

# 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\*



*\*TRT Advanced models are also available in version with common connector for H side cables, and common connector for X side cables. For more information, please contact DV Power or authorized DV Power distributor in your country.*

### 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

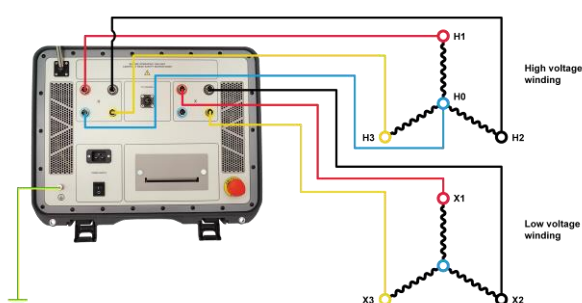
The list of instrument application includes:

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

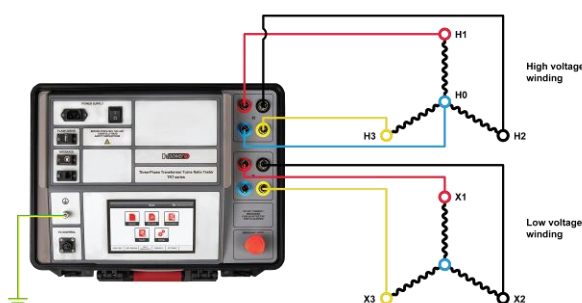
## Connecting TRT Advanced Series Instruments to Test Object

### 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.



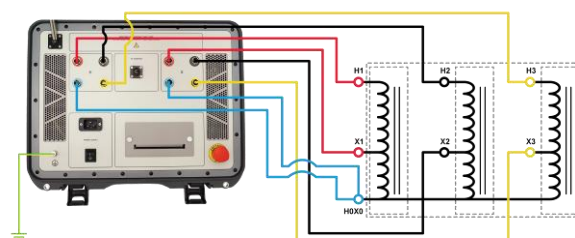
Connecting TRT500 to a three-phase transformer



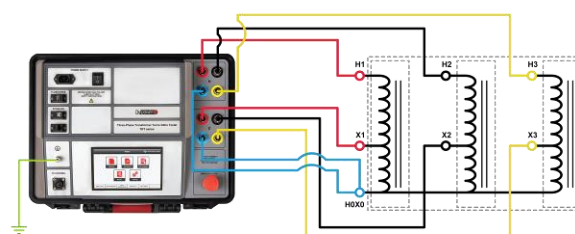
Connecting TRT400, TRT250, TRT100 to a three-phase transformer

### 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.



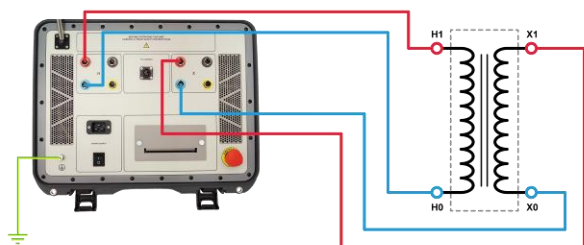
Connecting TRT500 to a three-phase autotransformer



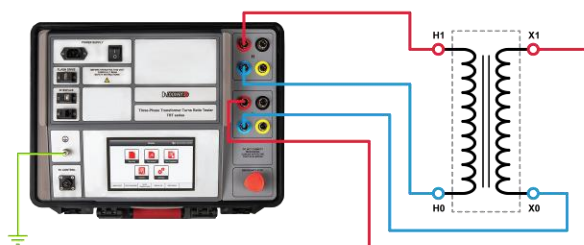
Connecting TRT400, TRT250, TRT100 to a three-phase autotransformer

## Single-Phase Transformer

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



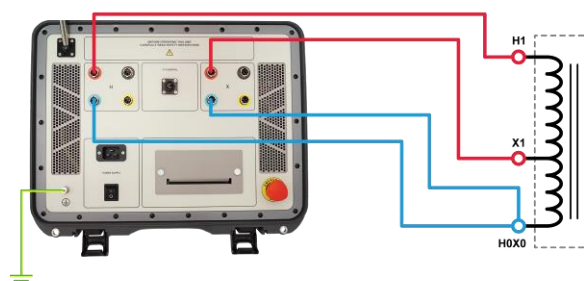
Connecting TRT500 to a single-phase transformer



