

True Three-Phase Transformer Turns Ratio Tester

TRT Advanced Series

- Single-phase test voltages up to 500 V AC
- True three-phase test voltages up to $3 \times 290 \sqrt{3}$ V AC
- Up to 5 kV AC with additional CVT20 for testing capacitive voltage transformers
- The best turns ratio accuracy of 0.03%
- Large 10.1" or 7" graphical touch screen display
- Automatic vector group detection
- Built-in tap changer control unit
- Interchangeable test leads with Three-phase Winding Ohmmeters & Tap Changer Analyzers TWA Series



Description

TRT advanced series instruments are true three-phase, fully automatic test devices specially designed for turns ratio, phase shift, and excitation current measurements of power, distribution, and instrument transformers. TRT advanced series instruments determine the transformer turns ratio by applying voltages across high voltage windings, accurately measuring voltages across the unloaded transformer windings, and then displaying the ratio of these voltages.

TRT advanced series instruments are based on a state of the art technology, using the most advanced technique available today. The test set can be used to test single-phase and three-phase transformers, both with and without taps in accordance with the requirements of the IEC 60076-1 standard.

For a three-phase measurement, the test set is connected to all the three phases of a transformer to be tested. If specific vector diagrams are selected for different types of transformers, the TRT will run a specific test for each transformer type (i.e., single phase, delta to wye/star,

wye/star to delta, delta to delta, wye/star to wye/star, delta to zig-zag, etc.) without a need to switch the test hookup cables. In addition, it can perform the test with true three-phase test voltage, allowing testing any transformer type. Following the test, it displays a turns ratio, phase shift, and excitation current obtained with single-phase and/or true three-phase test voltages.

TRT lets users enter a transformer's nameplate voltages for the turns ratio deviation calculation. This feature eliminates any error otherwise caused by an operator's manual calculation. The TRT also compares the test result with the nameplate ratio and prints out the % of error for each test.

Operating conditions messages or error messages identify incorrect test conditions, abnormal operating condition, or transformer problems. TRT advanced series instruments have a very high ability to cancel electrostatic and electromagnetic interference in HV electric fields. It is achieved by a very efficient filtration. The filtration is made utilizing the proprietary hardware and software design solutions.

Application

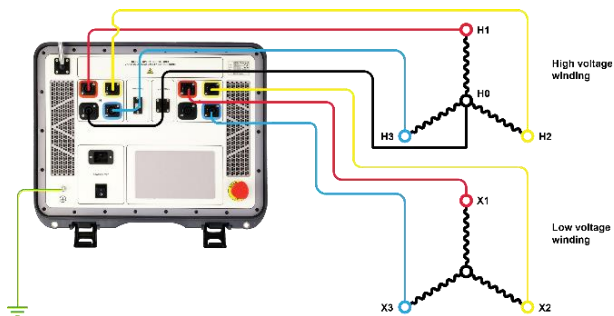
The list of instrument application includes:

- Turns ratio measurement
- Turns ratio deviation calculation
- Excitation current measurement
- Phase angle measurement
- Automatic vector group detection
- Verification of demagnetization process
- Magnetic balance test

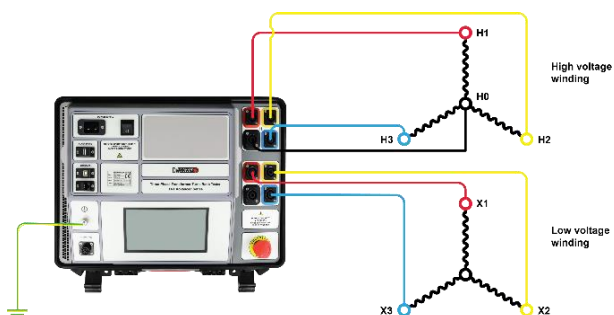
Connecting TRT Advanced Series Instruments to Test Object

Three-Phase Transformer

TRT advanced series instruments are programmed to automatically test turns ratio, phase shift, and excitation current of power and distribution transformer types defined by CEI/IEC, IEEE, and ANSI standards. Using two sets of four cables, all bushings of the primary and the secondary sides are connected only once.



