

# TTRU3 True 3 Phase Transformer Turns Ratiometer



- **Guaranteed accuracy  $\pm 0.05\%$  from  $-20^{\circ}\text{C}$  to  $+50^{\circ}\text{C}$**
- **3 $\emptyset$  test voltage - up to 250V**
- **3 $\emptyset$  step up ratio (patented)**
- **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 (patented).

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
- PhaBse 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
- Patented 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

The information herein is subject to change without notification

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

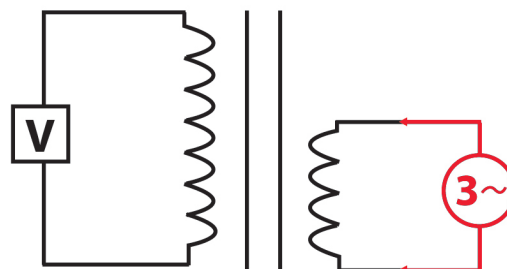
*The term “transformer turns ratio” (TTR) meter is commonly used to describe these instruments even though the actual turns ratio is not being measured.*

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!

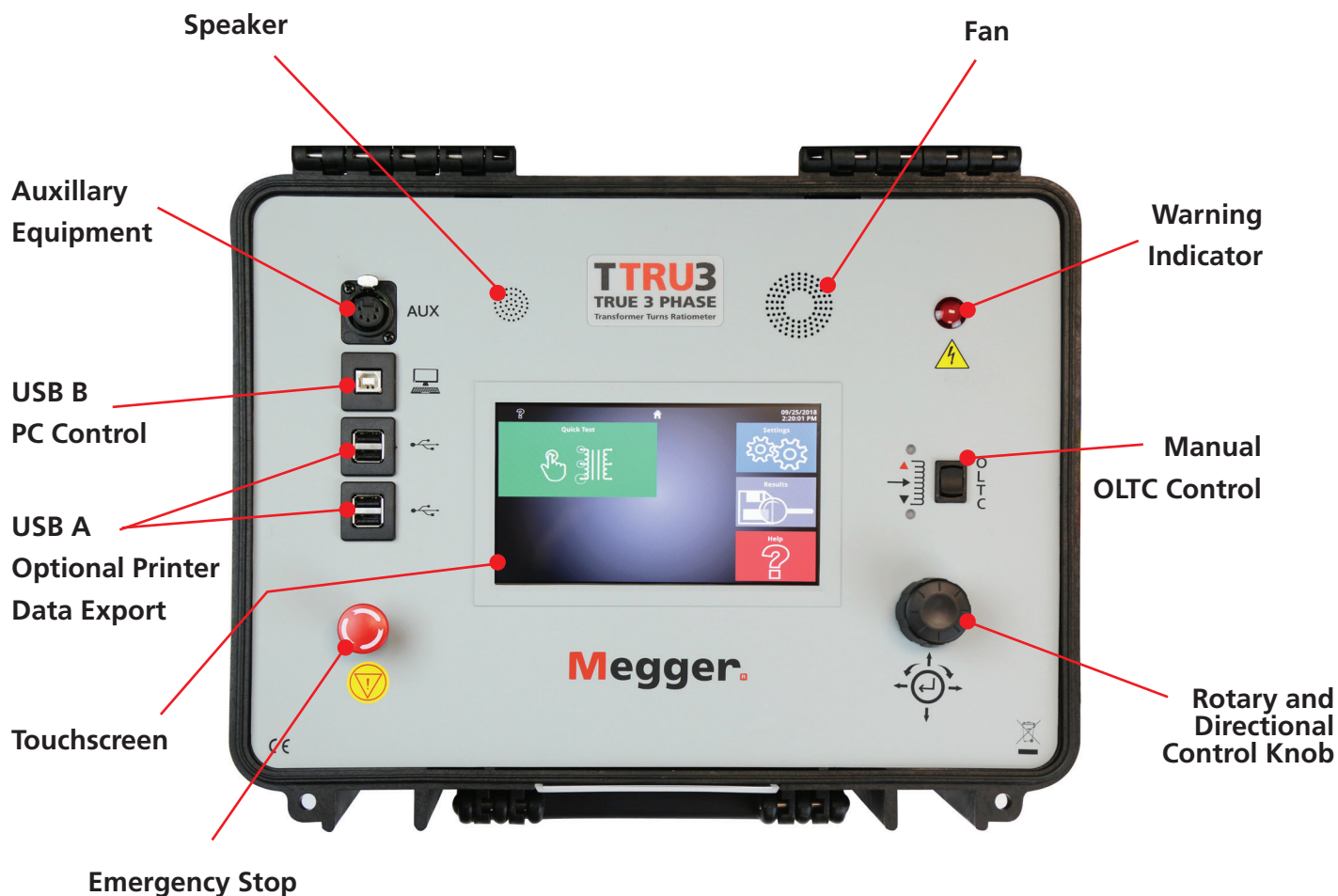
## STEP UP TURNS RATIO TESTING

The technology within the TTRU3 is based on patented 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 (CTs and PT/VTs), and distribution transformers without the need of traditional high voltage excitation. With our patented 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.

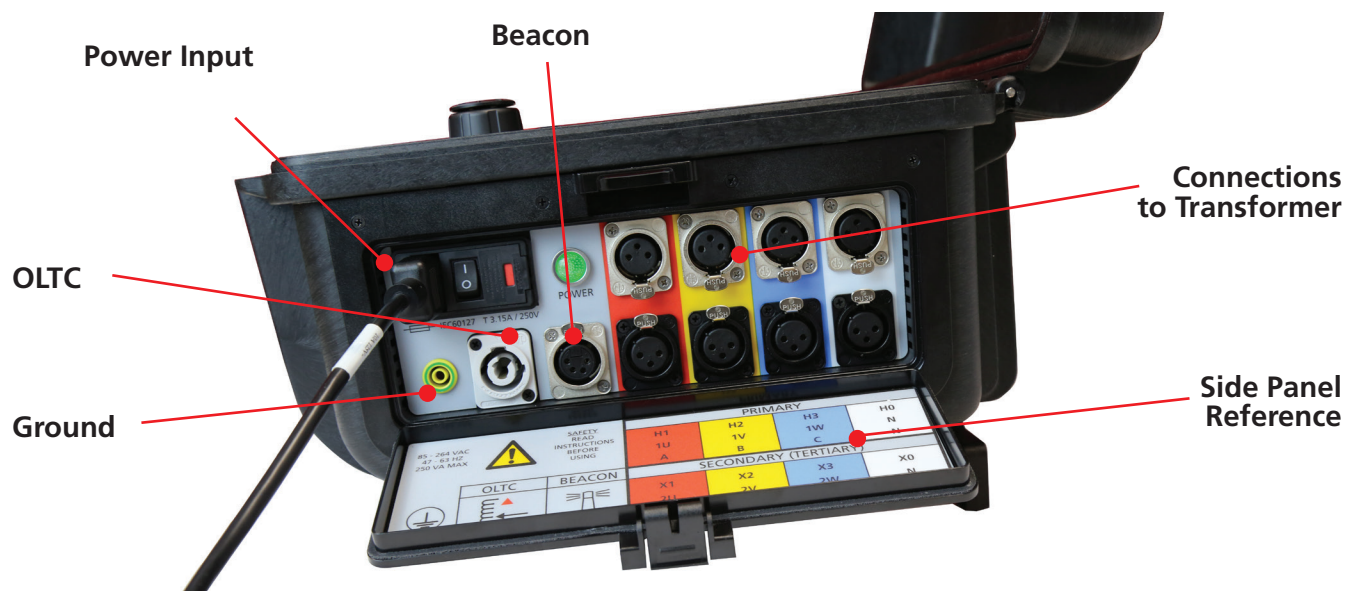
Together with ratio error, phase deviation can also be used as a reliable method of quickly verifying accuracy class of PTs and CTs at “zero burden” rating. This allows for proper validation of accuracy class of incoming CTs or PTs from the factory, or field validation during routine maintenance.

