

# DELTA4000 Series

## 12 kV Insulation Diagnostic System



- **Easy to use with automatic and manual operation**
- **Wide frequency test voltage (1-500 Hz)**
- **Accurate measurement results under high noise conditions as tested to 765 kV substations**
- **Lightweight, rugged two-piece design**
- **Patented built-in individual temperature correction eliminates the need for temperature correction tables**

### DESCRIPTION

The DELTA4000 Series is a fully automatic 12 kV insulation power factor/dissipation factor ( $\tan\delta$ ) test set designed for condition assessment of electrical insulation in high voltage apparatus such as transformers, bushings, circuit breakers, cables, lightning arresters and rotating machinery. In addition to performing insulation power factor tests, the DELTA4000 Series can be used to measure the excitation current of transformer windings as well as to perform automatic tip-up tests and HV turns-ratio testing (an optional TTR capacitor is available).

The test set is designed to provide a comprehensive AC insulation diagnostic test. The high power variable frequency design generates its own test signal independent of line frequency quality and the hardware design uses the latest technology available for digital filtering of the response signal. As a result, the DELTA4000 Series produces reliable results and stable readings in the shortest time with the highest accuracy, even in high interference substations.

The DELTA4000 Series operates with PowerDB software for automatic testing and reporting or with Delta Control software for real-time manual testing.

Measurements include voltage, current, power (loss), tan delta, inductance, power factor and capacitance. The test results are automatically stored in the computer and can also be downloaded directly to USB storage or a printer.

DELTA4110 test set is to be used with an external computer (not included) while the DELTA4310 test set comes with an onboard computer.

### APPLICATIONS

- |                             |                    |
|-----------------------------|--------------------|
| ▪ Power transformers        | ▪ Bushings         |
| ▪ Distribution transformers | ▪ Cables           |
| ▪ Instrument transformers   | ▪ Capacitors       |
| ▪ Rotating machines         | ▪ Circuit breakers |
| ▪ Oil insulation            | ▪ Surge arrestors  |

### TEST CAPABILITIES

- |                                       |                           |
|---------------------------------------|---------------------------|
| ▪ Power factor                        | ▪ Capacitance             |
| ▪ Dissipation factor ( $\tan\delta$ ) | ▪ Voltage                 |
| ▪ Excitation current                  | ▪ Current                 |
| ▪ Automatic tip-up                    | ▪ Turns ratio*            |
| ▪ Watts loss                          | * with optional accessory |
| ▪ Inductance                          |                           |



**DELTA manual control**

**FEATURES AND BENEFITS**

**Performance and Accuracy**

- Generates its own test signal – resulting in accurate and clean measurements even in the most severe conditions and in the event power is required from a portable generator.
- High noise suppression and advanced signal acquisition circuitry can handle up to 15 mA interference current or a signal to noise ratio of up to 1:20 resulting in extremely accurate and clean measurements even in the most severe conditions.
- Intelligent temperature correction (patent pending) allows the user to estimate the actual temperature dependence of the test object by measuring tan delta over a frequency range. Mathematically calculating accurate individual temperature correction results in a more accurate measurement of the insulating material's condition.
- Automatic voltage dependence detection (patent pending) Various high voltage components may have a voltage dependence where tip-up testing is recommended (i.e. the dissipation factor is pending test voltage). The DELTA4000 Series has a patented method for detecting voltage dependence and gives the user an alarm, suggesting additional tests should be performed at different voltage levels.
- Dynamic noise suppression minimizes actual test time.

**WIDE FREQUENCY RANGE TEST OUTPUT (1-500HZ)**

- Allows testing of large capacitive specimens as well as ITC.
- Easier to test and lighter weight solution for large capacitive specimen testing.
- The following table is a sample specimen size vs. frequency output:

I Max Continuous (mA)	Max Volt (kV)	Frequency (Hz)	Cap (nF)
300	12	60	67
300	8	60	100
300	6	60	133
300	4	60	200
300	2	60	400
300	12	45	89
300	8	45	133
300	6	45	178
300	4	45	267
300	8	30	200
300	6	30	267
300	4	30	400
300	4	15	800
300	2	15	1600

**Designed for the Field**

- Two-piece design, weighing 14 kg + 22 kg, saves on effort, space, and shipping costs.
- Designed for various work environments: in the field; in a test van; in a manufacturing facility; or in a repair facility.
- Units have performed successful testing in the world's most extreme conditions including: high temperatures, low temperatures, high elevations, high noise, and high humidity.

**Software Package — PowerDB LITE**

- Automatic and manual operation – provides fully automatic operation for tan delta as well as excitation current and tip-up testing. The user simply selects the test object and the unit will automatically run the complete test and report the results back to the test form.
- Easy to save and retrieve data – information will be saved in an XML file with all historical data. This allows the user to view previous year's test sheet or trend specific test points.
- Capability to trend a specific asset over time (with optional Advanced or Pro version).
- Easily recall transformer setups from the settings menu.



