MANUAL

UHF Directional Antenna Operating Manual

technology

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Version History

Date	Version	Author(s)	Notes
January 2022	V01.00.00	Will Platts	Initial Release

EA Technology Limited, Capenhurst Technology Park, Capenhurst, Chester, CH1 6ES;
Tel: 0151 339 4181 Fax: 0151 347 2404
http://www.eatechnology.com
Registered in England number 2566313

Contents

1. General Description

The UHF Directional Antenna (UHFDA1) is used in conjunction with the UltraTEV® Plus[2] (UTP2) and the UltraTEV® Plus[2] UHF Receiver (UHFR1). It identifies and locates Partial Discharge (PD) sources in High Voltage and Extra High Voltage (HV/EHV) plant without the need for an outage.

The UHFDA1 detects Radio Frequency Interference (RFI) generated as a result of PD within/on the surface of plant items and insulators. The UHFDA1 is a directional antenna which allows PD sources to be localised when used in conjunction with the UTP2 and UHFR1.

- UHF Directional Antenna
- UHF Test Source
- Coaxial cable
- Carry Case
- Operating Manual

UHF Test Source

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 do cause progressive deterioration of insulation that may lead to failure.

Non-intrusive partial discharge detection provides a means for identifying these potential sources of insulation failure that result not only in loss of supply to customers and damage to plant but can 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 UHFDA1 has been specifically developed to enable electromagnetic activity to be detected.

How does the UHFDA1 detect PD?

The UHFDA1 uses a flat antenna to detect Radio Frequency Interference (RFI) generated as a result of PD within/on the surface of plant items and insulators.

Radio Frequency Interference due to partial discharge 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.

When used with the UTP2/UHFR1, the viewing of distinct pulse groups relative to the power system frequency helps the user in determining the validity of any source detected.

Interference Rejection

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. Energy from Corona discharges is most prevalent below 200 MHz.

For this reason, the UHFDA1 is designed to operate at higher frequencies, centred around 800 MHz. When used with the UTP2/UHFR1, the user can tune the frequency up or down to move away from any local telecommunication transmissions which would interfere with measurements.

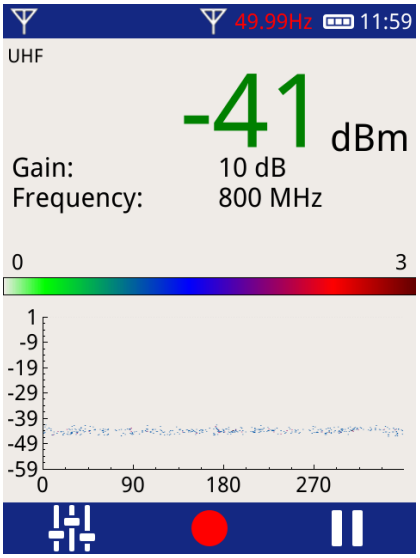
2. Preparations for Use

- Switch on the UltraTEV® Plus^2 and connect the UHF Receiver to the Smart Accessory port. Please refer to the UltraTEV® Plus^2 Operating Manual for further details.
- Using the supplied coaxial cable, connect the Signal Connector to the input of the UHFR1.
- If the UHFDA1 and/or UTP2/UHFR1 have not been used for a significant period of time, check the operation of the system using the UHF Test Source. Please refer to the UHF Test Source Operating Manual for further details.

3. Operating Instructions

3.1 Setting Up for Scanning

Background interference varies between sites. A high background level due to non-PD related interference can mask the identification of a partial discharge source so it is important to choose a scanning frequency with low background level.



- Use the UTP2/UHFR1 in “Phase Plot” mode. The background level (at the default gain) should normally be displayed as a faint line of dots towards the bottom of the phase plot.
- If the level is too high, adjust the frequency up or down until a low noise level is indicated.
- Holding the UHFDA1 in an elevated position and pointing away from the switchyard plant, sweep up and down, side to side and rotate the UHFDA1 through a full 90 degree arc. Adjust the gain to keep the noise level low without any spikes. In a quiet environment, this will normally be achieved at a gain of about 10 dB – 20 dB. The optimal gain setting is when the noise base just starts to rise if the gain is increased any further.
- In most cases the frequency will not need adjustment from the default of 800 MHz.

