Precautions for Personal and Instrument Protection

IMPORTANT

1. Before using any electrical instrument, it should be checked to make certain it is operating properly.

2. In many instances, you will be working with dangerous levels of voltages and/or current, therefore, it is important that you should avoid direct contact with any uninsulated, current carrying surfaces. Appropriate insulated gloves, safety glasses and protective clothing should be worn.

3. Before attaching anything to the conductor, make sure the voltage present is not beyond the range of the instrument.

4. When not in use, keep the instrument in its carrying case to protect it from damage.

5. When the Harmonalyzer™ will not be used for a long period of time, remove the batteries and place them in the six holes in the carrying case.

△ CAUTION - Refer to explanation on pg. 9 of this manual.

☐ Double Insulation

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LIMITED WARRANTY

Your AMPROBE instrument has a limited warranty against defective materials and/or workmanship for one year from date of purchase, provided in the opinion of the factory, the instrument has not been tampered with or abused. Should your instrument fail due to defective materials and/or workmanship during the one year period, return it along with a copy of your dated bill of sale which must identify your instrument by model number and manufacturer's number.

Above limited warranty covers repair and replacement of the instrument only and no other obligation is stated or implied. AMPROBE shall not be liable for any loss or damage arising out of the use or misuse of this product.

For your protection, please use this instrument as soon as possible. If unit is damaged or is ever in need of repair, please call AMPROBE at (516) 593-5600 to obtain a Return of Materials Authorization (RMA) number. The unit should then be securely wrapped to prevent further damage in transit, insured and sent along with proof of date of purchase to:

Service Division
AMPROBE INSTRUMENT
630 Merrick Road (For U.P.S.)
P.O. Box 329 (For P.P.)
Lynbrook, NY 11563-0329

Outside of the U.S.A., your AMPROBE representative will assist you.

for technical assistance call 1-800-477-VOLT

INTRODUCTION

After years of research into the cause and effect of power harmonics and hundreds of hours working with electric industry professionals, Amprobe engineers recognized that harmonic problems were prevalent throughout the commercial and industrial facilities in this country. However, the diagnosis of these problems was not happening due to the perceived complexity of the problem, and the high cost, in both time and money, of the analysis equipment. It became clear that there was a need for an economically-priced instrument that could simplify these diagnoses. Amprobe has succeeded in this task.

The Harmonalyzer couldn't be simpler: the three buttons quickly walk you through the complete analysis. We've taken out all the unnecessary information and left you with exactly what you need to do the job.

Low price doesn't mean low accuracy either. The Harmonalyzer's accuracy is the same as, or better than, our top multimeters.

The memory and download feature on the HA-2000 allows quick and easy data retrieval and documentation.

The Harmonalyzer is an excellent analysis tool that will precisely indicate your harmonic distortion levels. It will not, however, prescribe a solution to your harmonics problem. We have included some examples beginning on page 18 that may help you get started. May you enjoy using your Harmonalyzer as much as we enjoyed building it!

Please Read This Manual Carefully.
GENERAL

There are two Harmonalyzer models: HA-1000 and HA-2000. Both units come in a carrying case lined with foam that protects the unit from damage (Cat No. HACC).

Each HA-1000 includes:
- Harmonalyzer HA-1000
- HACT-1 Current transducer
- MTL-15 Voltage leads
- HA3R Memory pad & pencil
- HACC Carrying Case
- User's Manual

Each HA-2000 includes:
- Harmonalyzer HA-2000
- HACT-2 Current Transducer
- HAVL-2 Voltage leads and crocodile clips
- HA3R Memory pad & pencil
- HADISC Harmona-Link™ software
- HADC Data cord for download
- HACC Carrying Case
- User's Manual

WHAT ARE HARMONICS?

Any periodic distorted wave can be broken down into a series of sine waves each having an integer multiple of the 60 Hz fundamental frequency. The sine wave at 120 Hz is the 2nd harmonic, 180 Hz is the 3rd, and so on. Harmonic distortion is a steady-state problem and must not be confused with short-term phenomena like spikes, sags or surges.

