

# UltraTEV Plus+

## Operating Manual

Version 3

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## 1 Declaration of Conformity

Manufacturers Name: EA Technology Ltd,

Manufacturers Address: Capenhurst Technology Park,  
Capenhurst,  
Chester,  
CH1 6ES  
UK

Type of Equipment: UltraTEV Plus+

Model Number: UTP1

I hereby declare that the equipment specified above conforms to the provisions of the **EC DIRECTIVE 89/336/EEC** on Electromagnetic Compatibility (EMC). Having met the requirements of the following standards;

**EN 61000-6-2: 2001  
IMMUNITY STANDARD (INDUSTRIAL ENVIRONMENT)**

**EN 61000-6-3:2001  
EMISSION STANDARD (RESIDENTIAL, COMMERCIAL and LIGHT INDUSTRY ENVIRONMENT)**



Robert Davis,  
**Managing Director**



## 2 Safety Note

The instrument is designed to detect partial discharge sources in Medium/High Voltage (MV/HV) Plant. If no discharges are detected, this does not necessarily imply that an item of MV/HV Plant is discharge free. Discharge sites often have dormant periods and insulation structures can fail through causes other than those attributable to partial discharges. If discharges of considerable magnitude are detected in plant that is connected directly to the medium/high voltage power system, the authority responsible for the plant should be notified immediately.



### Warning

The UltraTEV Plus+ is designed for use at ground potential only.

- 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.
- Adhere strictly to local safety procedures.
- 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.
- This unit contains no user serviceable parts, always return to EA Technology or your local distributor for service and repair.



### 3 Operational Note

**When using TEV based instruments the following points should be noted:**

- 1) 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.
- 2) Strong electromagnetic fields from mobile phones, RF transmitters, VDUs and un-screened electronics in the frequency range DC to 1GHz can have an effect on the readings. A measure of local fields can be obtained by holding the UltraTEV Plus+ in free-air at least 1 metre away from any conducting surface.

If you have any specific requirement or operating conditions then please contact [instruments@eatechnology.com](mailto:instruments@eatechnology.com).



## 4 Non-Intrusive Detection of Partial Discharge Activity

### 4.1 General

Partial discharges are electric discharges that do not completely bridge the electrodes. The magnitude of such discharges is usually small; however, they do cause progressive deterioration of insulation that may lead to eventual failure.

Non-intrusive partial discharge detection provides a fast and simple to use method for identifying potential sources of insulation failure that could otherwise result in the loss of supply to customers or the endangering of staff or other personnel.

A partial discharge emits energy in the following ways:

#### **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 UltraTEV Detector has been specifically developed to enable electromagnetic and ultrasonic activity to be detected in a single simple to use instrument.

### 4.2 Airborne Ultrasonic Discharge Activity

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

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.



### 4.3 Electromagnetic Discharge Activity

When partial discharge activity occurs within high voltage switchgear insulation 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 also impinges on the metal casing of the switchgear producing a transient voltage in the external metal cladding of the switchgear. The Transient Earth Voltage (TEV) is a few millivolts to a few volts and lasts only a short time with a rise time of a few nanoseconds.

The partial discharge activity may be detected non-intrusively by placing a probe on the outside of the switchgear whilst the switchgear is in service.



## 5 The Partial Discharge Range of Equipment

The range consists of the UltraTEV Detector, UltraTEV Plus+, MiniTEV2, UltraMet, PD Locator (PDL1), UltraTEV Alarm, PD Monitor (PDM03CF) and PD Monitor Plus+.

### UltraTEV Detector



The UltraTEV Detector is an easy to use hand-held instrument which combines ultrasonic and Transient Earth Voltage (TEV) detection. The instrument is capable of early detection of both surface and internal partial discharge in electrical switchgear. The UltraTEV Detector can be used as part of a Condition Monitoring regime and also as a personal Safety Tool.

The UltraTEV Plus+ is the ultimate hand held instrument for the detection and measurement of partial discharge in switchgear. Both TEV and surface discharges can be detected and are displayed as numerical values on a colour screen. The instrument also has the ability to display the number of PD pulses per cycle, severity levels, maximum levels for internal discharges, and a numerical value for ultrasonic emissions, which can be heard with the supplied headphones.

### UltraTEV Plus+



### MiniTEV2



The MiniTEV2 is used to detect and measure TEV activity. The magnitude and rate of the TEV discharge activity is displayed on a LCD screen. A simple calculation is used to determine the severity of any discharge found.

### PD Locator



The PD Locator can be used in single probe mode for TEV magnitude measurements, or double probe mode to accurately locate the source of PD activity using the time of flight technique. The PD Locator can measure PD magnitude over a large range with high accuracy and is the benchmark instrument for the assessment of partial discharge activity.

