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**Three Phase Automatic  
Transformer Turns Ratiometer Test System  
Model: TR-Spy Mark II**

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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 USA, Inc. 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-SPY MARK II 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.

**GROUND THE INSTRUMENT**

To minimize shock hazard, the instrument chassis and cabinet must be connected to a properly grounded receptacle. 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.

**DO NOT OPERATE IN AN EXPLOSIVE ATMOSPHERE**

Do not operate the instrument in the presence of flammable gases or fumes.

**KEEP AWAY FROM LIVE CIRCUITS**

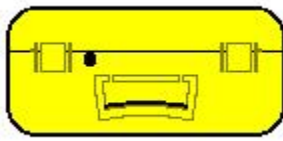
Operating personnel must not remove instrument covers. Component replacement and internal adjustments must be made by qualified service personnel. Do not replace components with power cable connected. To avoid injuries, always disconnect power, discharge circuits, and remove external voltage sources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

**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 USA 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.

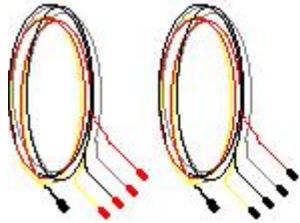
Unpack your new TR-SPY Mark II and check to see that you have the following items:



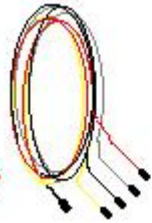
**TR-Spy Mark II**



**Cable bag**



**H lead  
Cable Side**



**X Lead  
Cable Side**



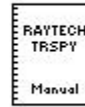
**2 Extension  
Cables**



**Power  
Cord**



**RS-232  
Cable**



**Manual**

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

**RAYTECH Toll free service & support telephone: 1 888 4 THE SPY**

\* Note 1:

The TR-Spy Mark II Fieldcase is a waterproof design that incorporates venting latches that will automatically equalize pressure differential inside the case when opened and seal the case against gas exchange when closed.

\* Note 2:

When the optional hard travel case (part number **ST0 822**) or the optional soft travel case (part number **MC845**) is ordered with a new TR-Spy Mark II, the cable bag depicted above is omitted from the shipping box.

**Raytech** first developed the Transformer Turns Ratio **Spy (TR-Spy)** for high degree of accuracy for the research and development of transformers. This technology was then packaged into a portable test system for use by transformer manufacturers, rebuild shops, and electrical maintenance crews. This first system had become the most widely respected precision instrument for the ease of use, design, and operation. This first system was developed with the assistance of transformer manufacturer's and utility test crews.

The **TR-Spy Mark II** takes this initial development and adds many new features to the system including a large memory base, external control for tap changer testing, and automatic voltage level detection test.

**The name:** The TR-Spy Mark II is a completely new approach in technology and has become the standard for ratio testing. Raytech is an innovative research and development company. To set this instrument apart from the other test sets on the market we chose a name that described the systems expert ability to investigate and report any transformer that it is connected to. The name is recognized immediately as the finest in instrumentation development. Of course this is an unconventional approach to naming test equipment, but we can afford a little fun because the equipment is precision built and extremely accurate.

**Ease of use:** This is the easiest instrument to use available on the market.

Once the buttons and few menus are learned the system is very simple to understand and operate. This intelligent system fully analyzes the configuration of a transformer and performs all required measurements automatically for Voltage Ratio, Turns Ratio, Current, and Phase Displacement. The system can operate a full 3 phase testing sequence with a single push button operation. Connect the leads, Select the transformer configuration with the Digi-Pot, then press GO to test.

**Impressive Accuracy:** The TR-Spy Mark II is a high precision, fully automatic, microprocessor based, Single and Three Phase Transformer Turns Ratio Test system. This system is designed for highly accurate readings on-site with laboratory precision. It is the most accurate system available.

**Unique Measuring Technique:** This newly designed technique of measurement incorporates a high precision dual-vector voltage meter for ratio readings and a rectification resolution circuit for phase displacement (vector group). The phase displacement (vector group) can be automatically detected and displayed without operator intervention. No other system performs this function.

**Operation:** The TR-Spy Mark II applies a preset voltage on the HIGH winding side of the transformer and measures back through the LOW side of the transformer. The results are reported on the easy to read liquid crystal display.

**Compact Design:** The TR-Spy Mark II is a lightweight system designed with its own rugged waterproof Fieldcase.

**Simple Maintenance:** There is No maintenance required. There is No calibration procedure outside of factory adjustments (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. The TR-Spy Mark II can even recognize shorted leads and will terminate the test without any damage to the test equipment. This works especially well when test leads accidentally fall free from the transformer while under full voltage measurement.

This, incidentally, is one of the many reasons we can extend our warranty to 5 years.

**SPECIFICATIONS:**

**MODEL:** TR-Spy Mark II  
**SIZE:** L: 18.5" (470 mm) W: 14.6" (371 mm) H: 7.5" (190 mm)  
**WEIGHT:** 18 lbs. (8.2 kg)  
**INPUT POWER:** 100 to 250 vac 50 / 60 Hz Autoranging. Fuse: 2 Amps  
**TEST VOLTAGE:** User Selectable: 100, 40, 10, 1 VAC, & Auto at 1 ampere (max.)  
**PANEL DISPLAY:** LCD Graphic with back lighting  
**FRONT PANEL:** Sealed, Piezo-electric actuation  
**INTERFACE:** 9 Pin RS232 Serial / 25 Pin Centronics Parallel  
**MEMORY STORAGE:** Internally stores more than 1,300 locations in memory

**VOLTAGE / TURNS RATIO RANGE:** 0.8 ... 13,000 **MAX. RESOLUTION:** 5 Digits  
**ACCURACY:**

Range 0.8 ..... 2000 ± 0.08 % with 100 & 40 Volt Ranges  
 Range 0.8 ..... 2000 ± 0.15 % with 10 Volt Range  
 Range 2001 ... 4000 ± 0.1 % with 100 & 40 Volt Ranges  
 Range 4001 ... 13,000 ± 0.3 % with 100 & 40 Volt Ranges

	<b>CURRENT</b>	<b>PHASE ANGLE</b>
<b>RANGE:</b>	0 ... 1 Ampere	± 90 Degrees
<b>ACCURACY:</b>	± 0.001 Ampere	± 0.05 Degree
<b>RESOLUTION:</b>	0.0001 Ampere	0.01 Degree

**TEMPERATURE:** Operating: - 10° C to 60° C Storage: - 40° C to 70° C

**CABLE SET / ACCESSORIES:**

Three Phase Cable set: H+X Leads; 5 meters long each, Red Extension leads, Qty. 2; 10 Meters long each (Total length of 3-Phase lead set with extensions: 15 meters or 49 feet), Cable case Power cord; length: 6 meters, RS-232 cable; length; 3 meters, and Instruction Manual.

