

# TTR<sup>®</sup>300 Series

## 3-Phase Transformer Turns Ratio Test Sets



TTR330 shown

- Stand-alone or remote-control operation
- Accurately measures ratio, phase deviation and exciting current
- Field upgradeable without compromise to calibration
- Built-in capability for storing and downloading test results in an XML format, via RS-232, Ethernet or USB ports (depending on model)
- Works in the presence of high interference/ high voltage
- Highest ratio measurement (45,000:1); highest accuracy (0.1%)
- Displays % error vs. name plate with pass/fail limits

### DESCRIPTION

The TTR300 Series of three-phase transformer turns ratio test sets are 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 are 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 measure 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.

Each unit 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 four instruments:

#### TTR300

The TTR300 is designed to be completely remote controlled via a PC running PowerDB LITE (included) or PowerDB (full version) PC software applications. The TTR300 is field upgradeable to the TTR310, TTR320 or TTR330.

Some of the features of the TTR300 are:

- Field upgradeable to a model TTR310, TTR320 or TTR330 without compromise to calibration
- Built-in capability for storing test results into internal memory in an open XML data format via PowerDB LITE
- Quickly download test results via RS-232 serial port



TTR300 — remote controlled "black box" unit



**TTR310 — text-based LCD interface unit**

**TTR310**

This unit features an easy-to-read, high-contrast LCD 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 TTR310 has the ability to store test results, upload results to a PC (via RS232 serial port), 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 TTR310 consist of:

- Fully automatic operation (either stand-alone or remote-control)
- Field upgradeable to a TTR330 or TTR320 without compromise to calibration
- 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<sup>®</sup> or XML format via PowerDB LITE



**TTR330 shown testing a pad mount three-phase transformer**

**TTR320**

The TTR320 features a high contrast bright 5.7" full VGA color display that can be seen in direct sunlight. The instrument employs a full QWERTY keyboard for entering nameplate-type information. Communications ports are provided in the form of RS-232, USB and Ethernet ports for easy on-board printing, storage, and downloading of test results.

Also, with a simple interface to PowerDB LITE PC software application (included), the user can perform data analysis and trending of results.

The TTR320 includes the following features:

- Fully automatic operation (stand-alone or remote-control)
- Field upgradeable to a model TTR330 without compromise to calibration
- Graphical User Interface allows for automated setup and control through easy-to-read ICON based screens
- Built-in capability for storing test results, in an open XML format, to either internal memory or to an external USB storage device
- 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
- 5.7" VGA bright color display



**TTR320 — graphical ICON based user interface unit**

**TTR330**

The TTR330 offers a new 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 screen. One of the primary benefits of this interface is that it displays the actual test form on the screen. An advanced feature of the TTR330 allows the user to customize these test forms via optional full-version PowerDB.

Other primary features of the TTR330 include three communications ports (two USB, one Ethernet). The USB "host" ports can be used for connecting directly to an optional printer (to print full size 8.5" x 11" completed test forms) and for data storage to a USB memory device (for later printing, analysis, archiving, and/or trending). The Ethernet port allows the TTR330 to interface (on a bi-directional basis) directly to a PC.

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
- Built-in USB port and optional USB printer allows for 8.5" x 11" test forms printing without the use of a laptop
- 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" VGA color display

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

All four units in the TTR300 Series come complete, at no extra charge, with PowerDB LITE (a new powerful PC Windows® based software program). PowerDB LITE allows the operator to completely program a test routine, in advance, for a transformer, save it under the transformer ID number, and then recall it in the future as required.

Testing on the TTRs can be performed in a remote control manner, via PowerDB LITE. Once testing is complete on all of the instruments, results are easily downloaded to the external PC in an "open" XML data format. The instruments' internal memory also maintains historical data-files so that, through interface to PowerDB LITE, current and past results can be archived, compared, analyzed, displayed in trend charts, and compiled into Test Reports.

Control of the TTRs in this remote-control manner offers the following benefits:

- Easy to use interface between operator and instrument.
- 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.

### **PowerDB™ (full version) Acceptance & Maintenance Test Data Management Software**

As an enhancement over the PowerDB LITE software (described above), a powerful "full version" PowerDB software is also available on the TTR300 Series as an option. PowerDB LITE and the internal architecture of the TTR Series has a seamless interface to the full version PowerDB, PC based software application.

