Downloading VEE and appropriate applications

1. In order to start using VEE Pro application you need to download VEE Pro by Keysight which can be accessed at this link: https://www.keysight.com/en/pd-1476554-pn-W4000D/vee-pro-932?pm=DL&nid=-32811.806312&cc=US&lc=eng
2. You have the option of entering a product key if available or getting a free 30-day student evaluation
3. The next application that needs to be downloaded to be able to communicate with an instrument is Keysight IO libraries suite which can be accessed at this link: https://www.keysight.com/main/software.jspx?cc=US&lc=eng&ckey=2175637&nid=-33330.977662&id=2175637
4. Once both these applications are installed you can begin on to the next step which involves connecting an instrument to work with VEE

Enabling instrument connection

1. In order to start the process, you need to open the VEE pro application and get to the home page to start a new window. This initial welcome home screen will appear which is shown in figure 1. Select the close button to continue onto the main window.

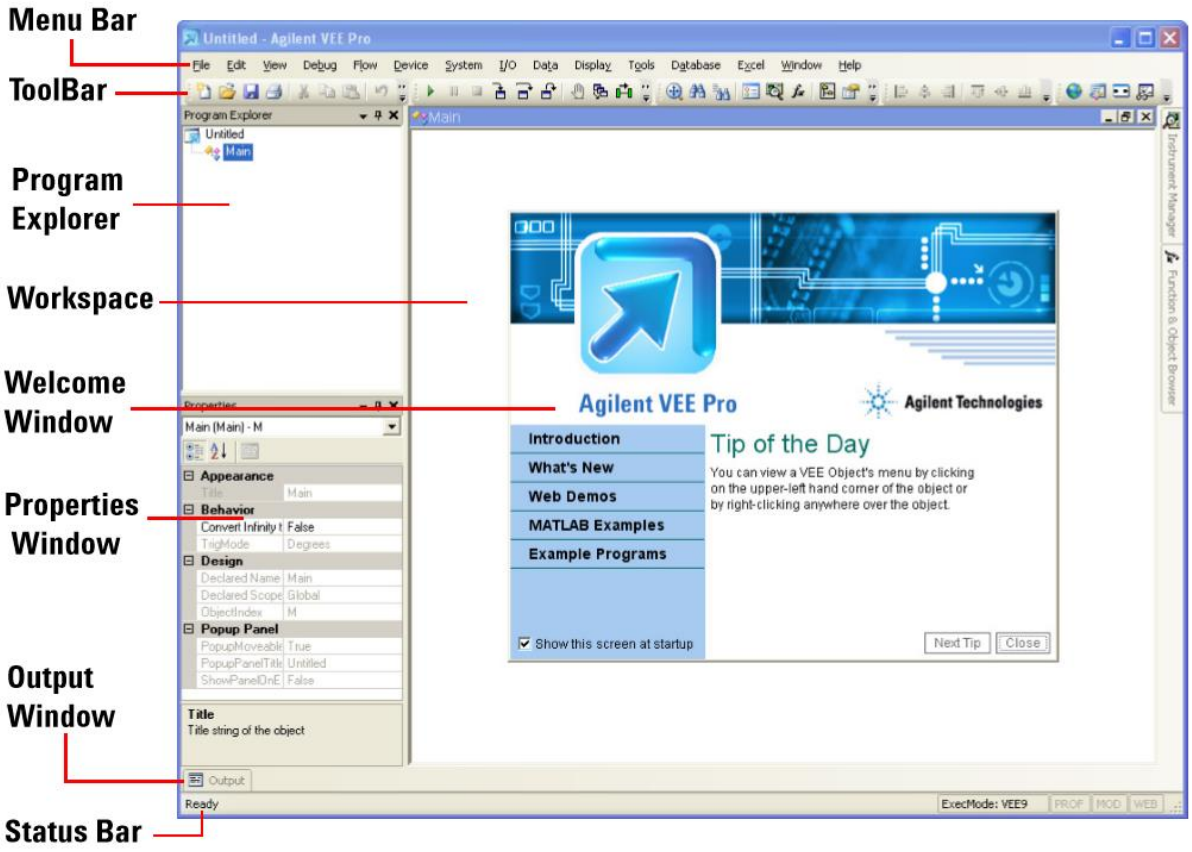

Figure 1: VEE home screen

2. In order to add an instrument to the program you can do it by opening the instrument manger tab on the right side of the screen.

