TECHNICAL INFORMATION

UltraTEV Monitor™

www.eatechnology.com

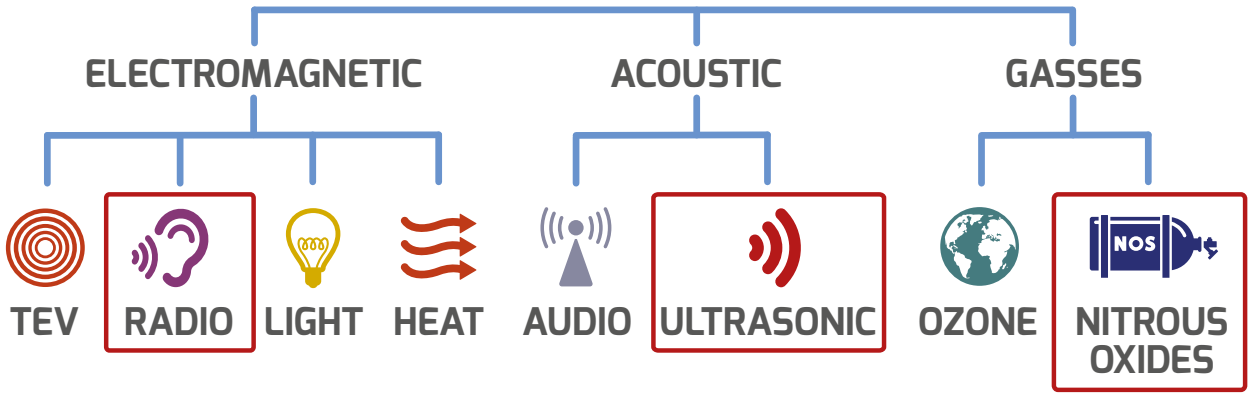
Background and Introduction

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 means for identifying these potential sources of insulation failure that result not only in loss of supply to customers, but can also endanger staff.

A partial discharge emits energy in the following ways:



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 Monitor has been specifically developed to enable electromagnetic and ultrasonic activity to be monitored in a single, simple to use instrument.

Airborne Ultrasonic Discharge Activity

Acoustic emissions from partial discharge activity is normally at a frequency too high for the human ear, i.e. ultrasonic. As the partial discharge progresses towards failure the frequency sometimes decreases into the audible range.

Using an instrument to detect the ultrasonic signal has several advantages: instruments are more sensitive than the human ear, are not operator dependent and ultrasonic frequencies are more directional. The most sensitive method of detection is using an airborne ultrasonic microphone. This method is very successful at detecting partial discharge activity provided there is an air path between the source and the microphone. However, in the case of sealed switchgear with no air path, an ultrasonic contact probe can be magnetically attached to the external surface of the switchgear to monitor internal activity.

Electromagnetic Discharge Activity

When partial discharge activity occurs within high voltage switchgear it generates Transient Earth Voltages (TEV) and electromagnetic waves in the radio frequency range.

The TEV signals are high frequency and therefore travel in the skin of the switchgear and can only escape from the inside of the switchgear through openings in the metal casing. These openings may be air gaps around covers, gasket materials or other insulating components.

In addition when the electromagnetic wave propagates from the partial discharge site it also impinges on the metal casing of the switchgear producing a Transient Earth Voltage (TEV).

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 to detect the Transient Earth Voltages.

Cable Discharge Activity

Partial discharge can occur in voids in cable insulation in a similar way to internal discharges in switchgear insulation. XLPE cable joints are particularly prone to partial discharge, more so than PILC joints, but less in both cases than the cables themselves.

Because cables are usually buried access is only available from either end, so the previously discussed ultrasonic and TEV measurement techniques cannot be used. Partial discharge activity can be accurately assessed in a cable using 'off-line' measurement techniques. The most successful of these is VLF mapping which will also give the location of any partial discharge activity as well as magnitude. However taking a cable 'off-line' can be inconvenient and expensive, so partial discharge can be detected in 'live' cables using a RFCT on the earth connection or strap between the cable sheath and the earthed switchgear.

The Value of Partial Discharge (PD) Testing

Detection and measurement of Partial Discharges (PD) is a highly effective technique for assessing the condition of MV/HV metal clad switchgear. PD is the most common cause of failure of insulation on MV/HV equipment and cables: and the detection of PD can indicate the presence of harmful defects, thus helping to identify potential future faults.

Testing of large parts of the network can help in the assessment of its overall condition, show how the assets are ageing, predict future failure rates and help assess the level of on-going expenditure (Capex and Opex) needed to meet requirements for future network reliability.

The UltraTEV Monitor

Portable Hub

The UltraTEV Monitor system consists of a Hub Unit, laptop-style power supply and between 1 and 20 Nodes with associated peripherals. The Nodes each contain TEV and temperature sensors. Further TEV, Cable PD and ultrasonic sensors may be connected to the Nodes to match the requirements of the substation.

The Hub Unit is a specialised data acquisition unit responsible for data collection, processing, interpretation and presentation to the user. In some variants this unit may be responsible only for interfacing measurement nodes to the EA Technology computing cloud.

Wall-Mount Hub

The UltraTEV Monitor system consists of a Hub Unit, Power Supply and at least one or more Nodes with associated peripherals. The Nodes each contain TEV and contact temperature sensors. Further TEV, Cable PD, Ultrasonic, ambient temperature and humidity sensors may be connected to the Nodes to match the requirements of the substation.

The Hub Unit is a specialised data acquisition unit responsible for data collection, processing, interpretation and presentation to the user. In some variants this unit may be responsible only for interfacing measurement nodes to the EA Technology computing cloud.

The Power Supply is responsible for powering the Hub Unit and measurement Nodes.

Nodes

The Node is housed in an injection moulded plastic case with the facility for attaching to the switchgear either using built in magnets on ferrous material or with tie wraps using the slots provided. Views of the front and back of the unit are included below.

