

Winding Resistance Ohmmeter

WRO Series

- Three resistance measurement channels
- One temperature measurement channel
- On-load tap changer DVtest (DRM)
- Automatic resistance measurement for heat run test
- Rapid automatic demagnetization
- Test current up to 20 A DC
- Automatic discharge circuit
- Large 7" graphical touch screen display
- Built-in tap changer control unit



Description

The Winding Resistance Ohmmeter of the WRO series is mainly designed for winding resistance measurement of inductive objects, such as transformers and rotating machines. It can also perform on-load tap changer DVtest (dynamic resistance measurement) and transformer demagnetization. The instrument generates a true DC ripple-free current with automatically regulated measurement and discharging circuit.

WRO series can perform a simple, quick, and reliable transformer on-load tap changer (OLTC) condition assessment. This series enables measurements of a winding resistance in every tap position, current ripple

values (percentage of a current drop during a tap change), and transition times during tap changes. Problems with connections, contacts, and selector/diverter switch operation (tap change with interruption) can be detected with these measurements.

Following a resistance measurement, WRO can perform transformer demagnetization quickly and successfully.

WRO instruments are equipped with thermal and overcurrent protection. They have a very high ability to cancel electrostatic and electromagnetic interference that exists in HV electric fields.

Application

The list of the instrument application includes:

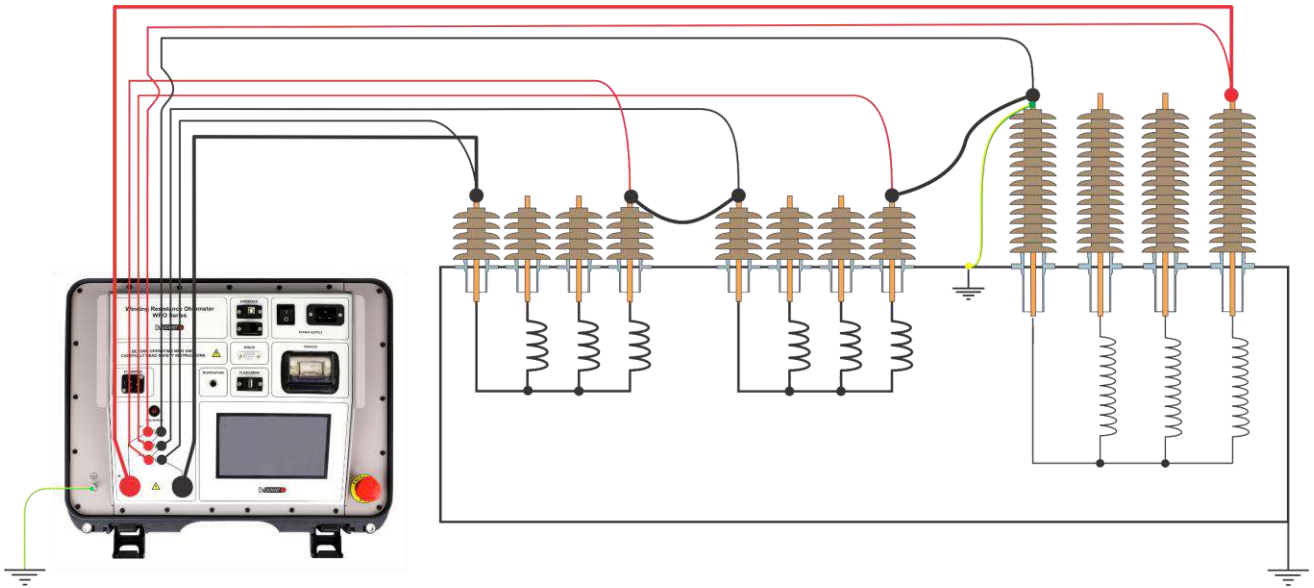
- Winding resistance measurement of inductive test objects, such as transformers and rotating machines
- Winding resistance measurement of resistive test object
- On-load tap changer (OLTC) DVtest (dynamic resistance measurement)
- Heat run test
- Transformer demagnetization

