ATRT-01 S2, ATRT-01B S2, and ATRT-01D S2
SINGLE PHASE TRANSFORMER TURNS-RATIO METERS

USER'S MANUAL

Vanguard Instruments Company, Inc.
1520 S. Hellman Ave.
Ontario, California 91761, USA

TEL: (909) 923-9390
FAX: (909) 923-9391

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SAFETY SUMMARY

This manual applies to the ATRT-01 S2, ATRT-01B S2, and ATRT-1D S2 current transformer turns-ratio meters. The operating procedures are virtually the same for all three models, and any differences are clearly described where applicable.

FOLLOW EXACT OPERATING PROCEDURES

Any deviation from procedures described in this User's Manual may create one or more safety hazards, damage the ATRT-01/01B/01D S2, 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-01/01B/01D S2.

SAFETY WARNINGS AND CAUTIONS

The ATRT-01/01B/01D S2 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-01/01B/01D S2 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 general term "ATRT" is used in this manual to refer to any of the ATRT-01 S2 models (ATRT-01 S2, ATRT-01B S2, and ATRT-1D S2).
- A key, switch, or knob on the ATRT is indicated as **[KEY], [SWITCH], [KNOB]**.
- Menu names are referenced as "MENU NAME"
- ATRT screen output is shown as:

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

- Warning messages are indicated as:

WARNING Warning message

- Important notes are indicated as:

NOTE Note details

1.0 INTRODUCTION

1.1 General Description and Features

The ATRT-01 S2 is Vanguard's third-generation micro-processor-based, single-phase, automatic, transformer-turns-ratio tester. This portable test equipment is offered in three models: the ATRT-01 S2, ATRT-01B S2, and ATRT-01D S2. The ATRT-01 S2 is ac-line powered; the ATRT-01B S2 is ac-line or rechargeable-battery powered, and the ATRT-01D S2 is powered by six D-cells.

The ATRT-01 S2 determines the transformer turns-ratio using the IEEE C57.12.90 measurement method. The transformer turns-ratio is determined by precisely measuring the voltages across the unloaded transformer windings. The ATRT-01 S2's measuring circuitry self calibrates before each measurement to ensure turns-ratio accuracy.

The ATRT-01 S2 measures turns-ratios ranging from 0.800 to 15,000 and can be used to test voltage regulators, power transformers, current transformers (CT), and Potential Transformers (PT). The ATRT-01 S2 also measures and displays transformer-winding excitation current, and winding polarity. Test results are displayed on a back-lit LCD screen (4 lines by 20 characters).

In addition to measuring a transformer's turns-ratio, nameplate voltages can also be entered via the keypad, and the ATRT-01 S2 will then display the turns-ratio error as a percentage. This convenient feature eliminates any user-calculation error when testing transformers.

If a 3-phase transformer is being tested, the ATRT-01 S2 will also provide connection information (H and X test probes to transformer bushings) for phases A, B, and C tests. Three-phase test results (turns-ratio, excitation current, winding polarity, and percentage error) are displayed on the LCD screen at the end of each test.

User Interface

The ATRT-01 S2 features a back-lit LCD screen (4 lines by 20 characters) that is viewable in both bright sunlight and low-light levels. Displayed test results include turns-ratio, winding polarity, excitation current, and percentage error calculation.

The ATRT-01 S2's rugged, 16-key membrane keypad is used to select a test and enter the nameplate voltages for turns-ratio percentage error calculation.

Computer Interface

The ATRT-01 S2, ATRT-01B S2 and the ATRT-01D S2 can be used with a PC via the RS-232C interface. Windows® XP/Vista-based software is provided with each unit and can be used to test transformers and to store the test results on the computer. The test results can be retrieved later, in the office for example, for analysis and for printing on an office printer. The test results can also be exported in text or Microsoft® Excel format, thus allowing the results to be used with other PC applications.

The included PC software can also be used to create test plans for specific transformers. A test plan is comprised of the transformer nameplate voltages for each tap setting. Computed turns-ratio is based on the nameplate voltages which can be compared to the measured ratio to derive percentage error.

Battery Power for Exceptional Portability

The ATRT-01B S2 is powered by a 6-Volt, 7 Ampere-hour, lead-acid battery. The high capacity battery, coupled with the ATRT-01B S2’s low power consuming circuitry, allows the unit to be used continuously for up to 6 hours between re-charges. A built-in charger lets the unit be used while the battery is being charged.

The ATRT-01D S2 uses 6 D-cell batteries. Up to 250 tests can be performed with one set of D-cell batteries.

1.2 Technical Specifications

1.2.1. ATRT-01 S2 Technical Specifications

Table 1. ATRT-01 S2 Technical Specifications

TYPE	Portable, automatic, single-phase transformer turns ratio meter
INPUT POWER	120 or 240Vac (Selectable), 50/60Hz (See section 2.1)
MEASUREMENT METHOD	ANSI/IEEE C57.12.90
RATIO MEASURING RANGE	0.8 – 15,000 (5-digit resolution)
TURNS-RATIO ACCURACY	0.800 – 1,999 (±0.1%), 2,000 – 3,999 (±0.25%), 4,000 – 15,000 (±1%)
TEST VOLTAGES	8 Vac @ 1.0 Amp, 40 Vac @ 0.6 Amp
EXCITATION READING RANGE	0 – 2 Amperes
CURRENT READING ACCURACY	±1 milli-amp, ±2% of reading (±1-digit)
DISPLAY	Back-lit LCD screen (4 lines by 20 characters), viewable in bright sunlight and low-light levels
COMPUTER INTERFACE	One RS-232C (19,200 baud) port
PC SOFTWARE	Windows® XP/Vista-based, included with purchase price
SAFETY	Designed to meet IEC61010 (1995), UL61010A-1, CSA-C22.2 standards
ENVIRONMENT	Operating: -10˚C to 50˚C (15˚F to 122˚F); Storage: -30˚ C to 70˚C (-22˚F to 158˚F)
HUMIDITY (MAX)	90% RH @ 40˚ C (104˚ F) non-condensing
ALTITUDE (MAX)	2000m (6562 ft) to fully safety specifications
CABLES	One 15-foot single-phase cable, one cable-carrying duffel bag included
OPTIONS	Transportation case
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.

1.2.2. ATRT-01B S2 Technical Specifications

Table 2. ATRT-01B S2 Technical Specifications

TYPE	Portable, automatic, single-phase transformer turns ratio meter
INPUT POWER	SLA battery (90–240Vac, 50/60Hz). Delivers up to 6-hours of operation.
MEASUREMENT METHOD	ANSI/IEEE C57.12.90
RATIO MEASURING RANGE	0.8 – 15,000 (5-digit resolution)
TURNS-RATIO ACCURACY	0.800–1,999 (±0.1%), 2,000–3,999 (±0.25%), 4,000–15,000 (±1.5%)
TEST VOLTAGES	8 Vac @ 350 mA, 40 Vac @ 70 mA
EXCITATION READING RANGE	0 – 2 Amperes
CURRENT READING ACCURACY	±1 Milli-amp, ±2% of reading (±1-digit)
DISPLAY	Back-lit LCD screen (4 lines by 20 characters), viewable in bright sunlight and low-light levels
COMPUTER INTERFACE	One RS-232C (19,200 baud) port
PC SOFTWARE	Windows® XP/Vista-based, included with purchase price
SAFETY	Designed to meet IEC61010 (1995), UL61010A-1, CSA-C22.2 standards
ENVIRONMENT	Operating: -10˚C to 50˚C (15˚F to 122˚F); Storage: -30˚ C to 70˚C (-22˚F to 158˚F)
HUMIDITY (MAX)	90% RH @ 40˚ C (104˚ F) non-condensing
ALTITUDE (MAX)	2000m (6562 ft) to fully safety specifications
CABLES	One 15-foot single-phase cable, one cable-carrying duffel bag included
OPTIONS	Transportation case
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.

1.2.3. ATRT-01D S2 Technical Specifications

Table 3. ATRT-01D S2 Technical Specifications

TYPE	Portable, automatic, single-phase transformer turns ratio meter
INPUT POWER	6 D Cells (250-test capacity)
MEASUREMENT METHOD	ANSI/IEEE C57.12.90
RATIO MEASURING RANGE	0.8 – 15,000 (5-digit resolution)
TURNS-RATIO ACCURACY	0.800–1,999 (±0.1%), 2,000–3,999 (±0.25%), 4,000–15,000 (±1.5%)
TEST VOLTAGES	8 Vac @ 350 mA, 40 Vac @ 70 mA
EXCITATION READING RANGE	0 – 2 Amperes
CURRENT READING ACCURACY	±1 Milli-amp, ±2% of reading (±1-digit)
DISPLAY	Back-lit LCD screen (4 lines by 20 characters), viewable in bright sunlight and low-light levels
COMPUTER INTERFACE	One RS-232C (19,200 baud) port
PC SOFTWARE	Windows® XP/Vista-based, included with purchase price
SAFETY	Designed to meet IEC61010 (1995), UL61010A-1, CSA-C22.2 standards
ENVIRONMENT	Operating: -10˚C to 50˚C (15˚F to 122˚F); Storage: -30˚ C to 70˚C (-22˚F to 158˚F)
HUMIDITY (MAX)	90% RH @ 40˚ C (104˚ F) non-condensing
ALTITUDE (MAX)	2000m (6562 ft) to fully safety specifications
CABLES	One 15-foot single-phase cable, one cable-carrying duffel bag included
OPTIONS	Transportation case
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-01 S2, ATRT-01B S2, and ATRT-01D S2 controls and indicators are shown in Figure 1, Figure 2, and Figure 3, respectively. A leader line with an index number points to each control and indicator, which is cross-referenced to a functional description in the corresponding table. The purpose of the controls and indicators may seem obvious, but users should familiarize themselves with them before using the ATRT. Accidental misuse of the controls will usually cause no serious harm. Users should also familiarize themselves with the safety summary information found on the front page of this User's Manual.

Figure 1. ATRT-01 S2 Controls and Indicators

Table 4. Functional Descriptions of ATRT-01 S2 Controls and Indicators

Item Number	Panel Markings	Functional Description
1	RS-232C	RS-232C computer interface port. Data rate is set to 19,200 baud, 1 start bit, 8 data bits, 2 stop bits, and no parity bit.
2		Back-lit LCD screen (20 characters by 4 lines), viewable in bright sunlight and low-light levels.
3		Rugged alpha-numeric keypad.
4		H and X lead connector; 16-pin male.
5	120 Vac, 2A, 50-60Hz	Input power connector and fused power switch with third-wire safety ground.

Figure 2. ATRT-01B S2 Controls and Indicators

Table 5. Functional Descriptions of ATRT-01B S2 Controls and Indicators

Item Number	Panel Markings	Functional Description
1	RS-232C	RS-232C computer interface port. Data rate is set to 19,200 baud, 1 start bit, 8 data bits, 2 stop bits, and no parity bit.
2		Back-lit LCD screen (20 characters by 4 lines), viewable in bright sunlight and low-light levels.
3		Rugged alpha-numeric keypad.
4		H and X lead connector; 16-pin male.
5	120 Vac, 2A, 50-60Hz	Input power connector and fused power switch with third-wire safety ground.
6	POWER	Power switch, momentary contact.
7	CHARGER	Battery charging indicator. LED lights up when battery is being charged.

Figure 3. ATRT-01D S2 Controls and Indicators

Table 6. Functional Descriptions of ATRT-01D S2 Controls and Indicators

Item Number	Panel Markings	Functional Description
1	RS-232C	RS-232C computer interface port. Data rate is set to 19,200 baud, 1 start bit, 8 data bits, 2 stop bits, and no parity bit.
2		Back-lit LCD screen (20 characters by 4 lines), viewable in bright sunlight and low-light levels.
3		Rugged alpha-numeric keypad.
4		H and X lead connector; 16-pin male.
5	POWER	Power switch, momentary contact.

2.0 PRE-TEST SETUP

2.1 ATRT-01 S2 Operating Voltages

The ATRT-01 S2 is powered by ac line voltage only. The operating voltage is preset at the factory and is selectable between 100-120 Vac, 50/60 Hz or 200-240 Vac, 50/60 Hz. Only the reference transformer requires voltage selection for the different operating voltages. The voltage is set by placing jumper(s) on the transformer (part number 200466-1) as shown in Figure 5 and Figure 6.

Table 7. ATRT-01 S2 Voltage Selection Jumper Settings

Voltage Selection	Transformer Jumpers
100 – 120 Vac	Pin 1 and 3, Pin 2 and 4
200 – 240 Vac	Pin 2 and 3

Figure 4. ATRT-01 S2 Voltage Selection Jumper Location

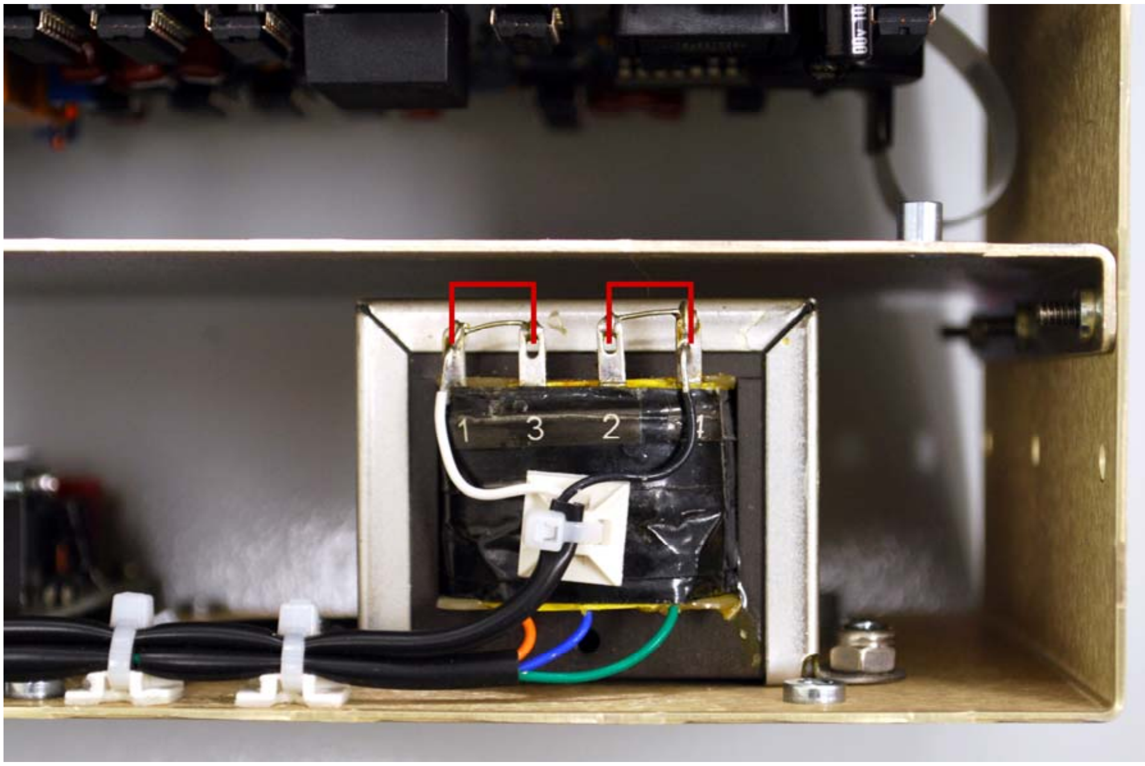


Figure 5. ATRT-01 S2 100 – 120 Vac Jumper Settings

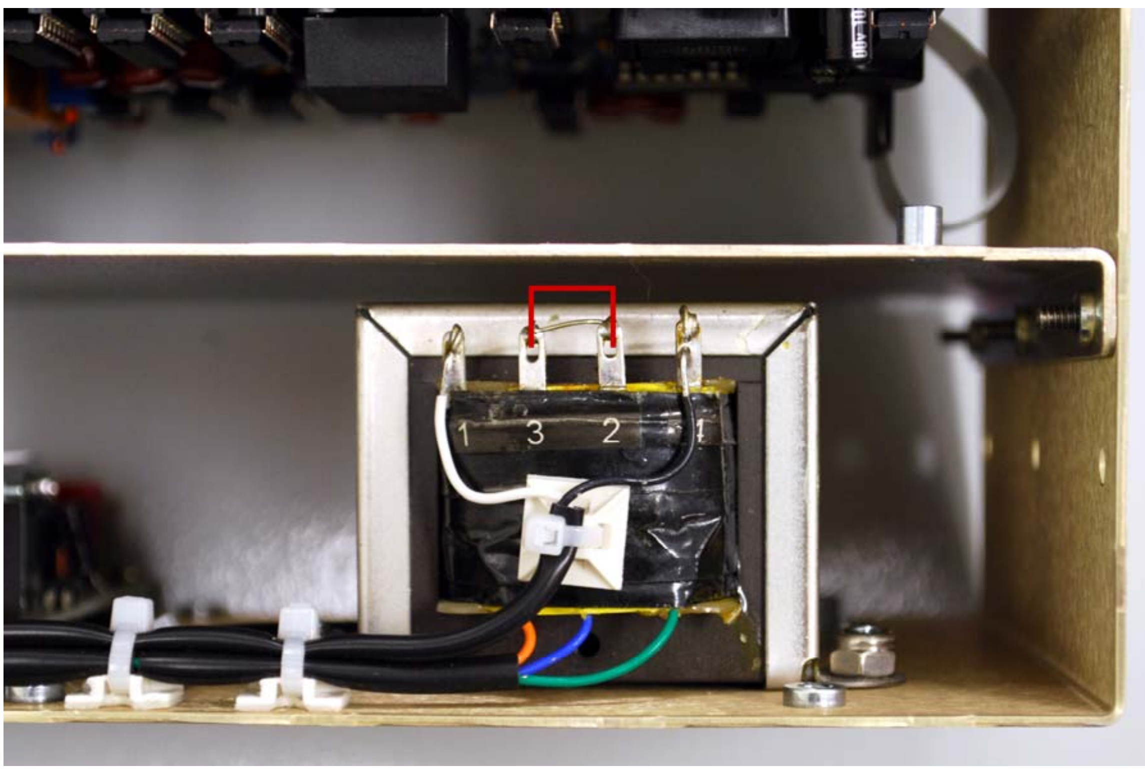


Figure 6. ATRT-01 S2 200 – 240 Vac Jumper Settings

2.2 ATRT-01B S2 Operating Power

The ATRT-01B S2 is powered by a rechargeable (6 Vdc / 7 AH) sealed lead acid gel battery. The unit can operate continuously for up to 6 hours between charges. It can also be used while charging. Plugging the ATRT-01B S2 into an ac power outlet after the battery is fully charged will not damage the battery.

