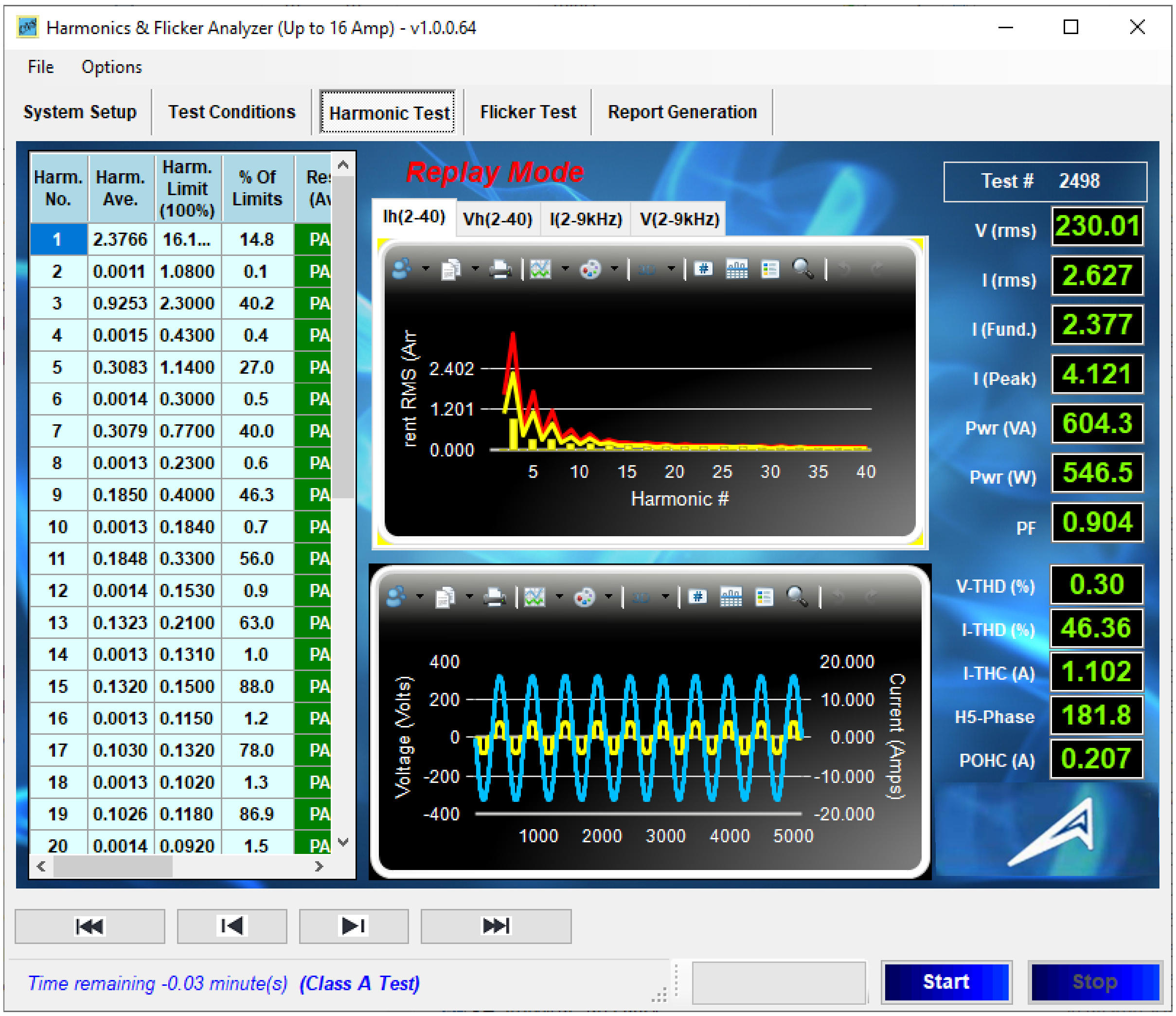
Advanced Test Equipment Corp.
www.atecorp.com 800-404-ATEC (2832)

HFA-1/3-16 Harmonics & Flicker Analyzer -

Quick start user guide & Specifications



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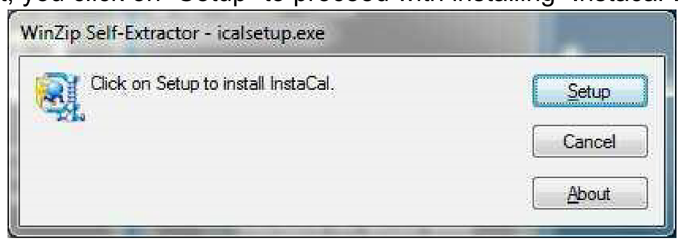
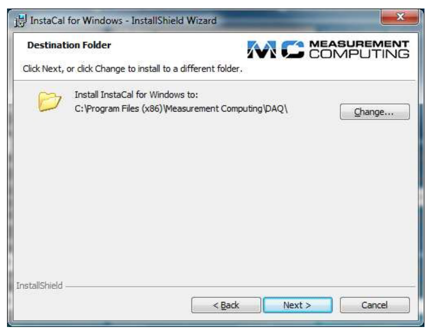
1. Software installation

This section guides you through the software installation steps.

a. The HFA-1/3 utilizes a 16 bit A/D sub-system. A generic driver is required to facilitate communications between a PC, via a USB-2 or USB-3 port, and the card inside the HFA-1/3. The generic driver utility is called “Instacal”, and the driver executable is called “icalsetup.exe”. The executable file is located on the system CD. So, you insert the system CD into the drive of your PC, and locate the “icalsetup.exe” in the main directory of the CD.
b. After the Instacal executable loads, it may ask for permission the change system files (messages may differ slightly for Windows 7 or Windows 10). Click on OK or “Permit changes” and the software will continue the install process. Another window will pop up with WinZip self Extractor, and you click on OK to continue. Next, you click on “Setup” to proceed with installing “Instacal”.





A couple windows will pop up with a copyright notice, and an install directory. You click on “Next” several times to continue installation. Finally, the InstallShield program will show the next window that lets you start the actual driver installation.

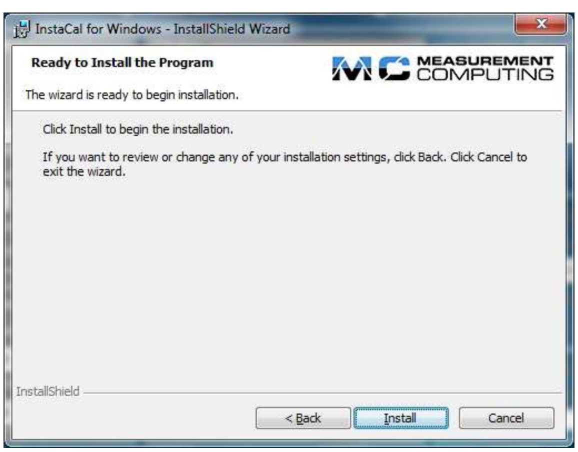


Figure 1 The USB card driver installation

You click on Install, and the installation process will create directories and copy the driver files. If it finds existing files, it may delete these and install the newer driver files. This may take a couple minutes to complete. After you click on “Finish” the program may ask you to restart your PC, so that it can update all system files.

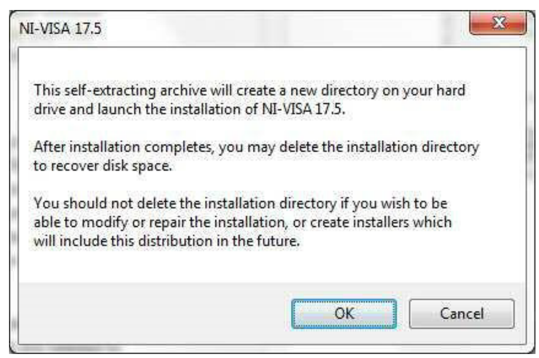
This process completes the Instacal installation. Next you need to install the VISA drivers that are needed to control the programmable power source (if you have a power source other than the public supply).

1. Installing the VISA utility.

This section guides you through the installation of the VISA utility.

a. The Virtual Instrument Software Architecture (VISA) is a standard for configuring, programming, and troubleshooting instrumentation systems comprising GPIB, VXI, PXI, Serial, Ethernet, and/or USB interfaces. VISA provides the programming interface between the hardware and development environments such as the National Instruments LabVIEW, LabWindows/CVI, and ***Microsoft Visual Studio***. Visual Studio is used to develop the HFA-1/3 software. Many programmable power sources use the GPIB or Serial interface for control purposes, and thus the NI-VISA interface can be used to communicate with those power sources. The HFA software can use the NI-USB/GPIB interface unit to communicate with power sources, or use the serial port that is still found on some PC's to control the power source. Also, a USB-RS232 (USB to COM) interface can be used. You can download the VISA utility from the NI web site, via the link below;

b. **http://search.ni.com/nisearch/app/main/p/bot/no/ap/tech/lang/en/pg/1/sn/catnav:du,n8:3.1637,ssna v:sup/**
c. ***For your convenience, a copy of the VISA install is included on the HFA-1/3 system CD. The program is called "NIVISA1750full.exe". Versions 17.0 and 17.5 were tested to work properly with the HFA-1/3 program, but later versions should be OK too.***
d. To install the VISA utility, you download the executable from the NI web site, or run it from the CD that comes with the HFA-1/3.



The process is very similar to the Instacal setup that is described in the previous section. You click on "Run" and just follow the instructions. As with Instacal, you may have to restart the PC after the installation completes.

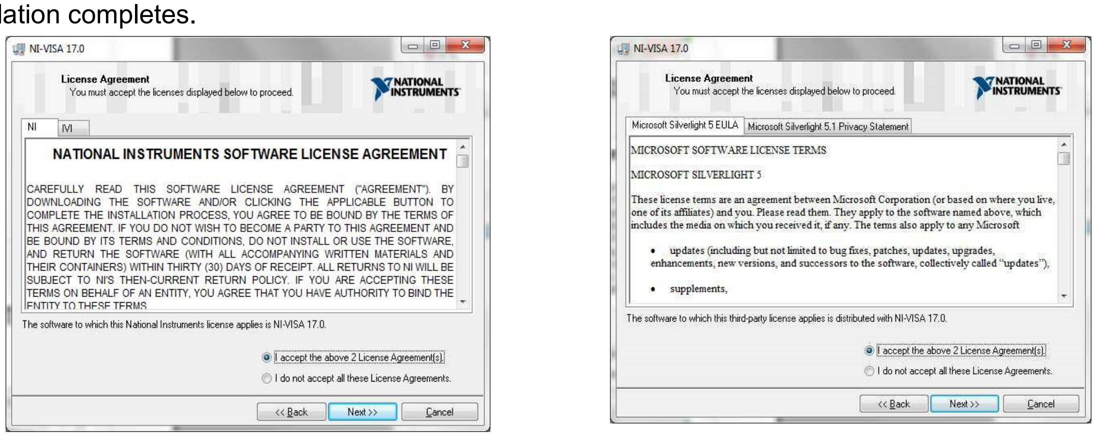


Figure 2 The VISA installation

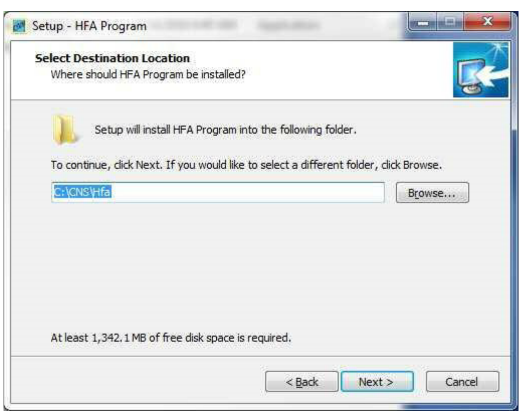
2. Installing & Running the HFA software

a. The software CD that comes with the HFA-1/3, includes an install executable,

called; HFA (16A) Program CNS Version 1.0.x.x.exe

b. where the "x.x" identify the software version number. Running the executable will result in a number of pop-up windows, similar to the Instacal and VISA utilities setup. Depending on your Windows version, you may have to allow the install program to make changes to your PC. You have to click "Yes to proceed with the installation, and then the Setup Wizard window will pop up.

You click on "Next" " and the License Agreement window will pop-up, which you have to acknowledge, by clicking "Accept the agreement".



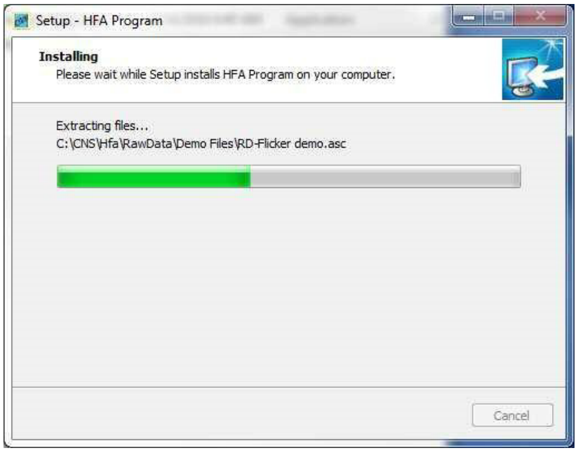
Then the install program will show the default installation directory, which we recommend you accept. Simply click on "Next". Also, the install program will ask you if it should install a desktop icon (shortcut), and after you click "Next" it will show a window listing the destination and start-up folders, as well as any additional tasks.

You then click on "Install", and the installation will proceed. The system will also install some demo files, which are actual test files for Class-A Pass and Fail. The HFA stores the "raw data" files, much like a data logger does, so that the files can be replayed later.

Figure 3 The HFA software installation

Additional demo files, including for Class-C < 25 Watt, and Flicker test files are available.

NOTE: Your install disk comes with a file called HFa16Calibration.xml (or HFa75Calibration.xml). You MUST copy this file into the C:\CNS\HFa16 (or HFa75) directory. It includes your specific license number. Without that number, the system will only run in replay mode.



When the installation is complete, you click on "Finish" and this will launch the program.

Note, however that the installation process will copy a default calibration file to the hard disk. That "HFaCalibration.xml" file needs to be replaced by the file for your specific unit. Your calibration file has a license number embedded. If that license number is missing or incorrect, the sytem will allow replay of test data, but will not allow a real test.

In case you forget to copy the calibration file for your unit, the system will "complain" that the calibration file is for a different serial number, and ask you if you want to proceed. Below is the structure that the program will create on the hard disk (see page 8). The calibration file is located in the C:\CNS\Hfa directory. ***Without the correct software license number, the system will ONLY replay files.***

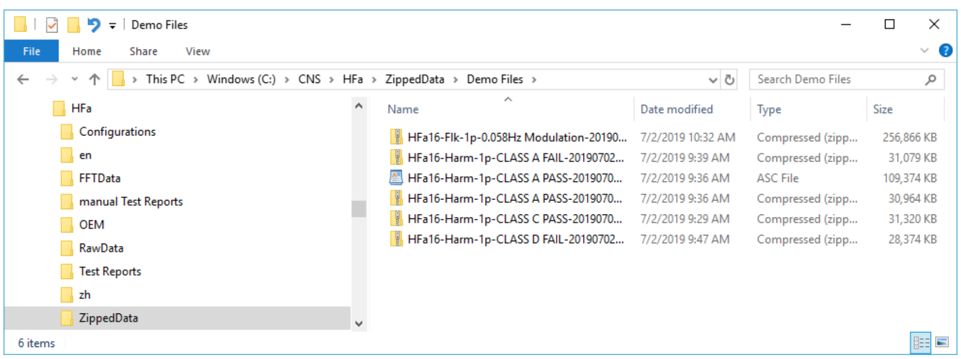
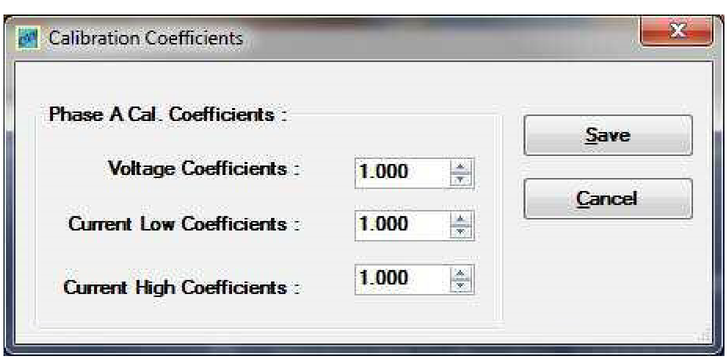


Figure 4 Software directory structure



The default calibration file will have the coefficients set to 1.000, and the system will be reasonably accurate, but not optimized for your specific serial number.

So, you should close the program, and first copy the calibration file (over-write the default file). Then, re-open the program and it is ready to measure.

Figure 5 Default Calibration coefficients.

3. Hardware connections

There are several versions of the HFa, see the pictures below and section 25-26-27

A; The small form factor HFA-1
hardware connections are shown on the top label of the HFA-1S. The figures and next page below provide a little more guidance yet. The HFA-1/3 has an internal measurement circuit that presents virtually no load to the circuit, but rather it just passes the power through to the EUT. The measurement circuit "consumes" about 0.2 mA @ 230 V AC. The supplied 12 VDC power supply can be plugged into any line voltage from 100 – 240 V AC.

In the direct measurement mode, the HFA-1/3 does all the signal conditioning. If the small selector switch is set to the PACS position, the HFA-1 needs to be connected to a PACS-1 or CCN1000-1 with the supplied DB-37 cable. If the HFA is connected to a PACS-1 or CCN1000-1, the system needs to be calibrated with the particular PACS or CCN1000.

B: The 19" HFA-1-19 and HFa-3-40/75 with a power source – such as Pacific Power ©
The HFA-1/3 is a 19" unit, that includes single phase and three phase versions, and thus the wiring includes several versions. (see section 23)

C: The Teseq © and California Instruments © or Ametek © CCN1000-1/3 and PACS-1/3 upgraded to the CNS Inc. © (USB based) HFa-16-1/3, or HFa-75-3. (see section 25-26-27)

Note; For direct connections (the normal operating mode) the calibration file that comes with the HFA-1/3 needs to be copied into the C:\CNS\Hfa directory. Alternatively, the user can run the calibration utility (see next pages).

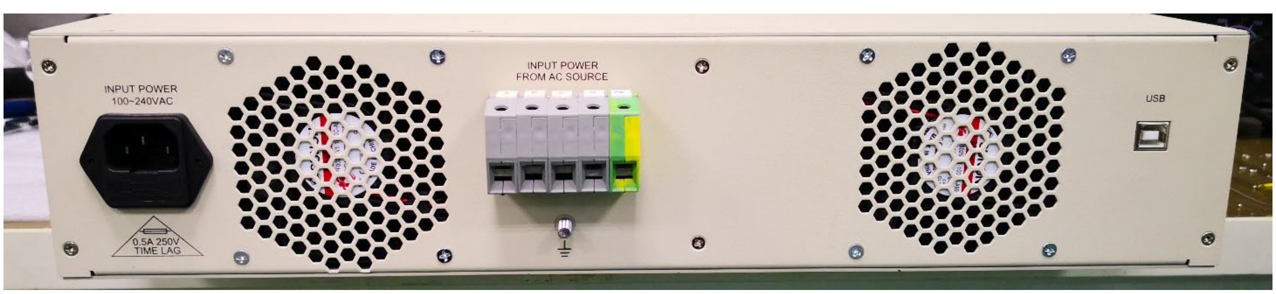


Figure 6 The 19" form factor HFA-1/3 front & rear panel

Shown is the 19" version of the HFa-1-16 with optional Reference Impedance

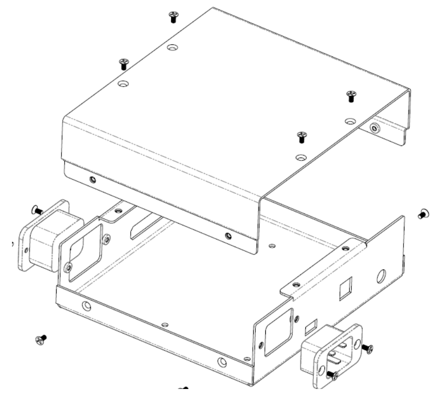


Figure 7 The small form factor HFA-1S

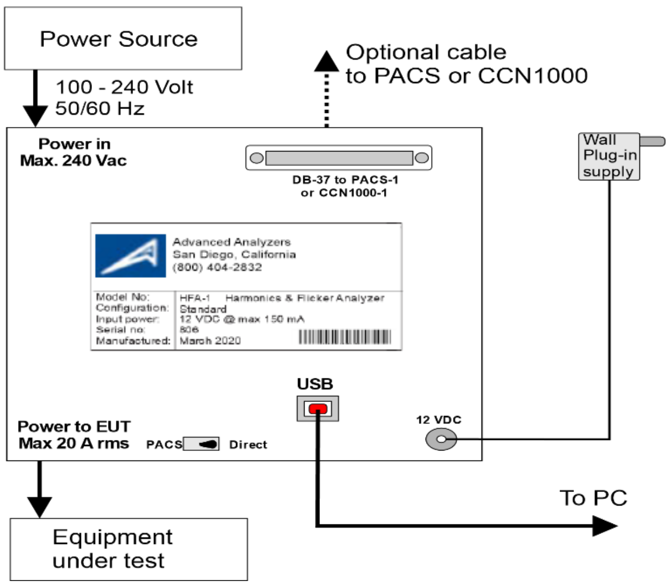


Figure 8 Hardware connections of the small form factor HFA-1/3

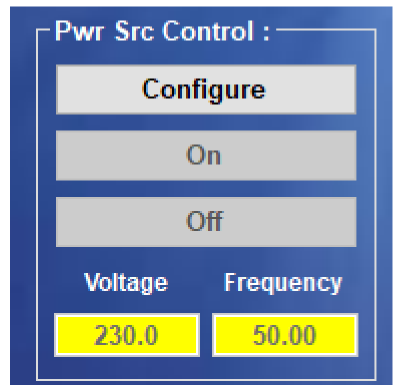
Figure 9 CCN1000-1 upgraded to HFa-1-16 (note the added USB plug on the front)

4. To operate the HFA-1/3;

- ***plug in the 12 VDC supply for the small form factor*** unit, or ***100/120/220/230/240 Volt AC for the 19" rack mount version. The input voltage for the rack mount version is universal.***
- Connect the "Power in" connector (or rear panel terminals) to a suitable power source. The public supply 100 / 120 V or 220-230 Volt can be used for pre-compliance testing.
- Connect the equipment under test to the "Power to EUT" connector (front panel Schuko on the 19" version) or to the IEC connector on the small form factor unit.
- Select a Test Class, and test time, and start the HFA-1/3 software.

See section 9 and 10 for system setup instructions.

Test voltage & frequency selections;

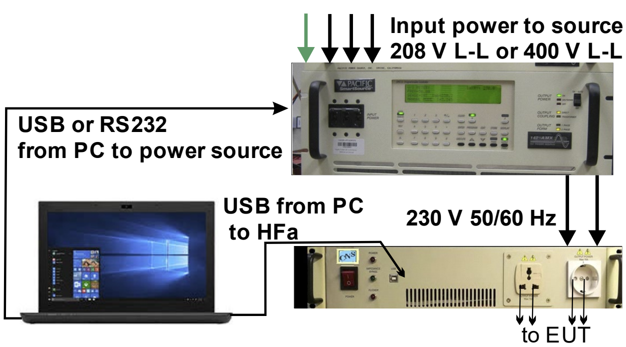


The system Setup will "pick up" the voltage and frequency settings from the Test Conditions screen. If the communication with the power source has been established, the user can turn-on/off the power with the buttons in the Pwr Src Control. The voltage and frequency settings in the yellow boxes will be transferred to the power source. The yellow fields are "read only" however. The power can be turned "on" to let the EUT start up.

Note that you can ***only*** change the voltage and frequency in the Test Conditions screen. The yellow boxes are "read only".

The software automatically changes the operating range of the power source if the source has that capability.

Power source control and connection diagram



The power source can be controlled (depending on type) via RS-232 (most common) or via USB, or via GPIB.

Alternatively, the user can select Manual Control, and set the voltage via the front panel.

Note that the user cannot have a source control program running – using the same port - that the HFa also needs to control the power source.

Power source range control

Many power sources have a "low" and a 'high" range, typically being 150 V and 300 Volt.

In the High range, a 4 kVA or 5 kVA power source is limited to about 17 - 18 Amp @ 230 Volt, while it can handle loads up to 34 - 37 amp in the low range (say for 100 Volt or 120 Volt tests). Most power sources require that the output is "off" when changing ranges.

So, if the user changes the test conditions from 120 V to 230 v or vice versa, the power source output must be turned "off" to change range. When the source is then turned "on" either via the Pwr Src Control button, or by clicking Start in the test screen, the source will be programmed by the HFa to the applicable range.

Note that the harmonics test standards IEC 61000-3-2, and IEC 61000-3-12, allow the user to ignore the first 10 seconds after the EUT is turned "on". So, the HFa will first do a 10 second pre-test, before starting to evaluate the harmonic current emissions.

