



# **UPEC INSPECTION KIT USER GUIDE**

**UPEC USB – UPEC-WR**

**UPEC-IO – UPEC-MC16**

**UWEC**

**EDDY CURRENT TESTERS**

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# 1 Introduction

## 1.1 Foreword

The UPEC instrument and UPECView software are designed to be compact, robust, easy to use and to take advantage of the modern developments in electronics, software engineering and user interfaces. The whole kit is thought to facilitate the life of the inspector from portability to advanced features, not normally found in this class of instruments, such as report generation. Sensima inspection thanks you for your trust and custom and hopes that you will enjoy using this inspection kit.

## 1.2 How to use this guide



WARNING

This guide is not an Eddy current course and does not replace in any fashion the user's NDT training. Since the UPEC instrument complies with ISO 15548-1 2013, the reader is referred to it and to ISO 12718 for complementary information.

User manuals are generally tedious and boring to read. We tried to make this one a little bit more entertaining by focusing on how to get quickly started with the instrument, deferring the more gruesome details for later.

We therefore strongly recommend to unpack the kit and check that all necessary components are present according to chapter 2 (Content of the box) and perform the steps described in the "Quick Start Guide" in chapter 3.

Chapter 4 describes the UPEC instrument specifications and chapter 5 goes through all the features of the UPECView software. We recommend to use these as reference or to discover the more advanced features of the UPEC inspection kit. In principle, the user interface is designed to be self-explanatory and quickly understandable by trained NDT personnel, meaning that with a little bit of trials and errors, any user should be able to discover and use most of the features with limited need for the manual.

Chapter 6 describes the procedure to install UPECView on another machine and can be skipped if you do not intend to do so.

Chapter 7 gives some tips for an efficient use of the UPEC kit while chapter 8 tries to give solutions to common (or extremely rare but very annoying) problems you may encounter.



NOTE

Despite our care and dedication to maintain the documentation current, some (small) differences may occur between the interface described in this guide and the one having been shipped with your device. In general, you should refer to the embedded help in the software in such cases. Furthermore, several tips and procedures described here depend on the operating system used by your display device (tablet or PC) and might not be directly applicable to yours. In this case, please refer to the help in your operating system.

# 2 Content of the box

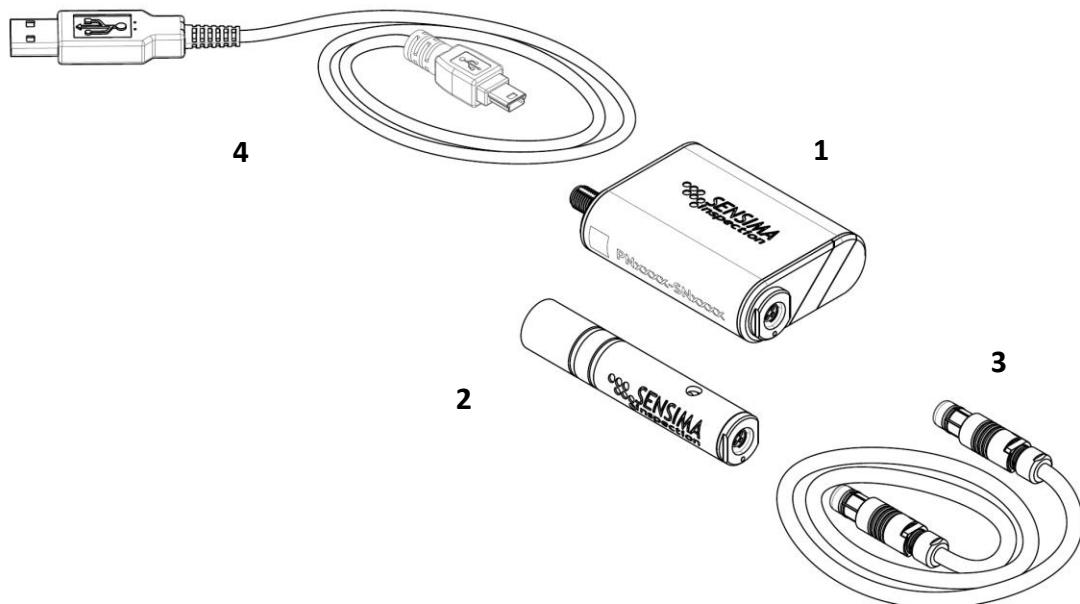


Figure 1: Partial content of the UPEC inspection kit. The waterproof carrying case, the USB key and the tablet are not shown

## 2.1 UPEC USB version

The kit is self-contained and allows to perform a standard inspection straight out of the box. It is composed of:

- A waterproof carrying case containing:
  - (1) Sensima's ultraportable EC tester (UPEC)
  - (2) EC probe
  - (3) Probe cable with Fischer 4-pin connectors to connect the probe to the UPEC tester
  - (4) USB cable to connect the UPEC tester to the tablet or a PC
  - USB key with drivers, software and electronic documentation allowing an optional installation on another PC
- Tablet with preinstalled software

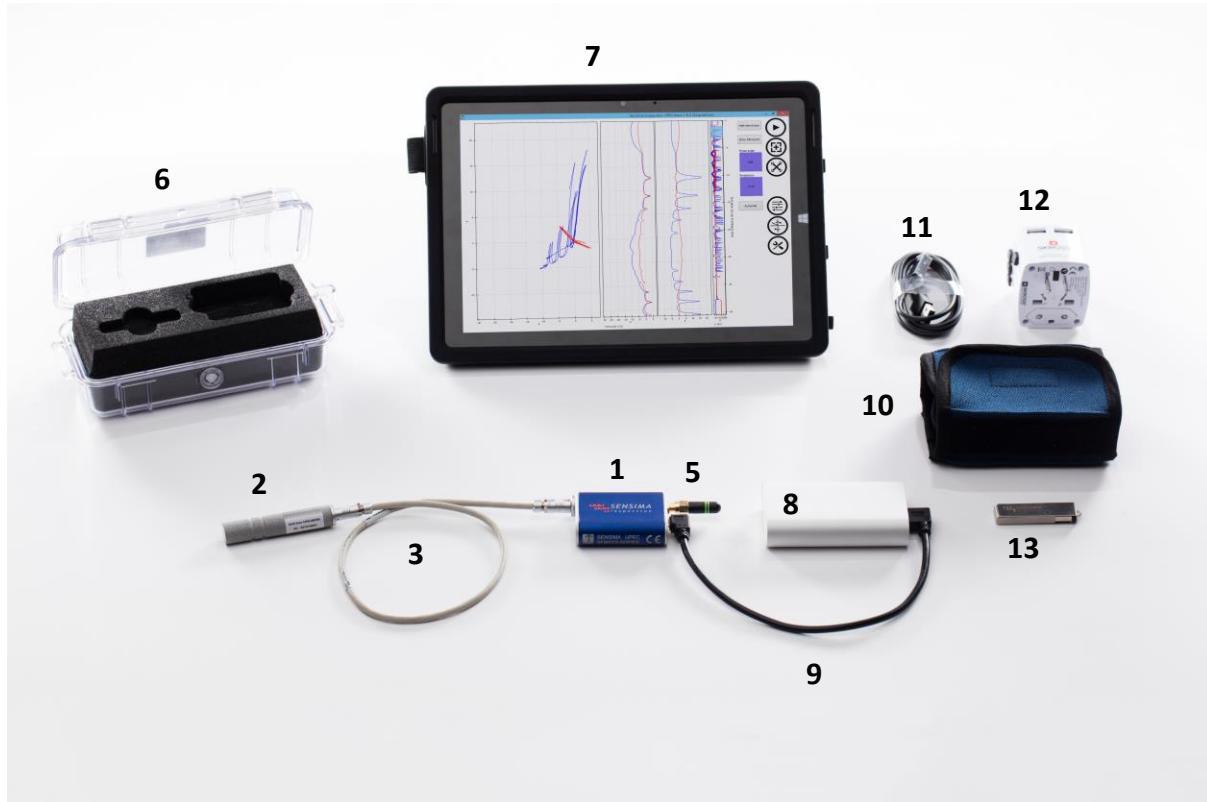


Figure 2: Content of the UPEC WR inspection kit.

## 2.2 UPEC WR version

The Wireless Rugged version of the UPEC tester comes with:

- A waterproof carrying case (6) containing:
  - (1) Sensima's ultraportable wireless rugged EC tester (UPEC-WR)
  - (5) Bluetooth antenna
  - (2) EC probe
  - (3) Probe cable with Fischer 4-pin connectors to connect the probe to the UPEC tester
  - (4) USB cable to connect the UPEC tester to the tablet or a PC (not shown in Figure 2, see Figure 1)
  - (13) USB key with drivers, software and electronic documentation allowing an optional installation on another PC
- (7) Rugged tablet with preinstalled software
- (8) Battery pack with (short) USB cable (9) to connect to the UPEC tester
- (10) Soft case with tester and battery pack enclosures as well as straps to hold up to two EC probes. The soft case can be attached in different ways to the inspector's garment (e.g. to the waist belt).
- (12) Multi-country dual-USB charger and USB cable (11) for tablet.

## 2.3 Other versions

The other versions of Sensima's UPEC tester, e.g.

- UPEC io (with input/output features such as TTL alarms and/or encoder inputs)

- UPEC MC (multi-channel instrument for EC arrays of up to 32 coils)
- UWEC (underwater UPEC EC tester)

may come with a different packaging, additional cables and different probes.

## 2.4 General notes for all versions

1. The delivered EC probe and tablet may depend on your specific order
2. Two notches (0.3 and 1 mm deep) are available on the Aluminium front panel of the UPEC tester allowing a quick functional test of the system.

# 3 Quick Start Guide

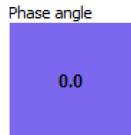
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## 3.1 Getting started with the UPEC inspection kit

Here are step-by-step instructions on how to perform a simple eddy current inspection including the generation of a report with the UPEC inspection kit. You should not hesitate to experiment several gestures when mentioned to get a better feel of the interface.

Here, you will learn to:

- Connect to the UPEC instrument
- Perform a liftoff rotation and manipulate the data
- Measure the signal from a reference defect
- Save the data and generate a report
- Load the data



Controls such as the phase angle setting are extremely powerful as they combine a slider and text or numeric keyboard inputs but they require a little bit of “getting used to”. The general principles of the user interface are described in section 5.2.1 and these controls are explained in section 0, just after this tutorial.

UPEC USB	UPEC WR
1. Connect the probe to the UPEC tester using the probe cable in the kit	



**Figure 3: Example of connection for the UPEC USB (note that the tablet shipped in the kit may be different from the one shown here). For the UPEC WR tester, connect it to the battery pack with the provided USB cable and not to the tablet.**

2. Connect the UPEC tester to the tablet or PC using the USB cable	Connect the UPEC tester to the battery pack using the (short) USB cable in the kit.
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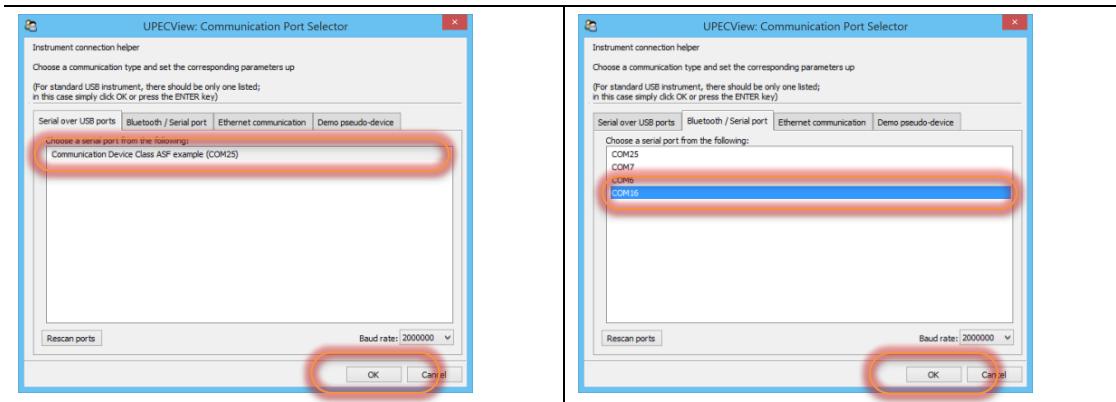
3. Start the UPECView software either by

- double-clicking on the UPECView icon on the desktop  

- starting UPECView from the Windows 8 main screen:  
press the Windows key () , type U P E C and click on the UPECView item in the list
- starting UPECView from a (Windows 8) tile with all the settings for an inspection task

A logging window will open followed by the opening of the communication window allowing to choose how to connect to the device

4. Select the appropriate USB communication port from the first panel (Serial over USB ports) and click OK.	Click on the second tab “Bluetooth / Serial port”, select the appropriate communication port and click OK
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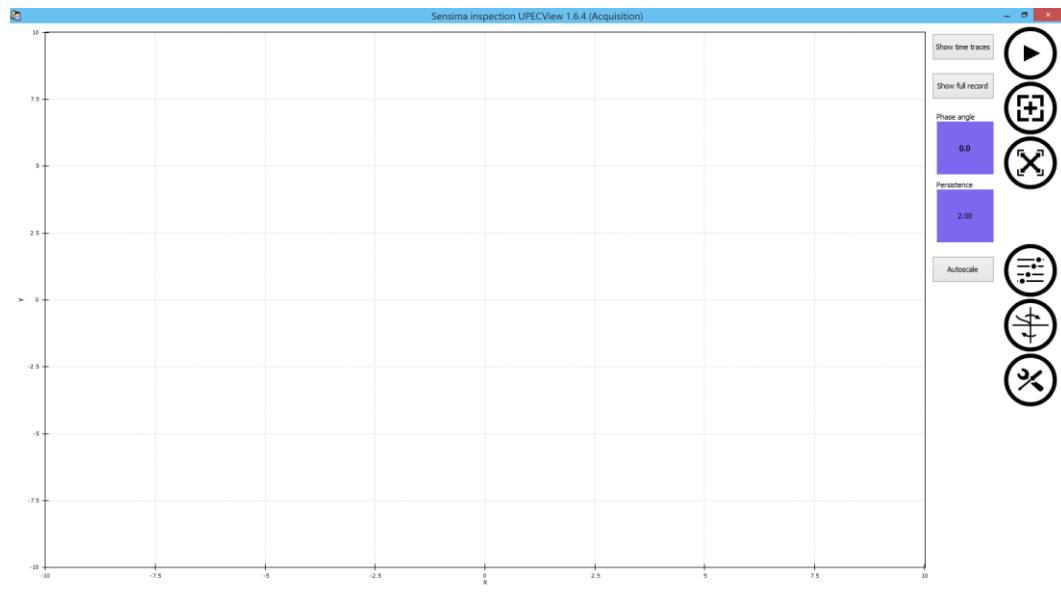


If you do not select any, the first listed communication port will be used.

See also:

- Finding out which communication port my UPEC device is using (7.1)
- Connecting to a device (5.3)

## 5. UPECView connects to your instrument and displays the main empty acquisition window



### 6. Press the “Play” button (▶).

The acquisition starts immediately and the button changes to “Pause” (⏸).

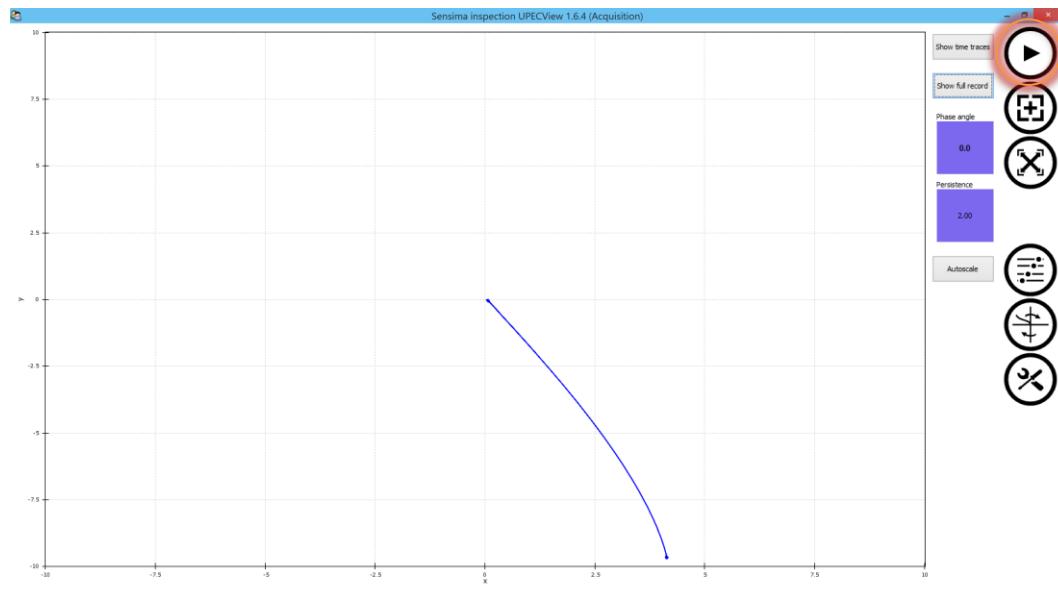


### 7. Put the probe on the calibration sample (or the tester body or front panel outside of the notches for Aluminium) and press the “Balance” (⟳) button. The signal is now shifted to the center of the axes (i.e. towards (0,0)).



### 8. Perform several liftoff movements<sup>1</sup> with the probe and press the “Pause” button (⏸) to stop the acquisition. You should obtain something similar to the screen on the side. Depending on your preference settings you may be asked if you want to save the data, in which case you can safely answer “No” (we shall save them later).

<sup>1</sup> Lift the probe off the surface up to a distance of a few inches (5 to 10 cm), bring the probe back towards the surface until putting it back in contact and repeat this several times.

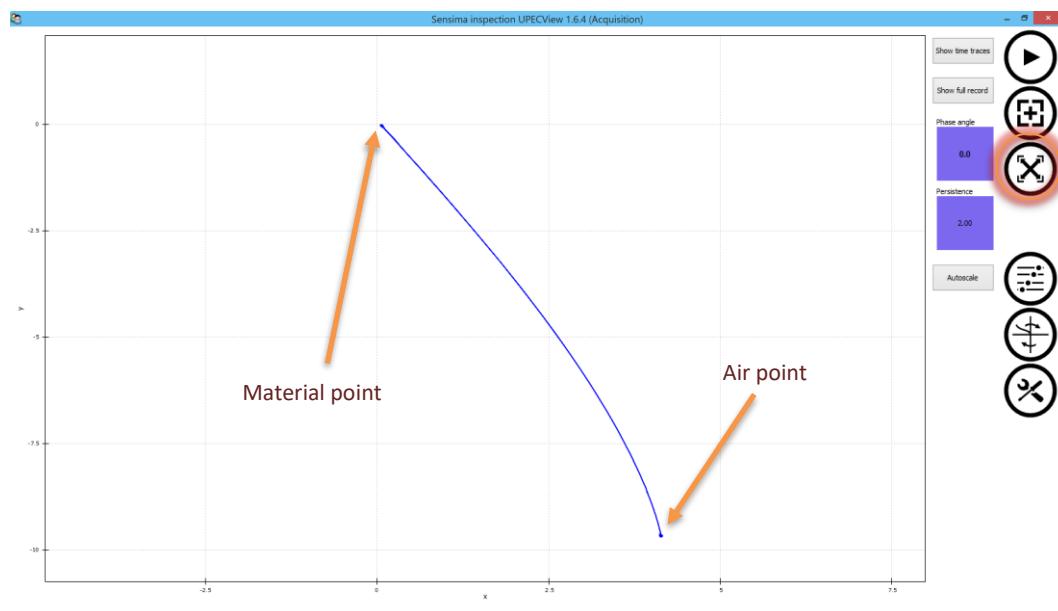


9. Rescale the signal to make a better use of the screen space

Press the “Autoscale” (⊗).

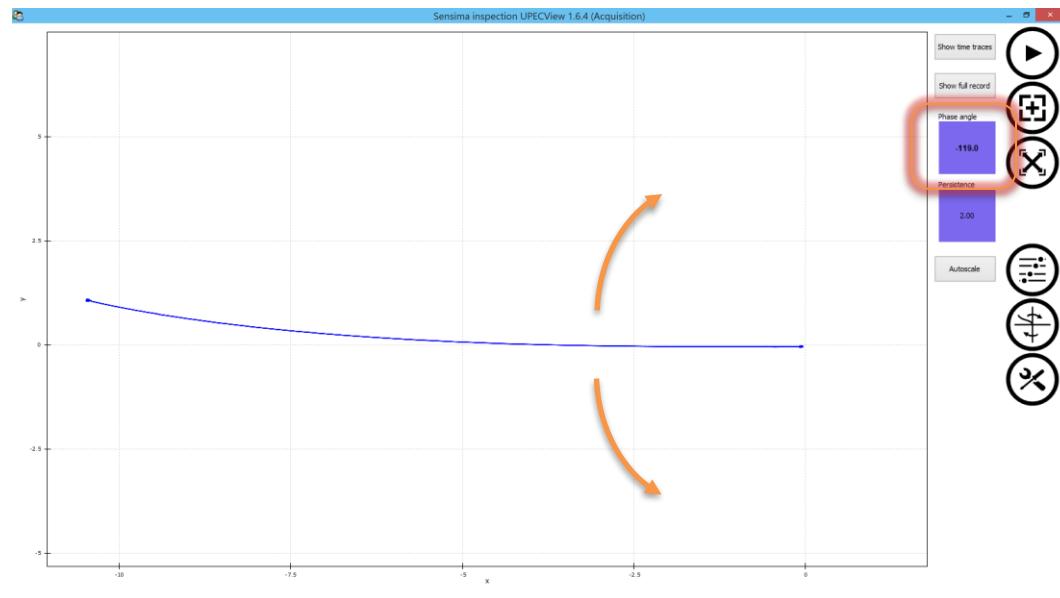
You can also:

- Pan the data: touch the plotting area and then touch and drag your finger
- Zoom in or out: touch the plotting area and then make a pinch (in or out) gesture with 2 fingers
- Zoom box: touch the plotting area and press the ‘Z’ on the keyboard; then touch and drag the blue box around the region of interest.



10. Rotate the signal using the phase control until the liftoff signal is horizontal and oriented towards the left.

To use the control: touch it without releasing your finger from the screen and slide your finger on the screen in any direction (drag). The control turns green and the phase angle is constantly updated. See also section 5.2.

