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Partial Discharge Monitoring and Diagnostic Solutions for Rotating Machines



En Monitoreo de la Condición con la mejor... Tecnología

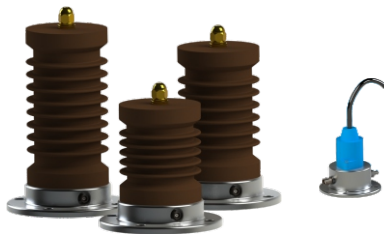
Sensors for Partial Discharge Measurements



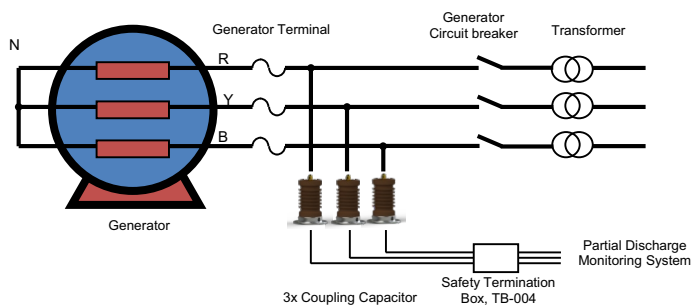
General

A Partial Discharge Sensor is used to separate the high frequency partial discharge signal from the line voltage and is in general a high pass filter in a frequency range several ten-kilohertz up to several ten megahertz. Typically so called coupling capacitors are used, but other high frequency sensors as high frequency current transformers or antennas

are available on the market. Whatever sensor is chosen, it must meet the requirements specified by the international standard and it must provide the partial discharge high frequency signal in a frequency range with the right coverage of the test object.



Coupling Capacitors from 7kV to 24kVrms



Typical Installation with 3 Coupling Capacitors

Partial Discharge Coupling Capacitors

Coupling Capacitors are the most common used sensor to measure partial discharges in rotating machines. They consist of a high voltage capacitor and a measuring impedance. the capacitor and the measuring impedance together defining the frequency range of the sensor. Sparks Instruments coupling capacitors are designed for heavy industrial environment and meet international standards as e.g. creeping distances, impulse lightning and over voltage width stand.

All the coupling capacitors have their quadrupole build-in in the bottom including over voltage protection for instrument and personnel safety. The quadrupoles are designed for a frequency range from several tens of kilohertz up to several hundred megahertz. the special designed quadrupole provides additionally the line frequency in a scale of 1:2000 to the applied line voltage, allowing to synchronise the partial discharge detector with the same signal cable. The virtual grounded signal output protects the signal cables from eddy currents due to the high magnetic fields in the testing environment.

For rotating machine monitoring, it is recommended to use the standard capacitance of 1000pF but for customers requiring 80pF coupling capacitors these models are available as well.

Installation of Coupling Capacitors

Typically one coupling capacitor per phase is installed at the phase exits of the machine. For large machines it is recommended to install additionally a coupling capacitor at the neutral point.

For customers who wants to install multiple sensors per

phase (e.g. each parallel phase), Sparks Instruments recommends to install the sensors by an authorized rewinding company or by the machine winding manufacturer.

High Frequency Current Transformers

High frequency current transformers are commonly used whenever an existing high voltage capacitance is available. Typically the high voltage capacitance separating the high frequency partial discharge signal from the line frequency, and instead of using the quadrupole to couple out the partial discharge signal, the high frequency current transformer is used.



High Frequency Current Transformers
ø17 and ø24mm



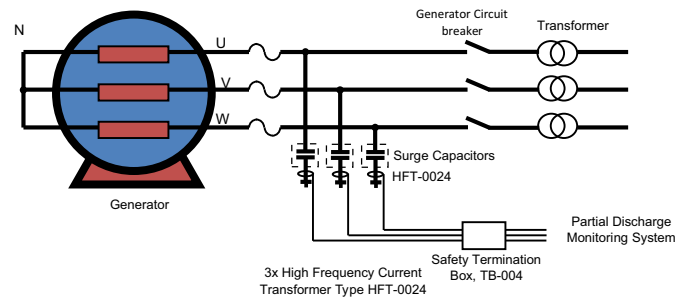
Partial Discharge Measurement with
Surge Capacitor and HFCT

