Model 2500A Series of AccuLoss® Precision AC Dividers

High Voltage Divider

- 120 to 960 kV
- Outputs of 120 VAC
- Primary Standard HV Measurements
- Loss Measurement Systems
- IEEE488 Interface
- Division Accuracy < 20 ppm
- Calibration Period 3 to 5 years

Model AccuLoss® 2500A Series

The model 2500A, 2501A, 2502A and 2503A complete the low voltage arm of a high voltage capacitive divider. Based on the compensated-current-comparator it provides ultra-precise ratio division of high AC voltages down to measureable levels. The output of the divider can be read by an AC/DC transfer device for precision measurements of the input voltage or by a precision power analyzer such as the MI model 2020A for direct measurements of transformer or reactor losses under control of the IEEE488 interface.

Model 2500A: The input current to the model 2500A is supplied by applying a high voltage to a low-loss high-voltage capacitor (100 pF for 120 kV, 50 pF for 240 kV) on its input. Several gain stages of 1, 2, 5, 10, 20, 50 and 100 are built in to allow flexibility for various input voltages. On gain 1 the full scale input is 100 kV while gain 100 offers a full scale input of 1,200 volts. The full scale output is 120 volts for 120 kV in with 10% overrange.

To apply 240 kV to the same divider a 50 pF standard capacitor is used on the input. On gain 1 the full scale input is 240 kV while gain 100 offers a full scale input of 2400 volts. The full scale output is 120 volts for 200 kV in with 10% overrange.

Model 2501A: The model 2501A will accept inputs up to 2400 VAC using a 1000 pF standard capacitor on its input. On gain 1 the full scale input is 2400 V while range 120 offers a full scale input of 120 volts. The full scale output for each range is 120 volts.

Model 2502A: The model 2502A will accept inputs up to 480 kV when a 100 pF, 500 kV standard capacitor is used and 960 kV when a 50 pF standard capacitor is used on the input. Several gain stages of 1, 2, 5, 10, 20, 50 and 100 are built in to allow flexibility for various input voltages. On gain 1 the full scale input is 480 kV while gain 100 offers a full scale input of 4,800 volts. The full scale output is 120 volts for all ranges. For an input capacitor of 50 pF the full scale input is 960 kV. On gain 1 the full scale input is 960 kV while gain 100 offers a full scale input of 9.6 kV.

Model 2503A: The model 2503A will accept inputs up to 300 kV when a 100 pF, 300 kV standard capacitor is used and 600 kV when a 50 pF standard capacitor is used on the input. Several gain stages of 1, 2, 5, 10, 20, 50 and 100 are built in to allow flexibility for various input voltages. On gain 1 the full scale input is 360 kV while gain 100 offers a full scale input of 3.0 kV with 10% over range. For an input capacitor of 50 pF the full scale input is 600 kV. On gain 1 the full scale input is 600 kV while gain 100 offers a full scale input of 6.0 kV. The full scale output is 100 volts for all ranges.

A 1,000 pF low-loss stand capacitor is supplied with each unit as the reference capacitor. An optional high voltage capacitor ranging from 1,000 pF, 2 kV to 800 kV can be ordered to be used on the input of the divider.

Operating Principle A simplified schematic of the current comparator based voltage divider is shown in Figure 1. The current in the low-loss high-voltage capacitor (C_H) is compared, using the current comparator, with the current obtained by applying the output voltage V_L to a stable low-loss standard capacitor (C_L).

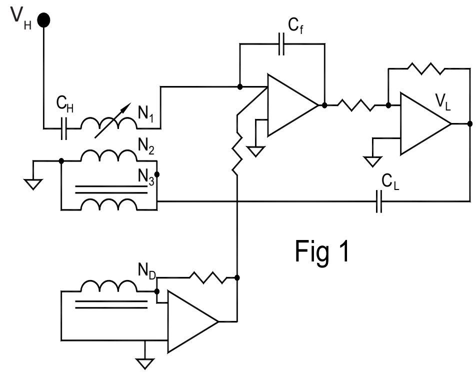

Fig 1

Due to the magnitude and phase errors of E_L, the current comparator will not be in ampere-turn-balance. The difference current derived from the output of the detection winding N_D is added through the feedback circuit to the current in the solid dielectric capacitor C_f resulting in a highly accurate and self-balancing voltage at V_L. Thus the feedback circuit is used to provide an ampere-turn balance in the current comparator to correct the magnitude and phase errors of the output voltage V_L.

The output voltage V_L of the current comparator based divider is given by:

$$V_L = \frac{C}{C_L * (N_2 / N_1)} * E_H$$

From the above equation, the capacitance ratio of C_H and C_L and the current comparator-winding ratio determine the divider output. Several gain stages are provided to ensure that the output voltage is always operated at near or full scale. To change the gain on the high voltage divider, a decrease in the current-comparator-winding ratio (N_2/N_1) is required to maintain ampere-turn balance. Relays, which are used to change the electronic gain and winding ratio are driven simultaneously to keep the winding ratio times the gain constant. The gain of the divider is set, as 1, 2, 5, 10, 20, 50, 100 where 1 corresponds to a voltage at V_H of 100 kV, 200 kV on the 2500A, 500 kV or 1000 kV on the 2502A and 300 kV or 600 Kv on the 2503A. Gain 100 would represent an input voltage at V_H of 1 kV, 2 kV, 5 kV and 10 kV respectively. The uncertainty of the high voltage divider is equal to the uncertainty associated with the two stage current transformer and the uncertainty of C_H and C_L. On the 2503A Gain 100 would represent an input voltage at V_H of 3 kV and 6 kV.

