RØI RED PHASE INSTRUMENTS

# PORTABLE MULTI CHANNEL PARTIAL DISCHARGE TESTER (PDT)

**KEY FEATURES:**

1. **PORTABLE AND LIGHTWEIGHT FOR TESTING VARIOUS UTILITY ASSETS IN THE FIELD, SUCH AS CABLES, TRANSFORMERS, SWITCHGEAR AND ANY MEDIUM TO HIGH VOLTAGE EQUIPMENT LIABLE TO SUFFER FROM PARTIAL DISCHARGE INSULATION DEGRADATION.**

2. **THE PDT CAN BE SUPPLIED WITH UP TO 4 PLUGIN PD BOARDS WHICH HAVE A HIGH BANDWIDTH FOR CAPTURING PD EVENTS.**

3. **EACH PLUGIN BOARD ALSO HAS A NOISE INPUT CHANNEL, SO THAT AMBIENT NOISE CAN BE DETECTED AND SPURIOUS PD EVENTS DELETED FROM TEST RESULTS.**

4. **THE PDT CONTAINS AN IBM / LENOVO THINKPAD NOTEBOOK PC WHICH IS USED TO RECORD ALL TEST RESULTS.**

5. **SOFTWARE PROVIDED IN THE PC ENABLES ALL THE LOGGED RESULTS TO BE DISPLAYED IN TABLES AND GRAPHS AS REQUIRED.**

## 1.0 APPLICATION

1.1. The Red Phase Instruments Partial Discharge Tester or **PDT** as it will be termed is used for general investigation of plant and equipment where **radiated** Partial Discharge (PD) events are suspected.
Partial discharge is always likely to be present in medium voltage and high voltage areas, and can be tolerated if it is within acceptable limits. However, PD will eventually cause degradation of insulation properties and can lead to complete failure.

1.2. The incidence of PD is something that has come under closer scrutiny in recent years. A better understanding of what levels of PD are tolerable, and what levels will lead to premature failure of plant and equipment, makes it very important for all utilities to be involved in PD monitoring.

1.3. A utility that becomes familiar with the concepts and investigation of PD can be proactive in avoiding costly failures, and at the same time be more confident in extending the service life of expensive and critical assets.

1.4. The assessment of test results from PD logging is often not an exact “GO – NO GO” situation.
There is a great deal of experience and judgement involved in making use of the results.
Collectively there are hundreds of utilities, equipment manufactures and universities throughout the world carrying out testing and research in this area.
This research leads to better understanding and better techniques to evaluate and predict what happens when PD affects insulation properties, and makes it easier for utility engineers to use the PDT and gain the benefit.

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## 2.0 HARDWARE FEATURES

2.1. The PDT has a lightweight rugged Pelican case with a hinged lid. An IBM / Lenovo ThinkPad PC is located on the top of the case as shown in the photo on page 1. It is protected by a foam cushion in the lid, which keeps it safe when the lid is closed and latched.

2.2. The Laptop has a separate switch-mode power supply which is fitted within the PDT case. Both the ThinkPad switch-mode supply and the internal switch-mode supply for the PDT's electronics are powered from 100V – 240V AC, 50/60Hz mains.

2.3. The panel has a combination IEC fused socket for the 100V – 240V AC supply and a mains switch,

2.4. The top panel has LEDs to indicate the activity of PD and Noise events detected by the plug in boards. There is also a LED for "POWER ON" and a LED for "VOLTAGE SYNCH".

2.5. Each plug-in card represents one PD and Noise processing channel. Each channel has three BNC sockets on the PDT panel
Two of the BNC sockets are inputs:

- One input for PD events.
- One input for Noise levels.

One output for viewing analysis if required.

**Note:**
*Up to 4 PD processor channels may be used, depending upon customer requirement.*
*The PDT generally comes in a 3 channel configuration.*

2.6. With provisions for up to 4 channels, the PDT's top panel reflects the maximum number of I/O represented by the four cards / channels.
i.e. Up to 8 BNC sockets arranged as inputs:

- 4 for accepting PD events
- 4 for accepting Noise levels

and

A group of 4 BNC sockets connected to buffered outputs on the channels, which can be viewed on a standard oscilloscope.

