Megger

TTRU1

Handheld transformer turns ratiometer

User Guide

Notice

The information presented in this manual is adequate for the intended use of the product. Use of the product or its individual instruments for purposes other than those specified herein requires confirmation of their validity and suitability from Megger. Refer to the warranty information below. Specifications are subject to change without notice.

WARRANTY

Products supplied by Megger are warranted against defects in material and workmanship for a period of 1 years following shipment. The warranty is void in the event of abuse (failure to follow recommended operating procedures) or failure by the customer to perform specific maintenance as indicated in this manual.

Contents

Introduction

Thank you for your purchase of the Megger TTRU1 Handheld transformer turns ratiometer. The TTRU1 design emphasizes safety, reliability, and ease of use. It will provide you with the information you need to test power, distribution, and instrument transformers and make informed electromechanical maintenance decisions

Purpose of this manual

This document is the user manual for the Megger TTRU1 handheld transformer turns. It provides a description of the instrument as well as operating instructions. Read this manual before using the equipment, with special emphasis on all safety discussions.

Audience

This manual is for technical personnel who are familiar with the various transformer measurements performed by electrical test equipment and have a general understanding of their use and operation. Such personnel should also be thoroughly familiar with the hazards associated with the use of this equipment and should have received proper safety training.

If you find any discrepancies in the TTRU1 manual or have any comments, please send them to Megger via fax, e-mail, or phone.

Items received

TTRU1 Models

Part Number	Description	Image
TTRU1-BASIC	37.5 VAC induced handheld turns ratiometer test set	
TTRU1-ADV	62.5 VAC induced handheld turns ratiometer and go / no go impedance test set with customizable vector lists, guided three phase tests, and PowerDB import	
TTRU1-PRO	125 VAC induced handheld step up turns ratiometer and go / no go impedance test set with phase deviation, customizable vector lists and transformer nameplates, guided three phase tests, and PowerDB import	
TTRU1-EXP	250 VAC induced handheld step up turns ratiometer and short circuit impedance / leakage reactance test set with phase deviation, customizable vector lists and transformer nameplates, guided three phase tests, PowerDB import, PC communication, and select hardware accessories	

Model Differentiation	TTRU1 BASIC	TTRU1 ADV	TTRU1 PRO	TTRU1 EXP
Induced Voltage - Max (V)	37.5	62.5	125	250
Step Up Ratio Measurement			Yes	
Phase Deviation Range	Additive / Subtractive		±180°	
Impedance Measurements		Go/No Go		Short Circuit Impedance
Customizable vector list		Yes		
PowerDB Import		Yes		
Three phase measurements	Yes, Unguided		Yes, Guided	
Customizable transformer nameplate			Yes	
PC Communication				Yes
Printer	Optional			Included
Hand Crank USB Charger	Optional			Included

TTRU1 Leads

Part Number	Description	Image
1015-031	2 m (6 ft) H and X leads	
1015-032	3 m (9 ft) H and X leads	
1015-033	6 m (18 ft) H and X leads	
1015-035	9 m (33 ft) H and X leads	
1015-037	3m (9 ft) H and X leads with banana connectors for CT/PT testing (not pictured)	

Included Accessories

Part Number	Description	Image
1015-031	2 m (6 ft) H & X leads	
1012-063	Soft Carry Case	
90041-001	USB C to A cable	
90041-002	USB C to C cable	

Part Number	Description	Image
90012-878	**USB Drive**	

Optional hardware accessories

Part Number	Description	Image
TTRU1-CAL-CERT	TTRU1 Calibration Certificate	
90041-005	NiMH batteries (qty 8)	
2012-180	Backpack lead bag	
90041-006	USB NiMH battery charger	
90029-573	USB Printer	
90029-573-P	USB Printer Paper (x48 rolls)	
TRS1-PLUS	TRS1+ Calibration Standard	
1015-532	Hard sided Transit Case	
90014-003	USB outlet adapters (US, UK, CE)	
90014-004	12V car accessory outlet adapter	

Items received

Part Number	Description	Image
1012-068	Magnetic Strap	
90041-007	Hand crank and solar battery pack	

Warnings and safety precautions

SAFETY IS THE RESPONSIBILITY OF THE USER

Only qualified and trained operators should operate the TTRU1. Operator must read and understand the Instruction Manual prior to operating the equipment.

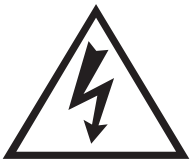
GENERAL SAFETY PRECAUTIONS

The TTRU1 and the Unit Under Test (UUT) should both be considered as sources of instantaneously lethal levels of electrical energy. Observe the following safety precautions

- **Observe all safety warnings on the TTRU1.**
  They identify areas of immediate hazard that could result in injury or death.
- **Treat all terminals of high-voltage power equipment systems as potential electric shock hazards. Use all practical safety precautions to prevent contact with energized parts of the equipment and related circuits.**
- **Never connect the test equipment to energized equipment.**
- **Always disconnect leads from UUT before disconnecting them at the test set.**

Warnings and safety precautions

Safety
Warnings and safety precautions



WARNING!

Death, serious injury, or fire hazard could result from improper use of this instrument. Read and understand this manual before installing this instrument.

Do not use parts other than those provided by Megger.

Usage of this instrument must comply with the National Electric Code and any additional safety requirements applicable to your country and company policies.

Qualified personnel MUST perform operation and maintenance of this instrument. The National Electrical Code defines a qualified person as one familiar with the construction and operation of the equipment and the hazards involved.

Safety Precautions

Take the following safety precautions whenever the instrument is used:

- Wear safety glasses and insulated gloves when making circuit connections
- Hands, shoes, floor/ground must be dry when making any connection to a powered line

These warnings and safety precautions are to be used where appropriate when following instructions in this manual.

CAUTION!

The equipment could be impaired from improper use not specified in this user guide. Read the complete manual before use.

CAUTION!

Only use NiMH and Alkaline AA batteries.Do not mix NiMH/Alkaline batteries.
Do not use non-rechargeable batteries when the battery setting is set to NiMH.

CAUTION!

Do not attempt to run tests while the TTRU1 is charging or connected to a PC.

SPECIFICATIONS

SPECIFICATIONS

Input power

6 x IEC LR6 1.5 V alkaline (AA)

6 x IEC HR6 1.2 V NiMH rechargeable (AA)

Battery life

1000 TTR tests on a single charge

Storage: 1+ years NiMH, 5+ years alkaline

Battery charging

USB-C when set to NiMH batteries

Protection against alkaline charging

PowerEx PRO NiMH battery charging: 0 to 45 °C.

Output

Voltage	Single phase, 1-50 V
Current	0.1 mA – 1 A

Regulatory

Safety	IEC 61010-1:2010 + AMD1:2016
EMI/EMC	IEC 61326-1:2012
RoHS2	EN50581
Vibe/Shock	MIL-STD -810G
Ingress	IP54

Transformer testing standards

IEEE	C57.152-2013
IEC	60076-1:2011
AS/NZS	6076 1:2014
CIGRE	445 2011
GOST	3484.1-88

Dimensions

22.8 x 10.5 x 7.5 cm	8.98 x 4.1 x 2.95 in

Weight

1 kg	2.2 lbs

Case

Heavy duty over-molded case with built-in connection for hook strap. Carry case with quick start guide, belt loop hook, and pouches for included lead set and accessories.

Internal/external data storage

Up to 10 custom vector storage

Up to 10 000 sets of single phase results internal storage

Transferable via USB 2.0 drive

USB-C connection to PC (EXP ONLY)

Communication/control software

USB Interface for PC download with custom GUI

Display

Full colour 88 mm (3.5 in) 320 x 240 px Hi-bright LCD screen with 'auto dim' and 'auto off' to preserve battery life

Printer (optional)

51 mm (2in) thermal printer

Prints all measurement data displayed on GUI

Environmental

Operating	-20 ° to 50 °C (-4 ° to +122 °F)
Storage	-30 ° to 70 °C (-22 ° to +158 °F)
Relative humidity	0-90 %, non-condensing

Max Technical Specifications

TTR

Turns ratio measurement methods

Single phase step up

Single phase step down

Turns ratio range and accuracy

Step down excitation

25-50 V

±0.05 % 0.8 – 1000

±0.10 % 1001 – 2000

±0.30 % 2001 – 15000
±1.0 % 15000 +

1-24 V

±0.10 % 0.8 – 1000

±0.20 % 1001 – 2000

±0.60 % 2001 – 15000
±2.0 % 15000 +

Step up measurement

25-250 V

±0.05 % 0.8 – 200
(most Power Tx)

