UNIVERSAL DATA ACQUISITION AND MONITORING SYSTEM FOR INSULATION CONDITION MONITORING OF HIGH VOLTAGE MACHINES

UDL-8000
Product Description
Company Profile
Sparks Instruments SA provides monitoring and diagnostic solutions for high voltage components in the power generation and distribution market. We are focused on developing and delivering high quality, specialised products and services that enable your power station to run proficiently, and to protect and maximise the life of its electrical components.

We offer a complete measurement chain solution through a flexible product and service portfolio that’s based on proven, leading technologies, and expert knowledge developed across diverse application domains. This includes an extensive range of monitoring devices and sensors for high voltage online applications and state of the art direct access tools that provide real time fault detection, and a trusted global customer support and service.

Our unique solutions provide the latest measurement technologies that can be found on the market today. Our products are designed to meet the demanding conditions that the power generation sector presents and comply with international standards. The services we offer include consulting, engineering, design and manufacturing of monitoring solutions, installation and commissioning, local and remote service contracts including data analysis of measurement data through remote access.

Sparks Instruments Head Office is located in Switzerland and we have a global team of specialised engineers and service technicians providing a global sales support network to all customers at a local cost. We listen carefully to all of our customers and we are attentive to their specific needs, as a result, our products reflect the demands of the world market.

Research & Development
Sparks Instruments R&D Team is continuously active in research and development in the field of high voltage and high frequency acquisition and monitoring. Our products are developed in-house, allowing special customer requirements to be integrated into standard products.

We have cooperations with local universities offering access to a large group of specialized engineers as well to their laboratories required for the development of products based on the latest technology standard.

Business relations ships with consultants, manufacturers and power station owners all around the world support Sparks Instruments in testing and approving new products before market launch.

Markets
Sparks Instruments is focused in the power generation and distribution market and offers a wide range of monitoring systems mainly for the condition monitoring of high voltage machines and their insulation systems.

Sparks Instruments is grown in the field of partial discharge measurement for high voltage insulation condition monitoring and has extended its product portfolio to cover all parameters related to insulation condition aging. Sparks Instruments offers complete insulation and diagnostic monitoring system solutions for the power generation and distribution market including:

- Hydro and Turbo Generators
- High Voltage Industrial Motors
- Busducts
- Power Transformers
- High- and Medium Voltage Cables
- Air and Gas Insulation Switchgears

Monitoring and Diagnostic Solutions for High Voltage Energy Systems
All data acquisition and monitoring systems manufactured by Sparks Instruments SA are designed in such way that they are compatible and share all the same software infrastructure. The products are based on a modular basis and can be centralized as well as decentralized. Decentralized acquisition and monitoring systems provide a cost effective solution and can be easily integrated into the plants company network. All collected data is stored into a centralized data center within the plant. Multiple data centers from different power stations or locations can be merged into one big data center, typically placed in the head quarter of the main company or in the data center at Sparks Instruments.

**Condition Monitoring of Electrical Machines in Power Generation and Distribution**

- **Rotating Machines**
  - TMS-5141 Ethernet Network
  - UDL-8000 EWM
  - UDL-8000 FLX
  - UDL-8000 SUJ

- **Busducts**
  - TMS-7141
  - UDL-8000 EWM-FLX SUJ

- **Transformers**
  - UDL-8000 PDAE
  - UDL-8000 PAM

- **HV & MV Cables**
  - TMS-7141
  - UDL-8000 PDSIM

- **Switchgears**
  - UDL-8000 UHF-PDSIM

### Application
- **Stator Insulation Condition Monitoring**
- **Rotor Insulation Condition Monitoring**
- **Stator Temperature Monitoring**

