Electronics & RF hands-on training

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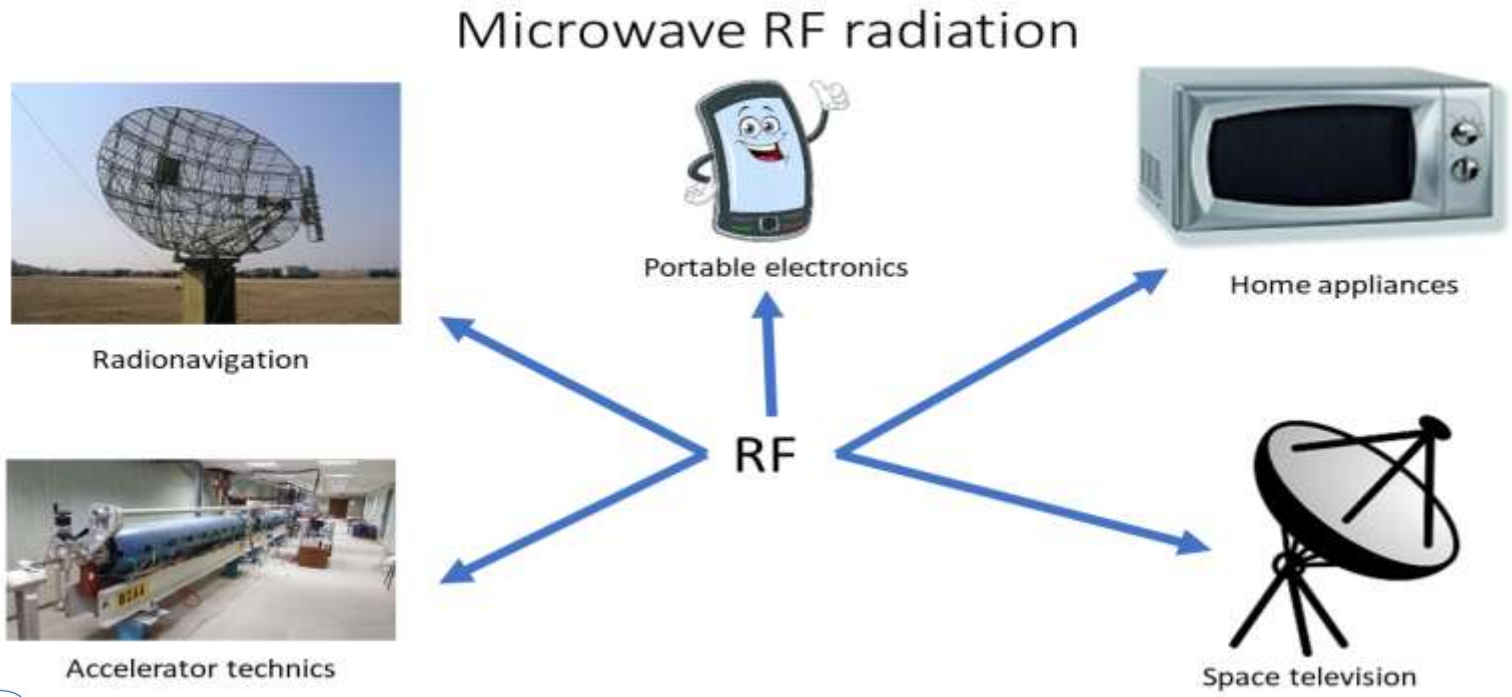
Introduction



Introduction cont’d

Oscilloscope

RF Generator

VNA

Diaphragms

Oscilloscope probe

Soldering iron

Resistors, capacitor and transistor

Aims

- Explore the application of fundamental radioelectronic components, ability to interpret electronic circuits, and grasp the fundamental principles behind electronic devices
- Provide an overview of the key elements of RF technology and demonstrating how waves behave under different conditions.
    - scenarios without any obstacles as well as situations involving various heterogeneity