5. The system setup screen

a. *The setup screen lets the user select a power source type, and configure the communications interface. Configuring the communication with a power source is easily accomplished.*

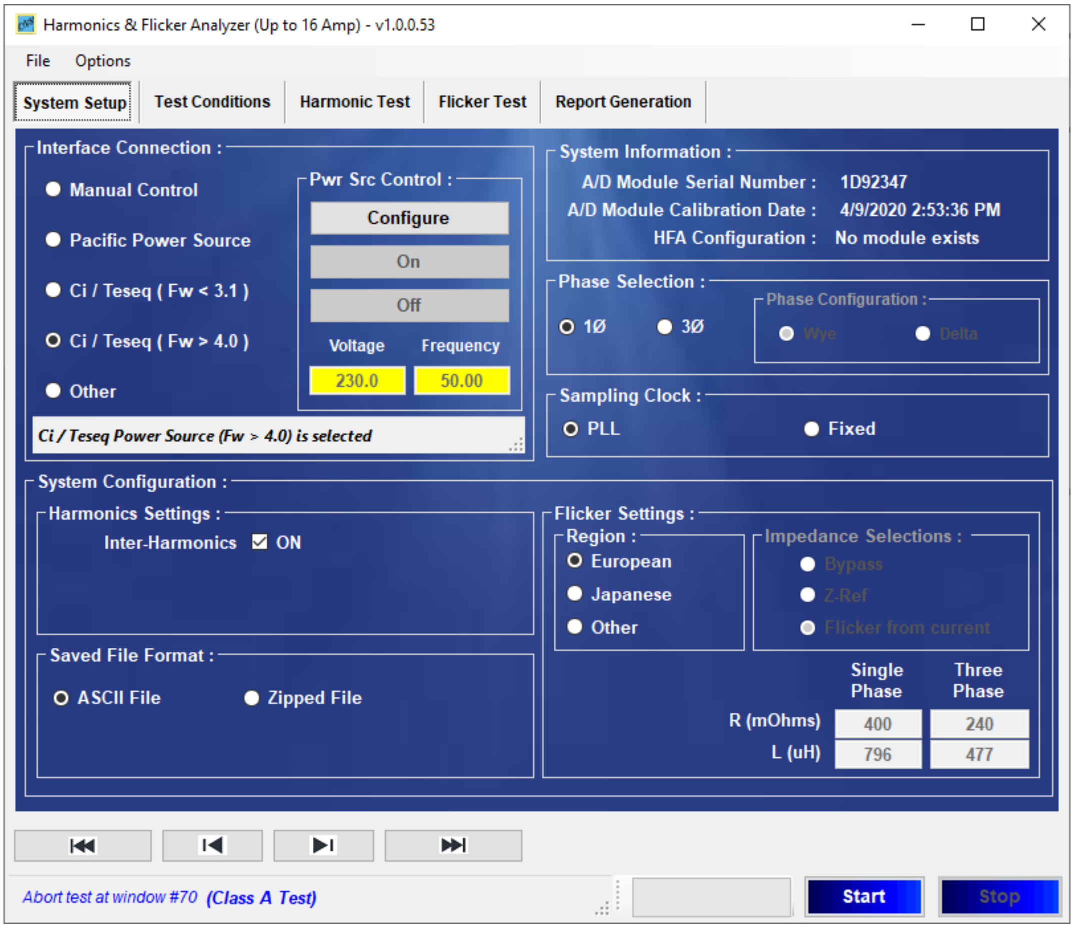
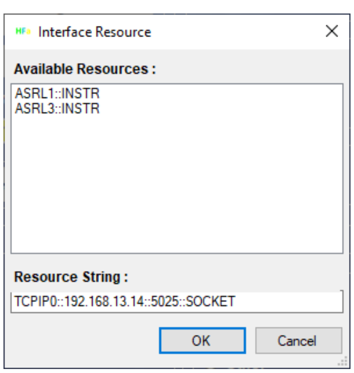
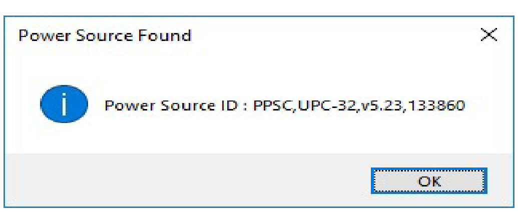


Figure 10 System Configuration screen



b. After you select a power source, and click the “Configure” button, you select which “port” from the “Available resources” the system PC uses for communications. When you click the “OK” button to verify connection – the HFA verifies this by sending the “*IDN?” command. If communication is successful, it will indicate that the power source is found and the instrument ID string will be displayed. (This can also be viewed if you run the NI I/O trace)

Also, see section 28 for California instruments / Teseq / Ametek sources



c. Note that you can also opt for manual control, using the source front panel, or even use the public supply (100 – 120 - 220 or 230 V 50/60 Hz) as the test voltage. Using the public supply is normally a pre-compliance test, because the voltage distortion is often more than the standards permit.

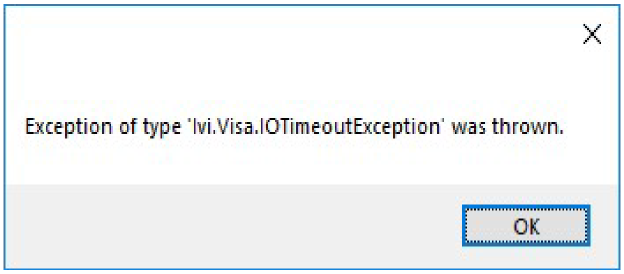


Figure 11 VISA exception error

d. If you get the “VISA exception thrown” message, the power source (AMX in this case) is not responding to the *IDN” command. In some cases, like the AMX, you may have to push the “clear” button on the power source front panel, so that the communication port is made available to the PC. Of course, if there is no communication, you also need to check the interface & cable to the source.

e. Various power sources will go into “remote” (for example with GPIB / IEEE-488 control) ***and you may be locked out*** from using the front panel controls. We try to avoid this situation, but sometimes this is beyond the HFa software control. If you are using Manual Control i.e. the public supply (for example 230 V – 50 Hz, or 120 Volt – 60 Hz) or front panel control of the source, the system will not ask you to verify/configure the power source communication.

f. After you verify communication with the power source, a new test can be run. You can select the voltage and frequency, and the power source will be programmed accordingly. You can check via the front panel of the power source, to make sure the right voltage and frequency has been programmed. Also, for some power sources, the programmable impedance is set to the required values, being minimum impedance for harmonics, or the Reference Impedance values for Flicker.

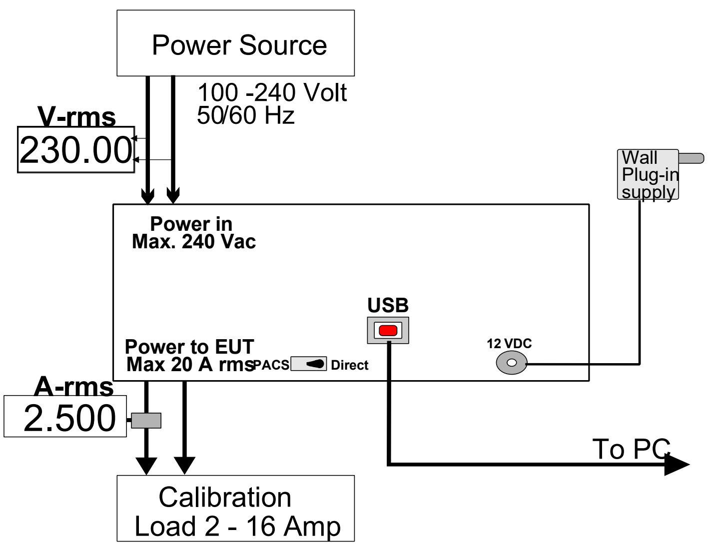


Figure 12 Hardware connections for *calibration*

When you have configured all the software, and “Start” a harmonics or Flicker test, the system will check the calibration data, and several other parameters.

If you see the error message as in figure 13, after you click “Start”, the system does not have the (correct) calibration file***. If you did not copy the right calibration file, with the correct license number, you can still replay data files.*** T***o run real tests, first copy the correct calibration file with license number to the C:\CNS\Hfa16 of \HFa75 directory***.

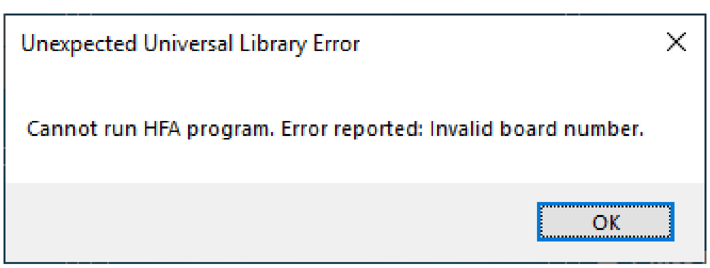


Figure 13 Incorrect or missing calibration file

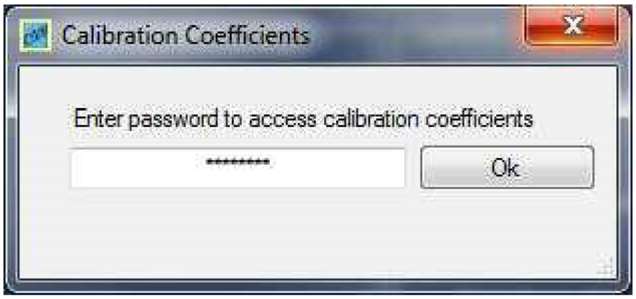
In the event that you do not have the calibration file, you can request it from CNS. To verify calibration, you should first arrange for an external reference voltage and current measurement method (see above figure 12 for the setup).

By applying a known external load, and measuring voltage and current with reference equipment, the user can update the cal.constants so that the HFA indicates the exact same values as the reference voltage and current meters. This process is easy and takes no more than 5 minutes.

So, prior to performing the calibration, connect the HFA to your power source, and connect a load that can be set to about 2.5 Amp rms, as well as to a current somewhere between 6 - 16 A-rms. Then proceed as follows (this assumes you have the correct calibration file to begin with);

Step 1: Start a harmonics test for a duration of say 3 minutes.

Step 2: Activate the calibration parameter process, by double clicking on "A/D Module Calibration Date" in the System Setup, as shown. Then switch to the Harmonic Test display.



A small window will pop up that requires you to click OK to continue. This to make sure that you do not inadvertently change the calibration file.

The system calibration can be updated by entering the new cal. Constants. There are 2 current ranges for Phase-A to be calibrated. The single phase calibration screen is shown below.

Step 3: Do not apply a load as yet, i.e. the voltage is adjusted without a load. Set the power source to the desired test voltage, such as 230.00 V-rms. Adjust the voltage calibration coefficient so that the voltage reading in the Harmonic Test display of the HFA matches the Reference DVM reading (± 0.1 V).

If the coefficient needs to be adjusted to a value that is less than 0.9700 or more than 1.030, the hardware calibration of the HFA should be performed first – see later in this manual.

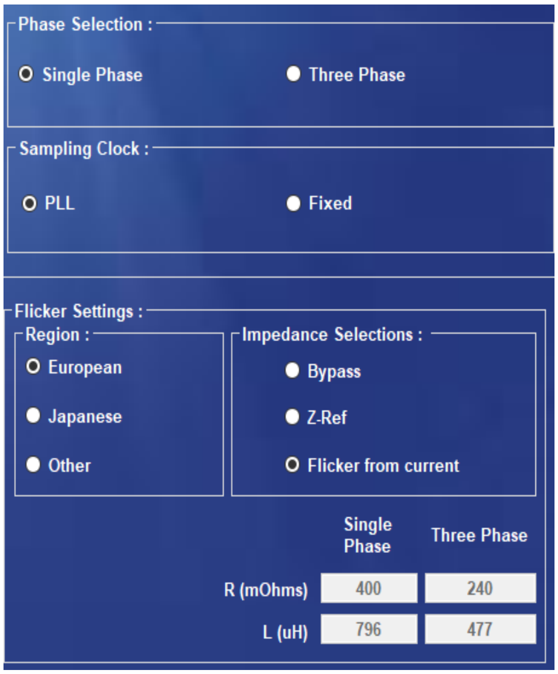
Step 4: Apply a load that takes a current between 5.000 – 16.000 A-rms. The exact current level is not important, but it should be at least 5 Amp rms, and it should be stable. Many multi-meters have a direct current measurement range up to 10 A-rms, and between 8 - 9 A-rms is certainly a good value. Make sure the load is stable. Adjust the "Current High Coefficients" so that the HFA displays the same level as the external reference meter (± 10 mA). During the calibration process, observe the voltage reading of the reference DVM and the HFA. ***When you apply a load for the high current calibration, the voltage should NOT decrease more than 0.2 Volt for 8 -10 Amp (i.e. be < 0.1 Volt for 5 Amp).*** If the voltage drops more than 0.1 Volt per 5 Amp, the source impedance plus wiring to the HFA is more than 20 mΩ, and this may result in flicker readings that are higher than they should be. If the voltage drop is acceptable, i.e. the power source and interconnect wiring are suitable, you can save the calibration data. If the voltage drop is too high, the system should be used with caution for compliance testing.

Step 5: Apply a load so that it takes a current between 1.500 – 2.500 A-rms. Make sure the load is stable. Adjust the "Current Low Coefficients" so that the HFA displays the same current level as the external reference meter ± 5 mA.

Step 6: Click the Save button. This generates an updated calibration file, and you are now ready to perform accurate harmonics and flicker testing.

6. Flicker test Impedance and sampling

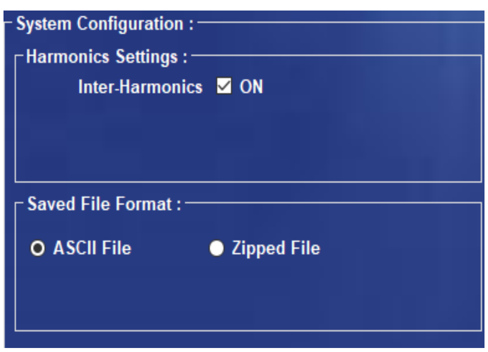
Depending on the HFA model (1 or 3 phase) the user can select 1 or 3 phase measurements.
The HFa-1S small form factor unit only supports single phase.



The system normally derives its sampling clock from the built-in PLL circuit. This circuit ensures that each 200 ms measurement window is perfectly synchronous with the 50 Hz or 60 Hz frequency from the power source, or public supply. The user can select “Fixed” for cases where a measurement must be made on the public supply voltage, and where the public supply is too distorted, i.e. where the phase locked loop may have difficulties synchronizing to a noisy signal. The fixed sampling rate is 25600 Samp./sec. for 50 Hz systems and 30720 Samp./sec for 60 Hz (in both cases 512 samples cycle) - simultaneous for all channels.

If the system power source has a programmable impedance, the user can select this, and enter the values for inductance and resistance that need to be programmed in the source. The values for European and Japanese impedance types are pre-programmed to their default values. When measuring using the public supply, the Flicker can be calculated from the current.

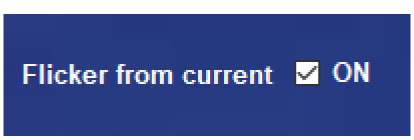
7. Inter-harmonics (grouping) & data file format



Normally the system measures with Inter-Harmonics set to “On”, i.e. the inter-harmonic frequencies are evaluated through the “grouping method” specified in IEC61000-4-7. As of this writing, this “grouping” is not yet mandatory, so the user has the option to turn the inter-harmonics evaluation “off”.

The system can store the raw data files in ASCII or in “zipped” format. ASCII is faster (as the zipping may take a minute or so) but the data files are big (100 Mbyte/minute). If you don’t plan on keeping all the data files, the ASCII format is probably the preferred choice.

8. Flicker measurement



If the user doesn’t have a Reference Impedance or Programmable Impedance in the power source, the Flicker measurement can be based on current (per IEC 61000-3-3 Ed. 3 clause 5.1).

Also, when running a harmonics test, the Flicker can be calculated simultaneously in the background. That measurement is based on the calculation using the instantaneous current ***I (t).***

The harmonics test may be of a shorter duration than the 10 minute test time required obtain Pst, and Plt, The parameters “dc” – “dmax” – “Inst. Pst” and “T-max” are available to the user while the test progresses.

9. The test conditions setup screen (HFa16)

The user selects from one of the main three selections, being IEC 61000-3-2, Flicker per IEC 61000-3-3, or JIS-C 61000-3-2. Depending on that choice, the selections in the field below the choice are used for the test. The bottom section of the setup windows lets the user select the voltage and frequency, select the test time, and enter further information.

Figure 14 Selecting a harmonics test class

In this example, the system is set up for a Class-A (harmonics) test. For this test, the EUT is the CNS Inc. HFC-III calibrator which is used as the test load, and it is configured to produce a current harmonic spectrum that passes the limits, but has some harmonics close to the limits – such as H15 at 83.4 % - see the Harmonics Test display page after next.

As the test progresses, the system generates a “raw data file” much like a data logger does. This raw data file can be replayed, and re-analyzed at any time. In fact, the Harmonics Test Display page shows the replay of the example Class-A Pass file that is included in the initial HFA software installation.

The user can enter an optional file name. If this field is left blank, the system generates a file name that includes the date, and a file sequence number. The sequence number simply increments, and the date precedes the sequence number.

For example, you may find data files as shown in the illustration below. The Raw Data sub-directory has these files. In the example below, the files are those that may come with the system installation. The file name includes the date the test was run, and then the sequence number. The file names can be changed as desired.

When re-playing a test, you can select from the raw data files, and run the test for any test class.

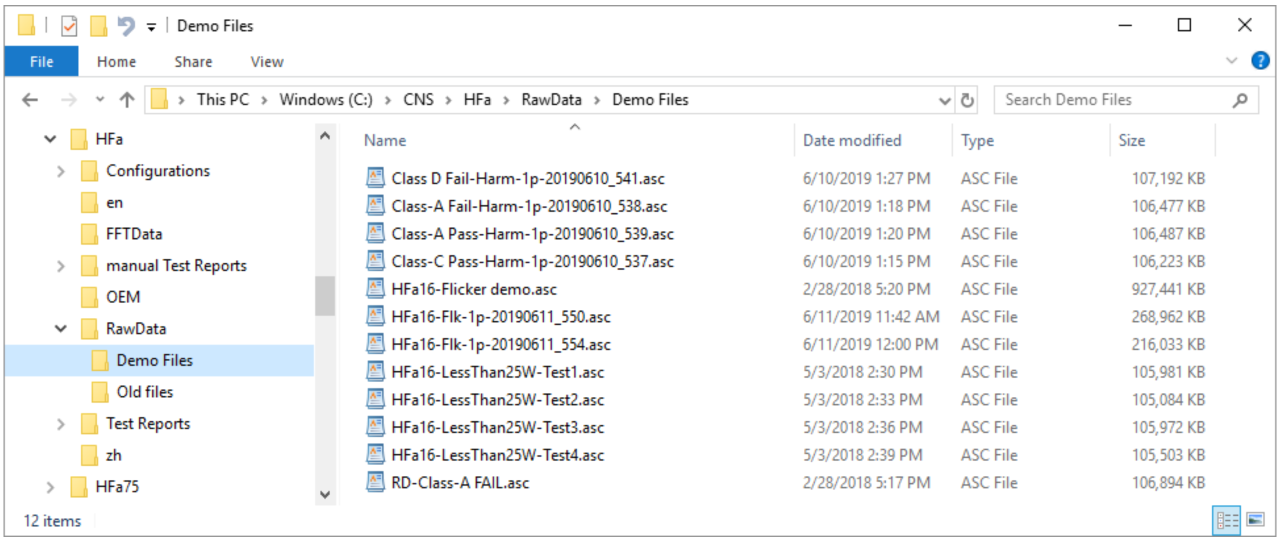
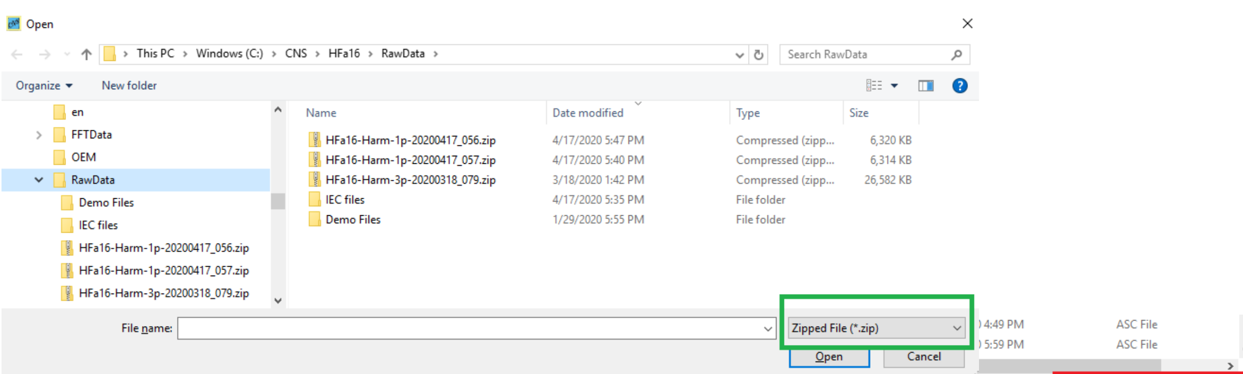


Figure 15 Directory structure for raw data files in ASCII format

When a test is completed, the system can be set to generate a zip (compressed) file from the raw data ASCII file. If the “zip” format is selected, and you close the program, it deletes the ASCII files, to save disk space. When you want to replay a “zip” data tests, you can select either the “asc” extension or the “zip” extension, and the system will automatically extract the file and run it.



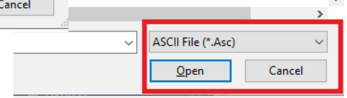


Figure 16 Directory structure and selecting file format for ZippedData and ASCII files

10. The Harmonics Test display

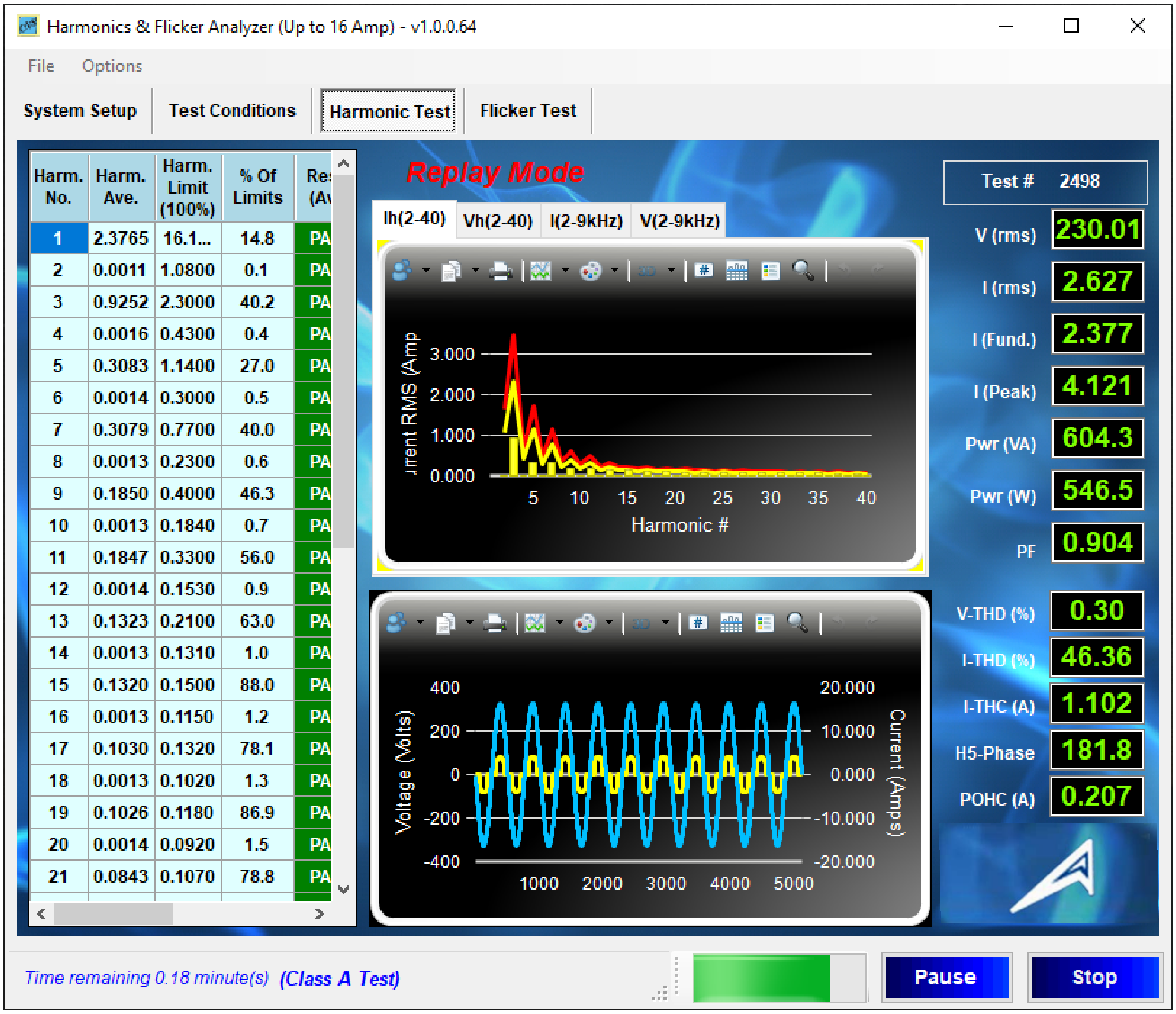


Figure 17 The Class-A "PASS" display

The Class-A PASS display example.

The leftmost columns display the current harmonics in numerical format, and show their absolute value as well as the percentage of limits and the PASS/FAIL condition. The “slider” below the data columns lets you move the display to the (maximum) values per measurement window. The HFa display is “scalable” – so if you increase the display size, all the data columns become all visible (see the next two pages with a Class-A FAIL example).

The top graph displays the harmonics (either current or voltage) in spectrum format, and can also display the harmonics/emissions at frequencies from 2 – 9 kHz. The bottom graph displays the 10 / 12 cycles of 50 or 60 Hz that are measured in the 200 ms window. When you select the voltage spectrum display, the data columns display the power source quality parameters (distortion) in absolute V-rms, and in percent of the permitted distortion per IEC 61000-3-2. The classical power parameters are shown to the right. Note also, that the phase angle of H_5 is displayed, as well as the V-THD and I-THD, in addition to the required I-THC and POHC per IEC 61000-3-2. The POHC calculation is per IEC61000-3-2 method C.3.