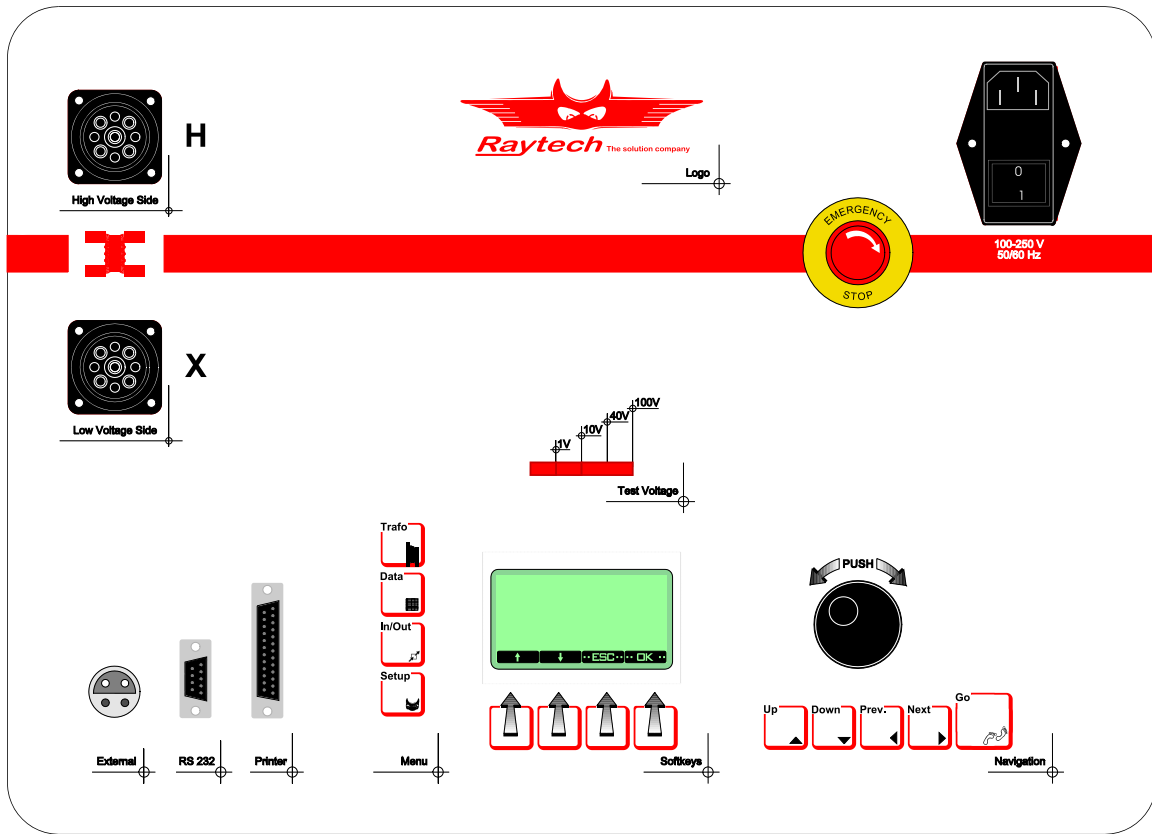
**TR-SPY MARK II FEATURES:**

- Automatic measurements of Voltage / Turns Ratio, Current, and Phase displacement
- Internal storage for 100 complete test results (greater than 1,300 memory locations)
- Six different languages to choose from for operation purposes
- Single push button operation
- Single hook up to the transformer
- Ratio testing from 0.8 to 13,000 turns
- Five test voltage ranges 1V, 10V, 40V, 100V, & Automatic
- Displays deviation from a nominal ratio
- Graphical tap changer display
- Load on test object < 0.05 VA
- Heavy duty protection circuitry
- Centronics (Parallel) Interface & RS232 (serial) Interface
- 5 Year standard warranty

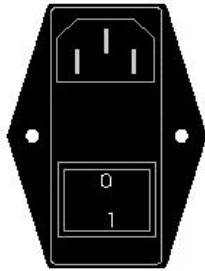
**TR-SPY MARK II OPTIONAL ITEMS:**

Part No. - TR0-203 – External / test switch for Tap changer testing  
 Part No. - 1002A-05002 – Extended cable lengths (user specified in 10 meter increments)  
 Part No. - SM203 – Custom clamping devices (user specified)  
 Part No. - SM206 – Test with three-phase voltage  
 Part No. - 1002A-04002 – Hard-sided travel case  
 Part No. - 1002A-04001 – Soft-sided travel case  
 Part No. - 1001X-17001 – Annual Warranty Extension

\* Specifications are subject to improvement at anytime.



**Power, High and Low Test Connections, and Safety Emergency Stop Button:**



- Power cord Connection
- Accepts 100...250 vac



- Test Voltage Emergency OFF
- Press to stop - Turn Clockwise to release

**Test Connections:**

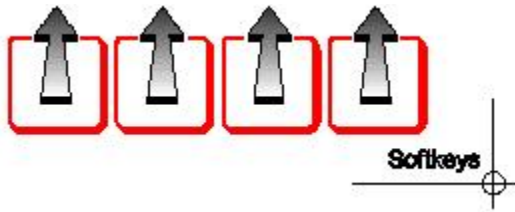


High Voltage Side - High Side Lead Connection

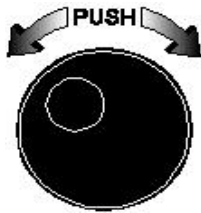


Low Voltage Side - Low Side Lead Connection

**Buttons:**



- **Soft Keys: UP ARROW Buttons** - Allows the user:  
To select the parameter or operation currently viewed in the display screen directly above the button.



**Digi-Pot control Knob:** - Allows the user:  
To select various parameters by scrolling. This rotating knob is also a press button for selecting items.



- Menu:

To select: “NEW” For desired transformer test configurations.  
To select: “INFO” For Information on the transformer selected for test.  
To select: “REF” For input of reference information of a transformer.  
To select: “EDIT” For Input of various parameters of a transformer.



- Menu:

To select: The Test Screen or last data set obtained from the test set.



- Menu:

To access the Archive/ Print data screen selection menu  
To PRINT actual Data  
To STORE actual Data  
To RECALL or retrieve Data from the archive (memory)  
To DELETE entries in memory  
To PRINT entries in memory



- Menu:

To access the Setup menu  
To Setup Clock  
To Select Standard (ANSI, IEC, Australian)  
To CR/LF Carriage feed or Line feed for printer  
To Printer Interface (Parallel or Serial Port)  
To Language Selection: English, German, French, Spanish, Italian,  
or Norwegian  
To Contrast adjustment control



**Buttons:**



- Navigation:

Allows movement of the cursor UP or DOWN in the menu that is displayed (the Digi-Pot performs the same function).



- Navigation:

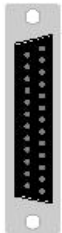
Allows selection of the NEXT or PREVIOUS menu screen or Data (The Digi-Pot performs a similar function).



- Navigation:

This is the Test START or GO Button. This initiates a test sequence.

**Printer and Computer Connections:**



**Printer** Centronics Printer 25 pin connection



**RS 232** Serial RS232 Computer 9 pin Connection

**External Control Connection:**



**External**

This port is used with the optional external control switch – Part No. SM201, for remote test start sequence of a dry contact tap changer.



**Initial screen:** This is the first start up screen. When this screen is displayed the Mark II is checking the system for problems. This screen will remain for a few seconds then, if no problems were detected, the Start screen will appear.



**Transformer selection screen:** Accessed by pressing the “Trafo” (Transformer select) button. This screen will access Menus for entering new configurations, Information, Reference, and the Edit option.

To select a new configuration press the “NEW” (up arrow) button on the front panel.

Note: A pop-up menu may be displayed: “Delete current Transformer”.

The User may now “STORE” the current transformer information, “ESC” escape from this menu, or press “OK” to erase the current transformer and enter in new Data by pressing the (up arrow) button on the front panel below each operation on the screen.

The Configuration Selection screen will appear:



**Configuration Selection screen:** rotating the Digi-Pot knob can now change the configuration that is underlined. Press the Digi-Pot down when selection is made and the next parameter can now be changed. Select both the High and Low side winding configuration, the expected phase displacement (or select “?” if it is unknown), and the test Voltage level (10, 40 100 or Automatic). Press “OK” when these operations are completed. The Tap select screen is now displayed.



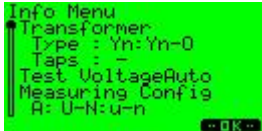
**Tap Select screen 1:** Press the “TAPS” (up arrow) button on the front panel. The following screen will appear and allow the setting of the upper and lower tap positions.



**Tap Select screen 2:** The 1<sup>st</sup> or lower tap positions to be tested can now be set by rotating the Digi-Pot knob. Press the Digi-Pot down when the last tap position is set. The upper tap positions to be tested can now be set by rotating the Digi-Pot knob. Press the Digi-Pot down when selection is made. Press “OK” when this operation is complete. The Pretest screen now appears.



**Pretest screen:** The transformer can be tested now or additional information can be entered for a particular transformer.



**Info screen:** From the Pretest screen press the “INFO” (up arrow) button on the front panel to access the current information of the transformer to be tested. This screen allows checking of all the parameters that will be saved into memory. Rotate the Digi-Pot to scroll down or up in the screen. Press “OK” to exit.



**Ref screen:** From the pretest screen press the “REF” (up arrow) button on the front panel to access the reference screen. This screen allows input of the transformer expected ratio or voltage ratio. When information is placed into this menu the test screen will give additional information of percent difference from nominal ratio expected. Rotate the Digi-Pot to scroll up or down in the screen. Press the Digi-Pot when the parameter to be changed is selected. The following reference select screen is displayed:



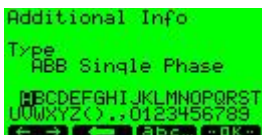
**Reference select screen:** The primary voltage can be selected by rotating the Digi-Pot until the first number of the high voltage is selected. The voltage level selected will be displayed as Kilovolts. Press the Digi-Pot to move to the second number and so on. When the primary voltage has been entered press “OK” to exit. Move the Digi-Pot to the secondary voltage and repeat the procedure. Press “OK” to exit this menu. Press “ESC” to exit to the pretest screen.



