



UltraTEV[®] Plus² Operating Manual



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Safety Precautions and procedures

FCC Warning Statement

This device complies with Part 15 of the FCC Rules.

Operation is subject to the following two conditions:

- (1) This device may not cause harmful interference, and
- (2) This device must accept any interference received, including interference that may cause undesired operation.

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. End users must follow the specific operating instructions for satisfying RF exposure compliance. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

IC Warning Statement

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada.

To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication.

This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Important Safety Information

- The UltraTEV[®] Plus² (UTP2) is designed for use at ground potential only. The UTP2, its accessories or connecting leads, do not provide any inherent protection against electric shock.
- When testing electrical plant ensure that the metalwork is earthed before taking any measurements.
- Maintain safety clearances between structures at high voltage and the instrument, its probes and the operator at all times.
- The UTP2 must only be used in conjunction with accessories and connecting leads as specified by EA Technology.
- HFCTs, connecting leads and test equipment do not provide protection against high voltage.
- UltraDish contains a visible 650nm Class II (<1mW) targeting laser. Care is required not to expose to human eyes or skin for any period.
- Under no circumstances are earth/ground connections to be loosened, disconnected, or otherwise altered to allow use of this equipment.
- Adhere strictly to local safety procedures. Not to be used in Explosive Hazardous areas (ATEX).
- Do not make measurements when there are electrical storms in the vicinity.
- Do not make measurements immediately following the energisation of a circuit.
- Do not disturb plant during measurements either mechanically (e.g. by shaking or striking it), electrically (e.g. by increasing the voltage) or physically (e.g. by applying heat).
- Do not operate the instrument or its accessories in an explosive atmosphere.
- Mains supply voltages are present within the battery charger.
- The UTP2 contains no user serviceable parts, always return to EA Technology or your local distributor for service and repair.
- Care must be taken where work is performed in tight corners, where the proximity of other earth planes will affect the reading. If possible, maintain a distance of more than 30cm from metal work which runs perpendicular to the sensor faceplate.
- Long-term exposure to loud sounds may cause hearing loss. To prevent possible hearing damage, do not listen at high volume levels for long periods of time.

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1. General Description

The UltraTEV[®] Plus² (UTP2) is a versatile hand-held tool used to easily detect and classify Partial Discharge (PD) in a wide range of electrical equipment.

The UTP2 uses inbuilt TEV and Ultrasonic sensors and external accessories to detect the presence of potentially damaging PD in switchgear, cables and overhead line equipment.

The UTP2 brings together several complementary sensor modes in a single handheld instrument. By regularly checking switchgear while it's in service using the UTP2, failure risks can be identified and action taken to avoid faults and downtime. Algorithms and analysis capability in-built to the UTP2 provide vital insight, classifying what you find to support the decisions you make and deliver the outcomes you need. It's never been simpler to interpret what you're seeing and choose a course of action.

The UTP2 records measurements at the touch of a button. Internal storage can be used to provide access to historical data while you are out in the field. Capturing what you have measured allows you to see trends in the performance of your network.

2. Non-Intrusive Detection of Partial Discharge Activity

What is Partial Discharge?

Partial discharges are electrical discharges that do not completely bridge the insulation between electrodes. The magnitude of these discharges is usually small, however they cause progressive deterioration of insulation that may eventually lead to failure.

Non-intrusive partial discharge detection provides a means for identifying these potential sources of insulation failure. If not detected the discharge may result in failure causing not only in loss of supply to customers and damage to plant but could also endanger staff.

How can Partial Discharge be detected?

A partial discharge emits energy in various ways and produces a number of effects which can be detected:

Electromagnetic:

Radio

Light

Heat

Acoustic:

Audio

Ultrasonic

Gases:

Ozone

Nitrous oxides

The most practical techniques for non-intrusive testing are based on the detection of the radio frequency part of the electromagnetic spectrum and ultrasonic emissions. The UTP2 has specifically been developed to enable electromagnetic and ultrasonic activity to be detected in a single simple to use instrument.

Airborne Ultrasonic Discharge Activity

Acoustic emissions from partial discharge activity occur over the whole acoustic spectrum. Audible detection is possible but depends on the hearing ability of the individual. Using an instrument to detect the ultrasonic part of the acoustic spectrum has several advantages; instruments are more sensitive than the human ear, are not operator dependent and are more directional when operating above the audible frequency.

The most sensitive method of detection is using an airborne ultrasonic Microphone centred at 40 kHz. This method is very successful at detecting partial discharge activity provided there is an air passage between the source and the Microphone.

Electromagnetic Discharge Activity

When partial discharge activity occurs within high voltage switchgear, it generates electromagnetic waves in the radio frequency range which can only escape from the inside of the switchgear through openings in the metal casing. These openings may be air gaps around covers, or gaskets, or other insulating components. When the electromagnetic wave propagates outside the switchgear, it produces a Transient Earth Voltage (TEV) on the metal casing of the switchgear. The Transient Earth Voltage (TEV) is only a few millivolts, of short duration having a rise time of a few nanoseconds and can be detected non-intrusively by placing a TEV probe on the outside of the earthed switchgear whilst the switchgear is in service.

Ultra-High Frequency (UHF) Partial Discharge Activity

Electromagnetic waves produced by partial discharge activity within high voltage switchgear can also radiate away from the asset through free space as Radio Frequency Interference (RFI). RFI due to partial discharge is broadband in nature and can be detected across a range of frequencies. These radiated emissions can be detected using a suitable antenna and radio receiver. Corona discharges around sharp points in air are common at EHV voltages and must not be allowed to mask damaging partial discharges originating from problem plant items. Corona discharges tend to be more of a problem when measuring below 200MHz. For this reason, the UltraTEV[®] Plus² UHF Receiver is designed to operate at higher frequencies (typically around 800 MHz). It has the ability to be tuned up or down to move away from any local telecommunication transmissions which would interfere with measurements.

Cable Partial Discharge Activity

When a partial discharge event occurs in a cable, there will be a resulting current pulse coupled onto the earthed sheath of the cable. These pulses will propagate away from the discharge site in both directions. Once the pulse reaches a change in impedance at a cable joint or termination, a partial reflection occurs. This results in the pulses travelling back down the cable several times (depending on the cable length) as they decay away. The current pulses can be detected non-intrusively using a High Frequency Current Transformer (HFCT) sensor placed around the cable earth strap.

3. Operating Instructions

3.1 UltraTEV[®] Plus² Overview



Figure 1



Figure 2

3.2 Charging

Use the supplied USB cable to charge the UTP2 with the mains charger, in-car charger or from a standard USB.



Micro USB charging port



Charging



UTP2 is charging



UTP2 is fully charged

For the quickest charging time, turn off the UTP2 during charging. Charging time is extended when connected to a USB port compared to the mains charger.

The UTP2 charging LED may flash from red to green during the charging cycle.

The TEV/Cable PD and Ultrasonic measuring features are automatically disabled when the UTP2 is being charged.

A fully-charged battery should provide approximately 6 hours of continuous use while switched on and measuring. For practical purposes, a fully charged battery should last a full day of surveying.

The UTP2 needs to have sufficient charge to remain powered on while viewing data through a USB port.

3.3 Turning the UltraTEV[®] Plus² On/Off

Power on - press and  hold for 1 second

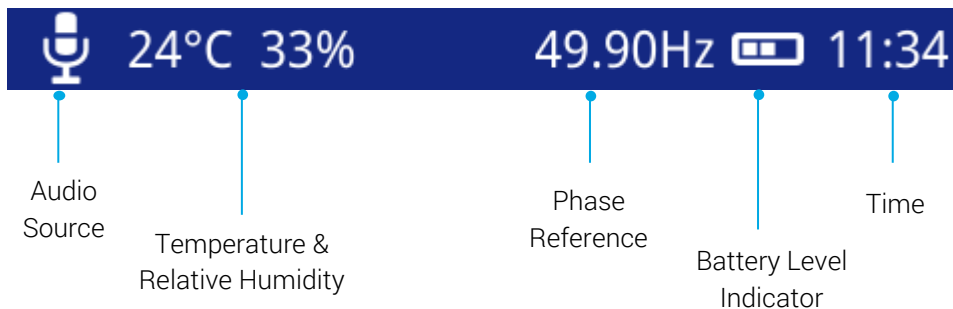
Power off - press and  hold for 2 seconds

3.4 Self-Test

During power up, the UTP2 performs a self-test on TEV, ultrasonic and Cable PD using the built-in test sources. The self-test is not a calibration check. During self-test, the ultrasonic sensor should be pointed away from sources of noise.

If the self-test consistently fails, contact product-support@eatechnology.com

3.5 Notification Bar



Below are other icons that could appear on the notification bar:



This icon indicates that the current audio source is TEV



This icon indicates that the current audio source is Ultrasonic



This icon indicates that the current audio source is the HFCT



This icon indicates that the current audio source is the UHF (left of screen)



This icon shows when an UltraDish has been connected to the UTP2



This icon shows when a HFCT has been connected to the UTP2



This icon shows when an Ultrasonic Contact Probe has been connected to the UTP2



This icon shows when a Flexible Sensor has been connected to the UTP2



This icon shows when a UHF Receiver has been connected to the UTP2 (right of screen)



This icon shows when the UTP2 is charging



This icon is used to show when a Wi-Fi connection has been established



This icon is used to show that HotSpot is enabled

3.6 Temperature & Humidity

The temperature and relative humidity reading is displayed on the notification bar only after connection of the Environmental Sensor.

The Environmental Sensor is connected to the Smart Accessory Port on the left hand side of the instrument. The connection of the accessory automatically starts the data collection with the latest reading being displayed in the notification bar at the top left of the screen.

In order to allow use of other optional accessories whilst still displaying a reference temperature, the final reading on removal of the sensor is persisted. Additional brackets around the measurement demonstrate that this is a historic reading.



Wait for the temperature and humidity reading to settle.

3.7 Menu Bar

The menu bar is located at the bottom of the screen. It displays icons that correlate to the Left, Middle and Right Buttons. The icons on the Menu bar change depending on which mode the UTP2 is in.






The Left button , Middle Button  and Right Button  can be pressed to select the Main menu buttons respectively.

3.8 Main Menu

After powering up, the UTP2 will load up to the Main Menu as shown below.

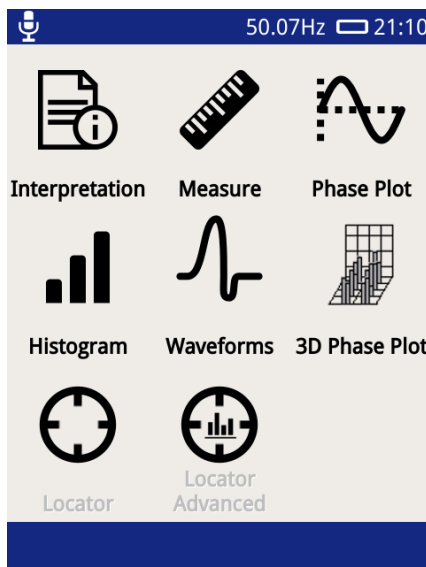


The Home Button  can be used to navigate back to the Main Menu at any time.

The TEV icon on the main screen will change to a Cable PD icon  when a HFCT accessory is plugged in and a UHF icon  when a UHF accessory is plugged in.

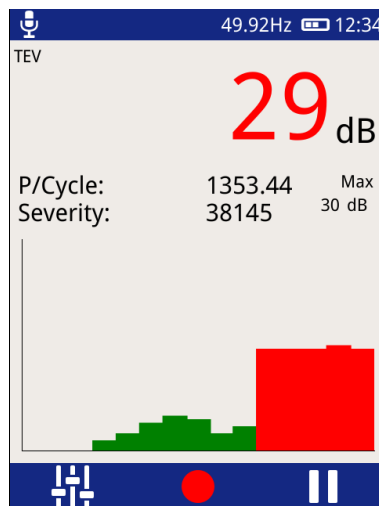
3.9 TEV/Cable PD Menu

The TEV/Cable PD screen, selected via the top left icon on the Main Menu contains different modes which can be used for the PD measurement. The Locator modes require an additional UltraTEV[®] Locator probe (UTL2) accessory. The Interpretation option is only applicable when in TEV mode.



The Measure mode is common to both TEV and Cable PD. This mode displays TEV readings in dBmV (dB) or (if the HFCT accessory is connected) Cable PD readings in picoCoulombs (pC).

To enter this mode, click the Measure icon



P/Cycle – Shows the pulses per cycle based on either a 50 or 60Hz mains frequency.

Severity – Shows the short term severity (calculated by multiplying TEV magnitude (mV) by Pulses Per Cycle). When in Cable PD mode, this is calculated by Charge (pC) multiplied by Pulses Per Cycle.

Max dB – displays the maximum dB value registered by the UTP2 since the screen was entered or paused/reset. This value is displayed in pC.

Chart - The bar chart is used to show the amplitude of the current values being read by the UTP2, from right to left.

To exit the TEV screen back to the main menu, press the Home button



There is an option to record a reading, this can be done by either clicking the red record icon on the screen or by pressing the Middle button. All recordings are stored within a 'survey' detailed in a later section of this manual.



Pausing a reading can also be achieved by either pressing the Right button or clicking on the 'Pause' icon. Audio output is also muted during a pause operation. After pausing the screen the measurement can be restarted by pressing the restart button.

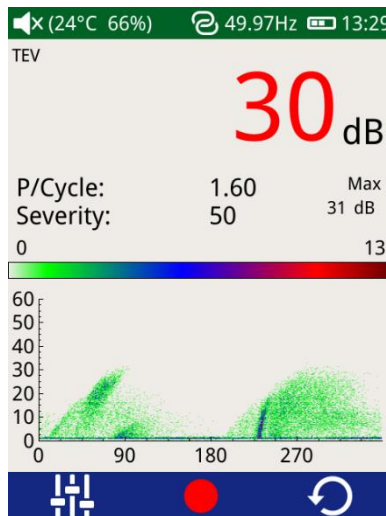


3.9.1 Phase Plot

The Phase Plot mode is common to both TEV and Cable PD. The upper section of the screen shows measurement values as detailed previously under the 'Measure Screen'. The lower section contains a phase resolved intensity plot 'Phase Plot' of the measured activity.

The plot displays either TEV or Cable PD events' phase angles (x-axis) against their amplitude (y-axis). The colour scale represents the intensity (pulse count) at a given phase angle and amplitude.

This option is useful for distinguishing between whether a measured PD activity is a genuine discharge source or just noise. For example, genuine PD activity may manifest itself as a stable phase resolved plot which will occur at the same position with respect to phase angle cycle by cycle; whilst white noise will not be phase related occurring at irregular positions on the phase plot.




The Pause and Record option is also available in this mode; Severity and P/Cycle are calculated as described under the Measure Screen.

To zoom in on a chart, slide your finger from bottom left to top right of the area of interest. To zoom out draw a diagonal line from top right to bottom left.

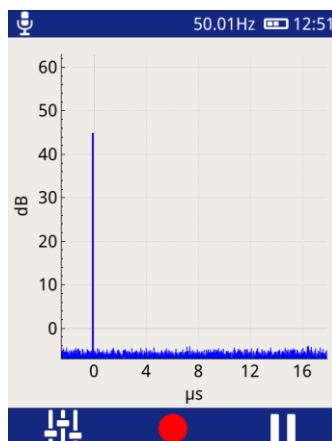
3.9.2 Waveform

The 'Waveform' mode is common to both TEV and Cable PD. When in Cable PD mode, values will be displayed in mA, whilst in TEV mode they will be measured in dBmV as below.



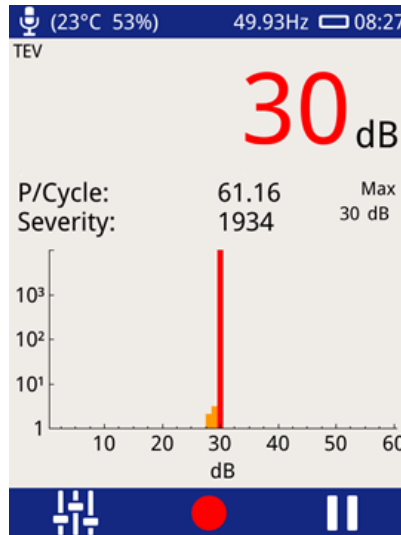
To enter this mode, click the Waveform icon .

This mode displays a plot of a TEV or Cable PD activity as a function of time allowing an instantaneous view of an activity's amplitude with respect to time. This option can be used to assist in distinguishing between genuine PD activity and noise. A Partial Discharge pulse will normally manifest as a sharp fast rising edge pulse whilst noise is often slower and less repeatable.





3.9.3 Histogram

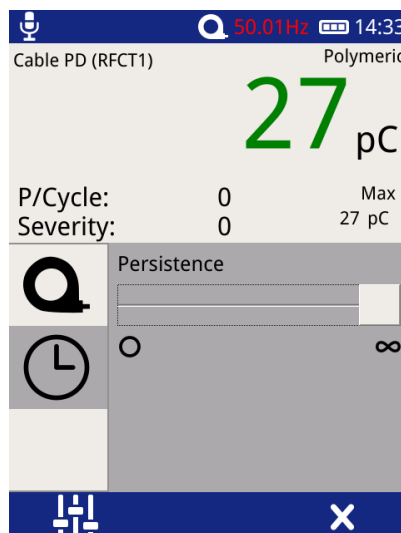
This Histogram mode displays the number of events registered (y-axis) for a given amplitude (x-axis). This measurement option is useful for determining if more than one discharge source is present; two distinct groups of bars on this chart could mean there are two sources of discharge at the respective dB (or pC) levels. The screen is also useful in positively identifying a genuine source of PD and assessing its pulse rate when there is a high pulse rate noise floor affecting the standard pulse per cycle calculation.



The Pause and Record option is also available in this mode; Severity, and P/Cycle are calculated and as described under the Measure Screen.

3.9.4 Persistence Mode


The Persistence mode is available in the Phase Plot and Amplitude Histogram screens for TEV, Cable PD and UHF readings. To enter this mode from these screens, click the Settings icon  until the Persistence icon  is displayed, then select it. To change the persistence level, move the slider between "0" (only recent pulses are shown, older pulses fade out quickly) and "∞" (all pulses continue to be shown until the screen is manually cleared).



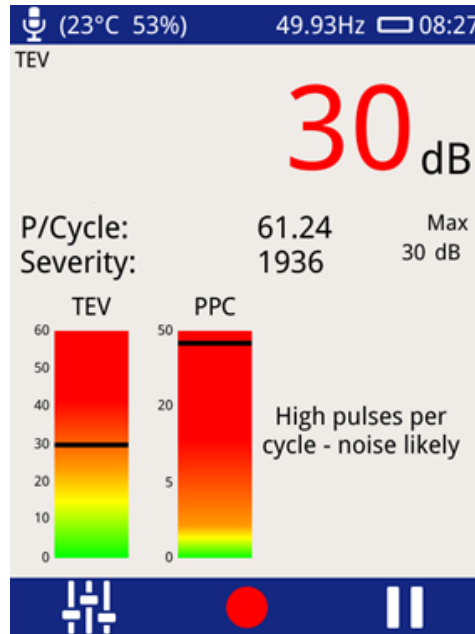
3.10 Interpretation

The 'Interpretation' mode available for TEV readings only.



To enter this mode, click the Interpretation icon .

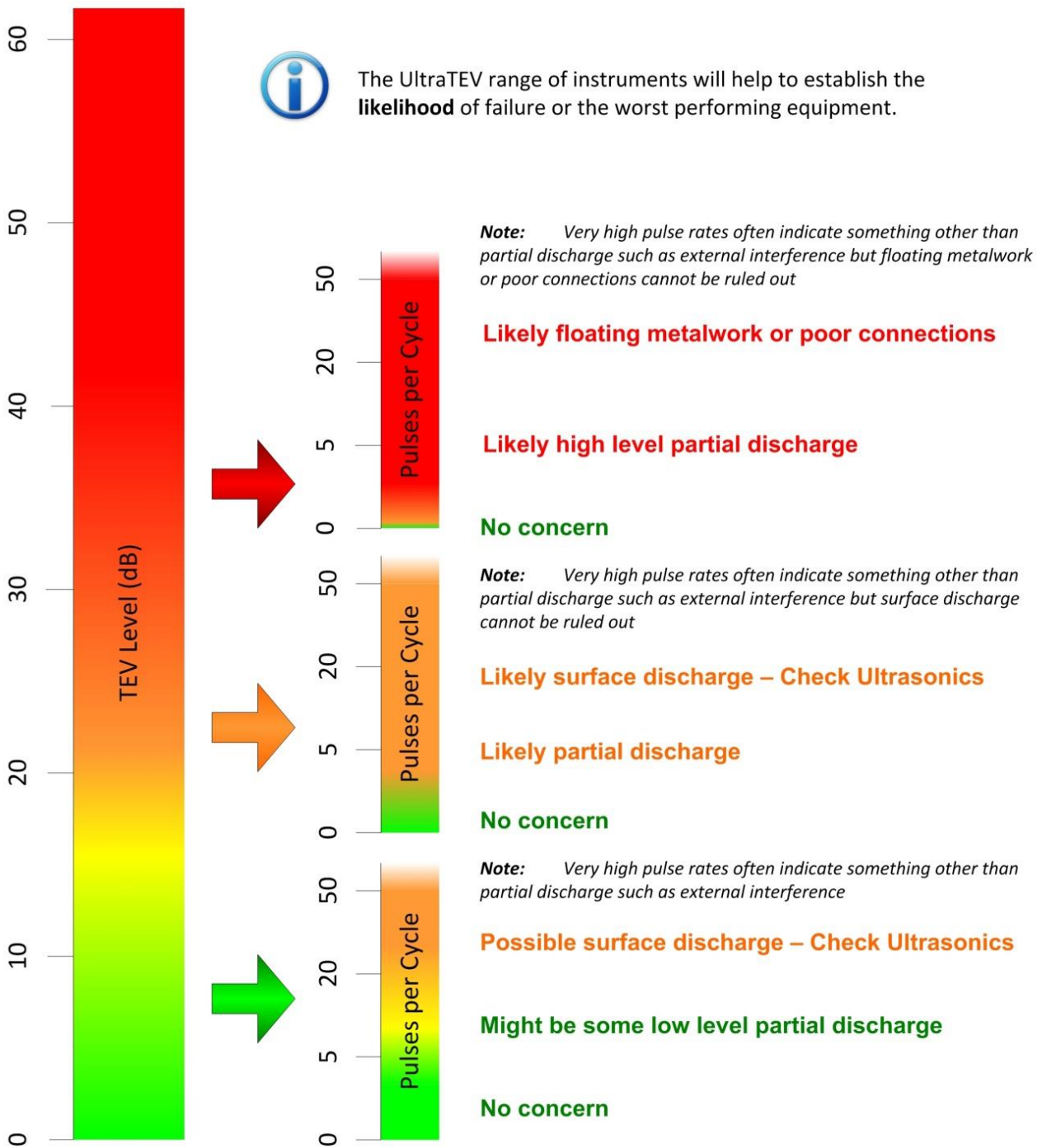
The interpretation screen provides a first pass summary of the switchgear's condition by taking into account both the magnitude and repetition rate of any detected pulses. The guide distinguishes between noise, surface tracking and internal discharge providing an indication of the suggested action.