## 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.



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## CONTROL SOFTWARE, SAVING, & PRINTING RESULTS

The intuitive user interface of the TTRU3 has large, self-explanatory buttons. Vectors are displayed on screen, making it easy to match them to a nameplate, giving you confidence that your test setup is correct. Whether using Quick test or setting up a Test Plan, minimal training is required. When exported, 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.

### One Touch OLTC

One touch OLTC allows you to run through an entire OLTC with one click; Just confirm the calculated tap voltages in the Test Plan and choose when the test should stop! .

### 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.

## Custom App Control

With Custom app control, the TTRU3 can be controlled by any program through the an API. Great for organizations looking to push their test program to the limit!

## VERSATILITY

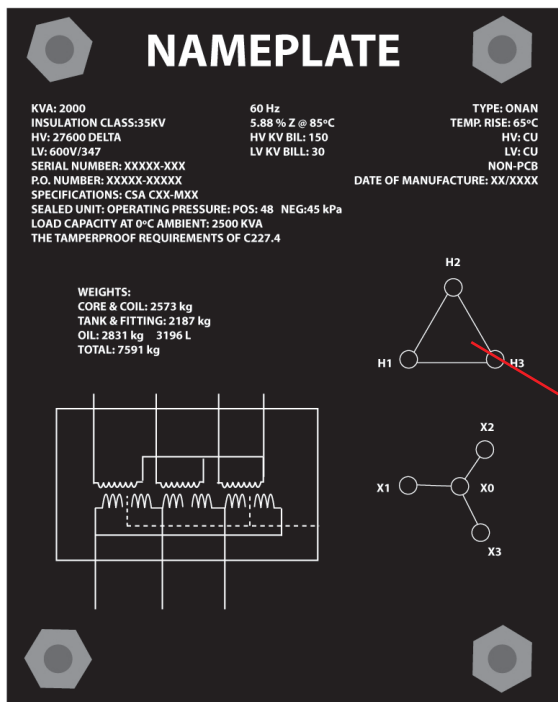
Be prepared for any situation with versatile software features.

### Phase Shifting

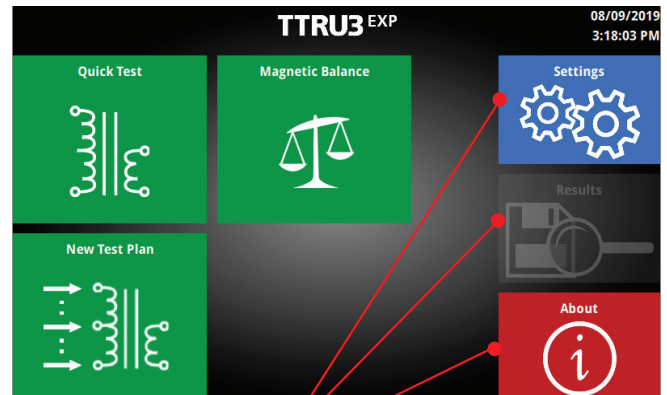
Phase shifting transformers can be tested quickly and easily with the phase shifting option. For the most demanding transformers, individual tap phase shifts can be defined when combined with test plans & automatic OLTC.

### Magnetic Balance

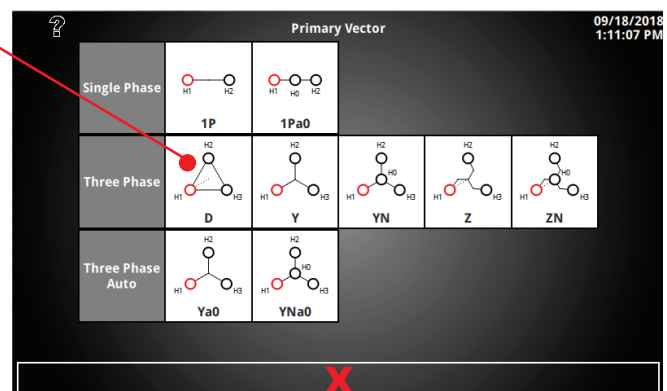
Magnetic balance is an advanced diagnostic test typically performed during transformer construction used to detect problems such as inter-turn and inter-strand shorts, external loops around the core, and wrong interleaving joints. It is also useful in determining if a transformer core is magnetized and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



