Raytech
SWITZERLAND

INSTRUCTION MANUAL

ENGLISH

T-Rex

3 Phase Voltage Extension

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Contents

1 Safety Precautions

The following safety precautions must be observed during all phases of operation, service and repair of this instrument. By purchasing this equipment the purchaser assumes all liability for the operation and use of this equipment. The intended use of the instrument, its design and manufacture, is to be conducted within the precautions or other specific warnings located within this manual. Failure to comply with these precautions and other specific warnings violates safety standards of design, manufacture, and intended use. Raytech GmbH assumes no liability for the operation and use of this equipment.

SAFE OPERATION:
Only qualified knowledgeable persons should be permitted or attempt to operate this test equipment. All test personnel should fully familiarize themselves with the correct application and operation of this and all test equipment prior to operation. Persons directly and indirectly engaged in the operation of this test equipment should keep clear of all high voltage apparatus while conducting tests and measurements.

BEFORE APPLYING POWER:
Do not vary the input power source voltage level (IE...Connected to a variable AC power source).

The TR-MARK III auto-senses the input power from the mains plus from 100 to 240 VAC 50/60Hz. Varying the input voltage will cause the test voltage to vary and result in a higher or lower test voltage than indicated. Heavy changes may even damage the device.

GROUND THE INSTRUMENT:
To minimize shock hazard, the instruments Ground Terminal must be connected to a properly grounded receptacle. In many cases, the quality of the safety ground provided by the power cord does not fulfil safety needs. Also the power cord supplied with the equipment must be connected an electrical receptacle with an electrical ground (safety earth ground). Non grounded instruments are dangerous and may cause instrument damage.

KEEP AWAY FROM LIVE CIRCUITS:
Operating personnel must not remove instrument covers. Component replacement and internal adjustments must be made by qualified service personnel. Do not replace components with power cable connected. To avoid injuries, always disconnect power, discharge circuits, and remove external voltage sources before touching components.

WARNING!

⇒ Never connect TR-MARK III to a transformer, which is energized or connected to power lines.

DO NOT OPERATE IN AN EXPLOSIVE ATMOSPHERE:
Do not operate the instrument in the presence of flammable gases or fumes.

DO NOT SUBSTITUTE PARTS OR MODIFY INSTRUMENT:
Because of the danger of introducing additional hazards, do not install substitute parts or perform any unauthorized modification to the instrument. Return the instrument to a Raytech service department for service to ensure proper operation and that safety features are maintained.

Instruments, which appear damaged or defective, should be made inoperative and secured against unintended operation until they can be repaired by qualified service personnel.

2 Introduction:

The Raytech three phase voltage system option T-Rex is an optional system accessory for 3-Phase transformer ratio meter test sets designed by Raytech (i.e. TR-MARK III).

T-Rex was designed to give Engineers and Test Technicians the ability to test the phase relationships and actual voltage ratios of transformer windings while applying three phase voltage.
The system can precisely measure the ratio and angular relationship of transformer phases with voltage applied to all three phases simultaneously. This is a “real condition” measurement, which allows greater understanding of how the transformer will operate connected to a 3 phase system.

The T-Rex is especially useful for transformers with:

- Phase relationships other than 30°.
- Zig Zag windings.
- Uncentered neutral points.
- Suspected broken, damaged, or missing core laminations.

The T-Rex is contained within a separate yellow case and comes complete to connect to the Raytech TR-Spy MARK II or TR-MARK III three phase transformer ratio meter.

T-Rex connected to TR-MARK III, ready for operation:

The system:

Raytech has developed a system for three phase measurements in a single lightweight package. The system is precision built and extremely accurate.

Ease of use:

The T-Rex is an intelligent system option that communicates with the TR-MARK III or TR-Spy Mark II during three phase voltage measurements. No additional programming is required. The system and option can operate a full 3 phase testing sequence with a single push button operation. Connect the leads, Select the transformer configuration and vector phasing, Press GO to initiate the test.

Measuring Technique:

This option incorporates high precision circuitry for phase resolution measurements. The design utilizes a precision crystal controlled frequency generator for precise phase generation.