### Parameters
- Partial Discharge
- Rotor Interturn Short Circuit Detection
- Shaft Voltage / Shaft Current

### Sensors
- Coupling Capacitors
- RF CT’s
- LF CT’s

### Application
- **Spacer Condition monitoring**
- **Gas Monitoring**

### Parameters
- Partial Discharge
- Ozone Gas, SF6
- Temperature & Humidity

### Sensors
- Coupling Capacitors
- RF CT’s
- Gas Monitors

### Application
- **Bushing Monitoring**
- **PD Monitoring**
- **Core and Coil Vibration Monitoring**

### Parameters
- Partial Discharge, Lossfactor
- Ultrasound
- Vibration

### Sensors
- RF CT’s
- AE-Sensors
- Vibration Sensors

### Application
- **Cable Termination Monitoring**
- **Cable Joint Monitoring**

### Parameters
- Partial Discharge
- Temperature
- Ultrasound

### Sensors
- RF CT’s
- AE-Sensors

### Application
- **PD Monitoring**

### Parameters
- **Partial Discharge**

### Sensors
- UHF Window Sensors
- UHF Ring Sensors
- AE-Sensors
The UDL-8000 is a multi-modular monitoring system, specially designed for the online condition monitoring of high voltage machines. The UDL-8000 is based on a central controller and various sensor interfaces and signal conditioning modules for a wide range of applications such as monitoring of stator and rotor insulation of rotating machines, monitoring of busducts, high voltage cables, high voltage transformers as well as air insulated and gas insulated switchgears.

In order to provide a greater flexibility, the UDL-8000 is available in various sized enclosure, generally for DIN-Rail or panel mounting. Optionally the system is also available as 19" Rackmount solution.

Depending on the customer requirements, individual application specific systems can be built such as standalone flux monitoring system for turbo generators or standalone acoustic partial discharge monitoring for large power transformers. Whenever multiple parameters are monitored, the system can be built up as a combined solution, sharing the central CPU controller for multiple applications, where each parameter is monitored sequentially. For applications where true simultaneous acquisition over multiple parameters is required, multiple UDL-8000 CPU controllers can be integrated into the same enclosure.

The UDL-8000 Central CPU controller includes the basic interfaces such as relay contacts and Modbus RTU. The relay contacts can be shared with any parameter acquired through the modules. Whenever additional interfaces are required such as individual relays or analogue inputs or outputs (4-20mA), the UDL-8000 system can be extended with the desired modules. Each UDL-8000 Controller can be equipped with up to eight modules, either input modules or output modules.

The UDL-8000 System is designed for a vast array of applications, the list below outlines the most common applications:

**For Rotating Machines:**
- Endwinding Vibration Monitoring
- Rotor Flux Monitoring Rotor Short Turn Detection
- Shaft Voltage and Shaft Voltage Monitoring
- Stator Insulation Partial Discharge Monitoring
- Stator Core Temperature Monitoring
- General Process Parameter Recording

**For Bus Ducts:**
- Partial Discharge Monitoring
- Ozone or Insulation Gas Monitoring (using dedicated Gas Detectors)
- Ambient Condition Monitoring
- Temperature Monitoring

**For Power Cables:**
- Partial Discharge Monitoring of Cables, Cable termination and Joints
- Temperature Monitoring
For Power Transformers:
- Acoustic Partial Discharge Monitoring
- UHF Partial Discharge Monitoring
- Temperature Monitoring
- Structural Vibration Monitoring (Tank / Core)
- Power Analysis
- Cooling Fan Monitoring

For Air Insulated Switchgears:
- TEV Partial Discharge Monitoring
- Ozone Gas Monitoring

For Gas Insulated Switchgears:
- Acoustic Partial Discharge monitoring
- UHF Partial Discharge Monitoring

Key features
One of the UDL-8000 key features is the flexibility the system offers. Standard off the shelf controllers, modules and software packages allows us to provide a customer specific solution. The UDL-8000 can be offered a dedicated, individual standalone system with single functions, up to a completely integrated system.

Controllers
The Controllers are based on a 500MHz DSP and are running on an embedded Real-time Operating System. Depending on the application and the customer needs, the UDL-8000 CPU controller is available in different options as:

- UDL-8000-C1  Controller standard, 18-36VDC, 3.5” LCD
- UDL-8000-C2  Controller with option PD Measurement, 18-36VDC, 3.5” LCD

For applications where no display is required, or the space is limited for individual LCD displays, the UDL-8000 CPU Controller is also available as a mini version:

- UDL-8000-C1-M1 Controller Mini Version, 18-36VDC
- UDL-8000-C2-M1 Controller Mini Version with option PD Measurement, 18-36VDC

The UDL-8000 can also be used as a mobile analysis system, by using a simplified controller and one single module. Using the UDL-8000 as a mobile system, the controller comes without any IO interfaces and the monitoring features are suppressed. The acquired data is visualized directly on the windows based software application.

