Technical University of Cluj-Napoca

MATLAB Project
Theme: Voltage Stabilizer with Zener Diode.

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Introduction

Chapter I

1.1 Background of MATLAB

MATLAB, short for "MATrix LABoratory," is a high-performance programming language and environment primarily used for numerical computing, data analysis, and visualization. It was created by Cleve Moler, who developed it in the late 1970s to provide easy access to the LINPACK and EISPACK matrix computation software without having to learn Fortran. The initial version was developed for use in control design at the University of New Mexico.

Over the years, MATLAB evolved into a powerful tool with a rich set of functions and toolboxes, making it widely adopted in various fields, including engineering, science, finance, and academia. MathWorks, the company founded by Cleve Moler, officially released the first commercial version of MATLAB in 1984.

MATLAB's popularity grew due to its intuitive syntax, extensive mathematical capabilities, and visualization tools. It became an essential tool in academia, research, and industry for tasks ranging from algorithm development to complex simulations.

As technology advanced, MATLAB expanded its capabilities, incorporating features for image processing, signal processing, machine learning, and more. The MATLAB Central online community provided a platform for users to share code, solve problems, and collaborate on various projects.

MATLAB remains a widely used and influential programming language, playing a crucial role in the fields of science and engineering. The continuous updates and enhancements by MathWorks ensure that MATLAB stays at the forefront of numerical computing and data analysis.

1.2 Project information

In this project we have a Parametric Voltage Stabilizer which maintains constant output voltage within specified limits despite variations in input voltage, load current, and temperature,that are represented in graphics.

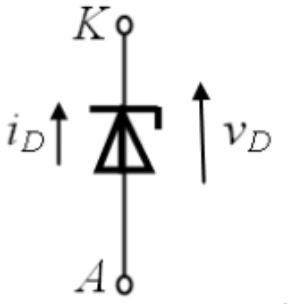
Chapter II

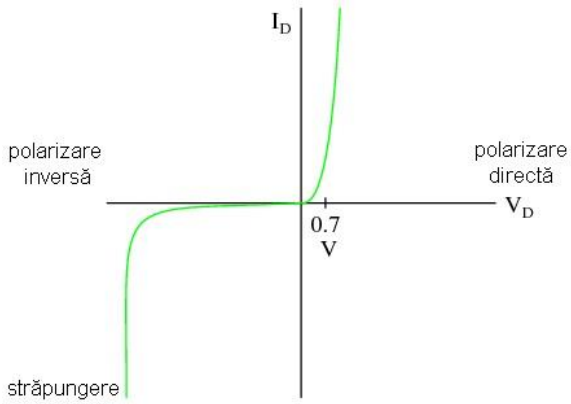
1.1 What is a zener diode?

The Zener diode behaves similarly to a normal general-purpose diode, consisting of a silicon PN junction, when forward-biased, with the positive anode relative to the cathode, allowing the nominal current to flow.

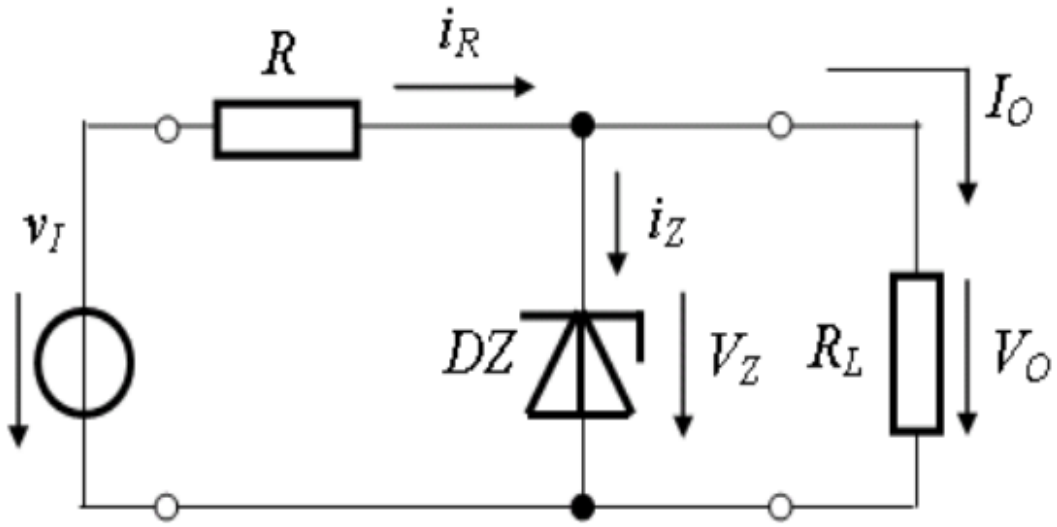
However, unlike a conventional diode that blocks any current flow when reverse-biased or when the cathode becomes more positive than the anode, as soon as the reverse voltage reaches a predetermined value, the Zener diode begins to conduct in the reverse direction.

