



POWER TRANSFORMER TESTING

# TRF-250A<sup>TM</sup>

## 3-PHASE TRANSFORMER TURNS RATIO FINDER

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# TRF-250A

3-Phase Transformer Turns Ratio Finder



## Product Overview

The TRF-250A is the battery-powered version of the TRF-250A. Its battery offers approximately 3 hours of continuous use. The TRF-250A features a built-in charger that allows the unit to be used while charging.

The TRF-250A provides a test voltage of 250Vac, a wireless Bluetooth PC interface, and features a 44-key "QWERTY"-style membrane keyboard. All these features greatly improve the accuracy of the turns ratio readings, ease of operation, and reliability.

The TRF-250A determines the turns ratio of the transformer under test using the IEEE C57.12.90 measurement method. The turns-ratio range is from 0.8 to 50,000 to 1. Transformer turns ratio, excitation current, and winding polarity are displayed on the built-in 128 x 64 pixels graphic LCD screen. The TRF-250A can be used as a standalone unit or can be computer-controlled.

## The 250V Test Voltage Advantage

The 250V test voltage provided by the TRF-250A provides more accurate test results when measuring the transformer turns ratios of very large transformers with a built-in LTC. The three figures below show the turns ratio test results and corresponding percentage error of a 600MVA transformer with an LTC in the Lowest position using 40V, 100V, and 250V test voltages. At the 250V test voltage, the percentage error is less than 0.5% as specified in IEC 60076-1 and IEEE C57.12.00-2006-1 standards.

### Test results using 40V test voltage

| RECORD NUMBER 6          |         |                    |       |       |
|--------------------------|---------|--------------------|-------|-------|
| TRANSFORMER TEST RESULTS |         |                    |       |       |
| DATE: 06/17/14           |         | TIME: 08:56:31     |       |       |
| TEST VOLTAGE = 40 V      |         |                    |       |       |
| TYPE: YNyn0              |         |                    |       |       |
| H TAP: _____             |         | H VOLTAGE: 310,500 |       |       |
| X TAP: _____             |         | X VOLTAGE: 141,500 |       |       |
| CALCULATED RATIO: 2.1943 |         |                    |       |       |
| PHS                      | M-RATIO | MA                 | PHASE | %DIFF |
| A                        | +2.2071 | 5.9                | -0.04 | 0.58  |
| B                        | +2.2054 | 4.9                | 0.09  | 0.51  |
| C                        | +2.2073 | 5.6                | -0.07 | 0.59  |

%Error &gt; 0.5%

### Test results using 100V test voltage

|                          |         |                    |                |       |  |
|--------------------------|---------|--------------------|----------------|-------|--|
| RECORD NUMBER 7          |         |                    |                |       |  |
| TRANSFORMER TEST RESULTS |         |                    |                |       |  |
| DATE: 06/17/14           |         |                    | TIME: 08:57:19 |       |  |
| TEST VOLTAGE = 100 V     |         |                    |                |       |  |
| TYPE: YNyn0              |         |                    |                |       |  |
| H TAP: _____             |         | H VOLTAGE: 310,500 |                |       |  |
| X TAP: _____             |         | X VOLTAGE: 141,500 |                |       |  |
| CALCULATED RATIO: 2.1943 |         |                    |                |       |  |
| PHS                      | M-RATIO | mA                 | PHASE          | %DIFF |  |
| A                        | +2.2059 | 8.0                | 0.24           | 0.53  |  |
| B                        | +2.2044 | 6.6                | 0.39           | 0.46  |  |
| C                        | +2.2056 | 7.3                | 0.69           | 0.51  |  |

%Error &gt; 0.5%

### Test results using 250V test voltage

| RECORD NUMBER 8          |         |                    |                |       |  |
|--------------------------|---------|--------------------|----------------|-------|--|
| TRANSFORMER TEST RESULTS |         |                    |                |       |  |
| DATE: 06/17/14           |         |                    | TIME: 08:58:15 |       |  |
| TEST VOLTAGE = 250 V     |         |                    |                |       |  |
| TYPE: YNyn0              |         |                    |                |       |  |
| H TAP: _____             |         | H VOLTAGE: 310,500 |                |       |  |
| X TAP: _____             |         | X VOLTAGE: 141,500 |                |       |  |
| CALCULATED RATIO: 2.1943 |         |                    |                |       |  |
| PHS                      | M_RATIO | mA                 | PHASE          | %DIFF |  |
| A                        | +2.2047 | 10.4               | 0.11           | 0.47  |  |
| B                        | +2.2039 | 8.2                | 0.00           | 0.44  |  |
| C                        | +2.2042 | 9.2                | 0.02           | 0.45  |  |