The IEC 61000-3-10 Display

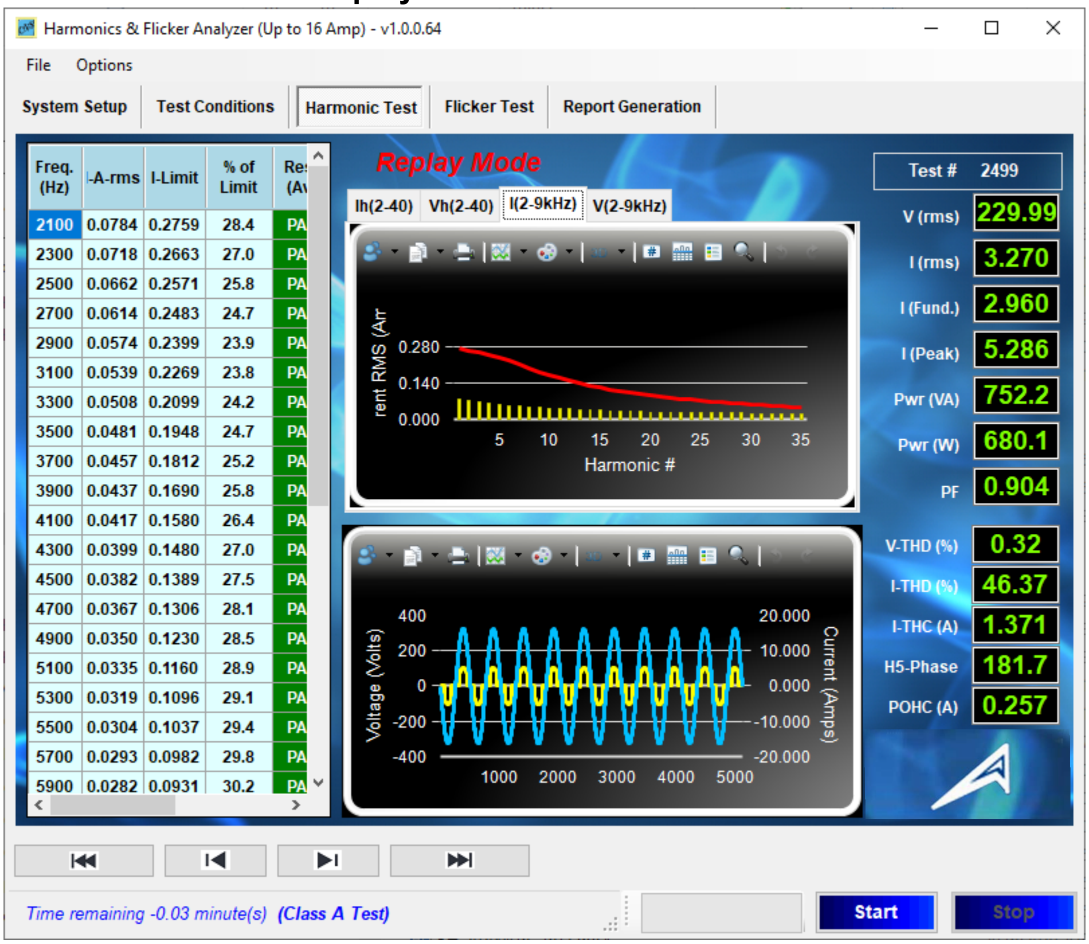


Figure 18 The grouped current emissions and the limit line from 2-9 kHz

The top graph shows 2-9 kHz for a Class-A "FAIL" test, and single phase limits

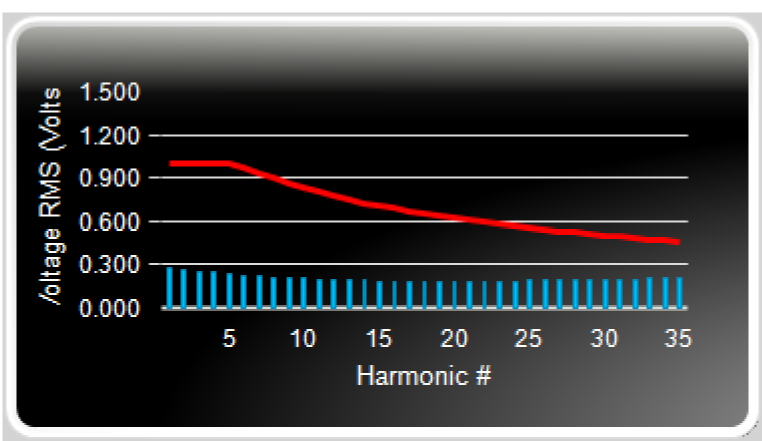


Figure 19 The grouped voltages calculated from the current, and the single phase AMN from 2-9 kHz.

The user can select the top graph display to be either the current or voltage harmonics from 2-40, or the currents or voltages from 2 - 9 kHz.

The data grid to the left “switches along” with the graph selection. So, for harmonic currents from 2-40, the emission limits and status are displayed. When selecting the voltage harmonics from 2-40, the actual distortion and the permitted limits per IEC 61000-3-2 are displayed. Equally, when selecting the display from 2-9 kHz the measured and calculated values are shown, as well as the permitted limits.

Note that the measurement of values from 2-9 kHz are not yet considered when evaluating PASS/FAIL conditions, as IEC 61000-3-10 with the applicable limit sets is not yet published.

The Class-A Fail display

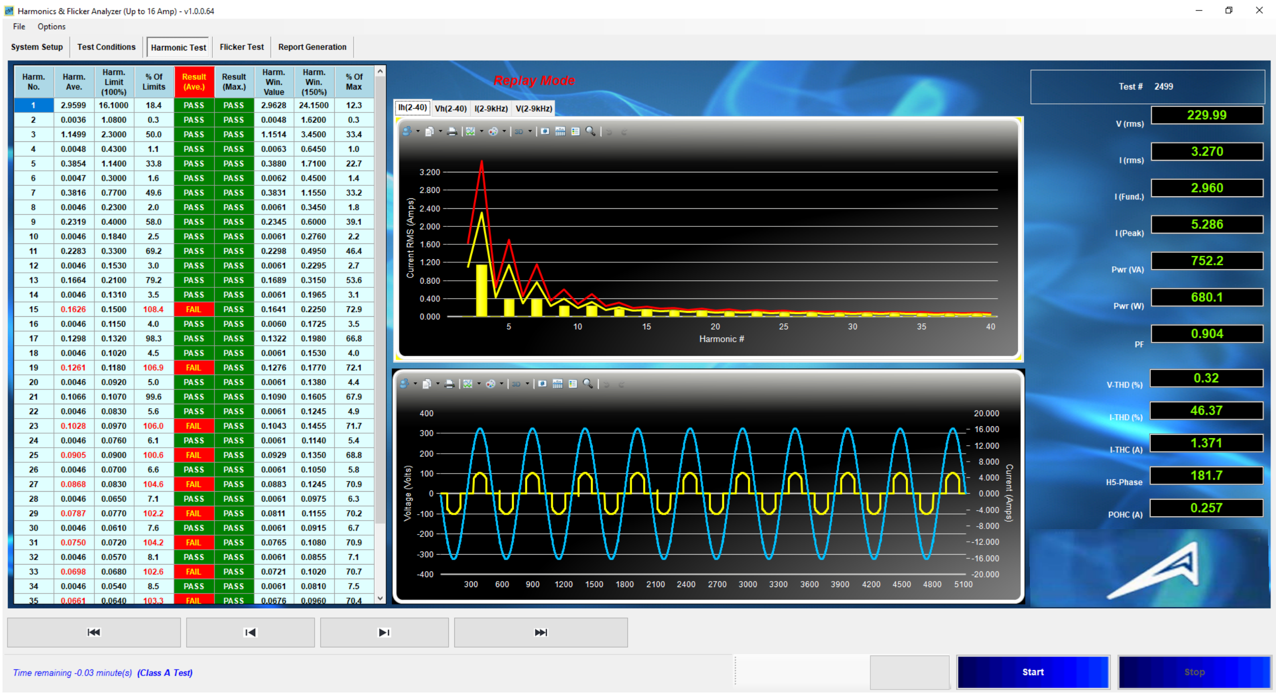
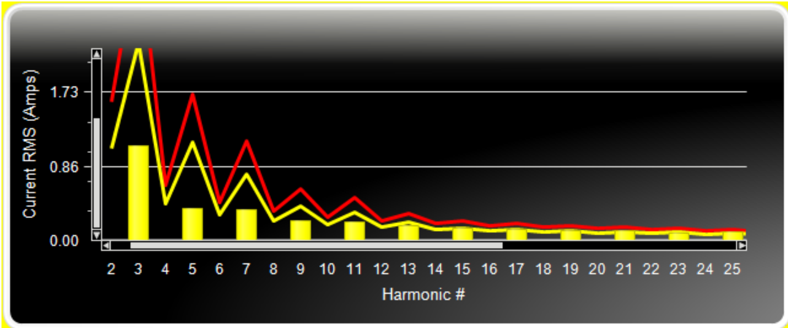


Figure 20 The Class-A "FAIL" display, "stretched" to include all data columns

For this Class-A Fail test, the CNS Inc. HFC-III calibrator was set to produce a spectrum with some harmonics failing the limits for Class-A. The leftmost columns display the current harmonics in numerical format, and show their percentage of limits as well as PASS/FAIL condition. The HFA display window was enlarged (maximized), so that the average harmonics, as well as the maximum individual window value against the 150 % limit are displayed. The numerical display is very helpful, as it is difficult - or sometimes impossible - to see in the spectrum graph, whether the higher order harmonics pass or fail.

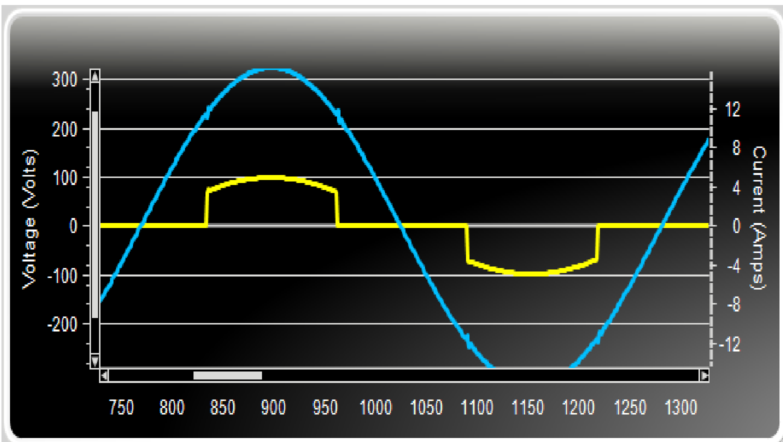
The first 3 columns on the left show the harmonic order, the (running) average of the harmonic current and the Pass/Fail status vs. the 100 % limits. With the scroll bar to the right, one can move to the higher order harmonics. The IEC 610003-2 standard requires that the average of each harmonic is below the 100 % limit, but it also requires that the harmonics of individual 200 ms measurement windows, are below the maximum (150 %) limit. The 3 rightmost columns display the status vs. the 150 % maximum value, the maximum (filtered) value for individual measurement windows, and the percent of the maximum limit.

The scale of the top spectrum graph was set to 3.45 Amp for this screen shot, as the 150 % limit for H_3 is 3.45 Amp. The bottom graph shows the 10 cycles of the 200 ms measurement window. The user can zoom in on particular sections of either graph. It is also possible to copy the graphs and past them into a document, or print them out directly – see the next page.



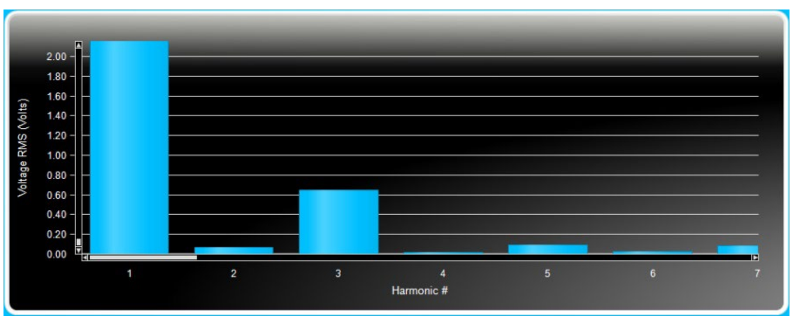
One can simply copy the graphs to either the Windows Clipboard, as a bitmap, for inclusion into reports, such as was done for the current. The vertical scale of the top spectrum graph was auto-scaled, based on the "selected zoom" level, in this case about 1.75 A.

Figure 21 The "zoomed in" current spectrum



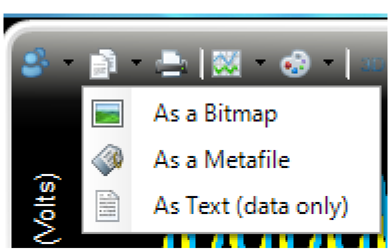
The waveform graph displays the same data as shown in the Class-A Fail screen shot, but with some different settings. The "zoom level" determines the axis to show the waveform in more detail. The "slider" below and on the side of the graph is used to "zoom in" on a particular section of the 10 windows. Whatever is displayed is copied. The user can move around the (200 ms – 10 cycle) graph with the scrollbars or sliders at the bottom and left-hand side of the graph, and zoom in as required.

Figure 22 The "zoomed in" waveform graph display



When selecting the voltage spectrum graph, one can zoom in, so that low level voltage harmonics are better visible. Thus, one can see the voltage distortion components in detail, as shown to the left, with H_3 at about 0.6 V-rms, or 0.25 % of the 230 Volt fundamental.

Figure 23 The voltage spectrum (distortion) in detail



To copy a graph, click on the "two pages" icon, to the left of the printer icon, and select the copy format. The text format lets you copy data into a spreadsheet.

Figure 24 Selecting the voltage spectrum (distortion) as a bitmal

11. The Harmonics Class-A Test Report

Test File:	**H-20201115_ 2499**
EUT:	**HFC-III**
Test Standard:	**Test per IEC 61000-3-2 Ed. 5.1 – 2020**
Test Class:	**(Class A Test)**
Test Result:	**FAIL - 100% average**
Test Date:	**10/2/2020**
Start Time:	**3:34:07**
Stop Time:	**3:35:33**
Test Duration (min):	**1**

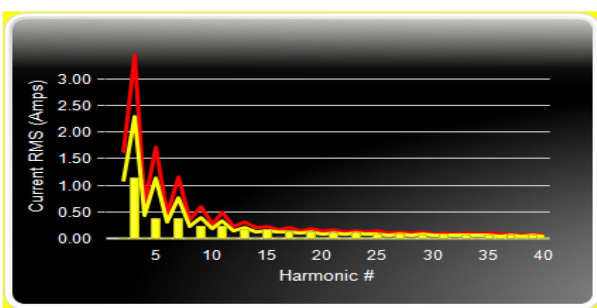
Source Qualification: **Compliance with IEC61000-3-2**

Power Source Distortion:	**OK**
Customer:	**CISCO**
Test By:	**CNS**
Comments:	**Class A Fail**

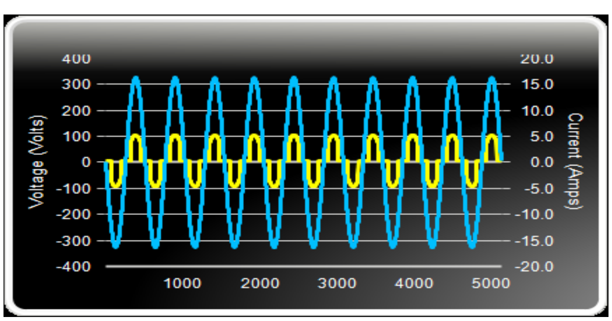
General Test Data: (Phase A)

Vrms (Volts):	**230.00**	**Frequency (Hz):**	**50.00**
I_rms (Amps):	**3.270**	**Power (VA):**	**752.2**
I_fund (Amps):	**2.960**	**Power (W):**	**679.9**
I_peak (Amps):	**5.286**	**Power Factor:**	**0.904**
V-THD (%):	**0.33**	**I-THD (%):**	**46.37**
POHC (A):	**0.257**	**POHC Limit (A):**	**0.250**
I-THC (A):	**1.371**	**Meas. Pwr (Min / Max)**	**679.9W/683.0W**
Phase angle of H5 (deg):	**181.7**		

Harmonic Spectrum



Voltage & Current Waveform



Current Harmonics (values at the end of test)

Harm No.	Harm. Ave.	Harm. Limit (100%)	% Of Limits	Result (Ave.)	Result (Max.)	Harm. Win.	Harm. Win. (150%)	% Of Max
2	0.0036	1.0800	0.3	PASS	PASS	0.0048	1.6200	0.3
3	1.1499	2.3000	50.0	PASS	PASS	1.1514	3.4500	33.4
4	0.0048	0.4300	1.1	PASS	PASS	0.0063	0.6450	1.0
5	0.3854	1.1400	33.8	PASS	PASS	0.3880	1.7100	22.7
6	0.0047	0.3000	1.6	PASS	PASS	0.0062	0.4500	1.4
7	0.3816	0.7700	49.6	PASS	PASS	0.3831	1.1550	33.2
8	0.0046	0.2300	2.0	PASS	PASS	0.0061	0.3450	1.8
9	0.2319	0.4000	58.0	PASS	PASS	0.2345	0.6000	39.1
10	0.0046	0.1840	2.5	PASS	PASS	0.0061	0.2760	2.2
11	0.2283	0.3300	69.2	PASS	PASS	0.2298	0.4950	46.4
12	0.0046	0.1530	3.0	PASS	PASS	0.0061	0.2295	2.7
13	0.1664	0.2100	79.2	PASS	PASS	0.1689	0.3150	53.6
14	0.0046	0.1310	3.5	PASS	PASS	0.0061	0.1965	3.1
15	0.1626	0.1500	108.4	FAIL	PASS	0.1641	0.2250	72.9
16	0.0046	0.1150	4.0	PASS	PASS	0.0060	0.1725	3.5
17	0.1298	0.1320	98.3	PASS	PASS	0.1322	0.1980	66.8
18	0.0046	0.1020	4.5	PASS	PASS	0.0061	0.1530	4.0
19	0.1261	0.1180	106.9	FAIL	PASS	0.1276	0.1770	72.1
20	0.0046	0.0920	5.0	PASS	PASS	0.0061	0.1380	4.4
21	0.1066	0.1070	99.6	PASS	PASS	0.1090	0.1605	67.9
22	0.0046	0.0830	5.6	PASS	PASS	0.0061	0.1245	4.9
23	0.1028	0.0970	106.0	FAIL	PASS	0.1043	0.1455	71.7
24	0.0046	0.0760	6.1	PASS	PASS	0.0061	0.1140	5.4
25	0.0905	0.0900	100.6	FAIL	PASS	0.0929	0.1350	68.8
26	0.0046	0.0700	6.6	PASS	PASS	0.0061	0.1050	5.8
27	0.0868	0.0830	104.6	FAIL	PASS	0.0883	0.1245	70.9
28	0.0046	0.0650	7.1	PASS	PASS	0.0061	0.0975	6.3
29	0.0787	0.0770	102.2	FAIL	PASS	0.0811	0.1155	70.2
30	0.0046	0.0610	7.6	PASS	PASS	0.0061	0.0915	6.7
31	0.0750	0.0720	104.2	FAIL	PASS	0.0765	0.1080	70.9
32	0.0046	0.0570	8.1	PASS	PASS	0.0061	0.0855	7.1
33	0.0698	0.0680	102.6	FAIL	PASS	0.0721	0.1020	70.7
34	0.0046	0.0540	8.5	PASS	PASS	0.0061	0.0810	7.5
35	0.0661	0.0640	103.3	FAIL	PASS	0.0676	0.0960	70.4
36	0.0046	0.0510	9.0	PASS	PASS	0.0061	0.0765	8.0
37	0.0626	0.0600	104.3	FAIL	PASS	0.0649	0.0900	72.1
38	0.0046	0.0480	9.6	PASS	PASS	0.0061	0.0720	8.5
39	0.0590	0.0570	103.4	FAIL	PASS	0.0605	0.0855	70.8
40	0.0035	0.0460	7.5	PASS	PASS	0.0047	0.0690	6.7

Power Source Verification Data

Harm No.	Harm. Value	Harm. Limit	% Of Limits	% Of Vfund	Result
2	0.0714	0.4600	15.5	0.031	OK
3	0.6276	2.0700	30.3	0.273	OK
4	0.0446	0.4600	9.7	0.019	OK
5	0.0653	0.9200	7.1	0.028	OK
6	0.0179	0.4600	3.9	0.008	OK
7	0.0716	0.6900	10.4	0.031	OK
8	0.0112	0.4600	2.4	0.005	OK
9	0.0569	0.4600	12.4	0.025	OK
10	0.0128	0.4600	2.8	0.006	OK
11	0.1066	0.2300	46.4	0.046	OK
12	0.0104	0.2300	4.5	0.005	OK
13	0.0761	0.2300	33.1	0.033	OK
14	0.0087	0.2300	3.8	0.004	OK
15	0.0733	0.2300	31.9	0.032	OK
16	0.0072	0.2300	3.1	0.003	OK
17	0.0662	0.2300	28.8	0.029	OK
18	0.0091	0.2300	3.9	0.004	OK
19	0.0774	0.2300	33.7	0.034	OK
20	0.0408	0.2300	17.7	0.018	OK
21	0.0785	0.2300	34.1	0.034	OK
22	0.0076	0.2300	3.3	0.003	OK
23	0.0789	0.2300	34.3	0.034	OK
24	0.0076	0.2300	3.3	0.003	OK
25	0.0792	0.2300	34.5	0.034	OK
26	0.0089	0.2300	3.9	0.004	OK
27	0.0707	0.2300	30.7	0.031	OK
28	0.0047	0.2300	2.1	0.002	OK
29	0.0773	0.2300	33.6	0.034	OK
30	0.0056	0.2300	2.4	0.002	OK
31	0.0708	0.2300	30.8	0.031	OK
32	0.0048	0.2300	2.1	0.002	OK
33	0.0693	0.2300	30.1	0.030	OK
34	0.0077	0.2300	3.3	0.003	OK
35	0.0785	0.2300	34.1	0.034	OK
36	0.0070	0.2300	3.0	0.003	OK
37	0.0762	0.2300	33.1	0.033	OK
38	0.0076	0.2300	3.3	0.003	OK
39	0.0845	0.2300	36.7	0.037	OK
40	0.0260	0.2300	11.3	0.011	OK

The Flicker test conditions selection

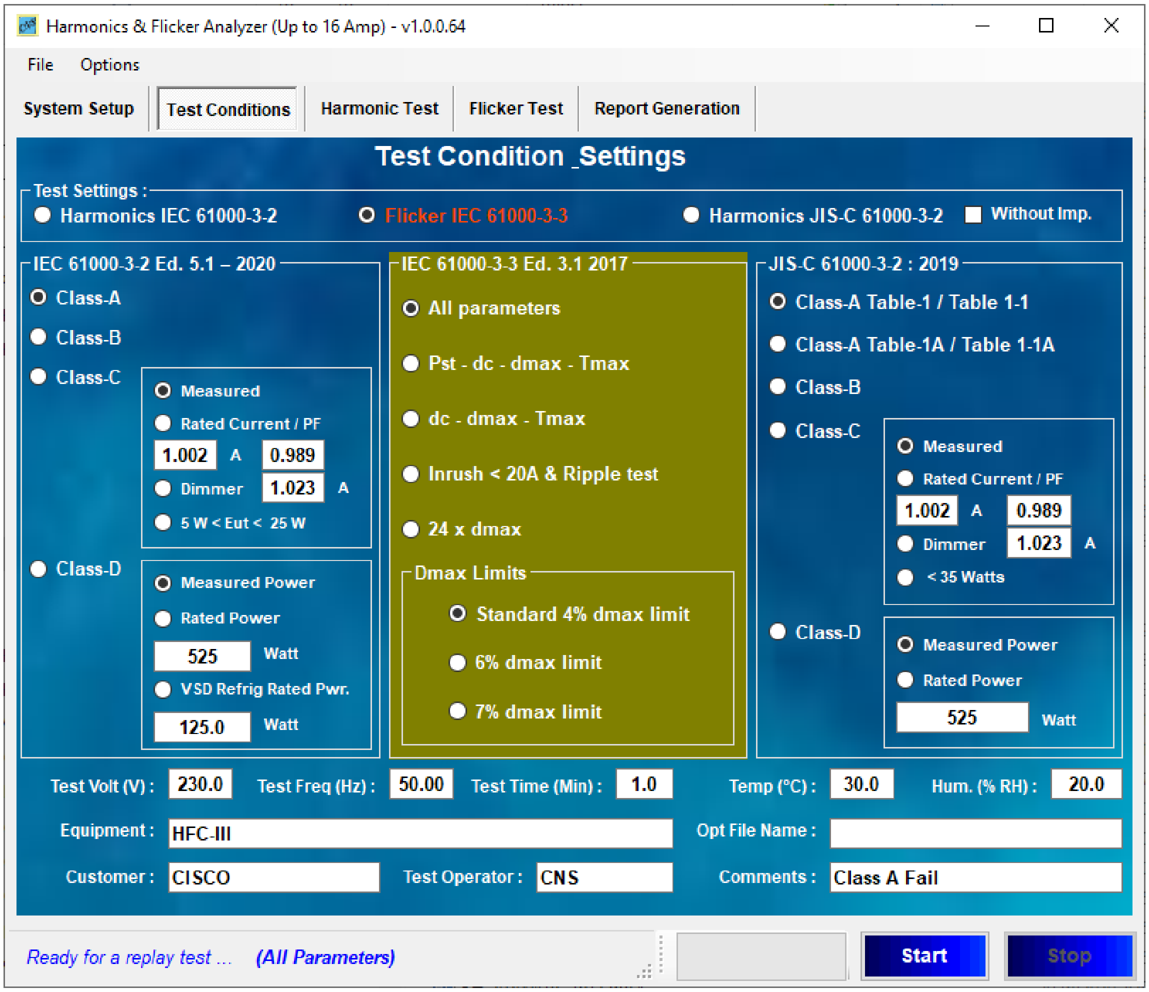


Figure 25 The Flicker test setup screen

There are a number of possible tests that a user can select from. For some products (so-called brown goods, like audio equipment, gaming products), only “dc-dmax-Tmax” are required. This also applies for vacuum cleaners, and food mixers. For a number of products with relatively short operating cycles, Pst-dc-dmax-Tmax is the correct choice. So, no Plt evaluation for portable tools, cookers, refrigerators, and hair dryers. For manually switched products, the user can select the simplified “Inrush current < 20 A rms & Ripple” test. This includes a test of current fluctuation after the initial inrush, and the current has to remain stable to within +/- 1.5 Amp. The < 20 A rms guarantees that the product PASSES the dmax and dc limits, and the +/- 1.5 A-rms, means that worst case the Pst will be less than the 1.000 limit (actually < 0.95).

The user must select a dmax limit, and 4 % is the default or “safe choice”. For equipment that is switched manually, or automatically more often than 2 x per day, the 6 % limit may be selected (and the 24 x dmax procedure can be followed). The 7 % applies to equipment that is attended whilst in use, such as hair dryers, vacuum cleaners, some kitchen appliances, and portable tools.

For air conditioners, the user may select the 24 x dmax test. The procedure for this test is specified in Annex B of IEC 61000-3-3. The sequence is; Start the measurement with the EUT turned “off”, then turn it “on” for 1 minute. Next – turn the unit off until the unit has no moving parts, and any “d-max mitigation” device has cooled down. Then start the next measurement, and repeat the sequence 24 times. Next remove the highest and lowest observed dmax value, and take the average of the remaining 22.

