



**ONLINE CONDITION  
MONITORING SOLUTION**

## 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 occur.



### 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.”

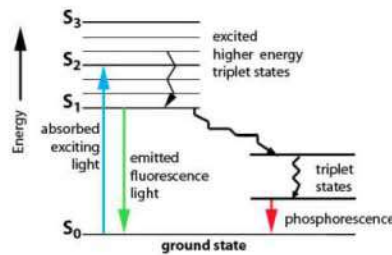
- **Quality** • **Customer Satisfaction** • **Safety**
- **Experts Team** • **Reliability** • **Commitment**

# ONLINE FIBRE OPTIC TEMPERATURE MONITORING



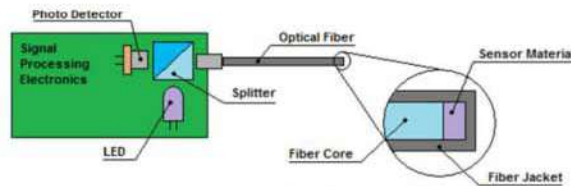
## FLUORESCENT TECHNOLOGY OVERVIEW

The scientific principle is  
 Fluorescent Time Decay



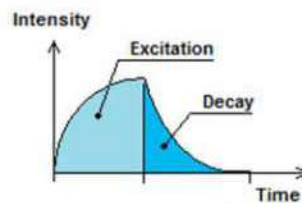
OSENSA's technology leads the world in accuracy

A special fluorescent  
 phosphor is excited with light



OSENSA uses an exceptionally long -life LED source

Electronics measure the time  
 constant ( $\tau$ ) for the glowing  
 phosphor which is proportional  
 to temperature



$$I(t) = I_0 e^{-t/\tau}$$

A shorter decay time means higher temperature



## 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)

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

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



(C)

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



(D)

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

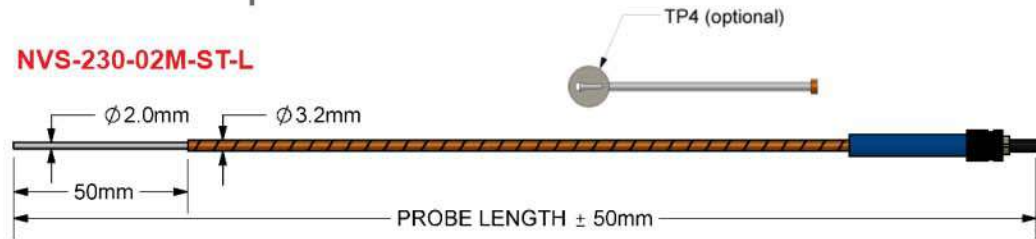
# Oil-Filled Transformer Winding Temperature Measurement

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.

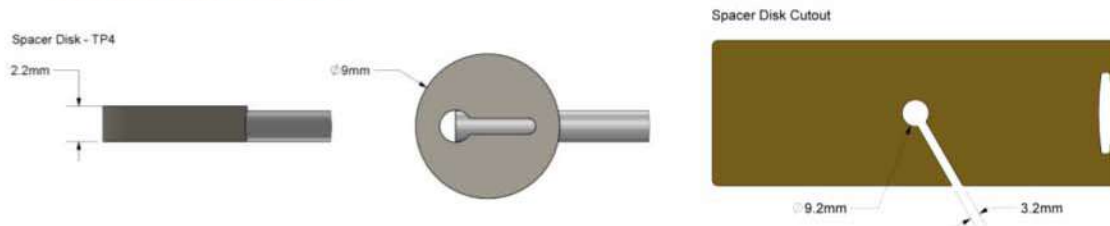
## Product Specifications

### 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:

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

## INDUSTRIAL CAST RESIN TRANSFORMER MONITORING

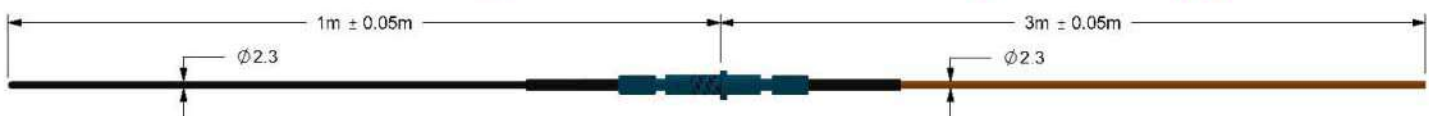
- FTX - 310 - PWR + R 3 Channel Temp Transmitter
- FTX - 610 - PWR + R 6 Channel Temp Transmitter
- FTX - 910 - PWR + R 9 Channel Temp Transmitter



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)

