Microwave Experiment: Week 1

AP 4018
Columbia University

Objective

- Learn how to operate a reflex klystron
- Measure the relationship between reflector voltage, V_{ref}, and the frequency and power output from the klystron

How Does a Reflect Klystron Work?

- See online materials
- Read "Reflex-Klystron Oscillators," by E.L. Ginzton and A.E. Harrison, *Proceedings of the IRE*, **34**(3), (1946), pp. 97-113; http://doi.org/10.1109/JRPROC.1946.233883
- Read *Data Sheet for Reflex Klystrons 2 K 25 and 723 A/B* (on line)

How Does a Reflect Klystron Work?

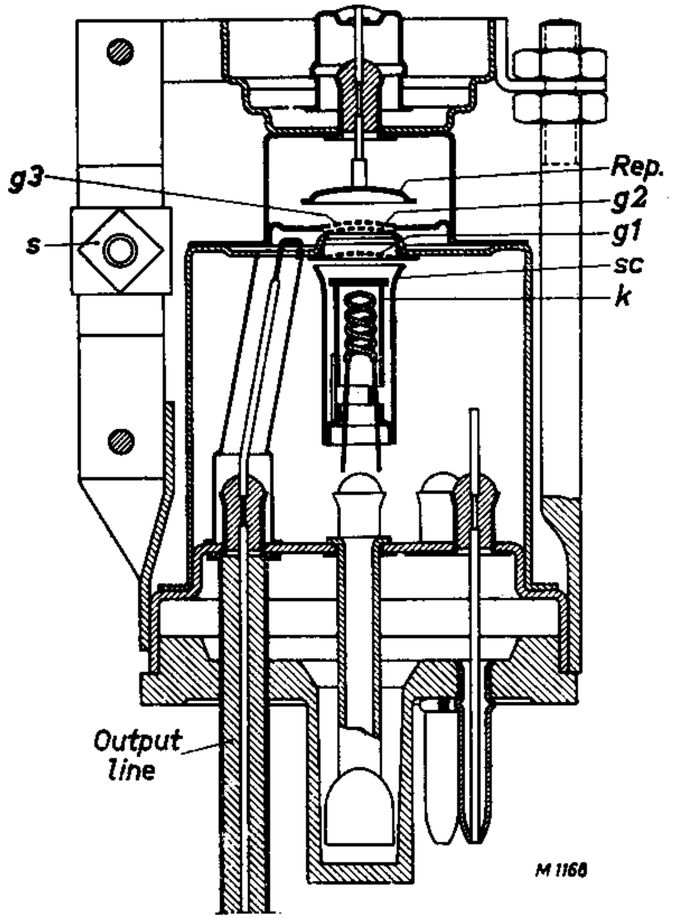

Fig. 50. Cross section of the 2K25 and 723 A/B.

Operating Parameters

TECHNICAL DATA of the 723 A/B

The reflex klystron type 723 A/B is specially designed for operation at 9370 Mc/s. Its frequency range is smaller than that of the 2K25; viz. 8702-9548 Mc/s.

HEATER DATA

Heating: indirect by a.c. or d.c.: parallel supply

Heater voltage	$V_f =$	6.3 V ± 8%
Heater current	$I_f =$	0.44 A

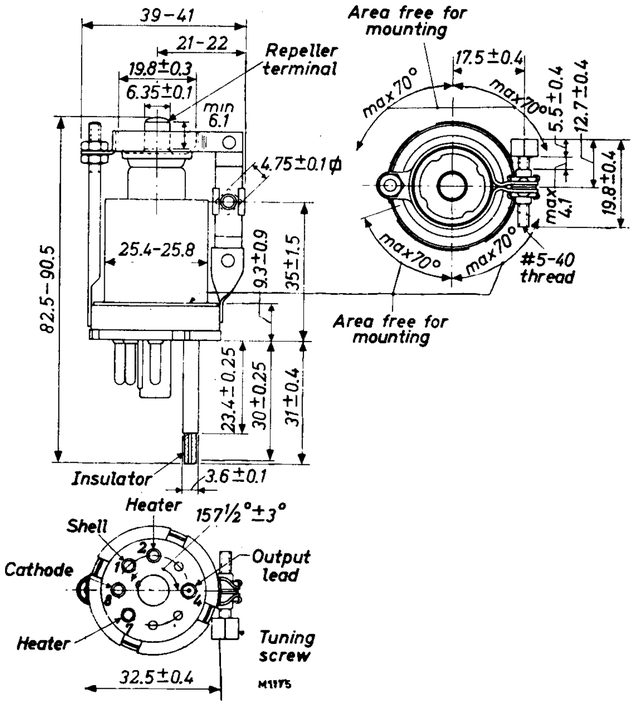

Fig. 55. Dimensional drawing; dimensions in mm.

