

AVTM 672001  
Rev. B  
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Instruction Manual  
for  
**DELTA-2000**  
**10-kV Automated Insulation Test Set**  
Catalog No. 672001

High-Voltage Equipment  
Read the entire manual before operating.

Aparato de Alto Voltaje  
Antes de operar este producto lea este manual enteramente.

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**DELTA-2000**  
**10-kV Automated Insulation Test Set**  
Instruction Manual

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Specifications are subject to change without notice.



## Table of Contents

Section	Page
1	Introduction..... 1
	Receiving Instructions..... 1
	General Information..... 1
2	Safety ..... 3
	Precautions ..... 3
	Warning and Caution Notices ..... 5
3	Specifications..... 6
	Electrical ..... 6
	Environmental..... 8
	Physical Data ..... 9
	Safety Features..... 10
	Accessories Supplied ..... 10
	Optional Accessories..... 11
4	Controls, Indicators, and Connectors ..... 12
	Control Unit Front Panel..... 12
	Control Unit Connector Panels ..... 15
	High-Voltage Unit Connector Panel..... 17
5	Setup and Operation..... 18
	Safety Precautions..... 18
	Setup..... 18
	Description of Main Menu and Test Screens ..... 22
	Ac Insulation Test Procedure..... 33
	Transformer Excitation Current Test Procedure..... 36
6	Maintenance and Calibration ..... 40
	Maintenance..... 40
	Calibration..... 40
	Troubleshooting..... 48
	Repair ..... 49
7	Spare Parts List ..... 50
	Glossary ..... 51
	Warranty ..... 53
Appendix A	Data-Key Data Downloader Program
Appendix B	Applications Guide
Appendix C	Test Data Forms
Appendix D	Temperature Correction Tables

## List of Illustrations

Figure		Page
1	Control Panel.....	13
2	Connector Panel, Control Unit (Right).....	16
3	Connector Panel, Control Unit (Left).....	16
4	Connector Panel, Control Unit (Front).....	17
5	Connector Panel, High-Voltage Unit.....	17
6	Typical Test Setup for Ac Insulation Testing of a Three-Phase Power Transformer ..	19
7	Typical Test Setup for Transformer Excitation Current Measurements.....	20
8	Printer Dip Switch Settings .....	21
9	Opening Display Screen .....	22
10	Self-Diagnostic Results Screen.....	23
11	First Test Screen .....	23
12	First Menu Screen .....	25
13	Second Menu Screen .....	26
14	Recall Readings Submenu .....	28
15	Second Test Screen .....	29
16	Third Test Screen .....	30
17	Typical Test Results Screen .....	31
18	“New Test” Test Screen .....	32
19	First Test Screen if Resonating Inductor Is Connected .....	32
20	Second Test Screen if Resonating Inductor Is Connected.....	33
21	Sample Printout (Header and Test Results) Ac Insulation Test Measurement .....	35
22	Test Results, Transformer Excitation Test .....	38
23	Sample Printout of Excitation Current Measurement.....	39

## List of Tables

Table		
1	Maximum Measurable Specimen Capacitance at 50/60 Hz.....	8
2	Definition of Status Blocks on Test Screens.....	24
3	Analog PCB Calibration Checks .....	42
4	Relay and Range/Mode PCB Calibration Checks.....	44
5	Function of Relays and CMOS Switches.....	47

## **Section 1 Introduction**

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### **Receiving Instructions**

Check the equipment received against the packing list to ensure that all materials are present. Notify AVO International of any shortage. Telephone (610) 676-8500 and ask for the Customer Service Department.

Examine the instrument for damage received in transit. If damage is discovered, file a claim with the carrier at once and notify AVO International, giving a detailed description of the damage.

This instrument has been thoroughly tested and inspected to meet rigid specifications before being shipped. It is ready for use when set up as indicated in this manual.

### **General Information**

The DELTA-2000 is used for shop and field testing of high-voltage electrical insulating systems at test voltages up to 12 kV. Test results can be used to evaluate the nature and quality of electrical insulating materials and manufacturing processes to reveal contamination, fractures, punctures, and other defects that accompany the aging of insulation. The test set comprises a control unit, a high-voltage unit, cables, and a canvas carrying bag. Refer to the Specifications section for a list of included accessories.

Tests are made by measuring the capacitance, power factor (dissipation factor) and dielectric losses of a specimen. The values measured will change when undesirable conditions exist, such as moisture on or in the insulation; shorts or opens in windings or insulation; the presence of conductive contaminants in insulating oil, gas or solids; and the presence of internal partial discharges.

The test set measures the capacitance, power factor (dissipation factor) and dielectric losses of electrical insulation on high-voltage power equipment such as cables, bushings, insulators, circuit breakers, transformers, rotating machines, capacitors, and surge (lightning) arresters.

The test set measures changes of capacitance and dielectric loss due to variations of voltage level and ambient conditions, for example, changes in temperature, humidity, pressure, mechanical shock, vibration, and stress. Dielectric constant and transformer excitation current can also be measured. The test set makes all standard UST and GST tests on high-voltage apparatus; seven front-panel test mode switches set up test configuration.

