

CIRCUIT BREAKER TEST SOLUTION

simply but not simply



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Business partner that continuously grows



The circuit breaker test equipment of Enersys started with this one question, "How can we safely and easily conduct tests on the circuit breaker, which are usually complicated and dangerous?"

To find an answer, Enersys listened to the opinions of operators and workers in the industry who work on site and came up with the idea of the cradle type of integrated test equipment used by mounting the circuit breaker in. Through this successful invention, Enersys has been leading the innovation of safe and prompt maintenance of the plant by immediately checking the results, when conducting the test with easy and safe set up of test circuit.

The current method of using multiple equipments for measurement is vulnerable to error and high possibly leads to accidents. There are also many difficulties for maintenance due to the multiple numbers of equipment.

However, Enersys successfully developed the I.M.E (Integrated Measurement Equipment) for circuit breaker which integrates the power source required for the test, a control circuit for properly connecting the power source to the measurement target, and high-performance data collecting equipment to measure the values precisely.

To utilize the fast measuring abilities of developed I.M.E at the site, it provides the integrated program of the circuit breaker test equipment with user-friendly UI.

Developed integrated program by Enersys conducts test easily with just a few touches and print out the report after saving the result automatically. The history of the power circuit breaker can be managed by registering the information on the circuit breaker in the integrated program.

Certificates and Recognition



Certificate of the company with excellent technological capabilities



Recognition letter of Affiliated Technological Research Institute



Confirmation letter for venture companies



Verification of direct manufacture (software)



Verification of direct manufacture (system management)



ISO 9001:2015 Certificate of product quality management system



ISO 14001:2015 Certificate of the environmental management system



ISO 45001:2018 Certificate of safety and hygiene management system

Company History

- 2017**
- 02. Established Enersys Inc.
 - 05. Registered Osan factory of Enersys Inc.
 - 06. Registered Affiliated Technological Research Institute
 - 08. ISO 9001: certified in 2008
 - 08. Registered patent for automatic dual-type testing device for air circuit breakers
 - 08. Registered patent for automatic testing equipment for switchgear circuit breakers
 - 12. Selected as a certified venture company by the Korea Technology Finance Corporation
- 2018**
- 04. Asia Economy TV close-up on company site (Company info and interview with the CEO)
 - 08. Participated in Korea Nuclear Industry Exhibition 2018
 - Won commendation from Minster of Trade and Industry

- 2019**
- 01. Relocated company building to Dongtan, Hwaseong-si, Gyeonggi-do
 - 03. Registered software business
 - 03. Registered 2 cases of direct production on Public e-Procurement Information
 - 08. Participated in Korea Nuclear Industry Exhibition 2019
 - 10. Selected as new military service institution
 - 11. Certified as company with excellent technological capabilities
 - 12. Established company building in Yongin-si, Gyeonggi-do
- 2020**
- 06. ISO 9001: certified in 2015
 - ISO 14001: certified in 2015
 - ISO 45001: certified in 2018
 - 08. Participated in Purchase Consultation Fair of Korea Hydro & Nuclear Power Co. Ltd.

Patent Certificates



#10-1773433
(Automatic dual-type testing device for air circuit breakers)



#10-1697178
(Automatic testing equipment for switchgear circuit breakers)



#10-1673903
(Customized clip-type plug for testing equipment for circuit breaker's contacting plates)



#10-1673902
(Customized clip-type plug for testing equipment for circuit breaker's contacting plates)

※ The image of the plant above was provided by Korea Hydro & Nuclear Power Co., Ltd.



Features of Testing Equipment

▶ MINIMUM PICK-UP TEST

Test equipment developed by Enersys conducts the test by the procedural guidelines on "operational test on minimum control voltage" recommended by the KHNP Central Research Institute. Also the range of applied voltage can be limited or changed by this test equipment.

It is possible to measure the electric current required for charging the spring. The measurement is displayed in a graph of the electric current's intensity over time. Workers or operators can check the abnormalities through the warning pop-up.

- Test Voltage: DC 60V when close, DC 50V when open
- Rising Voltage: DC 5V
- Reference Voltage: DC 90V when close, DC 70V when open
- Electric Current Measurement: 0 A–10 A

▶ RESISTANCE MEASUREMENT

This test equipment can measure the general resistance, as well as the resistance of the motor coil, reclosing prevention relay, closing coil, tripping coil, and low voltage tripping device. The contact resistance of the main circuit and insulation resistance of the main and control circuit can also be measured.

