MRF646

MOTOROLA

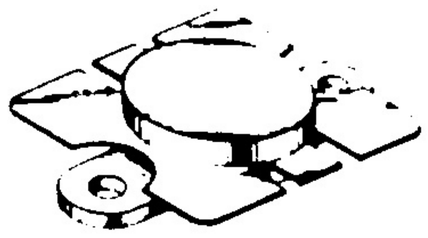
The RF Line

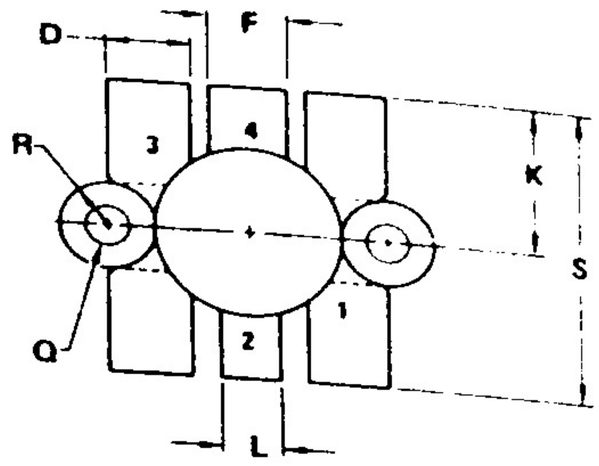
NPN SILICON RF POWER TRANSISTOR

. . . designed for 12.5 Volt UHF large-signal amplifier applications in industrial and commercial FM equipment operating to 512 MHz.

- Specified 12.5 Volt, 470 MHz Characteristics —
  Output Power = 45 Watts
  Minimum Gain = 4.8 dB
  Efficiency = 55%
- Characterized with Series Equivalent Large-Signal Impedance Parameters
- Built-In Matching Network for Broadband Operation
- Tested for Load Mismatch Stress at all Phase Angles with 20:1 VSWR @ 16-Volt High Line and 50% Overdrive.

45 W – 470 MHz
CONTROLLED Q
RF POWER TRANSISTOR
NPN SILICON





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

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	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	5.46 TYP		0.215 TYP	
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	10.67	10.92	0.420	0.430
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
S	21.34	21.84	0.840	0.860

CASE 278-06

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V_{CEO}	16	Vdc
Collector-Base Voltage	V_{CBO}	36	Vdc
Emitter-Base Voltage	V_{EBO}	4.0	Vdc
Collector Current — Continuous	I_C	9.0	Adc
Total Device Dissipation @ T_C = 25°C Derate above 25°C	P_D	117 0.67	Watts W/°C
Storage Temperature Range	T_{stg}	−65 to +150	°C