12. The Flicker measurement Display

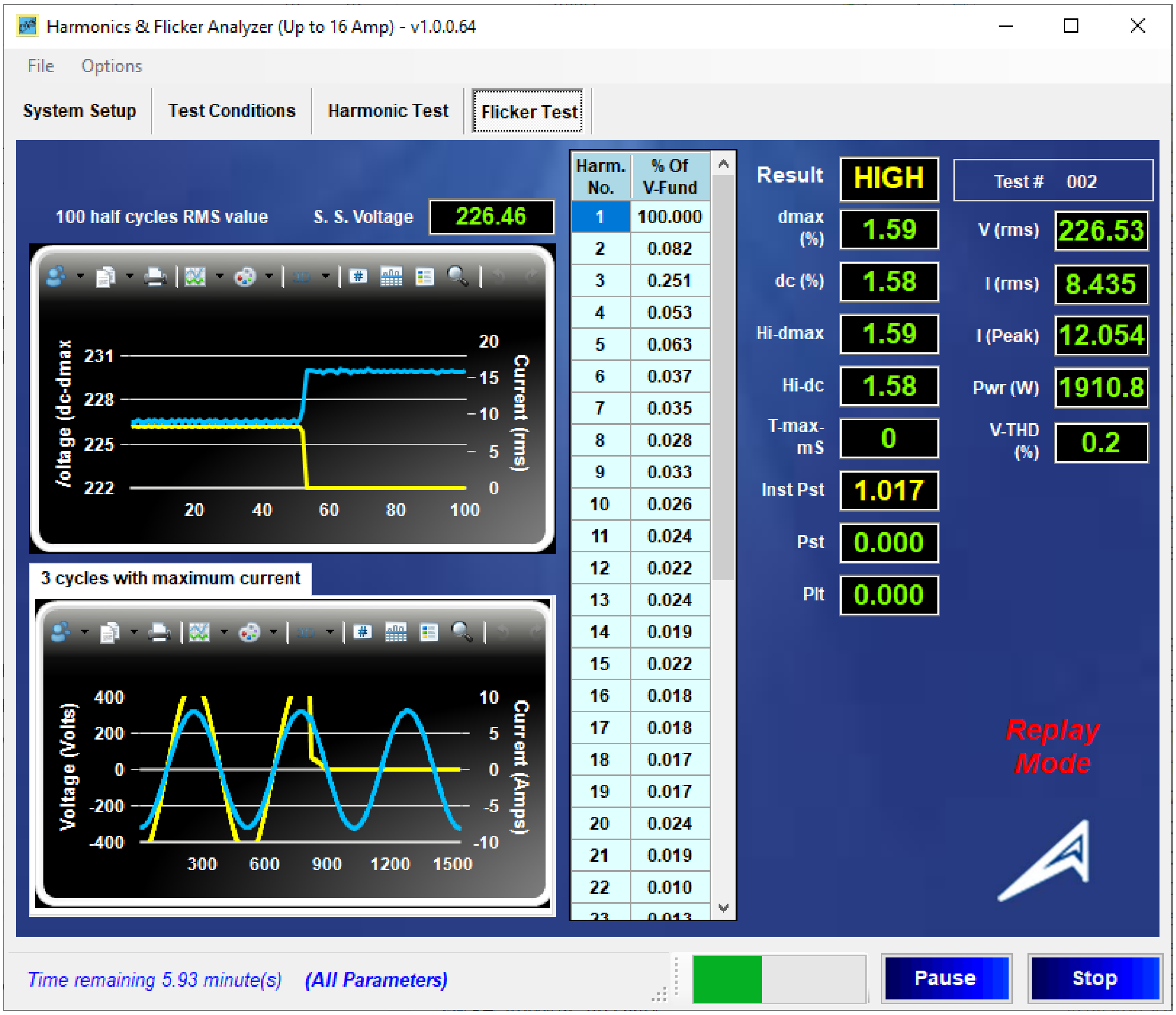


Figure 26 The Flicker test screen

The above Flicker measurement display for “All parameters” is “real time”, i.e. the display is updated every second. The top graph displays the voltage in V-rms per half cycle i.e. 100 ea. values per second (horizontal scale), as well as the 100 half cycle rms values for current per second.

In the above example, the load is turned “Off” (the yellow trace jumps from 8.44 A-rms to “0”). This causes the voltage change of about 1.50 % (the 1.59 % for “dmax” was from the previous voltage step – when the current had been turned on - the new “dc” is yet to be established after no change for > 1 sec.). When this load pattern is turned On/Off every ~ 7.8 seconds, the resulting Pst will be ~ 1.01. **The “Inst. Pst” parameter is updated (integrated per IEC 61000-4-15) every second**, and at the end of 10 minutes, this results in a Pst value. Of course, the other parameters are updated every second also. The system also monitors the voltage THD (the standard requires the V-THD to be less than 3 %), the power and the rms current level. So, a 10 minute test MUST be completed to get a Pst value.

Note also, that the system keeps track of the ***last measured Steady State voltage***. The following pages illustrate a few more load change patterns, as well as a voltage drop that triggers the “T-max” measurement.

The Flicker measurement Display (cont.)

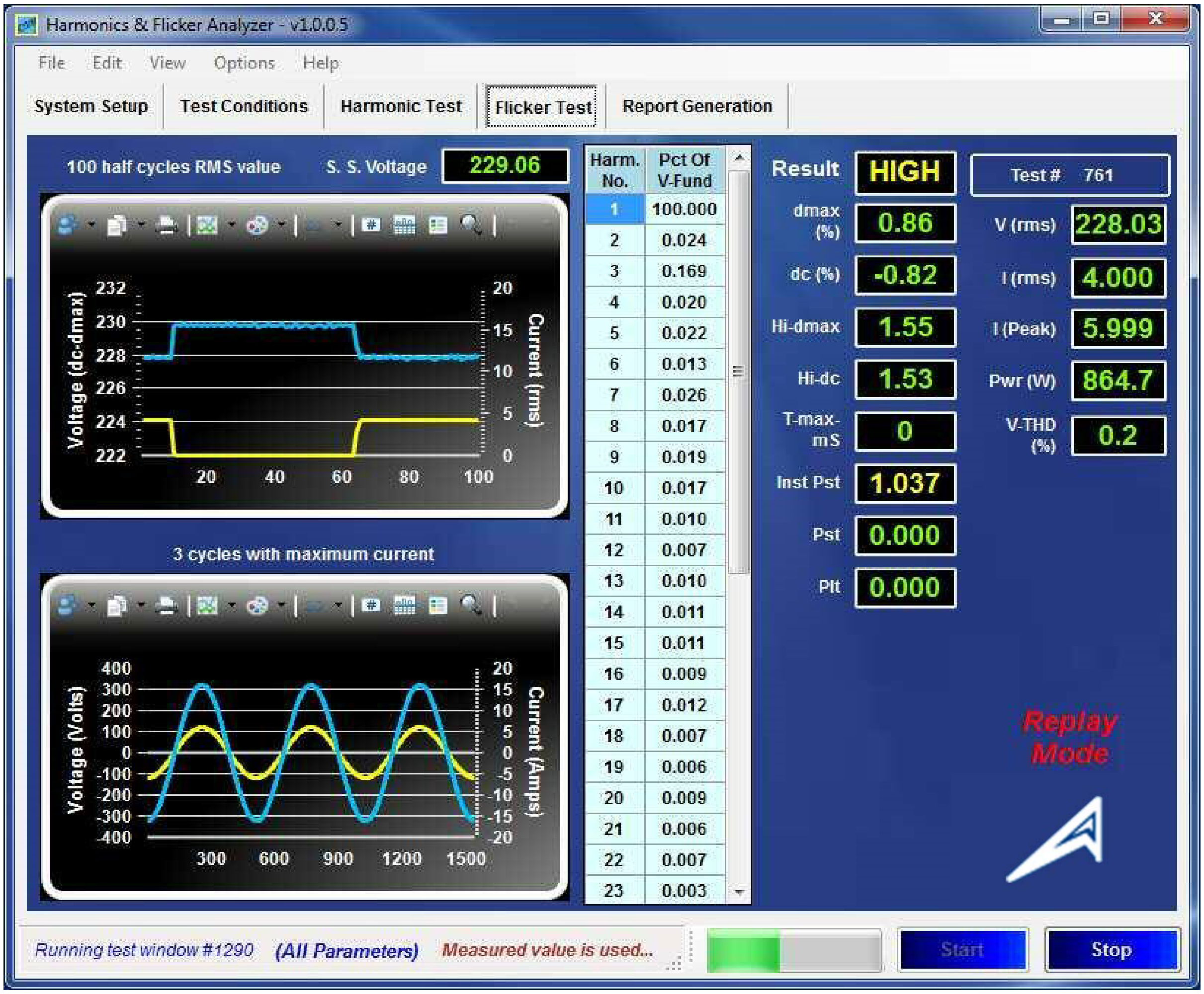


Figure 27 Flicker test with 0.917 Hz modulation

The above screen shot (replay of test 761) illustrates the 0.917 Hz modulation pattern (part of the Table 5 calibration points in IEC 61000-4-15). At 0.917 Hz, there is a transition every 545 ms i.e. the current is turned “On” or “Off” every 0.545 seconds. As the current is turned “On” there is a voltage drop through the Reference Impedance that is proportional to the amount of current, and thus the voltage fluctuation is inversely proportional to the current flow. The bottom graph shows a few periods where the load (current) is “On”. Given the small drop of about 2 Volts, the change is very difficult (if not impossible) to discern from the voltage. The relative drop, however, along with the modulating current (top graph) easily illustrate the pattern. The data grid shows the voltage harmonics, and the various flicker parameters are to the right. For Flicker tests, the V-THD (voltage distortion) must be < 3 %.

Given that the Instantaneous Pst is higher than 1.0, the test result at the moment the reading was recorded, shows “High” and the Inst. Pst value is highlighted yellow. Note, however, that the PASS/FAIL decision on the basis of Pst is not made until a 10 minute Pst value is available.

Also, the momentary current level and the power consumption of the equipment under test are shown.

The Flicker measurement display (cont.)

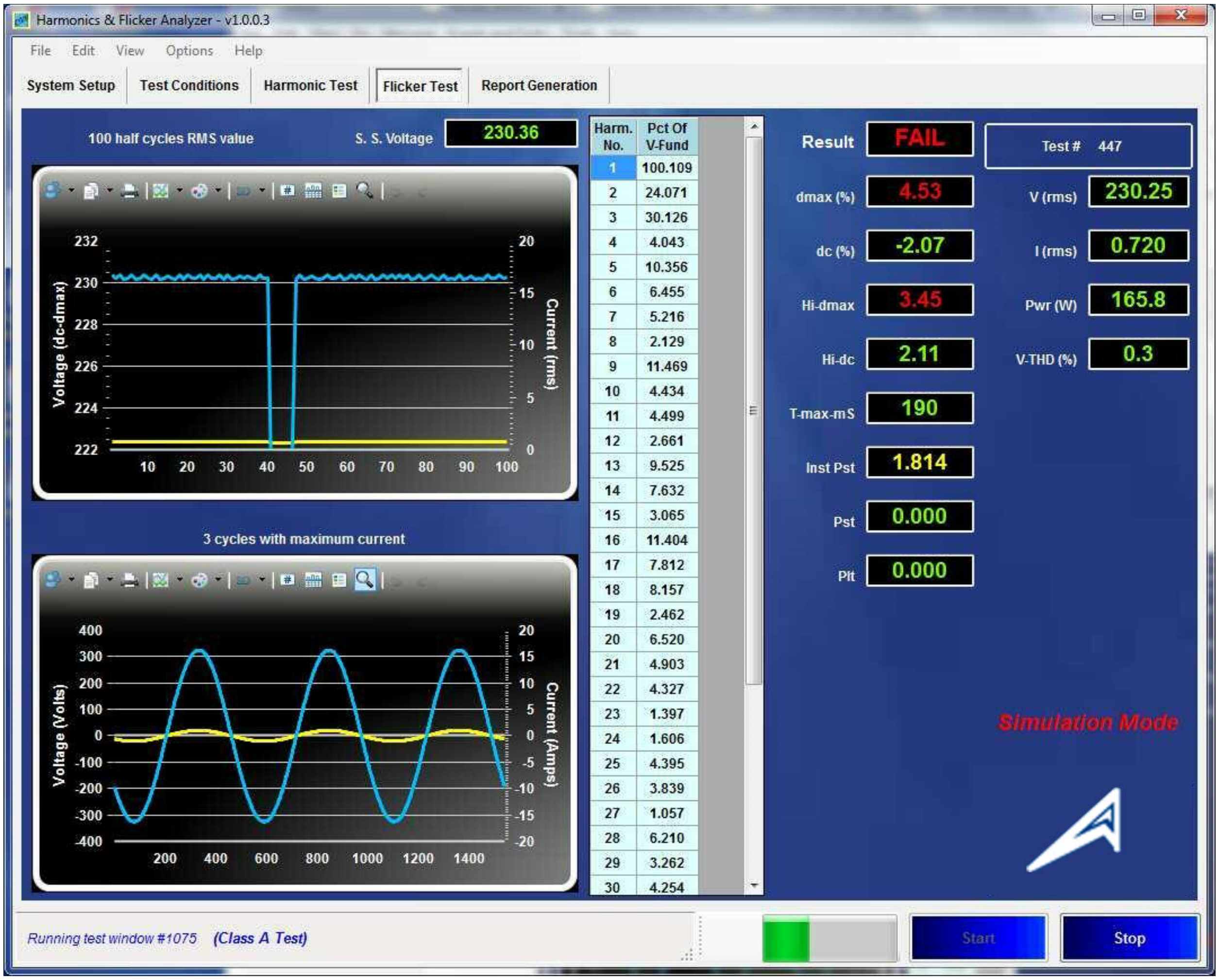
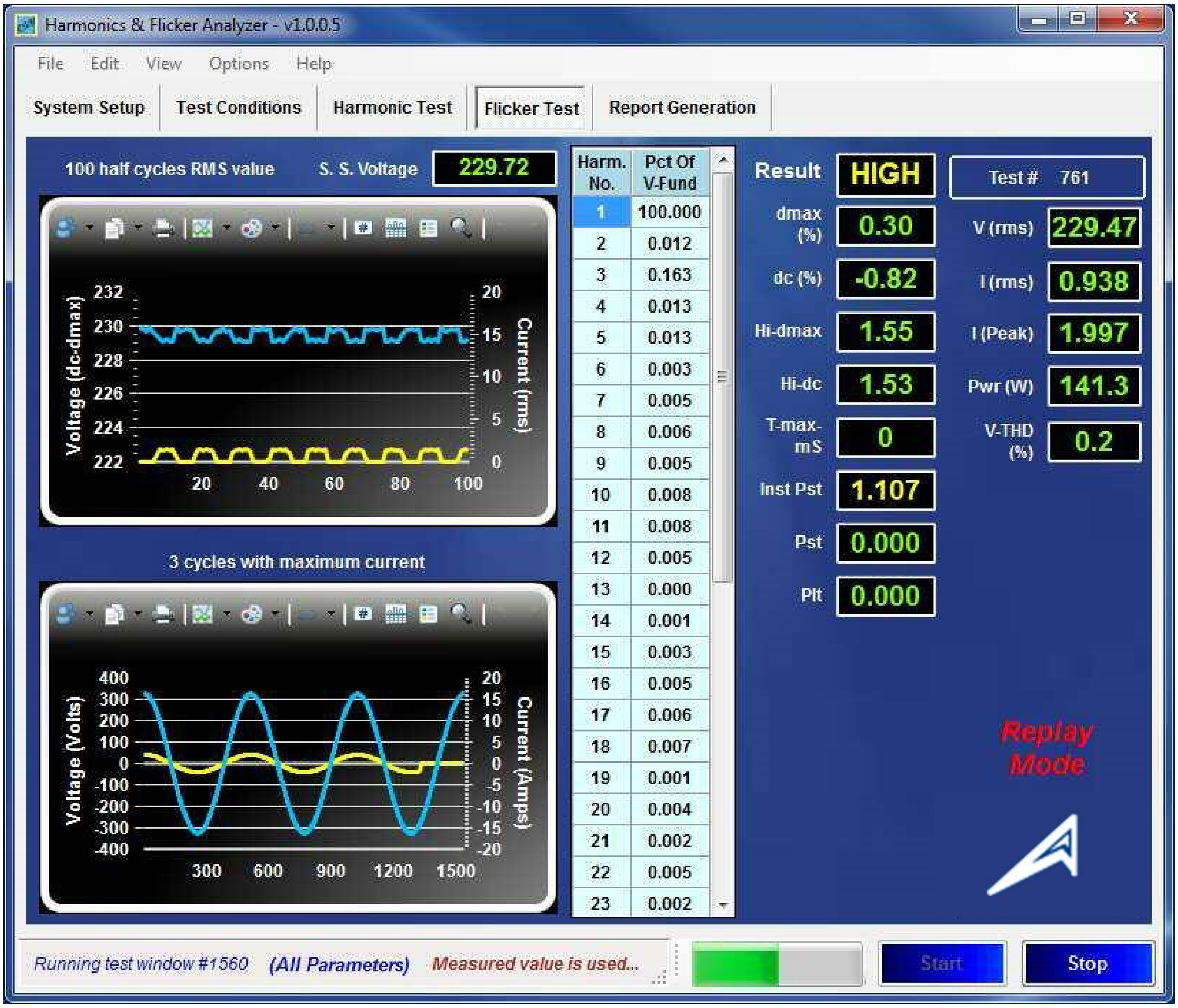


Figure 28 dmax exceeding the limit, and T-max of 190 ms

For the above screen shot, the power source was programmed to simulate a brief voltage drop (190 ms) of about 4.5 % and the display was recorded just before the “Hi-dmax” and several other parameters were updated. T-max is the time that a voltage dip duration exceeds a 3.3 % drop. The standard limits this duration (T-max) to 500 ms, so that the parameter with 190 ms still is within the maximum permitted time.

The limit for “dmax” however, is 4 % (for most equipment) and the measured value for this maximum voltage drop was 4.53 % and therefore the EUT FAILS the Flicker test.

The Flicker measurement display (cont.)



Harm. No.	Pct Of V-Fund
1	100.000
2	0.012
3	0.163
4	0.013
5	0.013
6	0.003
7	0.005
8	0.006
9	0.005
10	0.008
11	0.008
12	0.005
13	0.000
14	0.001
15	0.003
16	0.005
17	0.006
18	0.007
19	0.001
20	0.004
21	0.002
22	0.005
23	0.002

Figure 29 Modulation at 8.77 Hz

The above screen shot illustrates a modulation pattern at the frequency where Flicker has its most sensitive point on the curve. At 8.77 Hz (1052 changes per minute for rectangular voltage changes) even a small 0.276 % voltage modulation will produce a Pst level of 1.00.

A voltage change of 0.276 % means a voltage step of just 0.63 Volt (at 230 V – 50 Hz). In the top graph, the yellow trace depicts the current turning On/Off and the blue trace shows the voltage fluctuation that results from the current flow through the reference impedance. The “dc value” of – 0.82 % is from a previous step. At 8.77 Hz modulation, there is no steady state, and thus the last measured “dc” value remains in the display.

Page 32 shows the report for a Flicker test that was done, using the calculation from the instantaneous current level I_t (@ 256 samples per ½ cycle).

The following page shows the “24 x dmax” test example, and page 33 shows an example test report.

The 24 x dmax test

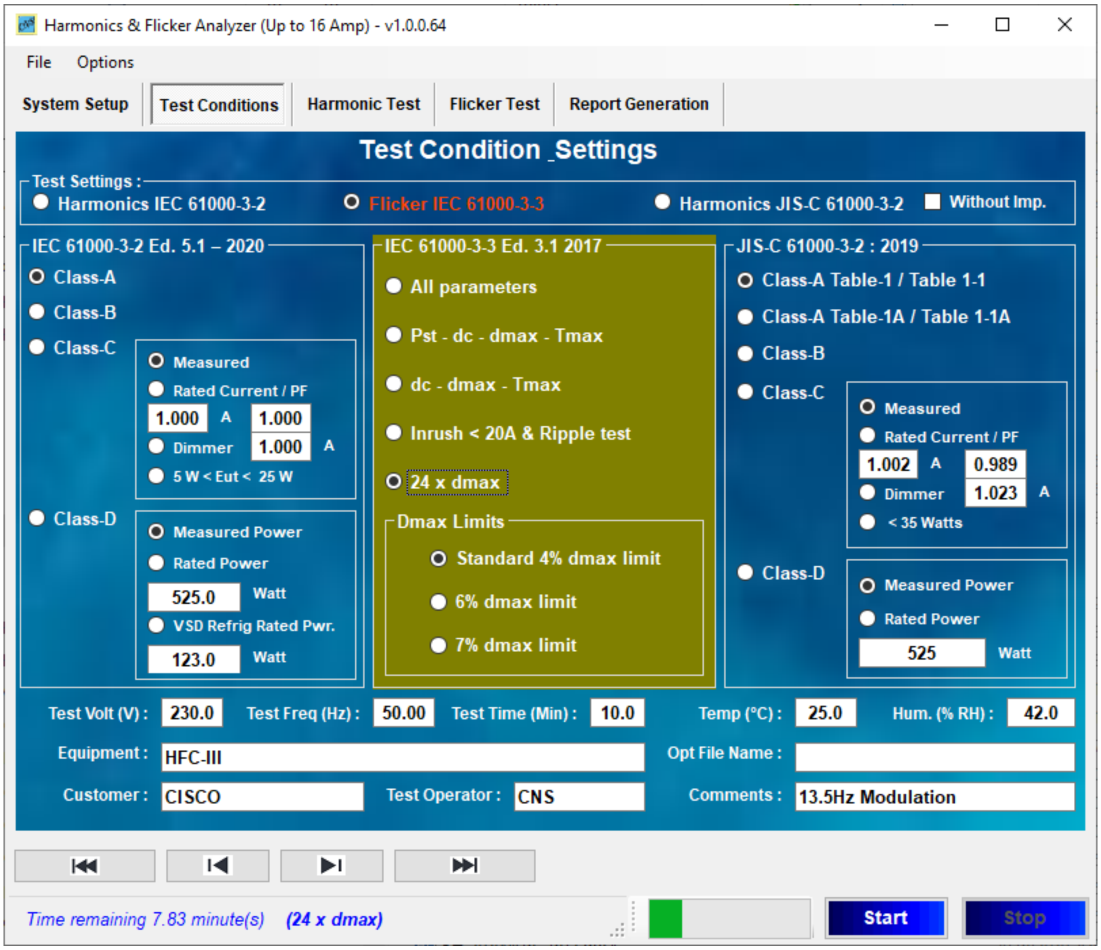


Figure 30

Selecting the “24 x dmax” test with the 4 % standard limit

When the user selects the 24 x dmax test, and then clicks on “Start”, the system will display a sub-window, giving instructions. The system wants you to ensure that the EUT is “off”.

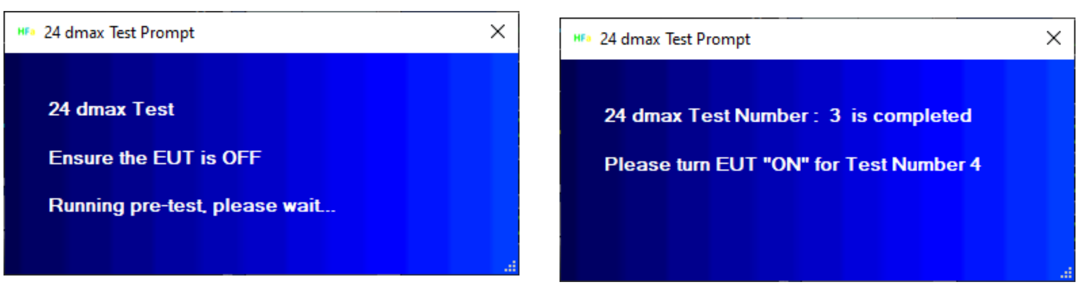
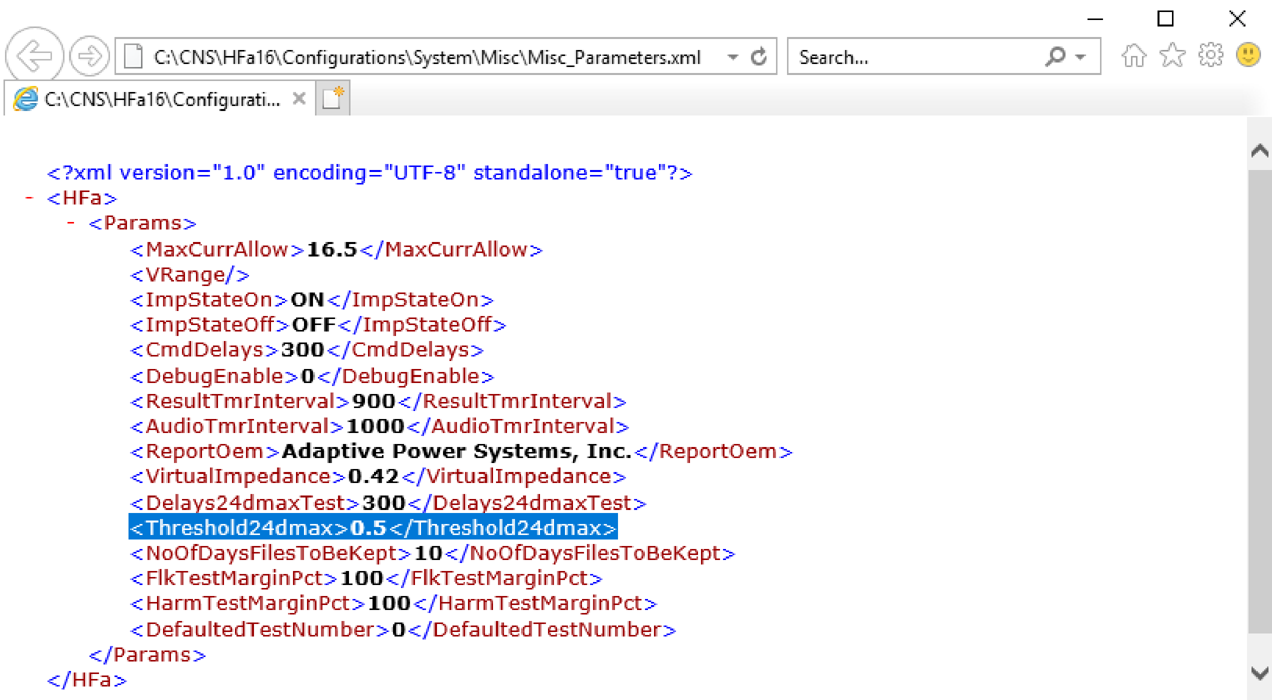


Figure 31 User prompts for 24 x dmax testing

When the current level is below 0.5 A rms, the unit is considered to be “off”. Conversely, when the current is > 0.5 A rms, the unit is considered to be “on”.

In case the EUT has a standby current that is higher – or has a current level that is below 0.5 A rms, when the unit is turned “on”. The user can edit the file called “Misc_Parameters.xml, in the directory as shown on the next page, i.e.

C:\CNS\HFa16\Configurations\System\Misc\Misc_Parameters.xml




```xml
<?xml version="1.0" encoding="UTF-8" standalone="true"?>
- <HFa>
  - <Params>
      <MaxCurrAllow>16.5</MaxCurrAllow>
      <VRange/>
      <ImpStateOn>ON</ImpStateOn>
      <ImpStateOff>OFF</ImpStateOff>
      <CmdDelays>300</CmdDelays>
      <DebugEnable>0</DebugEnable>
      <ResultTmrInterval>900</ResultTmrInterval>
      <AudioTmrInterval>1000</AudioTmrInterval>
      <ReportOem>Adaptive Power Systems, Inc.</ReportOem>
      <VirtualImpedance>0.42</VirtualImpedance>
      <Delays24dmaxTest>300</Delays24dmaxTest>
      <Threshold24dmax>0.5</Threshold24dmax>
      <NoOfDaysFilesToBeKept>10</NoOfDaysFilesToBeKept>
      <FlkTestMarginPct>100</FlkTestMarginPct>
      <HarmTestMarginPct>100</HarmTestMarginPct>
      <DefaultedTestNumber>0</DefaultedTestNumber>
    </Params>
  </HFa>
```


Figure 32 The location and content of the Misc_Parameters.xml file with 24x dmax threshold highlighted

Of course, the user must show what Flicker test method was used, and this is reflected in the test report. The line in the Flicker test report, called “Test class” shows what test method was applied. The next page shows an example for a report for a “All parameters” test.