CSTV :





Parametric Voltage Stabilizer scheme :



Formulas used :

$$i_z = \frac{V_I - V_Z}{R} - I_O$$

$$R = \frac{V_I - V_Z}{I_{Znom} + I_O}$$

Chapter III

1.1 Experimentation part

Using the following datasheet

Electrical Characteristics T_a = 25°C unless other

Device	V_Z (V) @ I_Z (Note 1)			Test Current I_Z (mA)
	Min.	Typ.	Max.	
1N4728A	3.135	3.3	3.465	76
1N4729A	3.42	3.6	3.78	69
1N4730A	3.705	3.9	4.095	64
1N4731A	4.085	4.3	4.515	58
1N4732A	4.465	4.7	4.935	53
1N4733A	4.845	5.1	5.355	49
1N4734A	5.32	5.6	5.88	45
1N4735A	5.89	6.2	6.51	41
1N4736A	6.46	6.8	7.14	37
1N4737A	7.125	7.5	7.875	34
1N4738A	7.79	8.2	8.61	31
1N4739A	8.645	9.1	9.555	28
1N4740A	9.5	10	10.5	25
1N4741A	10.45	11	11.55	23
1N4742A	11.4	12	12.6	21

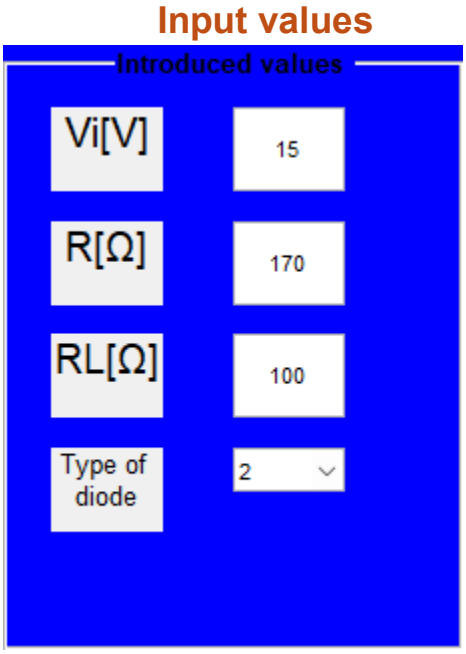
We will use the following diodes :

1N4728A – Vz tipic 3.3 [V]; Iz nominal 76 [mA]

1N4732A – Vz tipic 4.7 [V]; Iz nominal 53 [mA]

1N4733A – Vz tipic 5.1 [V]; Iz nominal 49 [mA]

1N4737A – Vz tipic 7.5 [V]; Iz nominal 34 [mA]



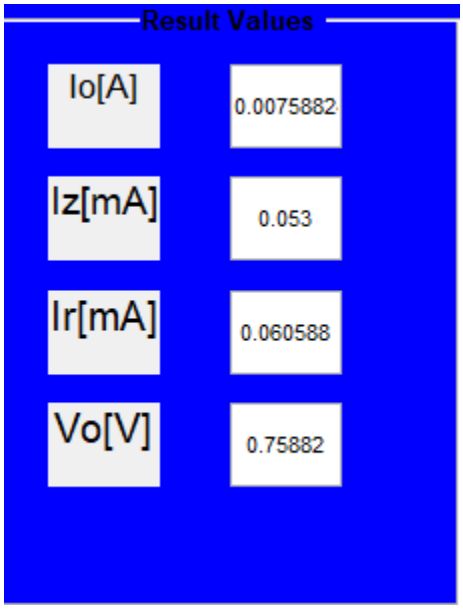
Vi[V] : Represents the input voltage.

