CLASS: B.E. E &TC **SUBJECT: RMT**
EXPT. NO.: 4 **DATE:**

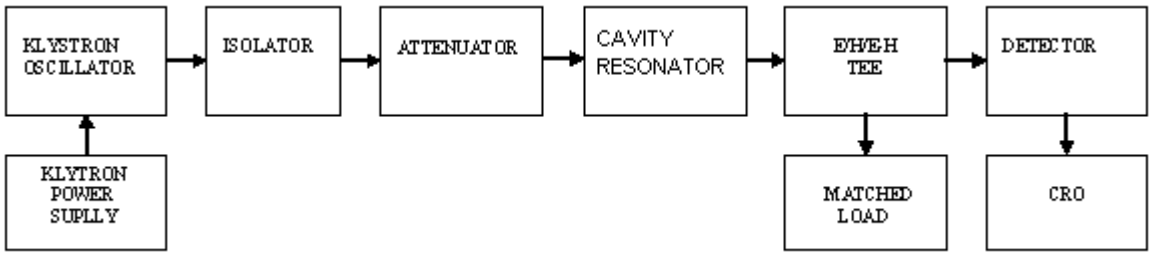
Roll No.: 42428

TITLE: To measure and verify port characteristics of microwave tees (E, H, E-H or magic planes).

OBJECTIVE:- To Verify the performance of E-plane Tee, H-plane Tee and E-H plane (Magic) tee

EQUIPMENTS:- Microwave oscillator,
Attenuator,
Isolator,
Frequency meter
E, H and E-H plane (magic) tees,
Detector mounts,
CRO
Matched loads.

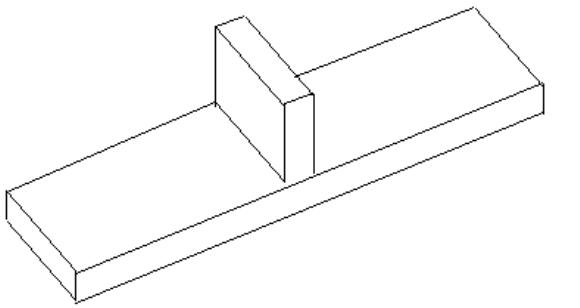
SETUP_DIAGRAM:-



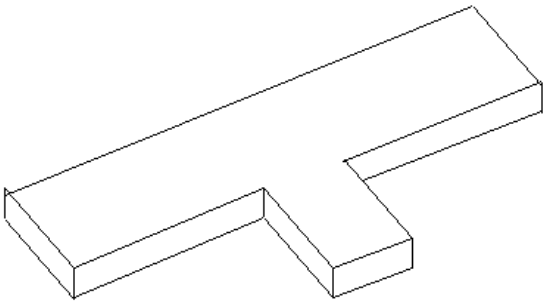
PROCEDURE:

1. Energize the microwave source for particular operation. Adjust the repeller voltage to get maximum signal voltage at the output. Tune the detector mount for maximum output. [Without any TEE connected]
2. Now feed this power to port 1. of E plane tee.

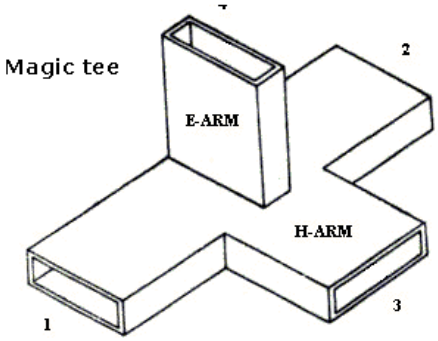
3. Connect a matched load at port 2 and then measure the voltage at port 3 by connecting the detector.
4. Then measure the voltage at port 2 by interchanging the detector and matched load. Tabulate the readings.
5. Repeat the steps 2 to 4 for all orientation of tee i. e 2 and then 3
6. Verify their port characteristics. Determine coupling and isolation by knowing input and output
7. Repeat steps 2 to 6 for H-plane.
8. Similarly, verify the port characteristics of E-H plane (magic) Tee also.