**Compare nameplate vector to  
images on screen**



**Self-explanatory buttons**



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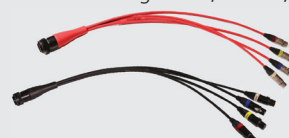
## UNIVERSAL LEAD SET

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



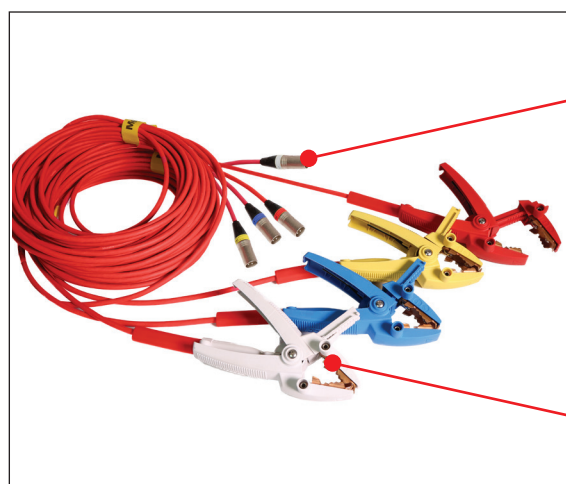
You can even use your old lead set with the TTRU3! Applies to PNs

H leads:

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

X-leads:

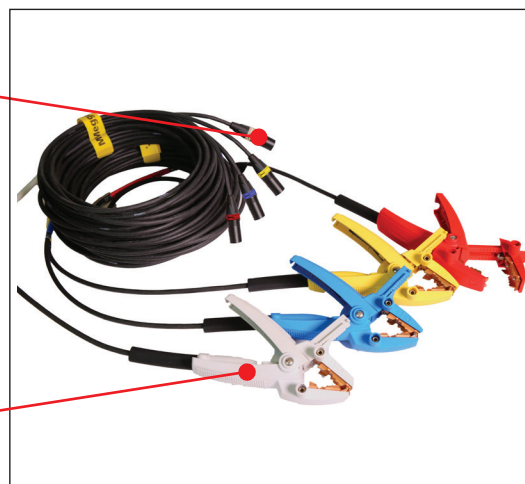
- 2008-005-XX
- 2008-006-XX
- 2008-007-XX
- 2008-008-XX