Sensors for Partial Discharge Measurements



Using Surge Capacitors for Partial Discharge Measurements

Large generators are typically equipped with surge capacitors to protect the machine winding. Installing a coupling capacitor directly next to the surge capacitor would significantly reduce the measurement sensitivity. In case, the surge capacitors can be used to measure partial discharges by adding a high frequency current transformer on the ground lead. For this type of installation, the installation of the surge capacitor must be slightly modified, by insulating the body of the surge capacitor to ensure all the signal is passing through the high frequency current transformer. As the grounding wire section varies from different diameters, different models of the high frequency current transformer are available. Sparks Instruments offers complete installation kits including fiberglass insulation sheet and bolts, cables etc.

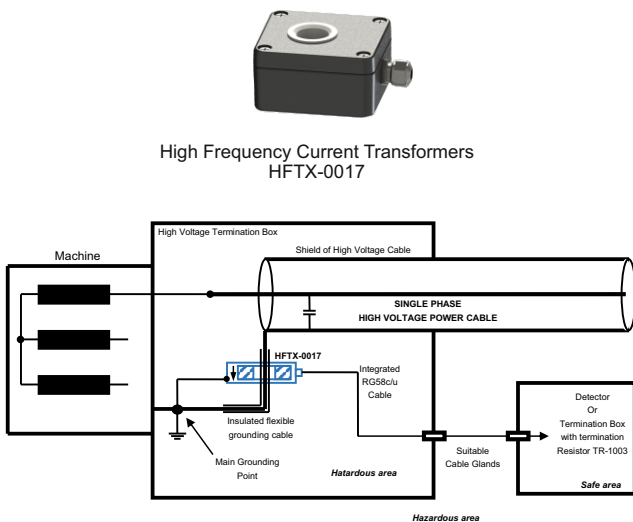


Using Cable Capacitance for Partial Discharge Measurements

Large industrial motors in the 6kV and 6.6kV range often have a small high voltage termination box, which do not provide enough space to install coupling capacitors. For such applications, a high frequency current transformer can be used on the ground lead of the high voltage cable to measure the partial discharge activity of the machine.

Hazardous Environment (ex)

For partial discharge measurements in explosive areas, often coupling capacitors cannot be installed, especially for installations in zone 1 where the sensor is located outside of the machine. The HFTX-0017 is specially designed for this type of application.

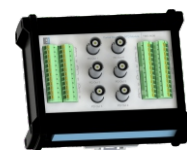


Partial Discharge measurement with RTD's

As RTD's are nearly every machine installed, they can be used as an additional sensor. As the RTD's are only covering a small portion of the machine winding, just around the RTD itself, it is only recommended to use them as an addition to the coupling capacitors or High frequency current transformers. Obviously it is recommended to use only the RTD's located at the high voltage part of the winding.

The TMS-9006 RTD module couples the high frequency signals out of the RTD signal cables. As the coupling is done via high frequency current transformers, even used

RTD's can be used, without influencing the temperature measurement. additionally the build in LP Filter reduces the noise of the RTD signal.



TMS-9006 RTD Module

Safety Termination Boxes

Partial Discharge measurement and requires a proper grounding of the signal cables between the sensor and the acquisition system and must provide a safe and secure connection interface for the operators.

Sparks Instruments offers e.g. the TB-004 safety termination box made of stainless Steel and offers IP66 protection and is suitable for indoor and outdoor installation. Alternatively smaller termination boxes as the TBS-003 and TBS-004 are available offering the same protection rating but have their BNC terminals externally..

