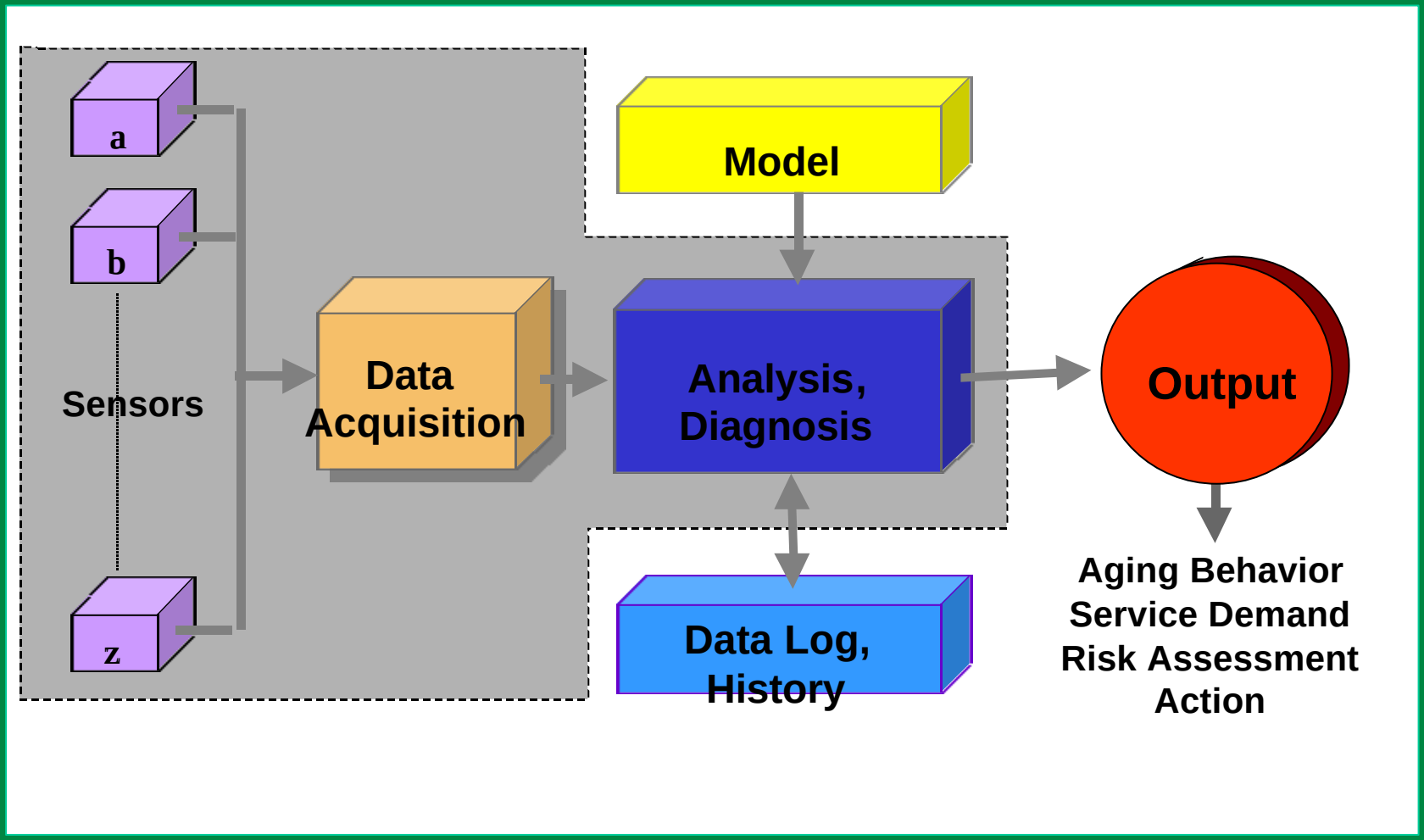
# PD Warning Device LDWD-6

# Concept of the Structure of a PD Monitoring System



# PD Warning Device LDWD-6

## On-Line Partial Discharge Monitoring and Testing of Rotating Machines

- Signal processing frequency 50 to 500 kHz according to IEC 270 standard
  => compatible with traditional off-line PD test results (using test-floor experience)
  => monitoring of the whole winding and HV accessories (not only the first start winding turns)

- Peak detector characteristic according to IEC 270 standard to distinguish between repetitive and stochastical pulses

- Very high dynamic (three decades); both wide band linear and logarithmic single pulse processing implemented

- Autoranging facility, automatic channel synchronization (also in multiplexing mode)

- Pulse resolution capability >100 kHz

- Noise rejection facility (gating) matched to the particular environmental noise condition of the tested generator (gating, windowing, filtering, implemented in hard- and software)

# PD Warning Device LDWD-6

## On-Line Partial Discharge Monitoring and Testing of Rotating Machines

- Real time monitoring of all three channels simultaneously
- Multiplexed signal acquisition after released alarm or forced by local or remote control
- Multiple Monitoring Systems are cascadable
- Automatic storage of pre-history files and post-history files (in case of alarm), intelligent data logger
- User-defined alarm criteria; threshold levels PD-signal magnitude, PD-repetition frequency, time of persistence (primary alarm criteria)
- Self-diagnosis ability of the complete signal path including the generator by injection of artificial test pulses to the neutral terminal
  - check of the alarm recognition performance
  - periodical check of signal transmission
  - recognize undesired signal attenuation e.g. due poor contacts