WHAT CAUSES HARMONICS?

Anything that alters the sine wave or only uses a part of the sine wave will cause distortion and therefore, harmonics. Switch-mode power supply’s (computers), variable frequency drives, and high efficiency ballasts are some examples.

WHAT PROBLEMS DO THEY CAUSE?

In general, the even-numbered harmonics, 2nd, 4th, etc., do not cause the majority of the problems. This is why we chose not to show them on the Harmonalyzer's display, but included them in the download.

Triplen harmonics, odd multiples of 3, combine on the neutral to create a potentially dangerous overheating situation: 2 to 3 times the phase current could be present. The 5th, 11th, and other negative sequence harmonics will oppose the normal flow of current through motors causing them to work harder and reduce their lives.

In general, the higher the harmonic number the less energy it has, and the less impact it will have on your equipment (except for transformers).
OPERATION

Your Harmonalyzer has been shipped to you with the batteries already installed to allow immediate operation and usage.

Turn the Harmonalyzer 'ON' by pressing any button: ◀, ■ or ►. The Amprobe logo will appear on the display. If the display is too light or dark adjust the contrast by pressing ■ and ► simultaneously to lighten or ■ and ◀ to darken.

During normal operation, pressing the ■ button will either select the highlighted menu option or return you to the main menu. Pressing the ◀ button will move the cursor up or to the left. Pressing the ► button will move the cursor down or to the right.

The HA-2000 has a backlit display which can be turned on and off by pressing all three buttons ◀, ■, and ► at once.

The Harmonalyzer will turn itself off automatically after 2 1/2 minutes of non-use. There is also a menu option to turn it off. In either case, the data that is in the buffer * will remain there until you replace it with new data or remove the batteries.

*The buffer is a temporary memory location where all new data is stored. To store this data permanently, see the Data Operations section.

Replacing the batteries: When the battery icon appears in the top left corner of the screen, it is an indication that your battery power is low. (Before replacing the batteries, save new measurement data in memory) Turn slotted head screw on back of unit 1/4 turn. Replace with 6 AA Alkaline cells.

TAKING A MEASUREMENT

Pressing ◀ and ► simultaneously will display the HOOK-UP MENU:

Pressing ■ will cause a ◀ to appear after VOLTAGE and change the last selection from MAIN MENU to MEASURE. You have just selected Voltage as the input to be measured. If you wish to take a measurement of both voltage and current simultaneously press ► once

Voltage Inputs
- Safety Banana Plugs (600V AC/DC Max)
- Low Battery Indicator
- Current Probe Input (1mV/A)
- Liquid Crystal Display (Backlit for the HA-2000)
- Side Slots
  - For the HA-1000's voltage leads
- Select Button
  - Causes Harmonalyzer to Perform Desired Function or Return to Main Menu
- Cursor Buttons
  - ◀ Moves Cursor Left or Up
  - ► Moves Cursor Right or Down
- Magnets (Rear)
  - Small magnets near the top and bottom help hold to metal surfaces.
  - CAUTION: may not be strong enough to hold unit to vertical surface
- RJ-11 Output Jack
  - Download data to your PC (HA-2000 only)
- Battery Compartment
  - 1/4 Turn Screw
  - 6 AA Alkaline batteries (Rear Side)
to bring the cursor down to CURRENT and then select it by pressing ■.

A ✓ should appear after CURRENT. Bring cursor down to "FUND" Press ■ to change selected frequency of electrical system you are measuring (50 or 60Hz). When frequency indicated is correct, move cursor to ‘MEASURE’ (If you make a mistake, pressing ■ again will remove the ✓).

