

TTRU3 True 3 Phase Transformer Turns Ratiometer



- **Guaranteed accuracy $\pm 0.05\%$ from -20°C to $+50^{\circ}\text{C}$**
- **3 \emptyset test voltage - up to 250V**
- **3 \emptyset step up ratio (patent pending)**
- **Phase shifting & zig-zag transformers tested easily and accurately**
- **Smallest/lightest 3 \emptyset test set on the market**
- **Fast 3 \emptyset tests - less than 10 seconds**

DESCRIPTION

The NEW Megger TTRU3 transformer turns ratiometer uses a revolutionary design to perform a complete series of measurements on a transformer, including 3 \emptyset step up turns ratio testing (patent pending).

3 \emptyset voltage output offers numerous advantages to testing with today's busy schedules. Features include:

- Validation and recognition of phase relationship of vector groups facilitated with on screen vector rotation and Auto vector recognition
- Accurate measurement of phase shift relationship (for phase shifting transformers and Zig Zag vector configurations).
- Faster testing – all 3 phases tested simultaneously
- More reliable - removes the requirement for internal relay switching which is a common cause of failure

The TTRU3 is an important tool for determining the mechanical condition of transformers. All ratio tests are performed in one instrument, with only one 3 \emptyset lead-set connection. The TTRU3 utilizes the latest 7 inch (180 mm) color touch display, as well as an optional printer so you never lose your results. This is complimented with remote control which can be operated from your PC, as well as the ability to download results to a USB memory device.

TYPICAL PROBLEMS FOUND USING THE TTRU3

- Loose connections
- Turn-to-turn shorts
- Broken Strands
- Winding deformation
- Tap changer contact problems
- Core problems

TESTING PERFORMED

All with one instrument and 3 \emptyset lead-set connection!

- Ratio - 3 \emptyset Step Up testing for power transformers
- Phase shift & phase deviation
- Polarity
- Magnetic balance/flux distribution
- Excitation current characteristics
- Auto vector detection/recognition

FEATURES AND BENEFITS

- 3 \emptyset test voltage - fast testing of all transformers
- Patent pending 3 \emptyset Step Up Testing
- Confirm expected nameplate vector configuration
- Ability to measure actual vs expected phase shift
- Unique kelvin clamps with adjustable 3-inch jaw
- Banana plug input for connection to terminal blocks
- Turns ratio % error vs nameplate with pass/fail
- PC interface via USB for remote control operation and downloading of test results

STEP UP - TURNS RATIO TESTING SIMPLIFIED

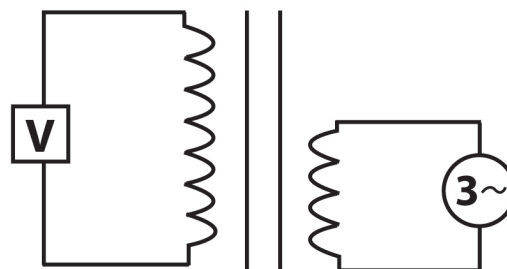
From IEEE C57.152 2013, under requirement for ratio measurement, the standard states:

The term “transformer turns ratio” (TTR) meter is commonly used to describe these instruments even though the actual turns ratio is not being measured.

Now you can measure “transformer turns ratio” as described in the standard with the new TTRU3. No need for higher voltage, heavy instruments that are more expensive and complex to operate - the TTRU3 automatically chooses the best test voltage and gives you the correct ratio the first time! All with one instrument and 3Ø lead-set connection!

