MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

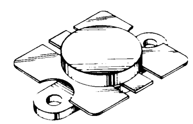
MRF309

The RF Line

50 W–450 MHz

CONTROLLED "Q" BROADBAND RF POWER TRANSISTOR

NPN SILICON



NPN SILICON RF POWER TRANSISTOR

. . . designed primarily for wideband large-signal output amplifier stages in the 420–450 MHz frequency range.

- Guaranteed Performance in 450 MHz Amplifier @ 28 Vdc
  Output Power = 50 Watts
  Minimum Gain = 7.0 dB @ 450 MHz
- Built-In Matching Network for Broadband Operation Using Double Match Technique
- 100% Tested for Load Mismatch at all Phase Angles with 20:1 VSWR
- Engineering Bulleting, EB67, describes the construction of a 100 W (PEP), 420 to 450 MHz linear amplifier using a pair of MRF309's

3

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V_{CEO}	33	Vdc
Collector-Base Voltage	V_{CBO}	60	Vdc
Emitter-Base Voltage	V_{EBO}	4.0	Vdc
Total Device Dissipation @ $T_C = 25^oC$ (1) Derate above 25^oC	P_D	146 0.83	Watts $W/^oC$
Storage Temperature Range	T_{stg}	-65 to +150	^oC

THERMAL CHARACTERISTICS

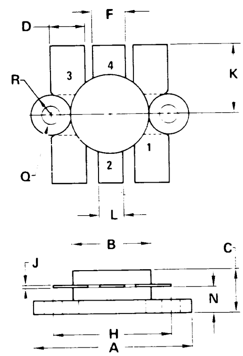
Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	1.2	$^oC/W$

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

MATCHING PROCEDURE

In the push-pull circuit configuration it is preferred that the transistors are used as matched pairs to obtain optimum performance.

The matching procedure used by Motorola consists of measuring h_{FE} at the data sheet conditions and color coding the device to predetermined h_{FE} ranges within the normal h_{FE} limits. A color dot is added to the marking on top of the cap. Any two devices with the same color dot can be paired together to form a matched set of units.



STYLE 1:
PIN 1. EMITTER
2. COLLECTOR
3. EMITTER
4. BASE
FLANGE-ISOLATED

DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	24.38	25.15	0.960	0.990
B	12.45	12.95	0.490	0.510
C	5.97	7.62	0.235	0.300
D	5.33	5.59	0.210	0.220
F	5.08	5.33	0.200	0.210
H	18.29	18.54	0.720	0.730
J	0.10	0.15	0.004	0.006
K	10.29	–	0.405	–
L	3.81	4.06	0.150	0.160
N	3.81	4.32	0.150	0.170
Q	2.92	3.30	0.115	0.130
R	3.05	3.30	0.120	0.130

CASE 316-01

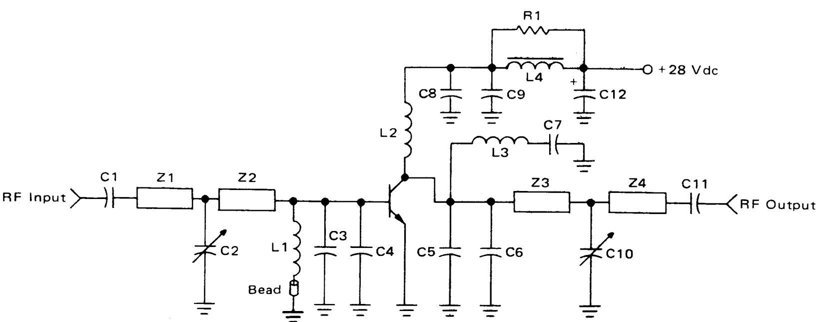
ELECTRICAL CHARACTERISTICS (T_C = 25°C unless otherwise noted)

Characteristics	Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage (I_C = 50 mAdc, I_B = 0)	$V_{(BR)CEO}$	33	–	–	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} = 30 Vdc, I_E = 0)	I_{CBO}	–	–	2.0	mAdc
ON CHARACTERISTICS					
DC Current Gain (I_C = 5.0 Adc, V_{CE} = 5.0 Vdc)	h_{FE}	10	–	100	–
FUNCTIONAL TESTS (Figure 1)					
Common-Emitter Amplifier Power Gain (V_{CC} = 28 Vdc, P_{out} = 50 W, f = 450 MHz)	G_{PE}	7.0	8.0	–	dB
Collector Efficiency (V_{CC} = 28 Vdc, P_{out} = 50 W, f = 450 MHz)	η	50	–	–	%
Electrical Ruggedness (P_{out} = 50 W, V_{CC} = 28 Vdc, f = 450 MHz, VSWR 20:1 all phase angles)	–	No Degradation in P_{out}			
Series Equivalent Input/Output Impedance (V_{CC} = 28 Vdc, P_{out} = 50 W, f = 450 MHz)	Z_{in} 0.7 + j1.6		Z_{OL}* 1.9 + j0.9		

NOTE: For linear operation, apply forward bias such that I_{CQ} (no RF signal) is 5.0–50 mA.

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

FIGURE 1 — 450 MHz TEST AMPLIFIER



C3, C4, C5 — Underwood 25 pF
C2, C10 — Johanson #JMC 5501 1–20 pF
C6 — Underwood 15 pF
C7, C8 — 0.1 µF Erie Red Cap, 100 V
C9 — Underwood 80 pF
C1, C11 — Underwood 40 pF
C12 — 1.0 µF Tantalum

Z1 — Microstrip 0.200″ W X 0.900″ L
Z2 — Microstrip 0.200″ W X 0.200″ L
Z3 — Microstrip 0.200″ W X 0.500″ L
Z4 — Microstrip 0.200″ W X 0.650″ L

L1, L3 — RFC, 0.15 µH Molded Coil
L2 — RFC, 4 Turns #20 Wire, 3/8″ ID, 1/2″ long
L4 — RFC, Ferroxcube VK200 19/4B

R1 — 5.6 Ω

Bead — Ferroxcube 56-590-65/4B

Board Material — 0.062″ Thick glass — Teflon, ϵ_r = 2.56

MRF313

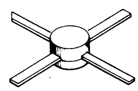
The RF Line

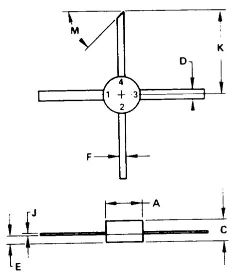
NPN SILICON HIGH FREQUENCY TRANSISTOR

. . . designed for wide band amplifier, driver or oscillator applications in military, mobile, and aircraft radio.

- Specified 28 Volt, 400 MHz Characteristics —
  Output Power = 1.0 Watt
  Minimum Gain = 15 dB
  Efficiency = 45%.
- Emitter Ballast and Low Current Density for Improved MTBF
- Common Emitter for Improved Stability

1.0 W — 400 MHz
HIGH FREQUENCY
TRANSISTOR
NPN SILICON





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

DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	5.03	5.59	0.200	0.220
C	2.41	3.30	0.095	0.130
D	1.40	1.65	0.055	0.065
E	1.02	1.27	0.040	0.050
F	0.64	0.89	0.025	0.035
J	0.08	0.18	0.003	0.007
K	11.05	–	0.435	–
M	45° NOM		45° NOM	

MRF313
CASE 305A-01

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector — Emitter Voltage	V_{CEO}	30	Vdc
Collector — Base Voltage	V_{CBO}	40	Vdc
Emitter — Base Voltage	V_{EBO}	3.0	Vdc
Collector Current — Continuous	I_C	150	mAdc
Total Device Dissipation @ $T_C = 25°C$ Derate above 25°C	P_D	2.5 35	Watts mW/°C
Storage Temperature Range	T_{stg}	−65 to +150	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	28.5	°C/W

