



## **3i Device TEV and Acoustic Portable PD measurement**

User Guide  
Version 3.2



DIMRUS  
Russia

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## Safety tips for general use in a substation before testing

The test engineer must read and understand these precautions. The engineer must always comply with the safety rules and regulations for the substation. The following safety precautions apply to the 3i when field-testing:

- 1) Avoid working alone
- 2) Have the appropriate health and safety training for use of the 3i and sensors
- 3) Should not interfere with any of the substation safety devices or equipment
- 4) Inspect and check all the grounding cables that will be test points, that the signal cable is properly connected, and in good condition
- 5) Users should read and understand the 3i user manual
- 6) Select the correct sensor, connections and attachments
- 7) 3i PD sensor design is only to be used on grounding metal housings, and cable or switch ground wire, or neutral points. In all cases, the 3i and the sensor are not allowed to be directly connected non-earthed high voltage components
- 8) Ensure the high voltage equipment test point is in good order and safe to use
- 9) All required safety PPE must be worn in the designated areas

Check before entering substation:

The engineer must only enter a substation after permission from the appropriate authority. Any question regarding substation high-voltage safety rules should be address before entering.

On entering:

On entering the testing area, the engineers should observe around the test area, this would assist the engineers in finding the test equipment, local power supply, identify potential hazards. Understand the type of device that you want to test and testing methods. A good understanding of the test sensors and how they should be used, is required before connecting them to the HV equipment.

# 1. 3i technical specifications

## 1.1 Introduction

The 3i is an acoustic and electrical partial discharge detector that combines two key detection methods. Partial discharge (or PD) exists in high voltage equipment as a sign of insulation defects. The 3i is intended for medium voltage (MV) region of 6kV to 33kV. The 3i device can measure and analyse the defects that cause partial discharge, and help locate the position.

The 3i detector target range is MV substations with metal clad switchgear.

The partial discharge detection for the instrument consists of three principle inputs, corresponding to different frequency bands of PD:

- Acoustic channels (low frequency, LF): 40kHz, using internal and external acoustic sensors
- HFCT (High Frequency Current Transformer ) frequency channel (high frequency, HF): 0,1 ~ 10MHz, using external RFCT sensor only
- TEV (Transient Earth Voltage) frequency channel (very high frequency, VHF): 10 ~ 100MHz, using internal and external TSM contact sensors

The 3i supports both inbuilt TEV and acoustic sensors and a connection for external sensors.

This device allows the engineer to select either sensor then display results as needed. The test data is stored in the device itself. The 3i has some unique methods for storing the data form the site that is pre-configured. A PC is required to set this pre-configured arrangement; options of using RFID or pre-set routes can be used for the storage tags.

The 3i can be used quickly and efficiently for TEV, HFCT and acoustic PD measurements. Minimal training is required, and the 3i provides a first line in medium voltage PD monitoring without any outage of the primary equipment.



The 3i uses a series of optimised algorithm for partial discharge signal de-noising that is utilised in other DIMRUS PD equipment. Real-time processing removes noise and non-PD signals as far

as possible for a simpler hand-held device. The 3i can be used in very hostile environments with many types of interference, and fully certified substation work environment.

The 3i equipment is protected by the durable plastic casing. The useable ambient temperatures are from -20°C; this significantly expands the scope of the test environment. A membrane-sealed keypad contains the control buttons, easy to operate on site. All survey information is reliably stored in the built-in memory. All data can be output to a computer for further processing and analysis.

The RFID function removes possible errors when recording results. This function takes away the need for manual recording of information and location of the measurements.

## **1.2 Delivery sets**

There are two delivery sets: Base and Extended Sensors.

The «3i» Base Delivery Set

Position	Quantity, pcs.
The «3i» device	1
Charger with USB output	1
USB cable	1
Headphones	1
AR-Sensor acoustic sensor	1
I-PD2 calibrator	1
«iNVA Portable» software	1
Transportation case	1
User manual and test report	1



The «3i» Base Delivery Set

The «3i» Extended Sensors Delivery Set

Position	Quantity, pcs.
«AR-Loc» external acoustic sensor with parabolic dish	1
External «TEV» sensor with cable	1
External «HFCT» sensor with cable	1
Reference signal transmitter «PFR-2»	1
Transportation case	1



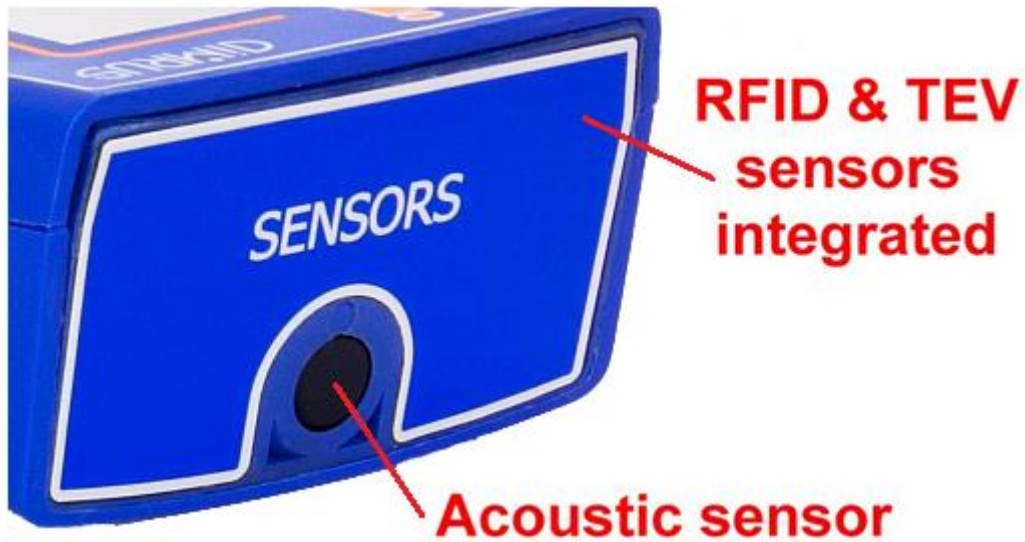
The «3i» Extended Sensors Delivery Set

### **1.3 Main technical parameters**

Main technical parameters of the 3i instrument as shown in the following table:

<b>Number</b>	<b>Parameters</b>	<b>Parameter value</b>
1	TEV channels	2
2	HFCT channels	1
3	Acoustic channels	2
4	TEV Channel bandwidth	10MHz ~ 100MHz
5	HFCT Channel bandwidth	0,1 ~ 10MHz
6	Acoustic bandwidth	40kHz ± 2kHz
7	Dynamic range in TEV and HFCT	60dB
8	Dynamic range in Acoustic	80dB
9	RFID	ISO14443A, 13.56MHz
10	External ports	1 x external sensor 1 x headphone 1 x USB
11	Battery usage time	12 hour
12	Built-in battery type	Lithium-ion
13	Power connector	Via USB
14	External power supply module input	220V AC
15	Operating temperature range	-20 ~ +55 °C
16	Equipment life	10 Year
17	Dimensions	85 × 45 × 220 (mm )
18	Communications interface	USB
19	3i Host weight	0.4 kg
20	Total weight (including boxes)	2.7 kg

## 1.4 Sensor interface description



At the top of the instrument, the sensors are built in:

- Acoustic sensor
- TEV sensor
- RFID antenna

On the bottom of the device are the external connections



These connections are:

- USB
- Headphones
- External TEV and acoustic sensor connections



## 1.5 External sensors

There is only one extended sensor in standard delivery set – external microphone:



External microphone

In addition, there are the four extended sensors in extended delivery set – parabolic dish microphone, RFCT sensor, TSM sensor and PFR-2 reference signal transmitter:



Parabolic dish



RFCT sensor



TSM sensor



PRF-2 transmitter

The parabolic dish is used for localising places of PD. It has 20dB gain and 1m location accuracy. It work on distance up to 100m.

RFCT sensors (Radio Frequency Current Transformer) is used for recording pulses from partial discharges in high-voltage switches, switchgear cells and suitable cable lines, in grounding circuits of power transformers.

These sensors are connected to the external sensor socket and should only be used with the cable provided with the 3i.

## **1.6 Instrument description**

The 3i primary measurements are for airborne acoustic and TEV signals. The primary sensor is inbuilt for ease of use. The sensor block houses the TEV sensor, RFID antenna, and in the centre, the acoustic input is visible.

The 3i is designed to be charged via the USB port. An external 5V USB charger is supplied, and most PCs or laptops can be used to charge the 3i. The built-in lithium-ion battery, it is modern, lightweight and has a long life, making it easy to carry and use for both in the field or laboratory tests, lasting many hours between charges.

The measurement of the PD is shown as level only. Some additional signal information may be recorded for the PC to analyse and display.

The signals detected are processed and only possible PD type pulses are recorded. Non-PD type signals are rejected. For both acoustic and TEV, the maximum PD pulse values are displayed. The peak value is shown largest on the display, and a small trend of the last few minutes of data is displayed.

The display units can be changed, along with the levels of warning (yellow) and alarm (red). This must be done via the USB connection and PC application.

For TEV measurements, it is very important that the user keep a firm grip of the 3i while taking readings. The TEV signal travels at high frequency on the earth panels, and the 3i must have a reference ground, similar to an antenna ground, via the user holding the 3i.

It should be noted that this effect of holding the 3i is no more dangerous than touching the earthed panel of the equipment. The capacitance of the user only provides an RF grounding path.

The acoustic signals are generated as micro pressure waves. Typically, these are in the higher acoustic bands, above human hearing. Sometimes extreme PD acoustic signals are heard in the audible range. The 3i sensor is tuned to the 40kHz band; this is sensitive to most airborne PD signals.

In addition, the 3i has a downconverter to allow the 40kHz signal to be heard by headphones. This circuit shifts the frequency from 40kHz down to 1.8kHz. Then the user can hear the signals normally above human hearing range.

The TEV signal is the higher frequency pulse from the PD travelling back to earth. The TEV sensor capacitively picks up the signal when in close proximity.

As a rule, measurements are made at places where defects are most likely to occur. For example, for cells, measurements are made at three points in front and, if possible, at three points behind the cell, namely at the locations of the buses and contacts:




For the external sensor, this 3i module can be attached magnetically to the metal panels.

The 3i acoustic sensors are directional sensors that are held some safe distance away the high voltage components. Generally, the airborne signal is best with a direct line of sight to the PD source, however, there are many circumstances where acoustic signals can be detected from gaps and joins in the switchgear.

The internal and external acoustic sensors must be pointed in the direction required. The direction is simply along the line of the 3i body, or external sensor.

## 2. 3i Instructions for operation

The 3i body shell is a plastic case. The main display has a resolution of 240x320 pixels. Control buttons are embedded on the front membrane keypad, under the display. The control buttons are multi-functional these are the following keys:

- Power / Select: "  "
- Function: " F "



### 2.1 Principle of button input


The menu of the 3i is only available as an option if the measurements have been stopped.