R[ohm] : Represents the resistance of the resistor.

RL[ohm] : Represents the saturation resistance.

Diode Type : Allows the user to choose from four types of diodes used in the program.

Output values



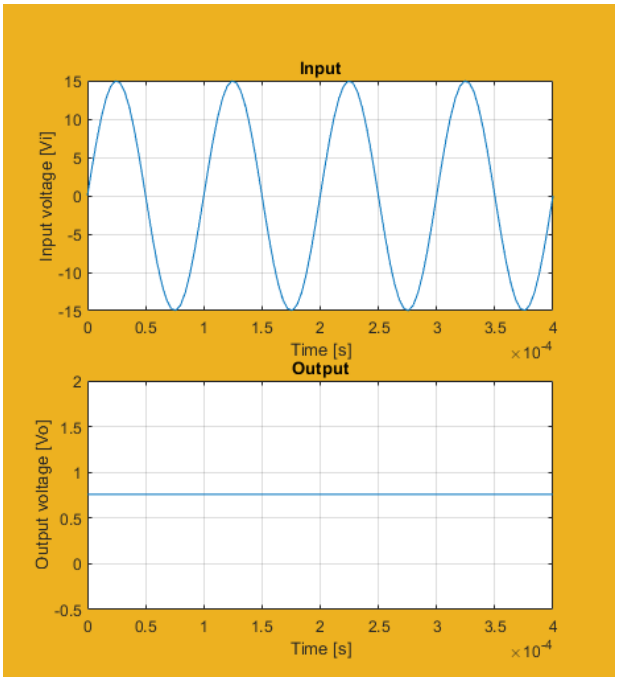
Io[A] - represents the current on the load

Iz[mA] - represents the nominal current on the diode

Ir[mA] - represents the current on the resistor

Vo[V] - represents the output voltage (or on the load)