NOTES

- It is recommended that the ATRT-01B S2 be plugged into an ac outlet when it is not in use.
- The ATRT-01B S2 battery can be replaced with the Enersys Genesis NP7-6 6V, 7.0Ah battery.

2.3 ATRT-01D S2 Operating Power

The ATRT-01D S2 is powered by six standard D cell batteries. We recommend industrial (1.5 volts) D cells such as the Duracell 1300.

To turn the unit on or off, press and hold the **[POWER]** switch for 2 seconds.

2.4 LCD Screen Contrast Control

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

For the ATRT-01B S2 and ATRT-01D S2, 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.

3.0 OPERATING PROCEDURES

3.1 ATRT Transformer Connection Diagrams

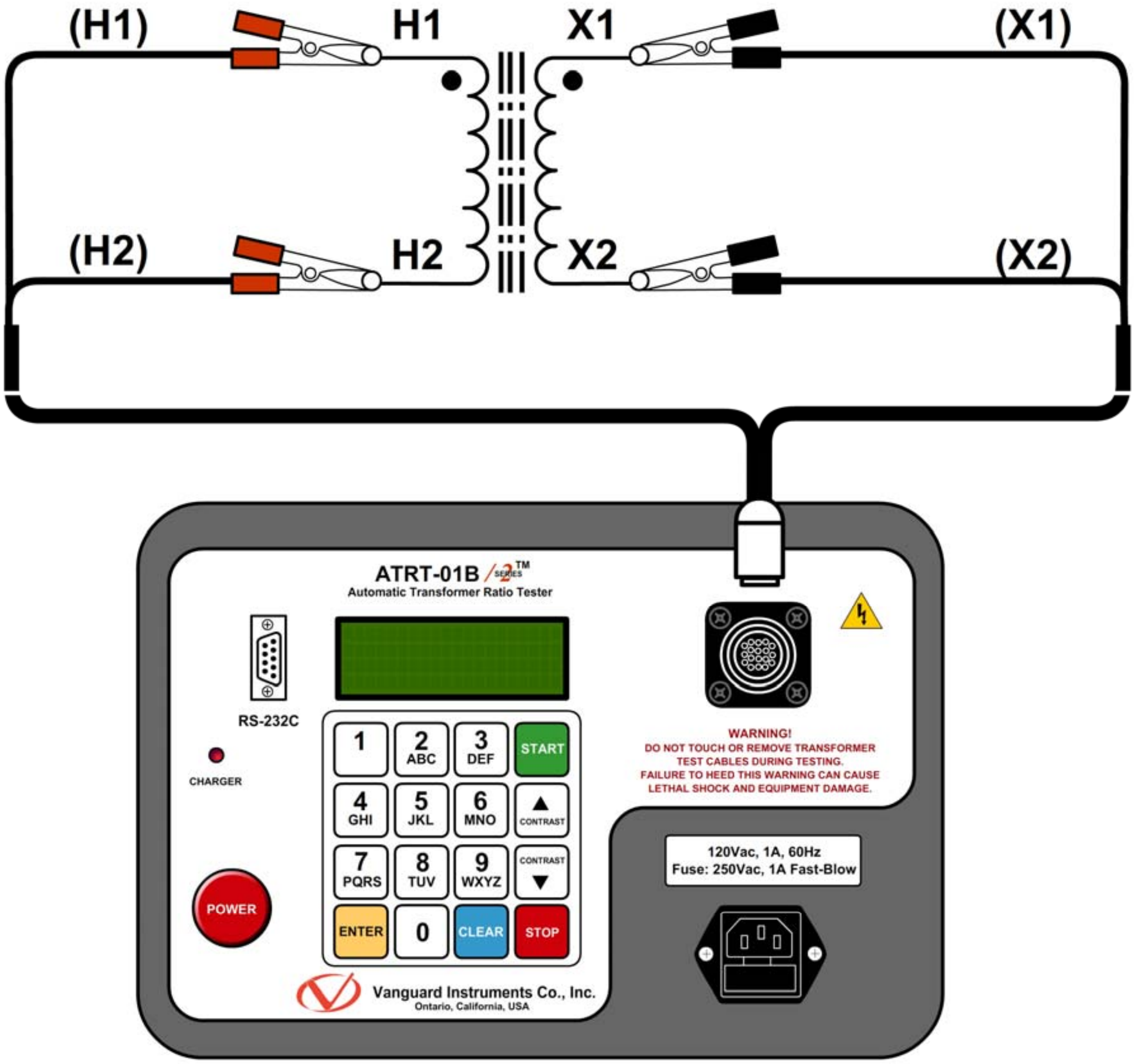


Figure 7. Typical Single-Phase Transformer Connection

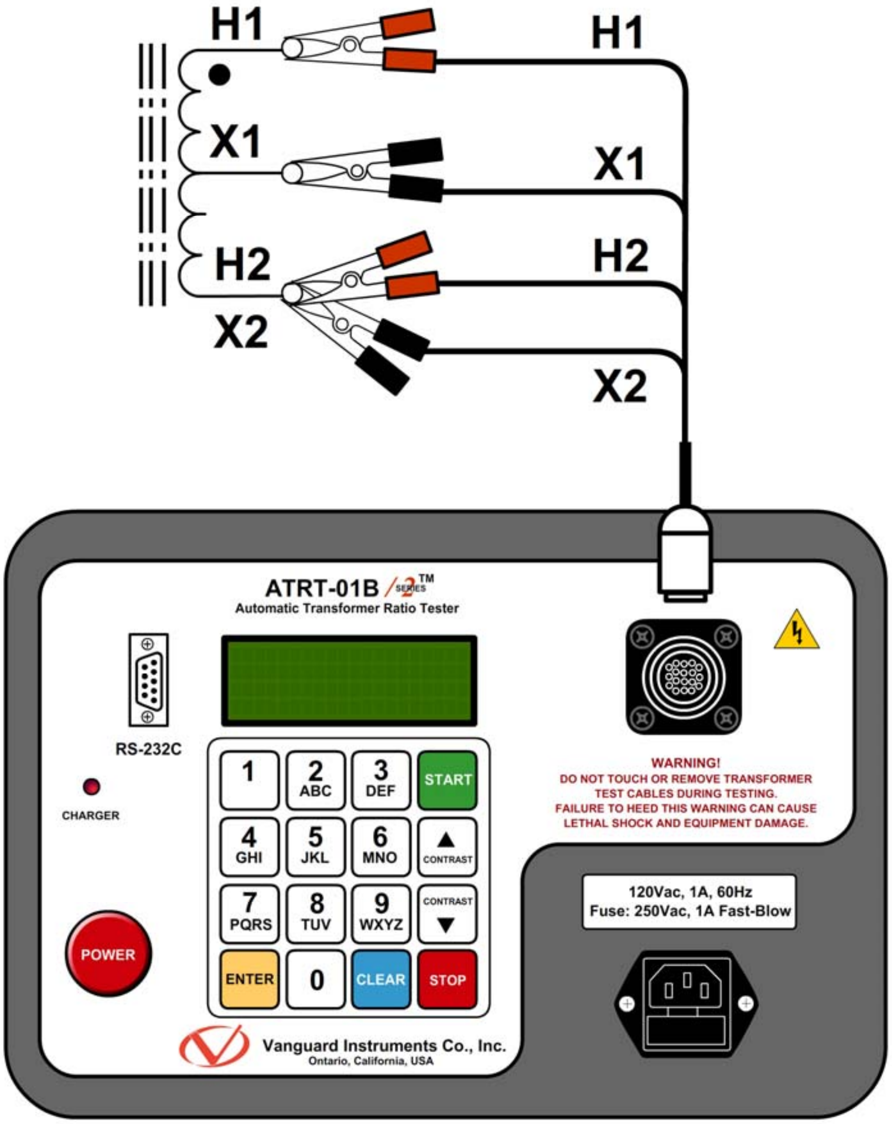


Figure 8. Typical Auto Transformer Connection

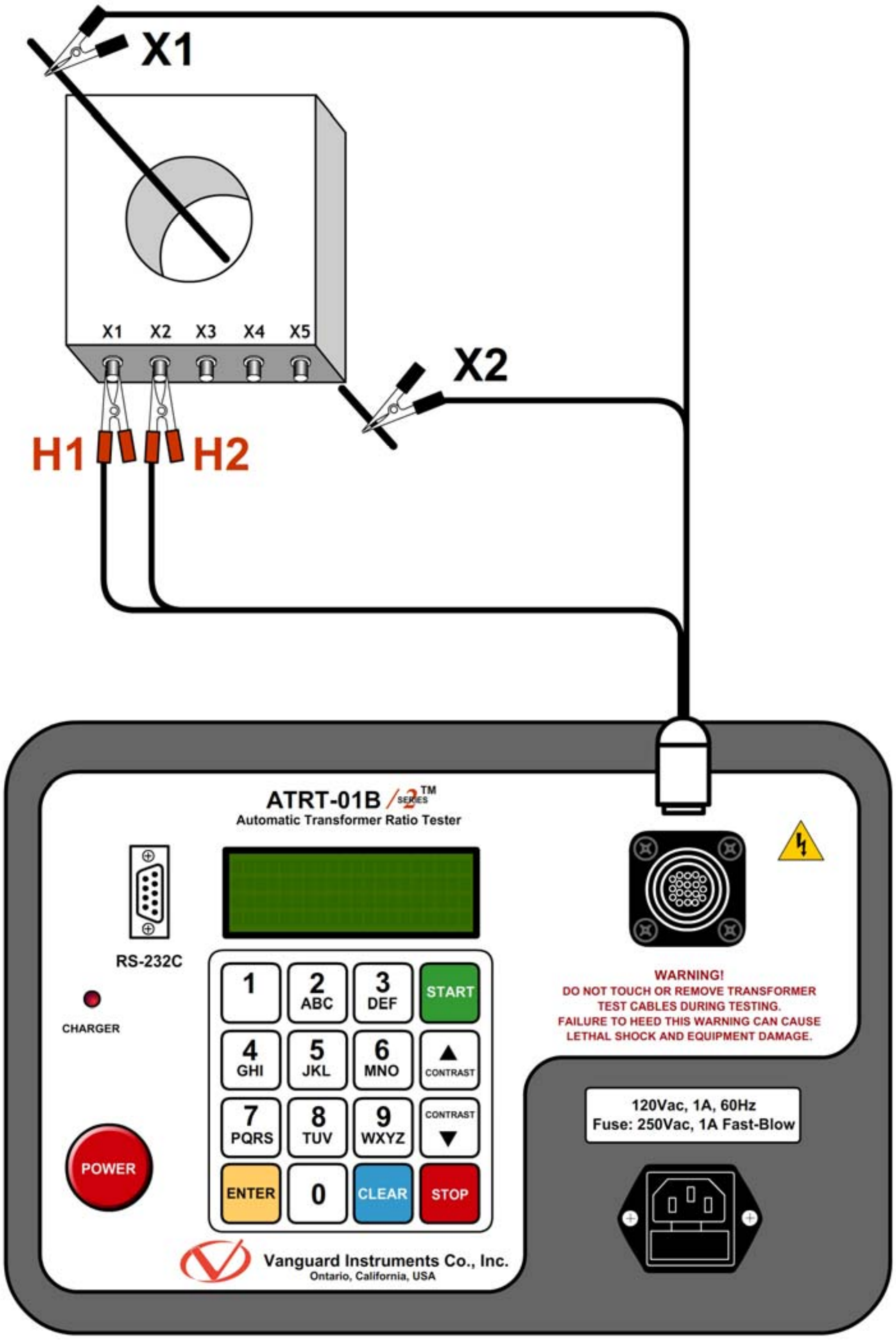


Figure 9. Typical CT Connection

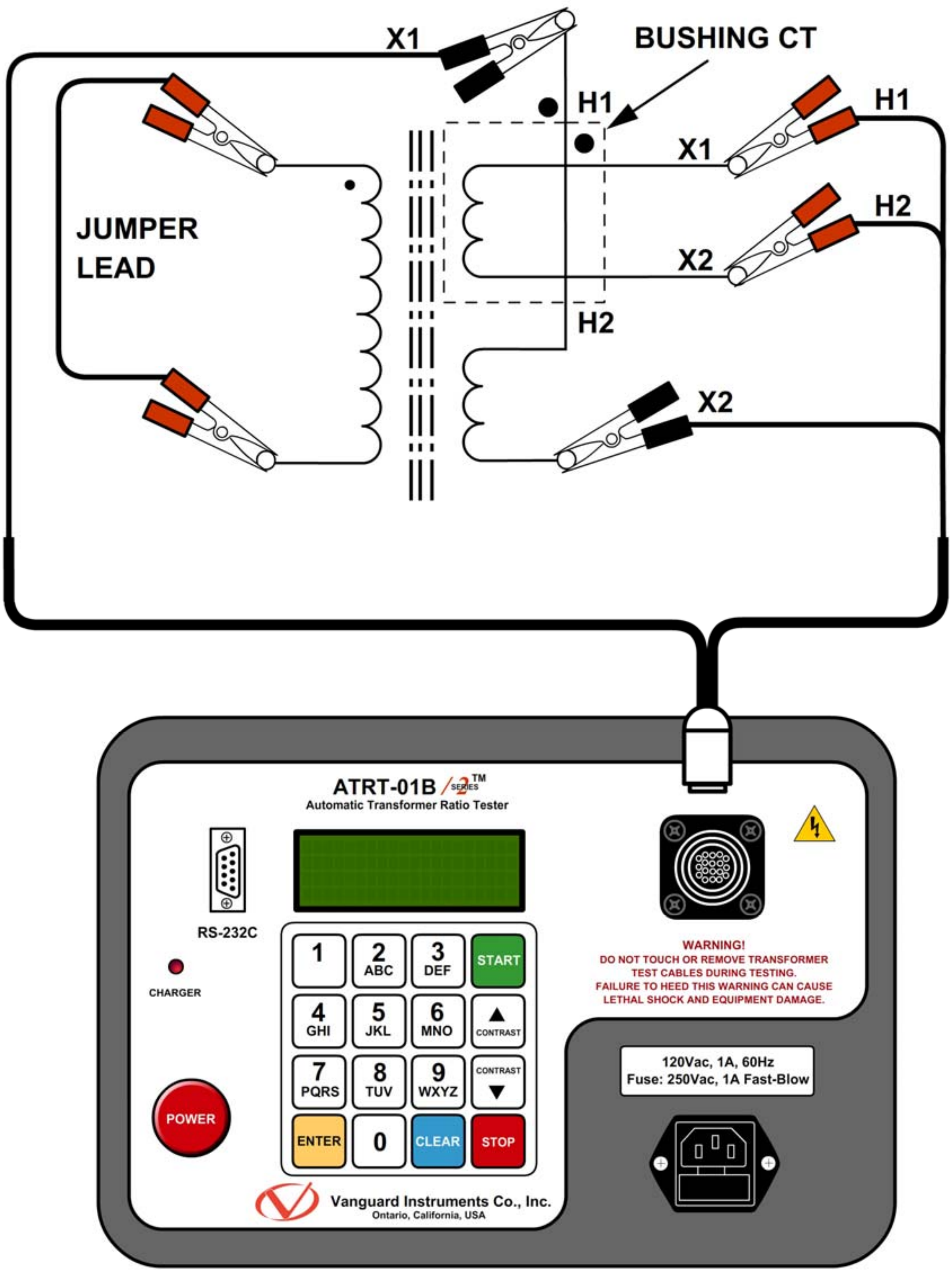


Figure 10. Typical Bushing CT Connection on a Single Transformer

3.2 Setting the Test Voltage

The ATRT offers two test voltages, 8 Vac and 40 Vac. The unit always defaults to 40 Vac at power-on. The 8 Vac test voltage can be used in situations where the 40 Vac excitation voltage may saturate the CT's. To set the test voltage:

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

```
1.TEST XFMR 06/02/10
2.SETUP     15:33:10
3.CALCULATOR
```

Press the **[2]** key (*SETUP*).

b. The following screen will be displayed:

```
1.SET TIME
2.SET TEST VOLTAGE
3.COMPUTER CONTROL
```

Press the **[2]** key (*SET TEST VOLTAGE*).

c. The following screen will be displayed:

```
1.SET 8 VOLTS
2.SET 40 VOLTS
```

Press the **[1]** key (*SET 8 VOLTS*) to select 8 volts as the test voltage ore press the **[2]** key (*SET 40 VOLTS*) to select 40 volts as the test voltage.

d. The voltage will be set and the following confirmation message will be displayed:

```
 TEST VOLTAGE SET TO
       8 VOLTS

 ANY KEY TO CONTINUE
```

Press any key to return to the "START-UP" menu.

3.3 Enabling the Computer Interface

The ATRT can be connected to a computer via the RS-232C interface port. In order to remotely control the unit using the provided Transformer Turns Ratio Analysis (TTRA) software, the unit must be placed in Computer Control mode. Use the steps below to place the unit in Computer Control mode:

a. Start from the "START-UP" menu:

```
1.TEST XFMR 06/02/10
2.SETUP     15:33:10
3.CALCULATOR
```

Press the **[2]** key (*SETUP*).

b. The following screen will be displayed:

```
1.SET TIME
2.SET TEST VOLTAGE
3.COMPUTER CONTROL
```

Press the **[3]** key (*COMPUTER CONTROL*).

c. The following screen will be displayed confirming that the unit has been placed in Computer Control mode:

```
  COMPUTER ITF MODE
  *** CAUTION! ***
CABLES MAY HAVE VLTG
   "STOP" TO ABORT
```

You can now use the Transformer Analysis software to remotely control the unit from the PC. Please see the software User's Manual for further information.

Press the **[STOP]** key to abort Computer Control mode and return to the "START-UP" menu.

NOTE The TTRA software only supports the single phase transformer test when used with the ATRT-01 S2.

