

# TTR®300 Series

## 3-Phase Transformer Turns Ratio Test Sets



TTR330

- Store and download test results in XML format, via RS-232, Ethernet or USB ports (depending on model)
- Works in the presence of high interference/ high voltage
- Capable of measuring phase-shifting transformers
- Highest ratio measurement (45,000:1)
- Displays % error vs. name plate with pass/fail limits
- Capability for automatic vector detection when testing via PowerDB

### DESCRIPTION

The TTR300 Series of three-phase transformer turns ratio test sets is designed to measure the turns ratio of power, instrument, and distribution transformers in a substation or manufacturing environment. A rugged and robust design makes these instruments well suited for use in a variety of harsh environments. Our leads are specially designed to provide the necessary flexibility needed in cold weather.

The TTR300 Series is ideal for use by power transformer manufacturers. Their unique testing procedures and storage capability allows an operator to set up and test difficult three-phase transformers (with multiple tap changers and bushing CTs) in a fraction of the time than it used to take with other TTRs. This test also includes a pass/fail limit of individual ratios.

The TTR300 Series also measures the phase deviation of the transformer primary versus secondary. This quickly indicates problems in the transformer such as partial shorted turns and core faults. This measurement is also useful in verifying phase errors in all types of PTs and CTs.

The TTR300 and TTR330 comes equipped with a remote-control switch for single person testing. This allows the operator to test transformers with LTCs very quickly.

The Series consists of three instruments:

#### TTR310E

The most popular in the series, this unit features an easy-to-read, transfective color display which can be seen in bright sunlight and provides the user interface for instrument set-up and test operation. The unit comes complete with the software application, PowerDB LITE.

The TTR310E has the ability to store test results, upload results to a PC (via RS232 serial port, Ethernet or USB), and/or print them in the field via optional thermal paper printer, without the use of an external computer.

Some of the features of the TTR310E consist of:

- Fully automatic operation (either stand-alone or remote-control)
- Built-in RS-232 port and optional thermal spool-paper printer allows for printing of test results, while in the field, and without the use of an external computer
- Built-in capability for storing test results into internal memory in an open data format for direct input into Excel® or XML format via PowerDB LITE



TTR310E — text-based unit with color display

**TTR300**

The TTR300 is designed to be completely remote controlled via a PC running PowerDB LITE (included) or PowerDB (full version) PC software applications.



TTR300 — remote controlled “black box” unit

**TTR330**

The TTR330 offers a user interface which allows the operator to interact with the PowerDB ONBOARD software system via full QWERTY and navigation keypads as displayed on an 8.4” VGA bright-color touchscreen. One of the primary benefits of this interface is that it displays the actual test form on the screen.

The TTR330 offers the following:

- Fully automatic operation (stand-alone or remote-control) with user interface via on-screen customizable test forms
- Integrated PowerDB ONBOARD allows for data analysis and trending while in the field without the use of an external computer
- Ability to perform and display magnetic balance
- Built-in USB port and optional USB printer
- Built-in capability for storing test results, in an open XML format, to either internal memory or to an external USB storage device
- Full 8.4” touchscreen VGA color display

### PowerDB LITE™ Acceptance & Maintenance Test Data Management Software

Testing can be performed in a remote control manner with PowerDB LITE. Control of the TTRs in this remote-control manner offers the following benefits:

- Problems such as PASS/FAIL are flagged visually using a RED highlight.
- Easily recall transformer setups from a custom settings menu.
- Quickly download results to the PC for completing a transformer test report.

**Built-in Memory**

The TTRs come equipped with sufficient internal memory to store test results. The outcome of the results are based on the model:

**TTR310E:** stores up to 200 three-phase data sets in the field for later retrieval. Test results can be printed on an optional printer or the data can be downloaded to a PC for archiving, analysis, trending, and/or printing.

**TTR330:** stores up to 100,000 data sets in the field for later retrieval. Test results can be printed on an optional in-lid printer (using 8.5” x 11” thermal paper), or the data can later be downloaded to a PC for archiving, analysis and/or printing.

