Current and Voltage Transformer Analyzer
CVA500
Manual

Manual version: M-TCVANN-303-EN
This Manual refers to the firmware versions 1.x
This Manual refers to the SBC application version 2.x.x
Publishing date: 2024-08-22

Contents

1 Introduction

The purpose of this Manual is to provide helpful instructions on how to use CVA500 instrument safely, properly, and efficiently.

The following instructions will help the user avoid unsafe situations, reduce maintenance costs, and will ensure the reliability and durability of CVA500 instrument.

CVA500 must be used in accordance with all existing safety requirements and regulations based on national/local standards for accident prevention and environmental protection. In addition, the relevant international standards are listed in the paragraph 0 of the “Technical Data” section of this document.

1.1 Safety Instructions

Safety is the responsibility of the user. Before operating CVA500, please read the following safety instructions carefully.

It is not recommended that CVA500 is used (or even turned on) without careful observation of the instructions listed in this Manual. CVA500 should only be operated by trained and authorized personnel.

1.1.1 Safety Terms and Symbols

Terms in this Manual

These terms may appear in the Manual:

WARNING: Warning statements identify conditions or practices that could result in injury or loss of life.

CAUTION: Caution statements identify conditions or practices that could result in damage to this product or to other property.

Terms on the Device

The following warning terms used in this document may appear on the device:

WARNING: indicates that potential hazard may occur.

CAUTION: indicates that potential damage may occur to the instrument or to the test object connected to the instrument.

Symbols on the Device

The following symbols may appear on the device:

Refer to manual

Protective earth terminal

1.1.2 Terms of Use

CVA500 shall be used only if it is in good technical condition. Its use shall be in accordance with local safety and industrial regulations. Adequate precautions must be taken to avoid any risks related to the high voltages associated with this equipment and nearby objects.

CVA500 shall be used only for the application purposes described in the ”Intended Use” section. The manufacturer and distributors are not liable for damage resulting from wrong usage. The user bears responsibility for not following the instructions defined in this document.

Do not remove the protective casing of CVA500.

All service and maintenance work must be performed by qualified personnel only.

1.1.3 Orderly Practices and Procedures

The Manual shall always be available on the site where CVA500 is used.

Before using CVA500, all personnel (even personnel who only occasionally, or less frequently, work with CVA500) assigned to operate CVA500 should read the operations Manual.

Do not make any modifications, extensions, or adaptations to CVA500.

Use CVA500 only with the original accessories provided by the manufacturer.

Use CVA500 and its original accessories for the device’s intended use only.

1.1.4 Instrument Maintenance

The device should be kept clean in order to prevent excessive cases of dust or other contaminants affecting its operation. It should be cleaned with water/isopropyl alcohol after any dirt/contaminants are noticed on its surfaces.

1.1.5 Operator Qualifications

Testing with CVA500 should only be carried out by authorized and qualified personnel.

Personnel receiving any training or instructions on CVA500 should remain under constant supervision of an experienced operator while working with the test set and the test object.

1.1.6 Safe Operating Procedures

Hazardous voltages of up to 2100 V can occur inside CVA500. Therefore, it is not permitted to remove the protective casing of CVA500.

Hazardous voltages exist on the terminals of CVA500 when the “HIGH VOLTAGE” LED is lit. Never assume connections are safe even if this LED is off. Switch off and unplug CVA500 before touching connections, particularly if a fault is suspected.

Before putting CVA500 into operation, check the test set for any visible damage.

Do not operate CVA500 under wet or moist conditions (condensation).

Do not operate CVA500 if explosive gas or vapors are present.

Removing the CVA500 protective casing will void the warranty. Any work inside the instrument without prior authorization from DV Power will also void the warranty.

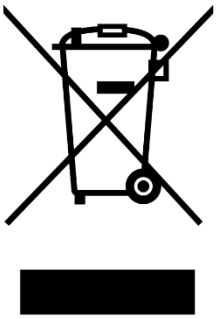
If CVA500 seems to be malfunctioning, please contact the DV Power Support Team (refer to the "Manufacturer Contact Information" section) after previously checking the "Error Messages" section.

Prior to connecting CVA500, ensure that an instrument transformer to be tested is completely de-energized and isolated from both the line and the load. Every terminal should be checked and verified before connecting CVA500. Ground connections may be left in place.

Wherever possible, the outer casing of an instrument transformer under test should also be connected to a safety earth to prevent the risk of shock. Where this cannot be achieved, adequate precautions should be taken to prevent access to the instrument transformer.

1.1.7 Disposal

DV Power instruments and its accessories are intended for professional use and are not intended for household use. As such they should not be disposed of with waste that was intended for household use.



For customers inside of the EU/EEA member states area

DV Power instruments and accessories are subject to the Directive 2012/19/EU on waste electrical and electronic equipment (WEEE). When disposing of DV Power instruments and accessories, please use your local WEEE collection systems. Instruments and accessories can be returned to DV Power for disposition and treatment of WEEE.

For customers outside of the EU/EEA member states area

It is important to follow guidelines that are prescribed for disposal of WEEE in the according country. Dispose DV Power instruments and accessories according to local legal requirements.

1.2 Power Supply

Supply CVA500 only from a power outlet equipped with a protective ground.

Besides supplying CVA500 from phase – neutral (L1-N, A-N), it may also be supplied from phase to phase (e.g., L1-L2; A-B). However, the voltage must not exceed 264 V AC. Please refer to the "Technical Data" section.

CVA500 should be positioned in such a way that it is possible to safely disconnect it from the power supply at any moment.

WARNING / AVERTISSEMENT

This is a class A product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

Il s'agit d'un produit de classe A. Dans un environnement domestique, ce produit peut provoquer des interférences radio, auquel cas l'utilisateur peut être amené à prendre des mesures adéquates.

1.3 Measurement Category

CVA500 is intended to be used for measurements in Measurement Category I (CAT I) for voltages up to 2100 V. The device is also designed to withstand occasional transient overvoltage up to 5000 Vpk.

WARNING / AVERTISSEMENT

This equipment is classified as measurement category I, and must not be used within measurement category II, III and IV.

Cet équipement est classé dans la I catégorie de mesure, et ne doit pas être utilisé pendant les catégories de mesure II, III et IV.

1.4 Intended Use

CVA500 is designed specifically for performing measurements on instrument transformers as follows:

- Turns ratio
- Phase angle (polarity check)
- Excitation current
- Winding resistance
- Demagnetization
- Saturation (knee point)
- Burden
- Insulation resistance

CAUTION: Any use of CVA500 other than mentioned above is being considered improper and will void the warranty and exempt the manufacturer from its liability for repair or exchange.

2 Description

2.1 Front Panel Components

Figure 2-1. CVA500 top plate

1. **Display**

   Graphical touch screen display 10.1”. Displays the settings during the device programming as well as the measured values during and after a test.

2. **Ethernet PC Communication Connector**

   Ethernet connector for connecting CVA500 to a PC for the purpose of operating CVA500 via DV-TR software.

3. **Flash Drive Connector**

   Connector for inserting USB memory stick to CVA500. Results and test templates can be exported from CVA500 to USB memory stick, and test templates can be imported from USB memory stick to CVA500.

4. **Safety Strobe Connector**

   Connector for connecting safety strobe lamp. The lamp provides blinking light during test.

5. **Debug Connector**

   Connector for connecting CVA500 to a PC for the purpose of debugging software application.

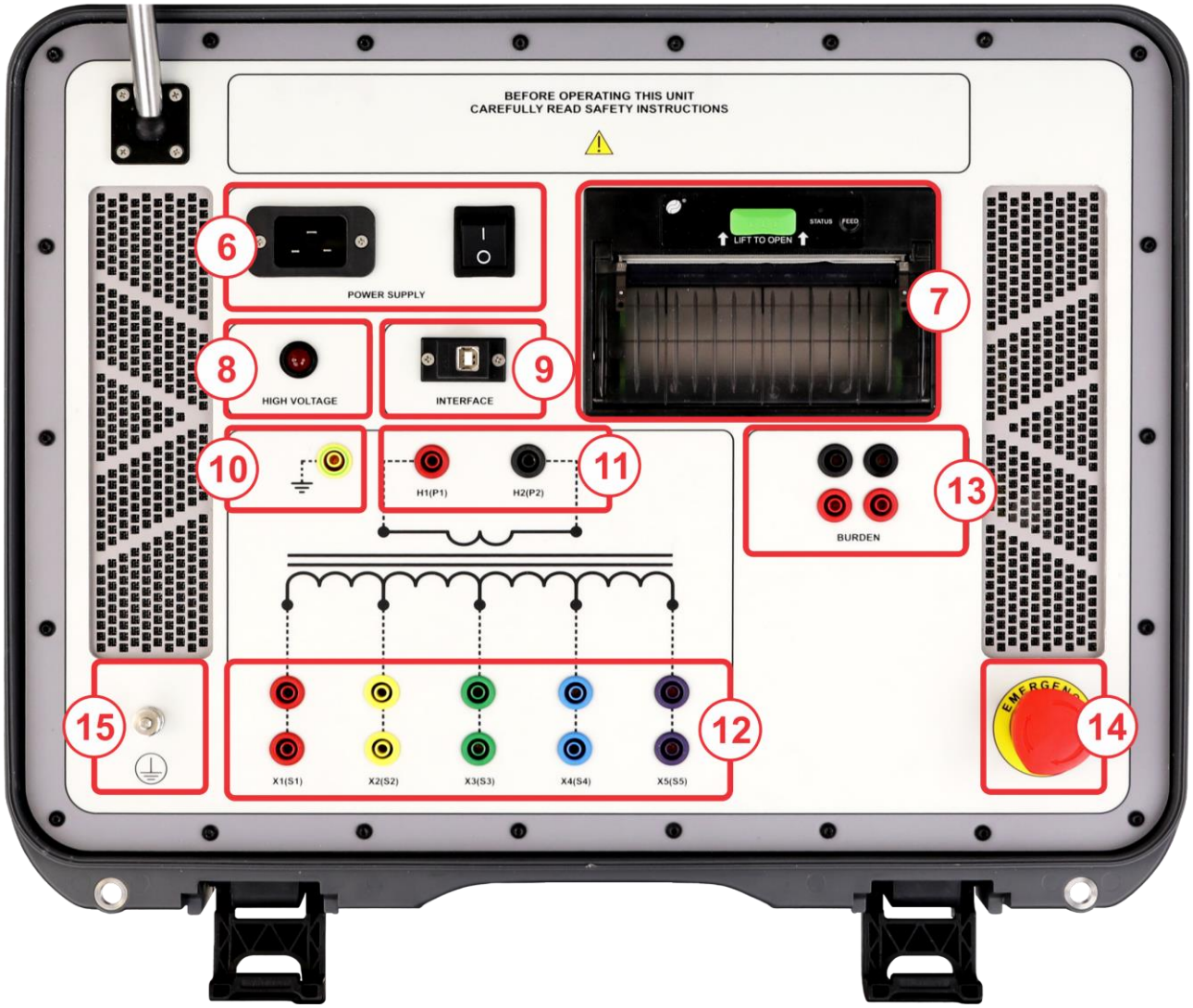


Figure 2-2. CVA500 bottom plate

6. Mains Power Supply

Mains power connector

For connecting CVA500 to the mains power supply with a power cord.

Power switch – Double pole switch

- **I** In this position, CVA500 is connected to the mains power supply.
- **0** In this position, CVA500 is separated from the mains power supply.

7. Printer

Built-in thermal printer 112 mm (4.4”) wide.

8. High Voltage Diode

Safety diode that lights during test.

9. USB PC Communication Connector

USB connector for connecting CVA500 to a PC for the purpose of operating CVA500 via DV-TR software.

10. Grounding Measurement Terminal

Measurement terminal for connecting CVA500 to test object grounding point. This terminal is used during insulation resistance tests, for testing insulation resistance between test object primary or secondary winding and a ground.

11. Primary Measurement Terminals

Measurement terminals for connecting CVA500 to test object primary winding.

12. Secondary Measurement Terminals

Measurement terminals for connecting CVA500 to test object secondary winding. It is possible to connect CVA500 to a maximum of 5 taps. Each tap is marked with a different color. Upper terminals are voltage/current output terminals. Bottom terminals are voltage measurement terminals.

13. Burden Measurement Terminals

Measurement terminals for connecting CVA500 to instrument transformer’s burden.

14. Emergency Stop

Pressing this switch turns off the output voltage and stops the test. To release the switch to normal position, rotate it slightly clockwise. This switch should be used only in emergency cases.

15. Protective Earth Connector

For protection against parasitic currents or voltages, always connect CVA500 protective earth connector to the protective ground (PE). Use only the original cable. For safety reasons, always establish this connection before establishing any other connection, and remove this connection as the very last.

3 Connecting CVA500

Before the CVA500 is to be connected to a test object, the following steps must be verified:

- The test object is disconnected from its circuit in accordance with the national safety regulations and it is properly grounded to the protective earth.
- The test object is completely de-energized.

NOTE: Always connect measuring cables to the CVA500 first and then to the test object terminals. Additionally, measuring cables can be connected to the test object terminals first, but only if the test object terminals are grounded.
When disconnecting, always disconnect cables from the test object terminals first and then from the CVA500. Additionally, measuring cables can be disconnected from the CVA500 first, but only if the test object terminals are grounded. Not following these instructions may cause life-threatening situations.

3.1 CVA Cables

CVA500 is provided with following standard accessories:

- Primary side cables set 4 x 10 m with banana plugs. A set of 4 cables, 2 red and 2 black, that have male banana plugs on both sides (one side contains angled banana plug). One end of cable is connected to CVA500, while the other end is connected either to dolphin clip, TTA clamp (when connecting point requires clamps with big opening jaw, typically for connecting to instrument transformer primary terminals), or via female-female cable coupler to Kelvin dolphin clips, cable lug, or flex wire (when connecting point is small, typically for connecting to instrument transformer secondary terminals).

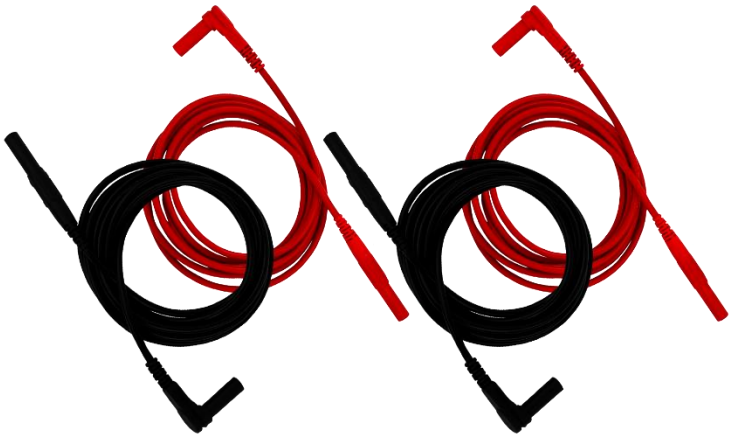


Figure 3-1. Primary side cables

Figure 3-2. TTA clamps

Figure 3-3. Dolphin clips

- Secondary side cables set 10 x 5 m with banana plugs. A set of 10 cables, 2 red, 2 yellow, 2 green, 2 blue, 2 purple, that have male banana plugs on both sides (one side contains angled banana plug). One end of cable is connected to CVA500, while the other end is connected either to dolphin clip, TTA clamp (when connecting point requires clamps with big opening jaw, typically for connecting to instrument transformer primary terminals), or via female-female cable coupler to Kelvin dolphin clips, cable lug, or flex wire (when connecting point is small, typically for connecting to instrument transformer secondary terminals).

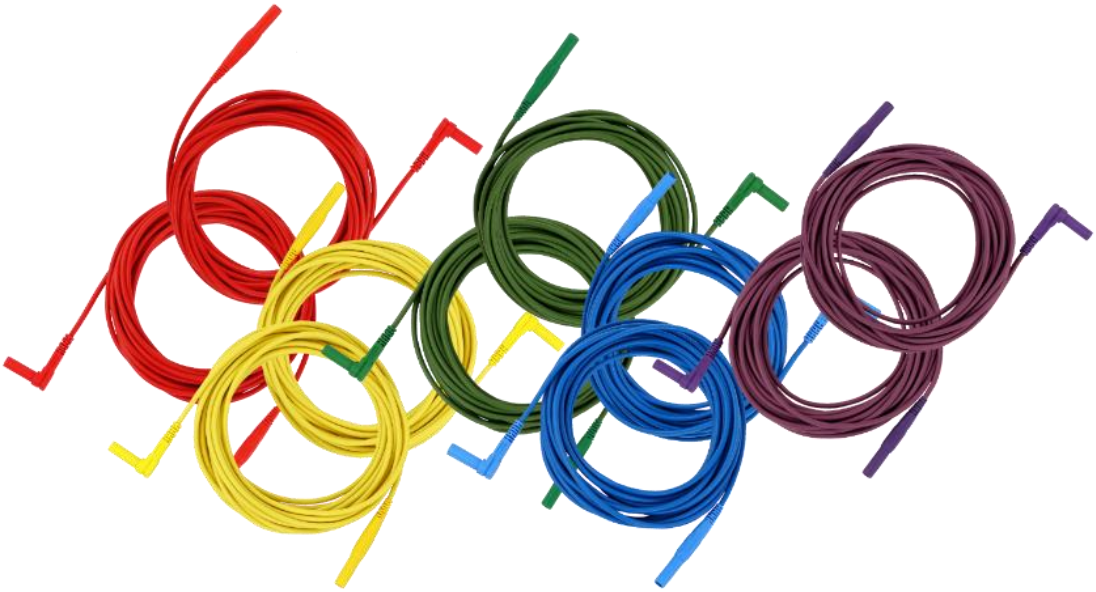


Figure 3-4. Secondary side cables

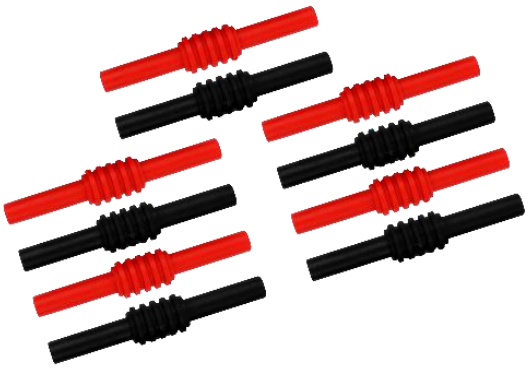


Figure 3-5. Cable coupler set

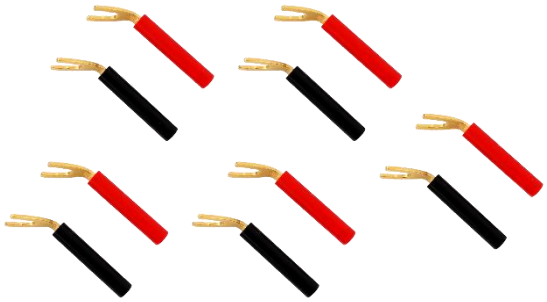


Figure 3-6. Cable lug adapter set

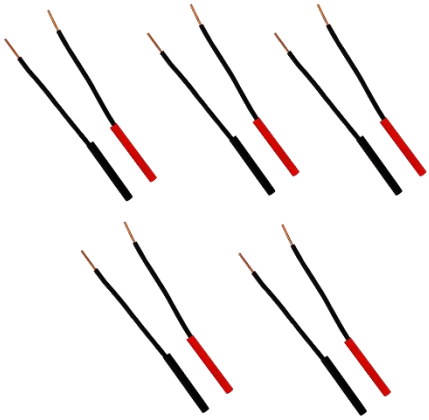


Figure 3-7. Flex wire adapter set

- Secondary side cables set 5 x 0.5 m with dolphin clips (Kelvin). A set of 5 red-black cables that have male banana plugs on one end, and dolphin clip on the other end. Dolphin clip jaws are galvanically separated to enable Kelvin 4-point method measurements. These cables are typically connected to instrument transformer secondary terminals.

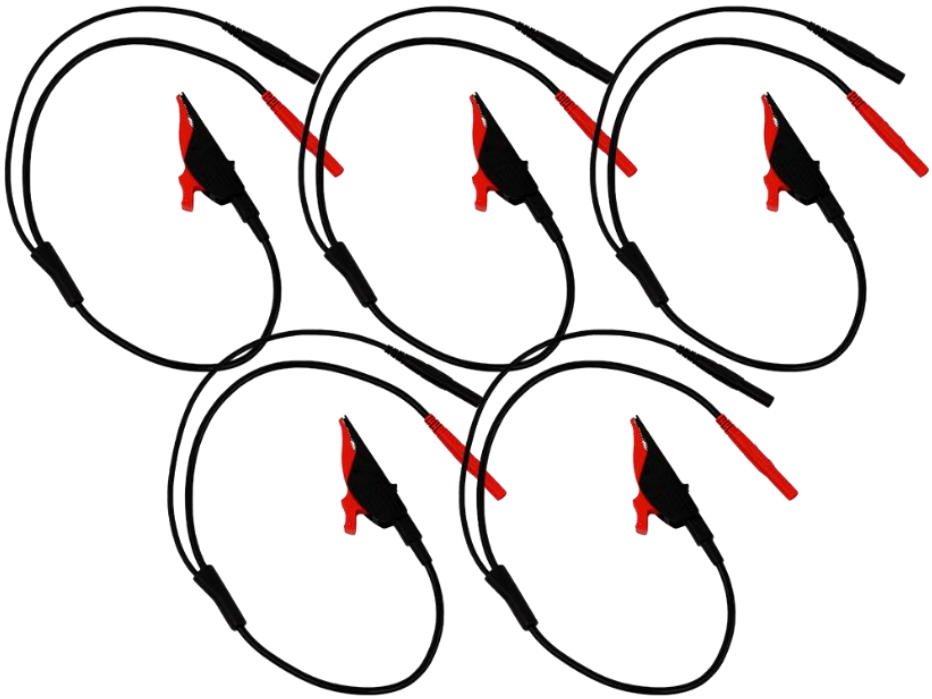


Figure 3-8. Secondary side cables with dolphin clips (Kelvin)

- Grounding measurement cable set 1 x 5 m with dolphin clip. A set of a green-yellow cable with male banana plugs on both sides (one side contains angled banana plug), and a green-yellow dolphin clip. This cable is used for connecting CVA500 to instrument transformer grounding terminal, for the purpose of measuring insulation resistance between grounding and primary or secondary winding.

Figure 3-9. Grounding measurement cable with dolphin clip

- Burden cables set 2 x 5 m with dolphin clips (Kelvin). A set of 2 red-black cables that have male banana plugs on one end, and dolphin clip on the other end. Dolphin clip jaws are galvanically separated to enable Kelvin 4-point method measurements. These cables are used for connecting CVA500 to the instrument transformer associated burden.

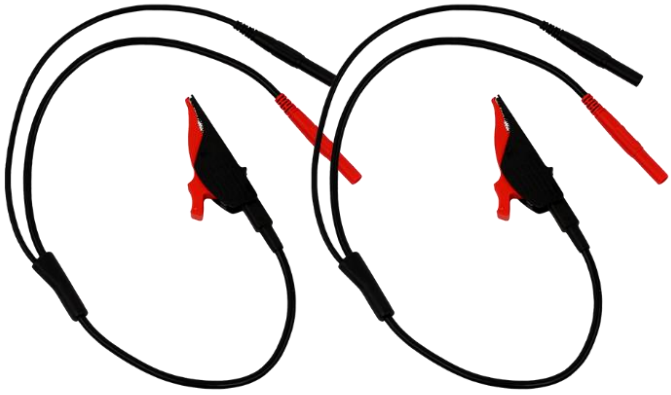


Figure 3-10 Burden cables with dolphin clips (Kelvin)

NOTE: To maximize the accuracy and measurement repeatability, make sure all clamps have a good connection to the test object and avoid any crossing between the measuring cables.

3.2 Connecting CVA500 to a CT

3.2.1 Single-tap CT

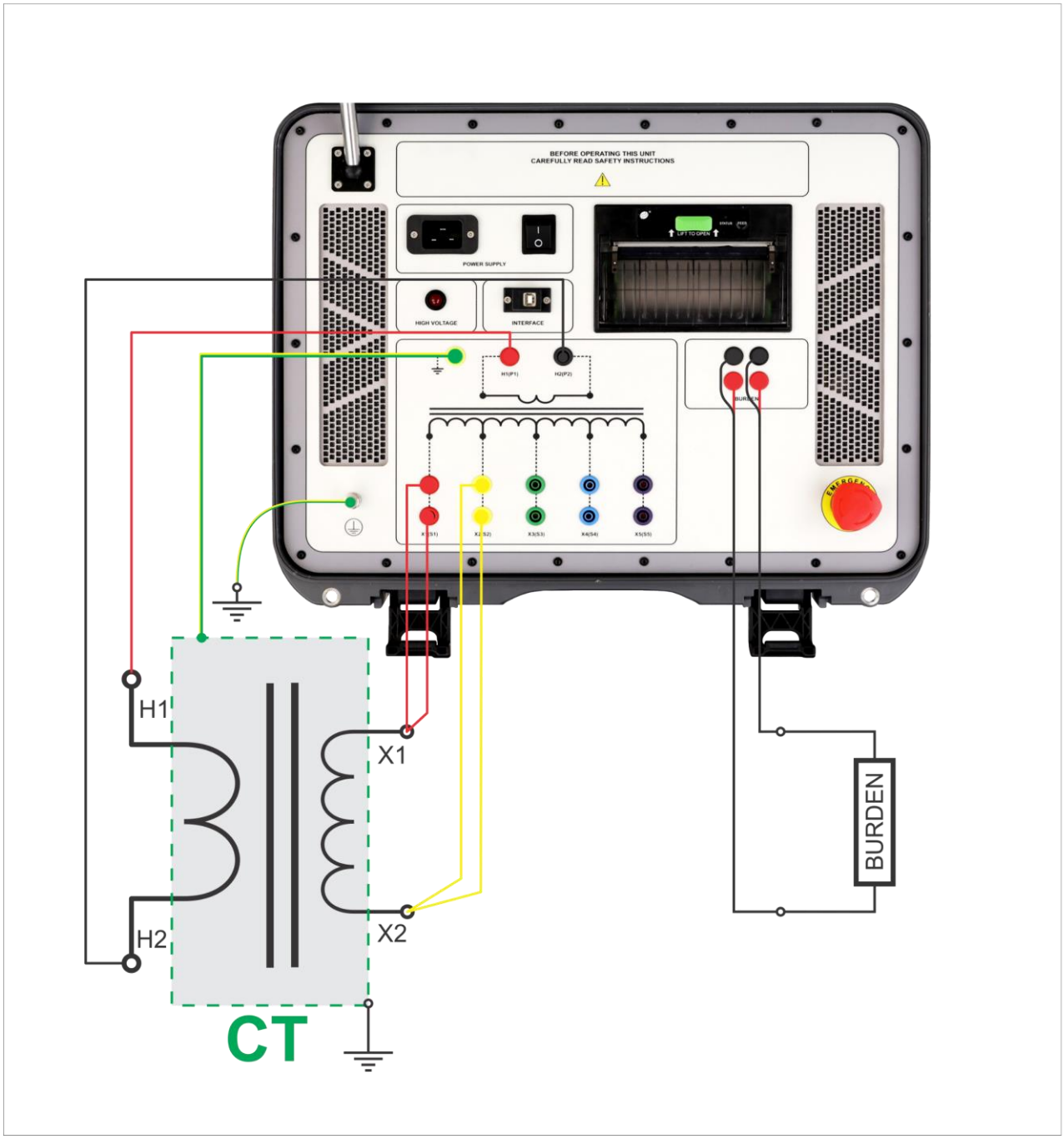


Figure 3-11. Connecting CVA500 to a single-tap CT

3.2.2 Multi-tap CT

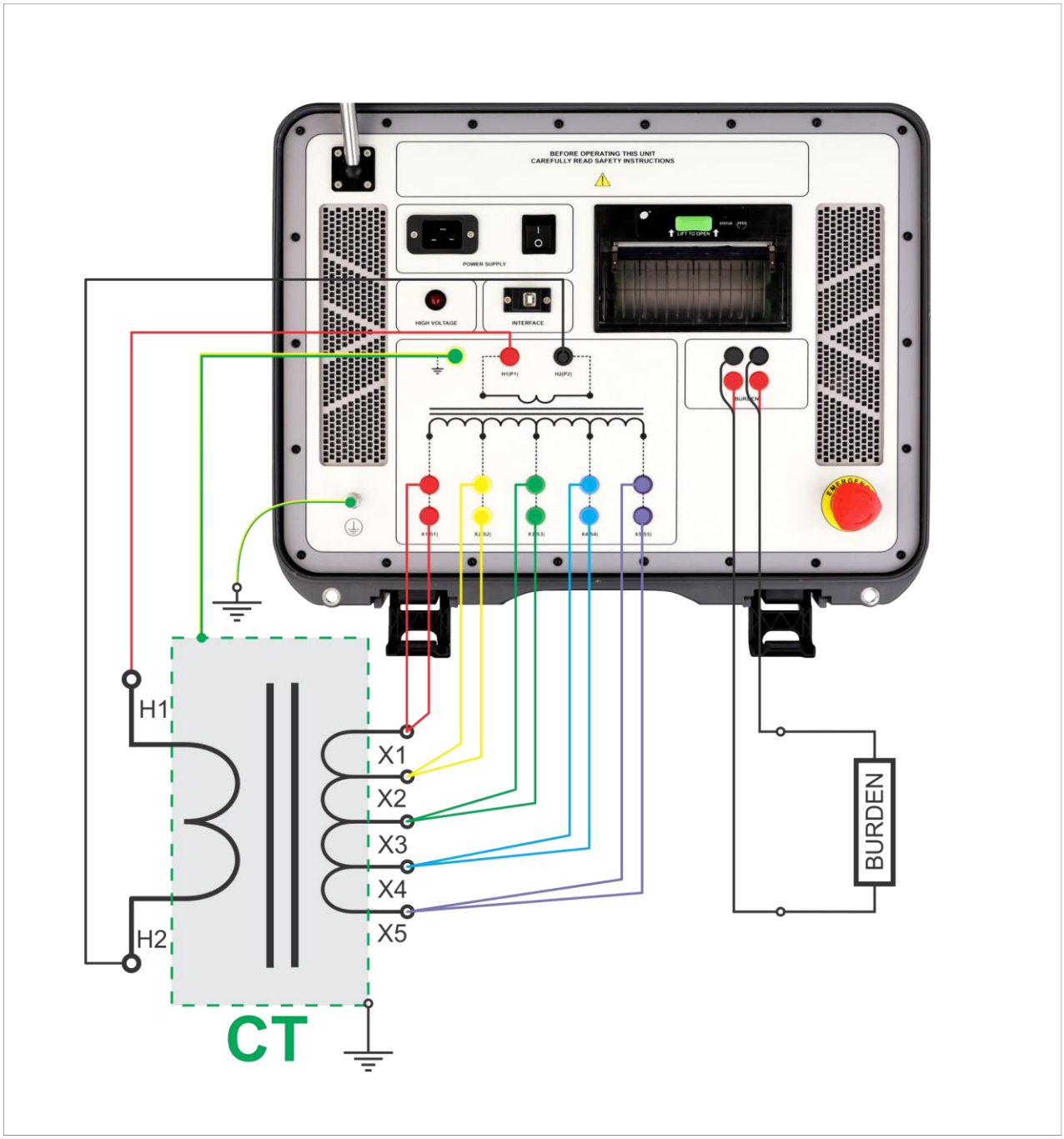


Figure 3-12. Connecting CVA500 to a multi-tap CT

3.3 Connecting CVA500 to a VT

3.3.1 Turns Ratio Test and Winding Resistance Primary Side Test

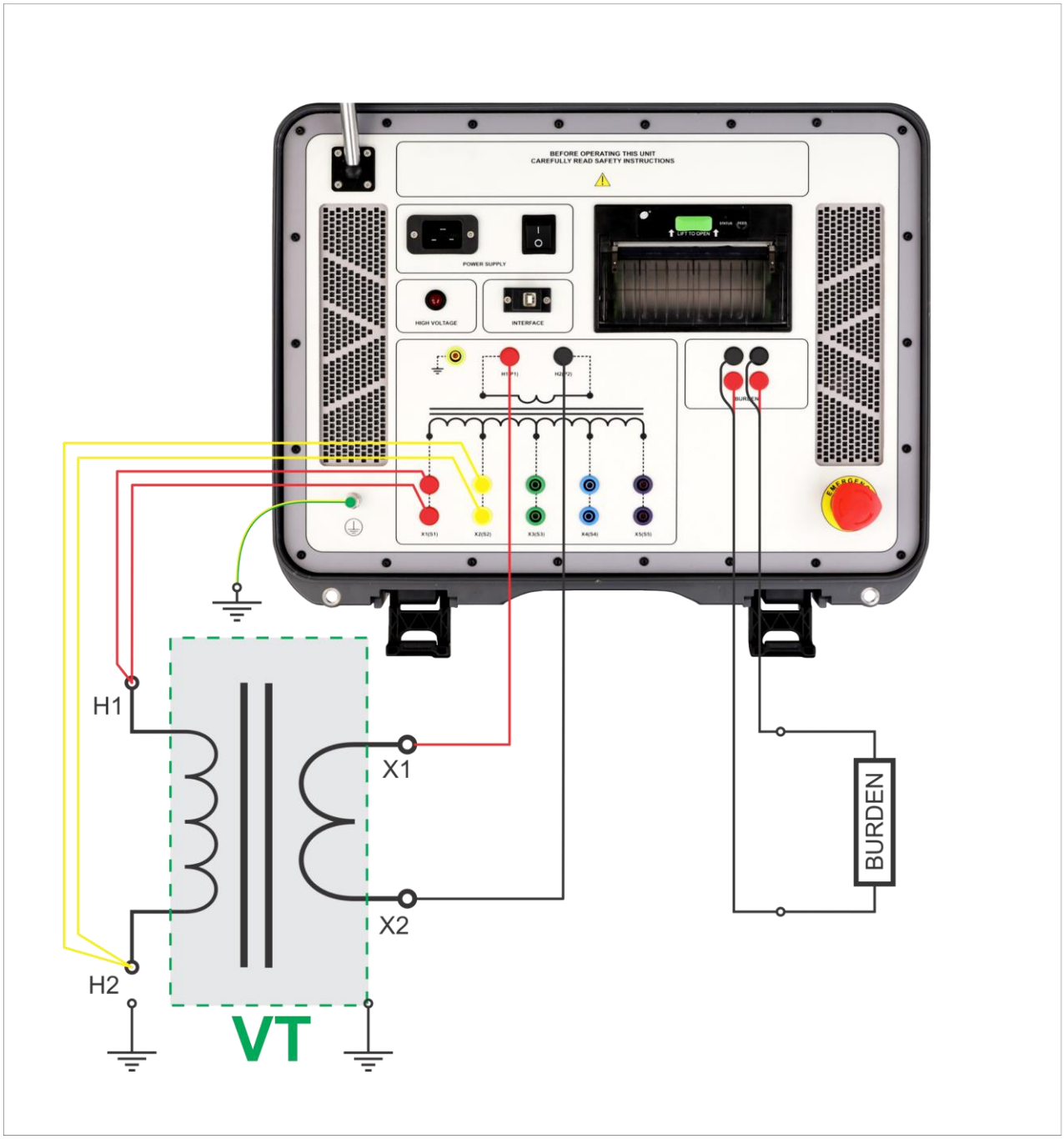


Figure 3-13. Connecting CVA500 to a VT, turns ratio test and winding resistance primary side test

