MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

MRF890

The RF Line

2.0 W 900 MHz

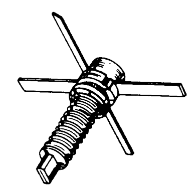
RF POWER TRANSISTOR

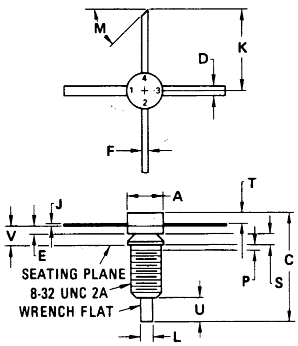
NPN SILICON

NPN SILICON RF POWER TRANSISTOR

. . . designed for 24 volt UHF large-signal, common-emitter amplifier applications in industrial and commercial FM equipment operating in the range of 804 – 960 MHz.

- Specified 24 Volt, 900 MHz Characteristics
  Output Power = 2.0 Watts
  Minimum Gain = 9.0 dB
  Efficiency = 55%
- Series Equivalent Large-Signal Characterization
- Capable of 30:1 VSWR Load Mismatch at Rated Output Power and Supply Voltage
- Gold Metallized, Emitter Ballasted for Long Life and Resistance to Metal Migration
- Silicon Nitride Passivated





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

DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	5.08	5.59	0.200	0.220
C	13.97	16.26	0.550	0.640
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	–
L	1.40	1.65	0.055	0.065
M	45° NOM		45° NOM	
P	–	1.27	–	0.050
S	1.40	1.65	0.055	0.065
T	1.40	1.78	0.055	0.070
U	2.79	3.81	0.110	0.150
V	2.41	2.92	0.095	0.115

CASE 305-01

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V_{CEO}	30	Vdc
Collector-Base Voltage	V_{CBO}	55	Vdc
Emitter-Base Voltage	V_{EBO}	4.0	Vdc
Collector Current — Continuous	I_C	0.5	Adc
Total Device Dissipation @ T_C = 25°C (1) Derate Above 25°C	P_D	7.0 40	Watts mW/°C
Storage Temperature Range	T_{stg}	-65 to +150	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case (2)	$R_{\theta JC}$	25	°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.

3

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

Characteristic	Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage (I_C = 5.0 mAdc, I_B = 0)	$V_{(BR)CEO}$	30	—	—	Vdc
Collector-Emitter Breakdown Voltage (I_C = 5.0 mAdc, V_{BE} = 0)	$V_{(BR)CES}$	55	—	—	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}	—	—	0.5	mAdc
ON CHARACTERISTICS					
DC Current Gain (I_C = 100 mAdc, V_{CE} = 5.0 Vdc)	h_{FE}	10	—	100	—
DYNAMIC CHARACTERISTICS					
Output Capacitance (V_{CB} = 30 Vdc, I_E = 0, f = 1.0 MHz)	C_{ob}	—	2.0	—	pF
FUNCTIONAL TEST					
Common-Emitter Amplifier Power Gain (P_{out} = 2.0 W, V_{CC} = 24 Vdc, f = 900 MHz)	G_{PE}	9.0	10.5	—	dB
Collector Efficiency (P_{out} = 2.0 W, V_{CC} = 24 Vdc, f = 900 MHz)	η	55	60	—	%

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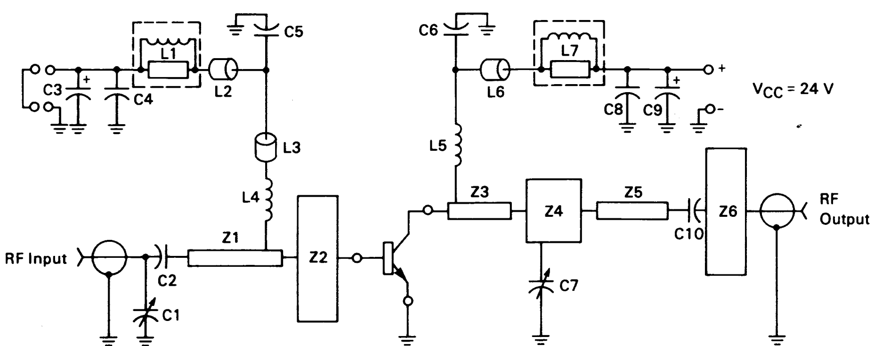
FIGURE 1 — 850 - 900 MHz TEST CIRCUIT



C1, C7 — Johanson 0.5 – 4.0 pF Giga-Trim
C2, C5, C6 — 91 pF Mini Underwood Mica
C3, C9 — 1.0 μF Electrolytic
C4, C8 — 250 pF Unelco
C10 — 39 pF Mini Underwood
L1, L7 — 10 Turns Around 10 Ω 1/2 W Resistor
L2, L3, L6 — Ferrite Bead
L4, L5 — 4 Turns 26 AWG 0.1″ ID
Z1, Z2, Z3, Z4, Z5, Z6 — Distributed Microstrip Elements (see photomask)
Board Material — Glass Teflon ϵ_r = 2.55 t = 0.031″

FIGURE 2 — OUTPUT POWER versus INPUT POWER

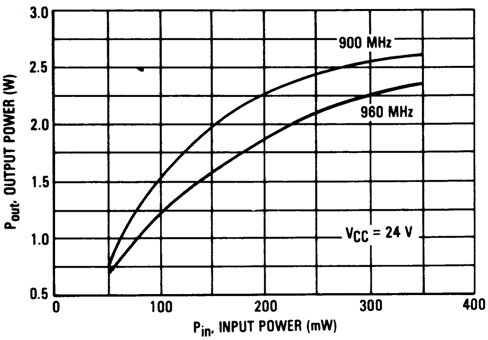


FIGURE 3 — OUTPUT POWER versus SUPPLY VOLTAGE

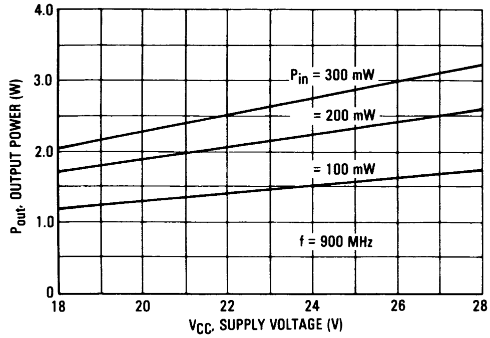


FIGURE 4 — OUTPUT POWER versus FREQUENCY

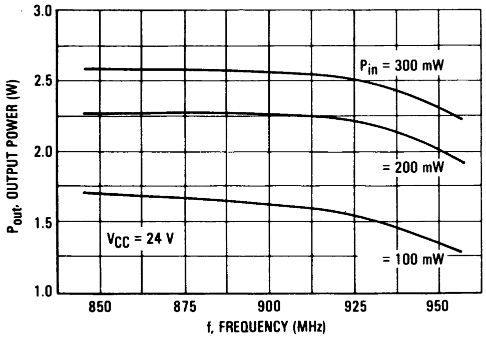


FIGURE 5 — TYPICAL PERFORMANCE IN BROADBAND CIRCUIT

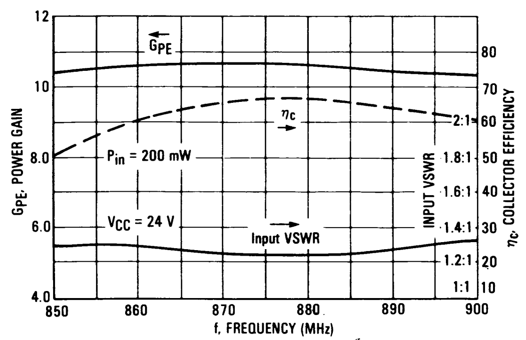
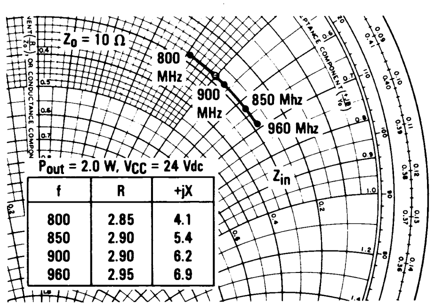


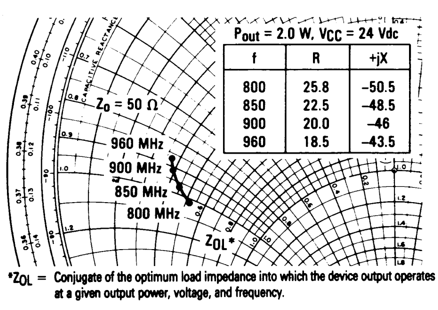
FIGURE 6 — SERIES EQUIVALENT INPUT IMPEDANCE



