NV SUBPOWER

Stay Ahead in Monitoring

NV SUBPOWER PRIVATE LIMITED

# ONLINE CONDITION MONITORING SOLUTION

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## About Us

N V SubPower is a privately listed company in India, and we are on a mission to redefine real time remote monitoring and health assessment of essential assets with our wide range of experience into this field.

We are online condition based monitoring solution provider for a wide range of remote monitoring solutions which are essential into the following segments.

1. Low to EHV Electrical assets like, substations, Transformers, GIS, AIS, UG Cable and SWGR.
2. Electrical / Electronics manufacturing.
3. Data Centres
4. Medical and Research
5. Electrical Vehicle
6. Industrial
7. Renewables.

### Online Fibre Optic Temperature Monitoring System - NFX Model Testing for export Project.

Our mission is to provide exceptional solutions, ensuring efficient and reliable asset assessment and predictive advance information before major failure occure.

### Online Dissolved Gas Analyser Installation at KPCL Raichur Site, OEM, BHEL.

**We are offering following proven solution in utilities and industrial customer in India and abroad:**

1. Online Fiber Optic Temperature Monitoring Solutions for Transformer and electrical substation.
2. Online Dissolve Gas Analyser - upto 9 gas with moisture photo acoustic spectrograph technology.
3. Online Bushing, Capacitance and Tan delta Monitoring.
4. Online Monitoring for EHV Switchgear.
5. Online Partial discharge Monitoring GIS, Electrical Sub Station and EHV Transformers.
6. Online Monitoring for rotating machines.
7. Online condition monitoring solutions for electrical substations.
8. Online Fibre Optic Real Time Temperature Monitoring for Data Centre. Online Fibre Optic System for Electrical Vehicle Testing and Research.

### MISSION

- To attain global level best manufacturing facility and proving world class quality level product and services.
- To provide affordable, reliable and high-quality products and solutions where we need to improve more through new technology development.
- To achieve excellence in service quality, reliability and customer care to that level so there is no need for the same in future.
- To earn the trust and confidence of all customers with reliability and on time support.
- To consistently achieve high growth with the highest levels of productivity and on time delivery according to demand.

### VISION

"To add value to India Power, EV, Oil and Gas, health and testing and measurement sector along with related condition monitoring software where requirement of high quality online and remote monitoring is the essence for development for India & Worldwide."

**• Quality • Customer Satisfaction • Safety**
**• Experts Team • Reliability • Commitment**

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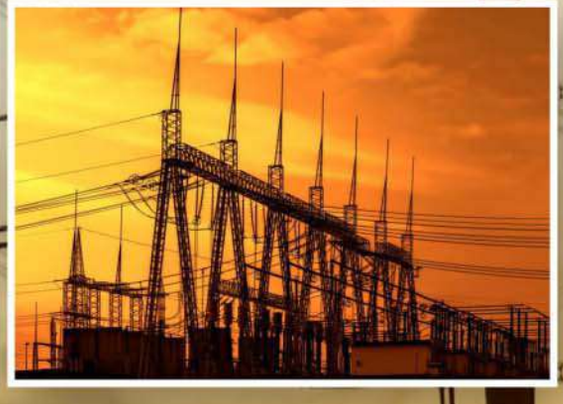
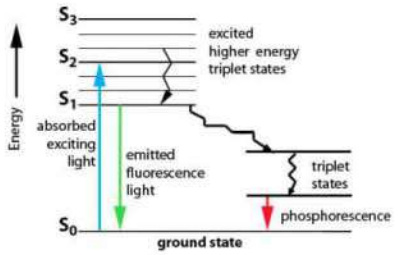
# ONLINE FIBRE OPTIC TEMPERATURE MONITORING



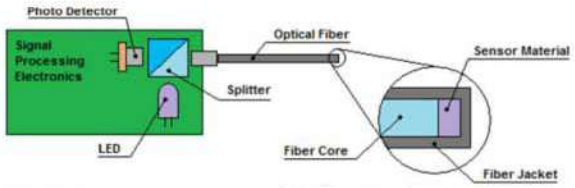
# FLUORESCENT TECHNOLOGY OVERVIEW

The scientific principle is Fluorescent Time Decay



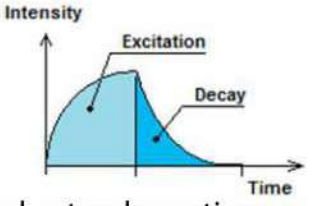

OSENSAs technology leads the world in accuracy

A special fluorescent phosphor is excited with light




OSENSA uses an exceptionally long -life LED source

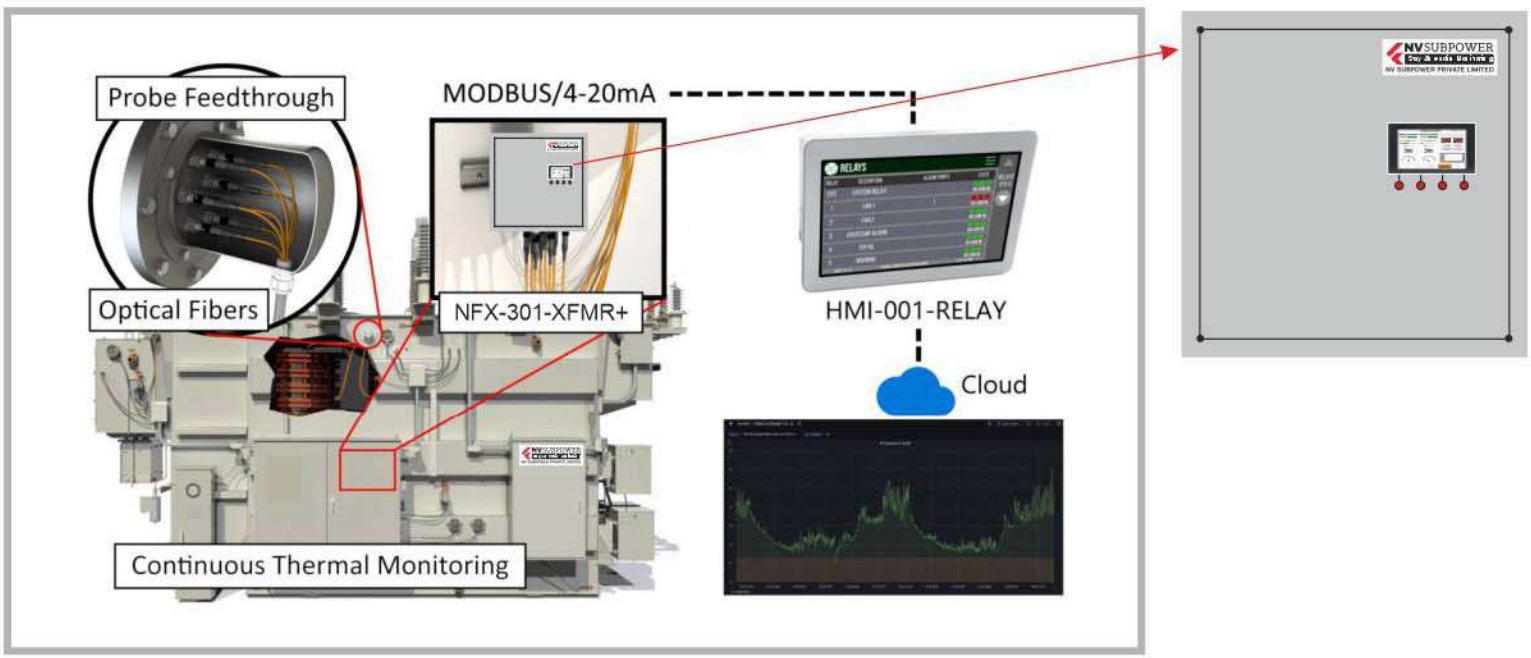
Electronics measure the time - constant ( <) for the glowing phosphor which is proportional to temperature




$$I_{(t)} = I_o e^{-t/\tau}$$

A shorter decay time means higher temperature

# POWER T & D TRANSFORMER WINDING HOT-SPOT MONITORING




- Real-time local and cloud monitoring for early detection of fault conditions.
- Maximize peak capacity and extend life of the transformer.
- Optimize maintenance schedules & extend equipment lifetime.
- Immune to EM interference & switching noise.
- Historical data and alarms.

# SENSOR INSTALLATION IN WINDINGS

- Probe tip is secured adjacent to windings hottest spot.
  - Typically, 1-3 windings down from the top.
  - Center phase typically installed with 2+ sensors / windings (HV +LV)
  - Lateral phases typically installed with 1+ sensors / winding (HV +LV)
- Probe tip should be secured in the spaces (most common) or on a conductor (less common), Free from excessive force caused by changes in current or from adjacent coils
  - Recommended to locate the tip in the center of the spacer.
  - Most transformer manufacturers install their sensors in radial spacers.
- Sensors should not be in direct contact with circulating oil.

(A)

(B)

©

(D)

1) Fig (A) Fiber optic sensor in axial spacer.

2) Fig (B) Inserting spacer into cooling duct.

3) Fig (C) Spacers fixed in cooling ducts.

4) Fig (D) Probe leads are taken out between two parts of the electrostic sheield to prevent the sensor leads from blocking oil flow.

