



**Measurements International**  
*Metrology is Our Science, Accuracy is Our Business™*

# Transformer and Reactor Loss Measurement Systems TLMS and RLMS

**Accurate. Proven. Fast.**

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# Confidence in Every Transformer You Deliver



You are expected to meet strict efficiency guarantees—on time and without risk.

Loss measurement is where that performance is proven. At low power factors, even small uncertainties can impact margins, delay shipments, or lead to disputes.

That's why manufacturers rely on AccuLoss® (TLMS) and Reactor Loss Measurement Systems (RLMS) from Measurements International—delivering metrology-level accuracy on the factory floor.



## Confidence That Protects Your Business

### Accurate. Defensible. Compliant.

- High-precision measurement at extreme low power factors
- Results you can trust and defend in any test or audit
- Fully aligned with IEC 60076
- SF6 Free Systems available

### Performance That Drives Results

- Increase throughput with fast, stable measurements
- Operate with confidence in real-world conditions
- Simplify testing with intuitive, automated workflows

### Complete Loss Measurement Coverage

- TLMS – Transformer and Reactor loss measurement for production environments
- RLMS – Dedicated reactor loss measurement systems
- One integrated solution across your full product range

### The Result

- Reduced financial risk
- Improved production efficiency
- Greater confidence in every test
- Fully Customizable solutions for your exact requirements

# Confidence That Wins Business

With TLMS and RLMS, you remove uncertainty from loss measurement—and gain a competitive advantage on every unit you deliver.

## Features & Benefits

| Feature                               | Benefit                                                                                                                       |
|---------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|
| Industry-Leading Measurement Accuracy | Ensures confidence in results, even at PF = 0.001, supporting compliance with global standards and improving product quality. |
| Simultaneous Sampling Technology      | Eliminates phase errors and delivers fast, stable, and highly repeatable measurements.                                        |
| Scalable to 6000 A / 800 kV           | Supports testing from distribution to ultra-high-voltage transformers within a single platform.                               |
| Modular System Architecture           | Enables easy upgrades and integration into existing facilities, protecting long-term investment.                              |
| Flexible Test Configurations          | Accommodates horizontal and vertical bushings and a wide range of transformer designs.                                        |
| Optimized for Low Power Factor        | Maintains high accuracy under the most challenging measurement conditions.                                                    |
| Supports Energy-Efficient Design      | Helps manufacturers reduce transformer losses and meet increasing efficiency requirements.                                    |
| Environmentally Responsible Design    | Contributes to reduced emissions and supports ESG and sustainability initiatives.                                             |

# Overview

The AccuLoss® Transformer Loss Measurement System (TLMS) and Reactor Loss Measurement Systems (RLMS) from Measurements International Limited are metrology-grade solutions designed for precise measurement of transformer and reactor losses. Engineered for modern high-voltage testing, these systems deliver industry-leading accuracy, even under challenging conditions such as extremely low power factor measurements ( $PF = 0.001$ ).

Using precision voltage dividers and advanced simultaneous sampling wattmeter technology, TLMS and RLMS provide fast, stable, and highly repeatable results, making them well suited for both production and laboratory environments.

Built on proven metrology principles, the system is simple to calibrate using traceable reference standards. This reduces complexity and downtime while ensuring long-term confidence in

measurement accuracy. The modular and scalable architecture supports configurations up to 800 kV and 6000 A, enabling seamless integration into new or existing test facilities across a wide range of applications.

The system supports a comprehensive range of testing applications, including load and no-load loss measurements, heat run testing, induced voltage testing, and reactor calibration at very low power factors. Integrated software provides automated test sequences, waveform analysis, and flexible data output, improving efficiency while maintaining consistent, high-quality results.

Optional oil-filled current transformers (CTs), including electronically aided and compensated designs, further extend system capability—allowing a single platform to support both transformer and reactor testing with high accuracy and stability. This option removes the need for bushings.