**Pretest screen:** From the pretest screen press the “EDIT” (up arrow) button on the front panel.



**Additional Information screen 1:** This screen allows entering data particular to the transformer under test. Rotate the Digi-Pot until the cursor highlights the area to enter Data. Press the Digi-Pot and the following, or similar, screen appears (dependent upon the cursor position):



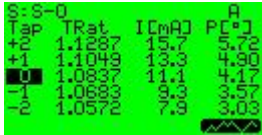
**Additional Information screen 2:** Rotate the Digi-Pot until the number required is highlighted. Press the “abc” button to select between Upper case and Lower case letters. Press the ← (single arrow) button to step backwards on the data line. Press the ↔ (double arrow) button to free up the cursor and move it anywhere on the Data line with the Digi-Pot. Press the Digi-Pot to select a number or letter. Press “OK” when complete.

There are four Menu screens. The Menu screens are selected by pressing the associated buttons to the left of the display screen.



**“TRAFO” Transformer selection screen:**

Accessed by pressing the “Trafo” (Transformer select) button. This screen will access Menus for entering new configurations, Information, Reference, and the Edit option.



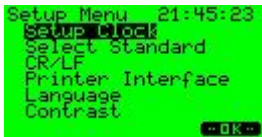
**“DATA” review screen:**

The Data screen can be displayed by pressing the “Data” front panel button. The Data screen allows review of test results. If a Tap changer had been selected and the results were obtained a “Graph” button will appear at the bottom of the screen. By pressing this button a graphical representation of the test results will be displayed. Press the last “up arrow” button on the front panel to exit the Graph screen.



**“IN/OUT” Control screen:**

The Archive/Print screen (menu) can be displayed by pressing the “In/Out” front panel button. The In/Out screen allows Printing, Recalling, Storing, and Deleting of test results.



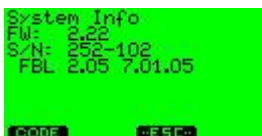
**“SETUP” screen:**

The Setup screen (menu) can be displayed by pressing the “Setup” front panel button. The Setup screen allows the setting of the Time, Selection of the Standard used (ANSI, IEC..etc.), Carriage or Line Feed on a printer, Printer Interface (Parallel or Serial Port), Language Selection (English, German, French, Spanish, Italian, and Norwegian), and Contrast adjustment control.

**Note:** Depending on what firmware version the TR-Spy Mark II has, these screens may be displayed:



**“SETUP” screen**



**“SYSTEM INFO” screen:**

This screen displays firmware version, serial number, and flash boot loader information.

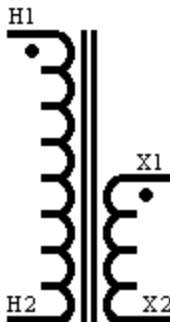
## Transformer Turns Ratio Testing:

A Transformer Turns Ratiometer does exactly as its name implies; it is used primarily for checking how many turns of wire are in the primary side and the secondary side of a transformer. The Turns Ratio test set does not tell exactly how many turns of wire are in the primary and secondary coils. But rather, it measures and displays the **Ratio** of (or comparison of) the number turns in the primary coil to the number of turns in the secondary coil.

This is an extremely useful device for checking for shorted turns and incorrect settings of tap changers. The TR-SPY Mark II has an additional feature of allowing the operator to measure the actual phase angle and vector relationship of the windings.

It is important to understand that the Nameplate Ratio on most transformers is the Voltage ratio (Voltage in: Voltage out) and this Ratio is determined, basically, by the number of turns of wire on the Primary (High side), the number of turns of wire on the Secondary (Low Side).

On a single phase Transformer the Turns Ratio is the same as the Voltage Ratio.



A Single Phase transformer:

For example: The High Side Winding may contain 960 Turns: Low Side Winding 440 Turns.  
Therefore:

$$\text{Turns Ratio} = \frac{\text{Primary Turns}}{\text{Secondary Turns}} = \frac{960}{440} = 2.182$$

With three (3) Phase Transformers of different configurations, the Turns Ratio & Voltage Ratio can, and usually is different.

**IMPORTANT NOTE 1:** The TR-SPY MARK II makes all the calculations and interconnections required when the correct configurations of single (1) phase and three (3) phase transformers are selected. In most cases, no other external connections, other than the test leads provided, are required.

### **IMPORTANT NOTE 2: Hooking up to a transformer:**

The TR-SPY MARK II protects against a wrong hook-up to a transformer or testing a severely defective transformer. Every effort has been made to alert the operator when something is wrong. Negative (Reverse Polarity) hook up is automatically detected (and will display a negative ratio).

### **Transformer Turns Ratiometer uses:**

Transformer Turns Ratiometer is very useful as a tool for investigating problems associated with the core, the windings, and the tap changer of transformers and should be used for:

1. Identify shorted turns and finding turn errors
2. Defective and incorrect tap settings
3. Finding mislabeled terminals and mislabeled nameplates

Turns Ratio testing is a required test during the manufacture of transformers.

Turns Ratio testing is a part of a good routine preventative maintenance program as well as for Acceptance testing.

**Comparison of International Standards****High Winding Side:**

<u>Wire Color</u>	<u>ANSI</u>	<u>Wire Color</u>	<u>IEC</u>	<u>Wire Color</u>	<u>Australian</u>
RED	H1	RED	U	RED	A
BLACK	H2	BLACK	V	WHITE	B
WHITE	H3	WHITE	W	BLUE	C
YELLOW	H0	YELLOW	N	BLACK	N

**Low Winding Side:**

<u>Wire Color</u>	<u>ANSI</u>	<u>Wire Color</u>	<u>IEC</u>	<u>Wire Color</u>	<u>Australian</u>
RED	X1	RED	u	RED	a
BLACK	X2	BLACK	v	WHITE	b
WHITE	X3	WHITE	w	BLUE	c
YELLOW	X0	YELLOW	n	BLACK	n

**This manual refers to the ANSI standards for all examples.** To change the standard in the test instrument please refer to pages 8 and 22.

**WARNINGS!**

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.

The TR-Spy Mark II auto-senses the input (mains) voltage from 100 TO 250 vac 50 / 60 Hz.

The TR-Spy Mark II then “locks-in” the test voltage range. If the input voltage (mains) is varied after the TR-Spy Mark II was powered on the actual test voltage may be higher or lower than indicated.

**Quick-SPY Training Instructions:**

As is the case with most new equipment, most users will want to plug in the new TR-Spy Mark II and operate it immediately (Plug -n- Play). Therefore, we have included Quick-SPY Training Instructions to help you get the TR-Spy Mark II up and running with minimum of effort (please turn to Section 8 – 4 page 15).

If you are familiar with transformer turns ratio testing then Quick-SPY instructions are for you.

If you are new to transformer turns ratio testing, please review the entire manual carefully before operating this equipment. If you have any questions please do not hesitate to contact your nearest representative or Raytech USA, Inc.

**Quick-SPY Training Instructions:**

**This manual refers to the ANSI designations for all examples** (see page 14).

These instructions assume that you would like to operate your new TR-Spy Mark II immediately, but do not have a transformer readily available. This example simulates a Yn-Yn transformer.

Open the case.

Connect the H (High side) multicolor-cable black connector to the H panel connector (TwistLock).

Connect the X (Low side) multicolor-cable black connector to the X panel connector (TwistLock).

Connect the colored lead clips of the TR-Spy Mark II together in the following manner:

**H1** lead to **X1** lead (RED wires together)      **H2** lead to **X2** lead (BLACK wires together)

**H3** lead to **X3** lead (WHITE wires together)      **H0** lead to **X0** lead (YELLOW wires together)

**Note 2:** You may use one of the red extension cables instead of the multicolor cables.

Plug the TR-Spy Mark II into an available grounded outlet receptacle (100...240 vac 50/60 Hz).

Turn the power switch on. Wait for initialization screen:



Press the “NEW” button. The following Configuration screen will be displayed.



**Configuration Selection Screen**

Rotate the Digi-Pot knob to change the configuration that is underlined. Press the Digi-Pot down when the cursor bar highlights the selection chosen and then the next parameter can now be changed.