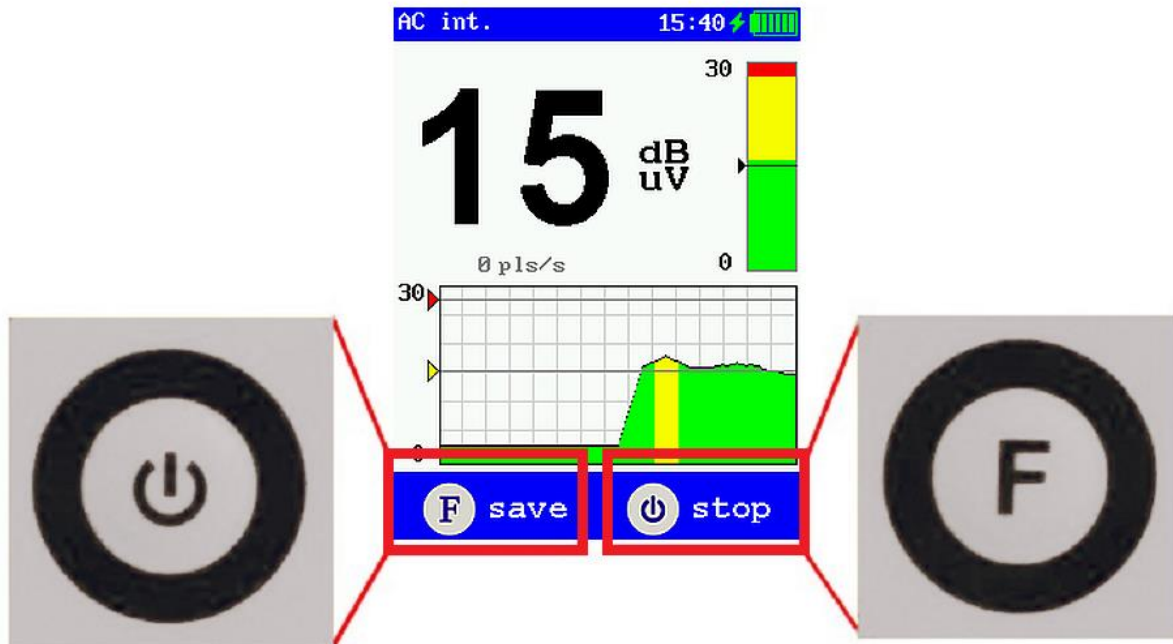
When the 3i is measuring then the only options are "Stop" and "Save".

When the measurements have stopped then the options are to "Start" or "Menu".

This principle of operation allows for fast operation when taking measurements. For normal use then either no buttons or one button is needed (unless changing sensor selection).

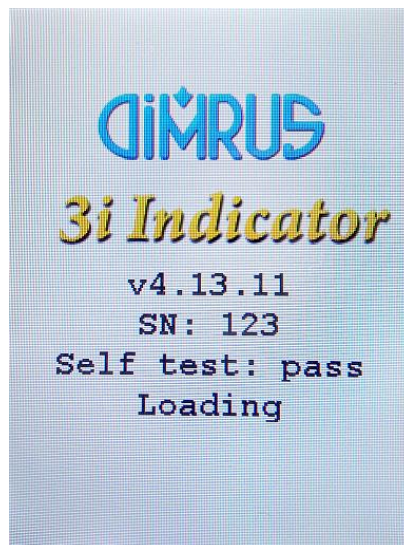
The button functions will change depending on the screens. At all times the screen will show that the button functions are.

The only additional feature is the power function. Press and hold the "  " button for a few seconds to switch the unit off.



## 2.2 Device boot

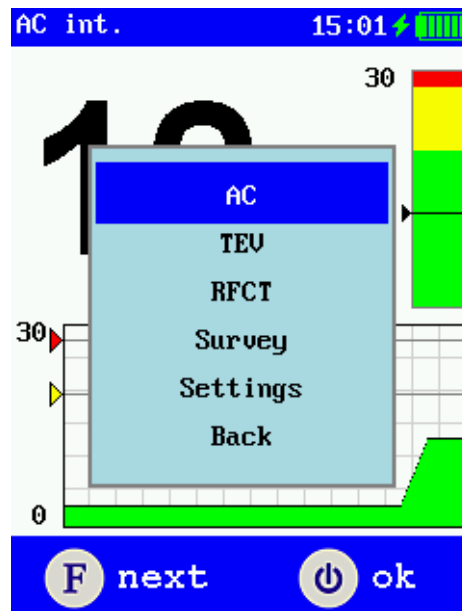
Press and hold the "⏻" button, wait for 2 to 3 seconds. The device enters the initial interface, makes the self-diagnostics and load a list of the measures:



After this screen, the 3i is running and ready to measure.

## 2.3 Main menu

Figure shows the 3i's main menu:



The 'F' button will step through the menu options. The "⏻" button will select that option.

The menu options are:

- **AC:** Acoustic sensor. It will show internal or external acoustic sensor if connected
- **TEV:** TEV sensor. It will show internal or external TSM sensor if connected
- **RFCT:** RFCT sensor only
- **Survey:** Starts route mode, where locations follow a pre-set route or locations are defined by RFID tags
- **Settings:** Allow to change some parameters
- **Back:** return to the back view

It must be noted that certain parameters can only be changed or entered from the INVA program on a PC. These include:

- Setting the device time
- Setting the warning (yellow) and alarm (red) levels
- Entering all route and RFID information

## 2.4 Acoustic PD measurement

Select the AC menu. The displays for internal and external sensors are shown:

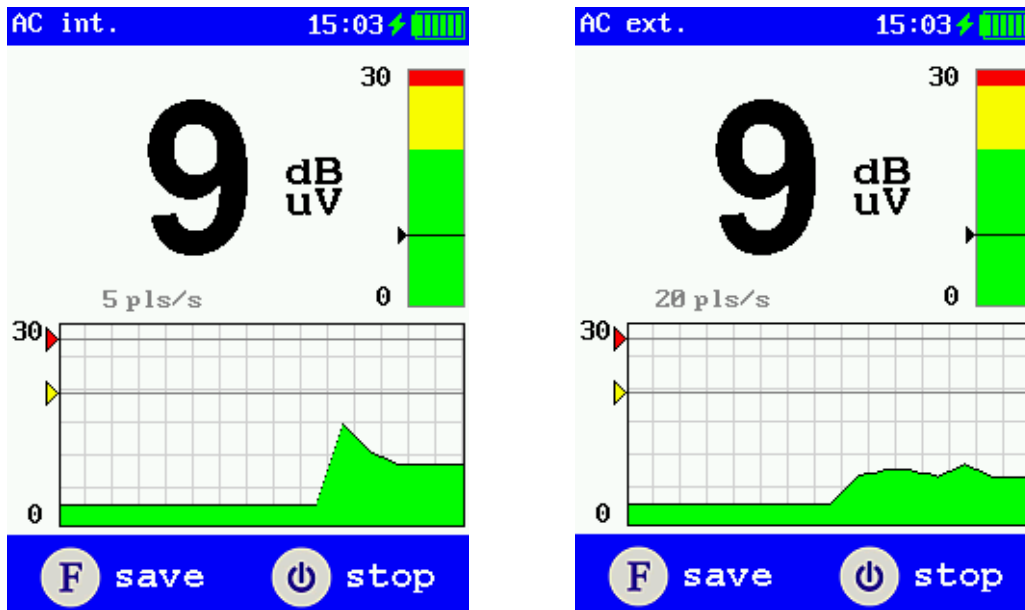
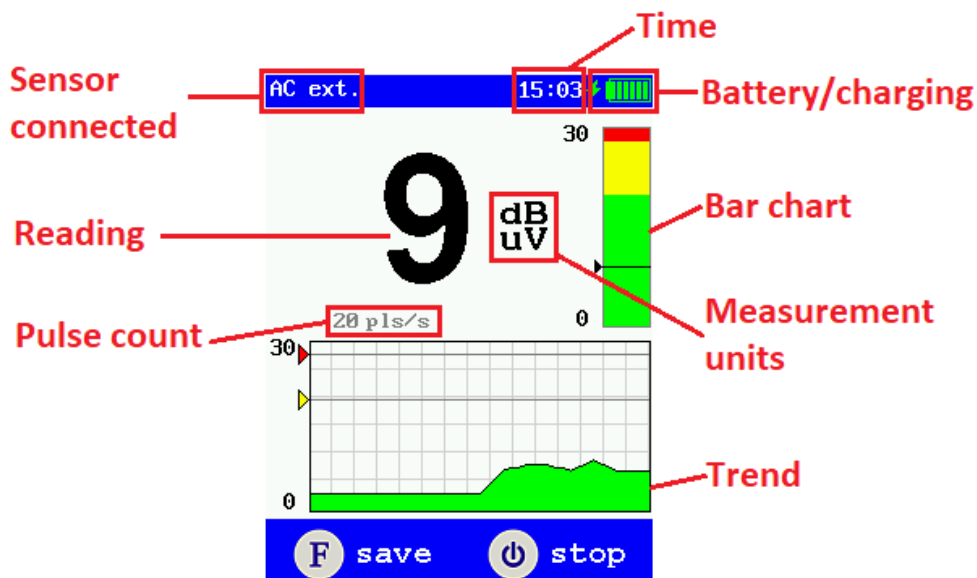


Figure below has the display in detail:



The screen sections are:

- Sensor connected: Current sensor in use
- Reading: Measurement value
- Measurement units: Units of main measurement value
- Pulse count: Number of measured pulses per second
- Time: Current time
- Battery/charging: Battery level, or charge status
- Bar chart: Level of current signal shown on scale with alarm levels
- Trend: Rolling trend showing the last few minutes of results



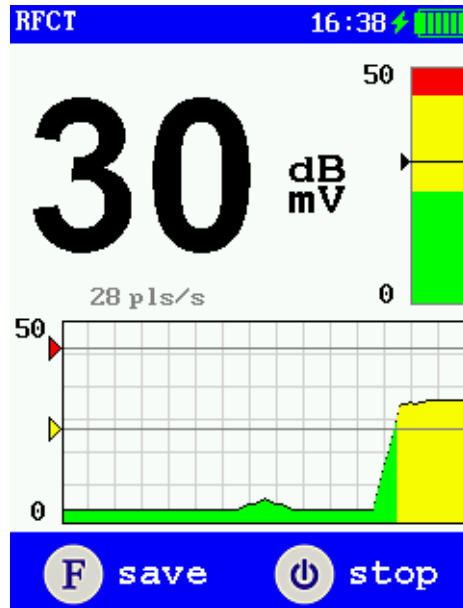
## 2.5 TEV PD measurement

Select the TEV menu. The displays for internal and external sensors are shown:



## 2.6 RFCT PD measurement

Select the RFCT menu. The displays for external sensor is shown:



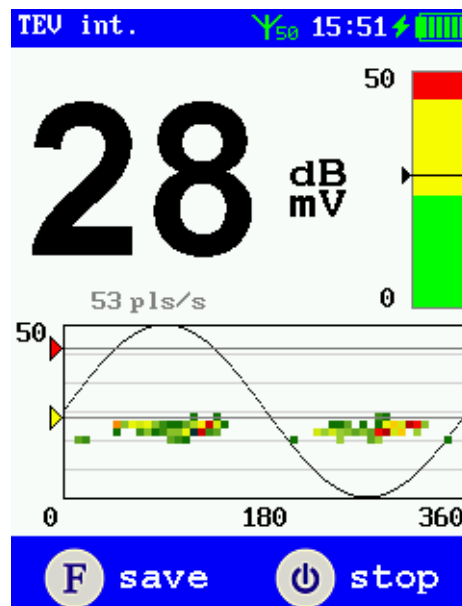
## 2.7 PRPD mode

In all channel modes, it is possible to view the PRPD (Phase-Resolved Partial Discharge distribution). Switch to PRPD mode and back to Trend mode by pressing both the button simultaneously.