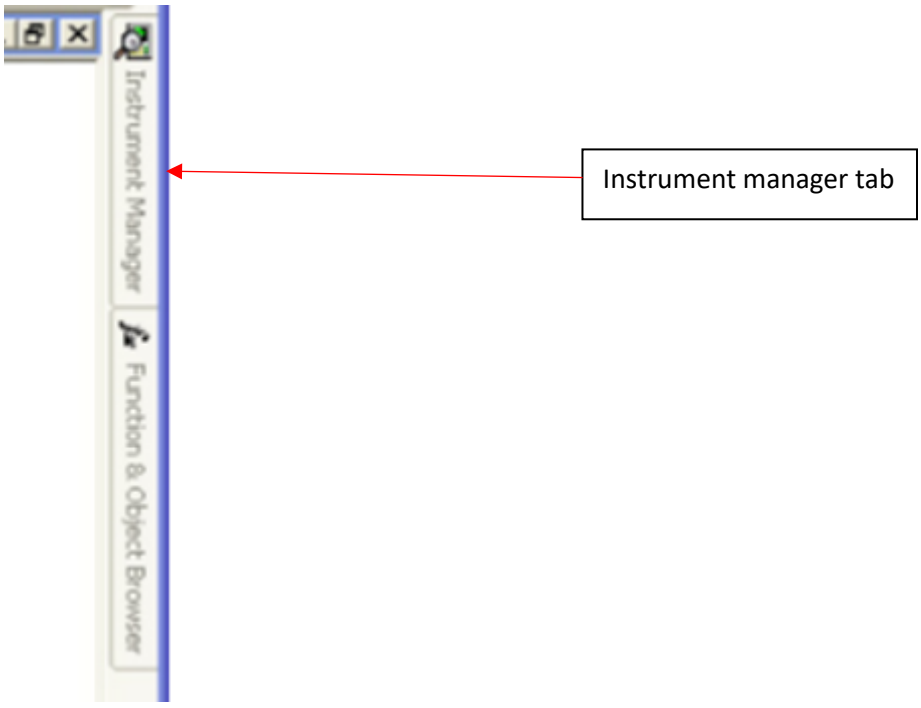

Figure 2: Instrument manger tab

3. If the instrument manager tab is not there than you can access it from the I/O drop down menu and selecting instrument manger

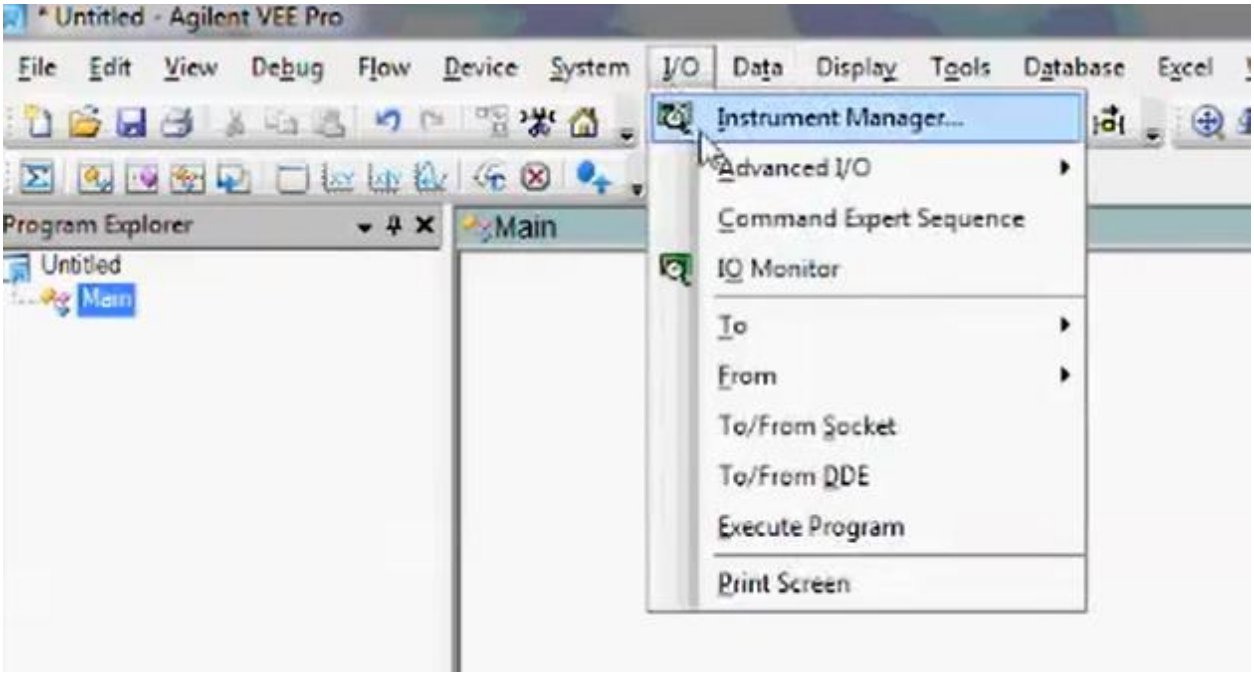

Figure 3: Turning on the instrument manger tab

4. To find an instrument click on find an instrument button which will find all instruments connected to computer or you can manually add an instrument with add instrument button.

