

PEC User's Guide

V2.0 – Level III

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Contents

1.	Introduction	6
1.1.	PEC description.....	6
1.2.	Mode control.....	6
1.3.	Menu, keyboard and touchscreen	6
1.4.	Miscellaneous.....	6
2.	Start program.....	7
3.	Features of the program	9
3.1.	The upper left pane.....	9
3.2.	The lower left pane	9
3.3.	The upper right pane.....	17
3.4.	The lower right pane	19
3.5.	Informative bars of the screen.....	24
3.6.	Switching screen modes.....	25
4.	Menu Item File.....	29
4.1.	Sub-menu Item File: Load	29
4.2.	Sub-menu Item File: Save.....	30
4.3.	Sub-menu Item File: Save As	30
4.4.	Sub-menu Item File: Import	31
4.5.	Sub-menu Item File: Export.....	31
4.6.	Sub-menu Item File: New	32
4.7.	Sub-menu Item File: Exit	33
5.	Menu Item Settings.....	34
5.1.	Sub-menu Item Settings: Users	34
5.2.	Sub-menu Item Settings: Clients	40
5.3.	Sub-menu Item Settings: Probes.....	40
5.4.	Sub-menu Item Settings: Monitoring.....	41
5.5.	Sub-menu Item Settings: Scan	43
6.	Menu Item Survey.....	46
6.1.	Sub-menu Item Survey: Measurement	46
6.2.	Sub-menu Item Survey: Reference	46
6.3.	Sub-menu Item Survey: Temperature.....	50
6.4.	Sub-menu Item Survey: Erase	51
6.5.	Sub-menu Item Survey: Delete	51
6.6.	Sub-menu Item Survey: Symbol	51
6.7.	Sub-menu Item Survey: Comment.....	52
6.8.	Sub-menu Item Survey: Defect mode	52
6.9.	Sub-menu Item Survey: Probe	52
6.10.	Sub-menu Item Survey: Live	54
7.	Menu Item Process	55
7.1.	Sub-menu Item Process: Select reference	55
7.2.	Sub-menu Item Process: Recalculate	55
7.3.	Sub-menu Item Process: Auto Scan	55
7.4.	Sub-menu Item Process: Induction	56
7.5.	Sub-menu Item Process: Noise	57
7.6.	Sub-menu Item Process: Calibrate	58
7.7.	Sub-menu Item Process: Remove raw data	59
7.8.	Sub-menu Item Process: Resampling.....	59

8.	Menu Item Tools	61
8.1.	Sub-menu Item Tools: Report	61
8.2.	Sub-menu Item Tools: Color scales	62
8.3.	Sub-menu Item Tools: Web browser	62
8.4.	Sub-menu Item Tools: Show Control Measurement	62
8.5.	Sub-menu Item Tools: Show Location.....	64
8.6.	Sub-menu Item Tools: Show Monitor Results.....	64
9.	Menu Item Miscellaneous	65
9.1.	Sub-menu Item Tools: Password.....	65
9.2.	Sub-menu Item Tools: Defaults.....	66
9.3.	Sub-menu Item Tools: Hardware	67
9.4.	Sub-menu Item Tools: Laser Distance.....	68
10.	Menu Item Help	69
10.1.	Sub-menu Item Help: View help.....	69
10.2.	Sub-menu Item Help: About PEC.....	69
10.3.	Sub-menu Item Help: Login screen	69
	Appendix A – Hot Keys	70
	Appendix B – Flow diagram: Taking a reference.....	72
	Appendix C – Flow diagram: Creating reference.	73
	Appendix D – Flow diagram: Taking a measurement.	74
	Appendix E – Flow diagram: Live mode.	75
	Appendix F – Flow diagram: Start program.	76
	Appendix G – Report replacement tokens WORD (*.docx)	77
	Appendix H – Report replacement tokens EXCEL (*.xlsx)	78

List of figures

Figure 1: <i>Login screen.</i>	7
Figure 2: <i>User selection mode (section 5.1).</i>	8
Figure 3: <i>Main screen of the program.</i>	8
Figure 4: <i>The upper left pane. With no references, you will see the message on the right.</i>	9
Figure 5: <i>The lower left pane and cursors.</i>	9
Figure 6: <i>Zooming area.</i>	10
Figure 7: <i>Zoomed grid.</i>	10
Figure 8: <i>Profile of the selected row and column.</i>	11
Figure 9: <i>Selecting a part of the profile of the selected row.</i>	12
Figure 10: <i>Gaussian fit to the selected part of the profile of the selected row.</i>	12
Figure 11: <i>Selecting a part of the profile of the selected row and columns.</i>	12
Figure 12: <i>Gaussian fit to the selected part of the profile of the selected rows and columns.</i>	13
Figure 13: <i>Decay of the selected row (colors refers to the logarithm of the voltage of the signal, a legend is presented).</i>	13
Figure 14: <i>Correlation of the selected quantities.</i>	14
Figure 15: <i>3D graph.</i>	14
Figure 16: <i>Shifting the grid display.</i>	15
Figure 17: <i>S is selected.</i>	16
Figure 18: <i>Pane division.</i>	16
Figure 19: <i>Upper right pane, Object.</i>	17
Figure 20: <i>Algorithm Variables.</i>	18
Figure 21: <i>Algorithm defaults.</i>	18
Figure 22: <i>Correlation in normal mode (left) and defect mode (right).</i>	19
Figure 23: <i>Lower right pane.</i>	19
Figure 24: <i>All boxes are selected.</i>	20
Figure 25: <i>'Log-x' is deselected.</i>	20
Figure 26: <i>'Log-x' and 'Log-y' are deselected.</i>	20
Figure 27: <i>'Log-y' is deselected.</i>	21
Figure 28: <i>'Chi2bar' is deselected.</i>	21
Figure 29: <i>Selected area by holding onto your left mouse button.</i>	21
Figure 30: <i>Graph will zoom in to this area by releasing your mouse.</i>	22
Figure 31: <i>By clicking on one of the lines presented in the legend, this line will be removed.</i>	22
Figure 32: <i>A line is removed.</i>	22
Figure 33: <i>Filter data.</i>	23
Figure 34: <i>Raw data.</i>	23
Figure 35: <i>Upper informative bar.</i>	24
Figure 36: <i>Not saved changes.</i>	24
Figure 37: <i>Lower informative bar.</i>	24
Figure 38: <i>Button for connecting to hardware.</i>	25
Figure 39: <i>A warning for lost connection to the hardware.</i>	25
Figure 40: <i>Switching screen mode.</i>	25
Figure 41: <i>Touchscreen mode.</i>	26
Figure 42: <i>Menu item File.</i>	29
Figure 43: <i>Opening a file.</i>	29
Figure 44: <i>Selecting a data file format.</i>	30
Figure 45: <i>Loading or saving bar.</i>	30
Figure 46: <i>Saving a file.</i>	30

Figure 47: A warning indicating data was not saved.	31
Figure 48: Export a file.....	31
Figure 49: Special file types while exporting data.....	32
Figure 50: A warning indicating data will be renewed.....	32
Figure 51: A new main screen.	32
Figure 52: A warning when some data is not saved.	33
Figure 53: Menu Item Settings.	34
Figure 54: User settings.....	34
Figure 55: Probe settings.....	40
Figure 56: Monitoring, options: Time laps or Series.....	41
Figure 57: Saving and editing names or comments.	42
Figure 58: Results of the monitoring process.	42
Figure 59: Scan editing.	43
Figure 60: Scangrid with white line as boarder of projection of a grid stretched on a bend...	45
Figure 61: Menu item Survey.....	46
Figure 62: Reference settings.	47
Figure 63: Lower left pane.....	47
Figure 64: Upper right pane: Object parameters.	48
Figure 65: Upper right pane: Fit results.....	49
Figure 66: Upper right pane: Variables.	49
Figure 67: Upper right pane: Algorithm Defaults.....	49
Figure 68: Lower right pane.	50
Figure 69: An erased value.	51
Figure 70: Symbol settings.	51
Figure 71: Edit grid cell comments.	52
Figure 72: Settings of the probe in the selected grid point.	53
Figure 73: Warning: hardware not connected.	54
Figure 74: Menu Item Process.....	55
Figure 75: A progress bar.	55
Figure 76: Scan progress display.	56
Figure 77: The pause button, appears directly after the start of the scan. It changes in a play button, when you paused the scan.	56
Figure 78: A warning for changing the measured induction.....	56
Figure 79: Screen in noise mode.....	57
Figure 80: Menu Item Tools.....	61
Figure 81: Color scale editing.	62
Figure 82: A example of a 'Control Measurement' screen.....	63
Figure 83: An example of a 'Show Location' window on top of the display.....	64
Figure 84: Menu Item Miscellaneous.	65
Figure 85: Create a new password.	65
Figure 86: Changing default values.	66
Figure 87: Changing hardware settings.	67
Figure 88: Disto laser distance reader connection screen.....	68
Figure 89: Menu item help.	69
Figure 90: Disclaimer PEC.....	69
Figure 91: Flow diagram of taking a reference.	72
Figure 92: Flow diagram of creating a reference.....	73
Figure 93: Flow diagram of taking a measurement.....	74

Figure 94: *Flow diagram of Live mode.* 75
Figure 95: *Flow diagram of Start program.*..... 76

1. Introduction

The acronym *PEC* represents the words *Pulsed Eddy Current*. It refers to the NDT system further developed by BonPhysics BV to obtain information on conducting objects based on the measurement of the decay of eddy currents that were created by a pulsed magnetic field. The software program with this name is designed to facilitate the interpretation of the decay signal for a user defined measurement grid.

1.1. PEC description

The program is based on the way that a typical NDT survey is performed. Initially one needs to know what needs to be investigated, which is represented by client (section 5.2) and object parameters (section 3.3). Important parameters are the kind of object (pipe, plate or bend), the nominal wall thickness, the lift off and the type of cladding used. Based on this information and the experience of the operator, a suitable probe is selected (section 5.3) and a suitable scan is defined (section 5.4). After a reference measurement is performed (section 6.2) and the complete survey is done (section 6.1), it can be saved (section 4.2 and 4.3). After the survey is saved it is possible to export the data in a convenient format for manipulations in other software systems (section 4.5).

The program gives tools to inspect, check, evaluate and report (section 8.1) the measurement data.

1.2. Mode control

The program can be used in different password protected modes. The simplest mode is 'Client', where the measurement results can be accessed and investigated only. The normal mode is 'Operator Level 1' mode, which gives all needed functionality to perform a typical NDT survey. The 'Operator Level 2' mode enables the adaptation of some of the graphical features (like colours, fonts and sizes) and the creation of adapted probe settings. Further it enables the possibilities to perform 'Monitoring measurements'. 'Operator Level 3' is for the advanced operators and the 'Superuser' mode gives full program control of all algorithm and probe settings. The way one can change the mode is described in section 5.1.

1.3. Menu, keyboard and touchscreen

The program has a menu structure and is mouse operated. However, a touchscreen mode is also implemented as described in section 3.6. Further, many function can be invoked by means of keys or key combinations as shown in Appendix A.

1.4. Miscellaneous

The program is written in Microsoft Visual Basic 2017 for Windows 10 Version using Microsoft Visual Studio Community 2017 Version 15.9.57 and Microsoft .NET Framework Version 4.8.09037. The target framework is Microsoft .NET Framework Version 4.6.1. This will already be installed on your computer, installed at set-up, or you should provide it yourself.

2. Start program

There are three methods to start the program. The first one is to double click on the pec icon,  you will be directed to the login screen (presented below) and the program will load the user information from the last session. The second method is to double click on a datafile, you will be directed to the login screen and the program will load the user information of the last session and open the datafile. The third way is to double click on a person file,  you will be asked for a password in a dialogue and the program will load the person file. This is elucidated in Appendix F.

All methods will enter the login screen, which shows a disclaimer you have to accept before the program continues:

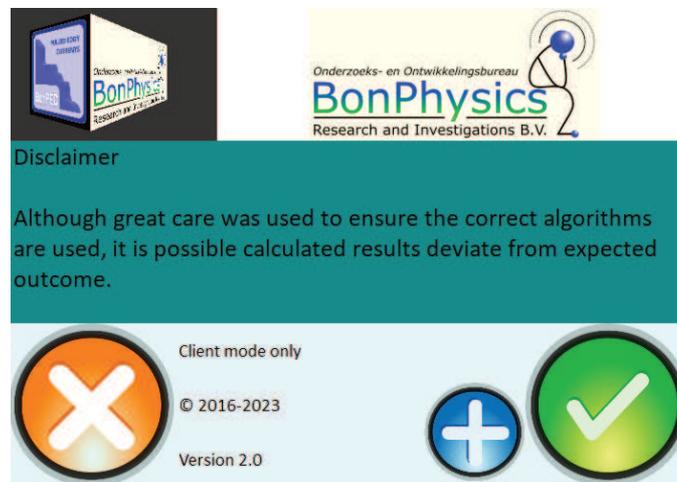


Figure 1: *Login screen.*

Push the green button if you agree that the use of the program is at your own risk and no rights or claims can be derived from using the program. If not, push the orange button, the program will shut down.

When you want to change the user mode, press the blue button.

By pressing the blue button you will enter the following screen:

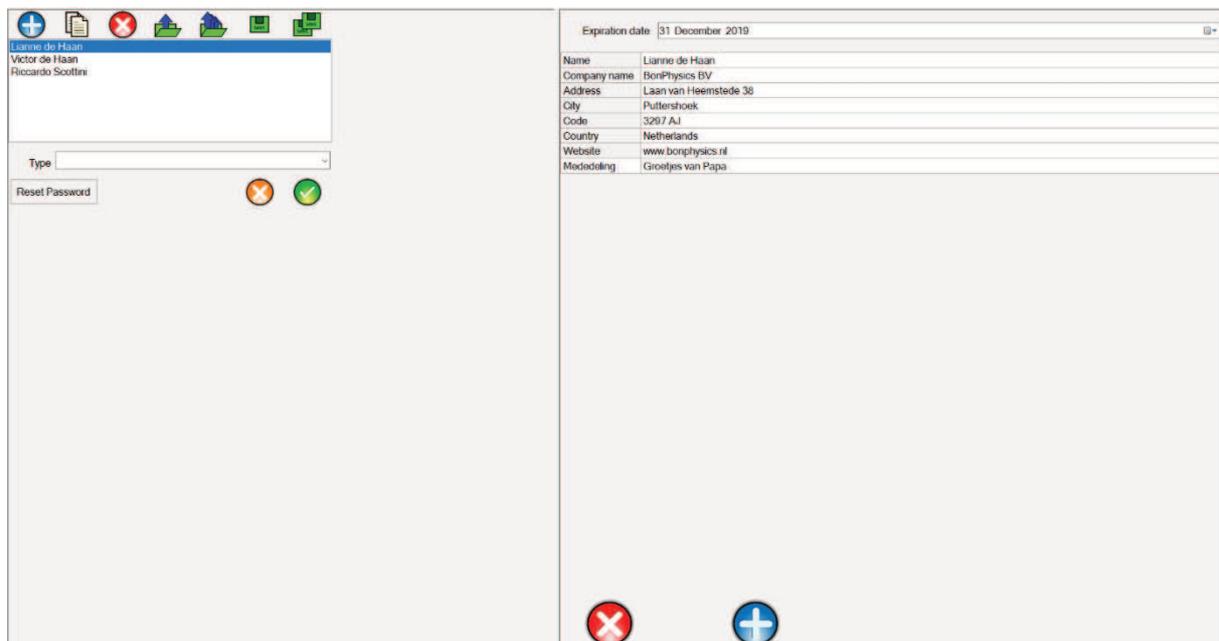


Figure 2: User selection mode (section 5.1).

By pressing the green button you will enter the following screen:

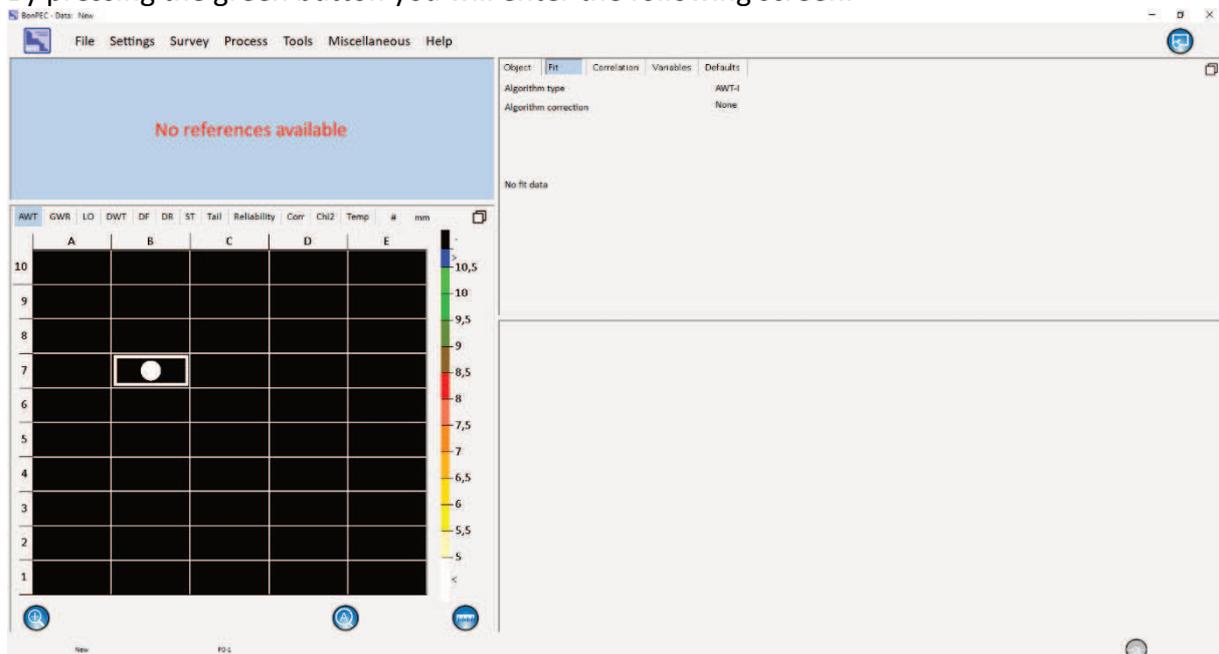


Figure 3: Main screen of the program.

As you can see, this screen is divided into different panes. Each pane has its own function, which will be described in the next chapter.

3. Features of the program

3.1. The upper left pane

In the upper left pane, depending on the chosen mode, the Average wall thickness, General wall reduction or Lift off is displayed. Below is explained how to select the mode you want. This value depends on which grid point in the pane below is selected. The values can be displayed in relative or absolute values, this is also explained in the next section. In absolute mode the number of decimals can be changed by adjusting the parameter 'Number of decimals thickness display (-1=auto)' in the Appearance tab of the default screen (see section 0).



Figure 4: The upper left pane. With no references, you will see the message on the right.

3.2. The lower left pane

Standard, the lower left pane shows the grid of relative thicknesses with a cursor indicated by a white or black box, a legend of colours, three buttons beneath the graph, several above the grid and three above the legend.

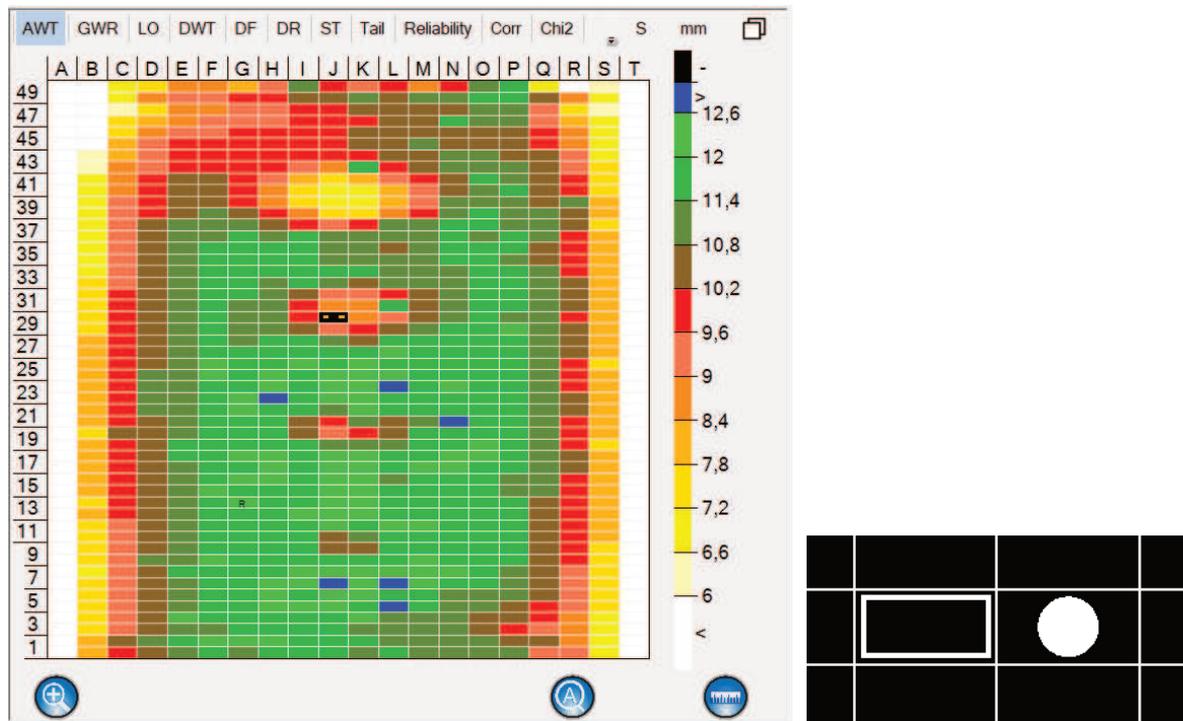


Figure 5: The lower left pane and cursors.

The square cursor is on the grid cell of which the data is currently displayed. The dot cursor represents the grid cell which is used as data storage for the next measurement.

The legend of colours shows per colour the corresponding relative thickness.

You can zoom in on a part of the grid. In normal mode you need to click and hold on the left mouse button to select the area you want to see. When you release the left mouse button, the graph will zoom to the selected area.

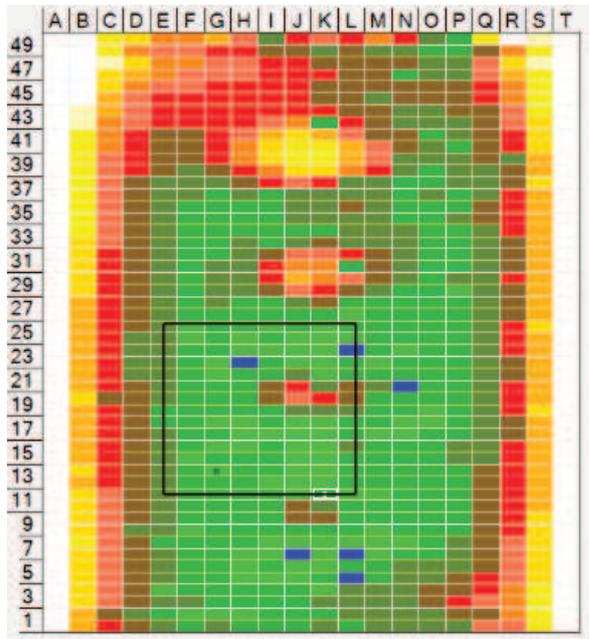


Figure 6: *Zooming area.*

When you release the left mouse button, the graph will zoom to the selected area.

