# PDS Insight™ 2 with OLPD Manager™ User Manual

On-line Partial Discharge Handheld Test Unit with an Asset Management Application – OLPD Manager™


Title: PR12102PT-001-4 HVPD PDS Insight 2 and OLPD Manager User Manual.docx

Model:12102-1

| Issue | Date | Changes / Notes |
|---|---|---|
| 1 | 20th October 2017 | First issue |
| 2 | 22nd March 2018 | Specification updated |
| 3 | 2nd November 2018 | Updates to OLPD Manager™ for Windows and user interface screen sequence |
| 4 | 6th November 2018 | Updated laser disclaimer |



HVPD reserve the right to make changes to this manual and to the software and equipment to which this manual refers without notice. HVPD will update all registered users of the PDS Insight™ 2 with any new releases of the product manual and/or if additional appendices are added to the manual from time to time.

High Voltage Partial Discharge Ltd
128 Metroplex Business Park
Broadway, MediaCityUK,
Salford, M50 2UW
United Kingdom

Tel: +44 (0)161 877 6142
Fax: +44 (0)161 877 6139
Email: info@hvpd.co.uk
Web: www.hvpd.co.uk

UK Registered Company Number: 05948347

**Environmental Protection Announcement**

This product contains general electronic components that may be environmentally harmful if improperly disposed. Please ensure that the correct waste disposal methods are made in accordance with local environmental regulations.

The device can be returned to HVPD at the end of use for proper disposal by HVPD if the customer so requires.

# Limited Warranty

**WARRANTY**
High Voltage Partial Discharge Ltd. HVPD warrants your product will be free from defects in material and workmanship for a period of 12 months from the original date of purchase. If you discover a defect in a Product covered by this warranty you must stop using the Product immediately and notify us, within 7 days of such discovery, giving us a reasonable opportunity to inspect the Product, following which we will repair the Product at our option using new or refurbished components or if a repair is not possible, replace the item.

**EXCLUSIONS**
This warranty covers defects in manufacturing discovered whilst using the Product as recommended by HVPD. The warranty does not cover loss or theft, nor does coverage extend to damage caused by misuse, abuse, unauthorised modification, improper storage conditions, fair wear and tear, abnormal use, neglect, damage, failure to follow any instructions provided, improper transportation or storage, nor to the extent that any non-compliance of the Products results from any improper installation, handling or repair of or accident to the Products, cabling, wiring or other materials connected to the Products which have not been supplied by HVPD, any upgrade to or modification of the Products, in each case to the extent that the installation or work has not been carried out by an HVPD-Accredited Installation Engineer, lightning, flash over or natural disaster, or other event of force majeure which is beyond the reasonable control of HVPD.

**LIMITS OF LIABILITY**
Should the Product(s) fail, your sole recourse shall be repair or replacement, as described in the preceding paragraphs. We will not be held liable to you or any other party for any damages that result from the failure of this Product. Damages excluded include, but are not limited to, the following: loss of profits, lost savings, lost data, damage to other equipment and incidental or consequential damages arising from the use, or inability to use this Product. In no event will HVPD be liable for more than the amount of your purchase price, not to exceed the current list price of the Product, and excluding tax, shipping and handling charges. However, nothing in this paragraph excludes or limits the liability of HVPD for death or personal injury caused by its negligence, for any matter for which it would be illegal to exclude, or attempt to exclude its liability for or for fraud or fraudulent misrepresentation.

HVPD excludes all other warranties and terms, express or implied to the full extent permitted by law.

By installing or using this product the user accepts all terms described herein.

**HOW TO OBTAIN SERVICE UNDER THIS WARRANTY**

Contact us or our agents using one of the following methods:

High Voltage Partial Discharge Ltd.
128 Metroplex Business Park
Broadway, MediaCityUK, Salford,
Manchester
M50 2UW, UK Tel: +44 161 877 6142
Fax: +44 161 877 6139
www.hvpd.co.uk
info@hvpd.co.uk

**REQUIREMENTS**

The cost of shipping to the manufacturer, or authorised repair centre and payment of any customs clearance fees and duties are the responsibility of the user. Return shipping costs are to be paid for by HVPD.

# Contents

# 1 Scope of Supply

The PDS Insight™ 2 test kit comprises the following standard components:

PDS Insight™ 2 Handheld

Smart Docking Station

Android tablet PC with OLPD Manager™ asset management application

HFCT 100/50 Sensor

Headphones

204x Barcoded POA Labels

2-metre RG223 BNC Cable

Mains AC/DC Battery Charger
and 2x USB A – Micro B cables

A5 User Manual

A5 Quick Start Guide

Hard Shell Carry Case

## Optional Accessories

| | | ORDER CODE |
|---|---|---|
|  | HVPD Indoor Acoustic Search Probe | PDSIAP |
|  | HVPD Outdoor Acoustic Parabolic Receiver & Laser Enhancement Eyewear | PDSOPR |
|  | PDS Insight™ Accessories Carry Case | PDSACC |
|  | 102x Additional POA Labels | PDSPOA |

**NOTE** To order optional accessories contact us via email at: info@hvpd.co.uk or by telephone on +44 (0) 161 877 6142

# 2 Specification

| | |
|---|---|
| **TEV Sensor** | |
| Measurement Range (Peak) | 0 – 70 dBmV |
| Measurement Range (Cumulative Activity) | 0 – 350,000 mV/cycle |
| Frequency Response | 5 – 60 MHz |
| Resolution | 1 dB |
| Accuracy | ±1 dB |
| **HFCT Sensor** | |
| Measurement Range (HFCT 100/50, $Z_{tr}$=3.9) | 100 pC – 100 nC |
| Measurement Range (Cumulative Activity) | 200 pC/cycle – 20,000 nC/cycle |
| Frequency Response (-3 dB response) | 100 kHz – 20 MHz |
| Resolution | 1 dB |
| Accuracy | ±1 dB |
| **AA Sensor** | |
| Measurement Range | 0 – 70 dBµV |
| Centre Frequency | 40 kHz |
| Resolution | 1 dB |
| Accuracy | ±1 dB |
| Gain stages | 1 |
| **Phase Resolved PD (PRPD)** | |
| Synchronisation Methods | Optical/Mains Field Detector/BNC input (selectable) |
| PRPD Plot Types | 2D & 3D |
| **Hardware** | |
| Enclosure | Polycarbonate ABS / TPE |
| Display | 3.5” 320x240 65k colour LCD |
| Control | 5 button membrane keypad |
| I/O Connections | BNC (HFCT), LEMO (external AA), USB Micro B (charger), 3.5mm Jack (headphones) |
| **Operating Environment** | |
| IP Classification | IP 54 |
| Temperature | -20 ºC to +55 ºC |
| Humidity | 0 – 90 % RH non-condensing |
| **Power** | |
| Internal Battery | Lithium-ion, 3.7 V, 4.5 Ah |
| Operating Time | Approx. 8 hours |
| Charge Time from Empty | Approx. 4 hours |

| | |
|---|---|
| **Battery Charger** | |
| Input ($V_{in}$) | 90 – 264 V, AC, 50/60Hz, max: 0.5A |
| Output ($V_{out}$) | 5 V DC (USB 1x 1A, 1x 2A) |
| Country Adapters | UK, EU, AU, USA |
| Operating Temperature | 0 ºC to 40 ºC |
| Humidity | 10 – 90 % RH non-condensing |
| **10.1" Android Tablet (minimum specification)** | |
| Processor | Quad-core Processor |
| Display | 10.1" LED WXGA (1280x800) |
| Camera | 2 MP |
| RAM | 1 GB |
| On-board Memory | 8 GB |
| Charging/PC connection | Micro USB B |
| Communications | Bluetooth®, Wi-Fi (WLAN802.11 b/g/n) |
| Battery Life | Up to 8 hours |
| **OLPD Manager™ Application** | |
| Operating System | Android™ (tablet) and Windows® 7/8/10 (PC) |
| Functionality | Bluetooth® synchronisation with PDS Insight™ (tablet), USB synchronisation with PDS Insight™ (PC), associate POA barcodes to physical plant/cables, store details of plant/cables under test, store photos of test site alongside measurement and plant |
| Results Display | Graphical representation of PD levels in the substation, trending graphs, summary tables, PRPD patterns |
| Report format | Microsoft® Excel® |
| Multiple Languages | Yes |
| **Dimensions** | |
| Size | HANDHELD: 227 mm x 122 mm x 75 mm; CARRY CASE: 310 mm x 355 mm x 245 mm |
| Weight | HANDHELD: 0.58 kg; FULL KIT IN CARRY CASE: 4.9 kg |

# 3 Important Safety Information

**DANGER**

**Always follow the high voltage (HV) network owner's specific site safety rules.**

**If you think that the substation or site is not safe, do not proceed with testing and contact the network owner/operator with your concerns.**

**WARNING** Before you use the PDS Insight™ 2 and its sensors in a substation or switchyard, you must read this manual and understand how to use the test unit properly and safely.

## 3.1 Before You Enter the HV Substation or Switchyard

Before you enter a substation or switchyard, and during your time inside, you should always obey this additional safety advice:

Listen for unusual sounds (such as fizzing or crackling).

Look for signs of damage or third-party entry.

Smell the air for any evidence of burning or ozone.

Before attaching the split-core HFCT sensor to a power cable, ensure that the power cable is earthed correctly.

## 3.2 Before You Use the PDS Insight™ 2 in an MV/HV Substation or Switchyard

Before you perform any test you must perform a background noise measurement for the substation or switchyard. See Section 7.

When you use the PDS Insight™ 2 you must always obey these safety rules:

The unit is for use on earthed metal-clad plant and cables. Always ensure that the safe minimum working distances for the voltage level of the plant under test are maintained at all times.

Never use damaged equipment – all damaged units must be returned to HVPD for repair or replacement.

Always make sure that the battery of the PDS Insight™ 2 unit is at least 75% charged before testing.

Always choose the appropriate sensor and sensor connections for the test application (as described in this manual) ensuring safe connection to the plant.

