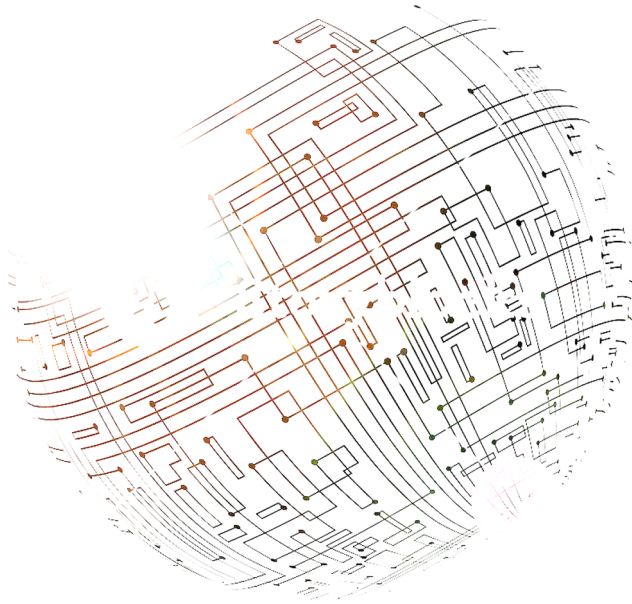
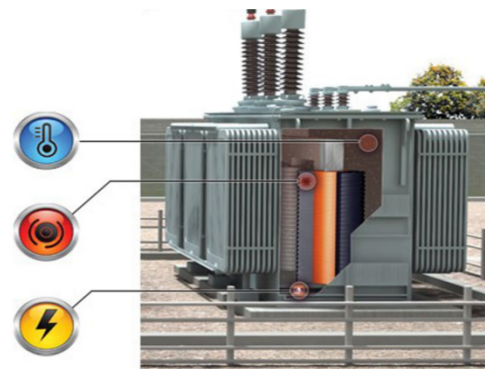




# Verticross India Pvt. Ltd.

## Transformer Monitoring Unit



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## INTRODUCTION

The Transformer Monitoring Unit (TMU) is a cutting-edge solution designed to enhance the efficiency and reliability of transformers, which are critical components in the power distribution network. By employing advanced monitoring technology, the TMU focuses on key parameters such as oil temperature, winding temperature, and oil level, providing utilities with the necessary tools to ensure optimal transformer performance. The importance of transformers in the electrical grid cannot be overstated, they are the backbone of power distribution systems, ensuring that electricity is delivered safely and efficiently from generation points to end-users.

In today's fast-paced and increasingly digital world, the demand for reliable power supply has never been higher. Utilities face significant challenges in managing distribution transformers (DTs) effectively, especially given the rising complexity of power distribution networks. The TMU addresses these challenges by offering real-time and historical data that empowers utilities to make informed decisions, ultimately enhancing the overall reliability of the power grid.

The TMU is equipped with state-of-the-art sensors that continuously monitor various parameters crucial for transformer operation. These sensors provide accurate intra-grid readings of voltage, energy consumption, current, temperature, and oil levels. By capturing this data in real-time, the TMU enables utilities to derive a comprehensive understanding of transformer performance and power quality. The ability to monitor these parameters not only helps in identifying potential issues before they escalate into major failures but also aids in optimizing the operational efficiency of transformers.

One of the most significant advantages of the TMU is its capability to facilitate preventive maintenance. By continuously monitoring the condition of distribution transformers, utilities can identify trends and anomalies that may indicate impending failures. This proactive approach allows for timely interventions, reducing the likelihood of unexpected outages and the associated costs of emergency repairs. Moreover, by minimizing transformer downtime, utilities can maintain a higher level of service reliability for their customers.

The TMU's real-time monitoring capabilities are further enhanced by its use of 4G technology for data transmission. This allows for seamless integration with centralized Supervisory Control and Data Acquisition (SCADA) systems. Utilities can monitor transformer data live through various devices, including PCs, laptops, and mobile devices, depending on the variant of the TMU deployed. This flexibility ensures that utility personnel can access critical information anytime and anywhere, facilitating quicker decision-making processes.



