

## MODEL AccuLoss® ALMS 1058, 2058 and 4058



### Loss Measurement System

- **Maximum voltage 100 kV Line to Line (58 kV line to ground)**
- **1000 A, 2000 A and 4000 A systems available**
- **Performance of Load and No Load Loss Measurements**
- **Heat Run Test**
- **Induced Voltage Test**
- **Zero Sequence Impedance Measurements**
- **Manual & Auto Ranging**
- **Automatic Calculation & Display of Power Measurements**

## MODEL INFORMATION

The measurement of electric power and energy at high voltages and currents at low power factors is becoming increasingly important economically as a way to reduce costs in an ever-growing industrial economy. Today the transformer purchaser subjects the transformer manufacturer to an economic penalty for losses that occur in load and no-load conditions. To keep these penalties as low as possible, it is important that the manufacturer accurately measure these losses. Failure to do so can result in the manufacturer losing important contract awards to their competitors who may be utilizing a more accurate system.

Using "State of the Art" proven two-stage-current comparator technology, the **AccuLoss®** Series of transformer loss measurement systems is designed to meet the needs of today's transformer manufacturer by providing the most accurate power loss measurement system in the world. Designed for power frequency testing and calibration, the **AccuLoss®** system can be used for testing small, medium and large power transformers as well as motors and turbines up to 400 Hz. The system is also ideal for R&D facilities and can also be used to measure losses in single and three phase reactors.

The **AccuLoss®** Series of transformer loss measurement systems has been accepted and installed by transformer manufacturers around the world and distinguished itself in the rugged transformer manufacturing environment. There are two types of bushings available for the AccuLoss® System, Vertical

for systems above 58 kV L-N and Horizontal for systems below 58 kV L-N.

The **AccuLoss®** system includes powerful "operator friendly" software. Included are voltage and current wave form analysis, manual and fully automatic time saving range selection and overvoltage and over current protection.

The **AccuLoss®** system controller can be directly connected to the plant LAN for transferring data to a host computer for backup and further processing including generating customer reports. As an option, AccuLoss® can be controlled remotely from a separate program running on another computer. This is very helpful in those situations when AccuLoss® has to be controlled automatically and from a different location.

The **AccuLoss®** system is a complete transformer loss measuring system and is in compliance with the latest standards and specifications dealing with the calibration of test systems to measure transformer losses.

### Capabilities

- Performance of Load and No Load Loss Measurements
- Heat Run Test
- Induced Voltage Test
- Zero Sequence Impedance Measurements
- Manual and Auto Ranging
- Automatic Calculation & Display of Power Measurements

## AccuLoss® Features

- Calibration Cycle for CT's and PT's:

In the voltage arm of AccuLoss® the Model 2500A Divider uses a two-stage compensated current comparator to correct for magnitude and phase errors within the divider. As a result, calibration does not drift from year to year. Recommended calibration for the dividers is every three to five years.

In the current arm of **AccuLoss®** the Model 7020H two-stage current transformer's accuracy is not affected by age. As a result, annual calibration is not necessary. Recommended calibration for the 7020H, the 7021U or 7022U current transformer is recommended every three to five years.

- Software: The **AccuLoss®** system utilizes globally recognized and accepted LabVIEW software running in a Windows environment. The software can be modified and adapted to fit specific measurement requirements at the time of order. Output Data is supplied in an ASCII file format ready to import into an Excel spreadsheet.
- Waveform Analysis: The **AccuLoss®** Systems features a built in waveform analyzer for extracting harmonics for each voltage and current channel. The waveforms are displayed on the measurement menu screen. The waveform on each channel can be printed.
- Range: Full Scale accuracy can be maintained over the full range of both voltage and current.
- Shielded Control Cabinet: The control cabinet houses the electronics and is shielded against outside interference and is protected against impulse surges through the input and ground connections.
- Automatic Test Procedure: Maximizes transformer throughput with increased accuracy and minimal operator involvement.
- Communication: IEEE 488 communication interface.