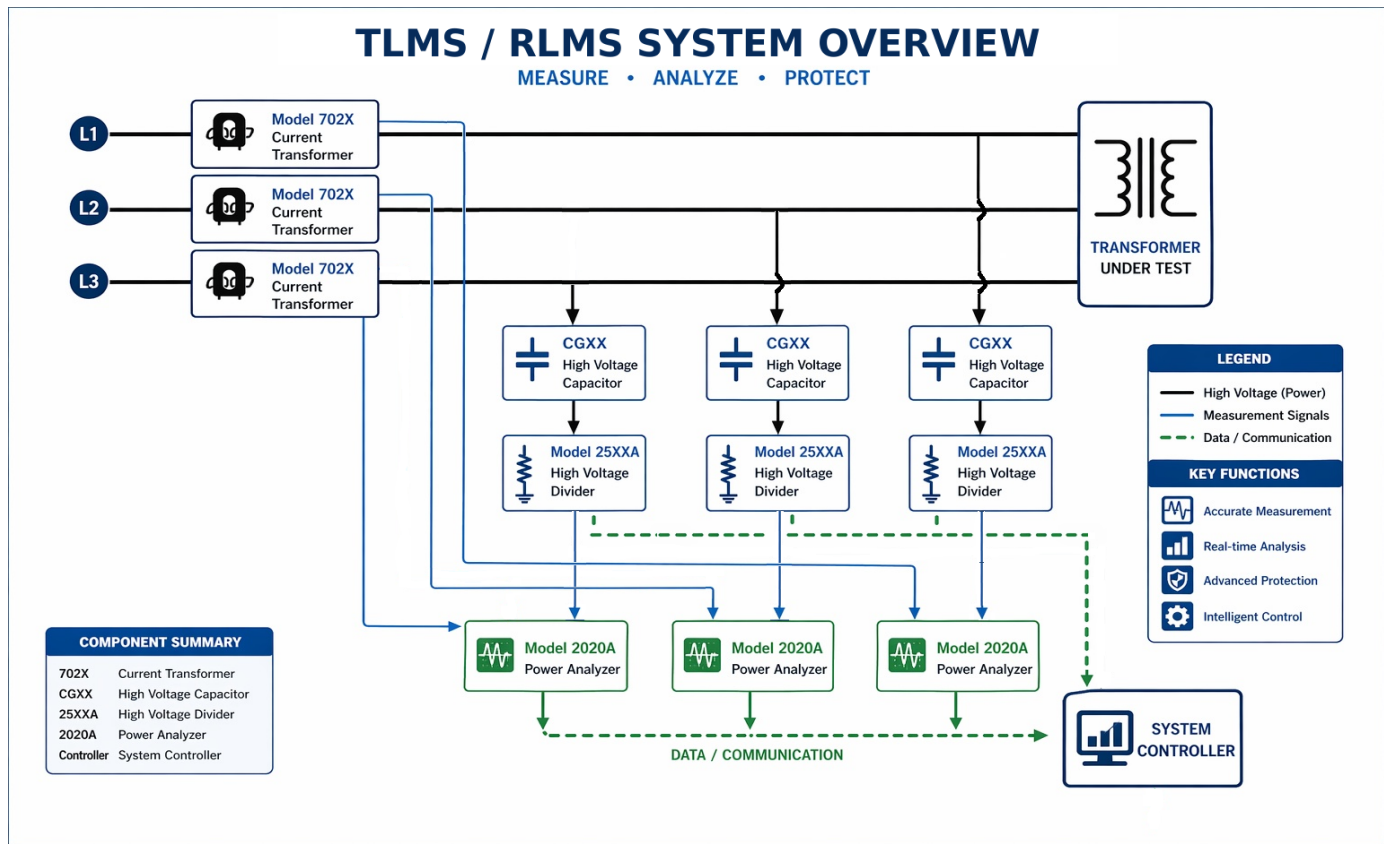
## Capabilities and Applications

### Accurate. Defensible. Compliant.

- Performance of Load and No-Load Loss Measurements
- Heat Run Test
- Induced Voltage Test
- Zero Sequence Impedance Measurements
- “Operator Friendly” software includes voltage and current waveform analysis, manual and fully automatic time-saving range selection, over-voltage, and over current protection.
- **Output Data:** Supplied in an ASCII file for easy import into Excel spreadsheets.
- **Electromagnetic Compatibility:** All components comply with the requirements of IEC Recommendations. In addition, the electronics is housed in one shielded enclosure.