3.4 Setting the Date and Time

To set the date and time:

a. Start from the "START-UP" menu:

```
1.TEST XFMR 06/02/10
2.SETUP      15:33:10
3.CALCULATOR
```

Press the **[2]** key (*SETUP*).

b. The following screen will be displayed:

```
1.SET TIME
2.SET TEST VOLTAGE
3.COMPUTER CONTROL
```

Press the **[2]** key (*SET TIME*)

c. The following screen will be displayed:

```
        ENTER
MM-DD-YY  HH:MM:SS
_
```

Type in the date and time using the alpha-numeric keypad. When the complete date and time has been entered, you will be immediately returned to the "START-UP" menu.

3.5 Performing Tests

3.5.1. Testing a Single Phase Transformer

Follow the steps below to test a single phase transformer:

a. Start from the "START-UP" menu:

```
1.TEST XFMR 06/02/10
2.SETUP      15:33:10
3.CALCULATOR
```

Press the **[1]** key (*TEST XFMR*).

b. The following screen will be displayed:

```
XFMR CONFIGURATION:
1.SNGL PHS    2.dT-Y
3.Y-dT        4.dT-dT
5.Y-Y
```

Press the **[1]** key (*SNGL PHS*).

c. The following screen will be displayed:

```
XFMR NAME PLATE VLTG
1. YES
2. NO
```

1. *YES*

   Press the **[1]** key (*YES*) if you would like to enter the transformer name plate voltage values. The following screen will be displayed:

```
   ENTER H WINDING
NAME-PLATE VOLTAGE:
             V
```

   Type the H winding name plate voltage value using the numeric keypad. The screen will be updated as shown:

```
   ENTER H WINDING
NAME-PLATE VOLTAGE:
         500 V
```

   Press the **[ENTER]** key. The following screen will be displayed:

```
  ENTER X WINDING
NAME-PLATE VOLTAGE:
              V
```

Type the X winding name plate voltage value using the numeric keypad. The screen will be updated as shown:

```
  ENTER H WINDING
NAME-PLATE VOLTAGE:
           10 V
```

Press the **[ENTER]** key. **Continue to step d**.

2. *NO*

   Press the **[2]** key (*NO*) if you do not want to enter the transformer name plate voltage. **Continue to step d.**

d. The following screen will be displayed:

```
SINGLE PHASE XFORMER
 "START" TO RUN TEST
         OR
   "STOP" TO ABORT
```

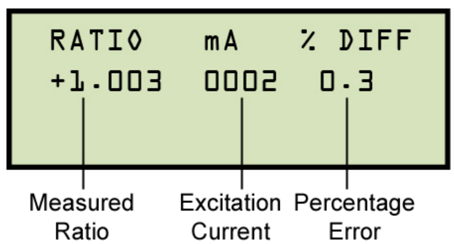
Press the **[START]** key to start the test.

e. The following screen will be displayed while the test is being performed:

```
SINGLE PHASE XFORMER

     PLEASE WAIT
  TEST IN PROGRESS
```

The test results will be displayed on the LCD screen when testing has finished:



The polarity is displayed as either a plus sign (+) for "in-phase" or a minus sign (-) for "out-of-phase". The value listed under "% DIFF" is the percentage error.

Press any key to continue.

f. The following screen will be displayed:

```
REPEAT TEST?
1. YES
2. NO
```

Press the **[2]** key (*NO*). You will be returned to the "START-UP" screen.

3.5.2. Testing a Three Phase Transformer

Follow the steps below to test a three phase transformer:

a. Start from the "START-UP" menu:

```
1.TEST XFMR 06/02/10
2.SETUP      15:33:10
3.CALCULATOR
```

Press the **[1]** key (*TEST XFMR*).

b. The following screen will be displayed:

```
XFMR CONFIGURATION:
1.SNGL PHS    2.dT-Y
3.Y-dT        4.dT-dT
5.Y-Y
```

Select a three-phase transformer test by pressing the corresponding key (**[2]** to **[5]**). For this example, press the **[2]** key (*dT-Y*) to select the Delta to Y phase transformer test.

c. The following screen will be displayed:

```
  dT-Y XFMR CONFIG:
1.Dyn1        2.Dyn3
3.Dyn5        4.Dyn7
5.Dyn9        6.Dyn11
```

Select the transformer configuration by pressing the corresponding key (**[1]** to **[6]**). For this example, press the **[1]** key (*Dyn1*).

d. The following screen will be displayed:

```
XFMR NAME PLATE VLTG
1. YES
2. NO
```

1. YES

Press the **[1]** key (*YES*) if you would like to enter the transformer name plate voltage values. The following screen will be displayed:

```
  ENTER H WINDING
NAME-PLATE VOLTAGE:
               V
```

Type the H winding name plate voltage value using the numeric keypad. The screen will be updated as shown:

```
  ENTER H WINDING
NAME-PLATE VOLTAGE:
         500 V
```

Press the **[ENTER]** key. The following screen will be displayed:

```
  ENTER X WINDING
NAME-PLATE VOLTAGE:
             V
```

Type the X winding name plate voltage value using the numeric keypad. The screen will be updated as shown:

```
  ENTER H WINDING
NAME-PLATE VOLTAGE:
          10 V
```

Press the **[ENTER]** key. **Continue to step e**.

2. *NO*

   Press the **[2]** key (*NO*) if you do not want to enter the transformer name plate voltage. **Continue to step e.**

e. The following screen will be displayed showing the Phase A cable connections for the selected test (this will differ depending on the test):

```
CABLE  PHS-A  XFMR
X1,X2   to    X1,X0
H1,H2   to    H1,H3
"START" TO RUN TEST
```

Make the cable connections per the instructions and then press the **[START]** key to run the Phase A test.

f. The following screen will be displayed while the test is being performed:

```
 DYN 1 TRANSFORMER


   PLEASE WAIT...
```

The Phase A test results will be displayed on the LCD screen when testing has finished:

```
 RATIO    mA    % DIFF
+15.003  001    0.02

 "ENTER" TO CONTINUE
```

Press the **[ENTER]** key to continue.

g. The following screen will be displayed showing the Phase B cable connections for the selected test:

```
CABLE  PHS-B  XFMR
X1,X2   to    X2,X0
H1,H2   to    H2,H1
"START" TO RUN TEST
```

Make the cable connections per the instructions and then press the **[START]** key to run the Phase B test.

h. The following screen will be displayed while the test is being performed:

```
  DYN 1 TRANSFORMER


   PLEASE WAIT...
```

The Phase A and B test results will be displayed on the LCD screen when testing has finished:

```
 RATIO    mA    % DIFF
+15.003  001    0.02
+15.015  001    0.10
 "ENTER" TO CONTINUE
```

Line 1 of the results shows the Phase A test results, and line 2 shows the Phase B test results.

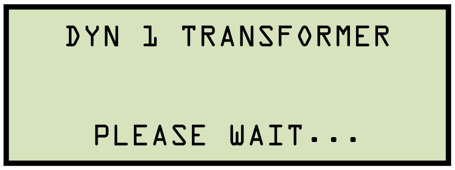
Press the **[ENTER]** key to continue.

i. The following screen will be displayed showing the Phase C cable connections for the selected test:

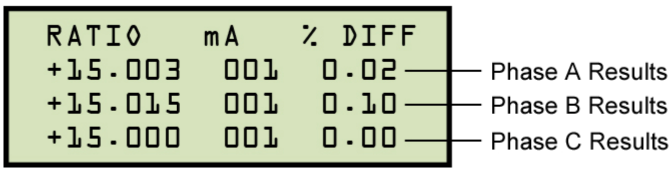
```
CABLE  PHS-C  XFMR
X1,X2   to    X3,X0
H1,H2   to    H3,H2
"START" TO RUN TEST
```

Make the cable connections per the instructions and then press the [START] key to run the Phase C test.

j. The following screen will be displayed while the test is being performed:

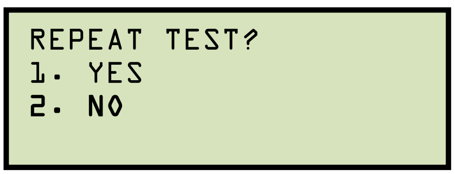


The Phase A, B, and C test results will be displayed on the LCD screen when testing has finished:



Press any key to continue.

k. The following screen will be displayed:



Press the **[2]** key (*NO*). You will be returned to the "START-UP" menu.

3.5.3. Performing a Quick Test

The ATRT provides a Quick Test mode that can be used to measure a transformer's turns ratio by only pressing a single button. To initiate a Quick Test:

a. Start from the "START-UP" menu:

```
1.TEST XFMR 06/02/10
2.SETUP     15:33:10
3.CALCULATOR
```

Press and hold down the **[START]** key.

b. The following screen will be displayed:

```
    "QUICK TEST"

HOLD START KEY UNTIL
BEEP FOR QUICK TEST
```

Continue to hold down the **[START]** key until the unit beeps again, and then release the **[START]** key.

c. The following screen will be displayed while the test is being performed:

```
SINGLE PHASE XFORMER

    PLEASE WAIT
  TEST IN PROGRESS
```

The test results will be displayed on the LCD screen when testing has finished:

```
 RATIO   mA
 +1.003  0002
```

Press the **[STOP]** key to return to the "START-UP" menu.

3.5.4. Performing a Single Phase Transformer Test Using Preset Voltage Table

The ATRT is pre-programmed with 46 transformer name plate voltages. These pre-programmed values can be used to quickly test a single phase transformer's turns ratio and compare the test results against the name plate voltage. Please see Table 8 for a list of the pre-programmed name plate voltages. Follow the steps below to perform a single phase transformer test using a pre-programmed name plate voltage:

a. Start from the "START-UP" menu:

```
1.TEST XFMR 06/02/10
2.SETUP     15:33:10
3.CALCULATOR
```

Press the **[CLEAR]** key.

b. The following screen will be displayed:

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

Press either the **[∧ Contrast]** key or the **[∨ Contrast]** key to scroll through the pre-programmed name plate voltage values.

Continue to press the **[∧ Contrast]** key or the **[∨ Contrast]** key until the desired name plate voltage values are displayed on the screen.

Press the **[START]** key when the desired name plate voltage values are displayed.

c. The following screen will be displayed while the test is being performed:

```
SINGLE PHASE XFORMER

    PLEASE WAIT
  TEST IN PROGRESS
```

The test results will be displayed on the LCD screen when testing has finished (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.

Please see Figure 11 below for a description of the test results elements.

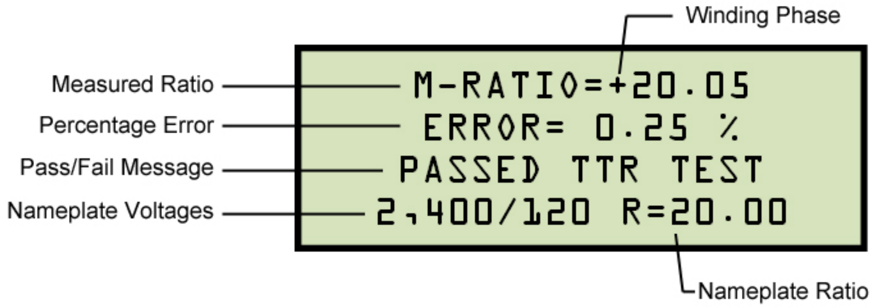


Figure 11. Test Results Elements

NOTE

In order for a test to pass, the error reading must be less than or equal to 0.5% and the winding must be in-phase (+).

Table 8. 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

APPENDIX A – TRANSFORMER VECTOR GROUP CODES

Utility power transformers manufactured in accordance with IEC specifications have a Rating Plate attached in a visible location. This plate contains a list of the transformer's configuration and operating specifications. One such rating is the winding configuration and phase-displacement code. This code follows a convention that comprises letter and number sets that denote three-phase winding configurations (i.e., Wye, delta, or zig-zag). Letter symbols for the different windings are noted in descending order of their rated voltages. That is, symbols denoting higher voltage ratings will be in upper-case letters and symbols denoting lower or intermediate voltage ratings will be in lower-case letters. If the neutral point of either a wye or zig-zag winding is brought out, the indication will be an N (high voltage) or n (lower voltage). The end numeral is a 300 multiplier that indicates phase lag between windings.

Accordingly, the following standard practice applies:

Wye (or star) = Y (high voltage) or y (low voltage)

Delta = D (high voltage) or d (low voltage)

Zig-zag = Z (high voltage) or z (low voltage)

For example, **Dyn11** decodes as follows:

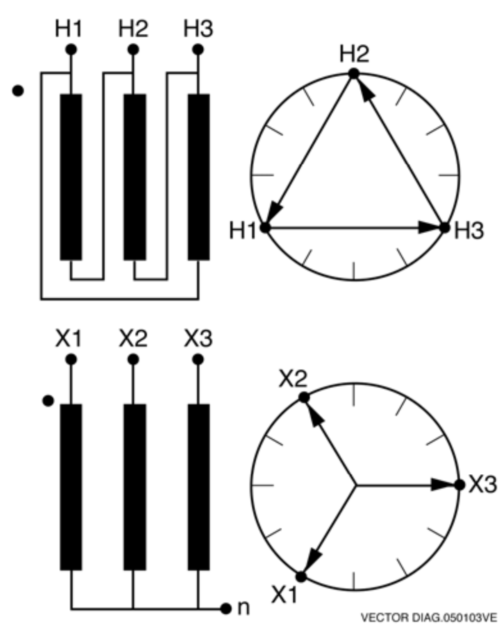
D indicates that the high-voltage windings are connected in a Delta configuration

(Since delta windings do not have a neutral point, the N never appears after a D).

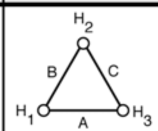
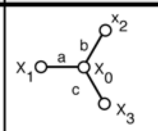
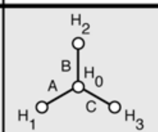
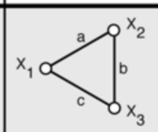
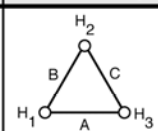
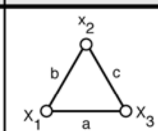
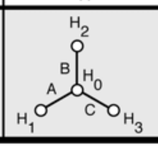
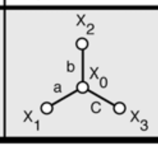
y indicates that the lower voltage winding is in a wye (or star) configuration.

n indicates that the lower voltage windings have the neutral point brought out.

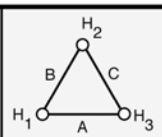
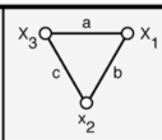
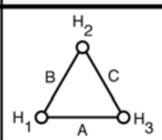
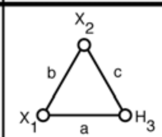
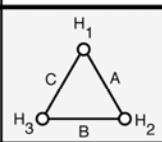
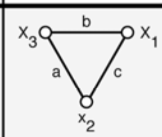
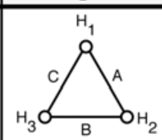
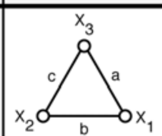
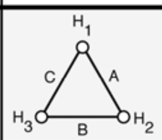
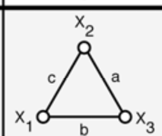
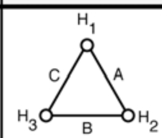
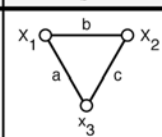
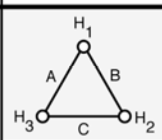
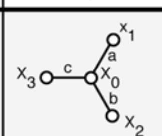
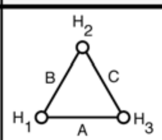
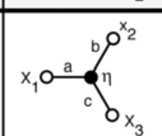
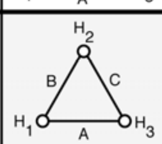
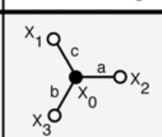
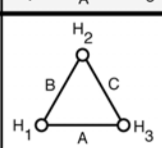
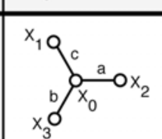
11 indicates a phase-displacement lag of 330 degrees between the Wye and the Delta winding.