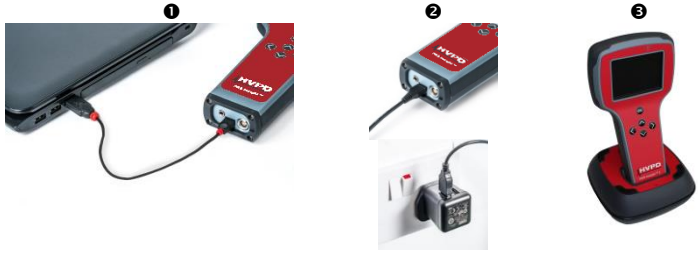
When you use the supplied charger and the external HFCT sensors or accessories, make sure that the coaxial signal cables do not pose a tripping hazard.

The laser pointer of the HVPD Outdoor Acoustic Parabolic Receiver is a Class 3B laser operating at 650 nm and is used to aid targeting of the PD location. DO NOT stare into the laser pointer or its reflections. DO NOT direct the laser at anyone. HVPD accept no responsibility for the misuse of the supplied laser pointer by the user.

# 4 How to Charge the Batteries of the PDS Insight™ 2 and Tablet PC

Before the first use, the user should fully charge the batteries of the both the *PDS Insight™ 2 handheld* and *Android tablet PC*, using either:

1. **USB + PC** – connect the PDS Insight™ 2 handheld and the Android tablet to a PC with the supplied USB charger cables.
2. **Mains** – connect the PDS Insight™ 2 handheld and the tablet to the mains power supply with the supplied mains charger (110–240 V AC 50/60 Hz).
3. **Docking Station** – Place the PDS Insight™ 2 in the supplied docking station (USB connection or 12–24 V DC).



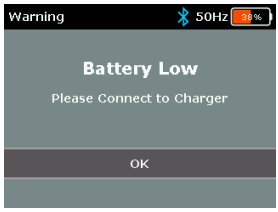

| | |
|---|---|
| **NOTE** | Only the battery charger supplied with the PDS Insight™ 2 handheld should be used to charge the unit. When the unit is charging, do not use or perform function checks on the handheld. |

**To Fully Charge the PDS Insight™ 2 Handheld Battery**

Connect the PDS Insight™ 2 to one of the three power source options for at least 4 hours.

With normal use you should look to recharge the PDS Insight™ 2 handheld every 24 hours.


If the battery level is below 25%, the PDS Insight™ 2 will emit a beep and displays a 'Battery Low' warning meaning that a recharge is required.



# 5 Introduction

## 5.1 Overview

The ***PDS Insight™ 2*** world-leading handheld test technology combines HVPD's knowledge from over 20 years of OLPD test technology development with the flexibility and functionality of the Android™ operating system and a 10.1" Tablet PC. The software is also compatible with Windows PCs, allowing data to be transferred for further analysis.


The PDS Insight™ 2 measures ***PD Levels***, ***PD Pulse Count*** and ***Cumulative PD Activity*** across the 50/60Hz power cycle to enable the severity of any partial discharge activity to be assessed. By combining three (3) types of PD sensor (TEV, HFCT and AA), the unit is suitable for the OLPD testing of most types of in-service medium voltage (MV) cables and plant and the surveying of outdoor high voltage (HV) switchyards.

Suitable for OLPD testing of power cables, switchgear, rotating machines and transformers, the handheld unit stores all measurement data that is then synchronised ('synced') via Bluetooth® to **the *OLPD Manager™ app*** on the supplied tablet 10.1" PC for ***analysis, benchmarking*** and ***trending***.

**NOTE** See section 5.2 to find out more about *PD Levels, PD Pulse Count and Cumulative PD Activity.*

**Features**

- Supplied with a 10.1" Android™ tablet PC with the OLPD Manager™ asset management application.
- Incorporates three OLPD sensors: TEV, HFCT & AA.
- Detects electromagnetic radiation from PD in metal-clad plant (TEV), current impulses from PD in cables and accessories (HFCT), and ultrasonic radiation from PD into air from air-insulated switchgear (AIS) and outdoor HV plant (AA).
- Combines PD Level, PD Pulse Count and Cumulative PD Activity measurements across the 50/60Hz cycle.
- Phase resolved PD (PRPD) patterns allow for differentiation of PD defects.
- An in-built barcode scanner is used with sensor POA barcode labels for automatic repeat testing.
- The unit displays data on a 3.5" colour LCD screen.
- Supplied with 3M™ PELTOR™ HT™ Series Listen Only Headset as standard (to listen to airborne acoustic (AA) PD activity in noisy environments).
- Supplied with a Smart Docking Station for charging, data download and function checking of the unit.
- Onboard data storage for quick testing and Bluetooth® communication to the Android™ Tablet PC for post-test data analysis, benchmarking and trending.
- All measurements can be downloaded into a CSV file to enable filtering measurements and peak values.
- The peak graph recorded with the HVPD PDS Insight™ 2 can be displayed and recalled on the tablet.
- 13 Languages options: English, Chinese, French, German, Polish, Portuguese, Russian, Korean, Spanish, Turkish, Vietnamese, Japanese and Arabic.

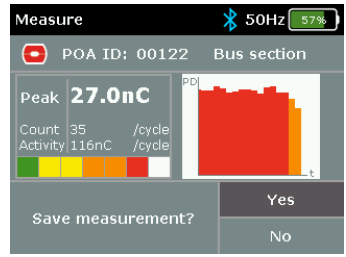
**Benefits**

- Easy-to-use, lightweight and portable handheld test unit.
- The OLPD Manager™ app on the 10.1” Android™ tablet PC makes it easy to setup a test record and to carry out repeat testing and trending.
- Designed for rapid OLPD screening of medium voltage (MV) and high voltage (HV) assets.
- Ensures the safe and reliable operation of HV networks, providing an ‘early warning’ against ‘incipient’ faults.
- The unit’s barcode scanner retrieves sensor location ID from the Point of Attachment (POA) labels automatically.
- All data between the PDS Insight™ 2 handheld and the Android™ tablet is synchronised (‘synced’) via Bluetooth®.
- Variations in PD levels in time can be viewed in real-time on the PDS Insight unit's 3.5” colour LCD screen with a standard 5-second recording of OLPD activity.
- Optional accessories include the Outdoor Acoustic Parabolic Receiver Extension Unit (for detecting corona and surface discharges in outdoor HV switchyards) and the Indoor Acoustic Search Probe (to extend the reach that the unit can detect airborne acoustic activity along the seams/gaps in MV switchgear).
- Asset operators and managers with multiple sites and multiple HVPD PDS Insight™ 2 units can now back up and share data across all tablets to provide an asset management global view.

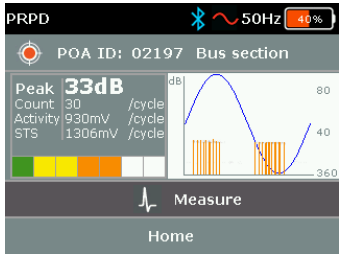
## 5.2 On-line Partial Discharge (OLPD) Measurements

The PDS Insight™ 2 measures on line partial discharge (OLPD) levels from three sensors, a Transient Earth Voltage (TEV) sensor, a high frequency current transformer (HFCT) sensor and an airborne acoustic (AA) sensor.

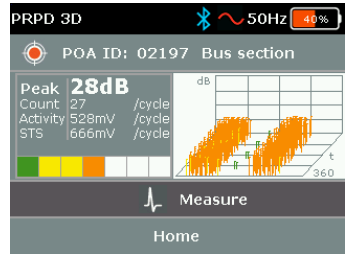

**Real-time data measurements**




**5-second results**




**PRPD data measurements**




**3D PRPD data measurements**

**The PDS Insight™ 2 OLPD Sensors and detection methods**

**Transient Earth Voltage (TEV) sensor**

The TEV sensor detects electromagnetic (EM) radiation from 'local' partial discharge in switchgear and other metal-clad plant. These discharges induce a transient voltage wave onto the plant housing that can be detected by the PDS Insight™ 2 unit's TEV sensor placed on the outer surfaces of metal-clad plant. Measurements are made in *millivolt decibels* (0-70 dBmV).

**High Frequency Current Transformer (HFCT) sensor**

HFCT sensors detect the current impulses from partial discharge in cables and plant that is remotely connected at the end of the cable. The sensor can be attached either to the cable earth or around the cable core + cable earth return. Measurements are made in *pico Coulombs* (pC) and *nano Coulombs* (nC) with a measurement range of 100pC to 100nC.

**In-built Airborne Acoustic (AA) sensor**

The AA sensors are used to detect ultrasonic radiation from discharges into air, such as surface discharges from within air-insulated MV switchgear and corona in outdoor HV switchyards. Measurements are made in *microvolt decibels* by the unit across the range of 0–70dBµV.

**The PDS Insight™ 2 measures three main key indicators of PD:**

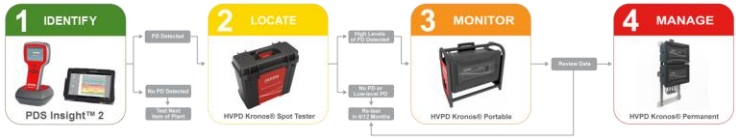
- **Peak PD Level:** the magnitude of the largest PD pulse
- **PD Count:** the number of PD pulses occurring in a 50/60 Hz power cycle
- **Cumulative PD Activity:** the sum of all the PD pulses across a power cycle
- **Phase Resolved PD (PRPD) Patterns:** indicative of the type of PD defect

These measurements are all made simultaneously throughout the 5-second measurement time by the unit.

| | |
|---|---|
| **NOTE** | The unit measures Peak PD level, PD Count and Cumulative PD activity for both the HFCT and TEV sensor measurements. However, with the AA sensor the unit only measures Peak PD level as cumulative measurements are not appropriate for airborne acoustic signal detection. |

## 5.3 Using the PDS Insight™ 2 and OLPD Manager™ to apply Condition Based Maintenance (CBM).

The PDS Insight™ 2 handheld and the OLPD Manager™ app are used in ***Phase 1*** of HVPD's ***4-Phase OLPD Condition Based Asset Maintenance Solution*** illustrated below**.** Phase 1 involves quick, low-cost OLPD screening of large numbers of medium voltage (MV) and high voltage (HV) assets and enables plant owners to identify those assets that require further diagnostic testing (Phase 2), OLPD monitoring (Phases 3 and 4) and/or preventative maintenance action.