The AccuLoss® System is designed to test small, medium, and large power transformers, up to 400 Hz and is ideal for R & D facilities. The AccuLoss® System also tests single and 3-phase reactors at power factors down to 0.001 and lower.

# Standard Configuration



## Power Factor Accuracy Performance

| Power Factor        | Range                                 | Accuracy |
|---------------------|---------------------------------------|----------|
| $\cos \phi = 1.000$ | $\geq 100 \text{ V} \geq 1 \text{ A}$ | 0.03 %   |
| $\cos \phi = 0.100$ | $\geq 100 \text{ V} \geq 1 \text{ A}$ | 0.04 %   |
| $\cos \phi = 0.050$ | $\geq 100 \text{ V} \geq 1 \text{ A}$ | 0.06 %   |
| $\cos \phi = 0.020$ | $\geq 100 \text{ V} \geq 1 \text{ A}$ | 0.13%    |
| $\cos \phi = 0.010$ | $\geq 100 \text{ V} \geq 1 \text{ A}$ | 0.27 %   |
| $\cos \phi = 0.005$ | $\geq 100 \text{ V} \geq 1 \text{ A}$ | 0.54 %   |
| $\cos \phi = 0.001$ | $\geq 100 \text{ V} \geq 1 \text{ A}$ | 2.74%    |

Accuracy specifications are calculated for an ambient temperature of 25 °C,  $\pm 10$  °C, and are of full scale. If the ambient temperature is less than or greater than 10 °C, contact Measurements International for an updated accuracy specification.

# Yokogawa Power Analyzer Configuration

For customers who do not require the highest accuracy level provided by MI's 2020A-based TLMS and RLMS systems, Measurements International offers an optional configuration using a single Yokogawa precision power analyzer/wattmeter.

This configuration provides a practical, lower-complexity measurement solution for transformer and reactor loss testing applications where standard production testing requirements are the primary focus and ultra-low uncertainty performance is not required. By replacing multiple MI 2020A Wattmeters with one Yokogawa

instrument, the system reduces hardware complexity while still supporting reliable and repeatable loss measurement.

The Yokogawa-based configuration is ideal for customers seeking a cost-effective and simplified system option, while the MI 2020A-based configuration remains the recommended choice for customers requiring the highest level of metrology-grade accuracy, low power factor performance, and reference-level measurement confidence.



## Measurement Configuration Comparison

Choose the right TLMS / RLMS architecture based on accuracy requirements and application needs.