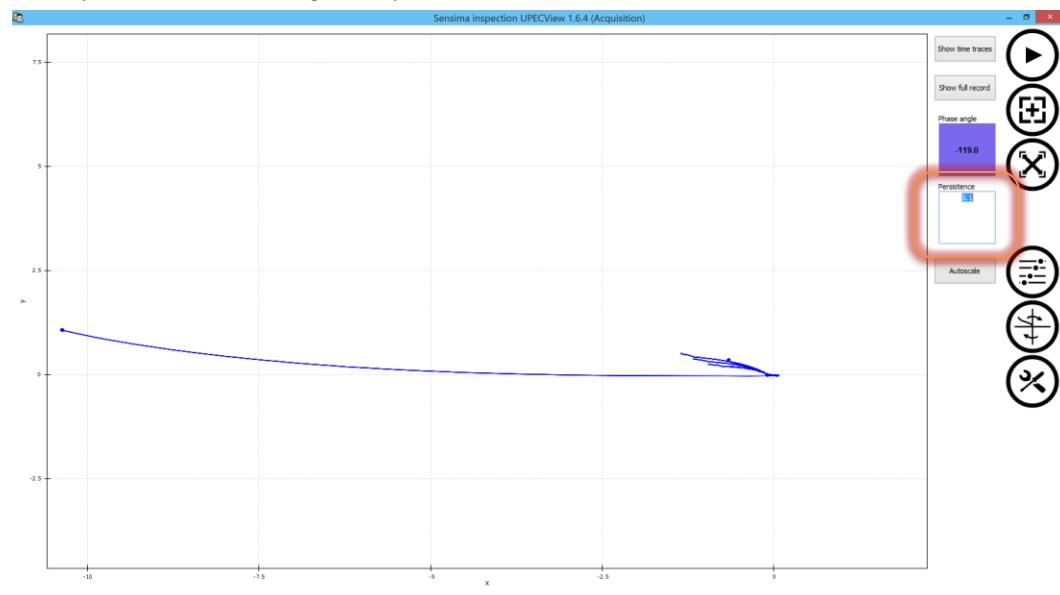


NOTE

This angle is a quick way to access the more general rotation filter. It is important to notice that there is a clear distinction between instrument settings, i.e. the settings affecting the measurement before digitization and processing chain ones, such as the rotation here, which can be altered and reverted at any time after the measurement.

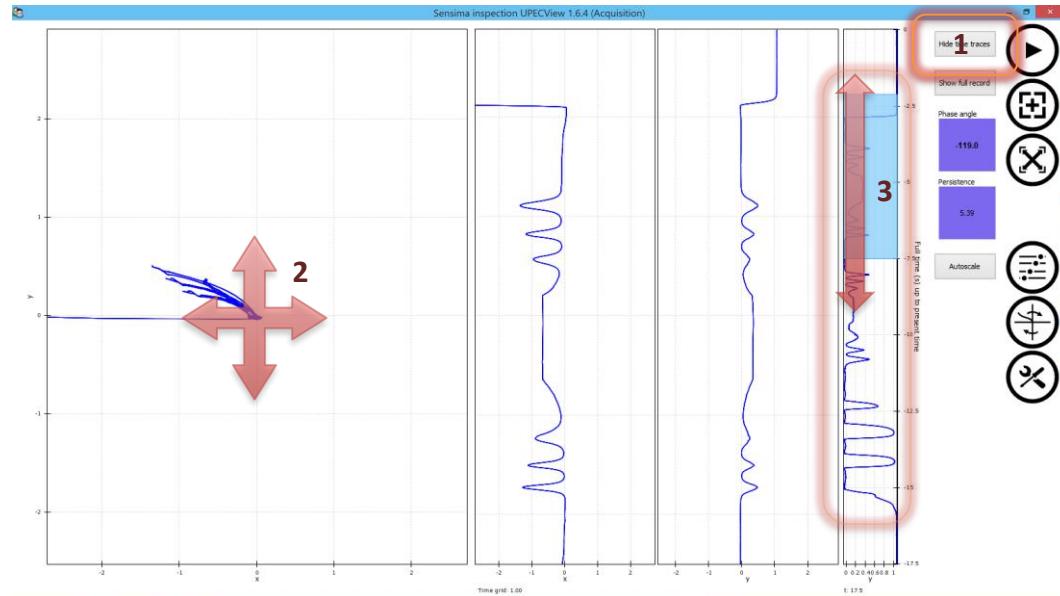
11. Restart and acquisition by pressing the “Play” button (▶) again. Put the probe back on the material and slide it across the reference notches. Then press “Pause” (⏸).
12. If you cannot see all the notch signals, you can adjust the amount of time which is displayed with the “Persistence” control.

By default, only the last 2 seconds of data are displayed, but by changing the persistence setting, you can alter this to your needs either during the acquisition or after.



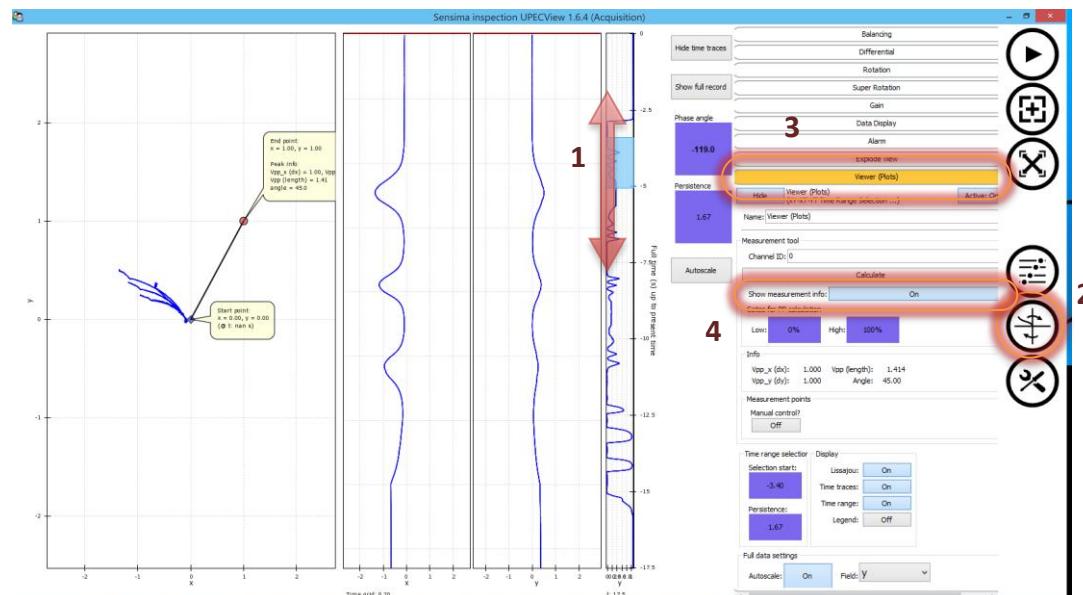
13. To go deeper into signal analysis, show the time traces (1). You may have to recenter somewhat the signal (2): touch the impedance plane plotting area and the touch and drag around. Finally, you can use the time range selector to choose which part of the signal you want to display (3).

Time range selector: Touch and drag on an empty region of the time range selector to create a new range (blue box). The amount of signal displayed and the persistence are constantly updated as you drag. To modify an existing range, you can touch and drag either near one extremity of the box to enlarge it or near the middle of the box to move it around.



14. We shall measure the signal from the largest notch.
  1. First narrow the time range selection to display only the interesting part of the signal.
  2. Bring up the signal processing settings .
  3. Select the “Viewer (Plots)” tab
  4. Activate the “show measurement info” option

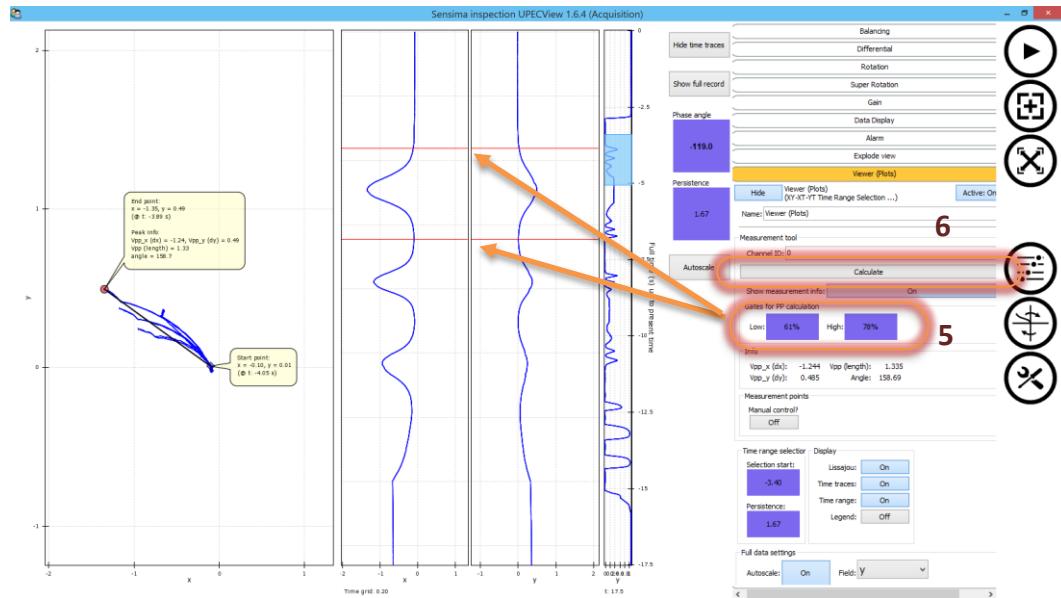
The default annotation appear in the plotting area.



5. Narrow the region used to compute the annotation by moving the top and bottom gates.
6. Click on the “Compute” button

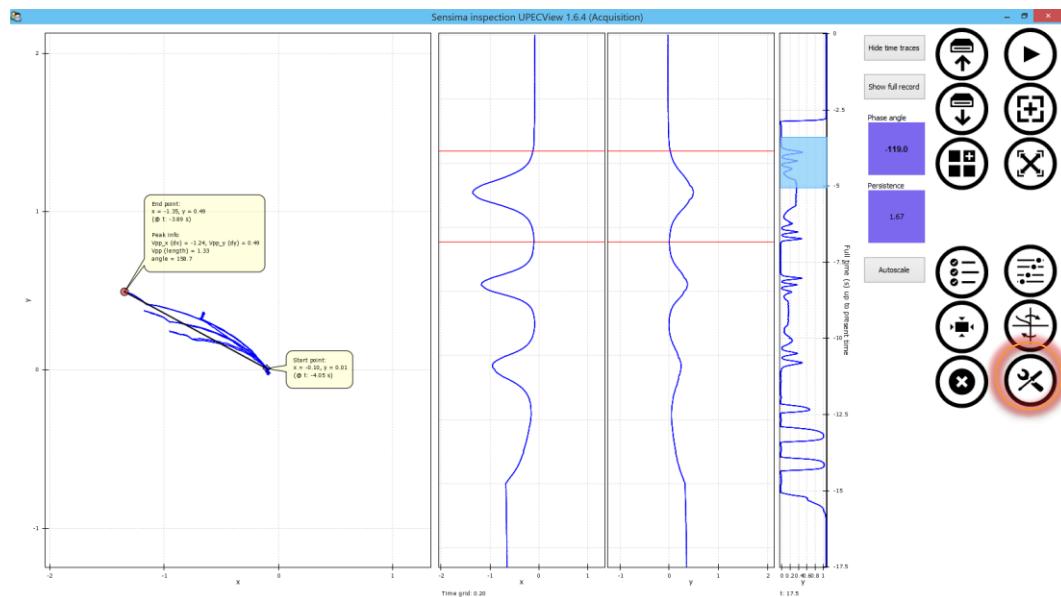
The length and orientation of the measured signal are shown in the balloons on the plot and in the settings panel.

The “balloons” can be moved around by right-clicking and dragging.<sup>2</sup>



15. Let's now save the data (and report).

Open the toolbox panel by pressing the “Toolbox” button (⊗).

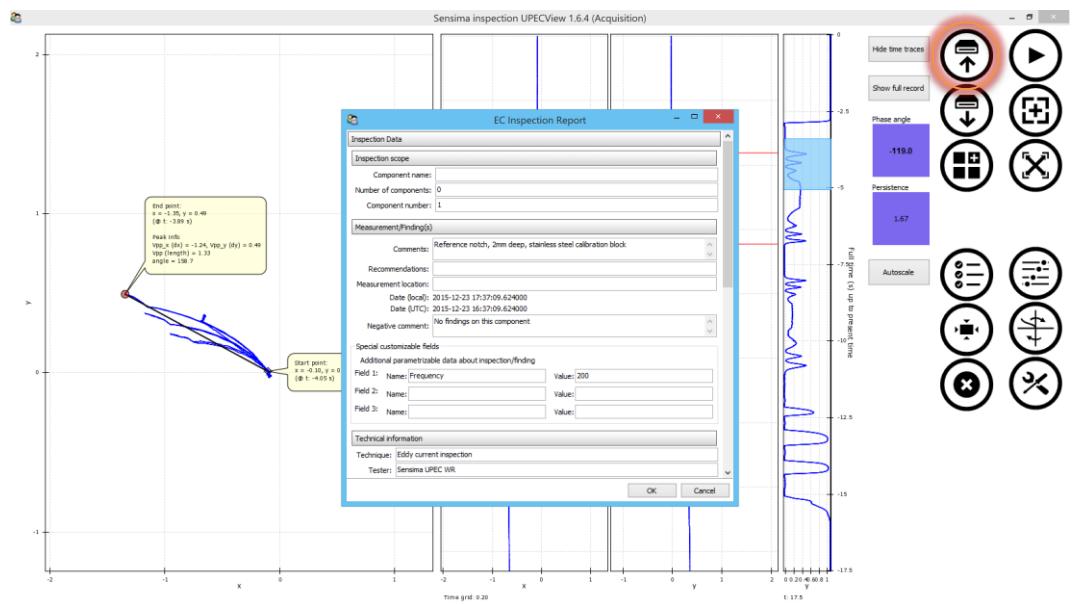


16. Press the “Save” button (⊕) at the top of the panel.

A dialog about the content of the report appears in the center of the screen.

Note: If you do not care about the report and only want to save data, you can completely ignore this and click “OK” to continue. It is however highly recommended to put something relevant in this report (at least comment) to be able to quickly browse through data later without having to open each file one by one.

<sup>2</sup> This is using a mouse. With a pen, this can be reproduced by pressing one of the pen button and dragging. It is not possible to do this with a touch gesture.



17. The inspection report is presented with the most useful fields first. Put an empty component name and fill something into the “comments” field.

If you scroll down, you will see that you can add (among others):

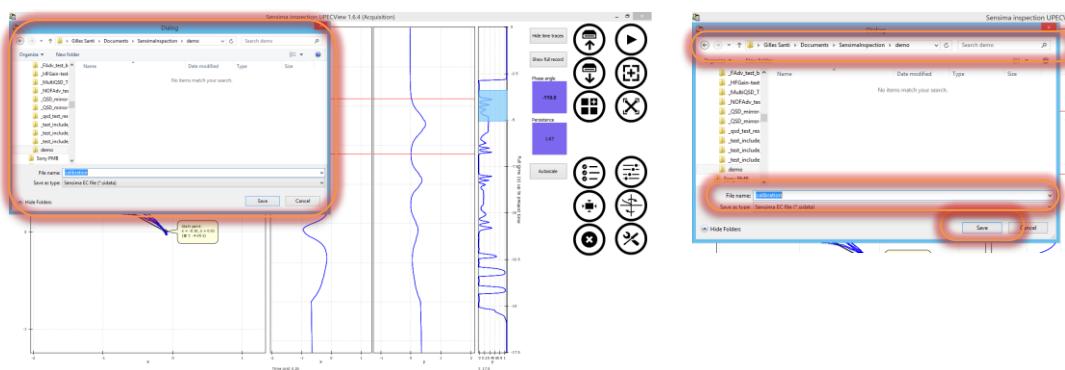
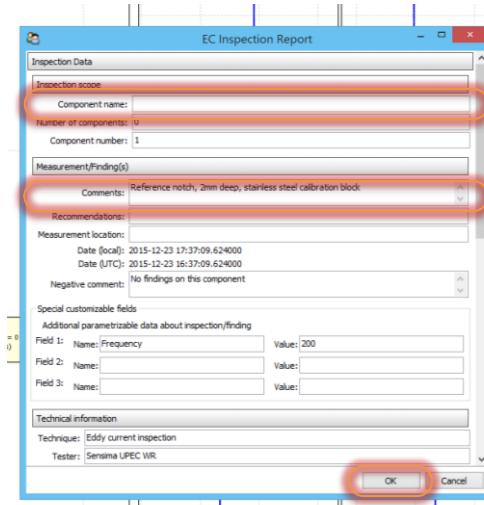
- A picture to the report
- Company logo and address
- Inspector name

Note that the changes you make in those fields are constantly stored on disk, meaning that the next time you save data, you are presented with all the fields and values from the last report.

Click “OK” to accept the changes and close the dialog.

18. The standard Windows save panel appears. Choose in which directory you want to save the data (by default it is in the SensimaInspection folder in your Documents directory). Give a file name, e.g. “calibration” (the extension is automatic since the data is saved in several formats) and click “Save”.

The data and report have been saved to disk.

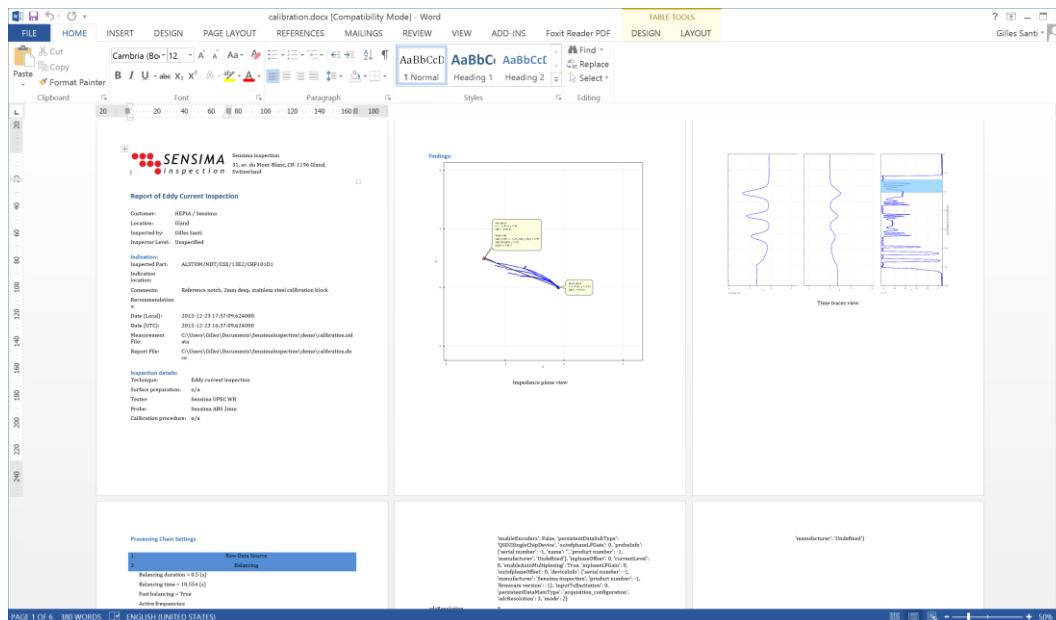


19. Open a Windows File Explorer window (e.g. using the taskbar<sup>3</sup> or with the windows key or button) and go to the folder you saved the data in (here: Documents > SensimaInspection > demo). Open the Word document with the name you chose (here: calibration.docx). Word opens.<sup>4</sup>

The number of files depends on your settings in the preferences. The main data file has the “sidata” extension. When exported to other formats (e.g. .csv for Excel or .mat for Matlab<sup>®</sup>), the processed data is saved with the same base file name and the raw data is saved in a file with \_raw appended to the name.

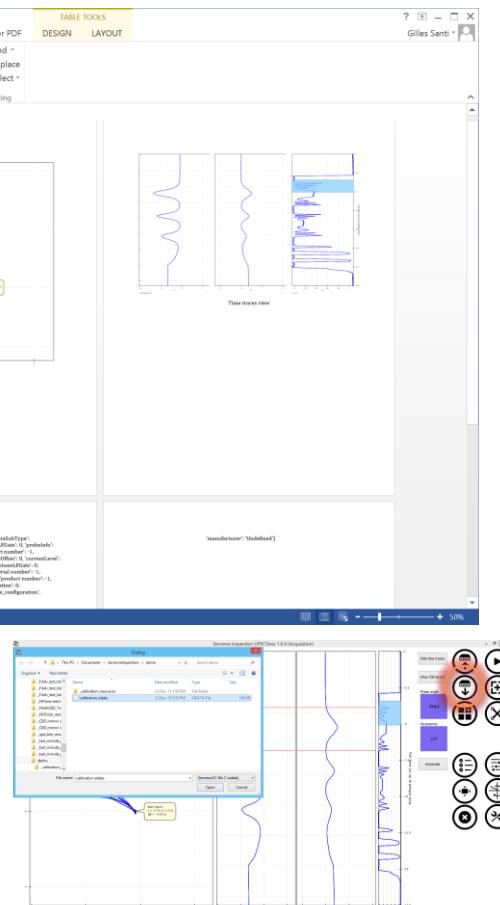
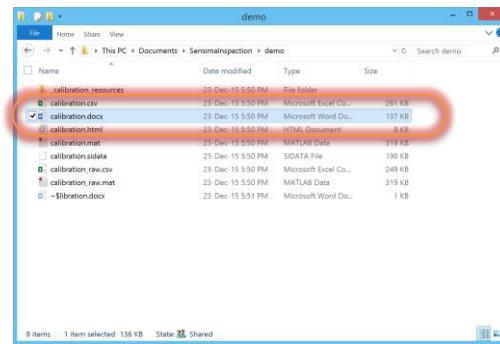
This is a typical view of the generated Word document with the fields from the inspection data form, the plots that were visible on the screen and the different settings. For instance, you could modify this document in-place or copy/paste elements of it in another Word document before delivering the final report.

Note: the company logo (Sensima inspection here) is the one you have selected in the inspection data form.



20. To conclude, let's load the data we just saved back in UPECView.

Press “Toolbox” button (⌚) if necessary to show the toolbox panel and the “Load” button (⬇️). A standard Windows Open dialog appears.



<sup>3</sup> If UPECView is in “Full screen” mode, you may not have access to the taskbar. You can leave the full screen mode by toggling the full screen state in the toolbox panel (⊕) or touching/clicking in a plot area and press the ‘f’ key.

<sup>4</sup> You need Microsoft Word installed on your system for you to be able to view and modify the generated reports (The generation will work irrespective of the presence of Word on your system). If this is not the case, you can use the HTML file which opens in your default internet browser. Note that depending on your tablet option, a one-year subscription to Office 365 may be included, but you need to activate it before trying to start Word.

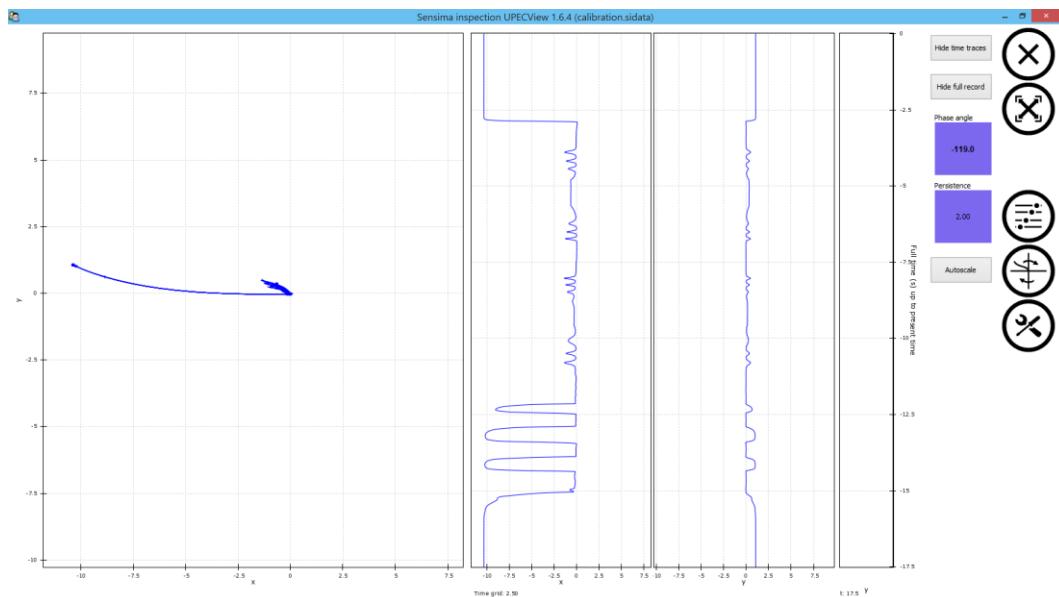
Select the SIDATA file you want to load (here: calibration.sidata) and click “Open” (or double-click on the file).

