

Instrument firmware version 4.02 and HA-PC Link version 4.0.

These releases implement the changes that have been made to the IEC standards since the last release. The firmware update can be applied to any HA1600, HA1600A or AC2000 of any age.

The main changes are the implementation of the extra assessment methods for Class C lighting equipment below 25 Watts, requiring the expression of harmonic levels as a percentage of the fundamental current.

The first part of this note describes the installation of the updates. This is followed by guidance on the additional measurements; most of this applies at both the instrument front panel and through the PC interface software.

Installing the instrument firmware update.

Connect the instrument to the PC using either a USB connection or a fully wired 9-way serial cable. Early HA1600 units have only a serial port which can be used with a serial to USB adapter if required, but this must support full hardware flow control. Adapters which use FTDI devices are known to work well.

Switch the instrument on and at the first screen chose 'Setup' and then 'update firmware by RS232 or USB' as required. If USB is selected the instrument will enumerate at that point. Using the upload utility provided transfer the file 1600F401.S; once the transfer is complete press 'Restart' and at the first screen select 'Restore Defaults' within 20 seconds. Do not select 'Resume operation', or allow the time-out to expire, as this may attempt to use historical configurations that the new release does not support. This selection can be repeated by power cycling the unit.

Instrument Firmware Version 4.02 (30 November 2022)

Fixes a crash in Flicker when current sensing is selected, introduced in 4.0 and present in 4.01.

Instrument Firmware Version 4.01 (9 November 2022)

This issue removes an intentional workaround included in version 4.00 for a known bug (affecting the "no limits below" power setting) in the then current version (3.02) of HA-PC Link. This is fixed in HA-PC Link version 4.0 and the instrument firmware must be updated to function properly with this new version.

The waveform phase angle processing for Class C lighting below 25W has been improved, and also no longer reports random values if there is no significant signal.

Instrument Firmware Version 4.00 (28 June 2022)

This release first implemented the changes that have been made to the IEC standards since the last version of the firmware. The new capabilities were only accessible from the front panel of the instrument. It also allowed operation in conjunction with the old HA-PC Link version 3.xx, which was fully functional for existing measurements, but there was no access to any of the new facilities. The firmware overrides the setting of 'no limits below' in class C to 5W.

For operation with HA-PC Link version 4.0 or later the instrument firmware must be updated to version 4.01 as above.

Installation of HA-PC Link version 4.0

Run the .msi installer file provided. If there is a previous version installed on the machine the installer may ask whether to modify, repair or remove it, in which case choose remove, then run the installer again.

First Use

After installing both HA-PC Link and the firmware upgrade to the instrument, restart the instrument and be sure to select 'Restore Defaults' from the initial start up screen.

First set the instrument into remote mode by selecting the 'Report' menu, then 'Set-up', then select the function 'Remote USB' or 'Remote serial' as required. Press the 'Local' key to enter Remote mode (the USB enumerates at this point). Start HA-PC Link and select the correct COM port. The software should start to receive and display data from the instrument.

It is recommended that the 'Measurement Mode' should be first switched to 'Flicker' and then back to 'Harmonics', then select Class A and set the 'no limits below' drop-down to 75W. This ensures that the instrument and the software are in the same configuration. Close HA-PC Link to save the start-up configuration file for the current user. This will also return the instrument to local control.

To continue press the Local key to put the instrument back into Remote operation restart HA-PC Link and set up the required configuration.

Instructions for use.

The following notes primarily describe setting up the instrument through the PC interface program HA-PC Link to make standard measurements. The front panel interface of the instrument offers some additional capabilities for engineering use which will not be explicitly mentioned here as they are accessed in the general style of the unit.

General power analyser measurements

Total Harmonic Distortion

Previously THD was not a required part of any assessment and the instrument displayed a THD value as a matter of interest only. It used the traditional definition of THD being the ratio of the rms sum of the harmonics to the rms value of the whole waveform, which is a value that cannot exceed 100%.

THD is now a required part of the assessment of some low power lighting equipment, and the standard applies the alternative definition of THD being the ratio of the sum of the harmonics to the level of the fundamental component. This ratio can exceed 100%, possibly without limit. The instrument now uses this definition wherever THD is displayed, but if it exceeds 200% then that indication is all that is reported.

The THD values shown for a particular load will therefore be different to previous versions of the firmware.

Voltage Variations and Flicker to EN61000-3-3:2013+A1:2021

The amendment A1:2021 to this standard makes changes to Annex A “Application of limits and type test conditions for specific equipment” which specify how the equipment under test should be operated during the test.

It is a matter for the operator to comply with these requirements. There are no changes to the measurements or assessment levels, so this part of the firmware is unchanged.