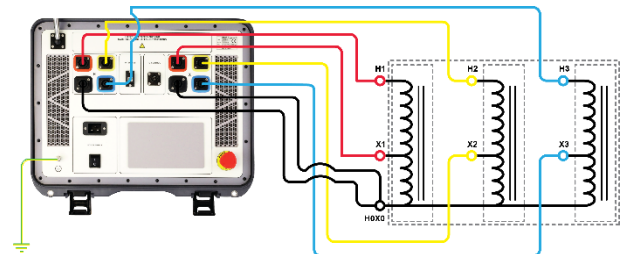
Connecting TRT500 to a three-phase transformer



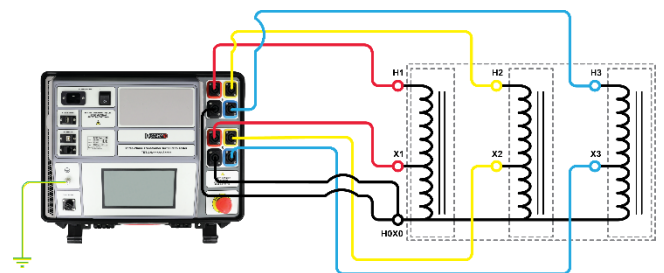
Connecting TRT400, TRT250, TRT100 to a three-phase transformer

Three-Phase Autotransformer

TRT advanced series instruments are also programmed to automatically test turns ratio, phase shift, and excitation current of autotransformer types defined by CEI/IEC, IEEE, and ANSI standards. Using two sets of four cables, all bushings of the primary and the secondary sides are connected only once.



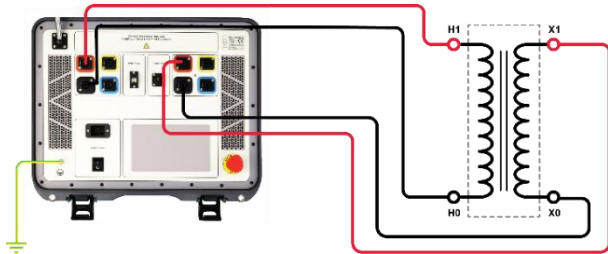
Connecting TRT500 to a three-phase autotransformer



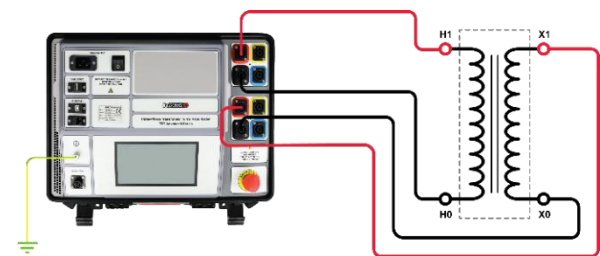
Connecting TRT400, TRT250, TRT100 to a three-phase autotransformer

Single-Phase Transformer

Although three-phase devices, TRT advanced series instruments can test single-phase transformers. Part of the cable set for three-phase transformers/ autotransformers can be used for this purpose.



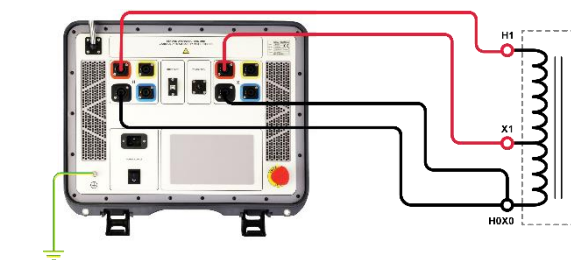
Connecting TRT500 to a single-phase transformer



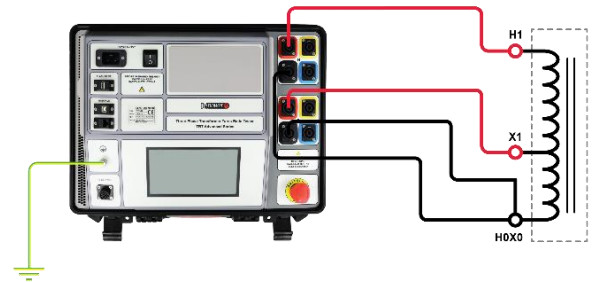
Connecting TRT400, TRT250, TRT100 to a single-phase transformer

Single-Phase Autotransformer

Although three-phase devices, TRT advanced series instruments can test single-phase autotransformers. Part of the cable set for three-phase transformers/ autotransformers can be used for this purpose.