Note that there will be NO value for Pst or a Pst graph, if the user doesn’t let a 10 minute test complete. So, for “All parameters” – the test time must at least be 10 minutes.

For longer tests, with multiple Pst periods, the report will show the Pst value for each 10 minute measurement period.

13. The Flicker test report

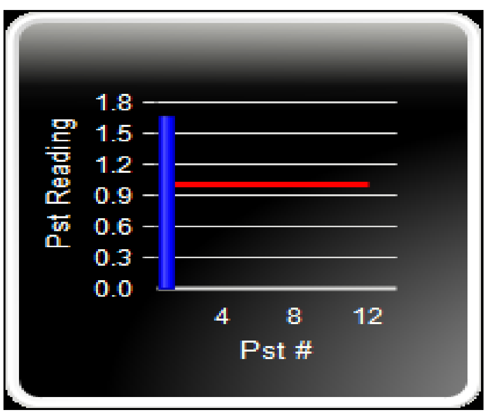
Test File:	**F-20190206_ 447**
EUT:	**HFC-III**
Test Class:	**Flicker Test, All Parameters (Calc. By Current Method)**
Test Result:	**FAIL**
Test Date:	**2/6/2019**
Start Time:	**3:24:31 PM**
Stop Time:	**3:48:17 PM**
Test Duration (min):	**10**

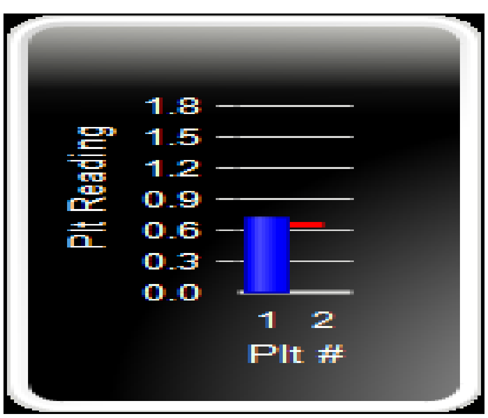
Source Qualification: **Compliance with IEC61000-3-3**

Customer:	**Customer**
Test By:	**Mathieu**
Comments:	**Comments**

General Test Data: (Phase A)

Vrms (Volts):	**229.02**	**Frequency (Hz):**	**50.00**
I_rms (Amps):	**2.905**	**Power (W):**	**665.3**
V-THD (%):	**0.301**	**T-Max (ms):**	**190 (500)**
dmax (%):	**1.18 (3.30)**	**Hi dmax (%):**	**4.59 (3.30)**
dc (%):	**-2.18 (3.30)**	**Hi dc (%):**	**2.82 (3.30)**
Pst-1 :	**1.667 (1.000)**		
Plt :	**0.728 (0.650)**		





14. The 24 x dmax report

Test File:	F-20190916_ 973
EUT:	HFC-III
Test Standard:	Test per IEC 61000-3-3 Ed. 3, 2017
Test Class:	Flicker Test, 24 x dmax (Calc. By Current Method)
Test Result:	**PASS**
Test Date:	9/16/2019
Start Time:	12:56:36
Test Duration (min):	10

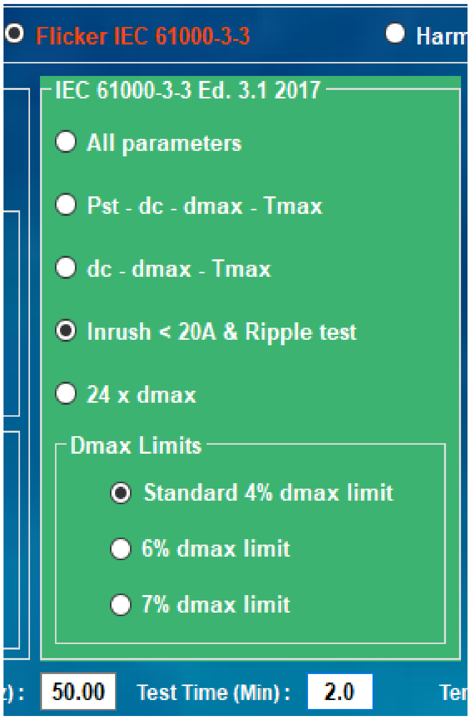
Source Qualification:	Compliance with IEC61000-3-3
Customer:	CNS Inc
Test By:	Mathieu
Comments:	24 x dmax test

Vrms (Volts):	229.85	Frequency (Hz):	50.00
I_rms (Amps):	6.155	Power (W):	2490.7
V-THD (%):	0.298	T-Max (ms):	0 (500)
dmax (%):	-0.969 (6.000)	Hi dmax (%):	-1.043 (6.000)
dc (%):	-0.975 (3.300)	Hi dc (%):	1.068 (3.300)
Average of 22 dmax :	0.966		
Lowest of dmax :	0.878		
Highest of dmax :	1.040		

Test Number:	24 dmax readings:	
1	0.968	
2	0.965	
3	0.883	
4	1.037	
5	1.029	
6	0.882	
7	0.958	
8	0.958	
9	0.953	
10	0.878	Disregarded lowest dmax
11	0.951	
12	0.966	
13	0.958	
14	0.961	
15	0.961	
16	0.888	
17	0.959	
18	0.962	
19	1.037	
20	0.961	
21	1.038	
22	0.957	
23	1.040	Disregarded highest dmax
24	1.029	

15. The Inrush < 20 A-rms and Ripple Test

This page and the next illustrate the test report for a <20 A & ripple test.



Generally, this test requires just a couple minutes. The user selects the test time (2 minutes in this example) . The tests starts, and the system does a 10 second pre-test. As soon as the pretest is complete, the user must turn on the EUT, so that the inrush current can be measured.

After 20 seconds, the system will evaluate the current variation (ripple test) to verify whether the ripple is < 1.5 A rms, or more than 1.5 A rms. Provided the inrush is < 20 A rms, the 'dmax" cannot be more than 3.5 %. Also, a 1.5 A rms ripple will not cause more than 0.26 % voltage modulation. Even at the most sensitive point on the Flicker curve, a voltage modulation of 0.276 % is needed to produce a Pst level of 1.00. So, if the product meets both test criteria, it is guaranteed to pass a long Flicker test.

The user may want to repeat the simplified Inrush & Ripple test a few times, to make sure that the maximum inrush current is captured. Given the short test duration, this method still has advantages over a lengthy (up to 2 hours) complete Flicker test.

Below is the test report for a unit that "Passes" the simplified test, and the next page shows a report for a unit that fails the test

==

Test File:	**F-20200509_ 1821**
EUT:	**INRUSH & Ripple**
Test Standard:	**Test per IEC 61000-3-3 Ed. 3.1 2017**
Test Class:	**Flicker Test, Inrush < 20A & Ripple test (Calc. By Current Method)**
Test Result:	**EUT meets IEC 61000-3-3 per Clause 6.1**
Test Date:	**5/2/2020**
Start Time:	**2:21:02**
Stop Time:	**2:23:12**
Test Duration (min):	**2**
Source Qualification:	**Compliance with IEC61000-3-3**
Customer:	**CNS Inc.**
Test By:	**CNS**
Comments:	**RIPPLE**

Phase A

Vrms (Volts):	**229.83**	**Frequency (Hz):**	**50.00**
I_rms (Amps):	**8.447**	**Power (W):**	**1273.2**
V-THD (%):	**0.247**	**T-Max (ms):**	**0 (500)**
dmax (%):	**-0.983 (4.000)**	**Hi dmax (%):**	**1.039 (4.000)**
I-Variation (A):	**-0.076 (1.5A)**	**I_rms-peak (A):**	**8.447 (20.0A)**

==

16. The Inrush < 20 A-rms and Ripple test report (fail)

Below is the test report for a product that fails the simplified "Inrush & Ripple" test, because the current variation exceeds the maximum permitted 1.5 A rms ripple.

==

Test File:	**F-20200509_ 1822**
EUT:	**INRUSH & Ripple**
Test Standard:	**Test per IEC 61000-3-3 Ed. 3.1 2017**
Test Class:	**Flicker Test, Inrush < 20A & Ripple test (Calc. By Current Method)**
Test Result:	**EUT fails simplified inrush-ripple current test**
Test Date:	**5/2/2020**
Start Time:	**2:21:15**
Stop Time:	**2:23:27**
Test Duration (min):	**2**

Source Qualification:	**Compliance with IEC61000-3-3**
Customer:	**CNS Inc.**
Test By:	**CNS**
Comments:	**Inrush & Ripple test**

Phase A

Vrms (Volts):	**229.83**	**Frequency (Hz):**	**50.00**
I_rms (Amps):	**5.696**	**Power (W):**	**1263.5**
V-THD (%):	**0.255**	**T-Max (ms):**	**0 (500)**
dmax (%):	**0.553 (4.000)**	**Hi dmax (%):**	**-1.093 (4.000)**
I-Variation (A):	**2.81 (1.5A)**	**I_rms-peak (A):**	**5.70 (20.0A)**

==

17. Sample no. 1 for Class-C < 25 Watt

Clause 7.4.3. of the standard, IEC 61000-3-2 (2020) Edition 5.1, offers 3 test criteria for lighting products between 5 – 25 Watt. The first 2 tests have been in the standard for over 10 years, the last test is new since the 2018 edition, and is also in Edition 5.1.

The first criterion is to test against the limits of Table-3, column 2. These are in essence the Class-D limits.

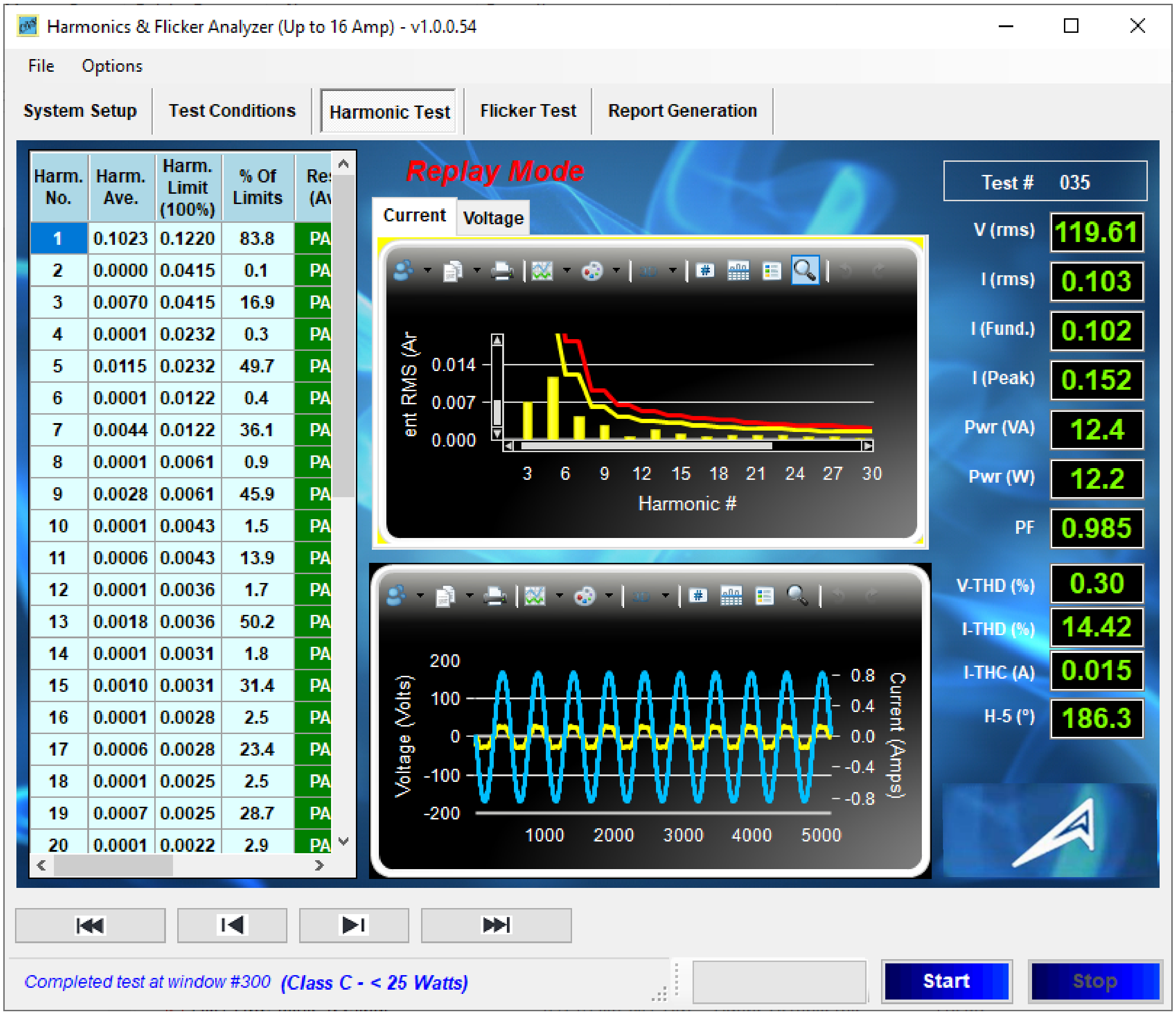


Figure 33 Lighting < 25 Watt meeting Table-3

The above figure 31 shows the measurement for a 12.2 Watt LED lamp that meets the requirements of IEC61000-3-2. It will be obvious that if the lamp meets the “Class-D” limits, there is no need for further testing, as the product passes the first test criterion. The top graph was “zoomed” so that the Table-3 limits are easier to see. If the product were to fail this first test, the system automatically “switches” to the second test criterion.

The following pages show the test report for this lamp, being the data, the limit curve, and the harmonic levels along with the power source voltage parameters. The power source verification page is omitted in order to save space, but the source was compliant with the requirements of IEC 61000-3-2.

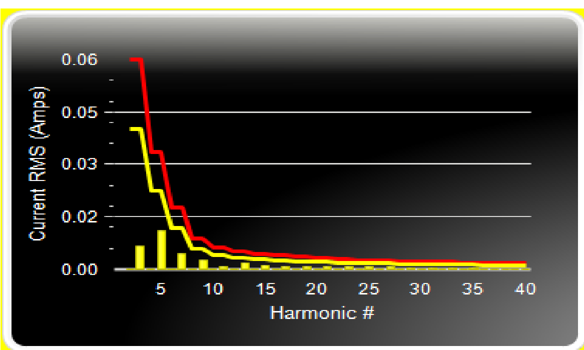
Test File:	**H-20190206_ 035**		
EUT:	**12.2 Watt LED**		
Test Class:	**(Class C - < 25 Watts)**		
Test Result:	**PASS – Table-3 Class D limits**		
Test Date:	**2/6/2019**		
Start Time:	**2:30:47 PM**		
Stop Time:	**2:31:26 PM**		
Test Duration (min):	**1**		

Source Qualification: **Compliance with IEC61000-3-2**

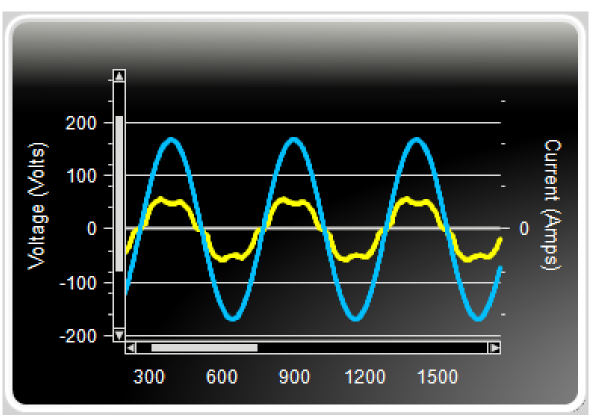
Power Source Distortion:	**OK**		
Customer:	**Customer**		
Test By:	**Mathieu**		
Comments:	**Comments**		

General Test Data: (Phase A)

Vrms (Volts):	**119.63**	**Frequency (Hz):**	**50.00**
I_rms (Amps):	**0.103**	**Power (VA):**	**12.4**
I_fund (Amps):	**0.102**	**Power (W):**	**12.2**
I_peak (Amps):	**0.145**	**Power Factor:**	**0.985**
V-THD (%):	**0.31**	**I-THD (%):**	**14.41**
I-THC (A):	**0.01**		



Harmonic Spectrum



Voltage & Current Waveform (zoomed)

Current Harmonics (average values at the end of test)

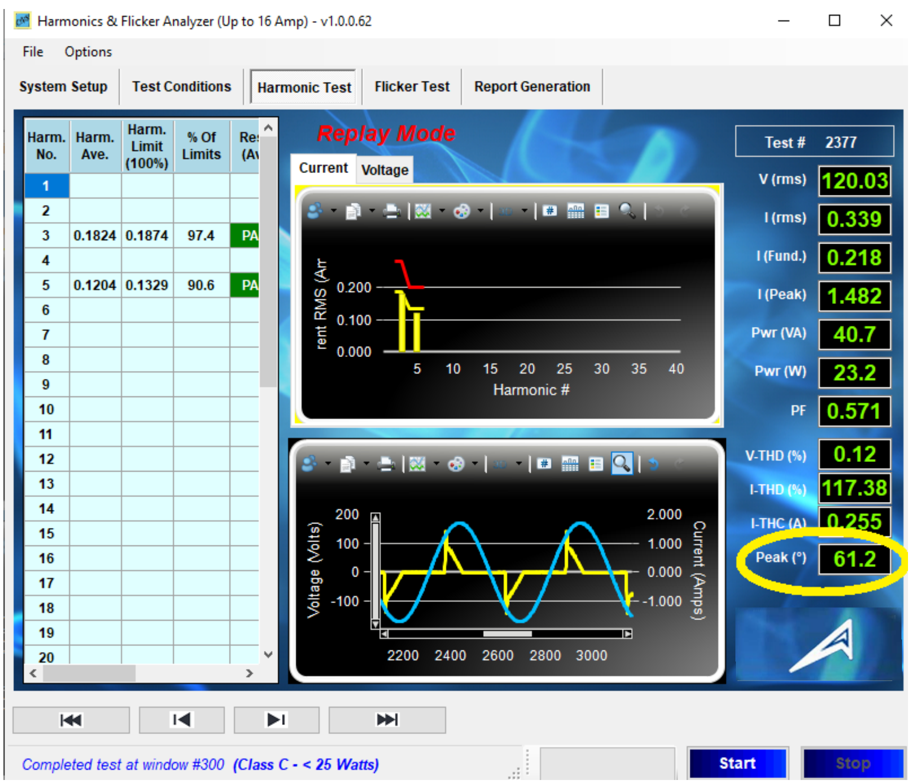
Harm No.	Harm. Ave.	Harm. Limit (100%)	% Of Limits	Result (Ave.)	Result (Max.)	Harm. Win.	Harm. Win. (150%)	% Of Max
2	0.0000	0.0415	0.1	PASS	PASS	0.0001	0.0622	0.1
3	0.0070	0.0415	16.9	PASS	PASS	0.0070	0.0622	11.3
4	0.0001	0.0232	0.3	PASS	PASS	0.0001	0.0348	0.3
5	0.0115	0.0232	49.7	PASS	PASS	0.0115	0.0348	33.2
6	0.0001	0.0122	0.4	PASS	PASS	0.0001	0.0183	0.5
7	0.0044	0.0122	36.1	PASS	PASS	0.0044	0.0183	24.1
8	0.0001	0.0061	0.9	PASS	PASS	0.0001	0.0091	1.0
9	0.0028	0.0061	45.9	PASS	PASS	0.0028	0.0091	30.8
10	0.0001	0.0043	1.5	PASS	PASS	0.0001	0.0064	1.5
11	0.0006	0.0043	13.9	PASS	PASS	0.0006	0.0064	9.5
12	0.0001	0.0036	1.7	PASS	PASS	0.0001	0.0054	1.8
13	0.0018	0.0036	50.2	PASS	PASS	0.0018	0.0054	33.8
14	0.0001	0.0031	1.8	PASS	PASS	0.0001	0.0047	2.1
15	0.0010	0.0031	31.4	PASS	PASS	0.0010	0.0047	21.4
16	0.0001	0.0028	2.5	PASS	PASS	0.0001	0.0041	2.8
17	0.0006	0.0028	23.4	PASS	PASS	0.0007	0.0041	15.9
18	0.0001	0.0025	2.5	PASS	PASS	0.0001	0.0037	2.9
19	0.0007	0.0025	28.7	PASS	PASS	0.0007	0.0037	19.5
20	0.0001	0.0022	2.9	PASS	PASS	0.0001	0.0033	3.2
21	0.0009	0.0022	38.2	PASS	PASS	0.0009	0.0033	25.8
22	0.0001	0.0020	2.9	PASS	PASS	0.0001	0.0031	3.4
23	0.0008	0.0020	39.7	PASS	PASS	0.0008	0.0031	27.0
24	0.0001	0.0019	3.2	PASS	PASS	0.0001	0.0028	3.7
25	0.0006	0.0019	30.3	PASS	PASS	0.0006	0.0028	20.9
26	0.0001	0.0017	3.2	PASS	PASS	0.0001	0.0026	3.6
27	0.0006	0.0017	33.0	PASS	PASS	0.0006	0.0026	23.0
28	0.0001	0.0016	3.6	PASS	PASS	0.0001	0.0024	4.1
29	0.0002	0.0016	13.2	PASS	PASS	0.0002	0.0024	10.3
30	0.0001	0.0015	3.5	PASS	PASS	0.0001	0.0023	3.9
31	0.0002	0.0015	14.2	PASS	PASS	0.0002	0.0023	11.0
32	0.0001	0.0014	3.8	PASS	PASS	0.0001	0.0021	4.2
33	0.0002	0.0014	17.5	PASS	PASS	0.0003	0.0021	13.4
34	0.0001	0.0013	3.9	PASS	PASS	0.0001	0.0020	4.3
35	0.0002	0.0013	18.4	PASS	PASS	0.0003	0.0020	13.4
36	0.0001	0.0013	4.2	PASS	PASS	0.0001	0.0019	4.4
37	0.0001	0.0013	8.1	PASS	PASS	0.0001	0.0019	6.7
38	0.0000	0.0012	4.1	PASS	PASS	0.0001	0.0018	4.3
39	0.0001	0.0012	12.4	PASS	PASS	0.0002	0.0018	9.3
40	0.0000	0.0012	3.8	PASS	PASS	0.0001	0.0018	3.9

18. Sample no. 2 for Class-C < 25 Watt

In the event that the limits for Class-D are not met, the lamp can be tested against two other parameter sets. The so-called waveform test has been in IEC 61000-3-2 Ed. 3.2 for many years. The test is to make sure that the current waveform meets certain requirements, which in essence assure that the 5th harmonic current somewhat compensates for the 5th harmonic of products like changers for tablets, small AC/DC power bricks of laptops, etc. The current flow is expected to have a “shark fin” type characteristic.

Provided the maximum current flow happens before 65 degrees, and provided there is some current flow at 60 degrees and at 90 degrees, the harmonic limits for H3 and H5 are very relaxed (86 % and 61 %) So, the test sequence is “does the product meet Class-D limits”? If not, do the waveform test, and if the phase angles requirements of the current waveform are met, compare H3 and H5 against the limits. If the phase angles and the limits are met, the product passes the test. The screen shot below shows the harmonics H3 – H5 vs. the limits, and the following 2 pages illustrate the test report. The bottom graph is “zoomed in” to illustrate the waveform better.

Notice the Peak phase angle display (yellow highlight) showing 61.2 degrees, i.e. the peak happens before 65 degrees. Also, there is current flow at 60 and 90 degrees, so the relaxed harmonics test criterion can be used. The harmonics vs. the limit are shown in graphical format in the top (bar graph)



Max Curr @ (deg) : 61.2

Max Curr Limit (deg): 65.0

Start Current (A): 0.873

Stop Current (A): 0.483

Figure 34 Lighting product < 25 Watt that meets the waveform criteria

Edited version of the harmonics tables, showing only H3 and H5.

Abbreviated list of parameters

Current Harmonics (values at the end of test)

Harm No.	Harm. Ave.	Harm. Limit (100%)	% Of Limits	Result (Ave.)	Result (Max.)	Harm. Win.	Harm. Win. (150%)	% Of Max
3	0.1824	0.1874	97.4	PASS	PASS	0.1842	0.2811	65.5
5	0.1204	0.1329	90.6	PASS	PASS	0.1208	0.1994	60.6

The system keeps track of the maximum values that occur, and identifies in which measurement window these maxima occurred.

Current Harmonics (150% of limits exceeded in window number xxx)

Harm No.	Harm. Ave.	Pct Of Limits	Result (Ave.)	Result (Max.)	Harm. Win.	Pct Of Max
3	0.1838	98.101	PASS	PASS	0.185	62.075
5	0.1207	90.787	PASS	PASS	0.117	55.198

19. **Sample no. 3 for Class-C < 25 Watt**

If the tested product fails the first 2 tests, a third test called the “THD test” can be performed. The THD test requires that the overall current THD is less than 70 %, with specific limits for the harmonics 2 – 11. The screen shot below illustrates the results of a tested CFL type lamp that fails all 3 test criteria. First it fails the Class-D limits (which is obvious from the waveform, and the harmonic spectrum). So, the software automatically “goes to” the waveform test. When it also fails the waveform test (Peak phase angle must be < 65 degrees, while actual angle is 73.1 deg.), the software performs the THD test, and when it fails this also (I-THD is 107.8 %), the test reports reflects this.

Note that the display “keeps” the phase angle where the maximum occurs, from the second step, when it tried to use the phase angle and start/stop current criteria.

