MRF475

The RF Line

12 W (PEP) — 12 W (CW) — 30 MHz

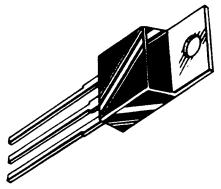
RF POWER TRANSISTOR

NPN SILICON

NPN SILICON RF POWER TRANSISTOR

. . . designed primarily for use in single sideband linear amplifier output applications in citizens band and other communications equipment operating to 30 MHz.

- Characterized for Single Sideband and Large-Signal Amplifier Applications Utilizing Low-Level Modulation.
- Specified 13.6 V, 30 MHz Characteristics —
  Output Power = 12 W (PEP)
  Minimum Efficiency = 40% (SSB)
  Output Power = 4.0 W (CW)
  Minimum Efficiency = 50% (CW)
  Minimum Power Gain = 10 dB (PEP & CW)
- Common Collector Characterization

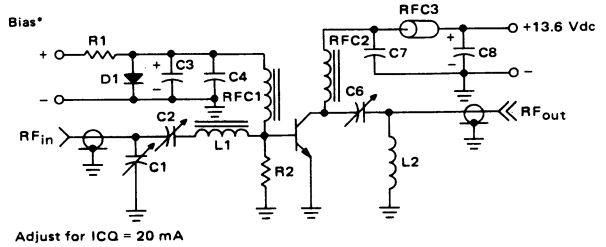


3

MAXIMUM RATINGS

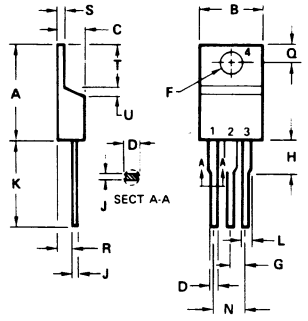
Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V_{CEO}	18	Vdc
Collector-Base Voltage	V_{CBO}	48	Vdc
Emitter-Base Voltage	V_{EBO}	4.0	Vdc
Collector Current — Continuous	I_C	4.0	Adc
Total Device Dissipation @ T_C = 50°C Derate above 50°C	P_D	10 0.1	Watts W/°C
Operating and Storage Junction Temperature Range	T_J, T_{stg}	-65 to +150	°C

FIGURE 1 — COMMON-EMITTER TEST CIRCUIT



Adjust for ICQ = 20 mA

C1, 2, 6 — ARCO 466 Trimmer Capacitors
C3 — 1000 μF, 3.0 Vdc Electrolytic
C4, 7 — 0.1 μF Disc Ceramics
C8 — 100 μF, 15 Vdc Electrolytic
R1 — 10 Ω, 5.0 Watt Resistor
R2 — 10 Ω, 1.0 Watt Resistor
L1 — 2.2 μH Molded Choke
L2 — 4 Turns #18 AWG Wire, 1/2" I.D., 5/16" Long
RFC1 — 10 μH Molded Choke
RFC2 — 15 Turns #20 AWG Wire on 5.6 kΩ, 1.0 Watt Carbon Resistor
RFC3 — 5 Ferroxcube, #56-590-65/3B, Beads on #18 AWG Wire
D1 — 1N4997



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

NOTE:
1. DIM. L & H APPLIES TO ALL LEADS.

DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	15.11	15.75	0.595	0.620
B	9.78	10.03	0.385	0.395
C	4.06	4.82	0.160	0.190
D	0.64	0.89	0.025	0.035
F	3.61	3.73	0.142	0.147
G	2.41	2.67	0.095	0.105
H	2.79	3.30	0.110	0.130
J	0.36	0.56	0.014	0.022
K	12.70	14.27	0.500	0.562
L	1.14	1.27	0.045	0.050
N	4.83	5.33	0.190	0.210
Q	2.54	3.04	0.100	0.120
R	2.04	2.79	0.080	0.110
S	1.14	1.39	0.045	0.055
T	5.97	6.48	0.235	0.255
U	0.76	1.27	0.030	0.050

CASE 221A-02
TO-220AB

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 = 50 mAdc, V_{BE} = 0)	$V_{(BR)CES}$	48	–	–	Vdc
Emitter-Base Breakdown Voltage (I_E = 5.0 mAdc, I_C = 0)	$V_{(BR)EBO}$	4.0	–	–	Vdc
Collector Cutoff Current (V_{CB} = 25 Vdc, I_E = 0)	I_{CBO}	–	–	1.0	mAdc
ON CHARACTERISTICS					
DC Current Gain (I_C = 500 mAdc, V_{CE} = 5.0 Vdc)	h_{FE}	30	60	–	–
DYNAMIC CHARACTERISTICS					
Output Capacitance (V_{CB} = 13.6 Vdc, I_E = 0, f = 1.0 MHz)	C_{ob}	–	125	145	pF
FUNCTIONAL TESTS (SSB)					
Common-Emitter Amplifier Power Gain (V_{CC} = 13.6 Vdc, *P_{out} = 12 W, f1 = 30 MHz, f2 = 30.001 MHz, I_{CQ} = 20 mA)	G_{PE}	10	12	–	dB
Collector Efficiency (V_{CC} = 13.6 Vdc, *P_{out} = 12 W, f1 = 30 MHz, f2 = 30.001 MHz, I_{CQ} = 20 mA)	η	40	–	–	%
Intermodulation Distortion (V_{CC} = 13.6 Vdc, *P_{out} = 12 W, f1 = 30 MHz, f2 = 30.001 MHz, I_{CQ} = 20 mA)	IMD	-30	–	–	%
FUNCTIONAL TESTS (CW)					
Common-Emitter Amplifier Power Gain (V_{CC} = 13.6 Vdc, P_{out} = 4.0 W, f = 30 MHz)	G_{PE}	10	12	–	dB
Collector Efficiency (V_{CC} = 13.6 Vdc, P_{out} = 4.0 W, f = 30 MHz)	η	50	–	–	%
Percentage Up-Modulation (1) (4.0 W Carrier)	–	–	100	–	%
IMPEDANCE CHARACTERISTICS					
Series Equivalent Input	V_{CC} = 13.6 Vdc, P_o = 12 W (PEP), f = 30 MHz, I_{CQ} = 20 mA	Z_{in}	–	4.5–j2.4	–	Ohms
Series Equivalent Output		Z_{out}	–	5.1–j3.2	–	Ohms
Parallel Equivalent Input		Z_{in}	–	5.8/10.9	–	Ω/pF
Parallel Equivalent Output		Z_{out}	–	7.1/11.3	–	Ω/pF

*PEP

(1) Percentage Up-Modulation is measured in the test circuit (Figure 1) by setting the Carrier Power (P_c) to 4.0 Watts with V_{CC} = 13.6 Vdc and noting the power input. Then the Peak Envelope Power (PEP) is noted after doubling the original power input to simulate driver modulation.

$$\text{Percentage Up-Modulation} = \left[\left(\frac{PEP}{P_c}\right) - 1\right] \bullet 100$$