3.3.2 Winding Resistance Secondary Side Test and Insulation Resistance Test

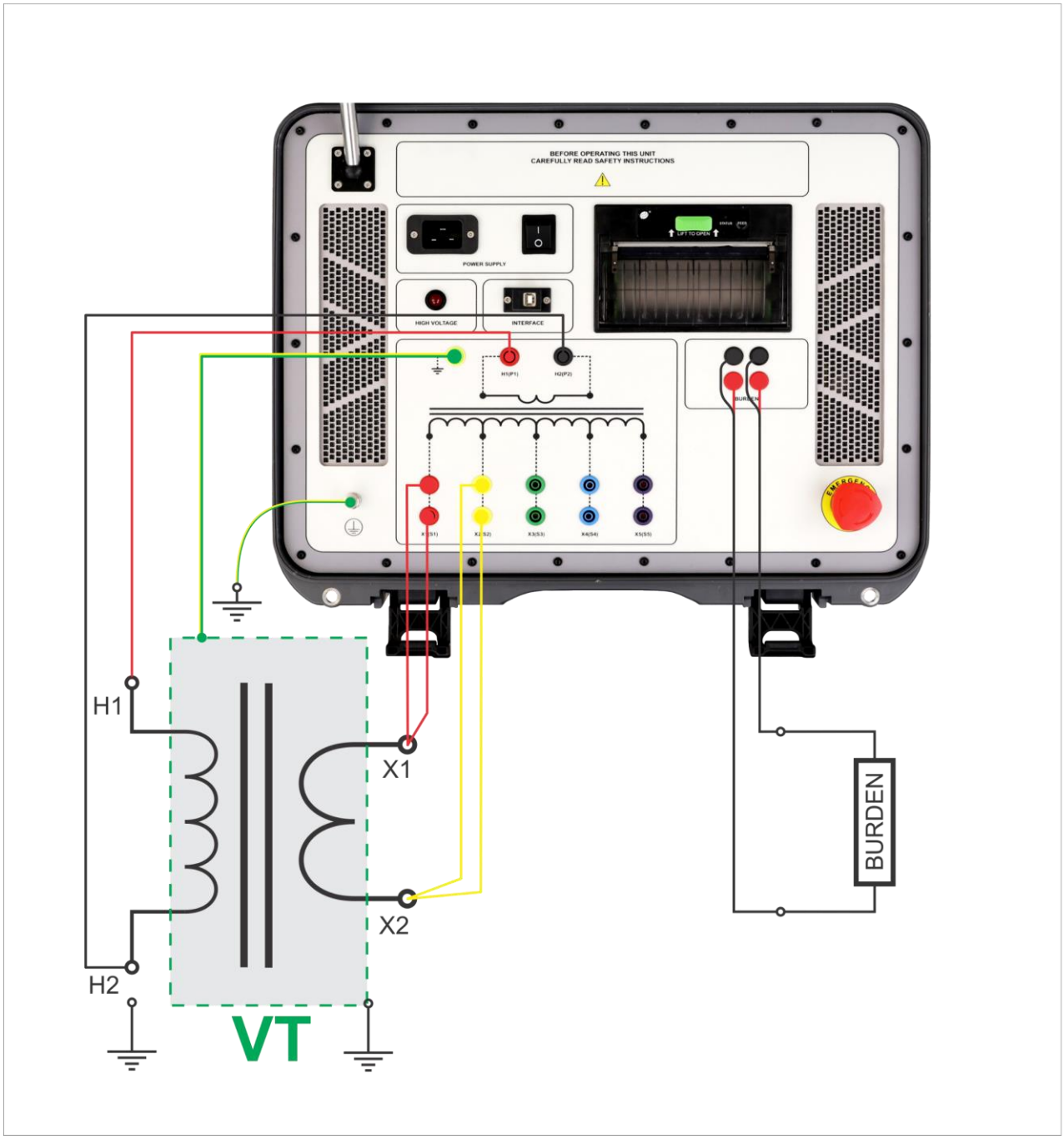


Figure 3-14. Connecting CVA500 to a VT, winding resistance secondary side test and insulation resistance test

3.4 Connecting CVA500 to a CVT

3.4.1 Turns Ratio Test

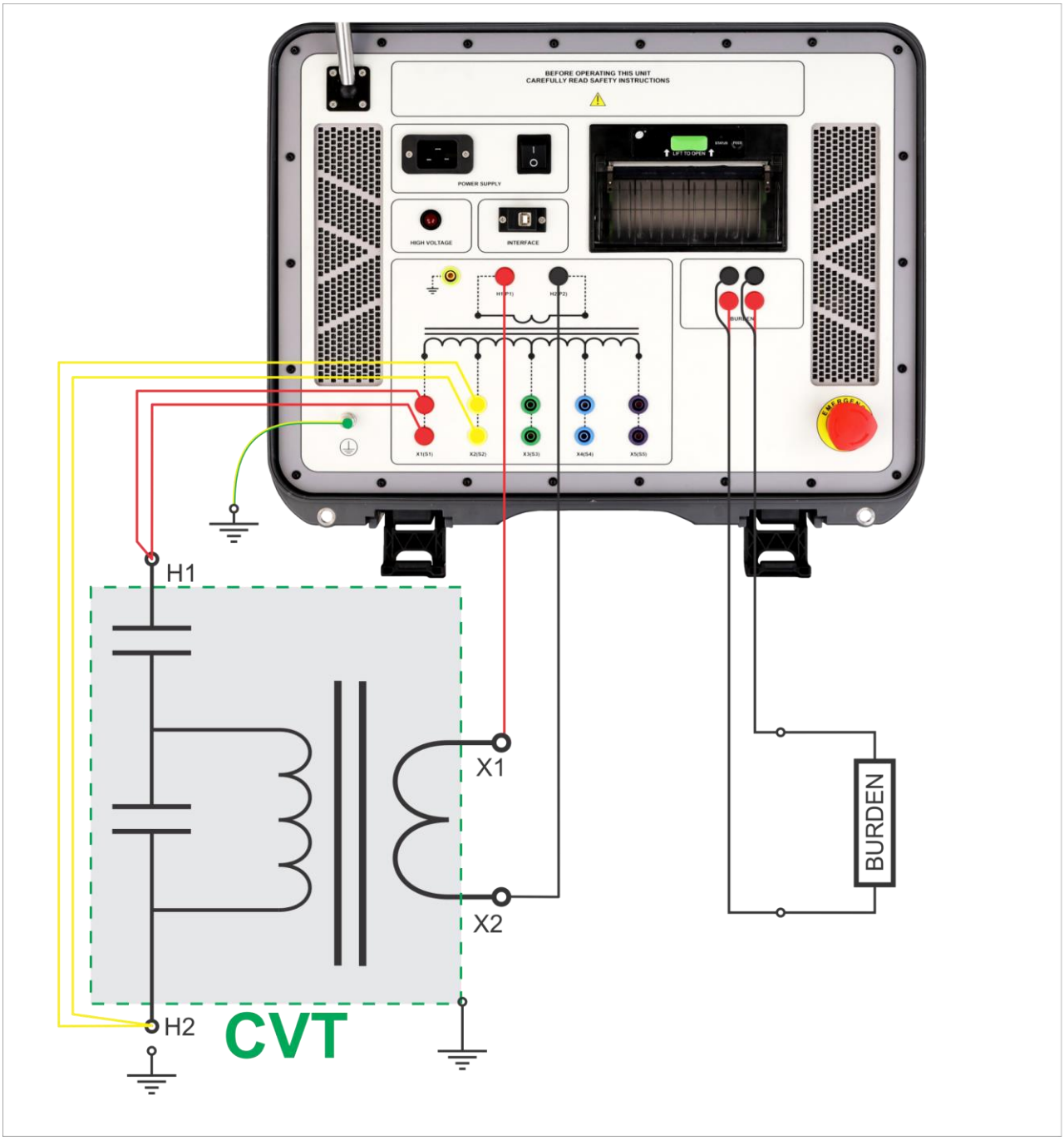


Figure 3-15. Connecting CVA500 to a CVT, turns ratio test

3.4.2 Winding Resistance Secondary Side Test and Insulation Resistance Test

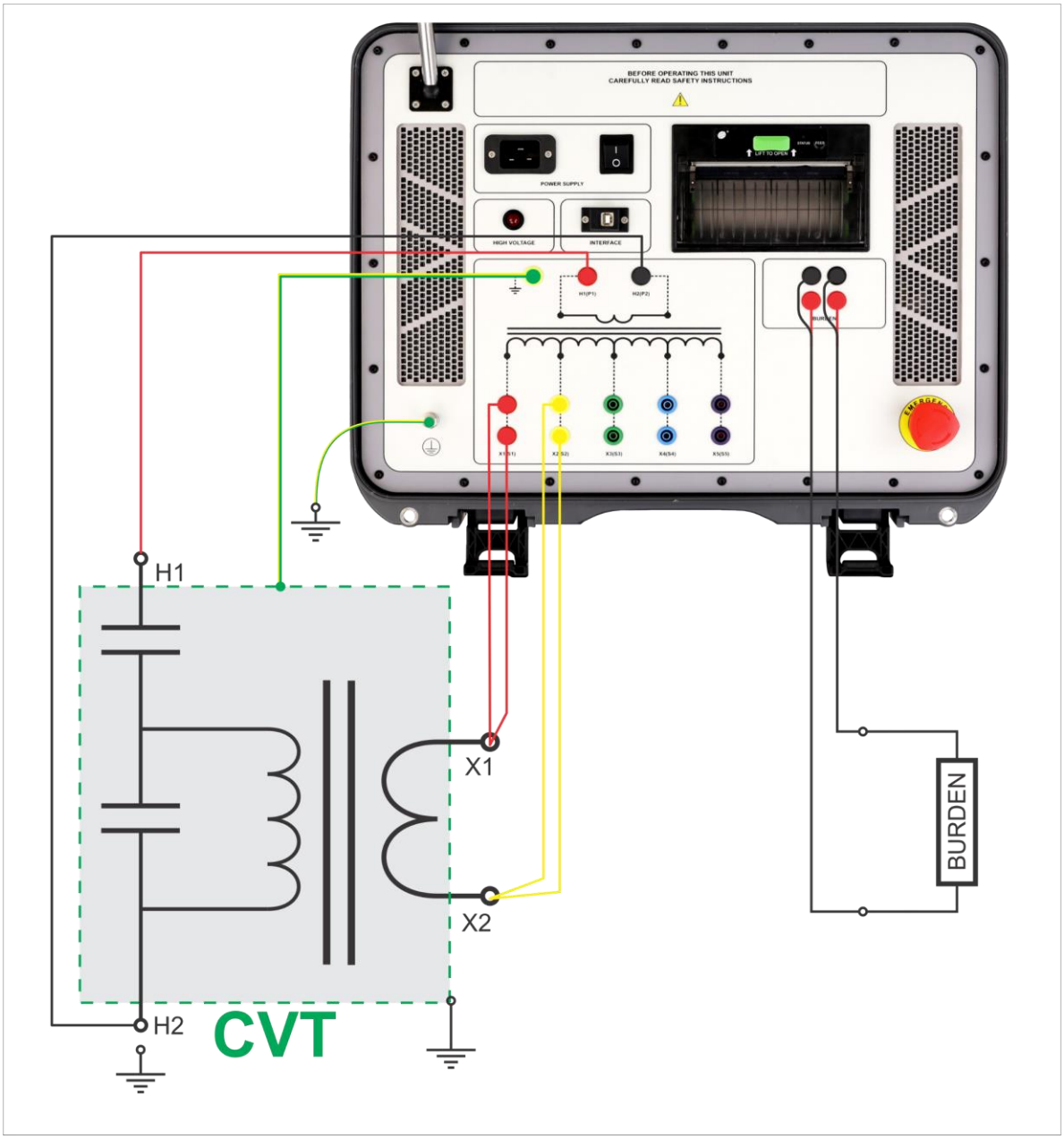


Figure 3-16. Connecting CVA500 to a CVT, winding resistance secondary side test and insulation resistance test

4 Getting Started

Upon turning on the CVA500 device, the SBC application will be automatically started in no longer than 10 seconds.

Once the application is started, the “Home” screen will be presented (Figure 4-1). There are 4 main menus: “New test”, “Test templates”, “Results”, and “Settings”. Each of these will be explained in this manual.

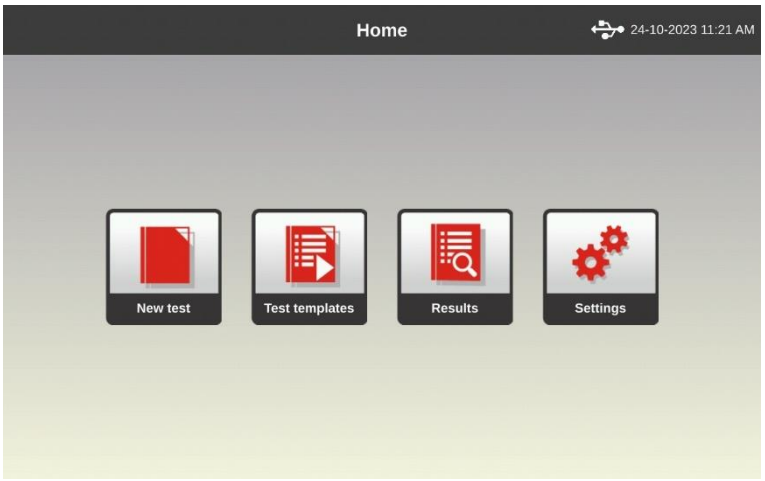


Figure 4-1. Home screen

Generally, CVA500 screen consists of 3 parts: header, body, and footer.

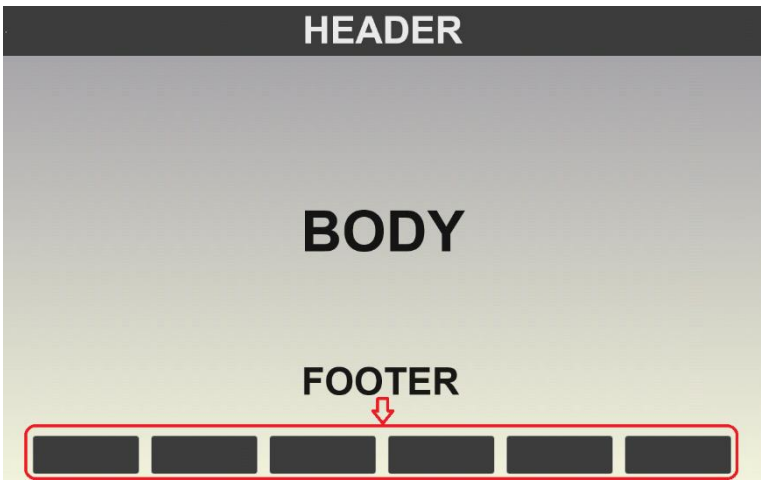


Figure 4-2. CVA500 screen parts

The left part of the header is reserved for the home icon. By clicking this icon, the user is returned to the starting screen.

The central part of the header shows the name of the current screen.

The right part of the header is reserved for current date and time. The symbol for USB connection might appear left to the date and time, and it indicates that a USB flash drive is inserted in the flash drive input and recognized by the CVA500 instrument.

The Header part is not present during the test, and the test status is shown in that part of the screen instead. The body of the application is where the test settings and test results are displayed.

The footer part consists of soft keys. These keys have different functions in different screens, and their functions will be explained for each screen.

5 Settings

This menu is used for making general settings and some of test settings that do not require frequent changes.

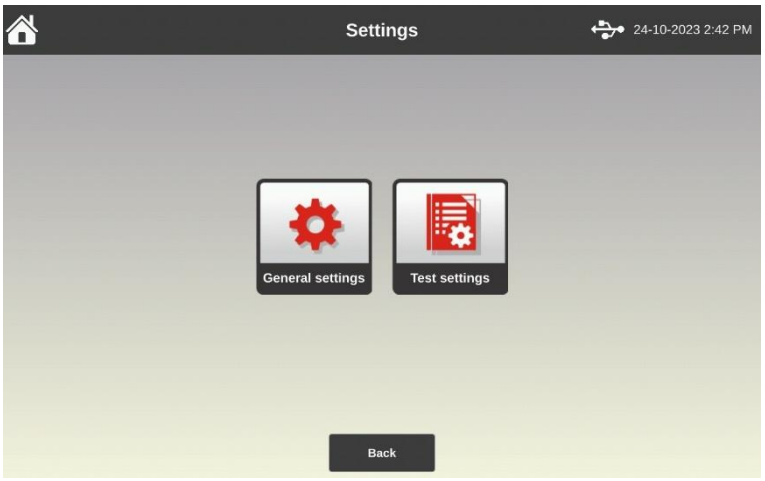


Figure 5-1. Settings menu

5.1 General Settings

These are general application settings. Four options are available: Language, Date/Time, Software, and Log to USB settings.

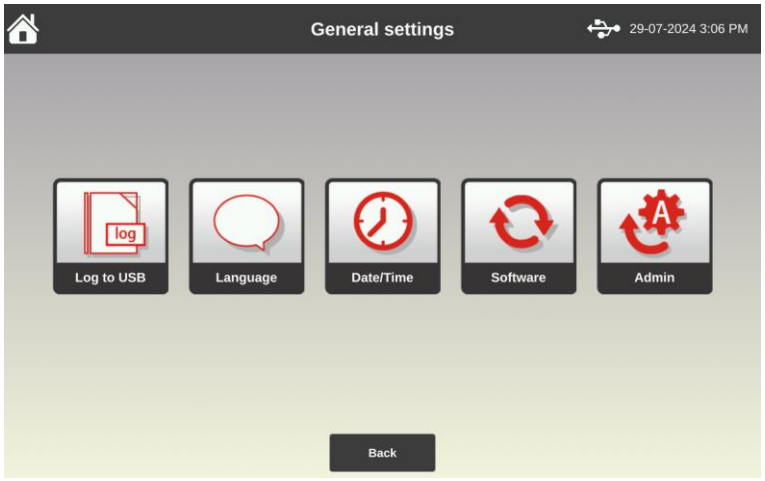


Figure 5-2. General settings menu

5.1.1 Language

Language is selected by swiping up and down. English language is selected by default.

Figure 5-3. Language selection

5.1.2 Date/Time

Date and time are set by swiping the appropriate columns up and down. To change date format, press the “Switch date format” footer button. Three formats are available: YYYY-MM-DD, DD-MM-YYYY, and MM-DD-YYYY, where DD represents date, MM represents month, and YYYY represents year. To change the time format between 12-hour and 24-hour formats, press the “Switch time format” footer button.

Figure 5-4. Date and time selection

5.1.3 Software

This menu shows the versions of firmware and SBC application currently loaded in the instrument, as well as the instruments’ serial number.

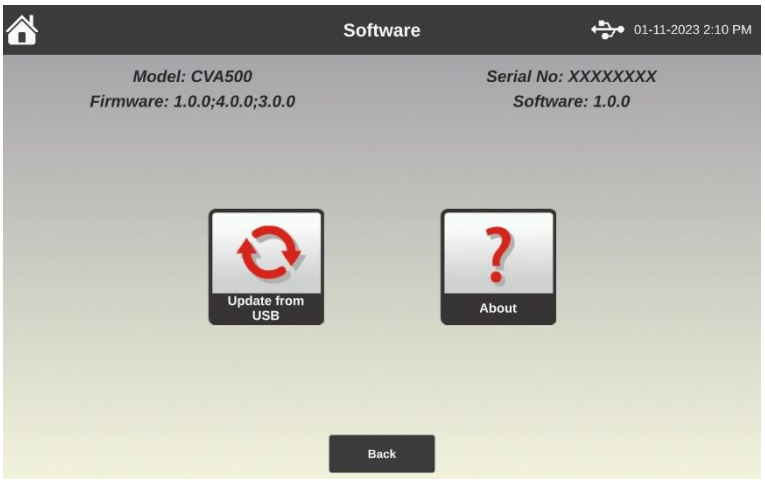


Figure 5-5. Software screen

5.1.3.1 Updating Software Application

It is possible to update the SBC application in this menu. To do this, first insert a USB memory stick, which contains the installation file, in the CVA500's USB flash drive port. When the USB stick is recognized by CVA500, the USB connection icon will appear in the right part of the header before the date and time, and the "Update from USB" button will become active. Clicking this button will open the new screen, where the USB content will be shown. Navigate to the folder that contains the installation file and select that setup file by long-pressing it. The check sign will appear left to the filename, indicating that file has been selected (Figure 5-6).

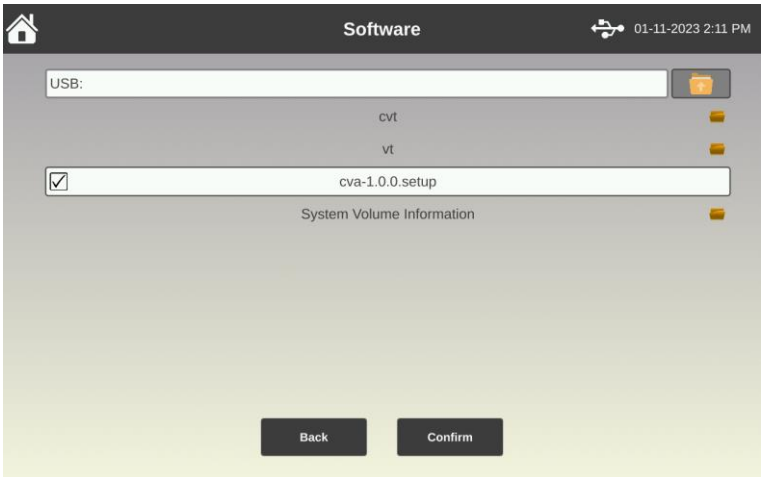


Figure 5-6. USB memory stick content, setup file selected

Click the footer button "Confirm" and new pop-up screen will appear asking to proceed (Figure 5-7).

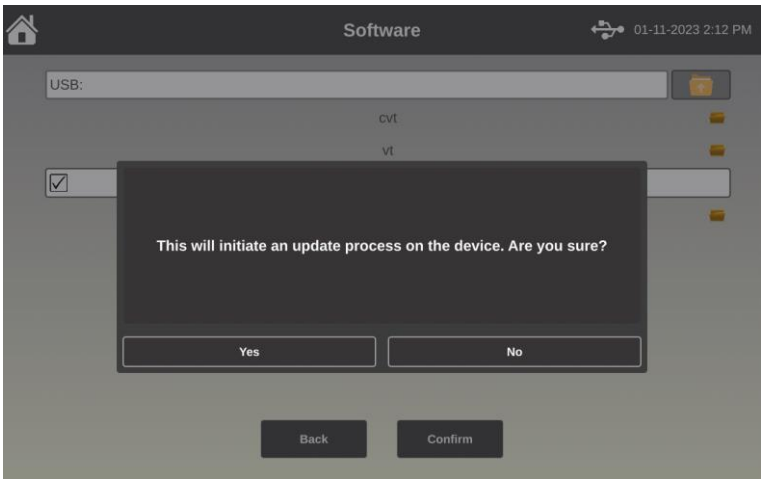


Figure 5-7. Confirming update process

After the installation, the application will automatically restart.

5.1.4 Log to USB

This option is used for copying a log file to a USB flash drive. This is done if the manufacturer requires the log file for analysis to analyze certain issues that may be reported by the user. This option is enabled only if a USB memory stick is inserted in a USB flash drive and recognized by the instrument. To copy the log file to the USB memory stick, click this option and select Yes when asked for confirmation (Figure 5-8).

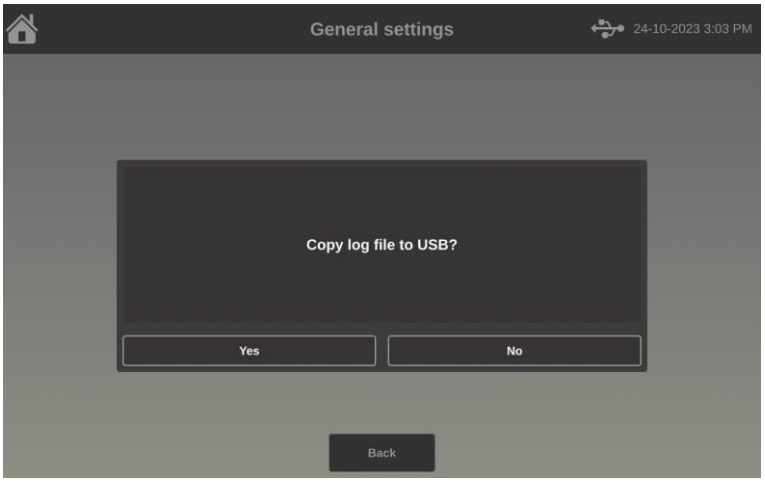


Figure 5-8. Copying log file to USB memory stick

5.2 Test Settings

These are settings related to tests that can be performed with CVA500. Four options are available: Standards, Winding resistance, Saturation, and Demagnetization settings (Figure 5-9).

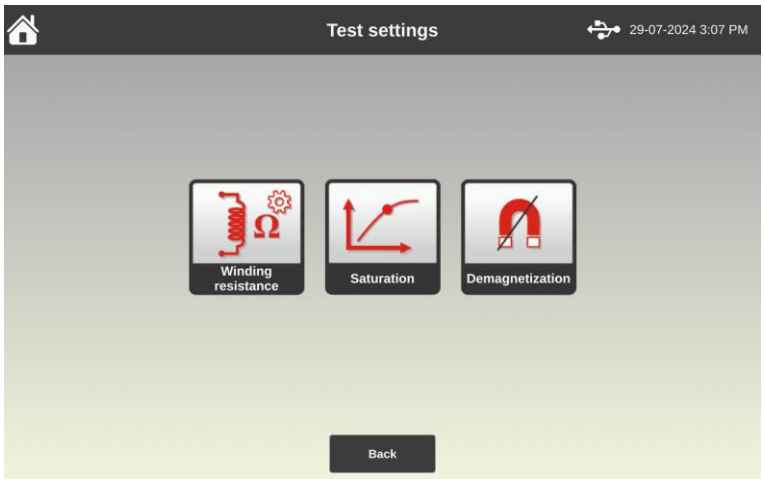


Figure 5-9. Test settings menu

5.2.1 Winding Resistance

In this menu, the user can adjust settings related to the winding resistance test. It is possible to select temperature compensation and set its parameters, and to set parameters for automatic determination of results stabilization.

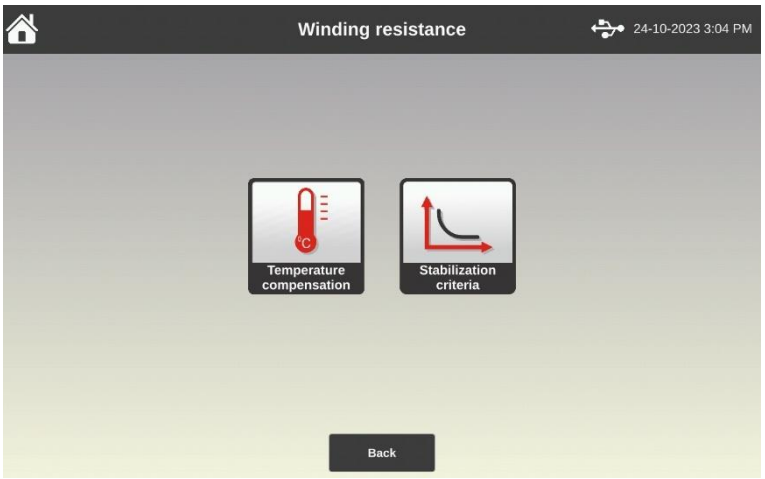


Figure 5-10. Winding resistance settings

5.2.1.1 Temperature Compensation

Temperature compensation is turned off by default. To turn it on, toggle the switch button at the right top corner of the screen (Figure 5-11).

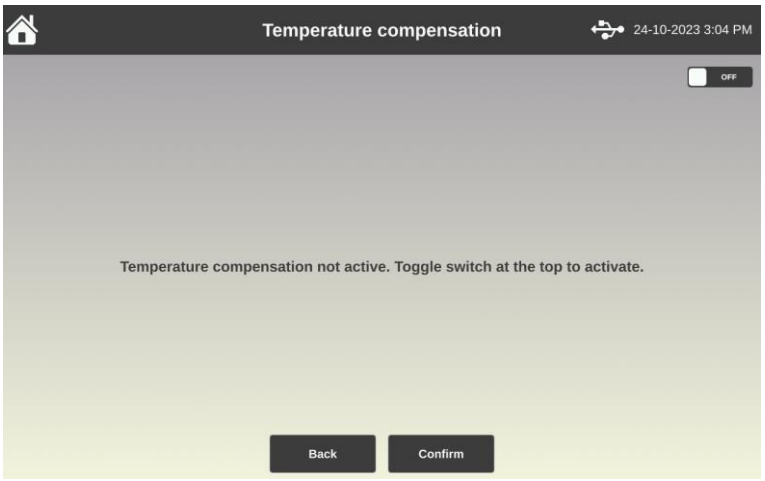


Figure 5-11. Temperature compensation turned off

When the compensation is turned on, it is possible to select the winding material (copper, aluminum, or other), and to enter device temperature and reference temperature in degrees Celsius. Values shown in the Figure 5-12 are default values.

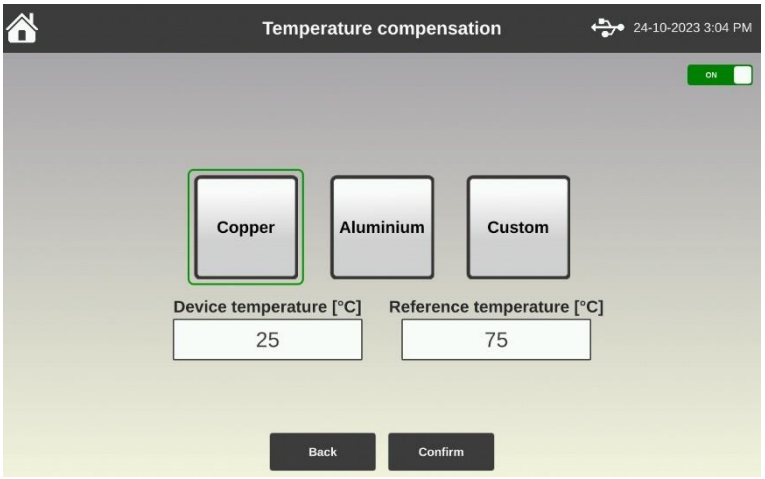


Figure 5-12. Temperature compensation turned on

If custom material is selected, an additional field appears where user needs to input temperature coefficient of the material (Figure 5-13).

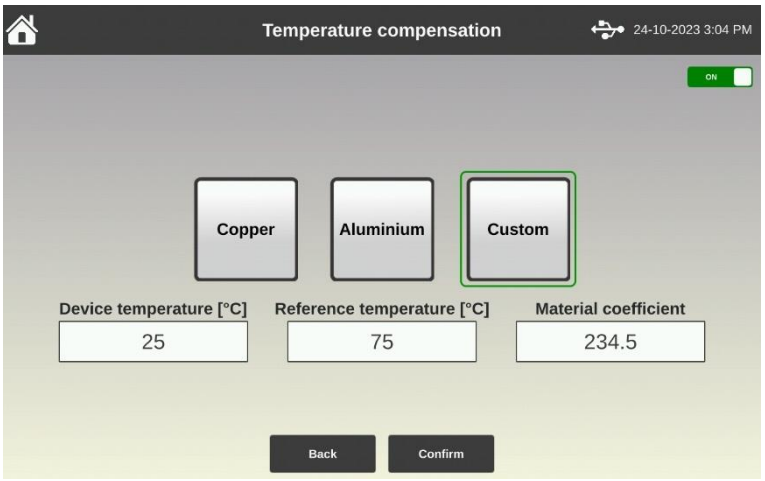


Figure 5-13. Custom material selected

5.2.1.2 Stabilization Criteria

Enables the selection of the stabilization criteria for the automated winding resistance recording mode of operation. The winding resistance result stabilization is tracked by the advanced software algorithm, which calculates the deviation ΔR as a percentage difference of the current resistance value compared to the average resistance value measured over the previous several seconds.

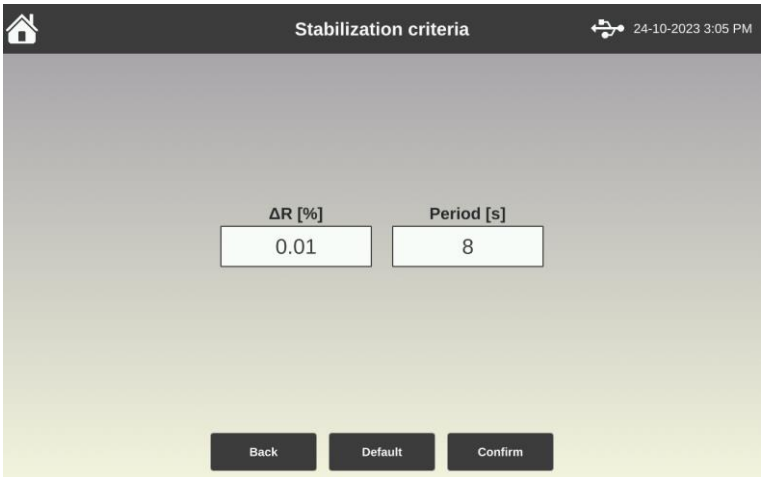


Figure 5-14. Selecting stabilization criteria

The “ΔR [%]” field is used to select the acceptable deviation threshold of the measured resistance, while the “Period [s]” field defines the waiting time for the stabilization. The algorithm will determine the result is stable if the ΔR value is below the selected threshold value for a period equal to the selected Period duration. These parameters can be modified and changed to fit the field condition and the operator’s preferences. Their values should be carefully selected – selecting a high threshold ΔR value and low period threshold value may result in recording an incorrect result, while an excessively low threshold ΔR value and high period threshold value may significantly extend the test duration.

5.2.2 Saturation

In this menu, the user can adjust limits for saturation test.