TYPICAL OPERATING CONDITIONS: (frequency 9370 Mc/s, mode A)

D.C. resonator voltage	$V_{res} =$	300 V	
D.C. repeller voltage range	$V_{rep} =$	−130 to −185 V	[1])
D.C. resonator current	$I_{res} =$	25 mA	
Half-power electronic tuning frequency range	$\Delta_f =$	40 Mc/s	[2])
Power output	$W_o =$	30 mW	

MOUNTING POSITION: any

ELECTRODE ARRANGEMENT

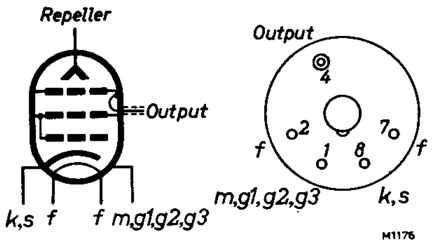

Fig. 57. Electrode arrangement and base connections.

LIMITING VALUES (absolute maxima)

D.C. resonator voltage	$V_{res} =$	max.	330 V
D.C. repeller voltage neg.	$-V_{rep} =$	max.	400 V
D.C. repeller voltage pos.	$V_{rep} =$	max.	0 V
D.C. resonator current	$I_{res} =$	max.	37 mA
Voltage between cathode and heater	$V_{kf} =$	max.	50 V
Temperature of coaxial output line	$T =$	max.	70 °C

[1]) Adjusted for maximum power output at the given operating frequency.

[2]) Change in frequency between the two half-power points when the repeller voltage is varied above and below the point of maximum power output corresponding to the given frequency.

Typical Power and Frequency vs. Repeller Voltage

(For Week #1, you are to make these measurements…)