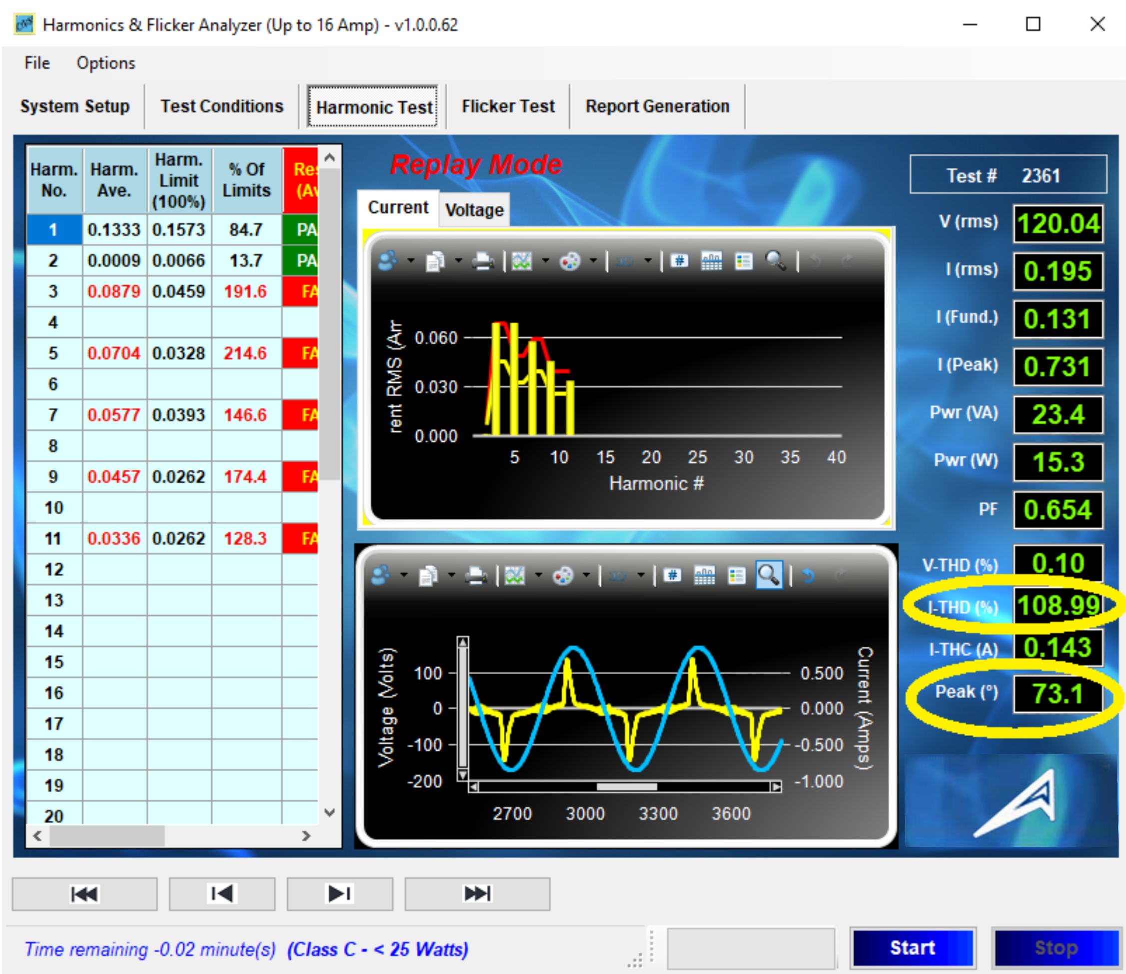


Figure 35 Lighting product < 25 Watt that fails all 3 tests per Clause 7 of IEC 61000-3-2 (2018)

So, to briefly review, the whole test for lighting products from 5- 25 Watt is “automatic”. The software tries to obtain a PASS condition for each test, and when all fail, it reports the FAIL condition for all 3 conditions per clause 7.4.3 of the standard. The next pages show the test report for this case.

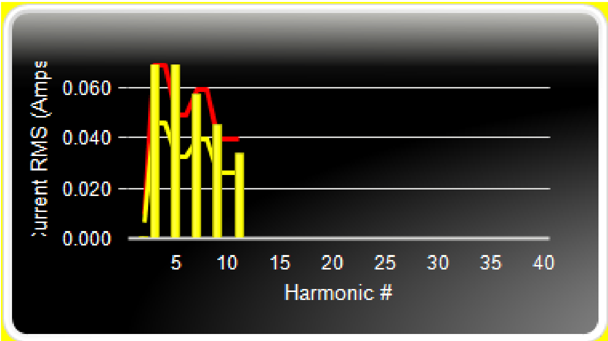
Note: In several cases, the tables and page display were edited to save some space. So, the actual report may show more rows etc.

Test File:	**H-20190308_ 037**
EUT:	
Test Class:	**(Class C - < 25 Watts)**
Test Result:	**FAIL - All (7.4.3)**
Test Date:	**3/8/2019**
Start Time:	**5:22:12 AM**
Stop Time:	**5:22:58 AM**
Test Duration (min):	**1**

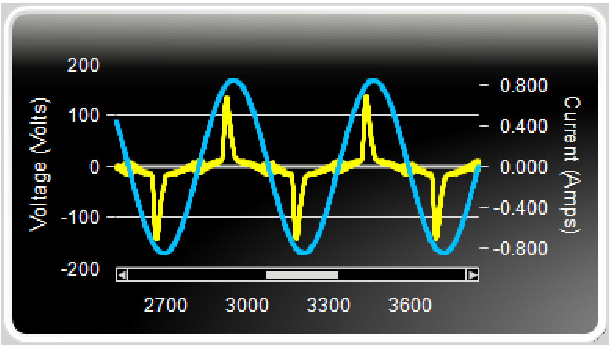
Source Qualification:	**Compliance with IEC61000-3-2**
Power Source Distortion:	**OK**
Customer:	**Customer**
Test By:	**Mathieu**
Comments:	**Comments**

General Test Data: (Phase A)

Vrms (Volts):	**119.62**	**Frequency (Hz):**	**50.00**
I_rms (Amps):	**0.168**	**Power (VA):**	**20.2**
I_fund (Amps):	**0.122**	**Power (W):**	**14.2**
I_peak (Amps):	**0.558**	**Power Factor:**	**0.706**
V-THD (%):	**0.48**	**I-THD (%):**	**94.73**
I-THC (A):	**0.12**		
Max Curr @ (deg) :	**72.42**	**Max Curr Limit (deg):**	**65.00**
Start Current (A) :	**0.114**	**Stop Current (A):**	**0.180**
3rd Harm (%) :	**60.05**	**3rd Harm Limit (%):**	**86.00**
5th Harm (%) :	**44.55**	**5th Harm Limit (%):**	**61.00**
I-THD (%):	**107.18**	**I-THD Limit (%):**	**70.00**



Harmonic Spectrum



Voltage & Current Waveform

Current Harmonics (values at the end of test)

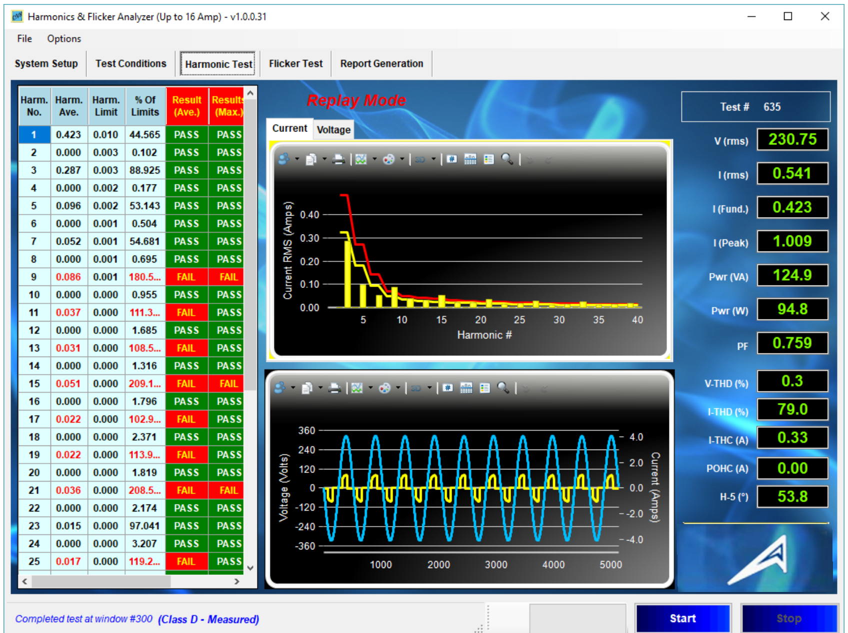
Harm No.	Harm. Ave.	Pct Of Limits	Result (Ave.)	Result (Max.)	Harm. Win.	Pct Of Max
2	0.000	7.013	PASS	PASS	0.000	4.550
3	0.073	171.581	FAIL	FAIL	0.076	118.411
5	0.054	178.205	FAIL	FAIL	0.057	124.056
7	0.043	118.532	FAIL	PASS	0.045	81.196
9	0.032	130.611	FAIL	PASS	0.033	89.312
11	0.023	92.345	PASS	PASS	0.022	61.455

Current Harmonics (150% of limits exceeded in window number)

Harm No.	Harm. Ave.	Pct Of Limits	Result (Ave.)	Result (Max.)	Harm. Win.	Pct Of Max
2	0.000	8.202	PASS	PASS	0.000	5.450
3	0.071	186.593	FAIL	FAIL	0.071	124.415
5	0.052	192.085	FAIL	FAIL	0.052	128.073
7	0.042	129.796	FAIL	PASS	0.042	86.537
9	0.031	143.397	FAIL	PASS	0.031	95.598
11	0.022	103.795	FAIL	PASS	0.022	69.196

20. Class-D Test example

The two screen shots below are for a Class-D “FAIL” test. The HFC-III calibrator was set to produce harmonics that fail the Class-D limits (with H-15 up to ~ 210 %).



This is the standard HFa display, while the figure below shows the display with “zoomed in” spectrum and waveform display.

The screen shot display is slightly expanded (horizontally) to also show which 150 % limits are exceeded.

Figure 36 The Class-D test screen

The following 3 pages show the standard test report. Note that the test report is in Rich Text Format, which can be opened with most word processing programs, such as Microsoft Word, Open Office, Quick Office, etc.

Whereas the power source verification page was omitted for several Class-C examples, it is included in the test for Class-D, as this test is more demanding, and some power sources cannot maintain the required low voltage distortion.

Figure 37 The Class-D display with "zoomed" in graphs

21. Class-D Test Report

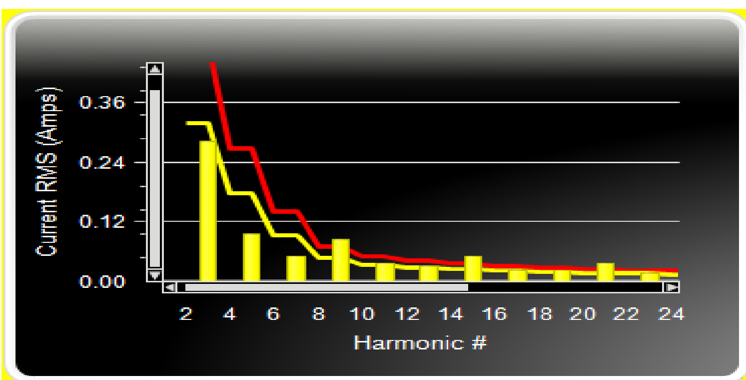
Test File:	**H-20190616_ 541**
EUT:	**Equipment**
Test Class:	**(Class D - Measured)**
Test Result:	**FAIL**
Test Date:	**6/10/2019**
Start Time:	**1:26:01**
Stop Time:	**6/10/2019 1:27:37**
Test Duration (min):	**1**

Source Qualification: **Compliance with IEC61000-3-2**

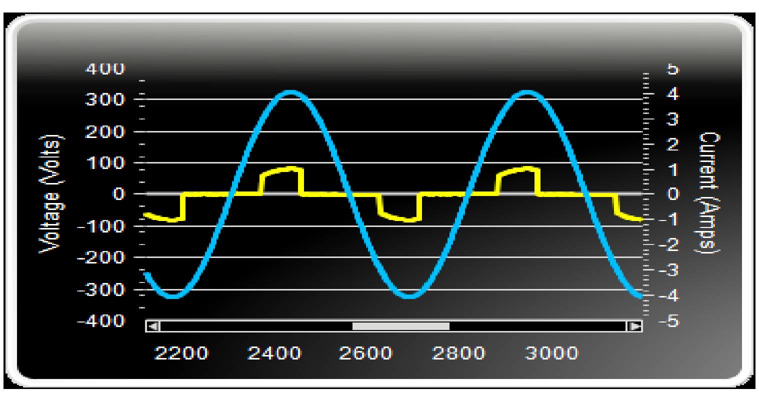
Power Source Distortion:	**OK**
Customer:	**CNS Inc.**
Test By:	**Cal. Lab**
Comments:	**Class-D non-mitigated**

General Test Data: (Phase A)

Vrms (Volts):	**230.17**	**Frequency (Hz):**	**50.00**
I_rms (Amps):	**0.544**	**Power (VA):**	**125.1**
I_fund (Amps):	**0.425**	**Power (W):**	**95.2**
I_peak (Amps):	**1.014**	**Power Factor:**	**0.761**
V-THD (%):	**0.193**	**I-THD (%):**	**78.444**
I-THC (A):	**0.334**	**Meas. Pwr (Min / Max)**	**94.5W/95.2W**
Phase angle of H5 (deg):	**56.8**		



Harmonic Spectrum



Voltage & Current Waveform

Current Harmonics (values at the end of test)

Harm No.	Harm. Ave.	Harm. Limit (100%)	% Of Limits	Result (Ave.)	Result (Max.)	Harm. Win.	Harm. Win. (150%)	% Of Max
2	0.0002	0.3234	0.1	PASS	PASS	0.0003	0.4851	0.1
3	0.2871	0.3234	88.8	PASS	PASS	0.2872	0.4851	59.2
4	0.0003	0.1807	0.2	PASS	PASS	0.0004	0.2711	0.2
5	0.0959	0.1807	53.1	PASS	PASS	0.0959	0.2711	35.4
6	0.0004	0.0951	0.4	PASS	PASS	0.0006	0.1427	0.4
7	0.0519	0.0951	54.6	PASS	PASS	0.0520	0.1427	36.4
8	0.0003	0.0476	0.6	PASS	PASS	0.0004	0.0713	0.5
9	0.0858	0.0476	180.3	FAIL	FAIL	0.0858	0.0713	120.3
10	0.0003	0.0333	0.9	PASS	PASS	0.0004	0.0499	0.8
11	0.0370	0.0333	111.2	FAIL	PASS	0.0371	0.0499	74.2
12	0.0004	0.0282	1.5	PASS	PASS	0.0006	0.0422	1.4
13	0.0305	0.0282	108.4	FAIL	PASS	0.0306	0.0422	72.4
14	0.0003	0.0244	1.1	PASS	PASS	0.0004	0.0367	1.0
15	0.0510	0.0244	208.8	FAIL	FAIL	0.0511	0.0367	139.3
16	0.0004	0.0215	1.7	PASS	PASS	0.0005	0.0322	1.5
17	0.0221	0.0215	102.8	FAIL	PASS	0.0221	0.0322	68.7
18	0.0004	0.0193	2.1	PASS	PASS	0.0005	0.0290	1.9
19	0.0220	0.0193	113.8	FAIL	PASS	0.0220	0.0290	76.0
20	0.0003	0.0174	1.5	PASS	PASS	0.0004	0.0261	1.4
21	0.0363	0.0174	208.3	FAIL	FAIL	0.0363	0.0261	139.0
22	0.0003	0.0159	2.1	PASS	PASS	0.0005	0.0238	1.9
23	0.0154	0.0159	96.9	PASS	PASS	0.0154	0.0238	64.8
24	0.0004	0.0146	2.8	PASS	PASS	0.0006	0.0220	2.6
25	0.0174	0.0146	119.0	FAIL	PASS	0.0175	0.0220	79.6
26	0.0002	0.0136	1.8	PASS	PASS	0.0003	0.0204	1.7
27	0.0280	0.0136	205.7	FAIL	FAIL	0.0280	0.0204	137.3
28	0.0003	0.0126	2.5	PASS	PASS	0.0004	0.0190	2.3
29	0.0116	0.0126	91.5	PASS	PASS	0.0116	0.0190	61.2
30	0.0004	0.0118	3.5	PASS	PASS	0.0006	0.0177	3.3
31	0.0146	0.0118	123.5	FAIL	PASS	0.0146	0.0177	82.6
32	0.0003	0.0111	2.4	PASS	PASS	0.0004	0.0167	2.1
33	0.0227	0.0111	204.4	FAIL	FAIL	0.0228	0.0167	136.5
34	0.0003	0.0105	3.1	PASS	PASS	0.0004	0.0157	2.9
35	0.0091	0.0105	86.7	PASS	PASS	0.0091	0.0157	58.0
36	0.0004	0.0099	4.0	PASS	PASS	0.0005	0.0148	3.6
37	0.0125	0.0099	126.8	FAIL	PASS	0.0126	0.0148	85.0
38	0.0002	0.0094	2.6	PASS	PASS	0.0004	0.0141	2.5
39	0.0191	0.0094	203.0	FAIL	FAIL	0.0192	0.0141	135.7
40	0.0003	0.0094	3.3	PASS	PASS	0.0004	0.0141	3.1

Power Source Verification Data

Harm No.	Harm. Value	Harm. Limit	% Of Limits	% Of Vfund	Result
2	0.0385	0.4600	8.4	0.017	OK
3	0.7069	2.0700	34.2	0.306	OK
4	0.0199	0.4600	4.3	0.009	OK
5	0.0308	0.9200	3.4	0.013	OK
6	0.0159	0.4600	3.4	0.007	OK
7	0.0403	0.6900	5.8	0.017	OK
8	0.0084	0.4600	1.8	0.004	OK
9	0.0207	0.4600	4.5	0.009	OK
10	0.0122	0.4600	2.7	0.005	OK
11	0.0222	0.2300	9.7	0.010	OK
12	0.0098	0.2300	4.3	0.004	OK
13	0.0171	0.2300	7.4	0.007	OK
14	0.0130	0.2300	5.6	0.006	OK
15	0.0080	0.2300	3.5	0.003	OK
16	0.0099	0.2300	4.3	0.004	OK
17	0.0203	0.2300	8.8	0.009	OK
18	0.0046	0.2300	2.0	0.002	OK
19	0.0099	0.2300	4.3	0.004	OK
20	0.0080	0.2300	3.5	0.003	OK
21	0.0104	0.2300	4.5	0.005	OK
22	0.0080	0.2300	3.5	0.003	OK
23	0.0047	0.2300	2.0	0.002	OK
24	0.0106	0.2300	4.6	0.005	OK
25	0.0067	0.2300	2.9	0.003	OK
26	0.0072	0.2300	3.1	0.003	OK
27	0.0181	0.2300	7.9	0.008	OK
28	0.0108	0.2300	4.7	0.005	OK
29	0.0085	0.2300	3.7	0.004	OK
30	0.0079	0.2300	3.4	0.003	OK
31	0.0098	0.2300	4.2	0.004	OK
32	0.0113	0.2300	4.9	0.005	OK
33	0.0095	0.2300	4.1	0.004	OK
34	0.0041	0.2300	1.8	0.002	OK
35	0.0044	0.2300	1.9	0.002	OK
36	0.0106	0.2300	4.6	0.005	OK
37	0.0056	0.2300	2.4	0.002	OK
38	0.0044	0.2300	1.9	0.002	OK
39	0.0114	0.2300	5.0	0.005	OK
40	0.0042	0.2300	1.8	0.002	OK

22. **Storing, Replaying & Analyzing data files**

The system stores data in either in ASCII format or “zipped” format. When a test is completed, the data file is either in ASCII or is converted to “zipped” format, in order to preserve disk space. The HFa functions as a data logger, so the ASCII files can be very big. For example, the harmonics and flicker test file in ASCII format can be several hundred Mega-bytes. Although hard disks are 1 Tera-Byte or 2 TB nowadays, i.e. can store 1000 files of 1 Giga-byte each, the “zipped” format compresses the test data by about a factor 5. Hence the typical hard drive of 1 TB can handle thousands of data files. Even a laptop PC with a 500 Giga-byte hard drive can store hundreds if not thousands of test files this way.

When the system is closed, and “zipped” data is selcted, it automatically deletes the large ASCII files, but keeps the zipped versions. The user can replay either ASCII or zipped files. The ZippedData as well as the RawData sub-directory are found under the C:\CNS\HFa directory.

The “zipping” process can take a minute or so, so sometimes Windows-10 will show a “not responding” message. In thatcase, just be patient and wait for the “zipping” to complete.

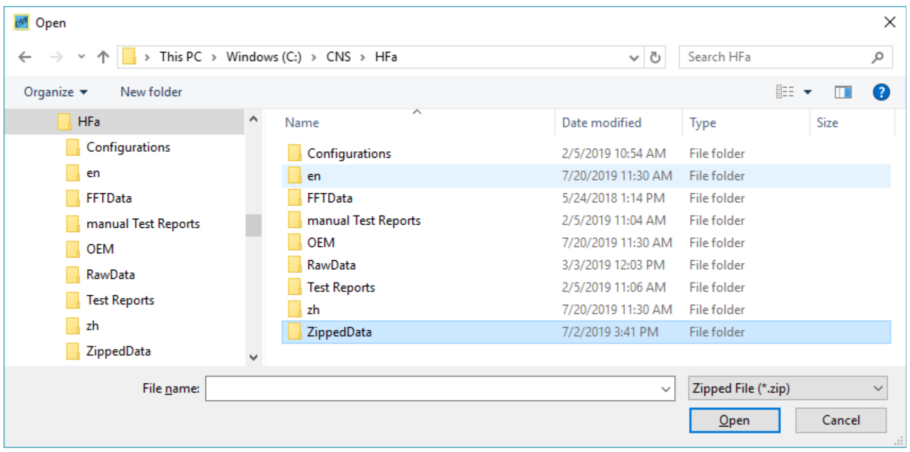


Figure 38 The ZippedData directory

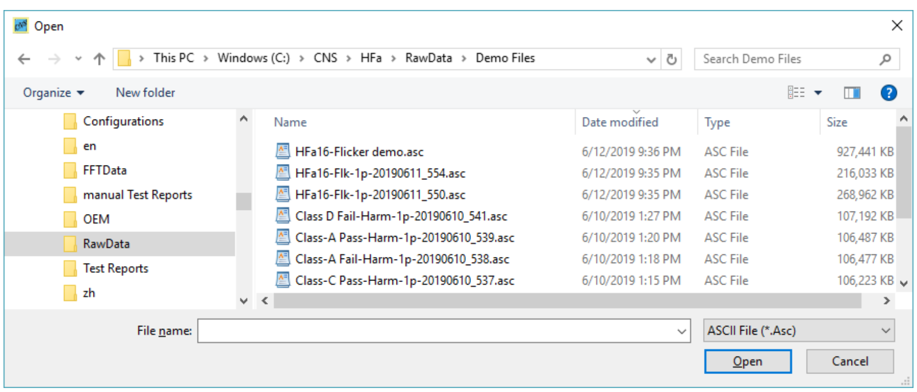


Figure 39 The RawData directory

To replay a file, click on “File” and then “Replay Test”, and then select the file to be replayed. Note that you can select either a Zipped File” or an ASCII file (see Figure 38, 39, & 40)

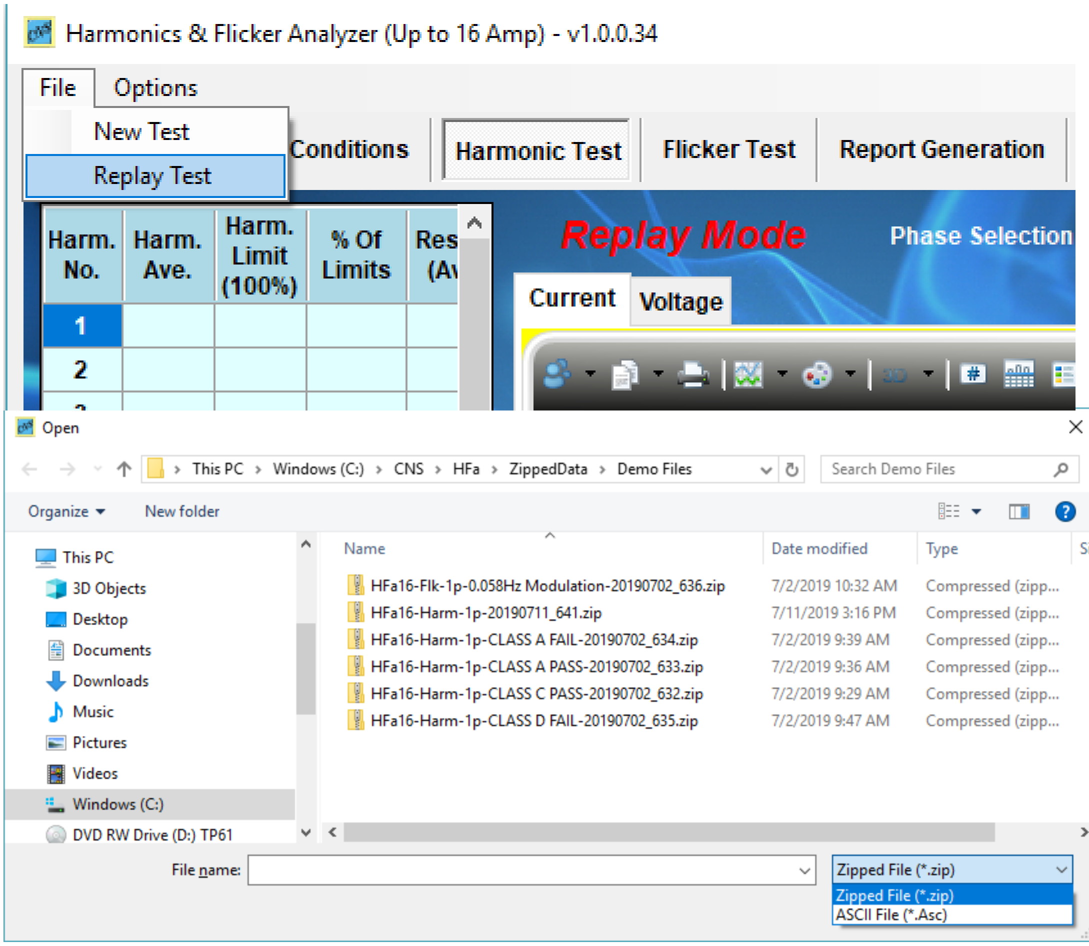


Figure 40 Selecting either a Zipped or an ASCII file type.

The replay mode is very powerfull, as it allows the user to look at unfiltered data for any 200 ms measurement window. For example, a product passes the Class-A test but the maximum value that is reported, shows brief excusions that are much higher than the average during the test. That situation is illustrated in Figure 41 and 42. The 1.5 second filter as specified in IEC 61000-4-7 will intentionally suppress brief excursions, and the average over the full observation period will “hide” brief excursions even more.

When replaying a data file, the same filtering and averaging are applied (Figure 41). But, if the user “steps back or forward” the unfiltered result of individual measurement windows are displayed, as the DFT and all calculations are based on the raw – unfiltered – 200 ms data. This allows the user to analyze and evaluate transient behavior of the equipment under test. For the illustrated case, some of the harmonics briefly exceed the limits, but the 1.5 sec filter “hides” this excustion unless it lasts long enough (normally at least 10 seconds or so). Also, the average at the end of the test may very well pass the limit. It will be clear that the user is served well with this detailed analysis capability.

Note that the user can step one 200 ms window forward or back, or ten windows.

Replay mode runs about twice as fast as an actual measurement. So, a 10 minute Flicker test will replay in 5 minutes, and so will a 10 minute harmonics test. The human eye can follow about 2 readings per second, so the “double speed” is about the optimum approach.