Pout = 2.0 W, VCC = 24 Vdc

f	R	+jX
800	2.85	4.1
850	2.90	5.4
900	2.90	6.2
960	2.95	6.9

FIGURE 7 — SERIES EQUIVALENT OUTPUT IMPEDANCE



Pout = 2.0 W, VCC = 24 Vdc

f	R	+jX
800	25.8	-50.5
850	22.5	-48.5
900	20.0	-46
960	18.5	-43.5

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

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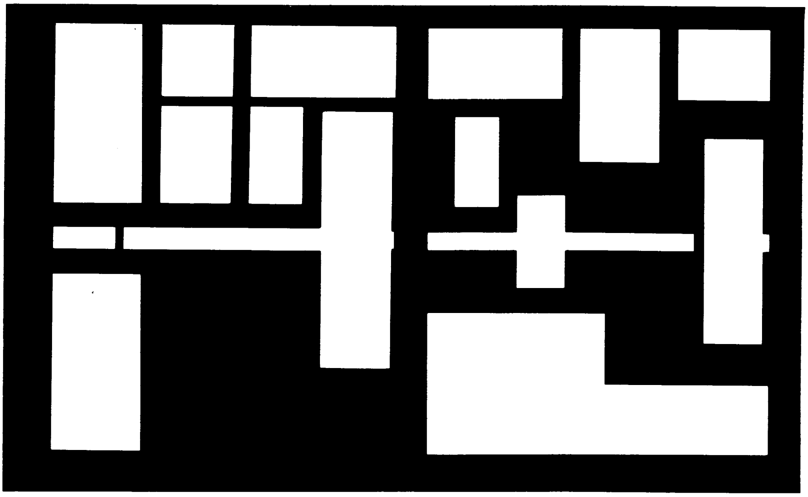
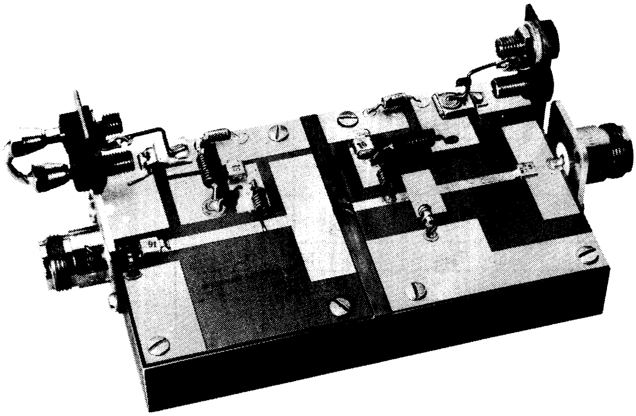
FIGURE 8 — PHOTOMASTER FOR TEST FIXTURE



NOTE: The Printed Circuit Board shown is 75% of the original.

FIGURE 9 — 850-900 MHz TEST CIRCUIT



MRF891

The RF Line

5.0 W 900 MHz

RF POWER TRANSISTOR

NPN SILICON

NPN SILICON RF POWER TRANSISTOR

. . . designed for 24 volt UHF large-signal, common-emitter amplifier applications in industrial and commercial FM equipment operating in the range of 800–960 MHz.

- Specified 24 Volt, 900 MHz Characteristics
  Output Power = 5.0 Watts
  Minimum Gain = 9.0 dB
  Efficiency = 50%
- Series Equivalent Large-Signal Characterization
- Capable of withstanding 20:1 VSWR Load Mismatch at Rated Output Power and Supply Voltage
- Gold Metallized, Emitter Ballasted for Long Life and Resistance to Metal Migration
- Silicon Nitride Passivated

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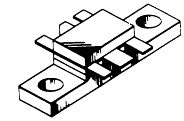

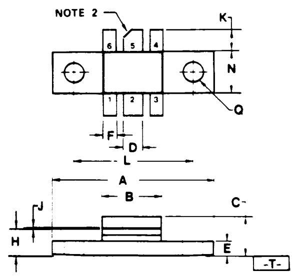

STYLE 2:
PIN 1. EMITTER (COMMON)
2. BASE (INPUT)
3. EMITTER (COMMON)
4. EMITTER (COMMON)
5. COLLECTOR (OUTPUT)
6. EMITTER (COMMON)

NOTES:
1. POSITIONAL TOLERANCE FOR Q HOLES:
| ⌖ | ϕ 0.15 (0.006) Ⓜ | T | A Ⓜ | N Ⓜ |
2. IDENTIFICATION NOTCH 1.0mm (0.04) MIN X 45°.
3. DIM D APPLIES 2 PLACES, DIM K APPLIES 2 PLACES, DIM Q APPLIES 2 PLACES, DIM F APPLIES 4 PLACES.
4. DIMENSIONS A AND N ARE DATUMS AND -T- IS A DATUM SURFACE.
5. DIMENSION B APPLIES TO LEAD FRAME AND Beo.
6. POSITIONAL TOLERANCE FOR D TERMINAL AND DIMENSION B:
| ⌖ | 0.38 (0.15) Ⓜ | T | A Ⓜ | N Ⓜ |

DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	24.51	25.02	0.965	0.985
B	9.02	9.52	0.355	0.375
C	5.84	6.60	0.230	0.260
D	2.92	3.18	0.115	0.125
E	2.69	2.95	0.106	0.116
F	1.91	2.16	0.075	0.085
H	4.06	4.31	0.160	0.170
J	0.10	0.15	0.004	0.006
K	2.29	2.79	0.090	0.110
L	18.42 BSC		0.725 BSC	
N	5.72	6.12	0.225	0.241
Q	3.18	3.43	0.125	0.135

CASE 319-04

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V_{CEO}	30	Vdc
Collector-Emitter Voltage	V_{CES}	55	Vdc
Emitter-Base Voltage	V_{EBO}	4.0	Vdc
Collector-Current — Continuous	I_C	0.6	Adc
Total Device Dissipation @ T_A = 50°C Derate above 50°C (1)	P_D	18 0.143	Watts W/°C
Storage Temperature Range	T_{stg}	−65 to +150	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case (2)	$R_{\theta JC}$	7.0	°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.

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)	$V_{(BR)CEO}$	30	—	—	Vdc
Collector-Emitter Breakdown Voltage (I_C = 20 mAdc, V_{BE} = 0)	$V_{(BR)CES}$	55	—	—	Vdc
Emitter-Base Breakdown Voltage (I_E = 0.5 mAdc, I_C = 0)	$V_{(BR)EBO}$	4.0	—	—	Vdc
Collector Cutoff Current (V_{CE} = 30 Vdc, V_{BE} = 0, T_C = 25°C)	I_{CES}	—	—	1.0	mAdc
ON CHARACTERISTICS					
DC Current Gain (I_C = 200 mAdc, V_{CE} = 5.0 Vdc)	h_{FE}	30	—	150	—
DYNAMIC CHARACTERISTICS					
Output Capacitance (V_{CB} = 24 Vdc, I_E = 0, f = 1.0 MHz)	C_{ob}	—	5.1	7.0	pF
FUNCTIONAL TESTS					
Common-Emitter Amplifier Power Gain (Broadband) (V_{CC} = 24 Vdc, P_{out} = 5.0 W, f = 900 MHz)	G_{pe}	9.0	10	—	dB
Collector Efficiency (V_{CC} = 24 Vdc, P_{out} = 5.0 W, f = 900 MHz)	η	50	57	—	%
Load Mismatch Stress (V_{CC} = 24 Vdc, P_{in} = 0.63 W, f = 900 MHz, VSWR = 20:1, all phase angles)	ψ	No degradation in output power			

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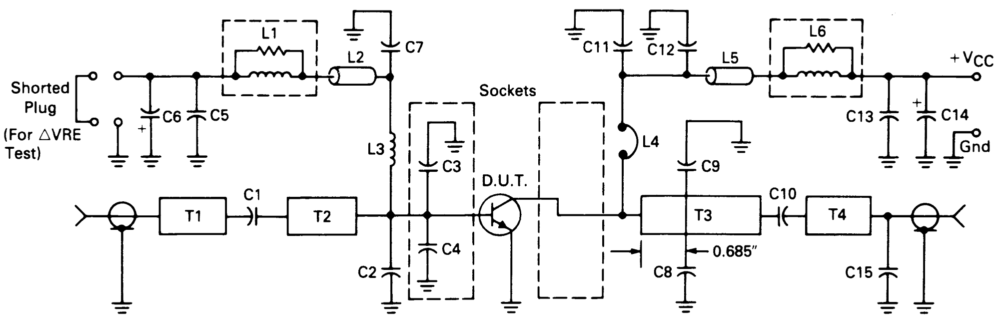
FIGURE 1 — BROADBAND TEST FIXTURE



C1	— 39 pF, 100 Mil Chip Capacitor	L1, L6	— 10 Turns #20 AWG Around 10 Ohm 1/2 Watt Resistor
C10	— 47 pF, 100 Mil Chip Capacitor	L3	— 4 Turns #16 AWG Choke
C6, C14	— 10 μF, 25 V Tantalum	L2, L5	— Ferrite Bead
C5, C13	— 1000 pF, 350 V Unelco	L4	— 0.5″, #18 AWG Wire
C7, C11, C12	— 91 pF, Mini-Unelco	T1, T4	— 50 Ohm Microstrip Line
C3, C4	— 12 pF, Mini-Unelco	T2	— W = 165 Mils, ℓ = 1946 Mils
C2, C8, C15	— 0.8–8.0 pF Johansen Gigatrim	T3	— W = 166 Mils, ℓ = 1563 Mils
C9	— 5.0 pF, Mini-Unelco	PC Board	— 0.031″ Glass Teflon (ϵ_r = 2.56)