EN61000-3-2:2019 +A1:2021

General notes on Harmonics Measurements

The facility to use the historical 16 cycle transform methods of EN61000-4-7:1993 has been deleted. The instrument now only supports measurements to the present issue of the standards. The selection box is still present but now has only the one option.

In HA-PC Link the setting for ‘no limits below’ now has four options (0, 5W, 25W and 75W). Users must be sure to select the correct value for the measurement they are making (the software does not attempt to pre-empt this decision).

Before taking a timed test always remember to lock the instrument’s current range to that needed for the highest current that will occur during the test. If an overload occurs the test results will be invalid.

Classes A, B and D

There are no changes to the measurements and assessments in the instrument for these classes, however users should note that this issue of the standard has made changes to the way some types of equipment must be operated, including many changes and additions to Annex B. These changes do not affect the firmware, but must be implemented by the operator. Be sure to set ‘No Limits below’ to 75W.

Class C (lighting equipment) measurements

The standard defines a number of different requirements for assessing lighting equipment depending upon both its nature and its rated power. Most of the changes in this issue of the standard apply to this class.

Once the load is declared as class C the user must select the type of assessment required from the options described below. In some cases of equipment rated at less than 25 Watts, the user may have to try more than one method to get the best result for the particular equipment being tested.

Assessment of standard class C products rated at over 25 Watts.

Most lighting equipment in this category is assessed against the permitted harmonic current limits of **table 2** in the standard, which are calculated relative to the rated fundamental current of the load. In previous issues of the standard the permitted level of the third harmonic current also depended on the actual Power Factor of the load, but this has been revised in the present issue to use a level calculated with a nominal value of 0.9 for the Power Factor. To allow users to repeat old measurements this instrument still offers the capability to set any power factor, but initially it automatically supplies the default value of 0.9.

After selecting Class C and ‘Standard (>25W) to Table 2’, set the ‘No limits below’ selection to 5W.

Declaration of the rated fundamental current

The value of fundamental current used to calculate the relative harmonic limits is described as the ‘Basis of Limits’. Set this ‘Basis of Limits’ to the rated fundamental current of the equipment being tested and (to avoid ambiguity) enter the

default Power Factor of 0.9. Note that the declaration for rated fundamental current must now always be in mA; the old shortcut that values less than 16 were taken as Amps has been deleted.

To repeat an old measurement with a previously recorded current and power factor it is possible to explicitly enter those values, but setting the Power Factor must be done last, as entering a new current, or returning to 'automatic', will trigger the restoration of the new 0.9 default power factor value. Entering the value 0 for power factor will also be taken as 0.9.

The instrument also offers the option of determining an automatic Basis of Limits from the maximum fundamental current observed during the test, together with the standard PF value of 0.9. Select the 'Automatic' check box to use this capability. The values obtained are reported in the 'Harmonics Summary' panel at the bottom right of the HA-PC Link window (not in the manual entry boxes).

However for strict compliance with the standard the user should enter the rated fundamental current of the equipment under test so that the correct limits can be calculated. Whichever method is used to specify the Basis of Limits it is the responsibility of the user to ensure that the actual value used during the test is within $\pm 10\%$ of the published rating.

No limits below 5W

Although this part of class C applies to equipment with a rated power $>25W$, measurements on some types of equipment (e.g. with dimming or colour control) must be made at settings that give lower power levels, possibly down to levels as low as 5W. If the power is less than this the results are assessed as a pass regardless of the actual readings.

Assessment to the harmonic current limits in table 1.

A limited class of equipment (with incandescent lamps and phase control dimming) is required to be assessed according to the limits of **table 1** (the class A) limits. To make these measurements with this instrument simply declare the load to be class A and set the 'no limits below' power level to be 5W, not the normal 75W.

Assessment of Class C lighting equipment with a rated power below 25 Watts.

There are now three possible ways of assessing the compliance of low power lighting given in clause 7.4.3 of the standard. These different methods appear to be designed to accommodate different types of implementations of small lamps, especially those with electronic control circuits. It is quite likely that a particular piece of equipment will only pass one of the options, but that is all that is required.

One method is by using the power related limits of **Table 3** (the Class D table). The other two methods use limits based on harmonic levels expressed as a percentage of the fundamental current, together with either a limit on Total Harmonic Distortion, or on a set of requirements for the phase angles of particular events in the current waveform.

Assessment against the power related limits of table 3

Table 3 defines the limits for class D, and apart from the different description and allowing for powers lower than the normal minimum of 75W the instrument behaves in a similar way.

This method is offered in the drop down list in HA-PC Link or in the TEST menu of the instrument. The Basis of Limits should be set to the rated power of the equipment being tested. There is no separate setting for 'No limits below'; if the rating is less than 5W then it needn't be tested, although a measurement is normally taken to confirm this.

