

# TRM-203/TRM-403

*transformer resistance meters*



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

# TRM-203/TRM-403

## transformer resistance meters



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 and TRM-403 can provide a fast and stable reading 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-ohm meters to measure EHV circuit breaker contact resistance, or for any low resistance measuring application.

### 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 interface
- Built-in 2.5" wide thermal printer

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 the factory test resistance values.

The TRM-203/403 can perform a special test to collect data automatically for up to 90 minutes (at 60-second sampling intervals) or 45 minutes (at 30 second sampling intervals). The 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 information can also be entered using the rugged, 44-key "QWERTY"-style membrane keypad.

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.

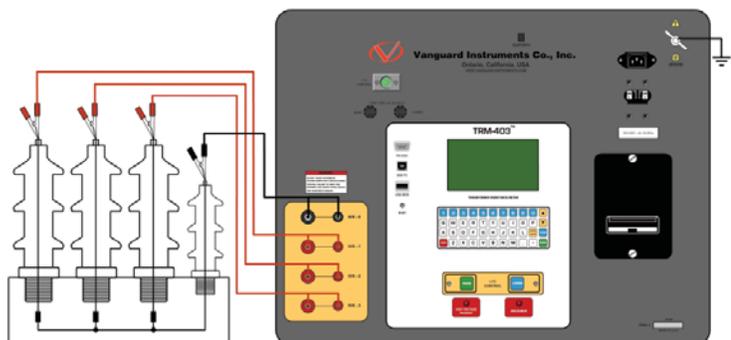
### ordering information

Part number **TRM-203** TRM-203, cables, software

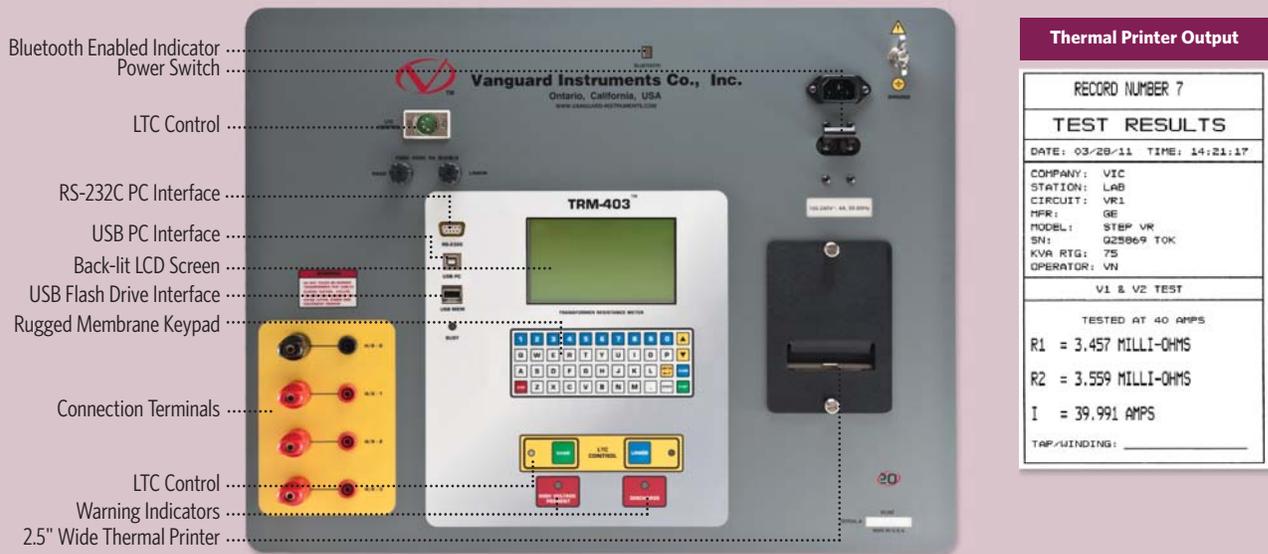
Part number **TRM-403** TRM-403, cables, software

Part number **TP3** 2.5-inch wide thermal printer paper

### TRM-203/403 connections



# TRM-203/403 Controls & Indicators



Thermal Printer Output	
RECORD NUMBER 7	
TEST RESULTS	
DATE: 03/28/11 TIME: 14:21:17	
COMPANY: VIC	
STATION: LAB	
CIRCUIT: VR1	
MPR: GE	
MODEL: 3STEP VR	
SN: Q25869 TOK	
KVA RTG: 75	
OPERATOR: VN	
V1 & V2 TEST	
TESTED AT 40 AMPS	
R1 = 3.457 MILLI-OHMS	
R2 = 3.559 MILLI-OHMS	
I = 39.991 AMPS	
TAP/WINDING: _____	

## User Interface

The TRM-203/403 features a back-lit graphic LCD screen (128 x 64 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.