Objectives

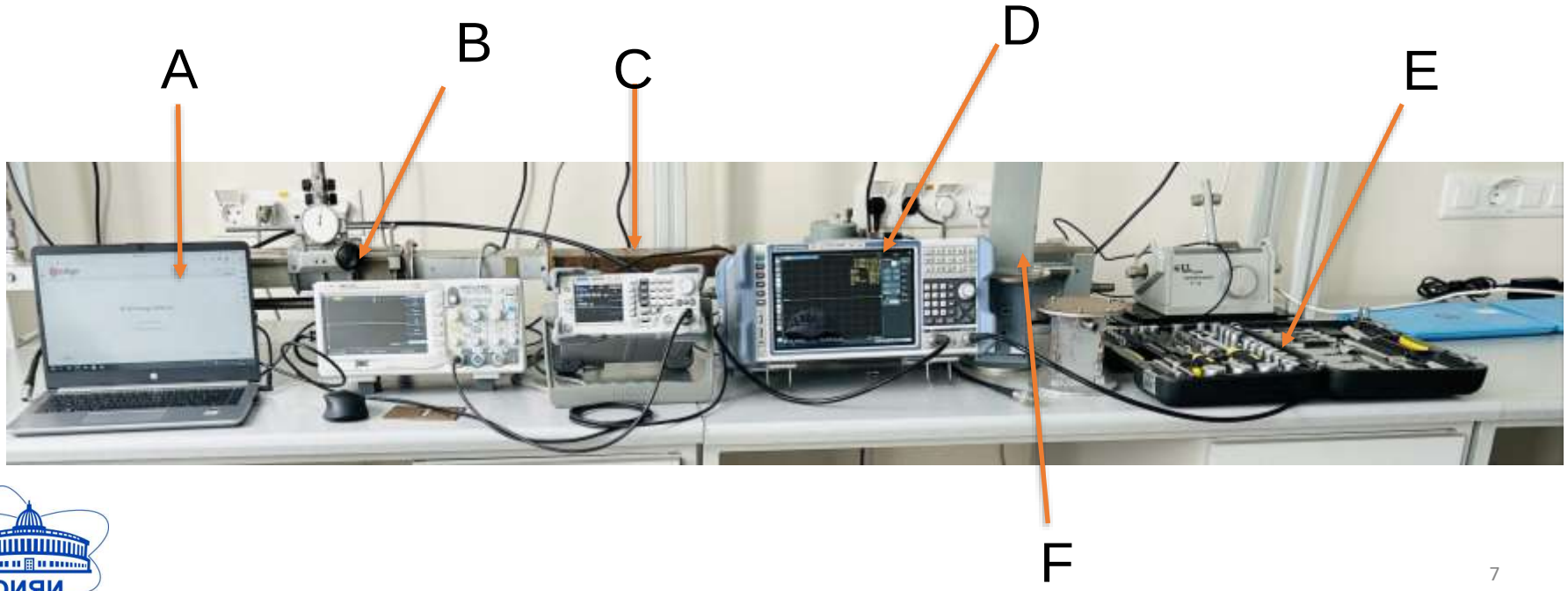
- Basics of Rf technology
- Determining the wavelength in the waveguide
- Matching quality coefficients (SWR, TWR and ρ_h)
- Determining total resistance of different irregularities theoretically and practically

Objectives

- Utilize the reactive dowel for narrow band matching
- Develop skills in calculating the cavity quality factor
- Soldering basic skills
- Evaluating the properties of semiconductors
- Calculation of stage transistor amplifiers

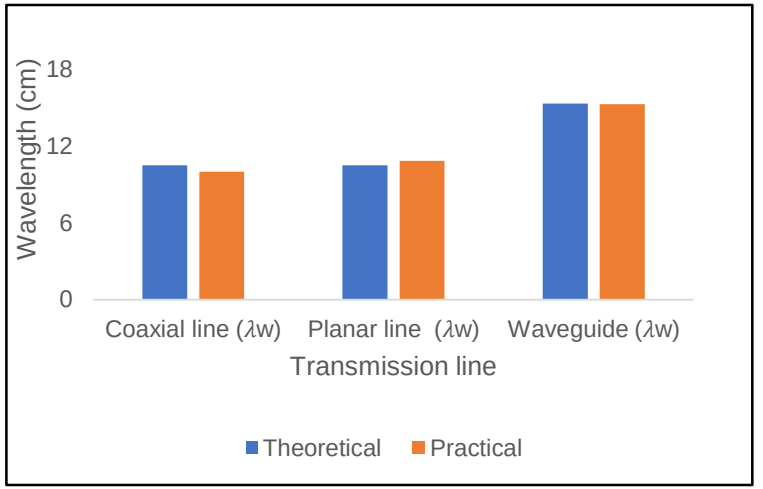
Experiment Procedure:RF Technology

Instruments: oscilloscope, a RF generator, vector network analyzer



Results and discussion: Determining wavelength

RF Power transmission	Wavelength (cm)	
Coaxial line (λ_w)	10.50	10.00
Planar line (λ_w)	10.50	10.86
Waveguide (λ_w)	15.34	15.30



$$\lambda_w = \frac{\lambda_o}{\sqrt{\varepsilon}}$$

$$\lambda_w = \frac{\lambda_o}{\sqrt{1 - \frac{\lambda_o^2}{\lambda_{cr}^2 \varepsilon\mu}\sqrt{\varepsilon\mu}}}$$

Results and discussion: Matching quality coefficients

Setup	Z min (cm)	Z max (cm)	U min (mV)	U max (mV)	SWR ($\frac{U_{max}}{U_{min}}$)
ML	12,9	13.3	173	175	1,01
OW	8.00	11.4	100	200	2.00
ID	4.00	8.40	10.0	32.0	3,20
CD	4.00	6.00	4.00	15.0	3,75
Cal	35.0	10.3	0.00	350	∞