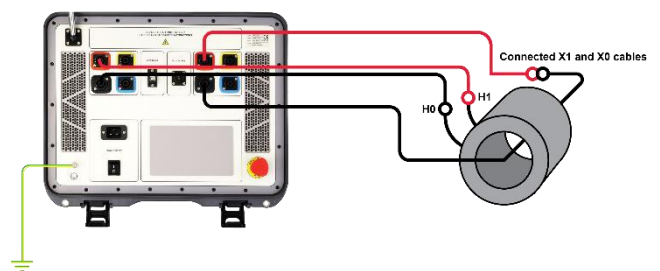
Connecting TRT500 to a single-phase autotransformer



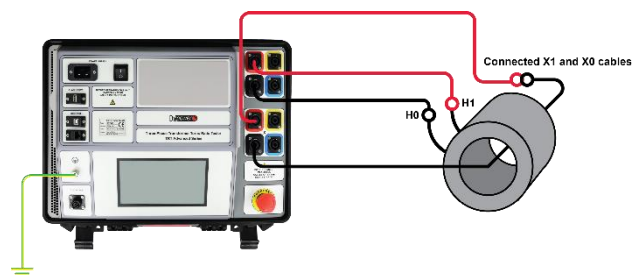
Connecting TRT400, TRT250, TRT100 to a single-phase autotransformer

Current Transformer

TRT advanced series instruments can also be used for verifying turns ratio and polarity of current transformers (CTs). CTs are specially constructed transformers – they are instrument transformers with only one, or occasionally two primary turns. Larger number of turns is on the “X” (secondary) side of CTs. For that reason, when verifying CTs, the “X” test cables must be connected to the primary of a CT. If there are no primary terminals, the “X” cables should be slid through the CT core and short-circuited.



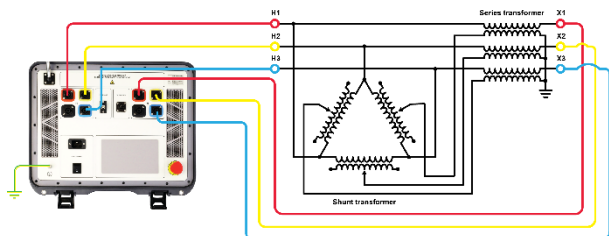
Connecting TRT500 to an unmounted current transformer



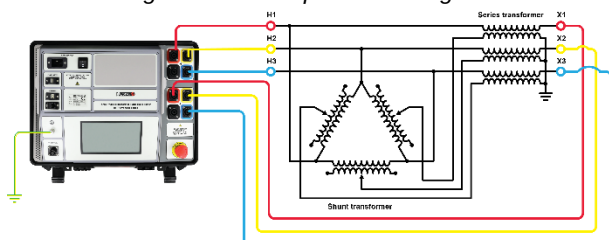
Connecting TRT400, TRT250, TRT100 to an unmounted current transformer

Phase-Shifting Transformer

The presence of true three-phase test voltage allows TRT advanced series instruments to test any type of transformer, even those with irregular vector groups, including phase-shifting transformers.



Connecting TRT500 to a phase-shifting transformer



Connecting TRT400, TRT250, TRT100 to a phase-shifting transformer

Benefits and Features

Single-Phase Test Voltage Up to 500 V AC

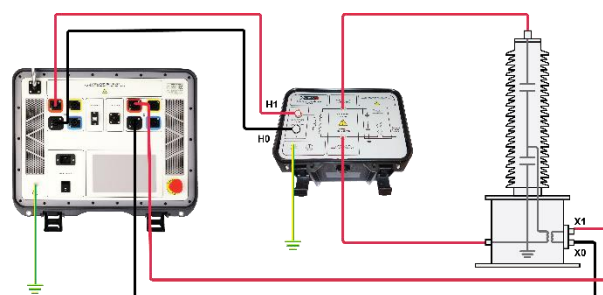
TRT advanced series instruments can output the highest single-phase test voltage of 500 V AC. This provides more accurate measurements on large power transformers and autotransformers used in power generation and transmission.