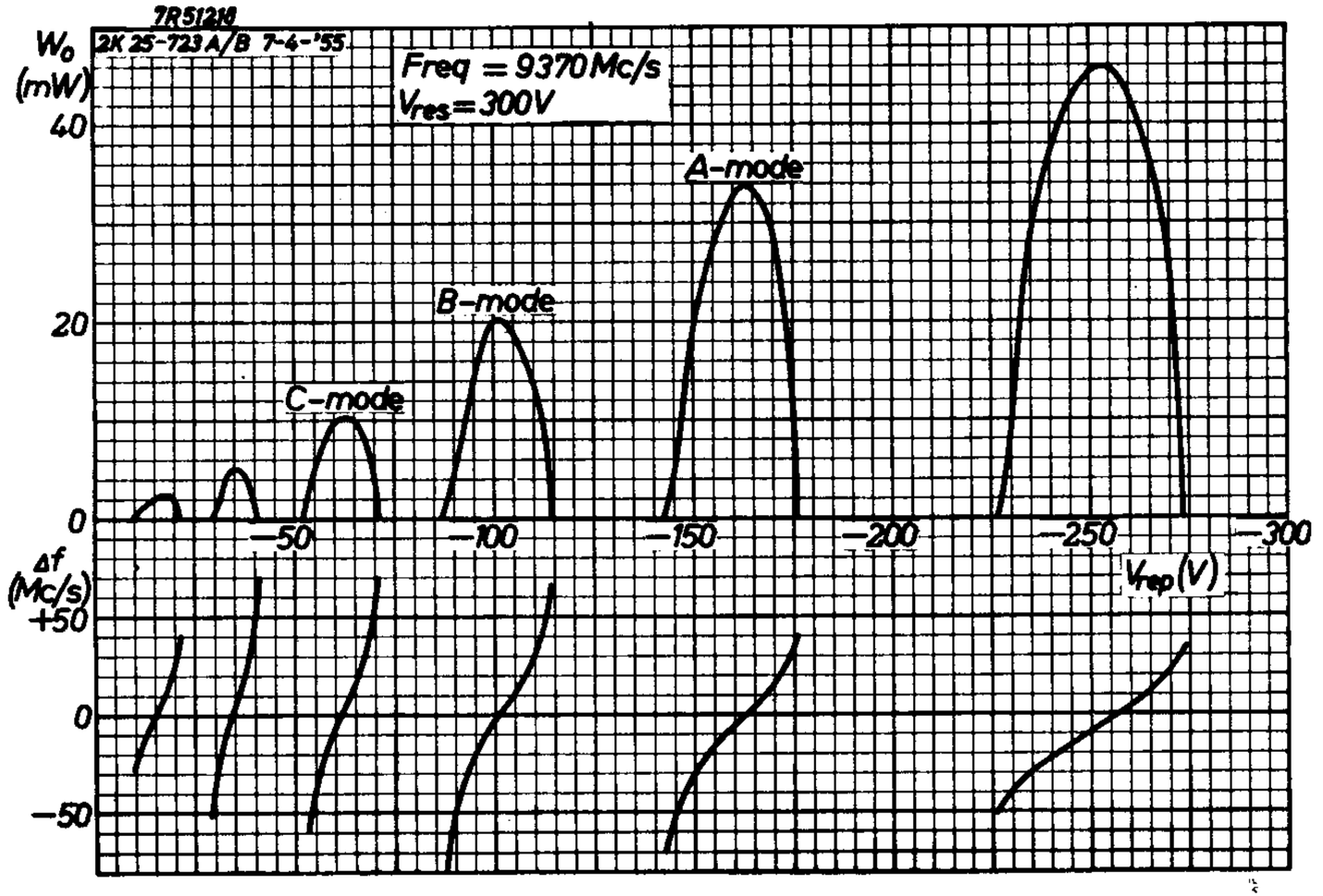

Fig. 53. Power output W_0 and frequency shift Δf as functions of the repeller voltage.

How Does a Reflect Klystron Work?

"Reflex-Klystron Oscillators," by E.L. Ginzton and A.E. Harrison

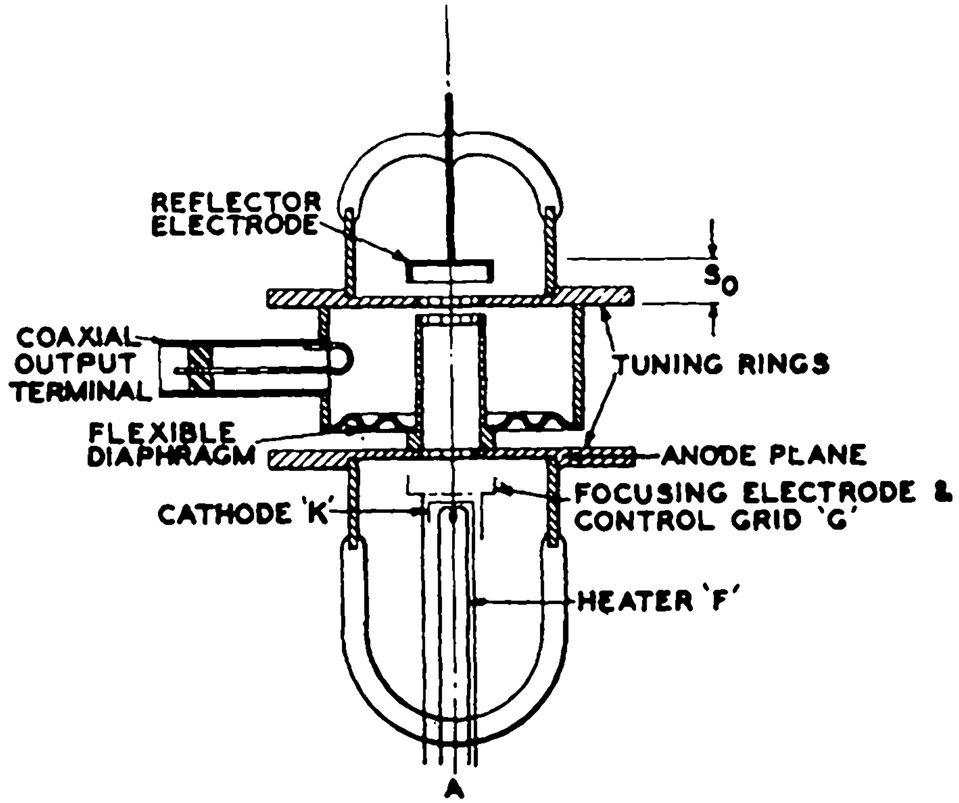

Fig. 1—Cross-section view of a reflex klystron.