3

FIGURE 2 – OUTPUT POWER versus INPUT POWER

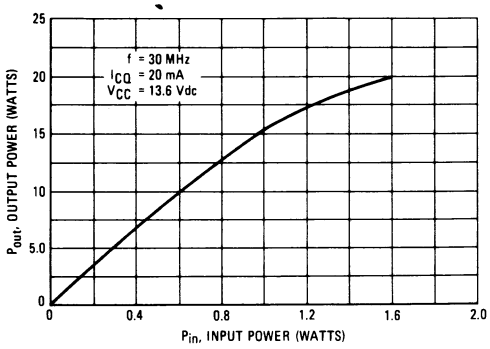


FIGURE 3 – INTERMODULATION DISTORTION versus OUTPUT POWER

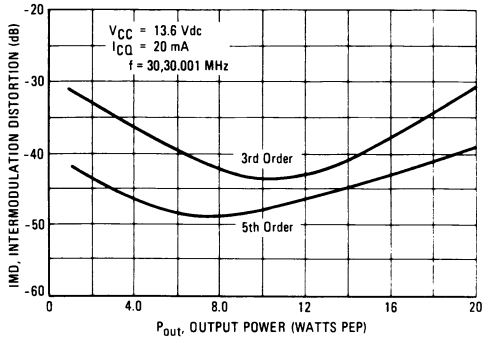


FIGURE 4 – OUTPUT POWER versus SUPPLY VOLTAGE

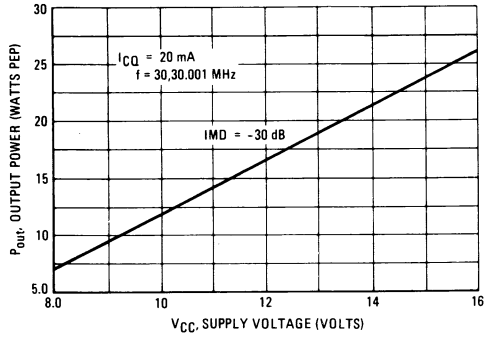


FIGURE 5 – OUTPUT CAPACITANCE versus FREQUENCY

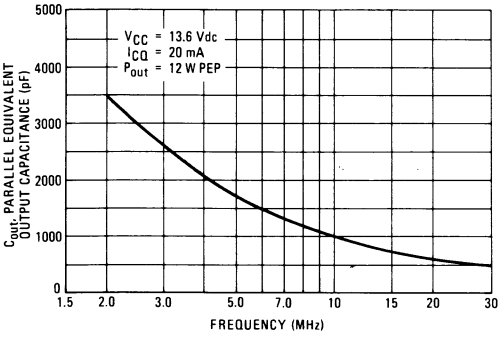


FIGURE 6 – OUTPUT RESISTANCE versus FREQUENCY

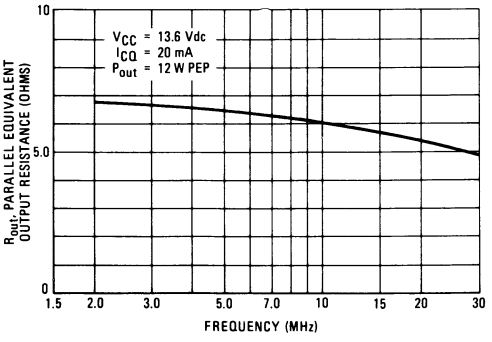


FIGURE 7 – POWER GAIN versus FREQUENCY

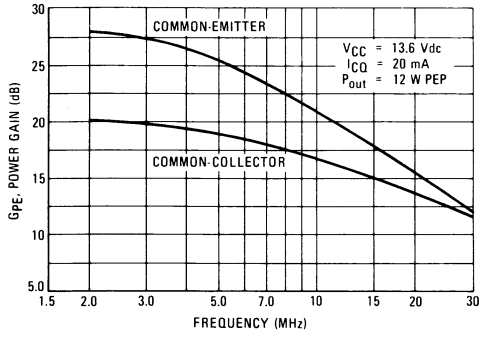
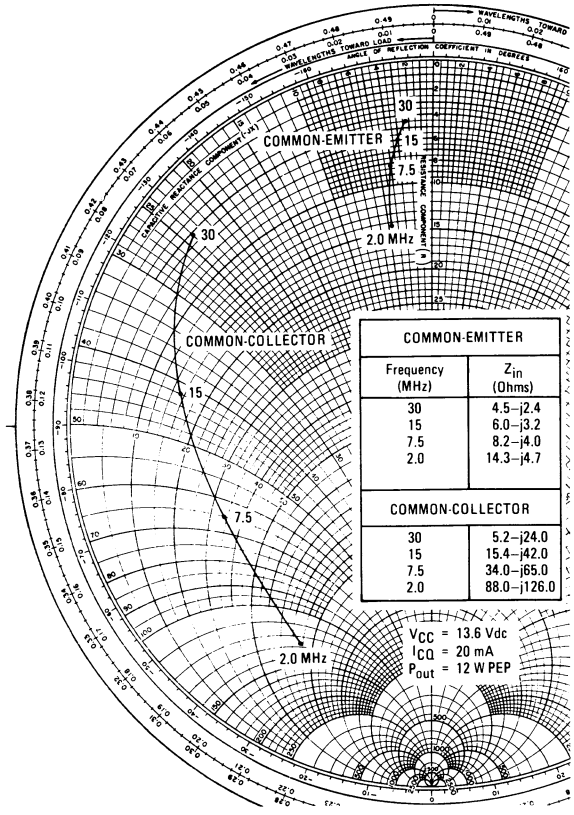
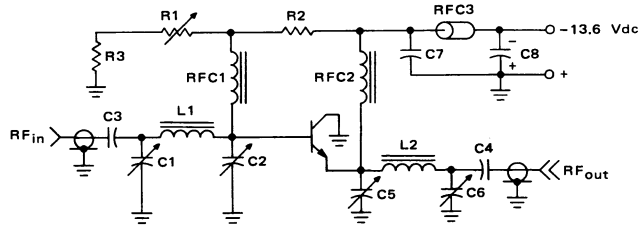


FIGURE 8 – IMPEDANCE COORDINATES – 50-OHM CHARACTERISTICS IMPEDANCE



COMMON-EMITTER	
Frequency (MHz)	Z_{in} (Ohms)
30	4.5–j2.4
15	6.0–j3.2
7.5	8.2–j4.0
2.0	14.3–j4.7
COMMON-COLLECTOR	
30	5.2–j24.0
15	15.4–j42.0
7.5	34.0–j65.0
2.0	88.0–j126.0

FIGURE 9 – COMMON-COLLECTOR TEST CIRCUIT



C1, 5 – ARCO 466 Trimmer Capacitors
C2 – ARCO 463 Trimmer Capacitor
C3, 4, 7 – 0.1 μF Ceramic Disc
C6 – ARCO 469 Trimmer Capacitor
C8 – 100 μF 15 Vdc Electrolytic
R1 – 250 Ω, 2.0 W Potentiometer
R2 – 5.1 Ω, 1/2 W Resistor
R3 – 51 Ω, 2.0 W Resistor

L1 – 0.33 μH Molded Choke
L2 – 4 Turns #18 AWG Wire, 1/8" I.D., 5/16" Long
RFC1 – 18 μH Molded Choke
RFC2 – 15 Turns #20 AWG Wire on 100 Ω, 1.0 W Carbon Resistor
RFC3 – Ferroxcube, #56-590-65/3B, Beads on #18 AWG Wire

3

MRF476

The RF Line

3.0 W (PEP)–3.0 W (CW) – 30 MHz

RF POWER
TRANSISTOR

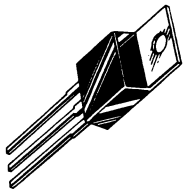
NPN SILICON

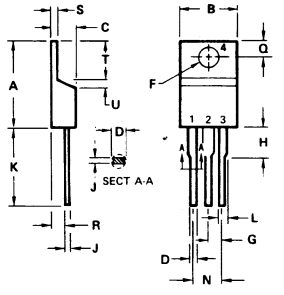
NPN SILICON RF POWER TRANSISTOR

. . . designed primarily for use in single sideband linear amplifier output applications in citizens band and other communications equipment operating to 50 MHz.

- Characterized for Single Sideband and Large-Signal Amplifier Applications Utilizing Low-Level Modulation
- Specified 12.5 V, 30 MHz Characteristics –

  Output Power = 3.0 W (PEP)
  Minimum Efficiency = 40% (SSB)
  Output Power = 3.0 W (CW)
  Minimum Power Gain = 15 dB (PEP)
- Common-Emitter Characterization





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

NOTE:
1. DIM. L & H APPLIES TO ALL LEADS.

DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	15.11	15.75	0.595	0.620
B	9.65	10.29	0.380	0.405
C	4.06	4.82	0.160	0.190
D	0.64	0.89	0.025	0.035
F	3.61	3.73	0.142	0.147
G	2.41	2.67	0.095	0.105
H	2.79	3.30	0.110	0.130
J	0.36	0.56	0.014	0.022
K	12.70	14.27	0.500	0.562
L	1.14	1.27	0.045	0.050
N	4.83	5.33	0.190	0.210
Q	2.54	3.04	0.100	0.120
R	2.04	2.79	0.080	0.110
S	1.14	1.39	0.045	0.055
T	5.97	6.48	0.235	0.255
U	0.76	1.27	0.030	0.050

CASE 221A-02
TO-220AB

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	1.0	Adc
Total Device Dissipation @ $T_A = 25^oC$ (1) Derate above 25^oC	P_D	10 57.2	Watts mW/^oC
Storage Temperature Range	T_{stg}	-65 to + 150	^oC

(1) These devices are designed for RF operation. The total device dissipation rating applies only when the devices are operated as RF amplifiers.

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	17.5	$^oC/W$

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

Characteristic	Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage (I_C = 10 mAdc, I_B = 0)	$V_{(BR)CEO}$	18	–	–	Vdc
Collector-Emitter Breakdown Voltage (I_C = 25 mAdc, V_{BE} = 0)	$V_{(BR)CES}$	36	–	–	Vdc
Emitter-Base Breakdown Voltage (I_E = 1.0 mAdc, I_C = 0)	$V_{(BR)EBO}$	4.0	–	–	Vdc
Collector Cutoff Current (V_{CB} = 15 Vdc, I_E = 0)	I_{CBO}	–	–	0.5	mAdc
ON CHARACTERISITCS					
DC Current Gain (I_C = 250 mAdc, V_{CE} = 5.0 Vdc)	h_{FE}	10	50	–	–
DYNAMIC CHARACTERISTICS					
Output Capacitance (V_{CB} = 12.5 Vdc, I_E = 0, f = 1.0 MHz)	C_{ob}	–	25	35	pF
FUNCTIONAL TESTS (SSB)					
Common-Emitter Amplifier Power Gain (V_{CC} = 12.5 Vdc, P_{out} = 3.0 W (PEP) f1 = 30 MHz, f2 = 30.001 MHz, ICQ = 20 mA)	G_{PE}	15	18	–	dB
Collector Efficiency (V_{CC} = 12.5 Vdc, P_{out} = 3.0 W (PEP) f1 = 30 MHz, f2 = 30.001 MHz, ICQ = 20 mA)	η	40	–	–	%
Intermodulation Distortion (V_{CC} = 12.5 Vdc, P_{out} = 3.0 W (PEP) f1 = 30 MHz, f2 = 30.001 MHz, ICQ = 20 mA	IMD	-30	-35	–	dB
50 MHz PERFORMANCE					
Common-Emitter Amplifier Power Gain (V_{CC} = 12.5 Vdc, P_{out} = 3.0 W, f = 50 MHz)	G_{PE}	–	15	–	dB

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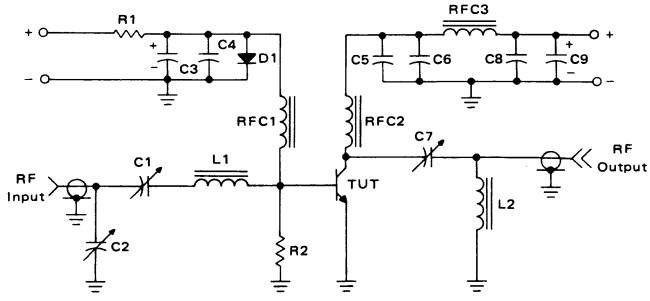
FIGURE 1 – 30 MHz TEST CIRCUIT SCHEMATIC



C2 – Arco 466 Trimmer
C1, C7 – Arco 469 Trimmer
C3 – 500 μF, 3.0 V Electrolytic
C4, C5, C8 – 0.1 μF Erie Redcap
C6 – 1000 pF UNELCO
C9 – 100 μF, 15 V Electrolytic

R1 – 33 Ω 5 W Wire Wound
R2 – 50 Ω 1/2 W Carbon

L1 – 0.22 μH Molded Choke
L2 – 5 Turns #18 Enameled Wire, 1/4" ID

RFC1 – 10 μH Molded Choke
RFC2 – 1.9 μH Molded Choke (Ohmite Z-144)
RFC3 – 6 Ferroxcube Beads on #18 AWG Wire

