

# TRM-203/403

transformer resistance meters



**Vanguard Instruments**  
A DOBLE COMPANY





# TRM-203/403

## transformer resistance meters

### Product Overview

The TRM-203 and TRM-403 are three phase transformer winding resistance meters that allow the user to connect all test cables to the transformer bushings. The unit will then measure the transformer resistance value for each of the phases without the need to disconnect and reconnect cables for each phase.

The TRM-203/403 can provide fast and stable readings of very large transformers by utilizing a 60Vdc power supply. The TRM-203 is capable of outputting a selectable test current from 1A to 20A while the TRM-403's test current is selectable from 1A to 40A.

Since both units can accurately measure resistance from 1 micro-ohm to 500 Ohms (up to 2000 Ohms for the TRM-203), they can be used as micro-ohmmeters to measure EHV circuit breaker contact resistance, or for any low resistance measuring application.

For a Delta transformer, the TRM-203/403 can measure the phase resistance readings and provide the individual Delta winding resistance values. The TRM-203/403 can also provide the individual winding resistance values for a Wye transformer without the neutral terminal.

If the transformer winding resistance temperature is available at the time of testing, the TRM-203/403 can calculate the equivalent resistance value at any temperature value. This useful feature can be used to compare the field readings against factory test resistance values.

A special test mode allows the TRM-203/403 to collect data automatically for up to 90 minutes at a 60-second sampling interval (10, 15, 20, and 30 second sampling rates are also available. Duration will vary accordingly). Test data is recorded with a time stamp.

All test results can be printed on the unit's built-in 2.5" wide thermal printer. Test record header information including the Company, substation name, transformer information, and operator name can also be entered.

The TRM-203/403 can automatically demagnetize the inductive device under test, eliminating the manual task of demagnetizing the transformer core after a resistance test.

The TRM-203/403 also has a "make-before-break" test mode that can be used to test the Load Tap Changer (LTC) or Voltage Regulator contact test sequence. The TRM-203/403 produces a "Dynamic-Resistance" graph of the LTC or Voltage regulator contact under operation. An opened contact can be detected visually from this resistance chart.

The TRM's built-in LTC/Voltage regulator can be used to conveniently change the LTC/voltage regulator tap position from the TRM-203/403 front panel.

### User Interface

The TRM-203/403 features a back-lit graphic LCD screen (240 x 128 pixels) that is clearly visible in both bright sunlight and low light levels. A 44-key "QWERTY"-style membrane keypad is used to enter test information and operate the unit.

### Computer Interface

The TRM-203/403 can be connected to a PC via the unit's RS-232C, USB, or Bluetooth interface. A PC can be used to control the TRM-203/403 to perform transformer resistance tests. Test records (stored in the TRM-203/403 or a USB Flash drive) can also be retrieved, reviewed, and printed. Test records are automatically exported to PDF, Excel, and XML formats.

### Safety Features

The TRM-203/403 automatically dissipates the energy stored in the transformer at the end of each test. The discharge circuit will continue to work even if the TRM-203/403 power supply is lost.

### Test Record Storage

The TRM-203/403 can store up to 256 static test records (111 tests per record) and 120 dynamic test records internally. For external test record storage, the TRM-203/403 features a USB Flash drive interface port. Up to 999 test records can be stored on a connected USB Flash Drive.