Multiple data files (from multiple instruments) can automatically be fed to PowerDB in order to generate comprehensive asset analysis in the form of Reports containing table of contents, test data sheets, commentary, and deficiency summaries.

Electrical utilities who have invested in sophisticated Computerized Maintenance Management Systems (CMMS) can easily link with the PowerDB software because it works with a number of systems.

### **PowerDB™ ONBOARD Acceptance & Maintenance Test Data Management Software (Model TTR330 only)**

The "PowerDB ONBOARD" logo means PowerDB software is running on a computer embedded within the TTR330. This powerful feature provides the TTR330 with a common "User Interface" to minimize operator training and provides a seamless interface to the full PowerDB (PC version) application.

Easy-to-read on-screen test forms provide the user interface for instrument set-up and test operation. Results are displayed against pass/fail nameplate limits and can be stored (either internally or to a USB storage device) in an open XML data format.

The ONBOARD software also maintains a historical data file so that, while in the field, current and past results can be analyzed, compared, and displayed in trend charts without the need of an external computer. An 8.5" x 11" test form can also be printed in the field via an optional USB printer, and without the use of an external computer.

### **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:

**TTR310:** stores up to 200 three-phase data sets in the field for later retrieval. Test results can be printed on an optional printer (using thermal spool paper) whenever a hard copy is desired, or the data can be downloaded to a PC for archiving, analysis, trending, and/or printing. The system software allows entry of the transformer alphanumeric serial number, transformer type and tap information for each test performed.

**TTR320:** stores up to 100,000 data sets in the field for later retrieval. Test results can be printed on an optional printer (using thermal spool paper) whenever a hard copy is desired, or the data can later be downloaded to a PC for archiving, analysis, trending, and/or printing. Identification of individual test readings is also easily done. The system software allows entry of the transformer alphanumeric serial number, transformer type and tap information for each test performed.

**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) whenever a hard copy is desired, or the data can later be downloaded to a PC for archiving, analysis and/or printing. Identification of individual test readings is also easily done. The system software allows entry of the transformer alphanumeric serial number, transformer type and tap information for each test performed.

## 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 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.

## SPECIFICATIONS

### Input Power

120/230 V ac  $\pm 10\%$ , single phase, 50/60  $\pm 2$  Hz 100 VA

### Battery Operation (Optional)

Inverter 12 V dc to 120 V/230 V ac for operation from vehicle battery

### 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, or for the centi-radian display

**Accuracy:**  $\pm 3$  minutes

### Turns Ratio Range and Accuracy

|                 |                                                                                                                              |
|-----------------|------------------------------------------------------------------------------------------------------------------------------|
| <b>8 V ac:</b>  | $\pm 0.1\%$ (0.8 to 2000)<br>$\pm 0.25\%$ (2001 to 4000)<br>$\pm 0.35\%$ (4001 to 8000)                                      |
| <b>40 V ac:</b> | $\pm 0.1\%$ (0.8 to 2000)<br>$\pm 0.15\%$ (2001 to 4000)<br>$\pm 0.3\%$ (4001 to 10,000)<br>$\pm 0.35\%$ (10,001 to 25,000)  |
| <b>80 V ac:</b> | $\pm 0.1\%$ (0.8 to 2000)<br>$\pm 0.15\%$ (2001 to 4000)<br>$\pm 0.25\%$ (4001 to 10,000)<br>$\pm 0.30\%$ (10,001 to 45,000) |

**Resolution:** 5 digit for all ratios

### Printer Interface

**TTR300:** Not applicable

**TTR310:** RS-232 port

**TTR320:** RS-232 port

**TTR330:** USB

### Computer Interface

**TTR300 and TTR310:** RS-232 port

**TTR320 and TTR330:** Ethernet

### User Interface

**TTR300:** Not applicable

**TTR310:** 5.7 in., B&W display, text on-screen view, numeric keypad

**TTR320:** 5.7 in., full-color VGA, graphical icon on-screen view, full QWERTY keypad and navigational pushbuttons

**TTR330:** 8.4 in., full-color VGA, test forms on-screen view, full QWERTY keypad and navigational pushbuttons

### Internal Data Storage

**TTR310:** up to 200 data sets

**TTR320 and 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

CEI/IEC 76-1:1993 and Publication 616:1978

AS-2374, Part 4-1982 (Australian Standard)