Operation:

The T-Rex applies a preset, three phase voltage on the HIGH windings of the transformer and measures back through the LOW side of the transformer. The results are reported on the easy to read display of the TR-Spy Mark II or TR-MARK III.

Compact Design:

The T-Rex is a lightweight option that comes complete with its own rugged waterproof field case.

Simple Maintenance:

There is NO maintenance required. There is NO calibration procedure (NO potentiometers to turn). This is due to the utilization of high precision components in the design.

Advanced Protection:

Upon powering on the system initializes itself with a self-calibrating, circuit checking sequence. If any problems are detected during this initialization period, or during operation, the operator is immediately notified. The system constantly monitors the condition of the transformer under test.

3 Theory of Operation

Circuitry Design:

The T-Rex system generates three (3) perfect sine waves from DC coupled ± 24 Volts. The incorporation of D/A converters with the proper amplification produces an AC sine wave on three (3) output channels. These sine waves are produced with identical amplitudes and are shifted in phase 120°. The T-Rex is basically an artificial 3 phase generator.

All system measurements are conducted in the appropriate ratio meter connected to the T-Rex. No measurements are conducted by the T-Rex. Standard ratio meter measurements can be made directly through the T-Rex without any influence.

Design Consideration:

The T-Rex system was designed to be used world wide with consideration to test engineers utilizing various specifications. Nomenclature and operation of the T-Rex was decided upon with that consideration.

It also was designed to assist the engineer in making precise phase angle measurements. The T-Rex measurements will indicate phase angles of ± 180°.

The measured result indicates to the engineer that the phase relationship is in a clockwise or counter clockwise direction. With this indication the engineer is able to adjust the vector grouping number to correspond to the closest relationship in 30 degree increments. This is done to allow for greater accuracy of the phase relationship measurement.

For example:
Measurement of a transformer with a phase angle of 42 degrees. The first step is to select and measure with a vector group 0 on the ratio meter. That would indicate that there is no phase angle displacement from the primary to the secondary windings.

The T-Rex would then measure and indicate an angular displacement of +42°.
The engineer would then correct the reading by adjusting the vector phase group selection to a 1 (indicating +30° shift). The resultant reading from the T-Rex would be +12.0° with a more accurate result.

Rotation convention and nomenclature:

All systems dispatched prior to May 2002 are sent with the following convention:

When transformer type 3P:3P-0 is chosen:
A Transformer with the following configuration D-Y 1 would have a (+) Positive 30 º result.
And likewise, a transformer with a configuration of D-Y 11 would have a (-) Negative 30 º result.

4 Unpacking Procedure

A complete shipment consists of the following items:

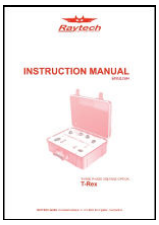
Instrument

H and X leads

Interface cable
(connection to TR-MARK II)

Interface cable
(connection to TR-MARK III)

Power jumper cable



Instruction manual

If any of the above items are missing or damaged contact your local representative or Raytech GmbH immediately.

NOTE

⇒ The T-Rex field case is a waterproof design. When the case is unlocked, a small hole automatically opens, to compensate atmospheric pressure changes.

5 Operating TR-Mark III with T-Rex

NOTE

⇒ To activate a properly connected T-Rex, all you must do is choose “3P“ when creating a new Transformer.

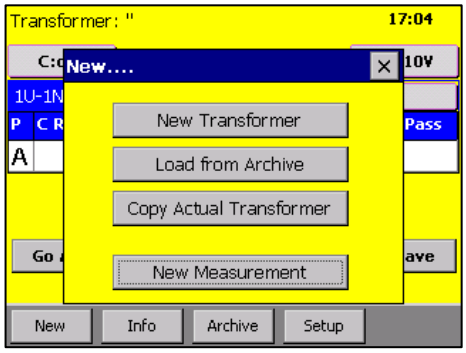
WARNING!

⇒ BEFORE OPERATING THIS OR ANY OTHER TEST EQUIPMENT READ ALL SAFETY WARNINGS AND UNDERSTAND THEM FULLY.

