Digital Automatic Winding Tester

DWX Series

Microprocessor controlled testing and evaluation for laboratory, QC and automatic production

- **An innovative design concept with modular enhancability**
- **Surge impulse testing at highest precision and sensitivity**
- **Very suitable for windings of extreme low impedance**
- **Partial discharge assessment with patented method**

RM Prüftechnik

Prüfsysteme für elektrische Maschinen und Wicklungen

DWX Features

The digital impulse winding tester DWX is designed for precise and non-destructive coil testing.

High voltage impulses with fixed rise time and same magnitude are discharged into a reference winding. The attenuated response oscillation is stored in the tester's memory as a "master" file together with certain tolerance criteria and serves as reference for evaluation of the DUT.

Through the micro processor control, this evaluation becomes fully automated for pass/fail testing.

Parameters like the signal time base and the number of applied impulses are stored within the master file. Thus it is secured that exactly same test conditions are provided for the master piece and the DUT.

The communication with the unit is performed over the large TFT colour LCD screen. All programming and test routines are displayed menu driven as well as the single waveforms of each test pulse, the results and the final pass/fail statement.

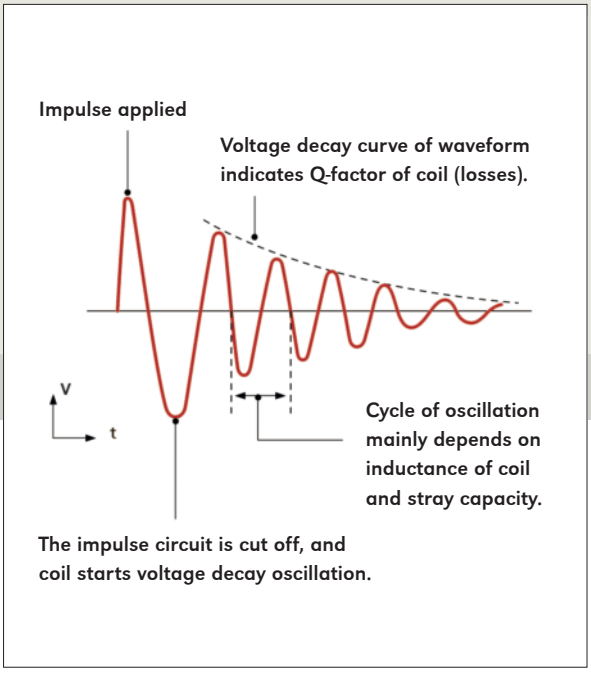
- Large colour LCD with intuitive menu driven user interface via function keys and jog dial for high user friendly usage.
- New impulse supply with fast semiconductor switch. Rise times of 100 – 200 ns are especially useful for qualification of motor windings for frequency converter applications and for testing of RF components in the computer and telecom industries.
- High sampling rate (100 MS/s) for high waveform resolution and reliable detection of corona/PD effects.
- Hardcopy function via parallel port (ESC/P format) and generation of BMP or CSV waveform data, stored into the integrated CF card or to external PC.
- Special software filter method for detection of partial discharge effects through Laplace transformation and display in a separate window.
- New designed resistive voltage divider guarantees enhancement of the application range up to extreme low impedance coils at high resolution and clear display.
- Integrated Compact Flash card reader for unlimited number of master files and easy storage of test results and statistical data.
- Direct and easy remote control options via serial port, LAN/Ethernet adapter (optional) and bit-parallel I/O port for PLC connection (24 V).

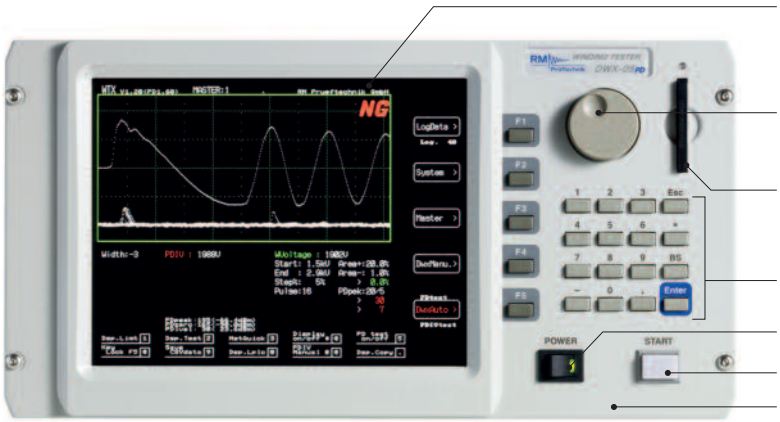
Surge/impulse testing principle

Voltage surge and response contain the information about the properties of the winding under test. The characteristic of the waveform pattern is determined by the impedance and Q-factor (losses) of the DUT. Thus all defects and incorrectness's are evaluated which affect these characteristics. These are in particular turn and layer shorts, wrong turn count, wire and size errors as well as defects in the iron/ferrite core or lamination stack.

