HAS Option

Waveform Harmonic Analysis and Synthesis

Available Features:

Harmonic Analysis

- Measures Harmonic Content of Voltage and Current
- Displays Amplitude and Phase Data (Polar Format) for Harmonics 2 through 51
- Calculates Total Harmonics Distortion (%THD), Odd Harmonics Distortion (%OHD) and Even Harmonics Distortion (%EHD)
- Covers Entire 15 Hz to 5000 Hz Fundamental Frequency Range (varies with controller)
- Available from Front Panel and Remote Interface
- Fast Data Processing Times with User Settable Sample Size
- Fully Compatible with and Accessible from UPC Studio Software

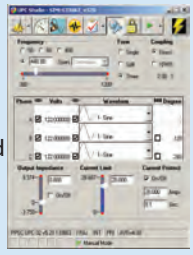
Waveform Synthesis

- Quickly Create User Waveforms by Specifying Individual Harmonic Components
- Enter Harmonic Number, Amplitude and Phase Angle for up to 51Harmonics to Create Any Harmonic Waveform
- Created Waveforms are Stored in Non-Volatile Memory for Quick Output Recall
- Use Synthesized Harmonically Distorted Waveforms in Transient Steps
- Complete Harmonics Waveform Definitions can be Made from the Front Panel Keyboard
- Fully Compatible with and Accessible from UPC Studio Software
- UPC Studio Software Dynamically Displays Time Domain or Frequency Domain Representation of Created Waveform

UPC Studio Software Suite

Master the Power of the Wave!

UPC Studio Software gives you the tools necessary to quickly and easily operate your AC Power Source. This software seamlessly integrates the HAS option when installed on the AC Power Source. All HAS option features are available through the remote interface and software provides enhanced data display's harmonic measurements and synthesized waveforms.



HAS Option

Harmonic Analysis and Synthesis (HAS) is a firmware option available for use with all Pacific Power Source products equipped with the universal programmable controller[1](UPC). This option can be accessed from either the AC Power Source front panel or remote interface. The option provides the ability to:

- Measure the harmonic content of the AC voltage and current waveforms.
- Synthesis voltage waveforms of varying harmonic content that may be applied to the unit under test.

Note 1: HAS is not available on AFX Series models which do not use a UPC type controller

Harmonic Measurements

The HAS option adds harmonic measurement of both voltage and load current on all output phases to the UPC controller, allowing for detailed analysis of voltage and/or current distortion. In particular, understanding the amount and frequency component of the AC current drawn by a unit under test can reveal important information about its operation and performance to specification.

Normally, this type of analysis requires the use of an external one or three phase power analyzer. The HAS option eliminates the need for this additional equipment and greatly simplifies this task as no external Current Transducers and voltage probes have to be connected to make such measurements. The HAS measurement function is only a few keystrokes away at any given time.

Harmonic analysis is done on a number of samples as specified by the user. The larger the sample size selected, the higher the number of harmonics that will be calculated and displayed. The relationship between sample size and displayed harmonics is shown in the table below. Measurement time increases with the number of samples selected.

HAS SAMPLE SIZE			
	Number of Samples	Number of Calculated Harmonics	Number of Displayed Harmonics
	512	512	51
	256	256	51
Default	128	128	51
	64	64	32
	32	32	16
	16	16	8

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Waveform Harmonic Analysis and Synthesis

HAS Option

Measured harmonic amplitudes and phase angles with respect to the fundamental frequency component are displayed on the UPC controller LCD display. The user can scroll from harmonics no 2 through harmonic no 51 (Figure 1).

The HAS option also calculates the RMS of all harmonics components with respect to the fundamental and displays percent THD. The same calculations are provided for odd harmonic distortion (%OHD) covering odd harmonic components only and even harmonic distortion (%EHD) for even harmonics only.

Harmonic Analysis Applications

Applications for harmonic measurements are numerous and include:

- AC load current characterization
- IEC harmonic pre-compliance test per IEC61000-3-2 and IEC61000-3-12
- Voltage distortion checks

Harmonic Waveform Generation

With the HAS option configured, the user is able to easily define harmonically distorted waveforms by entering a combination of harmonic amplitudes and phase angles directly from the front panel. The UPC controller takes the user provided input and generates an accurate representation of this series of sine waves made up of integer multiples of the fundamental frequency (Figure 2 and 3). Waveforms thus created can be saved in one of the 16 to 22 non-volatile memory locations for selection on any of the single or three phase AC power outputs.

This eliminates the need to calculate waveform data points or use other external software tools to create user defined waveforms. Waveform synthesis can be done for up to 51 harmonic components, incorporating both amplitude and phase angle for each harmonic component (Figure 4).

Waveform Synthesis Applications

Applications for harmonic waveform synthesis are numerous and include:

- Voltage Distortion Immunity Testing
- Simulate AC utility grid flat top voltage distortion
- Create custom waveforms with high harmonic frequency components