The UltraTEV Alarm provides substation monitoring of TEV and ultrasonic activity and gives an alarm indication locally and remotely if there is any significant activity above the UltraTEV alarm levels. The UltraTEV Alarm can have multiple nodes connected to allow full substation coverage. The system also reports on relative humidity and temperature within the substation, when the GPRS communication option is chosen.

### UltraTEV Alarm



### PD Monitor



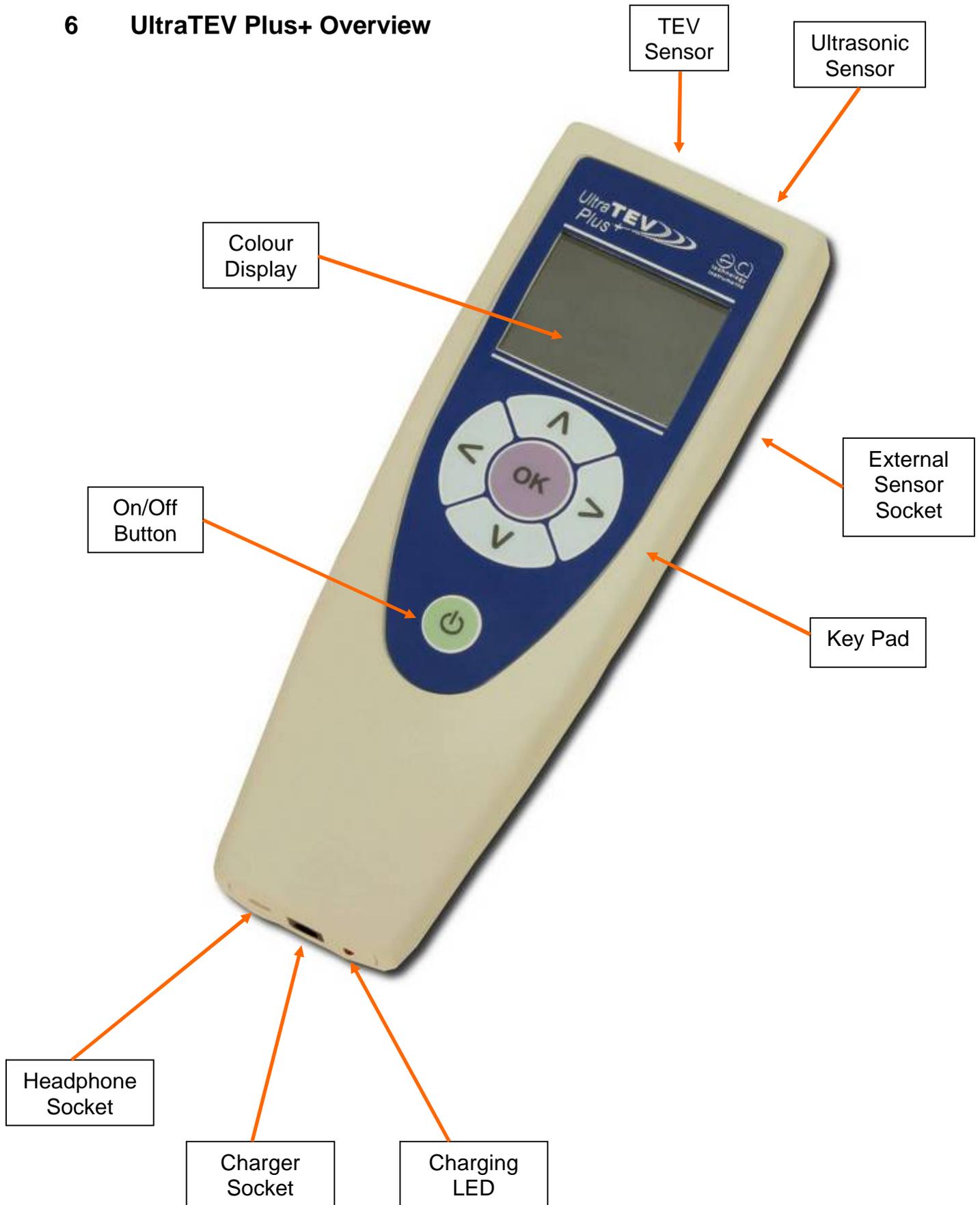
The PD Monitor is a twelve-channel instrument capable of monitoring discharge activity of a switchboard for a week or more and recording the results. Due to its sophisticated time of flight circuits this instrument is particularly effective where high background activity is present as it will screen out interference sources. The PD Monitor is also useful for detection of intermittent discharge activity, which is often missed when carrying out a survey with, for instance, the UltraTEV Detector or UltraTEV Plus+.