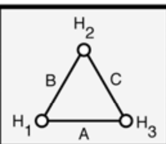
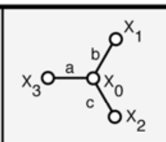
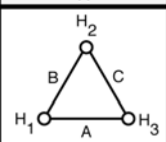
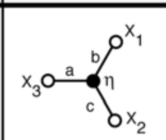
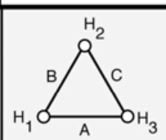
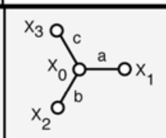
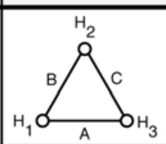
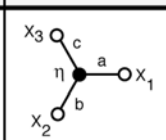
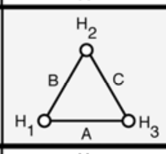
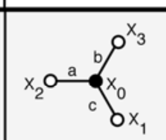
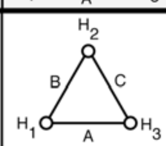
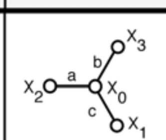
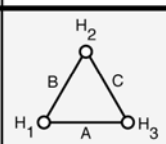
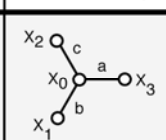
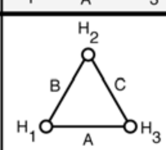
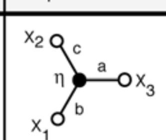
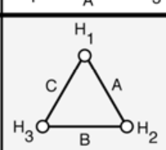
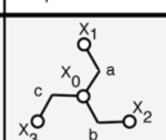
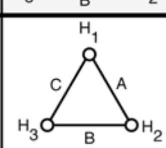
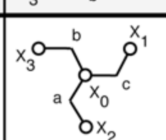
APPENDIX B – Common ANSI Transformer Descriptions

STD TEST NO.	TRANSFORMER CONFIGURATION: HIGH-VOLTAGE WINDING (H)	TRANSFORMER CONFIGURATION: LOW-VOLTAGE WINDING (X)	PHASE	WINDING TESTED: HIGH VOLTAGE WINDING	WINDING TESTED: LOW VOLTAGE WINDING	TURNS RATIO	VECTOR GROUP	NOTES
1			1 Ø	$H_1 - H_2$	$X_1 - X_2$	$\frac{V_H}{V_x}$	1ph0	SNG – PHS
2			A	$H_1 - H_3$	$X_1 - X_0$	$\frac{V_H \cdot \sqrt{3}}{V_x}$	Dyn1	d t – Y
			B	$H_2 - H_1$	$X_2 - X_0$			
			C	$H_3 - H_2$	$X_3 - X_0$			
3			A	$H_1 - H_0$	$X_1 - X_2$	$\frac{V_H}{V_x \cdot \sqrt{3}}$	YNd1	y – d t
			B	$H_2 - H_0$	$X_2 - X_3$			
			C	$H_3 - H_0$	$X_3 - X_1$			
4			A	$H_1 - H_3$	$X_1 - X_3$	$\frac{V_H}{V_x}$	Dd0	d t – d t
			B	$H_2 - H_1$	$X_2 - X_1$			
			C	$H_3 - H_2$	$X_3 - X_2$			
5			A	$H_1 - H_0$	$X_1 - X_0$	$\frac{V_H}{V_x}$	YNyn0	y – y
			B	$H_2 - H_0$	$X_2 - X_0$			
			C	$H_3 - H_0$	$X_3 - X_0$			

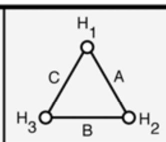
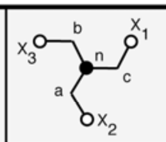
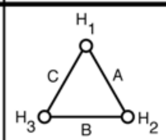
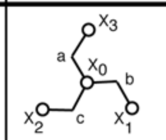
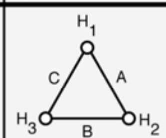
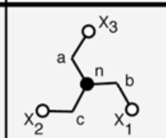
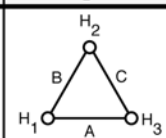
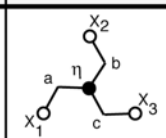
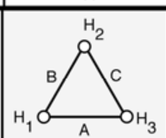
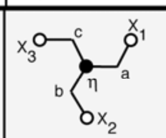
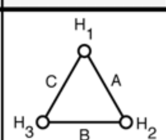
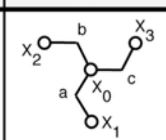
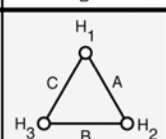
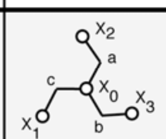
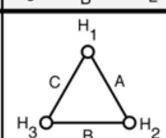
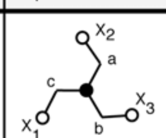
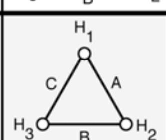
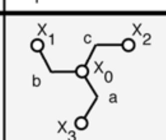
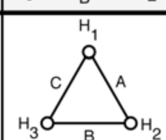
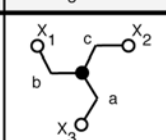
VANGUARD.050207V1

SPEC TEST NO.	TRANSFORMER CONFIGURATION: HIGH-VOLTAGE WINDING (H)	TRANSFORMER CONFIGURATION: LOW-VOLTAGE WINDING (X)	EXT. JUMPER	PHASE	WINDING TESTED: HIGH VOLTAGE WINDING	WINDING TESTED: LOW VOLTAGE WINDING	CAL. TURN RATIO	VECTOR GROUP	NOTES
1			—	A	$H_1 - H_3$	$X_3 - X_1$	$\frac{V_H}{V_x}$	Dd6	
				B	$H_2 - H_1$	$X_1 - X_2$			
				C	$H_3 - H_2$	$X_2 - X_3$			
37			—	A	$H_1 - H_3$	$X_1 - X_3$	$\frac{V_H}{V_x}$	Dd0	
				B	$H_2 - H_1$	$X_2 - X_1$			
				C	$H_3 - H_2$	$X_3 - X_2$			
38			—	A	$H_1 - H_2$	$X_3 - X_2$	$\frac{V_H}{V_x}$	Dd2	
				B	$H_2 - H_3$	$X_1 - X_3$			
				C	$H_3 - H_1$	$X_2 - X_1$			
39			—	A	$H_1 - H_2$	$X_3 - X_1$	$\frac{V_H}{V_x}$	Dd4	
				B	$H_2 - H_3$	$X_1 - X_2$			
				C	$H_3 - H_1$	$X_2 - X_3$			
40			—	A	$H_1 - H_2$	$X_2 - X_3$	$\frac{V_H}{V_x}$	Dd8	
				B	$H_2 - H_3$	$X_3 - X_1$			
				C	$H_3 - H_1$	$X_1 - X_2$			
41			—	A	$H_1 - H_2$	$X_1 - X_3$	$\frac{V_H}{V_x}$	Dd10	
				B	$H_2 - H_3$	$X_2 - X_1$			
				C	$H_3 - H_1$	$X_3 - X_2$			
42			—	A	$H_1 - H_3$	$X_1 - X_0$	$\frac{V_H \cdot \sqrt{3}}{V_x}$	Dyn1	
				B	$H_2 - H_1$	$X_2 - X_0$			
				C	$H_3 - H_2$	$X_3 - X_0$			
2			$H_3 - H_2$	A	$H_1 - H_3$	$X_1 - X_3$	$\frac{V_H \cdot \sqrt{3}}{V_x}$	Dy1	NO ACCESSIBLE NEUTRAL ON WYE WINDING
			$H_1 - H_3$	B	$H_2 - H_1$	$X_2 - X_1$			
			$H_2 - H_1$	C	$H_3 - H_2$	$X_3 - X_2$			
61			$H_3 - H_2$	A	$H_1 - H_3$	$X_1 - X_2$	$\frac{V_H \cdot \sqrt{3}}{V_x}$	Dy3	NO ACCESSIBLE NEUTRAL ON WYE WINDING
			$H_1 - H_3$	B	$H_2 - H_1$	$X_2 - X_3$			
			$H_2 - H_1$	C	$H_3 - H_2$	$X_3 - X_1$			
62			—	A	$H_1 - H_3$	$X_0 - X_2$	$\frac{V_H \cdot \sqrt{3}}{V_x}$	Dyn3	
				B	$H_2 - H_1$	$X_0 - X_3$			
				C	$H_3 - H_2$	$X_0 - X_1$			

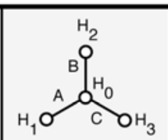
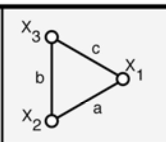
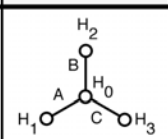
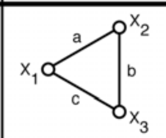
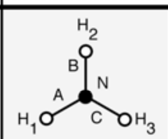
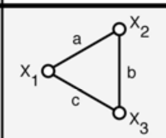
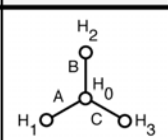
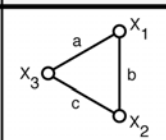
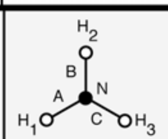
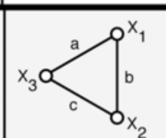
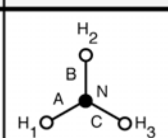
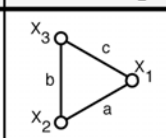
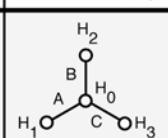
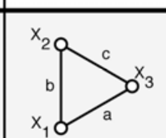
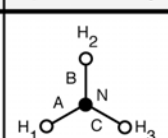
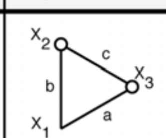
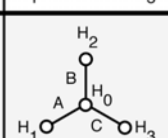
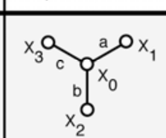
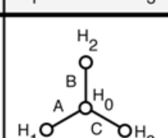
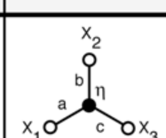
VANGUARD.050108V1

SPEC TEST NO.	TRANSFORMER CONFIGURATION: HIGH-VOLTAGE WINDING (H)	TRANSFORMER CONFIGURATION: LOW-VOLTAGE WINDING (X)	EXT. JUMPER	PHASE	WINDING TESTED: HIGH VOLTAGE WINDING	WINDING TESTED: LOW VOLTAGE WINDING	CAL. TURN RATIO	VECTOR GROUP	NOTES
3			—	A	H_1-H_3	X_3-X_0	$\frac{V_H \cdot \sqrt{3}}{V_x}$	Dyn5	
				B	H_2-H_1	X_1-X_0			
				C	H_3-H_2	X_2-X_0			
4			H_3-H_2	A	H_1-H_3	X_3-X_2	$\frac{V_H \cdot \sqrt{3}}{V_x}$	Dy5	NO ACCESSIBLE NEUTRAL ON WYE WINDING
			H_1-H_3	B	H_2-H_1	X_1-X_3			
			H_2-H_1	C	H_3-H_2	X_2-X_1			
5			—	A	H_1-H_3	X_0-X_1	$\frac{V_H \cdot \sqrt{3}}{V_x}$	Dyn7	
				B	H_2-H_1	X_0-X_2			
				C	H_3-H_2	X_0-X_3			
6			H_3-H_2	A	H_1-H_3	X_3-X_1	$\frac{V_H \cdot \sqrt{3}}{V_x}$	Dy7	NO ACCESSIBLE NEUTRAL ON WYE WINDING
			H_1-H_3	B	H_2-H_1	X_1-X_2			
			H_2-H_1	C	H_3-H_2	X_2-X_3			
63			H_3-H_2	A	H_1-H_3	X_2-X_1	$\frac{V_H \cdot \sqrt{3}}{V_x}$	Dy9	NO ACCESSIBLE NEUTRAL ON WYE WINDING
			H_1-H_3	B	H_2-H_1	X_3-X_2			
			H_2-H_1	C	H_3-H_2	X_1-X_3			
64			—	A	H_1-H_3	X_2-X_0	$\frac{V_H \cdot \sqrt{3}}{V_x}$	Dyn9	
				B	H_2-H_1	X_3-X_0			
				C	H_3-H_2	X_1-X_0			
7			—	A	H_1-H_3	X_0-X_3	$\frac{V_H \cdot \sqrt{3}}{V_x}$	Dyn11	
				B	H_2-H_1	X_0-X_1			
				C	H_3-H_2	X_0-X_2			
8			H_3-H_2	A	H_1-H_3	X_2-X_3	$\frac{V_H \cdot \sqrt{3}}{V_x}$	Dy11	NO ACCESSIBLE NEUTRAL ON WYE WINDING
			H_1-H_3	B	H_2-H_1	X_3-X_1			
			H_2-H_1	C	H_3-H_2	X_1-X_2			
45			H_2-H_3	A	H_1-H_2	X_1-X_0	$\frac{3}{2} \cdot \frac{V_H}{V_x}$	Dzn0	
			H_3-H_1	B	H_2-H_3	X_2-X_0			
			H_1-H_2	C	H_3-H_1	X_3-X_0			
46			H_2-H_3	A	H_1-H_2	X_0-X_2	$\frac{3}{2} \cdot \frac{V_H}{V_x}$	Dzn2	
			H_3-H_1	B	H_2-H_3	X_0-X_3			
			H_1-H_2	C	H_3-H_1	X_0-X_1			

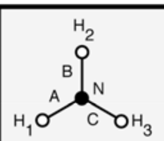
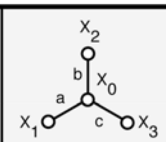
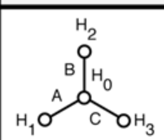
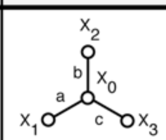
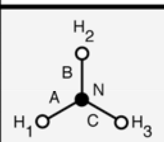
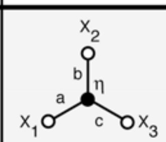
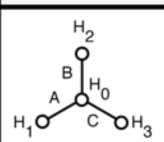
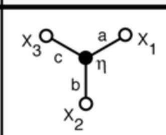
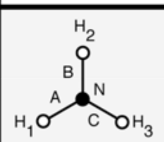
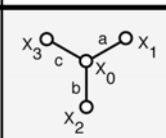
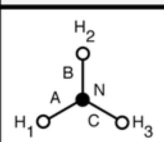
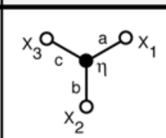
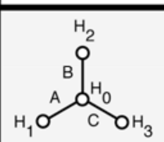
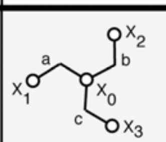
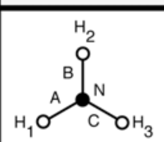
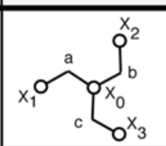
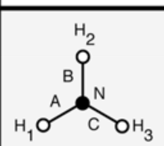
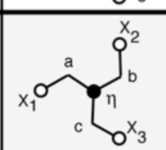
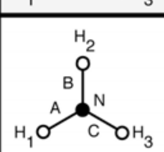
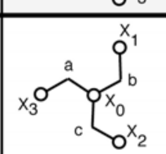
VANGUARD.050108V2

SPEC TEST NO.	TRANSFORMER CONFIGURATION HIGH-VOLTAGE WINDING (H)	TRANSFORMER CONFIGURATION LOW-VOLTAGE WINDING (X)	EXT. JUMPER	PHASE	WINDING TESTED HIGH VOLTAGE WINDING	WINDING TESTED LOW VOLTAGE WINDING	CAL. TURN RATIO	VECTOR GROUP	NOTES
47			—	A	H_1-H_2	X_3-X_2	$\frac{V_H}{V_x}$	Dz2	NO ACCESSIBLE NEUTRAL
				B	H_2-H_3	X_1-X_3			
				C	H_3-H_1	X_2-X_1			
48			H_2-H_3	A	H_1-H_2	X_3-X_0	$\frac{3}{2}\cdot\frac{V_H}{V_x}$	Dzn4	
			H_3-H_1	B	H_2-H_3	X_1-X_0			
			H_1-H_2	C	H_3-H_1	X_2-X_0			
49			—	A	H_1-H_2	X_3-X_1	$\frac{V_H}{V_x}$	Dz4	NO ACCESSIBLE NEUTRAL
				B	H_2-H_3	X_1-X_2			
				C	H_3-H_1	X_2-X_3			
9			—	A	H_1-H_3	X_1-X_3	$\frac{V_H}{V_x}$	Dz0	NO ACCESSIBLE NEUTRAL
				B	H_2-H_1	X_2-X_1			
				C	H_3-H_2	X_3-X_2			
10			—	A	H_1-H_3	X_3-X_1	$\frac{V_H}{V_x}$	Dz6	NO ACCESSIBLE NEUTRAL
				B	H_2-H_1	X_1-X_2			
				C	H_3-H_2	X_2-X_3			
50			H_2-H_3	A	H_1-H_2	X_0-X_1	$\frac{3}{2}\cdot\frac{V_H}{V_x}$	Dzn6	
			H_3-H_1	B	H_2-H_3	X_0-X_2			
			H_1-H_2	C	H_3-H_1	X_0-X_3			
51			H_2-H_3	A	H_1-H_2	X_2-X_0	$\frac{3}{2}\cdot\frac{V_H}{V_x}$	Dzn8	
			H_3-H_1	B	H_2-H_3	X_3-X_0			
			H_1-H_2	C	H_3-H_1	X_1-X_0			
52			—	A	H_1-H_2	X_2-X_3	$\frac{V_H}{V_x}$	Dz8	NO ACCESSIBLE NEUTRAL
				B	H_2-H_3	X_3-X_1			
				C	H_3-H_1	X_1-X_2			
53			H_2-H_3	A	H_1-H_2	X_0-X_3	$\frac{3}{2}\cdot\frac{V_H}{V_x}$	Dzn10	
			H_3-H_1	B	H_2-H_3	X_0-X_1			
			H_1-H_2	C	H_3-H_1	X_0-X_2			
54			—	A	H_1-H_2	X_1-X_3	$\frac{V_H}{V_x}$	Dz10	NO ACCESSIBLE NEUTRAL
				B	H_2-H_3	X_2-X_1			
				C	H_3-H_1	X_3-X_2			

VANGUARD.050108V3

SPEC TEST NO.	TRANSFORMER CONFIGURATION: HIGH-VOLTAGE WINDING (H)	TRANSFORMER CONFIGURATION: LOW-VOLTAGE WINDING (X)	EXT. JUMPER	PHASE	WINDING TESTED: HIGH VOLTAGE WINDING	WINDING TESTED: LOW VOLTAGE WINDING	CAL. TURN RATIO	VECTOR GROUP	NOTES
11			—	A	$H_1 - H_0$	$X_2 - X_1$	$\frac{V_H}{V_X \cdot \sqrt{3}}$	YNd7	
				B	$H_2 - H_0$	$X_3 - X_2$			
				C	$H_3 - H_0$	$X_1 - X_3$			
44			—	A	$H_1 - H_0$	$X_1 - X_2$	$\frac{V_H}{V_X \cdot \sqrt{3}}$	YNd1	
				B	$H_2 - H_0$	$X_2 - X_3$			
				C	$H_3 - H_0$	$X_3 - X_1$			
12			$H_3 - H_2$	A	$H_1 - H_3$	$X_1 - X_2$	$\frac{V_H}{V_X} \cdot \frac{\sqrt{3}}{2}$	Yd1	NO ACCESSIBLE NEUTRAL ON WYE WINDING
			$H_1 - H_3$	B	$H_2 - H_1$	$X_2 - X_3$			
			$H_2 - H_1$	C	$H_3 - H_2$	$X_3 - X_1$			
13			—	A	$H_1 - H_0$	$X_3 - X_2$	$\frac{V_H}{V_X \cdot \sqrt{3}}$	YNd5	
				B	$H_2 - H_0$	$X_1 - X_2$			
				C	$H_3 - H_0$	$X_2 - X_3$			
14			$H_3 - H_2$	A	$H_1 - H_3$	$X_3 - X_1$	$\frac{V_H}{V_X} \cdot \frac{\sqrt{3}}{2}$	Yd5	NO ACCESSIBLE NEUTRAL ON WYE WINDING
			$H_1 - H_3$	B	$H_2 - H_1$	$X_1 - X_2$			
			$H_2 - H_1$	C	$H_3 - H_2$	$X_2 - X_3$			
15			$H_3 - H_2$	A	$H_1 - H_3$	$X_2 - X_1$	$\frac{V_H}{V_X} \cdot \frac{\sqrt{3}}{2}$	Yd7	NO ACCESSIBLE NEUTRAL ON WYE WINDING
			$H_1 - H_3$	B	$H_2 - H_1$	$X_3 - X_2$			
			$H_2 - H_1$	C	$H_3 - H_2$	$X_1 - X_3$			
16			—	A	$H_1 - H_0$	$X_1 - X_3$	$\frac{V_H}{V_X \cdot \sqrt{3}}$	YNd11	
				B	$H_2 - H_0$	$X_2 - X_1$			
				C	$H_3 - H_0$	$X_3 - X_2$			
17			$H_3 - H_2$	A	$H_1 - H_3$	$X_1 - X_3$	$\frac{V_H}{V_X} \cdot \frac{\sqrt{3}}{2}$	Yd11	NO ACCESSIBLE NEUTRAL ON WYE WINDING
			$H_1 - H_3$	B	$H_2 - H_1$	$X_2 - X_1$			
			$H_2 - H_1$	C	$H_3 - H_2$	$X_3 - X_2$			
18			—	A	$H_1 - H_0$	$X_0 - X_1$	$\frac{V_H}{V_X}$	YNyn6	
				B	$H_2 - H_0$	$X_0 - X_2$			
				C	$H_3 - H_0$	$X_0 - X_3$			
19			$H_2 - H_0$	A	$H_1 - H_0$	$X_1 - X_2$	$\frac{V_H}{V_X}$	YNy0	NO ACCESSIBLE NEUTRAL ON LOW VOLTAGE WINDING
			$H_3 - H_0$	B	$H_2 - H_0$	$X_2 - X_3$			
			$H_1 - H_0$	C	$H_3 - H_0$	$X_3 - X_1$			