### Safety/EMC/Vibration

Meets the requirements of IEC-1010-1, CE and ASTM D999.75

### Temperature Range

**Operating:** 23° F to 122° F (-5° C to 50° C)

**Storage:** -58° F to 140° F (-50° 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

8.5 H x 21.5 W x 13 D in.

(216 H x 546.1 W x 330.2 D mm)

### Weight


Instrument only, not including leads

**TTR300:** 20 lbs (9.1 kg)

**TTR310:** 23 lbs (10.4 kg)

**TTR320:** 25 lbs (11.3 kg)

**TTR330:** 25 lbs (11.3 kg)

| <b>FEATURES AND BENEFITS GUIDE</b>                                                                                                                                                                                 | <br><b>TTR300</b> | <br><b>TTR310</b> | <br><b>TTR320</b> | <br><b>TTR330</b> |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------|
| Field upgradeable/interchangeable to any other TTR in the Series without compromising calibration ( <i>patent pending</i> )                                                                                        | ■                                                                                                  | ■                                                                                                   | ■                                                                                                    | ■                                                                                                    |
| 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” very quickly                                                                                  | ■                                                                                                  | ■                                                                                                   | ■                                                                                                    | ■                                                                                                    |
| Measures phase deviation of the transformer primary versus 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 for single- and three-phase transformers                                                                                                            | ■                                                                                                  | ■                                                                                                   | ■                                                                                                    | ■                                                                                                    |
| Units can be operated while in transit case                                                                                                                                                                        | ■                                                                                                  | ■                                                                                                   | ■                                                                                                    | ■                                                                                                    |
| Leads can stay connected while in transit case                                                                                                                                                                     | ■                                                                                                  | ■                                                                                                   | ■                                                                                                    | ■                                                                                                    |
| Printing of test results without the use of a computer                                                                                                                                                             | N/A                                                                                                | 4” thermal spool paper                                                                              | 4” thermal spool paper                                                                               | 8.5” x 11” thermal paper                                                                             |
| Software<br>PowerDB LITE                                                                                                                                                                                           | ■                                                                                                  | ■                                                                                                   | ■                                                                                                    | ■                                                                                                    |
| “PowerDB ONBOARD” allows for operation of the unit through on-screen customizable test forms ( <i>patent pending</i> )                                                                                             |                                                                                                    |                                                                                                     |                                                                                                      | ■                                                                                                    |
| Full version PowerDB                                                                                                                                                                                               | Optional                                                                                           | Optional                                                                                            | Optional                                                                                             | Optional                                                                                             |
| Communications port                                                                                                                                                                                                |                                                                                                    |                                                                                                     |                                                                                                      |                                                                                                      |
| Printer interface                                                                                                                                                                                                  | N/A                                                                                                | RS-232                                                                                              | RS-232                                                                                               | USB                                                                                                  |
| Internal data storage (data sets)                                                                                                                                                                                  | N/A                                                                                                | 200                                                                                                 | 100,000                                                                                              | 100,000                                                                                              |
| External storage device                                                                                                                                                                                            | N/A                                                                                                | N/A                                                                                                 | USB                                                                                                  | USB                                                                                                  |
| Computer interface                                                                                                                                                                                                 | RS-232                                                                                             | RS-232                                                                                              | Ethernet                                                                                             | Ethernet                                                                                             |
| User interface                                                                                                                                                                                                     |                                                                                                    |                                                                                                     |                                                                                                      |                                                                                                      |
| Display type                                                                                                                                                                                                       | N/A                                                                                                | 5.7” B&W                                                                                            | 5.7” color VGA                                                                                       | 8.4” color VGA                                                                                       |
| On-screen view                                                                                                                                                                                                     | N/A                                                                                                | Text                                                                                                | Graphical icons                                                                                      | Test forms                                                                                           |
| Keypad                                                                                                                                                                                                             | N/A                                                                                                | Numeric                                                                                             | QWERTY                                                                                               | QWERTY                                                                                               |