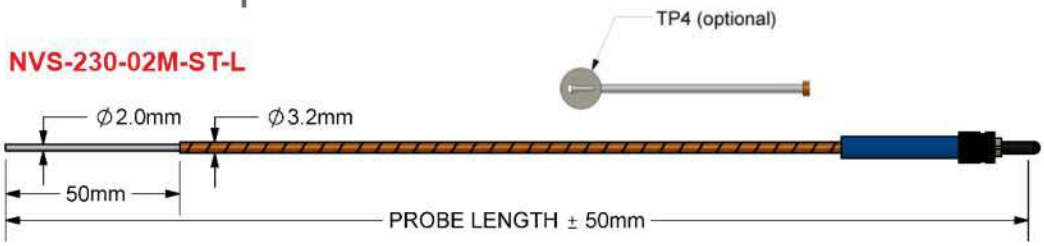
# Oil-Filled Transformer Winding Temperature Measurement

## Non-conducting, fiber optic probes with exceptionally long life

OSENSA's PRB-230 fiber optic temperature probes are specifically designed for oil-filled transformer applications where long life and accuracy are paramount. Not only are these probes stable and repeatable over the life of the transformer (no calibration required), they also offer industry leading accuracy, precision, and reliability. The PRB-230 style probes are fully compatible with all transformer oil types and kerosene desorption processes.

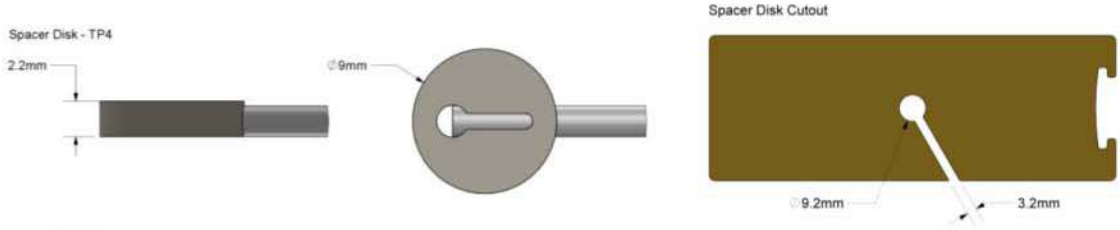
# Product Specifications

### NVS-230-02M-ST-L




| System Specifications | PRB-230-02M-ST-L/TP4 |
|---|---|
| Measurement Range | -40°C to 230°C |
| Accuracy | ± 1.0°C |
| Immersion Response Time Constant | 2.0s |
| Tip Diameter | 2.0mm |
| Minimum Bend Radius | 50mm |
| Probe Materials | PFTE & Polyimide |
| Dielectric Strength ASTM-D149 | 10 kV/mm |
| Partial Discharge IEC 60270 | Less than 10pC |

### NVS-230-02M-ST-L-TP4




Notes:

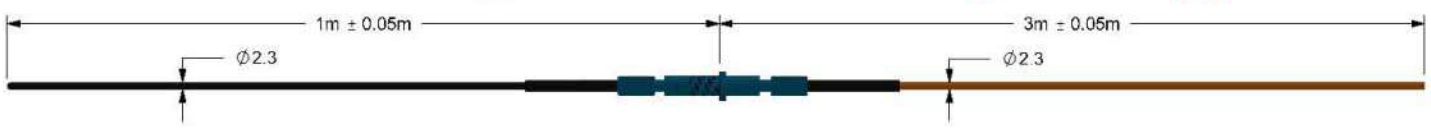
1. Compatible with OSENSA's FTX-101-XFMR+, FTX-201-XFMR+, FTX-301-XFMR+, FTX-402-XFMR+, FTX-602-XFMR+ fiber optic temperature transmitters.
2. Probe lengths can be specified from 0.5m to 10m.
3. Install in combination with tank wall feedthrough ACC-FEEDTHRU-NPT-200 and extension cable EXT-230-02M-ST-ST

# INDUSTRIAL CAST RESIN TRANSFORMER MONITORING

- FTX - 310 - PWR + R  3 Channel Temp Transmitter
- FTX - 610 - PWR + R  6 Channel Temp Transmitter
- FTX - 910 - PWR + R  9 Channel Temp Transmitter


| | |
|---|---|
| Measurement Range | -40°C to +200°C |
| Resolution | 0.1°C |
| Accuracy | ± 0.1.0°C |
| Programmable Alarms | 2x Form A Relays |

## PRB - 910 (200°C Max. for 1m probe tip)

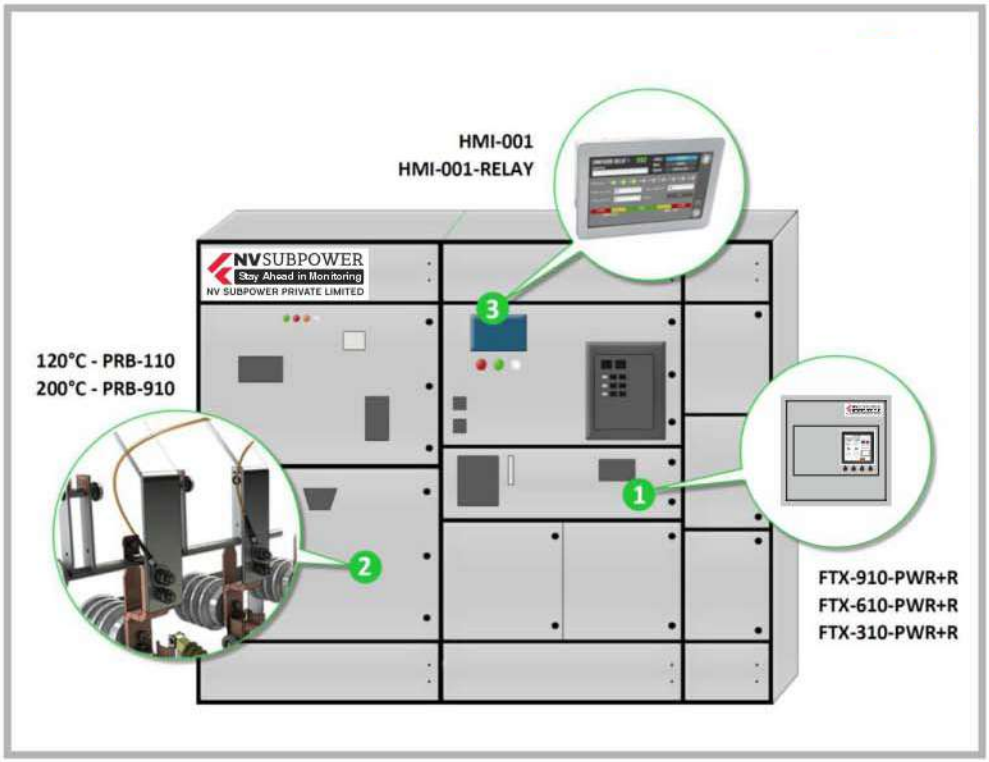


# SWITCHGEAR AND BUSBAR THERMAL MONITORING

Osensa has developed the worlds most reliable temperature sensing solution for switchgear and busbar monitoring.

- ✓ No calibration, no maintenance.
- ✓ High accuracy.
- ✓ Wide sensing range.
- ✓ High reliability technology.
- ✓ Simple installation.
- ✓ Long Life.

  (Designed to last for the life of the switchgear)



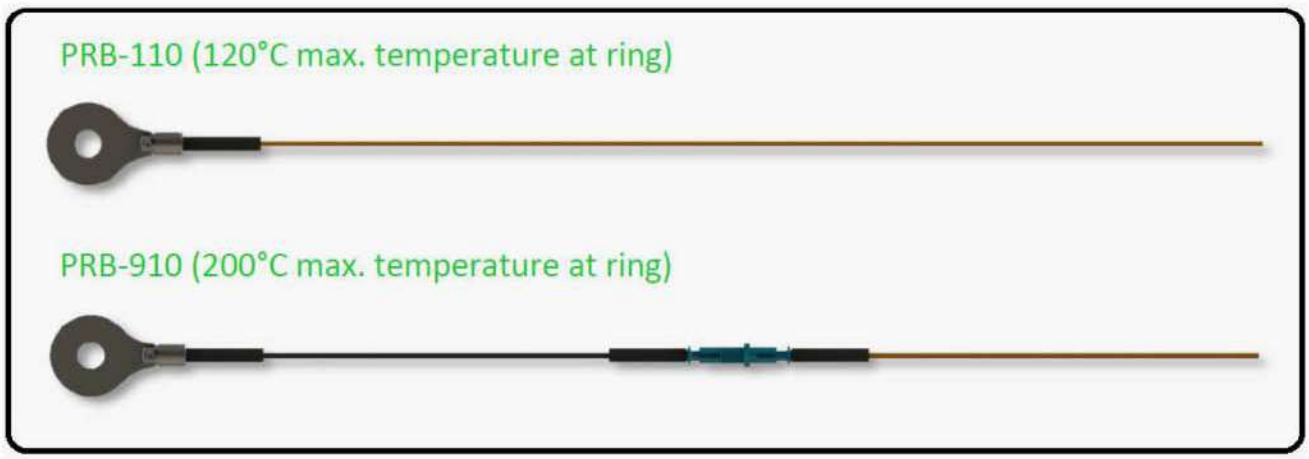

# SWITCH GEAR SENSOR

3,6, or 9 Channel transmitters with 2 relay outputs for alarms

- FTX - 310 - PWR + R
- FTX - 610 - PWR + R
- FTX - 910 - PWR + R

Two 38kV fiber optic probe options

- PRB - 110 - 5M - ST - TP2
- PRB - 910 - 5M - ST - TP2




| | |
|---|---|
| Measurement Range | -40°C to +200°C |
| Resolution | 0.1°C |
| Accuracy | ± 0.1.0°C |