VANGUARD.050108V4

SPEC TEST NO.	TRANSFORMER CONFIGURATION HIGH-VOLTAGE WINDING (H)	LOW-VOLTAGE WINDING (X)	EXT. JUMPER	PHASE	WINDING TESTED HIGH VOLTAGE WINDING	LOW VOLTAGE WINDING	CAL. TURN RATIO	VECTOR GROUP	NOTES
20			X_3-X_0	A	H_1-H_3	X_1-X_0	$\frac{V_H}{V_x}$	Yyn0	NO ACCESSIBLE NEUTRAL ON HIGH VOLTAGE WINDING
			X_1-X_0	B	H_2-H_1	X_2-X_0			
			X_2-X_0	C	H_3-H_2	X_3-X_0			
43			—	A	H_1-H_0	X_1-X_0	$\frac{V_H}{V_L}$	YNyn0	
				B	H_2-H_0	X_2-X_0			
				C	H_3-H_0	X_3-X_0			
21			—	A	H_1-H_3	X_1-X_3	$\frac{V_H}{V_x}$	Yy0	NO ACCESSIBLE NEUTRAL
				B	H_2-H_1	X_2-X_1			
				C	H_3-H_2	X_3-X_2			
22			H_2-H_0	A	H_1-H_0	X_2-X_1	$\frac{V_H}{V_x}$	YNy6	NO ACCESSIBLE NEUTRAL ON LOW VOLTAGE WINDING
			H_3-H_0	B	H_2-H_0	X_3-X_2			
			H_1-H_0	C	H_3-H_0	X_1-X_3			
23			X_3-X_0	A	H_1-H_3	X_0-X_1	$\frac{V_H}{V_x}$	Yyn6	NO ACCESSIBLE NEUTRAL ON HIGH VOLTAGE WINDING
			X_1-X_0	B	H_2-H_1	X_0-X_2			
			X_2-X_0	C	H_3-H_2	X_0-X_3			
24			—	A	H_1-H_3	X_3-X_1	$\frac{V_H}{V_x}$	Yy6	NO ACCESSIBLE NEUTRAL
				B	H_2-H_1	X_1-X_2			
				C	H_3-H_2	X_2-X_3			
65			—	A	H_1-H_3	X_1-X_0	$\frac{V_H \bullet \sqrt{3}}{V_x}$	YNzn1	
				B	H_2-H_1	X_2-X_0			
				C	H_3-H_2	X_3-X_0			
25			—	A	H_1-H_3	X_1-X_0	$\frac{V_H \bullet \sqrt{3}}{V_x}$	Yzn1	NO ACCESSIBLE NEUTRAL ON WYE WINDING
				B	H_2-H_1	X_2-X_0			
				C	H_3-H_2	X_3-X_0			
26			H_3-H_2	A	H_1-H_3	X_1-X_2	$\frac{V_H}{V_x} \bullet \frac{\sqrt{3}}{2}$	Yz1	NO ACCESSIBLE NEUTRAL
			H_1-H_3	B	H_2-H_1	X_2-X_3			
			H_2-H_1	C	H_3-H_2	X_3-X_1			
27			—	A	H_1-H_3	X_3-X_0	$\frac{V_H \bullet \sqrt{3}}{V_x}$	Yzn5	NO ACCESSIBLE NEUTRAL ON WYE WINDING
				B	H_2-H_1	X_1-X_0			
				C	H_3-H_2	X_2-X_0			

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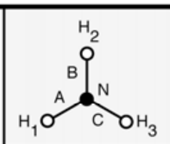
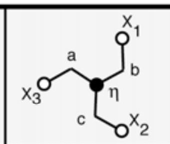
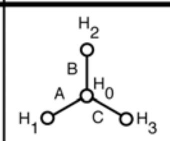
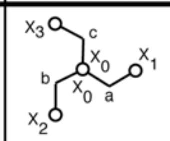
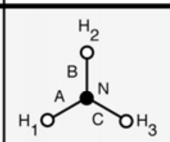
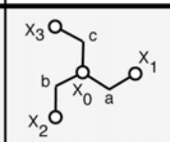
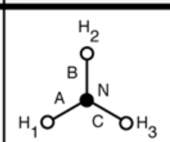
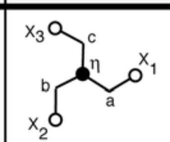
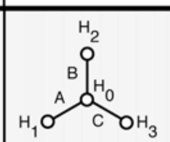
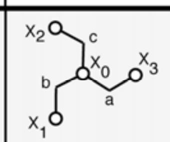
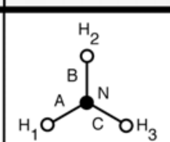
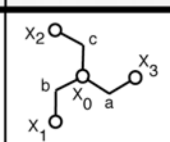
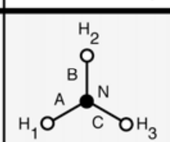
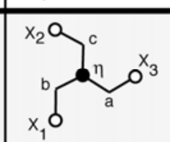
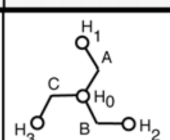
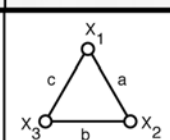
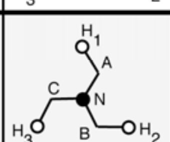
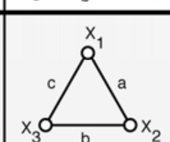
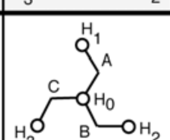
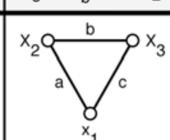
SPEC TEST NO.	TRANSFORMER CONFIGURATION HIGH-VOLTAGE WINDING (H)	TRANSFORMER CONFIGURATION LOW-VOLTAGE WINDING (X)	EXT. JUMPER	PHASE	WINDING TESTED HIGH VOLTAGE WINDING	WINDING TESTED LOW VOLTAGE WINDING	CAL. TURN RATIO	VECTOR GROUP	NOTES
28			H_3-H_2	A	H_1-H_3	X_3-X_1	$\frac{V_H}{V_X}\cdot\frac{\sqrt{3}}{2}$	Yz5	NO ACCESSIBLE NEUTRAL
			H_1-H_3	B	H_2-H_1	X_1-X_2			
			H_2-H_1	C	H_3-H_2	X_2-X_3			
66			—	A	H_1-H_3	X_0-X_1	$\frac{V_H}{V_X}\cdot\sqrt{3}$	YNzn7	
				B	H_2-H_1	X_0-X_2			
				C	H_3-H_2	X_0-X_3			
29			—	A	H_1-H_3	X_0-X_1	$\frac{V_H\cdot\sqrt{3}}{V_X}$	Yzn7	NO ACCESSIBLE NEUTRAL ON WYE WINDING
				B	H_2-H_1	X_0-X_2			
				C	H_3-H_2	X_0-X_3			
30			H_3-H_2	A	H_1-H_3	X_2-X_1	$\frac{V_H}{V_X}\cdot\frac{\sqrt{3}}{2}$	Yz7	NO ACCESSIBLE NEUTRAL
			H_1-H_3	B	H_2-H_1	X_3-X_2			
			H_2-H_1	C	H_3-H_2	X_1-X_3			
67			—	A	H_1-H_3	X_0-X_3	$\frac{V_H\cdot\sqrt{3}}{V_X}$	YNzn11	
				B	H_2-H_1	X_0-X_1			
				C	H_3-H_2	X_0-X_2			
31			—	A	H_1-H_3	X_0-X_3	$\frac{V_H\cdot\sqrt{3}}{V_X}$	Yzn11	NO ACCESSIBLE NEUTRAL ON WYE WINDING
				B	H_2-H_1	X_0-X_1			
				C	H_3-H_2	X_0-X_2			
32			H_3-H_2	A	H_1-H_3	X_1-X_3	$\frac{V_H}{V_X}\cdot\frac{\sqrt{3}}{2}$	Yz11	NO ACCESSIBLE NEUTRAL
			H_1-H_3	B	H_2-H_1	X_2-X_1			
			H_2-H_1	C	H_3-H_2	X_3-X_2			
55			X_2-X_3	A	H_1-H_0	X_1-X_2	$\frac{2}{3}\cdot\frac{V_H}{V_X}$	ZNd0	
			X_3-X_1	B	H_2-H_0	X_2-X_3			
			X_1-X_2	C	H_3-H_0	X_3-X_1			
56			—	A	H_1-H_2	X_1-X_2	$\frac{V_H}{V_X}$	Zd0	NO ACCESSIBLE NEUTRAL ON HIGH VOLTAGE
				B	H_2-H_3	X_2-X_3			
				C	H_3-H_1	X_3-X_1			
57			X_2-X_3	A	H_1-H_0	X_2-X_1	$\frac{2}{3}\cdot\frac{V_H}{V_X}$	ZNd6	
			X_3-X_1	B	H_2-H_0	X_3-X_2			
			X_1-X_2	C	H_3-H_0	X_1-X_3			

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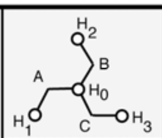
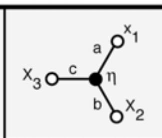
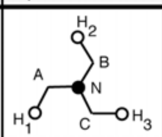
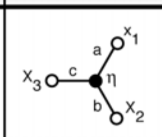
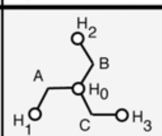
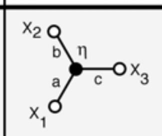
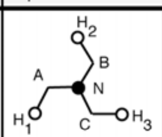
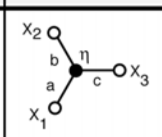
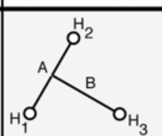
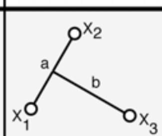
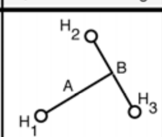
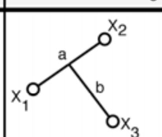
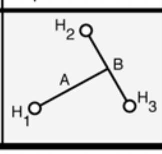
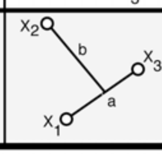
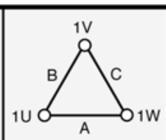
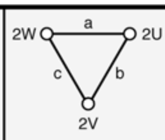
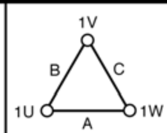
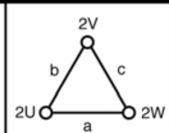
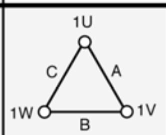
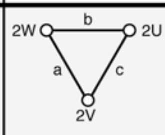
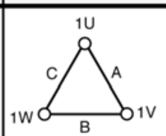
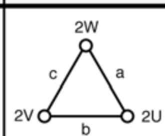
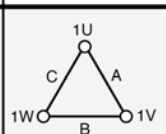
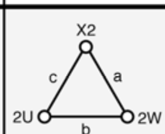
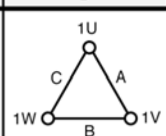
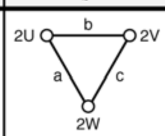
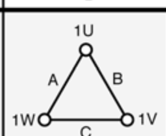
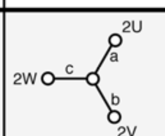
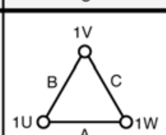
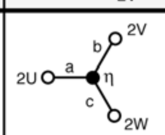
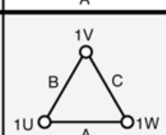
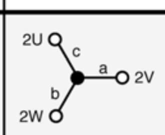
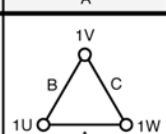
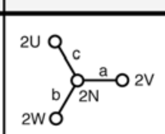
SPEC TEST NO.	TRANSFORMER CONFIGURATION: HIGH-VOLTAGE WINDING (H)	TRANSFORMER CONFIGURATION: LOW-VOLTAGE WINDING (X)	EXT. JUMPER	PHASE	WINDING TESTED: HIGH VOLTAGE WINDING	WINDING TESTED: LOW VOLTAGE WINDING	CAL. TURN RATIO	VECTOR GROUP	NOTES
33			—	A	$H_1 - H_0$	$X_3 - X_1$	$\frac{V_H}{V_x \cdot \sqrt{3}}$	ZNy5	NO ACCESSIBLE NEUTRAL ON WYE WINDING
				B	$H_2 - H_0$	$X_1 - X_2$			
				C	$H_3 - H_0$	$X_2 - X_3$			
34			$H_3 - H_2$	A	$H_1 - H_3$	$X_3 - X_1$	$\frac{V_H}{V_x} \cdot \frac{\sqrt{3}}{2}$	Zy5	NO ACCESSIBLE NEUTRAL
			$H_1 - H_3$	B	$H_2 - H_1$	$X_1 - X_2$			
			$H_2 - H_1$	C	$H_3 - H_2$	$X_2 - X_3$			
35			—	A	$H_1 - H_0$	$X_1 - X_3$	$\frac{V_H}{V_x \cdot \sqrt{3}}$	ZNy11	NO ACCESSIBLE NEUTRAL ON WYE WINDING
				B	$H_2 - H_0$	$X_2 - X_1$			
				C	$H_3 - H_0$	$X_3 - X_2$			
36			$H_3 - H_2$	A	$H_1 - H_3$	$X_1 - X_3$	$\frac{V_H}{V_x} \cdot \frac{\sqrt{3}}{2}$	Zy11	NO ACCESSIBLE NEUTRAL
			$H_1 - H_3$	B	$H_2 - H_1$	$X_2 - X_1$			
			$H_2 - H_1$	C	$H_3 - H_2$	$X_3 - X_2$			
58				A	$H_1 - H_2$	$X_1 - X_2$	$\frac{V_H}{V_x}$	T-T 0	
			$H_1 - H_2$ $X_1 - X_2$	B	$H_1 - H_3$	$X_1 - X_3$			
59			$H_2 - H_3$	A	$H_1 - H_3$	$X_1 - X_2$	$\frac{V_H}{V_x} \cdot \frac{\sqrt{3}}{2}$	T-T 30 Lag	
			$X_1 - X_2$	B	$H_2 - H_3$	$X_1 - X_3$	$\frac{V_H}{V_x} \cdot \frac{2}{\sqrt{3}}$		
60			$H_2 - H_3$	A	$H_1 - H_3$	$X_1 - X_3$	$\frac{V_H}{V_x} \cdot \frac{\sqrt{3}}{2}$	T-T 30 Lead	
			$X_1 - X_3$	B	$H_2 - H_3$	$X_2 - X_1$	$\frac{V_x}{V_H} \cdot \frac{2}{\sqrt{3}}$		

VANGUARD.050108V7

APPENDIX C – CEI/IEC 60076-1 Transformer Descriptions

SPEC TEST NO.	TRANSFORMER CONFIGURATION: HIGH-VOLTAGE WINDING (H)	TRANSFORMER CONFIGURATION: LOW-VOLTAGE WINDING (X)	EXT. JUMPER	PHASE	WINDING TESTED: HIGH VOLTAGE WINDING	WINDING TESTED: LOW VOLTAGE WINDING	CAL. TURN RATIO	VECTOR GROUP	NOTES
1			—	A	1U – 1W	2W – 2U	$\frac{U1}{U2}$	Dd6	
				B	1V – 1U	2U – 2V			
				C	1W – 1V	2V – 2W			
37			—	A	1U – 1W	2U – 2W	$\frac{U1}{U2}$	Dd0	
				B	1V – 1U	2V – 2U			
				C	1W – 1V	2W – 2V			
38			—	A	1U – 1V	2W – 2V	$\frac{U1}{U2}$	Dd2	
				B	1V – 1W	2U – 2W			
				C	1W – 1U	2V – 2U			
39			—	A	1U – 1W	2W – 2U	$\frac{U1}{U2}$	Dd4	
				B	1V – 1U	2U – 2V			
				C	1W – 1U	2V – 2W			
40			—	A	1U – 1V	2V – 2W	$\frac{U1}{U2}$	Dd8	
				B	1V – 1W	2W – 2U			
				C	1W – 1U	2U – 2V			
41			—	A	1U – 1V	2U – 2W	$\frac{U1}{U2}$	Dd10	
				B	1V – 1W	2V – 2U			
				C	1W – 1U	2W – 2V			
42			—	A	1U – 1W	2U – 2N	$\frac{U1 \cdot \sqrt{3}}{U2}$	Dyn1	
				B	1V – 1U	2V – 2N			
				C	1W – 1V	2W – 2N			
2			1W – 1V	A	1U – 1W	2U – 2V	$\frac{U1 \cdot \sqrt{3}}{U2}$	Dy1	NO ACCESSIBLE NEUTRAL ON WYE WINDING
			1U – 1W	B	1V – 1U	2V – 2W			
			1V – 1U	C	1W – 1V	2W – 2U			
61			1W – 1V	A	1U – 1W	2U – 2V	$\frac{\sqrt{U1} \cdot \sqrt{3}}{U2}$	Dy3	NO ACCESSIBLE NEUTRAL ON WYE WINDING
			1U – 1W	B	1V – 1U	2V – 2W			
			1V – 1U	C	1W – 1V	2W – 2U			
62			—	A	1U – 1W	2N – 2V	$\frac{U1 \cdot \sqrt{3}}{U2}$	Dyn3	
				B	1V – 1U	2N – 2W			
				C	1W – 1V	2N – 2U			