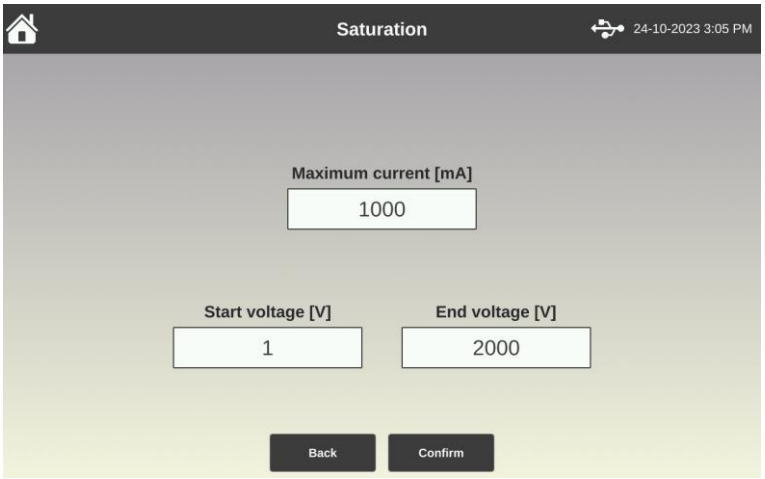


Figure 5-15. Saturation test settings

During saturation test, CVA500 increases the test voltage starting from the minimum value (1 V, default value) up to the maximum value (2000 V, default value) or to the 10% above the detected

knee point value, whichever is reached first. User can adjust the start and end voltage, especially if CT knee point range is already known by the user. Narrowing the voltage range may significantly speed up the testing time.

The maximum current is the upper limit of output current during saturation test. If this limit is reached before the end voltage is reached, the test will be stopped, and application will indicate overcurrent error. The maximum current that can be selected is 10 A, and this value is set by default.

5.2.3 Demagnetization

Demagnetization process is completely automated. During this process, CVA500 increases the output voltage up to the maximum value or to the 10% above the detected knee point value, whichever is reached first. After that, voltage is slowly decreased down to zero. User can select the maximum voltage value that can be reached during demagnetization. By default, this value is set to 2000 V.

The maximum current is the upper limit of output current during demagnetization test. If this limit is reached before the end voltage is reached, the test will be stopped, and application will indicate overcurrent error. The maximum current that can be selected is 10 A, and this value is set by default.

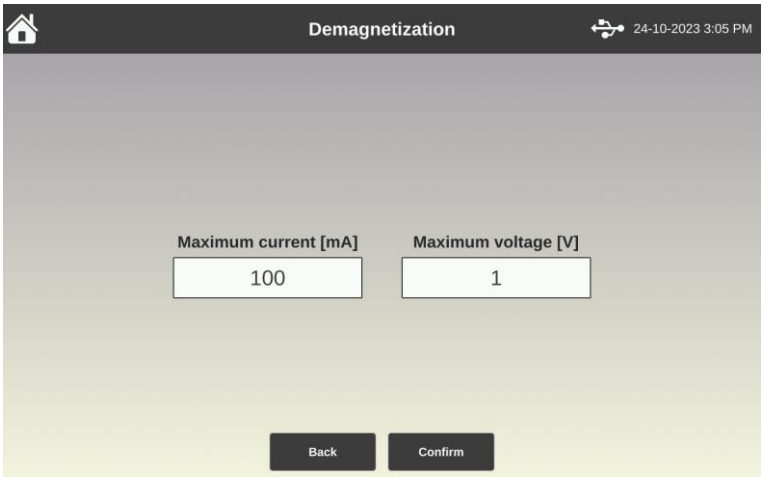


Figure 5-16. Demagnetization settings

6 Test Templates

CVA500 provides an option to create and store test templates offline, which can be later easily loaded and applied. This can save a significant amount of time spent in the field, as a complete test procedure can be prepared in the office.

6.1 Creating Test Templates

Test templates are created in the “New test” menu. Users can configure test object details and test parameters necessary for running a test.

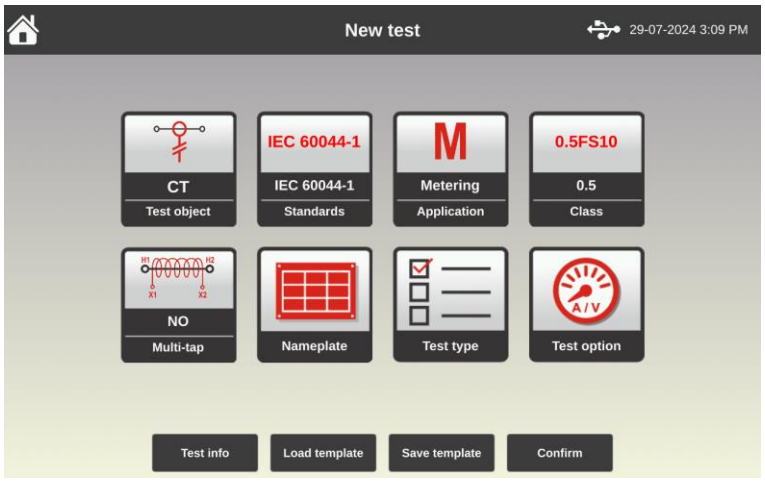


Figure 6-1. The New test menu

6.1.1 Test Info

The “Test info” screen (Figure 6-2) is accessed by clicking the footer button “Test info”. In this screen, the user can input information about test object, about test, as well as to input any kind of notes that may be considered useful. All fields in this screen are optional, and they can be left blank.

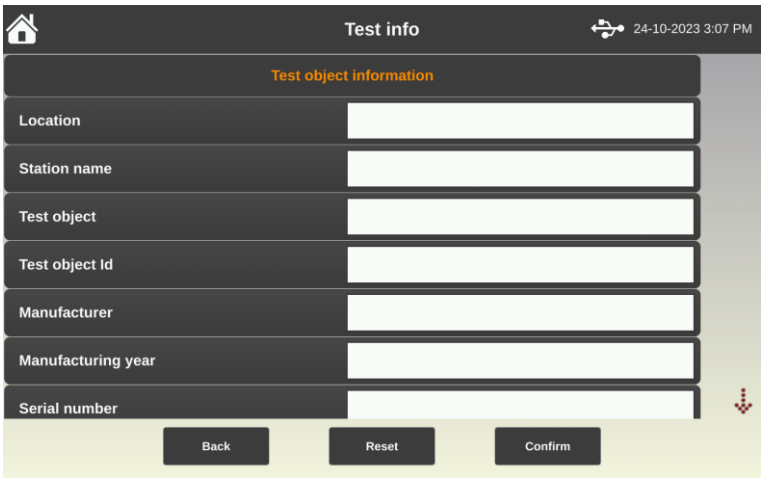


Figure 6-2. Test info screen

6.1.2 Test Object

In the “Test object” screen, the user needs to select transformer type. Three options are available: current transformer (CT), inductive voltage transformer (VT), and capacitive voltage transformer (CVT).

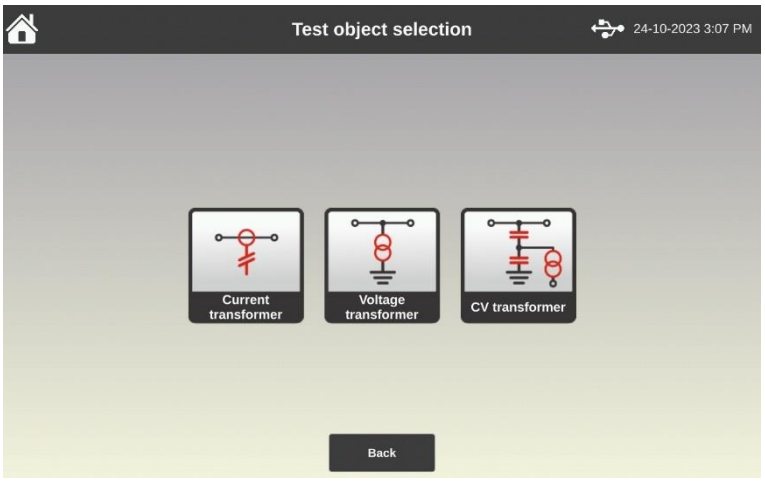


Figure 6-3. Test object selection screen

6.1.3 Standard

Here user selects standard which will be used for testing.

Figure 6-4. CT standard selection screen

The following options are available.

For CT:

- IEC 60044-1
- IEC 61869-2
- IEEE C57.13 (45°)
- IEEE C57.13 (30°)

Standard selection affects certain test parameters. The selection of classes will be different for IEC- or IEEE-based standards. The marking of terminals for IEC-based standards will be S1, S2, S3, S4, S5 (secondary side), and P1, P2 (primary side). The marking of terminals for IEEE-based standards will be X1, X2, X3, X4, X5 (secondary side), and H1, H2 (primary side). For IEEE

C57.13 (45°) standard, IEEE 45 knee point will be determined. For IEEE C57.13 (30°) standard, IEEE 30 knee point will be determined.

For VT and CVT:

- IEC
- IEEE

Standard selection affects terminal markings. The marking of terminals for IEC-based standards will be S1, S2 (secondary side), and P1, P2 (primary side). The marking of terminals for IEEE-based standards will be X1, X2 (secondary side), and H1, H2 (primary side).

6.1.4 Application

This option is available if selected test object is CT. Here user selects whether CT under test is for metering or protection application.

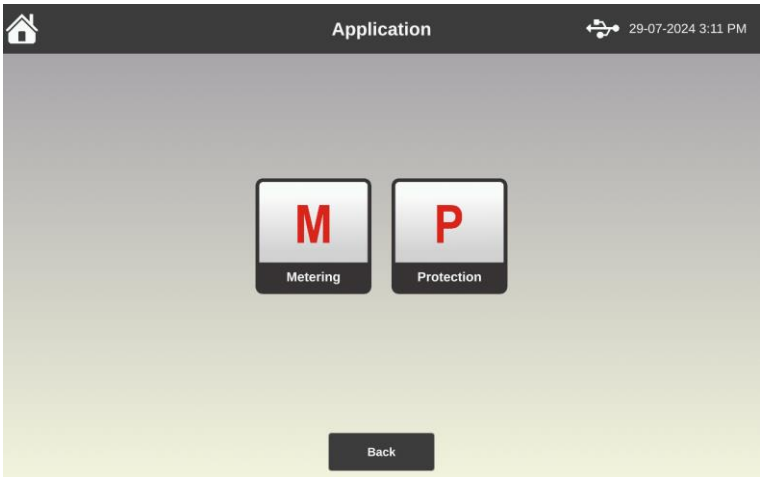


Figure 6-5. CT application selection screen

6.1.5 Class

This option is available if selected test object is CT. Here user selects the class of CT under test. The list of available classes depends on the selected standard and application. The list of available classes is shown in the Table 6-1.

Table 6-1. List of available CT classes

Standard	IEC-based		IEEE-based	
Application	Metering	Protection	Metering	Protection
Class	0.1 0.2 0.2S 0.5 0.5S 1 3 5	5P 10P 5PR 10PR S TPS TPX TPY TPZ	0.15S 0.15 0.15N 0.3S 0.3 0.6 1.2	C K T X

Figure 6-6. CT class selection screen

For IEC-based standards, besides class, user needs to select rated instrument security factor FS (for metering CT) or rated accuracy limit factor ALF (for protection CT classes 5P, 10P, 5PR, and 10 PR).

For rated instrument security factor FS available options are: 1, 1.5, 2, 5, 10, 15, 20, 30, and Not assigned. If Not assigned option is selected, there will be no assessment for measured FS.

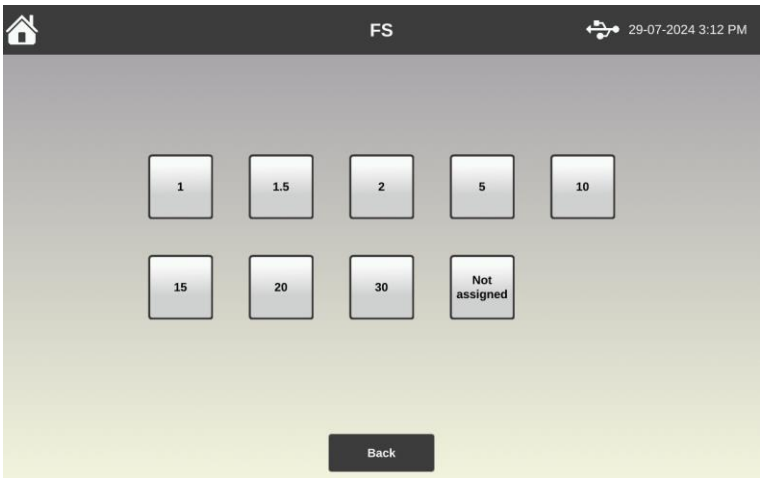


Figure 6-7. Metering CT instrument security factor (FS) selection

For metering type IEC-based CT, after selection of FS, user will be asked to select if CT has extended current rating. If yes, user must input extended current rating in percents. Available input range is from 121% to 999%.

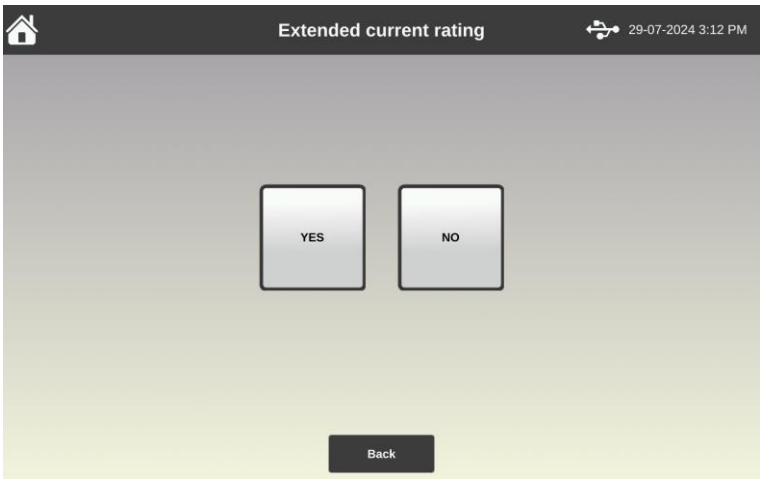


Figure 6-8. Metering CT extended current rating selection

For rated accuracy limit factor ALF available options are: 5, 10, 15, 20, 30, and Not assigned. If Not assigned option is selected, there will be no assessment for measured ALF.

For IEEE-based standards, besides class, user needs to select rating factor RF (for measurement CT) or rated secondary terminal voltage Vb (for protection CT classes C, K, T).

For rating factor RF available options are: 1, 1.33, 1.5, 2, 3, and 4.

For rated secondary terminal voltage Vb available options are: 10, 20, 50, 100, 200, 400, 800.

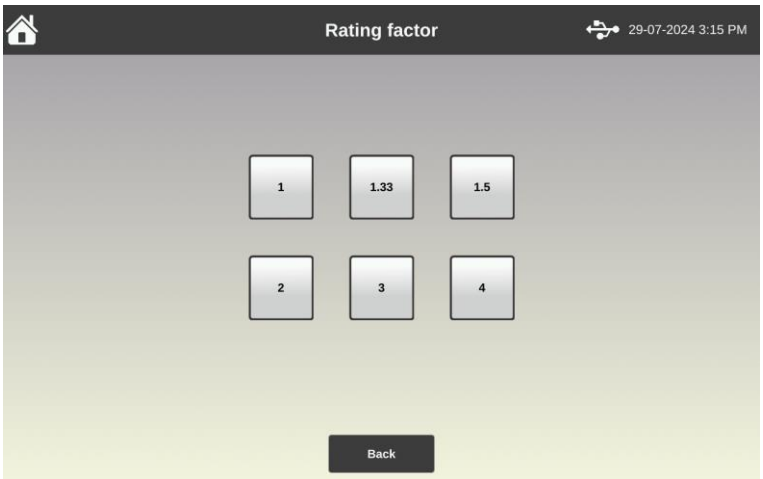


Figure 6-9. Rating factor (RF) selection screen

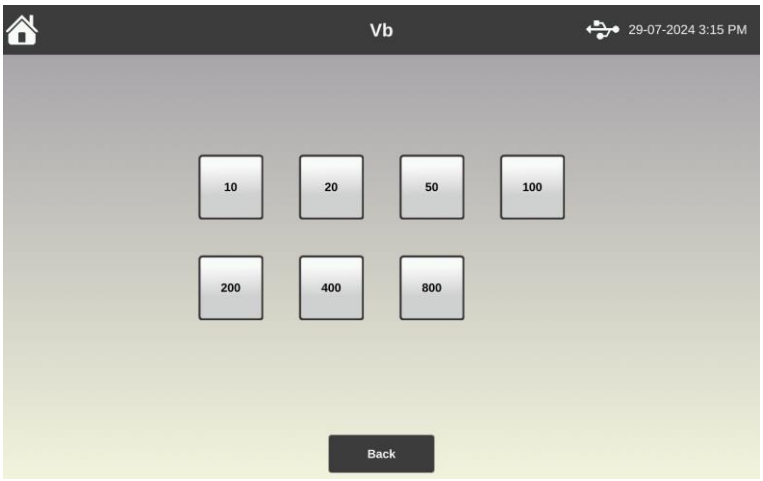


Figure 6-10. Rated secondary terminal voltage (Vb) selection screen

6.1.6 Multi-tap

This option is enabled if the selected test object is CT. It allows users to select whether the CT under test has multiple taps. Up to 5 taps can be selected.

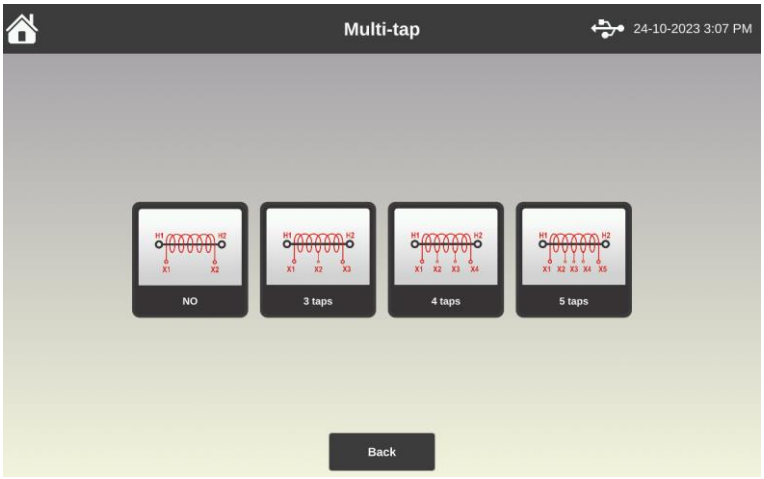


Figure 6-11. Multi-tap selection screen

6.1.7 Nameplate

In this screen, users must input transformer nameplate currents (for CTs) and voltages (for VTs and CVTs). In the case of multi-tap CT, it is necessary to enter primary currents for X1 to other taps combinations. Nameplate primary currents for other combinations will be calculated automatically based on X1 to other taps primary currents.

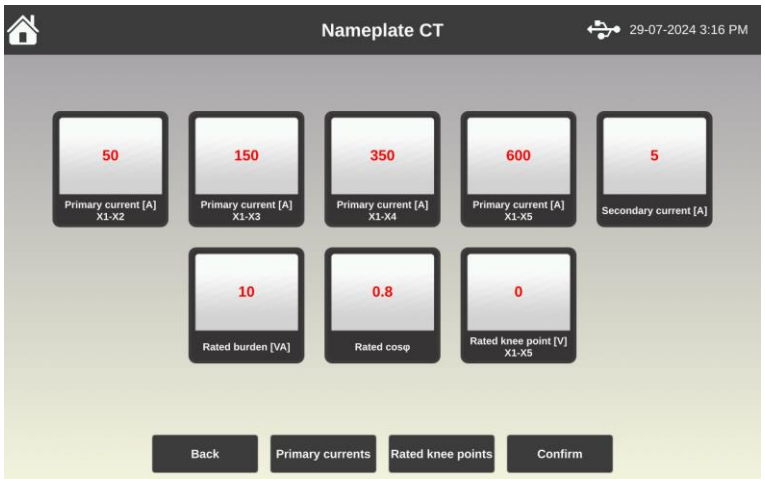


Figure 6-12. Nameplate screen, example of CT with 5 taps

Rated burden and rated cosφ are to be selected in this screen, if the test object is CT. For rated burden, it is possible to enter any value between 0.1 and 999.9 VA. For cosφ, it is possible to enter any value between 0.0 and 1.0. The cosφ will be automatically set based on the selected standard and entered rated burden, according to the Table 6-2.

Table 6-2. Default cosφ for IEC- and IEEE-based standards

Standard	**Application**	**Rated burden cosφ**
IEC-based	Metering or Protection	0.8 for burdens ≥5 VA 1 for burdens <5 VA
IEEE-based	Metering	0.9 for all burdens
	Protection	0.5 for burdens ≥25 VA 0.9 for burdens <25 VA

If the test object is CT, it is possible to enter rated knee point in this screen. If measured knee point is higher than the rated knee point, the test will be assessed as pass. The default value for rated knee point is 0, and in that case results will not be assessed.

For multi-tap CTs, rated knee point is entered for the highest tap (for example, X1-X5 for CT with 5 taps). Rated knee points for other tap combinations are automatically calculated as per the formula below:

Rated knee point [a-b] = Rated knee point [X1-Xmax] x Primary nameplate current (a-b) / Maximum primary nameplate current

Clicking the footer button “Rated knee points”, the new screen will be opened, where user can check and edit rated knee point of any tap combination.

6.1.8 Test Type

CVA500 can perform multiple tests – saturation (of CTs), demagnetization (of CTs), turns ratio, winding resistance, insulation resistance, and burden test. Users can choose to perform only one test, some of tests, or all of them. If multiple tests are performed, they will be executed in one test. The order of execution will be explained for each test object in the “Tests” paragraph.

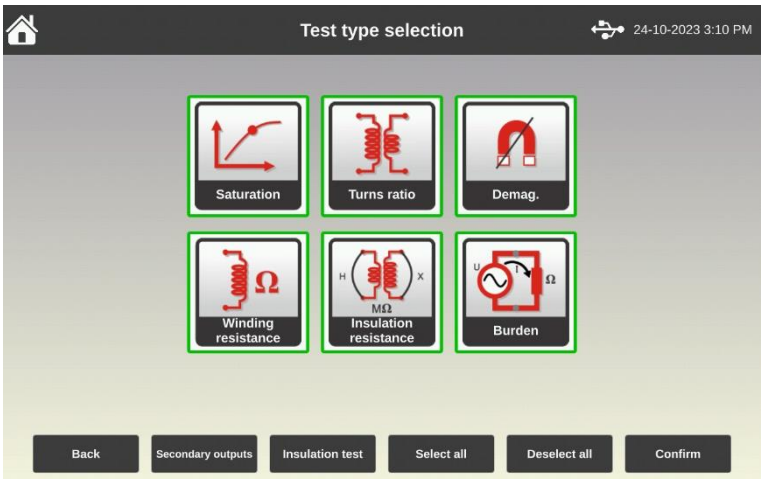


Figure 6-13. Test type selection, all tests selected

Besides these tests, CVA500 will automatically perform calculations of CT parameters stated in the Table 6-3.

Table 6-3. Additional parameters calculated for CTs

Parameter	Condition
Ratio and phase error table	Test object is CT Winding resistance is measured Saturation graph is recorded Turns ratio is measured
Composite error	Test object is CT Winding resistance is measured Saturation graph is recorded
Instrument security factor FS	Test object is metering CT Standard is IEC-based Winding resistance is measured Saturation graph is recorded
Accuracy limit factor ALF	Test object is protection CT Standard is IEC-based Class is 5P, 10P, 5PR, 10PR Winding resistance is measured Saturation graph is recorded
Rated secondary terminal voltage Vb	Test object is protection CT Standard is IEEE-based Class is C, K, T Winding resistance is measured Saturation graph is recorded

6.1.9 Test Options

In the test options screen, the user can select output parameters for selected tests:

- Turns ratio test. The user needs to select output AC voltage. It can be selected in the range 1 – 2000 V.

- Burden test. The user needs to select output AC current (if test object is CT) or AC voltage (if test object is VT or CVT). Output AC current can be selected either 1 A or 5 A. By default, this current is the same as CT secondary current selected in nameplate menu. Output AC voltage can be selected as 100/√3 V, 110/√3 V, 100 V, or 110 V. By default, this voltage is the same as VT / CVT secondary voltage selected in nameplate menu.
- Insulation resistance. The user needs to select output DC voltage. Either 500 V or 1000 V can be selected. The value of 1000 V is the default value.
- Winding resistance. The user needs to select output DC current. The following values can be selected: 5 A, 2 A, 1 A, 500 mA, 100 mA, 50 mA, 10 mA, 5 mA.

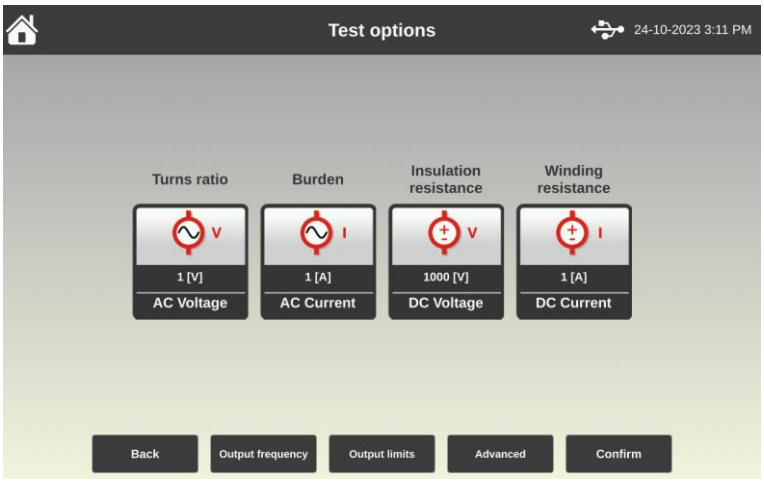


Figure 6-14. Test options screen

By clicking the footer button “Output frequency”, a new screen is opened where the user can change the frequency of output AC voltage (Figure 6-15).

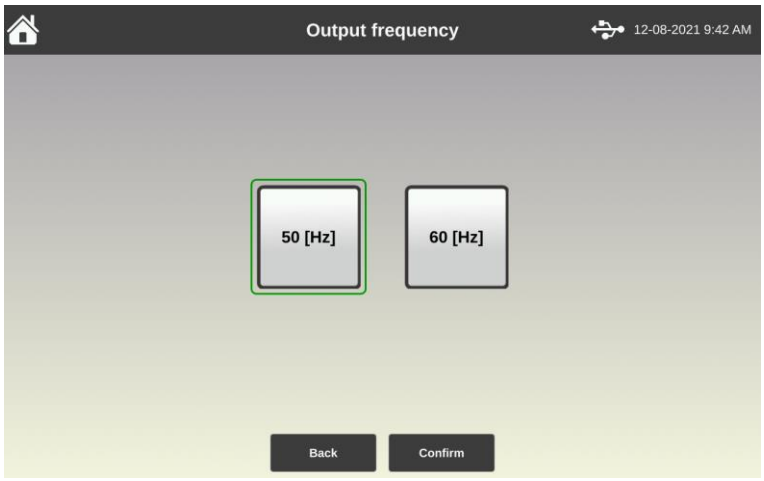


Figure 6-15. Output frequency selection

The default frequency of output AC voltage is the same as the frequency of the CVA500 mains power supply. Whenever the “New test” menu is opened, the CVA500 will automatically change the output frequency to the default one.

For CT saturation test, it is necessary to select the maximum output test voltage. This is done by clicking the footer button “Output limits” in the “Test option” screen. The maximum output voltage of CVA500 is 2000 V AC, and this value is set by default (Figure 6-16).

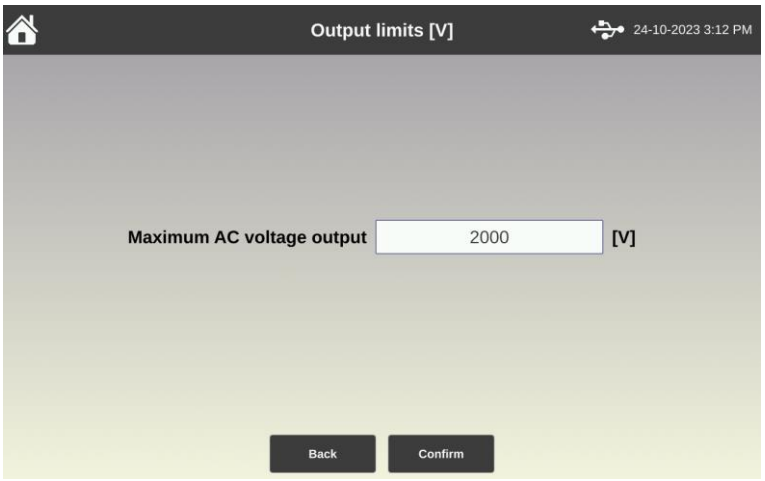


Figure 6-16. Output limit for CT with no taps

In the case of multi-tap CT, it is necessary to set maximum output test voltages for each tap combination (Figure 6-17). CVA500 automatically calculates these values according to entered nameplate ratio.

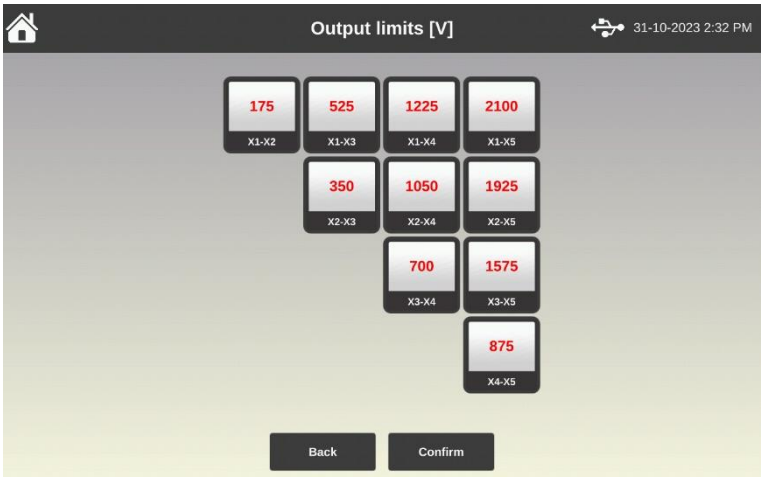


Figure 6-17. Output limit for CT with 5 taps

When determining maximum output test voltages for multi-tap CT, users must be aware of the secondary terminals maximum input voltage limitation. The CVA500 secondary terminals are rated to 2100 V AC. Any voltage higher than this value present at these terminals may damage the CVA500 instrument, cause incorrect measurements, or both. Therefore, maximum output voltages must be set so that induced voltage at any tap combination doesn't exceed 2100 V AC. A typical example is shown below.

Nameplate ratios of 5-tap CT are:

- X1-X2: 50:1
- X1-X3: 150:1
- X1-X4: 350:1
- X1-X5: 600:1

Based on this, ratios for other tap combinations can be calculated:

- X2-X3: 100:1
- X2-X4: 300:1

- X2-X5: 550:1
- X3-X4: 200:1
- X3-X5: 450:1
- X4-X5: 250:1

It can be seen that there are 12 times more turns (600:50) between X1-X5 terminals compared to X1-X2 terminals. If 2000 V AC would be applied between X1-X2 terminals, a voltage of 24000 V AC would be induced between X1-X5 terminals. If all secondary test cables are connected to CVA500 and to CT, this voltage would be present at CVA500 X1-X5 terminals and would damage the CVA500 instrument. Therefore, maximum test voltage applied between X1-X2 terminals must be limited to 2100 V / 12 = 175 V.

Users can edit calculated maximum test voltages, but attention must be paid to the fact that voltage higher than 2000 V AC must never be present at any CVA500 secondary terminal.

If it were necessary to test X1-X2 terminal with voltage higher than 175 V, then all other secondary cables must be disconnected from CVA500 instrument.

By clicking the footer button “Advanced”, user is navigated to the test settings, which is explained in the chapter 5.2 Test Settings.

6.1.10 Saving Test Template

When all settings are done, a template can be saved by clicking the footer button “Save template”. This will open the new screen with a keyboard (Figure 6-18), where it is necessary to enter the template name. Clicking the button “Confirm” will save the template in the instruments internal database.

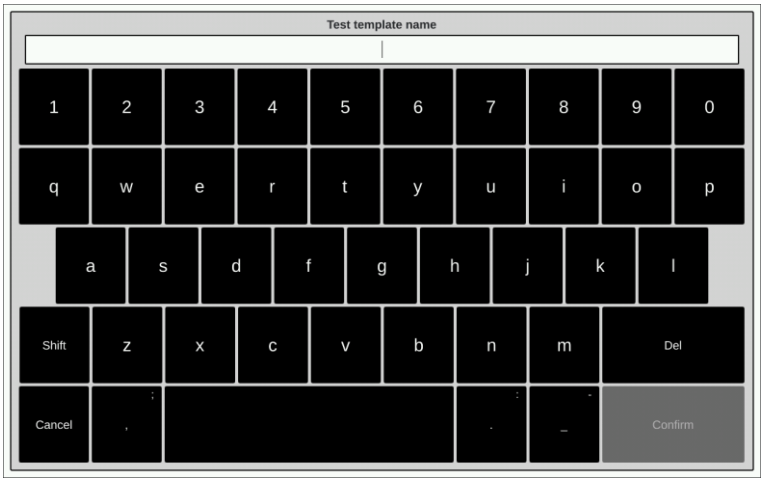


Figure 6-18. Saving test template

6.2 Managing Test Templates

The “Test templates” menu, approached from the “Home” page, lists all test templates stored in the instruments’ memory.

To open a template, highlight it by clicking on its name. The highlighted template is marked with a green border and a white background. Clicking the footer button “Confirm” will open the highlighted template, and user will be redirected to the “New test” menu, with all settings from the template

automatically applied. Please note that only one template can be highlighted at a time. Figure 6-19 shows first template highlighted.

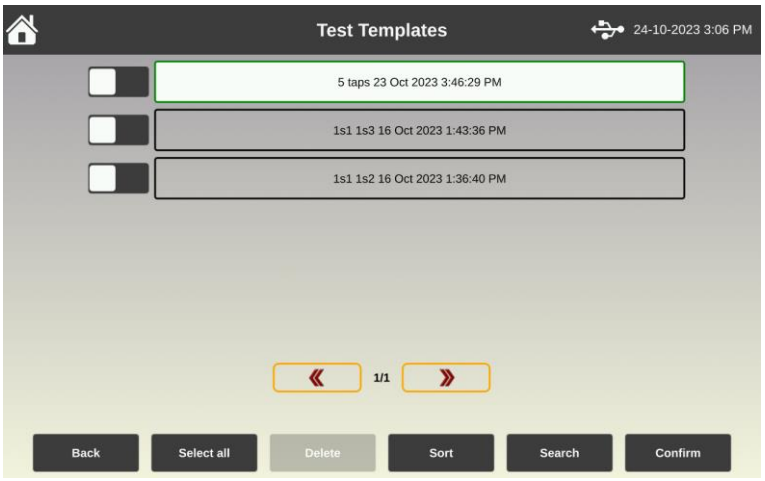


Figure 6-19. Template menu, first template highlighted

To select a template, press the toggle button on the left side of the template. Multiple templates can be selected at a time. Figure 6-20 shows the first test template selected.

