T-33-09

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

MRF331

The RF Line

10 W – 400 MHz

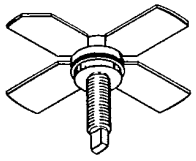
RF POWER TRANSISTOR

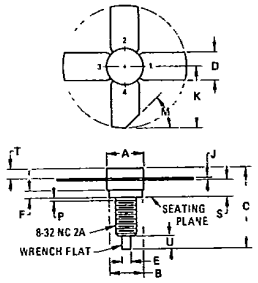
NPN SILICON

NPN SILICON RF POWER TRANSISTOR

. . . designed primarily for wideband large-signal driver and predriver amplifier stages in the 100–500 MHz frequency range.

- Guaranteed Performance at 400 MHz and 28 Vdc
  Output Power = 10 Watts
  Minimum Gain = 8 dB
  Efficiency = 55%
- 100% Tested for Load Mismatch at All Phase Angles With 30:1 VSWR
- Broadband Version of MRF321
- Gold Metallization System for High Reliability
- Controlled Wirebonding Gives High Input Impedance
- See EB74 for Broadband Circuit Details





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

DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	7.06	7.26	0.278	0.286
B	6.20	6.50	0.244	0.256
C	14.99	16.51	0.590	0.650
D	5.46	5.97	0.215	0.235
E	1.40	1.65	0.055	0.065
F	1.52	–	0.060	–
J	0.08	0.18	0.003	0.007
K	11.05	–	0.435	–
M	45° NOM		45° NOM	
P	–	1.27	–	0.050
S	3.00	3.25	0.118	0.128
T	1.40	1.78	0.055	0.070
U	2.92	3.68	0.115	0.145

CASE 244-04

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
Collector Current — Continuous — Peak	I_C	1.1 1.5	Adc
Total Device Dissipation @ T_A = 25°C (1) Derate above 25°C	P_D	27 160	Watts mW/°C
Storage Temperature Range	T_{stg}	−65 to +150	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case (2)	$R_{\theta JC}$	6.4	°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.

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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)	$V_{(BR)CEO}$	33	–	–	Vdc
Collector-Emitter Breakdown Voltage (I_C = 20 mAdc, V_{BE} = 0)	$V_{(BR)CES}$	60	–	–	Vdc
Collector-Base Breakdown Voltage (I_C = 20 mAdc, I_E = 0)	$V_{(BR)CBO}$	60	–	–	Vdc
Emitter-Base Breakdown Voltage (I_E = 2.0 mAdc, I_C = 0)	$V_{(BR)EBO}$	4.0	–	–	Vdc
Collector Cutoff Current (V_{CB} = 30 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}	20	–	80	–
DYNAMIC CHARACTERISTICS					
Output Capacitance (V_{CB} = 28 Vdc, I_E = 0, f = 1.0 MHz)	C_{ob}	–	10	12	pF
FUNCTIONAL TESTS					
Common-Emitter Amplifier Power Gain (V_{CC} = 28 Vdc, P_{out} = 10 W, f = 400 MHz)	G_{PE}	8.0	10.5	–	dB
Collector Efficiency (V_{CC} = 28 Vdc, P_{out} = 10 W, f = 400 MHz)	η	55	65	–	%
Load Mismatch (V_{CC} = 28 Vdc, P_{out} = 10 W, f = 400 MHz, VSWR = 30:1 all phase angles)	ψ	No Degradation in Power Output			

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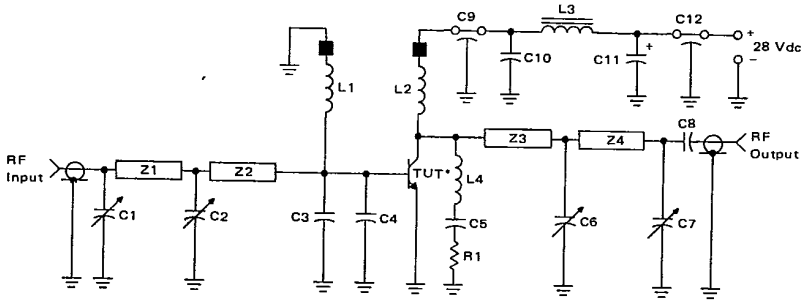
FIGURE 1 – 400 MHz TEST CIRCUIT



C1, C2, C6 – 1.0–20 pF Johanson Trimmer (JMC5501)
C3, C4 – 50 pF Chip Capacitor
C5, C10 – 0.1 μF Erie Redcap
C7 – 0.5–10 pF Johanson Trimmer (JMC5201)
C8 – 270 pF Chip Capacitor
C9, C12 – 680 pF Feedthru
C11 – 1.0 μF 50 V Tantalum

R1 – 5.1 Ω 1/4 Watt

L1, L2 – 0.15 μH Molded Choke with Ferrite Bead (Ferroxcube 56-590-65/4B)

L3 – VK-200-19/4B
L4 – 4 Turns #20 Enamel, 1/8" ID

Z1 – Microstrip 0.1" W X 1.35" L
Z2 – Microstrip 0.1" W X 0.55" L
Z3 – Microstrip 0.1" W X 0.8" L
Z4 – Microstrip 0.1" W X 1.75" L

Board – Glass Teflon ϵ_r = 2.56, t = 0.062"