THERMAL CHARACTERISTICS

Thermal Resistance, Junction to Case	$R_{\theta JC}$	1.5	°C/W

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

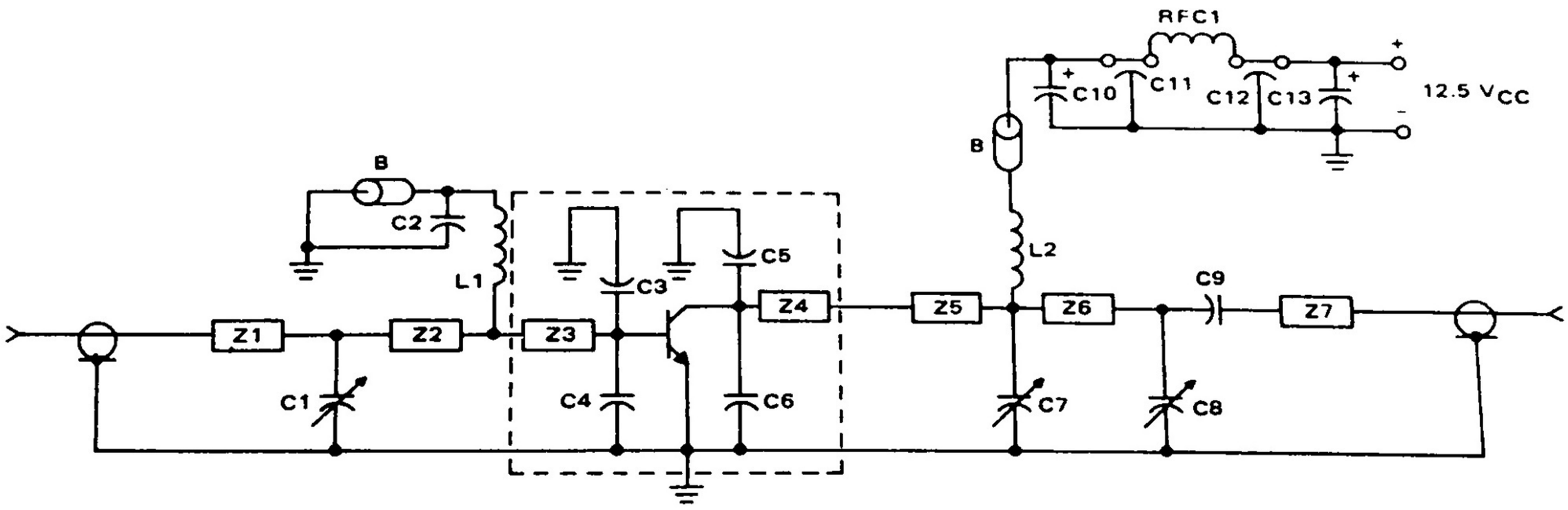
Characteristic	Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS					
Collector Emitter Breakdown Voltage (I_C = 20 mAdc, I_B = 0)	$V_{(BR)CEO}$	16	–	–	Vdc
Collector-Emitter Breakdown Voltage (I_C = 20 mAdc, V_{BE} = 0)	$V_{(BR)CES}$	36	–	–	Vdc
Emitter Base Breakdown Voltage (I_E = 5.0 mAdc, I_C = 0)	$V_{(BR)EBO}$	4.0	–	–	Vdc
Collector Cutoff Current (V_{CE} = 15 Vdc, V_{BE} = 0, T_C = 25°C)	I_{CES}	–	–	5.0	mAdc
ON CHARACTERISTICS					
DC Current Gain (I_C = 4.0 Adc, V_{CE} = 5.0 Vdc)	h_{FE}	40	70	100	
DYNAMIC CHARACTERISTICS					
Output Capacitance (V_{CB} = 12.5 Vdc, I_E = 0, f = 1.0 MHz)	C_{ob}	–	90	125	pF
FUNCTIONAL TESTS					
Common-Emitter Amplifier Power Gain (V_{CC} = 12.5 Vdc, P_{out} = 45 W, I_C (Max) = 5.8 Adc, f = 470 MHz)	G_{pe}	4.8	5.4		dB
Input Power (V_{CC} = 12.5 Vdc, P_{out} = 45 W, f = 470 MHz)	P_{in}	–	13	15	Watts
Collector Efficiency (V_{CC} = 12.5 Vdc, P_{out} = 45 W, I_C (Max) = 5.8 Adc, f = 470 MHz)	η	55	60		%
Load Mismatch Stress (V_{CC} = 16 Vdc, P_{in} = Note 1, f = 470 MHz, VSWR = 20:1, All Phase Angles)	ψ •	No Degradation in Output Power			
Series Equivalent Input Impedance (V_{CC} = 12.5 Vdc, P_{out} = 45 W, f = 470 MHz)	Z_{in}	–	1.4 + j4.0		Ohms
Series Equivalent Output Impedance (V_{CC} = 12.5 Vdc, P_{out} = 45 W, f = 470 MHz)	Z_{OL}	–	1.2 + j2.8		Ohms

Notes:

1. P_{in} = 150% of Drive Requirement for 45 W output @ 12.5 V.

• ψ = Mismatch stress factor—the electrical criterion established to verify the device resistance to load mismatch failure. The mismatch stress test is accomplished in the standard test fixture (Figure 1) terminated in a 20:1 minimum load mismatch at all phase angles.

FIGURE 1 – TEST CIRCUIT SCHEMATIC



C1, C8	1.0–20 pF JOHANSON	L2	5" # 20 AWG, 0.1" I.D.
C2	100 pF UNELCO	RFC1	Ferroxcube VR200-20-4B
C3, C6	33 pF 100 mil ATC	Z1	0.525" x 0.190" Microstrip
C4	30 pF 100 mil ATC	Z2	1.475" x 0.190" Microstrip
C5	39 pF 100 mil ATC	Z3, Z4	(0.2 x 0.2)/0.25 Alumina
C7	1–10 pF JOHANSON	Z5	0.190" x 0.190" Microstrip
C9	100 pF 100 mil ATC	Z6	1.150" x 0.190" Microstrip
C10, C13	1 µF 35 V TANTALUM	Z7	0.660" x 0.190" Microstrip
C11, C12	680 pF Feedthrough	Board	62.5 mil Glass Teflon, ϵ_R = 2.55, λ = 0.0018
B	Ferroxcube Bead 56-590-65-3B		
L1	5" # 22 AWG, 0.1" I.D.		