In addition to its monitoring capabilities, the TMU also plays a crucial role in managing distribution losses. By analysing the electrical parameters of DTs, utilities can identify areas where energy losses occur and implement targeted strategies to mitigate them. This not only enhances the overall efficiency of the power distribution network but also contributes to sustainability efforts by reducing waste and improving energy conservation.

The TMU's impact extends beyond operational efficiency; it also fosters a culture of data-driven decision-making within utility organizations. By leveraging the insights provided by the TMU, utilities can make informed strategic decisions regarding transformer maintenance, upgrades, and resource allocation. This shift towards a more analytical approach to transformer management can lead to significant improvements in both operational performance and customer satisfaction.

Furthermore, the TMU is designed with scalability in mind. As the demand for electricity continues to grow, utilities may need to expand their monitoring capabilities to accommodate additional transformers or integrate new technologies. The modular design of the TMU allows for easy upgrades and expansions, ensuring that utilities can adapt to changing demands without significant overhauls of their existing infrastructure.

The TMU also contributes to regulatory compliance and reporting. With the increasing focus on energy efficiency and sustainability, utilities are often required to report on their operational performance and environmental impact. The data collected by the TMU provides a reliable foundation for these reports, enabling utilities to demonstrate their commitment to performance excellence and regulatory adherence.

There are six Analog Input Channels in TMU which can be used as below:

- AI-1 = Ambient Temperature
- AI-2 = Oil Level and Oil Temperature
- AI-3 = R Phase Busbar Palm Temperature
- AI-4 = Y Phase Busbar Palm Temperature
- AI-5 = B Phase Busbar Palm Temperature
- AI-6 = N Phase Busbar Palm Temperature



**Dissolved Gas Analysis (DGA) Sensors:**

DGA sensors detect gases produced by the breakdown of insulation materials. The presence of specific gases can indicate insulation faults or other issues within the transformer, allowing for early intervention and maintenance.

**Data Acquisition System**

The data acquisition system collects real-time data from various sensors, ensuring data integrity and synchronization. This system is crucial for accurate monitoring and analysis of transformer health and performance.

**Communication Interface**

The communication interface facilitates the transmission of data between the TMU and central monitoring systems, such as SCADA (Supervisory Control and Data Acquisition) systems. It supports multiple communication protocols, including Modbus ensuring interoperability with various systems.

**Processing Unit**

The processing unit analyzes the collected data to detect trends and anomalies. It implements algorithms for predictive maintenance and fault diagnosis, helping utilities anticipate issues before they escalate into failures.