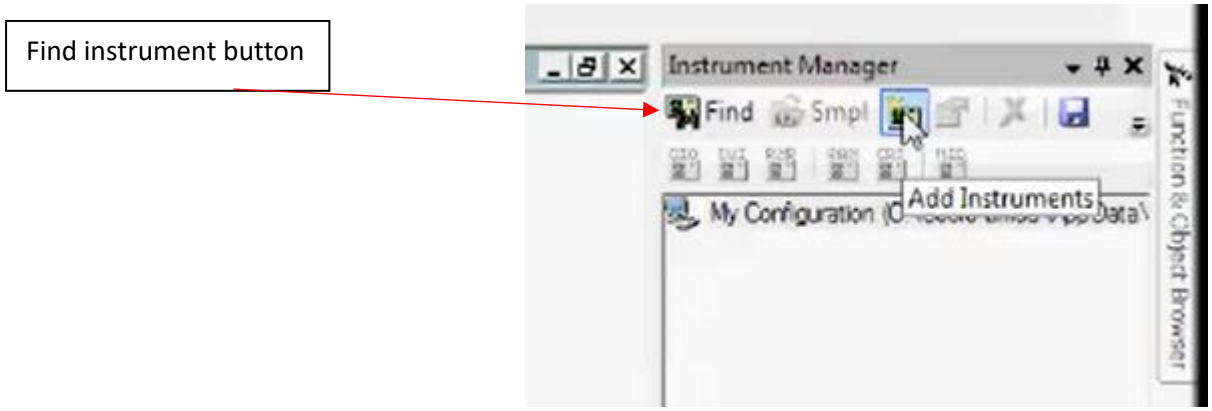

Figure 4: Adding and finding and instruments button

5. If you are going to add an instrument which is usually the case you will then have to add the interface type and select “OK” once selected

Figure 5: Selecting interface type

6. You will then be directed to the instruments properties page and you have the option to change the name of the instrument and you can specify VISA Alias or VISA Address.

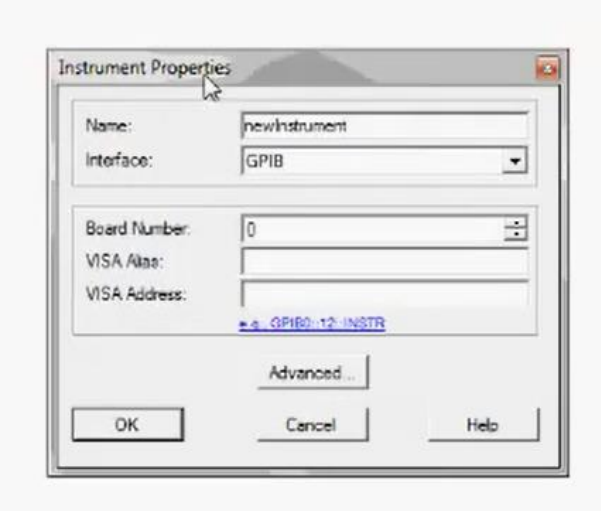

Figure 6: Instrument properties window

7. In order to get the VISA address or Alias you can open the Keysight IO libraries suite application to retrieve it. You would then copy and paste either one onto the appropriate section in the instrument properties window and hit “OK”.