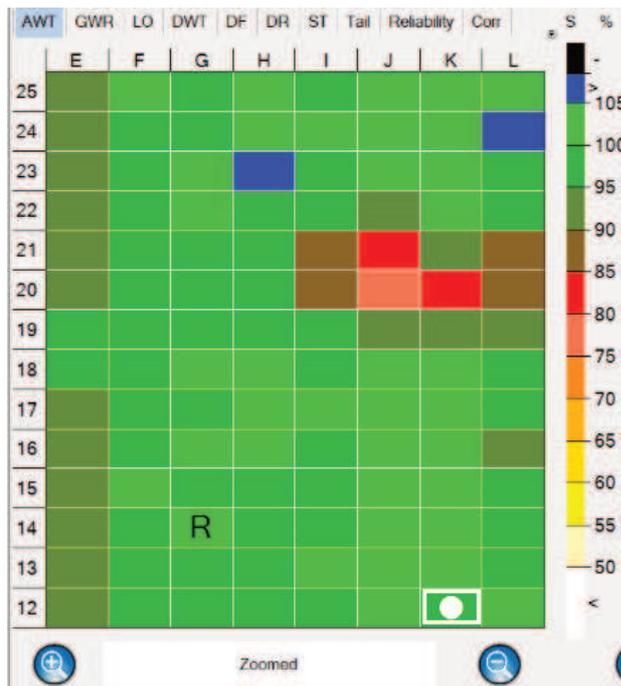


Figure 7: *Zoomed grid.*

As you can see, a symbol 'R' is present in this part of the graph. This 'R' refers to a reference measurement.

Three buttons beneath the graph enable zoom control of the grid.

By pressing the left button, , you are able to zoom in into grid, similar as before.

By pressing the right button, , the graph will return to its normal form.

You are also able to zoom in by pressing the right button when displaying . The program zooms automatically to the area around the cursor.

By clicking on this button: , you will see the profile of the object instead of the legend. You can also push F9 key on your keyboard. To be more precise, the profile of the column and row selected by the cursor appears. The profile of the selected column is shown to the right of the graph. And the profile of the selected row is shown below the graph.



Figure 8: Profile of the selected row and column.

In profile mode a button will appear left to the profile selection button with a text 'Val' (red circle Figure 8). This text indicates that either the values ('Val'), averages ('Avg'), Spread (Sig), minima ('Min'), maxima ('Max') of each row/column is shown in the profile.

In the profile mode it is possible to fit a Gaussian distribution to the wall thickness as function of the column number by dragging the mouse over the relevant columns and releasing the left mouse button (see figure Figure 9).

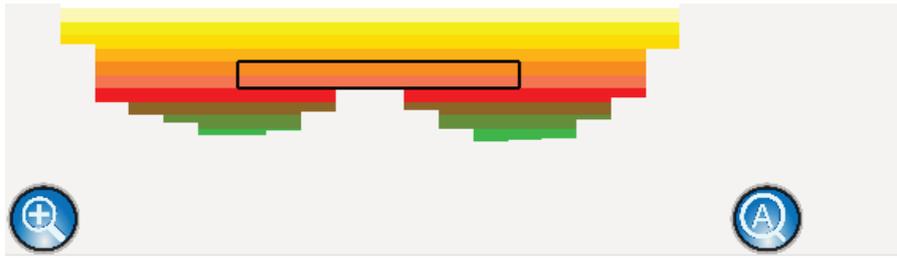


Figure 9: *Selecting a part of the profile of the selected row.*

If a fit is found, the response is a line of the Gaussian profile and the relevant parameters at the lower right corner of the scan grid display as shown in Figure 10. The parameters are in descending order: Location of maximum and deviation from center of the cell, full width half maximum of the Gaussian profile, the minimum wall thickness and the expected nominal wall thickness. Chi2 indicates the quality of the fit (should be less than 1). A similar procedure exist for a Gaussian profile along the rows. The red lines indicate the selected region.

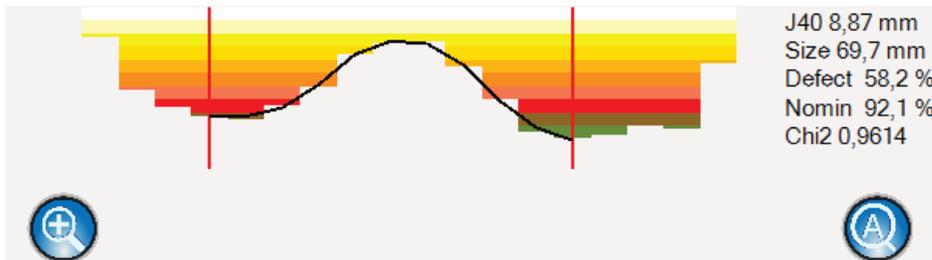


Figure 10: *Gaussian fit to the selected part of the profile of the selected row.*

It is also possible to fit a 2D Gaussian distribution to the wall thickness as function of column and row number. In that case one has to drag the mouse according to Figure 11 and release the left mouse.

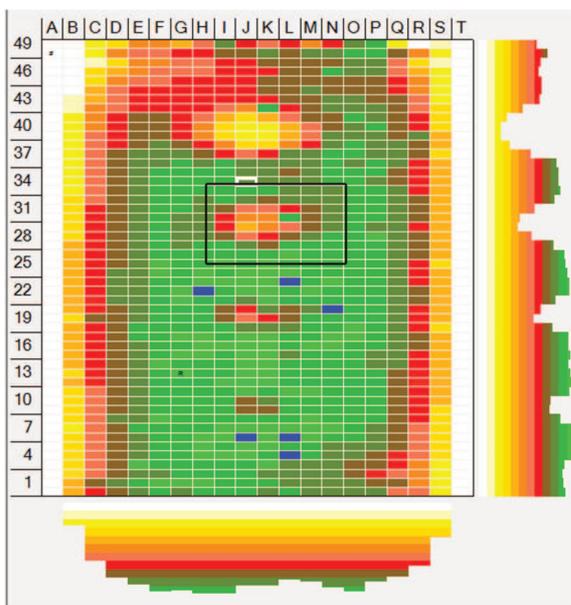


Figure 11: *Selecting a part of the profile of the selected row and columns.*

If a fit is found the response is a line of the Gaussian profile and the relevant parameters at the lower right corner of the scan grid display as shown in Figure 12. The parameters are in descending order: Location of maximum, full width half maximum of the Gaussian profile in the column direction, full width half maximum of the Gaussian profile in the row direction, the minimum wall thickness and the expected nominal wall thickness. Chi2 indicates the quality of the fit (should be less than 1). The red lines indicate the selected region.

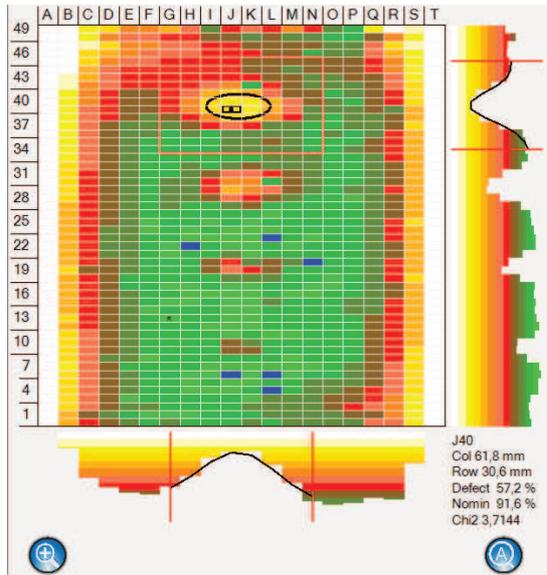


Figure 12: Gaussian fit to the selected part of the profile of the selected rows and columns.

By sequence clicking on the button , you will see different graphs in the following order:

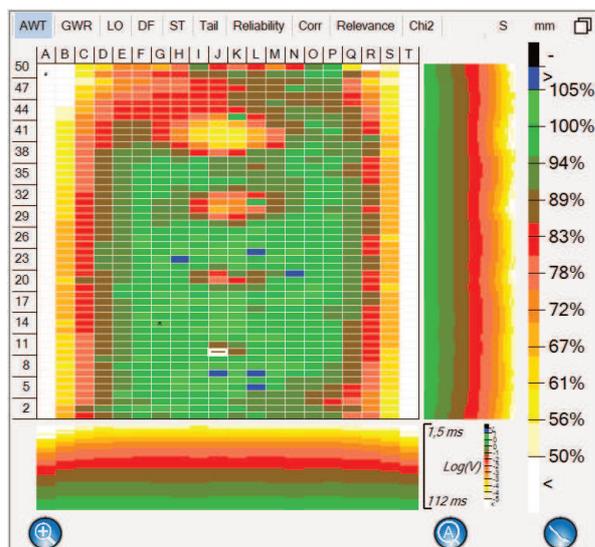


Figure 13: Decay of the selected row (colors refers to the logarithm of the voltage of the signal, a legend is presented).

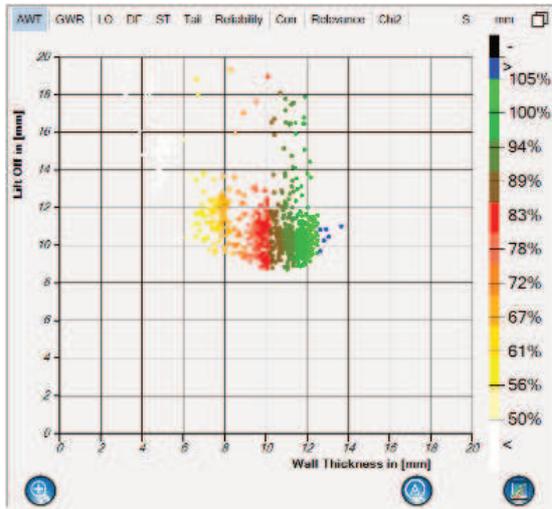


Figure 14: Correlation of the selected quantities.

The last graph is a 3D version of the object. With your left mouse button you can translate the object. With your right mouse button you can rotate the object and by scrolling with your mouse, you can zoom in or out.

You can also use the keyboard. For vertical movement, use SHIFT + 'page up' or 'page down'. For horizontal movement, use CTRL + 'page up' or 'page down'.

Use A, W, D, X keys for translations and SHIFT + AWDX for rotations and CTRL + AWDX for other kind of rotations. Use Q and Z keys for zooming. CTRL + 'Home' will bring the object to the begin position. CTRL + 'End' will bring it to the flipped begin position. SHIFT + 'Home' will present the front view. SHIFT + 'End' will present the bottom view. This can be done also in the pane 'Object control' and in the scan dialogue.

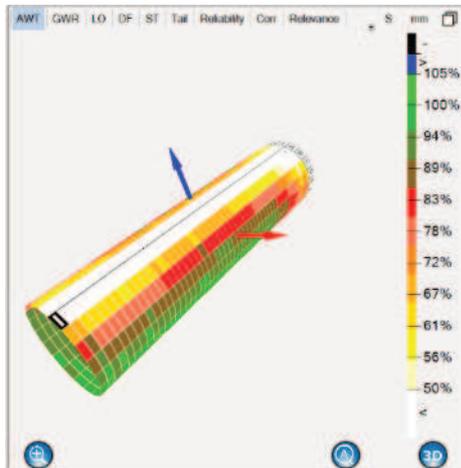


Figure 15: 3D graph.

You are also able to shift the grid presentation so that the displayed grid is shifted to the left or right or top or bottom by right-clicking on a label and shifting it to the desired new location as shown in the figure below. This can also be accomplished by putting the mouse over the labels to be shifted and using the scroll button. The shift is reset by right-clicking on the lower-right corner outside the grid.

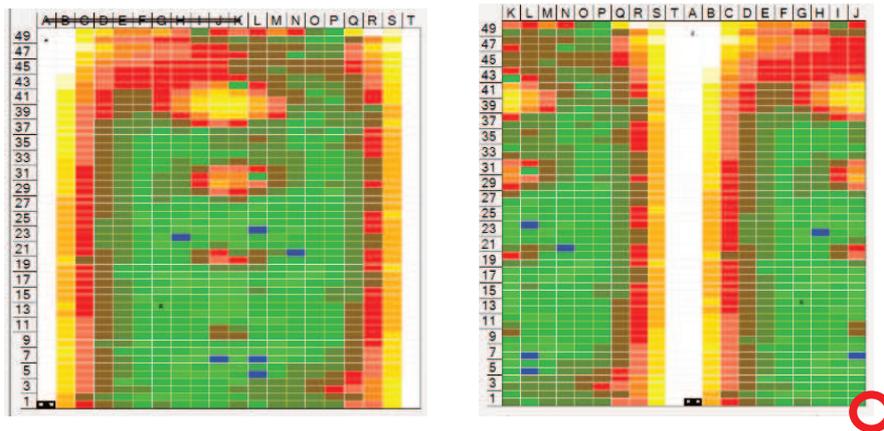


Figure 16: *Shifting the grid display.*

The buttons above the grid serve to change the presented data. AWT mode shows the Average wall thickness of the object (CTRL-T). GWR mode shows the General wall reduction (CTRL-G) and LO mode shows the Lift off (CTRL-L). DWT mode shows the Defect wall thickness of the object and DF mode shows the Defect fraction. DR mode shows the Defect relevance, this parameter should be above a certain threshold for the defect algorithm to be relevant. ST mode shows the Sheeting thickness if an algorithm is selected using a sheeting type. Tail mode shows the Tail ratio if the sheeting type is 'Aluzink' or 'Galvanized'. Reliability mode show the Reliability of the fitted parameters. Corr mode shows the correlation coefficient between AWT and LO in the normal calculation mode and the correlation coefficient between DWT and DF when the defect mode is activated. Chi2 mode shows the chi2-parameter of the fit line with respect to the data points measured. Temp mode shows the temperature of the measurement. This is copied from the reference measurement or can be adjusted manually (see section 6.3).

The three buttons above the legend serve to change the text filling of the grid, the display of absolute or relative values and the size of this pane.

By clicking on the 'S' the value at every single grid points appears. By clicking on the '#' the values will disappear again and the selected symbols will reappear.

By clicking on 'mm' you will change the absolute values to relative ones. To get the absolute ones back, you should press on the same button, only now there is a '%' sign. When in the defaults screen (see section 0) for the Unit type 'US standard' is selected the 'mm' sign is replaced by 'in'.

In monitoring mode (see section 5.4) you can also select 'M', for the mean value of all depth's, 'I', for the intercept value, 'C' for the corrosion rate. The time unit of the corrosion rate can be adjusted in the defaults values (see section 0).

You are also able to see the graph at full screen, you only have to left-click the right symbol. By left-clicking on it again, the graph will minimize again.

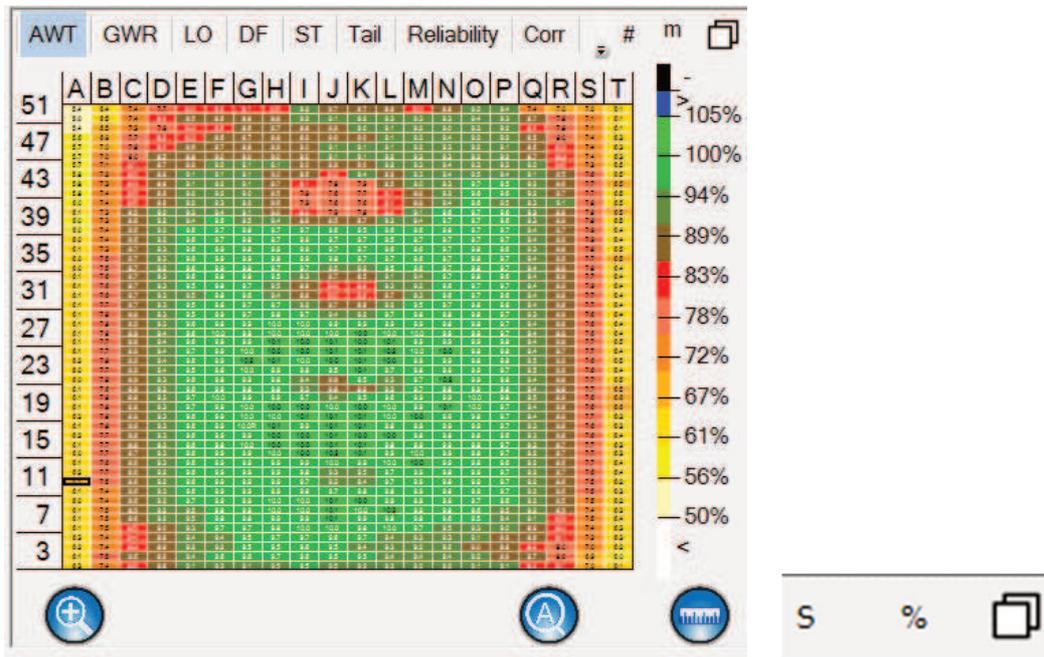


Figure 17: S is selected.

Finally, you are also able to customize the size of each pane. Look at the snapshot of the program shown in Figure 18. As you can see, each pane is surrounded by bars. When you click and hold onto a bar with your left mouse button you will be able to increase or decrease the size of the pane. After doing this you can make this the standard size by clicking with your right mouse button on the following symbol: □, this symbol will change into: □. This procedure applies to all panes.

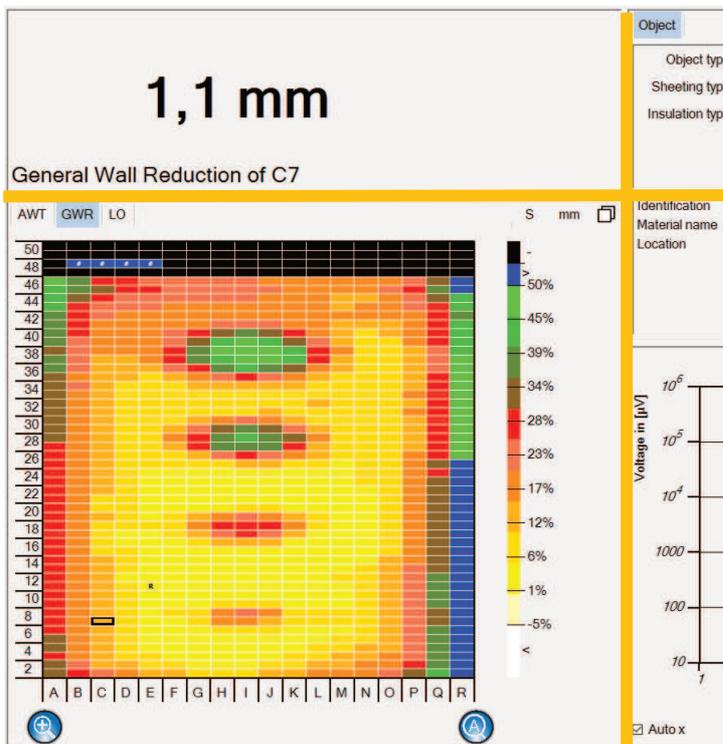


Figure 18: Pane division.

3.3. The upper right pane

The upper right pane describes the Object parameters, Fit results, Algorithm Vars, Algorithm Defaults and Correlation.

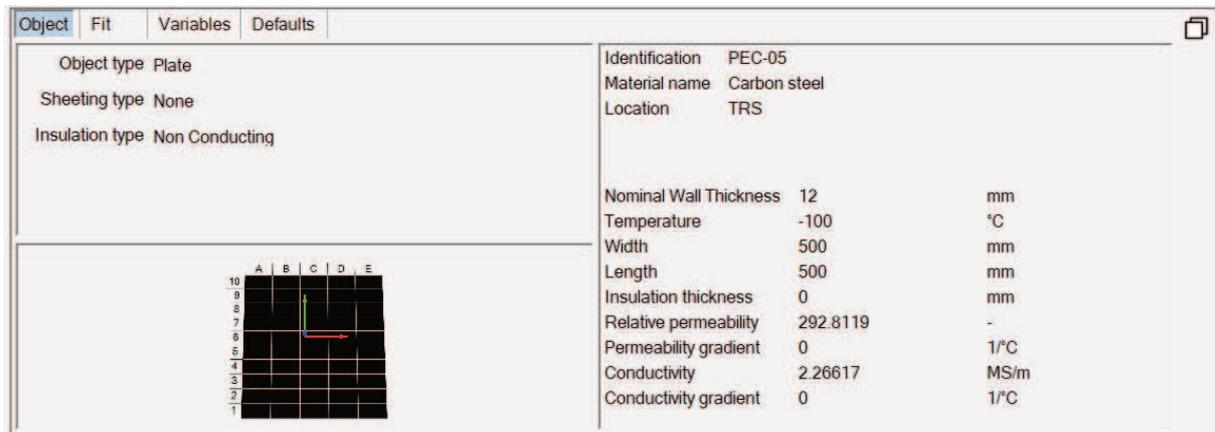


Figure 19: Upper right pane, Object.

The Object parameters are shown when you click on the tab Object.

For object type there are several options, among which: plate, pipe, profile, bend, segmented bend or dome. When the option plate is selected, you are able to change the length and the width of the plate. When the option pipe is selected, you can change the length and diameter of the pipe. When the option 'profile' is selected you can also define the number of segments (or sides) of the profile. When the option bend is selected, you can change the pipe diameter, pipe bend radius and pipe bend angle. When the option 'segmented bend' is selected you can define also the number of segments (straight pieces) of the bend. When the option 'dome' is selected you can define the length and diameter of the dome and also the height of the curved part of the dome and the dome angle (0 = no top or bottom, 90 = full top, no bottom, -90 = full bottom, no top, 180 = full top and bottom). Those changes can be made in the sub-menu 'Select Reference' in the menu 'Process'.

For sheeting type there are five options: None, Stainless steel, Aluminum, AluZinc and Galvanized. When an option other than 'None' is chosen for sheeting type, there will be an extra variable presented in the right part: Sheeting thickness. In that case the algorithm is adapted to take into account the influence of the sheeting on the signal (delay and tail).

For insulation type there are seven options: None, Rock Wool, Non Conducting, Paint, Coating, Reinforced and Conducting. When an option other than 'None' is chosen, there will be an extra variable presented in the right part: Insulation thickness. In case 'Conducting' the algorithm is adapted to reduce the tail of the sheeting signal by a fitted time constant ("Tail Tau").

The upper right part shows the identification of the test object, the material name of the object and the insulation type of the test material.

The Fit results are shown when you click on the tab 'Fit'.

The Algorithm type indicates the algorithm that is used. The Algorithm correction indicates which corrections to the algorithm are used. The Voltage and Current indicate the measured values just before the current trough the coil is shut-off. The Sheeting type should represent the sheeting used and determines the shape of the fit line. The Time constant and Signal amplitude represent vales used to calculate the fit line. The Chi2 is called the Chi-squared and represents the quality of the fit. Ideally it should be 1 or smaller. Reliability and Correlation are shown for additional information about the fit quality.

The algorithm variables are shown in the tab 'Variables'.

Object	Fit	Variables	Defaults
Max signal		4,096E+6	µV
Min signal		18,05259	µV
Min time		1,436473	ms
Max time		118,4014	ms
Relative accuracy		5	%
Slope correction		0,008657	-
Linear tau factor		0,245837	-
Tau zero term		38,51414	ms
Shape thickness		8,192203	mm

Figure 20: Algorithm Variables.

The Max signal, Min signal, Min time and Max time variables are shown as red lines in the lower right pane when tab 'Filter data' or 'Raw data' are selected (next section). They can also be changed by left-clicking and dragging with the mouse. The other variables are used in the calculation of the best fit line and algorithm correction parameters.

The algorithm defaults are shown in the tab 'Defaults'.

Object	Fit	Correlation	Variables	Defaults
DWT Fraction treshold		30		%
DWT Thickness treshold		10		%
DWT Relevancy treshold		0,1		-

Figure 21: Algorithm defaults.

The correlation is shown in the tab Correlation. These data need to be recalculated after loading a new file (Menu 'Process'- sub-menu 'Recalculate'). Two variants are possible, normal mode (change in Lift off % to Change in thickness %) or defect mode (Defect fraction % to Defect wall thickness %). In the defect mode a bar indicating the lift off for the defect value is shown. The colors of the bar are the same as for the Lift-off color bar in the lower left pane.

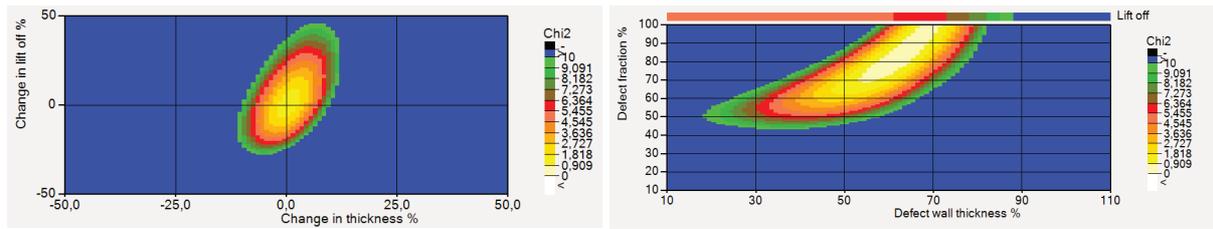


Figure 22: Correlation in normal mode (left) and defect mode (right).