1-24 V

±0.10 % 0.8 – 200

Excitation current resolution

Resolution 0.1 mA, 0.1 mA – 100 mA

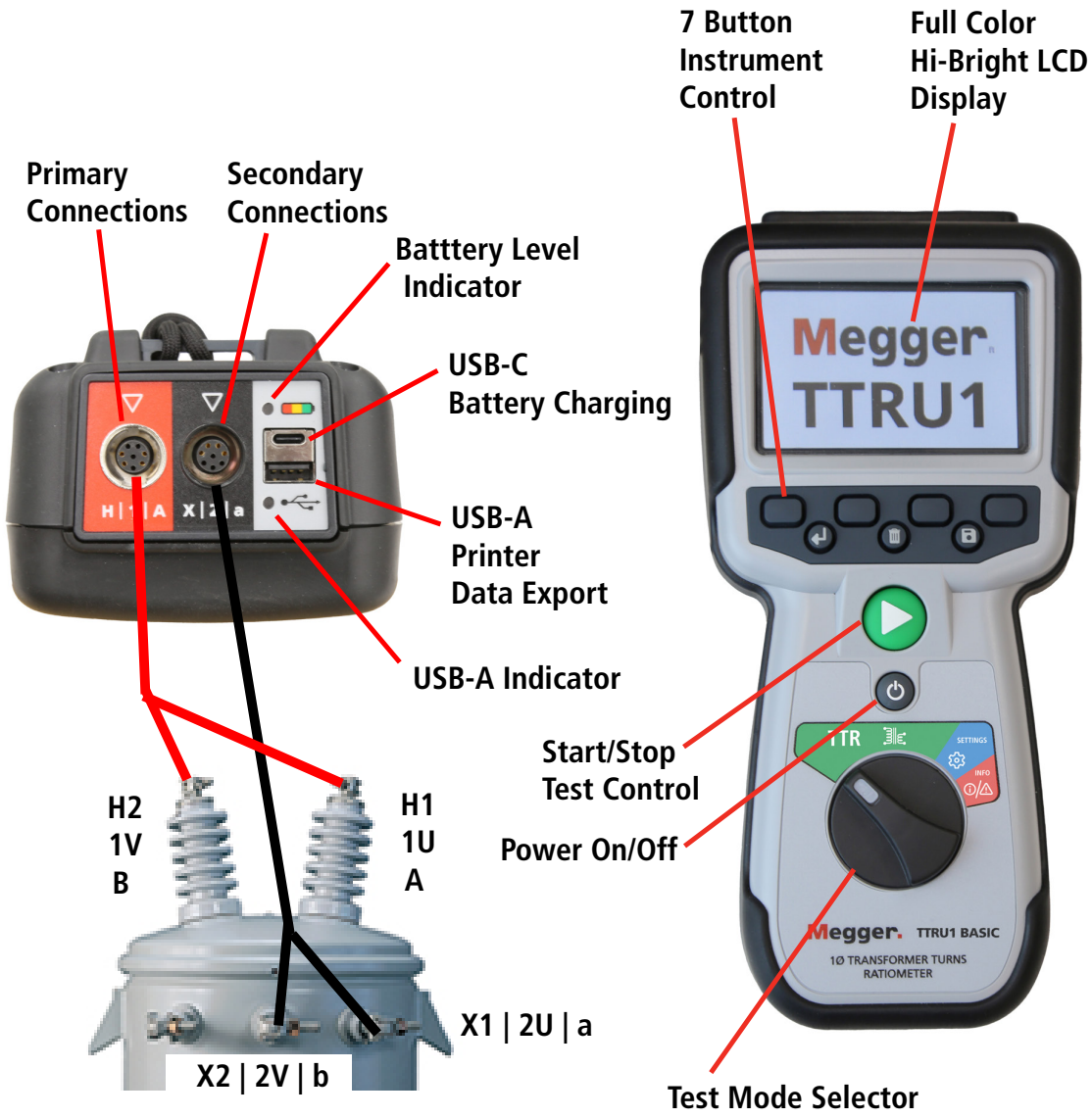
1.0 mA, 101 mA – 1000 mA

Excitation current accuracy	±1 % Reading, ±0.1 mA
Frequency accuracy	±1 % Reading, ±0.1 Hz
Phase range	0 – 360 °
Phase accuracy	±0.05 °
Max voltage output	45 V AC peak

SCI

Impedance measurement methods	Single phase
Frequency range	40 – 480 Hz
Impedance measurement range	0.1 Ω - 700 Ω
Impedance accuracy	±1 % reading, ±0.01 % ±1 % reading, ±0.10 m Ω
Reactance measurement range	0.1 Ω - 700 Ω
Reactance accuracy	±1 % reading, ±0.01 % ±1 % reading, ±0.10 mΩ
Inductance accuracy	±1 % reading, ±10 µH
Power factor Range	0.1 % – 100 %
Power factor accuracy	±5 % reading, ±0.1 %
AC current accuracy	±0.2 % reading, ±0.1 mA

Connections and controls



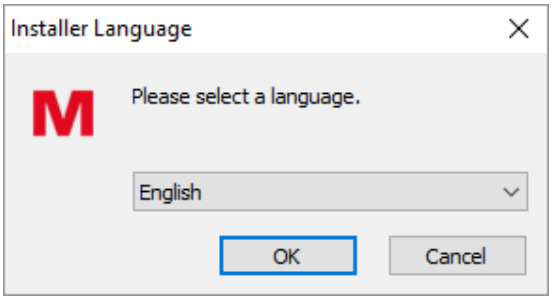
NOTE : TTRU1-EXP model shown. Test Mode selector and PC Data Download will vary by model.

PC Software Installation

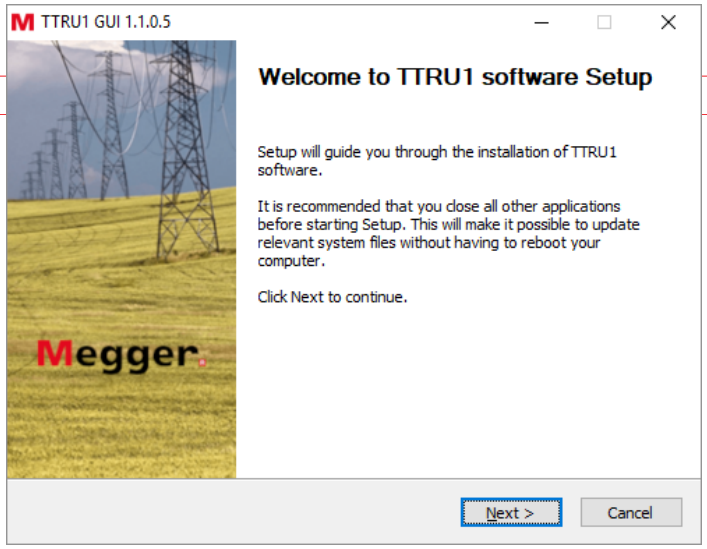
Before installing PC software, contact your IT department. Your IT department can assist with install and provide administrator approval if required.

Control of the TTRU1 is possible from the built-in touchscreen or from a USB connected PC with the PC software installed. To install the PC SW:

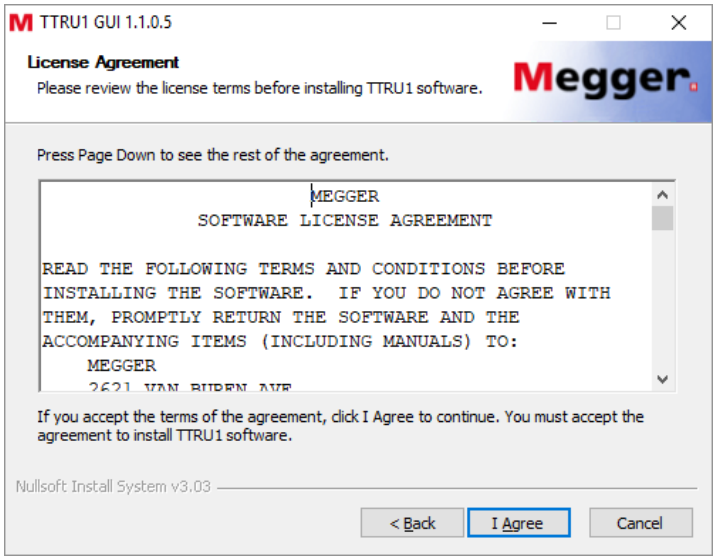
1. Locate the TTRU1 PC software installer
    a. From the TTRU1
        I Connect the TTRU1 to a PC with the included USB cable
        II Turn on the TTRU1
        III After initialization, a CD drive will appear on the PC which contains the software
        IV Locate the file named TTRU1_installer_X.xxx.exe. X.xxx is the version.
    b. From the internet
        I
        II Download the latest PC installer
2. Double click to launch the installer
3. Select a language for the install and click OK.



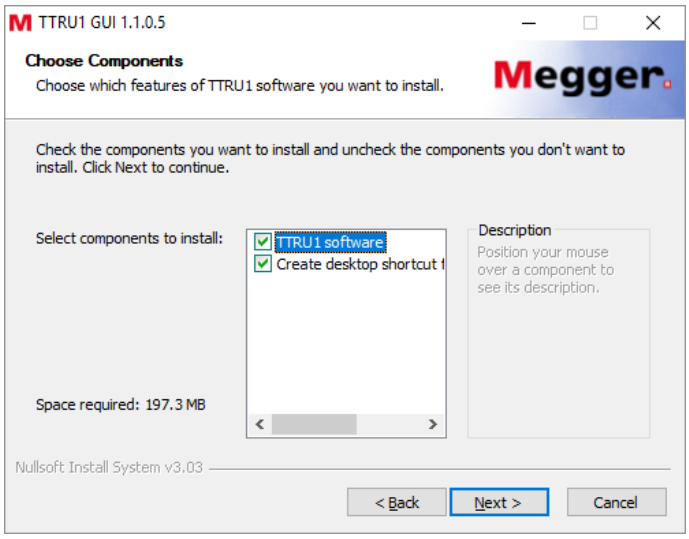
4. Click Next on the welcome screen



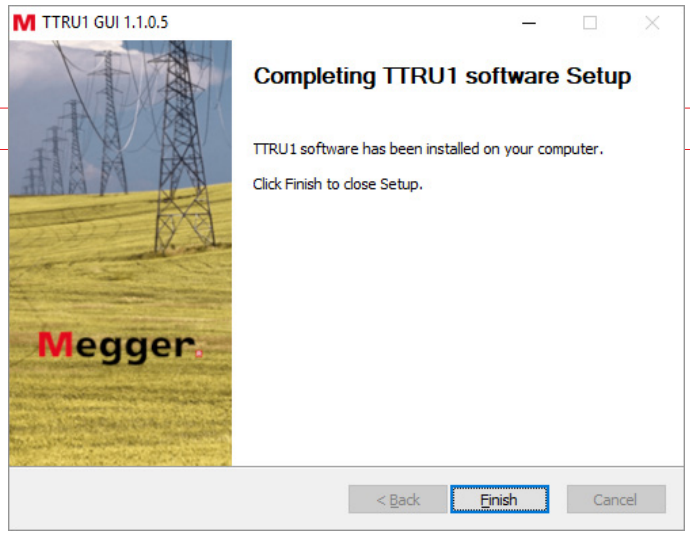
5. Review the license agreement and click I Agree



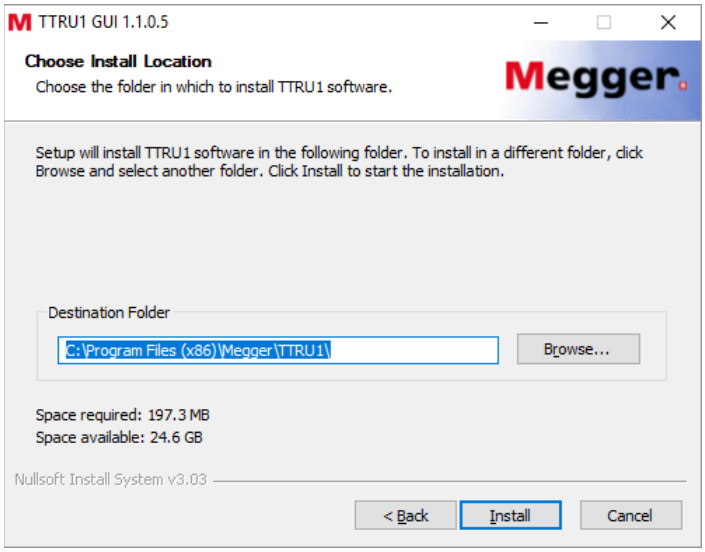
6. Choose components and select Next. Defaults recommended.