Connecting WRO to Test Object

Three-phase Transformer

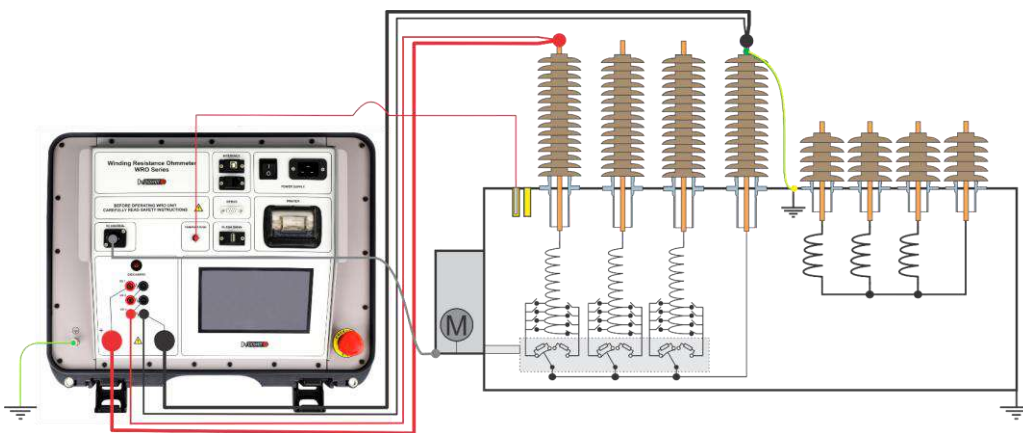
WRO is a single-phase device, which means it can be connected to one phase of a transformer at a time. It has 3 resistance measurement channels, which allows

simultaneous testing of up to 3 windings (e.g. primary, secondary, and tertiary winding). Those windings need to be externally connected in series.



When measuring winding resistance of a transformer with on-load tap changer (OLTC), or when performing DVtest (dynamic resistance measurement), WRO needs to be connected to one transformer winding at a

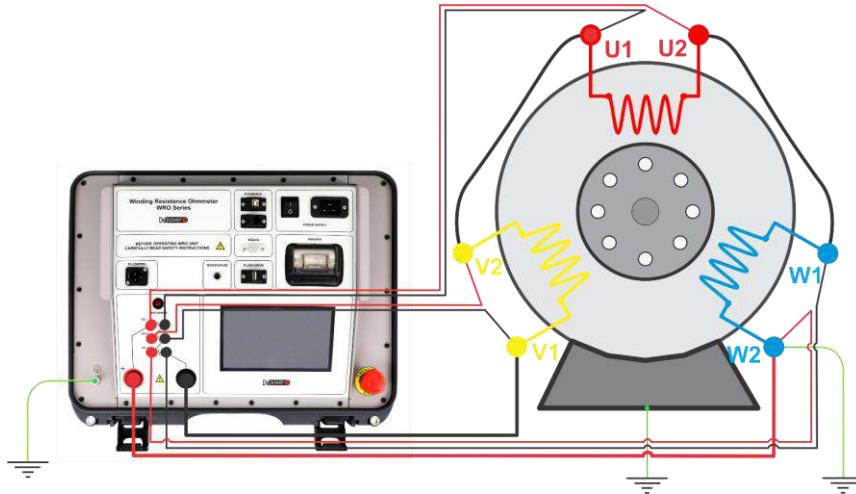
time. Connecting built-in tap changer control unit to an OLTC cabinet allows operator to change taps remotely from the device, or even to set WRO to automatically change OLTC tap positions.



Three-phase Motor/Generator

Using three separate resistance measurement channels available in WRO, it is possible to simultaneously measure all 3 phases of a

motor/generator stator windings. To do this, all 3 phases need to be externally connected in series.



Benefits and Features

Test Voltage up to 48 V DC

WRO injects the current with a voltage value as high as 48 V. This ensures that the magnetic core is saturated quickly, and duration of the test is as short as possible.