3.4. The lower right pane

The lower right pane shows a graph of the decay signal of the selected grid point or the last measurement. The vertical axis represents the received signal in microvolt, the horizontal axis represents the time in milliseconds. The axis scales can be changed by using the checkboxes below the graph. The black dots represent average values and the black bars represent their estimated standard deviation (the dots/bars turn red if the signal is negative). The larger the bars, the less accurate the data points. The blue line represents the fit results and the green line represents the reference fit results (when available).

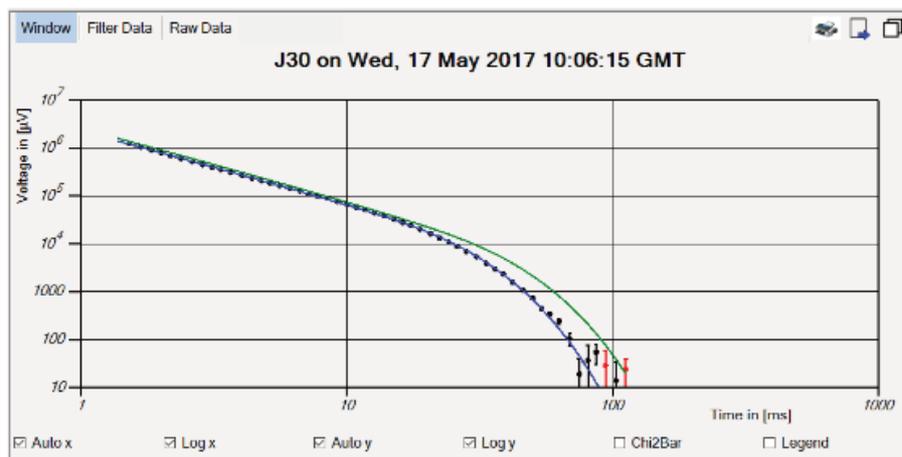


Figure 23: Lower right pane.

In Figure 23 three graphs are presented. The black points (including error bars) represent the measurement data. The blue line represents the fit to the data and the green line represents the fit to the reference measurement data.

If the checkboxes 'Log x' or 'Log y' are deselected the scale changes from logarithmic to linear. Note that negative time values are not possible and negative signal values are represented as red dots and bars in the logarithmic mode. See examples below:

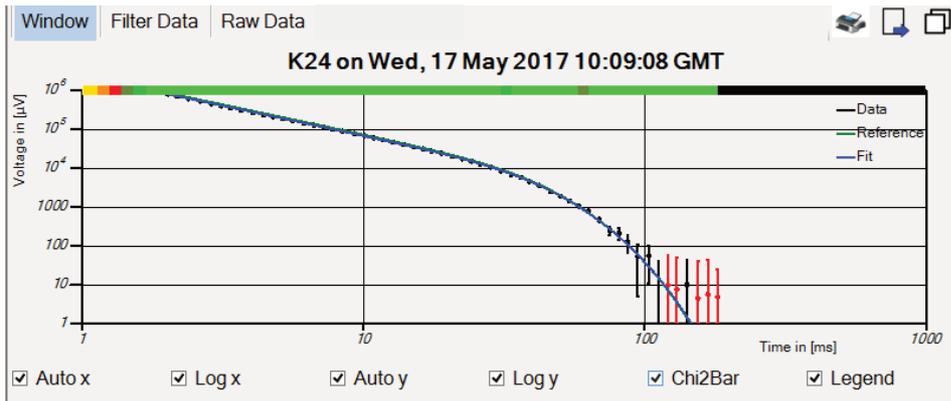


Figure 24: All boxes are selected.

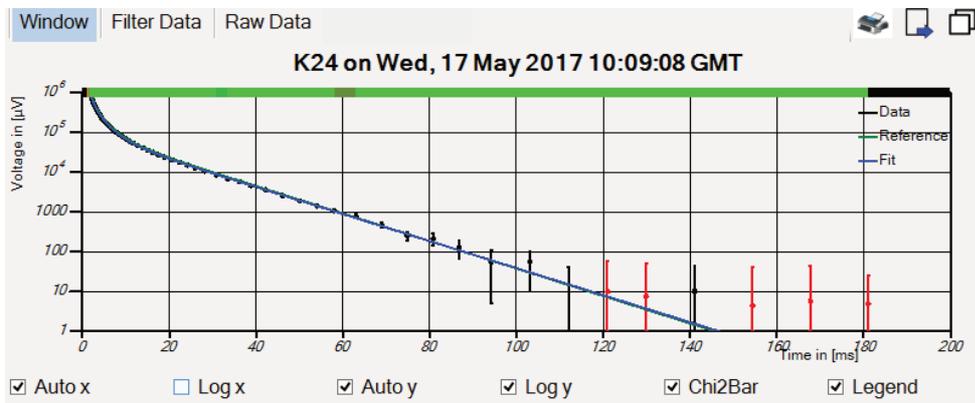


Figure 25: 'Log-x' is deselected.

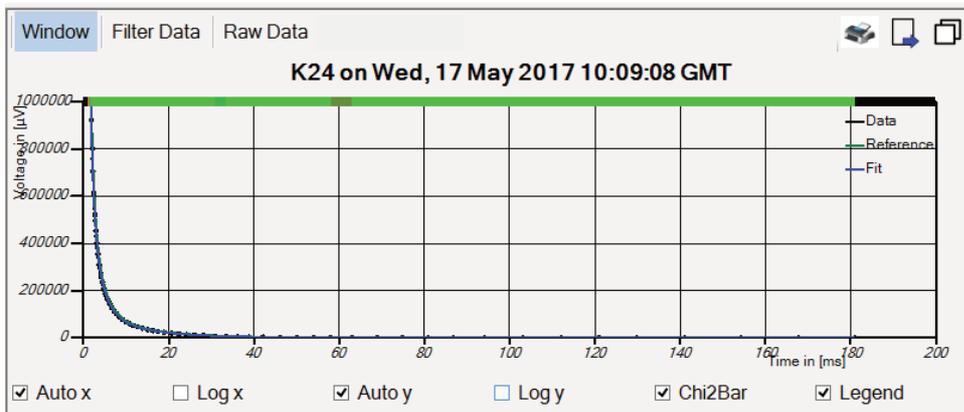


Figure 26: 'Log-x' and 'Log-y' are deselected.

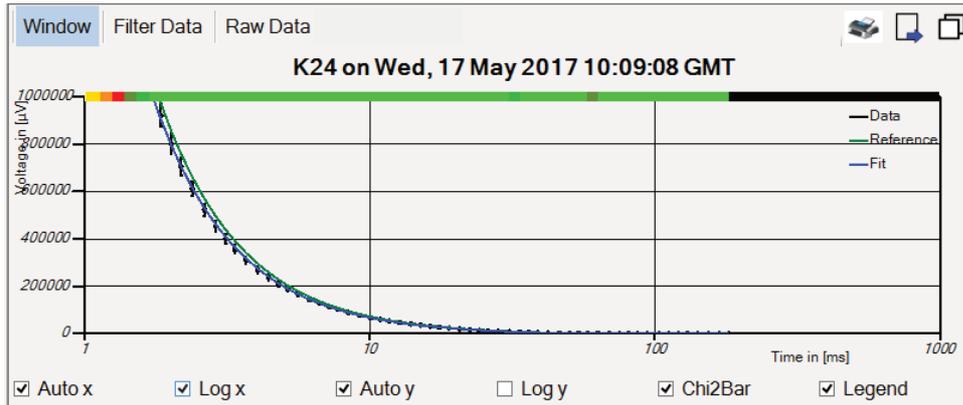


Figure 27: 'Log-y' is deselected.

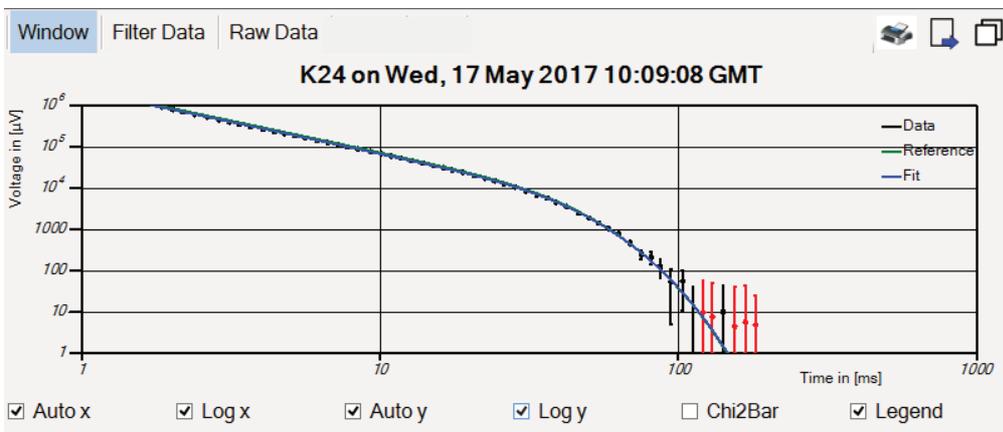


Figure 28: 'Chi2bar' is deselected.

If the checkboxes 'Auto x' or 'Auto y' are deselected it is possible to zoom in onto the graph by means of the mouse (described below) or by right clicking the mouse on the extrema of the axis labels, see examples below:

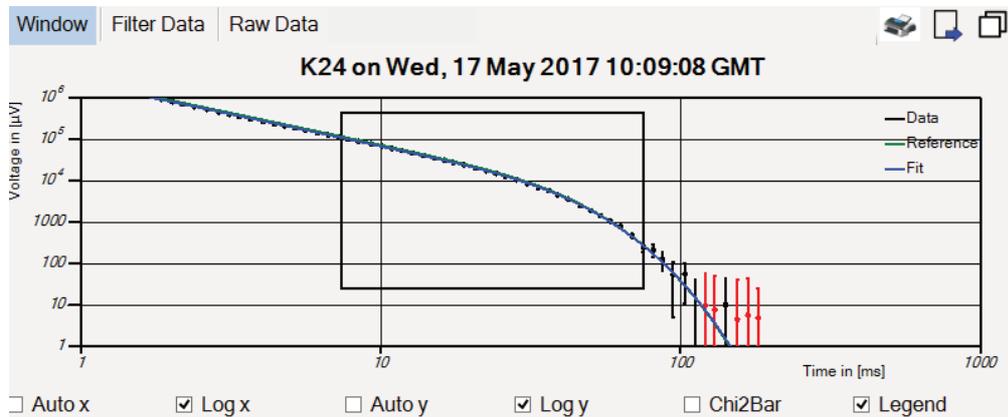


Figure 29: Selected area by holding onto your left mouse button.

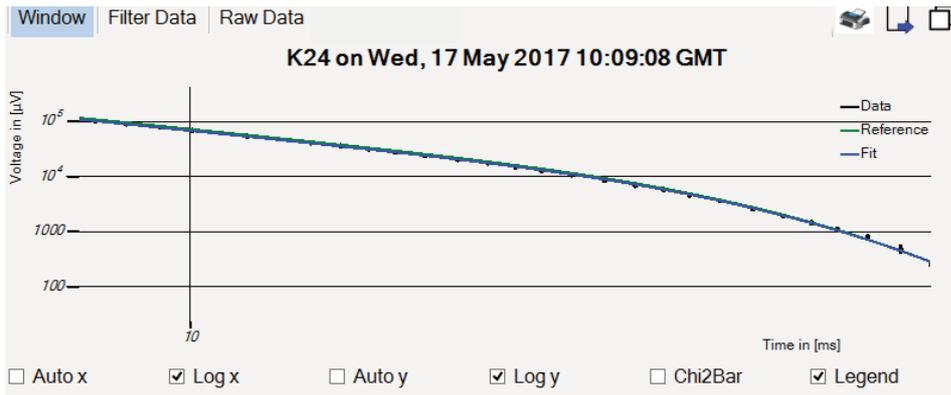


Figure 30: Graph will zoom in to this area by releasing your mouse.

In this case, the y axis and x axis are variable. By reselecting the 'Auto x' box, only the y-axis will be variable. The legend of the graph will pop up by clicking into the box 'Legend'. When the legend is visible you can remove a line by left clicking the corresponding agenda.

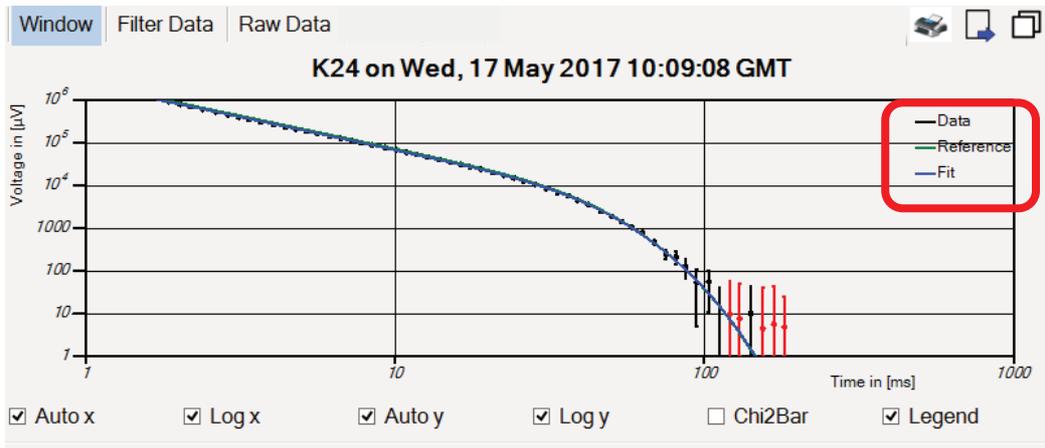


Figure 31: By clicking on one of the lines presented in the legend, this line will be removed.

For example clicking on the black line for 'Data', you will see the following graph:

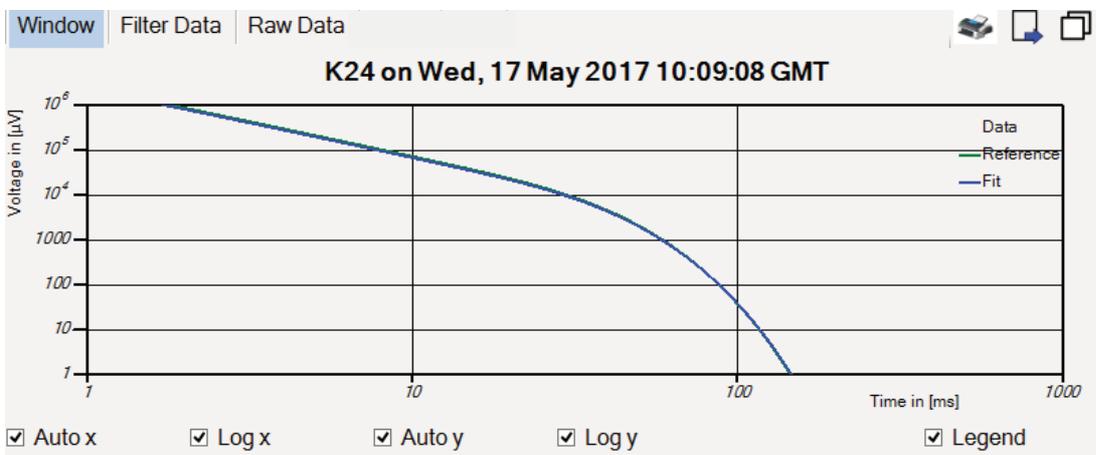


Figure 32: A line is removed.

By clicking on the same spot with your mouse, the line will reappear.

Finally, you are able to change the mode of the graph. The five buttons in the left upper corner are, Window, Filter Data, Raw data.

In the 'Filter Data' mode a red window and a (part of a) yellow window are shown. The red window represents the area where the signal is used in the data processing. It can be changed by left clicking and dragging the lines. The yellow window represents the extrema values for the selected probe.

In the 'Raw Data' mode all the samples are shown for both the measurement (orange dots) as the used induction signal (green dots) of the probe (if available). Note that negative signal values are represented as red dots for the measurement and light green dots for the induction signal.

The yellow window represents the extrema values for the selected probe. The points represent the logarithmic derivative.

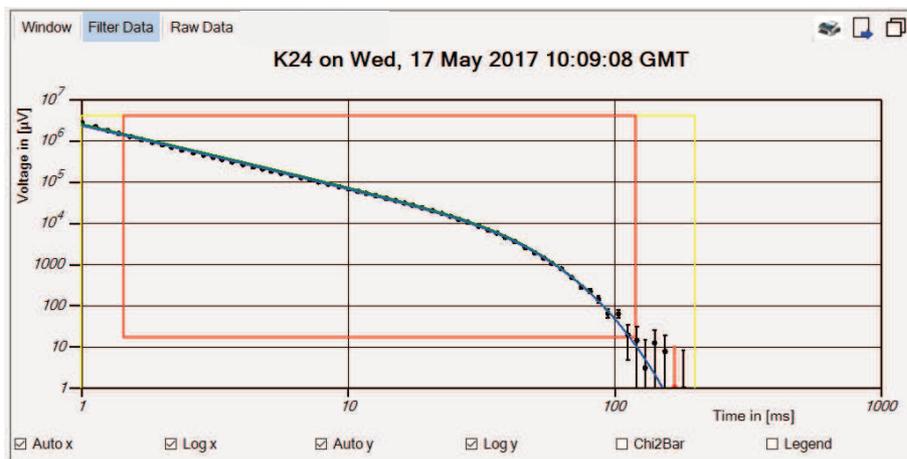


Figure 33: Filter data.

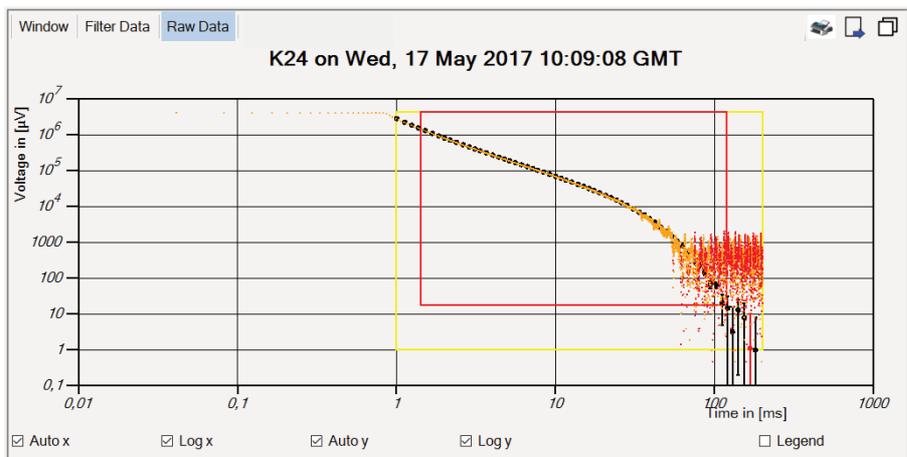


Figure 34: Raw data.

On the right above the graph, a button is present:



With this button you can change the size of this pane, which is described earlier.

3.5. Informative bars of the screen

By loading a data file into the program, the name of this file will be projected in the upper bar above the menu bar. By changing something in the file and not saving it, like adding a reference, a star will be presented next to the name of the data file.



Figure 35: Upper informative bar.

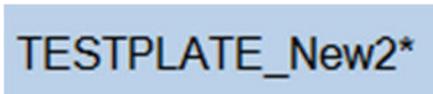


Figure 36: Not saved changes.

As you can see in Figure 35, to the right a minimize button and an exit button are available. The minimize button is only available in file mode. Sometimes the screen is not displaying correctly, then you can press the F5-key to maximize main window again.

To exit the program, click with your right mouse button on the exit button (or 'ALT' key + 'End' key).

In the lower bar underneath the panes, you can see from left to right: the name of the selected user (in the presented snapshot below: 'Lianne de Haan'), the name of the selected probe (in the presented snapshot below: AP_60Hz_2000ms), the name of the current reference and date of the last save action.



Figure 37: Lower informative bar.

When you move with your mouse to the reference part of this bar, the lower left pane will show for which grid points the selected reference is used by changing its color to green.

When you move with your mouse to the reference part of this bar, the lower left pane will show for which grid points the selected reference is used by changing its color to green.

At the right end of this lower informative bar, one of the button below is presented.



Figure 38: *Button for connecting to hardware.*

By clicking on the blue button, you will connect to the hardware, the button will turn green. When there is no connection to the hardware (indicated by gray or red button), you will get to see the following warning:

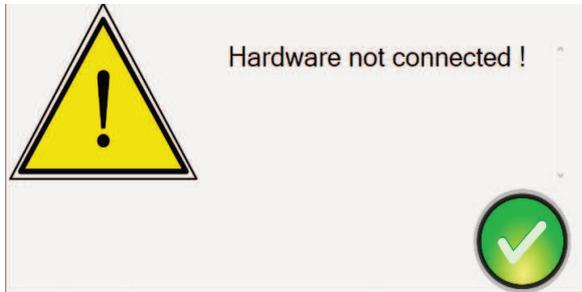


Figure 39: *A warning for lost connection to the hardware.*

By clicking on the green button in the warning box, you will be directed back to the program (see also section 6.10).

3.6. Switching screen modes

In the upper right corner you can see the button presented below. By clicking on this symbol, the mode of the program will change from 'mouse' to 'touchscreen'.



Figure 40: *Switching screen mode.*

After clicking the screen will look like:

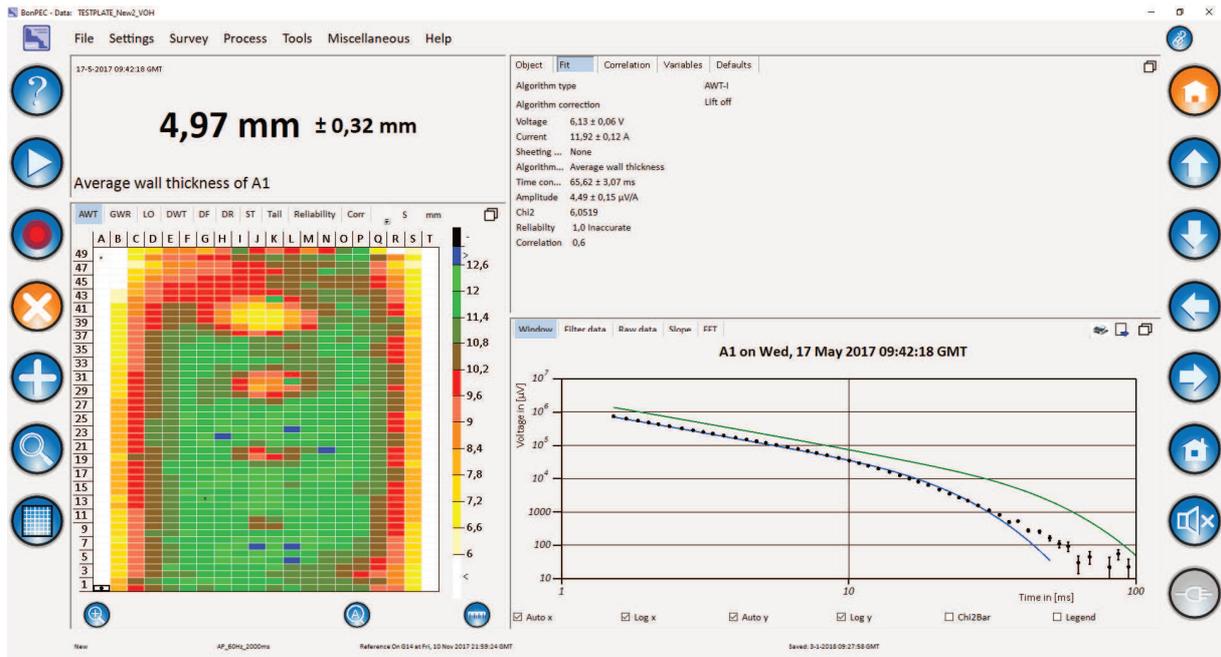


Figure 41: Touchscreen mode.

