Three-Phase Winding Ohmmeters &Tap Changer & Winding Analyzers 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 (OLTC) DVtest (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
- OLTC vibration measurement channel

TWA500 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.

The TWA has a 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.

TWA500 Application

The list of the instrument application includes:

- A six-winding measurement of transformer winding resistances with a one-time cable connection
- Simultaneous (QuickYN) mode, which enables measuring the resistances of three transformer windings in the YN configuration at the same time
- DVtest (Dynamic resistance measurement) of OLTC, which can be performed simultaneously on all three phases, or sequentially on individual phases
- An evaluation of OLTC synchronization between three phases
- A measurement of OLTC motor current by using a dedicated channel
- A measurement of OLTC vibration by using a dedicated channel
- A three-phase or single-phase automatic transformer demagnetization

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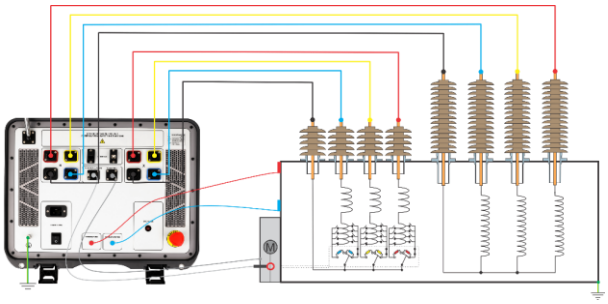
Connecting the TWA to a Transformer

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.



Benefits and Features

Test Voltage up to 55 V DC

The TWA injects the current with a voltage value as high as 55 V DC. This ensures that the magnetic core is saturated quickly, and the duration of the test is as short as possible.

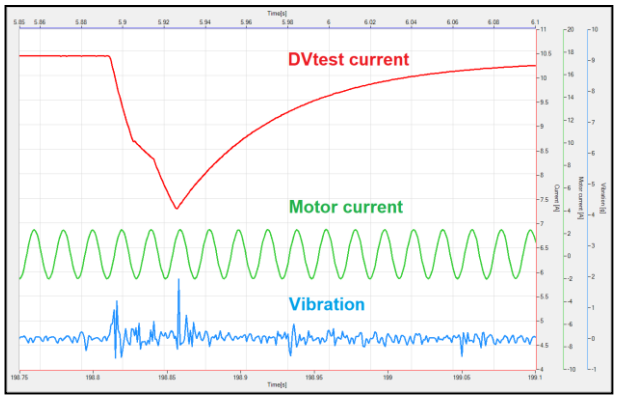
Six-Winding Resistance Measurement

Connecting all 3 phases at HV and LV side at the same time enables resistance measurement of all 6 transformer windings in a single test. If measurement of both HV and LV sides is selected, TWA will inject a current through corresponding HV and LV windings which are mounted on the same core limb. This enables fast saturation of transformer core and therefore fast results stabilization of measured results.

OLTC DVtest (DRM)

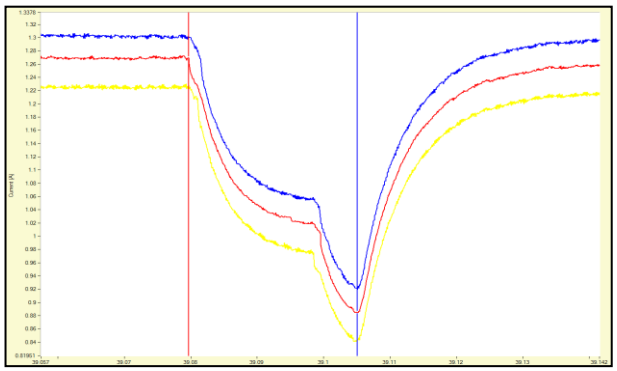
TWA can be used for measuring winding resistance of individual taps of a power transformer with OLTC without test current interruption between the tests. This way it checks whether the OLTC switches without an interruption. The moment a tap position is changed from one tap to another, the device detects a sudden, very short drop of the test current. These drops called "ripples" should be consistent, where any drop out-of-line should be investigated. OLTC malfunctions can be detected by analyzing transition ripple, transition time, and by visualizing DVtest (DRM) graphs. In addition, OLTC motor current and vibration are recorded using dedicated channels and displayed on the same graph.

