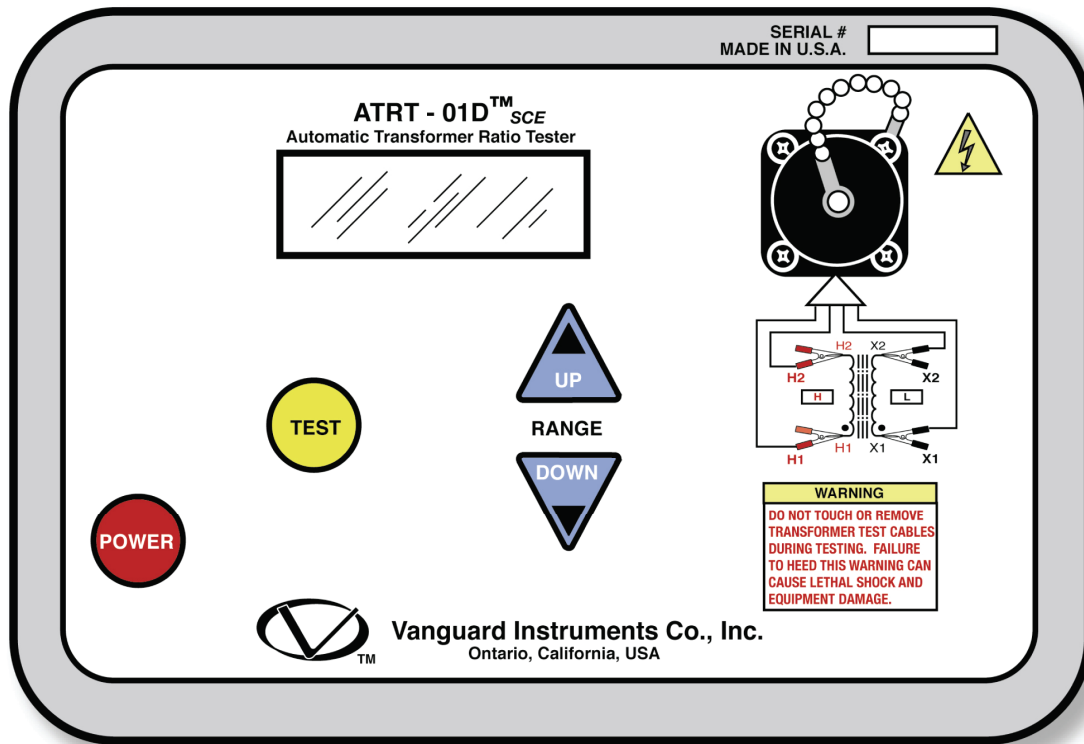


ATRT-01D SCE

SINGLE PHASE TRANSFORMER TURNS-RATIO METER

USER'S MANUAL



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SAFETY SUMMARY

This manual applies to the ATRT-01D SCE. The ATRT-01D SCE has been developed specifically for Southern California Edison Company. The term ATRT-01D used in this manual refers specifically to the ATRT-01D SCE model.

FOLLOW EXACT OPERATING PROCEDURES

Any deviation from procedures described in this User's Manual may create one or more safety hazards, damage the ATRT-01D SCE, damage the test transformer, or cause errors in the test results. Vanguard Instruments Company, Inc. assumes no liability for unsafe or improper use of the ATRT-01D SCE.

SAFETY WARNINGS AND CAUTIONS

The ATRT-01D SCE shall be used only by **trained operators**. All transformers under test shall be **off-line** and **fully isolated**. Do not perform test procedures or service unless another person is also present who is capable of rendering aid and resuscitation.

DO NOT MODIFY TEST EQUIPMENT

To avoid the risk of introducing additional or unknown hazards, do not install substitute parts or perform any unauthorized modification to any ATRT-01D SCE test unit. To ensure that all designed safety features are maintained, it is highly recommended that repairs be performed only by Vanguard Instruments Company factory personnel or by an authorized repair service provider. Unauthorized modifications can cause safety hazards and will void the manufacturer's warranty.

