RailCheck/Single Rail Eddy Current Trolley - Quick Start Guide

Version	Document Changes	Updated by	Date
1.0	Created	Ian Drew	03-06-2015
2.0	Added screen shots and photos	Ian Gough	22-11-2021
3.0	Included trolly details	Ian Gough	01-05-2023

Contents

Introduction

The RailCheck kit is a system designed to detect defects quickly, easily, and accurately in a rail. Results can be used in real-time to enable a defect to be marked or results can be analysed later either the instrument or a Personal Computer (PC).

The system comprises of:

- A multi-purpose, battery powered, Eddy Current instrument.
- An encoder wheel so that accurate location data can be stored.
- A dual sensor probe that allows the Head and Gauge corner to be tested.
- A trolley that encases all the above and allows ergonomic manual testing of relatively long distances of track.

This Quick Start guide will enable an operator to go from opening the box to testing a rail as simply as possible. Therefore, this document will cover configuring the:

- Setting up the trolly and instrument
- Encoder
- The Eddy Current signal response
- Inspection information
- Saving all data
- Detecting a defect in real-time
- Post analysis of the stored data.

RailCheck - Eddy Current Instrument and Trolley

The RailCheck Eddy Current (EC) instrument is a Dual Channel, multi-purpose, Eddy Current Instrument that works in conjunction with the Rail Trolly.

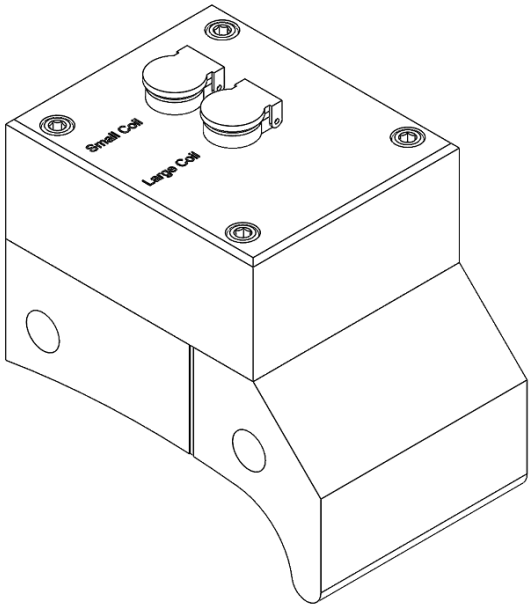
For operators skilled in using Hand Held Eddy Current instruments, the instrument can be removed from the trolley and used independently. The RailCheck instrument has the functionality to use a wide range of EC probes including Rotary drives for inspecting rivet and bolt holes and Weld Probes for the inspection of steel welds.

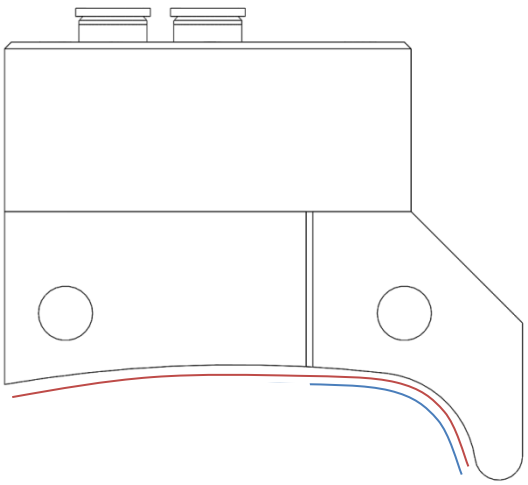
RailCheck - Probe

The Dual Coil Rail Probe is comprised of two Eddy Current sensing coils, one that is only sensitive to the gauge corner and another that covers the whole head. When configured correctly both channels of data are visible on the screen of the instrument during inspection. When Alarm Zones (often referred to as 'Gates') are being used a defect will instantly be identified by the instrument beeping and the instrument showing a coloured box on the screen.

Dual probe with: x1 Large Coil 80mm long covering the complete rail head

x1 Small Coil 30mm long covering the gauge corner





Top Level Kit:

The kit is composed of the following elements:

1. The explorer hard carry case
2. The flaw detector kit
3. The main trolly which is made up of the main body (lower part) and a collapsible handle.

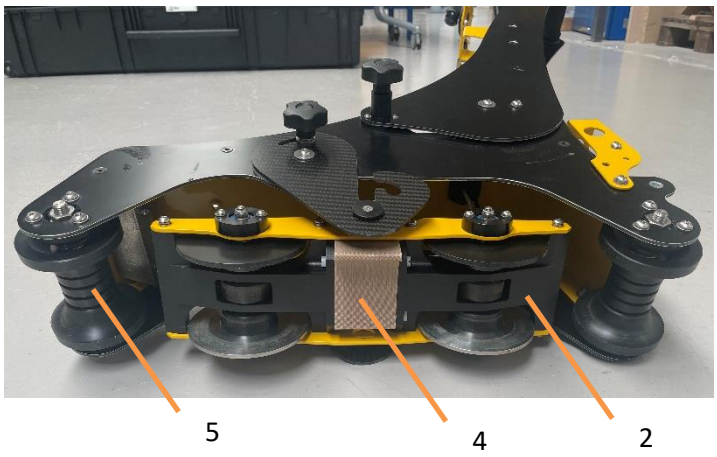
Instrument Kit:

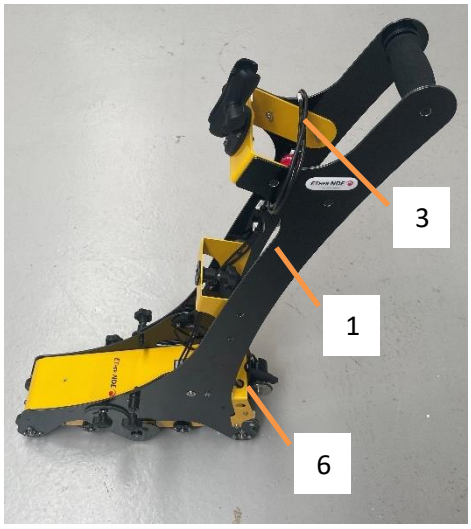
The kit is composed of the following elements:

1. RailCheck Instrument
2. Power Adapter + Input Plugs, (UK, EU, US & Australia)
3. Adjustable Padded Shoulder Strap, Quick-Release Clips
4. Soft Carry Case
5. USB CABLE - A to MINI B, 1m
6. Quick Reference Card - RailCheck
7. Accessory, Protective Splash Proof
8. Software, RailCheck USB Stick Image

Pre fitted adapter plate

Trolley Kit:





1. Main trolly which is made up of the main body (lower part) and a collapsible handle
2. Probe Carriage assembly held off the rails by adjusting height rollers to ensure a constant gap between the probe and the rail
3. X3 Cable assembly's (Large Coil, Small Coil, Encoder)
4. Rail Probe
5. Sprung diablo wheels to ensure a good reference to gauge face
6. A rotary encoder to provide distance information to the software and synchronise the sample rate with the speed.

Unpacking Procedure:

- Remove the trolley from the case

- Unscrew locking screw
- Lift handle until it locks in the position shown

- Tighten x2 locking screws

- Locate instrument as shown
- Insert ball of stand assembly into receiving trolly clamp
- Tighten x1 locking screws

This guide assumes the operator is using our Dual Rail Probe and that it is connected as below:

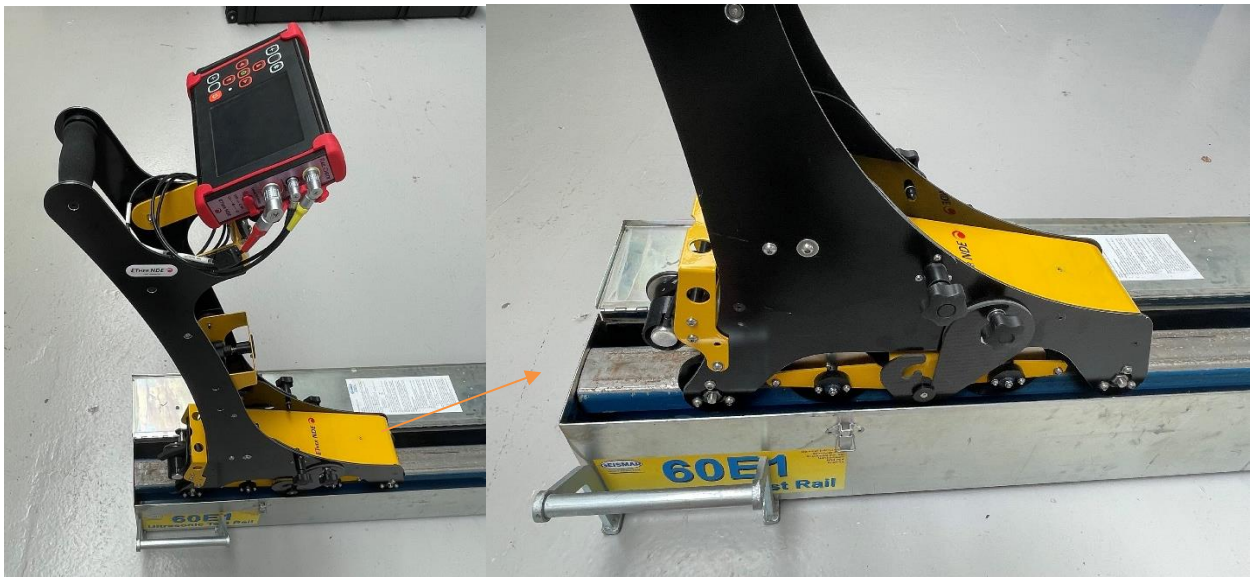
1. Plug in x3 Lemo's as shown
    1. Lemo 12-Way - Large Coil
    2. Lemo 4-Way - Small Coil
    3. Lemo 8-Way - Encoder

Rail Calibration/Reference standard

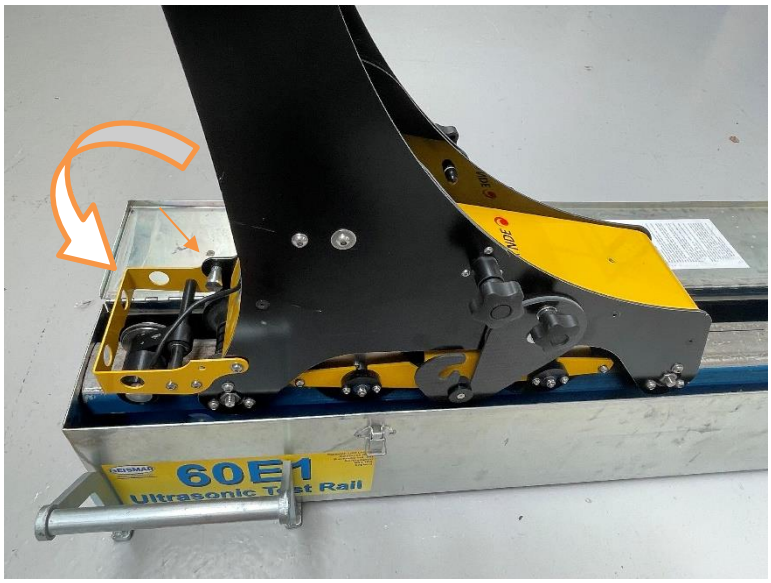
2. With Longitudinal and Transvers (gauge corner) Defects