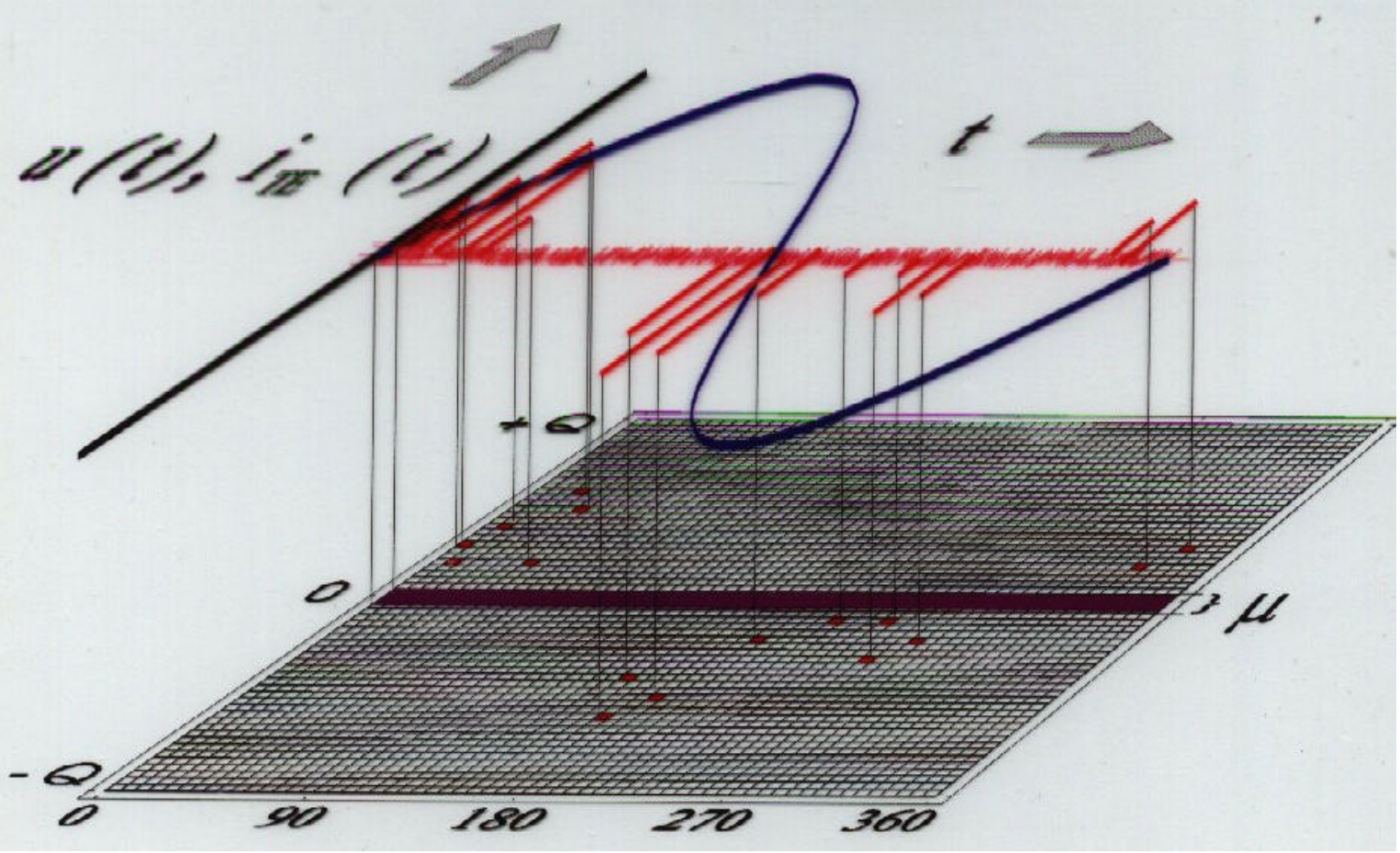
# PD Warning Device LDWD-6

## On-Line Partial Discharge Monitoring and Testing of Rotating Machines

- Continuous download and transmission of the PD datastream to remote host computers
  - Std. and optical Ethernet Interface, Modem implemented, Serial interface, GSM- or Pager-Module
  - LAN and WAN; Intra- and Internet Integration
  - Alarm Message, Data and RAS (Remote Access) port independent assignable
  - Link to Plant Control Systems, integrated alarm relay

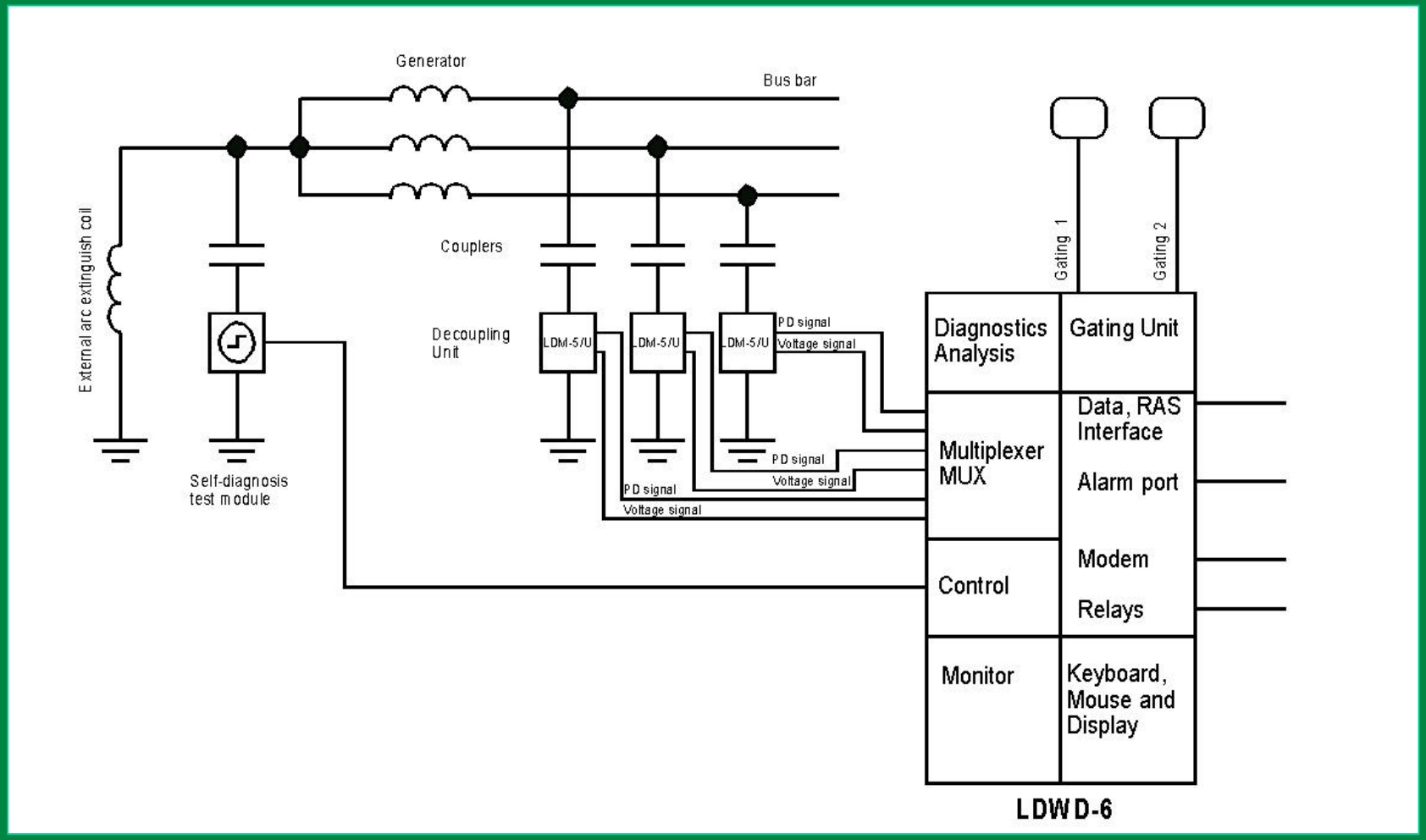
- All functions remote controlled
  - detailed PD diagnosis (PD pattern evaluation etc.) secondary alarm reaction
  - self-diagnosis of the system
  - matching of the noise sensors