Node Connections

The UltraTEV Monitor has a number of connections (see Figure 2 for connector positions).

- **TEV Sensor:** This input is for the connection of an external TEV probe or antenna.
- **2 x Ultrasonic Sensor:** These inputs are for the connection of external ultrasonic probes. The Monitor supports the connection of both air and contact probes.
- **Cable PD Sensor:** This input is for the connection of an external RFCT for the detection of Cable PD.
- **Node Communication:** This socket is for connection to further downstream nodes along the daisy chain.
- **Server Communication:** This socket is for connection to upstream (towards the Hub Unit) nodes along the daisy chain or to the Hub Unit itself.

NOTE: The two communication ports on the Node make use of Ethernet style sockets but these are **NOT** Ethernet and should not be connected to Ethernet systems.

Node Internal Contact Temperature Sensor

The Monitor includes a contact temperature sensor which measures the surface temperature of whatever surface the Node is mounted on. The temperature sensor is visible as the aluminium disk on the rear face of the Monitor Node. The temperature is logged every 3 seconds and the average value recorded at the Hub Unit.

Node Internal TEV Sensor

The internal TEV sensor is located in the top right corner on the face that touches the switchgear. This sensor is always considered to be active and therefore its corresponding data is always logged.

Figure 1: UltraTEV Monitor Node bottom

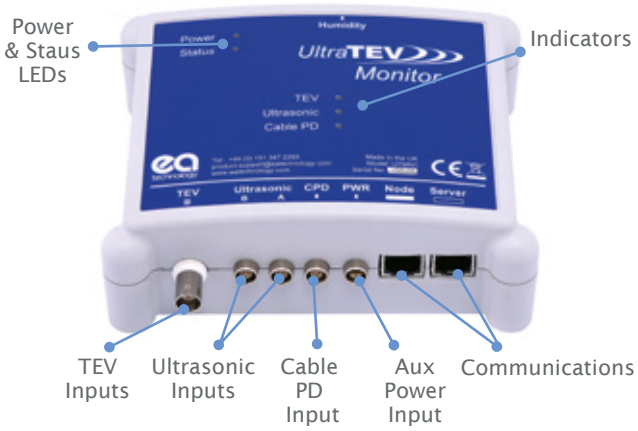


Figure 2: UltraTEV Monitor Node top and connectors

Sensors

Ultrasonic Sensors

The Ultrasonic sensor is housed in a plastic case similar in size to a key fob with the sensor at one end. There are a number of different mounting options as follows: clamp, with goose neck or simply using double sided sticking pads. The clamp can either be attached using the built in magnets on ferrous material or by using tie wraps with the slots provided.

The lead from the back of the sensor connects to the Node. Plug in extension leads are available should they be required.

External TEV Probe/Aerial

The external TEV probe or aerials are tried and tested designs, originally developed for the PD Monitor. They attach to the switchgear using either a magnetic base or an optional cable tie base. TEV probes are used where additional switchgear measurement points are required whilst aerials are used for detecting external interference. The probe or aerial is connected to the Node using standard BNC terminated 50Ω coaxial cable.

For both sensor types, the length of the coaxial cable must to be entered into the Hub Unit during the system discovery stage of system installation. All cables supplied with the instrument are marked with their individual lengths to aid this.

A single TEV probe or aerial may be connected to each Node.

Cable PD Sensor

The cable PD sensor is an Radio Frequency Current Transformer (RFCT). When installed around the earth connection or strap between the cable sheath and the earthed switchgear, it allows the high frequency current transients that are generated by PD activity within the cable or cable joints to be detected. The RFCT detects partial discharge pulses in the range of 200 kHz to 20MHz.

A single cable PD sensor may be connected to each Node.

External Temperature/Humidity Sensor

It has been shown that stratification of the air within substation environments can lead to variations in relative humidity, therefore the UltraTEV Monitor allows multiple temperature and humidity sensors to be connected, one per Node. The sensor plugs into the socket on the top face of the Monitor. It can be mounted onto ferrous surfaces using the integral magnetic mount or tie wrapped in place.

Ultrasonic Contact Probe

In some instances there is no direct air path between the PD source and the instrument for ultrasonic signals to pass along. In such cases the UltraTEV Monitor Contact Probe should be used to detect ultrasonic signals inside these sealed enclosures. It clamps onto a ferrous surface using built in magnets.

Software

All configuration of the UltraTEV monitor is performed via a web interface. This can either be via a direct connection to the device or through the UltraTEV Cloud web portal (if this option has been selected).

Connecting to the UltraTEV Monitor

To connect to the local user interface, there are a couple of options; the first being via a corporate LAN. Ethernet ports 1 and 2 are bridged internally. Port 1 can be connected to a corporate LAN if available and port 2 can then be connected to a laptop. This laptop will then also be able to connect to the corporate LAN. To use this option, the hub will have to be preconfigured by EA Technology. Once you know the IP address of the hub, type this into your internet browser's address bar.

The second option is more straight-forward. A direct Ethernet connection can be achieved by plugging a laptop into Ethernet port 4. Providing that your laptop is set to be dynamically allocated an IP address (as is normally the case), it should be allocated an IP address by the hub. In this scenario, type the address 192.168.0.200 into your internet browser's address bar.

In either option, you will first access the login screen. Use the following credentials to access the web-site:

Username: localuser

Password: eatl/eatl

The Local UltraTEV Monitor Web-Interface

Once connected and logged in, you will be greeted with the main home page. You can see the monitoring status indicator. This will be green if everything is running, orange if only some services are running and red if no services are running.

UltraTEV Cloud

The idea behind the UltraTEV Cloud system is simple; with the exception of the initial commissioning, the device can be managed entirely from the comfort of your home or office. Not only this but all of your devices can be managed from one place without the need to know any individual connection details.