Locate Trolly onto Rail

3. Locate trolleys sprung Diablo wheels on rail as shown



4. Lower encoder until it locks in the position shown
5. Ensure locking pin is located with the hole in the frame



Quick Set-up using Default Settings

Turn on instrument and recall default settings

1. Power on the unit via a long press on the green power key, release when the instrument beeps/splash screen is shown

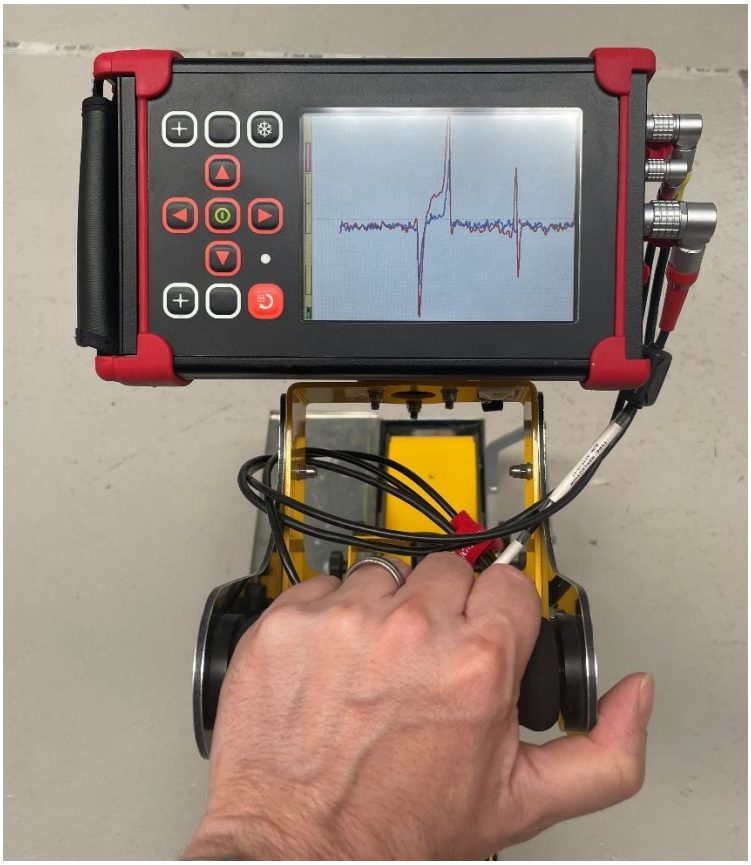
2. Press the red menu key, using the arrow keys scroll to Load & Save, then press the green OK key.

3. The Load & Save screen should now be shown, using the up/down arrows scroll to the folder “Rail Dual”, when correctly found the folder window should turn white, press the green OK key twice to load the folders settings.

4. The following screen should be shown.

5. Press the balance key, making sure the trolley is on the rail.

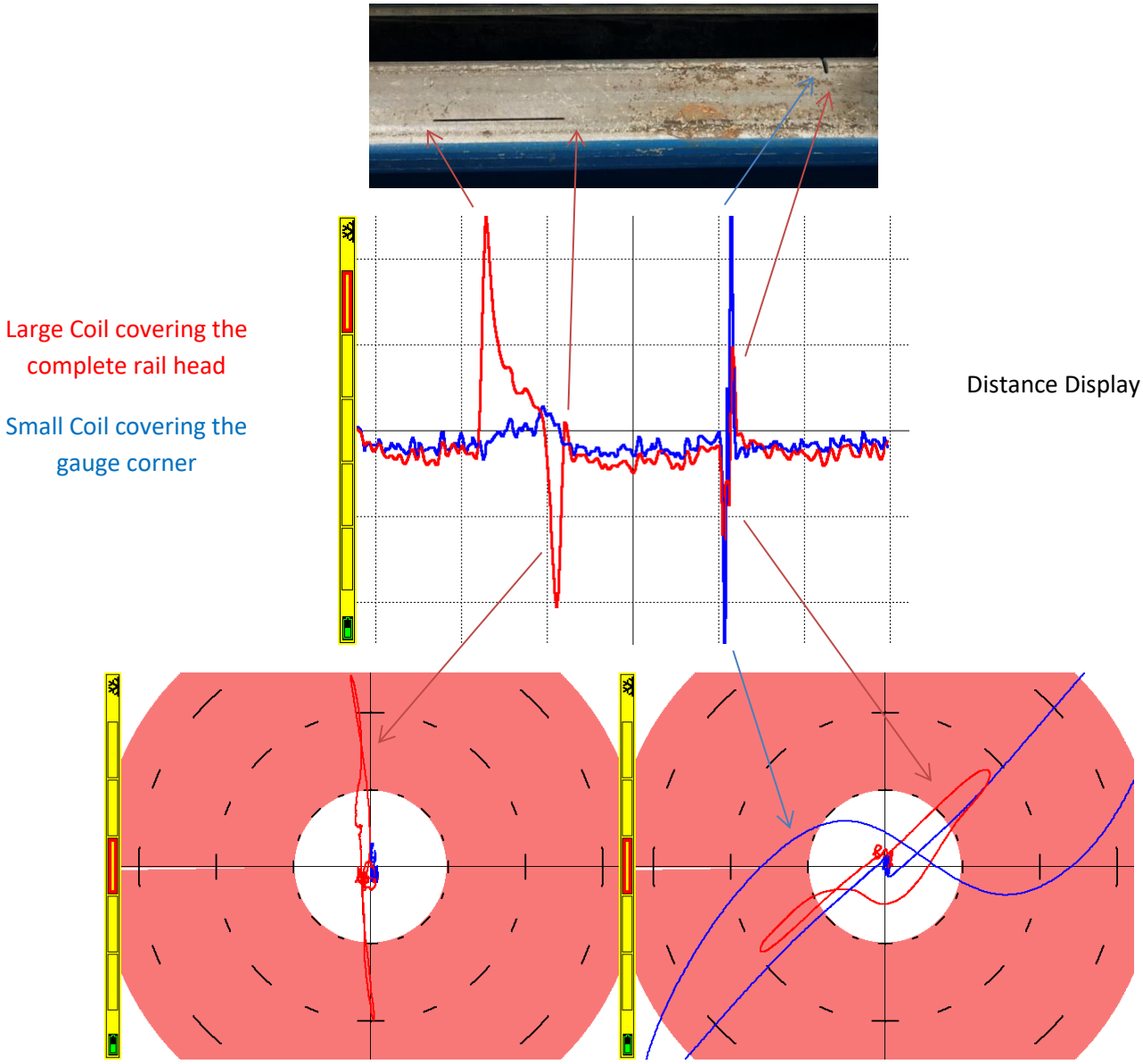
6. Push the trolley along the rail to start inspection.



(Please note that different calibration blocks will require different phase and gain settings):

Set-up Overview

The instrument will be set-up with the phase and gain adjusted to alarm as follows **(please note that different calibration blocks will require different phase and gain settings)**:



The first observation that should be noted in the data is that there is a good phase separation in the eddy current signal seen when passing over a longitudinal flaw (parallel with the scan axis) compared with a transverse flaw (at right angles to the scan axis).

This shows there are two modes of detection:

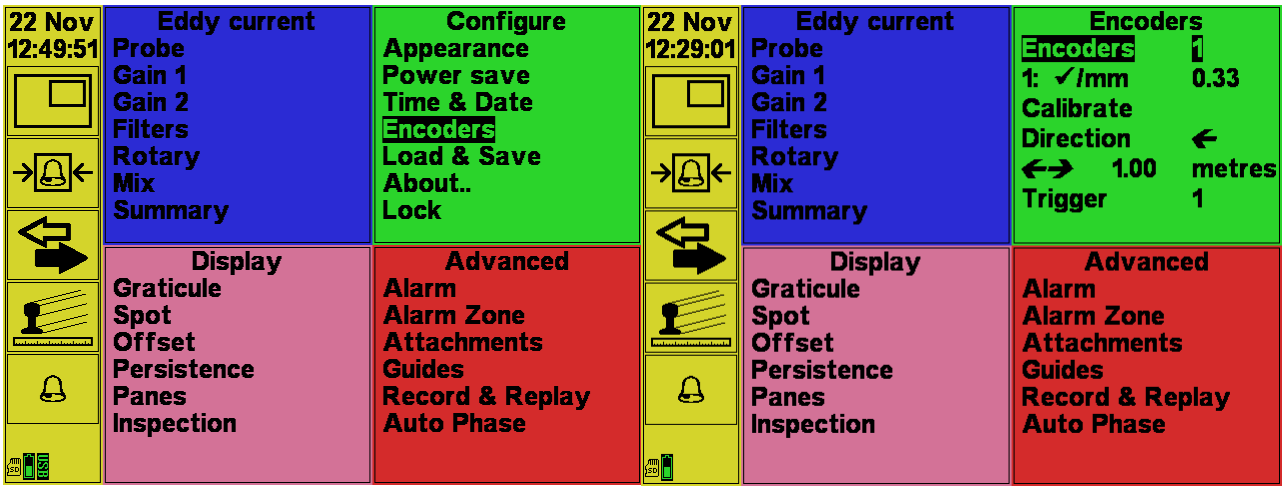
- **Transverse – where the field is interrupted**
- **Longitudinal – where the field is distorted**

For transverse flaws the signal amplitude is proportional to surface length (up to sensing length of coil, hence the shorter coil shows an increased amplitude).

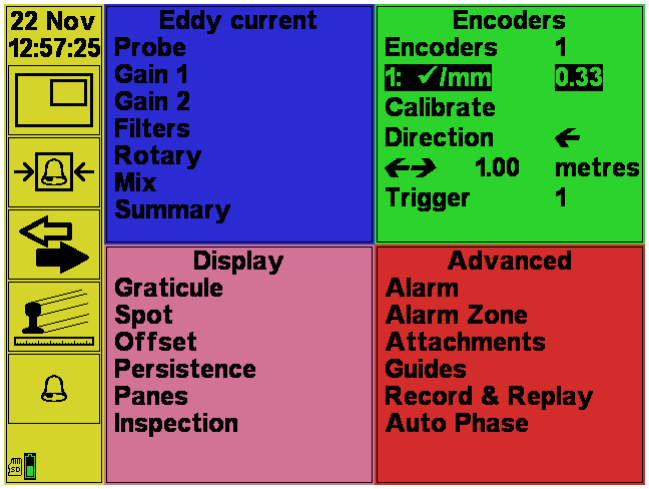
Step-by-step Setup

Configure - Encoder

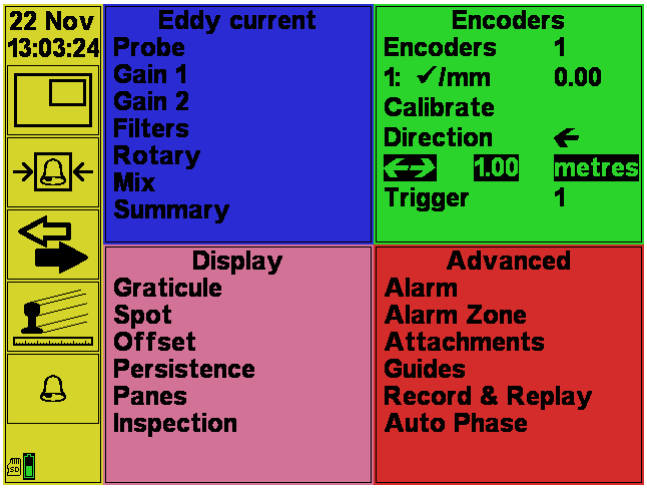
If a defect is only going to be identified in real-time then its real world location isn't important, but usually the location of a defect will need to be logged. To log the accurate location of a defect the encoder must be configured. The RailCheck needs to know how many 'Ticks' per mm the encoder wheel produces. The ticks/mm value can be entered manually if it is known or the RailCheck can learn this itself. To change the value enter the ***Encoders*** menu.



