Operation Manual

ECTS2 Series – Rev 1.11.0 P/N 160696-10

ECTS2 Series
EMC HARMONICS & FLICKER
TEST SYSTEMS

PACIFIC POWER SOURCE

Worldwide Supplier of Precision Programmable Power

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1 Contact Information

AMERICA / CANADA

Pacific Power Source
Irvine, USA
Phone: +1(949) 752-8400
Fax: +1 (949) 756-0838
Email: support@pacificpower.com

EUROPE

Pacific Power Source Europe GmbH.
Kappelrodeck, Germany
Phone: +49 7842 99722-20
Fax: +49 7842 99722-29
Email: support@pacificpower.eu

CHINA

PPST Shanghai Co. Ltd.
Shanghai, China
Phone: +86-21-6763-9223
Fax: +86-21-5763-8240
Email: support@pacificpower.com

Web: https://www.pacificpower.com

2 Warranty, Service & Safety Information

2.1 General Terms & Conditions

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2.2 Safety Information

This chapter contains important information you should read BEFORE attempting to install and power-up PPS Equipment. The information in this chapter is provided for use by experienced operators. Experienced operators understand the necessity of becoming familiar with, and then observing, life-critical safety and installation issues. Topics in this chapter include:

- Safety Notices
- Cautions
- Preparation for Installation
- Installation Instructions

Make sure to familiarize yourself with the **SAFETY SYMBOLS** shown on the next page. These symbols are used throughout this manual and relate to important safety information and issues affecting the end user or operator.

SAFETY SYMBOLS


Direct current (DC)


Alternating current (AC)

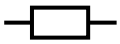

Both direct and alternating current

Three-phase alternating current


Protective Earth (ground) terminal

On (Supply)


Off (Supply)


Fuse


Caution: Refer to this manual before this Product.


Caution, risk of electric shock

2.3 Safety Notices

SAFETY SUMMARY

The following general safety precautions must be observed during all phases of operation, service, and repair of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the instrument. Pacific Power Source assumes no liability for the customer's failure to comply with these requirements.

GENERAL

This product is a Safety Class 1 instrument (provided with a protective earth terminal). The protective features of this product may be impaired if it is used in a manner not specified in the operation instructions.

ENVIRONMENTAL CONDITIONS

This instrument is intended for indoor use in an installation category I, pollution degree 2 environments. It is designed to operate at a maximum relative humidity of 95% and at altitudes of up to 2000 meters / 6560 feet. Refer to the specifications tables for the ac mains voltage requirements and ambient operating temperature range.

Keep all ventilation holes on the front and rear free from obstruction.

Do not operate or store under conditions where condensation may occur or where conducting debris may enter the cabinet.

BEFORE APPLYING POWER

Verify that the product is set to match the available line voltage and the correct fuse is installed.

GROUND THE INSTRUMENT

CAUTION

This product is a Safety Class 1 instrument (provided with a protective earth terminal). To minimize shock hazard, the instrument chassis or cabinet must be connected to an electrical safety ground. The instrument must be connected to the AC power supply mains through a properly rated three phase power cable with protective earth. Any interruption of the protective (grounding) conductor or disconnection of the protective earth terminal will cause a potential shock hazard that could result in personal injury.

FUSES

Only fuses with the required rated current, voltage, and specified type (normal blow, time delay, etc.) should be used. Do not use repaired Fuses or short circuit the fuse holder. To do so could cause a shock or fire hazard.

DO NOT OPERATE IN AN EXPLOSIVE ATMOSPHERE.

Do not operate the instrument in the presence of flammable gases or fumes.

KEEP AWAY FROM LIVE CIRCUITS.

Operating personnel must not remove instrument covers. Component replacement and internal adjustments must be made by qualified service personnel. Do not replace components with power cable connected. Under certain conditions, dangerous voltages may exist even with the power cable removed. To avoid injuries, always disconnect power, discharge circuits and remove external voltage sources before touching components.

DO NOT SERVICE OR ADJUST ALONE.

Do not attempt internal service or adjustment unless another person, capable of rendering first aid and resuscitation, is present.

DO NOT EXCEED INPUT RATINGS.

The inputs are rated at 1kVpeak or 500V rms. Do not exceed the rated input.

MAINS POWER DISCONNECT

CAUTION

The AC input connections must include a disconnect device (an external switch or circuit-breaker) as part of the installation. The disconnect device must be suitably located and easily reached and must be marked as the disconnecting device for the equipment. The disconnect device must disconnect all line conductors simultaneously.
An external overcurrent protection device must be provided (by, e.g., fuses or circuit breaker). The breaking capacity of the overcurrent protection device should be compatible with the current rating of the installation.
A minimum of basic insulation is required between mains-connected parts of opposite polarity on the supply side of the overcurrent protection device.
Overcurrent protection devices shall not be fitted in the protective conductor. Fuses or single pole circuit-breakers shall not be fitted in the neutral conductor of multi-phase equipment.

DO NOT SUBSTITUTE PARTS OR MODIFY INSTRUMENT.

There are no user serviceable parts inside the instrument – do not attempt to open the instrument, refer service to the manufacturer or his appointed agent.

Because of the danger of introducing additional hazards, do not install substitute parts or perform any unauthorized modification to the instrument. Return the instrument to an Pacific Power Source Sales and Service Office for service and repair to ensure that safety features are maintained.

Instruments that appear damaged or defective should be made inoperative and secured against unintended operation until they can be repaired by qualified service personnel.

AIRFLOW

CAUTION

This equipment is air cooled using forced air fans. Air intake is in the front of the unit or cabinet and is exhausted at the back. When installing this equipment, make sure all front panel air intake vents and rear panel exhaust vents are unobstructed and there is at least 2 feet / 60 cm of clearing at the back of the unit or instrument rack. When installed in a 19" width instrument rack, make sure front and rear airflow remains unobstructed. Do not use solid front or rear panels or doors on 19" racks.

3 Product Overview

This chapter describes the general features of the PPS ECTS2 Series Harmonics and Flicker Measurement Modules (HFMM) and associated HFa Harmonics and Flicker Windows Software. It introduces the reader to general operating characteristics of these measurement devices.

3.1 User Manual and HFa Software Versions

This manual covers HFa Software releases for ECTS2 Systems up to Version 1.0.0.0. Newer software and or new user manual releases may be available since this manual was published. Check with Pacific Power Source web site Technical Resources section for any available updates. https://tr.pacificpower.com/

3.2 General Description

The PPS HFa measurement modules contain all the signal conditioning and data acquisition hardware required to accuracy measure voltage, current and power on up to three phases.

Optionally, the required IEC 60725 lumped flicker impedance is built-in to the LFZ chassis. For single-phase ECTS2 systems, the LFZ-1 contains a flicker impedance rated for 16 Arms current. For three-phase ECTS2 systems, LFZ-3 impedance chassis are available in different current ratings up to 75 Arms per phase.

All measurements, data processing and analysis, display and reporting is performed by the HFa (Harmonics & Flicker Analyzer) software that runs on the Windows Operating system.

The HFMM is controlled by the HFa software using a simple USB-2 or USB-3 connection. This means no PCI bus PC is required to operate the ECTS2 systems as a Windows laptop with a USB port is all that is required.

3.3 Product Features

The following features and functions are supported by the ECTS2 Compliance Test Systems:

- Emissions Tests:
  - IEC 61000-3-2 Harmonics Emissions
  - IEC 61000-3-12 Harmonics Emissions
  - IEC 61000-3-3 Flicker Emissions
  - IEC 61000-3-11 Flicker Emissions
- Optional Immunity Test Software:
  - IEC 61000-4-11
  - IEC 61000-4-13 (Option1)
  - IEC 61000-4-14
  - IEC 61000-4-17
  - IEC 61000-4-27
  - IEC 61000-4-28

  - IEC 61000-4-29 (Pre-compliance only)
  - IEC 61000-4-34
- Optional Avionics Test Software:
  - RTCA/DO160, Section 16
  - MIL-STD 704
  - Airbus ABD0100.1.8 (A380)
  - Airbus ABD0100.1.8.1 (A350)
  - Airbus AMD24C (A400M)
  - Boeing 787B3-0147
- Single or Three Phase Configurations
- ISO17025 Certified Calibration Available
- New, Advanced Second Generation Harmonics & Flicker Measurement System
- Extensive Data Reporting
- Easy to Use Windows Software
- Choice of Lumped Impedance Networks

3.4 IEC Test Standards Editions Supported

IEC Test standards are revised from time to time and new editions are issued by the IEC Technical Committee on a regular basis. Pacific Power Source updates it ECTS2 test system software as needed when new standard editions are published. This is an ongoing process so you should stay in touch with your PPS reprehensive to stay informed of any important software updates. As of the publication of this manual version, the standards editions listed in the table below are supported.

Supported Version	Edition	Date of Publ.
IEC 61000-3-2:2018 RLV	5.0	2018-01-26
IEC 61000-3-3:2013+AMD1:2017 CSV	3.1	2017-05-18
IEC 61000-3-11:2017 RLV	2.0	2017-04-21
IEC 61000-3-12:2011	2.0	2011-05-12
IEC 61000-4-7:2002+AMD1:2008 CSV	2.1	2009-10-28
IEC 61000-4-15:2010 RLV	2.0	2010-08-24
IEC TR 60725:2012	3.0	2012-06-27
IEC 61000-4-11:2004+AMD1:2017 CSV	2.1	2017-05-18
IEC 61000-4-13:2002+AMD1:2009+AMD2:2015 CSV	1.2	2015-12-14
IEC 61000-4-14:1999+AMD1:2001+AMD2:2009 CSV	1.2	2009-08-12
IEC 61000-4-17: IEC 61000-4-17:1999+AMD1:2001+AMD2:2008 CSV	1.2	2009-01-28
IEC 61000-4-27:2000+AMD1:2009 CSV	1.1	2009-04-07
IEC 61000-4-28:1999+AMD1:2001+AMD2:2009 CSV	1.2	2009-04-07
IEC 61000-4-29:2000 (pre-compliance only)	1.0	2000-08-30
IEC 61000-4-34:2005+AMD1:2009 CSV	1.1	2009-11-26
IEC TR 61000-4-37:2016	1.0	2016-01-07
IEC TR 61000-4-38:2015	1.0	2015-08-24

Table 3-1: IEC Test Standards and Editions Supported

3.5 Principle of Operation

The HFMM analyzer and impedance modules is places between the output of a programmable AC source and the equipment to be tested for compliance to IEC 61000-3-2, IEC 61000-3-12 (Harmonics) and IEC 61000-3-3 / IEC 61000-3-11 (Flicker).

The power source is programmed to supply the exact voltage and frequency called out in the test standard.

For flicker testing, the lumped impedance in the ECTS2 test system is engaged during flicker testing. During Harmonics testing, the lumped impedance is bypassed so it is out of the circuit.

The user can configure specific test selections and durations as required by IEC 61000-3 product standards and save these settings for future use as needed.

Test run autonomously requiring no operator intervention. During the test, intermediate results are displayed providing an early indication if the EUT will pass or fail. This can save time as the operated can abort a potential two-hour long test early if is becoming clear the EUT will not pass.

3.6 Accessories Included

The following accessories are included with each ECTS2 Series Power Analyzer. If one or more of these is missing upon incoming inspection of the product, please contact Pacific Power Source customer service.

Item	Quantity
AC Line Cord	1
Interface Cables - USB	1
Software	CD ROM or Download from Pacific Power website
Documentation in PDF Format	Download from Pacific Power website

Table 3-2: Included Accessories

CAUTION

DO NOT replace the included detachable AC Line cord with an inadequately rated line cord. Line cord used must meet or exceed voltage and current ratings as specified in section 4.5, page 20.

3.7 Remote Control Interfaces

Following remote control interfaces are standard on the ECTS2 Series.

Standard Interfaces – LFZ Chassis	
USB Interface	Control Interface
Standard Interfaces – AC Power Source	
Power Source	Varies by power source model. See relevant Power Source Manual

Table 3-3: Available Remote Control Interfaces

3.8 Flicker Impedance Mode Settings

The 40A and 75A Impedance modules are equipped with a mode selection switch that allows selection between two modes of operation:

ECTS Mode In this mode, the R and L elements of the Phases and Neutral impedance modules are adjusted and calibrated at the factory so the overall system impedance of AC source, wiring, connectors and terminal blocks plus the lumped impedance matches the values call out in the IEC 60725 Flicker Impedance standard. This mode should always be used on ECTS2 EMC test systems.

IEC Mode In this mode, the R and L elements of the impedance are set to the exact values call out in the IEC 60725 Flicker Network Impedance standard. In this mode, no compensation is made for system wiring and the output impedance of the AC power source used in the EMC Test System. This mode is not recommended.

The mode selection switches for each impedance element can be access by removing the read panel of the ECTS2 cabinet. The red toggle switch is located at the top rear panel of each impedance module – Phase A, B, C and Neutral. The I (ON) switch position corresponds to the ECTS mode, the O (OFF) switch position corresponds to the IEC mode.

Refer to Figure 3-1 on the next page for Mode Selection switch locations. Examples shown are for the 16 Amps LFZ-3-16 and the 75 Amps LFZ-3-75 Impedance.

Figure 3-1: LFZ-3-16 Flicker Impedance Mode Selection Switch Locations

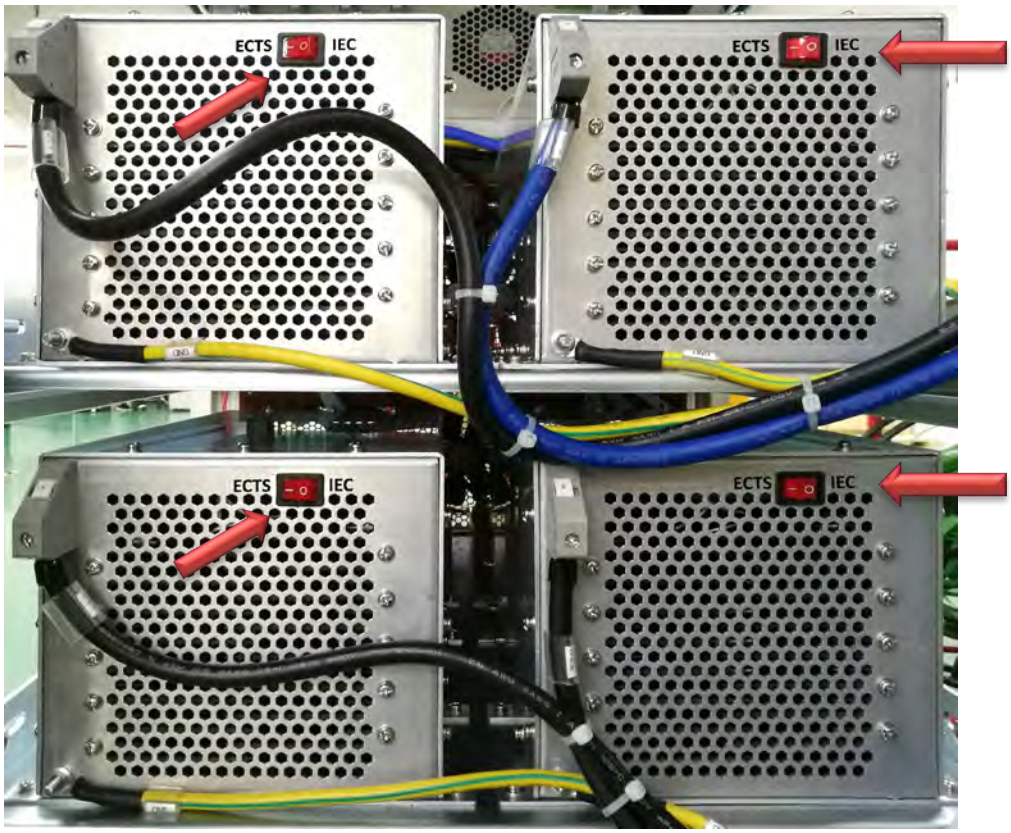


Figure 3-2: LFZ-3-75 Flicker Impedance Mode Selection Switch Locations

4 Technical Specifications

Technical specifications shown here apply at an ambient temperature of 25° C ± 5°.

4.1 Measurements

MEASUREMENT SPECIFICATIONS - HFMM		
Frequency		
Fundamental Frequency Range	45 Hz - 65 Hz	
Measurement Bandwidth	5 Hz - 20 kHz	
Resolution	0.05 Hz < 100 Hz	
Accuracy	0.01 %	
Voltage	**HFMM-1**	**HFMM-3**
No Inputs	1	3
Ranges	+/- 500Vrms (1000V pk-pk)	
Accuracy	0.1 % Rdg + 10 mV	
Current	**HFMM-1**	**HFMM-3**
Internal CT's	1	3
CT Rating	± 50 A pk	±150 A pk
Range	Multiple Ranges, Auto-select	Multiple Ranges, Auto-select
Accuracy	0.1 % Rdg + 3 mA	
Phase		
Range	0.00° - 359.99°	
Accuracy – 50Hz to 2500Hz	0.2° + (0.2° per 100Hz)	
Power		
Range	18 kVA / 18 kW	37.5 kVA / 37.5 kW per phase
Accuracy	0.15 % + 0.1 W	0.15 % + 0.5 W
Power Factor		
Range	-1.000 ~ 0 ~ +1.000	
Accuracy	± 0.002	
Crest Factor		
Range	2 - 20 depending on rms input level	
Other		
IEC Modes	IEC 61000-3-2, IEC 61000-3-3, IEC 61000-3-11, 61000-3-12 (Harmonics & Flicker)	
Application Modes	Fluctuating Harmonics, Flicker Meter, Standby Power, Inrush	

4.1.1 Current Measurement for Class C Product Tests

For lighting product test requirements, load currents will be very low as the power limit is 25W so at 230Vac, the rms current is in the order of 100 mA or less.

To support this, the HFMM current measurement design uses multiple current ranges that are active simultaneously. Thus, no current range chances are made during test runs to support no-gap measurements.

For low current measurements, the lowest range applies which is ± 5.0 A_{peak}, the highest range being ± 50 A_{peak} on the HFMM-1.

There is generally about 1 to 2 mA rms background reading, but less than 1.0 mA coherent noise error. At 20 mA rms load current, the resulting overall rms reading from a 2.0 mA rms-noise level is 20.1 mA.

The synchronous (fundamental or multiple signal) background reading of 1 mA is negligible above 10 mA yielding ann overall reading of (10 mA^2 + 1 mA^2)^0.5 = 10.05 mA.

Thus the error for any load power level above 5 VA (5 / 230 = 21.7 mA) is negligible.

Note that the HFMM-3 uses a ± 10 A_{peak} very low current range on phase A. The B and C phases do not have this very low current measurement range.

Thus, even though the overall current error might be slightly higher for low wattage applications, it is still very small and well within the IEC measurement requirements. Refer to sections 6.9.1 through 6.9.3 for examples of a low power class C product tests.

4.2 IEC Standard Compliance

4.2.1 Harmonics Measurements

IEC COMPLIANCE- HARMONICS	
Harmonics	
Fundamental Frequency (f_1)	50Hz or 60Hz
Harmonics Spectrum Display	2nd through 40th Harmonics (Expandable to 9 kHz)
Harmonic Analysis Range	Up to 200 Harmonics (10 kHz @ 50Hz / 12 kHz @ 60Hz)
Sampling Method	Phase Locked Loop, 512 Samples / period or fixed Frequency Sampling
Harmonics Accuracy	
Voltage	0.1 % + 0.1 % per 100 Hz + 5 mV
Current	0.1 % + 0.02 %/100 Hz+5 mA
Interharmonics	Conforms to IEC 61000-4-7
Sampling Rate	@50Hz: 25600 Hz / @60Hz: 30720 Hz
Interharmonic Resolution	5 Hz. DFT performed every 200 msec.
Smoothing Filter	1.5 sec per IEC Standard
Measurement Bandwidth	Anti-aliasing at 5kHz, > 60dB Attenuation of signals at 5 kHz is > 80 dB
Band pass Ripple	< 2.5% below 2.5 kHz < 2.0 % below 10 kHz

4.2.2 Flicker Measurements

IEC COMPLIANCE- Flicker		
Flicker		
Pst	Range	0.030 - 4.000
	Resolution	0.001
	Accuracy	3.0 %
	Integration Time	10 mins
Psti	Meaning	Instantaneous Pst value integrated over elapsed test time
	Specs	Same as Pst
Plt	Range	0.030 - 4.000
	Resolution	0.001
	Accuracy	3.0 %
	Integration Time	120 mins, 12 Pst intervals Note: Plt can be calculated over shorter periods if the EUT operation cycle is shorter than 2 hours. In those cases, the "missing" Pst values are deemed to be zero.

IEC COMPLIANCE- Flicker		
Dmax	Range	0.2 % - 100 % Note: The EUT is considered to be in steady state if the voltage remains within +/- 0.2 %, and as the "dmax" is referenced to the steady state, there is no "dmax" until the 0.2 % boundary has been exceeded.
Dc	Range	0.2 % - 100 %
Dt	Range	0.2 % - 100 %
Measurement Bandwidth	Anti-aliasing at 5kHz, > 60dB Attenuation of signals at 5 kHz is > 80 dB	
Band pass Ripple	< 2.5% below 2.5 kHz < 2.0 % below 10 kHz	

4.3 Data Logging

DATA LOGGING	
Functions	Voltage, Current, Power, VA, Harmonics, Interhamonics
Data log Window	Complete test cycle.
Memory	Stored to PC Hard Drive

4.4 Control Interface

ANALOG & DIGITAL I/O	
USB	USB device – 2.0 and 1.1 compatible

4.5 AC Input

AC INPUT	LFZ-x-16	LFZ-x-40	LFZ-x-75
Input Voltage	100 ~ 240 Vac ± 10%	100 ~ 240 Vac ± 10%	100 ~ 240 Vac ± 10%
Input Current	1 A	3 A	3 A
Internal Fuse Rating	2 A @ 250Vac	4 A @ 250Vac	4 A @ 250Vac
AC Input Connector	IEC-14		
Power Factor	0.98		
Detachable Line Cord	IEC C13, 300/500V, 3 * 1.0 mm²		
Frequency	50 / 60 Hz ± 3Hz		

4.6 Dimensions & Weights - LFZ Chassis

DIMENSIONS & WEIGHT		
Phase Mode	**HFMM-1**	**HFMM-3**
Models	**LFZ-1-16**	**LFZ-3-16**
Dimensions (H x W x D)	89 x 482.6 x 552 mm / 3.5” x 19” x 20.6” excl. rack handles 89 x 425 x 552 mm / 3.5” x 16.7” x 20.6” incl. rack handles	
Weight net	11.5 kg / 25.4 lbs	15.5 kg / 34.2 lbs
shipping	18 kg / 40 lbs	22 kg / 48.5 lbs
Models	**LFZ-3-40**	**LFZ-3-75**
Dimensions (H x W x D)	312 x 482.6 x 620 mm / 12.25” x 19” x 24.4” 312 x 432 x 620 mm / 12.25” x 17” x 24.4”	Rack Panel Height: 10U 444.5 mm / 17.5”
Weight net	38.5 kg / 84.9 lbs	
shipping	48 kg / 106 lbs	
19” Rack Mount Models	Removable Rack Handles Included	

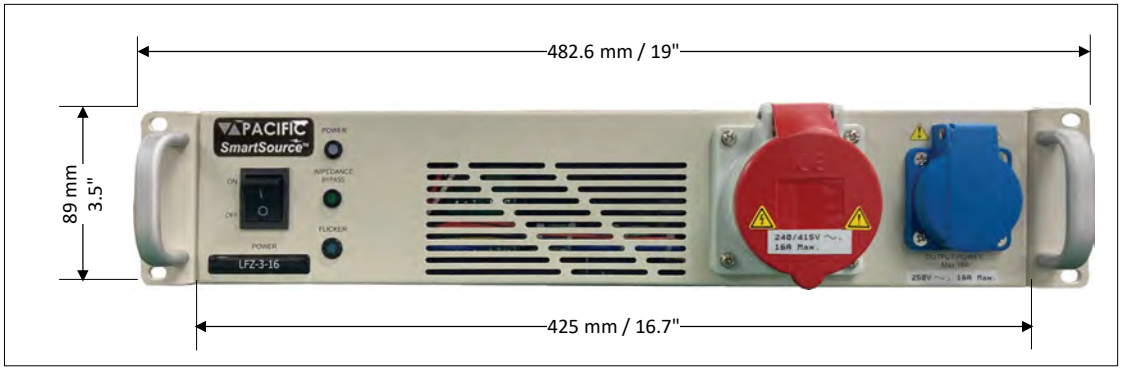


Figure 4-1: Dimension Drawing LFZ-3-16 Chassis

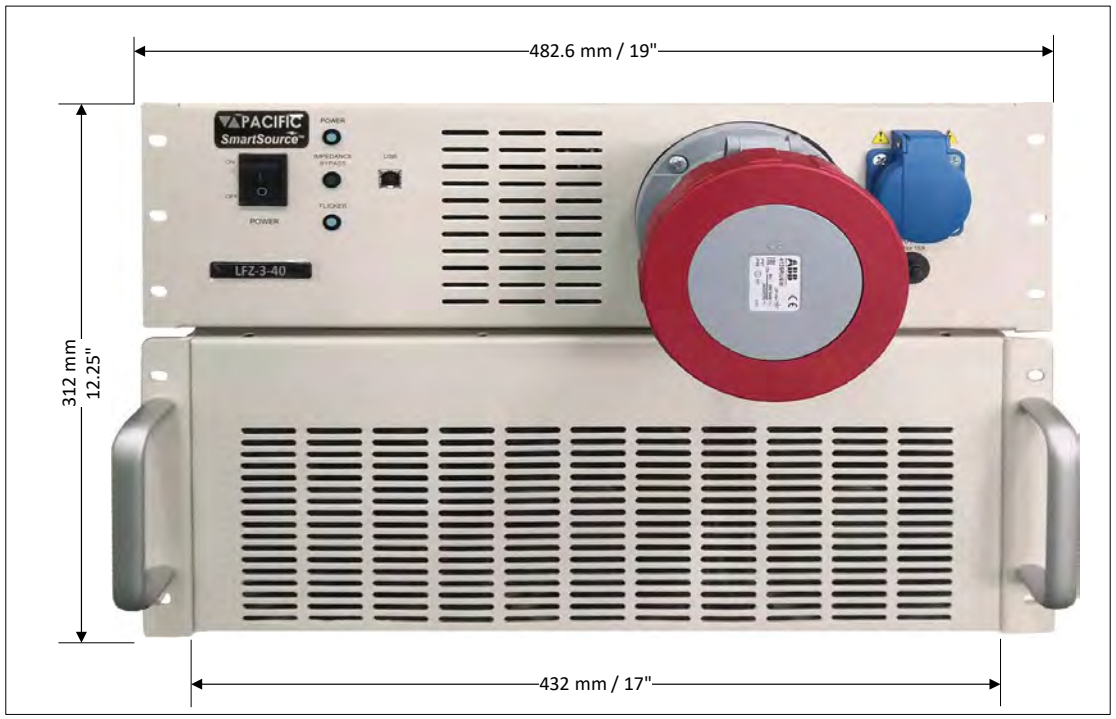


Figure 4-2: Dimension Drawing LFZ-3-40 Chassis

4.7 Environmental

ENVIRONMENTAL	
Cooling	Fan Cooled
Operating Temperature	0 to 40 °C / 32 to104 °F
Storage Temperature	-20 to 70 °C / -4 to 158 °F
Humidity	< 95%, non-condensing
Altitude (max.)	2000 m / 6550 feet
Equipment ingress protection rating per IEC 60529	IP20

5 Unpacking and Installation

5.1 Inspection

The ECTS2 Series of Power Analyzers are carefully inspected before shipment. If instrument damage has occurred during transport, please inform Pacific Power Source' nearest sales and service office or representative.

The Harmonics and Flicker Measurement Module chassis (LFZ) is shipped ready for use – complete with an appropriate power cord. It is supplied calibrated and does not require anything to be done by the user before it can be put into service.