21. The data is loaded (this may take a few seconds) and is shown in a new window.

Note that the Play button has been replaced by a “Close window” button and that the “Balancing” button has disappeared.

Click on the “Show full data” button and on the “Autoscale” if necessary.

All the processing chain settings are accessible and can be altered if desired, including the time range selection. It is therefore possible to generate another report with different views from the same data by saving the data from this window (normally with a different file name if you do not want to overwrite the previous report).



This concludes the overview and quick tutorial about the UPEC instrument and UPECView software. For a more in-depth description, the reader is referred to chapters 4 and 5.

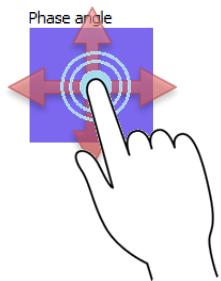
## 3.2 Using the controls

1. Phase angle



Controls work both as a slider and as a text or numeric input box.

2. Phase angle



Put your finger on the control and start dragging leaving it on the screen (do not release it from the screen). The control changes color while you slide. The value decreases when you slide towards the left or bottom of the screen and increases when you move towards the right or the top of the screen. The changes are immediately applied to the signal (if relevant as for the phase angle shown here). Once you are satisfied with the result, take your finger off the screen.

2b.



Alternatively, if you want to enter a precise value (with the keyboard):

- Tap on the control and release your finger from the screen
- The control turns white and the value is selected
- Use the keyboard to enter the desired value (if the on-screen keyboard does not appear immediately, you can bring it up by clicking on the keyboard icon in the taskbar).
- Press enter on the keyboard to validate your input or click or tap elsewhere on the screen. The changes you entered are applied at this moment.

# 4 The UPEC instrument

The UPEC family of testers are general-purpose eddy current instruments as per ISO 15548-1 2013. For the purposes of this document, the terms and definitions given in ISO 12718 apply.

## 4.1 UPEC USB, UPEC WR



The basic version of the UPEC tester comes with two excitation and acquisition units allowing for dual-frequency measurements (simultaneous injection) on a single eddy current probe.

Type of instrument	General purpose eddy current instrument	
Power supply	5 V USB powered, 100 mA typ. current draw 24h+ instrument battery life with the included USB battery	
Safety	CE, FCC Part 15B, RoHS,	
Technology	Signal proc.:	Analogue preamplification and demodulation Digital outputs and filtering
	Settings:	Manual, remote controlled, stored, preset
	Outputs:	Digital components outputs, optional TTL alarms
	Excitation:	Single frequency, dual frequency
Physical presentation	Weight:	90g (3.2 oz.)
	Size:	45 x 60 x 18 mm <sup>3</sup> (1.8 x 2.4 x 0.7 in <sup>3</sup> )
	Connectors:	USB mini A socket, Fischer 102 4-pin
Environmental effects	Warm-up time:	0s for typical use 200s for full precision
	Ingress protection:	IEC 60529 CODE IP67
	Operating temp.:	-40 °C to 60 °C
	EMC compatibility:	Compliant with CE, FCC Part 15B
Generator unit	Dual frequency, multi-frequency (time multiplexed)	

	Independent generator units:	2
	Frequency range (each generator):	5 kHz – 10 MHz down to 1 Hz with reduced data rate
	Current mode (each generator):	1-10 mA, up to 9 V p-p $> 10000 \Omega$ source impedance
	Voltage mode (each generator):	9 V p-p, 90 mA maximum $50 \Omega$ impedance
Input Stage	Input impedance:	100 kΩ
	Max. input voltage:	5V
Balance	Hardware balancing before the vector amplifier Software balancing after A/D conversion	
HF amplification	Gain setting range:	2 – 20 (6 – 26 dB), 2.9 dB steps <sup>5</sup>
	Bandwidth:	10 MHz
	Linear input range:	1.0 V
Demodulation	Bandwidth:	10 MHz
	Wave shape:	square
Vector amplification	Gain setting range:	1 – 100 (0 – 40 dB), 2.7 dB steps
	Software gain range:	0 – $\infty$ (infinity) <sup>6</sup>
LF filtering	Digital filters	
Phase setting	Range:	0 – 360°
	Step size:	<0.001° <sup>7</sup>
Digitized outputs	Data protocol:	USB 2.0 full speed and/or long range Bluetooth
Digitization	Digitization technique:	Sigma-delta
	Sampling rate:	375 Hz to 3 kHz <sup>8</sup>
	A/D resolution:	13 to 16 bits
	Stage:	After vector amplification and balancing

<sup>5</sup> The displayed values in UPECView are rounded to integer ones.

<sup>6</sup> Limited by UPECView's floating point numbers representation. The click/touch and drag interaction limits the range to 0.1 – 10, but any value can be entered as a number. The software gain comes in addition to the hardware gains above.

<sup>7</sup> In fact, as the phase rotation is controlled by UPECView, the steps are only limited by the representation of floating point numbers within UPECView. This means that the steps are virtually infinitely small for any practical purpose (more than 15 significant digits), meaning a step size  $< 10^{-11}$ . Note that the click/touch and drag interaction does not give you access to this resolution: to benefit from it, you need to enter the phase angle as a number.

<sup>8</sup> The effective acquisition rate is within 2.5% of those values.

## 4.2 UPEC io

The UPEC io tester has special input/output features such as encoder inputs and configurable TTL alarm signal output. It has the same specifications as UPEC USB above with the following additional features and differences.

Type of instrument	General purpose eddy current instrument with input/output features
Encoder inputs	Quadrature decoder inputs (A/B): 2 Maximum tick rate: 32 MHz Tick counter resolution: 32 bits
Additional digital outputs	Number of TTL outputs: up to 3 Real-time alarm signal delay: < 10 µs <sup>9</sup>
Physical presentation	Weight: 120 g (4.3 oz.) Size: 45 x 60 x 18 mm <sup>3</sup> (1.8 x 2.4 x 0.7 in <sup>3</sup> ) Connectors: USB mini A socket, Fischer 102 4-pin, Fischer 102 7-pin
Customizations	The input/output features and connector are customizable on request.

## 4.3 UPEC MC

The multi-channel version of the UPEC tester has the following additional features and differences compared to the io version.

Type of instrument	General purpose multi-channel eddy current instrument with encoder inputs and TTL outputs
Power supply	5 V USB powered, 500 mA typ. current draw, up to 2 A
Technology	Excitation: Single frequency, multi frequency (simultaneous injection) <sup>10</sup>
Physical presentation	Weight: 280 g (9.6 oz.) Size: 55 x 75 x 18 mm <sup>3</sup> (2.3 x 3.0 x 0.7 in <sup>3</sup> ) Connectors: USB mini A socket, other connectors customizable
Generator unit	Independent generator units: 16

<sup>9</sup> Note that this is the delay after the measured signal has reached an alarm condition; the actual delay depends on the acquisition rate.

<sup>10</sup> Multi-frequency injection with special connector.

## 4.4 UWEC



The underwater version is based on the UPEC USB with the following additional specifications.

Type of instrument	Underwater general purpose eddy current instrument
Underwater	Case material (2 versions): Al Stainless steel Maximum tested depth (case and connectors): 100 m (330 ft) Maximum depth (steel case): 1000 m (3300 ft)
Physical presentation	Weight: 0.5 kg (1.1 lb) for Al case 5 kg (11 lb) for stainless steel case Shape: Cylindrical Size: 50 x 160 mm (2.0 x 6.3 in), diameter x length Connectors: Special underwater Fischer connectors for probe and digital communication
Digitized outputs	RS-422 long distance digital communication protocol from UWEC to surface control and acquisition unit (PC or tablet), including a serial to USB converter. Maximum data rate: 2 Mb/s
Cables and probes (standard)	Shipped with a 50 m (160 ft) digital communication and power supply cable. Shipped with one underwater probe or adapter according to your specifications.
Options	<ul style="list-style-type: none"> <li>• Longer communication cable upon request</li> <li>• Visual feedback system for the diver</li> <li>• Custom probes or adapter to your probes</li> </ul>

# 5 UPECView User Guide

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This chapter provides in-depth description of UPECView's different features.



NOTE

This guide describes the features in version 1.6.4.x of UPECView. The features and user interface are constantly evolving and, although mostly similar, earlier and future versions may present a slightly different interface. Clearly, earlier versions lack some of the features described here.

## 5.1 Introduction and general philosophy

UPECView is designed to have a modern look and feel, self-explanatory and easy to use yet allowing advanced features. This is achieved by displaying only the relevant information on the screen, hiding unnecessary settings in order not distract the inspector from his main task. Those settings are however quickly available at your fingertips, only a few clicks or taps away from the main screen.

### 5.1.1 Inspection task – working with tiles and presets

To leverage the best of this user interface, presets and inspection task tiles should be used extensively. These allow to store and quickly recall all the relevant parameters for a given inspection task, so that the inspector can focus on the inspection task and not on the numerous settings of an eddy current instrument. This goes to the point where a task could be performed without any instrument setting at all (to the extent of even removing the need for balancing<sup>11</sup>). All those parameters can nonetheless be easily changed to experiment and optimize the signal for a specific task. It must be noted however that because all the settings can be changed live during the acquisition, it may be difficult to make sense of data acquired and saved in this way and users are strongly discouraged to save data containing settings variations (e.g. a hardware balancing in the middle of an acquisition).

### 5.1.2 Difference between instrument and processing chain settings

In UPECView, there is a clear distinction between instrument and processing chain settings.

The former regroup all the settings affecting the eddy current signal before digitization and transmission to the display and recording device (tablet or PC). In other words, these are all settings which cannot be changed after a measurement has been performed,<sup>12</sup> such as frequency or hardware gains.

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<sup>11</sup> In fact, balancing may still be necessary to compensate for the environmental changes, e.g. temperature or humidity.

<sup>12</sup> Or rather that the measurement should be redone if those are changed.

On the other hand, the processing chain parameters include all the settings which can safely be altered after the inspection data has been recorded or stored in memory such as rotations or software gains. In particular, any change in those settings will affect all the data, even the data having been acquired before the change. One example of this is performing a standard balancing in the middle of the acquisition (having forgotten to do it at the beginning): the current data point will be shifted to zero and all the data acquired previously (and after but this is obvious) will be translated correspondingly as if the balancing point had been defined at the beginning of the acquisition.

### 5.1.3 Raw data and data-centric approach

In fact, UPECView stores “only” the raw data, i.e. the digitized data transmitted by the tester, and all the processing chain settings. The displayed signal, i.e. the processed data, is always recalculated when necessary. The data file which is recorded to disk thus contains the raw data, information about all the instrument settings that were used to acquire it and all the processing settings but not the processed data itself.<sup>13</sup> A clear advantage of this is that you can subsequently change all the processing chain settings in loaded data for a better interpretation or for comparison with other data. In short, the acquired (raw) data is at the heart of the whole process and we call this a “data-centric approach”.

## 5.2 Overview of the user interface

### 5.2.1 General principles

The interface is designed to be comfortable with both a tactile display and a more traditional PC one with mouse and keyboard. We give here a few tips useful across the whole application.

	Description	Tactile	Mouse & keyboard
<b>Controls</b> 	Many settings can be changed through these controls which combine the functions of a slider and an editable box	Touch and drag to change the value continuously. You can drag in any direction (horizontally or vertically)  Touch and release to edit the value with the keyboard.	Click and drag to change the value continuously. You can drag in any direction (horizontally or vertically); you can use the CTRL and SHIFT keys to make fine or coarse adjustments respectively.  Touch and release to edit the value with the keyboard.
<b>Tooltips</b> 	Most of the buttons and controls can display a short summary of their function.	Touch the button or control and leave your finger on it until the tooltip appears.	Hover over the button or control with the mouse pointer until the tooltip appears

<sup>13</sup> This is not true for exported data which normally contains only processed or raw data.

<b>Shortcuts</b>	Some functions can be accessed by a simple key (e.g. toggling between full screen and windowed views with 'f').	Not relevant	The equivalent keyboard shortcut is shown in the help tooltip in square brackets ('[...]')
<b>Panels</b>	Settings are grouped in panels which are opened and closed by clicking on the corresponding button.	Touch the corresponding button.	Click the corresponding button.

## 5.2.2 Interacting with plots

The impedance plane and time traces are easy to interact with.

	<b>Tactile</b>	<b>Mouse &amp; keyboard</b>
<b>Panning</b>	Touch anywhere inside a plot area and drag	Click anywhere inside a plot area and drag
<b>Zoom</b>	"Pinch" in or out around the region of interest	Move the mouse pointer over the point of interest and use the mouse wheel to zoom in or out (or the "scroll" gesture on a trackpad)
<b>Zoom box</b>	(Not really relevant, but you can use the on-screen keyboard and follow the "mouse & keyboard" procedure).	Press the 'Z' key. The mouse pointer changes to a magnifier shape. Click and drag around the region of interest
<b>Zoom back to original</b>	(Not really relevant, but you can use the on-screen keyboard and follow the "mouse & keyboard" procedure).	Press the 'ESC' (escape) key.
<b>Show/ hide time traces</b>	Touch the "Show time traces" button to show a rolling chart of the horizontal and vertical components.	Click the "Show time traces" button to show a rolling chart of the horizontal and vertical components.
<b>Show/ hide full record</b>	Touch the "Show full record" to display the totality of the last scan. This option is accessible only when the measurement is stopped.	Click the "Show full record" to display the totality of the last scan.
<b>Navigate the full record</b>	The portion of the data displayed on-screen can be selected in the box on the right of the time traces.	Click and drag to select a zone within the time selection box on the right of the time traces. The selected region will be

Touch and drag to select a zone. The selected region will be highlighted in blue. You can touch within this region and drag to move it.

This feature is enabled only if the “Time slice selection viewer” is activated in the preferences.

highlighted in blue. You can click within this region and drag to move it.

## 5.3 Connecting to a device

When UPECView starts, it will display a device connection dialog (called “Communication Port Selector”) to connect to a UPEC device. Since different UPEC devices may have different communication interfaces, you have to select the one appropriate to your device. Most of the UPEC devices use a serial communication interface (COM port under Windows).

The panel has some help on the top and several tabs for the different communication interfaces which are described in details hereafter. Depending on the communication interface tab, a list of available communication ports is displayed with some additional settings.

### 5.3.1 USB devices

Select the “Serial over USB ports” tab (this is the default).

UPECView has already scanned the USB ports and your device should normally be listed (with the corresponding COM port<sup>14</sup>). If the list is empty, check that the UPEC device is correctly connected to the tablet/PC with the USB cable and click the “Rescan ports” button. If you have more than one device listed you have to know which COM port the device you want to connect to is using. There is also a communication speed setting (“Baud rate”) which “you should normally leave to 2000000. If you click “OK” without selecting a port, the first one is

Note that all the devices using a serial over USB communication protocol will be listed here, even devices not related to Sensima inspection. This is of course only relevant if you are using the UPEC in combination with other devices using the same tablet/PC, but in this case you have to be aware that some care is required in selecting the correct communication port. A typical situation is using a scanning system controlled through a serial interface and UPECView together on the same tablet/PC.

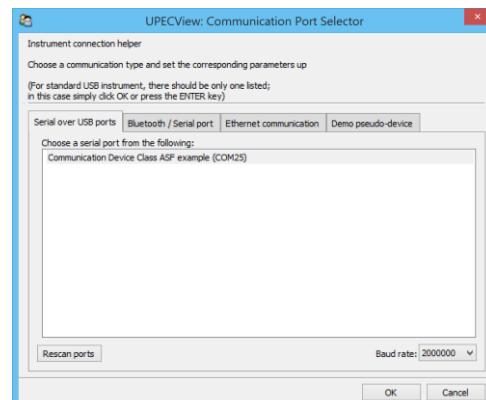


Figure 4: Device connection dialog for USB devices.

<sup>14</sup> The COM port number is attributed by Windows and is unique to a given device (on a given PC). This means that the same UPEC will always be given the same COM port number on a given PC/tablet, but this number may be different on another PC/tablet.

### 5.3.2 Wireless devices

Select the “Bluetooth / Serial port” tab which is very similar to the precedent one.

The list of serial ports shows all the serial (COM) ports on the system. This list includes:

- All the COM ports from the precedent tab (note the COM25 port which is the same as in the figure above since the UPEC WR device used for this example was connected to and powered by the tablet).
- All the COM ports associated with paired Bluetooth devices (this may include other devices using serial interfaces such as mobile phones for instance).
- Any serial port currently used on your PC. This should occur only in old PCs, some of which may use serial interfaces internally.<sup>15</sup>

In general, the listed devices are: the ones connected by USB and the ones having been paired with the tablet/PC. You can also rescan the ports for instance if you just paired your device after having started UPECView. The communication speed (“Baud rate”) should be left to 2000000.

#### Pairing a UPEC WR device to a tablet/PC



**TIP** The UPEC device is already paired with the tablet delivered in the kit. Those instructions are only for those wanting to use another tablet/PC to connect to the UPEC wireless device.

For Windows 8.1:

1. Go to the Bluetooth settings:
  - 1.1. Bring the “Charms” (e.g. by swiping your finger from the right hand side of the screen inwards to the left)
  - 1.2. Choose “Settings”, then “Change PC settings”
  - 1.3. Go to “PC and Devices” and then “Bluetooth”
2. Make sure that your UPECView WR device is powered (connected to the battery pack, to the tablet or to any USB power supply). Check that Bluetooth is on. Windows should be scanning for Bluetooth devices and your UPEC device, identified by its part and serial number should soon be listed.
3. Select the UPEC device with the correct part and serial number and click “Pair”. At the end of the process (taking a few seconds), the device is reported as “Connected”. It should then be visible in the list of Bluetooth and serial devices.

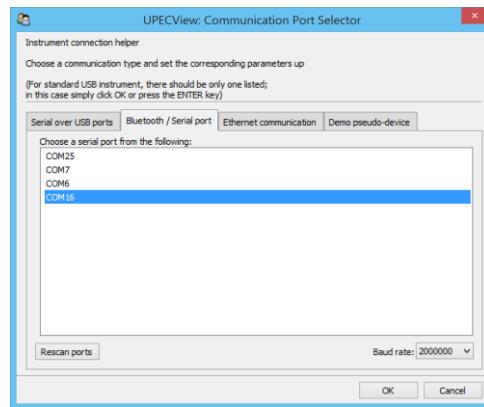


Figure 5: Device connection dialog for wireless (Bluetooth) devices and generic serial port devices.

<sup>15</sup> In particular, this should never be the case with the tablet delivered in the original UPEC inspection kit.

### 5.3.3 Ethernet devices

Select the “Ethernet communication” tab.

Enter the IP address and the port number given to your UPEC device. The default port number for UPEC Ethernet devices is 50123 as shown in the figure (default setting in UPECView). The IP address depends on your network configuration. The UPEC Ethernet devices come with special set up procedures to attribute them a fixed IP address in your local network. Contact support for more information

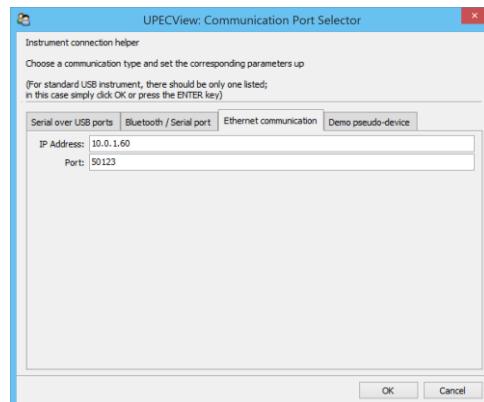


Figure 6: Device connection dialog for ethernet devices.

### 5.3.4 Deviceless mode (demo)

The last tab allows to start UPECView without any device attached. It is meant to be used as demo or training to give access to the interface and he processing chain settings, but it can be used to start without a device and load data files for further analysis or interpretation.

In this mode, a fake pseudo-device is created. This pseudo-device simulates the signal generated by a two absolute probe sensing head repeatedly passing over a notch. The instrument settings correspond to a legacy version of UPEC in which only 3 different frequencies could be chosen from. Apart from that the interface is identical to the one presented here.

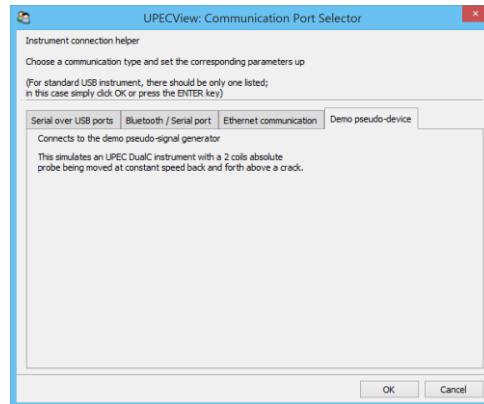
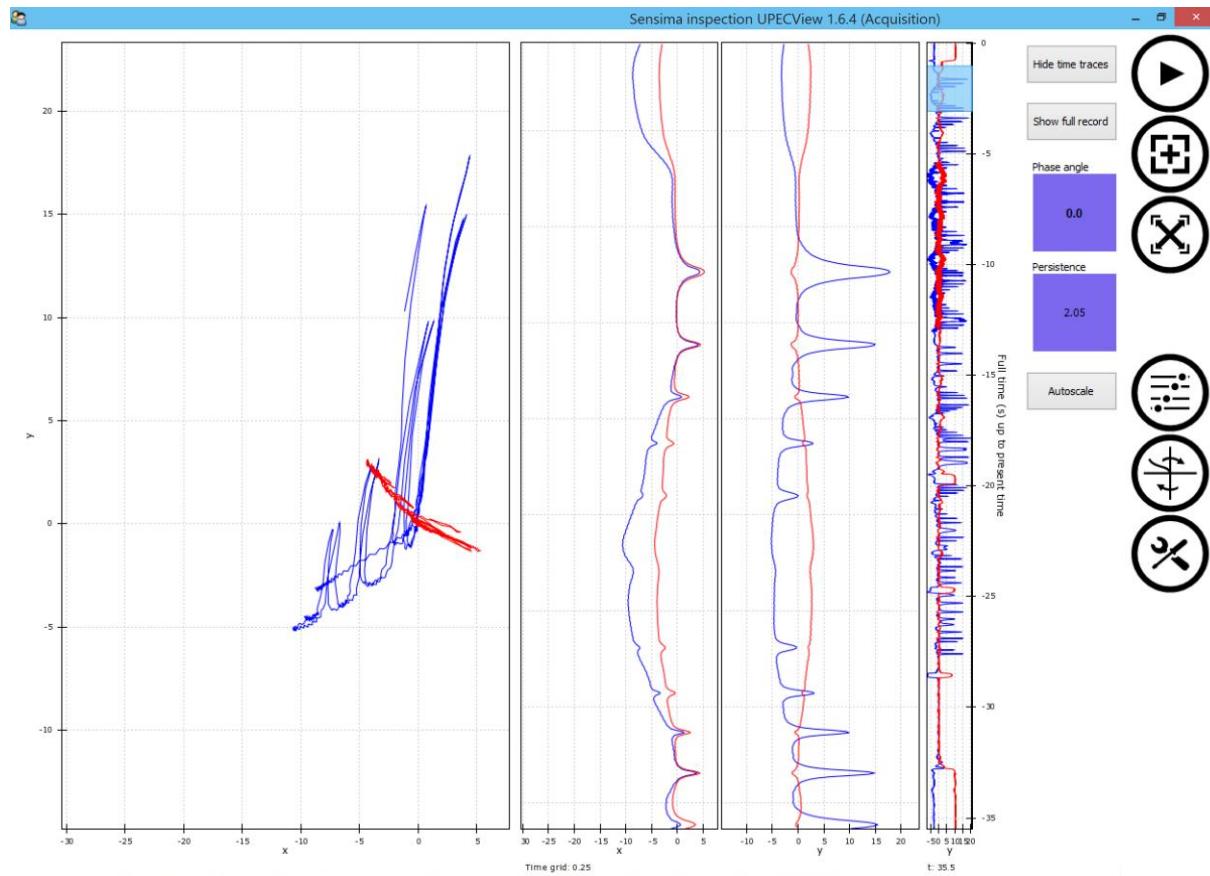


Figure 7: Device connection dialog for demo mode (deviceless mode).