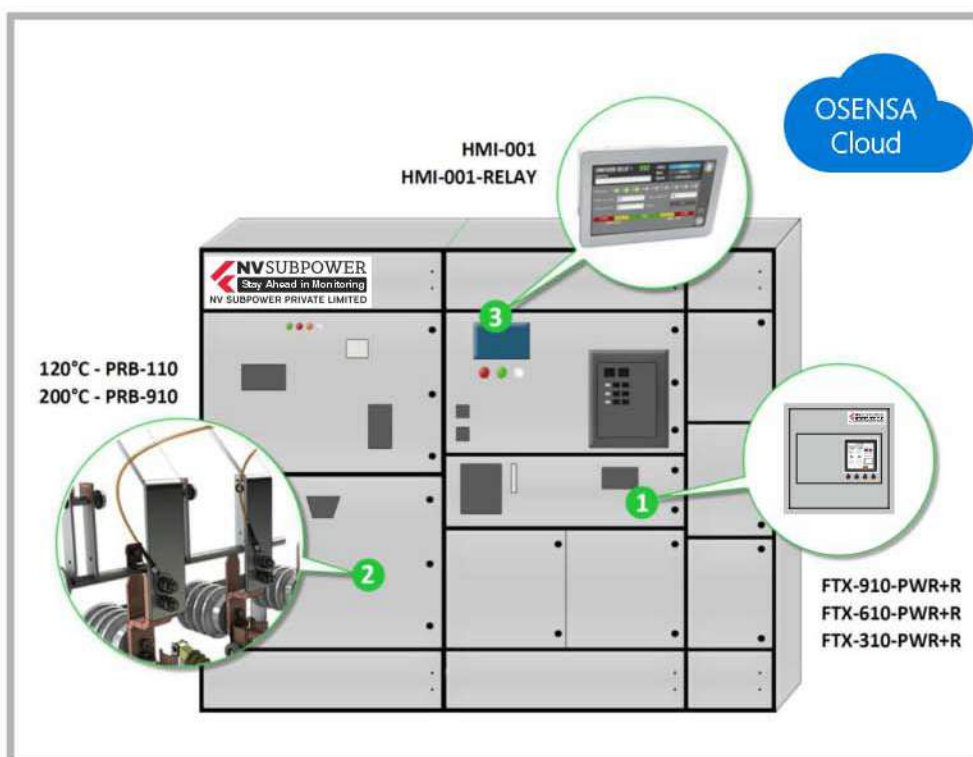


## SWITCHGEAR AND BUSBAR THERMAL MONITORING

Osenza 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

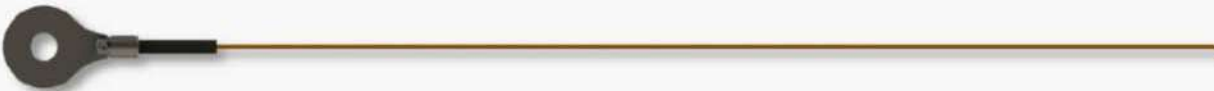
3,6, or 9 Channel transmitters with 2 relay outputs for alarms

- 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

PRB-110 (120°C max. temperature at ring)



PRB-910 (200°C max. temperature at ring)



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



### NV SubPower : NFX model technical parameters

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 reliability	100%
Wave length operational length	650nm
	inbuilt USB, Gigabyte ethernet; RS485
PC output interdate	Optional: Ethernet 10/100BASE-fx (Duplex, for 50 or 62.5 μ fibers)
Data display	Touch screen HMI Display
Self Diagnostc	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/Quartz 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 temprature 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



## 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 Gas Phase: 25 - 5,000 ppm in-oil equivalent
Accuracy <sup>1</sup>	± 20% of reading or 25 ppm (500 ppm gas) <sup>4</sup>
Repeatability <sup>2</sup>	± 10% of reading or 15 ppm (300 ppm gas) <sup>4</sup>
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 <sup>3</sup>	Oil Phase: -40° C to +105° C 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 (CSM 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)

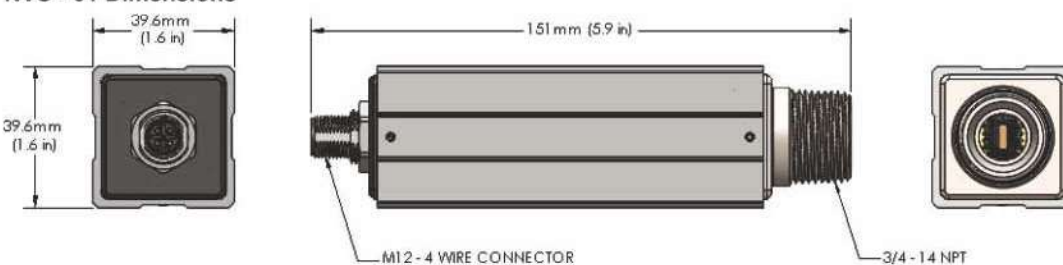
1 Accuracy of the sensor in the FIELD

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<sub>2</sub>, CH<sub>4</sub>, C<sub>2</sub>H<sub>6</sub>, C<sub>2</sub>H<sub>4</sub>, C<sub>2</sub>H<sub>2</sub>, CO, CO<sub>2</sub> (H<sub>2</sub>O)
- 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<sub>2</sub>O 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