The unit is grounded via the AC Input. A line cord with proper Earth Ground must be used at all times. Correct grounding of your electrical system infrastructure according to applicable national standards must also be observed.

5.2 Unpacking

5.2.1 Rack Mount LFZ Chassis Lifting & Carrying

CAUTION

THIS UNIT IS HEAVY. Two persons are required to lift or carry this unit. DO NOT attempt to lift alone. DO NOT use the front panel rack handles alone to lift this unit. The unit must be supported in front and back when carrying.

If the unit is to be installed in an instrument rack, a suitable lift must be used to position the unit at the desired rack height and pushed in place using L-brackets (not included with the unit). The front panel handles may be used to pull or push the unit in or out of a rack space only.

Inside the packaging, there should be the following items:

Item	Quantity
Harmonics & Flicker (HFMM or LFZ) Measurement unit	1
AC Line Cord	1
Interface Cables - USB	1
Software	CD ROM or Download from Pacific Power website
Documentation in PDF Format	Download from Pacific Power website Hardcopy User Manuals are available upon request from Customer Service

5.2.2 ECTS2 Cabinet System Handling

Integrated ECTS2 cabinets systems have all necessary system components installed in a 19" Instrument Rack. This rack is shipped in a wooden crate.

CAUTION

The cabinet total weight is high so DO NOT attempt to lift the cabinet. A forklift **MUST** be used to remove the cabinet from the crate.

These systems are shipped in a wooden crate. To move the crate and to remove the cabinet from the crate, a fort lift is required. To unload the unit from its shipping crate, remove the crate's side panels to allow fork lift access. See Section 5.4.2, "ECTS2 Cabinet Installation" on page 25 for directions on cabinet placement and movement once unpacked,

5.3 Software Installation

The following software components are required for the correct operation of the HFMM. If any utility is missing, the HFa program will go into simulation mode, permitting the user to replay various demo files. For ECTS2 Test systems, software is pre-installed on the supplied computer. For other situations, refer to Section 7, "Software Installation Instructions" on page 95 for details on installing all required software components on a new PC or laptop.

5.4 Hardware Installation

5.4.1 Rack Mount LFZ Chassis

The hardware connections are very straightforward and shown in Figure 5-2. The following devices connect to the rear panel of the HFMM Chassis:

1. AC grid power to provide bias power supplies to the HFMM circuits,
2. AC Power Output connections from programmable AC power source. The maximum amount of current hat can be routed through the HFMM chassis is 20A for the LFZ-1 (Single-phase version) or 40A to 75A for the HFMM-3 (Three-phase version).
3. USB interface connection to control the LFZ measurement and flicker impedance hardware using the HFa Application software.

The front panel of the LFZ chassis has the following controls, indicators and power connectors:

1. Bias Power On/Off Switch
2. Flicker Impedance Bypass Mode indicator LED (Green)
3. Flicked Impedance Enabled indicator LED (Red)
4. Bias Power On indicator LED (Red)
5. IEC 60309 Three-phase outlet socket
6. Euro Style Single-phase outlet socket

All other connections are made at the rear panel as described in the next several sections.

5.4.2 ECTS2 Cabinet Installation

CAUTION

The cabinet casters can only be used for temporary transportation or moving a cabinet in place. Once in place, all four corner supports must be fully extended to remove the weight to the cabinet from the casters and to prevent the cabinet from rolling out of place.

When using the ECTS2 cabinet, the corner supports **MUST** be lowered and fixed at all times. To move the cabinet to new location, raise the support before moving the cabinet on its caster and lower them once the cabinet is in its new location.

Figure 5-2: Lower All Four Cabinet Corner Supports to Support Cabinet weight

5.5 AC Input Power

5.5.1 Rack Mount LFZ Chassis

The LFZ requires only single-phase bias AC power. It has a standard IEC13 line cord connection at the rear. Total power consumption is less than 50W. AC input voltage is universal range of 100 ~ 240Vac ± 10%, 50 Hz or 60 Hz.

CAUTION

DO NOT replace the included detachable AC Line cord with an inadequately rated line cord. Line cord used must meet or exceed voltage and current ratings as specified in section 4.5, page 20.

5.5.2 Power input to the LFZ from an AC power source.

Power to the unit under test (UUT) is typically supplied from a Pacific Power or Pacific Power programmable power source. The AC power from the programmable power source is routed in through the real panel IEC19 socket on the LFZ-1 (Single-phase) or the Phoenix Style 3-Phase terminal block on the LFZ-3 (Three-phase).

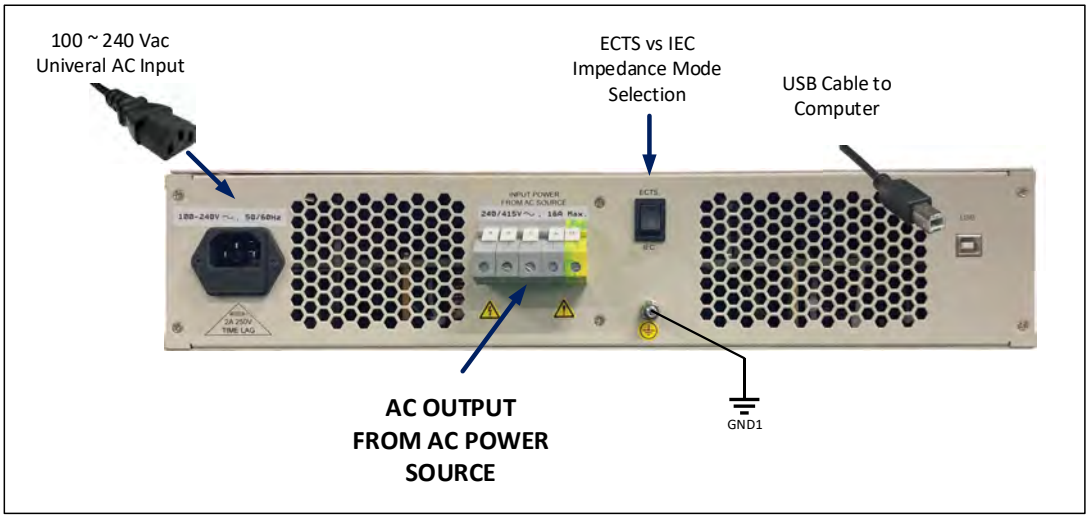


Figure 5-3: LFZ-1-16 Single Phase Connections.

5.6 USB Connection to Computer

The LFZ chassis has two USB Device ports, one on the rear panel and one on the front panel. These two USB ports are internally connected to each other, so only on needs to be connected to the controller computer. In ECTS2 Cabinet systems, the USB is connected to the PC in the cabinet through the rear panel USB connector.

For smaller tabletop setup, the front USB connector can be used to connect to a PC or Laptop running the HFa application software.

5.7 EUT Power Connections

To test a product for Harmonics and Flicker compliance, plug the equipment under test (EUT) into one of the available "OUTPUT POWER" socket on the front of the LFZ chassis. The type of mating socket will vary with system configuration depending on max. amount of current per phase. The mating plug is supplied with the unit in the ship kit.

CAUTION

Consult a certified electrician to determine require load wiring type and size in accordance with local electrical codes.

The HFMM has internal measurement circuits that present virtually no load to the circuit, but rather passes the power through to the EUT. The measurement circuits "consume" about 0.2 mA @ 230 V AC for each phase.

The HFMM-3 performs all signal conditioning required for voltage, current and power measurements.

Figure 5-4: HFMM-3 Chassis Front Panel EUT OUTPUT POWER Connectors

LFZ-3-xx Chassis have both a Three Phase and a Single Phase socket to connect an EUT. LFZ-1-XX Chassis are single phase only and only have a single phase outlet socket. Either outlet has a spring loaded cover when not in use, Red for 3 Phase (5 pins) and Blue for 1 Phase (3 pins) as shown in the image above. Both are standard IEC60309 standard sockets. Use correct mating plugs to connect the unit under test. Pin definitions are shown in the diagram below.

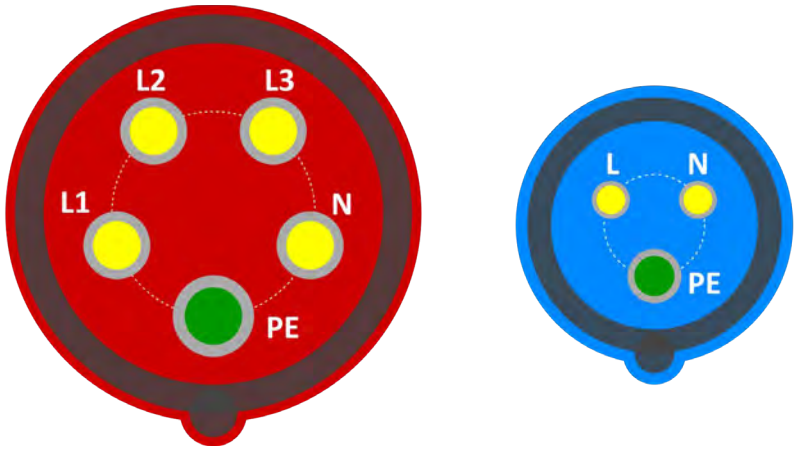


Figure 5-5: Front Panel Sockets Diagram

5.1 AC Bias Power

Before connecting the LFZ to a unit to be tested, first connect the mains cord from a properly grounded supply outlet to the inlet on the rear panel of the HFMM chassis.

The LZF requires only single-phase bias AC power. It has a standard IEC13 line cord connection at the rear.

CAUTION

DO NOT replace the included detachable AC Line cord with an inadequately rated line cord. Line cord used must meet or exceed voltage and current ratings as specified in section 4.5, “AC Input” on page 20.

5.2 In Case of Malfunction

In the unlikely event of an instrument malfunction or if the instrument does not turn on despite the presence of the correct AC line voltage, please attach a warning tag to the instrument to identify the owner and indicate that service or repair is required. Contact Pacific Power Source or its authorized representative to arrange for service.

5.3 Cleaning

CAUTION

BEFORE you clean the unit, switch the unit off at the front panel breaker AND remove all mains power using the mains disconnect.

- Please do NOT use any organic solvent capable of changing the nature of the plastic such as benzene or acetone.
- Please ensure that no liquid is allowed to penetrate this product.

5.4 Sound Levels

CAUTION

LFZ-x-40 & LFZ-x-75 Models:

During Flicker Test operation, the fans may run at high speed to cool down the Resistive Elements of the Flicker Impedance. This may result in elevated audible noise near the equipment.

Sound pressure levels during flicker test operation should be measured both at the operator's position in normal use and at whatever point 1 meter from the power source enclosure that has the highest sound pressure level.

The installer shall provide measures to reduce the sound pressure level at the operator's point of use to a safe level. These measures may include the fitting of noise-reducing baffles or hoods or the provision of protective earpieces.

6 Software Operation

6.1 Running the Harmonics & Flicker Analyzer Summary Steps

Basics steps to operate the HFa software are as follows:

1. Launch the HFa application.
2. Click on the System Setup tab, to configure the power source you are using.
3. Select which type of impedance you are using for Flicker testing. For Pacific Power ECTS2 cabinet systems, you will likely use a Reference Impedance, either in a separate 19” box (three-phase) or built-into the HFMM-1 measurement unit for single phase.
4. Select the test conditions, Harmonics or Flicker, and the test class for harmonics or the parameters to test for Flicker. If you select harmonics, the test impedance will be set to bypass. For Flicker tests, the selected impedance is activated.
5. Complete the fields for Equipment type, on behalf of what manufacturer the testing is done for, and the optional data file name and/or comments.
6. Specify the test voltage, frequency and the test duration.
7. Click on Start, and the system will do a 10 second pre-test, then show the real time measurements and intermediate results until the test is completed at which time final pass/fail test results will be displayed.

6.2 System Setup

The system 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.

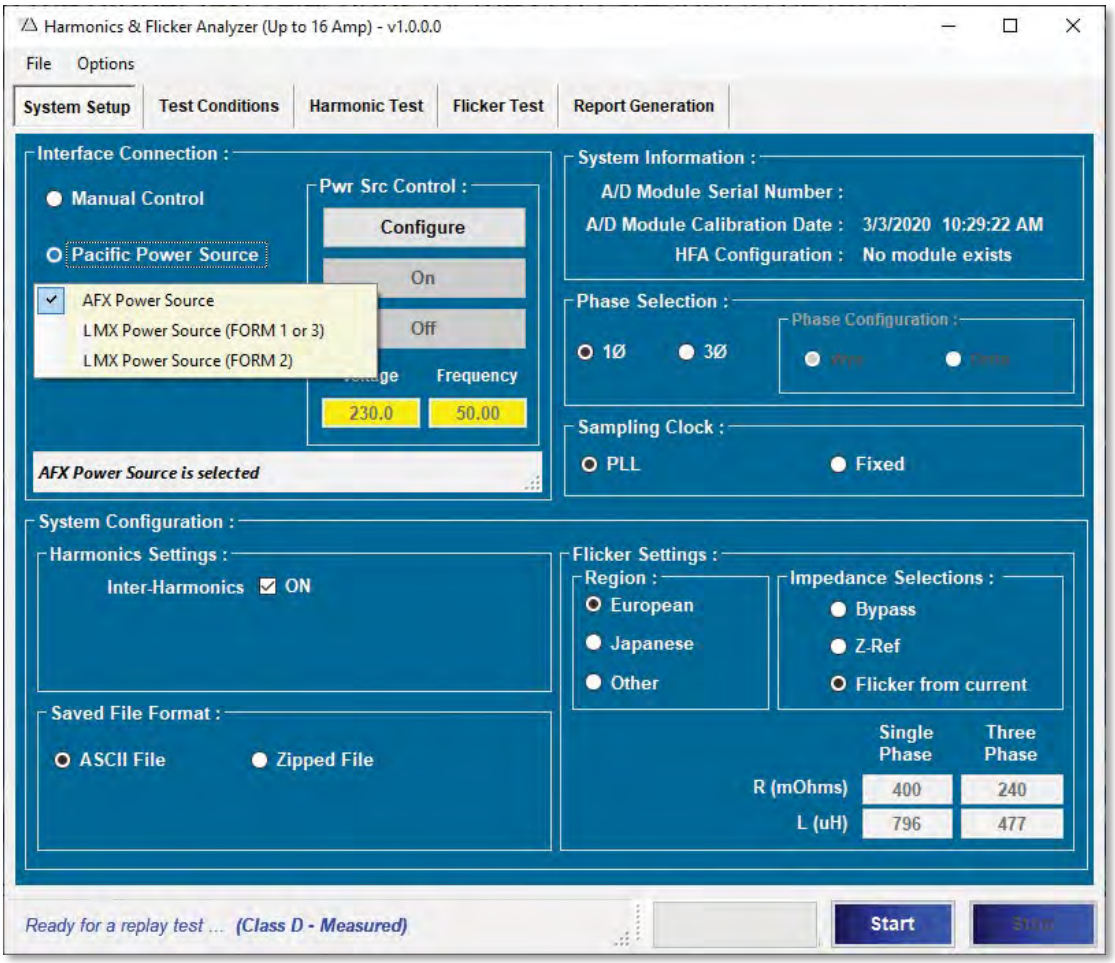
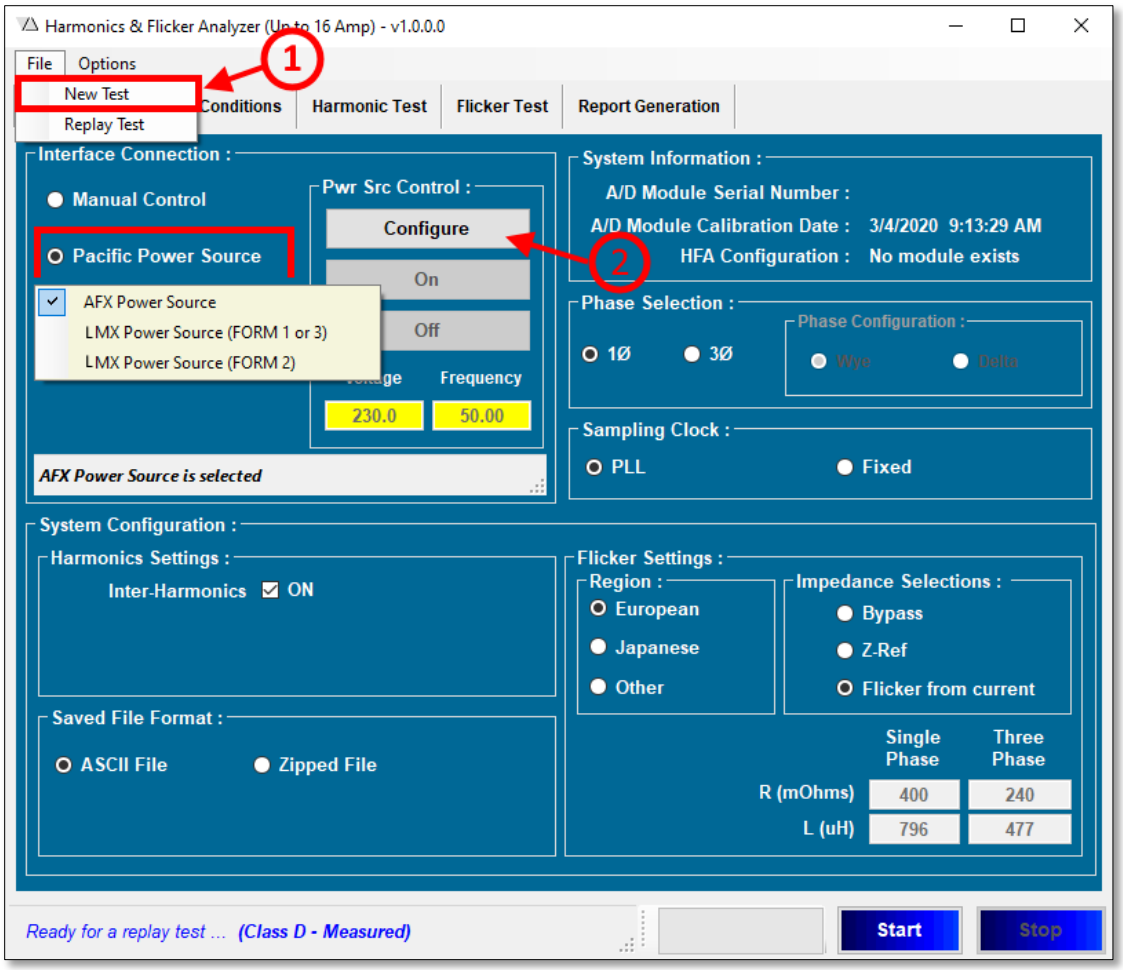
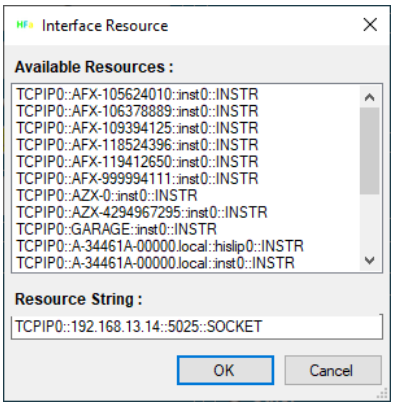


Figure 6-1: System Setup Screen

In the example below, we have selected an AFX Series Pacific Power Source unit. Click on the “Power Source Control” radio button text to see the drop down of available support power sources and select the one that is installed in the ECTS2 test system.

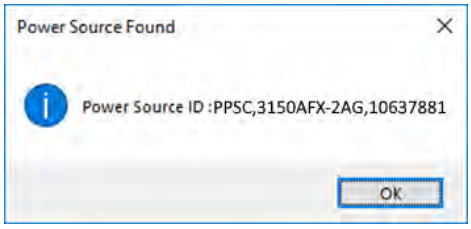


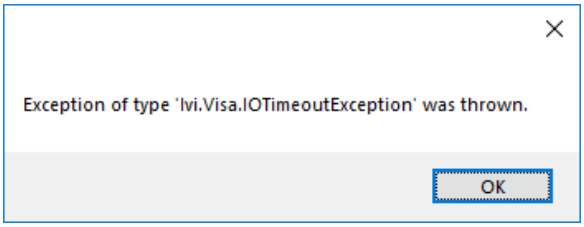
Click on New Test, and then click Configure. This brings up a small window that shows all connected instrument and their VISA resource string. Normally, there will be only one AC power source in this list. Click on the AFX to be used and then on OK in the Interface Resource window. The HFa software will establish 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).

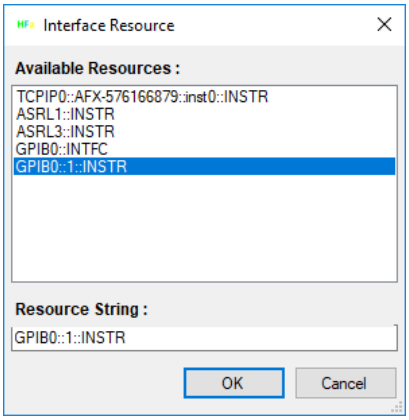
LMX responds normal.





If a VISA exception message is thrown, the power source is not responding to the *IDN command. Check the resource setting and interface settings on the PC and the power source to make sure they match. You can also use NI MAX explorer to troubleshoot the PC to power source connection.

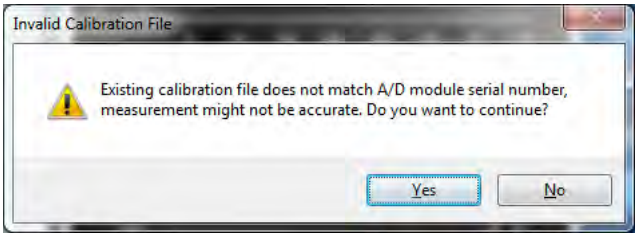
Note: Once the power source is "remote" state, you will be locked out from using the front panel controls. To re-gain front panel control, press the LOCAL button on the front panel of the power source.



After you verify communication with the power source, a new test can be run. Select the voltage and frequency, and the power source will be programmed accordingly. Check the front panel read-out of the power source, to make sure the right voltage and frequency has been programmed. Also, for power sources with programmable impedance, the impedance values are set to the required values, being minimum impedance for harmonics, or the Reference Impedance values for Flicker.

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.

6.2.1 Missing Calibration File



If you see the error message to the right after you click “Start”, the system does not have the correct calibration file. If you did not copy the right the calibration file, you can either click on “Yes” and have measurements that are generally within 1.0 %, or click on ”No” and copy the correct file to the “C:\Pacific Power Source\HFa directory”.

In the event that you do not have the calibration file, you can run the calibration utility, to generate a new calibration file. Refer to Section 8, “Calibration Information” on page 108 for further information.

6.3 The Test Condition Setting screen

The user selects from one of the main three selections, being IEC 61000-3-2, JIS-C 61000-3-2, or Flicker per IEC 61000-3-3. 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.

In this example, the system is set up for a Class-A PASS test. That is, a CNS Inc. HFC-III calibrator is configured to produce a current harmonic spectrum that has some harmonics close to the limits – such as H15 at 89.3 % - see Figure 6-4 on page 41.

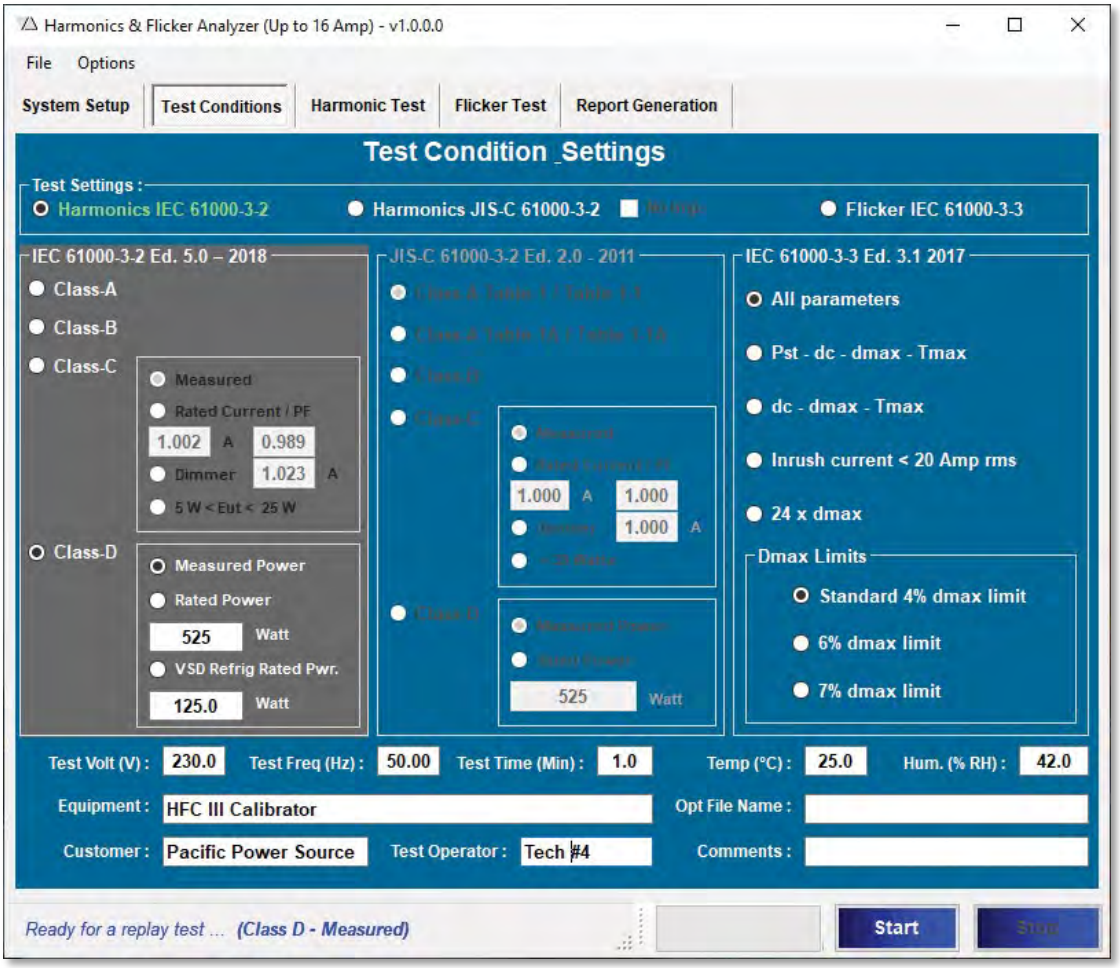


Figure 6-2: Test Condition Setting Screen

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 next 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

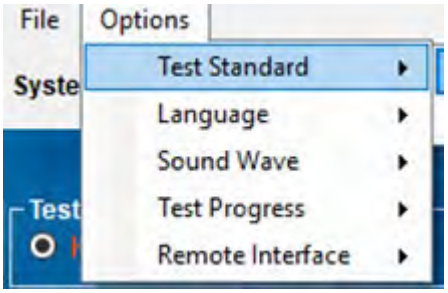
may find data files as shown in the illustration below. The "**RD**" stands for Raw Data, then follows the date the test ran, and then the sequence number.

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

6.4 Options Menu

The Options Menu offers the following selections to the user:

- Test Standard
- Language
- Sound Wave
- Test Progress
- Remote Interface



6.4.1 Options -> Test Standard

There are a few optional standard for both Harmonics and Flicker Test when testing to an older standard is required:

- **Harmonics:**
  - IEC 61000-3-2, Edition 5.1
  - IEC 61000-3-2, Edition 4.0
  - IEC 61000-3-2, Edition 3.2
- **Flicker:**
  - IEC 61000-3-3, Edition 3.1
  - IEC 61000-3-3, Edition 1.2

The Test Standard menu entry allows the user to select between the most recently released standard or and the older version. The older standards are still used by some EMC labs in Asia although no longer permissible for product testing exported to the European Union.

Harmonics Standard Versions

When selecting one of the older IEC 61000-3-2 Ed 4.0 2014 or Ed 3.2 2009 standards, the VSD and Dimmer tests selections will not be visible. (Not available).