## 5.4 UPECView main window



**Figure 8: Example of a start screen (no panels displayed) after a dual-frequency acquisition.**

To demonstrate the potential and ease of use of UPECView's interface, the plots show a dual-frequency acquisition on a set of calibration notches with the time traces on. This is more complicated than the typical use case (single frequency and only the impedance plane displayed) but some operations such as adjusting the relative responses from different frequencies can only be shown in this configuration.

### Units and general display information

The signal is in Volts, although this should be considered as an arbitrary unit as it is after the instrument and software gains. In addition, a “display” gain of 20 (multiplicative factor) has been added to avoid having to deal with too small signal values.

In terms of scales and units, there are two useful but hard to notice pieces of information at the bottom of the screen below the time traces: the size of the time grid and the current time from the start of the recording just below the time range selector, both of which are in seconds.

## 5.5 Main panel and buttons

The main buttons are explained in the figure on the side. They correspond to the most used commands and to be easily accessible without taking too much screen real estate.

The first group deals with signal acquisition: start/stop, balancing and autoscale.

The second group gives access to more functions and settings through unfolding three different panels: the instrument settings (pre-acquisition), the processing chain ones (post-acquisition) and the general toolbox for manipulating data and other files.



### Main acquisition controls

Play / Pause

Start or stop recording data. All data since the start is recorded in the tablet and the amount is only limited by the available memory.

Balancing

Performs the balancing of the signal. Its precise behavior is controlled by the balancing filter (delayed, hardware)

Autoscale

Changes the plot scales to fit the currently displayed signal into the screen while keeping the current aspect ratio

### Access to setting panels

Instrument settings

Shows or hides the instrument settings, i.e. all the settings applied before the digitization of the signal (frequency, hardware gains, etc.).

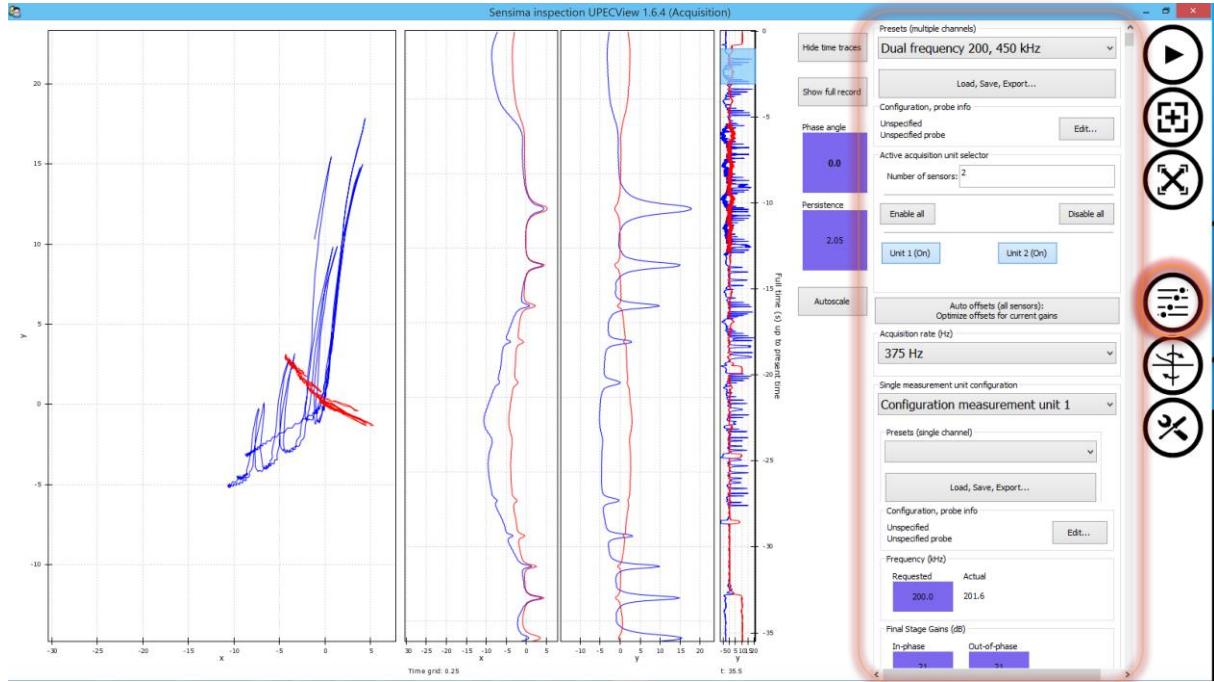
Processing chain settings

Shows or hides the processing chain. These are all the post-acquisition signal processing operations (e.g. rotation, software gains, etc.)

Toolbox

Shows or hides the tool panel, allowing to save and load data, generate reports, access global preferences, etc.

## 5.6 Instrument settings



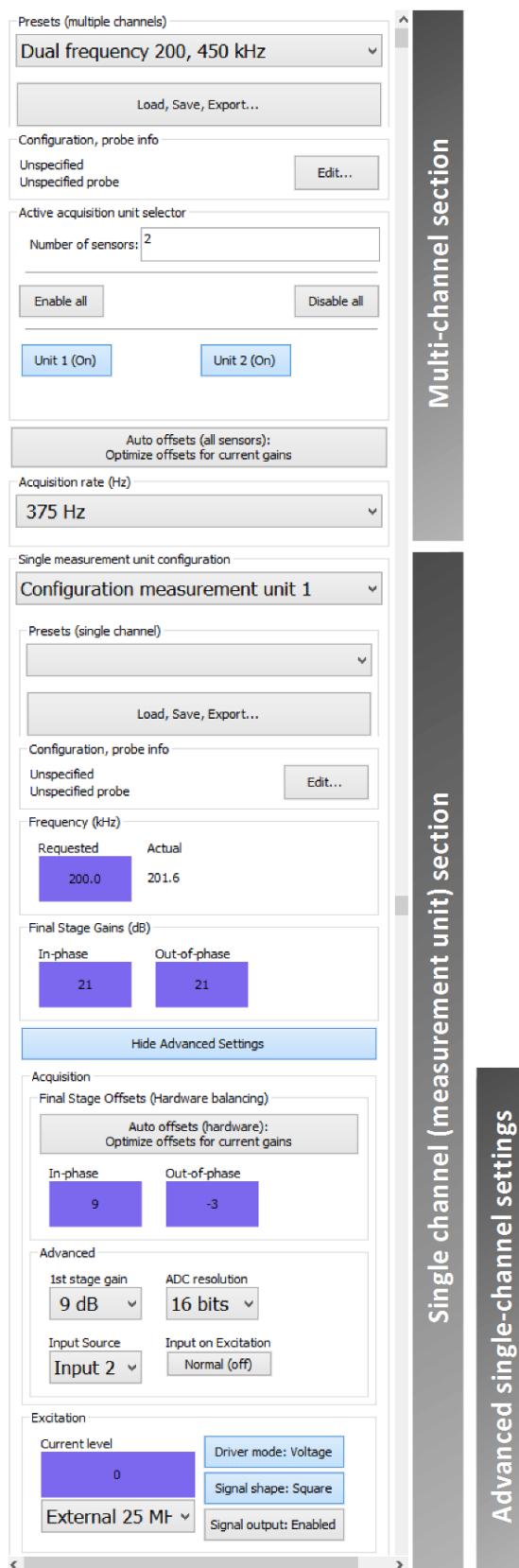
**Figure 9:** Click or tap on the “Instrument settings” button to show the corresponding panel. The example shown here is after having stopped a dual-frequency acquisition (blue and red signals) with time traces on and with a time region selected.

This is probably the most complex panel of the interface. It gives you a direct access to all the settings of the instrument.

The general organization of the panel is to present the most used options first, namely close to the top. This is in fact the general philosophy for all the panels in UPECView.



**TIP** As the panel may be longer than the screen, you may have to scroll it with the slider on the right hand side. If this slider is not visible, use the horizontal slider at the bottom of the screen.



Preset management  
(multi-channel presets)

Probe and configuration information (textual)

Selector of active measurement units for acquisition:

- Number of units
- Buttons to activate/deactivate measurement units

Hardware balancing (for all active units)

Acquisition rate (drop-down selector)

Measurement unit selector (drop-down list)

Preset management  
(single-channel presets)

Probe and configuration information (textual)

Excitation frequency (control to select requested frequency and actual frequency)

Gains (dB) just before digitization (in-phase and out-of-phase)

Button to show/hide advanced settings

Hardware balancing (for this unit only)

Offsets for the hardware balancing

Advanced settings for the acquisition:

- Gain (dB) before demodulation
- ADC resolution (related to acquisition rate)
- Input source used for this unit (1 or 2)
- Should input be connected to excitation

Advanced excitation settings:

- Driver mode (Voltage or Current)
- Current level (intensity) for current mode
- Signal shape (square or pseudo-sine)
- Clock source (default: external 25 MHz)
- Enable/Disable signal generation

Figure 10: The full instrument settings panel with explanations (see below for further clarifications)

### 5.6.1 Multi-channel vs single-channel settings

The UPEC USB, WR, io and MC instruments are all composed of several single-channel instruments, each of which possesses its own signal generation and acquisition modules. We call those single-channel instruments “measurement units”.

#### Channels and measurement units

In practice, “measurement unit” and “channel” could be used interchangeably in the interface or in this guide. We prefer “measurement unit” since it conveys the idea that each unit has its own signal generation and acquisition modules with their own excitation, input, gains or digitization settings whereas “channel” would refer to an acquired signal only.<sup>16</sup> To summarize,

$$\text{measurement unit} = \text{acquisition unit or unit} \cong \text{channel}$$

### 5.6.2 Multi-channel settings

The first section of the instrument settings panel (Multi-channel section in Figure 10) is dedicated to the settings common to all measurement units, such as:

- The number of units on the tester.

This determines how many buttons and unit settings you can access with the interface. Giving a smaller number than the number of units physically present on the instrument just means you cannot access the additional ones and is perfectly safe in all cases.<sup>17</sup> However, giving a larger number means that the settings for units not physically present will be ignored by the instrument and that (obviously) no signal will be acquired and recorded for those units. Although this may work in some cases, it may have undesired side effects on the resulting processed signal.

- Which are the active units.

This defines from which units a signal is acquired. By default, “unit 1” is active when UPECView starts (this is why if you tap/click on the “Play” button immediately after startup, a signal is immediately displayed). Note that this applied *only to signal acquisition*, i.e. an inactive unit can and will generate a signal into the probe according to the unit settings.

- The acquisition rate.

The acquisition rate can be chosen from four values and is common to all measurement units. It determines the effective resolution of the signal digitization, i.e. the “ADC resolution” (375 Hz – 16 bits, 750 Hz – 15 bits, 1.5 kHz – 14 bits and 3 kHz – 13 bits). This will override any individual unit setting for the ADC resolution.

- Multi-channel presets.

These presets or acquisition configurations contain all the multi-channel settings as well as all the single-channel ones for all the measurement units.

<sup>16</sup> In fact, a measurement unit is a multi-channel instrument since it can multiplex the signal acquisition between two independent inputs. This is however not available in UPEC USB and WR instruments (owing to the limitations of the 4-pin probe connector) and cannot be configured by UPECView (below version 1.7).

<sup>17</sup> This is useful in connection with presets: it is perfectly safe to use a preset or an acquisition configuration file designed for an UPEC instrument on another with a *larger* number of units.

- Auto offsets or hardware balancing.

This is shortcut button to perform an auto offset or hardware balancing (see section 5.6.7 below) on all active units instead of having to do it one measurement unit at a time.

### 5.6.3 Quick start – Single channel operation mode

In fact, when you start UPECView you are immediately set for single-channel acquisition: If you bring up the instrument settings' panel, you have all the settings available for the measurement unit 1 as shown in Figure 10 (just make sure that unit 1 is active and activate it if not). Here you can start the acquisition and change the settings (such as the frequency) to see the effect on the signal.

### 5.6.4 Further steps – Dual-frequency operation mode

To start a dual-frequency acquisition, just activate both units in the multi-channel section of the instrument settings' panel, select the second unit configuration from the drop-down menu ("Configuration measurement unit 2") and choose another frequency with the frequency control. If you are acquiring, you have two signals in blue for the 1<sup>st</sup> unit or channel and red for the second.

When dealing with single-channel settings in a dual-frequency mode, make sure to check which unit you are acting on by looking at the selected unit in the drop-down menu.



**WARNING**

The two generated frequencies are injected simultaneously. This has two consequences which could be detrimental to the measurement if misused: (1) the power injected into the EC probe is about doubled and this may damage the probe); (2) the larger frequency should in general not be too close to a multiple of the smaller one in order to avoid catching unwanted harmonics of the lowest frequency into the highest frequency channel (this is not absolutely necessary but should be considered as a good practice).

### 5.6.5 Single measurement unit settings

These are the settings in the second section in Figure 10. We describe them from top to bottom.

The first part is devoted to single measurement unit configuration management, i.e. presets and acquisition configuration for a single-channel module. It looks very similar to the very top of the instrument settings panel but its scope is limited to single channel parameters. It is followed by a probe and configuration naming section as for the multi-channel section.

#### Main settings

The main settings are the excitation and demodulation frequency and the hardware gains just before the digitization of the signal. The other settings are grouped as advanced and are hidden by default.

The frequency is controlled by the internal clocks on the UPEC device and its granularity depends on several advanced settings. This is why there is an "actual frequency" field next to the frequency or requested frequency control which displays the frequency effectively used to excite the probe and demodulate the signal. A measurement unit has only one frequency at any one time.

The “final stage gains” affect the signal after demodulation and can be set independently for the in-phase and out-of-phase components of the signal. They are displayed in dBs and rounded to an integer value.<sup>18</sup>

## Advanced settings

These settings allow a very fine control of the UPEC instrument. They are revealed by toggling the On/Off state of the “Show advanced settings” button.

The first button is the “auto offsets” or hardware balancing. When clicked, it triggers the procedure of tuning the offsets (voltage subtraction, see 5.6.7) after demodulation in order to make the signal as close to zero as possible. Since the steps are relatively coarse, especially at high gains, this procedure cannot completely null the signal and hence cannot replace the software balancing controlled by the processing chain. Although very useful, this button is put in the (normally hidden) advanced settings because the corresponding button acting on all active measurement units in the multi-channel section should be used in general.

Just below the “auto offsets” button, you find the manual settings for the offsets for the in-phase and out-of-phase components of the signal. The units are arbitrary (between -127 and +127). This is normally set by one of the “auto offsets” buttons, but you can change them manually if the automatic procedure does not give the expected result or to further optimize the gains if the signal is in a particular direction. These are further explained in section 5.6.7 below.

The advanced section allows you to fine-tune the acquisition settings:

- 1<sup>st</sup> stage gain. (default: 6 dB)

This is the gain of the signal amplification before demodulation and just after the signal input of the UPEC instrument. The reader is referred to ISO 15548 1 2013 for the detailed meaning of this amplification stage. It is advised to leave it to the minimal value of 6 dB to avoid difficult to diagnose saturation issues.<sup>19</sup> However, it can be used to perform further vector amplification if needed.

- ADC resolution. (default: 16 bits; do not change: use the acquisition rate to affect this value)

This is the signal digitization resolution. Unless you are using a UPEC instrument with a single measurement unit (legacy), you should use the acquisition rate setting in the multi-channel section to change this value. See also section 5.6.8 below.

- Input source. (default: Input 2)

Each measurement unit has two signal input which can be toggled in multiplexed signal acquisition configurations. You can define which input you want to use for this unit. This is not relevant to UPEC USB and WR version of the tester, but can be used in the io and MC versions.

- Input to excitation.

In addition to choosing between inputs 1 and 2, you can set the measurement unit to measure the signal directly at the output of the signal generator. The main use is in current-driven mode with an absolute probe.

Finally, the excitation section presents several advanced settings for the signal generation:

<sup>18</sup> They can be set in steps of 2.7 dB

<sup>19</sup> A saturation at that level would result in signal clipping in the high-frequency regime and could potentially alter the harmonics content of the signal before demodulation, something that is very difficult to notice on the final measured signal apart from it being quite unusual.

- Drive mode. (default: “Voltage”)

The output of the signal generator module can be either voltage-driven with a 9 V peak-to-peak signal output or current-driven with an output varying between 1 and 10 mA in 4 steps. In normal operation, use the voltage-driven mode which guarantees that most of the generated power is transferred to the eddy current probe. The current-driven mode is useful when dealing with single-coil absolute probes, allowing direct impedance measurement.

- Current level.

It allows to choose one of the 4 current level steps. Obviously it has an effect only in current-driven mode.

- Signal shape. (default: “Square”)

By default, the generated signal has a square shape (i.e. vertical rising and falling edges). You can change it to a “pseudo-sine” shape to approximate a pure sinusoidal signal with 8 time steps. Note however that you reduce the number of frequencies you can generate (or more precisely, you increase the steps between the actual frequencies that the generator can produce).

- Clock source. (default: “External 25 MHz”)

The clock is used to keep track of time in a measurement unit and to generate the signal. A faster clock means that frequencies can be generated more precisely, or that the actual frequency is closer to the requested one. A measurement unit has 4 possible settings for the clock source. The first one – the one that should be used in multi-channel instrument such as the UPEC USB or the UPEC WR testers – is the “External 25 MHz” clock source. This is provided by the multi-channel board and guarantees that all the measurement units are in-phase. The other ones are generated by the measurement unit internally with 25 or 170 MHz.

- Signal output. (default: “Enabled”)

This setting allows to disable the signal output completely for this measurement unit. This is useful mainly with array probes to use a measurement unit in signal acquisition only or to remove possible interferences.

## 5.6.6 Presets and instrument configuration management

All the instrument settings described here are grouped in what we call the acquisition configuration. This can be stored in the form of files or presets for quick access. This is the purpose of the drop-down menus and “load, save,...” buttons in the instrument settings panel. There is a distinction between multi-channel configurations which include all the instrument settings for all the measurement units, including which are the active ones and the single-channel configurations which store only the setting for a single measurement unit. The latter can be useful in array probe configuration (beyond the scope of this manual) or for keeping a quick access to single-channel configurations which are often used.

Note that changing any setting will invalidate the current preset (turning it to blank). This is to avoid confusions arising from having changed a setting by mistake and still having the preset name displayed in the preset box.

## Managing presets and configurations

Press on the corresponding “Load, save, export...” button in the instrument panel depending on whether you want to manipulate single-unit or multi-channel configurations. UPECView shows the configuration management panel below.

This panel is quite self-explanatory (additional help is available in the form of tooltips) and has 3 sections which are highlighted in the figure below:

### 1. Configuration file management

Here you can either load an instrument configuration from a file or save it to a file using the two buttons

### 2. Preset management

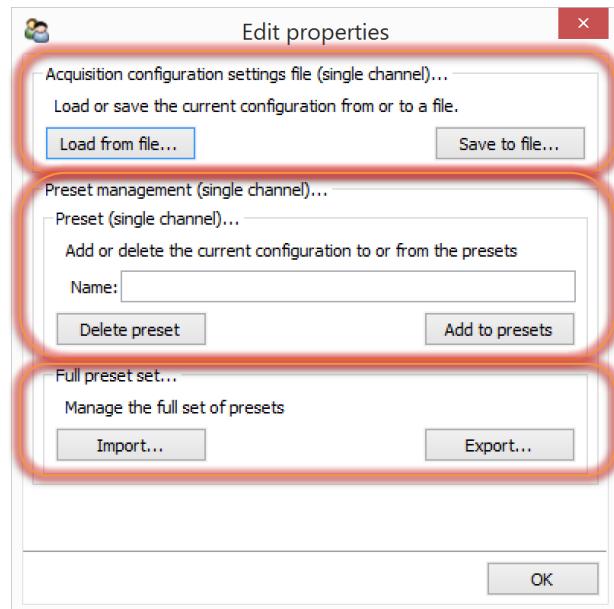
You can add the current configuration to the list of presets by entering a name in the corresponding box and clicking on “Add to presets”. Note that if the preset name already exists, it will be overwritten but you get a warning allowing you to cancel the operation.

Alternatively, you can delete a preset you do not need anymore by entering its name and clicking on “Delete preset”. You will be asked for a confirmation.

### 3. All preset management

The last part allows to export or import the full set of presets to or from a file. Note that if you import presets, it will erase all the existing ones you have and replace them by the imported ones. This is useful to transfer all the presets from one tablet/PC to another.

Once done, just click “OK” to close the panel.



**Figure 11: Configuration management panel example (for single-channel configurations)**

### 5.6.7 Hardware balancing (auto offsets)

In accordance with ISO 15548 1 2013, the offsets are an analog voltage subtraction performed after the demodulation and just before the second (final) amplification stage. They can be set independently for the in-phase and out-of-phase part of the signal. This allows to further increase the vector amplification (gain) without risking saturating the signal. The auto offsets or hardware balancing procedure is to find the offsets making the measured signal as close as possible to zero for both components. As the number of voltage steps is limited to 255, the signal cancellation cannot be perfect at this stage and has to be complemented by the standard post-processing balancing.

Note that the offsets are parts of the configuration settings and thus saved to configuration files or presets. This means that for an inspection task, the offsets should have been defined in the preset, tile

or acquisition configuration file when it was prepared on a reference sample and never touched during the actual inspection, the inspector using only the standard balancing button to compensate for the (small) material variations and environment changes.

**CAUTION**

If you perform a hardware balancing or auto offset after having done a standard (or “software”) balancing from the button in the main panel, it is very likely that the resulting ‘balanced’ signal is not close to zero as expected. Just hit the balancing button again and the signal will be at zero as expected.

## 5.6.8 Acquisition rate

The acquisition rate is related and controls the effective signal digitalization resolution (“ADC resolution”), losing one bit of resolution each time the acquisition rate is doubled:

<i>Acquisition Rate</i>	<i>ADC Resolution</i>
375 Hz <sup>20</sup>	16 bits
750 Hz	15 bits
1.5 kHz	14 bits
3 kHz	13 bits

For multi-channel instruments, the acquisition rate setting is only accessible from the multi-channel section of the settings, but changes affect every single-channel ADC resolution setting according to the correspondence table above. Note that although UPECView allows you to modify the ADC resolution setting for each measurement unit, it is strongly discouraged and we advise using the global acquisition rate to control the resolution instead of the individual ADC resolution.

The rate is understood per acquisition unit. For instance, a dual-frequency acquisition at a rate of 750 Hz generates  $2 \text{ (channels)} \times 750 \text{ (Hz)} = 1500 \text{ (measurements/s)}$ . Higher acquisition rates may result in slower refresh rates for the screen display.