## TRM-203/403 specifications

<b>type</b>	portable transformer winding resistance meter
<b>physical specifications</b>	21"W x 17"H x 9" D (53 cm x 43 cm x 24 cm); Weight: 35 lbs (15.8 kg)
<b>operating voltage</b>	100 – 240 Vac, 50/60 Hz
<b>resistance reading range</b>	<b>TRM-203:</b> 1 micro-ohm – 2000 ohms; <b>TRM-403:</b> 1 micro-ohm – 500 ohms
<b>accuracy</b>	1 – 19,999 micro-ohms: ±0.5% reading, ±1 count; 20 – 999 milli-ohms: ±1% reading, ±1 count; 1 – 2000 ohms: ±1.5% reading, ±1 count
<b>test current</b>	<b>TRM-203:</b> 1A – 20A in 1A increments; <b>TRM-403:</b> 1A – 40A in 1A increments
<b>test voltage</b>	60Vdc charging, 18V DC max during measurement
<b>input channels</b>	4 input channels for measuring resistance
<b>display</b>	back-lit LCD Screen (128 x 64 pixels); viewable in bright sunlight and low-light levels
<b>printer</b>	built-in 2.5-inch wide thermal printer
<b>internal data storage</b>	256 static test records (each can contain up to 111 readings) and 120 dynamic test records
<b>external data storage</b>	up to 999 test records on external USB Flash drive.
<b>computer interfaces</b>	RS-232C, USB, and Bluetooth
<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>	four 50-foot test cables, one LTC control cable, one ground cable, one power cord, one USB cable
<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

## Desktop printout of static resistance test results



**Vanguard Instruments Company, Inc.**

Filename: REC\_018      Manufacturer: PASTI  
 Date/Time: Oct 18, 2008 06:07 PM      Model: 1234567890  
 Company: DDE      SN: 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

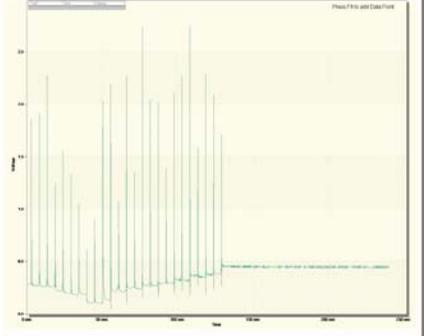
Test	Time	R1	R1S	R2	R2S	R3	R3S	Notes
1	00:00:00	3.0180 m-Ohm	3.7158 m-Ohm	70.000 u-Ohm	85.185 u-Ohm	33.000 u-Ohm	40.630 u-Ohm	
2	00:01:00	3.0180 m-Ohm	3.7158 m-Ohm	67.000 u-Ohm	82.491 u-Ohm	33.000 u-Ohm	40.630 u-Ohm	
3	00:02:00	3.0180 m-Ohm	3.7158 m-Ohm	65.000 u-Ohm	80.028 u-Ohm	31.000 u-Ohm	38.167 u-Ohm	

## Desktop printout of dynamic resistance test graph



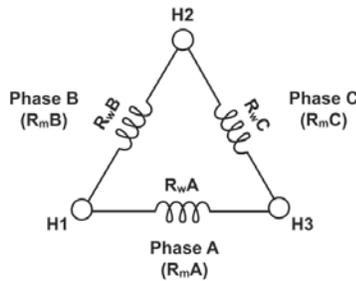
**Vanguard Instruments Company, Inc.**  
www.vanguard-instruments.com

Filename: REC\_018      Operator: HAI      Manufacturer: PASTI  
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 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