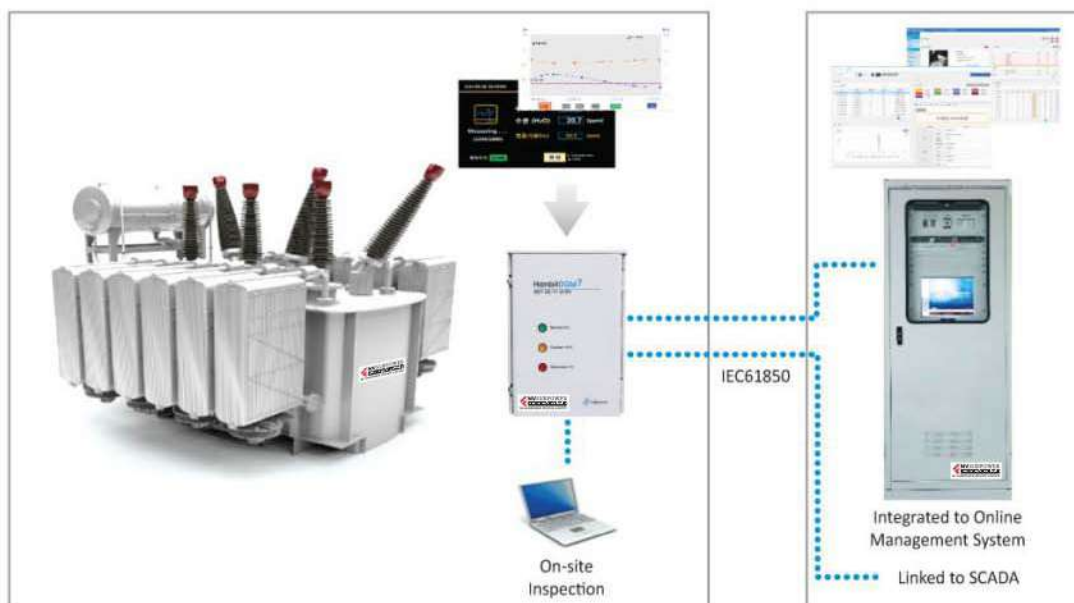
- Select up to 7 gases
- Gas selection considering transformer capacity, faults to be detected and types of insulation oil
- Transformer capacity :  
 1 gas type, 3~7 gases type, multi-tank type
- Faults to be detected :  
 H<sub>2</sub> / C<sub>2</sub>H<sub>2</sub> / C<sub>n</sub>H<sub>m</sub> type, etc.
- Insulation oil(vegetable oil, non-flammable oil) :  
 H<sub>2</sub> / C<sub>2</sub>H<sub>6</sub> type, etc.

### • t-DGMS

(*total* Dissolved Gas Monitoring System)

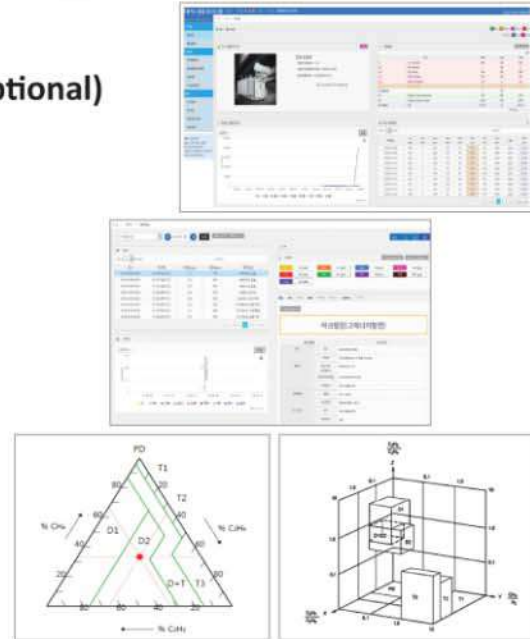
- Online t-DGMS allows monitoring and remote controlling in real-time
- Compatible with Online Electrical Asset Monitoring System
- Integrated to online GIS/TR monitoring system (i-TODs)