This display is an easy to use software implementation of the TEV measurement interpretation guide produced by EA Technology using decades of experience. The original summary document giving an overview of the original guidelines for the interpretation of TEV measurements is included on the next page.

The Interpretation screen is only available when in TEV mode.

3.10.1 TEV Interpretation Guide



The UltraTEV range of instruments will help to establish the **likelihood** of failure or the worst performing equipment.

Note: Very high pulse rates often indicate something other than partial discharge such as external interference but floating metalwork or poor connections cannot be ruled out

Likely floating metalwork or poor connections

Likely high level partial discharge

No concern

Note: Very high pulse rates often indicate something other than partial discharge such as external interference but surface discharge cannot be ruled out

Likely surface discharge – Check Ultrasonics

Likely partial discharge

No concern

Note: Very high pulse rates often indicate something other than partial discharge such as external interference

Possible surface discharge – Check Ultrasonics

Might be some low level partial discharge

No concern



The TEV reading in dB gives you a good place to start



Look at the number of pulses per cycle to see how severe things are

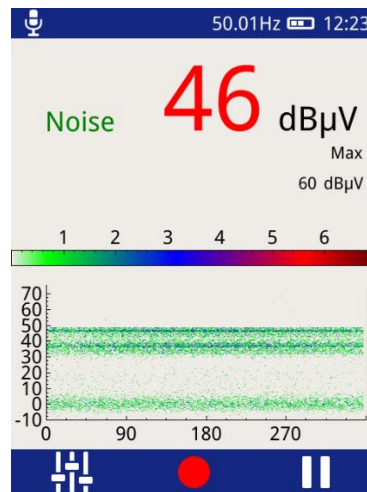


Use the measurements along with any **other information** you have about the equipment tested and the **consequence** of failure to assess the **risk to the network** so that you can decide what to do next



3.10.2 Ultrasonic Screen

The Ultrasonic screen shows measurements taken using either the inbuilt Ultrasonic sensor or the external Ultrasonic sensors (Ultrasonic Contact Probe, Flexible Sensor or UltraDish) if connected.



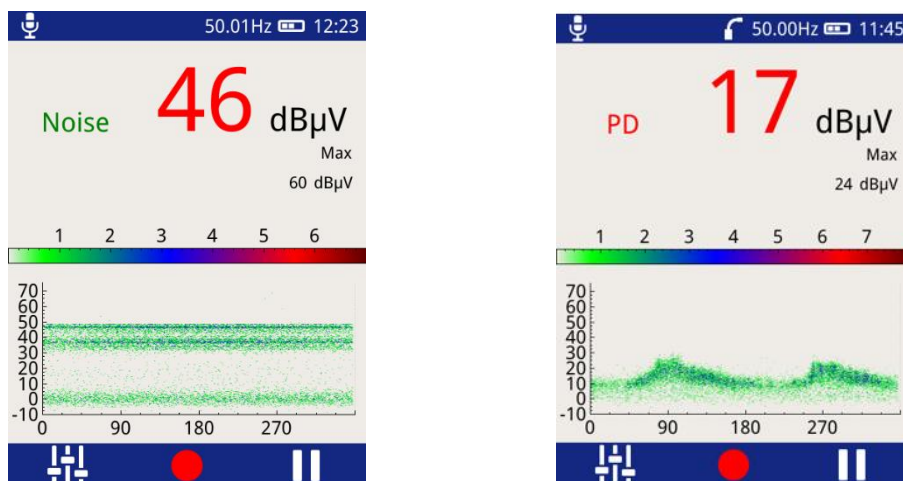
Ultrasonic magnitude is measured in dB μ V and is displayed on the chart as phase angle (x-axis) against amplitude (y-axis). The colour chart represents a key to show the intensity (pulse count) at a given amplitude and phase angle.

This phase resolved plot can be used to further confirm the presence of a partial discharge activity. In general PD activity will be displayed as a stable area which will occur at the same to phase angle each cycle; whilst noise tends to be out of phase and occurs at irregular positions on the phase plot.

3.10.3 Ultrasonic classification

The Ultrasonic display on the UTP2 includes the output of EA Technology's proprietary ultrasonic classification algorithm. The algorithm processes measured ultrasonic data in real time to give an indication whether the input data is a background noise source or partial discharge activity.

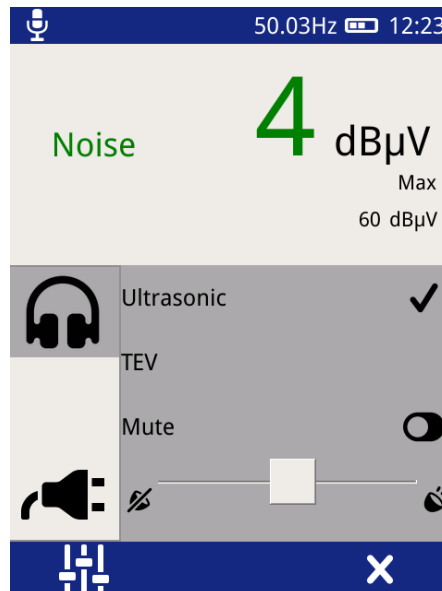
The algorithm processes the data from the ultrasonic Microphone along with the phase reference signal, and looks for patterns within the data stream which experts at EA Technology have identified as typical indicators of partial discharge.



The ultrasonic classification will not be displayed if the phase lock has not been achieved, see 3.11.3.

3.11 Context Menu


Pressing the Left Button whilst in TEV, Cable PD or Ultrasonic modes brings up the Context Menu as shown below. The Context Menu consists of a number of items with only those relevant to the current mode of operation visible at any time. This mode allows commonly used settings to be modified from within the measurement screen.



The Context Menu contents is context specific; its contents will differ for each measurement mode.

3.11.1 Audio output


The UTP2 allows audio output of either Ultrasonic, TEV or Cable PD (dependent on whether the HFCT is connected or not) activity through the connection of external headphones. The audio context menu allows control of the headphone output.

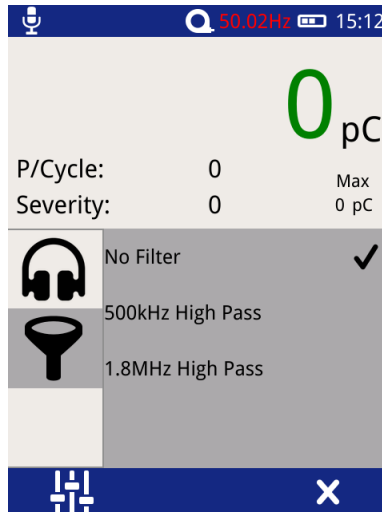
To modify the current audio settings, click on the Audio icon . Within this sub menu the audio output (TEV, Cable PD or Ultrasonic) can be selected, note this selection will persist across modes.

To turn off the audio output, toggle the Mute Button, the toggle icon will turn green to indicate the Mute mode has been activated.

The volume of the audio output can also be modified by adjusting the slider to the desired level as shown above.

3.11.2 Filters

Select the filter icon  to change the filter properties; this option is only enabled when in Cable PD Measurement Mode and enables noise to be filtered from the cable PD measurement.



Select the desired filter properties, a tick should appear when a selection has been made (shown above).

No Filter – This option passes all frequency types.

500 kHz High Pass – This option activates a high pass filter that passes all frequencies from 500kHz and above.

1.8 MHz High Pass – This option activates a high pass filter that passes all frequencies from 1.8 MHz and above.

3.11.3 Phase Reference

A properly 'phase referenced' Phase Plot will assist in the classification of potential partial discharge activity that has been recorded. It will provide a much clearer Phase Plot that can be analysed later and compared to other readings/phase plot patterns.

The most important time to achieve a phase reference is when a number of events (or discharges) are being captured and they are clustering on the screen of the UTP2.

For more information on phase reference, contact product-support@eatechnology.com


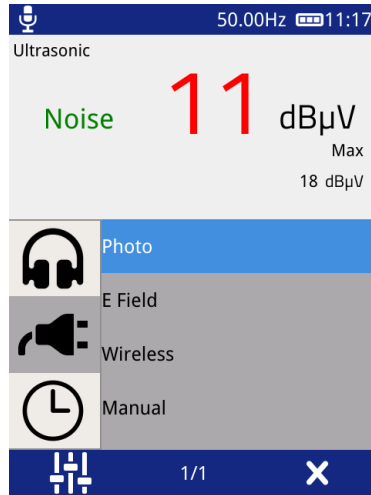
Select the  icon on the context menu to access the phase reference settings page. This allows the source of the phase reference for the UTP2 to be selected from the following options:

Photo – This option selects the Photo-sensor located on the front upper section of the UTP2 (see Figure 1) as the source of the Phase reference. The Photo-sensor requires line of sight to a mains frequency light source such as a fluorescent fitting.

E field – This option selects the built-in E-field sensor as the source of Phase reference. The sensor detects the phase reference from the stray electric field within the substation.

Wireless – This option selects the Wireless Phase Reference as the source for the Phase reference. The Wireless Phase Reference is wireless accessory for UTP2 which allow detection of Phase reference with Photo-sensor, E-Field, Rogowski coil and Mains. Details on how to connect can be found in 6.2

Manual – Allows the user to manually adjust the phase reference.



The current status of the phase reference is indicated by the colour of the phase readout.






A white phase display indicates a phase lock has been achieved.

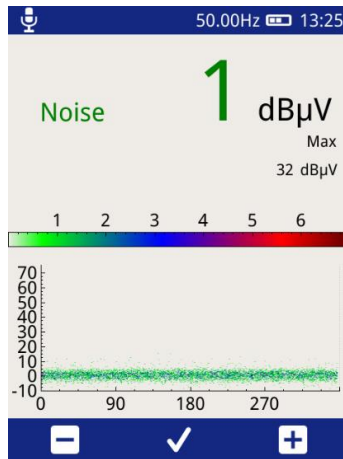


A red phase display indicates that a phase lock has not been achieved. A continuous red phase display would necessitate the change of mode.

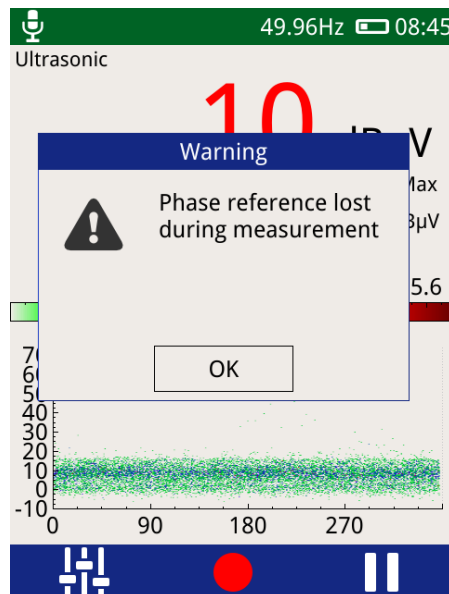


An amber phase display indicates that the frequency has been set manually.

When in Manual Mode the Right  and Left  buttons can be used to increase or decrease the phase reference respectively. Once the desired value has been reached, press the middle button  to store as shown below.

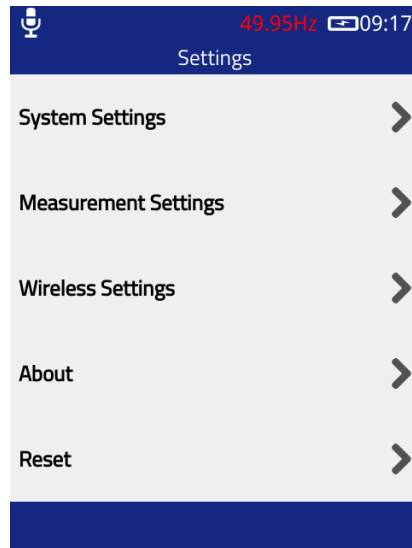


During a data capture the UTP2 monitors the phase lock to ensure a continuous sync is achieved. If the phase lock is lost at any time during a capture the unit displays a warning message on completion of the recording. Every attempt should be made to ensure a phase lock is present as the lack of this may affect the analysis of the data captured.

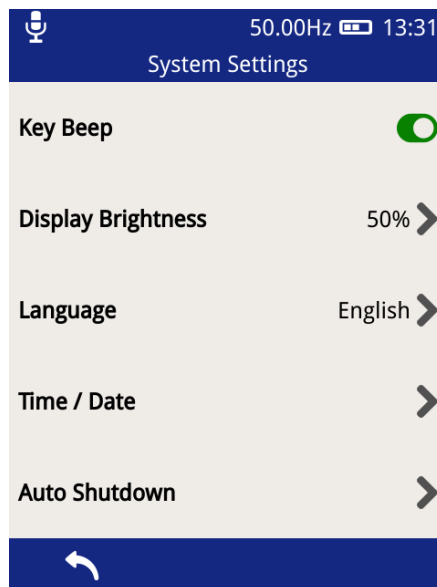


3.12 Settings Screen

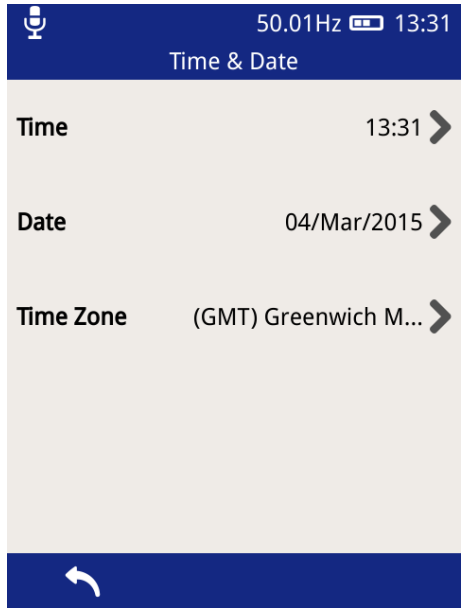
To access the settings page, click the Settings icon  on the Main Menu and the screen shown below will be displayed.



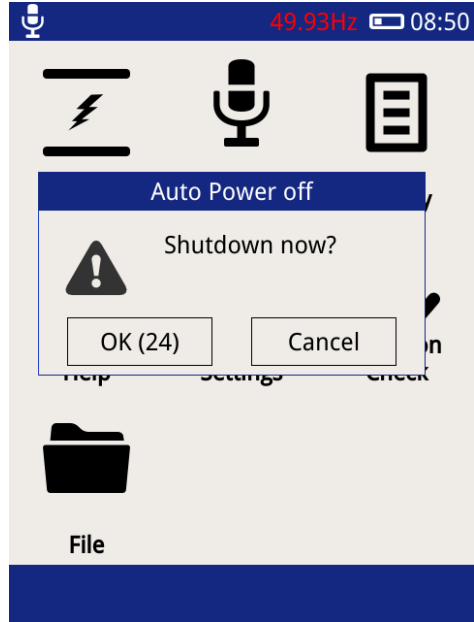
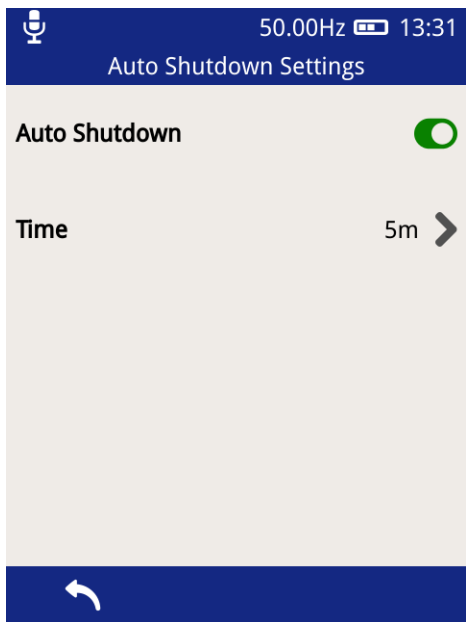
3.12.1 System Settings



- **Key Beep** – allows the turning ON/OFF of the audible beeps when any of the buttons are pressed and when an NFC tag is detected. The button toggles to a green colour when Key Beep is activated.
- **Display Brightness** – click on this to change the intensity of the backlight. Keeping the backlight to a minimal level will improve battery life.
- **Language** – select this option to change the UTP2 display language.
- **Time/Date** – select this option to change the Time and Date settings on the UTP2. The time zone can also be changed here as shown below.

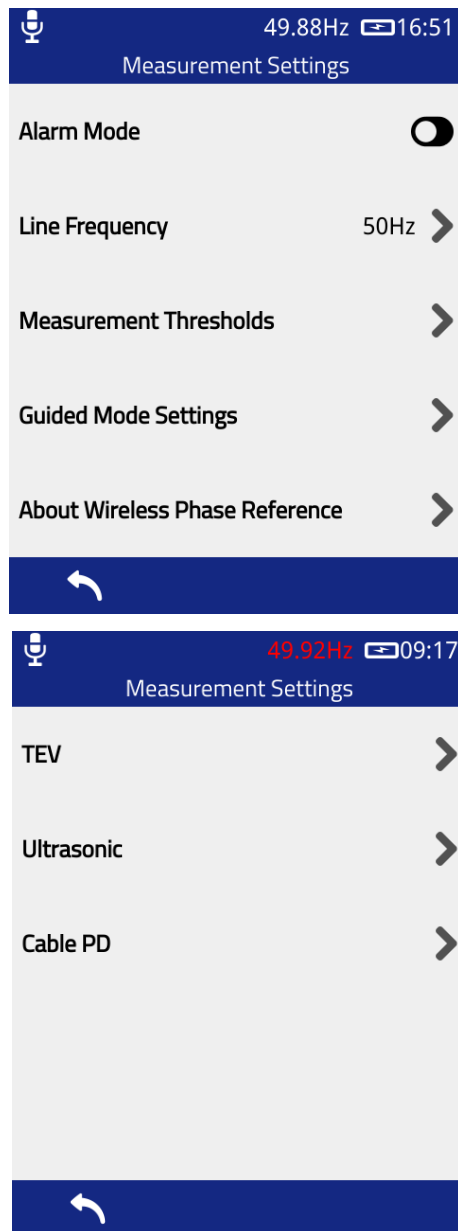


- Auto Shutdown** – this option can be used to Enable/Disable the Auto shutdown feature of the UTP2. After a defined period of push button inactivity, the UTP2 will display a warning message and then proceed to shut itself down to conserve power. The inactivity period can also be changed here as shown below.



3.12.2 Measurement Settings

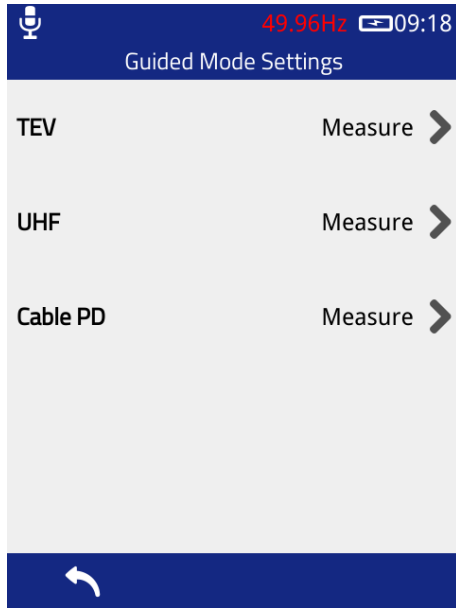
The Alarm Mode can be toggled on and off in this option. When the Alarm mode is activated, the inbuilt beeper of the UTP2 will be activated whenever the set red threshold level has been exceeded. In addition to this, threshold levels (Red and Amber levels) for the various measurement features of the UTP2 can be modified here together with the line frequency.



The Ultrasonic only contains a Red Level threshold setting.

The Guided Mode Settings, allow you to select the default measurement screen to be taken to when needing to do a TEV UHF or Cable PD measurement. Each Measurement type will bring up a list of possible measurement screens, for example, TEV:

- Interpretation (Default)
- Measure
- Phase Plot
- Histogram
- Waveforms
- 3D Phase Plot



The About Wireless Phase Reference allows you to check Wireless Phase Reference Model Number, Hardware Version and Firmware Version of Wireless Phase Reference when connected to UTP2.

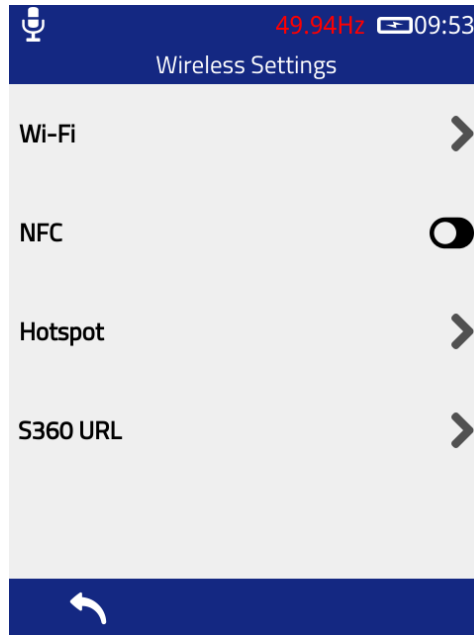


Note: When Wireless Phase Reference is not connected to UTP2, the device information will be unavailable.

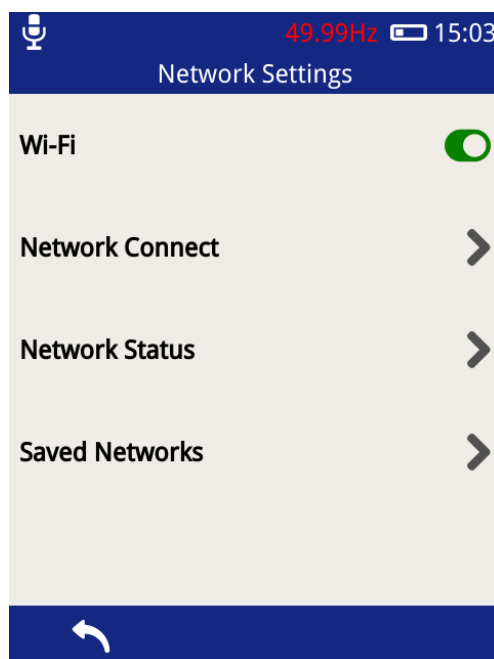
3.12.3 Wireless Settings

This section allows the setting of the Substation 360 Base URL, Wi-Fi & NFC features of the UTP2.