Input/Output Connectors – Type N

*Transistor Under Test

FIGURE 2 – POWER GAIN versus FREQUENCY

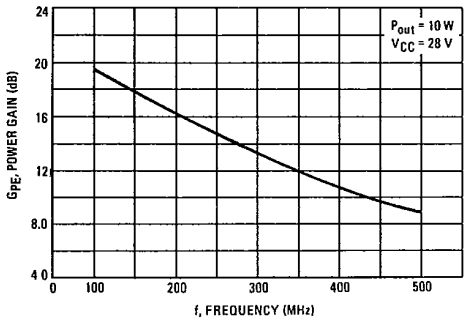


FIGURE 3 – OUTPUT POWER versus INPUT POWER

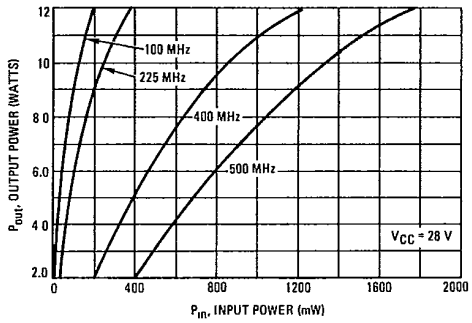


FIGURE 4 – OUTPUT POWER versus SUPPLY VOLTAGE

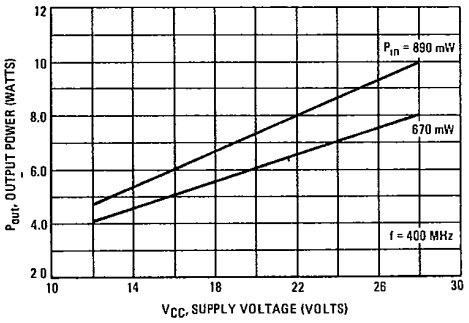


FIGURE 5 – TEST CIRCUIT

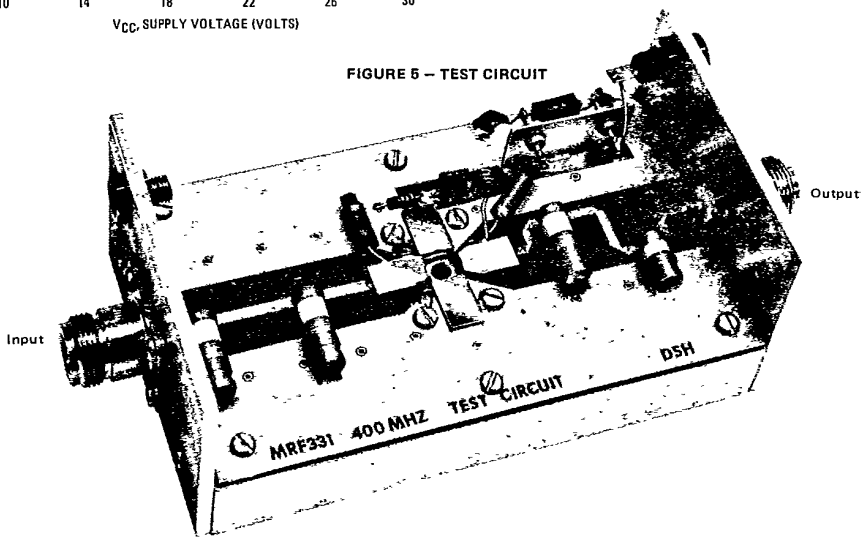
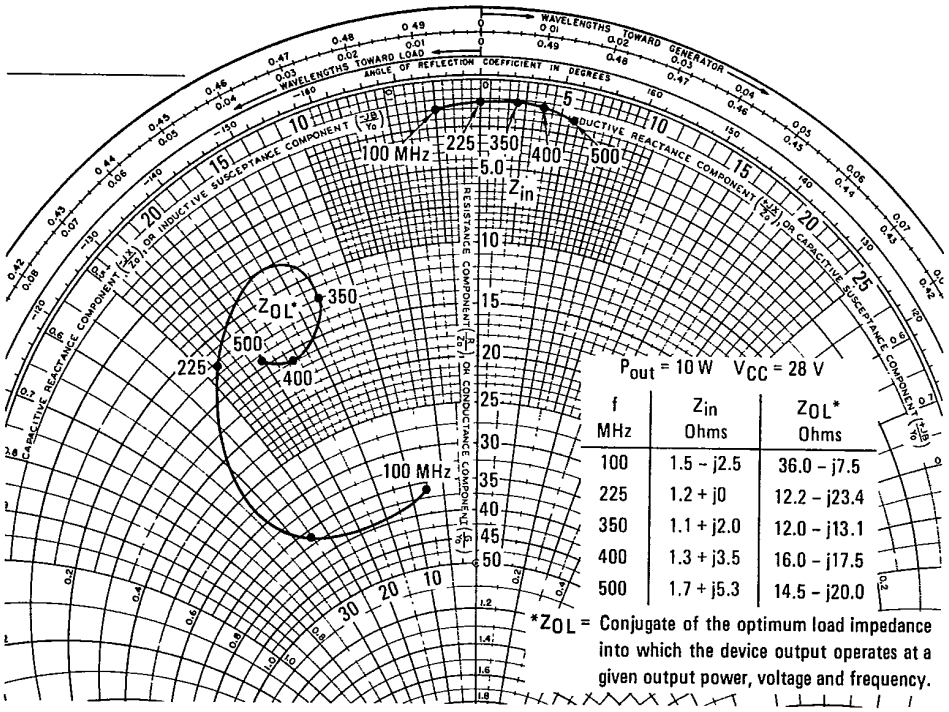


FIGURE 6 – SERIES EQUIVALENT INPUT/OUTPUT IMPEDANCE



P_{out} = 10 W V_{CC} = 28 V

f MHz	Z_{in} Ohms	Z_{OL}^* Ohms
100	1.5 – j2.5	36.0 – j7.5
225	1.2 + j0	12.2 – j23.4
350	1.1 + j2.0	12.0 – j13.1
400	1.3 + j3.5	16.0 – j17.5
500	1.7 + j5.3	14.5 – j20.0

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

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