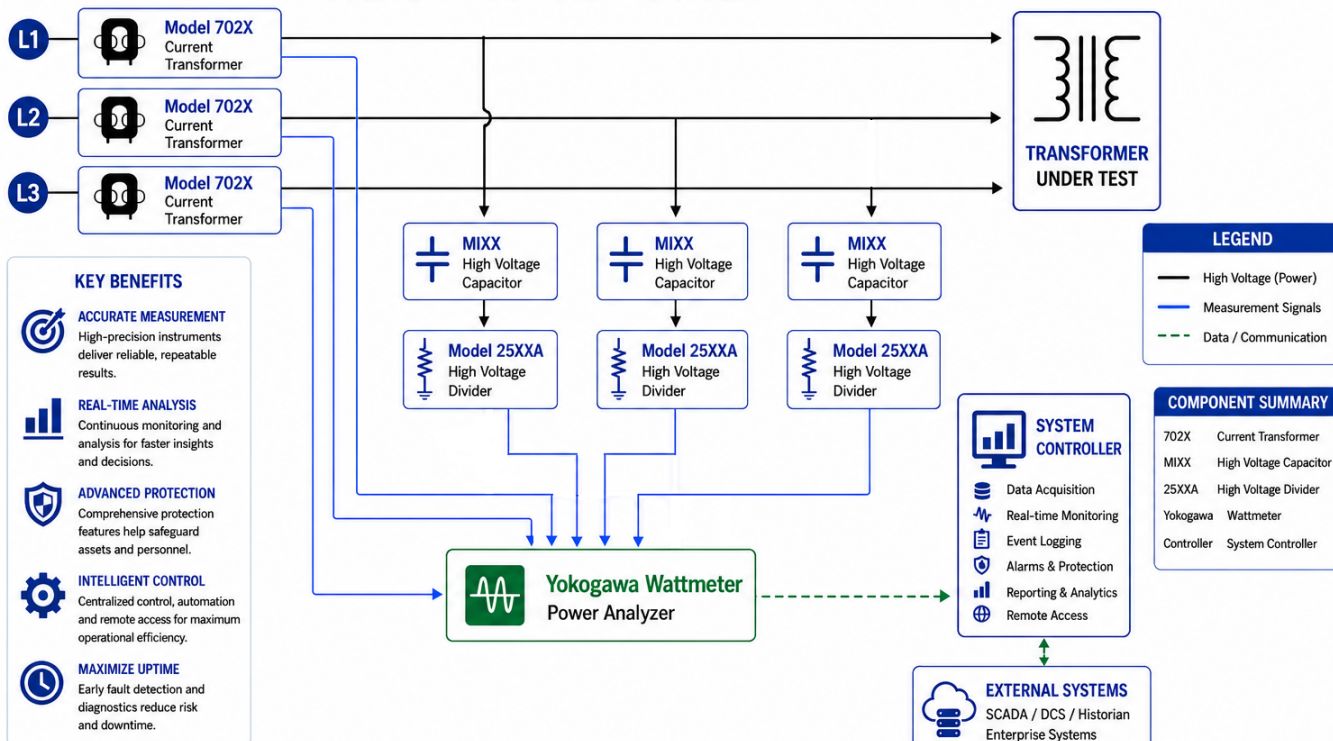
| Category             | MI 2020A-Based TLMS / RLMS System                                                                                   | Single Yokogawa Wattmeter Configuration                                                    |
|----------------------|---------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|
| Best Suited For      | Customers requiring the highest accuracy, low power factor performance, and metrology-grade measurement confidence. | Customers with standard production testing needs and less demanding accuracy requirements. |
| Accuracy Positioning | Premium reference-grade system performance.                                                                         | Practical solution when the full accuracy level of the MI 2020A system is not required.    |
| Power Measurement    | Uses multiple MI 2020A Power Analyzers as part of the measurement architecture.                                     | Uses a single Yokogawa precision wattmeter / power analyzer.                               |
| System Architecture  | High-performance configuration optimized for the most demanding measurement applications.                           | Simplified, lower-complexity configuration for routine loss measurement applications.      |
| Primary Advantage    | Maximum measurement confidence and premium low power factor performance.                                            | Reduced complexity and a more cost-effective solution.                                     |
| Recommended When     | The application demands the highest level of accuracy and metrology-grade confidence.                               | The application does not require the full accuracy level of the MI 2020A-based system.     |

MI 2020A-based systems remain the recommended choice for the highest-accuracy TLMS and RLMS applications.



# TLMS/RLMS SYSTEM OVERVIEW

MEASURE • ANALYZE • PROTECT



## Power Factor Accuracy Performance Yokogawa

| Power Factor        | Range                                  | Accuracy |
|---------------------|----------------------------------------|----------|
| $\cos \phi = 1.000$ | $\geq 100 \text{ V} \geq 10 \text{ A}$ | 0.06 %   |
| $\cos \phi = 0.100$ | $\geq 100 \text{ V} \geq 10 \text{ A}$ | 0.22 %   |
| $\cos \phi = 0.050$ | $\geq 100 \text{ V} \geq 10 \text{ A}$ | 0.42 %   |
| $\cos \phi = 0.020$ | $\geq 100 \text{ V} \geq 10 \text{ A}$ | 1.04%    |
| $\cos \phi = 0.010$ | $\geq 100 \text{ V} \geq 10 \text{ A}$ | 2.06 %   |
| $\cos \phi = 0.005$ | $\geq 100 \text{ V} \geq 10 \text{ A}$ | 4.11 %   |
| $\cos \phi = 0.001$ | $\geq 100 \text{ V} \geq 10 \text{ A}$ | 5.20%    |

Accuracy specifications are calculated for an ambient temperature of 25 °C,  $\pm 10$  °C, and are of full scale. If the ambient temperature is less than or greater than 10 °C, contact Measurements International for an updated accuracy specification.

