

# TRF-250

*automatic, 250V, 3-phase transformer ratio finder*



**Vanguard Instruments Company, Inc.**  
[www.vanguard-instruments.com](http://www.vanguard-instruments.com)

# TRF-250

## *automatic, 3-phase transformer ratio finder*

The TRF-250 is Vanguard's fourth generation transformer turns ratio tester. This latest design provides a higher turns-ratio test voltage of 250Vac, provides 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-250 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-250 can be used as a standalone unit or can be computer-controlled.

### outstanding features

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

### Auto-Detect Transformer Configuration

The TRF-250 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-250 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-250 to test CT's and PT's, as well as power transformers.

### Transformer 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.

### Optional Built-in Thermal Printer

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

### User Interface

The TRF-250 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.

### Bluetooth PC Interface

The TRF-250 offers an industry-first Bluetooth wireless interface along with an Android App that can be used to remotely control the unit.

## ordering information

Part number <b>9105-UC</b>	TRF-250, cables, and PC software
Part number <b>9105-PR</b>	TRF-250 built-in thermal printer option
Part number <b>9105-SC</b>	TRF-250 shipping case
Part number <b>TP4-CS</b>	TP4 thermal printer paper (24 rolls)

# TRF-250 Controls & Indicators



## 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.

## Internal Test Record Storage

Up to 112 test records can be stored in the TRF-250'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-250 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-250 via the available interfaces (Bluetooth, USB port, USB Flash drive port).

## The 250V Test Voltage Advantage

The 250V test voltage provided by the TRF-250 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: 2.1949				
PHS	R-RATIO	mA	PHASE	NDIFF
A	+2.2051	5.9	-0.04	0.56
B	+2.2054	4.9	0.09	0.81
C	+2.2079	5.6	-0.07	0.59

%Error > 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: 2.1949				
PHS	R-RATIO	mA	PHASE	NDIFF
A	+2.2089	6.0	0.24	0.53
B	+2.2044	6.6	0.39	0.46
C	+2.2056	7.9	0.69	0.51

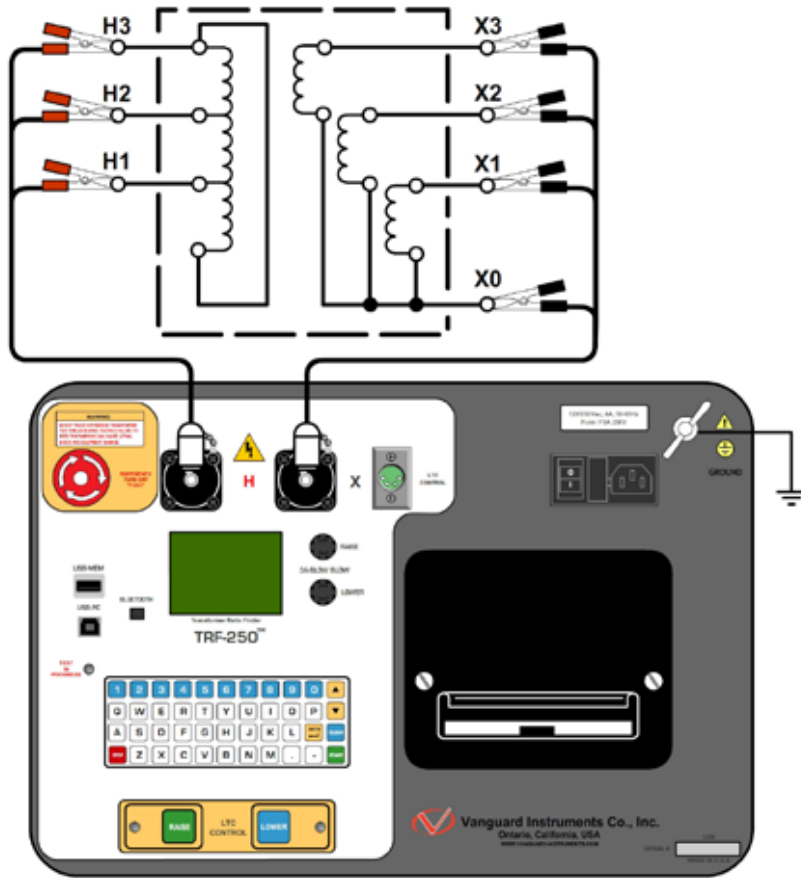
%Error > 0.5%

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: 2.1949				
PHS	R-RATIO	mA	PHASE	NDIFF
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 < 0.5%