**PREMIUM SUPPORT**

Region dependent; please contact your nearest Megger Sales Representative for details. Available in 1-yr, 3-yr, and 5-yr agreements.

- Extended product warranty protects your unit beyond the standard manufacturer's warranty.
- Loaner units and loaner accessories provide guaranteed reliability. Loaners are delivered within 1-2 business days.
- Field application support provided by former utility engineers and PhD's who have vast substation and transformer experience to guide you through your testing procedures and answer your questions.
- Software support and guidance through installation, porting Ider data, customizing forms, comparing results, and data trending.
- Annual onsite training on the equipment software, theory, field testing, data analysis, and PowerDB. Training can be provided on-site or at any of the AVO Training facilities.

**SPECIFICATIONS****Input Power**

90 - 264 V 45 - 66 Hz  
16 A max  
No loss in performance when used with portable generator.

**Output Voltage**

0 to 12 kV, continuously adjustable

**Test Frequency Range**

45-70 Hz (12 kV)  
15-400 Hz (4 kV)  
1-505 Hz (250V)  
0.0001 Hz maximum resolution

**Output Power**

3.6 kVA

**Output Current**

300 mA (4 minutes)  
200 mA (30 minutes)  
100 mA (continuous)  
The power supply capacity can be expanded to 4 A at 12 kV using the optional Resonating Inductor, (Cat. No. 670600-1).

**Measuring Ranges****Voltage**

25 V to 12 kV, 1 V resolution

**Current**

0 to 5 Amps, 0.1  $\mu$ A maximum resolution. The measurement can be corrected to either 2.5 kV or 10 kV equivalents.

**Capacitance:** 0 to 100  $\mu$ F, 0.01 pF maximum resolution

**Inductance:** 6 H to 10 MH, 0.1 mH maximum resolution

**Power factor:** 0-100% (0-1), 0.001% maximum resolution

**Dissipation factor:** 0-100 (0-10,000%), 0.001% maximum resolution

**Watt Loss**

0 to 2 kW, actual power, 0 to 100 kW when corrected to 10 kV equivalent. 0.1 mW maximum resolution. The measurement can be corrected to either 2.5 kV or 10 kV equivalents.

**Temperature Correction****Individual temperature correction**

from 5°C to 50°C insulation test temperature to 20°C reference

**Standard tables**

as by international standards and manufacturers' data

**Accuracy**

Voltage  $\pm$ (1% of reading + 1 digit)  
Current  $\pm$ (1% of reading + 1 digit)  
Capacitance  $\pm$ (0.5% of reading + 1 pF)  
Inductance  $\pm$ (0.5% of reading + 1 mH)  
Power Factor  $\pm$ (0.5% of reading + 0.02%)  
Dissipation Factor  $\pm$ (0.5% of reading + 0.02%)  
Watt Loss  $\pm$ (1% of reading + 1mW)  
Frequency  $\pm$ 0.005% of reading

**Noise Immunity****Electrostatic**

15mA induced noise into any test lead with no loss of measurement accuracy at maximum interference to specimen current of 20:1

**Electromagnetic**

500  $\mu$ T, at 50/60 Hz in any direction

**Measurement**

UST: Ungrounded Specimen Testing

GST: Grounded Specimen Testing

**PC Requirements****DELTA4110**

Operating system: Windows XP/Vista/7  
Processor: Min Pentium 1 GHz  
Memory: Min 1024 Mb RAM  
Hard drive: Min 1 Gb available  
Interface: USB and Ethernet  
with in-built LCD Display (Optional) refer CAT NO. DELTA4110D

**DELTA4310**

Internal PC with 8.4" full-color VGA, full QWERTY keypad, navigational pushbuttons, and joystick (external mouse can be connected), on-screen view of test forms, USB printer interface.

**Communication/Control/Data Management Software**

PowerDB and DELTA Control

**Environment****Temperature**

Operating: -20 to +55° C (-4 to +131° F)  
Storage: -50 to +70° C (-58 to +158° F)

**Relative humidity**

Operating and Storage: 0 to 95% non-condensing

**Standards****Safety**

IEC / ANSI 61010-1:2001

**Shock and vibration**

IEC 68-2-31, first edition, drop and topple (push over)  
IEC 68-2-31, second edition, free fall  
ISTA 2A

**EMC**

FCC 47 CFR Part 15 Class A Emissions requirements (USA)  
(FCC Subpart B of Part 15 Class A)  
EN 55011:1998/A1:1999/A2:2002 Group 1 Class A ISM Emissions requirements (EUROPE)  
AS/NZS CISPR 11:2004 Class A ISM Emissions requirements (Australia)  
EN 61326:1997/A1:1998/A2:2001/A3:2003  
IEC/EN 61000-4-2/3/4/5/6/8/11  
IEC/EN 61000-6-2  
Test Equipment Specifications Met: IEC/EN 61000-6-4;  
IEC 801-2(1984) Electrostatic Discharge; ANSI/IEEE C37.90.1 Surge Withstand Capability

**Dimensions**

Control Unit: 290 x 290 x 460 mm (11 x 11 x 18 in.)  
High Voltage Unit: 290 x 290 x 460 mm (11 x 11 x 18 in.)  
\*Does not include handles.