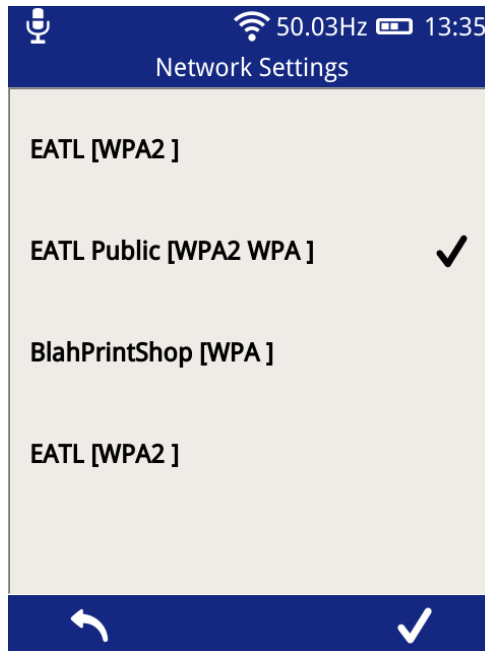
The S360 URL button will bring up the text editor to allow the user to update the URL to which the UTP2 will try to connect to. The default value is "substation360.co.uk". When editing this URL, please note, that only known base URLs will be accepted. If it does not match, an error will be shown and not saved. Upon a successful saved change, a reboot of the UTP2 will be required for the changes to take effect. A pop-up window will also inform the user of this.




The NFC is enabled system wide by sliding the toggle switch to green. Once active the NFC features can be accessed through the survey and measurement screens.



The Wi-Fi functionality can be switched on/off using the toggle button shown above. Select **'Network Connect'** above to connect it to a Wi-Fi network.




Using the on-screen keyboard, enter the Wi-Fi password and then the Middle Button  to save the network. The connection status of the UTP2 can be viewed by selecting **'Network Status'**.

3.12.4 About

The about screen displays a summary of the UTP2 components including both hardware and software version numbers. The display also provides details of **EA Technology's** dedicated Product Support team should any further information be required.



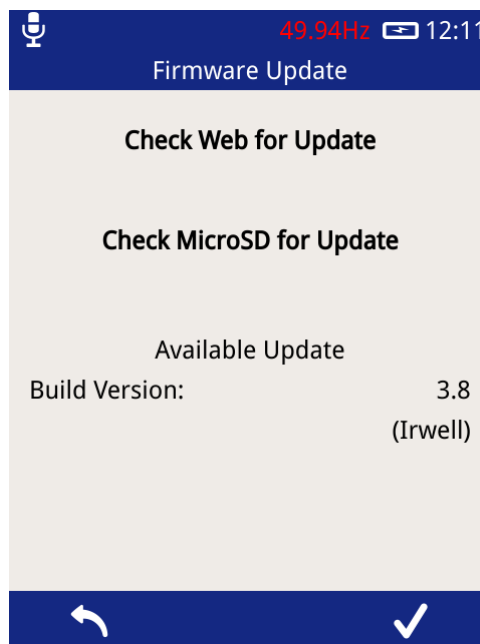
3.12.5 In-field Firmware Upgrade

Through the '**About**' screen, the firmware of the UTP2 can be updated. To access the firmware update screen press the update icon .

The UTP2 can be updated in the field from an update file loaded onto the MicroSD card. Please check with Product Support for any available update files. To use this feature the image will initially need to be copied from the distribution media to the 'updates' folder on the MicroSD card. An SD to MicroSD adapter is supplied for use with laptops or PCs which have an built-in SD card reader.

To install a firmware update from the MicroSD card, press the "Check MicroSD for Update" button on the above screen. The MicroSD card will be checked for any available updates, and details populated on the display as shown below. To install the update found, press the tick icon on the right of the menu bar and await the process to complete.

An update can only be installed if the UTP2 is plugged into the mains charger, to avoid any unwanted shutdown due to low battery whilst performing the update process. The update process can take up to 5 minutes to complete. Once installed, the UTP2 must be restarted to run the latest update.



To check you have the most current software version or if you need assistance in updating your UTP2, please contact product-support@eatechnology.com

3.12.6 Reset Settings

Reset All Users: This option removes all Substation 360 Users from the UTP2. This will include the Users information, Work Orders downloaded, the current state of the completed Surveys to be uploaded (this will not remove the surveys from the SD Card, just the ability to upload them to S360). Any new completed Work Order or Survey after this reset, will then be able to be uploaded. This option also resets survey PINs.

Reset All Settings: This option can be used to reset the UTP2 back to the default settings. Upon pressing this option, a notification will appear asking for the action to be confirmed.




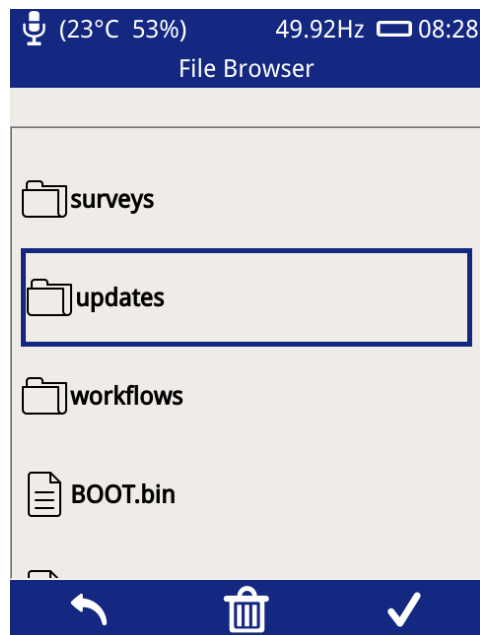
Once confirmed the follow settings will be reset back to their default state:




- Key Beep Enable
- Display Brightness
- Language
- Auto Shutdown Enable
- Auto Shutdown Time
- TEV Red and Amber Measurement Thresholds
- Ultrasonic Red Threshold
- Cable PD Thresholds
- Wi-Fi enable
- Wi-Fi credentials




- Line Frequency

3.13 File Browser

The File Browser screen can be used to manage files and folders stored on the UTP2's microSD card. To access the file browser, click File icon  on the Home screen.



Upon opening the File Browser, the contents at the root of the memory card will be displayed. Selecting a folder, represented by the folder icon , will cause it to be highlighted within the File Browser. The contents of the folder can then be displayed by pressing the  icon or the physical button below it on the instrument. A folder can be deleted by pressing the  icon or the physical button below it.

Selecting a file, represented by the file icon , will cause it to be highlighted within the File Browser. Information regarding the file such as size, date modified and time modified can then be displayed by pressing the  icon or the physical button below it on the instrument. A file can be deleted by pressing the  icon or the physical button below it.

Please note, that some files on the system are important to maintain the functionality of the UTP2. If these files are removed unwanted behaviour could occur while using some of the functionality.

Important Files:

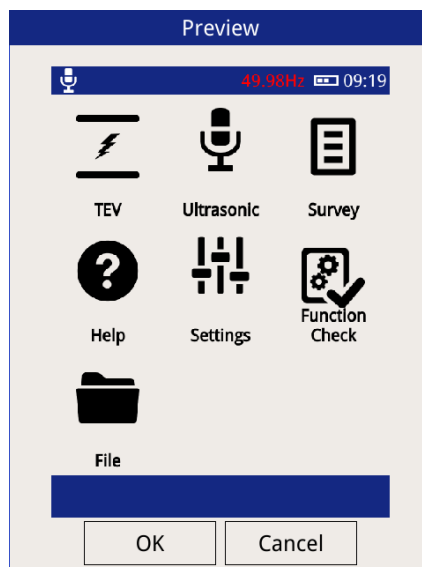
- Surveys -> surveys_list.json
 - Removing this file will remove the ability to upload some surveys to S360 via the upload screen.
 - The surveys zip files are un-touched.
- Usr directory
 - Removing this directory or anything within will affect the ability to login to S360 on the UTP2
 - If one of these folders/files has been deleted, then go to Settings -> Reset -> Reset All Users -> Yes.

3.13.1 Screenshot

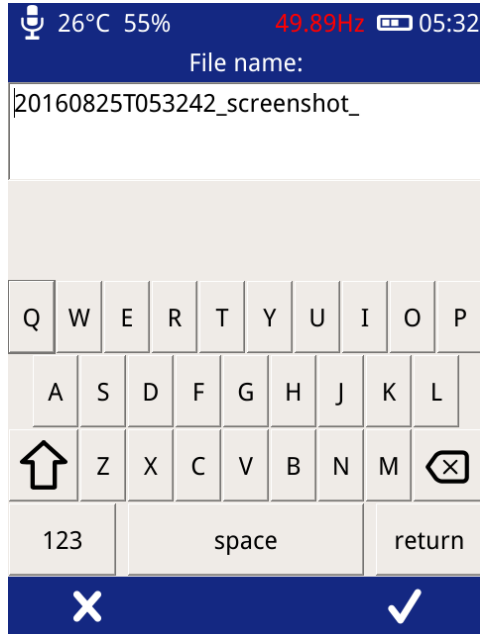
The UTP2 allows the user to capture an image of the screen at any time. To initiate a capture, press both the left and right hand buttons simultaneously for two seconds.



Once capture completes, a pop up window will appear giving a preview of the screen capture. This preview can either be rejected by pressing cancel which discards the image and returns to normal operations or accepted which will move onto the file naming screen.




The file name screen provides the opportunity to rename the file from the default as shown below. Selecting the tick in the bottom left hand corner of the image stores the file to the removable microSD Card. The files are stored at \data and can be verified through the file browser.

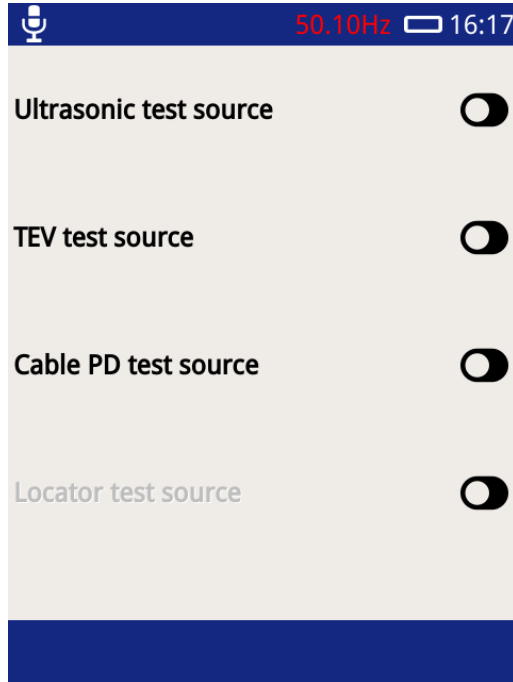


The screen shot image can be viewed by removing the SD card and inserting into a PC or similar device and navigating to \data and opening the relevant .png file, or by connecting to the UTP2 interface.

3.14 Function Check

The UTP2 function checker is designed to allow users to verify the functionality of their instrument using built-in test sources. The Function Check display option can be used to toggle these built-in test sources. To launch

the Function Check display, press the Function Check icon  on the Home screen.



To test a given function, for example, the TEV function, toggle on the TEV test source. Navigate to any of the TEV measurement displays which should display TEV activity. Multiple test sources can also be toggled and checked.

The Function Check is not in any form a calibration check.

Remember to turn off the Function Check before taking a measurement.

3.15 Survey

The UTP2 Survey mode is a powerful yet easy way to collect and store data from a range of assets. Data from TEV, Cable PD, Ultrasonic or UHF measurement modes can be recorded and stored with corresponding metadata linking the data and its associated context.

All data recorded on the UTP2 takes the form of a survey in order to give the data context and a common structure for use when analysing the data offline.






3.15.1 Create a Workflow using the Workflow Generator

Workflows are a pre-populated description of the measurements to be undertaken as part of a substation survey. A workflow consists of information regarding the assets and the specific measurements per asset that are to be performed.

Insert the UTP2 SD card into your PC or laptop and open the Workflow Generator (3784-SWREL--WorkflowGenerator.html) with a web browser.

- New workflow: clears any data entered and loads a blank, default workflow.
- Open workflow: allows a previously saved workflow (.json file) to be opened for further editing. Note: workflows from the legacy Excel workflow generator can also be imported into the tool in the same way.
- Save workflow: saves the workflow to a .json file.
- Undo/redo: allows mistakes to be corrected.
- Languages selection: changes the workflow generator to the user's chosen language.
- Advanced mode: enables various advanced workflow features to be selected.
- Metadata field selection: allows the pre-survey questions to be tailored to the user's requirements. If in doubt use the default fields.
- Add new metadata group: Adds a new group of questions to the workflow. This will be displayed as a separate screen when a survey is followed using the UTP2.
- Asset entry: enter asset names and panel numbers to the workflow. Note: asset names and panel numbers must be unique.
- Measurement selection: clicking the icons selects a measurement to be taken in the position indicated. Use the Measure Type dropdown to change between TEV, Ultrasonic, Cable PD, etc.

Once the required details have been completed, save the workflow file under the folder 'workflows' in the UTP2 microSD card. If this folder does not exist, it must be created (case sensitive).

 data	31/01/2017 10:34 PM	File folder
 surveys	30/03/2017 10:18 PM	File folder
 updates	30/09/2016 8:02 AM	File folder
 workflows	2/12/2016 4:01 PM	File folder
 utp2_log	30/03/2017 10:18 PM	Text Document

The screenshot shows the UltraTEV Plus² Workflow Generator interface. At the top, the title bar includes the EQ Technology logo, the text 'UltraTEV Plus² Workflow Generator v03.00.00', and a menu bar with icons for 'New workflow', 'Open workflow', 'Save workflow', 'Undo/redo', 'Language selection' (set to English), and 'Advanced mode' (set to Basic mode).

The main workspace is divided into three sections:

- Survey Metadata:** Contains a 'Job' dropdown menu with an 'x' icon. Below it is a table with columns for field name, type, and value. Two rows are shown: 'Job Number' (text) and 'Engineer Name' (text). An 'Add field' button is at the bottom left. A callout 'Metadata field selection' points to the 'Job' dropdown.
- Assets:** A table with two rows: '1 Feeder A' and '2 Feeder B', each with an 'x' icon. An 'Add asset' button is at the bottom. A callout 'Asset entry' points to the 'Feeder A' entry.
- Measures:** A table with a 'Measures' dropdown set to 'TEV'. The table has columns for 'Panel Number' (1 and 2) and rows for various components: 'Cables', 'Cable Box', 'CT Chamber', 'VT Chamber', 'Upper Busbars', 'Lower Busbars', 'Spouts', and 'Circuit Breaker'. Each cell contains a measurement icon. A callout 'Measurement selection' points to the 'Cable Box' row.

3.15.2 Creating a Workflow for an Existing Survey

When not in Survey Mode, a Workflow can be created for an existing survey by connecting to the UTP2 via Hotspot or USB (see section 3.17). Click on Generate Workflow for each survey file that is saved on the UTP2.



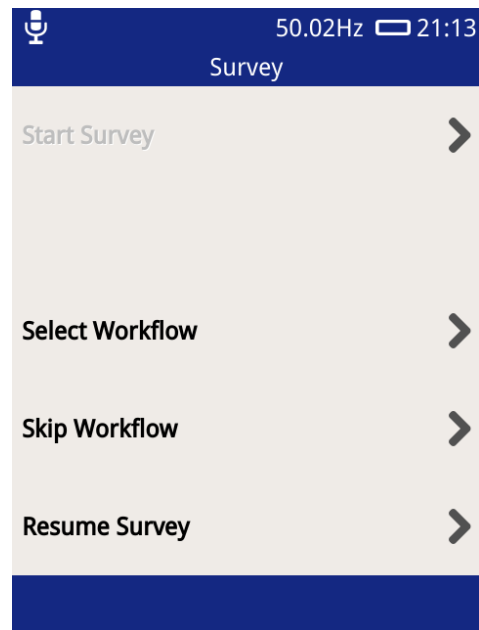
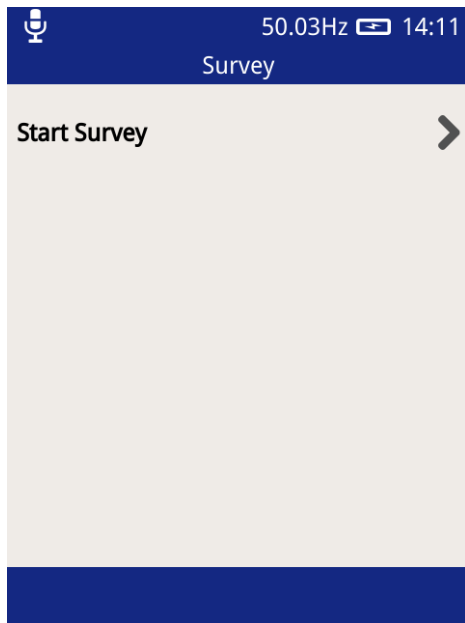
UltraTEV Plus² Interface




Surveys	Screenshots			
20210401T134153_Unnamed_Archive.zip		Download	View	Generate Workflow
20210401T134153_1_Unnamed.zip		Download	View	Generate Workflow
20210318T171037_Unnamed.zip		Download	View	Generate Workflow
20210318T171009_Unnamed.zip		Download	View	Generate Workflow

3.15.3 Starting a Survey

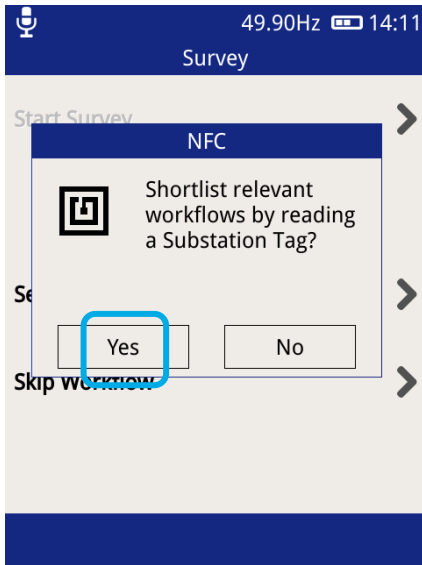
There are two ways to start a survey; either by going through the Survey display off the Main menu, or by starting a data capture from any measurement screen.



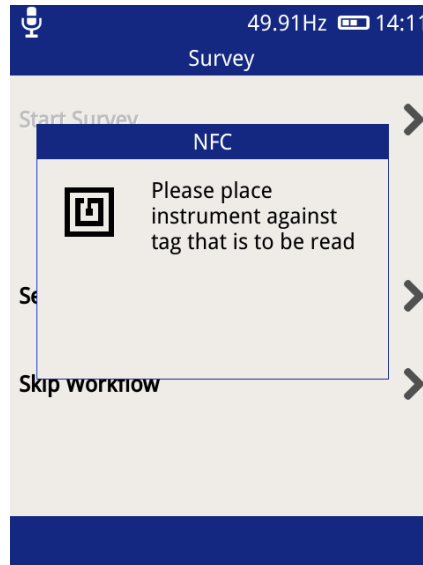
Pressing the Survey icon  on the Main menu will display the Survey Mode display. This display allows users to start, stop and view the progress of a survey.

To start a survey, press 'Start Survey' on the display. Doing this will show two options to select from; Select Workflow or Skip Workflow.

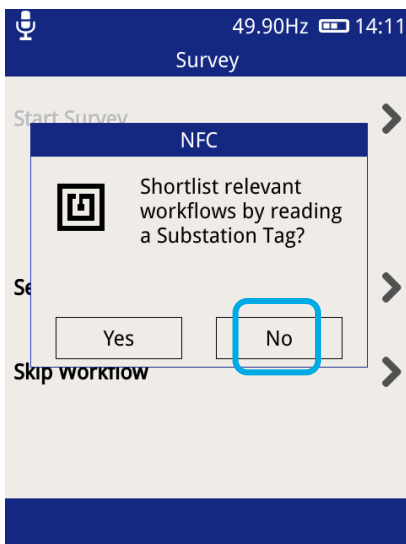
3.15.4 Select Workflow



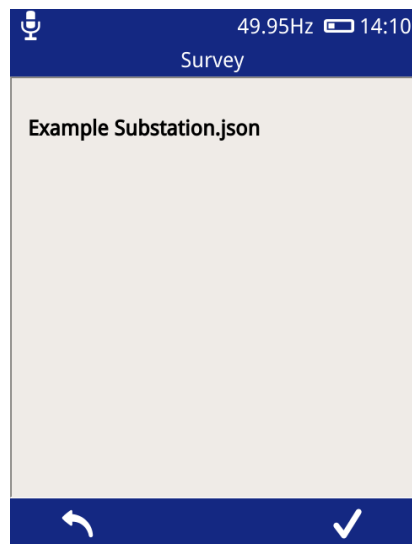
Recall workflow from substation tag



Read substation tag



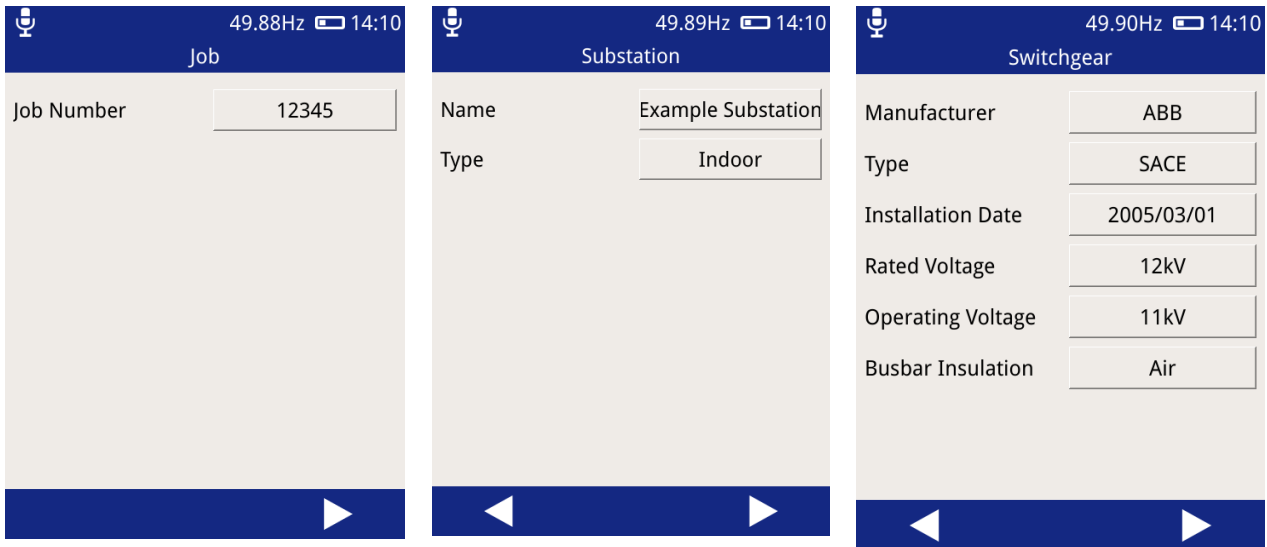
Go to workflow list



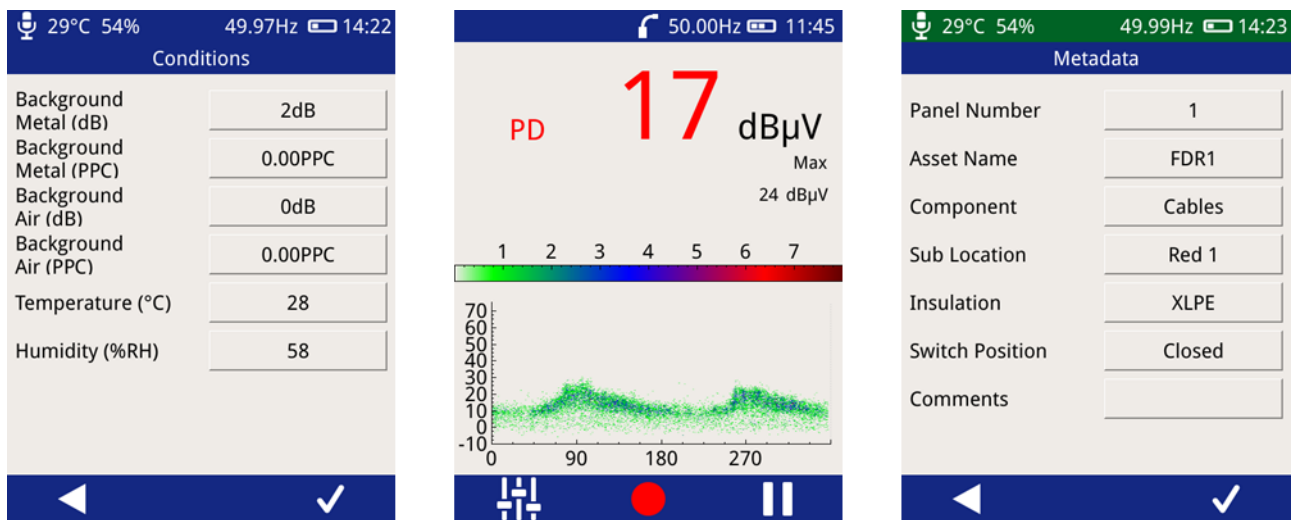
Select workflow

Note: When using an NFC Tag to filter the Workflows, if an error occurs, all available workflows on the UTP2 will be shown.