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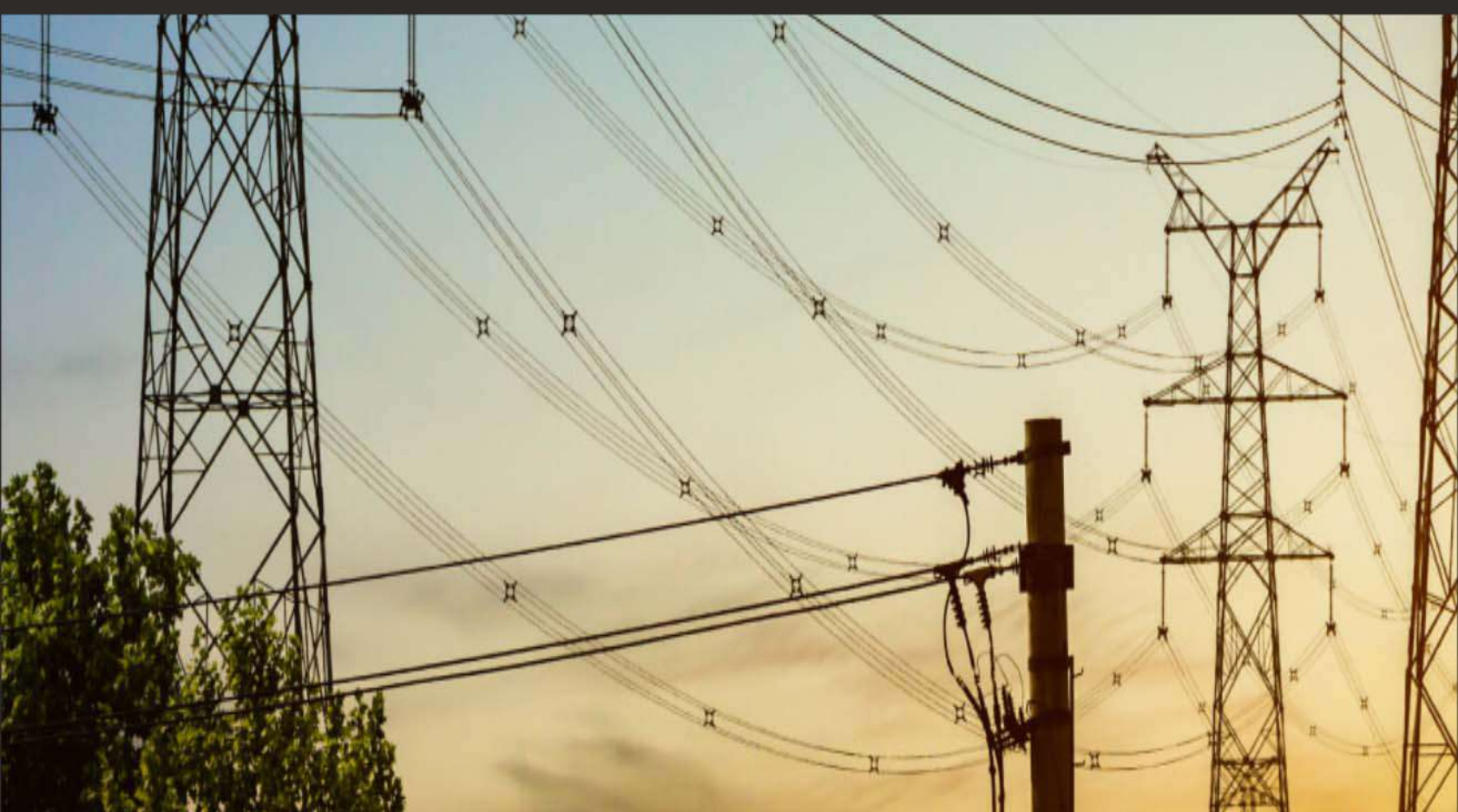
| NV SubPower : NFX model technical parameters | | |
|---|---|---|
| [II] | OPTIC FIBER TEMPERATURE SYSTEM | |
| | MAKE & TYPE | Fiber Optic Temperature Monitoring System NV Subpower Private Limited make |
| | Address of FO system supplier | NV Subpower Private Limited 406, V3 Landmark, Sun Pharma Road Vadodara 390012, India |
| | Nos. of channels | 16 number or customised up to 99 channel |
| | Sensors per channel | 1 |
| | Channel switching frequency | 20ms |
| | Sampling sensor rate | 20ms |
| | Switching reliablity | 100% |
| | Wave length operational length | 650nm |
| | | inbuilt USB, Gigabyte ethernet; RS485 |
| | PC output interdace | Optional: Ethernet 10/100BASE-fx (Duplex, for 50 or 62.5 µ fibers |
| | | |
| | Data display | Touch screen HMI Display |
| | Self Diagnositc | Yes |
| | Temp range & resolution | Temp Range :-'-80 to 250 C (-112 to 572 F) instrument Resolution: 0.1 Deg C |
| | Accuracy | ±1.0 °C(1.6 F) |
| | Response time | 20ms switching rate |
| | Front Panel display | Touch screen HMI Display |
| | Probe single strength readout | yes, available into software |
| | input power | Universal Power converter included |
| | Serial Output | modbus RTU, ASCII |
| | Fiber type | Glass/Qurtz fiber with internal 200 polyimide coating |
| | | |
| | Nos. of relays | Fully programmable from A relay customsable one per channel as per user requirements |
| | | |
| | Temprature Data stronge | 5 years at 10 sec interval rate (4GB), customizable |
| | LED alarm indicators | Indcators of power, alarm and system fault into trasreciever and into softerware |
| | | |
| | System fault relay | Fully programmable from A relay customer specific one per channel as per user requirements |
| | | |
| | System fault status indicator | Yes, LED indicators and relay |
| | Surge protection | Meets IEC 61000-4-5 sugare |
| | Connectors | Input channels : Optical: Standard ST connector |
| | Operating tempurature range | -40 to 65 Deg C |
| | Storage temperature | -40 to 70 Deg C |
| | | |
| | Probes material & dimensions | Fiber optical phosphor based precise probes, PTFE/FEG Probes Polyamide coating |
| | Analog output | used based customisable one per channel |
| | SCADA compatibility | Yes, customisable |
| | Nos. of probes | uptp 18 max single NFX unit - user customisable |


# ONLINE DISSOLVE GAS ANALYSER



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# NVS - 01
## SINGLE GAS COMPREHENSIVE TRANSFORMER MONITORING


## Extend the Life of Your Assets With the NV SUBPOWER Series.

NV SUBPOWER Series is a proven transformer monitor that provides meaningful and actionable insight into the condition of transformer fleets. NV SUBPOWER monitor alerts transformer operators when their assets enter into an abnormal state, prompting action to avoid catastrophic failure. The NV SUBPOWER's low cost, ease of deployment and operating life lends it to real-time fleetwide health monitoring.

Unlike competitive single-gas products, the NV SUBPOWER incorporates unique solid-state technology, eliminating the need for sensor maintenance, calibration and problematic consumables. The patented sensor is recognized in the industry as the "gold standard" and carries an exclusive 10-year warranty. It provides true set-and-forget monitoring (no more monitoring the monitor), allowing maintenance teams to focus on distressed assets identified by the NV SUBPOWER sensors and reducing OPEX while extending the life of critical transformer assets.

Using industry standard communication protocols, the NV SUBPOWER integrates seamlessly with a wide range of systems, making it an ideal standalone deployment by grid operators, or for integration into OEM solutions such as multi-gas DGA's or Transformer monitors.

Reliable and accurate hydrogen sensors have been monitoring transformer fleets for decades. They are:

- Designed to support fleetwide deployment
- Able to operate in the oil or gas phase of power transformers and ancillary equipment
- Ruggedly fabricated to offer market-leading range of environmental operating conditions (hot/cold/salt water/submersible)
- A compact form factor for tight installation spaces
- Ideal for a fleetwide IoT deployment strategy, but also support conventional SCADA connectivity

## Transform your Transformer Monitoring Program

Short time to value :
Hours, Not weeks or months

Longest life Hydrogen Sensor :
10-year warranty on the hydrogen sensing element

Patented Auto Calibration :
Eliminates drift and need for periodic calibrations to maximize uptime

Easy to Install and Operate :
No moving parts and small form factor

Rugged & Reliable : Rated for harsh environmental conditions

Broad Connectivity : IoT/SCADA/ ADMS ready with Modbus or DNP3

Flexible Integration : Wired or optional wireless communication capabilities

Standard 3-year warranty on the product

Protect critical transformer assets without worrying about maintaining sensors or calibration. NV SUBPOWER Series analyzers provide an accurate, reliable and affordable hydrogen process gas measurement solution for the oil or gas phase of power transformers and industrial process gas streams.