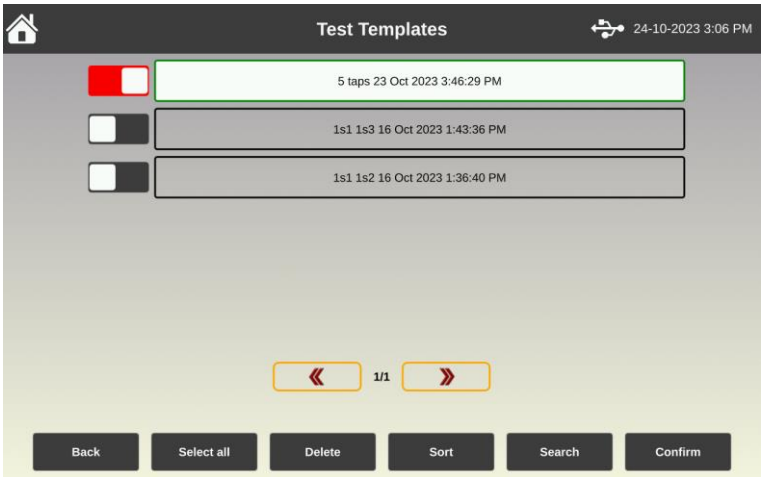


Figure 6-20. Template menu, first template selected

The following options are available using footer buttons:

- **Select all / deselect all** – selects or deselects all test templates displayed on that page.
- **Delete** – deletes selected test template(s).
- **Sort** – sorts all templates according to the selected criteria.
- **Search** – opens the appropriate search form according to the selected criteria.

7 Tests

There are two ways to prepare a test – by loading previously saved test template, or by creating the new test in the “New test” menu.

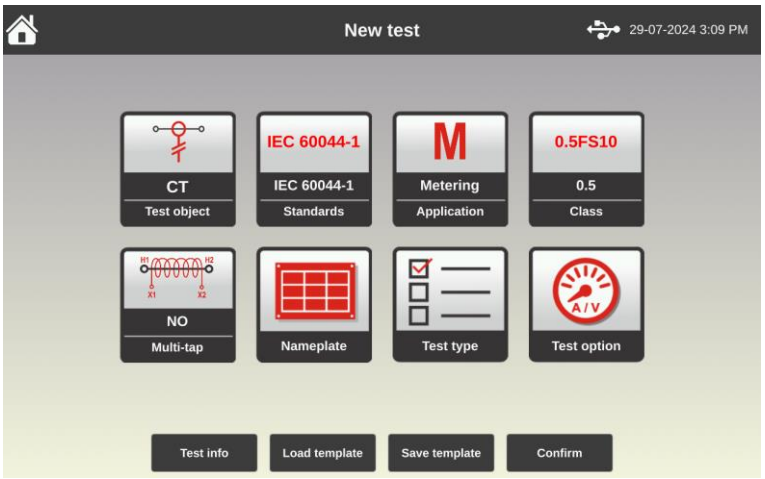


Figure 7-1. The New test menu

Once the test is prepared (Figure 7-1), user should press the footer button “Confirm”, which will proceed to the “Ready” screen (Figure 7-2). The test is started by pressing the “Start” button in the bottom right corner of the screen.

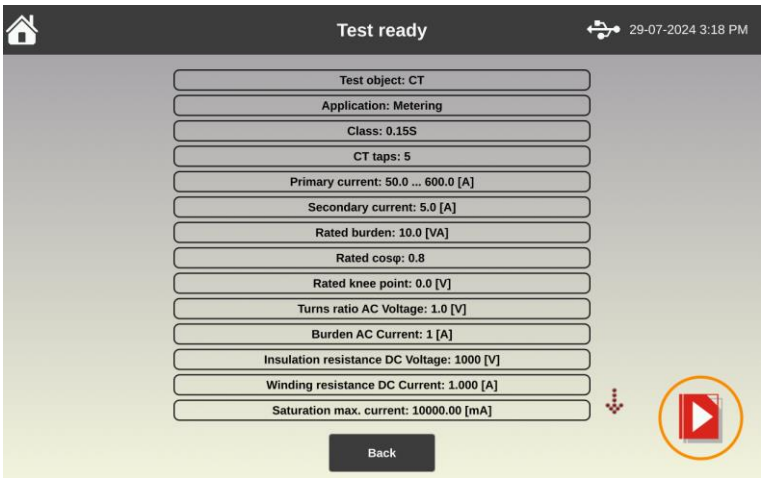


Figure 7-2. Ready screen

CVA500 can test 3 types of test objects: current transformers (CT), inductive voltage transformers (VT), and capacitive voltage transformers (CVT). For each test object, multiple tests can be performed.

7.1 Current Transformer

The following tests can be performed:

- Winding resistance
- Demagnetization
- Saturation (knee point)
- Turns ratio
- Burden

- Insulation resistance

Users can choose to perform only one test, some of tests, or all of them. If multiple tests are selected (Figure 7-3), they will be executed automatically in the above-mentioned order.

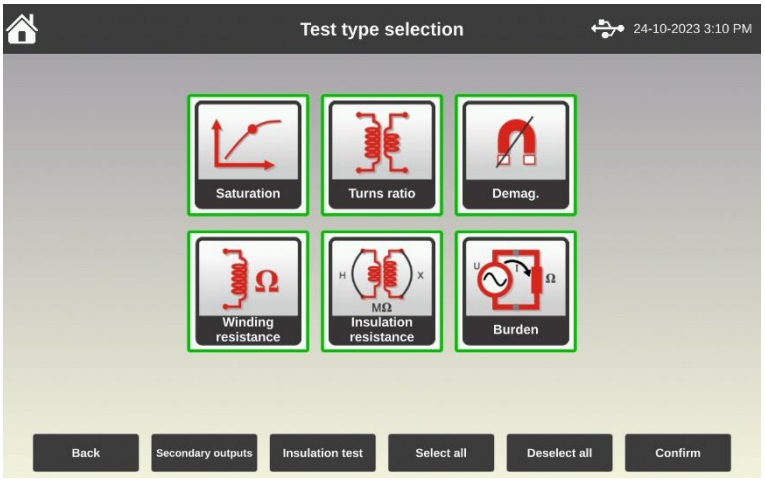


Figure 7-3. Test type selection, all tests selected

7.1.1 Winding Resistance Test

Winding resistance test is performed on a CT secondary winding.

In the “Test type” screen, winding resistance test should be selected (Figure 7-4).

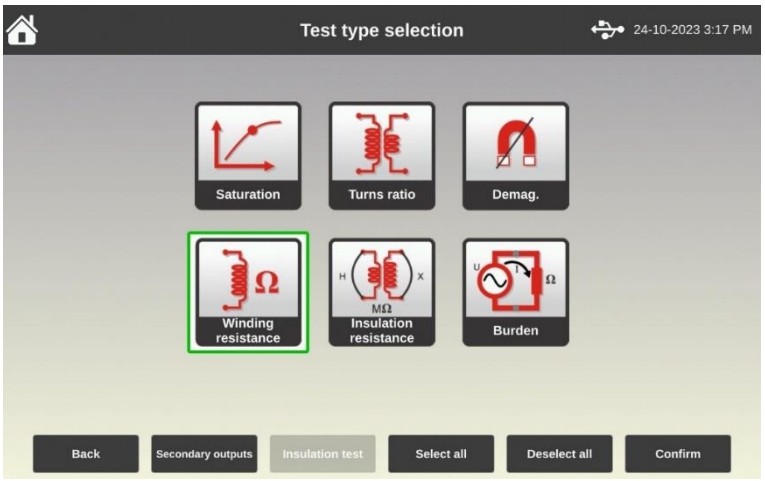


Figure 7-4. Winding resistance test selected

If CT has multiple taps, a winding resistance test is normally performed for each tap. However, it is possible to select taps for which winding resistance test will be performed (Figure 7-5).

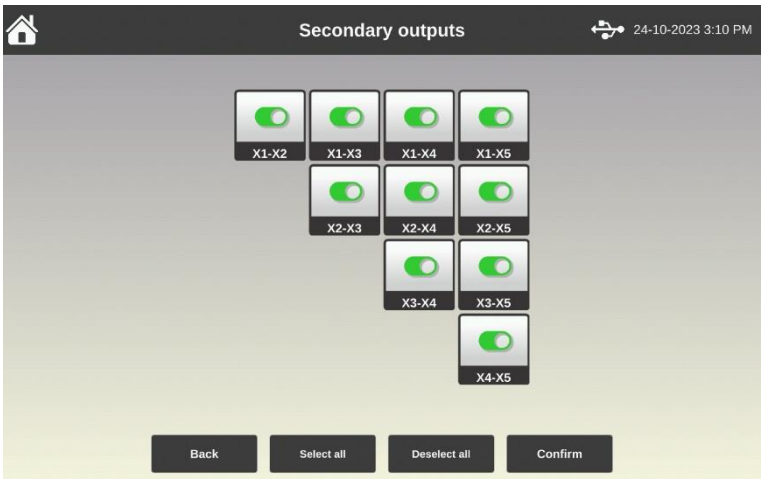


Figure 7-5. Selecting taps

If multiple taps are selected, winding resistance tests will be performed automatically, one after another.

For CT winding resistance test, it is necessary to select the test current. This is done in the “Test option” screen (Figure 7-6).

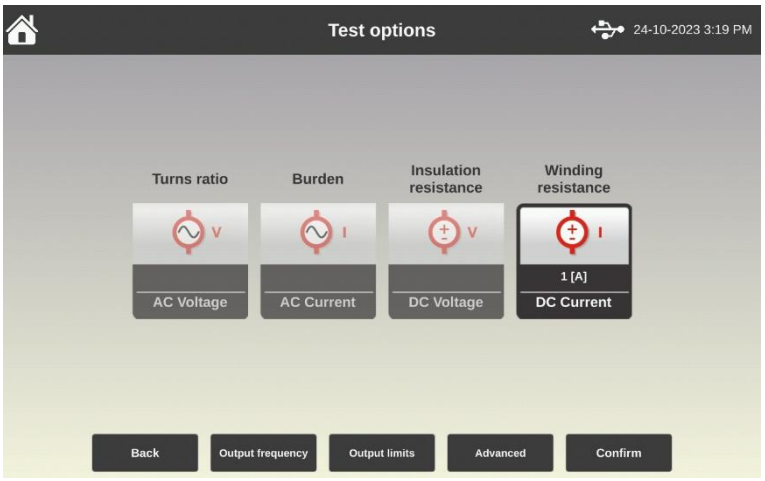


Figure 7-6. Selecting test current for winding resistance test

Winding resistance test consists of two sequences:

1. Injecting test current, also called charging
2. Measuring winding resistance

These two sequences are performed automatically, without any intervention from the user.

During the first sequence, CVA500 raises output DC voltage in order to achieve stable test current. The appropriate message is displayed during this phase (Figure 7-7).

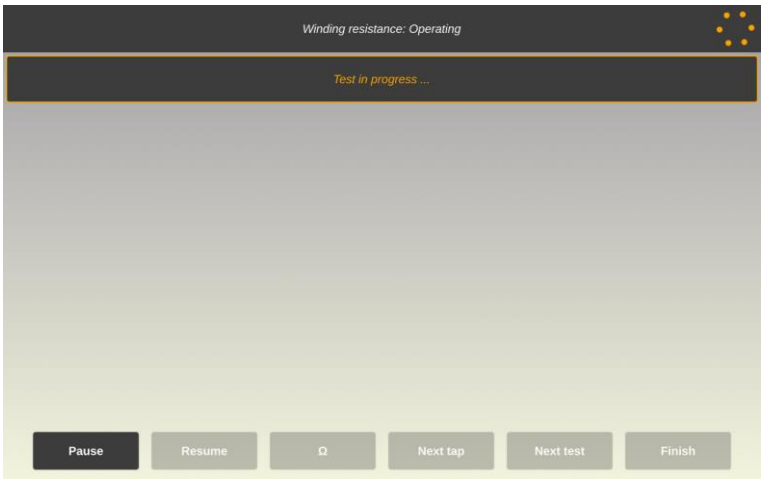


Figure 7-7. Injecting DC current

When the selected test current is injected, CVA500 automatically starts measuring winding resistance (Figure 7-8).

The winding resistance result stabilization is tracked by the advanced software algorithm, which calculates the deviation ΔR as a percentage difference of the current resistance value compared to the average resistance value measured over the previous several seconds. The lower the ΔR is, the more stable resistance is. The ΔR parameter is displayed on the screen during the test.

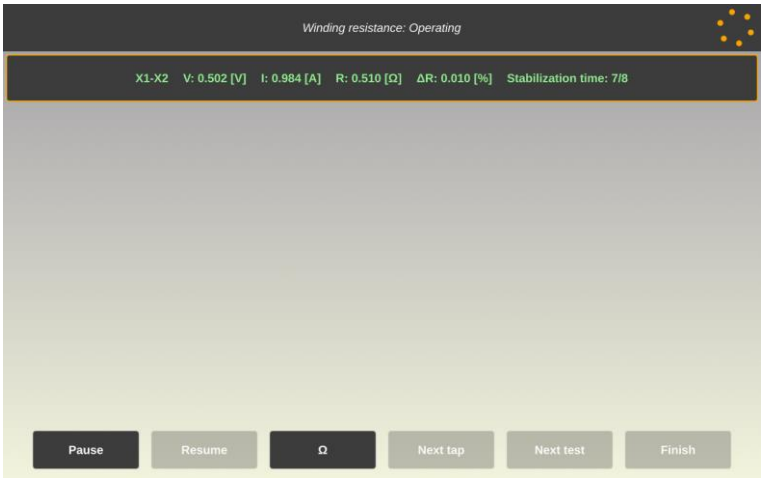


Figure 7-8. Measuring winding resistance

The measurement is refreshed every second. Winding resistance is measured either by pressing the footer button “Ω” or automatically if ΔR value falls below predefined limit for predefined period. If no other tests are selected, results are shown (Figure 7-9).

Figure 7-9. Winding resistance results, CT with 5 taps

7.1.2 Demagnetization

Demagnetization is performed on a CT secondary winding. The process is completely automatic.

In the “Test type” screen, demagnetization should be selected (Figure 7-10).

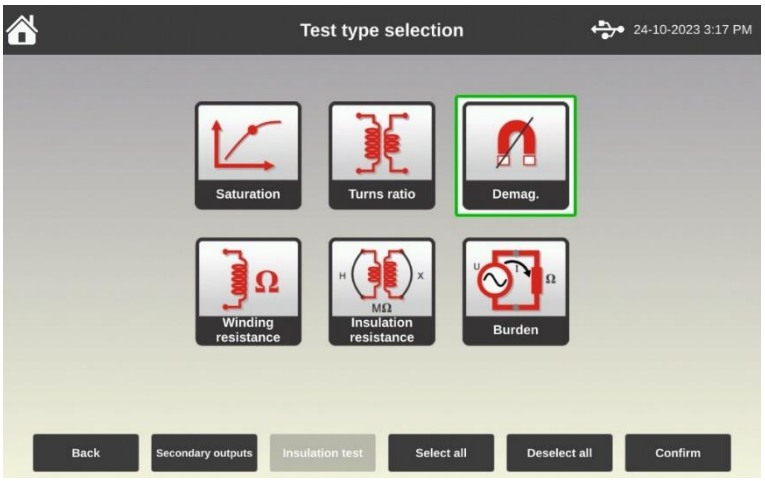


Figure 7-10. Demagnetization selected

If CT has multiple taps, demagnetization will be performed between first and last tap (e.g., between X1-X5 if CT has 5 taps, between X1-X4 if CT has 4 taps, and between X1-X3 if CT has 3 taps).

During demagnetization, the appropriate message is displayed on the screen (Figure 7-11).

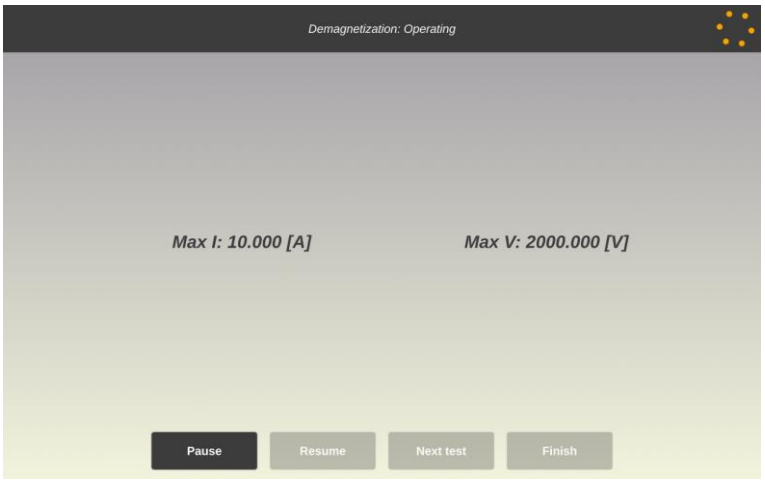


Figure 7-11. Demagnetization in progress

When the demagnetization process is completed, the appropriate message is displayed on the screen (Figure 7-12).

Figure 7-12. Demagnetization finished

7.1.3 Saturation Test

Saturation test is performed on a CT secondary winding. The purpose of this test is to record saturation graph and to determine the knee point of the CT secondary winding.

In the “Test type” screen, saturation test should be selected (Figure 7-13).

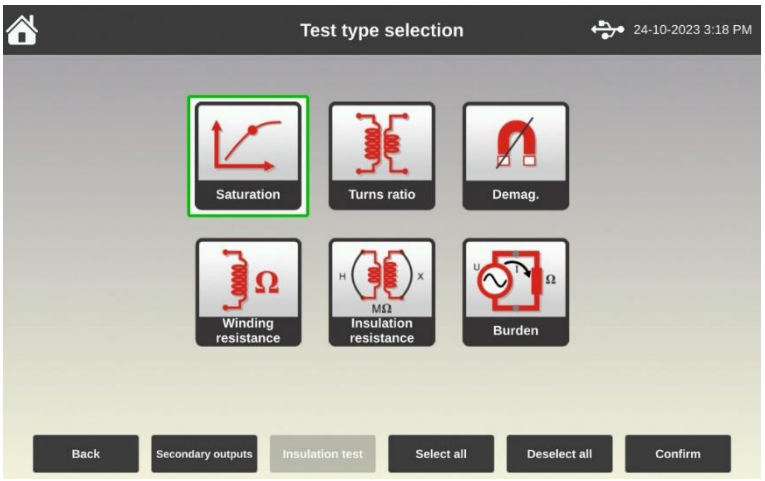


Figure 7-13. Saturation test selected

If CT has multiple taps, saturation test is normally performed for each tap. However, it is possible to select taps for which saturation test will be performed (Figure 7-14).

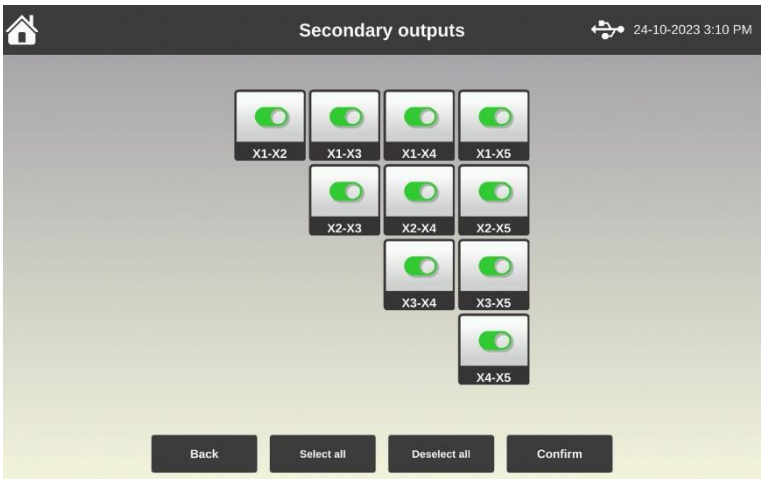


Figure 7-14. Selecting secondary terminals

If multiple taps are selected, saturation tests will be performed automatically, one after another.

For CT saturation test, it is necessary to select the maximum output test voltage. This is done by clicking the footer button “Output limits” in the “Test option” screen (Figure 7-15). The maximum output voltage of CVA500 is 2000 V AC, and this value is set by default.

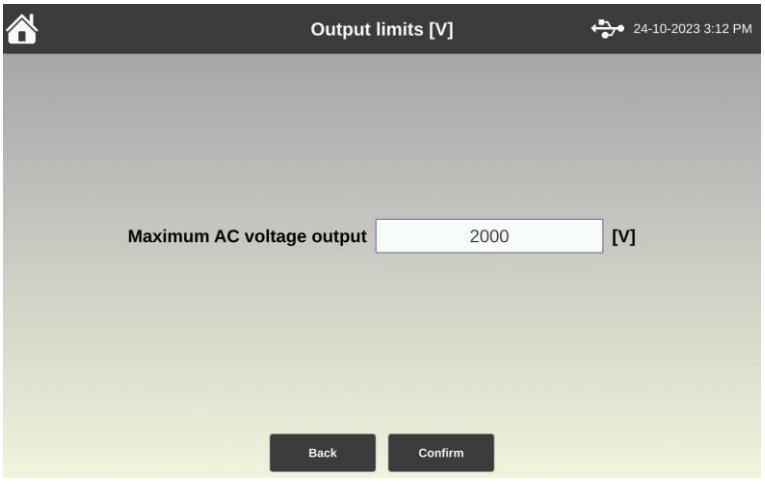


Figure 7-15. Output limit for CT with no taps

In the case of multi-tap CT, it is necessary to set maximum output test voltages for each tap combination (Figure 7-16). CVA500 automatically calculates these values according to entered nameplate ratio.

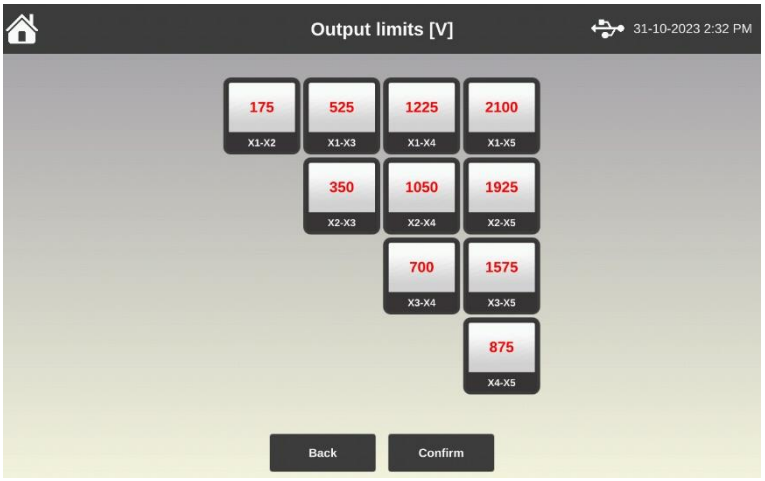


Figure 7-16. Output limit for CT with 5 taps

When determining maximum output test voltages for multi-tap CT, users must be aware of the secondary terminals maximum input voltage limitation. The CVA500 secondary terminals are rated to 2100 V AC. Any voltage higher than this value present at these terminals may damage the CVA500 instrument, cause incorrect measurements, or both. Therefore, maximum output voltages must be set so that induced voltage at any tap combination doesn't exceed 2100 V AC. A typical example is shown below.

Nameplate ratios of 5-tap CT are:

- X1-X2: 50:1
- X1-X3: 150:1
- X1-X4: 350:1
- X1-X5: 600:1

Based on this, ratios for other tap combinations can be calculated:

- X2-X3: 100:1
- X2-X4: 300:1
- X2-X5: 550:1
- X3-X4: 200:1
- X3-X5: 450:1
- X4-X5: 250:1

It can be seen that there are 12 times more turns (600:50) between X1-X5 terminals compared to X1-X2 terminals. If 2000 V AC would be applied between X1-X2 terminals, a voltage of 24000 V AC would be induced between X1-X5 terminals. If all secondary test cables are connected to CVA500 and to CT, this voltage would be present at CVA500 X1-X5 terminals and would damage the CVA500 instrument. Therefore, maximum test voltage applied between X1-X2 terminals must be limited to 2100 V / 12 = 175 V.

Users can edit calculated maximum test voltages, but attention must be paid to the fact that voltage higher than 2100 V AC must never be present at any CVA500 secondary terminal.

If it were necessary to test X1-X2 terminal with voltage higher than 175 V, then all other secondary cables must be disconnected from CVA500 instrument.

Saturation test consists of three sequences:

1. Analysis of CT under test
2. Demagnetization
3. Recording saturation graph

These three sequences are performed automatically, without any intervention from the user.

During the first sequence, CVA500 raises output voltage with a predefined slope and roughly determines the knee point voltage. This is necessary for CVA500 to automatically determine the output voltage range and to automatically select the test points for third sequence. The output voltage is raised 10% above the knee point voltage, or up to set maximum output voltage, whichever is lower.

When the knee point is roughly determined, the second sequence begins. In this sequence, the demagnetization of CT core is performed by keeping the core saturated for a certain amount of time. In other words, CVA500 keeps the achieved test voltage, which is above knee point, for a few seconds.

After demagnetization, the third phase begins in which the CVA500 decreases the output voltage. During this sequence, the saturation graph is recorded in real time (Figure 7-17). The voltage is decreased automatically, and the knee point is determined automatically after the test is completed.

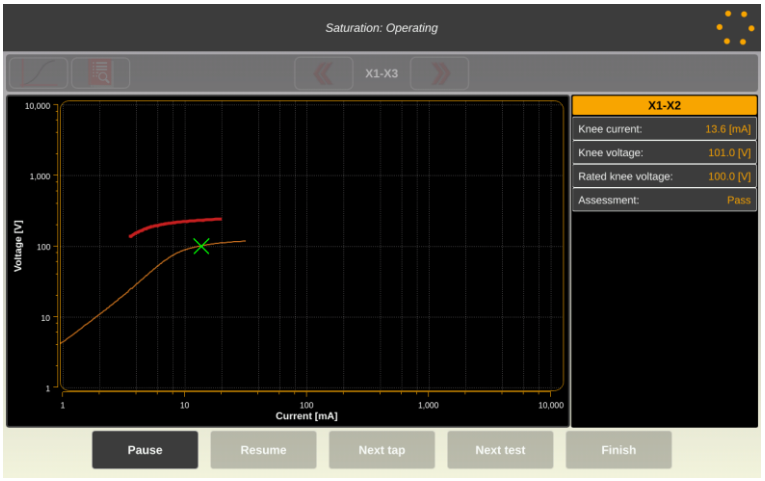


Figure 7-17. Saturation test in progress

Upon finishing the test, if no other tests are selected, results are shown (Figure 7-18).

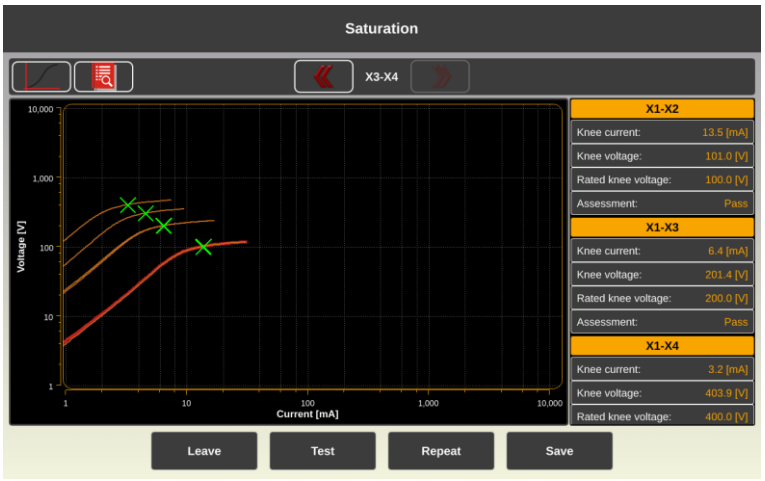


Figure 7-18. Saturation test finished

On the right side of the screen, numerical results for all taps are shown. It is also possible to show numerical results in the form of a table, instead of graphs. To do so, click the second left upper button, and the view will switch from graphical to numerical (Figure 7-19).

Figure 7-19. Numerical saturation results

7.1.4 Turns Ratio Test

CVA500 measures the no-load CT turns ratio. The test is performed using the voltage method. An AC voltage is applied to the CT secondary winding, and an induced AC voltage is measured at the CT primary winding. The ratio of these voltages is the no-load CT turns ratio.

Together with turns ratio, CVA500 measures the no-load CT excitation current and phase angle. Phase angle is the angle between the voltage applied to the CT secondary winding and the induced voltage at the CT primary winding. If this angle is close to 0°, CT polarity is considered correct. If this angle is close to 180°, CT polarity is considered reversed.

CVA500 calculates ratio deviation as the percentage difference between measured no-load turns ratio and nominal CT ratio.

In the “Test type” screen, turns ratio test should be selected (Figure 7-20).

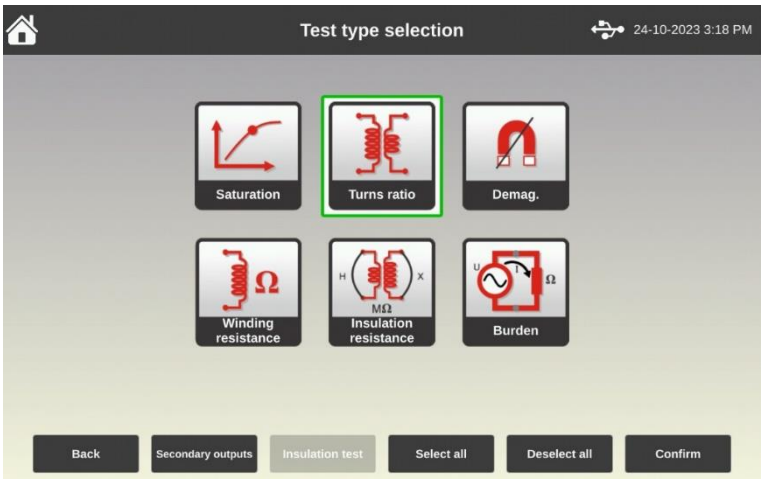


Figure 7-20. Turns ratio test selected

If CT has multiple taps, a turns ratio test is normally performed for each tap. However, it is possible to select taps for which turns ratio test will be performed (Figure 7-21).

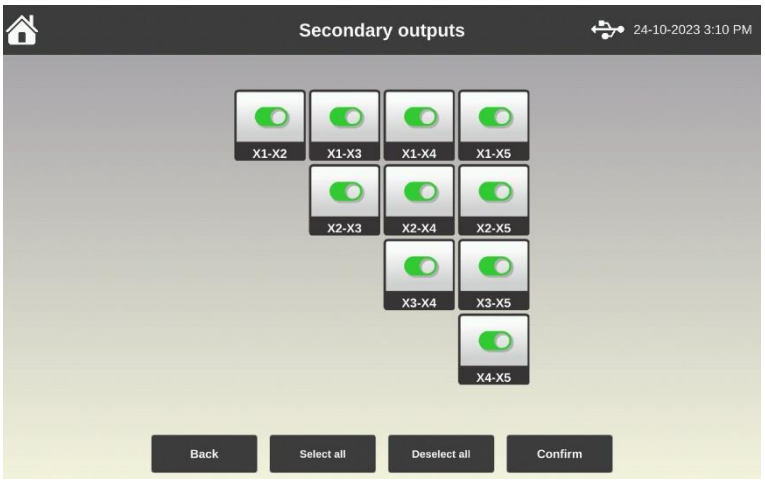


Figure 7-21. Selecting secondary terminals

If multiple taps are selected, turns ratio tests will be performed automatically, one after another.

For CT turns ratio test, it is necessary to select the test voltage. This is done in the “Test option” screen (Figure 7-22). If multi-tap CT is selected, test voltage for the highest tap (e.g. X1-X5 for 5-tap CT) must be selected.

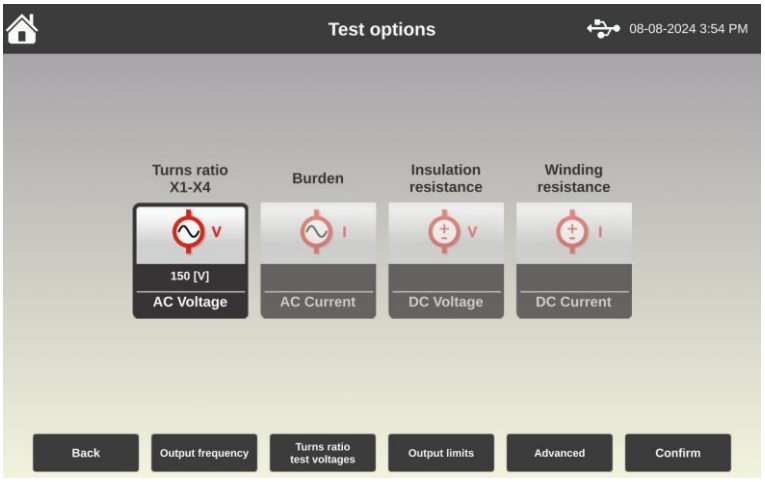


Figure 7-22. Selecting test voltage for turns ratio test

The recommendation is to select test voltage lower than the knee point of the CT under test, to get accurate results.

Test voltages for other tap combinations will be calculated automatically based on the nameplate voltages and selected test voltage for highest tap. It is possible to edit these voltages by clicking the footer button “Turns ratio test voltages”. The new screen will open, where calculated voltages for each tap combination will be shown (Figure 7-23). Clicking any of them will open the keyboard screen where it is possible to edit test voltage.

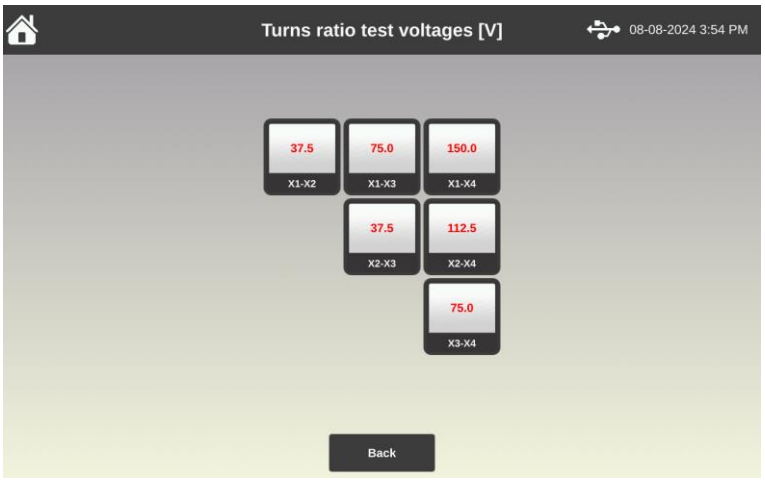


Figure 7-23. Turns ratio test voltages for each tap combination

The turns ratio test is completely automatic. During the test, the appropriate message is displayed on the screen (Figure 7-24).