Sparks Instruments generally sells the sensors as complete sets including all necessary parts for installation as screws, bolts, nuts, HV cables, safety termination box, signal cables (typically RG58 c/u) and the suitable BNC connectors



Safety Termination Box TB-004



Safety Termination Box
TBS-003 / TBS-004

Standalone Basic Continuous PD Monitoring

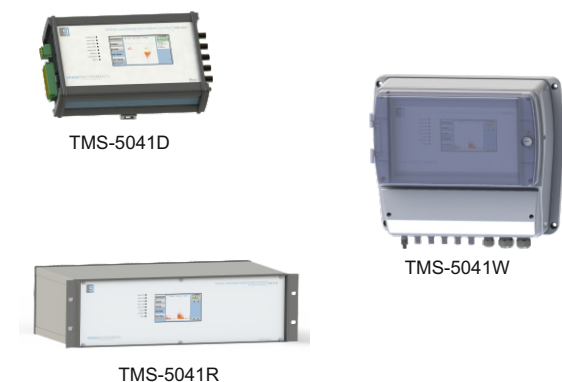
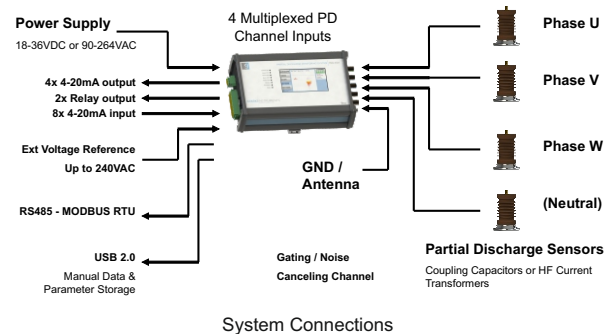


TMS-5041

The TMS-5041 is a lightweight easy operable partial discharge monitoring system mainly designed for standalone operation with a simple interface to a third party system or software. The TMS-5041 measures sequentially 4 Partial Discharge Channels, The system has a 4-20mA analogue output per channel, one common alarm relay output and Modbus RTU interface for the communication the scada system or any third party plant monitoring system. A Windows based Software is included to download actual partial discharge measurement results via the USB 2.0 interface.

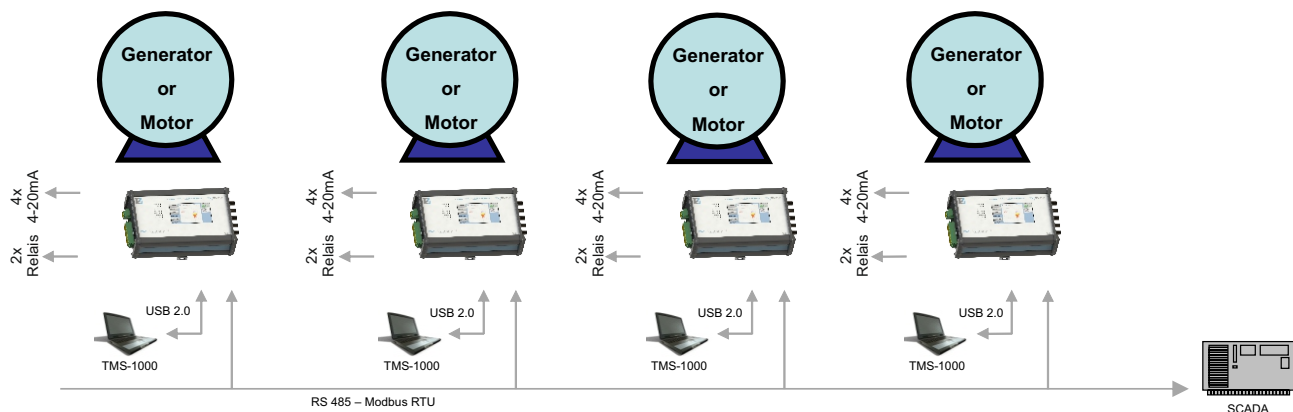
Build in variable high- and low pass filters and external gating channels allows to remove noise from the

measuring channel. Partial discharge results are shown as 8-bit phase resolved partial discharge patterns offering 256 amplitude windows and 256 phase windows.

