Three-Phase Winding Ohmmeters

TWA Advanced Series

- Resistance measurement of all tap positions in all six windings performed in a single test
- True three-phase on-load tap changer dynamic resistance measurement
- Extremely quick measurement, single-step cable setup
- Rapid automatic demagnetization
- Fully automated test mode
- Large 10.1'' or 7'' graphical touchscreen display
- Temperature measurement channel

Description

The TWA advanced series instruments are designed for six-winding resistance measurement and simultaneous three phase on-load tap changer analysis of both the primary and the secondary transformer windings. This is performed with a one single-step cable setup, with test currents of up to 40A.

Each transformer configuration has a special measurement algorithm which is optimized for the fast stabilization of test results. The TWA instruments generate a true DC ripple-free current. Both the injection of the current and the discharge of energy from the magnetic circuit are automatically regulated.

Application

The list of the instrument application includes:

- Six-winding measurement of transformer winding resistances with a one-time cable connection
- A special mode which enables measuring the resistances of three transformer windings in the YN configuration simultaneously
- Dynamic resistance measurement (DVtest) of on-load tap changers
- An evaluation of synchronization between on-load tap changer phases
- A measurement of on-load tap changer motor current by using a dedicated channel
- A three-phase or single-phase automatic transformer demagnetization
- Fully automated test mode, with automatic detection of result stabilization

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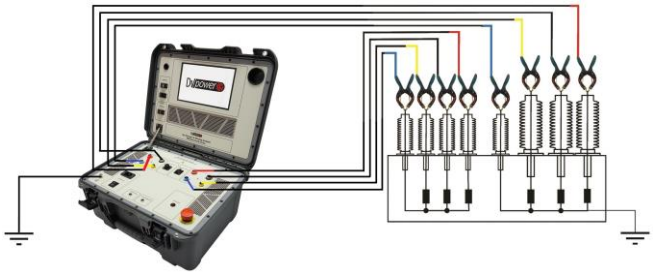
Connecting the TWA to a Transformer

Using two sets of four cables, all bushings of the primary and the secondary sides are connected only once. The connection to the transformer is made using two-contact clamps that provide the four-wire Kelvin test method.

The figure presents the simultaneous testing of both windings (high side and low side) on a three-phase transformer. The setup time is minimized and the test is performed very quickly. The speed is increased by saturating the magnetic core through the HV and LV windings at the same time, so the total test time is very short. The TWA test leads are interchangeable with the test leads for the TRT Three-Phase Transformer Turns Ratio Testers.



Benefits and Features
Six-Winding Resistance Measurement

The TWA injects the current with a voltage value as high as 55 V. This ensures that the magnetic core is saturated quickly and duration of the test is as short as possible. All transformer windings, both primary and secondary, can be measured with a single cable setup. The TWA has internal memory capacity to store up to 500 measurements. All measurements are time and date-stamped. The instrument is equipped with thermal and overcurrent protection. The TWA has very high ability to cancel electrostatic and electromagnetic interference that exists in HV electric fields. It is achieved by a proprietary solution applied to both the hardware construction and the application software implementation.

A special mode is provided for the resistance measurement in multiple de-energized tap changer (DETC) positions.

Another special mode enables measuring the resistances of three transformer windings in the YN configuration simultaneously. It is also possible to test the resistances of all tap changer positions of all three phases in a single pass through the tap changer positions.

On Load Tap Changers – Simultaneous Dynamic Resistance Measurement (DRM) of All Three Phases

The TWA can be used to measure the winding resistance of the individual taps of a power transformer without discharging between the tests.

The unit also checks whether the on-load tap changer (OLTC) switches without an interruption. The moment a tap position is changed from one tap to another, the device detects a sudden, very short drop of the test current. These drops called "Ripple" should be consistent, where any drop out-of-line should be investigated. Tap changer malfunctions can be detected by analyzing the measurements of transition ripple, transition time, and visualizing DRM graphs, can be observed too. The currents in all three phases are recorded simultaneously. Test currents can reach up to 40 A in total during the test.

Dynamic resistance graphs are recorded for all three phases simultaneously, so the synchronization is verified using the cursors provided in the DV-Win software. All three phase traces are plotted on the same graph. In addition, the tap changer motor current is recorded, and displayed on the same graph. The built-in tap changer control unit enables remote control of the tap changer operation from the instrument's keyboard. The test can be performed using either a standalone instrument or DV-Win PC software.