7. Select Install Location and click Install. Defaults recommended.



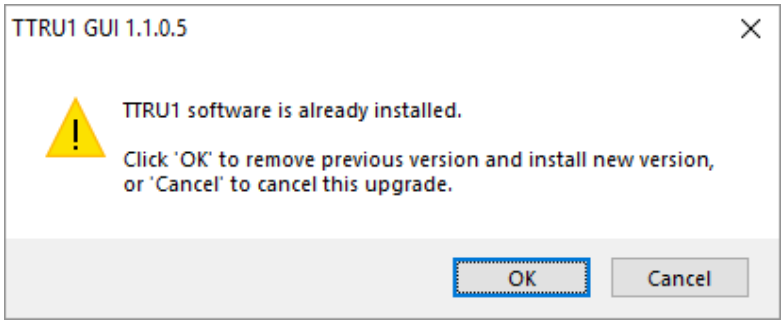
8. Click Finish to complete the install.



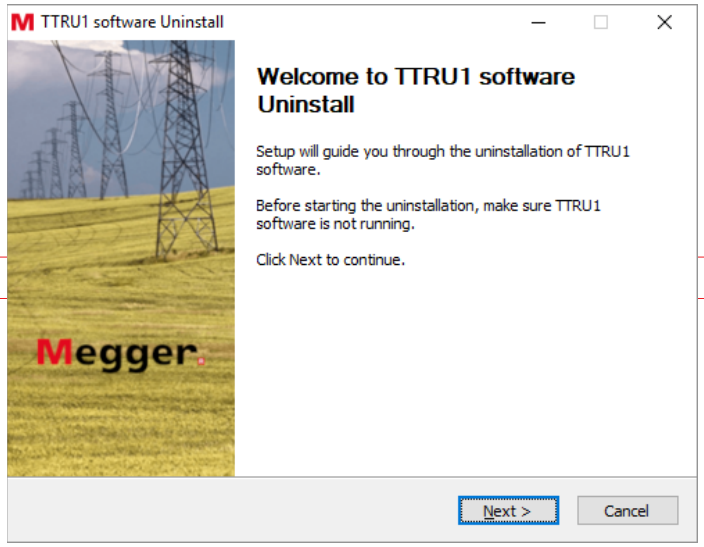
PC Software Update

When updating to a new version of the TTRU1 software, the installer will remove the installed version of software.

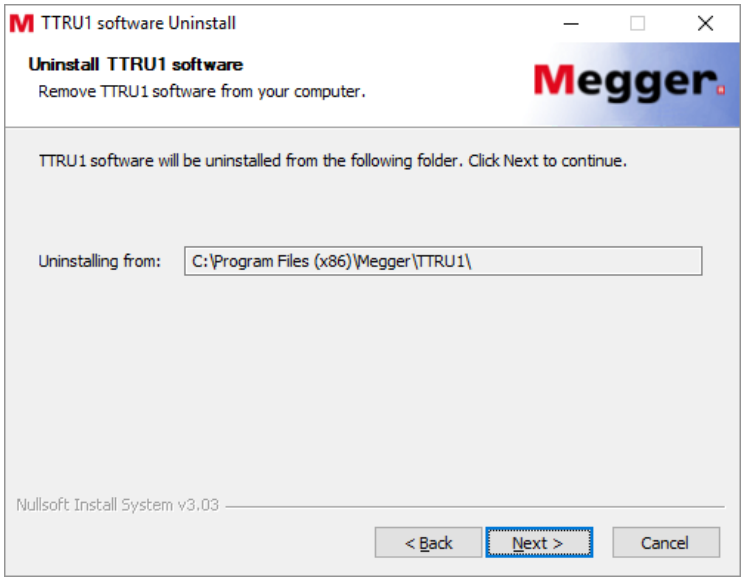
1. Locate the updated TTRU1 PC software installer
    a. From the TTRU1
        I Connect the TTRU1 to a PC with the included USB cable
        II Turn on the TTRU1
        III After initialization, a CD drive will appear on the PC which contains the software
        IV Locate the file named **TTRU1_installer_X.xxx.exe**. X.xxx is the version.
    b. From the internet
        I
        II Download the latest PC installer
2. Double click to launch the installer
3. Click OK to remove the previous TTRU1 version



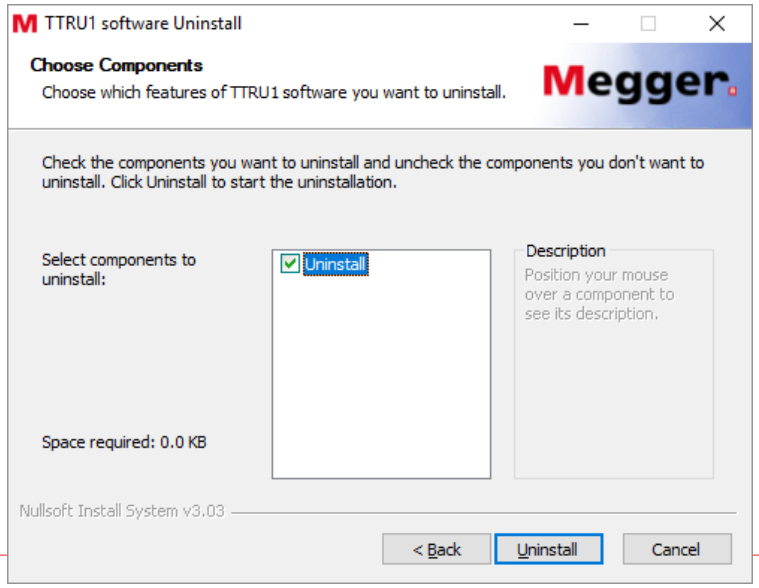
4. Click Next on the welcome screen



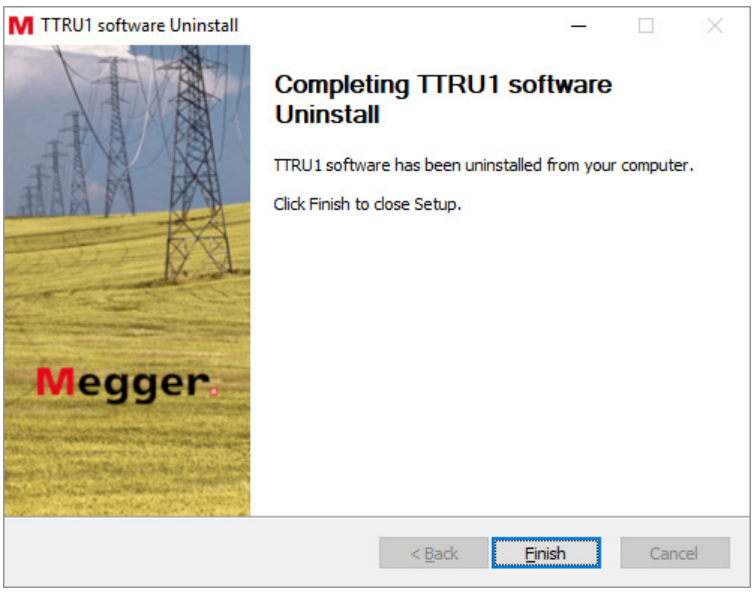
5. Click Next on the uninstall TTRU1 software screen



6. Click Uninstall



7. Click Finish



8. Proceed with the installation instructions from PC Software Installation

PowerDB Installation

PowerDB can import TTRU1 data.

To install PowerDB, download the latest version from www.powerdb.com. Follow the instructions on screen to install PowerDB.

Initialization and Power Off

Press the power button to turn on the TTRU1. After turning on the TTRU1, the Megger logo will display, followed by the screen corresponding to the rotary knob position.

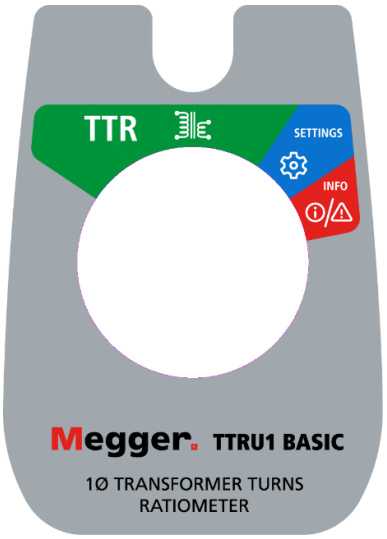
Press the power button to put the TTRU1 into sleep mode. While in sleep mode, the power button can be pressed again and the TTRU1 will immediately turn back on. If the power button is not pressed within 15 minutes, the instrument will shut down.

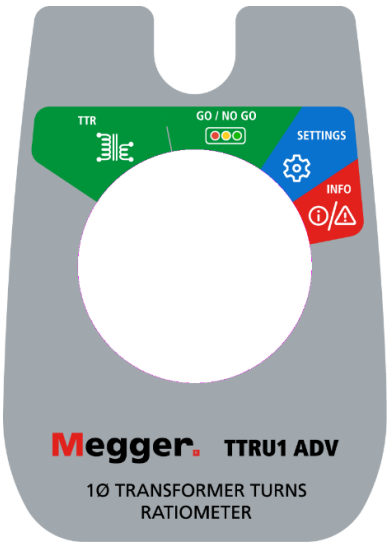
Press and hold the power button for 3 seconds to shut down the TTRU1. While holding, a timer will appear on screen. When the timer finishes counting down, release the power button and the TTRU1 will shut down.