D1 – MR751

Board – G10, 2-sided 2 oz. Copper Clad

Connectors – Type N

FIGURE 2 – POWER GAIN versus FREQUENCY

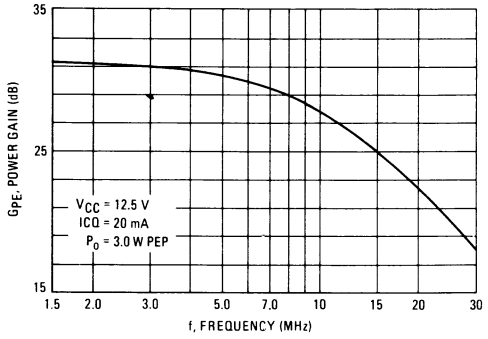


FIGURE 3 – OUTPUT POWER versus INPUT POWER

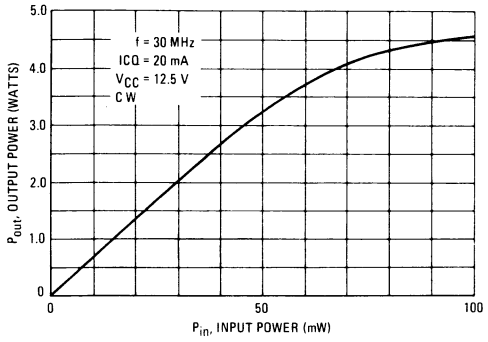


FIGURE 4 – OUTPUT POWER versus INPUT POWER

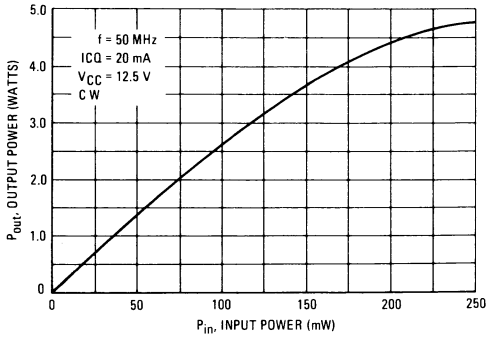


FIGURE 5 – OUTPUT POWER versus SUPPLY VOLTAGE

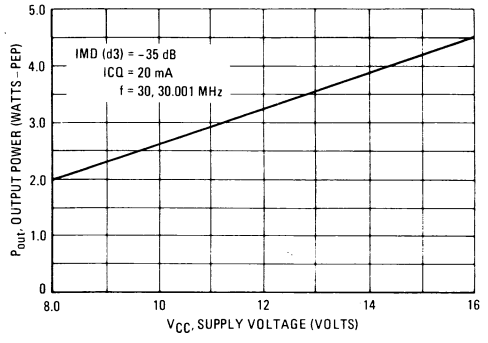


FIGURE 6 – INTERMODULATION DISTORTION versus OUTPUT POWER

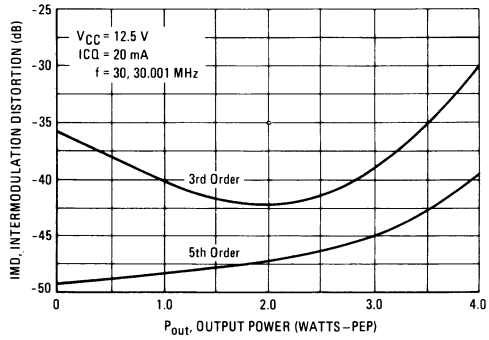


FIGURE 7 – OUTPUT CAPACITANCE versus FREQUENCY

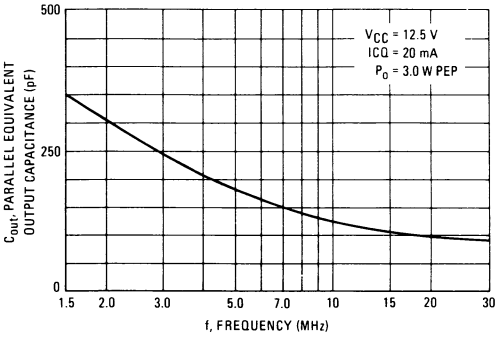


FIGURE 8 – OUTPUT RESISTANCE versus FREQUENCY

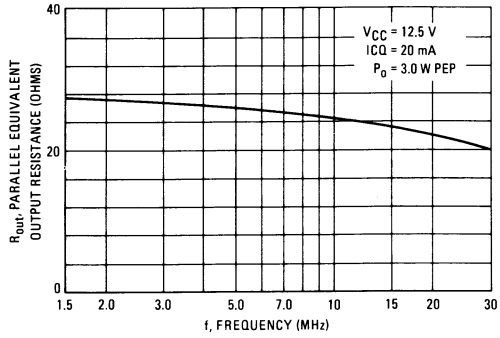
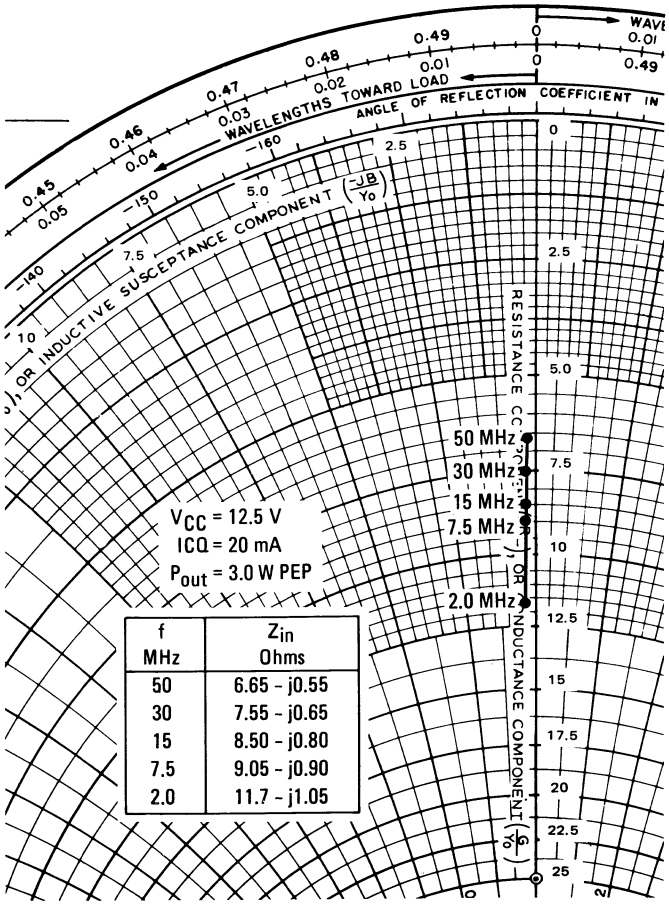


FIGURE 9 – SERIES EQUIVALENT INPUT IMPEDANCE



f MHz	Z_{in} Ohms
50	6.65 - j0.55
30	7.55 - j0.65
15	8.50 - j0.80
7.5	9.05 - j0.90
2.0	11.7 - j1.05

MRF477

The RF Line

40 W (PEP) — 30 MHz

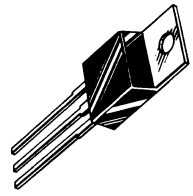
RF POWER TRANSISTOR

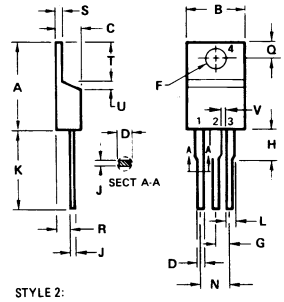
NPN SILICON

NPN SILICON RF POWER TRANSISTOR

. . . designed primarily for application as a high-power linear amplifier from 1.5 to 30 MHz, in single sideband mobile, marine and base station equipment.

- Low-Cost, Common-Emitter TO-220 Package
- Specified 12.5 Volt, 30 MHz Performance —
  Output Power = 40 W CW or PEP
  Power Gain = 15 dB Min
  Efficiency = 40% Min (PEP)
- Intermodulation Distortion @ 40 W (PEP) —
  IMD = −30 dB (Max)
- 30:1 VSWR Load Mismatch Capability at Rated Output Power and Supply Voltage





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

DIM	MILLIMETERS MIN	MAX	INCHES MIN	MAX
A	15.11	15.75	0.595	0.620
B	9.65	10.29	0.380	0.405
C	4.06	4.82	0.160	0.190
D	0.64	0.89	0.025	0.035
F	3.61	3.73	0.142	0.147
G	2.41	2.67	0.095	0.105
H	2.79	3.30	0.110	0.130
J	0.36	0.56	0.014	0.022
K	12.70	14.27	0.500	0.562
L	1.14	1.27	0.045	0.050
N	4.83	5.33	0.190	0.210
Q	2.54	3.04	0.100	0.120
R	2.04	2.79	0.080	0.110
S	1.14	1.39	0.045	0.055
T	5.97	6.48	0.235	0.255
U	0.76	1.27	0.030	0.050
V	1.14	-	0.045	-

CASE 221A-02
TO-220AB

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	5.0	Adc
Withstand Current (t = 5.0 s)	—	8.0	Adc
Total Device Dissipation @ $T_C = 25^oC$ (1) Derate above 25^oC	P_D	87.5 0.5	Watts $W/^oC$
Storage Temperature Range	T_{stg}	−65 to +150	^oC

THERMAL CHARACTERISTICS

Characteristics	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	2.0	$^oC/W$

(1) These devices are designed for RF operation. The total device dissipation rating applies only when the devices are operated as RF amplifiers.