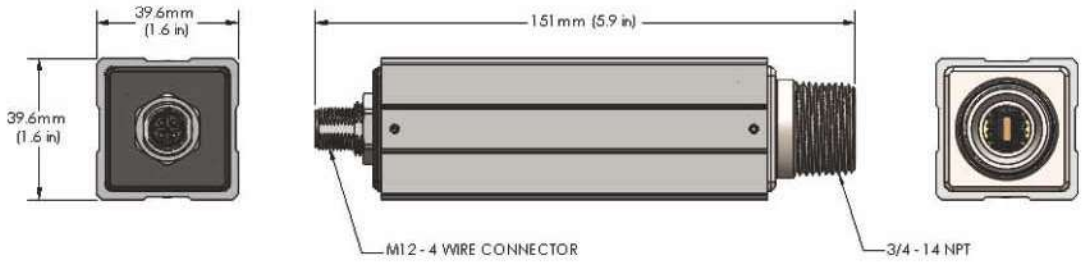
Certifications: The NV SUBPOWER meets all relevant global monitoring standards for transformer installations and is CE-approved for safe general-use operation.

| Hydrogen Sensor Specifications | |
|---|---|
| H2 Measurement Range | Oil Phase: 25 - 5,000 ppm<br>Gas Phase: 25 - 5,000 ppm in-oil equivalent |
| Accuracy [1] | ± 20% of reading or 25 ppm (500 ppm gas) [4] |
| Repeatability [2] | ± 10% of reading or 15 ppm (300 ppm gas) [4] |
| Response Time | < 60 minutes (location on Xfmr) |
| Operating Temperature (Ambient) | -40° C to +70° C |
| Storage Temperature | -40° C to +85° C |
| Oil Temperature Range [3] | Oil Phase: -40° C to +105° C<br>Gas Phase: n/a |
| Data Log Storage | 1 year |
| Cross-sensitivity to H2O, CO2, C2 H2, C2 H4, CO, etc. | <2% |
| Serial Communications | 2-Wire RS485, MODBUS RTU, DNP3.0 |
| Power Supply | 12-30 VDC, 10 Watt |
| Environment | IP68 (7.62 m [25 ft] water for 14 days) – Marine rated assembly (C5M equiv) |
| Insulating Liquid Supported | Mineral oil, silicone, natural ester, synthetic ester |
| Designed life Expectancy | 10+ years |

| Physical Specifications | |
|---|---|
| Wetted Materials and Internal Sealing | 316SS, 40% mineral filled nylon, polyimide, viton (fluoropolymer elastomer), hermetic glass-to-metal feedthrough |
| External Housing and Sealing | Hard anodized 6061 aluminum, 40% mineral filled nylon, viton (fluoropolymer elastomer), nickel-plated zinc (4-wire connector) |
| Humidity and Corrosion Resistance | Class C5M marine equivalent; salt-water condensing (IEC60068-2-11 & DIN EN ISO 12944) |
| Ingress Protection | IP68; 7.62 m [25 ft] water for 14 days (IEC 60529) |
| Certifications | FM Approved - FM 6520:2022 (In Oil Phase), CE Mark, ROHS 2011/65/EU compliant, EMC/RFI and Other Electrical Certification, IEC 55022 IFCC Part 15, IEC 55011, IEC 61000-4-2 through 61000-4-4, 61000-4-6, and 61000-4-8, IEC 61010-1, IEC 61326, IEC 60068-2-30 |
| Vibration | 3-axis Sinusoidal, Wideband and Random [Simulated Long-Life] (IEC 60068-2-6 table C.2, IEC 60068-2-64 paragraph A.2, category no. 2) |
| Shock | 30 g, shock duration 18 ms (IEC 60068-2-27) |

1 Accuracy of the sensor in the FIELD
2 For consecutive measurements to an identical hydrogen concentration
3 Main tank bulk oil temperature
4 Whichever is greater

**NVS - 01 Dimensions**



# Multi-Gas DGA- Dissolved Gas Analysers


## FEATURES

- Measuring gas : $H_2$, $CH_4$, $C_2H_6$, $C_2H_4$, $C_2H_2$, CO, $CO_2$ ($H_2O$)
- Measuring method : PAS, semiconductor sensor
- LCD(7.0") : operational data, test and diagnosis result
- LED : Power / Device Error / Gas Alarm
- Settings : operating time & cycle,
  diagnostic criterion
- Measuring cycle : min. 1hr
- Diagnosis of transformer fault
  based on gas concentration and trend


## FEATURES

- 3 tanks in 1 monitor - minimized installation space
- Measuring without contaminating oil or gas
- LCD(7.0") : operational data, test and diagnosis result
- LED : Power / Device Error / Phase A, B, C Gas Alarm
- Settings : operating time & cycle, diagnostic criterion
- Measuring cycle : min. 3hr
- Applicable to 3 phase transformer

** Designated as KEPCO exclusive DGA supplier over 9 gas GE, Camlin DGA – March, 2023 sole winner with no mixed oil error

Dissolved gas monitor device measuring gas concentration and $H_2O$ for oil-immersed transformers provides a real time inspection for early detection on faults in transformers

## BENEFITS

- **PAS(Photo Acoustic Spectroscopy)**
  - Enhanced product life cycle
  - Easy & affordable maintenance
  - No need for carrier gas
  - Minimized spare parts
  - Simple structure, high accuracy, less failure
  - Stabilized with wide measuring range

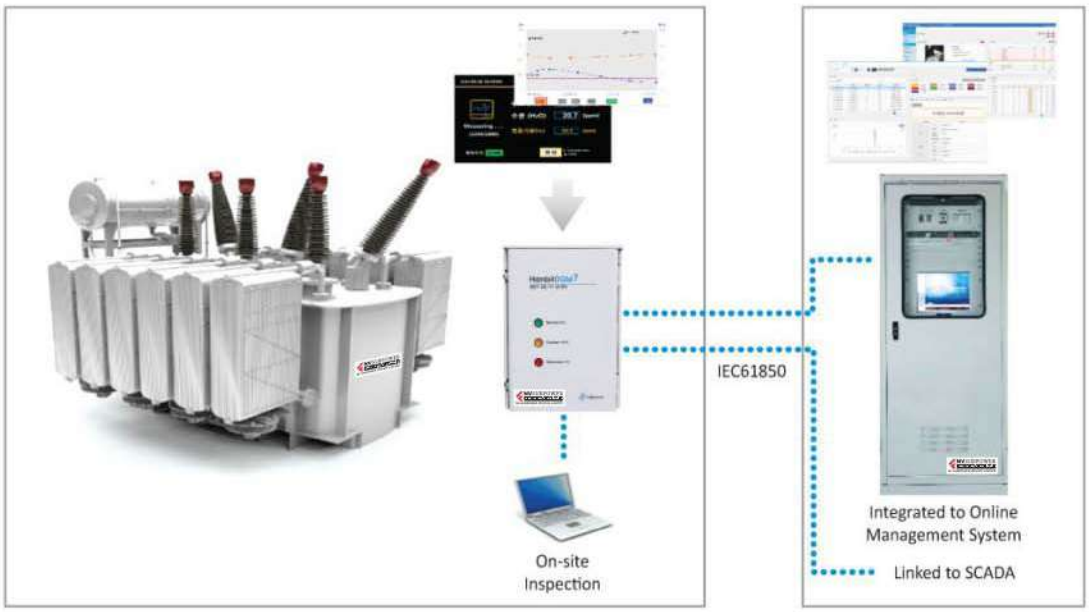
※ PAS(Photo Acoustic Spectroscopy) :
a most cutting-edge method of analyzing gas by means of the effect of absorbed light energy on gas with acoustic detection

- **i-DGMS**
  (*intelligent* Dissolved Gas Monitoring System)
  - Local S/W allows data collecting program for transformer faults
  - Operation settings, graphics and data management
  - Set up a diagnostic criteria

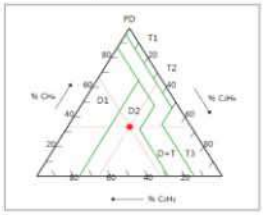
- **Specification Upon Needs**
  - Select up to 7 gases
  - Gas selection considering transformer capacity, faults to be detected and types of insulation oil
  - Transformer capacity :
    1 gas type, 3~7 gases type, multi-tank type
  - Faults to be detected :
    $H_2$ / $C_2H_2$ / $C_nH_m$ type, etc.
  - Insulation oil(vegetable oil, non-flammable oil) :
    $H_2$ / $C_2H_6$ type, etc.

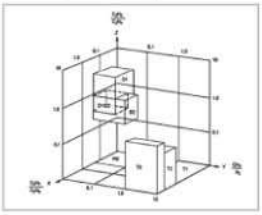
- **t-DGMS**
  (*total* Dissolved Gas Monitoring System)
  - Online t-DGMS allows monitoring and remote controlling in real-time
  - Compatible with Online Electrical Asset Monitoring System
  - Integrated to online GIS/TR monitoring system (i-TODs)

## SYSTEM CONFIGURATION



## *t*-DGMs (Online DGA Monitoring S/W) (Optional)





- Remote monitoring in real-time
- Remote control on operational data and settings
- Diagnose concentration and trend in fault gases
  - Normal/Abnormal/Warning
- Evaluates degradation in progress by CO and $CO_2$
- Creates a report on diagnosing result with DB and graphics
- Event alert with diagnosis of transformer
- Integrated diagnosing methods
  - Algorithm learning from accumulated test results (KEPCO, IEC, IEEE, Duval's Triangle, etc.)
  - Analyze faults in transformer (PD, thermal degradation, arcing, etc.)