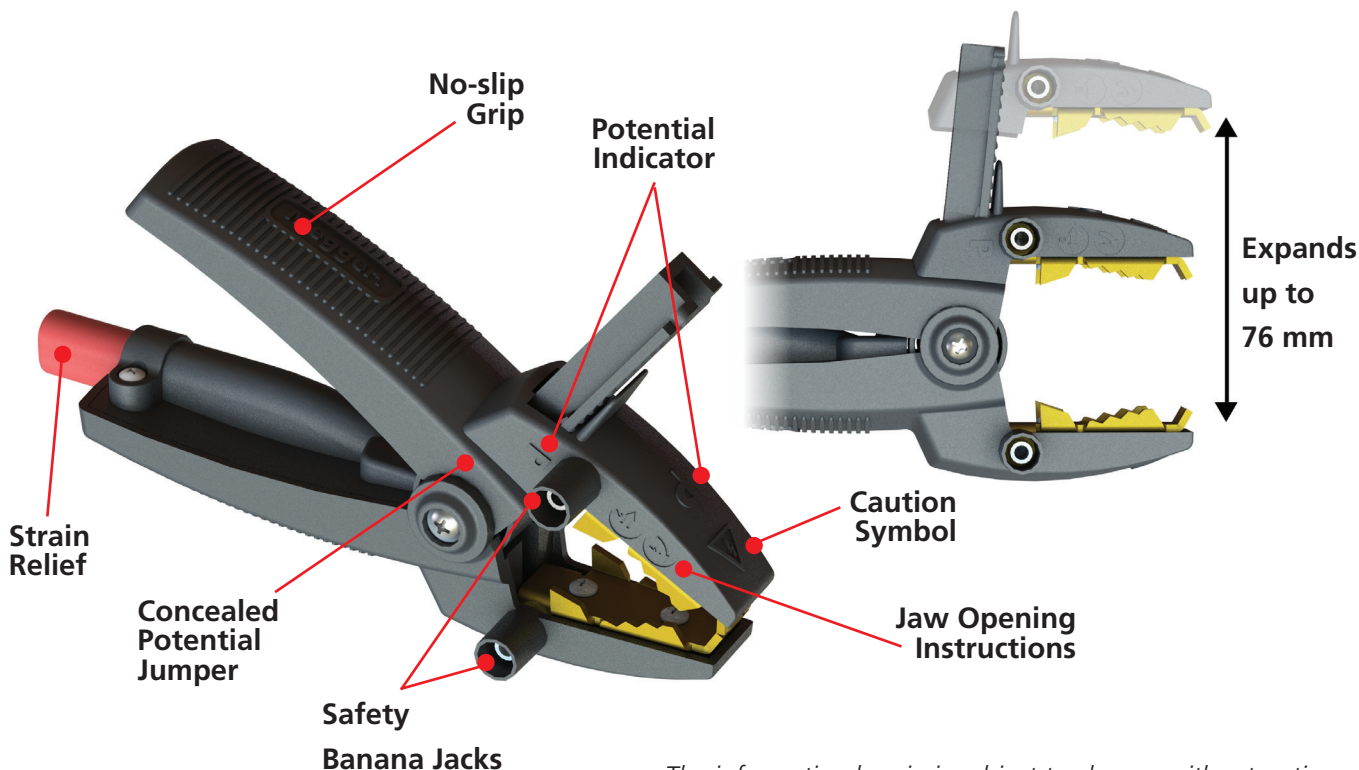
Color-coded Connectors

Color-coded Clamps

*H Leads*



*X Leads*



## 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 2A @ 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 101-2000mA

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

### Ingress Protection

TTRU3: IP 51

TTRU3 in transit case: IP 67

### 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 Plans
- Simultaneous 3Ø Excitation
- Predictive OLTC Voltage
- Vector Rotation on Screen
- Auto Vector Recognition
- Thumb Drive Export
- AUX CAN BUS
- 10s Test Time per Tap
- PowerDB Import

| TTRU3 Selection Guide           |                      |                             |                      |
|---------------------------------|----------------------|-----------------------------|----------------------|
| Model                           | TTRU3 <sup>ADV</sup> | TTRU3 <sup>PRO</sup>        | TTRU3 <sup>EXP</sup> |
| Max Turns Ratio                 | 50,000 Down / 100 Up | 50,000 Down / <b>200 Up</b> |                      |
| Max Induced Voltage             | 125V                 | <b>250V</b>                 |                      |
| Printer                         | Optional             |                             | ■                    |
| Power DB Control                | Optional             |                             | ■                    |
| Safety Beacon 18 m (60 ft)      | Optional             |                             | ■                    |
| OLTC Tap Changer Cable Adapters | Optional             |                             | ■                    |
| Power DB Control                | Optional             |                             | ■                    |
| One Touch OLTC                  | Optional             |                             | ■                    |
| Custom App Control              | Optional             |                             | ■                    |
| Ø Shifting TX's Measurement     | Optional             |                             | ■                    |
| Magnetic Balance                | Optional             |                             | ■                    |