**User Interface**

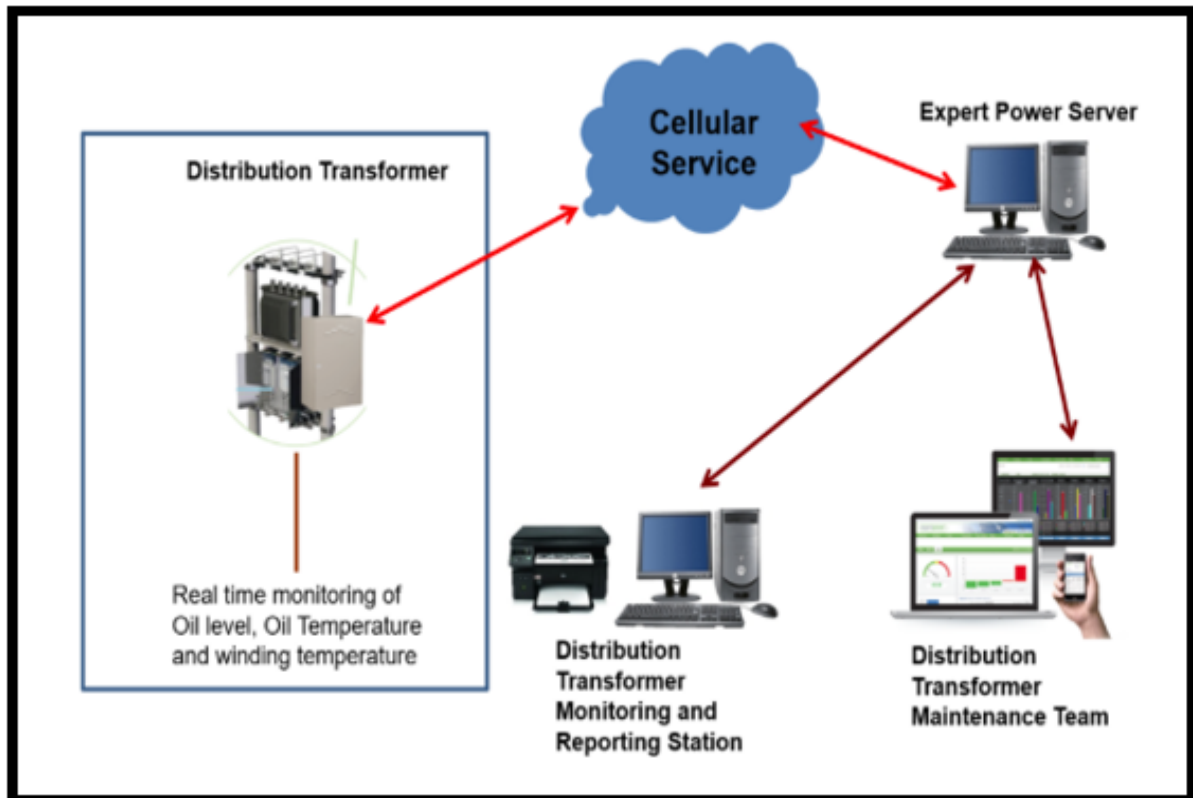
The user interface provides visualization tools for operators to monitor transformer health. It includes dashboards that display critical metrics and alerts that notify operators of any immediate issues requiring attention.

**Configuration Management**

The TMU allows for flexible configuration management. Whenever a firmware update is necessary, the modem can be initiated through an SMS or TCP/IP-based request. The modem will then connect to an FTP server to download the latest firmware version. Similarly, configuration settings can be modified via SMS or TCP/IP, with configurable details

**APN Name:** The Access Point Name required for mobile network connectivity.

**Destination Server IP Address:** The IP address of the server where data will be sent or received. This capability ensures that the TMU remains up-to-date and can be easily configured to meet the evolving needs of the utility, enhancing the overall effectiveness of transformer monitoring and management.



### **Common Types of Transformer Monitoring Units:**

#### **Standalone Units:**

These are independent devices that are installed directly on or near the transformer. They provide real-time data through sensors, and sometimes can be connected to local SCADA (Supervisory Control and Data Acquisition) systems. These are embedded within the transformer and may include multiple sensors for comprehensive monitoring. They can communicate directly with control systems for automated responses and alarms.

#### **Wireless Monitoring Systems:**

These systems use wireless technology (e.g., Wi-Fi, Zigbee, or cellular networks) to send data remotely to a central control station or cloud-based system, providing real-time alerts and analytics.



## FEATURES &FUNCTIONALITIES

- All functionalities of Power & Distribution Transformer Metering
- Monitoring of oil level
- Monitoring of transformer winding temperature
- Sending alarm for low oil level or high transformer winding temperature
- Provide status of feeder on/off
- OLTC position monitoring
- Providing Distribution Transformer's GPS co-ordinates.
- Low voltage detection and alarm.

### **Temperature Monitoring:**

Monitors the temperature of the transformer, including both oil temperature and winding temperature. Excessive heat can be a sign of overloading or insulation degradation.

Measures the oil level inside the transformer tank, which is critical for proper cooling and insulation. Monitors the dielectric strength and quality of transformer oil (detecting gas buildup, moisture content, or contaminants).