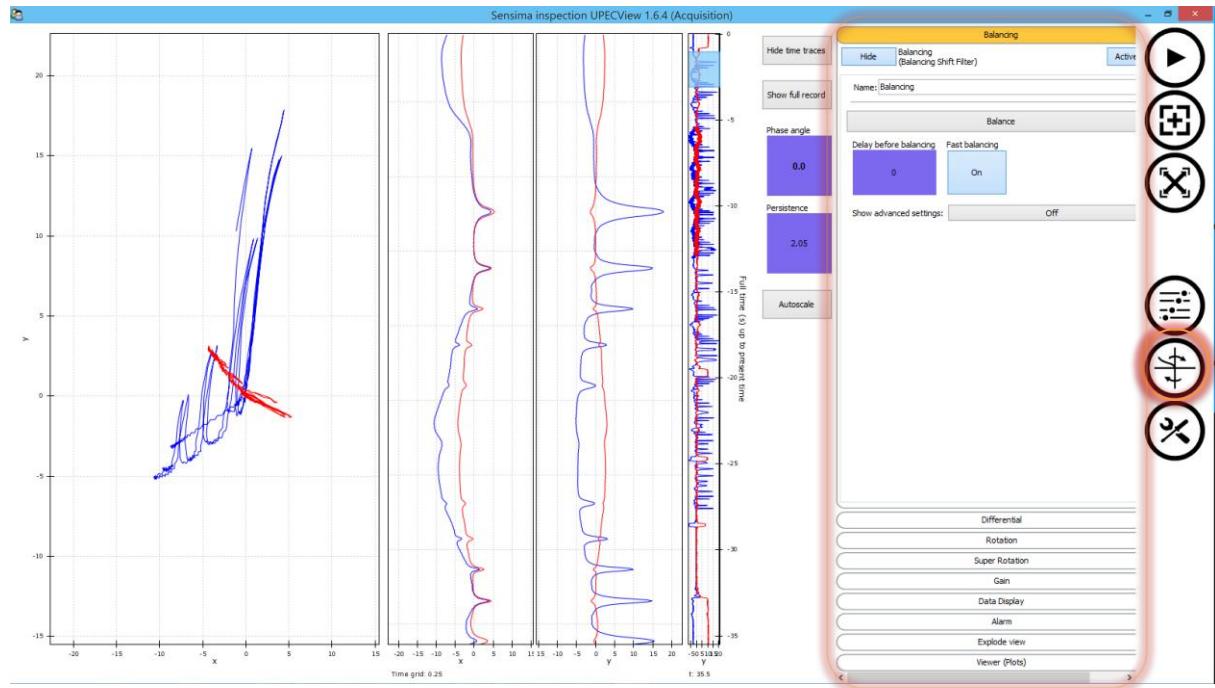
**UPEC WR  
WARNING**

Do not exceed 1500 measurements/second for UPEC WR devices used in wireless mode (Bluetooth). This corresponds to dual-channel at 750 Hz or single channel at 1.5 kHz. The bandwidth of the wireless channel is not sufficient and attempting to acquire faster may result in loss of communication.

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<sup>20</sup> Displayed acquisition rates are within 2.5% of the actual ones. Time stamps in the data stream are however exact.

## 5.7 Processing chain settings



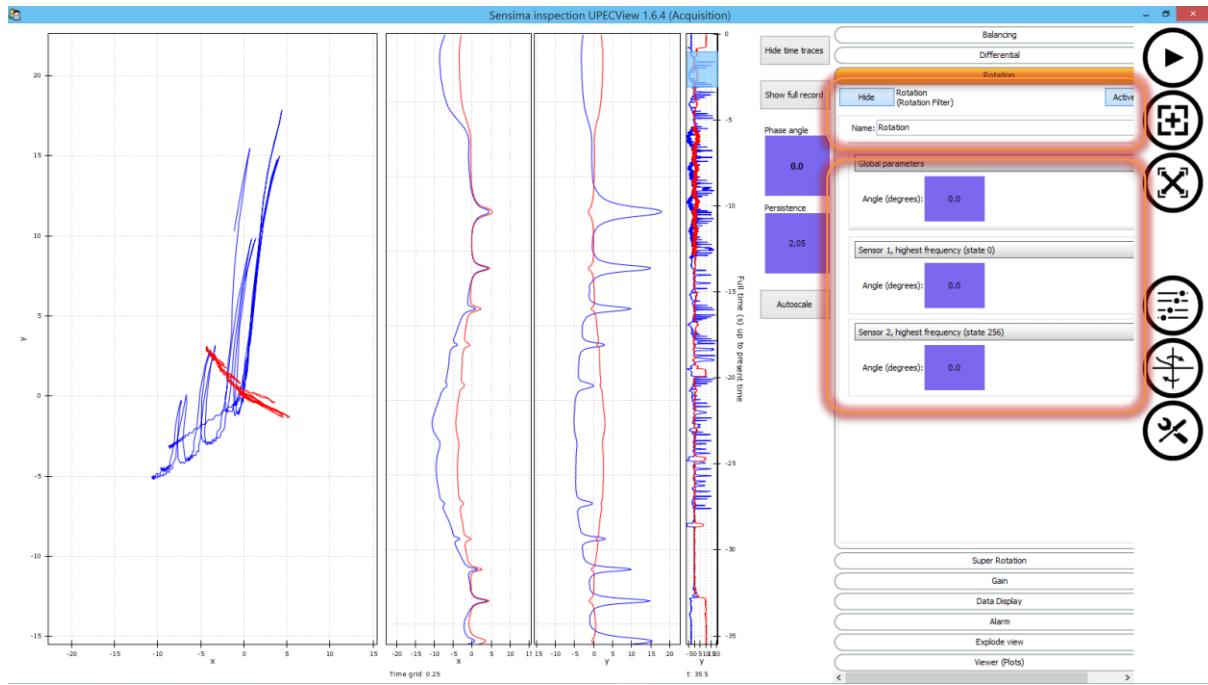
**Figure 12:** The processing chain settings panel is displayed through the corresponding button.

The processing chain is a stack of filters. The measured signal – the raw data – goes through each filter from top to bottom being transformed and becoming the processed data which is finally displayed on the plots.

The parameters for each filter are displayed by clicking/tapping on the banner carrying the filter's name.

The following sections describe all the filters and their parameters. Apart from the first filter (balancing) which has been set during the acquisition, the effect of the parameters are shown by the evolution of the corresponding dual-frequency signals. The description shows how to rotate, orthogonalize and (approximately) match a dual-frequency notch response.

### 5.7.1 Anatomy of a filter – example of the rotation filter



**Figure 13:** The generic sections of a filter: the header and the parameter sections (from top to bottom); the latter can be further split into global parameters affecting all the channels and per-channel ones for each channel.

The top section is generic and the same in all filters. Here you can:

- (button) Show or hide the filter parameters (do not use: with this way of displaying the processing chain, hiding parameters does not make sense)
- (button) Activate or deactivate the filter. Note that an inactive filter does nothing, i.e. it behaves like a pass-through for the signal.
- (text field) Give a name to the filter (the one in the banner)

The filter name and type are displayed between the two buttons.

The bottom section is devoted to the filter parameters, most of which can be modified live with “controls” (see 3.2 or 5.2.1).

#### Activate and deactivate a filter

Simply click on the “Active” button at the top right of the filter panel to toggle between the active and inactive states. An inactive filter is just a pass-through for the signal.



**CAUTION**

Although deactivating a filter can be convenient to quickly evaluate the effect of that filter, working with a deactivated filter may lead to disconcerting results. For instance, if you deactivate the rotation filter, any change made to the phase angle will not affect the signal anymore. Furthermore, deactivating the balancing filter will give the impression that the balancing button () has no effect.

#### Global and per channel settings

Many filters have both global and single-channel settings. The global settings affect all the channels whereas the single-channel ones affect only the specific channel. In general and where it makes sense,

the per-channel settings are added to the global ones. The way in which the effects are added depend on the filter and the operation on the signal. For instance,

- Rotation filter: the single-channel rotation angle is *added* to the global rotation one
- Gain filter: the single-channel gains further *multiply* the global ones
- Super rotation filter: the operation cannot be combined in a meaningful manner, meaning that either the global or the single-channel parameters are applied (there is a checkbox in the single-channel parameter to tell if it should override the global setting)

The specific channel settings are automatically added as new channels are encountered during the acquisition and are never removed. This means that if you activate a second unit, all the filters will add the corresponding settings and those will remain when you deactivate the unit later. The channel ID is listed as the state number of the channel.

## 5.7.2 Balancing filter

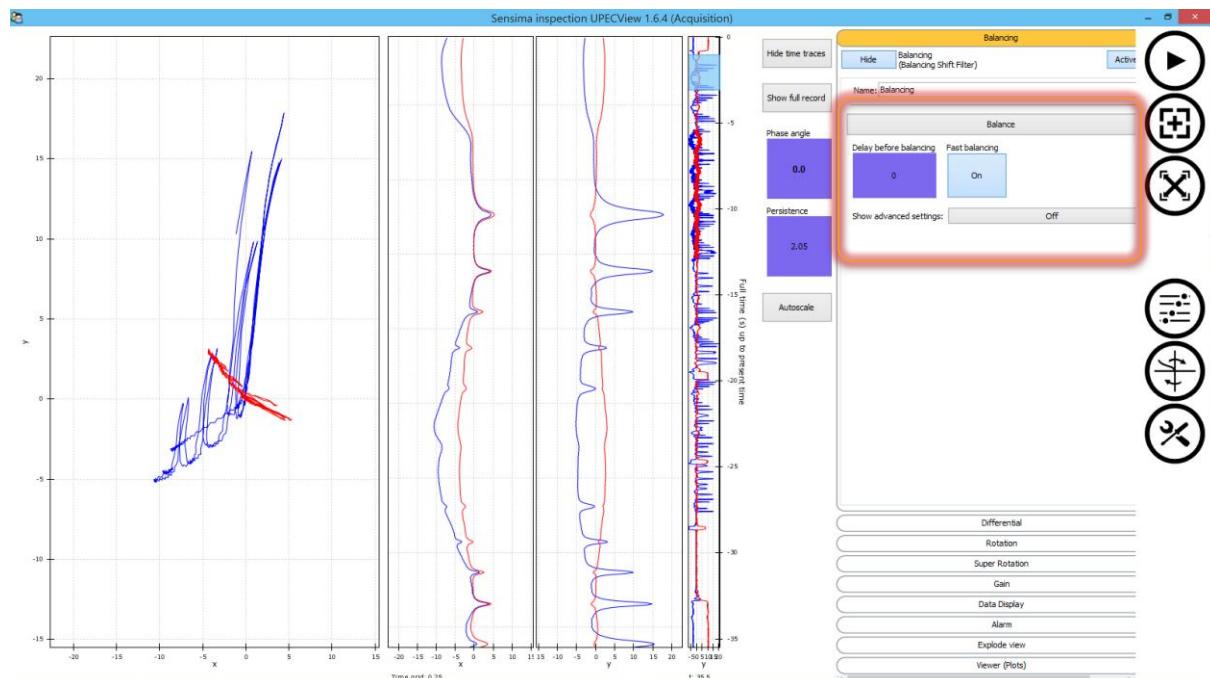


Figure 14: The balancing filter.

The balancing filter is responsible for zeroing or nulling the signal when the “Balancing” button (⊕) is pressed. This is done by averaging the signal in all channels over a period of 0.5 s just before the button is pressed. This is what we call “software” balancing as it can be modified or undone in post-processing. In general, there is no need to modify any settings in this filter except to access two useful optional features:

- Delayed balancing:

You can define a delay (in seconds) between the moment the balancing button is pressed and the moment the actual balancing is performed. The default is 0, i.e. no delay. This is particularly useful when holding the tablet in one hand and manipulating the probe with the other: it is difficult to access the balancing button while maintaining the probe on the inspection surface. A countdown is displayed on the screen after the button is pressed and a sound is emitted when the balancing is performed.

- Fast balancing:

This is on by default and correspond to the software balancing described above. If you set it to off, the balancing filter will first perform a hardware balancing (auto offsets) before the normal balancing. The use of the latter is discouraged for two reasons: (1) it is significantly slower than the standard balancing and (2) it is against the concept of inspection task instrument settings exposed in section **Error! Reference source not found.** in which the instrument settings are frozen for a given task allowing an easier and better comparison and interpretation of similar data.

The filter has also other settings. The balancing button in the filter is strictly equivalent to the button in the main panel. The period used for the signal averaging (0.5 s) can be altered in the advanced parameters. If you show the advanced parameters, you can also see the balancing values channel by channel (not shown in Figure 14).

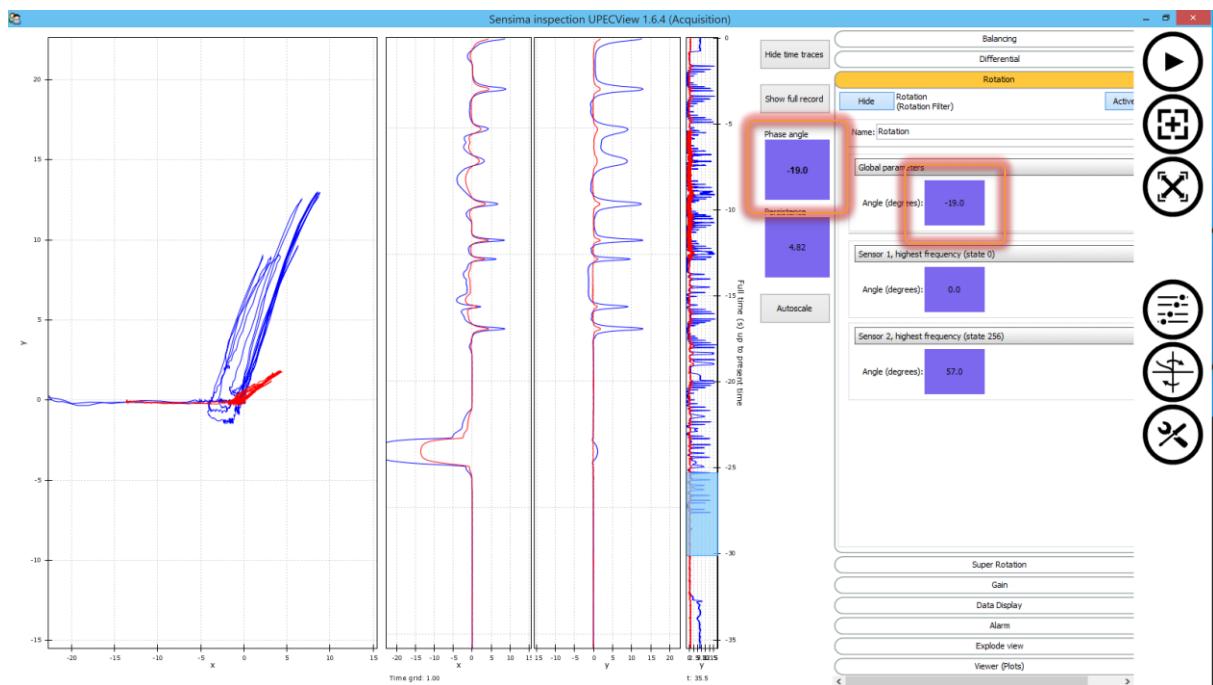


- If you have to hold the tablet and probe at the same time, use the “Delayed balancing” feature of the balancing filter.
- You can use the eddy current probe as a pen to point and select options on the screen. Be careful not to scratch the screen however.

### 5.7.3 Differential filter

In its default configuration, the differential filter replaces two channels (identified by their sensor indices) by their difference and sum respectively. It is intended for differential absolute configurations with 2 absolute coils in a probe. This configuration is not directly available with the probe connector pin-out of the UPEC USB and UPEC WR testers and the filter is therefore deactivated by default in UPECView and is not further documented here.

### 5.7.4 Rotation filter



**Figure 15: Rotation filter and its effect. The global rotation angle is equivalent to the “Phase angle” setting.**

The filter is obvious. It controls the additional rotation applied to the signal. The global setting affecting all the channels is in fact the same as the “Phase angle” setting which is always visible.<sup>21</sup> The channel specific rotation angles are added to the global one.

In our case, a global rotation of  $-19^\circ$  was necessary to make the liftoff signal horizontal and towards the left for the 1<sup>st</sup> channel (blue) and an additional rotation of  $57^\circ$  (total of  $38^\circ$ ) to do the same for the 2<sup>nd</sup> channel (red).

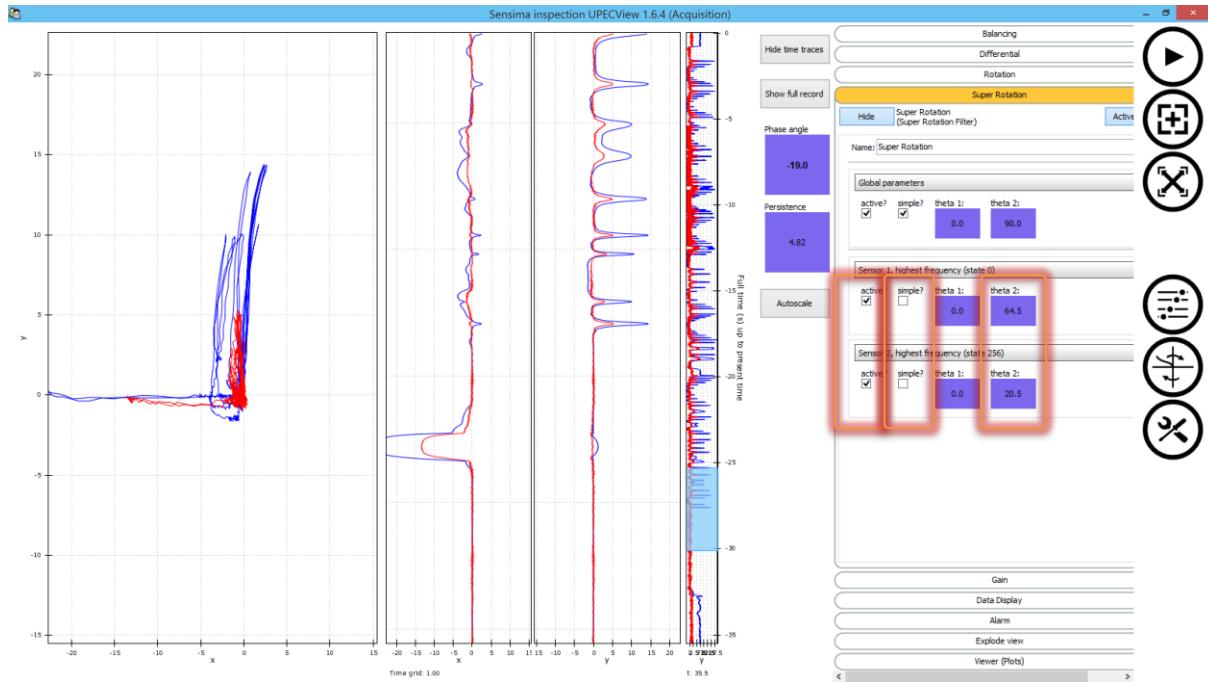
### 5.7.5 Super rotation filter



NOTE

This filter is only accessible if you have enabled the “Experimental filters” options in the preferences.

<sup>21</sup> CAUTION: Only the global rotation setting is reflected in the “Phase angle” quick control. Therefore it may not be sufficient to set the phase angle back to 0 to suppress all rotations as specific channels may have their own settings. In single-channel inspections, this may be confusing and we advise to use the global or phase angle to set the rotation in those cases (i.e. refrain from using the specific channel rotation angle).



**Figure 16: Super rotation filter and its effect.**

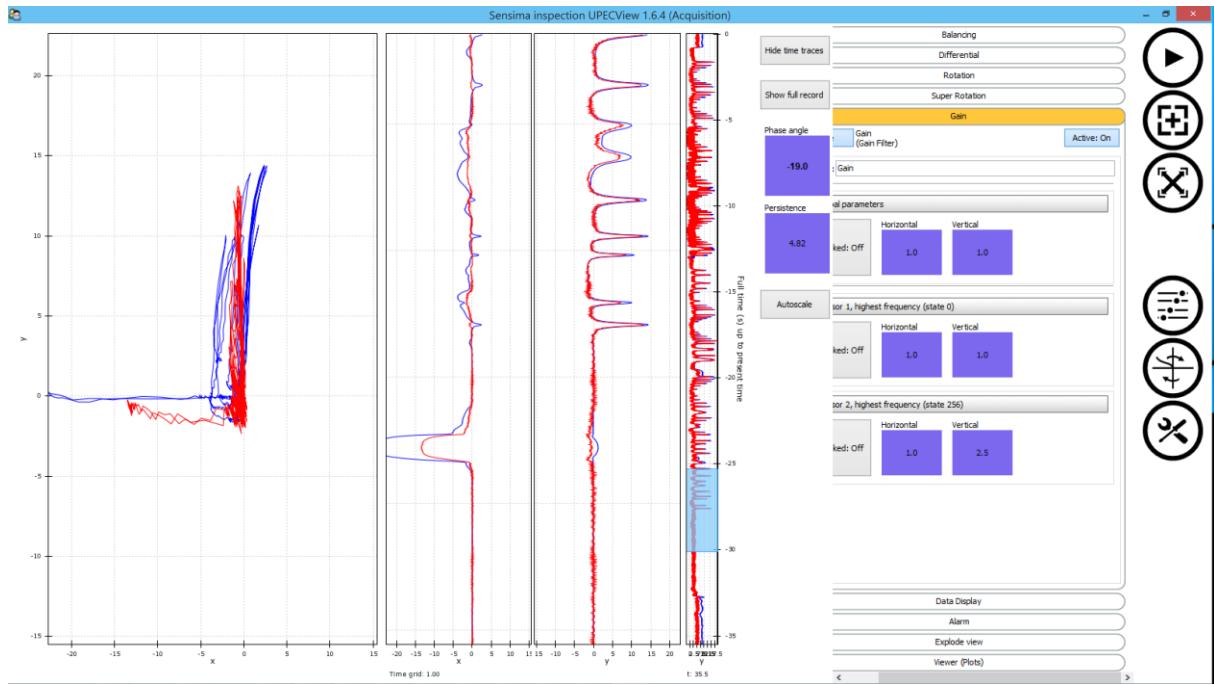
This filter is an extension of the rotation filter which can in addition make the signal from a relevant feature (e.g. a notch) as orthogonal as possible from that of another (e.g. a liftoff). Here, single-channel settings override global settings only if they are active (“active?” checkbox ticked).

In the simple mode (“simple?” checkbox ticked), the filter behaves like a rotation filter except for the parameter combination between global and per-channel settings. In this mode, theta2 is always 90° more than theta1 ( $\theta_2 = 90^\circ + \theta_1$ ).

In the super-rotation mode (“simple?” checkbox unticked), each theta angle is the angle between the corresponding basis vector and the horizontal. The default is theta1 = 0 and theta2 = 90° which correspond to the standard basis vectors and therefore to a filter doing nothing to the signal (pass-through). The best is to experiment with the settings.

For our example, we have left the global parameters to the default and activated the super-rotation for both channels. We have touched only the theta2 setting since the liftoff signal is nicely horizontal (in fact this has been taken care by the rotation filter just before). If you look at Figure 15, you should notice that the theta2 angle corresponds to the angles made by the notch signals with the horizontal, i.e. 64.5° and 20.5° respectively. In fact, by playing with the two angles, we could have replaced completely the previous rotation and this one. Note that the result is a quite nice orthogonality between the liftoff and notch signals for both frequency. With standard eddy current instruments, this is normally obtained by carefully choosing the right frequency for which this is the case.