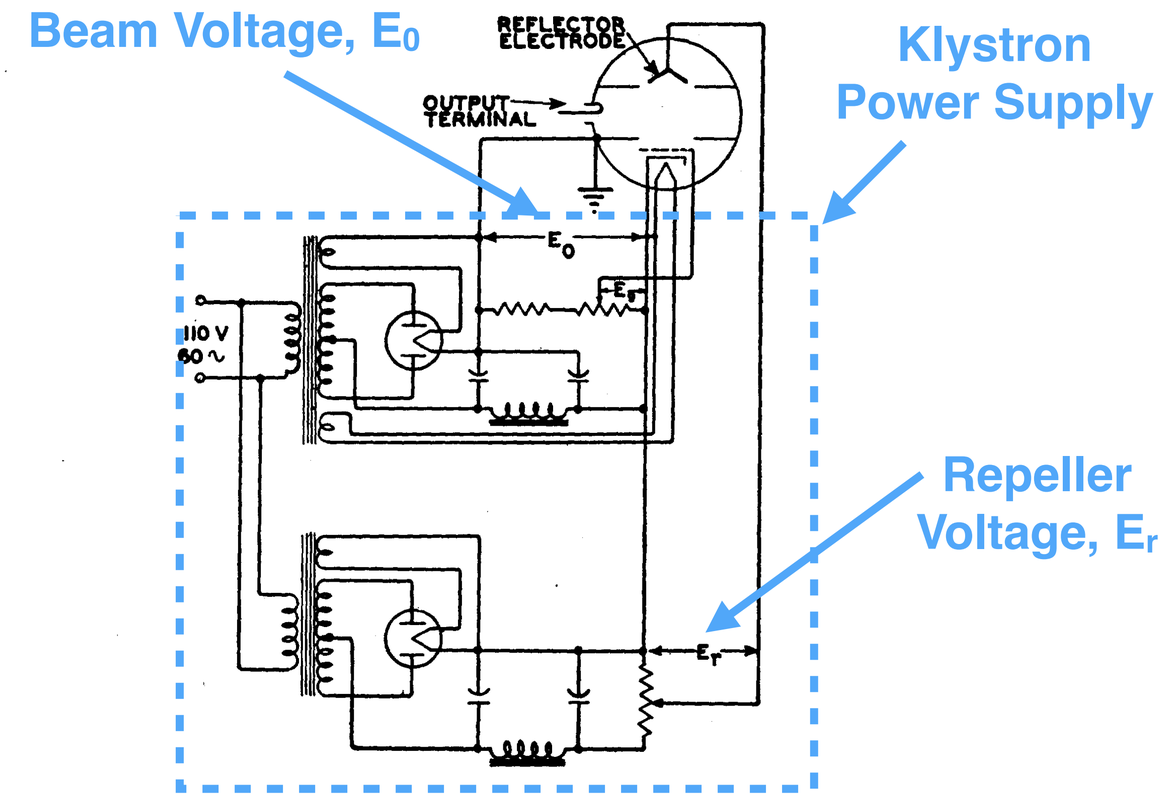

Fig. 2—Circuit diagram for a reflex oscillator and power supply.

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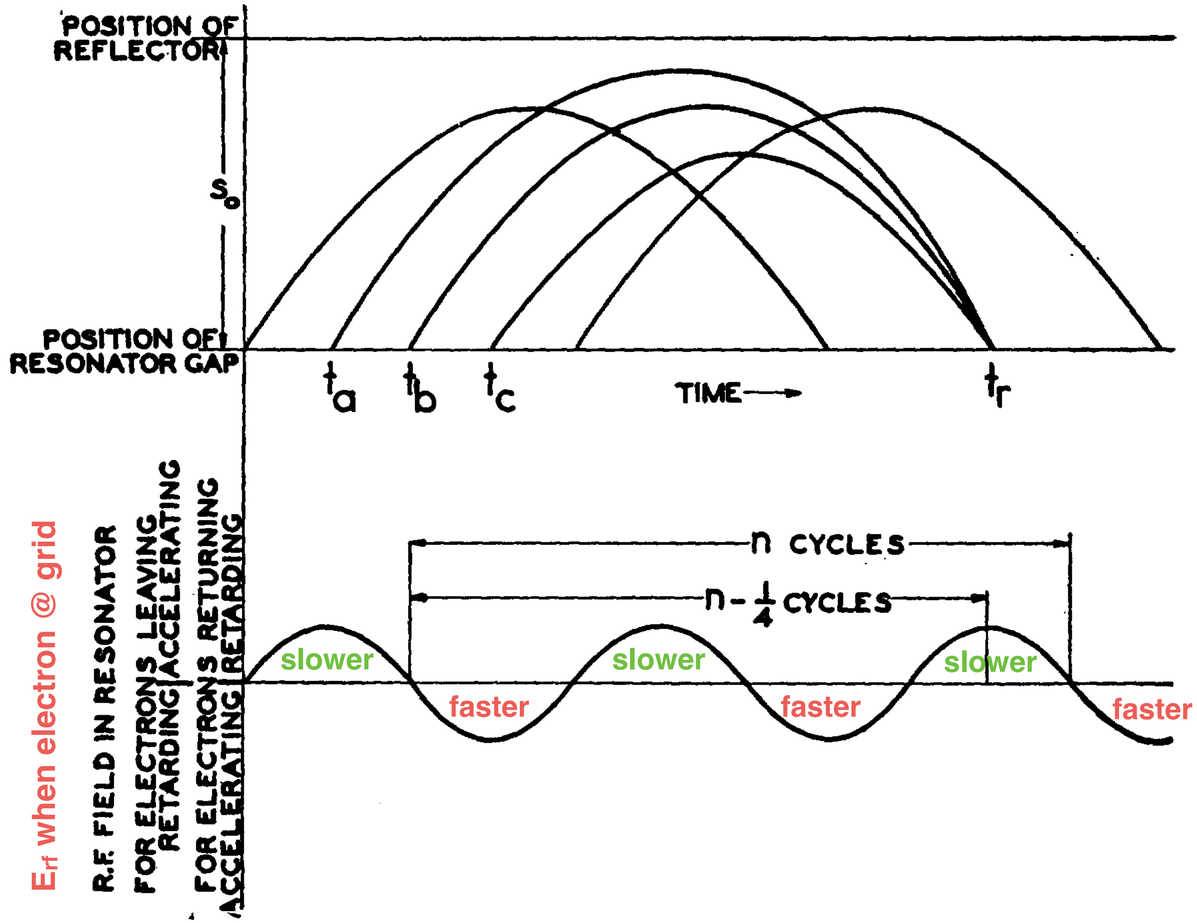