2.7. A circular AMP socket on the panel is used for voltage synchronisation. This is an input usually connected to one phase of a 3 phase supply or any signal (even a PD event) from 60 to 500Vac.
This input is used so that PD events on any phase can be referenced to the voltage or signal in that phase.

2.8. PD and noise events captured by the plug in boards are temporarily stored by the PDT processor board, then scanned and retrieved by the Laptop through its standard USB port.

**Some of the sensors used with the 832B**

**HF Toroidal CT**

**834B - HFCT**

**835B - Ultrasonic sensor**

**836B - Noise sensor**

The Red Phase Instruments PDT comes in 3 general Model formats which have different sensor combinations to suit most applications although customers may choose to select the type and number of sensors to suit their application.

**PDT – Comes in a portable rugged Pelican case**

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## 3. SPECIFICATIONS:

Major Components of the PDT

Each PDT includes the following 2 major components:
- PDT main unit – which resides in the Pelican case containing the PD measurement circuits.
- Notebook PC – also referred to as the host PC. It is used to run the Windows based software that controls the operation of the PDT main unit, via a USB interface cable.

**Notebook PC:**

- Minimum specification:
  IBM / Lenovo ThinkPad R52 (part number 18586SM): Pentium M 725A – 1.6GHz, 512MB DDR2 SDRAM, 40GB, 8x DVD-RW, integrated graphics, Win XP Pro, Modem, Gigabit Ethernet, 802.11a/b/g Wireless LAN.

**PDT Main Unit:**

- Contains firmware, A/D converters and noise gating functions for PD measurements.
- Up to 4 independent PD Boards may be installed in main unit – ie. 4 channels for PD measurements and 4 channels for noise gating.

**PD Processing boards**

**PD input channels:**
- High-pass: four bands 20, 35, 80 and 160kHz
- Low-pass: four bands 1.2, 2.5, 5 and 10MHz
- PD resolution 12-bits (11 bits plus sign)
- PD Threshold: selectable 10% to 50% (1% increment)

**Noise gating channels:**
- Radiated noise gating – connected to a radiated noise sensor via a coaxial cable.
- Conducted noise gating – not available.

Noise trigger threshold: 10mV to 9900mV (adjustable)
Blocking period: 5 to 1250usec (adjustable)

**Measurement Accuracy:**

- Accuracy of PD peak detection/measurement: 5% of full scale range
- Time stamp resolution (phase): 50nsec (phase)
- Channel to channel time difference resolution: 50nsec

**Phase reference voltage**

- Reference voltage can be directly connected to a PT secondary output or separate mains phase input. (Used as a zero crossing reference)
- Rated reference voltage input: 260V AC max

**Power supply & Consumption:**

- 100V to 240 VAC 50/60 Hz
- PDT main unit: 30W max
- Notebook PC heat output: 72W

**Operating temperature**

- 0° to 40° Celsius

**Weight and Dimensions:**

- 10.1kg (including notebook PC)
- Instrument case: 560 x 460 x 260 mm (W x D x H)

With transit case and typical set of accessories:
- 30kg
- Transit case: 700 x 470 x 340 mm (W X D X H)

**Software for Notebook PC**

- User friendly Windows based application
- All test data and user configuration for each plant tested is stored in a separate MS Access database file.

**Sensors and amplifiers:**

- Sensors and amplifiers are powered directly by the instrument via the BNC connectors.

**Available sensors and amplifiers:**

Sensors and amplifiers available for this PDT include:
- High Frequency Current Transformers (Model 833B + Amplifier (833) and Model 834B)
- Ultrasonic acoustic sensor (Model 835B)
- Radiated noise sensor amplifier (Model 836B)

**PDT Model types, inclusions and ordering information:**

**832B:** Main PDT processor unit
**832C:** 832B + 3 x 834B + 836B – 3ch
**832T:** 832B + 1 x 834B + 2 x 835B + 836B – 3ch
**840U:** 832B + 4 x 835B or C + (836B-optional) - 4ch