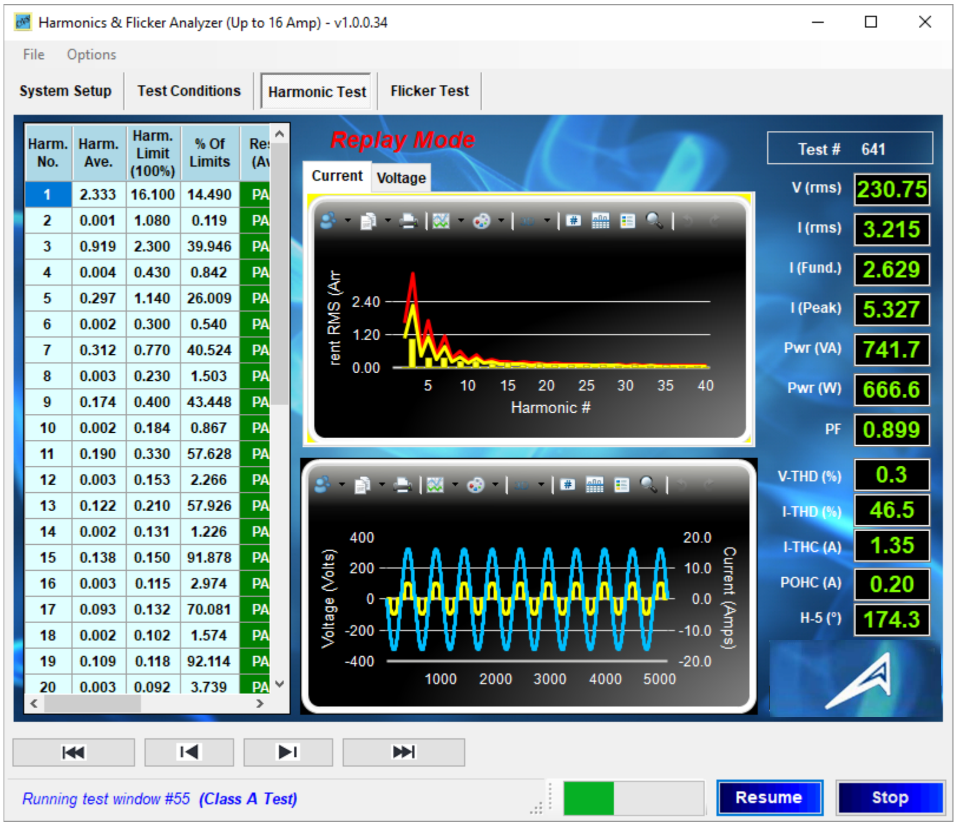


Figure 41 The 1.5 sec filtered data – averaged over the first 55 measurement windows of the test.

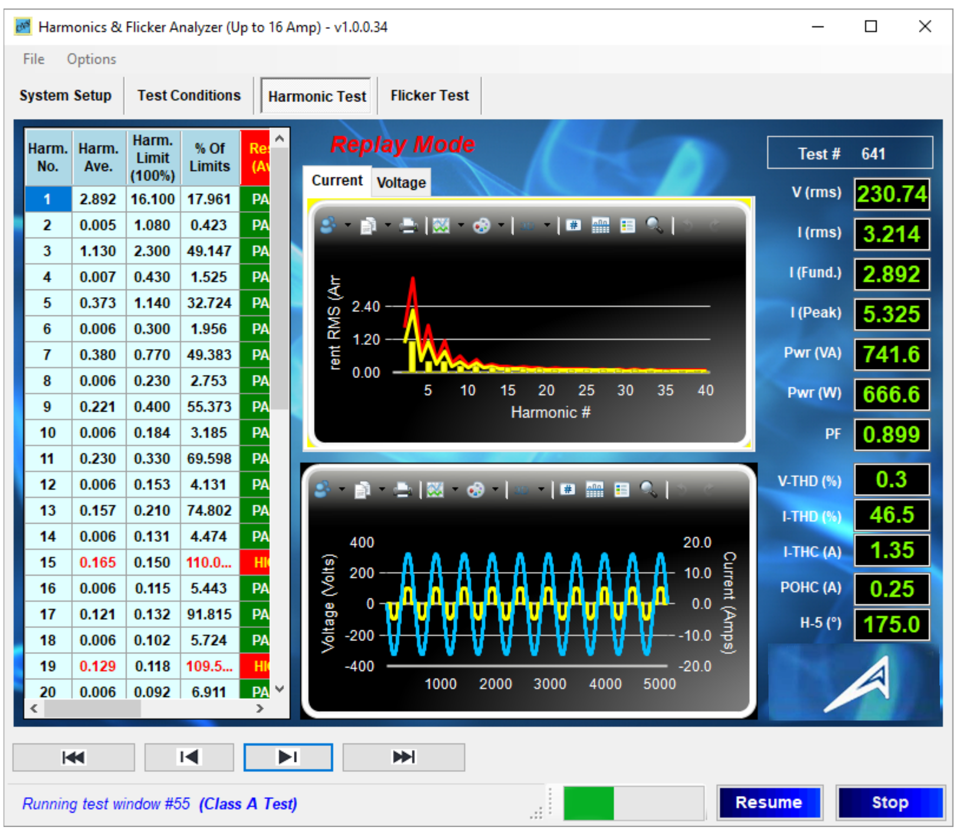


Figure 42 The same unfiltered measurement window # 55

This screen shot clearly shows the short excursion beyond the 100 % limit, which is averaged out as the test progresses.

"Stepping" to individual 200 ms measurement windows will show unfiltered data

This analysis capability is also beneficial when looking at transient behavior occurring during a Flicker test.

Figure 43 100 half cycles display

The instant during a Flicker test when a resistive load is turned "on"

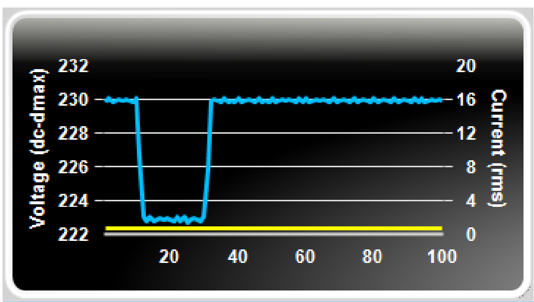


Figure 44 180 ms voltage drop-out

This copy of the graph shows the instant during a Flicker test when a voltage dip with a duration of 180 ms occurs.

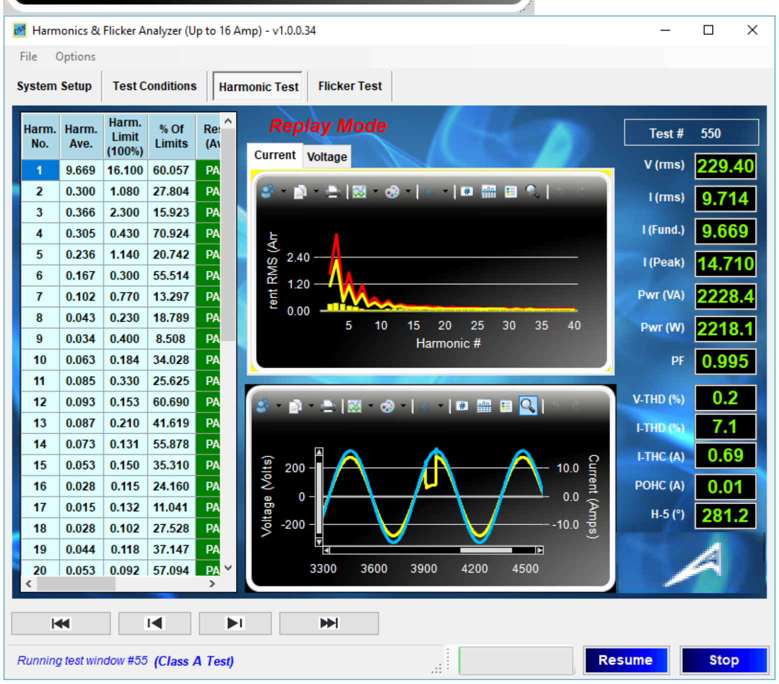


Figure 45 Short glitch

The instant where a brief glitch in the EUT current occurs (bottom graph – zoomed).

23. Some advanced user defined options

Selecting the IEC 61000- 3-2 standard revision for testing

There are some applications where the user may want to test to IEC 61000-3-2 Edition 3.2 (GB/T 14549 for China), instead of the presently valid edition 5.0 of the standard.

Edition 3.2 does not provide for some capabilities that are specified in Edition 5.0. These are;

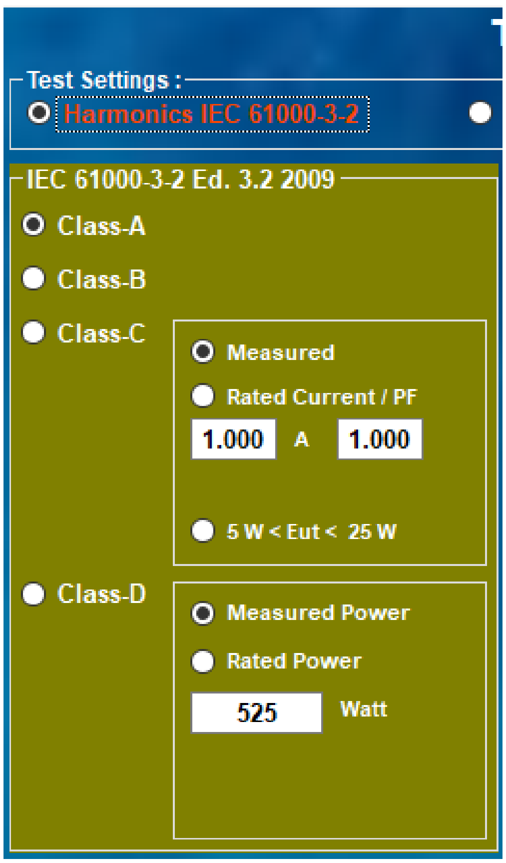
= The procedure and test option for VSD refrigerators is not specified in edition 3.2

= The procedure to test dimmers is not specified in Edition 3.2

= The third test method (generally called the THD test) for lighting products under 25 Watt (35 Watt for Japan) is not specified in Edition 3.2

The test settings are therefore different for IEC 61000-3-2 Ed. 3.2

Test settings for IEC 61000-3-2 Ed. 3.2



Test settings for IEC 61000-3-2 Ed. 5.1

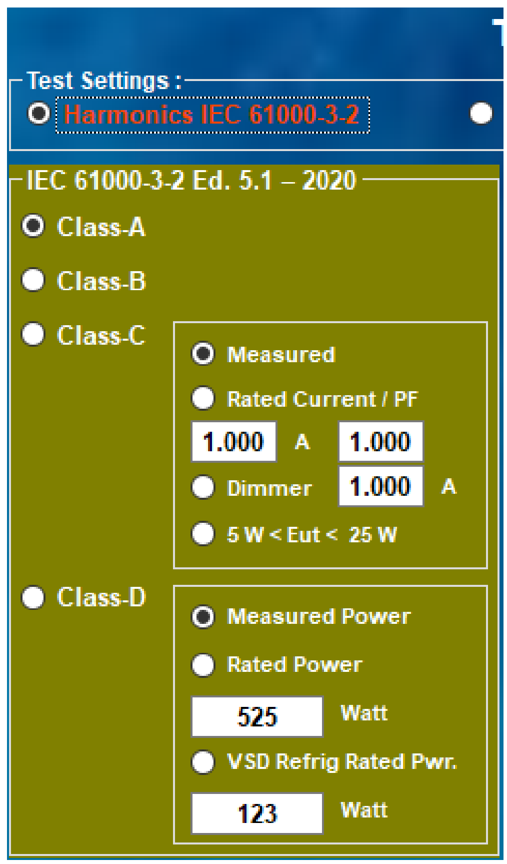


Figure 46 test settings for Ed. 3.2 and Ed. 5.1

The user can select which standard to test to as shown on the next page.

Selecting the IEC 61000-3-2/3 Editions to test to

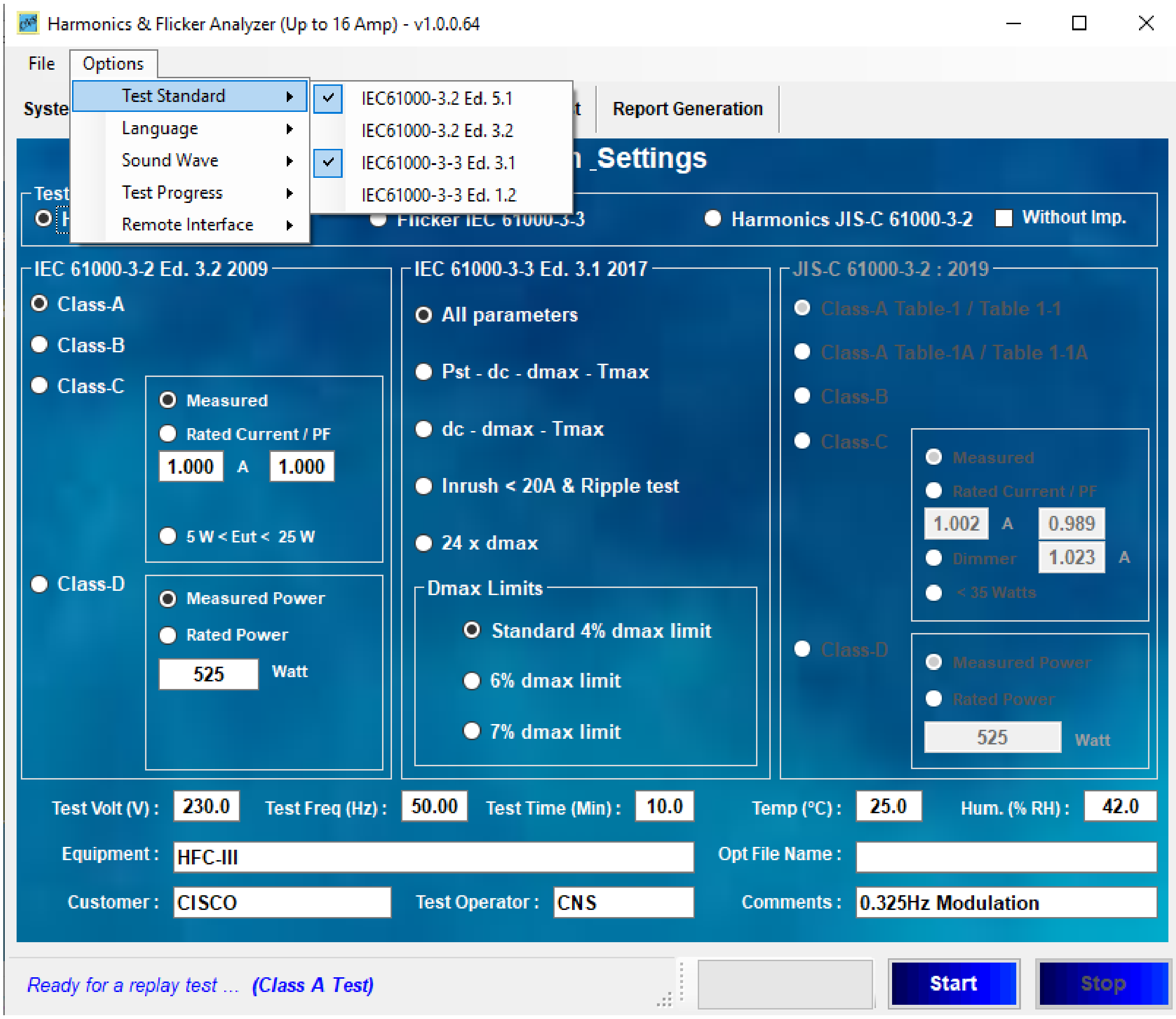


Figure 47 The Options tab on the menu has a selection for the test standard

Customizing the test report

There are several settings that the user can change to be specific for his/her application.

In the C:\CNS\Hfa\Test Reports\RTF\Templates\ is a Report Template file in “xml” format. The user can enter a name and other info that will appear as header is the test reports.

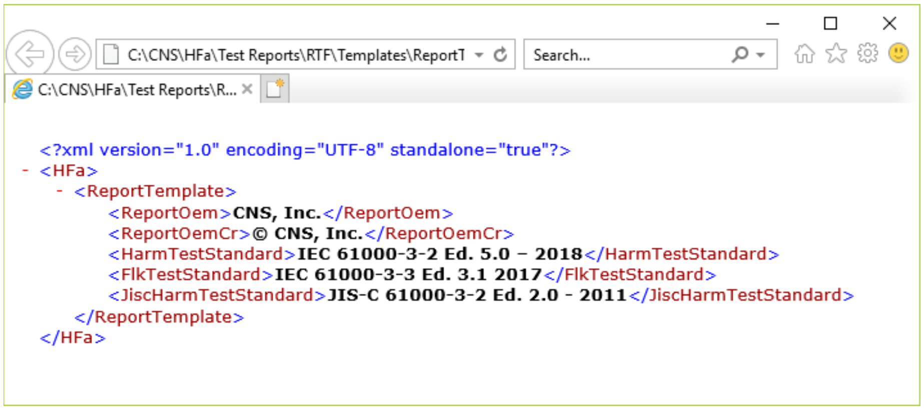
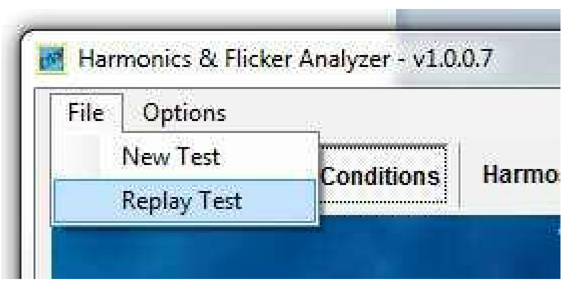


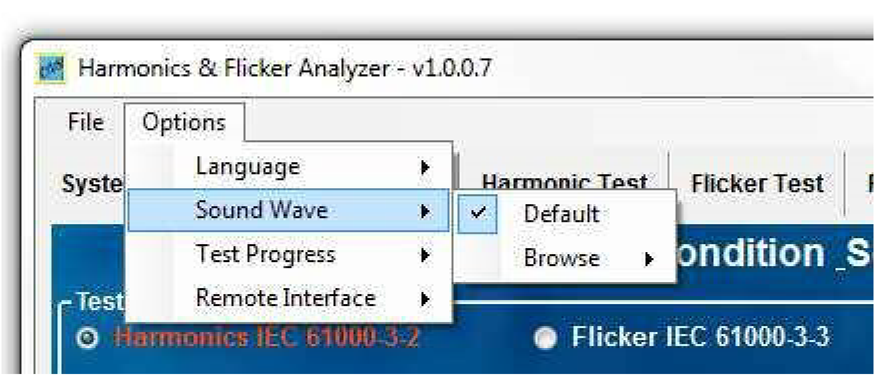
Figure 48 The report header template file

Selecting a file for replay



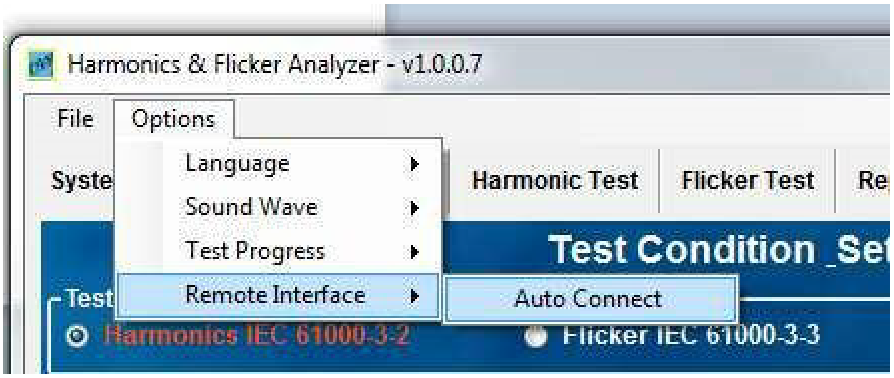
The user can select one of the demo files (used to generate this manual) and replay those files. These can be either “asc” files or “zip” files.

Selecting the sound file to play for PASS and FAIL conditions



The system has a couple default sound files that it will play when a test is finished. The user can change those files to play a specific tune.

Configuring the power source connection



The user can select "Autoconnect" which means that the software will "look" for the same PC interface that was defined earlier.

The alternate is to configure the interface when the system is turned "on" with the ability to select either serial, or GPIB connections as applicable to the selected power source.

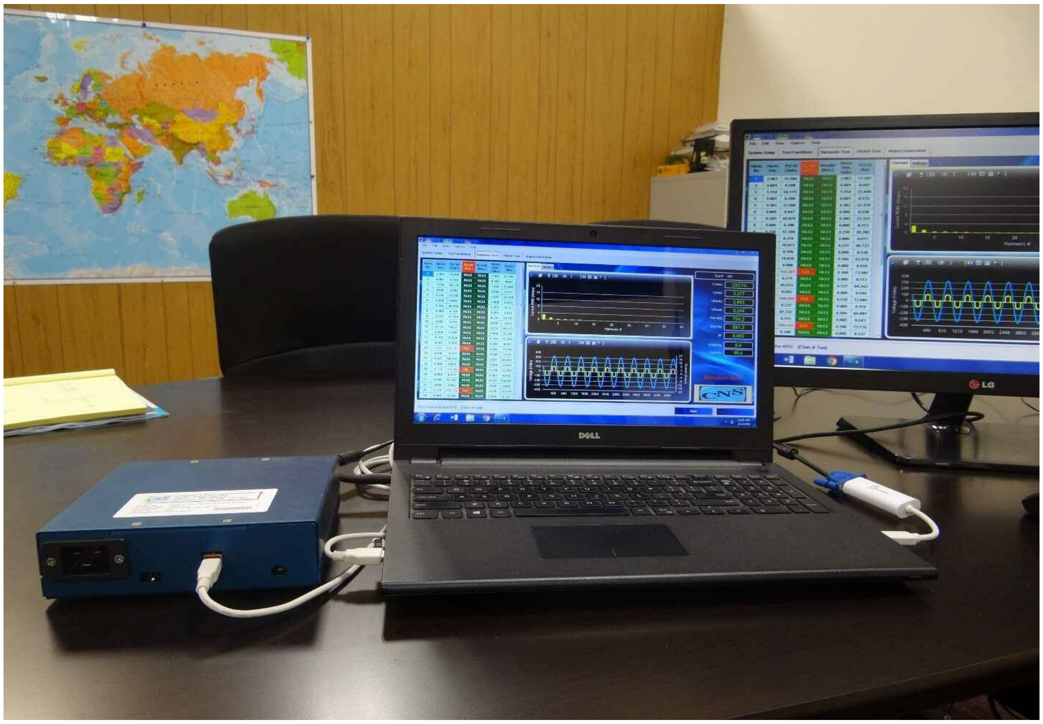


Figure 49 The small form factor HFA-1S box next to a laptop PC

Figure 50 The 19” form factor HFA-1/3-19 box front and rear panel

For assistance with the installation or operation of the HFA, you can contact ATEC.

at +1-800-404-2832, or e-mail to atecorp@atecorp.com

24. **Specifications for HFA-1-16S & HFA-1/3-16-19**

Electrical

Frequency range of fundamental line component; 45 – 65 Hz

Sampling method; PLL based with 512 samples/cycle (simultaneous per channel), or fixed frequency sampling

Harmonic analysis range; up to harmonic order 200 (10/12 kHz)

Harmonic spectrum display up to harmonic 40, can be selected to show 2 to 9 kHz

Voltage input range; 0 – 350 V-rms, ± 500 Volt peak std, 500 V-rms ± 700 V-peak optional.

Voltage measurement accuracy; 0.1 % + 10 mV, Voltage harmonics; 0.1 % + 0.1 % per 100 Hz + 5 mV

Current input range; 0 – 36 A-rms, 0- 100 A-pk for 10 seconds, 0 -100 A peak for HFa75.

Current measurement accuracy; 0.1 % + 5 mA in Phase-A, harmonics accuracy: 0.1 % + 0.02 %/100 Hz+5 mA

Power Factor range & accuracy; -1.000 – 0 - +1.000, +/- 0.003,

Power measurement: 1 – 15000 VA / 1 – 15000 Watt, per phase, measurement accuracy; 0.15% + 0.1 Watt

Phase measurement range; 0 – 360 °, Phase accuracy 50 – 2500 Hz; 0.2° + 0.2° per 100 Hz

EUT interface Standard version IEC plug for HFA-1/3S, Schuko and universal plug for HFA-1/3-19, plug-sleeve up to 40 A-rms or optional 75 A-rms for HFa75. Rear terminal block for up to 80 A-rms – 150 A-peak / phase

Optional IEC 60725 Reference Impedance or Z-test can be built-in (must be ordered separately).

Mechanical, input power & interface

19" rack version;16" x 3.5" x 22" (W x H x D). System comes with rack ears.

Weight; < 20 Lb (9 Kg) without optional Reference Impedance, 40 lb (18 Kg) with Reference Impedance

Input power; 100 – 240 Vac 50/60 Hz, max 50 Watt (70 Watt for models with built-in Reference Impedance)

PC interface; USB-2 or USB-3 compatible port, suitable for Windows-7-8-10.