The lighting < 25 Watt remains the same, but the "70 % THD" test will be disabled, including for the test report. Thus, a lamp that could possibly PASS the 70 % THD test, will FAIL under Edition 3.2. Harmonics standard Ed. 4.0 has Class-C dimmer and Class-D VSD but no Class-C <25W 70% ITHD.

The user can run another test, this time with the Edition 5.1 selection if they are concerned the lamp could PASS and is for the European market.

The other two < 25 Watt methods (Table-3 limits and special waveform) will still be automatically applied, regardless of this selection setting. The report will show which method PASSED. If both FAIL, it will show that, and the failing parameters.

Flicker Standard Versions

Edition 1.2 (2005) is in reality the same as Edition 2.0. Edition 3.0 and 3.0 plus amendment 1 (2017) is in principle identical to Edition 2.0 and 3.0. After edition 1.2, there were only editorial and test condition changes.

Thus, there is no actual difference in the flicker test between either versions selected.

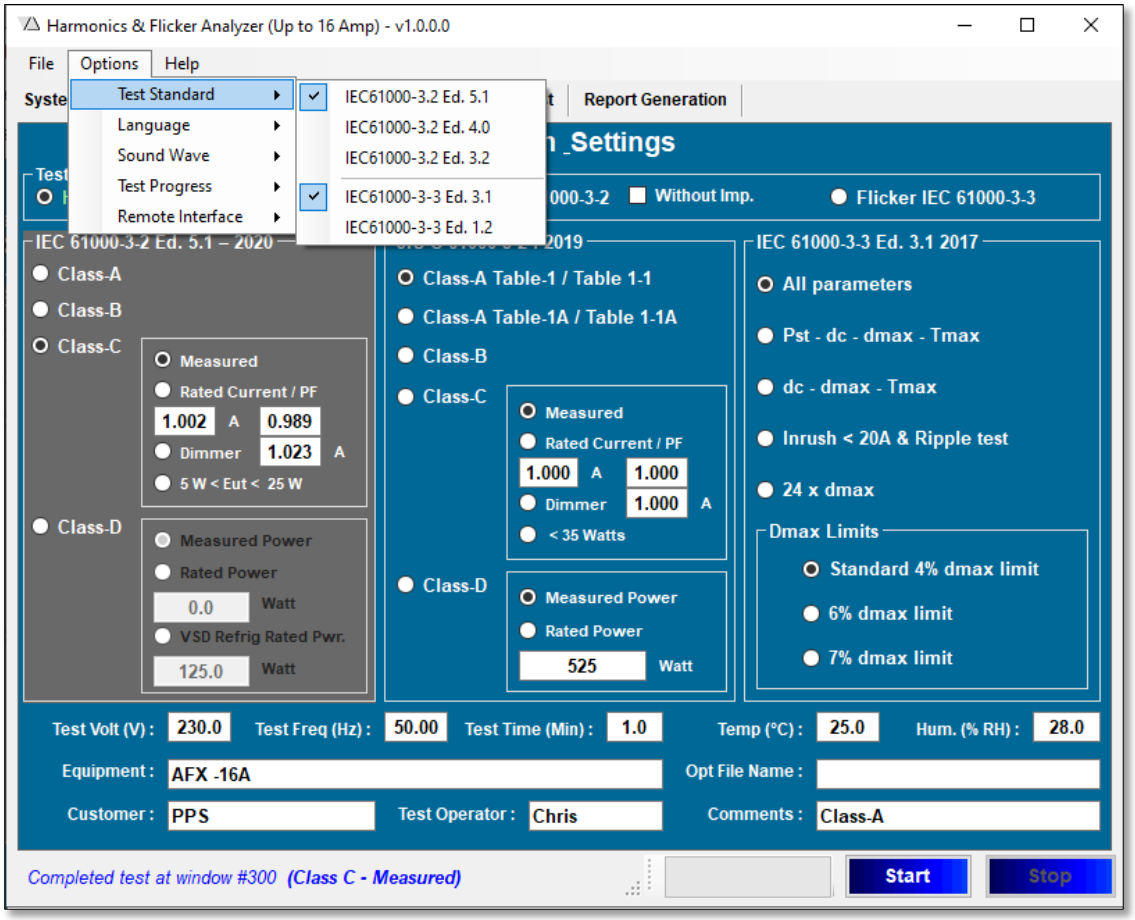


Figure 6-3: Harmonics Standard Selection Options

6.4.2 Options -> Language

Currently, only English or Chinese are supported. Note that language selections only applies to the menu and tab header text.

6.4.3 Options -> Sound Wave

The Sound Wave settings determine what sound is played when an EUT passes or fails. Either the Default sounds is used or a Sound wave file assigned by the user. Different sounds can be assigned for Pass and Fail conditions.

6.4.4 Options -> Test Progress

The Test Progress can be displayed in either acquisition windows or actual time. The default selection is “Windows”. Note that acquisition window times are different between harmonics (200 msec) and flicker (10 msec).

6.4.5 Options -> Remote Interface

The Remote Interface setting allows for auto-connection at the time the HFa program is launched using the last used connection settings. Alternatively, Manual setting can be chosen requiring the user to connect manually each time.

6.4.6 Options -> Harmonic Waveform

The display option for the time domain Voltage and Current Waveform graph on the Harmonics Results screen can be toggled between 10/12 cycles or 2 cycles at any time. The 2 cycle display may be more useful for low current EUT’s as more details is visible. The 10 or 12 Cycle display is confirm the Harmonics measurements windows of 200 msec per the IEC 61000-3-2 standard. The selection is made using the button in in the upper left corner of the Harmonics Test Tab.

The sample screens below illustrate the different display options.

6.5 Harmonics Tests

Harmonics test are accessible from the "Harmonic Test" tab. The HFa software supports current revisions of both European and Japanese Harmonics test standards. The following standards are supported:

Standard Number	Description	Notes
IEC 61000-3-2	Harmonics, Single Phase, < 16A	
JIS-C 61000-3-2	Harmonics, Single Phase, < 16A	
IEC 61000-3-12	Harmonics, Single Phase, < 75A	Available on HFMM-3 version
JIS-C 61000-3-12	Harmonics, Single Phase, < 75A	Available on HFMM-3 version

Table 6-1: Supported Harmonics Test Standards

All product classes are supported for both European and Japanese Harmonics standards per the table below.

Harmonics Classes	Product Categories	Notes
Class A	All equipment not covered by classes B through D	
Class B	Portable tools and other hand-held equipment	
Class C	Lighting equipment including dimmers	Select Measured or Rated Power to calculate limits
Class D	Equipment with special wave shape current and input power 75 ~ 600W. Includes PC, Monitors & TVs.	Select Measured or Rated Power to calculate limits Includes support for Variable Speed Drive (VSD) Refrigerators

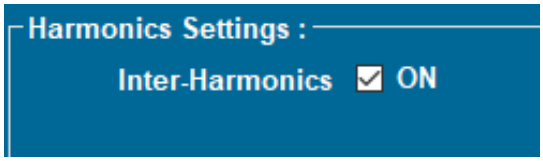
Table 6-2: Harmonics Product Classes

6.5.1 Sampling Clock Setting

The HFMM module normally derives its sampling clock from the built-in PLL circuit. This circuit ensures that each 200 ms harmonics measurement window is perfectly synchronous with the 50 Hz or 60 Hz frequency from the power source.

The user can select “Fixed” for cases where a flicker measurement must be made on the public supply voltage and where the public supply is distorted, i.e. where the phase locked loop may have difficulties synchronizing to a noisy signal. The fixed sampling rate used in this mode is 25.0 ks/Second.

6.5.2 Inter-Harmonics Grouping



Normally the system measures with Inter-Harmonics set to “On” as default. This means the inter-harmonic frequencies are evaluated through the “grouping method” specified in the IEC61000-4-7 test standard. This “grouping method” is not yet mandatory, so the user has the option to turn the inter-harmonics evaluation “off”.

6.5.3 Harmonics Class-A PASS display.

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, the data columns become all visible (see next page 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 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 H5 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.

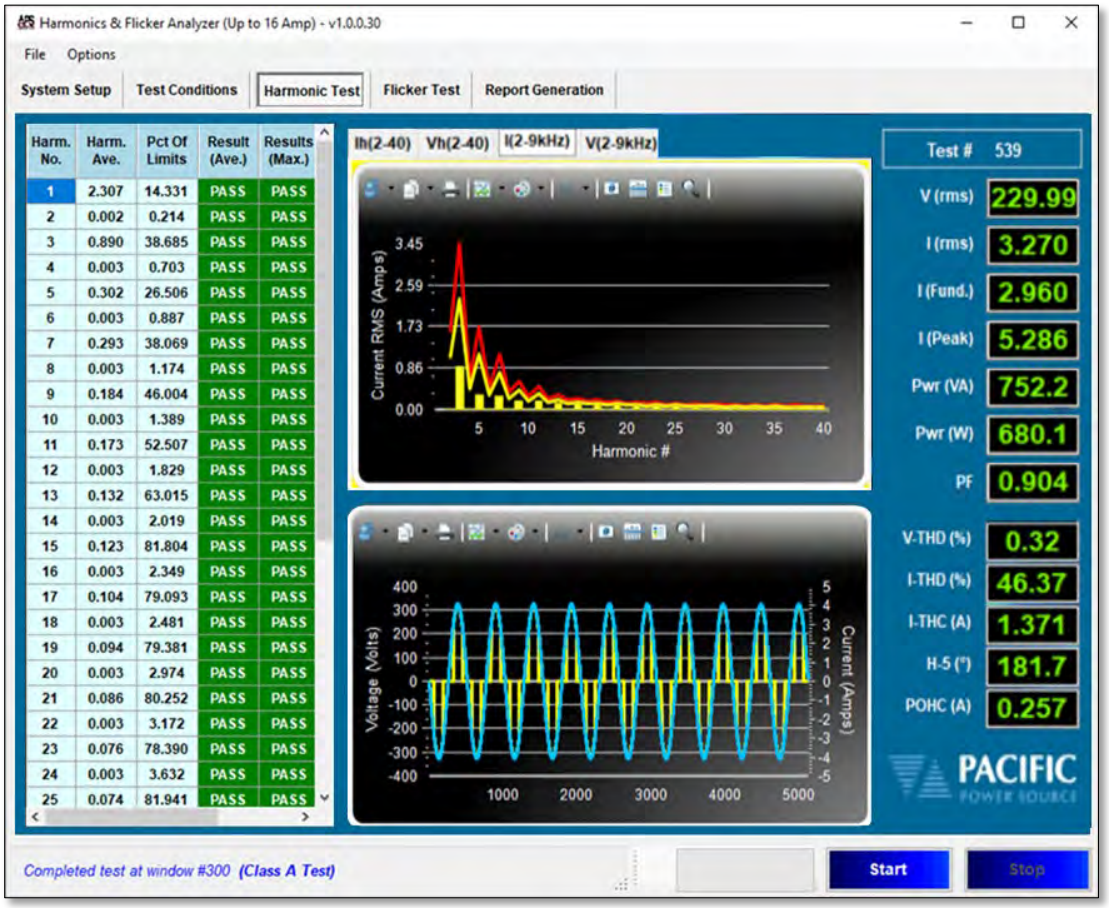


Figure 6-4: Harmonics Test Class A PASS display

6.5.4 The IEC 61000-3-10 Extended Harmonics Display

When selecting the 2-9kHz tabs for extended harmonics display per IEC 61000-3-10, the top graph shows 2-9 kHz for a Class-A "FAIL" test, and single phase limits

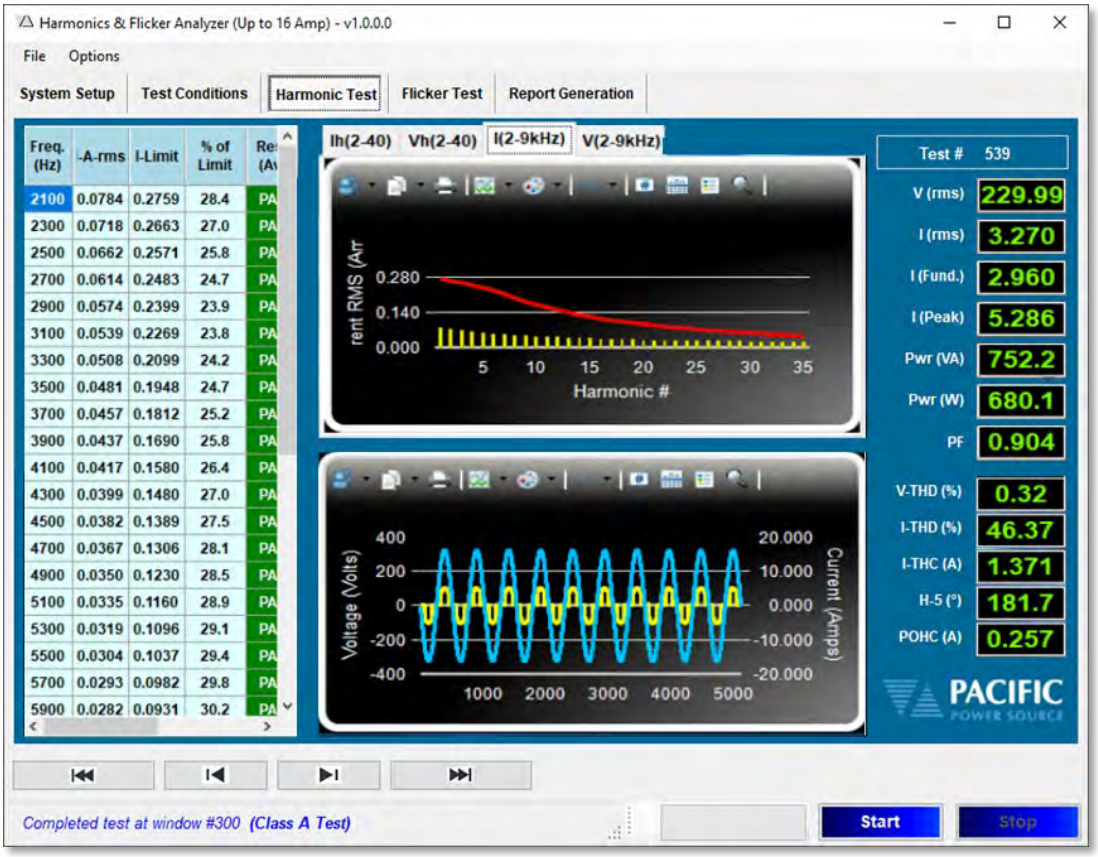
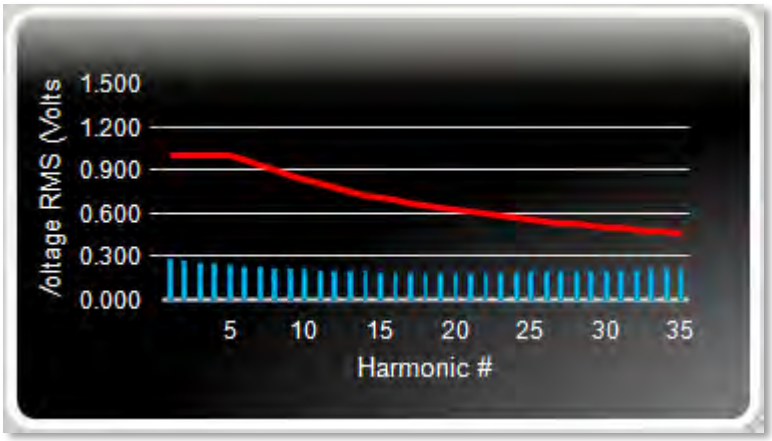


Figure 6-5: The grouped current emissions and the limit line from 2-9 kHz

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: 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.

6.5.5 Harmonics Class-A FAIL display

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, so that the average harmonics, as well as the 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.

Figure 6-6: Harmonics Test Class A FAIL display, "stretched" to include all data colum

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 scrollbar at the bottom of the columns, one can move the display to show the 3 rightmost columns. 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 right most 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, as the 150 % limit for H3 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.

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.

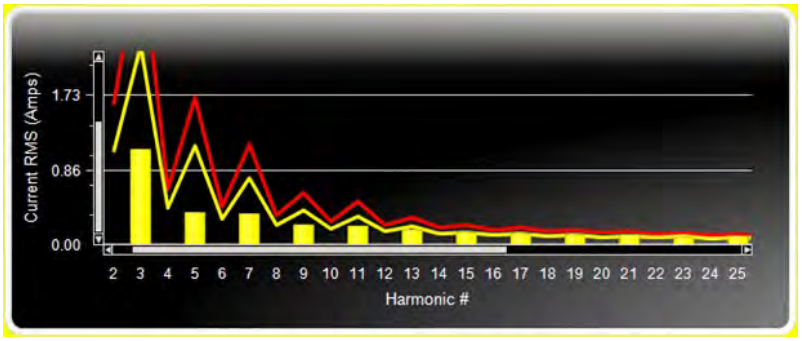


Figure 6-7: The "zoomed in" current spectrum

The waveform graph displays the same data as shown in the Class-A Fail screen shot, but with some different settings. The "zoom leve" 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.

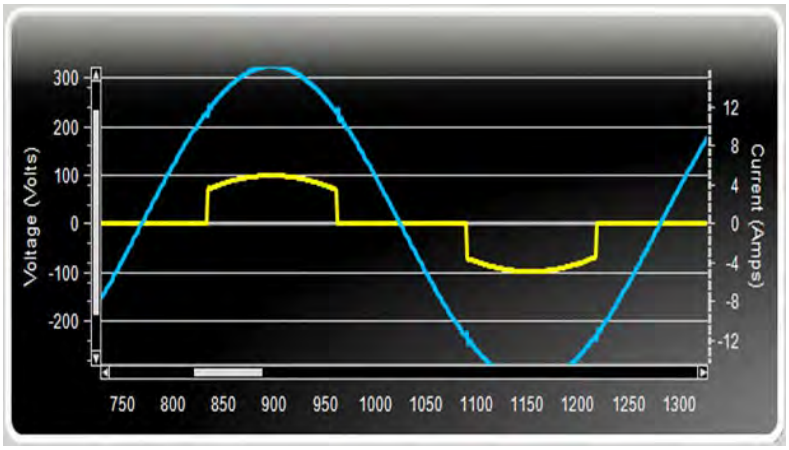


Figure 6-8: The "zoomed in" waveform graph display

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 H3 at about 0.6 V-rms, or 0.247 % of the 230 Volt fundamental.

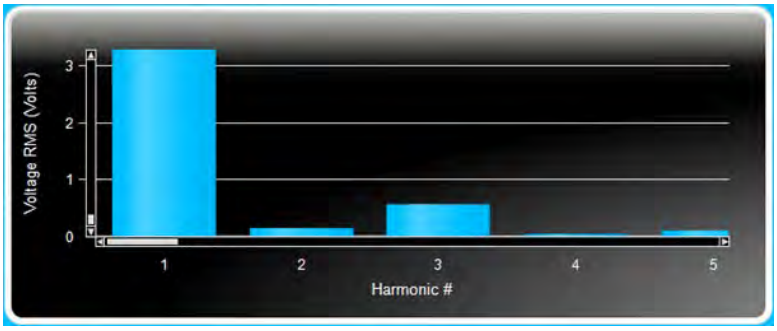
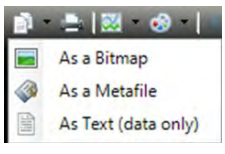


Figure 6-9: The voltage spectrum (distortion) in detail



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.

6.5.6 The Harmonics Class-A Test Report

A sample Class-A Harmonics Test Report is shown here:

Test File:	**H-CLASS A FAIL-20190704_ 634**
EUT:	**HFC-III Calibrator**
Test Standard:	**Test per IEC 61000-3-2 Ed. 5.0 – 2018**
Test Class:	**(Class A Test)**
Test Result:	FAIL - 100% average
Test Date:	**7/2/2019**
Start Time:	**9:37:49**
Stop Time:	
Test Duration (min):	**1**

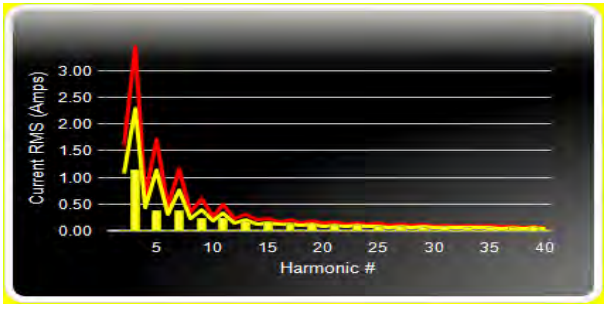
Source Qualification: **Compliance with IEC61000-3-2**

Power Source Distortion:	OK
Customer:	**PPS**
Test By:	**Eng**
Comments:	**Class-A**

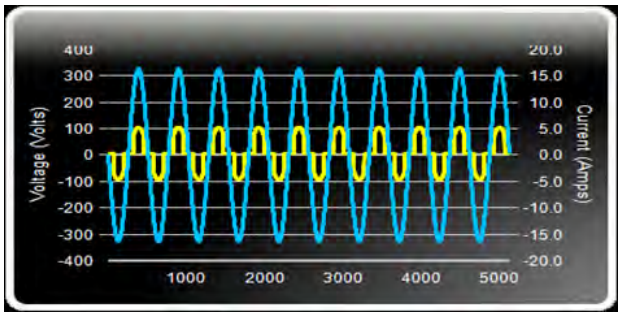
General Test Data: (Phase A)

Vrms (Volts):	**230.71**	**Frequency (Hz):**
50.00		
I_rms (Amps):	**3.202**	**Power (VA):**
738.3		
I_fund (Amps):	**2.880**	**Power (W):**
663.7		
I_peak (Amps):	**5.307**	**Power Factor:**
0.898		
V-THD (%):	**0.345**	**I-THD (%):**
46.716		
POHC (A):	**0.251**	**POHC Limit (A):**
0.250		
I-THC (A):	**1.344**	**Meas. Pwr (Min / Max)**
662.4W/665.3W		
Phase angle of H5 (deg):	**176.6**	

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	0.001	1.080	0.107	PASS	PASS	0.001	1.620	0.068
3	0.904	2.300	39.297	PASS	PASS	0.903	3.450	26.175
4	0.002	0.430	0.570	PASS	PASS	0.002	0.645	0.365
5	0.299	1.140	26.267	PASS	PASS	0.299	1.710	17.494
6	0.001	0.300	0.472	PASS	PASS	0.001	0.450	0.306
7	0.303	0.770	39.383	PASS	PASS	0.303	1.155	26.234
8	0.002	0.230	0.992	PASS	PASS	0.002	0.345	0.636
9	0.178	0.400	44.512	PASS	PASS	0.178	0.600	29.639
10	0.001	0.184	0.756	PASS	PASS	0.001	0.276	0.486
11	0.183	0.330	55.365	PASS	PASS	0.183	0.495	36.880
12	0.002	0.153	1.503	PASS	PASS	0.002	0.230	0.964
13	0.126	0.210	60.209	PASS	PASS	0.126	0.315	40.087
14	0.001	0.131	1.056	PASS	PASS	0.001	0.197	0.682
15	0.131	0.150	87.298	PASS	PASS	0.131	0.225	58.153
16	0.002	0.115	1.967	PASS	PASS	0.002	0.173	1.266
17	0.098	0.132	73.994	PASS	PASS	0.098	0.198	49.256
18	0.001	0.102	1.357	PASS	PASS	0.001	0.153	0.868
19	0.102	0.118	86.583	PASS	PASS	0.102	0.177	57.673
20	0.002	0.092	2.483	PASS	PASS	0.002	0.138	1.595
21	0.079	0.107	74.168	PASS	PASS	0.079	0.161	49.370
22	0.001	0.083	1.667	PASS	PASS	0.001	0.125	1.077
23	0.084	0.097	86.471	PASS	PASS	0.084	0.146	57.606
24	0.002	0.076	2.991	PASS	PASS	0.002	0.114	1.915
25	0.067	0.090	74.043	PASS	PASS	0.067	0.135	49.267
26	0.001	0.070	1.974	PASS	PASS	0.001	0.105	1.267
27	0.071	0.083	85.685	PASS	PASS	0.071	0.125	57.075
28	0.002	0.065	3.479	PASS	PASS	0.002	0.098	2.234
29	0.057	0.077	74.395	PASS	PASS	0.057	0.116	49.491
30	0.001	0.061	2.264	PASS	PASS	0.001	0.092	1.455
31	0.062	0.072	85.735	PASS	PASS	0.062	0.108	57.106
32	0.002	0.057	3.935	PASS	PASS	0.002	0.086	2.525
33	0.050	0.068	73.783	PASS	PASS	0.050	0.102	49.068
34	0.001	0.054	2.553	PASS	PASS	0.001	0.081	1.637
35	0.055	0.064	85.331	PASS	PASS	0.055	0.096	56.828
36	0.002	0.051	4.387	PASS	PASS	0.002	0.077	2.823
37	0.045	0.060	74.171	PASS	PASS	0.044	0.090	49.314
38	0.001	0.048	2.874	PASS	PASS	0.001	0.072	1.845
39	0.049	0.057	85.763	PASS	PASS	0.049	0.086	57.113
40	0.002	0.046	3.661	PASS	PASS	0.002	0.069	2.310

Power Source Verification Data

Harm No.	Harm. Value	Harm. Limit	% Of Limits	% Of Vfund	Result
2	0.040	0.200	8.768	0.017	OK
3	0.797	0.900	38.501	0.345	OK
4	0.017	0.200	3.627	0.007	OK
5	0.033	0.400	3.544	0.014	OK
6	0.020	0.200	4.423	0.009	OK
7	0.024	0.300	3.510	0.010	OK
8	0.006	0.200	1.298	0.003	OK
9	0.039	0.200	8.442	0.017	OK
10	0.013	0.200	2.826	0.006	OK
11	0.011	0.100	4.937	0.005	OK
12	0.010	0.100	4.555	0.005	OK
13	0.020	0.100	8.714	0.009	OK
14	0.014	0.100	6.199	0.006	OK
15	0.024	0.100	10.611	0.011	OK
16	0.009	0.100	3.734	0.004	OK
17	0.015	0.100	6.590	0.007	OK
18	0.005	0.100	2.162	0.002	OK
19	0.032	0.100	13.706	0.014	OK
20	0.008	0.100	3.471	0.003	OK
21	0.027	0.100	11.583	0.012	OK
22	0.010	0.100	4.281	0.004	OK
23	0.022	0.100	9.617	0.010	OK
24	0.010	0.100	4.389	0.004	OK
25	0.023	0.100	9.840	0.010	OK
26	0.006	0.100	2.702	0.003	OK
27	0.032	0.100	13.827	0.014	OK
28	0.011	0.100	4.743	0.005	OK
29	0.028	0.100	12.363	0.012	OK
30	0.006	0.100	2.824	0.003	OK
31	0.025	0.100	10.663	0.011	OK
32	0.014	0.100	5.872	0.006	OK
33	0.021	0.100	9.281	0.009	OK
34	0.004	0.100	1.850	0.002	OK
35	0.022	0.100	9.474	0.009	OK
36	0.010	0.100	4.184	0.004	OK
37	0.020	0.100	8.700	0.009	OK
38	0.007	0.100	2.878	0.003	OK
39	0.026	0.100	11.464	0.011	OK
40	0.005	0.100	2.206	0.002	OK

6.6 Flicker Tests

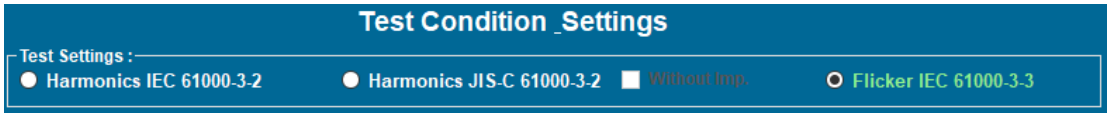
The IEC 61000-3-3 and IEC 61000-3-11 Flicker standards classify products by type & operation. The required Pst/Plt calculations are somewhat complicated and require a dedicated Flicker meter. The IEC/EN 60868-0, 1992 describes the Flicker meter implementation and is now issued as IEC61000-4-15, Ed. 2 (2010).