WARNING

Do not remove test leads during a test. Failure to heed this warning can result in electrical shock to personnel and damage to the equipment.

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CONVENTIONS USED IN THIS DOCUMENT

This document uses the following conventions:

- The term “ATRT-01D” used in this manual refers specifically to the ATRT-01D SCE model.
- A key, switch, or knob on the ATRT-01D is indicated as **[KEY]**, **[SWITCH]**, **[KNOB]**.
- ATRT-01D screen output is shown as:

```
TEXT LINE 1
TEXT LINE 2
TEXT LINE 3
TEXT LINE 4
```

- Warning messages are indicated as:



Warning message

WARNING

- Important notes are indicated as:



Note details

NOTE

1.0 INTRODUCTION

1.1 General Description and Features

The ATRT-01D SCE is a portable, microprocessor-based, automatic transformer turns ratio test meter designed specifically for Southern California Edison. It is ideal for on-site measuring of turns ratios, winding polarity, and no-load excitation currents of single and three-phase utility transformers. The ATRT-01D can also test potential transformers (PT's) as well as primary current transformers (CT's). The ATRT-01D should not be used to test some types of "donut" transformers (toroidal windings) since it is not designed for such applications.

The ATRT-01D measures transformer turns ratios by applying a test voltage across the H winding and sensing induced voltage on the secondary X winding. For safety, testing is always performed in a step-down transfer, regardless of the transformer's actual use. Since there is no load on windings during testing, the measured voltage ratio is virtually the same as the winding turns ratio.

The ATRT-01D can test and detect test lead hook-up errors before each test. A low-level test voltage (300 mV) is applied across the winding being tested, and the induced secondary voltage is sensed. If the induced voltage is greater than the applied excitation voltage, it is detected as a hook-up error. If a cross-connection error is detected, the ATRT-01D aborts the test and displays a "Hook-Up Error" message. If there are no hook-up errors detected, a full 20-volt test voltage is applied to the transformer being tested and the winding (voltage) ratio is displayed. The excitation current (in milli-amperes) and winding polarity are also displayed.

The ATRT-01D measures turns ratios ranging from 0.8 to 15,000. Excitation current is measured via the H leads for reference and ranges from 0.0 to 200 milli-amperes. The winding polarity is displayed as "+" (in-phase) or "-" (out-of-phase). The ATRT-01D self-calibrates its sensing circuits before each test and requires no adjustments to be made by the operator.

The ATRT-01D can also be used to test 3-phase transformers. When testing 3-phase transformers, the operator must connect the H and X test leads to the appropriate windings for each phase.

The ATRT-01D also allows the operator to select pre-programmed transformer nameplate voltages for specific turns ratio calculations. From this calculated turns ratio, the ATRT-01D will calculate and display the percentage difference (based on the difference between the calculated and measured values). A "PASS" message is displayed if the percentage difference is less than or equal to 0.5% and the winding is in-phase. A "FAIL" message is displayed if the percentage error is greater than 0.5% or if the winding is out-of-phase.

1.2 Technical Specifications

Table 1. ATRT-01D SCE Technical Specifications

TYPE	Portable, automatic, single-phase transformer turns ratio meter
PHYSICAL SPECIFICATIONS	12"W x 9"H x 8"D (30.5 cm x 22.9 cm x 20.3 cm); Weight: 9.5 lbs (4.3 Kg)
INPUT POWER	Six D-Cell Batteries
TURNS RATIO MEASURING RANGE	0.800 to 15,000
TURNS RATIO ACCURACY	0.8 – 999: $\pm 0.1\%$ 1,000 – 1,499: $\pm 0.2\%$ 1,500 – 1,999: $\pm 1.0\%$ 2,000 – 15,000: $\pm 2.0\%$
EXCITATION VOLTAGE	20 Volts ac
EXCITATION CURRENT	0 to 200 milli-amperes
CURRENT ACCURACY	$\pm 2\%$ of reading (± 1 digit)
WINDING POLARITY	Displayed on LCD screen
DISPLAY	Back-lit LCD Screen (20 characters by 4 lines); viewable in bright sunlight and low-light levels
ENVIRONMENT	Operating: -20° to 55° C (-4° F to $+131^{\circ}$ F); Storage: -40° C to 65° C (-40° F to $+149^{\circ}$ F)
WARRANTY	One year on parts and labor



NOTE

The above specifications are valid at nominal operating voltage and at a temperature of 25° C (77° F). Specifications may change without prior notice.