Analyzing motor current graph and/or vibration graph can reveal possible mechanical issues related to OLTC mechanism.



OLTC Synchronization Check

DVtest (DRM) graphs can be recorded for all three phases simultaneously, so the synchronization between phases can be checked. All three phase traces are plotted on the same graph.



Simultaneous Winding Resistance Measurement of Three Phases

Additional testing mode, Quick YN, is enabled by the DV-TR and standalone device. In this mode, it is possible to simultaneously measure

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the resistances of three transformer windings connected in the YN configuration. It is also possible to measure the resistances of all OLTC positions of all three phases in a single pass through the tap changer positions.

DV-TR Software

The Windows-based DV-TR software enables control and observation of the test process, as well as saving and analyzing the results on a PC. The software provides an OLTC condition assessment through analysis of the graphs representing DVtest (DRM) values during the OLTC transitions. Additionally, the DV-TR measures and calculates the OLTC transition time, the ripple and the winding resistance for each tap changing operation. Customized test report can be generated, edited, saved in several file formats including pdf, and printed.

On-Load Tap Changer Motor Current and Vibration Recording

The AC and/or DC current monitoring channel and vibration monitoring channel, enables recording the OLTC mechanical drive motor current and vibration during the OLTC operation. The motor current and vibration waveform are plotted on the same DVtest (DRM) graph and can help in detecting OLTC mechanical problems. Motor current channel allows triggering DVtest recording using OLCT motor current, which is useful for reactance tap changers.

Automatic Transformer Demagnetization

After a DC current test, such as a winding resistance measurement, the magnetic core of a 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. TWA instruments provide this alternating current by internally changing the polarity of a controlled DC current. During the demagnetization process the test current is supplied with decreasing magnitude for each step, following the proprietary developed program.

Tap Changer Control Unit

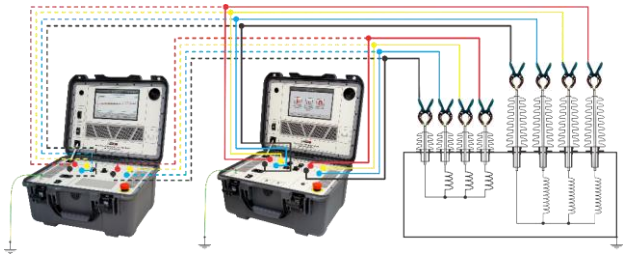
TWA instruments have a built-in tap changer control unit, which allows remote on-load tap changer operation. A single operator can perform complete testing very quickly.