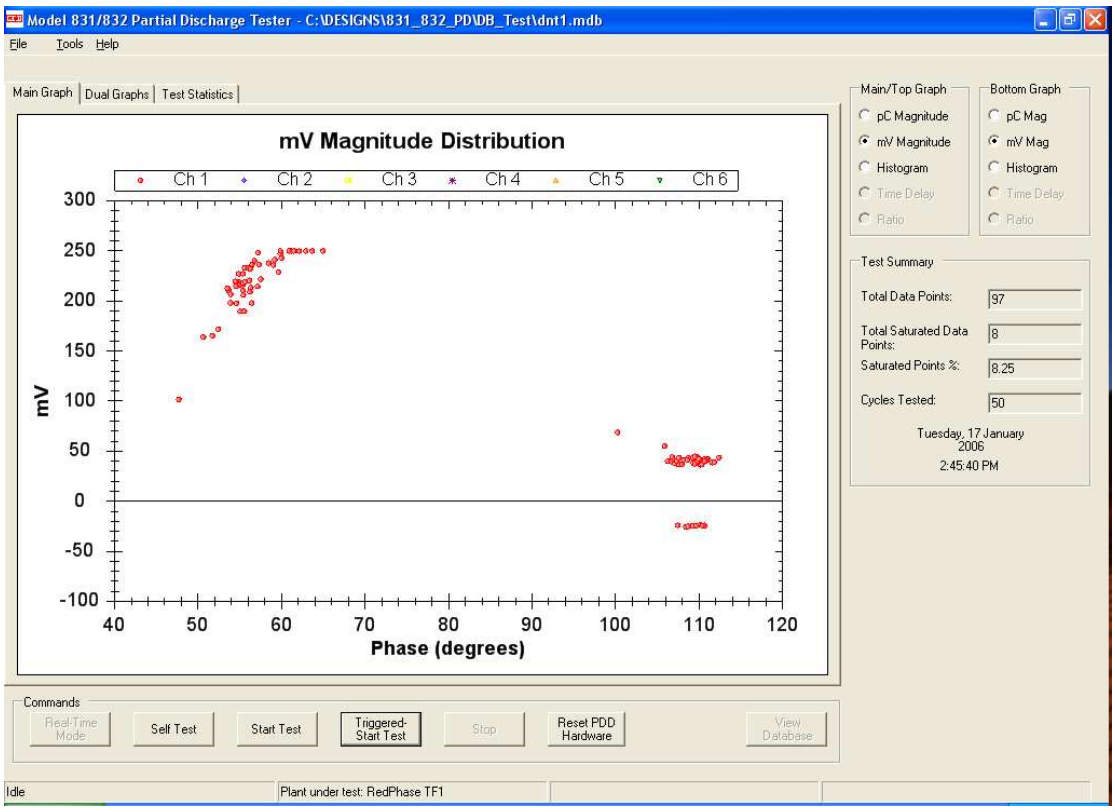
**Note:** All sensors and amplifiers come with a 10m coaxial cable extension.

## Typical On-site test procedure:

1. Install the required sensors at specific locations on plant or around site as required.
2. Connect required coaxial cables to sensors, preamplifier box and PDT.
3. Connect the USB cable to the notebook PC. Also connect the DC charger plug to the notebook to charge the notebook's internal battery if required.
4. Switch on the PDT main unit and notebook PC. Then start up host software on notebook PC.
5. Connect a reference voltage to the PDT. Check the "Voltage Synch" LED is lit.
6. Create a new plant to test under File -> New Plant To Test. Enter plant info. (Or open an existing Plant under File -> Open Existing Plant).
7. Configure PD and noise channel inputs under menu Tools -> Configuration.
8. Calibrate PD input channels by injecting known pC quantity on the required sensor. Go to Tools -> Calibration to complete this step.
9. Calibrate reference voltage input. Go to Tools -> Calibration to complete this step.
10. Configure the test to be performed. Setup number of cycles to test and enter test description etc… Go to Tools -> Configuration.
11. Click the Start Test button on the main screen. Test results will appear at the completion of the test and the graphs will be updated.
12. To avoid an excessive number of test points, adjust PD input threshold and gains to suit, including noise thresholds under Tools -> Configuration or in Real Time menu. Then repeat test.
13. Under Tools -> Options, users can select other user options such as save or don't save test results, etc…

A typical test result is shown in the photo below. Partial discharge peaks are represented as markers on the graph.

- The test graph may be "cut and paste" to other applications (e.g. Word) by performing a right-button mouse click with the cursor over the graph, then select "Copy" from the menu which will appear.
- Zoom into the graph by using the mouse wheel or by holding the left mouse down and drawing a rectangular area to zoom into.
- Dual graphs or test statistics can be viewed by clicking on the respective tabs above the test graph area.

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