### 5.7.6 Gain filter

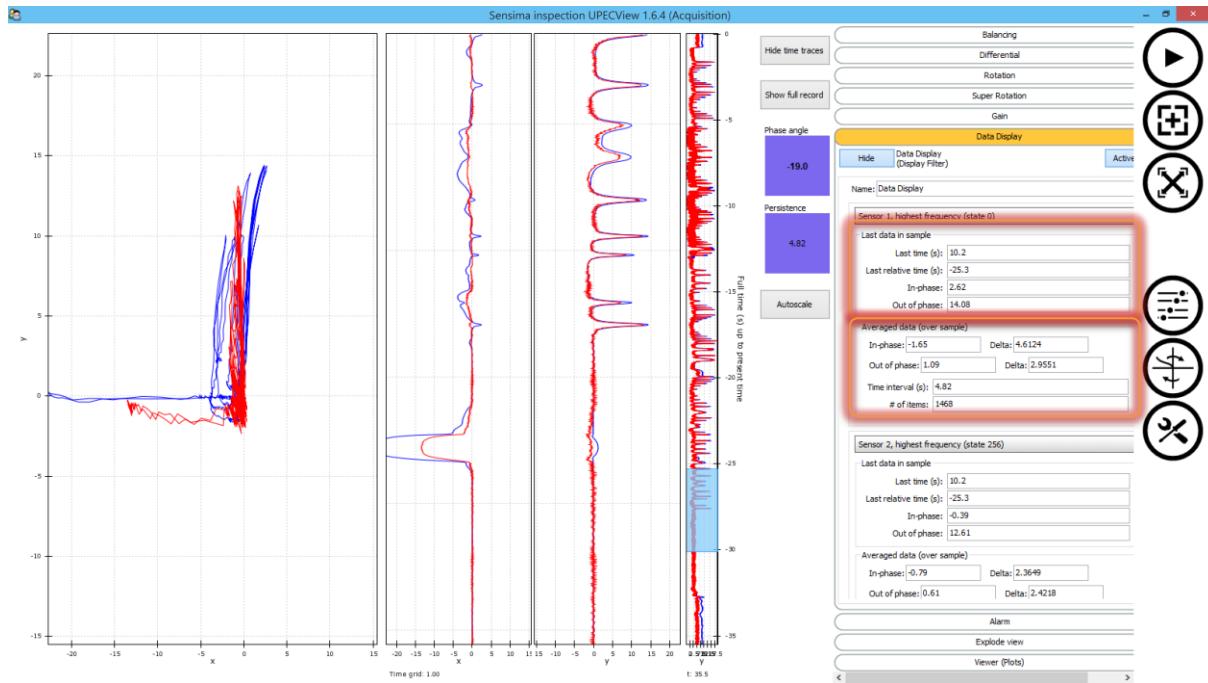


**Figure 17: Gain filter and its effect.**

The gain filter allows to adjust the horizontal and vertical gains individually or together. These gains come in addition (in a multiplicative sense) to the hardware gains in the instrument settings. The displayed values are the multiplicative factors (i.e. they are not in dB), meaning that a value of 1 does not change the signal. To link the horizontal and vertical gain parameters, change the “Linked” button to On and both horizontal and vertical gains will move together when you change either of them.

In our case, we adjusted the vertical gain of the 2<sup>nd</sup> channel (red) to a value of 2.5 in order to approximately match the vertical amplitude of the 1<sup>st</sup> channel. Note that we have not tried to match the notch signal to a given voltage value (e.g. 1 V for a 2 mm deep notch) although the same procedure could be performed on both channels to achieve this.

### 5.7.7 Data display filter



**Figure 18: Data display filter.** This is just an information filter which has no effect on the signal.

This filter is an information only filter and has no effect on the signal. The fields are editable<sup>22</sup> so that you can copy their values to paste them in another program. The global parameter section should be ignored since it has no meaning (the fields are filled with ‘nan’ – ‘not a number’).

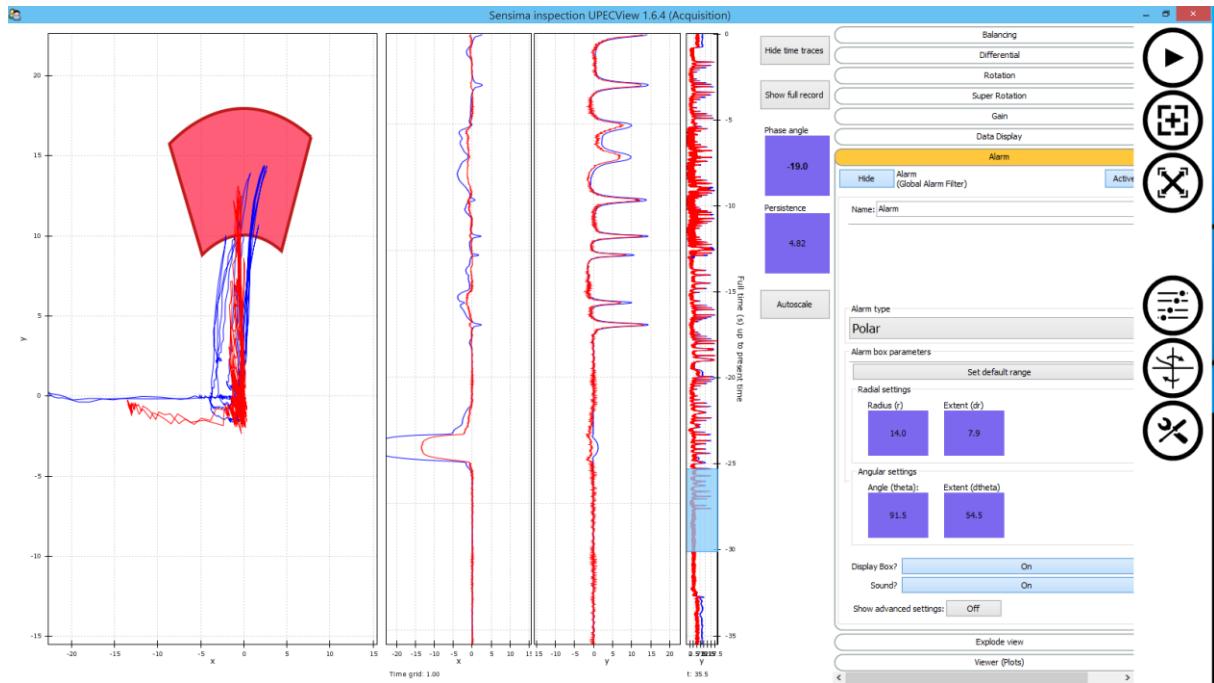
For each channel, the first section shows the last data (i.e. most recent) in the selected sample. There, the last time is measured from the beginning of the acquisition and the last relative time from the current acquisition time. The in-phase and out-of-phase values are the values of the signal at that moment.

The second section shows averaged values over the selected period. In the example shown here is has a very limited use since the selected region has both notches and liftoff, but it could be used with a proper selection to measure a signal or evaluate an average value. The “Delta” field shows the variation of the corresponding component of the signal over the selected region. Finally, the “Time interval” is the time span of the selected region in seconds (note that it is the same as the persistence, as expected<sup>23</sup>) and the “# of items” is the number of measurements (data points or items) in that time span.

<sup>22</sup> Meaning that you can change them, but it has no effect whatsoever: the values will be recalculated the next time there is any change in the signal (e.g. new data coming in during acquisition) or the processing chain.

<sup>23</sup> In a multiplexed signal acquisition, this may not be strictly true anymore. In fact, in this case, the last time may also vary from one channel to the next as the measurements are not done at the exact same moment.

### 5.7.8 Alarm filter



**Figure 19: Alarm filter.**

The alarm filter is deactivated by default. Click on the active button to activate it: an alarm box will appear in the impedance plane, either in green or red depending on whether a part of the signal is within the box or not.

You can choose between 3 alarm box types: Rectangular, Polar or Polar (semi-infinite). The alarm box parameters depend on that choice:

**Rectangular:** The box settings are split in horizontal (x) and vertical (y) sections. For each, you can control the center position and the extent of the box.

**Polar:** This is a sector or polar box. Its position is always relative to the origin of the plot, i.e. the (0,0) point in the impedance plane. The settings are split in radial and angular sections.

For the radial part, the radius ( $r$ ) is the average radius of the box (the radius of the box center) and the extent is the total height of the box along the radial direction.

In the angular part, the angle is the angular position of the box center (in polar coordinates), 0 being along the x-axis, 90 along the y-axis. The extent is the angular extent of the polar sector. All angles are in degrees.

**Polar (semi-infinite):** This is similar to the polar alarm box above except that the radius is the smallest radius of the box and the extent is infinite (no setting).

The “Set default range” button will set the alarm box parameter to a value depending on the current scale of the impedance plane axes so that it is within the visible region.

The two buttons below allows to control whether the box should be visible or not and whether a sound should be produced if an alarm condition is met.

During the acquisition, if the signal enters the box, the box turns red and a sound is produced (unless disabled by the buttons above). Note that the box remains red for half a second (see the visual alarm latency below) even if the signal exits immediately from the box. This is to make sure that the alarm condition is displayed on the screen for the operator to see. Furthermore, the sound, if allowed, is emitted only when the signal enters the box and no sound will be emitted in the next second (see audio alarm latency below). This is to avoid the annoying repetition of the sound when the signal is constantly within the alarm region.

The advanced settings allow to further control the behavior of the alarm filter (not shown in Figure 19). The alarm checkbox shows the current state of the alarm. The “Any state?” means that the alarm will be triggered by any channel if on (default). If you set it to ‘off’, you have to enter the ID of the channel which should trigger the alarm in the next field (“State/Channel”). If the “Rising edge” is on (default) it means that a sound will be produced only when the signal enters the box whereas if it is off, a sound will be produced when the signal enters and leaves the box. Finally, the visual latency controls for how long the box will remain red after the end of an alarm condition (0.5 s by default) and the audio latency controls the minimum period of time between two sounds. Normally you should not have to alter those advanced settings.

### 5.7.9 Explode view filter

In multi-channel data, the different signals are often superimposed in such a way that the identification of a defect signature in a particular channel may be difficult. This filter will separate the signals from one another and spread them around the plot (in several ways) with an animation.

### 5.7.10 Viewer controls

This behaves like a pass-through filter for the signal, but it gives further control on the plots. The different settings are explained in Figure 20 as well as below for some of them.

#### Time range selection

The time range selector which is hidden during acquisition allows to select the part of the signal being displayed in the impedance plane plot and the time traces. By default, this selector shows the vertical (y) component of the signal, although this can be changed to the horizontal (x) component or the absolute value of the signal.

To select a time range, click or tap and drag from an empty region in the selector (see Figure 21). The semi-transparent blue box shows the selected region (time range). To extend the selected region, click or tap and drag from one edge of the box. To move it around, do the same from the inside of the box. As it may be difficult to select a small time range, especially if the recorded signal spans a significant period of time, two controls are provided in the filter settings to refine the selection (Figure 20).

**Viewer (Plots) additional settings**

Standard filter header section (active button has no effect)	<b>Measurement tool</b>		
ID of the channel to use for the automatic measurement			
Button to trigger the calculation for the automatic measurement	<b>Time range selector and display</b>		
Button to display the measurement info in the impedance plane			
Special controls for restricting the part of the signal used in peak-to-peak (PP) calculations	<b>Additional settings</b>		
Information section showing values for the current measurement (Vpp is fo voltage peak-to-peak). x, y, length and angle are shown			
If the automatic measurement does not give satisfactory results, you can activate the manual controls			
Time range selector: these two controls allow a fine tuning of the selected region for cases when the blue box is difficult to grab			
Display: you can control which plots are displayed and whether or not you want the legend on the impedance plane plot			
Here you can set which signal component is display in the time range selector(x, y or absolute) and whether it should be autoscaled			
Current time since the start of the acquisition and time scale grid			
Button to show or hide the additional settings			
Here you can show or hide the vertical time axes in the time traces and in the time range selector			

Figure 20: The additional settings with explanations for a fine control of the view and the measurement or annotation tool.

## Signal measurement (annotation)

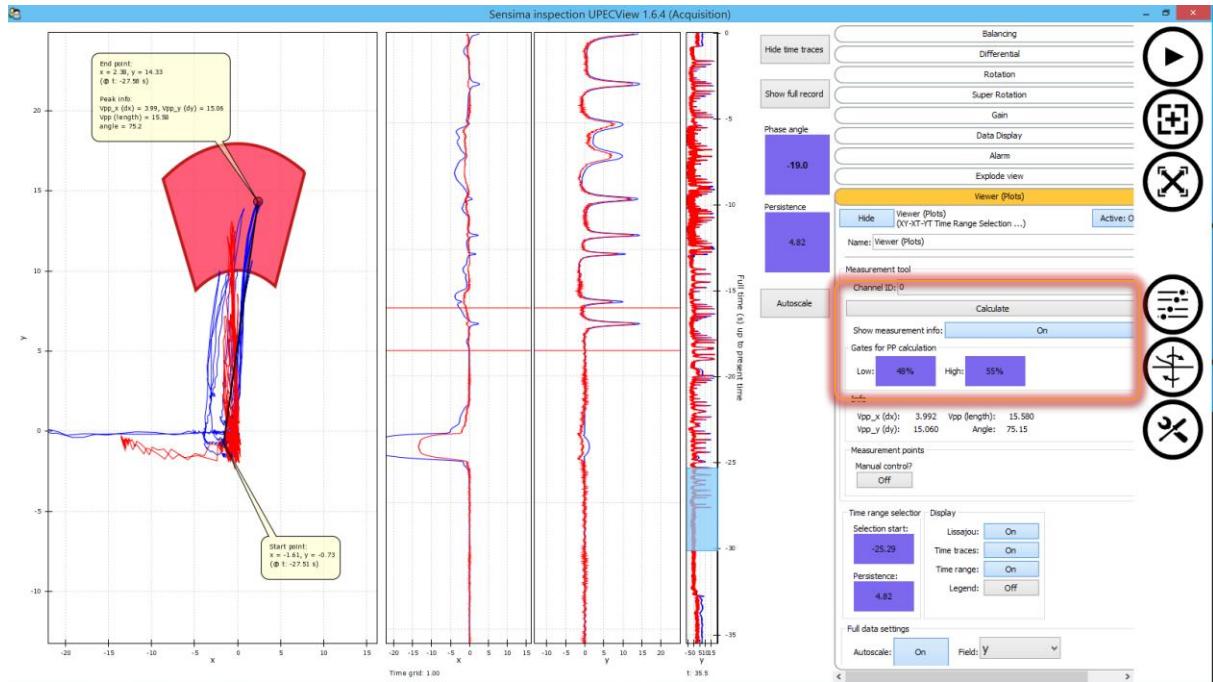
To perform a measurement of the signal from a specific feature, first click on the “Show measurement info” button. This displays a line with 2 information bubbles on the impedance plane plot at a default position. Then use the gate controls to further restrict the region of the signal that will be used to compute the measurement (see the highlighted box as well as the horizontal red lines over the time traces in Figure 21). The gate controls show the relative position of those gates in percent with respect to the bottom of the time traces. Note that this step is optional if you could select a time range sufficiently small to isolate the signal from the interesting feature to be measured. Then, click on the “Calculate” button (Figure 20 and Figure 21). The measuring line and bubbles are automatically adjusted and the information about the measurement (peak-to-peak voltage in length, x and y components and angle) is displayed in the bubbles and in the “Info” section as shown in Figure 21.

By default, the first channel is used for the measurement. If you want to do this on another channel, just enter the channel ID into the corresponding field (Figure 20).



**TIP** The information bubbles can be moved around by right-clicking on them and dragging. This is useful if they hide some otherwise interesting parts of the signal. Note that right clicking can be done with a pen connected to the tablet (by using the correct pen button).

The algorithm to determine the best line first finds the orientation in which the signal varies most and then connects the two data points which are the furthest away from one another along this direction. It works perfectly in most of the cases.



**Figure 21: Additional view controls.** The situation shown here is that of a signal measurement (“Show measurement info” on) within the gates (“Gates for PP calculation”) further restricting the selection range. The measurements are shown in the bubbles in the impedance plane and in the “info” section.

If the automatic measurement does not give satisfactory results or if you want to measure something different (e.g. the distance between the air point and say the maximum notch point: see Figure 22), you can use manual controls. To do so, activate the manual controls with the corresponding button and use the corresponding controls to move each point around (see highlighted region in Figure 22). Note that the information about the “peak-to-peak”<sup>24</sup> measurement is constantly updated both in the bubbles and in the info section.

<sup>24</sup> Misnamed in this case: in effect, it is the information about the line (length, orientation, etc.).

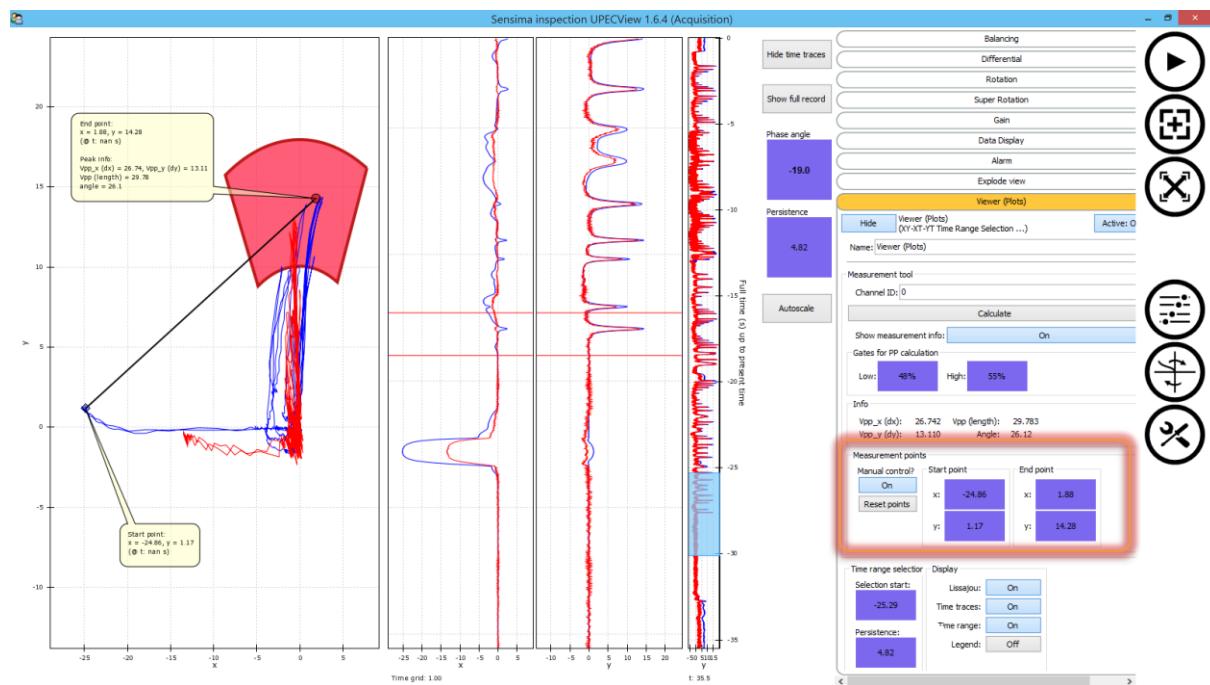


Figure 22: Using the manual controls for the measurement tool. The “Reset points” button allows to quickly go back to the default value for the measurement.

## Other settings

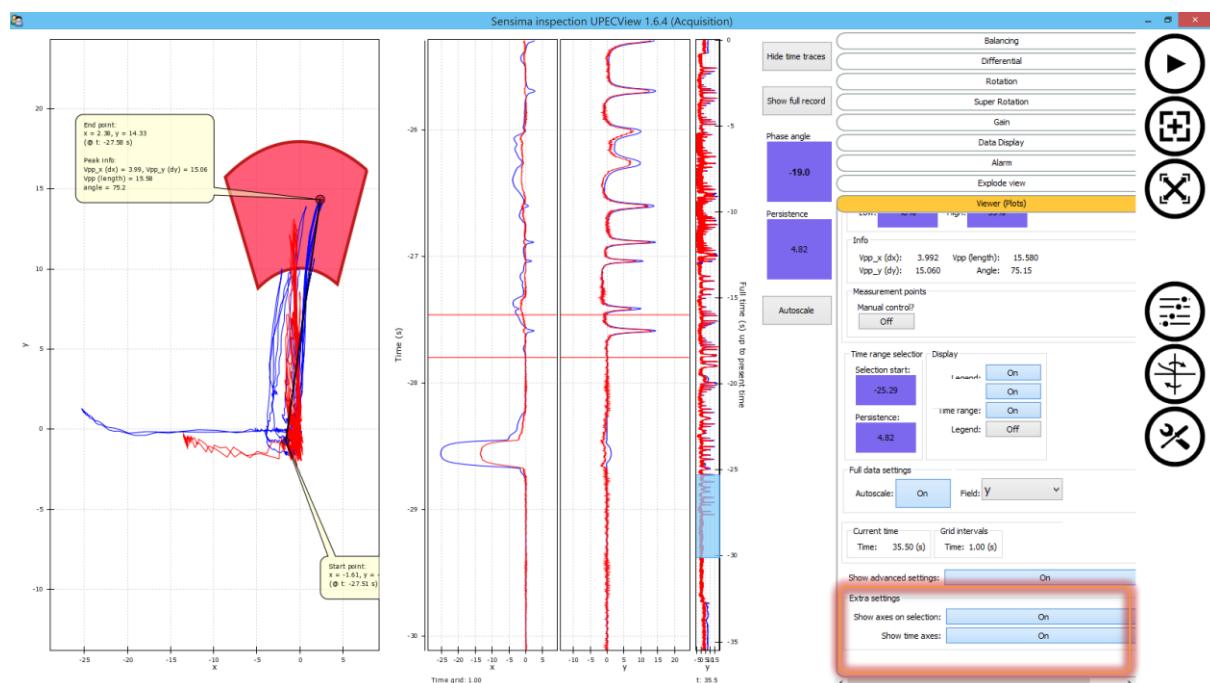


Figure 23: Result of displaying all the vertical time axes.

The other settings, e.g. the control of which plots are displayed are explained in Figure 20.

The effect enabling all the time axes display is shown in Figure 23.

## 5.8 Other advanced filters



These advanced filters do not appear in the list of filters by default. To activate them, set the Preferences > Advanced > Additional advanced filter to On.

TIP

### 5.8.1 Data import filter

Allows to import data acquired with instrument from some other manufacturers (details on request)

### 5.8.2 Encoder tick generation filter

This special filter is used to generate fake position information along a one axis. This is useful for generating images (C-scans) from manual scans over a surface with an array probe (see also 5.8.4 Array probe position shift filter). It works by using the time from the start of the acquisition and an effective scanning speed which you choose to add the position information to the data. You can choose which axis is affected by this. Note that if your data already contains encoder or position information, it is overwritten by the filter.<sup>25</sup>

### 5.8.3 Encoder tick conversion filter

This filter allows the conversion of encoder ticks in distance unit. You select the conversion factor (distance per encoder tick) for each axis independently. The filter displays the current<sup>26</sup> original (before the filter) and transformed position information for each axis. It is also possible to set the zero for each axis independently or together (see the corresponding buttons). Zeroing an axis simply means subtracting a constant value which is set by the button before transforming the coordinates. Note that this can be done at any time after the acquisition (even on loaded data) and at any location, i.e. you could move the selected time range to a feature of interest in the time traces and set the zero here, making the feature the origin of the scan.