Transformer Turns Ratio															
				H <sub>1</sub> - H <sub>0</sub> / X <sub>1</sub> - X <sub>0</sub>				H <sub>2</sub> - H <sub>0</sub> / X <sub>2</sub> - X <sub>0</sub>				H <sub>3</sub> - H <sub>0</sub> / X <sub>3</sub> - X <sub>0</sub>			
#	Tap H/L	Voltage H/L	Test V	TTR	Actual TTR	% error	I exc mA	Phase (Deg)	Actual TTR	% error	I exc mA	Phase (Deg)	Actual TTR	% error	I exc mA
1	Nominal	Nominal			10.000			0.00%	10.000			0.00%	10.000		0.00%
2	H1	H0			10.000			0.00%	15.000			0.00%	30.000		0.00%
3	H2	H0			20.000			0.00%	10.000			0.00%	20.000		0.00%
4	H3	H0			30.000			0.00%	15.000			0.00%	10.000		0.00%

Change Calc.

Magnetic Balance Test			
Applied Voltage to High Voltage Side B/W		Measured Percentage (%)	
		H1-H0	H2-H0
H1-H0		100.0000	66.6667
H2-H0		50.0000	100.0000
H3-H0		33.3333	66.6667

Magnetic balance test results use the voltage measured from each phase to validate the condition of core symmetry. Issues are highlighted by the state of imbalance seen. Above is an example of the format presented for a transformer:

#### APPLICATIONS

The TTR300 Series applies voltage to the high-voltage winding of a transformer and accurately measures the resulting voltage from the low voltage winding. In addition to turns ratio, the units measure excitation current, phase angle deviation between the high- and low-voltage windings and percent ratio error.

#### Transformer Turns Ratio

Transformer turns ratio is the ratio of the number of turns in the high-voltage winding to that in the low-voltage winding. Complexity in the measured ratio versus nameplate ratio occurs with most three-phase power transformers because multipliers such as  $\sqrt{3}$  are required to match the measured ratio to the nameplate ratio. The TTR300 Series automatically applies the multiplier in a form which allows the operator a direct comparison to the nameplate (or expected) ratio. The built-in calculator displays the % error versus nameplate for each tap and each winding, without the need for a computer.

#### Exciting Current

The TTR provides accurate measurement of exciting current (to 0.1 mA) which can help provide information about the condition of a transformer's core. Unwanted circulating currents or unintentional core grounds can increase the exciting current and indicate a problem.

#### Phase Angle Deviation and its Application

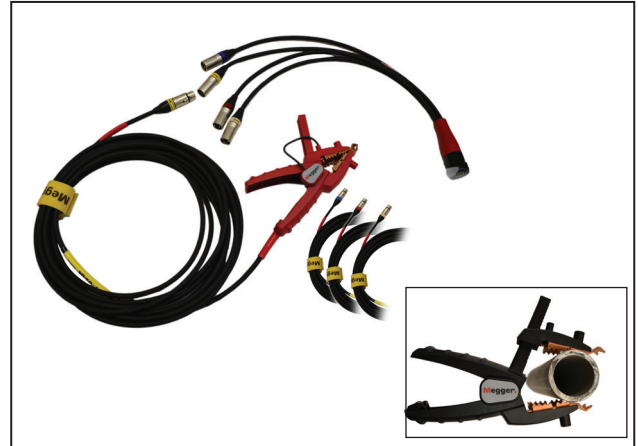
The phase angle deviation, displayed in either degrees (minutes) or radians, is the phase relationship between the voltage signal applied to the high-voltage winding and the voltage signal extracted from the low-voltage winding. The phase deviation, together with ratio error, can be used as a low-cost method of verifying approximate accuracy class of all types of PTs and CTs at "zero burden."

The phase deviation between the high and low side of a transformer is generally very small. If there is deterioration or damage in the transformer core, however, the phase deviation can change significantly. The three-phase TTR can measure this phase relationship with the resolution of 0.1 minutes (equal to 1/600 of a degree), which is necessary to detect problems.