We have taken our award-winning UltraTEV Monitor system and effectively split it in two. The usual PD, Ultrasonic and cable PD data is still collected on the device. This data is streamed to the No-Outage web portal, where it can be analysed from anywhere with an internet connection.

The web portal is central to the system. From here every device can be managed from one simple user interface. The main tasks are;

- Create new installations
- Analyse data
- View alarms
- Configure alarm settings
- Configure alarm notifications

In addition to these features, there are also all the usual management tasks such as changing passwords and contact details.

Getting Started

In order to use the system, you will need a laptop. Although the majority of tasks can be completed using the web portal, initial commissioning needs to be done via a local connection to the device. Other than that, any other interaction is done via the web-portal. During the setup process, an Installation Configuration File is used. This is downloaded from the web-portal and then must be uploaded to the device web-interface during the initial commissioning stage. This configuration file serves two purposes:

1. It contains information about the nodes and sensors that are expected to be connected and their locations on the switchgear.

2. It contains specially encrypted instructions telling the UltraTEV Monitor device where to send its data and how to make the connection.

In the UltraTEV Cloud, the Ultra TEV Monitor device will not function without the Installation Configuration file, and any attempt to commence monitoring will not work.

Connect to the UltraTEV Cloud web-portal using the following URL; **http://no-outage.eatechnology.com**

Upon visiting the site, you will need to log in with the email address that was registered for you. If you do not yet have an account, please speak to your account manager or EA Technology representative to obtain access. If you have forgotten your password, click on the "forgot your password?" link to have your password reset and a new password emailed to you.

Differences from non-cloud systems

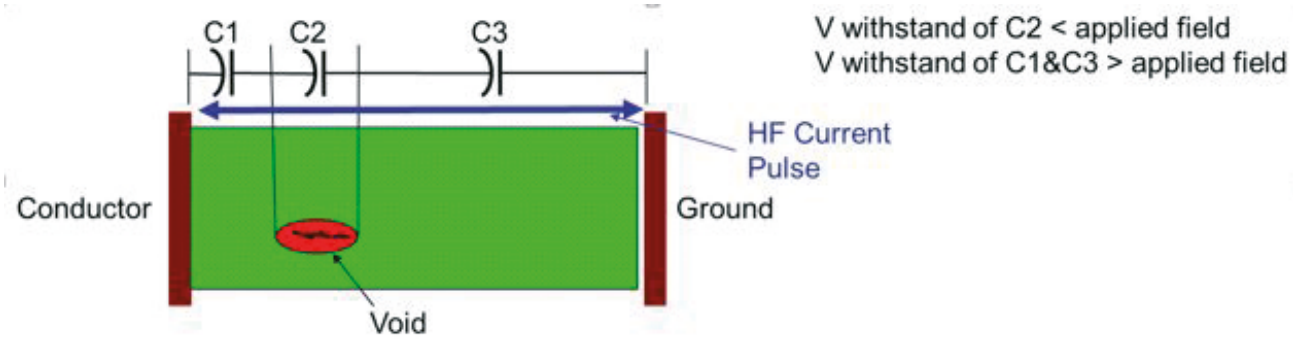
There is a crucial difference between the standard systems and systems that use the UltraTEV Cloud. With the cloud enabled systems, no data is stored on the device. This means that no analysis functionality is present on the device itself; instead all analysis of data is performed using the web portal.

As there is no data on the device, the download button on the portable hub will not be functional.

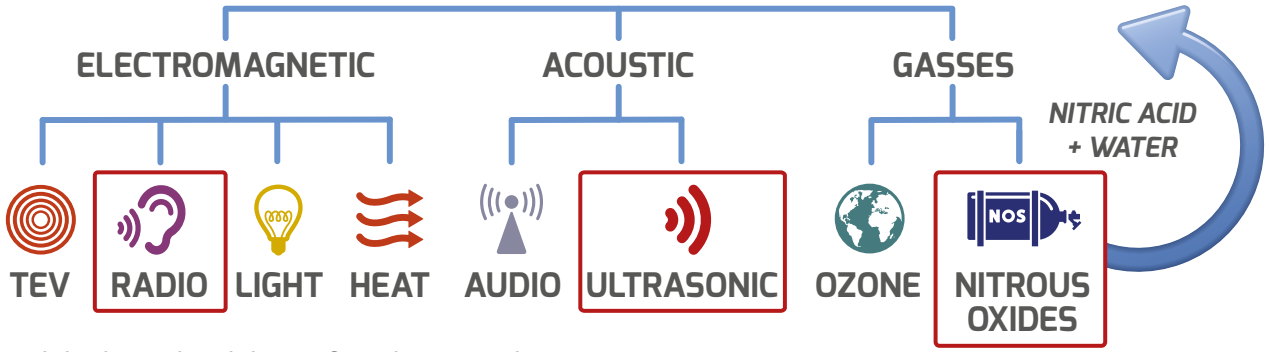
PD Testing – Practical Considerations

Partial Discharge - A flashover of part of the insulation system due to a localized electric field greater than the dielectric withstand capability of that part where the overall insulation system remains capable of withstanding the applied electrical field.

One effect of this flashover is a high frequency current pulse that travels through the capacitance of the insulation (C1 & C3).



