REFLEX KLYSTRON CHARACTERISTICS

Objective:

To study the repeller mode characteristics of the Reflex Klystron.

Components & Equipment Required:

S No	Name of The Item	Specifications	Qty
1	Klystron Power Supply	Beam Voltage 240-400 V, Repeller Supply 10-270 V	1
2	Klystron Tube	-	1
3	Isolator	Min Isolation:20 dB; Min Insertion Loss:0.4 dB	1
4	Frequency Meter	8.2 to 12.4 GHz	1
5	Variable Attenuator	Average Power:2 W; Max. Insertion Loss:0.2 dB	1
6	Detector Mount	IN23	1
7	Wave Guide Stands	-	5
8	VSWR Meter	Frequency :1 KHz; Range :70 dB Minima in 10 dB Steps	1
9	Oscilloscope	30 MHz	1
10	BNC Cable	-	2
11	Fan for cooling Reflex Klystron Tube	-	1

Theory:

The Reflex Klystron makes use of velocity modulation and current modulation to transform a continuous electron beam into microwave power. Electrons emitted from the cathode are accelerated and passed through the cavity resonator. The electron velocity is either accelerated or retarded depending on the instantaneous ac voltage across the resonator (velocity modulation). The electrons that leave the resonator and travel towards reflector need different times to return due to change in their velocities. As a result, returning electrons group together in bunches (current modulation). As the electron bunches pass through resonator, they interact with voltage at resonator grids. The bunches pass the grid during negative ac cycle and the electrons transfer their energy to the grid. This process is repeated once per ac cycle and sustained oscillations are obtained.The frequency of oscillations is primarily determined by the dimensions of resonant cavity. Hence, by changing the dimensions of resonator (mechanical tuning of Klystron), frequency of oscillations can be varied. Frequency variation.can also be obtained by adjusting the reflector and beam voltages (Electronic

Tuning).The specifications of various Microwave Components and Equipment are given in Appendix A.

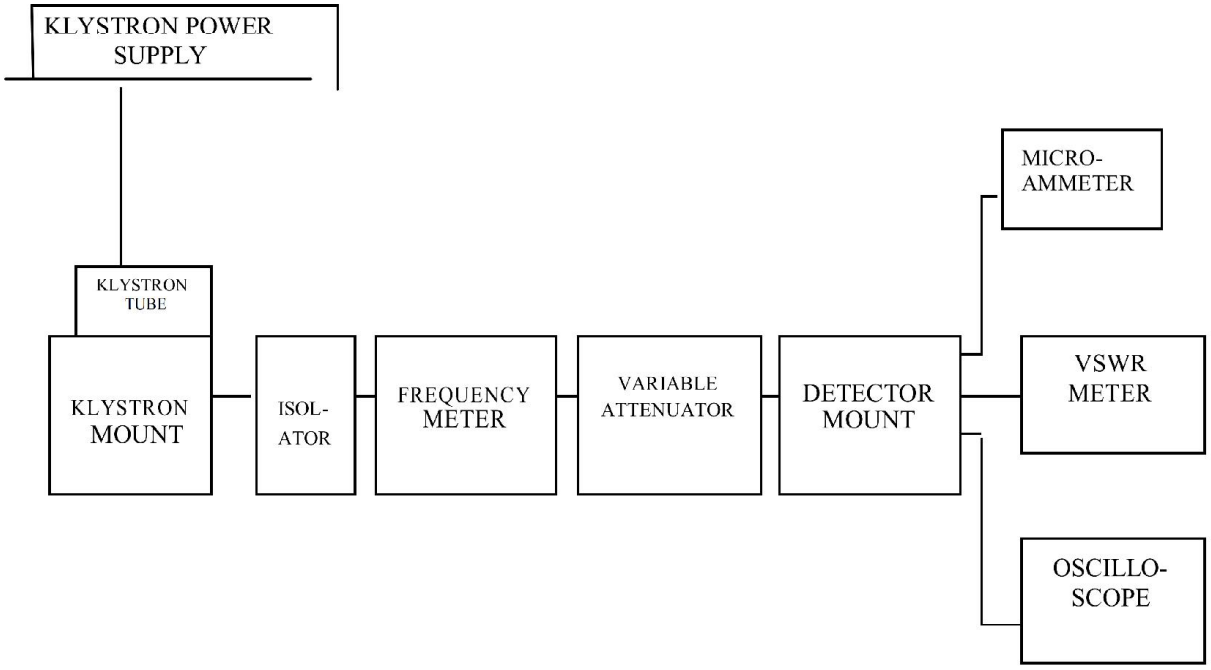

FIG.1 Set up for Reflex Klystron Characteristics

Procedure:

I Carrier Wave Operation

1. Connect the components and equipment as shown in the Fig 1.
2. Set the Variable Attenuator at the maximum attenuation position.
3. Set the Mod-Switch of Klystron Power Supply at CW position, beam voltage control knob to fully anti clock wise and reflector voltage control knob to fully clock wise and the Meter Switch to 'OFF' position.
4. Rotate the Knob of frequency meter to one side fully.
5. First connect the D.C micro-ammeter with Detector.
6. Switch on the Klystron Power Supply, VSWR Meter and Cooling fan.
7. Switch on beam voltage and rotate the knob slowly clockwise up to 250 V. Observe beam current value**. "The Beam Current should be less than 30 mA"**
8. Vary the reflector voltage slowly and watch ammeter. Set the voltage for maximum deflection in the meter.
9. Tune the plunger of Klystron Mount for the maximum output.

