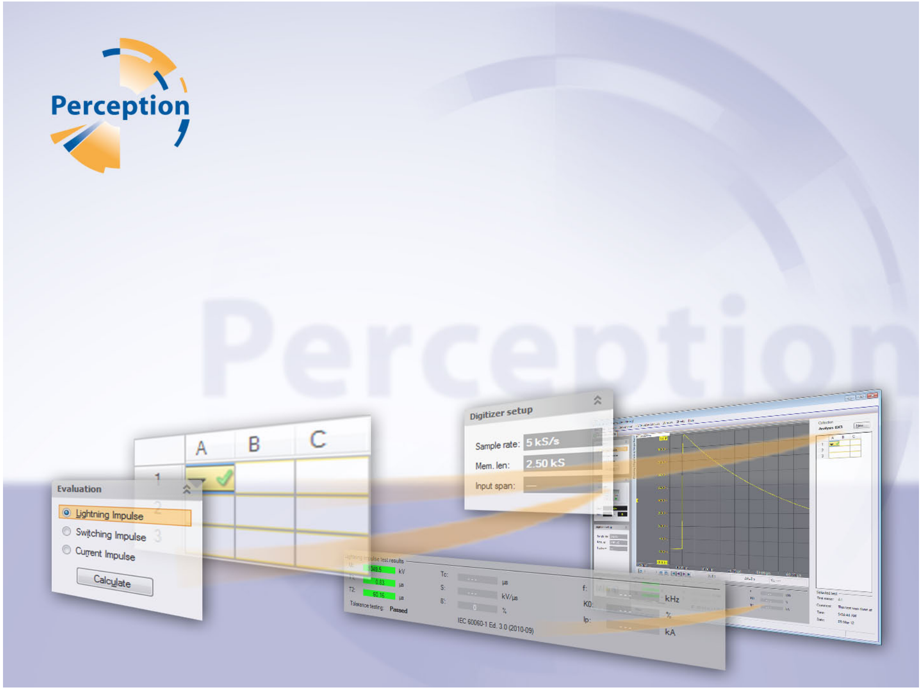
Genesis HIGH SPEED

User Manual

English



HV Impulse Analysis Option

Perception

HBM

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For Perception 6.06 or later

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Table of Contents

1 Getting Started

1.1 Introduction

The High Voltage Impulse Analysis (HV-IA) option calculates and analyzes a variety of parameters that are relevant in high-voltage impulse testing. The HV-IA option is typically used as a stand-alone application for repetitive tests. This option is focused on the results of tests and is tailored for ease of use.

The HV-IA option is a successor for the legacy HV-IA software that ran on the Nicolet Accura and Sigma DSO's with ProView software.

1.1.1 The software

- Measures the parameters of impulse waveforms in accordance with IEEE and IEC specifications.
- Automatic comparison of measured parameters against user entered tolerances.
- Provides reduced and full voltage waveforms for superimposed visual comparison.

You can do the following:

- Make and evaluate a “test”
- Create a series of tests as a collection
- Maintain/modify the collection of tests
- Set/modify the acquisition parameters
- Set/modify the attenuator and tolerances
- Save the results
- Create a report

Note *Measurements and calculations comply with current and new standards, including the K-factor filter for the revision of IEC60060-1 and -2.*

1.2 How to install the HV-IA option

The Perception software requires a HASP key. HASP (Hardware Against Software Piracy) is a hardware-based (hardware key) software copy protection system that prevents unauthorized use of software applications.
Each HASP key contains a unique ID number used for personalization of the application according to the features and options purchased. The key is also used for storing licensing parameters, applications and customer-specific data.
If you have purchased the HV-IA option as a separate item, you will receive a personalized "key file". Use this file to unlock the additional features.

You can find the serial number of your key in **Help** ▸ **About Perception**

To update the key information:

1. Choose **Help** ▸ **Update Key...**
2. In the Open dialog locate the Key File (*.pKey) and click **Open**.
3. If everything is OK you will see the following message:

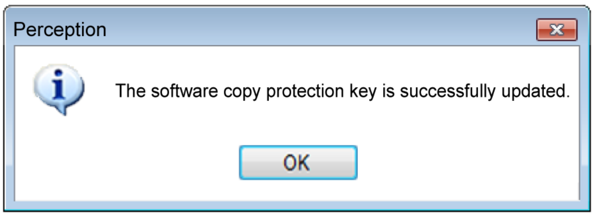


Figure 1.1: Software copy protection dialog

4. Click **OK**.

After the installation you can go to **Help** ▸ **About Perception** ▸ **More...** to see all installed options.

You will need to restart the program before the changes take effect. The HV Impulse Analysis option is now available.

1.3 Sheet overview

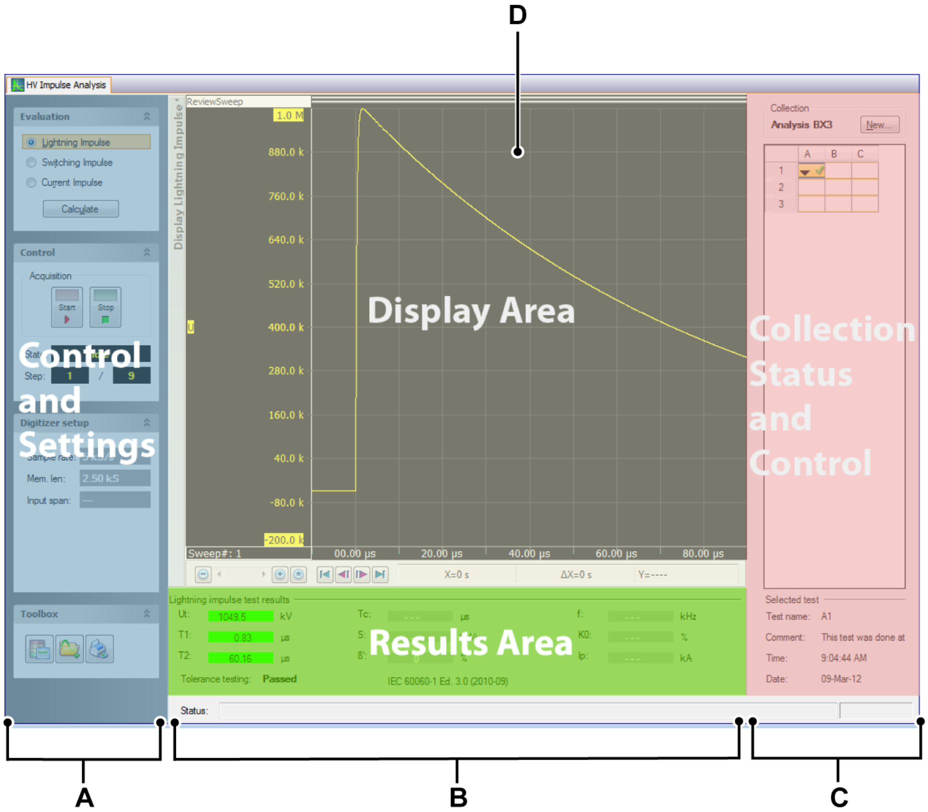


Figure 1.2: HV Impulse Analysis sheet

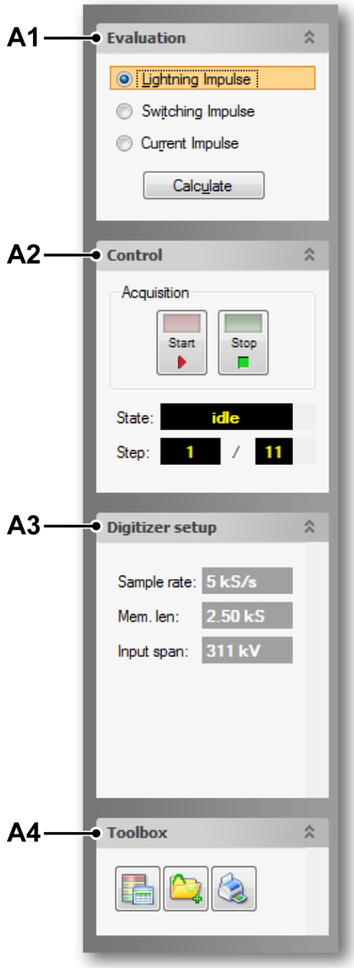
A Task pane

B Results area

C Collection pane

D Display area

A The **Task pane** contains the following groups:



A1 Evaluation group
A2 Control group
A3 Digitizer setup group
A4 Toolbox group

B Results area

The analysis settings and the results of a test will show in the results area, enabling tolerance testing in the **Analysis** settings window will highlight these results as shown below.

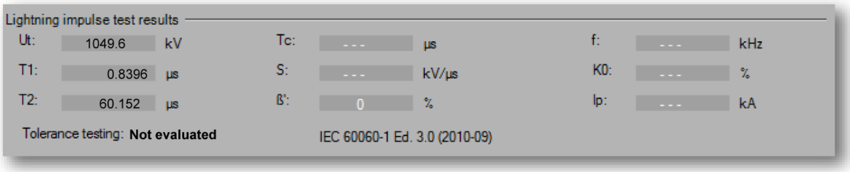


Figure 1.3: Lightning impulse test results (A)

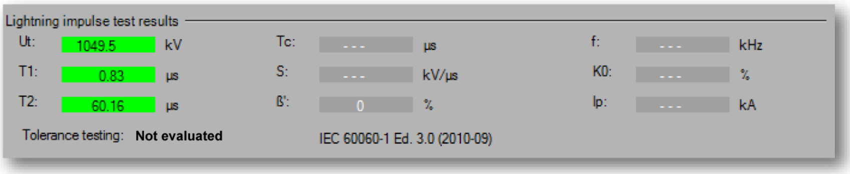


Figure 1.4: Lightning impulse test results (B)

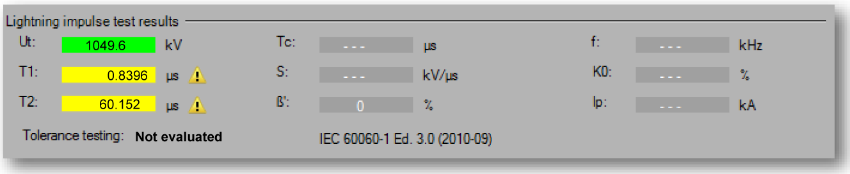


Figure 1.5: Lightning impulse test results (C)

If tolerance testing is enabled in the Analysis settings then the results which do not fall within the specifications of the testing parameters will show up highlighted in yellow, see Figure 1.5, whereas a good test result will be highlighted in green, see Figure 1.4. When tolerance testing is not enabled the results are not highlighted.

C Collection pane

This section explains the available controls and data show in the collection pane.

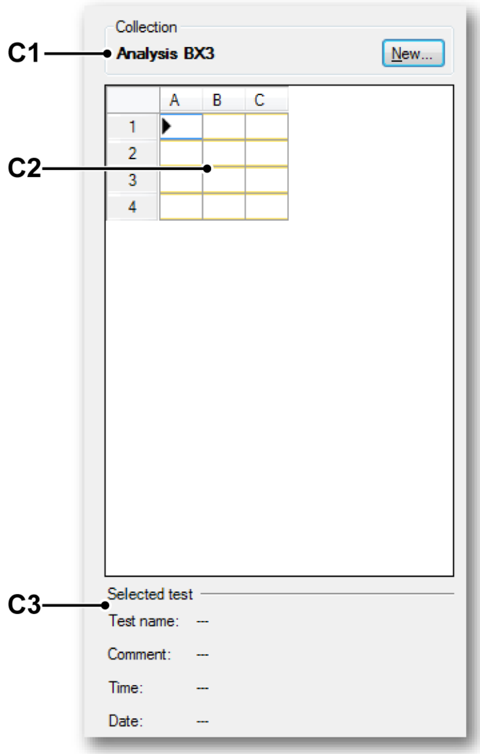


Figure 1.6: Collection pane

C1 Collection name This contains the name of the collection and the button **New...**

C2 Collection grid This area shows the current tests of a collection and their status.

C3 Collection test data This area shows, if available, the information related to the current test.

When a new collection is started the collection pane will appear as in Figure 1.7 "Start new collection area" on page 13.

To start a new collection click:

or select **New Impulse Analysis Collection** from the menu.

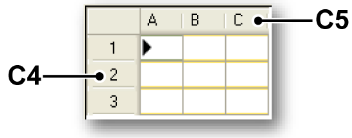


Figure 1.7: Start new collection area

C4 Tests

C5 Terminals

Complete test 

A Test has been done with no warnings.
B This test is on display.

Test error 

A Test has been done with a warning.
B This test is on display.
C The next test will be done in the next cell.

Collection control

You can navigate in a collection by using keyboard arrows to move to different cells. Double clicking or pressing enter will select a cell as active or you can right click and click **Select**. If the black arrow , is not pointing to start a test in the correct cell, right click and click **Start next test here.**

If a cell is selected for a test and it is occupied, a warning dialog will come up and informs you that it is not possible to start a new test because the test storage location is not empty. Before you can continue you have to empty the location, see Figure 1.8.

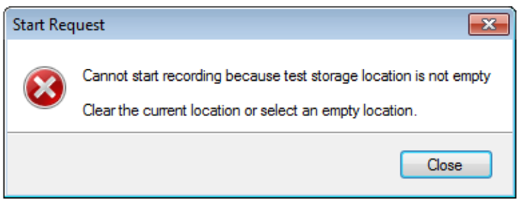


Figure 1.8: Start Request dialog

D Display area

The main graphical area of the screen.

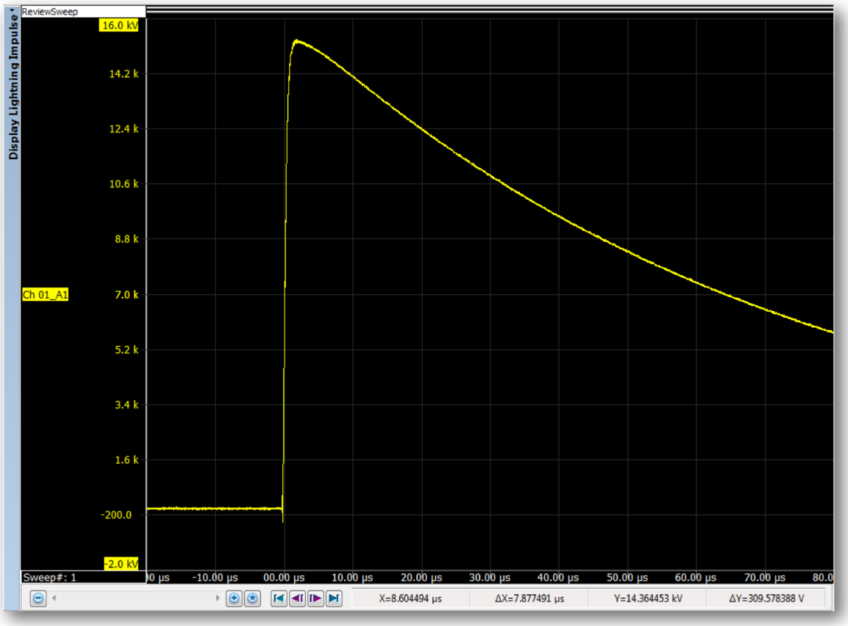


Figure 1.9: Display area

This area displays current waveforms and the controls and position axis to navigate current data. Cursors can be found in their default position in the top left of the area. Data sources can also be dragged into this area for viewing. The display setup menu is accessed via a right click in this area.

2 Functions – Control and Usage

2.1 Overview

For control and analysis of a high voltage test setup the HV-IA option is provided. This chapter will guide you through the various steps, required to obtain a general understanding of the concepts used in the HV Impulse Analysis sheet.