### 5.8.4 Array probe position shift filter

This filter allows to shift the encoder position by an arbitrary value corresponding to the relative position of the probe for a given channel in multiprobe probes.

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<sup>25</sup> You can however go back to your original position information by simply deactivating the filter: as for all filters, the original (raw) data is kept unmodified, only the displayed or exported data is processed.

<sup>26</sup> Current means for the most recent moment in the selected time range. During acquisition, this is “now”, but in post-processing, it is defined by the selected time slice.

## 5.8.5 Feature Signal Decomposition (FSD) filter

Details on request.

## 5.9 Toolbox – Data management and reporting

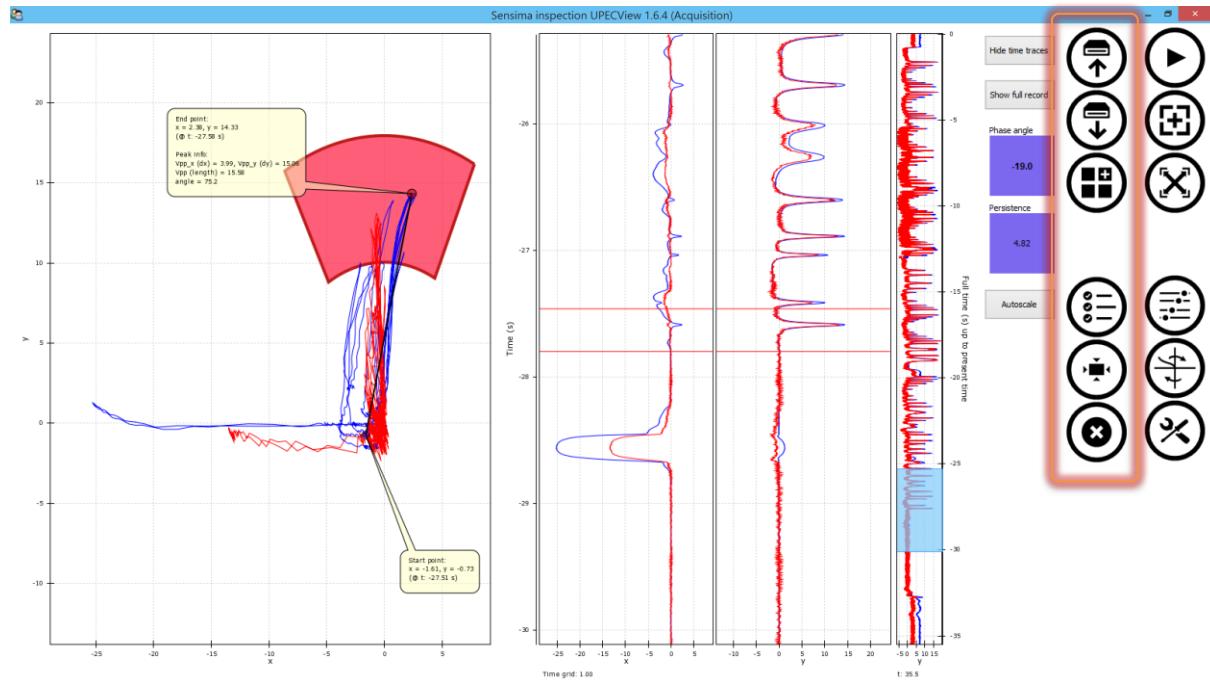


Figure 24: Toolbox panel

The last of the main buttons opens the toolbox panel whose different buttons are described from top to bottom in the following subsections.

### 5.9.1 Saving data and generating inspection reports

Clicking on the “Save” button starts the data saving process.

The first step is the possibility to fill in the EC inspection report<sup>27</sup> form which is used to generate the report. This is optional but spending a small amount of time to fill in details about the results and findings will save a lot of time when browsing through data later.

The EC inspection report form is organized to present the most frequently modified fields at the top of the form and the least at the bottom so as to limit the necessary scrolling of the panel to a minimum. Typically, you will find comments, component name or inspection location near the top and company name and logo, inspector name or plant location near the bottom. You also have the opportunity to attach a picture file to the inspection data used for the report.



**TIP** The tablet delivered with the UPEC has a camera. To include a picture at that moment: just switch to the camera application, take a picture, go back to UPECView select the newly created file and tick the include picture checkbox.

<sup>27</sup> Also called inspection data form in preferences.

Once finished, click “OK” and then choose a file name in the standard file saving box. The file extension is automatically added. Depending on preferences, the data and report will be saved under the same base file name and the corresponding extension. Reports can be saved in Microsoft Word or HTML<sup>28</sup> formats and the data can be exported in raw or processed form to CSV (.csv), Matlab® (.mat) or Paraview (.vtk) formats for further custom processing.

The generated report starts with the company logo and address and then most of the inspection data from the EC inspection report form. The displayed plots are included (i.e. if you do not display the time traces, they are exported to the report), followed by the processing chain settings and then the instrument settings. The optional picture ends the report.

If necessary, the Word report can be either further edited or you can copy and paste elements to your own report template.

## 5.9.2 Loading data

The “Load” button opens a standard file selector dialog (see section 3.1). By default you can only choose SIDATA (.sidata) files. After clicking OK, the data will be loaded and displayed in a new window (this may take some time, especially if the amount of data was significant). This windows is very similar to the acquisition one except that the “Play” button is replaced by a “Close window” button and the balancing button has disappeared. You can change all the processing chain settings and you can even save the data again, maybe to show another indication or the data in a different way.

## 5.9.3 Creating tiles



Deprecated since version 1.7+ and only available in Windows 8. Replaced by a shortcut creation in version 1.7+.

**IMPORTANT NOTE**

Tiles, which are displayed in the main Windows 8+ screen are a convenient way to store and recall all the settings related to a specific inspection task including a descriptive name and picture. The tile itself, when clicked, starts UPECView with all the instrument and processing chain settings.

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<sup>28</sup> Note that the HTML report implies the creation of a subdirectory containing the pictures of the plots. This directory has the same base name as the data with ‘\_resources’ appended.

The procedure to create a tile is quite simple:

1. Click the “Tile creation” button which opens the tile creation dialog (Figure 25).
2. Enter the tile name in the corresponding field.
3. Select a picture for the tile. The ideal is to take a picture corresponding to the task with the probe and the inspected part.
4. Click on the “Create Tile” button.
5. Close the dialog either by “OK” or “Cancel”.

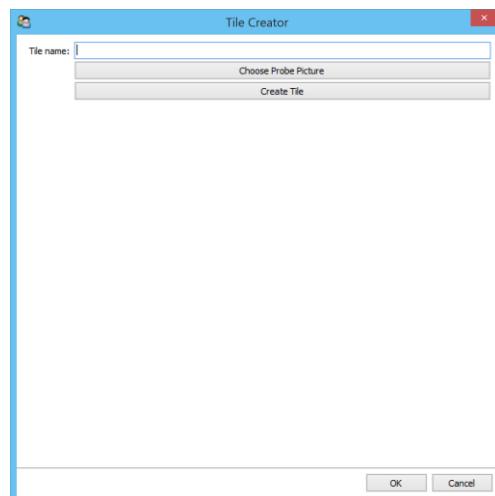


Figure 25: Tile creation dialog



TIP

The tiles can be reorganized and grouped at your convenience on the startup screen. Please refer to your operating system instruction for doing so.



NOTE

When you start UPECView from a tile, you have to answer “Yes” to a security question. This is normal. Just make sure that you indeed clicked on one of the UPECView tiles.

#### 5.9.4 Preferences and general options

The preferences are persistent from one session to the other. All changes are immediately saved to the disk.



TIP

The different settings are detailed below. Do not forget to use the embedded help, i.e. the tooltips giving further information on the settings: just hover with the mouse over the field or button or leave your finger on it until it appears.

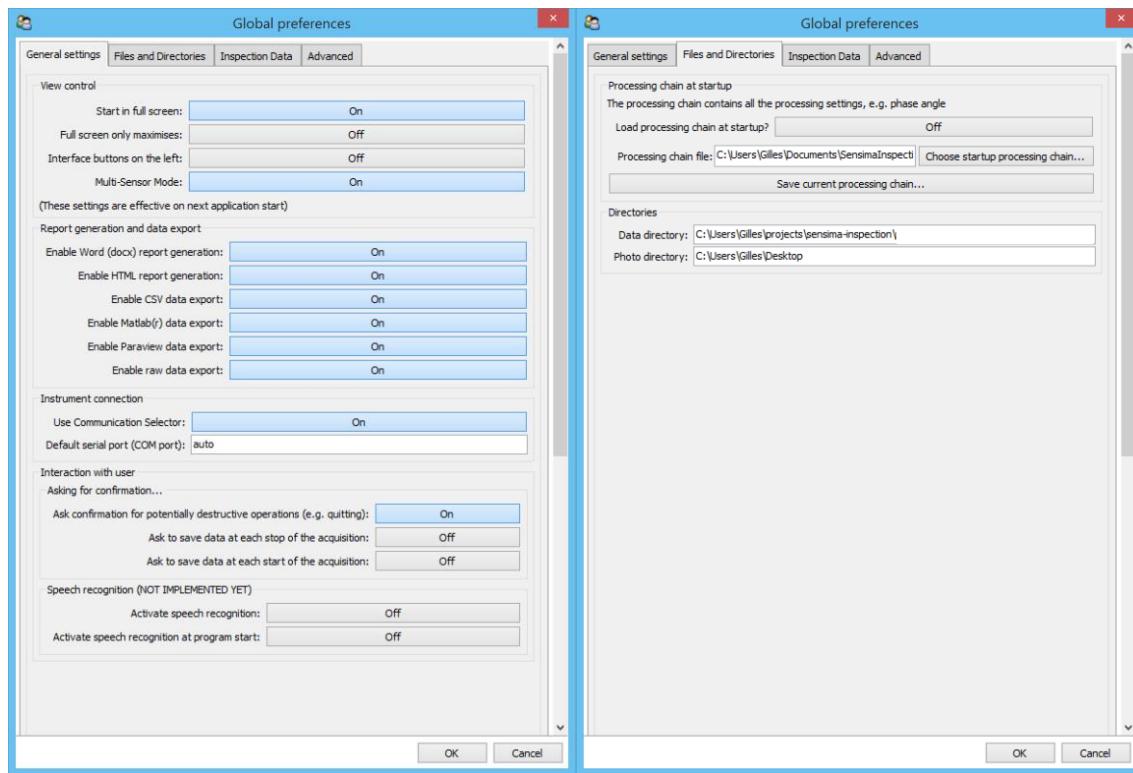


Figure 26: First two tabs of the preferences.

## General settings tab

(Figure 26)

In the first section, you can control the look of UPECView. You can decide if it should start in full screen mode or not (normal window), if toggling the full screen mode should maximize the window, i.e. take the whole screen but keep the window's titlebar or not, or if the interface buttons and panels should be on the left of the screen instead of the right

The second section controls which files are saved alongside the standard .sidata files. The reports can be generated in Microsoft Word (docx) format or HTML and the data can be exported automatically to CSV (to be used in any spreadsheet software such as Microsoft Excel), Matlab<sup>®</sup><sup>29</sup> or Paraview<sup>30</sup> formats. The exported data files have the same base name as the standard sidata file but a different extension and they are in the same directory. The exported data is the processed data, i.e. the data as you see it in the plot. This is generally what you want. The last option, when set to "on", allows you to export the raw or unprocessed data as well. For the raw data, '\_raw' is appended to the base name to distinguish it from the processed data. This can be useful if you want to perform custom processing in another software.

The next section, "Instrument connection" allows you to bypass the connection dialog when starting UPECView. It is advised to leave it on as it may attempt to connect to the wrong serial port depending on your PC settings.

In the "Interaction with user" section, you can decide when and for what you are asked additional confirmations. The first one, if off (not recommended), will disable all the confirmation dialogs: if you press the "quit" button, UPECView will quit immediately even if you have not saved the data. With the next two options, you can decide if you want UPECView to ask you if you want to save data when you

<sup>29</sup> This can be loaded directly into Matlab<sup>®</sup> or into Octave, an open source program almost equivalent to Matlab<sup>®</sup>.

<sup>30</sup> Paraview is an open source software capable of performing advanced visualization tasks. The actual exported file format is VTK.

stop the acquisition or when you start a new one. This can be useful as the recorded data is deleted when you start a new acquisition (press on the “Play” button) and is therefore lost if you hit the button by mistake.

The last section is used to activate the UPECView’s voice control feature.<sup>31</sup> This solves the problem of performing actions while both hands are busy, but requires a quiet environment to be effective.

## Files and directories tab

(Figure 26)

In the first section, you can activate the loading of a special processing chain at startup of the program as well as save the current one for subsequent use.



It is recommended to use the tile feature instead of this one as it is more powerful and easier to use for the on-site inspector.

TIP

In the second one, you control the default directories for data files<sup>32</sup> and for pictures.

## Inspection data tab

(Figure 27)

Here you can set the default values about the inspection data which are used for generating the report. Note that those are updated automatically each time you save data: if you alter it when saving, those changes will be reflected in this panel. You can use this to preset relevant values before a set of inspection tasks so that you only have to change a small subset of those when saving inspection results.

## Advanced tab

(Figure 27)

This tab presents several advanced settings which you should normally not need changing.

The optional vertical gain allows you to display an additional setting in the shortcut tools to set the global vertical gain. Since you can perform it with the gain filter, it is recommended to leave it to off.

The next option, on by default, means that you only see one settings’ panel at a time, i.e. the previously displayed panel is closed before displaying the new one in order to save precious screen real estate. If off, you can have several panels open at the same time, potentially giving you a fast and direct access to all settings at once but reducing the size of the plots.

The “Use experimental filters” should be on if you want to have access to the super rotation feature for instance.

The “Use time slice selector...” has no effect anymore as the display of the time range selector can be controlled directly and more easily from the Viewer controls in the processing chain.

The “Default view for filter panel” (default: “Fold”) alters the way the processing chain is displayed. An alternative option is the “List” view in which all the filters are unfolded. It is recommended to keep the default setting.

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<sup>31</sup> This feature is not implemented in the current version of UPECView: it is still in evaluation in prerelease development version of the software. You can contact us if you are interested in testing this experimental feature.

<sup>32</sup> Note however that the data directory is changed each time you load or save data in UPECView, limiting the usefulness of this option.

The “Use slider instead of dials” will replace the (blue) controls in some filters by sliders. It is recommended to leave to its “off” default value as sliders take more space and are less precise than controls.

The remote control options section allows you to define on which TCP/IP port UPECView listens to in order to receive remote commands. This is an advanced feature in which you can control UPECView remotely from another computer using an Ethernet or Wifi connection. One use case would be if the UPEC tester is mounted on an ROV and you would like to centralize the ROV controls and the inspection controls on the same remote PC. Please contact support if you are interested in using this feature.

The last option gives you access to an additional tab to access debugging features such as the level of details stored in the log files. There is no reason to use this extra tab unless asked for by our support team.

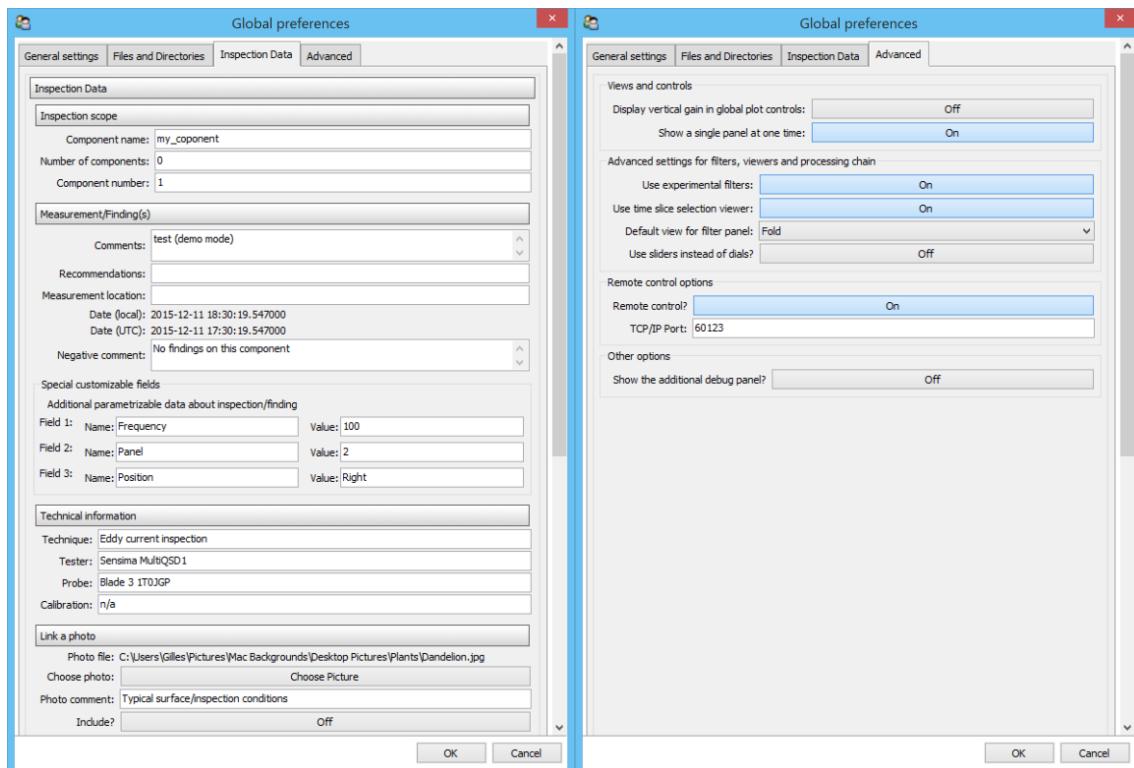


Figure 27: Last two tabs of the preferences.

### 5.9.5 Other tools: Full screen toggle and quitting

The two last buttons allow to toggle between the full screen and the windowed views and to quit the program.

# 6 UPECView Installation Guide

This guide describes the installation procedure for the UPECView software bundled with Sensima's UPEC line of Eddy current instruments. The software comes preinstalled on the display device (tablet, laptop, etc. depending on version). These instructions allow you to install the software on other devices.

## 6.1 OS Compatibility

The software runs under Windows, is tested and developed for Windows 8.1 and is certified to work on a selected set of display devices (list on request). In general, it should run smoothly on Windows 7 through 10.<sup>33</sup> The software is compiled for 32 bits and will therefore run on both 32 and 64 bit flavours of the OS.

## 6.2 Step-by-step installation instructions

The installation procedure is extremely straight-forward. The user only has to follow the installation wizard. Some steps may however be somewhat disconcerting (especially the installation of the additional drivers) and the procedure is thus described below step-by-step.



Please install software and device drivers BEFORE connecting the UPEC tester to your PC or tablet.

**IMPORTANT**

Note however that from Windows 8 onwards, Windows will attempt to download the latest drivers from the internet automatically. In general, this is perfectly fine and works out of the box, but there may be incompatibilities between the drivers shipped with UPECView and the newer ones and we therefore recommend to install the software before connection the device.

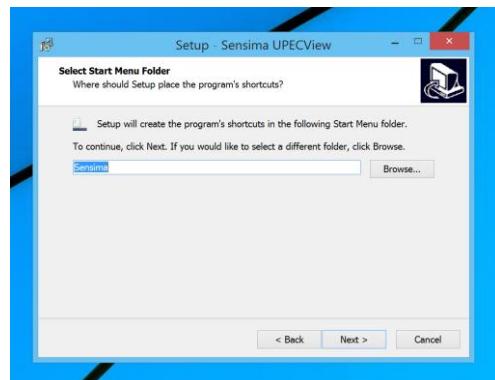
1. Open the installation wizard by double-clicking on the UPECView x.y.z.w Setup.exe program on the USB key or downloaded (x.y.z.w is the software version, e.g. 1.6.4.1). The following window should be displayed.  
It is recommended to copy the installation executable to your local disk before



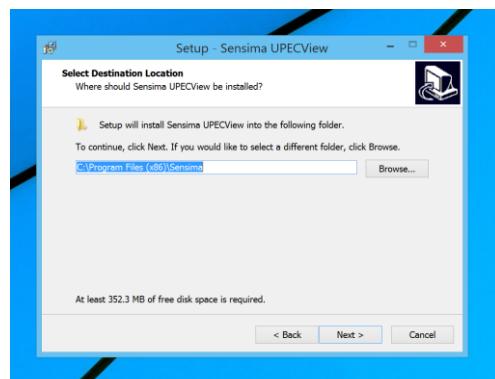
<sup>33</sup> Certain functions such as tile creation for instance do not make sense under Windows 7.

starting the installation (e.g. to your Documents folder)

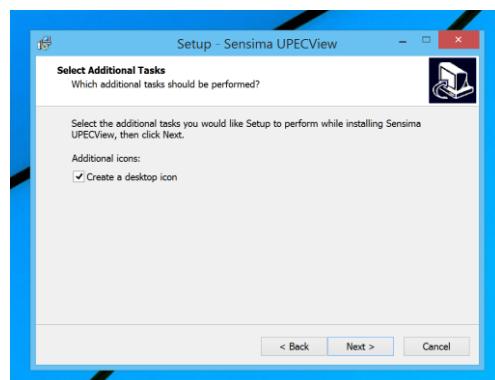
2. Choose the “Start Menu Folder” under which you want the program to be listed (default: Sensima)



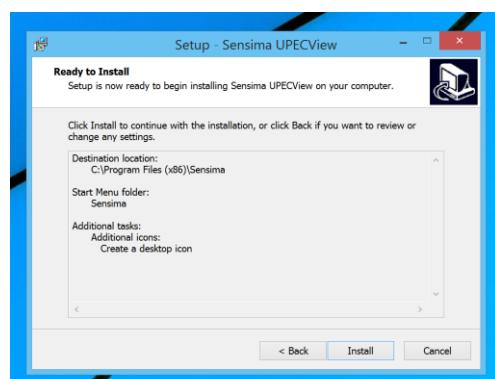
3. Choose where the program should be installed. It is recommended to leave the default setting since this allows to easily upgrade UPECView to a newer version without risking conflicts.



4. The creation of a desktop icon is recommended (default).

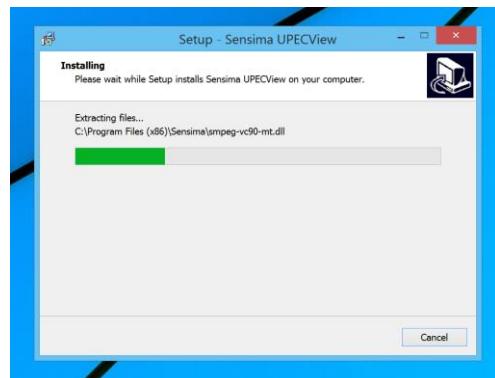


5. A summary of the procedure is displayed before performing it.



6. The files are copied to your disk with the progress indicated.

At the end of the copying, the installer may display several popup windows indicating the installation of Microsoft software components.



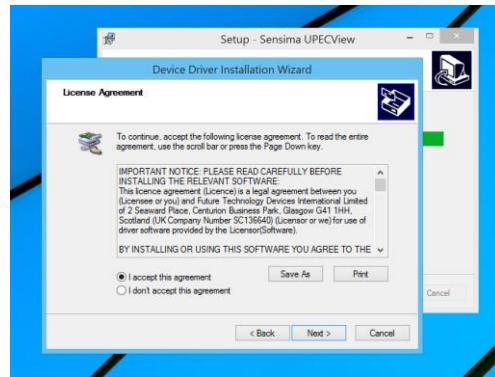
7. The installation of the first set of communication drivers begins: a popup window with the special driver wizard appears. Those drivers from FTDI ([www.ftdichip.com](http://www.ftdichip.com)) are necessary to some devices, including legacy ones (delivered before 2015).