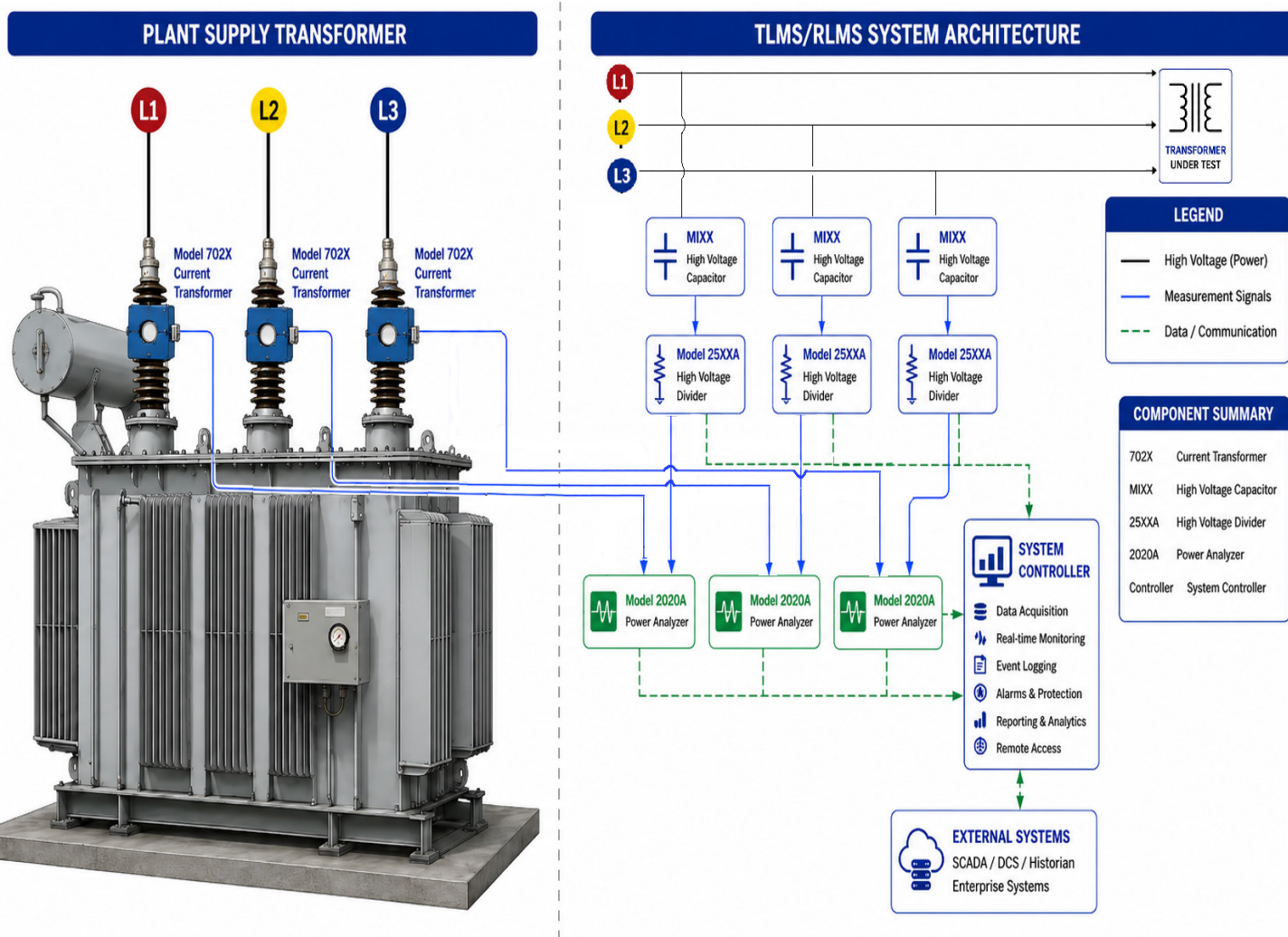
# Oil-Filled CT Configuration

For applications where a dedicated set of high-voltage bushings is not required or practical, Measurements International can supply the TLMS or RLMS with oil-filled current transformers mounted directly inside the plant supply transformer bushings.