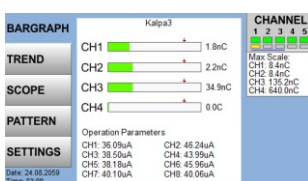


For installation within a cubicle, the device is available in a 35mm DIN Rail mountable enclosure or for standalone installation, the system is in a IP65 Protected Wall mount Enclosure integrated suitable for outdoor installation. On special request, the TMS-5041 is also available in a 19" enclosure. Operation and configuration can be done without any computer through the integrated true colour touch screen with a very high resolution of 480x272 pixel.

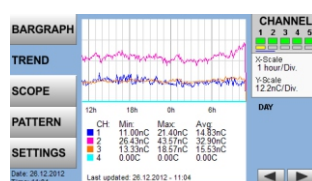
System Integration



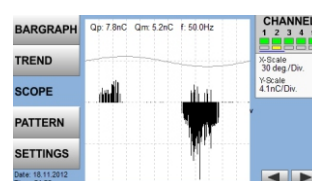
Local Display



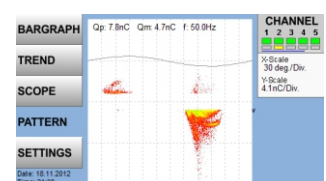
Bargraph Display



Trend Display



Realtime Oscilloscope Display



PRPD Display

Standalone Portable Partial Discharge Analyzer



General

Partial discharge measurements are often acquired non continuous in a defined interval of around 3 to 12 months based on the condition of the stator insulation. The TMS-6141 is a portable partial discharge analyser especially designed for this type of application. The light weight system weights less than 3.5kg and can be easily be transported within the

plant and also whenever measurements shall be performed in remote areas. The optional TMS-9441 Multiplexer extends the portable analyser to a 16 channel partial discharge acquisition system.

TMS-6141

The TMS-6141 is a portable extended partial discharge analyser offering simultaneous partial discharge measurement over 4 channels. The TMS-6141 is technically identical with the TMS-5141 monitoring system and is also offering the same noise rejection technologies as variable high- and low pass filters, noise rejection through the gating channel as well as the noise rejection through the common signals available on the input channels. The very high resolution 9-bit phase resolved partial discharge patterns are the state of the art partial discharge signal visualisation and offering a detailed information of any kind of partial discharge activity and allows to determine cross-relation of partial discharge activity between the channel / phases.

The large build in true colour 5.7" touch screen with a very high resolution of 640x480 pixel allows to operate the device directly without the need of any connected computer. The system can be operated standalone or it can be remote controlled through the build in 100Mbit Ethernet interface

with the Windows Based TMS-2141 Real-time partial discharge visualisation and control software. For temporary continuous monitoring the TMS-6141 can also be connected to the TMS-2000 Database Server for automatic long term data storage.

When the TMS-6141 is used standalone without any computer multiple configurations can be stored within the device which allows to keep system configuration for multiple machines. Up to 100 recordings per configuration can be stored within the device and can further either downloaded manually with the supplied software package or automatically into the TMS-2000 Database server if required.