- General Resistance: 1Ω–200kΩ
- Contact Resistance: 1μΩ–2mΩ (uses DC 100A)
- Insulation Resistance: 1MΩ–4000MΩ (uses DC 500V, 1000V)

▶ TIMING TEST

I,ME can measure the opening and closing time of the main circuit of the circuit breaker without any additional device or equipment.

It is possible to measure both operations of closing and opening in the circuit breaker. It displays the total opening and closing time, initiated and period of chattering time, and the analyzed number of chattering through the graph of measurement results.

▶ OVERCURRENT RELAY TEST

It is possible to test the overcurrent relay if the overcurrent relay is installed in the load center circuit breaker and reactor trip circuit breaker.

It checks the integrity of the overcurrent relay by measuring the pick-up current and long, short, and instantaneous time limits.



▶ UNDERVOLTAGE TRIP TEST

It can test the under-voltage trip attachment device installed in the reactor trip circuit breaker. The coil state of the under-voltage trip attachment device is checked through a resistance measurement circuit and it can check the integrity under the emergency of under-voltage by measuring the operating voltage and time to see if the tripping operation proceeds normally in a situation of actual under voltage.

▶ CIRCUIT BREAKER STATUS MONITORING

It displays the contact point to check both incoming status and opening/closing status of the power circuit breaker while conducting the test, in order to check the integrity of the control signal and prevent any accidents that may occur during the test.

▶ SELF-INSPECTION OF TEST EQUIPMENT

Before conducting the test, this circuit breaker test equipment secures the integrity by itself and prevent the possibility of errors or misjudgment with self-inspection functions for reliable testing equipment.

▶ TEST HISTORY MANAGEMENT

All test results are automatically saved so that users can freely check it at any time. It is possible to check the details of what is changed in the circuit breaker, which is tracked through changes in the graph according to the result of the general report as well as the test description of the selected circuit breaker and tested date.

▶ PRINT TEST REPORT

Auto-saved test results can be printed out in a test report programmed in the power circuit breaker test equipment.

All results measured using the test equipment can be checked in a report and can be printed out directly with the built-in laser printer.



Testing equipment for switchgear circuit breakers (VCB) – CBS V100



Business Performance

Item	Quantity	Year of Manufacture
HAF Hyundai Electric Inc.'s Hanul Nuclear Power Plant 3	2	2017
HVF Hyundai Electric Inc.'s Wolsong Nuclear Power Plant 1	1	2019
HVF Hyundai Electric Inc.'s Kori Nuclear Power Plant 2	3	2019
LVB LS Electric Inc.'s Wolsong Nuclear Power Plant 3	4	2019
KVAH Vitzrotech Inc.'s Saewool Nuclear Power Plant 2	2	2020
KVAH Vitzrotech Inc.'s Shin Hanul Nuclear Power Plant 1	4	2020
ML-17 POWELL Industries' Hanul Nuclear Power Plant 2	5	2020

Manufacturing History of Testing Equipment

Manufacturer	Type
Hyundai Electric Inc.	HAF, HVF
LS Electric Inc.	LVB
Vitzrotech Inc.	KVAH
POWELL Industries	ML-17

Not only for the above products, but also possible to manufacture the test equipment for all switchgear (VCB) circuit breakers that use a cradle.

Technical specifications

Mechanical data

Dimensions	1700(H) × 1000(W) × 1360(D)mm, Depending on breaker size
Weight	500 kg, Depending on cradle weight

Control Specification

TYPE	17" capacitance-type touchscreen 19" rack mount type
CPU	Intel quad-core N4200 onboard (1.1~2.5 Ghz)
RAM	8 GB
Storage	128 GB
Display	17" TFT LED Display 1280 × 1024 resolution
Communication	6 RS-232 & 6 USB

DC Power Output

Power	Voltage	Current	Accuracy
0 W ~ 3000 W (basic specifications)	DC 0 V ~ 150 V	0 A ~ 20 A	0.5 %FS
0 W ~ 3000 W (optional specifications)	DC 0 V ~ 300 V	0 A ~ 10 A	

Charging Motor Current Measurements

Source	Range	Accuracy
DC	0 A ~ 10 A	1 %FS

Resistance Measurements

Range	Voltage	Current	Accuracy
1 μΩ ~ 2 mΩ	DC 0 V ~ 5 V	100 A	1 %FS
1 Ω ~ 200 kΩ	DC 0 V ~ 12 V	0.2 A ~ 3 A	
1 MΩ ~ 4000 MΩ	DC 0 V ~ 1000 V	—	