This distribution shows the relationship between the moment of occurrence of partial discharges and the phase of the applied alternating voltage. Most often, discharges occur on the areas of growth of the applied mains voltage, both on the positive half-wave of the sinusoid, and on the negative one. Based on the analysis of the phase zones of the distribution of pulses (partial discharges), basic expert diagnostics is constructed, the type of defect in isolation, which is the source of partial discharges, is determined.

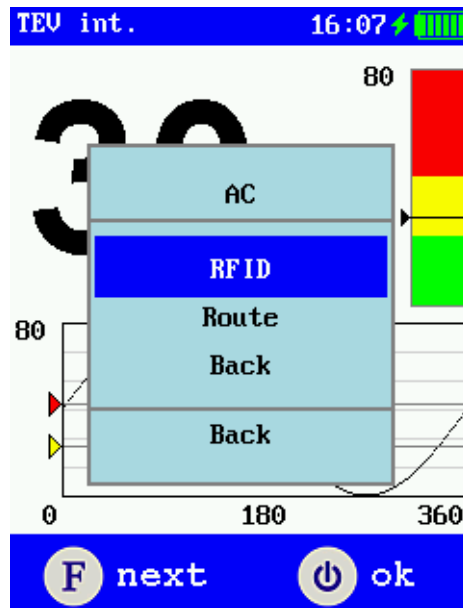
As this pulse distribution is synchronized to the sinusoid of supplied voltage, so this form of PD distribution is almost directly connected to the type of the insulation defect. That is why PRPD distribution is often called the «graph shape» of the defect type in the equipment insulation. Each defect has its own pattern, which can be determined by INVA software.

To determine the type of the defector, the measurement process must be synchronized with the phase of the primary voltage. For this, a "PFR-2" sensor is used. This device is connected to the reference voltage and sends synchronizing labels on the radio channel. The sending distance of the synchronizing pulse is up to 100 meters. The value of the reference voltage can vary from 85 to 300 V.



## 2.8 Survey mode

This menu starts the RFID or Route mode:



RFID menu item starts the RFID mode. The RFID tag on the panel stores all location information.

When running in this mode, hold the 3i up to the RFID tag when the searching message appears. Then move the 3i to the measurement point and select 'save' to store the result and move to the next RFID point. Repeat for all location points.

Route menu item allows:

- Select the substation to be tested
- Go to the measurement points indicated on the display
- Take the reading
- Save the reading
- Repeat until end of route is displayed

The process is automatic in a predefined route on the substation selected.

If a mistake has been made with the location or result, then press and hold the 'F' button and the last measurement will be deleted and the last point will be displayed again.

If the route is aborted or interrupted, then selecting the route again will cause the 3i to give options on what action has to be taken with options:

- **Next:** move to next location point
- **First:** go back to start of pre-set route
- **Previous:** move back to last location point
- **Cancel:** abort and exit route mode

## 2.9 Survey step by step

The route and RFID information must be pre-configured on the INVA program prior to use. No editing or entering route or RFID information can be done through the 3i.

The locations are formed from a tree structure where a company can have a list of substations. These substations must have the equipment group (such as 11kV sub or 33kV sub), the equipment (such as MV panel), and the location on the equipment (front, back, etc.).

The route selection will give a list of stored substations that can be selected. Once the substation is selected then the route will display which point has to be tested.

The RFID mode does not require anything to be set by the user. All location information is stored on the RFID tag mounted on the panel. Simply reading the RFID tag will allow the 3i to know where to store the result for that location.

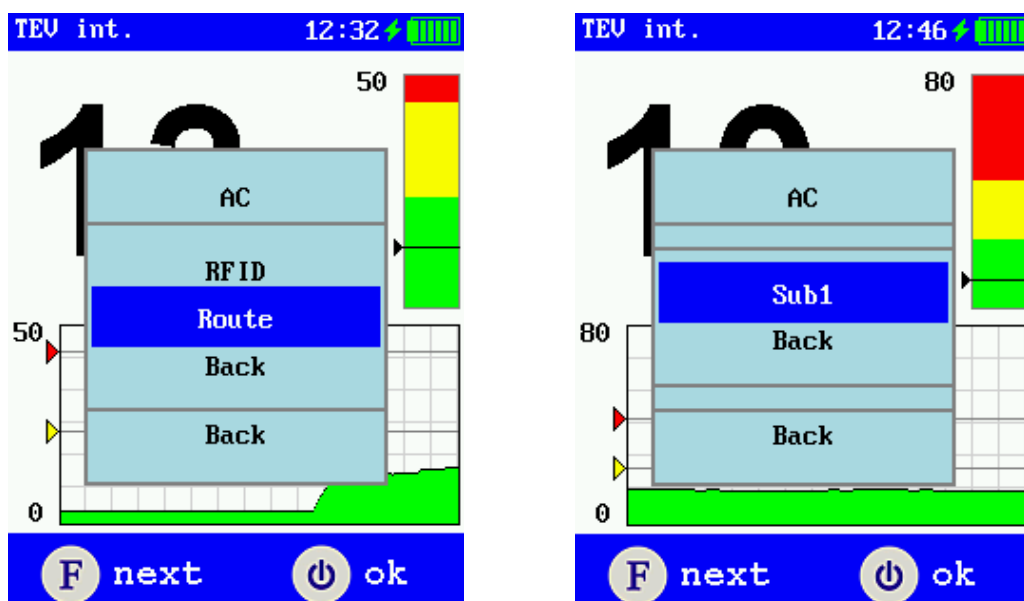
The RFID setup mode again uses the route information. This route information is used to program the RFID tags on site. Select the substation, and the 3i will go through each of the route points and ask for the RFID tag to be placed in front of the sensor block. The location point is displayed and the options are to program it, or go to the next point on the route.

### 2.9.1 Example of Route

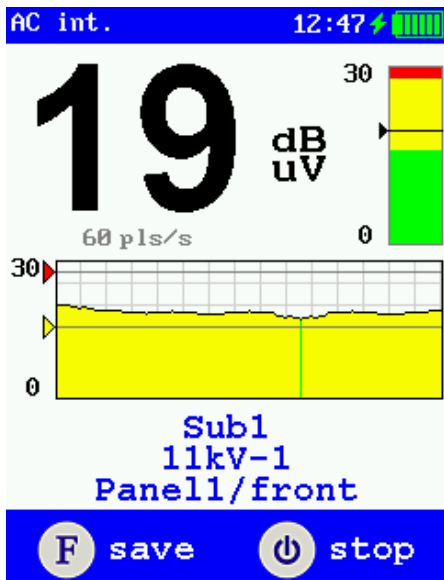
The following is a typical example of carrying out route measurement.

(Note: exact names should reflect the site-specific names entered in INVA)

Select '**Route**' from the Survey menu, then select the substation to be tested:



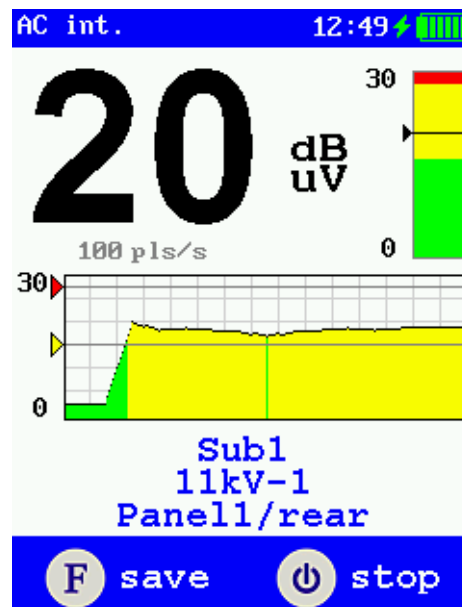
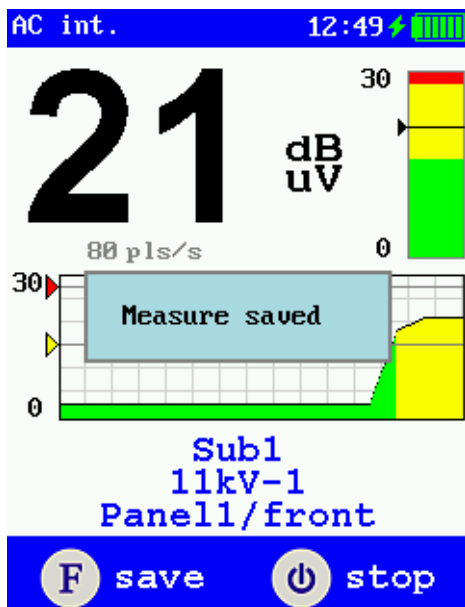
The 3i will now show the required location, shown here as Sub1, 11kV-1, Panel1, front. Place the 3i at the indicated point for measurement:



Allow the reading to stabilise to ensure that a representative signal is recorded.

Press the 'F' button when the reading is ready to be saved.

The 3i will now save the reading tagged with that location and date/time:



The 3i will now progress to the next location to be tested and display that on the screen, shown here as Sub1, 11kV-1, Panel1, rear.

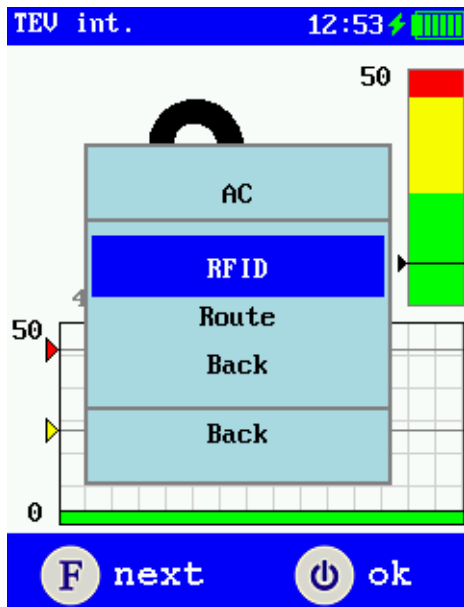
Continue around all locations until route finished appears.

### 2.9.2 Example of RFID

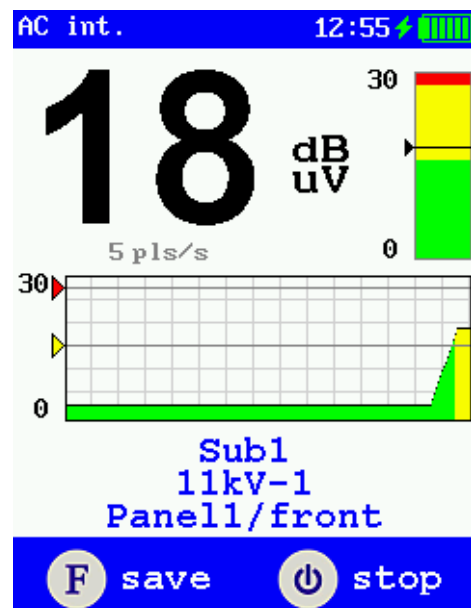
The following is a typical example of carrying out RFID measurement.