Before selecting MEASURE, make sure you have made the proper voltage and/or current connections:

⚠️ Do not apply more than 600VRMS to input terminals. Exceeding this limit creates a shock hazard and may damage the instrument

1. Connect the voltage leads to the Harmonalyzer by plugging the angled safety banana plugs into the voltage jacks at the top of the unit. If using the HA-2000, select either the probes or the crocodile clips and connect them to the other end of the leads.
2. Connect the current transducer (CT) by inserting its plug into the AMPS jack at the top of the unit.
3. Using proper safety procedures, attach the common (COM) voltage lead to neutral or ground. Attach the other lead to the line. Reversing these connections will cause decreased accuracies.
4. Clamp the CT around the line conductor with the AMPROBE logo facing the load.

Select MEASURE on the HOOK-UP MENU: ‘MEASURING ...’ will appear on the display for 3 to 9 seconds:

When the MAIN MENU appears, the measurement is complete. The Harmonalyzer has just taken a 'snapshot' of your current and voltage waveforms, performed all calculations, and stored all of the data in the buffer memory. You can now remove the leads and CT from the conductors.

Note: Returning to the Hook-up Menu will erase the buffer.

VIEWING THE DATA

Select the information you wish to see by moving the cursor up or down and select the highlighted option. The HA-1000 Main Menu will not have POWER as an option.
If you had measured both VOLTAGE and CURRENT, selecting either HARMONICS or WAVEFORM will require a choice between the two. Press ■ to select the highlighted option.

HARMONICS DISPLAY

% of the fundamental of the selected harmonic
Actual RMS value of the selected harmonic
Total Harmonic Distortion (THD)
% of the fundamental

Auto-ranging scale keyed to the magnitude of the THD
Reverse-tone indicates the selected harmonic.
Use ◀ and ▶ to select other Harmonics.
The bar-graph depicts the relative magnitude of the odd harmonics and Total Harmonic Distortion (THD). The scale is **auto-ranging** and will vary from 0 to 5% up to 0 to 1000% depending on the magnitude of the THD. This feature makes it easy to see which harmonics are significant and which are not. The characters at the bottom of the display refer to the individual harmonics: ‘F’ is the fundamental and is typically 60 Hz; ‘3’ is the third harmonic and is 3 times the fundamental, or 180 Hz; ‘5’ is the fifth harmonic at 300 Hz; and so on. THD is the Total Harmonic Distortion and is calculated by taking the square root of the sum of the squares of the first 31 harmonics divided by the square of the fundamental:

\[
THD = \sqrt{\sum_{n=2}^{31} \frac{h_n^2}{f^2}}
\]

THD is not the direct sum of each harmonic. See example #4 on page 20. Since all harmonics are relative to the fundamental, the fundamental is always 100%. At ranges below 100%, the bar above the ‘F’ will have an arrow showing that it goes to 100%.

Pressing the ▶ button repeatedly will move the cursor from the ‘F’ thru each harmonic. The value at the top left will indicate each magnitude as a percentage of the fundamental. This will help you to quickly determine whether you have a problem. The value at the top right is the actual value, in Volts or Amps, of the selected harmonic. This will help in determining how big your harmonic cancellation equipment needs to be. Pressing the ■ button will return you to the MAIN MENU.

---

**WAVEFORM DISPLAY**

Two cycles of waveform

If recalled from memory the memory location will be listed here

21.64 Arms 60.01 Hz

True RMS value of the complete waveform

Frequency of the fundamental

The waveform display lets you see how the waveform actually looks, along with its True RMS value and the frequency of the fundamental. Pressing the ◄ or ► buttons will remove the numbers from the display if they are obscuring your view of the waveform.

You can calculate the True RMS value yourself by taking the square root of the sum of the squares of the individual harmonics.

\[
I_{\text{rms}} \; \text{or} \; V_{\text{rms}} = \sqrt{f^2 + h_3^2 + \ldots + h_n^2}
\]

The example on page 20 illustrates this.
POWER DISPLAY
(HA-2000 only)

| 99.7 W | 459.7 VAR LAG |
| 1.392 KVAR | 0.715 PF |
| 0.912 VAR | 856.5 DVA |

**Watts, Working Power**
**Reactive (Non-Working) Power**
**Apparent Power**
**True Power Factor**
**Displacement Power Factor**
**Distortion Power**

Power data is derived from comparing the voltage waveform to the current waveform. You must measure both for power data to appear.