Timing Test

Phase	Sampling rate	Time	Accuracy
Phase A	100 kHz	20 μs ~ 500 ms	0.1 %FS
Phase B			
Phase C			

Environmental conditions

Temperature	-15 °C ~ 55 °C / 5 °F ~ 131 °F
Humidity	30 % ~ 70 %

Calibration

Basic	1 set of calibration cables for I,M,E Guide book for calibration is provided (Contact us for assistant service of calibration)
Warranty	2 years (contact us for extension)

※ The image of the plant above was provided by Korea Hydro & Nuclear Power Co., Ltd.



Testing equipment for load center power circuit breakers (ACB) – CBS A100



Business Performance

Item	Quantity	Year of Manufacture
HAT (dual-type) for Hyundai Electric Inc.'s Hanul Nuclear Power Plant 3	1	2017
HAT (single-type) for Hyundai Electric Inc.'s Wolsong Nuclear Power Plant 3	2	2019

Manufacturing History of Testing Equipment

Manufacturer	Type
Hyundai Electric Inc.	HAT

Not only for the above products, but also possible to manufacture test equipment for all load center (ACB) circuit breakers that use a cradle.

Technical specifications

Mechanical data

Dimensions	1400(H) × 650(W) × 860(D)mm, Depending on breaker size
Weight	350 kg, Depending on cradle weight

Control Specification

TYPE	17" capacitance-type touchscreen 19" rack mount type
CPU	Intel quad-core N4200 onboard (1.1~2.5 Ghz)
RAM	8 GB
Storage	128 GB
Display	17" TFT LED Display 1280 × 1024 resolution
Communication	6 RS-232 & 6 USB

DC Power Output

Power	Voltage	Current	Accuracy
0 W ~ 3000 W (basic specifications)	DC 0 V ~ 150 V	0 A ~ 20 A	0.5 %FS
0 W ~ 3000 W (optional specifications)	DC 0 V ~ 300 V	0 A ~ 10 A	

Charging Motor Current Measurements

Source	Range	Accuracy
DC	0 A ~ 10 A	1 %FS

Resistance Measurements

Range	Voltage	Current	Accuracy
1 μΩ ~ 2 mΩ	DC 0 V ~ 5 V	100 A	1 %FS
1 Ω ~ 200 kΩ	DC 0 V ~ 12 V	0.2 A ~ 3 A	
1 MΩ ~ 4000 MΩ	DC 0 V ~ 1000 V	—	

Timing Test

Phase	Sampling rate	Time	Accuracy
Phase A	100 kHz	20 μs ~ 500 ms	0.1 %FS
Phase B			
Phase C			

Check OCR Operation

Power	Voltage	Current	Accuracy
0 W ~ 100 W	AC 0 V ~ 1 V	0 A ~ 100 A	0.5 %FS

Environmental conditions

Temperature	-15 °C ~ 55 °C / 5 °F ~ 131 °F
Humidity	30 % ~ 70 %

Calibration

Basic	1 set of calibration cables for I,M,E Guide book for calibration is provided (Contact us for assistant service of calibration)
Warranty	2 years (contact us for extension)

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Testing equipment for reactor trip power circuit breakers (RTSG) – CBS R100



Business Performance

Item	Quantity	Year of Manufacture
DS-206(N) for WestingHouseElectric's Hanul Nuclear Power Plant 3	2	2019
DS-206 for WestingHouseElectric's Hanul Nuclear Power Plant 2	1	2020
DS-206(N) for WestingHouseElectric's Wolsong Nuclear Power Plant 3	2	2020

Manufacturing History of Testing Equipment

Manufacturer	Type
WestingHouseElectric	DS-206(N)

Not only for the above products, but also possible to manufacture test equipment for all reactor trip (RTSG) circuit breakers that use a cradle.