#### OPTIONAL ACCESSORIES

##### Test Leads

Newly designed test leads, shown in image below, are universal and can be used for winding resistance (MTO3XX) or turns ratio (TTR3XX) instruments. Expandable jaws, shown in inset, allow for testing any size transformer.

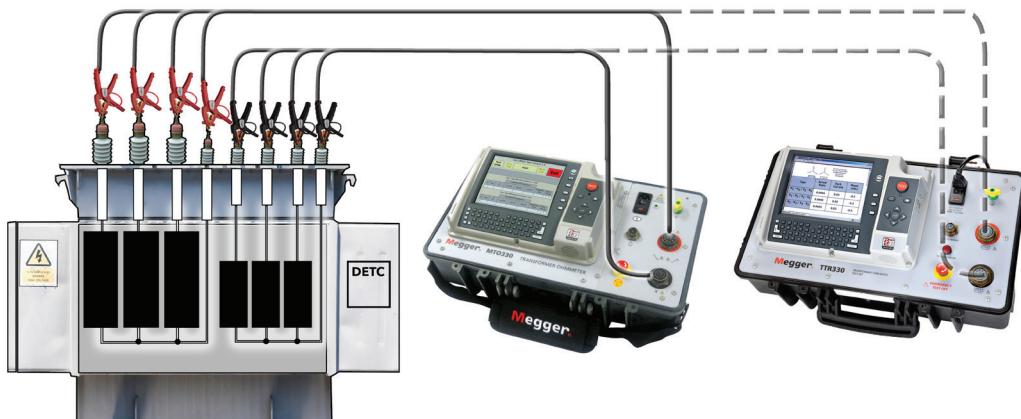


##### Remote Tap Controller

The RTC-1 is a manually operated remote tap controller designed to provide a more efficient method of controlling (on)load tap changer (LTC) while performing routine tests on power transformers. It removes the need to be physically close to the LTC while testing or to have a second person controlling the LTC while operating the testing instrument. A 30 ft (9 m) three-conductor cable is provided to allow proximity to the test instrument while performing testing and advancing tap positions as required throughout the test.



#### Two Instruments, One Set of Leads



The diagram shows the MTO3xx series and TTR300 series easily and conveniently using the same set of test leads. For example, the user can leave the leads connected to the transformer and use the same lead set to run turns-ratio testing with the Megger TTR3xx series, eliminating several up-and-down-the-ladder trips.

## SPECIFICATIONS

### Input Power

120V,  $\pm 10\%$  60Hz,  $\pm 2$  Hz, 100 VA  
240V,  $\pm 10\%$  50Hz,  $\pm 2$  Hz, 100 VA (-47)

### Excitation Voltage

8, 40, or 80 V rms, automatically or manually selected

### Excitation Current Range and Accuracy

0 to 500 mA, 3 digit resolution,  $\pm (2\%$  of reading + 1 digit)

### Phase Deviation Range and Accuracy

$\pm 90$  degrees, 1 decimal point for the minutes display, 2 decimal points for the degree display

Accuracy:  $\pm 3$  minutes ( $\pm 0.05$  degrees)

Phase angle measurement range up to 360 degrees is also available as per IEC, Accuracy:  $\pm 0.05$  degrees

### Turns Ratio Range and Accuracy

8 V ac:  $\pm 0.1\%$  (0.8 to 2000)  
 $\pm 0.25\%$  (2001 to 4000)  
 $\pm 0.35\%$  (4001 to 8000)  
40 V ac:  $\pm 0.1\%$  (0.8 to 2000)  
 $\pm 0.15\%$  (2001 to 4000)  
 $\pm 0.3\%$  (4001 to 10,000)  
 $\pm 0.35\%$  (10,001 to 25,000)  
80 V ac:  $\pm 0.1\%$  (0.8 to 2000)  
 $\pm 0.15\%$  (2001 to 4000)  
 $\pm 0.25\%$  (4001 to 10,000)  
 $\pm 0.30\%$  (10,001 to 45,000)  
Resolution: 5 digit for all ratios