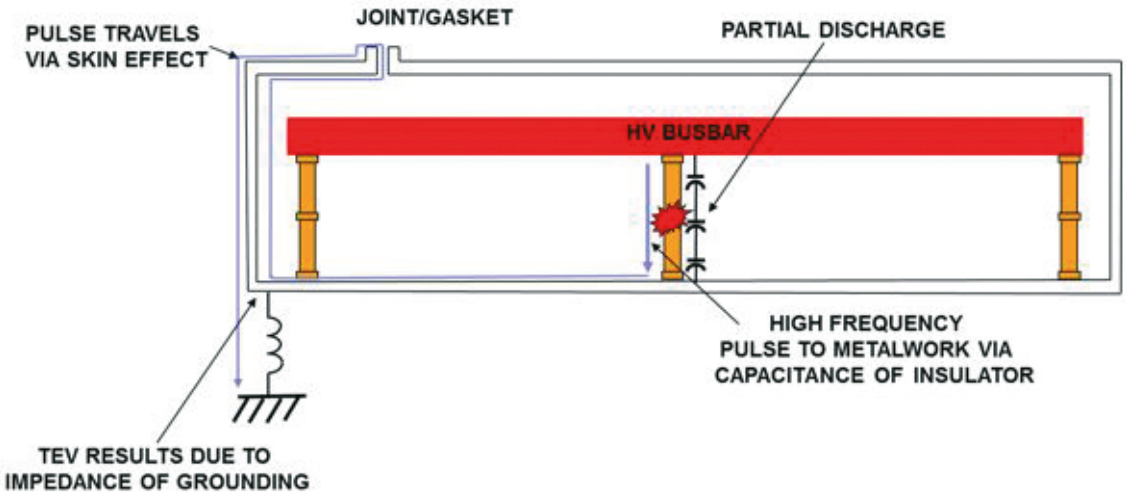
Products of Partial Discharge



Partial discharge breakdown of insulation produces:

- Transient Earth Voltage (TEV)
- Light
- Heat
- Smell
- Sound
- Electromagnetic Waves
- HF Electric Current

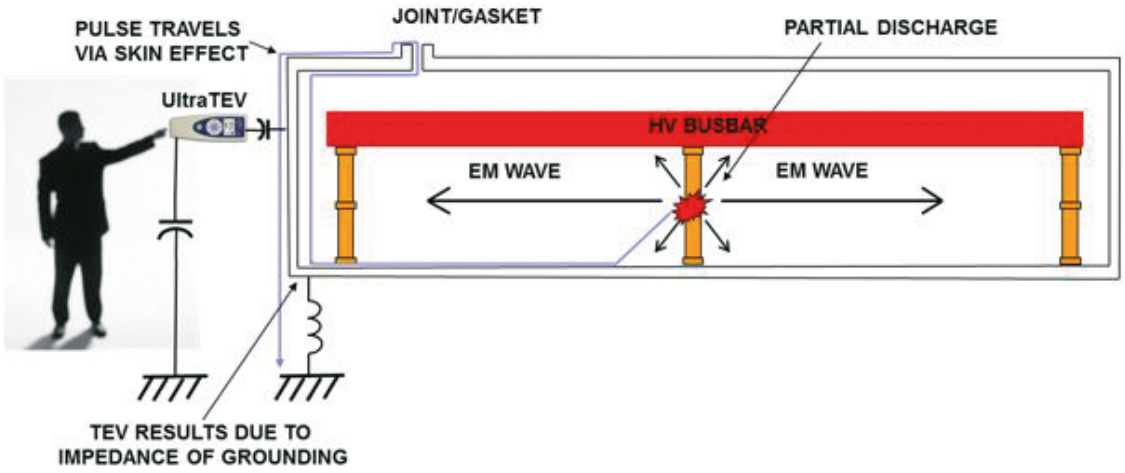
Internal Partial Discharge Effect 1 (current pulse - TEV)



At HF, PD currents are constrained to Flow in a thin layer on the surface of Conductor. Skin depth in mild steel at 100MHz 0.5um

Internal Partial Discharge Effect 2 (EM Wave)

This effect is usually less than the current pulse unless the PD is phase to phase!



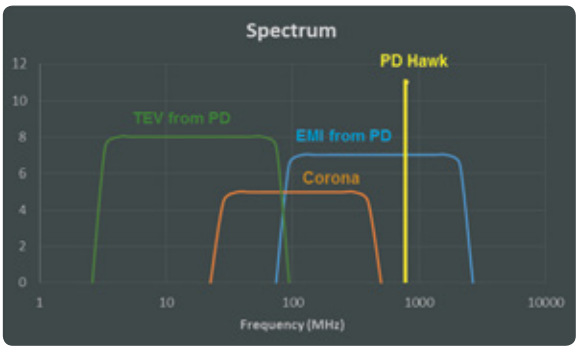
PD Spectrum (Simplified)

Partial Discharge causes a broadband EMI emission (approx. 100-3000 MHz)

Corona causes a smaller band EMI emission (30-400 MHz)

TEV caused by capacitive currents are typically in the 3-80 MHz band

PD Hawk is typically set to approx. 800 MHz



Internal Discharge Measurement (TEV)

- Internal discharge activity
  - Transient Earth Voltage (TEV) Detection
  - High Frequency (~ 3 to 80MHz)

- TEV magnitude is a function of:
  - The amplitude of the discharges
  - The attenuation of the propagation path
  - PD discharge path (Strong for phase to ground, weaker for phase to phase)

Installation Overview

Sensor Placement

The aerials should be placed around the switchgear's perimeter, with a reasonable clearance of approximately 1m. Nodes are placed centrally on the front or rear of each panel plus at the bus ends. External TEV sensors can be placed on any component required, most often this is a VT or cable termination box. Airborne ultrasonic microphones are placed at suitable air gaps. These are near spouts on switchgear that can be withdrawn, where loose bolts can be removed, etc. Contact ultrasonic probes can be placed at any location desired that cannot be monitored using the airborne sensors, typically these locations are cable termination boxes.

Earthing

Both the Hub Unit and the Power Supply have M4 earth studs on the left side of their casing to allow the UltraTEV Monitor to be bonded to an external ground system. Both the Hub Unit and Power Supply cases must be bonded to earth when the UltraTEV Monitor is installed in a substation.