Enter your unique job number, the substation and switchgear information will be filled in using the information from the Workflow.



Capture background readings, if 'yes' was not selected when the workflow was created, this data will not be captured.



A workflow can be created from a previous survey using the 'Generate Workflow' option in the UTP2 interface page.

3.15.5 Skip Workflow

To perform a survey without a workflow, press the "Skip Workflow" button. Similarly to the Workflow route, a series of forms will be displayed with fields about the substation, switchgear and conditions. The form field can be populated using the inbuilt virtual keyboard or a drop down list of available options.

The Notification bar changes from blue to green to indicate a survey is currently running.

3.15.6 Ad-hoc Measurement

If a survey is not in progress when the record button is pressed in any of the TEV, Cable PD, Ultrasonic or UHF measurement screens the data is still captured. On completion of the record, the default survey information fields are displayed to capture the measurement context data. This data is the same as entered when starting a survey through the menu icon. Once this information has been entered, survey mode stays active ready for further data to be recorded and added to the survey.

3.15.7 Survey Metadata Forms

As mentioned in the previous section, each survey requires the input of information about the substation the survey is being conducted in. Some fields have populated lists of values to select from, with each having the option to override by inputting a custom value, others allow only virtual keyboard input and a select few have special behaviours.

Navigation through the forms is done using the left and right buttons on the menu bar or using the corresponding physical buttons. The last form to be populated is indicated by the right hand button on the menu bar changing to become a tick icon.

Pressing this will close the last form, save the entered information and a prompt will pop up to start the survey in 'Guided Mode'. If 'Yes' is selected then you will be taken to details of the first measurement to be taken, in preparation to take the measurement. If 'No' was selected, then the screen will return to the home menu ready to start recording data. See section 3.15.12 for more detail on Guided Mode.

If a workflow is not being used, the default form fields used are set out below along with their behaviour:

Form 1		
Name	Job	
Field	Description	Behaviour
Job Number	The job number of the survey, used by many users to link a survey to a contract or package of work	Pressing the input field will show the virtual keyboard
Engineer Name	Name of engineer performing the survey	Pressing the input field will show the virtual keyboard

Form 2		
Name	Substation	
Field	Description	Behaviour
Name	Name of the substation being surveyed	Pressing the input field will show the virtual keyboard
Type	Type of the substation being surveyed	Pressing the input field will show a populated list of substation types, with the option to enter a custom value using the virtual keyboard

Cable Naming	Type of cable being surveyed	Pressing the input field will show a populated list of cable types
Form	3	
Name	Switchgear	
Field	Description	Behaviour
Manufacturer	Manufacturer name of the switchgear being surveyed	Pressing the input field will show a populated list of switchgear manufacturers, with the option to enter a custom value using the virtual keyboard
Type	The type of switchgear being surveyed	Pressing the input field will show a populated list of switchgear types with the option to enter a custom value using the virtual keyboard
Installation Date	Installation date of the switchgear	Pressing the input field will show a date selector to input the switchgear installation date
Rated Voltage	The rated voltage of the switchgear	Pressing the input field will show a populated list of voltages with the option to enter a custom value using the virtual keyboard
Operating Voltage	The operating voltage of the switchgear	Pressing the input field will show a populated list of voltages with the option to enter a custom value using the virtual keyboard
Busbar Insulation	The insulation material of the switchgear's busbar	Pressing the input field will show a populated list of busbar insulation materials with the option to enter a custom value using the virtual keyboard

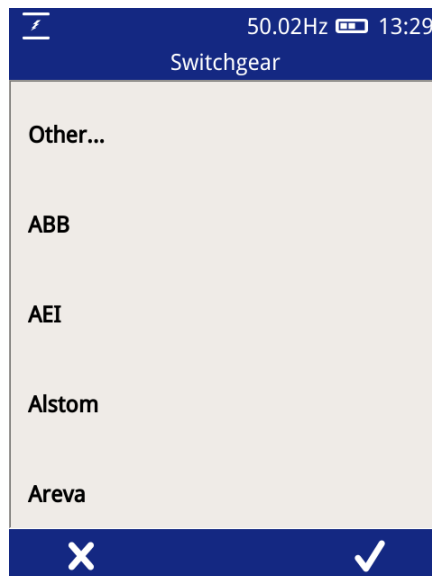
Form	4	
Name	Conditions	
Field	Description	Behaviour
Background Metal	Background metalwork TEV value	Pressing the input field will cause a background TEV measurement to be performed
Background Air	Background Air TEV value	Pressing the input field will cause a background TEV measurement to be performed
Temperature	Temperature as read by the Environmental Sensor	Pressing the input field will cause it to be populated with the current Temperature. The Temperature & Humidity sensor must be connected to do this.

Humidity	Humidity as read by the Environmental Sensor	Pressing the input field will cause it to be populated with the current Humidity. The Temperature & Humidity sensor must be connected to do this.
Condition Questions	<p>These are Questions generated by the Workflow creator.</p> <p>There is no limit to the number of questions, and each question can have different input fields.</p>	<p>Potential Input Fields:</p> <ul style="list-style-type: none"> • Text – Has the ability to apply a sense check on the data the user has entered. • List – User generated list for the user to select from • Date

Form	5 (optional)	
Name	Field Questions	
Field	Description	Behaviour
Questions	<p>These are Questions generated by the Workflow creator.</p> <p>There is no limit to the number of questions, and each question can have different input fields.</p>	<p>Potential Input Fields:</p> <ul style="list-style-type: none"> • Text – Has the ability to apply a sense check on the data the user has entered. • List – User generated list for the user to select from. • Date

3.15.8 Using Populated Lists

Populated lists used in many of the above fields will look like that of below.

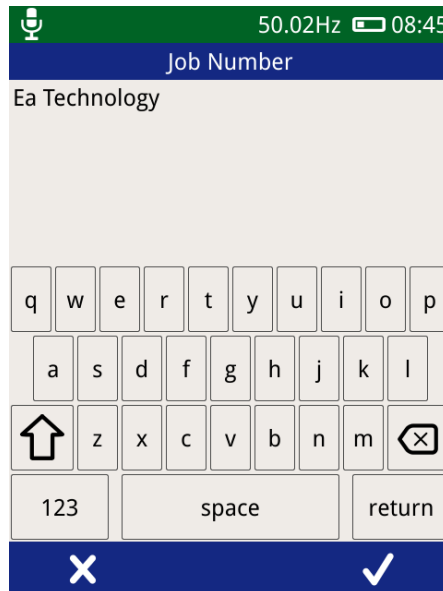


The list can be scrolled by dragging the list up and down using a finger or stylus. Selecting an item is done by pressing an item then pressing the tick in the menu bar. If the “Other...” option is selected a virtual keyboard prompt will be displayed for custom input. If the cross in the menu bar is pressed, the list will be closed and no input recorded.

3.15.9 Using the virtual keyboard

The virtual keyboard allows custom text to be input. Characters can be input using the buttons on the layout, with additional characters and numbers available through the “123” button. Uppercase letters can be entered by pressing the arrow (between A and Z). Double tapping the arrow will activate Caps lock, giving uppercase letters until it is next pressed.

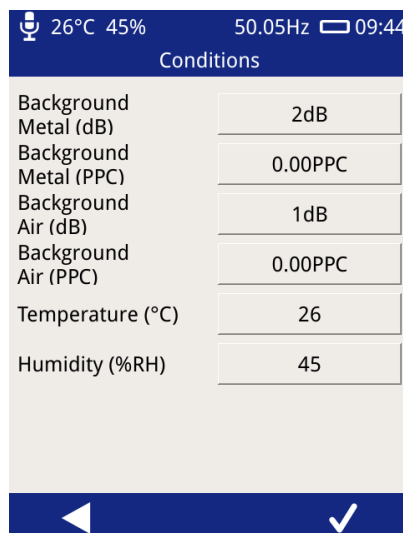
To accept the input text as input to the field, press the tick button on the menu bar, to cancel, press the cross on the menu bar of the Left button.



3.15.10 Background Measurements

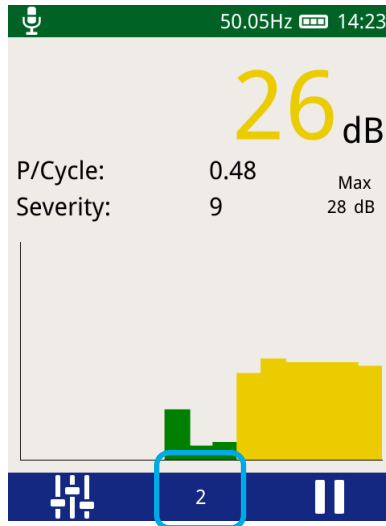
The background measurements fields on the survey metadata forms have special behaviour, pressing the input field triggers the UTP2 to start measuring the TEV level for a ten second period. Following this, the average measurement for the period is stored. When performing the Background Metal measurement, the TEV plate of the UTP2 should be held against an unearthed piece of metalwork in the substation not connected to the switchgear. The Background Air measurement requires holding the UTP2 in free space in order to get an ambient reading.

The background temperature and humidity are taken directly from the current measurement by the Environmental Sensor. Please note that the Environmental Sensor needs to be connected to the UTP2.



3.15.11 Recording Data

Once a survey has been started, data can be recorded from any TEV, Cable PD, Ultrasonic or UHF displays. The same data is recorded for TEV or Cable PD independent of which TEV/Cable PD screen is currently displayed. To record data, simply press the record icon visible on the menu bar, which will then start a 10 second period of data capture.



Different data is recorded for the different measurement modes as summarised below:

TEV recorded data

When recording data in any of the TEV modes, the following data is recorded and stored:

- Event data including phase angle, cycle count, amplitude, pulse width and rise time
- TEV Waveforms
- TEV audio

Cable PD recorded data

When recording data in any of the Cable PD modes, the following data is recorded and stored:

- Event data including phase angle, integral, pulse width and rise time
- Cable PD Waveforms

Ultrasonic recorded data

When recording data in Ultrasonic measurement modes, the following data is recorded and stored:

- Raw Ultrasonic audio
- Heterodyned Ultrasonic audio
- Processed Ultrasonic audio

The volume that the UTP2 is set to is also the volume that is recorded in the survey file.

3.15.12 Guided Mode

Upon starting a Workflow or a Work Order, a prompt will pop up asking, start this survey in 'Guided Mode'. Guided Mode is designed to help the user work through the workflow measurement by measurement, in the hopes to not miss anything and to move from measurement to measurement in an efficient manner.

Work Orders and version 1 surveys have an optional Ordering ID with each measurement, if this is the case then the order of the measurements will display is the set order. However, if the order counts are duplicated or missing then a default order is applied:

1. Order
2. Measurement Type:
 - a. TEV
 - b. Ultrasonic:
 - i. Internal
 - ii. Flexi
 - iii. Contact
 - iv. Parabolic
 - c. Cable PD
 - d. UHF
 - e. VPIS
3. Component Access
 - a. Front
 - i. Circuit Breaker
 - b. Back
 - i. Cable
 - ii. Cable Box
 - iii. CT Chamber
 - iv. VT Chamber
 - v. Spouts
 - vi. Upper Busbar
 - vii. Lower Busbar
4. Switchgear Panel Number
5. Component Type
 - a. Cable
 - b. Cable Box
 - c. CT Chamber
 - d. VT Chamber
 - e. Spouts
 - f. Upper Busbar
 - g. Lower Busbar
6. Substation Location
7. Ad-Hoc Measurements.
 - a. The Ad-Hoc measurements will be added to the end of the Measurements in the Order they are taken in.

Any Workflow or Survey with a populated measurement section, can be started/continued in Guided Mode. See section 3.15.13 for more details. Upon completing all measurements in the survey, the user will have the ability to view the state of all the measurements, continue to add new measurements or stop/complete the survey. See section 3.15.17 for more details on stopping a survey.

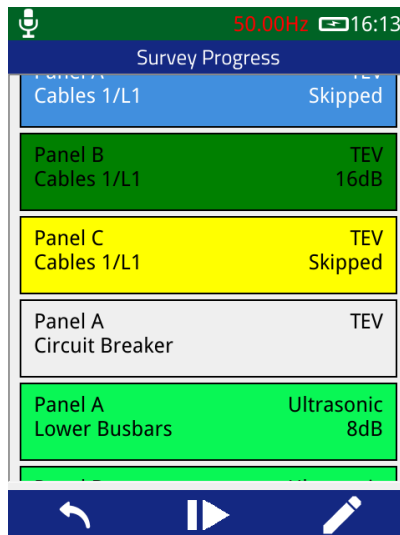
If a Survey is resumed/continued (Section 3.15.18), Guided Mode can be used again to help complete anything missing, edit comments, or overwrite previous measurements.

3.15.13 Viewing Survey Progress

The progress of a survey can be viewed at by navigating to the Survey menu then pressing 'View Progress'. The view progress displays the list of measurements to be taken in the loaded Workflow. If it is an Ad-Hoc Survey this list will initially be empty. The list is scrollable if there are too many measurements to fit on the screen. The selected Measurement is highlighted blue.

Each Measurement has its own state:

State	Description	Colour Representation
Incomplete	A Measurement still to be recorded	White
Complete	A Completed Measurement, all Recorded data saved, and Metadata filled in.	Green
Complete - Skipped	A Measurement with no Recorded data, but the Metadata filled in. The Comment is mandatory when skipping a measurement.	Yellow
Complete - Ad-Hoc	A Completed Measurement, all Recorded data saved, and Metadata filled in. However, this measurement was not part of the original Workflow.	Light Green



If a valid phase reference was not present when a measurement was taken, the measurement text will be highlighted red.

The View Progress screen also allows the user to filter the view on the page. When selecting a filter, the option is shown within the button.

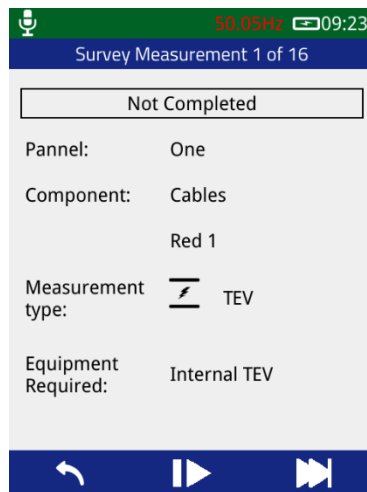
The Filter options:

- All Measurements (Default)
- Complete Measurements
- Incomplete Measurements
- Skipped Measurements

- Measurement Type
 - TEV
 - Ultrasonic
 - UHF
 - VPIS
- Panel Names
 - This is generated from the Workflow

While on the view progress screen, the left, centre and right button all have actions.

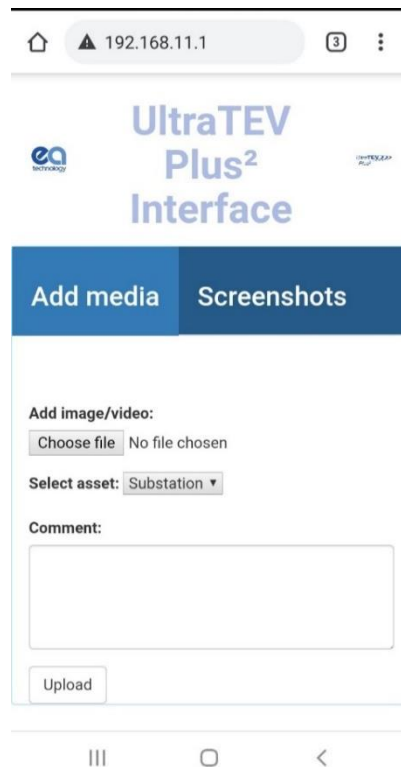
- Left Button
 - Return to the Survey Screen
- Middle Button
 - Play/ Continue/ Start Recording the selected Measurement
 - If a measurement is in a completed state, then clicking the Play button will bring up the detail screen and allow the user to re-record the same measurement.
 - If all are measurements are completed a pop up will appear informing the user.
- Right Button
 - Any measurement in a completed state, can be edited. The only editable section is the comment made with the measurement



3.15.14 Adding Media to a Survey

A photograph or video can be added to the survey file by connecting your smart device to the UTP2, via the Hotspot function, see section 3.17.1. To add an image or video, open the UTP2 interface by entering <http://192.168.11.1> to your web browser and select 'add image/video'. These can be viewed alongside other measurement data using the web-based reports, see section 3.17.

For quick access to the UTP2 interface, you can create a shortcut on your mobile device's homepage.



3.15.15 Edit Survey Meta Data

A survey's meta data can be edited at any time while in 'Survey Mode'. This action will mimic the same screens as when starting the Workflow.

3.15.16 Resume Guided Mode

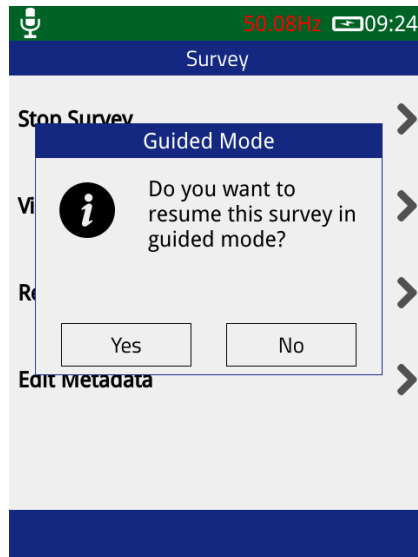
Any Survey can be resumed in Guided Mode by going back to the view progress screen and clicking the play button.

3.15.17 Stopping/Completing a Survey

A survey can be completed at any time by going to the Survey Menu and pressing the "Stop Survey" button. Upon completing a survey, a summary of the survey is written to the survey directory and the entire directory is archived into a zip file for safe keeping. If a large amount of data has been recorded, archiving the data can take up to a minute. Once archiving is completed the notification bar will return to its blue colour indicating that a survey is now no longer in progress.

3.15.18 Resuming a Survey

A survey can be resumed after it has been stopped. This feature is only available for surveys originally started in the last 12 hours, on the same UTP2 instrument, running the same firmware version. To resume a survey Press Survey, Start Survey, Resume Survey and select a survey to resume. The top menu bar will turn green to indicate a survey is in progress. A Prompt will appear if you wish to continue this Survey in Guided Mode, 'Yes' will bring up the details next measurement that still needs to be completed. 'No' Will take the user to the home screen.



3.16 NFC Functionality

The UTP2 has a built-in NFC tag reader/writer that can program NFC tags when they are used for the first time and recall the information during a survey.



Blank NFC tags are identical and can be programmed with substation *or* asset information. There is a space on the tag to write 'asset', 'substation' or other information. NFC tags can store approximately 100 records.

3.16.1 NFC Tag Installation

- Our standard NFC tags are not designed for outdoor installation
- NFC tags are designed to work on metal surfaces
- Clean the surface with alcohol prior to installation
- Install in a convenient place where the UTP2 can be held in contact with the NFC tag while the display is observed

NFC functionality is enabled by default. To turn off the NFC function, go to Main Menu, Settings, Wireless Settings. When taking a reading, align the UTP2 centre button with the NFC tag.



3.16.2 Substation Tag

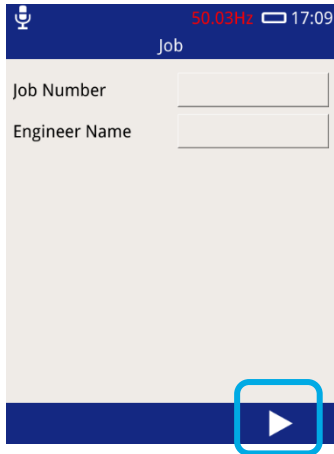
Use one NFC tag per substation to hold all the information relative to the substation being surveyed. This tag can be installed anywhere in the substation.

The following information is stored:

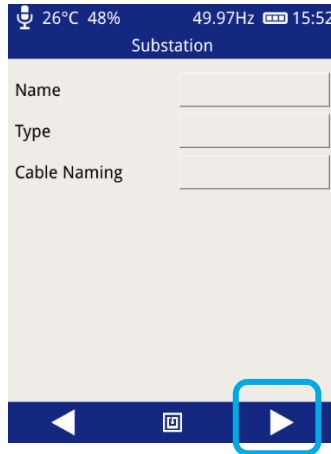
Substation Name	(up to 127 characters)
Substation type	(Indoor, outdoor, cabinet, other)
Switchgear Manufacturer	(up to 127 characters)
Switchgear Type	(up to 127 characters)
Installation Date	(Day, Month, Year)
Rated Voltage	(In KV)
Operating Voltage	(in KV)
Busbar Insulation Type	(Unknown, Air, Oil, Compound, SF6, Paper, XLPE, EPR)

3.16.3 Writing to a Substation Tag

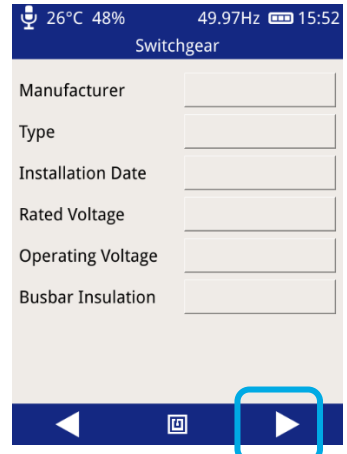
From the Main Menu select Survey, Start Survey, Skip Workflow.