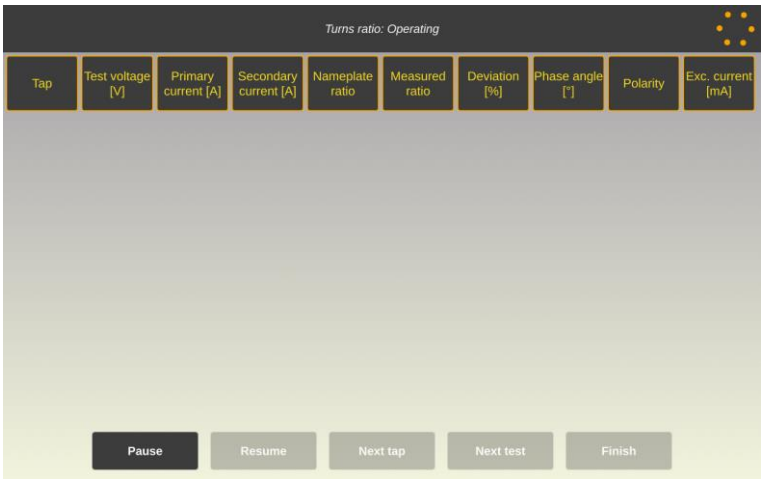


Figure 7-24. Turns ratio test in progress

When the turns ratio test is completed, results are displayed on the screen (Figure 7-25).

Figure 7-25. Turns ratio test finished

7.1.5 Burden Test

CVA500 measures the power, impedance, and power factor (cosφ) of the actual CT burden. The test is performed by injecting nominal CT secondary current (either 1 A or 5 A) to the actual CT burden. The voltage drop over the burden, as well as the phase angle (φ) between the burden voltage and current, are measured. The burden power and impedance are then calculated based on the measured parameters.

In the “Test type” screen, burden test should be selected Figure 7-26).

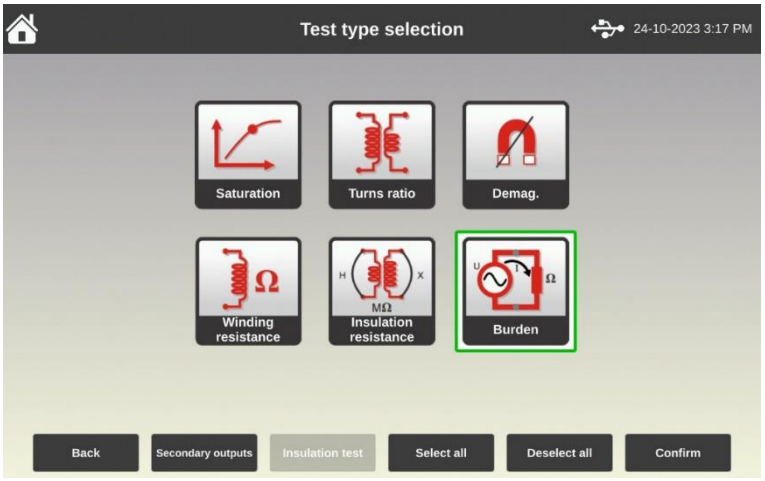


Figure 7-26. Burden test selected

For CT burden test, it is necessary to select the test current. This is done in the “Test option” screen (Figure 7-27). The test current should be the same as CT secondary rated current. That current is selected by default.

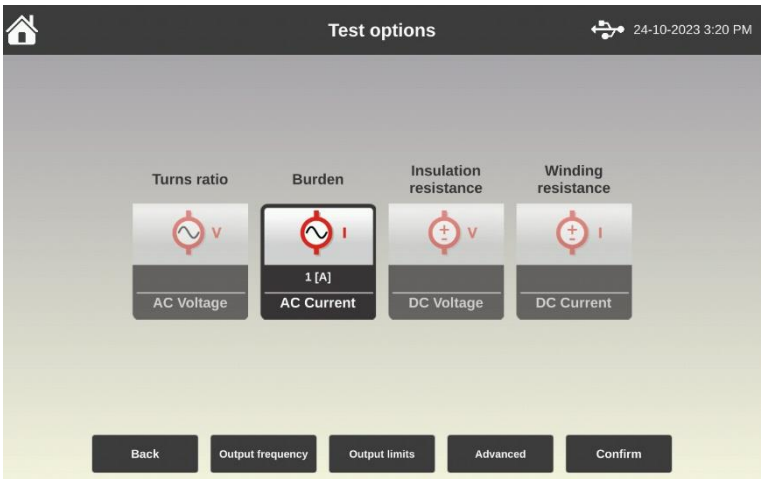


Figure 7-27. Selecting test current for burden test

The burden test is completely automatic. During the test, the appropriate message is displayed on the screen (Figure 7-28).

Figure 7-28. Burden test in progress

When the burden test is completed, results are displayed on the screen (Figure 7-29).

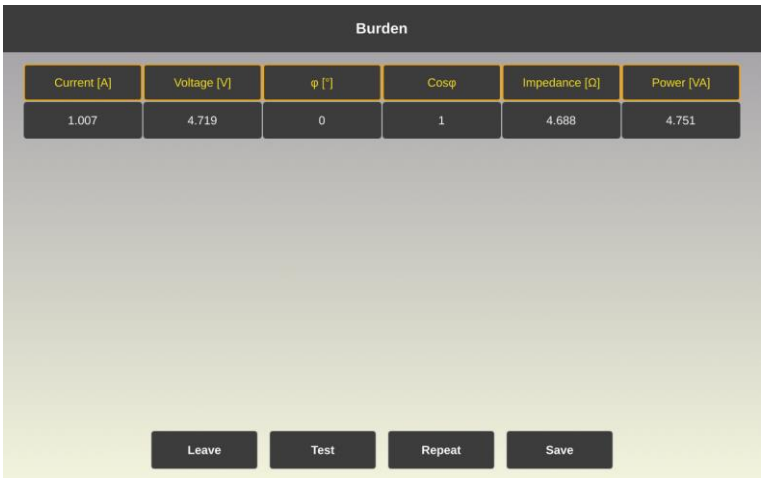


Figure 7-29. Burden test finished

7.1.6 Insulation Resistance Test

CVA500 can measure insulation resistance using test voltages of 500 V DC and 1000 V DC. The purpose of this test is to check the condition of insulation between conductive parts of a CT.

CVA500 uses three output terminals for insulation resistance test – primary terminals (H1/S1 and H2/S2), secondary terminals (X1/S1, X2/S2, X3/S3, X4/S4, and X5/S5), and grounding terminal. During insulation resistance test, CVA500 primary terminals (H1/P1 and H2/P2) are short-circuited internally, and all CVA500 secondary terminals (X1/S1, X2/S2, X3/S3, X4/S4, and X5/S5) are short-circuited internally.

In the “Test type” screen, insulation resistance test should be selected (Figure 7-30).

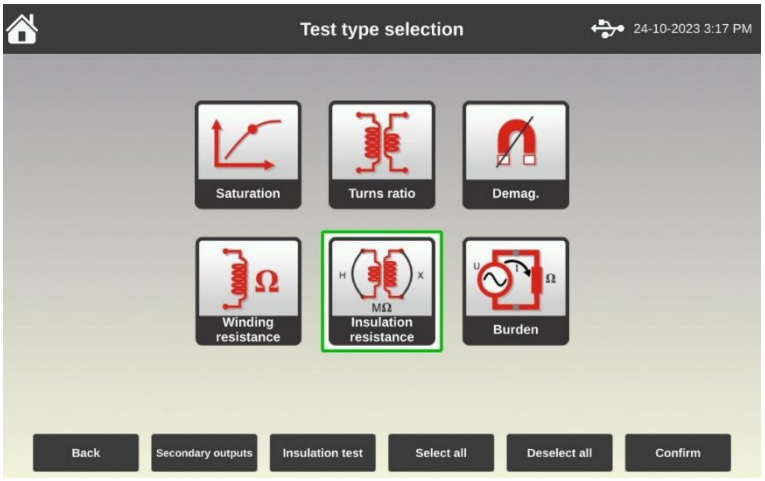


Figure 7-30. Insulation resistance test selected

By clicking the footer button “Insulation resistance”, a new screen is opened where it is possible to select insulation resistance tests that will be performed (Figure 7-31).

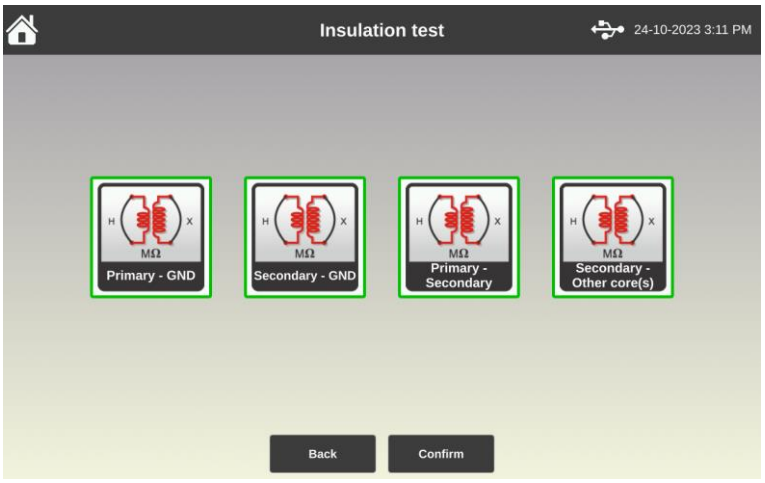


Figure 7-31. Selecting terminals between which insulation resistance is going to be measured

Normally, the insulation resistance is measured between:

1. Primary winding and secondary winding
2. Primary winding and ground
3. Secondary winding and ground
4. Secondary winding and other secondary winding(s), if CT is multi-core type

It is possible to select one of these four options, some of them, or all four. If 4th option is selected, then all other secondary windings should be externally shorted, and CVA500 grounding measurement terminal should be connected to that point.

For CT insulation resistance test, it is necessary to select the test voltage. This is done in the “Test option” screen (Figure 7-32).

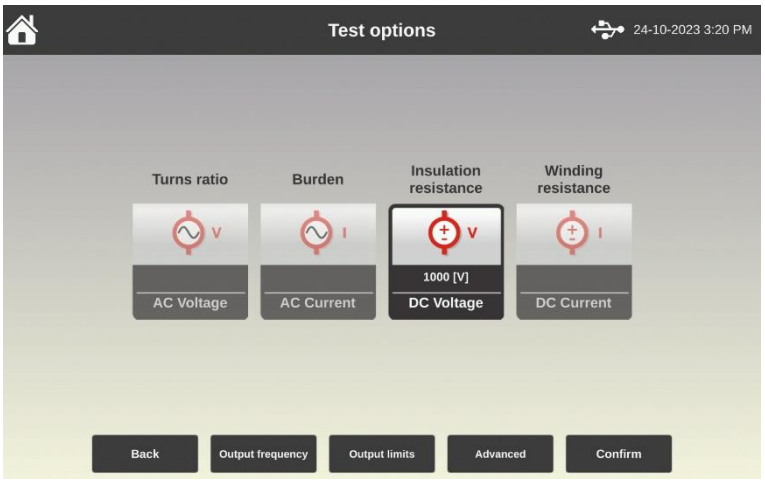


Figure 7-32. Selecting test voltage for insulation resistance test

Insulation resistance test consists of two sequences:

1. Applying test voltage
2. Measuring insulation resistance

These two sequences are performed automatically, without any intervention from the user.

During the first sequence, CVA500 raises output DC voltage to a selected level. The appropriate message is displayed during this phase (Figure 7-33).

Figure 7-33. Applying test voltage for insulation resistance test

When the selected test voltage is applied, CVA500 automatically starts measuring insulation resistance (Figure 7-34). The insulation resistance is measured for up to 60 seconds. The measurement is refreshed every second.

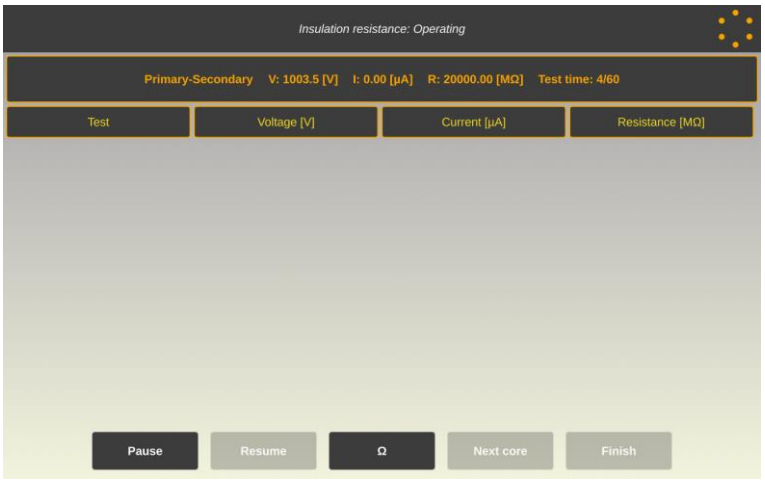


Figure 7-34. Measuring insulation resistance

Insulation resistance is measured either when a 60 second period elapses or when user presses the footer button “Ω” This is typically done when the insulation resistance reaches maximum possible value before 60 seconds. The last measured insulation resistance is taken as a result. When all selected insulation resistance tests are finished, results are shown (Figure 7-35).

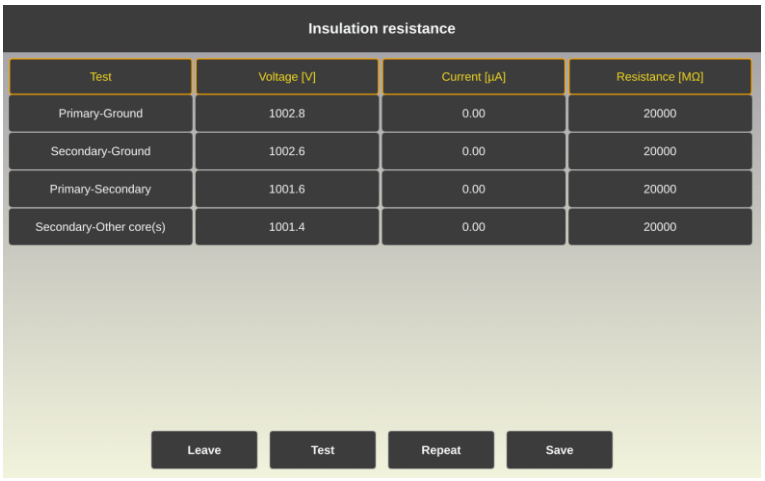


Figure 7-35. Insulation resistance test finished

7.1.7 Ratio And Phase Error

Upon completion of all tests, CVA500 will calculate CT ratio and phase error if winding resistance, saturation, and turns ratio are measured. If CT has multiple taps, ratio and phase errors will be calculated for all taps for which these three tests are successfully performed.

Ratio and phase errors are calculated for four different burdens, and for eight different primary currents (Figure 7-36 and Figure 7-37).

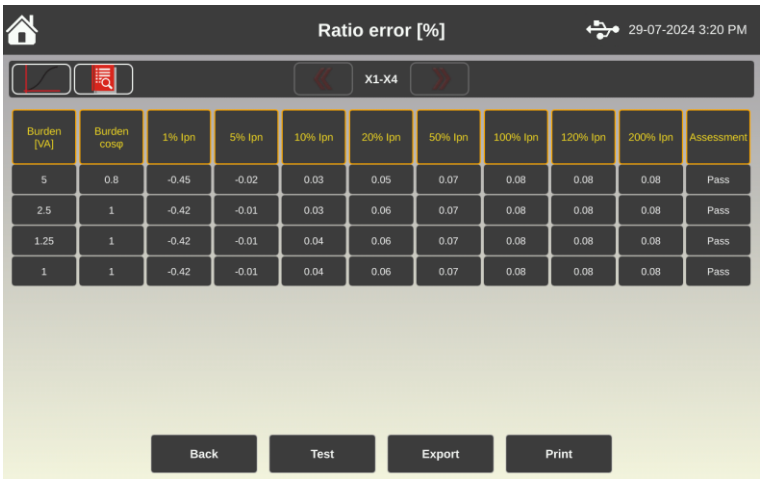


Figure 7-36. Ratio error results

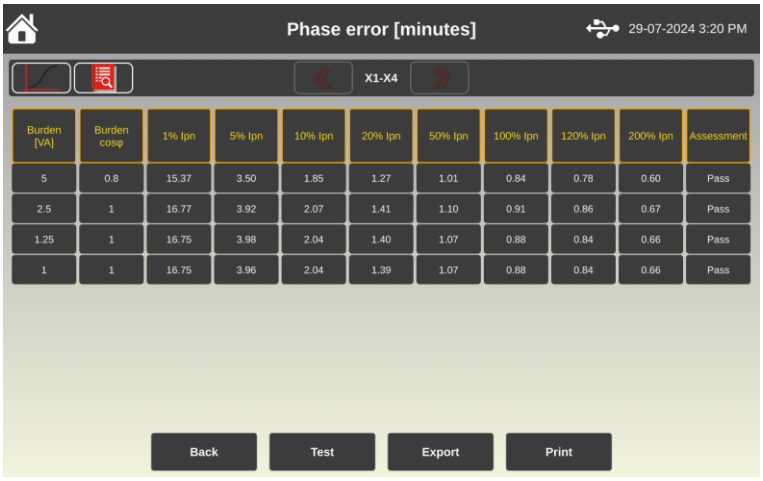


Figure 7-37. Phase error results

One of four burdens is always the rated burden entered before the test. The other three burdens are automatically determined.

For IEC-based standards, the other three burdens are half of rated burden, quarter of rated burden, and 1 VA.

For IEEE-based standards, the other three burdens are the first three standardized burdens lower than the rated burden. If there are not enough lower burdens, then the first higher burden(s) is/are selected. Standardized burdens are stated below.

Standardized burdens for measurement CT:

- 45.0 VA (B 1.8)
- 22.5 VA (B 0.9)
- 12.5 VA (B 0.5)
- 5.0 VA (B 0.2)
- 2.5 VA (B 0.1)

Standardized burdens for protection CT:

- 200.0 VA (B 8)
- 100.0 VA (B 4)
- 50.0 VA (B 2)
- 25.0 VA (B 1)
- 12.5 VA (B 0.5)
- 5.0 VA (B 0.2)
- 2.5 VA (B 0.1)

Seven primary currents for which ratio and phase errors are calculated are 1%, 5%, 10%, 20%, 50%, 100%, and 120% of CT rated primary current. The eighth primary current is variable and depends on the CT settings.

For IEC-based measurement type CTs, this current is 200% of rated primary current if no extended range is defined, and no assessment is made for that current. If extended range is defined, then this primary current is equal to the entered extended current range, and assessment criteria is the same as for 120% of rated primary current. For example, if an extended range of 300% is entered, then ratio and phase error will be calculated for 300% of rated primary current.

For IEC-based protection type CTs, this current is 200% of rated primary current, and no assessment is made for that current.

For IEEE-based measurement type CTs, the eight current depends on the selected rating factor RF. Available options are:

- RF = 1, eight current is 200%, and no assessment is made for that current.
- RF = 1.33, eight current is 133%, and assessment criteria is the same as for 100%
- RF = 1.5, eight current is 150%, and assessment criteria is the same as for 100%
- RF = 2, eight current is 200%, and assessment criteria is the same as for 100%
- RF = 3, eight current is 300%, and assessment criteria is the same as for 100%
- RF = 4, eight current is 400%, and assessment criteria is the same as for 100%

For IEEE-based protection type CTs, this current is 2000% of rated primary current, and assessment is made for that current.

The assessment is based on the limits prescribed by IEC and IEEE standards (Table 7-1 and Table 7-2). If all values for one burden are within the acceptable limits, the assessment for that burden is considered as “pass”. Otherwise, it is “fail”.

Table 7-1. Ratio error acceptable limits for different CT classes, in percents

Standard	Application	Class	Percentage of rated primary current							
			1%	5%	10%	20%	50%	100%	120%	2000%
IEC-based	Metering	0.1		±0.4		±0.2		±0.1	±0.1	
		0.2		±0.75		±0.35		±0.2	±0.2	
		0.2S	±0.75	±0.35		±0.2		±0.2	±0.2	
		0.5		±1.5		±0.75		±0.5	±0.5	
		0.5S	±1.5	±0.75		±0.5		±0.5	±0.5	
		1		±3		±1.5		±1	±1	
		3					±3		±3	
		5					±5		±5	
	Protection	5P 5PR						±1		
		10P 10PR						±3		
		TPS						±0.25		
		TPX						±0.5		
		TPY						±1		
		TPZ						±1		
IEEE-based	Metering	0.15S		±0.15				±0.15		
		0.15		±0.3				±0.15		
		0.15N			±0.3			±0.15		
		0.3S		±0.3				±0.3		
		0.3			±0.6			±0.3		
		0.6			±1.2			±0.6		
		1.2			±2.4			±1.2		
	Protection	C						±3		±10
		K						±3		±10
		T						±3		±10
		X						±1		User defined

Table 7-2. Phase error acceptable limits for different CT classes, in minutes

Standard	Application	Class	Percentage of rated primary current					
			1%	5%	10%	20%	100%	120%
IEC-based	Metering	0.1		±15		±8	±5	±5
		0.2		±30		±15	±10	±10
		0.2S	±30	±15		±10	±10	±10
		0.5		±90		±45	±30	±30
		0.5S	±90	±45		±30	±30	±30
		1		±180		±90	±60	±60
	Protection	5P 5PR					±60	
		TPX					±30	
		TPY					±60	
		TPZ					180±18	
IEEE-based	Metering	0.15S		±7.8			±7.8	
		0.15		±15.6			±7.8	
		0.15N			±15.6		±7.8	
		0.3S		±15.6			±15.6	
		0.3			±31.2		±15.6	
		0.6			±62.4		±31.2	
		1.2			±124.8		±62.4	

The ratio and phase error results can also be shown in graphical format, by clicking the graph icon above the numerical results.

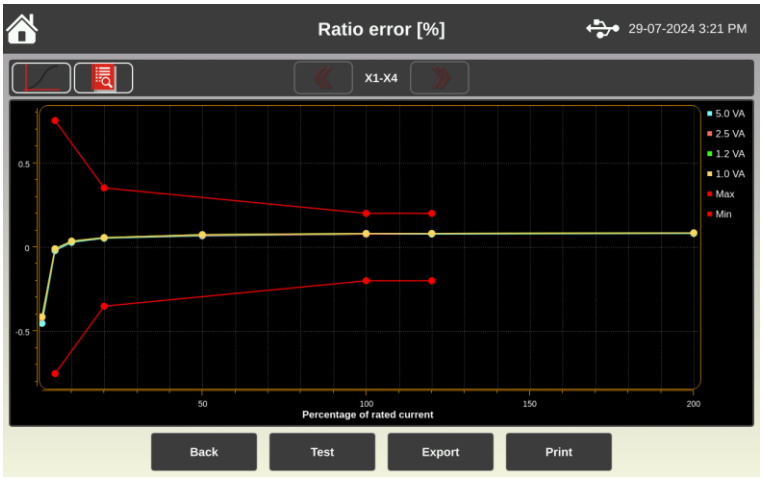


Figure 7-38. Ratio error results, graphical view

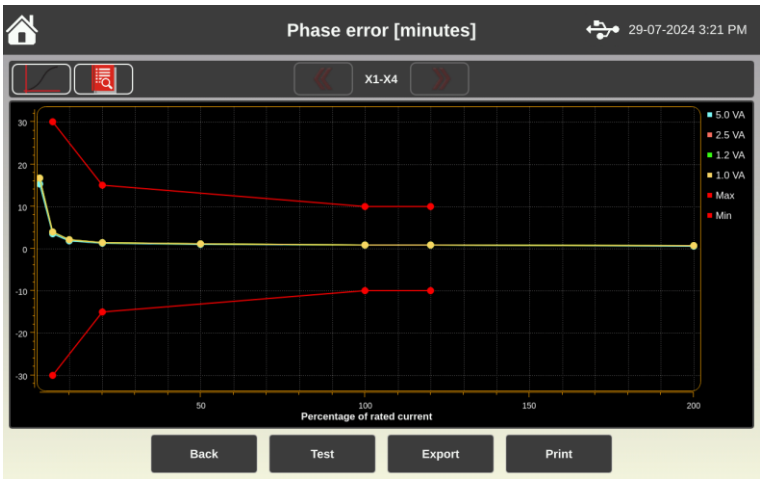


Figure 7-39. Phase error results, graphical view

7.1.8 Composite Error

Upon completion of all tests, CVA500 will calculate CT composite error if winding resistance and saturation are measured. If CT has multiple taps, composite error will be calculated for all taps for which these two tests are successfully performed.

Besides composite error, CVA500 will also calculate following parameters:

- Instrument security factor FS (for IEC-based metering CTs)
- Accuracy limit factor ALF (for IEC-based protection CTs classes 5P, 10P, 5PR, 10PR)
- Rated secondary terminal voltage Vb (for IEEE-based protection CTs classes C, K, T)

Instrument security factor and accuracy limit factor are calculated with both direct and indirect method. Results obtained with indirect method are marked with small letter “i” (FSi and ALFi).

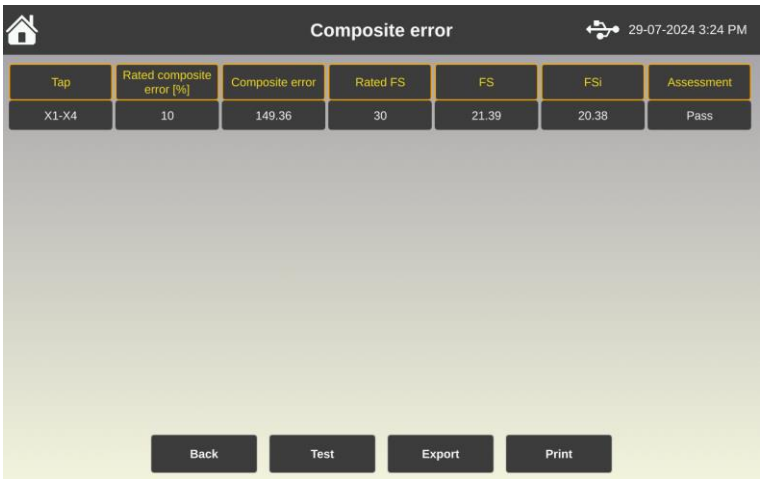


Figure 7-40. Composite error and FS results

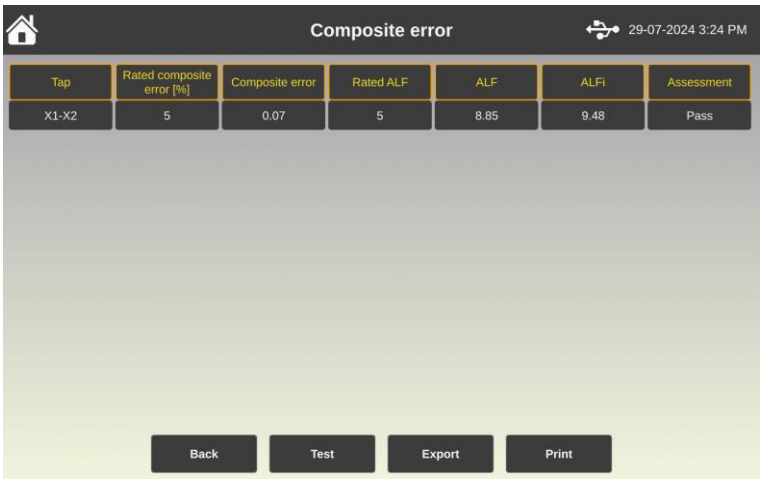


Figure 7-41. Composite error and ALF results

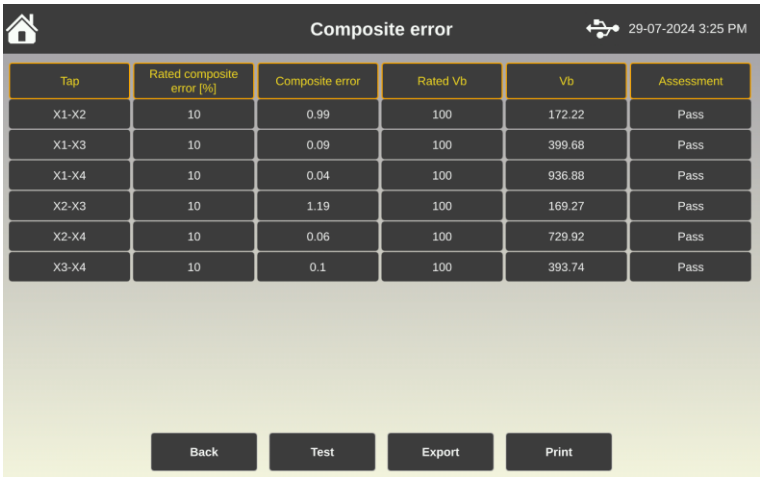


Figure 7-42. Composite error and Vb results

The assessment is based on the comparison with rated values. The assessment criteria are given below.

For instrument security factor FS, result is considered “pass” if:

- Composite error (ε) > Rated composite error (ε_n)
- FS and FSi ≤ Rated FS (FS_n)

For accuracy limit factor ALF, result is considered “pass” if:

- Composite error (ε) < Rated composite error (ε_n)
- ALF and ALFi ≥ Rated ALF (ALF_n)

For rated secondary terminal voltage Vb, result is considered “pass” if:

- Composite error (ε) < Rated composite error (ε_n)
- Vb ≥ Rated Vb (Vb_n)

Rated composite errors for different classes are given in the

Table 7-3.

Table 7-3. Rated composite error values

Standard	Application	Class	Rated composite error
IEC-based	Metering	All	10%
	Protection	5P, 5PR	5%
		10P, 10PR	10%
IEEE-based	Protection	C, K, T	10%

7.2 Voltage Transformer

The following tests can be performed:

- Turns ratio
- Winding resistance
- Burden
- Insulation resistance

Users can choose to perform only one test, some of tests, or all of them. If multiple tests are selected (Figure 7-43), they will be executed in the above-mentioned order.

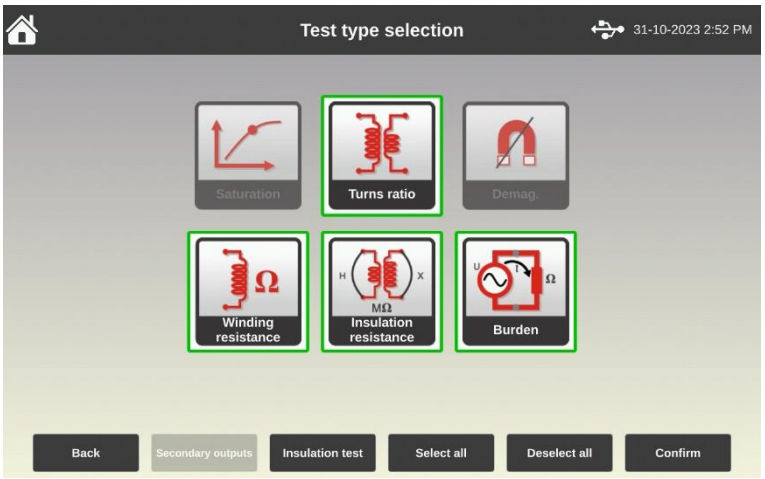


Figure 7-43. Test type selection, all tests selected

Tests will not be executed automatically. Instead, the user will need to manually confirm the start of test execution before each test. This is because the connection of CVA500 to test object may be different for different tests.

7.2.1 Turns Ratio Test

CVA500 measures the no-load VT turns ratio. The test is performed using the voltage method. An AC voltage is applied to the VT primary winding, and an induced AC voltage is measured at the unloaded VT secondary winding. The ratio of these voltages is the no-load VT turns ratio.

CVA500 outputs test voltage from the secondary terminals. Therefore, VT turns ratio test should be performed with secondary terminals (X1/S1 and X2/S2) connected to the VT primary side, and primary terminals (H1/P1 and H2/P2) connected to the VT secondary side (Figure 7-44).

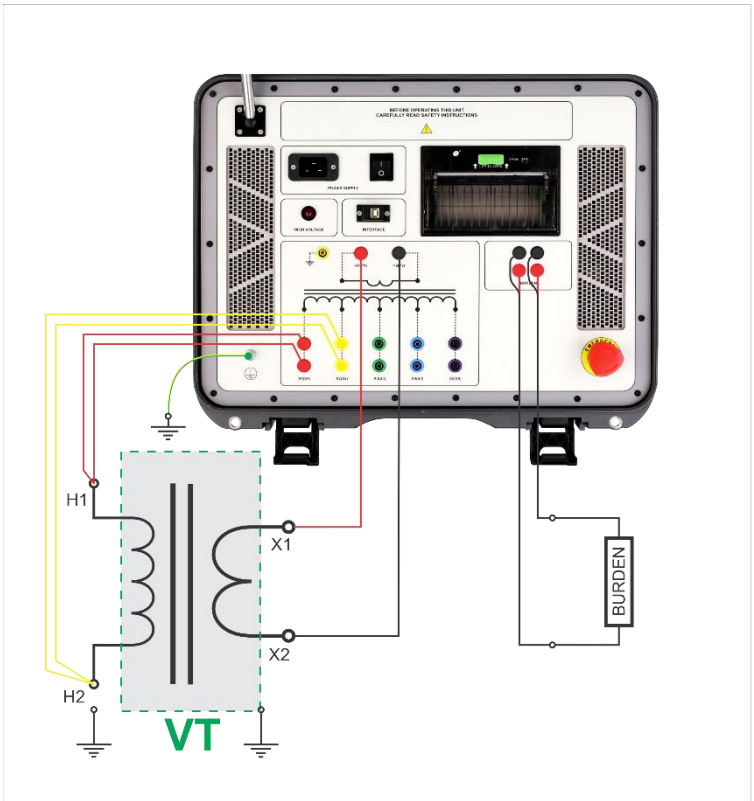


Figure 7-44. Connecting CVA500 to a VT, turns ratio test

Together with turns ratio, CVA500 measures the no-load VT excitation current and phase angle. Phase angle is the angle between the voltage applied to the VT primary winding and the induced voltage at the unloaded VT secondary winding. If this angle is close to 0°, VT polarity is considered correct. If this angle is close to 180°, VT polarity is considered reversed.

CVA500 calculates ratio deviation as the percentage difference between measured no-load turns ratio and nominal VT ratio.

In the “Test type” screen, turns ratio test should be selected (Figure 7-45).