True Three-Phase Test Voltage

TRT advanced series instruments are true three-phase turns ratio testers. Unlike other so-called “three-phase” testers that allow only connecting to three transformer phases at once, TRT advanced series instruments also can output true three-phase test voltage, without any additional devices or modules. This allows testing any transformer type, including special designs such as phase shifting, arc furnace, rectifier transformers, etc. Besides measuring a turns ratio, it can also measure a voltage ratio of three-phase transformers. By applying true three-phase test voltage, and by measuring induced three-phase voltage, TRT advanced series instruments are able to determine actual phase shifts between HV and LV side voltages, and not just 0 or 180 degrees angle that is

Capacitive Voltage Transformer

When measuring turns ratio of capacitive voltage transformers (CVTs), test voltage of several kilovolts is required, much higher than available in common turns ratio testers. Together with Extension Transformer CVT20, TRT500 can output up to 5 kV AC, which is suitable for measuring turns ratio of CVTs. Polarity can be checked at the same time.



Connecting TRT500 to a capacitive voltage transformer via CVT20

obtained by testing transformers with single-phase test voltage in turns.

Test Voltage up to 5 kV AC

TRT500 has specially designed option for testing turns ratio of capacitive voltage transformers (CVTs). Because of their design, these transformers require several kilovolts over capacitive part to excite inductive part and obtain correct turns ratio. Together with Extension Transformer CVT20, TRT500 can output up to 5 kV AC.

Accuracy

The highest accuracy in the market, for all three parameters measured – turns ratio, excitation current, and phase angle – makes potential transformer irregularities and faults more visible.

Automatic Vector Group Detection

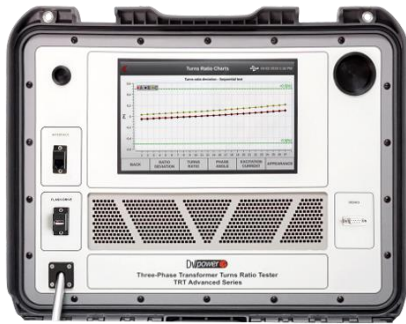
TRT advanced series instruments can automatically detect vector group of three-phase transformers and autotransformers. This is possible both with and without PC software.

Tap Changer Control Unit

TRT advanced series 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.

Large Graphical Touch Screen Display

TRT advanced series instruments come equipped with a large 10.1" (TRT500 model) or 7" (TRT400, TRT250, and TRT100 models) graphical touch screen display. This makes test preparation, test execution, and analysis of test results as easy as possible. Test template can be prepared and saved in the office, making the test execution in the field possible with only a few clicks. All test results are presented both numerically and graphically, for easy and convenient analysis.



10.1" display of TRT500 model



7" display of TRT400, TRT250, and TRT100 model

Memory

TRT advanced series instruments have internal SD card of 32 GB memory space. This enables saving tens of thousands of results and test templates.

Built-in Printer

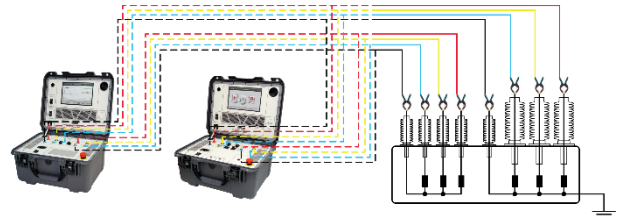
Built-in thermal printer, 112 mm (4.4 in) wide, is an optional accessory for TRT500, while 58 mm (2.3 in) is an option for TRT100, TRT250 and TRT400 models.