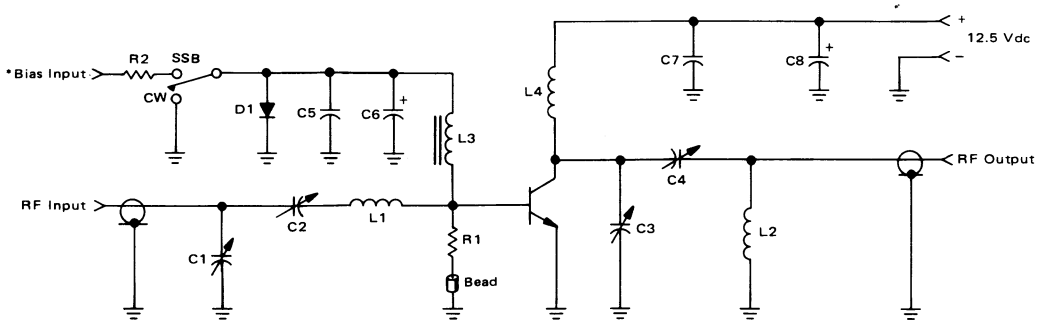
ELECTRICAL CHARACTERISTICS (T_C = 25°C unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage (I_C = 100 mAdc, I_B = 0)	$V_{(BR)CEO}$	18	–	–	Vdc
Collector-Base Breakdown Voltage (I_C = 100 mAdc, I_E = 0)	$V_{(BR)CBO}$	36	–	–	Vdc
Emitter-Base Breakdown Voltage (I_E = 5.0 mAdc, I_C = 0)	$V_{(BR)EBO}$	4.0	–	–	Vdc
Collector Cutoff Current (V_{CE} = 12.5 Vdc, V_{BE} = 0, T_C = 25°C)	I_{CES}	–	–	10	mAdc
ON CHARACTERISTICS					
DC Current Gain (I_C = 2.0 Adc, V_{CE} = 5.0 Vdc)	h_{FE}	20	70	–	–
DYNAMIC CHARACTERISTICS					
Output Capacitance (V_{CB} = 12.5 Vdc, I_E = 0, f = 1.0 MHz)	C_{ob}	–	175	250	pF
FUNCTIONAL TESTS					
Common-Emitter Amplifier Power Gain (V_{CC} = 12.5 Vdc, P_{out} = 40 W (PEP), f1 = 30 MHz, f2 = 30.001 MHz, I_{CQ} = 40 mAdc)	G_{PE}	15	17	–	dB
Collector Efficiency (V_{CC} = 12.5 Vdc, P_{out} = 40 W (PEP), f1 = 30 MHz, f2 = 30.001 MHz, I_{CQ} = 40 mAdc)	η	40	45	–	%
Intermodulation Distortion (1) (V_{CC} = 12.5 Vdc, P_{out} = 40 W (PEP), f1 = 30 MHz, f2 = 30.001 MHz, I_{CQ} = 40 mAdc)	IMD (d_3)	–	-35	-30	dB

(1) To MIL-STD-1311 Version A, Test Method 2204B, Two Tone, Reference Each Tone.

3

FIGURE 1 – 30 MHz TEST CIRCUIT



C1, C2, C4 – Arco 469, 190-780 pF
C3 – Arco 429, 90-400 pF
C5, C7 – 0.001 μF Disk Ceramics
C6 – 500 μF 3.0 Vdc Electrolytic
C8 – 100 μF 16 Vdc Electrolytic

R1 – 10 Ω 1.0 Watt Resistor
R2 – 5 Ω 5.0 Watt Resistor

L1 – 4 Turns #16 AWG 1/3" ID, 1/3" Long
L2 – 3 Turns #16 AWG 1/3" ID, 1/2" Long
L3 – 10 μH Molded Choke
L4 – 12 Turns #18 AWG 1/4" ID

Bead – Ferroxcube #56-590-65/3B

D1 – 1N4719

*Adjust Bias (Base) Voltage for I_{CQ} = 40 mA with no RF applied.

FIGURE 2 – OUTPUT POWER versus INPUT POWER

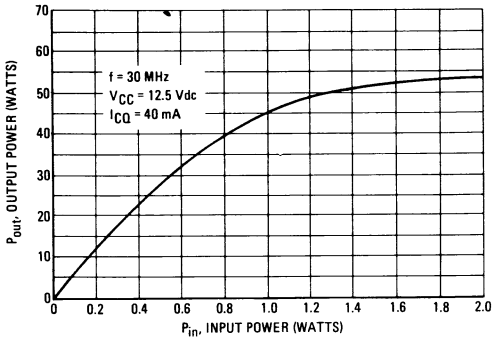


FIGURE 3 – OUTPUT POWER versus SUPPLY VOLTAGE

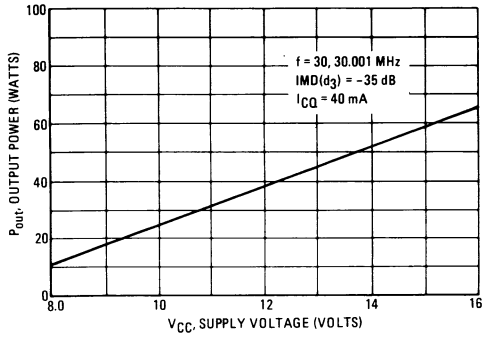


FIGURE 4 – POWER GAIN versus FREQUENCY

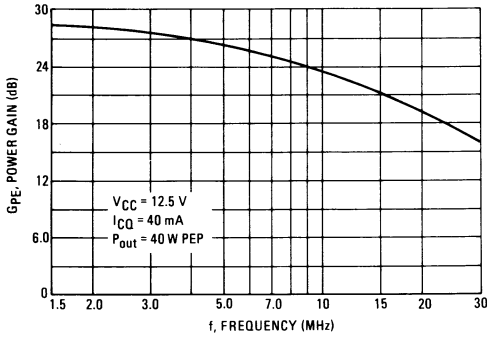


FIGURE 5 – INTERMODULATION DISTORTION versus OUTPUT POWER

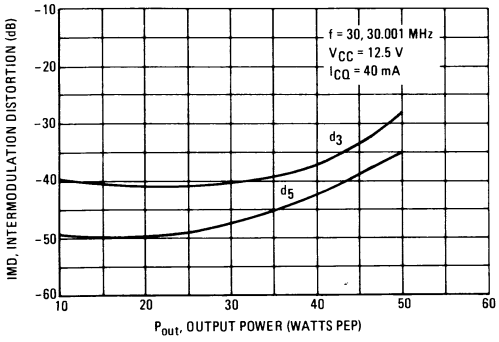


FIGURE 6 – SAFE OPERATING AREA

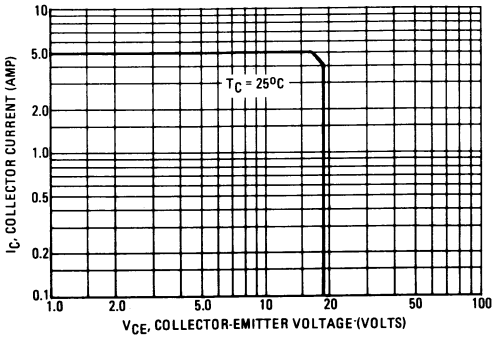
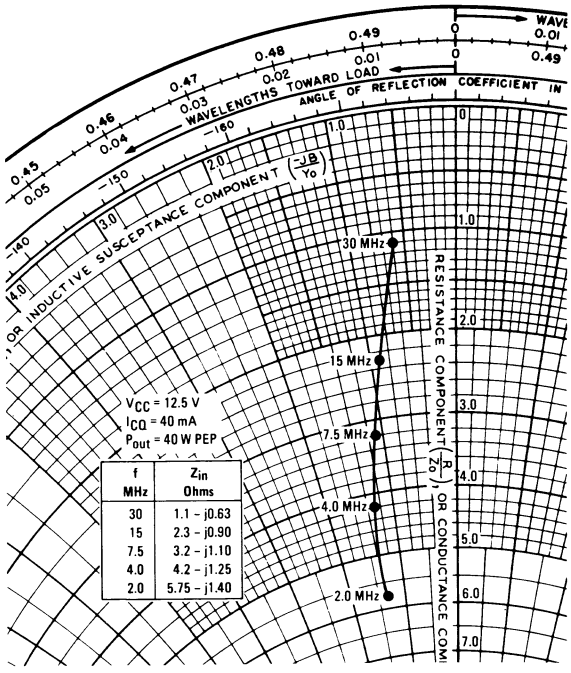


FIGURE 7 – SERIES EQUIVALENT INPUT IMPEDANCE



f MHz	Zin Ohms
30	1.1 – j0.63
15	2.3 – j0.90
7.5	3.2 – j1.10
4.0	4.2 – j1.25
2.0	5.75 – j1.40

3

FIGURE 8 – OUTPUT CAPACITANCE versus FREQUENCY

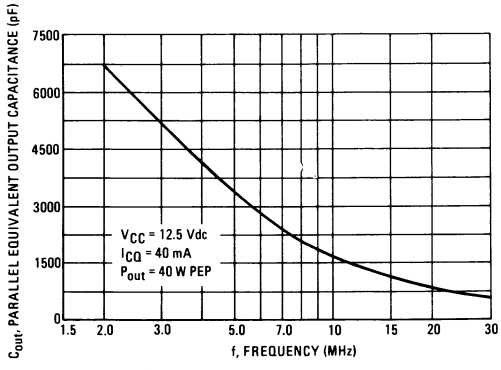
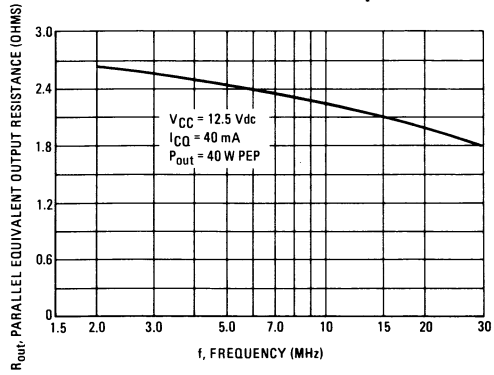


FIGURE 9 – OUTPUT RESISTANCE versus FREQUENCY



MRF479

The RF Line

15 W (PEP), 15 W (CW)—30 MHz

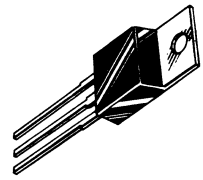
RF POWER TRANSISTOR

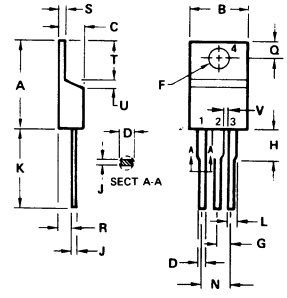
NPN SILICON

NPN SILICON RF POWER TRANSISTOR

. . . designed primarily for use in single sideband linear amplifier output applications and other communications equipment operating to 50 MHz.