Automated Test in Multiple OLTC Positions

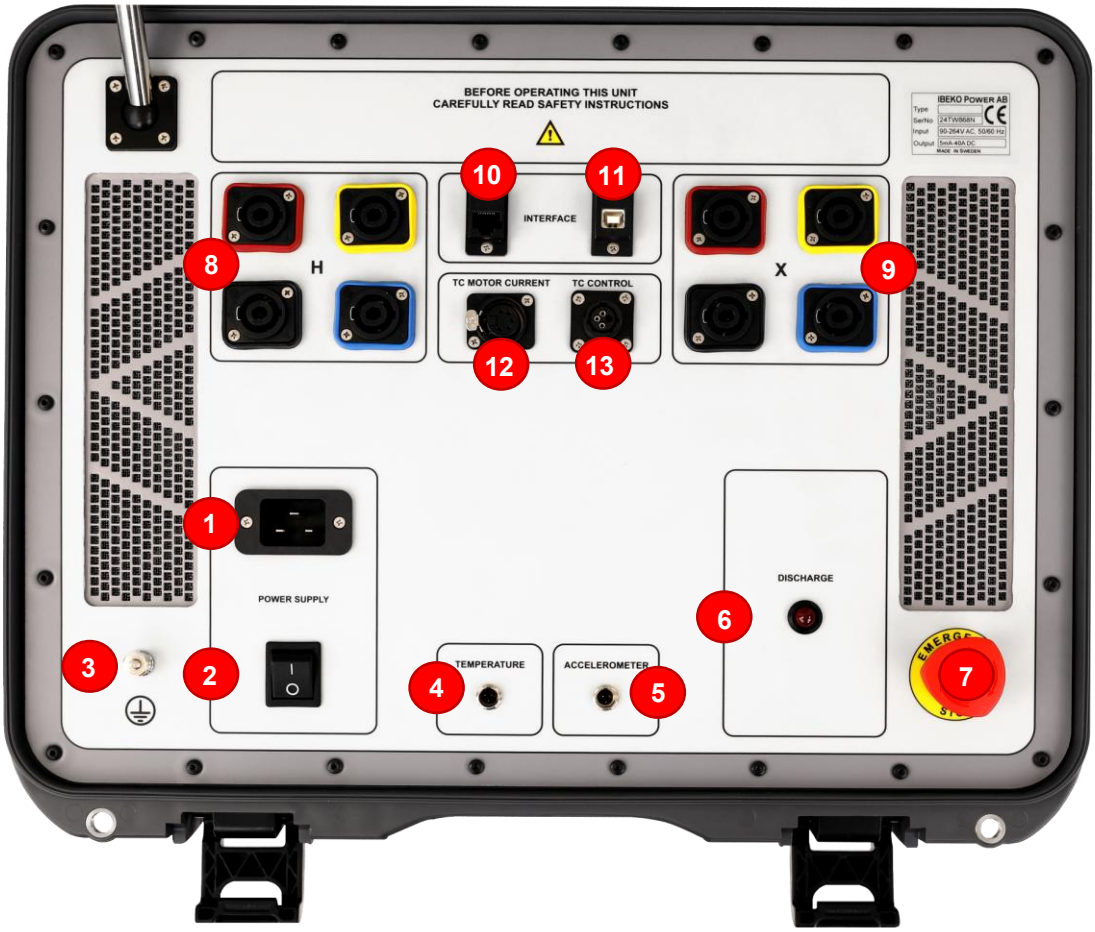
Built-in tap changer control unit allows fully automated tests in multiple OLTC positions. TWA instruments can control the entire process of measurements and changing taps automatically.

Interchangeable cables with Three-phase Turns Ratio Testers TRT

TWA uses the same cable set as Three-phase Turns Ratio Tester TRT devices. This enables one-time cable setup for performing six tests: turns ratio, excitation current, phase angle, winding resistance, on-load tap changer DVtest, and demagnetization, thus making TWA and TRT one measurement system.