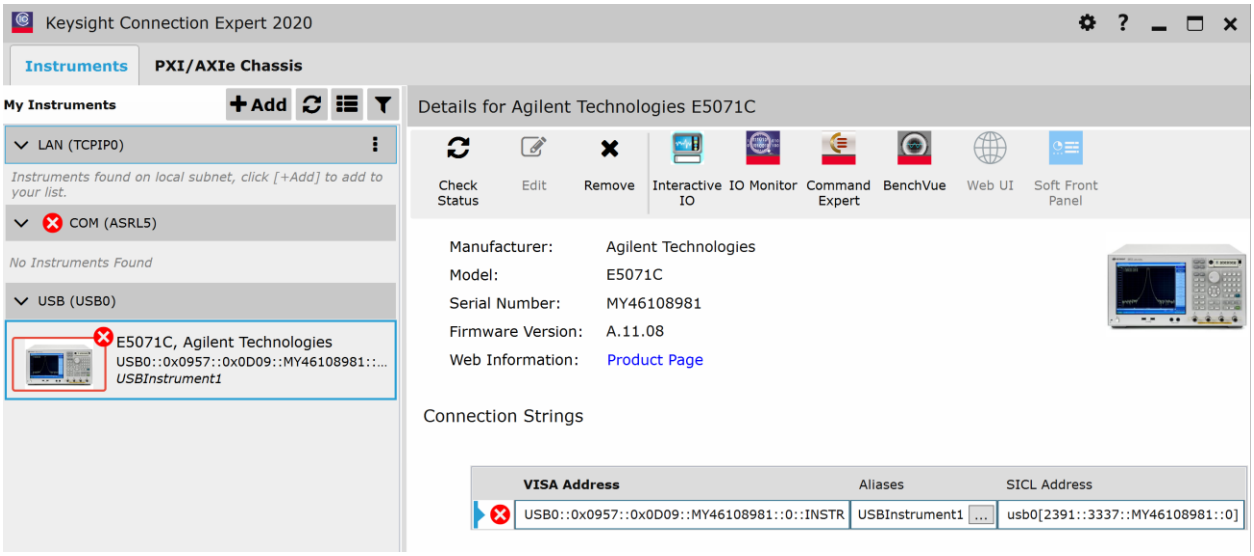

Figure 7: Finding VISA address or alias in IO libraries suite

8. You will then have the instrument added to the program as shown in figure 8.

Figure 8: Instrument created

9. You can then create a direct IO object by right clicking on the instrument you just added as shown on the left of figure 9 and the dragging the Direct IO block onto the program window as shown on the right of figure 9.

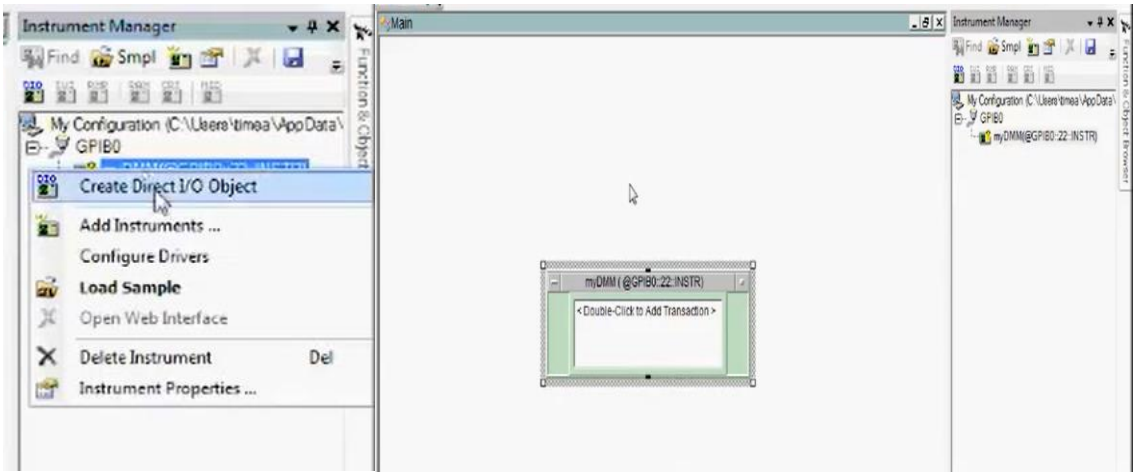

Figure 9: Creating direct IO block

10. You will then be able to add transactions to the Direct IO block as a write or read commands by double clicking. You will the be able to create a small program that will enable you to recognize if the instrument is connected to the program by retrieving its identification number. You start by with a write transaction and enter what is shown in the figure below and hit “OK”

