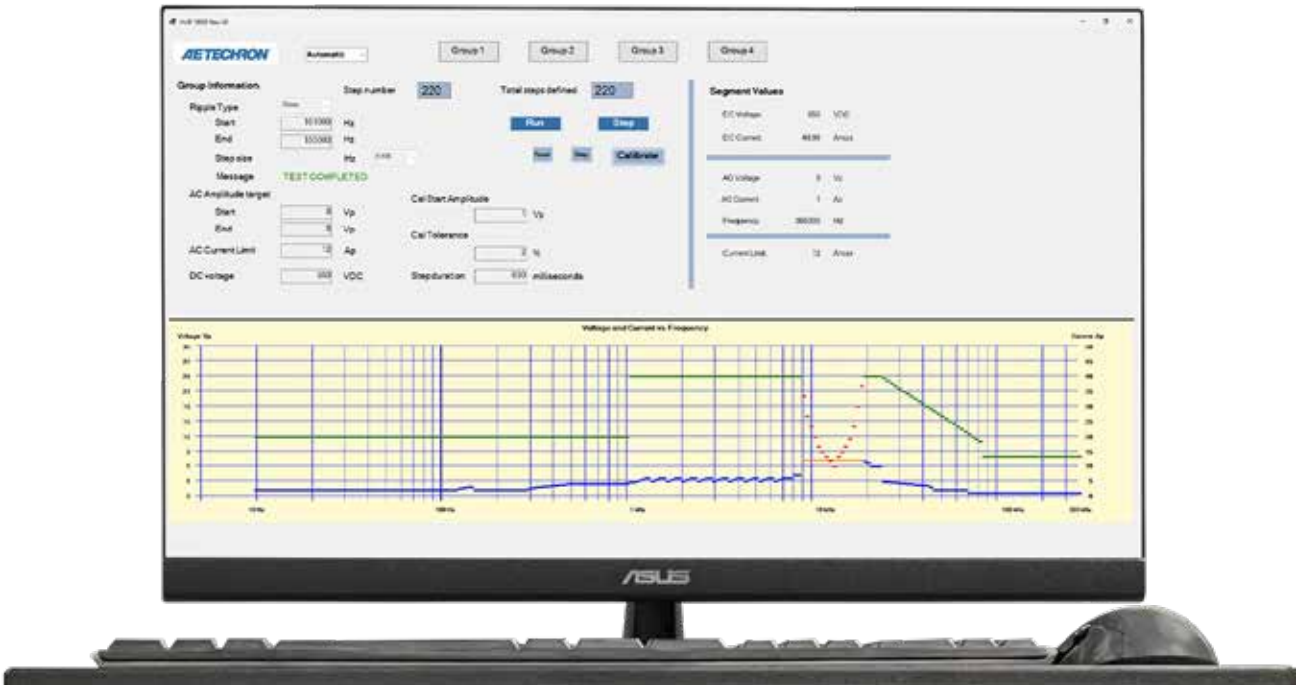
AETECHRON®



HVR Series Software Manual

High-Voltage Ripple Generator

574.295.9495 | www.aetechron.com
2507 Warren Street, Elkhart, IN 46516

Three-Year, No-Fault Warranty

SUMMARY OF WARRANTY

AE TECHRON INC., of Elkhart, Indiana (Warrantor) warrants to you, the ORIGINAL COMMERCIAL PURCHASER and ANY SUBSEQUENT OWNER of each NEW **AE TECHRON INC.** ***product, for a period of three (3) years from the date of purchase, by the original purchaser (warranty period) that the product is free of defects in materials and workmanship and will meet or exceed all advertised specifications for such a product. We further warrant the new AE Techron product regardless of the reason for failure, except as excluded in the Warranty.***

ITEMS EXCLUDED FROM WARRANTY

This AE Techron Warranty is in effect only for failure of a new AE Techron product which occurred within the Warranty Period. It does not cover any product which has been damaged because of any intentional misuse, or loss which is covered under any of your insurance contracts. This warranty does not extend to any product on which the serial number has been defaced, altered, or removed. It does not cover damage to loads or any other products or accessories resulting from **AE TECHRON INC.** product failure. It does not cover defects or damage caused by the use of unauthorized modifications, accessories, parts, or service.

WHAT WE WILL DO

We will remedy any defect, regardless of the reason for failure (except as excluded), by repair or replacement, at our sole discretion. Warranty work can only be performed at our authorized service centers or at our factory.

Expenses in remedying the defect will be borne by **AE TECHRON INC.,** including one-way surface freight shipping costs within the United States. (Purchaser must bear the expense of shipping the product between any foreign country and the port of entry in the United States and all taxes, duties, and other customs fees for such foreign shipments.)

HOW TO OBTAIN WARRANTY SERVICE

When you notify us or one of our authorized service centers of your need for warranty service, you will receive an authorization to return the product for service. All components must be shipped in a factory pack or equivalent which, if needed, may be obtained from us for a nominal charge. We will take corrective actions and return the product to you within three weeks of the date of receipt of the defective product, or will make available to you a product of equal or better performance on temporary loan until your product can be repaired or replaced and returned to you. If the repairs made by us are not satisfactory, notify us immediately.

DISCLAIMER OF CONSEQUENTIAL AND INCIDENTAL DAMAGES

You are not entitled to recover from us any consequential or incidental damages resulting from any defect in our product. This includes any damage to another product or products resulting from such a defect.

WARRANTY ALTERATIONS

No person has the authority to enlarge, amend, or modify this warranty. The warranty is not extended by the length of time for which you are deprived of the use of this product. Repairs and replacement parts provided under the terms of this warranty shall carry only the unexpired portion of this warranty.

DESIGN CHANGES

We reserve the right to change the design of any product from time to time without notice and with no obligation to make corresponding changes in products previously manufactured.

LEGAL REMEDIES OF PURCHASER

There is no warranty that extends beyond the terms hereof. This written warranty is given in lieu of any oral or implied warranties not contained herein. We disclaim all implied warranties, including, without limitation, any warranties of merchantability or fitness for a particular purpose. No action to enforce this Warranty shall be commenced later than ninety (90) days after expiration of the warranty period.
This statement of warranty supersedes any others contained in this manual for AE Techron products.

AE TECHRON INC.
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Contents

1 About the HVR Software

The HVR software is a Windows-based .NET application that runs on the tester. The user interface has been designed to be used quickly and easily for users with experience with the AE Techron 3110A Signal Wave Generator.

The software architecture is object-oriented and designed for long life and maintainability.

It provides the user with integrated device control of the various components of the system with minimal physical user interaction with those parts.