**ORDERING INFORMATION**

| <b>Item (Qty)</b>                                                                      | <b>Cat. No.</b> | <b>Item (Qty)</b>                                                                  | <b>Cat. No.</b> |
|----------------------------------------------------------------------------------------|-----------------|------------------------------------------------------------------------------------|-----------------|
| Three-Phase TTR, remote controlled                                                     | TTR300          | <b>Optional Accessories</b>                                                        |                 |
| Three-Phase TTR, stand alone or remote controlled                                      | TTR310          | PowerDB software, 1st machine license, soft key                                    | DB1001          |
| Three-Phase TTR, graphical user interface                                              | TTR320          | PowerDB, 1st machine license, USB dongle                                           | DB1001S         |
| Three-Phase TTR with PowerDB ONBOARD                                                   | TTR330          | TTR check box                                                                      | 550555          |
| <i>Note: 120 V 50/60-Hz operation standard.</i>                                        |                 |                                                                                    |                 |
| <i>For 230 V, 50/60-Hz operation Add -47 to Cat. No.</i>                               |                 |                                                                                    |                 |
| <b>Included Accessories</b>                                                            |                 |                                                                                    |                 |
| Canvas carrying bag for test leads                                                     | 30915-211       | 3-ø lead set adapter to allow use of<br>Megger TTR C/N 550503 lead set (30915-xxx) | 37087           |
| Power supply cord, 8 ft (2.5 m), 120 V                                                 | 17032-4         | 3-ø TTR calibration standard                                                       | 550055          |
| Power supply cord, 8 ft (2.5 m), 230 V                                                 | 17032-13        | 3-ø shielded test lead set,<br>X and H winding, 30 ft (9.1 m)                      | 37093           |
| Ground lead, 15 ft (4.6 m)                                                             | 4702-7          | 3-ø shielded test lead set,<br>X and H winding, 50 ft (15 m)                       | 37094           |
| Hand-held TEST switch assy<br>for remote operation                                     | 30915-220       | 1-ø shielded test lead set,<br>X and H winding, 30 ft (9.1 m)                      | 37095           |
| PowerDB LITE software                                                                  |                 | Inverter with 3 ft (0.91 m) cigarette adapter cord                                 |                 |
| RS232 cable for connecting to a PC<br>for use with TTR300, TTR310 and TTR320           | CA-RS232        | 12 V dc to 120 V ac, 60 Hz                                                         | 35271-1         |
| Ethernet cable for connecting to a PC<br>for use with TTR320 and TTR330                | 36798           | 12 V dc to 120 V ac, 50 Hz                                                         | 35271-3         |
| Bushing clips (6)                                                                      | MC7144          | 12 V dc to 230 V ac, 60 Hz                                                         | 35271-2         |
| Transformer Vector Voltage Diagram Set<br>(for ANSI, IEC, and AS Standards) for TTR310 | 35314           | 12 V dc to 230 V ac, 50 Hz                                                         | 35271-4         |
| Spare fuse kits:                                                                       |                 | TTR printer package for TTR310, TTR320                                             |                 |
| for TTR300 and TTR310                                                                  | 35026-3         | 120 V, 60 Hz                                                                       | 1001-390        |
| for TTR300-47 and TTR310-47                                                            | 35026-4         | 230 V, 50 Hz                                                                       | 1001-401        |
| for TTR320 and TTR330                                                                  | 35026-5         | USB portable thermal printer (120V) for TTR330                                     | 36493-1         |
| for TTR320-47 and TTR330-47                                                            | 35026-2         | USB portable thermal printer (230V) for TTR330                                     | 36494-1         |
| Instruction manuals:                                                                   |                 | Thermal paper (8.5" x 11") for printer                                             | 36809-1         |
| for TTR300                                                                             | AVTMTTR300      | Thermal paper (A4) for printer                                                     | 36809-2         |
| for TTR310                                                                             | AVTMTTR310      | Replacement/spare battery pack for printer                                         | 37077           |
| for TTR320                                                                             | AVTMTTR320      | Transit case (for instrument, leads and accessories)                               | 37009           |
| for TTR330                                                                             | AVTMTTR330      | Field upgrade kits                                                                 |                 |
|                                                                                        |                 | TTR330 interface panel                                                             | 37089-1         |
|                                                                                        |                 | TTR320 interface panel                                                             | 37089-2         |
|                                                                                        |                 | TTR310 interface panel                                                             | 37089-3         |
|                                                                                        |                 | TTR300 interface panel                                                             | 37089-4         |

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