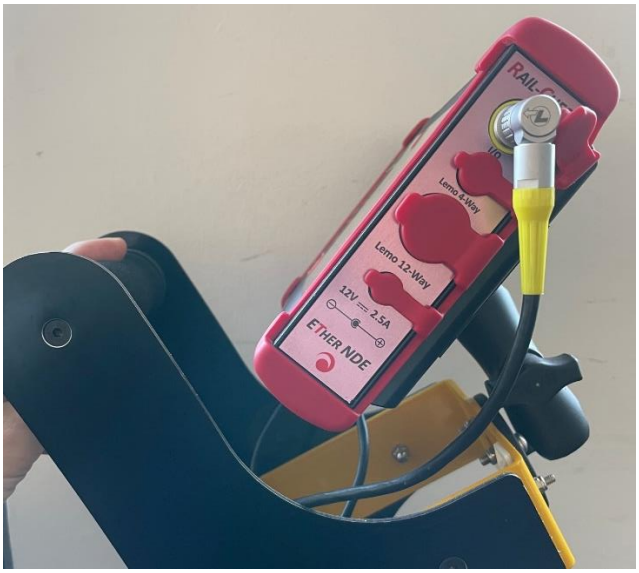
- To change the value manually, go to the 2nd menu item (✓/mm), press OK and then using the arrow keys set the value.

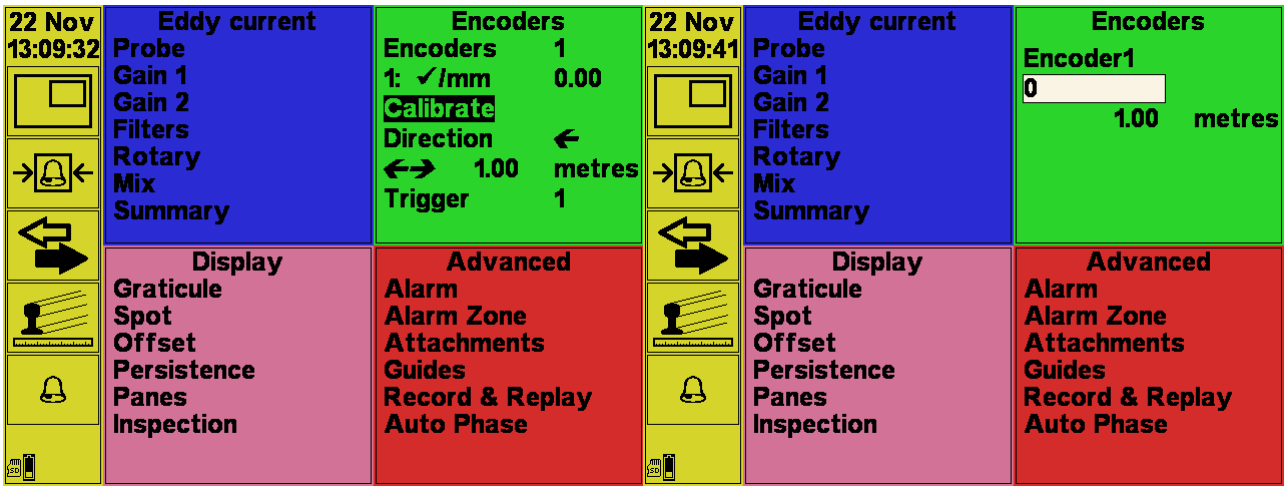


- To ***Calibrate*** the encoder, set the ***Timebase*** value to the distance the encoder wheel will travel.



- Plug Encoder Lemo 6-way lead into I/O socket on instrument as shown below, select ***Calibrate***, now move the trolly l the specified distance then press ***OK***. The ticks/mm value will be updated.



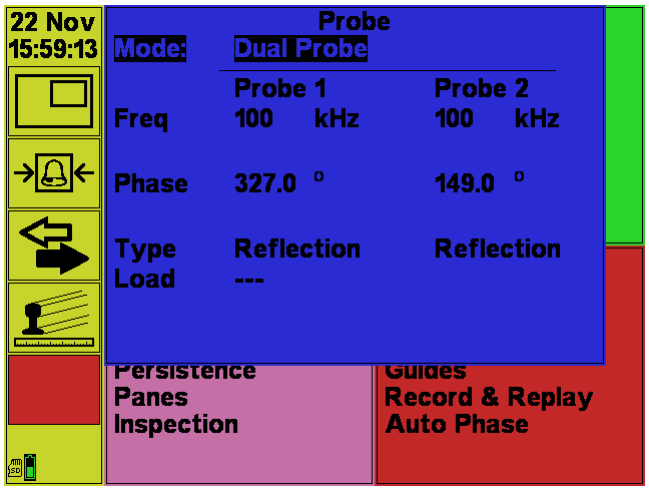


Other values for the purposes of the Quick Start Guide should be set as Encoders 1 and Trigger 1. Which simply indicates that there is 1 encoder and it is used to trigger data.

Once the Encoder ticks/mm is set correctly, the Timebase value should be set to how much data the user would like to see across the screen. The value set here is no way related to the amount of data that can be seen or stored as the data will wrap off one end of the display and on to the other. As a rule of thumb it would be pointless setting this value greater than the intended inspection distance and also to a value less than 1 metre unless inspecting very slowly.

Eddy Current - Probe

Within the Probe menu, set the initial values to:

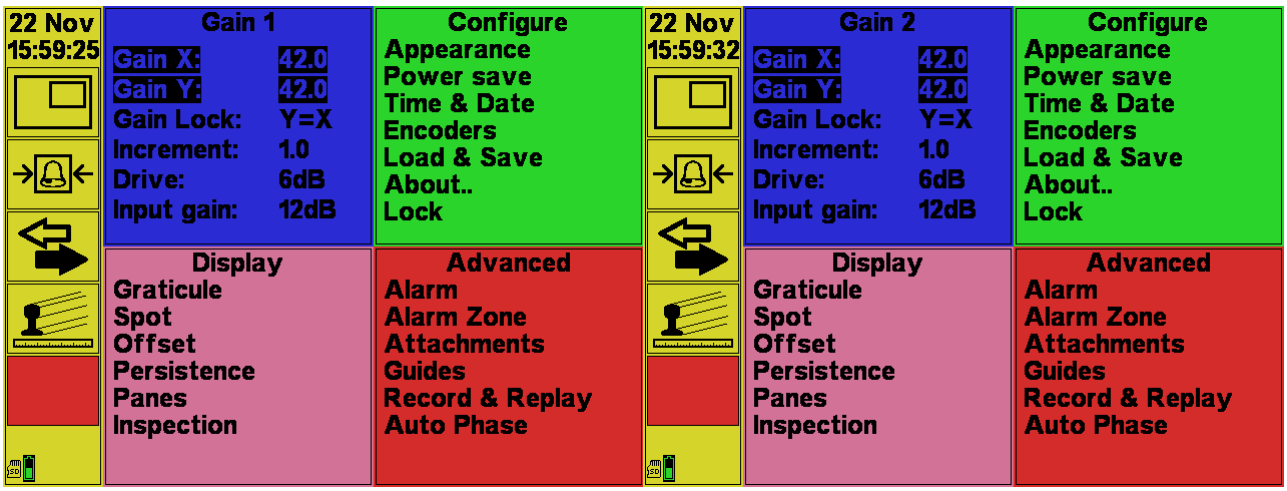


Eddy Current - Gain 1

This Gain, to put it simply, increases the sensitivity of the probes Large Coil (Rail Head) when passing over a defect, set the initial values to:

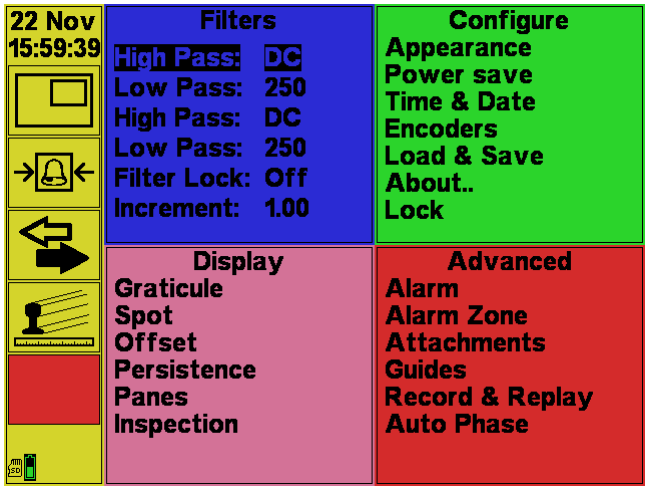
Eddy Current - Gain 2

This Gain, to put it simply, increases the sensitivity of the probes Small Coil (Gauge Corner) when passing over a defect. Initial values:



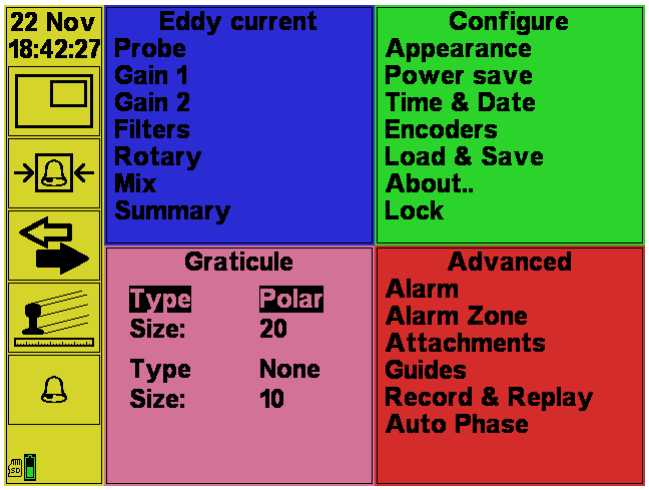
Eddy Current - Filters

Filters can be used to remove high frequency noise (i.e. surface roughness) or low frequency noise (gradual changing in shape of the rail). Usually only a Low Pass filter is used. Default values are:



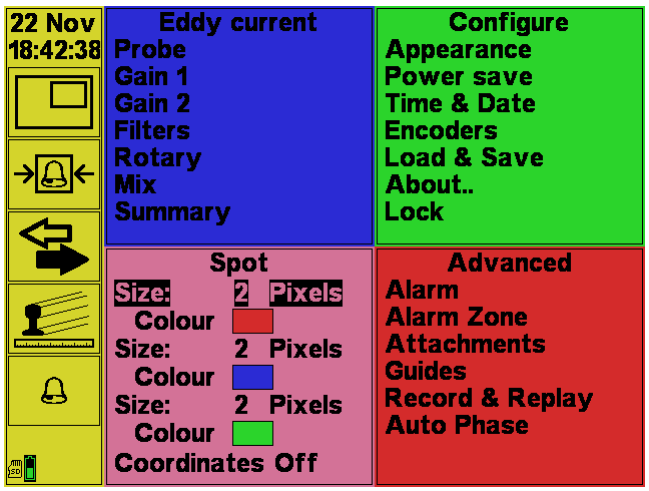
Display - Graticule

Sets the display graticule, for Pane 1 and Pane 2, in this case we have set the type to Polar and Size to 20 as we are interested in the length of the signal and angle.



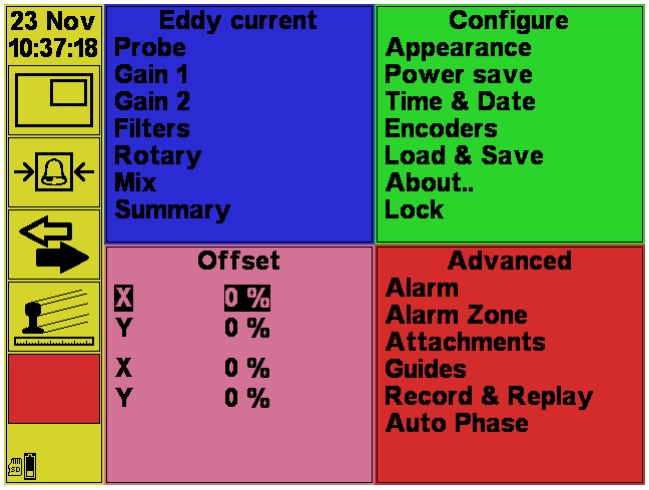
Display - Spot

This sets the colour and line width per channel, in this case we make Ch 1 red and Ch 2 and line width 2.



