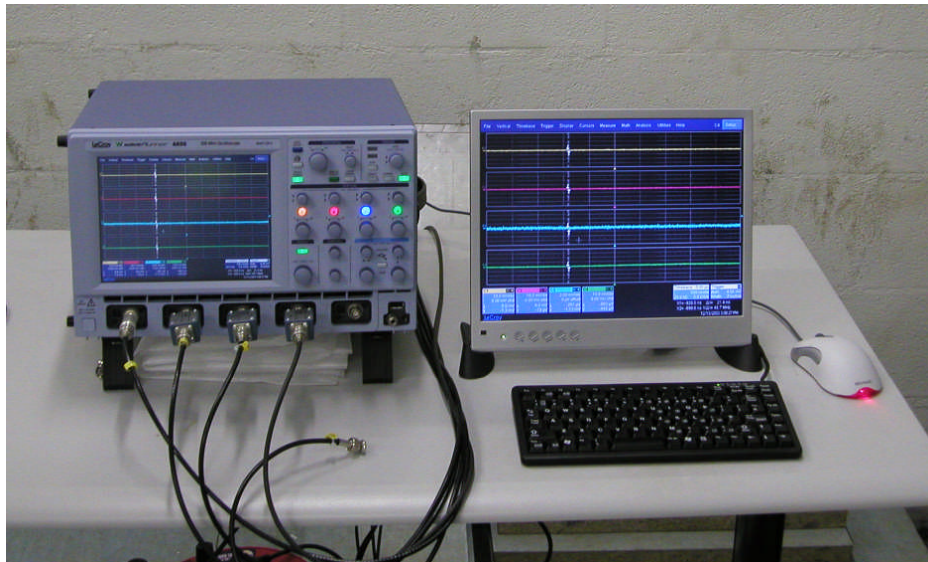


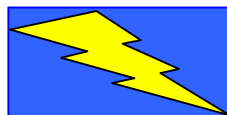
M&B Systems Power Test Equipment

Partial Discharge Mapping System for On-Line & Off-Line Measurements



PD Mapping hardware in Substation

Advanced Technology for Industry



A Partial Discharge (PD) mapping system

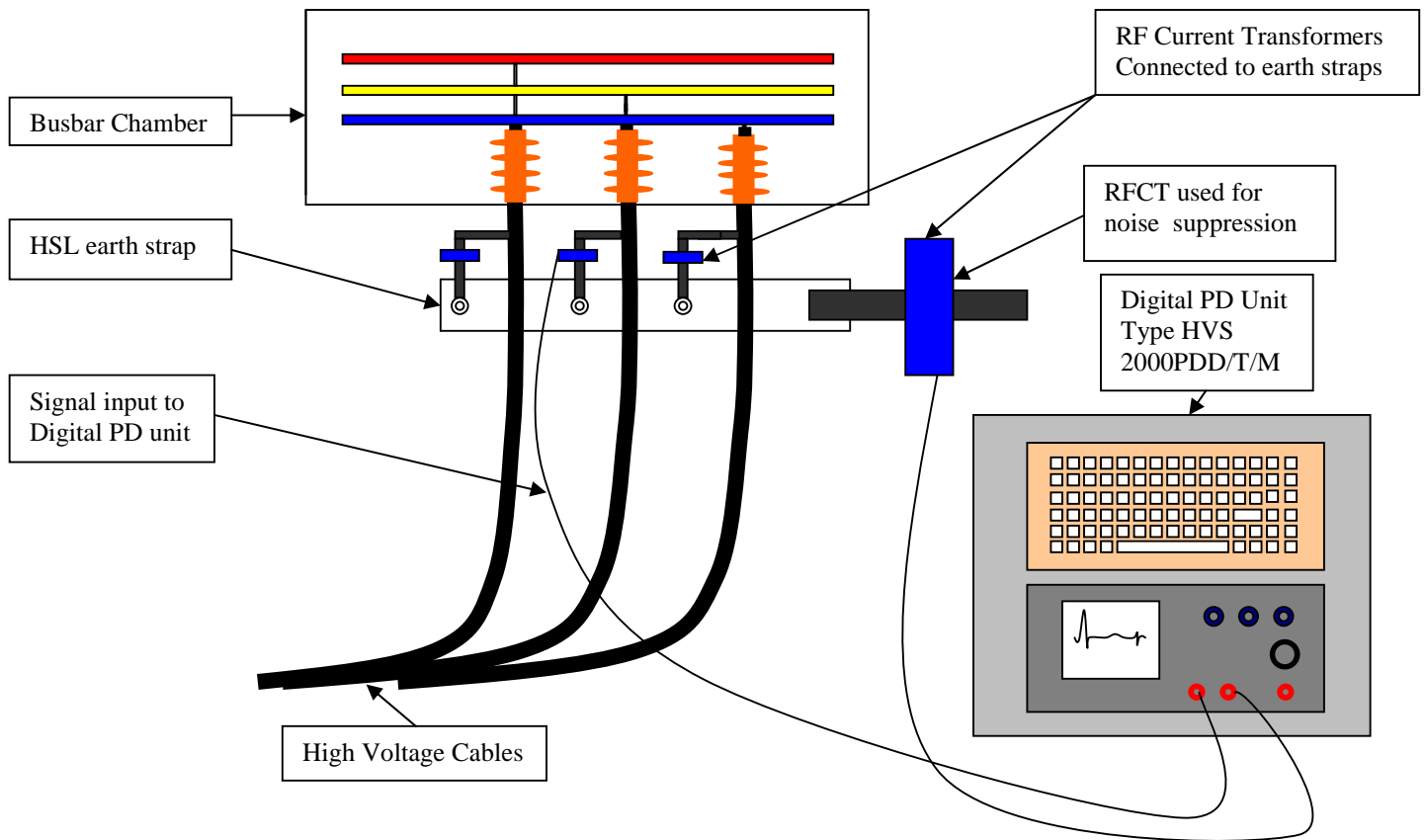
Introduction

Partial discharge (PD) mapping is currently the best way of estimating service performance of high voltage insulation in cables. For high voltage cables, no published criteria exist for the PD parameters which can be used as an 'alarm level', but several utilities are trying to establish exactly this. The PD mapping system is designed to locate the sites of PD along a high voltage cable, and display the data in an easy and understandable way. This is the basis of PD mapping which is carried out by research centres in the UK, the NETHERLANDS, and the USA.

General Specification

Accuracy of location of PD's	Approx., 1% of the cable length
Sensitivity	From 1pC to 100,000pC (noise dependant)
Location software	Uses computer aided location for PD waveforms
Pulse immune systems	Interfering pulses can be gated out of the system.
