

**MEGGER RELAY AND CURRENT TRANSFORMER TEST
INSTRUMENT
MRCT USER MANUAL**

**May 8, 2020
Part#82950R9**

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



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SAFETY PRECAUTIONS

WARNING:


VOLTAGES GENERATED BY THIS INSTRUMENT CAN BE HAZARDOUS

This instrument has been designed for operator safety; however, no design can completely protect against incorrect use. Electrical circuits are dangerous and can be lethal when lack of caution and poor safety practices are used. There are several standard safety precautions that should be taken by the operator. Where applicable, IEC safety markings have been placed on the instrument to notify the operator to refer to the user manual for instructions on correct use or safety related topics. Refer to the following table of symbols and definitions.

Symbol	Description
	Direct Current
	Alternating Current
	Both direct and alternating current
	Earth (ground) Terminal. There is a common chassis ground terminal located on the front panel (see Front panel under Description of Controls).
	Protective Conductor Terminal
	Frame or Chassis Terminal
	On (Supply)
	Off (Supply)
	Caution, risk of electric shock



Caution (refer to accompanying documents)

 **WARNING: Under no circumstances should the operator or technician attempt to open or service any Megger instrument while connected to a power source. Lethal voltages are present and may cause serious injury or death! SAFETY PRECAUTIONS (Continued)**

The following are some specific safety related items associated with the MRCT test system.

Read and understand all safety precautions and operation instructions before attempting to use this unit.

The purpose of this equipment is limited to use as described in this instruction manual. Should a situation arise that is not covered in the general or specific safety precaution please contact Megger regional representative or Megger, Dallas Texas.

Safety is the responsibility of the user. Misuse of this equipment can be extremely dangerous.

Always start with the power OFF, before connecting the power cord. Make sure outputs are off before attempting to make test connections.

DO NOT attempt to connect the test set to energized equipment.

DO NOT attempt to connect the test set to Current Transformers unless the Primary Side of the Current Transformer is grounded.

Always use properly insulated test leads. The optional test leads are rated for the continuous output ratings of the test system, and should be properly used and cared for. DO NOT use cracked or broken test leads.

Always turn the test system off before disconnecting the power cord.

DO NOT attempt to use the unit without a safety ground connected.

DO NOT attempt to use the unit if the power cord ground prong is broken or missing.

DO NOT use the test set in an explosive atmosphere.

The instrument must only be used by suitably trained and competent persons.

Observe all safety warnings marked on the equipment.

For safety related or other important topics, like the statement below, will be notated with the adjoined symbol. Read the topic carefully as it may relate either to the safe operation of the test system or the safety of the operator.



Under no circumstances should the operator put their hand or tools inside the test system chassis area with the test system connected to a power source. Lethal voltages are present and may cause serious injury or death!

WEEE

The crossed out wheeled bin placed on Megger products is a reminder not to dispose of the product at the end of its life with general waste.

Megger is registered in the UK as a Producer of Electrical and Electronic Equipment. The Registration No is WEE/HE0146QT

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1.0 STVI Introduction

STVI is a user friendly interface to control the **Megger MRCT** relay and current transformer test equipment. This manual contains the information that you will need in order to set up and use your STVI with the MRCT Test Systems. How the unit operates, some of the different types of testing you can do,

and how to save and view your test results with the Smart Touch View Interface software is described. It also covers running the STVI software using the PowerDB software on your PC.

Information regarding MRCT units can be found in the addendums.

1.1 Smart Touch View Interface



Figure 1 Smart Touch View Interface

1. **TFT LCD Color Display** – this 8.5 inch touch panel display provides high resolution, and features Wide Viewing Angle Technology with high luminance for reading in direct sunlight.
2. **Control Knob** – this knob will adjust values once the box location of the value to be changed is selected.



Figure 2 STVI Rear-View

3. **Built-in Foldout Stand** – the STVI may be operated as a handheld controller, or foldout the built-in stand and use a desktop controller.
4. **STVI Ethernet Port** – this Ethernet port is a 10/100BaseTX PoE (Power over Ethernet) port, and is the SMRT connection port.

5. **USB Interface** – the USB 2.0 Interface requires a Type A connector, and is primarily used as a communication and control port. A USB cable is not provided with the test set or in the optional accessories. For control of the SMRT, an Ethernet cable is provided since the STVI gets its power over the Ethernet cable. Even though the STVI has a built-in virtual keyboard, the user can use a USB keyboard with the STVI, as well as a mouse (including Logitech wireless mouse), keyboard and/or mouse are not provided with the accessories. The USB port is also used to update the firmware in the SMRT as well as update the software in the STVI using a USB memory stick. The STVI USB port does not support memory sticks larger than 2 GB. It may also be used to download test results from the STVI for download into another PC with Power DB software for storage or printing.

1.2 Terminology

The acronyms, terms, and definitions used throughout this manual are described below:

1.2.1 Acronyms

AC	Alternating Current
CW	Clockwise (rotation)
CCW	Counter Clockwise (rotation)
DC	Direct Current
GPS	Global Position System
GUI	Graphical User Interface
Hz	Hertz
ID	Identification
I/O	Input/Output
kHz	Kilo Hertz
LCD	Liquid Crystal Display
LED	Light Emitting Diode
MAG	Magnitude
PC	Personal Computer
ROM	Read-Only Memory
STVI	Smart Touch View Interface

USB	Universal Serial Bus
VIGEN	Voltage / Current Generator Module
VRMS	Volts Root Mean Square
UUT	Unit Under Test

1.3 Power Over Ethernet Input Power

The STVI gets Power Over Ethernet (PoE) of 48 Volts DC at 0.5 A from the MRCT.



CAUTION:

NOTE: The PoE power supply DC voltage is ON when the power supply is connected to a power source. Connect the Ethernet cable to the Data & Power Out port of the PoE power supply to the STVI Ethernet port prior to connecting to a power source.

2.0 MRCT with INTEGRATED DISPLAY

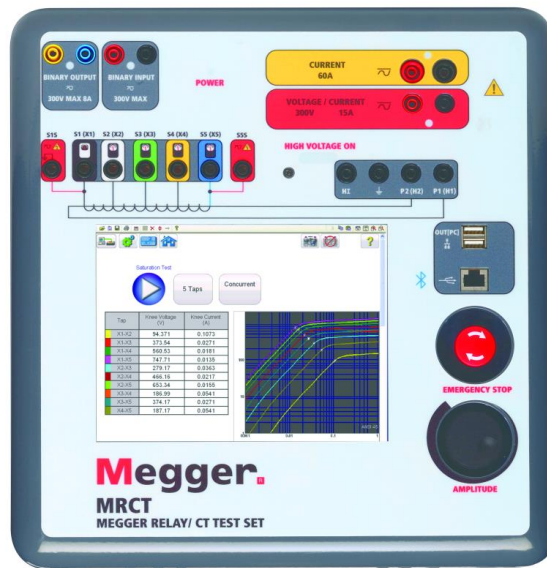


Figure 3 MRCT with Integrated Display

The MRCT can also be ordered with an integrated display instead of using the STVI to control the unit. The MRCT will have an 8.5 inch TFT LCD Color Display – this touch panel display provides high resolution, and features Wide Viewing Angle Technology with high luminance for reading in direct sunlight. The

control knob typically located on the STVI is located on the front panel. During manual testing this knob will adjust values once the box location of the value to be changed is selected.

3.0 SETUP

3.1 Unpack System

Unpack the unit and check for evidence of any shipping damage. If there is any visual damage, immediately notify the freight carrier to make a damage claim, and notify Megger of the damage.

3.1.1 Initial Start Up

1. If the unit was ordered with an STVI, using the Ethernet cable supplied with the unit connect the STVI Ethernet Port on the MRCT unit to the Ethernet port on the top of the Smart Touch View Interface (STVI).
2. Before connecting power to the unit, make sure the MRCT POWER ON/OFF Switch is in the OFF position (0). Plug the unit line cord into an appropriate power source and turn the POWER ON/OFF Switch to ON (I). As the MRCT unit goes through its power up sequence, in about a minute the STVI power up screen will appear, then the test configuration screen will appear.

3.2 Communication Ports

There are two types of communication ports on the STVI, one Ethernet, and two USB ports.

3.2.1 Ethernet Port

There is one Ethernet port on the STVI for connecting to the MRCT units. On the MRCT the port is labeled STVI. For the MRCT it connects to the PoE power supply unit, and the PoE unit is connected to the PC/IN port on the MRCT



Figure 4 STVI port on MRCT

3.2.2 USB 2.0 Interface

There are two USB 2.0 Interface ports on the STVI unit. These ports are used for upgrading firmware to the MRCT unit, or upgrading the STVI software using a USB Memory Stick. They may also be used in conjunction with a USB mouse for ease of manual control, even a USB wireless mouse maybe used with the STVI.

Ethernet Port is a 10/100BaseTX port, and is the primary PC connection port. This port supports MDI/MDI-X auto cross over configuration, which means both standard and “crossover” Ethernet cables may be used. The SMRT comes standard with a crossover cable. This port may also be used to interconnect multiple SMRT units together for synchronous multi-phase operation.

3.3 Smart Touch View Interface

Depending on how the unit was ordered, the MRCT can be controlled using the integrated display, an STVI, or a personal computer using PowerDB Lite software. All three of these methods of control will have the same user interface in the software and this will be outlined throughout.

For units being controlled with the integrated display or the STVI, the system will perform several self checks upon power up. Once these checks are complete the Introduction Screen will appear, see the following figure.

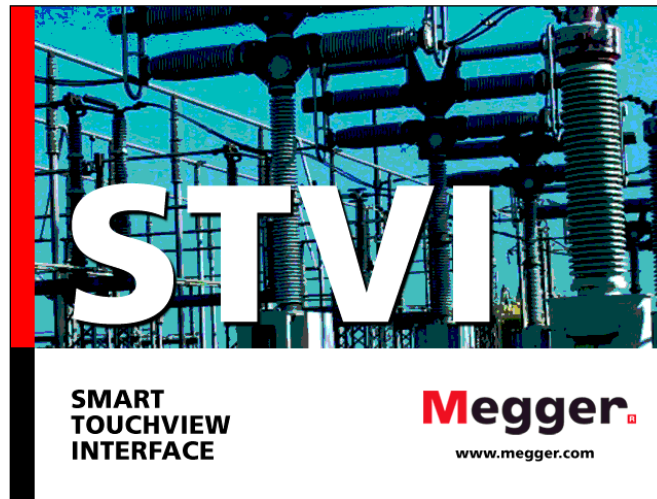
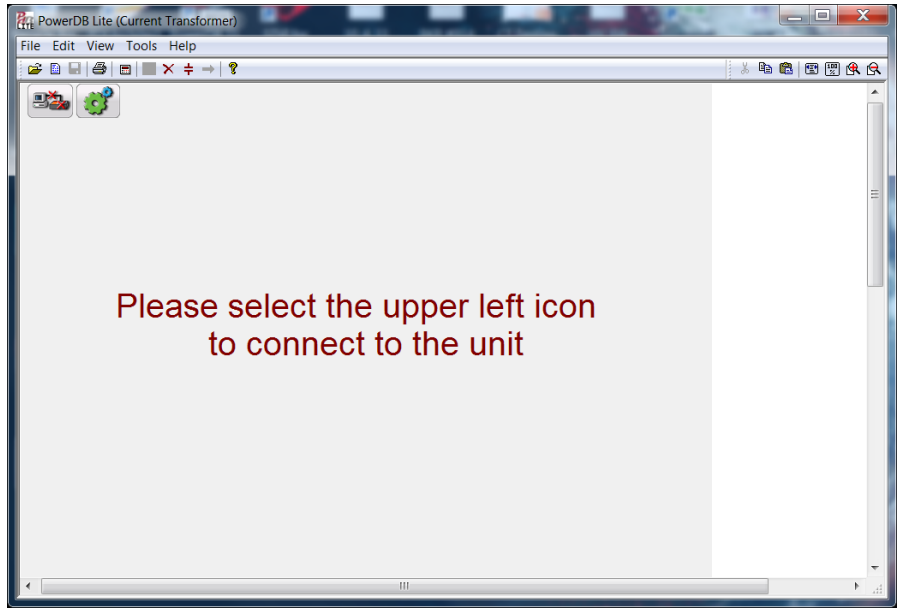


Figure 5 Introduction Screen

Shortly afterward the screen will change to the instrument connection screen if the MRCT is being controlled with either an STVI or a laptop.



The user should select the connection icon in the top left corner to connect to the MRCT. The user will then be brought to the "Home Screen". If the MRCT has an integrated display, after powering up the MRCT, the user will be brought to the "Homes Screen" automatically. The MRCT can be configured from several different modes of testing such as CT, VT, CVT, and Relay. Any testing mode that was configured at the factory will be available by selecting the buttons along the top of the screen. Any mode of testing that was not configured will be greyed out and unavailable. Different modes of testing can be enabled at any time so please contact the factory if you wish to add any testing configuration

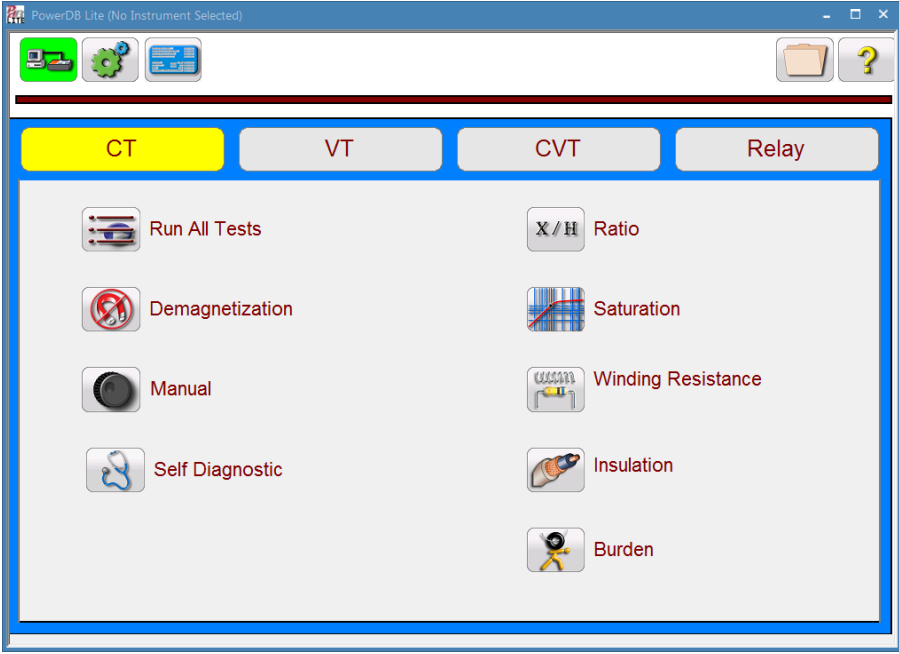
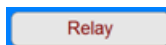
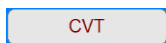
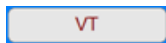


Figure 6 Boot Up Home Screen

From Home screen the user can navigate to the desired test screen. Set the testing mode of the MRCT by selecting one of the following button



After setting the desired mode, all individual test screens for the desired mode of testing as well as the settings for the unit can also be accessed from this screen. By pressing the navigation buttons on this screen, one can select the desired operation. Following are the user selectable operations.

The following operations are available across all modes of testing with the MRCT



Device Connection



Device Settings



Name Plate Information

The following operations are available when the MRCT is in CT testing mode



Run All Test s



Manual Test



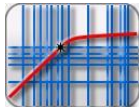
Demagnetization



“Self Diagnostic”



Relay



Saturation Test



Ratio Test



Winding Resistance Test



Insulation Test



Burden Test



User Help

The following operations are available when the MRCT is in Basic VT testing mode



Run All Tests



Demagnetization



“Self Diagnostic”

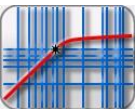


VT Ratio Test



VT Secondary Winding Resistance Test

Additional operations available when the MRCT is in Advanced VT testing mode



VT Saturation Test



VT Secondary Short Circuit Impedance Test

The following operations are available when the MRCT is in CVT testing mode



CVT Ratio Test

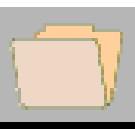
The following navigation buttons will appear in the home screen after a test has been completed and test data is available



View Test Report



Delete Test Data



File Manager

Refer to each menu item below for detailed description

3.3.1 STVI Menu Items

3.3.1.1 Device Connections



Selection of  Device Connection button will initialize the connection of a PC to the MRCT

3.3.1.2 Device Settings for CT Testing



Selection of  Device Settings, brings the user the following screen.

Saturation Standard ANSI 45	Show Connection Diagrams	Default Settings Options
Color Options	Knee Prediction Enabled	Update Firmware
Tolerance Setting	Leads Check Enabled	Display Versions
Ratio Error On Primary Current	Nameplate Estimate Disabled	Language (AmericanEnglish)
Default Ratio/Phase Error Table ANSI/IEC	Default Number of Taps 5	Primary Noise Filtration Disabled
Report and Assessment	Use Binary Input As Stop Disabled	Show Exc Curves As Generated
Asset Owner	Saturation / Demag method	Logging
Set Date & Time	Meter AC	Set Logos
Number Format	Protection AC	Adjust Screen Brightness
	Unspecified AC	

Ethernet:

Max AC Test Voltage (V):

Min. Fan Speed %

Saturation Curve Ramp Rate:

Figure 7 CT Device Settings

Within this screen all device settings are accessible. By selecting the appropriate button, the user can:

- Saturation Standard: Select between ANSI 45, ANSI 30, IEC 60044-1, IEC6044-6, or IEC61869
- Color Options: Select the desired colors for Background color, Grid color, Label color, Knee Marker color, and Saturation traces
- Tolerance Settings: Displays the ratio and phase error limits specified by either ANSI or IEC

- **Ratio Error on Primary/Secondary Current:** Allows user to select whether the ratio error is displayed on Primary Current (101:5) or displayed on Secondary Current (100:4.99)
- **Report and Assessment:** Allows the user to customize the report. He can select whether or not to display the ratio and phase error tables, the parallelograms, and whether or not to include an assessment
- **Default Ratio/Phase Error Table** Sets the MRCT's default ratio/phase error table format in the report to either ANSI/IEC or Indian
- **Asset Owner** Sets the asset owner in the report
- **Set Date Time** Change the time and date stored in the MRCT. This option is only Available on MRCT with integrated display
- **Show Connection Diagrams:** Allows user to turn off the functionality showing connection Diagrams before each test. This is not recommended because of safety concerns.
- **Knee Prediction Enabled/Disabled:** Allows the user to enable and disable the knee point prediction algorithms. If the user enters the nameplate information, the MRCT will use this information to predict the knee point of the CT which can reduce testing time.
- **Lead Check** Enables and disables the lead checking algorithms
- **Nameplate Estimate** Enables and disables the algorithms that estimate a CTs: ratio, accuracy class, VA and burden rating
- **Use Binary Input as Stop** Enables and disables the algorithms that monitor the binary IO ports and shuts down unit
- **Default Number Taps** Sets the number of taps that the MRCT will select by default. Set to 2 or a single ratio if the user primarily tests single ratio CTs
- **Saturation/Demag Method** If the MRCT has been configured to test with both AC and DC during the excitation test, the user can select which method is preferred for each class of CT be it either metering class, protection class, or an unknown class. In AC Saturation mode

the MRCT will utilize up to 2000 V AC to saturate the CT. In DC saturation mode the MRCT will utilize DC voltage to saturate CT's up to 30 kV and then convert testing results into AC equivalent.

- Languages: Select between American English, International English, Spanish, French, and German, Turkish
- Number Format Select between U.S. and International number formatting.
- Default Settings Options: Save changes made to defaults, restore defaults, or restore factory defaults
- Upgrade Firmware: Upgrade firmware for the MRCT or the STVI
- Display Versions: View all Software and hardware versions of the device.
- Primary Noise Filtration Enables and disables a primary noise filtration algorithm. This should only be used in very noisy environments where accurate results cannot be obtained. If used in a non noisy environment this algorithm can reduce the accuracy of the unit by approximately +/- 0.05%
- Show Excitation Curves as Generated Toggles between modes that "Shows Excitation Tests As Generated" and "Quick Test Mode". This quick test mode will perform 3 tests (Excitation, Ratio, and Winding Resistance) in a significantly reduced test time. During Quick Test mode only a progress bar will be displayed during tests. All results will be shown in report after all tests complete.
- Logging: Enable logging, clear all log files, or copy log files to USB
- Set Logos Sets the Logo for the report. Users bmp or jpeg file must be stored in specified location
- Adjust Screen Brightness: Change the screen brightness using the manual control knob. This option is only available on MRCT with integrated display
- Ethernet: Enable and disable DHCP
- Max Test Voltage: Set the maximum voltage the MRCT will output during a saturation test

- **Saturation Curve Ramp Rate:** Allows user to speed up and slow down the rate at which the voltage is increased during the saturation test. The default is “1” which sets the speed to normal. By entering a number less than 1, the ramp rate will be decreased. For example entering “0.4” will reduce the normal voltage increment by 60%. This feature can be very useful when a CT saturates very quickly with minimal voltage increases
- ❖ Please note that certain device settings will only be available for manipulation if the user is running the PowerDB application on an STVI (Smart Touch View Interface). These settings include: Number Format, Adjust Screen Brightness, Set Date & Time, and Logging. If the application is running on a standard PC or laptop then these settings are adjusted within the PC’s operating system such as Windows.

3.3.1.3 Device Settings for VT and CVT Testing



Selection of Device Settings, brings the user the following screen.

Standard IEC	Show Connection Diagrams	Default Settings Options
Color Options	Knee Prediction Enabled	Update Firmware
Tolerance Setting	Leads Check Enabled	Display Versions
Ratio Error On Primary Current	Nameplate Estimate Disabled	Language (AmericanEnglish)
Default Ratio/Phase Error Table ANSI/IEC	Default Number of Taps	Primary Noise Filtration Disabled
Report and Assessment	Use Binary Input As Stop Enabled	
Asset Owner		Logging
Set Date & Time		Set Logos
Number Format		Adjust Screen Brightness
Ethernet: DHCP		
Max AC Test Voltage (V):	2,000	
Min. Fan Speed %	50	Saturation Curve Ramp Rate: 1

Figure 8 VT and CVT Device Settings

Within this screen all device settings that are available to the specified mode of testing are accessible. By selecting the appropriate button, the user can:

- Standard: Select between ANSI and IEC
- Color Options: Select the desired colors for Background color, Grid color, Label color, Knee Marker color, and Saturation traces
- Report and Assessment: Allows the user to customize the report. He can select whether or not to display the ratio and phase error tables, the parallelograms, and whether or not to include an assessment
- Asset Owner Sets the asset owner in the report
- Set Date Time Change the time and date stored in the MRCT. This option is only Available on MRCT with integrated display
- Show Connection Diagrams: Allows user to turn off the functionality showing connection Diagrams before each test. This is not recommended because of safety concerns.
- Lead Check Enables and disables the lead checking algorithms
- Languages: Select between American English, International English, Spanish, French, and German, Turkish
- Number Format Select between U.S. and International number formatting.
- Default Settings Options: Save changes made to defaults, restore defaults, or restore factory defaults
- Upgrade Firmware: Upgrade firmware for the MRCT or the STVI
- Display Versions: View all Software and hardware versions of the device.
- Primary Noise Filtration Enables and disables a primary noise filtration algorithm. This should only be used in very noisy environments where accurate results cannot be obtained. If used in a non noisy environment this algorithm can reduce the accuracy of the unit by approximately +/- 0.05%
- Logging: Enable logging, clear all log files, or copy log files to USB
- Set Logos Sets the Logo for the report. Users bmp or jpeg file must be stored in specified location

- **Adjust Screen Brightness:** Change the screen brightness using the manual control knob. This option is only available on MRCT with integrated display
- **Ethernet:** Enable and disable DHCP
- **Max Test Voltage:** Set the maximum voltage the MRCT will output during a saturation test
- **Saturation Curve Ramp Rate:** Allows user to speed up and slow down the rate at which the voltage is increased during the saturation test. The default is “1” which sets the speed to normal. By entering a number less than 1, the ramp rate will be decreased. For example entering “0.4” will reduce the normal voltage increment by 60%. This feature can be very useful when a CT saturates very quickly with minimal voltage increases
 - ❖ Please note that certain device settings will only be available for manipulation if the user is running the PowerDB application on an STVI (Smart Touch View Interface). These settings include: Number Format, Adjust Screen Brightness, Set Date & Time, and Logging. If the application is running on a standard PC or laptop then these settings are adjusted within the PC’s operating system such as Windows.

3.3.1.4 Nameplate Information CT Testing



Selection of

Name Plate Information, brings the user to the following screen

Figure 9 CT Name Plate Data

Nameplate page is used to fill out the Name plate data of CT under test.

- No of CTs
- No of Cores
- Number of Taps
- CT Label
- CT Name
- Manufacturer: By touching the screen in this location a keyboard will appear that will allow the user to enter the manufacturer of the CT.
- Serial No: Use the virtual keyboard to fill CT serial no. from the nameplate of the CT under test.
- Asset ID: ID can be obtained from CT nameplate.
- Phase
- Metering or Relaying: Select the type of CT. Selection of the type of CT affects the performance of the excitation test. Typically a metering class CT will saturate and thus have a knee point of less than 30V. So in order to gather enough data points to calculate the knee point, if the type of CT is set to “Metering” the MRCT will increment the voltage during the excitation by $\frac{1}{2}$ V increments. Conversely a relaying/protection class CT will saturate at much higher voltage levels. So if the type of CT is set to “Relaying” the MRCT will increase voltage increment with each subsequent step until the knee point is reached. This allows the MRCT to reduce the number of data points and thus the testing time of relaying class CT. Please note that if the type of CT is unknown then it is best to omit this selection. For if the type of CT is unknown then the MRCT will increment the voltage by $\frac{1}{2}$ V up to 30 V and then begin increasing the voltage increment until the knee point is reached.

- Saturation Standard: Select which standard should be followed during the saturation test: either ANSI45, ANSI30, IEC 60044-1, IEC 60044-6, or IEC 61869-2 Accuracy Class: Use the drop down menu to select the CT accuracy class from available options such as

a) C10	h) T10
b) C20	i) T20
c) C50	j) T50
d) C100	k) T100
e) C200	l) T200
f) C400	m) T400
g) C800	n) T800
- VA
- Burden
- Actual Burden: Specify the actual measured burden connected to the CT and the ratio accuracies for the specified burden will be included in the ratio/phase error tables Buried CT in Delta Connection: The CT ratio is measured as $\text{ratio} = V_x/V_h$. However since the induced voltage measured through the H terminals of a Delta winding is $V = 2/3V_h$. Thus the measured ratio is $3/2$ higher than actual ratio. By checking this box when the CT under test is in a delta configuration, the MRCT will display the correct ratio by reducing measured ratio by $2/3$
- Simulated Primary Lead Swap: Rotates the phase calculation in the report by 180 degrees
- In Service Tap: Sets the in service tap designation in the report
- Ratio: For a multi- tap CT, different tap ratios can be obtained from nameplate and can be entered in nameplate screen. By entering these four ratios the MRCT will auto-determine all interior ratios and use these values when calculating ratio errors
- User Descriptions and Values are used to fill out the optional testing information such as
 1. Technician name,
 2. Company information,
 3. Substation location,
 4. Position and phase of CT
 5. type of CT - Bar Type or Window Solid Core
 6. Other relevant testing data.

Note: All the information in Nameplate screen is optional. It is not required to perform a test on CT. However by inputting proper data a more complete report can be generated.

3.3.1.5 Nameplate Information VT or CVT Testing


Selection of  Name Plate Information, brings the user to the following screen

Figure 10 VT & CVT Nameplate Data

Nameplate page is used to fill out the Name plate data of CT under test.

- No of VTs
- No of Windings
- Number of Taps
- VT Label
- VT Name
- Manufacturer: By touching the screen in this location a keyboard will appear that will allow the user to enter the manufacturer of the VT.
- Serial No: Use the virtual keyboard to fill VT serial no. from the nameplate of the VT under test.
- Asset ID: ID can be obtained from VT nameplate.
- Phase
- Metering or Relaying: Select the type of VT. Selection of the type of VT affects the performance of the excitation test. .
- Standard: Select which standard should be followed during the tests: either ANSI or IEC
- Accuracy Class: Use the drop down menu to select the VT accuracy class from available options such as

a)	0.3	h)	3P
b)	0.6	i)	6P
c)	1.2		

- VA : VA rating of VT
- Burden : Inputting the VA rating of the VT will default the Burden rating of the VT such as W, X, M, Y or ZZ
- Primary Voltage
- Check box for Primary voltage to be divided by Square root of 3
- Secondary Voltage
- Check Box for secondary voltage to be divided by either /Sq root 3 or /3
- Ratio: For VT, by entering both the Primary Voltage and the Secondary Voltage the unit will auto fill the ratio box or the value can be obtained from the nameplate
- User Descriptions and Values are used to fill out the optional testing information such as
 7. Technician name,
 8. Company information,
 9. Substation location,
 10. Position and phase of CT
 11. type of CT - Bar Type or Window Solid Core
 12. Other relevant testing data.

Note: NOT All the information in Nameplate screen is optional. Some information such as the rated Secondary Voltage and the VA rating of the VT is required in order for the unit to perform a test on VT. Input of proper data will prevent the unit from outputting a voltage or current during the test that could damage the VT

3.3.1.6 Home Screen

If using a PC, the user should select the connection icon in the top left conner to connect to the MRCT. The user will then be brought to the “Home Screen”. If the MRCT has an integrated display, after powering up the MRCT, the user will be brought to the “Homes Screen” automatically. The MRCT can be configured for several different modes of testing such as CT, VT, CVT, and Relay. Any testing mode that was configured at the factory will be available by selecting the buttons along the top of the screen. Any mode of testing that was not configured will be greyed out and unavailable. Different modes of testing can be enabled at any time so please contact the factory if you wish to add any testing configuration

From Home screen the user can navigate to the desired test screen. Set the testing mode of the MRCT by selecting one of the following button

CT

VT

CVT

Relay

After setting the desired mode, all individual test screens for the desired mode of testing as well as the settings for the unit can also be accessed from this screen. By pressing the navigation buttons on this screen, one can select the desired operation. Following are descriptions of the different testing modes available.