This configuration allows the system to measure current from the existing supply transformer outputs, eliminating the need to provide separate high-current bushings as part of the loss measurement system. By integrating the CTs at the transformer bushing outputs, customers can

reduce system footprint, simplify the high-voltage layout, and lower the amount of additional high-voltage hardware required for the test facility.

The oil-filled CT option is well suited for installations where the plant supply transformer is already part of the test infrastructure and where a cleaner, more integrated current measurement solution is preferred. It maintains the TLMS/RLMS measurement architecture while offering a practical alternative to separate bushing assemblies.





# SF6 Free TLMS and RLMS Systems

## Supporting Future Regulatory Requirements

Governments and regulatory bodies around the world are placing increasing pressure on the use of SF<sub>6</sub> gas due to its extremely high global warming potential and long atmospheric lifetime. As regulations continue to move toward the reduction, restriction, or phase-out of SF<sub>6</sub> in electrical equipment, transformer and reactor manufacturers are looking for test systems that reduce future environmental and compliance risk.

Measurements International offers an **SF<sub>6</sub>-free options for AccuLoss® TLMS and RLMS systems**, providing transformer and reactor manufacturers with a cleaner, lower-maintenance alternative

to traditional gas-insulated high-voltage measurement systems.

By eliminating SF<sub>6</sub>, the system helps reduce environmental impact, simplify long-term ownership, and support customers working toward stricter ESG, sustainability, and regulatory requirements. The SF<sub>6</sub>-free design maintains the high accuracy, stability, and repeatability expected from MI's metrology-grade loss measurement systems, while reducing the operational burden associated with handling, monitoring, and maintaining SF<sub>6</sub> gas.

## Portable Systems

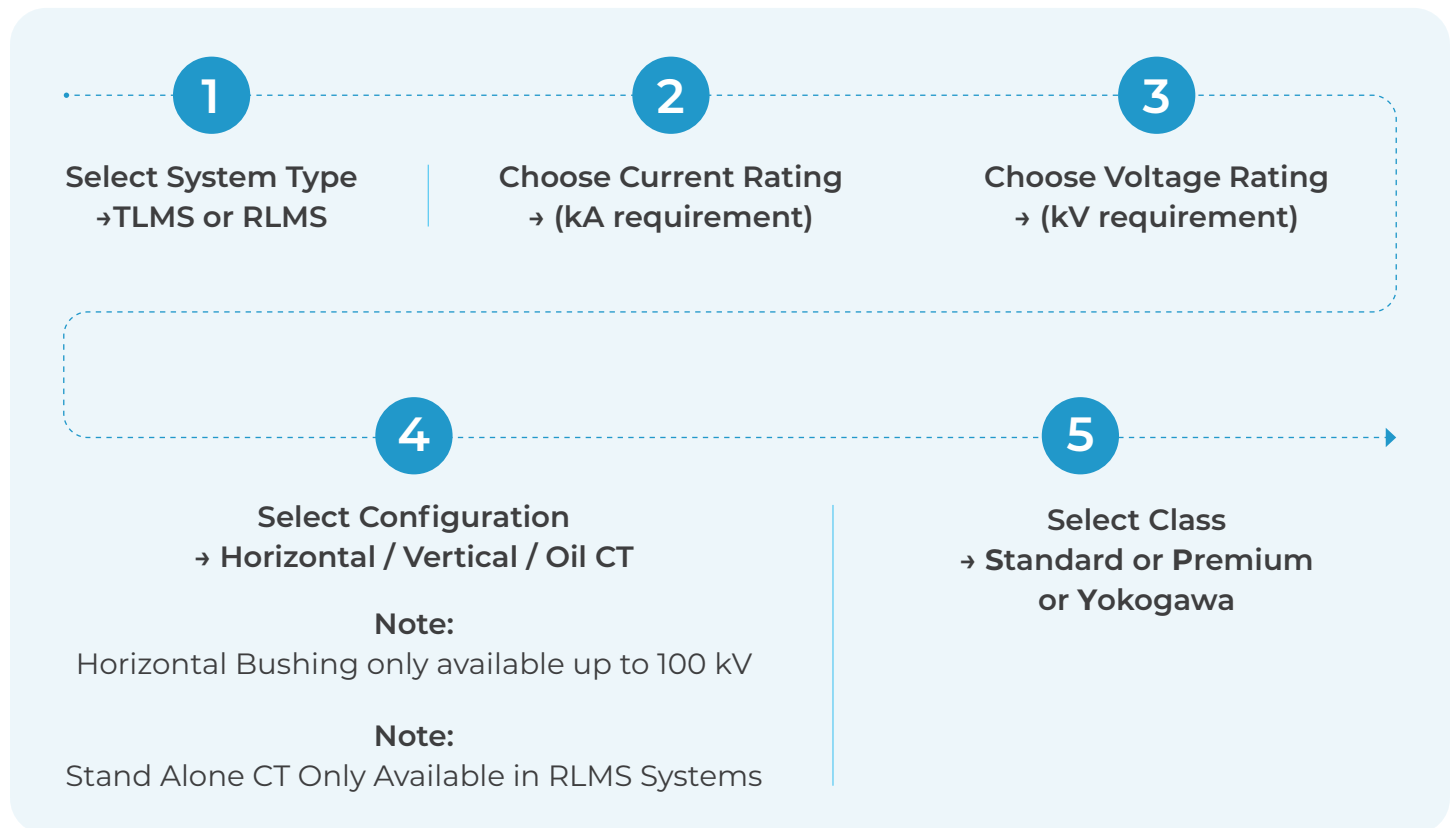
For customers requiring greater flexibility, Measurements International can offer the TLMS or RLMS as an optional portable measurement system. This configuration is designed for applications where the system may need to be moved between test bays, transformer lines, reactor test areas, or used for specialized factory and field measurement requirements.