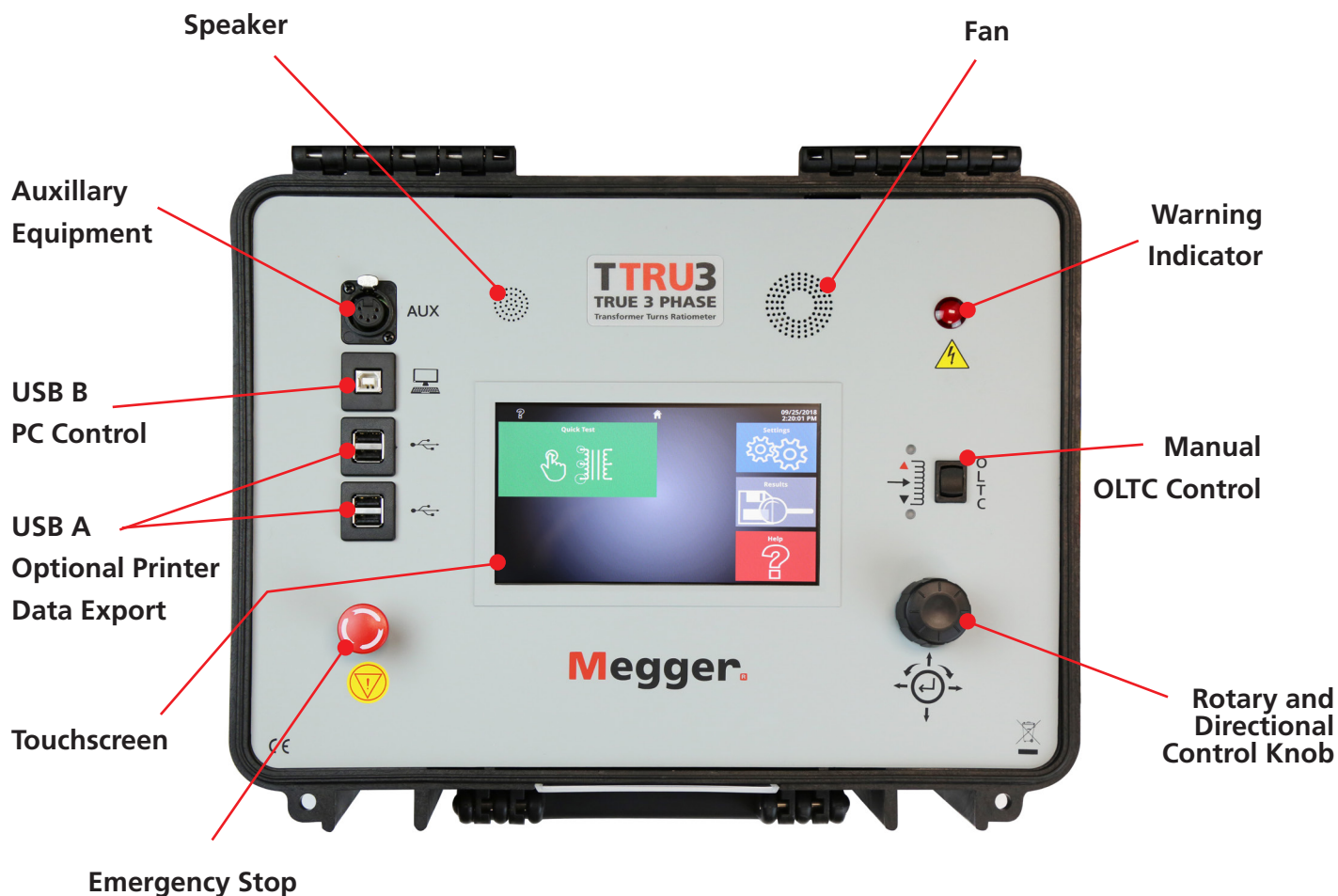
STEP UP TURNS RATIO TESTING

The technology within the TTRU3 is based on patent pending 3Ø step up ratio testing. When compared to traditional 1Ø step down test instruments, the TTRU3 removes the inaccuracy associated with test voltage. The user is no longer required to know the “proper” test voltage required to obtain a “valid” result. This makes testing much easier, as repetition of testing at proper voltage is no longer required.



SAFE WITH 3Ø STEP UP

Safety is the first priority at Megger, which is why the TTRU3 is CE Certified to IEC 61010 - Safety requirements for electrical equipment for measurement, control, and laboratory use. During a test, software will perform safety checks before applying full test voltage. In addition, the TTRU3 utilizes modern hardware to protect the operator in the event of faults.



DETAILED DESCRIPTION

The TTRU3 is designed to test ALL power, instrument, and distribution transformers without the need of traditional high voltage excitation. With our patent pending step up technique, you are no longer required to know the “proper” test voltage to apply to obtain a “good” result - the test set decides for you - all in a box that is up to 35% smaller and lighter than other turns ratio meters.