Simultaneous Three-Channel Winding Resistance Measurement

Three independent resistance measurement channels enable simultaneous testing of up to 3 windings connected in series – a primary, a secondary, and a tertiary transformer winding. This significantly speeds up the measurement and reduces the total transformer testing time. At the same time, by saturating the magnetic core through the primary winding, which has the higher number of turns, the stabilization time and subsequently the total testing time is further reduced.

On Load Tap Changer DVtest (DRM)

WRO can be used for measuring winding resistance of individual taps of a power transformer with on-load tap changer (OLTC) without test current interruption between the tests. This way it checks whether the OLTC switches without an interruption. The moment

a tap position is changed from one tap to another, the device detects a sudden, very short drop of the test current. These drops, called "ripples", should be consistent, where any drop out-of-line should be investigated. OLTC malfunctions can be detected by analyzing the measurements of transition ripple, transition time, and by visualizing DVtest (DRM) graphs.

Transformer Demagnetization

After a DC current test, such as a winding resistance measurement, the magnetic core of a power or a measurement transformer may be magnetized. Also, when disconnecting a transformer from a service, some amount of magnetic flux trapped in the core could be present. Demagnetizing the magnetic core of a transformer requires alternating current applied with decreasing magnitude down to zero. WRO instruments provide this alternating current by internally changing the polarity of a controlled DC current. During the demagnetization process the test current is supplied with decreasing magnitude for each step, following the proprietary developed program.

Tap Changer Control Unit

WRO instruments have a built-in tap changer control unit, which allows remote on-load tap changer operation. A single operator can perform complete testing very quickly.

Automated Test in Multiple OLTC Positions

Built-in tap changer control unit allows fully automated tests in multiple OLTC positions. WRO instruments can control the entire process of measurements and changing taps automatically.

Memory

WRO instruments have internal SD card of 32 GB memory space. This enables saving tens of thousands of results and test templates.

Built-in Printer

Built-in thermal printer, 58 mm (2.3 in) wide, is an included accessory. All numerical results can be printed either right after the test or later from any previously saved result.

Large Graphical Touch Screen Display

WRO instruments come equipped with a large 7" graphical touch screen display. This makes test preparation, test execution, and analysis of test results as easy as possible. Test templates can be prepared and saved in the office, making the test execution in the field possible with only a few clicks. All test results are presented both numerically and graphically, for easy and convenient analysis.

USB Flash Drive

Results can be exported to a USB memory through integrated USB flash drive for further analysis and processing with powerful DV-TR software.

DV-TR Software

The DV-TR software is included in the purchase price, and all its updates are free of charge. The software allows full control of WRO instruments functions from a PC. All results are presented both numerically and graphically, for easy and convenient analysis. Test results can be directly exported to an excel document. Customized test report can be generated, edited, saved in several file formats including pdf, and printed.

Heat Run Test

The DV-TR application software has an additional Heat Run temperature/resistance extrapolation feature. After the transformer heating is switched off, the timer is started and WRO should be immediately connected to up to 3 transformer windings. Upon connection to a test object, the test should be started, and winding resistances are measured at selected time intervals. This information is used to automatically extrapolate the values of temperature and resistance to the moment when the transformer was switched off.

Technical Data

Mains Power Supply

- Connection: according to IEC/EN60320-1; UL498, CSA 22.2
- Mains supply: 90 – 264 V AC, 50/60 Hz

Output

- Test current:
WRO10: 5 mA – 10 A DC
WRO20: 5 mA – 20 A DC
- Test voltage: up to 48 V DC

Winding Resistance Measurement

- Measurement range: 0.1 $\mu\Omega$ – 100 k Ω
- Measurement range / Typical accuracy:
0.1 $\mu\Omega$ – 1.999 k Ω : \pm (0.1% rdg + 0.025% F.S.)
2 k Ω – 9.999 k Ω : \pm (0.2% rdg + 0.1% F.S.)
10 k Ω – 100 k Ω : \pm (1.0% rdg + 1.0% F.S.)
- Measurement range / Resolution:
0.1 $\mu\Omega$ – 999.9 $\mu\Omega$: 0.1 $\mu\Omega$
1.000 m Ω – 9.999 m Ω : 1 $\mu\Omega$
10.00 m Ω – 99.99 m Ω : 10 $\mu\Omega$
100.0 m Ω – 999.9 m Ω : 0.1 m Ω
1.000 Ω – 9.999 Ω : 1 m Ω
10.00 Ω – 99.99 Ω : 10 m Ω
100.0 Ω – 999.9 Ω : 0.1 Ω
1.000 k Ω – 9.999 k Ω : 1 Ω
10.00 k Ω – 99.99 k Ω : 10 Ω