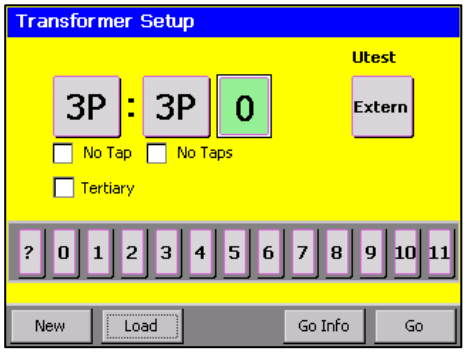
⇒ DO NOT VARY INPUT VOLTAGE (MAINS) AFTER POWERING ON TEST SET.

Quick Start Guide

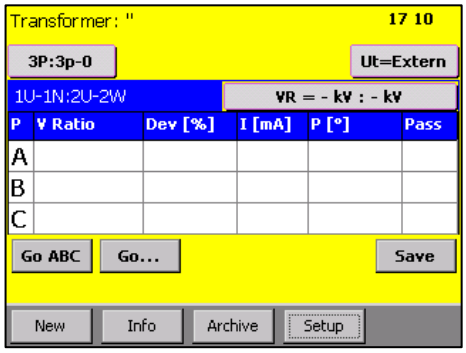
1. Setup T-Rex and Mark-III.
   Switch on the instrument.
   Tip ‘New’, then ‘New Transformer to create a new ’3P’ transformer.



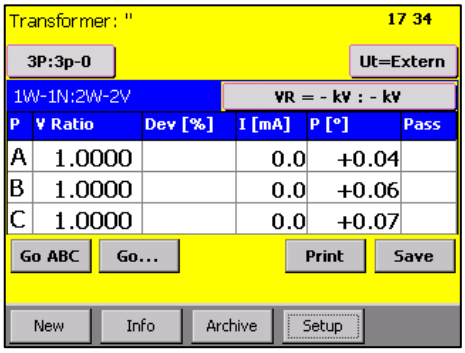
2. Choose ‘3P’ and ‘0’ for transformer type. Then press ‘GO’



3. Press ‘Go ABC’ or ‘Go…’ to start measurement.
   T-Rex operation is indicated by Ut=Extern



4. Get the results



NOTE

⇒ When T-Rex is connected to TR-MARK III, it is anytime possible, to do a common TR-MARK III measurement without using T-Rex.
To do that, just create or load any transformer except '3P'

Connection

1. Connect the two short red leads from the H & X connectors located on the top, right side of the T-Rex (marked "TO TURNS RATIO SPY") to the H & X connectors on the TR-MARK III.
2. Connect the Interface cable from the connector located on the middle- right side of the T-Rex (marked "TO TR SPY") to the "T-Rex" port of the TR-MARK III.
3. Connect the Power Interface cable from the connector located on the bottom-right side of the T-Rex (marked "POWER OUTPUT") to the Power connector of the TR-MARK III.
4. Connect the multi-colored test lead cables that were supplied with the TR-MARK III to the respective connectors, H & X, located on the top, left side of the T-Rex (marked "TO TEST OBJECT"). The clip lead end would then be connected to the respective connections on the transformer under test (Note: The long Red extension cables may be used, if required). Basically, this connection is performed as if a standard ratio test was to be made.
5. Connect the power cord supplied with the TR-MARK III to the "POWER INPUT" of the T-Rex. Plug the Power cord into a properly grounded 100 – 250 VAC outlet.

NOTE

⇒ TR-Mark II (two) and Mark III (three) are connected with different types of interface cable to T-Rex. If the new version with a Lemo plug and Mark III side is not included in your T-Rex cable set, please contact your local representative.
T-Rex was not shipped with the Mark III cable type before 2011.

Part Number: 30532-XXX
Type: Cable Remote T-Rex

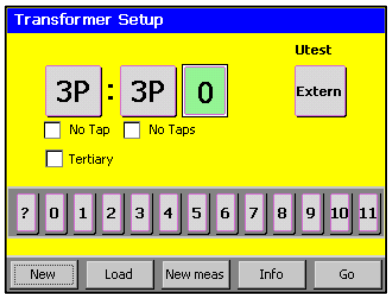
Operation in Details

After following the connection instructions previously listed, switch on the power to the TR-MARK III and also on the T-Rex. (Power on sequence is not critical as the TR-MARK III and the T-Rex communicate constantly). After a 2 second delay both systems should turn on. The T-Rex should have all three phase lamps illuminated and the TR-Mark II/III should have the display screen illuminated.