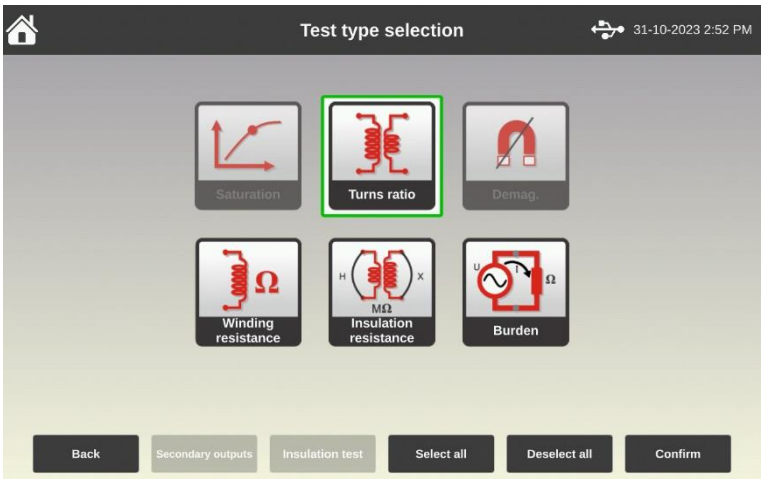


Figure 7-45. Turns ratio test selected

For VT turns ratio test, it is necessary to select the test voltage. This is done in the “Test option” screen (Figure 7-46).

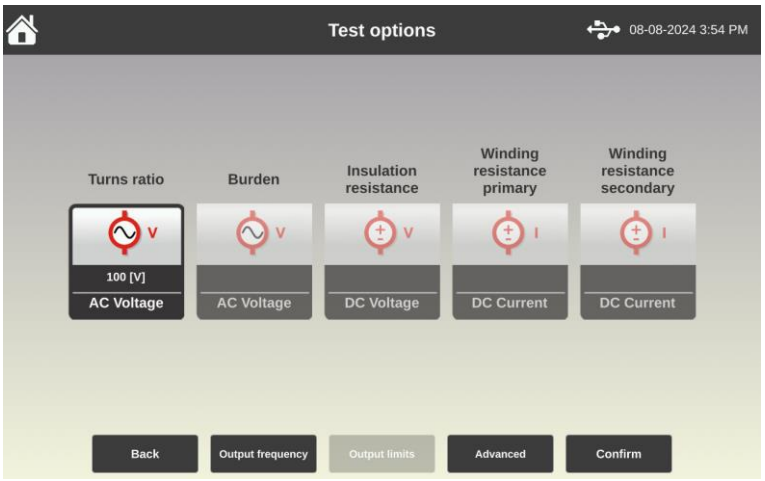


Figure 7-46. Selecting test voltage for turns ratio test

When the test is started, the user will be asked to confirm the test execution (Figure 7-47).

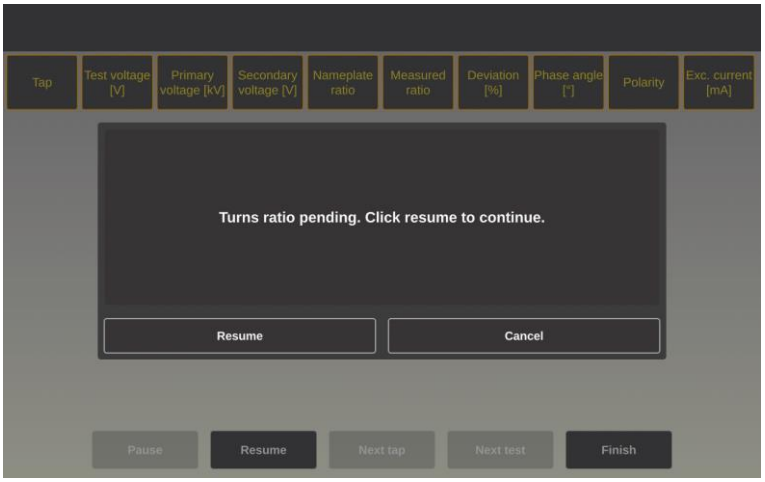


Figure 7-47. Turns ratio test pending message

The turns ratio test is completely automatic. During the test, the appropriate message is displayed on the screen (Figure 7-48).

Figure 7-48. Turns ratio test in progress

When the turns ratio test is completed, results are displayed on the screen (Figure 7-49).

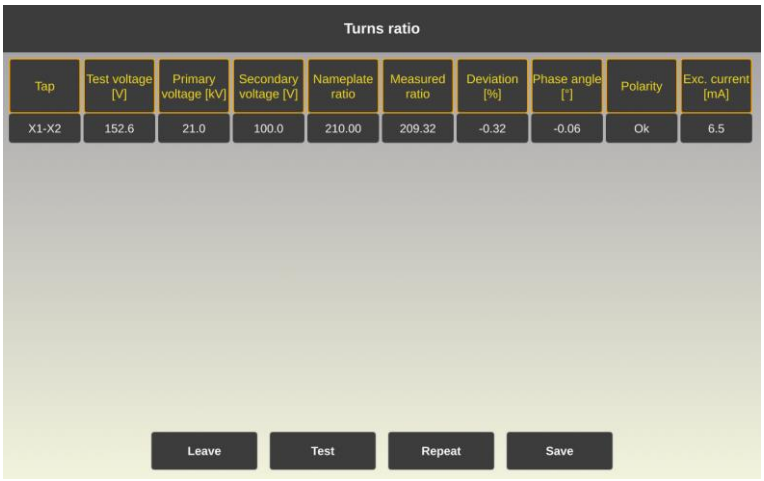


Figure 7-49. Turns ratio test finished

7.2.2 Winding Resistance Test

The winding resistance test is performed on both VT primary and VT secondary winding. CVA500 uses secondary terminals for testing winding resistance. When measurement of VT primary side winding resistance is selected, CVA500 secondary terminals (X1/S1 and X2/S2) should be connected to the VT primary side (Figure 7-50). When measurement of VT secondary side winding resistance is selected, CVA500 secondary terminals (X1/S1 and X2/S2) should be connected to the VT secondary side (Figure 7-51).

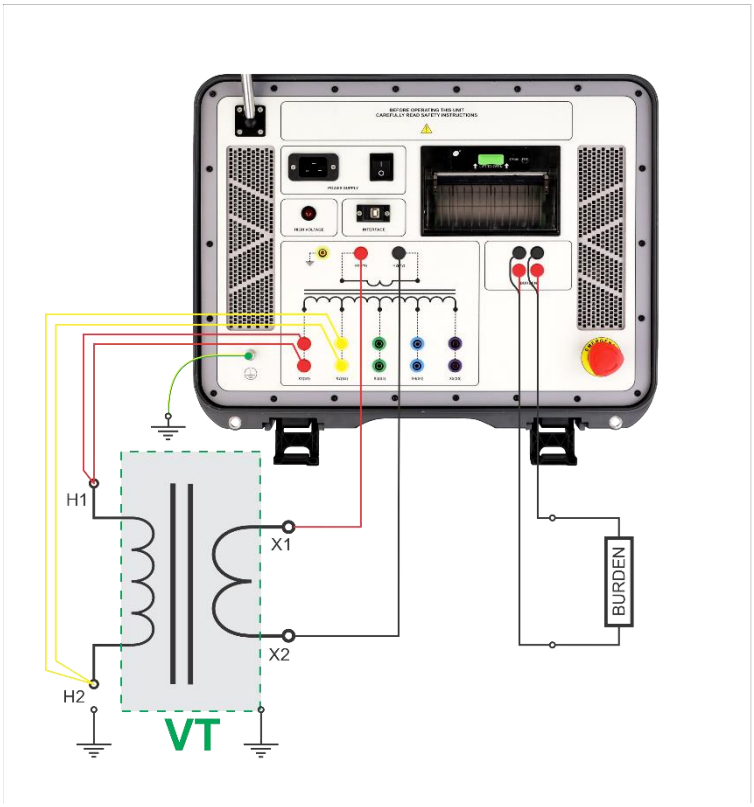


Figure 7-50. Connecting CVA500 to a VT, winding resistance test of primary side

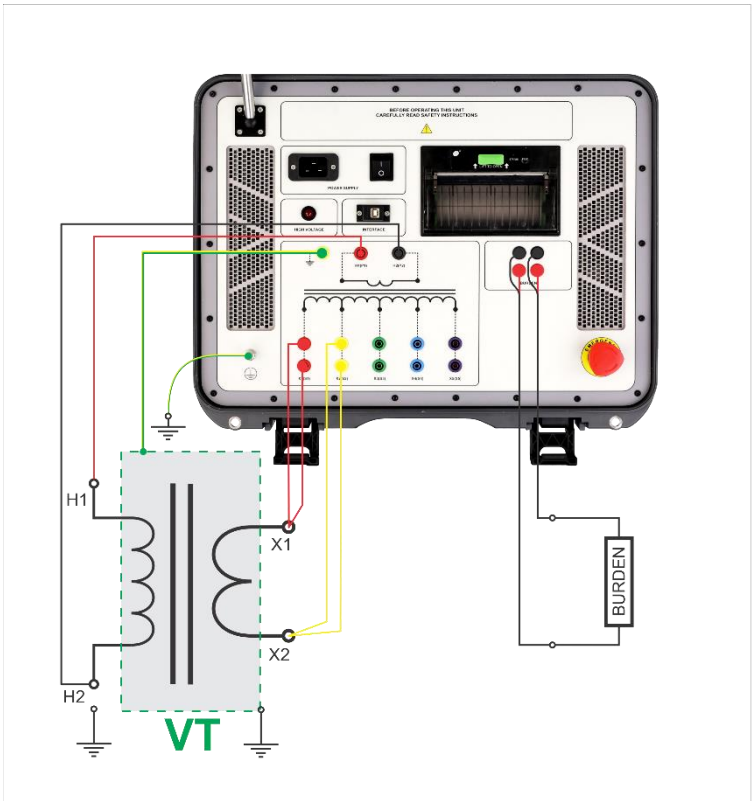


Figure 7-51. Connecting CVA500 to a VT, winding resistance test of secondary side

In the “Test type” screen, winding resistance test should be selected (Figure 7-52).

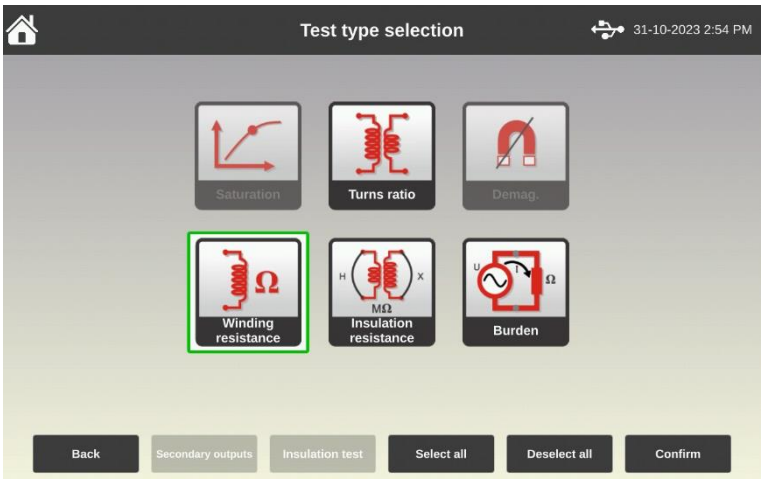


Figure 7-52. Winding resistance test selected

For VT winding resistance test, it is necessary to select the test current for testing VT primary and secondary winding resistance. This is done in the “Test option” screen (Figure 7-53).

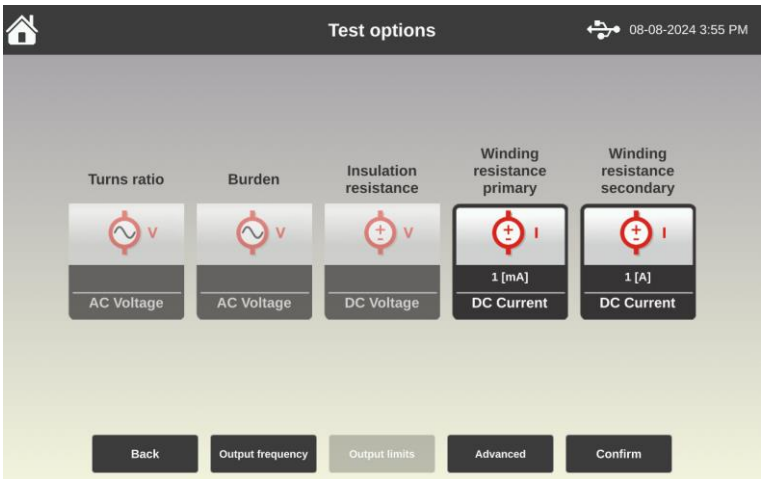


Figure 7-53. Selecting test current for winding resistance test

The recommendation for test current for VT primary winding resistance is to set it to 1 mA, as primary winding resistance is typically in kΩ.

7.2.2.1 Primary Side Winding Resistance Test

When the test is started, or when this test is next to be performed in case of multiple tests selected, the user will be asked to confirm the test execution (Figure 7-54)

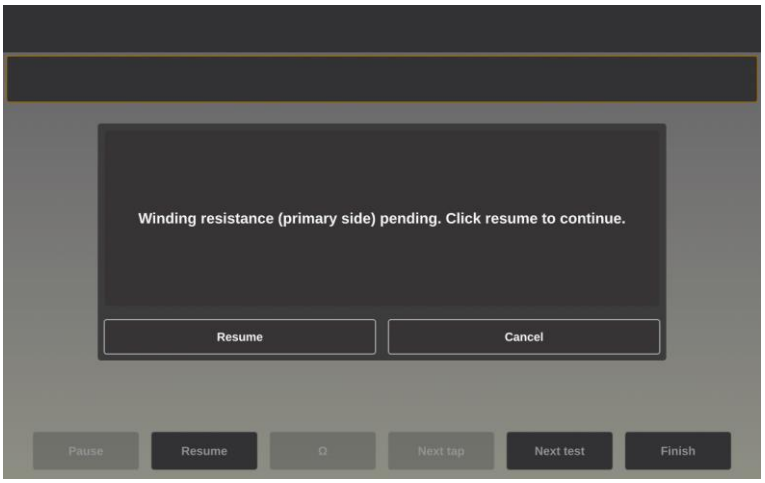


Figure 7-54. Primary side winding resistance test pending message

Winding resistance test consists of two sequences:

1. Injecting test current, also called charging
2. Measuring winding resistance

These two sequences are performed automatically, without any intervention from the user.

During the first sequence, CVA500 raises output DC voltage in order to achieve stable test current. The appropriate message is displayed during this phase (Figure 7-55).

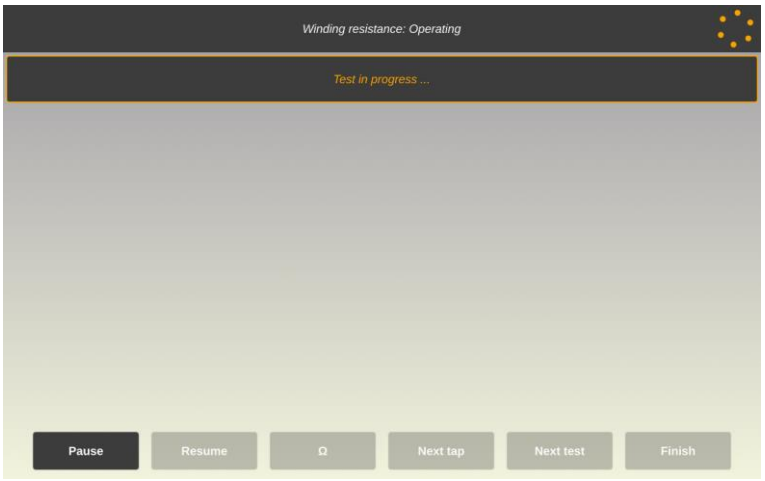


Figure 7-55. Injecting DC current

When the selected test current is injected, CVA500 automatically starts measuring winding resistance (Figure 7-56).

The winding resistance result stabilization is tracked by the advanced software algorithm, which calculates the deviation ΔR as a percentage difference of the current resistance value compared to the average resistance value measured over the previous several seconds. The lower the ΔR is, the more stable resistance is. The ΔR parameter is displayed on the screen during the test.

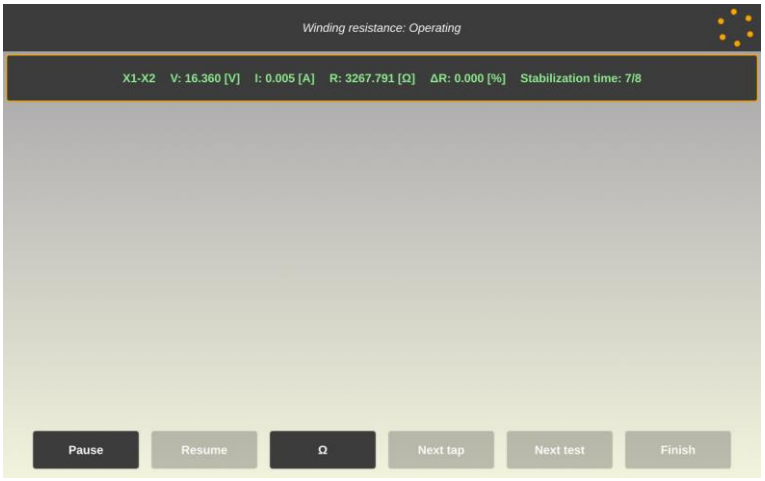


Figure 7-56. Measuring winding resistance of primary side

The measurement is refreshed every second. Winding resistance is measured either by pressing the footer button “Ω” or automatically if ΔR value falls below predefined limit for predefined period. If no other tests are selected, results are shown (Figure 7-57).

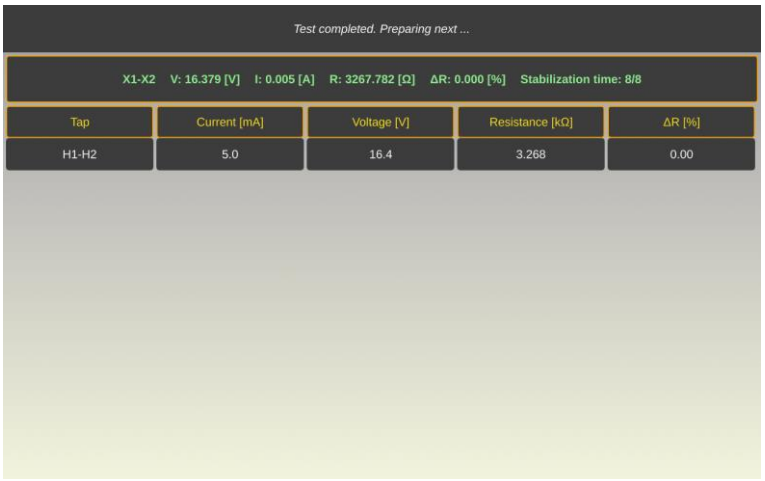


Figure 7-57. Winding resistance results, primary side

7.2.2.2 Secondary Side Winding Resistance Test

When the test is started, or when this test is next to be performed in case of multiple tests selected, the user will be asked to confirm the test execution (Figure 7-58)

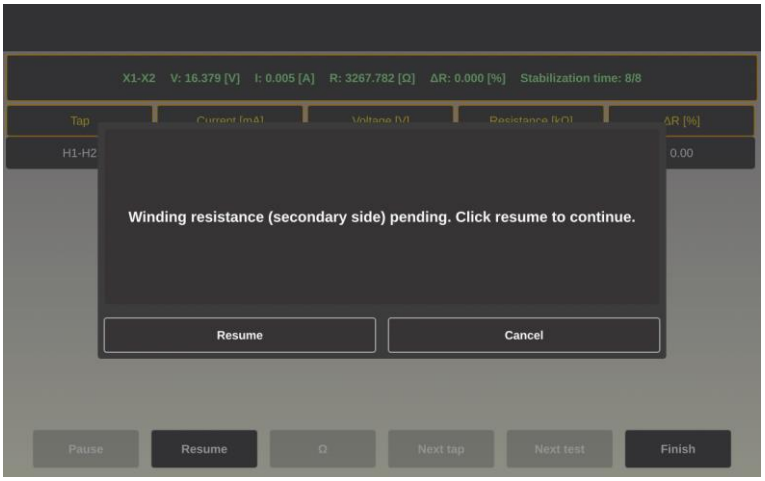


Figure 7-58. Secondary side winding resistance test pending message

Winding resistance test consists of two sequences:

1. Injecting test current, also called charging
2. Measuring winding resistance

These two sequences are performed automatically, without any intervention from the user.

During the first sequence, CVA500 raises output DC voltage in order to achieve stable test current. The appropriate message is displayed during this phase (Figure 7-59).

Figure 7-59. Injecting DC current

When the selected test current is injected, CVA500 automatically starts measuring winding resistance (Figure 7-60).

The winding resistance result stabilization is tracked by the advanced software algorithm, which calculates the deviation ΔR as a percentage difference of the current resistance value compared to the average resistance value measured over the previous several seconds. The lower the ΔR is, the more stable resistance is. The ΔR parameter is displayed on the screen during the test.

Figure 7-60. Measuring winding resistance of secondary side

The measurement is refreshed every second. Winding resistance is measured either by pressing the footer button “Ω” or automatically if ΔR value falls below predefined limit for predefined period. If no other tests are selected, results are shown (Figure 7-61).

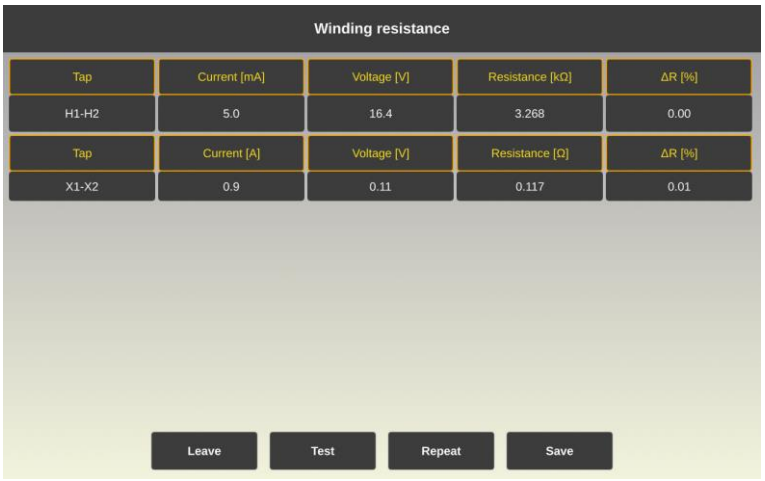


Figure 7-61. Winding resistance results, primary and secondary side

7.2.3 Burden Test

CVA500 measures the power, impedance, and power factor (cosφ) of the actual VT burden. The test is performed by applying nominal VT secondary voltage to the actual VT burden. The current drawn by the burden, as well as the phase angle (φ) between the burden voltage and current are measured. The burden power and impedance are then calculated based on the measured parameters.

In the “Test type” screen, burden test should be selected (Figure 7-62).

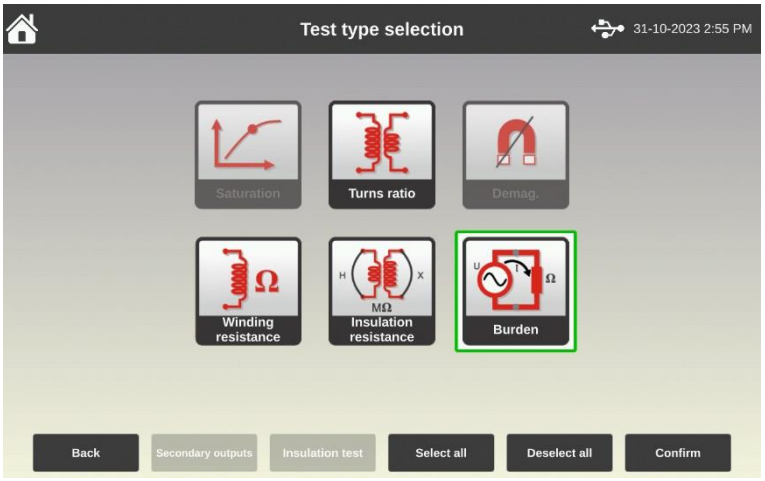


Figure 7-62. Burden test selected

For VT burden test, it is necessary to select the test voltage. This is done in the “Test option” screen (Figure 7-63). The test voltage should be the same as VT secondary rated voltage. That voltage is selected by default.

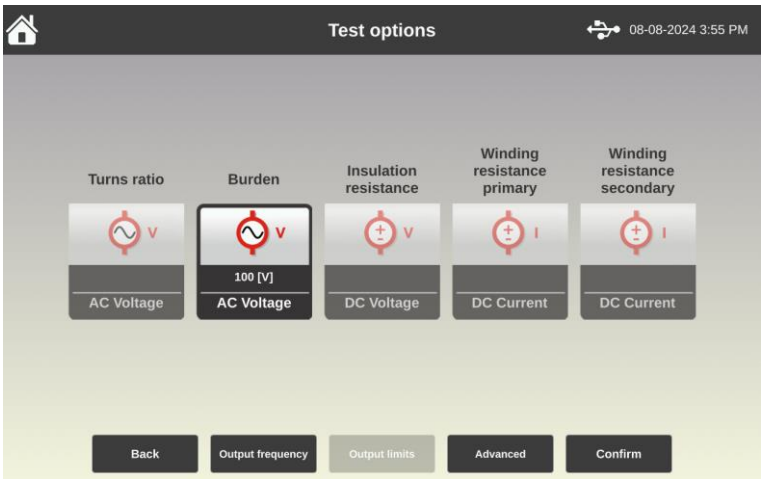


Figure 7-63. Selecting test voltage for burden test

When the test is started, or when this test is next to be performed in case of multiple tests selected, the user will be asked to confirm the test execution (Figure 7-64).

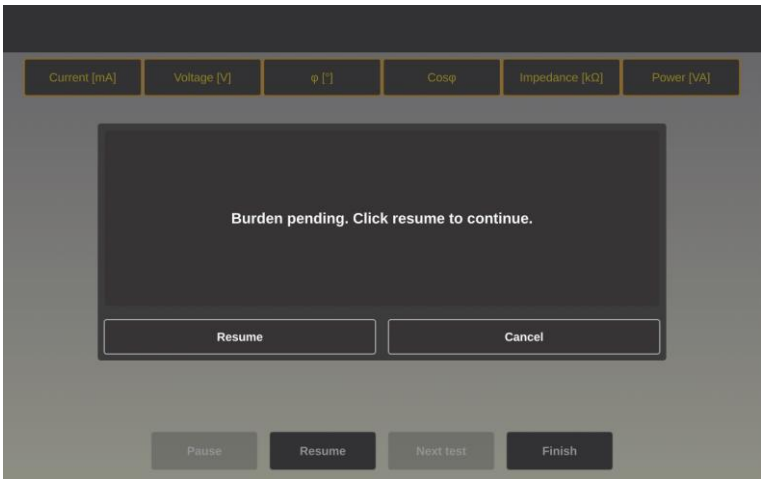


Figure 7-64. Burden test pending message

The burden test is completely automatic. During the test, the appropriate message is displayed on the screen (Figure 7-65).

Figure 7-65. Burden test in progress

When the burden test is completed, results are displayed on the screen (Figure 7-66).

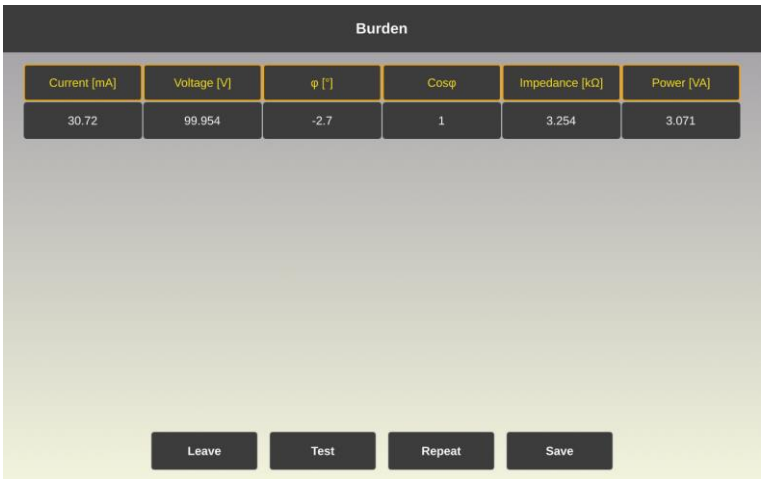


Figure 7-66. Burden test finished

7.2.4 Insulation Resistance Test

CVA500 can measure insulation resistance using test voltages of 500 V DC and 1000 V DC. The purpose of this test is to check the condition of insulation between conductive parts of a VT.

CVA500 uses three output terminals for insulation resistance test – primary terminals (H1/S1 and H2/S2), secondary terminals (X1/S1, X2/S2, X3/S3, X4/S4, and X5/S5), and grounding terminal. During insulation resistance test, CVA500 primary terminals (H1/P1 and H2/P2) are short-circuited internally, and all CVA500 secondary terminals (X1/S1, X2/S2, X3/S3, X4/S4, and X5/S5) are short-circuited internally.

In the “Test type” screen, insulation resistance test should be selected (Figure 7-67).

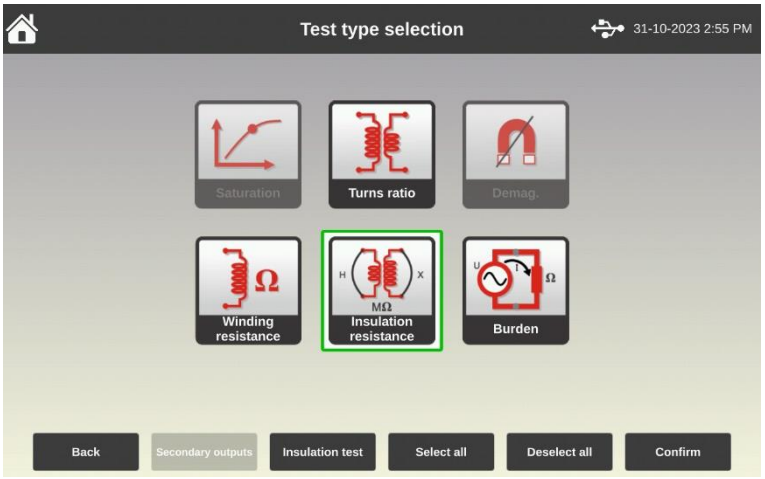


Figure 7-67. Insulation resistance test selected

By clicking the footer button “Insulation resistance”, a new screen is opened where it is possible to select insulation resistance tests that will be performed (Figure 7-68).

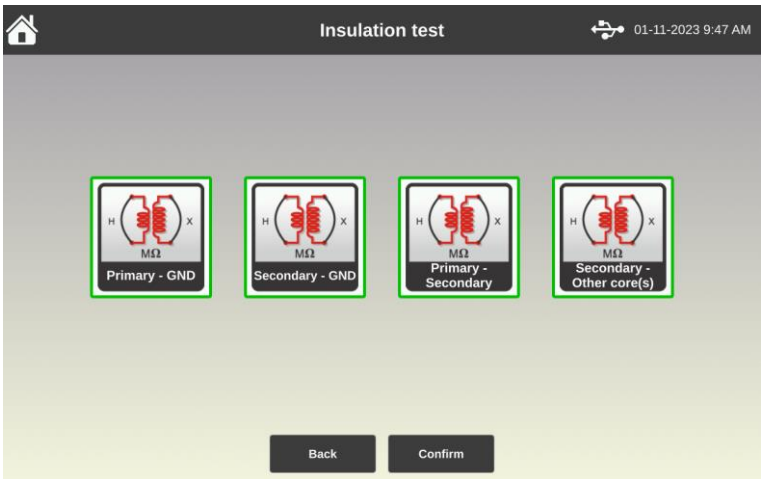


Figure 7-68. Selecting terminals between which insulation resistance is going to be measured

Normally, the insulation resistance is measured between:

1. Primary winding and secondary winding
2. Primary winding and ground
3. Secondary winding and ground
4. Secondary winding and other secondary winding(s), if VT is multi-core type

It is possible to select one of these four options, some of them, or all four. If the 4th option is selected, then all other secondary windings should be externally shorted, and CVA500 grounding measurement terminal should be connected to that point.

For VT insulation resistance test, it is necessary to select the test voltage. This is done in the “Test option” screen (Figure 7-69).

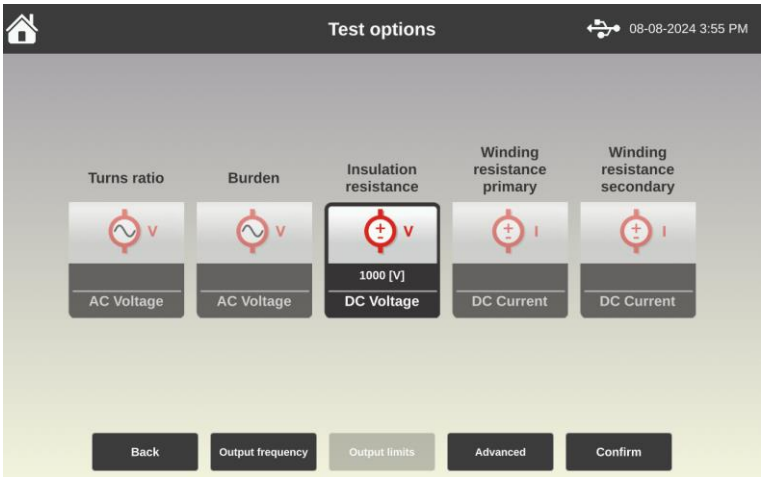


Figure 7-69. Selecting test voltage for insulation resistance test

When the test is started, or when this test is next to be performed in case of multiple tests selected, the user will be asked to confirm the test execution (Figure 7-70).

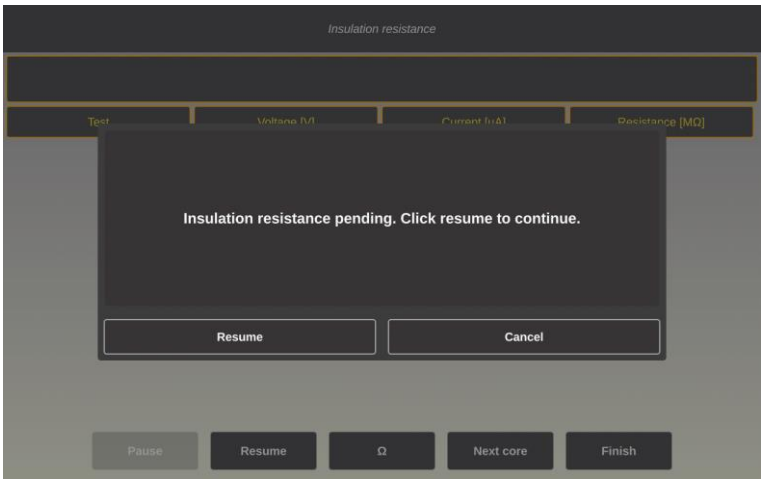


Figure 7-70. Insulation resistance test pending message

Insulation resistance test consists of two sequences:

1. Applying test voltage
2. Measuring insulation resistance

These two sequences are performed automatically, without any intervention from the user.