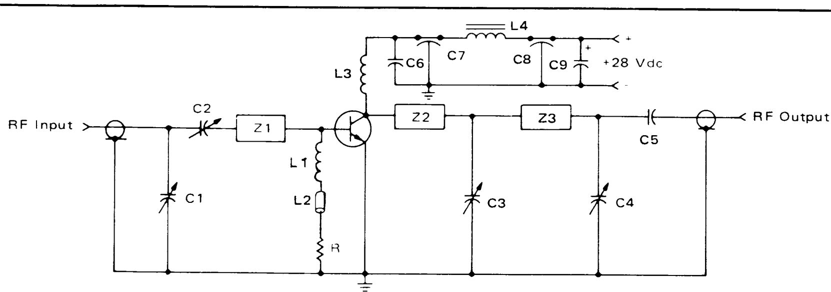
3

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

Characteristic	Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage (I_C = 10 mAdc, I_B = 0)	$V_{(BR)CEO}$	30	–	–	Vdc
Collector-Emitter Breakdown Voltage (I_C = 5.0 mAdc, V_{BE} = 0)	$V_{(BR)CES}$	35	–	–	Vdc
Collector-Base Breakdown Voltage (I_C = 0.1 mAdc, I_E = 0)	$V_{(BR)CBO}$	35	–	–	Vdc
Emitter-Base Breakdown Voltage (I_E = 1.0 mAdc, I_C = 0)	$V_{(BR)EBO}$	3.0	–	–	Vdc
Collector Cutoff Current (V_{CE} = 20 Vdc, I_B = 0)	I_{CEO}	–	–	1.0	mAdc
ON CHARACTERISTICS					
DC Current Gain (I_C = 100 mAdc, V_{CE} = 10 Vdc)	h_{FE}	20	60	150	–
DYNAMIC CHARACTERISTICS					
Current-Gain – Bandwidth Product (I_C = 100 mAdc, V_{CE} = 20 Vdc, f = 200 MHz)	f_T	–	2.5	–	GHz
Output Capacitance (V_{CB} = 28 Vdc, I_E = 0, f = 1.0 MHz)	C_{ob}	–	3.5	5.0	pF
FUNCTIONAL TEST					
Common-Emitter Amplifier Power Gain(1) (V_{CC} = 28 Vdc, P_{out} = 1.0 W, f = 400 MHz)	G_{pe}	15	16	–	dB
Collector Efficiency (V_{CC} = 28 Vdc, P_{out} = 1.0 W, f = 400 MHz)	η	–	45	–	%
Series Equivalent Input Impedance (V_{CC} = 28 Vdc, P_{out} = 1.0 W, f = 400 MHz)	Z_{in}	–	6.4-j4.8	–	Ohms
Series Equivalent Output Impedance (V_{CC} = 28 Vdc, P_{out} = 1.0 W, f = 400 MHz)	Z_{out}	–	75-j45	–	Ohms

(1) Class C

FIGURE 1 — 400 MHz POWER GAIN TEST CIRCUIT



C1,C2,C4 1.0-20 pF JOHANSON 9063
C3 1.0-10 pF JOHANSON
C5 150 pF Chip
C6 0.1 μF
C7,C8 680 pF Feedthru
C9 1.0 μF TANTALUM

L1,L3 5 Turns, AWG #20, ¼" I.D.
L2 Ferrite Bead, FERROXCUBE No. 56-590-65/4B
L4 FERROXCUBE VK200-20/4B
Input/Output Connectors — Type N
Board – Glass Teflon, ε = 2.56, t = 0.062"

R 4.7 Ohms, ¼ W
Z1 2.0" x 0.1" MICROSTRIP LINE
Z2,Z3 2.6" x 0.1" MICROSTRIP LINE

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

MRF314
MRF314A

The RF Line

NPN SILICON RF POWER TRANSISTOR

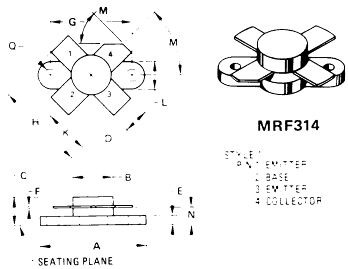
. . . designed primarily for wideband large-signal driver and output amplifier stages in the 30–200 MHz frequency range.

- Guaranteed Performance at 150 MHz, 28 Vdc
  Output Power = 30 Watts
  Minimum Gain = 10 dB
- 100% Tested for Load Mismatch at All Phase Angles with 30:1 VSWR
- Gold Metallization System for High Reliability Applications

30 W–30–200 MHz

RF POWER TRANSISTOR

NPN SILICON

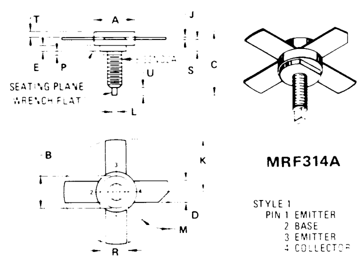


MRF314

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	[illegible]	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



MRF314A

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

CASE 145A-09

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	3.4	Adc
Total Device Dissipation @ $T_C = 25°C$ (1) Derate above 25°C	P_D	82 0.47	Watts W/°C
Storage Temperature Range	T_{stg}	-65 to +150	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	2.13	°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.

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

Characteristics	Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage (I_C = 30 mAdc, I_B = 0)	$V_{(BR)CEO}$	35	–	–	Vdc
Collector-Emitter Breakdown Voltage (I_C = 30 mAdc, V_{BE} = 0)	$V_{(BR)CES}$	65	–	–	Vdc
Collector-Base Breakdown Voltage (I_C = 30 mAdc, I_E = 0)	$V_{(BR)CBO}$	65	–	–	Vdc
Emitter-Base Breakdown Voltage (I_E = 3.0 mAdc, I_C = 0)	$V_{(BR)EBO}$	4.0	–	–	Vdc
Collector Cutoff Current (V_{CB} = 30 Vdc, I_E = 0)	I_{CBO}	–	–	3.0	mAdc
ON CHARACTERISTICS					
DC Current Gain (I_C = 1.5 Adc, V_{CE} = 5.0 Vdc)	h_{FE}	20	–	80	–
DYNAMIC CHARACTERISTICS					
Output Capacitance (V_{CB} = 30 Vdc, I_E = 0, f = 1.0 MHz)	C_{ob}	–	30	40	pF
FUNCTIONAL TESTS (Figure 1)					
Common-Emitter Amplifier Power Gain (V_{CC} = 28 Vdc, P_{out} = 30 W, f = 150 MHz)	G_{PE}	10	13.5	–	db
Collector Efficiency (V_{CC} = 28 Vdc, P_{out} = 30 W, f = 150 MHz)	η	50	–	–	%
Load Mismatch (V_{CC} = 28 Vdc, P_{out} = 30 W, f = 150 MHz, VSWR = 30:1 all phase angles	–	No Degration in Power Output			

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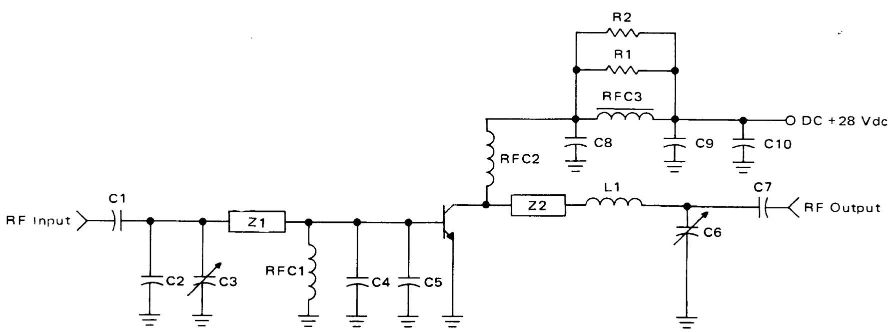
FIGURE 1 – 150 MHz TEST CIRCUIT



C1, C7 – 18 pF, 100 mil ATC
C2 – 68 pF, 100 mil ATC
C3, C6 – Johanson #JMC 5501
C4 – 270 pF, 100 mil ATC
C5 – 240 pF, 100 mil ATC
C8, C9 – 100 pF Underwood
C10 – 1.0 µF Tantalum
L1 – 2 Turns, 2.5" #20 Wire, ID = 0.275"

R1, R2 – 10 Ω, 1.0 W
RFC1 – 15 µH Molded Coil
RFC2 – 2 Turns, 2.5" #20 Wire, ID = 0.2"
RFC3 – Ferroxcube VK200–19/4B
Z1 – Microstrip 0.168" W x 1.6" L
Z2 – Microstrip 0.168" W x 1.2" L
Board – Glass Teflon $\epsilon_R \approx 2.55$