USB Flash Drive

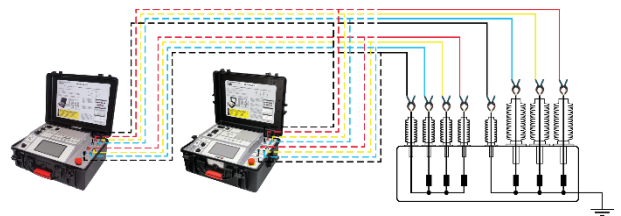
Results can be exported to a USB memory through integrated USB flash drive for further analysis and processing with powerful DV-TR software. Test templates created in DV-TR software can be imported from a USB memory through this integrated USB flash drive.

Interchangeable Cables with TWA

TRT advanced series instruments use the same cable set as Three-phase Winding Ohmmeter & Tap Changer Analyzer TWA series. This enables one-time cable setup for performing 8 tests: turns ratio, excitation current, phase angle, vector group detection, magnetic balance, winding resistance, OLTC DVtest, and demagnetization, thus making TRT advanced series instruments and TWA one measurement system.



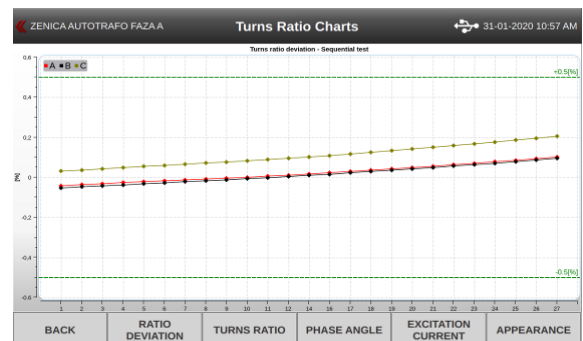
Connecting TRT500 and TWA500 to a three-phase transformer



Connecting TRT400 and TWA400 to a three-phase transformer

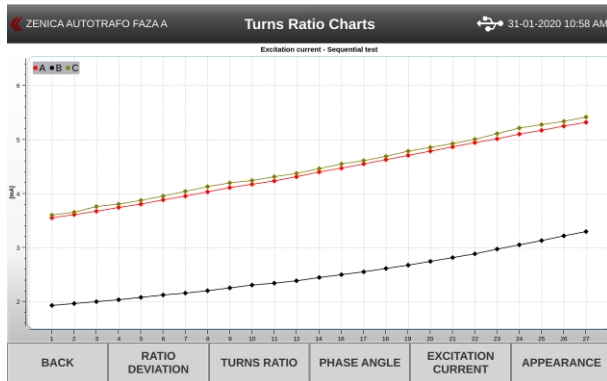
Automated Test in Multiple OLTC Positions

Built-in tap changer control unit allows fully automated turns ratio test in multiple OLTC positions. TRT advanced series instruments can control the entire process of measurements and changing taps automatically.



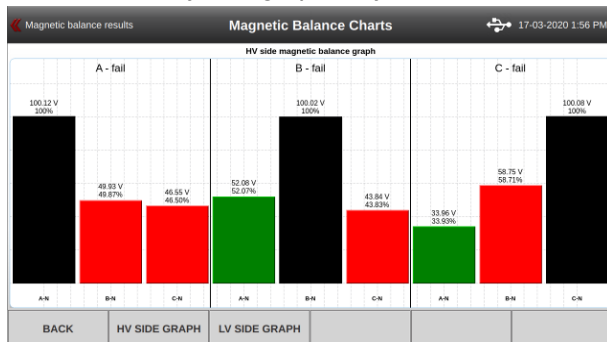
Resolution

Excitation current measurement is important for determining problems in the transformer magnetic core. High measurement resolution enables better tracking of the current trend through all tap positions.