## Benefits

- Measuring Accuracy: Measuring accuracies are better than any system available on the market today with power measurements accuracies <0.13% at power factor of 0.05 and voltage and current measurements <0.05%. All accuracy specifications are stated as 2 sigma.
- ROI/Payback: High accuracy first time measurements maximize testing time and production throughput resulting in a shorter payback period, increased ROI and lower operating cost.
- Quality/Reliability: **AccuLoss®** system components are designed and tested to stringent quality control standards ensuring exceptional reliability and years of trouble free operation in the rugged transformer test environment.
- Operator Training: Operators can be fully trained in all aspects of the system in one to two days.
- Reduced Calibration Cost: Annual calibration of the AccuLoss® system voltage divider and current transformer components is not required reducing future calibration cost and downtime. Recommended calibration is three years.

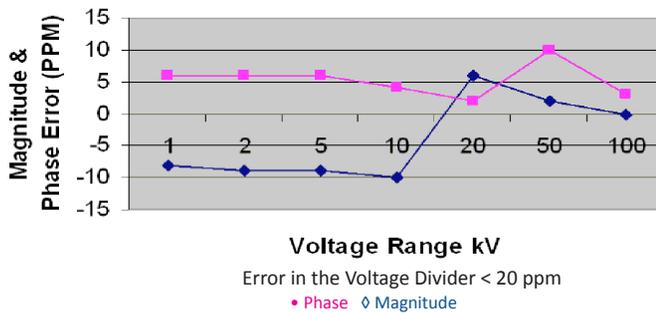
## System Measurements

**Voltage Arm:** A capacitive divider consisting of three (3) shielded gas-filled (SF6) high-voltage-standard capacitors and three Model 2500A Voltage Dividers are used for measuring the phase to ground voltage in each phase. The output of the high voltage standard capacitor is connected to the voltage input of the Instrument Rack and then directly into the voltage input of the Model 2500A Voltage Divider.

The output of the voltage divider is connected to the input of the wattmeter where the voltage divider output is displayed. System input voltage is displayed on the controller screen as RMS or AVG value.

For in house calibration, the dividers can be calibrated using the MIL Model 7010A or 7010B High Voltage Capacitance Bridge over the full range. See the voltage divider error graph below.

## Voltage Divider Error

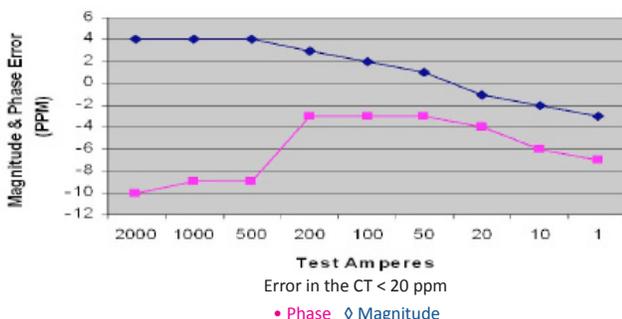


**Current:** A current divider consisting of three (3) Model 7020H precision two-stage-compensated-current-transformers are supplied as part of the current measurement system in each phase. The output and compensation windings of the 7020H is connected to the current input of the instrument rack and then directly to the current and compensation input in the Model 2010A Wattmeter.

In the ALMS 1058 (1000A) and ALMS 2058 (2000A) the Model 7020H precision Current Transformer has only one range of 1000:1. In the model ALMS 4058 (4000A) the range is 2000:1. The linearity of the two-stage-compensated current transformer is less than a few ppm, so measurements as low as one ampere (1A) can be made with ease. Subsequent current ranging is provided in the Wattmeter which has 10 current ranges in stages of 5, 2, 1, 0.5, 0.2, 0.1, 0.05, 0.02, 0.01 and 0.005A.