With a purely resistive load, the voltage and current waves lie on top of each other, reducing phase angle \( \Theta \) to zero and making the Watts equal the VA's. Adding inductive or capacitive loads will cause the current waveform to be displaced from the voltage. Inductive loads will cause the current to 'LAG' the voltage as shown at left, and capacitive loads will cause a 'LEAD'ing current. The effect of this is that power is 'wasted' in magnetizing the inductors and charging the capacitors. This non-working power is Volt-Ampere Reactive (VAR), and causes the Apparent Power (VA) to be larger than the working power (Watts). The utility has to generate more VA's in order for you to get the same amount of watts. Power Factor (cos \( \Theta \)) is an indicator of how efficiently the generated power is utilized.

Adding distortion to the system complicates the calculations and adds a third dimension to the power triangle:

DVA, Distortion Volt-Amperes is also non-working power. You can see that it also increases the VA, requiring even more power to be generated in order to perform the same amount of work.

**Working Power, Watts** is the summation of the apparent powers attributed to each harmonic:

\[
\sum_{n=1}^{31} V_{\text{RMS}} \times I_{\text{RMS}} \times \cos \Theta_{\text{DIS}}
\]

**Reactive Power, VAR** is the non-working power needed to charge capacitors and magnetize inductors:

\[
\sum_{n=1}^{31} V_{\text{RMS}} \times I_{\text{RMS}} \times \sin \Theta_{\text{DIB}}
\]

'LAG' in the display indicates a negative VAR or an inductive load. 'LEAD' indicates a positive VAR or a capacitive load.

Note: If watts are negative,
Up to 21 waveforms can be saved in the Harmonalyzer's non-volatile memory. The memory is powered by a separate lithium cell that has an expected life of eleven years.

Select the next available memory location by using the ▼ or ▲ buttons and then pressing the ■ button. If saving a single waveform measurement a V or I will appear in that location. If saving a measurement of both voltage and current, a V will appear in that location, an I will appear in the next location and for the HA-2000, PWR will link the two locations. This is referred to as a 'Power Pair'.

In order for you to remember which measurement is in which location, we have provided a separate memory pad and pencil to record the specifics of each measurement.

NOTE: You cannot save a Power Pair in memory locations 7, 14 or 21. Also, you cannot save on top of another waveform, it must first be deleted. This feature keeps you from accidentally losing a measurement by recording over it.

To return to the DATA OPERATIONS MENU advance the cursor to the last memory location screen and select 'EXIT'.

Select the location you wish to delete and press ■. The V or I or Power Pair will vanish. Advance past the 21st memory location to EXIT and return to the Data Operations Menu.

DOWNLOAD (HA-2000 only)

Selecting DOWNLOAD will cause the Harmonalyzer to prepare itself to transfer all 21 memory locations to your Personal Computer. 'DOWNLOAD WHEN READY' will be displayed. Prior to this, however, you must connect the Harmonalyzer to your computer and load the Harmona-Link™ software. Included in the HA-2000 kit is a data cord and a 3 1/2" floppy disk.

The Data Cord (HADAPT) is three feet long, terminated at both ends with an RJ-11 plug and includes an RJ-11/DB-9 Adapter. Most computers have a nine pin (DB-9) serial communication port for data transfer. Plug the DB-9 connector into your DB-9 input port. Plug the other end of the cord into the Harmonalyzer. If you do not have a DB-9 input jack on your computer, please consult your computer vendor or an electronics store. (You may have to free up a port by unplugging your mouse or adapt up to a DB-25 jack).
The Harmona-Link™ Version 1 software was written for MS-DOS 3.3 or greater. Load the disk into your computer, type 'install' <enter>, then CD/ WVM <enter>, then HA <enter>', and it will display a MAIN MENU. With your Harmonalyzer displaying 'DOWNLOAD WHEN READY', enter 'D' on your computer. The Harmona-Link™ software communicates with the Harmonalyzer and transfers the contents of the memory bank. When your PC indicates that the download is complete you may disconnect the Harmonalyzer. In addition to the information displayed on the Harmonalyzer, the Harmona-Link™ software will also show you the odd and even harmonics to the 31st.