- UDL-8000-C1-M0 Controller Micro Version 18-36VDC
- UDL-8000-C2-M0 Controller Micro Version with option PD Measurement, 18-36VDC

Depending of the used sensors, multiple sensor interface and conditioning modules are available. Each module offers the typical interfaces needed. This modular design, allows also to develop custom specific modules in order to fulfill the customer requirements. For any special requirements or modifications, please contact Sparks Instruments for a proposal.

Hardware Modules
The UDL-8000 CPU controller supports up to eight modules, were each module has typically eight acquisition channels. For partial discharge measurement applications the UDL-8000 CPU controller C2 is required, it includes six additional partial discharge acquisition channels.

- M8001 8 ch voltage measurement module with 1x & 2x integrator, 1x reference input
- M8002 8 ch standard voltage and current measurement module
- M8003 8 ch Vibration sensor module, constant current, 1x integrator
- M8007 8 ch RTD temperature module
- M8008 Temperature chain monitoring module, 4 sensor chains, 64 sensors per chain
- M8009 Magnetic flux monitoring module, 1x reference input, 2x flux probe input
- M8011 8 ch 4-20mA output module
- M8012 3 ch power analyzer module, 3x voltage, 3x current
- M8013 8 ch Relay Module SPDT
- M8014 3 ch UHF PD module, 1x RF, 1x Ref
- M8015 8 ch digital input
- M8016 Shaft current and shaft voltage module, 1x reference, 5x 4-20mA input
- M8017 Transformer Bushing monitoring module, 3x tan delta, 1x reference
- M8018 1 ch UHF module, 1x RF, 1x ref
- M8019 5 ch Partial Discharge Monitoring Module (Multiplexed), 16kHz .. 300MHz
- M8020 5 ch Partial Discharge Monitoring Module (Simultane), 16kHz .. 300MHz
- M8021 4 ch Ultrasonic Partial Discharge Module, 4x AEPD, 1x RF PD, 1x ref
- M8022 6 ch Partial Discharge Monitoring Module, 40MHz .. 350MHz
Software Modules / Firmware Package

In order to simplify the handling and the configuration of the system, the UDL-8000 is based on dedicated application specific software packages built into the systems operating system. A simple selection of the desired application allows us or the customer to configure the system with just a few mouse clicks. The UDL-8000 is supplied with a single configuration software to be used for all types of applications and Modules.

The following Software Packages are available:

- **PDSEQ** Sequential partial discharge acquisition, 8 bit prpd patterns, pulse height distribution
- **PDSIM** Simultaneous partial discharge acquisition, 8 bit prpd patterns, pulse height distribution, TR pattern, CMR
- **PDBAS** Basic partial discharge monitoring, 6bit prpd patterns, pulse height distribution
- **PDAE** Simultaneous partial discharge monitoring for acoustic pd measurement
- **SUI** Shaft voltage and shaft current monitoring
- **FLM** Flux monitoring module
- **EWM** Endwinding Vibration Monitoring
- **PAM** Power Analyzer Module
- **TAN3** Bushing Monitoring
- **BVIB** Basic vibration monitoring
- **RTD** Temperature Monitoring

Whenever the UDL-8000 is running multiple applications sequentially and is extended with output Modules represented as digital outputs, Relays and 4-20mA Outputs, each measurement channel can be freely assigned to any of the output channels. There is no limit of extension modules except the maximum of eight modules per controller.

Simultaneous Acquisition and Distributed Acquisition

If the UDL-8000 system is used with a single application, all UDL-8000 systems can be synchronised; allowing a simultaneous acquisition over multiple systems installed over multiple locations.

This feature is typically used, whenever large objects are monitored such as busducts or gas insulated switchgears. The group of systems are assigned to one master system which triggers the acquisition of the slave systems. When connected to the TMS-2000 Data Server, all raw data is streamed into the database simultaneously. As each data set is assigned to a timestamp and the trigger information, the raw data can further be analysed simultaneously. For standard server applications, up to 16 UDL-8000 can be synchronised together. This setup is offering up to 128 simultaneous acquired voltage channels or up to 80 partial discharge channels.