### **Pressure and Gas Detection:**

Monitors gas buildup inside the transformer, such as hydrogen, which can indicate internal faults (e.g., arcing, insulation breakdown). Gas-in-oil analysis can provide valuable early warnings about developing issues.

Tracks the load (current) being drawn by the transformer, ensuring it operates within its rated capacity. Provides information about potential overloads or operational inefficiencies. Detects abnormal vibrations in the transformer, which may signal mechanical issues such as loose components or damage to internal parts.

Measures moisture content inside the transformer, which can negatively affect insulation and lead to failure. Monitors the condition of the transformer bushings, which are critical for maintaining electrical insulation and preventing leakage currents.

### **Oil Temperature and Winding Temperature Differential:**

Monitors the temperature differential between the transformer windings and oil, which can indicate the transformer's internal health. Continuously tracks transformer parameters, providing instant insights into operational conditions. Uses data analytics to determine when maintenance is needed, reducing unnecessary downtime and costs.

Employs machine learning and statistical methods to identify early signs of failure, enabling proactive intervention. Maintains historical data for analysis and compliance, supporting regulatory requirements.



### **Remote Access:**

Allows engineers and operators to access transformer data from remote locations, enhancing flexibility and responsiveness. Support remote configuration of the TMU for different parameters such as time interval for data push, setting of threshold parameters for alert generation like Phase imbalance, over-heating of transformer, threshold for power quality parameters such as power factor and voltage.

### **Individual Enable / Disable following thresholds to operate ACB can be possible**

- Phase Imbalance
- Over-heating of transformer
- Low Power factor
- Low Voltage

## **DATASHEET**

### **Phase Imbalance**

Difference between any two-phase voltages is  $\geq 30\%$  - Phase Imbalance, Threshold value can be configurable.

### **Over-heating of transformer**

- If temperature is  $\geq 50^\circ\text{C}$  Over temperature
- If temperature is  $< 30^\circ\text{C}$  Normal temperature
- Both values can be configurable, Normal temperature threshold should be not less than  $10^\circ\text{C}$  than Over temperature threshold.

### **Network information**

- 4G/3G/2G operation status can be included in TMU diagnosis.
- SIM APN information can be included in TMU diagnosis.
- Individual Enable / Disable following thresholds to operate ACB can be possible in the event of Over-heating of transformer

### **Digital Input Specification**

- No of Channels : Two
- Voltage range : 12V DC to 36V DC
- Isolation : 5KV isolation
- Feeder Status On/Off
- Oil Level Normal/Low



### Digital output specification

- No of channels : Two
- Output type : Relay floating contacts
- Current : 3A maximum @250V AC  
2A maximum @ 24V DC
- Siron On
- Operate ACB

### Temperature measurement

- Sensor type - PT-100
- Range 0°C to 200°C / 0°C to 500°C
- Accuracy +/- 1.0°C / 2.5°C
- Measurement of winding temperature

### Analog Channels

- No of Channels: Two
- Measuring type: 0-5 V DC or 0 to 20ma current loop (Transducers)
- Accuracy : 1.0% Latitude and Longitude (GPS) coordinates for TMU/DT position.

### Power factor

- < 0.80 Lag - Low Lag Power Factor Alert
- < 0.80 Lead - Low Lead Power Factor Alert
- values can be configurable

### Voltage

- Less than 96V for any phase voltage is low voltage alert,
- Value can be configurable
- TMU Cover open tamper

## BENEFITS

- Improved Reliability: By monitoring key parameters, TMUs help prevent transformer failures and extend asset lifespan.
- Cost Efficiency: Condition-based maintenance strategies reduce maintenance costs and unplanned outages.
- Enhanced Safety: Early fault detection minimizes risks to personnel and equipment.
- Provide efficient electricity transmission.
- Minimize energy losses during transmission.
- Step up or step down voltage levels as required.



- Provides consistent electricity supply.
- Supports various industrial and residential applications.
- Regulate voltage levels and enhance the safety of equipment and life.