TYPICAL PERFORMANCE CURVES

FIGURE 2 – OUTPUT POWER versus INPUT POWER

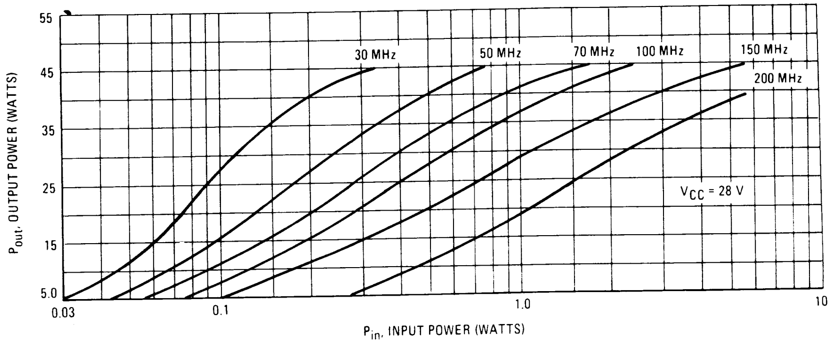


FIGURE 3 – OUTPUT POWER versus INPUT POWER

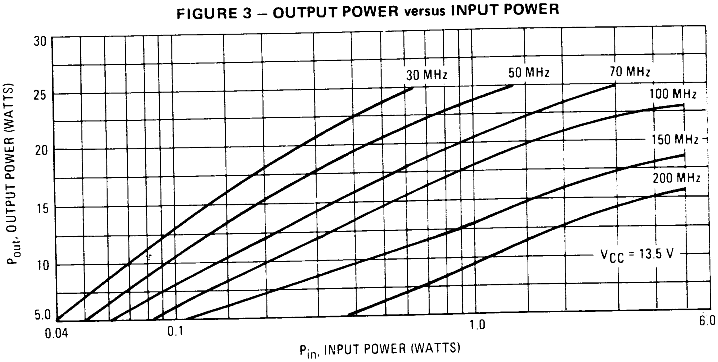


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FIGURE 4 – POWER GAIN versus FREQUENCY

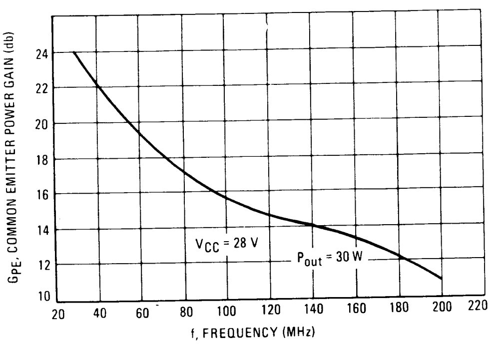


FIGURE 5 – EFFICIENCY (η%) versus FREQUENCY

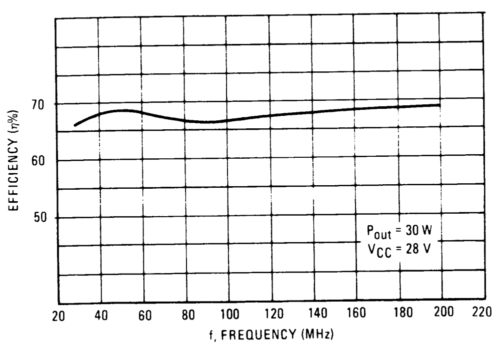
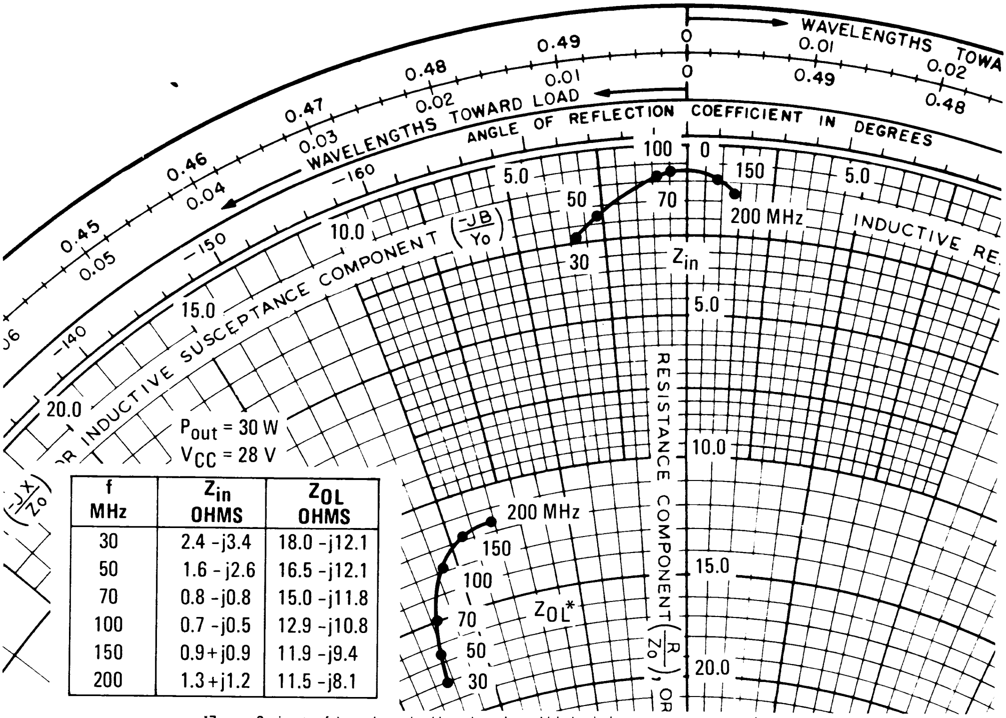


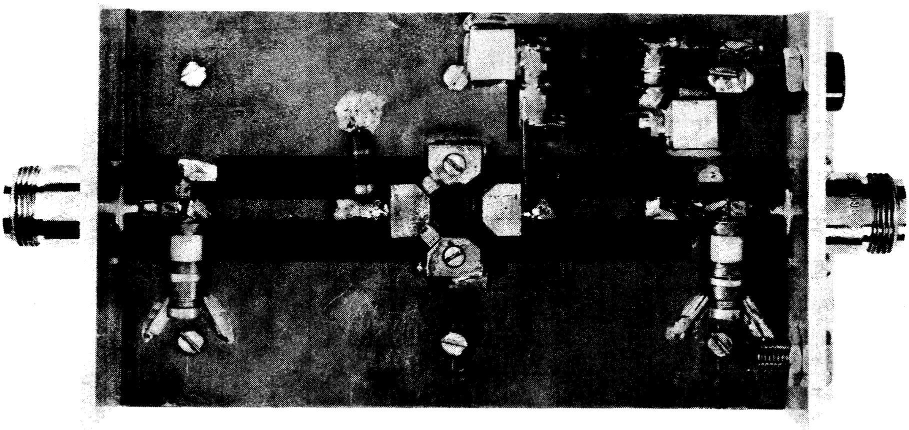
FIGURE 6 – SERIES EQUIVALENT INPUT/OUTPUT IMPEDANCE



f MHz	Z_{in} OHMS	Z_{OL} OHMS
30	2.4 -j3.4	18.0 -j12.1
50	1.6 - j2.6	16.5 -j12.1
70	0.8 -j0.8	15.0 -j11.8
100	0.7 -j0.5	12.9 -j10.8
150	0.9+j0.9	11.9 -j9.4
200	1.3+j1.2	11.5 -j8.1

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

FIGURE 7 – TEST FIXTURE



MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

MRF315
MRF315A

The RF Line

NPN SILICON RF POWER TRANSISTOR

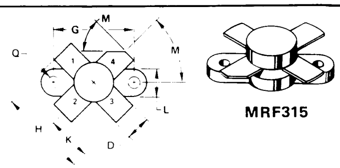
. . . designed primarily for wideband large-signal output amplifier stages in the 30–200 MHz frequency range.

