

S-Band Radar Transistor

The high power pulsed radar transistor device part number IB2731MH25 is designed for S-Band radar systems operating over the instantaneous bandwidth of 2.7-3.1 GHz. While operating in class C mode this common base device supplies a minimum of 25 watts of peak pulse power under the conditions of 200µs pulse width and 10% duty cycle. All devices are 100% screened for large signal RF parameters, including power gain compression. Excellent spectral stability into output mismatch over a broad input power range make it ideal for use in reliable high power solid state transmitters.



- Silicon Bipolar
 - Ultra-high f_T
- Class C Operation
 - High Efficiency
- Common Base Configuration
 - Single Power Supply
- Gold Metal
 - Maximum Reliability
- Emitter Ballasting
 - Optimum Thermal Distribution
- Internal Impedance Matching
 - Ease of Use
 - Ultra-low Loss Design
- BeO Package
 - Unmatched Thermal Reliability
 - Solder Seal Hermeticity
- RF Test Fixture
 - Broadband
 - Matched to 50Ω
 - Long-term Correlation
 - 100% Device RF Screening
 - No External Tuning Allowed
- Insertion Phase Marking
 - 5° Increment Marking
- Patents Issued
 - US 6181200 B1
 - US 6331931 B1

TYPICAL DATA		TYPICAL DATA		TYPICAL DATA		TYPICAL DATA		TYPICAL DATA		TYPICAL DATA		TYPICAL DATA		TYPICAL DATA		TYPICAL DATA	
Test Sequence Name	Freq (GHz)	PW (us)	Duty (%)	Vcc (V)	P _{IN} (W)	IRL (dB)	P _{OUT} (W)	G _p (dB)	OPC (dB)	OPF (dB)	I _c (A)	n _c (%)	Droop (dB)	VSWR 1.5:1	VSWR 3:1		
OPC	2.700	200	10	36.0	3.1	--	36	--	0.25	--	--	--	--	--	--		
Nominal	2.700	200	10	36.0	2.8	-10	34	10.9	--	0.55	1.85	51	-0.070	--	P		
1.5:1 Stability/OD	2.700	200	10	36.0	3.3	--	--	--	--	--	--	--	--	S	--		
OPC	2.900	200	10	36.0	3.1	--	33	--	0.43	--	--	--	--	--	--		
Nominal	2.900	200	10	36.0	2.8	-12	30	10.3	--	--	1.79	47	-0.010	--	P		
1.5:1 Stability/OD	2.900	200	10	36.0	3.3	--	--	--	--	--	--	--	--	S	--		
OPC	3.100	200	10	36.0	3.1	--	33	--	0.15	--	--	--	--	--	--		
Nominal	3.100	200	10	36.0	2.8	-14	32	10.5	--	--	1.83	48	-0.430	--	P		
1.5:1 Stability/OD	3.100	200	10	36.0	3.3	--	--	--	--	--	--	--	--	S	--		

MAXIMUM RATINGS

Screen	Parameter	Symbol	Min	Max	Units	Test Conditions
BD	Collector-Emitter Voltage	V_{CES}	--	70	V	$V_{BE}=0V$.
BD	Emitter-Base Voltage	V_{EBO}	--	2.5	V	--
BD	Storage Temperature Range	T_{STG}	-65	+200	°C	--
BD	Operating Junction Temperature Range	T_J	-55	+200	°C	--
Note	Screen 'BD' = parameter qualified By Design.					

THERMAL CHARACTERISTICS

Screen	Parameter	Symbol	Min	Max	Units	Test Conditions
BD	Thermal Resistance	$R_{TH(JC)}$	--	1.20	°C/W	$V_{CC}=V1, PW=PW1, DF=DF1, T_F=25\pm5^\circ C, P_{OUT}=25W$.
Note	Screen 'BD' = parameter qualified By Design.					

PROCESSING SPECIFICATIONS

Screen	Parameter	Symbol	Min	Max	Units	Test Conditions
100%	DC Wafer Probe	--	--	--	--	Per Integra specification.
Q1	Wafer DC and RF Qualification	--	--	--	--	Per Integra specification.
LM	Wire Bond Strength	--	--	--	--	Line monitor per Integra specification.
100%	Pre-cap visual inspection	--	--	--	--	Per Integra specification.
100%	Gross leak test	--	--	--	--	MIL-STD-750D, Method 1071.6, Test Condition C.
Note	Screen 'Q1' = parameter is qualified by assembly and test of 3 pieces minimum per wafer.					
Note	Screen 'LM' = parameter is qualified by assembly line monitor.					