The first step in operation of the T-Rex is to ascertain the correct Vector phasing of the transformer under test (See also “Test Result Notes” below for better understanding). This is accomplished by running a standard Ratio test on the transformer using the TR-MARK III. If the correct Phase displacement is known proceed to step 2.

1. Select the correct transformer configuration on the TR-MARK III then select “?” if the Vector phasing is unknown. Run a standard ratio test (refer to the TR-MARK III instructions). The TR-MARK III will display the correct vector phasing at the completion of the test.

2. Select the following screen (New Transformer) on the TR-MARK III to initialize operation of the T-Rex.



3. Enter the correct Phase displacement number. Note: The Vector phasing (number 0 shown in the example) should be the same as previously tested. The Vector phasing can be changed if desired.
4. Press “GO” then “Go ABC” on the TR-MARK III and the test sequence will check, calibrate, and test each phase sequentially (A, B, C) while applying three phase voltage to the transformer.
5. The Results of the voltage ratio and phase relationship will be displayed on the TR-MARK III screen.
6. End of Test. It is now possible to print or store the test results (see the TR-MARK III instructions).

Testing Notes

1. Transformer regulators may have a nameplate that lists phase displacements referred to zero degrees. Select “0” as the phase displacement and test. Afterwards check the results against the nameplate.
2. Greater accuracy of the actual phase displacement can be achieved by selecting a vector grouping as close to the actual phase displacement as possible. For example: If the initial vector grouping selected was “0”(0°) and the resulting phase was 62° then select vector phasing “2” (2 x 30°).
3. The Phase displacement result is the phase relationship between H1 and X1, H2 and X2, etc...

6 Operating a TR-Mark II with a T-Rex

WARNING!

⇒ BEFORE OPERATING THIS OR ANY OTHER TEST EQUIPMENT READ ALL SAFETY WARNINGS AND UNDERSTAND THEM FULLY.

⇒ DO NOT VARY INPUT VOLTAGE (MAINS) AFTER POWERING ON TEST SET.

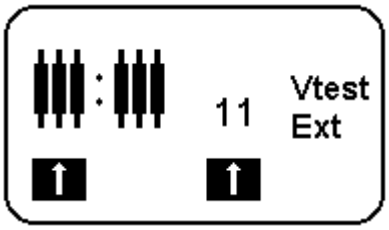
After following the connection instructions listed in chapter '5 Operating TR-Mark III with T-Rex', switch on the power to the TR-Spy Mark II and also on the T-Rex. (Power on sequence is not critical as the TR-Mark II and the T-Rex communicate constantly). After a 2 seconds delay both systems should turn on.
The T-Rex should have all three phase lamps illuminated and the TR-Spy should have the display screen illuminated.

The first step in operation of the T-Rex is to ascertain the correct Vector phasing of the transformer under test (See also Testing Notes in chapter "5 Operating TR-Mark III with T-Rex for better understanding).

This is accomplished by running a standard Ratio test on the transformer using the TR-Spy Mark II.

If the correct Phase displacement is known proceed to step 2.

1. Select the correct transformer configuration on the TR-Spy Mark II then select "?" if the Vector phasing is unknown. Run a standard ratio test (refer to the TR-Spy Mark II manual). The TR-Spy Mark II will display the correct vector phasing at the completion of the test.
2. Select the following screen on the TR-Spy Mark II to initialize operation of the T-Rex:



T-Rex Operation screen

Enter the correct Phase displacement number. Note: The Vector phasing (number 11 shown in the example) should be the same as previously tested. The Vector phasing can be changed if desired.

3. Press "GO" then "ALL" on the TR-Spy Mark II and the test sequence will check, calibrate, and test each phase sequentially (A, B, C) while applying three phase voltage to the transformer.
4. The Results of the voltage ratio and phase relationship will be displayed on the TR-Spy Mark II screen.
5. End of Test. It is now possible to print or store the test results (see the TR-Spy Mark II manual).