Graphics

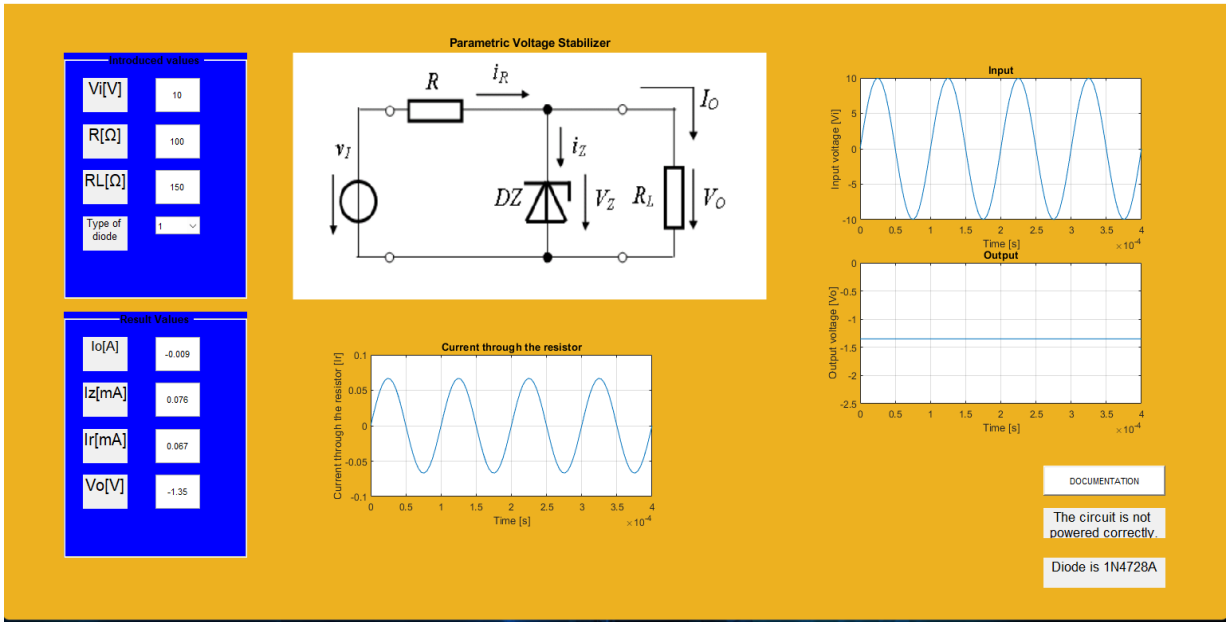


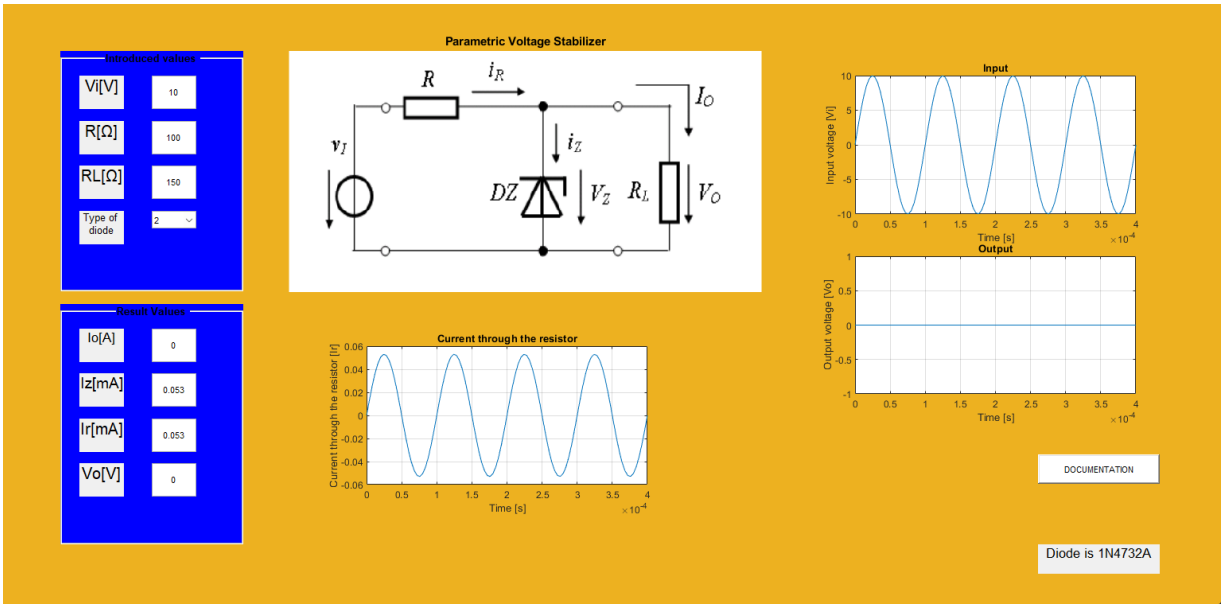
The first graph : represents the timeline of the input voltage.

The second graph : represents the timeline of the output voltage.

1.2 Experimente

In the following sequence we can see that in the first screenshot the circuit is not powered correctly because of the value I selected because the current is to high for the first model from the zener diodes to function,but for the second model the current is not to high so the current can circulate through the circuit.In this project we can play with the values to see how the graphs are modified and different from one diode to the other.





Chapter IV

1.1 Conclusion

In conclusion the Parametric Voltage Stabilizer results are how I expected them to be and I'm quite pleased with the results I got.

For future improvements I would like to discover more of the design part of the program,so that I will be able to modify my future projects,as to bring a more beautiful estatic to it and to learn shortcuts or commands that can help ease the coding process.

Chapter V

References :

1.https://ch.mathworks.com/discovery/what-is-matlab.html

2. https://ch.mathworks.com/help/matlab/creating_plots/specify-plot-colors.html#mw_fd74824f-3b08-4bfe-a526-008b68ccb92c

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4.http://www.bel.utcluj.ro/dce/didactic/ed/C5.%20Zener%20diodes.%20Operational%20amplifiers..pdf

5. https://ch.mathworks.com/help/matlab/ref/uibuttongroup.html

6. https://ch.mathworks.com/help/matlab/ref/switch.html