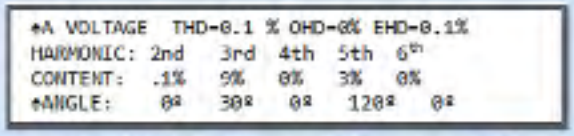

Figure 1: HAS Option Harmonic Measurement Display

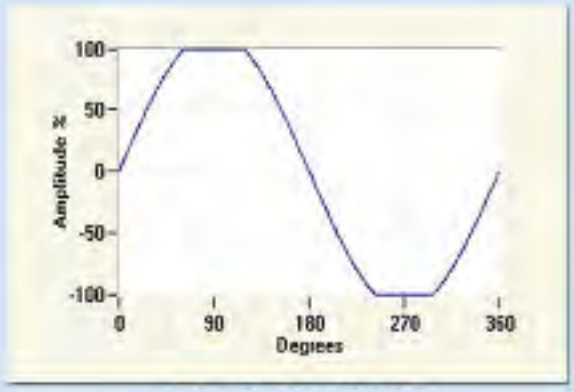

Figure 2: Flat Top Sine Wave

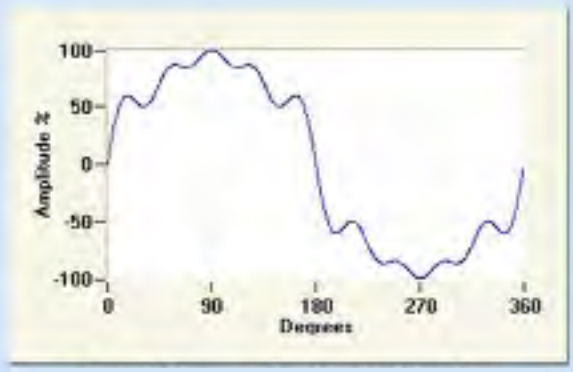

Figure 3: Harmonic Combination Waveform

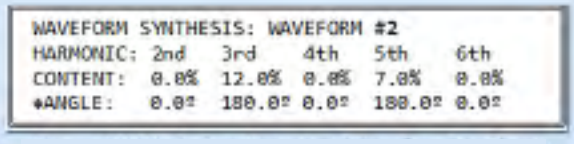

Figure 4: HAS Option Harmonic Waveform Synthesis Display

Specifications

HAS OPTION SPECIFICATIONS			
Compatible UPC Controllers:	UPC1, UPC3, UPC12, UPC32		
HARMONIC MEASUREMENTS			
Fundamental Frequency Range:	15 Hz to 5000 Hz		
Harmonic Measurement Range:	2nd through 51st		
Data Sample Size	16, 32, 64, 128, 256 or 512 (varies with oscillator)		
MAGNITUDE			
Resolution:	0.1%		
Accuracy:	±1% of Fundamental if peak values are at least 20% of meter range. Low amplitude signals will have reduced accuracy.		
PHASE ANGLE			
Resolution:	1°		
Accuracy:	Phase angle accuracy data is a guideline value only. It cannot be precisely stated as it varies with waveform type and magnitude. In general, it is most accurate with quasi-sinusoidal waveforms and least accurate with pulse shaped waveforms or waveforms containing many discontinuities, in particular for higher order harmonics.		
	Fout < 100 Hz	2^{nd}-20^{th}:	± 1%
		21^{st}-51^{st}:	± 2%
	Fout: 100 Hz-500 Hz		± 5%
HARMONIC WAVEFORMS SYNTHESIS			
Format:	Waveform data points are synthesized using a sine series with coefficients expressed in polar format (magnitude and phase angle).		
Harmonic Range:	2 through 51		
MAGNITUDE	All magnitudes are referenced to fundamental. Fundamental = 100%		
Range:	0% to 999%		
Resolution	0.1%		
Accuracy:	± 1.0% referenced to fundamental		
PHASE ANGLE	Based on Sine Series		
Range:	0° to 359.9°		
Resolution	0.1°		
Accuracy:	± 2% of Full Scale		

Remote Control

All HAS functions are available from the front panel as well as the available remote control interfaces. Industry standard SCPI syntax commands are used to control and query HAS option data. Relevant commands are shown in the table below.

HAS OPTION SCPI BUS COMMANDS	
Syntax	SCPI
SIGNAL ROUTING SCPI COMMANDS	
:SENSe:SPECTrum:RANGe <n>	Sets the number of data samples per cycle used for harmonic analysis. The number of harmonics calculated is n/2, e.g. if n=64 then the highest harmonic calculated is the 32nd. Only the numbers listed below are valid values for n. If any other value is sent, the default value of 128 will be used. n = 512, 256, 128, 64, 32, 16 (default is 128)
METERED DATA QUERIES	
:MEASure:SPECTrum:VOLT1[:MAGnitude]? :MEASure:SPECTrum:CURRent1[:MAGnitude]	Query: waveform harmonic magnitudes Use: VOLT1 for ΦA, :VOLT2 for ΦB, and : VOLT3 for ΦC volts Use: CURR1 for ΦA, :CURR2 for ΦB, and : CURR3 for ΦC volts Returns a data set of up to 256 (default=64), NR2 type numbers, comma delimited, representing harmonic magnitudes. The first element is the magnitude of the fundamental, for reference. The 2nd element is the 2nd harmonic, etc. Each magnitude is a percent of the fundamental. The number of harmonics is defined by :SENSe:SPECTrum:RANGe
:MEASure:SPECTrum:PHASe	Query: phase angles in degrees for the most recent harmonics data Returns a data set of up to 256, NR2 type numbers, comma delimited. The first element is the angle of the fundamental, for reference. The 2nd element is the angle of the 2nd harmonic, etc. The previous :MEASure:SPECTrum: command defines which data are sent. If parameter was VOLT1 then the phase angles will be for VOLT1
:MEASure:SPECTrum:THD?	Query: Returns Total Harmonic Distortion of the most recent :MEASure:SPECTrum:parameter command
:MEASure:SPECTrum:OHD?	Query: Returns Total Harmonic Distortion of the most recent :MEASure:SPECTrum:parameter command
:MEASure:SPECTrum:EHD?	Query: Returns Even Harmonic Distortion of the most recent :MEASure:SPECTrum:parameter command

Order Example

320AMX-UPC32-G/HAS

- 3-Phase AC Power Source 2 kVA with programmable controller UPC32
- Option GPIB Interface
- HAS Option

Note: HAS option is **NOT** available on AFX Series

Parts of the Standard Delivery

- Factory Installed
- HAS option covered by standard UPC Controller manuals
- Compatiable with UPC Studio Software

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