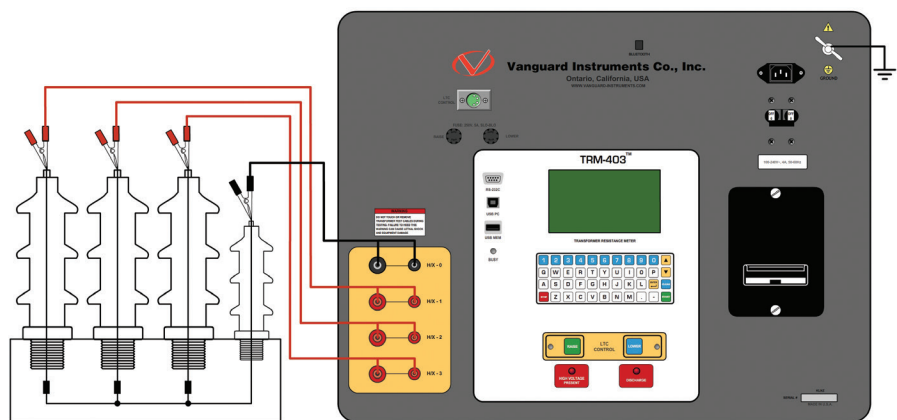
### outstanding features

- Perform three phase test on a transformer without the need to switch cables
- Can provide individual Delta winding resistance values
- Can provide individual Wye (with no neutral) winding resistance values
- Demagnetize transformer after test
- Selectable test current from 1A to 20A (TRM-203) and 1A to 40A (TRM-403)
- Computer control via RS-232C, USB, or bluetooth wireless interface
- Built-in 2.5" wide thermal printer

### ordering information

Part No.	Description
9060-UC	TRM-203, cables, and PC software
9006-UC	TRM-403, cables, and PC software
TP3-CS	TP3 thermal printer paper (36 rolls)

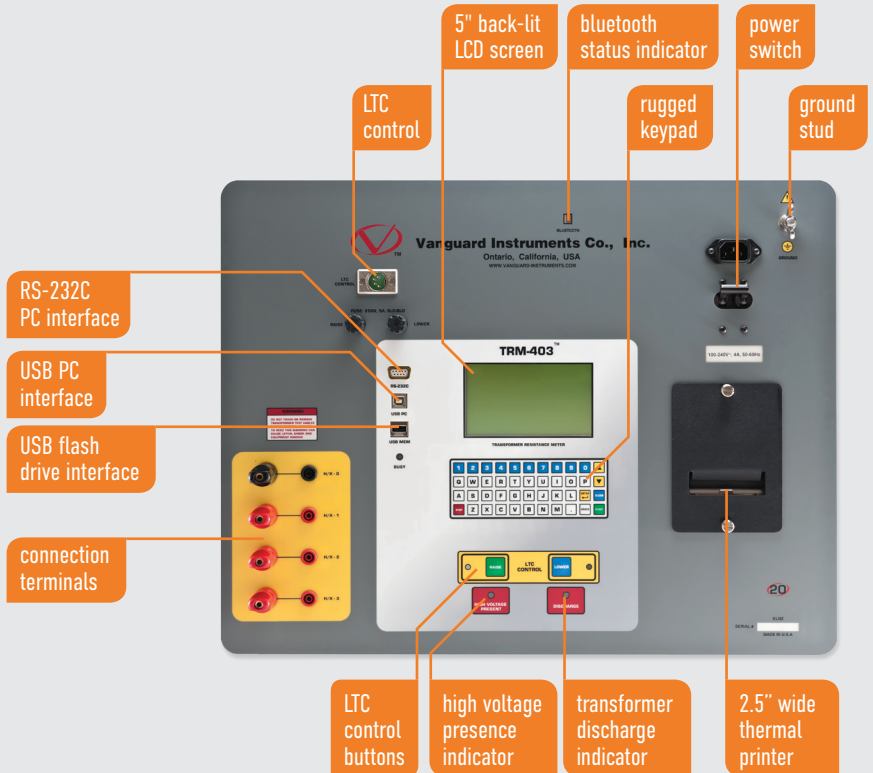
### TRM-203/403 connections



## Thermal Printer Output

RECORD NUMBER 7	
TEST RESULTS	
DATE: 01/28/15 TIME: 14:21:17	
COMPANY:	VIC
STATION:	LAB
CIRCUIT:	VR1
MFR:	GE
MODEL:	STEP VR
SN:	Q25869 TOK
KVA RTG:	75
OPERATOR:	
V1 & V2 TEST	
TESTED AT 40 AMPS	
R1 =	3.457 MILLI-OHMS
R2 =	3.559 MILLI-OHMS
I =	39.991 AMPS
TAP/WINDING:	