(Note: exact names should reflect the site-specific names entered in INVA)

Enter the 'RFID' mode from the Survey menu. The 3i will now scan for RFID tags that are in close proximity to the sensor block:



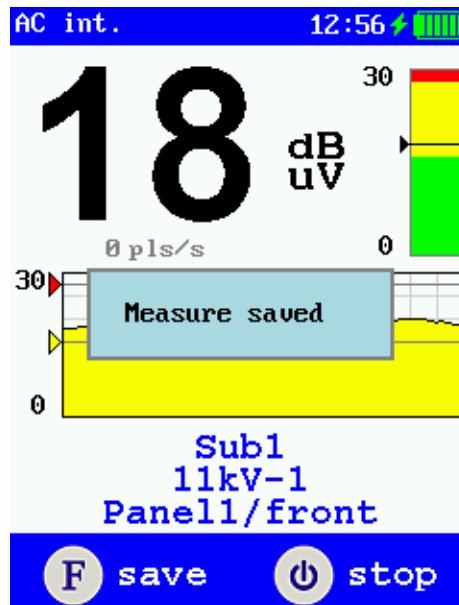
Hold the 3i up to the RFID tag until the location information is read:



The 3i will now confirm the location read on the display, shown here as Sub1, 11kV-1, Panel1, front.

Move the 3i to the measurement point and allow the reading to stabilise.

Press the 'F' button to save the result, confirmed by the 3i:



The 3i will have stored the measurement along with the location and date/time.

The 3i will now return to the RFID search mode as it scans for another RFID tag.

Place the 3i on the next RFID tag until it reads the location information.

The 3i will display the read location as before, Sub1, 11kV-1, Panel1, rear in this example.

Repeat for all RFID tags.

### 2.9.3 Example of RFID setup

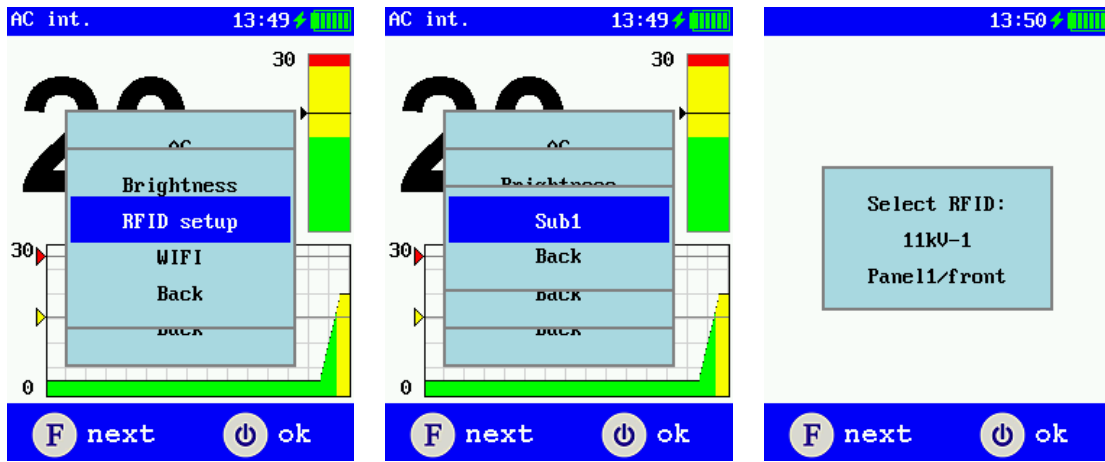
The following is a typical example of carrying out RFID programming.

(Note: exact names should reflect the site-specific names entered in INVA)

Programming will take the names entered in the INVA and write them into the RFID tags so that these tags will store the location information.

Select '**RFID setup**' from the **Settings** menu:

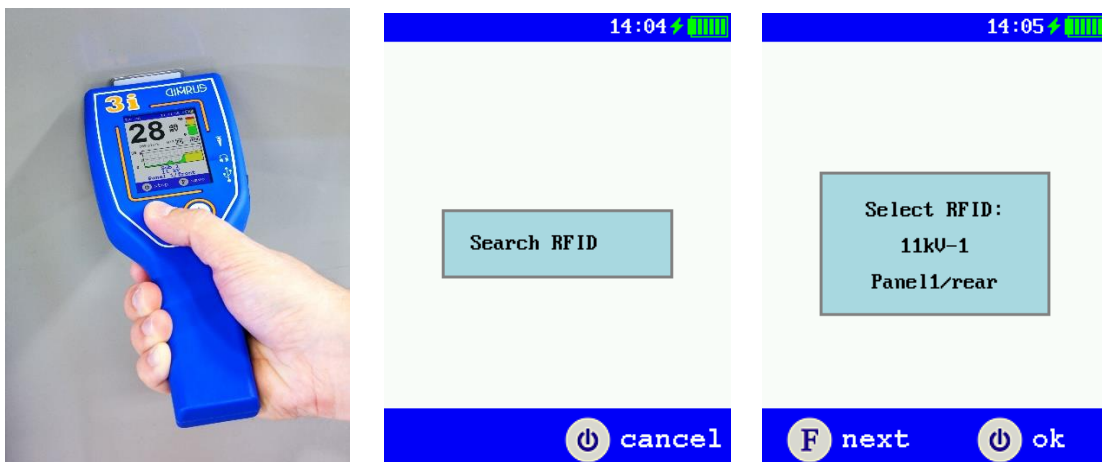




Choose the substation for the list of substations on the 3i.

The 3i will now show the first location on the route information, shown here as Sub1, 11kV-1, Panel1, front. Select 'ok' to continue and program that location into an RFID tag, or 'cancel' to abort the programming.

Hold the 3i up to the RFID tag, and the message will change from 'Search RFID' to the next location once programming is complete, shown here as Sub1, 11kV-1, Panel1, rear.



All details regarding the location structure and names is controlled by the INVA software. The order of the route can also be edited in the INVA software.

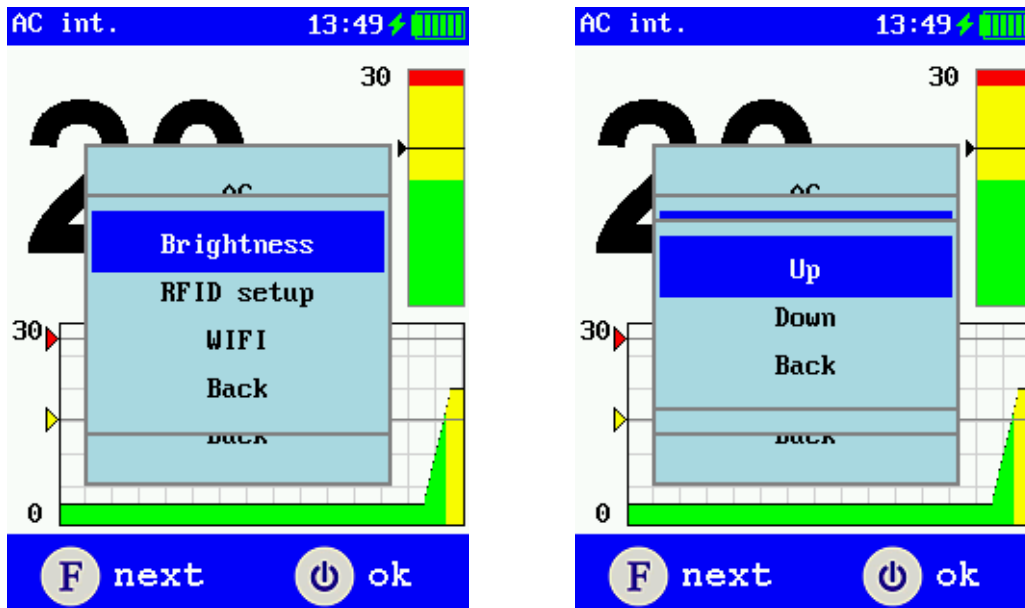
The 3i will only store routes and RFID information if they have been synchronised from the INVA.

If the process is interrupted then the on selecting, that substation again will give the options for to do next:

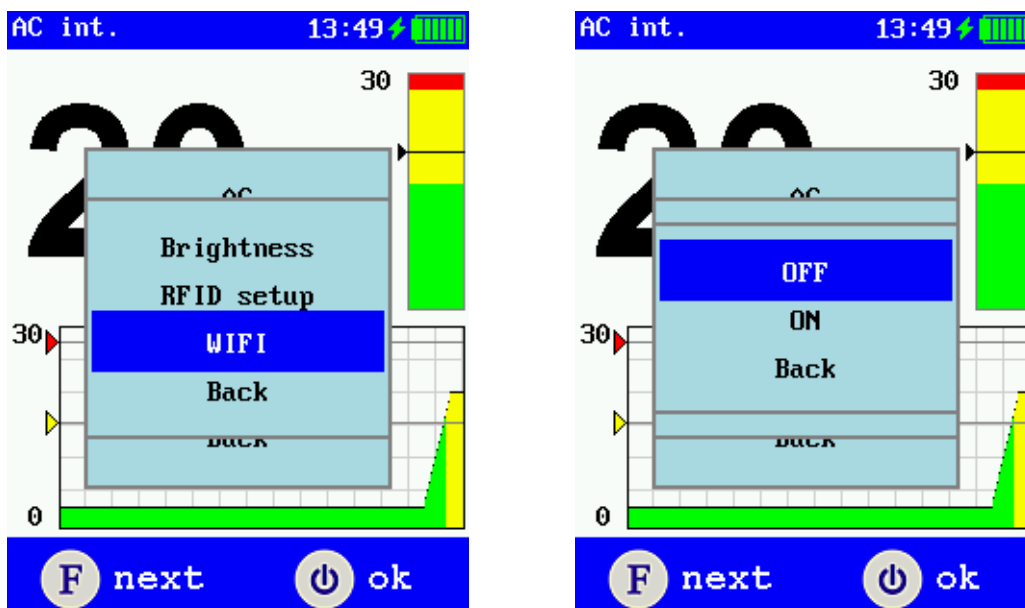
- **Next:** move to next location point
- **First:** go back to start of pre-set route
- **Previous:** move back to last location point
- **Cancel:** abort and exit route mode

## 2.10 Device Settings

This menu allows to change the screen brightness by selecting 'Settings' and 'Brightness' menu:



Additionally, it can be possible switch on or off the internal WiFi module:



Therefore, it will be possible to connect with PC via WiFi. In this case, the device acts as an access point with the name "3i\_N", where N is the serial number of the device.

### 3. Software Description

#### 3.1 INVA Software introduction

The 3i uses software for DIMRUS general software platform for portable devices, INVA. It is suitable for downloading, data management, and storage and viewing.