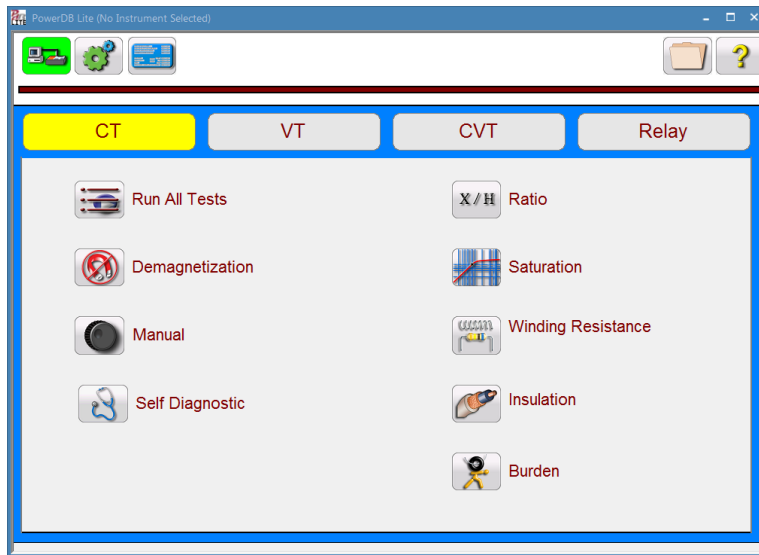


Figure 11 Home Screen

4.0 CT Testing Functions

4.1 Run All Tests



Selection of Run All Tests button will bring the user to the Test Configuration screen

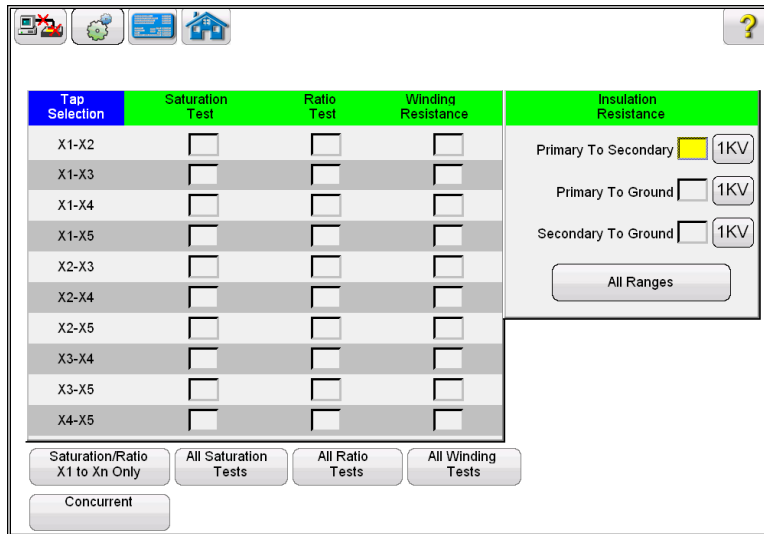


Figure 12 Run All Test Screen

The user can easily configure a test plan for a current transformer by checking the box adjacent to the desired test of the desired tap. The various buttons at the bottom of the screen can also be used to easily configure a test:

**Saturation/Ratio
X1 to Xn Only**

Used to auto select Saturation and Ratio Test on all external taps. Uses nameplate "Number of Taps" to configure

**All Saturation
Tests**

Used to auto select Saturation Test on all taps

**All Ratio
Tests**

Used to auto select Ratio Test on all taps

**All Winding
Tests**

Used to auto select Winding Resistance Test on all taps

Concurrent

**Non-
Concurrent**

Used to toggle between Concurrent Testing of all taps and testing tap individually.

All Ranges

500V

1KV

Button used to toggle insulation test between 1KV and 500V

4.2 Manual Test



Selection of the Manual Test Button, will bring the user to the following Manual Test Screen.

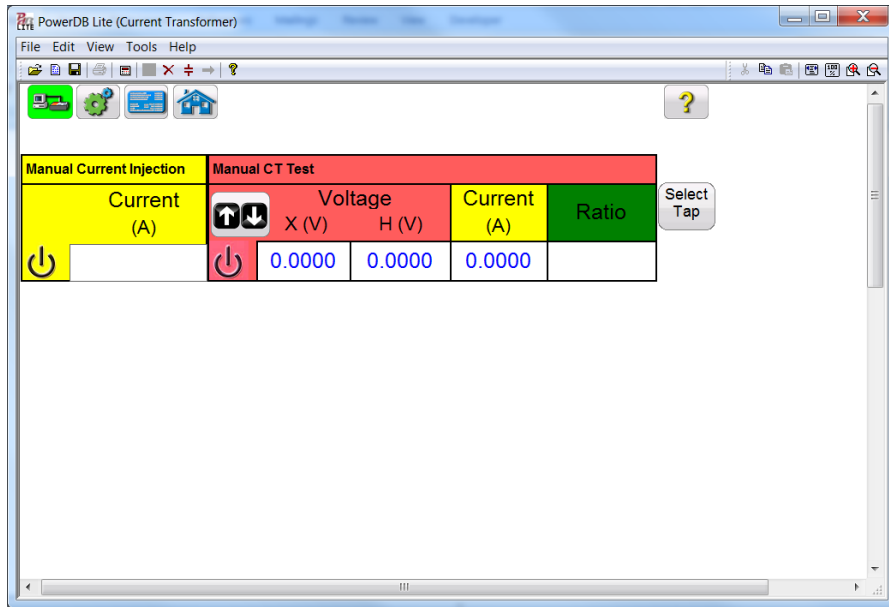
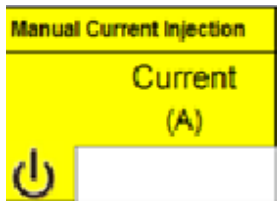



Figure 13 Manual Test Screen

Within the Manual Test Screen the user has the options of performing various operations from injecting current into a load to manually testing the ratio and saturation point of a CT.

Current Injection: If the MRCT has been ordered with the “Relay Testing” option then the Manual Current Injection screen will be available. To inject current into any load, the user must enter the desired current level into current box.



Then selecting the ON button  on the touch screen the MRCT will first display a connection diagram. Once the user verifies the connection, by selecting the blue play button the MRCT will output the specified current level

Ratio Testing; To manually test the ratio of a CT the user is required to first select which individual tap is desired



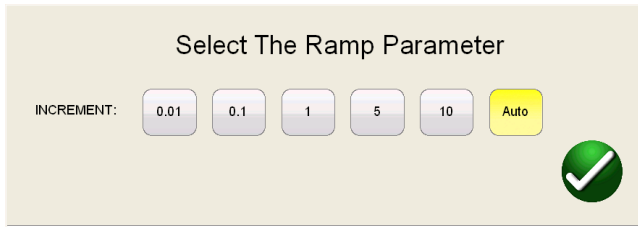
Hitting the select tap button will activate the tap selection dialog




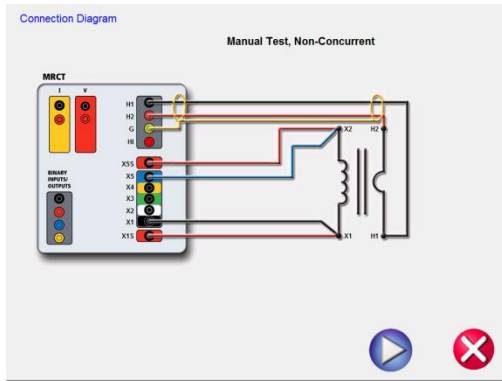
After selection of the desired individual tap selection, the user may adjust the voltage increment selecting the Ramp adjustment button



This will activate the ramp parameter dialog allowing the user may select the amount of increment the voltage is either decreased or increased by turning the knob on the STVI or the up/down arrow keys on a laptop



After the desired tap selection is made and any adjustments made to the ramp parameter, the user must select the ON button.  to begin the test. At this time a connection diagram will be displayed. Once the user has verified proper connections, the test is continued by selecting the blue play button on the connection diagram.



After the MRCT has begun to inject voltage, the voltage and current readings will be displayed along with the calculated ratio. In order to ensure accurate results on the ratio, the voltage should be ramped to a level of at least 10% of the value of the knee point of the CT. The readings should also be allowed to stabilize.

Running Manual CT Test					
Manual Current Injection	Manual CT Test		X1-X2		
Current (A)	Voltage X (V)	H (V)	Current (A)	Ratio	
	1.0000	0.0500	1.0000	100:5	

Up to 14 points can be saved

Manual Saturation Test: To manually run a Saturation test on a CT the user is required to first select which individual tap is desired



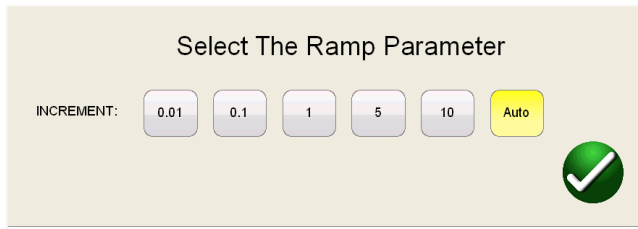
Hitting the select tap button will activate the tap selection dialog




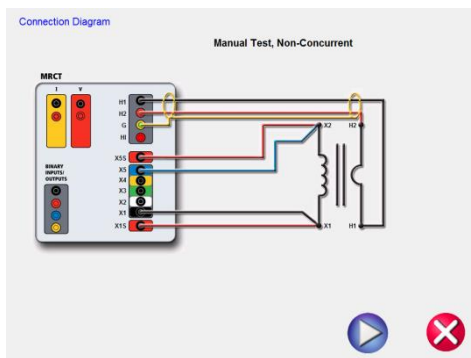
After selection of the desired individual tap selection, the user may adjust the voltage increment selecting the Ramp adjustment button



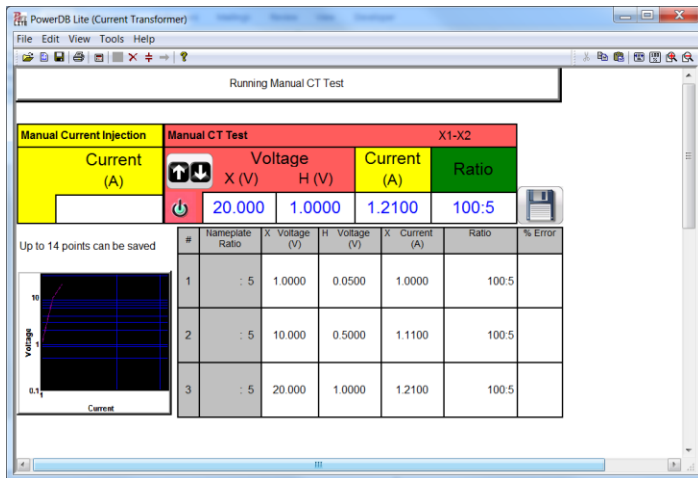
This will activate the ramp parameter dialog allowing the user may select the amount of increment the voltage is either decreased or increased by turning the knob on the STVI or the up/down arrow keys on a laptop



After the desired tap selection is made and any adjustments made to the ramp parameter, the user must select the ON button.  to begin the test. At this time a connection diagram will be displayed. Once the user has verified proper connections, the test is continued by selecting the blue play button on the connection diagram.



After the MRCT has begun to inject voltage, the voltage and current readings will be displayed along with the calculated ratio. The user must ramp the voltage using either the round control knob on the STVI or the up/down arrow keys on a laptop. Once the user has reached a desired voltage, a point may be saved by selecting the image of a floppy disk.



Once the user has generated at least two data points, the MRCT will begin to graph the saturation curve. The user can then continue to ramp the voltage while taking data points until the CT reaches saturation. The user may store up to 14 data points.

4.3 Demagnetization



Selection of Demagnetization, brings the user to the following connection diagram .

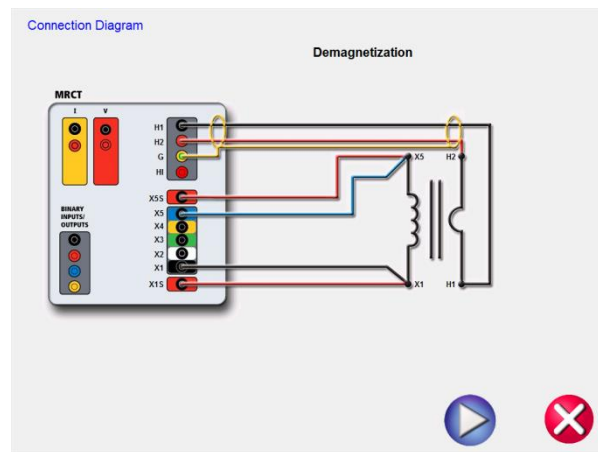


Figure 14 Demagnetization Connection Diagram

After confirming the connections are correct, continue with demagnetizing the CT by selecting the green CHECK. The red X will cancel the operation.

After selecting to continue the operation, the user will be advised that the CT is being demagnetized

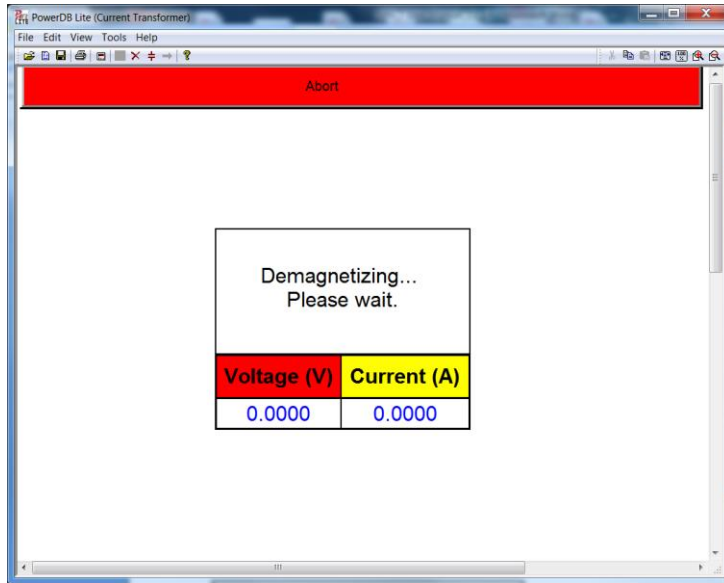


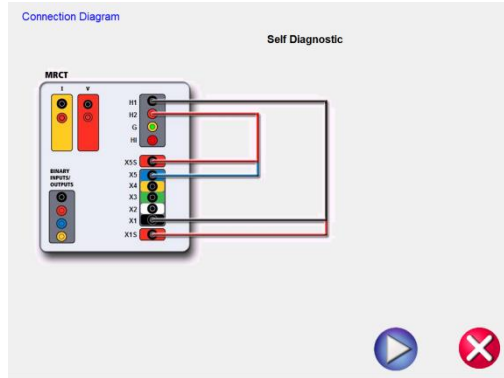
Figure 15 Demagnetization Process

Upon completion, the user will be returned to the Main Test Configure Screen and notified the demagnetization process is complete.

4.4 Self Test



Selection of the “Self Diagnostic” navigation button from the home screen will display a connection diagram



After the user has ensured the MRCT is connected properly as in the diagram, the self test is begun by selecting the blue play button



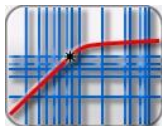
While the user can completely test a current transformer from the Run All Tests screen, individual tests may be accessed from the correlating buttons in the drop down list.

4.5 Relay



Selection of the Relay button allows the user to quickly and easily switch from the MRCT's current transformer testing screens to the relay testing screens. However, if the MRCT was ordered without the relay functionality, this operation will not be successful.

4.6 Saturation



Selection of Saturation Test button from the test configuration screen will bring the user to the following Saturation Test screen



Figure 16 Saturation Test Screen

Within this screen the user can select between Concurrent and Non concurrent Testing



When Concurrent Mode of testing is selected, the user is required to select how many taps is desired to test simultaneously



However if the Non Concurrent Mode of testing is selected, the user is required to select which individual tap is desired



Hitting the select tap button will activate the tap selection dialog



After either selecting the number of taps or the individual tap selection, the saturation test is begun by selecting the blue play button.



4.7 Ratio




Selection of  Ratio Test button from the test configuration screen will bring the user to the following Ratio Test screen



Figure 17 Ratio Test Screen

Within this screen the user can select between Concurrent and Non concurrent Testing



When Concurrent Mode of testing is selected, the user is required to select how many taps is desired to test simultaneously



However if the Non Concurrent Mode of testing is selected, the user is required to select which individual tap is desired



Hitting the select tap button will activate the tap selection dialog



After either selecting the number of taps or the individual tap selection, the ratio test is begun by selecting the blue play button.



4.8 Winding Resistance



Selection of Winding Resistance Test button from the test configuration screen will bring the user to the following Winding Resistance Test screen.

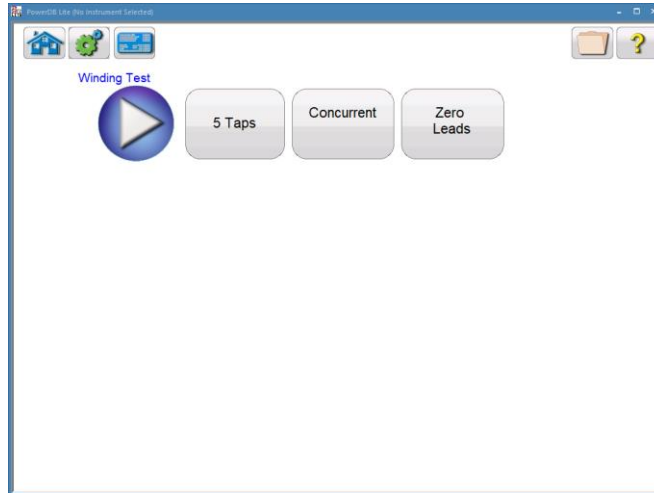
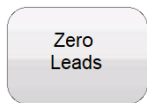
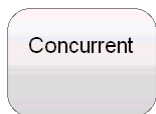


Figure 18 Winding Resistance Test Screen



Use the Zero Leads button to zero out the leads from the measurement. This will ensure no resistance from the leads is included in the resistance measurement and improve the accuracy of the measurement.

Within this screen the user can select between Concurrent and Non concurrent Testing



When Concurrent Mode of testing is selected, the user is required to select how many taps is desired to test simultaneously



However if the Non Concurrent Mode of testing is selected, the user is required to select which individual tap is desired



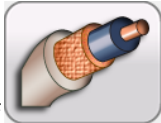
Hitting the select tap button will activate the tap selection dialog



After either selecting the number of taps or the individual tap selection, the Winding Resistance test is begun by selecting the blue play button.



4.9 Insulation Test



Selection of Insulation Test button from the test configuration screen will bring the user to the following Insulation Test screen

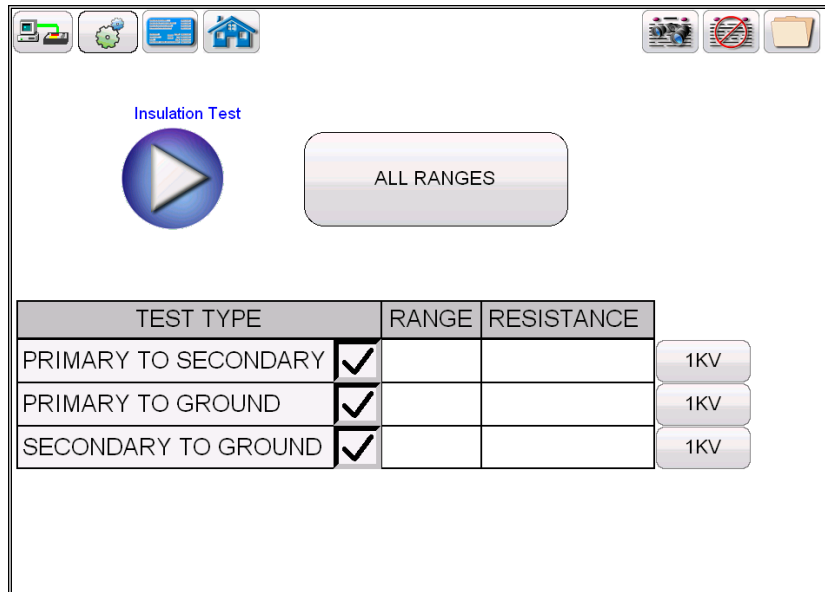


Figure 19 Insulation Resistance Test Screen

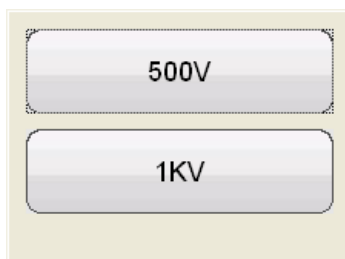
Within the Insulation test screen, the user may select the desired test level of either 500V or 1 KV by using the Voltage selection button



Each test may be set to a different test voltage. The user can also set the same test voltage to all tests by selecting the all Ranges Button



And then selecting the desired voltage



After selecting the desired test voltage, the user may select which test is desired by checking the correlating check box.

Then after selecting both the desired test voltage and the desired test, the insulation testing is begun by selecting the blue play button.



4.10 Burden



Selection of Burden Test button from the test configuration screen will bring the user to the following Burden Test screen

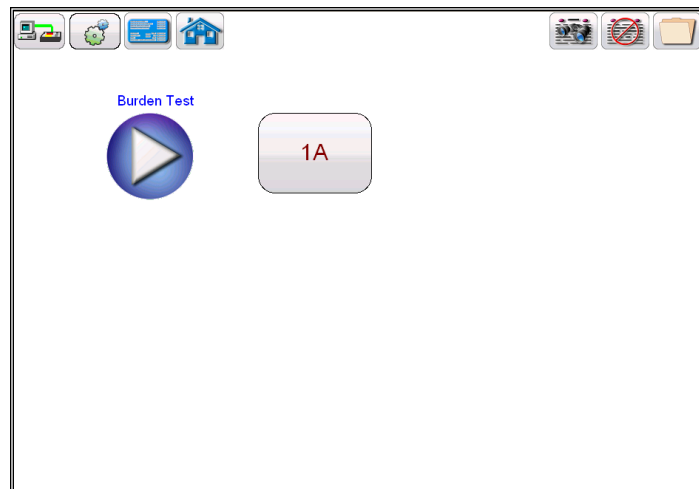
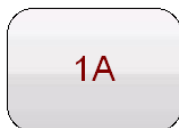


Figure 20 Burden Test Screen

Within the Burden test screen, the user may select the appropriate test current of either

1 Amp or 5 Amp based upon secondary current rating of the CT under test





After either selecting the appropriate test current, the burden test is begun by selecting the blue play button.





4.11 View CT Report



If a test has been run and data is present the View Test Report button will be available. Selection of this button will generate a report of all test data for the active CTs. Data in the report regarding customer information may be entered here

A screenshot of a web form titled "CT TEST REPORT". The form includes the Megger logo and website address, a "Your Company Logo" placeholder, and several input fields for customer information. The date is pre-filled as 2/18/2015. The page number is 1.

 **Megger.** www.megger.com **CT TEST REPORT** 

PAGE 1

AMBIENT TEMP. _____ DATE 2/18/2015

SUBSTATION _____ HUMIDITY _____ % JOB # _____

POSITION _____ ASSET ID _____

EQUIPMENT LOCATION _____

Figure 21 Customer Information



CT TEST REPORT



PAGE 1

AMBIENT TEMP. _____ DATE 2/18/2015

SUBSTATION _____

HUMIDITY _____ % JOB # _____

POSITION _____

ASSET ID _____

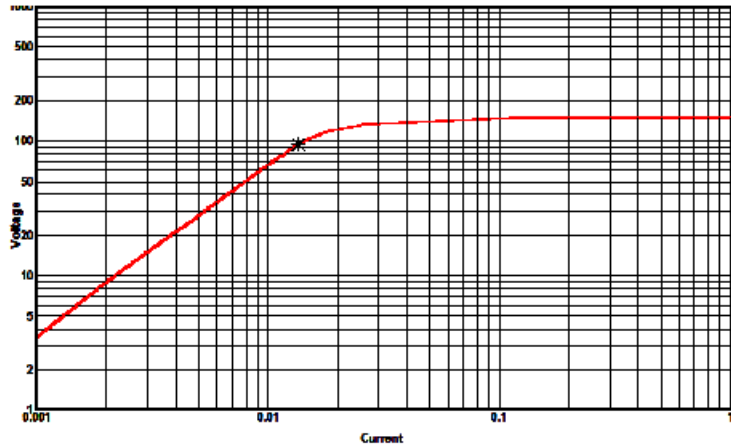
EQUIPMENT LOCATION _____

NAMEPLATE DATA		CT: <u>CT1X</u>	Protection _____
MANUFACTURER _____	SERIAL NO. _____		PHASE _____
ASSET ID _____	ACCURACY CLASS <u>C100</u>		SATURATION STD <u>ANSI 45</u>
BURDEN <u>B-4</u>	VA _____	50	Ratio Phase Error

Secondary Voltage Injection

Tap	X1-X2	
R A T I O	Nameplate	500:5
	Measured	505.047:5
	% Error	1.009
	Test V (V)	36.323
	Test I (A)	0.0064
	Prim V (V)	0.3596
Phase Dev.	0°30'	
Polarity	Correct	
Knee	Volt. (V)	94.383
	Cur. (A)	0.0135
Resist. (Ohms)	6.000	

Insulation Resistance	Primary To Secondary		Primary To Ground		Secondary To Ground	
	1KV	3.20G	1KV	3.21G	1KV	3.22G



X1-X2

Comments and Deficiencies

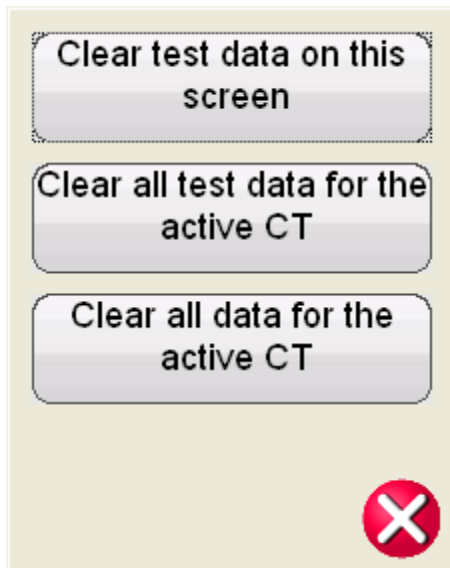
TEST EQUIPMENT USED: _____ TESTED BY: _____

Figure 22 Sample Test Report

4.12 Delete CT Data



If a test has been ran and data is present; the Delete Test Data button will be available. Selection of this button activates the following dialog



This will allow the user three options of deleting data

- Clear test data on screen will only clear the data of the test screen currently active
- Clear all test data for active CT will the test data for the active CT but not delete the nameplate information that has been entered
- Clear all data for active Ct will delete all test data and nameplate information

4.13 Report Configuration

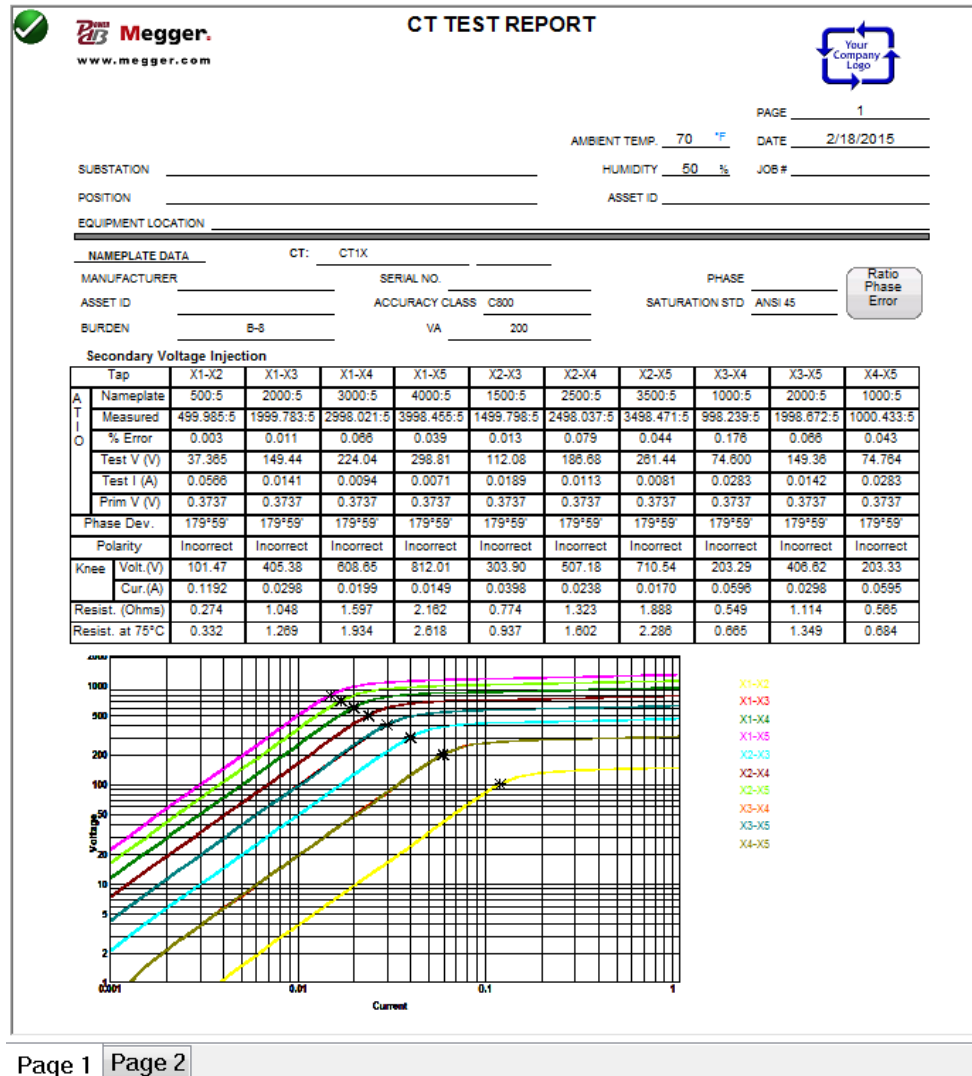


Figure 23 Sample Multitap CT Test Report

The MRCT will provide a concise one page report that will include all testing results including the data from the following tests: excitation; ratio; phase deviation; polarity; winding resistance; and insulation resistance. The MRCT report can also be configured to provide additional data including the ratio and phase errors at various percentages of primary current and at different levels of burden as seen below. Inclusion of the ratio/phase error tables and graphs as well as the ANSI metering parallelograms and a CT Assessment can be configured within the device settings using the Report/Assessment button.