With 3Ø excitation, testing is up to five times faster than previous phase-by-phase switching single instruments, and errors due to loading of delta secondary and tertiaries are problems of the past.

POLARITY

The TTRU3 quickly and efficiently checks for correct polarity between high and low side windings.

PHASE SHIFT MEASUREMENT

Today's industrial power systems and utility power grids use transformers that generate secondary's with multiple phase angles in various vector configurations, including zig-zag windings. The new TTRU3 handles each phase displacement as easily as standard 3Ø transformer configurations. Phase shift measurement results can now be compared to expected phase shift for all three phases independently.

VECTOR RECOGNITION

The TTRU3 provides the capability for automatic vector group detection. This is very useful in validating “expected” versus “measured” vector group. This does not mean one does not require knowledge about the windings, as this is critical to the proper operation of a transformer. Vector recognition is an effective tool in validating the expected nameplate vector configuration, and should

be used as such. Windings such as Zig Zag, can be MISTAKENLY seen as a Delta configuration. This mistake could have catastrophic consequences when line voltage is applied to the transformer, thus supporting the importance of proper use of vector recognition.

PHASE ANGLE DEVIATION

Phase angle deviation (not to be confused with phase shift) is the phase relationship between in-phase vectors of the high side versus the low side windings. Phase deviation denotes the quality of the core and the winding, and when functioning properly should exhibit very low values (< 0.1 degrees). Shorted or partial shorted turns and/or a deteriorated or damaged core can cause significant changes in the phase deviation values.

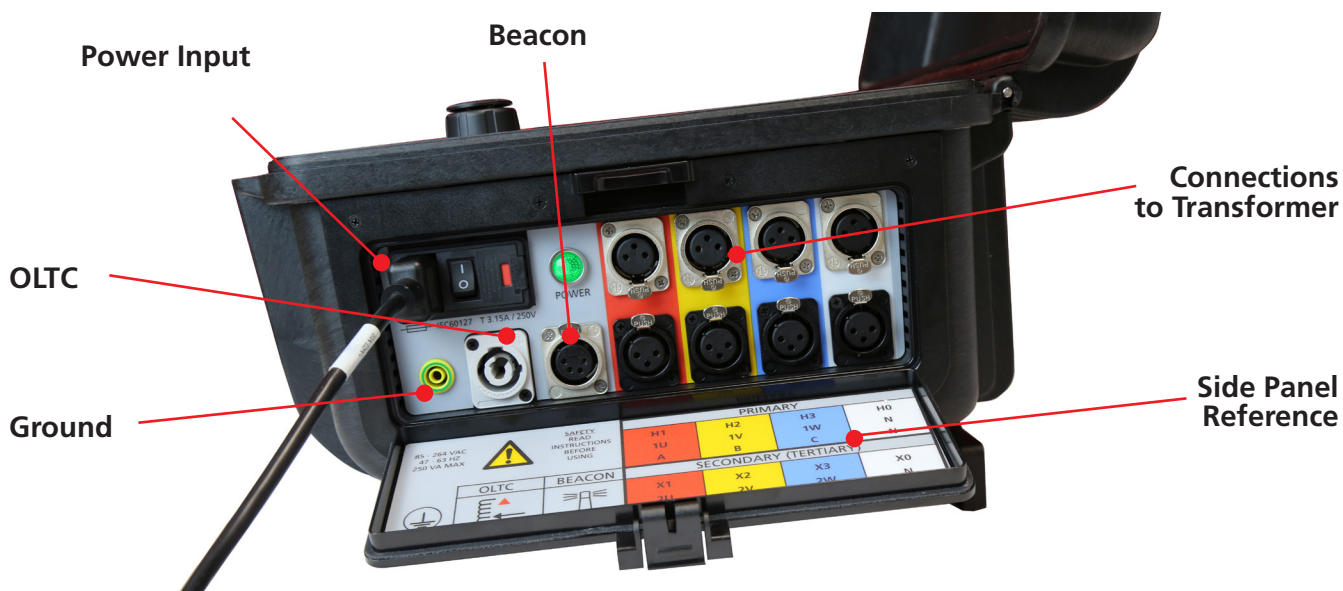
Together with ratio error, phase deviation can also be used as a reliable method of quickly verifying accuracy class of PTs and CTs at “zero burden” rating. This allows for proper validation of accuracy class of incoming CTs or PTs from the factory, or field validation during routine maintenance.