Display – Offset

Sets to spot position for pane 1 and pane 2 in %, in this case we have set all offsets to 0% to put the signal in the middle of the screen.

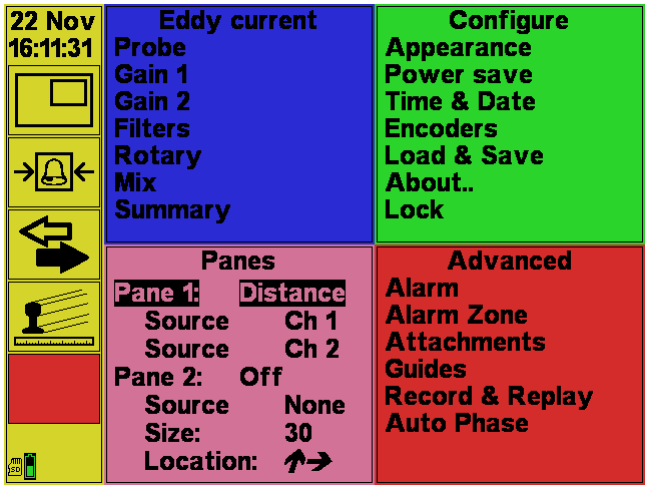


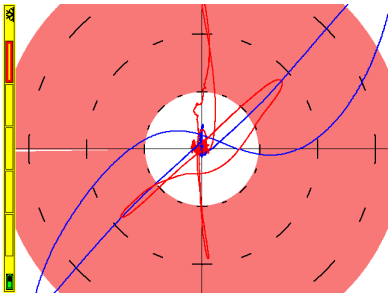
Display – Panes

The Eddy Current data when in real-time mode is displayed on a graph. There are several different types available that show the data in different ways. For example the Phase Plane graph is useful for setting up of a probe and instrument where Distance is best suited for data when an encoder is present. As 2 graphs can be shown simultaneously this menu allows the operator to choose what channel is visible on what graph.

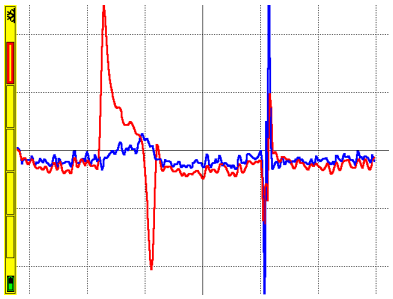
For the RailCheck the default setting is Distance which shows both coils of the probe simultaneously on 1 graph that shows Distance travelled on the X (Horizontal) axis and defect size on the Y (Vertical) axis.

Default values:





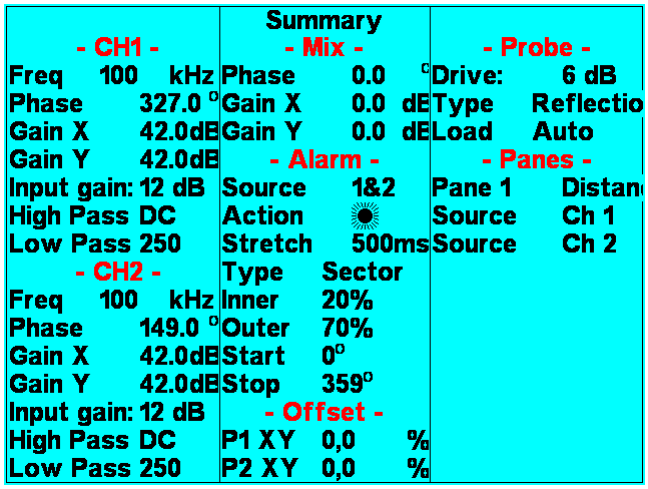
Phase Plane (XY) Example



Distance Example

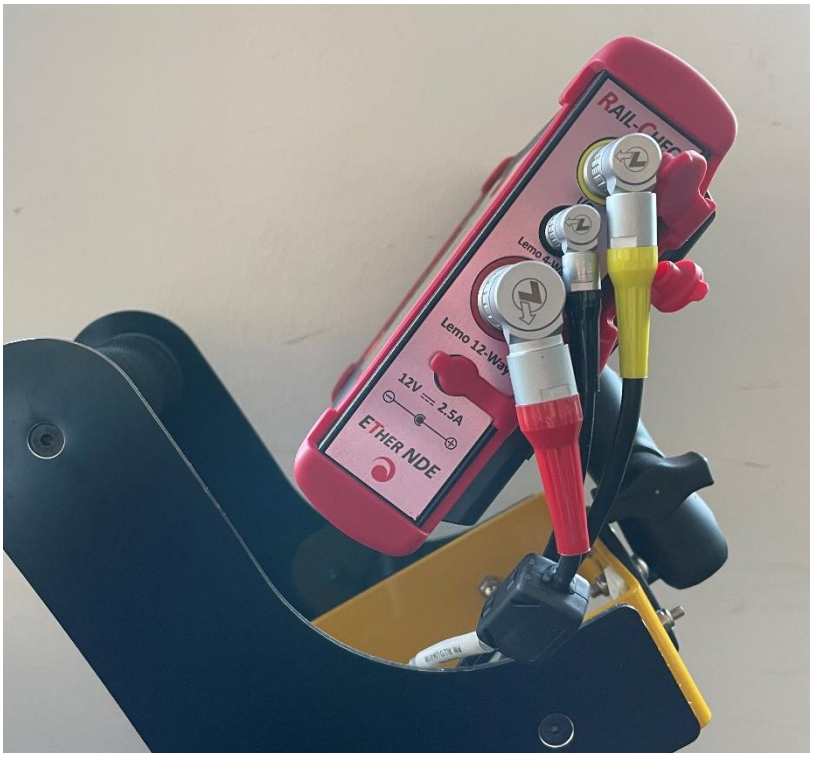
Summary

Shows a snap shot of all the setting on the instrument.

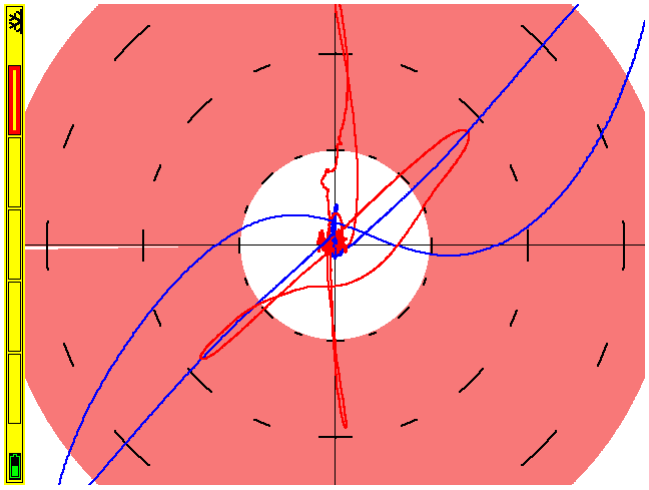


Inspection

Plug Lemo 12-Way probe lead and Lemo 4-Way probe lead into instrument as shown.



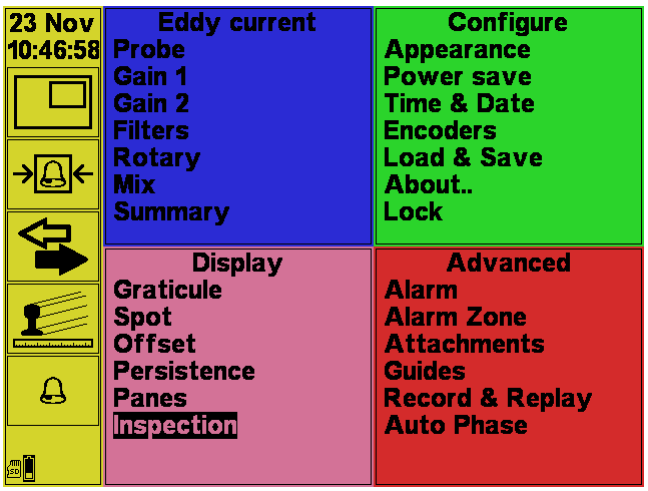
The RailCheck is now configured to detect cracks and defects in a Rail, although with the aid of a suitable representative test piece the Gain, Frequency and Phase should be tailored to the equipment and setup.



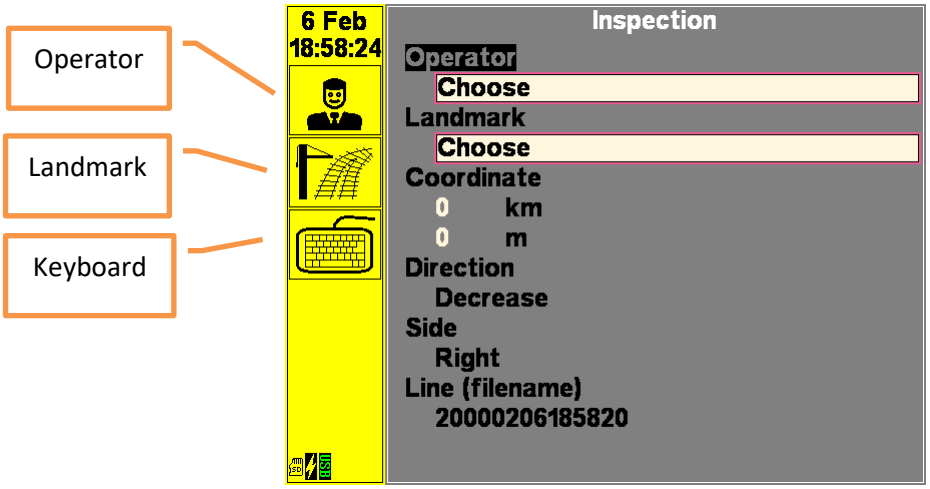
When then taking the leap from setting up the instrument to performing a fully traceable and real inspection, the **Inspection** menu comes in to play.