- Guaranteed Performance at 150 MHz, 28 Vdc
  Output Power = 45 Watts
  Minimum Gain = 9.0 dB
- 100% Tested for Load Mismatch at All Phase Angles with 30:1 VSWR
- Gold Metallization System for High Reliability Applications

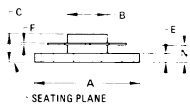
45 W – 30-200 MHz

RF POWER TRANSISTOR

NPN SILICON



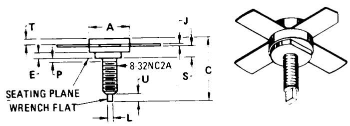
MRF315



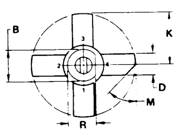
STYLE 1
PIN 1. EMITTER
2. BASE
3. EMITTER
4. COLLECTOR

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



MRF315A



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

CASE 145A-09

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	4.0	Adc
Total Device Dissipation @ $T_C = 25^\circ C$ (1) Derate above 25°C	P_D	110 0.63	Watts W/°C
Storage Temperature Range	T_{stg}	-65 to +150	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	1.59	°C/W

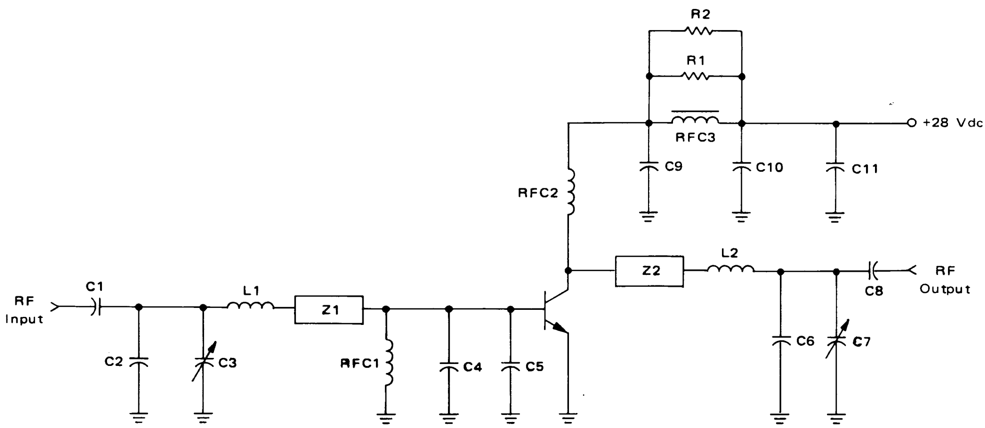
(1) These devices are designed for RF operation. The total device dissipation rating applies only when the devices are operated as RF amplifiers.

3

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

Characteristics	Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage (I_C = 40 mAdc, I_B = 0)	$V_{(BR)CEO}$	35	–	–	Vdc
Collector-Emitter Breakdown Voltage (I_C = 40 mAdc, V_{BE} = 0)	$V_{(BR)CES}$	65	–	–	Vdc
Collector-Base Breakdown Voltage (I_C = 40 mAdc, I_E = 0)	$V_{(BR)CBO}$	65	–	–	Vdc
Emitter-Base Breakdown Voltage (I_E = 4.0 mAdc, I_C = 0)	$V_{(BR)EBO}$	4.0	–	–	Vdc
Collector Cutoff Current (V_{CB} = 30 Vdc, I_E - 0)	I_{CBO}	–	–	4.0	mAdc
ON CHARACTERISTICS					
DC Current Gain (I_C = 2.0 Adc, V_{CE} = 5.0 Vdc)	h_{FE}	20	–	80	–
DYNAMIC CHARACTERISTICS					
Output Capacitance (V_{CB} = 30 Vdc, I_E = 0, f = 1.0 MHz)	C_{ob}	–	45	60	pF
FUNCTIONAL TESTS (Figure 1)					
Common-Emitter Amplifier Power Gain (V_{CC} = 28 Vdc, P_{out} = 45 W, f = 150 MHz)	G_{PE}	9.0	11	–	dB
Collector Efficiency (V_{CC} = 28 Vdc, P_{out} = 45 W, f = 150 MHz)	η	50	–	–	%
Load Mismatch (V_{CC} = 28 Vdc, P_{out} = 45 W, f = 150 MHz, VSWR = 30:1 all phase angles)	No Degradation in Power Output				

FIGURE 1 — 150 MHz TEST CIRCUIT



C1 — 30 pF, 100 mil ATC
C2 — 47 pF, 100 mil ATC
C3, C7 — Johanson #JMC 5501
C4, C5 — 200 pF, 100 mil ATC
C6 — 24 pF, 100 mil ATC
C8 — 27 pF, 100 mil ATC
C9, C10 — 100 pF Underwood
C11 — 1.0 μF Tantalum

L1 — 0.5″ #18 Wire
L2 — 2 Turns, 1.5″ #20 Wire, ID = 0.15″
Z1, Z2 — Microstrip 0.168″ W x 1.25″ L
RFC1 — 15 μH Molded Coil
RFC2 — 2 Turns, 2.5″ #18 Wire, ID = 0.2″
RFC3 — Ferroxcube VK200—19/4B
R1, R2 — 10 Ω, 1.0 W
Board — Glass Teflon $\epsilon_R \approx 2.55$

TYPICAL PERFORMANCE CURVES

FIGURE 2 – OUTPUT POWER versus INPUT POWER

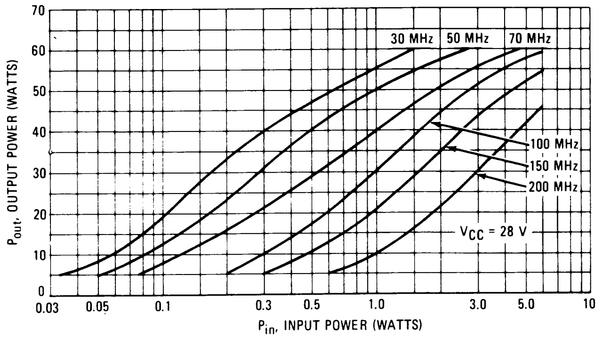


FIGURE 3 – OUTPUT POWER versus INPUT POWER

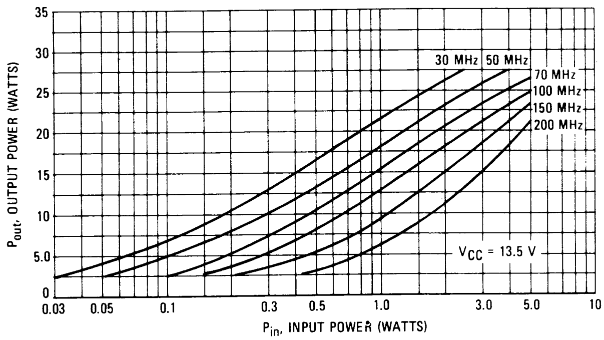


FIGURE 4 – POWER GAIN versus FREQUENCY

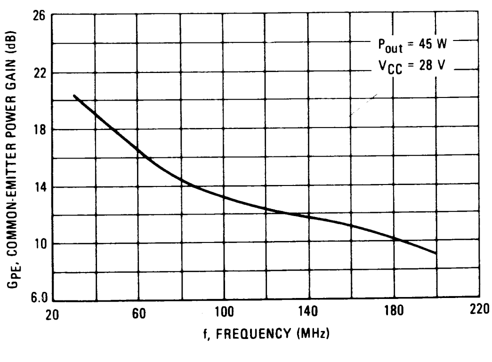
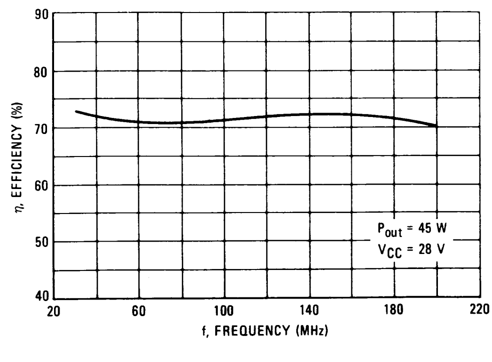
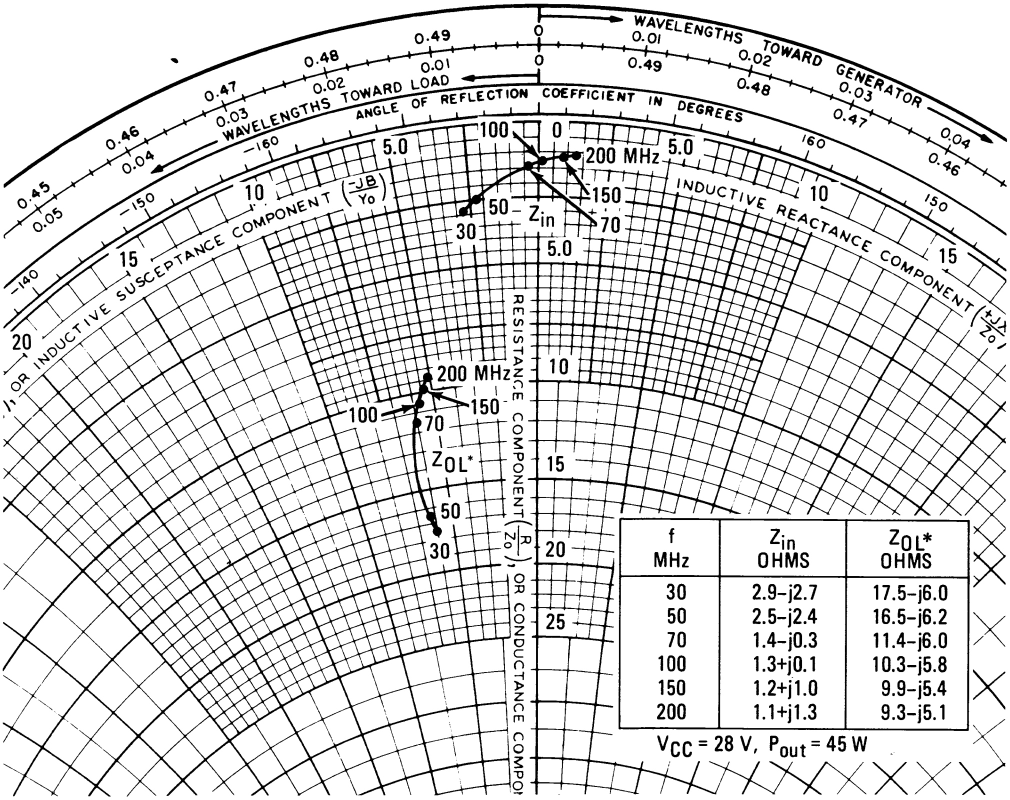