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## ORDERING INFORMATION

| Item (Qty)                                                                                                                                                                       | Cat. No.                            | Item (Qty)                                                                                            | Cat. No.     |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|-------------------------------------------------------------------------------------------------------|--------------|
| 3Ø Transformer Turns Ratio Test Set                                                                                                                                              | TTRU3-EXP<br>TTRU3-PRO<br>TTRU3-ADV | <b>Accessories Required for Operation</b>                                                             |              |
| <b>Included Accessories</b>                                                                                                                                                      |                                     | <b>Lead P/Ns 2008-XXX-XX (8 total) can be used with the TTRU3 and qualify as required accessories</b> |              |
| 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 |                                     |                                                                                                       |              |
| AC Adapters & Power Cord - 2.5m (8ft)                                                                                                                                            | 2009-874                            | 5m (15ft) H & X                                                                                       | 2008-15KIT2  |
| USB 2.0 Cable                                                                                                                                                                    | CA-USB                              | 9m (30ft) H & X                                                                                       | 2008-30KIT2  |
| OLTC Tap Changer cable - 9m (30ft)                                                                                                                                               | 1011-622                            | 18m (60ft) H & X                                                                                      | 2008-60KIT2  |
| Cable bag - backpack                                                                                                                                                             | 2012-180                            | 30m (100ft) H & 18m (60ft) X                                                                          | 2008-100KIT2 |
| Ground Cable - 5m (16ft)                                                                                                                                                         | 1011-352                            | 5m (15ft) H                                                                                           | 2008-300-15  |
| Thumb Drive                                                                                                                                                                      | 1011-585                            | 5m (15ft) X                                                                                           | 2008-301-15  |
| Triple Function Pen                                                                                                                                                              | 2011-538                            | 9m (30ft) H                                                                                           | 2008-300-30  |
| <b>Optional Hardware Accessories</b>                                                                                                                                             |                                     | 9m (30ft) X                                                                                           | 2008-301-30  |
| 1:1 Test Jig                                                                                                                                                                     | 2005-249                            | 18m (60ft) H                                                                                          | 2008-300-60  |
| Safety Beacon – 18m (60ft)                                                                                                                                                       | 1004-639                            | 18m (60ft) X                                                                                          | 2008-301-60  |
| Transit Case (for instrument)                                                                                                                                                    | 2012-236                            | 30m (100ft) H                                                                                         | 2008-300-100 |
| TRS1+ Calibration Standard                                                                                                                                                       | TRS1PLUS                            | <b>Optional Lead Accessories</b>                                                                      |              |
| Calibration Certificate                                                                                                                                                          | CERT-NIST                           | 9m (30ft) H extensions                                                                                | 2008-300-30X |
| USB Printer                                                                                                                                                                      | 90029-573                           | 9m (30ft) X extensions                                                                                | 2008-301-30X |
| USB Printer Paper (x48 rolls)                                                                                                                                                    | 90029-573-P                         | 9m (30ft) H & 9m (30ft) X extensions                                                                  | 2008-30XKIT2 |
| OLTC Tap Changer cable adapters                                                                                                                                                  | 1011-622-A                          |                                                                                                       |              |
| <b>ADV/PRO Software Options</b>                                                                                                                                                  |                                     |                                                                                                       |              |
| <b>TTRU3-EXP includes all software options and will receive automatic activation of new features upon their release</b>                                                          |                                     |                                                                                                       |              |
| All Automation SW (three options below)                                                                                                                                          | SW-AUTOKIT                          |                                                                                                       |              |
| PowerDB Control                                                                                                                                                                  | SW-POWERDB                          |                                                                                                       |              |
| One Touch OLTC                                                                                                                                                                   | SW-AUTOOLTC                         |                                                                                                       |              |
| Custom App Control                                                                                                                                                               | SW-CUSTOMAPP                        |                                                                                                       |              |
| All Versatile SW (both options below)                                                                                                                                            | SW-VERSATILEKIT                     |                                                                                                       |              |
| Phase Shifting                                                                                                                                                                   | SW-PHASESHIFT                       |                                                                                                       |              |
| Magnetic Balance                                                                                                                                                                 | SW-MAGNETICBAL                      |                                                                                                       |              |