Technical specifications

Mechanical data

Dimensions	1400(H) × 650(W) × 860(D)mm, Depending on breaker size
Weight	350 kg, Depending on cradle weight

Control Specification

TYPE	17" capacitance-type touchscreen 19" rack mount type
CPU	Intel quad-core N4200 onboard (1.1~2.5 Ghz)
RAM	8 GB
Storage	128 GB
Display	17" TFT LED Display 1280 × 1024 resolution
Communication	6 RS-232 & 6 USB

DC Power Output – Electric motor control and UVTA (2-channel use)

Power	Voltage	Current	Accuracy
0 W ~ 3000 W (basic specifications)	DC 0 V ~ 150 V	0 A ~ 20 A	0.5 %FS
0 W ~ 3000 W (basic specifications)	DC 0 V ~ 300 V	0 A ~ 10 A	

Charging Motor Current Measurements

Source	Range	Accuracy
DC	0 A ~ 10 A	1 %FS

Resistance Measurements

Range	Voltage	Current	Accuracy
1 μΩ ~ 2 mΩ	DC 0 V ~ 5 V	100 A	1 %FS
1 Ω ~ 200 kΩ	DC 0 V ~ 12 V	0.2 A ~ 3 A	
1 MΩ ~ 4000 MΩ	DC 0 V ~ 1000 V	—	

Timing Test

Phase	Sampling rate	Time	Accuracy
Phase A	100 kHz	20 μs ~ 500 ms	0.1 %FS
Phase B			
Phase C			

Check OCR Operation

Power	Voltage	Current	Accuracy
0 W ~ 100 W	AC 0 V ~ 1 V	0 A ~ 100 A	0.5 %FS

Environmental conditions

Temperature	-15 ~ 55 / 5 ~ 131
Humidity	30 % ~ 70 %

Calibration

Basic	1 set of calibration cables for I,M,E Guide book for calibration is provided (Contact us for assistant service of calibration)
Warranty	2 years (contact us for extension)

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Screen Contents of Integrated Program

CIRCUIT BREAKER MANUAL CONTROL

This button turns on and off the electric motor or main circuit of the circuit breaker. Workers or operators can easily turn on and off the electric motor or main circuit with just one touch.

MINIMUM PICK-UP TEST

Energysys applied standard procedural guidelines of KHNP on the "operational test on minimum control voltage". After measuring the electric current and time flowing during the operation of the motor, it shows the results in graphs. When charging is complete, apply a minimum voltage of 100 ms to the closing coil of the circuit breaker and check whether the closing operation is performed. If it is not turned on, set an idle time, and then increase the voltage value and apply the voltage again for 100 ms. When it is operated, the measurement is complete.

For measuring the minimum voltage of opening operation, it uses the same method as when measuring the minimum voltage of the closing coil.

UNDERVOLTAGE TRIP TEST

If an under-voltage trip attachment device is installed in the circuit breaker, the device can be tested. Under voltage trip device measures the operating voltage and the main circuit trips by operating the device, then it measures the time from the voltage drop to the tripping point.

TIMING TEST

It measures the time for opening and closing the main circuit of the circuit breaker. It can check the differences between the phase of opening and closing time of the circuit breaker and possible to check the detailed analysis with graphs by the button at the bottom.

The opening and closing time is measured by the definition of IS/ IEC 62271. It reads 25,000 times value per second for detailed measurements.

CIRCUIT BREAKER STATUS MONITORING

There is a contact point for checking the status of the circuit breaker, although the name varies depending on the type of circuit breaker and additional circuits.

It provides real-time checks of the condition of the circuit breaker through the contact points in the circuit breaker including contacts between the auxiliary switch, position switch, overcurrent operation, Auto Contact, MOC, TOC, etc., to prevent any accidents that may occur during the test.

CIRCUIT BREAKER SELECTION

Before the actual testing, select the circuit breaker model that will be tested and the test results of the selected circuit breaker are saved accordingly. If the workers or operators need it, it is possible to check all test results at any time.

RESISTANCE MEASUREMENT

It is possible to check the integrity by measuring the circuit breaker's motor coil resistance, reclosing prevention relay resistance, closing coil resistance, UVTA coil resistance, and the contact resistance and insulation resistance of the main circuit. For the regular resistance, a 4-terminal comparison method is used. For the contact resistance, DC 100A is used according to IS/IEC 62271.

For the insulation resistance, DC 500V and DC 1000V voltages are used according to the standards of ANSI/NETA ATS-2017.

OVERCURRENT RELAY TEST

It is possible to test the overcurrent relay if the overcurrent relay is installed in the load center circuit breaker and reactor trip circuit breaker.

Considering the time characteristics of the installed relay, it checks the pick-up current for long, short, and instantaneous times to check the integrity.