%Error &lt; 0.5%

## Outstanding Features

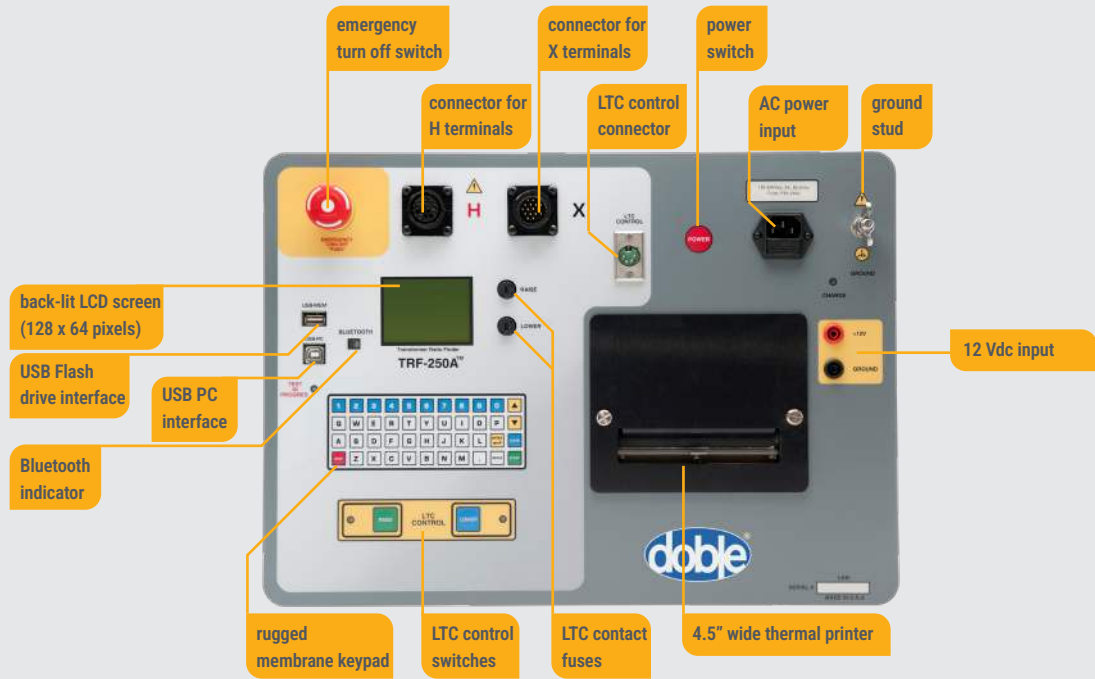
- Battery-powered
- Ratio range: 0.8 ~ 50,000 : 1
- Capable of detecting 130 different 3-phase transformer types defined by ANSI, IEC, and Australian standards
- 4 test voltages: 4Vac, 40Vac, 100Vac, and 250 Vac
- Phase angle and excitation current measurement
- Bluetooth and USB PC interfaces
- 4.5" wide thermal printer

## Ordering Information

| Part No. | Description                          |
|----------|--------------------------------------|
| 9106-UC  | TRF-250A, cables, and PC software    |
| 9106-SC  | TRF-250A shipping case               |
| TP4-CS   | TP4 thermal printer paper (24 rolls) |



# TRF-250A Features



## Auto-Detect Transformer Configuration

The TRF-250A can automatically detect 130 specific vector groups for different transformer types defined by ANSI, CEI/IEC, and Australian standards.

## Transformer Test Voltages

To prevent an accidental wrong test-lead hook-up (e.g., when the operator reverses H and X leads), the TRF-250A outputs a low-level test voltage to verify the hook-up condition before applying the full test voltage to the transformer. Four test voltages (4 Vac, 40 Vac, 100 Vac, 250 Vac) allow the TRF-250A to test CT's and PT's, as well as power transformers.