Connecting TWA Advanced and TRT Advanced to a transformer


BEFORE OPERATING THIS UNIT
CAREFULLY READ SAFETY INSTRUCTIONS
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INTERFACE
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TC MOTOR CURRENT
TC CONTROL
POWER SUPPLY
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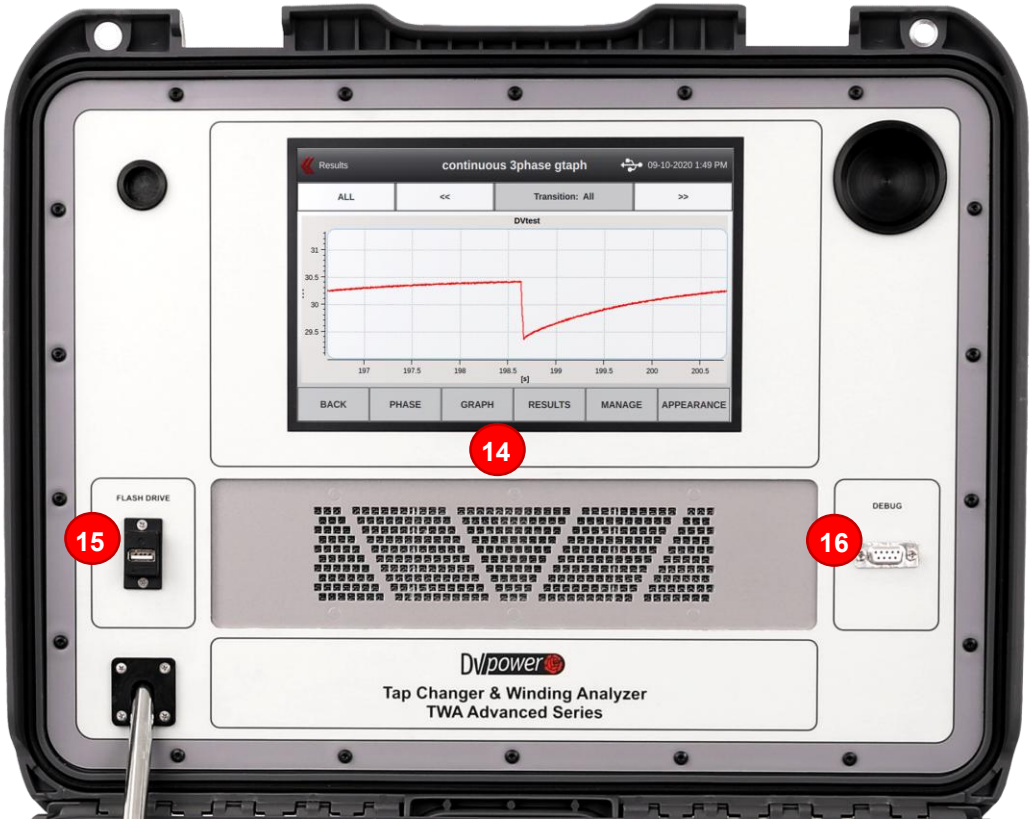
Results
continuous 3phase gtaph
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ALL
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Transition: All
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DVtest
BACK
PHASE
GRAPH
RESULTS
MANAGE
APPEARANCE
FLASH DRIVE
DEBUG
DV power
Tap Changer & Winding Analyzer
TWA Advanced Series
14
15
16

1 - Mains power supply
90 – 264 V AC; 50 Hz – 60 Hz

2 - On/Off switch
Powering device switch.

3 - Earth (ground terminal)
For protection against parasitic currents or voltages, always connect the TWA Advanced protective earth connector to protective ground (PE).

4 - Temperature Measurement Chanel
The terminal for connecting the PT temperature sensor.

5 - Vibration Measurement Chanel
Terminal for connecting the vibration measurement sensor

6 - Discharge diode
Safety diode that lights during the discharge process.

7 - Emergency stop
Pressing this switch turns off the output voltage and stops the test.

8 - H terminals
Terminal for connecting the H test cables.

9 - X terminals
Terminal for connecting the X test cables.

10 - Ethernet PC interface
Ethernet connector for connecting TWA Advanced to a PC.

11 – USB PC interface
USB connector for connecting TWA Advanced to a PC.

12 - Motor Current Measurement Chanel
AC current monitoring channel for recording the OLTC motor current