Select both the High and Low side winding configuration, the expected phase displacement (or select “?” if it is unknown), and the test Voltage level (10, 40 100 or Automatic).

For this example choose: **YN : YN 0 Utest / Auto** (like the screen shown above).

Press “OK” after the parameters are entered.



To begin a test immediately, press the “GO” button:

The test set advances to the Pretest screen and is ready to perform a test.

Now you have a choice: If you press the GO button again a three-phase test sequence will begin. The test set will test Phase A, Phase B, & Phase C sequentially.

Or

You can press down on the Digi-Pot to select the test sequence of all three phases or just one of the phases. A pop-up menu will be displayed. Highlight the test desired and push the Digi-Pot again. The test sequence will begin.

\*Note 1: **Do not touch the test clips – Test voltage will be present.**

\*Note 2: “**Interrupted Overcurrent**” error will be displayed with some configurations.

It is **OK** to run through all the transformer selections with the leads tied together.

While the test set is measuring, you can push the “Cont” Continuous button to keep the system measuring in a continuous mode. It will stop measuring in the continuous mode after the “OK” button is pressed.

Press the “Trafo” button to return to the transformer set screen to try another configuration.

## STEP BY STEP OPERATION:

9 – 0

This section describes a typical, step by step, operation of the TR-Spy Mark II.

Plug the TR-Spy Mark II into an available grounded outlet with 110/240 vac 50/60 Hz power source. Do not power the instrument on yet.

Connect the TR-Spy Mark II to the transformer under test with the Red (10 meter) measuring lead extensions (if required) and the colored test leads. The extensions will connect into the multicolor leads.

Check the nameplate information of the transformer. If the nameplate is missing it is still possible to test the transformer by a trial and error method. The TR-Spy Mark II test set is designed to detect errors in transformer hook ups. Contact Raytech Service & Support department if you need assistance.

**Note:** No extra external leads or jumpers are required when using the TR-Spy Mark II. All interconnections are made internally.

The colored leads are marked to indicate which transformer terminal it must be connected to for correct operation.

**For a Three (3) phase transformer use leads:**

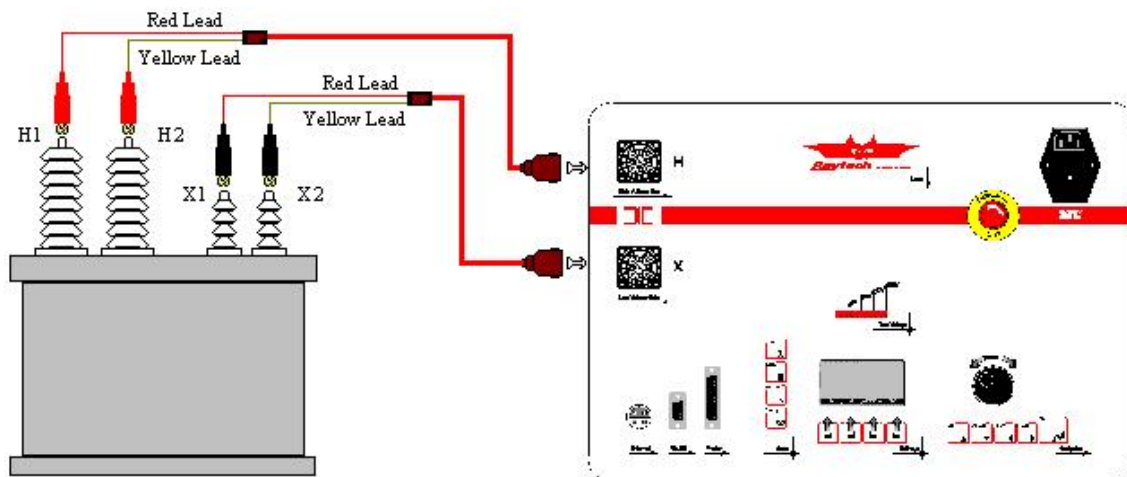
### WIRE COLOR

- **RED** indicates **H1** phase (Red clip) or **X1** phase (Black clip)
- **BLACK** indicates **H2** phase (Red clip) or **X2** phase (Black clip)
- **WHITE** indicates **H3** phase (Red clip) or **X3** phase (Black clip)
- **YELLOW** indicates **H0** neutral (Red clip) or **X0** neutral (Black clip)

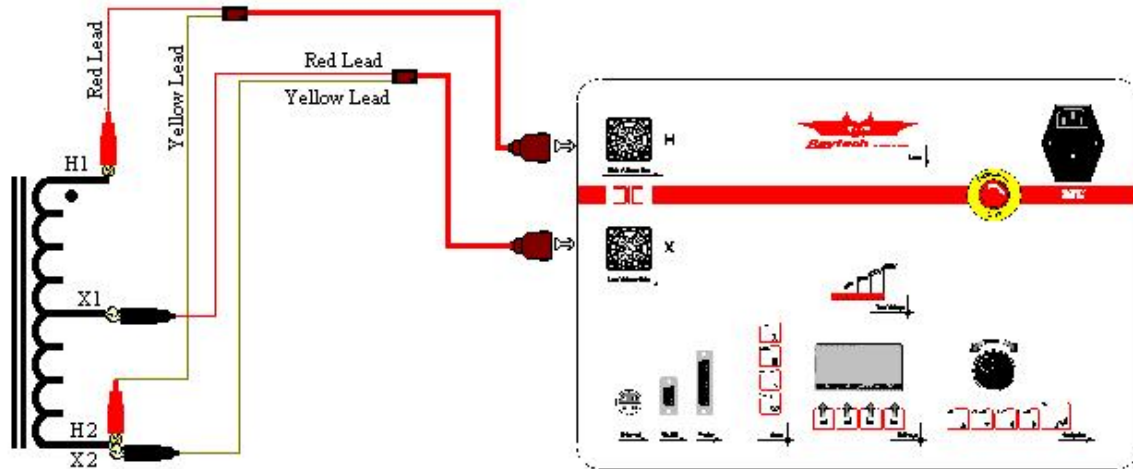
**For a Single (1) phase transformer or Auto-transformer use leads:**

### WIRE COLOR

- **RED** indicates **H1** phase (Red clip) or **X1** phase (Black clip)
- **YELLOW** indicates **H0** neutral (Red clip) or **X0** neutral (Black clip)







Typical Auto-Transformer

After the connections of the test leads to the transformer have been made, turn on the power switch of the TR-Spy Mark II.

**INITIALIZATION:**

When the TR-Spy Mark II is first turned on the “**initialization**” screen appears.



After a few seconds the Transformer Test/Selection screen will appear:



**Transformer selection screen:**

A previous test result may or may not be displayed now. Press the up arrow just below the “New” in the display to start the selection of the transformer under test. Note: A pop-up menu may be displayed saying: “**Delete current Transformer**”. This message asks if it is OK to clear the screen for the input of a new transformer. Press “OK” To begin a new test sequence. Note: The User may also “STORE” the current transformer information, “ESC” escape from this menu, or press “OK” to erase the current transformer and enter in new Data by pressing the (up arrow) button on the front panel below each operation on the screen.

The Configuration Selection screen will appear:



**Configuration Selection screen:**

Rotate the Digi-Pot knob to change the configuration that is underlined. Press the Digi-Pot down when that particular selection is made. The underline will then move to the next parameter.

The next parameter can now be changed. Select both the High and Low side winding configurations. 21 different configurations can be selected. They are listed below:

Y <sub>n</sub> : Y <sub>n</sub>	Δ : Δ	Y : Y	Z : Y	
Y <sub>n</sub> : Y	Δ : Y <sub>n</sub>	Y : Y <sub>n</sub>	Z : Y <sub>n</sub>	<b>CT : CT</b>
Y <sub>n</sub> : Δ	Δ : Y	Y : Δ	Z : Δ	:
Y <sub>n</sub> : Z	Δ : Z	Y : Z	:	
Y <sub>n</sub> : Z <sub>n</sub>	Δ : Z <sub>n</sub>	Y : Z <sub>n</sub>		

The **CT : CT** is selected for Current Transformers exclusively. The test set has a special Voltage/Current function built-in for Current Transformers.

**Note:** 180° Ratio measurements are shown on the display and saved in memory as a Negative Ratio.

The | : | is selected for single phase transformers (and some CT's).