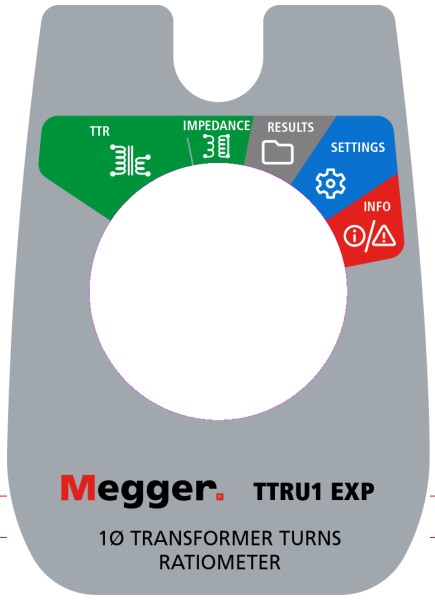
In the event that the TTRU1 becomes unresponsive, press and hold the power button for 10 seconds. This will force shut down the TTRU1 and return it to a proper operating state.

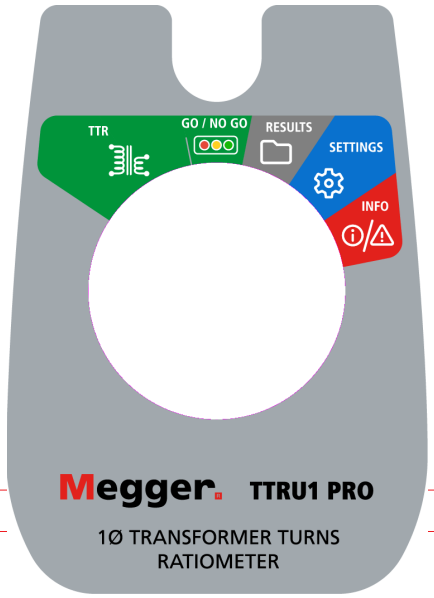
Rotary Knob Functions

The rotary knob is used to select different functions of the TTRU1. Move the rotary knob to the left or right to select the desired function. Some functions may have more than one rotary knob position.







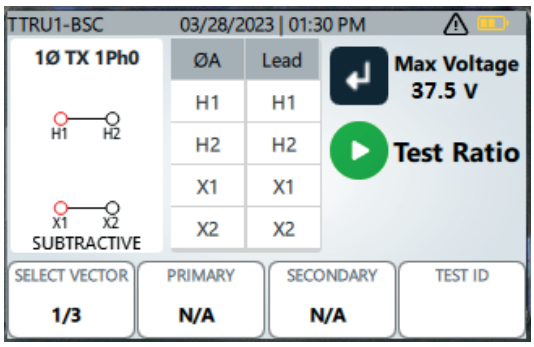


Buttons

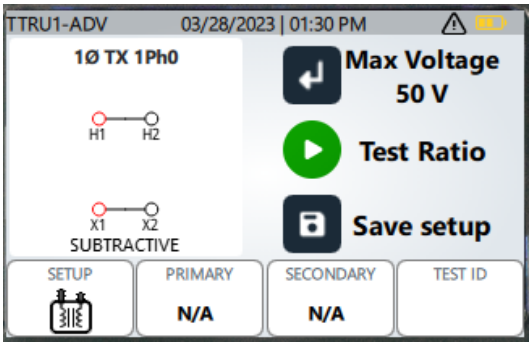
The 8 buttons shown below are the primary controls for the TTRU1. The four rectangle buttons will be mapped to functions displayed on screen directly above the buttons. The enter, delete, and save buttons will have different functions based on the screen displayed. The play button will start and stop tests when the rotary button is set to TTR, Go/No Go (ADV and PRO models), and Impedance testing (EXP model).

TTR Screen

When the rotary knob is set to TTR, the TTR test setup screen will be displayed. The TTR screen displayed with vary based on model. The differences are shown below.



TTRU1 BASIC TTR Screen



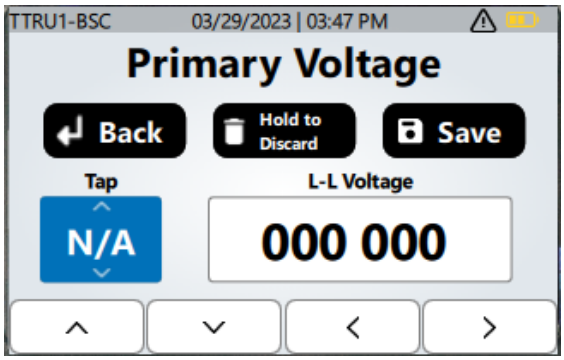
TTRU1 ADV, PRO, and EXP TTR Screen

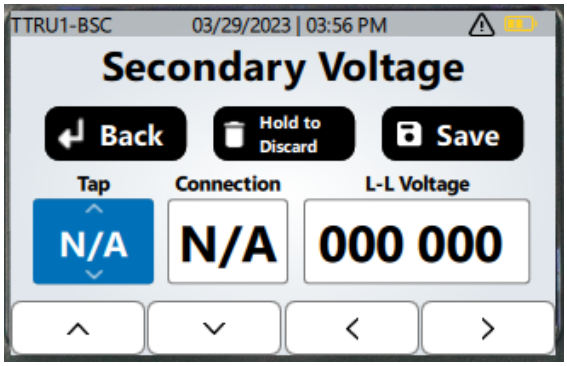
TTRU1 BASIC Test Setup

Press the enter key to select the maximum test voltage from the following options: 1 V, 4 V, 8V, 16 V, 32 V, or 50V.

Vectors can be changed with the SELECT VECTOR button. Vectors available are 1ph0, CT, and PT.

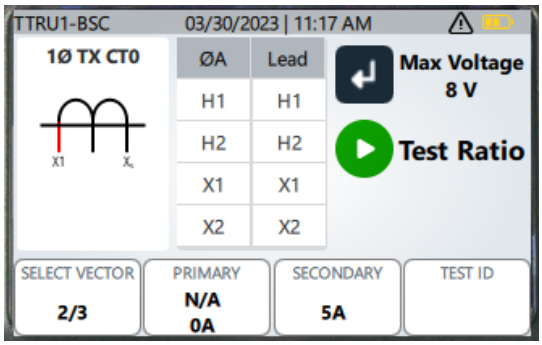
With 1ph0 selected, press the PRIMARY button to set the tap and L-L voltage for the primary winding. Press the SECONDARY button to set the tap or connection and L-L voltage for the secondary winding.

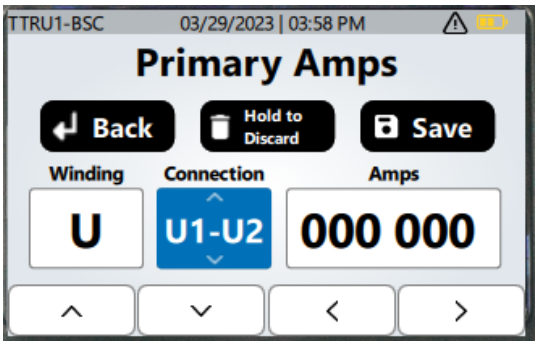




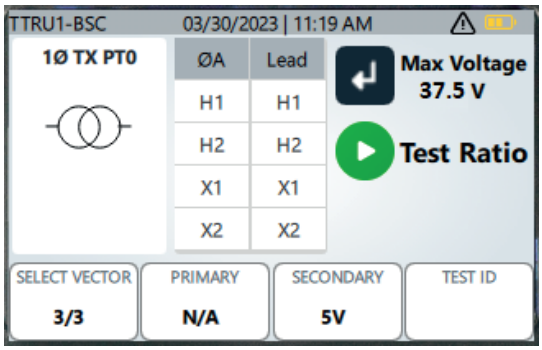
Use the up and down arrows to change the highlighted value. Use the left and right arrows to select a value to change. Press the enter button to return to the previous screen without saving changes. Press and hold the delete button to discard changes. Press the save button to save changes and return to the previous screen.

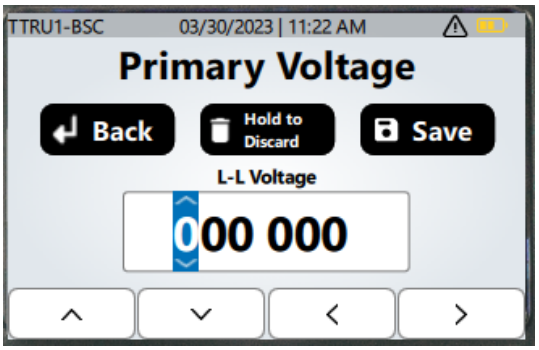
With CT selected, press the PRIMARY button to set the winding, connection, and amps for the primary winding.
Press the SECONDARY button to cycle through secondary Amp selections

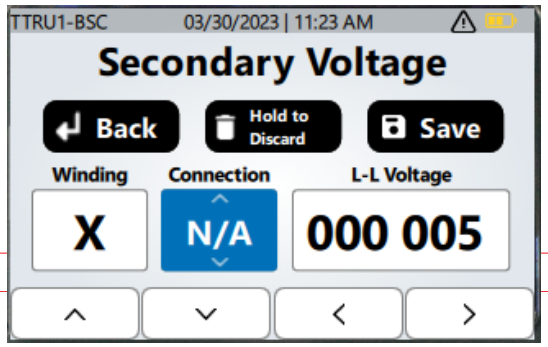




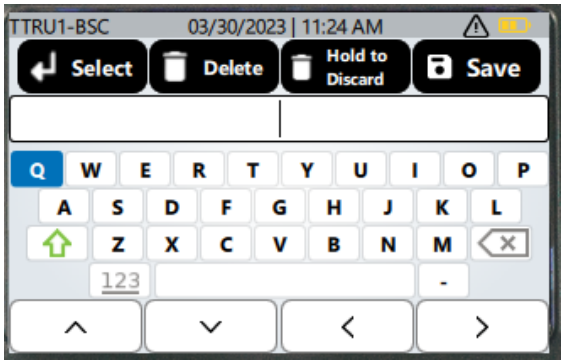
With PT selected, press the PRIMARY button to set the primary winding voltage.
Press the SECONDARY button to set the winding, connection, and L-L voltage for the secondary winding.