1.3 Controls and Indicators

The ATRT-01D's controls and indicators are shown in Figure 1. A leader line with an index number points to each control and indicator, which is cross-referenced to a functional description in Table 2. The table describes the function of each item on the control panel. The purpose of the controls and indicators may seem obvious, but users should become familiar with them before using the ATRT-01D. Accidental misuse of the controls will usually cause no serious harm. Users should also be familiar with the safety summary found on the front page of this User's Manual.

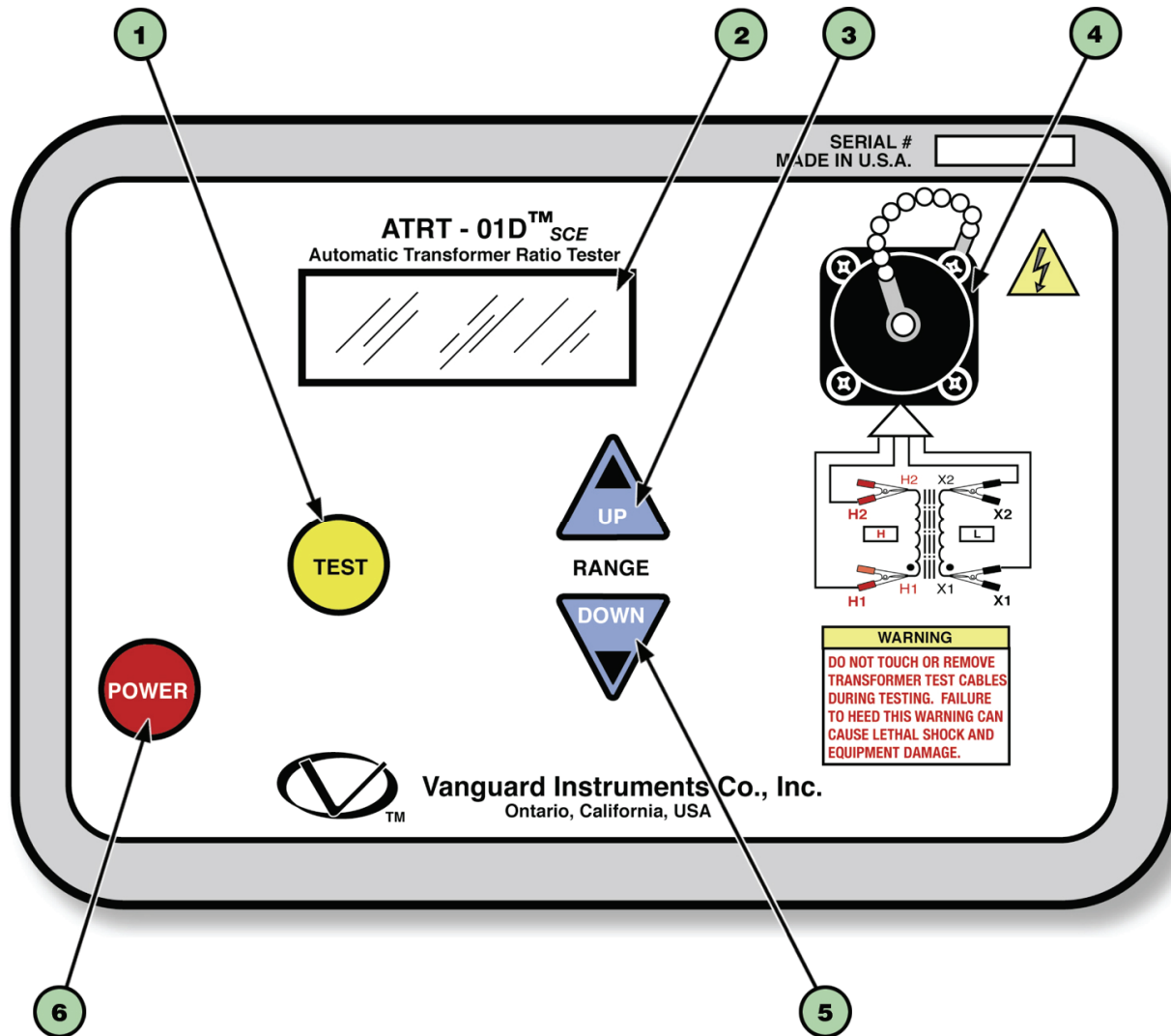


Figure 1. ATRT-01D SCE Controls and Indicators

Table 2. Functional Descriptions of ATRT-01D SCE Controls and Indicators

Item Number	Panel Markings	Functional Description
1	TEST	Test switch. Press and hold for 1 second, then release switch to initiate a test.
2	None	Back-lit LCD screen (20 characters by 4 lines), viewable in bright sunlight and low-light levels.
3	UP	Press and release the [UP] key to scroll up through the list of pre-programmed transformer nameplate voltages. Press and hold the [UP] key for more than 2 seconds to increase the LCD contrast.