## Load Tap Changer Control

Voltage regulator or LTC tap positions can be changed remotely using the unit's built-in transformer load tap changer. This feature eliminates the need to manually raise or lower tap positions from the transformer control panel.

## Built-in Thermal Printer

The TRF-250A offers an optional built-in 4.5" wide thermal printer that can be used to print test results.

## User Interface

The TRF-250A features a back-lit LCD screen (128 x 64 pixels) that is viewable in both bright sunlight and low-light levels. The test results screen displays the transformer turns-ratio, excitation current, phase angle, and percentage error. The unit is controlled via a rugged, 44-key, "QWERTY"-style membrane keypad.

## Computer Interface

In computer-controlled mode, the unit can be controlled via the Bluetooth or USB interface using the supplied PC software (Transformer Turns-Ratio Analyzer application provided with each unit). This Windows®-based application can be used to run tests and to store test results on a PC. Test results can also be exported to Excel, PDF, and XML formats for further analysis.

## USB Flash Drive Interface

A built-in USB Flash drive interface provides a convenient method for transferring test plans and test records to or from a USB Flash drive. The user can store up to 999 transformer test plans and test records on a USB Flash drive, and the supplied PC software can be used to view the test records.

## Battery-powered

The TRF-250A uses two sealed lead acid batteries (12V, 2AH) that can provide up to three hours of operation. It features a built-in charger that allows the unit to be used while charging.

## Internal Test Record Storage

Up to 112 test records can be stored in the TRF-250A's Flash EEPROM memory. Each test record may contain up to 99 turns-ratio, excitation current, phase angle and nameplate voltage readings. Test records can be recalled locally or transferred to a PC via the available interfaces (Bluetooth, USB port, USB Flash drive port).

## Transformer Test Plans

The TRF-250A can store up to 128 transformer test-plans in its Flash EEPROM. A test-plan is comprised of the transformer nameplate voltages for each tap setting. The calculated turns ratio based on the nameplate voltages is compared with the measured turns-ratio to derive the percentage error and Pass/Fail results. By using a test plan, a transformer can be quickly tested and turns-ratio Pass/Fail reports can be reviewed. Test plans can be created with the PC software and can be transferred to the TRF-250A via the available interfaces (Bluetooth, USB port, USB Flash drive port).



Measured Ratio for  
Phase A, B, and C

Excitation Current  
Reading

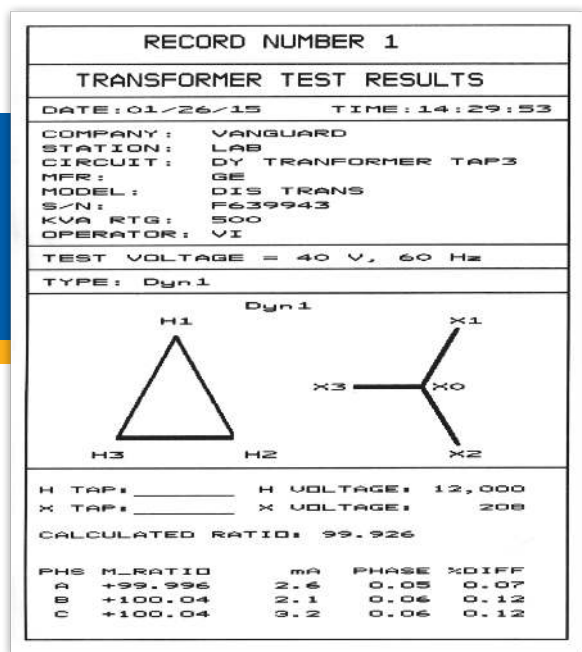
Percentage  
Error



typical test results screen

Winding Polarity

Transformer Type



thermal printer  
output (optional)

Test results can be quickly printed in the field on the TRF-250A's optional built-in thermal printer without the need to connect the unit to a PC.