Standard Number	Description	Notes
IEC 61000-3-3	Flicker Test	EUT's up to 16A / phase
IEC 61000-3-11	Flicker Test	EUT's up to 75A / phase

Table 6-3: Flicker Test Standards Supported

A reference impedance per IEC 60725 or (for IEC61000-3-12) per Z-test is required during flicker testing. Edition 3 of 60725 was last published in July 2012. The HFMM chassis contains the requisite reference impedance for single phase testing per IEC 61000-3-3 up to 16A rms. Three-phase reference impedance models up to 75A rms per phase are available as well to support IEC 61000-3-11.

6.6.1 Flicker Test Condition Settings.

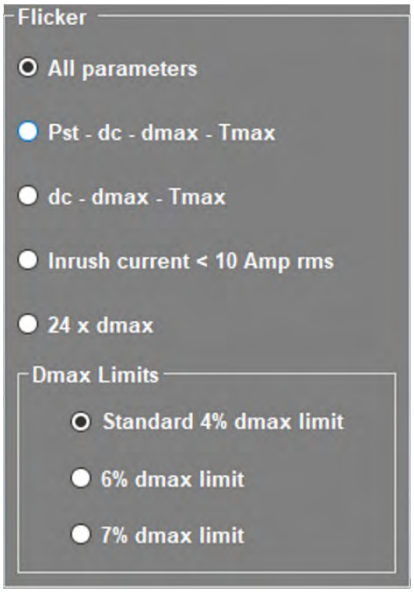


To set up for a flicker test, select the Flicker option in the Test Setting box.

The following settings can be selected for the required flicker test and pass/fail determination as determined by the product category of the EUT.

Available Flicker selections are:

- All Parameters
- Pst – dc – dmax – Tmax
- Dc – dam – Tmas
- Inrush current < 10 Amp rms
- 24 x dmax:
  - Standard 4% dmax limit
  - B 6 % dmax limit
  - B 7% dmax limit



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).

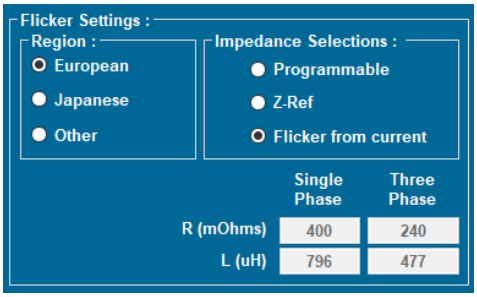
The user must select a dmax limit, and 4 % is the default or “safe choice”. For equipment that is switched manually, or automatically more often than 2 x per day, the 6 % limit may be selected (and the 24 x dmax procedure can be followed). The 7 % applies to equipment that is attended whilst in use,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

6.6.2 Flicker Test Impedance Selection

If the test system’s AC power source has a programmable impedance, the user can select this feature and enter the values for inductance and resistance that need to be set.

Also select the correct Region for the EUT export destination. The values for European and Japanese impedance types are pre-set to their default values and displayed below the Impedance Selection controls as shown here.



6.6.3 Running a Flicker Test

Once relevant settings are made, click on the Start button at the bottom of the screen to start a flicker test. A 10 second pre-test period is used prior to starting any flicker measurements.

As the test runs, preliminary results are displayed and continuously updated. Final results required the complete test window – typically 2 hours – to be completed. However, in many cases, it will be evident far sooner that an EUT will not pass. In that situation, the operator may decide to abort the flicker test early.

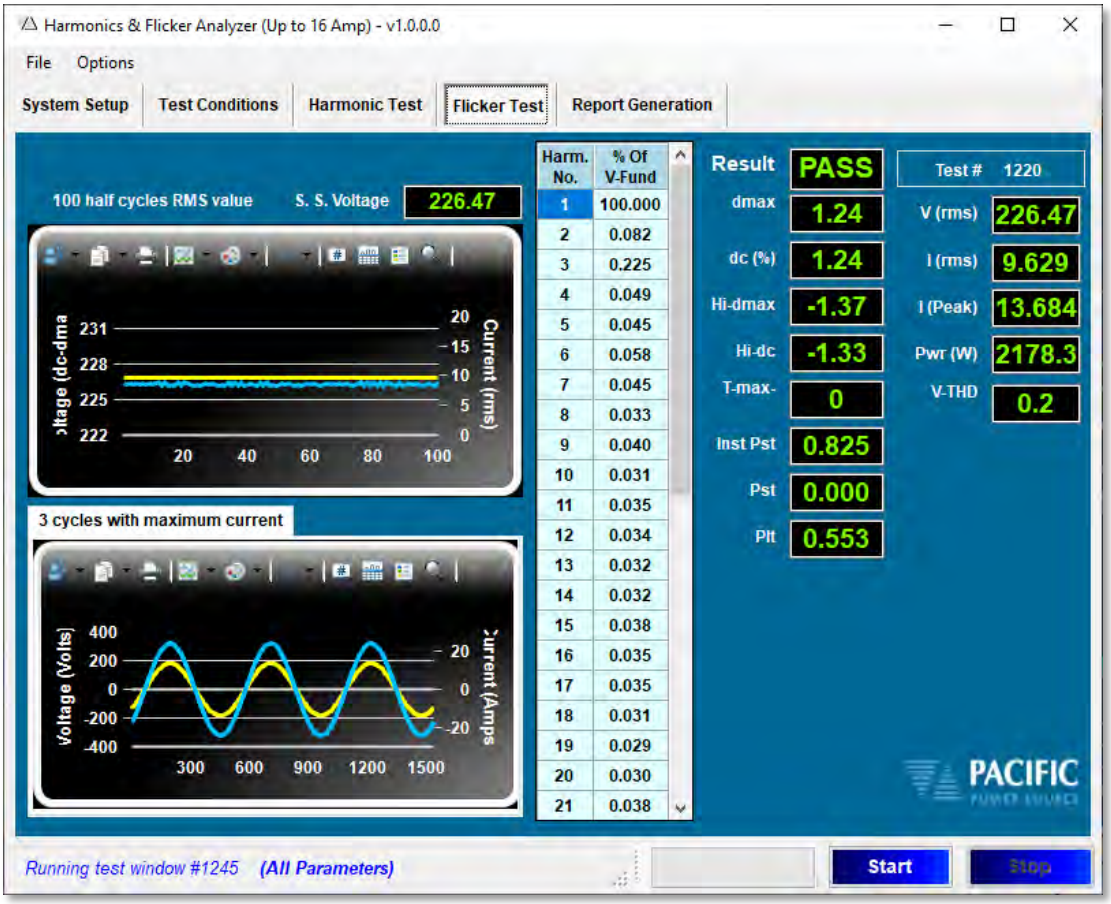


Figure 6-10: Flicker Test Execution Window

The Flicker measurement display 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 ea. half cycle rms values for current per second.

In the above example, the load is turned “On” (the yellow trace jumps from “0” to 7.1 A-rms. This causes the voltage to drop by about 1.43 %. When this load pattern is turned On/Off every ~ 10 seconds, the resulting Pst will be 0.94. **The “Inst. Pst” parameter is updated (integrated per IEC 61000-4-15) every second**, and at the end of 10 minutes, this

resultys 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 %).

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.

Figure 6-11: Flicker Test with 0.917 Hz Modulation Execution Window – PASS

The above screen shot 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 0.545 sec, i.e. the current is turned "On" or "Off" every 0.545 sec. As the current is turned "On" there is a voltage drop across 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 one of the periods where the load (current) is turned "On". The data grid shows the voltage harmonics, and the various parameters are to the right.

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.

Figure 6-12: Flicker Test Voltage Drop Sample Window

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 dip lasts that exceeds 3.3 %. 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.

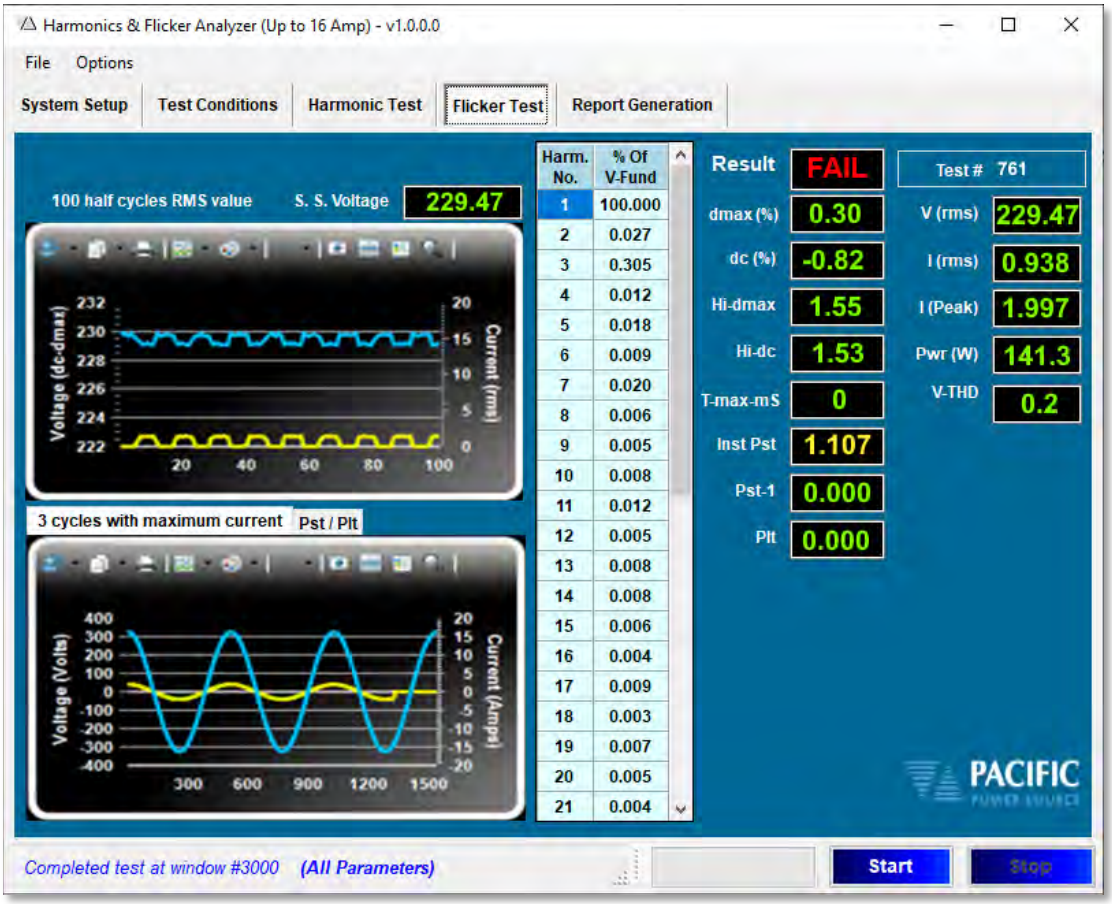


Figure 6-13: Flicker Modulation Window

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

6.6.4 The 24 x dmax Test

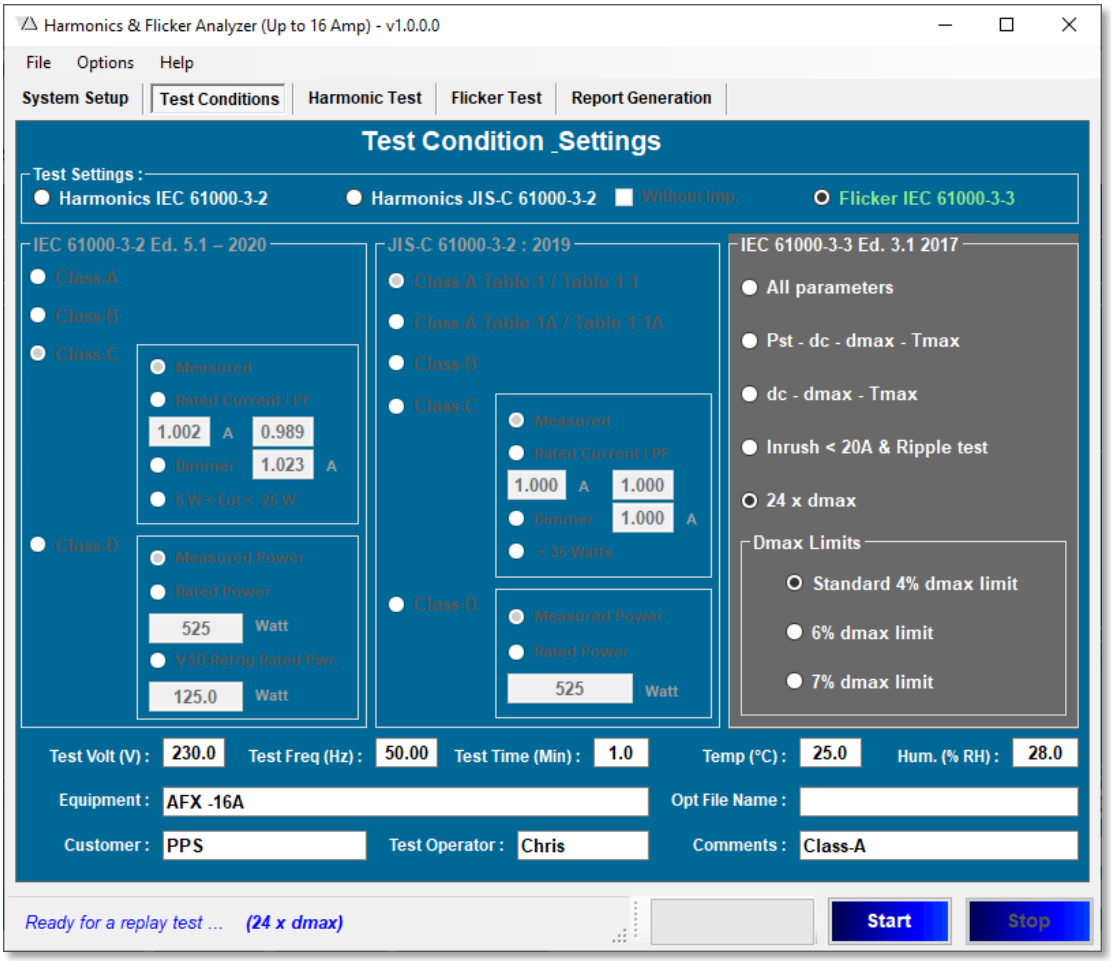


Figure 6-14: Selecting the "24 x dmax" test with the 4 % standard limit

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 6-15: 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 0.5A 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:\Pacific Power Source\HFa16\Configurations\System\Misc\Misc_Parameters.xml

```
<?xml version="1.0" encoding="utf-8" standalone="yes"?>
<HFa>
  <Params>
        <MaxCurrAllow>16.5</MaxCurrAllow>
        <VRange></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>0.40</VirtualImpedance>
        <Delays24dmaxTest>300</Delays24dmaxTest>
        <Threshold24dmax>0.5</Threshold24dmax>
        <NoOfDaysFilesToBeKept>10</NoOfDaysFilesToBeKept>
        <FlkTestMarginPct>100</FlkTestMarginPct>
        <HarmTestMarginPct>100</HarmTestMarginPct>
        <DefaultedTestNumber>0</DefaultedTestNumber>
  </Params>
</HFa>
```

Figure 6-16: 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.

6.6.5 The Harmonics Class-A Test Report

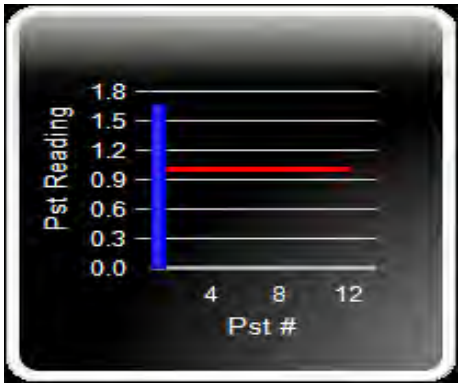
A sample Flicker Test Report is shown here:

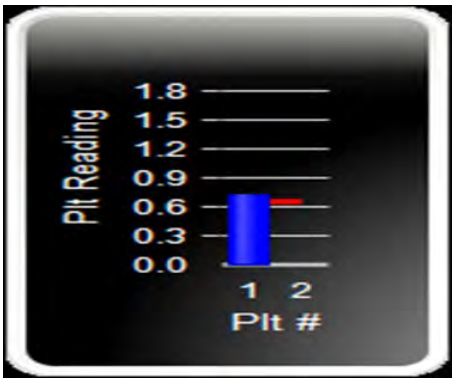
Test File:	**F-20190206_ 447**
EUT:	**HFC-III**
Test Class:	**Flicker Test, All Parameters (Calc. By Current Method)**
Test Result:	FAIL
Test Date:	**2/6/2019**
Start Time:	**3:24:31 PM**
Stop Time:	**3:48:17 PM**
Test Duration (min):	**10**

Source Qualification:	**Compliance with IEC61000-3-3**
Customer:	**Customer**
Test By:	**Eng**
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)		





6.6.6 The 24 x dmax Report

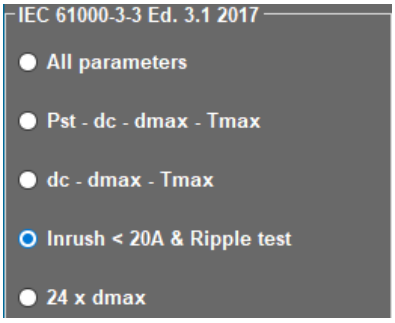
Test File:	F-20190916_ 973
EUT:	HFC-III
Test Standard:	Test per IEC 61000-3-3 Ed. 3, 2017
Test Class:	Flicker Test, 24 x dmax (Calc. By Current Method)
Test Result:	PASS
Test Date:	9/16/2019
Start Time:	12:56:36
Test Duration (min):	10

Source Qualification:	Compliance with IEC61000-3-3
Customer:	PPS
Test By:	Eng
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	

6.6.7 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:	PPS
Test By:	Eng
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)

==========

6.6.8 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:	PPS		
Test By:	Eng		
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)

==========

6.7 Test Reports

Test reports are generated by the HFa software in Rich Text Format to support documenting EUT compliance. This report format is easily converted to other common file formats like MS Word or PDF using MS Word or a similar word processor application.

Reports can be generated immediately after completion of a test or at a later date by using the Test Replay Mode (see next section).

6.7.1 Report Generation

To create a test report:

1. Select the “Report Generation” tab at the top of the program window. (Call out 1 in figure below).
2. Click on the “Generate Report” button to the right. (Call out 2 in figure below).

The report for the last test run or replayed will now be created.

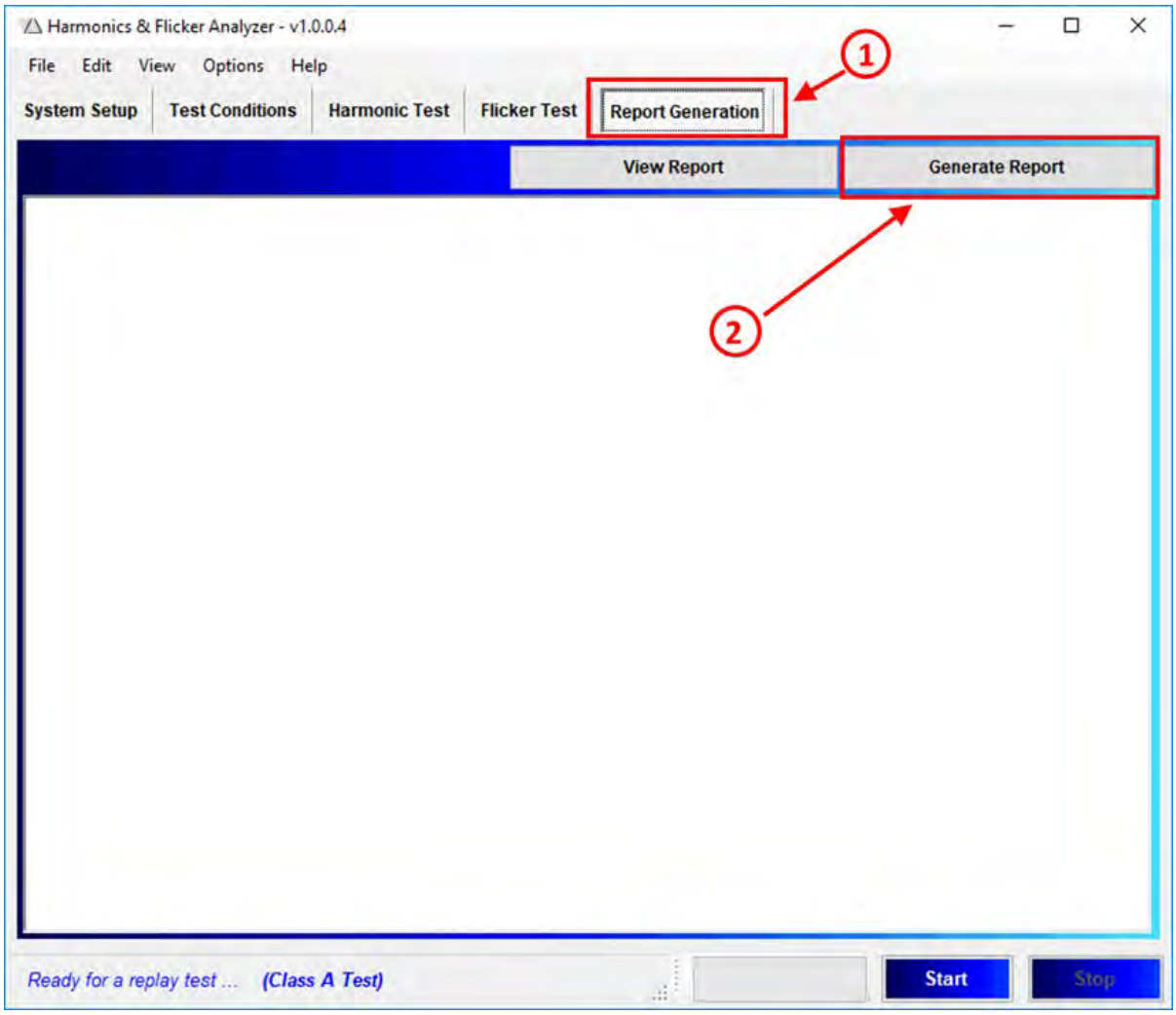
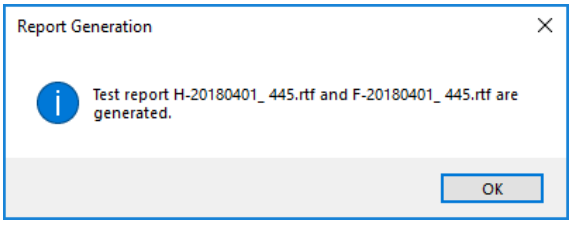


Figure 6-17: Report Generation Selection

A dialog box is displayed when report generation is complete. Harmonics test reports have the letter "**RH**" as a prefix. Flicker reports used an "**RF**". The report name consists of the current date stamp and a sequence number. If needed, report file names can be changed by the user.



6.7.2 Harmonics Test Report Format

A typical Harmonics report opened in MS Word is shown below. It contains the following three pages:

1. Harmonics Test Selections, Pass/Fail indication, AC source voltage harmonics compliance pass or fail indication, EUT voltage, frequency, current and power, etc. Harmonics Bar Chart image, Voltage and Current Time Capture image.

2. Current Harmonic measurements, % of Limit and Pass/Fail by individual harmonic
3. AC Source voltage harmonics measurements and qualification against permissible AC source distortion limits.

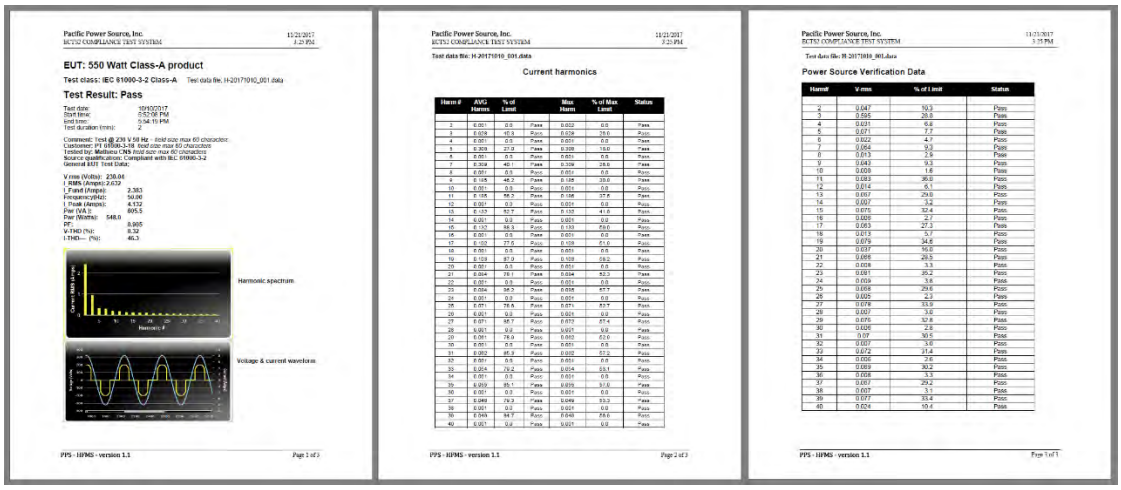


Figure 6-18: Typical HFa Harmonics Report Layout

6.7.1 Flicker Test Report Format

A typical Flicker report opened in MS Word is shown on the right. It contains the following page:

1. Flicker Test Selections, Pass/Fail indication, AC source voltage harmonics compliance pass or fail indication, EUT voltage, frequency, current, power, etc.

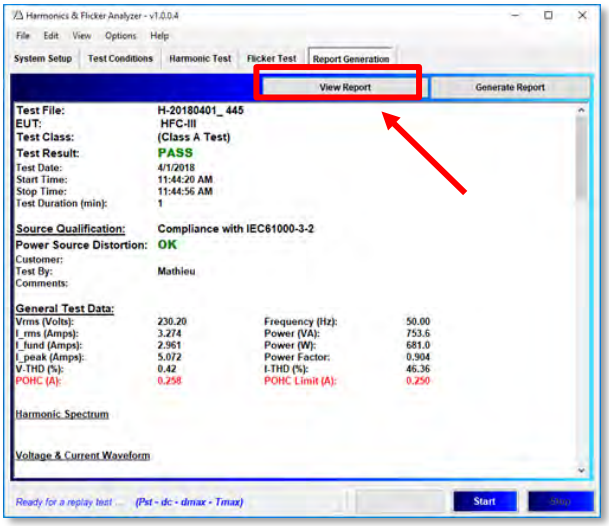
6.7.2 Test Report Directory Locations

Harmonics and Flicker report RTF files are stored in the following directories:

RH-xxxxxx Harmonics Reports	C:\Pacific Power Source\HFa\Test Reports\RTF\Harmonics
RF-xxxxxx Flicker Reports	C:\Pacific Power Source\HFa\Test Reports\RTF\Flicker

6.7.3 Report View Mode

Test reports can also be viewed from within the HFa application program by selecting the View Report button in the "Report Generation" tab.



6.8 Storing and Replaying Test Data

The system stores data in either in ASCII format or "zipped" format. When a test is completed, the data file 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 easily 1 Terabyte or 2 Terabyte nowadays and thus can store 1000 files of 1 Giga-byte each, the "zipped" format compresses the test data by about a factor five. 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.