4	None	H and X lead connector; 16-pin male.
5	DOWN	Press and release the [DOWN] key to scroll down through the list of pre-programmed transformer nameplate voltages. Press and hold the [DOWN] key for more than 2 seconds to decrease the LCD contrast.
6	POWER	Power switch. Press and hold down the [POWER] switch for 2 seconds to turn the power on or off.

2.0 PRE-TEST SETUP

2.1 Turning the ATRT-01D Power On/Off

To turn the unit's power on/off, press and hold the **[POWER]** switch for 2 seconds.

2.2 LCD Screen Contrast Control

To increase the LCD screen contrast, press and hold the **[UP]** key for two seconds. Release the button when the desired contrast level has been reached.

To decrease the LCD screen contrast, press and hold the **[DOWN]** key for two seconds. Release the button when the desired contrast level has been reached.

The ATRT-01D's screen is back-lit. The back-light turns off after 30 seconds of operation to conserve power. Press any key on the keypad to re-light the back-light.

2.3 Replacing the ATRT-01D Batteries

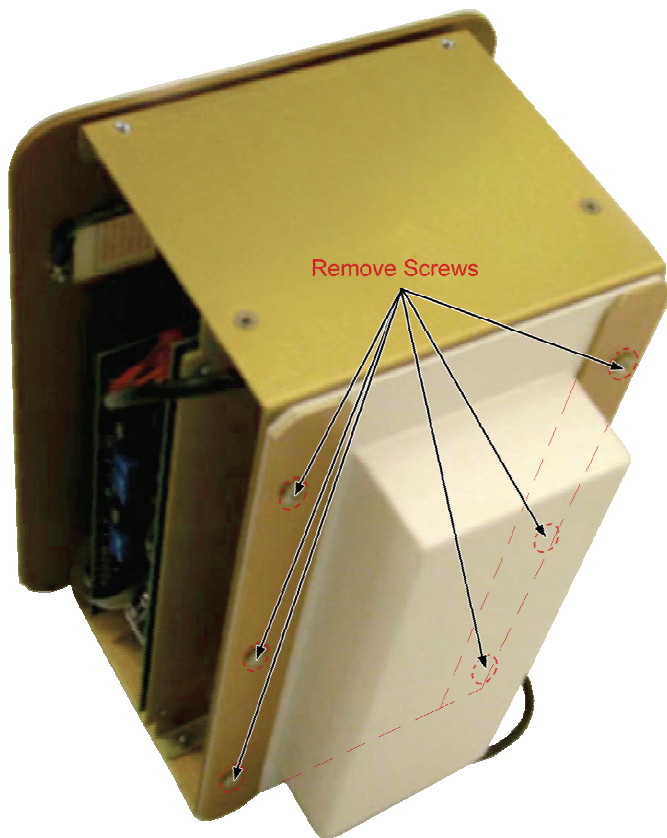
The ATRT-01D is powered by six standard alkaline D-cell batteries. Follow the steps below to replace the batteries:

