) | $C_{ob}$ | – | – | 200 | pF |
| **FUNCTIONAL TESTS (Figure 1)** | | | | | |
| Common-Emitter Amplifier Power Gain ($V_{CC}$ = 13.6 Vdc, $P_{out}$ = 50 W, $I_C$(max) = 6.13 Adc, f = 30 MHz) | $G_{PE}$ | 11 | 15 | – | dB |
| Collector Efficiency ($V_{CC}$ = 13.6 Vdc, $P_{out}$ = 50 W, $I_C$(max) = 6.13 Adc, f = 30 MHz) | $\eta$ | 50 | – | – | % |
| Series Equivalent Input Impedance ($V_{CC}$ = 13.6 Vdc, $P_{out}$ = 50 W; f = 30 MHz) | $Z_{in}$ | – | 1.56-j.89 | – | Ohms |
| Series Equivalent Output Impedance ($V_{CC}$ = 13.6 Vdc, $P_{out}$ = 50 W, f = 30 MHz) | $Z_{out}$ | – | 174-j.50 | – | Ohms |

FIGURE 1 – 30 MHz TEST CIRCUIT SCHEMATIC




| | |
|---|---|
| C1 – | 14-150 pF, ARCO 424 |
| C2,C3,C4 – | 170-780 pF, ARCO 469 |
| C5,C8 – | ERIE 0.1 μF @ 100 V RED CAPS |
| C6 – | 1000 pF UNELCO, 350 Vdc |
| C7 – | 10 μF, 35 Vdc |
| R1 – | 100 Ω, 2 W Carbon |
| L1 – | 0.15 μH Molded Choke MILLER |
| L2 – | FERROXCUBE, VK200-20-4B |
| L3 – | 3 Turns, #14 Bare Tinned Wire, 0.3" (0.79) I.D. x 0.38" (0.97) Long |
| L4 – | 9 Turns, #20 Enamal Wire, Close Wound on R1 |
| L5 – | FERROXCUBE #56-570-65/3B, 5 Ferrite Beads, on 1" Long #20 Wire |

Input/Output Connectors – Type N

Board – Glass Teflon Mounted on a 4" x 4" x 2" SEEZAK Box

FIGURE 2 – INPUT POWER versus OUTPUT POWER

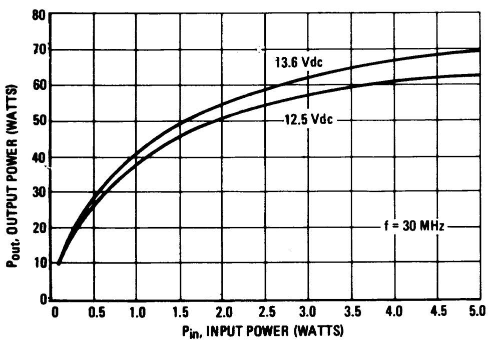
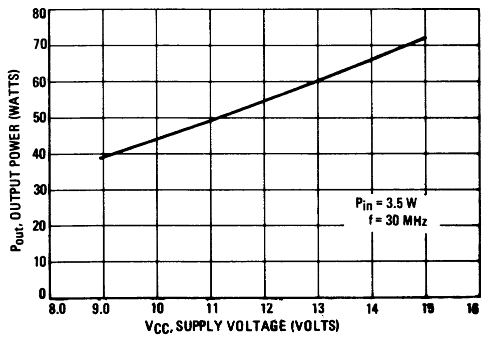



FIGURE 3 – OUTPUT POWER versus SUPPLY VOLTAGE

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