AccuLoss™

Loss Measurement System

Highest Accuracy Available
State of the Art Technology
Exceptional Reliability
Operator Friendly Software
Proven in Manufacturing Environments

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. The **AccuLoss™** system 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 at and above 58kV L-N and Horizontal for systems below 58kV L-N. In all cases the neutral is grounded.

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 overcurrent 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**
- **Heat Run Test**
- **Induced Voltage Test**
- **Zero Sequence Impedance Measurements**
- **Manual and Auto Ranging**
- **Automatic Calculation & Display of Power Measurements**

AccuLoss™

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 their 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.
- **Communication**: IEEE 488 communication interface.

Benefits

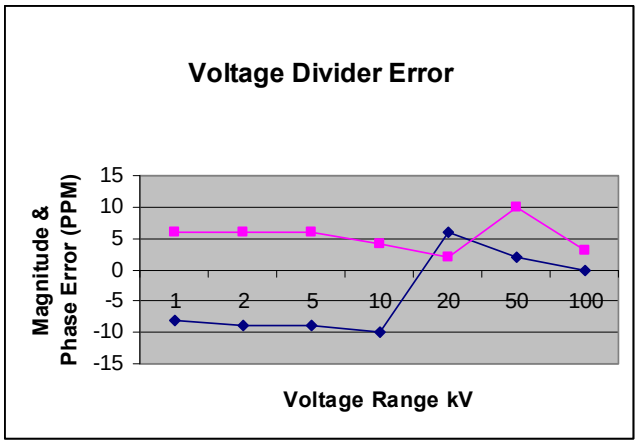
- **Measuring Accuracy**: Measuring accuracies are better than any system available on the market today with power measurements accuracies <0.13% at power factor of 0.05 and voltage and current measurements <0.05%. All accuracy specifications are stated as 2 sigma
- **ROI/Payback**: High accuracy first 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 by our highly qualified service personnel as part of the system installation and commissioning.
- **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 of these two devices is three years.

System Measurements

Voltage: A capacitive divider consisting of three (3) shielded gas-filled (SF_6) 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 (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 years.

For in house calibration, the dividers can be calibrated using the MIL Model 7010A or 7010B High Voltage Capacitance Bridge, two Low Voltage 1000 pF Standard Capacitors and two of the High Voltage Standard Capacitors. Both the High Voltage Standard Capacitors and Voltage Dividers can be calibrated over the full range.



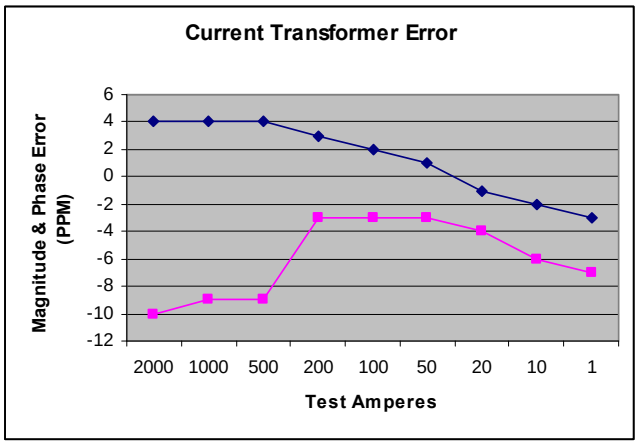
Error in the Voltage Divider < 20 ppm
▪ Phase ◊ Magnitude

Current: A current divider consisting of three (3) Model 7021U 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 precision Current Transformer has 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.



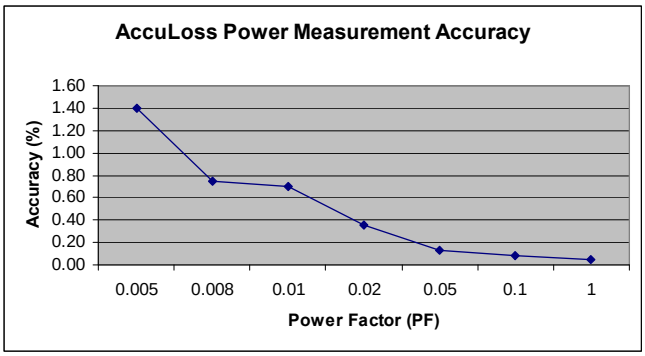
Error in the CT < 20 ppm
▪ Phase ◊ Magnitude

AccuLoss™

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 asking for a National Measurement Institute (NMI) calibration of the components. An optional system calibration is also available.



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.

Laser Printer: A quality laser printer is supplied with the system.

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.

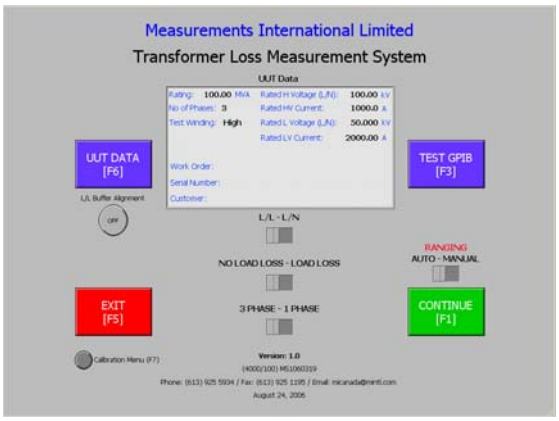
(Control Cabinet with Components)

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.