- Ungrounded specimen test (UST), three positions
- Grounded specimen test (GST), one position
- Grounded specimen test using guard connection (GST), three positions

Features include:

- Automatic balance control by high-performance microprocessor.
- User-friendly operation.
- Automatic self-checking of test set calibration and operation.
- Large, easy-to-read LCD shows alphanumeric and graphic data.
- Front-panel MENU switches select operating mode.
- Dual low-voltage input cables simplify measurements on multi-winding transformers and circuit breakers containing inboard and outboard bushings.
- Automatic interference suppression circuit ensures trouble-free operation in switchyards (up to 765 kV) under electrostatic and magnetic interference conditions. The interference suppressor circuit is turned on and off using MENU switches. When the interference suppressor circuit is turned on, the level of interference is shown on the display.
- Direct reading of the following quantities:
  - Voltage
  - Capacitance
  - Current at 2.5 kV or 10 kV
  - Percent power factor
  - Percent dissipation factor
  - Watts at 2.5 kV or 10 kV
- External printer records test data.
- External personal computer (PC) or laptop can be connected instead of a printer to transfer test results.
- Data key stores 127 tests for retrieval and analysis. Stored data can be transferred to a PC.
- Optional bar code wand records equipment identification and temperature.
- Two safety interlocks (hand switch or foot switch).
- Built-in interface to the optional Resonating Inductor provides extended range of capacitive measurements.
- Two-piece design makes the test set easy to transport.
- Meets the requirements of both the European EMC and Low Voltage Directives.



## Section 2 Safety

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### Precautions

The test set and the specimen to which it is connected are a possible source of high-voltage electrical energy and all persons making or assisting in tests must use all practical safety precautions to prevent contact with energized parts of the test equipment and related circuits. Persons actually engaged in the test must stand clear of all parts of the complete high-voltage circuit, including all connections, unless the test set is de-energized and all parts of the test circuit are grounded. Persons not directly involved with the work must be kept away from test activities by suitable barriers, barricades, or warnings. An interlock circuit is provided on the control unit of the test set to enable the operator to enclose all parts of the complete high-voltage circuit within a secure area. The interlock circuit should be used to shut off input power automatically upon unauthorized entry into the high-voltage area or for any other safety reasons.

Treat all terminals of high-voltage power equipment as a potential electric shock hazard. There is always the potential of voltages being induced at these terminals because of proximity to energized high-voltage lines or equipment. Always use a safety ground stick to ground the high-voltage conductor. A safety ground jumper must then be installed between all terminals of apparatus under test and ground. Always disconnect test leads from power equipment before attempting to disconnect them at the test set. The ground connection must be the first made and the last removed. Any interruption of the grounding connection can create an electric shock hazard.

This instrument operates from a single-phase power source. It has a three-wire power cord and requires a two-pole, three-terminal, live, neutral, and ground type connector. The voltage to ground from the live and neutral poles of the power source must be within the following rated operating voltage:

For Cat. No. 672001	120 V $\pm$ 10%, 60 $\pm$ 2 Hz
For Cat. No. 672001-44	120 V $\pm$ 10%, 50 $\pm$ 2 Hz
For Cat. No. 672001-45	230 V $\pm$ 10%, 60 $\pm$ 2 Hz
For Cat. No. 672001-47	230 V $\pm$ 10%, 50 $\pm$ 2 Hz

Before making connection to the power source, determine that the instrument rating matches the voltage of the power source and has a suitable two-pole, three-terminal grounding connector.

The power input plug must be inserted only into a mating receptacle with a ground contact. Do not bypass the grounding connection. Any interruption of the grounding connection can create an electric shock hazard. Determine that the receptacle is properly wired before inserting the plug.

For test sets energized with 230 V input, the neutral terminal of the input supply cord (white or blue lead) must be connected to the neutral pole of the line power source. The ground terminal of the input supply cord (green or yellow/green lead) must be connected to the protective ground (earth) terminal of the line power source. The black or brown cord lead is the live (hot) lead.

To avoid electric shock hazard, operating personnel must not remove the instrument from the case or remove the protective cover from the power supply. Component replacement and internal adjustment must be performed by qualified service personnel.

The control circuits in all test sets are protected by two mains circuit fuses. These fuses are not replaceable by the operator. Refer fuse replacement to qualified service personnel only. To avoid electric shock and fire hazard, use only the fuse specified in Section 3, Specifications, that is identical in respect to type, voltage rating and current rating.

AVO International has made formal safety reviews of the initial design and any subsequent changes. This procedure is followed for all new products and covers areas in addition to those included in applicable standards. Regardless of these efforts, it is not possible to eliminate all hazards from electrical test equipment. For this reason, every effort has been made to point out in this instruction manual the proper procedures and precautions to be followed by the user in operating this equipment and to mark the equipment itself with precautionary warnings where appropriate. It is not possible to foresee every hazard which may occur in the various applications of this equipment. It is therefore essential that the user, in addition to following the safety rules in this manual, also carefully consider all safety aspects of the test before proceeding.

- Safety is the responsibility of the user.
- Misuse of this high-voltage equipment can be extremely dangerous.
- The purpose of this equipment is limited to use as described in this manual. Do not use the equipment or its accessories with any device other than specifically described.
- Never connect the test set to energized equipment.
- Operation is prohibited in rain or snow.
- Do not use the test set in an explosive atmosphere.
- A qualified operator should be in attendance at all times while the test equipment is in operation.
- Observe all safety warnings marked on the equipment.
- Corrective maintenance must only be performed by qualified personnel who are familiar with the construction and operation of the test set and the hazards involved.