The PD Monitor Plus+ provides permanent and semi-permanent substation monitoring. It has all of the capabilities of the PD Monitor and can have up to 255 nodes attached. This provides the ultimate in TEV detection and location with full analysis available, over the internet, from anywhere in the world, providing continuous monitoring of critical assets.

### PD Monitor Plus+



## 6 UltraTEV Plus+ Overview



## 6.1 Charging the Unit

Before first use the unit should be charged. Full charge time is around 7 hours, however, if the unit is partially charged the charging time will be reduced. The unit automatically stops charging once the battery is full. The charging status is indicated by the LED next to the charger socket.

- If the LED is on the battery is being charged.
- If the LED is off the unit is not charging, i.e. charge complete or charger switched off.
- If the LED is flashing there has been a fault whilst charging and the unit should be returned to EA Technology for inspection / repair.
- Always turn off the UltraTEV Plus+ during charging.
- Do not take measurements with the unit whilst the charger is plugged in.



Not Charging / Charge Complete



Charging

## 6.2 Turning the Unit On/Off

Push  to turn the unit on. If the beeper is enabled the unit will beep once to confirm power on. A second later the EA Technology Logo will appear on screen for 3 seconds. Push  to skip the logo screen. To turn the unit off push .

## 6.3 System Information and Self Test Screen

After the logo screen the self test screen is displayed for 6 seconds. Push  to skip the self test screen.

The self test screen displays the following information:

- Self Test Result – This displays the result of the power on self test, it displays either PASS or **FAIL**. If the unit fails the self test on power up it should be returned for repair / calibration.
- Model – This displays the model name and number
- Software – This displays the current version of software installed on the unit
- Serial Number – The serial number of the unit
- Calibration due date – This displays the calibration due date of the unit. The unit should be returned for calibration annually.

The system information screen can also be viewed by selecting: SETTINGS >> SYSTEM INFO from the main menu.



## 6.4 Main Menu

After the self test screen, the main menu is displayed, as shown below:



Menu items are highlighted using the  &  buttons. Press  to select the menu item.

- TEV Mode – The TEV measurement screen
- Ultra Mode – The Ultrasonic measurement screen
- Settings – Allows the user to change settings for TEV and Ultrasonic modes as well as system settings and to view the system information shown at unit power up.

## 6.5 Setting up the Unit

The UltraTEV Plus+ is set to default settings in the factory and is ready to take measurements immediately. Some users may wish to modify the settings according to their preferences or procedures.

From the main menu select SETTINGS and press . The Settings menu shows:

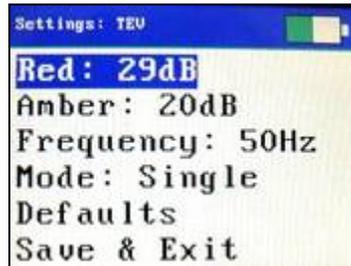


- Main Menu – Return to main menu
- TEV Settings – Settings for the TEV measurement screens
- Ultra Settings – Settings for the Ultrasonic measurement screens
- System Settings – Set the backlight and beeper preferences
- System Info – View the system information screen that shows at power on

## 6.6 Adjusting Settings

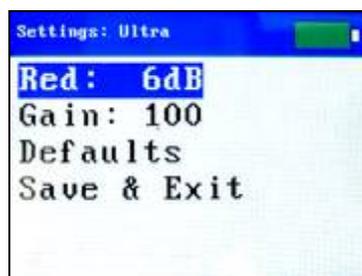
In the TEV Settings, Ultra Settings, and System Settings menus, use the  &  buttons to select the setting you wish to modify. Press  to modify the value. The setting selected will be highlighted in red. Use the  &  buttons to modify the value and then push  to accept.

## 6.7 TEV Settings



- Red – Sets the red ‘traffic light’ threshold (default 29dB)
- Amber – Sets the amber ‘traffic light’ threshold (default 20dB)
- Frequency – Sets the mains frequency reference, used to calculate pulses per cycle (default 50Hz)
- Mode – Sets the measurement mode, Single takes a single measurement when the  button is pressed (mimics the MiniTEV). Continuous takes measurements continuously without any button presses. (Continuous is the default setting)
- Defaults – Restores the default values for all items on this menu
- Save & Exit – Returns to the main settings menu saving any changes

## 6.8 Ultrasonic Settings



- Red - Sets the red ‘traffic light’ threshold (default 6dB)
- Gain – Adjusts the gain for measurement, higher gains allow measurement of smaller signals (default 60dB)
- Defaults – Restores the default values for all items on this menu
- Save & Exit – Returns to the main settings menu saving any changes