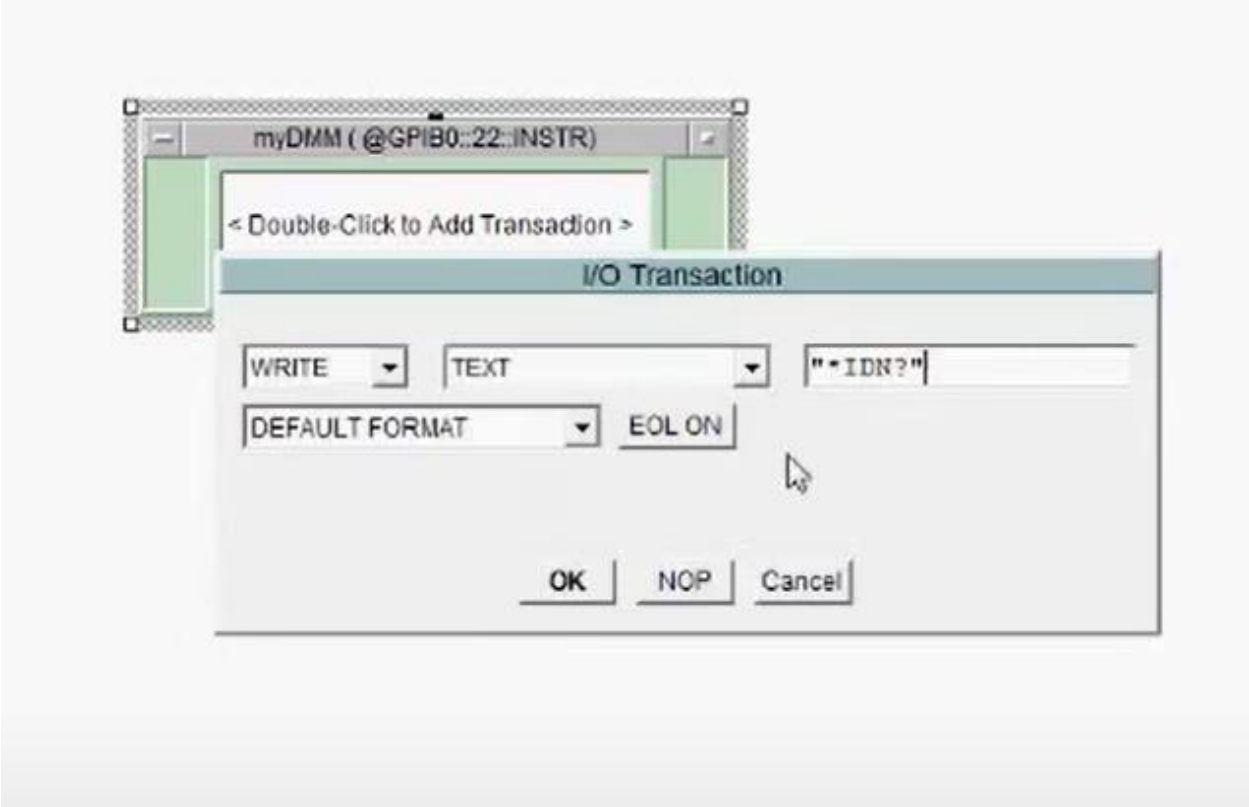

Figure 10: Adding write transaction

11. Next you will add another command that is a read transaction and enter what is shown in the figure below and hit “OK”

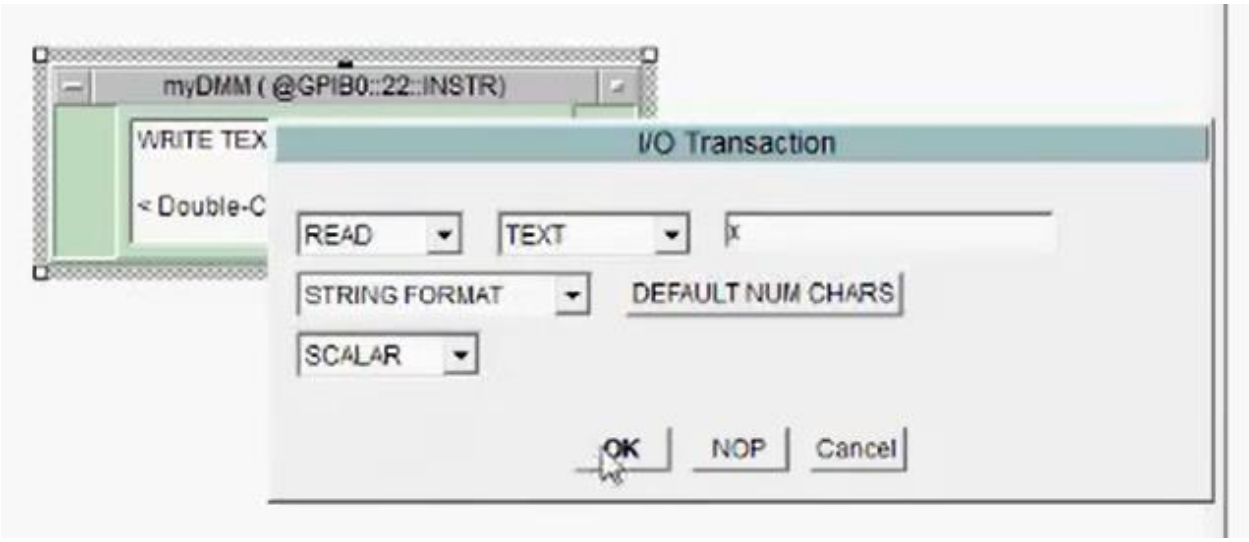

Figure 11: Adding read transaction

12. You will then go to the top and click on display and in the drop-down menu choose the alpha numeric display and place it onto the program window.

