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## AccuLoss®

MODELS ALMS 2100, ALMS 4100, ALMS 4200, ALMS 6200 & ALMS 4300



## Loss Measurement Systems for voltages up to 300 kV and Currents to 6000A

- 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. The AccuLoss® series of loss measurement systems was specially developed for highly accurate power loss measurements in transformers.

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. 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 the power generator, which is not part of the loss measurement system, 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 for stray loss measurements and transformer excitation.
- Heat run tests to verify the temperature rise of the transformer oil and windings.
- Induced Voltage Test for checking the withstand voltage of the transformer
- Zero Sequence Impedance Measurements
- Manual and Auto Ranging
- Automatic Calculation & Display of Power Measurements



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## • Features

- **Current Comparator Technology:** The **AccuLoss®** system Model 2500A High Voltage Dividers use a current-comparator to automatically correct for any drifts or offsets in magnitude and phase. The Two-Stage-Current Transformer in the High Voltage Current Transformer is passive and its accuracy is not affected by age.
- **Software:** The **AccuLoss®** system utilizes globally recognized and accepted LabVIEW software running on Windows XP. Software can be modified and adapted to fit specific measurement requirements. 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 on each voltage and current channel which is displayed on the measurement menu screens. 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 with short throughput times and no manual intervention or transformer rewiring.

## • 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.

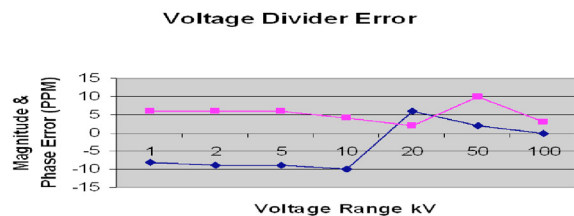
- **Operator Training:** Operators can be fully trained in all aspects of the system in one to two days by our highly qualified service personnel as part of the system installation and commissioning.
- **AccuLoss®** system voltage divider and current transformer components is not required reducing future calibration cost and downtime. Recommended calibration of these two devices is three to five years.

The **AccuLoss®** system comes complete with component calibration certificates and a system calibration certificate. The calibration certificate contains the results of all listed power factor measurements. A complete system calibration can be performed on site for the calibration of the voltage and current transformers. This can be easily done on-site by our qualified service personnel.

## System Measurements

**Voltage:** 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



Error in the Voltage Divider < 20 ppm  
 • Phase ◊ Magnitude

input of the wattmeter where the voltage (input/range) is displayed. System input voltage is displayed on the controller screen as RMS or AVG value.

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.

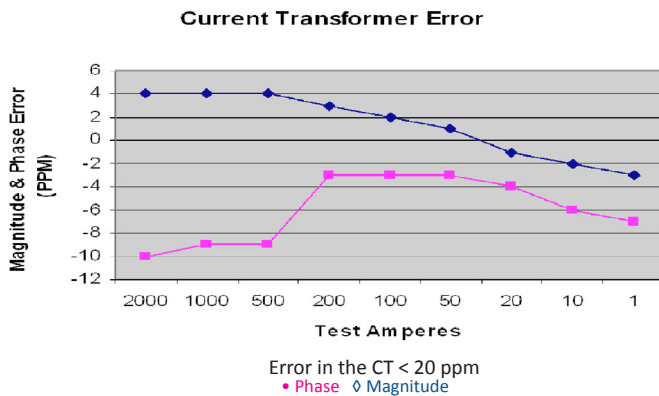


**Current:** A current divider consisting of three (3) Model 7021U (100kV or (200kV) precision two-stage-compensated-current transformers are supplied as part of the current measurement system in each phase. The output and compensation of the Model 7021U current transformer is connected to the current input of the Instrument Rack and then directly to the current and compensation input of the Model 2010A Wattmeter.

The Model 7021U and Model 7022 precision Current Transformer have only one range of 2000:1. The linearity of the current transformer is less than 10 ppm, so measurements as low as one ampere (1A) can be made with ease. Subsequent current ranging is provided on 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 two-stage current transformer's accuracy is not affected by age. As a result, annual calibration is not necessary. Calibration for the 7021U current transformers is recommended every three years.

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 Transformer to a < 20 ppm in magnitude and phase.