EXCITATION CURRENT

The excitation current test is very useful in locating problems such as defects in magnetic core balance, magnetic core structure, shifting of windings, failures in the turn-to-turn insulation, or problems in tap changers.

WINDING BALANCE

Winding balance (also referred to as magnetic balance) is performed to assess the health of the windings, core assembly condition, and flux distribution within the transformer. This test, performed safely and efficiently by the TTRU3, is a measure of how well balanced (electrically) the transformer is versus nameplate specifications.



CONTROL SOFTWARE, SAVING, & PRINTING RESULTS

The intuitive user interface of the TTRU3 uses large, self-explanatory buttons that lessen the need for exhaustive operator training. Vectors are displayed on screen, making it easy to match them to a nameplate, giving you confidence that your test setup is correct. When exported, quick test results are grouped by file name, producing an XLS/PDF report that is easy to read, email, or import into PowerDB. If you need results on the spot, use the optional USB printer!

When you connect the TTRU3 to your PC, not only can you control the device, but a CD drive will appear. The user manual, datasheet, and TTRU3 PC application installer can be found on this drive so you always have the necessary documentation and applications on hand.

AUTOMATION

Maximize your time in the field with automation options.

Test Plans & Automatic OLTC – Summer 2019

Test Plans & Automatic OLTC allow you to enter transformer nameplate information and run through an entire OLTC with one click; Just confirm the calculated tap voltages and choose when the test should stop. Exported results, just like quick test, will produce an XLS/PDF report that contains all of the information entered in the Test Plan.

PowerDB Control

If you're looking to step up your reporting, use PowerDB to configure and execute your tests. With PowerDB you can produce consistent test reports from all of your Megger instruments.

Using either PowerDB Lite or the TTRU3 GUI, one is able to test quickly, completely, and produce a useful report for today's data based asset management culture. While we are all being challenged with more reporting requirements, the ability to print critical results "on the fly" is not lost on the TTRU3. Each 3Ø set of results can be printed as required for security of testing as well as for future results entry into customer test reports.

VERSATILITY

Be prepared for any situation with versatile software features.

Phase Shifting

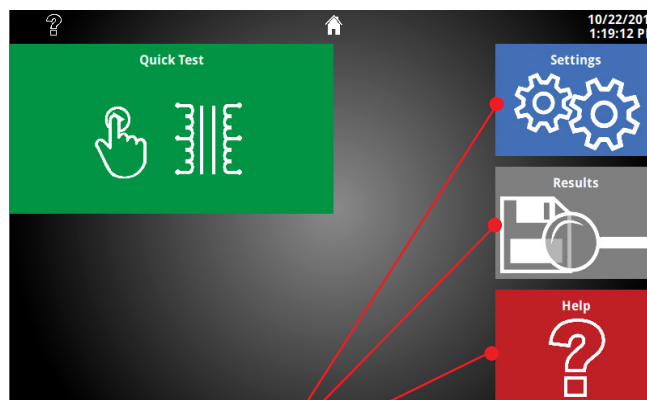
Phase shifting transformers can be tested quickly and easily with the phase shifting option. For the most demanding transformers, individual tap phase shifts can be defined when combined with test plans & automatic OLTC.