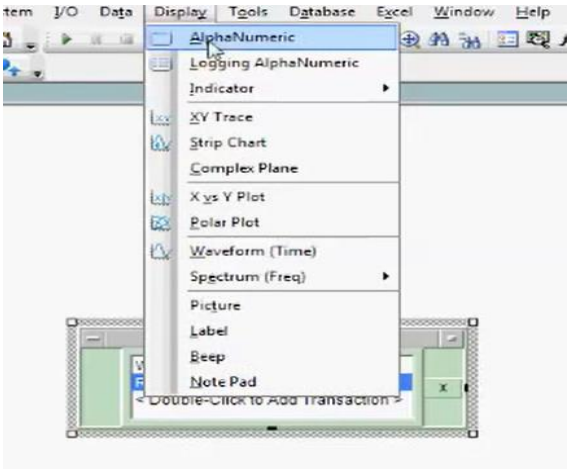

Figure 12: Adding alpha-numeric display

13. You will then wire it up to the output of the direct IO object as shown below.

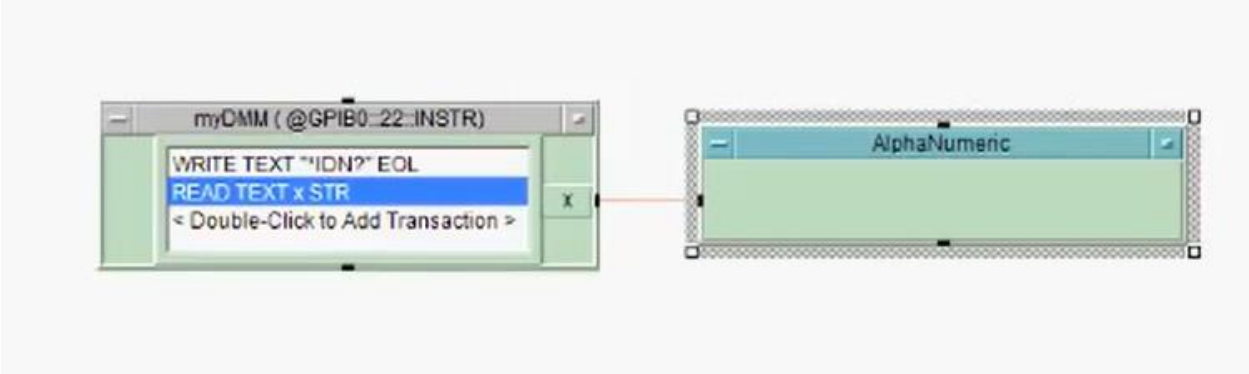

Figure 13: Adding a wire between the two blocks

14. You then hit the green play button at the top of the screen to run the program and in the alpha numeric display it will show the instruments identification number if it is hooked up correctly.