The portable system maintains the same metrology-grade measurement performance as the fixed TLMS/RLMS configuration, while providing a more flexible setup for facilities that do not require a permanently installed system. Precision voltage, current, and power measurement components can be supplied in a transportable arrangement, allowing users to perform accurate transformer or reactor loss measurements where and when required.

This option is ideal for manufacturers, utilities, and laboratories looking to expand testing capability without committing to a dedicated permanent installation. It provides a practical solution for multi-location testing, temporary test setups, system upgrades, and production environments where test flexibility is important.



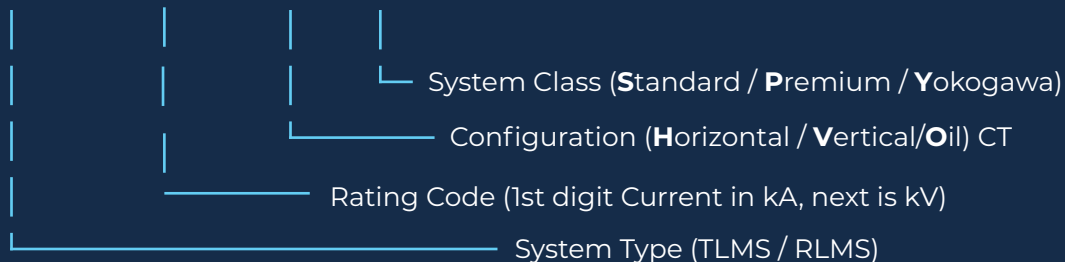
# Simple 5-Step Selection Process



## MODEL SELECTION GUIDE

AccuLoss® Transformer (TLMS) & Reactor Loss Measurement Systems (RLMS)

TLMS – 2100 – V – P



Example:

TLMS-2100-V-P → 2 kA, 100 kV, Vertical, Premium System

For Portable Systems and SF6 Free Systems please request at time of quotation

## Transformer Loss Measurement Systems (TLMS)

| Model Series | Maximum Current | Voltage Capability |
|--------------|-----------------|--------------------|
| 2100 – 2300  | Up to 2 kA      | Up to 300 kV       |
| 3100 – 3300  | Up to 3 kA      | Up to 300 kV       |
| 4100 – 4300  | Up to 4 kA      | Up to 300 kV       |

## Reactor Loss Measurement Systems (RLMS) with Stand Alone CT

| Model Series | Maximum Current | Voltage Capability |
|--------------|-----------------|--------------------|
| 2300 – 2800  | Up to 2 kA      | 300 – 800 kV       |
| 4300 – 4800  | Up to 4 kA      | 300 – 800 kV       |
| 6300 – 6800  | Up to 6 kA      | 300 – 800 kV       |

## Calibration and Support Options

Measurements International offers flexible calibration support for TLMS and RLMS systems. Complete Onsite system calibration can be performed using MI's 7010 Capacitance Bridge, providing a proven and traceable method to verify system performance.