During the first sequence, CVA500 raises output DC voltage to a selected level. The appropriate message is displayed during this phase (Figure 7-71).

Figure 7-71. Applying test voltage for insulation resistance test

When the selected test voltage is applied, CVA500 automatically starts measuring insulation resistance (Figure 7-72). The insulation resistance is measured for up to 60 seconds. The measurement is refreshed every second.

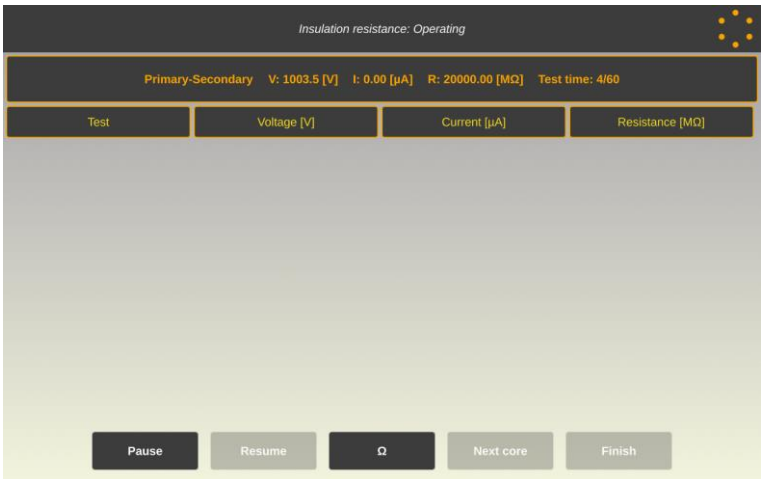


Figure 7-72. Measuring insulation resistance

Insulation resistance is measured either when a 60 second period elapses or when user presses the footer button “Ω” This is typically done when the insulation resistance reaches maximum possible value before 60 seconds. The last measured insulation resistance is taken as a result. When all selected insulation resistance tests are finished, results are shown (Figure 7-73).

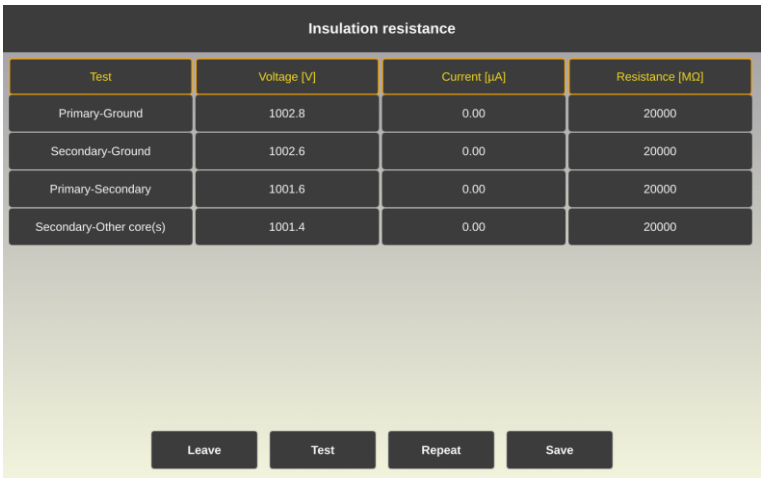


Figure 7-73. Insulation resistance test finished

7.3 Capacitive Voltage Transformer

The following tests can be performed:

- Turns ratio
- Winding resistance
- Burden
- Insulation resistance

Users can choose to perform only one test, some of tests, or all of them. If multiple tests are selected (Figure 7-74), they will be executed in the above-mentioned order.

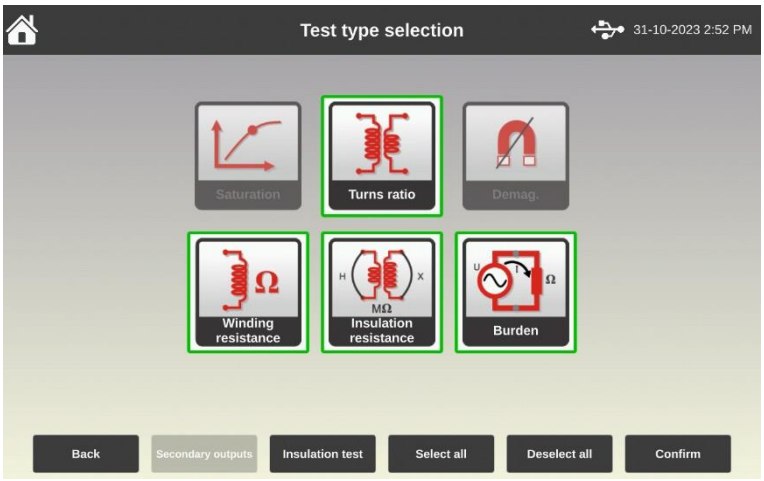


Figure 7-74. Test type selection, all tests selected

Tests will not be executed automatically. Instead, the user will need to manually confirm the start of test execution before each test. This is because the connection of CVA500 to test object may be different for different tests.

7.3.1 Turns Ratio Test

CVA500 measures the no-load CVT turns ratio. The test is performed using the voltage method. An AC voltage is applied to the CVT primary winding, and an induced AC voltage is measured at the unloaded CVT secondary winding. The ratio of these voltages is the no-load CVT turns ratio.

CVA500 outputs test voltage from the secondary terminals. Therefore, CVT turns ratio test should be performed with secondary terminals (X1/S1 and X2/S2) connected to the CVT primary side, and primary terminals (H1/P1 and H2/P2) connected to the CVT secondary side (Figure 7-75).

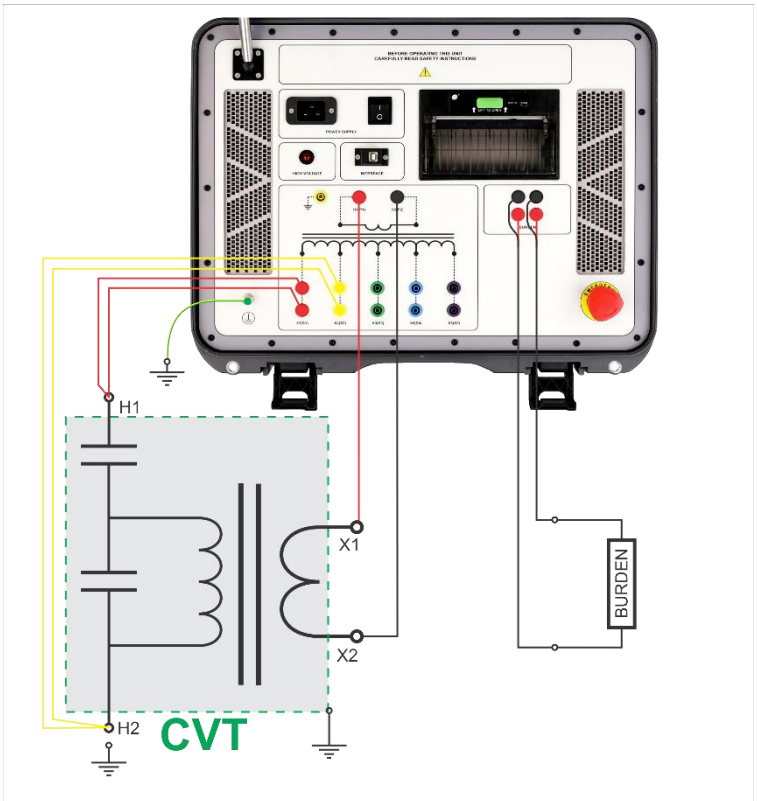


Figure 7-75. Connecting CVA500 to a CVT, turns ratio test

Together with turns ratio, CVA500 measures the no-load CVT excitation current and phase angle. Phase angle is the angle between the voltage applied to the CVT primary winding and the induced voltage at the unloaded CVT secondary winding. If this angle is close to 0°, CVT polarity is considered correct. If this angle is close to 180°, CVT polarity is considered reversed.

CVA500 calculates ratio deviation as the percentage difference between measured no-load turns ratio and nominal CVT ratio.

In the “Test type” screen, turns ratio test should be selected (Figure 7-76).

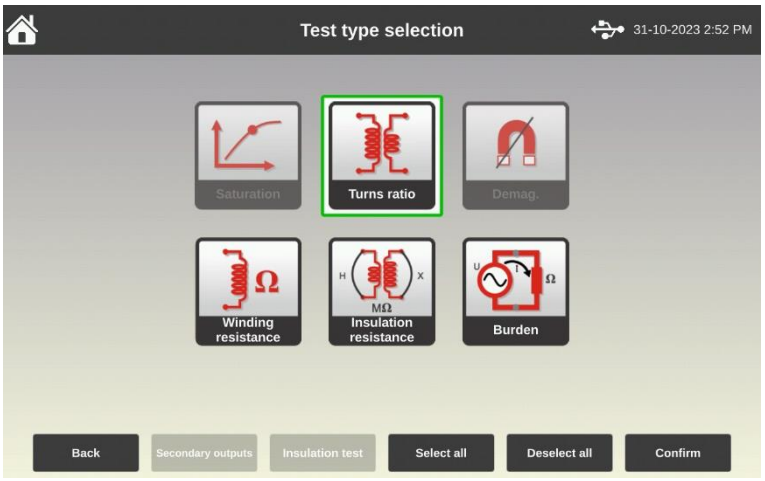


Figure 7-76. Turns ratio test selected

For CVT turns ratio test, it is necessary to select the test voltage. This is done in the “Test option” screen (Figure 7-77).

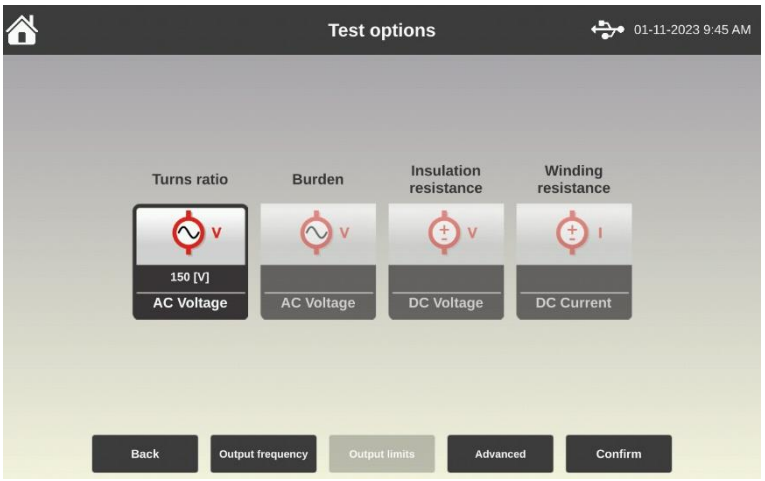


Figure 7-77. Selecting test voltage for turns ratio test

When the test is started, the user will be asked to confirm the test execution (Figure 7-78).

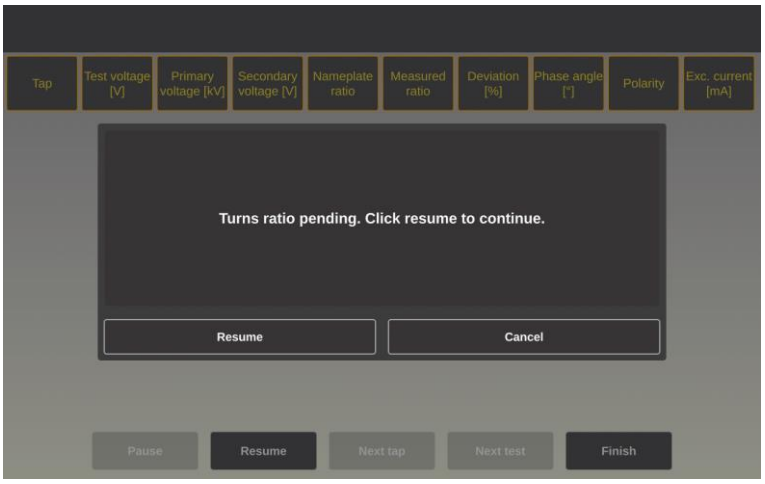


Figure 7-78. Turns ratio test pending message

The turns ratio test is completely automatic. During the test, the appropriate message is displayed on the screen (Figure 7-79).

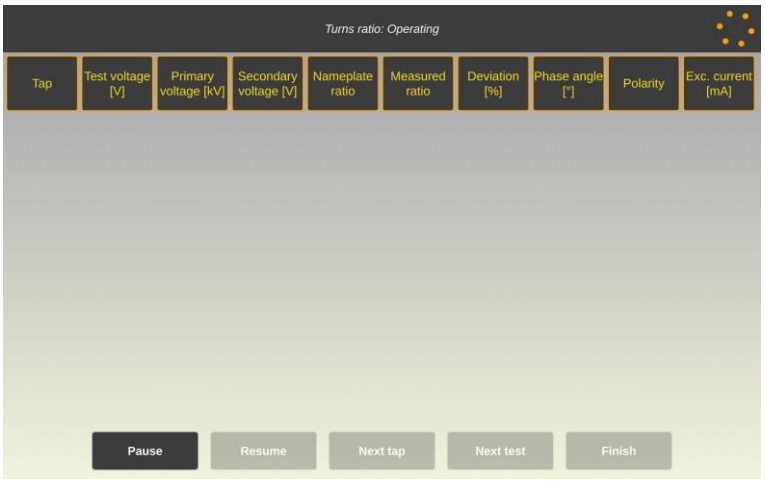


Figure 7-79. Turns ratio test in progress

When the turns ratio test is completed, results are displayed on the screen (Figure 7-80).

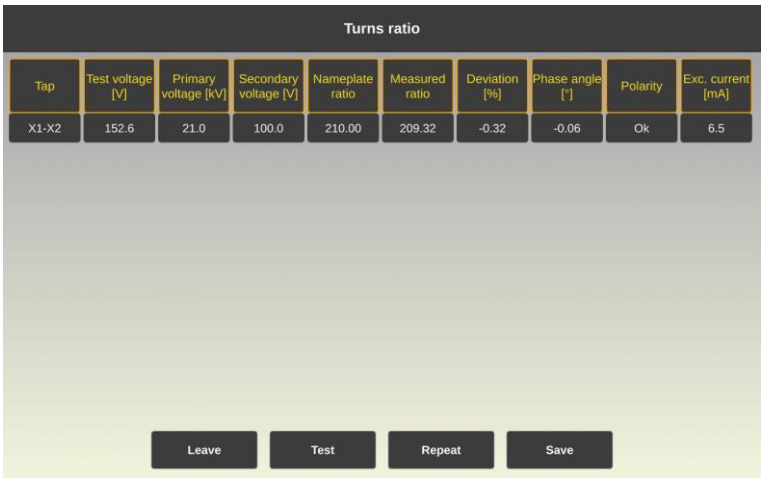


Figure 7-80. Turns ratio test finished

7.3.2 Winding Resistance Test

The winding resistance test is performed on CVT secondary winding. CVA500 uses secondary terminals for testing winding resistance. When CVT secondary side winding resistance is measured, CVA500 secondary terminals (X1/S1 and X2/S2) should be connected to the CVT secondary side (Figure 7-81).

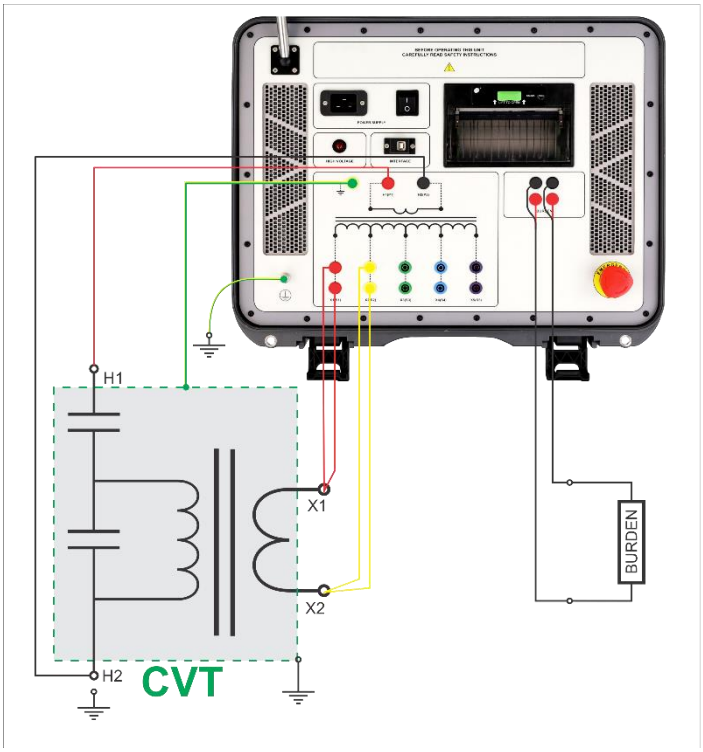


Figure 7-81. Connecting CVA500 to a CVT, winding resistance test of secondary side

In the “Test type” screen, winding resistance test should be selected (Figure 7-82).

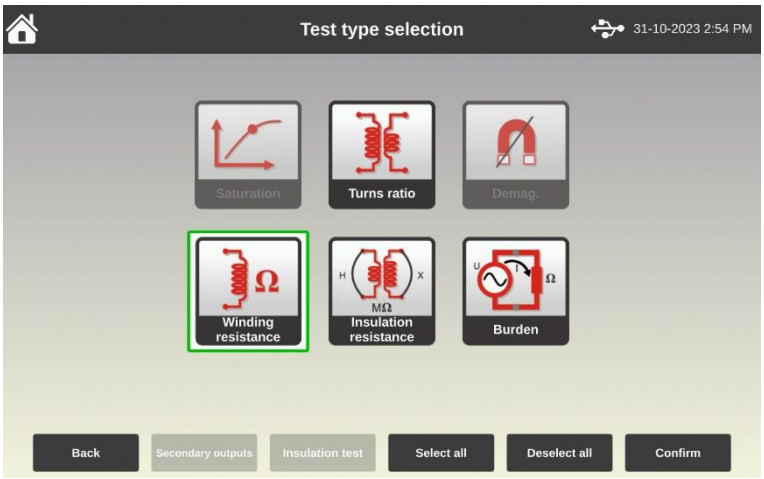


Figure 7-82. Winding resistance test selected

For CVT winding resistance test, it is necessary to select the test current. This is done in the “Test option” screen (Figure 7-83).

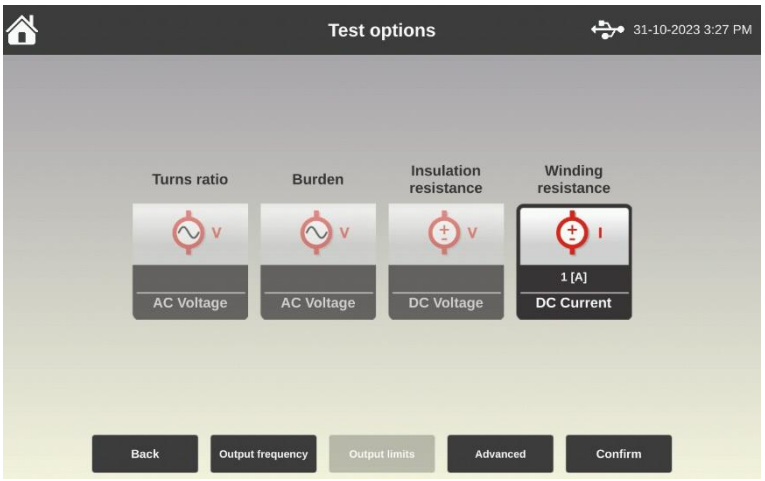


Figure 7-83. Selecting test current for winding resistance test

When the test is started, or when this test is next to be performed in case of multiple tests selected, the user will be asked to confirm the test execution (Figure 7-84)

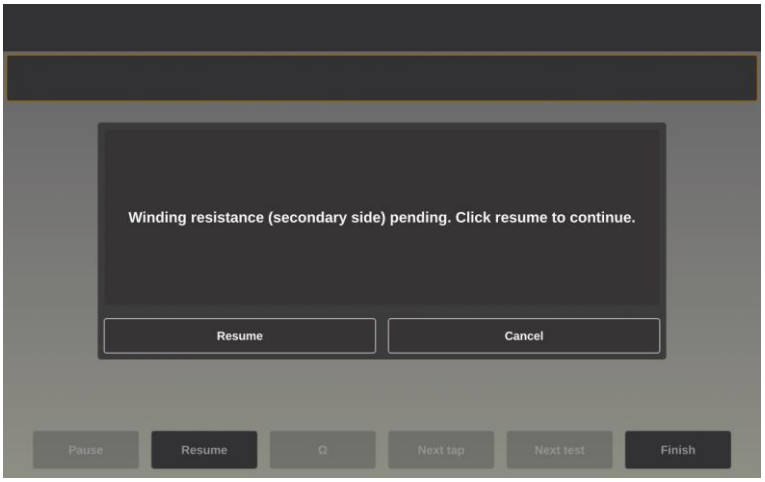


Figure 7-84. Secondary side winding resistance test pending message

Winding resistance test consists of two sequences:

1. Injecting test current, also called charging
2. Measuring winding resistance

These two sequences are performed automatically, without any intervention from the user.

During the first sequence, CVA500 raises output DC voltage in order to achieve stable test current. The appropriate message is displayed during this phase (Figure 7-85).

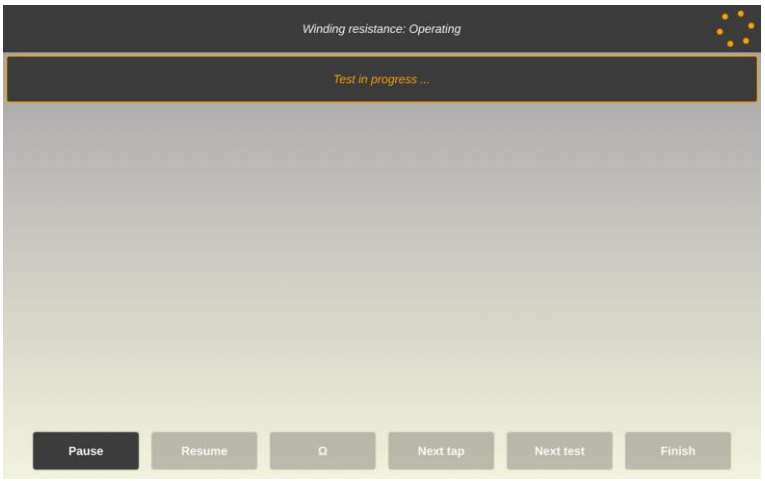


Figure 7-85. Injecting DC current

When the selected test current is injected, CVA500 automatically starts measuring winding resistance (Figure 7-86).

The winding resistance result stabilization is tracked by the advanced software algorithm, which calculates the deviation ΔR as a percentage difference of the current resistance value compared to the average resistance value measured over the previous several seconds. The lower the ΔR is, the more stable resistance is. The ΔR parameter is displayed on the screen during the test.

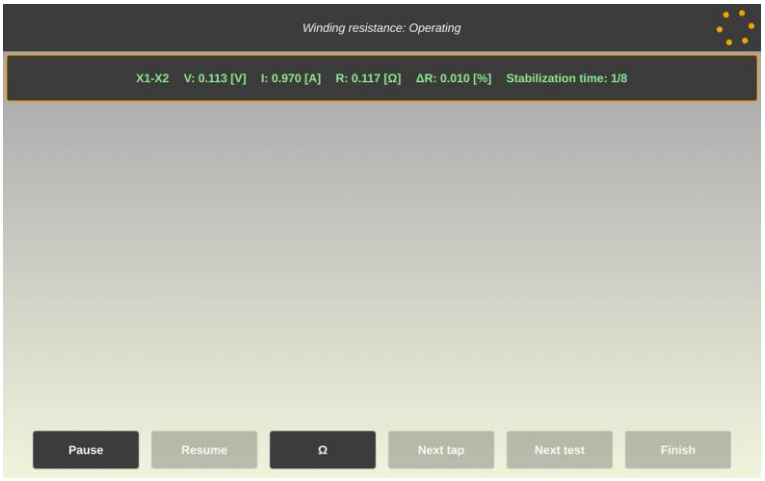


Figure 7-86. Measuring winding resistance of secondary side

The measurement is refreshed every second. Winding resistance is measured either by pressing the footer button “Ω” or automatically if ΔR value falls below predefined limit for predefined period. If no other tests are selected, results are shown (Figure 7-87).

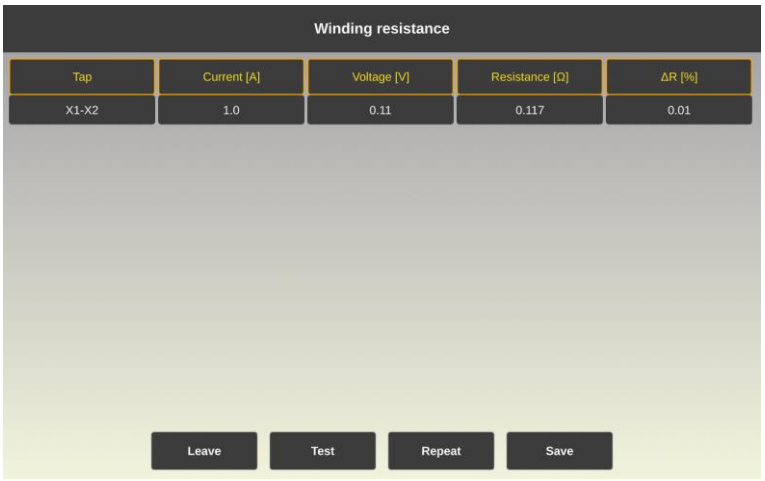


Figure 7-87. Winding resistance results, primary and secondary side

7.3.3 Burden Test

CVA500 measures the power, impedance, and power factor (cosφ) of the actual CVT burden. The test is performed by applying nominal CVT secondary voltage to the actual CVT burden. The current drawn by the burden, as well as the phase angle (φ) between the burden voltage and current are measured. The burden power and impedance are then calculated based on the measured parameters.

In the “Test type” screen, burden test should be selected (Figure 7-88).

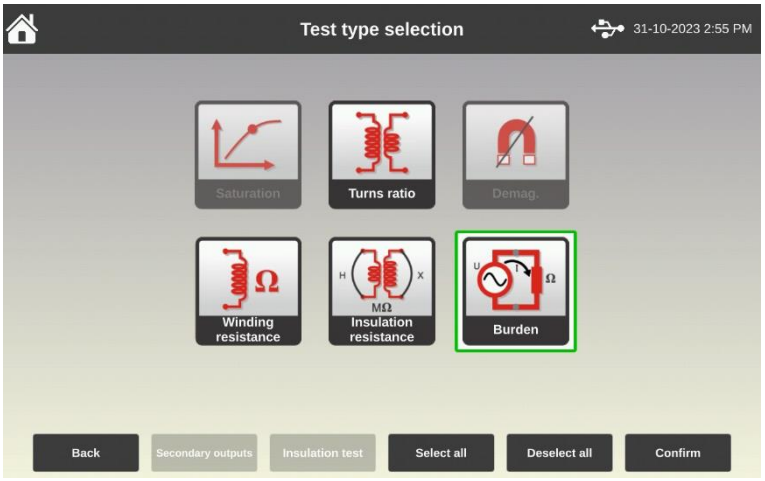


Figure 7-88. Burden test selected

For CVT burden test, it is necessary to select the test voltage. This is done in the “Test option” screen (Figure 7-89). The test voltage should be the same as CVT secondary rated voltage. That voltage is selected by default.

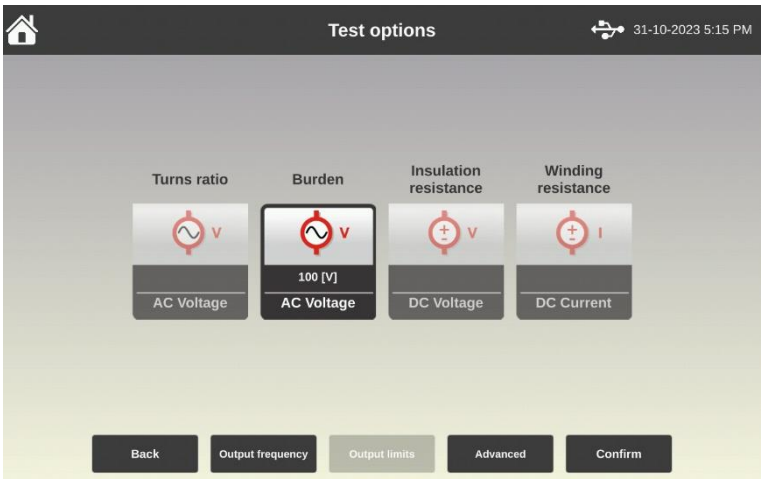


Figure 7-89. Selecting test voltage for burden test

When the test is started, or when this test is next to be performed in case of multiple tests selected, the user will be asked to confirm the test execution (Figure 7-90).

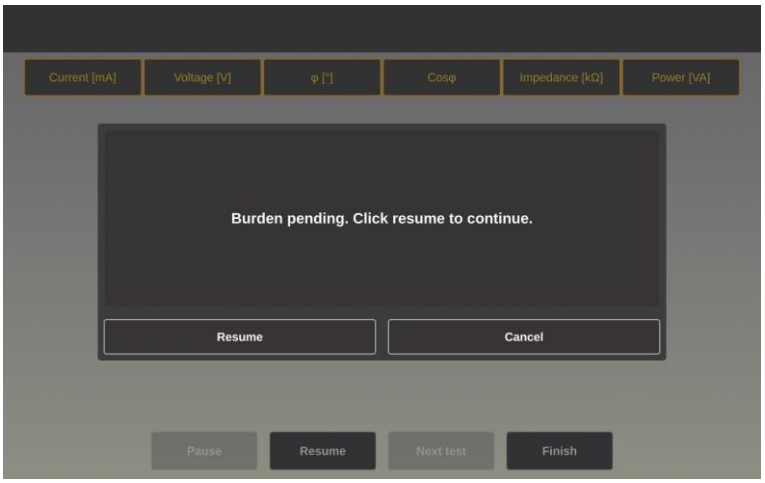


Figure 7-90. Burden test pending message

The burden test is completely automatic. During the test, the appropriate message is displayed on the screen (Figure 7-91).

Figure 7-91. Burden test in progress

When the burden test is completed, results are displayed on the screen (Figure 7-92).

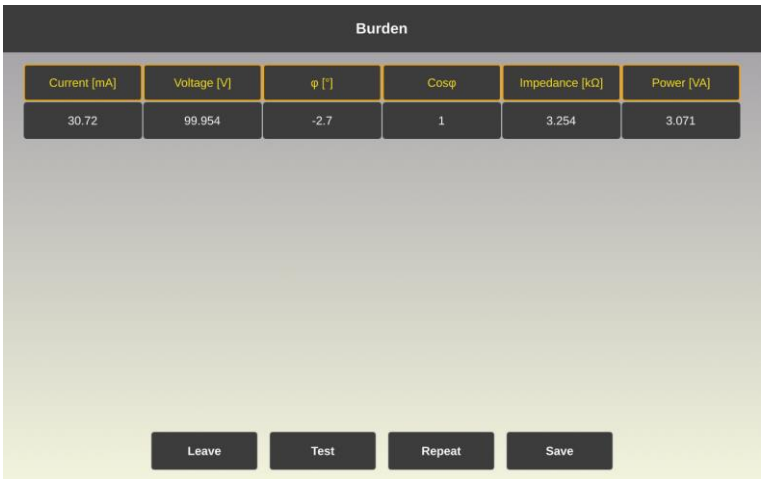


Figure 7-92. Burden test finished

7.3.4 Insulation Resistance Test

CVA500 can measure insulation resistance using test voltages of 500 V DC and 1000 V DC. The purpose of this test is to check the condition of insulation between conductive parts of a CVT.

CVA500 uses three output terminals for insulation resistance test – primary terminals (H1/S1 and H2/S2), secondary terminals (X1/S1, X2/S2, X3/S3, X4/S4, and X5/S5), and grounding terminal. During insulation resistance test, CVA500 primary terminals (H1/P1 and H2/P2) are short-circuited internally, and all CVA500 secondary terminals (X1/S1, X2/S2, X3/S3, X4/S4, and X5/S5) are short-circuited internally.

In the “Test type” screen, insulation resistance test should be selected (Figure 7-93).

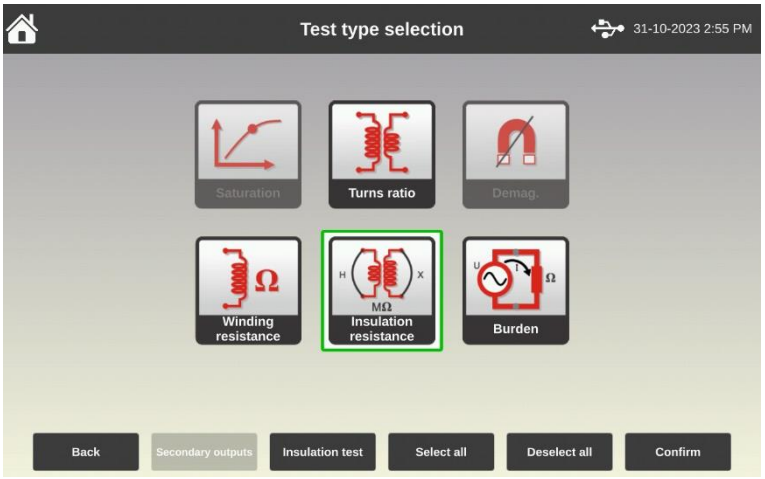


Figure 7-93. Insulation resistance test selected

By clicking the footer button “Insulation resistance”, a new screen is opened where it is possible to select insulation resistance tests that will be performed (Figure 7-94).