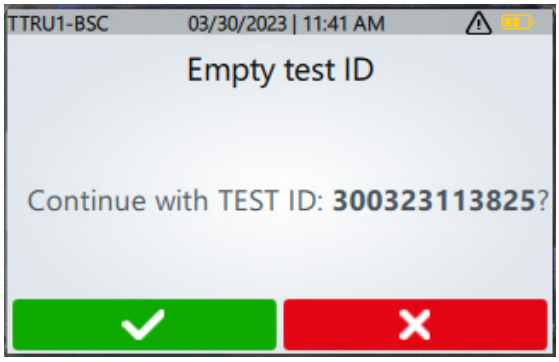


Press the TEST ID button with any vector selected to enter a TEST ID. Use the up, down, left, and right arrows to select a character, change upper case to lower case, or to show numbers. Press the select button to enter a character. Press the delete button to delete the last character entered. Press and hold the delete button to discard changes and return to the TTR setup screen. Press the Save button to save the TEST ID.



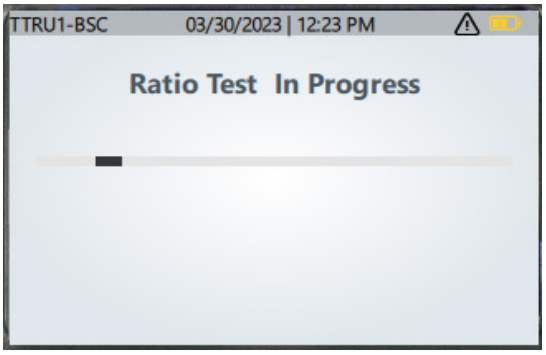
Press the Play button to start a test.

If a TEST ID was not entered when the PLAY button was pressed, the TTRU1 will ask the user if they would like to enter a test ID. Click the buttons below the green check mark to use the default TEST ID. Click the buttons under the red cross and the TEST ID entry screen will be displayed.



TTRU1 BASIC, ADV, PRO, and EXP TTR Test in Progress

With a TEST ID entered, clicking the play button will show a brief countdown, followed by a test in progress screen.



TTRU1 BASIC Test Complete

When the ratio test completes, the result will be automatically saved to the instrument. Results will also automatically save to a USB thumb drive if inserted into the TTRU1.

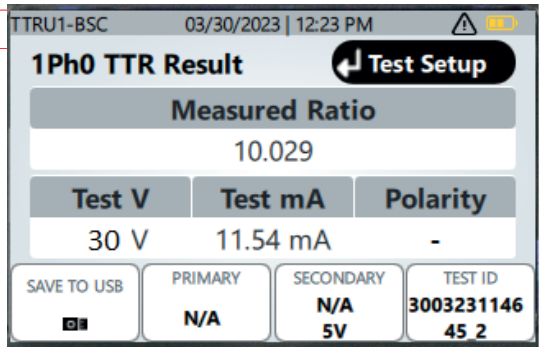
The results screen will show the measured ratio, test voltage, test current, and polarity (subtractive – or additive +). If primary and secondary voltage or current are entered, calculated ratio and % error will be displayed. If the polarity measured does not match the test setup, the polarity will be highlighted in red.

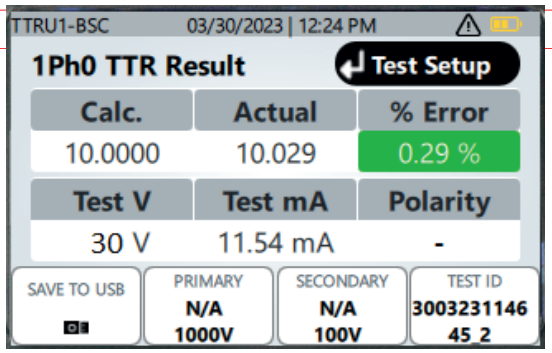
Press the primary and secondary buttons to change the tap, voltage, connection, or winding values. The TEST ID will be saved automatically when new primary or secondary information is entered. Changing the TEST ID will also automatically save the test.

If a thumb drive was not present when the test completed, insert a USB thumb drive and select the SAVE TO USB button to save the result.

Connect the USB Printer to the TTRU1 and select the PRINT button to print the results.

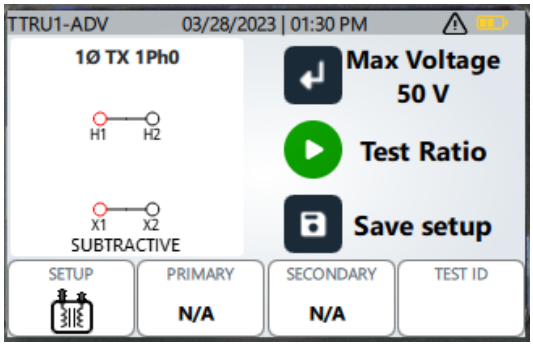
Press the enter button to return to the TTR Test Setup screen. The TEST ID will automatically increment to facilitate data grouping.





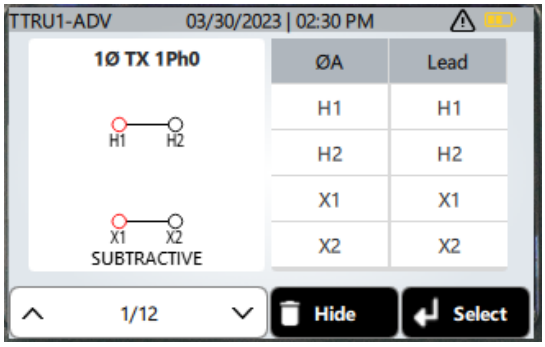
TTRU1 ADV TTR Test Setup

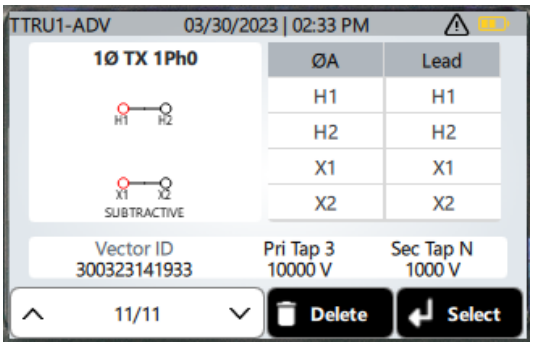
The operation of the TTRU1 ADV is comparable to the TTRU1 BASIC. Key changes are highlighted below.



Clicking the SAVE button will save the vector, primary, and secondary winding information as a custom vector based on the TEST ID. Custom vector primary and secondary winding information can be updated and resaved to update the custom vector. Up to 10 custom vectors can be saved.

Click SETUP to view a list of vectors, including saved custom vectors.

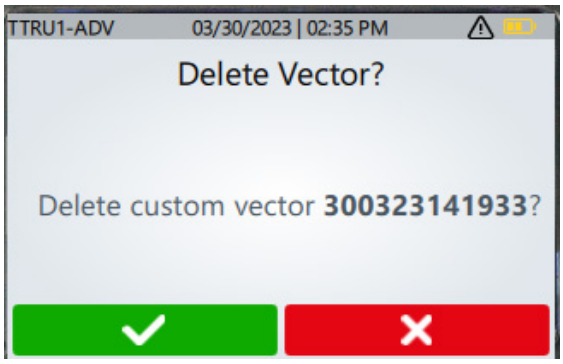




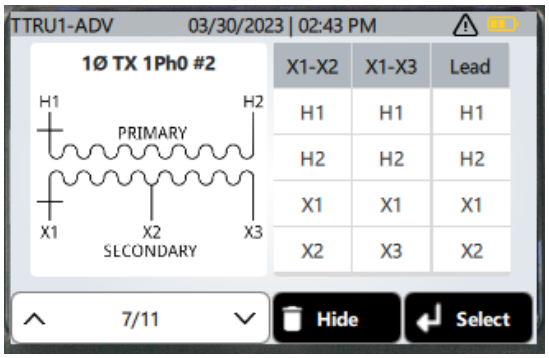
Use the up and down buttons to change the displayed vector. Press the enter button to select the displayed vector. The instrument will return to the test setup screen with the vector selected.

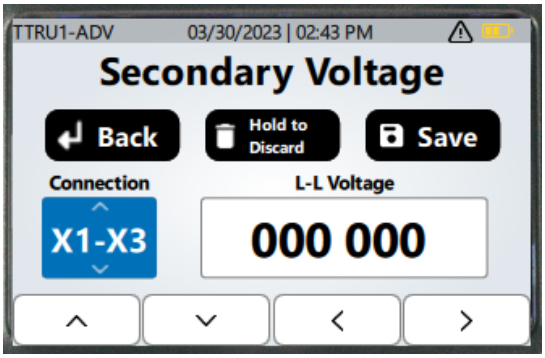
Vectors can be hidden from display by pressing the delete button. Hidden vectors can be redisplayed in settings.

Custom vectors can be deleted by clicking the delete button when they are selected. Confirmation is required when deleting custom vectors. Click the green check mark button(s) to confirm deletion and click the red cross button(s) to cancel deletion of the custom vector.



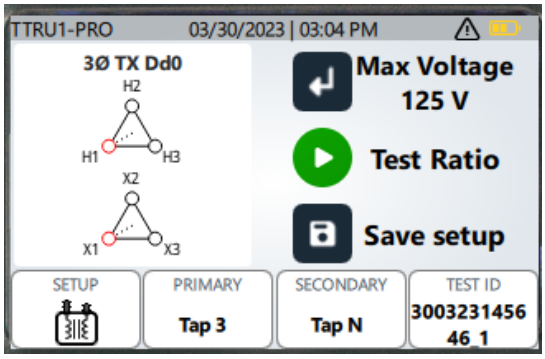
A single phase vector that has multiple secondary connections have the connections options limited to those available. For example, 1Ø TX 1Ph0 #2 has two secondary connections: X1-X2, and X1-X3. When configuring the secondary voltage, the options to select will be X1-X3, X1-2, and N/A.