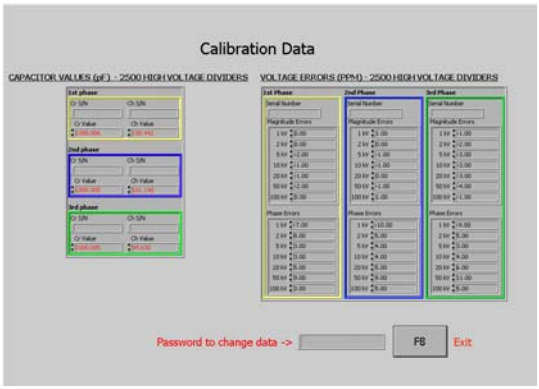
Main Screen: The Main screen provides easily recognized icons for entry into the UUT Data, Test GPIB and Calibration data entry screens. Test configuration selectors are also available.



(Main Menu Screen)

The Main Menu screen is divided into four (5) 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] (enter the Certification errors of each component)

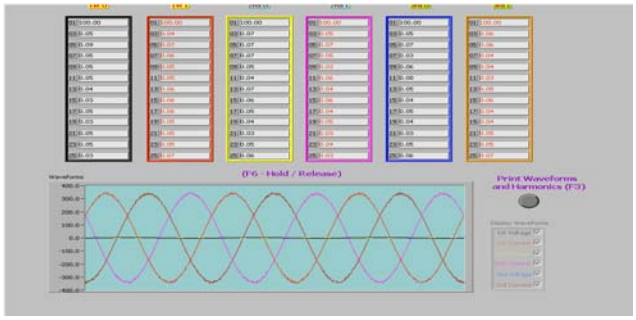


(Calibration Data Screen)

(Measurement 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.

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



(Waveform Analyzer Screen)

Typical Specifications

	ALMS2100	ALMS 4200
Voltage[1]		
Applied Voltage	100V to 100kV	200V to 200kV
Accuracy	0.05%	0.05 %
Ranges	1kV, 2kV, 5kV, 10kV, 20kV, 50kV, 100kV	2kV, 4kV, 10kV, 20kV, 40kV, 100kV, 200kv
Current[2]		
Applied Current	1A to 2000A	1A to 4000A
Accuracy	0.05%	0.05%
Ranges	10A, 20A, 40A, 100A, 200A, 400A, 1000A, 2000A	10A, 20A, 40A, 100A, 200A, 400A, 1000A, 2000A, 4000A
Safety Clearances		
To adjacent walls	1 meter	2 meters
Between phases	1 meter	2 meters
Power Supply		
Voltage	100, 120, 220, 240 ±10%	100, 120, 220, 240 ±10%
Frequency	50/60 Hz	50/60 Hz
Power	1200 VA	1200 VA
Environmental Conditions		
Operating temperature	Control Cabinet: 15° to 30°C Bushings and Capacitors: 10° to 38°C	
Storage Temperature	-20 to 50°C	
Relative Humidity	30 to 80% (non condensing)	
Statement of Standard Deviation	2 Sigma	2 Sigma

(1) 10 to 110% range utilization, includes uncertainty of calibration
(2) Current measurement has 50% over range capability

Power Measurement

Power Factor	Range	Accuracy (1ø)*
cos φ = 1.000	≥ 100V, ≥ 1 A	0.05%
cos φ = 0.100	≥ 100V, ≥ 1 A	0.08%
cos φ = 0.050	≥ 100V, ≥ 1 A	0.13%
cos φ = 0.020	≥ 100V, ≥ 1 A	0.35%
cos φ = 0.010	≥ 100V, ≥ 1 A	0.7%
cos φ = 0.008	≥ 100V, ≥ 1 A	0.75%

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

AccuLoss™ Components

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.

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.

High Voltage Standard SF_6 Capacitors

Standard SF_6 compressed gas capacitors.
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 (Tanδ). 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 single phase reactors.

Winding Resistance Measurement System

The Automated Winding Resistance and Ratio Measurement System, Model AWRMS features capabilities for testing winding resistance in one set-up and performs measurement in accordance to IEEE and international standards. This measurement system provides the best accuracy and convenience based on the most recent developments in power switching technology.

AccuLoss™

Ordering Information (1)

AccuLoss™ System

Model Number	Description	HV Bushing Style
ALMS 2100	2000A / 100kV Line to ground	Vertical
ALMS 4100	4000A / 100kV Line to ground	Vertical
ALMS 2200	2000A / 200kV Line to ground	Vertical
ALMS 4200	4000A / 200kV Line to ground	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
CG Series	HV Standard Capacitor	3
971110	Line to Line Buffer	1
1404-A	Low Voltage Standard Capacitor	3

MI-Canada
Measurements International Ltd.
PO Box 2359, 118 Commerce Drive
Prescott, Ontario, Canada K0E 1T0

Phone: (613) 925-5934

Toll-Free: 1-800-324-4988
Fax: (613) 925-1195
Email: sales@mintl.com

MI-USA
Measurements International Inc.
812 Proctor Ave.
Ogdensburg, NY, USA 13669

Phone: (315) 393-1323

Toll Free: 1-800-324-4988
Fax: (315) 393-1452
Email: sales@mintl.com

MI-Europe
Druzstevni 845
686 05 Uherske Hradiste
Czech Republic

Phone: (420) 572 572 801
Fax: (420) 572 572 358
Email: mieurope@mintl.com

www.mintl.com