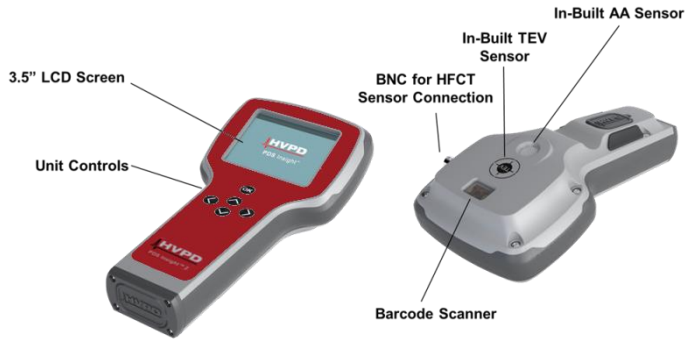



Regular testing with the PDS Insight™ 2 handheld can provide an ***'early warning'*** of ***'incipient'*** MV and HV insulation faults. Measurement results are colour-coded to provide easy-to-understand ***'OLPD Criticality'*** levels to identify plant which requires further diagnostic OLPD testing, PD source location and OLPD monitoring in Phases 2, 3 and 4.

| GREEN | YELLOW | ORANGE | RED |
|---|---|---|---|
| **No/Low PD** | **Moderate PD** | **Moderate-to-High PD** | **High PD** |
| Re-test in 6-12 months. | Re-test in 3-6 months. | Investigate the source of the PD using a diagnostic OLPD test unit. Locate the source and review data. | Test to urgently determine the cause of PD, locate the source of the PD and continuously monitor the PD activity |

**NOTE** Whilst the guidelines and recommendations given in the table above and in this manual are based on HVPD's experience from over 20 years of OLPD testing, the user should note that the recommended actions in the table above are provided as ***guidelines only***. For further technical information about partial discharge refer to Appendix A: *Introduction to Partial Discharge Measurements*.

## 5.4 PDS Insight™ 2 – Overview




| Functionality | Description |
|---|---|
| **Turn on** | Press and hold OK for one second until the **Welcome Screen** appears. |
| **Turn off** | Press and hold OK until the screen switches off. |
| **Move between screens** | Press ◀ or ▶. |
| **Select buttons and fields** | Press ▲ or ▼. |
| **Choose selected fields and buttons** | Press OK. |
| **Change settings** | In the **Home Screen** press ◀. |

## Languages

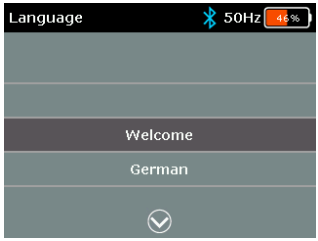
The unit has thirteen (13) languages options:

- English
- Chinese
- French
- German
- Korean
- Polish
- Portuguese
- Russian
- Spanish
- Turkish
- Vietnamese
- Japanese
- Arabic

The default language is English and to change the displayed language from this:

1 Press ◀ to access **Settings,** then scroll down to **Language** using ▼ and press OK.

Choose the preferred language.




2 Choose the **Set as Default** setting to save the language choice for future use.

## Settings

| Setting | Icon | Description |
|---|---|---|
| **Choose Substation** |  | Select and choose an existing substation from the list provided. |
| **Function Check** |  | Check if the handheld and its sensors operate correctly. |
| **Bluetooth®** |  | Turn Bluetooth® communication on. |
| **Pair Bluetooth®** |  | Connect the handheld with the tablet. |
| **New File** |  | Create a new measurement file. |
| **Power Frequency** |  | Choose between 50 Hz and 60 Hz power cycle. |
| **Volume** |  | Adjust the sound level of the internal speaker and headset from 1-10 (default level 5). |
| **Key Volume** |  | Adjust the sound level of the unit's control keys (default level 5). |
| **Date** |  | Set the current date. |
| **Time** |  | Set the current time. |
| **Screen Brightness** |  | Adjust the screen brightness from 1-10 (default level 5). |
| **About** |  | View the handheld's serial number, software version, software installation date and recalibration date. |
| **Language** |  | Change the display language (13 options). |
| **PRPD Settings** |  | Change the settings for PRPD |

## PRPD Settings

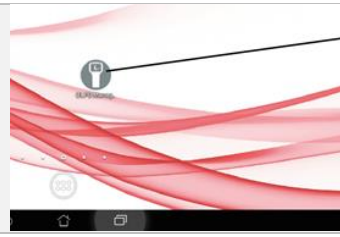
| Setting | Icon | Description |
|---|---|---|
| **Sync Type** | | Select sources for 50/60Hz synchronisation. Light: internal photodiode. Coil: internal mains field detector. BNC: BNC input. |
| **Colour Depth** |  | Select data point colour on PRPD graphs. 1: black, 8:greyscale. |
| **Peaks** |  | Select between lines and dots for PRPD graph points. |
| **Scale Factor** |  | Used for scaling results. Default 1. |
| **Resolution** |  | Select between low and high resolution of points on X axis |

## Status Icons

| Icon | Description |
|---|---|
| **50Hz / 60Hz** | Shows the power frequency mode. |
|   | Shows the PDS Insight™ 2 unit's battery level %. |
|  | Confirms Bluetooth® is on and paired with the tablet. |
|  | The USB data cable from the PDS Insight™ 2 is connected to a PC. |
|  | Mains sync |

## 5.5 Tablet with OLPD Manager™ App

### Overview

| Functionality | Description |
|---|---|
| **Turn the tablet on** |  Hold power button for two seconds |
| **Turn the tablet off** |  Hold power button for two seconds and select **Power Off** and **Ok** |
| **Load the OLPD Manager™ app** |  Select icon |

## Tablet/OLPD Manager™ App Icons

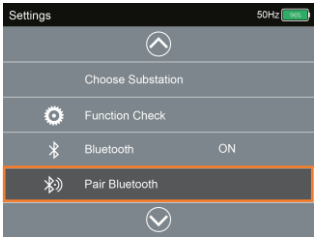
| Icon | Description |
|---|---|
|   | Create a new site/substation in the OLPD Manager™ app. |
|   | Get a guide to testing a substation in the OLPD Manager™ app. |
|   | View the results for a site/substation in the OLPD Manager™ app. |
|  | Android/Tablet settings. |
|  | Site with multiple substations. |
|  | The location of the substation. |
|  | A substation. The colour indicates the average peak reading over all of the results stored. |
|  | Transient Earth Voltage (TEV) sensor icon (see section 6 for further details). |
|  | Airborne Acoustic (AA) icon (see section 6 for further details). |
|  | High Frequency Current Transformer (HFCT) (see section 6 for further details). |
|  | Peak PD (see section 5.2 for further details). |
|  | PD Count (see section 5.2 for further details). |
|  | Cumulative PD Activity (see section 5.2 for further details). |
|  | Help – tap on this for more information (shown on screen). |
|  | Upload the substation setup data to the PDS Insight™ 2 unit. |
|  | Measurement file from the PDS Insight™ 2. |
|  | Delete the POA data from the switchgear panel and the OLPD Manager™ app. |
|  | 5 second peak measurement. |
|  | PRPD graph |

## 5.6 How to ‘Pair’ the PDS Insight™ 2 Handheld with OLPD Manager™ App Using Bluetooth®

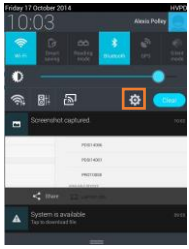
For the PDS Insight™ 2 and the OLPD Manager™ app to automatically synchronise substation information and measurement results, ***you must ensure*** that they are ‘paired’ with each other.

To ‘pair’ the devices:

1 Activate Bluetooth® on the PDS Insight™ 2. Press ◀ to access **Settings,** select **Pair Bluetooth®** and press OK.



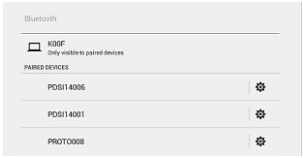

2 Activate Bluetooth® on the tablet. Swipe down from the top of the screen and tap the **Bluetooth® ( )** icon. In the same window tap ⚙.




3 Make sure Bluetooth® is ON.

Check in the **PAIRED DEVICES** list if the serial number of your PDS Insight™ 2 is already there.

- If it is, you do not have to pair it again.
- If not, go to step 4.



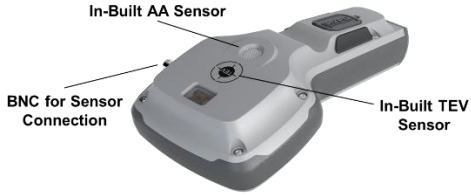

4 Tap **SEARCH FOR DEVICES** in the top right corner of the screen. Choose the serial number of your PDS Insight™ 2 from the **AVAILABLE DEVICES** list.

On the PDS Insight™ 2, choose **Accept.**
In OLPD Manager™, choose **Pair**.

# 6 How to Select and Use On-line Partial Discharge (OLPD) Sensors

## 6.1 OLPD Sensor Selection Guide

The unit's OLPD sensors detect partial discharge (PD) activity within in-service cables, switchgear, transformers, rotating machines and other MV/HV plant to enable an ***insulation condition assessment*** of the asset under test to be made.




It is imporant to choose the correct sensor for each measurement.

| | | Asset Under Test | | | | |
|---|---|---|---|---|---|---|
| | | Power Cables | Metal-Clad Air-Insulated Switchgear and Plant | Remotely Connected Plant | Outdoor Switchyards | Overhead Lines |
| Sensor | **HFCT** [1] | ⊙ | ○ | ⊙ | ○ | ○ |
| | **TEV** | ○ | ⊙ | ○ | ○ | ○ |
| | **AA** | ○ | ⊙ | ○ | ○ | ○ |
| | **AA with Indoor Acoustic Probe** | ○ | ⊙ | ○ | ○ | ○ |
| | **AA with Outdoor Parabolic Dish** | ○ | ○ | ○ | ⊙ | ⊙ |

⊙: suitable ○: unsuitable

To make safe measurements of in-service plant you must know how to use each sensor correctly and safely whilst always abiding by the MV/HV network owners safety rules.