## 6.9 System Settings



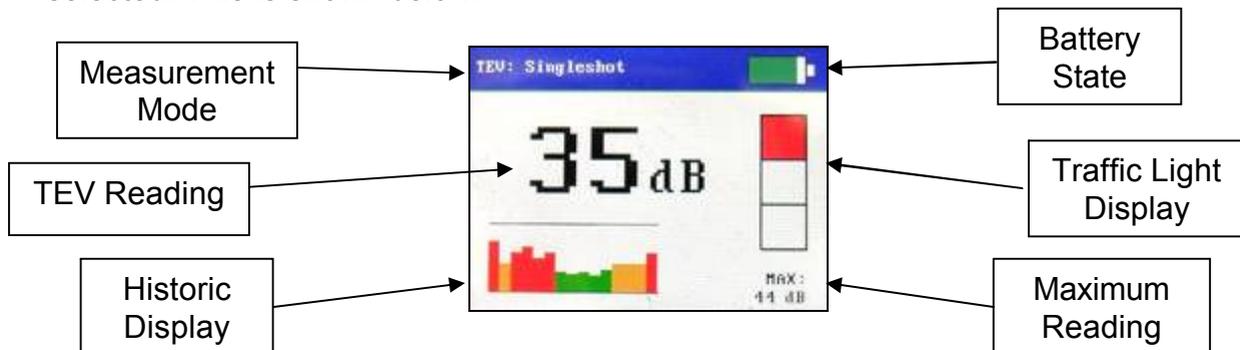
- Backlight – Allows the user to turn on or off the display backlight. Turning the backlight off will enable the user to see the screen more easily in bright sunlight. (default ON)
- Key Beep – Selects whether the beeper is enabled on key presses. This also mutes the power on beep (default ON)
- Defaults – Restores the default values for all items on this menu
- Save & Exit – Returns to the main settings menu saving any changes

## 6.10 System information

This option displays the self test and system information screen that is shown at start-up.

## 6.11 TEV Measurement Screen

By default the standard TEV measurement screen is shown when TEV Mode is selected. This is shown below.



- Measurement Mode – informs the user whether the device is in single shot mode (push  to take a measurement), or continuous mode where measurements are updated continuously.
- TEV Reading – shows the current measured TEV level in dB
- Historic Reading – shows the last 15 measured values on a scrolling histogram, colour coded as per the traffic lights.
- Traffic Light Display – Shows the status of the current TEV level as either, Green, Amber, or Red, and is determined in the settings. The default is the

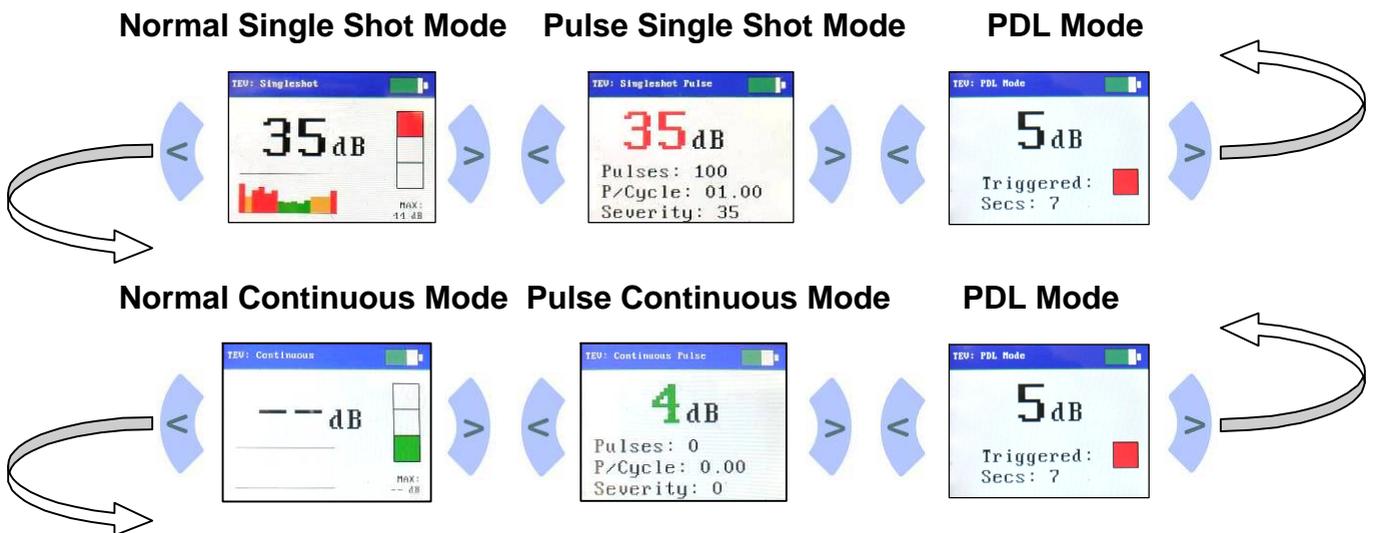
same as the UltraTEV Detector (less than 20 dB = green, 20-29 dB = amber, and greater than 29dB = red).