The following buttons are present:

	<p>By clicking on this button, this user guide will be opened.</p>
	<p>By clicking on this button, a measurement at the cursor will be done and afterward the cursor will go to the next position. [Press ENTER on your keyboard]</p>
	<p>By clicking on this button, the program will try to apply the defect-algorithm. [Press F10]</p>
	<p>By clicking on this button, you will erase the value of the grid point. [Press CTRL+E]</p>
	<p>By clicking on this button, you will be able to add a reference measurement. [Press CTRL + ENTER]</p>
	<p>By clicking on this button, you will be directed to the probe selection mode (tab settings, sub-item: probes). [Press CTRL + P]</p>
	<p>By clicking on this button, you will be directed to the scan mode (tab settings, sub-item: scan).</p>
	<p>By clicking on this button, you will be starting the automatic scan (tab Process, sub-item: Auto scan, live mode).</p>
	<p>This button shows the other possible mode (touch screen or mouse mode), clicking on it will lead to change into this mode.</p>
	<p>By clicking on this button, you will be directed to the 'end-position'. This the last point of the grid. [Press 'End' on your keyboard]</p>

	<p>These four buttons are to be used while moving through the grid.</p> <ul style="list-style-type: none"> - Clicking on the arrow pointed upwards, your cursor will move one row up. - Clicking on the arrow pointed downwards, your cursor will move one row down. - Clicking on the arrow pointed to the left, your cursor will move one column to the left. - Clicking to the arrow pointed to the right, your cursor will move one column to the right.
	<p>By clicking on this button, you will be directed to the 'home-position'. This is the first point of the grid. [Press 'Home' on your keyboard]</p>
	<p>By clicking on this button, you can turn the volume on or off.</p>
	<p>By clicking on this button, you will connect to the hardware. This will lead to the presentation of the 'live' button for the auto scan. When there is no connection to the hardware, you will get to see the warning shown in Figure 38 .</p>
	<p>A battery and a temperature icon are presented. By clicking with your right mouse button on the battery icon, the status will turn into 100%. These are only available in live mode.</p>

4. Menu Item File

By pressing the 'File' button, you will see seven options:

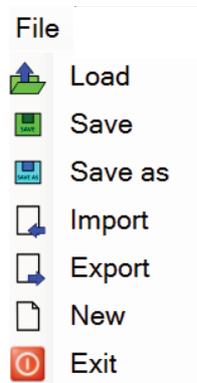


Figure 42: Menu item File.

4.1. Sub-menu Item File: Load

You press 'Load' when you want to load data from measurements into the program.

By pressing 'Load' you will be directed to the following screen:

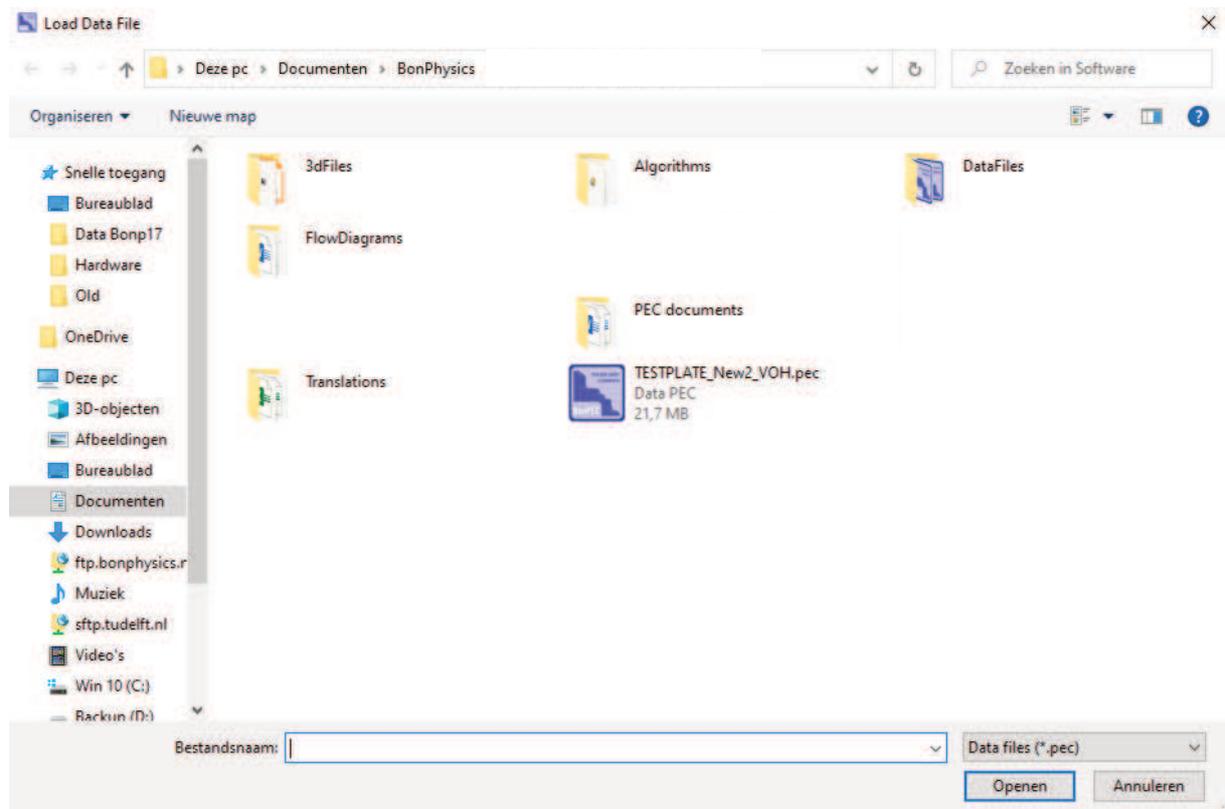


Figure 43: Opening a file.

Right now, you need to choose which file you want to load and click 'Open'. By clicking on open, you will see the wait screen as shown in Figure 45. After it disappears, the file has

been loaded. When you press the Escape key the loading will be aborted. You can select either 'pec' or 'txt' filename extension as shown in

Figure 44. 'pec' stores the data in a coded format, but takes longer to save. 'txt' stores the data in ASCII format and is faster, but the data is easily accessible.

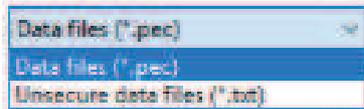


Figure 44: Selecting a data file format.

4.2. Sub-menu Item File: Save

When you would like to save the data, you should click on save.

By clicking on save, you will see the wait screen as shown in Figure 45. After it disappears, the file has been saved. When you press the Escape key the saving will be aborted.

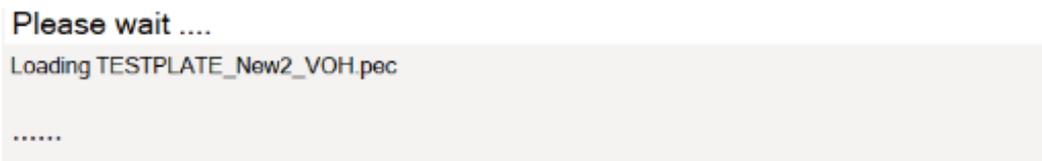


Figure 45: Loading or saving bar.

4.3. Sub-menu Item File: Save As

When you would like to change the document folder or name of the document while saving, you should choose 'Save As'.

By clicking on 'Save As', you will get to see:

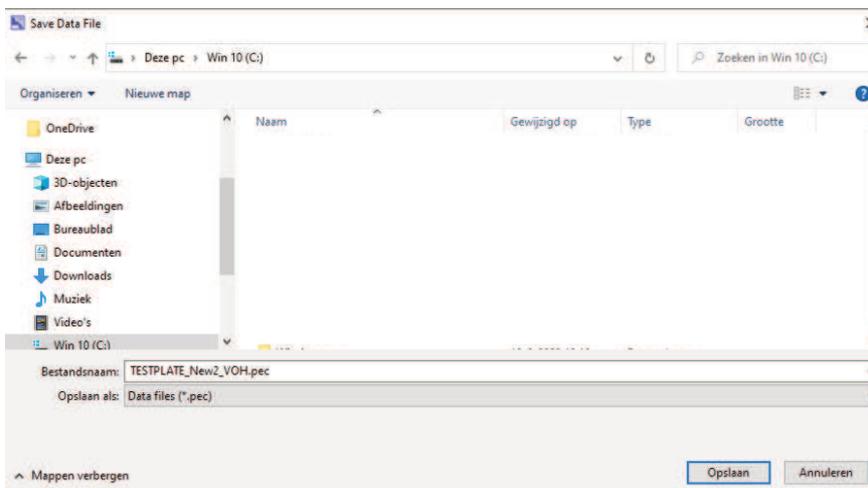


Figure 46: Saving a file.

Right now, you are able to choose the right document folder, file type and file name for your analysis. But when you choose to click on 'Cancel', you will be directed to the following warning:

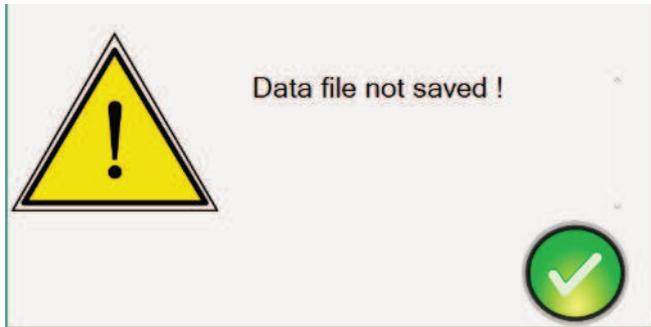


Figure 47: A warning indicating data was not saved.

After clicking on the green button, you are directed back to the program.

You can select either 'pec' or 'txt' filename extension as shown in

Figure 44. 'pec' stores the data in a coded format, but takes longer to save. 'txt' stores the data in ASCII format and is faster, but the data is easily accessible.

4.4. Sub-menu Item File: Import

You press 'Import' when you want to load data from other systems. It works like loading a normal file.

4.5. Sub-menu Item File: Export

To change the file type to excel or other specific ASCII-file types, you have to use this option. After clicking on 'Export' you will be directed to the following screen:

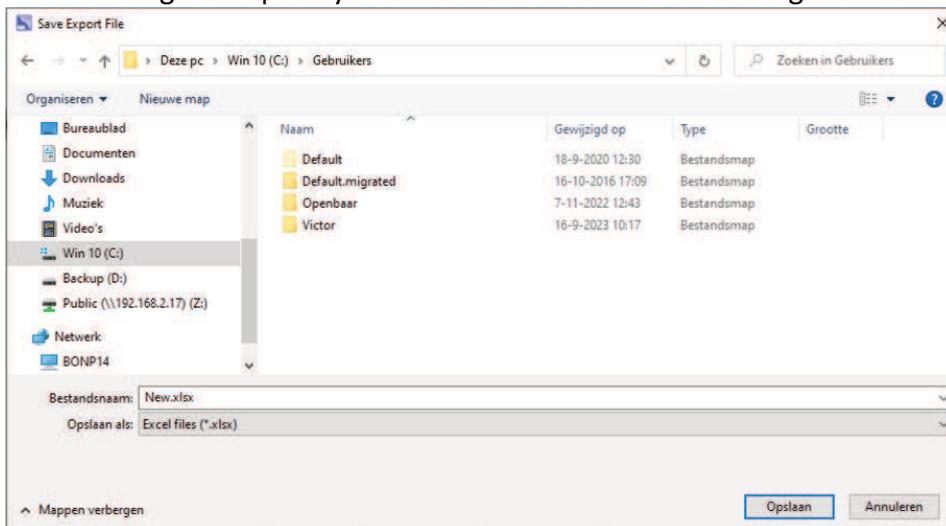


Figure 48: Export a file.

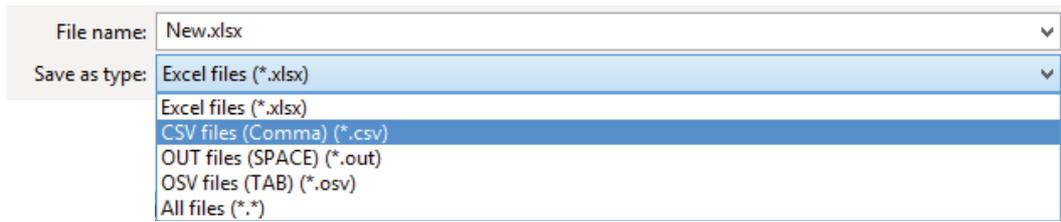


Figure 49: Special file types while exporting data.

Right now, you are able to choose the right document folder, file type and file name for your analysis.

4.6. Sub-menu Item File: New

When all your data is saved, you can choose to open a new file. You need to click on 'New'. You will see the following warning:



Figure 50: A warning indicating data will be renewed.

If you are sure, press the green button. If you are not, press the orange one. By pressing the orange one, you will be directed back to the main screen. By pressing the green one, you will be directed to an empty main screen:

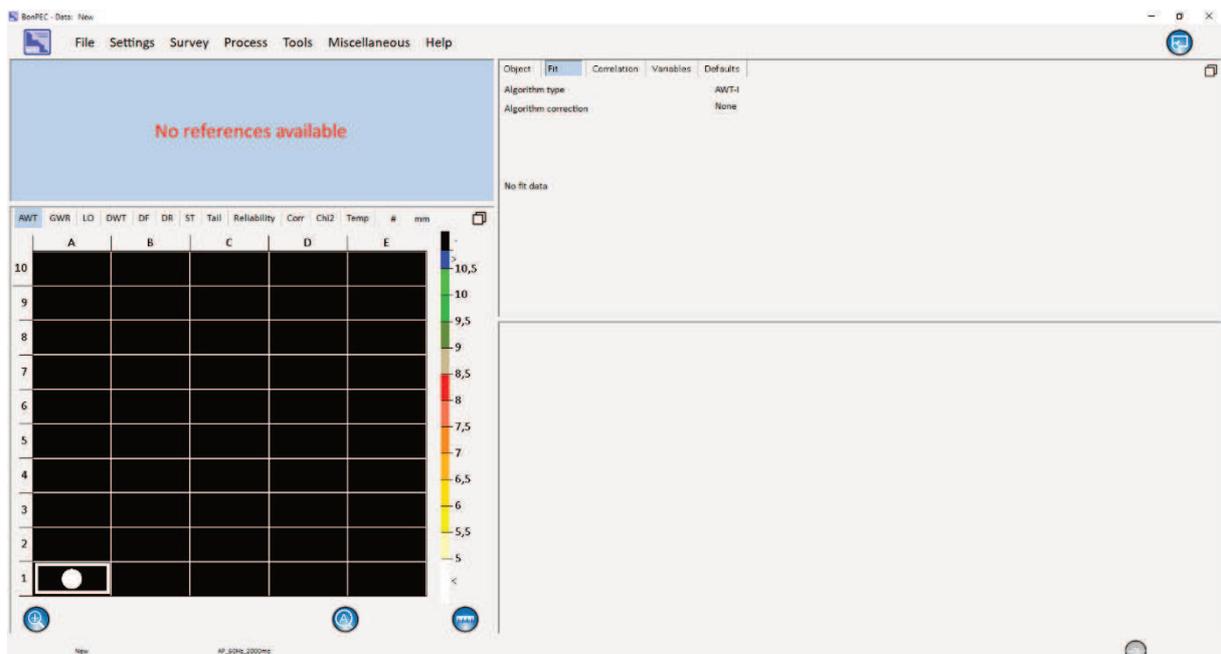


Figure 51: A new main screen.

4.7. Sub-menu Item File: Exit

When you want to shut down PEC, you have to click the 'Exit' button. The program will immediately shut down, without any warning unless you have unsaved changes, then you will see:

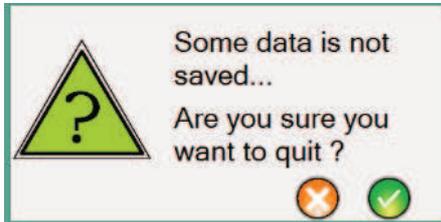


Figure 52: A warning when some data is not saved.

Press the green button if you want to shut down the program without saving the changes and the orange one, when you want to save the changes before shutting down.

5. Menu Item Settings

This menu is used to set users, clients, probes and to define your scan.

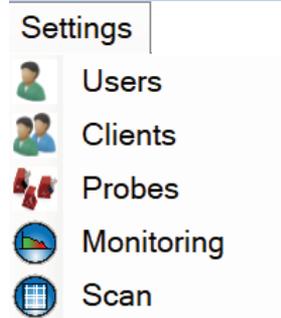


Figure 53: Menu Item Settings.

5.1. Sub-menu Item Settings: Users

The user represents the person operating the program. To change the user you click on the sub-menu 'Users'.

You will enter the following screen:

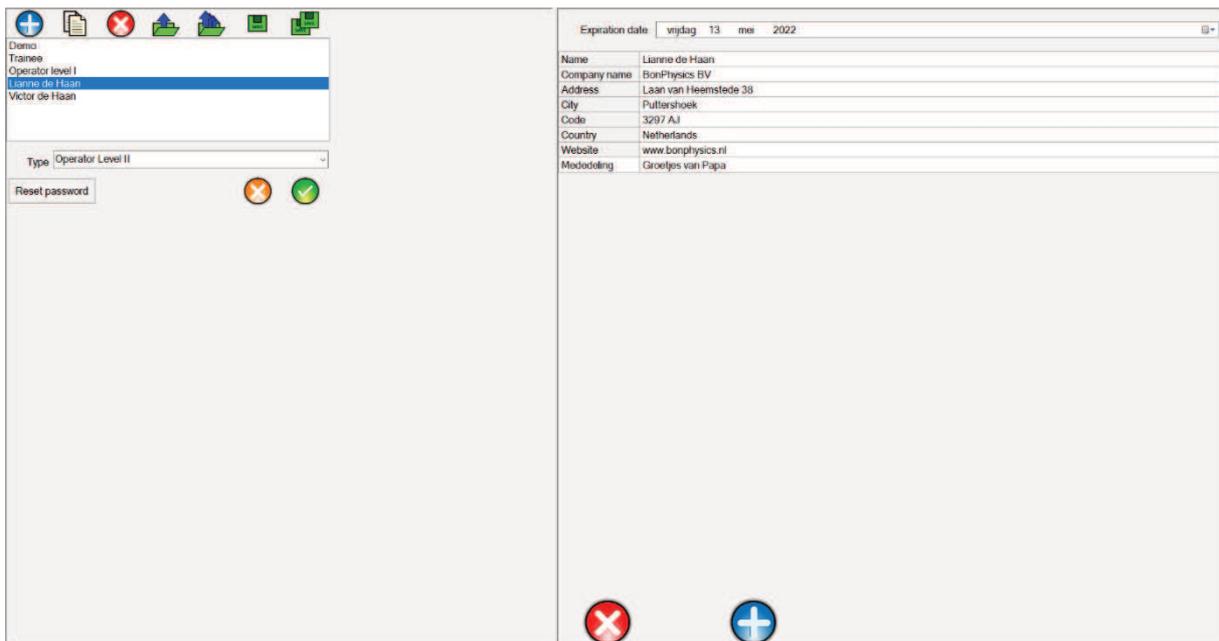


Figure 54: User settings.

The following buttons are present:



By clicking on this button, you will add a user. 'New Name'

As you can see, you can select the type of user and on the right side, you are able to fill in details about this user and his or her expiration date. You are also able to reset the password. For example: when a client has forgotten his password, clicking on the button below will lead to the resetting of the password into the standard one. But you are only able to reset the password of a user level below yours.



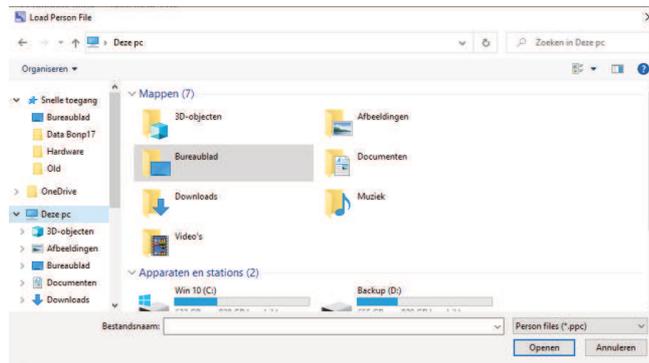
Clicking on this button will lead to the creation of a copy of the user.



Clicking on this button will lead to the erasing of the selected user.

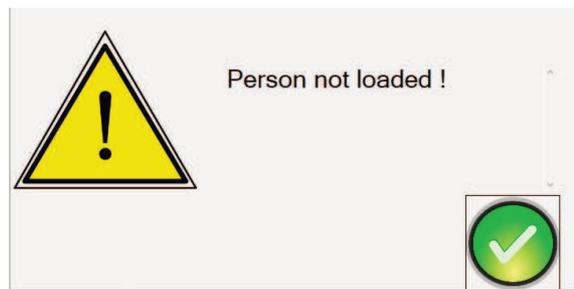


Clicking on this button will lead to the option of loading person files, you will be directed to the following screen:



Right now, you can choose from all files which user you will add. Select one and click 'Open'.

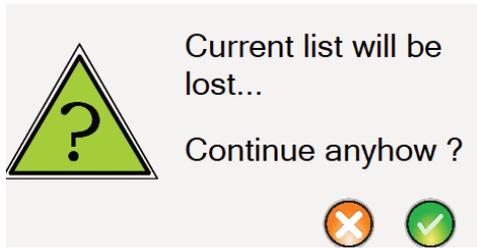
By clicking on 'Cancel', you will be directed to the following screen:



When pressing the green button, you will go back to the users overview.



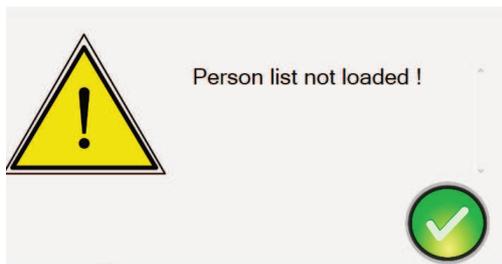
Clicking on this button will first lead you to the following warning:



If you do not want your current list to be lost, you should press the orange button. If you want to load a new list of users you click the green button.



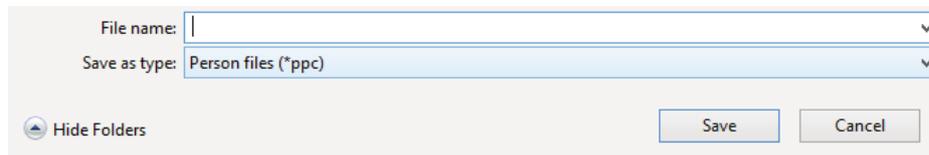
Choose the right person list file and hit 'Open'. When you want to cancel, click 'Cancel', you will see the following screen:



By clicking on the green button, you will enter the user list again.



Clicking on this symbol will lead to the saving of your current and selected user.



You can choose the right location, file type and name to save your user. Click on 'Save'. If you want to cancel the procedure, click on 'Cancel', you will be directed to the following warning:



By clicking on the green button, you will enter the user list again.



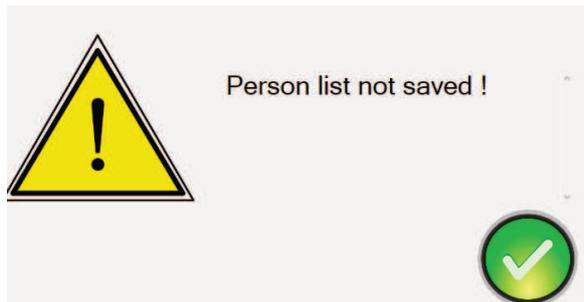
Clicking on this symbol will lead to the saving of the entire user list.

File name:

Save as type: Person list files (*.plf)

de Folders

You can choose the right location, file type and name to save your user list. Click on 'Save'. If you want to cancel the procedure, click on 'Cancel', you will be directed to the following warning:



Clicking on this button will lead to the return to the main screen without any changes.



Clicking on this button will lead to the return to the home screen with the changes you made.



This button is presented in the right pane too, when clicking on it, you will add a parameter to the user information.

Name	New Name
Company name	
Address	
City	
Code	
Country	
Website	
New Parameter	?



If you do so, you will get access to a new symbol:

Clicking on it, leads to the erasing of the selected information parameter.