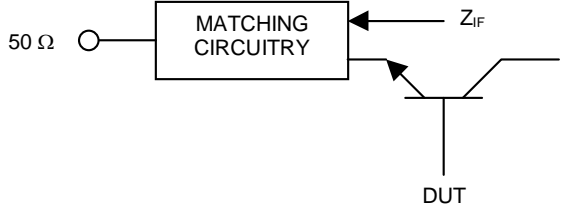
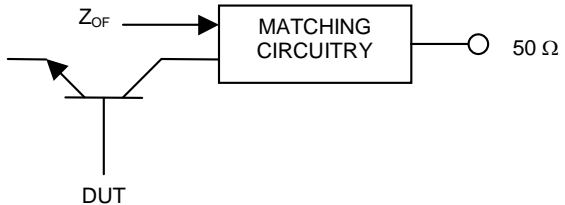
DC ELECTRICAL CHARACTERISTICS

Screen	Parameter	Symbol	Min	Max	Units	Test Conditions
100%	Collector-Emitter Breakdown Voltage	BV_{CES}	70	--	V	$I_C=10mA, V_{BE}=0V, T_F=25\pm5^\circ C$.
100%	Zero Base Voltage Collector Leakage Current	I_{CES}	--	1.5	mA	$V_{CE}=30V, V_{BE}=0V, T_F=25\pm5^\circ C$.
100%	DC Current Gain	H_{FE}	10	150	--	$V_{CE}=5V, I_C=0.1A, T_F=25\pm5^\circ C$.