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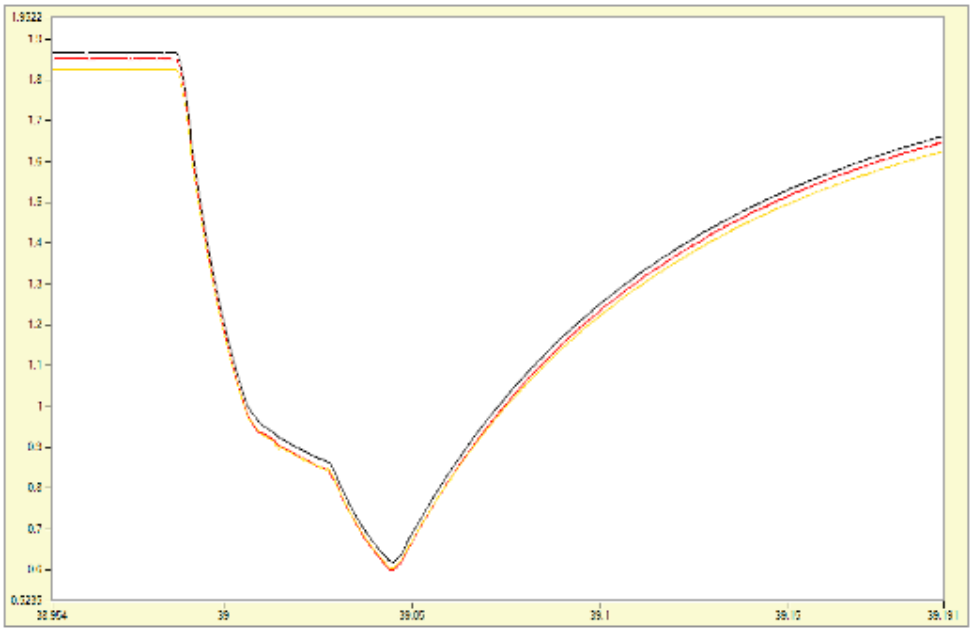

DV-Win Software

The Windows-based DV-Win software enables control and observation of the test process, as well as saving and analyzing the results on a PC. It provides a test report, arranged in a selectable form as an Excel spreadsheet, PDF, Word, or ASCII format. The software provides an OLTC (tap changer) condition assessment through analysis of the graphs representing dynamic resistance values during the tap changer transitions. Additionally, the DV-Win measures and calculates the OLTC transition time, the ripple and the winding resistance for each tap changing operation. The standard interfaces are USB and Ethernet.

Tap Changer Motor Current Monitoring Channel

The AC and/or DC current monitoring channel enables monitoring and recording the OLTC mechanical drive motor current during the tap changer operation. The motor current waveform (or another useful signal) is printed on the same DRM graph as the DC test current, and can help in detecting OLTC mechanical problems. Motor recording allows for DRM recording using the motor operation trigger, which is useful for reactance tap changers.

Vibration Testing

The condition of on-load tap changers can also be observed by analyzing the graph of vibrations during its operation. The vibrations are measured on the external tank using an accelerometer and a dedicated measurement channel on the instrument. An accelerometer is available for purchase as an optional accessory.

Automatic Transformer Demagnetization

After a DC current test, such as a winding resistance measurement, the magnetic core of a power or instrument transformer may be magnetized. Also, when disconnecting a transformer from a service, some amount of magnetic flux trapped in the core could be present.

Demagnetizing the magnetic core of a transformer requires alternating current applied with decreasing magnitude down to zero. The TWA provides this alternating current by internally changing the polarity of a controlled DC current. During the demagnetization process the TWA supplies current at decreasing magnitude for each step, following the proprietary developed program.

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Technical Data

Winding Resistance Measurement

- Test currents: 5 mA – 40 A DC
- Output voltage: up to 55 V DC
- Measurement range: 0,1 µΩ - 10 kΩ
- Typical accuracy: ± (0,1 % rdg + 0,1 % F.S.)

Resolution

- 0,1 µΩ – 999,9 µΩ: 0,1 µΩ
- 1,000 mΩ – 9,999 mΩ: 1 µΩ
- 10,00 mΩ – 99,99 mΩ: 10 µΩ
- 100,0 mΩ – 999,9 mΩ: 0,1 mΩ
- 1,000 Ω – 9,999 Ω: 1 mΩ
- 10,00 Ω - 99,99 Ω: 10 mΩ
- 100,0 Ω – 999,9 Ω: 0,1 Ω
- 1 000 Ω – 9 999 Ω: 1 Ω

OLTC Dynamic Resistance Measurement

- Sampling rate: 0,1 ms
- Automatic open circuit detection and warning
- Transition current ripple measurement
- Transition time measurement using DV-Win software
- Timing measurement of different transition changes using DV-Win graph analysis tool