## KOLAS AUTHORIZED TEST

| Category | Test | Result |
|---|---|---|
| Electrical Test | IEC 60255-5 (Insulation Resistance Test)<br>IEC 60947-5-2 Clause 8.3.3.4 or IEC 60950-1(Power Frequency Voltage Test) | Pass<br>Pass |
| Environmental Test | IEC 60068-2-6 (Test Fc: Vibration (sinusoidal))<br>IEC 60068-2-1 (Test A: Cold)<br>IEC 60068-2-2 (Test B: Dry heat)<br>IEC 60068-2-30 (Test Db: Damp heat, cyclic (12 h + 12 h cycle)) | Pass<br>Pass<br>Pass<br>Pass |
| Electromagnetic Compatibility (EMC) Test | IEC 61000-4-2 (Electrostatic discharge test)<br>IEC 61000-4-3 (Radiated, radio-frequency, electromagnetic field immunity test)<br>IEC 61000-4-4 (Electrical fast transient/burst immunity test)<br>IEC 61000-4-5 (Surge immunity test)<br>IEC 61000-4-6 (Immunity to conducted disturbans, induced by radio-frequency field)<br>IEC 61000-4-8 (Power frequency magnetic field immunity test)<br>IEC 61000-4-11 (Control Power Failure Test) | Grade A (Pass)<br>Grade A (Pass)<br>Grade A (Pass)<br>Grade A (Pass)<br>Grade A (Pass)<br>Grade A (Pass)<br>Grade A (Pass) |
| Ingress Protection Test | IEC 60529 (Ingress Protection Test) – Degrees of dust-proof/water-proof | IP55 / IP56 (Pass) |

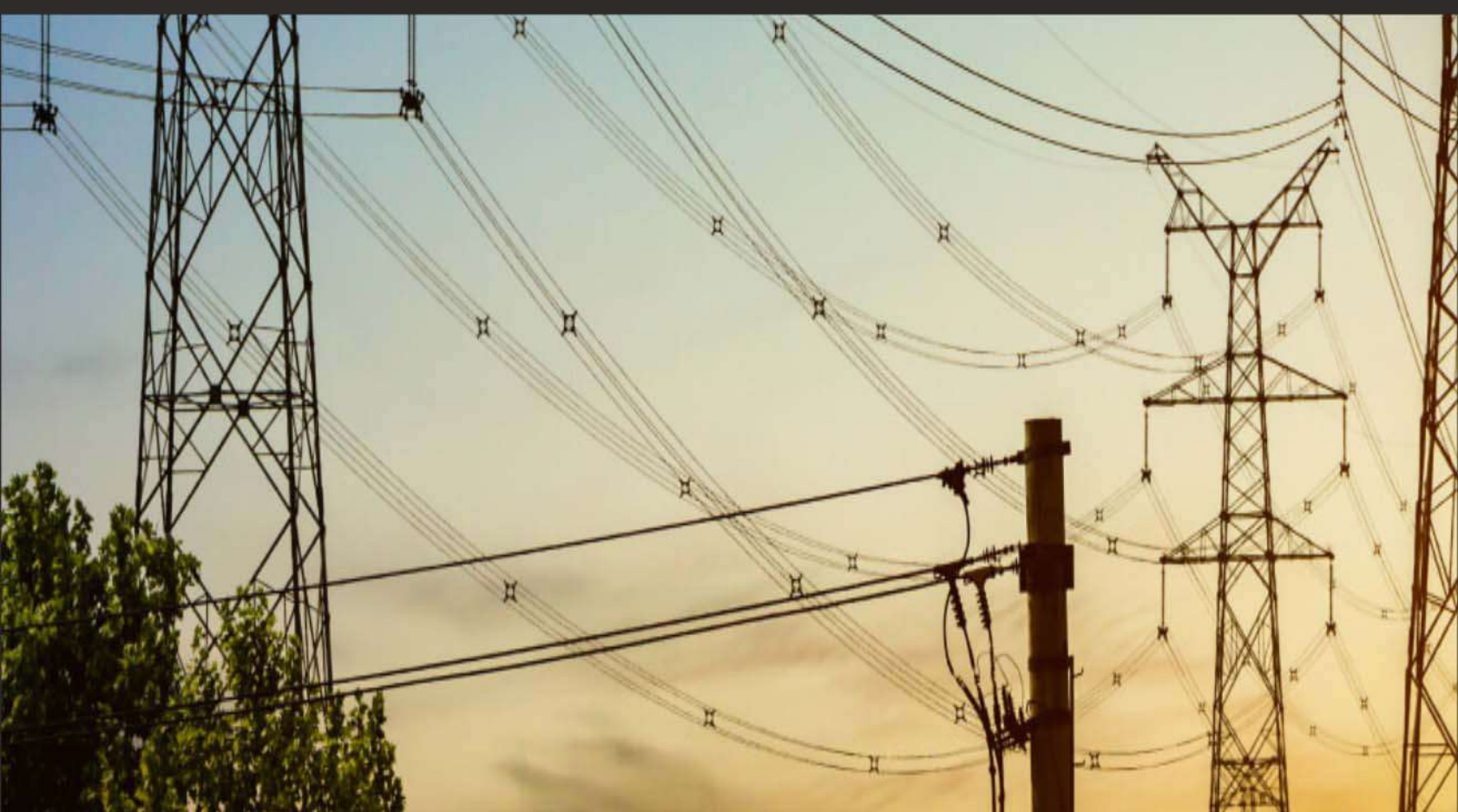
※ KOLAS : Korea Laboratory Accreditation Scheme [Korean Governmental Org.]

# TECHNICAL SPECIFICATIONS

| | | Composition | Measuring Range (customizable) | Model | |
|---|---|---|---|---|---|
| | | | | [redacted] | [redacted] |
| Measuring Gases | | $H_2$ (Hydrogen) | 5 ~ 5,000 ppm | o | o |
| | | $CH_4$ (Methane) | 1 ~ 5,000 ppm | o | o |
| | | $C_2H_6$ (Ethane) | 1 ~ 5,000 ppm | o | o |
| | | $C_2H_4$ (Ethylene) | 1 ~ 5,000 ppm | o | o |
| | | $C_2H_2$ (Acetylene) | 0.1 ~ 5,000 ppm | o | o |
| | | CO (Carbon monoxide) | 1 ~ 10,000 ppm | o | o |
| | | $CO_2$ (Carbon dioxide) | 0 ~ 10,000 ppm | o | o |
| | | $O_2$ (Oxygen), $N_2$ (Nitrogen) ※ Optional | | | |
| | | $H_2O$ (Moisture) | | o | o |
| Measuring Range | | Min. ~ Max. (full range calibration) / $H_2O$ : 0~100 % (Relative Humidity) (in ppm) | | | |
| Measuring Cycle | | Minimum | | 1 hr / cycle | 1 hr / cycle |
| Dimensions / Weight | | W x H x D (mm) / (kg) | | 460 x 700 x 332 / 54kg | 480 x 700 x 350 / 65kg |
| LED Alert | | Enclosure Embedded | | Power ●, Device Error ●, Alarm ● | Power ●, Device Error ●, Alarm ●●● |
| LCD Display | | 7 inch screen with 6 function keys | | | |
| Measuring Method | | Photo Acoustic Spectroscopy(PAS), Semiconductor Sensor | | | |
| *Accuracy | | Less ±5 % or LDL (Repeatability: ≤ 1%) | | | |
| Operating Ambient Conditions | Temperature | -40 ~ 60 ℃ | | | |
| | Humidity | 0 ~ 95 % RH | | | |
| | Oil Temperature | -20 to +100°C | | | |
| | Altitude | Under 1,500m | | | |
| Software | | Online Monitoring: t-DGMs (DGA only) or i-TODs (Asset Monitoring)<br>Local S/W: i-DGMs | | | |
| Diagnosing Methods | | KEPCO, IEC, IEEE, Duval's Triangle, Roger's Ratio, Key Gas, Doernenburg, etc (for t-DGMs & i-TODs only) | | | |
| Power | | 110~240 Vac / 50~60 Hz or 120 ± 20% Vdc | | | |
| Enclosure | | IP56, SUS304 with paint coating | | | |
| Communication | | Protocol | IEC61850®, MODBUS®, MODBUS/TCP, DNP3.0, RS485 | | |
| | | Port | Standard 1Gb Ethernet (RJ45) | | |
| Output | | 3 Digital Relay Output (Output sorts and quantities are customizable)<br>1 Lan port for local connection to PC | | | |
| Optional Accessories | | Mounting Stand, Communication Box, Sun Canopy | | | |

*Accuracy is based on test results from standard gas in calibration.


# ONLINE BUSHING MONITORING



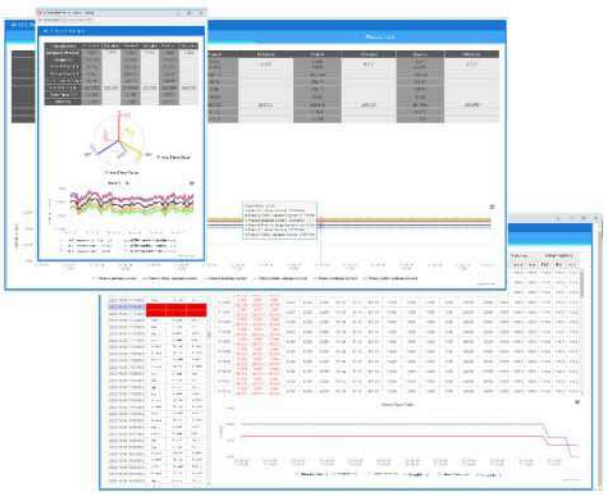
# NVS-100

*Bushing Monitoring Module for online monitoring system*

## Features

*Realtime leakage current tracking is available with stable monitoring of the facility – Advanced information of Power Factor, C1, Watt/Loss, Phase angle of voltage and current.*

*MDAS-100 allows monitoring on deterioration of bushing by constantly measuring leakage current flows in the bushing and calculating C1 value of the objective bushing HV and LV sides both.*



*Trend tracking shows measured / calculated values and histories of the bushing status. MDAS-100 provides vector diagram for three phase analysis of the objective bushing and transformer at one sight.*