When testing, the 3i can store results in the internal 3i memory. Once the tests are complete, the 3i can be connected to the computer, and download the new data, or all new data into the INVA.

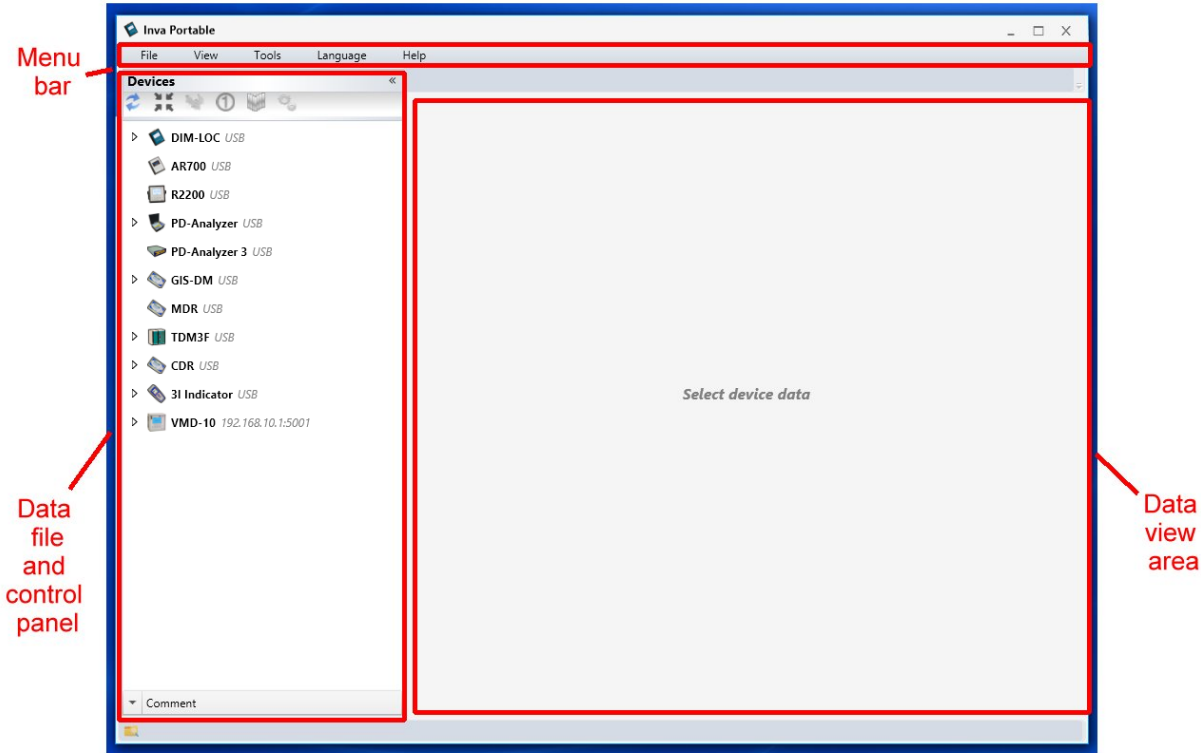
The 3i test data that has been downloaded to the computer is not automatically deleted from the 3i. It can be downloaded to the computer again if lost. The 3i device will automatically delete the oldest data when the memory is full.

The INVA must be installed along with the device driver. Without the device driver, the 3i will NOT be seen by the PC when connected by USB.


Windows7 is minimum recommended, Windows10 is compatible, both 32-bit and 64-bit.

The 3i must be switched on when connected for the PC to recognise the 3i in the INVA.

#### 3.2 The main interface



The INVA main interface is in four parts, the menu bar at the top, device list on the left side, data display on the right, and the information bar at the bottom. The information bar displays the current folder for the data address.

When a device is successfully connected, the USB icon  is shown on the 3i, along with the battery status (if available).

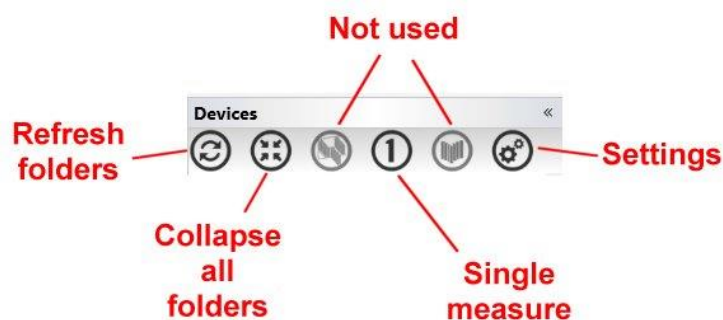
Click the sign  above the devices to hide the equipment bar.

### **3.3 The menu bar**

Menu bar structure and function are as follows:

- File
  - Open simulator: not used for 3i
  - Importing data archive: Advanced feature not used for 3i
  - Create a data archive: Advanced feature not used for 3i
  - Exit: Close INVA
- View
  - Show trends: Display / Hides the current data trends over time in the selected folder
- Tools
  - Settings:
    - General: Change the current data folder or other user settings
    - Trends: Selected trend chart options to be displayed
  - Console: Advanced feature not used for 3i
- Language
  - Chinese Simplified
  - English
  - Russian
- Help
  - Check for updates: Software update via the Internet
  - Version information

Short cut menu bar is shown:



The shortcut icons perform the same function as the right click menu options for the 3i.

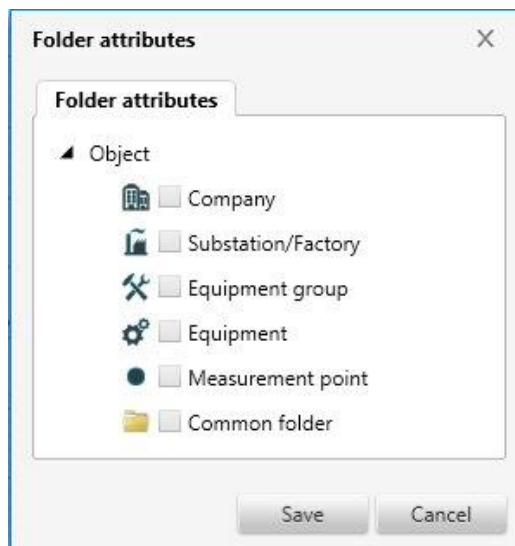
## **3.4 Data sorting and device management**

### **3.4.1 Creation and management of the data folders**

The INVA uses a file-based system to save measurement data. In the menu bar "settings", specify INVA data folder path. The default path is in "My Documents". The folder structure is left open and up to the user to define and order. Best practice would be to group by customer, site or substation. Then have subfolders for equipment tested on that site or location.

To add a new folder, select "Add folder" in the context menu (right click). Repeat as required for adding more folders according to site requirements and test data storage structure.

In General, a 'company' – 'substation / factory' – 'device groups' – 'equipment' – 'point' structure will facilitate the archiving structure of the test data, and help subsequent analysis. It is also possible to create a new 'regular' folder. All folders are in the actual INVA subfolder of the data folder; these can be rearranged using windows explorer.



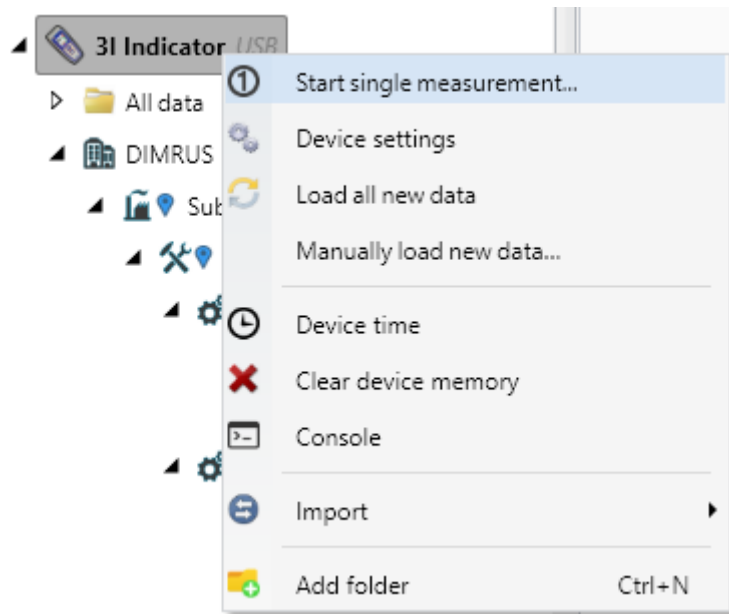
If the route and RFID functions are to be used then the full structure from 'company' to 'measurement point' must be created. In this case, the all substations listed under that 'company' are synchronised to the 3i.

Typically: Company -> Substation -> Equipment group -> Equipment -> measurement point.  
For example: DIMRUS -> Sub1 -> 11kV -> MVPPanel1 -> Front

Within the INVA, these are built as folder trees. These folders are matched to the route or RFID tags when the 3i is recording measurements. Careful consideration should be made when naming the folders so that a coherent system can be applied to the measurement results.

### **3.4.2 3i device options**

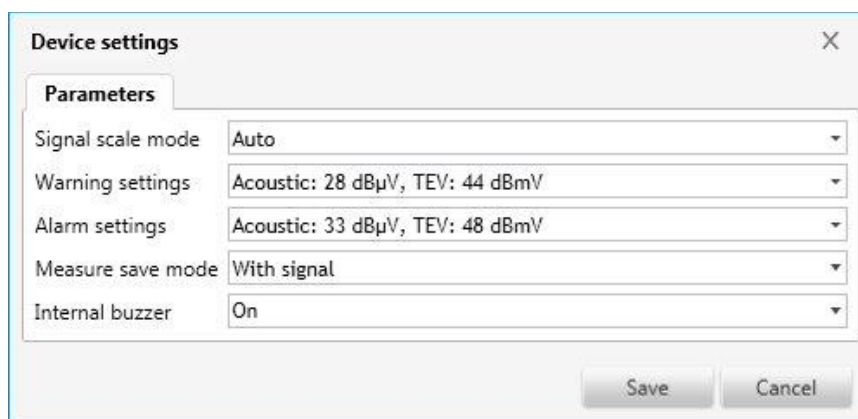
Right clicking on the 3i will display the options for the 3i root menu, as shown:



These options are

- **Start single measurement:** Carry out a single measurement, save and transfer it
- **Device settings:** Configures the basic settings, see below
- **Load all new data:** Refer to data import
- **Manually load new data:** Refer to data import
- **Device time:** Sets device time, can be manually set, or set to the PC time via 'Sync'
- **Clear device memory:** Removes all measurements stored in the 3i
- **Console:** Advanced mode, not used with 3i
- **Import:** Not used for 3i
- **Add folder:** Add new folder on the location selected

The basic device settings are shown:

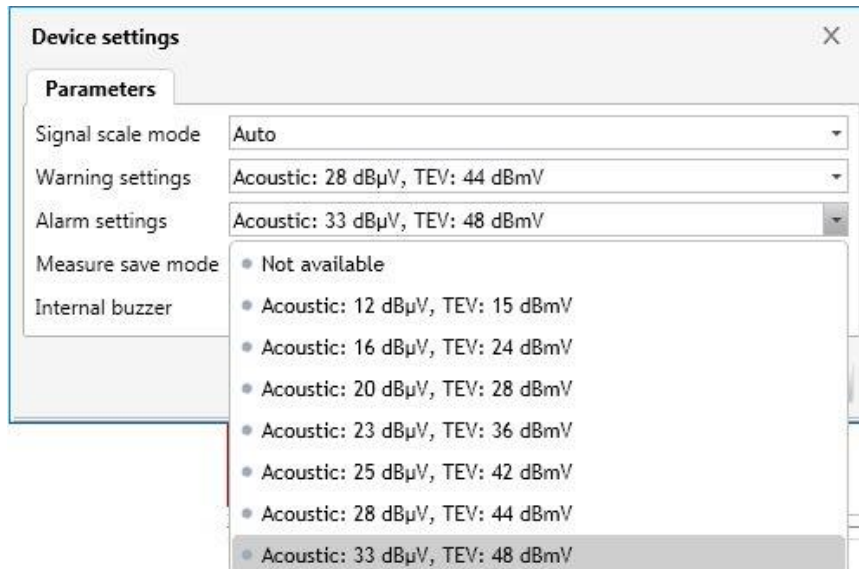


The device setting options are:

- **Signal scale mode:** The bar chart will either auto-scale, or start low and only increase
- **Warning settings:** selects the warning or yellow band
- **Alarm settings:** selects the alarm or red band
- **Measure save mode:** Saves raw data or only the result values

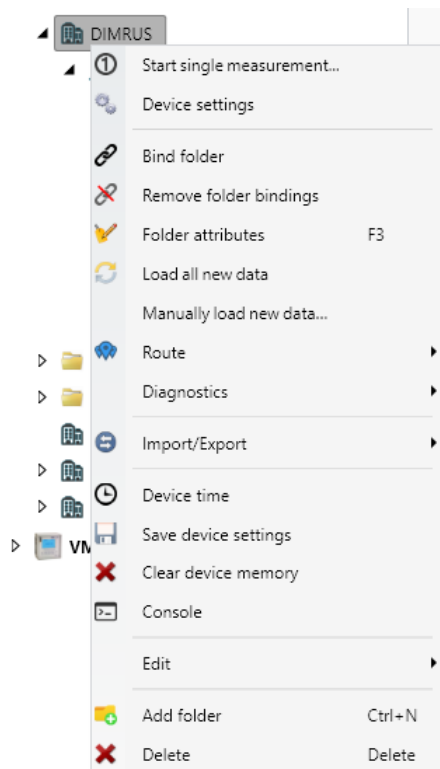
- **Internal buzzer:** Buzzer off or on

The warning and alarm settings have a range of levels for the yellow or red bands on the bar chart. Figure below shows the options available for each.



### 3.4.3 3i company folder options

The folders defined as 'company' have unique options, shown in figure:

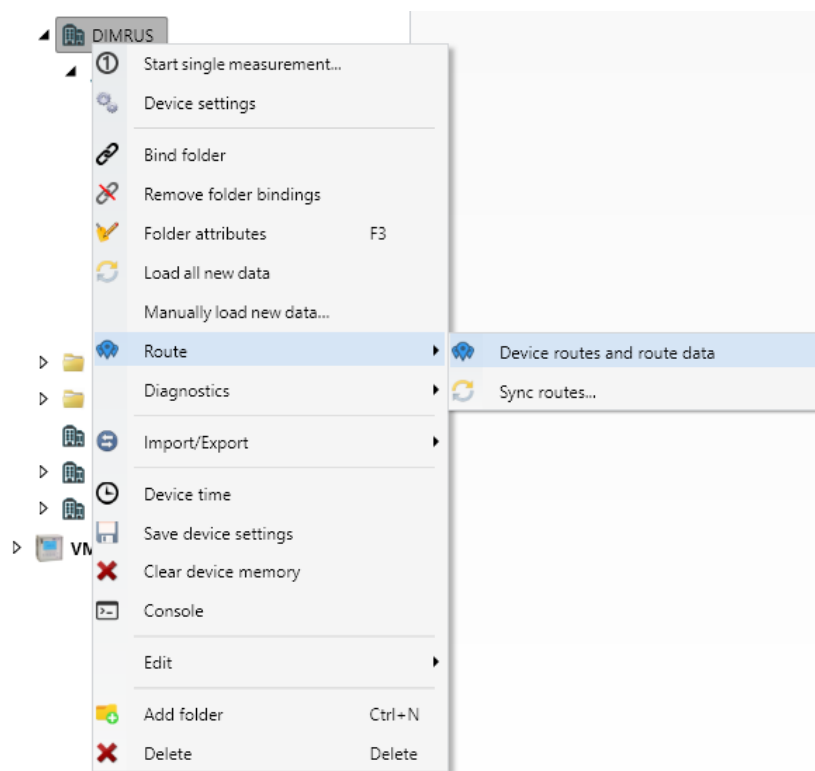


These options are

- **Start single measurement:** Carry out a single measurement, save and transfer it
- **Device settings:** Configures the basic settings, see below
- **Bind folder:** Not used with 3i

- **Remove folder bindings:** Not used with 3i
- **Folder attributes:** Sets the folder type
- **Load all new data:** Refer to data import
- **Manually load new data:** Refer to data import
- **Route:** refer to route option below
- **Diagnostics:** refer to diagnostics option below
- **Device time:** Sets device time, can be manually set, or set to the PC time via 'Sync'
- **Save device settings:** Transfers and stores current settings
- **Clear device memory:** Removes all measurements stored in the 3i
- **Console:** Advanced mode, not used with 3i
- **Edit:** refer to edit option below
- **Import:** Not used for 3i
- **Add folder:** Add new folder on the location selected

The route options are shown:

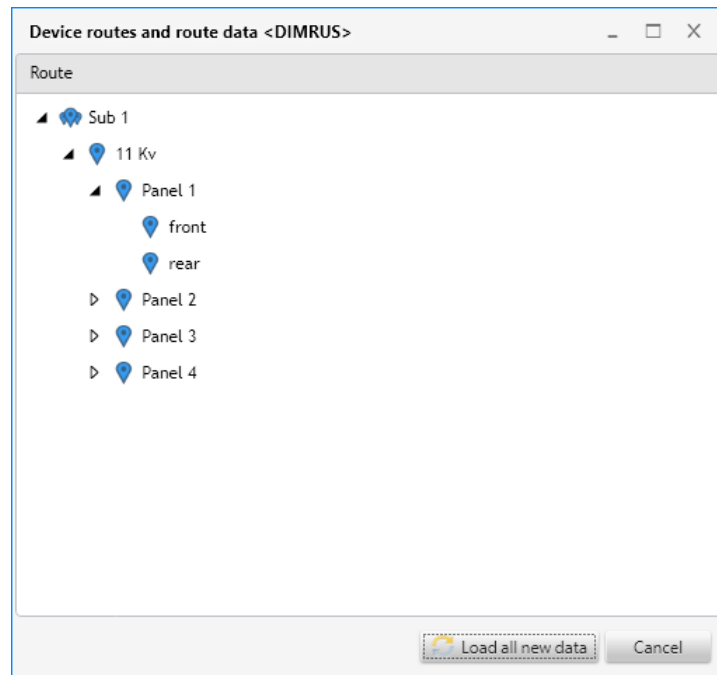



Route options:

- **Device routes and route data:** loads and displays the current routes on 3i
- **Sync routes:** Transfer all INVA routes into the 3i for that company folder

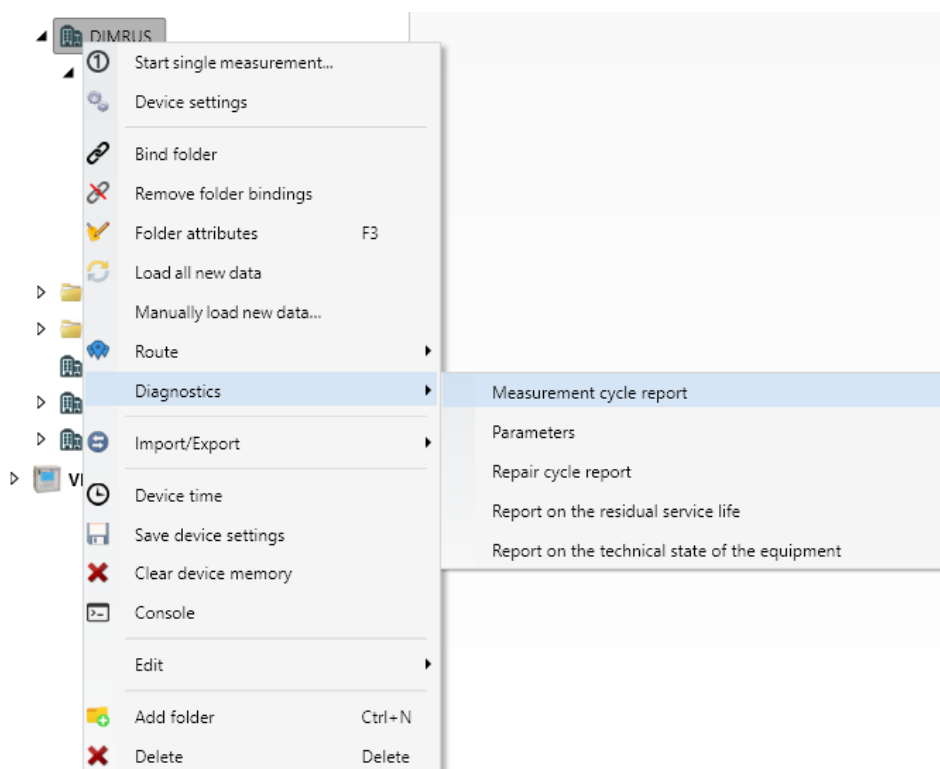
Typical route information is shown in the same tree format as the INVA folder tree:





Note that once a route has been synchronised then it has the  symbol to show it is now a route point on every folder tied to that route. If the symbol does not show then check that the full tree structure is as described in section 3.4.1

The diagnostic options are shown:

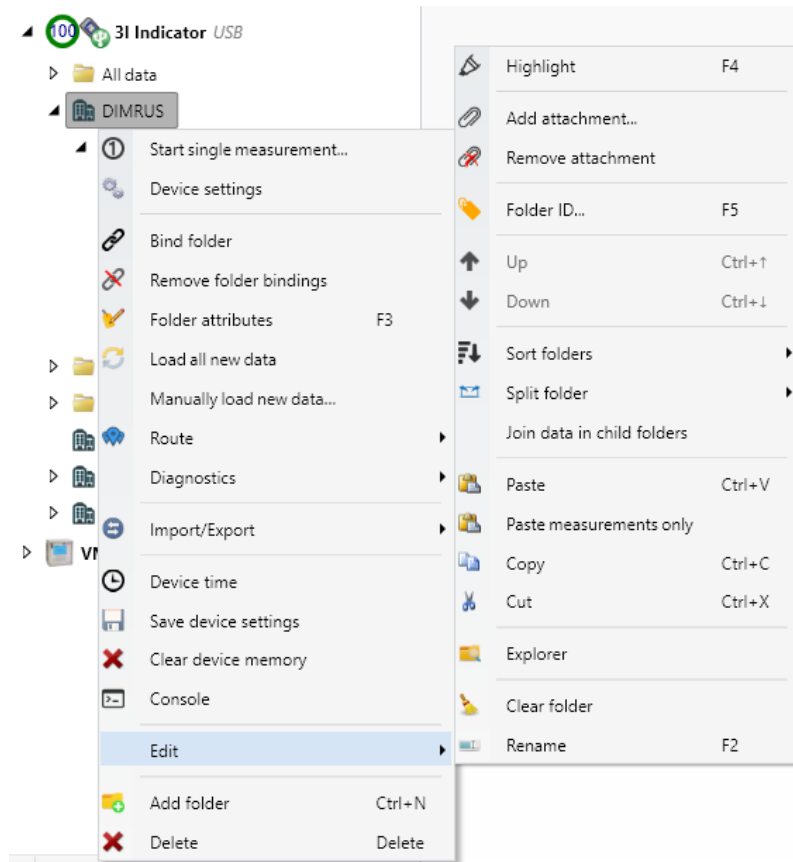


The diagnostic options are:

- **Measurement cycle report:** summary report of when each point was last tested and due
- **Parameters:** List of parameters for all points

- **Repair cycle report:** Not currently used
- **Report on the residual service life:** Residual life based on trend increase towards alarm
- **Report on the technical state of the equipment:** Overall equipment PD summary

The edit options are shown:



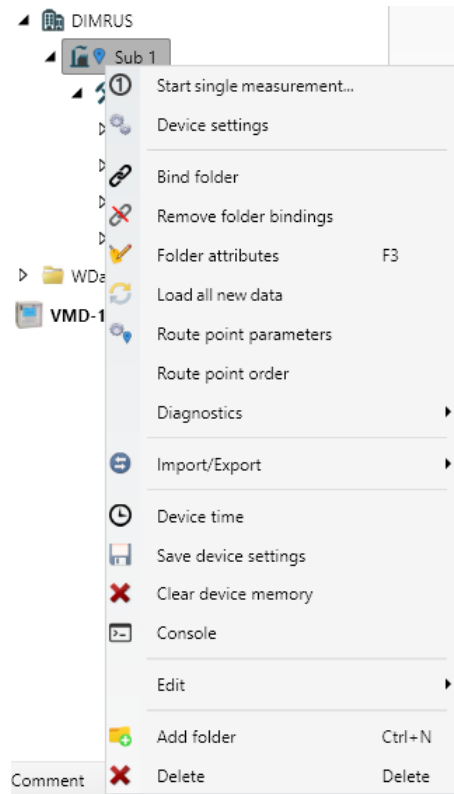
The edit options are:

- **Highlight:** Any folder or measurement can be highlighted with a colour for reference
- **Add attachment:** Any folder can have a PDF or JPG attached as an image for the folder (Note that this disables the bar chart for the folder)
- **Remove attachment:** Removes any attachment for the folder
- **Folder ID:** Alternative folder names can be allocated. The 3i routes only accepts ASCII characters, hence the INVA can display non-ascii names for the same folder
- **Up:** moves the folder up in the display order
- **Down:** moves the folder down in the display order
- **Sort folders:** Subfolders can be reset by name or date
- **Split folders:** Large folder can be split into smaller groupings or days, weeks or months
- **Join data in child folders:** Not currently used for 3i
- **Paste:** Any cut or copy folder can be pasted in this folder
- **Paste measurements only:** Any cut or copy folders will only have measurements pasted
- **Copy:** Copy selected folder
- **Cut:** Cut selected folder
- **Explorer:** Opens window explorer at this folder location

- **Clear folder:** Removes data and settings from the folder
- **Rename:** Rename the folder name

### 3.4.4 3i subfolder options

Most of the subfolder options are the same as the company folder options. These are shown:



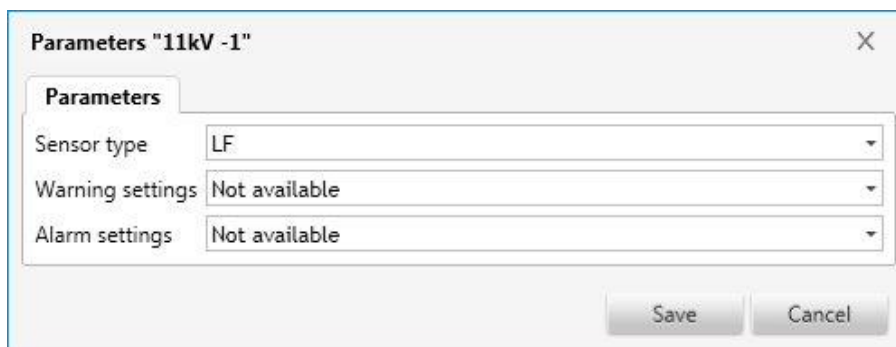
Refer to company folder options for the definition. The different options are:

- **Route point parameters**
- **Route point order:** opens the route sort order window

### 3.4.5 3i Route specific options

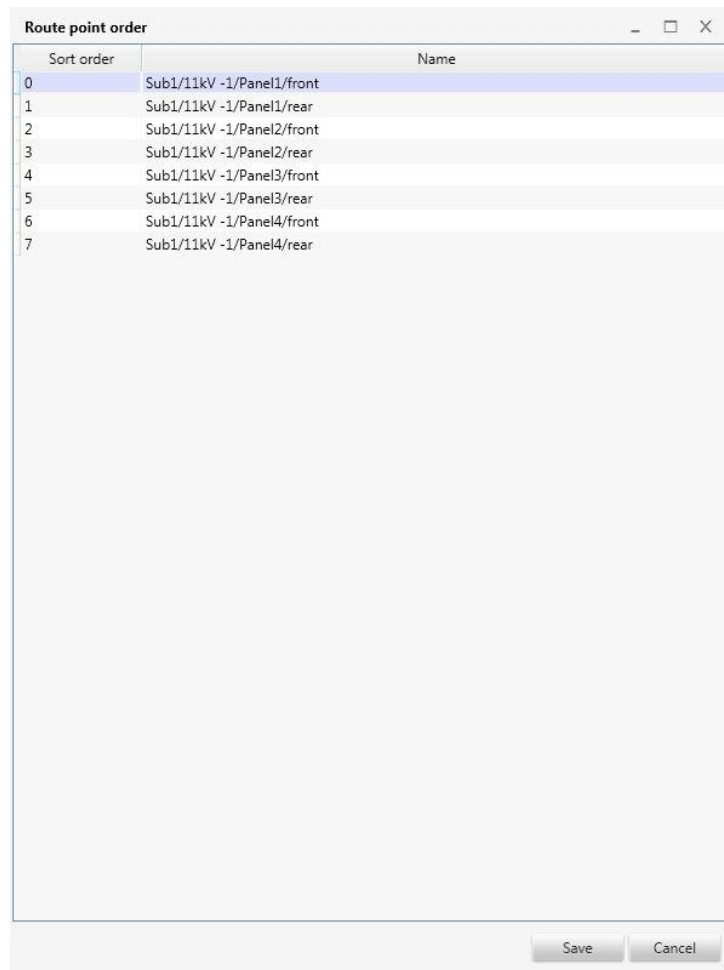
When a set of folders are determined to be a route (rather than just subfolders), new options will appear that allow the settings to be applied for the routes.

Route point parameters set the sensor type used and warning alarm levels, as shown:



The warning and alarm levels are as shown. It is important that the correct sensor is selected for the measurement required. This can be set per point.

Route sort order window, shown below. Drag and drop to sort the route points as required. This should match the walk round route on sites. If necessary, the route order can be optimised after the first site visit.



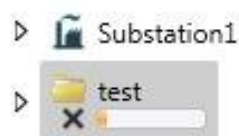
### **3.5 Data import**

Connect the 3i to a computer via USB; there is a choice of three basic types of data import. Note that route data is treated differently to general data. If the data is marked with route information then the INVA will expect these results to be downloaded into the correct route.

a) All new data is loaded

The INVA automatically loads all of the device's internal storage data to a user-specified folder. Only data that has not been downloaded previously will be downloaded, the old data will not be downloaded again.

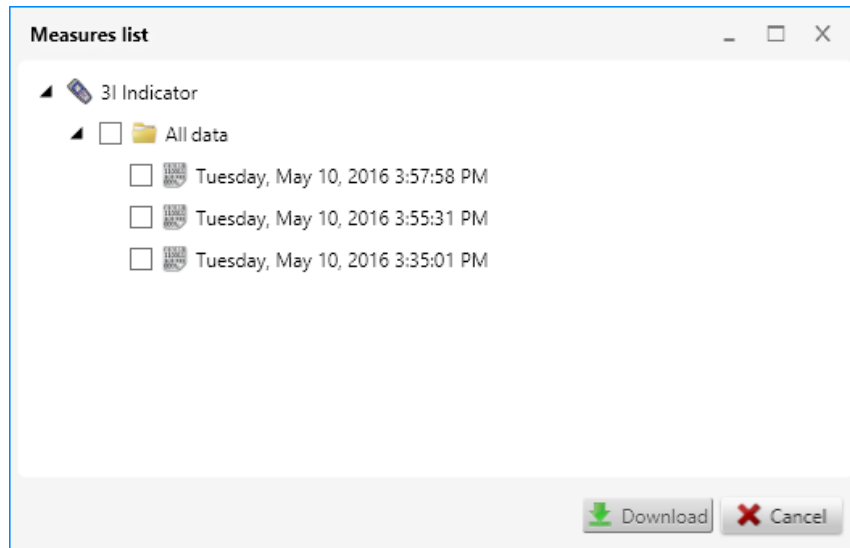
The progress bar below the folder shows how much has been downloaded:



Note that all data is downloaded, including route data to generic folders.  
All data is downloaded into the selected folder.

#### b) Load new data manually

The INVA will show all the data stored within the 3i. The user can manually select which datasets have to be downloaded by ticking the datasets



Note that manually downloaded data will go into the selected folder. For the download.

#### c) Downloading route data

If the data has been taken on during a route or RFID measurement, then the location from the route tag is stored with the data.

If download is selected from company or substation folder, then these tagged datasets are automatically placed in the appropriate folder. Meaning that all the results from one location are stored in that one corresponding folder.