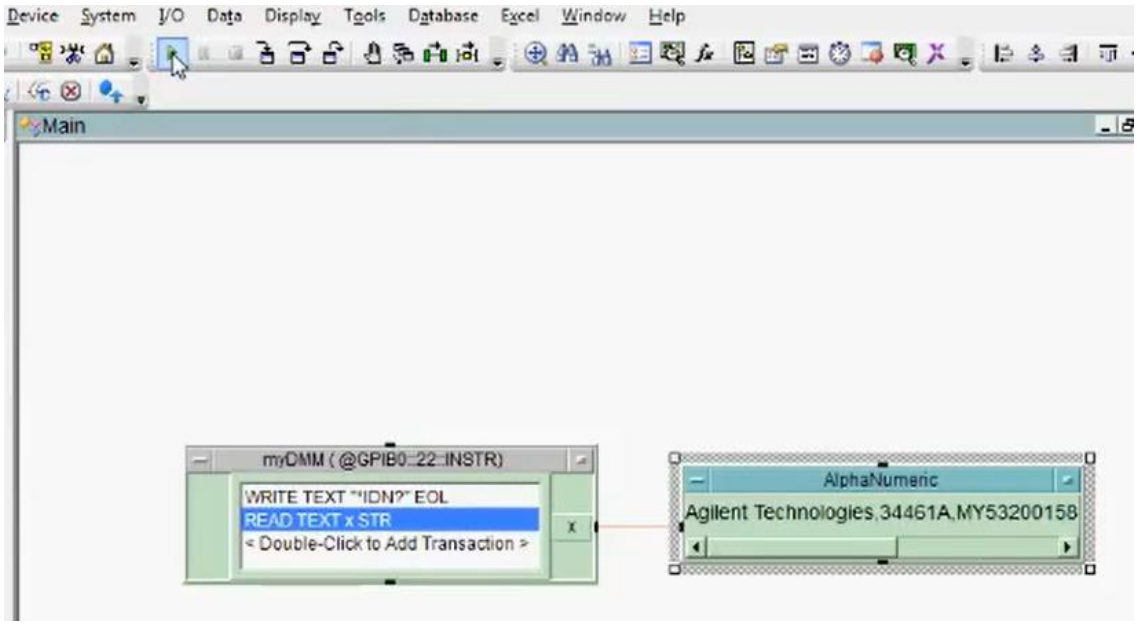

Figure 14: Result of retrieving identification number

How the VEE program works to control VNA

1. In the figure below you can see the entire program built with all the components working to control the VNA.

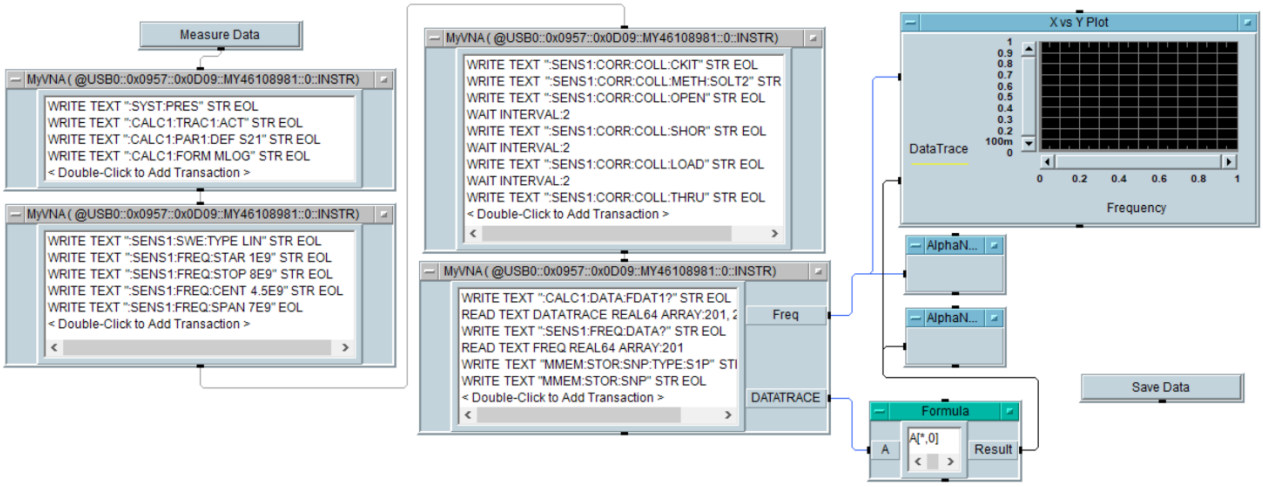

Figure 15: Completed program for controlling VNA

2. I separated the Direct IO block into different categories so that the program may be easier to read and modify. In the first block I have defined Channel 1 to be used and have turned on Trace 1 as well. I have also defined the S parameter to be measured which in this case is S21. If the S parameter needs to be changed simply enter S11, S12, or S22 where the S21 is.

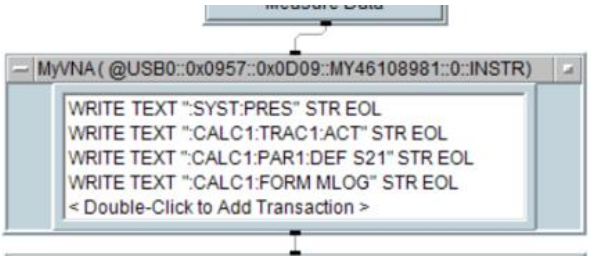

Figure 16: First direct IO block

3. In the next block I have defined everything that will control the frequency in VNA and have specified the frequency sweep to be linear. In order to change the frequency to whatever is desired you can do so by entering the number. 1E9 means 1 GHz so just change the beginning number and last number which is the order of magnitude. The “E” must remain between the numbers.

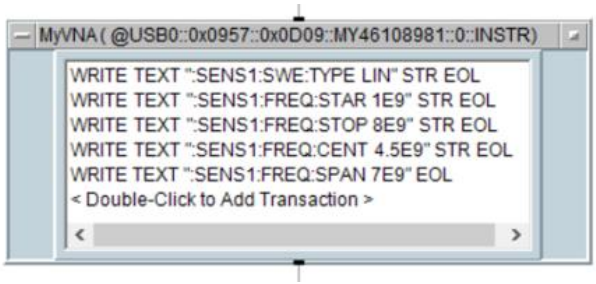

Figure 17: Second direct IO block

4. The next block defines the calibration kit to be used for this measurement and this is the most basic type of calibration for the VNA. A wait time is put between each transaction since the calibration needs to happen sequentially.

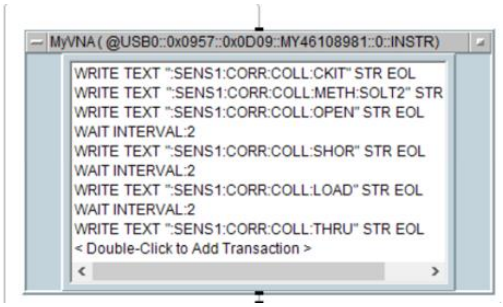

Figure 18: Third direct IO block

5. In this final direct IO block, we write the data of the S parameter and read it so the we can display it in an alpha-numeric display and in the X vs Y plot which is a miniature version of what the VNA displays. We do the same thing for the frequency so that it gets displayed on the alpha-numeric display and in the X vs Y plot. The only thing that does not currently work is the saving of SNP file which is also specified in this block.