**Weight**

DELTA4100	DELTA4300	DELTA4010
15 kg (33 lbs)	23kg (48 lbs)	15 kg (33 lbs)

HV Cable	Other Cables
11 kg (25 lbs)	10 kg (23 lbs)

**ORDERING INFORMATION**

Item [Qty]	Cat. No.	Item [Qty]	Cat. No.
DELTA4110 Insulation Diagnostic System (DELTA4100 control unit and DELTA4010 HV unit)	DELTA4110	<b>Optional Accessories</b>	
DELTA4110 Insulation Diagnostic System (DELTA4100 control unit with LCD Display and DELTA4010 HV unit)	DELTA4110D	Standard accessory kit, includes:	670501
DELTA4310 Insulation Diagnostic System with onboard computer (DELTA4300 control unit and DELTA4010 HV unit)	DELTA4310	<ul style="list-style-type: none"> <li>▪ Mini bushing tap connectors [set of 2] P/N 670506</li> <li>▪ Hot collar straps [set of 3] P/N 670505</li> <li>▪ Thermometer - hygrometer - clock [1] P/N 670504</li> <li>▪ Temperature and humidity probe, complete with 20 ft (7 m) lead, P/N 2002-138</li> <li>▪ 0.75" bushing tap adapter [1] P/N 30918-000</li> <li>▪ 1" bushing tap adapter [1] P/N 30918-100</li> <li>▪ "J" probe bushing tap adapter [1], P/N 30917</li> <li>▪ 3 ft (1 m) non-insulating shorting lead, 3 each of P/N 34726-1</li> <li>▪ 6 ft (2 m) non-insulating shorting lead, 3 each of P/N 34726-2</li> <li>▪ Bushing tap adapter - ABB (older style bushings) P/N 2006-375</li> <li>▪ Bushing tap adapter, female-to-female banana jack [3] P/N 90014-353</li> </ul>	
<b>Included Accessories</b>		Safety hand switch, Interlock #2, 2.5 m (8 ft)	1001-851
High voltage lead: 21 m (70 ft), double shielded	30012-11	External HV strobe P/N 90009-210, complete with 60 ft (18 m) detachable lead P/N 1004-532	1004-639
Measurement lead, color-coded red	25572-1	Soft padded carrying case for control or HV unit [2 required]	2001-766
Measurement lead, color-coded blue	25572-2	Transport case [2 required]	2005-115
Ground lead: 9 m (30 ft)	2002-131	Transport cart / trolley	1001-530
Input power cable 25A EU	17032-19	High-voltage reference standard	670500-1
Input power cable 16A US	17032-23	Transit case for 670500-1	670635
Input power cable 16A UK	17032-21	HV TTR capacitor, single phase (10 nF, 10 kV)	36610
Safety hand switch, Interlock #1: 18 m (60 ft)	1001-850	HV reference capacitor (100 pF, 10 kV)	36610-1
Safety foot interlock	1001-852	HV reference capacitor (1000 pF, 10 kV)	36610-2
HV unit power cable, 1 m (3 ft)	2002-132	Transit case for capacitor, set of 3 above	36610-CC
HV unit control cable, 1 m (3 ft)	2002-133	Capacitor kit (TTR cap, 2 ref caps, transit case)	36610-KIT2
Ground lead cable, 1 m (3 ft)	2002-134	Resonating inductor	670600-1
USB cable, 2 m (7 ft)	CA-USB	Adapter kit for DELTA4000 and competitor's resonating inductor	1002-455
Ethernet cable, CAT 5, 2 m (7 ft)	36798	Oil test cell, field model, complete with transit case	670511
Soft case for HV cable	2001-507	Oil test cell, high-temperature lab model, complete with transit case	1004-716
Soft case for other cables/accessories	2005-265		
DELTA4000 software bundle	1001-981		
PowerDB Lite software			
<b>Optional Software</b>			
PowerDB Pro software, on USB dongle	DB1001S-A		
Advanced PowerDB software, on USB dongle	DB1011		
<b>Extended Product Warranty</b>			
Priority Access annual support plan	D4K-P-ACCESS		
Additional 12-month product warranty	Y12-WARRANTY		
Additional 24-month product warranty	Y24-WARRANTY		
Additional 36-month product warranty	Y36-WARRANTY		