8. Follow the wizard's instructions



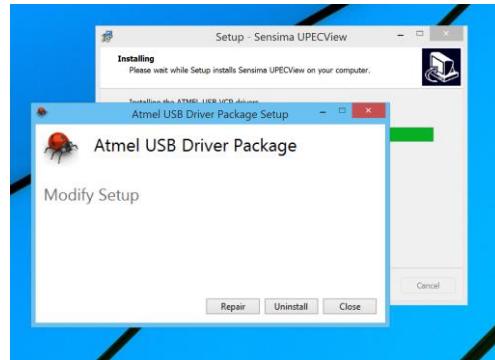
9. Accept the license agreement from FTDI. The drivers' installation starts. If the drivers were already installed on your system, the next window appears immediately.



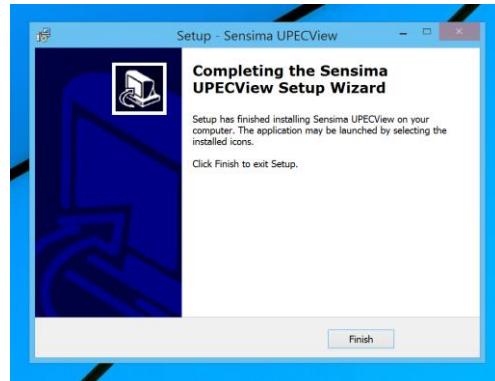
10. Click “Finish” at the end of the FTDI drivers’ installation.



12. A popup window for the installation of the Atmel USB Driver Package appears. Follow the instructions from the driver installation wizard. During the process, you may be asked to trust drivers from Atmel ([www.atmel.com](http://www.atmel.com)). It is recommended to choose the “always trust drivers from Atmel” option.
13. If the Atmel USB drivers were already present on your system, the following window is displayed, giving you the opportunity to uninstall or repair them. Unless you have a problem with those drivers, click “Close” since you do not want to change anything.



14. The installation is complete.



## 6.3 Files and directories – Uninstall procedure

Unless you chose differently at install time, all the executable and library files are stored in C:\Program Files (x86)\Sensima. Preferences, presets and log files are stored for each user in the C:\Users\[user]

name]\AppData\Roaming\SensimaInspection<sup>34</sup> folder. Data and setup files are normally stored in the C:\ [user name]\Documents\Sensima folder (unless you decided differently).

### 6.3.1 Uninstall procedure

There is no uninstall program, but you can do this from the Windows Control Panel or manually. The first procedure will not remove all the files since some are created at run-time. To uninstall all the files related to UPECView manually:

- Delete the C:\Program Files (x86)\Sensima folder and all its content<sup>35</sup>
- Remove the tiles from the main screen
- For each user:
  - Delete the UPECView shortcut on the Desktop
- For each user having used the program:
  - Delete the C:\Users\[user name]\AppData\Roaming\SensimaInspection folder and its content

The procedure leaves the communication drivers which should not be a problem. If you want to remove them, follow the uninstall procedure from FTDI ([www.ftdichip.com](http://www.ftdichip.com)) and Atmel ([www.atmel.com](http://www.atmel.com)). It does not remove the data files or setup files you may have saved on your disk although the presets will have been destroyed since they are in C:\Users\[user name]\AppData\Roaming\SensimaInspection.

## 6.4 Additional notes

### 6.4.1 Drivers

The drivers can also be found in the `drivers` directory on the USB key shipped with the UPEC device.

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<sup>34</sup> Replace [user name] by your actual user name in Windows.

<sup>35</sup> If you installed it at a custom location, delete the Sensima folder at this location

# 7 Tips and “how-to’s”

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## 7.1 Finding out which communication port my UPEC device is using

### 7.1.1 USB

Normally, if you connect your UPEC USB device to your tablet or PC (and only this one) and start UPECView, you should have this device with the COM port number displayed in the list. If you want to discover this port number from Windows:

1. Connect your UPEC USB device to the tablet or PC (and only this one).
2. Open the Device Manager (from the Control Panel or directly).
3. Expand the Ports (COM & LPT) section
4. All the paired Bluetooth devices are listed, but the one you are interested in is the one with something similar to “Communication Device Class ASF example (COMxx)”, where xx is the COM port number attributed to your device.

### 7.1.2 Bluetooth

For Wireless devices, this is a bit more complicated since all the attributed COM ports are listed in the communication panel irrespective of whether they are in range or not.

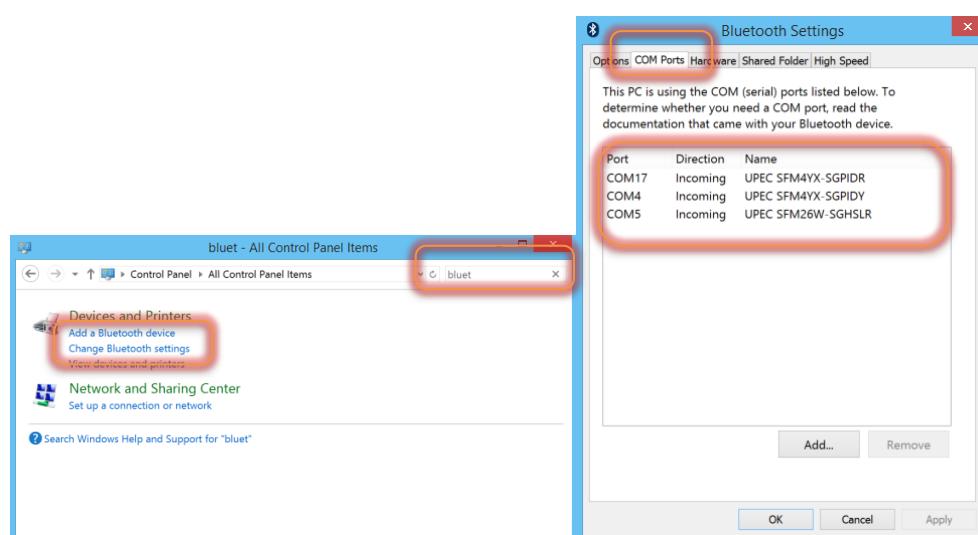


Figure 28: COM port identification for Bluetooth devices.

1. Make sure that your device has been paired with the system.
  - 1.1. If not, power it and go through the pairing process.
2. Open the Windows Control Panel (Figure 28) and search for 'bluetooth'
3. Click on the "Change Bluetooth settings. This opens another window (Figure 28)
4. Click on the COM Ports tab and wait for Windows to fill the list (can take a few seconds)
5. Find the COM port corresponding to your UPEC tester's product and serial numbers.

## 7.2 How to move the presets and tiles from one computer to another?

On the "source" PC:

- Prepare settings and tiles as usual
- Take the case of a single tile named 'MyTile':<sup>36</sup>
  - Go to the C:\Users\[YOUR\_USERNAME]\AppData\Roaming\SensimaInspection<sup>37</sup> folder (you may have to allow the display of hidden files and folders in the Windows Explorer to get to that directory)
  - Copy (Do not move!, i.e. use CTRL+click+drag) the 2 files named MyTile.siproCESSing and MyTile.siacqsetup to a desired folder for future use, and/or to a USB key

Later, on the "target" inspection PC/tablet:

- Create tiles with the exact same name as the ones you have created on the 'source' PC
- In our case, create a tile named 'MyTile'
- Do not worry about the settings: you may as well save the default ones as we shall replace them with the "source" PC settings shortly
- Go to the C:\Users\[YOUR\_USERNAME]\AppData\Roaming\SensimaInspection<sup>37</sup> folder (same remark as above about hidden files)
- Connect your USB key with the files from the "source" PC to the "target" PC
- Copy those files to the C:\Users\[YOUR\_USERNAME]\AppData\Roaming\SensimaInspection<sup>37</sup> folder (Windows will ask you if you want to replace/skip/... the existing files as they indeed exist on the target PC: replace all the files)

You are set: the settings from the "source" PC will now be loaded by the tiles on the target PC.

You should consider transferring any picture used to create the tile to the target PC before this so that it is accessible at tile creation.

## 7.3 Gain optimization – How to efficiently use the “auto offsets / hardware balancing”

The purpose of vector amplification is to improve the signal to noise ratio (SNR) and to ensure a better detectability of flaws resulting in small signal variations. In doing so, the part of the impedance plane

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<sup>36</sup> Replace this name with the actual name of the tile you want to transfer.

<sup>37</sup> Replace [YOUR\_USERNAME] by your actual user name on your system.

which can be represented by the instrument is drastically reduced, leading to signal saturation when this signal moves out of the accessible impedance plane region.

We take the example of optimizing the gains for a set of notches in a calibration or reference block. The goal is to maximize the gains so that the deepest notch signal is still completely visible and shows no signs of saturation.

The general idea is to slowly increase the hardware gains ("Final stage gains") and while doing this to perform several hardware balancing ("Auto offsets" button). During this procedure, the probe should be constantly moved over the deepest notch (and the other as well if possible). This is important because we are changing the instrument settings and the results can only be seen by actually performing a measurement. The normal balancing ("Balancing" button) should not be used during this procedure. To be more explicit, here are the different steps:

1. Set the excitation type and frequency (Instrument settings' panel). Make sure to set the hardware gains to zero (this is the default). It is better to set all the processing chain parameters to their defaults (i.e. no rotation, no gains).
2. Start the acquisition ("Play" button).
3. Put the probe on the reference block, sufficiently away from any notch or edge (i.e. a suitable balancing location).
4. Perform a hardware balancing ("Auto offsets" button).
5. Move the probe across the notches or at least across the deepest notch. Look at the shape of the signal: typically starting linearly and possibly curving near the maximum variation (slight "comma" shape). You can adjust the zoom in the display, e.g. with the autoscale button, to have a better view of the signal.
6. Increase both in-phase and out-of-phase hardware gains by a few dB (same amount for each). Typically, you should increase by 3–6 dB.
7. Move the probe to a place on the reference block sufficiently away from any notch or edge (ideally the same location as in point 3).
8. Perform a hardware balancing ("Auto offsets" button).
9. Move the probe across the notches or at least across the deepest notch.
10. The signal should have the same overall shape apart from being amplified. If this is the case, repeat the operations from point 6.
11. If the signal shape has changed (typically near the maximum of the signal), the gains are too large and saturation occurred. Reduce the gains to the last value showing no signal shape change.
12. You are set. Now you can use the standard balancing function to make a better zeroing of the signal (again, ideally at the same location as in point 3 or 7). You can now make a liftoff and adjust the phase angle to make the liftoff signal horizontal as usual. Note that only the first part of the liftoff signal from the balancing point should be aligned with the horizontal as it is likely that saturation will occur at relatively large liftoffs as a consequence of the large gains.

The procedure described here is in fact quite standard and would be similar with any other eddy current instrument. It is however made much easier with Sensima's UPEC testers because the instrument settings can be changed "live" and the results can be immediately seen on the display.

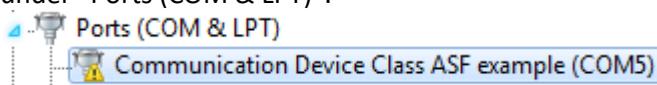
# 8 Troubleshooting

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## 8.1 Connection problems

### 8.1.1 USB devices

- Make sure that your device is connected to the USB port of the tablet and that the USB cable is not damaged. If unsure, disconnect and reconnect the device: Windows should make a sound in both cases.
- Check that the correct communication port is selected:
  - In the connection dialog, select the first tab (“Serial over USB ports”).
  - Click “Rescan ports”.
  - If you have more than one port displayed, you certainly have more than one UPEC device connected to your PC/tablet: disconnect all the UPEC devices except the one you want to use and click on “Rescan ports”.
  - Connect to the only one listed.
- Check the communication speed / baud rate setting (see 8.1.3 below).
- If Windows does not recognize the USB device (a special warning bubble is issued):
  - Reinstall the drivers either by reinstalling the software (the standard procedure goes through the driver installation) or by using the drivers on the USB key shipped with your device.
  - If this does not solve the problem, it is likely to be a hardware failure. Please contact support for further assistance and, if necessary, to get the replacement of the UPEC device.
- Windows 8.x or previous versions are not officially supported; therefore you may experience some compatibility issues. It may occur that the connected device is not properly recognised and a wrong driver is associated by default; a workaround is possible:
  - Go to the “device manager”, and check that you have a device “AT32UC3Cxxxx”. Right-click on it and choose to update the driver.
  - Then, choose to select manually from a list of driver. You need to look for “Communication Device Class ASF Example”, under the manufacturer “Atmel”. After you apply this driver, the associated COM port should appear in the device manager under “Ports (COM & LPT)”.



### 8.1.2 Wireless devices (Bluetooth)

First, the obvious:

- Check that your UPEC WR is powered, i.e. connected to the battery pack and that the USB cable is not damaged (you could try with another USB cable)
- Check that the battery is not empty: in general, press on the button situated on the top of the battery pack and make sure that several of the LEDs close to the button light up.
- Make sure that Bluetooth is activated on your tablet or PC. In particular, check that you have not enabled the airplane or flight mode.
- Make sure your device is (still<sup>38</sup>) paired with the tablet or PC you are using (see 5.3.2 for the pairing procedure) and that you are using the correct serial (COM) port to try to connect to your device (see 7.1.2).
- Make sure your device is in range.<sup>39</sup>

Then, the less obvious:

- If you do not use your UPEC WR device for a long period of time, it enters into a sleep mode to save the battery life. In this mode, it does not respond to any request and is not transmitting anything. To exit the sleep mode, just press on the button on the top of the battery pack: it has the effect of restarting the device. You would typically have done that if you had checked that the battery is still charged as described above. Note that you may have to restart UPECView and reconnect to the device.
- If you have used your UPEC WR device in USB mode, i.e. directly connected to the tablet with an USB cable, you cannot use it in Bluetooth without restarting it. This is because the communication interface is selected at boot time (or rather after the first connection) and all the others are deactivated. Just restart the device (unplug and replug the device).

### 8.1.3 Communication speed (baud rate)

Check that the baud rate in the connection dialog is set to 2000000 (i.e. 2 Mb/s). This is particularly important for legacy devices. In any case, it is recommended to leave the speed to this value.

## 8.2 The UPEC device is not responding

In general, this is because the connection between the acquisition PC/tablet and the device has been lost, either because the device has been disconnected and reconnected or for the wireless (Bluetooth) version because the acquisition rate has been set too high (above 1500 Hz).

In all cases, you must:

- Close UPECView

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<sup>38</sup> Maybe someone has unpaired it by inadvertence, or you are using another tablet or PC which has not been paired with the UPEC yet.

<sup>39</sup> It is difficult not to be in range since that range is larger than 50 m (about 150 ft) if you have the direct line of sight between the UPEC device and the display device, but maybe the path between your UPEC and the tablet is obstructed by a large metallic object.

- Restart the UPEC device (by disconnecting the USB cable from the PC/tablet or battery pack)
- Start everything again

To remedy this problem:

- Use a lower acquisition rate
- Make sure that the UPEC tester cannot be inadvertently disconnected from the tablet or battery pack.

## 8.3 UPECView does not start

### 8.3.1 UPECView does not show the connection dialogue

The typical symptom is a window (usually black) opens and closes shortly after. If you see the connection dialog and you have a problem with the UPEC device, please refer to other sections in this chapter and 8.1–Connection problems in particular.



**NOTE**

Depending on your version of UPECView, you may get a window with a list of errors<sup>40</sup> instead of a disappearing console window. The list of errors should typically mention a problem with “anydbm”.

This is most probably caused by a damaged file for either the acquisition configuration presets or the preferences. These files are in the Application Data specific folder for UPECView:

C:\Users\[YOUR\_USERNAME]\AppData\Roaming\SensimaInspection<sup>41</sup>

The two files are:

- Preferences: .si\_global\_preferences (note that it starts with a dot)
- Presets: acquisition\_configuration.sipreset

In principle, you could delete those files and start UPECView which will create new ones, but this means you will lose all your preference and preset settings.<sup>42</sup> The procedure is to rename the files:

1. Create a subdirectory (e.g. ‘old\_settings’) in the SensimaInspection folder in AppData (C:\Users\[YOUR\_USERNAME]\AppData\Roaming\SensimaInspection).
2. Move the preference file .si\_global\_preferences to this subdirectory
3. Start UPECView.

If it works, you are set: you can delete the subdirectory you just created and its content and you will have to go through the preferences if you had made changes from the default.

4. Move the preset file acquisition\_configuration.sipreset to this subdirectory.

---

<sup>40</sup> Ignore the paths to the different files: they correspond to the file location in the computer making the bundle.

<sup>41</sup> Replace [YOUR\_USERNAME] by your actual user name on the system. You may have to set the ‘show hidden files’ option in the Windows File Explorer to access this directory.

<sup>42</sup> Note that if you have a backup copy of your presets (made through the acquisition configuration management), you could safely remove the files and reload your backup copy after.

5. Start UPECView.

If it works, you are set: you can delete the subdirectory you just created and its content and you will have to go through the preferences if you had made changes from the default.

6. If none of this has worked, contact support.

You may be asked to

- 6.1. Provide the application log files (with the log extension, possibly followed by a number).
- 6.2. Delete, rename or move the SensimalInspection folder and reinstall UPECView.



**NOTE**

The solution presented above is the cleanest. You can alternatively delete (or rename/move) the whole ...\\AppData\\Roaming\\SensimalInspection (C:\\Users\\[YOUR\_USERNAME]\\AppData\\Roaming\\SensimalInspection) and restart UPECView. This folder and its contents will be recreated with default values by UPECView.

### 8.3.2 UPECView stops with an error when attempting to connect to the device

**Symptom:**

UPECView stops AFTER having shown the connection dialogue box. In general, a Windows appears showing a long list of errors.

**Solution:**

The most likely cause for that is that another instance of UPECView, connected to the same device,<sup>43</sup> is already running. In this case, it should be closed.

Sometimes, UPECView does not fully close despite not showing any windows. In this case:

1. Open the Windows “Task manager”
2. Find and select the instance of UPECView in the list of tasks
3. End the task (right-click on it and choose “End task”)
4. Disconnect and reconnect the device (this step is normally not necessary)
5. close the task manager
6. Start UPECView

### 8.4 UPECView does not close



**NOTE**

This only applies to versions before 1.7.x or if you started UPECView in console mode (“UPECView Console” shortcut in the list of applications)

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<sup>43</sup> In some advanced use cases, it is possible to have several instances of UPECView connected to different devices.

The logging (black) window sometimes remains open after having closed UPECView. Just close it.

## 8.5 Signal display is not fluid



This only applies to devices using an FTDI communication chip. The communication port settings described here will not be available for other devices.

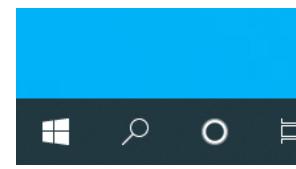
NOTE

Symptom: During acquisition, the refresh rate for the signal seems abnormally slow, i.e. the signal is updated in steps (most visible with traces on).

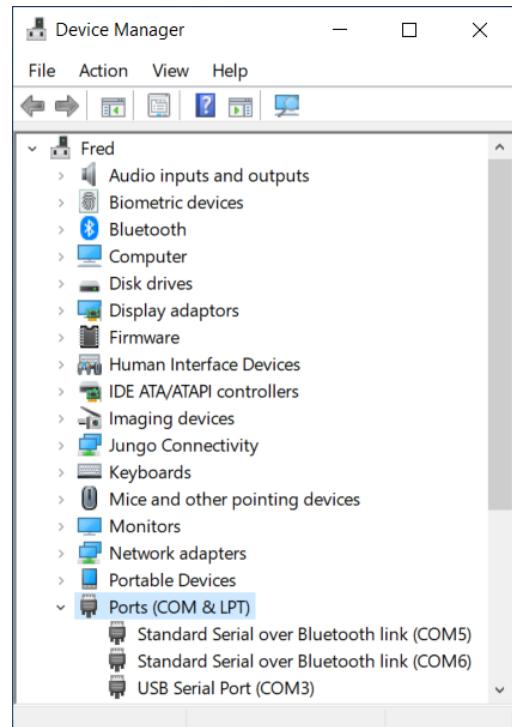
Solution:

1. Open the Windows “Device manager” and open the COM and LPT tab

- a. Search for “device manager” using the “Search” button in the Windows task bar

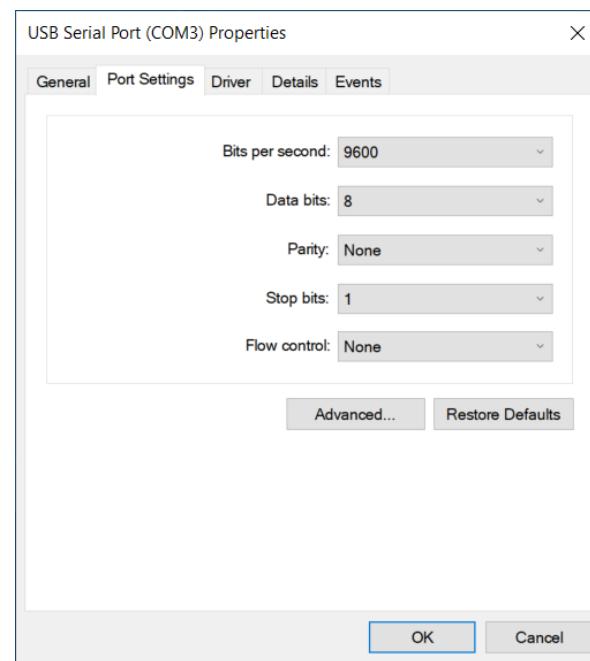


2. Open the “COM & LPT” tab (unfold with the arrow on the left)
3. Right-click on the COM port corresponding to your device (e.g. “USB Serial Port (COM3)” here) and select Properties or double-click on it

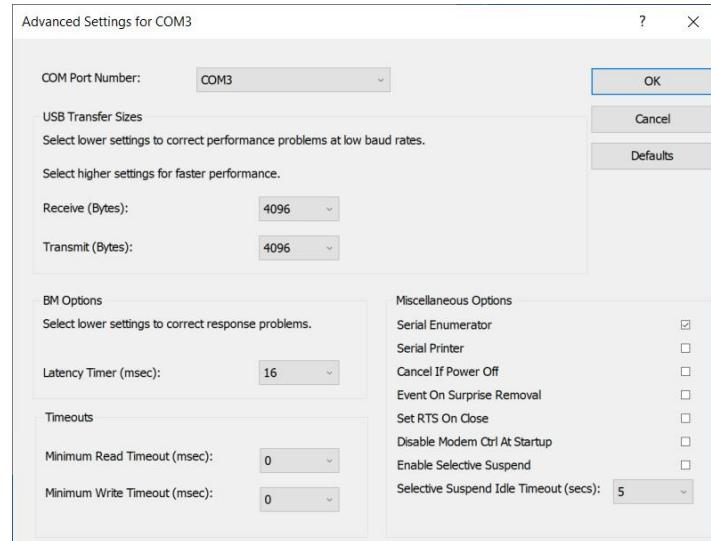


- 4.

5. In the dialogue box, select the “Port Settings” tab and click on the “Advanced” button



6. In the new dialogue box, set the “Latency Timer” to 5 msec



7. Click OK for all the opened boxes and close the device manager.
8. You may have to reboot your system (follow the instructions from Windows)