# Phase Resolved PD Classification phase position

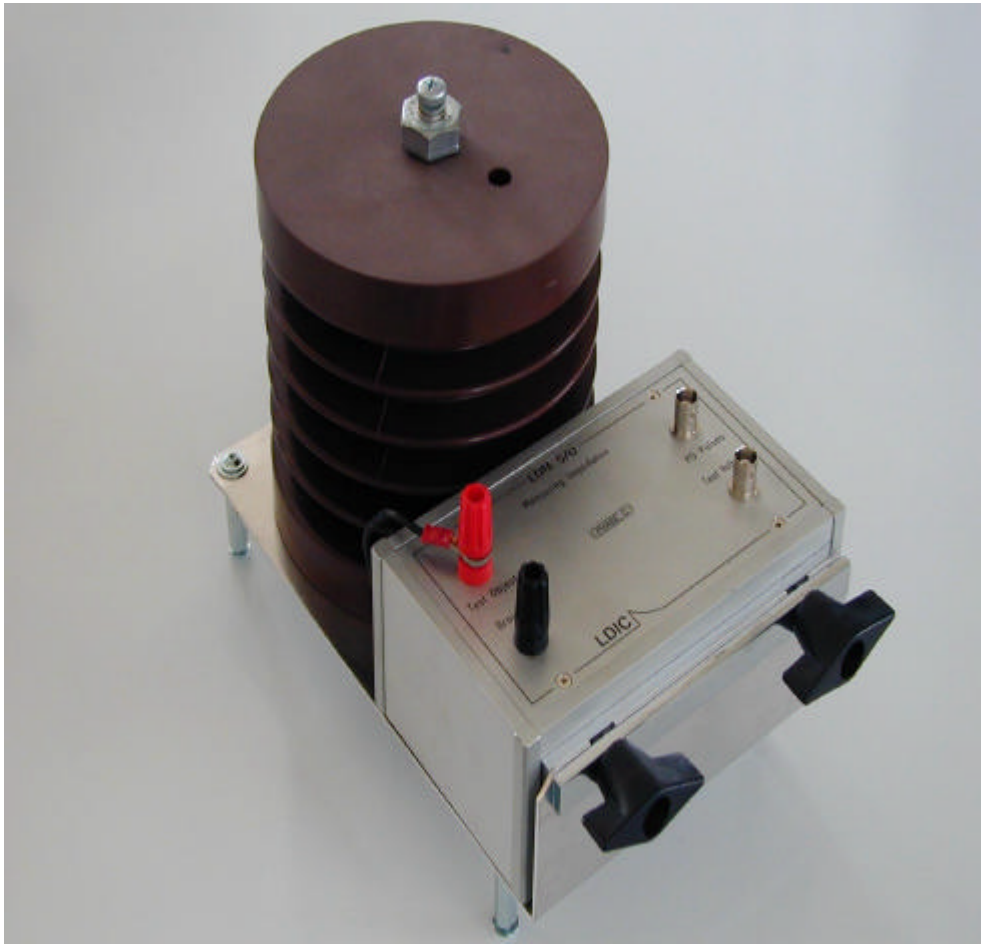


# PD Warning Device LDWD-6

## On-Line Partial Discharge Monitoring and Testing of Rotating Machines



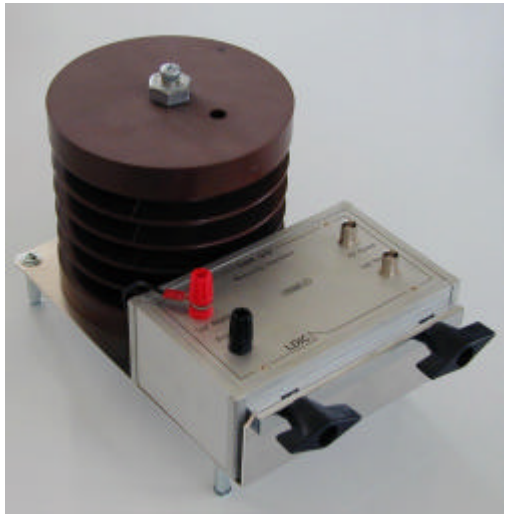
# PD Coupler for installation in a generator busbar



# PD Warning Device LDWD-6

## PD decoupling with the Measuring Impedance LDM-5

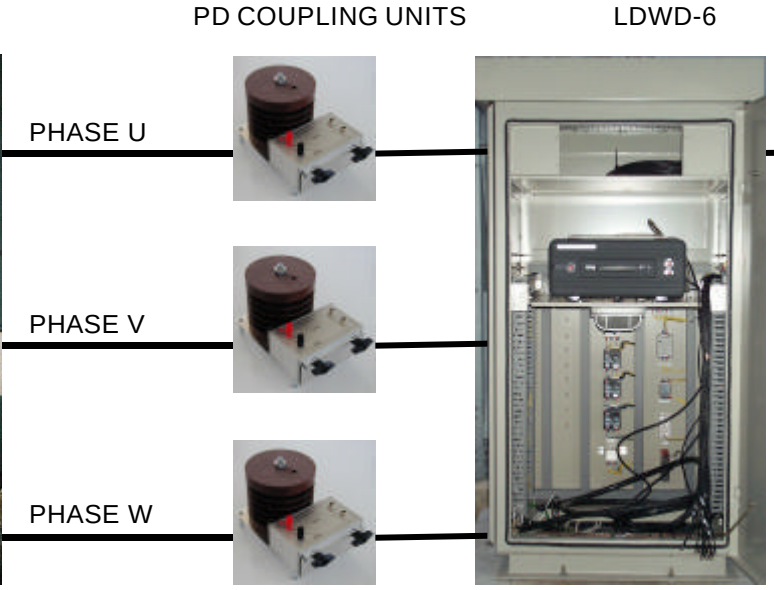
- busbar insulators of the three phases of the high voltage generator can be replaced with insulators
- higher capacitance for PD decoupling
- recommended capacity of the couplers: $C_K$ = 1 to 4 nF
- capacitance embedded in the insulator
- used as insulator and spacer as well as PD decoupling unit