1.1 Disclaimer

Although AE Techron has made substantial effort to ensure the accuracy of the Segment test files, which are included with the HVR unit, no warranty, expressed or implied, is made regarding accuracy, adequacy, completeness, legality, reliability or usefulness of the information provided. It is the responsibility of the user to ensure the accuracy and applicability of these test files for their intended purposes.

2 Architectural Overview

The HVR Series Application runs on the HVR system and provides the user interface into the tester.

The top of the display has the segment definitions and some user controls in the top left, the step level data in the top right, and a voltage/current vs. frequency chart at the bottom:

Figure 2.1 is actual data, plotted with the E48 step type, saved from the testing of reactive load during development, exported to a Report through the menu, and used as a demonstration for the HVR Complete System (CS) (10 Hz to 150 kHz). The bow near 100 Hz shows voltage reduced due to current limiting. The target line appears in grey.

Controls allow replacing the Voltage and Current chart with an Impedance chart calculated for each step as voltage/current or a DFT representation of the data collected (chart for each step) through the menu item “View.”

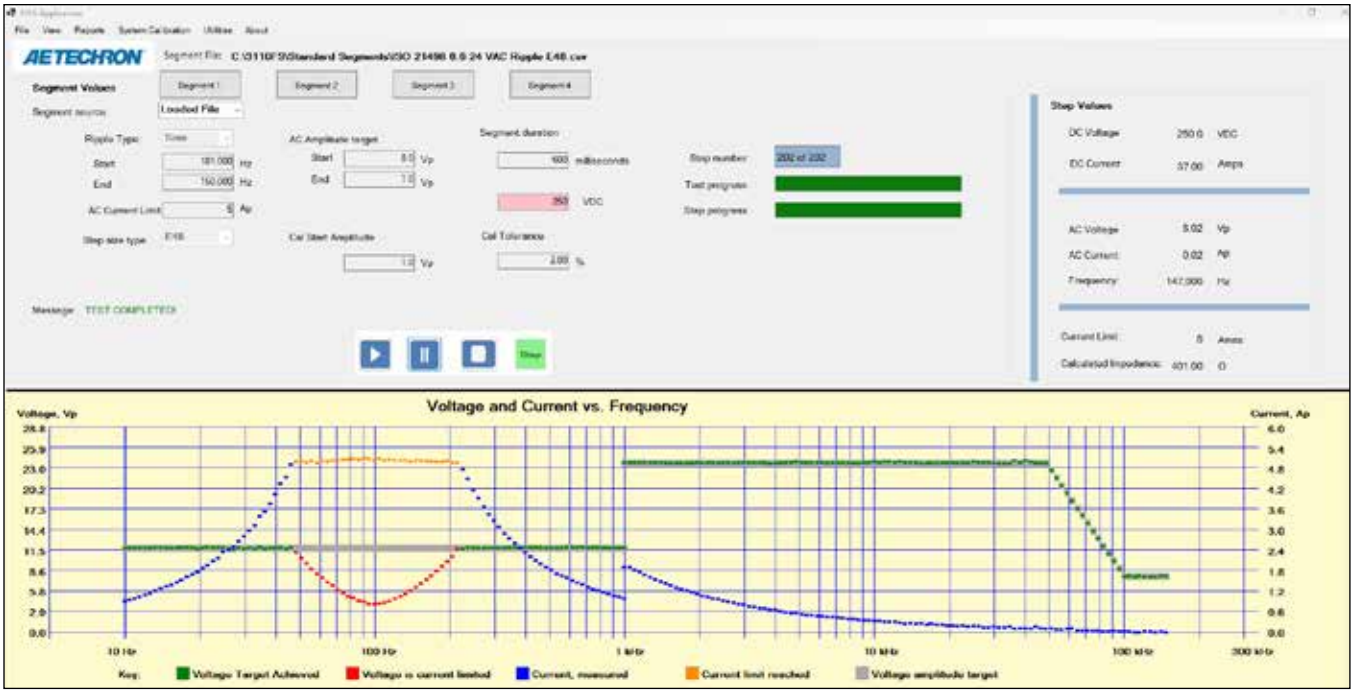

Figure 2.1 – HVR CS Data with E48

Figure 2.2 shows the corresponding impedance plot for the HVR CS data shown in Figure 2.1.

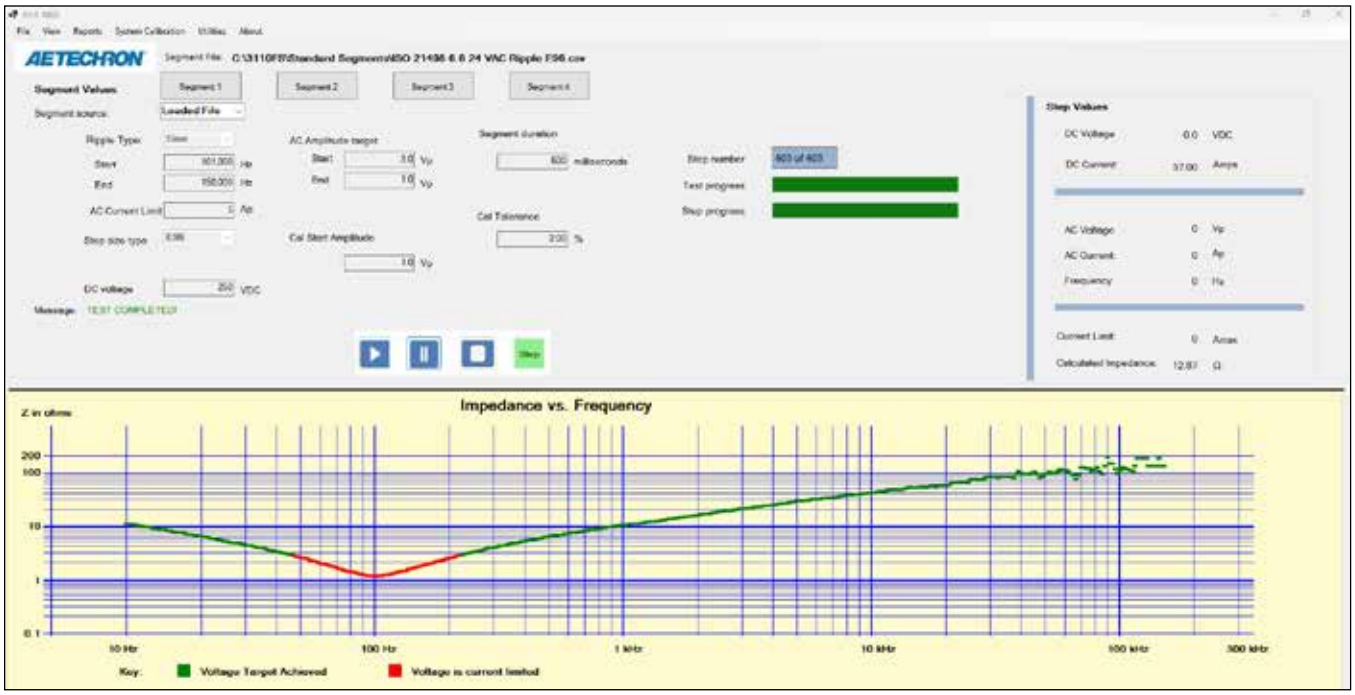

Figure 2.2 – HVR CS Impedance Data with E48

Figure 2.3 shows the corresponding DFT plot for the HVR CS data shown in Figure 2.1.