6.8.1 Data File Locations and File Management

When the application program is closed, 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-directories are:

C:\Pacific Power Source\HFa\ZippedData

C:\Pacific Power Source\HFa\RawData

Managing these data files and the use of either type has an important effect on available disk space. Since .asc files are large, over time the available hard drive space on the PC or Laptop used can diminish. To prevent this from happening, the program uses a configuration setting that will delete .asc type data files after a set number of days. This setting is default 10 days but can be changed by the user by editing the relevant entry in the Misc_Parameters.xml file. This file is located in the

"C:\Pacific Power Source\HFa16\Configurations\System\Misc"

or

"C:\Pacific Power Source\HFa75\Configurations\System\Misc"

Directory depending on which HFaXX program is being used. The relevant configuration value is:

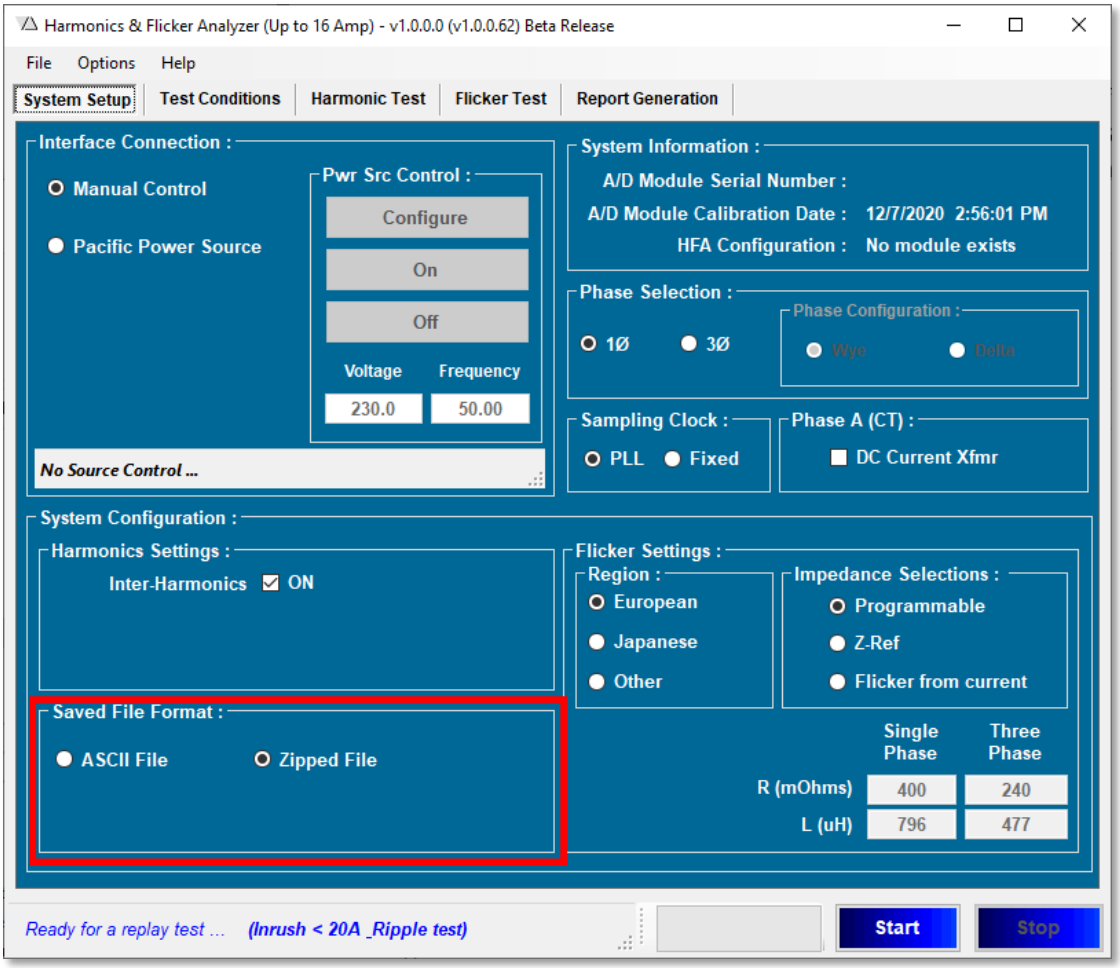
<NoOfDaysFilesToBeKept>10</NoOfDaysFilesToBeKept>

Change the default setting of "10" to a larger no. of days if you want to retain these large files longer.

To avoid this disk space issue, it is recommended to select the Zipped file type in the Test Setup screen of either HFaXX program. This setting is retained when closing the program so only needs to be set one time.

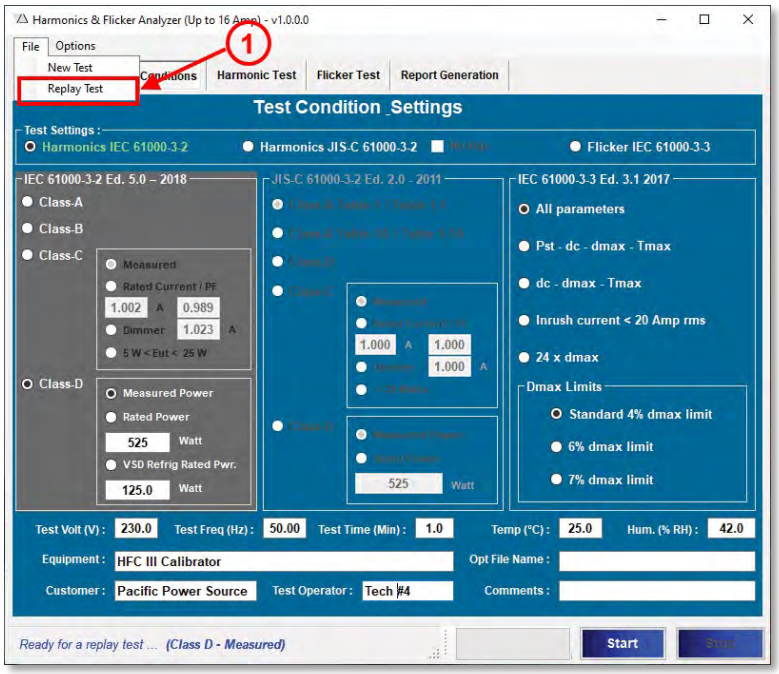
Zipped data files are not subject to this deletion after a specific number of days. They also occupy far less disk space. The tradeoff is that after each test run or Replay run, the data must be extracted (unzipped) from the relevant .zip file. This process may take a few seconds or more depending on the length of the test run and thus the size of the raw .asc file contained in the zip archive file.

This file type selection is shown in the figure below.



6.8.2 Replay Mode

This stored test data can be replayed for verification or for product demonstration purposes at any time using the "**File -> Replay Test**". See image call out 1 to the right.



To replay a file, select the RawData (*.zip) or ASCII File (*.asc) file extension in the file dialog box as shown below.

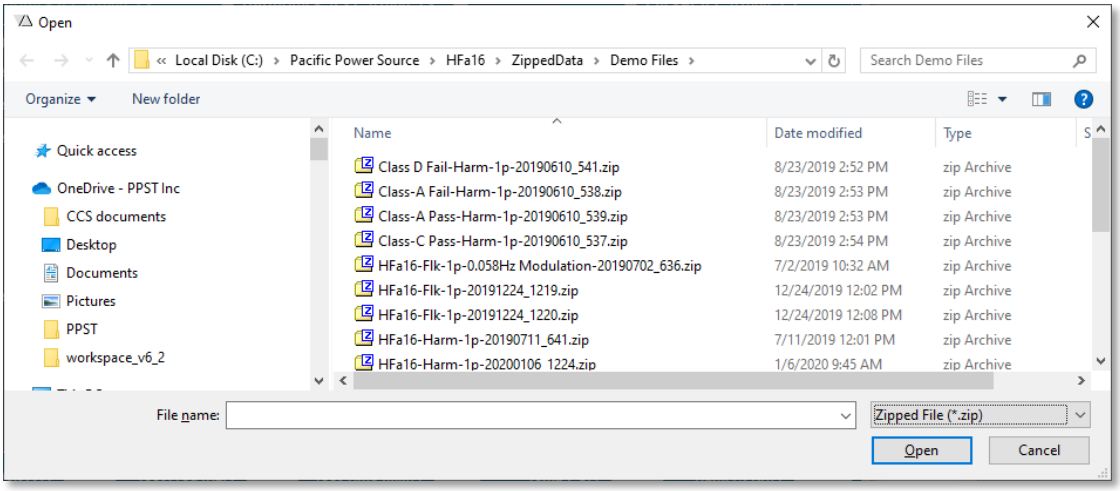


Figure 6-20: Selecting either a Zipped or an ASCII file type

Note that data display screens for both Harmonics and Flicker tests that result from replaying a previously recorded test data file are identified by a
"**Replay Mode**"
indication in the lower right hand corner of the data display window. Refer to example below.

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 6-19 and Figure 6-20 below.

The 1.5 second filter asspecified inIEC 61000-4-7 will intentionally suppress brief excursions, and the average over the full observation period will “hide” brief excursions even more. When replaying adata file, the same filtering and averaging are applied (Figure 6-19). But, if the user “steps back or forward” the unfiltered result of individual measurement windows are displayed. This allows the user to analyze and evaluate transient behavior of the equipment under test. For the illustrated case, some 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 (10 measurement windows) forward or back.

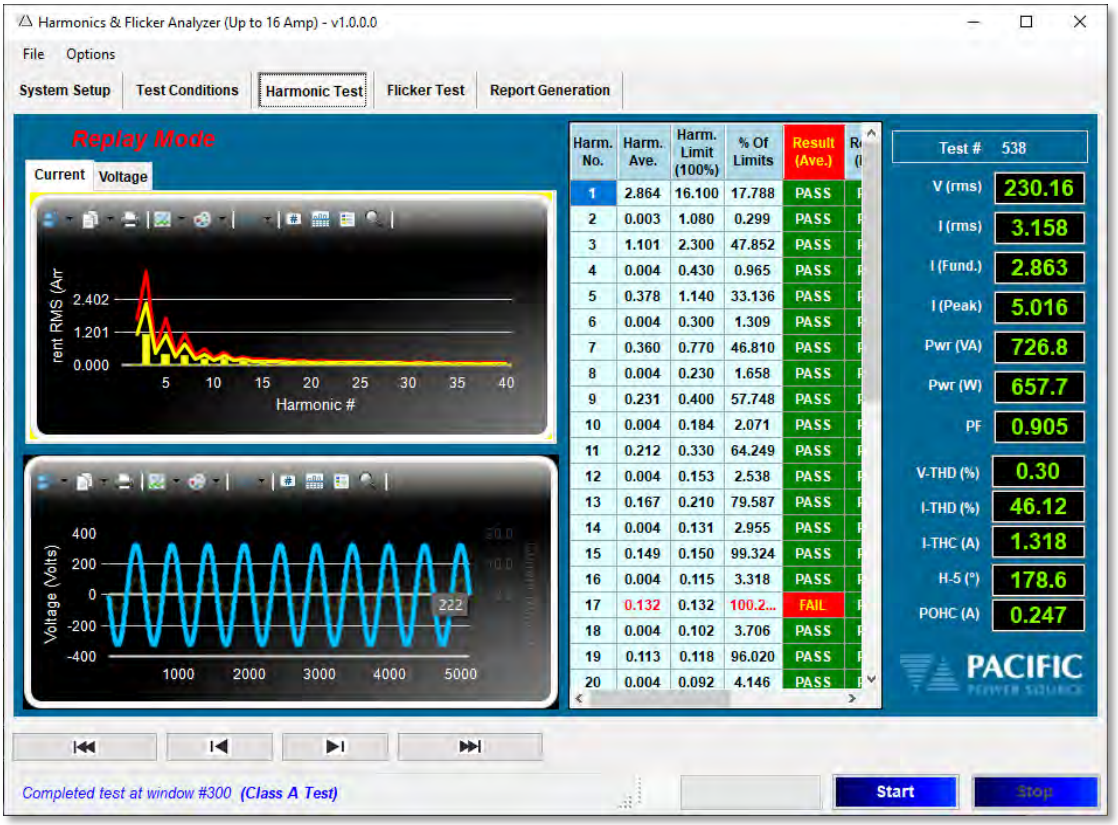


Figure 6-21: Data Averaged over the first 55 Measurement Windows

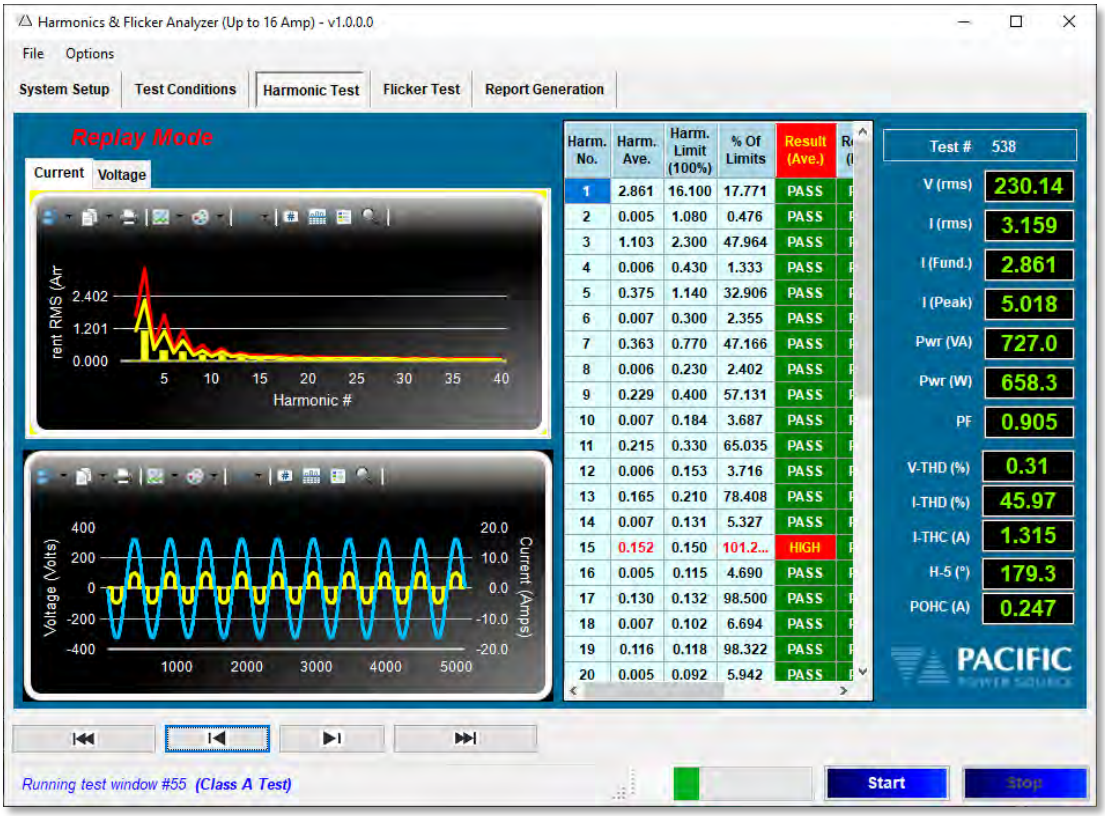


Figure 6-22: Same Unfiltered Measurement Window # 55

This screen shot clearly shows the short excursion beyond the 100 % limit.

6.8.3 Troubleshooting EUTS in Replay Mode

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

This screen shows the instant during a Flicker test when a resistive load is turned “on”:

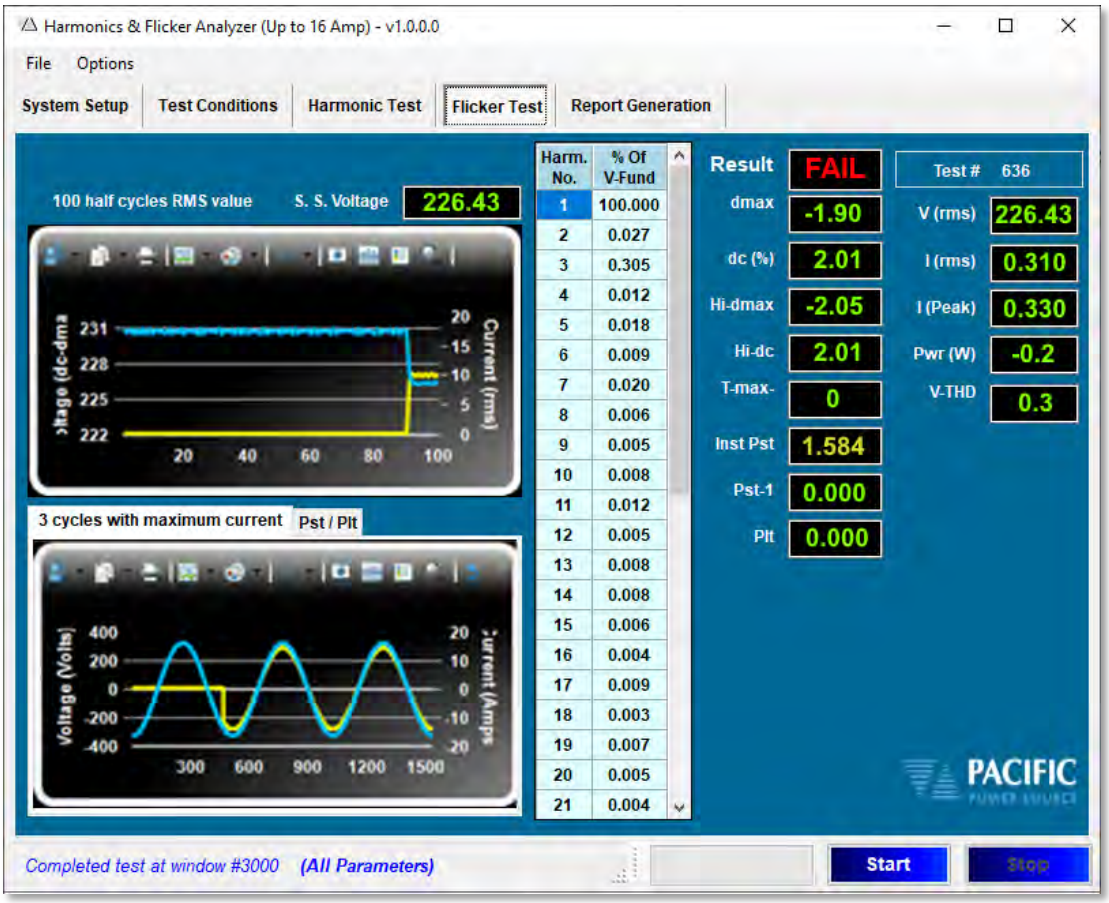


Figure 6-23: 100 Half Cycles Display in Replay Mode

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

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

Figure 6-24: Short Glitch during Harmonics Test revealed during Replay

6.9 Test Examples

This section contains several examples of several and Flicker tests and one Harmonics test performed with the ECTS2 test system.

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

In clause 7.4.3. of the standard, IEC 61000-3-2 (2018) Edition 5, offers 3 test criteria for lighting products between 5 – 25 Watt. The first two tests have been in the standard for over 10 years, the last test is new in the 2018 edition. The first criterion is to test against the limits of Table-3, column 2. These are in essence the Class-D limits.

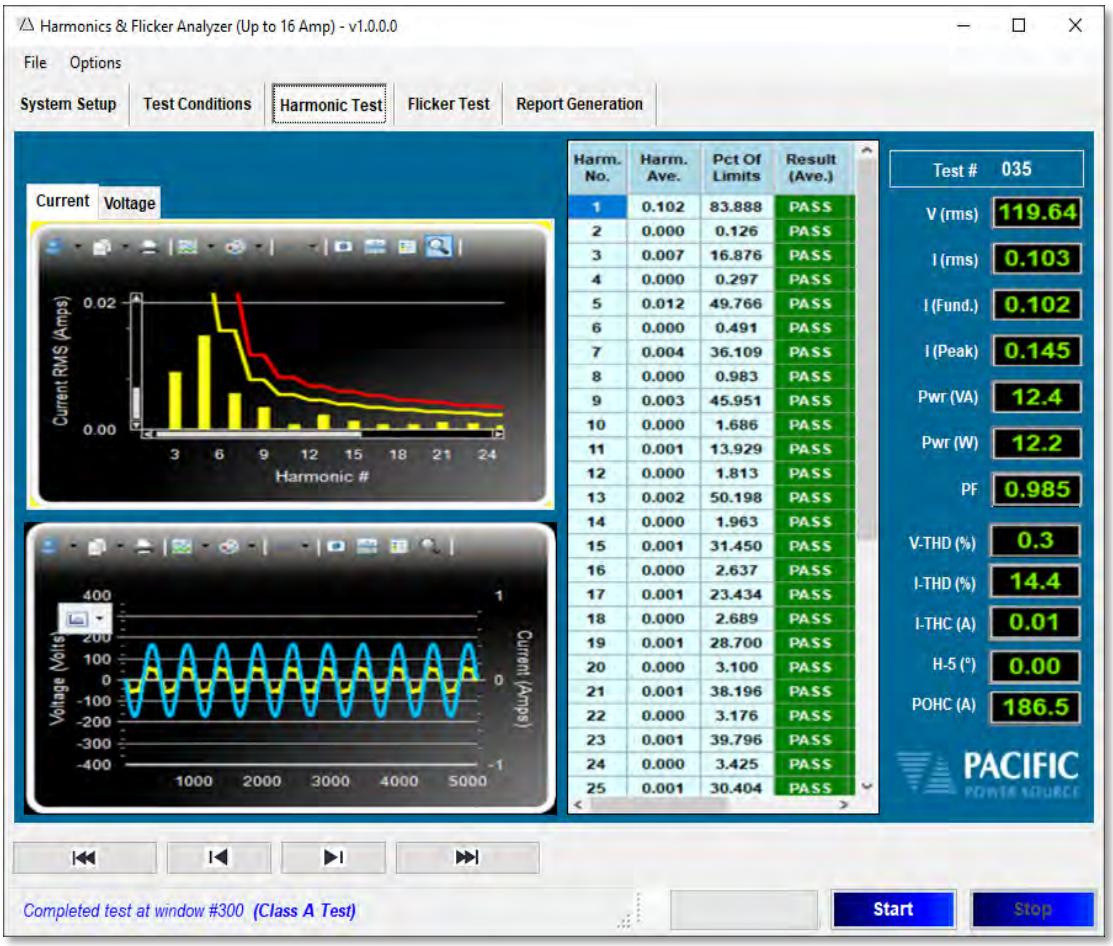


Figure 6-25: Lighting < 25 Watt meeting Table-3

The above figure shows the measurement for a 12.2 Watt LED lamp that meets the requirements. It will be obvious that if the lamp meets “the Class-D” limits, there is no need for further testing.

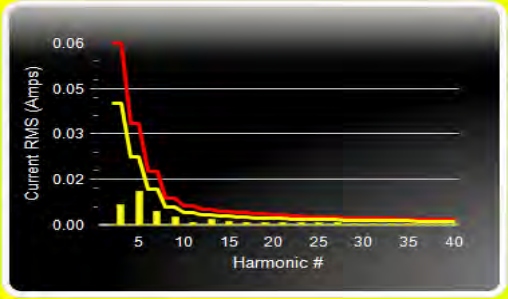
The following three pages show the test report for this lamp, being the data, the limit curve, and the harmonic levels along with the power source voltage parameters.

Test File:	**H-20190206_ 035**
EUT:	
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**

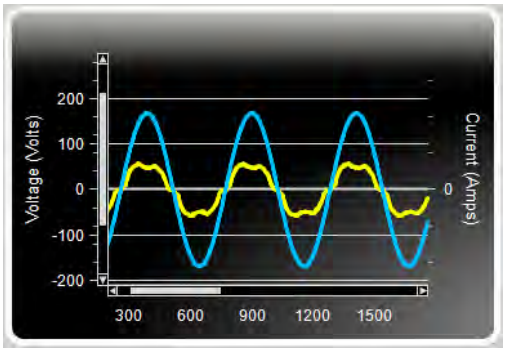
Source Qualification:	**Compliance with IEC61000-3-2**
Power Source Distortion:	OK
Customer:	**Customer**
Test By:	**Eng**
Comments:	**Comments**

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	0.000	0.041	0.126	PASS	PASS	0.000	0.062	0.084
3	0.007	0.041	16.876	PASS	PASS	0.007	0.062	11.304
4	0.000	0.023	0.297	PASS	PASS	0.000	0.035	0.204
5	0.012	0.023	49.766	PASS	PASS	0.012	0.035	33.178
6	0.000	0.012	0.491	PASS	PASS	0.000	0.018	0.335
7	0.004	0.012	36.109	PASS	PASS	0.004	0.018	24.087
8	0.000	0.006	0.983	PASS	PASS	0.000	0.009	0.709
9	0.003	0.006	45.951	PASS	PASS	0.003	0.009	30.497
10	0.000	0.004	1.686	PASS	PASS	0.000	0.006	1.053
11	0.001	0.004	13.929	PASS	PASS	0.001	0.006	9.416
12	0.000	0.004	1.813	PASS	PASS	0.000	0.005	1.165
13	0.002	0.004	50.198	PASS	PASS	0.002	0.005	33.518
14	0.000	0.003	1.963	PASS	PASS	0.000	0.005	1.365
15	0.001	0.003	31.450	PASS	PASS	0.001	0.005	21.189
16	0.000	0.003	2.637	PASS	PASS	0.000	0.004	1.820
17	0.001	0.003	23.434	PASS	PASS	0.001	0.004	15.559
18	0.000	0.002	2.689	PASS	PASS	0.000	0.004	1.881
19	0.001	0.002	28.700	PASS	PASS	0.001	0.004	19.156
20	0.000	0.002	3.100	PASS	PASS	0.000	0.003	1.759
21	0.001	0.002	38.196	PASS	PASS	0.001	0.003	25.445
22	0.000	0.002	3.176	PASS	PASS	0.000	0.003	2.156
23	0.001	0.002	39.796	PASS	PASS	0.001	0.003	26.733
24	0.000	0.002	3.425	PASS	PASS	0.000	0.003	2.406
25	0.001	0.002	30.404	PASS	PASS	0.001	0.003	20.400
26	0.000	0.002	3.441	PASS	PASS	0.000	0.003	2.419
27	0.001	0.002	33.054	PASS	PASS	0.001	0.003	22.128
28	0.000	0.002	3.905	PASS	PASS	0.000	0.002	2.611
29	0.000	0.002	13.356	PASS	PASS	0.000	0.002	9.005
30	0.000	0.002	3.844	PASS	PASS	0.000	0.002	2.579
31	0.000	0.002	14.262	PASS	PASS	0.000	0.002	9.454
32	0.000	0.001	4.155	PASS	PASS	0.000	0.002	2.912
33	0.000	0.001	17.610	PASS	PASS	0.000	0.002	11.857
34	0.000	0.001	4.299	PASS	PASS	0.000	0.002	2.974
35	0.000	0.001	18.507	PASS	PASS	0.000	0.002	12.500
36	0.000	0.001	4.564	PASS	PASS	0.000	0.002	3.347
37	0.000	0.001	8.467	PASS	PASS	0.000	0.002	5.837
38	0.000	0.001	4.597	PASS	PASS	0.000	0.002	3.092
39	0.000	0.001	12.606	PASS	PASS	0.000	0.002	8.350
40	0.000	0.001	3.819	PASS	PASS	0.000	0.002	2.724

Power Source Verification Data

Harm No.	Harm. Value	Pct Of Limits	Pct Of Vfund	Result
2	0.012	4.907	0.010	OK
3	0.362	33.495	0.302	OK
4	0.014	5.741	0.012	OK
5	0.028	5.770	0.023	OK
6	0.013	5.396	0.011	OK
7	0.073	20.191	0.061	OK
8	0.008	3.294	0.007	OK
9	0.035	14.525	0.029	OK
10	0.005	1.907	0.004	OK
11	0.014	11.374	0.011	OK
12	0.007	5.915	0.006	OK
13	0.006	5.357	0.005	OK
14	0.001	0.962	0.001	OK
15	0.009	7.393	0.007	OK
16	0.007	5.457	0.005	OK
17	0.009	7.607	0.008	OK
18	0.003	2.327	0.002	OK
19	0.006	5.254	0.005	OK
20	0.005	3.849	0.004	OK
21	0.005	4.081	0.004	OK
22	0.001	0.971	0.001	OK
23	0.003	2.687	0.003	OK
24	0.006	4.961	0.005	OK
25	0.005	4.402	0.004	OK
26	0.004	2.967	0.003	OK
27	0.005	3.810	0.004	OK
28	0.001	1.192	0.001	OK
29	0.002	1.445	0.001	OK
30	0.001	0.599	0.001	OK
31	0.002	1.289	0.001	OK
32	0.005	3.817	0.004	OK
33	0.001	0.706	0.001	OK
34	0.001	0.475	0.000	OK
35	0.002	1.334	0.001	OK
36	0.002	2.015	0.002	OK
37	0.005	4.444	0.004	OK
38	0.001	1.103	0.001	OK
39	0.002	1.374	0.001	OK
40	0.003	2.107	0.002	OK

6.9.2 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 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 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 three pages illustrate the test report. The two graphs are “zoomed in” to illustrate things better.