## Meet The Expert At Bushing Monitoring & Analysis

- Measuring real time bushing leakage current
- Realtime current & voltage trend graph display
- Voltage-current phase angle difference analysis per phase in vector diagram
- Power factor and capacitance(C1) value tracking
- 3 steps alarm with customizable standards

## Diagnosis Function

- Building Database by location and date
- Reviewing saved diagnosis data
- Displaying monitors deterioration of bushing by measuring leakage current in graph and vector diagram
- Easily export data in excel format for user's database management

## Diagnostic Monitoring Software

- *i*-TODs allows highly accurate analysis algorithm proven by field operators
- Trend tracking available with individual measuring point detail information

## Supply Record

- KEPCO (Korea Electric Power Corporation)
  - *supplied as total solution for substation monitoring system over 10 years*
- Indonesia - PERTAMINA Hulu Rokan

# Specification

## System Diagram


## Technical Specification

### System Configuration

| | |
|---|---|
| Test Tap Adaptor | Need drawing of bushing test tap for fabrication |
| Transformer Monitoring Panel | A panel that includes electrical apparatus for operating MDAS-100 as an online monitoring system |
| MDAS-100 | Bushing Analysis Module |
| CT Box | Gaining current by cable connection from tap adaptor |
| CT | Installed within CT box and chained to the cable connection between CT box ports and tap adaptor. Current transform at certain ratio (ex. 100:1) and delivery of transformed current to current input of MDAS-100 for analysis |
| PT Source | For referential voltage source gaining |
| Workstation | An online monitoring server PC that provides diagnosis software (*i*-TODs) |
| *i*-TODs | Intelligent Total Online Diagnostic System (Online Monitoring Software), Can be integrated with other monitoring subjects |

### Environmental

| | |
|---|---|
| Operating Temp. | -25°C ~ 55°C |
| Storage Temp. | -25°C ~ 75°C |
| Humidity | 0~97% |
| Circuit to Circuit Insulation | > 2000 V |
| Circuit to Grounding Insulation | > 2000 V |

# Specification

## Mechanical

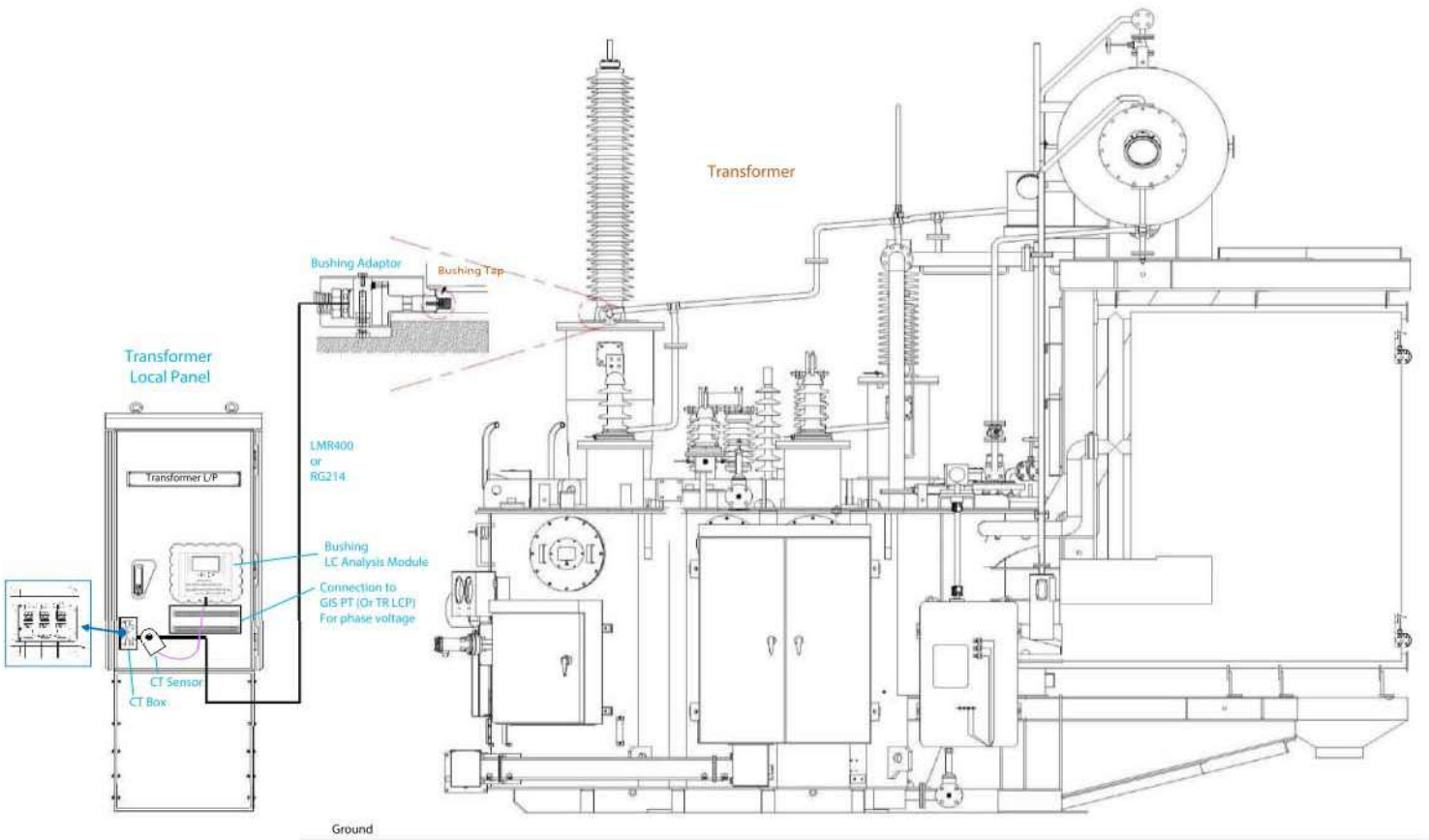
| | |
|---|---|
| Power Supply | AC 220V / 60Hz ( AC105~235V, 50~60Hz) |
| Enclosure Material | Aluminium |
| Display | 3.5" TFT RGB 65K LCD, 480x320 Pixel, Resistive Touch Screen |
| Mounting Option | To be installed within a standalone panel<br>Need electrical accessories: CT sensor, CT box, terminal block |
| Dimension | 480 (W) x 130(D) x 132(H) mm |
| Weight | 3,100 g |

## Data Processing

| | | |
|---|---|---|
| Measuring Base | Raw waveform of leakage current | |
| Tap Current Range | 0~60mA - customizable | |
| Voltage Source. | Transformer/GIS PT Source input | |
| Sampling Rate | 128 sample/cycle | |
| Magnitude Accuracy | ±1% | |
| Phase Accuracy | 0.08° | |
| Resolution | 16-Bit AD Conversion | |
| Monitoring Coverage | 1 SET of 3 phase transformer X ( HV & LV ) = 6 EA of bushings | |
| Input Channel | Voltage | 6 CH (AC 0~230V - customizable) |
| | Current | 6 CH (AC 0~60mA - customizable) |
| I/O | Digital Output | 4 CH (+2 CH Optional) |
| | Digital Input (DC 5V) | 2 CH (+1 CH Optional) |
| | Analog Input (4~20mA) | 2 CH (+1 CH Optional) |
| | Analog Output | 0 CH (+ 6 CH Optional) |
| Communication | Ethernet (IEC61850 Protocol, 10Mbps or 100Mbps) x 3 ports | |
| | RS485 (Modbus RTU, DNP 3.0: default baud rate: 9,600 bits/s) x 1 port | |
| Circuit to Circuit Insulation | > 2000 V | |
| Circuit to Grounding Insulation | > 2000 V | |

# Transformer Monitoring System

## Bushing Site Plan - Design Drawing



# Transformer Monitoring System

## Bushing Adaptor

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PRODUCT BRIEF

# NVPoDAS

*Portable GIS Partial Discharge Diagnostic System*

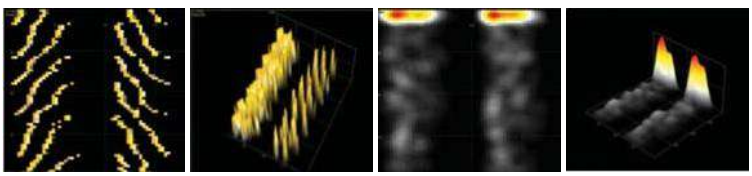
## Product Descriptions

Gas Insulated Switchgear is safe, compact, stable and easier to setup indoor or outdoor comparing conventional switchgears. The system deterioration caused by thermal, electrical, mechanical and environmental aging might lead to serious accidents but not be visible from outside.

PoDAS enables to monitor UHF signals from GIS, diagnose types of PD and analyze the PD location accurately. The accuracy of PD analysis algorithm was proven by field operators.

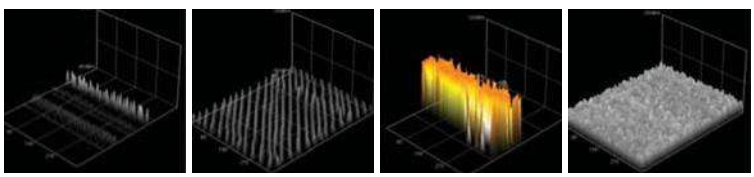
Utilizing noise sensor and band rejection filter enables isolating ambient noise efficiently. User–friendly HMI and self–explanatory functions benefit users to diagnose and analyze GIS Partial Discharges effortlessly.