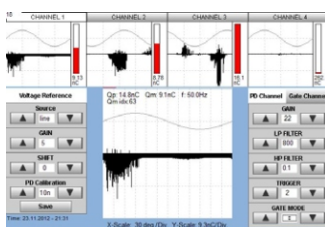


TMS-6141 4-Channel Portable Partial Discharge Analyzer

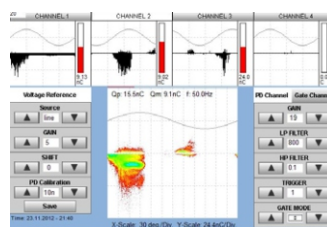


TMS-9441 16-Channel Multiplexer

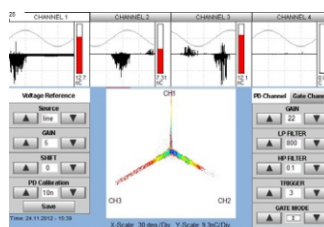
Local Data Visualisation



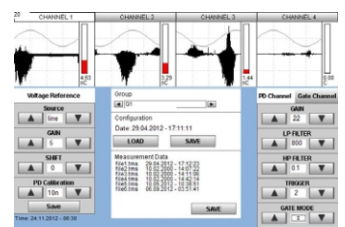
Oscilloscope View



PRPD View



TR Pattern View

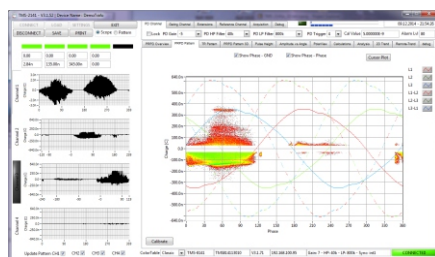


Local Data Manager

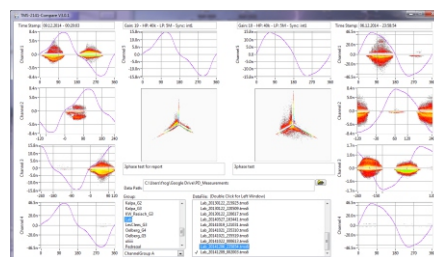
TMS-2141 Software Package

The TMS-6141 comes with the windows based software package TMS-2141 used for the data acquisition and data management, system configuration and data visualisation

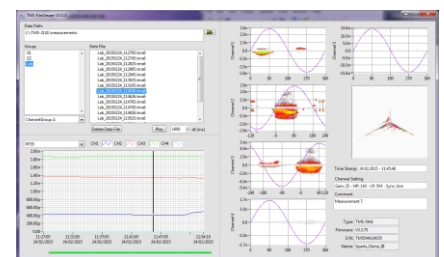
and analysis. A build in report generation tool allows to generate automatic pdf reports.



TMS-2141 Control and Acquisition Software



TMS-Compare Pattern Comparison Software



TMS-Fileviewer PD Result Viewer and manual trend builder

Standalone Extended Continuous PD Monitoring



TMS-5141

The TMS-5141 is an online partial discharge monitoring system with extended functionalities. It measures simultaneously 4 partial discharge Channels, allowing enhanced partial discharge analysis as the system is able to distinguish automatically discharges between the channels as e.g. discharges between phases. The system has for each channel one 4-20mA and one alarm relay output and a Modbus RTU interface for the communication the scada system or a third party plant monitoring system.

The System operates standalone and can be connected to the optional TMS-2000 Database server for automatic data storage into an SQL based database.

The System is available in 19" Rackmount, Panelmount for the installation in a cubicle. For simple installations, the

system is available in an integrated wallmount enclosure.