FIGURE 2 — OUTPUT POWER versus INPUT POWER

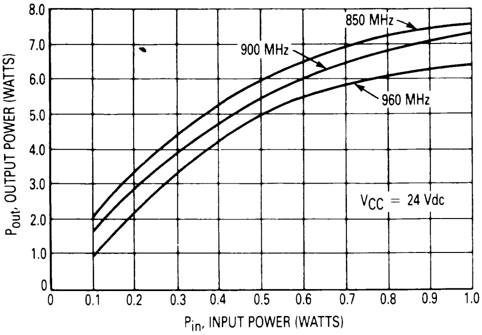


FIGURE 3 — OUTPUT POWER versus SUPPLY VOLTAGE

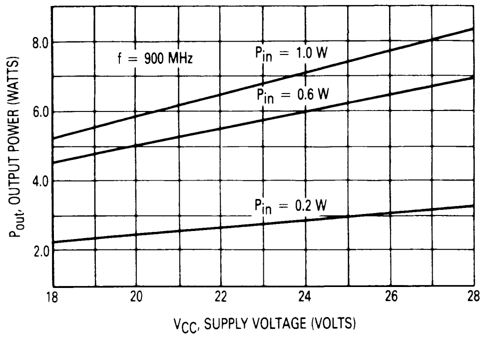


FIGURE 4 — OUTPUT POWER versus FREQUENCY

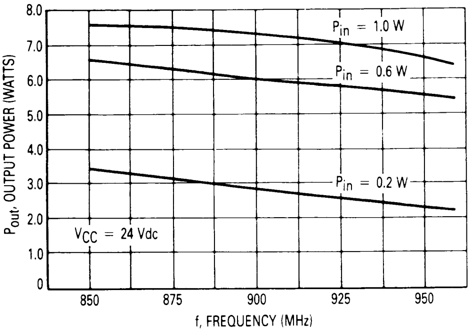


FIGURE 5 — TYPICAL BROADBAND CIRCUIT PERFORMANCE

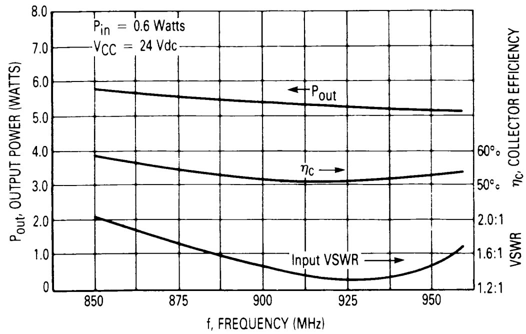


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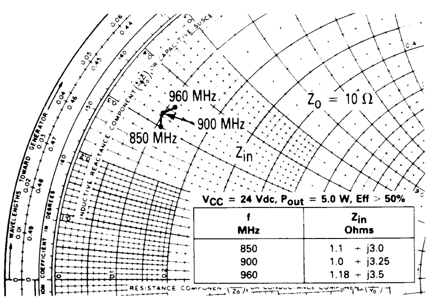
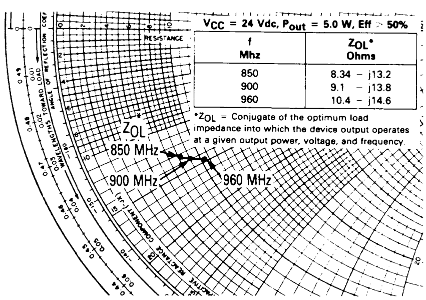
FIGURE 6 — SERIES EQUIVALENT INPUT IMPEDANCE



V_{CC} = 24 Vdc, P_{out} = 5.0 W, Eff > 50%

f MHz	Z_{in} Ohms
850	1.1 + j3.0
900	1.0 + j3.25
960	1.18 + j3.5

FIGURE 7 — SERIES EQUIVALENT OUTPUT IMPEDANCE

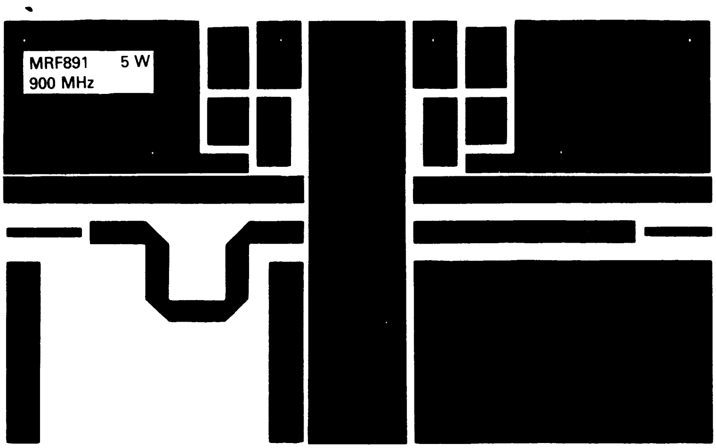


V_{CC} = 24 Vdc, P_{out} = 5.0 W, Eff > 50%

f Mhz	Z_{OL}* Ohms
850	8.34 − j13.2
900	9.1 − j13.8
960	10.4 − j14.6

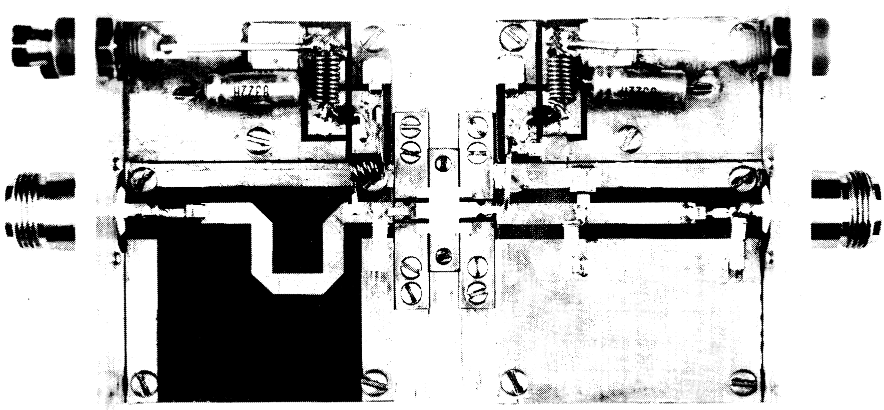
*Z_{OL} = Conjugate of the optimum load impedance into which the device output operates at a given output power, voltage, and frequency.

FIGURE 8 — PHOTOMASTER FOR TEST CIRCUIT



NOTE: The Printed Circuit Board shown is 75% of the original.

FIGURE 9 — BROADBAND TEST CIRCUIT



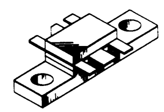
MRF892

The RF Line

14 W 900 MHz

RF POWER TRANSISTOR

NPN SILICON



NPN SILICON RF POWER TRANSISTOR

. . . designed for 24 volt UHF large-signal, common-base amplifier applications in industrial and commercial FM equipment operating in the range of 804 – 960 MHz.

- Specified 24 Volt, 900 MHz Characteristics
  Output Power = 14 Watts
  Minimum Gain = 8.5 dB
  Efficiency = 55%
- Series Equivalent Large-Signal Characterization
- Capable of 30:1 VSWR Load Mismatch at Rated Output Power and Supply Voltage
- Gold Metallized, Emitter Ballasted for Long Life and Resistance to Metal Migration
- Silicon Nitride Passivated

3

MAXIMUM RATINGS

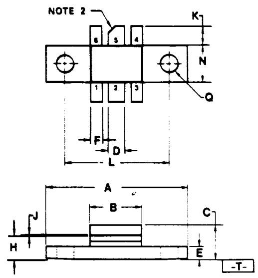
Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V_{CEO}	30	Vdc
Collector-Base Voltage	V_{CBO}	50.0 V	Vdc
Emitter-Base Voltage	V_{EBO}	4.0	Vdc
Collector Current — Continuous	I_C	2.5	Adc
Total Device Dissipation @ T_C = 25°C (1) Derate Above 25°C	P_D	50 0.29	Watts mW/°C
Storage Temperature Range	T_{stg}	-65 to +150	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case (2)	$R_{\theta JC}$	3.5	°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.



STYLE 1:
PIN 1. BASE (COMMON)
2. EMITTER (INPUT)
3. BASE (COMMON)
4. BASE (COMMON)
5. COLLECTOR (OUTPUT)
6. BASE (COMMON)

NOTES:
1. POSITIONAL TOLERANCE FOR Q HOLES:
   ⌖ | ϕ 0.15 (0.006) Ⓜ | T | A Ⓜ | N Ⓜ
2. IDENTIFICATION NOTCH 1.0mm (0.04) MIN X 45°.
3. DIM D APPLIES 2 PLACES, DIM K APPLIES 2 PLACES, DIM Q APPLIES 2 PLACES, DIM F APPLIES 4 PLACES.
4. DIMENSIONS A AND N ARE DATUMS AND -T- IS A DATUM SURFACE.
5. DIMENSION B APPLIES TO LEAD FRAME AND Beo.
6. POSITIONAL TOLERANCE FOR D TERMINAL AND DIMENSION B:
   ⌖ | 0.38 (0.15) Ⓜ | T | A Ⓜ | N Ⓜ

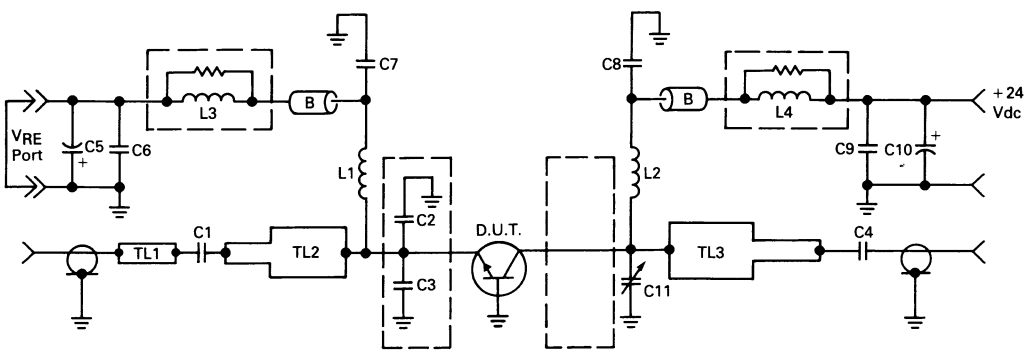
DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	24.51	25.02	0.965	0.985
B	9.02	9.52	0.355	0.375
C	5.84	6.60	0.230	0.260
D	2.92	3.18	0.115	0.125
E	2.69	2.95	0.106	0.116
F	1.91	2.16	0.075	0.085
H	4.06	4.31	0.160	0.170
J	0.10	0.15	0.004	0.006
K	2.29	2.79	0.090	0.110
L	18.42 BSC		0.725 BSC	
N	5.72	6.12	0.225	0.241
Q	3.18	3.43	0.125	0.135