Connecting the Nodes

The UltraBus communication cables to the Nodes are wired in a daisy chain manner, i.e. each Node has two connections, one for connection to the previous Node or Hub Unit (Server) and one for connection to the next Node (see Figure 3). The connections are made using CAT 7 Screened Twisted Pair (STP) Ethernet cable. The cables supplied with the Monitor are colour coded to the colour blocks on the Node label to simplify connection. If additional cables are required, they are available from EA Technology.

Figure 3: Details of Node Ethernet cable colour coding

No specific Node connection order is required although a linear flow along the switchgear will make the system easier to set up. Each Hub Unit can support up to 20 Nodes. Please contact EA Technology if you require a larger system.

The Hub uses a loopback system to connect the string of Nodes. Up to 10 Nodes can be connected in a string from the 'Out' UltraBUS port on the Hub. To connect between 10 and 20 an extra loopback cable is required from the last Node in the string to the 'Loop' UltraBUS port on the Hub (see Figure 4 and Figure 5).

Two ferrite chokes should be fitted on the cable that connects the first Node in the string to the Hub Unit. One choke should be fitted at each end of the cable as shown in Figure 9 and Figure 10. To install, release the clips on the side of the choke and loop the cable through the core once before clicking the choke closed.

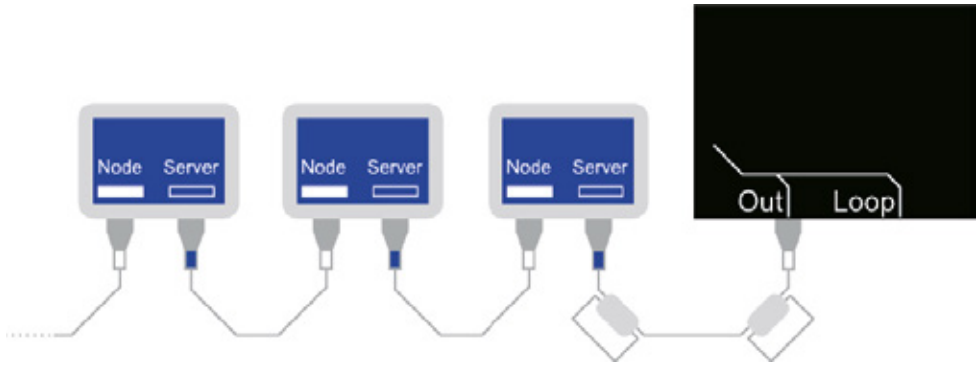


Figure 4: A single string can be used for up to 10 nodes

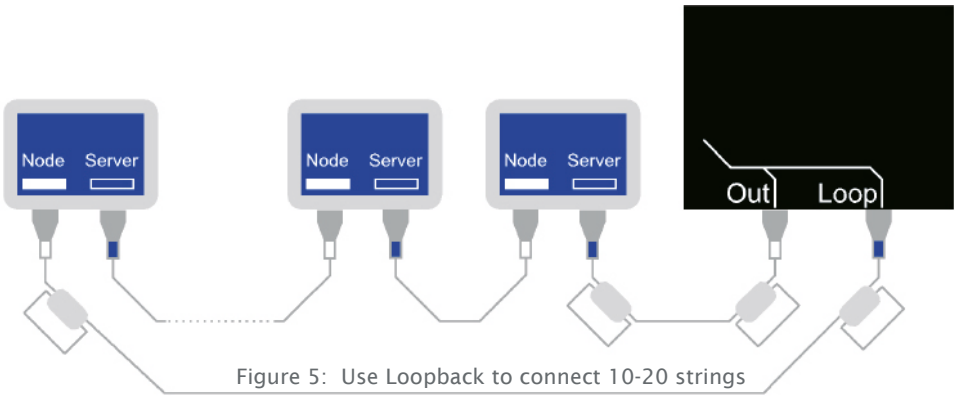


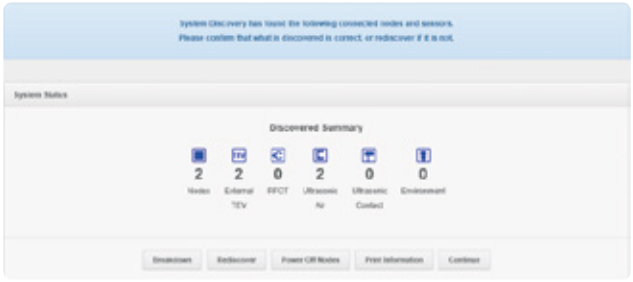
Figure 5: Use Loopback to connect 10-20 strings

System Configuration

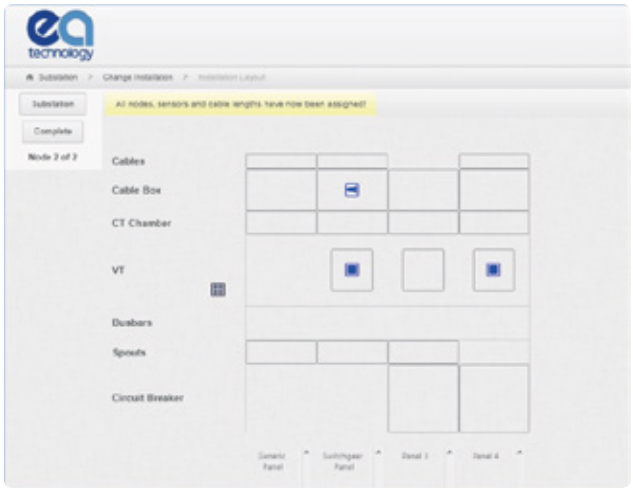
System discovery is the process where the connected hardware is discovered by the hub and configured accordingly to the layout of the system. When using UltraTEV Cloud, the initial part of the system discovery process is performed on the web portal.