File storage	Each circuit mapped will have a file containing all the data from the circuit, (includes all the waveform data.

The PD mapping system comprises a Digital PD unit, software and interface devices.



On-line PD cable mapping using the digital PD unit

Software specification

The software controls the data capture from the oscilloscope. All the digitizer parameters are initialised by the software, and the computer controls the data capture automatically. Timebase and vertical gain are selectable from the PC. Other settings on the digitizer can be changed by altering the front panel controls. When all the system is ready to make measurements, a measurement file is created for the tests, and a button is then created to start the process. All the waveforms and data will be stored in this measurement file.

An input window is used to input all the relevant details of the substation, circuit, joint positions etc. These are stored in the measurement file.

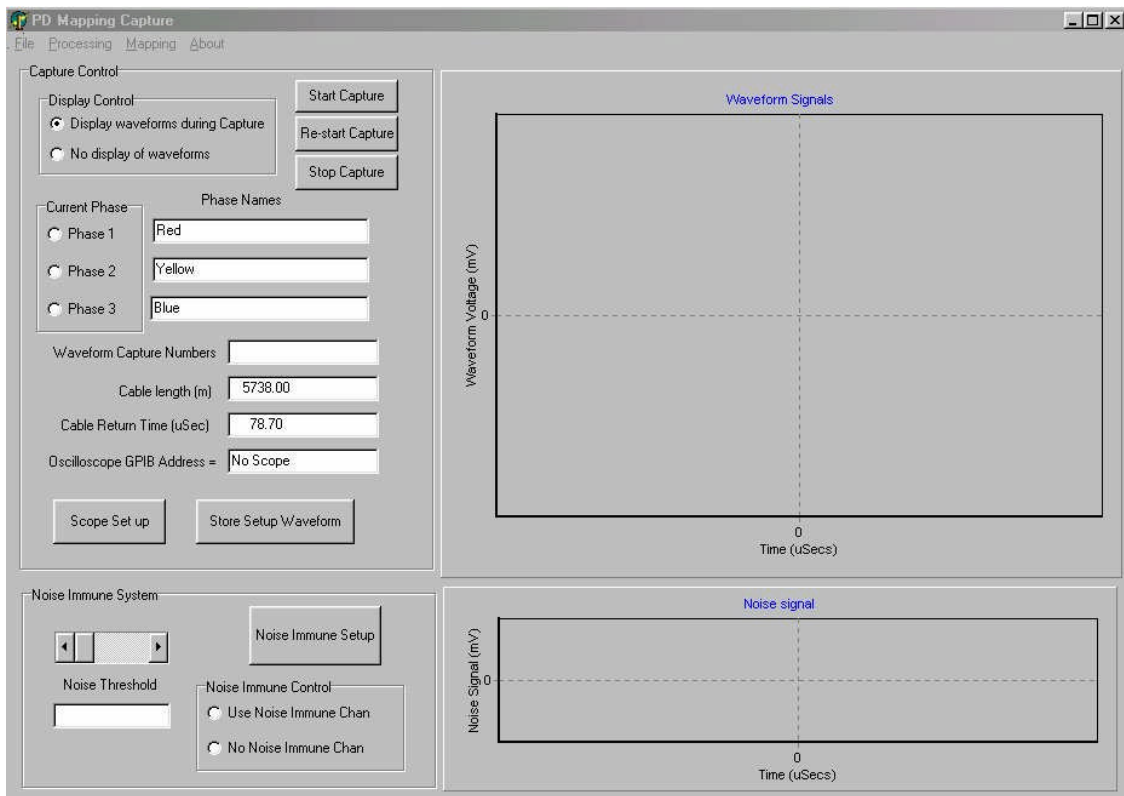
Once the waveforms have been stored, the magnitude and location of the PD is calculated from cursor positions, which have to be set from each waveform. The computer makes its best guess, and these should be confirmed manually. The software stores this processed information in the file.