TTRU1 PRO TTR Test Setup

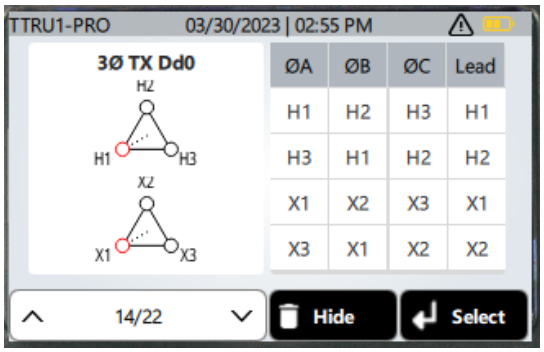
The operation of the TTRU1 PRO is comparable to the TTRU1 ADV. Key changes are highlighted below.

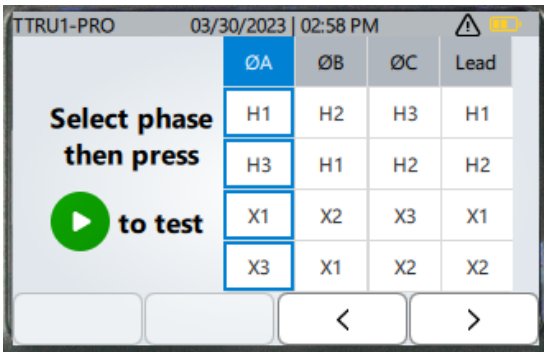


Press the enter key to select the maximum test voltage from the following options: 1 V, 4 V, 8V, 16 V, 32 V, 50 V, 80 V, or 125 V. Voltages above 50 V will use the step up method of ratio testing.

Three phase vectors are selectable from the vector list. Not all three phase vectors are presented, but common configurations can be found.

With a three phase vector selected, clicking the test button will present an intermediate screen. The intermediate screen is used to select which phase is being tested. Use the left or right arrows to select the phase to test, then press the play button to start the test.

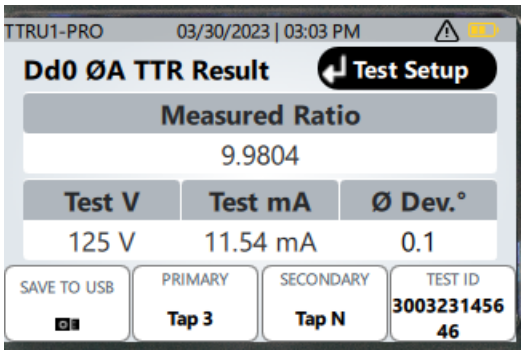


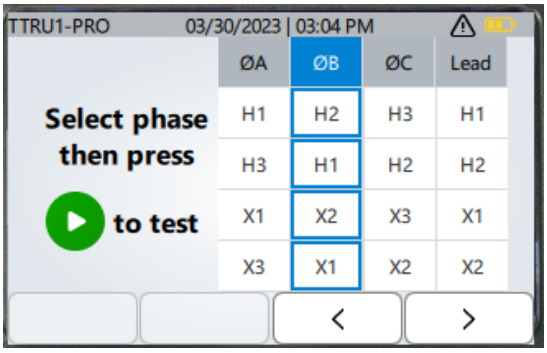


A custom vector can be upgraded to a custom nameplate in settings. When a custom nameplate is selected, the primary and secondary winding information cannot be changed – only the different taps or connections associated with the nameplate can be selected.

TTRU1 PRO TTR Results

In place of additive/subtractive phase deviation, the results screen of the TTRU1 PRO shows phase deviation. This is a more accurate representation of the relationship between the primary and secondary winding.

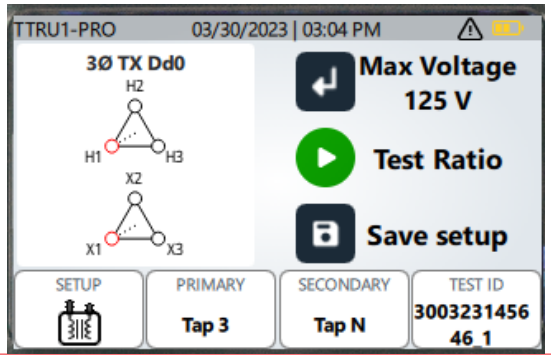




When testing three phase vectors, using the enter button to return to the test setup and then pressing play will highlight the next phase to be tested, guiding the customer through all three phases of tests.

TTRU1 EXP TTR Test Setup

The operation of the TTRU1 EXP is comparable to the TTRU1 PRO. Key changes are highlighted below.



Press the enter key to select the maximum test voltage from the following options: 1 V, 4 V, 8V, 16 V, 32 V, 50 V, 80 V, 125 V, 160 V, 200 V, or 250 V. Voltages above 50 V will use the step up method of ratio testing.

TTRU1 ADV and PRO Go/No Go Impedance Test Setup

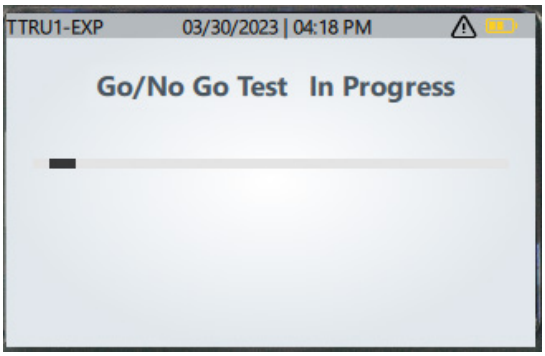
The Go/No Go impedance test of the TTRU1 is very similar for the ADV and PRO units. The only difference

The vector select options, including custom vectors, are the same as the TTR Test Setup. Please refer to the previous sections for selecting vectors.

When testing three phase vectors with the TTRU1 PRO, the TTRU1 will guide the user through testing each phase

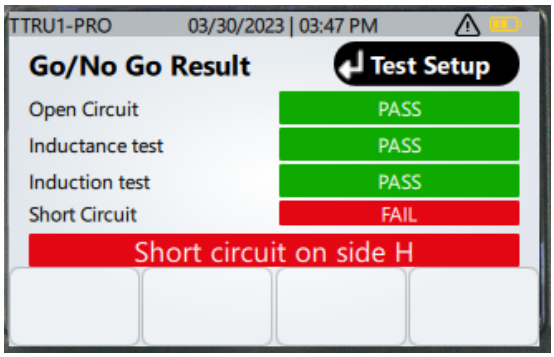
TTRU1 ADV and PRO Go/No Go Impedance Test in Progress

With a TEST ID entered, clicking the play button will show a brief countdown, followed by a test in progress screen.



TTRU1 ADV and PRO Go/No Go Impedance Test Results

When testing is complete, the TTRU1 will report pass or fail for open circuits, short circuits, inductance, and induction



Open circuit ensures continuity through a winding.

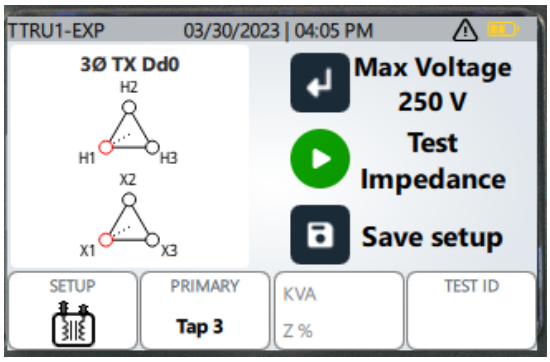
Short circuit ensures no short circuits between winding terminals.

Inductance checks that the winding has a minimum inductance (no capacitance).

Induction checks that there is some ratio transformation between the primary and secondary windings, but only from a pass/fail criteria.

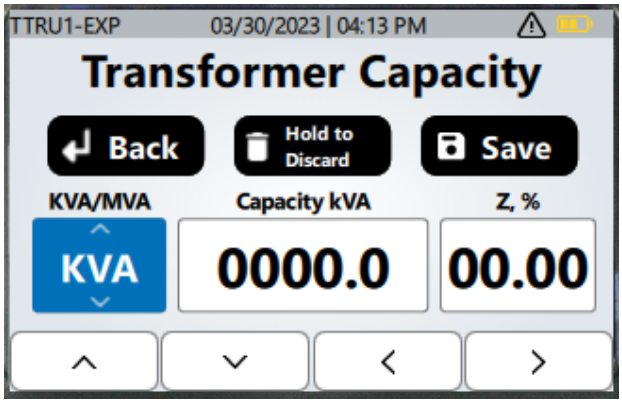
TTRU1 EXP Short Circuit Impedance / Leakage Reactance Test Setup

The short circuit impedance / leakage reactance test is only available in the TTRU1 EXP.



As with TTR, pressing enter will change the maximum test voltage.

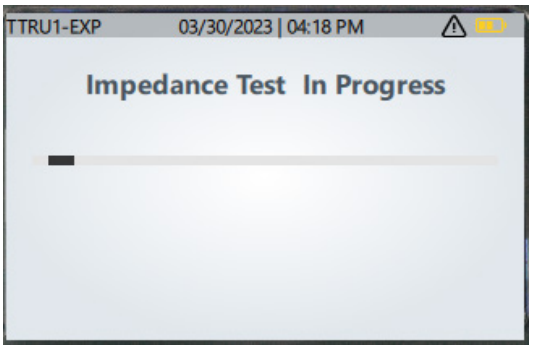
Pressing the KVA and Z% button enables entry of KVA/MVA and impedance % values. These values will be used to



Pressing save will create a custom vector or update the selected custom vector ID with the KVA and Z% information.

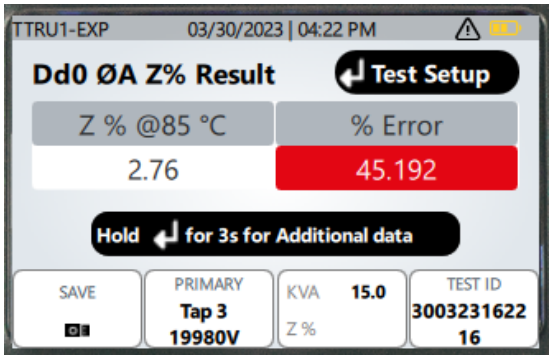
TTRU1 EXP Short Circuit Impedance / Leakage Reactance Test in Progress

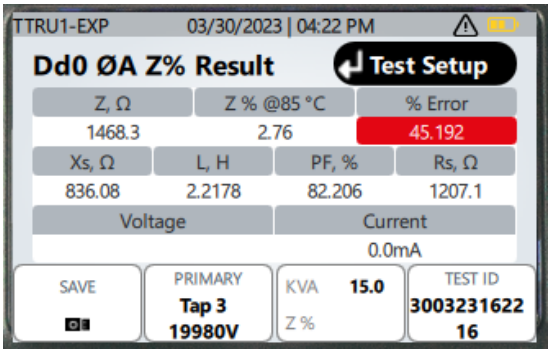
With a TEST ID entered, clicking the play button will show a brief countdown, followed by a test in progress screen.