- a. Remove the 4 screws from the locations shown below:

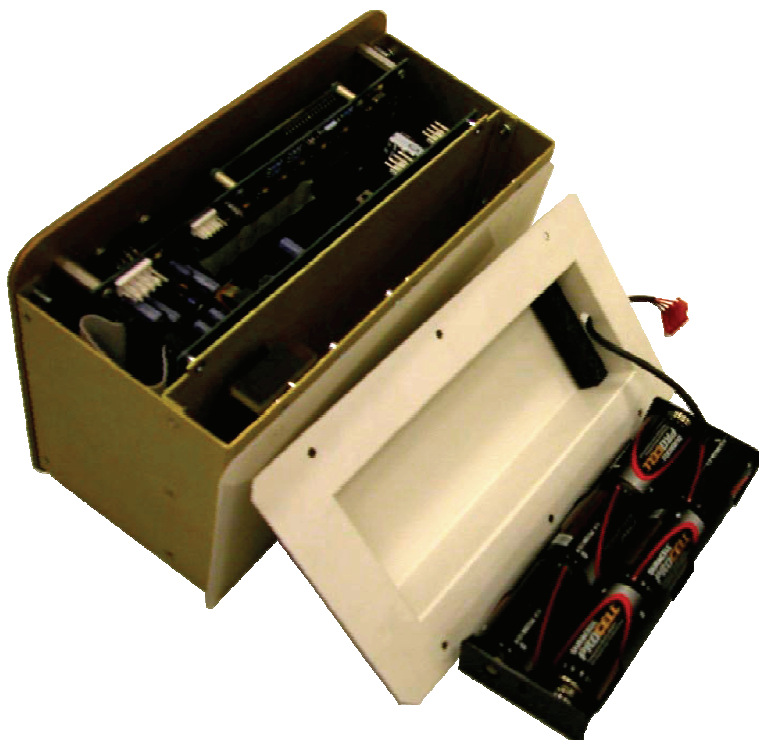


- b. Remove the unit's bottom casing.

- c. Remove the 6 screws from the locations shown below (bottom of unit):



- d. Replace the 6 batteries in the compartment shown below:



3.0 OPERATING PROCEDURES

3.1 ATRT-01D Transformer Connections

A typical connection of the ATRT-01D to a single-phase transformer is shown in Figure 2 below.