A PD map is then constructed from the file. This shows the joint positions, and positions and magnitudes of all the PD events captured. The PD map is the final output of the process, and full printing facilities are supplied for a PD 'Report' which can contain comments about the circuit, cable, failures, circumstances etc, as required by the user, in addition to the measurement details and PD map.

The final part of the software, is an optional database, which can show all the PD maps, and additional stored data. The original waveforms will not be stored in this database, as this would require very large storage. (The raw data for each map could easily be 5Mbytes).

Data Capture	Initialisation in software, and Timebase & vertical settings adjusted from software. Other adjustments use the digitizer.
Waveform display	Current waveform displayed in real time.
File storage	Up to 1000 waveforms stored in each file
Data input sheet	Screen of details of cable under test. Includes:- Date (auto fill from date on PC) Full substation details Circuit details Joint positions Cable section lengths Manufacturer Cable types (chosen from drop down menu) Phase names Switchgear & terminations
Waveform processing	Each waveform shows automatic cursors to measure time of flight. Manual adjustments for all cursors possible. Waveforms marked as processed or not
PD map display	PD map displayed with joint positions. Single phase or any combination of phases displayed.
Report printouts	PD maps displayed with printed selection of recorded data. Space for comments
File management	Files can be accessed for both waveforms and maps to be displayed and reported.
Database	This is optional, and requires additional input from the customer for its compatibility requirements. The starting point for the database would be all data in the PD file map

PD mapping software opens with the main capture window.



Data input window

Default Prop Speed m/uSec

Default Attenuation dB/km

Default Cable type

Default Manufacturer

Total Cable Length (m) No of Cable sections Calculated return Time (uSec)

Section No	Length (m)	Start	End	Cable Type	Manufacturer	Prop Speed	Attenuation
<input type="text" value="1"/>	<input type="text" value="3284.0"/>	<input type="text" value="0.0"/>	<input type="text" value="3284.0"/>	<input type="text" value="Screened Oil Rosin"/>	<input type="text" value="Unknown"/>	<input type="text" value="72.00"/>	<input type="text" value="22.00"/>
<input type="text" value="2"/>	<input type="text" value="2454.0"/>	<input type="text" value="3284.0"/>	<input type="text" value="5738.0"/>	<input type="text" value="Screened Oil Rosin"/>	<input type="text" value="Unknown"/>	<input type="text" value="72.00"/>	<input type="text" value="22.00"/>

Circuit name/Description

Measurement End Name Remote End Name

Measurement arrangements Remote arrangements

Cable operating Volts (kV) Test Voltage (kV) Measured return Time (uSec) Cable Impedance (ohms)

Voltage Cal Ratio (actual/measured) CT Calibration (1/Tr) Comments on direct or CT detection Test Frequency

Comments on measurements and results

Analysis window

Interpretation Section

File

Current File data

File Name	Hazel Grove No2	Date of File	21/07/00	No of Joints	2
No of records	37	Circuit Name	Hazel Grove - Differton - Adswood No2	Cable RT time	78.70