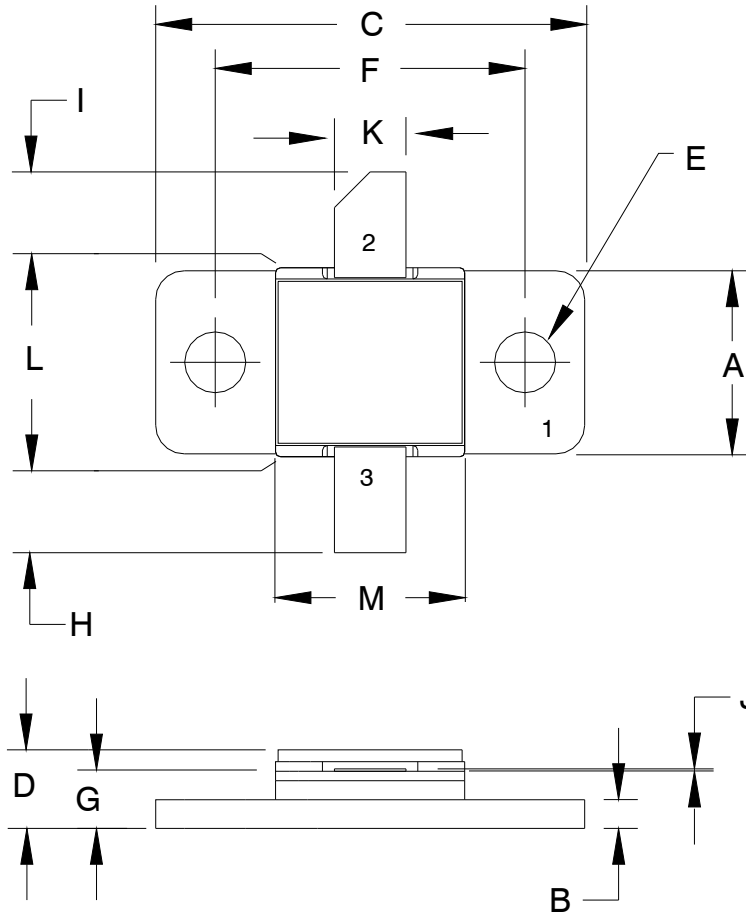
RF ELECTRICAL CHARACTERISTICS

Screen	Parameter	Symbol	Min	Max	Units	Test Conditions
100%	Input Return Loss	IRL	8	--	dB	$V_{CC}=V1, PW=PW1, DF=DF1, T_F=25\pm5^\circ C, P_{IN}=P_{IN1}, P_{IN2}, P_{IN3}, F=F1, F2, F3.$
100%	Output Power 1	P_{O1}	25	--	W	$V_{CC}=V1, PW=PW1, DF=DF1, T_F=25\pm5^\circ C, P_{IN}=P_{IN1}, F=F1.$
100%	Output Power 2	P_{O2}	25	--	W	$V_{CC}=V1, PW=PW1, DF=DF1, T_F=25\pm5^\circ C, P_{IN}=P_{IN2}, F=F2.$
100%	Output Power 3	P_{O3}	25	--	W	$V_{CC}=V1, PW=PW1, DF=DF1, T_F=25\pm5^\circ C, P_{IN}=P_{IN3}, F=F3.$
100%	Collector Efficiency ($P_O/I_C/V_{CC}$) 1	N_{C1}	36	--	%	$V_{CC}=V1, PW=PW1, DF=DF1, T_F=25\pm5^\circ C, P_{IN}=P_{IN1}, F=F1.$
100%	Collector Efficiency ($P_O/I_C/V_{CC}$) 2	N_{C2}	36	--	%	$V_{CC}=V1, PW=PW1, DF=DF1, T_F=25\pm5^\circ C, P_{IN}=P_{IN2}, F=F2.$
100%	Collector Efficiency ($P_O/I_C/V_{CC}$) 3	N_{C3}	36	--	%	$V_{CC}=V1, PW=PW1, DF=DF1, T_F=25\pm5^\circ C, P_{IN}=P_{IN3}, F=F3.$
100%	Pulse Amplitude Droop	D	-0.7	--	dB	$V_{CC}=V1, PW=PW1, DF=DF1, T_F=25\pm5^\circ C, P_{IN}=P_{IN1}, P_{IN2}, P_{IN3}, F=F1, F2, F3.$
100%	Output Power Flatness = $10 \cdot \text{LOG}(P_{OMAX}/P_{OMIN})$	OPF	--	1.0	dB	Calculate from P_O at each frequency F.
100%	Output Power Compression = $10 \cdot \text{LOG}(P_{OC}/P_O)$	OPC	-0.02	+0.52	dB	P_{OC} measured with P_{IN} increased by 0.5dB at $F=F1, F2, F3.$
100%	Delta Insertion Phase Variation	d-IP	-30	+30	Deg	$V_{CC}=V1, PW=PW1, DF=DF1, T_F=25\pm5^\circ C, P_{IN}=P_{IN2}, F=F2, F3.$ Mark in 5° increments.
100%	Stability into 1.5:1 VSWR	VSWR-S	--	--	--	$V_{CC}=V1, PW=PW1, DF=DF1, T_F=25\pm5^\circ C, P_{IN}=P_{IN1} + 0.75 \text{ dB}, F=F1, F2, F3.$ Rotate 1.5:1 output VSWR through 360° phase. No oscillatory or pulse break-up characteristics allowed on detected output pulse. All non-harmonically related signals must be at least -65 dBc.
100%	3:1 Load Mismatch Tolerance	LMT	--	--	--	$V_{CC}=V1, PW=PW1, DF=DF1, T_F=25\pm5^\circ C, P_{IN}=P_{IN1}, P_{IN2}, P_{IN3}, F=F1, F2, F3.$ Rotate 3:1 output VSWR through 360° phase. Post test $P_O = \text{Pre test } P_O \pm 0.20 \text{ dB}.$
BD	Pulse Rise time	RT	--	150	ns	$V_{CC}=V1, PW=PW1, DF=DF1, T_F=25\pm5^\circ C, P_{IN}=P_{IN1}, P_{IN2}, P_{IN3}, F=F1, F2, F3.$ Measure between 10% and 90% detected power points.
Note	$V1 = 36V; PW1 = 200\mu s; DF1 = 10\%; P_{IN1} = P_{IN2} = P_{IN3} = 2.8W; F1 = 2.7 \text{ GHz}, F2 = 2.9 \text{ GHz}, F3 = 3.1 \text{ GHz}.$					
Note	$T_F = \text{Device flange temperature}.$					
Note	Parts are binned and marked in 5 degree increments for Insertion Phase IP : ITI -1, -2, -3, -4, -5, -6, -7, -8, -9, -10, -11, -12.					
Note	Screen 'BD' = parameter qualified By Design.					