Typically moving a few MHz or tens of MHz away from 800MHz is all that is necessary when a problem with interference is found. The gain is best adjusted in the Phase Resolved screen as it is more readily apparent where the noise floor is in this mode.

Increasing the gain further will only increase the amount of ‘hiss’ heard through the headphones.

3.2 Frequency Spectrum Scan

- If it is difficult to find a suitable test frequency, it may be necessary to perform a Spectrum Scan to find one. Please refer to the UTP2 Operating Manual for further details.
- Pick a part of the spectrum close to 800 MHz with a low background level and use this as the start point for setting the frequency.

3.3 Surveying High Voltage Plant

- Plan a logical walking route through the switchyard, ensuring that a clear line of sight is possible to every item of plant.
- Following the survey route, walk along the switchyard bays holding the UHFDA1 in an elevated position. At each phase or pole of a plant item, sweep up and down, side to side, and rotate the UHFDA1 through a full 90 degree arc to ensure signals of all polarisations are detected.
- Use the headphones supplied with the UltraTEV® Plus[2] to listen for discharge-like sounds, as well as checking the level received on the screen.

The UHFDA1 and PD source are both polarised so it is necessary to rotate the UHFDA1 through 90 degrees to be sure of detecting the signals.

If there are many partial discharge sources present in a substation it may be necessary to survey from inside and outside the site in order to obtain good location information.

3.4 Locating a PD Source

3.4.1 Where is the possible PD source?

If a PD source is encountered, there will be a pronounced rise in signal amplitude, accompanied by an immediate increase in the audio signal in the headphones on the UTP2.

- STOP at this position.
- Scanning around the area where the source was detected, use both the audio output and Measure mode to determine where the signal is at a maximum.
- Steadily approach the area where the maximum signal originates and keep checking where the signal is at a maximum.

3.4.2 Is it PD?

Partial discharge signals will normally be clustered at two positions on the Phase Plot or 3D Phase Plot screens and are stable when a proper phase reference is achieved.

The UTP2 has an audio output to allow discharge events to be heard. Partial discharge activity has a recognisable sound which can be very useful in identifying sources. Genuine discharge can be identified by a crackling sound (like a sizzling frying pan) in the headphones.