Although the standard requires the user to declare the rated power of the load, it is also possible to select the 'automatic' basis of limits, which uses the highest power found during the test. This is also subject to the requirement that the actual value should be within $\pm 10\%$ of the published rating. It is the user's responsibility to verify this. Additionally on the instrument front panel the 'store present' option can be used to set the basis to the power that is consumed under particular conditions of the load.

Assessment by inspecting characteristics of the current waveform

There are two possible methods for assessing a load based on limits for the harmonic levels which are quoted as percentages relative to the fundamental current. The two methods differ in the number of harmonics specified and their permitted percentages, and also in the other requirements, either for THD or the phase angles of the conduction characteristics of the current waveform taken by the load.

To make these assessments select 'Class C below 25W by waveform' in the user interface. This instrument makes both of these assessments simultaneously and indicates separately Pass or Fail for each possibility. The equipment under test needs only to pass one (and is unlikely to pass both). The standard does not give any identification to the two options; in this instrument and HA-PC Link they are arbitrarily called A and B to relate the two pass or fail assessments to the two sections of the table display.

Basis of limits

To set the 'basis of limits' the rated fundamental current of the load should be entered, but as usual the 'automatic' option can be selected to use the highest fundamental current measured during the test. Alternatively (on the front panel

only) select 'store present' to base the limits on a particular operating condition of the load. The use of a declared rating best provides for repeating the measurements at any time in the future. Note that manually entering 0 would cause a divide by zero error, so the table cells are blanked.

Displaying the results

Selecting this category of class C automatically configures the table display of HA-PC Link to show the specialist summary of the relative harmonic measurements, the waveform phase angles and the two assessments. To view the corresponding display on the front panel of the instrument use the HARMONICS set-up screen to choose the option 'C<25W by waveform'.

The top line shows the present fundamental current and the maximum value that has occurred during the test. If the assessment basis is set to 'Automatic' then this maximum value is the basis for the calculation of limits. If a rated fundamental current has been declared (as it is supposed to be) then the ratio of the maximum to that declaration is shown. The standard requires this to be between 90% and 110%, and a tick or cross is displayed to assess this, but failure here does not over-ride the rest of the assessment.

The second line confirms the basis of the calculation of the limits.

The third line shows the maximum power that has occurred during the test and reports if it is below the minimum power for which limits are applied. This is an over-riding condition, and all the other assessments will be reported as 'pass', regardless of the values, although the actual values continue to be shown.

Below this there are two tables, which separately report the results against the two options given in clause 7.4.3 of the standard, arbitrarily identified here as A and B.

For assessment A the top line shows the maximum THD and an assessment of that against the 70% requirement of the standard, followed by an assessment of the overall combination of THD and the levels of the harmonics 2, 3, 5, 7, 9 and 11 below.

Each line in the table reports the results for a single harmonic. The columns, left to right, are:-

The present (smoothed) value of that harmonic current in mA.

Three columns showing values of the percentage of the basis current (the fundamental) for that harmonic: the smoothed value now, the average over the duration of the test and the maximum that has occurred over the test.

Next is the limit quoted in the standard (the maximum permitted percentage of the basis current for that harmonic).

The final two columns show the average and maximum values expressed as percentages of the (percentage) limit shown. To meet the requirements of the standard the average must be less than the limit and the maximum must be less than 150% of the limit.

The tick or cross at the end of the line combines those two requirements into a pass or fail for that harmonic.

For assessment B the overall pass or fail result includes the values of the significant phase angle characteristics of the waveform shown at the bottom of the table. The present filtered values are for information only; the 'worst' values, which are used for the assessment, are the angles which occurred at the same time as the maximum peak current found during the test. This assessment also includes the relative levels of harmonics 3 and 5; note that the measured results are the same as shown for assessment A, but the limits are different, so the percentages of limit are also different.

If the load is switched off, or only takes a small fundamental current, the percentage calculations can become very large, but as the power is below 5W this is not important.

In HA-PC Link the two assessments are also shown in the blue harmonics summary panel below the table.

Phase angles of the characteristics of the current waveform.

This issue of the firmware makes some changes to previous behaviour.

For the "start of conduction" angle, if the current is already above the threshold at the rising zero crossing of the voltage waveform then the start of conduction angle is recorded as 0°. Previous versions would scan forward until the current fell below the threshold and then rose again late in the cycle and record the start of conduction as 270° or greater.

The peak value shown is the largest peak in the cycle (the old 'last peak' requirement has been removed from the standard). Although the bandwidth of this instrument is less than 9kHz, so the peak measurement is not influenced by components above 9kHz, some averaging is applied to reduce errors introduced by noise.

The 'end of conduction' algorithm is unchanged.

If there is no significant signal then the values are reported as 0°, 0° and 180°.

On the instrument front panel the **Wave** menu shows the voltage and current waveforms with small vertical markers added at the three significant events, as well as a numerical read-out of the present phase angle values.