- Maximum Reading - the maximum reading obtained since entering the TEV measurement mode. This can be reset by pushing .
- Push  to exit back to the main menu
- To change between TEV mode screens use  &  as described below

### 6.12 Switching between TEV Modes

TEV measurement has 3 modes of operation, normal mode (as shown above), pulse mode, and PDL mode (as shown below). Both the Normal mode and the Pulse mode can work in either Single or Continuous modes selectable in the Settings menu

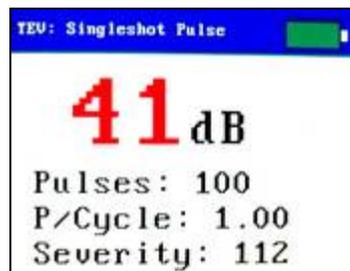
(section 6.7) or by holding the  button and pressing the  button. By default, selecting TEV mode from the main menu shows the normal TEV Screen. To Change between modes use the left and right buttons to cycle through the different mode screens



### 6.13 TEV Pulse Mode Screen

The TEV pulse screen shows more advanced information about the TEV levels detected, both in Single shot mode, and Continuous mode. The pulse mode screen is shown below:



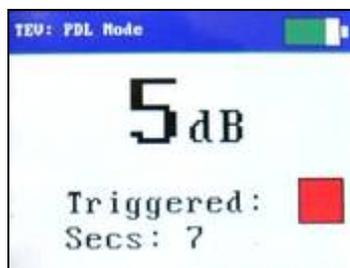


- Pulses – Shows the pulse count over a 2 second period. (The UltraTEV+ measures pulses over a half second period and multiplies this by 4 to provide the same readout as a MiniTEV).
- P/Cycle – Shows the pulses per cycle based on either a 50 or 60Hz mains frequency.
- Severity – Shows the short term severity (Calculated by TEV magnitude (mV) x Pulses Per Cycle)
- Push  to exit back to the main menu

- To change between TEV mode screens use  &  as described above

#### 6.14 TEV PDL Mode Screen

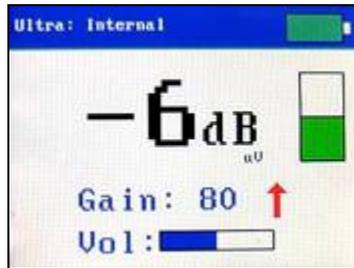
The PDL Mode screen offers a similar interface to that on the PD Locator where the user can manually increment the TEV level and monitor value at which the device triggers. This is indicated by a **Red** square.



- Use the  &  buttons to increase or decrease the TEV level shown as a large number
- Triggered – shows whether the UltraTEV Plus+ is triggering at that TEV level.
- To work out the TEV level, increase the trigger to the point where the device stops triggering and then decrease to the point where the device just triggers, with at least 1 pulse every 2 seconds
- Secs – Counts the seconds since the last change to the TEV level

## 6.15 Ultrasonic Measurement Screen

The ultrasonic measurement screen is shown below:



- The reading is displayed in dB microvolts ( $\mu\text{V}$ )
- The 'traffic light' indicator shows if the reading is above the threshold set in the 'Ultrasonic Settings'. The default value is the same as the UltraTEV, i.e.  $>1\text{dB} = \text{RED}$ .
- The gain is adjusted from 60 to 100 dB in 20dB steps using  & . If the red up arrow next to the gain is flashing (as shown above), increase the gain setting to improve the accuracy of the reading. If a down arrow is flashing, decrease the gain.

- The volume of the heterodyne signal to the supplied headphones can be

adjusted using  & .