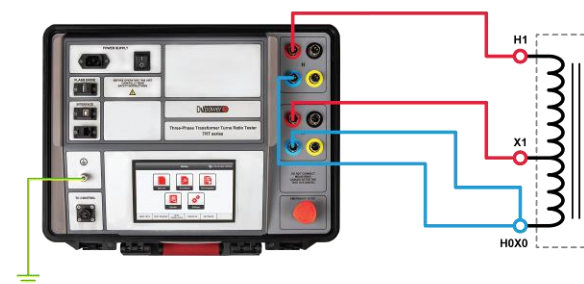
Connecting TRT400, TRT250, TRT100 to a single-phase transformer

## Single-Phase Autotransformer

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



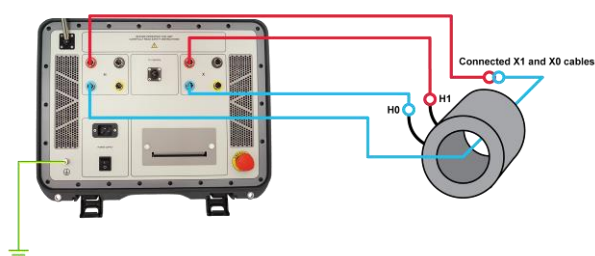
Connecting TRT500 to a single-phase autotransformer



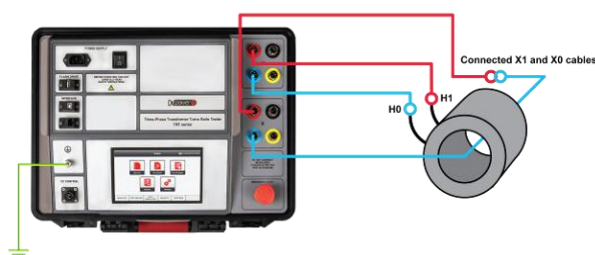
Connecting TRT400, TRT250, TRT100 to a single-phase autotransformer

## 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.



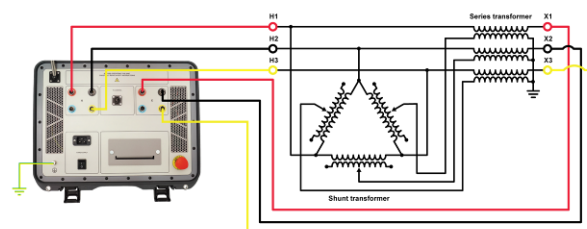
Connecting TRT500 to an unmounted current transformer



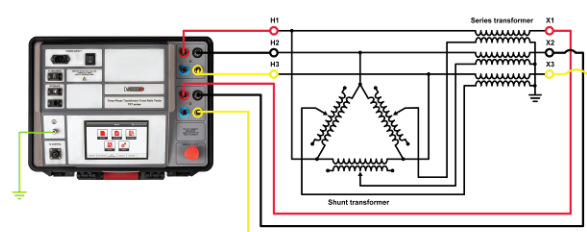
Connecting TRT400, TRT250, TRT100 to an unmounted current transformer

## 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.



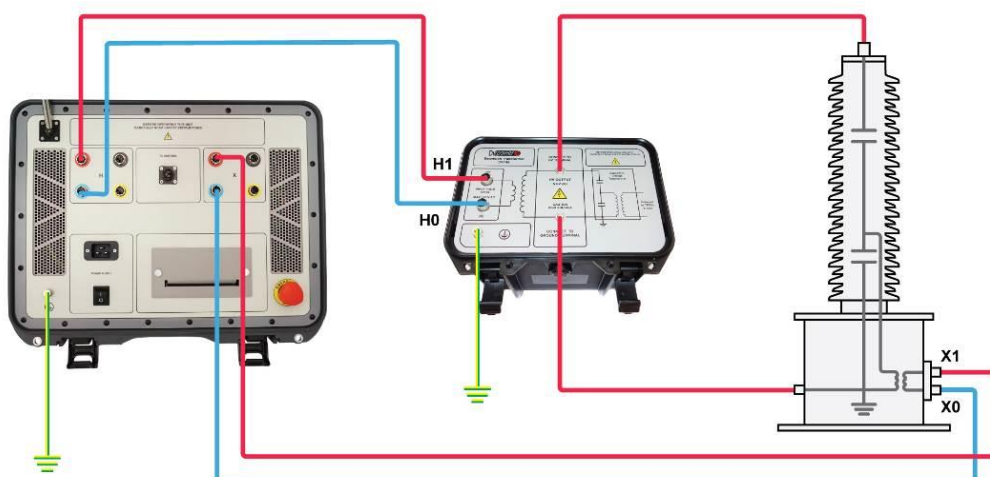
Connecting TRT500 to a phase-shifting transformer