Display – Inspection

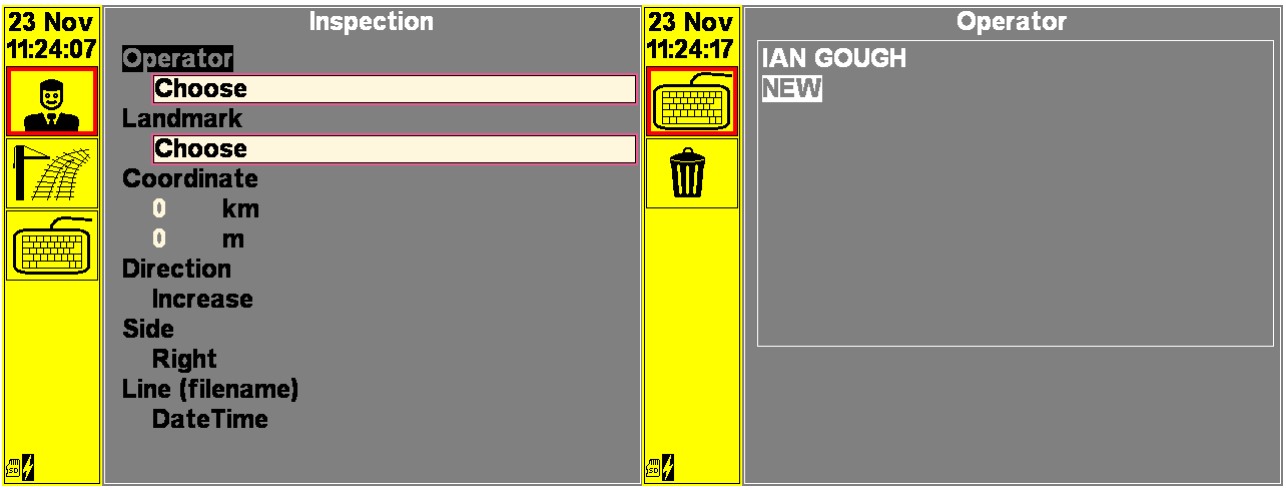
Go to Display - **Inspection**:

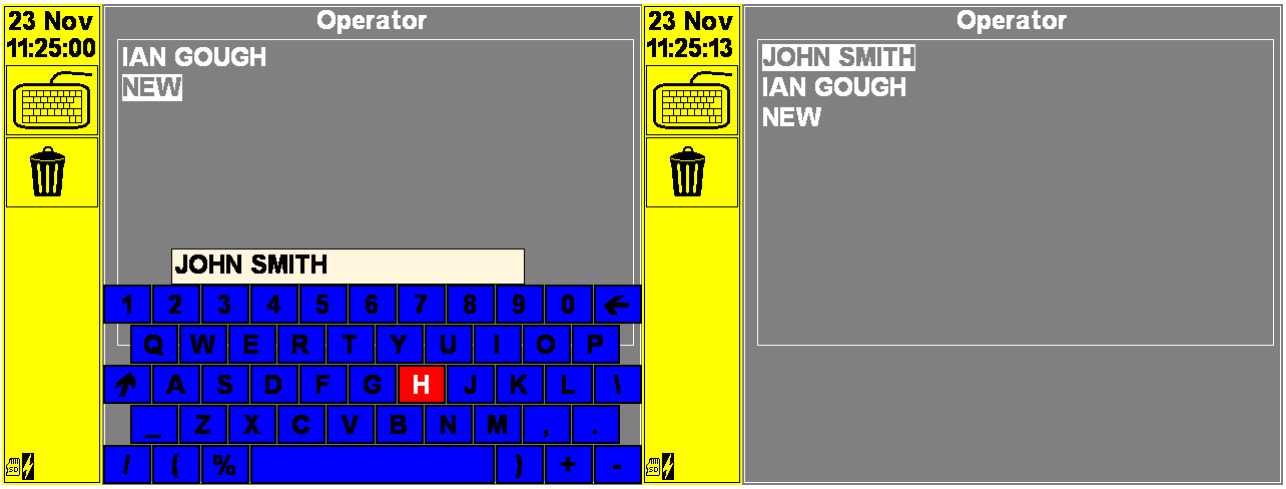


Set-up via the 3 Menus on the Quick Menu:

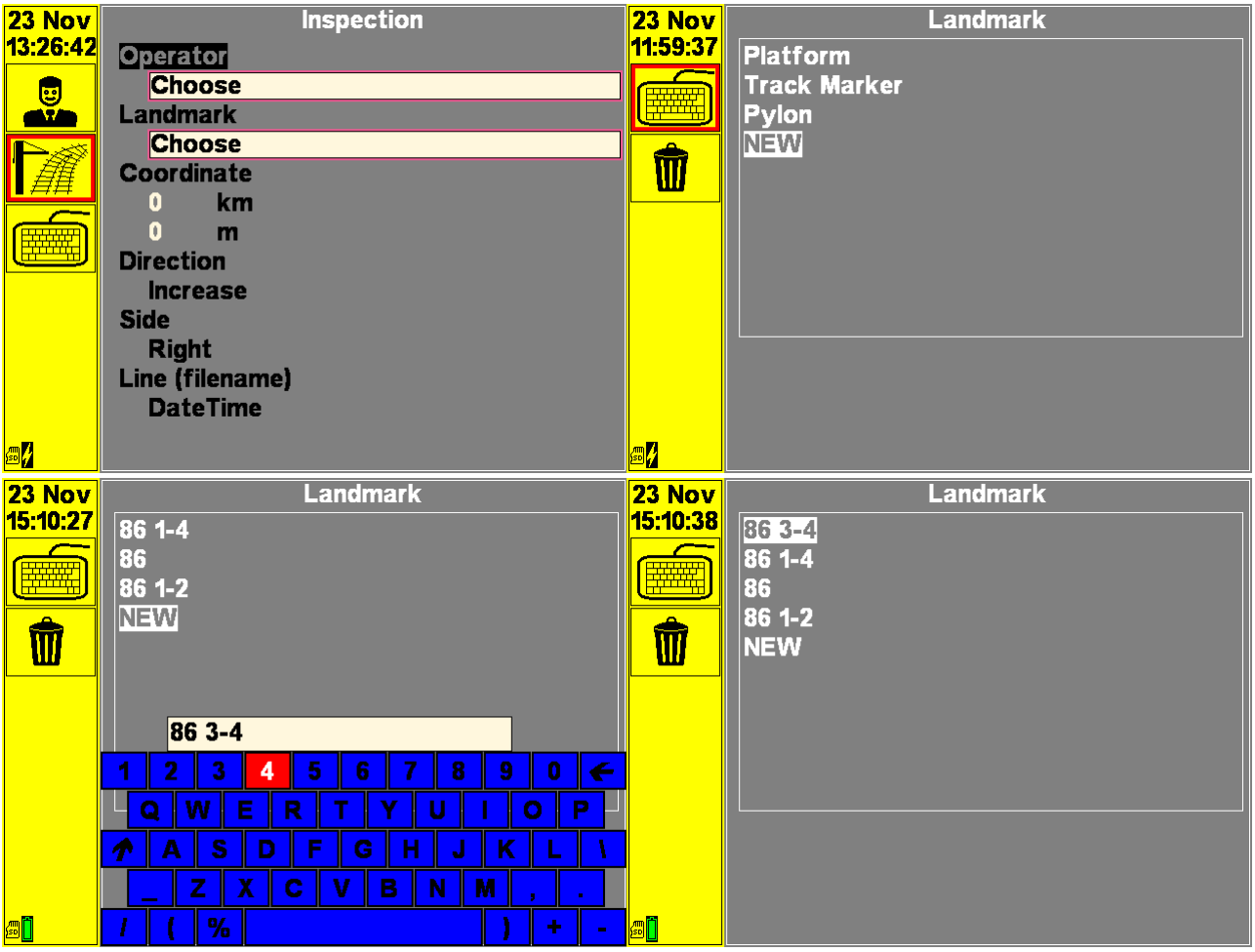


- **Operator** - Allows Operators to be added, removed and edited. 10 Maximum
  1. In the below example we have added new operator ‘John Smith’ to the existing operator list.
  2. Highlight the operator icon using the arrow keys, the press the green OK button
  3. The operator list will then be shown, to add a new operator scroll down to new, then left arrow to highlight the keyboard icon, then press the green OK button, type in the operator name, then press the red back arrow key to confirm, the new operation name should now be in the operator list.



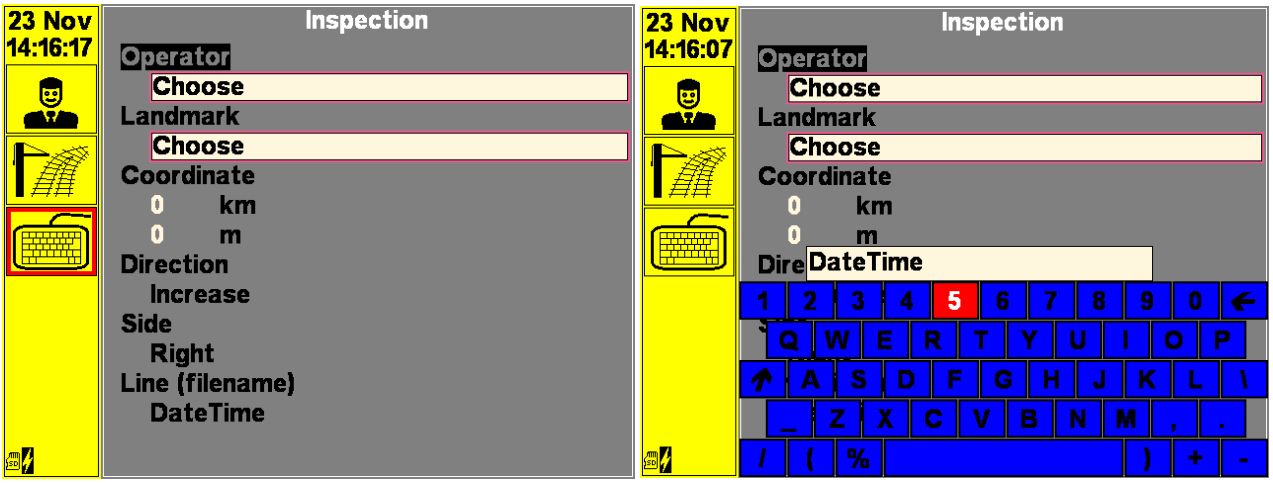


- **Landmark** - Allows Landmarks to be added, removed and edited. 10 Maximum
  1. In the below example we have added new landmarks ’86, 86 ¼, 86 ½, 86 ¾ ’ to the existing landmark list.
  2. Highlight the landmark icon using the arrow keys, the press the green OK button
  3. The landmark list will then be shown, to add a new landmark scroll down to new, then left arrow to highlight the keyboard icon, then press the green OK button, type in the landmark name, then press the red back arrow key to confirm, the new operation name should now be in the landmark list.

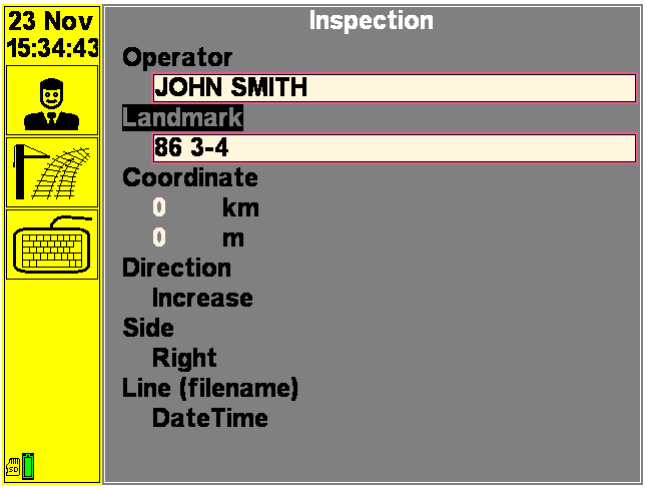


Keyboard - Edits the Line(filename) text.

1. This is free text that is then used as the filename for the save data. The default value is auto-generated from the Time & date, in this case we have left it as the default.