System discovery has the following steps:

- Change the current installation and give the installation a name. This information is pre-configured when using UltraTEV Cloud
- Give the installation some information, such as the substation name. This information will come from the installation configuration file when using UltraTEV Cloud
- Discover the connected nodes and sensors, this may take several minutes
- Compare the discovered hardware with the installation configuration file when using UltraTEV Cloud
- Place the connected hardware (including the hub) onto the layout diagram by dragging items from the palette. With UltraTEV Cloud this only has to be done if the connected hardware does not match the installation configuration file
- Assign cable lengths by opening the context menu on each sensor
- Finalise the process by completing communication with the hardware.



Example System Discovery results



Example screen confirming the installation layout

Analysis

How to Analyse the Data

A system is provided to enable the user to view the data and create custom graphs to show the data specific to their needs. The data analysis screen, shown in figure 6, is broken down into a few sections. At the very top is the area where any graphs will be shown. Beneath this is a “control box” where the timeframe for the data can be set. Finally, at the base of the screen are sections showing a summary of the data for each measurement type; TEV, Ultrasonic, Cable PD and Environmental. See “Measurement Types” for an explanation of each of the measurements types.

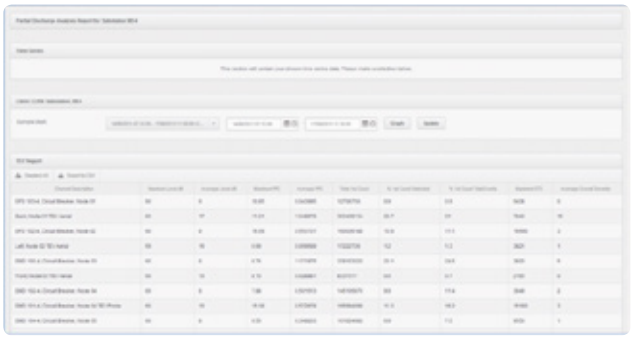


Figure 6: Summary tables

The control box can be used to select the timeframe for which the data will be displayed. Either select from the list the sample period or enter a custom date range as shown in Figure 7. The sample periods are whole periods where the UltraTEV Monitor was running. Each time the UltraTEV Monitor is stopped and restarted, a new sample period is

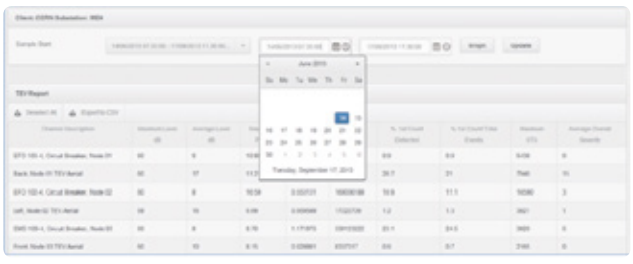


Figure 7: Selecting timeframe

created. The last item in the list will allow the selection of all data.

Data can be selected from any measurement point in any of the summary tables, see Figure 8. Groups of measurement points can be selected by dragging a 'box' over the items to be selected or alternatively, individual items can be selected whilst holding the control or shift keys.

Depending on the selected data types, one or more graphs will be displayed for the selected timeframe. Figure 9 shows an example of how the graph might look. Depending on the selected timeframe, the granularity of the data might be different. For example, selecting a years-worth of data will not show every single sample value within that year but instead an average (or maximum depending on if the field is an average or maximum) of each days/weeks/months data.

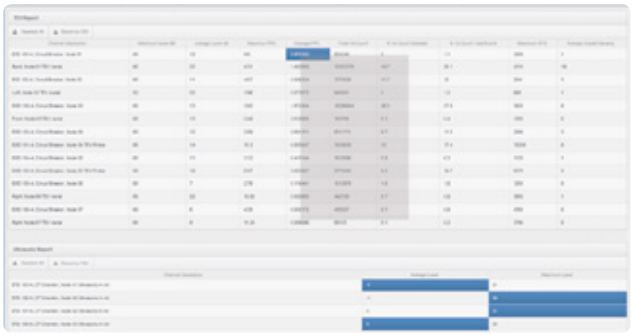


Figure 8: Selecting values to graph

Figure 9: Viewing a graph of selected data

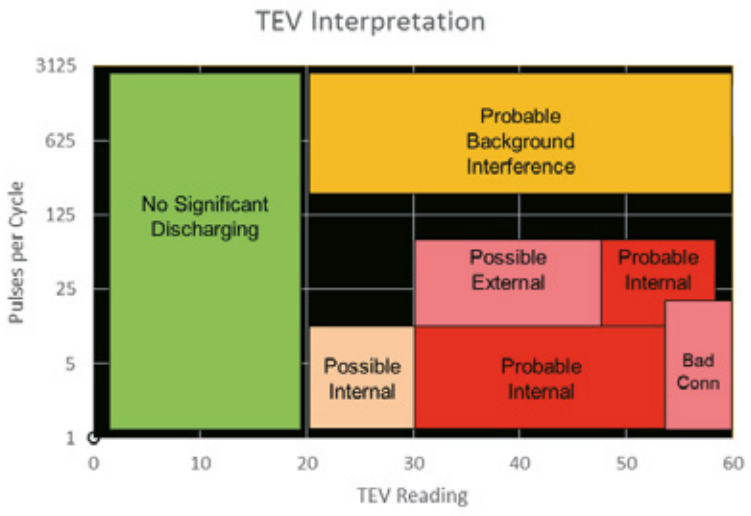
Measurement Types

Each of the UltraTEV Monitor channels collects a variety of different measurements and these are recorded in the summary table. The following table explains what each of these different measurement types is.