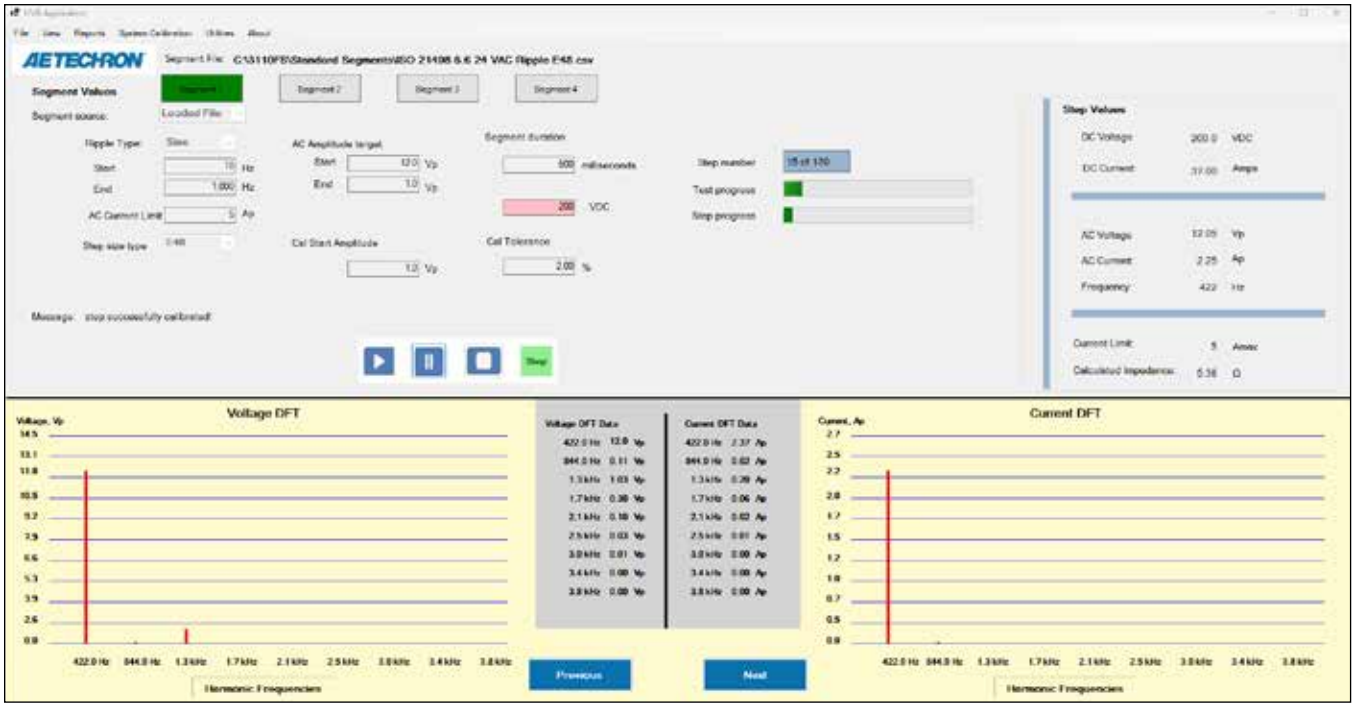

Figure 2.3 – HVR DFT Data for a Given Step

Figure 2.4 shows the same data as Figure 2.1 plotted for the frequency range of the HVR Ripple Generator (RG) (200 Hz to 150 kHz).