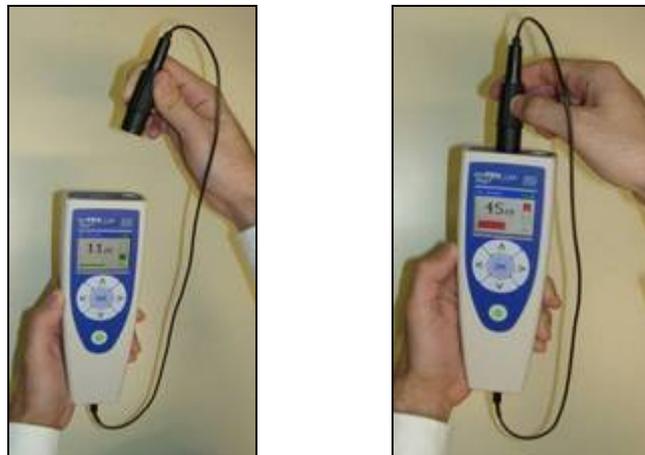
## 7 Function Checker

UltraTEV Plus+ is supplied with a function checker. The purpose of this accessory is to verify the UltraTEV Plus+ is operational before taking a measurement on switchgear. It is not intended to check the calibration of the instrument.



The function checker consists of a combined discharge and ultrasonic source which is energised via the charger socket on the UltraTEV Plus+.

To check whether the UltraTEV Plus+ is operating plug the function checker into the charger socket on the instrument with the unit turned on and select either TEV or Ultrasonic mode. Hold the checker adjacent to the front face of the UltraTEV Plus+. As the function checker is brought closer to the plate the readings should increase to indicate the device is working as shown in the pictures below. Verify operation of the instrument in both TEV mode and Ultrasonic mode.



Disconnect the function checker after checking the UltraTEV Plus+; do not attempt to use the UltraTEV Plus+ with the checker plugged in.

**It is recommended that the UltraTEV Plus+ is checked before each use and periodically thereafter.**

## 8 TEV Measurement Procedure

### 8.1 Background Noise

Electromagnetic signals from sources outside the switchgear can also produce transient earth voltages on the outside of the switchgear. These sources may be from overhead line insulators, transformer bushings, strong radio signals, and even traffic on a nearby Motorway. These sources also produce TEV signals on metalwork not connected to the switchgear such as metal substation doors or fencing. The background noise must therefore be measured on such surfaces before measurements are made on the switchgear. If the background noise is <10dB then the UltraTEV Plus+ pulse counter is not incremented and will read zero.

Measure the background noise level on metalwork which is not part of the switchgear, e.g. a metal door, a metal fence, etc. Record three consecutive values of dB and counts on the metalwork and take the middle amplitude reading as the background measurement.

### 8.2 Making a Measurement

Turn on the unit ensuring the TEV sensor is in free air away from metalwork as this may affect the self test. Select TEV Mode. To take a measurement hold the TEV probe squarely in contact with the metalwork on which the measurement is to be taken (preferably keeping the UltraTEV Plus+ body away from neighbouring metalwork as shown below). If the unit is in continuous measurement mode it will display a reading immediately, however the reading will not stay on screen once the

TEV probe is removed from the metalwork. If in single shot mode push . The unit will beep on pressing the button and will beep again once the measurement has been taken. In this mode the reading will remain on the screen. You may wish to repeat the measurement a few times to ensure consistency.



**Correct**



**Incorrect**



Measurements on switchgear are made at the centre of each component of each panel e.g. cable box, CT chamber, busbar chamber, circuit breaker and VT. The position of the circuit breaker or other MV/HV switch is recorded, because if these are in the off position certain components will not be energised and therefore readings will not be valid on such components.

Record the first set of readings at each position unless the amplitude is greater than 10dB above the background, and greater than 20dB, and greater than 50 counts. If this is the case, record three consecutive sets of readings.



## 9 Ultrasonic Measurement Procedure

Turn on the unit and select Ultra Mode from the menu, plug in the supplied headphones and adjust the volume. The reading will continuously update on screen. A measurement of the background noise should be taken. Turn the gain to maximum to start with and reduce the gain if the reading becomes too high. To survey the switchgear point the ultrasonic sensor towards any air gaps in the switchgear, particularly breaker spouts, air filled cable boxes, VT and busbar chambers. At all times ensure safety distances are adhered to.

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.

To convert from dB $\mu$ V to dB SPL (sound pressure level) subtract 19dB from the reading.



## 10 Accessories

If required an extension microphone can be plugged in to reach up to hard to reach places safely or the parabolic dish can be used to measure pole cable terminations.



**UltraDish**



**Extension Microphone**

## 10.1 UltraDish

This sensor is a highly directional ultrasonic measurement tool that minimizes background noises and concentrates on electrical discharges at distances of more than a few metres.



The UltraDish is equipped with a high precision laser pointer to enable the detection of surface discharges at short or large distances.

The dish is transparent to allow the target object to be seen whilst taking a measurement. To enable to target object to be aimed at accurately the dish has two sights: a rifle sight and a very effective laser pointer sight.

When the UltraDish is being used the UltraTEV Plus+ will indicate 'Parabolic' rather than 'Internal' on its display.