[1] The unit is compatible with a wide range of HVPD HFCT sensor types including the HFCT50, HFCT75, HFCT100, HFCT100HC, RFP100, RFP100HC, HFCT140, HFCT140HC, HFCT220. Contact HVPD for further details of our HFCT sensor range.

## 6.2 How to Use the Unit's TEV Sensor

The unit's Transient Earth Voltage (TEV) sensor is designed to measure 'local' PD in metal-clad switchgear and other plant. The TEV sensor detects EM radiation that induces a transient earth voltage onto both the inside and outside of the metal-clad equipment. If double-skinned switchgear is to be tested then it is necessary to perform the measurement on the inner skin of the switchgear.

**Correct Placement**

Place the PDS Insight™ 2 unit's TEV sensor flat against the outside of the metal-clad switchgear or other plant. It is normal to make three (3) TEV measurements per switchgear panel, at the top (bus), middle (main housing) and bottom (cable box).

## 6.3 How to Use the AA Sensor

The Airborne Acoustic (AA) sensor detects discharges into air and is suitable for testing air-insulated switchgear and other air-insulated plant. The PDS Insight™ 2 unit has a demodulated output so the user can listen to any acoustic activity with the 3M™ PELTOR™ HT™ Series Listen Only Headset supplied with the unit.

**External Accessory**

Connect the external noise cancelling headset to the PDS Insight™ 2 handheld via the 3.5 mm jack at the bottom of the unit as shown opposite.

3.5 mm Headset Jack

**Correct Placement**

The AA sensor requires a 'line-of-sight' to the source of the airborne discharge and so it is necessary to place the sensor over any openings in the switchgear panel (i.e. a vent, seam, gasket, etc.).

## 6.4 How to Use the Unit's Split-core HFCT Sensor

The High Frequency Current Transformer (HFCT) sensor is used to measure PD activity in cables and remotely connected plant. The split-core sensor is normally attached to the earth-strap of the power cable, or the cable and earth return as shown below.

**NOTE** In order to make a measurement the following is required:

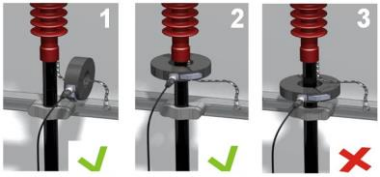
- There must be independent access to either the earth-straps or the cores of the cables at the asset under test.
- There must be an **insulated gland** between the cable earth screen and switchgear/plant cable box earth.

**External Accessories**

The 2m coaxial BNC cable connects the HFCT sensor to the PDS Insight™ 2 unit.

**Correct Connection**

Connect the HFCT sensor as per ❶ or ❷ below (See Appendix B).




## 6.5 How to Use the Unit with Permanently Installed HFCT Sensors

The PDS Insight™ 2 can be used to test cable circuits where permanent HFCT sensors have been installed to measure PD at any time without the need for an outage. HVPD supply a wide range of permanent HFCT sensors with sensor termination boxes (as shown below). The 2m coaxial cable is used to connect the output(s) from each HFCT the PDS Insight™ 2 unit.

**External Accessory**

2m Coaxial Cable

**Correct Connection**

1. Use the 2m coaxial BNC cable to connect the PDS Insight™ 2 to the sensor termination box.
2. Disconnect the coaxial cable after use.

## 6.6 How to Use the Unit's AA Sensor with the Indoor Acoustic Search Probe

The Indoor Acoustic Search Probe helps the user to measure PD in MV air-insulated switchgear where it is difficult to access vents and seams where the acoustic signals emanate from inside the switchgear.

**External Accessories**
Connect the headset and the Indoor Acoustic Search Probe to the PDS Insight™ 2.


**What to do**
Hold the search probe over any gaps, seams or vents in the air insulated switchgear.

## 6.7 How to use the AA Sensors with Outdoor Parabolic Receiver

The Outdoor Parabolic Receiver helps the user to measure surface discharge and corona from overhead outdoor insulation in outdoor high voltage (HV) switchyards. To detect PD accurately on outdoor HV plant under test, press and hold the laser pointer button on the receiver's handle to position the laser pointer onto the insulation.

**External Accessories**
Connect the Outdoor Parabolic Receiver and the headset to the PDS Insight™ 2.

**What to do**
Point the parabolic receiver to the asset under test using the laser pointer to make a measurement.

The maximum measurement distance is around 20 metres.

| **Note** | Background noise may be higher when using external probe/parabolic receiver. |
|---|---|

# 7 How to Measure Background Noise

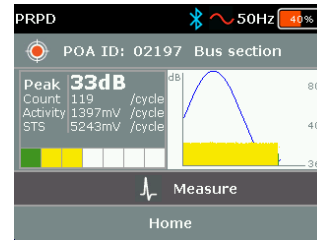
Electromagnetic (EM) interference can affect the PDS Insight™ 2 unit's TEV measurements. To ensure that the OLPD measurements to be made are reliable and not subject to EM noise it is important to perform a ***background noise measurement*** when you enter a substation.

To measure the background noise level:

1 Place the PDS Insight™ 2 TEV sensor flat against an earthed metal surface that is not part of the high voltage plant, for example a metal door.


2 Measure the background noise TEV level. If this background level is higher than 20 dB then proceed with caution and try to investigate and locate the cause of the high background EM noise measurement.


3 This level can be more easily recognised as noise using PRPD if a flat level is observed over the power cycle.



# 8 Mains Synchronisation

To make PD measurements in the PRPD and 3D PRPD modes the unit should be synchronised to the 50/60 Hz voltage of the plant under test. This can be achieved by one of the following means: The synchronisation method is selected in the PRPD settings menu item.

- Internal mains field detector – this is built into the unit and detects 50/60 Hz magnetic fields; the unit should be placed close to the plant under test to detect this.

- Internal photodiode – this detects flicker from lights that is synchronous to the 50/60 Hz. The mains power to the lights should be synchronous to the high voltage of the equipment under test. The sensor is above the display and must not be covered.

# 9 Testing a Complete Substation with PDS Insight™ 2 and OLPD Manager™ App

The PDS Insight™ 2 uses the OLPD Manager™ app to link the assets under test to the sensor point of attachment (POA) labels. The user enters the asset details in the OLPD Manager™ app on the tablet prior to testing. This data is then uploaded to the PDS Insight™ 2 handheld to guide the user through the measurements in the substation.

## 9.1 Summary

1 Set up a **'New Site'** in OLPD Manager™

See section 9.2.


2 **Upload your 'New Site'** data to the PDS Insight™ 2

See section 9.3.

3 **Perform the guided PDS Insight™ 2 measurements** in the new substation.

See section 9.4.

4 **Download the measurement results** back to the OLPD Manager™ on the tablet PC.

See section 9.5.

## 9.2 Set up a Substation in the OLPD Manager™

The OLPD Manager™ app records and stores substation details for the PDS Insight™ 2 to guide the user through the measurements. Prior to testing, the substation must be set-up using the OLPD Manager™ app as a ***New Site***. The app creates a database containing all of the information and produces the list of POA numbers for the test. The substation then needs no additional set-up when it is re-tested in the future to enable trending measurements to be made.

**NOTE** Only ASCII characters are recognised on the PDS Insight™ (for substation names etc.).

1 On the OLPD Manager™ home screen tap on '**New Site'**. Enter the substation name and location.

**NOTE** Use the on-screen keyboard to enter test site information into OLPD Manager™

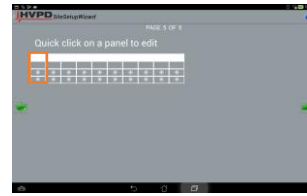

2 Complete the required fields, choosing a default switchgear type that will be applied to all switchgear panels in the substation. This switchgear type can then be altered on a panel by panel basis for different switchgear panel types (Step 5).


3 Answering the questions with Yes/No highlights the recommended Point of Attachment (POA) template. The POA template displays the list of POA labels per panel that will be used for the repeatable measurements on each switchgear panel.


4 Using the barcoded POA labels supplied, enter the number of the first label (POA XXXXX) in to the POA Number field.

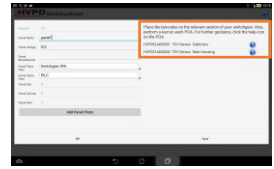
The OLPD Manager™ app then automatically assigns individual POA labels to individual measurement points on the asset.

5 Tap on the first panel in the switchgear line-up to set up the specific test information for that panel as requested.

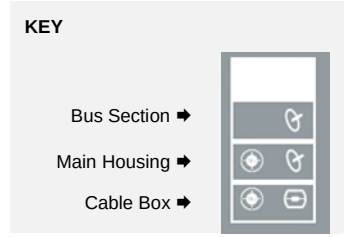



**5a** Adjust the defaults in the panel information.

The table on the right of the screen in the OLPD Manager™ app lists how many POA labels you need and where to place them.

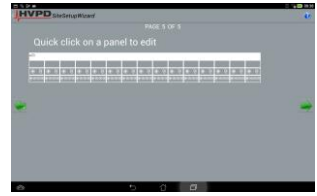


**5b** Affix the POA labels onto the panel.

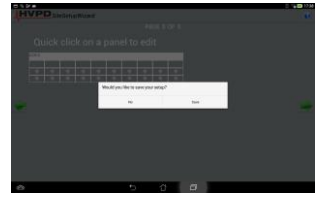




6 Tap on the next panel in the line-up and repeat steps **5a** and **5b**.

| | |
|---|---|
| **NOTE** | If the line-up does not all fit on the screen, swipe from right to left. |




7 After you have set up all the panels in the line-up, tap **Save and Upload** to save the set-up the data ready for synchronising to PDS Insight™ 2 via Bluetooth.




The new site/substation and all of the POA details are now saved to the OLPD Manager™ app database. Go to section 9.3.

## 9.3 Upload Substation Setup Data to the PDS Insight™ 2

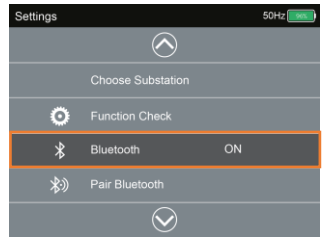
The PDS Insight™ 2 handheld unit requires the New Site substation information to guide the user through the measurements.