Small form factor, 7" x 2" x 7" (W x H x D)

Weight; < 6 Lb (< 3 Kg)

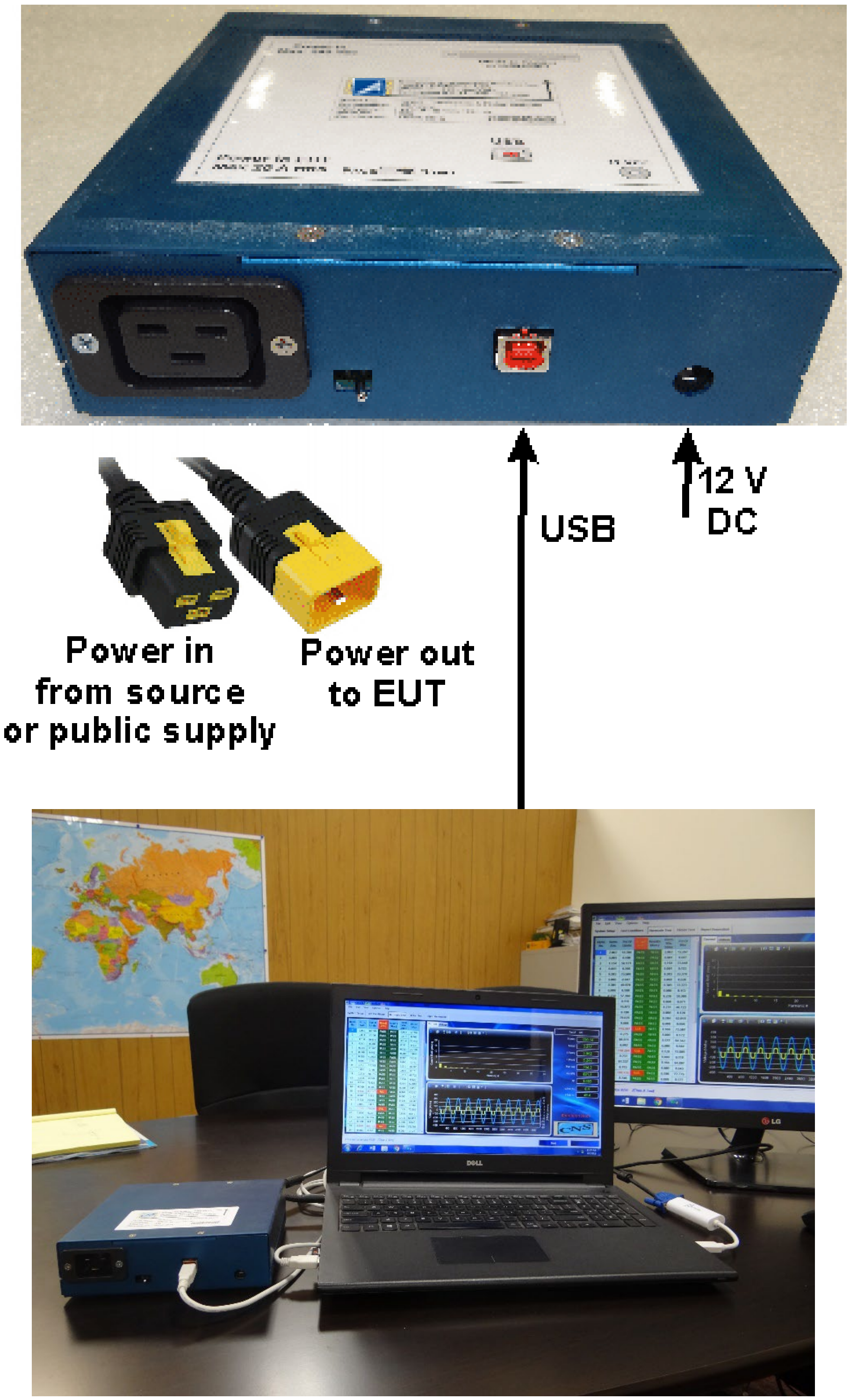
Input power; From 12 Volt Wall adapter (included with unit), max. 200 mA

PC interface; USB-2 or USB-3 port, suitable for Windows 7-8-10.

Software:

Fully compliant with latest editions of IEC 61000-3-2, IEC 61000-3-3, IEC 61000-3-11, IEC 61000-3-12, and measurement standards IEC 61000-4-7, IEC 61000-4-15. System can control power sources from most manufacturers.

25. **Typical hardware connections (1) HFa-1S**



The small form factor HFa-1S comes with IEC C19 V-lock connectors input and output cables.

The user connects the end of the “Power in” cable to the public supply or a suitable power source, and plugs the female connector into the HFa-1S.

Any voltage from100 – 240 Volt and either 50 Hz or 60 Hz can be used.

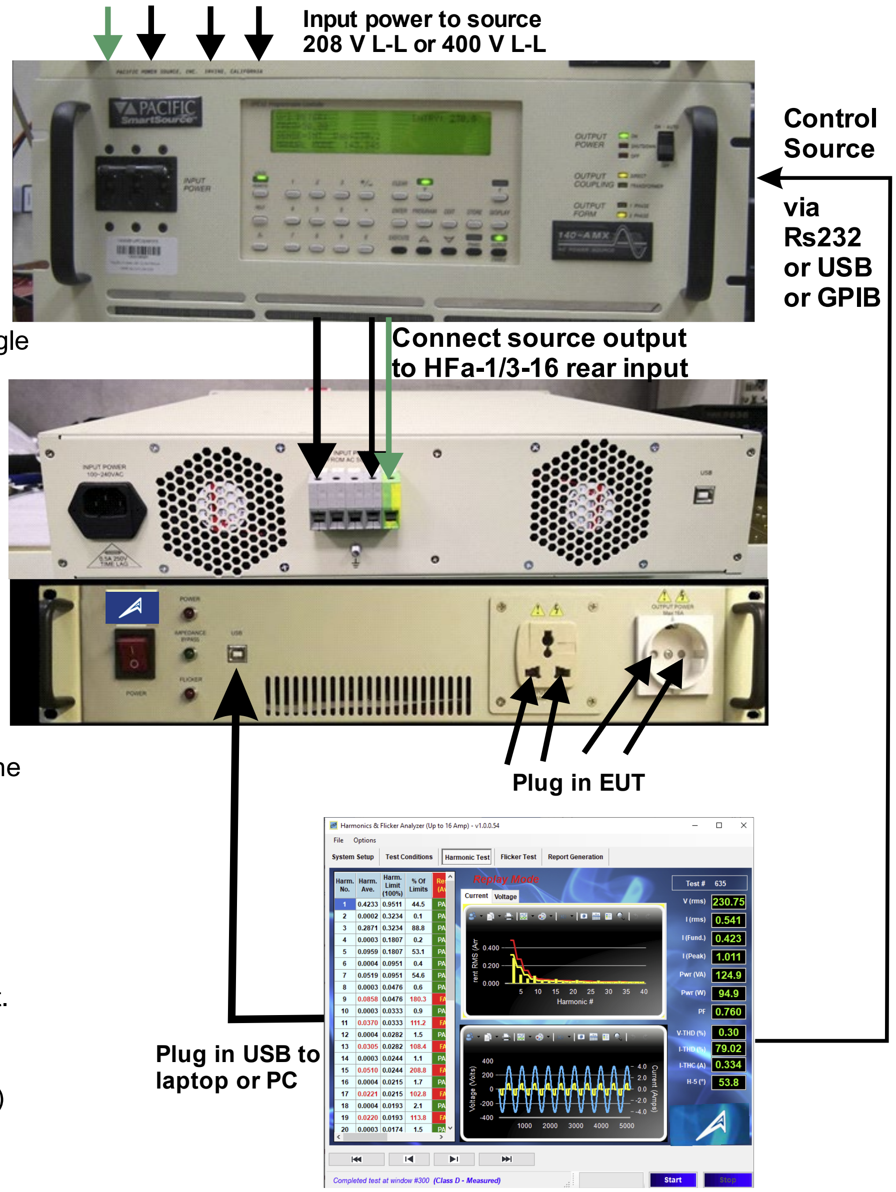
The Power out cable with male pins plugs into the other side of the Hfa-1S, and the user can connect the power to the EUT or a suitable outlet.

The picture below and to the left, shows the HFa-1S next to a laptop

26. **Typical hardware connections (2) Pacific Power©**

Provide input power to the power source, usually 3 phase 208 V L-L in the US, and 380 – 440 V L-L in many international markets.

Connect the source output voltage to the HFa-16 input. This can be single phase (Line-neutral and GND) or 3 phase for the HFa-3-16/40/75 (single phase shown)



Plug the equipment under test into the front outlet socket

Connect the USB connector of the Hfa to the laptop or PC USB port.

Connect the PC or laptop to the Power source via RS232 (COM port) GPIB, or USB depending on power Source type.

27. Typical hardware connections (3) Ametek©/Teseq©

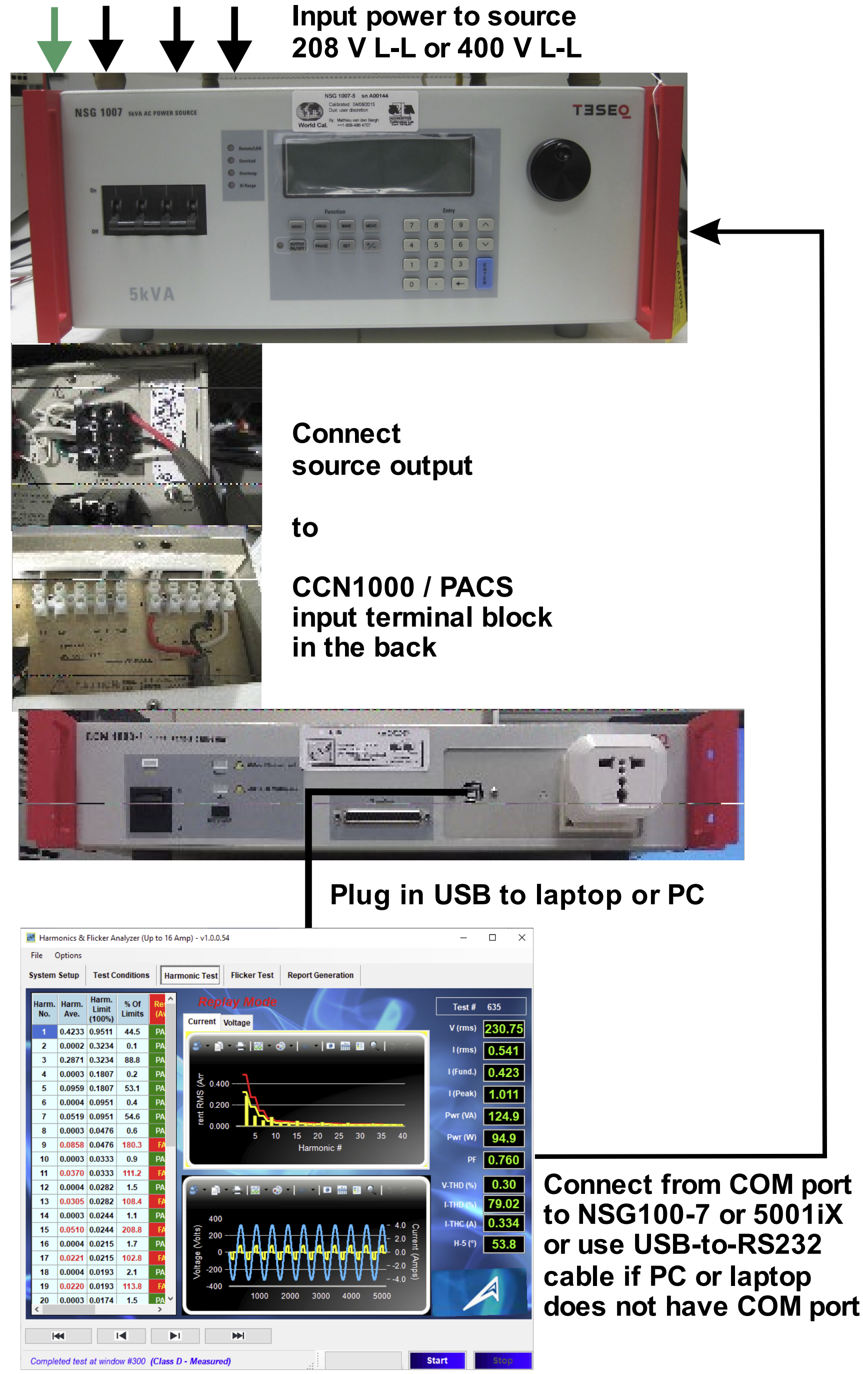
Provide input power to the power source, usually 3 phase 208 V L-l in the US, and 380 – 440 V L-L in many European and other international markets.

Connect the source output voltage (Line-Neutral-GND) to the CCN1000 (or PACS) or the HFa input terminals in the back of the chassis.

This can be single phase (Line-neutral and GND) or 3 phase for the HFa-3-16 and HFa-3-75 (single phase shown)

Plug the equipment under test into the front USB outlet socket (CCN1000 or PACS upgraded to HFa – USB ifc.

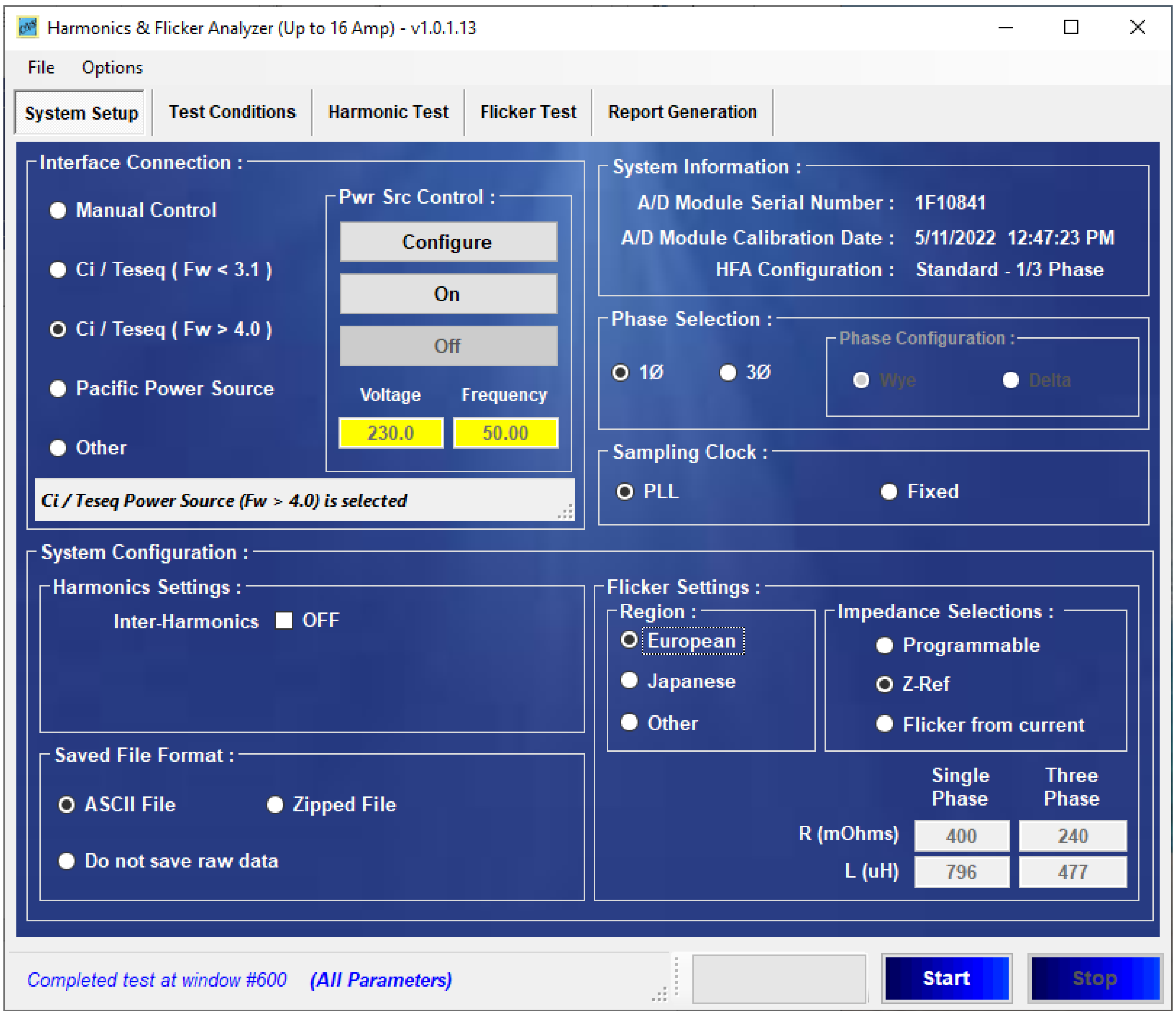
Connect the HFa - USB to the laptop or PC USB port. If power source control is desired, connect the PC or laptop to the power source.



28. Connecting California Instruments / Ametek©/Teseq©

For the example below, a Teseq/Schaffner power source NSG 1007-5 was used. The NSG1007-5 can have a product ID that calls out Schaffner (Teseq used to be part of Schaffner, before being spun out to Teseq, and before being acquired by Ametek).

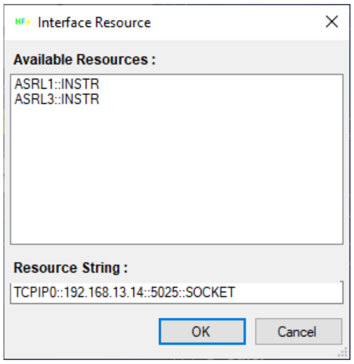
The same power source types with programmable impedance can be marketed under the California Instruments brand name as 3001iX (the 3 kVA version) or the 5001iX (5 kVA version). There are also the 10001iX, the 15003iX (3 phase 3 x 5 kVA) or NSG1007-15.



The user can configure the power source control – similar to the description in section 6 of this manual, but with a few additional settings.

Before starting the configuration, check the firmware version in the power source, and see if it is 3.03 or lower, or version 4.x or higher. The firmware version (and the model/serial number) of the source is displayed during power-up. In our example, the source has firmware version 4.3, and is identified as a “Schaffner” source.

The California Instrument/Teseq/Ametek source configuration steps

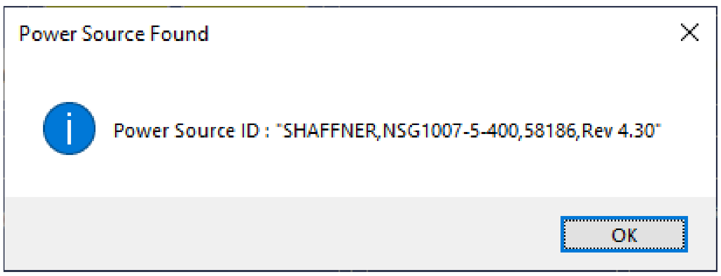


1: Click on the Configure button, which will bring up a small window as shown to the left.

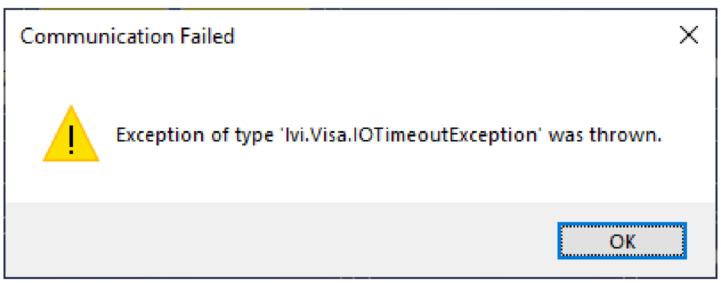
The VISA utility will identify each available resource.

In this example, the power source is connected via a RS232, serial, interface, and it is ASRL1, but that can be different for each system, i.e. it can be ASRL2, or 3, or 4.

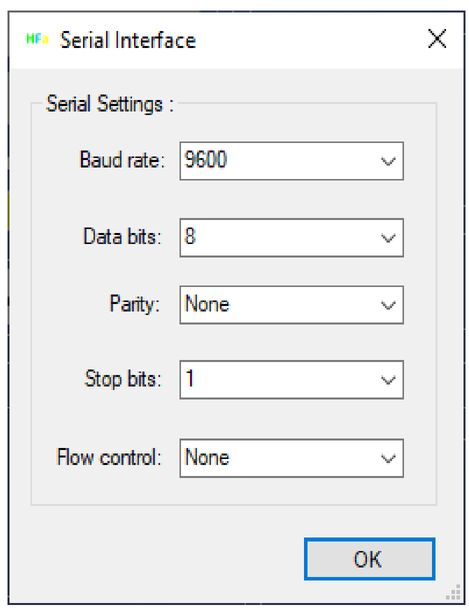
Click on what you believe is the right resource.



If you click on the right number, the software will recognize the power source, and show a little window as to the left, identifying the brand name, the source model, the serial number and the firmware version.



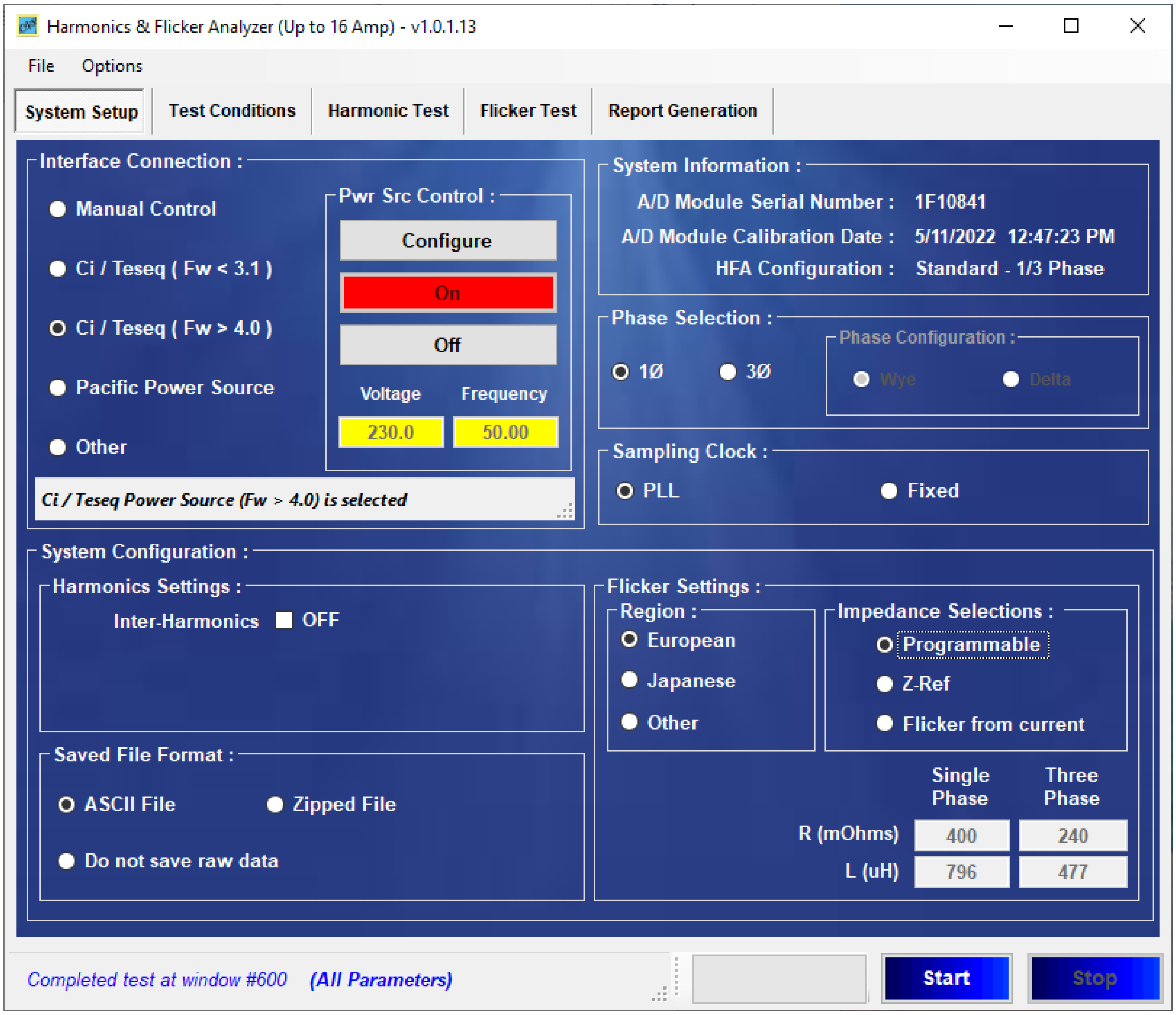
If you clicked on the wrong number, it will trigger a communication failure, showing an error as to the left, and you have to try a different number.



In this example, the power source was set to 9600 Baud, i.e. using the serial port communication of the power source. The interface setting is found under “UTILITY” (press MENU button several times) and select GPIB/RS232 SETUP.

Many users prefer 38400 baud or higher, and the HFa supports whatever speed the system PC and the power source can do.

So, you have to select the same settings for the serial interface in the HFa (the window will pop up).



After the serial communication is established, you can now turn the power source On/Off, and select the Programmable impedance for Flicker, as the Ametek / Teseq / California Instruments power sources have a programmable impedance. The impedance values are automatically programmed, but can be edited if so required.

The values are stored in a “xml” file, that is located in the C:\CNS\HFa16\Configurations\Flicker sub-directory. The content of the xml file are shown on the next page. In some cases the resistance can be set to less than the ideal 400 mΩ, to correct for long interface cables, or for a source that has drifted.

The programmable impedance in the power source includes an analog summation circuit with programmable (D/A) multipliers, and those can drift a bit over time. The correct way to fix the issue, is to make hardware adjustments, but the xml file can be edited as a temporary solution.

Flk_Impedance.xml - Notepad

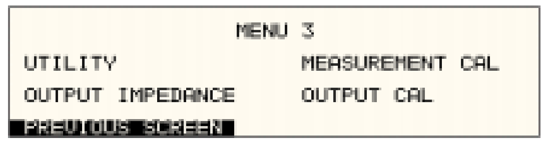
File Edit Format View Help


```
<?xml version="1.0" encoding="utf-8"
standalone="yes"?>
<Impedance>
  <EuropeanLimit1P>
    <Resistance>400</Resistance>
    <Inductance>796</Inductance>
  </EuropeanLimit1P>
  <EuropeanLimit3P>
        <Resistance>240</Resistance>
        <Inductance>477</Inductance>
  </EuropeanLimit3P>
  <JapaneseLimit1P>
    <Resistance>400</Resistance>
    <Inductance>370</Inductance>
  </JapaneseLimit1P>
  <JapaneseLimit3P>
        <Resistance>190</Resistance>
        <Inductance>230</Inductance>
  </JapaneseLimit3P>
  <Other1P>
    <Resistance>400</Resistance>
    <Inductance>796</Inductance>
  </Other1P>
  <Other3P>
              <Resistance>240</Resistance>
        <Inductance>477</Inductance>
  </Other3P>
</Impedance>
```


To the left is the xml file, that has the impedance values that will be sent to the power source, for Flicker testing.

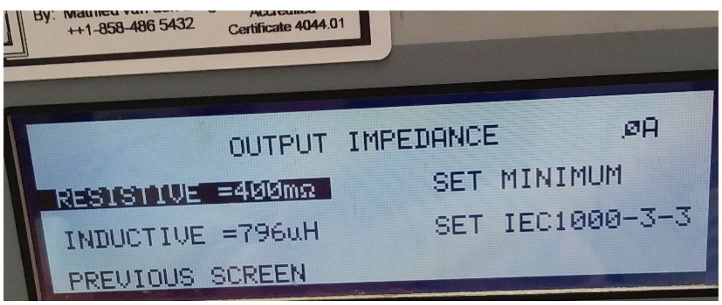
When running a Flicker test, the user can check the impedance via the source front panel.

Pressing the MENU button a couple times, will show MENU 3 on the source display, and one can select “OUTPUT IMPEDANCE”



When selecting OUTPUT IMPEDANCE, the display will be like below, after the HFa programs the source.

For harmonics testing, the HFa will set the source impedance to minimum. The values for minimum are usually less than 20 mΩ and less than 100 µH.



Also, if the user selects “Flicker from current” in the System Setup of the HFa, the power source will be programmed to minimum output impedance.

END of instructions for Ametek / Teseq / California Instruments power source configuration