5.2. Sub-menu Item Settings: Clients

This sub menu works the same as the one above, only the purpose differs. Via this menu you are able to add, select, adapt and remove client data or information.

5.3. Sub-menu Item Settings: Probes

This sub menu works the same as the 'Users' one, only the purpose differs. In the right pane the specifications of the probe selected for a new measurement are shown.

The five buttons beneath the upper left pane, enable you to either copy (📄) the algorithm from the current reference or apply induction measurements (⚡), or select the mains frequency (50 Hz), or cancel the process (orange cross button) or apply the changes (green check button). With the Type section box one can select the probe type (standard or others). When the probe is Read/Write enabled, holding down the control key simultaneously will change the probe type.

Further description under section 6.9.

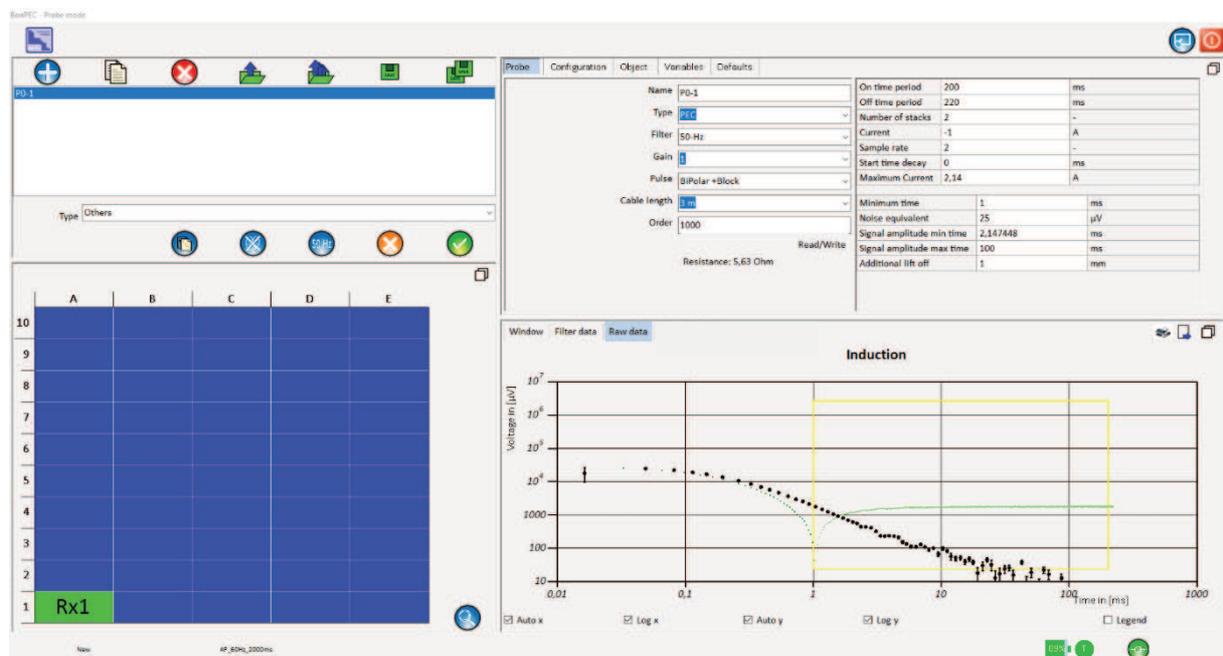


Figure 55: Probe settings.

5.4. Sub-menu Item Settings: Monitoring

You can monitor the parameters of an object over time or in different conditions, using this option. You can either choose for time laps or series divided in depths, in which every depth corresponds to a complete grid.

By clicking on the blue plus you can add your current grid as a depth. By clicking on the single-file load symbol, you can add one depth. And by clicking on the multiple-file load symbol, you can add multiple depths.



Figure 56: *Monitoring, options: Time laps or Series.*

Once you added multiple depths, you are able to save the selected depths as a data file. You can click on the single save button: save only one depth into a data file. You can also click on the double save button: save all depths into one data file.

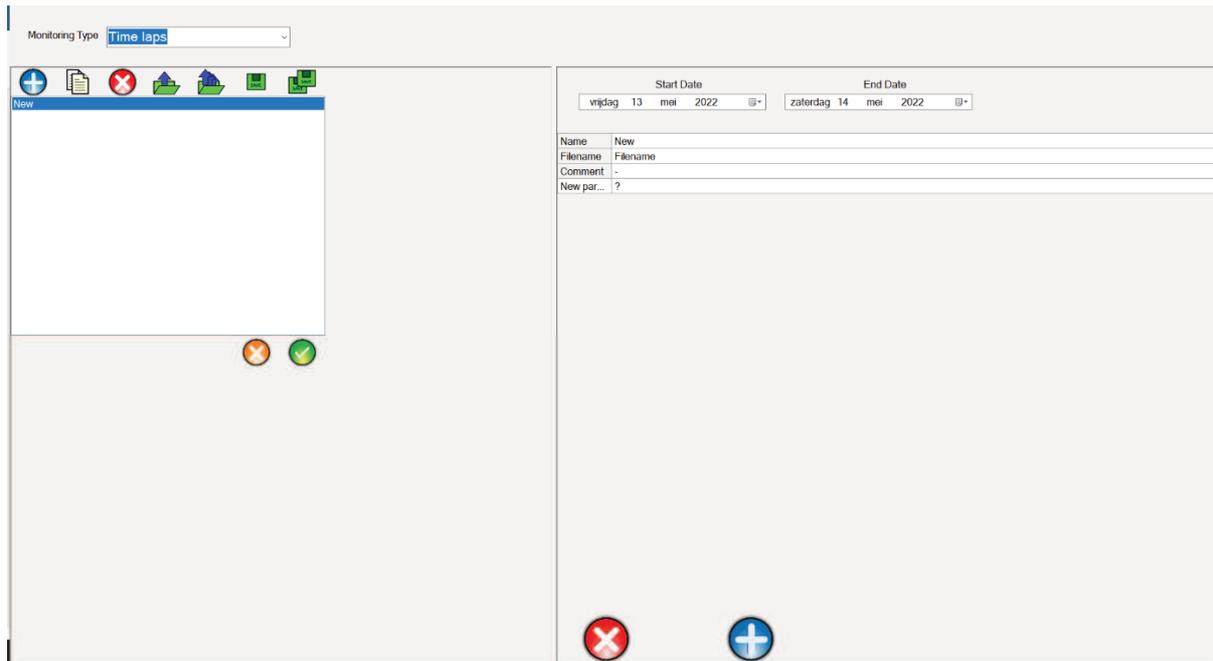


Figure 57: Saving and editing names or comments.

In the right pane you are able to see the date, this will be obtained from the loaded data file. You can change the name and filename and leave a comment.

Once you turn back to the main screen and go with your cursor to the grid and push 'CTRL'+ 'F7', a screen with all the monitor results will pop up:

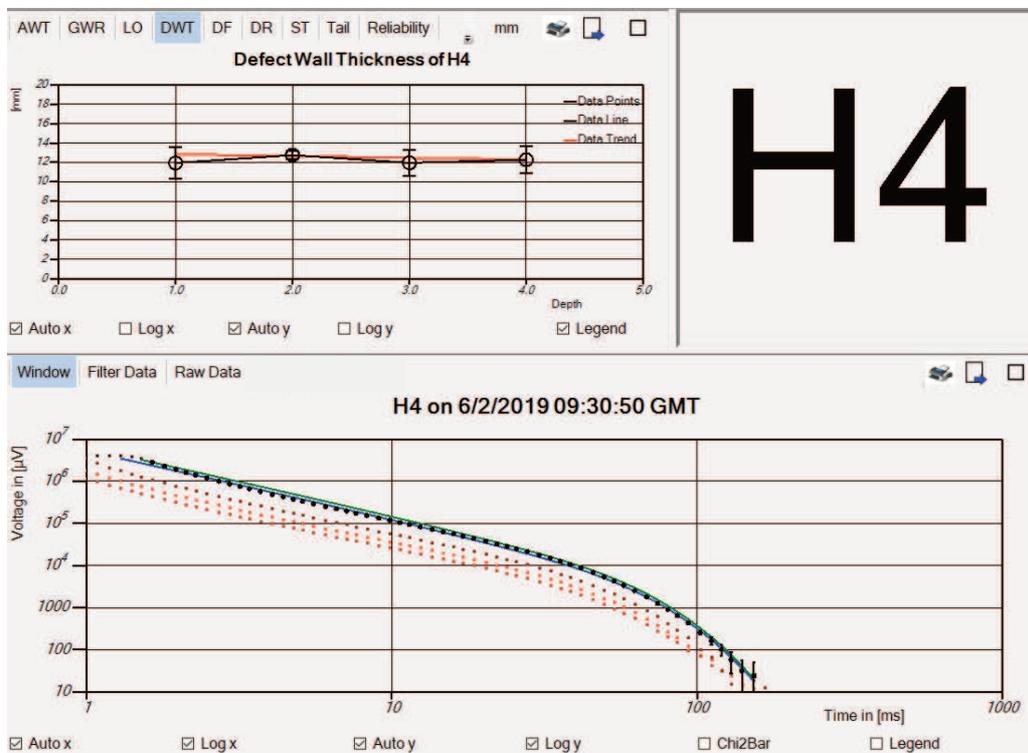


Figure 58: Results of the monitoring process.

In the upper left part of this pane you can see the Results versus Time, based on the depths you added. When the 'Legend' box is ticked, you can see the labels of the presented data. In the upper right pane, you can see the location of your cursor in the grid. And in the lower pane you can see the same graph as in the main screen, only now all graphs of all added graphs are visualized. All buttons present work in the same way as explained before.

5.5. Sub-menu Item Settings: Scan

You can change the grid size and grid labels using the input boxes at the top of the form. The 'Offset' boxes determine the starting values of the labels. If you want to change the way of scanning, the orientation of the grid, the way of 'moving' through the grid and more.

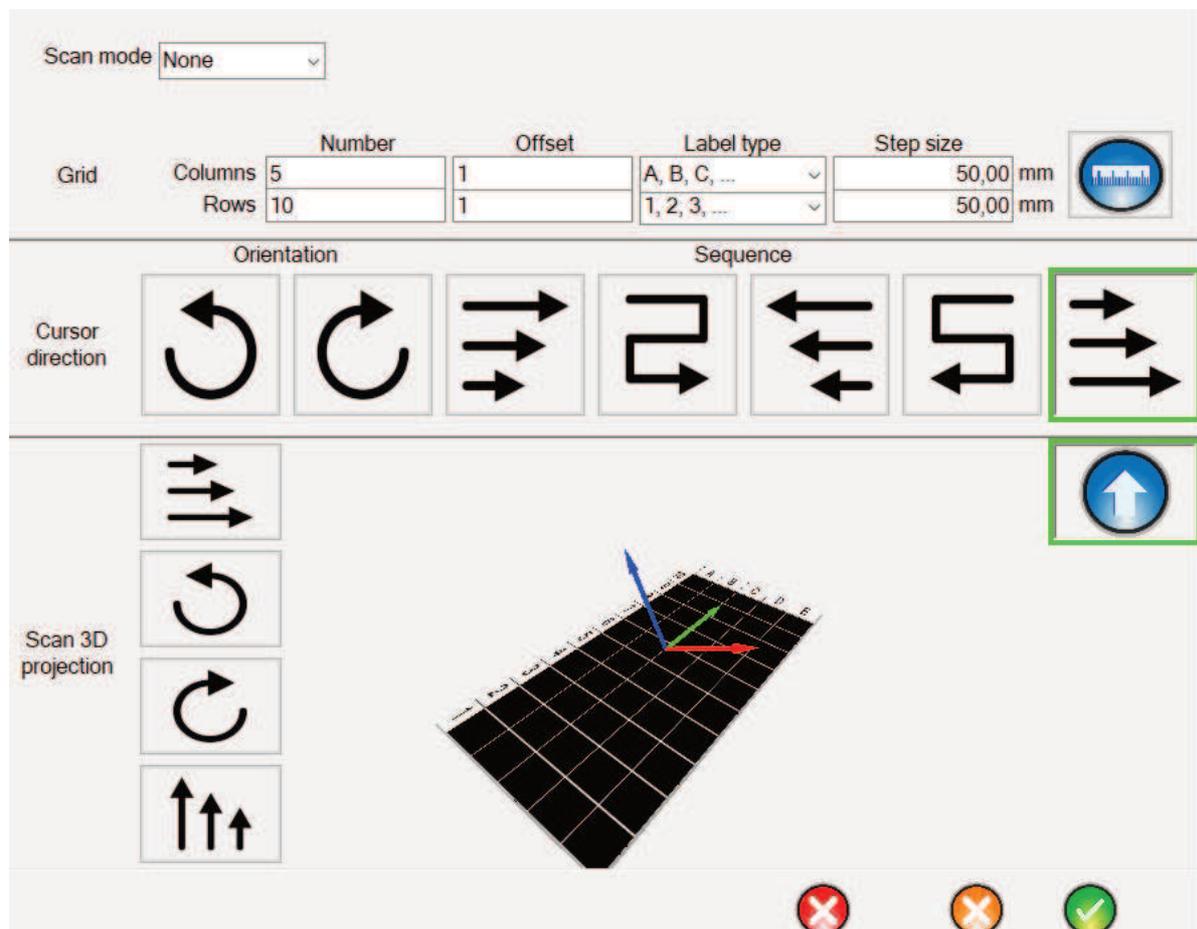


Figure 59: Scan editing.

In monitoring mode, you can change the scan depth, which refers to the monitor depth, by entering the preferred level.

You can change the scan mode in the upper left box. Choose between: None, Time, Disto.

When 'Time' is selected, periodic measurements will be done. The interval time can be adjusted by changing the 'Repeat in seconds' text box that will appear.

When 'Disto' is selected, a Disto laser distance measurement device connected by bluetooth can be used. The same button appears for selection of the scanning direction.

On the left side of this the 'Scale' button is presented, when you click on this button, the step sizes will automatically adjust to the object sizes.

On the left side of the 'Scale' button you can change the number of columns and rows in the grid, change the type of label of the axis and the distance between rows or columns (Step size).

Underneath these boxes and button, you can see a row with different arrows. These arrows enable you to change the sequence direction of the cursor. By clicking on the arrow turning to the left, the cursor direction will flip 90 degrees to the left. Same for the arrow turning to the right, then the cursor flips to the right.

Clicking on the third button in this row (the button on the right side of the arrow pointing right), will start the scan at the highest value in the grid and by pressing the 'Enter' key, you will move through the grid from left to right.

By clicking on the fourth symbol (right of the one described above), you will move through the grid following the direction of this arrow. So by pressing 'Enter' you will first go the right and on the next row you will move to the left.

By clicking on the fifth symbol, you will start at the highest value in the grid and by pressing the key 'Enter' you will move through the grid from the right side to the left one.

By clicking on the sixth symbol, you will move through the grid following the direction of this arrow. So by pressing 'Enter' you will first go the left and on the next row you will move to the right.

The most right picture in this row represents the selected sequence direction, this outlined in green.

In the lower part of this screen, the scan 3D projection is presented. With the four buttons on the left you can flip and turn the scan projection. With the first and fourth button, you can flip the axis, this leads to the inversion of the order of the values (possible for the vertical and horizontal axis).

The other two buttons can be used for the projection of the scan on your object, they change the rotation of this projection.

The arrow picture to the upper right represents the selected project direction.

The button at the lower right represents the stretching of the grid on the surface and is only available when the selected object is a bend or a segmented bend:



The left picture represents a non-stretched projection of the grid on the bend, in such a way that the cell size of the grid varies when projected on the bend. The right picture represents a stretched projection of the grid on the bend, in such a way that the cell size on the bend is kept constant. In that case a white line is visible on the grid. When you click on the picture of the band, it will change to the other representation.

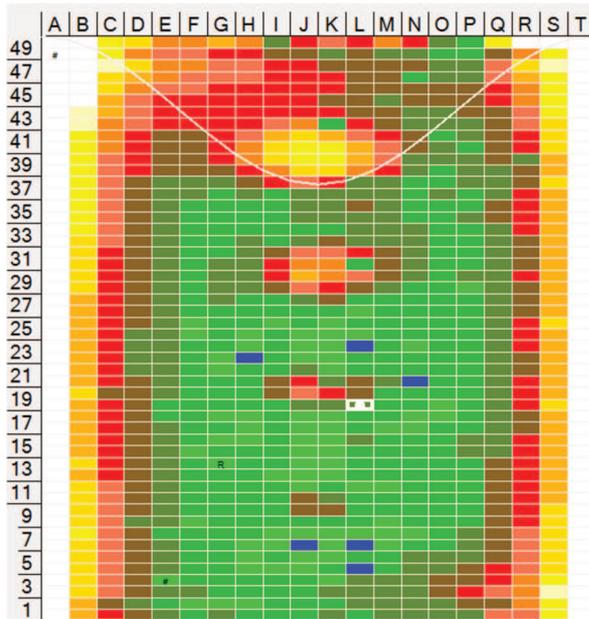


Figure 60: Scangrid with white line as boarder of projection of a grid stretched on a bend.

Only the part at the convex side of the white line in the grid is used in the projection.

Using the following buttons, you are able to choose whether you want to save and apply your changes or delete them.



By clicking on this button, you will delete all the data. So your home screen will be empty. But first you will see the following warning:



By pressing on the blue plus button, the reference data of each grid point will remain the same as before.



By clicking on this button, you will cancel the changes you made in the orientation or order.



By clicking on this button, you will apply the changes you made in the orientation or order. The reference data of each grid point will be reset.

The blue upward pointing arrow presented, shows the direction of the scan mode.

6. Menu Item Survey

Using this menu, will give you the opportunity to view a single measurement, add reference values, erase ones, switch to defect mode or live connection. Next to that, every sub-menu has a keyboard short-cut, which are given with the name of the sub-menu.

Survey		
	Measurement	ENTER
	Reference	CTRL-ENTER
	Temperature	SHIFT-T
	Erase	CTRL-E
	Delete	CTRL-Delete
	Symbol	SHIFT-S
	Comment	SHIFT-C
	Defect mode	F10
	Probe	CTRL-P
	Live	F2

Figure 61: *Menu item Survey.*

6.1. Sub-menu Item Survey: Measurement

Every time you hit the button 'Enter' on your keyboard or click at 'Sub-menu Measurement' a measurement will be started according to the flow diagram in Appendix D. Afterwards the cursor in the lower left pane moves to the next position. To stop the measurement directly press 'ESC' on your keyboard. By pressing the '\'-key, just above 'Enter' the measurements are repeated constantly as long as the key is held down. By pressing the 'SHIFT' and '\'-key, the cursor first moves to the first empty grid cell and then measurements are repeated constantly as long as the key is held down.

6.2. Sub-menu Item Survey: Reference

If you want to add a reference measurement, you have to click on the sub-menu 'Reference' or press the 'CTRL' and 'Enter' buttons at the same time.

By doing that, a new reference is created according to the flow diagram in Appendix B and C, and you will be directed to the following screen:

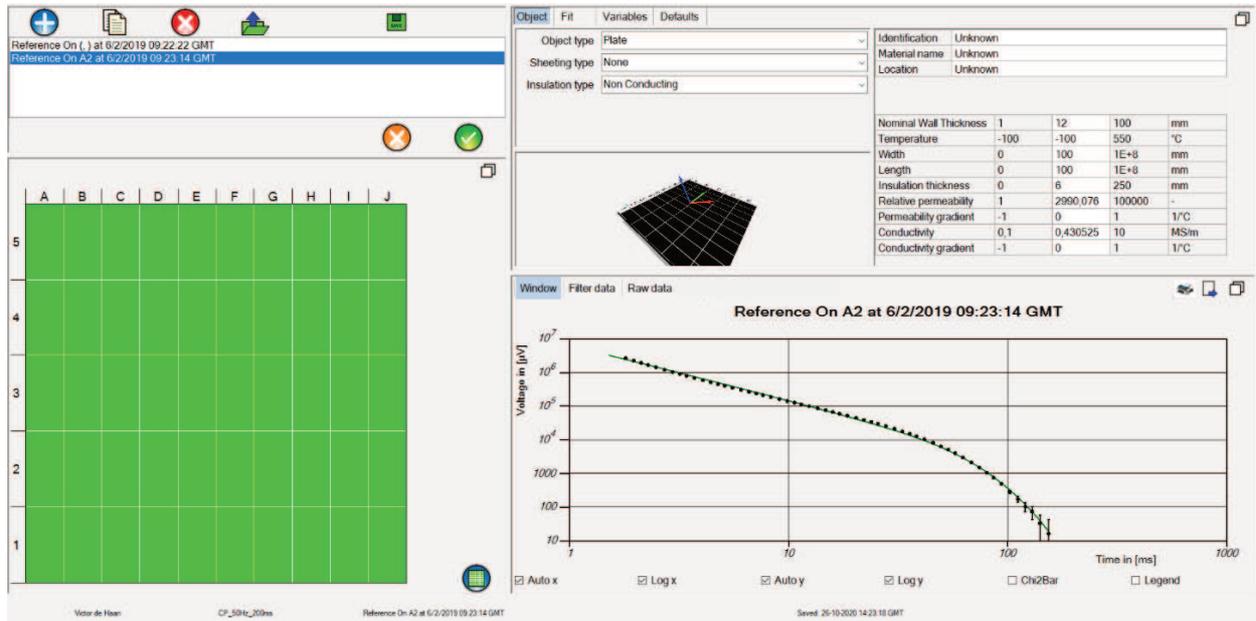


Figure 62: Reference settings.

In the upper left pane you are able to copy references (copy button, ) , remove ones (red cross button, ) , load (load button, ) and save references (save button ) .

When you press the add button , the selected reference is copied, but the probe is replaced by the current selected probe from the probe list.

In the upper right pane you can see and change the object parameters or algorithm parameters corresponding to the reference point.

Lower left pane

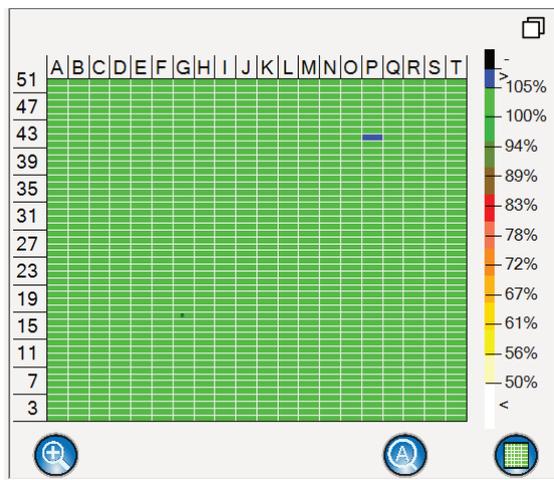


Figure 63: Lower left pane.

Grid points presented in blue are not coupled to the selected reference value. Grid point presented in green are. When you want to apply this reference to all of the grid point, you have to click the following button:



Upper right pane

By selecting the 'Object' tab in this pane you are able to select and adapt the object parameters:

Identification	PEC-05	
Material name	Carbon steel	
Location	TRS	
Nominal Wall Thickness	12	mm
Temperature	-100	°C
Pipe length	10	mm
Pipe diameter	3	mm
Insulation thickness	0	mm
Relative permeability	292.8119	-
Permeability gradient	0	1/°C
Conductivity	2.26617	MS/m
Conductivity gradient	0	1/°C

Figure 64: Upper right pane: Object parameters.

The displayed variables in the lower right part of the 'Object' tab depend on the object, sheeting and insulation type chosen. You can adjust them.

Further to the right a profile is shown. The value represented by the profile can be selected by clicking with the left mouse button on the texts below it (red oval). There are 5 possibilities:

Value:

The profile represents the value shown in the column the cursor has selected, but only when the grid cell belongs to the same reference as was used for the grid cell, otherwise the value is omitted.

Average/Minimum/Maximum/Spread:

The profile represents the average/minimum/maximum/spread value of the row the cursor has selected, but only values are taken into account that cell belongs to the same reference as was used for the grid cell, otherwise the value is omitted.