CASE 319-04

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

Characteristic	Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage (I_C = 25 mAdc, I_B = 0)	$V_{(BR)CEO}$	30	—	—	Vdc
Collector-Emitter Breakdown Voltage (I_C = 25 mAdc, V_{BE} = 0)	$V_{(BR)CES}$	50	—	—	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 = 1.0 Adc, V_{CE} = 5.0 Vdc)	h_{FE}	10	—	100	—
DYNAMIC CHARACTERISTICS					
Output Capacitance (V_{CB} = 30 Vdc, I_E = 0, f = 1.0 MHz)	C_{ob}	—	12.5	—	pF
FUNCTIONAL TEST					
Common-Base Amplifier Power Gain (P_{out} = 14 W, V_{CC} = 24 Vdc, f = 900 MHz)	G_{PE}	8.5	9.5	—	dB
Collector Efficiency (P_{out} = 14 W, V_{CC} = 24 Vdc, f = 900 MHz)	η	55	60	—	%

FIGURE 1 — 850-900 MHz BROADBAND CIRCUIT SCHEMATIC



C1 — 51 pF, 100 Mil Chip Capacitor
C2, C3 — 13 pF Mini-Unelco
C4 — 43 pF, 100 Mil Chip Capacitor
C5, C10 — 10 μF, 35 WV
C6, C9 — 500 pF Unelco J101
C7, C8 — 91 pF Mini-Unelco
C11 — 0.8-8.0 pF Johanson Gigatrim
L1, L2 — 4 Turns #18 Enameled, 5/32″ ID
L3, L4 — 14 Turns #22 Enameled Over 10 Ω Carbon Resistor

B — Ferrite Bead, Ferroxcube 56-590-65-3B
TL1 — Micro Strip, 50 Ω
TL2 — Micro Strip, Z_0 = 26 Ω, λ/4 @ 875 MHz
TL3 — Micro Strip, Z_0 = 14 Ω, λ/4 @ 875 MHz
Board — 0.032″ Glass Teflon
2 oz. Cu CLAD, ϵ_r = 2.55

3

FIGURE 2 — OUTPUT POWER versus INPUT POWER

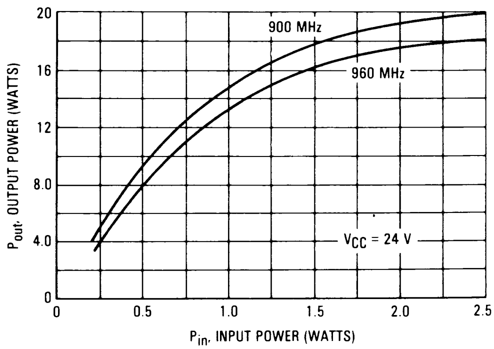


FIGURE 3 — OUTPUT POWER versus SUPPLY VOLTAGE

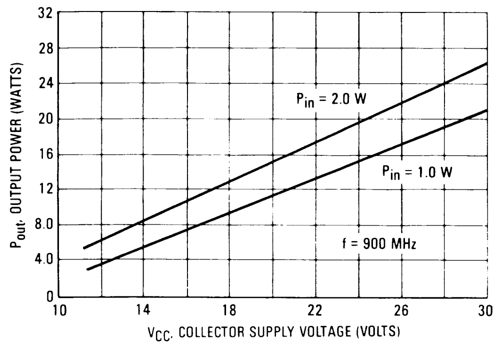


FIGURE 4 — OUTPUT POWER versus FREQUENCY

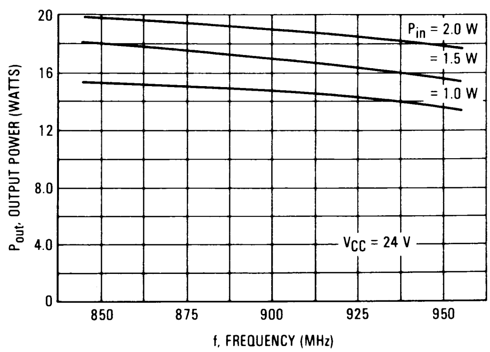
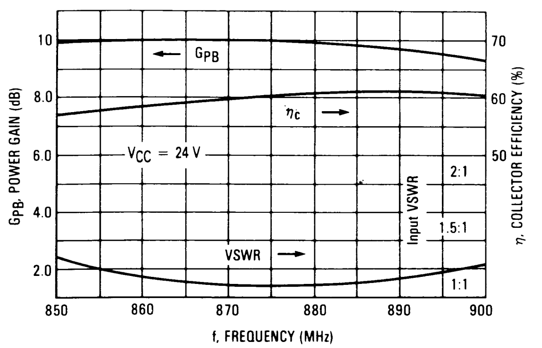
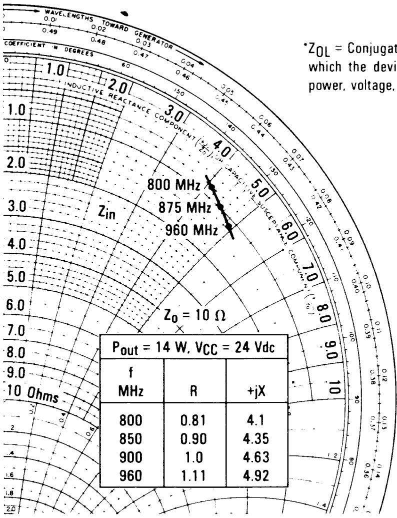


FIGURE 5 — TYPICAL PERFORMANCE IN BROADBAND CIRCUIT



3

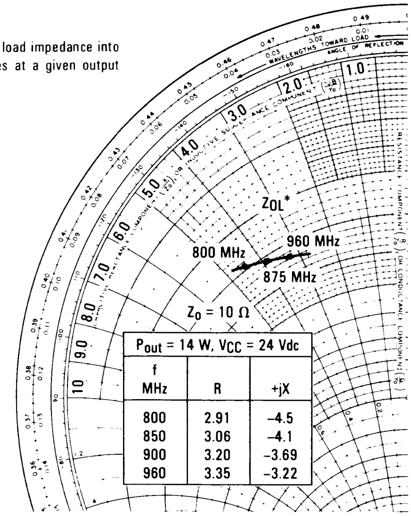
FIGURE 6 — SERIES EQUIVALENT INPUT IMPEDANCE



P_{out} = 14 W, V_{CC} = 24 Vdc		
f MHz	R	+jX
800	0.81	4.1
850	0.90	4.35
900	1.0	4.63
960	1.11	4.92

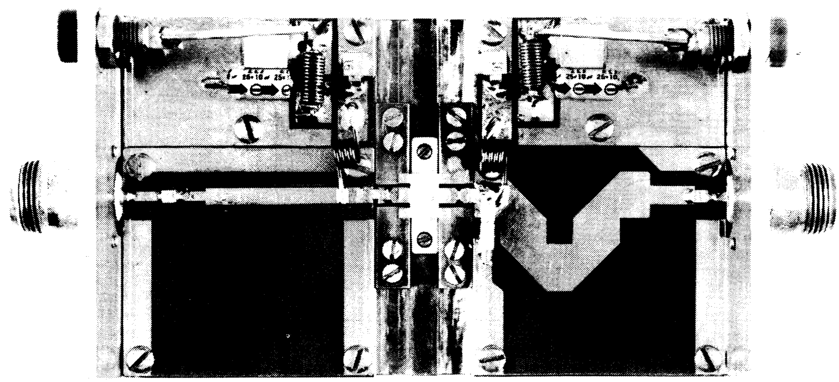
FIGURE 7 — SERIES EQUIVALENT OUTPUT IMPEDANCE

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



P_{out} = 14 W, V_{CC} = 24 Vdc		
f MHz	R	+jX
800	2.91	-4.5
850	3.06	-4.1
900	3.20	-3.69
960	3.35	-3.22

FIGURE 8 — 850-900 MHz TEST CIRCUIT



3

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

MRF894

The RF Line

NPN SILICON RF POWER TRANSISTOR

. . . designed for 24 volt UHF large-signal, common-base amplifier applications in industrial and commercial FM equipment operating in the range of 804 – 960 MHz.

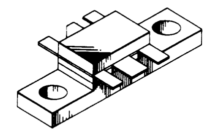
- Specified 24 Volt, 900 MHz Characteristics
  Output Power = 30 Watts
  Minimum Gain = 7.0 dB
  Efficiency = 55%
- Series Equivalent Large-Signal Characterization
- Capable of 30:1 VSWR Load Mismatch at Rated Output Power and Supply Voltage
- Gold Metallized, Emitter Ballasted for Long Life and Resistance to Metal Migration
- Silicon Nitride Passivated

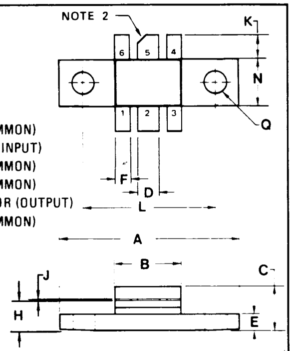
3

30 W 900 MHz

RF POWER TRANSISTOR

NPN SILICON





STYLE 1:
PIN
1. BASE (COMMON)
2. EMITTER (INPUT)
3. BASE (COMMON)
4. BASE (COMMON)
5. COLLECTOR (OUTPUT)
6. BASE (COMMON)

NOTE:
1. HOLES WITHIN .15 mm (.006) TRUE POSITION TO EACH OTHER AT MAXIMUM MATERIAL CONDITION.
2. IDENTIFICATION NOTCH 1.0mm (0.04) MIN X 45°.
3. DIM D APPLIES 2 PLACES, DIM K APPLIES 2 PLACES, DIM Q APPLIES 2 PLACES, DIM F APPLIES 4 PLACES.