The Model 2010A wattmeter uses a multi tapped two-stage-compensated CT to perform the switching on its input to measure the current. The current value is displayed on the wattmeter and the control screen. The two-stage-compensated CT within the wattmeter reduces the error of the High Voltage Current

## Current Transformer Error



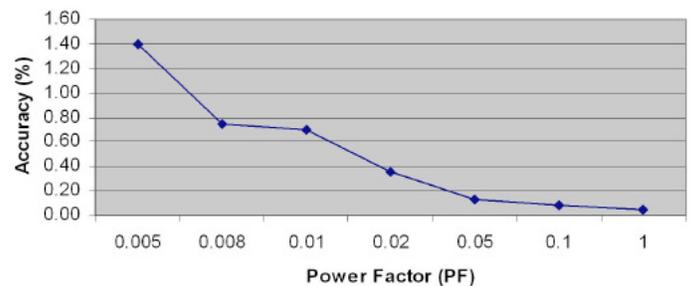
Transformer to a few ppm in magnitude and phase.

## Power Measurement

The Model 2010A Wattmeters display the power of all three phases at the input to the wattmeter. The sum of the three phases is calculated and displayed on the 17" controller screen. Automatic ranging of the Model 2500A High Voltage Dividers and the Model 2010A Wattmeter ensures that each component measures in the best range. The values are calculated and displayed with 5 digit numbers on the screen.

**Accuracy and Uncertainty:** The maximum power measurement accuracy and uncertainty of the AccuLoss® Series of loss measurement systems is shown below as a function of power factor. This accuracy can further be improved by asking for a National Measurement Institute (NMI) calibration of the components. An

## AccuLoss Power Measurement Accuracy



optional system calibration is also available.

## Software

The **AccuLoss®** Series of loss measurement systems utilizes the globally recognized LabVIEW interface from National Instruments. The software runs in a Windows operating environment and is fast, easy and intuitive. Large buttons on the Main screen are used to insure correct settings for the measurements. All measurement data is displayed on the Measurement screen as well as waveforms for the three voltage and three current channels. Measurement data is stored to an ASCII file which can be exported over the Ethernet to a main computer for analyzing and producing calibration reports.

The software can be modified to meet the specific needs of the User prior to shipment of the system. MI offers an 8 hour window for modifying the software to fit your

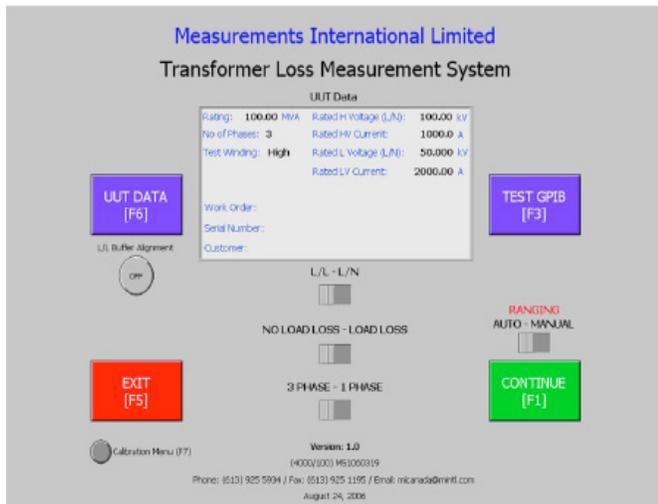


**Main Screen:** The Main screen provides easily recognized icons for entry into the UUT Data, Test GPIB and Calibration data entry screens. Test configuration selectors are also available.