Magnetic Balance

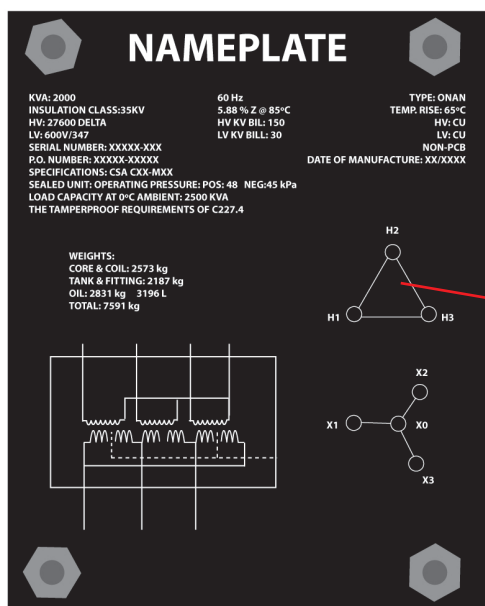
Magnetic balance is an advanced diagnostic test typically performed during transformer construction used to detect problems such as inter-turn and inter-strand shorts, external loops around the core, and wrong interleaving joints. It is also useful in determining if a transformer core is magnetized and checking that the mechanical properties of the core and windings have not changed after a fault.

3Ø Diagnostics – Winter 2019

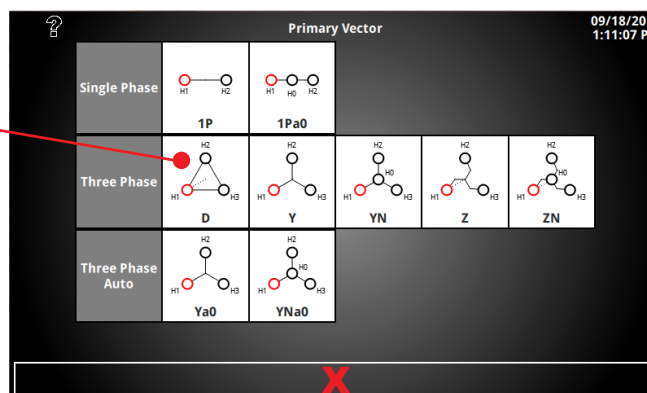
Today's power protection systems rely on sequence components to determine when to trip relays and prevent catastrophic failures. With the TTRU3, you can see if the transformer contributed to the relay tripping by looking at the negative and zero sequence components.



Self-explanatory buttons



Compare nameplate vector to images on screen



UNIVERSAL LEAD SET

The 3Ø Universal lead set simplifies connecting to any transformer. The durable kelvin clamps extend up to 3" for connecting to any bushing size. Lead spans range from 5m (15ft) to 30m (100ft), ensuring you can connect and test any transformer configuration. All of the leads can be connected in one ladder climb, reducing the risk of fall injuries.

The kelvin clamps also accept safety banana plugs, making it easy to connect the 3Ø lead set to a CT terminal block. Electrical shock and potential markings are clearly displayed on the clamp, informing operators how to connect safely and securely.

The TTRU3 lead set can be used with most existing MTOs, MWAs, and TTRs. Requires PNs

- 2008-009 - H lead breakout
- 2008-010 - X lead breakout

You can even use your old lead set with the TTRU3! Applies to PNs

H leads:

- 2008-001-XX
- 2008-002-XX
- 2008-003-XX
- 2008-004-XX

X-leads:

- 2008-005-XX
- 2008-006-XX
- 2008-007-XX
- 2008-008-XX

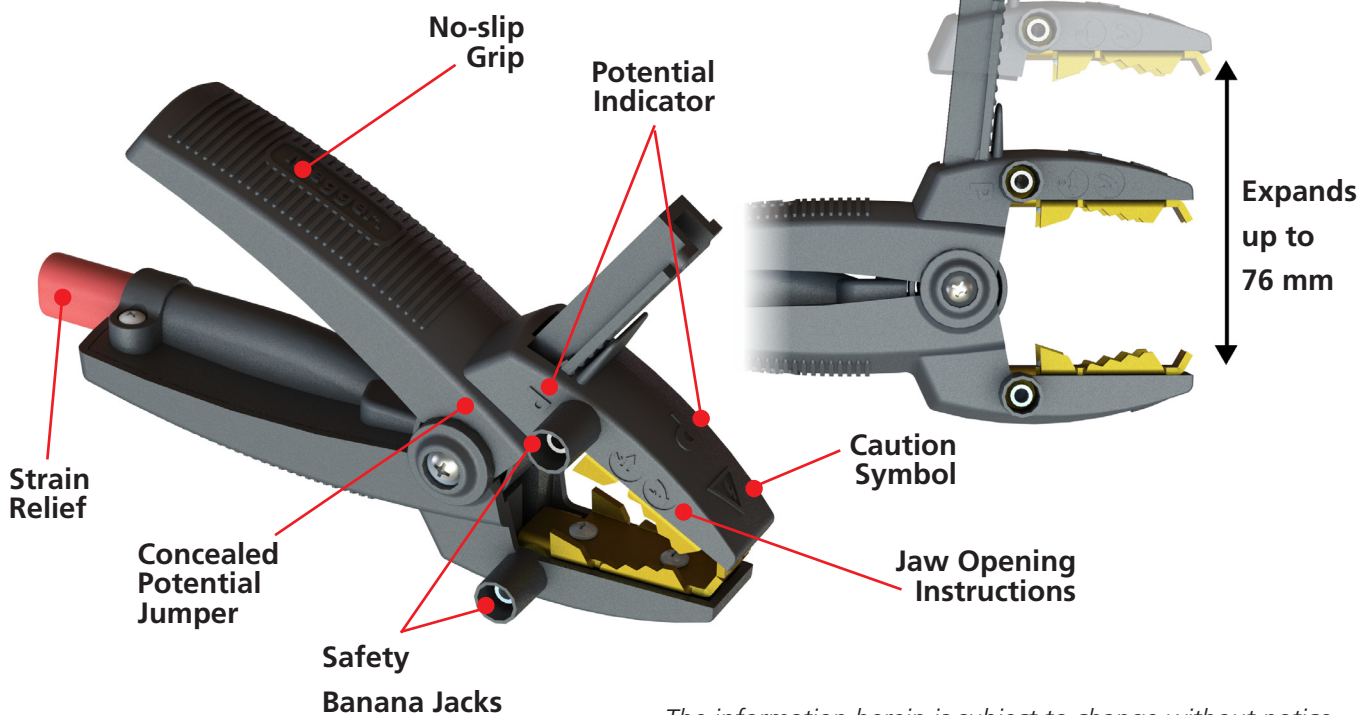


H Leads



X Leads

Color-coded Connectors



The information herein is subject to change without notice

SPECIFICATIONS

Input Power

90-264VAC, 47-63Hz, 250VA Max

Output

Voltage: 3Ø, 1 - 48VAC, up to 250V on Primary

Frequency: 50-480Hz

Current: 0.1mA - 1A, Max 1A @ 48V

Turns Ratio Measurement Methods

3Ø Step Up

3Ø Step Down

1Ø Step Up

1Ø Step Down

Turns Ratio Range and Accuracy - Guaranteed accuracy from -20°C to +50°C

Step Down Excitation

25-48V

±0.05% 0.8 - 1000

±0.10% 1001 - 2000

±0.30% 2001 - 15000

±1% 15001 - 50000

1-24V

±0.10% 0.8 - 1000

±0.20% 1001 - 2000

±0.60% 2001 - 15000

Step Up Measurement

25-250V

±0.05% 0.8 - 200 (most Power Tx)

1-24V

±0.10% 0.8 - 200

5 digit resolution

Excitation Current Measurement

Resolution: 0.1mA 0.1mA - 100mA

1mA 101-1000mA

Accuracy: ± 1% ±0.1 mA

Frequency Measurement

Resolution: 0.1 Hz

Accuracy: ±0.1% ±0.1 Hz

Transformer Phase Measurement

Range: 0 - 360 Degrees

Accuracy: ± 0.05 Degrees

Weight

6.5kg 14lbs

Dimensions

406 x 304 x 254mm 16 x 12 x 8in

Environmental

Operating -20°C to +50°C (-4°F to +122°F)

Storage -30°C to +70°C (-22°F to +158°F)

Relative Humidity 0-90%, non-condensing

Regulatory

Safety

IEC 61010-1:2010 + AMD1:2016

EMV/EMC

IEC 61326-1:2012

RoHS2

EN50581

Vibration/Drop/Shock

MIL-STD-810G



Touchscreen

180mm (7 in.)