- Low-Cost, Common-Emitter TO-220 Package
- Specified 12.5 V, 30 MHz Performance —
  Output Power = 15 W (PEP) or (CW)
  Power Gain = 12 dB Min
  Efficiency = 40% Min
- Intermodulation Distortion @ 15 W (PEP) —
  IMD = -30 dB (Max)
- 30:1 VSWR Load Mismatch Capability at Rated Output Power and Supply Voltage
- Characterized from 2.0 to 50 MHz





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

NOTE:
1. DIM. L & H APPLIES TO ALL LEADS.

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	2.0	Adc
Total Device Dissipation @ T_C = 25°C (1) Derate above 25°C	P_D	30 0.17	Watts mW/°C
Storage Temperature Range	T_{stg}	-65 to +150	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case (2)	$R_{\theta JC}$	5.85	°C/W

(1) These devices are designed for RF operation. The total device dissipation rating applies only when the devices are operated as RF amplifiers.

(2) Thermal Resistance is determined under specified RF operating conditions by infrared measurement techniques.

DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	15.11	15.75	0.595	0.620
B	9.65	10.29	0.380	0.405
C	4.06	4.82	0.160	0.190
D	0.64	0.89	0.025	0.035
F	3.61	3.73	0.142	0.147
G	2.41	2.67	0.095	0.105
H	2.79	3.30	0.110	0.130
J	0.36	0.56	0.014	0.022
K	12.70	14.27	0.500	0.562
L	1.14	1.27	0.045	0.050
N	4.83	5.33	0.190	0.210
Q	2.54	3.04	0.100	0.120
R	2.04	2.79	0.080	0.110
S	1.14	1.39	0.045	0.055
T	5.97	6.48	0.235	0.255
U	0.76	1.27	0.030	0.050
V	1.14	-	0.045	-

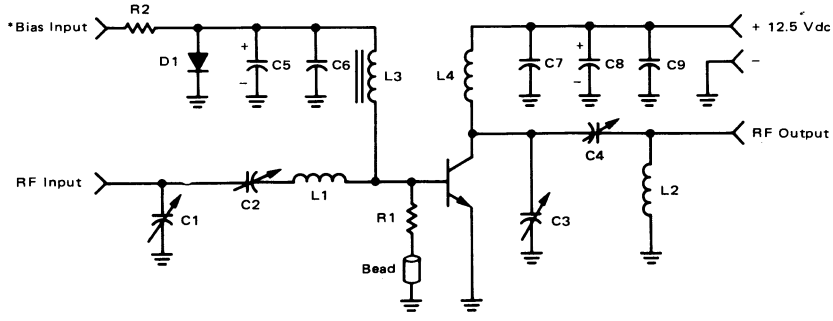
CASE 221A-02

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 = 20 mAdc, V_{BE} = 0)	$V_{(BR)CBO}$	36	—	—	Vdc
Emitter-Base Breakdown Voltage (I_E = 5.0 mAdc, I_C = 0)	$V_{(BR)EBO}$	4.0	—	—	Vdc
Collector Cutoff Current (V_{CB} = 15 Vdc, I_E = 0)	I_{CES}	—	—	5.0	mAdc
ON CHARACTERISTICS					
DC Current Gain (I_C = 500 mAdc, V_{CE} = 5.0 Vdc)	h_{FE}	30	60	—	—
DYNAMIC CHARACTERISTICS					
Output Capacitance (V_{CB} = 12.5 Vdc, I_E = 0, f = 1.0 MHz)	C_{ob}	—	125	155	pF
FUNCTIONAL TESTS (SSB)					
Common-Emitter Amplifier Power Gain (V_{CC} = 12.5 Vdc, P_{out} = 15 W (PEP), f_1 = 30 MHz, f_2 = 30.001 MHz, I_{CQ} = 20 mA)	G_{PE}	12	14	—	dB
Collector Efficiency (V_{CC} = 12.5 Vdc, P_{out} = 15 W (PEP), f_1 = 30 MHz, f_2 = 30.001 MHz, I_{CQ} = 20 mA)	η	40	—	—	%
Intermodulation Distortion (1) (PEP) (V_{CC} = 12.5 Vdc, P_{out} = 15 W (PEP), f_1 = 30 MHz, f_2 = 30.001 MHz, I_{CQ} = 20 mA)	d_3	—	—	-30	dB

(1) To MIL-STD-1311 Version A, Test Method 2204B, Two Tone, Reference Each Tone.

FIGURE 1 — 30-MHz COMMON EMITTER TEST CIRCUIT



C1, C2, C4 — 469 Arco 170–780 pF
C3 — 426 Arco 37–250 pF
C5 — 500 μF, 3.0 V
C6, C7 — 0.1 μF Erie Redcap
C8 — 0.01 μF Erie Redcap
C9 — 100 μF, 16 V

L1 — 4 Turns #18 AWG 0.3" ID X 0.25"
L2 — 5 Turns #16 AWG 0.35" ID X 0.9"

L3 — 10 μH Molded Choke
L4 — 12 Turns #18 AWG 0.25" ID X 0.75"

R1 — 10 Ω, 1.0 W
R2 — 5.0 Ω, 5.0 W

Bead — Ferroxcube Bead #56-590-65/3B

D1 — 1N4997

*Adjust Bias (Base) Voltage for I_{CQ} = 20 mA with no RF applied.

FIGURE 2 – OUTPUT POWER versus INPUT POWER

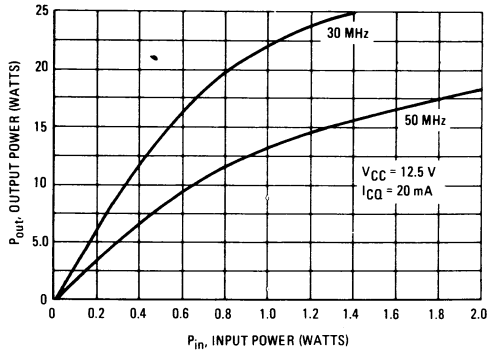


FIGURE 3 – POWER GAIN versus FREQUENCY

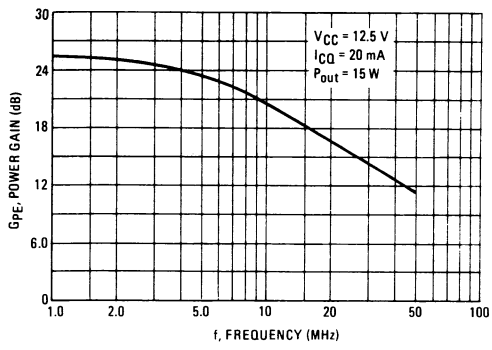


FIGURE 4 – OUTPUT POWER versus SUPPLY VOLTAGE

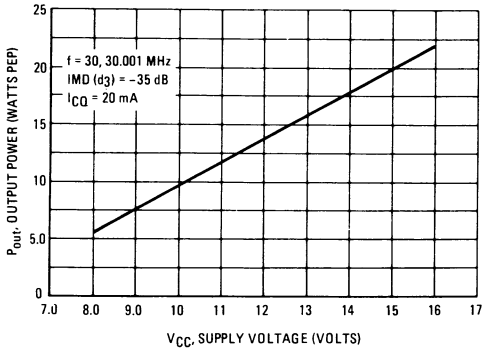


FIGURE 5 – INTERMODULATION DISTORTION versus OUTPUT POWER

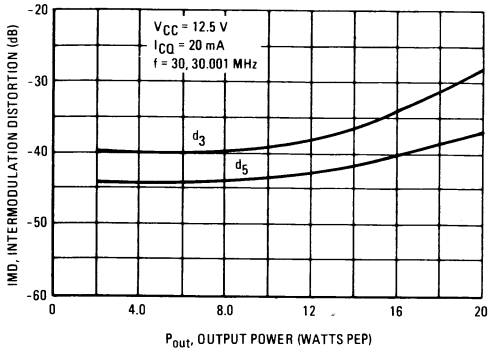


FIGURE 6 – OUTPUT CAPACITANCE versus FREQUENCY

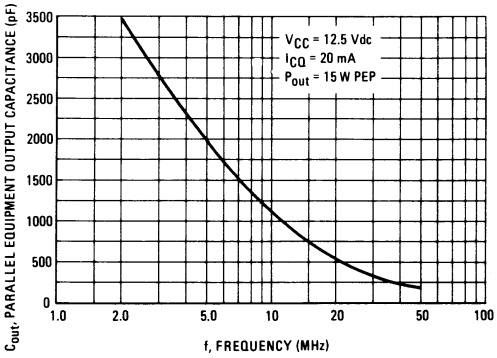


FIGURE 7 – OUTPUT RESISTANCE versus FREQUENCY

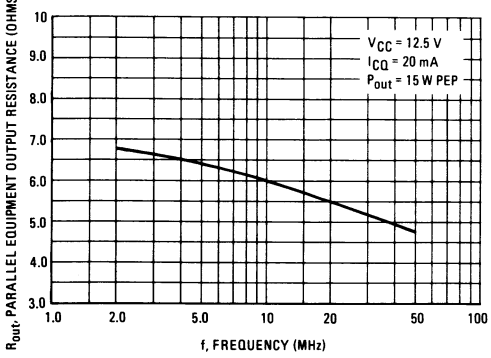
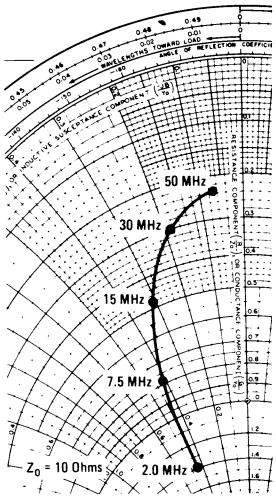


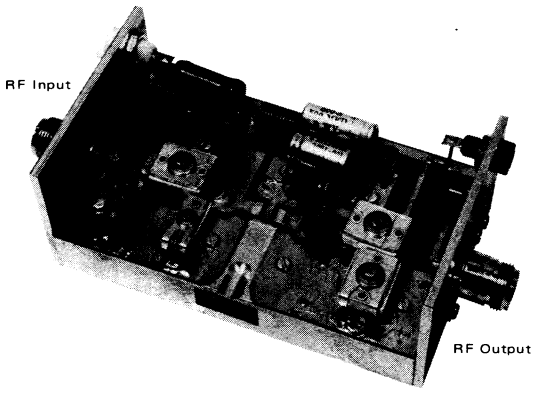
FIGURE 8 – SERIES EQUIVALENT INPUT IMPEDANCE