The Main Menu screen is divided into four (4) sections:

1. UUT Data [F6]
2. Test Configurations [slide selectors]
3. Continue [F1] (move onto the Measurement screen)
4. Test GPIB [F3] (permits testing of the IEEE 488 communications interface between each of the individual components)
5. Calibrate Menu [F7]

Main Menu Screen



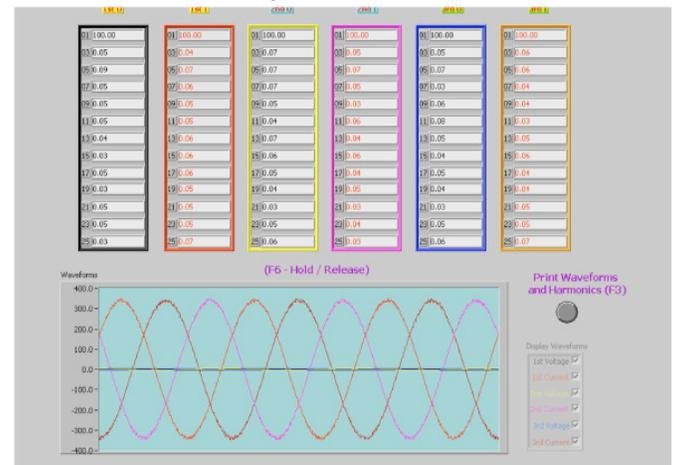
The **Measurement Screen** allows the Operator to quickly review the measurement data. Included on this screen is the Hold [F6] and Save button for saving the data to an ASCII file. The Hold and Save button toggle back and forth depending on which is selected. Each phase is distinguished by different colours making the screen data easier to view and monitor. Large green displays are used to display the combined power, voltage and current. The large screens can also be used to monitor the generator voltage adjustments.

Measurement Screen



Scrolling down to the bottom of the screen reveals the Waveform Analyzer showing the waveforms for both current and voltage on all three phases including even and odd harmonics up to the 25th harmonic. These waveforms can also be printed at the time of measurement.

Waveform Analyzer Screen



The Measurement Screen displays are updated every one second. The controller reads each wattmeter and displays the input voltage and current and calculates the real power, the apparent power and the power factor.

## Hardware

**Control Cabinet:** The control cabinet houses the electronics and is protected against impulse through the input and ground connections.





The Model 2500A Voltage Dividers, Model 2010A Wattmeter's, a Line-to-Line Buffer and Industrial Grade CPU Controller are housed in the cabinet. The three current transformer and three high voltage capacitor connections are made at the rear of the control cabinet. A printer, keyboard and monitor port is also available on the rear panel.

### Model 2500A High Voltage Divider

Voltage ranging of the **AccuLoss**® system is performed by the Model 2500A High Voltage Dividers. The divider has 7 ranges with an uncertainty of better than 20 PPM in both magnitude and phase. Accuracy is maintained through automatic compensation for magnitude and phase errors by the current comparator. Calibration Reports are supplied.



### High Voltage Standard SF6 Capacitors



Standard SF6 compressed gas capacitors. Calibration reports are supplied.

### Model 2010A TDM Wattmeter

Current ranging of the **AccuLoss**™ system is performed by the Model 2010A TDM Wattmeter with 10 current ranges. The wattmeter has an uncertainty of less than 50 PPM in both magnitude and phase. The 2010A displays watts, volts, and amps and communicates with the controller through its IEEE 488 port. Additional outputs, 2 volts full scale for current and voltage are inputted directly into the National Instruments Harmonic Analyzer A/D card. Accuracy for the 2 volt outputs for current and voltage is < 0.02%. Calibration reports are supplied.



### Model 7020H Two-Stage High Voltage Current Transformer and 7021/1000/2000 and 7021/4000 Bushing

The **AccuLoss**® current transformer is a proven 2-stage compensated design. The advantage of this design is that there are no electronics in the CT. Accuracy <20 PPM in both phase and magnitude. The 7020H slides onto the 7021 horizontal bushing. Calibration reports are supplied



**PC/Controller:** The **AccuLoss**® system is controlled and monitored by an industrial grade PC/Controller. The keyboard and monitor are external to the control rack where they can be easily placed near the generator control where the ALMS monitor can view for setting the generator voltage more accurately.

**Laser Printer:** As an option, a quality laser printer can be supplied with the system.

**Cable Leads:** Interconnection cables between the Current Transformers, the High Voltage Capacitors and the electronic rack are included. Systems have been installed with cable lead lengths up to 60 meters. The cables can be left long in case the ALMS system is moved to a new location.