## 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<sub>2</sub>
- 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)	Pass
	IEC 60947-5-2 Clause 8.3.3.4 or IEC 60950-1(Power Frequency Voltage Test)	Pass
Environmental Test	IEC 60068-2-6 (Test Fc: Vibration (sinusoidal))	Pass
	IEC 60068-2-1 (Test A: Cold)	Pass
	IEC 60068-2-2 (Test B: Dry heat)	Pass
	IEC 60068-2-30 (Test Db: Damp heat, cyclic (12 h + 12 h cycle))	Pass
Electromagnetic Compatibility (EMC) Test	IEC 61000-4-2 (Electrostatic discharge test)	Grade A (Pass)
	IEC 61000-4-3 (Radiated, radio-frequency, electromagnetic field immunity test)	Grade A (Pass)
	IEC 61000-4-4 (Electrical fast transient/burst immunity test)	Grade A (Pass)
	IEC 61000-4-5 (Surge immunity test)	Grade A (Pass)
	IEC 61000-4-6 (Immunity to conducted disturbs, induced by radio-frequency field)	Grade A (Pass)
	IEC 61000-4-8 (Power frequency magnetic field immunity test)	Grade A (Pass)
IEC 61000-4-11 (Control Power Failure Test)	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	
			HanbitDGM 3 ~ 7	HanbitDGM 3T
Measuring Gases	H <sub>2</sub> (Hydrogen)	5 ~ 5,000 ppm	○	○
	CH <sub>4</sub> (Methane)	1 ~ 5,000 ppm	○	○
	C <sub>2</sub> H <sub>6</sub> (Ethane)	1 ~ 5,000 ppm	○	○
	C <sub>2</sub> H <sub>4</sub> (Ethylene)	1 ~ 5,000 ppm	○	○
	C <sub>2</sub> H <sub>2</sub> (Acetylene)	0.1 ~ 5,000 ppm	○	○
	CO (Carbon monoxide)	1 ~ 10,000 ppm	○	○
	CO <sub>2</sub> (Carbon dioxide)	0 ~ 10,000 ppm	○	○
	O <sub>2</sub> (Oxygen), N <sub>2</sub> (Nitrogen) ※ Optional			
	H <sub>2</sub> O (Moisture)		○	○
Measuring Range	Min. ~ Max. (full range calibration) / H <sub>2</sub> O : 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 °C		
	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) 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) 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

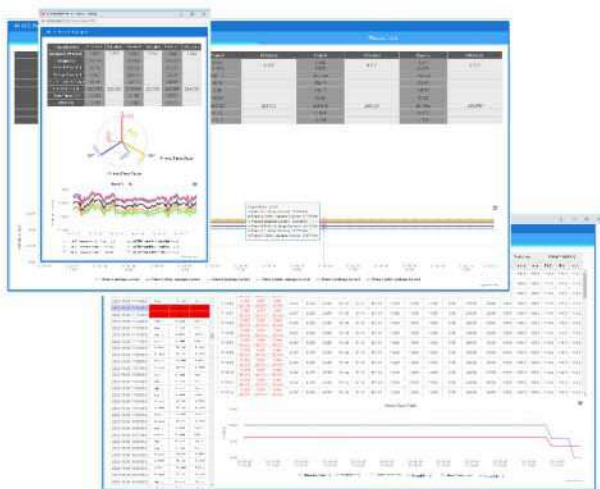
Bushing Monitoring Module for online monitoring system



## 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>i</i> -TODs)
<i>i</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

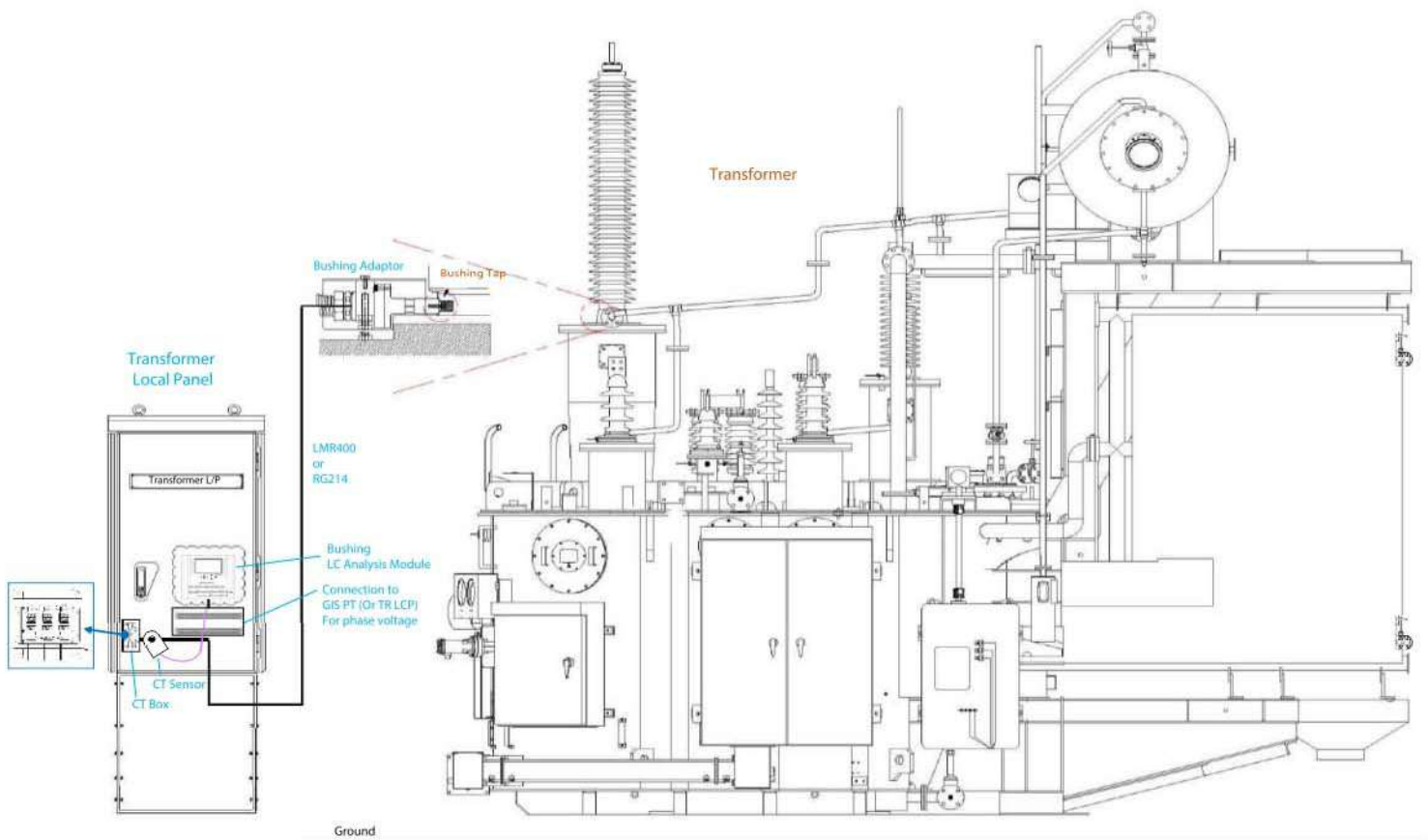
Power Supply	AC 220V / 60Hz ( AC105~235V, 50~60Hz)
Enclosure Material	Aluminium
Display	3.5" TFT RGB 65K LCD, 480x320 Pixel, Resistive Touch Screen
Mounting Option	To be installed within a standalone panel Need electrical accessories: CT sensor, CT box, terminal block
Dimension	480 (W) x 130(D) x 132(H)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