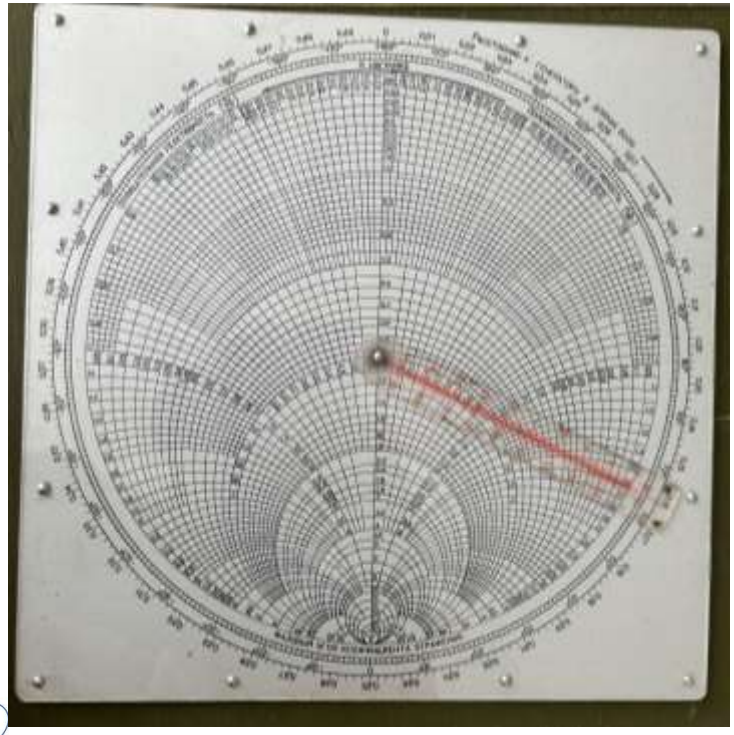
Results and discussion: Total resistance (Theoretically)

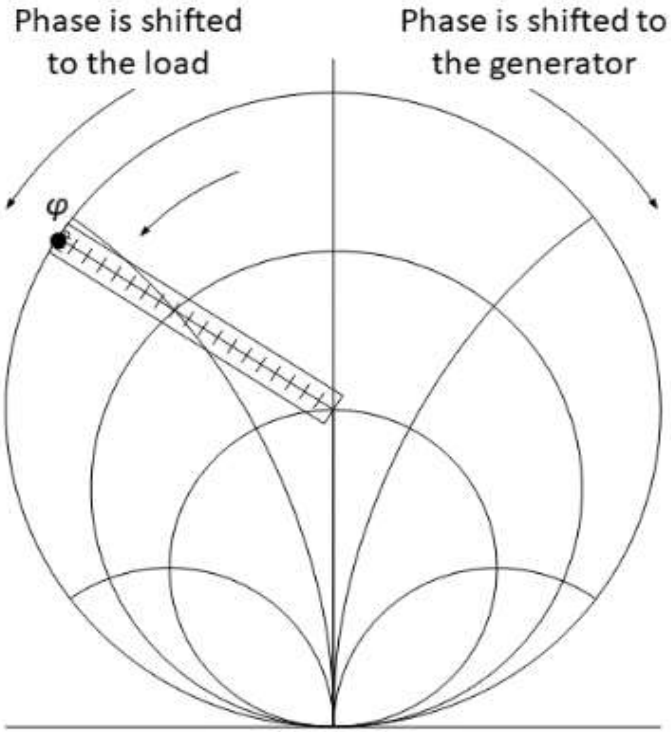
$$Z = R + jX$$

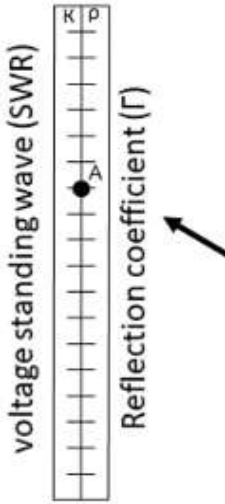
$$Y = \frac{1}{Z}$$

$$Z_L^* = \frac{2SWR - j(1 - SWR^2)\sin\varphi}{(SWR^2 + 1) - (SWR^2 - 1)\cos\varphi} \qquad \varphi = \frac{4\pi\Delta z}{\lambda_W}$$

Results and discussion: Total resistance (Smith Chart)