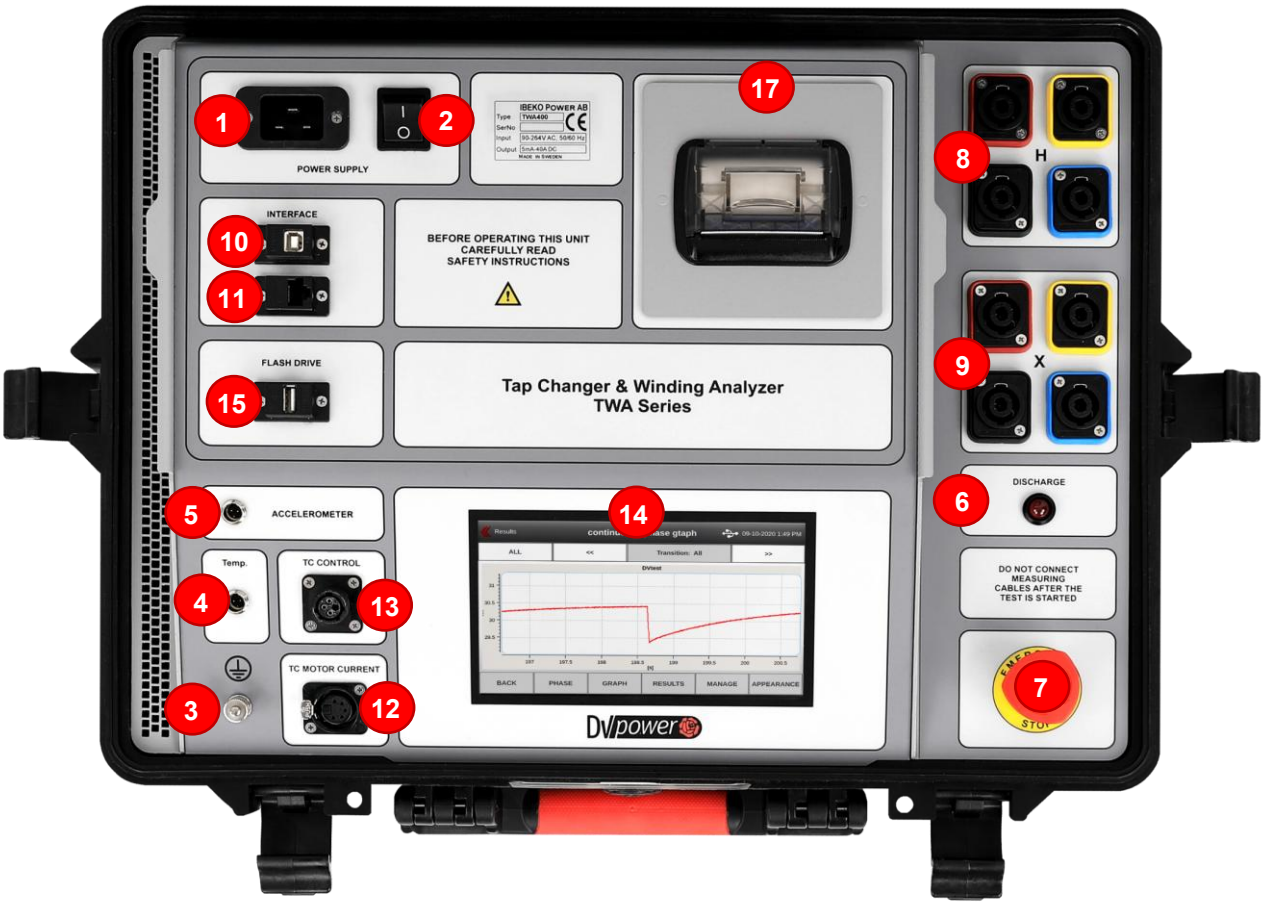
13 - Tap Changer Control Unit
External tap changer control unit is used for tap changer driving.

14 - Display
Graphical touch screen display (TWA500-10.1”; TWA400 -7”). Displays the settings during the device programming as well as the measured values during and after a test.

15 - Flash drive
Used for a direct download of test results on a USB memory stick.

16 – Debug connector
Connector for connecting CVA500 to a PC to debug software applications.

17 – Thermal printer (optional)
Built-in 58 mm (2.28 inch) wide) for numeric results printout



Technical Data

Mains Power Supply

- Connection according to IEC/EN60320-1; UL498, CSA 22.2
- Mains supply: 90 V - 264 V AC, 50/60 Hz
- Input power: 1500 VA

Output

- Test currents: 5 mA – 40 A DC
- Output voltage: up to 55 V DC

Winding Resistance Measurement

- Measurement range: 0.1 µΩ - 10 kΩ
- Measurement range / Typical accuracy:
  0.1 µΩ – 1.999 kΩ: ± (0.1% rdg + 0.1% F.S.)
  2 kΩ – 9.999 kΩ: ± (0.2% rdg + 0.1% F.S.)
- Measurement range / 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 kΩ – 9.999 kΩ:	1 Ω