**Vanguard Instruments Company, Inc.**

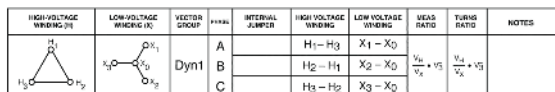
1520 S. Hellman Avenue, Ontario, CA 91761, USA Phone: 909.923.9390 FAX: 909.923.9391  
www.vanguard-instruments.com

#### TRANSFORMER TURNS RATIO REPORT

Filename: test001.txt Date: January 28, 2015 Time: 04:02 PM Page (1/1)

Company: VANGUARD  
Location: LAB  
Circuit: DY TRANSFORMER TAP3  
Operator:  
Comment:

MFR: GE  
Device: Transformer  
Type: Dyn1  
Model: DIS TRANS  
Rating: 500  
Serial #: F639943  
Max Deviation %: .3  
Test Voltage: 40V



desktop  
printer output

Test reports can be generated with the included TTRA S2 PC software. Test records can be exported to Excel, PDF, and XML formats for further analysis.

| TEST | H VOLT | H TAP | X VOLT | X TAP | C-RATIO | M-RATIO                                  | DEV [%]              | P/F         | I[mA]                   | DEGREE                  | RES |
|------|--------|-------|--------|-------|---------|------------------------------------------|----------------------|-------------|-------------------------|-------------------------|-----|
| 1    | 12000  |       | 208    |       | 99.9260 | A: +99.996<br>B: +100.042<br>C: +100.043 | 0.07<br>0.12<br>0.12 | P<br>P<br>P | 2.600<br>2.100<br>3.200 | 0.050<br>0.060<br>0.060 |     |

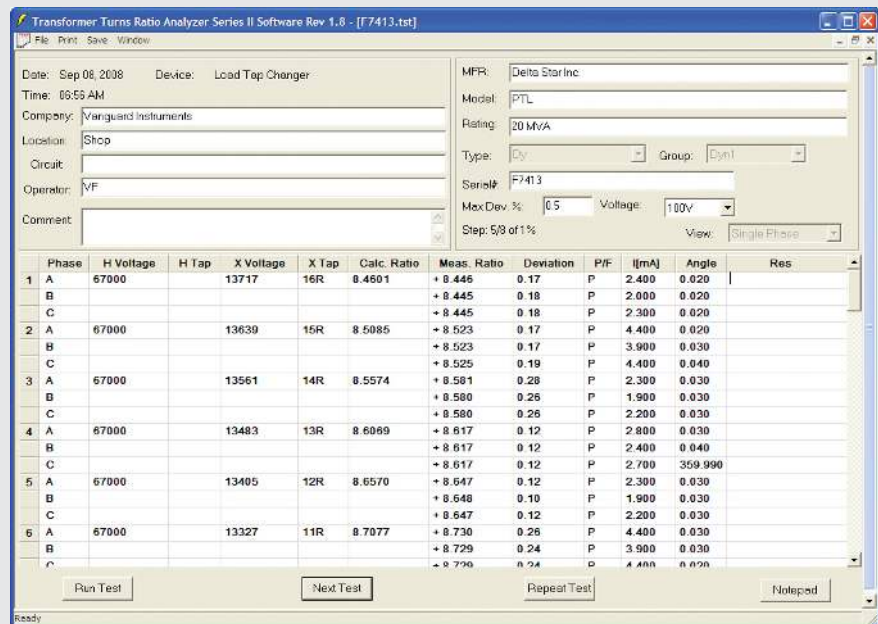


# TTRA S2 Software

The TRF-250A comes with the Doble Transformer Turns Ratio Analysis Series 2 (TTRA S2) PC software. The TTRA S2 software can be used to test winding turns ratios of transformers, voltage regulators, and load-tap changers. Test plans can be created using the TTRA S2 application and then transferred to the TRF-250A. Test records can be exported to Excel, PDF, and XML formats for further analysis.

The latest version of the TTRA S2 software can always be downloaded free from the Doble web site at [www.doble.com/vanguard-instruments](http://www.doble.com/vanguard-instruments).

Please note that you will need to create a free account on our site in order to download software or firmware.