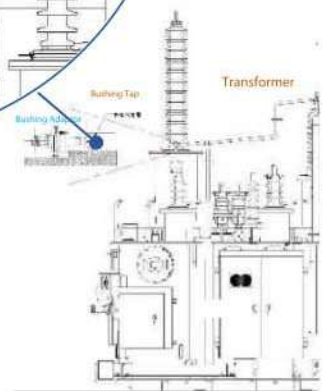
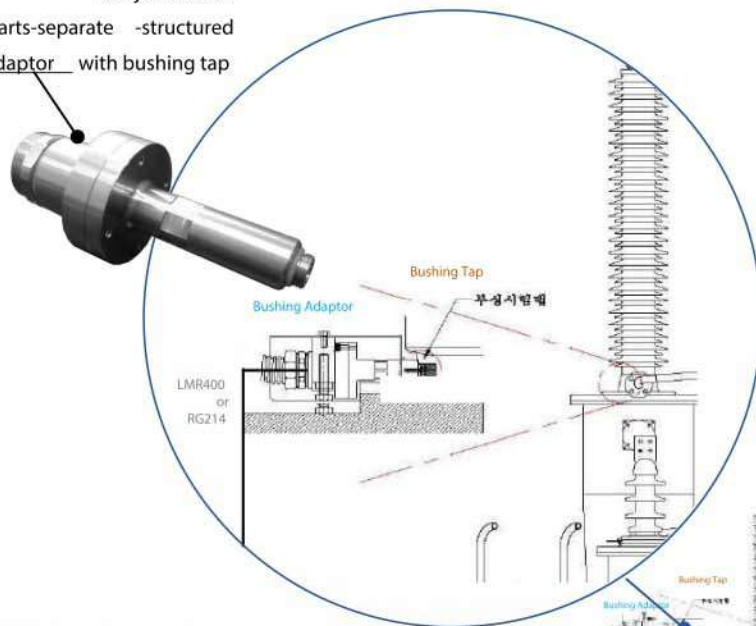


# Transformer Monitoring System

## Bushing Adaptor



Conjunction of  
 two-parts-separate -structured  
bushing adaptor with bushing tap