V_{CC} = 12.5 Vdc
I_{CQ} = 20 mA
P_{out} = 15 W PEP

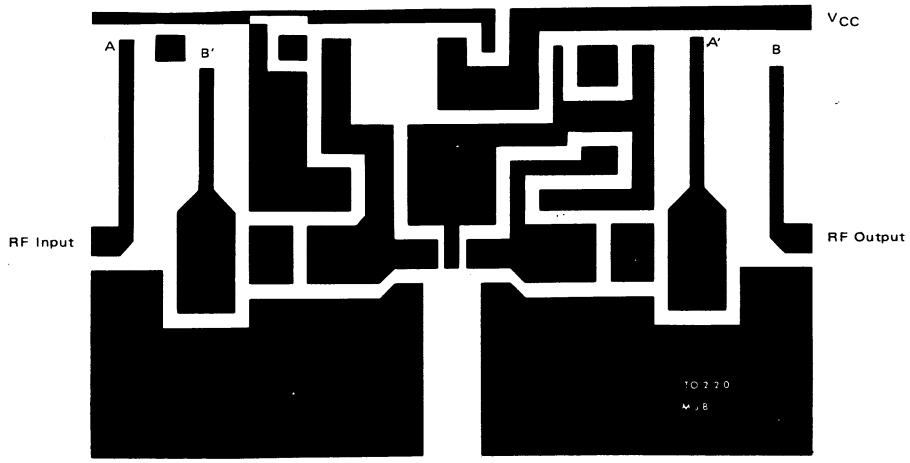
f MHz	Z_{in} Ohms
50	2.35 – j0.7
30	3.0 – j1.9
15	4.8 – j3.1
7.5	7.9 – j4.1
2.0	14 – j4.7

FIGURE 9 – 30 MHz TEST AMPLIFIER



3

FIGURE 10 – TEST AMPLIFIER PCB PHOTOMASTER



NOTE: Points A, A' and B, B' are connected via 50 Ω coaxial cable under the PCB.
The Printed Circuit Board shown is 75% of the original.

MRF485

The RF Line

15 W (PEP) – 15 W (CW) – 30 MHz

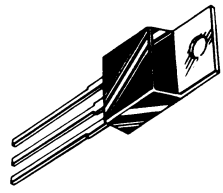
RF POWER
TRANSISTOR

NPN SILICON

NPN SILICON RF POWER TRANSISTOR

. . . designed primarily for use in single sideband linear amplifier output applications and other communications equipment operating to 30 MHz.

- Characterized for Single Sideband and Large-Signal Amplifier Applications Utilizing Low-Level Modulation
- Specified 28 V, 30 MHz Characteristics –
  Output Power = 15 W (PEP)
  Minimum Efficiency = 40% (SSB)
  Minimum Power Gain = 10 dB (PEP & CW)



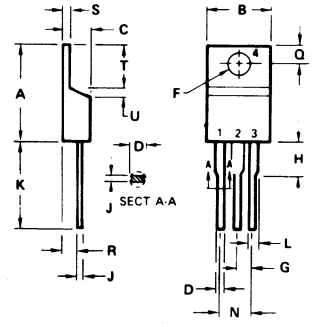
MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V_{CEO}	35	Vdc
Collector-Base Voltage	V_{CBO}	65	Vdc
Emitter-Base Voltage	V_{EBO}	4.0	Vdc
Collector Current – Continuous	I_C	1.0	Adc
Total Device Dissipation @ $T_C = 50^oC$ (1) Derate above 50^oC	P_D	30 0.3	Watts $W/^oC$
Storage Temperature Range	T_{stg}	–65 to +150	^oC

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	3.33	$^oC/W$

(1) These devices are designed for RF operation. The total device dissipation rating applies only when the devices are operated as RF amplifiers.



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

NOTE:
1. DIM. L & H APPLIES TO ALL LEADS.

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	15.11	15.75	0.595	0.620
B	9.78	10.03	0.385	0.395
C	4.06	4.82	0.160	0.190
D	0.64	0.89	0.025	0.035
F	3.61	3.73	0.142	0.147
G	2.41	2.67	0.095	0.105
H	2.79	3.30	0.110	0.130
J	0.36	0.56	0.014	0.022
K	12.70	14.27	0.500	0.562
L	1.14	1.27	0.045	0.050
N	4.83	5.33	0.190	0.210
Q	2.54	3.04	0.100	0.120
R	2.04	2.79	0.080	0.110
S	1.14	1.39	0.045	0.055
T	5.97	6.48	0.235	0.255
U	0.76	1.27	0.030	0.050

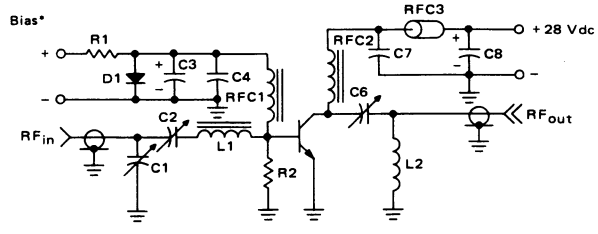
CASE 221A-02
TO-220AB

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)	$V_{(BR)CEO}$	35	–	–	Vdc
Collector-Emitter Breakdown Voltage (I_C = 50 mAdc, V_{BE} = 0)	$V_{(BR)CES}$	60	–	–	Vdc
Emitter-Base Breakdown Voltage (I_E = 5.0 mAdc, I_C = 0)	$V_{(BR)EBO}$	4.0	–	–	Vdc
Collector Cutoff Current (V_{CB} = 25 Vdc, I_E = 0)	I_{CBO}	–	–	1.0	mAdc
Collector-Cutoff Current (V_{CE} = 28 Vdc, V_{BE} = 0)	I_{CES}	–	–	5.0	mAdc
ON CHARACTERISTICS					
DC Current Gain (I_C = 500 mAdc, V_{CE} = 5.0 Vdc)	h_{FE}	10	30	–	–
DYNAMIC CHARACTERISTICS					
Output Capacitance (V_{CB} = 28 Vdc, I_E = 0, f = 1.0 MHz)	C_{ob}	–	85	100	pF
FUNCTIONAL TESTS (SSB)					
Common-Emitter Amplifier Power Gain (V_{CC} = 28 Vdc, P_{out} = 15 W (PEP, f1 = 30 MHz, f2 = 30.001 MHz, I_{CQ} = 20 mA)	G_{PE}	10	13	–	dB
Collector Efficiency (V_{CC} = 28 Vdc, P_{out} = 15 W (PEP), f1 = 30 MHz, f2 = 30.001 MHz, I_{CQ} = 20 mA)	η	40	–	–	%
Intermodulation Distortion (1) (V_{CC} = 28 Vdc, P_{out} = 15 W (PEP), f1 = 30 MHz, f2 = 30.001 MHz, I_{CQ} = 20 mA)	$IMD_{(d3)}$	–	–35	–30	dB
Load Mismatch (V_{CC} = 28 Vdc, P_{out} = 15 W (PEP), f1 = 30 MHz, f2 = 30.001 MHz, VSWR = 30:1 All Angles)	ψ	No Degradation in Output Power			

(1) To MIL-STD-1311 Version A, Test Method 2204B, Two Tone, Reference Each Tone.

FIGURE 1 – COMMON-EMITTER TEST CIRCUIT



*Adjust for I_{CQ} = 20 mA

C1, 2, 6 – ARCO 466 Trimmer Capacitors
C3 – 1000 μF, 3.0 Vdc Electrolytic
C4, 7 – 0.1 μF, Disc Ceramics
C8 – 100 μF, 15 Vdc Electrolytic

R1 – 10 Ω, 5.0 Watt Resistor
R2 – 10 Ω, 1.0 Watt Resistor

L1 – 2.2 μH Molded Choke
L2 – 7 Turns #18 AWG Wire, 3/8" I.D.

RFC1 – 10 μH Molded Choke
RFC2 – 0.84 μH Molded Choke
RFC3 – 2 Ferroxcube, #56-590-65/3B, Beads on #18 AWG Wire