BROADBAND RF TEST FIXTURE IMPEDANCE CHARACTERISTICS

Frequency (GHz)	$Z_{IF} (\Omega)$	$Z_{OF} (\Omega)$
2.7	5.70 -j 9.16	20.17 -j 4.94
2.9	4.70 -j 8.0	14.47 -j 5.18
3.1	4.10 -j 7.0	12 -j 3.46
Impedance Definition		

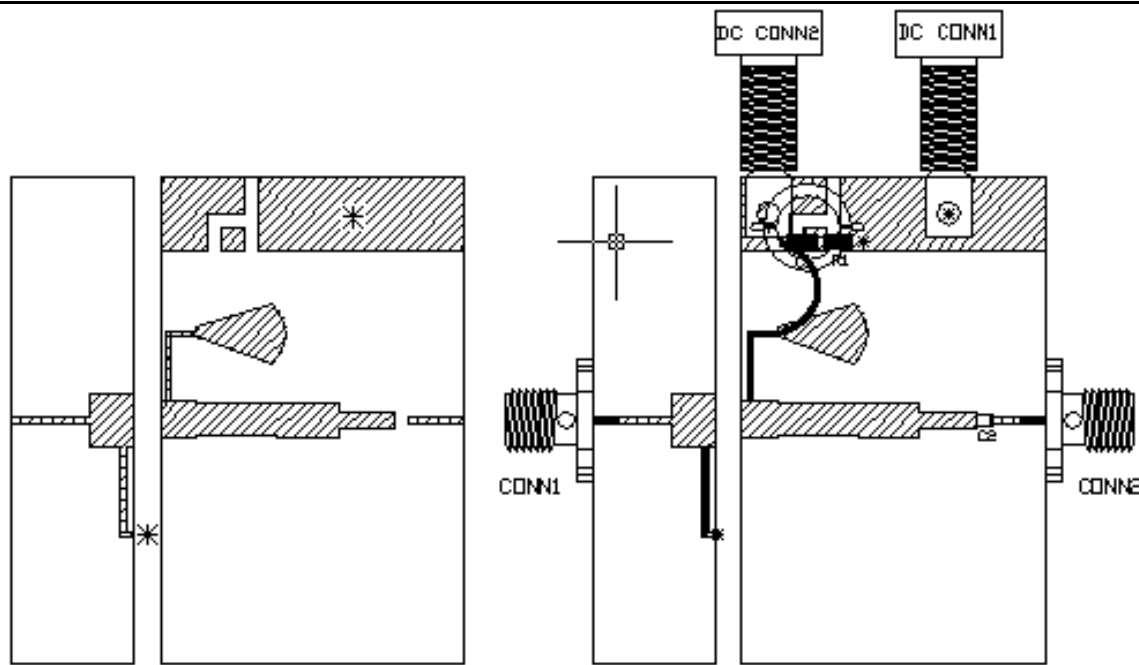
PACKAGE DIMENSIONAL OUTLINE DRAWING



DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.380	0.390	9.65	9.91
B	0.058	0.062	1.47	1.57
C	0.895	0.905	22.73	22.99
D	0.155	0.175	3.93	4.44
E	0.125	0.135	3.18	3.43
F	0.645	0.655	16.38	16.64
G	0.112	0.132	2.84	3.35
H	0.190	0.210	4.82	5.33
I	0.190	0.210	4.82	5.33
J	0.002	0.005	0.05	0.13
K	0.140	0.160	3.55	4.06
L	0.392	0.402	9.95	10.21
M	0.392	0.402	9.95	10.21

