3. Using the Hysteresis Device

The hysteresis device is used to view the property of hysteresis of materials by interfacing software on the computer with the lab test equipment and with the hysteresis device which contains the material and mechanisms for the hysteresis measurement.

3.1. Functionality

There are two pieces to the hysteresis device setup: The physical artifact containing the material to measure and the mechanisms with which to measure, and the computer which does the appropriate calculations on the data obtained from the physical artifact using the function generator and the scope. The device is therefore controlled solely by the computer using the HYS316.vxe executable control interface.

3.2. Controls and Interface

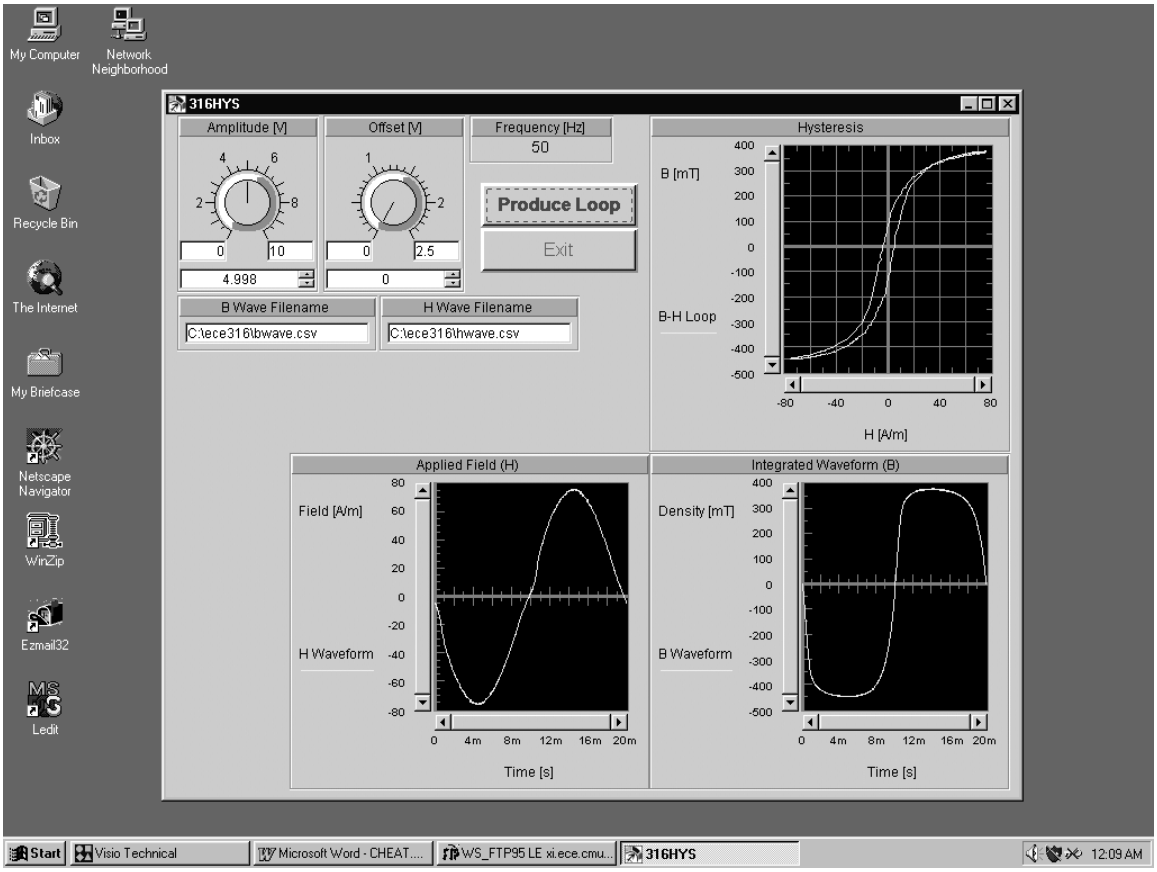
The device is controlled entirely by the computer. For that reason, follow the steps below using the interface on the computer, but do not make any adjustments directly to the scope nor the function generator. Doing so could cause the executable to fail.

3.2.1. **Turn on** both the scope and function generator.

3.2.2. The device is controlled using the script found at "C:\ece316\HYS316.vxe." Open it.

3.2.3. Upon opening, the executable will attempt to automatically create the hysteresis loop, even though you have not connected the physical artifact to the system as yet; this is alright, although the data displayed will be meaningless. Remember: DO NOT control the scope, nor the function generator directly after this point.

3.2.4. Control the device using the buttons, file name ports and displays as described below. Refer to the figure of the control script, "HYS316.vxe" as it is shown below.



3.2.4.1. Amplitude Control Knob: The amplitude control knob will control the peak-to-peak voltage that is being applied to the circuit on the primary coil. The magnitude of the applied magnetic field inside of the ferrite material is directly proportional to the magnitude of the applied voltage. The program defaults to a value of 5V, which causes a well-formed loop to occur.

3.2.4.2. Offset Voltage Knob: This control allows the user to vary the offset voltage of the applied waveform to the device. The default value is zero.

3.2.4.3. Frequency Display: This only displays the applied frequency, but it does not allow for adjustment; the devices have been designed for use with this frequency only.

3.2.4.4. B Wave Filename: Allows the user to select the path and name of the file to be saved when the program is run that will contain the data points from the B-Wave (y-axis of the loop). Note: The data contained in this file has not been scaled appropriately to be in the units of magnetic flux density (B).