For customers who require component-level calibration, MI also offers a loaner program to help eliminate system downtime. Individual components can be returned to MI one at a time for calibration while a loaner unit remains in service, allowing customers to continue operating their test system with minimal interruption.

# Specifications: Premium/Standard Systems

| HV Bushing Style                                            | Horizontal                                                              |           |           | Vertical                 |                 |                 |
|-------------------------------------------------------------|-------------------------------------------------------------------------|-----------|-----------|--------------------------|-----------------|-----------------|
| Voltage                                                     |                                                                         |           |           |                          |                 |                 |
| Applied Voltage<br>Line to Neutral                          | 100 V to 100 kV                                                         |           |           | 100 V to 100 kV          | 100 V to 200 kV | 100 V to 300 kV |
| Accuracy                                                    | ≤ 0.05 % of full scale                                                  |           |           |                          |                 |                 |
| Current                                                     |                                                                         |           |           |                          |                 |                 |
| Applied Current (A)                                         | 1 to 2000                                                               | 1 to 4000 | 1 to 6000 | 1 to 4000                | 1 to 6000       | 1 to 4000       |
| Input Current Ratio                                         | 2000:1                                                                  |           |           | 2000:1                   |                 |                 |
| Accuracy                                                    | ≤ 0.005 % of full scale                                                 |           |           |                          |                 |                 |
| Ranges, A<br>(Blue - Premium)                               | 10                                                                      | 10        | 10        | 10                       | 10              | 10              |
|                                                             | 20                                                                      | 20        | 20        | 20                       | 20              | 20              |
| Note: All CT's are pro-<br>tected against power<br>outages. | 40                                                                      | 40        | 40        | 40                       | 40              | 40              |
|                                                             | 100                                                                     | 100       | 100       | 100                      | 100             | 100             |
|                                                             | 200                                                                     | 200       | 200       | 200                      | 200             | 200             |
|                                                             | 400                                                                     | 400       | 400       | 400                      | 400             | 400             |
|                                                             | 1000                                                                    | 1000      | 1000      | 1000                     | 1000            | 1000            |
|                                                             | 2000                                                                    | 4000      | 6000      | 4000                     | 6000            | 4000            |
| Power                                                       |                                                                         |           |           |                          |                 |                 |
| Power Factor                                                | 1, 0.1, 0.05, 0.02, 0.01, 0.005, 0.002, 0.001                           |           |           |                          |                 |                 |
| Accuracy                                                    | ≤ 0.03% to ≤ 2.74 %                                                     |           |           |                          |                 |                 |
| Safety Clearances                                           |                                                                         |           |           |                          |                 |                 |
| To Adjacent Walls                                           | 1.3 m                                                                   |           |           | 2.6 m : 3.9 m for 300 kV |                 |                 |
| Between Phase                                               | 1.3 m                                                                   |           |           | 2.6 m : 3.9 m for 300 kV |                 |                 |
| Power Supply                                                |                                                                         |           |           |                          |                 |                 |
| Voltage                                                     | 100, 120, 220, 240 V ± 10 %                                             |           |           |                          |                 |                 |
| Frequency                                                   | 50/60 Hz                                                                |           |           |                          |                 |                 |
| Power                                                       | 1200 VA                                                                 |           |           |                          |                 |                 |
| Environmental Conditions                                    |                                                                         |           |           |                          |                 |                 |
| Operating Temperature                                       | Control Cabinet: 15 °C to 30 °C, Bushings and Capacitors: 0 °C to 40 °C |           |           |                          |                 |                 |
| Storage Temperature                                         | - 20 °C to 50 °C                                                        |           |           |                          |                 |                 |
| Relative Humidity                                           | 30 % to 90 % (non condensing)                                           |           |           |                          |                 |                 |

## Corporate Headquarters

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