By selecting the 'Fit' tab in this pane you are able to select the Algorithm Type that will be used to fit the data:

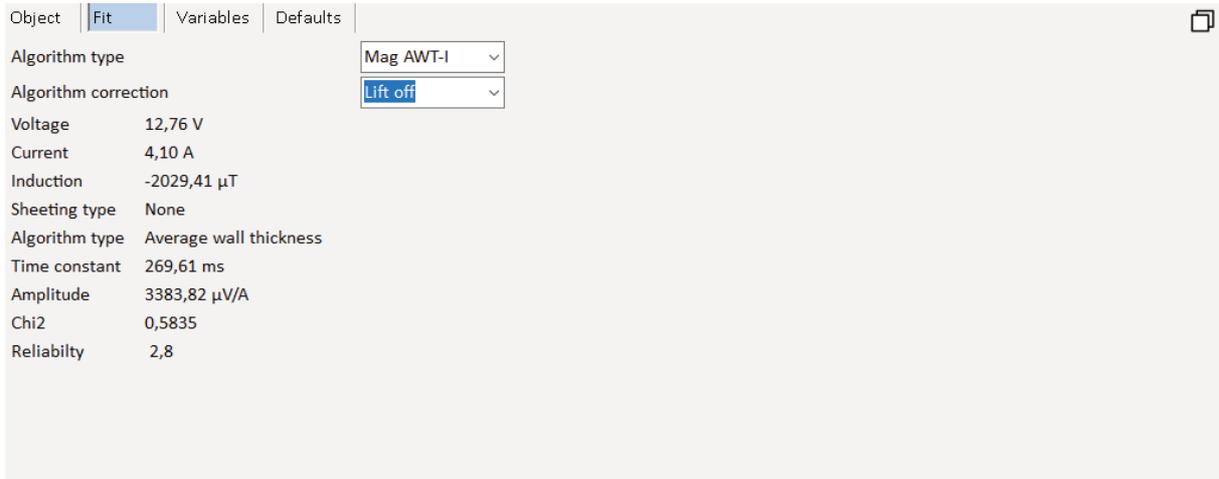


Figure 65: Upper right pane: Fit results.

By selecting the 'Variables' tab in this pane you are able to select and adapt the variables that will be used to fit the data:

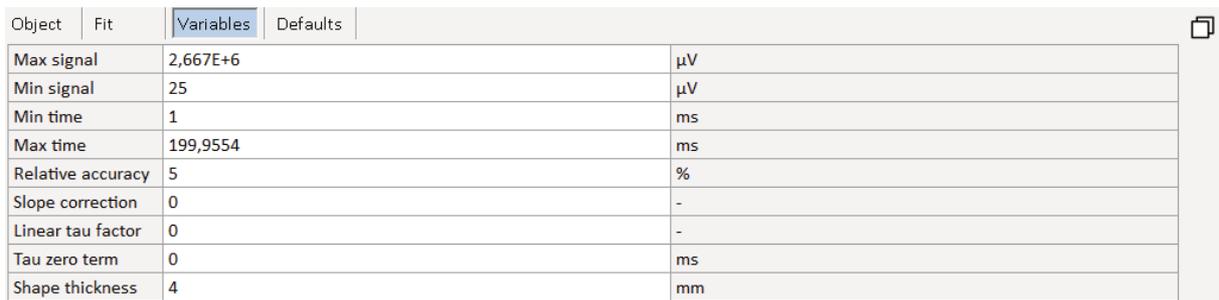


Figure 66: Upper right pane: Variables.

By selecting the 'Defaults' tab in this pane you are able to select and adapt the default values that will be used to fit the data:

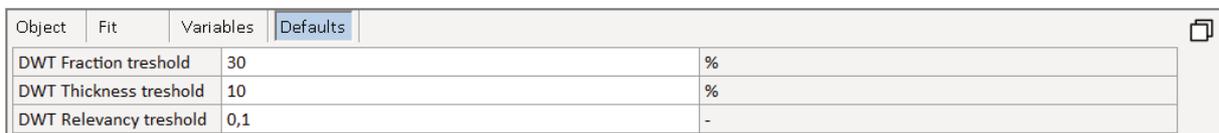


Figure 67: Upper right pane: Algorithm Defaults.

Lower right pane

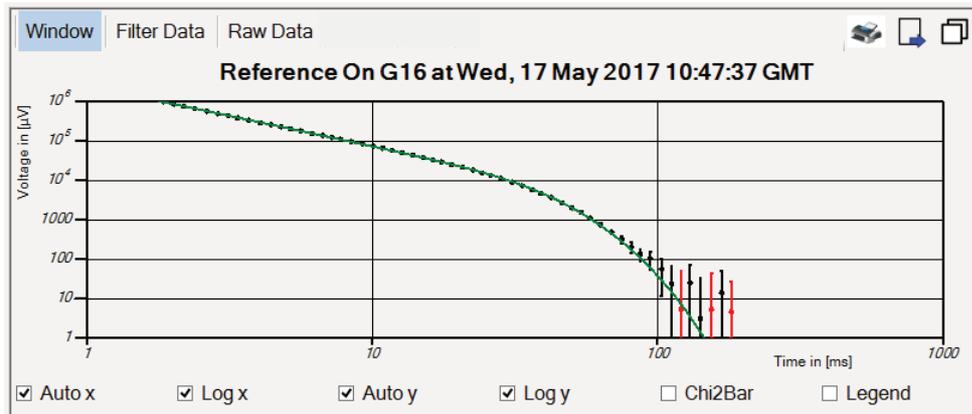


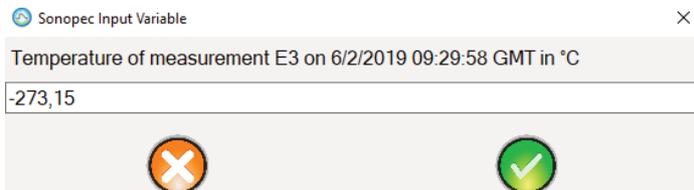
Figure 68: Lower right pane.

This pane shows the same as the lower right pane on the main screen, but for the reference value.

Select the orange cross button in the upper left pane to leave this screen and the green check button to save and add changes.

6.3. Sub-menu Item Survey: Temperature

By pressing on 'Temperature' or the 'Shift' button together with the 'T', you are asked to give the value of the temperature of the grid cell the cursor is on,



By clicking on the orange cross, you will cancel the procedure, by clicking on the green button the temperature of the current cell is adjusted and the calculation of thickness and lift-off is corrected for the temperature difference.

6.4. Sub-menu Item Survey: Erase

By pressing on 'Erase' or the 'Control' button together with the 'E', the value in the selected box will be erased. If you also press the 'Shift' key the complete visible grid will be erased.

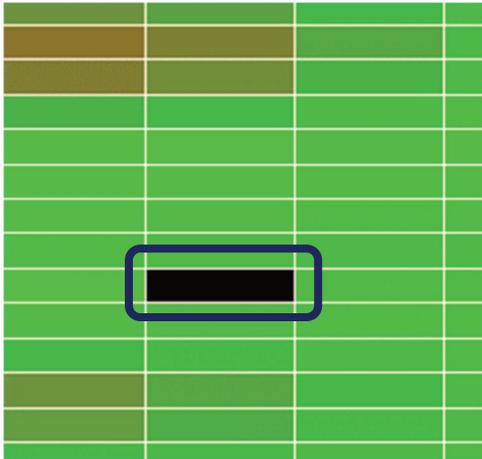


Figure 69: An erased value.

6.5. Sub-menu Item Survey: Delete

You are only able to delete grid points when those have already been erased. To delete an erased value, you need to select this grid point and press delete or the 'CTRL' key together with 'Delete'. If you also press the 'Shift' key the complete visible grid will be deleted.

6.6. Sub-menu Item Survey: Symbol

If you want to mark a grid point with a symbol, you should press 'Symbol' or the 'SHIFT' key and 'S' at the same time. You will be directed to the following screen:



Figure 70: Symbol settings.

You can select one of the standard symbols in the program or add your own by pressing the blue plus sign.

By selecting the text, you can type your own description and symbol. Click on the red cross button to remove a symbol, click on the 'loading' button to choose a symbol from your computer, click on the save button to save these settings, click on the orange cross to cancel all changes and click on the green check button to apply the changes.

You can also press 'ALT'+ additional key to add the symbol on the additional key to the grid.

6.7. Sub-menu Item Survey: Comment

If you want to add a comment to a grid point, you should press 'Comment' or the 'SHIFT key and 'C' at the same time. You will be directed to the following screen:

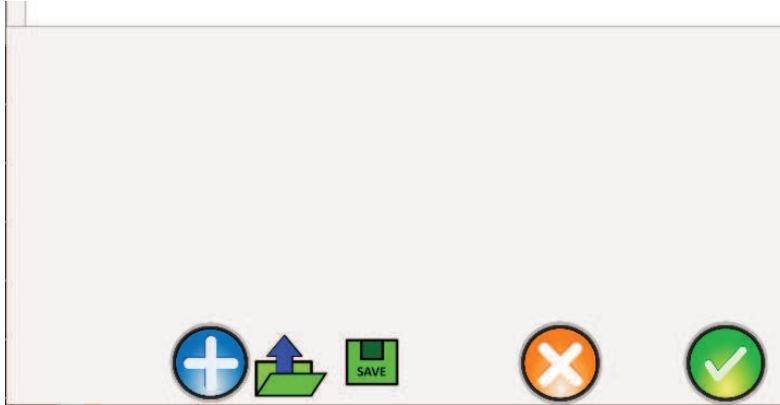


Figure 71: *Edit grid cell comments.*

You can select grid cell name or add your another grid cell name by pressing the blue plus sign. By selecting the text, you can type your comment. Click on the red cross button to remove a comment, click on the 'loading' button to choose a comment from your computer, click on the save button to save these comments, click on the orange cross to cancel all changes and click on the green check button to apply the changes.

6.8. Sub-menu Item Survey: Defect mode

If you want to change the measurement evaluation mode for the selected grid point, you should press 'Defect mode' or F10 on your keyboard.

Normally, the average wall thickness is calculated for every point in the grid. By applying 'Defect mode' to a grid point, the defect wall thickness is calculated instead. If the defect mode is successful, it will be indicated by a black triangle in the grid point. Moreover a correlation graph will be available in the right upper pane of the main screen. The criteria for success can be changed in the 'Algorithm Defaults' tab.

It is also possible to change all grid cells by pressings SHIFT-F10 or CTRL-F10.

6.9. Sub-menu Item Survey: Probe

If you want to add, change or select probes, you should select this menu or press 'CTRL' + 'P' keys on your keyboard.

By doing that, you will be directed to the following screen:

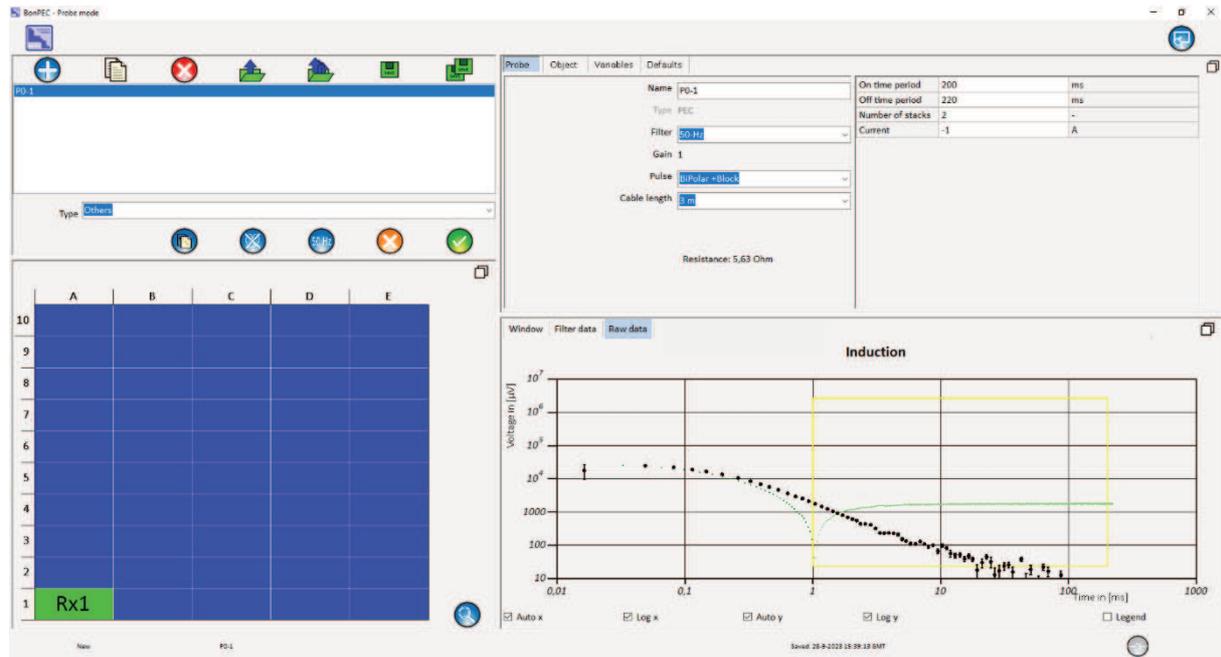


Figure 72: Settings of the probe in the selected grid point.

The upper left pane includes all the same functions as with adding Users and in the upper right pane, you are able to change settings for the probe as described earlier (see section 5.3).

In the lower left pane, you can change the locations of the sub-probes in the grid. By left clicking on the mouse and dragging the sub-probe, you are able to change the location. During live mode, the locations of the additional sub-probes in the scan grid are denoted by red coloured cursors instead of white coloured ones.

In the upper right pane you can see the probe definition, change configuration settings (choose which hardware channel or receiver channel you want), the object properties, algorithm variables and defaults (section 3.3).

At the tab 'Probe', you can select and adapt probe parameters, Name, Type, Filter, Gain, Pulse and Cable length. You can also indicate if the probe is 'read only' or 'read/write' by pressing on the label. The resistance value displayed is measured when the induction measurement is performed. This value is used to check if the correct probe was connected to the system.

Also the Pulse On Time Period and Pulse Off Time Period, Number of Stacks and Current (<0: VCC, >0: ICC) The minimum time and noise equivalent indicated by the yellow lines in the lower right pane represent the minimum allowed values of the signal.

The tabs 'Object', 'Variable', and 'Defaults', function in the same way as described in section 6.2.

6.10. Sub-menu Item Survey: Live

If you want to create a 'live' connection with the hardware, you have to hit 'Live' button or F2 on your keyboard. Then the sequence as shown in Appendix E is followed to try and establish a connection to the hardware.

When there is no connection available the button will be gray  and you will see the warning shown below. Click on the green button and try to solve the problem, when you solved it, try again.



Figure 73: *Warning: hardware not connected.*

When there is a connection available the button will be blue  and when the connection has been established and the hardware is ready it will turn into green . You can press F2 again to deactivate the hardware. You can also press the on/off button on the hardware to shut down the connection. If SHIFT-F2 is used the COM ports are scanned to find the right port number. A red button  indicates an hardware error has occurred. Try switching off the hardware to reset it.

7. Menu Item Process

If you want to select and apply other reference values or you want to recalculate all values, you need this menu.

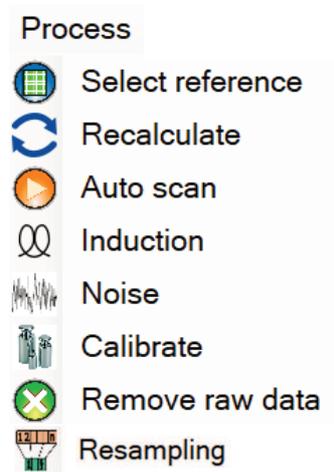


Figure 74: Menu Item Process.

7.1. Sub-menu Item Process: Select reference

If you want to add a reference or select another one, you should click 'Select reference'. You can proceed according to section 6.2.

7.2. Sub-menu Item Process: Recalculate

When you changed references, you can let the program recalculate all the values. You need to click 'recalculate'. After doing that, the program will process the changes indicated by a progress bar (see Figure 75). It is possible to press the ESC-key. In that case the processing will stop immediately and not all cells will be processed with the new reference data.



Figure 75: A progress bar.

7.3. Sub-menu Item Process: Auto Scan

If you want to start automatic measurements during the 'Live' connection, you should use this menu, the play button (described in the touchscreen mode) or F12-key. The right upper pane will now change into the following screen:

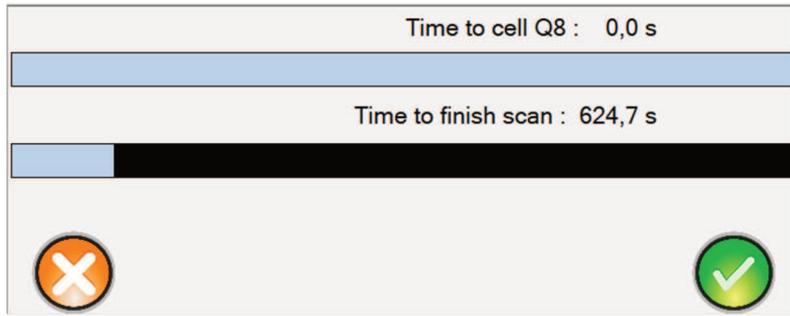


Figure 76: Scan progress display.

The program will use the settings as selected in the sub menu 'Scan' of the menu 'Settings'. By pressing the orange cross button or the 'ESC' key, the measurement will end. By pressing the green button, you will directly measure the following point instead of waiting for the selected time. And by pressing the orange pause button, you are able to pause the auto scan.



Figure 77: The pause button, appears directly after the start of the scan. It changes in a play button, when you paused the scan.

7.4. Sub-menu Item Process: Induction

When you want to measure the induction, you should click this sub-menu. First you will see the following warning:

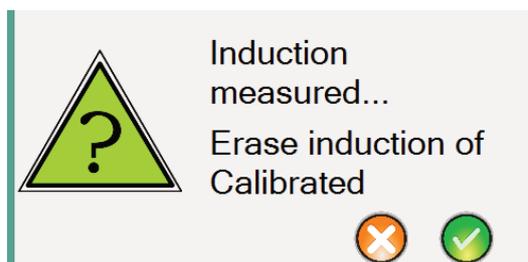


Figure 78: A warning for changing the measured induction.

By selecting the cross symbol, you will cancel the process and you will be directed to the home screen. By pressing the green check button, the induction measurement will be completed and you will be directed to the 'Probe' section. See section 6.9 for a description of the procedure.

7.5. Sub-menu Item Process: Noise

By clicking on this sub-menu during live mode, the noise will be measured. A graph of the frequency spectrum will be presented in tab 'FFT'. A graph of the signal can be presented in tab 'Raw Data'.

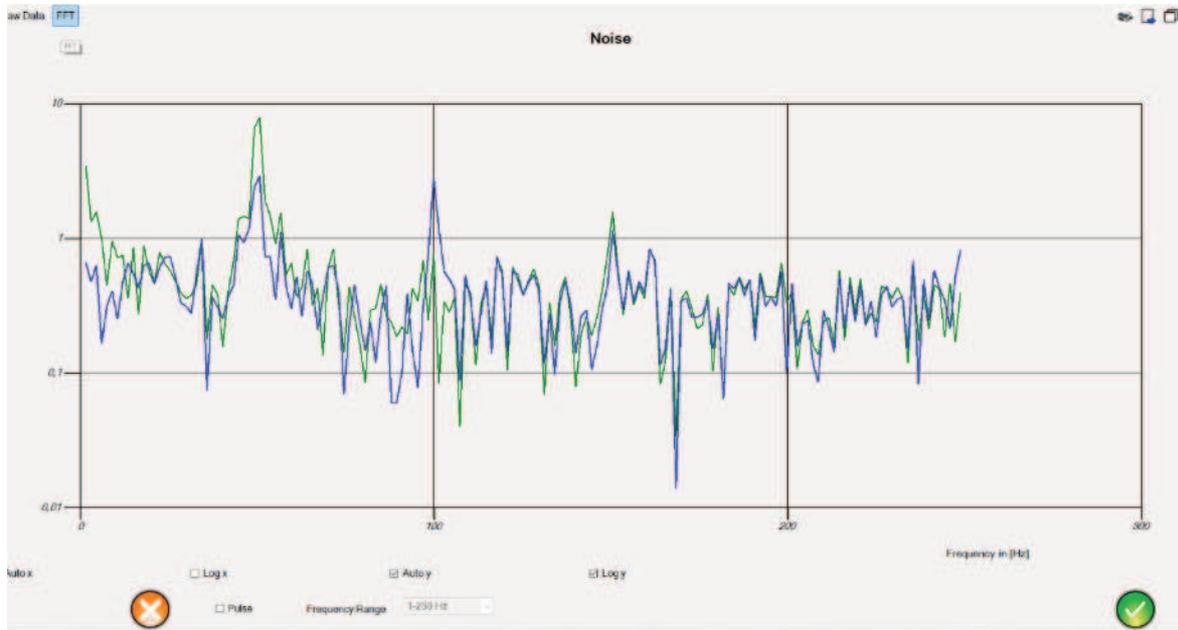
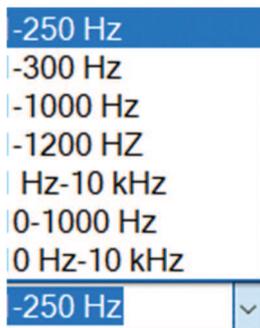


Figure 79: Screen in noise mode.

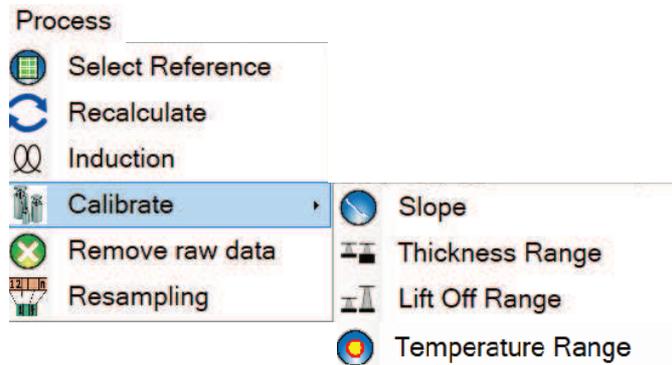
You can choose the frequency range:



Click on a play  or pause  button to start and interrupt the noise measurements. You can control the pulse of the probe with the pulse check box and quit via the quit  button.

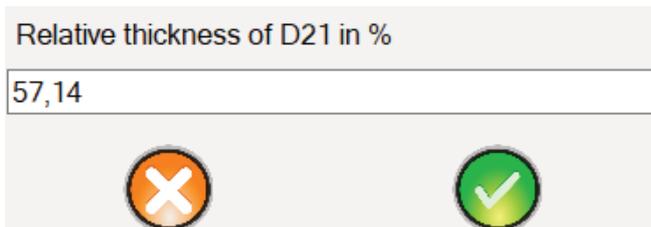
7.6. Sub-menu Item Process: Calibrate

By selecting this sub-menu, an additional sub-sub-menu is presented with 5 options:



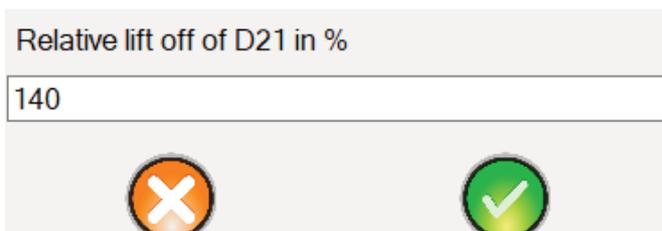
By selecting 'Slope' the slope of the current reference is fitted to obtain a better match to the reference data and all data cells that use this reference are adapted accordingly. Also a new probe is created with a new name with the words 'Fitted Slope' in front of the old name with the calibrated values for future reference.

By selecting 'Thickness Range' you are asked to give the value of the wall thickness of the grid cell the cursor is on relative to the thickness of the current reference in %:



By clicking on the orange cross, you will cancel the procedure, by clicking on the green button the algorithm of the current reference is adjusted as to give the correct given thickness value for the selected data point. All data cells that use this reference are adapted accordingly. Also a new probe is created with a new name with the words 'Calibrated Thickness' in front of the old name with the calibrated values for future reference.