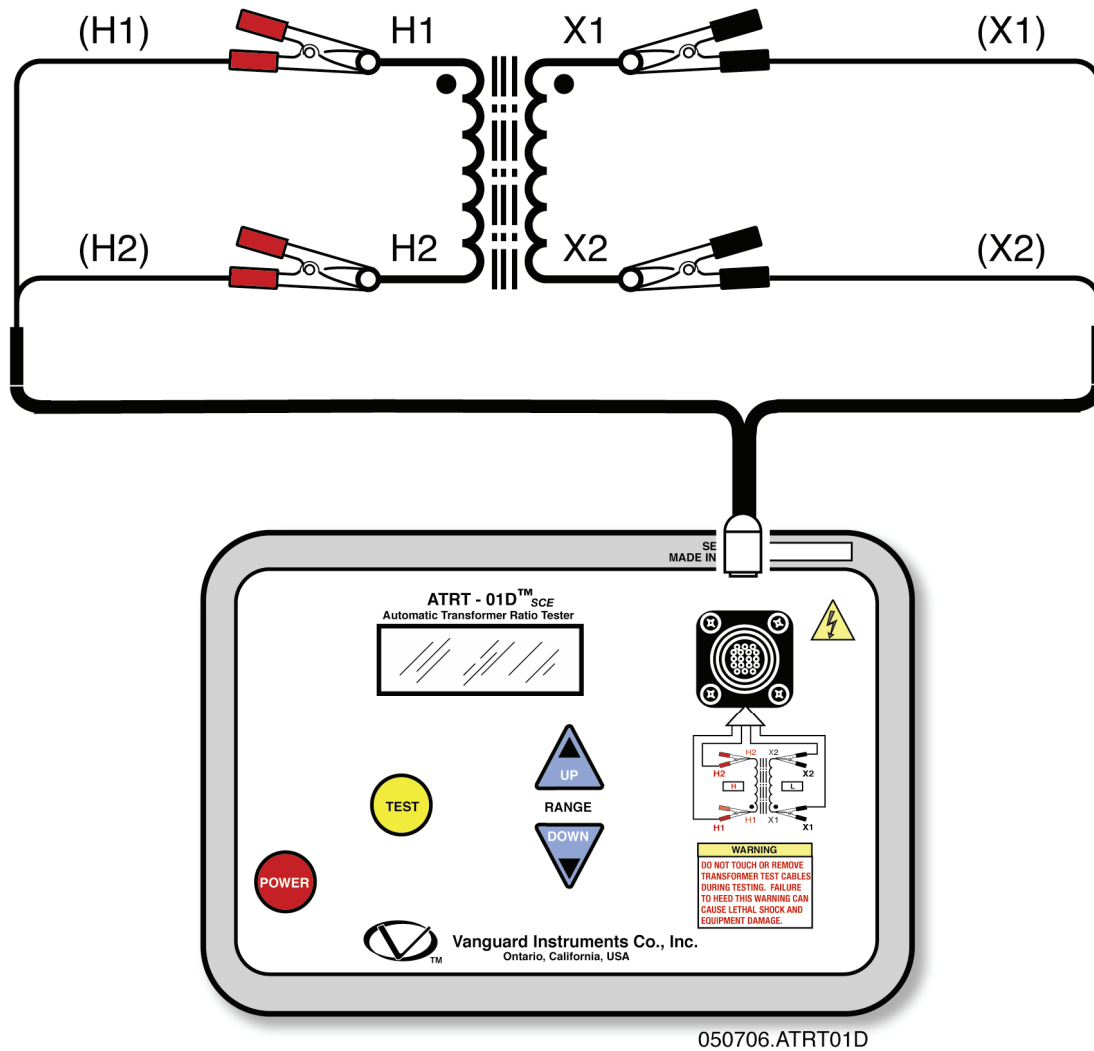


Figure 2. Typical Single-Phase Transformer Connection

3.2 Performing Tests

The ATRT-01D is pre-programmed with 45 transformer nameplate voltages (listed in Table 3). A nameplate voltage can be selected before performing a test and serves as the baseline for determining whether a test passes or fails. If a nameplate voltage is selected, the ATRT-01D will calculate and display the percentage difference of the turns ratio. The percentage difference is calculated by comparing the test results with the nameplate turns ratio values. A "PASS" message is displayed if the percentage difference is less than or equal to 0.5% and the winding is in-phase. A "FAIL" message is displayed if the percentage error is greater than 0.5% or if the winding is out-of-phase. Follow the steps below to test a single phase transformer:

- a. Turn on the unit and start from the "START-UP" screen:

```

# SCROLL TO SELECT
  "TEST" TO START

NO VOLTAGE SELECTION
  
```



NOTE

When the unit is turned on for the first time, the "NO VOLTAGE SELECTION" message will be displayed. For subsequent uses, it will display the nameplate voltage values from the last test performed. If nameplate voltage values are displayed and you do NOT wish to perform a test using nameplate voltages, press either the **[UP]** or **[DOWN]** key until the "NO VOLTAGE SELECTION" message is displayed.