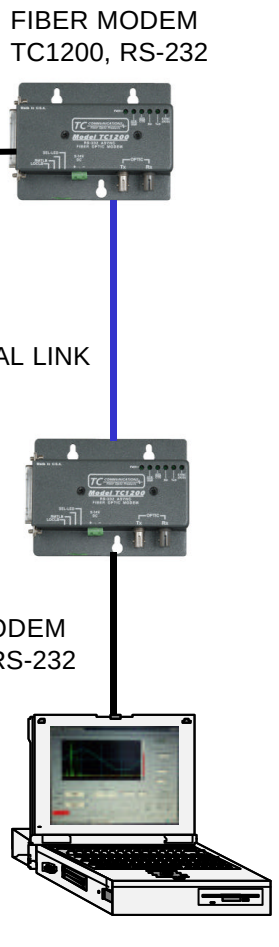


PD Coupler Unit – Coupling Capacity with Measuring Impedance

# PD Warning Device LDWD-6

## Arrangement of the PD Monitoring System of Rotating Machines



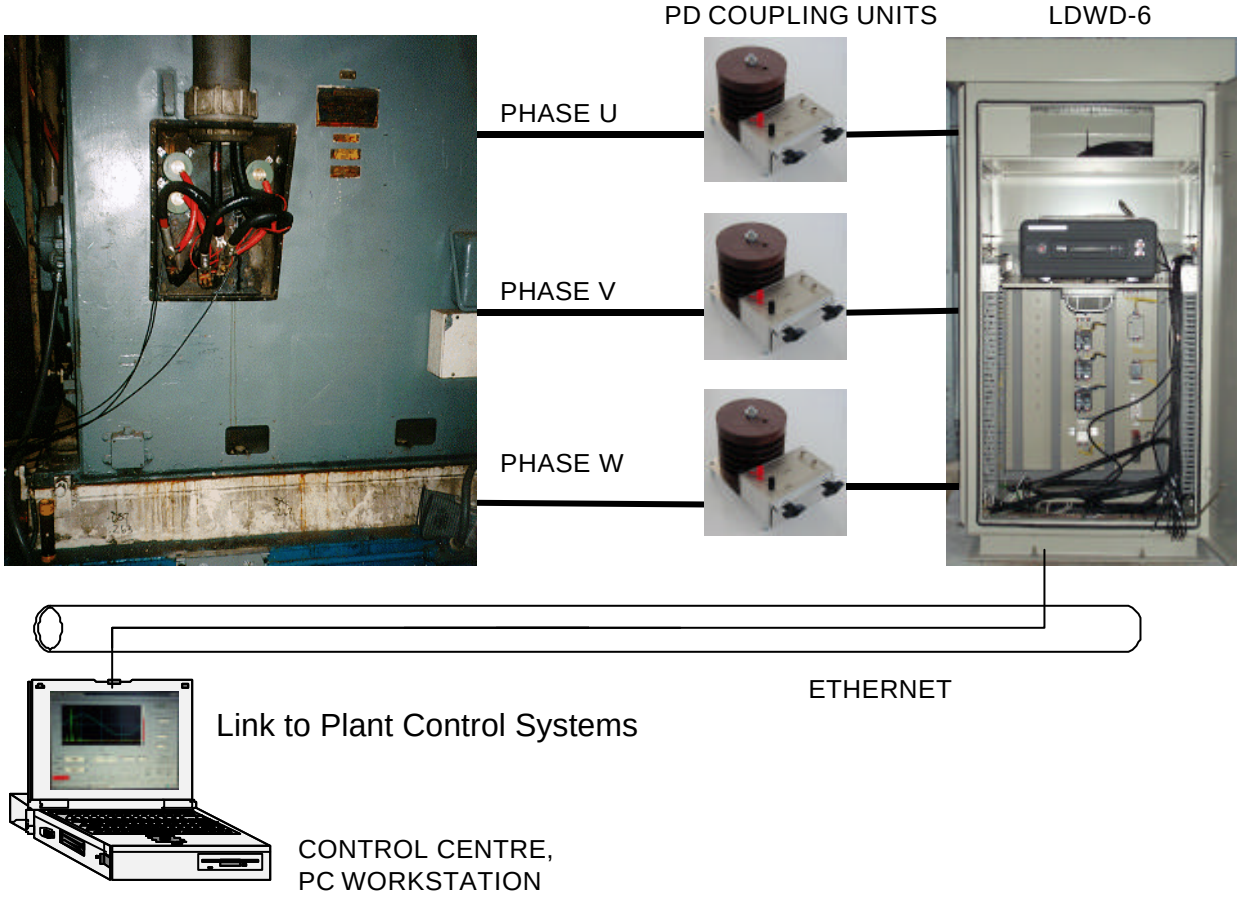




**Arrangement of the PD test of the full winding**

- multi-channel mode
- permanently installed PD Couplers

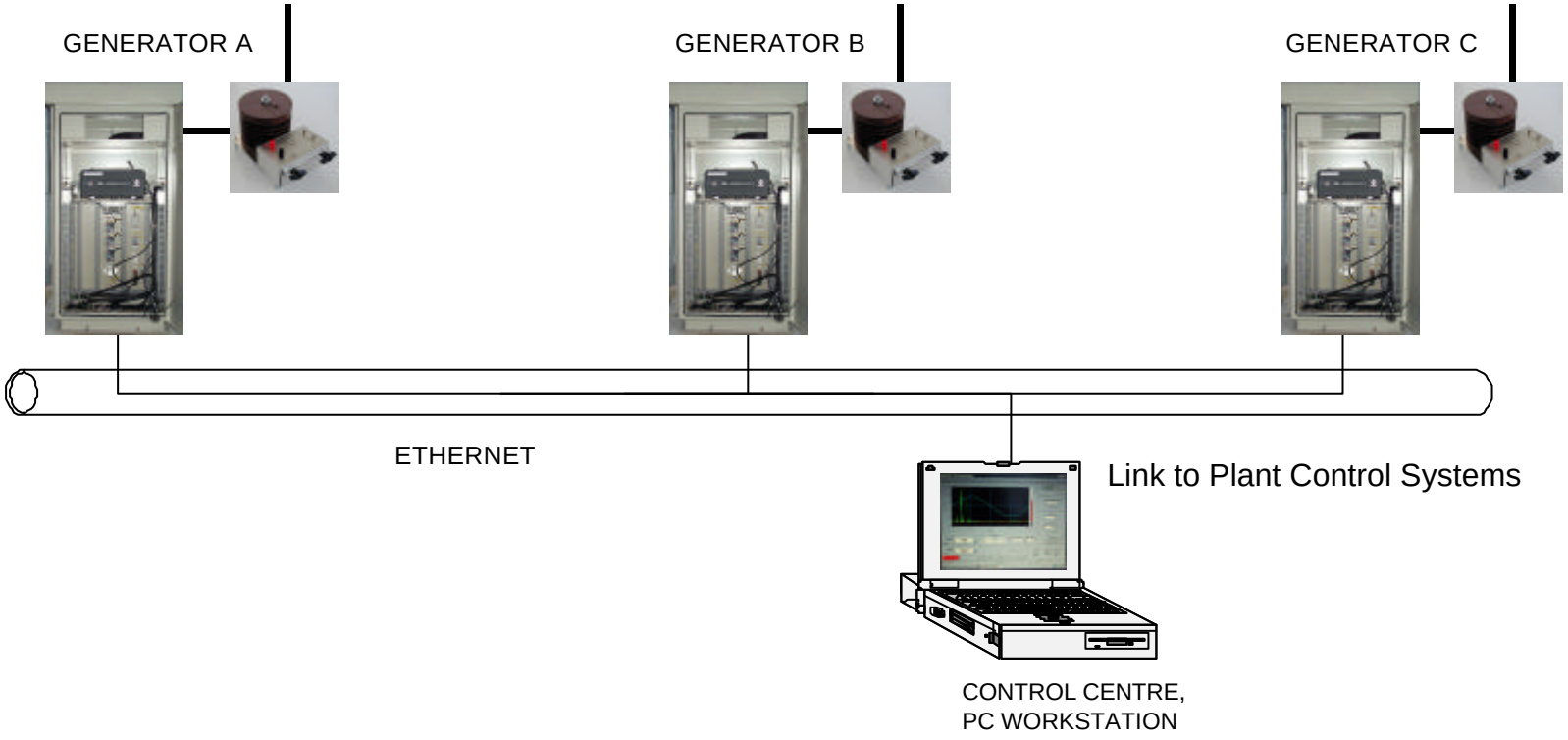