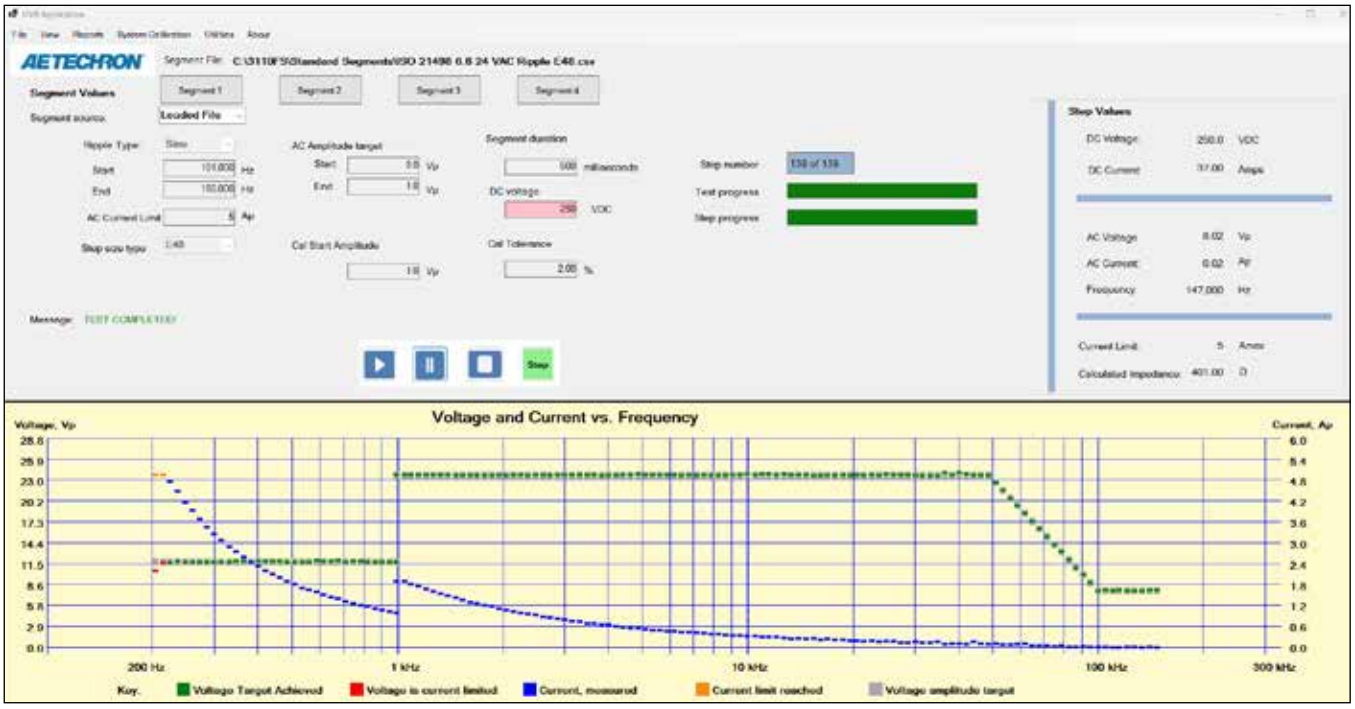

Figure 2.4 – HVR RG Data with E48

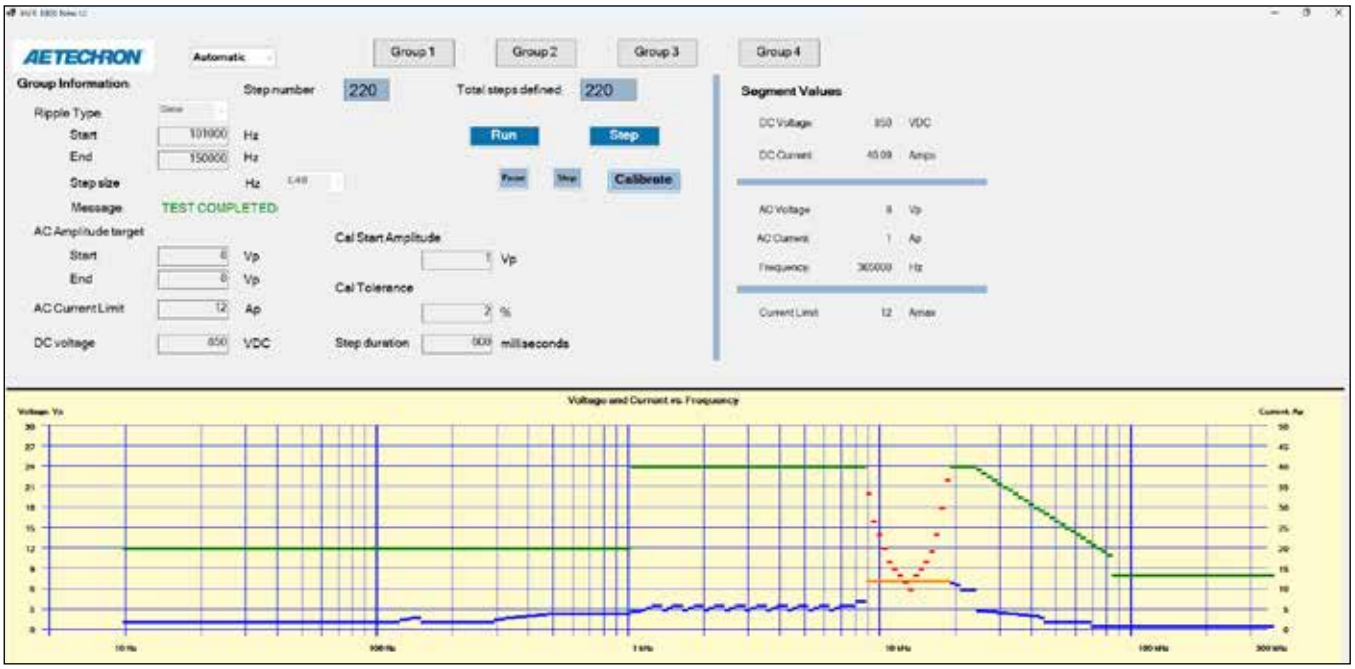

Figure 2.5 – HVR CS Data with E48 from a Reactive Load

2.1 Segment Definitions

Segment definitions are an easy and convenient way to describe a test set without needing to define each step. The wave forms are simple AC ripple riding on top of a DC carrier. The user creates the segment definitions based on shared characteristics and these definitions are stored in a csv.

The software creates the steps from the segment definitions without user intervention based on the step size defined in the Segment file. As a test is running, the Segment number is identified at the top as the labels turn green.

Overlaps between Segments are only allowed at the endpoint; multiple points may not be overlapped. For example, **Figure 2.4** shows a point at 1 kHz for 12 V and one for 24 V.

The role of the signal generator loads and runs a single ripple wave step on command.

With the Complete System (CS) models, the DC Power Subsystem will provide the DC voltage as well as the ripple below 200 Hz. The Control Program will make the determination of how to command the power supply and the signal generator as it goes through the steps and the transition is seamless.

Feedback for compensation is provided by a digitizer within the HVR system, which collects the current and voltage data. The time domain data captured by the digitizer are analyzed through a Discrete Fourier Transform (DFT) process for each step to separate out the fundamental frequency from the harmonics. The results of the DFT analysis are retained for each step and included in the report that can be generated at the end of the test.

2.2 Segment File

The creation of a Segment File for a specific set of test parameters begins with the user specifying these values for a segment of steps that share a voltage target, current limit, and frequency step size over a frequency range:

Start:	Ripple Frequency	10 Hz
	AC Amplitude Target	10 Vp
	Current Limit	50 Ap
	DC Voltage	400 VDC
End:	Ripple Frequency	1000 Hz
	Step Size	E12, E48, E96 or Linear with user-defined step size.

E12, E48, and E96 are fully supported and display nicely on the logarithmic scale.

The number of segments is unlimited, so the user could make complicated test sequences with this UI.

2.3 Step Handling

The step is handled during the automated compensation process. A manual compensation process is envisioned as well (where the user can choose data differently than the automation would). Safety limits will need to be enacted to keep the user from deliberately driving past the current limit or the power limits on the DC Power Subsystem.

The compensation/test results will be stored in a file through the Reports menu item.

3 Compensation

3.1 Step Compensation Process

The Step Compensation Process always starts with an amplitude of (target/30) as the command voltage to the signal generator. This is not equal to the voltage at the output of the system, due to the impedance dependent frequency response, but reflects the first iteration of the compensation process.

“Current Limit Danger” is calculated as (targetVoltage / CalculatedImpedance >= current limit). In other words, assuming the impedance to be fixed at that frequency, will the current limit be triggered by the target voltage.

If there is no “Current Limit Danger” found, the next iteration will apply the amplitude as 90% of the target voltage. The step impedance is then recalculated to ensure that it has not changed or changed within the current limit parameters. “Current Limit Danger” is then recalculated with the new impedance and, if no danger exists, the output amplitude is set to the target at 100%. If not within tolerance yet, repeat the iterations until it reaches the target within tolerance.