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	24.51	25.02	0.965	0.985
B	8.76	9.02	0.345	0.355
C	5.84	6.60	0.230	0.260
D	2.92	3.18	0.115	0.125
E	2.69	2.95	0.106	0.116
F	1.91	2.16	0.075	0.085
H	4.06	4.31	0.160	0.170
J	0.10	0.15	0.004	0.006
K	2.29	2.79	0.090	0.110
L	18.42	BSC	0.725	BSC
N	5.72	5.97	0.225	0.235
Q	3.18	3.43	0.125	0.135

CASE 319-04

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V_{CEO}	30	Vdc
Collector-Base Voltage	V_{CBO}	50	Vdc
Emitter-Base Voltage	V_{EBO}	4.0	Vdc
Collector Current — Continuous	I_C	7.0	Adc
Total Device Dissipation @ T_C = 25°C (1) Derate Above 25°C	P_D	115 0.66	Watts W/°C
Storage Temperature Range	T_{stg}	-65 to +150	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case (2)	$R_{\theta JC}$	1.5	°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.

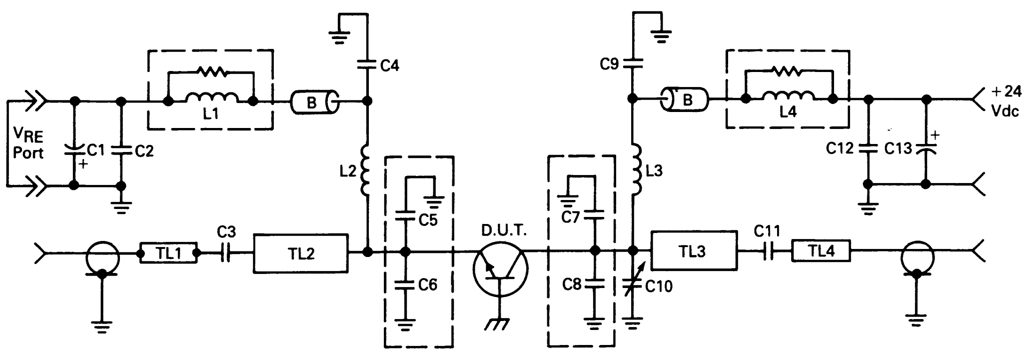
(2) Thermal Resistance is determined under specified RF operating conditions by infrared measurement techniques.

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

Characteristic	Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage (I_C = 25 mAdc, I_B = 0)	$V_{(BR)CEO}$	30	—	—	Vdc
Collector-Emitter Breakdown Voltage (I_C = 25 mAdc, V_{BE} = 0)	$V_{(BR)CES}$	50	—	—	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}	—	—	10	mAdc
ON CHARACTERISTICS					
DC Current Gain (I_C = 2.0 Adc, V_{CE} = 5.0 Vdc)	h_{FE}	10	—	120	—
DYNAMIC CHARACTERISTICS					
Output Capacitance (V_{CB} = 30 Vdc, I_E = 0, f = 1.0 MHz)	C_{ob}	—	45	—	pF
FUNCTIONAL TEST					
Common-Base Amplifier Power Gain (P_{out} = 30 W, V_{CC} = 24 Vdc, f = 900 MHz)	G_{PB}	7.0	8.5	—	dB
Collector Efficiency (P_{out} = 30 W, V_{CC} = 24 Vdc, f = 900 MHz)	η	55	60	—	%

3

FIGURE 1 — 850–900 MHz BROADBAND CIRCUIT SCHEMATIC



C1, C13 — 5 μF, 50 Vdc
C2, C12 — 1000 pF Unelco
C3, C11 — 47 pF, 100 Mil Chip Capacitor
C4, C9 — 91 pF, Mini-Underwood
C5, C6 — 12 pF, Mini-Underwood
C7 — 18 pF, Mini-Underwood
C8 — 24 pF, Mini-Underwood
C10 — 0.8–8.0 pF Johanson Gigatrim

L1, L4 — 11 Turns #20 Enameled Over 10 Ω Carbon Resistor
L2, L3 — 4 Turns #20 Enameled, .15″ ID
B — Ferrite Bead, Ferroxcube 56-590-65-3B
TL1, TL4 — Micro Strip Line, 50 Ω
TL2 — Micro Strip, Z_o = 30 Ω, λ/4 @ 875 MHz
TL3 — Micro Strip, Z_o = 22 Ω, λ/4 @ 875 MHz
Board — 0.032″ Glass Teflon
2 oz. Cu CLAD, ϵ_r = 2.55

FIGURE 2 — OUTPUT POWER versus INPUT POWER

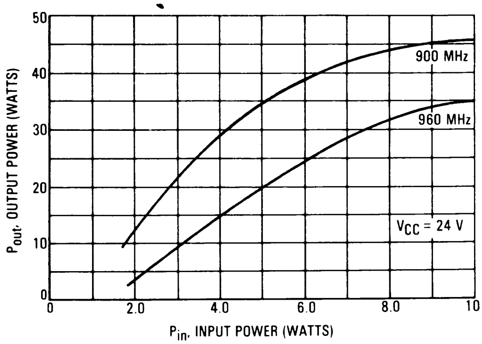


FIGURE 3 — OUTPUT POWER versus FREQUENCY

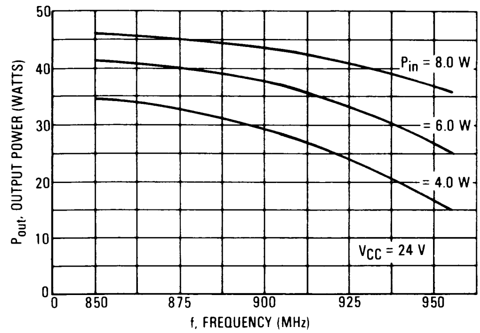


FIGURE 4 — OUTPUT POWER versus SUPPLY VOLTAGE

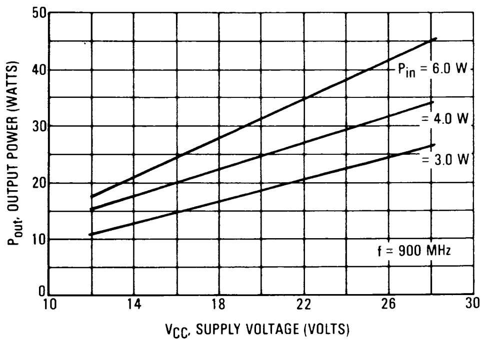


FIGURE 5 — TYPICAL BROADBAND CIRCUIT PERFORMANCE

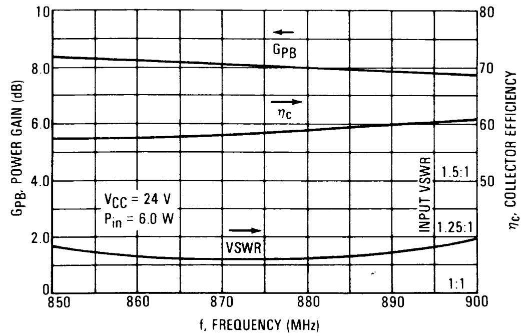
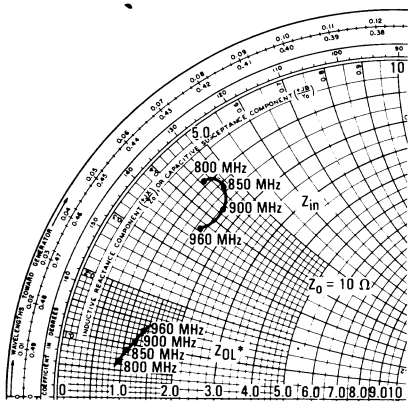


FIGURE 6 — SERIES EQUIVALENT IMPEDANCE



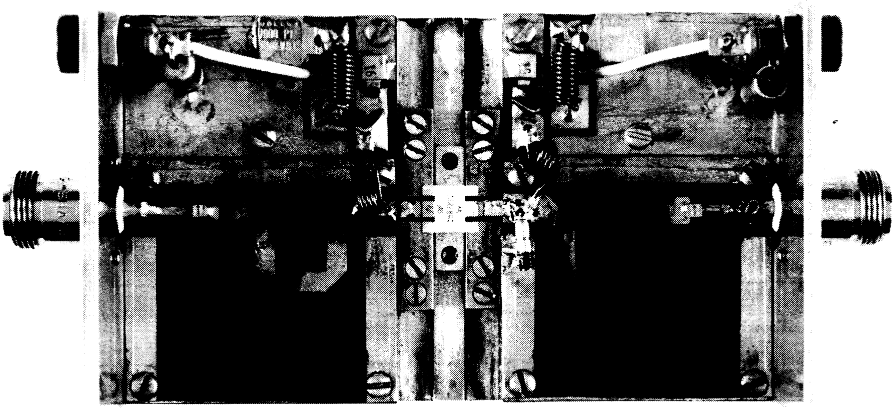
V_{CC} = 24 Vdc, P_{out} = 30 W

f Frequency MHz	Z_{in} Ohms	Z_{OL}* Ohms
800	0.9 + j4.5	1.0 + j0.7
850	1.3 + j4.7	1.1 + j0.9
900	1.6 + j4.4	1.2 + j1.1
960	1.5 + j3.7	1.2 + j1.3

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

3

FIGURE 7 — 850-900 MHz BROADBAND CIRCUIT



MRF898

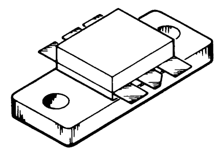
The RF Line

NPN Silicon RF Power Transistor

60 WATTS, 850–960 MHz RF POWER TRANSISTOR NPN SILICON

... designed for 24 Volt UHF large-signal, common base amplifier applications in industrial and commercial FM equipment operating in the range 850–960 MHz.