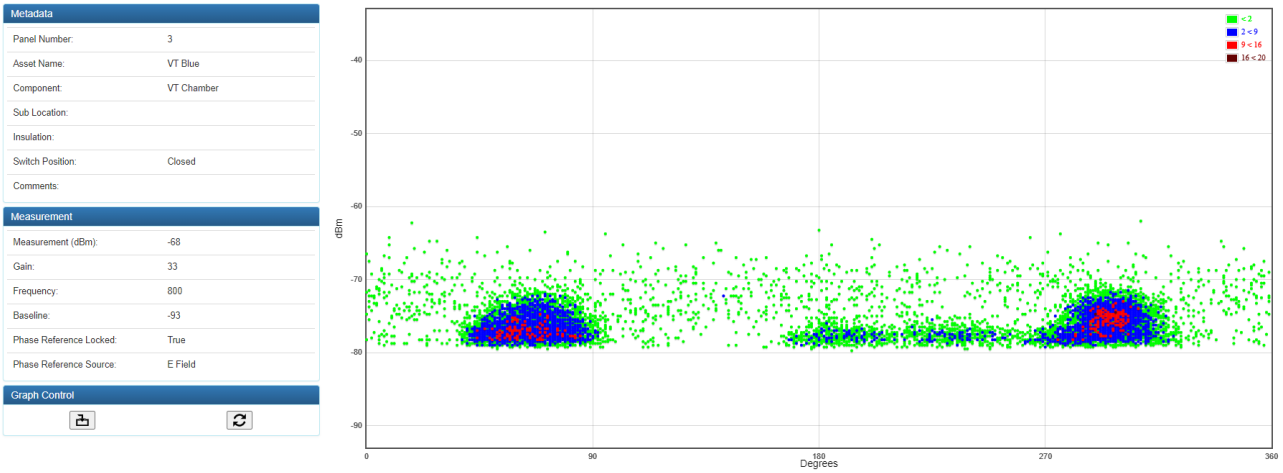


Figure 1 Example of surface PD

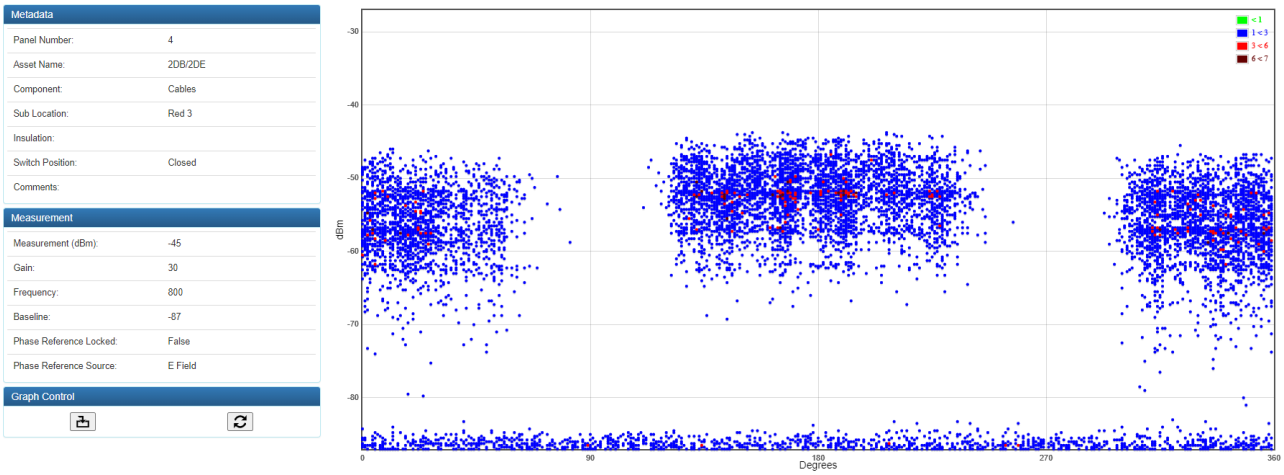


Figure 2 Example of contact type PD (sparks jumping a gap on overhead assets)

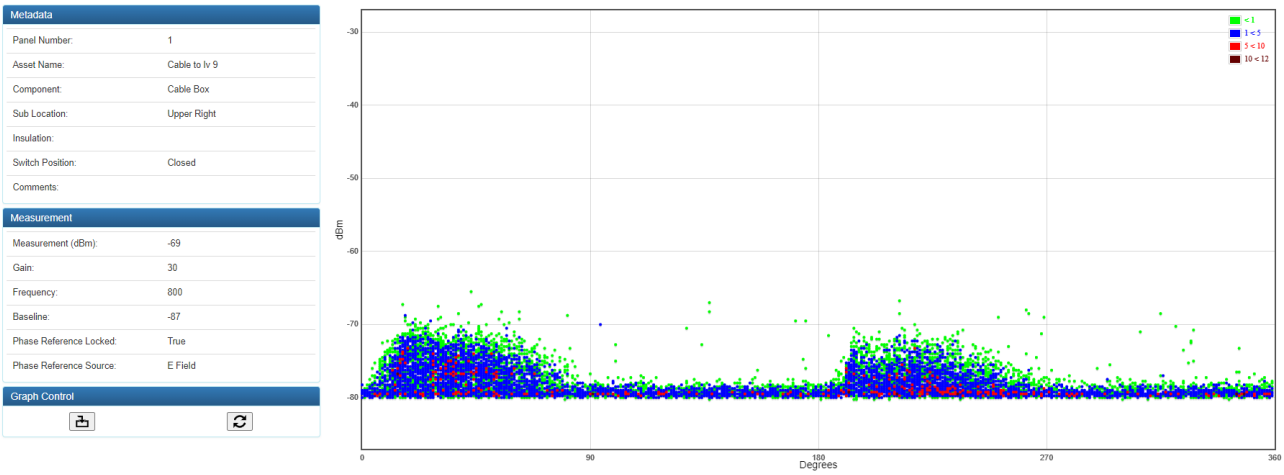


Figure 3 Example of an internal void

3.4.3 Making Comparisons

- Cross-checking of identical or similar plant types is important to confirm the existence of a true partial discharge source. For example, if one phase or pole is discharging, check the other poles of the same item to compare the readings and confirm the signal level is abnormal.
- It is important to be vigilant when checking other equipment of the same type to ensure the partial discharge source does not occur in all other units.
- If common patterns are detected, then further investigation is needed to identify the cause. The UltraTEV® Plus[2] Survey Mode can be used to record data for further analysis. See the UltraTEV® Plus[2] Operating Manual for more details.