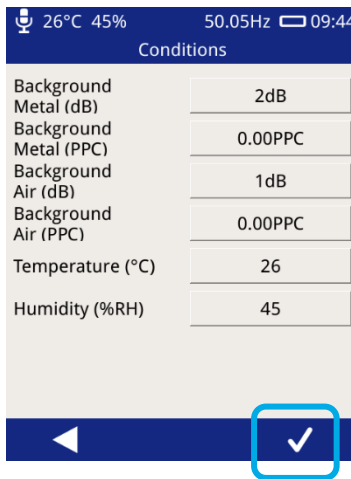
Enter unique survey reference



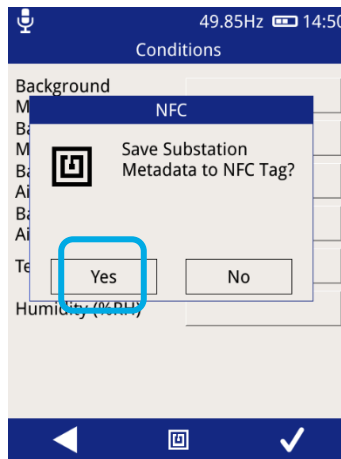
Enter substation name & type



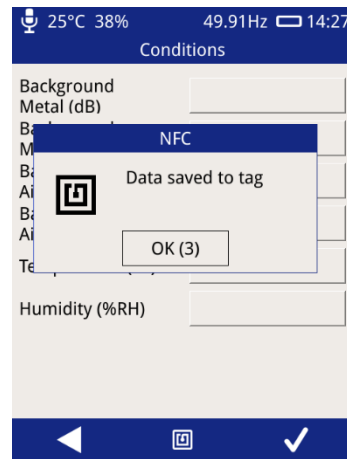
Enter switchgear information



Take background readings



Align the UTP2 centre button with the NFC tag



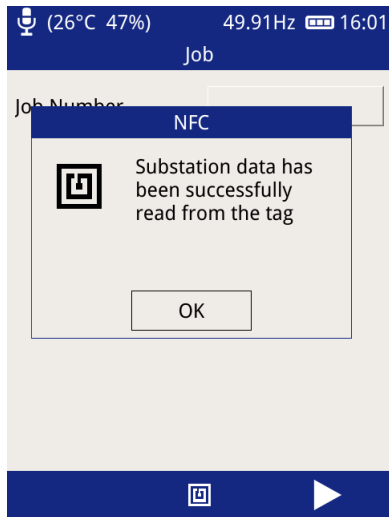
The UTP2 will beep once to indicate a tag has been detected, followed by two beeps to indicate a successful tag write

Following a successful tag write, the UTP2 will continue in Survey mode.

3.16.4 Reading a Substation Tag

Substation tag reads can take place in the Job, Substation and Switchgear screens within Survey mode.

From the Main Menu select Survey, Start Survey, Skip Workflow. Align the UTP2 centre button with the NFC tag and press the centre button or NFC icon to trigger a scan. The UTP2 will beep once to indicate a tag has been detected, followed by another beep to indicate a successful tag read.



Successful scan



Substation information added to survey

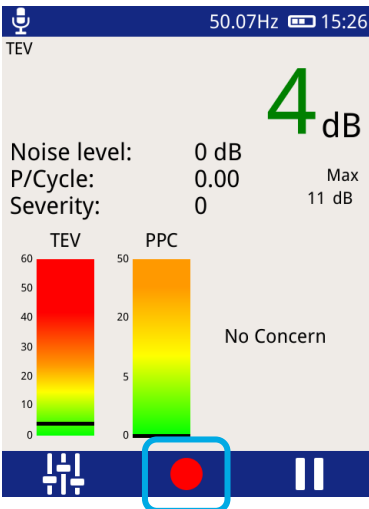
3.16.5 Asset Tag

We suggest two NFC tags per panel, one on the front and one on the rear. The asset tag will store the following information required in the Metadata screen of Survey mode:

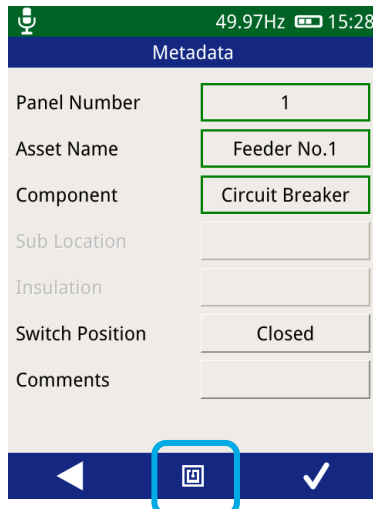
- Asset Name (up to 127 characters)
- Panel Number (up to 127 characters)

3.16.6 Writing to an Asset Tag

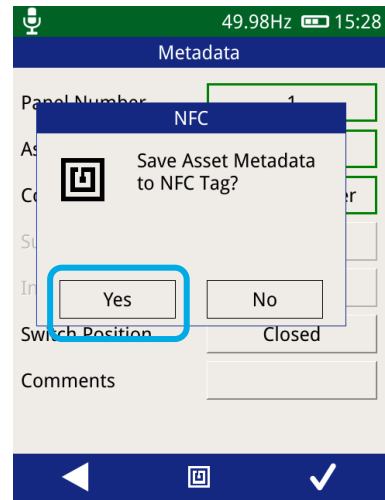
The recording data option is available in Survey, TEV and Ultrasonic mode.



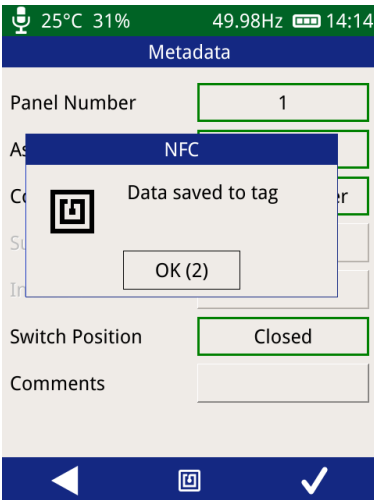
On any screen press record



Input asset information



Select 'yes' and align the UTP2 centre button with the NFC tag

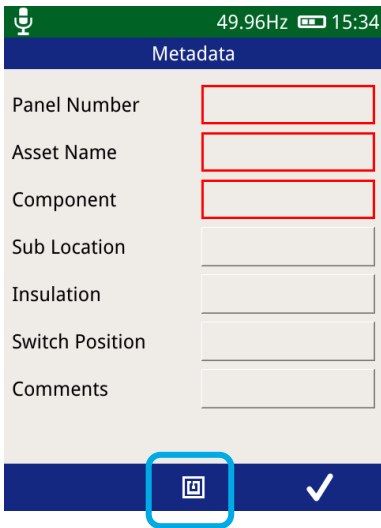


The UTP2 will beep once to indicate a tag has been detected, followed by two beeps to indicate a successful tag write

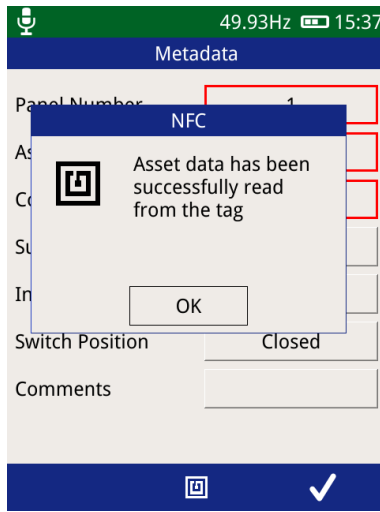
Once completed, the asset information is available for re-call on future measurements.

3.16.7 Reading an Asset Tag

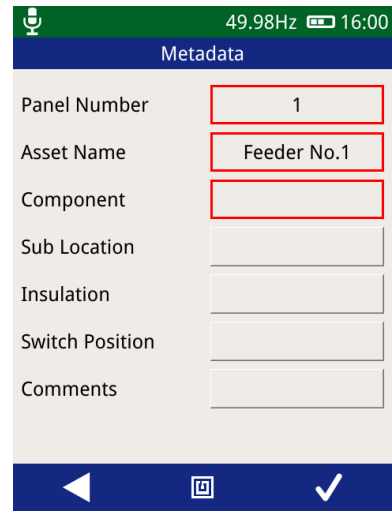
Whenever the record option is used in Survey mode and the measurement 'Metadata' screen is displayed, a tag read is possible.



Press the centre button or NFC icon to trigger a scan



The UTP2 will beep once to indicate a tag has been detected, followed by another beep to indicate a successful tag read

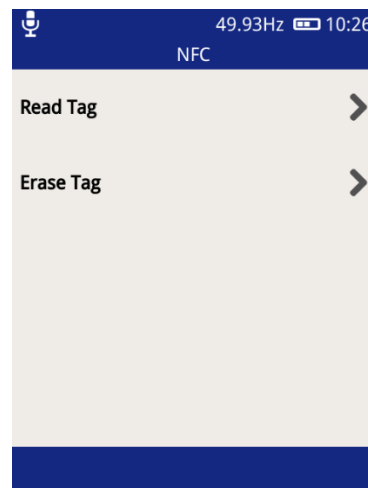
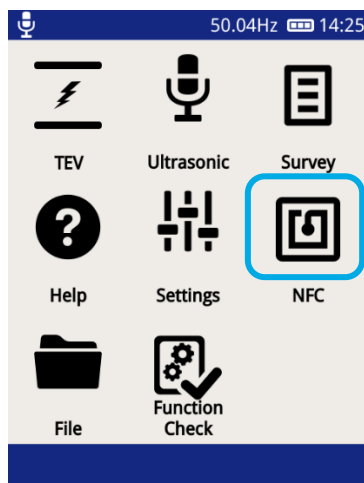


Data will populate asset information

Measured values are stored on the tag. Past results can now be viewed in the html file on the UTP2 SD Card, for trending purposes, as long as the reading was taken in the same location.

3.16.8 Reading an NFC Tag from the Main Menu

NFC tags which have previously been written to, can be read or erased from the Main Menu.



3.16.9 NFC Tag Trouble Shooting

'blank tag detected, no data read'

The NFC tag has no data

'wrong tag type'

Attempting to read substation data from an asset tag

'no tag detected'

Re-position the UTP2 in contact with the NFC tag and try again

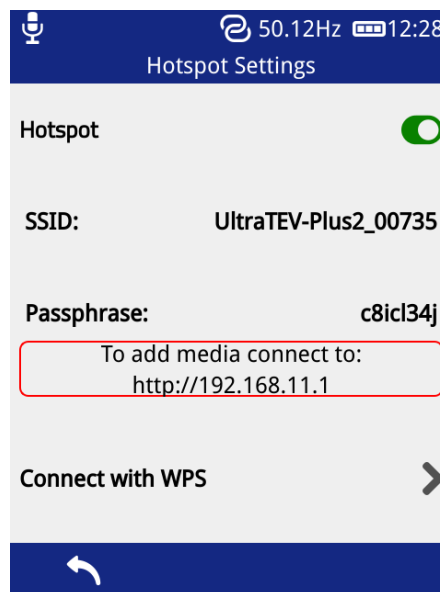
3.17 Reviewing Results

Data collected during Survey mode or through ad-hoc recording is stored on the UTP2 MicroSD card. To facilitate viewing of the data, the UTP2 provides four methods of connection.

- Hotspot – Allows direct connection via the UTP2 personal hotspot to a Wi-Fi enabled device.
- Wi-Fi – Allows a direct connection from the UTP2 to a Wi-Fi enabled device.
- USB – Direct connection from the UTP2 to a Windows based machine.
- Removal of the MicroSD card for viewing on a Windows/Linux/ Mac OS X based machine.

3.17.1 Hotspot Connection

1. Go to Main Menu select Settings, Wireless Settings, Hotspot and enable Hotspot
2. Go to the Wi-Fi settings on your Wi-Fi device e.g. mobile phone, laptop
3. Select the SSID from the list of available networks on your Wi-Fi device
4. Connect by entering the Passphrase from your UTP2 Hotspot Settings
5. Alternatively, connect to UTP2 by pressing “Connect with WPS” option.
6. Go to the Wi-Fi settings on your device and select WPS.



7. Once connected, enter IP address 'http://192.168.11.1' in a web browser address bar, such as Google Chrome, Mozilla Firefox or Microsoft Edge/Internet Explorer.



Note: The number of currently connected devices to UTP2 hotspot is displayed at the bottom of hotspot logo.



3.17.2 Wi-Fi Connection

1. Go to Main Menu, Settings, Wireless Settings and enable Wi-Fi.
2. Select Network Connect, choose your network from the list and connect.
3. Once connected, go to Network Status and make a note of the IP address.
4. Enter this IP address in a web browser address bar, such as Google Chrome, Mozilla Firefox or Microsoft Edge/Internet Explorer.

The home page, shown below displays a list of all surveys and screenshots stored on the UTP2 MicroSD Card.

Surveys	Screenshots
20170424T091816_Test.zip	Download View @ Generate Workflow
20170424T080045_Unnamed.zip	Download View @ Generate Workflow
20170424T075750_Test.zip	Download View @ Generate Workflow
20170418T144015_Test.zip	Download View @ Generate Workflow

v1.12 (Moonaker)

3.17.3 USB Connection (Windows PC only)

Connect the UTP2 via the USB port using the supplied cable. The UTP2 should install as an Ethernet Gadget.

If the drivers do not install automatically, you can install them as follows:

Go to device manager and select the instrument from the network adaptors list, it will have a yellow triangle by it, then right click this and update driver software:

- Browse my computer for driver
- Let me pick from list of drivers on my computer
- Network adaptors
- Microsoft Corporation
- Remote NDIS based internet sharing device, next install

Note: The user needs to have administrator rights for the computer.

Once connected, enter the IP address 192.168.10.1 in a web browser such as Google Chrome, Mozilla Firefox or Microsoft Edge/Internet Explorer.

The index of surveys on the UTP2 can be used to quickly identify the site of interest allowing the user to navigate either directly to the data analysis (view button) or to download a zip file (compressed folder) containing the raw data (download button).

Clicking the view button takes the user to the data analysis screens.

3.17.4 MicroSD Card & Data Zip Files

An alternative method of viewing the data held on the UTP2 is by direct file access. This can either be from a previously downloaded data zip as above or by accessing the MicroSD card directly.

To directly access the MicroSD card ensure the UTP2 is powered down, then locate the MicroSD card at the base of the instrument and gently push on the card to eject it.

The MicroSD card will contain a separate .zip file (compressed folder) for each survey and ad-hoc measurement undertaken. Inside each folder there is an html page named 'index.html'. Extracting the zip file and then opening the 'index.html' file inside this folder will direct you to the analysis pages.

3.17.5 Data Analysis Screens

The UTP2 has a web interface for analysing data captured by the instrument. These analysis pages can be accessed through a web browser or downloaded for offline analysis as detailed above.




Following selection of 'View' on the landing page, or opening of an 'index.html' file from the decompressed zip folder, a new page will appear with a visualisation of the switchgear surveyed.

The screenshot displays the 'View' page for 'Sub No.1' on '2017/06/29 11:50:48'. On the left, a metadata table provides details for the job, substation, switchgear, and conditions. The main area shows a grid of components for five panels. The 'CT Chamber' in Panel 1 and 'VT Chamber' in Panel 3 are highlighted in red, indicating a measurement. The 'Circuit Breaker' in Panel 1, 2, 3, 4, and 5 are highlighted in green, indicating a measurement. A 'Download Survey Summary CSV' button is located at the bottom left.

Job	Panel Number	1	2	3	4	5
Job Number: Test	Cables					
Substation Name: Sub No. 1	Cable Box					
Substation Type: Indoor	CT Chamber	⚡				
Substation Cable Naming: Red/Yellow/Blue	VT Chamber			⚡		
Switchgear Manufacturer: ABB	Upper Busbars					
Switchgear Type: Advance	Lower Busbars					
Switchgear Installation Date: 2000/06/29	Spouts					
Switchgear Rated Voltage: 11	Circuit Breaker	⚡	⚡	⚡	⚡	⚡
Switchgear Operating Voltage: 11	Asset Name	Panel 1	Panel 2	Panel 3	Panel 4	Panel 5
Switchgear Busbar Insulation: Air						
Conditions Background Metal (dB): 2						
Conditions Background Metal (PPC): 0.00						
Conditions Background Air (dB): 2						
Conditions Background Air (PPC): 0.00						
Conditions Temperature (°C): 23						
Conditions Humidity (%RH): 54						

The overview or 'index' page provides diagrammatic representation of the switchgear surveyed along with an icon detailing each measurement. An overview of the metadata entered during the substation visit is included on the left hand side of the page. This data includes substation information such as site name and switchgear information such as manufacturer, voltage etc. Below the metadata on the left hand side of the page a 'download survey summary' button is available. When pressed this button downloads a Comma Separated Variable (CSV) file containing an overview of the survey results.

The measurement icons shown below are positioned on the panels as per the location entered during the site survey. Clicking any of the available measurements on a panel component will open the analysis page for the corresponding measurement. The measurement section is colour coded, to correspond with the green/amber/red thresholds.

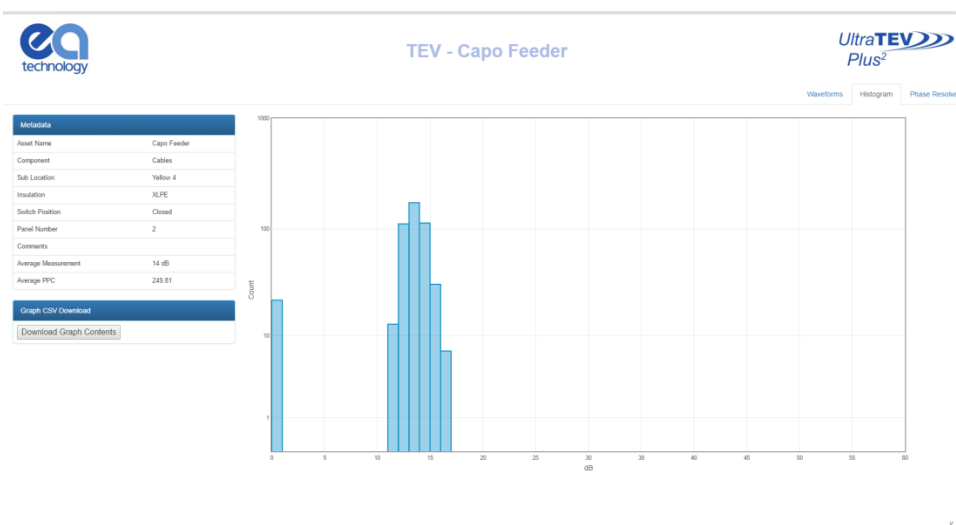
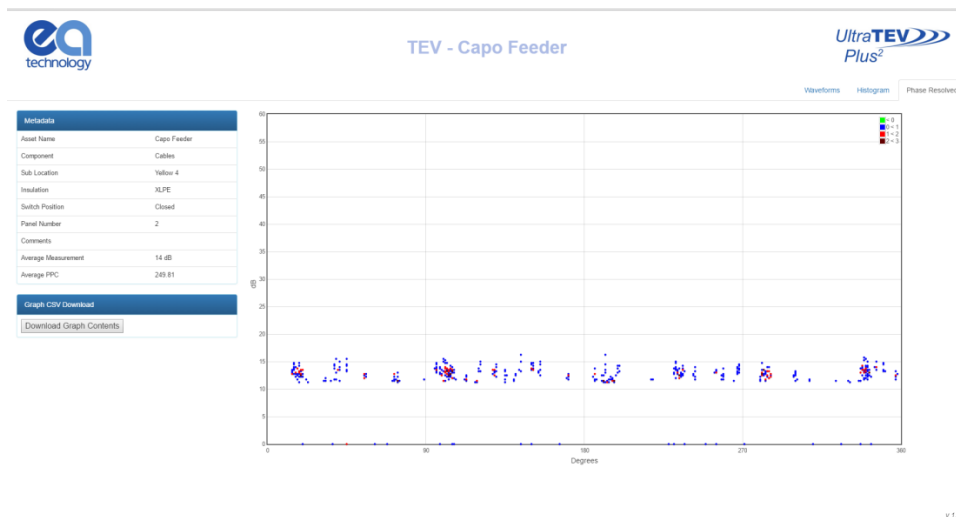
-  - TEV
-  - Cable PD
-  - Ultrasonic

3.17.6 TEV & Cable PD Analysis Screen

Both TEV and Cable PD recorded data share the same suite of analysis screens. Once a TEV or Cable PD measurement has been selected from the index page a new tab will open in the browser displaying the analysis page corresponding to the measurement selected. Multiple individual analysis pages can be opened simultaneously in this way to aid comparison.

The TEV and Cable PD analysis pages both have metadata regarding the current measurement on the left side of the page, with another button beneath to download the raw dataset for each graph to CSV. The chart displayed on each page can be changed between Waveform, Histogram and Phase Resolved by clicking the tabs in the upper right hand corner.

Both Phase Resolved and Waveform graphs are able to be zoomed by clicking and dragging on the graph area; the original zoom level can be returned to by clicking the respective graphing tab in the upper right hand corner. Hovering the mouse over a point/bar on each respective graph will produce a tooltip with information regarding that event. On the Phase Resolved graph a legend can be seen on the upper right of the graph area, indicating the scaling of colours for each point.



When the Waveforms tab is opened, a new control will appear beneath the metadata on the left. The 'Waveform Control' section allows navigation through the waveforms collected using the up/down arrows next to the waveform number. The 'Show All' button can be used to show all waveforms on the same graph.