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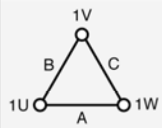
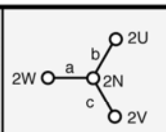
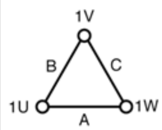
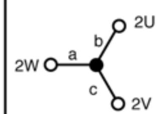
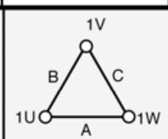
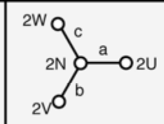
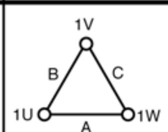
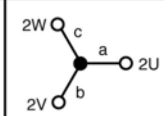
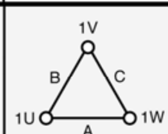
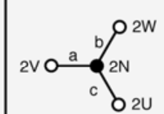
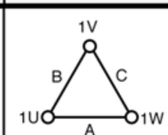
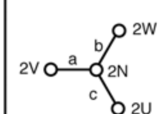
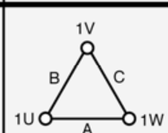
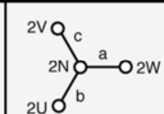
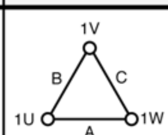
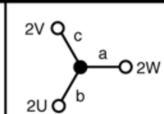
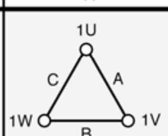
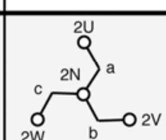
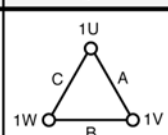
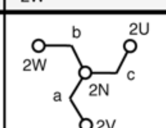
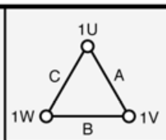
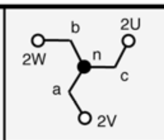
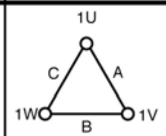
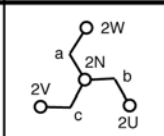
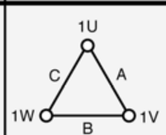
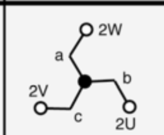
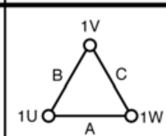
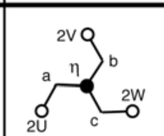
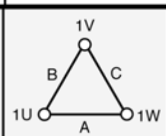
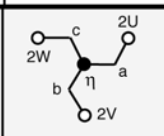
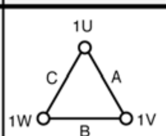
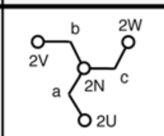
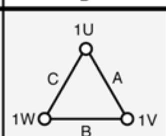
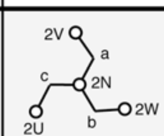
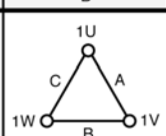
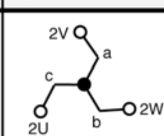
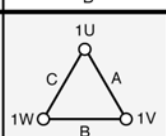
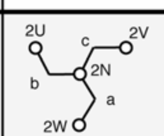
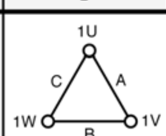
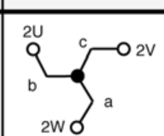
SPEC TEST NO.	TRANSFORMER CONFIGURATION: HIGH-VOLTAGE WINDING (H)	TRANSFORMER CONFIGURATION: LOW-VOLTAGE WINDING (X)	EXT. JUMPER	PHASE	WINDING TESTED: HIGH VOLTAGE WINDING	WINDING TESTED: LOW VOLTAGE WINDING	CAL. TURN RATIO	VECTOR GROUP	NOTES
3			—	A	1U– 1W	2W – 2N	$\frac{U1 \cdot \sqrt{3}}{U2}$	Dyn5	
				B	1V – 1U	2U – 2N			
				C	1W – 1V	2V – 2N			
4			1W – 1V	A	1U– 1W	2W – 2V	$\frac{U1 \cdot \sqrt{3}}{U2}$	Dy5	NO ACCESSIBLE NEUTRAL ON WYE WINDING
			1U – 1W	B	1V – 1U	2U – 2W			
			1V – 1U	C	1W – 1V	2V – 2U			
5			—	A	1U – 1W	2N – 2U	$\frac{U1 \cdot \sqrt{3}}{U2}$	Dyn7	
				B	1V – 1U	2N –2V			
				C	1W – 1V	2N– 2W			
6			1W –1V	A	1U – 1W	2W – 2U	$\frac{U1 \cdot \sqrt{3}}{U2}$	Dy7	NO ACCESSIBLE NEUTRAL ON WYE WINDING
			1U–1W	B	1V – 1U	2U – 2V			
			1V–1U	C	1W – 1V	2V – 2W			
63			1W –1V	A	1U– 1W	2V – 2U	$\frac{U1 \cdot \sqrt{3}}{U2}$	Dy9	NO ACCESSIBLE NEUTRAL ON WYE WINDING
			1U–1W	B	1V – 1U	2W – 2V			
			1V–1U	C	1W – 1V	2U – 2W			
64			—	A	1U– 1W	2V – 2N	$\frac{U1 \cdot \sqrt{3}}{U2}$	Dyn9	
				B	1V – 1U	2W – 2N			
				C	1W – 1V	2U – 2N			
7			—	A	1U – 1W	2N – 2W	$\frac{U1 \cdot \sqrt{3}}{U2}$	Dyn11	
				B	1V – 1U	2N– 2U			
				C	1W – 1V	2N – 2V			
8			1W– 1V	A	1U – 1W	2V – 2W	$\frac{U1 \cdot \sqrt{3}}{U2}$	Dy11	NO ACCESSIBLE NEUTRAL ON WYE WINDING
			1U –1W	B	1V – 1U	2W – 2U			
			1V–1U	C	1W – 1V	2U – 2V			
45			1V –1W	A	1U – 1V	2U – 2N	$\frac{3}{2} \cdot \frac{U1}{U2}$	Dzn0	
			1W– 1U	B	1V – 1W	2V – 2N			
			1U –1V	C	1W – 1U	2W – 2N			
46			1V –1W	A	1U– 1V	2N – 2V	$\frac{3}{2} \cdot \frac{U1}{U2}$	Dzn2	
			1W –1U	B	1V – 1W	2N – 2W			
			1U–1V	C	1W – 1U	2N – 2U			

CEI/IEC.050108C2

SPEC TEST NO.	TRANSFORMER CONFIGURATION HIGH-VOLTAGE WINDING (H)	TRANSFORMER CONFIGURATION LOW-VOLTAGE WINDING (X)	EXT. JUMPER	PHASE	WINDING TESTED HIGH VOLTAGE WINDING	WINDING TESTED LOW VOLTAGE WINDING	CAL. TURN RATIO	VECTOR GROUP	NOTES
47			—	A	1U – 1V	2W – 2V	U1/U2	Dz2	NO ACCESSIBLE NEUTRAL
				B	1V – 1W	2U – 2W			
				C	1W – 1U	2V – 2U			
48			1V – 1W	A	1U – 1V	2W – 2N	3/2 • U1/U2	Dzn4	
			1W – 1U	B	1V – 1W	2U – 2N			
			1U – 1V	C	1W – 1U	2V – 2N			
49			—	A	1U – 1V	2W – 2U	U1/U2	Dz4	NO ACCESSIBLE NEUTRAL
				B	1V – 1W	2U – 2V			
				C	1W – 1U	2V – 2W			
9			—	A	1U – 1W	2U – 2W	U1/U2	Dz0	NO ACCESSIBLE NEUTRAL
				B	1V – 1U	2V – 2U			
				C	1W – 1V	2W – 2V			
10			—	A	1U – 1W	2W – 2U	U1/U2	Dz6	NO ACCESSIBLE NEUTRAL
				B	1V – 1U	2U – 2V			
				C	1W – 1V	2V – 2W			
50			1V – 1W	A	1U – 1V	2N – 2U	3/2 • U1/U2	Dzn6	
			1W – 1 U	B	1V – 1W	2N – 2V			
			1U – 1V	C	1W – 1U	2N – 2W			
51			1V – 1W	A	1U – 1V	2V – 2N	3/2 • U1/U2	Dzn8	
			1W – 1U	B	1V – 1W	2W – 2N			
			1U – 1V	C	1W – 1U	2U – 2N			
52			—	A	1U– 1V	2V – 2W	U1/U2	Dz8	NO ACCESSIBLE NEUTRAL
				B	1V – 1W	2W – 2U			
				C	1W – 1U	2U – 2V			
53			1V – 1W	A	1U – 1V	2N – 2W	3/2 • U1/U2	Dzn10	
			1W – 1U	B	1V – 1W	2N – 2U			
			1U – 1V	C	1W – 1U	2N – 2V			
54			—	A	1U – 1V	2U – 2W	U1/U2	Dz10	NO ACCESSIBLE NEUTRAL
				B	1V – 1W	2V– 2U			
				C	1W –1U	2W – 2V			

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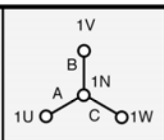
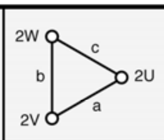
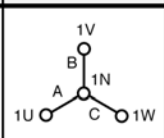
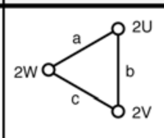
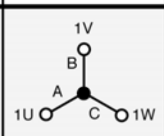
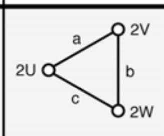
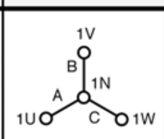
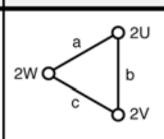
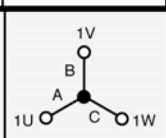
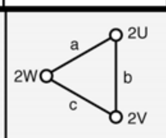
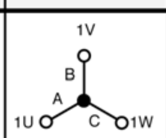
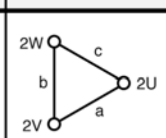
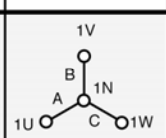
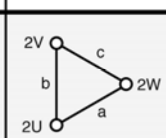
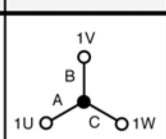
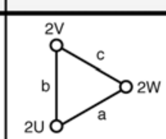
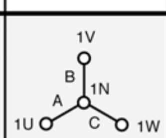
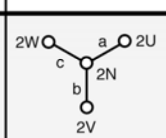
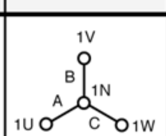
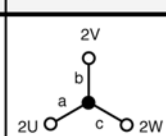
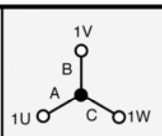
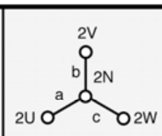
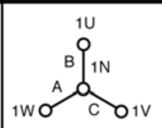
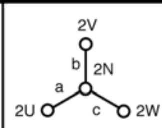
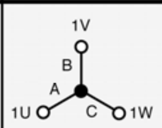
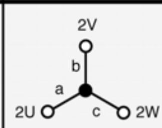
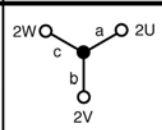
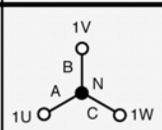
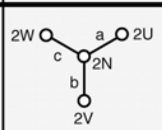
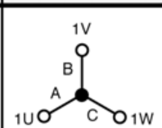
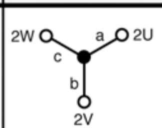
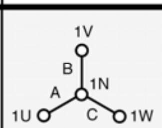
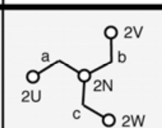
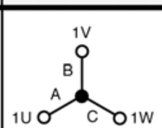
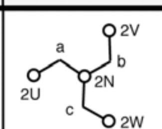
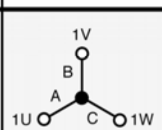
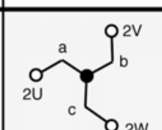
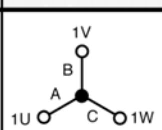
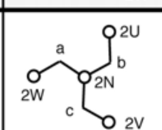
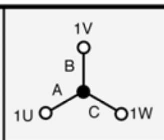
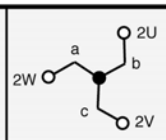
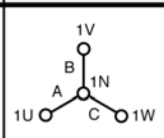
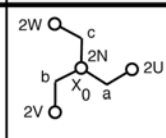
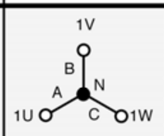
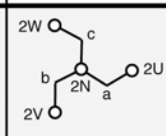
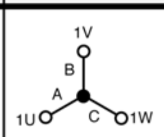
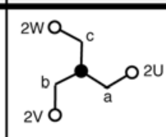
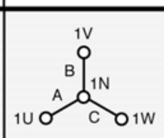
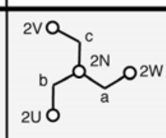
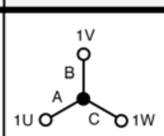
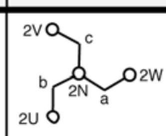
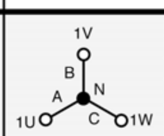
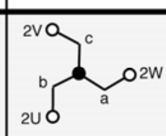
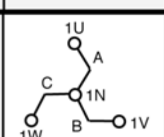
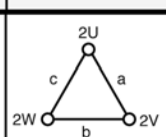
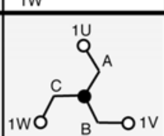
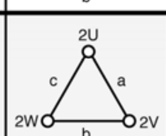
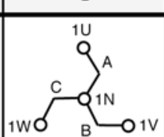
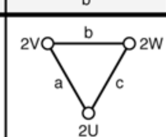
SPEC TEST NO.	TRANSFORMER CONFIGURATION: HIGH-VOLTAGE WINDING (H)	TRANSFORMER CONFIGURATION: LOW-VOLTAGE WINDING (X)	EXT. JUMPER	PHASE	WINDING TESTED: HIGH VOLTAGE WINDING	WINDING TESTED: LOW VOLTAGE WINDING	CAL. TURN RATIO	VECTOR GROUP	NOTES
11			—	A	1U – 1N	2V – 2U	$\frac{U1}{U2 \cdot \sqrt{3}}$	YNd7	
				B	1V – 1N	2W – 2V			
				C	1W – 1N	2U – 2W			
44			—	A	1U – 1N	2U – 2V	$\frac{U1}{U2 \cdot \sqrt{3}}$	YNd1	
				B	1V – 1N	2V – 2W			
				C	1W – 1N	2W – 2U			
12			1W–1V	A	1U – 1W	2U – 2V	$\frac{U1}{U2} \cdot \frac{\sqrt{3}}{2}$	Yd1	NO ACCESSIBLE NEUTRAL ON WYE WINDING
			1U–1W	B	1V – 1U	2V – 2W			
			1V–1U	C	1W – 1V	2W – 2U			
13			—	A	1U– 1N	2W – 2U	$\frac{U1}{U2 \cdot \sqrt{3}}$	YNd5	
				B	1V – 1N	2U – 2V			
				C	1W – 1N	2V – 2W			
14			1W–1V	A	1U – 1W	2W – 2U	$\frac{U1}{U2} \cdot \frac{\sqrt{3}}{2}$	Yd5	NO ACCESSIBLE NEUTRAL ON WYE WINDING
			1U–1W	B	1V – 1U	2U – 2V			
			1V–1U	C	1W – 1V	2V – 2W			
15			1W–1V	A	1U – 1W	2V – 2U	$\frac{U1}{U2} \cdot \frac{\sqrt{3}}{2}$	Yd7	NO ACCESSIBLE NEUTRAL ON WYE WINDING
			1U–1W	B	1V – 1U	2W – 2V			
			1V–1U	C	1W – 1V	2U – 2W			
16			—	A	1U– 1N	2U – 2W	$\frac{U1}{U2 \cdot \sqrt{3}}$	YNd11	
				B	1V – 1N	2V– 2U			
				C	1W – 1N	2W – 2V			
17			1W–1V	A	1U– 1W	2U – 2W	$\frac{U1}{U2} \cdot \frac{\sqrt{3}}{2}$	Yd11	NO ACCESSIBLE NEUTRAL ON WYE WINDING
			1U–1W	B	1V – 1U	2V – 2U			
			1V–1U	C	1W – 1V	2W – 2V			
18			—	A	1U – 1N	2N – 2U	$\frac{U1}{U2}$	YNyn6	
				B	1V – 1N	2N – 2V			
				C	1W – 1N	2N – 2W			
19			1V–1N	A	1U – 1N	2U – 2V	$\frac{U1}{U2}$	YNy0	NO ACCESSIBLE NEUTRAL ON LOW VOLTAGE WINDING
			1W–1N	B	1V – 1N	2V – 2W			
			1U–1N	C	1W – 1N	2W – 2U			