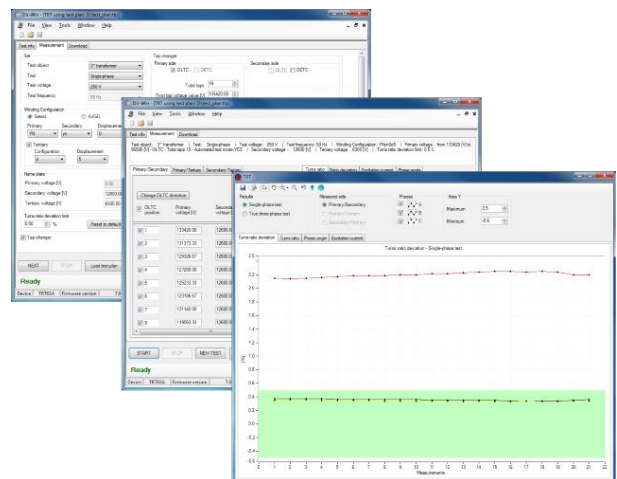
Magnetic Balance Test

This test helps in detecting possible problems in the transformer magnetic core. The test is completely automatic and requires no changes in cable setup comparing to turns ratio test. Results are presented both numerically and graphically.



DV-TR Software

The DV-TR software is included in the purchase price, and all its updates are free of charge. The software allows full control of TRT advanced series instruments functions from a PC, creating and storing test templates. All results are presented both numerically and graphically, for an easy and convenient analysis. Test results can be directly exported to excel document. Customized test report can be generated, edited, saved in several file formats including pdf, and printed.



TRT Advanced Series Technical Data

Mains Power Supply

- Connection: according to IEC/EN60320-1; UL498, CSA 22.2
- Mains supply: 90 – 264 V AC, 50/60 Hz
- Input power: 250 VA

Turns Ratio Measurement

- Range: 0.8 – 50 000
- Resolution: 5 digits
- Typical accuracy:

@500, 430 & 250 V AC

0.8 – 999: $\pm 0.03\%$

1 000 – 3 999: $\pm 0.05\%$

4 000 – 14 999: $\pm 0.05\%$

15 000 – 19 999: $\pm 0.05\%$

20 000 – 50 000: $\pm 0.1\%$

@40 V AC

0.8 – 999: $\pm 0.05\%$

1 000 – 3 999: $\pm 0.1\%$

4 000 – 14 999: $\pm 0.2\%$

15 000 – 20 000: $\pm 0.3\%$

@1 V AC

0.8 – 999: $\pm 0.05\%$

1 000 – 4 000: $\pm 0.1\%$

@170, 100 & 80 V AC

0.8 – 999: $\pm 0.05\%$

1 000 – 3 999: $\pm 0.05\%$

4 000 – 14 999: $\pm 0.1\%$

15 000 – 19 999: $\pm 0.2\%$

20 000 – 50 000: $\pm 0.25\%$

@10 & 8 V AC

0.8 – 999: $\pm 0.05\%$

1 000 – 3 999: $\pm 0.1\%$

4 000 – 15 000: $\pm 0.2\%$

Test Voltages

- TRT500: 1, 8, 10, 40, 80, 100, 170, 250, 430, 500 V AC
- TRT400: 1, 8, 10, 40, 80, 100, 170, 250, 430 V AC
- TRT250: 1, 8, 10, 40, 80, 100, 170, 250 V AC
- TRT100: 1, 8, 10, 40, 80, 100, 170 V AC

Display (TRT500)

- 10.1" graphical touch screen display

Display (TRT400, TRT250, TRT100)

- 7" graphical touch screen display

Interface

- Ethernet
- USB

Internal Memory

- SD card 32 GB

Environmental Conditions

- Operating temperature: -20 °C – +60 °C / -4 °F – +140 °F
- Storage & transportation temperature: -40 °C – +70 °C / -40 °F – +158 °F
- Humidity: 0 – 95% relative humidity, non-condensing

Dimensions and Weight (TRT500)

- Dimensions (W x H x D): 505 x 257 x 409 mm / 19.9 x 10.1 x 16.1 in
- Weight: 10.5 kg / 23.1 lbs

Dimensions and Weight (TRT400, TRT250, TRT100)

- Dimensions (W x H x D): 478 x 194 x 390 mm / 18.82 x 7.64 x 15.35 in
- Weight: 9 kg / 19.8 lbs

Warranty

- 3 years + 1 additional year upon registration on [DV Power official website](https://www.dvpower.com)

Excitation Current Measurement

- Range: 0 – 2 A
- Resolution:

0.0000 – 9.9999 mA	0.1 μ A
10.000 – 99.999 mA	1 μ A
100.00 – 999.99 mA	10 μ A
1.0000 – 2.0000 A	100 μ A
- Typical accuracy: $\pm(0.25\% \text{ rdg} + 0.5 \text{ mA})$

Phase Angle Measurement

- Range: 0 – 360°
- Resolution: 0.01°
- Typical accuracy: $\pm 0.05^\circ$

Printer (optional)

- Built-in thermal printer
- Paper width 112 mm / 4.4 in (for TRT500), 58 mm / 2.3 in (for TRT100, TRT250, TRT400)
- 112 mm printer operating temperature: -10 °C – +60 °C / +14 °F – +140 °F
- 58 mm printer operating temperature: -20 °C – +70 °C / -4 °F – +158 °F

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

CVT20 Technical Data

Input Data

- Power supply: Only from associated TRT500 device, via provided connection cables
- Maximum input voltage: 250 V AC
- Frequency: 50/60 Hz

Output Data

- Maximum output voltage 5 kV AC

Measurement

- Turns ratio range 20:1
- Turns ratio accuracy $\pm 0.5\%$ of ratio
- Maximum excitation capacity: 0.02 μ F

Dimensions and Weight

- Dimensions (W x H x D):
223 x 260 x 284 mm
8.78 x 10.24 x 11.18 in
- Weight: 10 kg / 22 lbs

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

Applicable Standards

- Installation/Overvoltage category: II
- Pollution degree: 2
- Safety: LVD 2014/35/EU (CE Conform)
Standard EN 61010-1:2001
- EMC: Directive 2014/30/EU (CE Conform)
Standard EN 61326-1:2006

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



H winding test cable set



X winding test cable set



Transport case (TRT500)



Plastic transport case – medium size (TRT400, TRT250, TRT100)



Cable plastic case – large size



Cable plastic case with wheels – large size



Cable plastic case – medium size



Cable plastic case with wheels – medium size



Extension Transformer CVT20



High voltage cable set



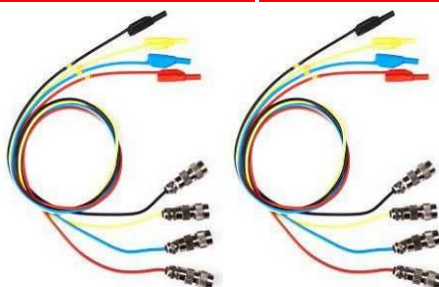
H test cable set for connecting to TRT500



X test cable set for measurement, with banana plugs + dolphin clip



TRTC Verification Calibrator



TRTC cables with banana plugs



Cable bag

TRT Advanced Series – Models

TRT500

	The highest test voltage: 500 V AC Up to 5 kV AC using external booster CVT20 Display size: 10.1"	Dimensions (W x H x D): 505 x 257 x 409 mm 19.9 x 10.1 x 16.1 in Weight: 10.5 kg 23.1 lbs
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TRT400

	The highest test voltage: 430 V AC Display size: 7"	Dimensions (W x H x D): 478 x 194 x 390 mm 18.82 x 7.64 x 15.35 in Weight: 9 kg 19.8 lbs
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TRT250

	The highest test voltage: 250 V AC Display size: 7"	Dimensions (W x H x D): 478 x 194 x 390 mm 18.82 x 7.64 x 15.35 in Weight: 9 kg 19.8 lbs
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TRT100

	The highest test voltage: 170 V AC Display size: 7"	Dimensions (W x H x D): 478 x 194 x 390 mm 18.82 x 7.64 x 15.35 in Weight: 9 kg 19.8 lbs
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Ordering Info

Instrument	Article No
True Three-phase Transformer Turns Ratio Tester TRT500	TRT500N-N-W3
True Three-phase Transformer Turns Ratio Tester TRT400	TRT400N-N-03
True Three-phase Transformer Turns Ratio Tester TRT250	TRT250N-N-03
True Three-phase Transformer Turns Ratio Tester TRT100	TRT100N-N-03

Included Accessories
Windows-based DV-TR PC software
USB cable
Ethernet cable
Tap changer control cable 5 m (16.4 ft)
Mains power cable
Ground (PE) cable
Debug adapter*
Plastic Transport case with wells*
Plastic transport case – medium size**