FIGURE 2 – POWER OUTPUT versus POWER INPUT

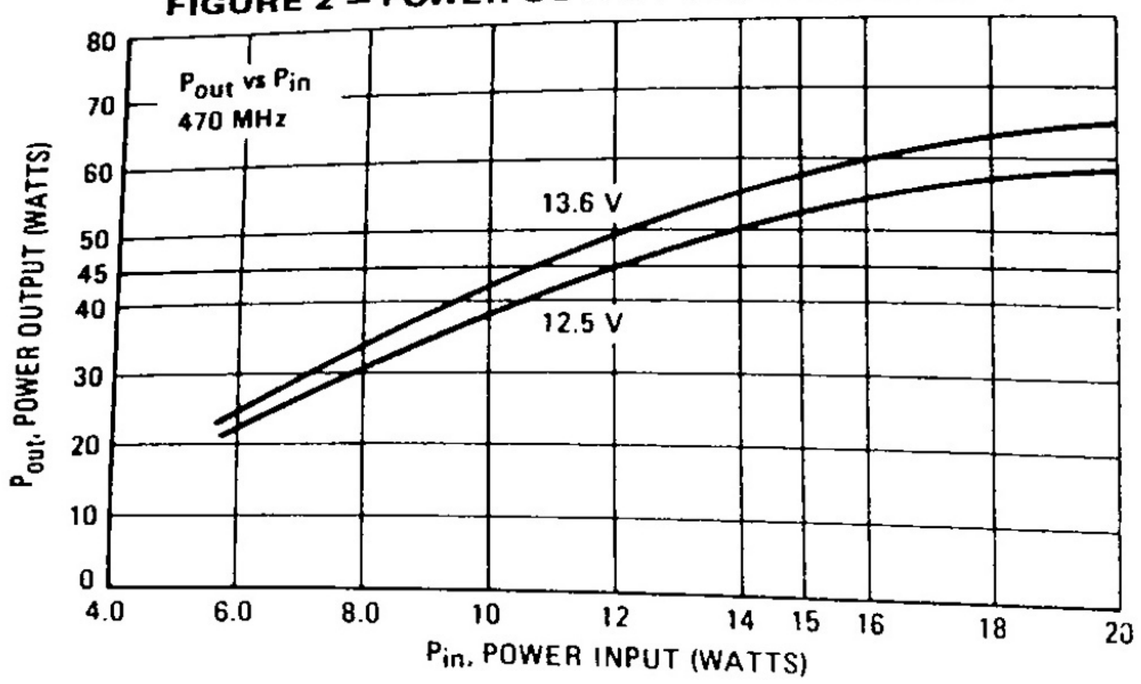


FIGURE 3 – POWER