CEI/IEC.050108C4

SPEC TEST NO.	TRANSFORMER CONFIGURATION: HIGH-VOLTAGE WINDING (H)	TRANSFORMER CONFIGURATION: LOW-VOLTAGE WINDING (X)	EXT. JUMPER	PHASE	WINDING TESTED: HIGH VOLTAGE WINDING	WINDING TESTED: LOW VOLTAGE WINDING	CAL. TURN RATIO	VECTOR GROUP	NOTES
20			2W–2N	A	1U – 1W	2U – 2N	$\frac{U1}{U2}$	Yyn0	NO ACCESSIBLE NEUTRAL ON HIGH VOLTAGE WINDING
			2U–2N	B	1V – 1U	2V– 2N			
			2V–2N	C	1W – 1V	2W – 2N			
43			—	A	1U – 1N	2U – 2W	$\frac{U1}{U2}$	YNyn0	
				B	1V – 1N	2V – 2N			
				C	1W – 1N	2W – 2N			
21			—	A	1U – 1W	2U – 2W	$\frac{U1}{U2}$	Yy0	NO ACCESSIBLE NEUTRAL
				B	1V – 1U	2V – 2U			
				C	1W – 1V	2W – 2V			
22			1V–1N	A	1U – 1N	2V – 2U	$\frac{U1}{U2}$	YNy6	NO ACCESSIBLE NEUTRAL ON LOW VOLTAGE WINDING
			1W–1N	B	1V – 1N	2W – 2V			
			1U–1N	C	1W – 1N	2U – 2W			
23			2W–2N	A	1U – 1W	2N – 2U	$\frac{U1}{U2}$	Yyn6	NO ACCESSIBLE NEUTRAL ON HIGH VOLTAGE WINDING
			2U–2N	B	1V – 1U	2N – 2V			
			2V–2N	C	1W – 1V	2N – 2W			
24			—	A	1U – 1W	2W – 2U	$\frac{U1}{U2}$	Yy6	NO ACCESSIBLE NEUTRAL
				B	1V – 1U	2U – 2V			
				C	1W – 1V	2V – 2W			
65			—	A	1U – 1W	2U – 2N	$\frac{V_H \cdot \sqrt{3}}{V_x}$	YNzn1	
				B	1V – 1U	2V – 2N			
				C	1W – 1V	2W – 2N			
25			—	A	1U – 1W	2U – 2N	$\frac{U1 \cdot \sqrt{3}}{U2}$	Yzn1	NO ACCESSIBLE NEUTRAL ON WYE WINDING
				B	1V – 1U	2V – 2N			
				C	1W – 1V	2W – 2N			
26			1W–1V	A	1U – 1W	2U – 2V	$\frac{U1}{U2} \cdot \frac{\sqrt{3}}{2}$	Yz1	NO ACCESSIBLE NEUTRAL
			1U–1W	B	1V– 1U	2V – 2W			
			1V–1U	C	1W – 1V	2W – 2U			
27			—	A	1U – 1W	2W – 2N	$\frac{U1 \cdot \sqrt{3}}{U2}$	Yzn5	NO ACCESSIBLE NEUTRAL ON WYE WINDING
				B	1V – 1U	2U – 2N			
				C	1W – 1V	2V – 2N			

CEI/IEC.050108C5

SPEC TEST NO.	TRANSFORMER CONFIGURATION		EXT. JUMPER	PHASE	WINDING TESTED		CAL. TURN RATIO	VECTOR GROUP	NOTES
	HIGH-VOLTAGE WINDING (H)	LOW-VOLTAGE WINDING (X)			HIGH VOLTAGE WINDING	LOW VOLTAGE WINDING			
28			1W–1V	A	1U – 1W	2W – 2U	$\frac{U1}{U2} \cdot \frac{\sqrt{3}}{2}$	Yz5	NO ACCESSIBLE NEUTRAL
			1U–1W	B	1V – 1U	2U – 2V			
			1V–1U	C	1W – 1V	2V – 2W			
66			—	A	1U – 1W	2N – 2U	$\frac{V_H}{V_X} \cdot \sqrt{3}$	YNzn7	
				B	1V – 1U	2N – 2V			
				C	1W – 1V	2N – 2W			
29			—	A	1U – 1W	2N – 2U	$\frac{U1 \cdot \sqrt{3}}{U2}$	Yzn7	NO ACCESSIBLE NEUTRAL ON WYE WINDING
				B	1V – 1U	2N – 2V			
				C	1W – 1V	2N – 2W			
30			1W–1V	A	1U– 1W	2V – 2U	$\frac{U1}{U2} \cdot \frac{\sqrt{3}}{2}$	Yz7	NO ACCESSIBLE NEUTRAL
			1U–1W	B	1V – 1U	2W – 2V			
			1V–1U	C	1W – 1V	2U – 2W			
67			—	A	1U – 1W	2N – 2W	$\frac{V_H \cdot \sqrt{3}}{V_X}$	YNzn11	
				B	1V – 1U	2N – 2U			
				C	1W – 1V	2N – 2V			
31			—	A	1U – 1W	2N – 2W	$\frac{U1 \cdot \sqrt{3}}{U2}$	Yzn11	NO ACCESSIBLE NEUTRAL ON WYE WINDING
				B	1V – 1U	2N – 2U			
				C	1W – 1V	2N – 2V			
32			1W–1V	A	1U – 1W	2U – 2W	$\frac{U1}{U2} \cdot \frac{\sqrt{3}}{2}$	Yz11	NO ACCESSIBLE NEUTRAL
			1U–1W	B	1V – 1U	2V – 2U			
			1V–1U	C	1W – 1V	2W – 2V			
55			1V–1W	A	1U – 1N	2U– 2V	$\frac{2}{3} \cdot \frac{U1}{U2}$	ZNd0	
			1W–1U	B	1V – 1N	2V – 2W			
			1U–1V	C	1W – 1N	2W – 2U			
56			—	A	1U – 1V	2U – 2V	$\frac{U1}{U2}$	Zd0	NO ACCESSIBLE NEUTRAL ON HIGH VOLTAGE
				B	1V – 1W	2V – 2W			
				C	1W – 1U	2W – 2U			
57			1V–1W	A	1U – 1N	2V – 2U	$\frac{2}{3} \cdot \frac{U1}{U2}$	ZNd6	
			1W–1U	B	1V – 1N	2W – 2V			
			1U–1V	C	1W – 1N	2U – 2W			

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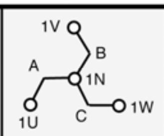
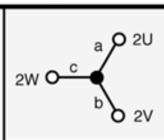
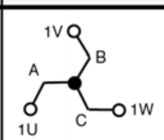
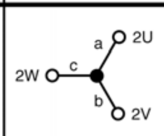
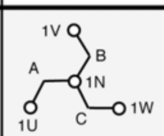
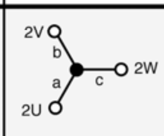
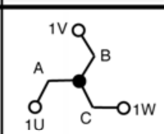
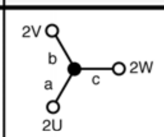
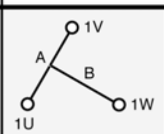
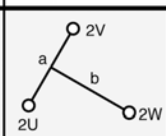
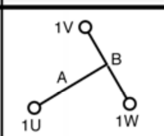
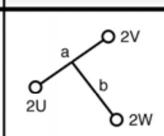
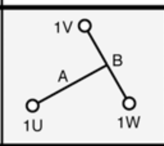
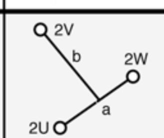
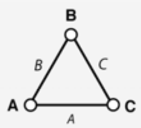
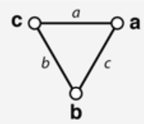
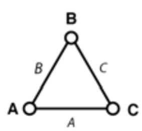
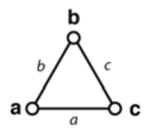
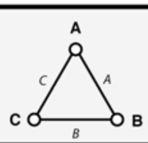
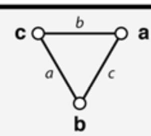
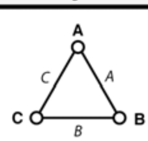
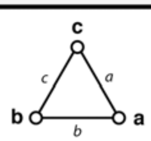
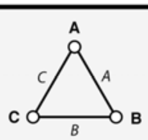
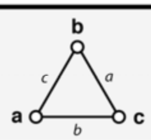
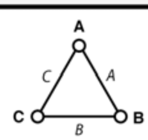
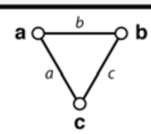
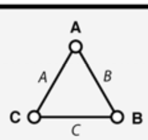
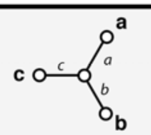
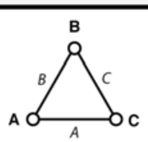
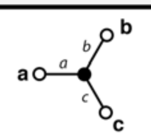
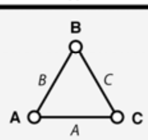
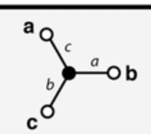
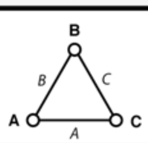
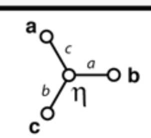
SPEC TEST NO.	TRANSFORMER CONFIGURATION HIGH-VOLTAGE WINDING (H)	TRANSFORMER CONFIGURATION LOW-VOLTAGE WINDING (X)	EXT. JUMPER	PHASE	WINDING TESTED HIGH VOLTAGE WINDING	WINDING TESTED LOW VOLTAGE WINDING	CAL. TURN RATIO	VECTOR GROUP	NOTES
33			—	A	1U – 1N	2W – 2U	$\frac{U1}{U2 \cdot \sqrt{3}}$	ZNy5	NO ACCESSIBLE NEUTRAL ON WYE WINDING
				B	1V – 1N	2U – 2V			
				C	1W – 1N	2V – 2W			
34			1W–1V	A	1U – 1W	2W – 2U	$\frac{U1}{U2} \cdot \frac{\sqrt{3}}{2}$	Zy5	NO ACCESSIBLE NEUTRAL
			1U–1W	B	1V – 1U	2U – 2V			
			1V–1U	C	1W – 1V	2V – 2W			
35			—	A	1U – 1N	2U – 2W	$\frac{U1}{U2 \cdot \sqrt{3}}$	ZNy11	NO ACCESSIBLE NEUTRAL ON WYE WINDING
				B	1V – 1N	2V – 2U			
				C	1W – 1N	2W – 2V			
36			1W–1V	A	1U – 1W	2U – 2W	$\frac{U1}{U2} \cdot \frac{\sqrt{3}}{2}$	Zy11	NO ACCESSIBLE NEUTRAL
			1U–1W	B	1V – 1U	2V – 2U			
			1V–1U	C	1W – 1V	2W – 2V			
58				A	1U – 1V	2U – 2V	$\frac{U1}{U2}$	T-T 0	
			1U–1V 2U–2V	B	1U – 1W	2U – 2W			
59			1V–1W	A	1U – 1W	2U – 2V	$\frac{U1}{U2} \cdot \frac{\sqrt{3}}{2}$	T-T 30 Lag	
			2U–2V	B	1V – 1W	2U – 2W	$\frac{U1}{U2} \cdot \frac{2}{\sqrt{3}}$		
60			1V–1W	A	1U – 1W	2U – 2W	$\frac{U1}{U2} \cdot \frac{\sqrt{3}}{2}$	T-T 30 Lead	
			2U–2W	B	1V – 1W	2V – 2U	$\frac{U1}{U2} \cdot \frac{2}{\sqrt{3}}$		

CEI/IEC.050108C7

APPENDIX D – Australian Std.2374 Transformer Descriptions

SPEC TEST NO.	TRANSFORMER CONFIGURATION: HIGH-VOLTAGE WINDING (H)	TRANSFORMER CONFIGURATION: LOW-VOLTAGE WINDING (X)	EXT. JUMPER	PHASE	WINDING TESTED: HIGH VOLTAGE WINDING	WINDING TESTED: LOW VOLTAGE WINDING	CAL. TURN RATIO	VECTOR GROUP	NOTES
1			—	A	A – C	c – a	$\frac{HV}{LV}$	Dd6	
				B	B – A	a – b			
				C	C – B	b – c			
37			—	A	A – C	a – c	$\frac{HV}{LV}$	Dd0	
				B	B – A	b – a			
				C	C – B	c – b			
38			—	A	A – B	c – b	$\frac{HV}{LV}$	Dd2	
				B	B – C	a – c			
				C	C – A	b – a			
39			—	A	A – B	c – a	$\frac{HV}{LV}$	Dd4	
				B	B – C	a – b			
				C	C – A	b – c			
40			—	A	A – B	b – c	$\frac{HV}{LV}$	Dd8	
				B	B – C	c – a			
				C	C – A	a – b			
41			—	A	A – B	a – c	$\frac{HV}{LV}$	Dd10	
				B	B – C	b – a			
				C	C – A	c – b			
42			—	A	A – C	a – η	$\frac{HV \cdot \sqrt{3}}{LV}$	Dyn1	
				B	B – A	b – η			
				C	C – B	c – η			
2			C – B	A	A – C	a – c	$\frac{HV \cdot \sqrt{3}}{LV}$	Dy1	NO ACCESSIBLE NEUTRAL ON WYE WINDING
			A – C	B	B – A	b – a			
			B – A	C	C – B	c – b			
61			C – B	A	A – C	a – b	$\frac{V_H \cdot \sqrt{3}}{V_X}$	Dy3	NO ACCESSIBLE NEUTRAL ON WYE WINDING
			A – C	B	B – A	b – c			
			B – A	C	C – B	c – a			
62			—	A	A – C	η – b	$\frac{HV \cdot \sqrt{3}}{LV}$	Dyn3	
				B	B – A	η – c			
				C	C – B	η – a			

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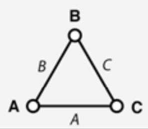
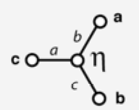
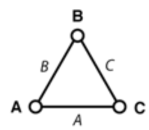
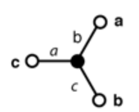
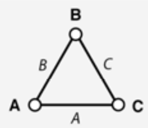
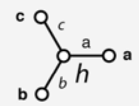
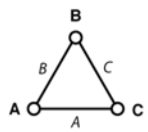
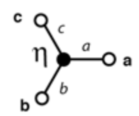
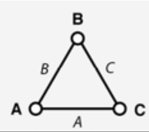
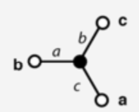
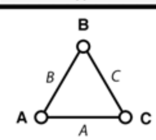
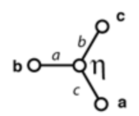
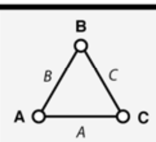
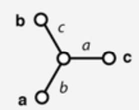
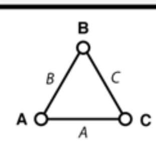
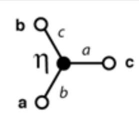
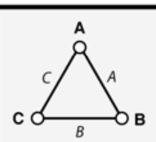
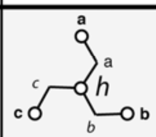
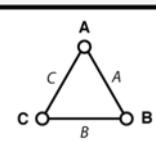
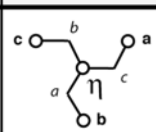
SPEC TEST NO.	TRANSFORMER CONFIGURATION: HIGH-VOLTAGE WINDING (H)	TRANSFORMER CONFIGURATION: LOW-VOLTAGE WINDING (X)	EXT. JUMPER	PHASE	WINDING TESTED: HIGH VOLTAGE WINDING	WINDING TESTED: LOW VOLTAGE WINDING	CAL. TURN RATIO	VECTOR GROUP	NOTES
3			—	A	A – C	c – η	$\frac{HV}{LV} \cdot \sqrt{3}$	Dyn5	
				B	B – A	a – η			
				C	C – B	b – η			
4			C – B	A	A – C	c – b	$\frac{HV}{LV} \cdot \sqrt{3}$	Dy5	NO ACCESSIBLE NEUTRAL ON WYE WINDING
			A – C	B	B – A	a – c			
			B – A	C	C – B	b – a			
5			—	A	A – C	η – a	$\frac{HV}{LV} \cdot \sqrt{3}$	Dyn7	
				B	B – A	η – b			
				C	C – B	η – c			
6			C – B	A	A – C	c – a	$\frac{HV}{LV} \cdot \sqrt{3}$	Dy7	NO ACCESSIBLE NEUTRAL ON WYE WINDING
			A – C	B	B – A	a – b			
			B – A	C	C – B	b – c			
63			C – B	A	B – C	b – a	$\frac{HV}{LV} \cdot \sqrt{3}$	Dy9	NO ACCESSIBLE NEUTRAL ON WYE WINDING
			A – C	B	B – A	c – b			
			B – A	C	C – B	a – c			
64			—	A	A – C	b – η	$\frac{HV}{LV} \cdot \sqrt{3}$	Dyn9	
				B	B – A	c – η			
				C	C – B	a – η			
7			—	A	A – C	η – c	$\frac{HV}{LV} \cdot \sqrt{3}$	Dyn11	
				B	B – A	η – a			
				C	C – B	η – b			
8			C – B	A	A – C	b – c	$\frac{HV}{LV} \cdot \sqrt{3}$	Dy11	NO ACCESSIBLE NEUTRAL ON WYE WINDING
			A – C	B	B – A	c – a			
			B – A	C	C – B	a – b			
45			B – C	A	A – B	a – η	$\frac{3}{2} \cdot \frac{HV}{LV}$	Dzn0	
			C – A	B	B – C	b – η			
			A – B	C	C – A	c – η			
46			B – C	C	A – B	η – b	$\frac{3}{2} \cdot \frac{HV}{LV}$	Dzn2	
			C – A	A	B – C	η – c			
			A – B	B	C – A	η – a			