If “Current Limit Danger” is detected on any iteration, the system will approach the current limit at an amplitude set to reach 60% of the current limit and recalculate. The next iteration will be either:

- Approach current limit at an amplitude to achieve 90% of the current limit (no “Current Limit Danger”) and then the amplitude where the current limit is triggered.
- If still not at the current limit, slowly approach until within tolerance or the current limit is triggered.

The Step Compensation algorithm was chosen to balance speed with caution relative to the current limit and the protection of the equipment.

3.2 Network Setup

The HVR tester uses an internal ethernet connection and IP configuration to communicate between various parts of the system. The HVR tester comes from the factory set up in a standalone fashion: the internal ethernet network is not set up for connection to a customer’s intranet.

If requested by the customer, AE Techron will configure it as public in the factory to reduce the inconvenience to the customer at setup.

3.2.1 Private network setup (factory default):

Signal generator internal set up:

- IP address – 192.168.2.250 (arbitrary)
- Gateway - 192.168.2.0
- Network Mask - 255.255.255.0
- DNS1 - 8.8.8.8
- DNS2 - 8.8.4.4
- No changes are needed for the 3110FS file share access
- Power off and back on

Micro-PC network set up:

- IP address - 192.168.2.5
- Ping the signal generator to confirm the connection
- Mark ethernet as private in Windows

3.2.2 Public network setup:

Signal generator:

- IP address – set internally and changed by customer; this should be a static IP address

Micro-PC

- IP address - set internally and changed by customer
- Ping the signal generator to confirm
- Reconnect the 3110FS file share drive on the 3110A client application on the micro-PC

4 Navigation

The menu at the top provides navigation into the various functions of the HVR application.

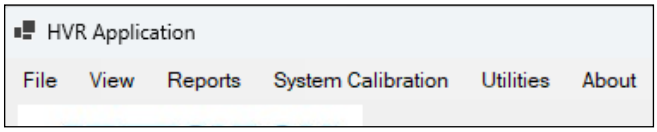

Figure 4.1 – Navigation Menu

4.1 The File Menu Item

Under the File menu item, the “Load Segment File” selection opens the Standard Segments folder to select an existing Segment File (see **Fig. 4-2**). This folder is read-only, but files can be read in, modified and stored into the individual’s user folder. The contents of the Standard Segments folder are determined by the standards supported.

Under the File menu item, the “Modify or Create Segment File” selection can be used to modify and save an of the existing Segment Files. It opens a new page where data can be entered and modified (see **Fig. 4-3**).

For ripple testing the start and end amplitude will be the same for AC and DC. Where options are limited, drop downs are provided. The Step Size Type has 4 built-in values to select from: E12, E48, E96, and Linear. E12 and E48 are the most typical for ISO 21498 testing.

Under the File menu item for this page, are typical file operations:

- New file
- Open
- Save
- Save As
- Close form

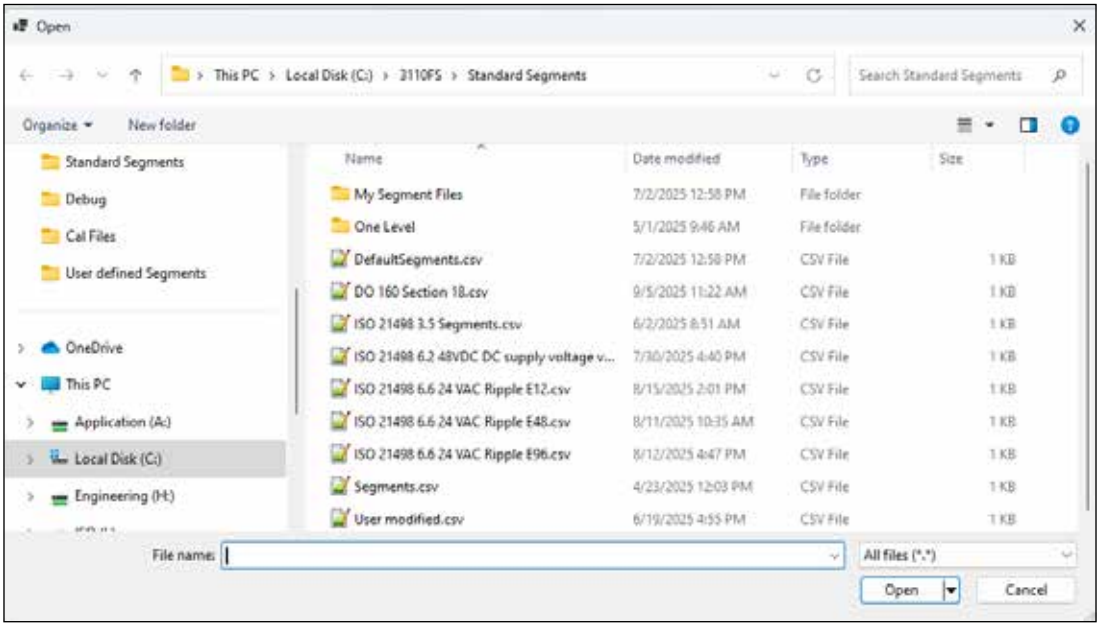

Figure 4.2 – File Menu, Load Segment File Window

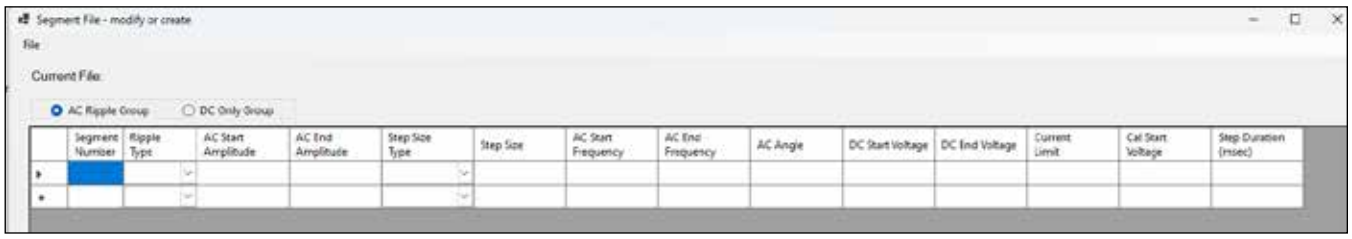

Figure 4.3 – Modify or Create Segment File Window

4.2 The View Menu Item

Under the View menu item, the “Voltage/Current Chart” is the default selection. During testing, the voltage and current are both displayed on this chart with the voltage scaled on the left and the current scaled on the right (see **Fig. 4-4**).