2.2 Choose a test type

Before performing any analysis, choose an evaluation method, either **Lightning Impulse** or **Switching Impulse**:

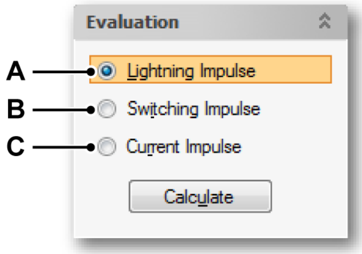


Figure 2.1: Evaluation contol

A Lightning Impulse

B Switching Impulse

C Current Impulse

This is done before making a new collection as a collection can only use one method of evaluation.

2.3 Open a collection

Before you are allowed to start an acquisition you must open a collection. In the collection pane click **New…** or select **New Impulse Analysis Collection** from the menu.

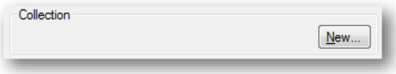
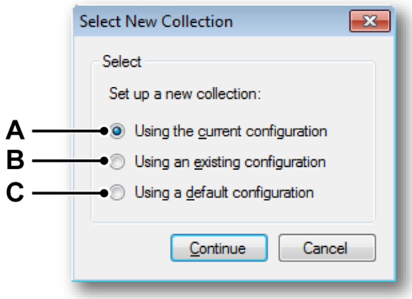


Figure 2.2: New collection

Note *A saved collection or a default collection contain with it configurations and settings which apply to the entire user interface. Loading a collection will therefore also load the corresponding HV-IA sheet settings and layout.*

A dialog will then open with 3 Options as shown in Figure 2.2.



A Set up a new collection using the current configuration
This will only open a new collection with the same configuration and setup as is currently running.

B Set up a new collection using an existing configuration
Locate your own settings and test setup that you want to use with the new collection.

C Set up a new collection using a default configuration
This is a fast way to setup your test environment to a preferred default when opening a new collection.

Note *If you are using the HV-IA sheet for the first time it is recommended to use option **C** to get started.*

After selecting your collection type you will be presented with a collection setup dialog. In this dialog you will design your collection layout and properties.

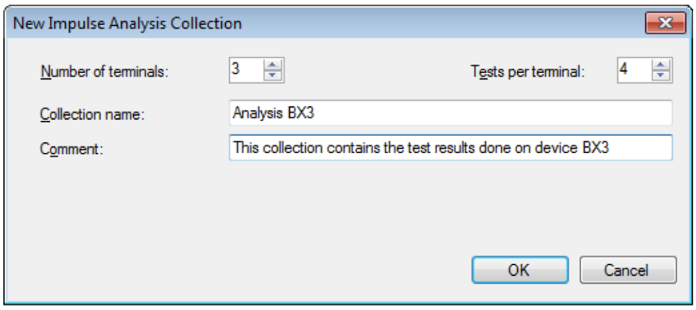


Figure 2.3: New Impulse Analysis Collection

Number of terminals
Choose from a number of 1 to 20 terminals using the up and down arrows. In the terminal window, terminals will fill up with results in numerical order until all tests are complete and then the next terminal will start to fill up.

Tests per terminal
A range of 1 to 200 tests can be associated with each terminal (all terminals have the same number of tests).

Collection name
Each collection should have a unique name. This name is also used for the name of the file which contains all the measured and calculated data including the system configuration.

Comment
Use this entry field to add additional comments and remarks to the collection. This comment can be used for reporting.

After you Click **OK** the collection will be ready for tests and the main screen collection pane will look like Figure 2.4.

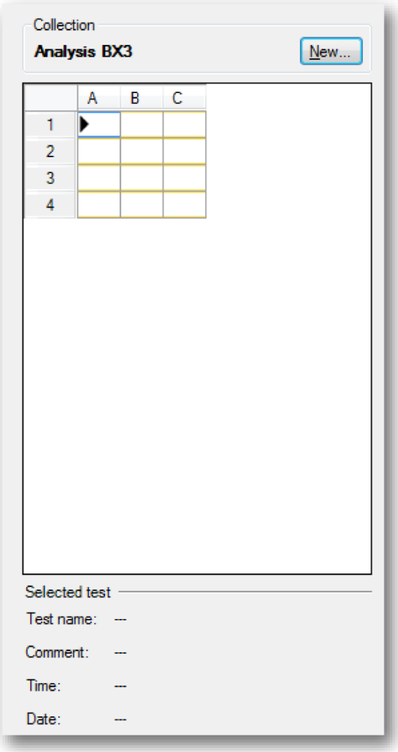


Figure 2.4: Collection pane

 Notice that the right arrow in the upper left cell of the collection grid indicates that the next test will be saved here.

The system is now ready for aquiring the first test.

2.4 Start an acquisition

Click **Start** in **Control** to activate the system.

Figure 2.5: Control Acquisition

Note *The control pane will display "waiting for trigger" and the current step to be filled in the collection matrix.*

The system is ready for a triggered input or event to start recording the impulse data. A few seconds after the trigger a physical test is done, and a pop up dialog will ask if the test is to be accepted or rejected.

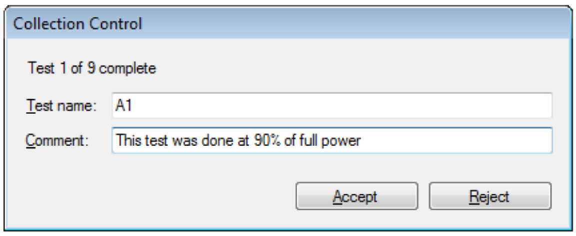


Figure 2.6: Collection Control dialog

1. Click **Accept** to save the current results to the collection, after this a new test can be started.
2. Click **Reject** if for some reason you do not want to save the results to the collection.

At this point you can enter a test name to replace the automatically created name "A1". This name is created from the current terminal name and test number. If a test name is changed the system will remember the name, this will now become the default name for the "A1" test position. A comment can also be added to the **Comment** text box. Once a comment is added and accepted the display will look like Figure 2.7.

Note *The name can be reset by clicking **Reset** in the **Collection...** settings via the sheet menu.*

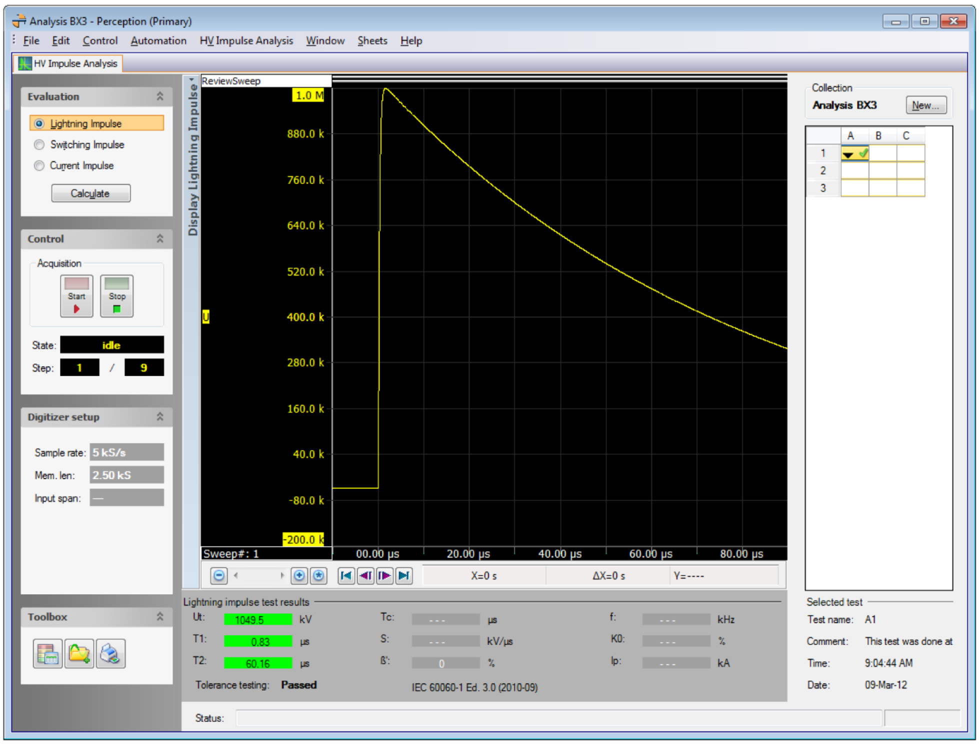


Figure 2.7: HV Impulse Analysis sheet with Display Lightning Impulse

 The upper left hand cell in the collection table now indicates that the test has been done; the results are within tolerance and that the next test will be done in the cell below ("A2").

Note *If you cannot see the waveform click the **star** key in the display control area to fit the waveform to the screen.*

The results are always displayed as described in Figure 1.3 "Lightning impulse test results (A)" on page 11 and the following figures.

Note *If you have selected the standard IEC 60060-1 Ed. 3.0 (2010-09) and you are doing* ***Lightning Impulse*** *tests and you are evaluating a tail chopped signal then an additional not chopped signal is needed to do the calculations. The application assumes that the first test of a terminal is a not chopped signal and will automatically be used. If this signal is not available then you can measure it later and do a manual recalculation on the chopped signal afterwards.*

Note *The calculations will automatically detect if there is a major oscillation for Lightning or Switching Impulse tests. In those cases the standard IEC 60060-3 (2006) will automatically be used to do the calculations.*

2.5 The Collection Manager

To modify and manage test results a data manager is provided, a button is available in the Toolbox pane to access this.

Figure 2.8: Toolbox options

Click the collection manager button and the dialog in Figure 2.9 should appear.

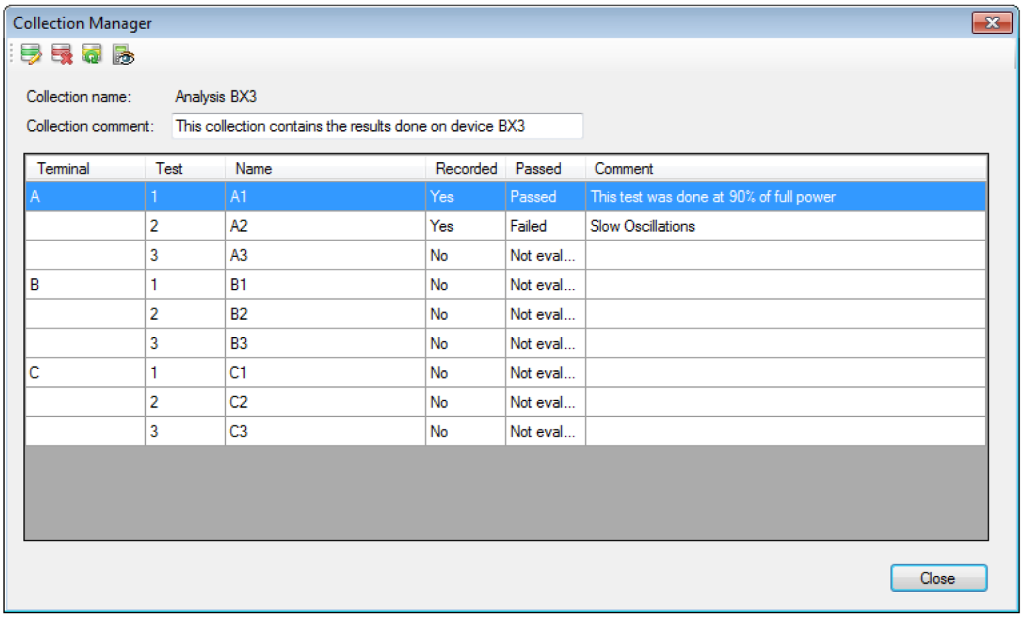


Figure 2.9: Collection Manager dialog

Within this dialog you have a selection of 4 buttons, first you must select a test or row then:

Click to edit the comment for this test.

Click to simply clear this test data.

Click to re-evaluate the calculations for this particular test.

Click or double click the test in question to view the result data of this test.

Note *A comment can also be added for the entire collection*

Re-evaluate multiple tests
It is possible to redo the calculation for more than one test at the same time. Open the collection manager and select the tests you want to recalculate.

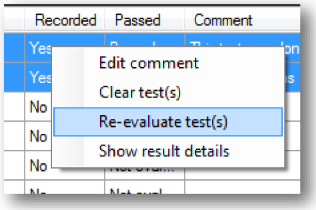


Figure 2.10: Re-evaluate test(s) option

Once highlighted right click and select **Re-evaluate test(s)**. The tests will be recalculated one test at a time.

3 The HV Impulse analysis menu

3.1 Analysis Menu

This is a break down of the HV Impulse Analysis menu.

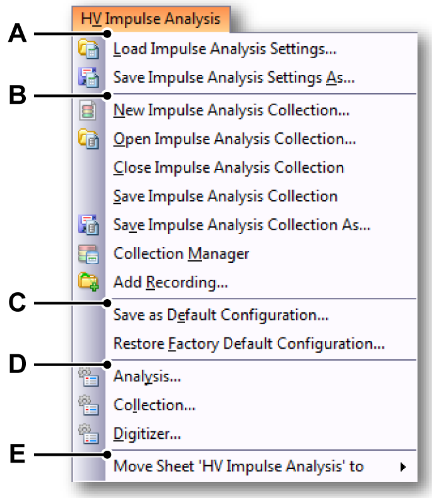


Figure 3.1: HV Impulse Analysis menu

A Load or save

B Collection menu items

C Configuration defaults

D Test Analysis Setup

E Miscellaneous

A Load or save

Load Impulse Analysis Settings

Loads a previously saved HV Impulse Analysis sheet.

Save Impulse Analysis Settings As

The settings of the HV Impulse Analysis sheet can be saved in a separate file with extension ".pHVIASettings". This file contains **only** settings related to this sheet, it contains the layout of the displays, the tolerance settings etc.

B Collection menu items

The next 6 items in the menu are related to collections. The menu offers the possibility to do the following with Impulse analysis collections:

Make a **New** collection
Use this menu item to make a new collection. See "Open a collection" on page 17 for more detailed information.

Open Impulse Analysis Collection
Self defined

Close Impulse Analysis Collection
Self defined

Save Impulse Analysis Collection
Saves the current collection into a collection file. The save action always automatically takes place after a test is recorded and the calculations are done.

Save Impulse Analysis Collection As
Saves the current collection into a collection file. The save action always automatically takes place after a test is recorded and the calculations are done.

Collection Manager
Opens the collection manager dialog for an overview of the active collection, see Figure 4.1 "Add Recording dialog" on page 35 for more information.

Add Recording
Adds an already existing recording to the active collection, see Figure 4.1 "Add Recording dialog" on page 35 for more information.

C Configuration defaults

Save as Default Configuration
You can set up your own default configuration. By using this menu item your current configuration will be saved as default. This means that each time you start a new collection and select **Using a default configuration** this configuration will be used. A default configuration can be saved for each test type, either Lightning Impulse or Switching Impulse.

Restore Factory Default Configuration
The HV-IA option comes with default configurations for the different test types. These configurations will be changed each time you select **Save as Default Configuration**. However using the **Restore Factory Default** Configuration will reset the configuration to the initial defaults that HV-IA came installed with.

D Test Analysis Setup

These menus give access to the setup parameters of the HV-IA application. Before performing any analysis, the HV-IA application must know what kind of impulses to expect and which channel or channels will acquire them.