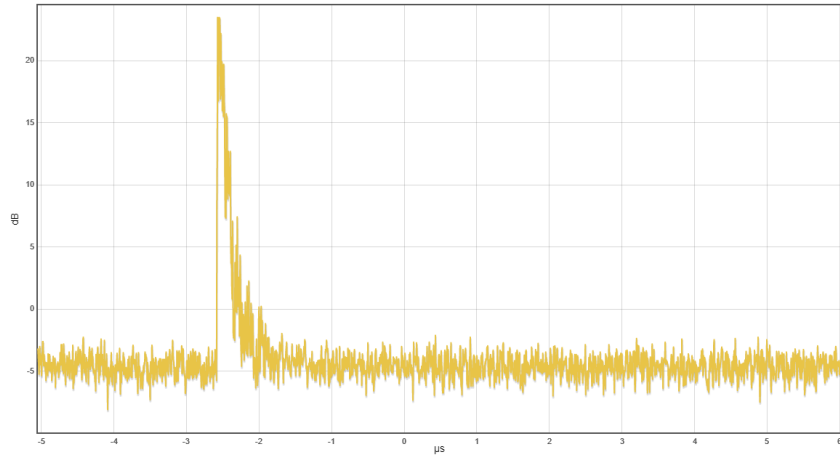


TEV - MSS33CB10



NFC Waveforms Histogram Phase R

Data	
Number:	1
Name:	MSS33CB10
Component:	Cables
Location:	Blue 2
Insulation:	XLPE
Switch Position:	Closed
Orientation:	Rear
Measurement	
Measurement (dB):	29
Measurement (PPC):	1.74
Level (dB):	0
Interpretation:	Likely medium level internal partial discharge
Reference Locked:	True
Reference Source:	E Field
Control	
1	Show All



3.17.7 Ultrasonic Analysis

Once an 'Ultrasonic' measurement has been selected on the index page, a new tab will open in the browser with the analysis page corresponding to the measurement selected. The metadata section will be displayed to the left side of the page, and the 'Play' button aligned with the 'Heterodyned Ultrasonic' label can be used to listen to or download the .wav file (browser dependent). If the browser does open the file and begin to play it, right click the player and select 'Save file as' to save the file.



Ultrasonic - Capo Feeder



Ultrasonic

Metadata	
Asset Name	Capo Feeder
Component	Sprouts
Sub Location	Right
Insulation	
Switch Position	Open
Panel Number	23
Comments	This is a comment
Average Measurement	-1 dB/V

Heterodyned Ultrasonic

Play

v 1.0.4

4. Detecting Partial Discharge using the UltraTEV[®] Plus²

Due to the tri-sensor capability, the UTP2 is able to detect Partial Discharge activity on the surface of insulation using Ultrasonic detection, internal to insulation by measuring TEV signals and in cables and cable accessories using the HFCT accessory.

This section covers how to use the UTP2 to detect PD activity using the three sensor technologies.

4.1 TEV Measurement

TEV measurements are performed using the TEV sensor embedded into the front face of the instrument.

TEV measurements cannot be taken with the HFCT accessory connected to the instrument.

4.1.1 Background Noise

Electromagnetic signals from sources outside the switchgear can also produce voltages on the outside of the switchgear. These electromagnetic sources can come from a multitude of sources such as overhead line insulators, transformer bushings and strong radio signals.

These sources will produce equivalent signals on metalwork which is not electrically connected to the switchgear such as metal substation doors or fencing. Measuring the interference levels on these surfaces before taking readings from the switchgear will help allow identification of PD over background noise.

If the background noise is less than 10dB then the UTP2 pulse counter is not incremented and will read zero.

4.1.2 Measuring TEV

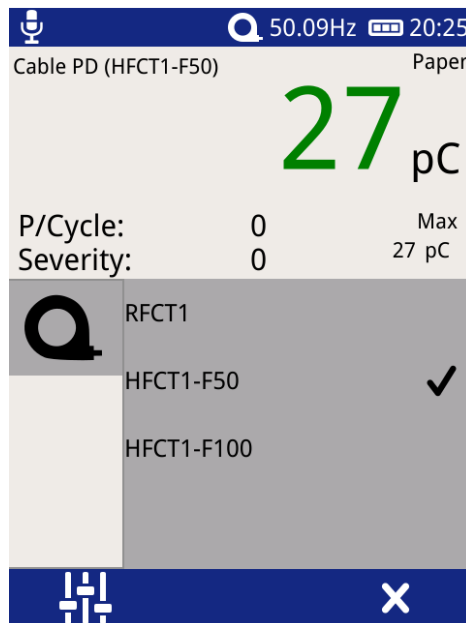
Switch on the UTP2 and wait until home menu is displayed. Press the TEV icon on the home menu then choose which TEV display is required. The 'Interpretation' display is recommended for first pass with the advanced functionality of the other modes being utilised to further inform the user once a signal is detected.

To take a measurement, hold the TEV sensor squarely against the metalwork of the asset under test as shown overleaf. Any readings will be displayed on the screen with the interpretation message adjusted to take account of the reading's amplitude and pulses per cycle. Please note that the readings will not remain on the screen once the TEV sensor has been removed from the metalwork.



4.2 Cable PD Measurement

To perform Cable PD measurements, the HFCT accessory needs to be connected to the UTP2. The HFCT connects to the Smart accessory port found on the left hand side of the instrument. Select the Cable PD accessory by pressing the Settings icon in any of the Cable PD measurement screens, until the Cable PD icon is displayed and select the correct Cable PD accessory.



EA Technology HFCTs are designed to be installed by suitably competent operators on cable earth/ground straps which are suitably and efficiently connected to earth/ground to maintain safety.

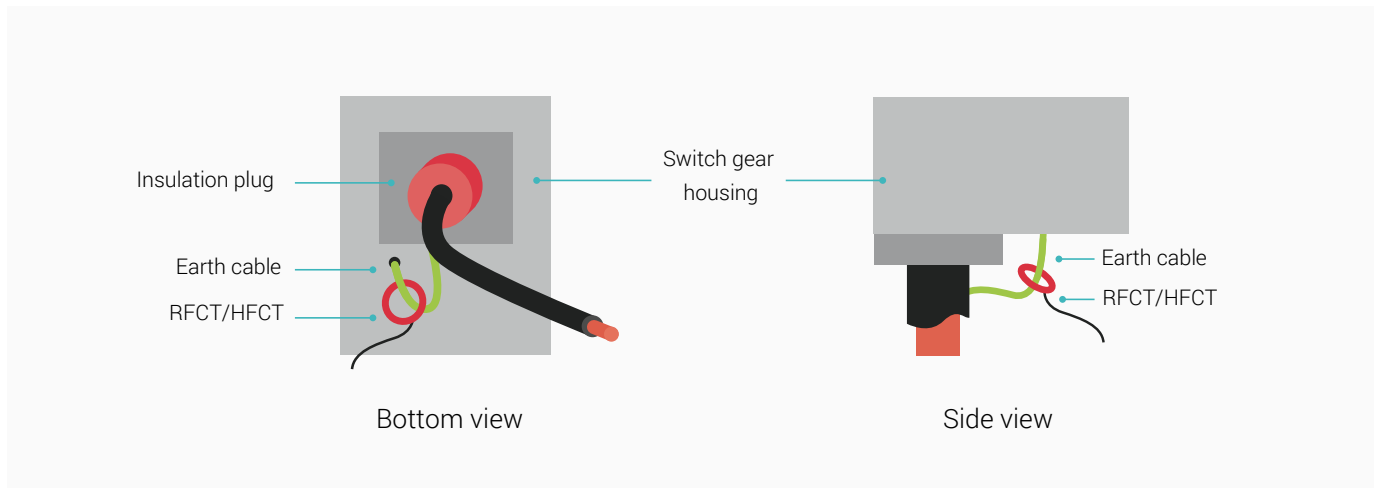
HFCTs, connecting leads and test equipment **do not** provide protection against high voltage.

If permanent installation of HFCTs is being considered, contact Product Support for guidance notes.

4.2.1 Practical HFCT Connection Requirements

Using the HFCT for online PD tests on medium voltage power cables requires direct access to the earth bonding strap. If present the split core radio frequency current transformer HFCT can simply be clamped around the earth cable. This method can be used on-line without disconnecting cables or switching off supplies to customers.

With XLPE cable installations the user can normally get access to the cable earth strap or the core of the cables. The earth strap can be looped out of the termination box to give better access. With PILC (Paper Insulated Lead Covered) cables difficulty may arise attaching the HFCT as the cable earth and switchgear earth can be bonded together. This is more usual on older PILC cables using compound filled cable boxes.



4.2.2 Measuring PD in cables

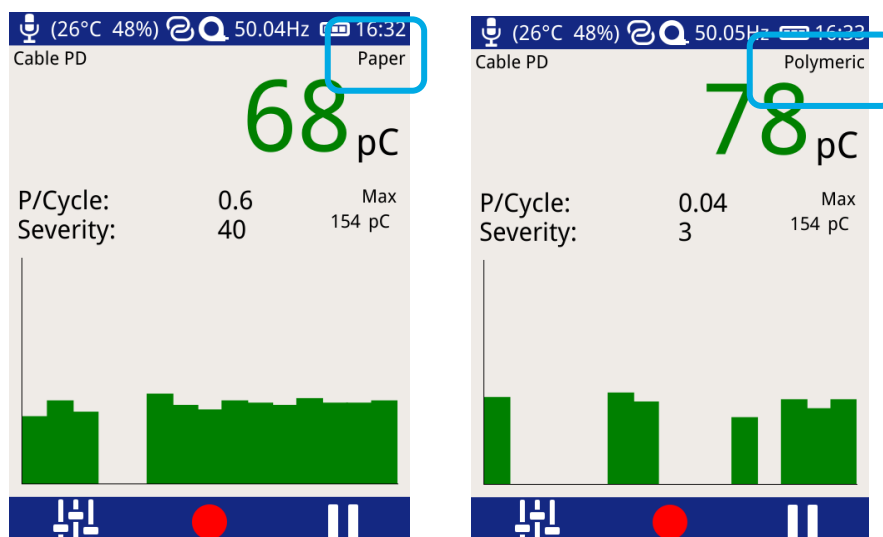
Switch on the UTP2 and wait until home menu is displayed. If the conditions set out above are met, install the HFCT around the earth strap of the cable under test. Proceed to connect the fitted HFCT to the UTP2 using the supplied cable; connect the BNC to the HFCT and the LEMO™ connector into the Smart accessory port. The home menu on the UTP2 will now display a Cable PD icon in place of the usual TEV icon.

HFCTs, connecting leads and test equipment do not provide protection against high voltage. Ensure that the accessory is only connected to cables at earth potential.

Install the HFCT around the earth strap of the cable under test before connecting it to the UTP2.

Press the Cable PD icon on the home menu and proceed to press on the Measure option. The screen will display a bar graph of the measured PD values in picocoulombs (pC). To obtain a further insight into the discharge activity on a cable, select the 'Phase Plot' option on the Cable PD screen. This screen provides a phase resolved reading of Cable PD activity within the cable under test.

The cable type can be changed by pressing the text 'paper' or 'polymeric'. The UTP2 green/amber/red thresholds will change according to which cable insulation type has been selected.



4.3 Ultrasonic Measurement

The UTP2 is equipped with a built-in ultrasonic sensor which can be used to detect the acoustic emissions of surface partial discharge activity. External ultrasonic sensors are also available to use with the UTP2 allowing use in outdoor compounds, on sealed assets or in hard to reach places. When taking airborne ultrasonic readings, the sensor should not touch the asset or plant being investigated.

4.3.1 Measuring Ultrasonic

Switch on the UTP2 and wait until home menu is displayed. Proceed to plug in the supplied Headphones; select the Ultrasonic icon on the main menu. The screen will now display a phase resolved plot of ultrasonic activity.

Ultrasonic activity above the background level may be significant. Genuine discharge can be identified by a crackling sound (like a sizzling frying pan) in the headphones or by phase related groups on phase plot. Further confidence of a detection can be obtained by the classification algorithm output displayed on the top left of the screen.

The UTP2 defaults to the built-in ultrasonic sensor if no accessory is plugged into the Ultrasonic Accessory port.

4.3.2 Connecting an Ultrasonic Accessory

Ultrasonic accessories are connected to the UTP2 Ultrasonic Accessory Port. Line up the red dot on the ultrasonic accessory connector with the groove in the UTP2 Ultrasonic Accessory Port and push in place. Once firmly latched, connection cannot be broken by pulling on the cable or any other component part other than the outer release sleeve. To remove, the connector is disengaged by a single axial pull on the outer release sleeve. This first disengages the latches and then withdraws the plug from the socket.



Release Sleeve

4.3.3 Measuring Ultrasonic with the UltraDish

The UltraDish provides a means of detecting discharge sources at a distance. It comprises a transparent parabolic reflector that focuses the ultrasonic sound on to a sensor mounted at the focus point of the reflector. The UltraDish gives an effective increase in gain compared to the built-in sensor allowing discharges to be detected at much greater distances such as insulator strings on overhead assets.



Warning: Laser pointer contains 650nm Class II (<1mW) laser. Ensure no exposure to human eyes or skin.

The UltraDish is aimed at the point of interest with either the optical sight or by switching on the laser pointer with the button on the handle (Press to energize, depress to de-energize).

Due to the gain of the UltraDish, readings taken with the UltraDish cannot be compared to readings taken with the Internal Sensor, the Flexible Sensor or the Contact Probe.



UltraDish

4.3.4 Measuring Ultrasonic using the Flexible Sensor

The Flexible Sensor provides a means of reaching inaccessible parts on the switchgear. The sensor is mounted at the end of a flexible goose-neck which allows the angle of the sensor to the handle to be adjusted. This allows the user to make measurements where it would be difficult to use the built-in sensor and still be able to read the display.

The Flexible Sensor is used in the same manner as the Internal Sensor.

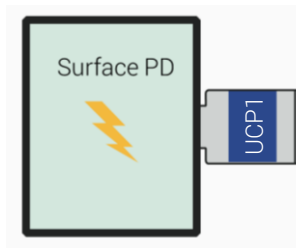


Flexible Sensor

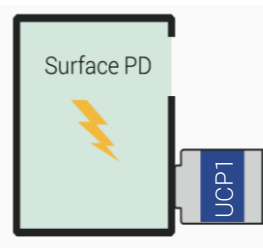
The Flexible Sensor should not touch the asset or plant being investigated.

4.3.5 Measuring Ultrasonic using the Ultrasonic Contact Probe

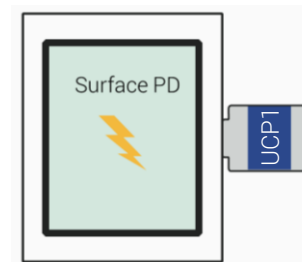
The Ultrasonic Contact Probe (UCP1) is designed to detect Partial Discharge (PD) in sealed chambers. It should be used if there is no direct path between the PD source and instrument sensor. However, it must not be used if the tank containing the expected PD source is separated with another layer. In cases where there is a direct air path between the source of PD and the instrument, an airborne sensor should be used. Due to the physics of ultrasound, in most cases using an airborne sensor may offer better sensitivity than that obtained using the Ultrasonic Contact Probe.



No available air gaps - using an Ultrasonic Contact Probe is the best practice.



Ultrasonic signal can propagate through the air path. The Ultrasonic Contact Probe can be used; however, better results may be obtained using the airborne sensor.



There is no access to the tank containing PD source, neither the airborne sensor nor the Ultrasonic Contact Probe will provide a valid reading.

Detection of Partial Discharge using the Ultrasonic Contact Probe is based on the PD pattern recognition carried out by operators. The audio signature of a Partial Discharge detected by the Ultrasonic Contact Probe is similar to those obtained using airborne sensors. Care must be taken to eliminate other sources that could cause the signals from discharges to be masked, e.g. accidental movement of the probe itself or strong vibration on the panel.

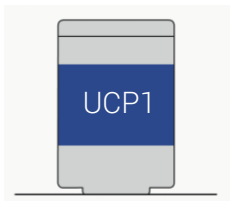
When the instrument dB values are read for comparison purposes, always use the same type of the sensor, in the same position as previously used. The asset measuring point can be marked on the plant item to facilitate easy location in future.

Due to the differing propagation paths of the ultrasonic signals, measurements carried out using the Ultrasonic Contact Probe cannot be compared against measurements carried out using airborne sensors.

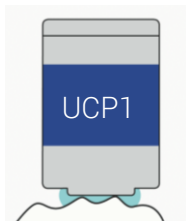


Ultrasonic Contact Probe

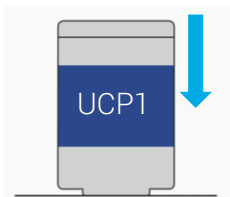
The Ultrasonic Contact Probe (UCP1) is clamped on to the area of interest using the magnets surrounding the sensor plate. Any air gap between the sensor head and measurement point will effectively attenuate signals to a level where even strong discharges will not be detected. Therefore, before any permanent or temporary installation, the sensor head and asset surface need to be cleaned of any loose or unstable material. If the assets surface is very rough and uneven this will create air gaps which will result in poor contact between the sensor head and the asset.



The UCP1 should be attached to a relatively flat and smooth surface.



Using suitable couplant in the case of a rough surface e.g water based, oil based or existing stickers such as warning notices.



Carefully pressing the UCP1 towards the asset to increase coupling may eliminate the need to use a couplant.



A rough or uneven surface will drastically decrease the amount of signal being transferred to the sensor head.

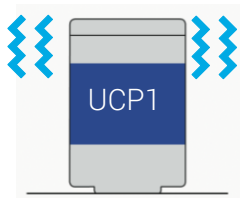


Dust ingress between the UCP1 sensor head and the asset surface.

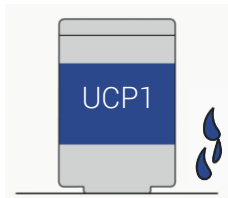
The following images present some examples of how unwanted signals may be introduced during the PD detection process when using the Ultrasonic Contact Probe. These can be categorised as sources of noise and sources of phantom PD signals. The difference between the two is that noise decreases our detection capabilities by masking the PD signal, whereas phantom signals may be confused as a PD source.

The first image shows that when the Ultrasonic Contact Probe is kept in the hand during measurements, even tiny movements of the hand can introduce significant noise to measurements through surface noise. In cases where it is necessary to hold the Ultrasonic Contact Probe during measurements (e.g. pushing the sensor to obtain more signal or non-magnetic asset enclosure), a coupling fluid may help to reduce this type of noise.

Any vibrations of the asset surface caused for example by rain in outdoor assets or vibration of transformers may cause phantom signals. In such cases the audible signal may be appear exactly the same as a genuine PD source.



Shaking the UCP1, e.g. when held in the hand



Rain in outdoor assets



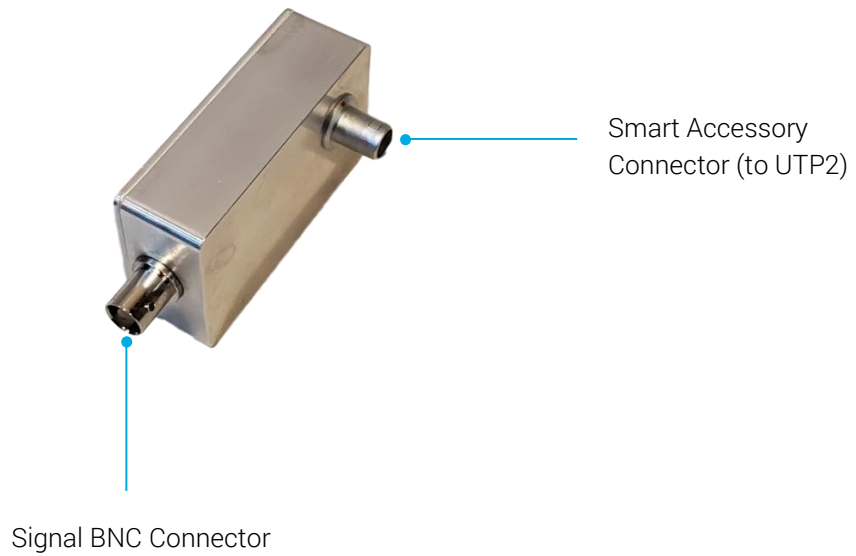
Vibration (including transformers) of asset enclosure where the UCP1 is attached

4.4 UHF Measurement

The UHF Receiver (UHFR1) is an accessory for the UltraTEV[®] Plus² (UTP2) which allows Radio Frequency Interference (RFI) from partial discharge (PD) sources to be detected in the Ultra High Frequency (UHF) region.

Partial discharge detection using UHF is particularly relevant in outdoor switchyards, when used with a suitable antenna, such as the UHF Directional Antenna (UHFDA1). RFI due to PD is broadband in nature and can be detected across a range of frequencies. Lower frequencies tend to radiate further from a source than higher frequency so it follows that detection at higher frequencies will allow a more precise location of a source.

The UHFR1 can be used with either the supplied omnidirectional whip antenna or the UHF Directional Antenna.

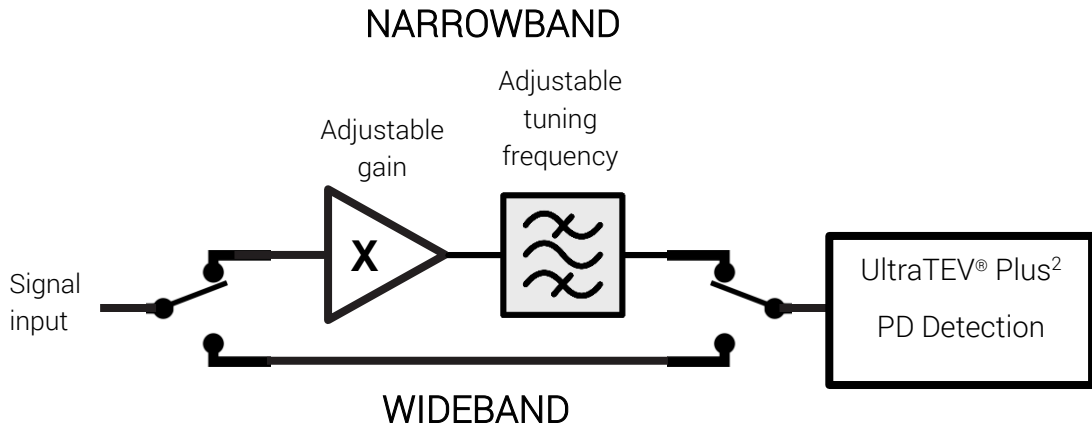


UHF Receiver and whip antenna connected to the UTP2



UHF Directional Antenna

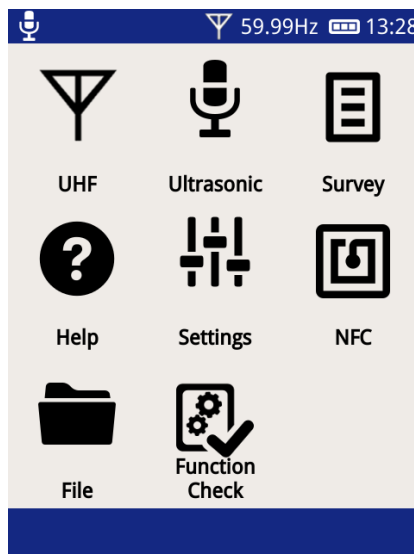
The UHFR1 includes narrowband and wideband modes which can be selected by software. In narrowband mode, the signal is amplified by an adjustable gain and filtered to an adjustable frequency. In wideband mode, the full bandwidth of the signal is received by the UTP2 at all times.



4.4.1 Using the UHF Receiver

To prepare for partial discharge detection:

- Turn on the UTP2.
- After it boots to the home screen, connect the UHFR1 to the UTP2 by pushing the Smart Accessory connector into the Smart Accessory Port of the UTP2.
- The TEV icon on the Main Menu will change to a UHF icon. UHF functionality can be accessed by selecting this icon.