**Note:** 180° Ratio measurements are shown on the display and saved in memory as a Negative Ratio.

The ||| : ||| is selected when using the Raytech model, **T-Rex**, three phase voltage option SM206 (See the T-Rex manual for correct operation).

After selection of the configuration of the transformer is made then the expected phase displacement (Vector Phase) is selected (or select “?” if it is unknown and the Mark II will detect it automatically). **Note:** The phase displacement is the phase relationship of the primary winding to the secondary winding and is usually in 30° increments (0°=0, 30°=1, 60°=2, 90°=3 120°=4 and so on). Selections with the TR-Spy Mark II are the numbers from 0...11 (0°...330°).

The displayed "Phase angle" is a deviation (in Degrees) from the phase displacement selected. Therefore, an actual phase displacement of 30.2° (vector group 1) the displayed phase angle result is 0.2° (30° - 0.2°).

For phase displacements other than 30° refer to the Option : T-Rex.

**Important Note:** If any value is selected for phase displacement the TR-Spy Mark II will force the test to perform for that specific transformer configuration. If the operator selects the wrong configuration the test set will display erroneous values.

Press “OK” when these operations are completed. The Tap select screen is now displayed. If the Transformer does not have a tap changer, skip to page 19, Section 9-1 **Pretest screen**.



**Tap Select screen 1:**

Press the “TAPS” (up arrow) button on the front panel. The following screen will appear and allow the setting of the upper and lower tap positions.



**Tap Select screen 2:**

The 1<sup>st</sup> or lower tap positions can now be set by rotating the Digi-Pot knob. Press the Digi-Pot down when the last lower tap position is set and the cursor will move to the upper tap position selection. The upper tap positions can now be set by rotating the Digi-Pot knob. Press the Digi-Pot down when this selection is made. Press “OK” when this operation is complete. The Pretest screen now appears.



**Pretest screen:**

The transformer can be tested now or additional information can be entered for a particular transformer. To Test the Transformer now, skip to Page 21, Section 9-4, **Performing a Test**.

**Entering Transformer Information**

Information about a particular transformer can be entered into the test set from the Pretest screen.

Press the “EDIT” up arrow button to access the menu where the particular information about the transformer can be made. The following screen appears:

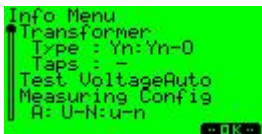


**Additional Info (screen 1):**

This screen allows entering data particular to the transformer under test. Rotate the Digi-Pot until the cursor highlights the area required for Data entry. Press the Digi-Pot and the following, or similar, screen appears (dependent upon the cursor position, this example is for “Type” selection):



**Additional Information screen 2:** Rotate the Digi-Pot until the number required is highlighted. Press the “abc” button to select between Upper case and Lower case letters. Press the ← (single arrow) button to step backwards on the data line. Press the ↔ (double arrow) button to free up the cursor and move it anywhere on the Data line with the Digi-Pot. Press the Digi-Pot to select a number or letter. Press “OK” when complete. The test set returns to the Pretest screen.



**Info screen:**

The data for that particular transformer can be checked now by accessing the: Info” button. From the Pretest screen press the “INFO” (up arrow) button on the front panel to access the current information of the transformer to be tested. This screen allows checking of all the parameters that will be saved into memory. Rotate the Digi-Pot to scroll down or up in the screen. Press “OK” to exit. The test set returns to the Pretest screen.



**Ref screen:**

The nominal ratio for percent error information can be entered in the “Ref” screen. From the pretest screen press the “REF” (up arrow) button on the front panel to access the reference screen. This screen allows input of the transformer expected Turns ratio, Voltage ratio, or in the case of a CT, Current Ratio. When information is placed into this menu the test screen will give additional information of percent difference from nominal Turns Ratio, Voltage Ratio, or Current Ratio expected.

**Entering Transformer Information**

**Ref Screen Cont'd.**

Rotate the Digi-Pot to scroll up or down in the screen to select either the Primary (Prim...kV) or Secondary (Sec...kV) Voltage Ratings, Turns Ratio (TRat) or Voltage Ratio (VRat).

In the case of a current transformer you may select the Primary (Prim...A) or Secondary (Sec...A) Current Ratings, Turns Ratio (TRat) or Current Ratio.

If desired press the “Ratio”, “UH/UL” or “None” button to toggle between the nominal and Turn/Voltage (Turn/Current) Ratio.

Press the Digi-Pot when the parameter to be changed is highlighted. The following reference select screen (or similar) is displayed:



**Reference select screen:**

The primary voltage (in this example) can now be selected by rotating the Digi-Pot until the first number of the high voltage is selected. The voltage level selected will be displayed as Kilovolts. Press the Digi-Pot to move to the second number and so on. When the primary voltage has been entered press “OK” to exit. Move the Digi-Pot to the secondary voltage and repeat the procedure. Press “OK” to exit this menu. Press “ESC” to exit to the pretest screen.

From the pretest screen press the “EDIT” (up arrow) button on the front panel.



**Additional Information screen 1:**

This screen allows entering data particular to the transformer under test. Rotate the Digi-Pot until the cursor highlights the area to enter Data. Press the Digi-Pot and the following, or similar, screen appears (dependent upon the cursor position):



**Additional Information screen 2:**

Rotate the Digi-Pot until the number required is highlighted. Press the “abc” button to select between Upper case and Lower case letters. Press the ← (single arrow) button to step backwards on the data line. Press the ↔ (double arrow) button to free up the cursor and move it anywhere on the Data line with the Digi-Pot. Press the Digi-Pot to select a number or letter. Press “OK” when complete.

To view all of the data that has been entered into the system press the “INFO” (up arrow) button while in the Pretest screen to access the current information of the transformer to be tested.

**Performing a Test**

The minimum information that must be entered into the test set prior to performing a test is; Transformer Configuration, Test Voltage and Phase Displacement. After this has been entered then a test can be performed. For Tap changer test sequence skip to the section below



To begin a test immediately, press the “GO” button only once. The test set advances to the Pretest screen and is ready to perform a test.

Now you have a choice: If you press the GO button again a three-phase test sequence will begin (if it is a three phase transformer being tested). The test set will test Phase A, Phase B, & Phase C sequentially.

**Or**

You can press down on the Digi-Pot to select the test sequence of all three phases or just one of the phases. A pop-up menu will be displayed that shows the phase or phases that can be measured. Highlight the test sequence desired and push the Digi-Pot again. The test sequence will begin.

\*Note 1: **Do not touch the test clips – Test voltage will be present.**

\*Note 2: “**Interrupted Overcurrent**” error may be displayed. If you see this error there is something wrong with the hook-up. Turn off the test set and check all cables and connections.

While the test set is measuring, you can push the “Cont” Continuous button to keep the system measuring in a continuous mode. The test set will continue to measure until it receives an input to stop. The test set will stop measuring in the continuous mode after the “OK” button is pressed.

After the test results have been obtained the results can be saved into memory or printed to an external printer (Page 22 Section 9.5).


**Test sequence with a Tap Changer:**

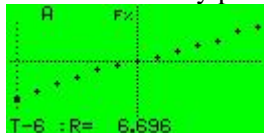
If the transformer has a Tap Changer and the tap positions have been entered into the test set the operator can quickly advance through the Tap Changer test sequence in the following manner:



To begin the test sequence press the “GO” button only once. The test set advances to the Pretest screen and is ready to perform a test. Turn the Digi-Pot to select the first Tap position to test.

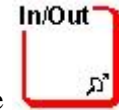
Press down on the Digi-Pot to select the test sequence. A pop-up menu will be displayed that shows the phase, phases or Tap Position that can be measured. Highlight the “Go Tap” test sequence and push the Digi-Pot again. A pop-up menu will be displayed that says, “waiting for external trigger”. The test set is waiting for a closed contact signal input on the “Extern” connector on the front panel or the front panel “Go” (up arrow) button to be pressed. The optional external trigger button (part No. SM201) can be used to initiate the test or the front panel “Go” (up arrow) button can be used. Press the external button (or the up arrow “Go”) one time. The test set will test the tap position, save the information to memory and advance to the next higher tap position.


After all Tap positions have been tested the test system returns to the Pretest screen. A graphical result can be viewed by press the  button.



The Tap changer results plotted on the display screen.