D1 – 1N4997

FIGURE 2 – OUTPUT POWER versus INPUT POWER

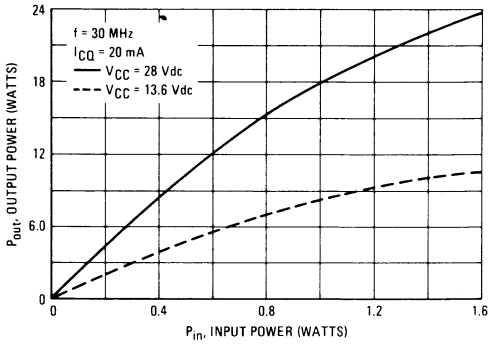


FIGURE 3 – INTERMODULATION DISTORTION versus OUTPUT POWER

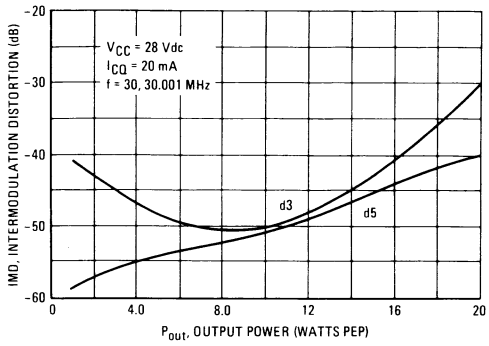


FIGURE 4 – OUTPUT POWER versus SUPPLY VOLTAGE

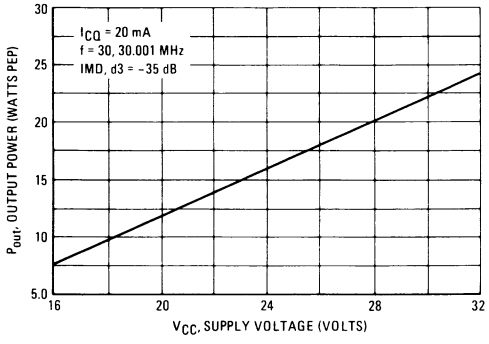


FIGURE 5 – OUTPUT CAPACITANCE versus FREQUENCY

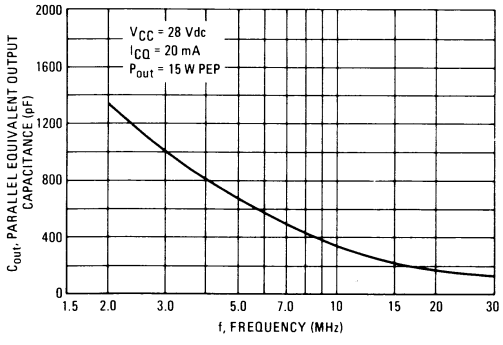


FIGURE 6 – OUTPUT RESISTANCE versus FREQUENCY

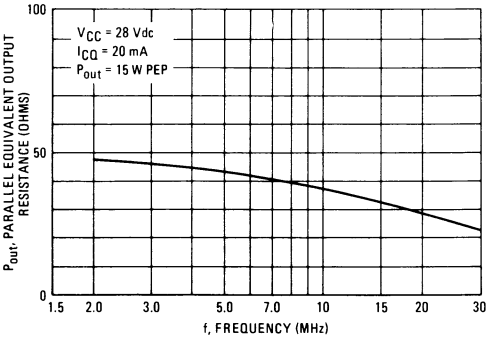


FIGURE 7 – POWER GAIN versus FREQUENCY

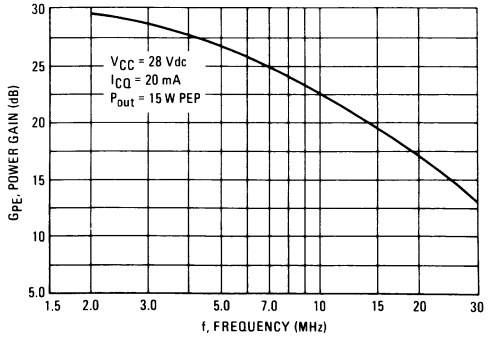
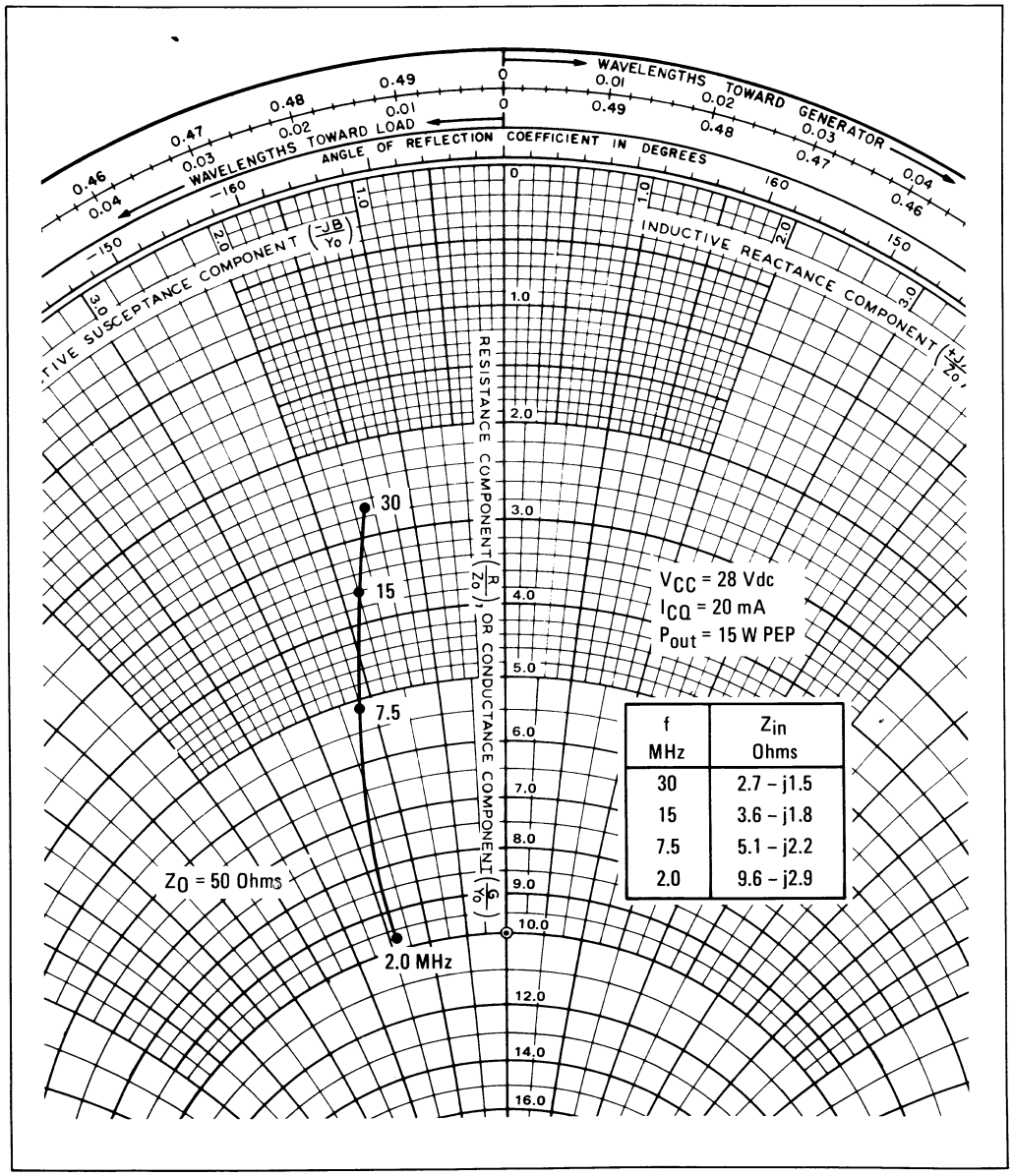


FIGURE 8 – SERIES EQUIVALENT INPUT IMPEDANCE



3

MRF486

The RF Line

40 W (PEP) – 30 MHz

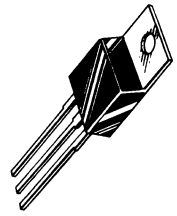
RF POWER TRANSISTOR

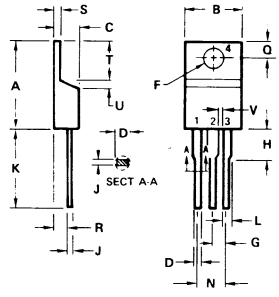
NPN SILICON

NPN SILICON RF POWER TRANSISTOR

. . . designed primarily for application as a high-power linear amplifier from 1.5 to 30 MHz, in single sideband mobile, marine and base station equipment.

- Low-Cost, Common-Emitter TO-220 Package
- Specified 28 Volt, 30 MHz Performance –
  Output Power = 40 W (PEP)
  Power Gain = 15 dB Min
  Efficiency = 40% Min
- Intermodulation Distortion @ 40 W (PEP) –
  IMD = –30 dB (Max)
- 30:1 VSWR Load Mismatch Capability at Rated Output Power and Supply Voltage





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

DIM	MILLIMETERS MIN	MAX	INCHES MIN	MAX
A	15.11	15.75	0.595	0.620
B	9.65	10.29	0.380	0.405
C	4.06	4.82	0.160	0.190
D	0.64	0.89	0.025	0.035
F	3.61	3.73	0.142	0.147
G	2.41	2.67	0.095	0.105
H	2.79	3.30	0.110	0.130
J	0.36	0.56	0.014	0.022
K	12.70	14.27	0.500	0.562
L	1.14	1.27	0.045	0.050
N	4.83	5.33	0.190	0.210
Q	2.54	3.04	0.100	0.120
R	2.04	2.79	0.080	0.110
S	1.14	1.39	0.045	0.055
T	5.97	6.48	0.235	0.255
U	0.76	1.27	0.030	0.050
V	1.14	–	0.045	–

CASE 221A-02
TO-220AB

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V_{CEO}	35	Vdc
Collector-Base Voltage	V_{CBO}	65	Vdc
Emitter-Base Voltage	V_{EBO}	4.0	Vdc
Collector Current – Continuous	I_C	3.0	Adc
Withstand Current (t = 5.0 s)	–	6.0	Adc
Total Device Dissipation @ $T_C = 25^oC$ (1) Derate above 25^oC	P_D	87.5 0.5	Watts $W/^oC$
Storage Temperature Range	T_{stg}	–65 to +150	^oC

THERMAL CHARACTERISTICS

Characteristics	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	2.0	$^oC/W$

(1) These devices are designed for RF operation. The total device dissipation rating applies only when the devices are operated as RF amplifiers.