Fig. 3—Applegate diagram for a reflex-klystron oscillator.

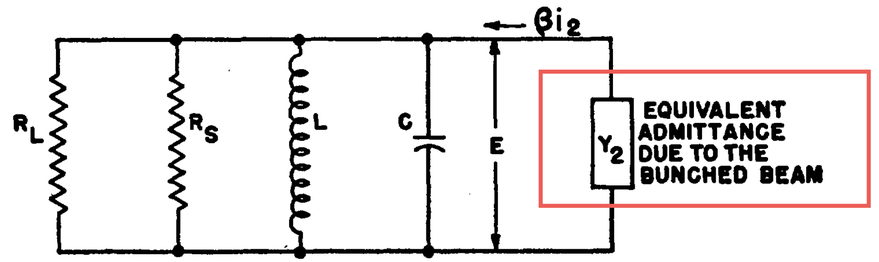


Fig. 8—Equivalent circuit for a reflex-klystron oscillator.

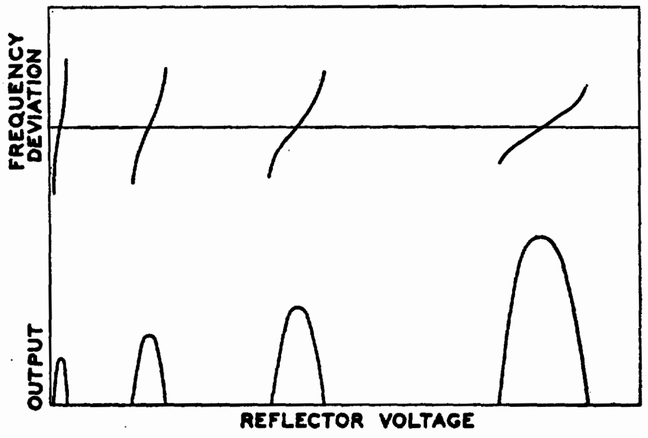
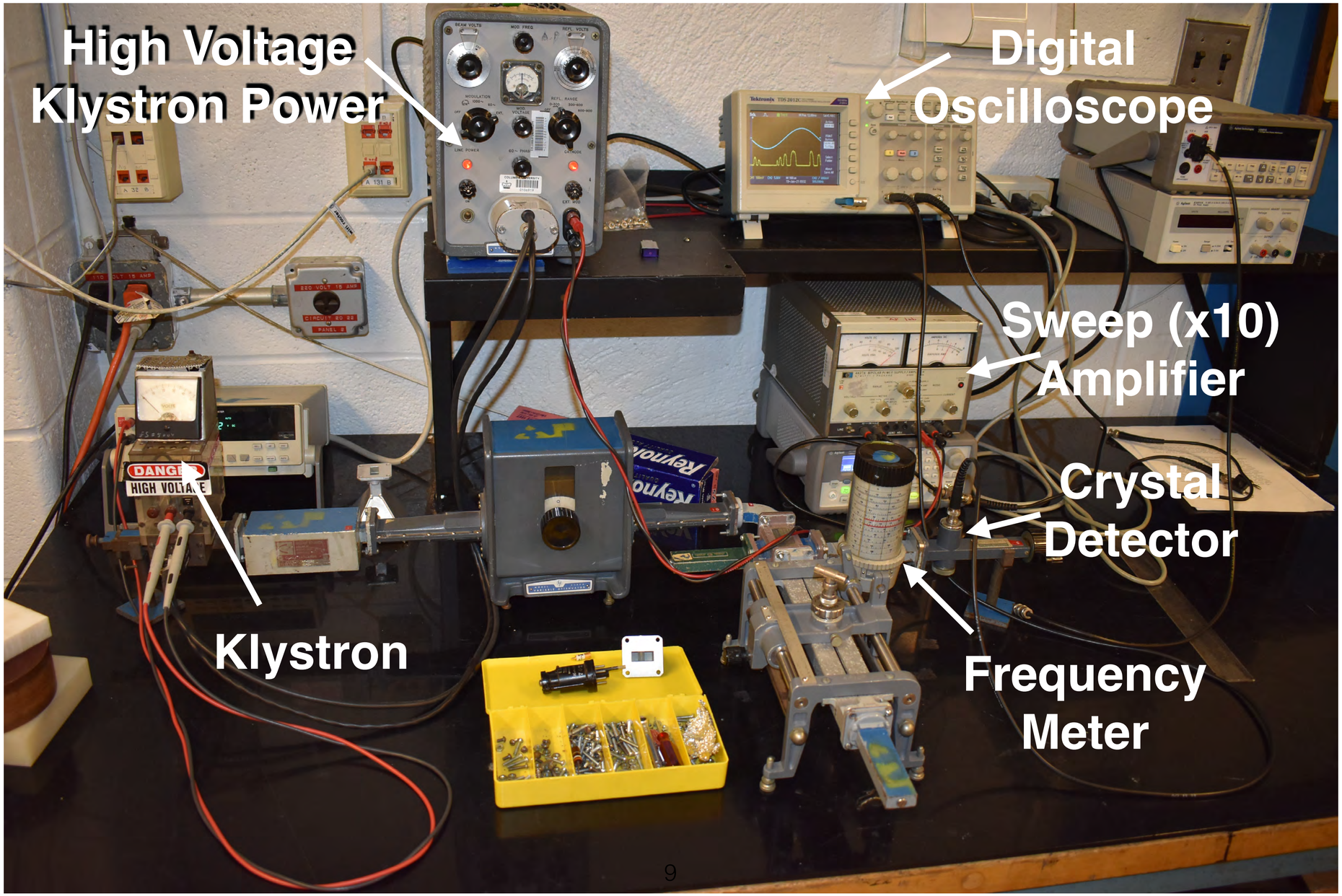
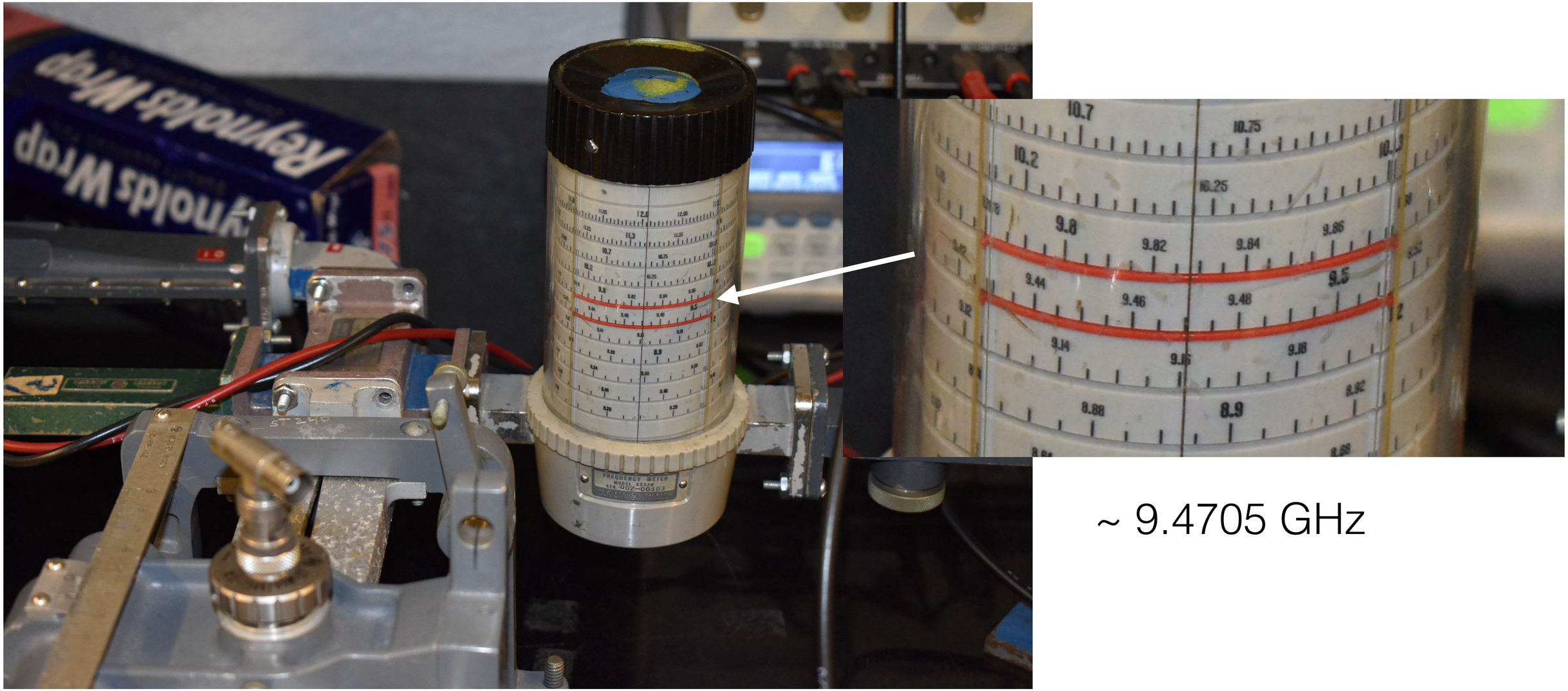