# PD Warning Device LDWD-6

## Arrangement of the PD Monitoring System of Rotating Machines



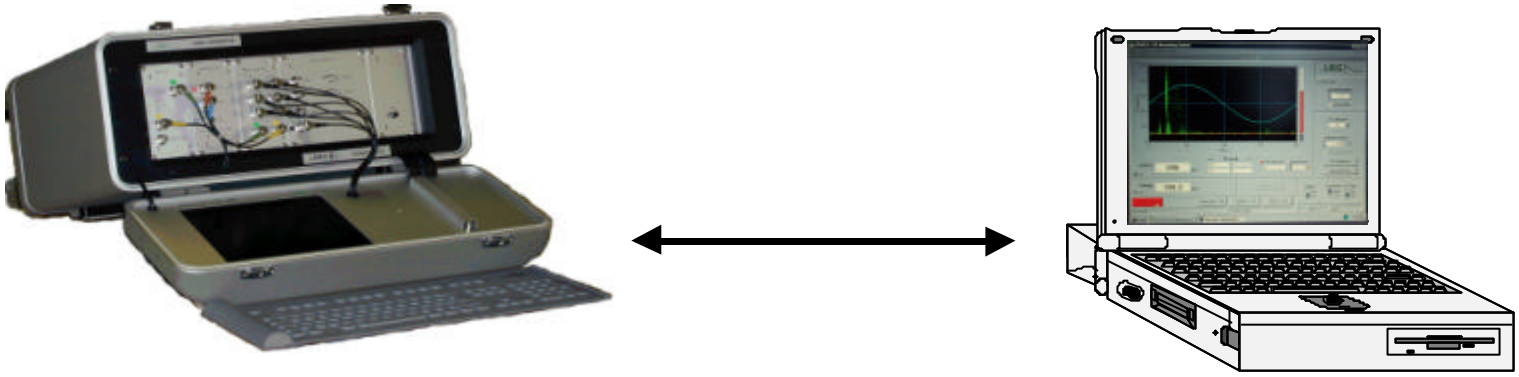
# PD Warning Device LDWD-6

## Arrangement of the PD Monitoring System of Rotating Machines



# PD Warning Device LDWD-6

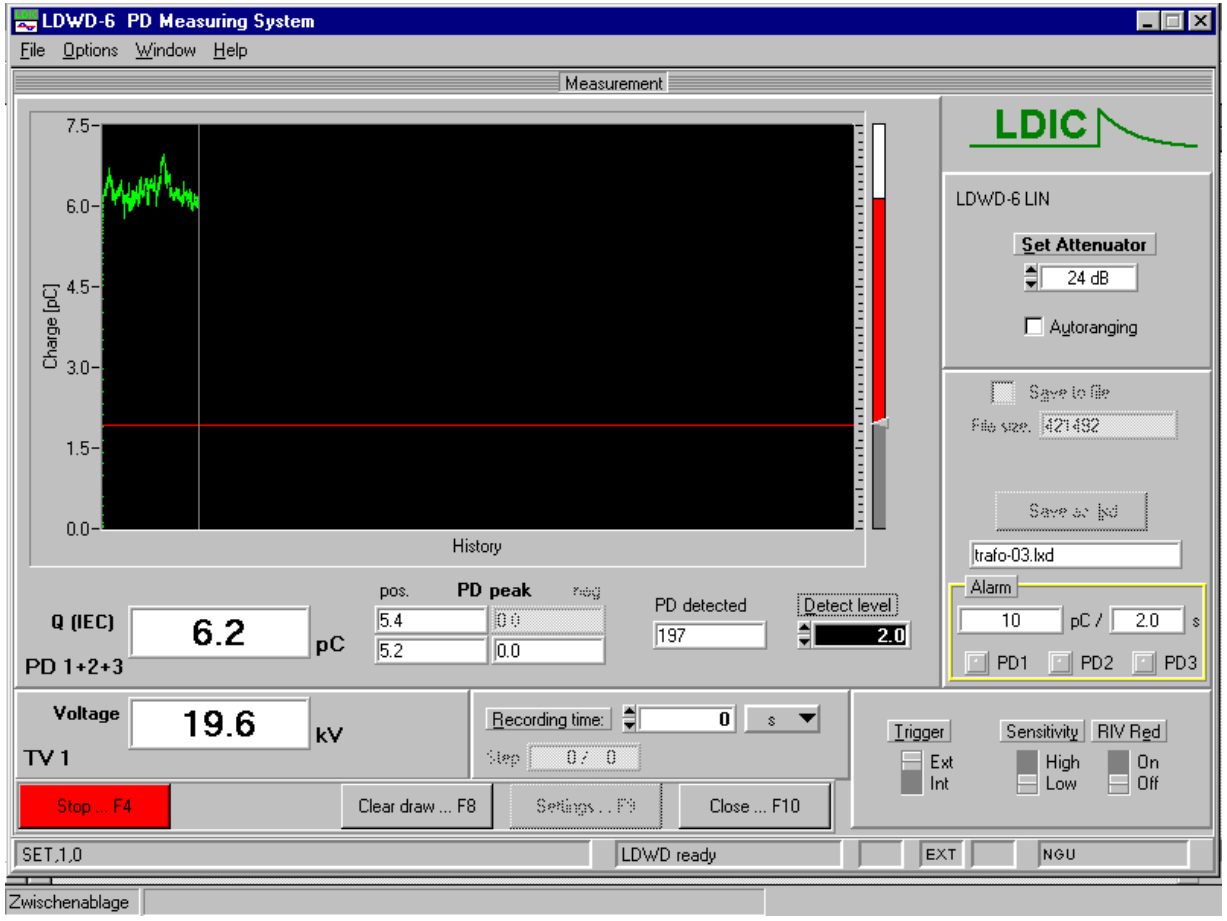
## Arrangement of the PD Monitoring System of Rotating Machines