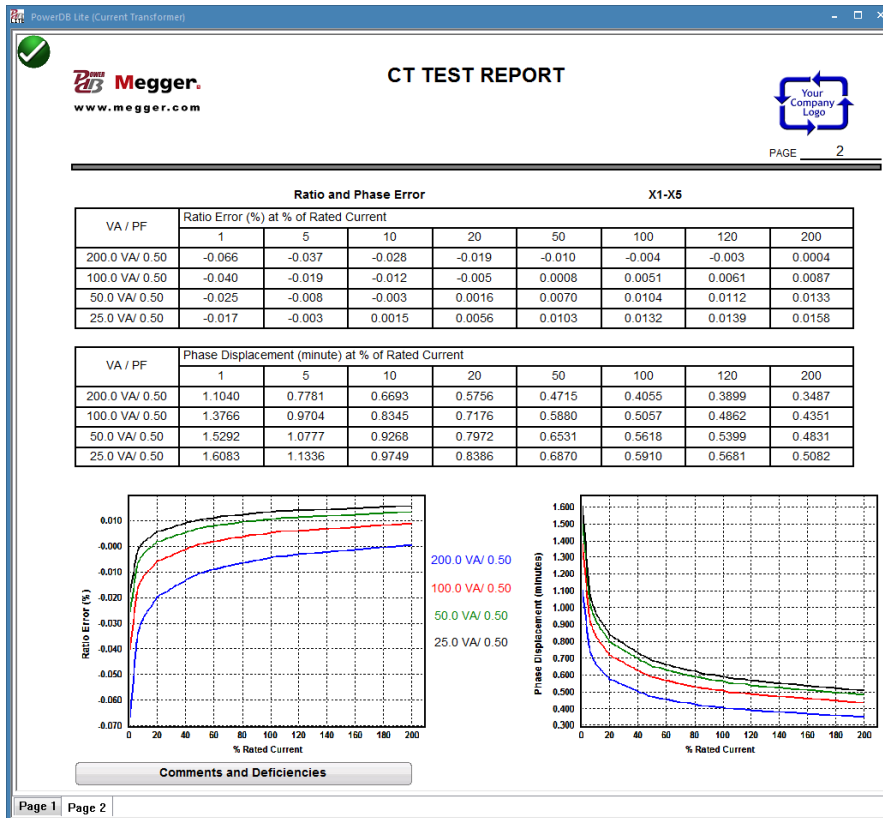
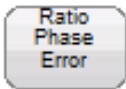


Figure 24 Ratio and Phase Error Tables



Ratio & Phase Error Button

If the user has selected to include the tables and graphs within the report, the following CT Name Plate information needs to be entered:

- CT Type either Metering or Relaying
- Accuracy Class
- Burden and/or VA
- Ratio

After the user has ran the following tests:

- Saturation/Excitation
- Ratio
- Winding Resistance

Then the “ Ratio & Phase Error “ button will be visible within the report. This button will give the user access to the “Report Contents Screen”.

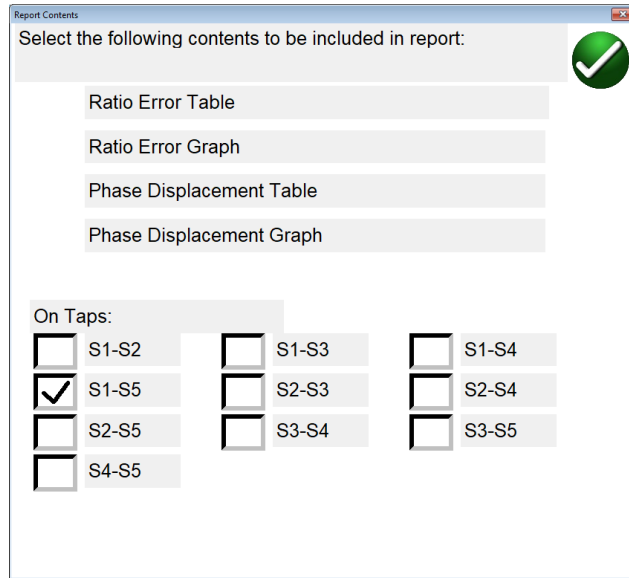


Figure 25 Report Configuration

Here, a list of tables and graphs the user has configured the report to contain will display. If the CT is a multi-ratio CT, the user can select which taps is desired to display in the report. By default the ratio and phase error tables and graphs are displayed for only the most outer tap tested. But within this screen the user can select to display these ratio and phase error tables and graphs for any combination of taps or for all taps. Place a check mark in the box beside the desired data and the desired tap and data for that tap will be included in the report. Please note that the nameplate data can be entered at any time either before the test or after the test has been completed and saved and the “ Ratio & Phase Error “ button will become available within the report. Also please note that by default, only the external tap is initially included.

4.14 Excitation Curve Data

Data points for the excitation curve graphs are saved within each test file. Up to 30 data points for each excitation curve can be displayed within the report by selecting the “Display Saturation Test Data” check box within the report.

Additional data points can be viewed from the Saturation/Excitation Test Screen.

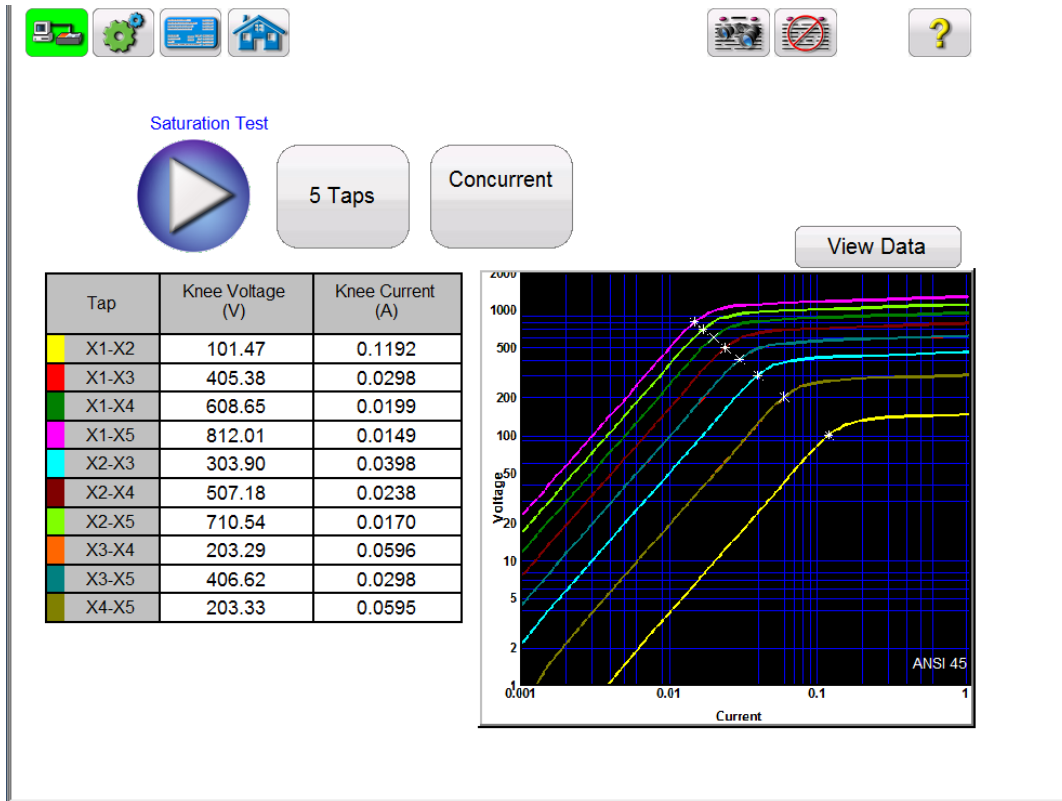


Figure 26 View Saturation Data

Within the test screen, if the test has completed and data is available, the user can access this data by selecting the “View Data” button.



Selection of the view data button will launch a data viewer that will allow the user to view, or copy the data for inclusion into a separate file that can be included with the standard CT Test Report.

Raw Data

Select all points Copy data points

X1-X2		X1-X3		X1-X4		X1-X5		X2-X3	
I(A)	V(V)	I(A)	V(V)	I(A)	V(V)	I(A)	V(V)	I(A)	V(V)
0.0016	0.2534	0.0004	0.9992	0.0003	1.4995	0.0002	1.9993	0.0005	0.7458
0.0055	2.0190	0.0014	7.9973	0.0009	11.996	0.0007	15.995	0.0019	5.9783
0.0079	3.4831	0.0020	13.792	0.0013	20.691	0.0010	27.581	0.0027	10.309
0.0135	7.2217	0.0034	28.600	0.0023	42.900	0.0017	57.204	0.0045	21.378
0.0206	12.484	0.0052	49.435	0.0035	74.162	0.0026	98.886	0.0070	36.951
0.0293	19.169	0.0074	75.918	0.0049	113.89	0.0037	151.85	0.0099	56.749
0.0372	25.757	0.0094	101.99	0.0063	153.00	0.0047	203.86	0.0126	76.233
0.0435	31.747	0.0110	125.73	0.0073	188.62	0.0055	251.19	0.0147	93.983
0.0562	43.621	0.0142	172.72	0.0095	258.86	0.0071	345.49	0.0190	129.10
0.0705	57.983	0.0178	229.15	0.0119	344.22	0.0089	459.23	0.0239	171.17
0.0816	68.959	0.0206	272.64	0.0137	409.44	0.0103	546.21	0.0276	203.68
0.0959	83.178	0.0242	329.00	0.0161	493.97	0.0121	658.91	0.0324	245.82
0.1022	89.749	0.0258	355.03	0.0172	533.01	0.0129	710.94	0.0346	265.28
0.1046	91.966	0.0264	363.77	0.0176	546.10	0.0132	728.44	0.0354	271.80
0.1069	94.133	0.0270	372.37	0.0180	558.98	0.0135	745.63	0.0362	278.24
0.1101	96.314	0.0278	381.07	0.0185	572.01	0.0139	762.96	0.0372	284.76
0.1125	98.528	0.0284	389.73	0.0189	585.08	0.0142	780.40	0.0381	291.20
0.1149	100.72	0.0290	398.41	0.0193	598.15	0.0145	797.84	0.0389	297.69
0.1180	103.01	0.0298	407.54	0.0199	611.78	0.0149	815.99	0.0399	304.53
0.1236	107.35	0.0312	424.68	0.0208	637.50	0.0156	850.33	0.0418	317.33
0.1450	119.12	0.0366	471.39	0.0244	707.53	0.0183	943.64	0.0490	352.27
0.2012	132.16	0.0509	522.87	0.0339	784.89	0.0254	1046.8	0.0681	390.71
0.8784	148.20	0.2220	586.49	0.1479	880.20	0.1109	1173.8	0.2970	438.29

Figure 27 Excitation Curve Data

5.0 VT Testing Functions

Within the “Home Screen “ selecting the VT TEST button will cause the button to turn bright yellow. This will inform the user that the MRCT is now in VT Testing mode. From here the user will have access to the tests available for VT testing. With Basic VT Testing, the Ratio/Phase Error test and the Winding resistance test is available. If the MRCT is configured for Advanced VT Testing, in addition to the tests available in Basic, the MRCT will also have the Excitation/Saturation test, and the Short Circuit Impedance Test.

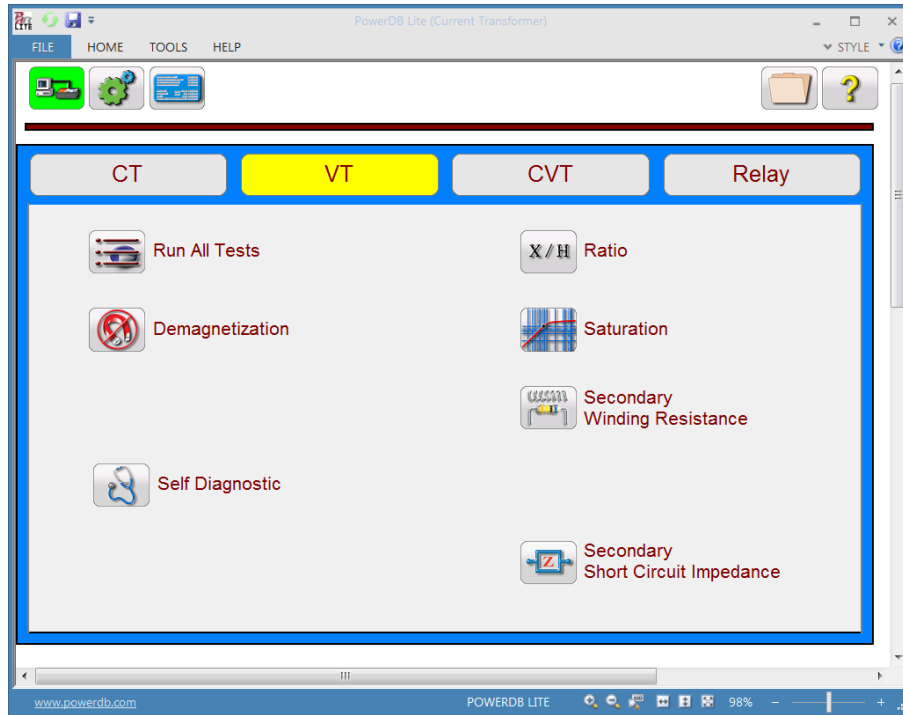


Figure 28 Advanced VT Testing Mode

5.1 Run All Tests



Selection of Run All Tests button will bring the user to the Test Configuration screen

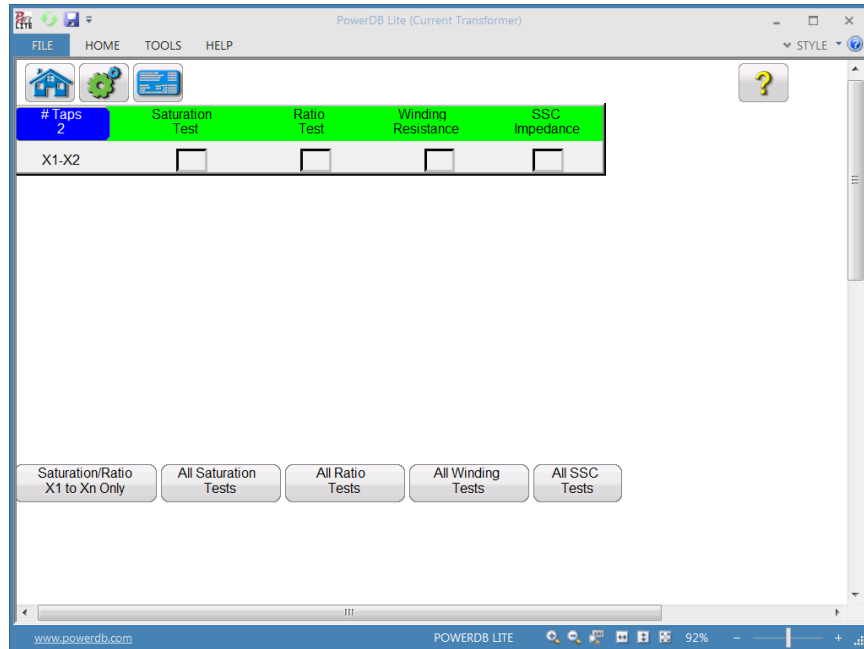


Figure 29 Run All Test Screen

In order for the MRCT to estimate the performance of the VT, the MRCT must have the Advanced VT package installed and each test outlined in the Run All test screen must be performed on the VT. In the Basic VT testing the Saturation Test and Short Circuit Impedance Test are not available. The user can easily configure a test plan for a voltage transformer by checking the box adjacent to the desired test. The MRCT will then cycle through and perform each test. Please note though that a lead change may be required after completion of one test and before beginning of the next test. The MRCT will alert the user as to the proper connections for the upcoming test prior to the test beginning. Please closely evaluate each connection diagram and ensure the unit is properly connected before continuing.

**** Please note that both proper and improper connections during a test can result in an extremely dangerous environment being generated. The user should carefully read all safety precautions and understand them prior to beginning any testing. The user should also follow all connections diagrams and read the warnings on such in order to be aware of the environment.**

The various buttons at the bottom of the screen can also be used to easily configure a test:

All Saturation
Tests

Used to auto select Saturation Test on all windings

All Ratio
Tests

Used to auto select Ratio Test on all windings

All Winding Tests

Used to auto select Winding Resistance Test on all windings

All SSC Tests

Used to auto select Secondary Short Circuit Impedance test on all windings

5.2 Demagnetization



Selection of Demagnetization, brings the user to the following connection diagram .

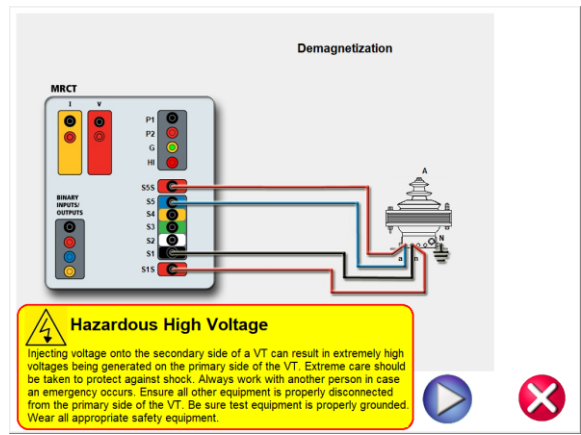


Figure 30 Demagnetization Connection Diagram

After confirming the connections are correct, continue with demagnetizing the VT by selecting the blue play button. The red X will cancel the operation.

After selecting to continue the operation, the user will be advised that the VT is being demagnetized

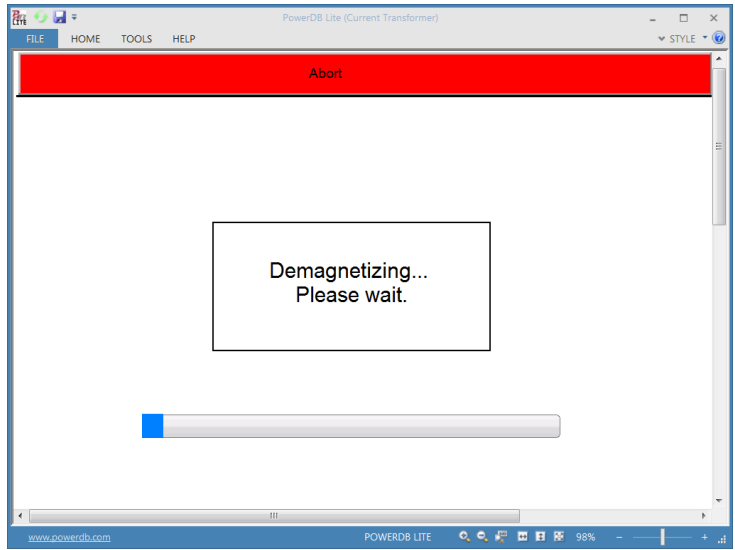


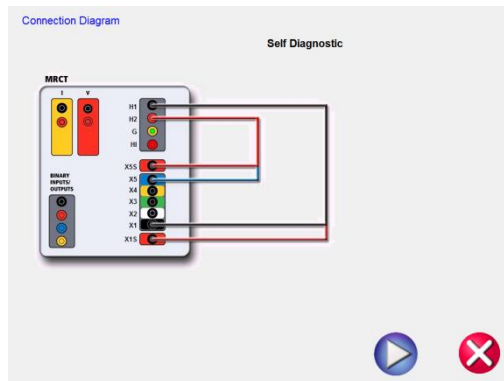
Figure 31 Demagnetization Process

Upon completion, the user will be returned to the Main Test Configure Screen and notified the demagnetization process is complete.

5.3 Self Test



Selection of the “Self Diagnostic” navigation button from the home screen will display a connection diagram



After the user has ensured the MRCT is connected properly as in the diagram, the self test is begun by selecting the blue play button



5.4 Ratio



Selection of Ratio Test button from the home screen will bring the user to the following Ratio Test screen

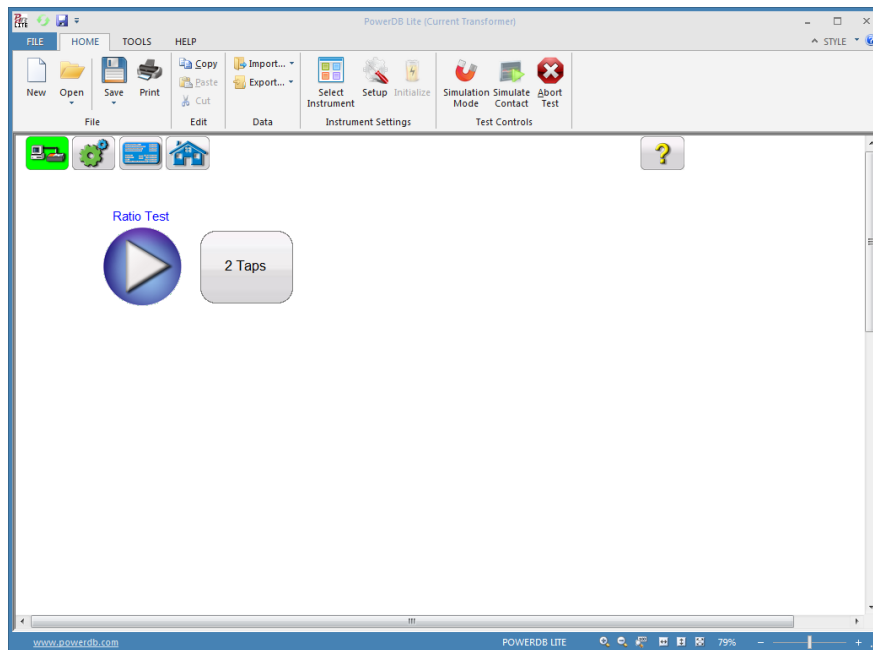


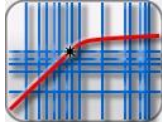
Figure 32 VT Ratio Test Screen

The default number of taps is two.

Since the connections are different that when testing CT, the MRCT is only capable of testing VTs one tap at a time. The ratio test is begun by selecting the blue play button.



5.6 Saturation



Selection of Saturation Test button from the test configuration screen will bring the user to the following Saturation Test screen



Figure 33 Saturation Test Screen

The Saturation test is begun by selecting the Blue Play button



5.7 Winding Resistance



Selection of Winding Resistance Test button from the test configuration screen will bring the user to the following Winding Resistance Test screen.

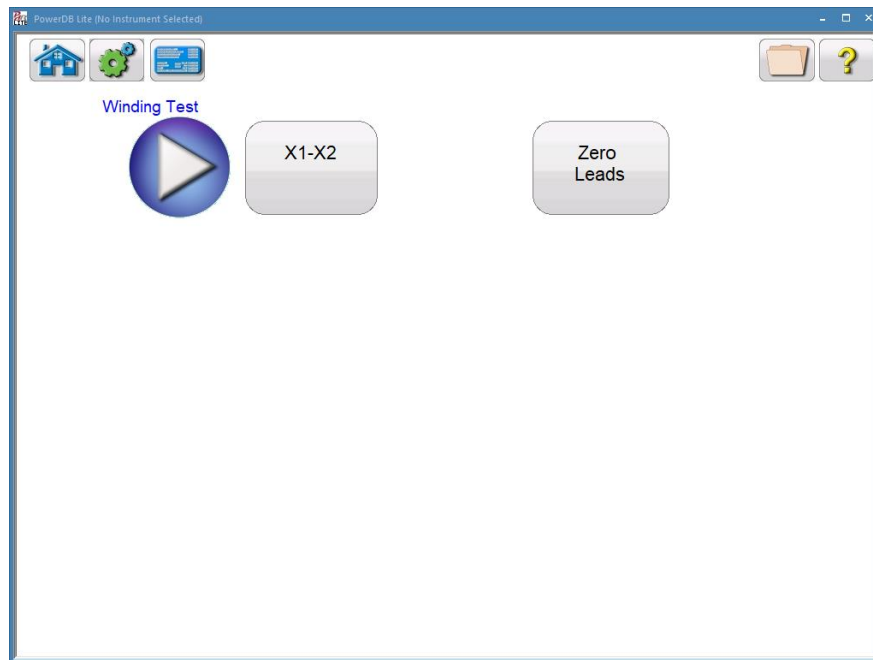
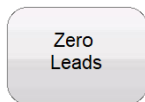


Figure 34 VT Winding Resistance Test Screen



Use the Zero Leads button to zero out the leads from the measurement. This will ensure no resistance from the leads is included in the resistance measurement and improve the accuracy of the measurement.

The winding resistance test is begun by selecting the Blue Play button



5.8 Secondary Short Circuit Impedance



Selection of Impedance Test button from the test configuration screen will bring the user to the following Secondary Short Circuit Impedance Test screen.

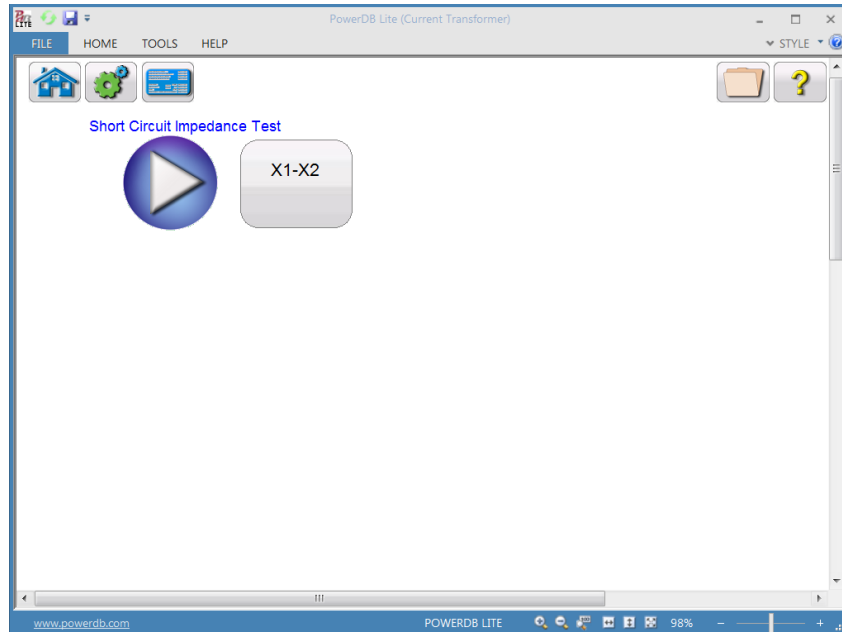


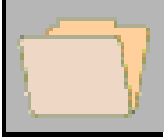
Figure 35 Short Circuit Impedance Test Screen

The Short Circuit Impedance is begun by selecting the Blue Play button



6.0 Functions Available for All Configurations

6.1 File Operations

Selection of  File Manager, brings the user to the following tool bar

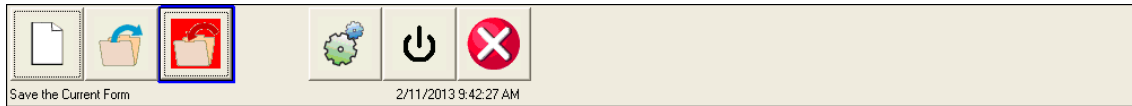


Figure 36 File Operation Tool Bar

The toolbar is used to Open File; Close File; or Cancel. Selecting either Open File or Close File will open the File Manager Dialog (see below)

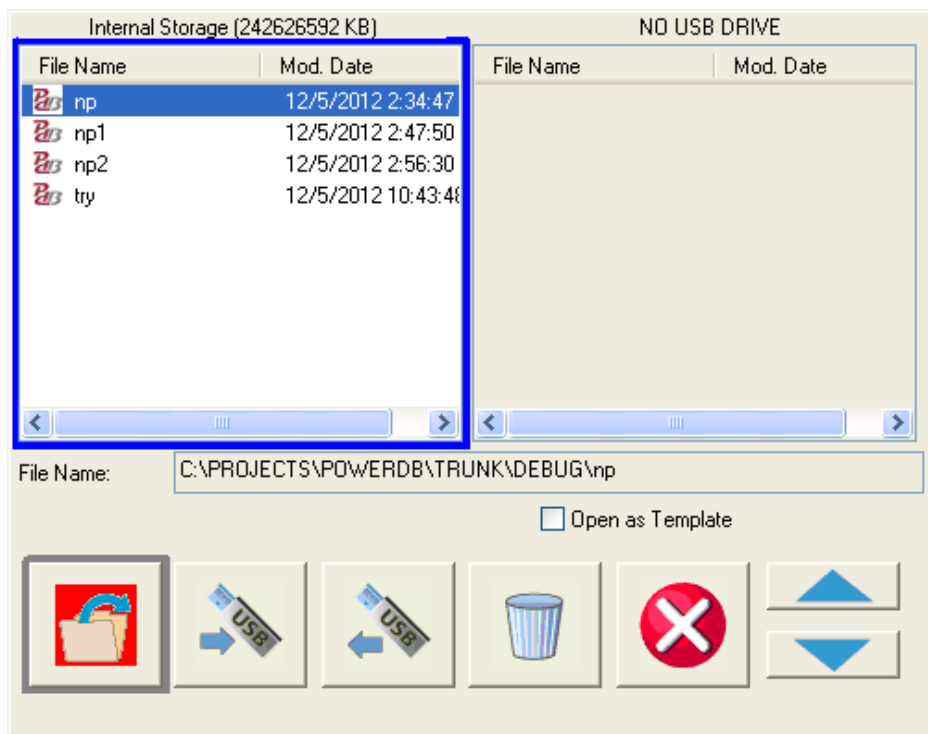


Figure 37 File Manager Screen

File manager screen is used to view and access the stored test results. All stored test results are displayed in alphabetical order along with date and time stampings.