# TRM-203/403 thermal printer output

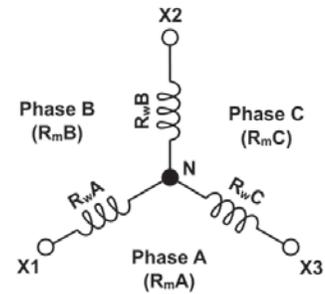
TEST RESULTS	
DATE: 05/11/12 TIME: 09:44:24	
COMPANY: COMPANY 2	
STATION: STN 3	
CIRCUIT: CIR 4	
NFR: MAN 5	
MODEL: HDD 6	
SN: SN 7	
KVA RTG: KVA 8	
OPERATOR: OPER 9	
DELTA TEST	
EQUIVALENT RESISTANCE DATA	
MEAS TEMP: T <sub>a</sub> = 25.0C 77.0F	
REF TEMP: T <sub>r</sub> = 75.0C 167.0F	
ALUMINUM WINDINGS, T <sub>k</sub> = 225.0C	
R <sub>s</sub> = R <sub>meas</sub> × C[(T <sub>a</sub> +T <sub>k</sub> )/(T <sub>r</sub> +T <sub>k</sub> )]	
All temps for eqn are in deg C	
PHASE A	
H-X1 = H-X3	
R <sub>m</sub> = 2.4007 OHMS	..... Phase A measured resistance
R <sub>s</sub> = 2.8808 OHMS	..... Calculated phase A resistance at reference temp.
R <sub>w</sub> = 3.9895 OHMS	..... Calculated phase A winding resistance
R <sub>ws</sub> = 4.7874 OHMS	..... Calculated phase A winding resistance at reference temperature
I = 0.994 AMPS	
PHASE B	
H-X2 = H-X1	
R <sub>m</sub> = 2.1127 OHMS	
R <sub>s</sub> = 2.5352 OHMS	
R <sub>w</sub> = 3.0278 OHMS	
R <sub>ws</sub> = 3.6334 OHMS	
I = 0.995 AMPS	
PHASE C	
H-X3 = H-X2	
R <sub>m</sub> = 2.1018 OHMS	
R <sub>s</sub> = 2.5221 OHMS	
R <sub>w</sub> = 3.0004 OHMS	
R <sub>ws</sub> = 3.6005 OHMS	
I = 0.995 AMPS	



..... Phase A measured resistance  
 ..... Calculated phase A resistance at reference temp.  
 ..... Calculated phase A winding resistance  
 ..... Calculated phase A winding resistance at reference temperature

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 (R<sub>s</sub> and R<sub>ws</sub>, respectively).

TEST RESULTS	
DATE: 05/11/12 TIME: 09:27:56	
COMPANY: COMPANY 2	
STATION: STN 3	
CIRCUIT: CIR 4	
NFR: MAN 5	
MODEL: HDD 6	
SN: SN 7	
KVA RTG: KVA 8	
OPERATOR: OPER 9	
Y (no Neut) TEST	
EQUIVALENT RESISTANCE DATA	
MEAS TEMP: T <sub>a</sub> = 25.0C 77.0F	
REF TEMP: T <sub>r</sub> = 75.0C 167.0F	
ALUMINUM WINDINGS, T <sub>k</sub> = 225.0C	
R <sub>s</sub> = R <sub>meas</sub> × C[(T <sub>a</sub> +T <sub>k</sub> )/(T <sub>r</sub> +T <sub>k</sub> )]	
All temps for eqn are in deg C	
PHASE A	
H-X1 = H-X3	
R <sub>m</sub> = 3.0176 OHMS	..... Phase A & C measured resistance
R <sub>s</sub> = 3.6212 OHMS	..... Calculated phase A resistance at reference temp.
H-X1 = H-X0	
R <sub>w</sub> = 1.9984 OHMS	..... Calculated phase A winding resistance
R <sub>ws</sub> = 2.3981 OHMS	..... Calculated phase A winding resistance at reference temperature
I = 0.993 AMPS	
PHASE B	
H-X2 = H-X1	
R <sub>m</sub> = 2.4980 OHMS	
R <sub>s</sub> = 2.9976 OHMS	
H-X2 = H-X0	
R <sub>w</sub> = 499.64 MILLI-OHMS	
R <sub>ws</sub> = 599.57 MILLI-OHMS	
I = 0.994 AMPS	
PHASE C	
H-X3 = H-X2	
R <sub>m</sub> = 1.5189 OHMS	
R <sub>s</sub> = 1.8227 OHMS	
H-X3 = H-X0	
R <sub>w</sub> = 1.0193 OHMS	
R <sub>ws</sub> = 1.2231 OHMS	
I = 0.996 AMPS	