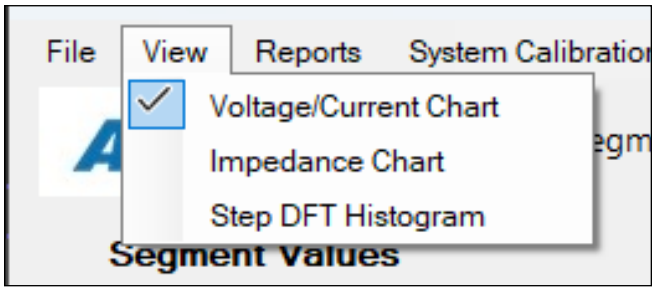

Figure 4.4 – View Menu

Changing the selection changes the chart view at the bottom of the page.

Under the View menu item, the “Impedance Chart” selection displays the Impedance calculated from the voltage and current values on the Voltage/ Current Chart.

Under the View menu item, the “Step DFT Histogram” selection shows the results of the DFT analysis of the time domain voltage and current data. Eight levels of harmonics are displayed.

4.3 The Reports Menu Item

Under the Reports Menu Item, selecting “Generate Report to File” will save off the test data for this test (see **Fig. 4-5**). A partially completed test will include only the data from the steps that have completed. The data file is in a csv format and stored on the computer at location C:\3110FS\Reports with a time and date stamp (see Fig. **4-6**).

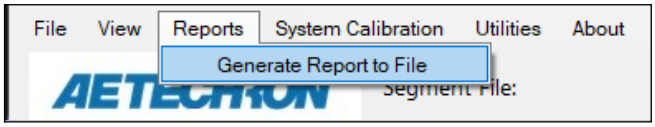

Figure 4.5 – Reports Menu

The csv file may be opened in Excel for further analysis (see **Fig. 4-7**).

The data includes the initial Segment File information for each step along with the captured values for voltage, current, and the calculated impedance. The voltage and current DFT values are included at the end of the row with headings like vDFT1 (voltage amplitude at the fundamental frequency), vDFT2 (voltage amplitude at the first harmonic (fundamental frequency * 2)), and so forth. The current DFT is labeled as iDFT1, iDFT2, etc. In both cases, the captured value is the amplitude at the fundamental frequency.

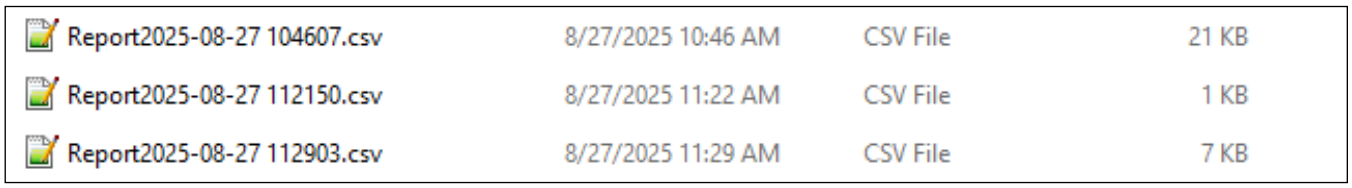

Figure 4.6 – Generate File Report to File List

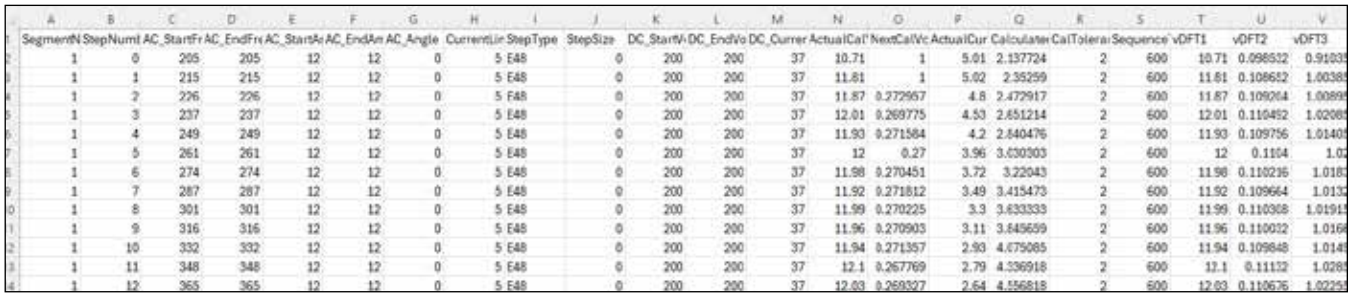

Figure 4.7 – Report File Opened in Excel

4.4 The System Calibration Menu Item

The HVR test system comes from the factory with System Calibration already performed. The System Calibration file is stored on the HVR system and is read during the application initialization. The System Calibration should be repeated annually after each subsystem item is confirmed to be calibrated. Selecting this menu item presents this message box:

The System Calibration is performed into a completely resistive 4 Ω load at 10 pre-determined frequencies. Once the System Calibration is completed, the step-wise calibration is performed during the testing sequence.

Select the System Calibration Menu Item and verify that a “Load Connection” message box (see **Fig. 4-8**) appears and after confirmation of the 4 Ω load, the System Calibration form opens. (See **Fig. 4-9**).

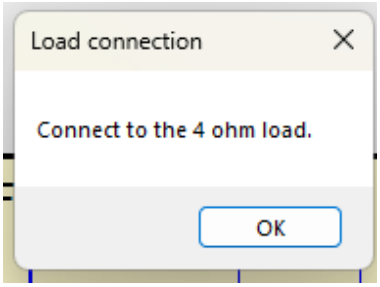

Figure 4.8 – Load Connection Message

The System Calibration form is opened to 200 Hz by default. Each calibration frequency can be cycled by the “Next Frequency” and “Previous Frequency” buttons.

The **Target Value** is the target amplitude at the DUT for a ripple sine wave at the given frequency. The Target Value is pulled from the calibration file on the system and would rarely be changed. The Target Value is in Vp but also displayed in Vrms.

The **Set Value** is the amplitude sent to the signal generator. The System Calibration function will change the Set Value as the System voltage value and the Meter reading values change. A message will appear when the application has changed the Set Value (as shown above). The Set Value is in Vp but also displayed in Vrms.

The **System voltage value** is the amplitude measured by the internal digitizer. The System voltage value is displayed in both Vp and in Vrms.

The **Meter Reading value** is entered into the Vrms box after checking the inputs to the 4 Ω load and noting the Vrms value on the calibrated meter.

The goal of the System Calibration process is to produce matching readings between the **Target Value (Vrms)** and the **Meter Reading (Vrms)**.