# TRF-250 connections



# TRF-250 test results screen



Phase  
Winding Polarity  
Measured Turns Ratio  
Excitation Current  
Transformer Type  
%Error

# TRF-250 desktop printer output

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TRANSFORMER TURNS RATIO REPORT

Filename: test001.tst Date: June 26, 2014 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

TEST	H VOLT	H TAP	X VOLT	X TAP	C-RATIO	M-RATIO	DEV [%]	PIF	I[=A]	DEGREE	RES
1	12000		208		99.9260	A: +99.996 B: +100.042 C: +100.043	0.07 0.12 0.12	P P P	2.600 2.100 3.200	0.050 0.060 0.060	

# TRF-250 thermal printer output

RECORD NUMBER 1

TRANSFORMER TEST RESULTS

DATE: 06/26/14 TIME: 14:29:53

COMPANY: VANGUARD  
STATION: LAB  
CIRCUIT: DY TRANSFORMER TAP3  
MFR: GE  
MODEL: DIS TRANS  
S-N: F639943  
KVA RTG: 500  
OPERATOR: VI

TEST VOLTAGE = 40 V, 60 Hz

TYPE: Dyn1

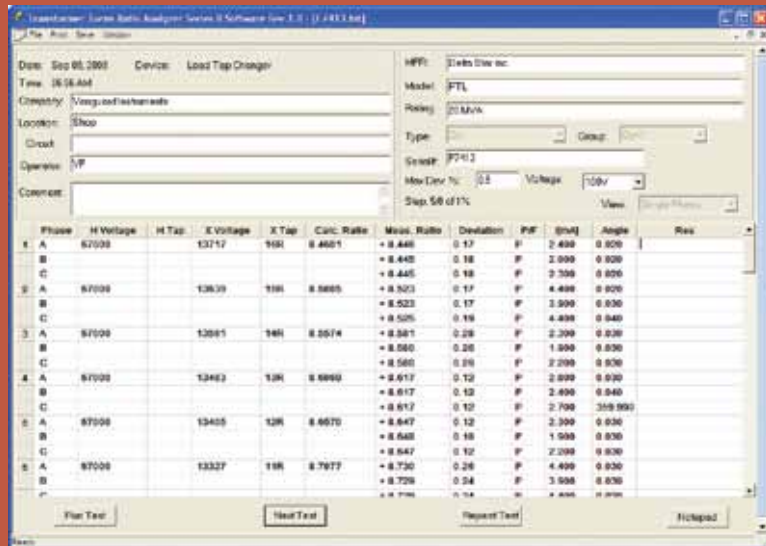
H TAP: \_\_\_\_\_ H VOLTAGE: 12,000  
X TAP: \_\_\_\_\_ X VOLTAGE: 208

CALCULATED RATIO: 99.926

PHS	M-RATIO	mA	PHASE	%DIFF
A	+99.996	2.6	0.05	0.07
B	+100.04	2.1	0.06	0.12
C	+100.04	3.2	0.06	0.12

# Computer control and analysis with included TTRA S2 Software

The TRF-250 comes with the Vanguard 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-250. Test records can be exported to Excel, PDF, and XML formats for further analysis.