Low Loss Capacitor and Feedback Capacitor

For the divider to have a zero temperature coefficient and loss-less high voltage capacitor C_H the stability and accuracy of the divider are determined by the stability and accuracy of the divider are determined by the stability and accuracy of the low-loss standard capacitor and the gain of the feedback circuit. Capacitor C_L is a 1,000 pF low-loss standard capacitor with dissipation and magnitude errors and a temperature coefficient of a few PPM. The capacitance values of C_L and C_f have been chosen to provide a nominal output voltage of 100 volts for all units.

Current Comparator

The current comparator used in the high voltage divider is a two-stage-compensated current comparator. The ratio turns consists of N_1, which is variable, and N_2 equal turns. The compensation winding N_3 is connected in parallel with N_2, which has the same number of turns to reduce its leakage impedance. The detection winding N_D is connected to a current-to-voltage converter to obtain a voltage proportional to, and in phase with, the unbalanced ampere turns in the current comparator.

Feedback Circuit

The gain of the feedback circuit, approximately 100, is sufficient for the feedback circuit to correct for the dissipation factor and capacitance variation of the solid dielectric feedback capacitor (C_f). The feedback circuit is set to 100%.

All models are front panel and IEEE488 controllable. The two LCD displays monitor the internal test voltages and output of the divider. The divider is housed in a rack mounted enclosure and is fully protected against transients. All connections are made to the rear of the instrument.

Loop Gain Check

The high voltage divider has two conditions that it can be operated in, Open Loop and Closed Loop. To verify the loop gain and that the current comparator feedback is functioning properly an error can be introduced using the Gain Trim potentiometer. The Gain Trim potentiometer along with a Null Indicator is located on the front panel of the divider. In open loop condition, the gain trim potentiometer can be adjusted to minimize the error as indicated on the null indicator. For example, a 500 ppm error introduced in the Open Loop Mode should be reduced to 5 ppm when the loop is closed. In operation, the divider is always operated in closed loop.

Applications

1. Reactor Loss Measurement Systems
2. Transformer Loss Measurement Systems
3. AC High Voltage Measurement Systems
4. Power Calibration Systems

How to Order

Model: 2500A - High Voltage Divider	Model CG100 - 100(100 pF, 100 kV)
Model: 2500A - High Voltage Divider	Model CG200 - 50 (50 pF, 200 kV)
Model: 2501A - High Voltage Divider	Model CS2 - 1000(1000 pF, 2 kV)
Model: 2502A - High Voltage Divider	Model CG600 - 100 (100 pF, 600 kV)
Model: 2502A - High Voltage Divider	Model CG800 - 50 (50 pF, 800 kV)
Model: 2503A - High Voltage Divider	Model CG300 - 50 (50 pF, 300 kV)

Other values are available for shipping weight of HV capacitors contact factory

Specifications: Rev 5

2500A

Input Capacitor 100 pF	Input Voltage: 120, 60, 24, 12, 6, 2.4, 1.2 kV	
	Output Voltage: 120 Volts	
Input Capacitor 50 pF	Input Voltage: 240, 120, 48, 24, 12, 4.8, 2.4 kV	
	Output Voltage: 120 Volts	

2501A

Input Capacitor 1000 pF	Input Voltage: 2400, 1200, 600, 480, 360, 240, 120 V
	Output Voltage: 120 Volts

2502A

Input Capacitor 50 pF	Input Voltage: 480,240, 96, 48, 19.2, 9.6, 4.8 kV
	Output Voltage: 120 Volts
Input Capacitor 50 pF	Input Voltage: 960, 480, 192, 96, 38.4, 19.2, 9.6 kV
	Output Voltage: 120 Volts

2503A

Input Capacitor 50 pF	Input Voltage: 300, 150, 60, 30, 15, 6, 3 kV
	Output Voltage: 100 Volts

*Note: The input capacitor must be able to withstand the maximum applied voltage.

Other input and output voltages are available, consult factory

General

Maximum Primary Output Voltage	120 VAC RMS with 10% Over Range
Division Ratio Uncertainty	Magnitude <20 ppm Quadrature <20 ppm
Frequency Range of Measured Values	40 Hz to 400 Hz
Gain Selection	7 Gain Setting of 1, 2, 5, 10, 20, 50, 100
Warm Up Time	<5 Minutes to Full Rated Accuracy
Operating Environment	10 to 34°C, 10 to 18% RH
Warranty	1 Year Parts & Labor

Dimensions (W x D x H):
221mm x 482mm x 584mm

Weight:
18 kg

Shipping Weight:
22 kg

Operating Power:
100/120/220/240V - 50/60Hz

Corporate Headquarters

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