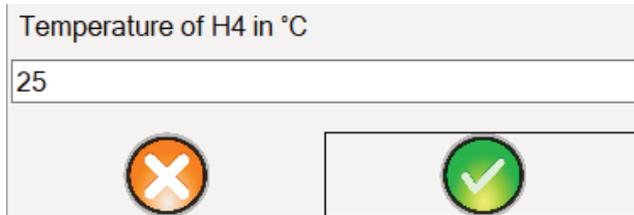
By selecting 'Lift Off Range' you are asked to give the value of the lift off of the grid cell the cursor is on relative to the lift off of the current reference in %:



By clicking on the orange cross, you will cancel the procedure, by clicking on the green button the algorithm of the current reference is adjusted as to give the correct given lift off value for the selected data point. All data cells that use this reference are adapted

accordingly. Also a new probe is created with a new name with the words 'Calibrated LiftOff' in front of the old name with the calibrated values for future reference.

By selecting 'Temperature Range' you are asked to give the value of the temperature of the grid cell the cursor is on:

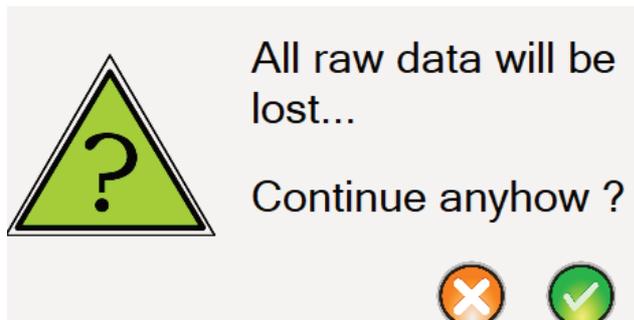


A dialog box titled "Temperature of H4 in °C" with a text input field containing the value "25". Below the input field are two buttons: an orange button with a white 'X' and a green button with a white checkmark.

By clicking on the orange cross, you will cancel the procedure, by clicking on the green button the algorithm of the current reference is adjusted as to give the correct given thickness value for the selected data point. All data cells that use this reference are adapted accordingly. Also a new probe is created with a new name with the words 'Calibrated Temperature Range' in front of the old name with the calibrated values for future reference.

7.7. Sub-menu Item Process: Remove raw data

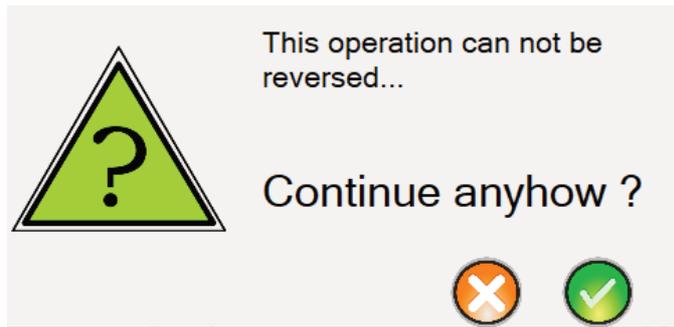
By clicking on this sub-menu you will be prompted by the following query box:



By clicking on the orange cross, you will cancel the procedure, by clicking on the green button **all the raw data (i.e. all the ADC samples) will be removed**. When the raw data is already processed (as is usually the case), the filtered data will remain and the reference can still be adapted. This will speed up data processing and reduce the data file size considerably. However, it will be impossible to perform any change of probe induction or filtering.

7.8. Sub-menu Item Process: Resampling

By clicking on this sub-menu you will be prompted by the following query box:



By clicking on the orange cross, you will cancel the procedure, by clicking on the green button **all the raw data (i.e. all the ADC samples) will be resampled (two consecutive samples are averaged)**. This will speed up data processing and reduce the data file size considerably. This procedure can be repeated until all raw data is lost.

8. Menu Item Tools



Figure 80: *Menu Item Tools.*

8.1. Sub-menu Item Tools: Report

Click this sub-menu to auto generate a report and save it on a desired location. A standard template is used during generation, this can be changed in de sub-menu Defaults. A standard template is available for word files (select *.docx extension) and for excel files (select *.xlsx extension). When a file is selected, the standard template is copied, while special tokens are replaces by different items. In the word file a certain text is replaced by either another text, a figure or a table created from the current dataset. The possibilities are shown in Appendix G – Report replacement tokens WORD (*.docx) and

Appendix H – Report replacement tokens EXCEL (*.xlsx).

8.2. Sub-menu Item Tools: Color scales

If you want to change the colour scales of the program, you should use this sub menu.

You will be directed to the following screen:

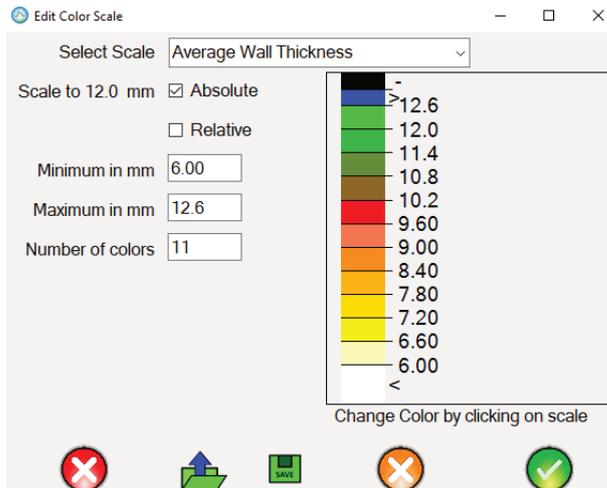


Figure 81: Color scale editing.

You can choose which scale you want to adjust and which percentages should be present and how much colours. You can change the colour by left clicking on the colour in the colour bar. You can change the intervals by right clicking on the colour in the colour bar. You can export the colour scale by pressing the button with an arrow pointing outward. You can import a colour scale by pressing the button with an arrow pointing inward. Clicking on the red cross button will lead to the resetting of the colour scale, on the orange cross button will lead to the cancellation of the changes and clicking on the green check button will lead to applying of the changes.

8.3. Sub-menu Item Tools: Web browser

To use the web browser, you should click on this sub-menu.

8.4. Sub-menu Item Tools: Show Control Measurement

To enable/disable the control measurement screen use this item or press CTRL-F11-key.

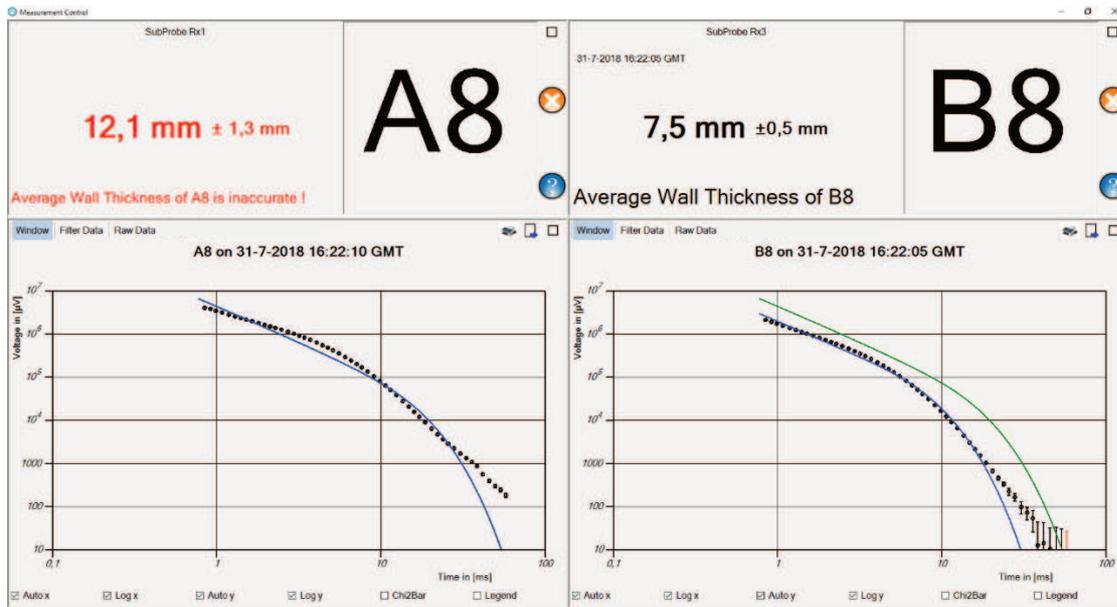


Figure 82: A example of a 'Control Measurement' screen.

In the screen as many windows as subprobes that are selected (see section 6.9) are presented. Each window is divided in an upper and lower pane. The upper pane shows the measurements results (see section 3.1) and the location of the subprobe. The lower pane shows the corresponding decay (see section 3.4). With the erase button  you can erase the measurement corresponding to the window. With the button  you can select the location for re-measurement. If so the button changes to the measurement button . You can deselect the location by the erase button. If you press a measurement button the measurement is repeated and the selected locations will be replace by the new data.

8.5. Sub-menu Item Tools: Show Location

To enable/disable the location screen use this item or press F11-key.



Figure 83: *An example of a 'Show Location' window on top of the display.*

8.6. Sub-menu Item Tools: Show Monitor Results

To view the results of the monitoring process press this item or use, as described earlier, 'CTRL' + 'F7' (see section: 5.4).

9. Menu Item Miscellaneous



Figure 84: *Menu Item Miscellaneous.*

9.1. Sub-menu Item Tools: Password

If you want to change your password, you should use this sub menu. You will be directed to the following screen:

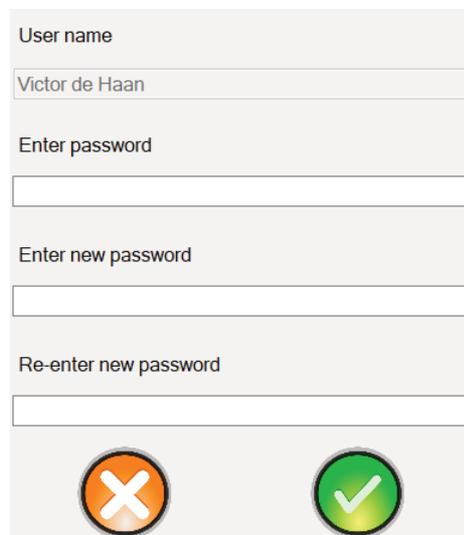
A screenshot of a password change form. It features four text input fields stacked vertically. The first field is labeled "User name" and contains the text "Victor de Haan". The second field is labeled "Enter password" and is empty. The third field is labeled "Enter new password" and is empty. The fourth field is labeled "Re-enter new password" and is empty. At the bottom of the form, there are two circular buttons: an orange button with a white 'X' (cancel) and a green button with a white checkmark (confirm).

Figure 85: *Create a new password.*

You have to enter the old password and two times the new password. By hitting the green button you will apply the changes to the selected user, by hitting the orange one you will cancel the process.

9.2. Sub-menu Item Tools: Defaults

To change any default value in the program, click this sub-menu. You will see the following screen:

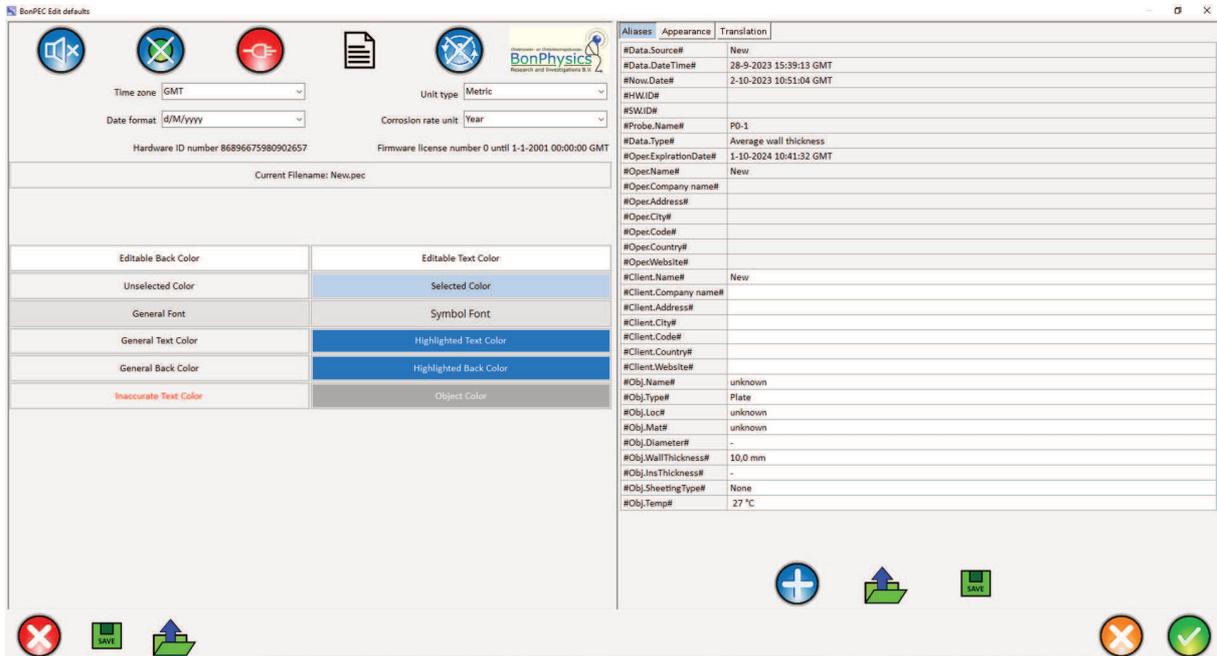


Figure 86: Changing default values.

In the left pane, the following buttons are present:

- Sound button (on/off)
- Trigger button (on/off)
- Red live button (renew license, when the license is renewed the hardware clock is reset)
- Report (loading of a default template for auto report generation, use .docx file)
- Translate button (on/off)
- Picture Button (to use in 3D-logo)
- Time zone (options: Local, GMT and UTC)
- Date format (d/M/yyyy)
- Unit type (US standard or metric)¹
- Corrosion rate unit (Year)
- Current file name (clicking on it leads to a process comparable to 'Save as')
- Resources Directory (clicking on it leads to the opening of 'windows explorer' in the current resources directory)
- All buttons for layout: font sizes, text colors, etc. You are able to change all kind of (text) settings; colors, sizes, fonts and so on. By clicking on one of the options in the lower left pane, you will be directed to a screen in which you can choose the different possible settings.

¹ When the unit is changed displayed values might change a small bit, due to rounding errors. This is solved after performing a recalculation of the grid (see section 7.2).

- Red cross button (resetting of defaults)²
- Save button (saving all defaults)
- Import button (load defaults)

In the right pane, the following buttons are present:

- 4 tab buttons:
 - Aliases: text strings for the report templates, you can add text strings (blue plus), load an alias list (load button) and save (save button) them.
 - Appearance (default program parameters concerning the appearance of the presentation)
 - Translations (All available languages, you can change the definitions and words used)
- Red cross button (removing newly added parameters in Aliases tab)
- Blue plus button (adding a certain default, e.g. a text string)
- Import button (load defaults)
- Save button
- Orange cross button (cancel all changes in default settings)
- Green check button (apply all changes in default settings)

9.3. Sub-menu Item Tools: Hardware

This item is only available in 'File' mode. To change the default hardware settings in the program, click this sub-menu. You will see the following screen:

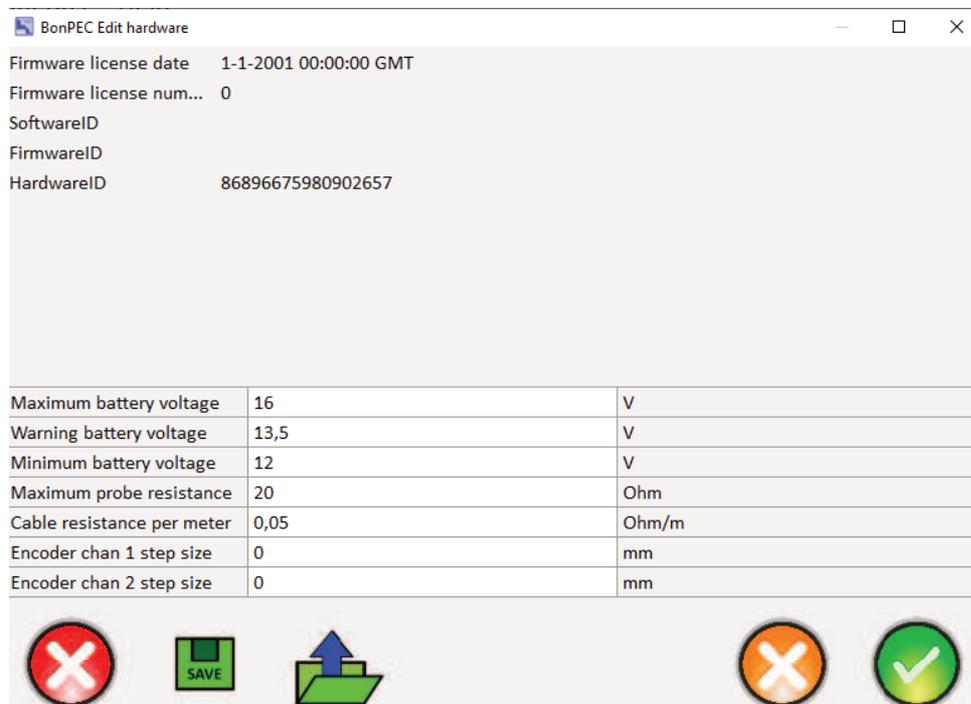


Figure 87: Changing hardware settings.

² Note that also the report file templates are reset to the original ones.

Red cross button: Resetting of hardware settings to defaults

Save button: Saving all defaults settings

Load button: Loading all defaults settings

Orange cross button: Cancel all changes in hardware settings

Green check button: Apply all changes in default settings

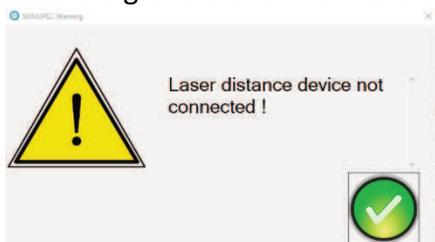
9.4. Sub-menu Item Tools: Laser Distance

Click this sub-menu to connect to the Disto laser distance reader. You get a screen:

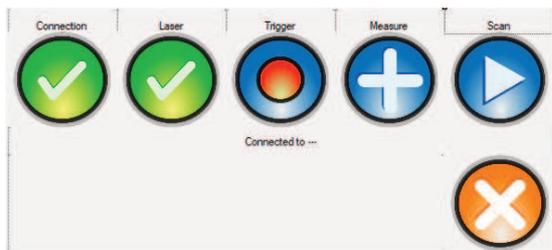


Figure 88: Disto laser distance reader connection screen.

Click the green button to make the connection. If the device is not found you get a warning:



Otherwise you get the screen:



and the device is ready to be used in a scan.

10. Menu Item Help

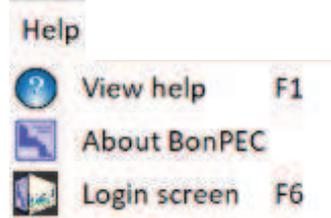


Figure 89: Menu item help.

10.1. Sub-menu Item Help: View help

By clicking on this sub menu, you will be directed to the user guide of the program.

10.2. Sub-menu Item Help: About PEC

By clicking on this sub menu, you will be directed to the disclaimer of PEC.

The disclaimer looks like:

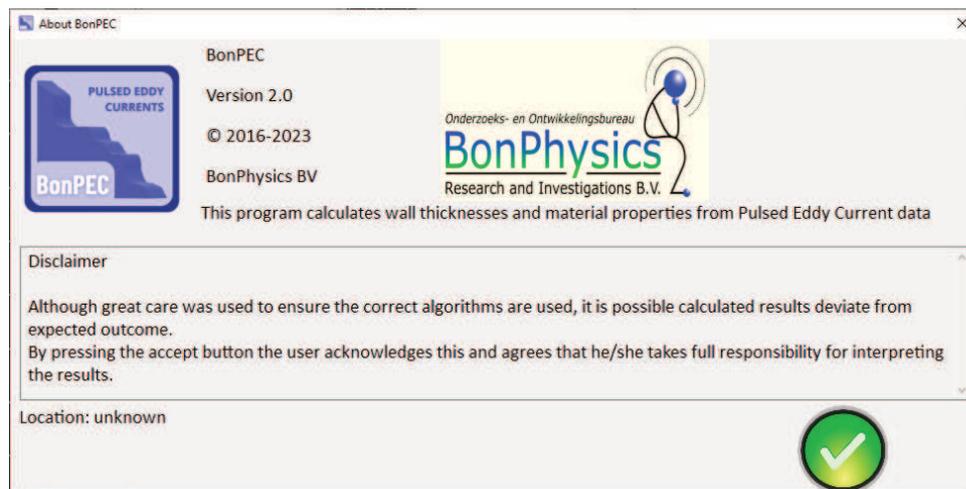


Figure 90: Disclaimer PEC.

By clicking on the green button (and by using this program) you will agree with this disclaimer and be directed back to the home screen.

When available the longitude and latitude of the computer are presented too.

10.3. Sub-menu Item Help: Login screen

By pressing on this sub-menu item or F6 on your keyboard, you will be directed to the login screen (see section 2).

Appendix A – Hot Keys

The following table shows a list of hot-keys, their description and references to the relevant sections.

A	Translate object to the left in 3D mode
SHIFT – A	Rotate object backward in 3D mode
CTRL – A	Rotate azimuth backward in 3D mode
CTRL – Delete	Delete a measurement from the grid
CTRL – SHIFT – Delete	Delete all visible measurements from the grid
D	Translate object to the right in 3D mode
SHIFT – D	Rotate object forward in 3D mode
CTRL – D	Rotate azimuth forward in 3D mode
CTRL – E	Erase measurement result from the grid
CTRL – SHIFT – E	Erase all measurement results in visible grid
CTRL – G	Show General Wall Reduction
CTRL – L	Show Lift off
CTRL – P	Open probe settings dialogue
Q	Zoom out from object in 3D mode
SHIFT – S	Change symbol in current cell
CTRL – T	Show Wall Thickness
SHIFT – T	Edit temperature value current cell
W	Translate object upwards in 3D mode
CTRL – W	Rotate azimuth to the left in 3D mode
SHIFT – W	Rotate object to the left in 3D mode
X	Translate object downwards in 3D mode
CTRL – X	Rotate azimuth to the right in 3D mode
SHIFT – X	Rotate object to the right in 3D mode
Z	Zoom in on object in 3D mode
Enter	Perform measurement once
CTRL – ENTER	Perform reference measurement
\	Perform measurements repeatedly
Shift \	Move cursor to first empty grid cell and perform measurement ³
Space	Move cursor to the next sub probe (when available)
End	Move cursor to end position in grid
ALT – End	End the program
CTRL – End	Change view to end view in 3D mode
SHIFT – End	Change view to bottom view in 3D mode
Home	Move cursor to start position in grid
SHIFT – Home	Change view to top view in 3D mode
CTRL – Home	Change view to home view in 3D mode
ESC	End current operation
F1	Show help

³ When monitoring type is 'spread' the measurement is performed in the first empty depth of the current grid cell.

F2	Activate or deactivate hardware (when available)
CTRL – F2	Turn off hardware (when on)
SHIFT – F2	Search for hardware by scanning COM available ports
F3	Sound off
F4	Sound on
F5	Minimize main window
F6	Open Login screen
F7	Show Monitoring Results dialogue (when available)
CTRL – F7	Toggle Monitoring depth (when available)
F8	Show Edit Scan dialogue
F9	Toggle display type
F10	Recalculate current cell in defect mode
CTRL – F10	Display all cells in wall thickness mode
SHIFT – F10	Display all cells in defect mode
F11	Enable/disable the location screen
CTRL – F11	Enable/disable the measurement control screen
F12	Start/Pause auto scanning mode (when hardware activated) ⁴
Left Arrow	Move cursor to cell to the left of current cell
Right Arrow	Move cursor to cell to the right of current cell
Up arrow	Move cursor to cell to the above of current cell
Down Arrow	Move cursor to cell to the below of current cell
SHIFT – page down	Change view to down view in 3D mode
CTRL – page down	Change view to right view in 3D mode
SHIFT – page up	Change view to up view in 3D mode
CTRL – page up	Change view to left view in 3D mode
ALT – key	If 'key' is A – Z or 0 – 9 → add symbol to cell point

⁴ In superuser mode F12 starts the grid filter dialogue, SHIFT-F12 applies the filter with lift-off variation, CTRL-F12 applies the filter without lift-off variation.