## 11 Guide to Interpretation of UltraTEV Plus+ TEV Readings

TEV Reading	Conclusion
1. High background reading, i.e. greater than 20dB.	<p>(a) High levels of background noise can mask discharges within the switchgear</p> <p>(b) Possibly due to an external influence. If possible remove the external source and re-test alternatively re-survey using the PD Monitor to identify any discharges in switchgear.</p>
2. If all the readings on the switchgear and the background reference are less than 20dB.	No significant discharging. Re-survey annually.
3. For switchgear readings greater than 10dB above the background and if the reading is greater than 20dB (absolute), i.e. not 20dB above the background level, and is more than 50 counts.	<p>Strong possibility of internal discharge activity within the switchgear.</p> <p>Recommend further testing using the PD Locator or PD Monitor.</p>
4. For readings with a count rate greater than 1000.	<p>There may be transmitted background electromagnetic activity in the region. If the readings are greater than 20dB then it is recommended that a PD Monitor be installed to identify external electromagnetic activity.</p> <p>A high count rate may be caused by surface discharges. If this is the case, ultrasonic emissions will be present which can be detected with the UltraTEV Plus+ provided an air path is present.</p>

## 12 Relating TEV Reading (in dB) to Discharge Magnitude (in pC)

Conventional Partial Discharge detection according to IEC60270, measures the apparent charge transfer from the high voltage conductor system when a discharge occurs. Thus the discharge magnitudes are normally expressed in pico-coulombs (pC). At the detection frequencies used by conventional PD detectors (typically 10 - 300 kHz), all items of high voltage plant, with the exception of long cables, can be considered to be lumped capacitors.

The TEV measurement works over the frequency range 3 - 100MHz. At these frequencies high voltage power plant items behave like transmission lines rather than capacitors. The area under the voltage/time curve would be proportional to the charge transfer during the discharge process.

TEV sensors measure the peak voltage of the detected transient, rather than the area under the curve. Therefore, it does not measure the charge directly.

Furthermore, it is the peak of the wave detected on the external surface of the metal-cladding that is measured and this will be a fraction of that within the cladding.

As the pulse travels along the external surfaces of the metal-cladding it disperses, i.e. spreads out. This has the effect of reducing the peak amplitude whilst maintaining the area under the curve. Therefore, the further away from the discharge source the pulse is detected, the greater the attenuation.

Clearly the relation between dB and pC is dependent on many factors, most of which are difficult to quantify.

Some recent laboratory tests undertaken by an independent party, and field measurements undertaken by EA Technology, on various system components, combining both conventional discharge detection and TEV measurements, yielded the results detailed in the tables on pages 24 and 25.

### 12.1 Surface Discharges

The most successful way of detecting surface discharges is using ultrasonic techniques. Surface discharges produce very low TEV signals compared to internal discharges. In addition, the electromagnetic signals produced by surface discharges are lower in frequency than the operating band of the TEV instruments. This is due to the slower rise times of the waveforms. In many cases the signals will not be picked up by TEV only instruments as they will be lower than the ambient noise levels.



**Table 1 dB-pC guidance for 25kV close to termination**

<b>TEV Reading (dB)</b>	<b>PD Conventional Measurement (pC)</b>
0	32
5	56
10	100
15	178
20	316
25	560
30	1,000
35	1,780
40	3,160
45	5,600
50	10,000
55	17,800
60	31,600

Table 2 gives some empirical results for a phase to earth discharge in a compound-filled 11kV cable end box.

**Table 2 dB-pC guidance for compound-filled 11kV distribution cable end box**

<b>TEV Reading (dB)</b>	<b>PD Conventional Measurement (pC)</b>
0	100
5	178
10	316
15	562
20	1,000
25	1,780
30	3,160
35	5,620
40	10,000
45	17,800
50	31,600
55	56,200
60	100,000



Table 3 gives some empirical results for a phase to earth discharge in a SRBP bushing in an Oil Circuit Breaker.

**Table 3 dB-pC guidance for SRBP Bushing in Oil Circuit Breaker**

TEV Reading (dB)	PD Conventional Measurement (pC)
0	134
5	239
10	423
15	753
20	1,340
25	2,390
30	4,230
35	7,530
40	13,400
45	23,900
50	42,300
55	75,300
60	134,000

Table 4 gives some empirical results for an internal discharge in a Cast Resin CT at 11kV.