Function buttons are used to recall, delete or transfer the test results. The function buttons are used to manage files as below:



Used to open file highlighted in the internal storage list



Used to save file named in edit box to system memory



Used to transfer file highlighted in the internal storage list to a USB stick



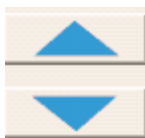
Used to transfer file highlighted in the USB drive list to internal system



Used to delete file highlighted in internal storage list



Cancel operation and closes dialog



Used to scroll file selection highlight up and down

Warranty Statement

Megger warrants the product is free of defects in material and workmanship for a period of one (1) year from date of shipment. This warranty is non-transferable. This warranty is limited and shall not apply to equipment that has damage, or cause of defect, due to accident, negligence, and improper operation, faulty installation by the purchaser, or improper service or repair by any person, company or corporation not authorized by Megger. Megger will, at its' option, either repair or replace those parts and/or materials it deems to be defective.

The warranty is in lieu of all other warranties, either expressed or implied on the part of Megger and in no event shall Megger be liable for the consequential damages due to the breach thereof.

7.0 Service Data

7.1 Preventive Maintenance

The unit utilizes surface mount technology (SMT) and other components which require little or no service except for routine cleaning, etc. The unit should be serviced in a clean atmosphere away from energized electrical circuits.

7.1.1 Examine the unit every six months for:

Dust and Dirt	To clean the unit, never use spray liquids or industrial cleaners. Some cleaning solvents can damage electrical components, and should never be used. Use a lightly damp cloth (not dripping wet) to wipe off the unit. Remove dust with dry, low pressure, compressed air.
Moisture	Remove moisture as much as possible by putting the test set in a warm, dry environment.

7.1.2 Upgrading STVI Software

Upgrade via Megger Website

To download the newest STVI software from the Megger website,

1. Get the serial number of your unit.
2. Go to WWW.Megger.com
3. **Log In.** If you have not registered before you will need to do so first.
4. Go to **Software Downloads**
5. Click on **STVI**
6. You will see instructions to enter the serial number of the STVI unit, and then click on **Continue.** The serial number is 12 digits long. Make sure you enter all 12 digits. There will be two versions

of the software. One is for your PC and one is for the STVI. For the STVI unit, go to the **STVI software for STVI Installation or Upgrade** and press on the Click Here link. The software will be downloaded onto your PC as a zip file. Unzip the file, **Select All** files, and **Copy** to a USB memory stick, or create a file on your PC for storage to unzip or extract to a file.

Upgrade via Compact Disk

Where internet access may not be available or blocked on your computer, Megger can provide a CD with the latest version of software on it. Contact your local Megger representative to order a copy of the firmware.


How to Download STVI Software into STVI

USB Memory Stick: With the STVI powered up, insert the USB memory stick into the USB port on top of the STVI. If the Windows “Removable Disk (E)” Explorer screen appears, press the Cancel button, and then go to the STVI Configuration Screen and press the Update Firmware button. Press the “STVI Firmware” button. A window will appear stating that there is a software upgrade available and will ask if you want to execute the upgrade. Press Yes and the unit will automatically upgrade the software. When complete, power down the STVI by disconnecting the Ethernet cable. Wait about 5 to 10 seconds and reconnect the cable. Observe the STVI display screen. When the basic test screen appears, press the Configuration button, then press the Display Versions button and verify the version of the software upgrade.

7.2 Service and Repair Instructions


Basic troubleshooting information has been provided to guide the technician to the possible source of a problem.

Since the STVI uses Surface Mount Technology, repairs of the individual printed circuit boards are beyond the scope of the basic troubleshooting guide, and should be referred to the Service Department at Megger or handled through the Megger Representative.

 If the unit is still within the original warranty period, or limited warranty period following factory servicing, **the factory must be contacted before attempting any repairs or the warranty will be void.**

7.2.1 Basic Troubleshooting


The troubleshooting information relies on the technician to have a good understanding of the operation of the unit. The technician should contact the factory should they have any questions regarding the operation of the unit. Provide the Megger the serial number of the STVI when making inquiries.

 **WARNING** It is necessary to energize the MRCT to properly troubleshoot the STVI. The technician must take all applicable safety precautions for working with the possible energized outputs of the MRCT.

NOTES

Before suspecting a failure in the STVI review the Description of Controls and Theory of Operation sections to ensure that the problem is not a result of operating error.

Common causes of malfunctions, other than improper operation, are bad Ethernet cable or cable connectors, or incorrect power input (voltage above or below specified limits).

 **NOTE:** Under no circumstance should the technician take the STVI apart without following proper ESD protection and handling procedures. Failure to do so, will damage sensitive parts.

7.2.1.1 Power Input

Input voltage affects the whole unit, including the 48 Volts DC to the STVI from the PoE port, and may or may not cause permanent damage if voltage is incorrect. These problems can often be corrected by simply using a better source of input power. See unit front panel for input voltage rating.

Some symptoms are as follows:

1. Low voltage: Erratic operation, no display, or a dim display.
2. High voltage: Circuit breaker operation on MRCT unit, power supply failure.
 - a. For MRCT, the internal power supply needs to be repaired or replaced, contact the factory for further instructions.

7.2.1.2 Ethernet Cable

Basic troubleshooting of the Ethernet communication cable as follows,


1. No power: Check power source and line cord. If the MRCT powers up, but the STVI display does light up, check the cable and cable connectors. Typical problem is usually a broken conductor or cracked cable connector. Replace cable to see if this resolves issue.
2. Erratic Manual Control
 - A. Communication cable is not properly connected, thus cannot receive proper commands.
 - B. Internal problem with communications inside the MRCT

7.2.1.3 Ratio Errors

Ratio errors can be caused by a couple of things

1. Ground issues


- a. The MRCT requires proper grounding either through the power supply cord or through the chassis using the supplied grounding strap. The unit uses this ground as a reference so for accurate testing ensure that the MRCT is properly grounded using the supplied chassis ground strap.
- b. Testing large power transformers and auto transformers. The MRCT has a ground path inside the H1 (Primary 1) lead. This is included in the design of the MRCT for the dissipation of induced voltage in high voltage yards. This allows the MRCT to test in environments that other instruments cannot. However, care must be taken when connecting the primary test leads on large transformers to ensure that a ground loop is not being created. If a transformer is grounded in such a way that the both sides of the CT are grounded then a ground loop is created and the MRCT cannot properly measure any voltage. This will result in extremely large ratio errors. To correct this, check all grounding on the transformer and ensure no ground loops are being created.
- c. Testing in HIGH Voltage yards such as 500 and 765KV can also cause ratio errors. It should be common practice for safety to ground one side of the CT before connecting the primary test leads. It is also recommended to leave this ground in place during testing to improve ratio results. Since the H1P1 lead contains a ground path care must be taken not create a ground loop by grounding both sides of the CT. Therefore external grounding should be on the same side as the H1P1 lead is connected.

 Contact the factory for a Repair Authorization Number and return instructions if service is required. A Repair Authorization (RA) number will be assigned for proper handling of the unit when it arrives at the factory. Any non-warranty repair cost incurred for the repair or replacement of parts and/or materials shall be the responsibility of the purchaser.

Provide the factory with model number, Unit serial number, nature of the problem or service required, return address, your name, and how to contact you should the factory need to discuss the service request.


You may need to provide a purchase order number, cost limit, billing, and return shipping instructions. If an estimate is requested, provide the name and contact information.

8.0 Preparation for Reshipment

 Save the original shipping container for future use. The shipping container is designed to withstand the rigors of shipping via a common commercial carrier.

Pack the equipment appropriately to prevent damage during shipment. If a reusable container is utilized, the unit will be returned in the same shipping container if it is in suitable condition.

Add the Return Authorization Number to the address label of the shipping container for proper identification and quicker handling.

 NOTE: Ship the equipment without nonessential items such as test leads, etc. These items are not needed by the factory to perform service.

9.0 Step by Step Testing a CT with MRCT

9.1 Test Plan Creation and Testing of CT

Refer to the safety instructions first before use of the equipment.

1. Verify the Power ON/OFF switch is OFF. Power the test set from a suitable source of power (95-265 V50/60 Hz).
2. Connect the ground wing nut to a suitable ground.

WARNING

There is always the possibility of voltages being induced at the terminals of a test specimen because of proximity to high voltage energized lines. A residual static voltage charge may also be present at these terminals. Ground each terminal to be tested with a safety ground stick. before making connections.

3. Connect the test set secondary output **SOURCE** binding posts **X1S** to the secondary of the current transformer X1, and **X5S** to the secondary of the current transformer on the most external tap.
4. Connect the test set secondary output binding posts X1 X2, X3, X4 and XN to secondary of the current transformer X1, X2, X3, X4 and X5 (if less than 5 taps are available on the CT, then connect the test set secondary output binding posts X1, X2... to the correlating secondary of the current transformer with the EXCEPTION of connecting the test set secondary output binding X_n to the most external secondary of the current transformer. For Example on a 3 Tap CT Connect X1(test set) to X1(CT), X2(test set) to X2 (CT), and Xn (test set) to X3 (CT)
5. Connect the test set primary binding posts H1 and H2 to CT primary bushings H1 and H2.Observe the polarity marks on the CT (H1 on the test set is polarity terminal).

WARNING

The MRCT produces high voltages and currents during the performance of tests. DO NOT TOUCH connector clips or test leads while the MRCT is performing a test.

6. Turn Power ON/OFF switch to ON.
7. After the boot up, select the “Nameplate Information” menu by selecting



Name Plate navigation button.

8. Fill in nameplate information about the CT. At a minimum, the number of taps must be selected
9. In the Home Screen, select the Run All Tests button. Within the Run All Test screen select all of the desired tests by placing a check in the adjacent box

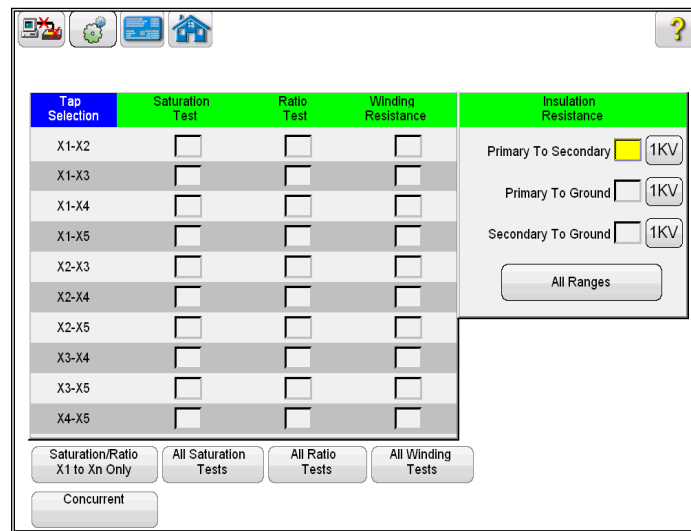


Figure 38 Run All Tests – Configuration

10. Select the individual taps for saturation testing by placing a check in the corresponding

box. Or select all taps by selecting the



button. This will place a check corresponding to all taps.

11. Select the individual taps for ratio testing by placing a check in the corresponding

box. Or select all taps by selecting the



button. This will place a check corresponding to all taps.

12. Select the individual taps for Winding Res testing by placing a check in the corresponding

box. Or select all taps by selecting the  button. This will place a check corresponding to all taps.

13. Place a check in the corresponding box next to each desired insulation test – Primary to Secondary, Primary to Ground, and Secondary to Ground.
14. Select the desired voltage range to conduct the insulation test; either 500V or 1KV
15. At this point, this test file could be saved, opened at a later date , and ran.

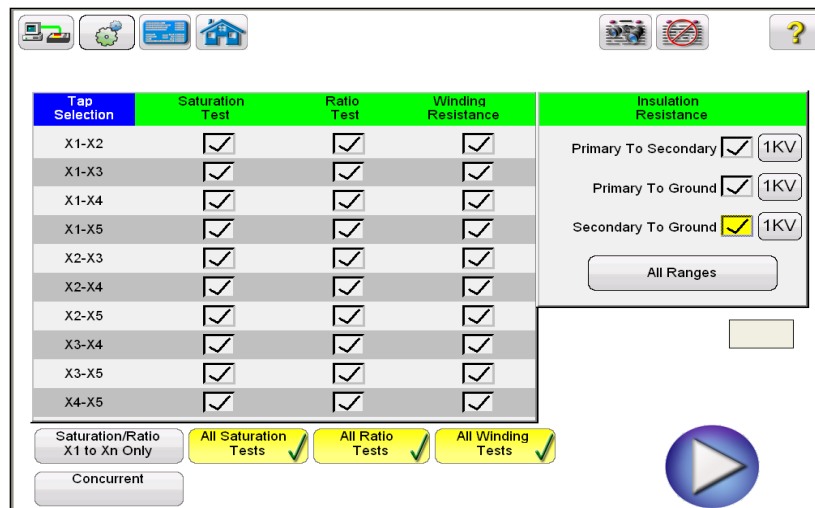


Figure 39 Run All Tests - Multi Tap

16. It can also be ran at this time by selecting the Blue Play button



17. A connection diagram will appear showing how to properly connect the MRCT to the CT

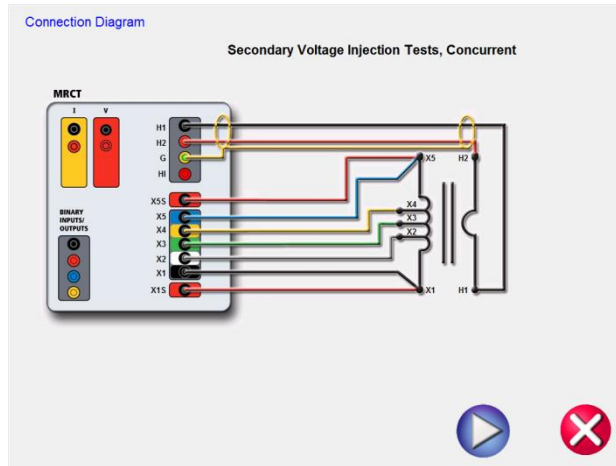


Figure 40 Connection Diagram 5 Tap Concurrent

18. Continue the test by selecting the Blue Play button



19. At any point of time Test can be terminated by hitting the ABORT button at the top of any testing screen.

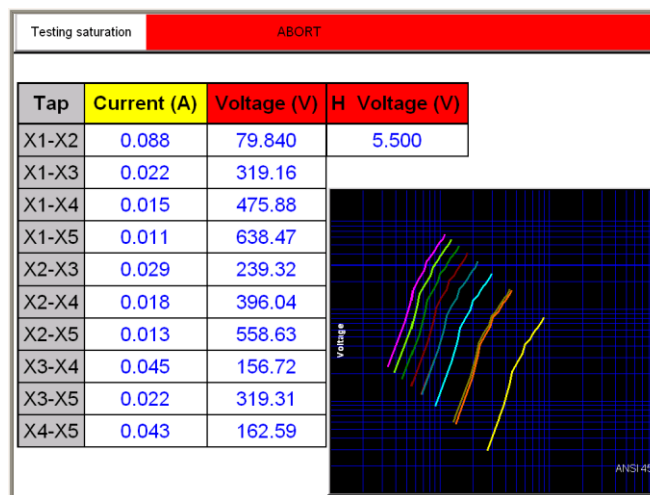


Figure 41 Saturation Testing Screen – Concurrent

20. Test can also be stopped under emergency condition by hitting the “Emergency Push to Stop” button on the front panel of MRCT. Unit will shut off the output voltage

21. After releasing the Emergency Stop Button, the test will need to be restarted
22. Upon completion of test, the results will be displayed in a test report

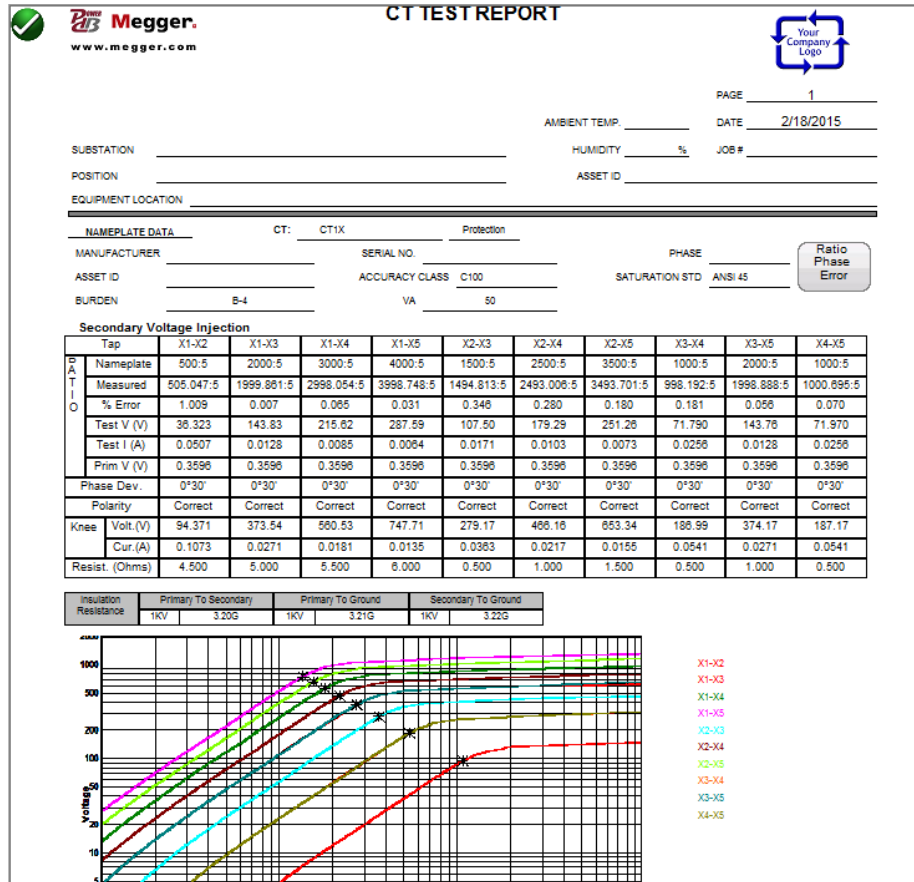


Figure 42 Testing Report - Concurrent

9.2 CT Saturation Test

9.2.1 Method 1 – Concurrent

Refer to the safety instructions first before use of the equipment.

1. Verify the Power ON/OFF switch is OFF. Power the test set from a suitable source of power (95-265 V50/60 Hz).
2. Connect the ground wing nut to a suitable ground.

WARNING

There is always the possibility of voltages being induced at the terminals of a test specimen because of proximity to high voltage energized lines. A residual static voltage charge may also be present at these terminals. Ground each terminal to be tested with a safety ground stick, before making connections.

3. Connect the test set secondary output **SOURCE** binding posts **X1S** to the secondary of the current transformer X1, and **X5S** to the secondary of the current transformer on the most external tap.
4. Connect the test set secondary output binding posts X1 X2, X3, X4 and XN to secondary of the current transformer X1, X2, X3, X4 and X5 (if less than 5 taps are available on the CT, then connect the test set secondary output binding posts X1, X2... to the correlating secondary of the current transformer with the EXCEPTION of connecting the test set secondary output binding Xn to the most external secondary of the current transformer. For Example on a 3 Tap CT Connect X1(test set) to X1(CT), X2(test set) to X2 (CT), and Xn (test set) to X3 (CT)
5. Connect the test set primary binding posts H1 and H2 to CT primary bushings H1 and H2.Observe the polarity marks on the CT (H1 on the test set is polarity terminal).

WARNING

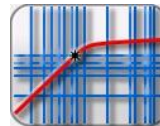
The MRCT produces high voltages and currents during the performance of tests. DO NOT TOUCH connector clips or test leads while the MRCT is performing a test.

6. Turn Power ON/OFF switch to ON.
7. After the boot up, select the “Nameplate Information” menu by selecting



Name Plate navigation button.

8. Fill in nameplate information about the CT. At a minimum, the number of taps must be selected



9. From the Home Screen select the “Saturation Test” button.
10. In the saturation test screen, selecting the Concurrent Mode of operation will allow the user to test multiple taps in parallel.



Figure 43 Saturation Test Screen – Concurrent

11. Select the play button and a connection diagram will appear showing the proper connections for the MRCT to the CT

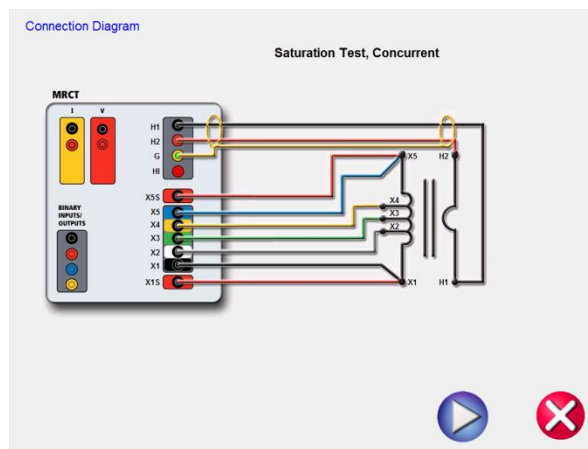


Figure 44 Saturation Connection Diagram – Concurrent

12. Check all connections to ensure correctness
13. Hit Blue Play button to begin test.



14. The saturation test will begin.

⇒ X Voltage (V): The MRCT displays the real time voltage readings of the secondary X winding while the test is in progress.

- ⇒ X Current (A): The MRCT the real time current readings for the secondary X winding while the test is in progress.
- ⇒ Saturation Curve: The excitation curve is Log-Log curve with secondary current on X coordinate and secondary voltage on Y coordinate. Saturation curves for all correlating taps will be graphed in the chart in the right hand corner of the screen in real time as data is accumulated.

15. At any point of time Test can be terminated by hitting the ABORT button at the top of the screen.

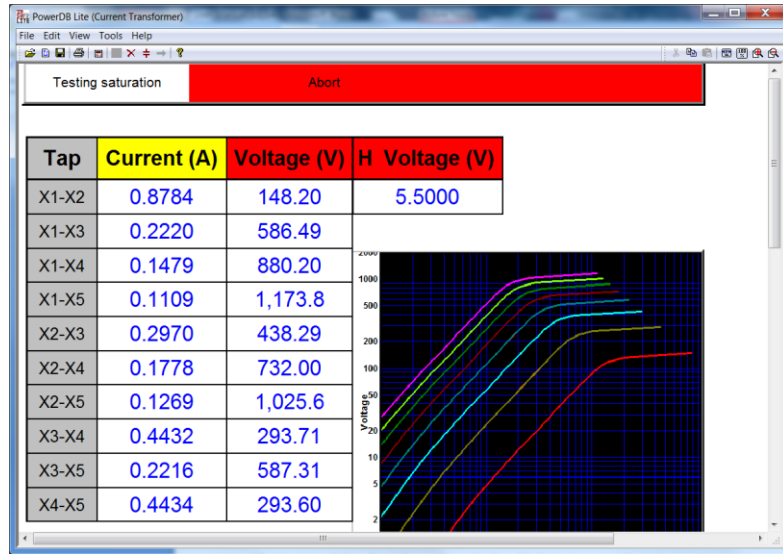


Figure 45 Saturation Testing Screen – Concurrent

- 16. Test can also be stopped under emergency condition by hitting the “Emergency Push to Stop” button on the front panel of MRCT. Unit will shut off the output voltage
- 17. After releasing the Emergency Stop Button, the test will need to be restarted
- 18. Upon completion of test, the results can be viewed in the test screen or in a test report.

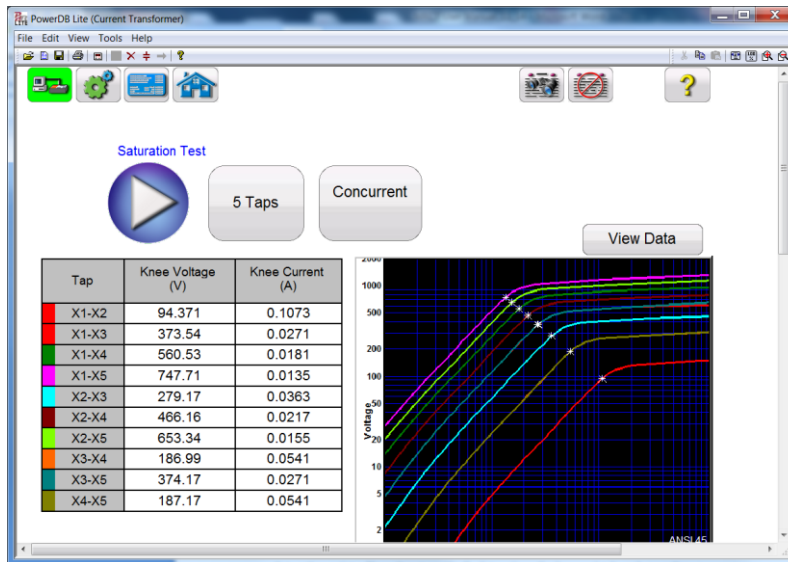


Figure 46 Saturation Results Screen – Concurrent

Saturation points: The unit automatically determines the knee point based upon the user selected standard (ANSI 30, ANSI 45 or IEC 60044-1). Saturation voltage and saturation current corresponding to that knee point are displayed along with other results at the completion of the test.

9.2.2 Method 2 – Non Concurrent or Testing a Single Tap

Refer to the safety instructions first before use of the equipment.

1. Verify the Power ON/OFF switch is OFF. Power the test set from a suitable source of power (95-125 or 195-265 V50/60 Hz).
2. Connect the ground wing nut to a suitable ground.

WARNING

There is always the possibility of voltages being induced at the terminals of a test specimen because of proximity to high voltage energized lines. A residual static voltage charge may also be present at these terminals. Ground each terminal to be tested with a safety ground stick, before making connections.

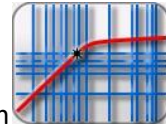
3. Connect the test set secondary output SOURCE binding posts X1S and X5S to the secondary of the current transformer on the desired tap.

4. Connect the test set secondary output binding posts X1 and X5 to secondary of the current transformer on the desired tap. Observe the polarity marks on the CT (X1 on test set is polarity terminal).
5. Connect the test set primary binding posts H1 and H2 to CT primary bushings H1 and H2. Observe the polarity marks on the CT (H1 on the test set is polarity terminal).

WARNING

The MRCT produces high voltages and currents during the performance of tests. DO NOT TOUCH connector clips or test leads while the MRCT is performing a test.

6. Turn Power ON/OFF switch to ON.



7. After the boot up, in the Home Screen select the "Saturation Test" button

8. In the saturation test screen, deselect the Concurrent Mode of operation. This will allow the user to conduct a saturation test upon an individual tap

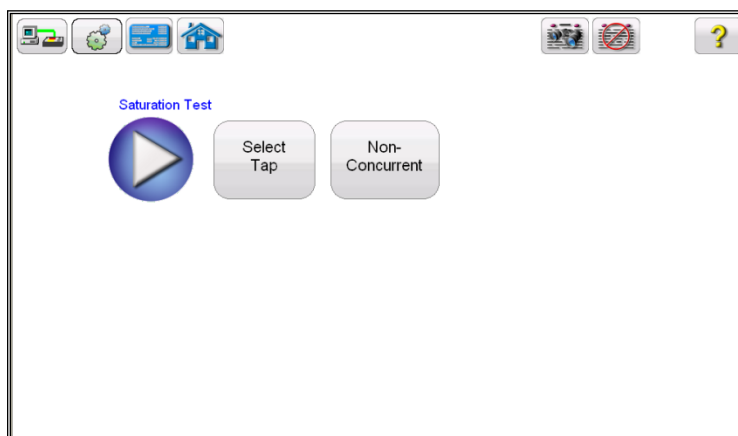
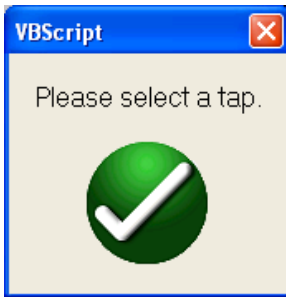


Figure 47 Saturation Test Screen – Non Concurrent

9. Hit the Select Tap function button to select the appropriate tap to be tested



- Select the tap configuration before hitting the PLAY button. If PLAY button is pressed before selecting the tap, following message will appear:



- After selecting the appropriate tap, select the play button and a connection diagram will appear showing how to correctly connect the MRCT to the CT

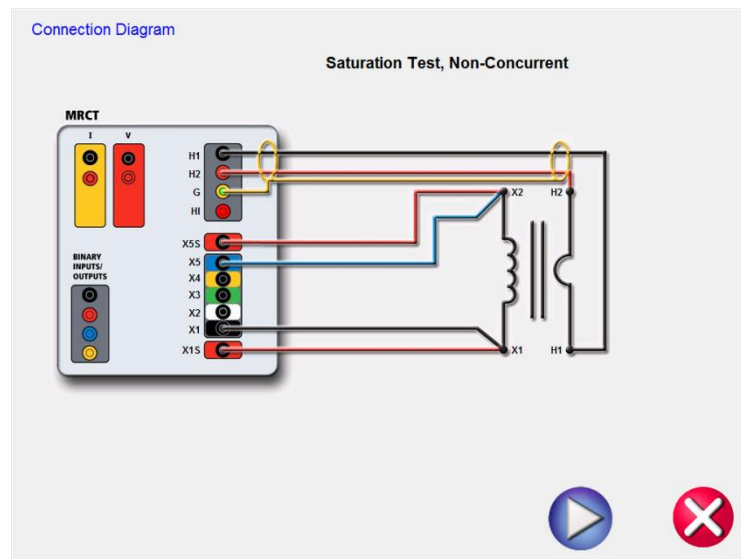


Figure 48 Saturation Connection Diagram - Non Concurrent

- Check all connections to ensure correctness



- Hit Blue Play button to begin test.

- ⇒ The saturation will begin. X Voltage (V): The MRCT displays the real time voltage readings of the secondary X winding while the test is in progress.
- ⇒ X Current (A): The MRCT the real time current readings for the secondary X winding while the test is in progress.
- ⇒ Saturation Curve: The excitation curve is Log-Log curve with secondary current on X coordinate and secondary voltage on Y coordinate. Saturation curves for all correlating taps will be graphed in the chart in the right hand corner of the screen in real time as data is accumulated.