Appendix B – Flow diagram: Taking a reference.

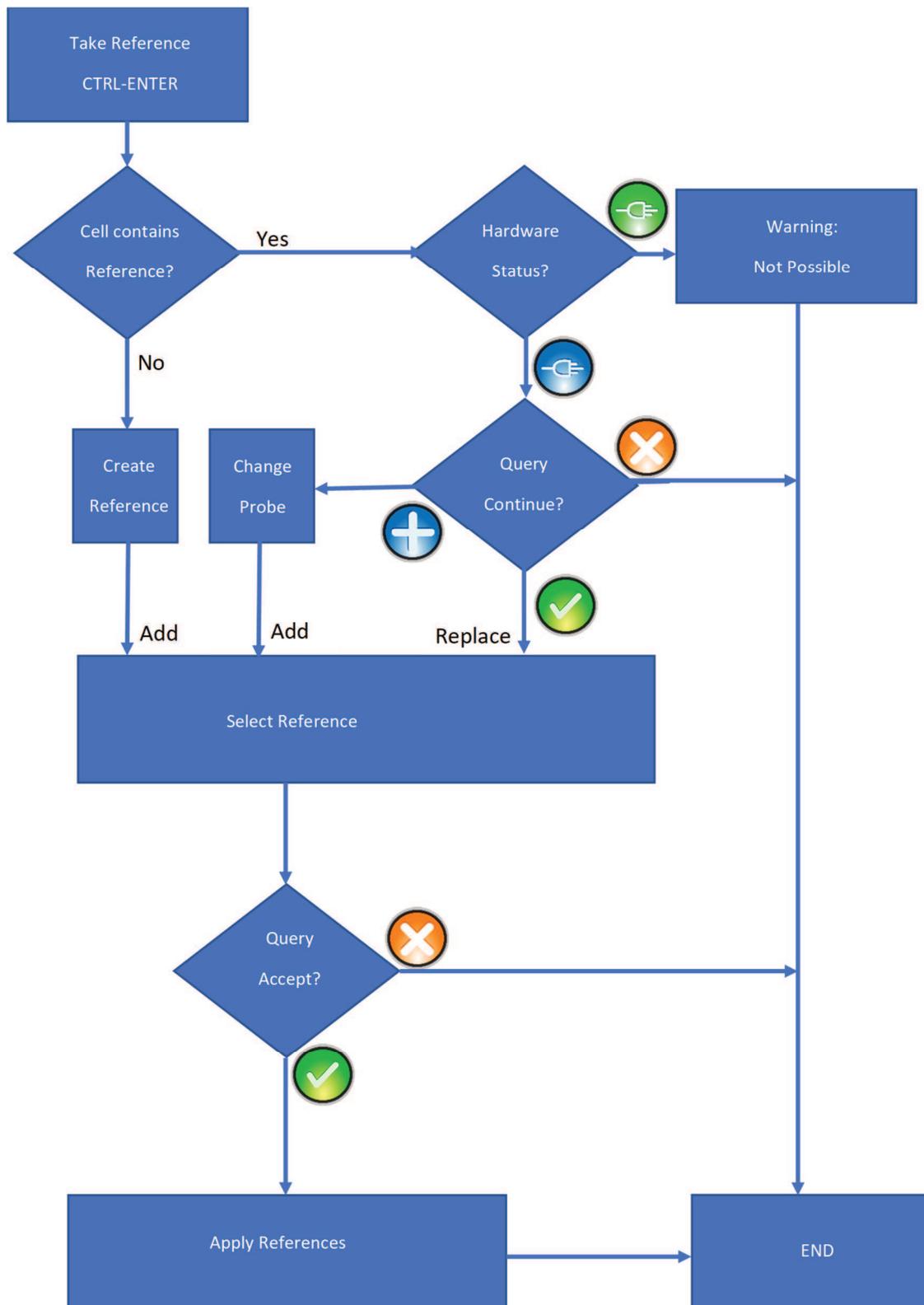


Figure 91: Flow diagram of taking a reference.

Appendix C – Flow diagram: Creating reference.

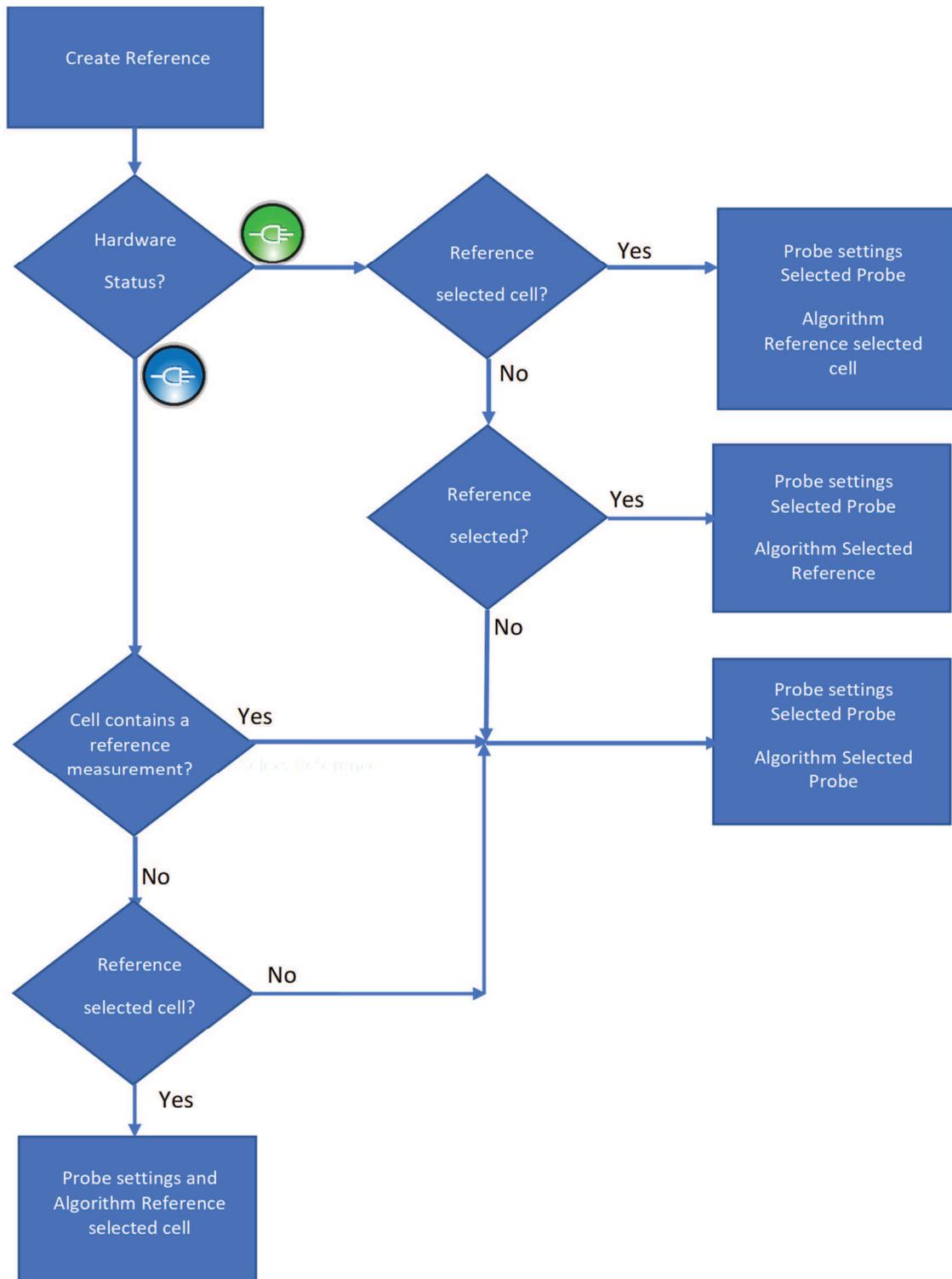


Figure 92: Flow diagram of creating a reference.

Appendix D – Flow diagram: Taking a measurement.

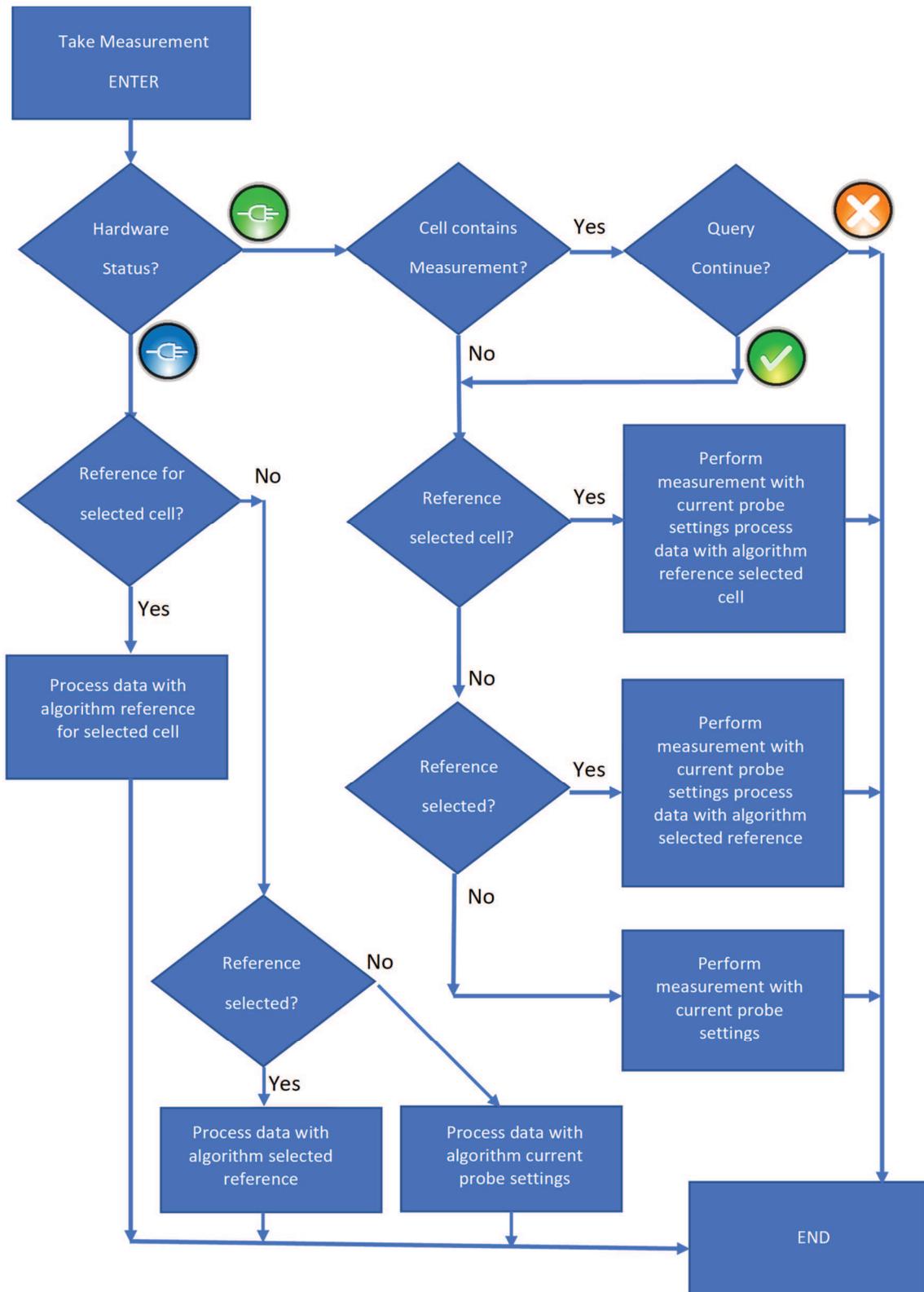


Figure 93: Flow diagram of taking a measurement.

Appendix E – Flow diagram: Live mode.

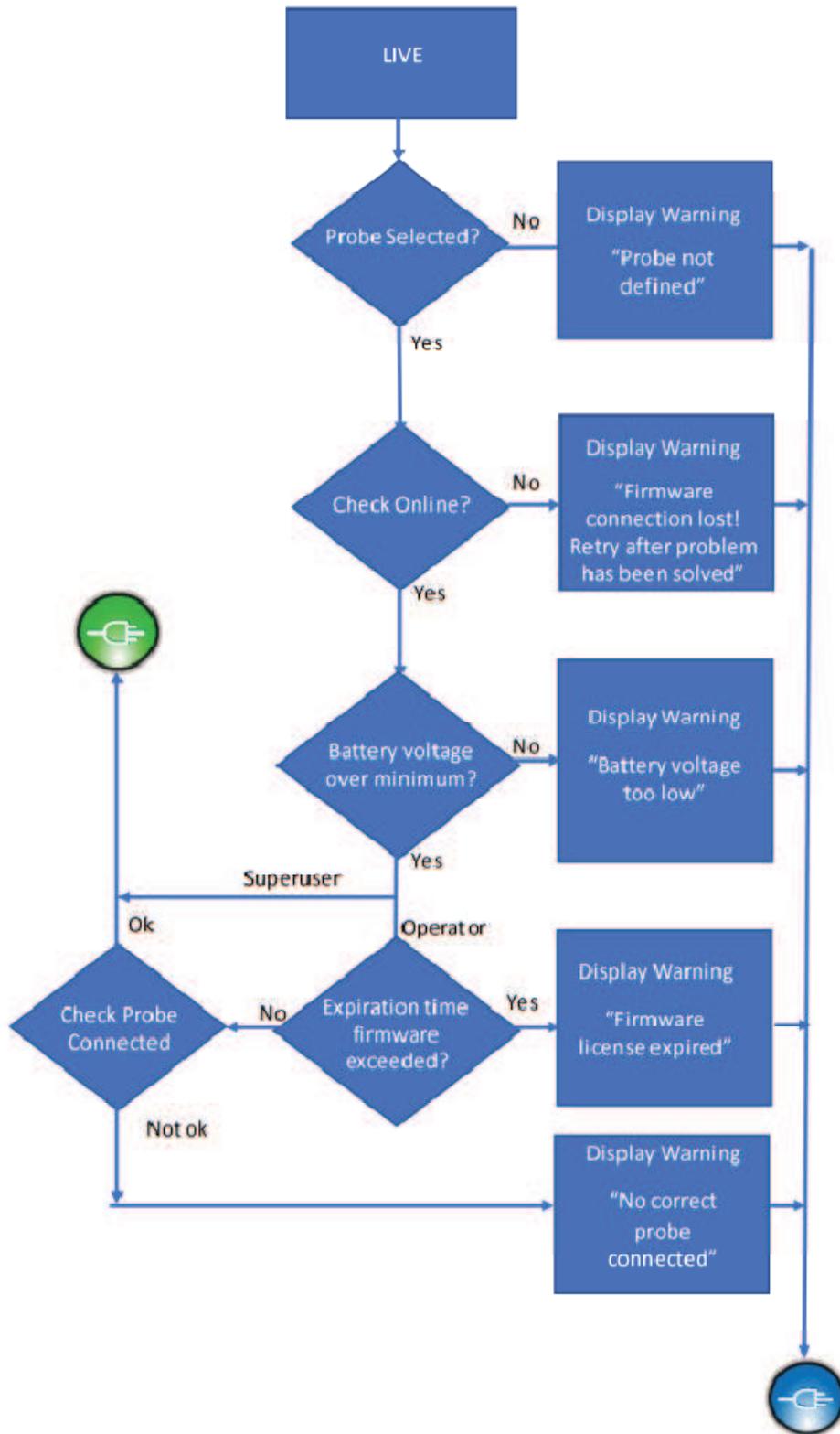


Figure 94: Flow diagram of Live mode.

Appendix F – Flow diagram: Start program.

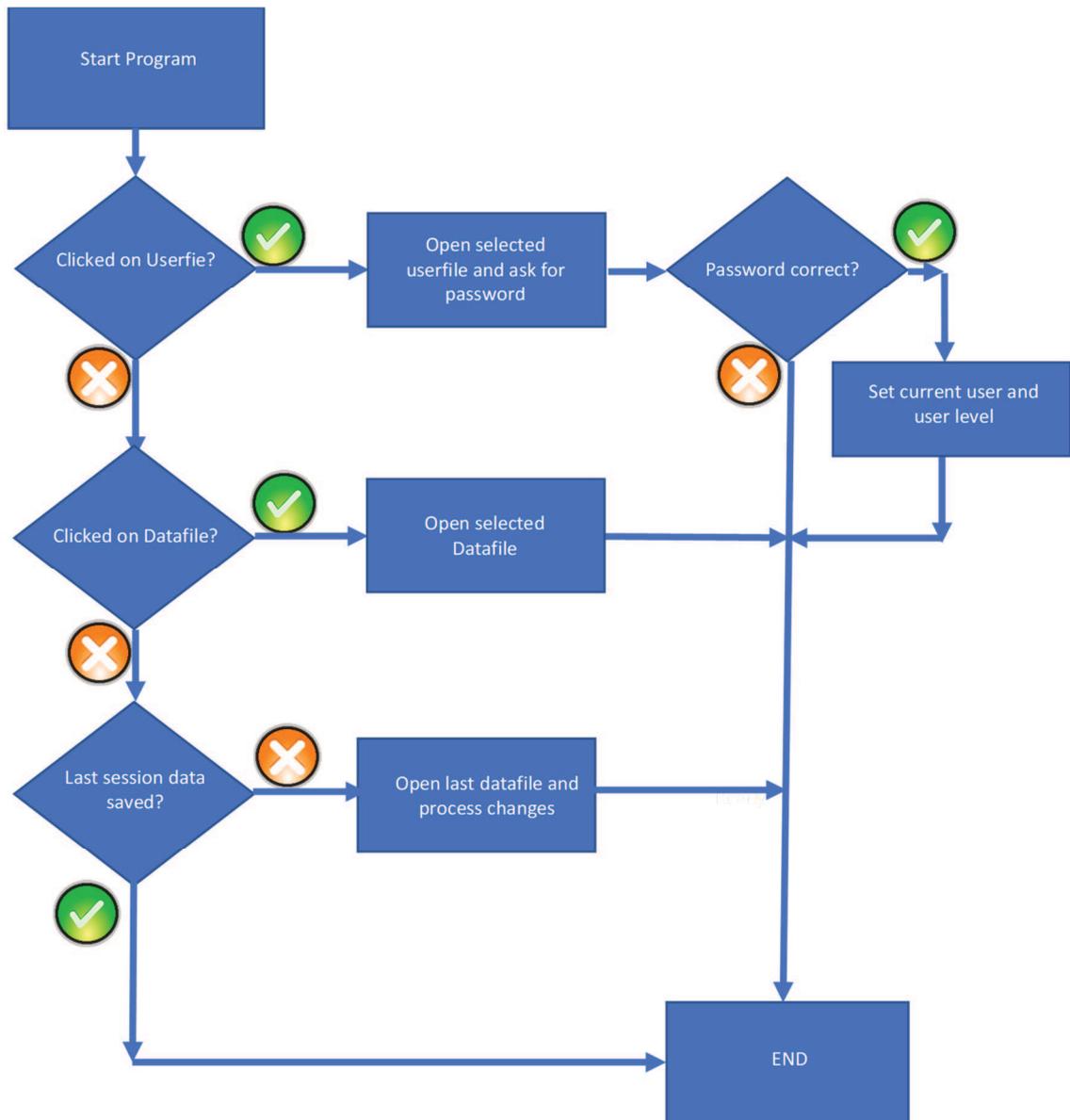


Figure 95: Flow diagram of Start program.

Appendix G – Report replacement tokens WORD (*.docx)

The following table shows a list of tokens that can be used for in the WORD template. Multiple occurrences of the same token will be replaced by the same item.

Token	Replaced by
Alias list item (see section 0)	Text of item
#Symbol.List#	a list of symbols (see Figure 70)
#Scan.Header#	information on scan size
#BitMap.Grid#	a picture of the grid layout
#BitMap.Results#	a picture of the current grid 2D display
#BitMap.Scan0#	a picture of the current grid 3D display
#BitMap.Scan90#	a picture of the current grid 3D display rotated 90 degrees
#BitMap.Scan180#	a picture of the current grid 3D display rotated 180 degrees
#BitMap.Scan270#	a picture of the current grid 3D display rotated 270 degrees
#Scan.WT#	A coloured table of the wall thicknesses
#Scan.ColourLegend.WT#	A table of the wall thicknesses colour legend
#Scan.GWR#	A coloured table of the general wall reduction
#Scan.ColourLegend.GWR#	A table of the general wall reduction colour legend
#Scan.LO#	A coloured table of the lift off
#Scan.ColourLegend.LO#	A table of the lift off colour legend
#Scan.DF#	A coloured table of the defect fraction
#Scan.ColourLegend.DF#	A table of the defect fraction colour legend
#Scan.Symbols#	A table of the symbols in the grid
#Scan.Comments#	A table of the grid cell and column/row comments

Appendix H – Report replacement tokens EXCEL (*.xlsx)

The following table shows a list of tokens that can be used for in the EXCEL template. Each cell can contain only 1 token. Cells containing the same token are replaced by the same item.

Token	Replaced by
Alias list item (see section 0)	Text of item
#Symbol.List#	a list of symbols (see Figure 70)
#Scan.Comments#	A table of the grid cell and column/row comments
#Resultname# (Resultname is the location as show in section 8.5)	Actual value of currently selected display type (The buttons above the grid on the lower left pane).
##\$# #\$+# #\$-# #+\$# #-\$# #++# #-+# #+-# #--#	The same type of value as the last occurred type of value in the spreadsheet. A '\$' indicates that the sequence number is fixed, a '+' indicates that the sequence number must be increased by 1, a '-' indicates that the sequence number must be decreased by 1, all with respect to the previous used sequence number. The symbol to the left indicates the column and the one to the right the row.
##\$# ##+# ##-#	The same type of value as the last occurred type of value in the spreadsheet. A '\$' indicates that the sequence number is fixed, a '+' indicates that the sequence number must be increased by 1, a '-' indicates that the sequence number must be decreased by 1, all with respect to the previous used sequence number (for profile values only).
#d_Resultname# (Resultname is the location as show in section 8.5)	Actual value of currently selected display type of monitoring depth 'd' (The buttons above the grid on the lower left pane).
#Resultname_XXX# (Resultname is the location as show in section 8.5)	Value of XXX display type (XXX can have a value similar to the buttons above the grid on the lower left pane). #A1_LO# is replaced by the lift-off of grid cell 'A1'
#d_Resultname_XXX# (Resultname is the location as show in section 8.5)	Value of XXX display type of monitoring depth 'd' (XXX can have a value similar to the buttons above the grid on the lower left pane). #2_A1_LO# is replaced by the lift-off of grid cell 'A1' in monitoring depth 2.
#T_Resultname_XXX# (Resultname is the location as show in section 8.5)	Value of all monitoring depths of TextInCell type T and display type XXX (In monitoring mode, section 5.4 T can be 'M', for the mean value of all depth's, 'I', for the intercept value, 'C' for the corrosion rate. XXX can have a value similar to the buttons above the grid on the lower left pane). #C_A1_LO# is replaced by the corrosion rate of the lift-off of grid cell 'A1' in monitoring mode.
#Labelname_XXX_YYY#	Profile value YYY of XXX display type (YYY can have a value Val, Avg, Sig, Min or Max as defined in section 3.2. XXX can

<p>(Labelname is the label as defined in section 5.5)</p>	<p>have a value similar to the buttons above the grid on the lower left pane). #A_AWT_Avg# is replaced by the column/row average of the average wall thickness of column/row 'A'.</p>
<p>#T_Labelname_XXX_YYY# (Labelname is the label as defined in section 5.5)</p>	<p>Profile value YYY of all monitoring depths of TextInCell type T and display type XXX (YYY can have a value Val, Avg, Sig, Min or Max as defined in section 3.2. In monitoring mode, section 5.4 T can be 'M', for the mean value of all depth's, 'I', for the intercept value, 'C' for the corrosion rate. XXX can have a value similar to the buttons above the grid on the lower left pane). #C_A1_LO# is replaced by the corrosion rate of the lift-off of grid cell 'A1' in monitoring mode.</p>