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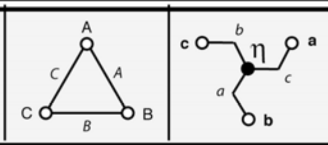
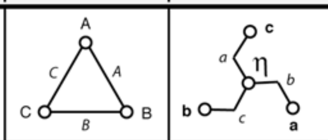
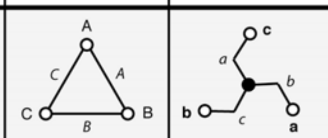
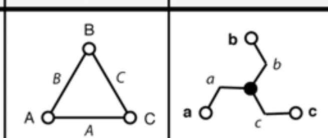
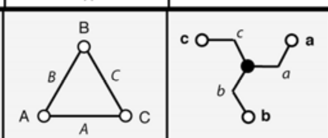
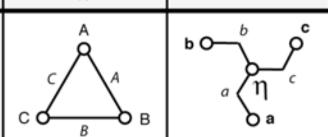
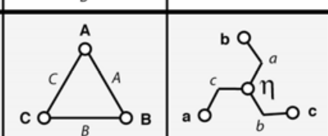
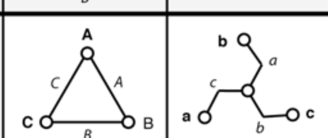
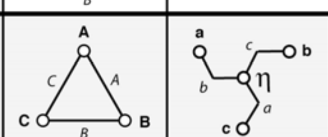
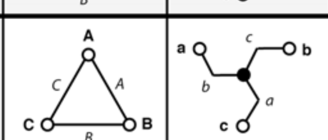
SPEC TEST NO.	TRANSFORMER CONFIGURATION HIGH-VOLTAGE WINDING (H)	TRANSFORMER CONFIGURATION LOW-VOLTAGE WINDING (X)	EXT. JUMPER	PHASE	WINDING TESTED HIGH VOLTAGE WINDING	WINDING TESTED LOW VOLTAGE WINDING	CAL. TURN RATIO	VECTOR GROUP	NOTES
47			—	A	A – B	c – b	$\frac{HV}{LV}$	Dz2	NO ACCESSIBLE NEUTRAL
				B	B – C	a – c			
				C	C – A	b – a			
48			B – C	A	A – B	c – η	$\frac{3}{2} \cdot \frac{HV}{LV}$	Dzn4	
			C – A	B	B – C	a – η			
			A – B	C	C – A	b – η			
49			—	A	A – B	c – a	$\frac{HV}{LV}$	Dz4	NO ACCESSIBLE NEUTRAL
				B	B – C	a – b			
				C	C – A	b – c			
9			—	A	A – C	a – c	$\frac{HV}{LV}$	Dz0	NO ACCESSIBLE NEUTRAL
				B	B – A	b – a			
				C	C – B	c – b			
10			—	A	A – C	c – a	$\frac{HV}{LV}$	Dz6	NO ACCESSIBLE NEUTRAL
				B	B – A	a – b			
				C	C – B	b – c			
50			B – C	A	A – B	η – a	$\frac{3}{2} \cdot \frac{HV}{LV}$	Dzn6	
			C – A	B	B – C	η – b			
			A – B	C	C – A	η – c			
51			B – C	A	A – B	b – η	$\frac{3}{2} \cdot \frac{HV}{LV}$	Dzn8	
			C – A	B	B – C	c – η			
			A – B	C	C – A	a – η			
52			—	A	A – B	b – c	$\frac{HV}{LV}$	Dz8	NO ACCESSIBLE NEUTRAL
				B	B – C	c – a			
				C	C – A	a – b			
53			B – C	A	A – B	η – c	$\frac{3}{2} \cdot \frac{HV}{LV}$	Dzn10	
			C – A	B	B – C	η – a			
			A – B	C	C – A	η – b			
54			—	A	A – B	a – c	$\frac{HV}{LV}$	Dz10	NO ACCESSIBLE NEUTRAL
				B	B – C	b – a			
				C	C – A	c – b			

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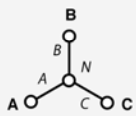
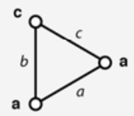
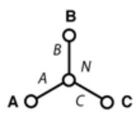
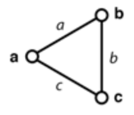
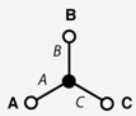
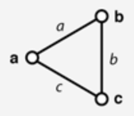
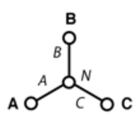
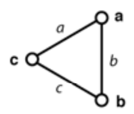
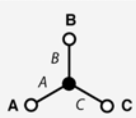
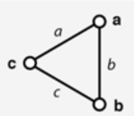
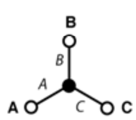
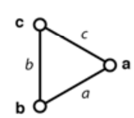
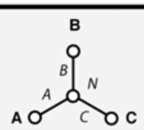
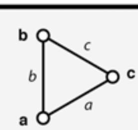
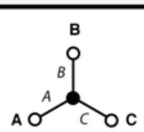
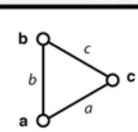
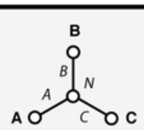
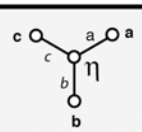
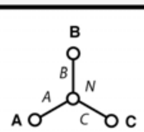
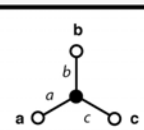
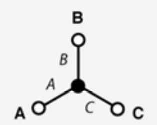
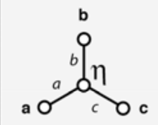
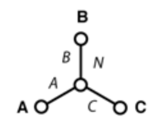
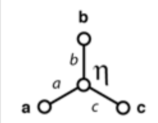
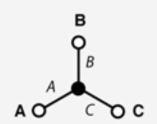
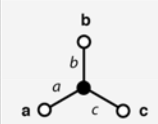
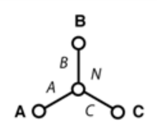
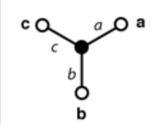
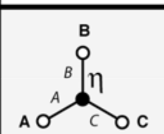
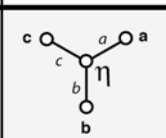
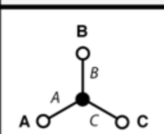
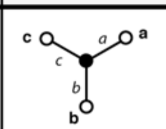
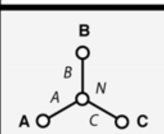
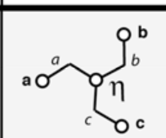
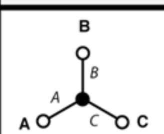
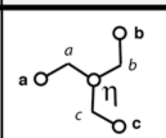
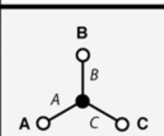
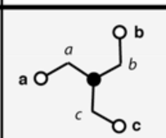
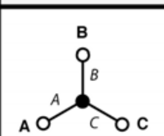
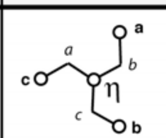
SPEC TEST NO.	TRANSFORMER CONFIGURATION HIGH-VOLTAGE WINDING (H)	TRANSFORMER CONFIGURATION LOW-VOLTAGE WINDING (X)	EXT. JUMPER	PHASE	WINDING TESTED HIGH VOLTAGE WINDING	WINDING TESTED LOW VOLTAGE WINDING	CAL. TURN RATIO	VECTOR GROUP	NOTES
11			—	A B C	A – N B – N C – N	b – a c – b a – c	$\frac{HV}{LV \cdot \sqrt{3}}$	YNd7	
44			—	A B C	A – N B – N C – N	a – b b – c c – a	$\frac{HV}{LV \cdot \sqrt{3}}$	YNd1	
12			C – B A – C B – A	A B C	A – C B – A C – B	a – b b – c c – a	$\frac{HV}{LV} \cdot \frac{\sqrt{3}}{2}$	Yd1	NO ACCESSIBLE NEUTRAL ON WYE WINDING
13			—	A B C	A – N B – N C – N	c – a a – b b – c	$\frac{HV}{LV \cdot \sqrt{3}}$	YNd5	
14			C – B A – C B – A	A B C	A – C B – A C – B	c – a a – b b – c	$\frac{HV}{LV} \cdot \frac{\sqrt{3}}{2}$	Yd5	NO ACCESSIBLE NEUTRAL ON WYE WINDING
15			C – B A – C B – A	A B C	A – C B – A C – B	b – a c – b a – c	$\frac{HV}{LV} \cdot \frac{\sqrt{3}}{2}$	Yd7	NO ACCESSIBLE NEUTRAL ON WYE WINDING
16			—	A B C	A– N B – N C – N	a – c b – a c – b	$\frac{HV}{LV \cdot \sqrt{3}}$	YNd11	
17			C – B A – C B – A	A B C	A – C B – A C – B	a – c b – a c – b	$\frac{HV}{LV} \cdot \frac{\sqrt{3}}{2}$	Yd11	NO ACCESSIBLE NEUTRAL ON WYE WINDING
18			—	A B C	A – N B – N C – N	η – a η – b η – c	$\frac{HV}{LV}$	YNyn6	
19			B – N C – N A – N	A B C	A – N B – N C – N	a – b b – c c – a	$\frac{HV}{LV}$	YNy0	NO ACCESSIBLE NEUTRAL ON LOW VOLTAGE WINDING

AUSTRALIAN.050108A4

SPEC TEST NO.	TRANSFORMER CONFIGURATION HIGH-VOLTAGE WINDING (H)	LOW-VOLTAGE WINDING (X)	EXT. JUMPER	PHASE	WINDING TESTED HIGH VOLTAGE WINDING	LOW VOLTAGE WINDING	CAL. TURN RATIO	VECTOR GROUP	NOTES
20			c – h a – h b – h	A B C	A – C B – C C – B	a – η b – η c – η	$\frac{HV}{LV}$	Yyn0	NO ACCESSIBLE NEUTRAL ON HIGH VOLTAGE WINDING
43			—	A B C	A – N B – N C – N	a – η b – η c – η	$\frac{HV}{LV}$	YNyn0	
21			—	A B C	A – C B – A C – B	a – c b – a c – b	$\frac{HV}{LV}$	Yy0	NO ACCESSIBLE NEUTRAL
22			B – N C – N A – N	A B C	A – N B – N C – N	b – a c – b a – c	$\frac{HV}{LV}$	YNy6	NO ACCESSIBLE NEUTRAL ON LOW VOLTAGE WINDING
23			c – h a – h b – h	A B C	A – C B – A C – B	η – a η – b η – c	$\frac{HV}{LV}$	Yyn6	NO ACCESSIBLE NEUTRAL ON HIGH VOLTAGE WINDING
24			—	A B C	A – C B – A C – B	c – a a – b b – c	$\frac{HV}{LV}$	Yy6	NO ACCESSIBLE NEUTRAL
65			—	A B C	A – C B – A C – B	a – η b – η c – η	$\frac{V_H \cdot \sqrt{3}}{V_X}$	YNzn1	
25			—	A B C	A – C B – A C – B	a – η b – η c – η	$\frac{V_H \cdot \sqrt{3}}{LV}$	Yzn1	NO ACCESSIBLE NEUTRAL ON WYE WINDING
26			C – B A – C B – A	A B C	A – C B – A C – B	a – b b – c c – a	$\frac{HV}{LV} \cdot \frac{\sqrt{3}}{2}$	Yz1	NO ACCESSIBLE NEUTRAL
27			—	A B C	A – C B – A C – B	c – η a – η b – η	$\frac{HV \cdot \sqrt{3}}{LV}$	Yzn5	NO ACCESSIBLE NEUTRAL ON WYE WINDING

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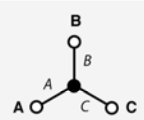
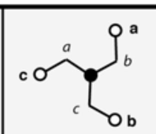
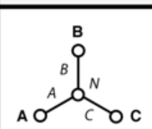
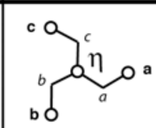
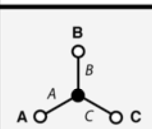
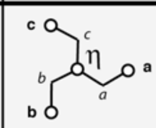
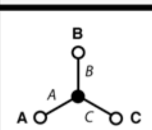
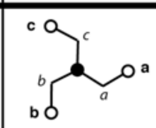
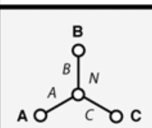
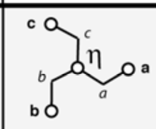
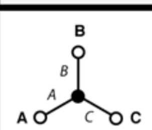
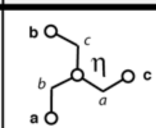
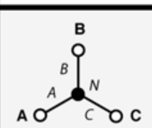
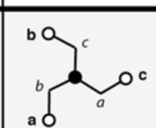
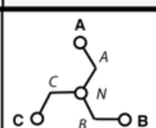
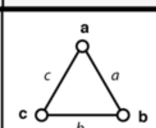
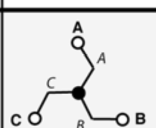
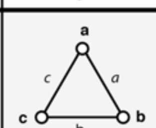
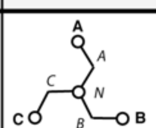
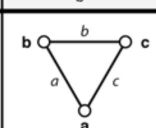
SPEC TEST NO.	TRANSFORMER CONFIGURATION HIGH-VOLTAGE WINDING (H)	TRANSFORMER CONFIGURATION LOW-VOLTAGE WINDING (X)	EXT. JUMPER	PHASE	WINDING TESTED HIGH VOLTAGE WINDING	WINDING TESTED LOW VOLTAGE WINDING	CAL. TURN RATIO	VECTOR GROUP	NOTES
28			C – B A – C B – A	A B C	A – C B – A C – B	c – a a – b b – c	$\frac{HV}{LV} \cdot \frac{\sqrt{3}}{2}$	Yz5	NO ACCESSIBLE NEUTRAL
66			—	A B C	A – C B – A C – B	η – a η – b η – c	$\frac{V_H}{V_x} \cdot \sqrt{3}$	YNzn7	
29			—	A B C	A – C B – A C – B	η – a η – b η – c	$\frac{HV \cdot \sqrt{3}}{LV}$	Yzn7	NO ACCESSIBLE NEUTRAL ON WYE WINDING
30			C – B A – C B – A	A B C	A – C B – A C – B	b – a c – b a – c	$\frac{HV}{LV} \cdot \frac{\sqrt{3}}{2}$	Yz7	NO ACCESSIBLE NEUTRAL
67			—	A B C	A – C B – A C – B	η – c η – a η – b	$\frac{V_H \cdot \sqrt{3}}{V_x}$	Yzn11	
31			—	A B C	A – C B – A C – B	η – c η – a η – b	$\frac{HV \cdot \sqrt{3}}{LV}$	Yz11	NO ACCESSIBLE NEUTRAL ON WYE WINDING
32			C – B A – C B – A	A B C	A – C B – A C – B	a – c b – a c – b	$\frac{HV}{LV} \cdot \frac{\sqrt{3}}{2}$	Yz11	NO ACCESSIBLE NEUTRAL
55			b – c c – a a – b	A B C	A – N B – N C – N	a – b b – c c – a	$\frac{2}{3} \cdot \frac{HV}{LV}$	ZNd0	
56			—	A B C	A – B B – C C – A	a – b b – c c – a	$\frac{HV}{LV}$	Zd0	NO ACCESSIBLE NEUTRAL ON HIGH VOLTAGE
57			b – c c – a a – b	A B C	A – N B – N C – N	b – a c – b a – c	$\frac{HV}{LV}$	ZNd6	

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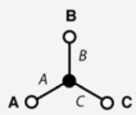
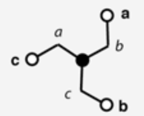
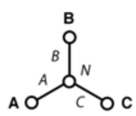
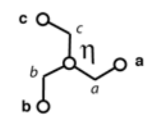
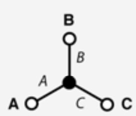
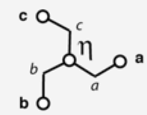
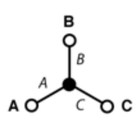
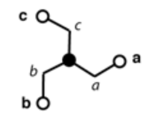
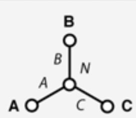
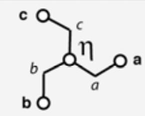
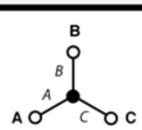
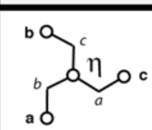
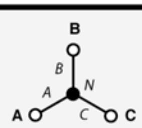
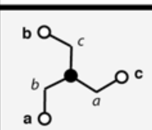
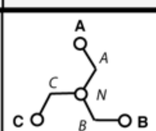
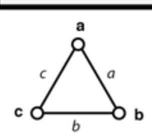
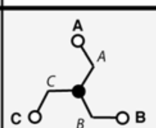
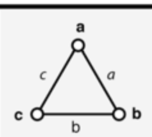
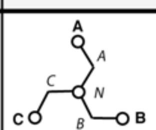
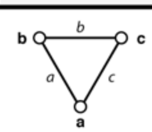
SPEC TEST NO.	TRANSFORMER CONFIGURATION HIGH-VOLTAGE WINDING (H)	TRANSFORMER CONFIGURATION LOW-VOLTAGE WINDING (X)	EXT. JUMPER	PHASE	WINDING TESTED HIGH VOLTAGE WINDING	WINDING TESTED LOW VOLTAGE WINDING	CAL. TURN RATIO	VECTOR GROUP	NOTES
28			C – B	A	A – C	c – a	$\frac{HV}{LV} \cdot \frac{\sqrt{3}}{2}$	Yz5	NO ACCESSIBLE NEUTRAL
			A – C	B	B – A	a – b			
			B – A	C	C – B	b – c			
66			—	A	A – C	η – a	$\frac{V_H}{V_X} \cdot \sqrt{3}$	YNzn7	
				B	B – A	η – b			
				C	C – B	η – c			
29			—	A	A – C	η – a	$\frac{HV \cdot \sqrt{3}}{LV}$	Yzn7	NO ACCESSIBLE NEUTRAL ON WYE WINDING
				B	B – A	η – b			
				C	C – B	η – c			
30			C – B	A	A – C	b – a	$\frac{HV}{LV} \cdot \frac{\sqrt{3}}{2}$	Yz7	NO ACCESSIBLE NEUTRAL
			A – C	B	B – A	c – b			
			B – A	C	C – B	a – c			
67			—	A	A – C	η – c	$\frac{V_H \cdot \sqrt{3}}{V_X}$	Yzn11	
				B	B – A	η – a			
				C	C – B	η – b			
31			—	A	A – C	η – c	$\frac{HV \cdot \sqrt{3}}{LV}$	Yz11	NO ACCESSIBLE NEUTRAL ON WYE WINDING
				B	B – A	η – a			
				C	C – B	η – b			
32			C – B	A	A – C	a – c	$\frac{HV}{LV} \cdot \frac{\sqrt{3}}{2}$	Yz11	NO ACCESSIBLE NEUTRAL
			A – C	B	B – A	b – a			
			B – A	C	C – B	c – b			
55			b – c	A	A – N	a – b	$\frac{2}{3} \cdot \frac{HV}{LV}$	ZNd0	
			c – a	B	B – N	b – c			
			a – b	C	C – N	c – a			
56			—	A	A – B	a – b	$\frac{HV}{LV}$	Zd0	NO ACCESSIBLE NEUTRAL ON HIGH VOLTAGE
				B	B – C	b – c			
				C	C – A	c – a			
57			b – c	A	A – N	b – a	$\frac{HV}{LV}$	ZNd6	
			c – a	B	B – N	c – b			
			a – b	C	C – N	a – c			

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Vanguard Instruments
Company, Inc.

1520 S. Hellman Ave • Ontario, CA 91761 • USA

Phone: 909-923-9390 • Fax: 909-923-9391

www.vanguard-instruments.com