OLTC DVtest

- Resolution: 0.1 ms

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% rdg

Vibration Measurement

- ICP accelerometer, ±100 mV/g, ±50 g
- Resolution 0.1 ºC

Temperature Measurement

- Measurement range
  -50 ºC – +180 ºC / -58 ºF – +356 ºF
- Thermometer Pt100 class B
- Resolution 0.1 ºC

Display

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

Interface

- USB
- Ethernet

Printer (TWA400)

- Thermal printer
- Paper width 58 mm / 2.28 in

Internal Memory

- 32 GB

Environmental Conditions

- Operating temperature:
  -20 °C – +55 °C / -4 °F – +131 °F
- Storage & transportation temperature:
  -40 °C – +70 °C / -40 °F – +158 °F
- Humidity: 0 – 95% relative humidity, non-condensing

Dimensions and Weight (TWA500)

- Dimensions (W x H x D):

  505 x 257 x 409 mm/ 19.9 x 10.1 x 16.1 in
- Weight:15.9 kg/ 35.0 lbs

Dimensions and Weight (TWA400)

- Dimensions (W x H x D):

  543 x 218 x 427 mm/ 21.4 x 8.6 x 16.8 in
- Weight:15.0 kg/ 33.0 lbs

Warranty

- 3 years + 1 additional year upon registration on DV Power official website

Applicable Standards

- Installation/Overvoltage category: II
- Pollution degree: 2
- Safety: LVD 2014/35/EU (CE Conform)

  Standard EN 61010-1:2010
- EMC: Directive 2014/30/EU (CE Conform)

  Standard EN 61326-1:2013

All specifications herein are valid at ambient temperature of +25 °C / +77 °F and standard accessories.
Specifications are subject to change without notice

Accessories

			
H winding test lead set with TTA clamps	**X winding test lead set with TTA clamps**	**Plastic transport case with wheels**	**Transport case**
			
Cable plastic case – large size	**Cable plastic case with wheels – large size**	**Cable plastic case – medium size**	**Current clamp 30/300 A**
			
Tap changer control cable	**Test shunt**	**Temperature sensor with cable**	**ICP accelerometer with connecting cable and mounting tools**

TWA Advanced Series – Models

TWA500

The highest test current:

25 A DC for winding resistance measurement

40 A DC for OLTC synchronization checking

Winding resistance measurement:

Sequential (phase by phase)

Simultaneous (all phases at once) when transformer is YN connected

DVtest:

Recording DVtest current, OLTC motor current and vibration

Resolution 0.1 ms

Demagnetization:

Three-phase and single-phase

TWA400

The highest test current:

25 A DC for winding resistance measurement

40 A DC for OLTC synchronization checking

Winding resistance measurement:

Sequential (phase by phase)

Simultaneous (all phases at once) when transformer is YN connected

DVtest:

Recording DVtest current, OLTC motor current and vibration

Resolution 0.1 ms

Demagnetization:

Three-phase and single-phase

Ordering Info

Instrument	Article No
Tap Changer & Winding Analyzer TWA500	TWA500N-N-W3
Tap Changer & Winding Analyzer TWA400	TWA400N-N-01

Included accessories
DV-TR PC software including USB cable and Ethernet cable
Tap Changer Control cable 5 m (16.4 ft)
Debug adapter**
Mains Power cable
Ground (PE) cable
Transport case

Standard accessories	Article No
H winding test lead set, 4 x 10 m (32.8 ft) with TTA clamps (compatible with TWA and TRT series)	HC-10-4FNCWC
X winding test lead set, 4 x 10 m (32.8 ft) with TTA clamps (compatible with TWA and TRT series)	XC-10-4FNCWC
Current clamp 30/300 A power supplied from the instrument with 5 m (16.4 ft) extension	CACL-0300-06
Cable plastic case - large size	CABLE-CAS-03