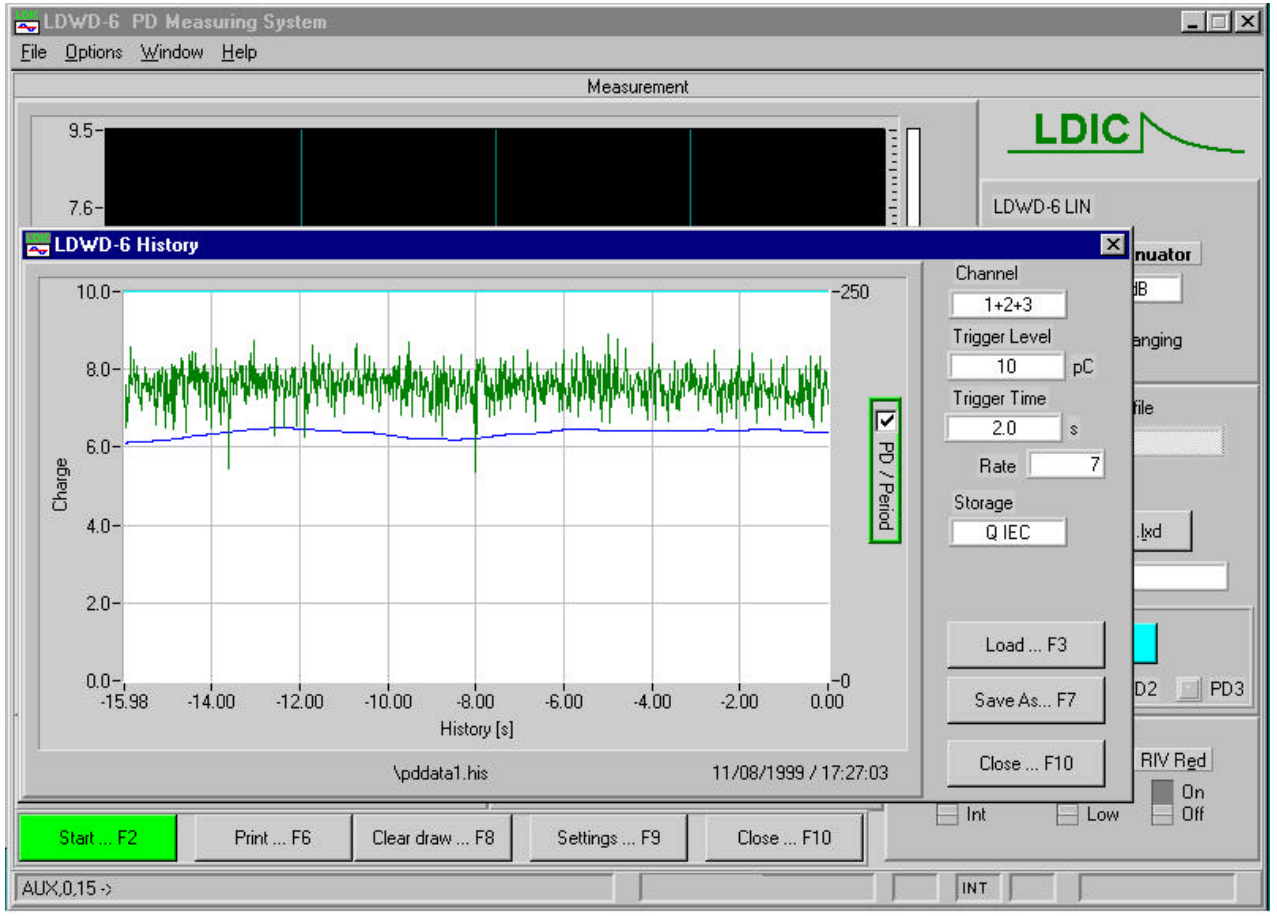
**Continuous download and transmission of the PD datastream to remote host computers**

- Std. and optical Ethernet Interface, Modem implemented, Serial interface, GSM- or Pager-Module
- LAN and WAN; Intra- and Internet Integration
- Alarm Message, Data and RAS (Remote Access) port independent assignable
- Link to Plant Control Systems, integrated alarm relay