To synchronise the substation information between the OLPD Manager™ app and the PDS Insight™ 2 handheld:

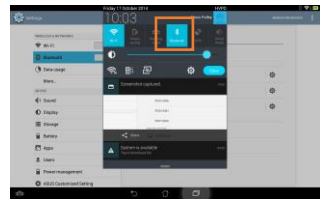
1 Activate Bluetooth® on both devices (note: the PDS Insight™ 2 handheld and the Android tablet should already be paired – if not, see section 5.6 on how to do this).

**1a PDS Insight™ 2:**

Press ◀ to access **Settings,** then scroll down to **Bluetooth** using ▼ and press OK to switch to 'ON'.




**1b Tablet:** Swipe down from the top of the screen to activate the **Settings** menu. Make sure that Bluetooth® is active (it should be highlighted).



2 In the OLPD Manager™ app choose your PDS Insight™ 2 device from the list and press **Connect**.

**NOTE** If you cannot connect, see section 14.

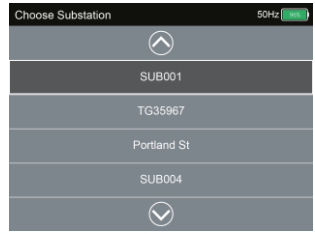
3 Open the list of substations by choosing the site, then tap on your substation to upload it to the PDS Insight™ 2 handheld unit.

## 9.4 Perform a Guided Test with the PDS Insight™ 2 in a Substation

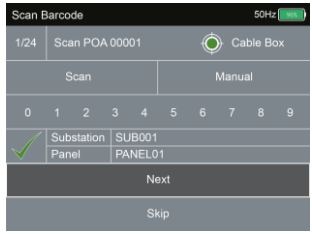
The PDS Insight™ 2 provides step by step advice as to which point of attachment (POA) to test and which sensor to use for each measurement.

To perform a guided test in your substation:

1 Press ◀ to access **Settings,** then select **Choose Substation**, select new substation from the list and press OK.




2 The PDS Insight™ 2 displays the POA label that you must use for the test.

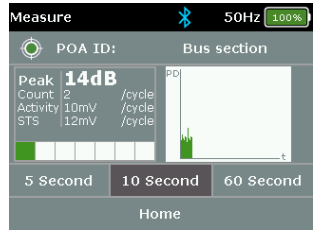



Direct the PDS Insight™ 2 handheld unit's barcode scanner onto the POA label and choose **Scan**.

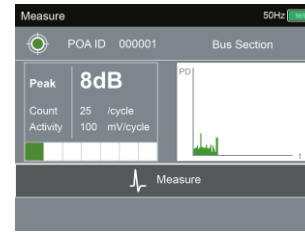
| | |
|---|---|
| **NOTE** | If you cannot scan the POA label using the barcode scanner for any reason, choose **Manual** and select numbers individually to enter the POA number. |

3 The PDS Insight™ 2 handheld displays the sensor that you must use for this POA.

Choose the desired length of measurement for this test, and press OK.



4 Select **Measure.** The PDS Insight™ 2 handheld unit measures for the selected time and will emit a beep when complete.

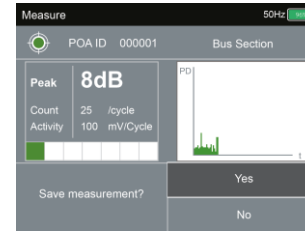



5 Select **Yes** to save the measurement. Then select one of the following:

**1** To repeat the measurement choose **Retest.**

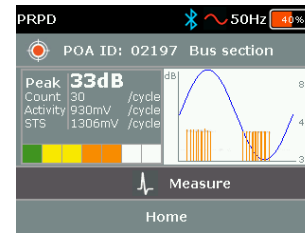
**2** To cycle between Measure, Measure PRPD or Measure PRPD 3D for this POA, select ❯ until the desired screen is active.

**3** To measure at the next POA choose **Next**.



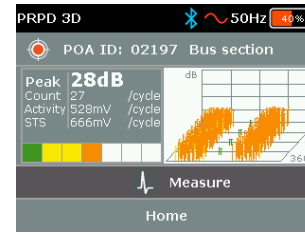

6 From the Measure screen, selecting ❯ will enter the PRPD measurement screen.

Choose the desired length of measurement for this test, and select **Measure**. The PDS Insight™ 2 handheld unit measures PRPD for the selected time and will emit a beep when complete. Repeat step 4.




7 From the PRPD measurement screen, selecting ❯ will enter the PRPD 3D measurement screen.

Choose the desired length of measurement for this test, and select **Measure**. The PDS Insight™ 2 handheld unit measures PRPD for the selected time and will emit a beep when complete. Repeat step 4.




8 Repeat steps 2–4 until all POAs in the substation have been tested and the PDS Insight™ 2 handheld unit displays ‘Test Complete’.

## 9.5 Download Measurements Results from the PDS Insight™ 2 Handheld to the OLPD Manager™ App

Measurement results from a test are stored on the hard disk of the PDS Insight™ 2 handheld ready for synchronisation to the OLPD Manager™ app on the tablet PC for analysis, benchmarking and trending.

To download the results:

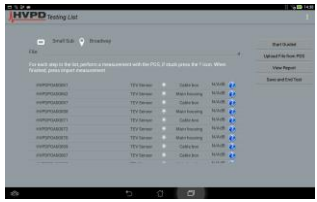
1 Activate Bluetooth® on both devices (note: the PDS Insight™ 2 handheld and the Android tablet should already be paired – if not, see section 5.6).

2 Go to **Site Retest** > **Import Measurements**.



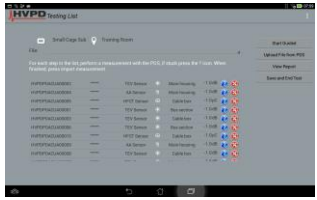
3 From the list of devices, choose your device and then tap **Connect**.

The OLPD Manager™ app displays a list of test files sorted by date, tap on the test file you need to download to the tablet.



4 The OLPD Manager™ app lists all measurements made from that file. Tap **Save**.

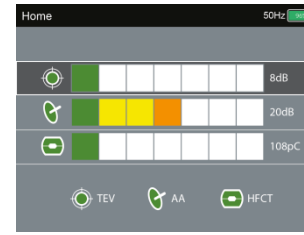
To see how you can view and analyse the test results refer to section 11.



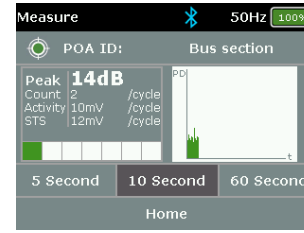
# 10 How to Test a Switchgear Panel with the PDS Insight™ 2 Handheld

If the switchgear panel already has a point of attachment (POA) label installed, you can make a measurement and the PDS Insight™ 2 handheld and OLPD Manager™ app will link the measurement to that POA.

1 From the **Home Screen** on the PDS Insight™ 2 handheld choose the sensor relevant to the POA.




2 Select the desired length of measurement for this test and press OK.

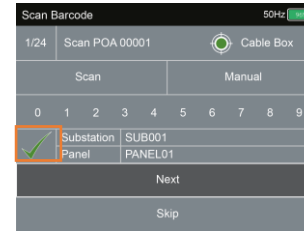



3 Scan the POA label with the PDS Insight™ 2 unit's barcode scanner (or enter its number manually) by highlighting either **Scan** or **Manual** and then press OK.

The green tick indicates that the PDS Insight™ 2 handheld recognises the POA and its linked sensor. You can now make a measurement, go to step 4.

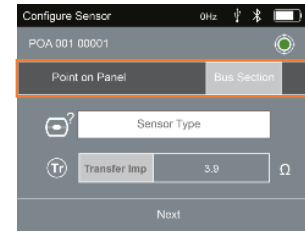
A red cross indicates that you must still link the sensor to that POA before you make a measurement.

You can also choose skip to make a measurement without assigning a POA ID.

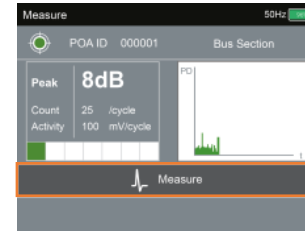


4 It is necessary to configure the sensor so that the PDS Insight™ 2 handheld can link the measurement to the asset under test.
For AA, TEV and HFCT sensors you must select the sensor **Point on Panel**.
For the HFCT sensor, you must also select the **Sensor Type**.

You can now make a measurement.

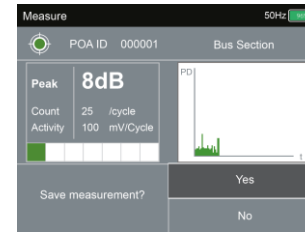



5 Choose **Measure.** The PDS Insight™ 2 handheld unit measures for 5 seconds and will emit a beep when complete.



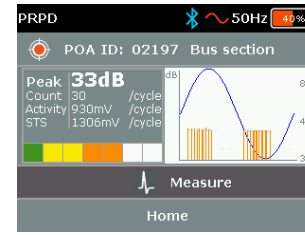

6 Select **Yes** to save the measurement. Then select one of the following:

- **4** To repeat the measurement choose **Retest.**
- **5** To cycle between Measure, Measure PRPD or Measure PRPD 3D for this POA, select ❯ until the desired screen is active.
- **6** To measure at the next POA choose **Next**.



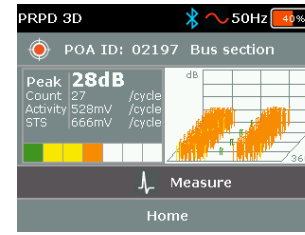

7 From the Measure screen, selecting ❯ will enter the PRPD measurement screen.

Choose **Measure.** The PDS Insight™ 2 handheld unit measures PRPD for 5 seconds and will emit a beep when complete. Repeat step 5.




8 From the PRPD measurement screen, selecting ❯ will enter the PRPD 3D measurement screen.

Choose **Measure.** The PDS Insight™ 2 handheld unit measures PRPD for 5 seconds and will emit a beep when complete. Repeat step 5.