Optional Accessories	Article No
H winding test lead set, 4 x 5 m (16.4 ft) with TTA clamps (compatible with TWA and TRT series)	HC-05-4FNCWC
X winding test lead set, 4 x 5 m (16.4 ft) with TTA clamps (compatible with TWA and TRT series)	XC-05-4FNCWC
H winding test lead set, 4 x 10 m (32.8 ft) with TTA clamps (compatible with TWA and TRT series)	HC-10-4FNCWC
X winding test lead set, 4 x 10 m (32.8 ft) with TTA clamps (compatible with TWA and TRT series)	XC-10-4FNCWC
H winding test lead set, 4 x 15 m (49.2 ft) with TTA clamps (compatible with TWA and TRT series)	HC-15-4FNCWC
X winding test lead set, 4 x 15 m (49.2 ft) with TTA clamps (compatible with TWA and TRT series)	XC-15-4FNCWC
H winding test lead set, 4 x 20 m (65.6 ft) with TTA clamps (compatible with TWA and TRT series)	HC-20-4FNCWC
X winding test lead set, 4 x 20 m (65.6 ft) with TTA clamps (compatible with TWA and TRT series)	XC-20-4FNCWC

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H winding cable extension set, 4 x 5 m (16.4 ft) (compatible with TWA and TRT series)	HE-05-4FNCNC
X winding cable extension set, 4 x 5 m (16.4 ft) (compatible with TWA and TRT series)	XE-05-4FNCNC
H winding cable extension set, 4 x 10 m (32.8 ft) (compatible with TWA and TRT series)	HE-10-4FNCNC
X winding cable extension set, 4 x 10 m (32.8 ft) (compatible with TWA and TRT series)	XE-10-4FNCNC
H winding cable extension set, 4 x 15 m (49.2 ft) (compatible with TWA and TRT series)	HE-15-4FNCNC
X winding cable extension set, 4 x 15 m (49.2 ft) (compatible with TWA and TRT series)	XE-15-4FNCNC
Current clamp 30/300 A power supplied from the instrument with 5 m (16.4 ft) extension	CACL-0300-06
Temperature sensor 1 x 50 mm (1.97 in) + 5 m (16.4 ft) cable	TEMP1-050-05
Temperature sensor 1 x 50 mm (1.97 in) + 10 m (32.8 ft) cable	TEMP1-050-10
Temperature sensor 1 x 50 mm (1.97 in) + 15 m (49.2 ft) cable	TEMP1-050-15
Temperature sensor 1 x 50 mm (1.97 in) + 20 m (65.6 ft) cable	TEMP1-050-20
ICP Accelerometer with 5 m (16.4 ft) connecting cable and mounting tools	ICP0-100-005
ICP Accelerometer with 10 m (32.8 ft) connecting cable and mounting tools	ICP0-100-010
ICP Accelerometer with 15 m (49.2 ft) connecting cable and mounting tools	ICP0-100-015
Test Shunt 1 mΩ (150 A / 150 mV)	SHUNT-150-MK
Transport case for instrument in Plastic housing - large size*	HARD-CASE-BC
Transport case for instrument in Plastic housing with wheels - large size*	HARD-CASE-BW
Cable plastic case – medium size	CABLE-CAS-02
Cable plastic case with wheels – medium size	CABLE-CAS-W2
Cable plastic case – large size	CABLE-CAS-03
Cable plastic case with wheels – large size	CABLE-CAS-W3
Built-in thermal printer 58 mm (2.28 in)*	PRINT-058-00
Thermal paper roll 58 mm (2.28 in)*	PRINT-058-RO
TWA-TRT safety switchbox with ground cable	SWTCH-BOX-N0
H connection between instrument and switchbox, 4 x 0.8 m (2.6 ft)	HE-08-4FNCNC
X connection between instrument and switchbox, 4 x 0.8 m (2.6 ft)	XE-08-4FNCNC

** For TWA400 model*

*** For TWA500 model*