4.4.2 Assembly

Connect an appropriate antenna or sensor to the Signal connector of the UHFR1.

- Antennas can be connected either directly or using a coaxial cable.
- The Signal Connector is a BNC connector. Push the sensor or cable onto the Signal Connector then twist clockwise one quarter turn.



Antenna connected to the UHFR1 using a coaxial cable



Antenna connected directly to the UHFR1

4.4.3 Operation

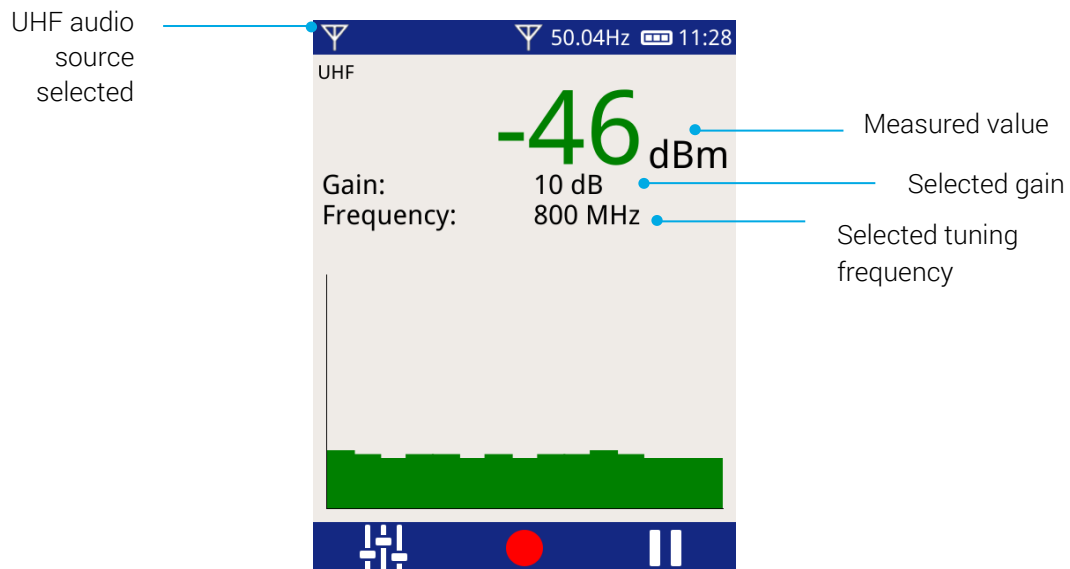
Once the UHF¹ is connected, access the UHF functionality by pressing the UHF icon from the UTP2 home screen.

- The normal TEV measurement screens are available for use in UHF mode.
- In addition, there is also a 3D Phase Plot screen and a Spectrum screen

4.4.4 UHF Measurement Screens

The measurement screens are adapted for UHF measurements:

- The amplitude measurements are shown in decibel-milliwatts (dBm)¹.
- The selected gain and tuning frequency are displayed (in Narrowband mode only)
- The audio source icon will show the UHF symbol if this audio source is selected

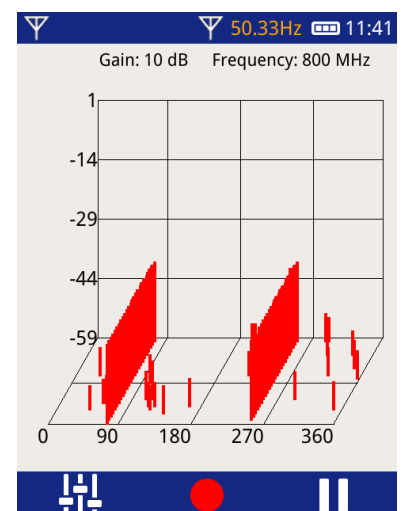


4.4.5 3D Phase Plot

The 3D Phase Plot screen shows a phase-resolved view of the received signal over time.

- The phase plot for each mains cycle is plotted.
- The plot continually updates with the most recent cycle shown at the front of the graph.

This screen can be used to determine whether a PD source is continuous or is changing over time.

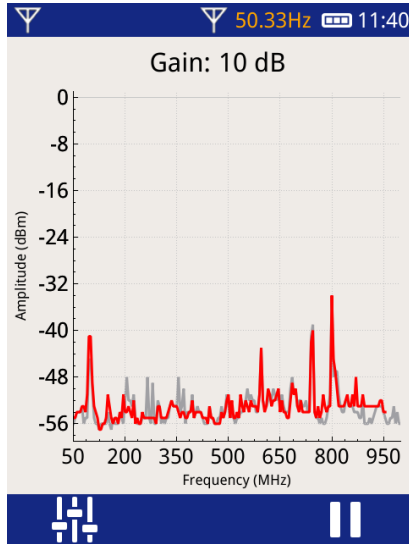


¹ This is a logarithmic scale comparing the received power to 1 milliwatt (1 mW). The value is negative when the power received is less than 1 mW.

4.4.6 Spectrum Screen

The Spectrum Screen shows the peak power received by the UHFR1 over its full tuning range.

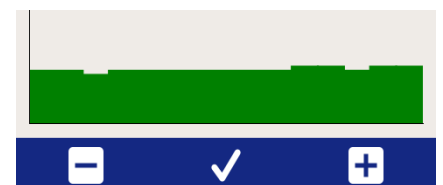
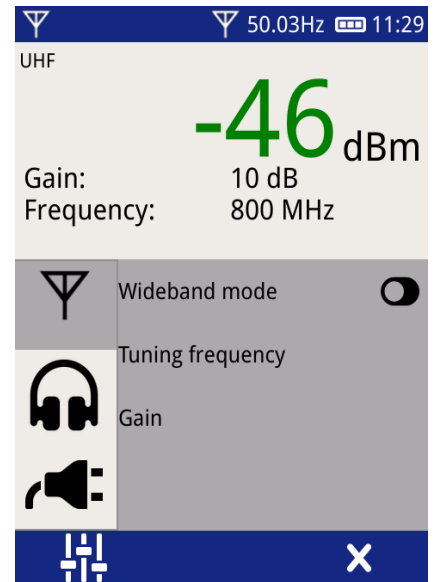
- The tuning frequency is quickly swept from 50 MHz to 1000 MHz.
- The peak power received is plotted.
- Each time a new sweep is started, the previous sweep is shown in grey and the new sweep in red. This highlights any changes.



4.4.7 Adjusting the Mode, Gain and Tuning Frequency

To adjust the UHF Mode, Gain or Tuning Frequency, press the Context Settings button. This will display the Context Settings menu showing the most appropriate settings for the current operating mode.

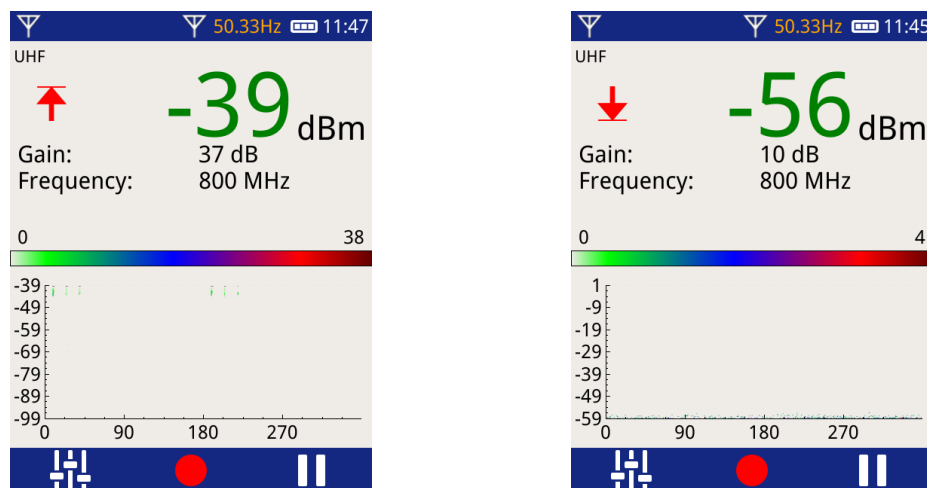
- To switch between Narrowband and Wideband modes, press the “Wideband mode” toggle button.
- To adjust the Gain or Tuning Frequency, press the relevant button. The Context Settings menu will close, showing ‘+’ and ‘-’ buttons.
- The on-screen or physical buttons can be pressed to adjust the Gain or Tuning Frequency, or the physical buttons can be held down to make the adjustment quicker.
- Once the correct gain/frequency is selected, press the tick or the central button to confirm.



4.4.8 Clipping

If the received signal is close to the upper or lower measurement range limit, a clipping indicate will be shown.

- If the signal is close to the **upper limit** of the measurement range, an arrow **pointing upwards** towards a bar will be shown. In narrowband mode, it may be possible to achieve a better measurement by **reducing** the gain.
- If the signal is close to the **lower limit** of the measurement range, an arrow **pointing downwards** towards a bar will be shown. In narrowband mode, it may be possible to achieve a better measurement by **increasing** the gain.

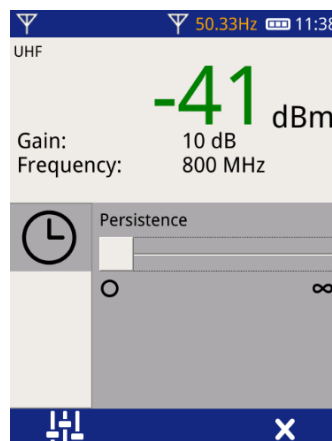


4.4.9 Persistence Level

On the Phase Plot and Histogram screens, it is possible to control the persistence of the display.

To access this setting, press the Context Settings button. It may be necessary to press the button more than once to scroll through different settings pages until the Persistence control is shown.

- Persistence can be set to 4 different levels by moving the slider.
- Moving the slider to the “0” position indicates the shortest level of persistence. The display will regularly refresh itself, only showing recent activity.
- Moving the slider to the “∞” position indicates infinite persistence. The display will show all activity that has occurred since the display was last manually reset.



4.4.10 Spectrum Mode

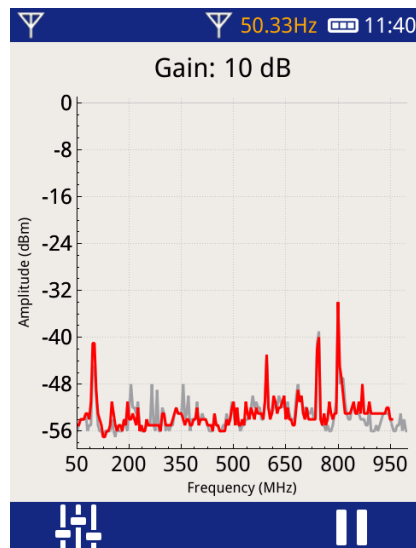
Spectrum mode can be used to compare measurements with previous results or de-energized results to look for significant changes.

When using a directional antenna, Spectrum mode can be used to compare the signal when the antenna is aimed away from the asset, with the signal when it is aimed at the asset. When aimed away, it gives an indication of noise levels not generated by the equipment.

4.4.11 Wideband Versus Narrowband

The wideband function will allow signals from the entire spectrum of ~5 MHz to >3300 MHz to be measured. This can result in undesired high levels from radio transmitters like mobile phones, Wi-Fi access points, etc. To avoid this interference, narrowband mode is usually used for all measurements. It uses a narrow slice of the RF band, centered at the set frequency.

The default frequency for narrowband mode is 800 MHz. This frequency typically does not have many interfering sources present. If non-phase resolved signals are very high when you take a measurement, you can adjust the center frequency as described above.

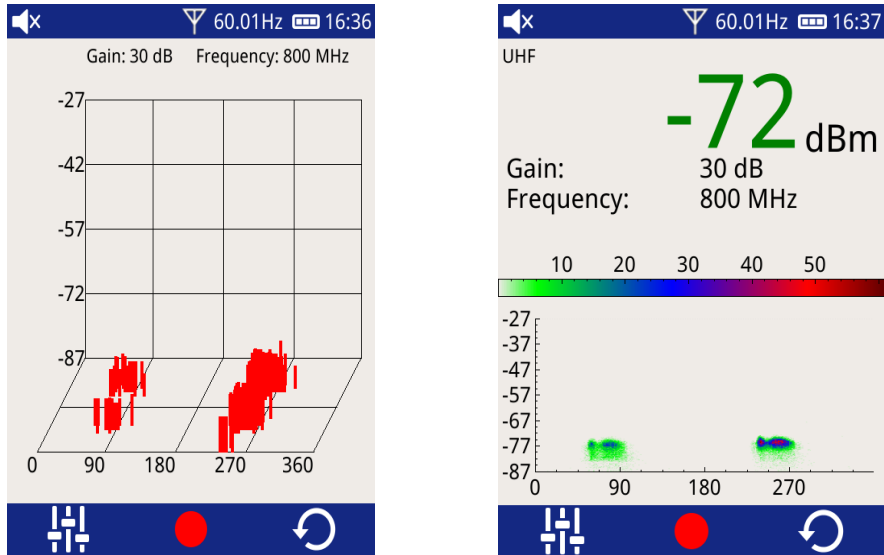


4.4.12 Taking Measurements

With the sensor of choice and the screen of choice, move the sensor around the asset, tilting it through 90 degrees looking for the highest levels. When you find the highest levels, adjust the gain so the signal is clear and neither red arrow is indicated. You want to show the highest possible signal without overwhelming the screen with noise.

Partial discharge, unlike most other interfering signals, will be phase resolved. This means there will be groups indicated on the phase resolved screen that are at a constant phase angle. This is easy to see on the 3D phase resolved screen.

When there is a clear phase resolved pattern on the screen, save the data using survey mode.



Screen shots showing phase resolved patterns

4.4.13 Using Headphones

When the UHF interface is selected, the audio source is changed to UHF. The sound in the headphones will change with varying signals. Listen for a signal with mains frequency content: 50/60 Hz or 100/120 Hz.

5. Substation 360

5.1 What is Substation 360

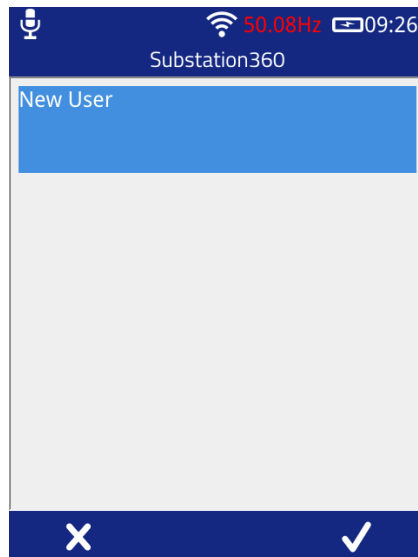
Substation360 (S360) is an intelligent, centralized asset condition knowledge platform, for hosting a range of data types. It is a gateway for instruments to submit that data, and a website for configuration and analysis of the data.

5.2 Login



Selecting the Substation 360 icon from the home page, will bring up the list of known users on the UTP2. 'New User' will be at the top of the list, see 5.2.1. Each known user will be displayed as the username to S360.

5.2.1 New User



Selecting a new user from the list will prompt the user to first enter their username, secondly their password. Once both have been entered, the UTP2 will connect with S360. If the user's information is incorrect or there is an issue with the Wi-Fi, a prompt will appear to the user informing them. If any errors persist, contact Product Support. If the user's information is correct the UTP2 will then Register itself with S360 and prompt the user to Set a 'PIN'. See section 5.2.2 for more details.

5.2.2 PIN

This is a 4-digit Personal Identification Number (PIN). The first time entering this PIN the user will have to enter it twice and both times the PIN must match. The PIN set cannot be changed at a later date. After a successful login, any subsequent login attempt by this user can be done using this PIN. If a PIN is forgotten, then the User must delete their account from the UTP2 and log in again using the above information.

5.2.3 Logout

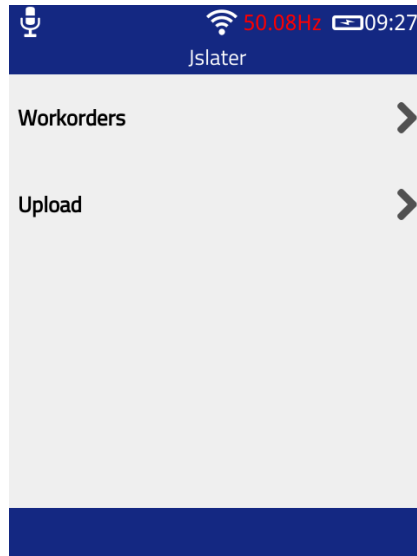
The only way to log out as a particular user on the UTP2 once signed in, is to turn the UTP2 off and back on.

5.2.4 Resetting All Users

To reset all users, navigate to Reset screen as described in section 3.12.6. If Reset All Users is selected, Substation 360 PIN will also be deleted and the user would have to log in to Substation 360 again and create new 4-digit PIN.

5.3 Online Mode

When the UTP2 is connected to the Internet and logged in to Substation 360, it is in “Online Mode”. In this mode the following options are available:

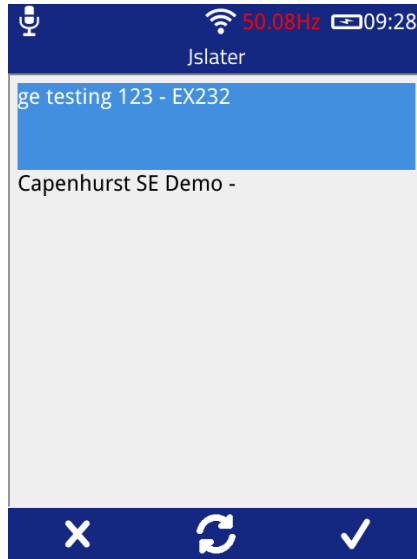


5.3.1 Work Orders

This screen will display a list of Work Orders downloaded from S360 to the UTP2. The first time displaying this screen it will be blank. Clicking the middle button will initiate a “Sync’ with S360.

Upon clicking the sync button, a prompt will pop up displaying to the user the current step underway. The sync will download all Work Orders assigned to the user in S360 (depending on the number of Work Orders the download may take a while to complete). The prompt will keep the user updated with the progress.

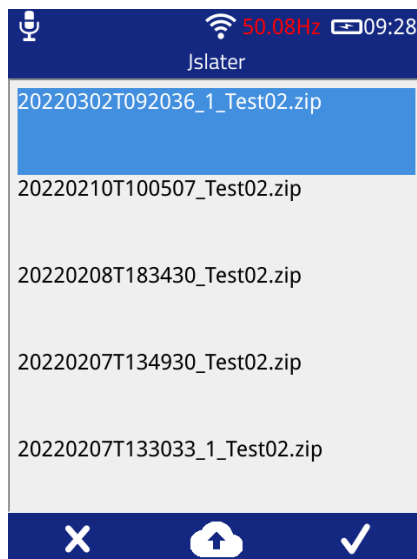
The right button will start the selected Work Order. This will bring up the details screen, See section 5.5.



5.3.2 Upload

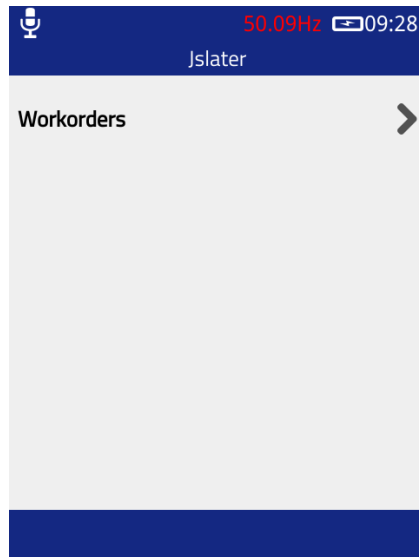
This screen will display a list of completed Surveys to be uploaded from UTP2 to Substation 360. The middle button while on this screen is to 'Auto Upload', clicking this will start to upload all the Surveys.

Each Survey shown in the list can be uploaded individually by selecting the survey and clicking the right button. Upload notes may be completed to be sent with the Survey to S360. If an upload fails, the Upload notes will be saved for next time.



5.4 Offline Mode

If the UTP2 is logged in to S360 but not connected to the Internet, it is in "Offline Mode". The following options are available:



5.4.1 Work Orders

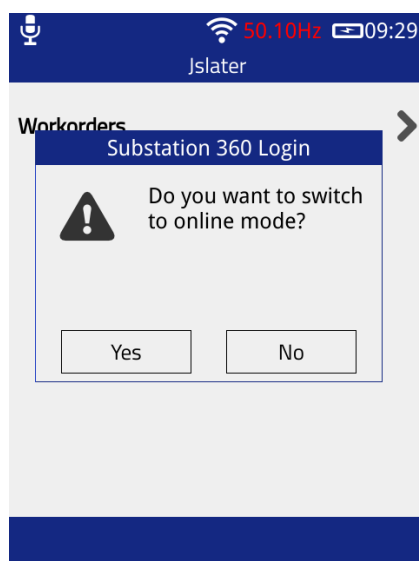
The Work Orders screen while in offline mode will only display the Work Order already downloaded and syncing Work Orders is disabled. It is still possible to view and complete previously downloaded Work Orders.

5.4.2 Upload Surveys

The Upload button will not be displayed while in offline mode.

5.4.3 Switch to Online Mode

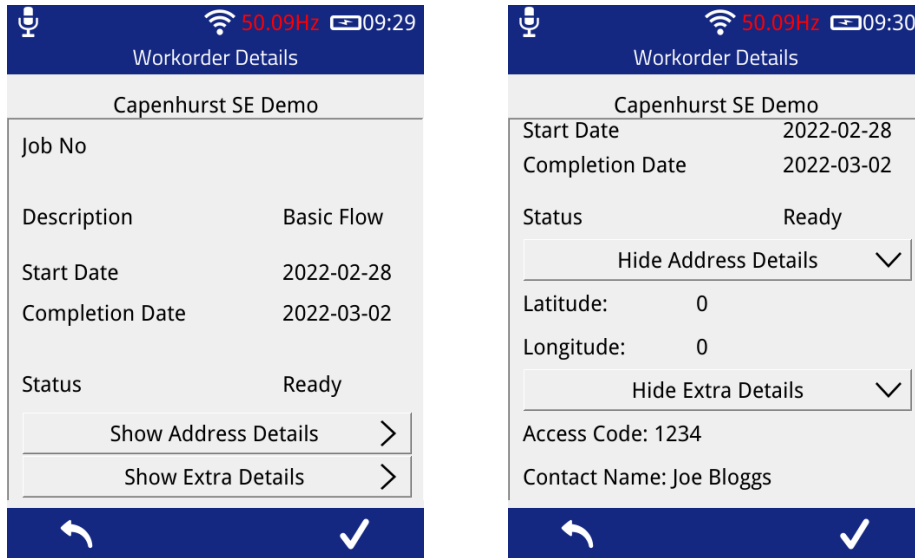
While the UTP2 is on offline mode, it is possible to switch to online mode, giving the ability to sync and upload completed Surveys. To do this you need to connect the UTP2 to an internet connected Wi-Fi network. Once the UTP2 is successfully connected, select the Substation 360 icon from the home screen and a prompt will appear asking if you would like to switch to online mode. Select 'Yes' and the UTP2 will connect to S360, using the already logged in user's details.