**Memory / Archive**



To access the internal memory for retrieval or saving a test result, press the  - Menu button  
The following In/Out screen will appear:



**“IN/OUT” Control Screen:**


The Archive/Print screen (menu) can be displayed by pressing the “In/Out” front panel button. The In/Out screen allows Printing, Recalling, Storing, and Deleting of test results.

After completion of a test press the “In/Out” button then rotate the Digi-Pot to scroll the cursor bar down to highlight “Store actual Data”.

Press the Digi-Pot and the test set will save the results to the next location in memory. There are over 4,000 memory locations allowing the operator to save 100 complete test results. Complete test results include all Tap changer position results as well as the transformers particular information.

**Instrument Setup**



Press the  - Menu button to access the Setup menu.

**Clock Set up:**

In this menu the operator can set the time of the clock. Rotate the Digi-Pot until the “Setup Clock” is highlighted with the cursor. Press the Digi-Pot to access the edit clock mode. Rotate the Digi-Pot until the correct year is displayed. Press the Digi-pot to accept the input and advance to the Month setting. Rotate the Digi-Pot to select the month. Press the Digi-Pot to accept the input and advance to the Day setting.

The same procedure is used to set the Day, Hour and Minute.

Press “OK” when complete.

**Standard Setup:**

In this menu the operator can also select the standard to test by. Rotate the Digi-Pot until the “Select Standard” is highlighted with the cursor. Press the Digi-Pot to access the select standard mode. Rotate the Digi-Pot until the correct standard is highlighted (ANSI, IEC, or Australian). Press the Digi-Pot to accept and exit the menu.

**CR/LF Carriage feed or Line feed:**

Some printers require a command to perform correctly called Carriage feed or Line feed.

Refer to the printer manual to select the correct command. Trial and error also works (50-50 chance).

Use the Digi-Pot in a similar fashion as in the preceding steps.

**Printer Interface (Parallel or Serial Port):**

The Test set allows use of a Parallel or Serial printer. The operator can select where to direct the print command output. Either the Parallel or Serial port can be selected. The serial port is 19200 Baud, 8 bits, no parity. Use the Digi-Pot in a similar fashion as in the preceding steps.

**STEP BY STEP OPERATION:** Cont.

9 – 7

**Instrument Set up Cont'd.**

9 – 7

**Language Selection:**

Six international languages can be selected: English, German, French, Spanish, Italian, and Norwegian. Use the Digi-Pot in a similar fashion as in the preceding steps to select the language to be displayed on the instrument.

**Contrast adjust:**

Select “Contrast” to allow the adjustment of the display panel adjustment control. Use the Digi-Pot to select “Contrast”. Rotate the Digi-Pot or use the front panel buttons to increase or decrease the contrast.

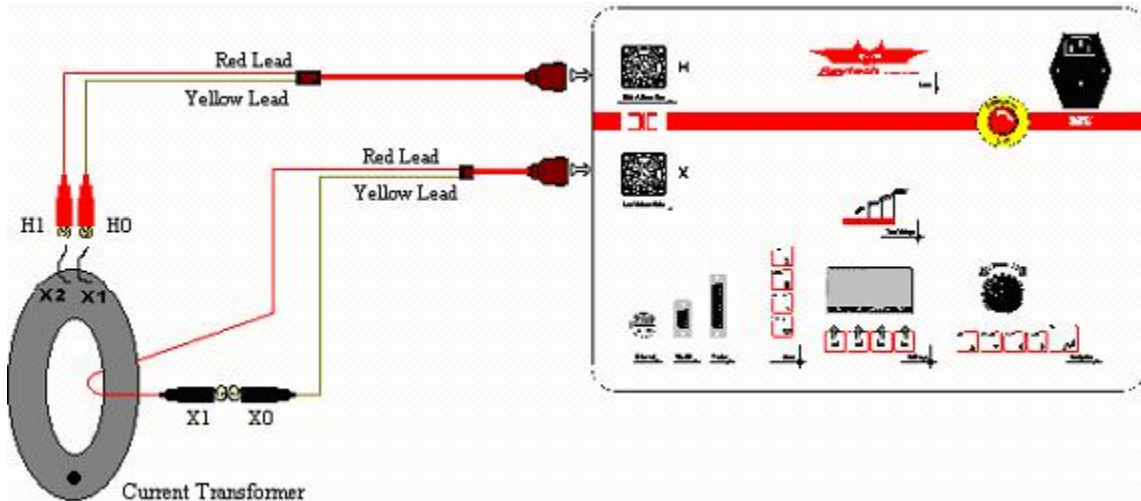
*\*\*Contrast may also be adjusted after powering on the system – once display illuminates, rotate the Digi-pot left or right to increase or decrease the contrast.*

**Current Transformer Testing:**

10 – 1

Current transformers are, in effect, an opposite wound voltage transformer. This basically means that the largest number of windings are on the “X” (low current) side of the current transformer.

The TR-Spy Mark II applies a voltage (from 1 to 100 vac) from the “H” leads and measures back through the “X” leads. The “X” leads always must have a lower voltage than the “H” leads or an error will be displayed. **Therefore, when testing Current transformers the “H” test leads are connected to the “X” terminal of the Current Transformer.**



Connect the test leads as shown. For the highest accuracy, select Single Transformer testing first:



For greatest accuracy select the test voltage range: **40V, 10V, or Automatic**

**Automatic mode** allows the maximum power output from the TR-Spy Mark II up to 40V.

The system will adjust the output voltage in this mode.

Run a test.

In certain cases where the impedance (inductance) of the CT is lower than the power available from the TR-Spy Mark II, a result indicating an “Interrupted / Over Current” message will appear on the screen.

It is then recommended to run the test with **1V** or **10V**.

If an error is still present, then select the configuration of **CT:CT** ratio (See Section 9-1 page 18 for **CT:CT** selection).

**Tapped Secondary CT:**

Current transformers with multiple secondary taps are tested similar to single secondary taps.

After each specific ratio is tested the H1 (or H0) lead can be moved to the next position and that ratio can then be tested.

In addition to the previous test the secondary of the CT can be tested like an auto transformer (See figure in Section 9-1 Page 17).

**Note:** 180° Ratio measurements are shown on the display, and saved in memory, as a Negative Ratio.



The TR-Spy Mark II will print out a test report for each transformer test.

Connect one end of a Centronics parallel printer cable to the “PRINTER” port of the TR-Spy Mark II and the other end to a parallel printer (Centronics type).

At the completion of each test press the “In/Out” button, Select “print Actual data” and the TR-Spy Mark II will down load the last test completed. A header will be printed the first time a test is run. Each consecutive test that is run will be printed immediately after.

The user may recall previous tests from a memory location and print these results as well.

The test report is printed in the following manner:

**Test Report**  
\*\*\*\*\*

**S/N** : 214-104  
**Firmware** : TR Spy by Raytech 2.20  
**Date** : 27, Nov 01 10:05

**Transformer Information**

**Primary Voltage** :Yn 120.00kV  
**Secondary voltage** :Yn 3.000kV  
**Vector Group** : 0  
**Taps** : -1... +1  
**Test Voltage** : 100 V

**Nominal Voltage Ratio** : 40.0  
**Nominal Turn Ratio** : 40.0

**Additional Info**

**Type** : Cooper 3 Phase  
**Serial Number** : 100973276  
**Operator** : R.B.  
**Location** : New Kensington  
**Remarks** : New Installation  
**Standard** : ANSI Standard

Tap	Phase	Prim	Sec	TRatio	I [mA]	Phase	Diff %
-1	A	H1-N	X1-n	40.03	3.5	- 0.0	0.08%
-1	B	H2-N	X2-n	40.02	2.7	- 0.0	0.05%
-1	C	H3-N	X3-n	40.03	3.5	- 0.0	0.08%
-0	A	H1-N	X1-n	40.03	3.5	- 0.0	0.08%
-0	B	H2-N	X2-n	40.02	2.7	- 0.0	0.05%
-0	C	H3-N	X3-n	40.03	3.5	- 0.0	0.08%
+1	A	H1-N	X1-n	40.03	3.5	- 0.0	0.08%
+1	B	H2-N	X2-n	40.02	2.7	- 0.0	0.05%
+1	C	H3-N	X3-n	40.03	3.5	- 0.0	0.08%

## COMPUTER INTERFACE

12 – 0

### TR-SPY MARK II Communication Serial Port RS 232

#### Hardware protocol

12 – 1

9 pin D-Sub miniature

Pin #	Designation	Notes
1	GND	Chassis ground
2	TXD	Transmit Data from TR-SPY MARK II to Computer
3	RXD	Transmit Data from Computer to TR-SPY MARK II
5	RGND	Signal reference ground

Protocol: 19200 Baud, 8 Bit, 1 Stopbit, no parity

#### Software protocol

12 – 2

Note: Required Firmware 2.08 and later. Do not use former versions for remote control. Call for updates.