However the most important effect of this test method is the real turn/turn voltage stress, since the high frequent voltage pulse "travels" across the coil as a wave and generates brief dv/dt potential differences across the turns. At damaged turn, layer or coil insulations, sparks or arc-overs of very low energy will occur.

Through the high scan speed of the A/D converter, even smallest weaknesses in the insulation, which generate corona or partial discharges, will be recognized, captured and evaluated.





The 8.4-inch color TFT LCD screen
Master and test waveforms are clearly displayed together with all test parameters and results.

Rotary dial
Setting and execution of various functions and operations

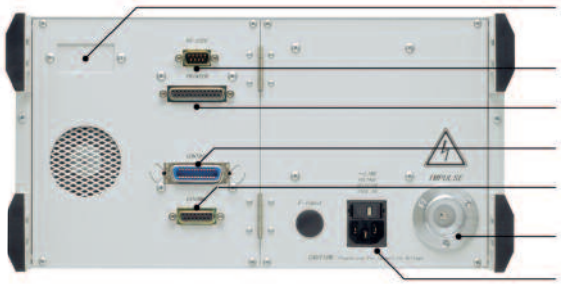
Compact flash memory card slot
Master memory extension, saving of waveforms and test results in PC readable format

Function keys, numeral keys

Power switch

Start switch

Compact and durable body with handle



Optional Ethernet installing slot

RS-232C (9 pins)

Printer port (25 pins)

I/O parallel (24 pins)

Special external port (15 pins)

Impulse output

AC line in

Evaluation methods

The master waveform is completed by more or less strict evaluation methods which allow the automatic pass/fail indication.

Since the different winding defects or incorrectness's result in different effect to the wave shape, various mathematic methods are applied, which act differently to certain changes and allow to distinguish typical groups of defects. An error code, which is transferred in real time to the host PC, can be used to control a part selector and helps to gain useful statistical data for process error research.

1. **Area size comparison** (Figure 1)
   This compares each area size of the master coil and the sample coil waveforms in the intentionally determined zone (% value). The area size of the wave is nearly proportional to the energy loss in the coil; therefore, the test coil is considered to be OK/NG by the amount of its energy loss. For example, when a sample coil layer has a short circuit, the short circuit area is reflected as an increase of energy loss.

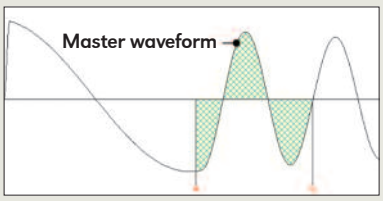


Figure 1

2. **Differential area comparison** (Figure 2)
   This calculates the area size of differential portion between the master coil and the sample coil waveforms in the intentionally determined zone. The differential area size represents the L value and total energy loss. This method is especially effective, for example, when the change of the L value causes major problems.

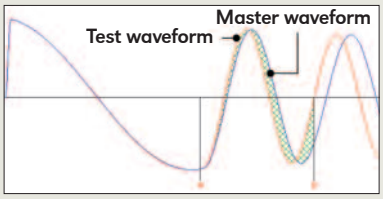


Figure 2

3. **Corona/partial discharge detection** (Figure 3)
   Regardless of the difference in waveforms, this method only detects the high frequency energy of corona discharge. The wave is converted by derivative calculation and its area size is calculated. In an equivalent analog circuit, the energy value of the wave that passes through high pass filter is measured.

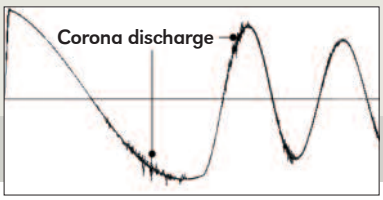


Figure 3

4. **Corona/partial discharge detection with Laplace filter** (Figure 4)
   The Laplacian is a method in digital filter processing used for detecting the edge intensity of an image. It measures the 2nd derivative of the image to find and extract the partial discharge. The discontinuity of the value hidden in the wave data (noise) can be digitized, offering an easier detection of the partial discharge.