10. Rotate the Knob of frequency meter slowly. At some particular position there will be a dip in micro-ammeter. Note down the frequency meter reading where output current is lowest. Read frequency directly between two horizontal lines and vertical marker in case of direct reading type wave meter and use the frequency chart to find frequency from micrometer reading.

11. Change the reflector voltage and read the current and frequency for each reflector voltage.

IISquare Wave Operation

1. Connect the equipment and components as shown in the Fig 1.
2. Set Micrometer of variable attenuator at some position.
3. Set the range switch of VSWR meter at 40 dB position, input selector switch to crystal impedance position, meter switch to narrow position.
4. Set Mod-selector switch to AM-MOD position, beam voltage control knob to fully anticlockwise position.
5. Switch 'ON' the Klystron Power Supply, VSWR meter and cooling fan. Wait for few minutes.
6. Switch 'ON' the Beam voltage switch and rotate the beam voltage knob clockwise up to 300 V deflections in meter.
7. Keep the AM-MOD amplitude knob and AM-FRE, knob at the mid-position.
8. Rotate the reflector voltage knob to get deflection in VSWR meter.
9. Rotate the AM-MOD amplitude knob to get the maximum output in VSWR meter.
10. Maximize the deflection with frequency knob to get the maximum output in VSWR meter.
11. If necessary, change the range switch of VSWR meter 30 dB or 50 dB if the deflection in VSWR meter is out of scale or less than normal scale respectively. Further the output can also be reduced by variable attenuator to set the output for any particular value.

III Mode study on Oscilloscope.

1. Set up the components and equipment as shown in Fig 1.
2. Keep position of variable attenuator at minimum attenuation position.
3. Set mode selector switch to FM-MOD position, FM amplitude and FM frequency knob at mid position, keep beam voltage knob fully anticlockwise and reflector voltage knob to fully clockwise and Beam switch to 'OFF' position.
4. Keep the Time/division scale of oscilloscope around 100Hz frequency

(t=0.01sec) measurement and Volt/division to lower scale.

5. Switch 'ON' the Klystron Power Supply and Oscilloscope.
6. Switch 'ON' Beam voltage and set beam voltage to 300 V by beam voltage control knob.
7. Keep amplitude knob of FM Modulator to maximum position and rotate the reflector voltage anticlockwise to get modes on the oscilloscope. The horizontal axis represents reflector voltage and vertical axis represents output power.

8. By changing the reflector voltage and amplitude of FM modulation, any mode of Klystron tube can be seen on Oscilloscope . Model Waveforms are shown in Fig 2.

Observations:

Carrier Wave Operation

Beam Voltage: - 250 Volts

S .No.	Repeller Voltage (Volts)	Micrometer reading (μA) (α power)	Frequency meter reading (GHz)
1			
2			
3			
4			

Square wave operation:

S No.	Reflector Voltage (in Volts)	Amplitude (from display)	Frequency (in GHz)
1			
2			
3			

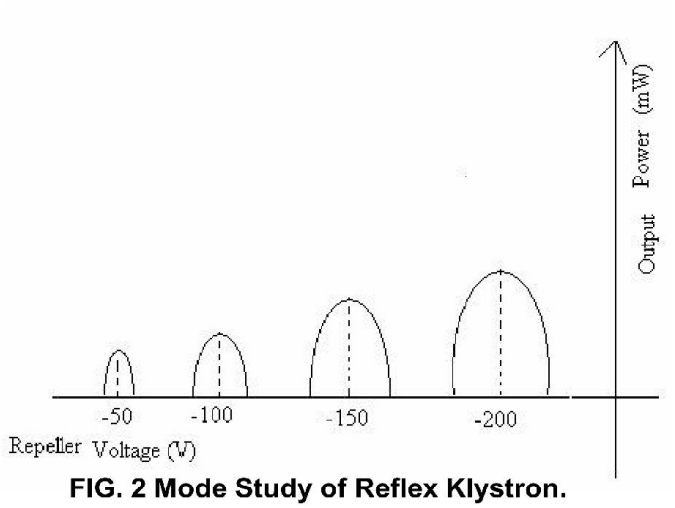

FIG. 2 Mode Study of Reflex Klystron.

Result:

The performance characteristics of reflex klystron tube are observed.