## TRF-250A Technical Specifications

|                                                                                     |                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                     |                                   |                                                                          |
|-------------------------------------------------------------------------------------|-------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-----------------------------------|--------------------------------------------------------------------------|
|    | <b>physical specifications</b>      | <b>Dimensions:</b> 18"W x 5"H x 12" D (45.7 cm x 12.7 cm x 30.5 cm)<br><b>Weight:</b> 20 lbs. (9.1 Kg)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |    | <b>input power</b>                | 100 ~ 240 Vac,<br>50/60 Hz or 12 Vdc                                     |
|    | <b>measuring method</b>             | ANSI/IEEE C57.12.90                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |    | <b>ratio measuring range</b>      | 0.8 ~ 50,000 : 1                                                         |
|  | <b>batteries</b>                    | two lead acid batteries (12V, 2AH) provide up to 3 hours of operation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |  | <b>lte contact</b>                | 240 Vac, 2A                                                              |
|  | <b>typical turns-ratio accuracy</b> | <b>4 Vac:</b> 0.8 ~ 1,000 ( $\pm 0.08\%$ ), 1,001 ~ 4,000 ( $\pm 0.1\%$ ), 4,001 ~ 15,000 ( $\pm 0.25\%$ )<br><b>40 Vac:</b> 0.8 ~ 1,000 ( $\pm 0.05\%$ ), 1,001 ~ 4,000 ( $\pm 0.1\%$ ), 4,001 ~ 15,000 ( $\pm 0.25\%$ ), 15,001 ~ 20,000 ( $\pm 0.4\%$ ), 20,001 ~ 50,000 ( $\pm 0.5\%$ )<br><b>100 Vac:</b> 0.8 ~ 1,000 ( $\pm 0.05\%$ ), 1,001 ~ 4,000 ( $\pm 0.1\%$ ), 4,001 ~ 15,000 ( $\pm 0.25\%$ ), 15,001 ~ 20,000 ( $\pm 0.4\%$ ), 20,001 ~ 50,000 ( $\pm 0.5\%$ )<br><b>250 Vac:</b> 0.8 ~ 1,000 ( $\pm 0.03\%$ ), 1,001 ~ 4,000 ( $\pm 0.1\%$ ), 4,001 ~ 15,000 ( $\pm 0.2\%$ ), 15,001 ~ 20,000 ( $\pm 0.4\%$ ), 20,001 ~ 50,000 ( $\pm 0.5\%$ ) |                                                                                     |                                   |                                                                          |
|  | <b>test voltages</b>                | 4 Vac @ 120 mA, 40 Vac @ 50 mA, 100 Vac @ 20 mA, 250 Vac @ 10 mA                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |  | <b>current reading range</b>      | 0 ~ 1 Ampere, accuracy: $\pm 0.1$ mA, $\pm 2\%$ of reading ( $\pm 1$ mA) |
|  | <b>display</b>                      | back-lit LCD screen (128 x 64 pixels)<br>viewable in bright sunlight and low-light levels                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |  | <b>phase angle measurement</b>    | 0 ~ 360 degrees<br>accuracy: $\pm 0.2$ degree ( $\pm 1$ digit)           |
|  | <b>printer</b>                      | built-in 4K" wide thermal printer (optional)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |  | <b>computer interfaces</b>        | Bluetooth, USB port                                                      |
|  | <b>pc software</b>                  | Windows®-based transformer turns-ratio analysis software is included with purchase                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |  | <b>internal test plan storage</b> | stores up to 128 transformer test plans; plans can be transferred to PC. |
|  | <b>internal test record storage</b> | stores 112 complete transformer test records, each record holding the test record header and up to 99 readings                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |  | <b>external data storage</b>      | up to 999 test records on external USB flash drive (drive not included)  |
|  | <b>safety</b>                       | designed to meet UL 61010A-1 and CAN/CSA C22.2 No. 1010.1-92 standards                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |  | <b>humidity</b>                   | 90% RH @ 40°C (104°F)<br>non-condensing                                  |
|  | <b>temperature</b>                  | <b>Operating:</b> -10°C to +50°C (+15°F to +122°F)<br><b>Storage:</b> -30°C to +70°C (-22°F to +158°F)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |  | <b>altitude</b>                   | 2,000 m (6,562 ft)<br>to full safety specifications                      |
|  | <b>cables</b>                       | One 15-foot (4.57m) single-phase set, one 15-foot (4.57m) 3-phase set, one 25-foot (7.62m) extension set, one safety ground, one USB, cable bag                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                     |                                   |                                                                          |
|  | <b>options</b>                      | shipping case, 30' (9.14 m) 3-phase H and X leads, 30' (9.14 m) single phase H and X leads                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |  | <b>warranty</b>                   | one year on parts and labor                                              |

NOTE : the above specifications are valid at nominal voltage and ambient temperature of +25°C (+77°F). Specifications are subject to change without notice.



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