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

HA-PC Link

An update to HA-PC Link will follow shortly. This version of the firmware will operate in conjunction with HA-PC Link version 3.03, but there is no access to any of the new facilities. The firmware does override the setting of 'no limits below' in class C to 5W. That HA-PC Link version also continues to report the old standard date, but as the measurements are the responsibility of the instrument that can be overwritten.

General 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 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% that is all that is reported. The value shown will therefore be different to previous versions of the firmware.

Voltage variations and Flicker to EN61000–3–3:2013+A2:2021

The amendment A2:2021 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 +A2:2021

The facility to use the historical 16 cycle transform methods of EN61000-4-7:1993 is deleted. The instrument now only supports measurements to the present issue of the standards.

Classes A, B and D

There are no changes to the measurements and assessments in the instrument for these classes, but here also there are changes to the way some types of equipment must be operated, including may changes and additions to Annex B. These changes do not affect the firmware.

Class C lighting equipment

The standard defines a number of different requirements for assessing lighting equipment depending upon both its nature and its rated power. On the TEST menu once the load is declared as class C the instrument offers these options by selection on the TEST menu in the field "Basis of Assessment" depending on the rated power of the load.

An exception is a limited class of equipment (with incandescent lamps and phase control dimming) which 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.

Standard class C rated at over 25 Watts.

Equipment of this type is assessed against the permitted harmonic current limits of **table 2** in the standard. These limits are calculated depending on the rated fundamental current of the load, and in previous issues of the standard also on its power factor.

Third harmonic limit and power factor.

Previously the permitted level of the third harmonic current depended upon both the rated fundamental current and the power factor of the load. This issue of the standard has replaced the use of the actual power factor with a limit calculated using a presumed power factor of 0·9.

This issue of the firmware implements this by default, by inserting the value of 0.9 for the power factor (which can still be seen on the screen). If it is required to repeat old measurements then this can be over-ridden on the Test setup screen by selecting the **Declare PF** softkey and entering the desired value. This must be done last, as subsequently entering a fundamental current declaration or returning to automatic will restore the 0·9 PF. Alternatively enter Declare PF as 0 which will also restore the 0·9.

Fundamental current declaration

By default the instrument will use as an automatic basis of the limits the maximum fundamental current observed during the test. 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.

It is also possible to store the level of fundamental current occurring under a particular operating condition of the load. However for consistency of repeated measurements it is preferable that the proper rating is entered.

In this issue of the firmware the class C fundamental current declaration is now always entered in mA – it no longer accepts values <=16 as being Amps. This is to better suit low power lighting below 25 Watts (see below).

No limits below 5W

Although this 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.

The limit value can be changed on the TEST menu if desired to allow the investigation of cases close to the limit.

Class C lighting equipment rated at less than 25 Watts

There are now three possible ways of assessing the compliance of low power lighting. The different requirements appear to be designed to accommodate different types of load, and it is unlikely that a particular piece of equipment will pass more than one of the options.

Measurements against the power limits of table 3

To make these assessments select this option on the TEST menu set-up screen and enter the rated power of the load. Table 3 defines the limits for class D, and apart from the different description and the different setting for 'no limits below' (5W not 75W) the instrument behaves in a similar way.

Although the standard requires the user to declare the rated power of the load, it is possible to use either the highest power found during the test (the 'automatic' selection) or the power that is consumed under particular conditions of the load by using the 'store present' option.

Assessment using phase angles of the current waveform and relative levels of harmonics 3 and 5, *or* Assessment using THD and the relative levels of harmonics 2, 3, 5, 7, 9, and 11.

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

This release of the firmware makes both these assessments simultaneously. On the TEST menu set-up screen select 'C<25W by waveform'.

Basis of limits

The rated fundamental current of the load should be entered, but as usual the instrument offers the options either 'automatic' to use the highest fundamental current measured during the test, or 'store present' to base the limits on a particular operating condition of the load. Whichever way it is set, this value is referred to as the "basis of measurement". Note that the use of a declared rating best provides for repeating the measurements at any time in the future.

Relative harmonics

The previous issue of the firmware implemented these assessments by taking the declared fundamental current of the load and multiplying it by the relevant limit percentage for each harmonic to obtain a set of current limits in mA. The actual harmonic currents were compared against these limits in the same way as other classes. Although correct this method was not what users expected.

This issue of the firmware changes that to handle all these assessments by displaying the measured value of each harmonic current as a percentage of the fundamental basis of limits current and comparing that percentage against the percentage limit given in the standard.

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.

Some vestiges of the old 'last peak' requirement have been removed, so it now looks only for the peak. The bandwidth of this instrument is less than 9kHz so the peak measurement is not influenced by components above 9kHz.

The 'end of conduction' algorithm is unchanged.

Display of the results

On the HARMONICS set-up screen choose the option 'C<25W by waveform' to obtain a specialist summary of the relative harmonic measurements and these two assessments.

Description of the Class C<25W by waveform screen

This is available as a choice on the harmonics view when the sub-class is set to C<25W by waveform. The screen is divided into three areas.

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 two of the options given in clause 7.4.2 of the standard when the 'Assessment basis' selection on the TEST menu is 'class C<25W by waveform'.

Results of the assessment by THD and relative harmonics

This is the table in the middle of the screen.

The top line shows the THD and adjacent to that an assessment against the 70% requirement of the standard.

On the far right is the overall combination of the THD and the harmonic levels relative to the fundamental shown below. A tick here indicated compliance with all the requirements of this paragraph and is a 'Pass' for the load under test.

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 for the percentage of fundamental (or basis current) 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 (harmonic current as a percentage of basis current).

> The final two columns show the percentages of that (percentage) limit that the average and maximum columns to the left represent when expressed as a percentage of the 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.

All of these are combined into the tick or cross on the heading line of this table.

Results of the assessment by waveform conduction angles and relative harmonics.

On the right hand end of the title of this table is a combined assessment of all the requirements of this paragraph, both the relative harmonics and all the phase angles, so a tick here is a 'Pass' for the load on that basis.

Below that are the reports of the individual results. There are two lines for harmonics 3 and 5, which are the only two with requirements in this paragraph of the standard. Except for the different percentage limits demanded by the standard the contents are similar to the description above. Each line has a separate assessment.

The results of the phase angle measurements on the current waveform are shown below, together with their individual pass or fail assessments.

Other notes

The Report facility can be used to send reports through the serial port from the instrument to a terminal program (such as TeraTerm) running on a computer, as well as directly to a printer with a Centronics or serial port. The capability to edit title strings for these reports has been deleted; titles entered previously will be retained.