800 x 480 Resolution

1100 NITS

Transformer Testing Standards

IEEE C57.152-2013

IEC 60076-1:2011

AS/NZS 6076 1:2014

CIGRE 445 2011

Case

Ruggedized case with fold out feet

Canvas carrying bag for leads and accessories

Internal/External Data Storage

Up to 2000 sets of 3 phase results internal storage

Transferable via USB 2.0/3.0 thumb drive

Communication/Control Software

180mm (7in) built in display running custom GUI

USB Interface for PC Control running custom GUI

Printer Output

51mm (2in) thermal printer

Prints all measurement data displayed on GUI

TTRU3 STANDARD FEATURES:

- OLTC Control
- Test Mode / Time - Simultaneous / 10s 3Ø
- Predictive OLTC Voltage
- Vector Rotation on Screen
- Auto Vector Recognition
- Thumb Drive Export
- AUX CAN BUS

TTRU3 Selection Guide

Model	TTRU3 ^{EXP}	TTRU3 ^{PRO}	TTRU3 ^{ADV}
Max Turns Ratio	50,000 Down / 200 Up	50,000 Down / 200 Up	50,000 Down / 100 Up
Max Induced Voltage	250V	250V	125V
Ø Shifting TX's Measurement	■	Optional	Optional
Magnetic Balance	■	Optional	Optional
Printer	■	Optional	Optional
Power DB Control	■	Optional	Optional

CONFIGURATOR

Model	TTRU3-		—	—			
Select a model	250V 3ø + Accs.	EXP					
	250V 3ø	PRO					
	125V 3ø	ADV					
— — STOP IF NO LEADS/ACCESSORIES REQUIRED — —							
Lead Kit	Buying leads al a carte/customer has leads (customer must verify PN)						X
	5m Kit						1
	9m Kit						2
	18m Kit						3
	30m/18 Kit						4
— — IF SELECTING EXP, STOP HERE. — —							
Printer		No Printer					X
		Printer	P				
Automation SW				None	X		
				PowerDB	2		
Versatile SW				None	X		
				Versatile Kit	1		
				Phase shifting	2		
				Magnetic Balance	3		

ORDERING INFORMATION

Item (Qty)	Cat. No.
3Ø Transformer Turns Ratio Test Set	TTRU3-EXP TTRU3-PRO TTRU3-ADV

Included Accessories

AC Power Cord & Adapters	2009-874
USB 2.0 Cable	CA-USB
Tap Changer	1011-622
Canvas carrying bag for test leads	2005-265
Ground Cable	2011-716
Thumb Drive	1011-585
Triple Function Pen	2011-538

Optional Hardware Accessories

1:1 Test Jig	2005-249
Beacon	1004-639
Transit Case (for instrument)	2012-236
TRS1+ Calibration Standard	TRS1PLUS
TRS1D Calibration Standard	TRS1D
Calibration Certificate	CERT-NIST
USB Printer	90029-573
USB Printer Paper (x48 rolls)	90029-573-P
OLTC Multi-contact connectors	1011-622-A

Item (Qty)	Cat. No.
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ADV/PRO Software Options

TTRU3-EXP includes all software options and will receive automatic activation of new features upon their release

PowerDB Control	SW-POWERDB
All Versatile SW	SW-VERSATILEKIT
Phase Shifting	SW-PHASESHIFT
Magnetic Balance	SW-MAGNETICBAL

Required Accessories

Lead P/Ns 2008-XXX-XX (8 total) can be used with the TTRU3 and qualify as required accessories

3Ø universal shielded test lead sets compatible with MTO3XX, MWA3XX, TTRU3 instruments (up to 10A max), complete with color-coded Kelvin Clamps: Choose Kit or mix & match H & X

5m (15ft) H & X	2008-15KIT2
9m (30ft) H & X	2008-30KIT2
18m (60ft) H & X	2008-60KIT2
30m (100ft) H & 18m (60ft) X	2008-100KIT2
5m (15ft) H	2008-300-15
5m (15ft) X	2008-301-15
9m (30ft) H	2008-300-30
9m (30ft) X	2008-301-30
18m (60ft) H	2008-300-60
18m (60ft) X	2008-301-60
30m (100ft) H	2008-300-100

Group exporter:
Multi-Tek International
Email: mti@multitekintl.com

TTRU3_DS_V02_EN

ISO 9001

The word 'Megger' is a registered trademark