## TRM-203/403 Features



## TRM-203/403 technical specifications


<b>physical specifications</b>	<b>Dimensions:</b> 21"W x 17"H x 9" D (53 cm x 43 cm x 24 cm) <b>Weight:</b> 35 lbs. (15.8 Kg)	<b>input power</b>	100 – 240 Vac, 50/60 Hz
<b>resistance reading range</b>	<b>TRM-203:</b> 1 micro-ohm – 2,000 ohms <b>TRM-403:</b> 1 micro-ohm – 500 ohms	<b>test currents</b>	<b>TRM-203:</b> 1A – 25A in 1A increments <b>TRM-403:</b> 1A – 40A in 1A increments
<b>accuracy</b>	<b>1 – 19,999 micro-ohms:</b> ±0.5% reading, ±1 count <b>20 – 999 milliohms:</b> ±1% reading, ±1 count <b>1 – 2,000 ohms:</b> ±1.5% reading, ±1 count	<b>input channels</b>	4 input channels for measuring resistance
<b>display</b>	5" back-lit LCD screen (240 x 128 pixels) viewable in bright sunlight and low-light levels	<b>test voltage</b>	60 Vdc charging, 18 Vdc max during measurement
<b>printer</b>	built-in 2½" wide thermal printer	<b>ac current input</b>	clamp-on current sensor, 1 – 20 A
<b>pc software</b>	Windows®-based software is included with purchase price	<b>computer interfaces</b>	one RS-232C port, one USB port, one USB flash drive port, bluetooth
<b>internal test record storage</b>	256 static test records (each can contain up to 111 readings) and 120 dynamic test records	<b>load tap changer contact</b>	designed to meet IEC 61010 (1995), UL 61010-a, and CAS-C22.2 standards
<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>temperature</b>	<b>Operating:</b> -10°C to +50°C (+15°F to +122°F) <b>Storage:</b> -30°C to +70°C (-22°F to +158°F)	<b>humidity</b>	90% RH @ 40°C (104°F) non-condensing
<b>cables</b>	four 50-foot (15.24m) test cables, one LTC control cable, one ground cable, one power cord, one USB cable	<b>altitude</b>	2,000 m (6,562 ft) to full safety specifications
<b>options</b>	shipping 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.

# TRM-203/403 desktop printer output

## static resistance test results

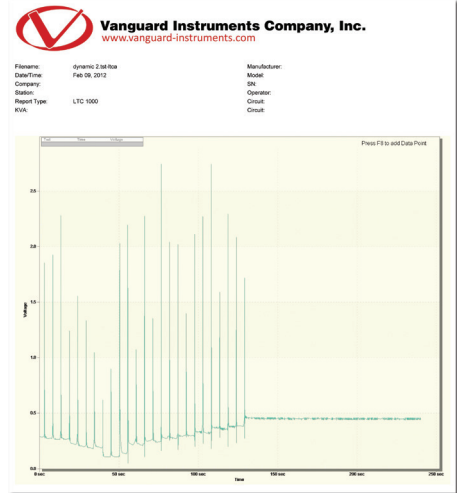
## dynamic resistance test graph



**Vanguard Instruments Company, Inc.**

Filename: REC\_018 Manufacturer: PASTI  
 Date/Time: January 18, 2015 06:07 PM Model: 1234567890  
 Company: DDE Station: 12345678901234567890  
 Station: 2358 Operator: HAI  
 Report Type: V1,V2,V3 Circuit: AFO 4 GI CPK  
 KVA: 10 MVA Measure Temp: 25.0 C Reference Temp: 85.0 C Temp Constant: 234.5

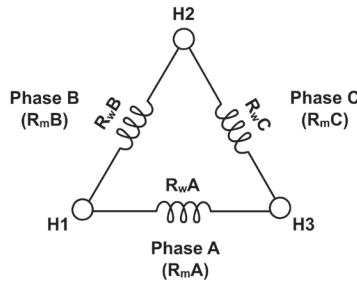
Test	Time	R1	R1S	R2	R2S	R3	R3S	Notes
1	00:00:00	3.0180 m-Ohm	3.7158 m-Ohm	70.000 u-Ohm	86.185 u-Ohm	33.000 u-Ohm	40.630 u-Ohm	
2	00:01:00	3.0180 m-Ohm	3.7158 m-Ohm	67.000 u-Ohm	82.491 u-Ohm	33.000 u-Ohm	40.630 u-Ohm	
3	00:02:00	3.0180 m-Ohm	3.7158 m-Ohm	65.000 u-Ohm	80.028 u-Ohm	31.000 u-Ohm	38.167 u-Ohm	