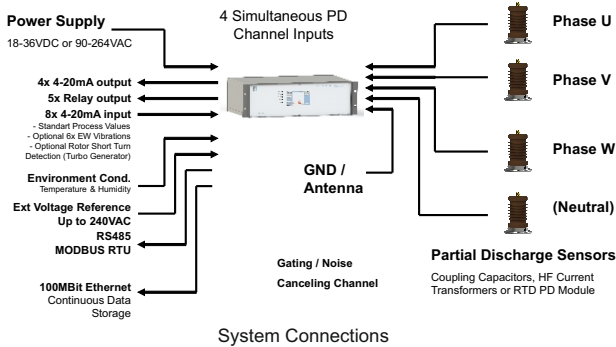
19" Rack Enclosure
TMS-5141R



Wallmount Enclosure
TMS-5141W



Panelmount Enclosure with optional
Wallmount Cabinet
TMS-5141P with WME-600



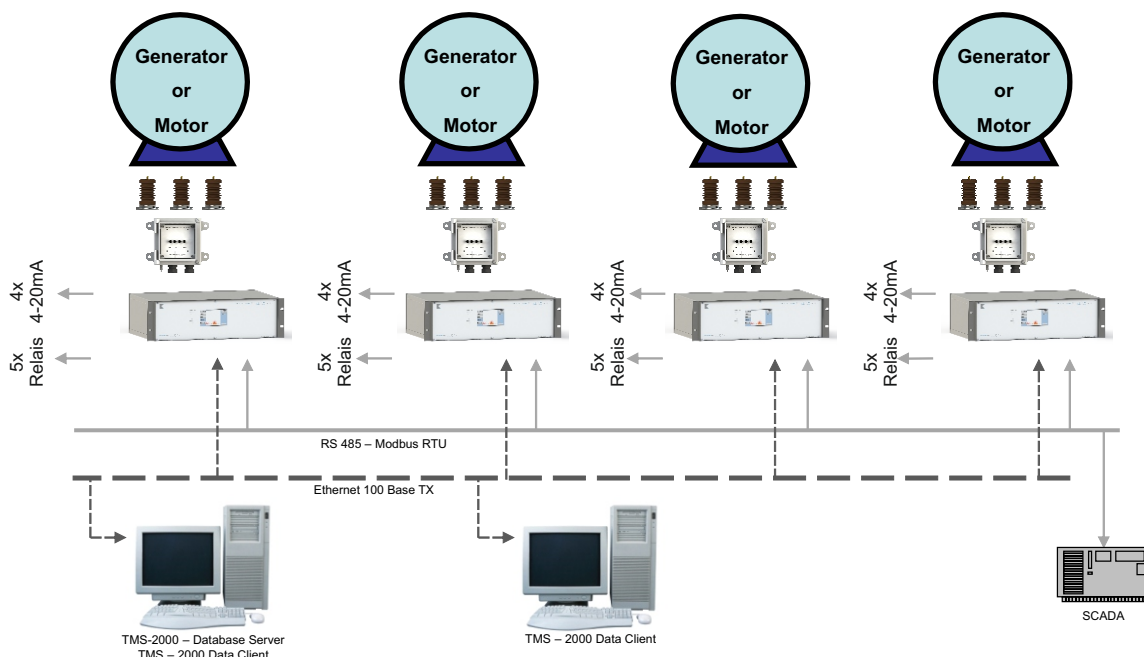
The TMS-5141 accepts most partial discharge sensors available on the market as classical partial discharge coupling capacitors or high frequency current transformers.

The build in touch based true color LCD display shows locally the pd activity as well as the actual system status. Basic system settings can be changed locally, for extended system configuration the supplied TMS-2141 software package is used.

System Integration

The integration into existing SCADA or other monitoring systems is relatively simple, as the system provides classical analogue outputs and relay contacts. The Modbus RTU interface offers the same information on a digital

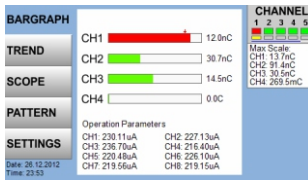
communication link. For other protocols than Modbus RTU, external gateways are used to offer e.g. Profibus DP, Modbus TCP or IEC61850.



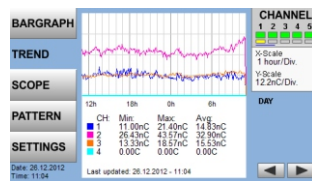
Standalone Extended Continuous PD Monitoring



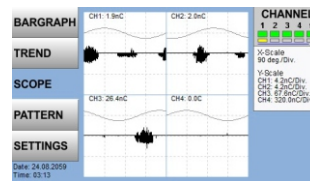
Local Display



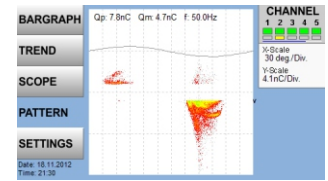
Bargraph Display



Trend Display



Realtime 4 Channel Oscilloscope Display



Realtime 4 Channel PRPD Display

TMS-5441 16-Channel System

Whenever it is required to use more than the standard 4 partial discharge channels, the TMS-5441 is an extension of the TMS-5141 offering the same functionalities but with a build in 4x4 multiplexer at the input. The TMS-5441 is acquiring sequentially 4 channels simultaneous. Analog

outputs and relay contacts are grouped together where on the Modbus RTU interface all data is available individually. The TMS-5441 is available in standard 19" rack mount or as 19" panel mount enclosure.