## TRF-250 specifications

<b>type</b>	Portable, lightweight, automatic, 3-phase transformer turns-ratio meter
<b>physical specifications</b>	18"W x 5"H x 12"D (45.7 cm x 12.7 cm x 30.5 cm ); Weight: 20 lbs (9.1 kg)
<b>operating voltage</b>	100 – 240 Vac, 50/60 Hz
<b>measurement method</b>	ANSI/IEEE C57.12.90
<b>turns ratio measuring range</b>	0.8 – 50,000 to 1
<b>turns ratio accuracy</b>	0.8 – 1,999: ±0.1%, 2,000 – 3,999: ±0.25%, 4,000 – 14,999: ±1%, 15,000 – 50,000: ±2% @ 4Vac 0.8 – 1,999: ±0.1%, 2,000 – 3,999: ±0.20%, 4,000 – 14,999: ±1%, 15,000 – 50,000: ±1.5% @ 40Vac 0.8 – 1,999: ±0.1%, 2,000 – 3,999: ±0.20%, 4,000 – 14,999: ±1%, 15,000 – 50,000: ±1.5% @ 100Vac 0.8 – 1,999: ±0.1%, 2,000 – 3,999: ±0.15%, 4,000 – 14,999: ±0.8%, 15,000 – 50,000: ±1.2% @ 250Vac
<b>test voltages</b>	4 Vac @ 1 Amp, 40 Vac @ 200 mA, 100 Vac @ 100 mA, 250 Vac @ 50 mA
<b>excitation current reading range</b>	0 – 2 Amperes; Accuracy: ±0.1 mA, ±2% of reading (±1 mA)
<b>phase angle measurement</b>	0 – 360 Degrees; Accuracy: ±0.2 degree (±1 digit)
<b>display</b>	Back-lit LCD screen (128 x 64 pixels) viewable in bright sunlight and low-light levels
<b>printer</b>	Built-in 4.5-inch wide thermal printer
<b>computer interfaces</b>	Bluetooth, USB port
<b>external data storage</b>	One USB Flash drive interface port; Up to 999 transformer test records can be stored on a USB Flash drive (not included)
<b>internal test record storage</b>	Can store 112 transformer test records internally. Each record holds the test record header and up to 99 readings.
<b>internal test plan storage</b>	Can store 128 transformer test plans internally. Test plans can be transferred to the unit from the PC via Bluetooth/USB port or via the USB Flash drive interface
<b>pc software</b>	Windows®-based Transformer Turns Ratio Analyzer application is included with purchase price
<b>load tap changer contact</b>	240 Vac, 2 Amps
<b>safety</b>	Designed to meet UL 61010A-1 and CAN/CSA C22.2 No. 1010.1-92 standards
<b>environment</b>	Operating: -10°C to +50°C (+15°F to +122°F); Storage: -30°C to +70°C (-22°F to +158°F)
<b>humidity</b>	90% RH @ 40°C (104°F) non-condensing
<b>altitude</b>	2,000 m (6,562 ft) 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>	transportation case
<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.



## Instruments designed and developed by the hearts and minds of utility electricians around the world

Vanguard Instruments Company, (VIC), was founded in 1991. Currently, our 28,000 square-foot facility houses Administration, Design & Engineering, and Manufacturing operations. From its inception, VIC's vision was, and is to develop and manufacture innovative test equipment for use in testing substation EHV circuit breakers and other electrical apparatus.

The first VIC product was a computerized circuitbreaker analyzer, which was a resounding success. It became the forerunner of an entire series of circuitbreaker test equipment. Since its beginning, VIC's product line has expanded to include microcomputer-based, precision micro-ohmmeters, single and three phase transformer winding turns-ratio testers, transformer winding-resistance meters, mega-ohm resistance meters, and a variety of other electrical utility maintenance support products.

VIC's performance-oriented products are well suited for the utility industry. They are rugged, reliable, accurate, user friendly, and most are computer controlled. Computer control, with innovative programming, provides many automated testing functions. VIC's instruments eliminate tedious and time-consuming operations, while providing fast, complex, test-result calculations. Errors are reduced and the need to memorize long sequences of procedural steps is eliminated. Every VIC instrument is competitively priced and is covered by a liberal warranty.



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