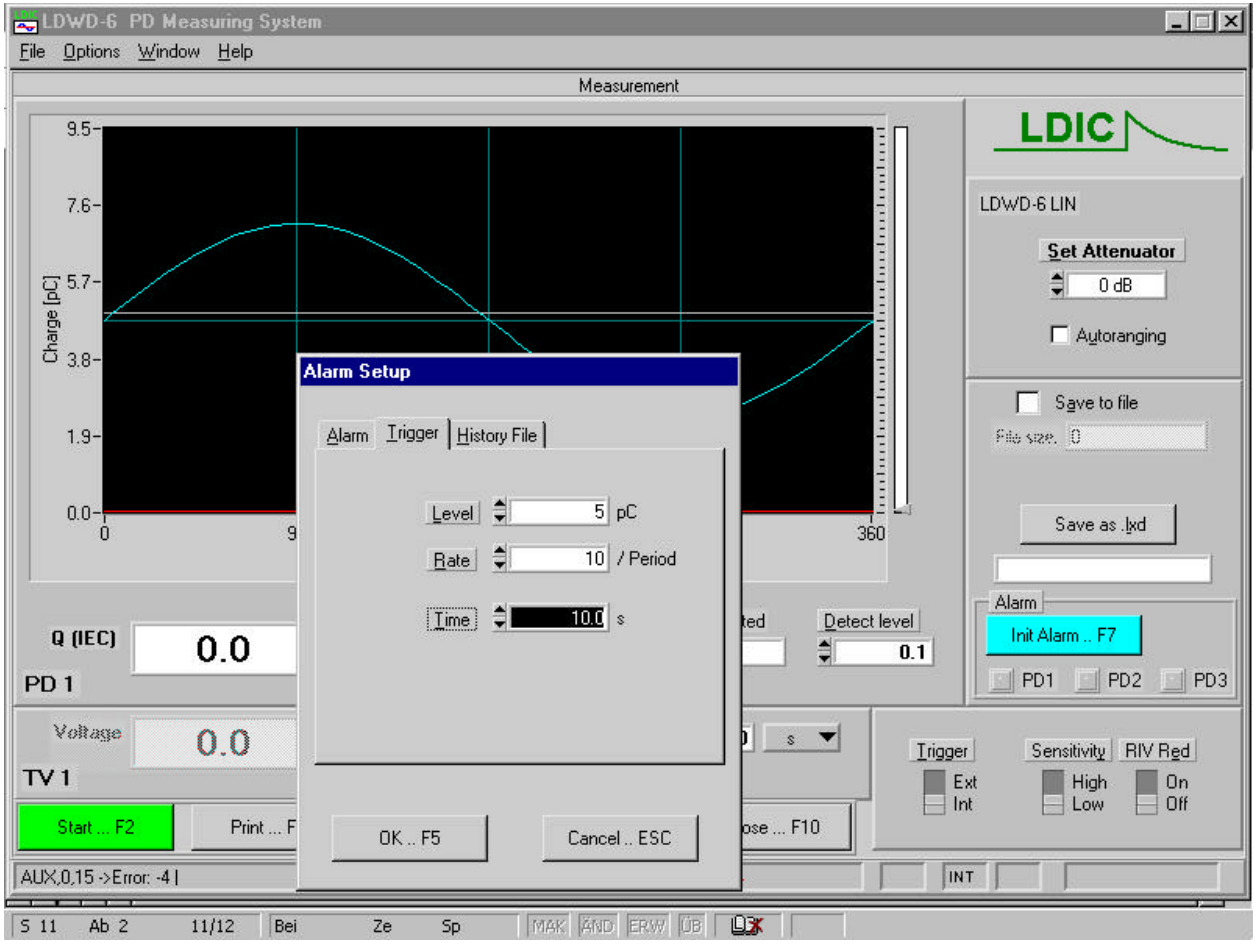
# PD-Monitoring System LDWD-6, Monitoring Chart



# PD-Monitoring System LDWD-6, History File

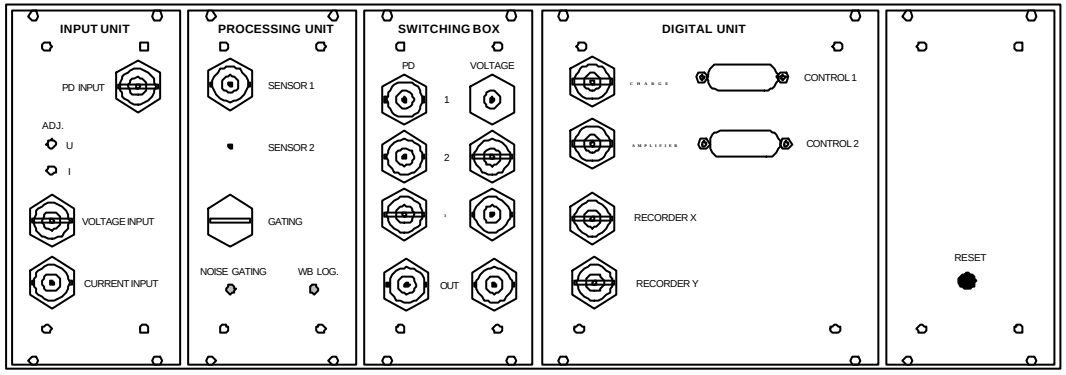


# PD-Monitoring System LDWD-6, Alarm Setup



# PD Warning Device LDWD-6

## Hardware Components




The Basic Device LDWD-6 with **Input Unit**, **Processing Unit**, **Switching Box** and **Digital Unit**

| | |
|---|---|
| Minimum detectable apparent charge | < 1 pC |
| Upper limit of detectable apparent charge | > 10000 pC |
| Selectable input attenuation | 0 ... 93 dB, 3-dB-steps |
| Single pulse resolution capability | up to 100 kHz repetition rate |
| Critical double pulse distance | > 1 µs |
| Measuring frequency range | 30 – 300 Hz |
| Pulse polarity recognition | > 2 pC resp. 5% of dynamic range |
| PD pulse processing (wide band) – frequency limit | 100 kHz – 400 kHz |

# PD Warning Device LDWD-6

## Hardware Components – Input Unit

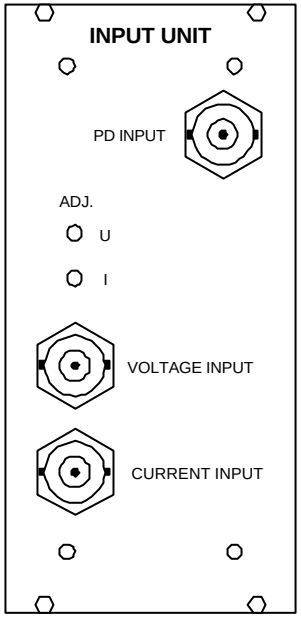
• Signal acquisition from the PD-decoupling system, mainly the standardized PD measuring quadripole

• Wide band pre-amplification (selectable gain)

• Pre-attenuator selectable in 3-dB-steps, provides a total attenuation up to 93 dB (provides a comfortable autoranging routine)

• Separate voltage input for acquisition of instanteous values of the applied test voltage

• Additional input for acquisition of the instanteous current values or other relevant magnitudes