- Motorola Advanced Amplifier Concept Package
- Specified 24 Volt, 900 MHz Characteristics
  Output Power = 60 Watts
  Minimum Gain = 7 dB
  Efficiency = 60%
- Double Input/Output Matched for Wideband Performance and Simplified External Matching
- Series Equivalent Large-Signal Characterization
- Gold Metallized, Emitter Ballasted for Long Life and Resistance to Metal Migration
- Silicon Nitride Passivated



CASE 333A-01

3

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V_{CEO}	30	Vdc
Collector-Base Voltage	V_{CBO}	55	Vdc
Emitter-Base Voltage	V_{EBO}	4	Vdc
Collector-Current — Continuous	I_C	10	Adc
Total Device Dissipation @ T_C = 25°C Derate above 25°C	P_D	175 1	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	°C/W

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

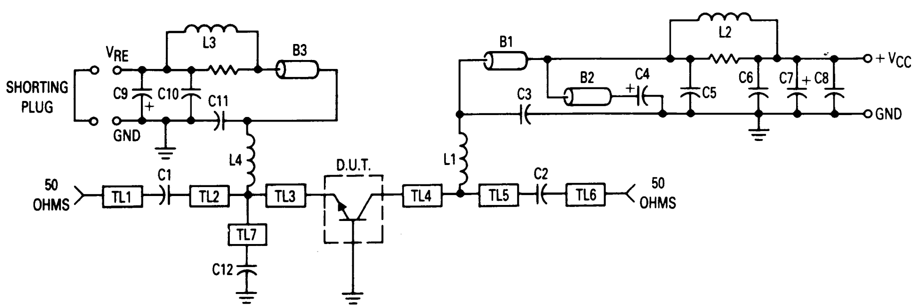
Characteristic	Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage (I_C = 50 mAdc, I_B = 0)	$V_{(BR)CEO}$	30	—	—	Vdc
Collector-Emitter Breakdown Voltage (I_C = 50 mAdc, V_{BE} = 0)	$V_{(BR)CES}$	55	—	—	Vdc
Emitter-Base Breakdown Voltage (I_E = 5 mAdc, I_C = 0)	$V_{(BR)EBO}$	4	—	—	Vdc
Collector Cutoff Current (V_{CE} = 30 Vdc, V_{BE} = 0, T_C = 25°C)	I_{CES}	—	—	10	mAdc

(continued)

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

Characteristic	Symbol	Min	Typ	Max	Unit
ON CHARACTERISTICS					
DC Current Gain (I_C = 2 Adc, V_{CE} = 5 Vdc)	h_{FE}	20	50	150	—
DYNAMIC CHARACTERISTICS					
Output Capacitance* (V_{CB} = 24 Vdc, I_E = 0, f = 1 MHz)	C_{ob}	—	60	—	pF
FUNCTIONAL TESTS					
Common-Base Amplifier Power Gain (V_{CC} = 24 Vdc, P_{out} = 60 W, f = 900 MHz)	G_{pb}	7	7.9	—	dB
Collector Efficiency (V_{CC} = 24 Vdc, P_{out} = 60 W, f = 900 MHz)	η	60	65	—	%
Output Mismatch Stress V_{CC} = 24 V, P_{out} = 60 Watt, f = 900 MHz, VSWR = 5:1 (all phase angles)	ψ	No Degradation in Output Power			

*Value of "C_{ob}" is that of die only. It is not measurable in MRF898 because of internal matching network.



B1, B2, B3 — Bead, Ferroxcube 56-390-65/3B
C1, C2, C12 — 39 pF, 100 Mil Chip Capacitor
C3, C11 — 91 pF, Mini Underwood or Equivalent
C4, C7, C9 — 10 μF, 35 V Electrolytic
C5 — 4000 pF, 1 kV Ceramic
C6, C10 — 1000 pF, 350 V Unelco or Equivalent
C8 — 47 pF, 100 Mil Chip Capacitor
L1, L4 — 4 Turns #18 AWG Choke
L2 — 11 Turns #20 AWG Choke on 10 Ohm, 1 Watt Resistor
L3 — 3 Turns #18 AWG Choke on 10 Ohm, 1 Watt Resistor

Board — 3M Epsilam-10, 50 Mil
TL1, TL6 — 50 Ohm Microstrip
TL2 — 400 x 950 Mils
TL3, TL4 — 140 x 200 Mils
TL5 — 320 x 690 Mils
TL7 — 260 x 230 Mils
Bias Boards — 1/32″ G10 or Equivalent

Figure 1. 850–960 MHz Broadband Test Circuit

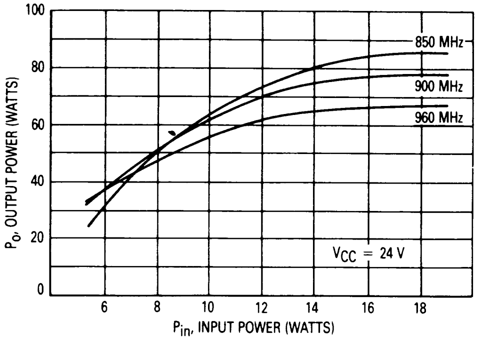


Figure 2. Output Power versus Input Power

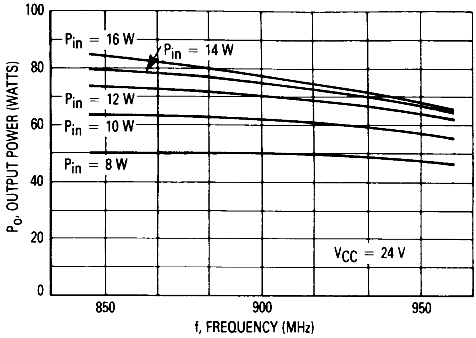


Figure 3. Output Power versus Frequency

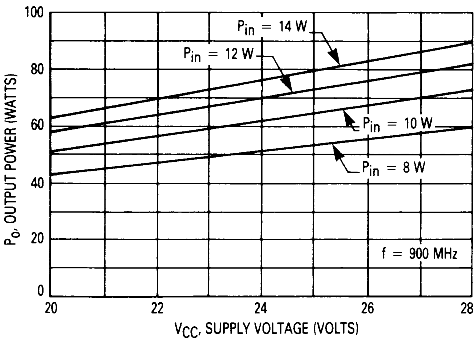


Figure 4. Output Power versus Supply Voltage

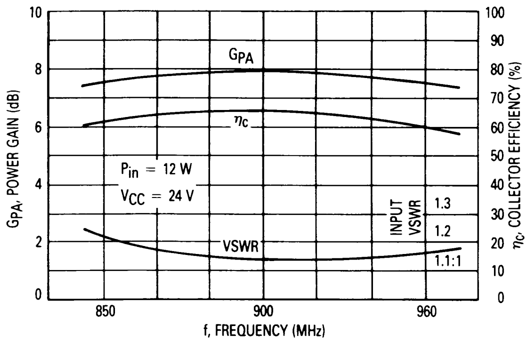
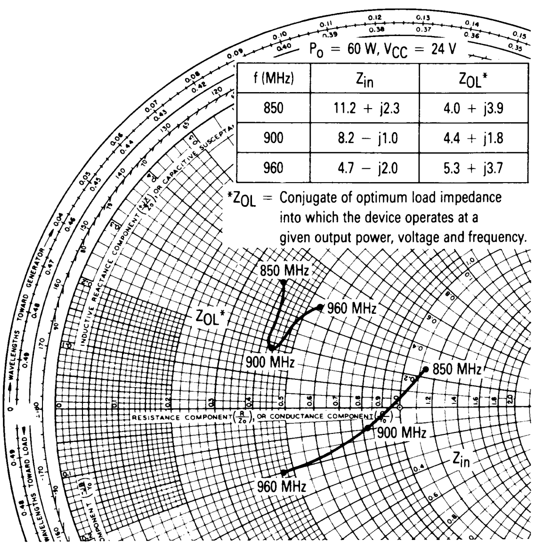


Figure 5. Typical Broadband Circuit Performance

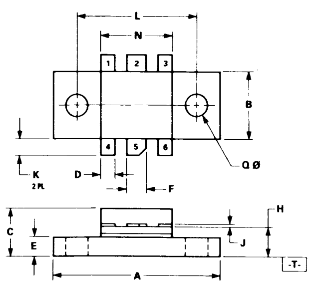


f (MHz)	Z_{in}	Z_{OL}*
850	11.2 + j2.3	4.0 + j3.9
900	8.2 − j1.0	4.4 + j1.8
960	4.7 − j2.0	5.3 + j3.7

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

Figure 6. Input/Output Impedance versus Frequency

OUTLINE DIMENSIONS

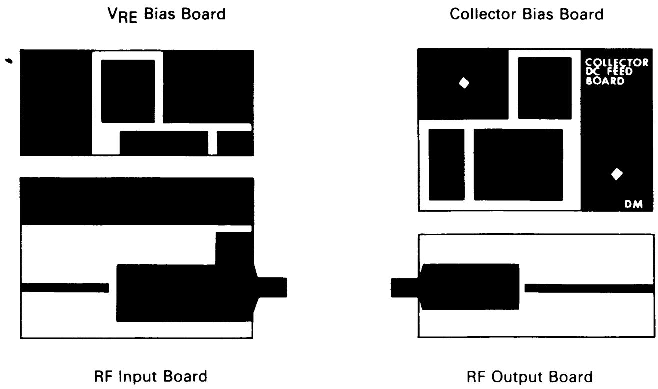


STYLE 1:
PIN 1. BASE
2. EMITTER
3. BASE
4. BASE
5. COLLECTOR
6. BASE

NOTES:
1. DIMENSIONS A AND B ARE DATUMS AND T IS A DATUM PLANE.
2. POSITIONAL TOLERANCE FOR Q HOLES: ⌖ | ϕ .13 (0.005) Ⓜ | A Ⓜ | B Ⓜ
3. DIMENSION -D- FOUR PLACES. DIMENSION -F- TWO PLACES.
4. DIMENSIONING AND TOLERANCING PER Y14.5M, 1982.
5. CONTROLLING DIMENSION: INCH.

DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	24.51	25.02	0.965	0.985
B	9.91	10.41	0.390	0.410
C	6.86	7.36	0.270	0.290
D	1.91	2.28	0.075	0.090
E	2.42	2.92	0.095	0.115
F	5.47	5.96	0.110	0.130
H	3.94	4.44	0.155	0.175
J	0.10	0.15	0.004	0.006
K	2.29	2.94	0.090	0.116
L	18.41 BSC		0.725 BSC	
N	10.54	11.04	0.415	0.435
Q	3.18	3.42	0.125	0.135

CASE 333A-01



NOTE: The Printed Circuit Board shown is 75% of the original.

Figure 7. Photomaster

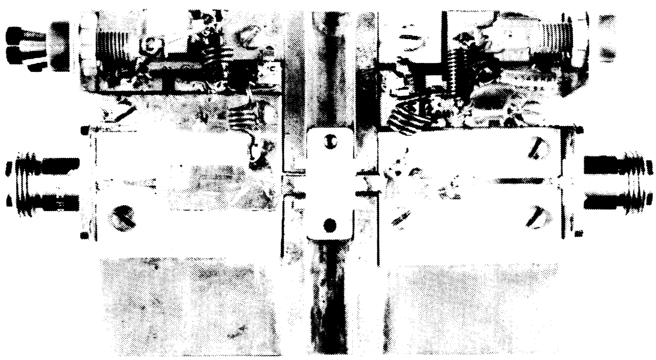


Figure 8. 850–960 Broadband Test Circuit

MRF901

The RF Line

NPN SILICON HIGH-FREQUENCY TRANSISTOR

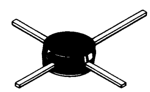
. . . designed primarily for use in high-gain, low-noise small-signal amplifiers. Also usable in applications requiring fast switching times.

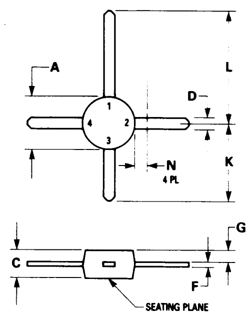
- High Current-Gain-Bandwidth Product — f_T = 4.5 GHz (Typ) @ I_C = 15 mAdc
- Low Noise Figure @ f = 1.0 GHz — NF = 2.0 dB (Typ) and 2.5 dB (Max)
- High Power Gain — G_{pe} = 10 dB (Min) @ f = 1.0 GHz
- Third Order Intercept = +23 dBm (Typ)

2.5 dB @ 1.0 GHz

HIGH FREQUENCY TRANSISTOR

NPN SILICON





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

NOTE:
DIMENSION D NOT APPLICABLE IN ZONE N.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.44	5.21	0.175	0.205
C	1.90	2.54	0.075	0.100
D	0.84	0.99	0.033	0.039
F	0.20	0.30	0.008	0.012
G	0.76	1.14	0.030	0.045
K	7.24	8.13	0.285	0.320
L	10.54	11.43	0.415	0.450
N	—	1.65	—	0.065

CASE 317-01

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V_{CEO}	15	Vdc
Collector-Base Voltage	V_{CBO}	25	Vdc
Emitter-Base Voltage	V_{EBO}	3.0	Vdc
Collector Current — Continuous	I_C	30	mA
Total Device Dissipation @ T_C = 25°C Derate above 25°C	P_D	0.375 3.3	Watt mW/°C
Storage Temperature Range	T_{stg}	150	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	300	°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 = 1.0 mAdc, I_B = 0)	$V_{(BR)CEO}$	15	–	–	Vdc
Collector-Base Breakdown Voltage (I_C = 0.1 mAdc, I_E = 0)	$V_{(BR)CBO}$	25	–	–	Vdc
Emitter-Base Breakdown Voltage (I_E = 0.1 mAdc, I_C = 0)	$V_{(BR)EBO}$	2.0	–	–	Vdc
Collector Cutoff Current (V_{CB} = 15 Vdc, I_E = 0)	I_{CBO}	–	–	50	nAdc
ON CHARACTERISTICS					
DC Current Gain (I_C = 5.0 mAdc, V_{CE} = 5.0 Vdc)	h_{FE}	30	80	200	–
DYNAMIC CHARACTERISTICS					
Current-Gain-Bandwith Product (I_C = 15 mAdc, V_{CE} = 10 Vdc, f = 1.0 GHz)	f_T	–	4.5	–	GHz
Collector-Base Capacitance (V_{CB} = 10 Vdc, I_E = 0, f = 1.0 MHz)	C_{cb}	–	0.4	1.0	pF
Noise Figure (I_C = 5.0 mAdc, V_{CE} = 6.0 Vdc, f = 1.0 GHz)	NF	–	2.0	2.5	dB
FUNCTIONAL TESTS (Figure 1)					
Common-Emitter Amplifier Power Gain (V_{CC} = 6.0 Vdc, I_C = 5.0 mA, f = 1.0 GHz)	G_{pe}	10	12	–	dB
Third Order Intercept (I_C = 5.0 mAdc, V_{CE} = 6.0 Vdc, f = 0.9 GHz)	–	–	+23	–	dBm

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FIGURE 1 — 1.0 GHz TEST CIRCUIT SCHEMATIC