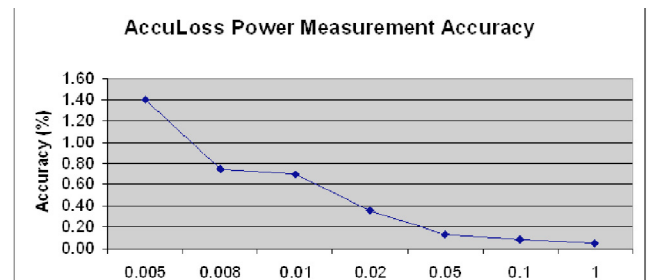


## Power Measurement

**Power:** 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 reducing the environmental temperature conditions of the high voltage capacitors. The accuracy of the system is stated over a range of +/- 15 °C.



## 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, Line-to-Line Buffer and Industrial Grade CPU Controller are housed in the cabinet.

All connections are made at the rear of the control cabinet. Channels include the three current channels and the three voltage channels. The inputs to the wattmeters are updated every one (1) 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.

**PC/Controller:** The AccuLoss® system is controlled and monitored by an industrial grade PC/Controller. The PC comes equipped with a Pentium D CPU with a 2.8GHz clock speed, 80GB hard disk, multiple expansion slots and USB ports and a DVD/CD-RW, IDE drive with read/write capability. The keyboard and monitor are external to the control rack where they can be easily placed near the generator control.

**Cable Leads:** Interconnection cables between the Current Transformer, High Voltage Capacitor and the electronic rack are included. Systems have been installed with cable lead lengths up to 50 meters.



Control Cabinet with Components

## Software

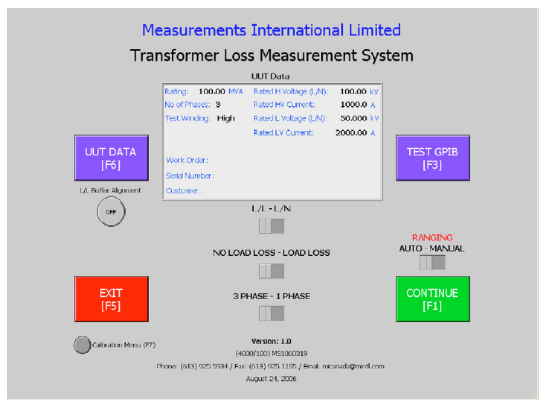
**Software:** Software for the AccuLoss® Series of loss measurement systems utilizes the globally recognized LabVIEW interface from National Instruments. The software runs in a Windows XP operating environment and is fast, easy and intuitive. Large buttons on the Main screen are used to insure correct settings for the measurements. All measurement data is displayed on the Measurement screen as well as waveforms for the voltage and 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.

Software can be modified to meet the specific needs of the User prior to shipment of the system.

**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:

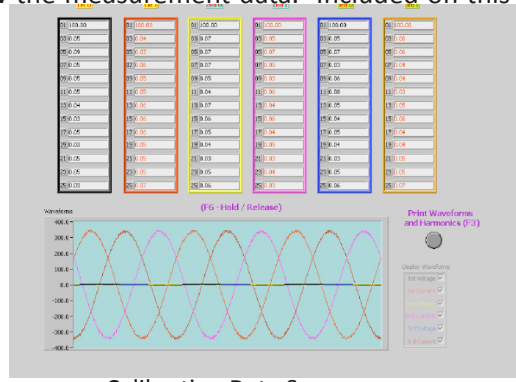
1. UUT Data [F6]



Main Manual Screen

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] (enter the Certification errors of each component)  
The Measurement screen allows the Operator to quickly review the measurement data. Included on this screen



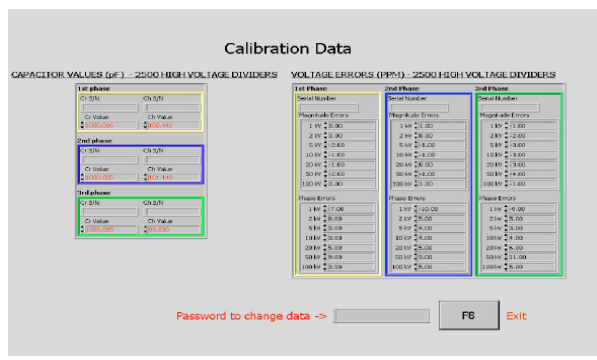
Calibration Data Screen

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.