7 Technical Specifications (T-Rex)

Features

- Outputs a pure three phase sine wave
- Fully remote controlled by TR-MARK III or TR-Spy MARK II
- Single hook up to the transformer
- Automatic selection of test voltage frequency
- To measure phase relationships other than 30°
- To measure phase shifting transformers
- To measure power rectifier transformers
- Unique system on market
- Extremely rugged (can withstand a drop test of 1 meter)

Output Parameters

Voltage	Voltage Accuracy*	Phase Accuracy*	Current
3 x 24 Vac	±0.08 %	0.08 Degree	0 .. 200 mA

*between phases

Turns ratio range 0.8 to 2000
Temperature Operating –10 °C to 60 °C, Storage –40 °C to 70 °C

Specifications

- Model T-Rex
- Size L: 470 mm (18.5”) W: 371 mm (14.6”) H: 190 mm (7.5”)
- Weight 7.8 kg (17.2 lbs.)
- Input Power 100 to 250 Vac 50/60 Hz Auto ranging
- Test Voltage 3 phase 24 Vac 50/60 Hz Auto selecting
- Front Panel Sealed, Anodized

Accessories

- Complete cable set (consisting of two 1m cable and 1 parallel interface cable),
- Power extension cord, instruction manual

Options

- T-Rex R Rackmount version

8 Warranty Conditions

Raytech GmbH Switzerland shall at their option and expense, repair, replace or newly provide any parts or services that prove to be defective within the warranty limitation period- irrespective of the operating time of the test equipment provided that the cause of the defect occurred prior to the time at which the risk was passed.
Warranty claims are subject to a warranty limitation period of 24 months from the date of shipment.
The purchaser is obligated to immediately notify Raytech GmbH Switzerland in writing form of any defects of the supplied test equipment.
Raytech GmbH Switzerland must always be given the opportunity to rectify a defect within a reasonable time. The purchaser shall grant an adequate time within the test equipment shall be repaired.
Raytech GmbH Switzerland covers the costs associated with the repair of the defect. Especially the costs for the material and work. Cost for sending the faulty test equipment shall be borne by the purchaser. Raytech GmbH Switzerland shall not be liable for material damage, or financial loss due to the loss of production, loss of data, loss of information, data or interest, regardless of their legal basis.
Warranty claim rights on replacement parts as well as repair of defective parts shall expire after 12 months.
Warranty limitation period shall be extendable according to the price list. The purchaser has the right to extend the warranty period by purchasing additional warranty years.

Limitation of Warranty

The foregoing warranty shall not apply to defects resulting from improper and unauthorized modifications or misuse and abuse of the product, negligence, alteration, modification, faulty installation by the customer, customer's agents or employees. Attempted or actual dismantling, disassembling, service or repair by any person, firm, or corporation not specifically authorized in writing by Raytech GmbH Switzerland.

Defects caused by or due to handling by carrier, or incurred during shipment, trans-shipment, or other move. Inadequate maintenance by the customer, second source supplied software or interfacing, operation outside the environmental limits, or improper site preparation. Exclusive remedies provided herein are the customer's sole and exclusive remedies. Raytech Switzerland shall not be liable for any damages resulting from the use of this equipment whether direct, indirect, special, incidental, or consequential damages, or whether based on contract, tort, or any other legal theory.

NO OTHER WARRANTY IS EXPRESSED OR IMPLIED.

Arbitration

All disputes arising out of or in connection with the contract between the purchaser and Raytech GmbH Switzerland and including those regarding the legal validity of this contract and this arbitration clause shall be settled out of court and shall be referred to arbitration for final decision.
Any disputes between the purchaser and Raytech GmbH Switzerland shall be settled according to the rules of settlement and arbitration of the chamber of commerce in Zurich by one or more arbitrators appointed also according to the rules of arbitration of the chamber of commerce in Zurich Switzerland.

9 Trouble Shooting

NOTE

⇒ TR-MARK III is designed to be trouble free.
If problems or questions do arise please contact your nearest representative or our service support group in Switzerland.

A Contacts

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Your local Representative