### Printer Interface

TTR300: Not applicable  
TTR310E: RS-232 port  
TTR330: USB

### Computer Interface

TTR300 and TTR310E: RS-232 port, TTR310EE also has an Ethernet port  
TTR330: Ethernet

### User Interface

TTR300: Not applicable  
TTR310E: 5.7 in., color display, text on-screen view, numeric keypad  
TTR330: 8.4 in., full-color VGA, test forms on-screen view, touch controls, full QWERTY keypad and navigational pushbuttons

### Internal Data Storage

TTR310E: up to 200 data sets  
TTR330: up to 100,000 data sets

### Communication/Control Software

PowerDB LITE and PowerDB (full version, optional)  
TTR330: PowerDB ONBOARD

### Transformer Winding Phase Relationship

ANSI C57.12.70-1978  
CE/IEC 76-1:1993 and Publication 616:1978  
AS-2374, Part 4-1982 (Australian Standard)

### Safety/EMC/Vibration

Safety: IEC-1010-1  
CE: IEC 61326-1  
Vibration: ISTA Guidelines (packaged), IEC61010 (unpackaged)

### Temperature Range

**Operating:** 23° F to 122° F (-5° C to 50° C)  
**Storage:** -22° F to 140° F (-30° C to 60° C)

### Relative Humidity

0 to 90% noncondensing

### Measuring Time

8 to 20 seconds depending on mode of operation and type of transformer

### Measurement Method

ANSI/IEEE C57.12.90

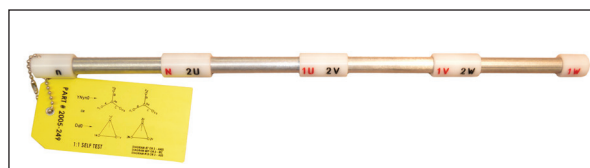
### Dimensions

Instrument:  
8.5 H x 21.5 W x 13 D in. (216 H x 546.1 W x 330.2 D mm)  
Case:  
25 H x 19 W x 26 D in. (635 H x 483 W x 660 D mm)




### Weight

Catalog No.	TTR300	TTR310E	TTR330
Instrument with Standard Leads	24 lb (10.8 kg)	25 lb (11.3 kg)	28 lb (12.7 kg)
Instrument with Optional Leads, 30 ft (10 m)	46 lb (20.9 kg)	47 lb (21.3 kg)	50 lb (22.7 kg)
Instrument with Transit Case	83 lb (37.6 kg)	84 lb (38.1 kg)	87 lb (39.4 kg)

Case: 37 lb (16.7 kg)



Shown above, 1:1 test jig, cat. no. 2005-249

<b>FEATURES AND BENEFITS GUIDE</b>	  		
	TTR300	TTR310E	TTR330
Remote controllable	■	■	■
Works in the presence of high interference/high voltage	■	■	■
Displays % error vs. name plate with pass/fail limits	■	■	■
Measures the widest turns ratio range in the industry (45,000:1) and provides the highest accuracy (0.1%)	■	■	■
Enables operator to enter the ratio of transformer and all of its taps letting operator know immediately when a tap is outside acceptable limits so problem can be flagged	■	■	■
Equipped with “Remote TEST” switch for single person testing, allowing the operator to test transformers with “LTCs” quickly	■		■
Measures phase deviation of the transformer primary vs. secondary; quickly indicates problems in the transformer such as partial shorted turns and core faults. Useful in verifying phase errors in PTs and CTs.	■	■	■
Rugged, lightweight design ideal for a harsh field and substation environment	■	■	■
User selectable standards: ANSI, IEC, and Australian. Meets IEC 1010 and other standards such as CSA and UL	■	■	■
“Quick Test” mode provides a fast determination of turns ratio single- and three-phase transformers	■	■	■
Capability for automatic vector detection when testing via PowerDB	■	■	■
Capability for testing phase-shifting and tilted transformers, in accordance with IEC61378, when testing via PowerDB	■	■	■
Printing of test results without the use of a computer	N/A	4” thermal spool paper	8.5” x 11” thermal paper
Software			
PowerDB LITE	■	■	■
“PowerDB ONBOARD” allows for operation of the unit through on-screen customizable test forms			■
Full version PowerDB	Optional	Optional	Optional
Communications port			
Printer interface	N/A	RS-232	USB
Internal data storage (data sets)	N/A	200	100,000
External storage device	N/A	USB	USB
Computer interface	RS-232	RS-232, Ethernet	Ethernet
User interface			
Display type	N/A	5.7” color VGA	8.4” color VGA
On-screen view	N/A	Text	Test forms
Keypad	N/A	Numeric	QWERTY