PIN	
1	BASE
2	COLLECTOR
3	EMITTER

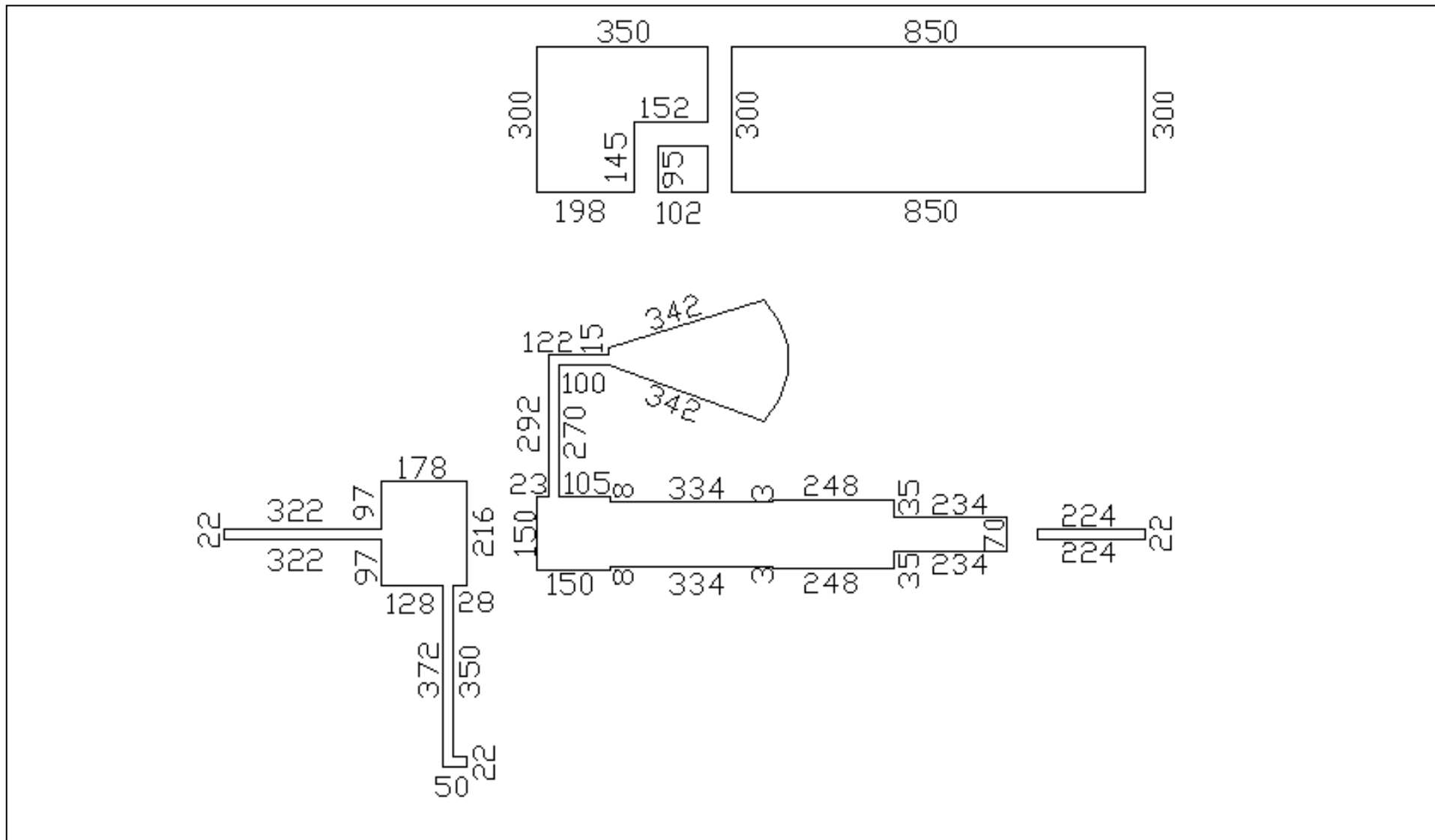
BROADBAND RF TEST FIXTURE



COMPONENT	DESCRIPTION
DUT	TRANSISTOR #IB2731MH25, MOUNT HARD TO THE RIGHT
PC BOARD	ROGERS #RD6010.2LM, TH=0.025" 1oz. Cu
C1	SNOB CAPACITOR, 0.1uF
C2	CHIP CAPACITOR 39pF
C3	ELECTROLYTIC CAPACITOR 68uF/63V
C4 (NOT SHOWN)	ELECTROLYTIC CAPACITOR 4700uF/50V
R1	SNOB RESISTOR 6.81 OHMS
GS	GROUND SHIM, COPPER, TH=0.001"
CONN1, CONN2	SMA CONNECTOR, TYPE DS #2052-5636-02
INPUT PC BOARD CARRIER	2 INCH BRASS - 01 (0.5")
OUTPUT PC BOARD CARRIER	2 INCH BRASS - 04 (1.25")
TRANSISTOR CARRIER	2 INCH COPPER - 02
TRANSISTOR CLAMP	NORYL CLAMP - 02
HEATSINK	2 INCH HEATSINK - 09
DC CONN1	BANANA JACK, BLACK
DC CONN2	BANANA JACK, RED
NOTE	FIXTURE HARDWARE LISTINGS AVAILABLE ON REQUEST