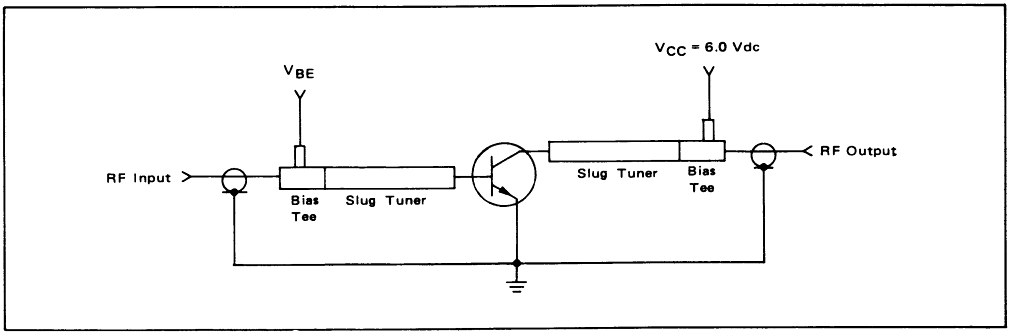

FIGURE 2 — MAXIMUM UNILATERAL GAIN versus FREQUENCY

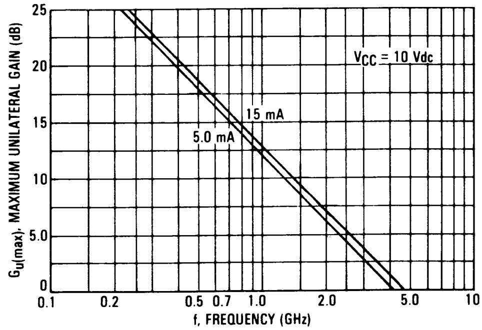

FIGURE 3 — CURRENT GAIN — BANDWIDTH PRODUCT versus COLLECTOR CURRENT

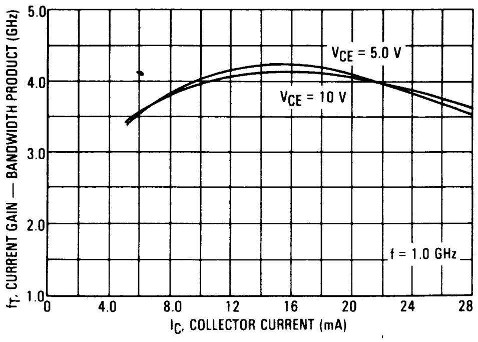

FIGURE 4 — NOISE FIGURE versus FREQUENCY

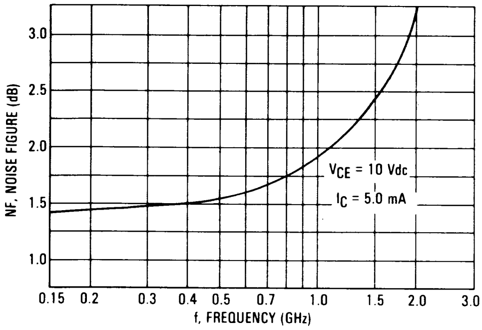

FIGURE 5 — NOISE FIGURE versus COLLECTOR CURRENT

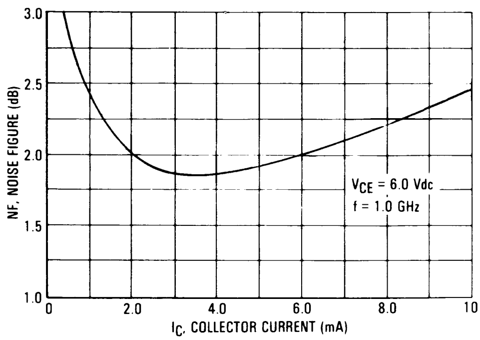

FIGURE 6 — MAXIMUM UNILATERAL GAIN versus COLLECTOR CURRENT

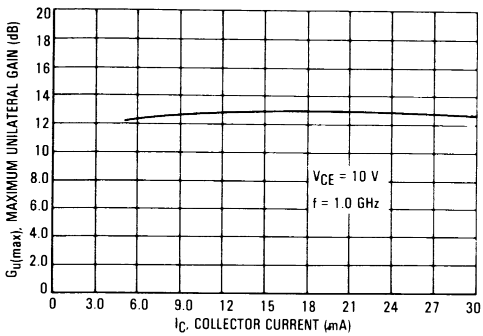

FIGURE 7 — $|S_{21}|^2$ versus FREQUENCY

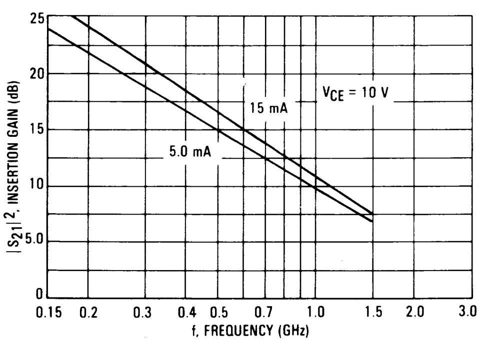

FIGURE 8 — COLLECTOR-BASE CAPACITANCE versus COLLECTOR-BASE VOLTAGE

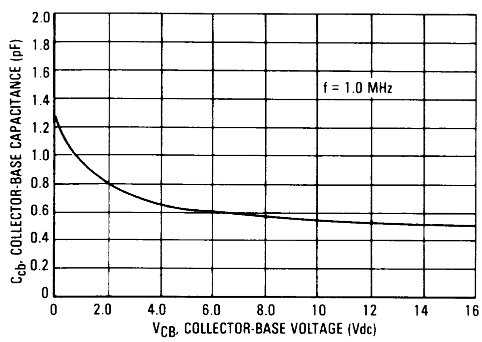

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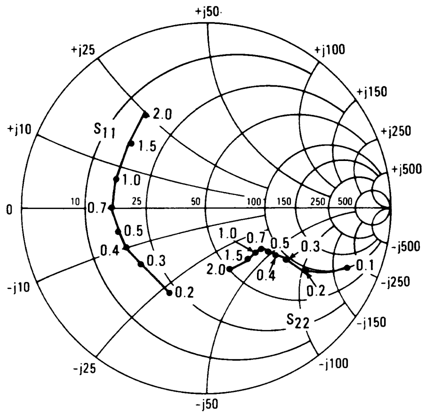
TABLE I

V_{CE} (Volts)	I_C (mA)	f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}	
			$\|S_{11}\|$	∠φ	$\|S_{21}\|$	∠φ	$\|S_{12}\|$	∠φ	$\|S_{22}\|$	∠φ
5.0	5.0	100	0.71	-38	11.30	153	0.03	68	0.92	-17
		200	0.62	-75	9.48	133	0.05	55	0.76	-29
		500	0.54	-141	5.40	100	0.07	43	0.48	-44
		1000	0.53	178	2.93	76	0.09	48	0.40	-56
		2000	0.59	130	1.51	48	0.16	62	0.35	-85
	10	100	0.57	-58	16.95	145	0.03	63	0.85	-23
		200	0.51	-103	12.61	123	0.04	53	0.64	-35
		500	0.52	-161	6.24	93	0.06	50	0.38	-45
		1000	0.52	166	3.24	73	0.09	61	0.33	-54
		2000	0.59	125	1.66	47	0.17	67	0.29	-84
	15	100	0.48	-75	20.08	139	0.02	61	0.80	-27
		200	0.47	-121	13.89	117	0.04	53	0.57	-38
		500	0.53	-170	6.44	91	0.05	56	0.34	-44
		1000	0.53	162	3.33	72	0.09	66	0.31	-52
		2000	0.60	123	1.70	46	0.18	68	0.28	-82
	20	100	0.44	-88	21.62	136	0.02	60	0.76	-28
		200	0.47	-132	14.33	114	0.03	54	0.53	-38
		500	0.53	-175	6.45	89	0.05	60	0.32	-41
		1000	0.53	159	3.31	70	0.09	68	0.31	-50
		2000	0.61	122	1.69	45	0.18	70	0.28	-80
	30	100	0.43	-112	21.45	130	0.02	58	0.72	-28
		200	0.50	-148	13.38	109	0.03	57	0.51	-33
		500	0.57	178	5.82	86	0.05	65	0.35	-34
		1000	0.57	156	2.99	68	0.08	73	0.35	-46
		2000	0.65	121	1.50	42	0.18	74	0.33	-78

TABLE II

V_{CE} (Volts)	I_C (mA)	f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}	
			$\|S_{11}\|$	∠φ	$\|S_{21}\|$	∠φ	$\|S_{12}\|$	∠φ	$\|S_{22}\|$	∠φ
10	5.0	100	0.73	-35	11.32	154	0.03	69	0.93	-14
		200	0.63	-69	9.69	135	0.05	57	0.79	-25
		500	0.53	-135	5.65	101	0.07	43	0.54	-38
		1000	0.51	-177	3.11	77	0.08	50	0.47	-48
		2000	0.57	132	1.58	48	0.14	66	0.41	-75
	10	100	0.59	-52	17.06	147	0.02	64	0.87	-19
		200	0.52	-95	13.06	125	0.04	54	0.69	-30
		500	0.49	-156	6.58	95	0.05	51	0.45	-37
		1000	0.50	170	3.44	74	0.08	62	0.41	-45
		2000	0.57	126	1.75	47	0.16	70	0.36	-72
	15	100	0.51	-66	20.36	141	0.02	63	0.83	-22
		200	0.47	-112	14.48	119	0.03	54	0.63	-31
		500	0.50	-166	6.81	92	0.05	57	0.41	-35
		1000	0.50	164	3.54	72	0.08	67	0.39	-43
		2000	0.58	124	1.78	46	0.16	72	0.35	-70
	20	100	0.47	-78	22.08	138	0.02	61	0.80	-23
		200	0.46	-123	15.07	116	0.03	55	0.60	-30
		500	0.50	-171	6.84	90	0.05	60	0.40	-32
		1000	0.51	162	3.51	71	0.08	69	0.39	-41
		2000	0.59	123	1.77	45	0.17	73	0.35	-68
	30	100	0.44	-98	22.70	133	0.02	59	0.76	-23
		200	0.47	-139	14.47	111	0.03	55	0.57	-27
		500	0.53	-177	6.33	87	0.04	65	0.43	-28
		1000	0.54	158	3.26	69	0.07	74	0.43	-39
		2000	0.62	122	1.61	42	0.16	77	0.39	-68

FIGURE 9 — INPUT AND OUTPUT REFLECTION COEFFICIENTS versus FREQUENCY (V_{CE} = 10 V, I_C = 15 mA)



Coordinates in Ohms

FIGURE 10 — FORWARD/REVERSE TRANSMISSION COEFFICIENTS versus FREQUENCY (V_{CE} = 10 V, I_C = 15 mA)

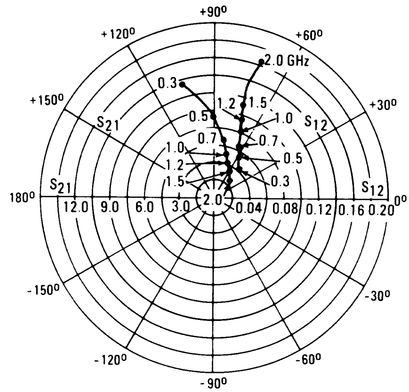


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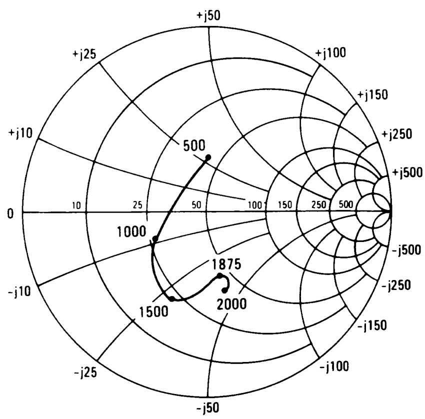
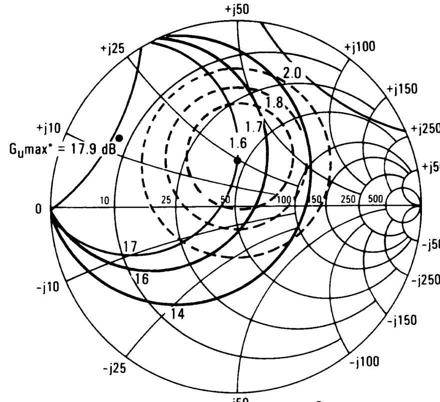
FIGURE 11 — SOURCE IMPEDANCE (Γms) FOR OPTIMUM NOISE FIGURE versus FREQUENCY (V_{CE} = 10 Vdc, I_C = 5.0 mA)



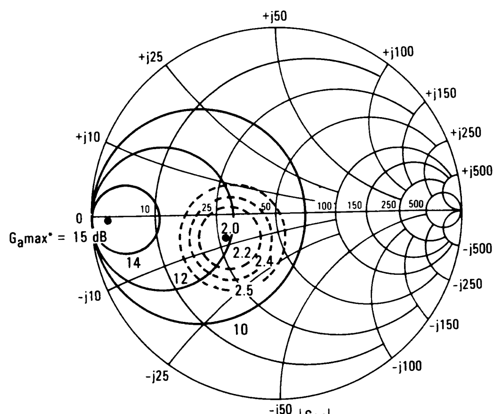
Coordinates in Ohms

FIGURE 12 — CONSTANT GAIN AND NOISE FIGURE CONTOURS
(V_{CE} = 10 Vdc, I_C = 5.0 mA f = 500 MHz)



*Maximum Unilateral Gain, $G_u max = \frac{|S_{21}|^2}{(1-|S_{11}|^2)(1-|S_{22}|^2)}$, (K < 1)

FIGURE 13 — CONSTANT GAIN AND NOISE FIGURE CONTOURS
(V_{CE} = 10 Vdc, I_C = 5.0 mA f = 1.0 GHz)



*Maximum Available Gain, $G_a max = \frac{|S_{21}|}{|S_{12}|}(K \pm \sqrt{K^2-1})$ (K > 1)