The system configuration, channel descriptions, alarm events, parameter trend data and raw data are stored into an SQL based database and allows access to third party applications. This makes the complete monitoring system easily to be integrated into the plant monitoring system or any kind of superior software application.

Networking and SCADA interface

All UDL-8000 Systems are compatible with the Partial Discharge Monitoring Systems of the TMS-Series and can be connected via the Ethernet network to the same TMS-2000 Data Server. Depending on the quantity of UDL-8000 Systems and the different locations, the UDL-8000 systems have to be connected to multiple TMS-2000 Data Servers. Each Data server an be replicated via a star like replication server located either within the same plant or via Internet or Intranet via multiple plants.

Besides the own Ethernet protocol used for the communication between the UDL-8000 monitoring systems and the TMS-2000 Data servers, each UDL-8000 has an additional Modbus RTU slave interface, for the intercommunication to the SCADA system. This allows the acquired data to be published to the SCADA system or to collect process parameters of the machine to the individual monitoring systems. For SCADA systems using other interfaces and protocols as e.g. Modbus TCP, Profibus DP or IEC61850, external interface gateways are used through the Modbus RTU slave.

The UDL-8000 controller offers an additional Modbus RTU Master interface, allowing the collection of data from third party devices, as e.g. vibration monitoring systems or dissolved gas analyzer (DGA).
EXAMPLES OF APPLICATION SPECIFIC SOLUTIONS
Rotating Machines

Endwinding Vibration Monitor
UDL-8000-C1 - EWM
1x UDL-8000, 2x M8001

Shaft Voltage & Current Monitor
UDL-8000-C1 - SUI
1x UDL-8000, 1x M8016

RTD Monitor
UDL-8000-C1 - RTD
1x UDL-8000, 2x M8007

Rotor Flux Monitor
UDL-8000-C1 - FLX
1x UDL-8000, 1x M8009

Partial Discharge Monitor
TMS-5141 or TMS-5441

Turbine  
Generator  
Excitation
Bus Ducts

**PD Monitor**
UDL-8000-C1 - PDSEQ
1x UDL-8000, 1x M8019

**PD Monitor**
UDL-8000-C1 - PDSEQ
1x UDL-8000, 1x M8019

**Partial Discharge Monitor**
UDL-8000-C1-M1 - PDSIM
1x UDL-8000, 1x M8020, 1x8032

**Partial Discharge Monitor**
UDL-8000-C1-M1 - PDSIM
1x UDL-8000, 1x M8020, 1x8032

**Partial Discharge Monitor**
UDL-8000-C1-M1 - PDSIM
1x UDL-8000, 1x M8020, 1x8032

**Partial Discharge Monitor**
UDL-8000-C1-M1 - PDSIM
1x UDL-8000, 1x M8020, 1x8032

HV / MV Cables
Transformers

Basic Transformer Monitor
UDL-8000-C1 - RTD, PAM, AI, DI, BVIB
1x UDL-8000, 1x M8007, 1x M8012
1x M8015, 1x M8003

Acoustic Partial Discharge
UDL-8000-C2 - PDAE
1x UDL-8000, 2x M8021

UHF Partial Discharge
UDL-8000-C2 - PDSEQ
1x UDL-8000, 1x M8018

Partial Discharge Monitor
UDL-8000-C1-M1 - PDSIM
1x UDL-8000, 1x M8020, 1x M8032

Bushing Monitor
UDL-8000-C1 - TAN3 - PDSEQ
1x UDL-8000, 1x M8017, 1x M8019

Busduct

Bushing

Bushing Adapter

Cooling Fans

Cable Bushing

AE Sensor

UHF

HFCT

DGA

CT
Air Insulated Switchgears

- 4 Channel PD Monitor
  UDL-8000 - PDSEQ
  1x UDL-8000, 1x M8019

- 20 Channel PD Monitoring System
  UDL-8000 - PDSEQ
  1x UDL-8000-C2, 5x M8019

Gas Insulated Switchgears

- 3 Channel UHF PD Monitor
  UDL-8000-C2 - PDSIM
  1x UDL-8000, 1x M8014

- 3 Channel UHF PD Monitor with integrated FO Switch
  UDL-8000-C2-M1 - PDSIM
  1x UDL-8000, 1x M8014, 1x M8032