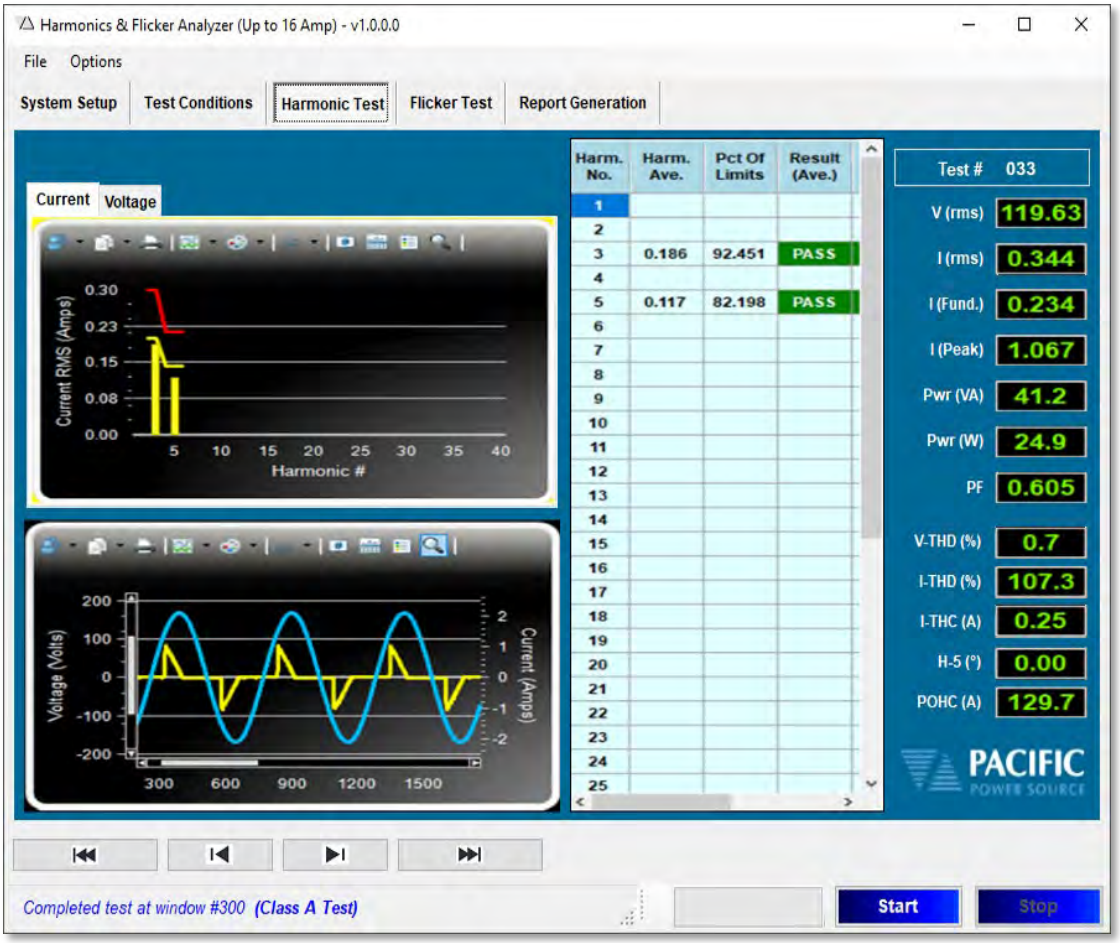


Figure 6-26: Lighting product < 25 Watt that meets the waveform criteria

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.	Pct Of Limits	Result (Ave.)	Result (Max.)	Harm. Win.	Pct Of Max
3	0.186	92.713	PASS	PASS	0.186	61.998
5	0.117	82.395	PASS	PASS	0.117	54.999

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)

Harm No.	Harm. Ave.	Pct Of Limits	Result (Ave.)	Result (Max.)	Harm. Win.	Pct Of Max
3	0.185	93.101	PASS	PASS	0.185	62.075
5	0.117	82.787	PASS	PASS	0.117	55.198

Power Source Verification Data

Harm No.	Harm. Value	Pct Of Limits	Pct Of Vfund	Result
2	0.014	5.922	0.012	OK
3	0.733	67.887	0.613	OK
4	0.018	7.530	0.015	OK
5	0.278	57.967	0.233	OK
6	0.008	3.484	0.007	OK
7	0.113	31.291	0.094	OK
8	0.011	4.615	0.009	OK
9	0.085	35.453	0.071	OK
10	0.005	2.123	0.004	OK
11	0.118	98.647	0.099	OK
12	0.006	4.616	0.005	OK
13	0.085	70.937	0.071	OK
14	0.002	1.354	0.001	OK
15	0.052	43.224	0.043	OK
16	0.008	6.537	0.007	OK
17	0.060	50.044	0.050	OK
18	0.002	1.595	0.002	OK
19	0.053	44.403	0.045	OK
20	0.005	3.801	0.004	OK
21	0.040	33.497	0.034	OK
22	0.002	1.263	0.001	OK
23	0.041	33.917	0.034	OK
24	0.001	1.090	0.001	OK
25	0.041	34.213	0.034	OK
26	0.003	2.754	0.003	OK
27	0.035	29.137	0.029	OK
28	0.001	0.498	0.000	OK
29	0.033	27.316	0.027	OK
30	0.001	1.052	0.001	OK
31	0.029	24.413	0.024	OK
32	0.002	1.854	0.002	OK
33	0.027	22.659	0.023	OK
34	0.002	2.011	0.002	OK
35	0.025	20.445	0.021	OK
36	0.003	2.745	0.003	OK
37	0.026	21.596	0.022	OK
38	0.001	1.016	0.001	OK
39	0.025	20.864	0.021	OK
40	0.004	3.209	0.003	OK

6.9.3 Sample no. 3 for Class-C < 25 Watt

If the tested product fails the first two 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 (lower) limits for the harmonics 2 – 11. The screen shot below illustrates the results of a tested CFL type lamp that fails all three test criteria. First it fails the Class-D limits, so the software automatically "goes to" the waveform test, when it also fails the waveform test, the software performs the THD test, and when it fails this also, the test reports reflects this.

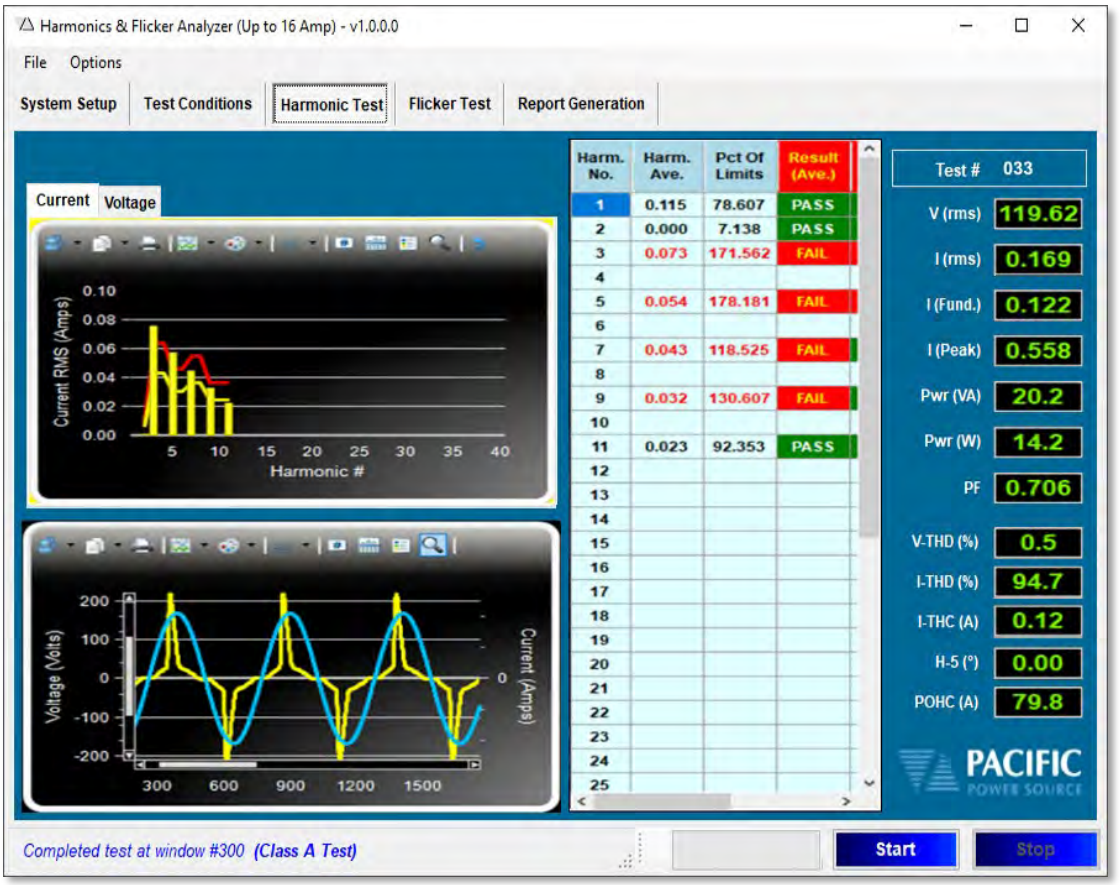


Figure 6-27: Lighting product < 25 Watt that fails all 3 tests per Clause 7 of IEC 61000-3-2 (2018)

So, to 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 fails, it reports the FAIL condition for all three conditions in clause 7.4.3. of the standard. The next pages show the test report for this case. **In several cases, the tables and page displays were edited to save some space. The actual report may show more rows etc.**

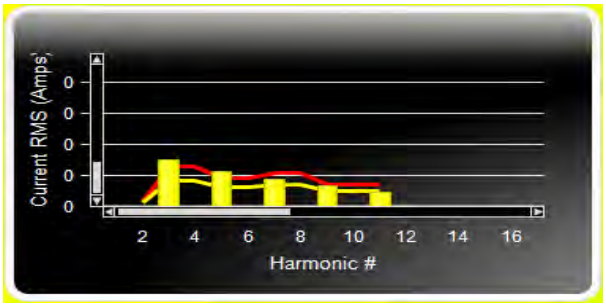
Test File:	**H-20190308_ 037**
EUT:	
Test Class:	**(Class C - < 25 Watts)**
Test Result:	FAIL - All (7.4.3)
Test Date:	**3/8/2019**

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:	**Eng**
Comments:	**Comments**

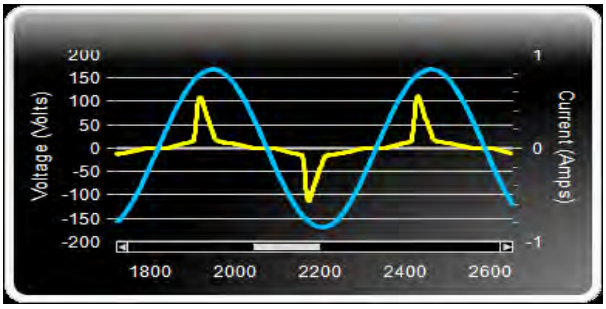
General Test Data: (Phase A)

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 (%):	**94.73**	**I-THD Limit (%):**	**70.00**

Harmonic Spectrum



Voltage & Current Waveform



Current Harmonics (average 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

Power Source Verification Data

Harm No.	Harm. Value	Pct Of Limits	Pct Of Vfund	Result
2	0.016	6.539	0.013	OK
3	0.535	49.526	0.447	OK
4	0.020	8.272	0.017	OK
5	0.137	28.464	0.114	OK
6	0.007	3.027	0.006	OK
7	0.081	22.506	0.068	OK
8	0.011	4.741	0.010	OK
9	0.104	43.269	0.087	OK
10	0.003	1.154	0.002	OK
11	0.040	33.343	0.033	OK
12	0.009	7.176	0.007	OK
13	0.037	31.067	0.031	OK
14	0.003	2.763	0.003	OK
15	0.036	29.819	0.030	OK
16	0.008	6.343	0.006	OK
17	0.018	15.153	0.015	OK
18	0.002	1.911	0.002	OK
19	0.023	18.864	0.019	OK
20	0.004	3.412	0.003	OK
21	0.016	13.493	0.014	OK
22	0.001	0.919	0.001	OK
23	0.013	11.070	0.011	OK
24	0.006	4.678	0.005	OK
25	0.014	11.466	0.012	OK
26	0.005	4.420	0.004	OK
27	0.010	8.071	0.008	OK
28	0.002	1.831	0.002	OK
29	0.005	4.261	0.004	OK
30	0.001	0.540	0.001	OK
31	0.006	4.838	0.005	OK
32	0.002	1.504	0.002	OK
33	0.005	4.391	0.004	OK
34	0.001	0.957	0.001	OK
35	0.002	1.413	0.001	OK
36	0.004	3.416	0.003	OK
37	0.002	1.978	0.002	OK
38	0.002	1.832	0.002	OK
39	0.006	4.729	0.005	OK
40	0.002	1.602	0.002	OK

6.9.4 Class-D Test example

The two screen shots below are for the same Class-D test. The HFC-III calibrator was set to produce harmonics that fail the Class-D limits.

The software allows the user to “expand” the display, and zoom in on the graphs. To the right is the standard HFa display, while the figure below shows the display with “zoomed in” spectrum and waveform display.

Figure 6-28: The Class-D test screen

Generally, the limit lines are too close the harmonics to see if the harmonics exceeded the limits or not. The numerical data is more meaningful. The user can however zoom in the get a better view of the graphs. The following pages show the Class-D 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, etc.

Figure 6-29: The Class-D display with "zoomed" in graphs

6.9.5 Class D Test Report

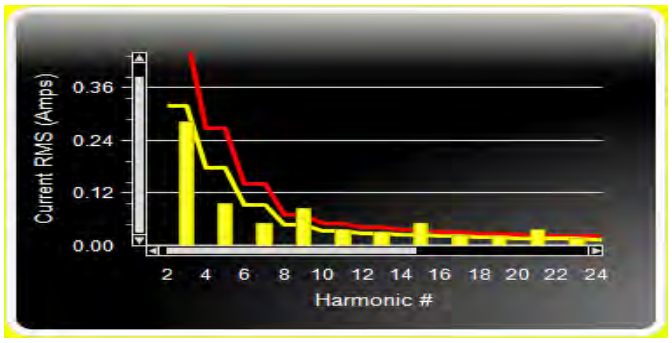
Test File:	**H-20190616_ 541**
EUT:	**Equipment**
Test Class:	**(Class D - Measured)**
Test Result:	**FAIL**
Test Date:	**6/10/2019**
Start Time:	**1:26:01**
Stop Time:	**6/10/2019 1:27:37**
Test Duration (min):	**1**

Source Qualification:	**Compliance with IEC61000-3-2**
Power Source Distortion:	**OK**
Customer:	**PPS**
Test By:	**Cal. Lab**
Comments:	**Class-D non-mitigated**

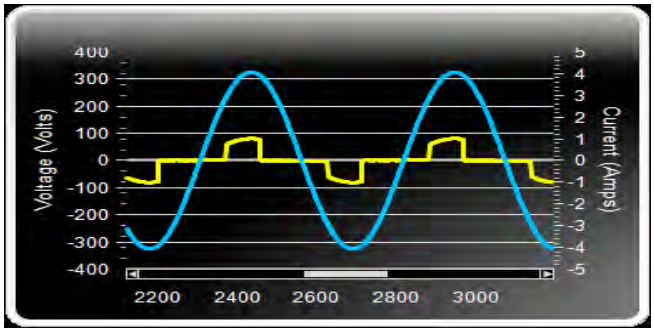
General Test Data: (Phase A)

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	0.000	0.323	0.103	PASS	PASS	0.000	0.484	0.073
3	0.287	0.323	88.925	PASS	PASS	0.287	0.484	59.292
4	0.000	0.180	0.178	PASS	PASS	0.000	0.271	0.133
5	0.096	0.180	53.143	PASS	PASS	0.096	0.271	35.436
6	0.000	0.095	0.505	PASS	PASS	0.001	0.142	0.358
7	0.052	0.095	54.681	PASS	PASS	0.052	0.142	36.453
8	0.000	0.047	0.696	PASS	PASS	0.000	0.071	0.518
9	0.086	0.047	180.596	FAIL	FAIL	0.086	0.071	120.418
10	0.000	0.033	0.957	PASS	PASS	0.000	0.050	0.707
11	0.037	0.033	111.364	FAIL	PASS	0.037	0.050	74.267
12	0.000	0.028	1.687	PASS	PASS	0.001	0.042	1.197
13	0.031	0.028	108.553	FAIL	PASS	0.031	0.042	72.363
14	0.000	0.024	1.320	PASS	PASS	0.000	0.037	0.986
15	0.051	0.024	209.134	FAIL	FAIL	0.051	0.037	139.453
16	0.000	0.021	1.799	PASS	PASS	0.000	0.032	1.279
17	0.022	0.021	102.952	FAIL	PASS	0.022	0.032	68.674
18	0.000	0.019	2.374	PASS	PASS	0.000	0.029	1.687
19	0.022	0.019	113.922	FAIL	PASS	0.022	0.029	75.939
20	0.000	0.017	1.823	PASS	PASS	0.000	0.026	1.352
21	0.036	0.017	208.598	FAIL	FAIL	0.036	0.026	139.103
22	0.000	0.016	2.178	PASS	PASS	0.000	0.024	1.597
23	0.015	0.016	97.043	PASS	PASS	0.015	0.024	64.741
24	0.000	0.015	3.210	PASS	PASS	0.000	0.022	2.274
25	0.017	0.015	119.220	FAIL	PASS	0.017	0.022	79.472
26	0.000	0.014	2.231	PASS	PASS	0.000	0.020	1.683
27	0.028	0.014	205.984	FAIL	FAIL	0.028	0.020	137.376
28	0.000	0.013	2.669	PASS	PASS	0.000	0.019	1.977
29	0.012	0.013	91.686	PASS	PASS	0.012	0.019	61.184
30	0.000	0.012	3.970	PASS	PASS	0.000	0.018	2.802
31	0.015	0.012	123.662	FAIL	PASS	0.015	0.018	82.431
32	0.000	0.011	2.881	PASS	PASS	0.000	0.017	2.144
33	0.023	0.011	204.696	FAIL	FAIL	0.023	0.017	136.517
34	0.000	0.010	3.267	PASS	PASS	0.000	0.016	2.390
35	0.009	0.010	86.862	PASS	PASS	0.009	0.016	57.978
36	0.000	0.010	4.619	PASS	PASS	0.000	0.015	3.291
37	0.013	0.010	127.029	FAIL	PASS	0.013	0.015	84.684
38	0.000	0.009	3.161	PASS	PASS	0.000	0.014	2.377
39	0.019	0.009	203.362	FAIL	FAIL	0.019	0.014	135.655
40	0.000	0.009	3.353	PASS	PASS	0.000	0.014	2.367

Power Source Verification Data

Harm No.	Harm. Value	Pct Of Limits	Pct Of Vfund	Result
2	0.109	23.628	0.047	OK
3	0.663	32.020	0.288	OK
4	0.029	6.265	0.013	OK
5	0.074	8.081	0.032	OK
6	0.032	6.990	0.014	OK
7	0.032	4.701	0.014	OK
8	0.021	4.565	0.009	OK
9	0.091	19.840	0.040	OK
10	0.024	5.220	0.010	OK
11	0.018	7.877	0.008	OK
12	0.011	4.994	0.005	OK
13	0.032	13.799	0.014	OK
14	0.020	8.728	0.009	OK
15	0.042	18.263	0.018	OK
16	0.027	11.632	0.012	OK
17	0.030	12.911	0.013	OK
18	0.016	6.838	0.007	OK
19	0.013	5.515	0.006	OK
20	0.017	7.444	0.007	OK
21	0.021	9.305	0.009	OK
22	0.011	4.899	0.005	OK
23	0.008	3.651	0.004	OK
24	0.007	2.916	0.003	OK
25	0.025	10.955	0.011	OK
26	0.011	4.603	0.005	OK
27	0.030	12.942	0.013	OK
28	0.013	5.601	0.006	OK
29	0.006	2.678	0.003	OK
30	0.010	4.376	0.004	OK
31	0.022	9.665	0.010	OK
32	0.008	3.387	0.003	OK
33	0.037	16.040	0.016	OK
34	0.004	1.829	0.002	OK
35	0.006	2.769	0.003	OK
36	0.003	1.379	0.001	OK
37	0.025	11.056	0.011	OK
38	0.001	0.633	0.001	OK
39	0.033	14.440	0.014	OK
40	0.005	2.314	0.002	OK

6.10 Advanced user defined options

There are several settings that the user can change to be control the behavior of the program.

6.10.1 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, instead of the presently valid edition 5.0 of the standard.

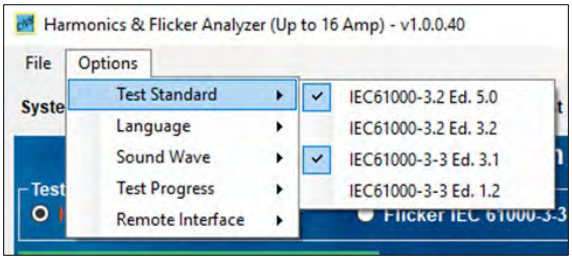
Edition 3.2 does not provide for some capabilities that are specified in Edition 5.0. These are:

- 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.

Figure 6-30: Test Settings for IEC 61000-3-2, Ed. 3.2 versus Ed 5.0

To change settings, user the Options Menu -> Test Standards entry. Refer to section 6.4.1 on page 36.

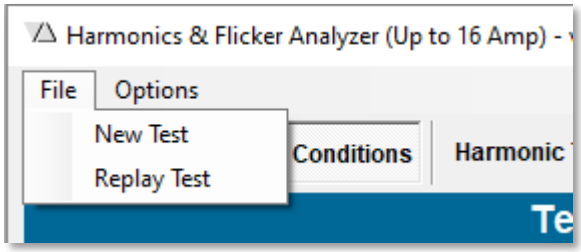


6.10.2 Customizing Report Headers

The folder “C:\Pacific Power Source\HFa\Test Reports\RTF\Templates” contains a “ReportTemplate.xml” XML format file. The user can edit this file to enter a name and other info that will appear as header is the test reports.

```
<?xml version="1.0" encoding="utf-8" standalone="yes"?>
<HFa>
 <ReportTemplate>
        <ReportOem>Pacific Power Source, Inc.</ReportOem>
 </ReportTemplate>
</HFa>
```

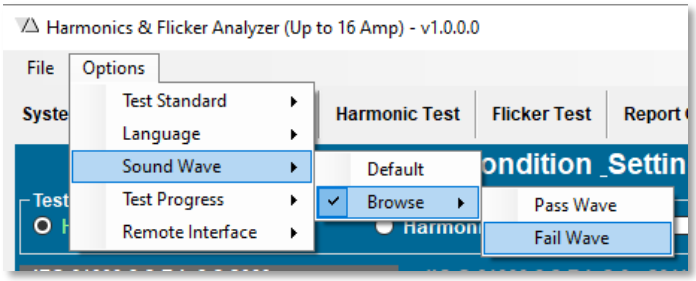
6.10.3 Demo File Replay



The user can select one of the demo files (used to generate this manual) and replay those files.

6.10.4 Customizing Pass and Fail Sounds

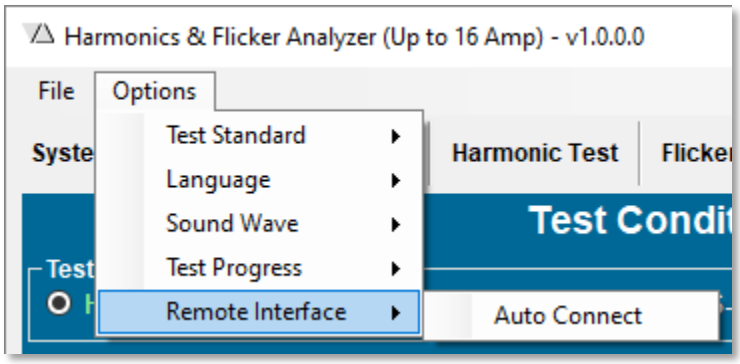
The system has a couple default sound files that it will play when a test is finished. The user can change those files to play a specific tune.



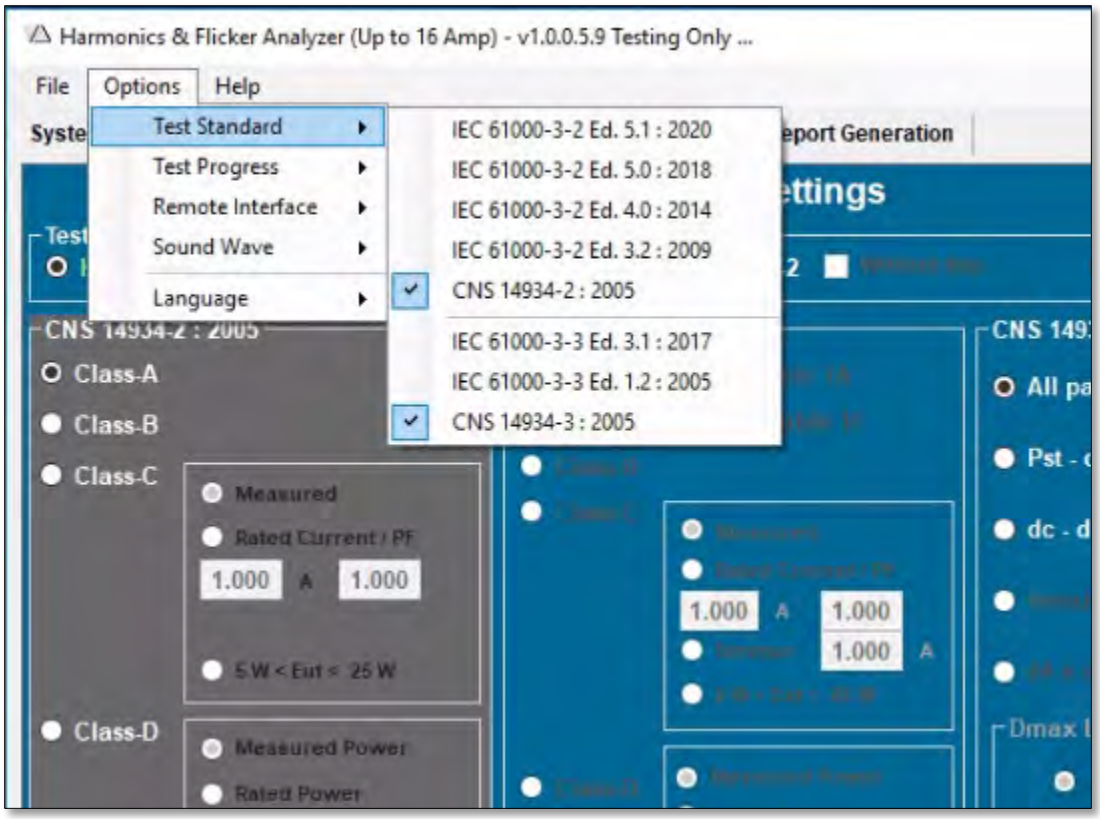
6.10.5 Setting Auto Connector Power Source Interface

The user can select “Auto Connect” which means that the software will “look” for the same PC interface that we defined earlier.