### **3.6 Data displays and trends**

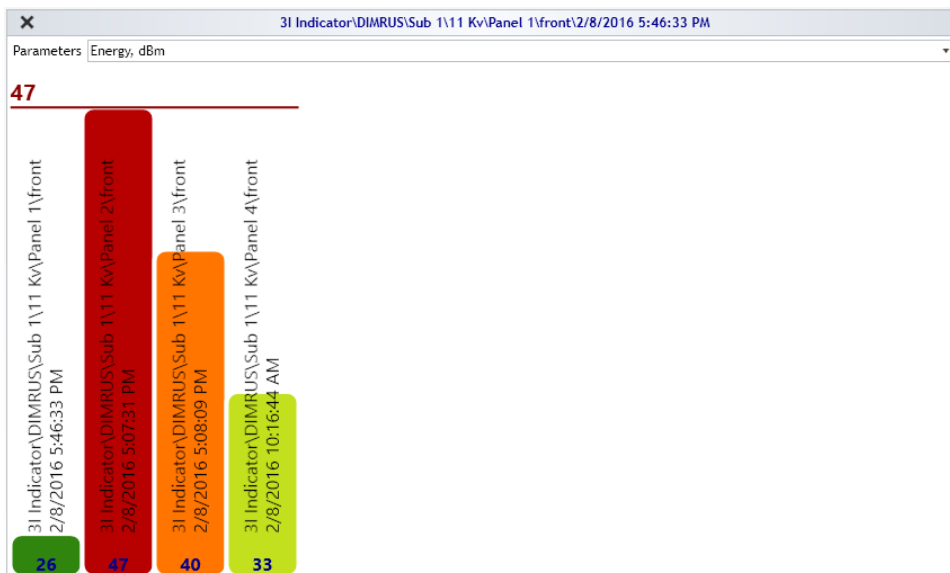
There are three basic data types stored for the 3i:

- TEV data: marked as “TEV”
- Acoustic data: marked as “LF”
- Setting data: marked “Settings”

Each dataset stores the type, the result and the date/time recorded. In addition, selecting a folder will show a bar chart summary of the data in that folder.

#### **3.6.1 Folder summary**

The folder summary is a bar chart of all measurement points from that folder to the lower subfolders, shown in figure below:

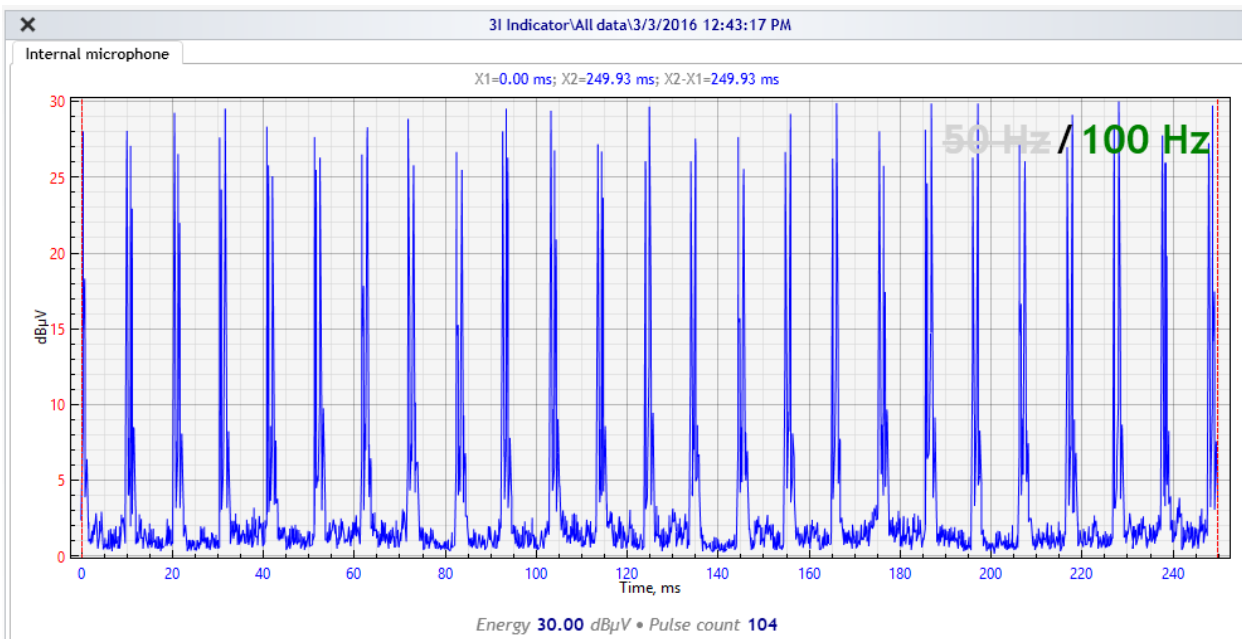


Each bar has the ident of the measurement point, and the date of the measurement shown. The height of the bar indicates the value of the result for that folder.

The dropdown option at the top selected the parameter displayed, between TEV and acoustic, or energy and pulse count.

### 3.6.2 Acoustic display

Selecting an acoustic result will show the amplitude of the acoustic signal relative to time, as shown in figure:



The time scale is in milliseconds.

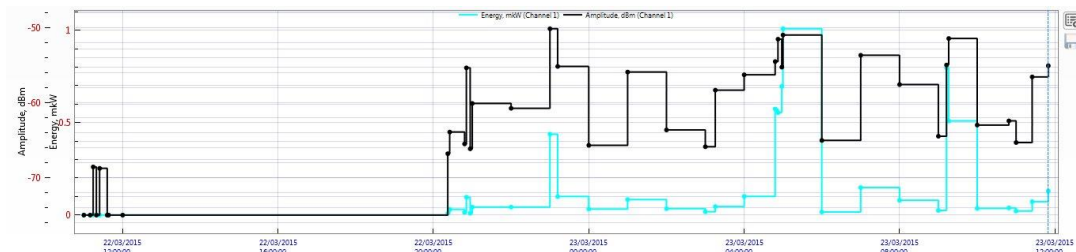
Additional aids show if 50Hz or 100Hz patterns are present in the captured signals.

### 3.6.3 TEV display


The TEV display is unavailable at this time.

### 3.6.4 Trend analysis

Ensure trends are active, this is enabled in the menu "Tools" -> "Settings" -> "Trend", if checked for "display trends" then trend is shown for the selected folder and its subfolders over time, as shown in figure:



The trend is key to see how the PD is changing with time.

Click on  button to display the trace selection settings. The option will depend on the measurement type. This will be energy, TEV dBmV, TEV pulses/sec, Acoustic dBmV, and Acoustic pulses/sec.


The x-axis is the date range. By default, the range will cover the entire range of the results in the folder. Dragging the mouse over a section will zoom into that section. Double right click to reset the trend zoom. Or drag with the right mouse button held to pan the view of the trace.

### 3.6.5 Data set selection

The individual results can be selected from the list of datasets in the folders.

The trend will display this point by putting a marker in that date. Double left clicking on the trend will also select the dataset result for that point selected.

### 3.6.6 Comments

Comments can be added to a folder. Select the file or folder, click on device column to the left of the "remarks" column, notes can be added to the file or folder. If notes exist to items display then the icon  appears on the file or folder. Hovering the mouse over the item will automatically display notes.

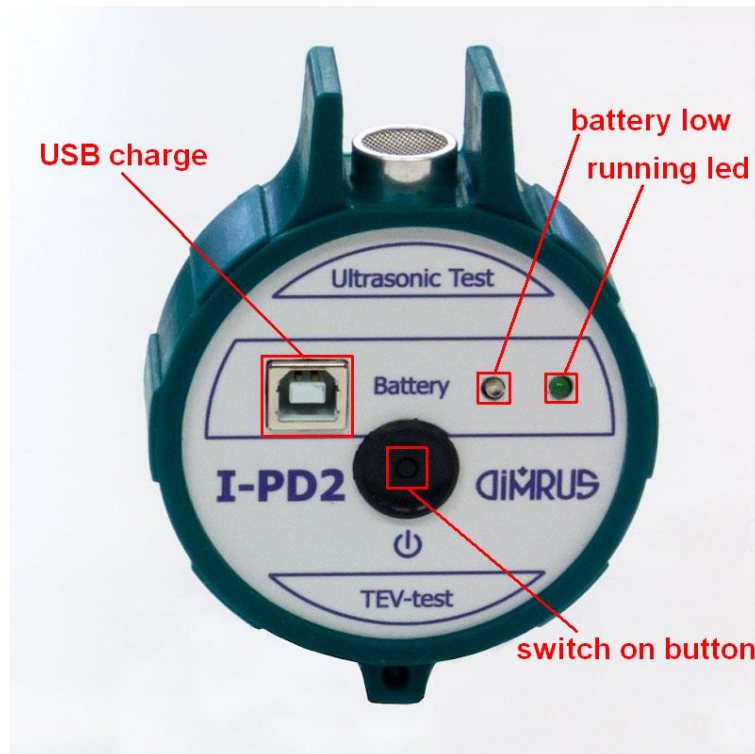
Notes are added or edited in the comment box under the device tree.

## 4. The Use of 'I-PD2' Calibrator

The 'I-PD2' calibrator is intended for testing acoustic and TEV channels of 3i device. On the front panel of the calibrator is the power switch button, USB charge connector and two leds – battery low indicator and running state indicator.

The ultrasonic phone is on the side surface. The TEV sensor is on the back of the device.

When the switch on button is pressed, the calibrator will work for 10 seconds and then will switch off. You can hold this button so long as you need.



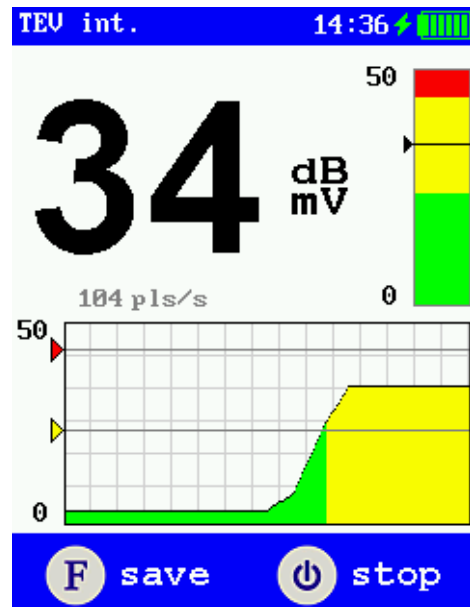
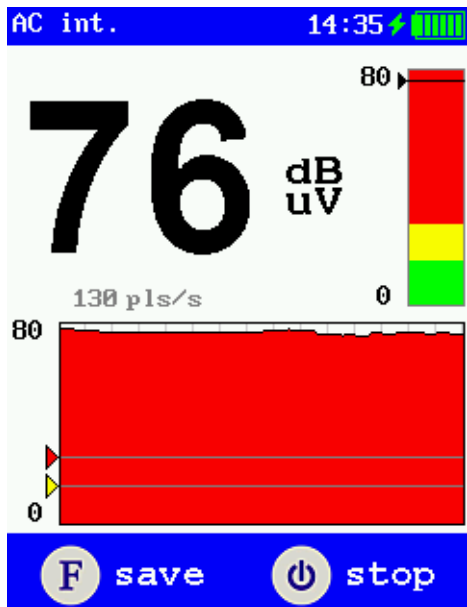
The calibrator has got the following parameters:

1. Ultrasonic frequency – 40+- 2 kHz, pulses frequency – 110 Hz
2. Ultrasonic power – 80 dB
3. TEV pulses frequency – 110 Hz
4. TEV power – 20 dB

To check the acoustic channel, it is necessary to place the calibrator opposite the microphone at a distance of approximately 10-30 cm and put the device into acoustics measurement mode.

To check the TEV channel, the calibrator should be brought close to the sensor of the device put into the TEV measurement mode:





## 5. Contact information



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