The Crest factor (C): \[
\text{PEAK} \quad \text{RMS} \quad \text{RMS} \quad \text{AVG}
\]

the Form factor (F): \[
\text{RMS} \quad \text{RMS} \quad \text{AVG}
\]

and the K factor:

\[
\frac{\sum (h^2 \times (fh)^2)}{\sum (fh)^2}
\]

where fh is the % harmonics and h the harmonics number.

Please Note:
Proper interpretation of the data produced by the Harmonalyzer is essential for a correct diagnosis of the problem. For example, a high K-factor value does not necessarily require a transformer change. % loading, location of measurement, etc. will dictate whether action is required.

**EXAMPLE #1**

**THREE-PHASE POWER MEASUREMENT - DELTA**

Measurement Procedure:

a. Clamp the CT around the phase A conductor with the Amprobe logo facing the load.

b. Attach the 'com' voltage lead to the 'B' lug.

c. Attach the other ('hot') voltage lead to the 'A' lug. (See figure 1)

#2. Select both Current and Voltage from the Harmonizer’s Hook-up menu, take a measurement and store it in memory.

#3a. Clamp the CT around the phase C conductor with the Amprobe logo facing the load.

b. Leave the 'com' voltage lead attached to the 'b' lug.

c. Attach the other ('hot') voltage lead to the 'C' lug. (See Figure 2).

#4. Select both current and voltage from the Harmonizer’s Hook-up menu, take a measurement and store it in memory.

Calculations:

Total KW (working power) is the sum of the two KW values.

\[\text{KW}_{TOT} = \text{KW}_{A-B} + \text{KW}_{C-B}\]

Total KVA (apparent power) is the larger of the two KVA readings multiplied by 1.732.

\[\text{KVA}_{TOT} = \text{maxKVAr} \times 1.732\]

Power Factor is KW divided by KVA:

\[\text{PF} = \frac{\text{KW}_{TOT}}{\text{KVA}_{TOT}}\]

**Example:**

<table>
<thead>
<tr>
<th>Phase A referenced to B</th>
<th>Phase C referenced to B</th>
</tr>
</thead>
<tbody>
<tr>
<td>69.13 KW</td>
<td>51.42 KW</td>
</tr>
<tr>
<td>16.73 KVAR LAG</td>
<td>53.10 KVAR LAG</td>
</tr>
<tr>
<td>71.90 KVA</td>
<td>75.70 KVA</td>
</tr>
<tr>
<td>0.96 PF</td>
<td>0.67 PF</td>
</tr>
<tr>
<td>0.97 dPF</td>
<td>0.70 dPF</td>
</tr>
<tr>
<td>10.52 KDVA</td>
<td>16.32 KDVA</td>
</tr>
</tbody>
</table>

\[\text{KW}_{TOT} = 69.13 + 51.42 = 120.55\]

\[\text{KVA}_{TOT} = 75.70 \times 1.732 = 131.12\]

\[\text{PF} = \frac{120.55}{131.12} = 0.92\]
EXAMPLE #2
THREE-PHASE POWER MEASUREMENT - WYE

Measurement Procedure:

1. Clamp the CT around the phase A conductor with the Amp Probe logo facing the load.
2. Attach the 'com' voltage lead to the Neutral lug.
3. Attach the other ('hot') voltage lead to the 'A' lug. (See figure at left)

#2. Select both Current and Voltage from the Harmonizer's Hook-up menu, take a measurement and store it in memory.

#3. Repeat steps 1 and 2 for both the 'B' and 'C' phases, keeping the 'com' lead connected to the Neutral lug.