FIGURE 5 – EFFICIENCY versus FREQUENCY



3

FIGURE 6 – SERIES EQUIVALENT INPUT-OUTPUT IMPEDANCE

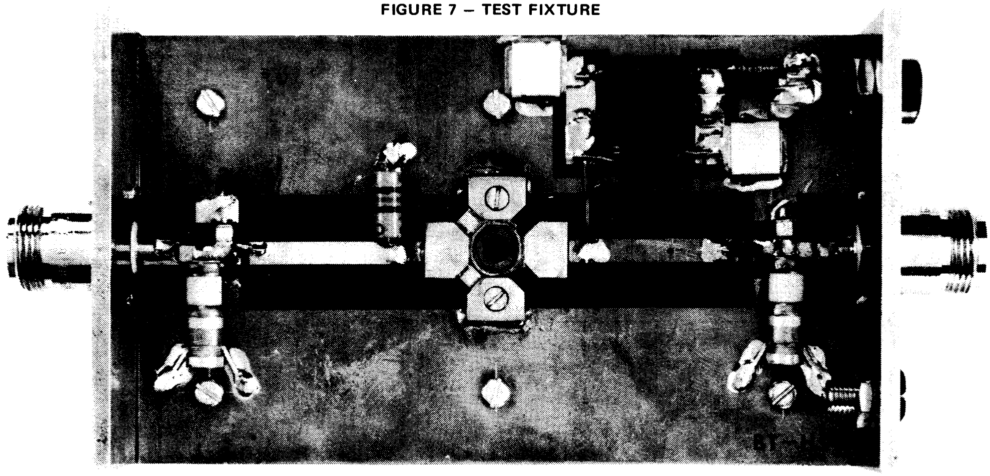


f MHz	Z_{in} OHMS	Z_{OL}* OHMS
30	2.9–j2.7	17.5–j6.0
50	2.5–j2.4	16.5–j6.2
70	1.4–j0.3	11.4–j6.0
100	1.3+j0.1	10.3–j5.8
150	1.2+j1.0	9.9–j5.4
200	1.1+j1.3	9.3–j5.1

V_{CC} = 28 V, P_{out} = 45 W

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

FIGURE 7 – TEST FIXTURE



3

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

MRF316

The RF Line

NPN SILICON RF POWER TRANSISTOR

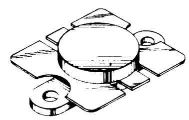
. . . designed primarily for wideband large-signal output amplifier stages in the 30–200 MHz frequency range.

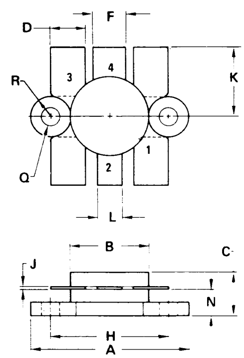
- Guaranteed Performance at 150 MHz, 28 Vdc
  Output Power = 80 Watts
  Minimum Gain = 10 dB
- Built-In Matching Network for Broadband Operation
- 100% Tested for Load Mismatch at all Phase Angles with 30:1 VSWR
- Gold Metallization System for High Reliability Applications

80 W – 30-200 MHz

CONTROLLED "Q" BROADBAND RF POWER TRANSISTOR

NPN SILICON





STYLE 1:
PIN 1. EMITTER
2. COLLECTOR
3. EMITTER
4. BASE
FLANGE-ISOLATED

DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	24.38	25.15	0.960	0.990
B	12.45	12.95	0.490	0.510
C	5.97	7.62	0.235	0.300
D	5.33	5.59	0.210	0.220
F	5.08	5.33	0.200	0.210
H	18.29	18.54	0.720	0.730
J	0.10	0.15	0.004	0.006
K	10.29	–	0.405	–
L	3.81	4.06	0.150	0.160
N	3.81	4.32	0.150	0.170
Q	2.92	3.30	0.115	0.130
R	3.05	3.30	0.120	0.130

CASE 316-01

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 Peak	I_C	9.0 13.5	Adc
Total Device Dissipation @ $T_C = 25^{\circ}C$ (1) Derate above $25^{\circ}C$	P_D	220 1.26	Watts $W/^{\circ}C$
Storage Temperature Range	T_{stg}	-65 to +150	$^{\circ}C$

THERMAL CHARACTERISTICS

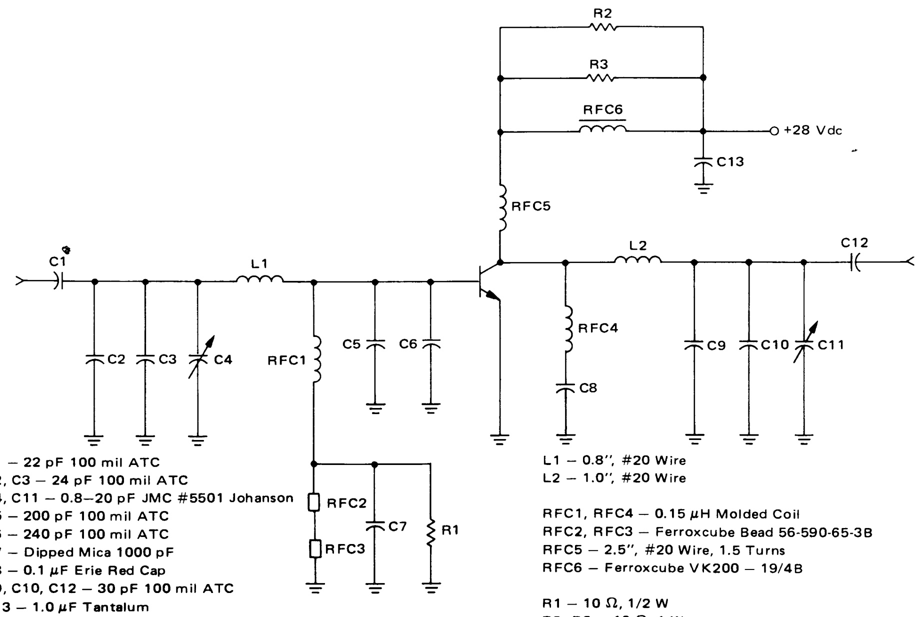
Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	0.8	$^{\circ}C/W$

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

ELECTRICAL CHARACTERISTICS ($T_C = 25^oC$ unless otherwise noted)

Characteristics	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_{CB} = 30 Vdc, I_E = 0)	I_{CBO}	–	–	5.0	mAdc
ON CHARACTERISTICS					
DC Current Gain (I_C = 4.0 Adc, V_{CE} = 5.0 Vdc)	h_{FE}	10	–	80	–
DYNAMIC CHARACTERISTICS					
Output Capacitance (V_{CB} = 28 Vdc, I_E = 0, f = 1.0 MHz)	C_{ob}	–	130	200	pF
NARROW BAND FUNCTIONAL TESTS (Figure 1)					
Common-Emitter Amplifier Power Gain (V_{CC} = 28 Vdc, P_{out} = 80 W, f = 150 MHz)	G_{PE}	10	13	–	dB
Collector Efficiency (V_{CC} = 28 Vdc, P_{out} = 80 W, f = 150 MHz)	η	55	–	–	%
Load Mismatch (V_{CC} = 28 Vdc, P_{out} = 80 W CW, f = 150 MHz, VSWR 30:1 all phase angles)	ψ	No Degradation in Power Output			