TTRU1 EXP Short Circuit Impedance / Leakage Reactance Test Complete

When testing is complete, Z % will be displayed. If temperature correction is enabled in settings, the Z % result will be corrected to the specified temperature. The Z % value will be compared to the nameplate value, and if the limit in settings is exceeded, the result will be displayed in red.





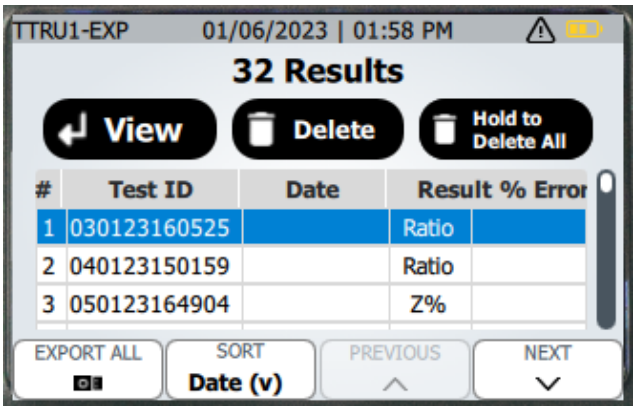
Click and hold the enter button for three seconds to view additional test information, including measured impedance, reactance, inductance, power factor, and AC resistance, and test voltage and current.

Press enter to return to the test setup. If testing three phase transformers, the TTRU1 will guide testing to the next phase.

TTRU1 PRO and EXP Results

All Results

Saved results can be viewed on the TTRU1 PRO and EXP models only.



Test results are listed with a test number, Test ID, Date of test, Result type (Ratio, Go/No Go, or Z%), and % error. % error will be blank if primary or secondary information was not saved with the result. % error will be Pass or Fail if the result is a go/no go impedance test.

Press enter to view the selected result.

Press delete to the selected results. Deleting a result requires confirmation before the deletion is completed.

Press and hold the delete button until the "Release!" message is displayed to delete all results. Confirmation is also required to delete all results.

Press Export All to export all results to a usb thumb drive.

Press the sort button to change the sorting. The following sort options are available:

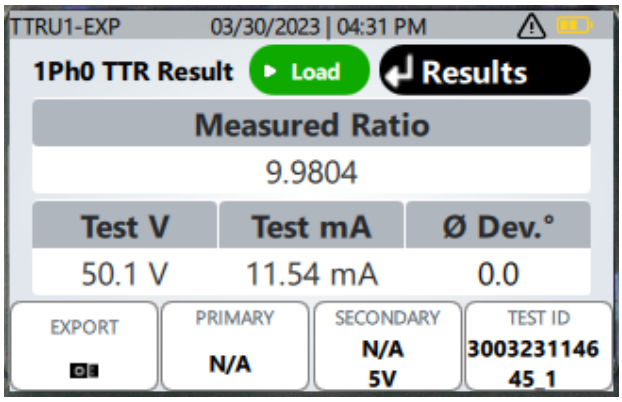
- Date (descending)
- Date (ascending)
- Test ID (A-Z)
- Test ID (Z-A)
- % Error (descending)
- % Error (ascending)

Press the previous button to go to the previous result in the list

Press the next button to go to the next result in the list

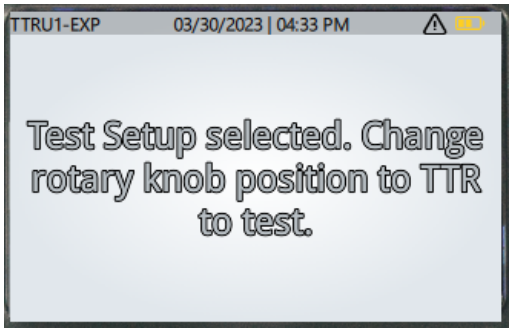
Individual Results

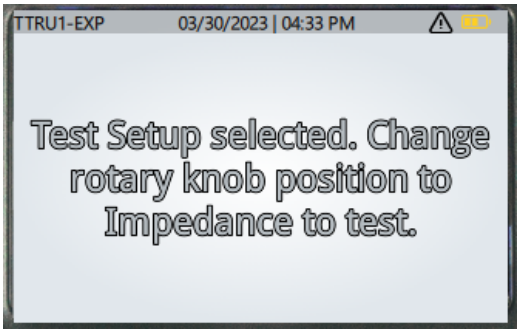
Viewing individual results is the same as viewing results after a test completes, with a few notable changes.



Press enter to return to the All Results screen.

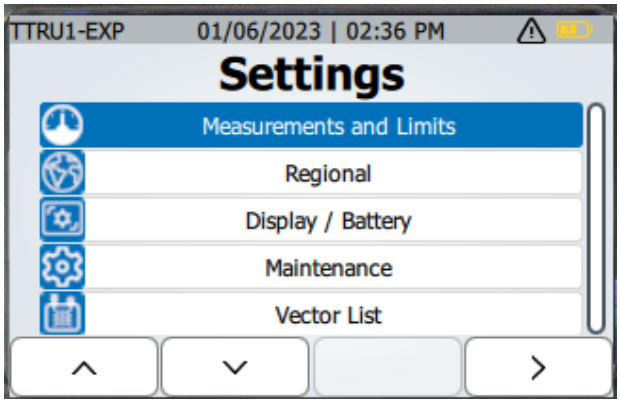
Press the play button to load the test setup for TTR and Impedance testing. After pressing the play button, the TTRU1 will instruct the user to choose the appropriate rotary knob position. Once the rotary knob is set to the correct position, the test setup will load on the display.





Settings

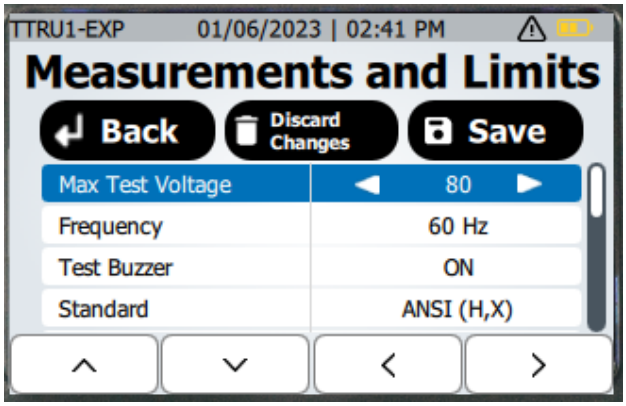
Turn the Rotary Knob to Settings to view the settings screen



Press the up and down button to change the selected settings

- Measurement and Limits
- Regional
- Display / Battery
- Vector List
- Factory Settings
- Press the right arrow button to view the selected settings options

Measurement and Limits



Press the back button to return to the settings screen without saving the changes

Press and hold the delete button until the "Release!" message is displayed to discard changes made to the settings.

Press the save button to save changes to the settings

Press the up and down arrow to select a setting to change

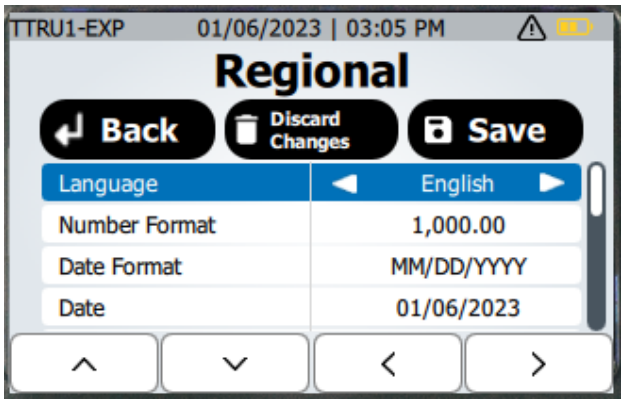
Press the left and right arrow to adjust the selected setting

Available settings in Measurement and Limits

- Max Test Voltage Options
  - TTRU1 BASIC
    - 1, 8, 30

  - TTRU1 ADV
    - 1, 8, 30, 50
  - TTRU1 PRO
    - 1, 8, 30, 50, 80, 125
  - TTRU1 EXP
    - 1, 8, 30, 50 80, 125, 160, 200, 250
- Frequency (Hz)
  - 50, 60
- Test Buzzer
  - On, Off
- Standard
  - ANSI (H,X)
  - IEC (1U,2U)
  - Australian (A#, a#)
  - GOST (A,a)
- Taps
  - 1,2,3
  - 1R,N,1L
  - +1,0,-1
  - A,B,C
- Ratio Error Limit
  - 0.5%, 1.0%, 1.5%, 2.0%
- Ratio Display
  - TTR, TNR
- Ratio Evaluation
  - % Error, Pass/Fail
- Phase Dev Limit (TTRU1 PRO, TTRU1 EXP)
  - 0.5°, 1.0°, 5.0°
- Winding Temp (TTRU1 EXP)
  - 0°C to 85 °C, 1°C increment
- Correct to Temp (TTRU1 EXP)
  - 0°C to 85 °C, 1°C increment
- Correct Z% to Temp (TTRU1 EXP)
  - Enabled, Disabled

Regional



Press the back button to return to the settings screen without saving the changes

Press and hold the delete button until the "Release!" message is displayed to discard changes made to the settings.