E-Plane Tee



H-Plane Tee



OBSERVATION TABLE:

Beam Voltage = 238 V

Beam Current = 14 mA

Repeller voltage = -241 V

Frequency = 11.75 GHz

E plane tee

Input arm Voltage (V)	Output arm Voltage (V)	Matched Arm	Isolation / Attenuation $\alpha = 20\log_{10}(\frac{input-voltage}{output-voltage})db$	Coupling factor C $C = 10^{-\alpha/20}$
1=1.26	2= 1.20	3	0.423785	0.95238
1=1.26	3=686m	2	5.280928	0.54444
2=1.26	1=1.03	3	1.750666	0.81746
2=1.26	3=668m	1	5.511881	0.53015
3=1.26	1=645m	2	5.816216	0.51190
3=1.26	2=743m	1	4.587634	0.58968

H plane

Input arm Voltage (V)	Output arm Voltage (V)	Matched Arm	Isolation / Attenuation $\alpha = 20\log_{10}(\frac{input-voltage}{output-voltage})db$	Coupling factor C $C = 10^{-\alpha/20}$
1=5.52	2=4.39	3	1.989491	0.79528
1=5.52	3=3.60	2	3.712731	0.65217
2=5.52	1=3.88	3	3.062147	0.70289
2=5.52	3=3.72	1	3.427922	0.67391
3=5.52	1=2.77	2	5.989186	0.50181
3=5.52	2=2.29	1	7.642071	0.41485

Magic tee

Input arm Voltage (V)	Output arm Voltage (V)	Matched Arm	Isolation / Attenuation $\alpha = 20\log_{10}(\frac{input-voltage}{output-voltage})db$	Coupling factor C $C = 10^{-\alpha/20}$
1=1.26	2=402m	3, 4	9.922889	0.31904
1=1.26	3=1.26	2, 4	0	1
1=1.26	4=1.21	2, 3	0.351703	0.96031
2=1.26	1=350m	3, 4	11.126050	0.27777
2=1.26	3=1.21	1, 4	0.351703	0.96031
2=1.26	4=1.23	1, 3	0.209308	0.97619
3=1.26	1=1.02	2, 4	1.835407	0.80952
3=1.26	2=1.10	1, 4	1.179557	0.87301
3=1.26	4=686m	2, 1	5.280928	0.54444
4=1.26	1=1.31	2, 3	-0.338015	1.03968
4=1.26	2=1.27	1, 3	-0.068663	1.00793
4=1.26	3=100m	1, 2	22.007411	0.07936

CALCULATIONS:-

For E-plane Tee

$\alpha = 20\log_{10}(1.26/1.20) = 20\log_{10}(1.05) = 0.4237859dB$

$c = 10^{-0.4237859/20} = 10^{-0.0211893} = 0.95238$

For H-plane Tee

$\alpha = 20\log_{10}(5.52/4.39) = 20\log_{10}(1.2574032) = 1.98949115dB$

$c = 10^{-1.98949115/20} = 10^{-0.09947456} = 0.795289$

For Magic Tee

$\alpha = 20\log_{10}(1.26/0.402) = 20\log_{10}(3.13432) = 9.9228898dB$

$c = 10^{-9.922889/20} = 10^{-0.4961445} = 0.31904$

CONCLUSION:-

In this experiment we verified the performance of E-plane Tee, H-plane Tee and E-H plane (Magic) tee. For each Tee we applied input voltage at one port and observed the output voltages at other ports and according to the output voltages, we verified the functionality. For E-plane Tee when the input is applied at port 1 it appears at port 2 and port 3 gets isolated. Similarly, with other 2 ports. In the magic Tee when input is applied at port 1, it appears at ports 3 and 4 and port 2 gets isolated. Similarly, we can observe with other ports.

REFERENCES:-

1. Microwave and Radar Engineering—M.Kulkarni
2. Basic Microwave Lab Manual—Sisodia