Results and discussion: Total resistance

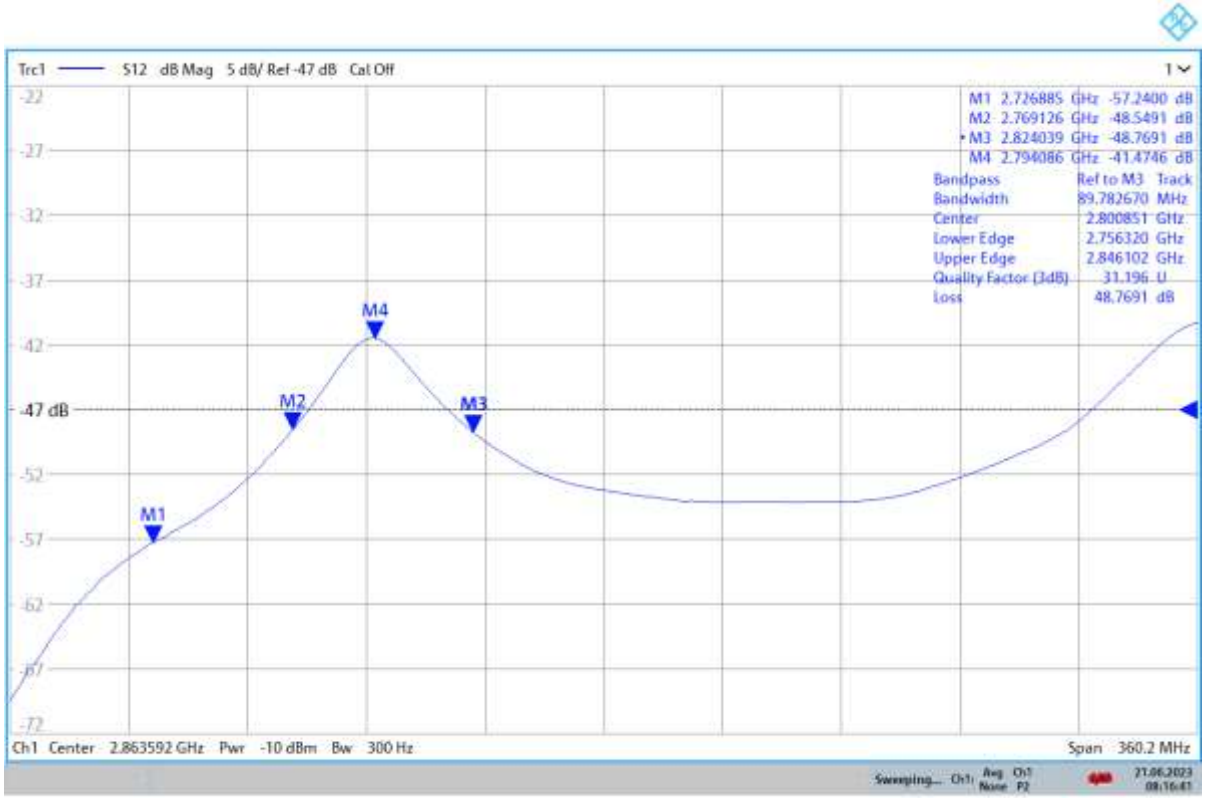
Results and discussion: total resistance

Setup	Angle (φ)	SWR	Z (theoretical)	Z (VNA)
ML	1.35	1.01	1.00 + j0.01	0.92 + j1.25
OW	5.37	2.00	1.26 + j0.75	0.62 + j0.50
ID	8.64	3.20	0.36 - j0.37	0.36 - j0.42
CD	8.64	3.75	0.31 + j0.38	0.31 + j0.42
S	16.8	∞	-	-

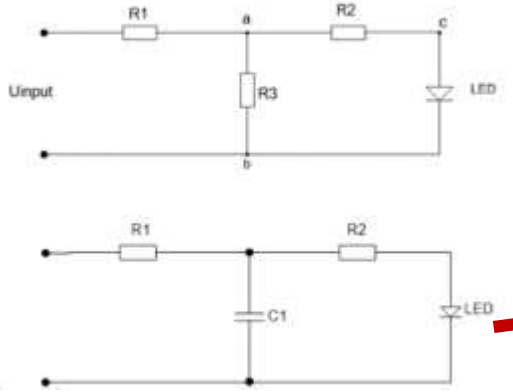
Results and discussion: Reactive dowel

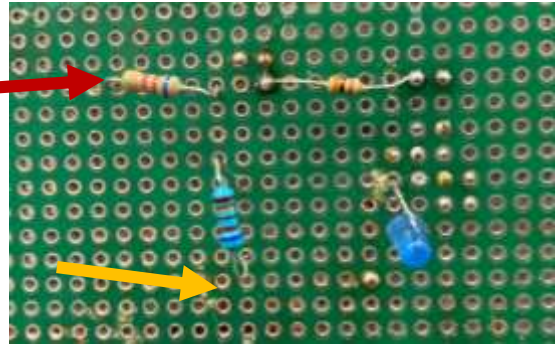
Height (mm)	φ	SWR	Z	Y (theoretical)	Y (practical)
0	6.5	1.86	1.75 + j6.5	0.00	-0.14
2	6.3	1.97	1.79 + j4.2	-0.51	-0.20
4	5.8	1.81	1.29 + j2.1	-0.29	-0.35
6	6.1	1.91	1.50 + j3.0	-0.13	-0.27
8	6.0	1.76	1.48 + j2.6	-0.13	-0.29
10	5.9	1.79	1.38 + j2.4	-0.00008	-0.32

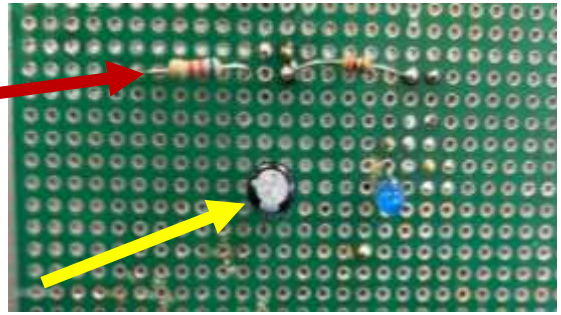
Results and discussion: cavity resonator