5.5 Starting a Work Order

5.5.1 Work Order Detail Screen

This screen shows the user the details of the selected Work Order. This screen is scrollable, when there is too much information to be shown on the screen it will continue below.



The details shown:

Label	Type	Description
Title	Text	Name of the Work Order in substation 360
Job Number	Text	The Job Number for this Work Order.
Description	Text	A short description of the Work Order.
Start Date	Date	Format YYYY-MM-DD
Completion Date	Date	Format YYYY-MM-DD
Status	Text	The Current state of the Work Order.
Address	Button	Drop down button to bring up the full Address. The address will only show the fields populated. Clicking the button again will hide the address
Extra Details	Button	Drop down button to bring up the Extra details set in the Work Order. There is not a set number of details that can be set, if none are in the Work Order, the button will not be displayed.
Customer Details	Button	Drop down button to bring up the Customer details set in the Work Order. There is not a set number of details that can be set, if none are in the Work Order, the button will not be displayed.

5.6 Folder System

Every User that has logged into Substation 360 on the UTP2, will have their own encrypted folder created. Any user's details stored on the UTP2 use multi-level encryption.

Location: <SD card>/usr/<Username>

The user's downloaded Work Orders will be stored here.

All data stored in the user's directory can be downloaded again from S360. In-case anything is deleted from settings or the 'File' view screen no data is lost. All completed Work Orders or Surveys are still stored in the same location and are not deleted when removing S360 Users.

6. Wireless Phase Reference

The Wireless Phase Reference is an accessory for the UTP2 which allows it to receive a phase reference in places where it is onboard sensors might not. The Wireless Phase Reference utilizes a combination of photo-sensors, mains power, Rogowski coil, and E-Field sensor to achieve accurate phase capture and transmit phase data wirelessly and in real-time to UTP2.

6.1 Wireless Phase Reference Overview



6.1.1 How to turn ON/OFF

Turn on Wireless Phase Reference – Press and hold power button for 1 second.

Turn off Wireless Phase Reference – Press and hold power button for 3 seconds.

6.1.2 How to switch between Phase-sources

Press Source button to switch between available phase sources. A Green LED will illuminate next to the source currently selected.

6.1.3 Phase-reference source LEDs



Photo: This option selects the photo-sensor located on the front upper section of the Wireless Phase Reference (see label) as the source of the Phase reference. The photo-sensor requires line of sight to a mains frequency light source such as fluorescent fitting.



E-Field: This option selects the build-in E-field sensor as the source of phase reference. The sensor detects the phase reference from the stray electric field within the substation.



Rogowski: This option selects the Rogowski input as the source of phase reference. Plug in the Rogowski coil (GCS1) into the Rogowski input. Then wrap the coil around the conductor of interest to measure the current flowing through it and obtain the phase reference.



Power: This option selects the power input as the source of Phase reference. Connect the power supply the barrel connector and the phase reference will be obtained from your mains plug.

Note: When the charger is plugged in, the UTP2-WPR will automatically switch to use “power” as a source.



6.1.4 Battery Charging LED

Plug the charger into the charging port. The battery charging LED will illuminate Amber to indicate charging and Green when fully charged. When the UTP2-WPR is powered on, the battery charge LEDs indicate capacity status, and a battery charging animation is displayed whenever the charger is plugged in.

6.1.5 Auto Power-Off Feature

To preserve battery, the UTP2-WPR will auto power-off after 15 minutes when it is not connected to a Wi-Fi network and the charger is not plugged in.

6.1.6 Buzzer


The UTP2-WPR features a built-in buzzer that is activated 1 minute after connection to the UTP2 is lost. This is to remind the user to retrieve the UTP2-WPR after testing and ensure it is not left behind. The buzzer will continue to sound until the UTP2-WPR is turned off manually or reconnected with UTP2.

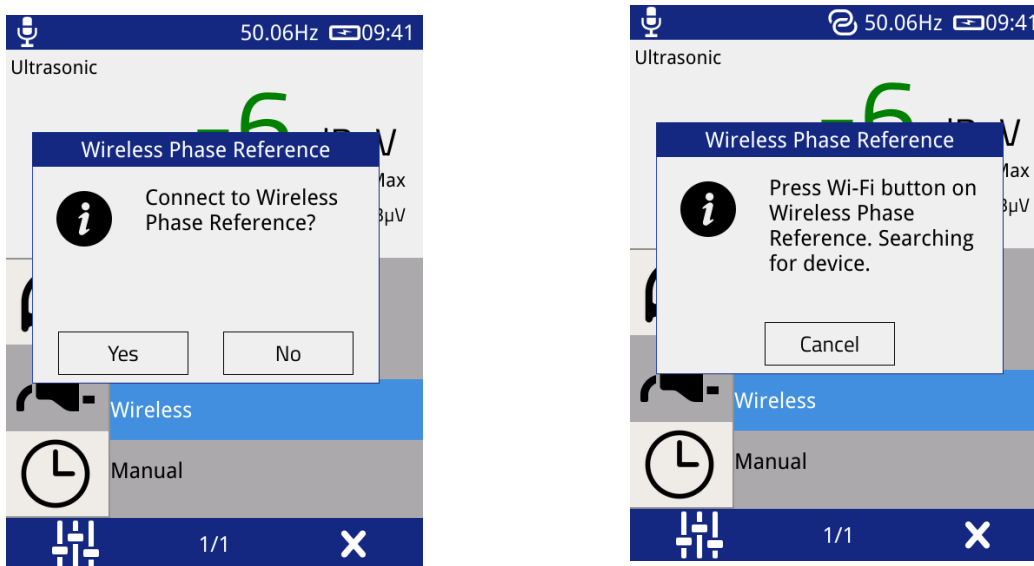
6.1.7 Mounting

There are 3x ways Wireless Phase Reference can be mounted:

- Attach to metal surfaces with magnetic feet
- Tie around cables with Velcro strap
- Free standing

6.2 Pair Wireless Phase Reference with UTP2

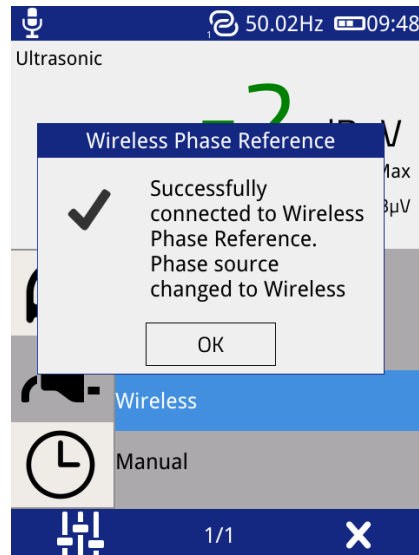
Power on UTP2 and open the context menu on one of the measurements screens. Select the  icon on the context menu to access the phase reference settings page. Select "Wireless" and press Yes.



On the Wireless Phase Reference press the Wi-Fi button to start the pairing process. The Wi-Fi Status LED will flash Red indicating the UTP2-WPR is in pairing mode.

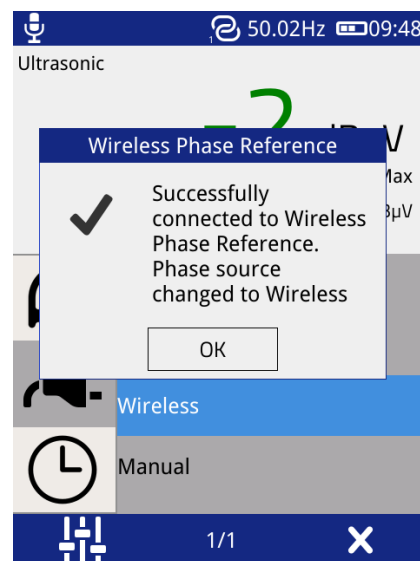
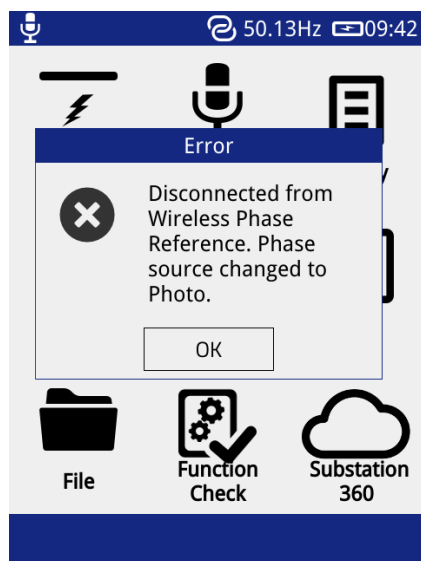
Once the devices are paired the Wi-Fi status LED will illuminate Green and notification will be displayed on the UTP2.

The Wi-Fi status LED will illuminate RED if the Wireless Phase Reference is disconnected.



Note: Once a Wireless Phase reference is successfully paired to a UTP2 it will automatically connect on subsequent power cycles without the need for re-pairing, using a different UTP2, you will require a new pairing.

When the Wireless Phase Reference connects to a UTP2, the phase reference source will be changed to Wireless automatically. When disconnected the UTP2 will revert to using "Photo". In both cases a notification will inform you of the change (see below).



6.3 Wireless Phase Reference Maintenance

The UTP2-WPR should be cleaned with a damp cloth. If more heavily soiled, a foam cleanser may be used, provided care is taken not to allow fluid to enter the instrument. Abrasive cleaners must not be used.

The UTP2-WPR contains no user serviceable parts, always return to EA Technology or your local distributor for service and repair.

7. Maintenance

Calibration

Calibration interval: 12 months

The calibration date and due date can be viewed through the About screen. A warning message will be displayed on start up, when the UTP2 is past the calibration due date.

Cleaning and Storage

The UltraTEV[®] Plus² should be cleaned with a damp cloth. If more heavily soiled, a foam cleanser may be used, provided care is taken not to allow fluid to enter the instrument. Abrasive cleaners must not be used. Take care not to scratch the plastic overlay of the front panel.

No attempt should be made to gain access to the internal circuitry of the UltraTEV[®] Plus², or its accessories. Advice should be sought from the manufacturer, or the supplier, if any doubt exists over the equipment's performance or operation.

Avoid storage in damp and humid conditions and do not subject it to temperature extremes, excessive vibration or shocks. Do not stand on the case of the UltraTEV[®] Plus².

Waste electrical and electronic equipment directive (WEEE)

EA Technology is a member of an approved compliance scheme as defined by the WEEE directive. When an EA Technology product reaches the end of its operational life, it must be recycled by a licensed waste management operator or returned to EA Technology for recycling.

8. UTP2 Technical Specification

Key features

Partial discharge detection	Allows measurement of partial discharge by electromagnetic and acoustic methods in accordance with PD IEC/TS 62478:2016
Advanced partial discharge analysis	Phase-resolved partial discharge (PRPD) display Waveform display
Audio output	Partial discharge signals transformed into audible range
Survey mode	Self-contained survey mode with workplan feature Zip file output with self-contained analysis tools
Language support	English, Chinese, Spanish, Arabic, French, Russian, Portuguese, Indonesian, German, Turkish, Korean, Vietnamese, Italian, Thai, Polish, Malaysian, Czech, Swedish, Norwegian, Welsh
Built-in self-test	Tests hardware functionality on power-on or on request
Accessories	Wide range of supported accessories

Physical

Size	201 x 76 x 34 mm
Weight	0.44 kg
Enclosure	Self-coloured injection moulded plastic case
Screen	3.5" TFT resistive touchscreen LED backlight 640 x 480 resolution
Indicators	Charging indicator LED
Controls	LCD resistive touchscreen Membrane Keypad (4x push-buttons)
Connectors	External Ultrasonic Sensor External Smart Sensor 3.5 mm stereo headphone socket Micro USB port
Connector safety class	All connectors are Extra-Low Voltage
Headphones	Min. 16 ohms

TEV

Sensor	Capacitive
Measurement Range	0 – 60 dBmV
Pass band	3 – 80 MHz
Resolution	1 dB
Accuracy	±1 dB
Min. Level for Pulse Count	10 dBmV
Interpretation	Integrated algorithm determines likely type of partial discharge or if noise is present.

Ultrasonic

Sensor	Ultrasonic microphone
Measurement Range	-7 – +71 dB μ V
Resolution	1 dB
Accuracy	\pm 1 dB
Transducer Sensitivity	-65 dB (0 dB = 1 volt/ μ bar rms SPL)
Transducer Centre Frequency	40 kHz
Transducer Diameter	16 mm
Classification	Integrated algorithm discriminates between partial discharge and noise.

Cable partial discharge

Sensor	High Frequency Current Transformer
Measurement Range	25 pC – 25,000 pC (HFCT1-F50) 100 pC – 100,000 pC (RFCT1)
Frequency response (-3 dB response)	20 MHz
Accuracy	\pm 1dB
Filtering	Configurable digital filter

Environmental

Operating Temperature	-20 – +50 degrees C
Humidity	0 – 90% non-condensing
IP Rating	42 (EN 60529)

Storage and connectivity

Storage	Up to 64 GB via microSD slot (FAT32 only)
Wireless connectivity	Wi-Fi (IEEE 802.11) – access to integrated web server for survey results. Frequency: 2.4 GHz Maximum Power: +17.3 dBm Module: TI WL1801-MOD Antenna: TDK ANT016008LCD2442MA1
Near-field communication (NFC)	Used for asset identification. Frequency: 13.56 MHz Maximum Power: +17 dBm Antenna: Integrated loop
USB	USB network device – access to integrated web server for survey results.

Phase reference

Sources	Lighting (Photo sensor) Electric field (High-Z sensor) Manual
Frequency range	50 Hz ± 1%, 60 Hz ± 1%

Power supplies

Internal Batteries	3.7V, rechargeable Lithium-Ion
Typical Operating Time	Approx. 8 hours
Battery Conservation	Automatic shutdown after 5 minutes of inactivity (configurable)
Charging Time	Approx. 6 hours

Battery charger

Rated voltage	100 – 240 V
Frequency	50/60 Hz
Charger output current	2 A
Battery charging current	1.8 A @ 5 V nominal
Input Current (RMS Max)	0.3 A
Operating temperature	0 – 40 degrees C
Operating humidity	20 – 85% RH non-condensing
Storage humidity	5 – 95% RH non-condensing
Altitude	Up to 2000 m
UL Listed charger details	Manufacturer: Stontronics Part no.: T5848ST Model: DSA-10PFP-05 UL: QQGQ.E135856

Compliance

Electromagnetic compatibility (EMC)	<p>BS EN IEC 61326-1:2021 (Electrical equipment for measurement, control and lab use – EMC requirements)</p> <p>BS EN IEC 61000-6-2:2019 (EMC Immunity for industrial environments)</p> <p>BS EN 55032:2015+A1:2020 (Electromagnetic compatibility of multimedia equipment. Emissions requirements)</p> <p>BS EN IEC 61000-6-3:2021 (EMC emissions for residential environments)</p>
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Radio	<p>ETSI EN 300 328 V2.2.2 (July 2019) (Wideband transmission systems; Data transmission equipment operating in the 2,4 GHz ISM band and using wide band modulation techniques; Harmonised Standard covering the essential requirements of article 3.2 of Directive 2014/53/EU)</p> <p>ETSI EN 300 330 V2.1.1 (Feb 2017) (Short Range Devices (SRD); Radio equipment in the frequency range 9 kHz to 25 MHz and inductive loop systems in the frequency range 9 kHz to 30 MHz; Harmonised Standard covering the essential requirements of article 3.2 of Directive 2014/53/EU)</p>
Safety	BS EN 61010-1:2010+A1:2019 (Safety requirements for electrical equipment for measurement, control, and laboratory use)
FCC Approval (USA)	2AGGB-UTP2A (HVIN: UTP2A)
ISED Approval (Canada)	21907-UTP2A (HVIN: UTP2A)

9. UHFR1 Technical Specification

Physical

Size	81 x 40 x 35 mm
Weight	0.1 kg
Enclosure	Aluminium
Indicators	None
Controls	None
Connectors	1x BNC antenna port 1x LEMO (UltraTEV [®] Plus ² connection)

Environmental

Operating Temperature	0 – 55 degrees C
Humidity	0 – 90% non-condensing
IP Rating	42 (EN 60529)

Power

Power supply	Powered from UltraTEV [®] Plus ²
Supply voltage	5 V

UHF Measurement - General

Modes	Switchable narrowband/wideband
Resolution	1 dBm
Input impedance	50 Ω

UHF Measurement - Narrowband

Measurement range	-85 – +5 dBm
Tuning frequency	47 – 1000 MHz
Bandwidth	8 MHz
Gain setting	-10 – +40 dB
Accuracy	± 2 dB (0 dB gain; -50 dBm – 0 dBm input, 25°C)

UHF Measurement - Wideband

Measurement range	-61 – -1 dBm
Bandwidth	5 – 3300 MHz
Accuracy	±2 dB

Compliance

Electromagnetic compatibility (EMC)	<p>EN 61326-1:2013 (Electrical equipment for measurement, control and laboratory use – EMC requirements. General requirements.)</p> <p>EN 61000-6-2:2019 (Electromagnetic compatibility. Generic standards. Immunity standard for industrial environments.)</p> <p>EN 55011:2016+A1:2017 (Industrial Scientific and Medical equipment – Radio frequency disturbance characteristics – Limits & methods of measurement)</p>
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10. Wireless Phase Reference Specification

Physical

Size	115*118*50mm
Weight	200g
Enclosure	Injection moulded plastic case
Connectors	1x GCS1 Current Sensor (for a cable of 1.5m in length) 1x Power Barrel connector
Mounting Mechanisms	Freestanding Magnets in feet to attach to any magnetic surface. Velcro Strap to wrap around cables (up to 100mm diameter)

Environmental

Operating Temperature	-20 – +50 degrees C
Humidity	0 – 95% non-condensing
IP Rating	42 (BS EN 60529)
Impact Rating	IK08 (BS EN 62262)

Indicators and Controls

Indicators	4x LEDs to indicate current Phase Reference Source 1x bicolour LED for Wi-Fi/WPS status 1x LED to indicate charging status 3x LEDs for the Battery Level
Controls	3x Push Buttons

Power Supplies

Internal batteries	Lithium Polymer 3.7V, 2000mAh
Operating Time	Approx. 16 hours
Battery Conservation	Automatic shutdown after 15 minutes of not being connected.
Power input	9Vac 50Hz/60Hz, 5W
Charging Time	Approx. 3h

Battery Charger/AC power port

Rated voltage	230 VAC
Frequency	50Hz
Max output current	1.1 A

Output Voltage	9VAC
Power Rated	15W
Environment	-10 To 40 degrees C, 0-90%RH
Cable Length	Input: 2.0m / Output: 1.8m

Connectivity

Wireless	<p>Wi-Fi (IEEE 802.11) – Connecting to the UTP2</p> <p>Frequency: 2.4 GHz</p> <p>Maximum Power: +19.97 dBm</p> <p>Model Number: ESP32-C3-WROOM-02</p> <p>Antenna: PCB Antenna, 3.42dBi</p> <p>Certificate Number: E1177-210909</p> <p>Certificate Issued by: Notified Body 1177, TIMCO Engineering, Inc.</p>
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Phase Reference

Sources	Mains Input Power, Lighting (Photo sensor), Electric field (High-Z sensor), Rogowski Coil
Frequency Range	50 Hz \pm 1%, 60 Hz \pm 1%
Accuracy	\pm 5deg

Compliance

Electromagnetic compatibility (EMC)	<p>BS EN IEC 61326-1:2021 (Electrical equipment for measurement, control, and lab use – EMC requirements)</p> <p>BS EN 61000-3-2: 2019 Electromagnetic compatibility (EMC) Part 3-2: Limits – Limits for harmonic current emission</p> <p>BS EN 61000-3-3: 2013 + A1: 2019 (Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply Systems)</p>
Radio	<p>ETSI EN 301 489-17 V3.2.4 (EMC standard for radio equipment and services, for Broadband Data Transmission Systems)</p> <p>ETSI EN 301 489-1 V2.2.3 (EMC standard for radio equipment and services; Part 1: Common technical requirements)</p>
Safety	BS EN 61010-1:2010+A1:2019 (Safety requirements for electrical equipment for measurement, control, and laboratory use)

11. Sales and Service

Head Office

EA Technology Ltd
Capenhurst Technology Park
Chester, UK, CH1 6ES
Tel: +44 (0)151 339 4181

For details of EA Technology's international offices and distributors, please visit our website:
www.eatechnology.com/contact-us/corporate-offices

Sales

Email: sales@eatechnology.com

Product Support

Email: product-support@eatechnology.com
Tel: +44 (0)151 347 2293

Continuous Improvement

EA Technology has a policy of continual product development and enhancement. Consequently, there may be minor variations in specifications or operation that are not covered in this operating manual.

Every effort has been made to ensure that the information provided in this operating manual is accurate at the time of going to print.

If any errors or omissions are noticed, please notify: product-support@eatechnology.com

Accessories and Options

Part	Kit 1	Kit 2	Kit 3	Kit 2 Upgrade	Kit 3 Upgrade
UltraTEV [®] Plus ²	✓	✓	✓	✓	✓
Mains Charger	✓	✓	✓	✓	✓
Car Charger	✓	✓	✓	✓	✓
USB Lead	✓	✓	✓	✓	✓
8GB MicroSD & SD adapter	✓	✓	✓	✓	✓
Environmental Sensor	✓	✓	✓	✓	✓
Stylus x 2	✓	✓	✓	✓	✓
NFC Starter Pack	✓	✓	✓	✓	✓
Neckband Headphones	✓	✓	✓		
Ultrasonic Contact Probe		✓	✓		
Ultrasonic Flexible Sensor		✓	✓		
HFCT1-F50 & Cable		✓	✓	✓	✓
UltraDish			✓		
Tough Carry Case	UTP2-CAS1	UTP2-CAS1	UTP2-CAS2	UTP2-CAS1	UTP2-CAS2

Additional Accessories

UltraTEV[®] Locator Probe (UTL2)

UHF Receiver (UHFR1)

UHF Directional Antenna (UHFDA1)

Wireless Phase Reference (UTP2-WPR)

Declaration of Conformity

Hereby, EA Technology declares that the equipment described in this document is in compliance with EU Directive 2014/53/EU, UK Statutory Instrument 2017 No. 1206, and all other applicable EU Directives and UK Statutory Instruments.

The full text of the EU and UK declarations of conformity are available at the following internet address:
www.eatechnology.com/declaration

Claims of compliance made in any document other than the relevant declaration of conformity are for guidance only.

Notes



Safer, Stronger, Smarter Networks

EA Technology Limited
Capenhurst Technology Park
Capenhurst, Chester CH1 6ES

t +44 (0) 151 339 4181
e sales@eatechnology.com
www.eatechnology.com