OUTPUT versus FREQUENCY

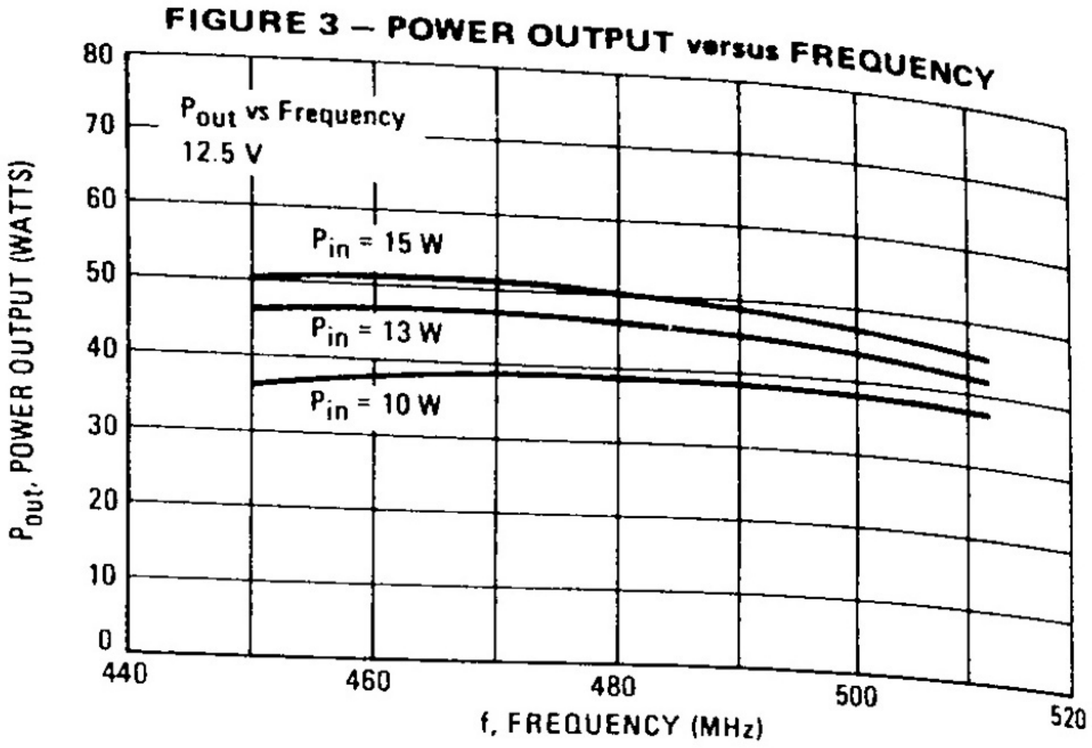


FIGURE 4 – POWER OUTPUT versus SUPPLY VOLTAGE