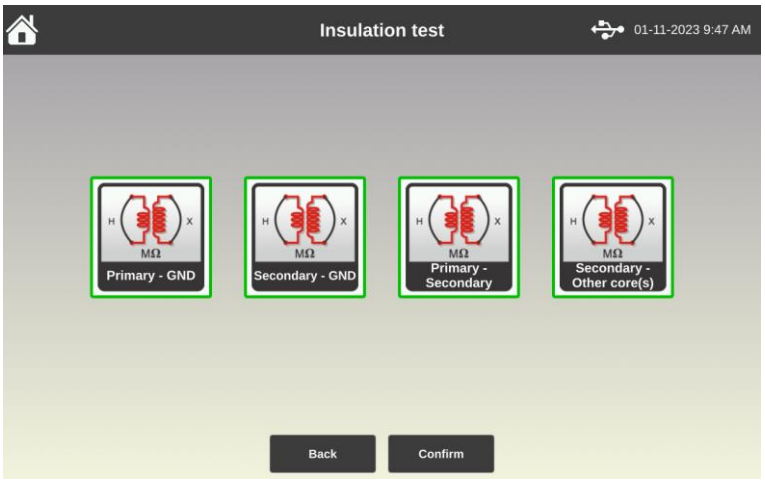


Figure 7-94. Selecting terminals between which insulation resistance is going to be measured

Normally, the insulation resistance is measured between:

1. Primary winding and secondary winding
2. Primary winding and ground
3. Secondary winding and ground
4. Secondary winding and other secondary winding(s), if CVT is multi-core type

It is possible to select one of these four options, some of them, or all four. If the 4th option is selected, then all other secondary windings should be externally shorted, and CVA500 grounding measurement terminal should be connected to that point.

For CVT insulation resistance test, it is necessary to select the test voltage. This is done in the “Test option” screen (Figure 7-95).

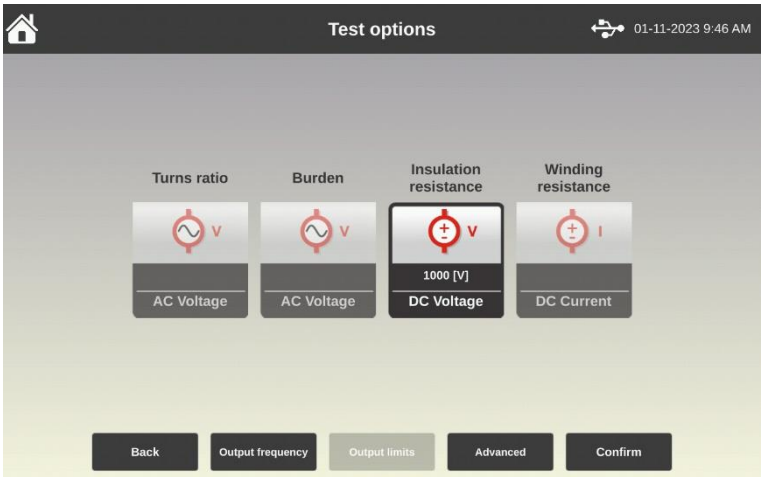


Figure 7-95. Selecting test voltage for insulation resistance test

When the test is started, or when this test is next to be performed in case of multiple tests selected, the user will be asked to confirm the test execution (Figure 7-96).

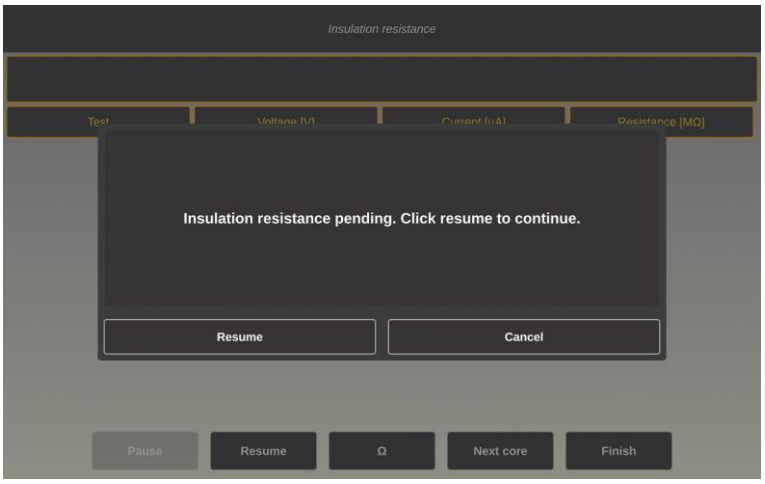


Figure 7-96. Insulation resistance test pending message

Insulation resistance test consists of two sequences:

1. Applying test voltage
2. Measuring insulation resistance

These two sequences are performed automatically, without any intervention from the user.

During the first sequence, CVA500 raises output DC voltage to a selected level. The appropriate message is displayed during this phase (Figure 7-97).

Figure 7-97. Applying test voltage for insulation resistance test

When the selected test voltage is applied, CVA500 automatically starts measuring insulation resistance (Figure 7-98). The insulation resistance is measured for up to 60 seconds. The measurement is refreshed every second.

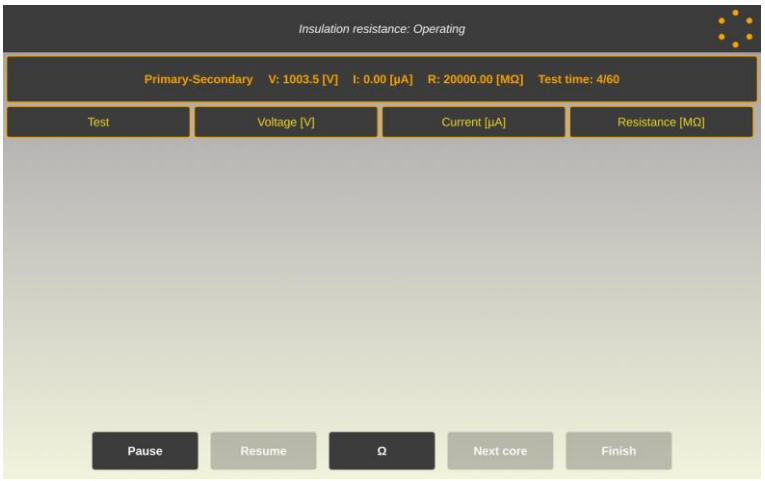


Figure 7-98. Measuring insulation resistance

Insulation resistance is measured either when a 60 second period elapses or when user presses the footer button “Ω” This is typically done when the insulation resistance reaches maximum possible value before 60 seconds. The last measured insulation resistance is taken as a result. When all selected insulation resistance tests are finished, results are shown (Figure 7-99).

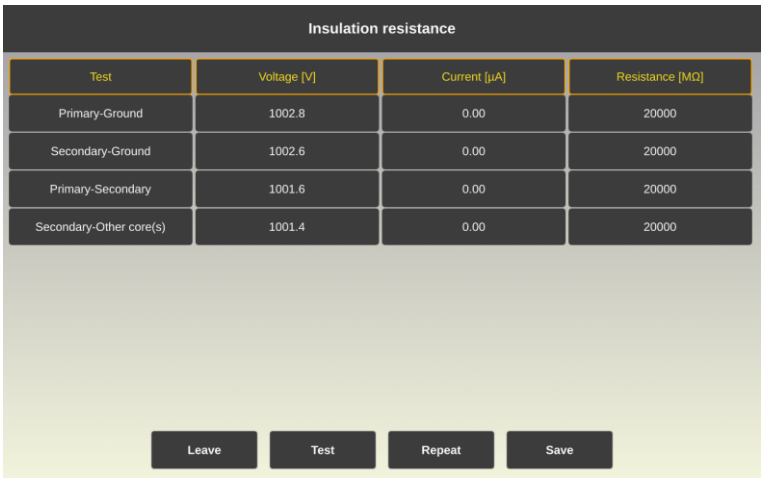


Figure 7-99. Insulation resistance test finished

8 Results

The “Results” menu, approached from the “Home” page, lists all results stored in the instruments’ memory.

Results can be highlighted and/or selected.

8.1 Highlighting Results

To highlight a result, click on its name. The highlighted result is marked with a green border and a white background. Only one result can be highlighted at a time. Figure 8-1 shows first result highlighted.

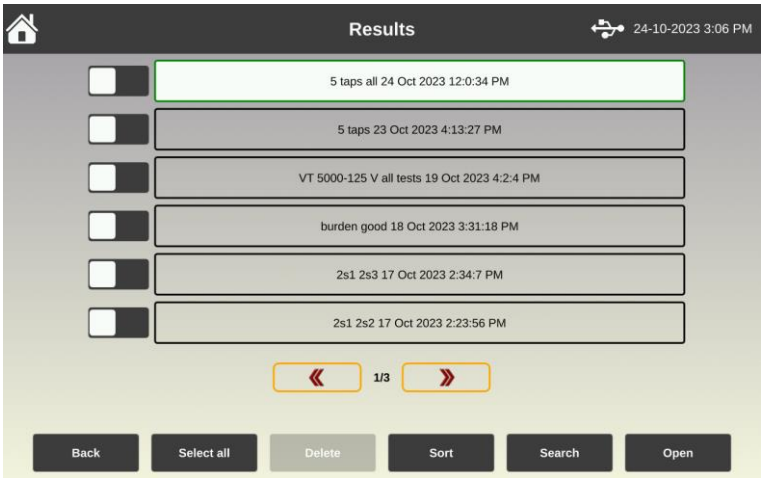


Figure 8-1. Results menu, first result highlighted

8.2 Selecting Results

To select a result, click the toggle button on the left side of the result. Multiple results can be selected at a time. Figure 8-2 shows the first test template selected.

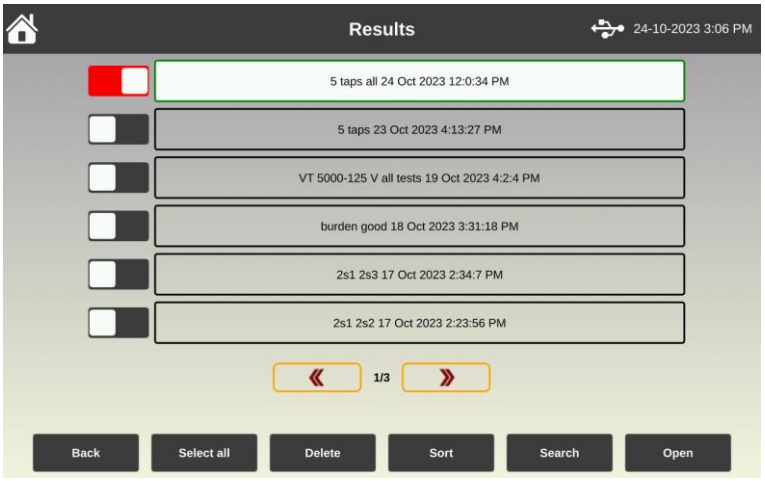


Figure 8-2. Results menu, first result selected

The following options are available using footer buttons:

- **Select all / deselect all** – selects or deselects all test results displayed on that page.
- **Delete** – deletes selected test result(s).
- **Sort** – sorts all results according to the selected criteria.

- **Search** – opens the appropriate search form according to the selected criteria.

8.3 Opening Results

To open a result, highlight it by clicking on its name. Press the footer button “Open”. The result will be opened, and results of first performed test will be displayed (Figure 8-3).

Figure 8-3. Opened result

One result may contain data obtained from all tests (winding resistance, turns ratio, saturation, burden, insulation resistance). To view results from different tests, press the footer button “Test”, and select desired test to view its results (Figure 8-4).

Figure 8-4. Changing result view

8.4 Exporting Results

Results can be exported to USB memory stick. To do so, first insert the USB memory stick in the CVA500’s USB flash drive port. When the USB stick is recognized by CVA500, the USB connection icon will appear in the right part of the header before the date and time. Open the result that should be exported and click the footer button “Export”. When the export is completed, an appropriate message will be displayed (Figure 8-5).

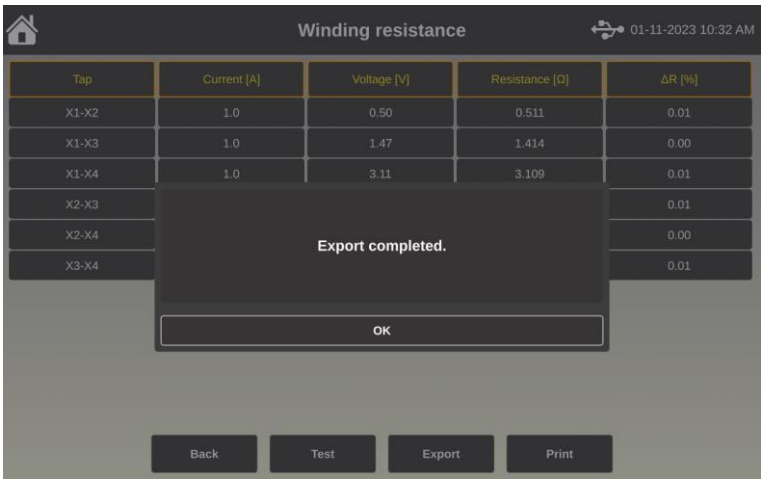


Figure 8-5. Result exported

If a USB memory stick is not inserted in the CVA500's USB flash drive port, or if it is not recognized by CVA500 instrument for any reason, the footer button "Export" will be inactive.

8.5 Printing Results

Results can be printed on a built-in thermal printer. To do so, open the desired result and click the footer button "Print". A new screen will be displayed, where users can filter what tests are going to be printed (Figure 8-6).

Figure 8-6. Print menu

Clicking the footer button "Taps", the new screen will be displayed (Figure 8-7). Here users can select if results for all taps or just for certain tap(s) will be printed.

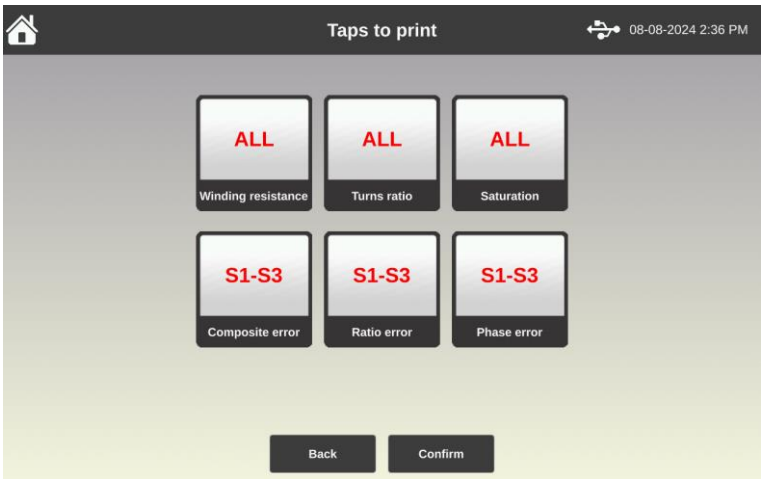


Figure 8-7. Selecting taps to print

The default settings are:

- All taps for winding resistance, turns ratio, and saturation results.
- Highest tap for composite error, ratio error, and phase error results

To change any of these, simply click the desired test, and a new screen will be displayed (Figure 8-8). Here users can (de)select tap(s) to be printed.

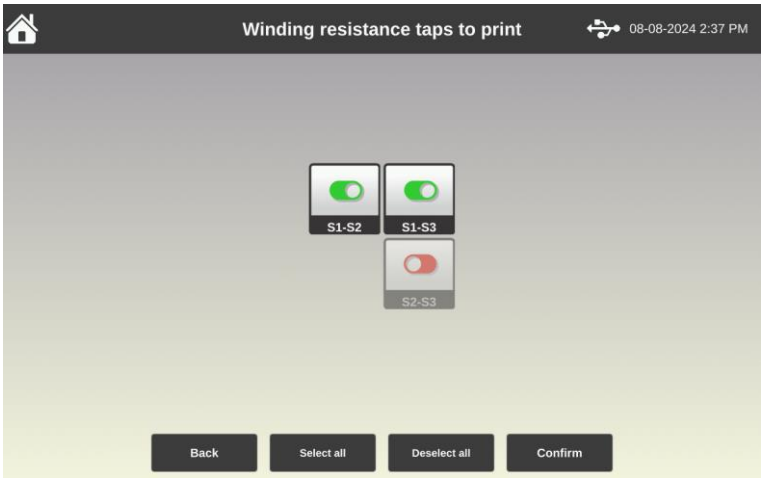


Figure 8-8. Selecting taps to print for individual test

Clicking the footer button “Graphs”, the new screen will be displayed (Figure 8-9). Here users can (de)select if saturation, ratio error, and phase errors graphs will be printed. All 3 graphs are selected by default.

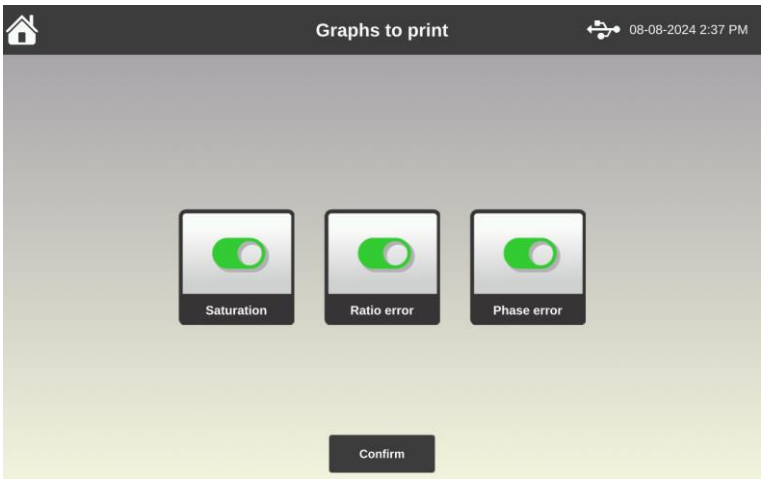


Figure 8-9. Selecting graphs to print

The CVA500 instrument will provide an appropriate message during the printing process (Figure 8-10).

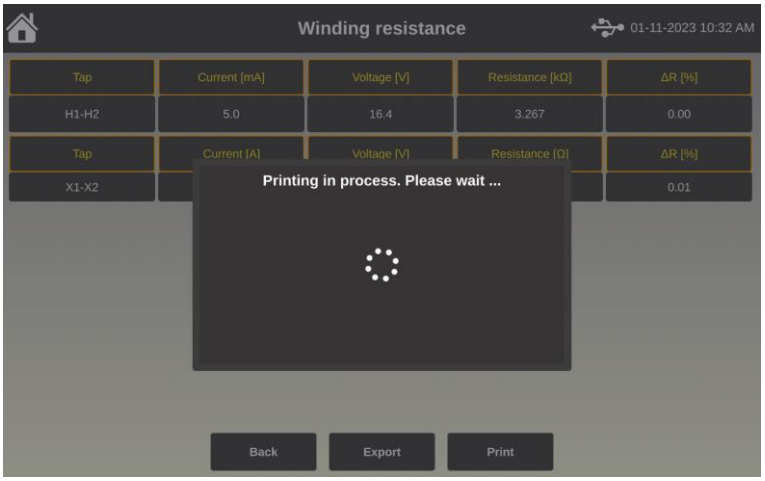


Figure 8-10. Printing in process

When the printing process is completed, the CVA500 instrument will provide an appropriate message (Figure 8-11).

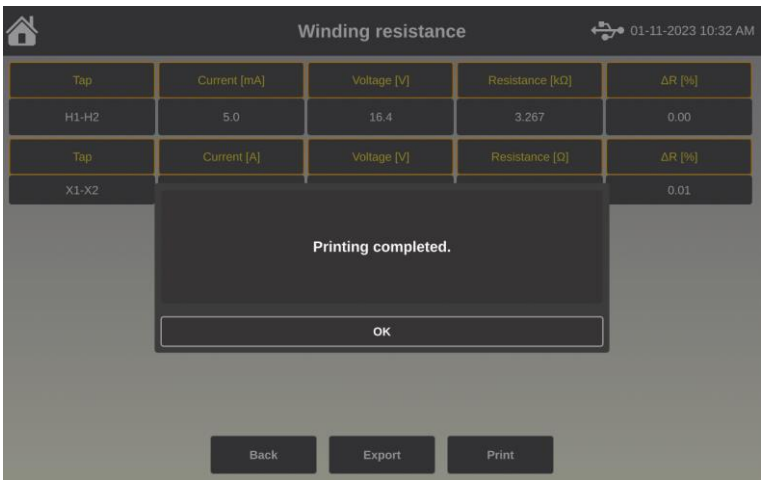


Figure 8-11. Printing completed

9 Error Messages

Any operational error is indicated on the instrument's screen. If two or more errors are detected at the same time, their codes are indicated on the instrument's screen. The list of errors and their associated codes is given below.

Table 9-1. List of error messages

Error message	Code	Description
Malfunction	10	Device malfunction.
Malfunction DC	11	DC module malfunctions.
Malfunction DCM1	12	
Malfunction DCM2	13	
Malfunction AC	14	AC module malfunctions.
Malfunction ACM1	15	
Malfunction ACM2	16	
Incorrect config	20	Incorrect test configuration.
Test start abort	21	Test not started.
Incorrect command parameter	22	Incorrect command parameters.
Winding resistance failed	31	Winding resistance test failed.
Insulation resistance failed	32	Insulation resistance test failed.
Demagnetization failed	33	Demagnetization test failed.
Saturation failed	34	Saturation test failed.
Turns ratio failed	35	Turns ratio test failed.
Burden test failed	36	Burden test failed.
Overcurrent AC	40	Overcurrent during AC test.
Overvoltage AC	41	Overvoltage during AC test.
Overvoltage LV AC	42	
Current limit AC	43	Current limit reached during AC test.
Voltage limit AC	44	Voltage limit reached during AC test.
Overload AC	45	Overload during AC test.
Overcurrent DC	50	Overcurrent during DC test.
Overvoltage DC	51	Overvoltage during DC test.
Change current DC	52	Selected DC current can't be reached. Repeat test with lower current.
Open connection	53	DC current can't be injected. There is open connection in the test circuit.
Circuit break AC	54	Test circuit broken during AC test.
Circuit break DC	55	Test circuit broken during DC test.
Polarity DC	56	Polarity of voltage sense cables is reversed, during DC test.
Emergency stop	60	Emergency stop button activated.

In case of any error message, please contact the DV Power Support Team (please refer to the "Manufacturer Contact Information" section).

10 Members Area

DV Power customers can create an account to get access to the DV Power Members Area. By creating the account with DV Power you get access to:

- Application notes
- Published articles

To create the account please visit DV Power page: dv-power.com/register/.

If you register a valid DV Power instrument, you will get access to:

- DV-TR software
- Manuals
- Troubleshooting guides

To register the instrument please log in and visit dv-power.com/register-new-product/. Your access will be granted after a verification process for which is normally one working day required.

If you require additional help during the process of registration, please contact us via e-mail support@dv-power.com.

11 Customer Service

Before calling or sending an e-mail to the DV Power Customer Service for assistance, please perform the following steps:

- Check all cable connections.
- If possible, try testing on another instrument of the same type.
- Provide the following information: instrument serial number, instrument's installed software revision number, details about a PC configuration used and operating system installed.
- As comprehensive as possible description of the problem, including DUT (Device Under Test), error messages and the sequence of events before the problem appeared.

The DV Power Customer Service can be reached at:

- Local support (Sweden): +46 8 731 78 24
- International support: +46 70 0925 000
- US support: +1 800 599 8113
- E-mail: support@dv-power.com, USAsupport@dv-power.com

The preferred contact is via e-mail. In this way the case is documented and traceable. Also, time zone problems and busy telephone lines do not delay the response.

12 Packing Instrument for Shipment

Prior to sending the instrument to DV Power for servicing, please contact the DV Power Customer Service at:

- Local support (Sweden): +46 8 731 78 24
- International support: +46 70 0925 000
- US support: +1 800 599 8113
- E-mail: support@dv-power.com, USAsupport@dv-power.com

for the return instructions.

DV Power is not responsible for any damage during shipping. Please carefully protect each instrument from shipping and handling hazards. Ensure the protective covers are securely in place. The instrument must be sent to DV Power as freight pre-paid unless other arrangements have been authorized in advance by the DV Power Customer Service.

To prepare the instrument for shipment:

- Disconnect and remove all external cables. Do not include manuals and cables unless recommended by the DV Power Customer Service.
- Reuse the original packing material if it is available.

If it is not available:

Pack the instrument following a practice used for fragile electronic equipment. It has to include a 2-wall minimum corrugated cardboard box with minimum 5 cm (2 inch) thick poly foam padding, or a wooden crate with minimum of 5 cm (2 inch) thick poly foam pads wrapping the instrument completely.

13 Technical Data

13.1 Mains Power Supply

- Connection: According to IEC/EN60320-1; UL498, CSA 22.2
- Input voltage: 90 – 264 V AC
- Input frequency: 50 or 60 Hz

13.2 Output

- AC test voltage (ratio and saturation test): Up to 2000 V AC
- AC test current (CT burden test): Up to 5 A AC
- AC test voltage (VT/CVT burden test): Up to 110 V AC
- DC test voltage (insulation resistance test): 500 V or 1000 V DC
- DC test current (winding resistance test): Up to 5 A DC

13.3 Turns Ratio Measurement

- Measurement range: 0.8 – 20000
- Resolution: 5 digits
- Typical accuracy:

@ > 500 V AC		@ 100 V ≤ 500 V AC		@ < 100 V AC	
0.8 – 2000:	±0.02%	0.8 – 2000:	±0.05%	0.8 – 2000:	±0.2%
2000 – 5000:	±0.03%	2000 – 5000:	±0.1%	2000 – 5000:	±0.4%
5000 – 20000:	±0.05%	5000 – 20000:	±0.2%	5000 – 20000:	±0.8%

- Guaranteed accuracy:

@ > 500 V AC		@ 100 V ≤ 500 V AC		@ < 100 V AC	
0.8 – 2000:	±0.05%	0.8 – 2000:	±0.2%	0.8 – 2000:	±0.5%
2000 – 5000:	±0.1%	2000 – 5000:	±0.3%	2000 – 5000:	±1%
5000 – 20000:	±0.2%	5000 – 20000:	±0.6%	5000 – 20000:	±2%

13.4 Phase Angle Measurement

- Measurement range: 0° – 360°
- Resolution: 0.01°
- Typical accuracy: ±0.05°
- Guaranteed accuracy: ±0.1°

13.5 Saturation (Knee Point Measurement)

- Voltage measurement range: 0 – 2100 V
- Voltage measurement resolution: 0.1 V
- Voltage measurement typical accuracy: ±0.05% @ ≥ 5 V
±0.5% @ < 5 V
- Voltage measurement guaranteed accuracy: ±0.1% @ ≥ 5 V
±1% @ < 5 V
- Current measurement range: 0 – 1 A / 10 A
- Current measurement resolution: 0.1 mA @ < 1 A
1 mA @ ≥ 1 A
- Current measurement typical accuracy: ±(0.05% rdg +0.05% FS)
- Current measurement guaranteed accuracy: ±(0.1% rdg +0.1% FS)

13.6 Winding Resistance Measurement (CT, VT, CVT Secondary Side)

- Measurement range: 0 – 999.9 Ω
- Resolution: 4 digits
- Typical accuracy: ±(0.2% rdg + 2 mΩ)
- Guaranteed accuracy: ±(0.4% rdg + 4 mΩ)

13.7 Winding Resistance Measurement (VT Primary Side)

- Measurement range: 0 – 99.99 kΩ
- Resolution: 4 digits
- Typical accuracy: ±(0.2% rdg + 2 Ω)
- Guaranteed accuracy: ±(0.4% rdg + 4 Ω)

13.8 Insulation Resistance Measurement

- Measurement range: 0 – 20 GΩ
- Range / resolution:

0 – 99.99 MΩ	0.01 MΩ
100.0 – 999.9 MΩ	0.1 MΩ
1000 – 20000 MΩ	1 MΩ

- Typical accuracy: ±(3% rdg + 0.2 per GΩ) @ 1000 V DC
±(3% rdg + 0.4 per GΩ) @ 500 V DC
- Guaranteed accuracy: ±(5% rdg + 0.4 per GΩ) @ 1000 V DC
±(5% rdg + 0.8 per GΩ) @ 500 V DC

NOTE: Declared insulation resistance accuracies are valid if leakage currents are minimized as much as possible. Test cables must be positioned completely in the air, without touching any other object (such as floor, ground, CVA500 device, test object, etc.). If this is not the case, measurement accuracy might be affected. The example of good and bad insulation resistance test cables positioning is shown in Figure 13-1 below.

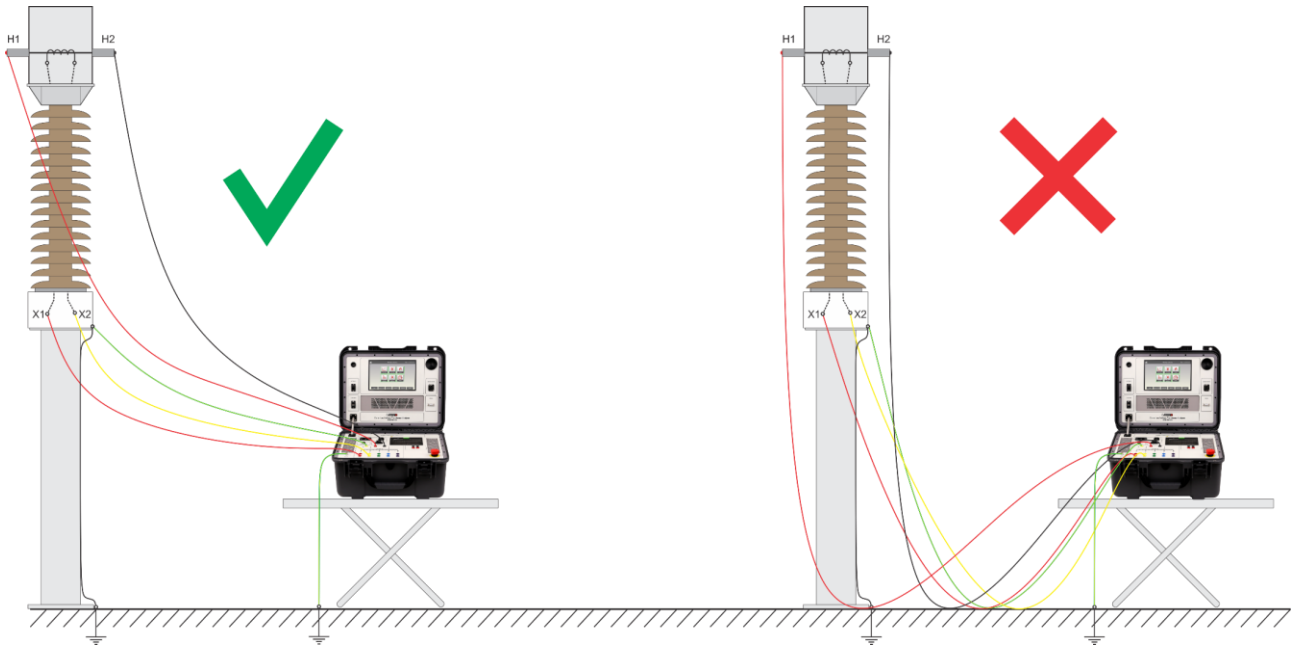


Figure 13-1. Insulation resistance test cables positioning

13.9 Burden Measurement (CT)

- Voltage measurement range: 0 – 45 V
- Voltage measurement resolution: 0.001 V
- Voltage measurement typical accuracy: ±0.05% @ ≥ 5 V
  ±0.5% @ < 5 V
- Voltage measurement guaranteed accuracy: ±0.1% @ ≥ 5 V
  ±1% @ < 5 V
- Current measurement range: 0 – 1 A / 7 A
- Current measurement resolution: 0.001 A
- Current measurement typical accuracy: ±(0.05% rdg +0.05% FS)
- Current measurement guaranteed accuracy: ±(0.1% rdg +0.1% FS)

13.10 Burden Measurement (VT, CVT)

- Voltage measurement range: 0 – 300 V
- Voltage measurement resolution: 0.001 V
- Voltage measurement typical accuracy: ±0.05% @ ≥ 5 V
±0.5% @ < 5 V
- Voltage measurement guaranteed accuracy: ±0.1% @ ≥ 5 V
±1% @ < 5 V
- Current measurement range: 0 – 1 A / 7 A
- Current measurement resolution: 0.01 mA
- Current measurement typical accuracy: ±(0.05% rdg +0.05% FS)
- Current measurement guaranteed accuracy: ±(0.1% rdg +0.1% FS)

13.11 Display

- 10.1” graphical touch screen display

13.12 PC Interface

- USB
- Ethernet

13.13 Internal Memory

- SD card 32 GB

13.14 Environmental Conditions

- Operating temperature -20 °C – +55 °C / -4 °F – +131 °F
- Storage temperature -40 °C – +70 °C / -40 °F – +158 °F
- Humidity 0% – 95% relative humidity, non-condensing

13.15 Dimensions and Weight

- Dimensions (W x H x D) 505 x 257 x 409 mm / 19.9 x 10.1 x 16.1 in
- Weight 20.5 kg / 45.2 lbs

13.16 Built-in Thermal Printer

- Paper width: 112 mm / 4.4 in
- Operating temperature -10 °C – +60 °C / 14 °F – +140 °F
- Storage temperature -20 °C – +70 °C / -4 °F – +158 °F
- Humidity 10% – 85% relative humidity, non-condensing

13.17 Applicable Standards

- Installation/overvoltage 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 °C (+77 °F) and standard accessories.
Specifications are subject to change without notice.

14 Accessories

Instrument	Article No
Multi-tap Current and Voltage Transformer Analyzer CVA500	CVA500X-N-W3

Included accessories	Article No
Built-in thermal printer 112 mm (4.4 in)	
Windows-based DV-TR PC software	
USB cable	
Ethernet cable	
Mains power cable	
Ground (PE) cable	
Debug adapter	
Plastic transport case with wheels	

Standard accessories	Article No
Primary side cables set 4 x 10 m (32.8 ft) with banana plugs	PR4-10-ABPBP
TTA clamps with banana plugs (red)	TTA-CL0-2RBP
TTA clamps with banana plugs (black)	TTA-CL0-2BBP
Dolphin clip (red)	DOLPIN-CL-R0
Dolphin clip (black)	DOLPIN-CL-B0
Secondary side cables set 10 x 5 m (16.4 ft) with banana plugs	S10-05-ABPBP
Cable lug adapter set	CABLE-LUG-10
Flex wire adapter set	WIRE-FLEX-10
Secondary side cables set 5 x 0.5 m (1.64 ft) with dolphin clips (Kelvin)	S05-0Z5-BPDC
Cable coupler set	CABLE-CPL-10
Grounding cable set 1 x 5 m (16.4 ft) with dolphin clip	GND1-05-BPDC
Burden cables set 2 x 5 m (16.4 ft) with dolphin clips (Kelvin)	BUR2-05-BPDC
Cable plastic case – small size	CABLE-CAS-01

Optional accessories	Article No
Safety strobe light with 5 m cable	SFTY-STRB-05
Thermal paper roll 112 mm (4.4 in)	PRINT-112-RO
Cable bag	CABLE-BAG-00
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

IBEKO Power AB 2024

Manufacturer Contact Information

IBEKO Power AB

Box:	1346, 181 25 Lidingö, Sweden
Fax:	+46 8 731 77 99
Local support (Sweden):	+46 8 731 78 24
International support:	+46 70 0925 000
E-mail:	support@dv-power.com
Website:	http://www.dv-power.com