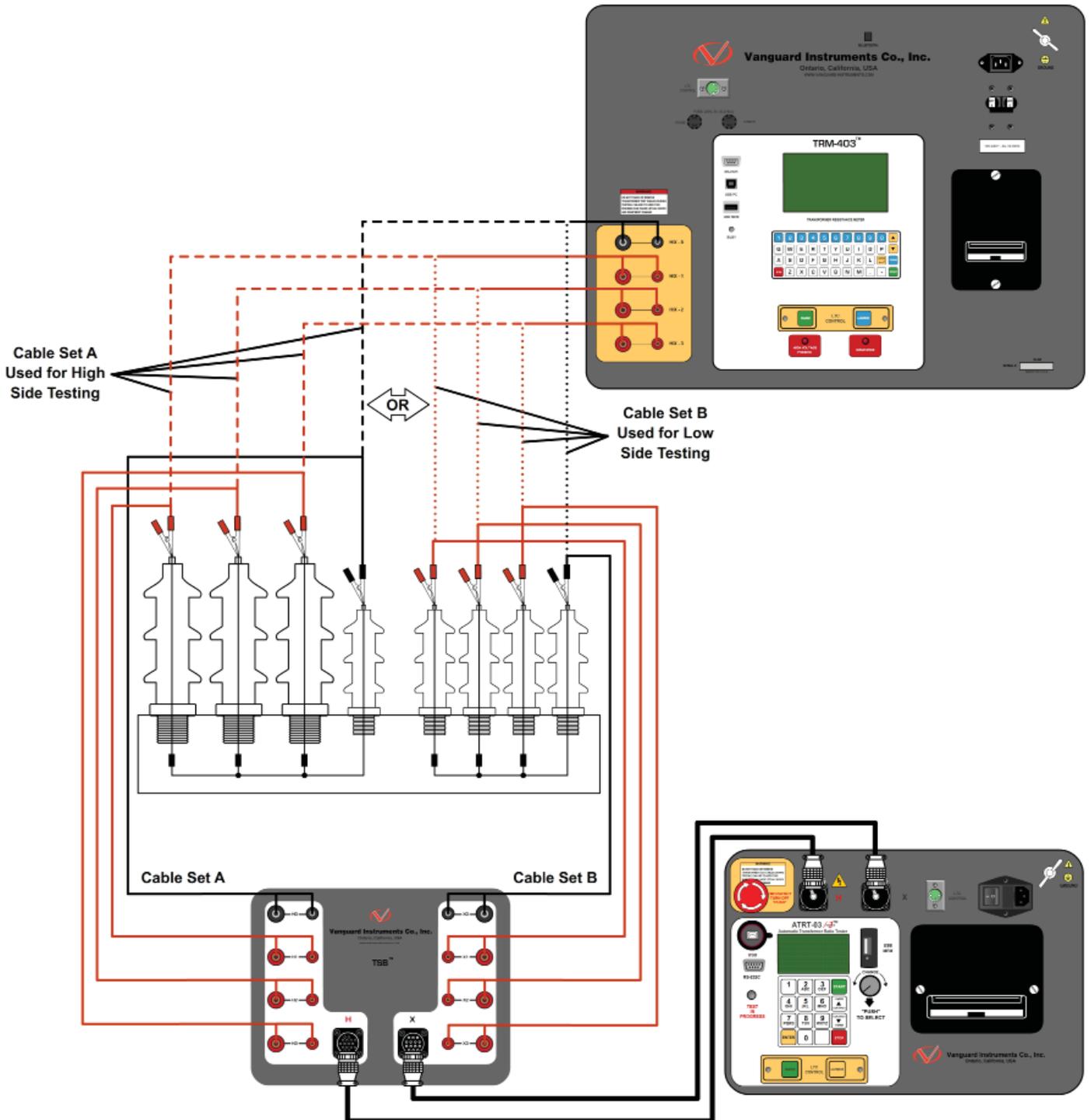


..... Phase A & C measured resistance  
 ..... Calculated phase A resistance at reference temp.  
 ..... Calculated phase A winding resistance  
 ..... Calculated phase A winding resistance at reference temperature

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 (R<sub>s</sub> and R<sub>ws</sub>, respectively).

# TSB Option

The Vanguard TSB (sold separately) can be used with a Vanguard ATRT-03 series turns ratio tester to perform transformer turns ratio tests using the same cable set provided with the TRM-203/403. Using the TSB, there is no need to connect and reconnect cables from the transformer after the initial connections are made. The user can conveniently perform resistance tests using the TRM-203/403 and turns ratio tests using an ATRT-03 without having to make trips to the transformer to connect and disconnect cables.





## 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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