Analysis ...
Click **Analysis** in the sheet menu and the dialog in Figure 3.2 will be shown:

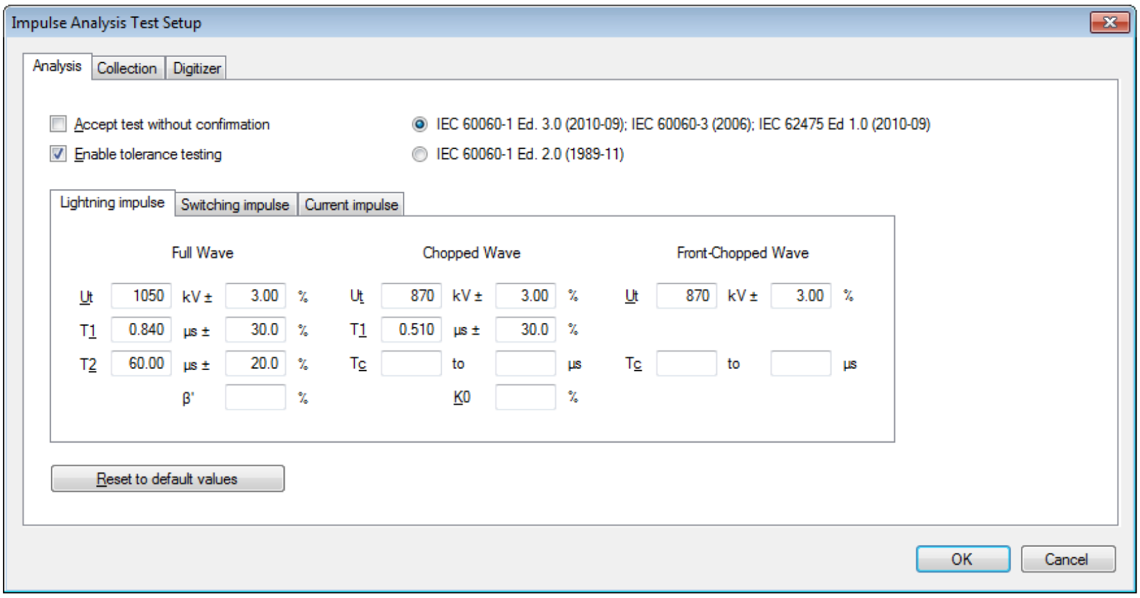


Figure 3.2: Impulse Analysis Test Setup dialog

Accept test without confirmation

Select this check box if you want to automatically accept tests. The dialog in Figure 2.6 on page 20 will not be shown.

The **Enable Tolerance Testing** option is off by default. This option will enable the program to compare the analysis results to the entered tolerances. The default tolerance percentages are specified by the **IEC** standards.

Selecting the **Lightning Impulse** tab enables testing between three groups of tolerance values:

- Full wave
- Chopped wave
- Front Chopped wave

Selecting the **Switching Impulse** tab will only apply one set of testing parameters in all cases.

Click **Reset to default** values to return all tolerance percentages in view back to their original values.

Note *The HV-IA application supports three different types of available IEC working standards. For Lightning and Switching Impulse you either can select **IEC 60060-1 Ed. 2.0 (1989-11)** or **IEC 60060-1 Ed. 3.0 (2010-09)**, the (2001-09) standard uses the k-factor filtering method. For Current Impulse the standard **IEC 62475 Ed. 1.0 (2010-09)** will always be used.*

Collection...

Click **Collection** in the sheet menu and the dialog in Figure 3.3 will be shown:

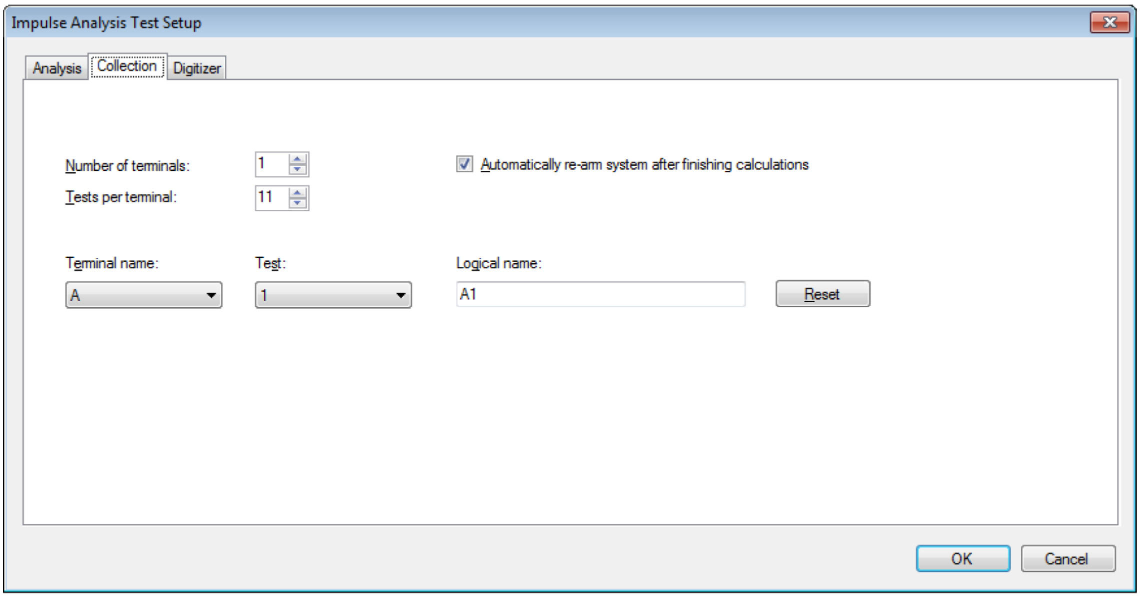


Figure 3.3: Impulse Analysis Test Setup - Collection

The Collection tab provides the ability to modify a current collection matrix without changing the saved collection file or it's name.

Also in this tab is **Logical name.** Each test is given a unique name. Select the **Terminal name** and **Test number** using the related drop down boxes. Now you can change the default logical name by typing in the new name in the **Logical name** box.

Click **Automatically re-arm system after finishing calculations** when you want that the system re-arms itself after finishing the recording and calculations of a previous test. The time delay before the system is re-armed can be set via the HVIA **Miscellaneous Preferences** dialog (**Delay before auto restart**).

Click **Reset** to set all logical names back to their defaults (A combination of the **Terminal name** and **Test** number).

Note *For more information on collections please see Figure 1.6 "Collection pane" on page 12.*

Digitizer...

Click **Digitizer** in the sheet menu and the dialog in Figure 3.4 will be shown:

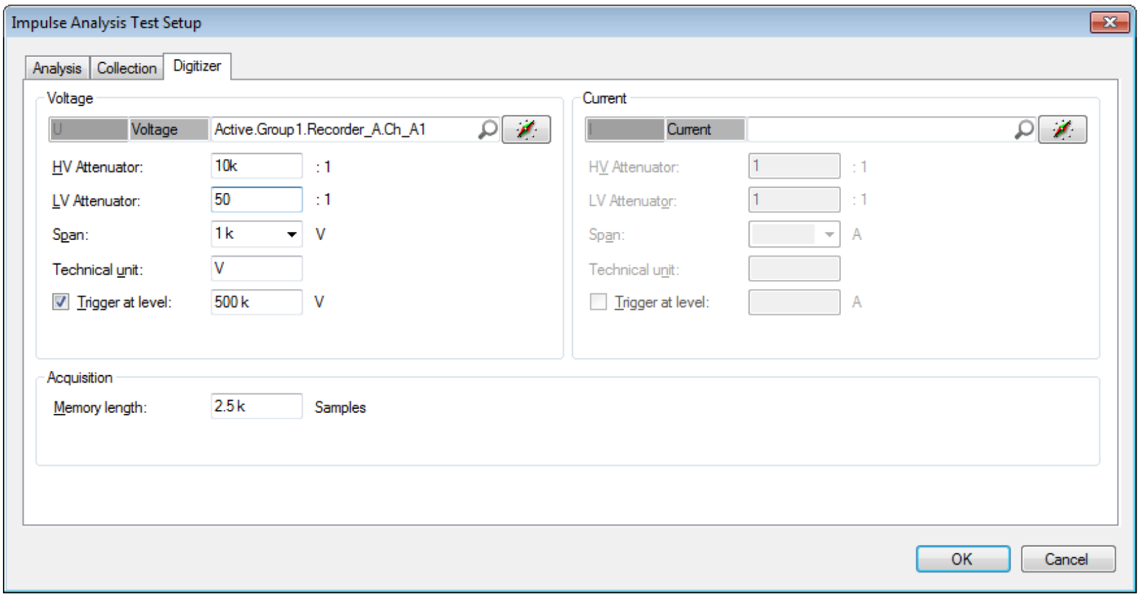


Figure 3.4: Impulse Analysis Test Setup dialog - Digitizer

Voltage Channel
This channel measures the voltage signal. The voltage channel defaults to the first channel of the first recorder.

Current Channel
The current channel is optional and can be used to measure a current signal. Make this field empty if you do not use a current signal.

Change the data source
You can change a data source by selecting another channel using the  button.

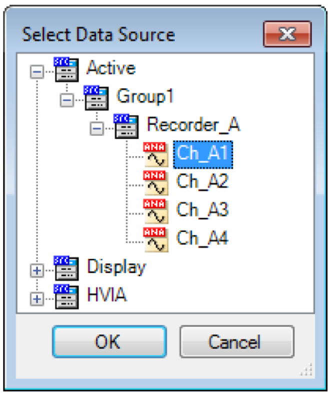


Figure 3.5: Select Data Source dialog

Please see "Introduction" on page 40 for more details on data sources.

Both the voltage channel and the current channel have high voltage attenuator and low voltage attenuator settings.

The **High Voltage attenuator** and **Low voltage attenuator** settings are combined to reduce the signal at the digitizer input to less than 100 V. If the HV attenuator ratio is 2000:1 and the LV attenuator ratio is 50:1 then the total attenuation will be 100 000:1.

Note *The Perception setting **Technical Units Multiplier** of the selected hardware channel is automatically set to 100 kV/V.*

When connected to **Active** hardware, the following will become active for data input:

- **Span** (Voltage span/range)
  This is the Peak-to-peak scale that the digitizer can measure at the input. It defines the physical measurement range.
- **Technical unit**
  The technical units (y scale) as displayed in displays, tables, meters or reports.
- **Trigger Level** (The level used to trigger the acquisition)
  If the trigger level is set to e.g. 100 kV then the acquisition is triggered if the signal goes above 100 kV or below -100 kV.

Note *The Perception Trigger mode is set to Dual and the primary level is set to the entered trigger level while the secondary level is set to the negative value of this entered trigger level.*

- **Memory Length** (Total number of samples in 1 acquisition)
  The number of samples per channel saved during an acquisition. If the number of samples is set to 25 k and the sampling rate is 100 MS/s than the length in time of the recorded signal is 25 k/100 MS/s = 250 µs.

E Digitizer Extra

The **Digitizer Extra** tab is only available if the HVIA miscellaneous preference **Allow working with 2nd channel** has been enabled. For more information see the appendix “HV-IA Preferences - Miscellaneous” on page 79.

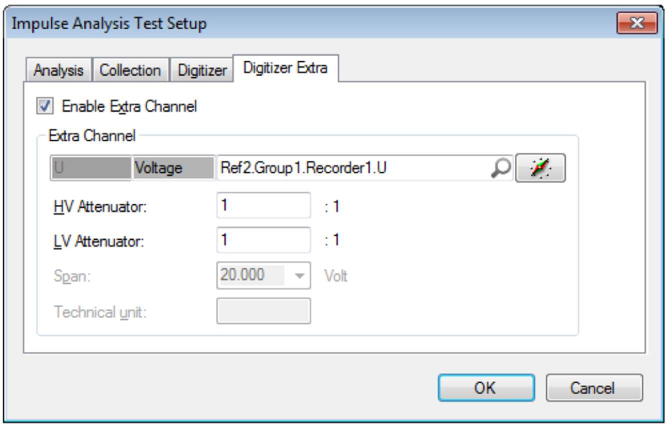


Figure 3.6: Impuls Analysis Test Setup dialog - Digitizer Extra

It is possible to measure an extra channel and do the same calculations as those which are done on the first channel. This feature can be used for calibrating purposes.

Enable Extra Channel

Select this check box if you want to measure with an extra channel.

Voltage Channel

This channel measures the voltage or current signal of the extra channel. This channel defaults to the second channel of the first recorder.

Change the data source

You can change a data source by selecting another channel using the button.

Please see “HV Impulse Analysis Data sources” on page 40 for more details on data sources.

Both the voltage channel and the current channel have high voltage attenuator and low voltage attenuator settings.

When connected to active hardware, the following will become active for data input:

- **Span (Voltage span/range)**
  This is the Peak-to-peak scale that the digitizer can measure at the input. It defines the physical measurement range.
- **Technical unit**
  The technical units (y scale) as displayed in displays, tables, meters or reports.

F Miscellaneous

If you have multiple monitors you can open the HV Impulse Analysis sheet into a new window. This is only possible if the option Workbooks in your key have been enabled. See “Perception Data Acquisiton” manual.

4 Commands – How to

4.1 Introduction

This section describes, in short summaries, how to carry out some of the most useful functions in the HV-IA sheet.

4.1.1 Functions in the HV-IA sheet

- **To do a repeat test**
  Load the collection needed. Place the collection “pointer” using a double click or a right click and select **Start next test here**. If the operator clicks on a test that has data in it, another dialog comes up to confirm deletion of the selected test data.
- **Continuing an old test**
  Make sure the correct collection is loaded. Click the empty slot to place the “pointer” within the collection and start a test.
- **Start an acquisition**
  Make sure you have a collection ready, click **Start** and then wait for a trigger.
- **Visually analyze the waveform**
  Drag a zoom box around the area of interest and the position the two available cursors to intersect the data curve and read the relative data points.
- **Print the results of a test**
  When you have completed all tests in a collection and would like to print click the print button in the toolbox pane to print a default report. To modify default reports please refer to the Perception manual.
- **Save the results of a test** (the data of a test is saved by default)
- **Modify a default report**
  The HV-IA provides a default layout for reporting, however to override this default and design a specific report do the following:
  Go to the Sheets menu and click Manage Sheets, from here select the Reporting sheet and click Load. Once the report sheet has been you loaded you may modify the report according to the methods set out in the Perception Manual.
  If the report has been modified to a preferable format, this format can be saved in the HV-IA menu. Navigate to **HV Impulse Analysis** in the menu bar and click **Save as Default Configuration...** This will save the default report in this style for future report making.
- **Add a Recording**
  Via the HV-IA option you may import **.wft** data files that were made with older hardware including: PowerPro, Accura 100HV, Sigma 100HV. HV-IA now uses **.pnrf files**, however importing either file is done in the same way.

  Click the Add recordings button the **Add Recording** dialog will be shown.

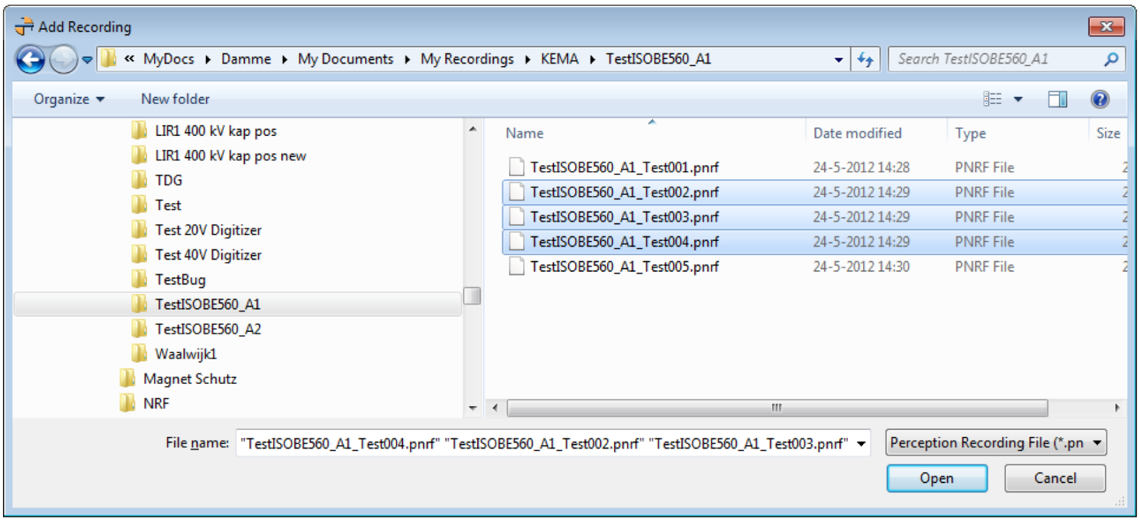


Figure 4.1: Add Recording dialog

Select multiple files from the recordings folder using the **Ctrl** key and then click **Open.** The file will then be loaded into the **Collection Recording Loader** where you may select a **Channel** for it to be placed.