**Table 4 dB-pC guidance for Cast Resin CT at 11kV**

TEV Reading (dB)	PD Conventional Measurement (pC)
0	224
5	399
10	708
15	1,260
20	2,240
25	3,990
30	7,080
35	12,600
40	22,400
45	39,990
50	70,800
55	126,000
60	224,000

It must be stressed that the tables above should only be used as a rough guide. Whilst it is generally correct that increasing pC levels equates to increasing dB levels, factors such as the source of the discharge activity and the attenuation path all have significant influence on calibrating results.



## 13 Instrument Specification

### 13.1 TEV Measurements

<b>Sensor:</b>	Capacitive
<b>Measurement Range:</b>	0 – 60dBmV
<b>Resolution:</b>	1dB
<b>Accuracy:</b>	±1dB
<b>Max Number of Pulses/Cycle:</b>	655
<b>Min Pulse Rate:</b>	10Hz

### 13.2 Ultrasonic Measurements

<b>Measurement Range:</b>	-7dB $\mu$ V to 68 dB $\mu$ V
<b>Resolution:</b>	1dB
<b>Accuracy:</b>	±1dB
<b>Transducer Sensitivity:</b>	-65dB (0dB = 1volt/ $\mu$ bar rms SPL)
<b>Transducer Centre Frequency:</b>	40 kHz
<b>Transducer Diameter:</b>	16mm
<b>Heterodyning Frequency:</b>	38.4 kHz

### 13.3 Hardware

<b>Enclosure:</b>	Self-coloured injection moulded plastic case
<b>Indicators:</b>	Colour back-lit LCD Charging indicator LED
<b>Controls:</b>	Membrane keypad
<b>Connectors:</b>	2.1mm LV DC Charger Input 3.5mm stereo headphone socket External Ultrasonic Sensor Input
<b>Headphones:</b>	Min. 8 ohms

### 13.4 Environmental

<b>Operating Temperature:</b>	0 – 55 degrees C
<b>Humidity:</b>	0 – 90 % RH non-condensing
<b>IP Rating:</b>	54

### 13.5 Dimensions

<b>Size:</b>	205mm x 72mm x 35mm
<b>Weight:</b>	0.3kg



### 13.6 Power Supplies

<b>Internal Batteries:</b>	3.7V 3.6Ah Lithium-Ion
<b>Typical Operating Time:</b>	approx. 5 hours
<b>Battery Conservation:</b>	Automatic 'switch off' when low battery voltage detected or 10 minutes elapsed.

### 13.7 Battery Charger

<b>Rated Voltage:</b>	90 – 264V AC
<b>Frequency:</b>	47 - 63Hz
<b>Charging Voltage:</b>	6V DC
<b>Charging Current:</b>	500 mA
<b>Time for Full Charge:</b>	7 hours
<b>Dimensions:</b>	74mm x 44mm x 34 mm
<b>Weight:</b>	0.12 kg
<b>Operating Temperature:</b>	0 - 40 degrees C
<b>Humidity:</b>	20 – 85% RH non-condensing

### 13.8 UltraDish

<b>Measurement Gain:</b>	16dB (compared to internal sensor @ 2.5m)
<b>Transducer Centre Frequency:</b>	40 kHz
<b>Transducer Diameter:</b>	16mm
<b>Laser Power:</b>	4.5 mW Class IIIR
<b>Laser Spot Size:</b>	6mm at 5m
<b>Dish External Diameter:</b>	275mm
<b>Dish Nominal Diameter:</b>	250mm
<b>Weight:</b>	0.6 kg
<b>Operating Temperature:</b>	-10 to 50 degrees C
<b>Humidity:</b>	0 – 90 % RH non-condensing
<b>IP Rating:</b>	54



## 14 Maintenance

It is important that the unit is kept clean and dry. It is not weatherproof. 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.

Internal, rechargeable batteries power the instrument.

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

The unit 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, especially in the area of the LCD window.

## 15 Calibration

The recommended calibration interval of 12 months is based on EA Technology's experience with this product.

Your application may require a different calibration interval dependant on the frequency of use. The calibration interval should begin on the date the instrument is placed in service. Proper storage prior to being placed in service will not affect the recommended calibration interval.

## 16 Waste Electrical and Electronic Equipment Directive (WEEE)

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



## 17 Warranty

This product is warranted against defects in material and workmanship for twenty four months from the date of shipment subject to its return for annual calibration. The battery and accessories (charger, headphones, sensors, etc.) are guaranteed for a period of twelve months. During the warranty period, EA Technology will, at its option, either repair or replace units that prove defective.

For warranty service and repair, this product should be returned to EA Technology at the address below. The warranty shall not apply to defects caused by improper maintenance, modification or misuse.

### Note

EA Technology has a policy of continual product development and enhancement. While every effort has been made to ensure the accuracy of this document, there may be minor variations between the details given and the equipment supplied.

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## Notes