# NVPoDAS

Portable GIS Partial Discharge Diagnostic System

## Hanbit

Smart Diagnostic Solution

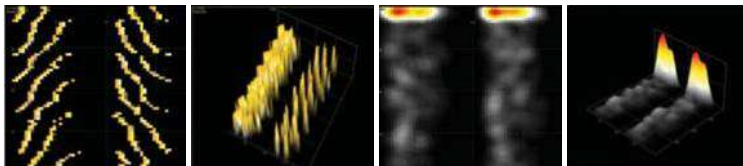
### Product Descriptions

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



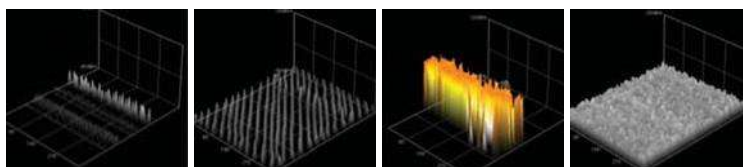
2D PRPS

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

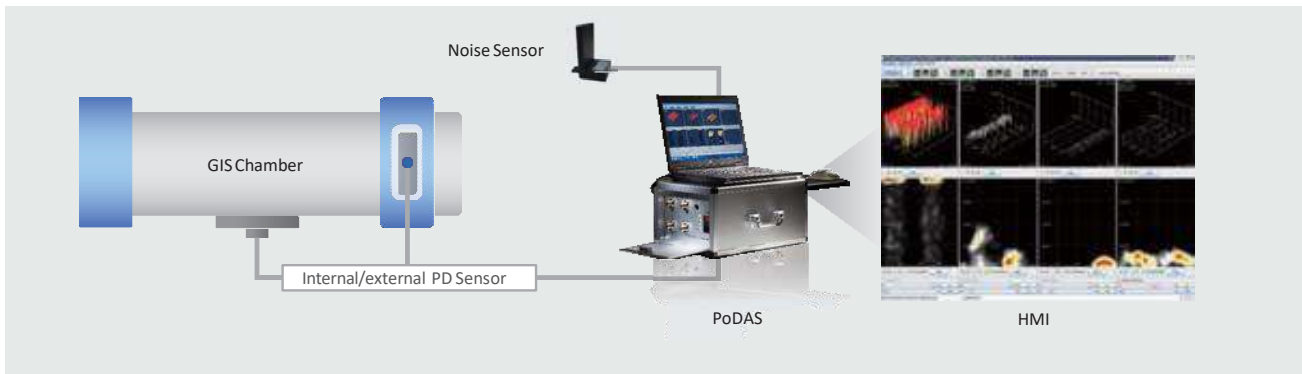
### SUPPLY RECORD

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



# 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) ( $\pm$ 5%) [mm] Accessories Case: 450(W) x 350(D) x 450 (H) ( $\pm$ 5%) [mm]

# 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

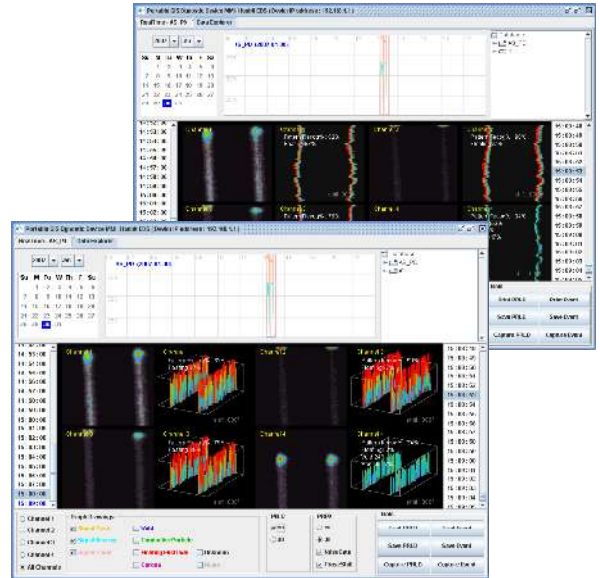
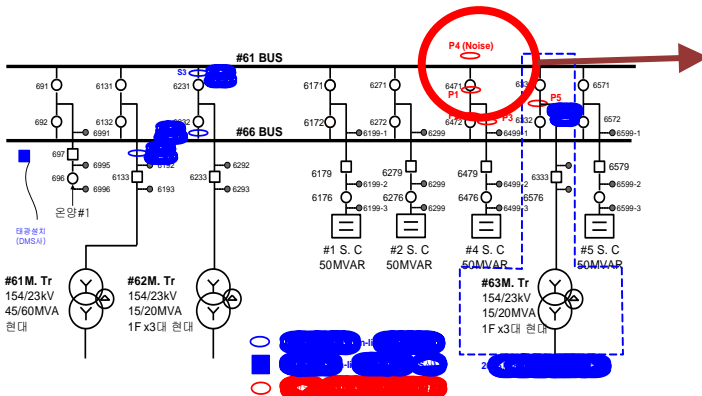
# NPoDAS Package