Calculations:

Total KW (working power) is the sum of the three KW values.

\[ \text{KW}_{\text{TOT}} = \text{KW}_A + \text{KW}_B + \text{KW}_C \]

Total KVA (apparent power) is the sum of the three KVA readings:

\[ \text{KVA}_{\text{TOT}} = \text{KVA}_A + \text{KVA}_B + \text{KVA}_C \]

Power Factor is KW divided by KVA:

\[ \text{PF} = \frac{\text{KW}_{\text{TOT}}}{\text{KVA}_{\text{TOT}}} \]

Example:

<table>
<thead>
<tr>
<th>Phase A</th>
<th>Phase B</th>
<th>Phase C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1200 W</td>
<td>1500 W</td>
<td>304 W</td>
</tr>
<tr>
<td>146 VAR LAG</td>
<td>217 VAR LAG</td>
<td>98 VAR LAG</td>
</tr>
<tr>
<td>1300 VA</td>
<td>1500 VA</td>
<td>320 VA</td>
</tr>
<tr>
<td>0.90 PF</td>
<td>0.99 PF</td>
<td>0.95 PF</td>
</tr>
<tr>
<td>0.98 dPF</td>
<td>0.95 dPF</td>
<td>0.93 dPF</td>
</tr>
<tr>
<td>202 DVA</td>
<td>215 DVA</td>
<td>15 DVA</td>
</tr>
</tbody>
</table>

\[ \text{KW}_{\text{TOT}} = 1200 + 1500 + 304 = 3004 \]

\[ \text{KVA}_{\text{TOT}} = 1300 + 1500 + 320 = 3120 \]

\[ \text{PF} = \frac{3004}{3120} = 0.96 \]

EXAMPLE #3:
An electrical contractor was given the task of improving the power factor in a facility powered by a 2000 kVA, 13.8 KV/480V transformer. Using the Harmonizer HA-2000 at the secondary of the transformer, he measured the following:

<table>
<thead>
<tr>
<th>Voltage THD</th>
<th>4.0%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current THD</td>
<td>19.5%</td>
</tr>
<tr>
<td>3rd</td>
<td>1.1%</td>
</tr>
<tr>
<td>5th</td>
<td>16.0%</td>
</tr>
<tr>
<td>7th</td>
<td>2.9%</td>
</tr>
<tr>
<td>Working Power</td>
<td>355 KW</td>
</tr>
<tr>
<td>True Power</td>
<td>0.53</td>
</tr>
</tbody>
</table>

The Harmonizer measured the following:

<table>
<thead>
<tr>
<th>Voltage THD</th>
<th>1.3%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current THD</td>
<td>11.4%</td>
</tr>
<tr>
<td>3rd</td>
<td>1.0%</td>
</tr>
<tr>
<td>5th</td>
<td>4.8%</td>
</tr>
<tr>
<td>7th</td>
<td>1.8%</td>
</tr>
<tr>
<td>Working Power</td>
<td>325 KW</td>
</tr>
<tr>
<td>True Power</td>
<td>0.95</td>
</tr>
</tbody>
</table>

The large percentage of fifth and seventh harmonics indicate a 6-

pulse variable speed drive. It was determined by a filter manufacturer that a 600 kVA harmonic filter, tuned to the fifth harmonic, would not only improve the power factor to near unity, but would also reduce the distortion levels. After installation, the Harmonizer measured the following:

EXAMPLE # 4:
The following pages are copies of the data from the Harmon-Link™ software showing a measurement of both voltage and current. The following sample calculations employ the harmonic values from this data.