# TRM-203/403 thermal printer output

## test results for a delta transformer

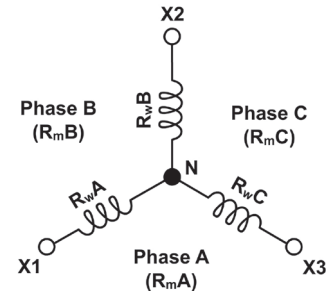
TEST RESULTS	
DATE: 01/11/15	TIME: 09:44:24
COMPANY: COMPANY 2	STATION: STN 3
CIRCUIT: CIR 4	MFR: MAN 5
MODEL: MOD 6	SN: SN 7
KVA RTG: KVA 8	OPERATOR: OPER 9
DELTA TEST	
EQUIVALENT RESISTANCE DATA	
MEAS TEMP $T_m = 25.0C$ 77.0F	
REF TEMP $T_s = 75.0C$ 167.0F	
ALUMINUM WINDINGS, $TK = 225.0C$	
$R_s = R_{meas} \times C[(T_s+TK)/(T_m+TK)]$	
All temps for eqn are in deg C	
PHASE A	
H/X1 - H/X3	
$R_m = 2.4007$ OHMS	..... Phase A measured resistance
$R_s = 2.8808$ OHMS	..... Calculated phase A resistance at reference temp.
$R_w = 3.9895$ OHMS	..... Calculated phase A winding resistance
$R_{ws} = 4.7874$ OHMS	..... Calculated phase A winding resistance at reference temperature
$I = 0.994$ AMPS	
PHASE B	
H/X2 - H/X1	
$R_m = 2.1127$ OHMS	
$R_s = 2.5352$ OHMS	
$R_w = 3.0278$ OHMS	
$R_{ws} = 3.6334$ OHMS	
$I = 0.995$ AMPS	
PHASE C	
H/X3 - H/X2	
$R_m = 2.1018$ OHMS	
$R_s = 2.5221$ OHMS	
$R_w = 3.0004$ OHMS	
$R_{ws} = 3.6005$ OHMS	
$I = 0.995$ AMPS	



Sample test results showing individual winding resistance values for a Delta transformer. The TRM-203/403 can also calculate the phase resistance and individual winding resistance values at a given reference temperature (Rs and Rws, respectively).