### Related Products

#### Automated High Voltage Capacitance Bridge

The Model 7010C is a microprocessor controlled, metrology based, high voltage Capacitance Bridge. Its operation is fully automatic. A large vacuum florescent display presents relevant measuring quantities such as capacitance (Cx) and dissipation factor (Tan). Easy to use front panel keyboard menus allow the operator to select the number of readings for statistical analysis of uncertainty calculations at the 95% (2s) level. All measured parameters can be transmitted over the IEEE488 interface for storage to a computer. The capacitance bridge is used to calibrate the high voltage capacitors, high voltage dividers, low voltage capacitors and current transformers.



### Power Measurement Specifications

Power Measurement	Range	Accuracy (1σ)*
cos = 1.000	≥ 100V, ≥ 1 A	0.05%
cos = 0.100	≥ 100V, ≥ 1 A	0.08%
cos = 0.050	≥ 100V, ≥ 1 A	0.13%
cos = 0.020	≥ 100V, ≥ 1 A	0.35%
cos = 0.010	≥ 100V, ≥ 1 A	0.7%
cos = 0.008	≥ 100V, ≥ 1 A	0.8%

\* Accuracy specifications are calculated for an ambient temperature of 25°C, ±15°C. Accuracies can be improved by asking for NRC Calibration.



## Specifications

Model	ALMS 1058 & ALMS 2058	ALMS 4058
<b>Voltage<sup>(1)</sup></b>		
Applied Voltage	100V to 100kV Line to Line	100V to 100kV Line to Line
Accuracy	0.05%	0.05%
Ranges	1kV, 2kV, 5kV, 10kV, 20kV, 50kV, 100kV	1kV, 2kV, 5kV, 10kV, 20kV, 50kV, 100kV
<b>Current<sup>(2)</sup></b>		
Applied Current	1A to 2000A (1000:1 ratio)	1A to 4000A (2000:1 ratio)
Accuracy	0.05%	0.05%
Ranges ALMS 1058	10A, 20A, 40A, 100A, 200A, 400A, 1000A	10A, 20A, 40A, 100A, 200A, 400A, 1000A, 2000A, 4000A
Ranges ALMS 2058	10A, 20A, 40A, 100A, 200A, 400A, 1000A, 2000A	
<b>Safety Clearances</b>		
To Adjacent Walls	1 meter	2 meters
Between Phase	1 meter	2 meters
<b>Power Supply</b>		
Voltage	100, 120, 220, 240 ±10%	100, 120, 220, 240 ±10%
Frequency	50/60 Hz	50/60 Hz
Power	1200 VA	1200 VA
<b>Environmental Conditions</b>		
Operating Temperature	Control Cabinet: 15° to 30°C, Bushings and Capacitors: -10° to 40°C	
Storage Temperature	-20 to 50°C	
Relative Humidity	30 to 90% (non condensing)	
Statement of Standard Deviation	2 Sigma	

(1) 10 to 110% range utilization, includes uncertainty of calibration

(2) Current measurement has 50% over range capability, minimum current is 100 mA with 100 mA option

Ordering Information <sup>(1)</sup>		
AccuLoss® System		
Model Number	Description	HV Bushing Style
ALMS 1058	1000A / 100kV Line to Line	Horizontal
ALMS 2058	2000A / 100kV Line to Line	Horizontal
ALMS 4058	4000A / 100kV Line to Line	Horizontal
<i>(1) Please contact the factory for dimensions and weight.</i>		
AccuLoss® Components		
Model Number	Description	Units per System
2500A	High Voltage Divider	3
2010A	TDM Wattmeter	3
7020H	Two-Stage-Current Transformer	3
7021	Horizontal Bushing	3
GC Series	HV Standard Capacitor	3
971110	Line to Line Buffer	1
1404-A	Low Voltage Standard Capacitor	3

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