The screenshot displays the 'Circuit Breaker Manual Control' and 'Circuit Breaker Status Monitoring' sections. The manual control section includes buttons for 'Motor Charging', 'Close', and 'Open', along with 'On' and 'Off' status indicators. The status monitoring section shows 'Aux. Switch Status' and 'T.O.C. Switch Status' with corresponding indicator lights. Below these are 'Test Items' including 'Pick-Up Test', 'Resistance Measurement', and 'Timing Test'. The 'Resistance Measurement' section has buttons for 'Minimum Pick-Up Close / Trip Test', 'Motor Coil', 'Anti-Pump Relay Coil', 'Close Coil', 'Trip Coil', and 'UVTA Coil'. The 'Timing Test' section includes 'UVTA Test', 'Timing Test', and 'Overcurrent Relay Test'. At the bottom, there are 'Select All' and 'Test Start' buttons, and a 'Status Message is Here!' area.



Major Functions of Program

SELF-INSPECTION OF TEST EQUIPMENT

It tests all the functions of I,M,E including the power source, control circuit, and data collecting device.

It can check the integrity and build the credibility of the test equipment.

The inspected results are saved and listed for management. This can be printed out as a test report and used as data.

Test No.	Test Date	Test Result	Test Item
1	2013-08-06 14:01:42	Pass	AC Power Supply
2	2013-08-06 14:01:42	Pass	DC Power Supply
3	2013-08-06 14:01:42	Pass	Charging Current
4	2013-08-06 14:01:42	Pass	Insulation Resistance Tester
5	2013-08-06 14:01:42	Pass	Micrologger
6	2013-08-06 14:01:42	Pass	Control Board
7	2013-08-06 14:01:42	Pass	Test Report

PRINT TEST REPORT

Auto-saved test results can be printed out in the form of a test report.

All test results can be printed out with the installed laser printer in the form of test items, measurement values, reference values, and judged results.

The results form can be modified according to the customer's request.

Test No.	Test Date	Test Result	Test Item
1	2013-08-06 14:01:42	Pass	ACB Test Report
2	2013-08-06 14:01:42	Pass	ACB Test Report
3	2013-08-06 14:01:42	Pass	ACB Test Report
4	2013-08-06 14:01:42	Pass	ACB Test Report
5	2013-08-06 14:01:42	Pass	ACB Test Report
6	2013-08-06 14:01:42	Pass	ACB Test Report
7	2013-08-06 14:01:42	Pass	ACB Test Report

CHARGING CURRENT GRAPH

It applies DC power to the motor coil of the circuit breaker and then charges the motor coil.

Then, measuring the maximum charging current (A), average charging current (B) and the time for complete charging (C) and if there are any errors or problems, the test is stopped with a warning sign.

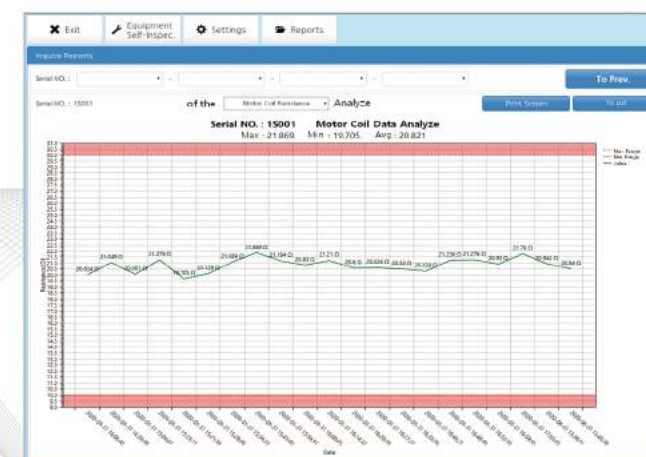
By measuring the electric current, it is possible to check the deteriorated level of the motor coil and prevent damage / over damage to the circuit breaker.



TEST HISTORY ANALYSIS

The test history of the circuit breaker can be analyzed through the integrated program.

Select the circuit breaker you want to check and select the test description. Then, the test results will be shown in graphs.



TIMING GRAPH

It is possible to observe the chattering that arises during the closing and tripping of the circuit breaker as if observed with an oscilloscope, it provides precise measurements. It calculates the time consumed in closing and tripping operations for each phase to check whether there is a difference between the phases and whether the operations are within the range.



WIRELESS COMMUNICATION

It is possible to check the test results directly on a computer or mobile phone.

If wireless communication is available, it can connect to the test machine by an additional system.