OLTC DVtest

- Resolution: 1 ms

Temperature Measurement

- Measurement range
-50 $^{\circ}\text{C}$ – +180 $^{\circ}\text{C}$ / -58 $^{\circ}\text{F}$ – +356 $^{\circ}\text{F}$
- Thermometer Pt100 class B
- Resolution 0.1 $^{\circ}\text{C}$

Display

- 7" graphical touch screen display

Interface

- Ethernet
- USB

Internal Memory

- SD card 32 GB

Environmental Protection

- IP67 (lid closed)
- IP20 (lid open)

Environmental Conditions

- Operating temperature:
-20 $^{\circ}\text{C}$ – +60 $^{\circ}\text{C}$ / -4 $^{\circ}\text{F}$ – +140 $^{\circ}\text{F}$
- Storage & transportation temperature:
-40 $^{\circ}\text{C}$ – +70 $^{\circ}\text{C}$ / -40 $^{\circ}\text{F}$ – +158 $^{\circ}\text{F}$
- Humidity: 0 – 95% relative humidity, non-condensing

Dimensions and Weight

- Dimensions (W x H x D):
503 x 193 x 406 mm / 19.8 x 7.6 x 16.0 in
- Weight: 9 kg / 19.8 lbs

Warranty

- 3 years + 1 additional year upon registration on [DV Power official website](#)

Printer




- Built-in thermal printer
- Paper width 58 mm / 2.3 in

Applicable Standards

- Installation/Oversvoltage category: II
- Pollution degree: 2
- Safety: LVD 2014/35/EU (CE Conform)
Standard EN 61010-1:2010
- EMC: Directive 2014/30/EU (CE Conform)
Standard EN 61326-1:2013

All specifications herein are valid at ambient temperature of +25 $^{\circ}\text{C}$ / +77 $^{\circ}\text{F}$ and standard accessories.
Specifications are subject to change without notice.

Accessories

			
<p>Current and sense cables with TTA clamps</p>	<p>Voltage sense cables with TTA clamps</p>	<p>Current connection cable with TTA clamps</p>	<p>Plastic transport case</p>
			
<p>Cable plastic case – large size</p>	<p>Cable plastic case with wheels – large size</p>	<p>Cable plastic case – medium size</p>	<p>Cable plastic case with wheels – medium size</p>
			
<p>Tap changer control cable</p>	<p>Test shunt</p>	<p>Temperature sensor with cable</p>	<p>Cable bag</p>

Order Info

Instrument	Article No
Winding Resistance Ohmmeter WRO10	WRO10NN-N-03
Winding Resistance Ohmmeter WRO20	WRO20NN-N-03

Included Accessories
Built in thermal printer 58 mm (2.28 in)
Windows-based DV-TR PC software
USB cable
Ethernet cable
Debug adapter
Tap Changer Control cable 5 m (16.4 ft)
Mains power cable
Ground (PE) cable
Plastic transport case

Standard accessories	Article No
Current cables 2 x 10 m 10 mm ² (32.8 ft, 7 AWG) and sense cables 2 x 10 m (32.8 ft) with TTA clamps	CS-10-10LMWC
Sense cables 2 x 10 m (32.8 ft) with TTA clamps	S2-10-02BPWC
Current connection cable 1 x 5 m 10 mm ² (16.4 ft, 7 AWG) with TTA clamps	CX-05-102XWC
Cable bag	CABLE-BAG-00