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
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 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
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)	HE-15-4FNCNC

(compatible with TWA and TRT series)	
X winding cable extension set, 4 x 15 m (49.2 ft) (compatible with TWA and TRT series)	XE-15-4FNCNC
H winding test lead set, 4 x 5 m (16.4 ft) with TTA clamps (compatible with TRT series only)	HC-05-4TRTNW
X winding test lead set, 4 x 5 m (16.4 ft) with TTA clamps (compatible with TRT series only)	XC-05-4TRTNW
H winding test lead set, 4 x 10 m (32.8 ft) with TTA clamps (compatible with TRT series only)	HC-10-4TRTNW
X winding test lead set, 4 x 10 m (32.8 ft) with TTA clamps (compatible with TRT series only)	XC-10-4TRTNW
H winding test lead set, 4 x 15 m (49.2 ft) with TTA clamps (compatible with TRT series only)	HC-15-4TRTNW
X winding test lead set, 4 x 15 m (49.2 ft) with TTA clamps (compatible with TRT series only)	XC-15-4TRTNW
H winding test lead set, 4 x 20 m (65.6 ft) with TTA clamps (compatible with TRT series only)	HC-20-4TRTNW
X winding test lead set, 4 x 20 m (65.6 ft) with TTA clamps (compatible with TRT series only)	XC-20-4TRTNW
H winding cable extension set, 4 x 5 m (16.4 ft) (compatible with TRT series only)	HE-05-4TRTNN
X winding cable extension set, 4 x 5 m (16.4 ft) (compatible with TRT series only)	XE-05-4TRTNN
H winding cable extension set, 4 x 10 m (32.8 ft) (compatible with TRT series only)	HE-10-4TRTNN
X winding cable extension set, 4 x 10 m (32.8 ft) (compatible with TRT series only)	XE-10-4TRTNN
H winding cable extension set, 4 x 15 m (49.2 ft) (compatible with TRT series only)	HE-15-4TRTNN
X winding cable extension set, 4 x 15 m (49.2 ft) (compatible with TRT series only)	XE-15-4TRTNN
Cable plastic case – small size	CABLE-CAS-01
Cable plastic case – medium size	CABLE-CAS-02
Cable plastic case with wheels – medium size	CABLE-CAS-W2
Cable plastic case with wheels – large size	CABLE-CAS-W3
Plastic transport case – medium size**	PLCAS-P00-02
Plastic transport case with wheels – medium size**	PLCAS-P00-W2
Thermal printer 112 mm (built-in)*	PRINT-112-01
Thermal paper roll 112 mm*	PRINT-112-RO
Thermal printer 58 mm (built-in)**	PRINT-058-01
Thermal paper roll 58 mm**	PRINT-058-RO
Verification Calibrator TRTC	TRTC-05-4800
H winding test lead set, 4 x 1 m (3.28 ft) with banana plugs	HC-01-4LNCBP
X winding test lead set, 4 x 1 m (3.28 ft) with banana plugs	XC-01-4LNCBP
Extension Transformer CVT20*	CVT20XN-N-00
High voltage cable set 2 x 10 m (32.8 ft)*	CET-10-03EWC
High voltage cable set 2 x 15 m (49.2 ft)*	CET-15-03EWC
High voltage cable set 2 x 20 m (65.6 ft)*	CET-20-03EWC

H test cable set for connecting to TRT500, 2 x 5 m (16.4 ft)*	HET-05-2NCNC
X test cable set for measurement, 2 x 15 m (49.2 ft) with banana plugs + dolphin clip*	XM-15-NCBPDC
Cable bag	CABLE-BAG-00
TWA-TRT safety switchbox with ground cable	SWTCH-BOX-N0
H connection between instrument and switchbox, 4 x 0.8 m (2.62 ft)	HE-08-4FNCNC
X connection between instrument and switchbox, 4 x 0.8 m (2.62 ft)	XE-08-4FNCNC

*For TRT500 model only

**For TRT400, TRT250, TRT100 models only