#### Printer Re-direction Mode:

After sending the Command "SP 1" the printer output is directly sent to the serial port, 19200 Baud, 8 Bit, 1 Stop. The Command "SP 0" disables this feature.

#### Switch to Remote

Switching the Mark II to Remote:

- Command "RM"
- Every Command which executes a measurement (MA, MB, MC, MF etc..)

#### Switch to Local

Command SL (Set to Local) or with the Local Button on the Remote Display.

#### Syntax of Commands

„cc[Data 1 [;Data]..]CR  
cc = 2 ASCII Character for the Command  
; (semicolon or space) Separator for multiple Data fields  
Numeric Format of Numbers: float (C - Language) "." as decimal point  
Format of Strings: all ASCII Characters from 0x20 to 0x7f  
Terminator: „CR “ (=0x0D) or LF (0x0A)

Answers without data

- \* 0 ok ok
- \* 1 unkn Syntax Error

Answers with data

xx,Message1[,Message2;[Message3]..]”,CR  
xx Type of answer (the command itself)

- sl** Set Local Set MARK II to Local State
- slr** Set Local Set MARK II to Local State, "trafo Setup Menu"
- slx** Set Local Set MARK II to Local State with a Warmboot.  
Return: "\*0 ok"
- rm** Set Remote Set system to Remote State  
All keys except SK4 are locked
- gv p** Get Version Get Version, Release of the Firmware, Date of Firmware  
e.g. gv „,TR Spy by Raytech 2.08 21.12.01"  
or  
gv1 (short form) "SPY 2.08"  
gv f (Flash boot loader) " FBL 2.00 22.11.01"
- gs** Get Serial # Asks the serial number. The Serial Number is unique for each unit.  
e.g. gs „,GS 224-123“
- sp x** Set Protocol Redirect printing output  
x = 0 Print to Parallel port  
x = 1 Print output to serial port

**so abcdef** Set options Set options

- a** [01] 0-> Print to LPT  
1-> Print to Com
- b** [0...9] Set Language  
0-> "English"  
1-> "German"  
2-> "French"  
3-> "Spanish"  
4-> "Italian"
- c** [01] 0-> LF as terminator  
1-> CR as terminator
- d** [0..3] Set the Applicable Standard  
0-> "IEC Standard"  
1-> "ANSI Standard"  
2-> "Australian"
- e** [0..9A...F] LCD Contrast
- f** [01] reserved

Invalid Parameters ignored.

Return: Actual Parameters "SO ABCDEF"

Example: SO...A

Will set contrast to value 10, Invalid Parameters ignored "SO 1002A0"

**st,a,b,c,d,** Set Xformer Data. (Please use new Command: "stt")

- a** => Trafo setup H (High side)
  - 0 = Delta
  - 1 = Yn
  - 2 = Y
  - 3 = Single
  - 4 = Zn
  - 5 = 3 Phase (T Rex option)
  - 6 = CT (Current Transformer)
  - 7 = Z (Without Neutral)
- b** => Trafo setup X (Lowside ) Code same as parameter "a" above
- c** => Test Voltage
  - 0 = 100 V
  - 1 = 40 V
  - 2 = 10 V
  - 3 = 1 V
  - 4 = Ext
  - 5 = Auto
- d** => Phase displacement 0...11, or "?"  
All Even and Odd numbers valid depending upon Traof setup H & X  
Invalid numbers are interpreted as unknown "?"  
e.g. st,2,4,2,5 (= Yzn5 Testvoltage 10V),,\*0 ok"

**stt,a,b,c,d,** Set Transformer Type

- a** => Primary setup [Y,YN,Z,D,S,C,3P]
- b** => Secondary setup [y,yn,z,d,s,c,3p]
- c** => Vector Group [0...11, ?]
- d** => Test Voltage [1V,10V40V,100V,Auto,Ext]
- e** => TapCount (position) [1...41]
- f** => First Tap [ (1-TapCount)...0]  
", " delimiter may also be used "-,;"

Parameters c...f are optional, default values ",?,Auto,1,0"  
Example: stt D:yn-5,40,21,-10

Transformer: D-yn-5  
Test Voltage: 40V  
Taps: -10...+10 (21 Taps total)

Ret:       "\* ok"  
          "\*10" to less Parameter  
          "\*11\* Parameter Invalid  
          "\*4 Range" unknown voltage

**san** "Text" Set Add Info Set additional Transformer Information

- SA0** "Trafo Type" sets textfield Trafo type
- SA1** "Serial Number" Info
- SA2** "Operator Info"
- SA3** "Location Info"
- SA4** "Remarks" Info

<b>Sr 0</b>	Set Reference	Set Reference to No Ref. e.g. sr 0	„*0 ok"
<b>Sr 1,a</b>	Set Reference	Set Reference to Nominal Ratio A = Nominal Turn Ratio (format float) e.g. sr 1,23.5 (Nominal Turn Ratio = 23.5)	„*0 ok"
<b>Sr 2,a,b</b>	Set Reference	Set Reference to Refvoltages <b>a</b> => Vh (in kV) <b>b</b> => Vx (in kV) e.g. sr 2,10.4,5 Uh=10.4kV, Ux = 5 kV	„*0 ok"
<b>gt</b>	Get Trafo Data	Asks for the Transformer set up. Result with Primary Setup, secondary set-Up, Test voltage, Phase Displacement, Date, Time of Measurement result: „GT,a,b,c,d,ddmmyy,hhmm“ <b>a</b> = [0...7] Primary Type (Codes see commands <b>st</b> ) <b>b</b> = [0...7] Secondary Type <b>c</b> = [0...5] Test Voltage <b>d</b> = [0...11,12] Phase Displacement, 12 = 'unknown' ddmmyy -> Date of Measurement hhmm -> time of the Measurement e.g. <b>gt</b> Answer: „GT,2,4,2,5,160697,1803“ => Yzn5, Testvoltage 10 V, 16.06.97 18:03	
<b>gr</b>	Get Reference	Asks for the type of reference, and the reference. Result: Reference type, Nominal Ratio or H-X Voltages „GR,0,0.0,0.0" No reference value „GR,1,Ratio,0.0" Reference is TurnsRatio „GR,2,Uh,Ux" Reference is H - X Voltages	
<b>?tt</b>	Get Trafo Type	Get the type of the actual transformer: Ret: ?TT prim,sec,vg,volt,count,first (see command <b>sst</b> ) Example: ?TT,Y:D-3,40,11,-5	
<b>?tg</b>	Get Trafo General Info	Get General Information, Date & time of last measurement Ret: ?TG,f,date,time,standard Example: ?TG,1,110102,1232,2	

**?tr** Get Trafo Reference Ret: ?TR,typ,Tratio,Vratio,PrimVolt,SecVolt,res,res,res,res  
Typ = 0: No reference value  
= 1: Reference ratios (Tratio & Vratio valid)  
= 2: Reference are H-X (Tratio,Vratio,PrimVolt,SecVolt valid)  
Tratio: Nominal Turn Ratio  
Vratio: Nominal Voltage/Current Ratio  
PrimVolt: Nominal Primary Voltage  
SecVolt: Nominal Secondary Voltage  
Res: Reserved  
Tratio: Nominal Turnratio  
Example: ?TR,1,10,5.7735,10,1,0,0,0,0

**?tm** Get Actual Measurement of the actual Type

**?tma** Get All Measurements of all Taps

**?tm n** Get Actual Measurement of Tap n [0.....TapCount-1]

Ret: ?TM,t,ra,pa,ca,rb,pb,cb,rc,pc,cc

T: Tap [First Tap]

r\_: Ratio

p\_: Phase

c\_: Current

\_a: Phase A \_b: Phase B \_c: Phase C

Example:

?TMA (Single Phase Transformer with 3 Taps)

?TM,-1,9.99135,-0.0292503,0.1875,0,0,0,0,0,0

?TM,+0,10.01,-0.0180002,0.2375,0,0,0,0,0,0

?TM,+1,10.0149,-0.0135001,0.175,0,0,0,0,0,0

**?ta** Get Trafo Additional Info Ret: ?TA Type,S/N,Operator,Loc,Rem

Example:

?TA

?TA "H8-35S ", "123.435.223 ". "JW ". "Shop-54 ". "ok

**?di** Get Archive Index Ret: ?di used,max

used: number of datasets in the archive

max: Size of the Archive (datasheets)

Example:

?dt

?DT,10,100 (10 of 100 Datasets are used)

Valid dataset numbers 0..9

**?dt p** Get Trafo Type from Archive

Parameter  
P = " " Actual dataset  
P = n Only Dataset n  
P = n,m Datasets n...m (inclusive)

Syntax like command **?tt** but with the index of dataset  
End of list with "\*ok"

Example  
?dt  
?DT,0,Yn:Yn-0 , 40 ,1,0  
?DT,1,S:S-0 , 10 ,11,-5  
?DT,3,3p:3p-1 , Ext,1,0  
\*0 ok

**?dr p** Get Reference from Archive

**?dg p** Get General Information from Archive

**?da p** Get Additional Information from Archive

Syntax of parameter p is similar to the command **?dt p**  
Datafield like the command **?ta,?tg,?tr**

**?dm p** Get Results from Archive

p: Number of Datasets  
Ret: ?dm,Dataset, <Datafield like command ?tm>  
Example:  
?dm 1 (Dataset with S:S-0 Transformer with 3 Taps)  
?DM,1,-1,9.99135,-0.292503,0.1875,0,0,0,0,0  
?DM,+0,10.01,-0.0180002,0.2375,0,0,0,0,0  
?DM,+1,10.0149,-0.0135001,0.175,0,0,0,0,0  
\*0 ok

**?re** Get Relay Config from actual Transformer

**?re n** Get Relay Config from Dataset n

Ret: ?RE Prim:Sec-VG RelPA:Rel:SA RelPB:Rel:SB RelPC:Rel:SC

Example:  
?RE Y:D-3 A-BC:c-b B-CA:a-c C-AB:ba

**ga n** Get Results A

**gb n** Get Results B

**gc n** Get Results C Asks the Results of the measured Values for Phase A,B or C from Actual Tap

Results: „Mx,a,b,c“  
x = [A,B,C,] Phase  
a -> Ratio of Phase x  
b -> Angle of Phase deviation of Phase x (units in degrees)  
c -> Current of Phase x (in mA)  
With Parameter n:  
Actual Tap is set to n (with command TS x)

- gm x** Recall Dataset from Archive  
 x = 0....  
 Recall Dataset <x>  
 Ret: „\*0 ok" "\*4 Range"
- sm x** Store Actual Dataset to Memory loc x  
 Stores actual values to Memory Location x  
 If x < 0 the actual dataset is stored after the last dataset (Append)  
 If x > 0 the actual dataset is stored in position x (Overwrite)  
 Ret: „\*0 ok" "\*4 Range"
- cm x** Clear Dataset in x Archive  
 Clear Dataset x  
 Dataset x is cleared, Archive is not packed
- cm -x** Clear Dataset in x Archive  
 Clear Dataset x and pack the Archive (CMP)  
 Indexes of the other datasets may be changed!!
- cmp** Pack the Archive  
 Deleted Datasets are removed and moved together  
 Necessary after several cm x  
 Indexes of the other datasets may be changed!!
- ma,x** Measure Phase A  
**mb,x** Measure Phase B  
**mc,x** Measure Phase c  
 Measure Phase A,B,or C of the actual Tap  
 x = " " No results during measurement  
 x = 1 during measuring, the actual values are sent to the Host. Syntax see Command GA,GB,GC  
 After approx. 10 sec the System stops Automatically.  
 x = 11 measure and display values of the transformer without time-out. A new command stops the mode  
 Ret:  
 "\*6 Wait" immediately to confirm command  
 "\*0 ok" Measurement stopped  
 "\*3 Emerg" Emergency pressed  
 Results, see Command GA,GB,GC
- mf,x** Measure Full  
 Measure all Phases of the actual Tap  
 x = “ “ Process without showing results  
 x = 1 Results are sent to the computer  
 Ret:  
 "\*6 Wait" immediately to confirm command  
 "\*0 ok" after approx. 3\*10 sec when the measurement stops
- ts n** Tap set  
 Sets the actual Tap: n [ First Tap.....Last Tap]
- xx** Garbage  
 Syntax Error „\*1 unkn “



# Troubleshooting

13 – 0

## General

At powering on, the TR-Spy Mark II internal calibration and check sequence is performed. Upon completion of the check sequence the TR-Spy Mark II will proceed to the Pretest display. Should there be any problem with the test set an error message will appear.

### SYSTEM DOES NOT DISPLAY ANYTHING:

1. Check the display for any Initialization.
2. Check Main power to the test set.
3. Check the contrast of the test screen (See pages 8, 12, 23) or  
Turn the Digi-Pot back and forth while powering on the system.

### SYSTEM DISPLAYS BUT FADES OUT OR BLINKS:

1. Check Main Power and ground terminal to the test set (AC power plug).

### TEST VOLTAGE CANNOT BE TURNED ON.

1. Does the unit have an external safety switch incorporated? Is it properly operating?

### TEST VOLTAGE CHANGES RANGE BEFORE TEST:

The system will automatically change to a lower voltage range if it detects an over-current condition. For example, 100vac test voltage is selected, The TR-Spy Mark II will pretest the arrangement and if it detects an over-current condition at 100 vac, it will automatically adjust to a lower test voltage. An “Interrupted / Over Current” message will appear if the condition far exceeds the maximum current output.

### INTERRUPTED / OVER CURRENT EXCEEDED ERROR MESSAGE



This error screen may be displayed at anytime the TR-Spy Mark II senses an over-current condition. Try the test again. Possible causes for over-current:

1. Faulty transformer under test.
2. Cables reversed (Low side measuring leads (X cables) on high side of transformer).
3. Low-inductive / low resistive loads such as windings without cores.
4. Main power disrupted or erratic main power input.

**Note:** To see if the internal safety circuit is working properly, set the transformer selection to **1:1 0 100V**, clip these leads together: **H1** and **X0**, **X1** and **H0**, then test again. “Interrupted! Overcurrent! Check Trafo set up” should be displayed.

### ERRATIC OR ERRONEOUS READINGS

Possible causes

1. Wrong phase displacement set (see page 18).
2. Test lead not connected.
3. Erratic main power input.
4. Open or defective Tap changer.
5. Open or defective core ground.
6. Poor test lead connection.

The TR-Spy Mark II is designed to be trouble free. If problems or questions do arise, please contact our service support group.

RAYTECH USA, Inc. warrants to the original purchaser of any new TR-SPY MARK II, 3-Phase transformer turns ratiometer that it will be free from defects in material and workmanship under normal use and service for a period of 2 years from the original date of shipment. An additional 3 year extended warranty is provided, at no cost to the end user, for the products covered under this warranty if the products are returned on each calendar year from the original date of shipment, prepaid, to Raytech USA, for system evaluation. **Failure to do so will void the additional 3 year extended warranty.**

The obligation of RAYTECH USA, Inc. under this warranty is limited, in its exclusive option, to repair, replace, or issue credit for parts or materials which prove to be defective, and is subject to purchaser's compliance with the RAYTECH USA, Inc. warranty claim procedure as set forth within this manual.

This warranty covers only those parts and/or material deemed to be defective resulting from manufacturer's workmanship. The liability of RAYTECH USA, Inc. shall be limited to the repair, replacement, or issuance of credit for parts deemed defective within the meaning of this warranty. Costs for labor or other expenses that may have occurred incidental to the inspection, repair, replacement, or issuance of credit for such parts and/or materials shall be the sole responsibility of purchaser. This warranty shall not apply to any accessories, parts, or materials not manufactured or supplied by RAYTECH USA, Inc.

Equipment must be returned prepaid with a Return Material Authorization (RMA) to:

RAYTECH USA, Inc.	or	RAYTECH GmbH
118 S., 2 <sup>nd</sup> Street		Oberebenstrasse 11
Perkasi, PA 18944		CH-5620 Bremgarten
USA		Switzerland
Tel. 1 267 404 2676		Tel. + 41 56 640 0670
Fax. 1 267 404 2685		Fax. + 41 56 640 0674
www.RaytechUSA.com		www.Raytech.ch

### **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 USA, Inc.

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 USA, Inc. 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.**