Now info has been entered, you can now set-up the complete inspection page:

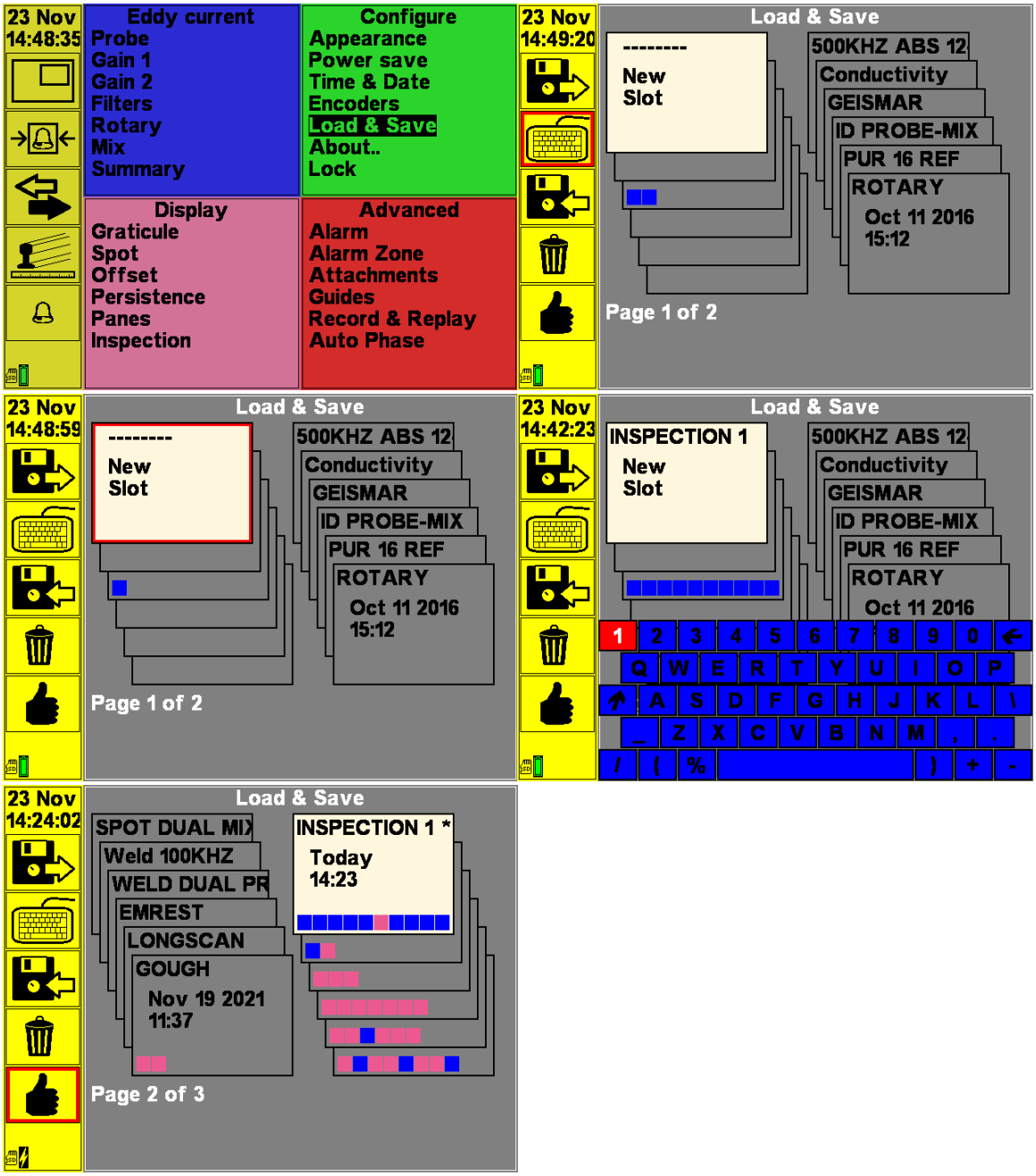


- **Operator** - Select the name of the person performing the inspection from the drop-down list.
- **Landmark -** If the starting Coordinate is referenced from a specific landmark, select it from the drop-down list.
- **Coordinate** - Enter the **km** and **m** (Kilometres and Meters) of the starting Coordinate.
- **Direction** - Is the inspection Increasing or Decreasing in distance from the Coordinate.
- **Side** - Which side of the rail track is the Inspection taking place, **Left** or **Right**.
- **Line** - This is free text that is then used as the filename for the save data. The default value is auto-generated from the Time & date.

Load & Save

Important: Now everything has been configured for an initial inspection, time to save it. Saving all current data not only stores everything that has been setup already but it also creates a folder for saving all data that will be created during the inspection i.e. Scan Data, future Landmarks, Screen shots.

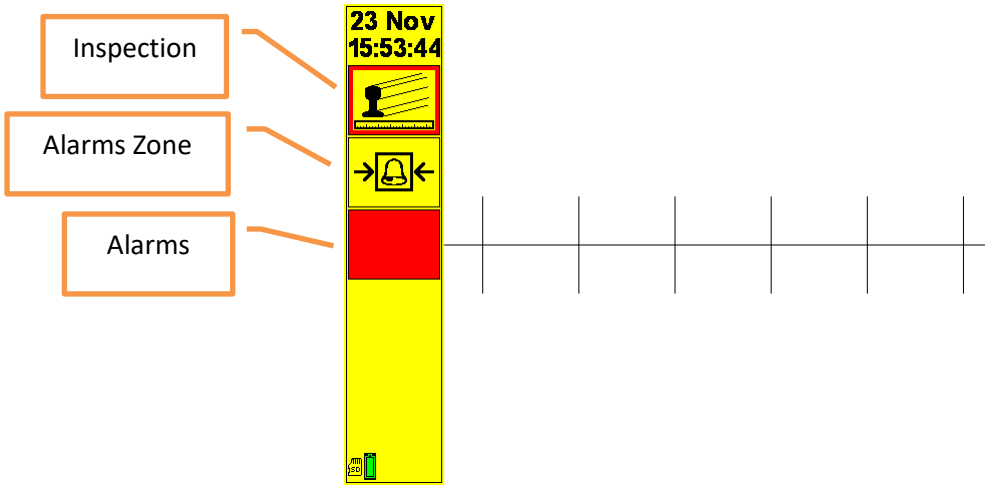
1. Go to the **Load & Save**. The Slot that is selected is by default the last one.
2. Use the UP arrow to change the highlighted slot to the first, which has no name.
3. Press the LEFT and then DOWN arrow to highlight the keyboard. Press OK.
4. Enter a unique name for the save slot, press BACK.
5. Optionally, now go to the Thumbs Up icon; press OK to make this slot a favourite and therefore quickly available when first turning ON the instrument, a star is now shown in the top right hand corner of the file window.



Final Preparation

The menu items on the Quick Menu (the yellow area to the left of the screen) allow quick access and quick information while carrying out an inspection. The most useful to have here is the Inspection menu which is depicted by a piece of rail above a ruler. If this is not present in the top 4 items:

1. If all of the top 4 slots are full (out of a total of 5) then an existing menu item must be removed. Do this by highlighting one of them and then holding down the BACK key until it disappears.
2. In the Main Menu highlight Inspection and then hold down the BACK key until the icon appears in the Quick Menu.
3. Optionally repeat the above steps to add Alarm Zone and Alarms to the Quick Menu.



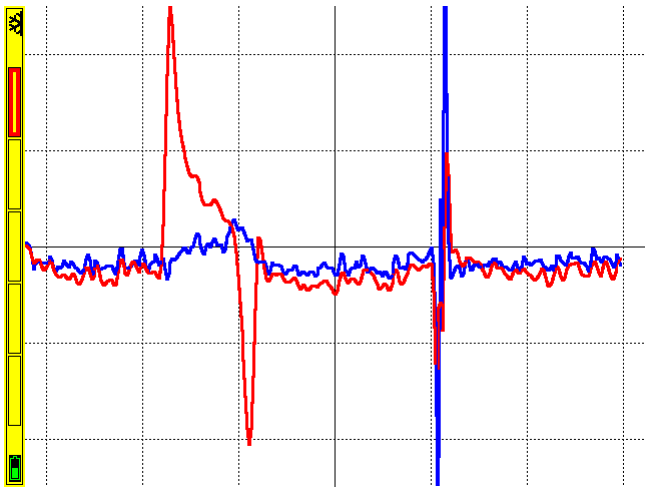
Live Scan Data is not automatically saved, for this to happen Streaming must be enabled. This is done using the blank programmable keys. To configure these:

1. Hold down the top BLANK key until a menu appears.
2. If STREAMING is highlighted, press OK. Otherwise use the UP & DOWN arrow keys to highlight it and then press the OK key.

Let's Inspect!

With the trolley on the rail, all of the above preparation done and the RailCheck in real-time mode, we can start.

1. Press the **BALANCE** key (top left key).
2. Press the **LEFT** key; this will shrink the **Quick Menu** so that more of the screen is visible.
3. Push the trolley forwards and backwards a few centimetres to ensure that data appears on the screen.
4. Hold down the **FREEZE** key until the screen clears itself.
5. Press the top **BLANK** key to begin streaming. A message box will indicate that **Streaming** has begun and it will also display the **Line** name that is used as a filename.
6. Pres **RIGHT** to restore the **Quick Menu**. Go to the **Inspection** icon and press OK. This brings up the Inspection details on the **Status Bar**.
7. Scan a section of rail by walking along with the trolley. The data should be appearing on the graph; both a blue and red trace should be visible. Every 10cms of travel will change toggle the black & white square on the **Status Bar**. Every metre of travel and the distance travelled (starting at the coordinate entered earlier) will be updated.
8. When complete press the top **BLANK** key to stop **Streaming**.

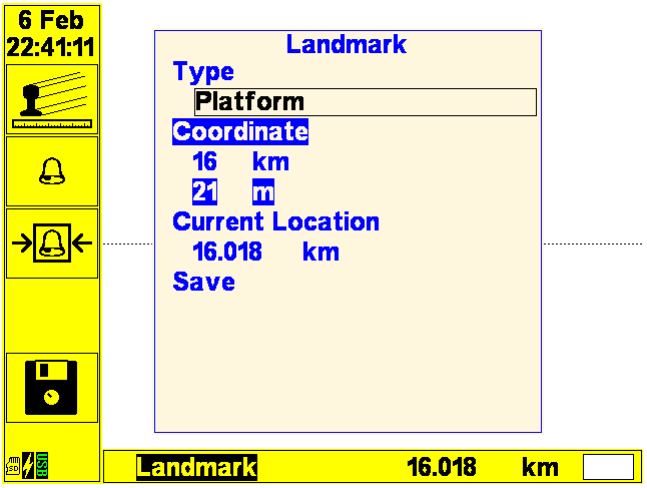


Additional Functionality

The above section covered the basics on the setting up and recording of an Inspection. The RailCheck has many other features that may or may not be of use, but below are a couple that probably will.

Adding Landmarks

During an inspection that is in the hundreds of metres or more, there will often be landmarks by the track that have their own coordinates (in km and m). In theory these coordinates will match the values displayed on the **Inspection** Status Bar. In practice these is often a discrepancy.



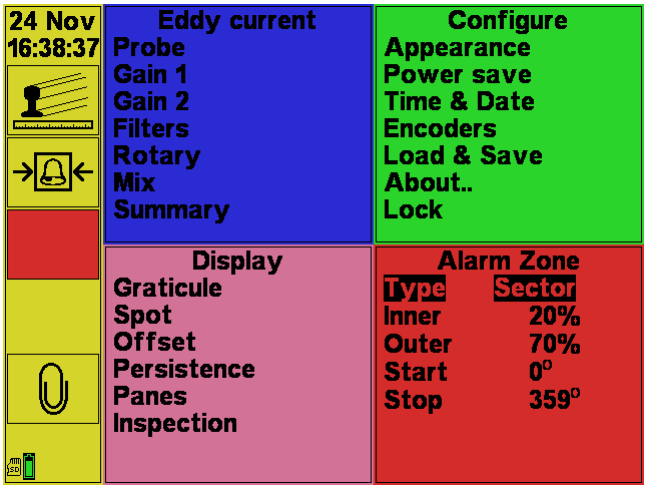
New coordinates can be entered during an inspection if they become available, like so:

- Ensure that the **Inspection** Status Bar is visible on the Real time display.
- Landmarks will be highlighted, press the **OK** key to see the **Landmarks** menu.
- From the drop down choose the type of Landmark that the coordinates are referenced from.
- Enter the new coordinates in km and m.
- The CURRENT coordinates are shown for information only.
- When complete, go to **Save** and press OK.
- A landmarks file is created in the save slots folder with the Line name followed by the postfix "_l" to indicate that it is a Landmark file.
- The Inspection can now continue and the coordinates shown now reflect the modified value.