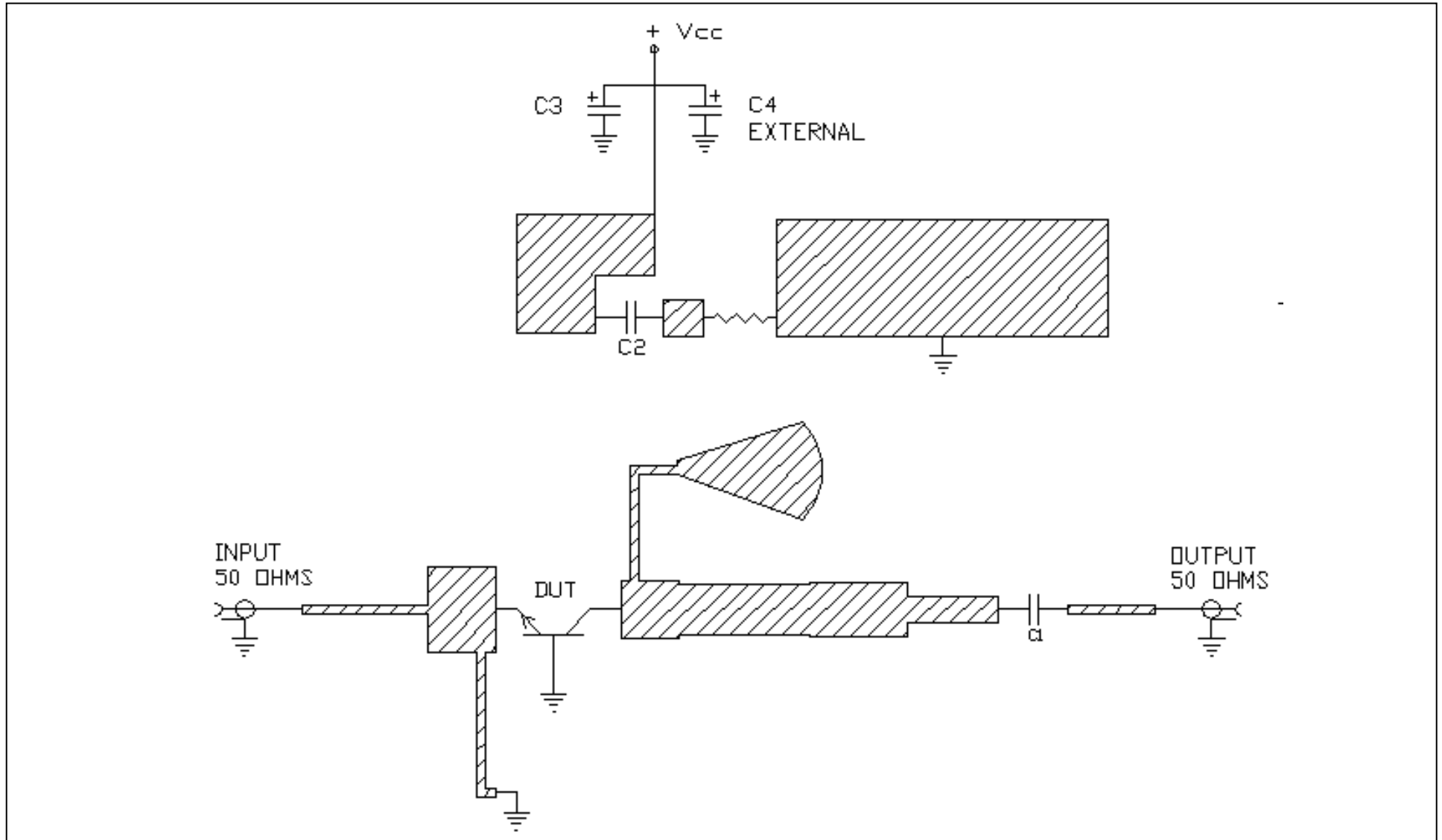
ASSEMBLY AND PARTS LIST

BROADBAND RF TEST FIXTURE

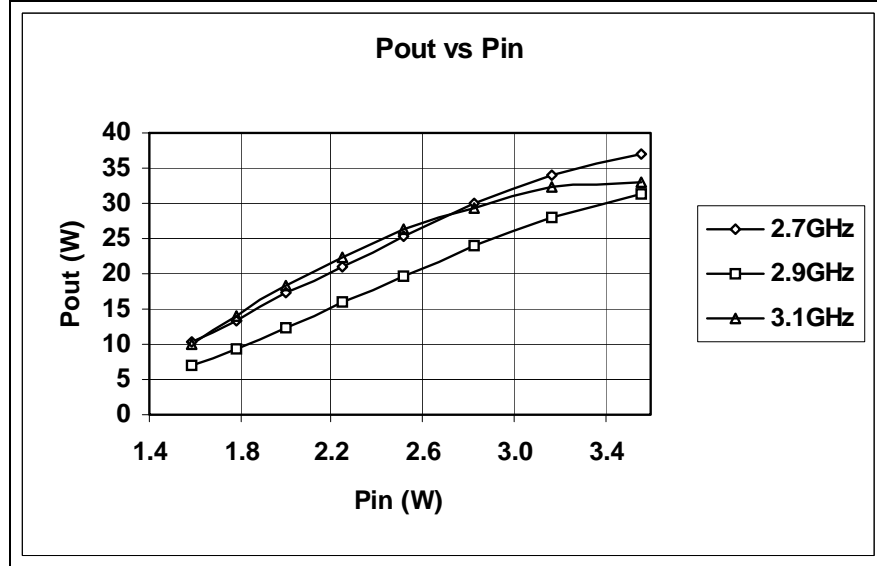


CIRCUIT DIMENSIONS IN MILS

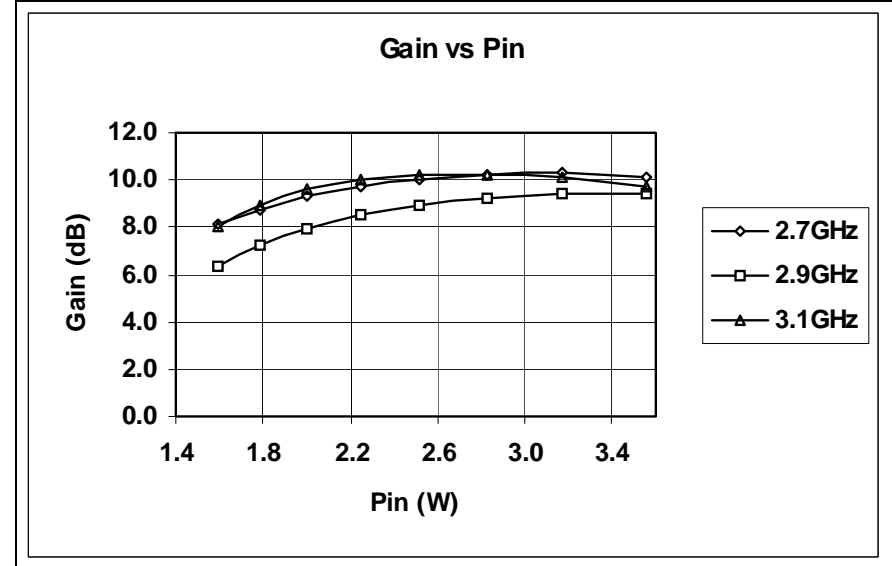
BROADBAND RF TEST FIXTURE



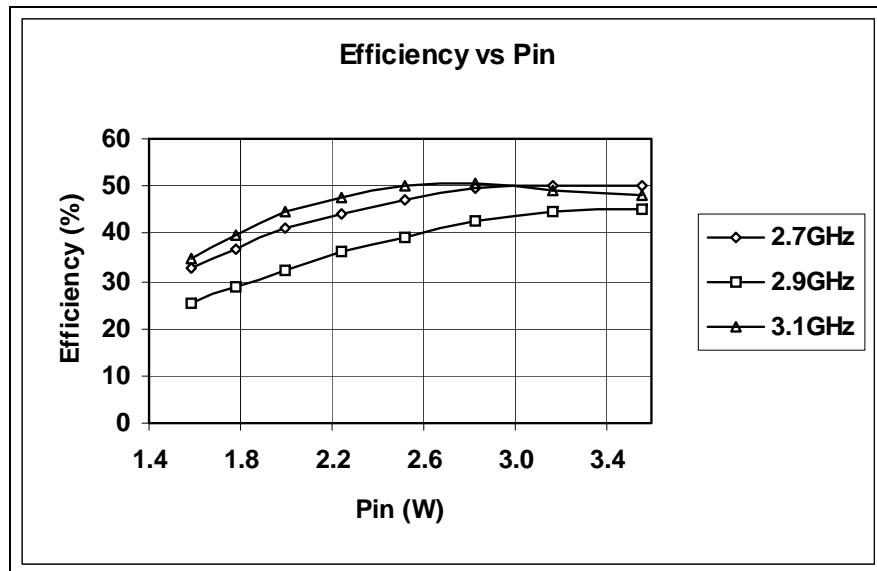
ELECTRICAL SCHEMATIC



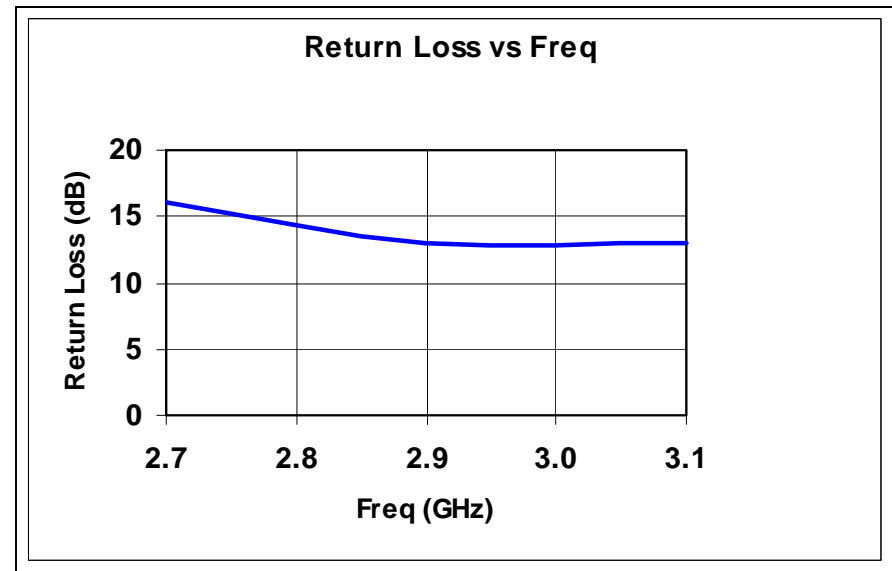
Typical values, $V_{cb} = 36\text{ V}$, $200\mu\text{s}$ RF pulse, 10% duty cycle



Typical values, $V_{cb} = 36\text{ V}$, $200\mu\text{s}$ RF pulse, 10% duty cycle



Typical values, $V_{cb} = 36\text{ V}$, $200\mu\text{s}$ RF pulse, 10% duty cycle



Typical values, $V_{cb} = 36\text{ V}$, $200\mu\text{s}$ RF pulse, 10% duty cycle, $P_{in} = 3.3\text{ W}$

DEFINITIONS

Data Sheet Status	
Proposed Specification	This data sheet contains proposed specifications.
Preliminary Specification	This data sheet contains specifications based on preliminary measurements and data.
Product Specification	This data sheet contains final product specifications.
Maximum Ratings	
Stress above one or more of the maximum ratings may cause permanent damage to the device. These are maximum ratings only and operation of the device at these or at any other conditions above those given in the characteristics sections of the specification is not implied. Exposure to maximum values for extended periods of time may affect device reliability.	

WARNING

Product and environmental safety - toxic materials
This product contains beryllium oxide. The product is entirely safe provided that the BeO base is not damaged. All persons who handle, use or dispose of this product should be aware of its nature and of the necessary safety precautions. After use, dispose of as chemical or special waste according to the regulations applying at the location of the user. It must never be thrown out with general or domestic waste.

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