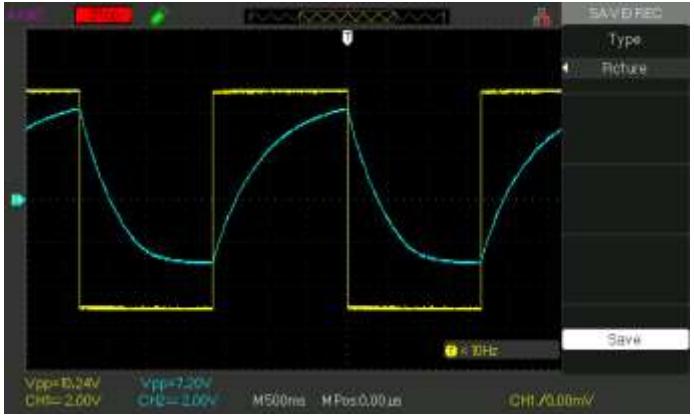


Voltage divider and RC circuit









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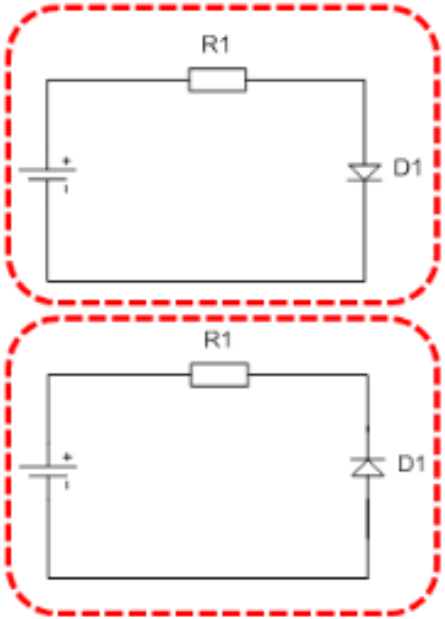
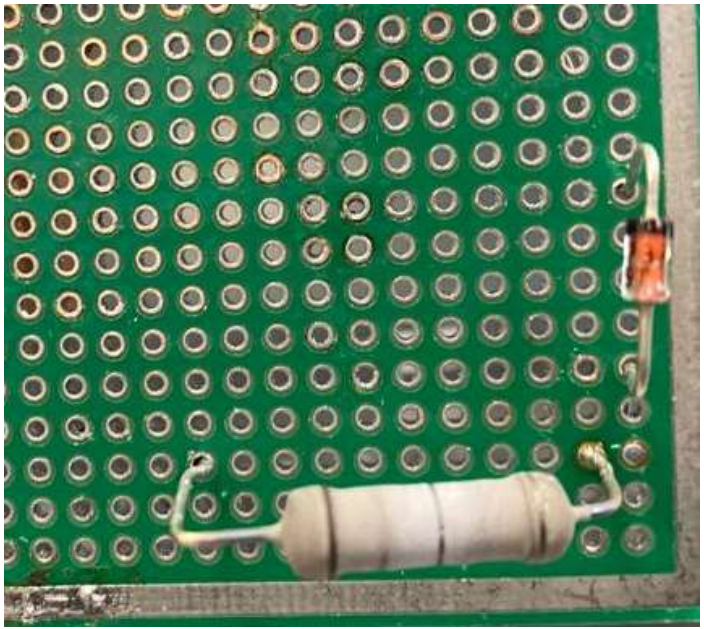
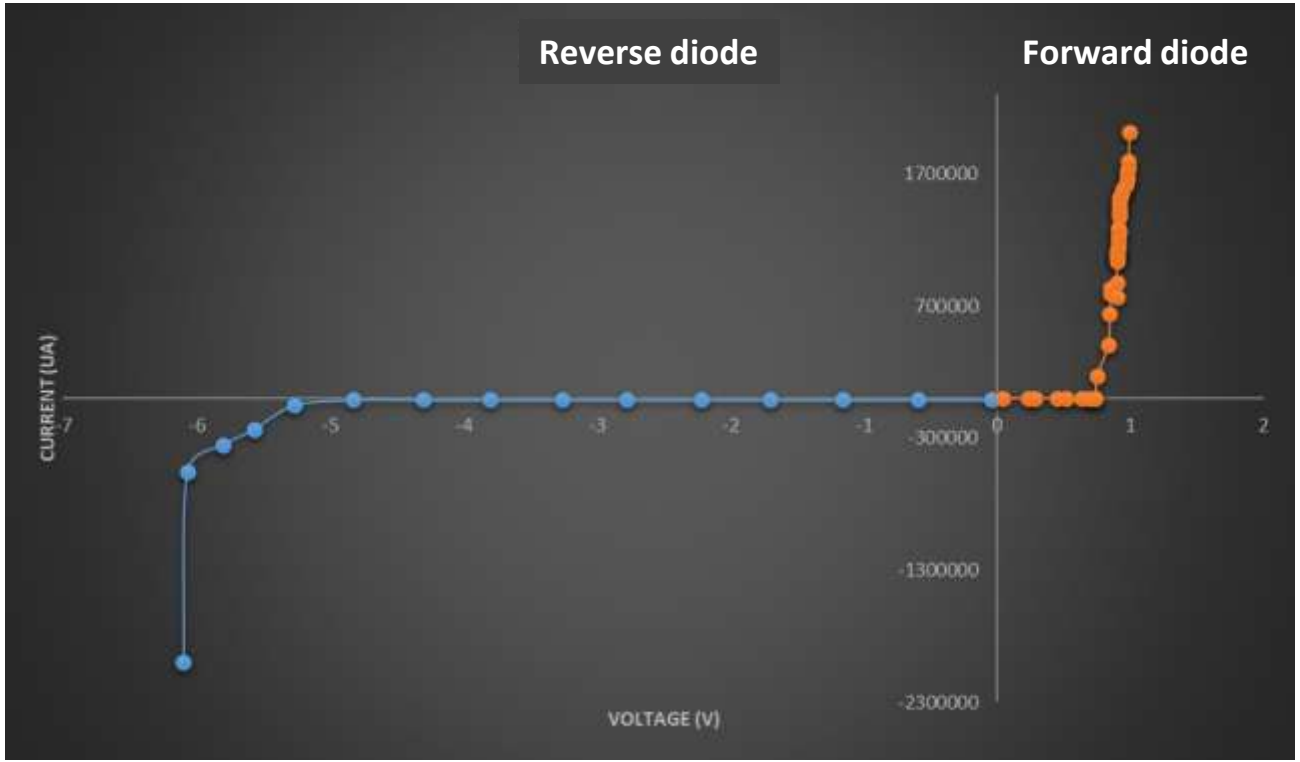
Reverse and forward diode connection