The application will look for empty test locations to place each of the new files. If you would like to place the files in different positions do the following:

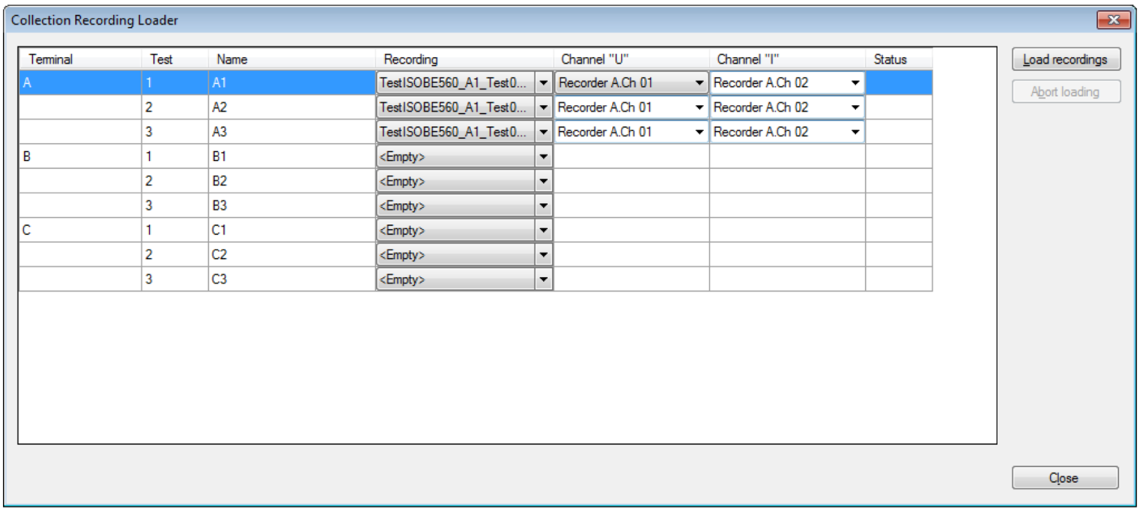


Figure 4.2: Collection Recording Loader dialog

1 Select the test to move.

2 In the Recording column select the drop down box as empty.
3 Go to the location you want the test to appear in.
4 Select the drop down box and choose the file you would like to appear.

Once you are satisfied click **Load recordings.** While loading, the status will change to one of the following fields.

- **Waiting** The Load recordings button has been pressed, the recording is waiting to be read.
- **Reading** The program is busy reading and doing calculations on the current recording.
- **Done** Recording has been read, calculations have been done, the data is now part of the collection.

Note *Some recordings can contain multiple channels, if this is the case, select the correct channel in the "U" and "I" columns.*

5 Measurements with an extra (second) channel

5.1 Introduction

You can use an extra channel during a test. This feature can be used for calibration tests.

The system will perform the same calculations for the second channel as for the first channel. The results of the second channel will be saved in a separate test. This test is located on the right-hand side of the first test in the collection grid. The test is also a different color (blue). Before you start any test, the light blue cell background indicates that you are working with an extra channel.

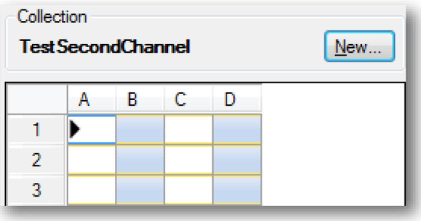


Figure 5.1: Test Second Channel (Part 1)

After you have done the first measurement, the first cell and the one directly next to it are both filled.

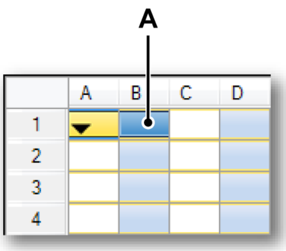


Figure 5.2: Test Second Channel (Part 2)

A Second channel

You can see the second channel results and other data by selecting its corresponding cell in the collection grid, just as you do in normal operation.

You cannot switch back to normal operation while a collection is open. First, you need to close the collection and then you can enable or disable the Extra Channel (see Figure 5.3).

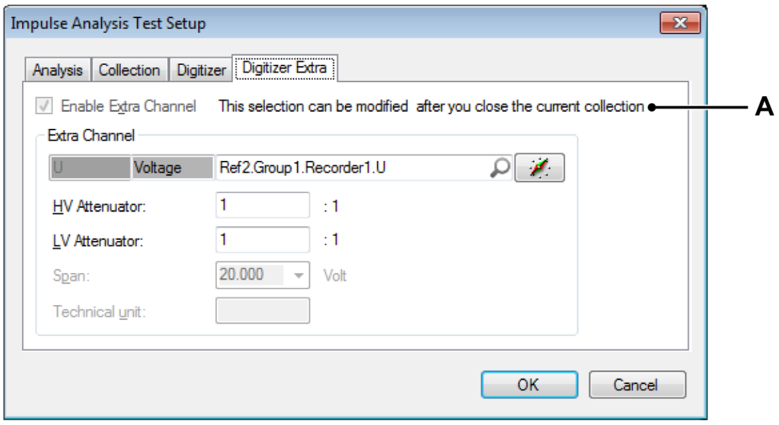


Figure 5.3: Impulse Analysis Test Setup dialog with the Extra Channel disabled

A This selection can be modified after you close the current collection

You can only change the Enabled Extra Channel option if you close the collection first (see Figure 5.4)

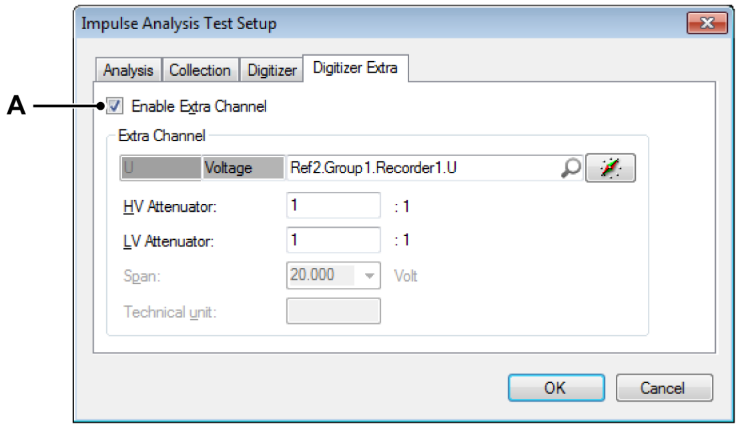


Figure 5.4: Impulse Analysis Test Setup dialog with the Extra Channel enabled

A Enabled Extra Channel

The extra channel functionality is only available if the HVIA miscellaneous preference **Allow working with 2nd channel** has been enabled. For more information, see the appendix “HV-IA Preferences - Miscellaneous” on page 79.

A HV Impulse Analysis Data sources

A.1 Introduction

The following is an explanation of data sources in the HV-IA sheet. Data sources and the data sources window are an important part of the HV-IA option to understand. When a test is done the results are saved and can be accessed at any time from the data sources window. Please refer to the Perception manual for more detail on how to use the data sources in Perception.

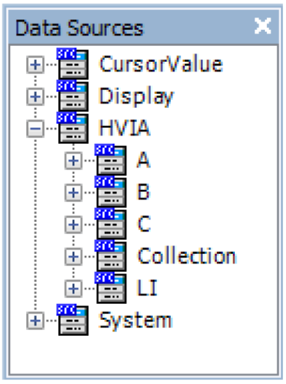


Figure A.1: Data sources navigator

All of the data sources; consisting of numbers, strings and waveforms are stored here, the main sections can be expanded by clicking on the respective plus sign.

The HV-IA data sources are structured like a tree as shown in Figure A.1. The main branch for this sheet is called **HVIA**.

The sub nodes of this HVIA entry are **A, B, C, … , Collection, LI.** The nodes **A,B,C** correspond to the number of used terminals and contain the calculation results per test.

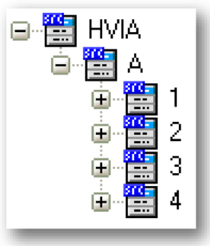


Figure A.2: HVIA node/terminal A

The sub nodes per test contain all the calculation results for a specific test:

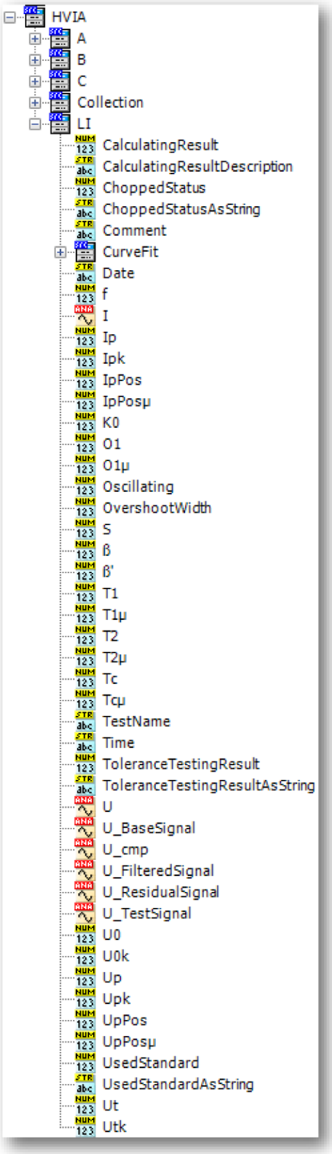


Figure A.3: HVIA node/subnodes

The variables marked by the icon are waveforms. These waveforms can be measured or calculated data. The waveforms can be displayed by any Perception display. If the name of the waveform ends with **"_cmp"** then we are dealing with a normalized waveform, the maximum of a normalized waveform is set to 1 and the minimum is set to 0

The variables marked by the icon are numerical values.

The variables marked by the icon are string values.

For detail on the meaning of each variable please refer to the tables in the Lightning impulse, Switching impulse and Current impulse parameters chapters starting on page 46.

If a data source has the same name as another data source but ends with a **k** or **µ** then this data sources refers to the same parameter; the only difference is that the parameter value is expressed differently:

- Name ends with k: Parameter value is divided by 1000. For example 1000 -> 1 or 1000 V becomes 1 kV.
- Name ends with µ: Parameter value is multiplied by 1e06. For example 0.000001 becomes 1 or 0.000001 s becomes 1 µs.

Those values can be useful for reporting.

The collection node contains only two variables:

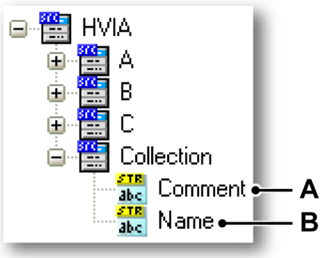


Figure A.4: HVIA node/collection subnodes

A Comment: The saved collection comment

B Name: Collection name

The last node will be **LI, SI** or **CI** depending on the selected test/evaluation type. This node represents the current selected test in the control area, see Figure A.5. The LI, SI or CI nodes show the current or active test results, Figure A.5 shows test A2 is highlighted, this means that LI, SI or CI will reflect the results obtained in node A2.

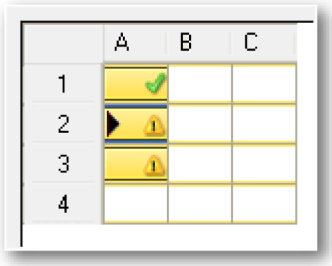


Figure A.5: New collection area

The **LI** node can look like:

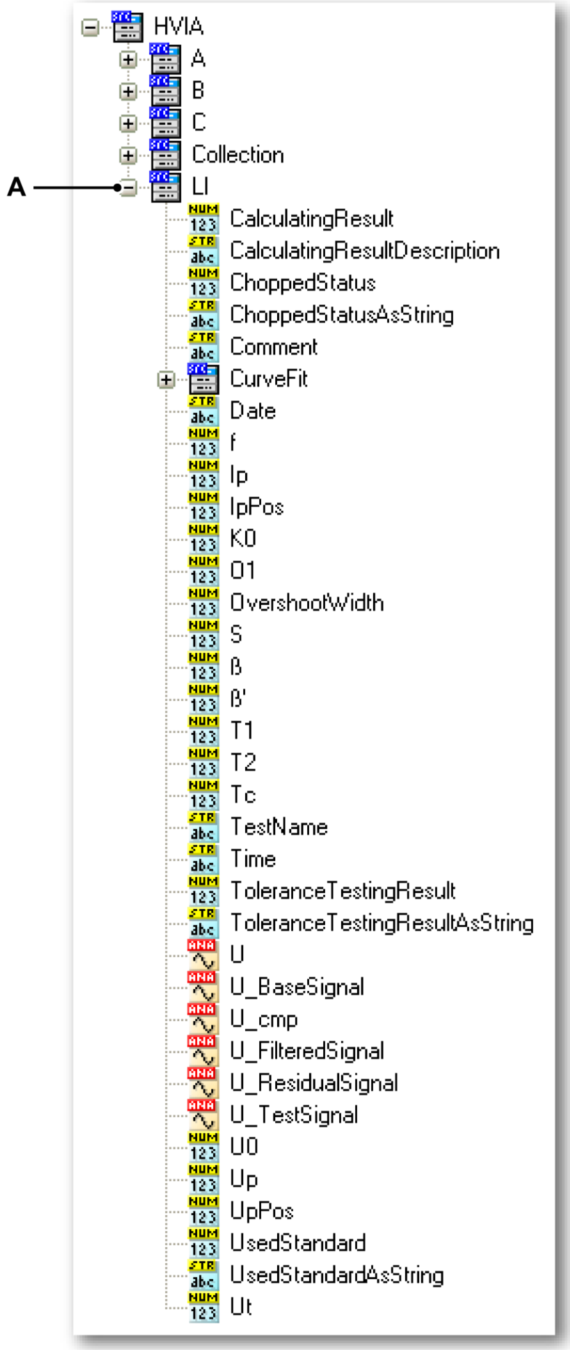


Figure A.6: HVIA node/LI node

A LI node

In the example above, the LI node will have the same “sub-node source structure” as represented by the data source HVIA, see Figure A.6.

Depending on the standard and test/evaluation type used, the variables can differ and will have another meaning. Therefore we will explain the different cases.

A.2 Lightning impulse parameters IEC 60060-1 Ed. 2.0 (1989-11)

This standard has been used by the old HV-IA ProView software that ran on the Nicolet Accura and Sigma DSO’s.

The data sources are shown in Figure A.7.