### ORDERING INFORMATION

Item	Cat. No.	Item	Cat. No.
Three-Phase TTR, remote controlled	TTR300	<b>Optional Accessories</b>	
Three-Phase TTR, stand alone or remote controlled	TTR310E	3-phase universal shielded test lead sets compatible with MTO3XX, MWA3XX & TTR3XX series instruments (up to 10A max), complete with color-coded Kelvin clamps:	
Three-Phase TTR with PowerDB ONBOARD	TTR330	3-phase universal, 9 m (30 ft) H & X	2008-30-KIT
Note: 120 V 60-Hz operation standard. For 230 V, 50-Hz operation	Add <b>-47</b> to Cat. No.	3-phase universal, 18 m (60 ft) H & X	2008-60-KIT
<b>Included Accessories</b>		3-phase universal, 30 m (100 ft) H & X	2008-100-KIT
Canvas carrying bag for test leads	2005-265	3-phase universal, 9 m (30 ft) H	2008-113-30
Power supply cord, 8 ft (2.5 m), [120 V versions]	17032-4	3-phase universal, 9 m (30 ft) X	2008-114-30
Power supply cord, 8 ft (2.5 m), [230 V versions]	17032-13	3-phase universal, 18 m (60 ft) H	2008-113-60
Ground lead, 15 ft (4.6 m)	4702-7	3-phase universal, 18 m (60 ft) X	2008-114-60
Hand-held TEST switch assy for remote operation (TTR300, TTR330 only)	30915-220	3-phase universal, 30 m (100 ft) H	2008-113-100
PowerDB LITE software		3-phase universal, 30 m (100 ft) X	2008-114-100
RS232 cable for connecting to a PC for use with TTR300 and TTR310E	CA-RS232	3-phase universal, 10 m (33 ft) X, extension	36486-7
Ethernet cable for connecting to a PC for use with TTR330, TTR310E	36798	3-phase universal, 10 m (33 ft) H, extension	36486-8
Ethernet CAT 5E/6 crossover adapter for TTR330 and TTR330-47	90011-383	3-phase universal, 10 m (33 ft) H & X, extension	36486-9
Transformer Vector Voltage Diagram Set (for ANSI, IEC, and AS Standards) for TTR310E	35298 35299 35300	TTR printer package for TTR310E	
1:1 test jig (instrument self test)	2005-249	120 V, 60 Hz	1001-390
Instruction manuals:		230 V, 50 Hz	1001-401
for TTR300	TTR300_UG	USB portable thermal printer (120/240V) for TTR330	1005-521
for TTR310E	TTR310E_UG	Replacement/spare battery pack for TTR310E printer	37077
for TTR330	TTR330_UG	Bushing clips (6)	MC7144
<b>Optional Replacement Lead Sets for older style TTR C/N550503</b>		Transit case (for instrument, leads and accessories)	2005-340
3-Ø "H" lead, 30 ft (9m) with old style H connector	2008-115-30	TTR check box	550555
3-Ø "X" lead, 30 ft (9m) with old style X connector	2008-116-30	TTR calibration standard	Y550055
		Remote tap controller, manual operation, model RTC-1, complete with quick guide, and red/black/white (total 3) alligator clips	1007-502