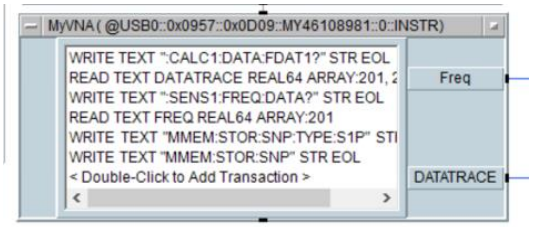

Figure 19: Fourth direct IO block

6. Now that you understand how the program works you can click on the "Measure Data" button to run the program assuming that the VNA is already connected. The program would look like the figure below. I wasn't able to get a clearer picture due to license issues and remote access problems. Other than that, the VNA and VEE program display looked identical with alpha-numeric display working properly for frequency and S21 parameter.

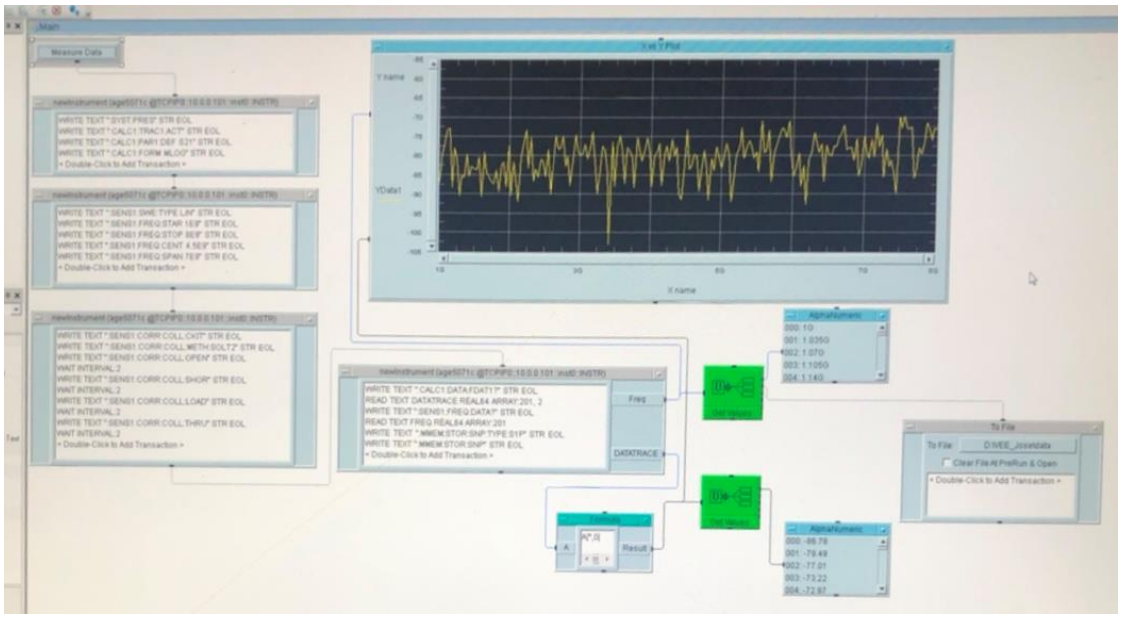

Figure 20: Program in action

<u>Command descriptions for VEE</u>

1. The commands are described more in depth individually on what they do below in the order they are listed in the direct IO blocks. Each line of code was taken straight from the E5071C VNA instruction manual.

Line 1: Presets the VNA

Line 2: Activates channel 1 and trace 1

Line 3: Defines parameter S21 for measurement

Line 4: Defines measurement format as magnitude log

Line 5: Performs a linear sweep

Line 6: Set start frequency

Line 7: Set stop frequency

Line 8: Set center frequency

Line 9: Set span frequency

Line 10: Activate calibration kit

Line 11: Select full 2 port calibration

*There is a wait interval between (line 12-15) each measurement so that the commands don't overwrite each other and happen sequentially

Line 12: Measure open for calibration

Line 13: wait interval 2 seconds

Line 14: Measure short for calibration

Line 15: wait interval 2 seconds

Line 16: Measure load for calibration

Line 17: wait interval 2 seconds

Line 18: Measure thru for calibration

Line 19: wait interval 2 seconds

Line 20: write the formatted data array for the S21 parameter

Line 21: Read the data array of the S21 parameter in Real 64 bit with 201 points

Line 22: write the formatted data array for the frequency

Line 23: Read the data of the frequency array with 201 points

Line 24: determines a file type in touchstone file format and specifies a port

Line 25: saves measurement data in touchstone format

The program currently does not save that data in SNP file