## GIS Partial Discharge (Particle) Sample



2D PRPS | 3D PRPS | 2D PRPD | 3D PRPD

## Noise Signals Sample



Radar | Airplane | Circuit Breaker | Cell Phone

### IN-SERVICE MEASUREMENT

- Real–time PRPS 2D/3D, PRPD 2D/3D Display
- Real–time noise elimination
- Measuring each channel simultaneously
- Saving data automatically and periodically (0.5, 1, 5, 10, 30 min, 1 hour and infinite)
- Phase Shift Function
- Real–time Analysis

### ANALYSIS FUNCTIONS AND REPORTING

- Building Database by location and date
- Reviewing saved diagnosis data
- Displaying signal trend with PD types and amplitude
- Analyzing signal amplitude and phase in PRPS/PRPD 2D/3D
- Eliminating noise signal using noise sensor
- Shifting phase
- Various reports

### DIAGNOSTIC SOFTWARE

- Highly accurate PD analysis algorithm proven by field operators
- Analyzing the signal into Particle, floating, Corona, Void or Noise, irrespective of the phase
- Screen captures of PD and noise signals in the diagnostic software library

### SUPPLY RECORD

- KEPCO (Korea Electric Power Corporation)
- Korea Water Resources Corporation
- Samsung Corning Precision Materials
- SK Energy
- Air Products Korea Inc. (APCI Inc.)
- Malaysia, China etc.

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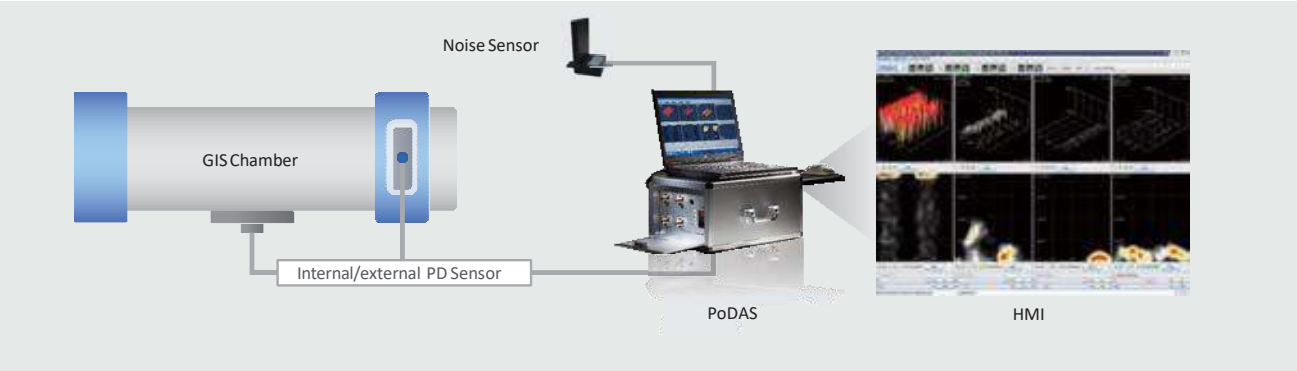
# Specification

## System Diagram




## Technical Specification

### System Configuration

| | |
|---|---|
| NPoDAS | Receiving and processing signal, transmitting data |
| Laptop Computer | Running Diagnosis Software |
| Diagnosis Software | Eliminating noise and analyzing PD signal |
| External PD Sensor | Detecting signals from inside of GIS |
| Noise Sensor | Detecting ambient noise signals |
| Band Rejection Filter | Eliminating preset UHF bandwidth |
| Cable | Coaxial, Power, LAN |

### NPoDAS

| | |
|---|---|
| Input Channels | 4 channels (1 channel for noise sensor) |
| Supply Voltage | 85~264Vac, 50/60Hz |
| Sampling Time | 260$\mu$s (128sample/1cycle) |
| Communication | UDP/IP |
| Detection Bandwidth | 500~1,500 MHz |
| Min. Pick-up Level | -65 dBm |
| Sync | Source Voltage |
| NPoDAS Package | PoDAS + Laptop + S/W + UHF PD Sensor(4) + Noise Sensor(1) + BRF(4) + LMR400UF(4) |
| Dimensions | Main Case: 450(W) x 350(D) x 270 (H) (±5%) [mm]<br>Accessories Case: 450(W) x 350(D) x 450 (H) (±5%) [mm] |

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# Specification

### Laptop Computer

| | |
|---|---|
| CPU | 2GHz Dual Core or above |
| RAM | 1GB or above |
| Hard Disk | 500GB or above |
| Operating System | Windows 10 or above |

### External GIS PD Sensor

| | |
|---|---|
| Detection Bandwidth | 500 ~ 1,500 MHz |
| Sensor Sensitivity | -40dBm @5pC |
| Max Output | -26dBm |
| Connector | N-type connector |
| Installation | Spacer of GIS |

### Noise Sensor

| | |
|---|---|
| Detection Bandwidth | 300 ~ 3,000 MHz |
| Connector | N-type connector |
| Installation | Place on top of GIS (Using magnetic force of sensor) |

## Test Reports

### Environment Test

| | |
|---|---|
| Cold Test | IEC 60068-2-1(Test A: Cold) |
| Dry Heat Test | IEC 60068-2-2(Test B: Dry heat) |
| Temperature/Humidity Cyclic Test | IEC 60068-2-30 (Test Db: Damp heat, cyclic (12 h + 12 h cycle)) |
| Vibration Test | IEC 60068-2-6(Test Fc: Vibration (sinusoidal)) |
| Separate-Source Voltage Withstand Test | IEC 60947-5-2, clause 8.3.3.4 |
| Lightning Impulse Withstand Voltage Test | IEC 60947-5-2, clause 7.2.3.1 |

### Electro-Magnetic Susceptibility Test

| | |
|---|---|
| Electrostatic Discharge Immunity Test | KS C IEC 61000-4-2 |
| Radiated RF Electromagnetic Field Immunity Test | KS C IEC 61000-4-3 |
| Electrical Fast Transient/Burst Immunity Test | KS C IEC 61000-4-4 |
| Surge Immunity Test | KS C IEC 61000-4-5 |
| Immunity to Conducted Disturbans, Induced by Radio-Frequency Field Test | IEC 61000-4-6 |

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# NPoDAS Package

| | | |
|---|---|---|
| NPoDAS with Laptop |  | - PoDAS: Calculate and process PD signals and transmit data to a diagnostic program<br>- Laptop: Operating a program that performs signal analysis and diagnosis<br>- Power: 85~265VAC, 60/50Hz<br>- Frequency Range: 500~1,500MHz<br>- Input: PD Sensor – 3 Ch<br>Noise sensor – 4 Ch<br>- Communication: UDP/IP Protocol |
| Diagnosing Software |  | - Analyzing and diagnosing PD types and noise by type<br>- Real-time PRPS, 3D/2D display and analysis by synchronizing with power phase<br>- S/W option settings: standard value, report writing, phase shift<br>- Built-in libraries and noise signals for each type of PD<br>- Data storage and report function |
| External UHF PD Sensor |  | - Measurement range: 500 ~1,500 MHz<br>- Mounting method: fixed to GIS spacer<br>- Connector: N-Type |
| Noise Sensor |  | -Measurement range: 300 ~3,000MHz<br>- Mounting method: Magnet type, mounted around GIS equipment<br>- Connector: N-Type |
| Band Rejection Filter |  | - For removing surrounding noise such as communication noise<br>- Mounting method: Connected to the input channel of diagnostic equipment |
| Accessories Case |  | - accessory storage box<br>- Coaxial cable: LMR400UF 15m, 4 sets<br>- 1 set each of power cable and LAN cable |

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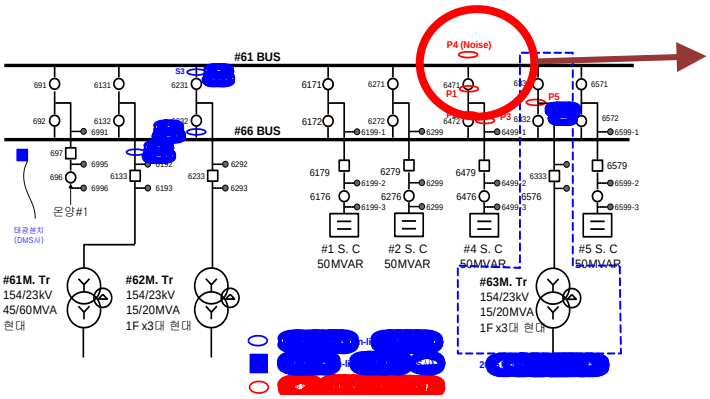
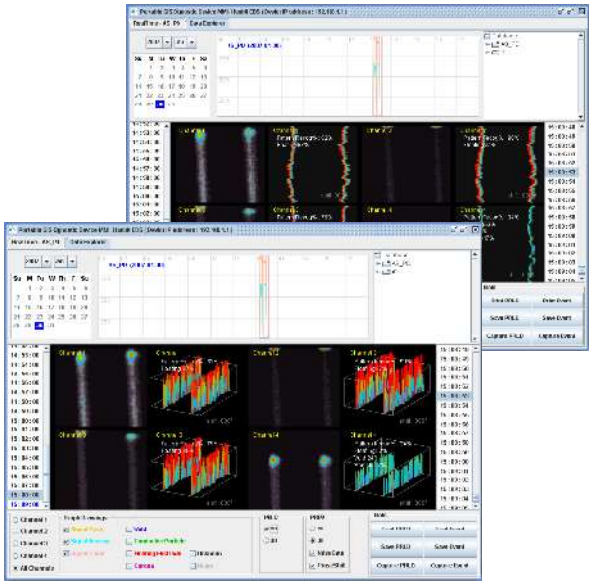
# Case Study