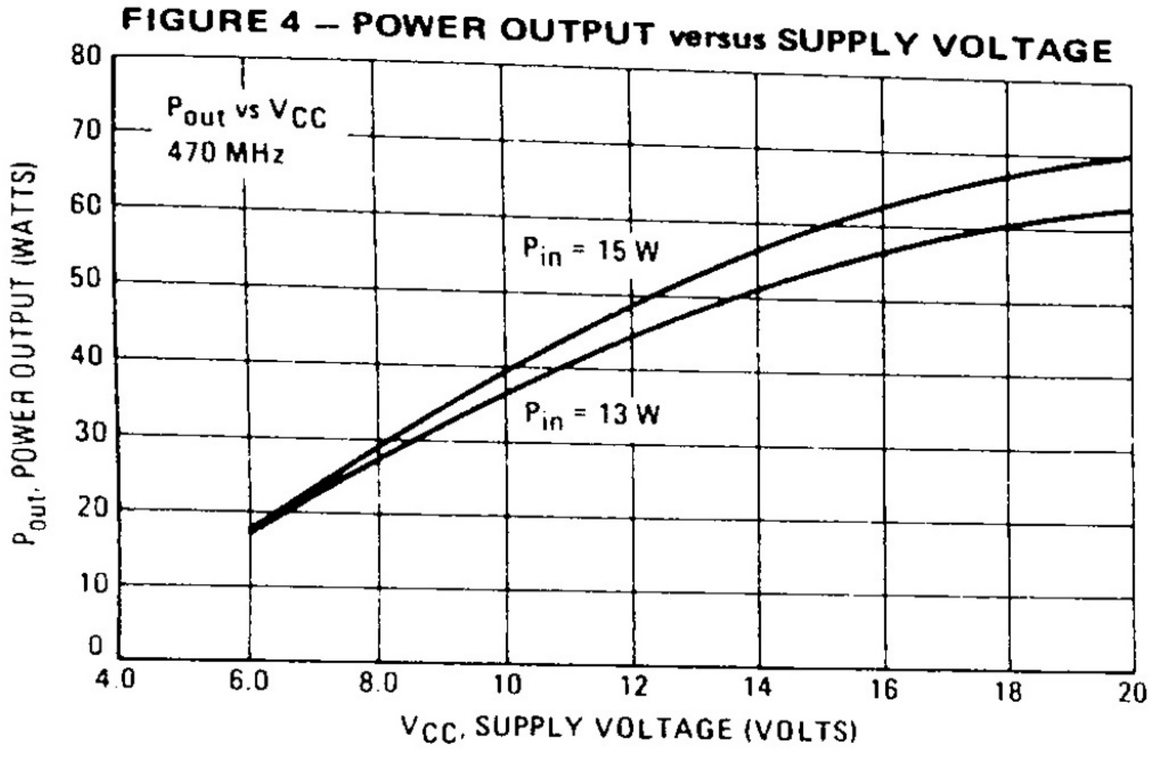


FIGURE 5 – POWER SATURATION PROFILE