Alarms

With the Rail Check configured correctly, the larger a defect the further from the centre line the trace will be. Therefore, it is simple and useful to set up a point at which the user is alerted and the status saved, when this threshold is breached. This is where Alarms come in. To configure an alarm:

- In the Main Menu go to Alarm Zones and ensure that of the options (Off, Sector and Box) **Sector** is selected.
- Add Alarm Zones and Alarms to the Quick Menu if they are not already there.
- Ensure the settings are as follows:



- Press BACK and BACK again to close the Alarm Zone menu and go to real time mode.
- The Alarm Zone is visible by the red area. If the red area straddles the centre line then the trace exiting the area will trigger the alarm. This Alarm condition is indicated by the Alarm Quick Menu item glowing RED, an audible alarm (if so configured) and if the data is being saved, this state is also saved.
- Open the **Alarm Zone** quick menu. The top and bottom line can be moved up and down over the live data so that an accurate position of the alarm zone can be set up, assuming that a test piece is handy with a known defect present.

Post Inspection Analysis

The format for saved inspection data is the standard CSV (Comma Separated Value) format. This is human readable in a text editor or can be opened up with Microsoft Excel and very quickly displayed as a graph.

All files are stored in the microSD card inside the instrument. This card can be removed and

The columns of data in this file are as follows:

Channel 1 X, Channel 1 Y, Channel 2 X, Channel 2 Y, Encoder 2, Encoder 1, Status.

Channel 1 is usually the Large Coil.

Channel 2 is usually the Small Coil.

Encoder 2 is usually not used.

Encoder 1 is the wheel and the values are in ticks, NOT units of distance.

Please Note: The X & Y components of a channel are both important for detailed Eddy Current analysis. Once the RailCheck is correctly configured it is usually only the Y component that indicates a defect and is the value that is visible on the **Distance** graph display on the instrument.

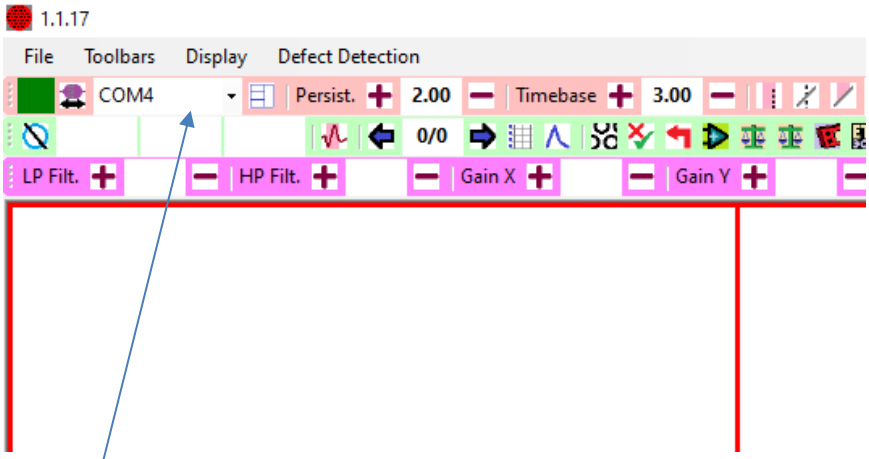
ETherMap

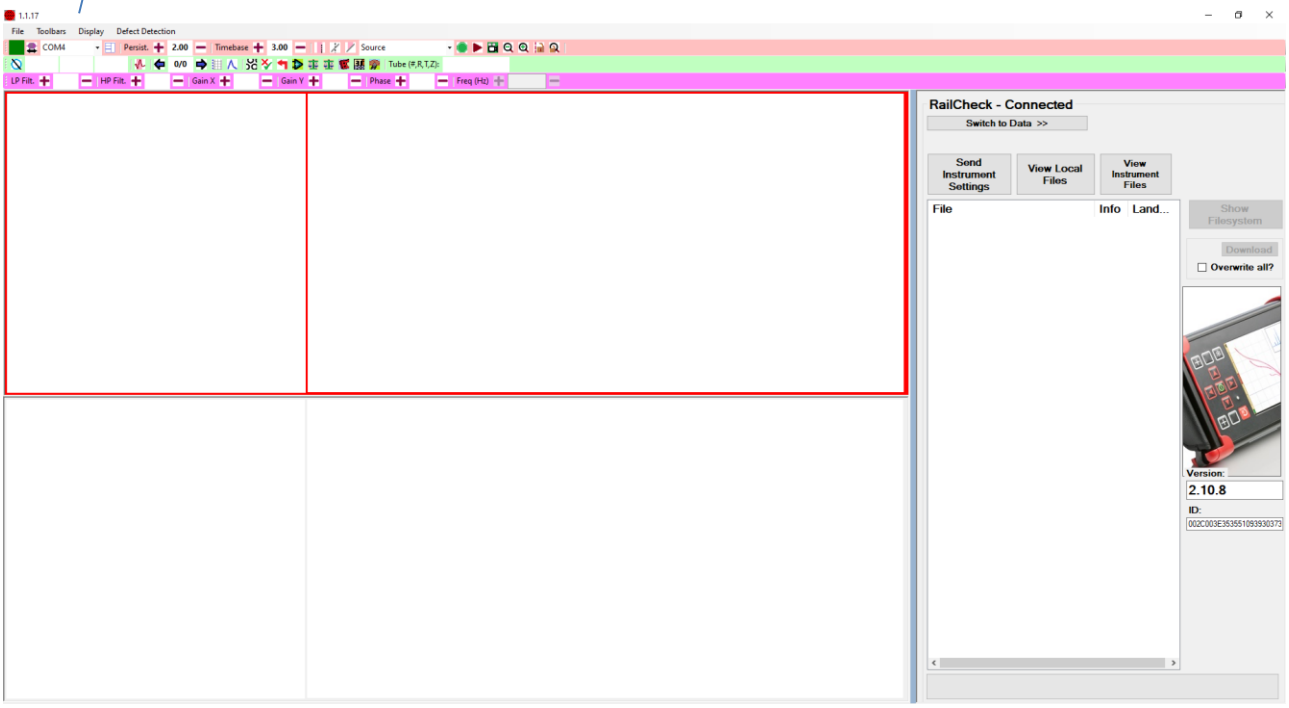
Software that will allow saved data files to be viewed and includes other features that are not as easily visible using the spreadsheet method.

Viewing Inspection data

ETherMap can open files that have been saved on the local PC, or where the microSD card is visible to the PC. To do this:

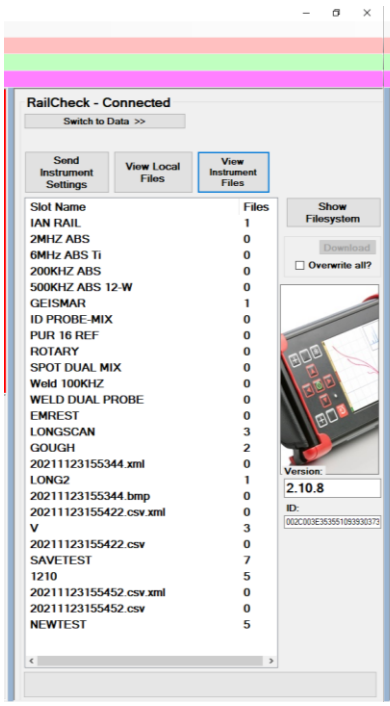
1. Plug RailCheck into PC with ETherMap software pre-loaded via supplied USB lead.
2. Open ETherMap software
3. Turn on RailCheck
4. The software will now recognise the virtual COM port and automatically connect to the RailCheck, the RailCheck window will be shown.





5. Now you need to collect the data stored on the RailCheck to the PC by selecting the “View instrument Files” button.
6. Select the folder the streeming data was stored under.
7. Select the file.
8. Select the “Download” button, a tick should be shown next to the file name.
9. Select “View Local Files”, the slot should now be shown on the PC.

5



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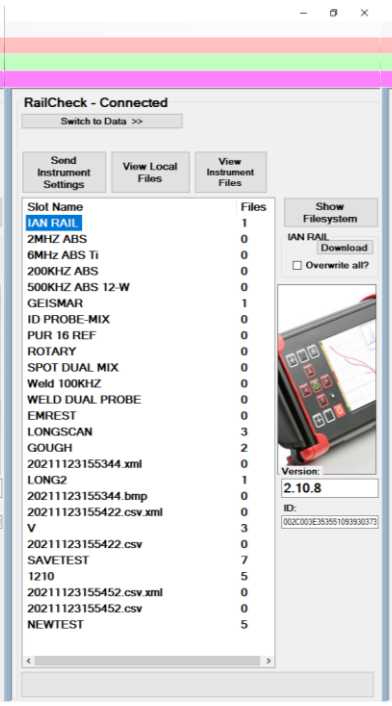

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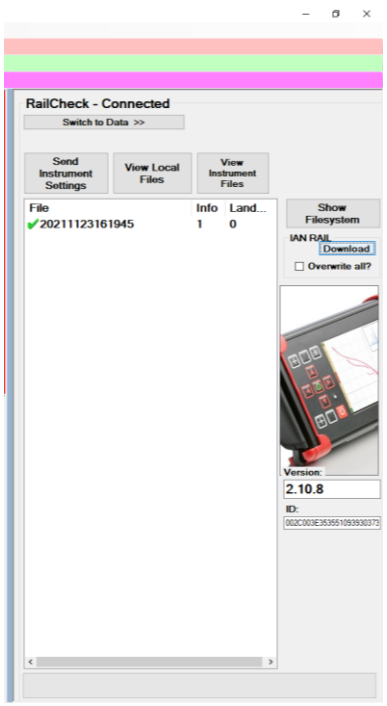

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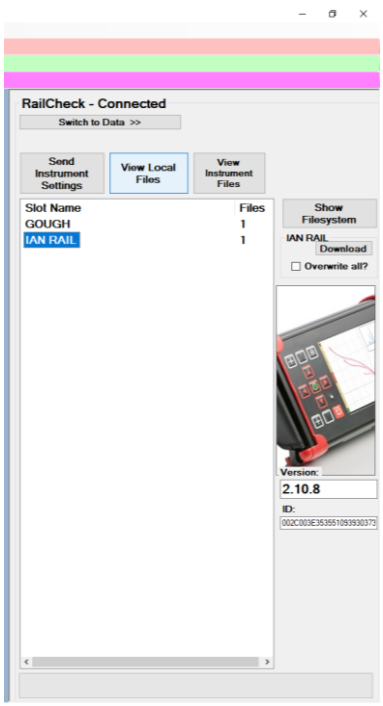
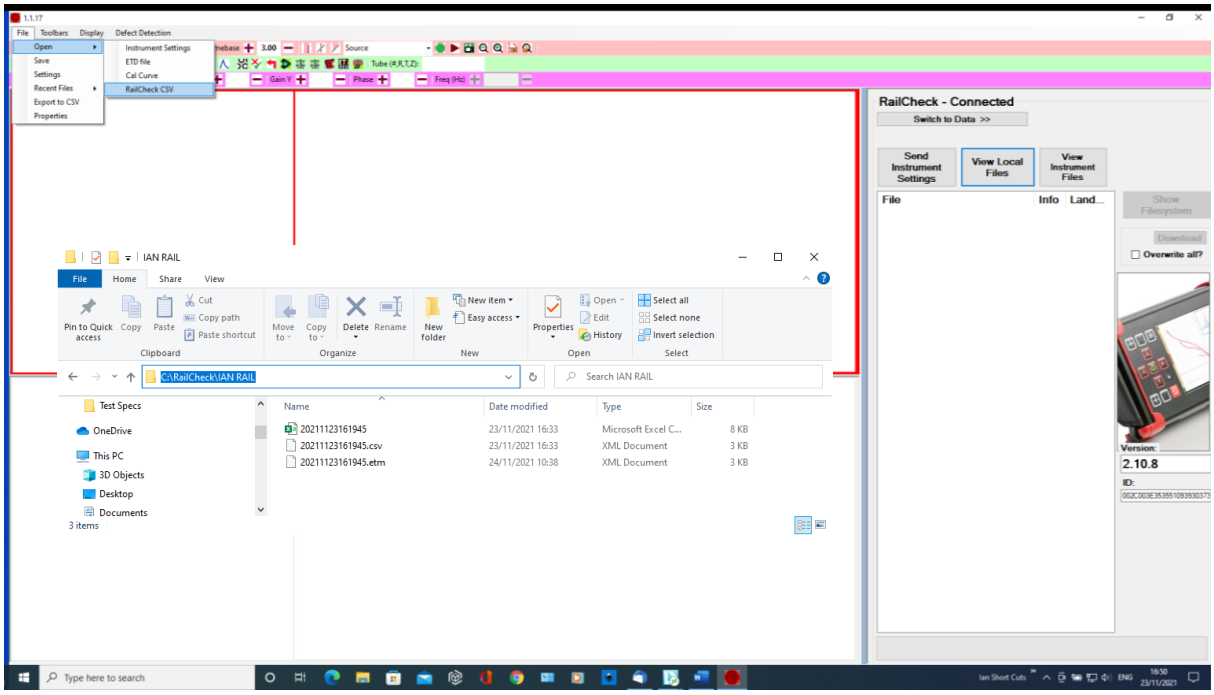