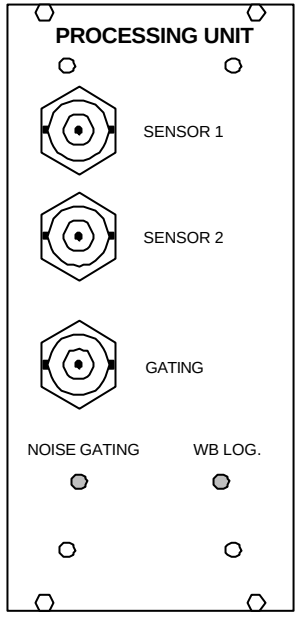


# PD Warning Device LDWD-6

## Hardware Components – Processing Units & Switching Box

**Processing Unit – WB LOG.**

• Logarithmic processing unit, provides logarithmic single pulse processing with a good dynamic range and single pulse resolution capability




**Noise Gating**

• Windowing method for elimination of phase stable noise pulses (at least for two phase windows selectable)

• Noise pulse gating, controlled by external noise pulses captured via external sensors or antennas

**Internal Multiplex Unit**

• Software controlled multi channel

• Switch for successive measurements at different measuring points

• Remote controllable

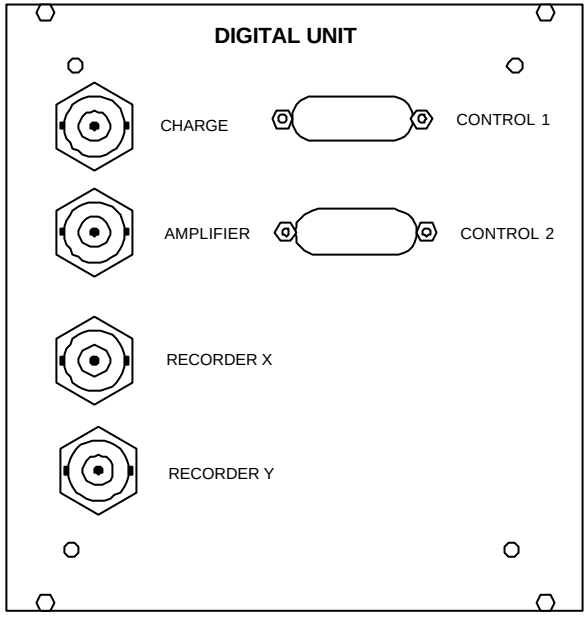
# PD Warning Device LDWD-6

## Hardware Components - Matching & Control Unit

### Analog / Digital conversion

### Digital-Signal-Processing modul

- fast data processing and compression,
- short duration data buffer,
- time and phase resolution of PD events,
- conversion of control commands to optional external components




### High speed programmable gate array pre-processing

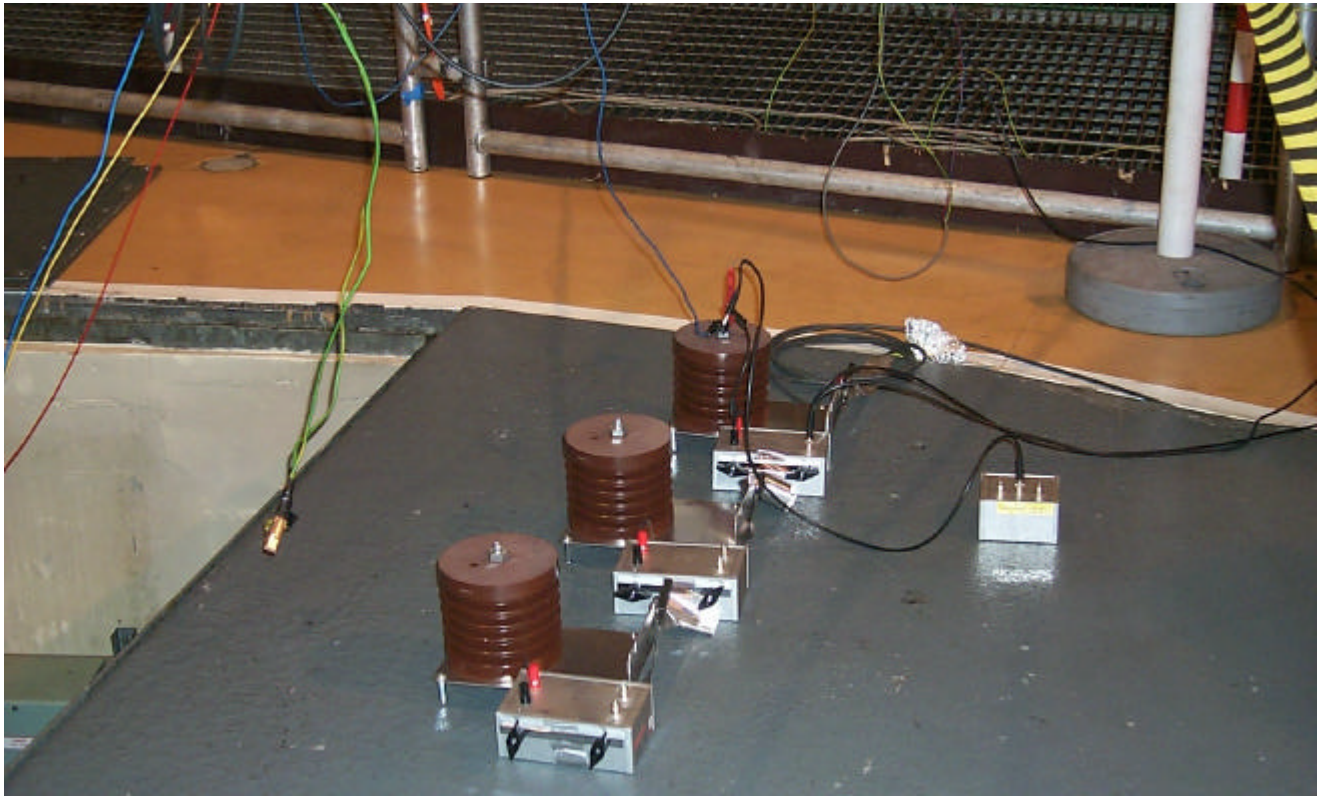
- recognition of PD-, current and voltage amplitude,
- pulse polarity discrimination,
- peak-detection,
- single conditioning for further post processing,
- digital noise rejection,
- time gating for suppression of not desired signal oscillation and reflections

### µ-Controller based bus system for controlling the devices and components

### Auxiliary ports for implementation of supplement functions (External Switching Box )

# PD Warning Device LDWD-6

## Pre-Installation of the Arrangement for the PD Monitoring System



Pre-Installation of the Arrangement of the PD test of the full winding

# Inductive Field Coupling for Location of PD affected Coils in a Hydro Generator

LDIC

# Inductive Field Coupling for Location of PD affected Coils in a Hydro Generator

# On-Site installed PD Monitoring System LDWD-6

LDIC

# PD Decoupling Units of the Monitoring System LDWD-6 installed at a Power Transformer