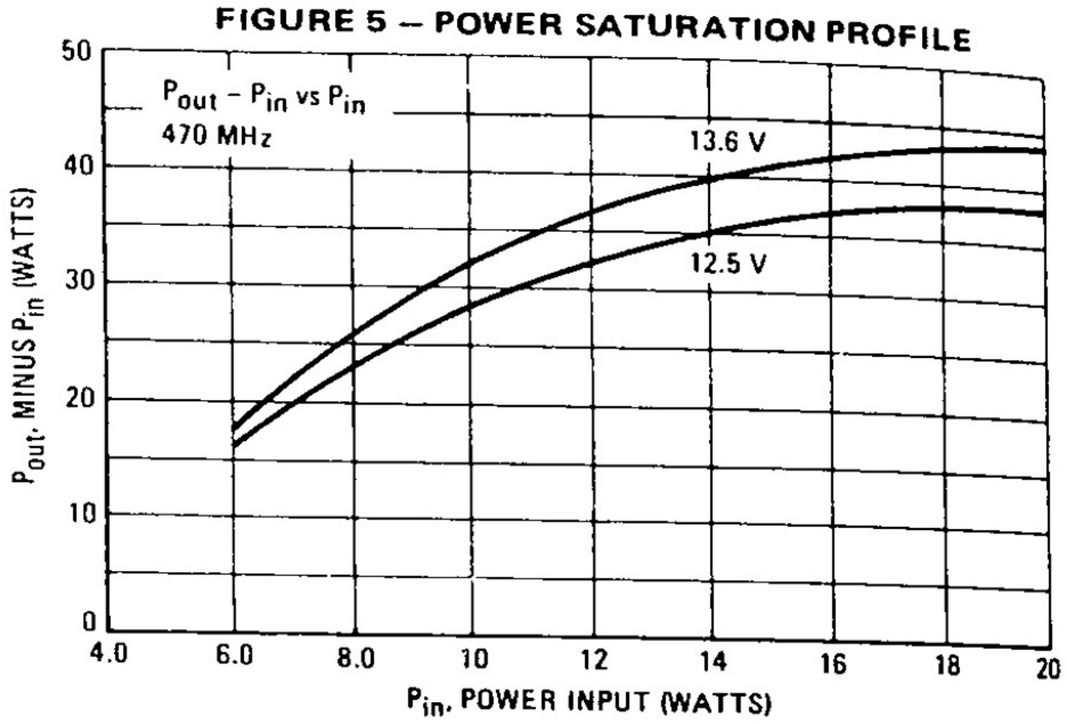
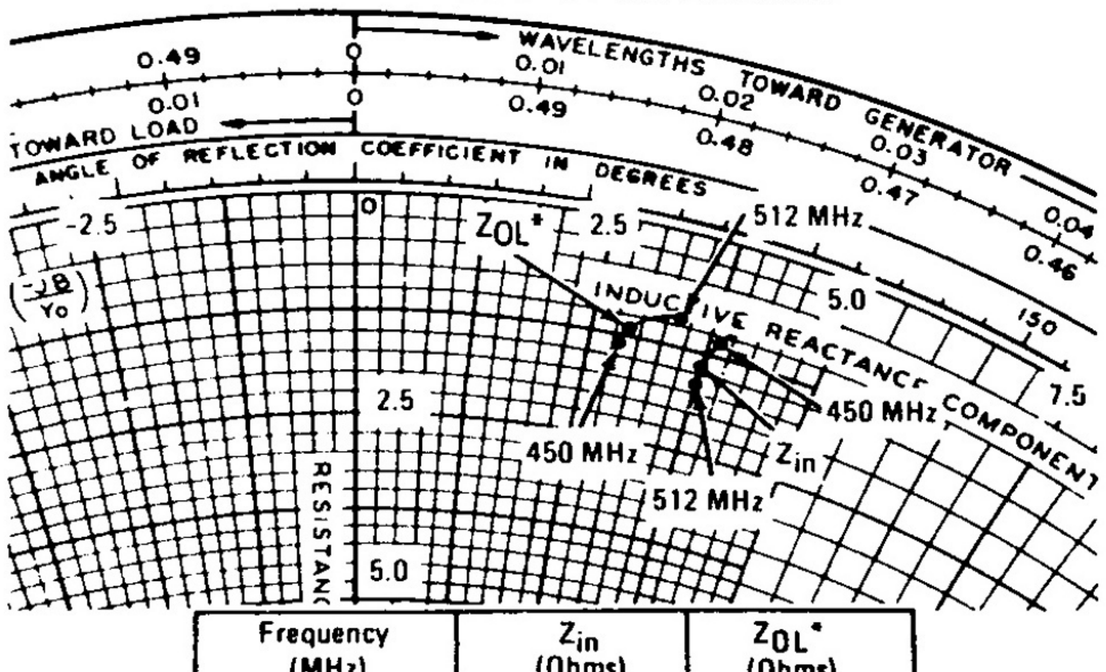
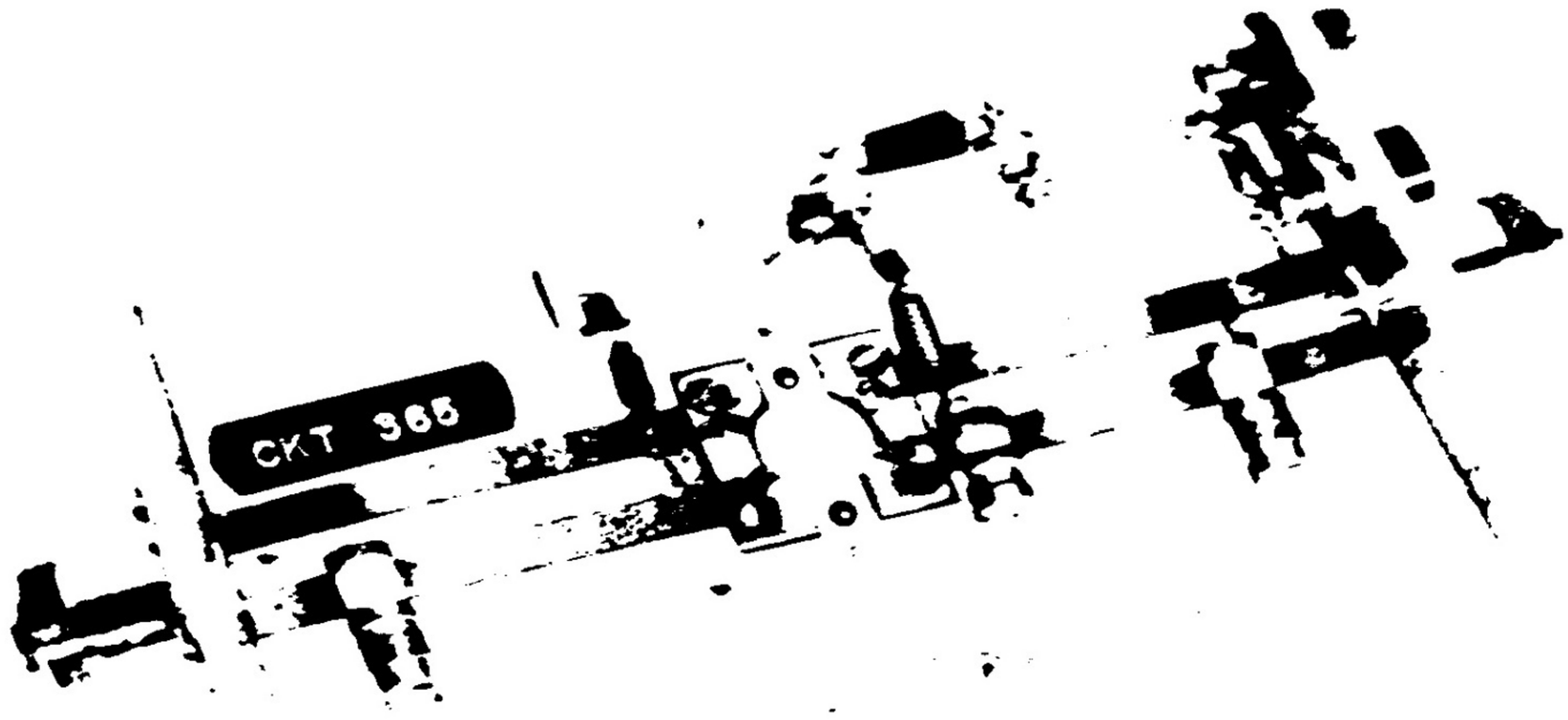