FIGURE 1 — 150 MHz TEST AMPLIFIER



C1 — 22 pF 100 mil ATC
C2, C3 — 24 pF 100 mil ATC
C4, C11 — 0.8–20 pF JMC #5501 Johanson
C5 — 200 pF 100 mil ATC
C6 — 240 pF 100 mil ATC
C7 — Dipped Mica 1000 pF
C8 — 0.1 µF Erie Red Cap
C9, C10, C12 — 30 pF 100 mil ATC
C13 — 1.0 µF Tantalum

L1 — 0.8″, #20 Wire
L2 — 1.0″, #20 Wire

RFC1, RFC4 — 0.15 µH Molded Coil
RFC2, RFC3 — Ferroxcube Bead 56-590-65-3B
RFC5 — 2.5″, #20 Wire, 1.5 Turns
RFC6 — Ferroxcube VK200 — 19/4B

R1 — 10 Ω, 1/2 W
R2, R3 — 10 Ω, 1 W

3

TYPICAL PERFORMANCE CURVES

FIGURE 2 — OUTPUT POWER versus INPUT POWER

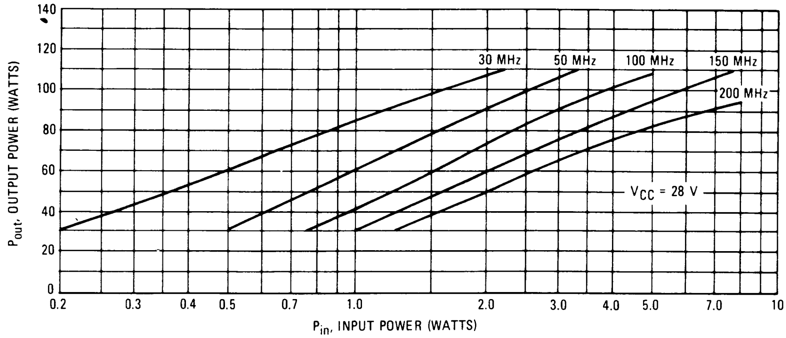


FIGURE 3 — POWER GAIN versus FREQUENCY

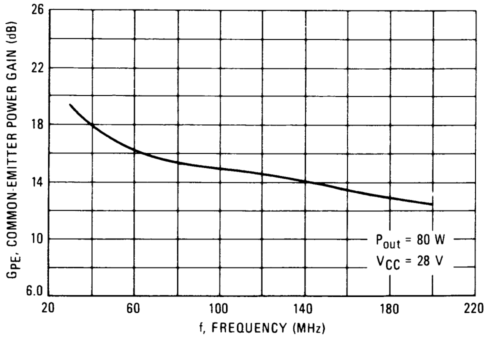


FIGURE 4 — OUTPUT POWER versus SUPPLY VOLTAGE
f = 100 MHz

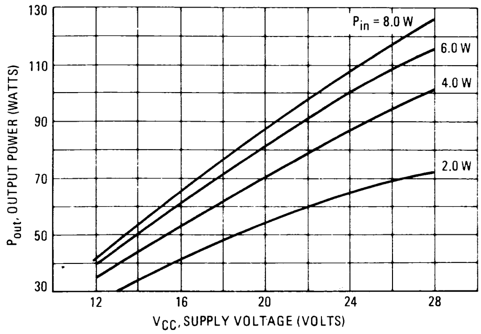


FIGURE 5 — OUTPUT POWER versus SUPPLY VOLTAGE
f = 150 MHz

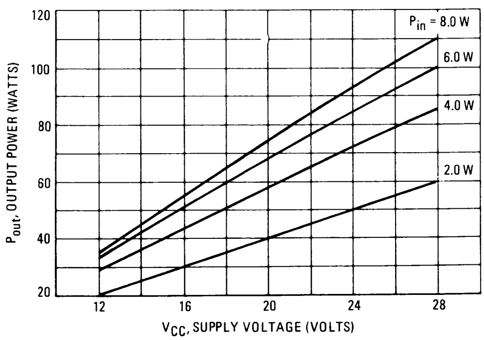


FIGURE 6 — OUTPUT POWER versus SUPPLY VOLTAGE
f = 200 MHz

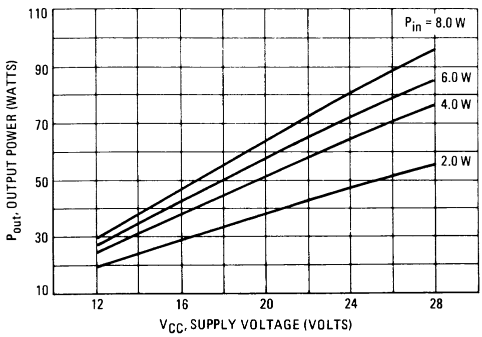
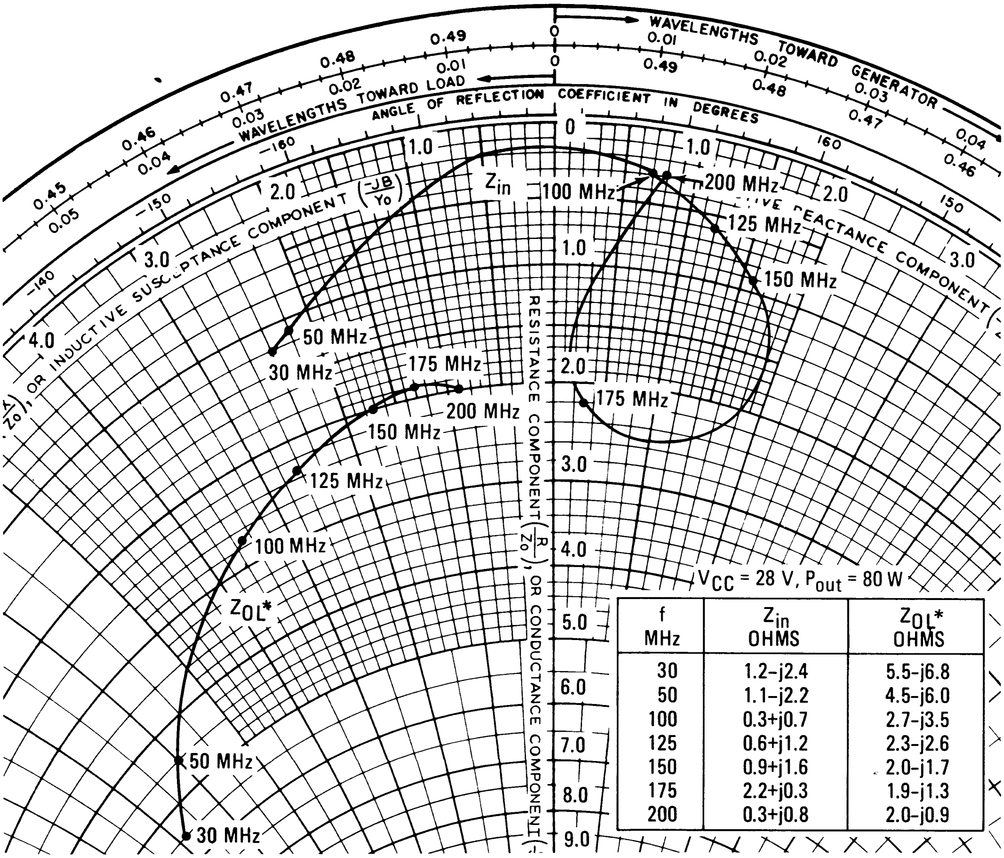