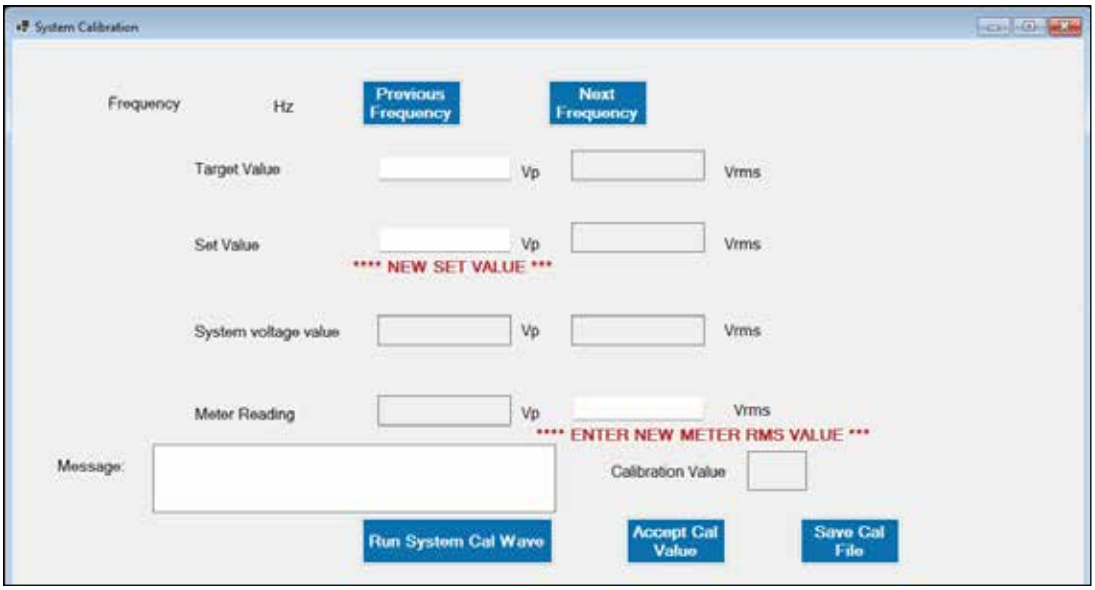

Figure 4.9 – System Calibration Window

The other data on the page is used during the calibration process but is not meaningful during normal operation. It might be useful for AE Techron Technical Support if a support call is registered about the calibration.

The function of the buttons at the bottom are:

- **"Run System Cal Wave"** – after the Meter Reading is updated, select this button to re-run the calibration cycle. This button is disabled when it is not a valid next step (for example if a calibration cycle has been run but the Meter Reading has not been entered).
- **"Accept Cal Value"** – confirms that the calibration cycle is complete. This step can be done implicitly by moving to the next frequency.
- **"Save Cal File"** – writes the results of all the calibration steps to the System Calibration file. This step also invalidates a currently loaded Segment File as the file must be reloaded to use the new calibration values.

4.5 The Utilities Menu Item

Under the Utilities menu item, the "Reset digital ports device" selection can be used if the internal controls of the digital ports devices need to be reset or re-initialized.

Under the Utilities menu item, "Reset data collection device" can be used if the data collection device needs to be reset or re-initialized (See **Fig. 4-10**).

Figure 4.10 – Utilities Menu

4.6 The About Menu Item

Under the About menu item, the "Network Information" selection is used to confirm that the HVR system and signal generator devices are connected to the network and their respective IPs are displayed (see **Fig. 4.11**).

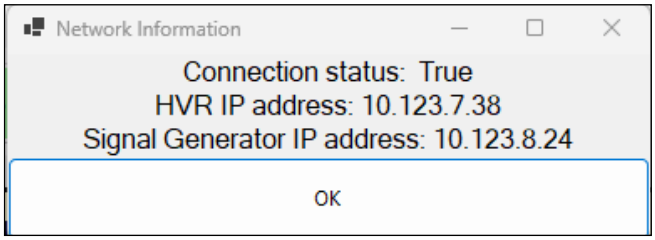

Figure 4.11 – Network Information Window

Under the About menu item, the "HVR Series Operator's Manual" selection displays the HVR Series Operator's Manual (see **Fig. 4-12**).

Under the About menu item, the "HVR Series Software Manual" selection displays this HVR Software Manual.

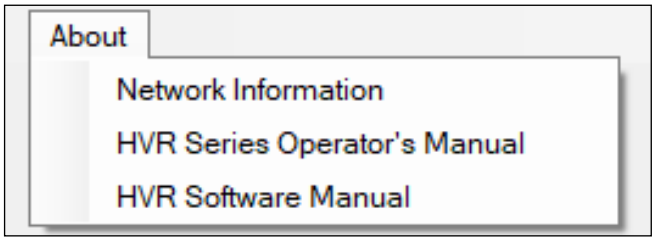

Figure 4.12 – About Menu

5 Operation

The HVR Series is designed to require as little operator intervention as possible. Therefore, a typical test sequence would be:

1. Select the Standard Segments file to load and run (see **Fig. 5-1**).
2. If the external DC power supply is being set by the HVR system, enter the DC voltage into the pink box and hit enter (see **Fig. 5-2**). For more details on external DC power supplies, see **section 5.1**.
3. Confirm the output of the DC power supply (regardless of whether the HVR system is controlling it or not).
4. Select the Run button and the test will start.

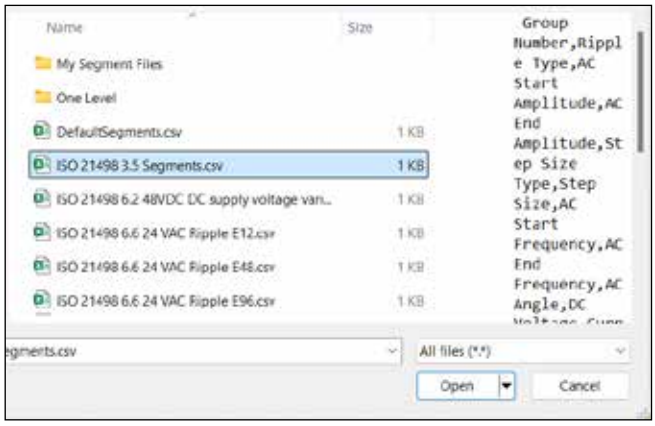

Figure 5.1 – Standard Segments File to Load Window

During the running of each step, the output amplitude on the ripple is calibrated to provide the requested voltage at that frequency. If the DUT power circuit resonates at that frequency, the current limit will be invoked to protect the testing equipment and the voltage will fall below the target voltage. This subset of the chart shows the resonance around 100 Hz (see **Fig. 5-3**).