AC Current Measurement Channel

- Resolution: 0,1 ms
- Amplitude resolution: 16 bit

Display

- 10.1'' graphical touchscreen display (TWA500)
- 7'' graphical touchscreen display (TWA400)

Computer Interface

- USB
- Ethernet

Current Clamp Meter Specifications

- Nominal current: 300 A_{RMS} or 450 A DC_{PK}
- Measuring ranges: 30/300 A
- Frequency range: DC to 20 kHz (-3 dB)
- Resolution: ± 50 / ± 100 mA
- Accuracy: ± 1% of the reading

Warranty

- Three years

Environmental Conditions

- Operating temperature:
  -10 ºC - + 55 ºC / 14 ºF - +131 ºF
- Storage & transportation:
  -40 ºC - + 70ºC / -40 ºF - +158 ºF
- Humidity 5 % - 95 % relative humidity, non-condensing

Dimensions and Weight (TWA500)

- Dimensions (W x H x D):
  505 mm x 257 mm x 409 mm
  19.9 in x 10.1 in x 16.1 in
- Weight: 17,3 kg / 38.1 lbs

Dimensions and Weight (TWA400)

- Dimensions (W x H x D):
  550 mm x 215 mm x 420 mm
  21.6 in x 8.5 in x 16.5 in
- Weight: 17,3 kg / 38.1 lbs

Mains Power Supply

- Connection according to IEC/EN60320-1; UL498, CSA 22.2
- Mains supply: 90 V - 264 V AC

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- Frequency: 50/60 Hz
- Mains supply voltage fluctuations up to ±10 % of the nominal voltage
- Input power: 1500 VA
- Fuse 15 A / 250 V, type F, not user replaceable

Temperature Measurement

- One temperature measurement channel
  Thermometer Pt100
  -50 ºC +180 ºC / -58 ºF +356 ºF
  50 mm x 6 mm

Printer (optional, TWA400 only)

- Thermal printer
- Paper width 80 mm

Vibration Measurement Channel

- Resolution: 0,1 ms
- ICP accelerometer, ±100 mV/g, ±50 g

Applicable Standards

- Installation/overvoltage: category II
- Pollution: degree 2
- Low voltage directive:
  Directive 2014/35/EU (CE Conform)
  Applicable standards, for a class I instrument, pollution degree 2, installation category II : IEC EN 61010-1
- Electromagnetic compatibility:
  Directive 2014/30/EU (CE Conform)
  Applicable standard EN 61326-1
- CAN/CSA-C22.2 No. 61010-1, 2nd edition, including Amendment 1

All specifications herein are valid at ambient temperature of + 25 °C and recommended accessories.
Specifications are subject to change without notice
Specifications are valid if the instrument is used with the recommended set of accessories

H winding test cable set

X winding test cable set

Cable plastic case

Current clamp 30/300 A

Test shunt

Transport case

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Ordering Information

Instrument with included accessories	Article No
Tap Changer & Winding Analyzer TWA500	TWA500D-N-01
Tap Changer & Winding Analyzer TWA400	TWA400D-N-01

Instrument with included accessories
DV-Win PC software including USB cable and Ethernet cable
Tap Changer Control cable 5 m (16.4 ft)
Mains Power cable
Ground (PE) cable
Transport case

Recommended	Article No
H winding test lead set, 4 x 10 m (32.8 ft) with TTA clamps	HC-10-4FMCWC
X winding test lead set, 4 x 10 m (32.8 ft) with TTA clamps	XC-10-4FFCWC
Current clamp 30/300 A power supplied from the instrument with 5 m (16.4 ft) extension	CACL-0300-06
Cable plastic case	CABLE-CAS-03

Optional	Article No
H winding test lead set, 4 x 15 m (49.2 ft) with TTA clamps	HC-15-4FMCWC
X winding test lead set, 4 x 15 m (49.2 ft) with TTA clamps	XC-15-4FFCWC
H winding test lead set, 4 x 20 m (65.6 ft) with TTA clamps	HC-20-4FMCWC
X winding test lead set, 4 x 20 m (65.6 ft) with TTA clamps	XC-20-4FFCWC
Test shunt 1 mΩ (150 A / 150 mV)	SHUNT-150-MK
Temperature sensor 1 x 50 mm (1.97 in) + 5/10/15 m (16.4/32.8/49.2 ft)	TEMP1-050-XX
Bluetooth communication module	BLUETOOTH-00
ICP Accelerometer with 5/10/15 m connecting cable and mounting tools ICP0-100-0XX	ICP0-100-0XX
Thermal printer 80 mm (3.15 in) (built-in) (TWA400)	PRINT-080-00
Thermal paper roll 80 mm (3.15 in) (TWA400)	PRINT-080-RO

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