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



6.10.6 Chinese CNS 14934-2 and CNS 14934-3 Test Standard selection



These Harmonics and Flicker test standards are mostly used in China and Taiwan and can be enabled by setting the appropriate flag in the Misc_parameters.xml file located at:

C:\Pacific Power Source\HFa16\Configurations\System\Misc\Misc_parameters.xml

To enable selection of these test standards, set the MenuStripCNSEnabled setting in the UIObject section to **true**.

Edit file "Misc_parameters.xml" using a text editor:

```
<UiObjects>
      <ResultTmrInterval>900</ResultTmrInterval>
      <Btn1PhaseEnabled>true</Btn1PhaseEnabled>
      <Btn1PForm3Enabled>false</Btn1PForm3Enabled>
      <MenuStripCNSEnabled>true</MenuStripCNSEnabled>
</UiObjects>
```

The hide these test menu selections - default setting after installation – set this field to **false**.

```
<UiObjects>
      <ResultTmrInterval>900</ResultTmrInterval>
      <Btn1PhaseEnabled>true</Btn1PhaseEnabled>
      <Btn1PForm3Enabled>false</Btn1PForm3Enabled>
      <MenuStripCNSEnabled>false</MenuStripCNSEnabled>
</UiObjects>
```

Note: HFa software has to be restarted to have these settings take effect.

6.10.7 HFa16 Operation Miscellaneous User Preference Settings

This sections covers user preference settings for several aspects of the HFa16 Software operation relating to the AC power source state and other user preference selections.

AC Power Source Behavior Settings

The <MiscParams> section of the "Misc_Parameters.xml" configuration file contains two entries that control the state of the AC power source output when the program is closed and when communication with the power source is established using the HFa program.

```
<?xml version="1.0" encoding="utf-8" standalone="yes"?>
<HFa>
  <MiscParams>
      <CmdDelays>300</CmdDelays>
      <DebugEnable>0</DebugEnable>
      <CloseHfaWithPowerOff>false</CloseHfaWithPowerOff>
      <ConnectWithPowerOff>false</ConnectWithPowerOff>
      <FreqToleranceHz>2.0</FreqToleranceHz>
  </MiscParams>
```

The **CloseHfaWithPowerOff** parameter default is false so unless changed to 'true' by the user, the AC power source output will remain ON when the HFa16 program is closed. This avoids having the turn the EUT back on and allowing it to reboot between harmonics or flicker tests and other tests such as IEC 61000-4-11 voltage dips.

If this parameter is changed to “true” by the user, the AC source output will be turned off when the HFa16 program is closed.

Note: Changes in settings for any .xml file take effect once the program is restarted.

The **ConnectWithPowerOff** parameter default is false so unless changed to ‘true’ by the user, the AC power source output will remain ON when the HFa16 program connects to the AC power source.

If this parameter is changed to “true” by the user, the AC source output will be turned off when the HFa16 program connects to it using the selected interface type.

Frequency Tolerance Setting

```
<?xml version="1.0" encoding="utf-8" standalone="yes"?>
<HFa>
  <MiscParams>
      <CmdDelays>300</CmdDelays>
      <DebugEnable>0</DebugEnable>
      <CloseHfaWithPowerOff>false</CloseHfaWithPowerOff>
      <ConnectWithPowerOff>false</ConnectWithPowerOff>
      <FreqToleranceHz>2.0</FreqToleranceHz>
  </MiscParams>
```

The **FreqToleranceHz** parameter determines the frequency tolerance allowed in percent during harmonics testing and during flicker pre-test. The default setting value is 2%.

Class D EUT tests with power < 75 Watt

```
  <TestParams>
      <DefaultedTestNumber>0</DefaultedTestNumber>
      <AudioTmrInterval>1000</AudioTmrInterval>
      <VirtualImpedance>0.42</VirtualImpedance>
      <Delays24dmaxTest>300</Delays24dmaxTest>
      <Threshold24dmax>0.5</Threshold24dmax>
      <FlkTestMarginPct>100</FlkTestMarginPct>
      <HarmTestMarginPct>100</HarmTestMarginPct>
      <EvaluateLess75WTest>true</EvaluateLess75WTest>
  </TestParams>
```

The **EvaluateLess75WTest** setting determines if the HFa16 program will evaluate test results for Class D loads with a power level less than 75W. The default setting is true.

6.10.8 HFa75 Operation Miscellaneous User Preference Settings

This sections covers user preference settings for several aspects of the HFa75 Software operation relating to the AC power source state and other user preference selections.

AC Power Source Behavior Settings

The <MiscParams> section of the "Misc_Parameters.xml" configuration file contains two entries that control the state of the AC power source output when the program is closed and when communication with the power source is established using the HFa program.

```
<?xml version="1.0" encoding="utf-8" standalone="yes"?>
<HFa>
  <Params>
      <MaxCurrAllow>76.0</MaxCurrAllow>
      <VRange></VRange>
      <ImpStateOn>ON</ImpStateOn>
      <ImpStateOff>OFF</ImpStateOff>
      <CmdDelays>100</CmdDelays>
      <DebugEnable>0</DebugEnable>
      <CloseHfaWithPowerOff>false</CloseHfaWithPowerOff>
      <ConnectWithPowerOff>false</ConnectWithPowerOff>
      <FreqToleranceHz>2.0</FreqToleranceHz>
```

The **CloseHfaWithPowerOff** parameter default is false so unless changed to 'true' by the user, the AC power source output will remain ON when the HFa75 program is closed. This avoids having the turn the EUT back on and allowing it to reboot between harmonics or flicker tests and other tests such as IEC 61000-4-11 voltage dips.

If this parameter is changed to "true" by the user, the AC source output will be turned off when the HFa75 program is closed.

Note: Changes in setting for any .xml file take effect once the program is restarted.

The **ConnectWithPowerOff** parameter default is false so unless changed to 'true' by the user, the AC power source output will remain ON when the HFa75 program connects to the AC power source.

If this parameter is changed to "true" by the user, the AC source output will be turned off when the HFa75 program connects to it using the selected interface type.

Frequency Tolerance Setting

```
<?xml version="1.0" encoding="utf-8" standalone="yes"?>
<HFa>
  <Params>
      <MaxCurrAllow>76.0</MaxCurrAllow>
      <VRange></VRange>
      <ImpStateOn>ON</ImpStateOn>
      <ImpStateOff>OFF</ImpStateOff>
      <CmdDelays>100</CmdDelays>
      <DebugEnable>0</DebugEnable>
```

```
<CloseHfaWithPowerOff>false</CloseHfaWithPowerOff>
<ConnectWithPowerOff>false</ConnectWithPowerOff>
<FreqToleranceHz>2.0</FreqToleranceHz>
```

The **FreqToleranceHz** parameter determines the frequency tolerance allowed in percent during harmonics testing and during flicker pre-test. The default setting value is 2%.

7 Software Installation Instructions

7.1 Preface

This section describes the required software installation steps in detail. Typically, ECTS2 harmonics and flicker test systems are shipped with a suitable PC, monitor and keyboard and all required software and drivers pre-installed and test.

If the need arises to install the software on a new or different PC or Laptop, follow the instructions in this manual section to install all required drivers and HFa application software.

There are three software components that need to be installed to support HFa operation. They are:

1.	**Instacal** Utility Software	Includes A/D conversion and USB drivers.
2.	**NI-VISA** Utility	Supports power source control via USB, LAN GPIB or RS232.
3.	**HFa** Application Software	Performs all measurements, data processing, analysis, display and reporting for Harmonics and Flicker.
4.	**Calibration File**	Copy the calibration file that came with your unit to the "*C:\Pacific Power Source\HFa directory*", or – alternatively – run the calibration utility.

7.2 Windows Operating Systems Supported

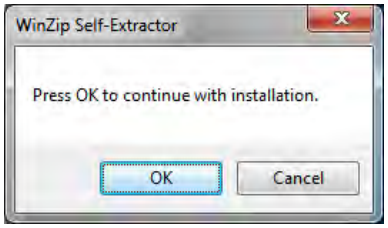
Recommended operating system for all ECTS2 test systems is Microsoft Windows 10. Older versions like Windows 7 or 8 may still be used but are not recommended and support for these older operating systems for future releases for HFa software is **not** guaranteed.

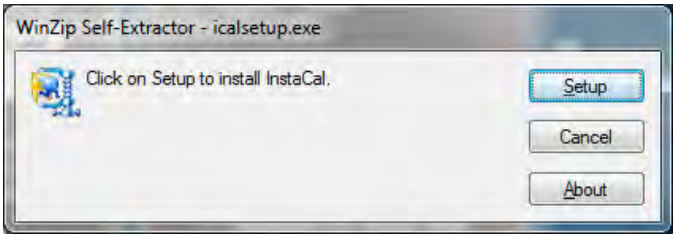
7.3 DAQ Driver and Instacal Utility Software Installation v6.7.2

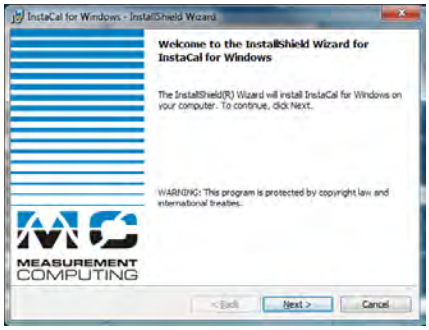
This version supports Windows 10. For Windows 11, see next section. The data acquisition system that is used to measure all voltage, current and power parameters of the unit under test and provides digitized data for processing of Harmonics and Flicker data requires device drivers to be installed.

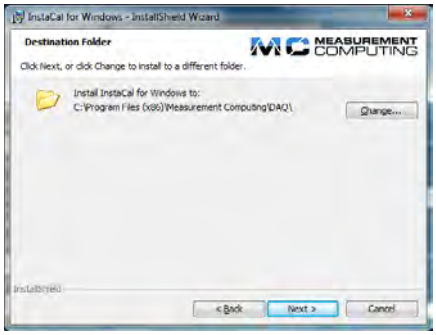
1. The HFMM-1 utilizes a 16 bit A/D sub-system. A generic driver is required to facilitate communications between a PC, via a USB-2 or USB-3 port, and the data acquisition module inside the HFMM-1 chassis. The generic driver is installed as part of the **Instacal** utility software using the "**icalsetup.exe**".setup program. The exceutable file is located on the provided system CD or a part of the downloadable setup archive.
2. Insert the system CD into the drive of your PC, and locate the "icalsetup.exe" in the main directory of the CD.
3. After the exceutable loads, it may ask for permission the change system files (messages may differ slightly for Windows 7, 8, 10 or Windows 10).

4. 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”.

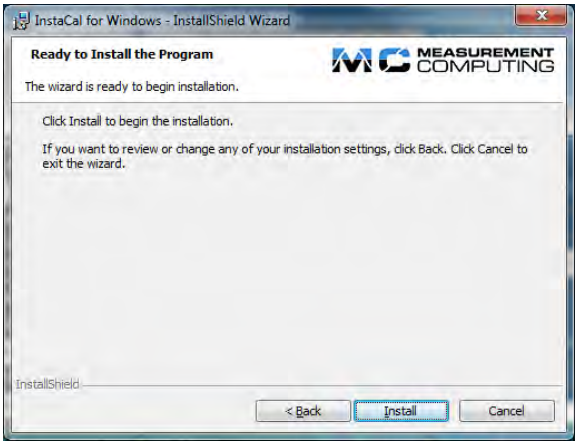








A couple pop-up windows will appear with a copyright notice, and an install directory. You click on “Next” several times to continue installation. Finally, the InstallShield program will show the next window that lets you start the actual driver installation. (shown on the right ▶)



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.

Thisprocess completes the driver and utility software installation. Next you need to install the VISA drivers that are needed to control the programmable AC power source.

7.4 DAQ Driver and Instacal Utility Software Installation v6.7.3

This version supports both Windows 10 and Windows 11. The data acquisition system that is used to measure all voltage, current and power parameters of the unit under test and provides digitized data for processing of Harmonics and Flicker data requires device drivers to be installed. The DAQami device driver **must** be selected (default). The Instacal utility program is not strictly required for HFa support but can be useful for troubleshooting if the need ever arise and is recommended (default). The ULx for LabView is not required for HFa support but may be selected is LabView .program development is relevant.

1. The HFMM-1 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 data acquisition module inside the HFMM-1 chassis. The generic driver utility is called DAQami and the setup executable is called "**w11-icalsetup.exe**". The exceutable file is located on the provided system CD or a part of the downloadable setup archive.
2. Insert the system CD into the drive of your PC, and locate the "icalsetup.exe" in the main directory of the CD.
3. After the exceutable loads, it may ask for permission the change system files (messages may differ slightly for Windows 7, 8, 10 or Windows 11).
4. 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".

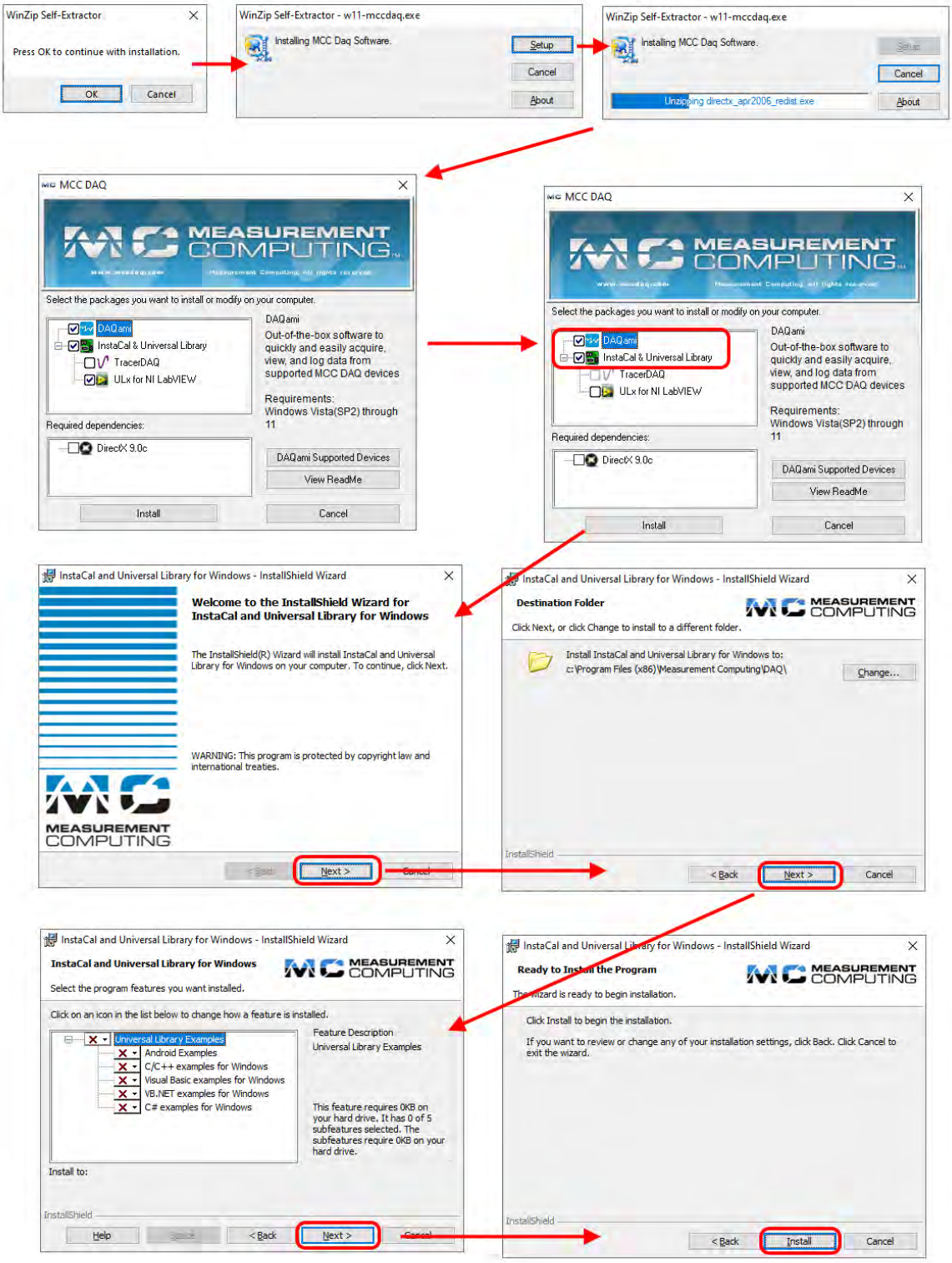
The installation process will consists of a series of Dialog boxes that require the operator to click on Next or Install button. See the next three pages for the sequence of dialogs to follow.

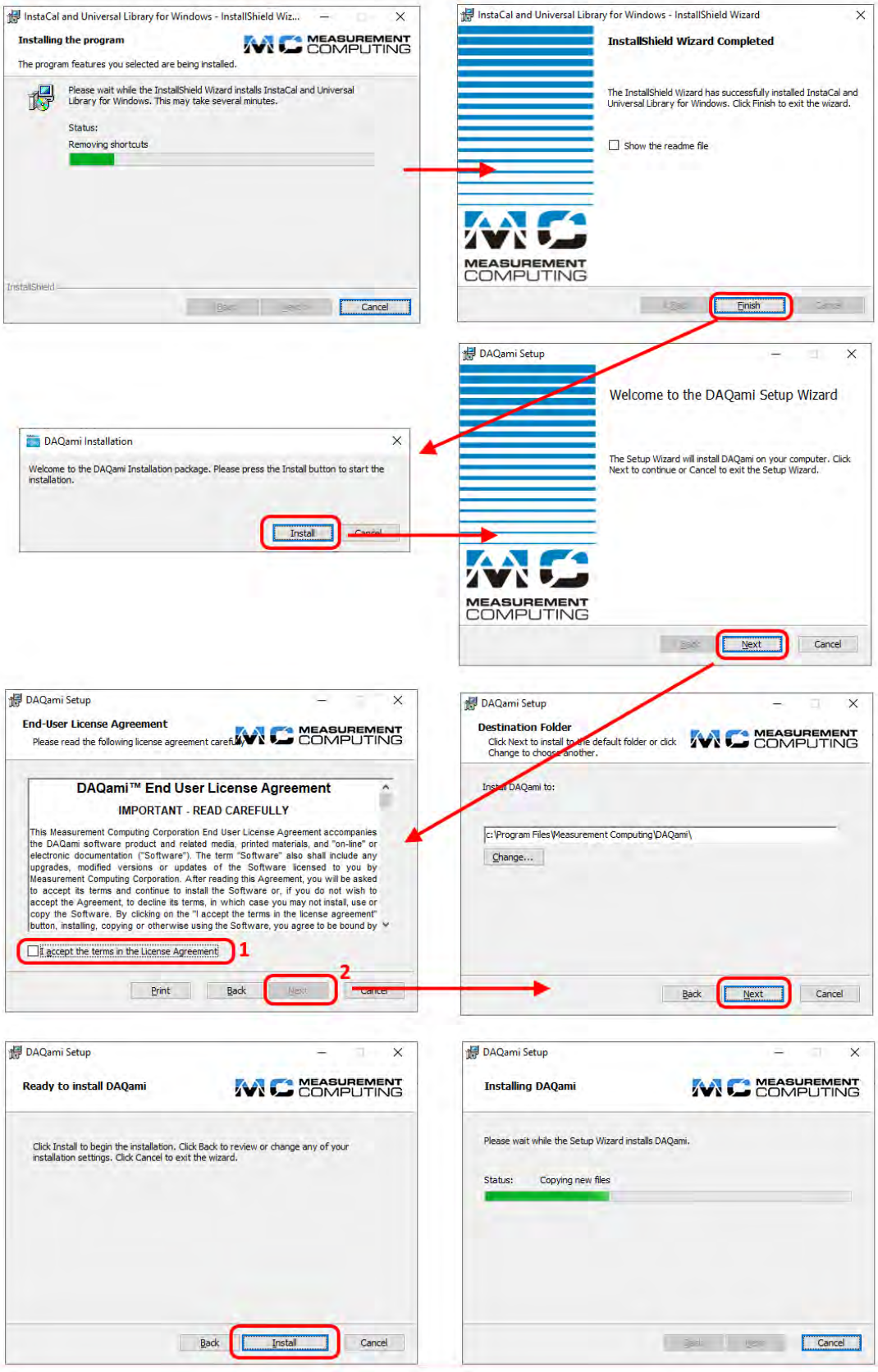
A couple pop-up windows will appear with a copyright notice, and an install directory. You click on "Next" several times to continue installation. Finally, the InstallShield program will show the next window that lets you start the actual driver installation.

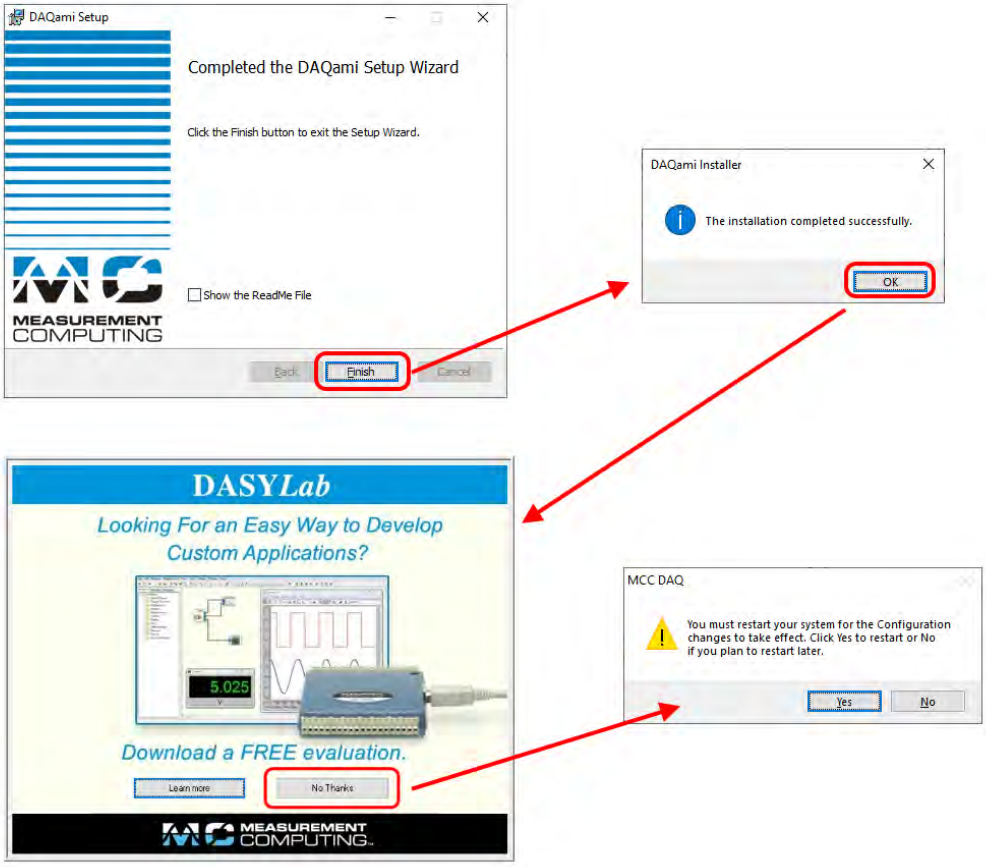
Click on Install, and the installation process will create directories and copy the driver files. If it finds existing files, it may delete these and install the newer driver files. This may take a couple minutes to complete.

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 driver and utility software installation. Next you need to install the VISA drivers that are needed to control the programmable AC power source.







7.5 Installing the VISA utility.

The National Instruments VISA drivers are used by the HFa application program to control the programamble AC power source. Multiple models from both Pacific Power Source and Pacific Power Source are supported by the HFa software.

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

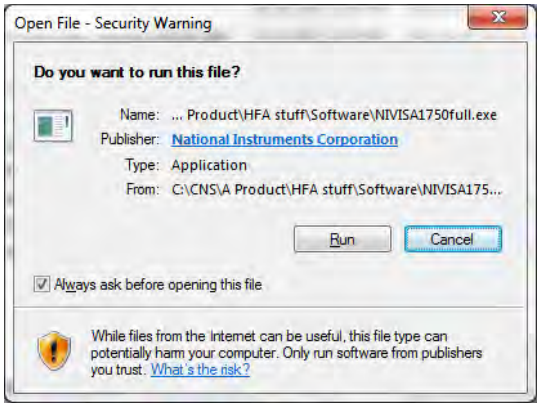
1. The Virtual Instrument Software Architecture (VISA) is a standard for configuring, programming, and troubleshooting instrumentation systems comprising GPIB, VXI, PXI, Serial, Ethernet, and/or USB interfaces. VISA provides the programming interface between the hardware and development environments such as the National Instruments LabVIEW, LabWindows/CVI, and Microsoft Visual Studio.
2. MicroSoft Visual Studio is used to develop the HFa software. Many programmable power sources use the LAN, 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 or NI-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.

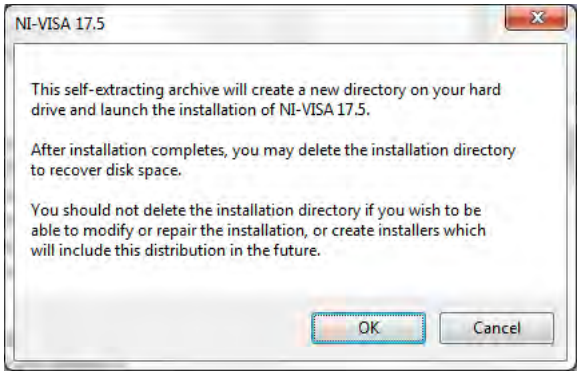
You can download the VISA utility from the NI web site, via the link below;

http://search.ni.com/nisearch/app/main/p/bot/no/ap/tech/lang/en/pg/1/sn/catnav:du,n8:3.1637,ssnav:sup/

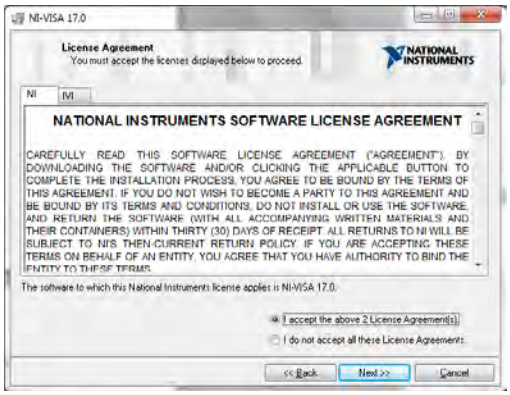
For your convenience, a copy of the VISA install is included on the HFMM-1 system CD. The progam is called "**NIVISA1750full.exe**". Versions 17.0 and 17.5 were tested to work properly with the HFa program at the time of its release. Newer version of the NI-VISA drivers may become available and should be backward compatible.

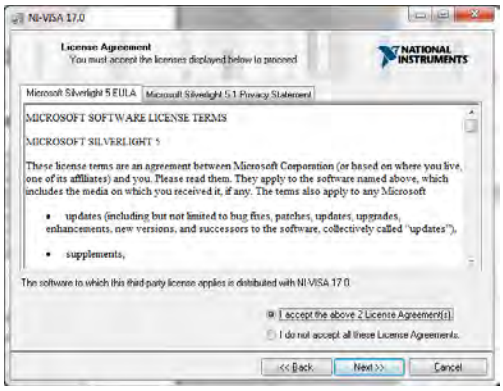
To install the VISA utility, you download the executable from the NI web site, or run it from the CD that comes with the HFa.





The process is very similar to the Instacal installation 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 NI VISA installation completes.