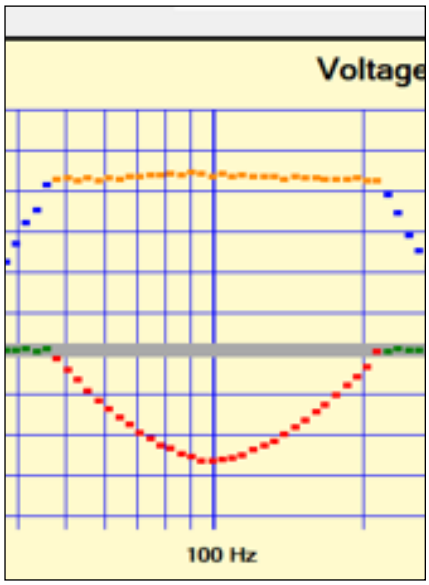

Figure 5.3 – 100 Hz Resonance Chart

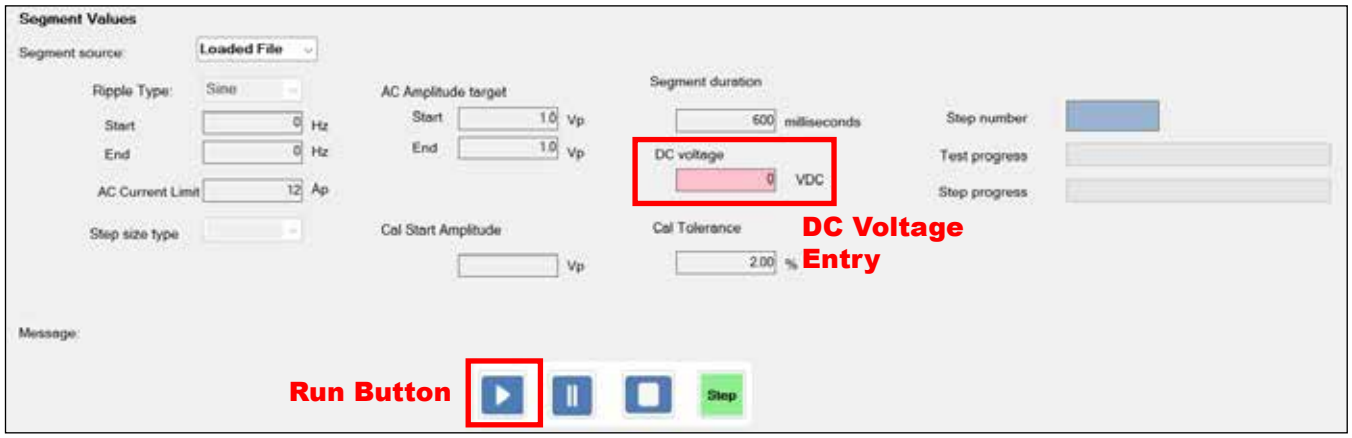

Figure 5.2 – Segment Values Window

The achieved amplitude is in green, the applied current is in blue, and the target amplitude is in grey. As the circuit reaches resonance, the current is limited (dark orange) and the amplitude begins to drop. This effect is also reflected in the Impedance Chart as the impedance is dropping (see **Fig. 5-4**).

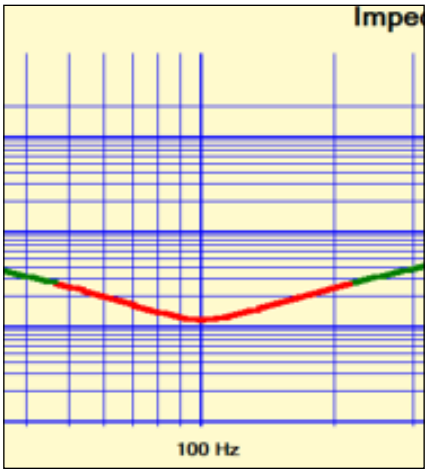

Figure 5.4 – Impedance Chart

This compensation process was described earlier as the “Step Compensation Process.”

The entire test sequence should run without further operator intervention unless an issue is encountered.

5.1 DC Power Supply Control

The HVR test system (HVR 2000RG model) is designed to allow users to control the output of an external DC Power Supply with an analog output from the HVR test system. The analog output is identified as DC Power Control on the back panel.

The analog output is 0–10 VDC and will function with most DC Power Supplies. If an external power supply is controlled by a different signal, say 0–5 VDC, it is necessary for the user to account for the differences.

The DC voltage setting is in the center of the main page (highlighted here in pink):

The HVR 2000RG will control an external power supply with up to 2000 VDC output. Entering a voltage value between 0 and 2000 into the DC voltage box will set the control output of the HVR tester to a scaled value between 0 and 10 VDC.

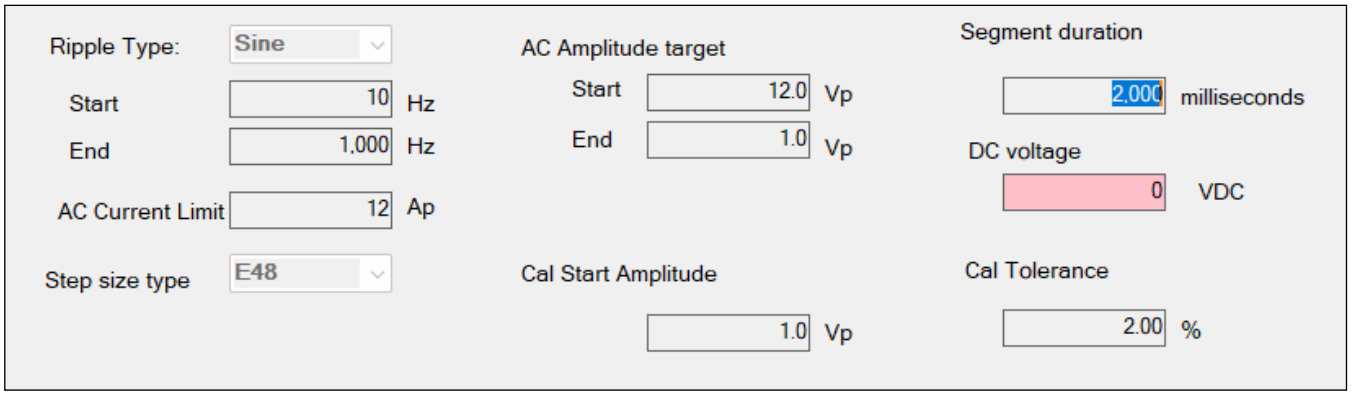

Figure 5.5 – Segment Values Window: DC Voltage Setting