If you do not wish to use nameplate voltages, continue to step c.

If you wish to use nameplate voltages, continue to step b.

- b. Press either the **[UP]** or **[DOWN]** key. If the **[UP]** key is pressed, the first value from the nameplate voltage table will be listed as shown:

```

# SCROLL TO SELECT
  "TEST" TO START
    H = 2,400
    X = 120
  
```

If the **[DOWN]** key is pressed, the last value from the nameplate voltage table will be listed:

```

# SCROLL TO SELECT
  "TEST" TO START
    H = 34,400
    X = 9,430
  
```

Continue to press the **[UP]** or **[DOWN]** key until the desired nameplate voltage values are displayed on the screen.

- c. Press the **[TEST]** key. The following screen will be displayed momentarily while the test is being performed:

```
SINGLE PHASE XFORMER
PLEASE WAIT
TEST IN PROGRESS
```

When testing is finished, the results will be displayed as shown (multiple examples shown):

```
M-RATIO=+20.05
ERROR= 0.25 %
PASSED TTR TEST
2,400/120 R=20.00
```

Example results from a passed test using nameplate voltages.

```
M-RATIO=+20.05
ERROR= 2.5 %
FAILED TTR TEST
2,400/120 R=20.00
```

Example results from a failed test using nameplate voltages.

```
M-RATIO=+20.05
NO VOLTAGE SELECTION
```

Example results from a test not using nameplate voltages.

Please see Figure 3 below for a description of the test results elements.

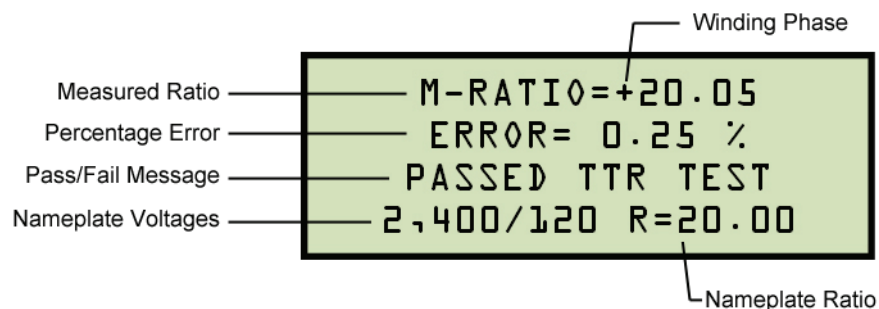
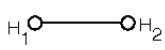
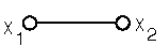
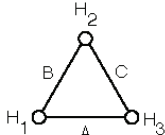
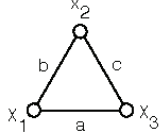
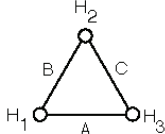
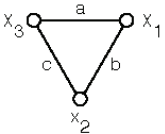
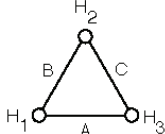
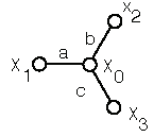
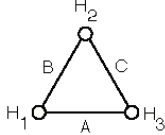
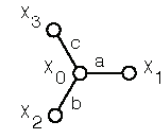
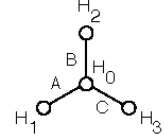
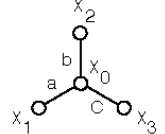
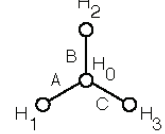
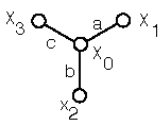
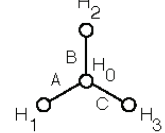
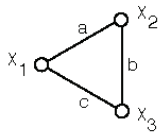
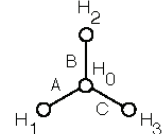
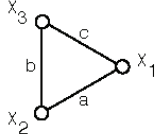