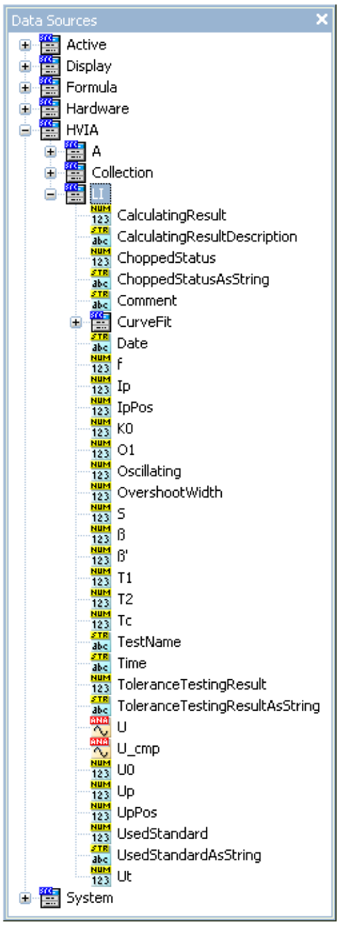


Figure A.7: Data sources navigators

Before explaining each individual variable we will show a lightning impulse with some characteristic measured information.

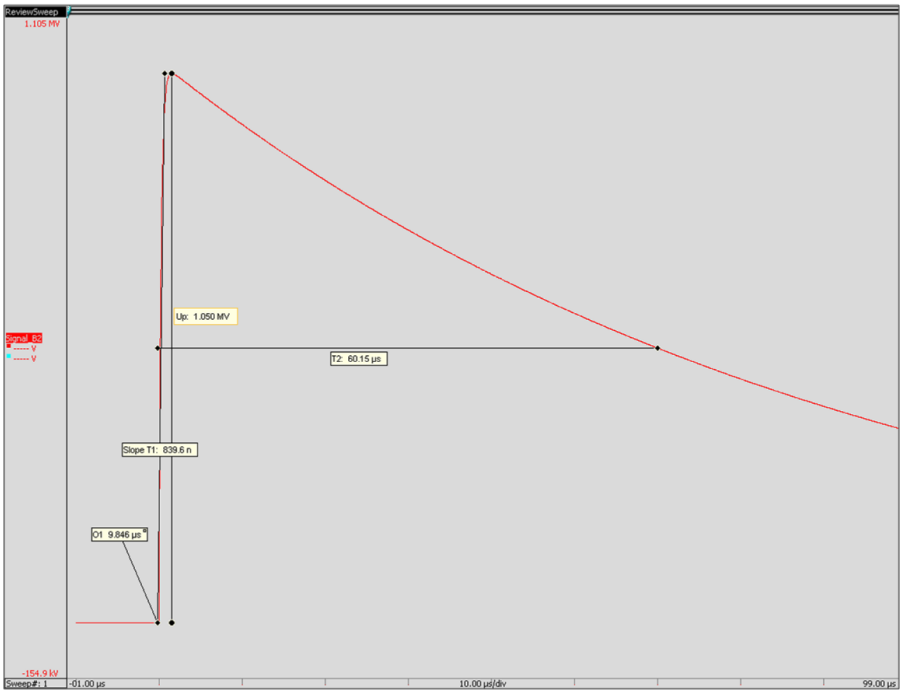


Figure A.8: Review Sweep area with LI calculations

The above display can be constructed with your current HV-IA application, see following chapter for more details. In Figure A.8 we see the main parameters of the LI calculations. The table below describes these and all other parameters. Description of the data sources when dealing with **lightning impulse** measurement, calculated with the standard **IEC 60060-1 Ed. 2.0 (1989-11).**

Variable Name	Description	Possible Value
CalculatingResult	This variable returns 0 if the HV-IA calculations have been done successfully, else it returns 1.	*0*
CalculatingResult-Description	Description of the calculation result. If calculation was OK it will be empty else it gives information what went wrong.	*“Peak value between start and end signal is below 10 % of range”*
ChoppedStatus	Returns chopped status, possible values: 0 = not chopped 1 = front chopped 2 = tail chopped	*0*

Variable Name	Description	Possible Value
ChoppedStatus-AsString	Returns chopped status as a string, possible values: “Front-chopped”, ”Tail-chopped”, “Not Chopped”	*“Not Chopped”*
Comment	Returns the test comment.	*“Reduced wave 50 %“*
Date	Date test was done.	*02-12-2009*
f	Oscillation frequency: the 1/period of any overshoot [Hz] or oscillation detected [Hz]. Displayed only if overshoot less than 1 µs duration or fast oscillation is detected.	*636.94 kHz*
Ip	Ip is the peak value of the current signal minus the current base line. This peak is defined at least 5 µs after the virtual origin (O1). The Ip value is only displayed if a current channel is selected.	*120 kA*
IpPos	The position in time of the maximum current.	*2.15 µs*
K0	Undershoot amount is the Percentage of undershoot below baseline zero. Displayed only for chopped impulses.	*9.207 %*
O1	The virtual origin is calculated as: the time location in the recorded curve that is one half the 30 % to 90 % rise time (before the time of the 30 % crossing). This calculation is the same as extending the unfit straight line between the 90 % and 30 % crossings to the intersection with the baseline.	*9.846 µs*
OvershootWidth	Width of the overshoot in seconds.	*870.0 ns*
S	Virtual Steepness is the slope on the front of the best-fit straight line between 30 % and 90 % of the peak. This value is only displayed for front chopped impulses.	*1157 kV/µs*
ß	Overshoot amount is the percentage of overshoot above the estimated mean curve. Displayed only if overshoot is less than 1 µs duration or a fast oscillation is detected.	*0.000 %*
ß'	Not applicable for this standard.	*0.000 %*

Variable Name	Description	Possible Value
T1	Front Time, is the rise time of the curve between 30 % and 90 %of the peak voltage, multiplied by 1.67.	*839.6 ns*
T2	Time to Half Value is the time from virtual origin to 50 % of the peak voltage on the tail.	*60.15 µs*
Tc	Time to chopping. This is a virtual parameter defined as the time interval between the virtual origin 0 and the instance of chopping.	*450.2 ns*
TestName	Name of the test.	*B2*
Time	The time when the test has been done.	*10:51:38*
ToleranceTesting-Result	Returns the result of the tolerance testing, possible values are: 0 = tolerance testing failed 1 = tolerance testing successful 2 = no tolerance testing done	*2*
ToleranceTesting-ResultAsString	Returns the result of the tolerance testing as a string.	*Not evaluated*
U0	The baseline of the impulse is calculated from the statistical mean of the first 50 points of the impulse signal. Impulse Analysis requires a pre-trigger setting of at least 100 data points.	*-49.97 kV*
Up	For slow or no overshoot Up is the actual peak voltage. For overshoot (less then 1us duration) or oscillations (greater than 500 kHz) Up is the peak of the mean curve.	*1.050 MV*
UpPos	Position of the actual peak voltage.	*11.58 µs*
UsedStandard	Returns the used standard, possible values are: 2: IEC 60060-1 Ed. 2.0 (1989-11) 3: IEC 60060-1 Ed. 3.0 (2010-09)	*2*
UsedStandard-AsString	Returns the used standard as a string.	*IEC 60060-1 Ed. 2.0 (1989-11)*
Ut	Is not applicable for this standard.	

A.3 Lightning impulse parameters IEC 60060-1 Ed. 3.0 (2010-09)

This standard uses a so called k-factor method (with curve fitting and filtering) during the evaluation of lightning impulse voltages.

The following paragraph gives a basic overview of the used calculation method, for exact details we refer to the above mentioned standard.

See Figure A.9, start with **U(t)** this is the **recorded curve** (red) and the **base curve U_b(t)** (green).

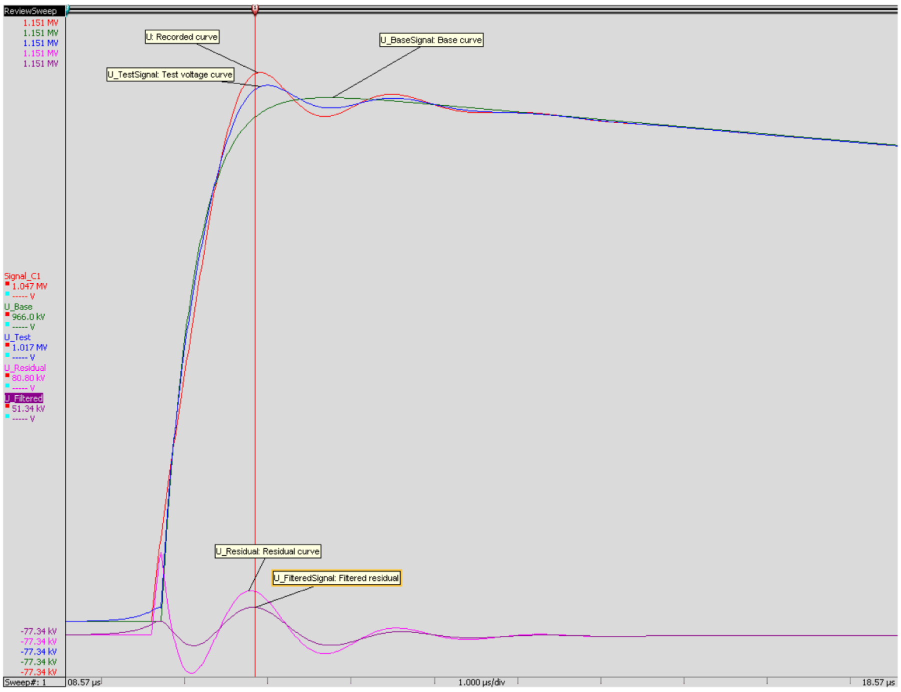


Figure A.9: Review Sweep area with voltage curve

Description of the data sources when dealing with lightning impulse measurement and calculated with the standard **IEC 60060-1 Ed. 3.0 (2010-09).**

Variable Name	Description	Possible Value
CalculatingResult	This variable returns 0 if the HV-IA calculations have been done successfully, else it returns 1.	*0*

Variable Name	Description	Possible Value
CalculatingResult-Description	Description of the calculation result. If calculation was OK it will be empty else it gives information what went wrong.	*“Peak value between start and end signal is below 10 % of range”*
ChoppedStatus	Returns chopped status, possible values: 0 = not chopped 1 = front chopped 2 = tail chopped	*0*
ChoppedStatus-AsString	Returns chopped status as a string, possible values: “Front-chopped”, ”Tail-chopped”, “Not Chopped”	*“Not Chopped”*
Comment	Returns the test comment.	*“Reduced wave 50 %“*
Date	Date test was done.	*02-12-2009*
f	-	
Ip	Ip is the peak value of the current signal minus the current base line. This peak is defined at least 5 µs after the virtual origin (O1). The Ip value is only displayed if a current channel is selected	*120 kA*
IpPos	The position in time of the maximum current.	*2.15 µs*
K0	-	
O1	The virtual origin is calculated as: the time location in the recorded curve that is one half the 30 % to 90 % rise time (before the time of the 30 % crossing). This calculation is the same as extending the unfit straight line between the 90 % and 30 % crossings to the intersection with the baseline.	*9.846 µs*
OvershootWidth	-	
S	Virtual Steepness is the slope on the front of the best-fit straight line between 30 % and 90 % of the peak. This value is only displayed for front chopped impulses.	*1157 kV/µs*
ß	Not applicable for this standard.	

Variable Name	Description	Possible Value
ß'	The ratio of the overshoot magnitude to the extreme value, expressed as a percentage.	*0.000 %*
T1	Front Time, is the rise time of the curve between 30 % and 90 %of the peak voltage, multiplied by 1.67	*839.6 ns*
T2	Time to Half Value is the time from virtual origin to 50 % of the peak voltage on the tail.	*60.15 µs*
Tc	Time to wave chopping. This is a virtual parameter defined as the time interval between the virtual origin 0 and the instance of chopping.	*450.2 ns*
TestName	Name of the test.	*B2*
Time	The time when the test has been done.	*10:51:38*
ToleranceTesting-Result	Returns the result of the tolerance testing, possible values are: 0 = tolerance testing failed 1 = tolerance testing successful 2 = no tolerance testing done	*2*
ToleranceTesting-ResultAsString	Returns the result of the tolerance testing as a string.	*Not evaluated*
U0	The baseline of the impulse is calculated from the statistical mean of the first 50 points of the impulse signal. Impulse Analysis requires a pre-trigger setting of at least 100 data points.	*-49.97 kV*
Up	Not applicable in this standard.	
UpPos	Position of the actual peak voltage or Ut.	*11.58 µs*
UsedStandard	Returns the used standard, possible values are: 2: IEC 60060-1 Ed. 2.0 (1989-11) 3: IEC 60060-1 Ed. 3.0 (2010-09) 4: IEC 60060-3 (2006)	*2*
UsedStandard-AsString	Returns the used standard as a string.	*IEC 60060-1 Ed. 3.0 (2010-09)*
Ut	The maximum value of the **test voltage curve** measured from the base level.	*1.050 MV*

A.4 Switching impulse parameters IEC 60060-1 Ed. 2.0 (1989-11)

This standard has also been used by the old HV-IA ProView software that ran on the Nicolet Accura.

The data source window looks like:

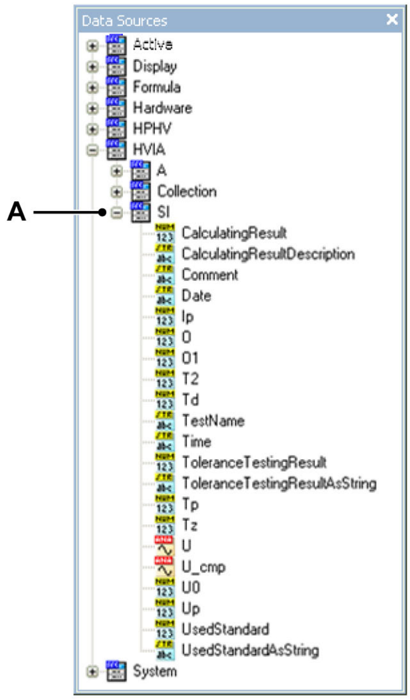


Figure A.10: HVIA node/SI node

A SI node

Variable Name	Description	Possible Value
CalculatingResult	This variable returns 0 if the HV-IA calculations have been done successfully, else it returns 1.	*0*
CalculatingResult-Description	Description of the calculation result. If calculation was OK it will be empty else it gives information what went wrong.	*“Peak value between start and end signal is below 10 % of range”*
Comment	Returns the test comment.	*“Reduced wave 50 %“*

Variable Name	Description	Possible Value
Ip	Ip is the peak value of the current signal minus the current base line. The Ip value is only displayed if a current channel is selected.	*120 kA*
O	Not applicable for this standard	
O1	The virtual origin of the waveform .	*798.4 µs*
T2	Time to Half Value is the time from virtual origin to 50 % of the peak voltage on the tail.	*2.516 ms*
Td	Td is the time above 90 % and is calculated as the time difference between the first crossing of 90 % of the test voltage before the peak and the first crossing of 90 % of the test voltage after the peak.	*529.1 µs*
TestName	Name of the test.	*B2*
Time	The time when the test has been done.	*10:51:38*
ToleranceTesting-Result	Returns the result of the tolerance testing, possible values are: 0 = tolerance testing failed 1 = tolerance testing successful 2 = no tolerance testing done	*2*
ToleranceTesting-ResultAsString	Returns the result of the tolerance testing as a string.	*Not evaluated*
Tp	The time to peak is the difference between, the virtual origin and the position where the voltage has reached its peak.	*253.4 µs*
Tz	The time to zero is calculated as the time difference between the virtual origin and the first crossing of the baseline after the peak of the impulse.	
U0	The baseline of the impulse is calculated from the statistical mean of the beginning of the waveform. Impulse Analysis requires a pre-trigger setting of at least 100 data points.	*49.50 kV*
Up	Up is the peak value of the impulse minus the impulse baseline.	*950.8 kV*
UpPos	x-Position of the actual peak voltage.	*11.58 µs*

Variable Name	Description	Possible Value
UsedStandard	Returns the used standard, possible values are: 2: IEC 60060-1 Ed. 2.0 (1989-11) 3: IEC 60060-1 Ed. 3.0 (2010-09)	*2*
UsedStandard-AsString	Returns the used standard as a string.	*IEC 60060-1 Ed. 2.0 (1989-11)*

A.5 Switching impulse parameters IEC 60060-1 Ed. 3.0 (2010-09)

This is the new upcoming standard uses the true origin instead of the virtual origin for its calculations.