# 11 How to Manage OLPD Data with the OLPD Manager™ App

The OLPD Manager™ app creates a database of measurement results which you can use to view asset criticality, for benchmarking, to analyse OLPD activity trends over time and to generate automatic Excel® test reports.

## 11.1 View and Filter Measurements

1 To view the measurements by substation and panel go to **Home Screen** > **Results**

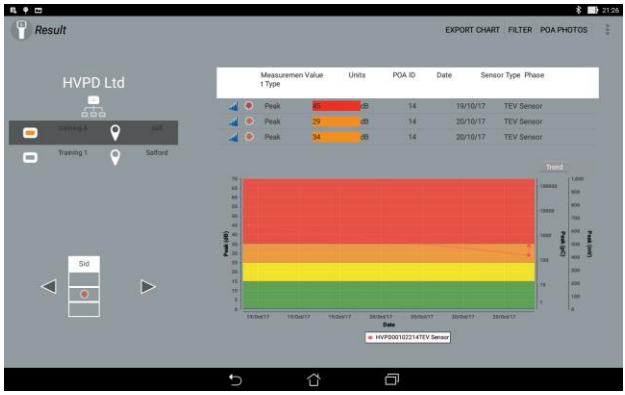

2 Select a substation. Choose **View Panels** from the menu.


3 Select a panel. Choose **View Panel Measurements** from the menu.

4 To change the way the OLPD Manager™ app displays both table and chart data, select **Filter** in the menu

You can filter the measurements by:

- PD Measurement Type (Peak, Count, Cumulative Activity)
- Sensor type (TEV, AA, HFCT)
- Date range
- Criticality and condition colour (Green, Yellow, Orange, Red)

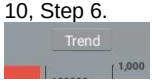


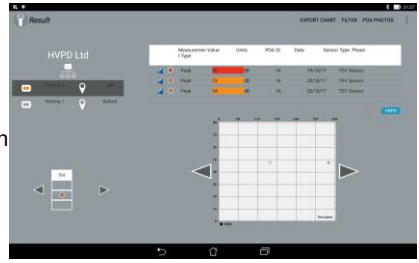

5 To save the chart as a BMP image file choose **Export Chart** from the menu. It will be saved to the tablet data storage in the following folder: \HVPD\Reports\SUBSTATION NAME

6 To view the 5 – second peak, press the graph icon next to the measurement:



7 To view the PRPD pattern, press the Trend/PRPD button at the top right of the trend graph . Note: PRPD patterns must have been recorded as per Section 10, Step 6.



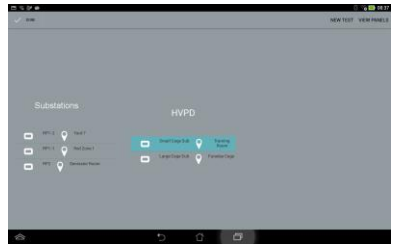
## 11.2 How to Create an Excel® Test Report

The OLPD Manager™ app can produce automatic Excel® reports for a substation using the following steps:

1 From the **Home Screen** choose **View Results.**


2 Select a Substation

Choose **Report** from the menu




3 The automated Excel® Report displays on the screen and is also saved to the tablet data storage in the following folder: \HVPD\Reports

| Site Name | Location | Panel | Plant Type | Cable Type | POA Id | Sensor Type | Date | Time | Measurement Type | Measurement Value | Units |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Collecting 2 | Collecting 2 | H02 | Switchgear SF6 | XLPE | HVPD00127708 | TEV Sensor | 19/04/2017 | 05:06:49 | Peak | 6 | dB |
| Collecting 2 | Collecting 2 | H02 | Switchgear SF6 | XLPE | HVPD00127708 | TEV Sensor | 19/04/2017 | 05:06:49 | Count | 0 | /cycle |
| Collecting 2 | Collecting 2 | H02 | Switchgear SF6 | XLPE | HVPD00127708 | TEV Sensor | 19/04/2017 | 05:06:49 | Activity | 0 | mV/cycle |
| Collecting 2 | Collecting 2 | H02 | Switchgear SF6 | XLPE | HVPD00127707 | TEV Sensor | 19/04/2017 | 05:06:30 | Peak | 6 | dB |
| Collecting 2 | Collecting 2 | H02 | Switchgear SF6 | XLPE | HVPD00127707 | TEV Sensor | 19/04/2017 | 05:06:30 | Count | 0 | /cycle |
| Collecting 2 | Collecting 2 | H02 | Switchgear SF6 | XLPE | HVPD00127707 | TEV Sensor | 19/04/2017 | 05:06:30 | Activity | 0 | mV/cycle |
| Collecting 2 | Collecting 2 | H05 | Switchgear SF6 | XLPE | HVPD00127713 | TEV Sensor | 19/04/2017 | 05:08:15 | Peak | 7 | dB |
| Collecting 2 | Collecting 2 | H05 | Switchgear SF6 | XLPE | HVPD00127713 | TEV Sensor | 19/04/2017 | 05:08:15 | Count | 0 | /cycle |
| Collecting 2 | Collecting 2 | H05 | Switchgear SF6 | XLPE | HVPD00127713 | TEV Sensor | 19/04/2017 | 05:08:15 | Activity | 0 | mV/cycle |
| Collecting 2 | Collecting 2 | H05 | Switchgear SF6 | XLPE | HVPD00127714 | TEV Sensor | 19/04/2017 | 05:08:35 | Peak | 8 | dB |
| Collecting 2 | Collecting 2 | H05 | Switchgear SF6 | XLPE | HVPD00127714 | TEV Sensor | 19/04/2017 | 05:08:35 | Count | 0 | /cycle |
| Collecting 2 | Collecting 2 | H05 | Switchgear SF6 | XLPE | HVPD00127714 | TEV Sensor | 19/04/2017 | 05:08:35 | Activity | 0 | mV/cycle |
| Collecting 2 | Collecting 2 | H03 | Switchgear SF6 | XLPE | HVPD00127709 | TEV Sensor | 19/04/2017 | 05:07:03 | Peak | 15 | dB |
| Collecting 2 | Collecting 2 | H03 | Switchgear SF6 | XLPE | HVPD00127709 | TEV Sensor | 19/04/2017 | 05:07:03 | Count | 104 | /cycle |
| Collecting 2 | Collecting 2 | H03 | Switchgear SF6 | XLPE | HVPD00127709 | TEV Sensor | 19/04/2017 | 05:07:03 | Activity | 391 | mV/cycle |
| Collecting 2 | Collecting 2 | H03 | Switchgear SF6 | XLPE | HVPD00127710 | TEV Sensor | 19/04/2017 | 05:07:23 | Peak | 6 | dB |
| Collecting 2 | Collecting 2 | H03 | Switchgear SF6 | XLPE | HVPD00127710 | TEV Sensor | 19/04/2017 | 05:07:23 | Count | 0 | /cycle |
| Collecting 2 | Collecting 2 | H03 | Switchgear SF6 | XLPE | HVPD00127710 | TEV Sensor | 19/04/2017 | 05:07:23 | Activity | 0 | mV/cycle |
| Collecting 2 | Collecting 2 | H01 | Switchgear SF6 | XLPE | HVPD00127706 | TEV Sensor | 19/04/2017 | 05:06:09 | Peak | 9 | dB |
| Collecting 2 | Collecting 2 | H01 | Switchgear SF6 | XLPE | HVPD00127706 | TEV Sensor | 19/04/2017 | 05:06:09 | Count | 0 | /cycle |
| Collecting 2 | Collecting 2 | H01 | Switchgear SF6 | XLPE | HVPD00127706 | TEV Sensor | 19/04/2017 | 05:06:09 | Activity | 0 | mV/cycle |
| Collecting 2 | Collecting 2 | H01 | Switchgear SF6 | XLPE | HVPD00127705 | TEV Sensor | 19/04/2017 | 05:05:52 | Peak | 10 | dB |
| Collecting 2 | Collecting 2 | H01 | Switchgear SF6 | XLPE | HVPD00127705 | TEV Sensor | 19/04/2017 | 05:05:52 | Count | 0 | /cycle |
| Collecting 2 | Collecting 2 | H01 | Switchgear SF6 | XLPE | HVPD00127705 | TEV Sensor | 19/04/2017 | 05:05:52 | Activity | 0 | mV/cycle |
| Collecting 2 | Collecting 2 | H04 | Switchgear SF6 | XLPE | HVPD00127711 | TEV Sensor | 19/04/2017 | 05:07:43 | Peak | 7 | dB |
| Collecting 2 | Collecting 2 | H04 | Switchgear SF6 | XLPE | HVPD00127711 | TEV Sensor | 19/04/2017 | 05:07:43 | Count | 0 | /cycle |
| Collecting 2 | Collecting 2 | H04 | Switchgear SF6 | XLPE | HVPD00127711 | TEV Sensor | 19/04/2017 | 05:07:43 | Activity | 0 | mV/cycle |
| Collecting 2 | Collecting 2 | H04 | Switchgear SF6 | XLPE | HVPD00127712 | TEV Sensor | 19/04/2017 | 05:08:02 | Peak | 9 | dB |
| Collecting 2 | Collecting 2 | H04 | Switchgear SF6 | XLPE | HVPD00127712 | TEV Sensor | 19/04/2017 | 05:08:02 | Count | 0 | /cycle |
| Collecting 2 | Collecting 2 | H04 | Switchgear SF6 | XLPE | HVPD00127712 | TEV Sensor | 19/04/2017 | 05:08:02 | Activity | 0 | mV/cycle |
| Collecting 1 | Collecting 1 | H02 | Switchgear SF6 | XLPE | HVPD00127697 | TEV Sensor | 19/04/2017 | 04:38:26 | Peak | 9 | dB |
| Collecting 1 | Collecting 1 | H02 | Switchgear SF6 | XLPE | HVPD00127697 | TEV Sensor | 19/04/2017 | 04:38:26 | Count | 0 | /cycle |
| Collecting 1 | Collecting 1 | H02 | Switchgear SF6 | XLPE | HVPD00127697 | TEV Sensor | 19/04/2017 | 04:38:26 | Activity | 0 | mV/cycle |
| Collecting 1 | Collecting 1 | H02 | Switchgear SF6 | XLPE | HVPD00127698 | TEV Sensor | 19/04/2017 | 04:38:43 | Peak | 12 | dB |
| Collecting 1 | Collecting 1 | H02 | Switchgear SF6 | XLPE | HVPD00127698 | TEV Sensor | 19/04/2017 | 04:38:43 | Count | 20 | /cycle |
| Collecting 1 | Collecting 1 | H02 | Switchgear SF6 | XLPE | HVPD00127698 | TEV Sensor | 19/04/2017 | 04:38:43 | Activity | 64 | mV/cycle |
| Collecting 1 | Collecting 1 | H04 | Switchgear SF6 | XLPE | HVPD00127702 | TEV Sensor | 19/04/2017 | 04:40:00 | Peak | 6 | dB |
| Collecting 1 | Collecting 1 | H04 | Switchgear SF6 | XLPE | HVPD00127702 | TEV Sensor | 19/04/2017 | 04:40:00 | Count | 0 | /cycle |
| Collecting 1 | Collecting 1 | H04 | Switchgear SF6 | XLPE | HVPD00127702 | TEV Sensor | 19/04/2017 | 04:40:00 | Activity | 0 | mV/cycle |