FIGURE 7 – SERIES EQUIVALENT
INPUT-OUTPUT IMPEDANCE

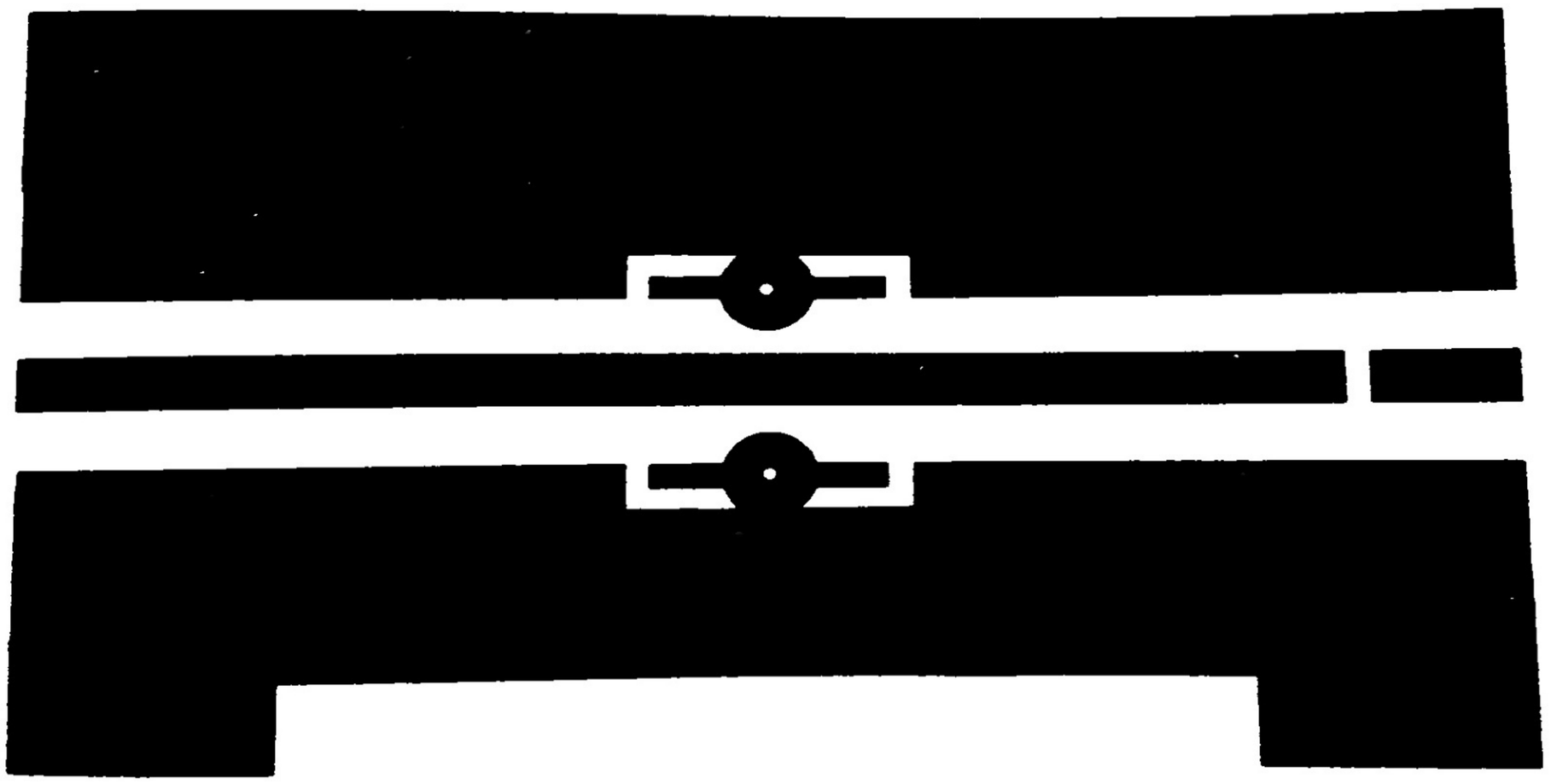


Frequency (MHz)	Z_{in} (Ohms)	Z_{OL}* (Ohms)
450	1.21 + j3.91	1.27 + j2.79
470	1.41 + j3.75	1.20 + j2.80
512	1.64 + j3.75	0.93 + j3.36

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



TEST CIRCUIT TEST FIXTURE



MRF646 TEST CIRCUIT 8/75 REV. 01