Variable Name	Description	Possible Value
CalculatingResult	This variable returns 0 if the HV-IA calculations have been done successfully, else it returns 1.	*0*
CalculatingResult-Description	Description of the calculation result. If calculation was OK it will be empty else it gives information what went wrong.	*“Peak value between start and end signal is below 10 % of range”*
Comment	Returns the test comment.	*“Reduced wave 50 %”*
Date	Date test was done.	*02-12-2009*
Ip	Ip is the peak value of the current signal minus the current base line. The Ip value is only displayed if a current channel is selected.	*120 kA*
O	The true origin is the instant where the recorded curve begins a monotonic increase or decrease.	*800.6 µs*
O1	Not applicable in this standard.	
T2	Time to Half Value is the time from virtual origin to 50 % of the peak voltage on the tail.	*2.516 ms*
Td	Td is the time above 90 % and is calculated as the time difference between the first crossing of 90 % of the test voltage before the peak and the first crossing of 90 % of the test voltage after the peak.	*529.1 µs*
TestName	Name of the test.	*B2*
Time	The time when the test has been done.	*10:51:38*
ToleranceTesting-Result	Returns the result of the tolerance testing, possible values are: 0 = tolerance testing failed 1 = tolerance testing successful 2 = no tolerance testing done	*2*
ToleranceTesting-ResultAsString	Returns the result of the tolerance testing as a string.	*Not evaluated*

Variable Name	Description	Possible Value
Tp	The time interval from the true origin to the time of maximum value of a switching impulse voltage.	*253.4 µs*
Tz	The time to zero is calculated as the time difference between the origin and the first crossing of the baseline after the peak of the impulse.	
U0	The baseline of the impulse is calculated from the statistical mean of the beginning of the waveform.	*49.50 kV*
Up	Up is the peak value of the impulse minus the impulse baseline.	*950.8 kV*
UpPos	x-Position of the actual peak voltage	*11.58 µs*
UsedStandard	Returns the used standard, possible values are: 2: IEC 60060-1 Ed. 2.0 (1989-11) 3: IEC 60060-1 Ed. 3.0 (2010-09) 4: IEC 60060-3 (2006)	*2*
UsedStandard-AsString	Returns the used standard as a string.	*IEC 60060-1 Ed. 3.0 (2010-09)*

A.6 Current impulse parameters IEC 62475 Ed. 1.0 (2010-09)

The data source window looks like:

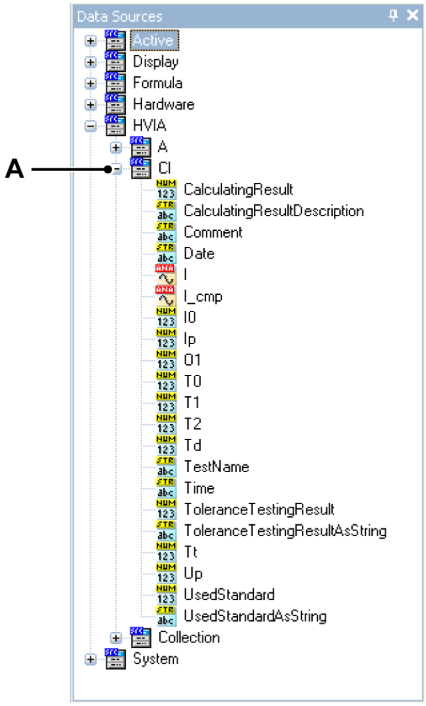


Figure A.11: HVIA node/CI node

A CI node

Variable Name	Description	Possible Value
CalculatingResult	This variable returns 0 if the HV-IA calculations have been done successfully else it returns 1.	*0*
CalculatingResult-Description	Description of the calculation result. If calculation was OK it will be empty else it gives information what went wrong.	*"Peak value between begin signal and end signal is below 10 % of range"*
Comment	Returns the test comment	*"50 % of range used"*
Date	Date test was done	*02-12-2009*
I0	The baseline of the impulse is calculated from the statistical mean of the beginning of the waveform.	*1.8 A*

Variable Name	Description	Possible Value
Ip	Ip is the peak value of the impulse minus the impulse baseline.	*120 kA*
O1	The virtual origin is calculated as the time location in the record that is one eighth of the rise time between the crossing of 10 % of the test current and the crossing of 90 % of the test current before the time of the 10 % crossing. This calculation is the same as extending the unfit straight line between the 90 % and 10 % crossings to the intersection with the baseline.	*798.4 µs*
T0	The time to zero is calculated as the time difference between the virtual origin and the first crossing of the baseline after the peak of the impulse.	*11.55 µs*
T1	The front time is 1.25 times the time interval between the 10 % and 90% crossings of the test current.	*4.237 µs*
T2	Time to Half Value is the time from virtual origin to 50 % of the peak voltage on the tail.	*9.127 µs*
Td	Td is the time above 90 % and is calculated as the time difference between the first crossing of 90 % of the test current before the peak and the first crossing of 90 % of the test current after the peak.	*529.1 µs*
TestName	Name of the test	*SI_A1*
Time	The time when the test has been done	*10:51:38*
ToleranceTesting-Result	Returns the result of the tolerance testing, possible values are: 0 if tolerance testing did fail 1 if tolerance testing is successful 2 if no tolerance testing has been done	*2*
ToleranceTesting-ResultAsString	Returns the result of the tolerance testing as a string.	*Not evaluated*
Tt	The total duration is the time during which the rectangular impulse current is higher than 10 % of its peak value	*10.37 µs*
Up	Not applicable	

Variable Name	Description	Possible Value
UsedStandard	Returns the used standard, possible values are: 4: IEC 62475 Ed. 1.0 (2010-09)	*4*
UsedStandard-AsString	Returns the used standard as a string	*IEC 62475 Ed. 1.0 (2010-09)*

A.7 Example: Markers using calculation results

In this example we use the calculated results to control markers in a display using the LI test evaluation type and the standard … 1980/11 … The display might look like Figure A.12:

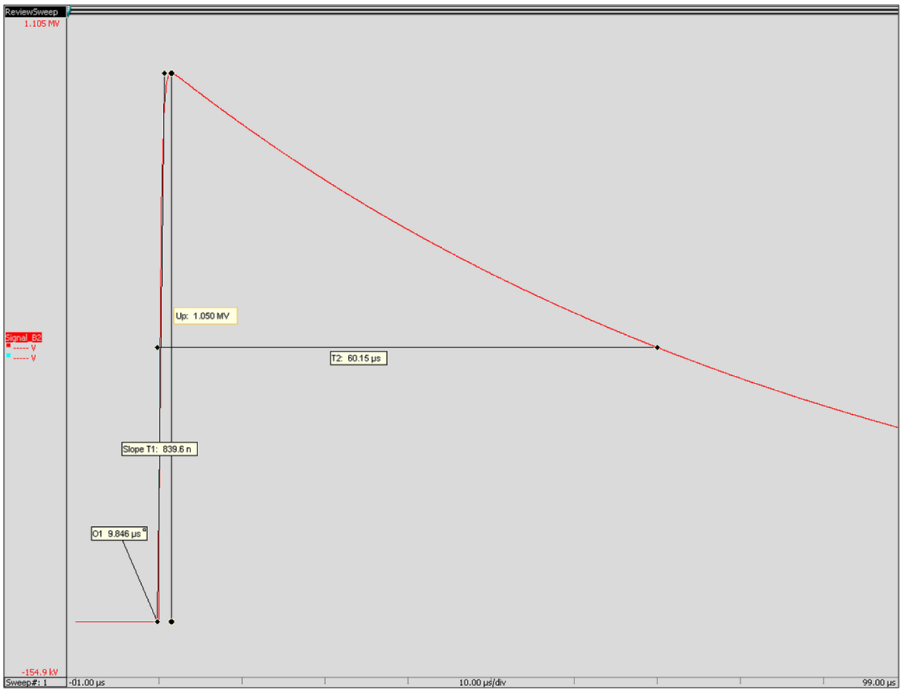


Figure A.12: Review Sweep area with the calculated results

After zooming you will see Figure A.13:

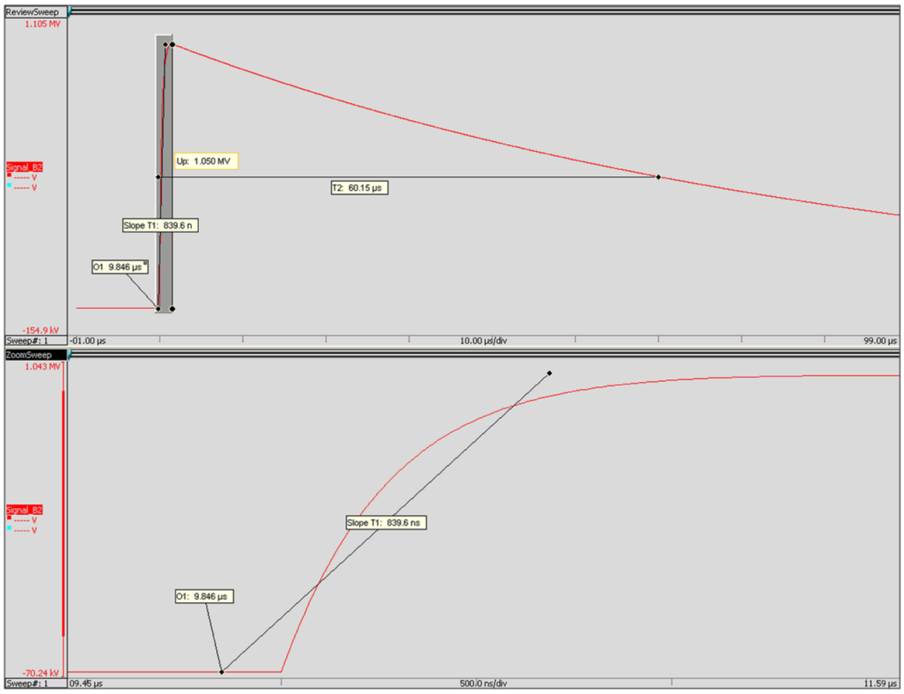


Figure A.13: Review Sweep area with the calculated results (zoomed)

To be able to show these markers the following formulas must be defined:

Num	Name	Formula
1		Used by vertical y-range marker to show Up
2	Upeak	HVIA.LI.U0 + HVIA.LI.Up
3	U50 %_Level	HVIA.LI.U0 + 0.5 * HVIA.LI.Up
4		
5		Used by horizontal x-range marker to show T2
6	UT2_x1	HVIA.LI.O1
7	UT2_x2	HVIA.LI.O1 + HVIA.LI.T2
8		
9		Used by slope cursor to show the slope used Formula calculating T1
10	Rise	(HVIA.LI.T1 + 0.000000002) / 1.67
11	X1	HVIA.LI.O1
12	X2	HVIA.LI.O1 + HVIA.LI.T1

Num	Name	Formula
13	Y1	HVIA.LI.U0
14	Y2	Formula.Upeak

The markers will use these formulas and they are defined as follows:

Name	Type	Label text	Anchor 1 (x)	Anchor 1 (y)	Anchor 2 (x)	Anchor 2 (y)
Up	Y-Range	Up: {HVIA.LI.Up! Value,#.###k!Units}	HVIA.LI.UpPos	Formula.Upeak	-	HVIA.LI.U0
T2	X-Range	T2: {HVIA.LI.T2! Value,#.###k!Units}	Formula.UT2_x1	Formula.U50%_Level	Formula.UT2_x2	-
O1	Trace	O1: {HVIA.LI.O1! Value,#.###k!Units}	HVIA.LI.O1	-	-	-
Slope T1	Slope	Slope T1: {HVIA.LI.T1! Value,#.###k!Units}	Formula.X1	Formula.Y1	Formula.X2	Formula.Y2
Ozoom	Trace	O1: {HVIA.LI.O1! Value,#.###k!Units}	HVIA.LI.O1	-	-	-
Slope Zoom	Slope	Slope T1: {HVIA.LI.T1! Value,#.###k!Units}	Formula.X1	Formula.Y1	Formula.X2	Formula.Y2

B HV Impulse Test Set-up

B.1 Introduction

There are several ways to set up experiments for HV-IA analysis. This chapter depicts the difference between the traditional equipment set up versus the newer set ups made possible by the ISOBE5600 series.

B.1.1 Technical Problem

Producing HV Impulses up to several MV and dividing these voltages down for measurement purposes is a technology of its own and specialized manufacturers provide solutions to HV labs. To ensure safe operation for the human operators, as well as for the equipment itself, standards from regulatory organizations describe how a proper set-up has to be done. This includes proper grounding with earth pits and conducting mesh in the foundation of the HV lab. This is part of the customer’s installation.

B.1.2 Challenge

The main challenge for any measurement equipment is to operate as safely and accurately as possible in severe electromagnetic environments. High voltages in combination with fast rise/fall times create additional problems. Each piece of wire acts as an antenna. Each series resistor in a connection between two points creates a potential difference and hence a voltagedrop, which in turn results in current flow. The higher the voltages and the faster the rise/fall times are, the more serious the effects.

B.1.3 Impulse Generation and Test Object Set-up

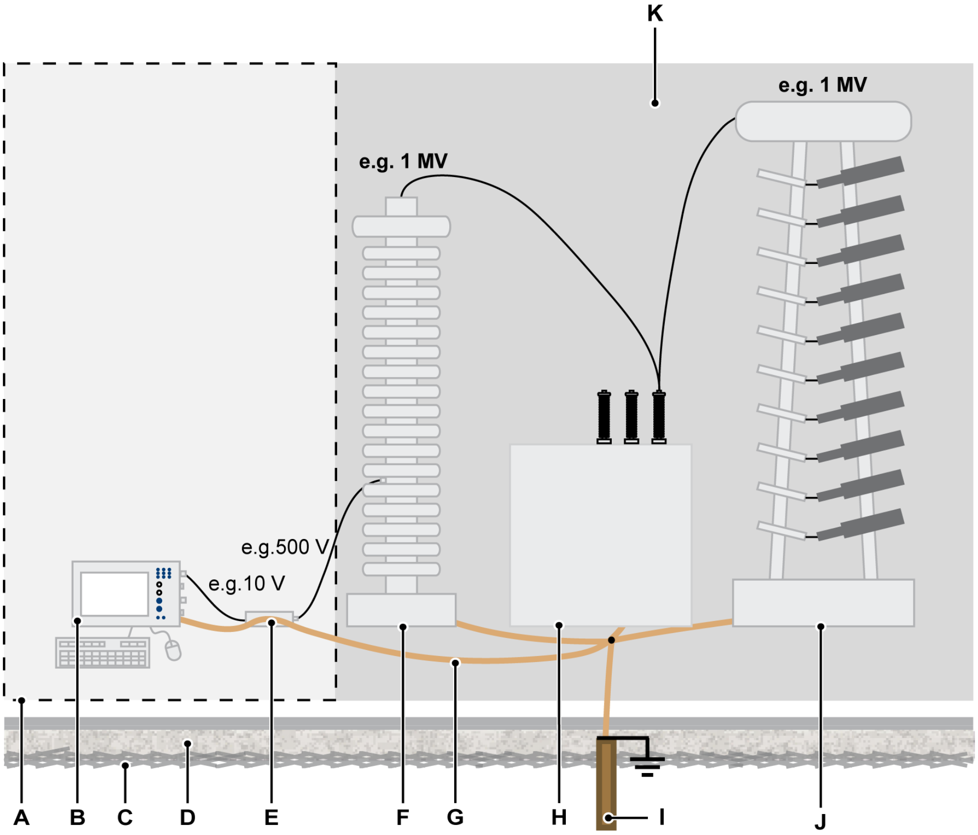
The output of the impulse generator is connected to the test object - here the energy is transferred. From the same terminal of the test object, there is a connection to a voltage divider (either resistive or capacitive), which is used to produce a proportionally smaller signal of the impulse for measurement purpose. All of these three components are connected to the same earth point in the HV lab by a copper strip, ideally in a star connection. The copper strip has two major characteristics: it is low impedance for low frequency energy because of its big sectional area and it has a lot of surface, which results in low impedance for high frequency energy. The high frequency components of the energy are produced by the high rise/fall times (high dU/dt). The voltage divider brings the impulse's voltage down by a known factor. For example a 1 MV impulse is divided by a 2000:1 ratio down to 500 V.