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

## 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

## 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 have the ability to 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 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 in order 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 are able to 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 models

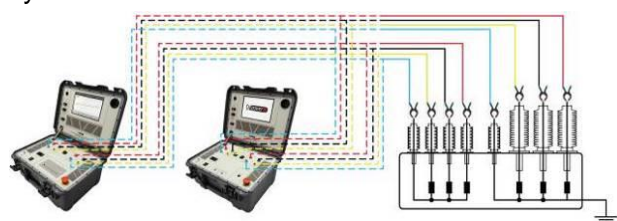


## Memory

TRT advanced series instruments have internal SD card of 8 GB memory space. This enables saving tens of thousands of results and test templates.

## 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.



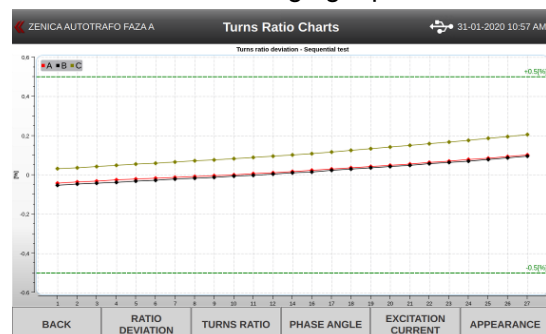
Connecting TRT500 and TWA500 to a three-phase transformer



Connecting TRT400 and TWA40D to a three-phase transformer

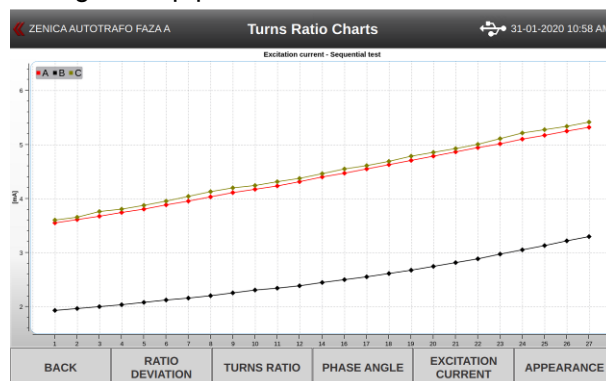
## Automated Test in Multiple OLTC Positions

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



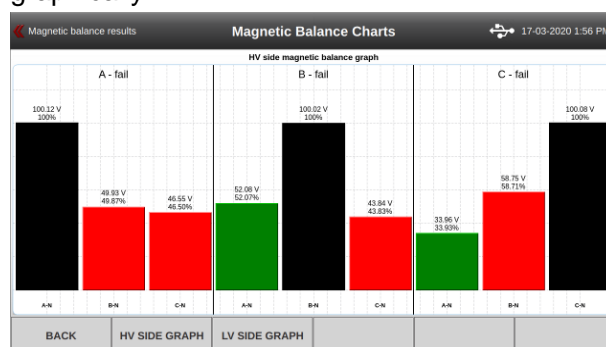
## Resolution

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.