FIGURE 7 — SERIES EQUIVALENT INPUT-OUTPUT IMPEDANCE

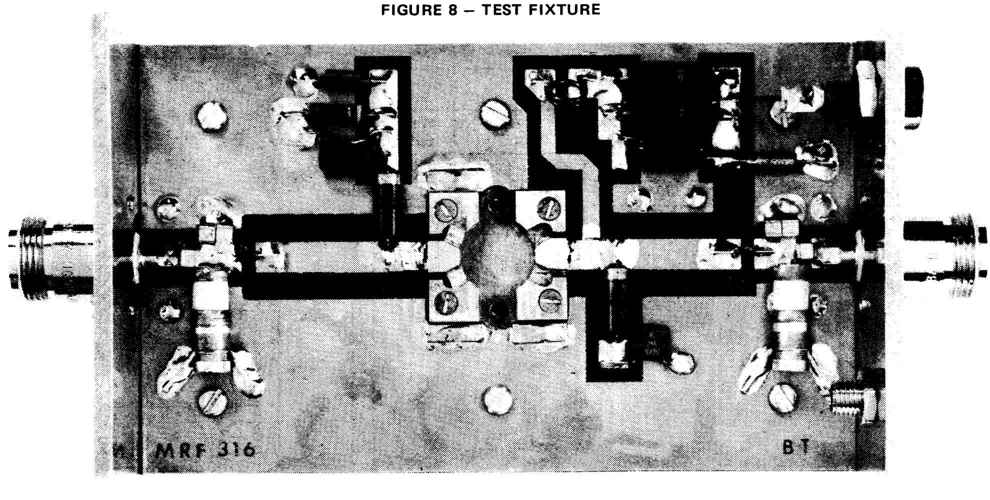


f MHz	Z_{in} OHMS	Z_{OL}* OHMS
30	1.2–j2.4	5.5–j6.8
50	1.1–j2.2	4.5–j6.0
100	0.3+j0.7	2.7–j3.5
125	0.6+j1.2	2.3–j2.6
150	0.9+j1.6	2.0–j1.7
175	2.2+j0.3	1.9–j1.3
200	0.3+j0.8	2.0–j0.9

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

3

FIGURE 8 — TEST FIXTURE



MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

MRF317

The RF Line

100 W—30-200 MHz

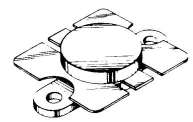
CONTROLLED Q BROADBAND RF POWER TRANSISTOR

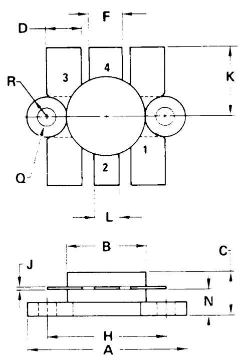
NPN SILICON

NPN SILICON RF POWER TRANSISTOR

. . . designed primarily for wideband large signal output amplifier stages in 30—200 MHz frequency range.

- Guaranteed Performance at 150 MHz and 28 Vdc
  Output Power = 100 W
  Minimum Gain = 9 dB
- Built-In Matching Network for Broadband Operation
- 100% Tested for Load Mismatch at All Phase Angles with 30:1 VSWR
- Gold Metallization System for High Reliability
- High Output Saturation Power — Ideally Suited for 30 W Carrier/ 120 W Peak AM Amplifier Service
- Guaranteed Performance in Broadband Test Fixture





STYLE 1:
PIN 1. EMITTER
2. COLLECTOR
3. EMITTER
4. BASE
FLANGE-ISOLATED

DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	24.38	25.15	0.960	0.990
B	12.45	12.95	0.490	0.510
C	5.97	7.62	0.235	0.300
D	5.33	5.59	0.210	0.220
F	5.08	5.33	0.200	0.210
H	18.29	18.54	0.720	0.730
J	0.10	0.15	0.004	0.006
K	10.29	–	0.405	–
L	3.81	4.06	0.150	0.160
N	3.81	4.32	0.150	0.170
Q	2.92	3.30	0.115	0.130
R	3.05	3.30	0.120	0.130

CASE 316-01

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 — Peak (10 seconds)	I_C	12 18	Adc
Total Device Dissipation @ T_C = 25°C (1) Derate Above 25°C	P_D	270 1.54	Watts W/°C
Storage Temperature Range	T_{stg}	-65 to +150	°C
THERMAL CHARACTERISTICS			
Thermal Resistance, Junction to Case	$R_{\theta JC}$	0.65	°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.

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)	$V_{(BR)CEO}$	35	–	–	Vdc
Collector-Emitter Breakdown Voltage (I_C = 100 mAdc, V_{BE} = 0)	$V_{(BR)CES}$	65	–	–	Vdc
Collector-Base Breakdown Voltage (I_C = 100 mAdc, I_E = 0)	$V_{(BR)CBO}$	65	–	–	Vdc
Emitter-Base Breakdown Voltage (I_E = 10 mAdc, I_C = 0)	$V_{(BR)EBO}$	4.0	–	–	Vdc
Collector Cutoff Current (V_{CB} = 30 Vdc, I_E = 0)	I_{CBO}	–	–	5.0	mAdc
ON CHARACTERISTICS					
DC Current Gain (I_C = 5.0 Adc, V_{CE} = 5.0 Vdc)	h_{FE}	10	25	80	–
DYNAMIC CHARACTERISTICS					
Output Capacitance (V_{CB} = 28 Vdc, I_E = 0, f = 1.0 MHz)	C_{ob}	–	200	250	pF
FUNCTIONAL TESTS (FIGURE 2)					
Common-Emitter Amplifier Power Gain (V_{CC} = 28 Vdc, P_{out} = 100 W, f = 150 MHz, I_C(Max) = 6.5 Adc)	G_{PE}	9.0	10	–	dB
Collector Efficiency (V_{CC} = 28 Vdc, P_{out} = 100 W, f = 150 MHz, I_C(Max) = 6.5 Adc)	η	55	60	–	%
Load Mismatch (V_{CC} = 28 Vdc, P_{out} = 100 W CW, f = 150 MHz, VSWR = 30:1 all phase angles)	ψ	No Degradation in Output Power			

FIGURE 1 — BROADBAND (110–160 MHz) TEST FIXTURE

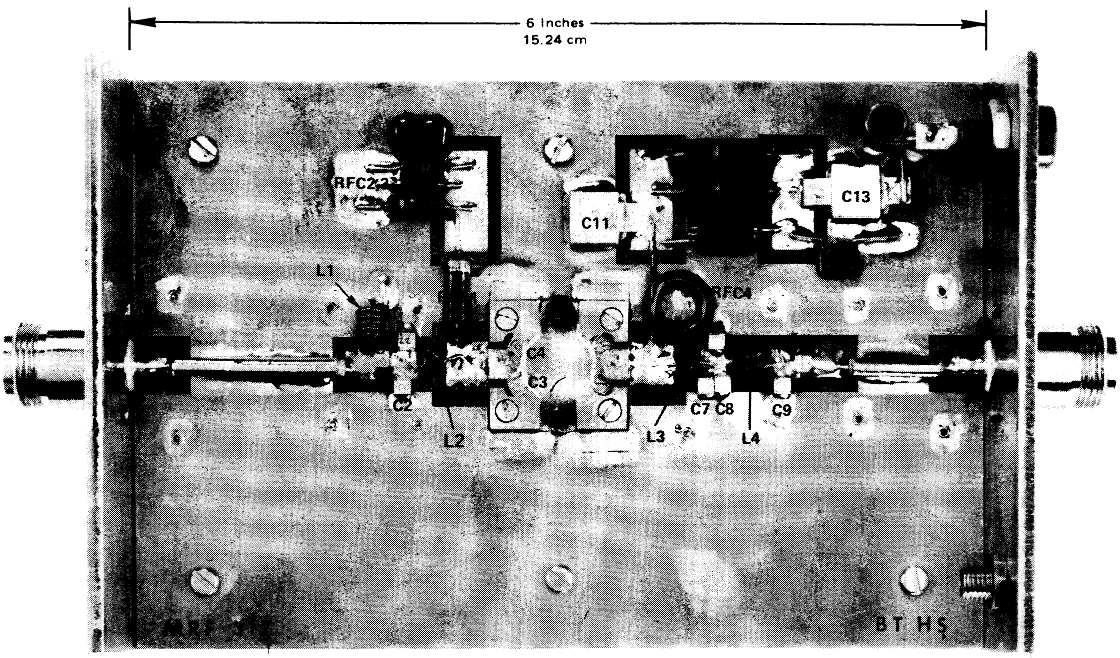


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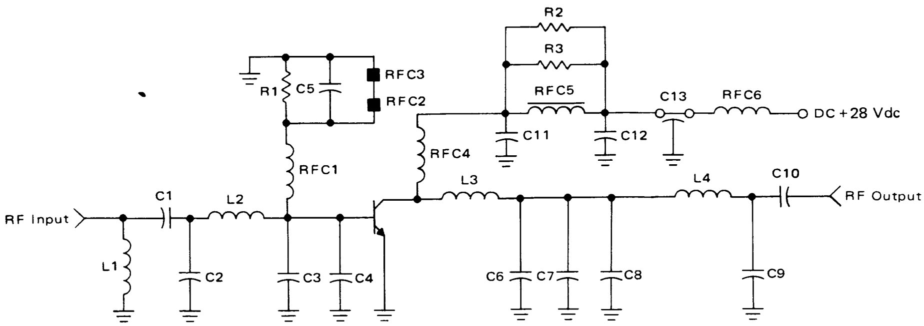
FIGURE 2 — 110-160 MHz BROADBAND AMPLIFIER — TEST FIXTURE