<table>
<thead>
<tr>
<th>True RMS</th>
<th>$\sqrt{F^2 + h_2^2 + h_3^2 + h_4^2 + \ldots + h_{31}^2}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amps RMS</td>
<td>$\sqrt{(153.2)^2 + (0.9)^2 + (15.7)^2 + (0.8)^2 + (12.3)^2 + \ldots}$</td>
</tr>
<tr>
<td>Volts RMS</td>
<td>$\sqrt{(118.2)^2 + (0.4)^2 + (3.2)^2 + (0.2)^2 + \ldots}$</td>
</tr>
<tr>
<td>Volt RMS</td>
<td>118.3</td>
</tr>
<tr>
<td>THD</td>
<td>$100 \sqrt{h_2^2 + h_3^2 + h_4^2 + \ldots h_{31}^2}$</td>
</tr>
<tr>
<td>Amps THD</td>
<td>$100 \sqrt{(0.9)^2 + (15.7)^2 + (0.8)^2 + \ldots}$</td>
</tr>
<tr>
<td>Voltage THD</td>
<td>$100 \sqrt{(0.4)^2 + (3.2)^2 + (0.2)^2 + \ldots}$</td>
</tr>
<tr>
<td>Voltage THD</td>
<td>3.9%</td>
</tr>
</tbody>
</table>
SPECIFICATIONS

RANGES
Voltage  1-600 Vrms AC/DC  
1000 Volts peak  
Current  1-1000 Amps rms AC  
Power  0-600 Kilowatts (HA-2000 only)  
Frequency readout  40-65 Hz

HARMONICS
HA-1000  First 19 odd harmonics plus THD  
HA-2000  First 19 odd harmonics plus THD displayed on unit; first 31 harmonics plus THD when downloaded to your PC using the Harmona-Link™ software

ACCURACIES
True RMS
Voltage ±2% of reading  
Current ±2% of reading (without current transducer)

Harmonics
Voltage ±2% +6 LSD *  
Current ±2% +6 LSD *  
THD (>1%) ±1% of reading +3 LSD *  
when fundamental (I) is 60Hz ±0.1 Hz

Power
Watts, VA, VARs, ±2% of reading  
PF, dPF ±0.01

Frequency
±0.1 Hz

Memory
21 non-volatile, user-addressable, protected locations. Powered by non-user-serviceable lithium cell with an expected life of eleven years.

Download
EIA-232-E (RS-232) Interface via RJ-11 telephone jack. Optically isolated, 9.6K baud rate Harmona-Link™ software: 3 1/2" floppy disk, MS-DOS® 3.3 or greater, 640 KB required. Provides full harmonic analysis (to 31st) along with crest factor, form factor, K factor and power data.

DISPLAY
Super twisted liquid crystal with adjustable contrast.  
Backlight (HA-2000 only)

GENERAL
Auto-Off  
Auto Ranging  
Unit size: 8.62" x 3.50" x 1.76" (219x89x50mm)  
Unit weight: 1.22 lbs (0.55 kg)  
Case size: 11" x 15 1/2" x 4" (394 x 279 x 102mm)  
Weight of HA-2000 kit: 4.56 lbs (2.069 kg)  
Operating Conditions: 32° to 122° F (0° to 50° C)RH < 85%  
Storage Conditions: -4° to 140° F (-2° to 60° C) RH < 90%  
Battery: Six alkaline 'AA' cells, ANSI/NEDA 15A, IEC-LR6  
Life: 24 hrs continuous with backlight off  
8 hrs continuous with backlight on  
Instrument case material: Flame retardant ABS911  
Case Breakdown Voltage - 3000V  
Insulation Coordination: Installation Category III, Polution Degree 2.

ACCESSORIES
Current Transducer ............... # HACT-1 & HACT-2  
Range .................................. 1-1000A  
Frequency ................................ 20-2000Hz  
Output .................................. 1mV AC per 1 Amp AC  
Accuracy ................................ ±1% of reading  
Case breakdown voltage .... 3000V  
Jaw capacity ................... 2 " dia. or 2000 MCM  
Output leads ....................... 3.5 mm phono jacks  
Voltage Leads ..................... HAVL-2

Catalog # HA-1000 includes:

HA-1000 Harmonalyzer™, MTL-15 voltage leads, 
HACT-1 Current transducer, HA3R Memory pad & pencil and HACC carrying case.

Catalog # HA-2000 includes:

HA-2000 Harmonalyzer™, HAVL-2 voltage leads, 
HACT-2 Current transducer, HADAPT Data cord, 
Harmona-Link™ software (HADISC) 
HA3R Memory pad & pencil and HACC carrying case.