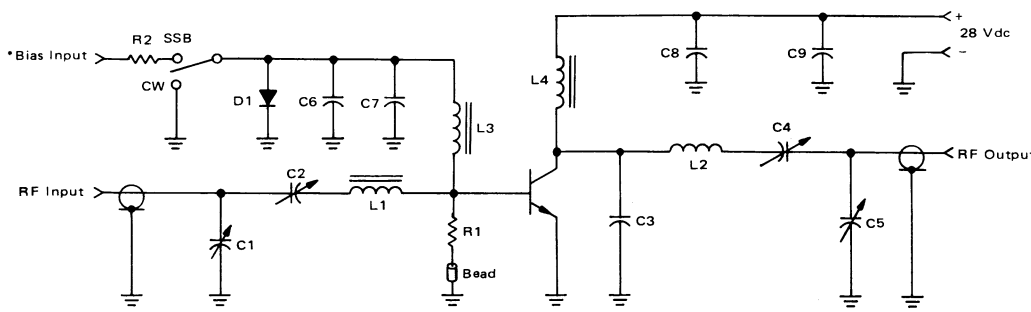
ELECTRICAL CHARACTERISTICS (T_C = 25°C unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage (I_C = 50 mAdc, I_B = 0)	$V_{(BR)CEO}$	35	–	–	Vdc
Collector-Emitter Breakdown Voltage (I_C = 50 mAdc, V_{BE} = 0)	$V_{(BR)CES}$	65	–	–	Vdc
Collector-Base Breakdown Voltage (I_C = 50 mAdc, I_E = 0)	$V_{(BR)CBO}$	65	–	–	Vdc
Emitter-Base Breakdown Voltage (I_E = 5.0 mAdc, I_C = 0)	$V_{(BR)EBO}$	4.0	–	–	Vdc
Collector Cutoff Current (V_{CE} = 28 Vdc, V_{BE} = 0, T_C = 25°C)	I_{CES}	–	–	10	mAdc
ON CHARACTERISTICS					
DC Current Gain (I_C = 2.0 Adc, V_{CE} = 5.0 Vdc)	h_{FE}	10	40	–	–
DYNAMIC CHARACTERISTICS					
Output Capacitance (V_{CB} = 27 Vdc, I_E = 0, f = 1.0 MHz)	C_{ob}	–	130	200	pF
FUNCTIONAL TESTS					
Common-Emitter Amplifier Power Gain (V_{CC} = 28 Vdc, P_{out} = 40 W (PEP), f1 = 30 MHz, f2 = 30.001 MHz, I_{CQ} = 40 mAdc)	G_{PE}	15	17.5	–	dB
Collector Efficiency (V_{CC} = 28 Vdc, P_{out} = 40 W (PEP), f1 = 30 MHz, f2 = 30.001 MHz, I_{CQ} = 40 mAdc)	η	40	45	–	%
Intermodulation Distortion (1) (V_{CC} = 28 Vdc, P_{out} = 40 W (PEP), f1 = 30 MHz, f2 = 30.001 MHz, I_{CQ} = 40 mAdc)	IMD(d_3)	–	-35	-30	dB

(1) To MIL-STD-1311 Version A, Test Method 2204B, Two Tone, Reference Each Tone.

3

FIGURE 1 – 30 MHz TEST CIRCUIT



C1, C2 – Arco 469, 190–780 pF
C3 – 150 pF ELMENCO**
C4, C5 – Arco 429, 90–400 pF
C6, C9 – 0.001 μF Disc Ceramics
C7 – 500 μF, 3 Vdc Electrolytic
C8 – 50 μF, 50 Vdc Electrolytic

R1 – 10 Ω, 1.0 Watt Resistor
R2 – 5 Ω, 5.0 Watt Resistor

L1 – 0.15 μH Molded Choke
L2 – 7 Turns, #16 AWG Enameled Close-Wound, 1/2" ID
L3 – 10 μH Molded Choke
L4 – 1.9 μH Molded Choke

One Bead – #56-590-65/3B (Ferroxcube or equiv.)

D1 – 1N4997

*Adjust Bias (Base) Voltage for I_{CQ} = 40 mA with no RF applied.
**Type MCM01/010 or UNELCO 3 HS 0006.

FIGURE 2 – OUTPUT POWER versus INPUT POWER

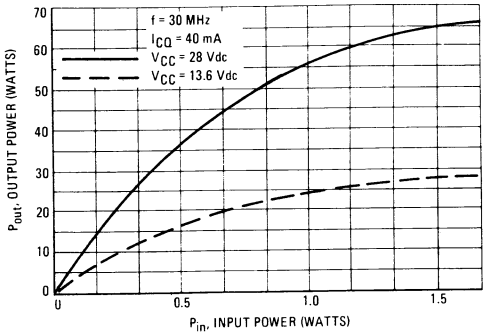


FIGURE 3 – OUTPUT POWER versus SUPPLY VOLTAGE

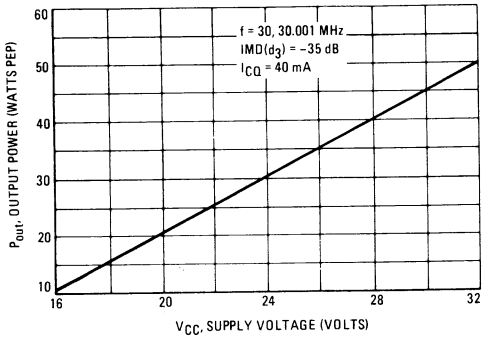


FIGURE 4 – POWER GAIN versus FREQUENCY

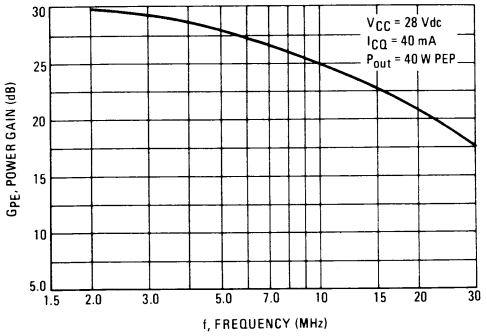


FIGURE 5 – INTERMODULATION DISTORTION versus OUTPUT POWER

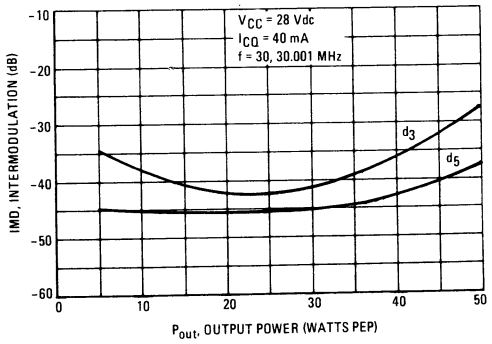


FIGURE 6 – SAFE OPERATING AREA

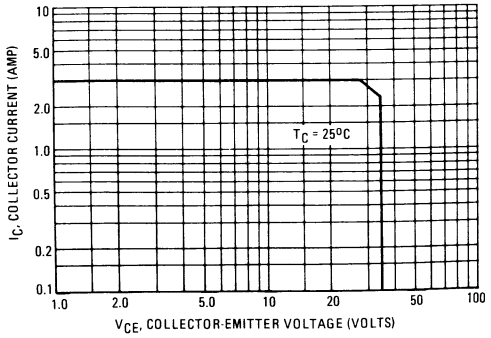
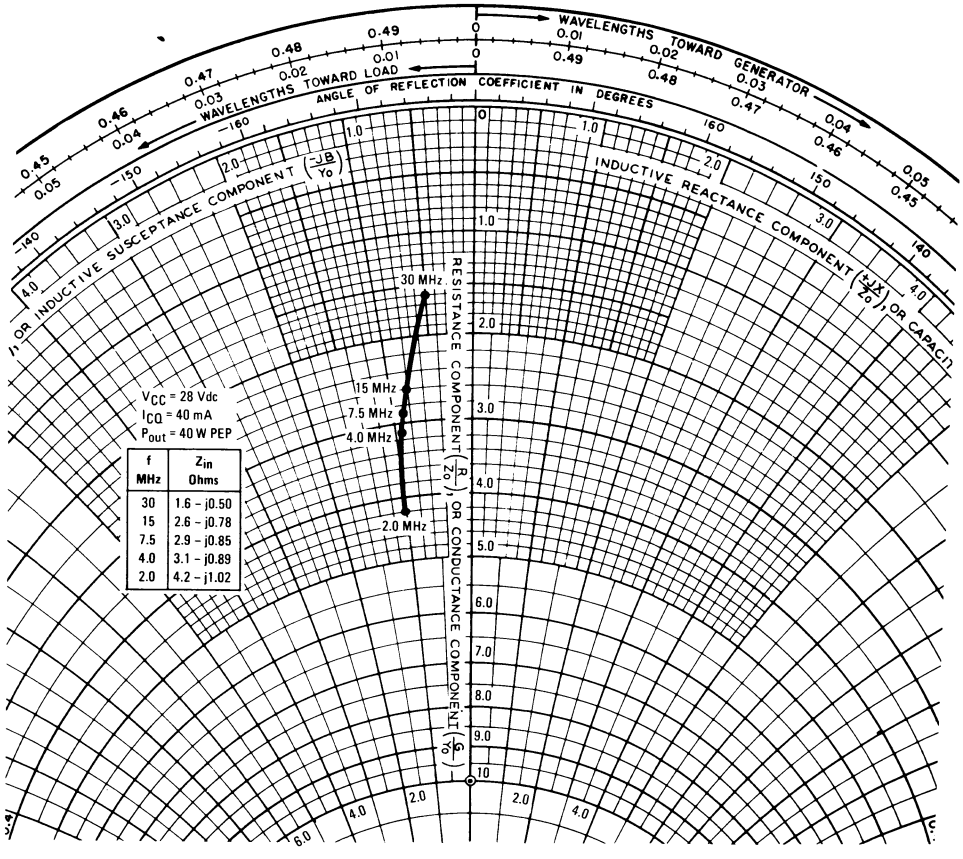


FIGURE 7 – SERIES EQUIVALENT INPUT IMPEDANCE



f MHz	Zin Ohms
30	1.6 – j0.50
15	2.6 – j0.78
7.5	2.9 – j0.85
4.0	3.1 – j0.89
2.0	4.2 – j1.02

FIGURE 8 – OUTPUT CAPACITANCE versus FREQUENCY

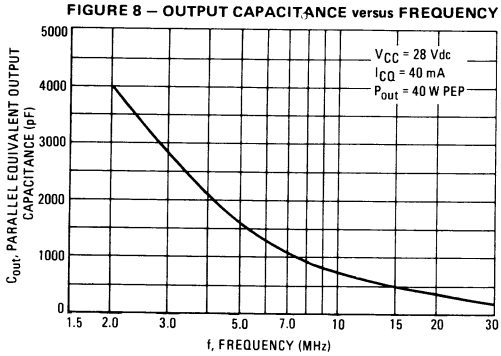
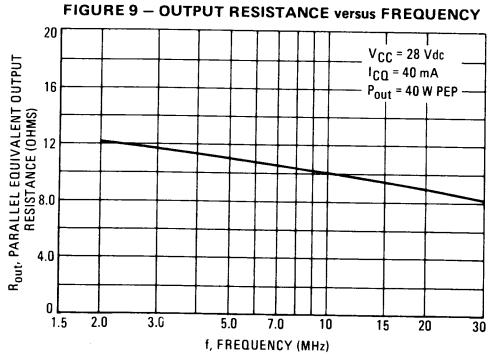


FIGURE 9 – OUTPUT RESISTANCE versus FREQUENCY



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