Press the save button to save changes to the settings

Press the up and down arrow to select a setting to change

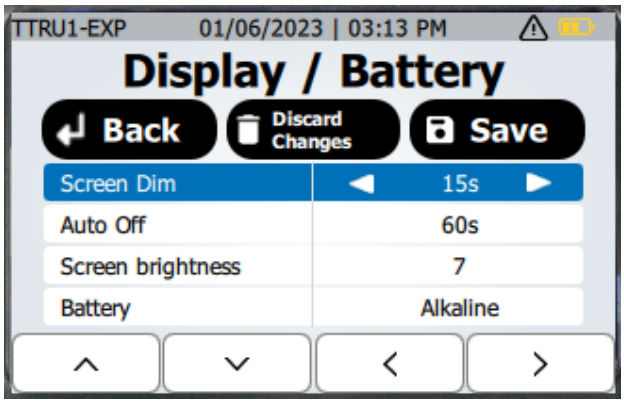
Press the left and right arrow to adjust the selected setting

Press the edit button to adjust date and time settings

Available settings in Regional

- Language
  - English, German, French, Spanish
- Number format
  - 1,000.00, 1.000,00
- Date Format
  - MM/DD/YYYY, DD/MM/YYYY, YYYY/MM/DD
- Date
  - Adjust Year, Month, Day using up, down, left, and right buttons. Press discard to return to the regional settings without saving changes. Press save to return to the regional settings with saving changes.
- Time Format
  - 12H, 24H
- Time
  - Adjust hours, minutes, and AM/PM using up, down, left, and right buttons. Press discard to return to the regional settings without saving changes. Press save to return to the regional settings with saving changes.

Display / Battery



Press the back button to return to the settings screen without saving the changes

Press and hold the delete button until the "Release!" message is displayed to discard changes made to the settings.

Press the save button to save changes to the settings

Press the up and down arrow to select a setting to change

Press the left and right arrow to adjust the selected setting

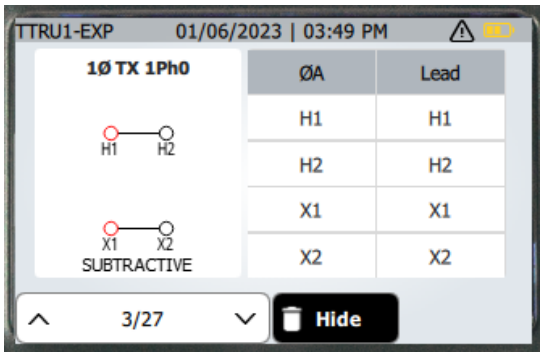
Press the edit button to adjust date and time settings

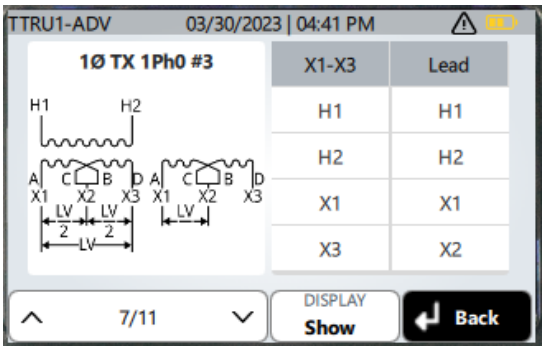
Available settings in Display / Battery

- Auto Off
  - 60s, 120s, 300s, 20 minutes
- Screen Brightness
  - 1,2,3,4,5,6,7
- Battery
  - Alkaline, NiMH

TTRU1 ADV, PRO, and EXP Vector List

The vector list is unavailable in the TTRU1 BASIC model.





Press the up and down arrows to change vectors

Press the Hide button to hide the selected vector from the display list in TTR or Impedance testing

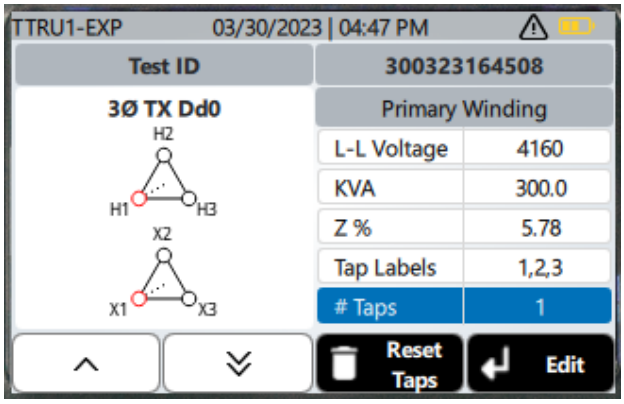
Press the Show button to show the selected vector from the display list in TTR or Impedance testing

Press the Delete button to delete custom vectors

Change the rotary dial position to exit the vector list

TTRU1 PRO and EXP Custom Nameplates

With a custom vector selected, press the edit button to enter complete nameplate information.



Press the up and down arrows to select a nameplate field to edit.

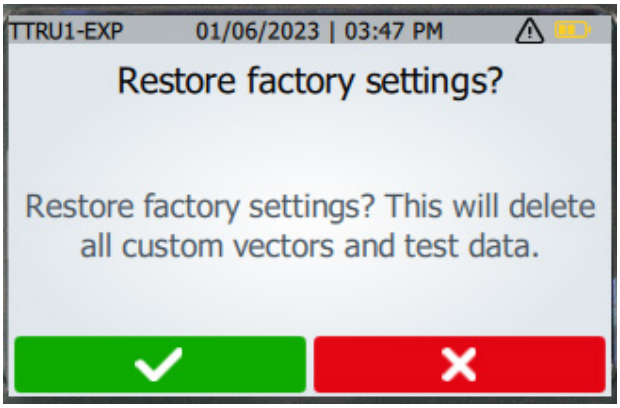
Nameplate fields available to edit:

- Test ID
- Single phase transformer with multiple connections
  - Primary Voltage
  - Connections Voltage
  - KVA
  - Z%
- Three Phase transformer
  - Primary
    - L-L Voltage
    - Z%
    - Tap Labels
    - # Taps
    - Tap voltage

      - Edit each tap voltage based on # of taps and labels
  - Secondary
    - L-L Voltage
    - Tap Labels
    - # Taps
    - Tap voltage

      - Edit each tap voltage based on # of taps and labels
- Potential Transformer
  - Secondary Voltage
  - Primary Winding Label
  - Primary # taps
  - Connection Voltages
- Current Transformer
  - Secondary Amps
  - Primary Winding Label
  - Primary # Taps
  - Primary connection Amps

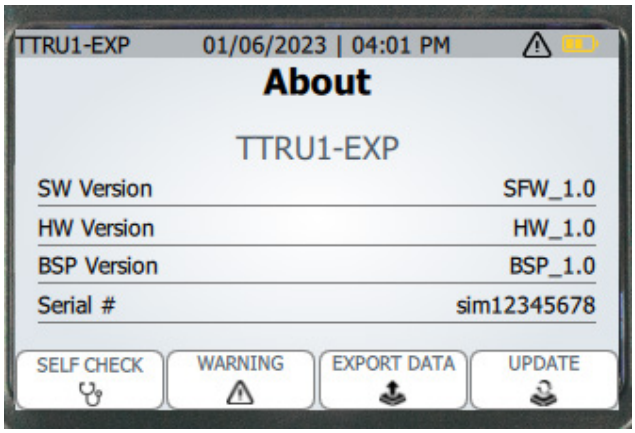
Factory Reset Settings



Choose to confirm or cancel after selecting factory reset settings.

Info / Warnings

Turn the Rotary Knob to Info to view the information and warning screen



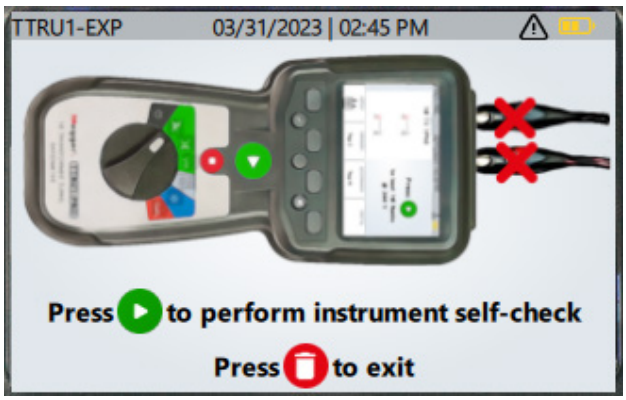
Software, hardware, and build support package versions and serial number will be displayed.

Press the warning button to view the warnings

Press the Export Data button to export results and logs

Press the update button to update the TTRU1 from a USB thumb drive.

Press the self check button to perform a self check.



Follow the directions on screen to complete the device self check.

PowerDB Import

The combined 3Ø form can be used to import TTRU1 data into PowerDB.

Service

Troubleshooting

The Troubleshooting Guide is designed to evaluate the reasons for a TTRU1 malfunction. The possible test set malfunctions and causes are listed below. Electronic circuit repairs should not be attempted in the field. Refer to Repair section.

TTRU1 does not turn on

- Check that the batteries inserted into the TTRU1 and in the proper orientation
- Check that the battery voltage is at acceptable levels for each battery.
- Hold the power button for 5 seconds. Press the power button again.
- Replace batteries.

TTRU1 Reports test failed

- Check lead connections. Reference Nameplate to ensure leads are connected to the correct bushing.

Printer not working

- Check battery is inserted into printer
- Charge printer battery using supplied charger
- Check printer paper is inserted properly
- Check USB cable is plugged into printer
- Check USB cable is plugged into TTRU1 USB port
- Check printer is turned on by holding power button
- Try other USB ports

Cannot connect TTRU1 to PC

Contact your IT department for primary assistance when connecting any device to your PC.

- Check USB-C end of cable is fully inserted into the TTRU1
- Check USB-A end of cable is fully inserted into PC
- Check the TTRU1 is powered on
- Check TTRU1 SW is installed
- Check TTRU1 is running
- Move USB cable to another USB port on your PC
- Try another USB Cable
- Try another PC

Maintenance

Only qualified persons familiar with the hazards involved with high-voltage test equipment should perform maintenance. Read and understand Sections 1, 2, 3, 4, and 5 before performing any service.

The TTRU1 requires only periodic inspection. Inspect all hardware items to ensure all are in good condition.

The TTRU1 may be cleaned periodically. In so doing, do not allow water to penetrate panel holes. An all-purpose, household spray cleaner can be used to clean the panel. Polish with a soft, dry cloth. Clean the cables and mating panel receptacles with isopropyl or denatured alcohol applied with a clean cloth.

Calibration

A complete performance and calibration check should be made at least once every year. This will ensure that the TTRU1 is functioning properly over the entire measurement range. The TTRU1 calibration is performed on each new or repaired unit before sending it to a customer.

Repairs

Megger

This instrument is manufactured in the United States.

The company reserves the right to change the specification or design without prior notice.

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