## USB Flash Drive

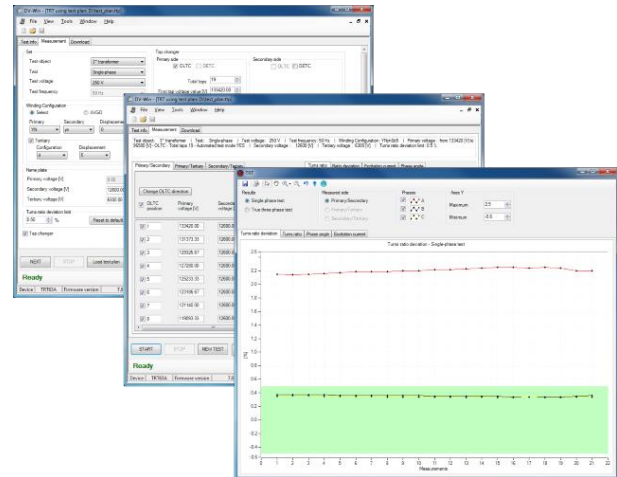
Results can be exported to a USB memory through integrated USB flash drive for further analysis and processing with powerful DV-Win software. Test templates created in DV-Win software can be imported from a USB memory through this integrated USB flash drive.

## Built-in Printer

Built-in thermal printer, 112 mm (4.4 in) wide, is an optional accessory.

## DV-Win Software

The DV-Win 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
- Fuse: 2 A / 250 V, type F, not user replaceable

### 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: $\pm 0.2\%$

### Excitation Current Measurement

- Range: 0 – 2 A
- Resolution:
 

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

### Phase Angle Measurement

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

### 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 8 GB

### Environmental Conditions

- Operating temperature: -10 °C – +55 °C / +14 °F – +131 °F
- Storage & transportation temperature: -40 °C – +70 °C / -40 °F – +158 °F
- Humidity: 5% – 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



### Printer (optional)

- Built-in thermal printer
- Paper width 112 mm / 4.4 in
- Printer operating temperature:  
0 °C – +50 °C / +32 °F – +122 °F
- Printer density is guaranteed in this range:  
+5 °C – +40 °C / +41 °F – +104 °F  
20 – 85% relative humidity, non-condensing

### Applicable Standards

- Installation/Overtoltage 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  $\mu\text{F}$

### 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:  
-10 °C – +55 °C / +14 °F – +131 °F
- Storage & transportation temperature:  
-40 °C – +70 °C / -40 °F – +158 °F
- Humidity: 5 % – 95 % relative humidity, non-condensing

### Applicable Standards

- Installation/Overtoltage 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 recommended accessories.  
Specifications are subject to change without notice.*



H winding test cable set



X winding test cable set



Transport case  
(for TRT400, TRT250,  
TRT100)



Plastic transport case  
(for 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



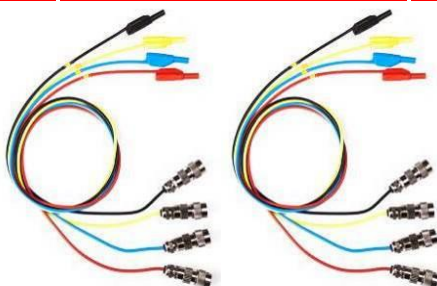
High voltage cable set



H test cable set for  
connecting to TRT500



TRTC Verification  
Calibrator




TRTC cables with banana plugs




Cable bag

## TRT Advanced Series – Models


### TRT500

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

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

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

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

Instrument	Article No
True Three-phase Transformer Turns Ratio Tester TRT500	TRT500X-N-01
True Three-phase Transformer Turns Ratio Tester TRT400	TRT400X-N-01
True Three-phase Transformer Turns Ratio Tester TRT250	TRT250X-N-01
True Three-phase Transformer Turns Ratio Tester TRT100	TRT100X-N-01

Included Accessories
Windows-based DV-Win PC software
USB cable
Ethernet cable
Tap changer control cable 5 m (16.4 ft)
Mains power cable
Ground (PE) cable
Transport case