14. At any point of time Test can be terminated by hitting the ABORT button at the top of the screen.

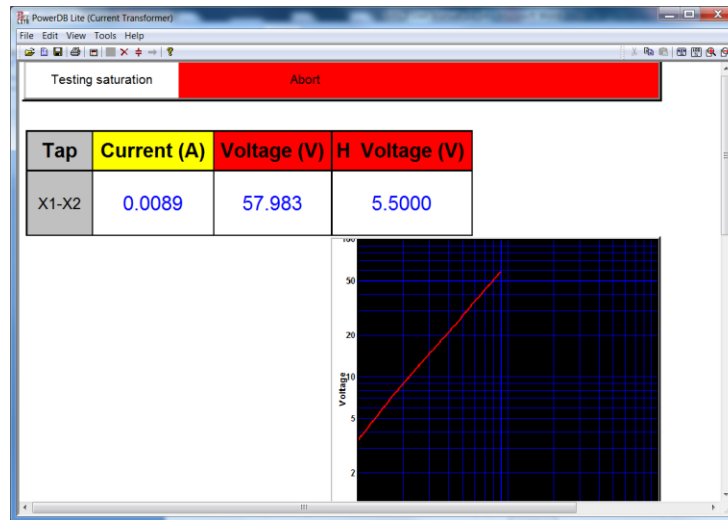


Figure 49 Saturation Test Screen Non Concurrent

- 15. The test can also be stopped under emergency condition by hitting the “Emergency Push to Stop” button on the front panel of MRCT. Unit will shut off the output voltage
- 16. After releasing the Emergency Stop Button, the test will need to be restarted
- 17. Upon completion of test the results will be displayed in the test screen or it can be displayed



in a test report by selecting the view report button

- 18. Saturation points: The unit automatically determines the knee point based upon the user selected standard (ANSI 30, ANSI 45 or IEC 60044-1). Saturation voltage and saturation current corresponding to that knee point are displayed along with other results at the completion of the test.

9.3 CT Ratio Test

9.3.1 Method 1 – Concurrent

Connections for the test set:

Refer to the safety instructions first before use of the equipment.

1. Verify the Power ON/OFF switch is OFF. Power the test set from a suitable source of power (95-265 V50/60 Hz).
2. Connect the ground wing nut to a suitable ground.

WARNING

There is always the possibility of voltages being induced at the terminals of a test specimen because of proximity to high voltage energized lines. A residual static voltage charge may also be present at these terminals. Ground each terminal to be tested with a safety ground stick, before making connections.

3. Connect the test set secondary output **SOURCE** binding posts **X1S** to the secondary of the current transformer X1, and **X5S** to the secondary of the current transformer on the most external tap.
4. Connect the test set secondary output binding posts X1 X2, X3, X4 and XN to secondary of the current transformer X1, X2, X3, X4 and X5 (if less than 5 taps are available on the CT, then connect the test set secondary output binding posts X1, X2... to the correlating secondary of the current transformer with the EXCEPTION of connecting the test set secondary output binding Xn to the most external secondary of the current transformer. For Example on a 3 Tap CT Connect X1(test set) to X1(CT), X2(test set) to X2 (CT), and Xn (test set) to X3 (CT)
5. Connect the test set primary binding posts H1 and H2 to CT primary bushings H1 and H2. Observe the polarity marks on the CT (H1 on the test set is polarity terminal).

WARNING

The MRCT produces high voltages and currents during the performance of tests. DO NOT TOUCH connector clips or test leads while the MRCT is performing a test.

6. Turn Power ON/OFF switch to ON.

- After the boot up, select the “Nameplate Information” menu by selecting



Name Plate navigation button.

- Fill in nameplate information about the CT. At a minimum, the number of taps must be selected.



From the Home Screen select the “Ratio Test” button

- In the Ratio test screen, selecting the Concurrent Mode of operation will allow the user to test multiple taps in parallel.



Figure 50 CT Ratio Test Screen – Concurrent

- Select the play button and a connection diagram will appear showing the proper connections for the MRCT to the CT

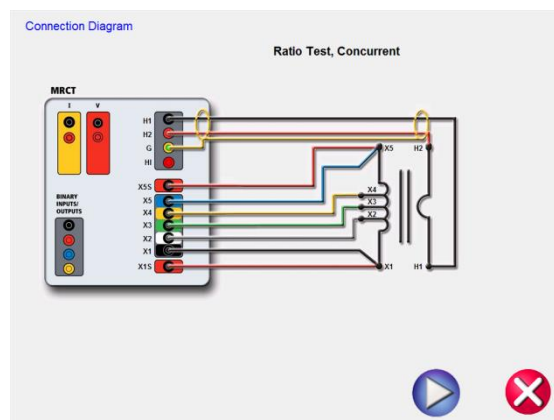


Figure 51 CT Ratio Connection Diagram – Concurrent

12 Check all connections to ensure correctness

13 Hit Blue Play button.



14 A dialog will appear requesting how much Voltage to apply to the CT during the ratio test



15 Enter a voltage 1V and 300V that is less than the knee point of the CT

16 Hit Blue Play button to begin test.



17 The Ratio Test will begin.

- ⇒ X Voltage (V): The MRCT displays the real time voltage readings of the secondary X winding while the test is in progress.
- ⇒ X Current (A): The MRCT the real time current readings for the secondary X winding while the test is in progress.
- ⇒ H Voltage (V): The MRCT the real time voltage readings of the primary H winding while the test is in progress.

19. At any point of time Test can be terminated by hitting the ABORT button at the top of the screen.

Testing ratio			
ABORT			
Tap	Current (A)	Voltage (V)	H Voltage (V)
X1-X2	0.064	46.220	0.463
X1-X3	0.016	185.83	
X1-X4	0.011	277.49	
X1-X5	0.008	370.58	
X2-X3	0.021	139.61	
X2-X4	0.013	231.27	
X2-X5	0.009	324.36	
X3-X4	0.032	91.660	
X3-X5	0.016	184.75	
X4-X5	0.032	93.090	

Figure 52 CT Ratio Test Abort

20. Test can also be stopped under emergency condition by hitting the “Emergency Push to Stop” button on the front panel of MRCT. Unit will shut off the output voltage
21. After releasing the Emergency Stop Button, the test will need to be restarted.
22. Upon completion of test, the results can be viewed in the test screen or in a test report.

TAP	NAMEPLATE RATIO	ACTUAL RATIO	RATIO % ERROR	PHASE DEV (Deg)	POLARITY	X VOLTAGE (V)	X CURRENT (A)	H VOLTAGE (V)
X1-X2	500 : 5	499.14 : 5	0.17	0.50	Correct	50.000	0.064	0.501
X1-X3	2,000 : 5	2,006.80 : 5	0.34	0.50	Correct	50.000	0.016	0.125
X1-X4	3,000 : 5	2,996.65 : 5	0.11	0.50	Correct	50.000	0.011	0.083
X1-X5	4,000 : 5	4,001.94 : 5	0.05	0.50	Correct	50.000	0.008	0.062
X2-X3	1,500 : 5	1,507.67 : 5	0.51	0.50	Correct	50.000	0.021	0.166
X2-X4	2,500 : 5	2,497.52 : 5	0.10	0.50	Correct	50.000	0.013	0.100
X2-X5	3,500 : 5	3,502.81 : 5	0.08	0.50	Correct	50.000	0.009	0.071
X3-X4	1,000 : 5	989.85 : 5	1.02	0.50	Correct	50.000	0.032	0.253
X3-X5	2,000 : 5	1,995.14 : 5	0.24	0.50	Correct	50.000	0.016	0.125
X4-X5	1,000 : 5	1,005.29 : 5	0.53	0.50	Correct	50.000	0.032	0.249

Figure 53 CT Ratio Test Results - Concurrent

Polarity: Unit automatically determines the polarity connections and displays the result as either polarity Correct or Incorrect. The phase angle deviation between the secondary and primary

voltage is also displayed along with polarity.

The ratio is defined as the number of turns in the secondary as compared to the number of turns in the primary.

$$N2/N1=V2/V1$$

Where,

N2 and N1 are no. of turns of secondary and primary windings respectively

V2 and V1 are the secondary and primary side voltage readings respectively.

A suitable voltage, below saturation is applied to the secondary of the CT under test and primary side voltage is measured to calculate the turns ratio from above expression.

9.3.2 Method 2 – Non Concurrent or Testing a Single Tap

Refer to the safety instructions first before use of the equipment.

1. Verify the Power ON/OFF switch is OFF. Power the test set from a suitable source of power (95-125 or 195-265 V50/60 Hz).
2. Connect the ground wing nut to a suitable ground.

WARNING

There is always the possibility of voltages being induced at the terminals of a test specimen because of proximity to high voltage energized lines. A residual static voltage charge may also be present at these terminals. Ground each terminal to be tested with a safety ground stick, before making connections.

3. Connect the test set secondary output **SOURCE** binding posts **X1S** and **X5S** to the secondary of the current transformer on the desired tap.
4. Connect the test set secondary output binding posts X1 and X5 to secondary of the current transformer on the desired tap. Observe the polarity marks on the CT (X1 on test set is polarity terminal).
5. Connect the test set primary binding posts H1 and H2 to CT primary bushings H1 and H2. Observe the polarity marks on the CT (H1 on the test set is polarity terminal).

WARNING

The MRCT produces high voltages and currents during the performance of tests. DO NOT TOUCH connector clips or test leads while the MRCT is performing a test.

6. Turn Power ON/OFF switch to ON.



7. After the boot up, in the Home Screen select the "Ratio Test" button
8. In the Ratio test screen, deselect the Concurrent Mode of operation. This will allow the user to conduct a ratio test upon an individual tap

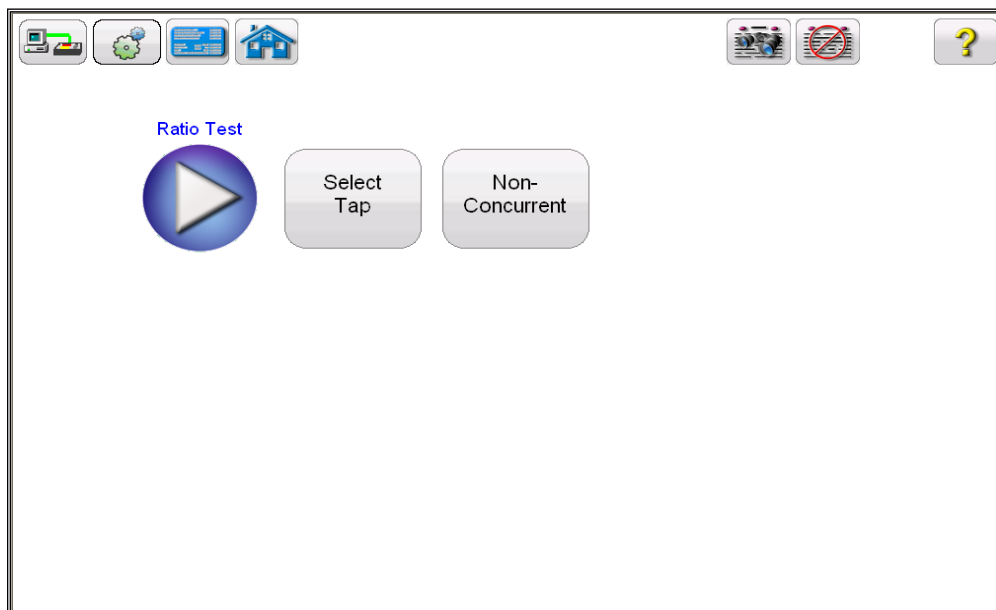
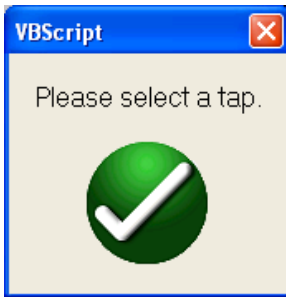


Figure 54 CT Ratio Test Screen – Non Concurrent

9. Hit the Select Tap function button to select the appropriate tap to be tested



10. Select the tap configuration before hitting the PLAY button. If PLAY button is pressed before selecting the tap, following message will appear:



11. After selecting the appropriate tap, select the play button and a connection diagram will appear showing how to correctly connect the MRCT to the CT

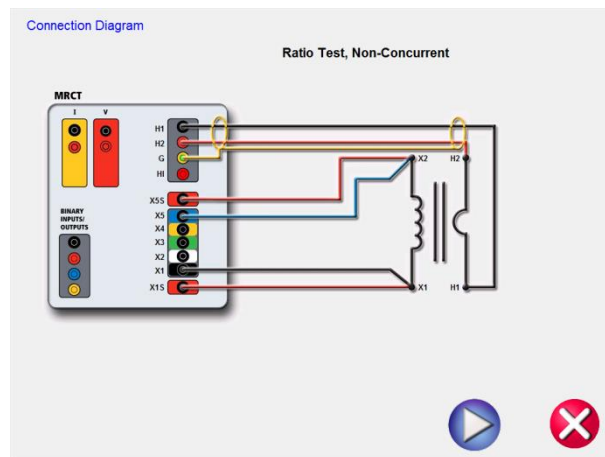
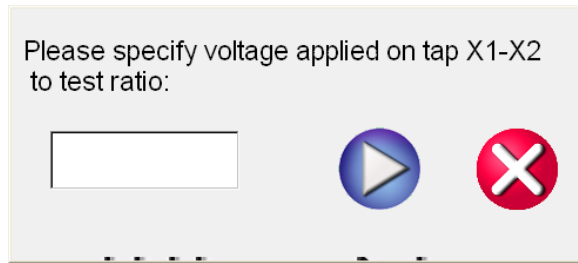


Figure 55 CT Ratio Test Connection Diagram - Non Concurrent

12. Check all connections to ensure correctness
13. Hit Blue Play button.



- A dialog will appear requesting how much Voltage to apply to the CT during the ratio test



- Enter a voltage 1V and 300V that is less than the knee point of the CT

- Hit Blue Play button to begin test.



- The Ratio test will begin.

X Voltage (V): The MRCT displays the real time voltage readings of the secondary X winding while the test is in progress.

X Current (A): The MRCT the real time current readings for the secondary X winding while the test is in progress.

H Voltage (V): The MRCT the real time voltage readings of the primary H winding while the test is in progress.

- At any point of time Test can be terminated by hitting the ABORT button at the top of the screen.

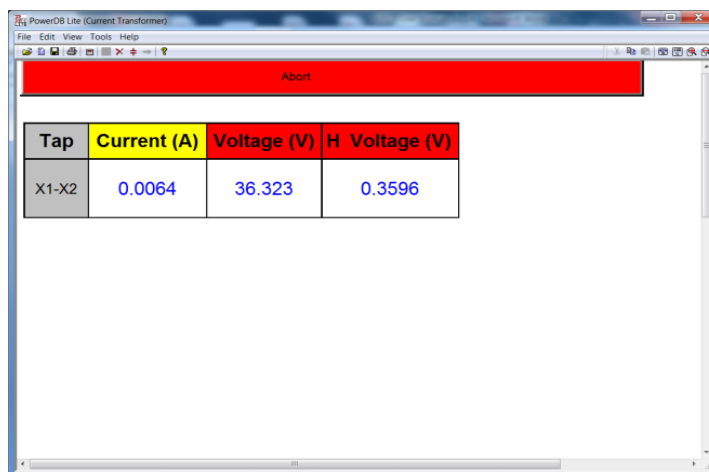


Figure 56 CT Ratio Testing Screen – Non Concurrent

19. Test can also be stopped under emergency condition by hitting the “Emergency Push to Stop” button on the front panel of MRCT. Unit will shut off the output voltage
20. After releasing the Emergency Stop Button, the test will need to be restarted.
21. Upon completion of all test the results will be displayed in the test screen or they can be displayed in a test report.

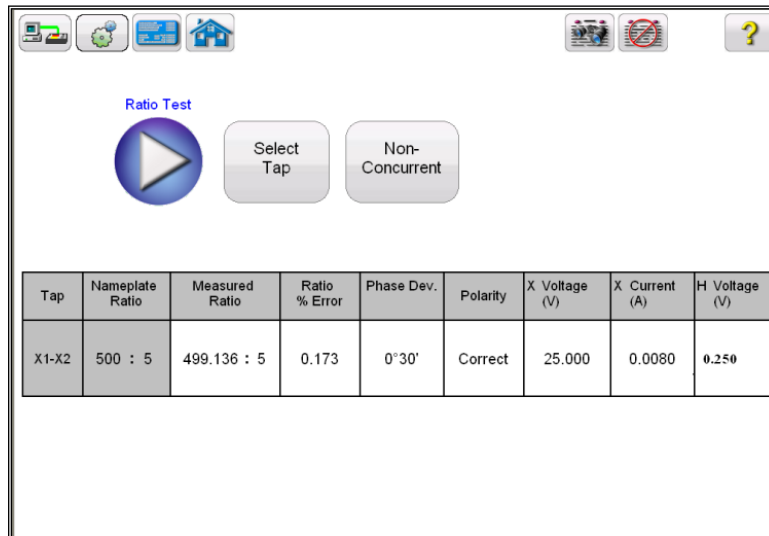


Figure 57 CT Ratio Test Results – Non Concurrent

Polarity: Unit automatically determines the polarity connections and displays the result as either polarity Correct or Incorrect. The phase angle deviation between the secondary and primary voltage is also displayed along with polarity.

The ratio is defined as the number of turns in the secondary as compared to the number of turns in the primary.

$$N2/N1=V2/V1$$

Where,

N2 and N1 are no. of turns of secondary and primary windings respectively

V2 and V1 are the secondary and primary side voltage readings respectively.

A suitable voltage, below saturation is applied to the secondary of the CT under test and primary side voltage is measured to calculate the turns ratio from above expression.

9.4 CT Winding Resistance Test:

9.4.1 Method 1 – Concurrent

Refer to the safety instructions first before use of the equipment.

1. Verify the Power ON/OFF switch is OFF. Power the test set from a suitable source of power (95-265 V50/60 Hz).
2. Connect the ground wing nut to a suitable ground.

WARNING

There is always the possibility of voltages being induced at the terminals of a test specimen because of proximity to high voltage energized lines. A residual static voltage charge may also be present at these terminals. Ground each terminal to be tested with a safety ground stick, before making connections.

3. Connect the test set secondary output **SOURCE** binding posts **X1S** to the secondary of the current transformer X1, and **X5S** to the secondary of the current transformer on the most external tap.
4. Connect the test set secondary output binding posts X1 X2, X3, X4 and XN to secondary of the current transformer X1, X2, X3, X4 and X5 (if less than 5 taps are available on the CT, then connect the test set secondary output binding posts X1, X2... to the correlating secondary of the current transformer with the EXCEPTION of connecting the test set secondary output binding Xn to the most external secondary of the current transformer. For Example on a 3 Tap CT Connect X1(test set) to X1(CT), X2(test set) to X2 (CT), and Xn (test set) to X3 (CT)

WARNING

The MRCT produces high voltages and currents during the performance of tests. DO NOT TOUCH connector clips or test leads while the MRCT is performing a test.

5. Turn Power ON/OFF switch to ON.

6. After the boot up, select the “Nameplate Information” menu by selecting



Name Plate navigation button.

7. Fill in nameplate information about the CT. At a minimum, the number of taps must be selected.



From the Home Screen select the “Winding Resistance” button

8. In the Winding Resistance test screen, selecting the Concurrent Mode of operation will allow the user to test multiple taps in parallel.



Figure 58 CT Winding Test Screen – Concurrent

9. Select the play button and a connection diagram will appear showing the proper connections for the MRCT to the CT

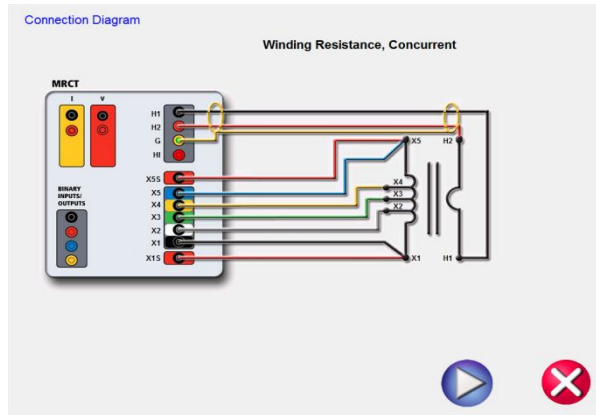


Figure 59 CT Winding Connection Diagram – Concurrent

10. Check all connections to ensure correctness

Hit Blue Play button to begin test.



11. The Winding Resistance test will begin.

- ⇒ Voltage (V): The MRCT displays the real time voltage readings of the secondary winding while the test is in progress.
- ⇒ Current (A): The MRCT the real time current readings for the secondary winding while the test is in progress.

12. At any point of time Test can be terminated by hitting the ABORT button at the top of the screen.

ABORT		
Tap	Current (A)	Voltage (V)
X1-X2	5.000	18.500
X1-X3	5.000	19.000
X1-X4	5.000	19.500
X1-X5	5.000	20.000
X2-X3	5.000	0.500
X2-X4	5.000	1.000
X2-X5	5.000	1.500
X3-X4	5.000	0.500
X3-X5	5.000	1.000
X4-X5	5.000	0.500

DC Current
5A

Figure 60 CT Winding Test ABORT

13. Test can also be stopped under emergency condition by hitting the “Emergency Push to Stop” button on the front panel of MRCT. Unit will shut off the output voltage
14. After releasing the Emergency Stop Button, the test will need to be restarted.
15. Upon completion of all tests, the results can be viewed in the test screen or in a test report.



Figure 61 CT Winding Results – Concurrent

Winding resistance test is used to determine if the dc resistance of the CT secondary winding is within specification or not. A DC current is applied and voltage is measured to determine the winding resistance for the selected tap. After measurement winding resistance is displayed in digital format on the screen.

Note: A CT should be demagnetized after running the winding resistance test. Run a saturation test to demagnetize the CT at the completion of all winding resistance tests.

9.4.2 Method 2 – Non Concurrent or Testing a Single Tap

Refer to the safety instructions first before use of the equipment.

1. Verify the Power ON/OFF switch is OFF. Power the test set from a suitable source of power (95-125 or 195-265 V50/60 Hz).
2. Connect the ground wing nut to a suitable ground.

WARNING

There is always the possibility of voltages being induced at the terminals of a test specimen because of proximity to high voltage energized lines. A residual static voltage charge may also be present at these terminals. Ground each terminal to be tested with a safety ground stick, before making connections.

3. Connect the test set secondary output **SOURCE** binding posts **X1S** and **X5S** to the secondary of the current transformer on the desired tap.
4. Connect the test set secondary output binding posts X1 and X5 to secondary of the current transformer on the desired tap. Observe the polarity marks on the CT (X1 on test set is polarity terminal).

WARNING

The MRCT produces high voltages and currents during the performance of tests. DO NOT TOUCH connector clips or test leads while the MRCT is performing a test.

5. Turn Power ON/OFF switch to ON.
6. After boot up, in the Home Screen select the “Winding Resistance Test” button In the Winding Resistance test screen, deselect the Concurrent Mode of operation. This will allow the user to conduct a winding resistance test upon an individual tap

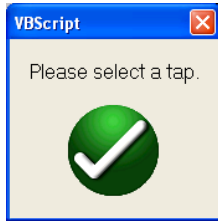


Figure 62 CT Winding Test Screen – Non Concurrent

7. Hit the Select Tap function button to select the appropriate tap to be tested



- Select the tap configuration before hitting the PLAY button. If PLAY button is pressed before selecting the tap, following message will appear:



- After selecting the appropriate tap, select the play button and a connection diagram will appear showing how to correctly connect the MRCT to the CT

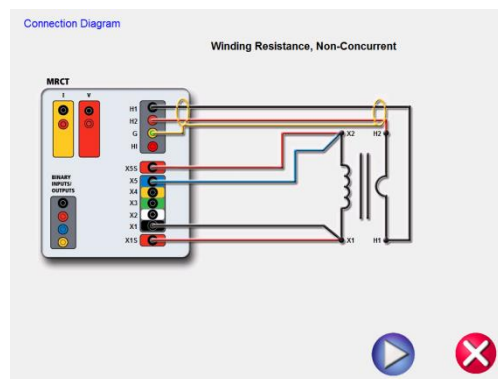


Figure 63 CT Winding Resistance Connection Diagram Non Concurrent

- Check all connections to ensure correctness

- Hit Blue Play button to begin test.



- The Winding Resistance test will begin.

⇒ X Voltage (V): The MRCT displays the real time voltage readings of the secondary X winding while the test is in progress.

⇒ X Current (A): The MRCT the real time DC current readings for the secondary X winding while the test is in progress.

13. At any point of time Test can be terminated by hitting the ABORT button at the top of the screen...

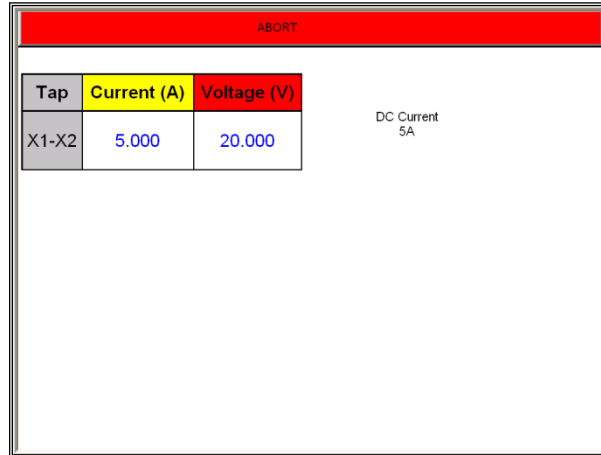


Figure 64 CT Winding Test Screen –Abort

14. Test can also be stopped under emergency condition by hitting the “Emergency Push to Stop” button on the front panel of MRCT. Unit will shut off the output voltage
15. After releasing the Emergency Stop Button, the test will need to be restarted.
16. Upon completion of all tests the results will be displayed in the test screen or in a test report.

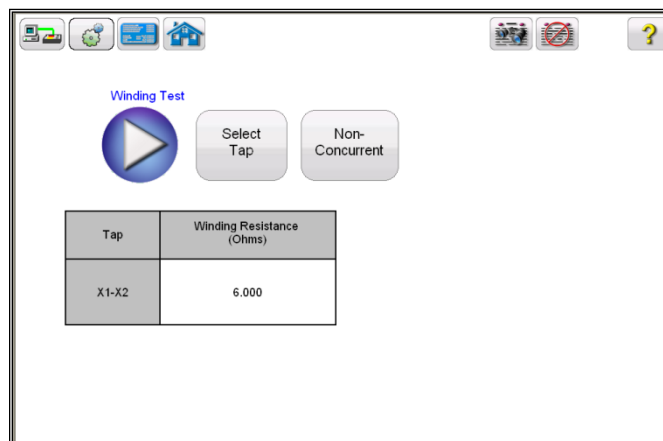


Figure 65 CT Winding Results - Non Concurrent

Winding resistance test is used to determine if the dc resistance of the CT secondary winding is within specification or not. A DC current is applied and voltage is measured to determine the winding resistance for the selected tap. After measurement winding resistance is displayed in digital and analog format on the screen.

Note: A CT should be demagnetized after running the winding resistance test. Run a saturation test to demagnetize the CT at the completion of all winding resistance tests.

9.5 CT Insulation Test:

Refer to the safety instructions first before use of the equipment.

1. Verify the Power ON/OFF switch is OFF. Power the test set from a suitable source of power (95-125 or 195-265 V50/60 Hz).
2. Connect the ground wing nut to a suitable ground.

WARNING

There is always the possibility of voltages being induced at the terminals of a test specimen because of proximity to high voltage energized lines. A residual static voltage charge may also be present at these terminals. Ground each terminal to be tested with a safety ground stick, before making connections.

3. Connect the test set secondary output **SOURCE** binding posts **X1S** and **X5S** to the secondary of the current transformer on the desired tap.
4. Connect the test set secondary output binding posts X1 and X5 to secondary of the current transformer on the tap of the Outer Winding. Observe the polarity marks on the CT (X1 on test set is polarity terminal).

WARNING

The MRCT produces high voltages and currents during the performance of tests. DO NOT TOUCH connector clips or test leads while the MRCT is performing a test.