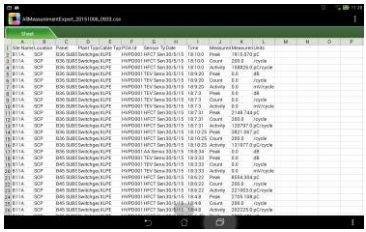
## 11.3 How to Export all measurements

The OLPD Manager™ app can produce a CSV file with all of the measurement data for your own analysis in Microsoft Excel ®.

1 From the **Home Screen** choose **View Results.**


2 Choose the All Measurement Report, this will export a CSV file


3 The report is saved to the tablet data storage in the following folder: \HVPD\Reports
You can copy this file to the PC and view using Microsoft Excel®.

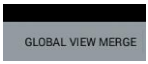


## 11.4 Global View Synchronisation

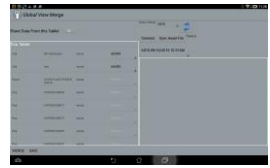
Global View Synchronisation is used to import PDS Insight™ 2 data from other tablets.

1 As a prerequisite to the data merge you should have
   a) Another tablet with data you would like to merge
   b) The two tablets' bluetooth paired with each other

2 On <u>both tablets</u>, choose **Global View Merge** from the **Home Screen**

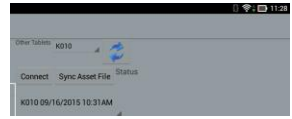


3 The merge screen is displayed.

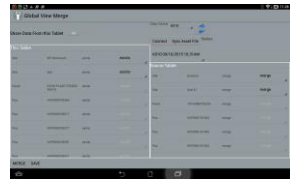


4 On the tablet you wish to copy from, set Share data from this tablet to ‘Share’


5 On the tablet you wish to copy to, choose the other tablet ID (i.e. K010) and then press connect.




6 Press Sync Asset File on the tablet you wish to copy to, this will download all of the data, which is shown in the ‘Source Tablet’ table.



7 Press Merge at the bottom of the screen, then press Save


8 All of the data can be viewed on the tablet as per section 11.1- View and Filter Measurements

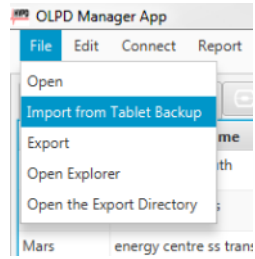
# 12 How to Analyse Data Using the OLPD Manager Software for Windows PC

Measurement results from a test can be synchronised from the PDS Insight™ 2 handheld or tablet PC with a windows PC for analysis, benchmarking and trending.

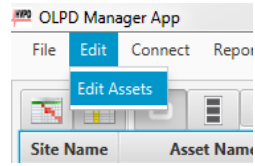
The first time a windows PC is used to analyse data, existing substation and POA data should be synchronised from the tablet PC.

1 Import Original Data from Tablet

- On the tablet App, select Home > Export. This saves a zip file on to the tablet in the HVPD > Exported folder.
- Copy the zip file to the PC.
- Click File > Import from Tablet Backup
- Select the zip file.

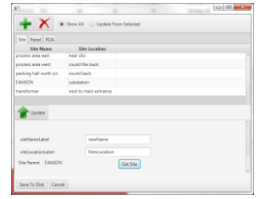



2 Sites/Panels/POAs can be created and edited by selecting Edit > Edit Assets



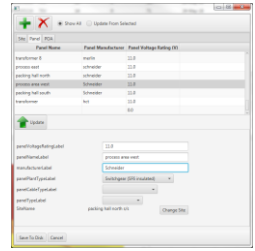

**To create:**

- Click + to add a new row to the table.
- Type in the fields below
- To choose the 'Parent', click Get Site
- Click Update to update the table.
- Click Save To Disk to save the changes.



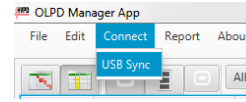
**To edit:**

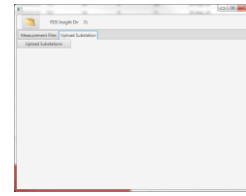
- Select an existing row in the table. This will update the data fields at the bottom of the screen
- Edit the required fields
- Click Update to update the table.
- Click Save To Disk to save the changes.



3 To upload the substation file from the OLPD Manager for Windows application to the PDS Insight handheld:

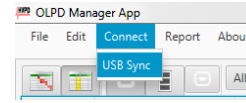
- Connect the PDS Insight to the PC using the USB cable. Ensure the PDS Insight is powered on
- Click Connect > USB Sync
- Click the Directory Icon, and select the PDS Insight removable disk
- Click the Upload Substation Tab
- Click Upload Substations. This will synchronise the data set on the PC to the PDS Insight handheld

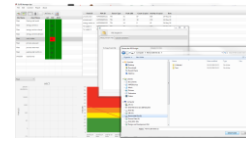


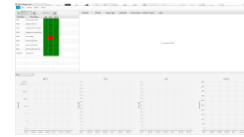



4 To import measured data from PDS Insight™ handheld to Windows application:

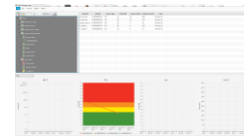
- Connect the PDS Insight to the PC using the USB cable, ensuring that the PDS Insight is powered on
- Click the Connect > USB Sync
- Click folder Icon, choose the PDS Insight Removable disk
- Click the  icon to copy the measurement files from the PDS Insight on to the PC.
- The results will be shown in the table view.



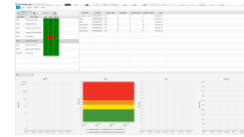





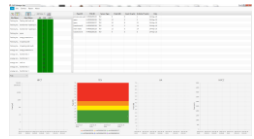
5 Viewing the data with Tree View – this allows you to select the Sites based on the hierarchy that has been set up.



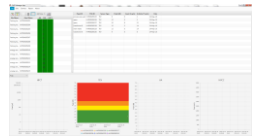
6 Viewing the data with Table View (Site) – the table shows a list of the Sites and the measured PD values over the time range selected.



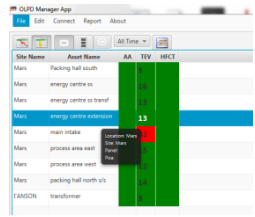
7 Viewing the data with Table View (Panel) – the table shows a list of panels with the measured PD values over the time range selected.



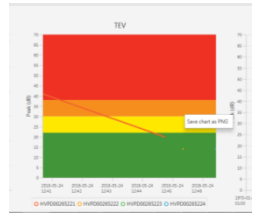
8 Viewing the data with Table View (POA) – the table shows a list of POAs with the measured PD values over the time range selected.



9 Selecting a row in the table will change the chart display to the list of POAs associated with the selected Site/Panel/POA.

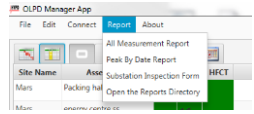



10 Right click to Export the chart as a PNG image file.




11 To generate and view reports, click Report and then select one of the following:

- All Measurement Report: exports all of the measurements in a single CSV file.
- Peak By Date Report: exports the Peak value for each Panel over each distinct measurement time.
- Substation Inspection Form: shows the values measured for each panel.
- Open the Reports Directory: opens the directory in which the reports are saved.



# 13 How to Use PDS Insight™ 2 Unit's Smart Function Checker

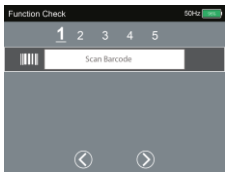
The PDS Insight™ 2 unit is supplied with a smart docking station that includes a built-in function checker. The function checker is used to prove the unit is working correctly prior to testing and generates reference signals to test each of the PDS Insight™ 2 handheld unit sensors. It is recommended to perform the function check at the start of the day before using the unit for testing.

To perform a function check:

1 Connect the PDS Insight™ 2 handheld to the docking station with the attached cable.

Go to **Settings** > **Function Check**.

The function checker is on the base of the docking station.




2 **Barcode check**

Scan barcode on the function checker label.

3 **TEV check**

Place the PDS Insight™ 2 flat on the docking station and press OK.

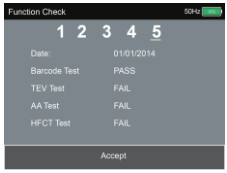
4 **AA check**

Place the PDS Insight™ 2 flat on the docking station and press OK.

5 **HFCT check**

Connect the BNC coaxial cable from the PDS Insight™ 2 handheld unit to the docking station BNC connector.

6 The pass/fail results of the function check are listed in a summary report. If the PDS Insight™ 2 handheld fails any of the checks, see section 12.



# 14 Troubleshooting

**Q** **Bluetooth® does not pair.**

**A**
- The units may be too far from each other (>10m).
- Bluetooth® is not enabled on one of your devices (see section 5.6)

**Q** **Cannot find PDS Insight™ 2 in OLPD Manager™ devices list**

**A**
- You need to 'Pair' the units (see section 5.6).

**Q** **The Barcode cannot be scanned.**

**A**
- Ensure POA label has been applied correctly.
- Adjust the angle of the PDS Insight™ 2 unit when scanning and try again.
- Use manual entry.