Optional accessories	Article No
Current cables 2 x 5 m 10 mm ² (16.4 ft, 7 AWG) with TTA clamps	C2-05-10LMWC
Current cables 2 x 10 m 10 mm ² (32.8 ft, 7 AWG) with TTA clamps	C2-10-10LMWC
Current cables 2 x 10 m 16 mm ² (32.8 ft, 5 AWG) with TTA clamps	C2-10-16LMWC
Current cables 2 x 15 m 10 mm ² (49.2 ft, 7 AWG) with TTA clamps	C2-15-10LMWC
Current cables 2 x 15 m 16 mm ² (49.2 ft, 5 AWG) with TTA clamps	C2-15-16LMWC
Current cables 2 x 20 m 10 mm ² (65.6 ft, 7 AWG) with TTA clamps	C2-20-10LMWC
Current cables 2 x 20 m 16 mm ² (65.6 ft, 5 AWG) with TTA clamps	C2-20-16LMWC
Current cables 2 x 5 m 10 mm ² (16.4 ft, 7 AWG) and sense cables 2 x 5 m (16.4 ft) with TTA clamps	CS-05-10LMWC
Current cables 2 x 10 m 16 mm ² (32.8 ft, 5 AWG) and sense cables 2 x 10 m (32.8 ft) with TTA clamps	CS-10-16LMWC
Current cables 2 x 15 m 10 mm ² (49.2 ft, 7 AWG) and sense cables 2 x 15 m (49.2 ft) with TTA clamps	CS-15-10LMWC
Current cables 2 x 15 m 16 mm ² (49.2 ft, 5 AWG) and sense cables 2 x 15 m (49.2 ft) with TTA clamps	CS-15-16LMWC
Current cables 2 x 15 m 25 mm ² (49.2 ft, 3 AWG) and sense cables 2 x 15 m (49.2 ft) with TTA clamps	CS-15-25LMWC
Current cables 2 x 20 m 10 mm ² (65.6 ft, 7 AWG) and sense cables 2 x 20 m (65.6 ft) with TTA clamps	CS-20-10LMWC
Current cables 2 x 20 m 16 mm ² (65.6 ft, 5 AWG) and sense cables 2 x 20 m (65.6 ft) with TTA clamps	CS-20-16LMWC

Current cables 2 x 20 m 25 mm ² (65.6 ft, 3 AWG) and sense cables 2 x 20 m (65.6 ft) with TTA clamps	CS-20-25LMWC
Sense cables 2 x 5 m (16.4 ft) with TTA clamps	S2-05-02BPWC
Sense cables 2 x 15 m (49.2 ft) with TTA clamps	S2-15-02BPWC
Sense cables 2 x 20 m (65.6 ft) with TTA clamps	S2-20-02BPWC
Current connection cable 1 x 5 m 16 mm ² (16.4 ft, 5 AWG) with TTA clamps	CX-05-162XWC
Current connection cable 1 x 12 m 10 mm ² (39.4 ft, 7 AWG) with TTA clamps	CX-12-102XWC
Current connection cable 1 x 12 m 16 mm ² (39.4 ft, 5 AWG) with TTA clamps	CX-12-162XWC
Temperature sensor 1 x 50 mm (1,97 in) + 5 m (16,4 ft) cable	TEMP1-050-05
Temperature sensor 1 x 50 mm (1,97 in) + 10 m (32,8 ft) cable	TEMP1-050-10
Temperature sensor 1 x 50 mm (1,97 in) + 15 m (49,2 ft) cable	TEMP1-050-15
Temperature sensor 1 x 50 mm (1,97 in) + 20 m (65,6 ft) cable	TEMP1-050-20
Test shunt 1 mΩ (150 A / 150 mV)	SHUNT-150-MK
Cable plastic case - small size	CABLE-CAS-01
Cable plastic case - medium size	CABLE-CAS-02
Cable plastic case with wheels - medium size	CABLE-CAS-W2
Cable plastic case - large size	CABLE-CAS-03
Cable plastic case with wheels - large size	CABLE-CAS-W3
Thermal paper roll 58 mm (2.28 in)	PRINT-058-RO

IBEKO Power AB

Lejonstigen 9
181 32 Lidingö, Sweden

Contact

Phone: +46 70 0925 000
E-mail: sales@dv-power.com