3.4.4 Pass/Fail Levels in the UHFDA1

There are a number of factors which effect the absolute amplitude of a UHF reading of this nature such as:

- Distance from asset
- Signal strength
- Direction of the transmission of the signal from the source
- Polarisation of the source relative to the polarisation of the UHFDA1

Due to this, the setting of absolute pass/fail level is inappropriate. Instead, it is reasonable to state that the levels of PD obtained during a UHFDA1 Survey are not as important as the fact that something has been detected which is likely to be PD (see). If this is the case, then further investigation is required, which may include trending the behaviour over time, adding measures to control for the variables outlined above.

3.4.5 Switch Off

On completion:

- Disconnect the UHFDA1 from the UHFR1
- Disconnect the UHFR1 from the UTP2
- Turn off the UTP2 and recharge if necessary
- Properly stow the equipment ready for the next use

4. Maintenance

The UHFDA1 may 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 device. Abrasive cleaners must not be used.

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 UHFDA1.

No attempt should be made to gain access to the internal circuitry of the UHFDA1. Advice should be sought from the manufacturer, or the supplier, if any doubt exists over the equipment's performance or operation.

5. Technical Specification

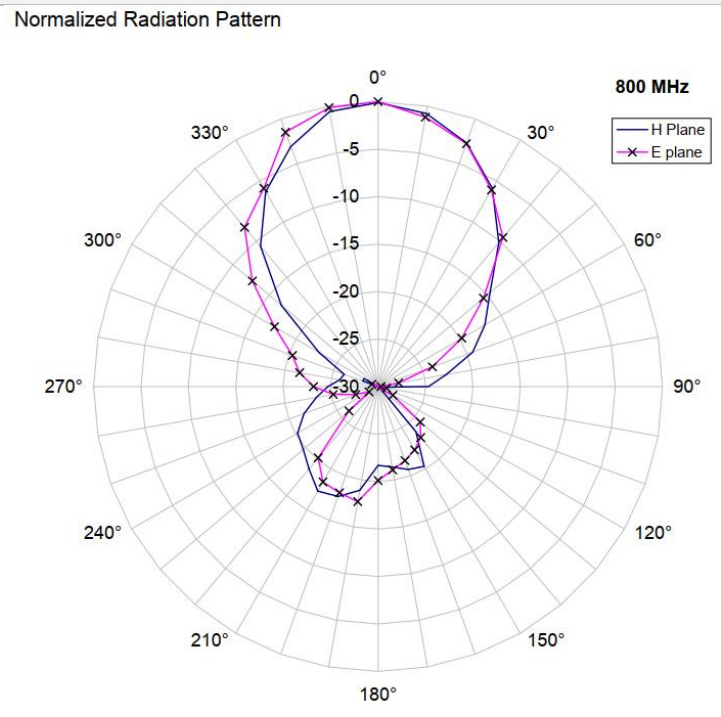
Physical

Size	440 x 440 x 110 mm
Weight	2.1 kg
Enclosure	Self-coloured vacuum formed plastic case
Indicators	None
Controls	None
Connectors	1x BNC signal port

Environmental

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

Antenna

Forward gain	13.6 dBi at 800 MHz
Beamwidth	40º in E-plane and 50º in H-plane
Approximate bandwidth	100 MHz centred on 800 MHz
Maximum sensitivity frequency	800 MHz
Front to back ratio	Approximately 20 dB
Radiation pattern (800 MHz)	

6. Sales and Service

Head Office

EA Technology Ltd, Capenhurst Technology Park Chester, UK, CH1 6ES

Tel: +44 (0)151 339 4181

For details of our international offices and distributors, please visit our website:

www.eatechnology.com/contact us

Sales

Email: sales@eatechnology.com

Product Support

Email: product-support@eatechnology.com

Tel: +44 (0)151 347 2293

Calibration

Calibration is not required.

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.

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

Declaration of Conformity

Hereby, EA Technology declares that the equipment described in this document is in compliance with all 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.

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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