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 the



odd and even harmonics up to the 25th harmonic. These waveforms can be printed.



Waveform Analyzer Screen



## Specifications

Model	ALMS 2100	ALMS 4200	ALMS 6200	ALMS 4300
<b>Voltage<sup>(1)</sup></b>				
Applied Voltage	100V to 100kV	200V to 200kV	200V to 150kV	300V to 300kV
Accuracy	0.05%	0.05%	0.05%	0.05%
Ranges (kV)	1, 2, 5, 10, 20, 50, 100	2, 4, 10, 20, 40, 100, 200	2, 4, 10, 20, 40, 100, 200	3, 6, 15, 30, 60, 150, 300
<b>Current<sup>(2)</sup></b>				
Applied Current	1A to 2000A	1A to 4000A	1A to 6000A	1A to 4000A
Accuracy	0.05%	0.05%	0.05%	0.05%
Ranges (A)	10, 20, 40, 100, 200, 400, 1000, 2000	10, 20, 40, 100, 200, 400, 1000, 2000, 4000	15, 30, 60, 150, 300, 600, 1500, 3000, 6000	10, 20, 40, 100, 200, 400, 1000, 2000, 4000
<b>Safety Clearances<sup>(3)</sup></b>				
To Adjacent Walls	1 meter	2 meters	2 meters	3 meters
Between Phase	1 meter	2 meters	2 meters	3 meters
<b>Power Supply</b>				
Voltage	100, 120, 220, 240 ±10%	100, 120, 220, 240 ±10%	100, 120, 220, 240 ±10%	100, 120, 220, 240 ±10%
Frequency	50/60 Hz	50/60 Hz	50/60 Hz	50/60 Hz
Power	1200 VA	1200 VA	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)			
Stated Uncertainty	2 Sigma			

(1) 10 to 110% range utilization, includes uncertainty of calibration, all voltages are line to ground

(2) Current measurement has 50% over range capability

(3) Minimum clearances

Power Measurement	Range	Accuracy <sup>(4)</sup>
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%

(4) Accuracy specifications for an ambient temperature of 23°C, ±15°C.

## 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, no external adjustments are required. 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 errors. The unit 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. Calibration reports are supplied. Accuracy for the 2 volt outputs for current and voltage is < 0.05%.

## Model 7021U or 7022 Two-Stage High Voltage Current Transformer

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.



Calibration reports are supplied

### Related Products

#### Automated High Voltage Capacitance Bridge

The Model 7010B 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 and



### Ordering Information<sup>(1)</sup>

AccuLoss™ System		
Model Number	Description	HV Bushing Style
ALMS 2100	1000A / 100kV Line to Line	Vertical
ALMS 4100	4000A / 100kV Line to Line	Vertical
ALMS 2200	2000A / 200kV Line to Line	Vertical
ALMS 4200	4000A / 200kV Line to Line	Vertical

(1) Please contact the factory for dimensions and weight.

AccuLoss™ Components		
Model Number	Description	Units per System
2500A	High Voltage Divider	3
2010A	TDM Wattmeter	3
7021U or 7022	Two-Stage Current Transformer	3
GC Series	HV Standard Capacitor	3
971110	Line to Line Buffer	1
1404-A	Low Voltage Standard Capacitor	3

Form MI 66, Rev. 8, Dated 2012-03-28 (QAP19, App. "N")

Data Subject to Change - Rev. A

### Corporate Headquarters

**Measurements International**  
 PO Box 2359, 118 Commerce Drive  
 Prescott, Ontario, Canada K0E 1T0  
 Phone: (613) 925-5934  
 Fax: (613) 925-1195  
 Email: sales@mintl.com  
 Toll Free: 1-800-324-4988

### Worldwide Offices

**MI-USA**  
 Phone: (407) 706-0328  
 Toll Free: 1-866-684-6393  
 Email: sales@mintl.com

**MI-China**  
 Phone: 86-10-64459890  
 Email: sales@mintl.com

**MI-Europe**  
 Phone: +(420) 731-440-663  
 Email: sales@mintl.com

**MI-Japan**  
 Phone: +(81) 72 39 64 660  
 Email: kaz@mijpn.com

**MI-India**  
 Phone: +(91) 98 10 134 932  
 Email: sales@MILLP.co.in



www.mintl.com