5. Turn Power ON/OFF switch to ON.
After boot up, in the Home Screen select the “Insulation Test” button
17. In the Insulation test screen, select the desired test level of either 500V or 1 KV by using the Voltage selection button

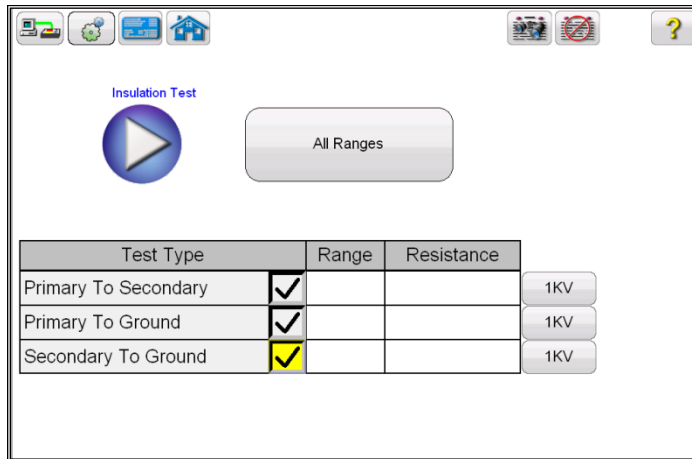


Figure 66 CT Insulation Test Screen

18. Select desired test by checking the adjacent check box next to the three available tests User can select one or any combination of the three test mode.
 - a) Primary to Secondary
 - b) Primary to Ground
 - c) Secondary to Ground
19. Select the play button and a connection diagram will appear showing how to correctly connect the MRCT to the CT

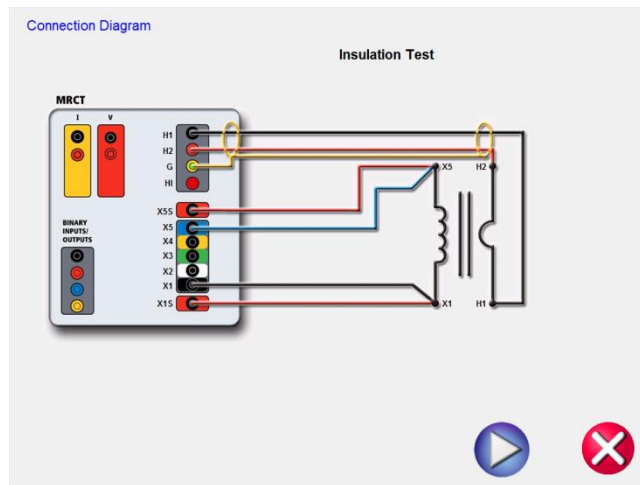


Figure 67 CT Insulation Test Connection Diagram

20. Check all connections to ensure correctness

21. Hit Blue Play button to begin test.



22. At any point of time Test can be terminated by hitting the ABORT button at the top of the screen.

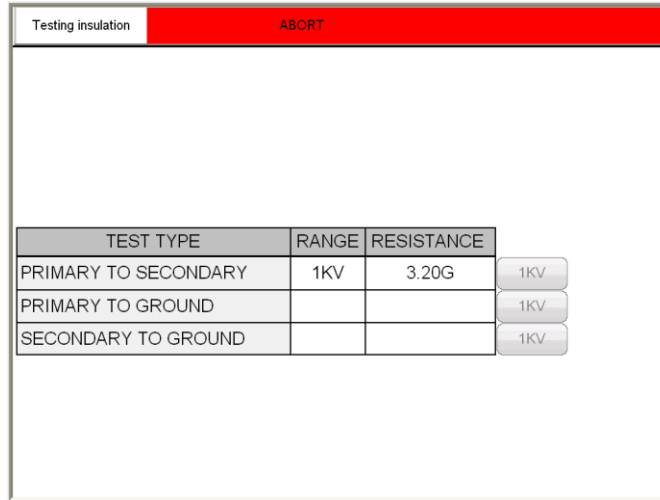


Figure 68 CT Insulation Testing Screen

23. Test can also be stopped under emergency condition by hitting the "Emergency Push to Stop" button on the front panel of MRCT. Unit will shut off the output voltage
24. After releasing the Emergency Stop Button, the test will need to be restarted the test begun again.
25. Upon completion of all tests the results will be displayed in the test screen or in a test report.

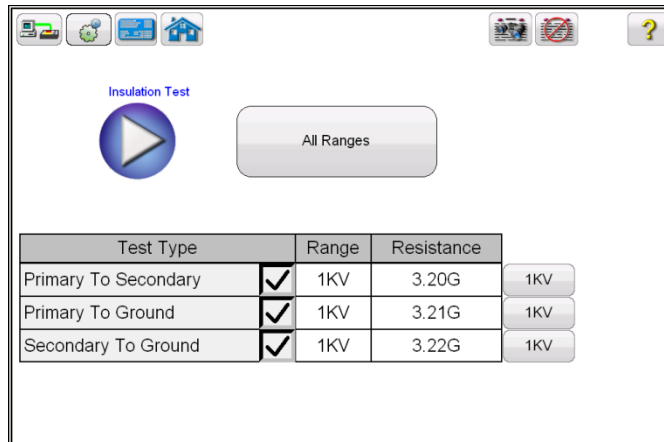


Figure 69 CT Insulation Test Results

9.6 CT Burden Test

Refer to the safety instructions first before use of the equipment.

1. Verify the Power ON/OFF switch is OFF. Power the test set from a suitable source of power (95-125 or 195-265 V50/60 Hz).
2. Connect the ground wing nut to a suitable ground.

WARNING

There is always the possibility of voltages being induced at the terminals of a test specimen because of proximity to high voltage energized lines. A residual static voltage charge may also be present at these terminals. Ground each terminal to be tested with a safety ground stick, before making connections.

3. Disconnect the burden on de-energized CT.
Note: Refer to the Burden Test connection diagram below for more details.
4. Connect the test set secondary output binding posts X1S and X5S to either side of the burden of the CT
5. Connect the test set primary binding posts H1 and H2 to either side of the CT burden. and H2.

WARNING

The MRCT produces high voltages and currents during the performance of tests. DO NOT TOUCH connector clips or test leads while the MRCT is performing a test.

6. Turn Power ON/OFF switch to ON.
After the boot up, in the Home Screen select the “Burden Test” button
7. In the Burden test screen, select the appropriate test current of either 1 Amp or 5 Amp based upon secondary current rating of the CT under test



Figure 70 CT Burden Test Screen

8. Select the play button and a connection diagram will appear showing how to correctly connect the MRCT to the CT

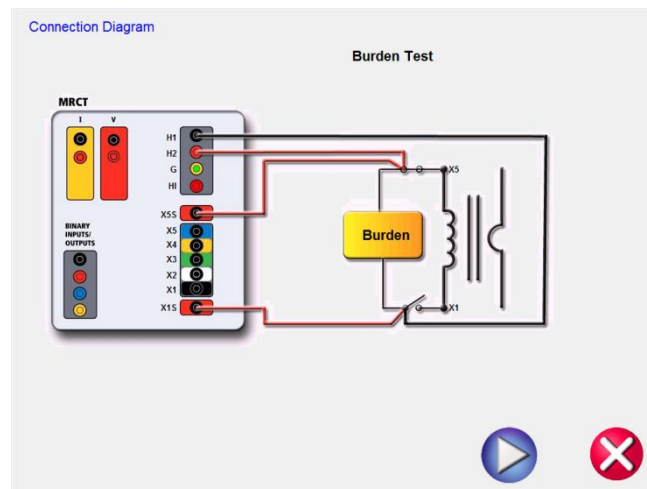


Figure 71 CT Burden Test Connection Diagram

9. Check all connections to ensure correctness
10. Hit Blue Play button to begin test.

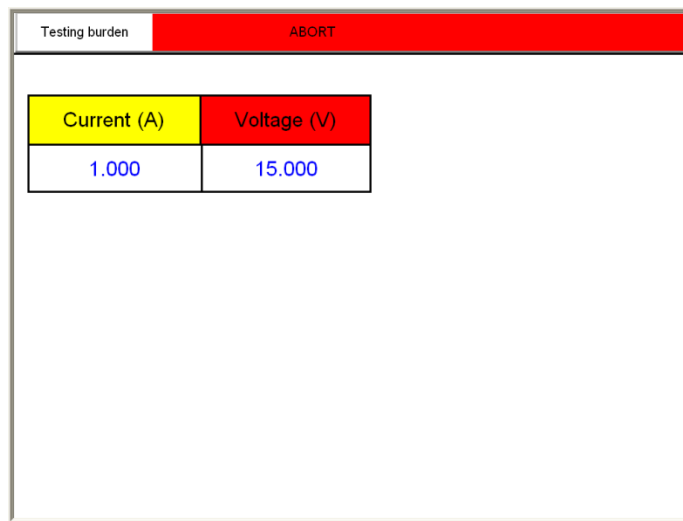


11. The Burden test will begin.

Voltage (V): The MRCT displays the real time voltage readings of the burden while the test is in progress.

Current (A): The MRCT the real time current readings for the burden while the test is in progress.

12. At any point of time Test can be terminated by hitting the ABORT button at the top of the screen. The following message will appear.



Current (A)	Voltage (V)
1.000	15.000

The screenshot shows a software interface for a CT Burden Test. At the top, there is a red bar with the text 'Testing burden' on the left and 'ABORT' on the right. Below this bar is a table with two columns: 'Current (A)' and 'Voltage (V)'. The 'Current (A)' column has a yellow background and displays the value '1.000'. The 'Voltage (V)' column has a red background and displays the value '15.000'.

Figure 72 CT Burden Test Abort

13. Test can also be stopped under emergency condition by hitting the “Emergency Push to Stop” button on the front panel of MRCT. Unit will shut off the output voltage
14. After releasing the Emergency Stop Button, the test will need to be restarted.
15. Upon completion of all tests the results will be displayed in the test screen or in a test report.

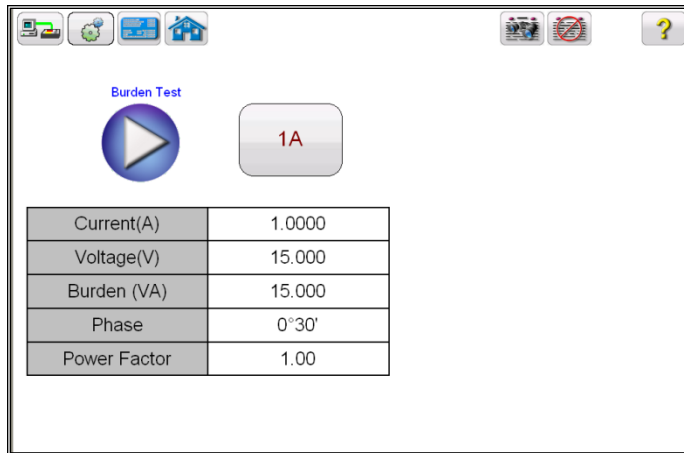


Figure 73 CT Burden Test Results Screen

Burden test is performed to verify that CT under test is capable of supplying a known current into a know burden while maintaining its stated accuracy. A burden test is typically performed at full rated secondary current value. Burdens are typically expressed in VA

X Current (A): It displays the applied current (user selected 1A or 5A) to the burden of the CT.

X Voltage (V): It displays the real time measured voltage across the burden of the CT.

Burden VA: Displays the burden on the CT in VA, after the completion of test.

Phase angle: Displays phase angle between X Current and X Voltage

PF: Displays ratio of real power to apparent power.

9.7 Manual Test of CT

Refer to the safety instructions first before use of the equipment.

1. Verify the Power ON/OFF switch is OFF. Power the test set from a suitable source of power (95-125 or 195-265 V50/60 Hz).
2. Connect the ground wing nut to a suitable ground.

WARNING

There is always the possibility of voltages being induced at the terminals of a test specimen because of proximity to high voltage energized lines. A residual static voltage

3. Disconnect the burden on de-energized CT.

Note: Refer to the Burden Test connection diagram below for more details..

- Connect the test set secondary output binding posts X1S and X5S to either side of the burden of the CT
- Connect the test set primary binding posts H1 and H2 to either side of the CT burden. and H2.

WARNING

The MRCT produces high voltages and currents during the performance of tests. DO NOT TOUCH connector clips or test leads while the MRCT is performing a test.

- Turn Power ON/OFF switch to ON.



- After the boot up, in the Home Screen select the “Manual Test” button

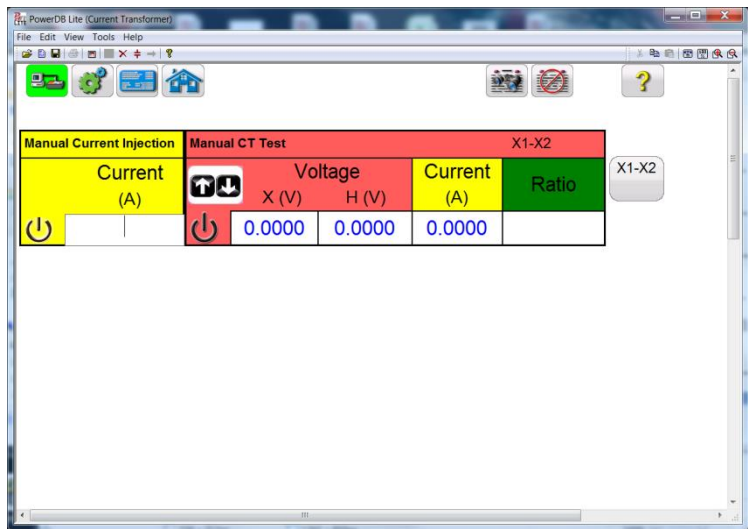

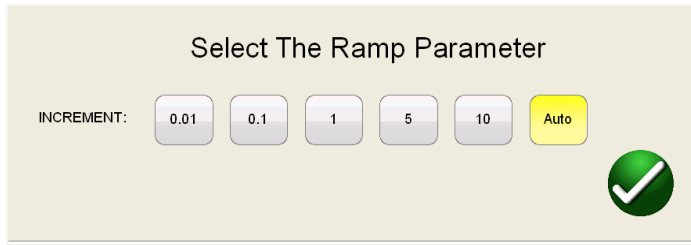


Figure 74 CT Manual Test Screen



- In the Manual Test screen, by selecting the Ramp adjustment button , the user may select the amount of increment the voltage is either decreased or increased by turning the knob on the STVI.



9. After making this selection, select the appropriate tap to be tested,

10. Begin the test by selecting the blue play button.



A connection diagram will appear showing the correct connects

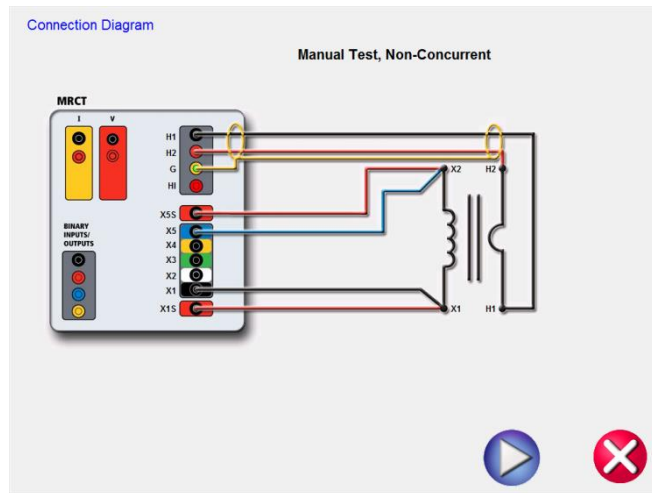


Figure 75 CT Manual Test Connection Diagram

11. Ensure the MRCT is properly connected.

12. Begin the test by selecting the Blue play button.



13. The MRCT will display:

Secondary (X) Voltage: The applied secondary test voltage is displayed on the screen in digital readout form.

Primary (H) Voltage: The measured primary voltage is displayed on the screen in digital readout form.

Secondary(X) Current: The secondary current is displayed for user reference to monitor while performing ratio and saturation tests.

14. Ramp the voltage up and down by turning the knob on the STVI or selecting the up/down arrows on a PC
15. At the desired voltage level select the Record Button and the secondary voltage and current levels will stored and then this point will be graphed into a log-log format.
16. This Manual Test allows the user to manual create saturation curves.

9.8 CT Demagnetization

Refer to the safety instructions first before use of the equipment.

1. Verify the Power ON/OFF switch is OFF. Power the test set from a suitable source of power (95-125 or 195-265 V50/60 Hz).
2. Connect the ground wing nut to a suitable ground.

WARNING

There is always the possibility of voltages being induced at the terminals of a test specimen because of proximity to high voltage energized lines. A residual static voltage charge may also be present at these terminals. Ground each terminal to be tested with a safety ground stick, before making connections.

3. Disconnect the burden on de-energized CT.
Note: Refer to the Burden Test connection diagram below for more details..
4. Connect the test set secondary output binding posts X1S and X5S to either side of the burden of the CT
5. Connect the test set primary binding posts H1 and H2 to either side of the CT burden. and H2.

WARNING

The MRCT produces high voltages and currents during the performance of tests. DO NOT TOUCH connector clips or test leads while the MRCT is performing a test.

6. Turn Power ON/OFF switch to ON.



7. After the boot up, in the Home Screen select the “Demagnetization” button
8. A connection diagram will appear showing how to properly connect the MRCT to the CT.

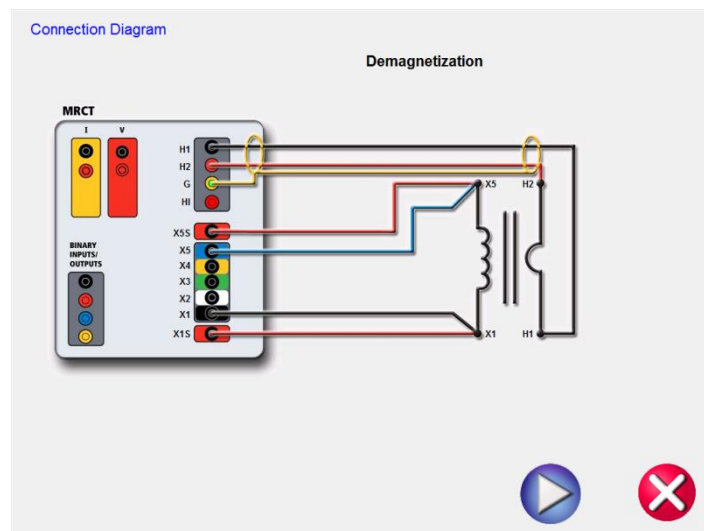


Figure 76 CT Demagnetization Connection Diagram

9. Confirming all the connections are correct,
10. Continue with demagnetizing the CT by selecting the Blue Play button CHECK. The red X will cancel the operation.
11. After selecting to continue the operation, the user will be advised that the CT is being demagnetized

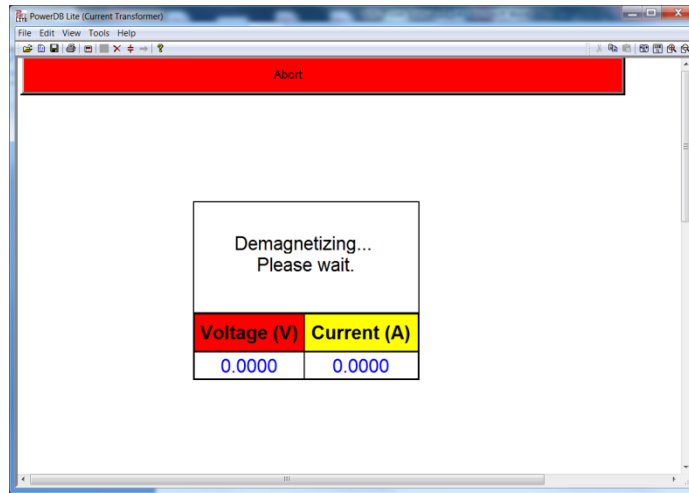


Figure 77 CT Demagnetizing Screen

12. Upon completion, the user will be returned to the Home Screen and notified the demagnetization process is complete.

10.0 Step by Step Testing an Inductive VT with MRCT

10.1 Running a Complete Test of VT and Test Plan Creation

Refer to the safety instructions first before use of the equipment.

1. Verify the Power ON/OFF switch is OFF. Power the test set from a suitable source of power (95-265 V50/60 Hz).
2. Connect the ground wing nut to a suitable ground.

WARNING

There is always the possibility of voltages being induced at the terminals of a test specimen because of proximity to high voltage energized lines. A residual static voltage charge may also be present at these terminals. Ground each terminal to be tested with a safety ground stick, before making connections.

WARNING

The MRCT produces high voltages and currents during the performance of tests. DO NOT TOUCH connector clips or test leads while the MRCT is performing a test.

3. Turn Power ON/OFF switch to ON.
4. After the boot up, set the testing mode to VT and select the “Nameplate Information” menu by selecting



Name Plate navigation button.

5. Fill in nameplate information about the VT. At a minimum, the number VA rating and the secondary voltage of the VT must be entered
6. In the Home Screen, select the Run All Tests button. Within the Run All Test screen select all of the tests by placing a check in the adjacent box

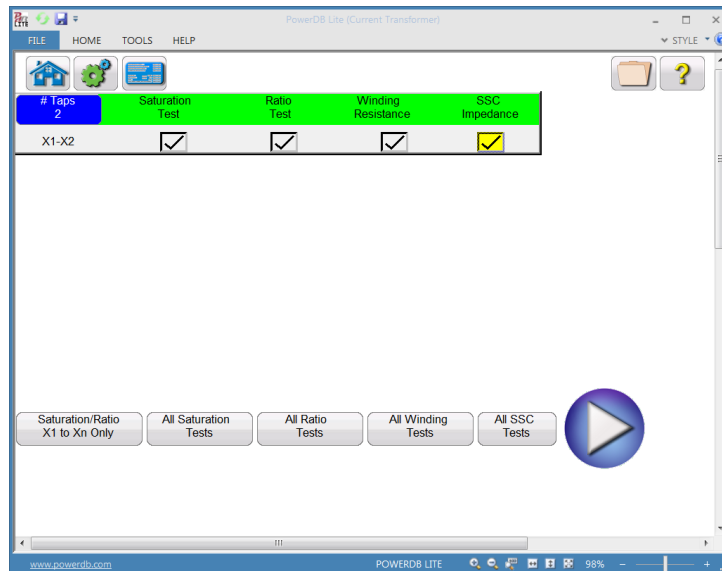


Figure 78 VT Test Plan Screen

7. Select the individual taps for saturation testing by placing a check in the corresponding

box. Or select all taps by selecting the



button. This will place a check

8. Select the individual taps for ratio testing by placing a check in the corresponding

box. Or select all taps by selecting the



button. This will place a check

9. Select the individual taps for Winding Res testing by placing a check in the corresponding

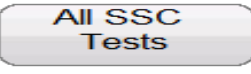
box. Or select all taps by selecting the



button. This will place a check

10. Select the individual taps for Short Circuit Impedance testing by placing a check in the corresponding

box. Or select all taps by selecting the



button. This will place a check

11. At this point, this test file could be saved, opened at a later date , and ran.

12. It can also be ran at this time by selecting the Blue Play button



13. A connection diagram will appear showing how to properly connect the MRCT to the VT

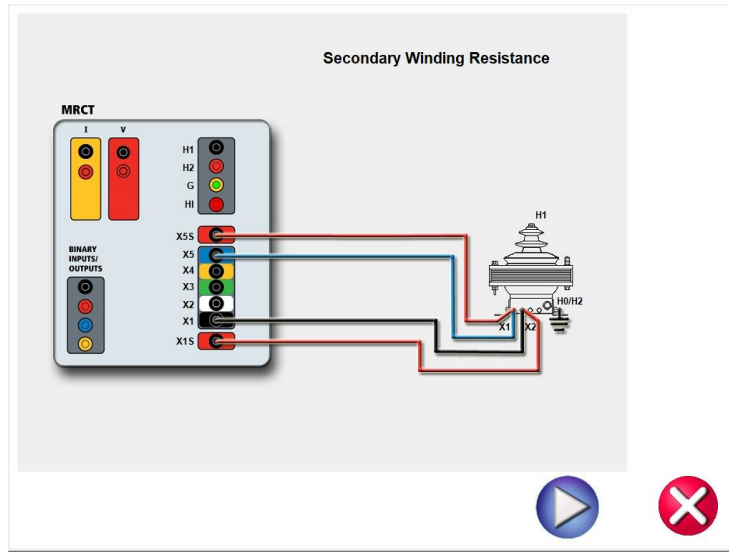


Figure 79 VT Connection Diagram for Winding Resistance

14. Continue the test by selecting the Blue Play button



15. At any point of time Test can be terminated by hitting the ABORT button at the top of any testing screen.

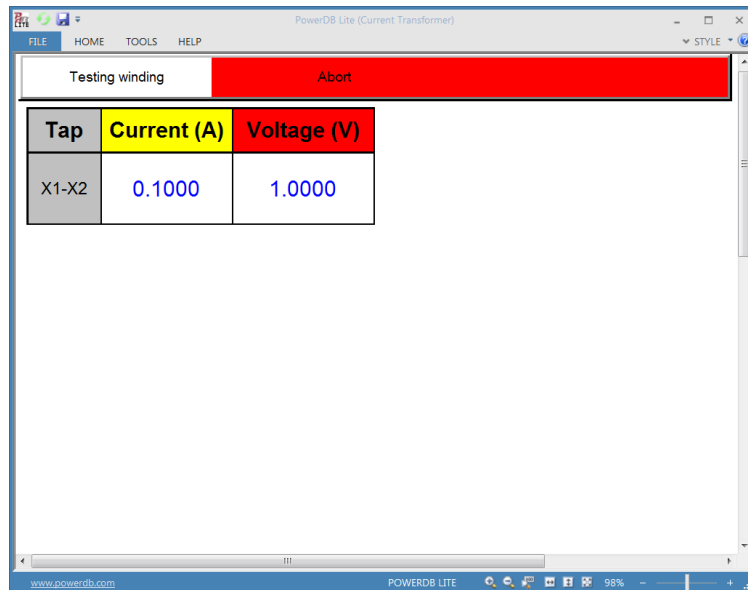


Figure 80 VT Winding Resistance Abort

16. Test can also be stopped under emergency condition by hitting the “Emergency Push to Stop” button on the front panel of MRCT. Unit will shut off the output voltage
17. After releasing the Emergency Stop Button, the test will need to be restarted
18. Upon completion of Winding Resistance Test, the MRCT will automatically demagnetize the VT

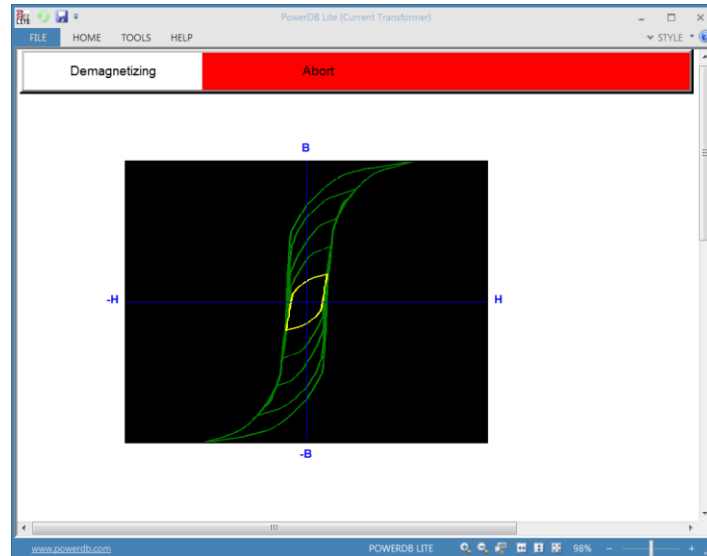


Figure 81 VT Demagnetization

19. Upon completion of demagnetization the MRCT will then perform an excitation/saturation test on the VT

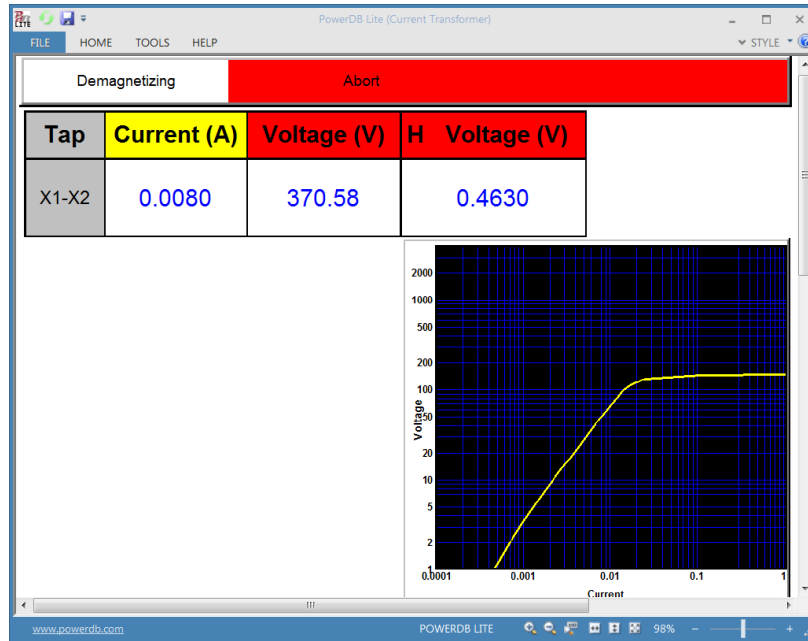


Figure 82 VT Saturation/Excitation Test

20 Upon completion of the excitation test, the MRCT will stop and display a connection diagram for the Secondary Short Circuit Impedance test

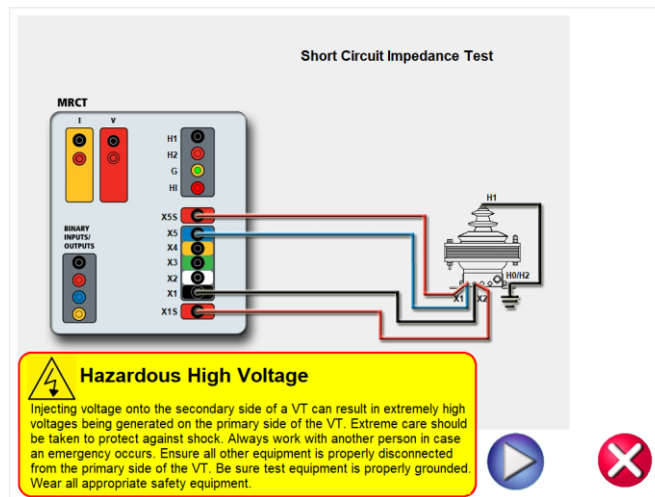


Figure 83 VT Short Circuit Impedance Connection Diagram

- 21 Follow the connection diagram and ensure the MRCT is properly connected for this test.
- 22 Select the Blue Play Button to continue the test



23 After completion of the Impedance test, the MRCT will display the connection diagram for the Ratio Test

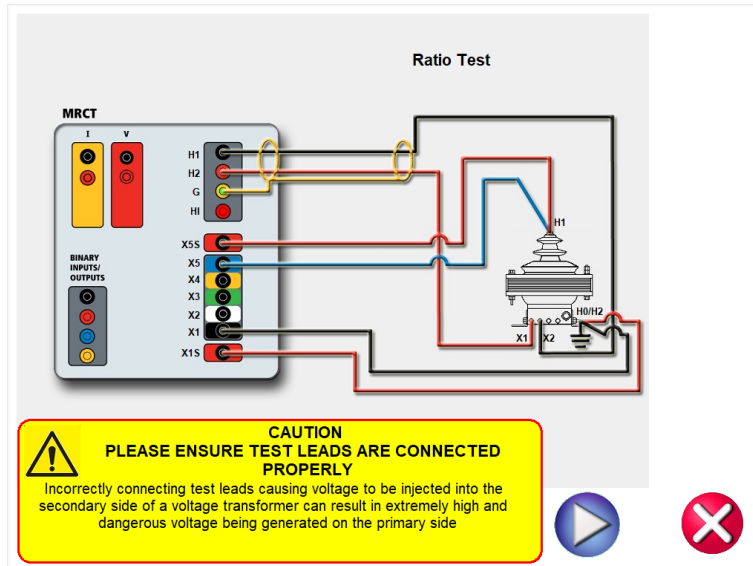


Figure 84 VT Ratio Test Connection Diagram

24 Follow the connection diagram and ensure the MRCT is properly connected for this test

25 Select the Blue Play Button to continue the test



26 After completion of the ratio test, the MRCT will take all the measurements and build a test report. This test report will be automatically displayed.