Fig. 14—Power-output and frequency characteristics when the reflector voltage of a reflex klystron is varied.

Arrangement of Waveguide and Detectors



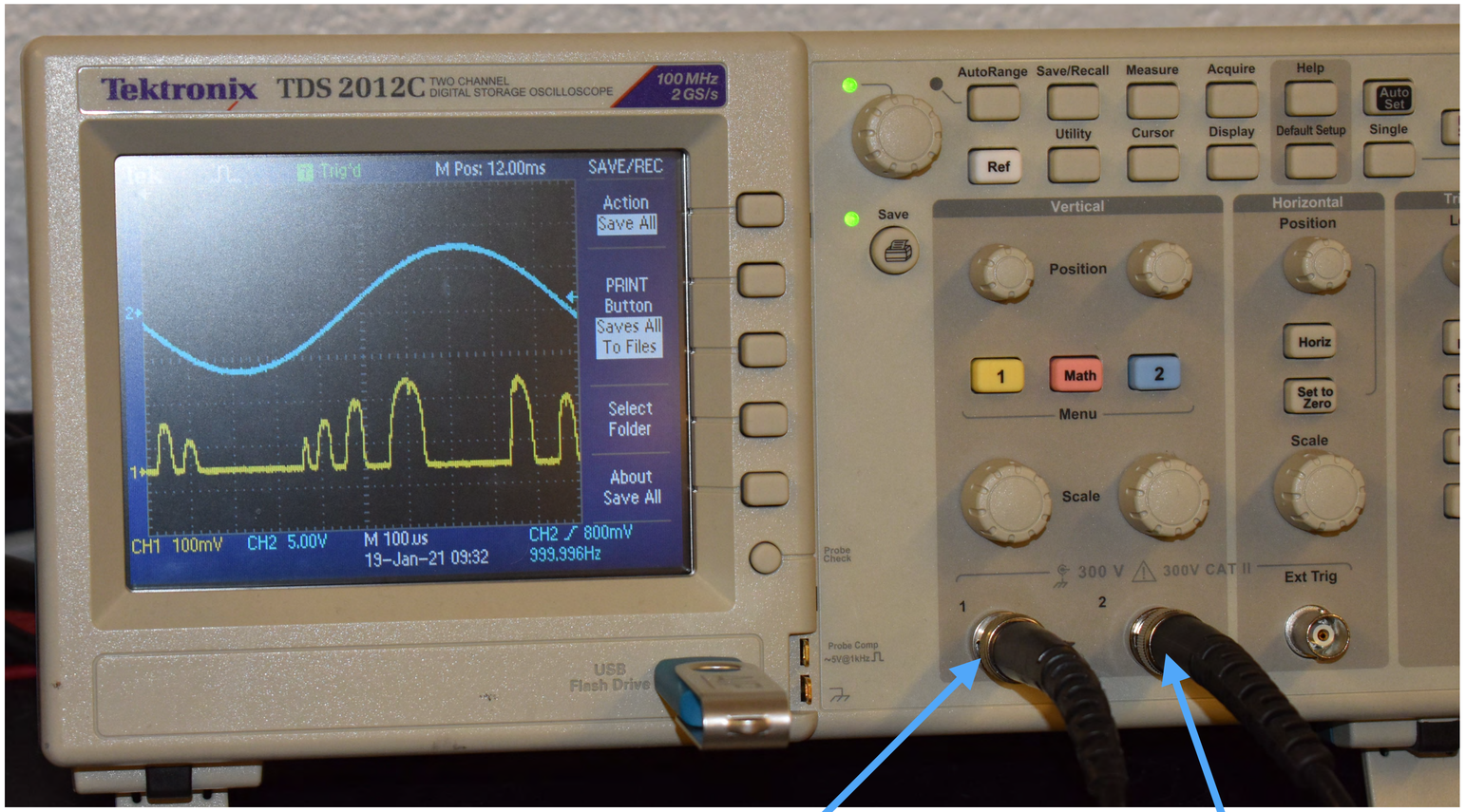
Frequency Meter/Cavity



~ 9.4705 GHz

Modulating the Repeller Voltage

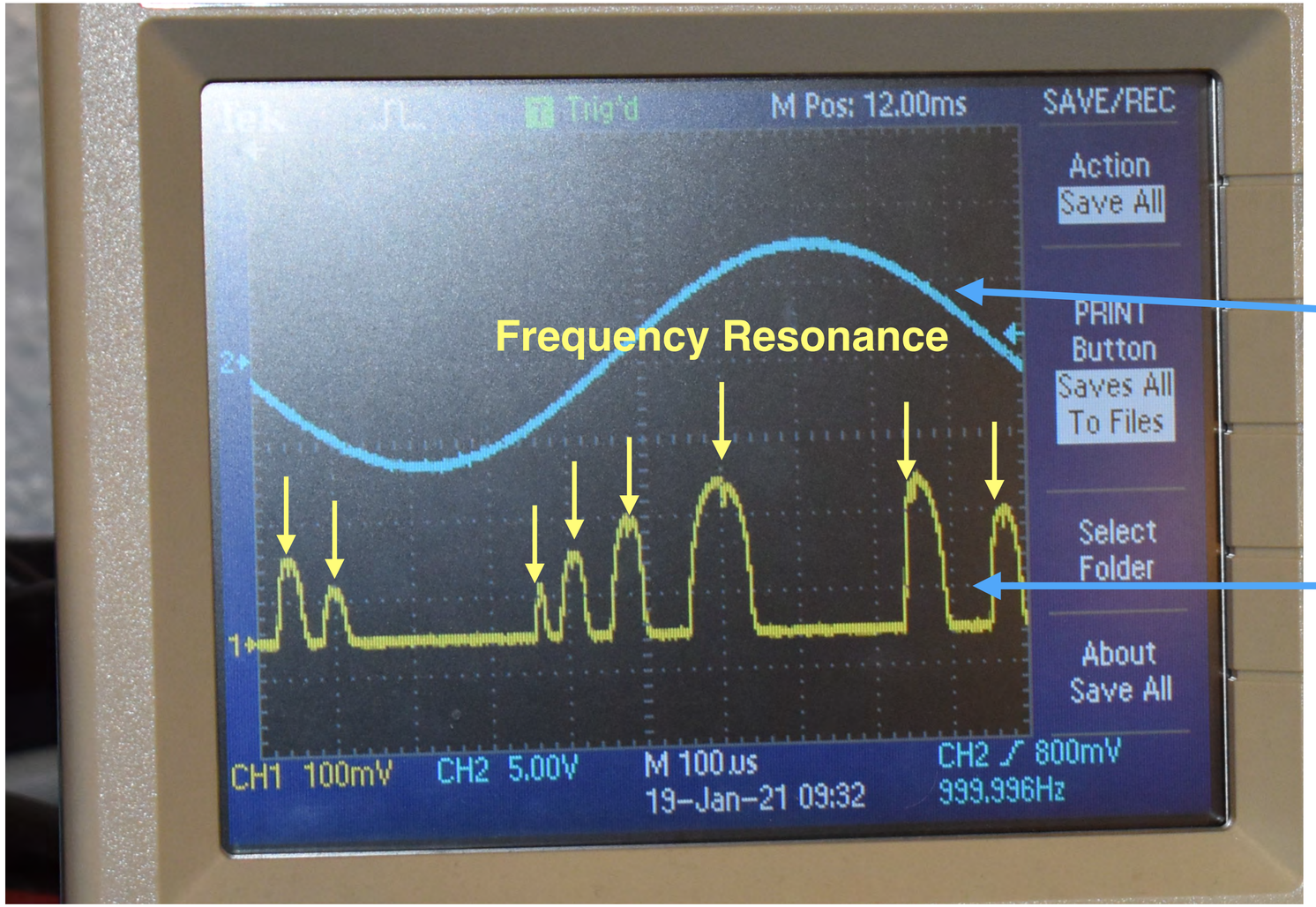
External Modulation Voltage Input



Crystal Detector (A.U.)

E_r Modulation (÷ 10)

Modulating the Repeller Voltage



E_r Modulation
(÷ 10)

Crystal Detector
(A.U.)

Summary: Week 1

- Learn how to operate a reflex klystron
- Measure the relationship between reflector voltage, V_{ref}, and the frequency and power output from the klystron
- Use the six data sets to examine the power output and frequency of the reflex klystron