Recommended 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-10-4FMCWC
X winding test lead set, 4 x 10 m (32.8 ft) with TTA clamps (compatible with TWA and TRT series)	XC-10-4FFCWC
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-05-4FMCWC
X winding test lead set, 4 x 5 m (16.4 ft) with TTA clamps (compatible with TWA and TRT series)	XC-05-4FFCWC
H winding test lead set, 4 x 15 m (49.2 ft) with TTA clamps (compatible with TWA and TRT series)	HC-15-4FMCWC
X winding test lead set, 4 x 15 m (49.2 ft) with TTA clamps (compatible with TWA and TRT series)	XC-15-4FFCWC
H winding test lead set, 4 x 20 m (65.6 ft) with TTA clamps (compatible with TWA and TRT series)	HC-20-4FMCWC
X winding test lead set, 4 x 20 m (65.6 ft) with TTA clamps (compatible with TWA and TRT series)	XC-20-4FFCWC
H winding cable extension set, 4 x 5 m (16.4 ft) (compatible with TWA and TRT series)	HE-05-4FMCFC
X winding cable extension set, 4 x 5 m (16.4 ft) (compatible with TWA and TRT series)	XE-05-4FFCMC
H winding cable extension set, 4 x 10 m (32.8 ft) (compatible with TWA and TRT series)	HE-10-4FMCFC
X winding cable extension set, 4 x 10 m (32.8 ft) (compatible with TWA and TRT series)	XE-10-4FFCMC

H winding cable extension set, 4 x 15 m (49.2 ft) (compatible with TWA and TRT series)	HE-15-4FMCFC
X winding cable extension set, 4 x 15 m (49.2 ft) (compatible with TWA and TRT series)	XE-15-4FFCMC
H winding test lead set, 4 x 5 m (16.4 ft) with TTA clamps (compatible with TRT series only)	HC-05-4TRTMW
X winding test lead set, 4 x 5 m (16.4 ft) with TTA clamps (compatible with TRT series only)	XC-05-4TRTFW
H winding test lead set, 4 x 10 m (32.8 ft) with TTA clamps (compatible with TRT series only)	HC-10-4TRTMW
X winding test lead set, 4 x 10 m (32.8 ft) with TTA clamps (compatible with TRT series only)	XC-10-4TRTFW
H winding test lead set, 4 x 15 m (49.2 ft) with TTA clamps (compatible with TRT series only)	HC-15-4TRTMW
X winding test lead set, 4 x 15 m (49.2 ft) with TTA clamps (compatible with TRT series only)	XC-15-4TRTFW
H winding test lead set, 4 x 20 m (65.6 ft) with TTA clamps (compatible with TRT series only)	HC-20-4TRTMW
X winding test lead set, 4 x 20 m (65.6 ft) with TTA clamps (compatible with TRT series only)	XC-20-4TRTMW
H winding cable extension set, 4 x 5 m (16.4 ft) (compatible with TRT series only)	HE-05-4TRTMF
X winding cable extension set, 4 x 5 m (16.4 ft) (compatible with TRT series only)	XE-05-4TRTFM
H winding cable extension set, 4 x 10 m (32.8 ft) (compatible with TRT series only)	HE-10-4TRTMF
X winding cable extension set, 4 x 10 m (32.8 ft) (compatible with TRT series only)	XE-10-4TRTFM
H winding cable extension set, 4 x 15 m (49.2 ft) (compatible with TRT series only)	HE-15-4TRTMF
X winding cable extension set, 4 x 15 m (49.2 ft) (compatible with TRT series only)	XE-15-4TRTFM
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
Transport case*	HARD-CASE-NC
Transport case with wheels*	HARD-CASE-NW
Transport case**	HARD-CASE-LC
Transport case with wheels**	HARD-CASE-LW
Plastic transport case**	HARD-CASE-PC
Plastic transport case with wheels**	HARD-CASE-PW
Built-in thermal printer 112 mm (4.4 in)	PRINT-112-00
Thermal paper roll 112 mm (4.4 in)	PRINT-112-RO
Inverter 12 V DC to 230 V AC, 50 Hz	IN650-12-230
Verification Calibrator TRTC	TRTC-05-4800



H winding test lead set, 4 x 1 m (3.28 ft) with banana plugs	HC-01-4LMCBP
X winding test lead set, 4 x 1 m (3.28 ft) with banana plugs	XC-01-4LFCBP
Extension Transformer CVT20*	CVT20XX-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-05-2MCFC
Cable bag	CABLE-BAG-00
TWA-TRT safety switchbox with ground cable	SWTCH-BOX-00
H connection between instrument and switchbox, 4 x 0.8 m (2.62 ft)	HE-08-4FMCMC
X connection between instrument and switchbox, 4 x 0.8 m (2.62 ft)	XE-08-4FFCFC

\*For TRT500 model

\*\*For TRT400, TRT250, TRT100 models