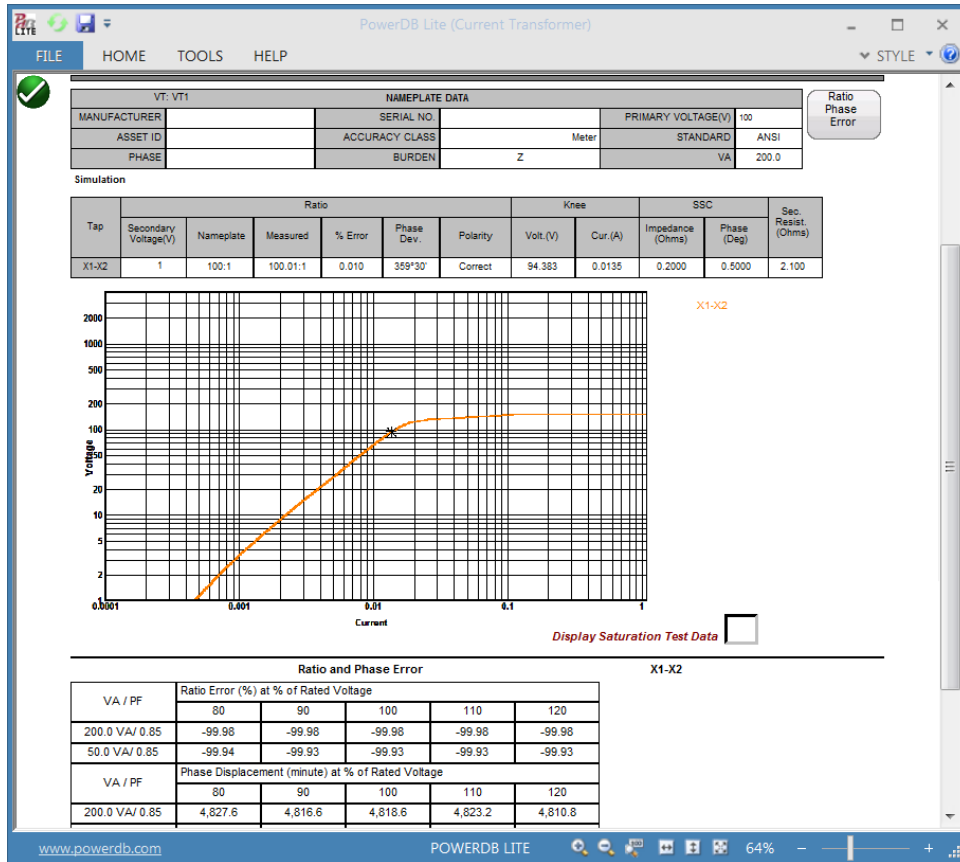


Figure 85 Sample VT Test Report

10.2 Testing Voltage Transformer Ratio and Phase

Refer to the safety instructions first before use of the equipment.

1. Verify the Power ON/OFF switch is OFF. Power the test set from a suitable source of power (95-125 or 195-265 V50/60 Hz).
2. Connect the ground wing nut to a suitable ground.

WARNING

There is always the possibility of voltages being induced at the terminals of a test specimen because of proximity to high voltage energized lines. A residual static voltage charge may also be present at these terminals. Ground each terminal to be tested with a safety ground stick, before making connections.

3. Connect the test set secondary output **SOURCE** binding posts **X1S** and **X5S** to the primary of the voltage transformer..

4. Connect the test set secondary output binding posts X1 and X5 to primary of the voltage transformer. Observe the polarity marks on the VT (X1 on test set is polarity terminal).
5. Connect the test set primary binding posts H1 and H2 to the secondary terminals of the voltage transformer. Observe the polarity marks on the VT (H1 on the test set is polarity terminal).

WARNING

The MRCT produces high voltages and currents during the performance of tests. DO NOT TOUCH connector clips or test leads while the MRCT is performing a test.

6. Turn Power ON/OFF switch to ON.
7. After the boot up, in the Home Screen first put the MRCT into voltage transformer mode by selecting the VT button.
8. After the MRCT has been placed into the voltage transformer mode, select the “Ratio

Test” button .

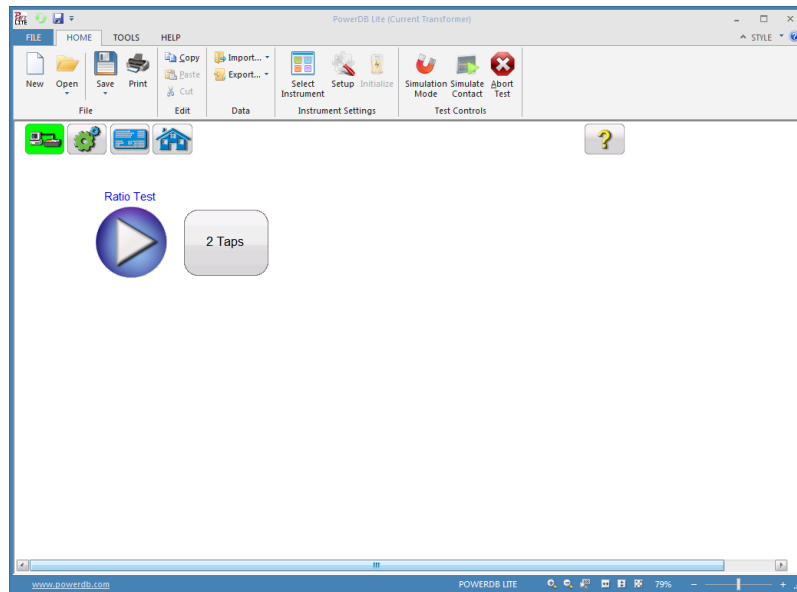


Figure 86 VT Ratio Test Screen

- Select the blue play button to begin the test and a connection diagram will appear showing how to correctly connect the MRCT to the VT

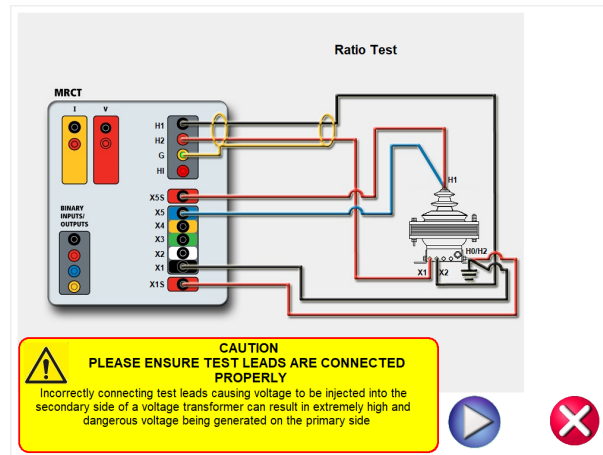


Figure 87 VT Ratio Test Connection Diagram

- Check all connections to ensure correctness

- Hit Blue Play button.



- The Ratio test will begin.

Voltage (V): The MRCT displays the real time voltage readings of the primary while the test is in progress.

Current (A): The MRCT the real time current readings for the primary while the test is in progress.

X Voltage (V): The MRCT the real time voltage readings of the secondary while the test is in progress.

- At any point of time Test can be terminated by hitting the ABORT button at the top of the screen.

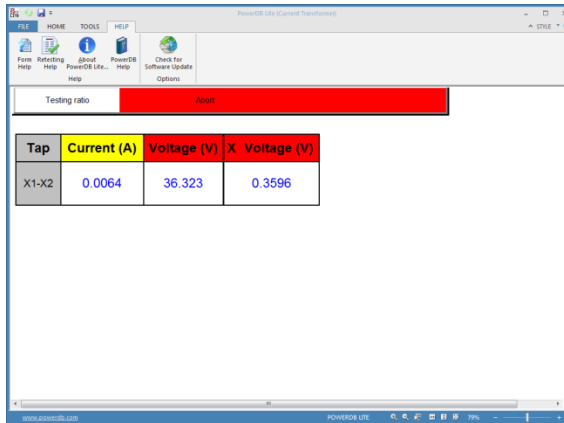


Figure 88 VT Ratio Testing Screen

14. Test can also be stopped under emergency condition by hitting the “Emergency Push to Stop” button on the front panel of MRCT. Unit will shut off the output voltage
15. After releasing the Emergency Stop Button, the test will need to be restarted.
16. Upon completion of the test the results will be displayed in the test screen or they can be displayed in a test report.

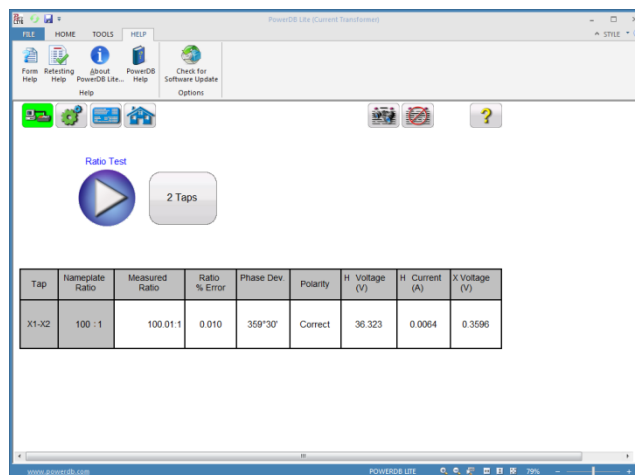


Figure 89 VT Ratio Test Results

A variable AC source is applied on the primary side. The primary and secondary voltages are measured to determine the ratio V_2/V_1

The angle between the primary system voltage V_p and the secondary voltage V_s is the phase error.

10.3 Testing Voltage Transformer – Saturation/Excitation Test

Refer to the safety instructions first before use of the equipment.

1. Verify the Power ON/OFF switch is OFF. Power the test set from a suitable source of power (95-125 or 195-265 V50/60 Hz).
2. Connect the ground wing nut to a suitable ground.

WARNING

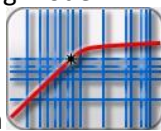
There is always the possibility of voltages being induced at the terminals of a test specimen because of proximity to high voltage energized lines. A residual static voltage charge may also be present at these terminals. Ground each terminal to be tested with a safety ground stick, before making connections.

3. Connect the test set secondary output binding posts X1 and X5 to secondary of the current transformer on the desired tap. Observe the polarity marks on the VT (X1 on test set is polarity terminal).

WARNING

The MRCT produces high voltages and currents during the performance of tests. DO NOT TOUCH connector clips or test leads while the MRCT is performing a test.

4. Turn Power ON/OFF switch to ON.
5. After the boot up, in the Home Screen, select the VT button at the top of the screen to put the MRCT in voltage transformer testing mode.



6. Select the “Saturation Test” button. This will bring the user to the Saturation/Excitation test screen

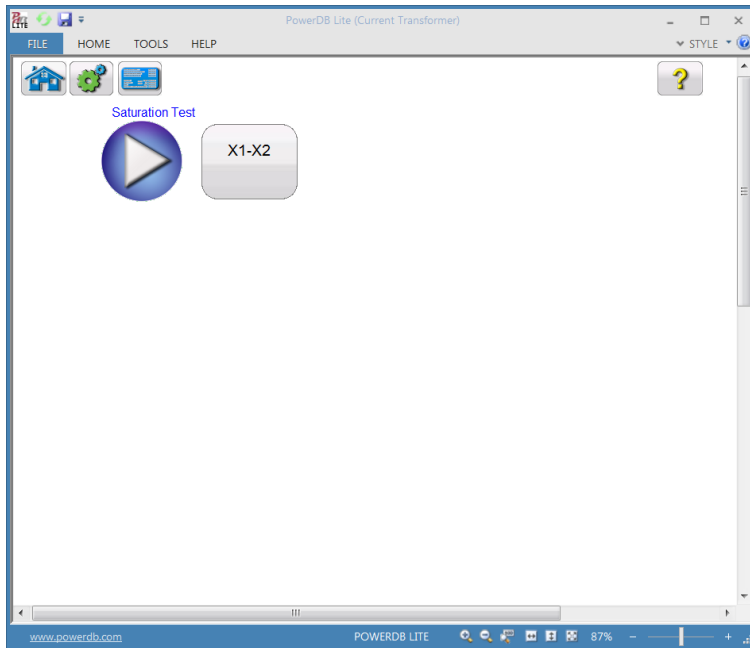


Figure 90 VT Saturation Test Screen

7. Select the blue play button and a connection diagram will appear showing how to correctly connect the MRCT to the VT

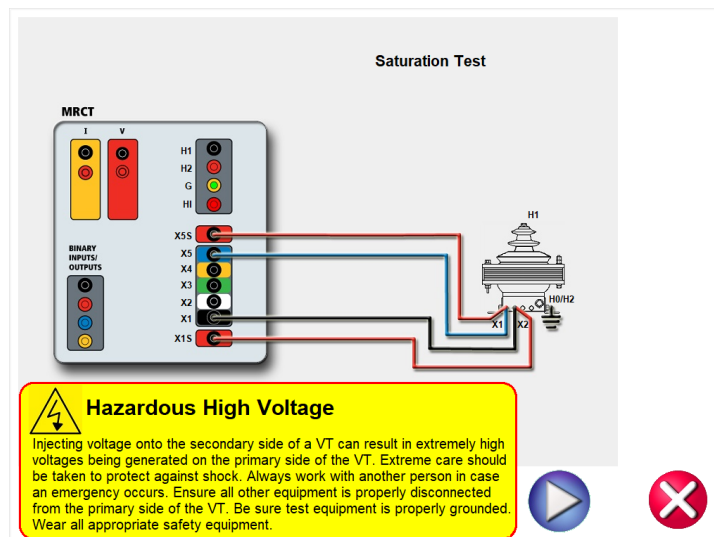


Figure 91 VT Saturation Connection Diagram

8. Check all connections to ensure correctness



9. Hit Blue Play button to begin test.
10. The saturation will begin and the test voltage and current will be displayed
 - ⇒ X Current (A): The MRCT the real time current readings for the secondary winding while the test is in progress.
 - ⇒ X Voltage (V): The MRCT displays the real time voltage readings of the secondary winding while the test is in progress.
 - ⇒ Saturation Curve: The excitation curve is Log-Log curve with secondary current on X coordinate and secondary voltage on Y coordinate. The Saturation curve will be graphed in the chart in the right hand corner of the screen in real time as data is accumulated.
11. At any point of time Test can be terminated by hitting the ABORT button at the top of the screen.

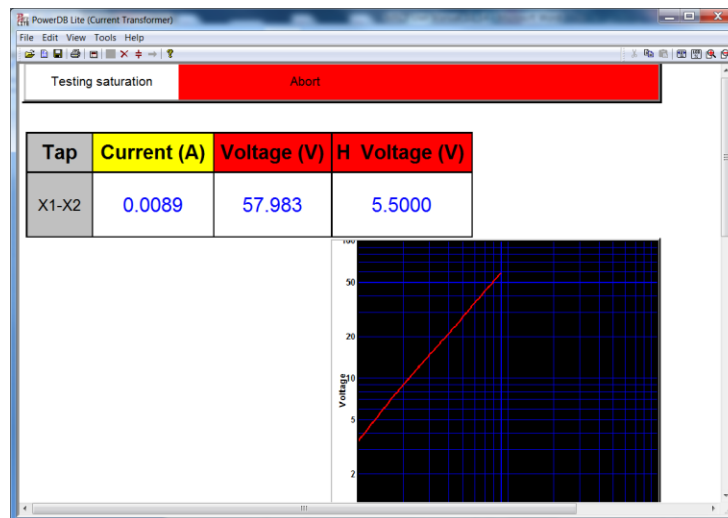


Figure 92 VT Saturation Test Screen

12. The test can also be stopped under emergency condition by hitting the "Emergency Push to Stop" button on the front panel of MRCT. Unit will shut off the output voltage
13. After releasing the Emergency Stop Button, the test will need to be restarted
14. Upon completion of test the results will be displayed in the test screen or it can be displayed



in a test report by selecting the view report button

10.4 Testing Voltage Transformer Secondary Winding Resistance

Refer to the safety instructions first before use of the equipment.

1. Verify the Power ON/OFF switch is OFF. Power the test set from a suitable source of power (95-125 or 195-265 V50/60 Hz).
2. Connect the ground wing nut to a suitable ground.

WARNING

There is always the possibility of voltages being induced at the terminals of a test specimen because of proximity to high voltage energized lines. A residual static voltage charge may also be present at these terminals. Ground each terminal to be tested with a safety ground stick, before making connections.

3. Connect the test set secondary output **SOURCE** binding posts **X1S** and **X5S** to the **desired** secondary terminals of the voltage transformer.
4. . Observe the polarity marks on the VT(X1 on test set is polarity terminal).

WARNING

The MRCT produces high voltages and currents during the performance of tests. DO NOT TOUCH connector clips or test leads while the MRCT is performing a test.

5. Turn Power ON/OFF switch to ON.
6. After boot up, in the Home Screen put the MRCT in voltage transformer testing mode by selecting the VT button.
7. Select the “Winding Resistance Test” button In the VT section of the Home Screen. This will activate the winding resistance test screen

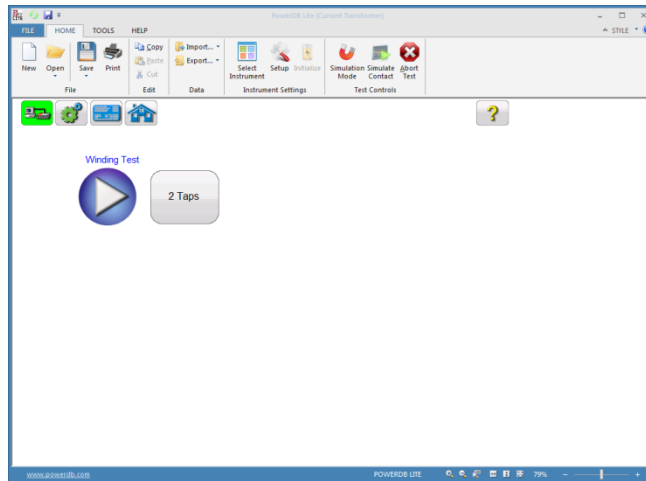


Figure 93 VT Winding Test Screen

8. Select the play button and a connection diagram will appear showing how to correctly connect the MRCT to the VT

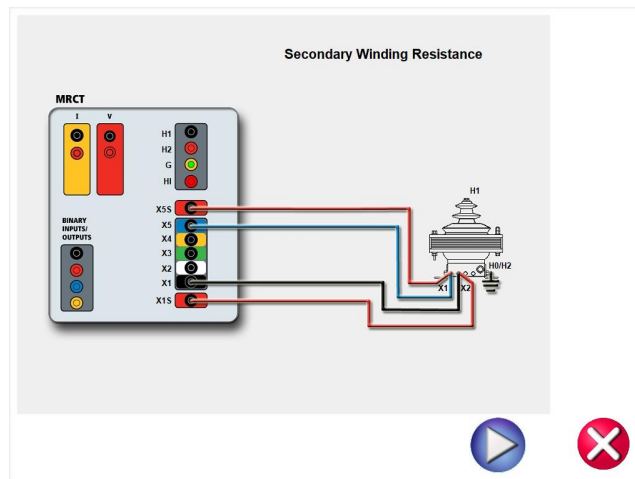


Figure 94 VT Winding Resistance Connection Diagram

9. Check all connections to ensure correctness

10. Hit Blue Play button to begin test.



11. The Winding Resistance test will begin.

- ⇒ X Voltage (V): The MRCT displays the real time voltage readings of the secondary X winding while the test is in progress.
- ⇒ X Current (A): The MRCT the real time DC current readings for the secondary X winding while the test is in progress.

12. At any point of time Test can be terminated by hitting the ABORT button at the top of the screen...

Tap	Current (A)	Voltage (V)
X1-X2	5.000	20.000

DC Current
5A

Figure 95 VT Winding Test Screen –Abort

13. Test can also be stopped under emergency condition by hitting the “Emergency Push to Stop” button on the front panel of MRCT. Unit will shut off the output voltage and current
14. After releasing the Emergency Stop Button, the test will need to be restarted.
15. Upon completion of test the results will be displayed in the test screen or in a test report if desired.

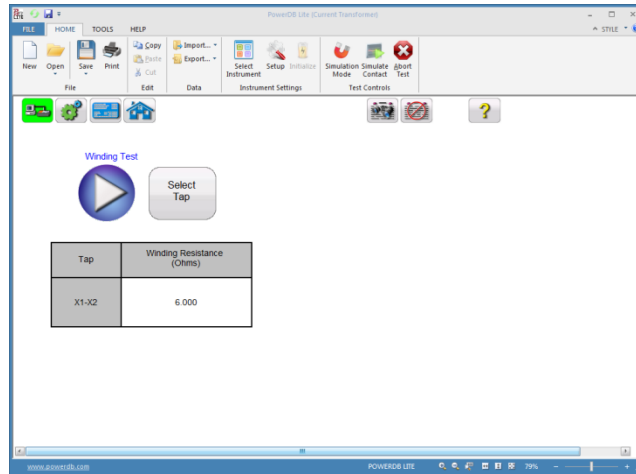


Figure 96 VT Winding Results

Winding resistance test is used to determine if the dc resistance of the VT secondary winding is within specification or not. A DC current is applied and voltage is measured to determine the winding resistance for the selected winding. After measurement the winding resistance is calculated displayed in on the screen.

10.5 Testing Voltage Transformer: Secondary Short Circuit Impedance

Refer to the safety instructions first before use of the equipment.

1. Verify the Power ON/OFF switch is OFF. Power the test set from a suitable source of power (95-125 or 195-265 V50/60 Hz).
2. Connect the ground wing nut to a suitable ground.

WARNING

There is always the possibility of voltages being induced at the terminals of a test specimen because of proximity to high voltage energized lines. A residual static voltage charge may also be present at these terminals. Ground each terminal to be tested with a safety ground stick, before making connections.

WARNING

The MRCT produces high voltages and currents during the performance of tests. DO NOT TOUCH connector clips or test leads while the MRCT is performing a test.

3. Turn Power ON/OFF switch to ON.
4. After boot up, in the Home Screen put the MRCT in voltage transformer testing mode by selecting the VT button.
5. Select the “Secondary Short Circuit Impedance” button In the VT section of the Home Screen. This will activate the impedance test screen

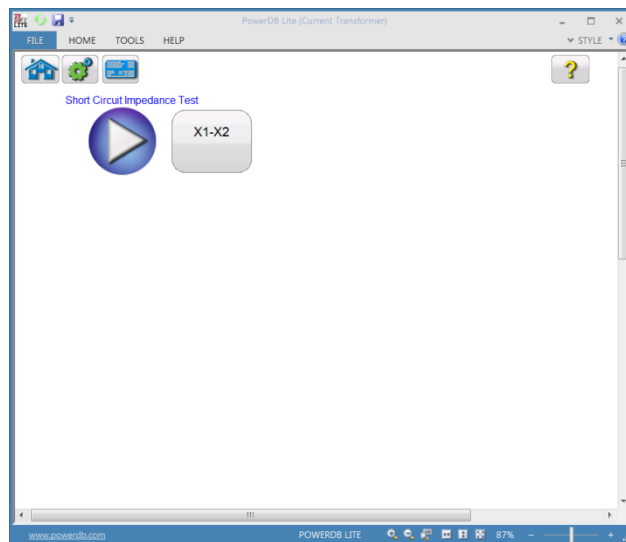


Figure 97 VT Secondary Short Circuit Impedance Test Screen

6. Select the play button and a connection diagram will appear showing how to correctly connect the MRCT to the VT

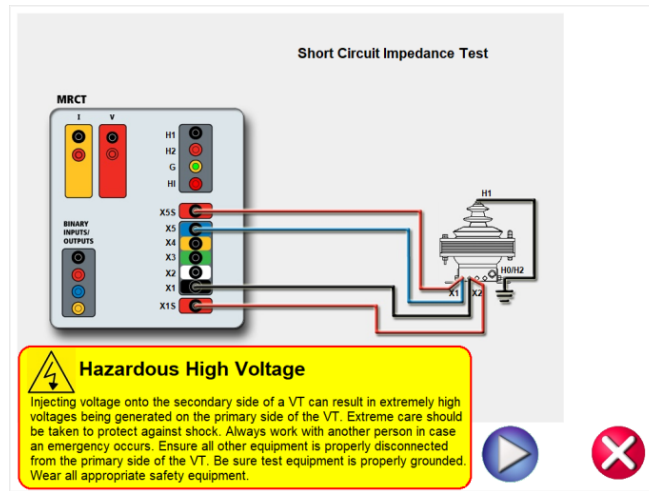


Figure 98 VT Short Circuit Impedance Connection Diagram

7. Check all connections to ensure correctness

8. Hit Blue Play button to begin test.



9. The Short Circuit Impedance test will begin.

- ⇒ X Current (A): The MRCT the real time DC current readings for the secondary X winding while the test is in progress.
- ⇒ Voltage (V): The MRCT displays the real time voltage readings of the secondary X winding while the test is in progress.
- ⇒

10. At any point of time Test can be terminated by hitting the ABORT button at the top of the screen...

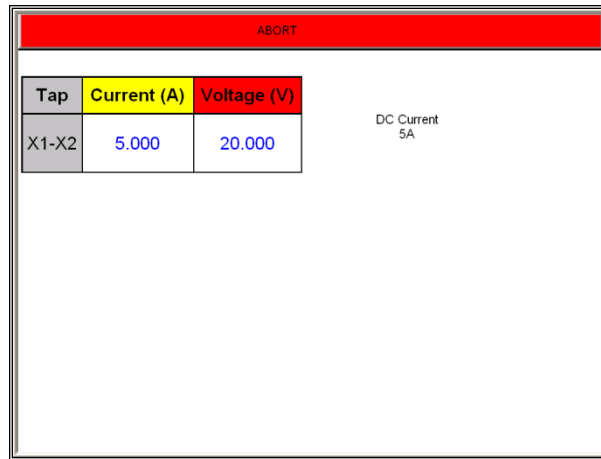


Figure 99 VT Short Circuit Impedance -Abort

11. Test can also be stopped under emergency condition by hitting the “Emergency Push to Stop” button on the front panel of MRCT. Unit will shut off the output voltage and current
12. After releasing the Emergency Stop Button, the test will need to be restarted.
13. Upon completion of test the results will be displayed in the test screen or in a test report if desired.

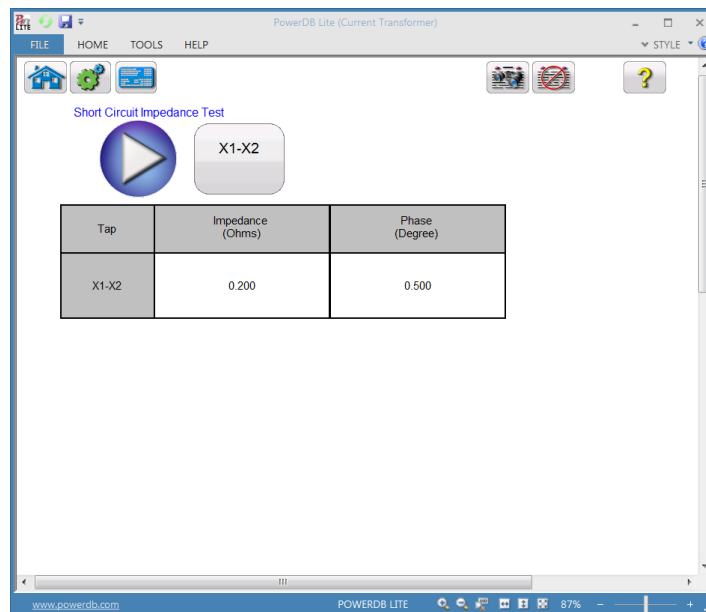


Figure 100 VT Short Circuit Impedance Results

Short Circuit Impedance test is used to determine the impedance of the VT secondary and primary windings. After measurement the impedance is calculated and displayed on the screen.

These values are used along with additional test values to estimate the VT performance at rated line voltage.

10.6 Testing Voltage Transformer : Demagnetization

Refer to the safety instructions first before use of the equipment.

1. Verify the Power ON/OFF switch is OFF. Power the test set from a suitable source of power (95-125 or 195-265 V50/60 Hz).
2. Connect the ground wing nut to a suitable ground.

WARNING

There is always the possibility of voltages being induced at the terminals of a test specimen because of proximity to high voltage energized lines. A residual static voltage charge may also be present at these terminals. Ground each terminal to be tested with a safety ground stick, before making connections.

3. Connect the test set secondary output **SOURCE** binding posts **X1S** and **X5S** to the **desired** secondary terminals of the voltage transformer.
4. . Observe the polarity marks on the VT (X1 on test set is polarity terminal).

WARNING

The MRCT produces high voltages and currents during the performance of tests. **DO NOT TOUCH** connector clips or test leads while the MRCT is performing a test.

5. Turn Power ON/OFF switch to ON.
6. After boot up, in the Home Screen put the MRCT in voltage transformer testing mode by selecting the VT button.

7. Select the “Demagnetization” button In the VT section of the Home Screen. This will activate a connection diagram showing how to correctly connect the MRCT to the VT

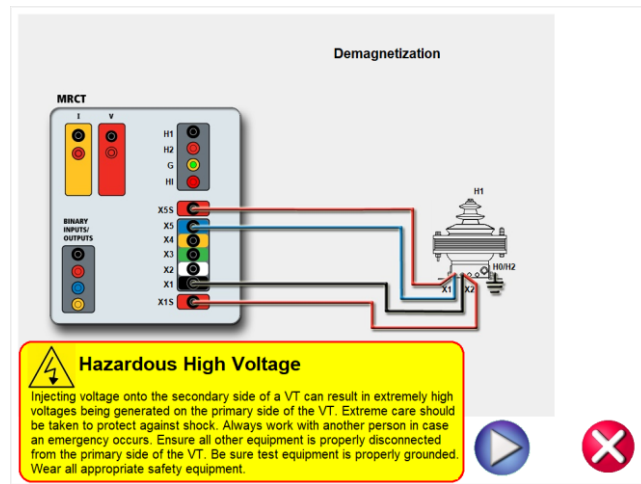



Figure 101 VT Demagnetization Connection Diagram

8. Check all connections to ensure correctness
9. Hit Blue Play button to begin process.

10. The Demagnetization process will begin.
11. At any point of time Test can be terminated by hitting the ABORT button at the top of the screen...