Figure 3. Test Results Elements

Table 3. Pre-programmed Nameplate Voltages

No	H Voltage	X Voltage
1	2400	120
2	2400	240
3	2400	277
4	2400	480
5	4160	120
6	4160	240
7	4160	277
8	4160	480
9	4800	120
10	4800	240
11	6930	120
12	6930	240
13	7200	2400
14	9430	120
15	9430	240
16	12000	120
17	12000	240
18	12000	277
19	12000	480
20	12000	2400
21	13800	120
22	13800	240
23	13800	277
24	13800	480
25	14400	120
26	14400	240
27	14400	277
28	14400	480
29	16340	120
30	16340	240
31	16340	277
32	16340	480
33	16340	2400
34	24900	120
35	24900	240
36	24900	277
37	34400	120
38	34400	240
39	34400	277
40	34400	480
41	34400	2400
42	34400	4800
43	34400	6930
44	34400	7200
45	34400	9430

4.0 Common Transformer Configuration and Calculation Formulas

TEST NO.	TRANSFORMER CONFIGURATION		XFMR TYPE	PHASE	HIGH VOLTAGE WINDING	LOW VOLTAGE WINDING	TURNS RATIO
	HIGH-VOLTAGE WINDING (H)	LOW-VOLTAGE WINDING (X)					
1			1 Ø STD	1 Ø	H ₁ -H ₂	X ₁ -X ₂	$\frac{V_H}{V_X}$
2			Δ-Δ STD	A	H ₁ -H ₃ (A)	X ₁ -X ₃ (a)	$\frac{V_H}{V_X}$
				B	H ₂ -H ₁ (B)	X ₂ -X ₁ (b)	
				C	H ₃ -H ₂ (C)	X ₃ -X ₂ (c)	
3			Δ-Δ REV	A	H ₁ -H ₃ (A)	X ₁ -X ₃ (a)	$\frac{V_H}{V_X}$
				B	H ₂ -H ₁ (B)	X ₂ -X ₁ (b)	
				C	H ₃ -H ₂ (C)	X ₃ -X ₂ (c)	
4			Δ-Y STD	A	H ₁ -H ₃ (A)	X ₁ -X ₀ (a)	$\frac{V_H \cdot \sqrt{3}}{V_X}$
				B	H ₂ -H ₁ (B)	X ₂ -X ₀ (b)	
				C	H ₃ -H ₂ (C)	X ₃ -X ₀ (c)	
5			Δ-Y REV	A	H ₁ -H ₃ (A)	X ₁ -X ₀ (a)	$\frac{V_H \cdot \sqrt{3}}{V_X}$
				B	H ₂ -H ₁ (B)	X ₂ -X ₀ (b)	
				C	H ₃ -H ₂ (C)	X ₃ -X ₀ (c)	
6			Y-Y STD	A	H ₁ -H ₀ (A)	X ₁ -X ₀ (a)	$\frac{V_H}{V_X}$
				B	H ₂ -H ₀ (B)	X ₂ -X ₀ (b)	
				C	H ₃ -H ₀ (C)	X ₃ -X ₀ (c)	
7			Y-Y REV	A	H ₁ -H ₀ (A)	X ₁ -X ₀ (a)	$\frac{V_H}{V_X}$
				B	H ₂ -H ₀ (B)	X ₂ -X ₀ (b)	
				C	H ₃ -H ₀ (C)	X ₃ -X ₀ (c)	
8			Y-Δ STD	A	H ₁ -H ₀ (A)	X ₁ -X ₀ (a)	$\frac{V_H}{V_X \cdot \sqrt{3}}$
				B	H ₂ -H ₀ (B)	X ₂ -X ₀ (b)	
				C	H ₃ -H ₀ (C)	X ₃ -X ₀ (c)	
9			Y-Δ REV	A	H ₁ -H ₀ (A)	X ₁ -X ₂ (a)	$\frac{V_H}{V_X \cdot \sqrt{3}}$
				B	H ₂ -H ₀ (B)	X ₂ -X ₃ (b)	
				C	H ₃ -H ₀ (C)	X ₃ -X ₁ (c)	



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