**Q** **Function checker reports an error.**

**A**
- Restart the function checker (see section 11).

**Q** **"POA not found. Measure anyway?"**

**A**
- Ensure substation has been set up on the tablet and has been uploaded to the PDS Insight™ 2 handheld unit.
- Ensure manual input POA has been entered correctly.

**Q** **Can only save peak PD for AA sensor.**

**A**
- AA supports peak PD measurements only as cumulative measurements are not appropriate for airborne acoustic signal detection.

**Q** **Home Screen shows no readings for HFCT.**

**A**
- Connect an HFCT sensor to the PDS Insight™ 2 (see sections 6.5 and 6.6).

**Q** **No audible AA sound.**

**A**
- Go to Settings > Volume and make sure the value is greater than 0 (factory level setting – 5)

If the above steps have been followed and the error cannot be resolved, please contact info@hvpd.co.uk for further help and advice.

# 15 Maintenance

## 15.1 How to Store and Transport the Units

To store and transport the PDS Insight™ 2 handheld, tablet and accessories always use the provided hard shell carry case.

## 15.2 BNC Coaxial Cable Maintenance

Perform routine tests and visual inspection for any kinks or damage. The BNC cable is tested as part of the function test routine as detailed in section 13.

## 15.3 Calibration

The date of calibration is shown on the welcome screen during start-up.
It is recommended that the PDS Insight™ 2 unit and sensors is calibrated every 12 months to ensure that readings remain accurate.

Contact HVPD to arrange for re-calibrations at info@hvpd.co.uk

# Appendix A: An Introduction to Partial Discharge (PD) Measurements

**What is PD?**

A partial discharge (PD) is an electrical discharge that occurs across a localised area of the insulation between two conducting electrodes, without completely bridging the gap. It can be caused by discontinuities or imperfections in the insulation system or by the effects of temperature and humidity. On-line Partial Discharge (OLPD) testing of in-service MV/HV plant and cables provides an indication of deterioration of the insulation and is the best 'early warning' indicator of incipient faults.

In general PD will occur in systems operating at voltages of ***3000 V and above*** however it should be noted though that in some cases PD can also occur at lower voltages, particularly at lower atmospheric pressures.

**PD at Insulation Interfaces Inside 33 kV Cable Joint**

**Insufficient Mastic Around 33 kV XLPE Connector**

**Failure of 110 kV Transformer Termination**

**10 kV Motor Stator Failure**

**Where does PD occur?**

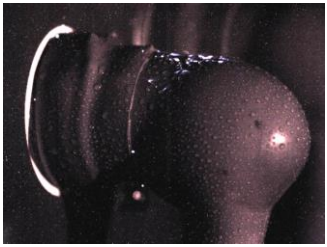
PD can occur at various points in the insulation system, for example: voids in the insulation medium, at the interface between insulation layers, in gas bubbles in liquid insulation or along the surfaces of polymeric insulation.

PD can often be observed at the commissioning of new equipment, caused by improper installation or poor design and/or workmanship – particularly in cable joints/splices and terminations which are made up on-site. Poor workmanship at the installation stage can lead to premature insulation failure ('infant mortality') that will typically occur within the first 3 years of service.

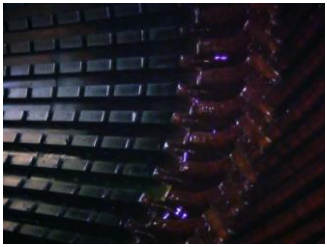
PD activity can start under normal working conditions in high-voltage equipment due to the effects of overvoltage transients, when the insulation condition has deteriorated with age, or has been aged prematurely due to thermal, environmental, mechanical or electrical stresses.

**Electrical Trees in PILC Paper Insulation**

**Corona Discharge – 400 kV Arcing Horn**



**Surface Discharges on 24 kV Cable Elbow Termination**



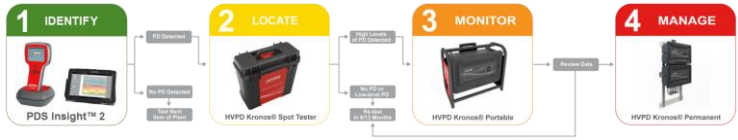
**Visible PD activity occurring near the end-winding region of the stator on a 11 kV, 20 MVA diesel generator**

**How does PD develop?**

Once started, PD can develop into electrical trees and surface tracking, eventually leading to a breakdown between phase and earth or between phases of the 3-phase system. Depending on the discontinuity and/or imperfection type and location in the insulation system, a failure can take anything from a few hours up to several years to occur.

While some discharges can be extremely dangerous to the health of the insulation system (e.g. internal discharges within polymeric cables and cable accessories), other types of discharge can be relatively benign (e.g. such as corona into air from sharp, exposed points on HV overhead networks). The key to OLPD diagnostic testing is to be able to differentiate the different types of PD, which can occur against any noise/interference.

**OLPD test and monitoring to support asset management**




OLPD monitoring allows for any trends in PD activity to be observed over time. While PD is incepted by the high-voltage stresses, it can be influenced by the other operating stresses. Correlation with environmental (temperature, humidity, etc.) or service conditions (e.g. changes in load) can also often be observed. As PD activity is often present well in advance of insulation failure, with advance warning typically of several months to several years, it is possible by observing PD trends to make strategic decisions about refurbishing and renewal programmes. Often it may not be necessary to replace an older asset, which is perfectly serviceable, and thereby the capital replacement cost can be deferred by using condition-based maintenance supported by the OLPD test and monitoring technology.

PD testing is particularly important when the MV/HV asset is critical to the operation of a network; this may be due to the asset's age, past failures or the financial consequences (Outage costs) of its failure. The qualification and quantification of PD criticality within the HV network can be achieved quickly and easily using HVPD's on-line screening and diagnostic PD test technology to provide an ‘early warning’ for any ‘incipient’ insulation faults.

Examples of MV and HV plant that can be OLPD tested include:

- Cables and cable accessories (terminations and joints/splices)
- Switchgear (Air, Solid and Gas insulated)
- Power transformers and bushings
- Motors and generators
- Instrument transformers (voltage and current)
- Capacitors

**On-line partial discharge (OLPD) testing**

OLPD testing of MV and HV plant gives an advance warning of pending insulation failure within in-service plant, allowing the plant owner to take remedial maintenance action during planned outages. Our past projects have shown that in general the earlier the advance warning can be made, the cheaper the maintenance or intervention costs will be.

OLPD testing and monitoring gives an accurate picture of the HV plant's health and performance under both normal and abnormal service conditions, including the effects of load, temperature and humidity.

# Appendix B: HFCT Attachment on Cable

## Suitable cable terminations

3x HFCTs around cable and earth (Type: HFCT140-100)

3x HFCTs around cable and earth (Type: HFCT140-100)

1x HFCT around combined earth (Type: HFCT100-50)

# Unsuitable Cable Terminations

**NOTE**

**Do not use HFCT sensors here. Use TEV sensors only**

Solidly bonded cable with no insulated gland – it is not possible to measure PD

Shorting links between cable and plant earth – it is not possible to measure PD

Solidly bonded, lead plumbed termination – it is not possible to test PD

# Glossary of Terms

| | |
|---|---|
| **BNC Coaxial Cable** | Used for interconnecting the HFCT sensor to the test unit. |
| **High Frequency Current Transformer Sensor (HFCT)** | A partial discharge sensor that is used for detecting PD in cables and remotely connected plant. Attached around the cable's earth connections in the switchgear, rotating machine or transformer HV cable terminal box. HFCT sensors are available in various sizes and portable and permanent versions. |
| **On-line Partial Discharge Testing (OLPD)** | Refers to the testing of in-service plant or cables for partial discharge. |
| **Partial Discharge (PD)** | A localised electrical discharge that only partially bridges the insulation between conductors. |
| **Point of Attachment (POA)** | The location on a switchgear panel or other plant item where a TEV test measurement is taken. |
| **Phase Resolved Partial Discharge (PRPD)** | Graph which shows position of PD pulses relative to the power frequency sine wave |
| **Transient Earth Voltage Sensor (TEV)** | A partial discharge sensor that is used to detect ‘local’ high-frequency PD pulses from switchgear, cable sealing ends, machine cable boxes, transformers and other plant. |

# Notes

HVPD are experts in the growing industry of partial discharge testing and monitoring. We offer a complete range of equipment that gives an early warning of faults and deterioration in medium and high voltage insulation, allowing plant owners to take early corrective action. We provide bespoke solutions to our customer base in oil and gas, renewables, shipping, transmission and distribution, and generation industries. Over 350 customers in 100 countries already trust our technology.

***"Our Knowledge is Your Power"***


**HVPD Head Office**
128 Metroplex Business Park
Broadway, MediaCityUK,
Salford, M50 2UW
United Kingdom

Tel: +44 (0)161 877 6142
Fax: +44 (0)161 877 6139
Email: info@hvpd.co.uk
Web: www.hvpd.co.uk

**HVPD Australia**
L24 Allendale Square
77 St Georges Terrace
Perth WA 6000
Australia

Tel: +61 (0) 8 6141 3279
Fax: +61 (0) 8 6141 3101
Email: info@hvpd.co.uk
Web: www.hvpd.co.uk

**HVPD China**
Room 819, Sweetland Hotel
No. 171 Chang Chun Road
Dalian 116021
China

Tel: +86 18604269606
Email:info@hvpd-china.co.uk
Web: www.hvpd-china.com

**HVPD USA**
16225 Park Ten Place
Suite 500
Houston, TX 77084
USA

Tel: +1 (832) 291 7560
Email: info@hvpd-usa.com
Web:www.hvpd-usa.com


ISOQAR REGISTERED
UKAS MANAGEMENT SYSTEMS
0026

Certificate Number 9329
ISO 9001, ISO 14001,
OHSAS 18001

THE QUEEN'S AWARDS FOR ENTERPRISE: INTERNATIONAL TRADE 2014

THE QUEEN'S AWARDS FOR ENTERPRISE: INNOVATION 2014