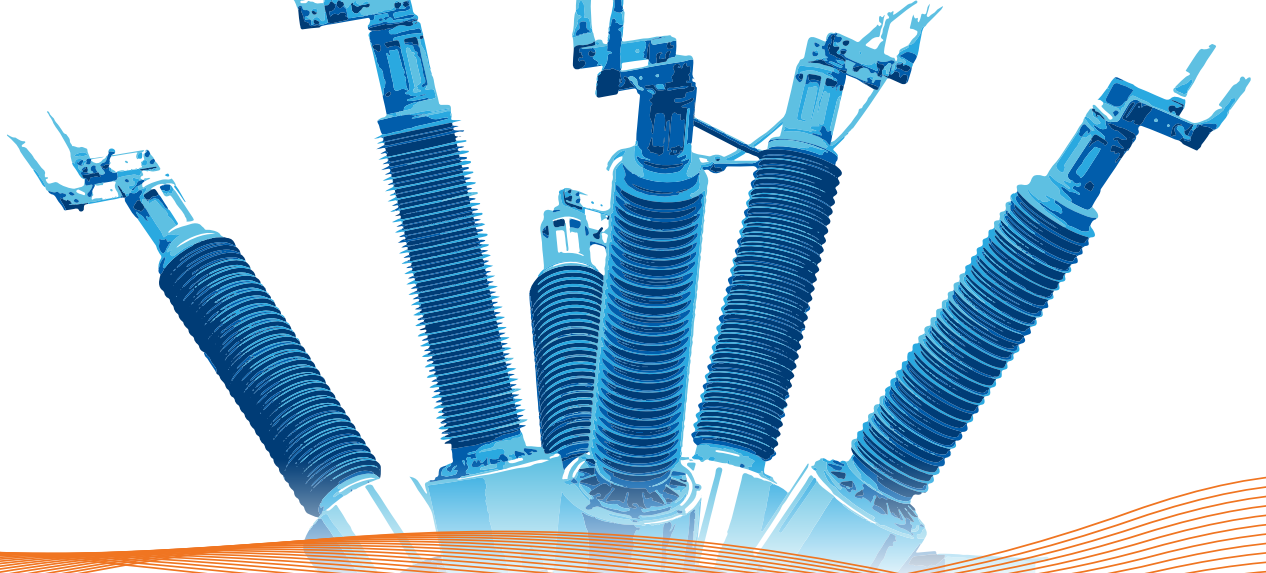
## test results for a wye transformer

TEST RESULTS	
DATE: 01/11/15	TIME: 09:27:56
COMPANY: COMPANY 2	STATION: STN 3
CIRCUIT: CIR 4	MFR: MAN 5
MODEL: MOD 6	SN: SN 7
KVA RTG: KVA 8	OPERATOR: OPER 9
Y (no Neut) TEST	
EQUIVALENT RESISTANCE DATA	
MEAS TEMP $T_m = 25.0C$ 77.0F	
REF TEMP $T_s = 75.0C$ 167.0F	
ALUMINUM WINDINGS, $TK = 225.0C$	
$R_s = R_{meas} \times C[(T_s+TK)/(T_m+TK)]$	
All temps for eqn are in deg C	
PHASE A	
H/X1 - H/X3	
$R_m = 3.0176$ OHMS	..... Phase A & C measured resistance
$R_s = 3.6212$ OHMS	..... Calculated phase A resistance at reference temp.
H/X1 - H/X0	
$R_w = 1.9984$ OHMS	..... Calculated phase A winding resistance
$R_{ws} = 2.3981$ OHMS	..... Calculated phase A winding resistance at reference temperature
$I = 0.993$ AMPS	
PHASE B	
H/X2 - H/X1	
$R_m = 2.4980$ OHMS	
$R_s = 2.9976$ OHMS	
H/X2 - H/X0	
$R_w = 499.64$ MILLI-OHMS	
$R_{ws} = 599.57$ MILLI-OHMS	
$I = 0.994$ AMPS	
PHASE C	
H/X3 - H/X2	
$R_m = 1.5189$ OHMS	
$R_s = 1.8227$ OHMS	
H/X3 - H/X0	
$R_w = 1.0193$ OHMS	
$R_{ws} = 1.2231$ OHMS	
$I = 0.996$ AMPS	



Sample test results showing individual winding resistance values for a Wye transformer with no accessible neutral. The TRM-203/403 can also calculate the phase resistance and individual winding resistance values at a given reference temperature (Rs and Rws, respectively).





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

Founded in 1991 and located in Ontario, California, USA, Vanguard Instruments™ offers a wide range of diagnostic test equipment that accurately and efficiently measures the health of critical substation equipment, such as transformers, circuit breakers, and protective relays.

Our first product was a computerized, extra high voltage (EHV) circuit breaker analyzer, which became the forerunner of an entire line of EHV circuit breaker test equipment. Over the years, our portfolio has grown tremendously 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 application-specific products.

Our instruments are rugged, reliable, accurate, and user friendly. They eliminate tedious and time-consuming operations, while providing fast, complex test-result calculations. Using our equipment helps reduce errors and eliminates the need to memorize long sequences of procedural steps.

In 2017, Vanguard Instruments became a part of Doble Engineering Company, an energy industry leader in hardware, software, and services that diagnose and monitor the health of critical assets.



**Vanguard Instruments**

A DOBLE COMPANY

1520 S. Hellman Avenue  
Ontario, California 91761, USA  
**Phone** 909-923-9390 • **Fax** 909-923-9391

[www.vanguard-instruments.com](http://www.vanguard-instruments.com)

Revision E. November 7, 2018

© Copyright 2018 Doble Engineering Company