<p>NPoDAS with Laptop</p>		<ul style="list-style-type: none"> <li>- PoDAS: Calculate and process PD signals and transmit data to a diagnostic program</li> <li>- Laptop: Operating a program that performs signal analysis and diagnosis</li> <li>- Power: 85~265VAC, 60/50Hz</li> <li>- Frequency Range: 500~1,500MHz</li> <li>- Input: PD Sensor – 3 Ch Noise sensor – 4 Ch</li> <li>- Communication: UDP/IP Protocol</li> </ul>
<p>Diagnosing Software</p>		<ul style="list-style-type: none"> <li>- Analyzing and diagnosing PD types and noise by type</li> <li>- Real-time PRPS, 3D/2D display and analysis by synchronizing with power phase</li> <li>- S/W option settings: standard value, report writing, phase shift</li> <li>- Built-in libraries and noise signals for each type of PD</li> <li>- Data storage and report function</li> </ul>
<p>External UHF PD Sensor</p>		<ul style="list-style-type: none"> <li>- Measurement range: 500 ~1,500 MHz</li> <li>- Mounting method: fixed to GIS spacer</li> <li>- Connector: N-Type</li> </ul>
<p>Noise Sensor</p>		<ul style="list-style-type: none"> <li>- Measurement range: 300 ~3,000MHz</li> <li>- Mounting method: Magnet type, mounted around GIS equipment</li> <li>- Connector: N-Type</li> </ul>
<p>Band Rejection Filter</p>		<ul style="list-style-type: none"> <li>- For removing surrounding noise such as communication noise</li> <li>- Mounting method: Connected to the input channel of diagnostic equipment</li> </ul>
<p>Accessories Case</p>		<ul style="list-style-type: none"> <li>- accessory storage box</li> <li>- Coaxial cable: LMR400UF 15m, 4 sets</li> <li>- 1 set each of power cable and LAN cable</li> </ul>

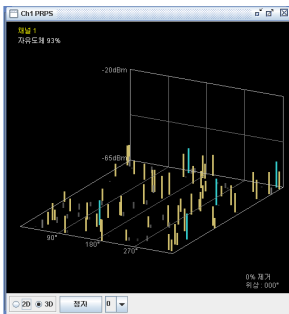
# Case Study

## PD Diagnosis Case

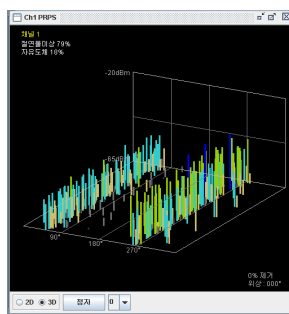
- Site: KEPCO ## Substation 154kV GIS
- Tool: PoDAS
- Result: Floating PD



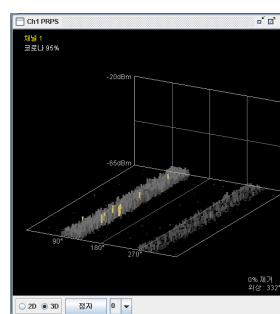
## PD Waveform Examples



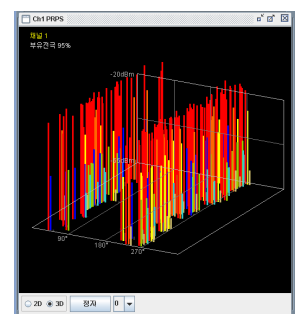
Particle



Void



Corona



Floating

**NV SubPower Private Limited**

603, Signet Hub, Near Reliance Mall

OP Road, Vadodara -390020

Gujarat India; LL :+91 265 3186013 ; +91 8140980160

# 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 lightweight
- 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:  $\geq 5$  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

### • Noise Sensor



- Purpose: Gaining of noise signals
- Detection range: 1~500 MHz
- Installation: Stand type
- Connector: N Type

### • Coaxial Cable



- BNC type (5m, 10m)

### • Rogowski Coil



- Purpose: Synchronizing signals when using battery without local power
- Detection range: 10 Hz~20 kHz
- Installation: External clamp fixation
- Connector: BNC

### • Calibrator



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

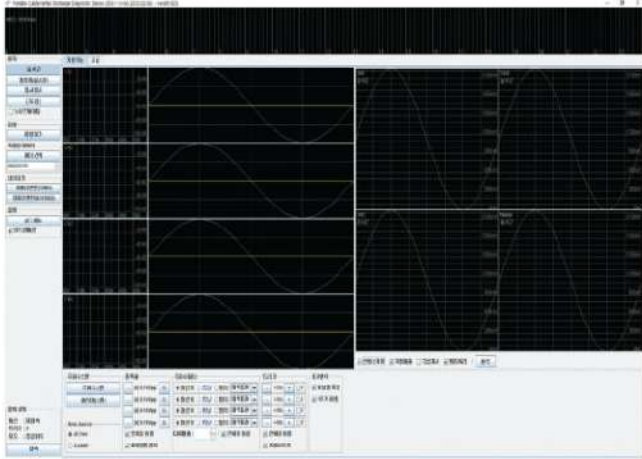
### • Auxiliary battery



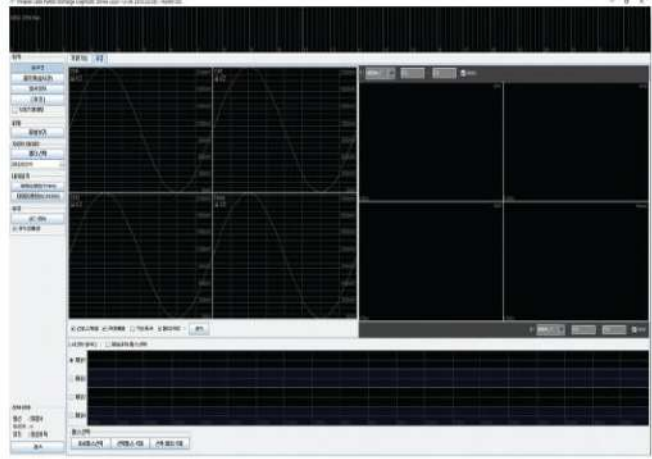
- For PoDAS C-100A (12 VDC)
- For Laptops (19 VDC)