Cursor Control

Cursor 1: 8.60 μ Sec

Cursor 2: 13.16 μ Sec

Cursor 3: 51.88 μ Sec

Approve + Next Reject + Next

Record Number

Re-Calc 2nd Pulse Re-Start Cursors

Recording type

Off line Voltage detect

On line CT detect

Calculations

Record Number: 7

Status: Manually Approved

Cursor 1 - 2: 4.56

Cursor 1 - 3: 43.28

PD Magnitude: 11172.50

Location (%): 45.01

W/F Length: 2500

Phase: Red

Waveform data in Time

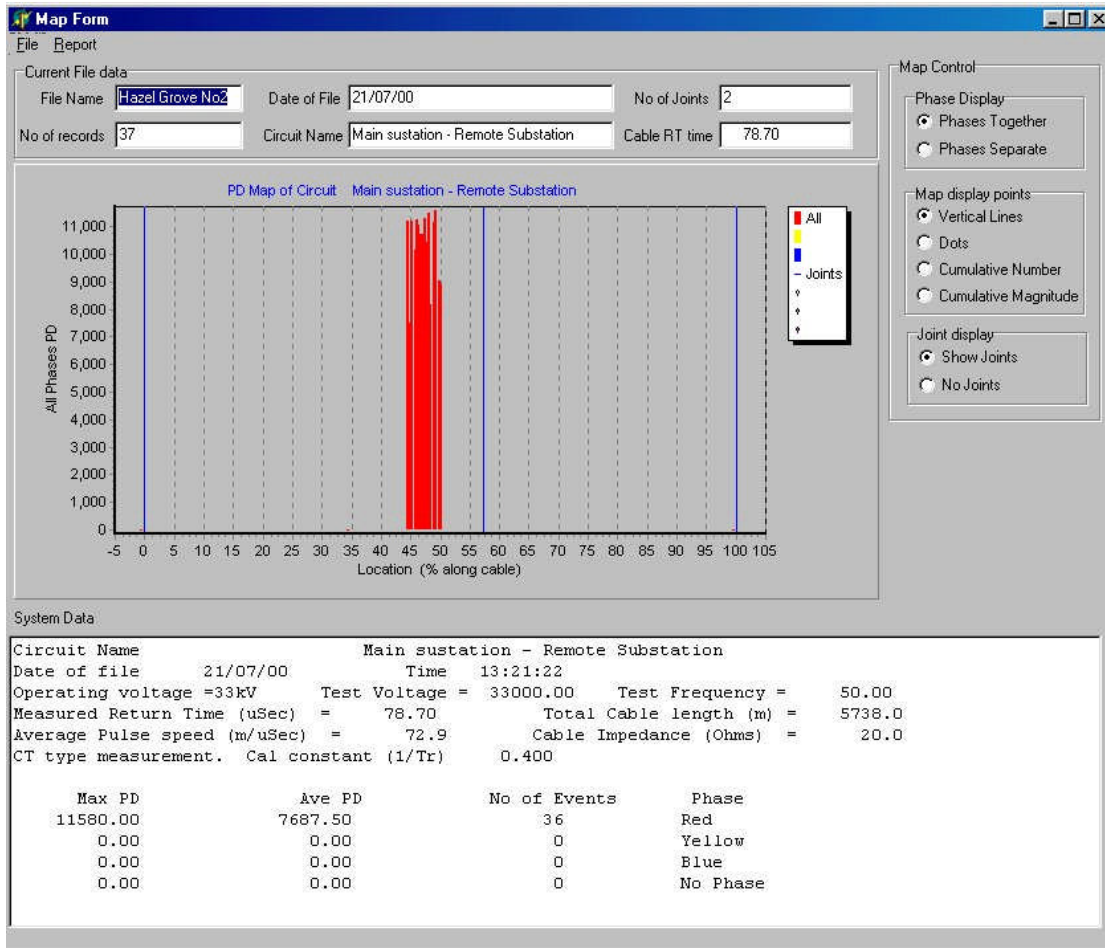
Simple PD map

Measurement Voltage Calibration

Measurement Calibration Ratio	CT Calibration (1/Tr)	Cable Impedance (Ohms)
2.00	0.40	20.00

PD mapping system output format

The PD mapping system will allow a PD map to be produced showing PD magnitude vs. distance along the cable, similar to the illustration below:



The data analysis windows will allow all of the location cursors to be set automatically, but will require approval before making final maps. This is because the measurement circumstances are always variable e.g. noise, end effects, cable impedance's, circuit parameters etc all produce waveforms which are hard to automate. Hence to ensure that the data locates the PD events correctly, the final arbitration is left to the user.

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