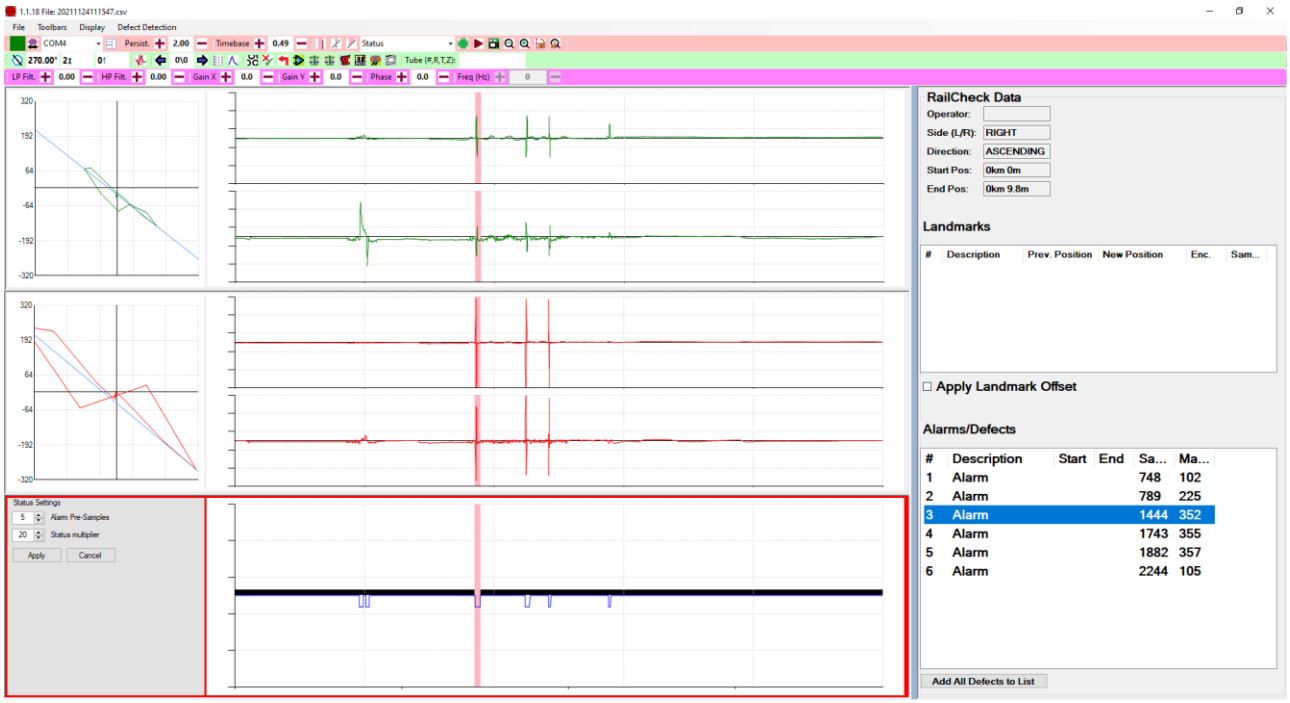
10. Open RailCheck .CSV file from PC, File, Open, RailCheck



Example data below from a 10 meter track with x1 longitudinal defect and x3 Transvers (gauge corner) Defects.

The green signal is from the Large Coil covering the complete rail head

The Red signal is from the Small Coil covering the gauge corner



Further analysis can be done, please refer to ETherMap manual for more info.

ETherRealTime

The freely available package ETherRealTime will allow saved data files to be viewed and includes other features that are not as easily visible using the spreadsheet method.

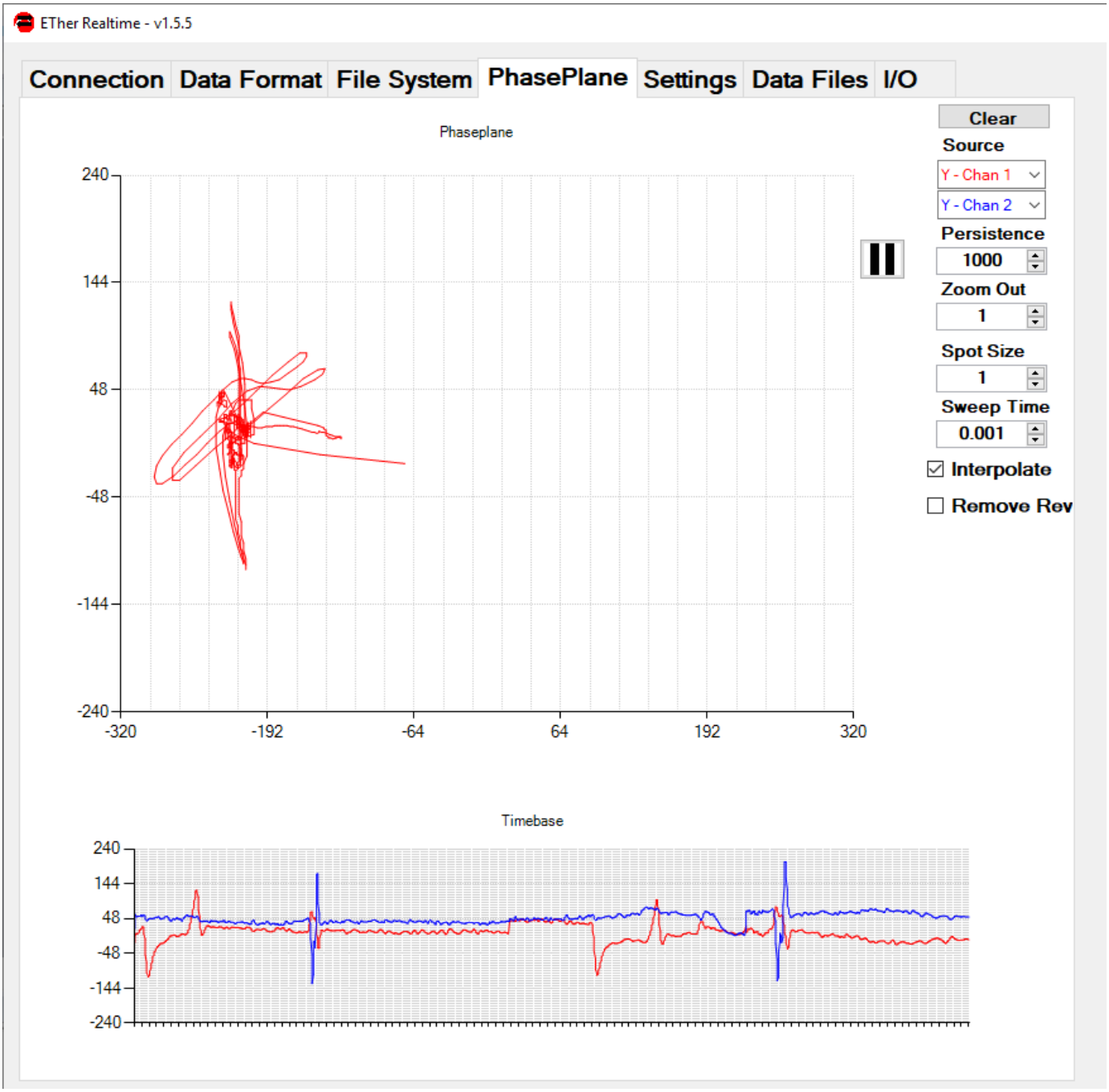
Viewing Inspection data

ETherRealTime can open files that have been saved on the local PC, or where the microSD card is visible to the PC. To do this:

- Go to the **Data Files** tab on ETherRealTime.
- Click **View a RailCheck File**.
- Browse to the .csv file and double click it.
- The data within the file will be displayed. With every csv file created by the RailCheck it also creates a .csv.xml file. This contains all of the settings of the instrument at the time of the inspection. If this file is present in the same folder as the .csv file, then an accurate distance is displayed on the horizontal axis.

The beauty of ETherRealTime is that is can take data directly from a RailCheck that is connected via USB. This is done like so:

- Open ETherRealTime and have the **Connection** tab visible.
- Connect the RailCheck to the PC with a USB mini cable and Turn ON the RailCheck (in any order). ETherRealTime should display **Device Change message**, and the Com Port box should now show a Com port number, i.e. **COM3 VCP**.
- If a Com port number is NOT shown:
    - If this is the first time this RailCheck and PC have been connected, wait for any drivers to be installed, close and reopen ETherRealTime.
    - Open Device manager on the PC. If there is a yellow triangle against Ports, contact the RailCheck distributor for advice on installing the device driver.
- Click the **Connect** button.
- Go to the **File System** tab. Each time this tab is shown the File System window will update its contents.
- Expand the **FileSystem, EtherCheck** and **Saves** folders. Visible now are the folders created for each Save Slot. Expand the slot where the Inspection data is.
- Files that should be present in this folder:
    - <Slot name>.xml - RailCheck settings for this inspection.
    - <Line name>.csv - CSV file containing the inspection data.
    - <Line name>.csv.xml - Inspection settings for the inspection data CSV file.
    - <Line name>_L.xml - The first Landmark file.
    - <Line name>_L(1).xml – The 2nd Landmark file.
    - <Line name>_L(n).xml - The nth Landmark file.
- Click on the .csv file then click the **View** button. The .csv and the associated csv.xml files will down load from the RailCheck and then the graphs will be populated and should appear like so:



Using ETherRealTime to analyse data

- Towards the top right ensure that the **Source** drop-down menus are set to **Y-Chan1 and Y-Chan2**. This will then show the data from both coils on the lower horizontal graph. This mimics the data display of the instrument if the RailCheck was configured as per this document.
- The graphs can be zoomed by dragging a square over the area of data of interest and then releasing the mouse button. Performing this on the horizontal graph will allow the X axis to be seen in more detail and then values on the axis show the real-world distance travelled.
- Zooms can be undone by clicking the small circle on each scroll bar. Each axis zoom must be undone independently.

- Clicking the Interpolate button applies to the upper (Phase plane) graph and connects individual points with a line improving the aesthetics. The Phase Plane graph is made up of the X and Y coordinates of whichever channel is present on the upper **Source** drop-down.
- The check box **Remove Rev** will remove data from the graphs that was obtained while the encoder was going backwards. This can be especially useful when an inspector has discovered a defect and to clarify that it was real, moved the trolley backwards and forwards over it, before continuing on with the inspection. The trace would indicate several defects when in fact there was only 1.