# Specification

## | MMI S/W



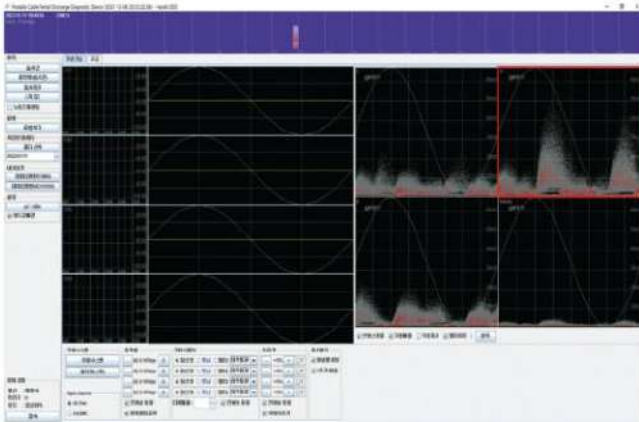
<MMI Main Sreen>



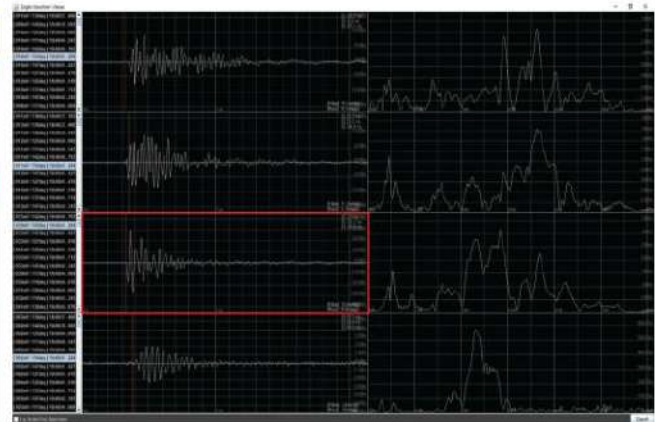
<MMI Diagnosis Screen>

## | Diagnosis Case

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

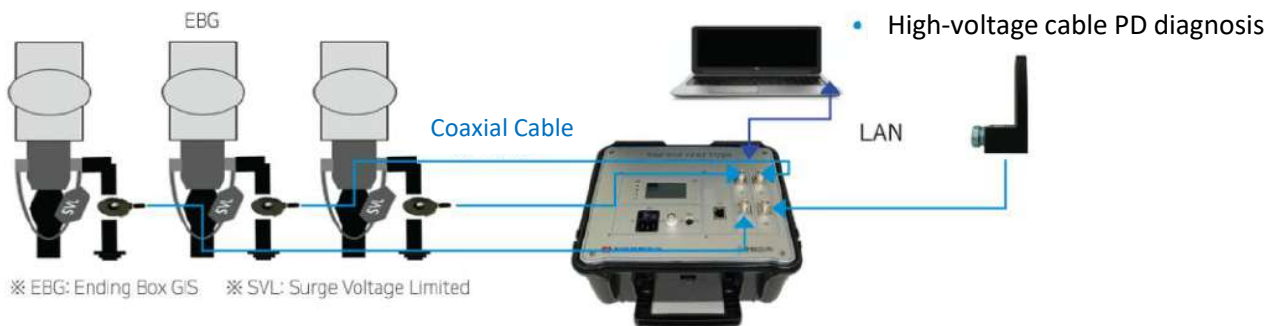


<Diagnosis Main Screen>



<Original Waveform Screen>

## | System Configuration Diagram



**NV SubPower Private Limited**

**LL: +91 265 3186013 ; Mob :+91 8140980160**

**[info@nvsubpower.com](mailto:info@nvsubpower.com) ; [n\\_var@nvsubpower.com](mailto:n_var@nvsubpower.com)**

**406, V3 Landmark, Sun Pharma Road, Vadodara 390020**

# Our Major Customers





**REGISTERED ADDRESS**

**NV SUBPOWER PRIVATE LIMITED**

406-C, V3 Landmark, Sun Pharma Road, Atladra, Vadodara - 390 012.

M : +91 81409 80160, +91265 - 3557650

Email : [sales@nvsubpower.com](mailto:sales@nvsubpower.com) / [n\\_var@nvsubpower.com](mailto:n_var@nvsubpower.com)

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