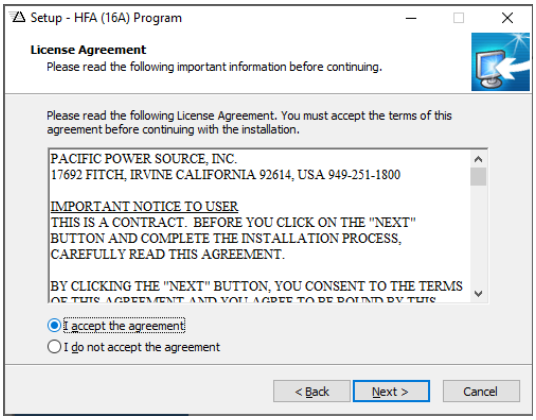
7.6 Installing the HFA Sotware Suite

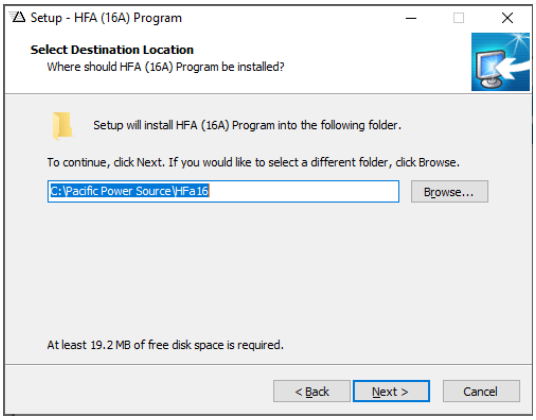
The software CD that comes with the HFMM-1, includes an install executable, called;

HFA Program PPS Version 1.0.x.x.exe

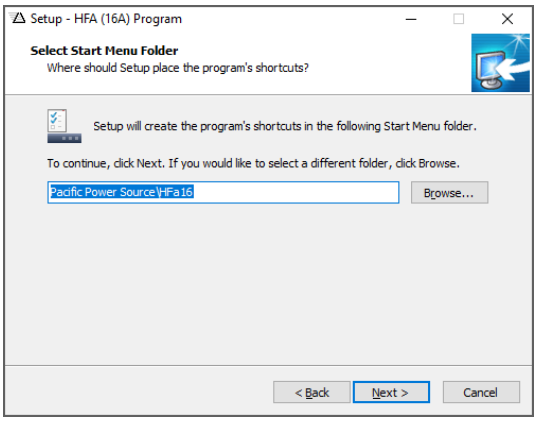
where the “x.x” indentify the software version no. Running the executable will result in a number of pop-up windows, similar to the Instacal and VISA utilities installation. Depending on your Windows version, you may have to allow the install program to make changes to your PC. You have to click “Yes to proceed with the installation, and then the Setup Wizard window will pop up.

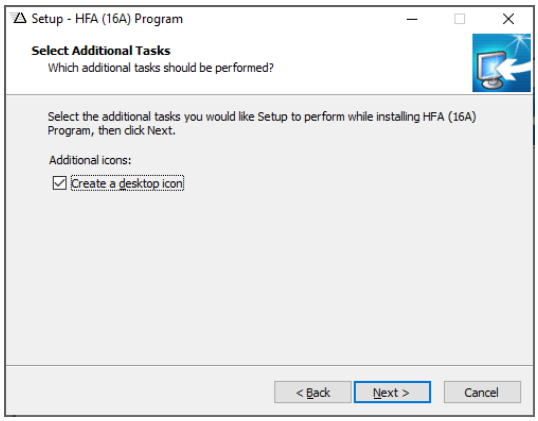
You click on “Next” and the License Agreement window will pop-up, which you have to acknowledge, by clicking “Accept the agreement”.

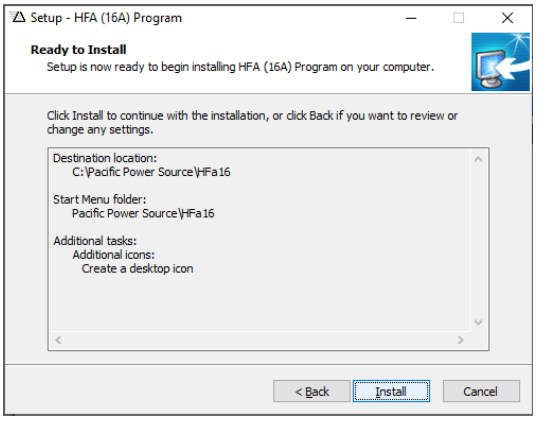




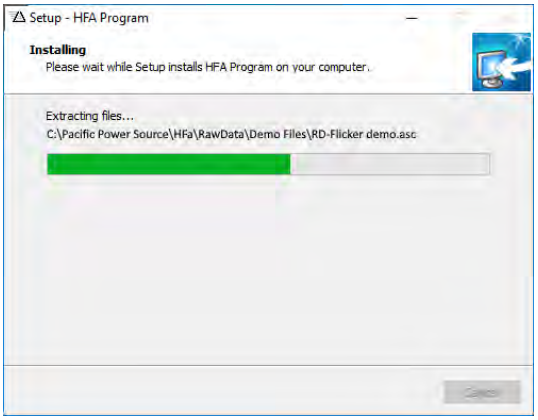
Then the install program will show the default installation directory, which we recommend you accept. Simply click on “Next” . Also, the install program will ask you if it should install a desktop icon (shortcut), and after you click “Next” it will show a window listing the destination and start-up folders,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







You then click on “Next”, and the installation will proceed. The system will also install some demo files, which are actual test files for various test classes and for Flicker. The HFa stores the “raw data” files, much like a data logger does, so that the files can be replayed later.

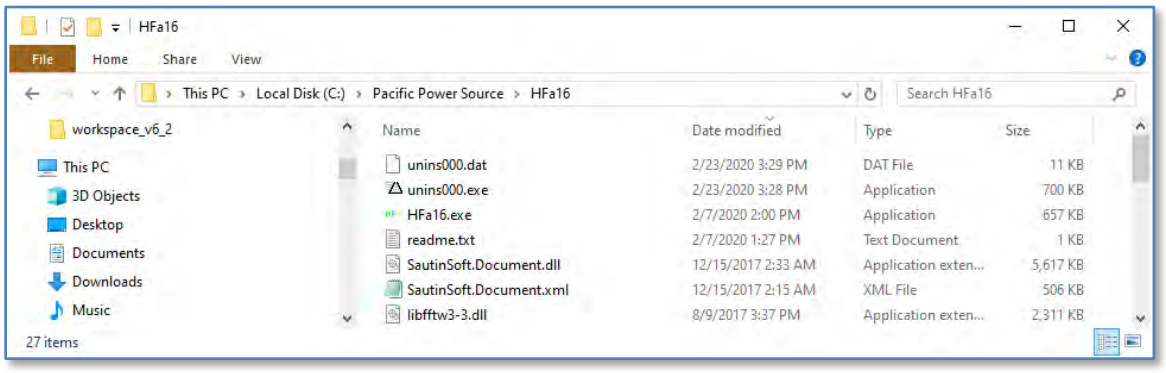


When the installation is complete, you click on “Finish” and this will launch the program.

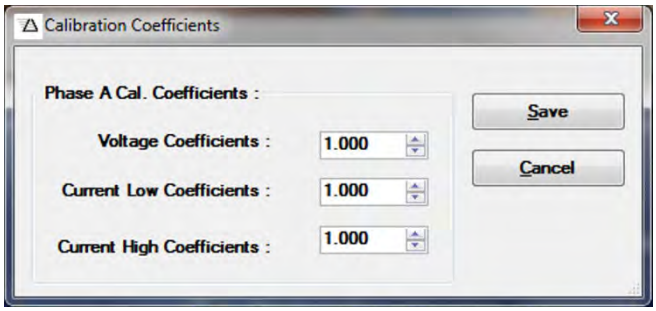
Note: The installation process will copy a default calibration file to the hard disk. This default“HFaCalibration.xml” file needs to be replaced by the actual calibration file for your specific unit.

In case you forget to copy the calibrration 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:\Pacific Power Source\HFa” directory.



The default calibration file uses the Cal. Constants 1.000, and will produce results that are generally within +/- 1 % of the ideal values for voltage, current, etc.



With these, the system will be reasonably accurate, but not optimized for the specific serial number.

To maximize performance, 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.

After completing the above steps, you can operate the HFa and perform harmonics and flicker analysis, produce test reports, and replay data files for tests that you performed.

7.7 Software Registration Process

The HFa Software represents many years of engineering development to ensure compliance to all relevant IEC 61000-3 and IEC 61000-4 test standards. As such, its use is licensed for a specific measurement system only and each copy of the HFa software has to be registered in order to operate.

If not registered, the HFa programs can only be used to play back previously acquired Harmonics and Flicker test data files. By registering the software, actual data can be captured and recorded on an EUT.

7.7.1 Requesting an HFa Software Registration Code.

The registration code for your instance of HFa16 or HFa75 can be requested by sending an email to Pacific Power's Customer Support department at support@pacificpower.com

Include the HFMM serial number in your email request. The serial number of your measurement unit can be obtained by connecting the LFZ or HFMM module via USB to your laptop or PC and launching the HFa program. Then select the "System Setup" tab (first tab on the left). The image below shows the location of the serial number.

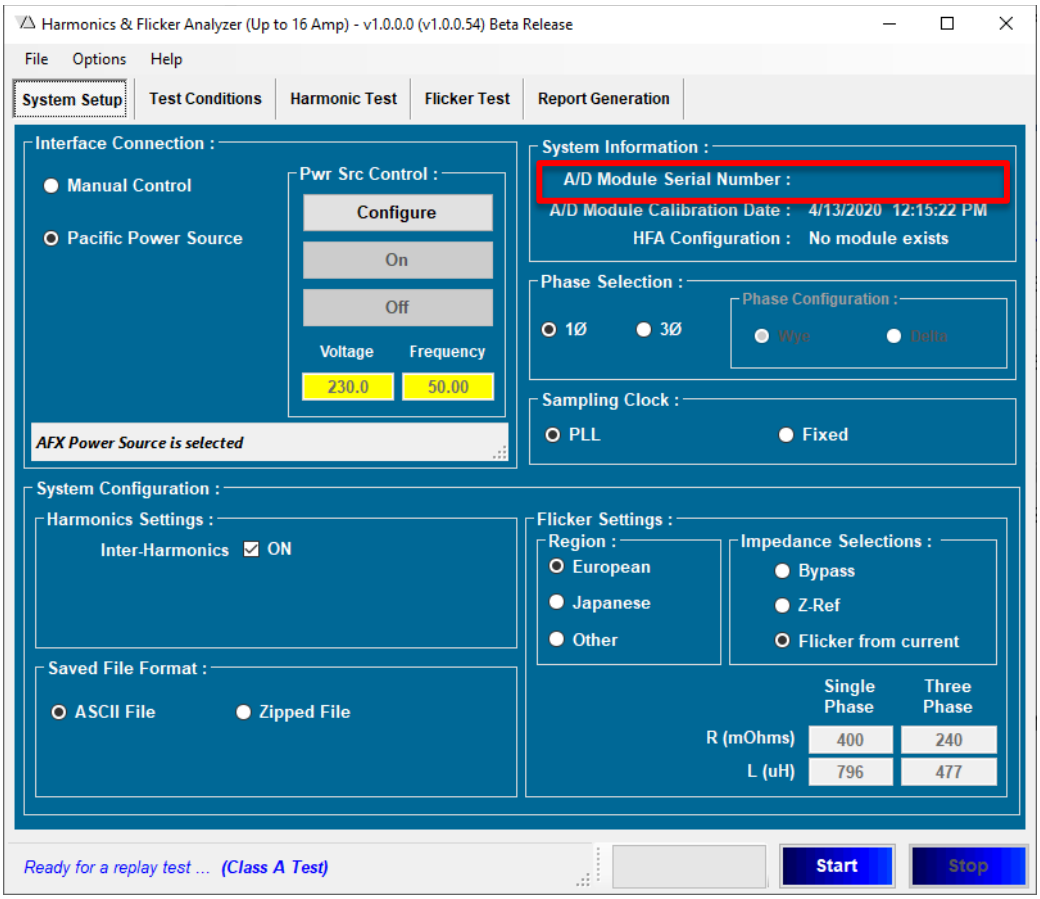


Figure 7-1: HFa Software Registration Serial Number Location

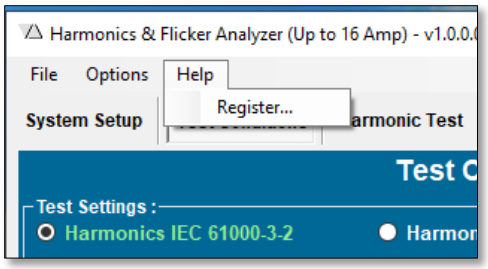
Note: The LFZ unit that contains the HFMM module must be connected to the Laptop or PC used or the serial number will not be displayed.

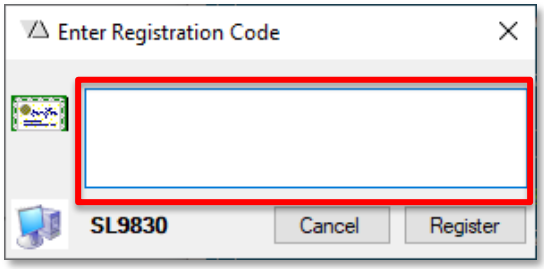
7.7.2 Entering your Registration Code

If the serial number you provided in your email is valid, you will receive a reply within 24 hours with the relevant registration code. The registration code consist of a six character string, for example “Y2F7J1”.

To activate your software registration, proceed as follows:

1. Launch the HFa program after installation.
2. From the main menu, select the Help, Register menu entry. This will display the dialog box shown below.





3. Copy the registration code from the email you received and paste it in the text box indicated above.
4. Click on the “Register” button in the lower right corner of the dialog box to complete the registration.

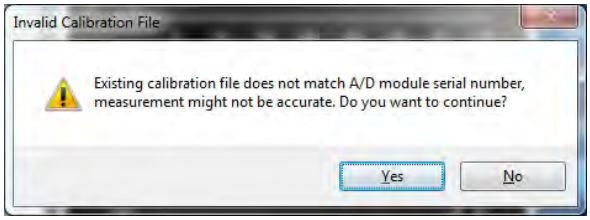
Your HFa software is now ready for use.

8 Calibration Information

8.1 Preface

This section cover system calibration of the harmonics and flicker measurement system. Normally, annual calibration is recommended. Calibration is also required if any hardware changes are made to the system such as changing AC power sources or flicker impedance hardware.

Calibration is also required if the following message pops up at the beginning of a new test run.



Note: Normally, the calibration process is not necessary as the system comes pre-calibrated, but if the HFMM is connected to an unknown power source and test impedance, it could be necessary to verify the calibration. By applying a known external load, and measuring voltage and current with reference equipment, the user can update the calibration constants so that the HFa indicates the exact same values. This process is quick and easy and takes no more than 5 minutes.

8.2 HFa Software Calibration

If you see the error message to the right after you click “Start”, the system does not have the correct calibration file. If you did not copy the right the calibration file, you can either click on “Yes” and have measurements that are generally within 1.0 %, or click on ”No” and copy the correct file to the “C:\Pacific Power Source\HFa directory”.

In the event that you do not have the calibration file, you can run the calibration utility, to generate a new calibration file.

8.2.1 Calibration Equipment

To do this, you should first arrange for an external reference voltage and current measurement method. This requires a suitable current shunt at the output of the HFMM module, a Resistive or programmable AC load to simulate an EUT and a 6 ½ Digit DMM to measure voltage and shunt current.

Suggested Equipment List is shown in the table.

Instrument	Manufacturer	Model
DMM (Volt)	Keysight	Model 34465A, 6 ½ digit or equivalent
DMM (Current)	Keysight	Model 34465A, 6 ½ digit with 10A current range or equivalent
AC & DC Load	Pacific Power Source	3C038-38 350Vac, 3750W Programmable Load or equivalent Load or Load Bank

Table 8-1: Calibration Equipment List

The required calibration setup is shown in the drawing below.

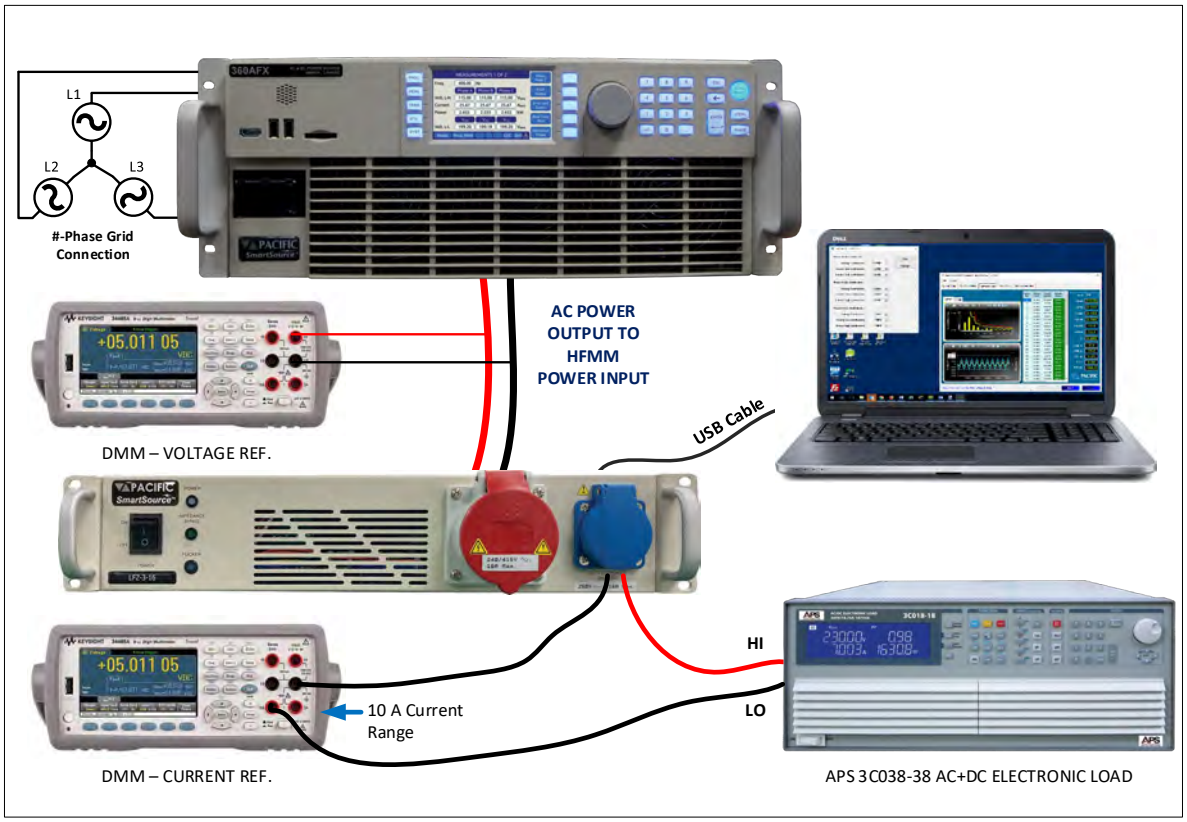


Figure 8-1: Calibration Equipment Setup

8.2.2 Calibration Steps

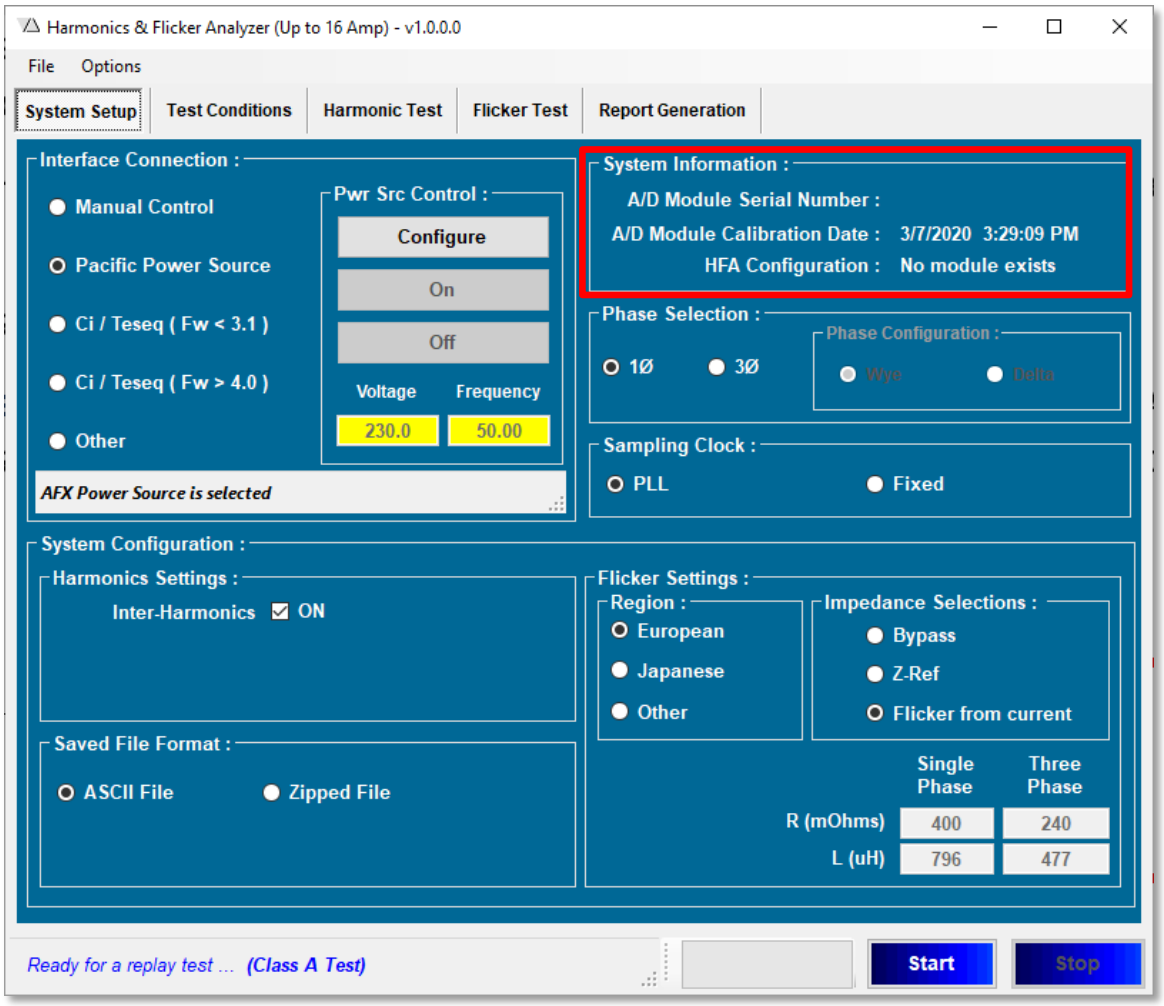
When you are ready to calibrate, click on “Yes” button on the dialog box shown above and let the new test begin.

The system calibration can be updated by entering new cal. Constants. There are two current ranges to be calibrated.

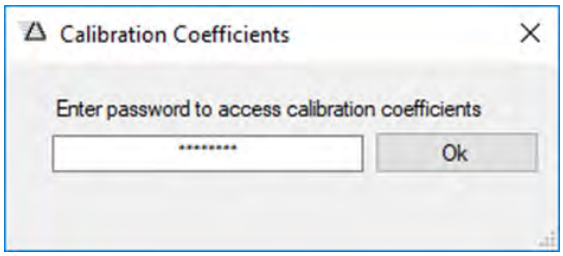
Connect the HFMM to the AC power source, and connect a load that can be set to both about 2.5 Amp rms and somewhere between 6 - 16 A-rms. Then proceed as follows:

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 is one voltage range and two current measurement ranges that require calibration for each phase.

Note: Make sure the Flicker impedance of the HFMM if present is in BYPASS mode.

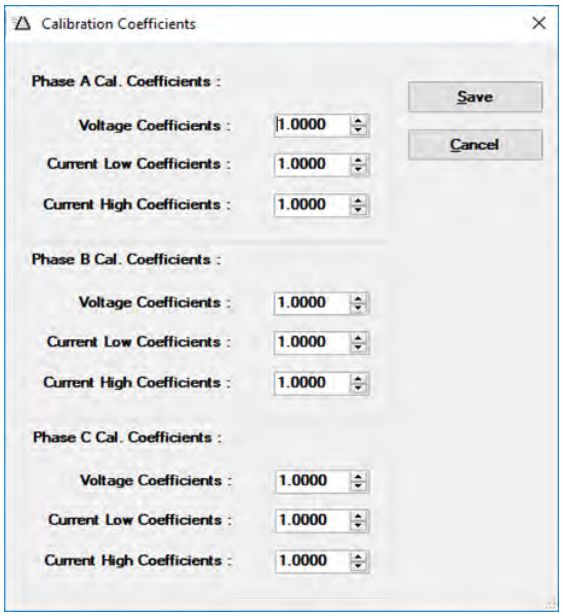


Figure 8-2: Calibration Window

Step 3: Voltage Calibration: Do not apply the load 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.

If the coefficient needs to be adjusted to a value that is less than **0.9800** or more than **1.0200**, a hardware calibration of the HFa may be required. Contact customer service.

Step 4: Low Range Current Calibration: Apply a load so that it takes a current between 1.500 – 3.000 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.

Step 5: High Range Current Calibration: Apply a load so that it 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. Some DMMs have a direct current measurement range up to 10 A-rms, and 10 A-rms is certainly a good value. If the DMM internal shunt is only 3A, an external current shunt must be used.

Make sure the load is stable. Adjust the "Current High Coefficients" so that the HFa displays the same current level as the external reference meter.

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

9 Service & Maintenance

9.1 Authorized Service Centers

There are NO end-user serviceable parts in this product. In case of a problem or malfunction, DO NOT ATTEMPT TO REPAIR! Instead, contact one of Pacific Power Source's authorized service centers or your local Pacific Power Source distributor. For a list of authorized service centers, refer to section 1, "Contact Information".

10 Declaration of Conformity

The Manufacturer hereby declares that the products:

Product Name: ECTS2 Harmonic & Flicker Measurement Systems, All Models in Series

Conforms to the following standards or other normative documents:

RoHS (DIRECTIVE 2015/863/EU)

Standard applied	EN 50581:2012

SAFETY (DIRECTIVE 2014/35/EC):

Standard applied	EN 61010–1: 2010; ED3/A1:2019

EMC (DIRECTIVE 2014/30/EU):

Standard applied	EN 61326-1: 2013

Reference Standards:

ELECTROMAGNETIC IMMUNITY:

RF Electromagnetic Field	IEC 61000-4-3:2020 1 kHz sinewave (80% AM)	80 – 1000 MHz, 3 V/m 1.4 – 2 GHz, 3 V/m 2.0 – 2.7 GHz, 1 V/m
Conducted RF Immunity	IEC 61000-4-6:2013 1 kHz sinewave (80% AM)	0.15-80 MHz, 3 V emf
Electrostatic Discharge	IEC 61000-4-2:2008	± 4 kV contact discharge ± 4 kV air discharge
Electrical Fast Transient/Burst	IEC 61000-4-4:2012	AC or DC power ports, ± 1.0 kV Signal and I/O ports, ± 0.5 kV
Surge	IEC 61000-4-5:2014+A1:2017	Input AC: 0.5kV L-L, 1.0kV L to Earth Input DC: 0.5kV Line to Earth Signal & Telecom: 1.0kV to Earth
Voltage Dips and Interruptions	IEC 61000-4-11:2020	Dips > 95% @ 0.5 Periods, Criterion B 30% @ 25 Periods, Criterion C Inter. > 95% @250 Periods, Criterion C
Conducted Disturbance at Mains	CISPR 11:2015+A1:2016+A2:2019	10-25MHz, < 60dBµV
Radiated Disturbance below 1GHz	CISPR 11:2015+A1:2016+A2:2019	30-200MHz, < 50 dBµV/m 201-1GHz, < 57 dBµV/m

Supplemental Information:

When and Where Issued
May 28, 2020
Irvine, California, USA

Authorized Signatory

Mitchel Orr,
Quality Manager, acting
Pacific Power Source

Responsible Person
Joe Abranko,
Pacific Power Source, Inc.
17692 Fitch, Irvine CA, 92614

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