B.2 Measurement Equipment Set-up

The output voltage of the voltage dividers can go up to approximately 1 kV, depending on the manufacturer and the model of the divider. This output voltage is still above the direct input capability of digitizers and the output connectors of the HV dividers are typically LEMO type. To interface between the voltage divider and the digitizer, a for example 50:1 impulse attenuator is used. The impulse attenuator divides the voltage by 50, in the above example from 500 V to 10 V. Additionally, the impulse attenuators input LEMO connection interfaces well with the customer's test setup, while the BNC output cable interfaces well with the digitizer.

B.3 Traditional Test Set-up and Earth Connections

Control room measurement



A Shielded control room

B Sigma 100 HV

C Conducting mesh

D Foundation material

E Impulse attenuator

F Voltage divider

G Earth connections

H Unit under test

I Earth pit

J Impulse generator

K Test cell (Customers installation)

All of the above-mentioned voltages at the generator output, the test object, the voltage divider input and output are the potential difference between the terminal and an earth. To have the impulse attenuator and the digitizer working on the same reference level, they also have to be connected to the same protective earth. For this purpose, the impulse attenuator and the Sigma 100 HV are equipped with protective earth screw terminals, so a proper protective earth connection with a copper strip can be made. The protective earth connection serves additional purposes. First, the metal housing is acting as a Faraday cage and the solid connection to protective earth allows offloading of the energy picked up from electromagnetic fields and keeps the inside free of disturbances.

There are two main disadvantages of such a traditional setup:

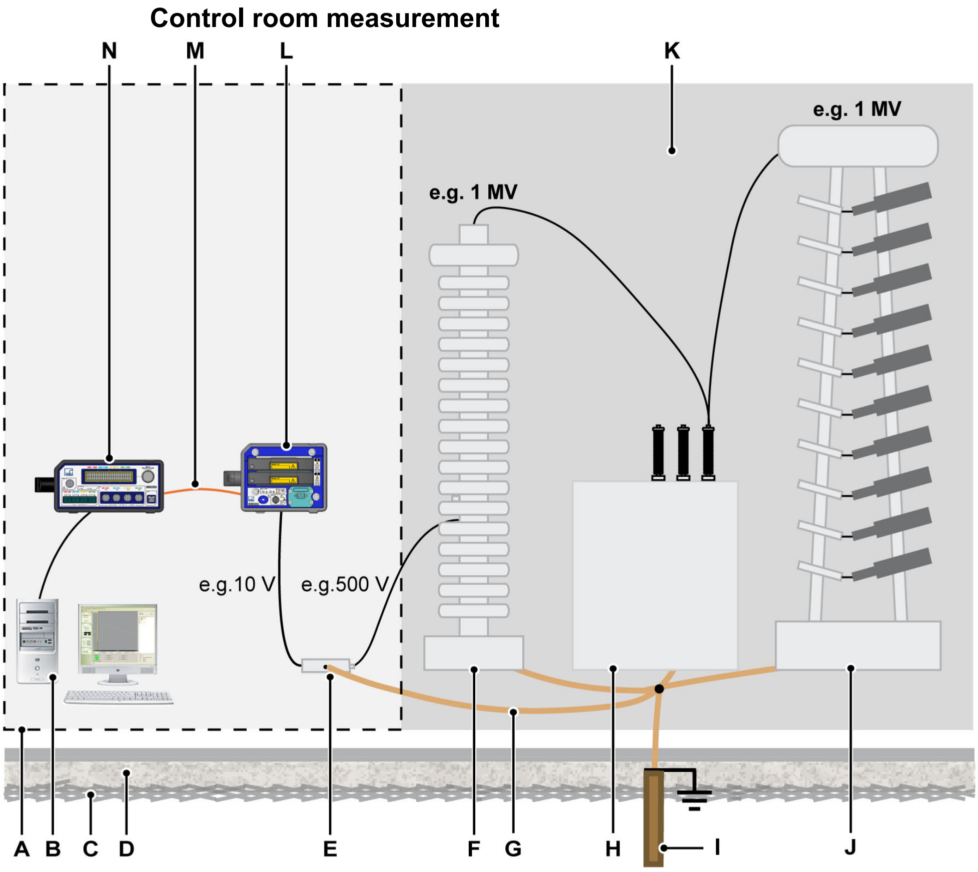
- **Grounding:** The digitizer is powered via mains in the control room. Each mains connection contains also an earth connection and the earth connection of the wall outlet is in most test labs not the same as the test cell earth connection. This may become an issue during impulse testing, as the high energy and the high dU/dt may result in short term potential differences in the earth connections. As a result, there will be equalizing currents, which may damage equipment over time.
- **Lethal voltages in control room:** The output signal of the HV divider can reach values of up to 1.5 kV. In the traditional set-up, these voltages are brought into the control room.

With HBM’s battery operated and fiber optic isolated digitizers ISOBE5600t, two new test set-up’s can be realized:

- Measurement point in control room
- Measurement point in test cell

For both of these set-up’s a few things need to be taken into account.

B.4 New Test Set-up (a) and Earth Connections



A Shielded control room
B PC with Perception (HV-IA)
C Conducting mesh
D Foundation material
E Impulse attenuator
F Voltage divider
G Earth connections
H Unit under test
I Earth pit
J Impulse generator
K Test cell (Customers installation)
L ISOBE5600t (Transmitter)
M Fiber Optic data cable
N ISOBE5600m (Receiver)

In this set-up, all the measurement equipment is still located in the well shielded control room. The PC and the ISOBE5600m (receiver with memory) are mains powered and earthed via this mains connection. The ISOBE5600t (battery operated digitizer) is connected to the ISOBE5600m only by means of fiber optic cables, so there is NO electrical connection between them. The digitizer does get the input signal from the impulse attenuator, which is properly grounded to the test cells earth connection.

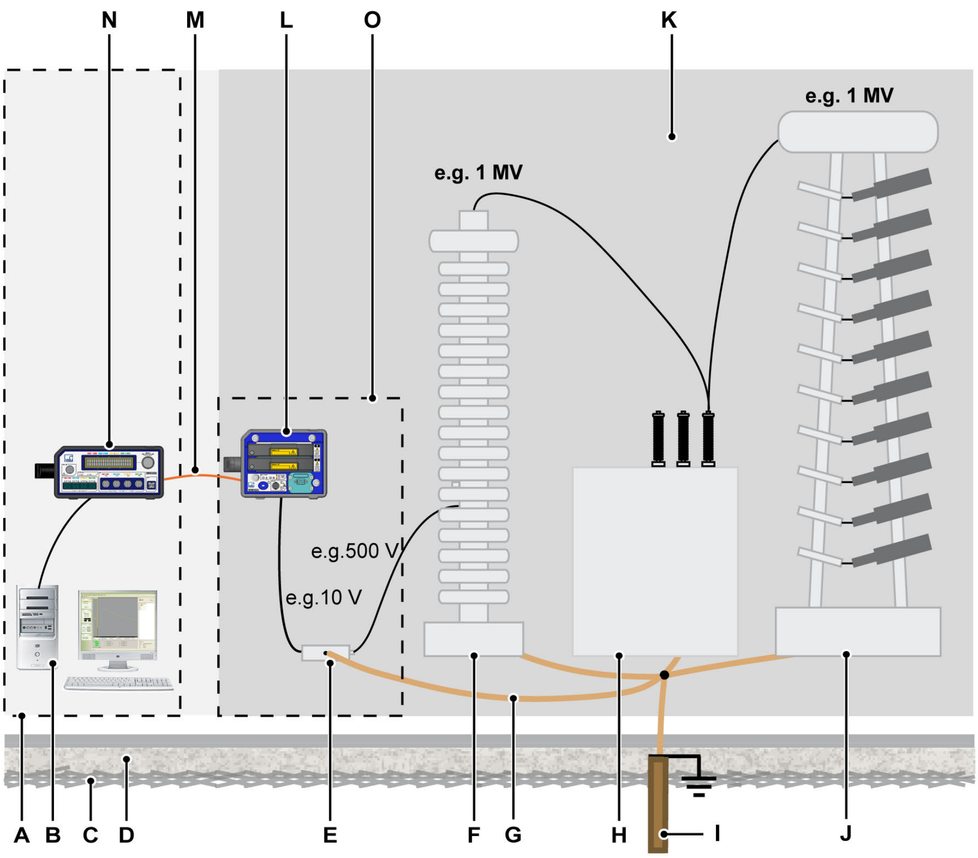
The **advantages** compared to the traditional test set-up:

- NO electrical connection between test cell signals and equipment powered in the control room (measurement system and PC).
- NO equalizing currents between test cell earth connection and mains earth connection.
- Impulse attenuator and battery operated digitizer still placed in the shielded control room, means a minimum exposure to electromagnetic disturbance.

There is no **disadvantage** compared to the traditional test set-up.

B.5 New Test Set-up (b) and Earth Connections

The ISOBE5600 set up with measurements done from inside the test cell



A Shielded control room

B PC with Perception (HV-IA)

C Conducting mesh

D Foundation material

E Impulse attenuator

F Voltage divider

G Earth connections

H Unit under test

I Earth pit

J Impulse generator

K Test cell (Customer installation)

L ISOBE5600t (Transmitter)

M Fiber Optic data cable

N ISOBE5600m (Receiver)

O Shielded compartment in test cell

In this set-up, half of the measurement equipment is still located in the well shielded control room, the PC and the ISOBE5600m (receiver with memory). They are mains powered and earthed via the mains connection.

The ISOBE5600t (battery operated digitizer) is connected to the ISOBE5600m only by means of fiber optic cables, so there is NO electrical connection between them. The digitizer does get the input signal from the impulse attenuator, which is properly grounded to the test cell’s earth connection. The ISOBE5600t and the impulse attenuator are placed in the test cell in a shielded box.

The **advantages** compared to the traditional test set-up:

- NO electrical connection between test cell signals and equipment powered in the control room (measurement system and PC).
- NO equalizing currents between test cell earth connection and mains earth connection.
- Impulse attenuator and battery operated digitizer are placed in the test cell, means NO lethal voltages are wired into the well shielded control room.

The **disadvantages** compared to the traditional test set-up:

- The electromagnetic disturbance in the test cell is much higher than in the well shielded control room, means the digitizer may pick unwanted signals and show them superimposed to the real signal. This signal pickup may heavily vary from several factors like distance to source of disturbance, wave shape used, etc.
- The 50:1 impulse attenuators were originally designed only for usage in the well shielded control room. To make them work in the test cell, it is absolutely necessary to place them in a shielded and earthed box or compartment.

Ideally, the ISOBE5600t, the impulse attenuator and the connecting short cable are all placed together in the same shielded and earthed box or compartment. The size and performance of such a box is up to the test cells requirement and part of the users installation. HBM does not offer such boxes.

C Calculate Uncertainty

C.1 Introduction

The method to calculate the SW uncertainty per parameter in this appendix is based on the method described in Appendix B of IEC 61083-2 Ed. 2.0 (CDV).

The values u_{B71} listed in the table below show the standard uncertainty of the algorithms used in the HV Impulse analysis option of the Perception software for each kind of waveshape and each parameter. The values u_{B72} show the standard uncertainty of the reference values according to tables B.1 to B.6 in the IEC 61083-2 Ed. 2.0 (CDV).

The last column with the values u_{B7} shows the resulting standard uncertainty as the result of u_{B71} and u_{B72}.

The symbol u_{B7} follows the numbering used in IEC 60060-2:2010 (clauses 5.2.1.3 to 5.9).

HV-IA uncertainty summary

Perception version:	6.20
Standard:	IEC 61083-2 Ed. 2.0 (CDV)
Draft document	42/290/CDV
Noise setting of TDG:	0.07 %

Full lightning impulse (LI) (1)			
Parameter	**Standard uncertainty of Perception HV-IA SW u_{B71}**	**Standard uncertainty of reference value u_{B72}**	**Resulting standard uncertainty u_{B7}**
Ut	0.021 %	0.015 %	0.03 %
T1	0.200 %	0.250 %	0.32 %
T2	0.046 %	0.030 %	0.06 %
Beta' [abs %]	0.075	0.040	0.09

Chopped lightning impulse (LIC) (1)			
Parameter	**Standard uncertainty of Perception HV-IA SW u_{B71}**	**Standard uncertainty of reference value u_{B72}**	**Resulting standard uncertainty u_{B7}**
Up, Ut	0.036 %	0.035 %	0.05 %
T1	0.337 %	0.450 %	0.56 %
Tc	0.225 %	0.200 %	0.30 %
Beta' [abs %]	0.057	0.025	0.06

Switching impulse (SI) (2)			
Parameter	**Standard uncertainty of Perception HV-IA SW u_{B71}**	**Standard uncertainty of reference value u_{B72}**	**Resulting standard uncertainty u_{B7}**
Up	0.154 %	0.065 %	0.17 %
Tp	1.361 %	2.000 %	2.42 %
T2	0.576 %	1.000 %	1.15 %

Current impulse (IC) (1)			
Parameter	**Standard uncertainty of Perception HV-IA SW u_{B71}**	**Standard uncertainty of reference value u_{B72}**	**Resulting standard uncertainty u_{B7}**
Ip	0.048 %	0.040 %	0.06 %
T1, Td	0.179 %	0.250 %	0.31 %
T2	0.143 %	0.300 %	0.33 %

Oscillating lightning impulse (OLI) (1)			
Parameter	**Standard uncertainty of Perception HV-IA SW u_{B71}**	**Standard uncertainty of reference value u_{B72}**	**Resulting standard uncertainty u_{B7}**
Up	0.074 %	0.070 %	0.10 %
T1	0.246 %	0.150 %	0.29 %
T2	0.779 %	0.400 %	0.88 %

Oscillating switching impulse (OSI) (2)			
Parameter	**Standard uncertainty of Perception HV-IA SW u_{B71}**	**Standard uncertainty of reference value u_{B72}**	**Resulting standard uncertainty u_{B7}**
Up	0.189 %	0.100 %	0.21 %
Tp	0.329 %	0.150 %	0.36 %
T2	0.475 %	0.650 %	0.81 %

(1) TDG 2.06 settings: 14 bit; 100 MS/s; noise

(2) TDG 2.06 settings: 14 bit; 1 MS/s; noise

NOTES

1 Each calculated parameter for every waveform is within the acceptance limits of the standard.

2 The calculated standard uncertainties per group of waveforms are calculated on ALL the waveforms in the standard. In some cases this results in a higher value of u_{B7} than some of the individual wafeforms limits in the standard. This is caused by the fact, that the acceptance limits and the standard uncertainties in the standard are not always the same for all waveform cases of the same group of waveforms.
As an example, the acceptance limit of Tp for SI-A1 and SI-A2 are ±2 % while the acceptance limit of Tp for SI-A3, SI-A4 and SI-A5 are ± 5%. The contribution of the reference value for SI is 2.000 % (due to SI-A5), while the contribution of the HV-IA option of Perception is only 1.361%.