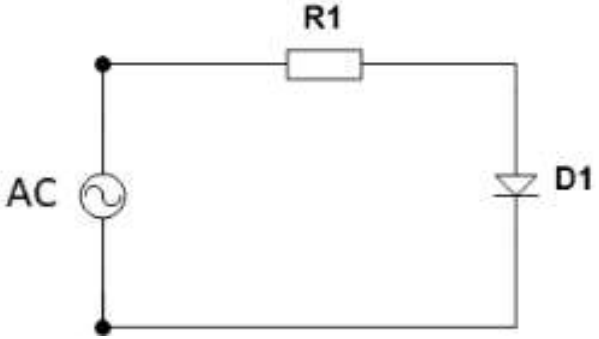


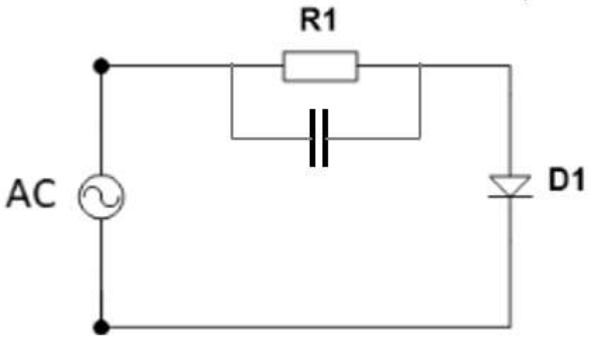


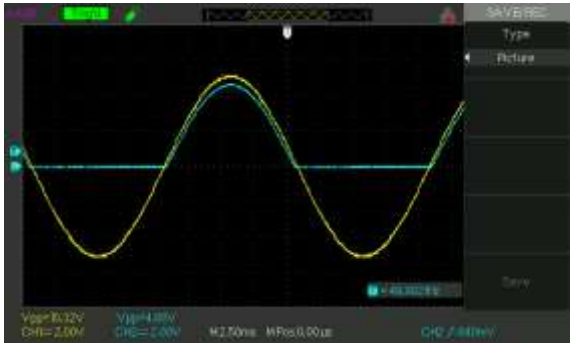
Characteristic V(A) of the diode

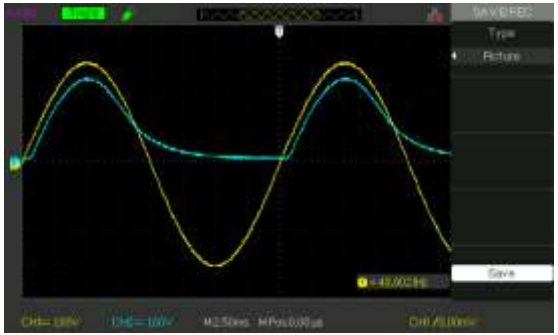


Diode application









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Diode application cont'd

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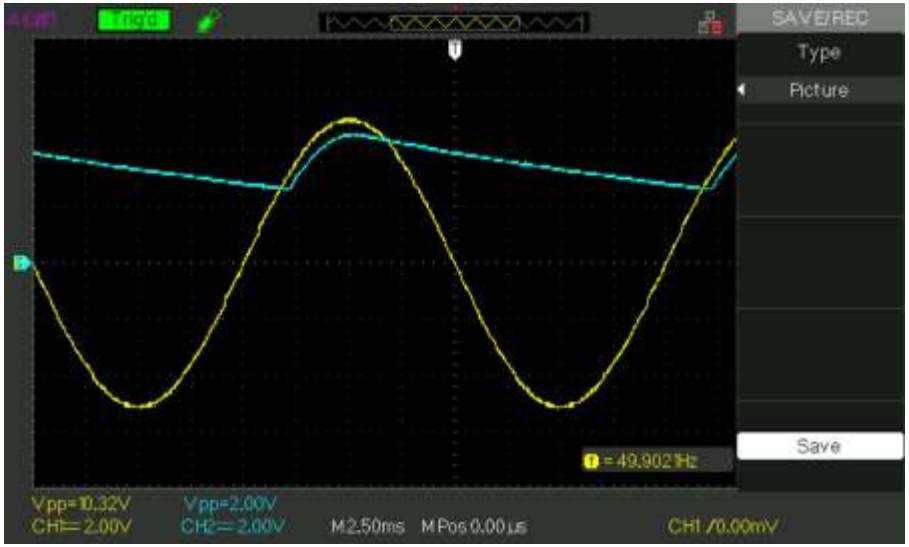