Maximum Level	This is the maximum of the Maximum Amplitude (dB for TEV, pC for Cable PD) of samples.
Average Level	This is the average of the Mean Amplitude (dB for TEV, pC for Cable PD) of samples.
Maximum PPC	This is the maximum of the Maximum Pulses Per Cycle of samples.
Average PPC	This is the average of the Mean Pulses Per Cycle of samples
Total 1st Count	This is the total of the First Counts of the samples
% Total Events	This is the Total First Count for the channel divided by the Total number of pulses detected by the system. Note that the total number of pulses detected by the system is the sum of TEV or Cable PD event count of the samples.
% 1st Count	This is the percentage of the total number of pulses that this channel detected first.
Maximum STS	This is the maximum of the Maximum Short Term Severity of samples.
Average Overall Severity	This is the average of the Overall Severity of the samples.

Interpreting the Data

- Investigate previous failures
- Is there a common failure mode
- Check previous results
  - Same switchboard
  - Similar switchboards
- Compare against specific information
- Compare against general information
- Maximum Level of Partial Discharge
- Maximum Short Term Severity
- Long Term Severity
- Working Voltage
- Equipment component
- History of failures, if any
- Circuit importance.



Setting Alarms

The creation of alarms can be undertaken on either the device or the web-portal in exactly the same manner.

There are a couple of actions that can be performed on each node, detailed below see figure 10.

- View Channels – View the channels that are connected to this node
- View Alarm Summary Report – View a summary of all alarms for this particular node (UltraTEV Cloud Only)

There are again a couple of available options, detailed below see figure 11

- Edit Alarm Settings – Create, edit, delete or copy a specific alarm setting
- View Alarm Summary Report – View a summary of all alarms for this particular channel (UltraTEV Cloud Only).

There are again a couple of available options, detailed below and see figure 12.

- Edit Alarm – Edit the alarm settings
- Copy Alarm – Copy the selected alarm to different channels
- Delete Alarm – Deletes the selected alarm.

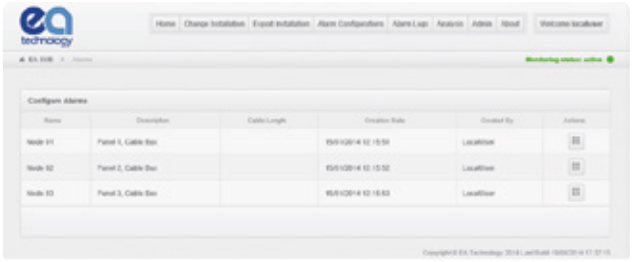


Figure 10: Connected nodes view

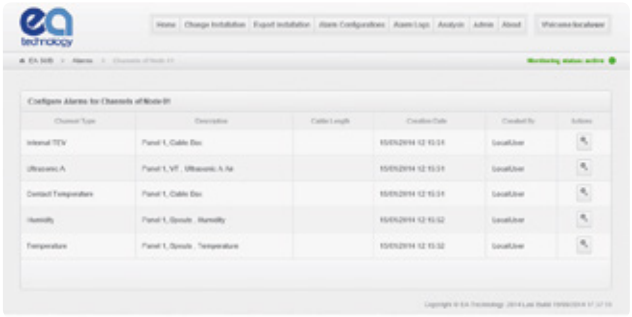


Figure 11: Viewing the channels for a node

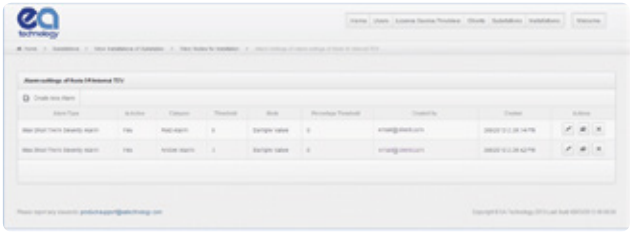


Figure 12: Configured Alarms

Alarm Types

The fields in the dropdown list use short names that match to different data recorded or calculated for the different types of channels in the system as listed below:

Max Amplitude	The maximum amplitude for TEV channels.
Mean Amplitude	The mean amplitude for TEV channels.
Max Level	The maximum amplitude for CPD channels.
Mean Level	The mean amplitude for CPD channels.
Max Pulses Per Cycle	The maximum pulses per cycle for TEV and CPD channels.
Mean Pulses Per Cycle	The mean pulses per cycle for TEV and CPD channels.
Max Short Term Severity	The maximum short term severity for TEV and CPD channels.
Overall Severity	The overall severity for TEV channels.
First Count	The first count of TEV channels.
Trigger Count	The trigger count of TEV and CPD channels.
Mean	The mean amplitude for Ultrasonic channels.
Max	The max amplitude for Ultrasonic channels.
Reading	The reading for Contact Temperature, Temperature and Humidity channels.
Mean ALC	The mean ALC level (used for advanced diagnostics only).
Max ALC	The maximum ALC level (used for advanced diagnostics only).

Technical Specification
UltraTEV Monitor Node

TEV	
Measurement Range	0 to 60dBmV
Pass Band	3 to 80 MHz
Resolution	1dB
Accuracy	±1dB
Precedence Resolution	1ns

ULTRASONIC	
Measurement Range	-7dBµV to 68dBµV
Resolution	1dB
Accuracy	±1dB
Transducer Sensitivity	-65dB (0dB = 1volt/µbar rms SPL)
Transducer Centre Frequency	40 kHz
Transducer Diameter	16mm

CABLE PD	
Measurement Range	0 to 102,400pC
Pass Band	200 kHz to 20MHz
Resolution	50pC

INDICATORS	
Power LED	Bi-colour Red/Green LED
Status LED	Bi-colour Red/Green LED
TEV State	Bi-colour Red/Green LED
Ultrasonic State	Bi-colour Red/Green LED
Cable PD State	Bi-colour Red/Green LED

CONNECTORS	
Power and Comms Signals	2x RJ45
Ultrabus TEV Sensor	1x BNC socket
Ultrasonic Sensor	2x 5-pin Lemo socket
Cable PD Sensor	1x 3-pin Lemo socket
Humidity Sensor	1x micro USB
Aux Power Connector	1x 2-pin Lemo socket