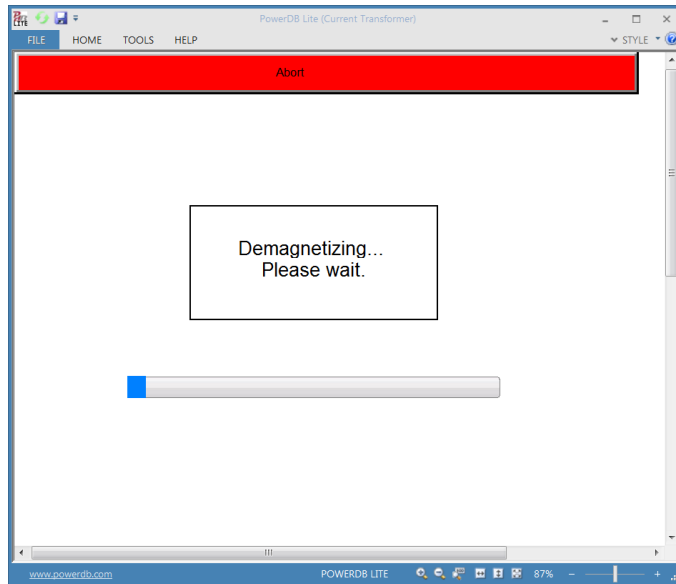


Figure 102 VT Demagnetization Screen –Abort

12. Process can also be stopped under emergency condition by hitting the “Emergency Push to Stop” button on the front panel of MRCT. Unit will shut off the output voltage and current
13. After releasing the Emergency Stop Button, the test will need to be restarted.
14. Upon completion of process the VT will be left in a demagnetized state

Demagnetization process is performed on an instrument transformer to remove any magnetizing forces on the windings that can effect the accuracy and performance of the instrument transformer

10.7 Testing Voltage Transformer: Self Diagnostic

Refer to the safety instructions first before use of the equipment.

1. Verify the Power ON/OFF switch is OFF. Power the test set from a suitable source of power (95-125 or 195-265 V50/60 Hz).
2. Connect the ground wing nut to a suitable ground.

WARNING

There is always the possibility of voltages being induced at the terminals of a test specimen because of proximity to high voltage energized lines. A residual static voltage charge may also be present at these terminals. Ground each terminal to be tested with a safety ground stick, before making connections.

WARNING

The MRCT produces high voltages and currents during the performance of tests. DO NOT TOUCH connector clips or test leads while the MRCT is performing a test.

3. Turn Power ON/OFF switch to ON.
4. After the boot up, in the Home Screen, place the MRCT in voltage transformer testing mode by selecting the VT button at the top of the screen.



5. Select the “Self Diagnostic” button
6. The following connection diagram will appear. Ensure the MRCT is connected properly.

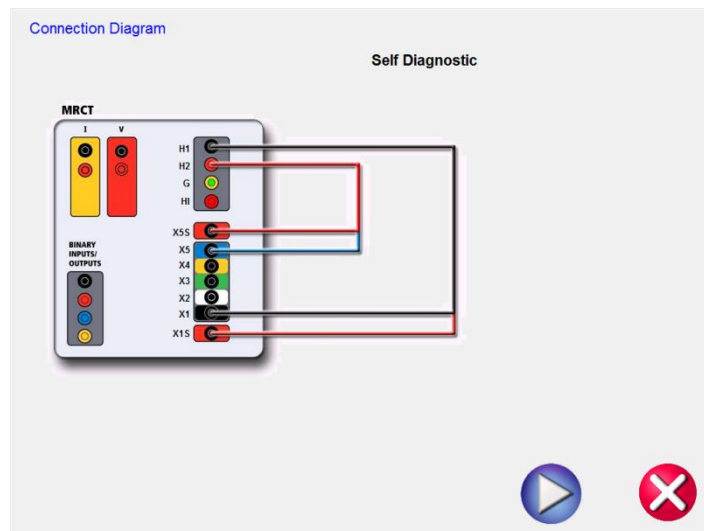


Figure 103 Self Diagnostic Connection Diagram

7. During the Self Test, Secondary Current, Secondary Voltage and Primary Voltage will be displayed

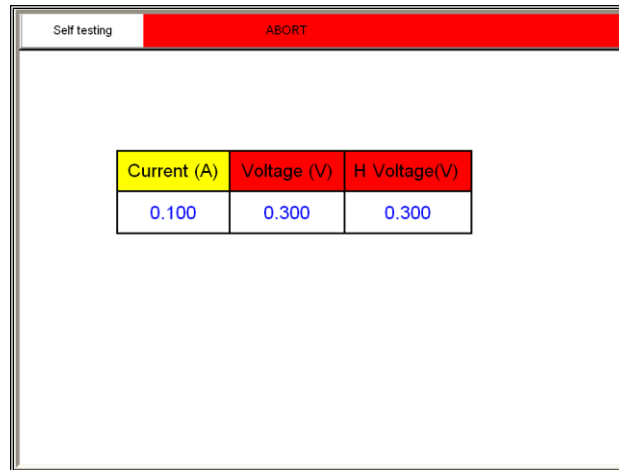
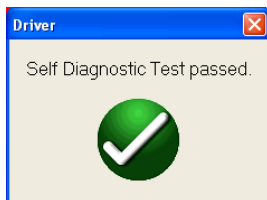


Figure 104 Self Diagnostic Test Screen

- After the unit has checked the voltage and current generators and meters are working properly, the user will be advised the unit has passed or failed the test



11.0 Step by Step Testing an Capacitive VT with MRCT

11.1 Testing Capacitive Voltage Transformer (CVT) Ratio and Phase

Refer to the safety instructions first before use of the equipment.

- Verify the Power ON/OFF switch is OFF. Power the test set from a suitable source of power (95-125 or 195-265 V50/60 Hz).
- Connect the ground wing nut to a suitable ground.

WARNING

There is always the possibility of voltages being induced at the terminals of a test specimen because of proximity to high voltage energized lines. A residual static voltage charge may also be present at these terminals. Ground each terminal to be tested with a safety ground stick, before making connections.

3. Connect the test set secondary output **SOURCE** binding posts **X1S** and **X5S** to the primary of the voltage transformer..
4. Connect the test set secondary output binding posts X1 and X5 to primary of the voltage transformer. Observe the polarity marks on the VT (X1 on test set is polarity terminal).
5. Connect the test set primary binding posts H1 and H2 to the secondary terminals of the voltage transformer. Observe the polarity marks on the VT (H1 on the test set is polarity terminal).

WARNING

The MRCT produces high voltages and currents during the performance of tests. **DO NOT TOUCH** connector clips or test leads while the MRCT is performing a test.

6. Turn Power ON/OFF switch to ON.
7. After the boot up, in the Home Screen first put the MRCT into capacitive voltage transformer mode (CVT) by selecting the CVT button.
8. After the MRCT has been placed into the CVT mode, select the “Ratio

Test” button  .

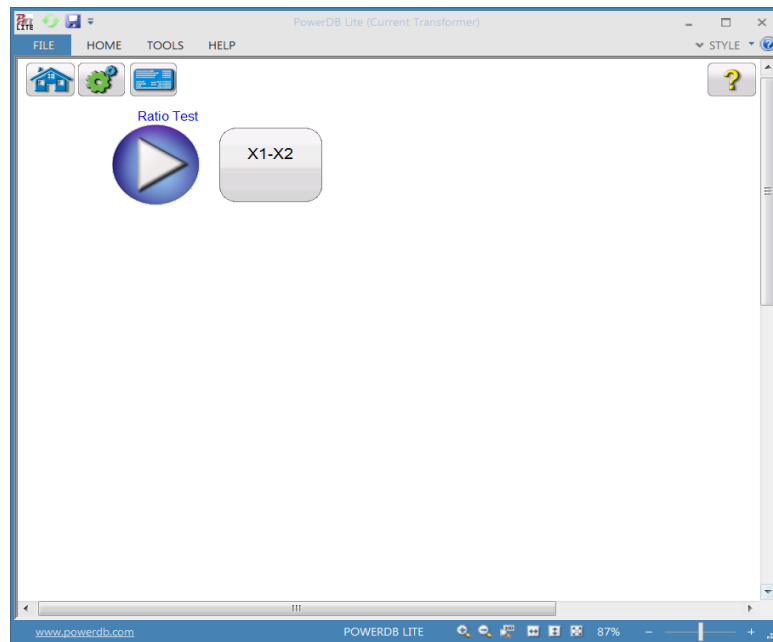


Figure 105 CVT Ratio Test Screen

- Select the blue play button to begin the test and a connection diagram will appear showing how to correctly connect the MRCT to the CVT

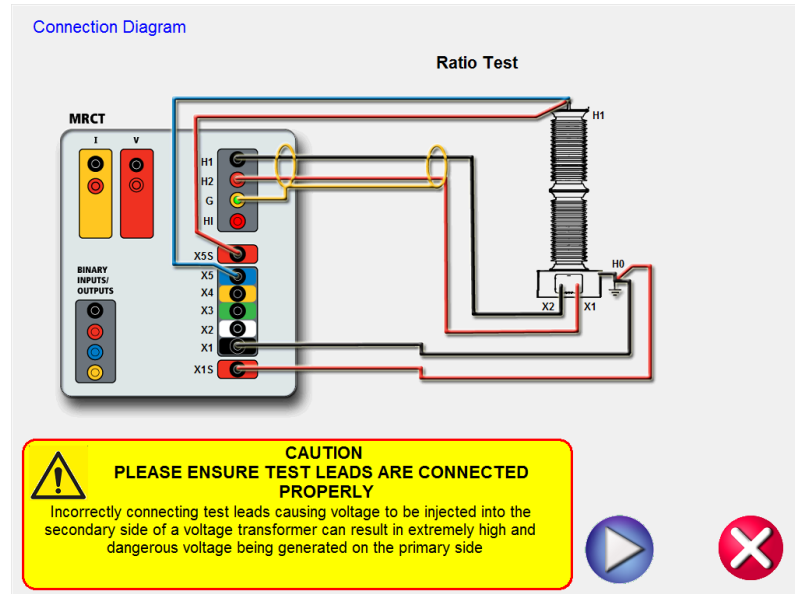


Figure 106 CVT Ratio Test Connection Diagram

- Check all connections to ensure correctness
- Hit Blue Play button.



- The Ratio test will begin.
 - Current (A): The MRCT the real time current readings for the primary while the test is in progress.
 - Voltage (V): The MRCT displays the real time voltage readings of the primary while the test is in progress.
 - X Voltage (V): The MRCT the real time voltage readings of the secondary while the test is in progress.
- At any point of time Test can be terminated by hitting the ABORT button at the top of the screen.

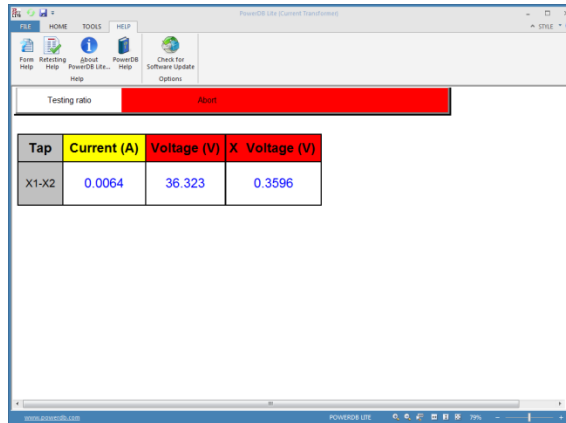


Figure 107 CVT Ratio Testing Screen

14. Test can also be stopped under emergency condition by hitting the “Emergency Push to Stop” button on the front panel of MRCT. Unit will shut off the output voltage
15. After releasing the Emergency Stop Button, the test will need to be restarted.
16. Upon completion of the test the results will be displayed in the test screen or they can be displayed in a test report.

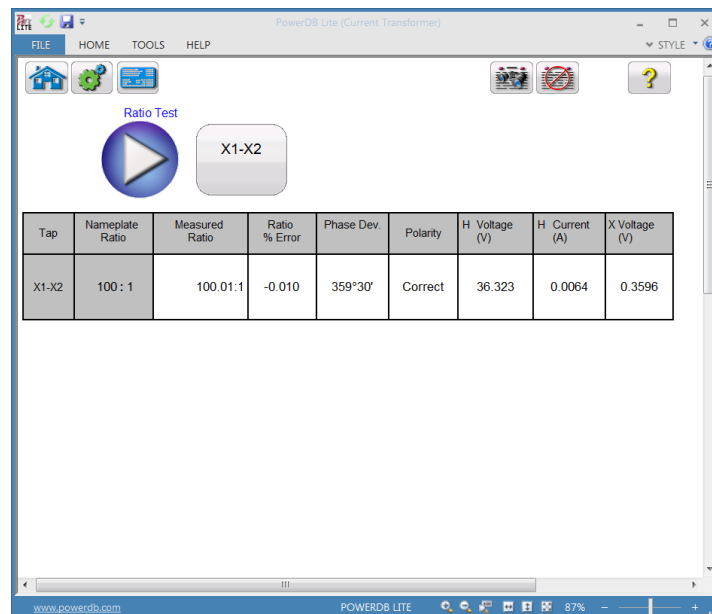


Figure 108 CVT Ratio Test Results

A variable AC source is applied on the primary side. The primary and secondary voltages are measured to determine the ratio V_2/V_1

The angle between the primary system voltage V_p and the secondary voltage V_s is the phase error.

Appendix

Bushing CT's can be tested in a de-energized circuit breaker which has been totally isolated from the power system. CT secondary leads will normally terminate in the control cabinet. Refer to the chart for connections.

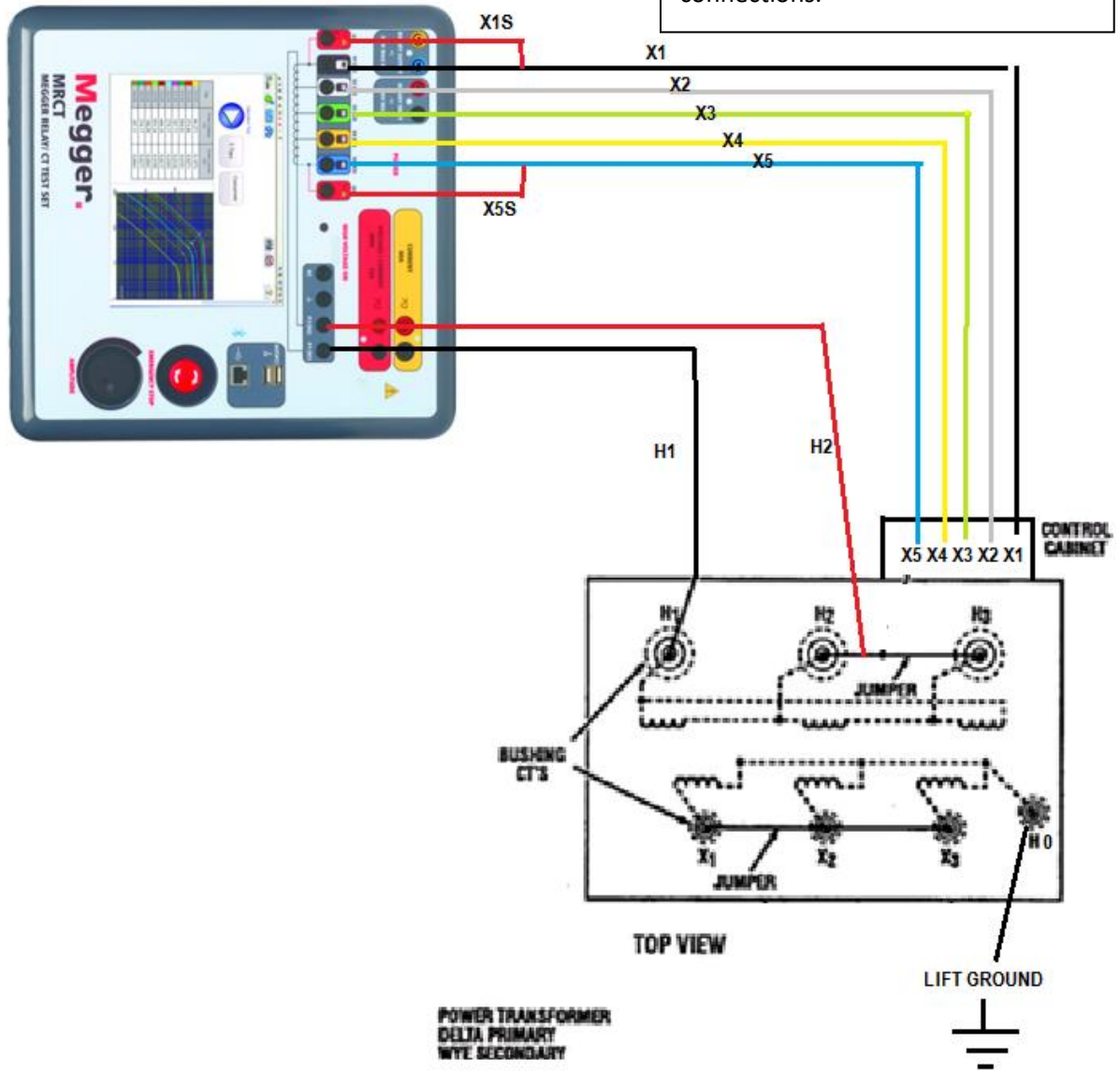


Figure 109 Testing bushing CT installed in a Power Transformer- A

CT Locations	Tests Set Connections			Jumpers
	X1 X2	H1	H2	
H1 Bushing	Secondary of H1 CT located in control cabinet	H1 Bushing	H2 Bushing	H2 - H3 X1 - X2 - X3
H2 Bushing	Secondary of H2 CT located in control cabinet	H2 Bushing	H3 Bushing	H3 - H1 X1 - X2 - X3
H3 Bushing	Secondary of H3 CT located in control cabinet	H3 Bushing	H1 Bushing	H1 - H2 X1 - X2 - X3

Bushing CT's can be tested in a de-energized circuit breaker which has been totally isolated from the power system. CT secondary leads will normally terminate in the control cabinet. Refer to the chart on for connections.

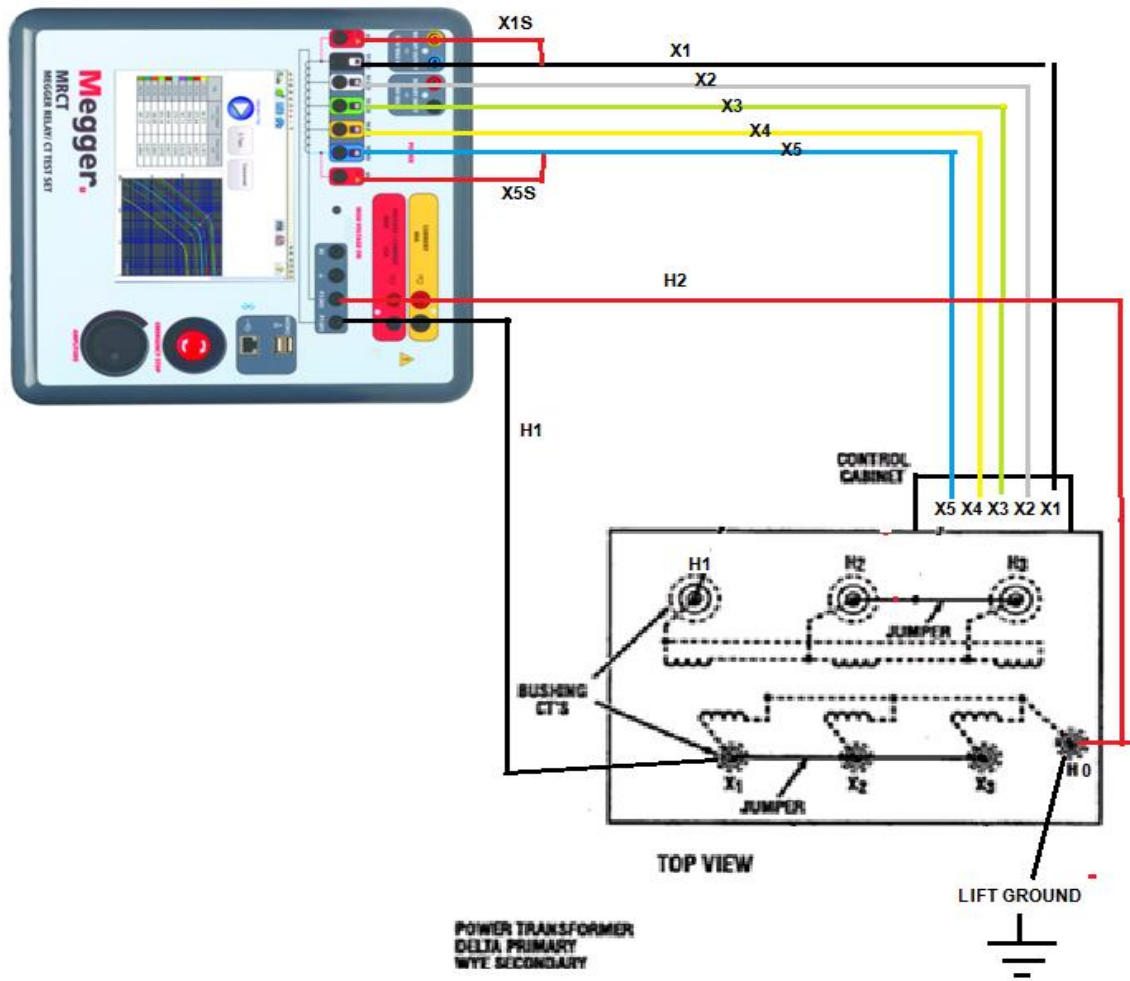


Figure 110 Testing bushing CT installed in a Power Transformer- B

CT Locations	Tests Set Connections			Jumpers
	X1 X2	H1	H2	
X1 Bushing	Secondary of X1 CT located in control cabinet	X1 Bushing	Neutral Bushing	H1 - H2 - H3
X2 Bushing	Secondary of X2 CT located in control cabinet	X2 Bushing	Neutral Bushing	H1 - H2 - H3
X3 Bushing	Secondary of X3 CT located in control cabinet	X3 Bushing	Neutral Bushing	H1 - H2 - H3

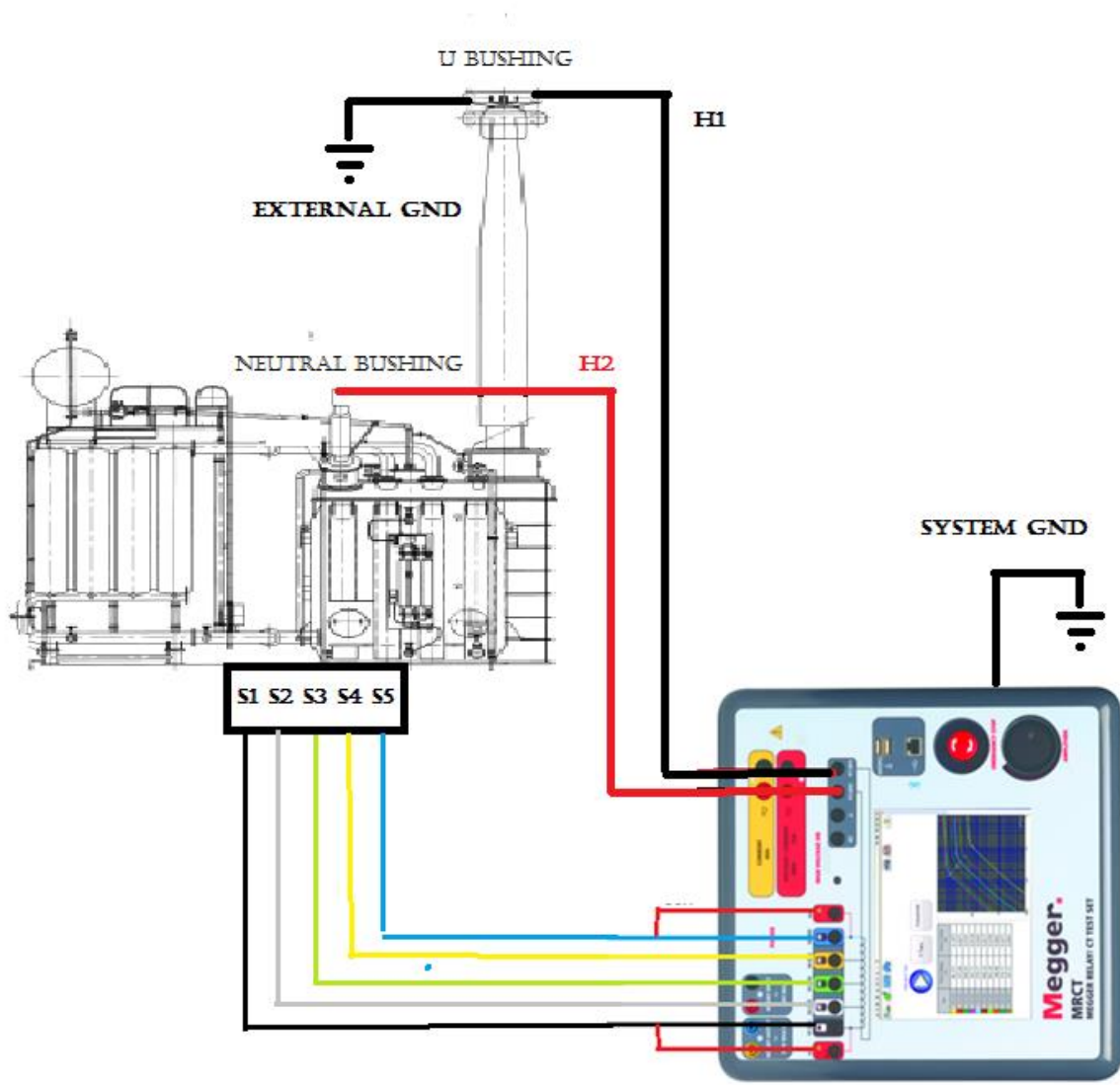


Figure 111 CONNECTION DIAGRAM SINGLE PHASE REACTOR

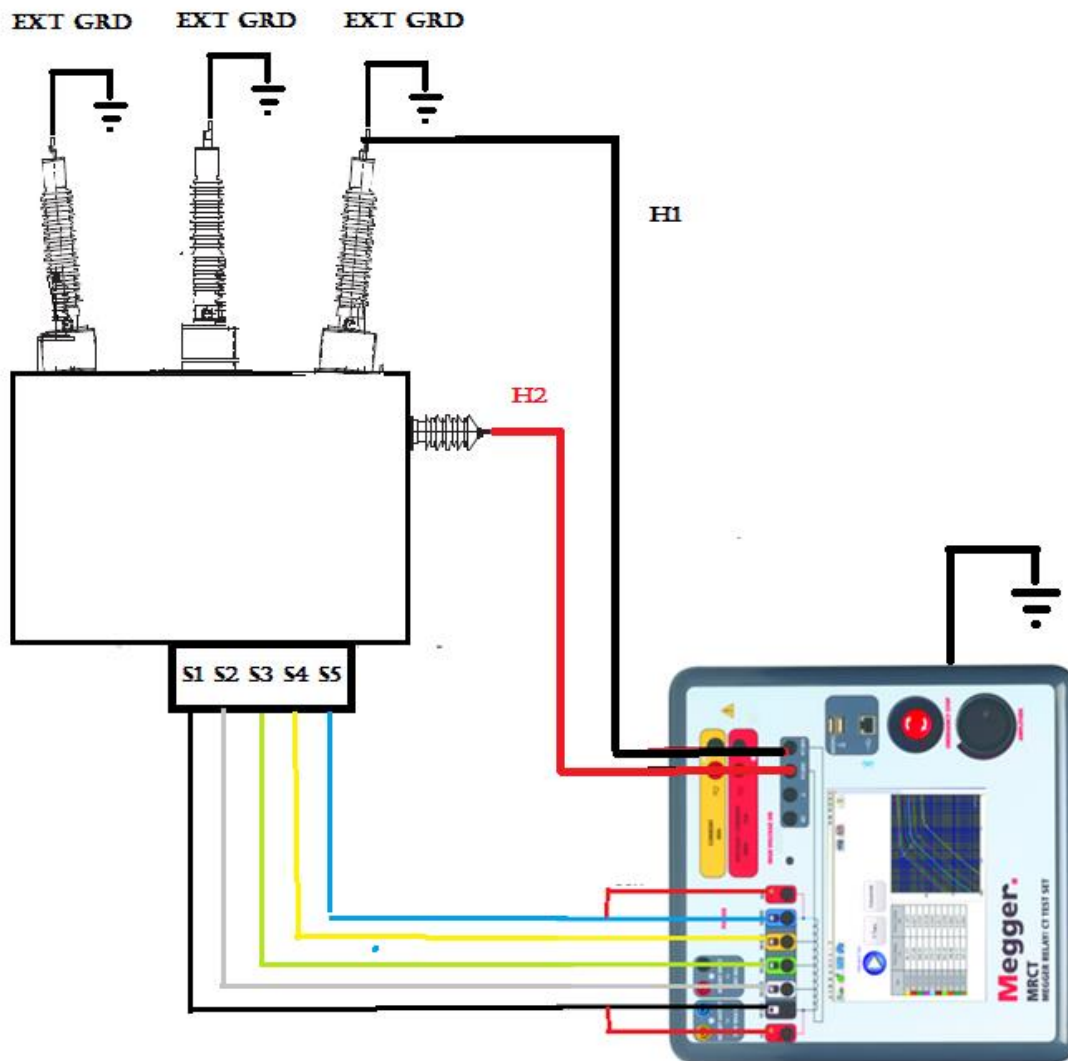


Figure 112 CONNECTION DIAGRAM THREE PHASE REACTOR