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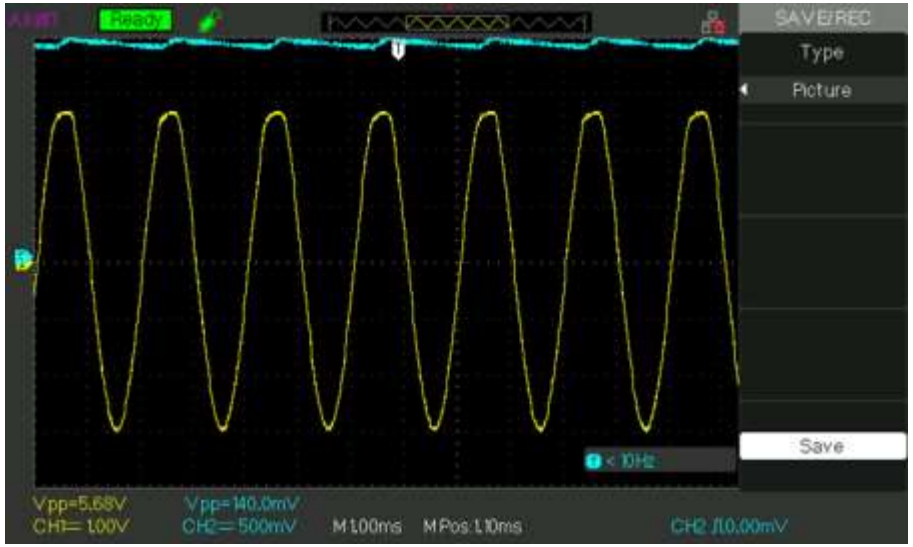
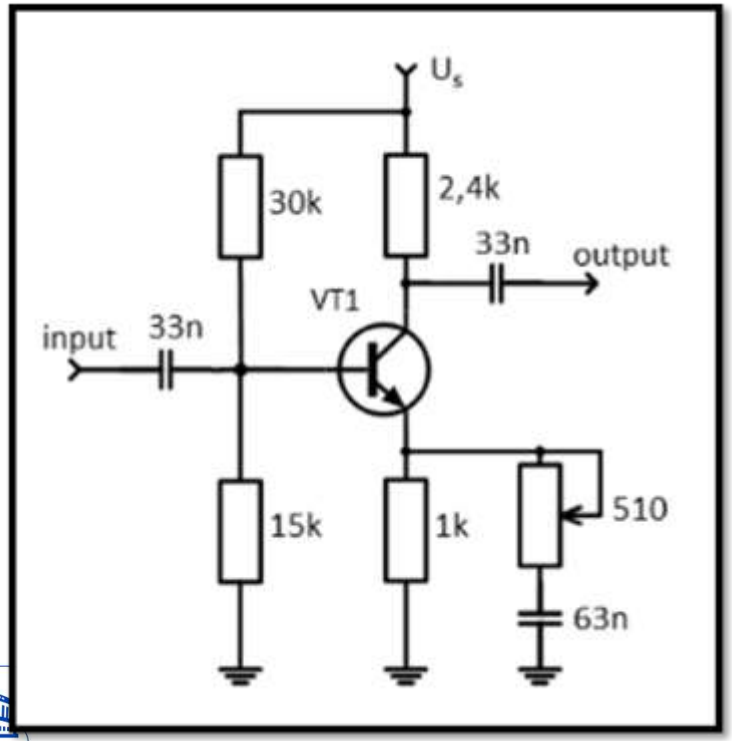
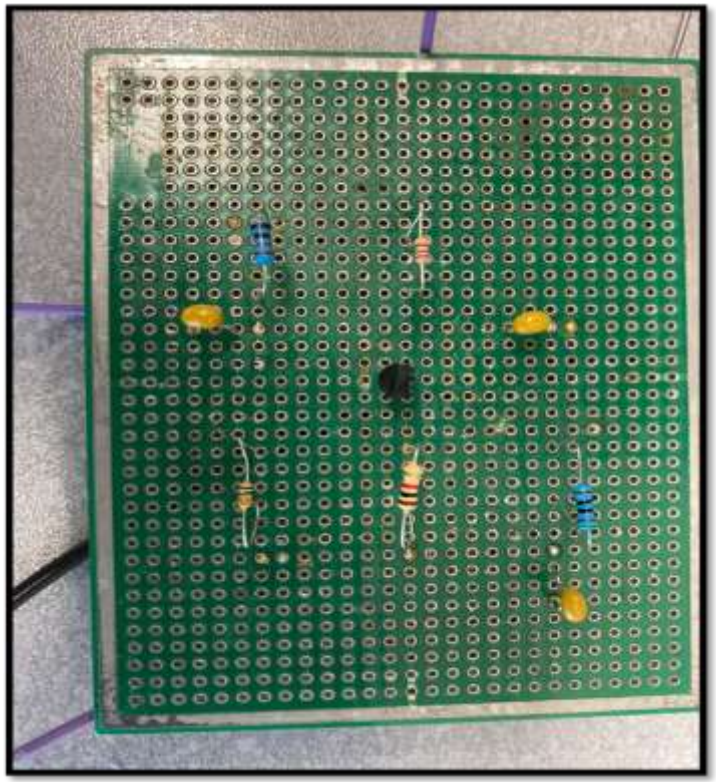
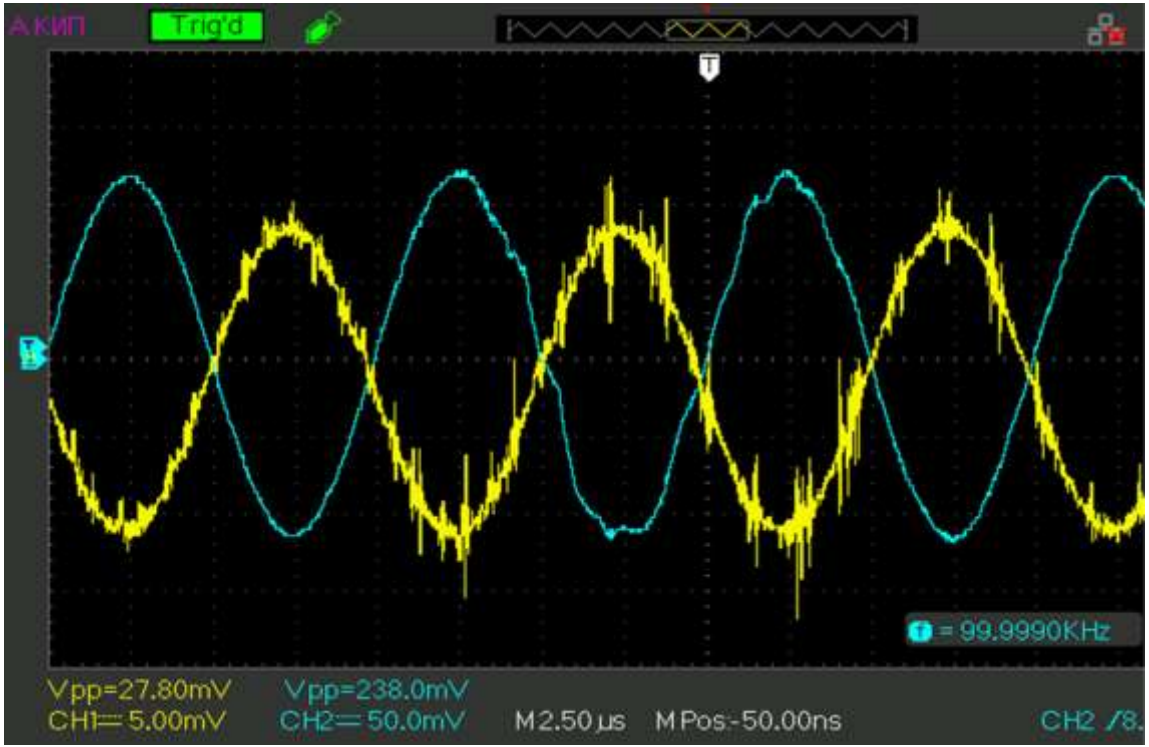


Voltage amplifier





Results cont'd: Amplifier



Conclusions

- Waveguide has a higher wavelength as compared to coaxial and planar lines
- Matched loaded has an ideal SWR value approximately equal to 1
- The reactive dowel does a narrow band matching
- Diodes can assist channel the voltage direction in a circuit
- Increase in capacitance causes the AC behaviour to lean towards DC
- Transistors amplify the input signal power

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