POWER SUPPLY	
Low Voltage DC	48V, 80 mA

DIMENSIONS	
Size	155 x 135 x 55mm (6.1 x 5.3 x 2.2 inches) 382 x 260 x 100 mm (15 x 10.2 x 3.9 inches)
Weight	0.45kg (0.9lbs) 3.6kg (7.9lbs) 4.2kg (9.2lbs)

ENVIRONMENTAL	
Operating Temperature	0 to 50˚C
Humidity	0 – 90% RH non-condensing
IP Rating	53

EMC/SAFETY	
Safety Class	SELV
EMC Immunity	Industrial Levels
EMC Emissions	Industrial Levels

Portable Hub Unit

POWER SUPPLY	
Voltage In	100-230V AC (nominal)
Voltage Out	48V DC
Frequency	50-60 Hz (nominal)
Maximum Power	250W
Fusing (on hub unit)	1 x Anti-surge (T) 5A Fuse NOTE: All fuses are 5 x 20 mm cartridge type

HUB UNIT INDICATORS	
System Power	1x Green LED
UltraBus Power	1x Green LED
Monitor Health	1x Green LED
Alarm, SCADA Outputs 1-3	4x Red LED

HUB UNIT CONNECTORS	
UltraBUS	RJ45 Connector
Ethernet	RJ45 Connector 10/100/1000mb
USB	2 off USB Type-A Sockets
Auxiliary Power/Comms	3-pin IEC Connector
Power In	1x Neutrik XLR
Wi-Fi	1x RP-SMA
VGA	1x Standard Female three row DE-15
RS232	1x Male DB9
Chassis Earth	1x M4 Stud

DIMENSIONS	
Size W x L x D	306mm x 248mm x 88mm
Hub Unit Weight	3.6kg
Power Supply Weight	4.2kg

ENVIRONMENTAL	
Operating Temperature	0 – 50˚C
Humidity	0 – 90% RH non-condensing
IP Rating	30

EMC/SAFETY	
EMC Class	1
EMC Immunity	Industrial Levels
EMC Emissions	Industrial Levels

Wall Mount Hub Unit and Power Supply

POWER SUPPLY IN	
Voltage	100-230V AC (nominal)
Frequency	50-60 Hz (nominal)
Maximum Power	350W
Fusing	2x Anti-surge (T) 5A Double Pole Fusing Minimum 1000A Breaking Capacity 1x Fast (F) 100mA

POWER SUPPLY OUT	
Hub Unit Power	12V DC, Maximum 5A
Node Power	48V DC, Maximum 5.2A
Phase Reference	9V AC, Maximum 100mA, Short-circuit Protected
Fusing	1x Anti-surge (T) 7A Fuse 1x Anti-surge (T) 8A Fuse NOTE: All fuses are 5 x 20 mm cartridge type

HUB UNIT INDICATORS	
System Power	1x Green LED
UltraBus Power	1x Green LED
Monitor Health	1x Green LED
Alarm, SCADA Outputs 1-3	4x Red LED

POWER SUPPLY INDICATORS	
Power On	1x Green LED

HUB UNIT CONNECTORS	
UltraBUS	4x RJ45
Ethernet	4x RJ45 Connector 10/100/1000Mb
USB	2x USB Type-A Socket
Auxiliary Power/Comms	2x 6 Pin Lemo 1B
Power In	1x Neutrik 8 Pin speakON
Mobile Comms	2x SMA
Wi-Fi	2x RP-SMA
VGA	1x Standard Female three row DE-15
RS485	1x Male DB9
RS232	1x Male DB9
SCADA/Alarm Volt Free Output	2x Header Weidmuller SL 3.5 - 6 pin
SCADA/Isolated Inputs	1x Header Weidmuller SL 3.5 - 4 pin
Chassis Earth	1x M4 Stud

POWER SUPPLY CONNECTORS	
Power Out	1x Neutrik 8 Pin speakON
Power In	1x Neutrik powerCON TRUE1

HUB UNIT VOLTS FREE CONTACTS	
Type	4x Fully isolated SPDT
Switching Voltage	AC/DC 5V-48V
Switching Current	AC/DC 10mA – 5A
Connector	2x Weidmuller BL 3.5/4, Socket Block, Screw Terminals

HUB UNIT ISOLATED INPUTS	
Type	2x Opto-Isolated
Switching Voltage	12V-90V DC
Connector	1x Weidmuller BL 3.5/6, Socket Block, Screw Terminals

DIMENSIONS	
Size W x L x D	382mm x 260mm x 100mm (15 x 10.2 x 3.9 inches)
Hub Unit Weight	3.6kg (7.9lbs)
Power Supply Weight	4.2kg (9.2lbs)

ENVIRONMENTAL	
Operating Temperature	0 - 40˚C with 3G Modem 0 - 50˚C without 3G Modem
Humidity	0 - 90% RH non-condensing
IP Rating	30

EMC/SAFETY	
Safety Class	1
EMC Immunity	Industrial Levels
EMC Emissions	Industrial Levels

FITTINGS	
Hub Unit and Power Supply each	4x 10mm/5mm keyhole slot
Interconnecting Cable	1.1m allowing installation above or next to each other

Global Support

The UltraTEV Detector™ can be supplied and supported anywhere in the world, through our network of international sales offices and distribution partners. We provide excellent lifetime support for this system, including:

- Installation and commissioning
- Training
- Lifetime technical support
- Online data analysis and reports

Our Expertise

We provide world-leading asset management solutions for power plant and networks.

Our customers include electricity generation, transmission and distribution companies, together with major power plant operators in the private and public sectors.

Our products, services, management systems and knowledge enable customers to:

- Prevent outages
- Assess the condition of assets
- Understand why assets fail
- Optimise network operations
- Make smarter investment decisions
- Build smarter grids
- Achieve the latest standards
- Develop their power skills

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