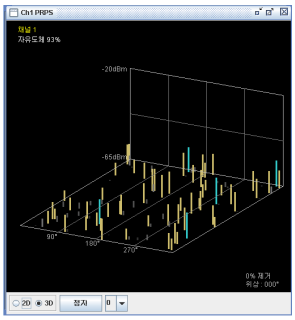
## PD Diagnosis Case

- Site: KEPCO ## Substation 154kV GIS
- Tool: PoDAS
- Result: Floating PD

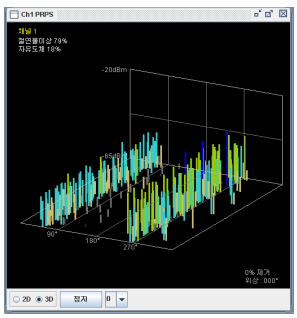


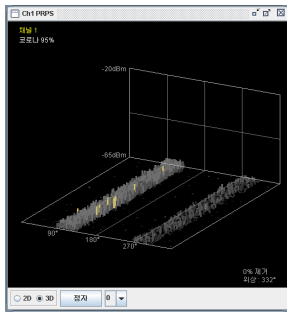
## PD Waveform Examples



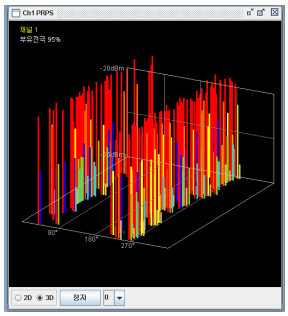
Particle



Void



Corona



Floating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PRODUCT BRIEF

# NPoDAS C-100A

*Portable Cable Partial Discharge Diagnostic Device*

## | Product Descriptions

*Partial discharge diagnosis device for high-voltage cables in a live status*

• **Features**
· High-speed acquisition of PD & high-speed diagnosis
- Batch diagnosis is possible by installing a high-performance scope function inside the diagnostic device which enables high-speed acquisition and diagnosis.
· Compact and lightweighted
· User-friendly and intuitive HMI with various diagnosis tools:
- Frequency tuning analysis, PRPD, T/F analysis, pulse shape analysis, etc.

• **Purpose**
· Real-time monitoring of partial discharge in cables and junction boxes of underground transmission lines
· Precise diagnosis of cable partial discharge waveform
· PD pattern analysis:
- metal foreign material (rabbit shape), void defects (turtle shape), electric tree (inverted triangle), scratches; pressure test during cable construction, completion test, and precise diagnosis of deteriorated equipment

## | Equipment specifications

• **NPoDAS C-100A**
· Channel: 4 ch (including 1 noise channel)
· Frequency range: 1~50 MHz
· Signal Amplitude: -55~0 dBm
· Detection supervision: ≥ 5 pC
· Connector type: BNC type
· Sampling: 128 sample/cycle
· Interface: Ethernet
· LED Status: Power & Operation
· Power: 220 VAC / 60 Hz, 12VDC
· Size: 227 x 274 x 155 mm,

## | Accessories

• **HFCT**
· Purpose: Gaining of signals from cable
· Detection range: 1~50 MHz
· Detection sensitivity: 5 pC or more
· Installation: External clamp fixation
· Connector: N Type

• **Rogowski Coil**
· Purpose: Synchronizing signals when using battery without local power
· Detection range: 10 Hz~20 kHz
· Installation: External clamp fixation
· Connector: BNC

• **Noise Sensor**
· Purpose: Gaining of noise signals
· Detection range: 1~500 MHz
· Installation: Stand type
· Connector: N Type

• **Calibrator**
· Purpose: Calibration of PoDAS C-100A
· Power: 9 VDC (Alkaline Battery – 6LF22)
· Output: 5~500 pC
· Connector: BNC Type

• **Coaxial Cable**
· BNC type (5m, 10m)

• **Auxiliary battery**
· For PoDAS C-100A (12 VDC)
· For Laptops (19 VDC)

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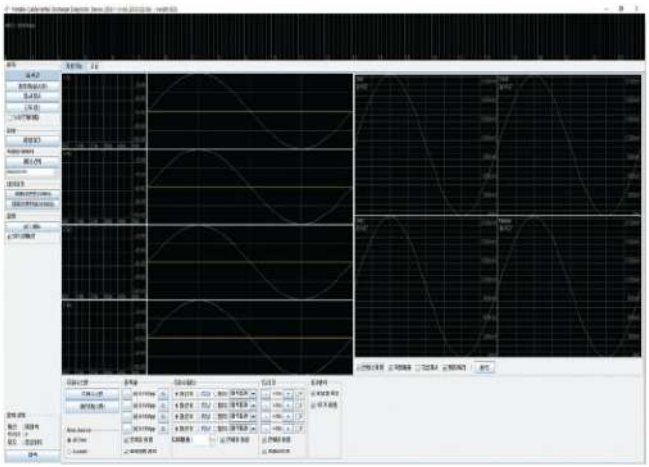
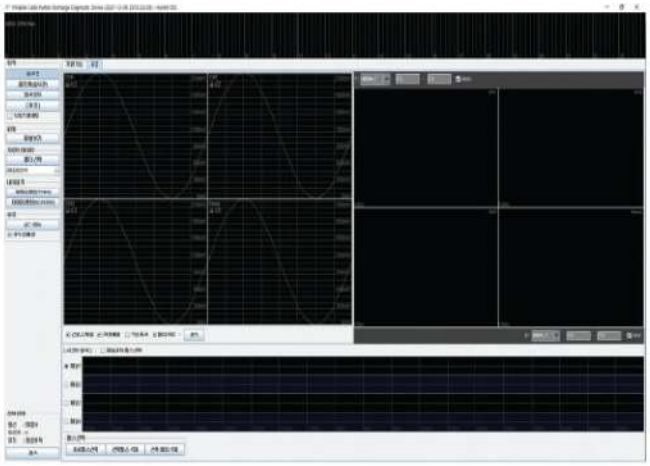
# Specification

## | MMI S/W



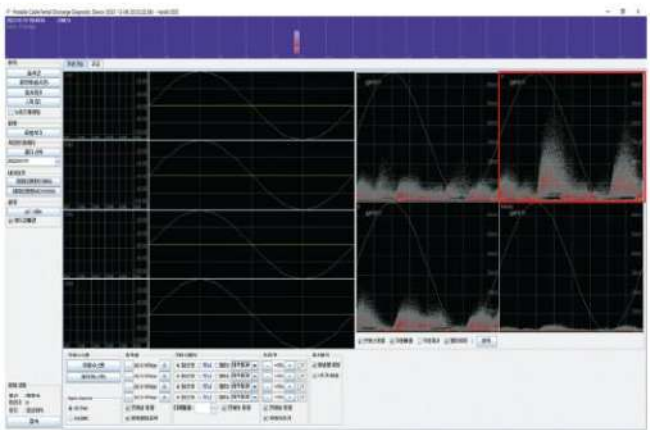
<MMI Main Sreen>



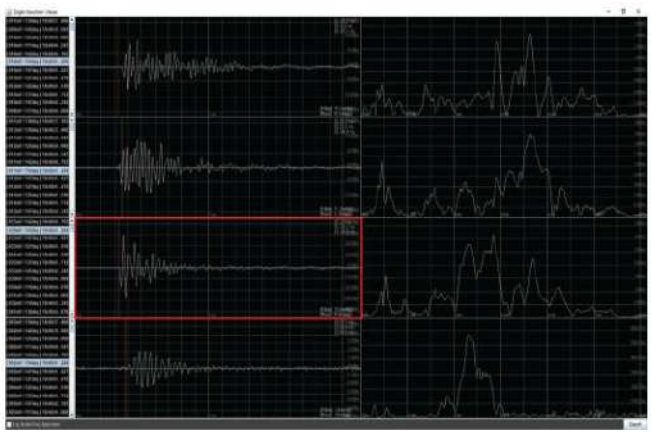
<MMI Diagnosis Screen>

## | Diagnosis Case

- Referential Site: A S/S #3 M.Tr (Jan 11th, 2022)

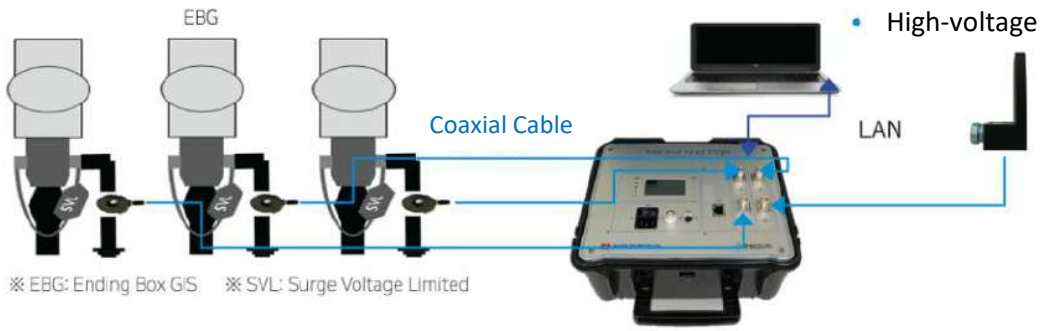


<Diagnosis Main Screen>



<Original Waveform Screen>

## | System Configuration Diagram




- High-voltage cable PD diagnosis

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BHEL
KARNATAKA POWER
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Alembic
Touching Lives over 100 years
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Maharashtra State Electricity Transmission Co. Ltd

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**REGISTERED ADDRESS**

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