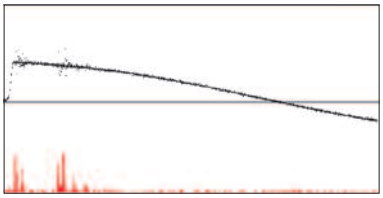


Figure 4

These evaluation methods can be programmed individually or together. The sensitivity and selectivity of the test methods can be increased by setting of test zones (evaluation windows). For quick manual tests in the lab, a simple visual comparison is possible.

Typical applications

- Automotive parts (valves, actuators, sensor coils, small motors)
- Chokes, filters in power supplies
- Deflection coils, ignition transformers, inverters for LCD
- Transformers, RF converters
- Chip devices (inductors for telecom etc.)
- AC motors of all kind, also for high dynamic applications (servo, inverter controlled, high speed)
- Solenoids, relays, contactors

Options

- The DWX can be remote controlled through **Ethernet network adapter** (TCP/IP serial convert protocol); LAN interface 10 base T1 port.
- The **PC database software** DWworkWIN can be utilized via RS232-C or LAN interface. Nearly all functions of the tester can be operated and master files, test results and waveforms can be transferred.
- Several **test lead multiplexers** with HV relays are available for connection of multi lead test objects and integration of peripheral instruments and devices.

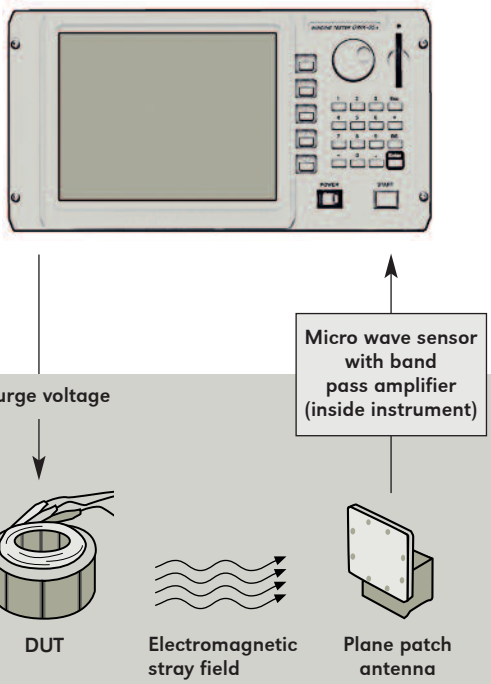
DWX-15/20

DWX-10 LI: Special version for extreme low inductances, power chokes, RF power transformers

Technical specification	DWX-01	DWX-05	DWX-10	DWX-10 LI	DWX-15	DWX-20
Applied voltage, step and energy (max)	50 V – 1 kV (10 V step) 5 mJ	300 V – 5.9 kV (100 V step) 0.12 J	500 V – 10 kV (100 V step) 0.5 J	500 V – 6 kV (100 V step) 0.5 J	500 V – 15 kV (100 V step) 4.5 J	500 V – 20 kV (100 V step) 2.5 J
Min test inductance	10 µH	10 µH	20 µH	0,5 µH	20 µH	20 µH
High voltage source	processor controlled DC inverter supply with automatic voltage regulation, fast semiconductor switch (0.1 – 0.3 µs impulse rise time)					
Sampling speed, storage depth	8 bit/10 ns (100 MS/s), 8 kByte					
Testing speed	0.05 s/impulse; typical test sequence 0.5 – 1 s		0.2 s/impulse; typical test sequence 1 – 2 s			
Screen display resolution	640 x 480 dots (VGA), 8.4" TFT color LCD, 4 color display 512 x 256 dots for test wave					
Master wave memory	internal RAM disk: 210 types; max. 5600 in CF memory card (14 types @ 400 pages)					
Connections/interfaces	1 Parallel-I/O 24 V 1 RS-232C (PC-connection), USB conversion possible 1 printer port (display hardcopy), ESC/P format 1 Ethernet-adapter (option)					
Powersupply/conditions	100 V – 240 V ± 5%; 50 Hz; max. 200 VA; 0°C – 40°C					
Dimension/weight	345 (W) x 195 (H) x 370 (D) mm, approx. 10 kg		345 (W) x 390 (H) x 370 (D) mm, approx. 16 kg		345 (W) x 570 (H) x 370 (D) mm, approx. 22 kg	

Impulse Winding and Partial Discharge Tester with Microwave Sensor DWX-PD

PD examination of a sensitivity previously unknown in the coil winding industry (according IEC 61934 and IEC 60034-18-41)

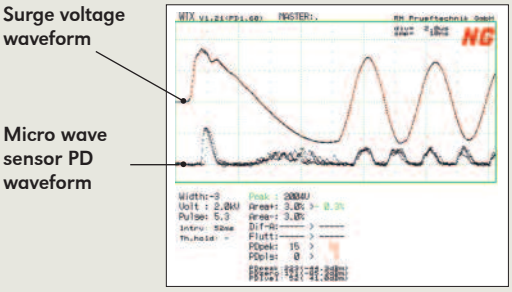


A narrowband microwave sensor detects the electromagnetic waves of partial discharges, which are generated in coils through surge impulses with a fast rising front (dv/dt). Thus an excellent simulation of the transient stresses of windings at highly dynamic control systems like PWM converters is given.