3 The settings used (sampling rate, resolution and noise) of the TDG is listed for each group of waveforms. The choices were made to be in line with the hardware specifications (ISOBE5600t and 6600HV digitizer) as well as to take worst case scenarios of user’s choice into account (sampling speed for slow waveforms like SI and OSI). The algorithms were verified with higher sampling speeds for SI and OSI as well.

D HV-IA Preferences

D.1 Introduction

The HV-IA application can be modified by using special HV-IA preferences. You can modify not only the user interface, but some behavior as well.

This section will describe all preferences available.

D.2 Preferences dialog

The HVIA preference settings are accessible via the Preferences dialog.

To open the **Preferences** dialog:

1 Select File ►Preferences

2 Select **HVIA Settings**

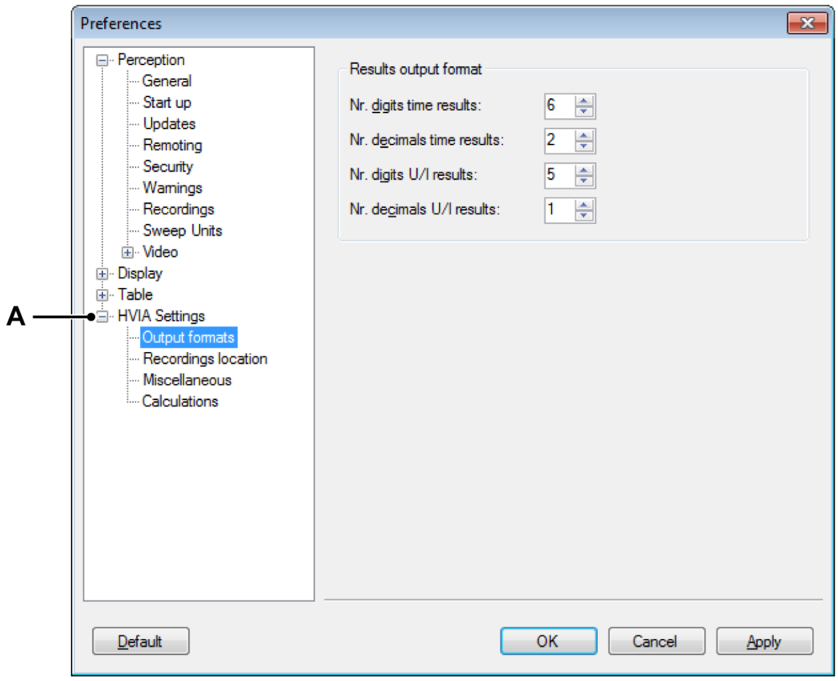


Figure D.1: Preferences dialog/HV-IA Settings

A HV-IA Settings node

D.3 Output formats

These preferences are used to define the output format of the results in the **Results Area**.

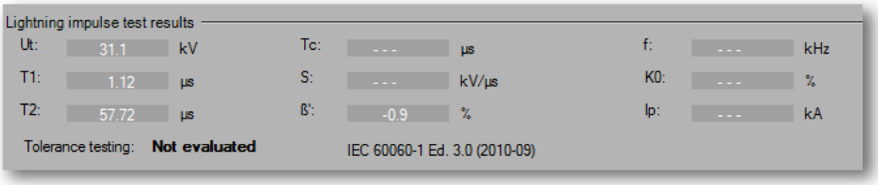


Figure D.2: Results area

- Nr. digits time results: Set the number of digits for all time results in the Lightning impulse test results area.
- Nr. decimals time results: Set the number of decimals for all time results in the Lightning impulse test results area.
- Nr. digits U/I results: Set the number of digits for all Voltage and Current results in the Lightning impulse test results area.
- Nr. decimals U/I results: Set the number of decimals for all Voltage and Current results in the Lightning impulse test results area.

D.4 Recording location

You can enable the preference setting **Create new folder per collection** by selecting a checkbox.

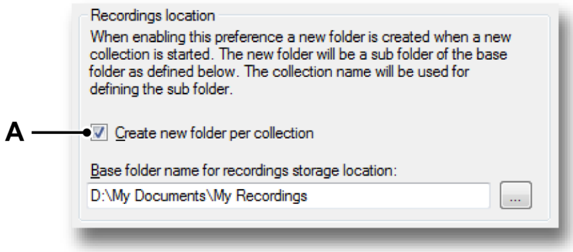


Figure D.3: Recordings location

A Create new folder per collection

Enabling this preference creates a new folder to store the individual recordings (*.pNRF files) for each test when a new collection is started. The new folder will be a sub-folder of the base folder as defined in the preferences recordings location dialog. The collection name is used for defining a sub-folder name.

HINT/TIP

All data from a collection is saved in a collection file (*.pHVIACollection). You do not need the individual recording (*.pNRF) files.

D.4.1 Miscellaneous

This section contains various preferences, most of which are related to the HV-IA application user interface.

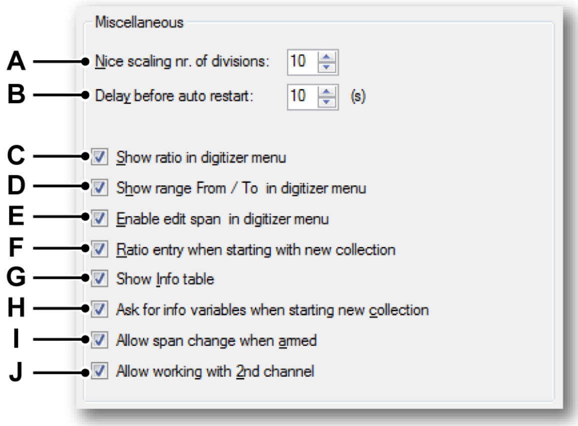


Figure D.4: Miscellaneous HV-IA preferences

A Nice scaling nr. of divisions

B Delay before auto restart

C Show ratio in digitizer menu

D Show range From/To in digitizer menu

E Enable edit span in digitizer menu

F Ratio entry when starting a new collection

G Show Info tables

H Ask for info variables when starting a new collection

I Allow span change when armed

J Allow working with an extra 2nd channel

A Nice scaling nr. of divisions

The **display from** and **display to** values are added to each waveform when the system performs recordings and calculations, as found in the HV-IA data sources sub-tree. These values are used to set the display to the correct Y-scaling automatically when such a waveform is shown. The number of horizontal divisions is a display property and can be manually set in the **Setup of Display** dialog. When you set the **Nice scaling nr. of divisions** preference to be equal to the number of horizontal divisions of the display, the Y-scaling values are set to nice values.

B Delay before auto restart

You can select the option **Automatically re-arm system after finishing calculations** in the Impulse Analysis Test Setup menu (see Figure 3.3 "Impulse Analysis Test Setup - Collection" on page 29).

The **Delay before auto restart** preference defines how long the system should wait before re-arming. You can look at the current test results during this delay period. These test results will disappear from the results area when the system is re-armed and waiting for the next trigger.

C Show ratio in digitizer menu

Click the **Show ratio in digitizer menu** to see the ratio used or the overall attenuation in the digitizer setup information field.

D Show range From/To in digitizer menu

Click the **Show range From/To in digitizer menu** to see the range used in the digitizer setup information field.

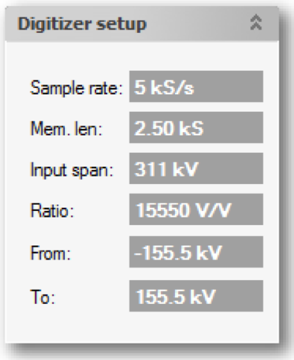


Figure D.5: Digitizer setup - Show range From/To

E Enable edit span in digitizer menu

Click the **Enable edit span in digitizer menu** to be able to edit the input range in the digitizer setup information field.

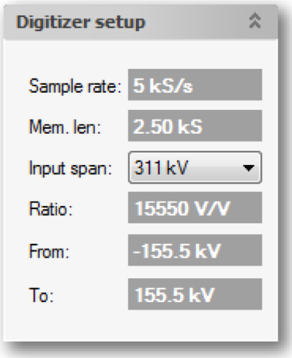


Figure D.6: Digitizer setup - Enable edit span

F Ratio entry when starting a new collection

Click the **Ratio entry when starting a new collection** to be able to set the ratio or total attenuation at the beginning of a new collection.

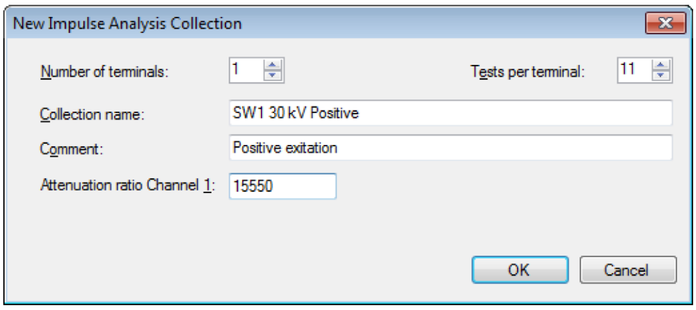
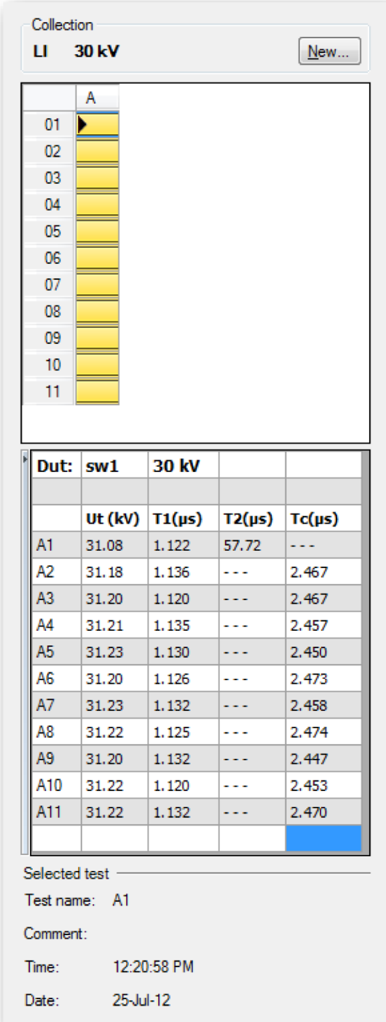


Figure D.7: New Impulse Analysis Collection dialog

G Show Info tables

Click the **Show Info tables** entry when you want to use an information table in the HV-IA sheet. This information table is a user table and is initially empty, just like any other new user table in Perception. You can configure this table and add the information of your choosing. The example below shows you an example as how the info table could be used.



Dut:	sw1	30 kV		
	Ut (kV)	T1(µs)	T2(µs)	Tc(µs)
A1	31.08	1.122	57.72	- - -
A2	31.18	1.136	- - -	2.467
A3	31.20	1.120	- - -	2.467
A4	31.21	1.135	- - -	2.457
A5	31.23	1.130	- - -	2.450
A6	31.20	1.126	- - -	2.473
A7	31.23	1.132	- - -	2.458
A8	31.22	1.125	- - -	2.474
A9	31.20	1.132	- - -	2.447
A10	31.22	1.120	- - -	2.453
A11	31.22	1.132	- - -	2.470

Figure D.8: Example of an Info table

H Ask for info variables when starting a new collection

Click the **Ask for info variables when starting a new collection** check box to be able to enter information variables at the beginning of a new collection.

These information variables are defined in the Information sheet (see Figure D.9). You can define new information variables here.

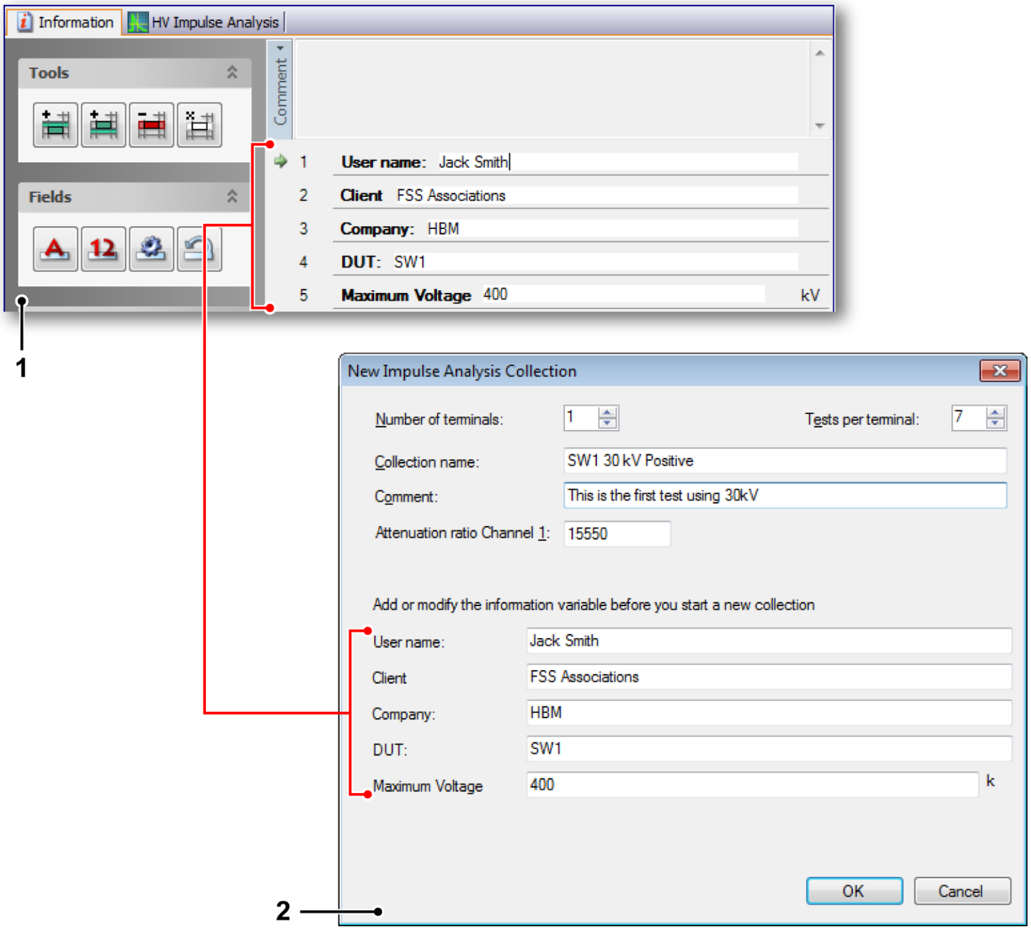


Figure D.9: Information sheet and New Impulse Analysis Collection

1 Information sheet

2 New Impulse Analysis Collection

I Allow span change when armed

Click the **Allow span change when armed** to be able to change the span when the system is armed.

J Allow working with 2nd channel

Click the **Allow working with 2nd channel** check box to be able to work with an extra (second) channel. This feature can be used for calibration measurements (see chapter “Measuring with extra (second) channel” on page 37).

D.5 Calculations

The standard IEC 60060-1 Ed 3.0 (2010-09) tries to generate a test signal using a double exponential curve fitting algorithm. If this curve fitting fails, the calculations cannot be performed in accordance with this standard. Calculations are performed in accordance with the new version of the IEC 60060-1 Ed 3.0 standard by default, although calculations can be performed in accordance with the older version of this standard. By enabling the following setting, the calculations will be automatically performed using the older standard IEC 60060-1 Ed. 2.0 (1989-11) when the new standard is selected and the curve fitting has failed.

Index

R

S

T

W

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