C1, C9 — 39 pF, 100 mil ATC
C2 — 120 pF, 100 mil ATC
C3, C4 — 360 pF, 100 mil ATC
C5 — 1000 pF Dipped Mica
C6, C7 — 100 pF, 100 mil ATC*
C8 — 18 pF, 100 mil ATC*
C10 — 43 pF, 100 mil ATC
C11 — 60 pF, Underwood
C12 — 0.1 μF Erie Redcap
C13 — 1000 pF, Underwood J102

L1 — 50 nH
L2 — 6.0 nH
L3 — 8.0 nH
L4 — 32 nH
RFC1 — 0.15 μH Molded Coil
RFC2, RFC3 — Ferroxcube Bead 56-590-65/3B
RFC4 — 1 Turn, #18 Wire, 2.0" L
RFC5 — Ferroxcube VK200 19/4B
RFC6 — 7 Turns, #18 Wire, 0.3" ID
R1 — 10 Ω 1/2 W
R2, R3 — 10 Ω 1 W
*Combination of C6, C7, C8 equals 220 pF.

FIGURE 3 — POWER GAIN versus FREQUENCY BROADBAND TEST FIXTURE

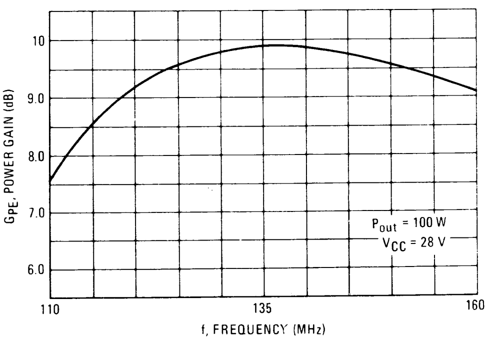
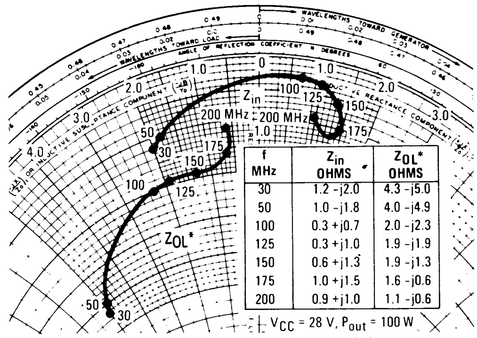


FIGURE 4 — SERIES EQUIVALENT INPUT-OUTPUT IMPEDANCE



f MHz	Z_{in} OHMS	Z_{OL}* OHMS
30	1.2 -j2.0	4.3 -j5.0
50	1.0 -j1.8	4.0 -j4.9
100	0.3 +j0.7	2.0 -j2.3
125	0.3 +j1.0	1.9 -j1.9
150	0.6 +j1.3	1.9 -j1.3
175	1.0 +j1.5	1.6 -j0.6
200	0.9 +j1.0	1.1 -j0.6

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

FIGURE 5 — EFFICIENCY versus FREQUENCY BROADBAND TEST FIXTURE

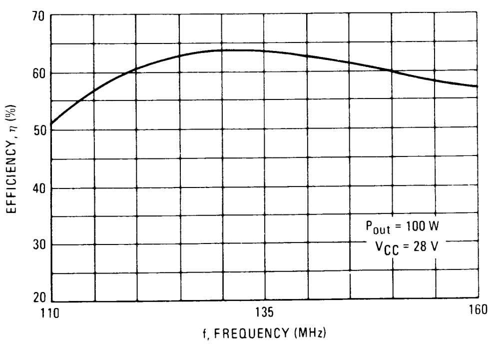
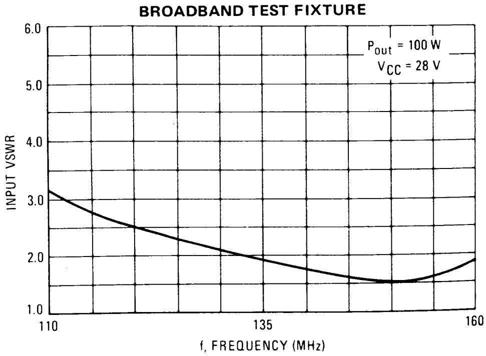


FIGURE 6 — INPUT VSWR versus FREQUENCY BROADBAND TEST FIXTURE



TYPICAL PERFORMANCE CURVES

FIGURE 7 – OUTPUT POWER versus INPUT POWER

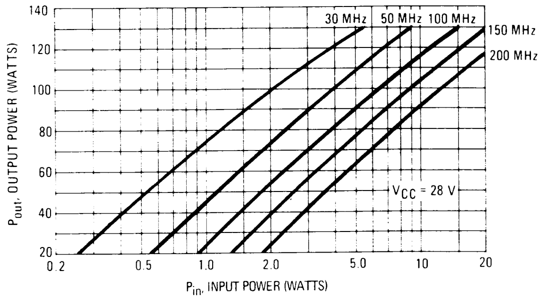


FIGURE 8 – POWER GAIN versus FREQUENCY

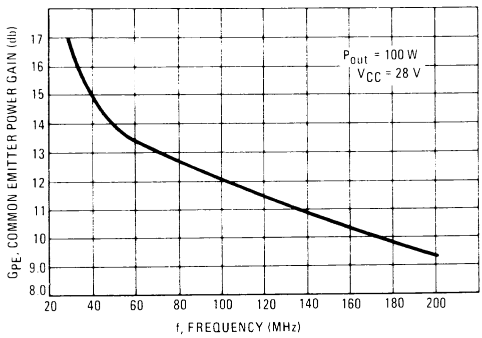


FIGURE 9 – POWER OUTPUT versus SUPPLY VOLTAGE
f = 100 MHz

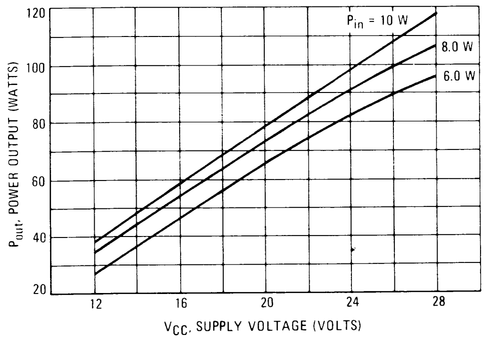


FIGURE 10 – POWER OUTPUT versus SUPPLY VOLTAGE
f = 150 MHz

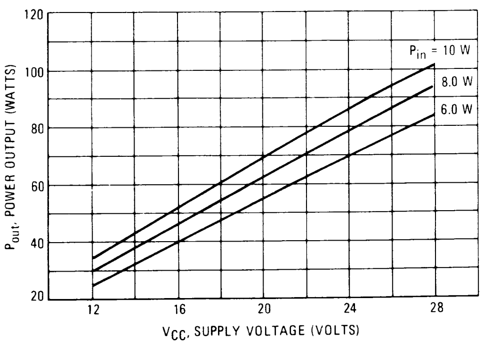
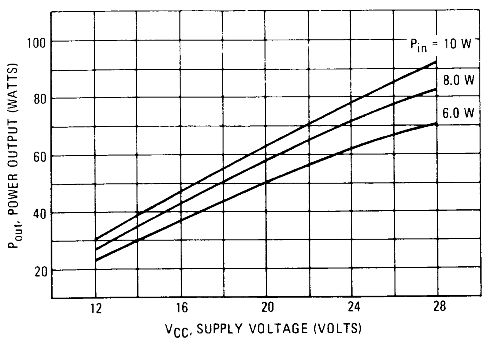


FIGURE 11 – POWER OUTPUT versus SUPPLY VOLTAGE
f = 200 MHz



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