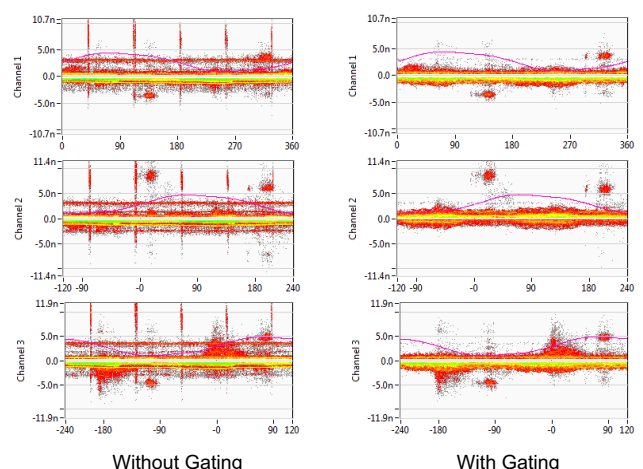
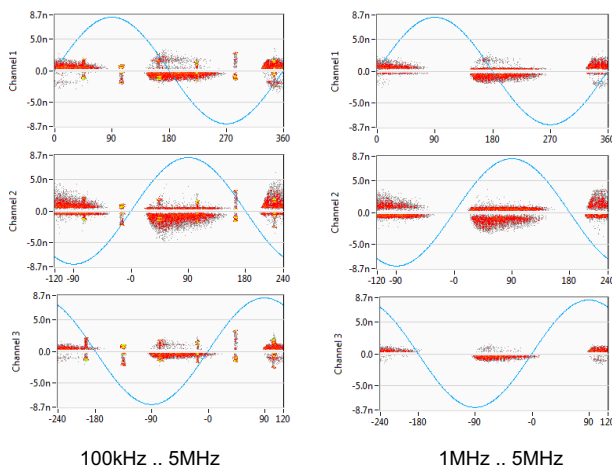
Noise Rejection Techniques

All devices of the TMS-Series offering variable high and low pass filters and an additional noise cancelling channel (gating) to reject or suppress external noises which might influence the partial discharge measurement. The extended

TMS Devices including the TMS-6141 portable acquisition system offering additionally the TR gating which is a rejection of signal common an all measuring channels.

Noise Rejection with Filtering

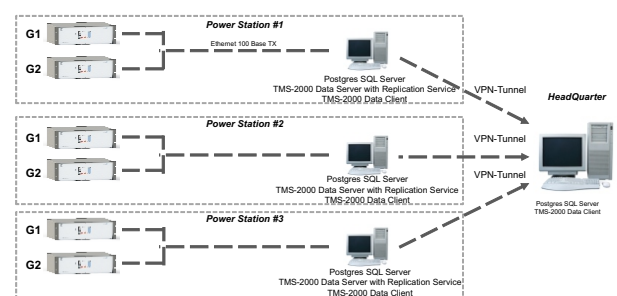
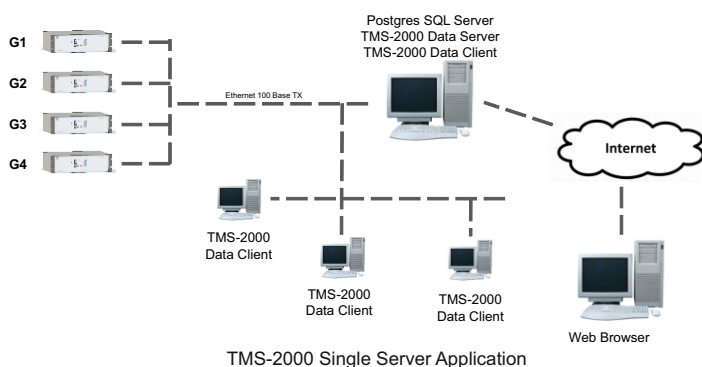
Noise Rejection with Gating



TMS-2000 SQL-Based Database Server

The TMS-2000 Database Server uses a SQL based database to store continuous measurement results from multiple systems connected to the same network. A build in database replication allows to combine multiple databases

from different physical location e.g. through a dedicated VPN connection within the company network. A build in Web-server allows a simple access to the acquired data.



TMS-2000 Single Server Application

TMS-2000 Multi Server Application



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