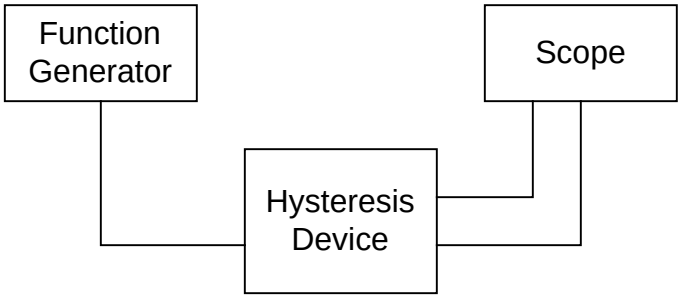
3.2.4.5. H Wave Filename: Allows the user to select the path and name of the file to be saved when the program is run that will contain the data points from the H-Wave (x-axis of the loop). Note: The data contained in this file has not been scaled appropriately to be in the units of applied magnetic field (H).

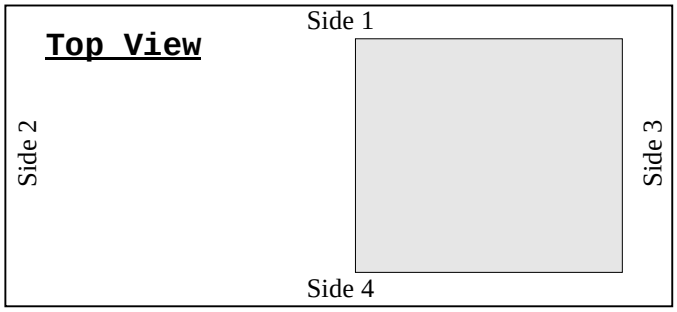
3.2.4.6. Waveform Displays: Displays the waveforms as they are labeled on the plots. All have the ability to scroll the waveform window and zoom by selecting an area of the plot with the mouse and/or using the right mouse button.

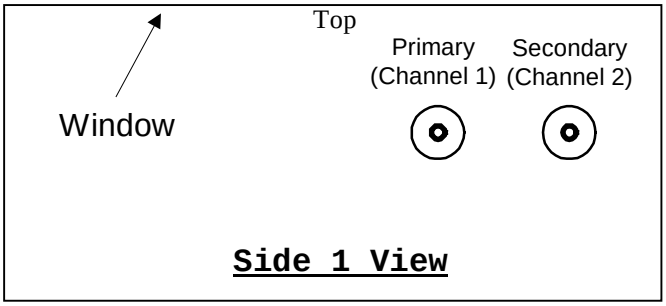
3.2.4.7. Produce Loop/Exit: Allows the user to force the program to recalculate the loop, taking new data from the physical artifact, and exit the program, respectively.

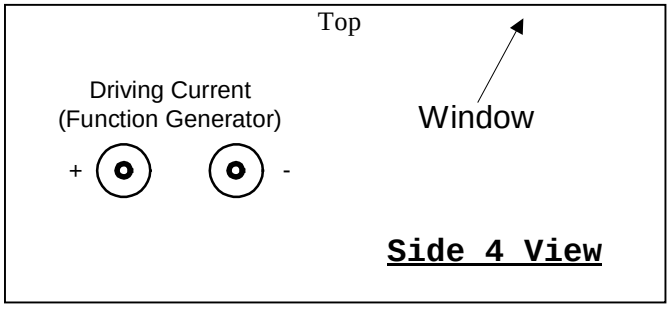
3.3. Connection and Setup

Connection of the device is accomplished by following the following instructions and diagram.









3.3.1. Connect the output of the function generator to the *function generator* port of the physical device using a BNC cable and a BNC-Banana plug adapter. Make sure that the plastic extension (polarization mark) on the side of the BNC-Banana adapter is plugged into the black port on the physical device.

3.3.2. Connect the *Primary* port to channel #1 of the scope using a BNC cable.

3.3.3. Connect the *Secondary* port to channel #2 of the scope using a BNC cable.

3.4. Creating the Hysteresis Loop

To create the hysteresis loop after the device has been connected and the scope and function generator have been turned on, start the script as described in section 3.2 or click on the *Produce Loop* button of the control window. If the loop does not appear correctly, check the connections and try again.

3.5. Importing Hysteresis Data into Matlab

Data may be imported into Matlab by means of the files saved in the B-Wave and H-wave fields of the control window. You will not use hpread() nor hpimport() to make the data import. Use the following instructions to import this data into Matlab:

3.5.1. Follow the steps in sections 3.2 and 3.4 to create the loop on the screen of the control window. Make sure that the names and paths of the B-Wave file and the H-Wave file are correct before producing the loop. When a satisfactory loop was produced, proceed on to the next step.

3.5.2. After opening Matlab, change the directory to the directory in which the files from the B-Wave and H-Wave fields were stored. This is done using the cd command.

3.5.3. Use the command data = csvread('filename'); to read the data from the .csv files into matlab. Make sure to place a semi-colon after the command, as the file contains much data. An example call to the command follows:

```
B = csvread('bwave.csv');
```

3.5.4. The data is imported into a n x 2 matrix, where n is the number of data points in the waveform. The first column of the waveform contains the x-axis data (time) of the waveform. The second column contains the y-axis data of the waveform (amplitude). Thus, plotting the waveforms would involve the function call to the plot command as follows:

```
plot(B(:,1),B(:,2));
```

3.5.5. To create the hysteresis loop in Matlab, the y-coordinates of the H-wave need to be used as the x-coordinates of the loop, and the y-coordinates of the B-wave need to be used as the y-coordinates of the loop. Thus the following command would create the hysteresis loop:

```
Plot(H(:,2),B(:,2));
```