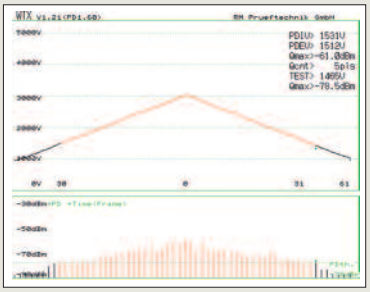
In addition to the known test of latent or galvanic turn and layer shorts in windings, it allows easy and fully automatic partial discharge evaluation within a coil for applications in production, QC and research/lab as well as predictive diagnostics.

This includes the recording of PD inception and extinction voltages (PDIV-PDEV) with a new developed algorithm.

Through the special filter method with a narrow band filter in the 1.7 GHz band, disturbing frequencies and noises are completely eliminated at persisting high signal sensitivity. This enables the equipment to be used in complex automatic systems or under production conditions without affecting the signal quality.



Winding with occurring PD



Example PDIV-PDEV graph

Partial discharge circuit specifications	
Micro wave sensor	Sensing the electromagnetic waves in the stray field by a narrowband plane patch antenna in 1.7 GHz band
Signal sensitivity	-90 dB ~ -30 dB within 30 cm distance from DUT
Antenna size	80 (W) x 80 (H) x 10 (D) mm, cable length = 2 m
Judgment methods	PD inception and extinction voltages (PDIV-PDEV), PD impulse counter (for RPDIV/RPDEV tests), relative PD level

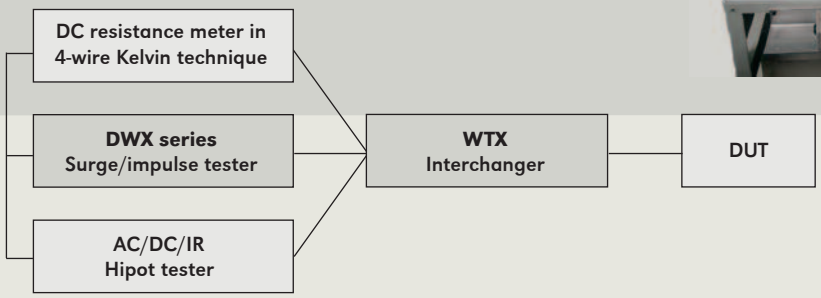
All other technical specifications see previous page.

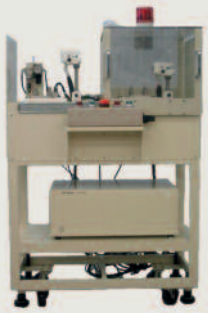
Automatic Winding Test System with 4 ch Controller/Interchanger WTX

With the system controller/multiplexer WTX, the **impulse tester** DWX series, an external **resistance meter** in 4 wire technique and an AC/DC **high voltage tester** can be combined to a modular and fully automatic winding test system. There are various connection configurations possible for pass/fail testing of coils and windings of any kind. The test results are displayed on the colour LCD of the DWX unit and can be directly stored to the integrated CF card. Additionally, a PC database connection is available.

Further test functions like **inductance test**, **rotation direction test** and various **test fixtures and adapters** are possible upon request. In this case the system will be individually composed within a 19 inch rack.

System structure (example)

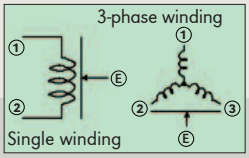




This configuration becomes an unbeatable setup in efficiency, test speed, accuracy and reliability for applications in the coil winding industry.

Examples:

Test item



Test sequence

Step	Test	Test terminal	Remarks
1	DC resistance meter	① - ②	4-terminal test
2		② - ③	
3		③ - ①	
4	Surge/impulse test	① - ②	Data comparison test vs reference
5		② - ③	
6		③ - ①	
7	AC/DC/IR Hipot test	①②③-Ⓔ	Test condition is freely settable

Technical data

Type of test	Detection range
Impulse test DWX-05	500 V–5 900 V
DC resistance meter CHROMA 16502	0.001 mΩ–199.99 kΩ
Hipot test CHROMA 19052	DC 50 V–5 kV AC 50 V–5 kV

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