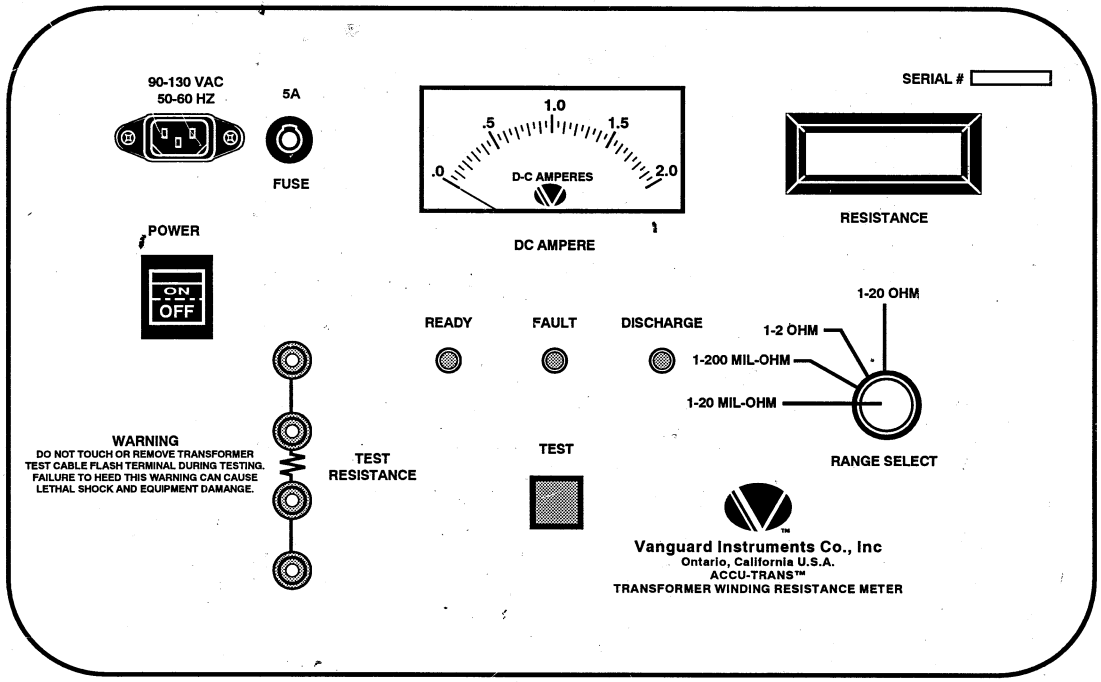
OPERATING INSTRUCTIONS
for the
ACCU-TRANS™

A transformer-winding, resistance-measuring meter



TM

Manufactured by
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1.0 INTRODUCTION

The Accu-Trans resistance meter precisely measures the resistance of inductive transformer windings (it also accurately measures any low milliohm resistance), which is quickly and directly read out on a 3½-digit liquid-crystal display.

The Accu-Trans measures winding resistance of single or three-phase transformers in both delta and wye configurations. The test current is automatically ramped up and very precisely regulated at 1 ampere for the read-out and is then ramped down for quick, easy, and reliable, operation (stored inductive energy is safely ramped and dissipated into a controlled load).

The Accu-Trans is light weight, easy to hook up, small, reliable, safe, and simple to operate with little or no user training.

Front-panel controls, meters, and indicators provide operators with status feedback and full control for quick, reliable operations.

2.0 FUNCTIONAL OVERVIEW

Accu-Trans operation is based on electrical relationships described by Ohm's law: R = V/I, where I is a known current (produced by a precisely regulated power supply); V is the voltage measured across the tested transformer winding. The test current is very accurately regulated and the IR voltage drop across the winding, at the winding terminals, is measured directly. (Voltage and current test leads are separate and voltage leads carry virtually no current, thus ensuring accurate readings without any mathematical conversion.)

An Accu-Trans does this in one easy operation. The digital meter is especially designed for this one application and reads out directly in micro-ohms. This direct-reading meter needs no calculation to off-set test-lead resistance. Since a known current (a highly regulated 1 ampere) is run through the winding, the resistance is read by a precision voltmeter calibrated to read directly in milliohms (the voltage drop across the winding is a direct function of its resistance).

Each Accu-Trans is furnished with 35-foot test-lead cables terminated with battery-type terminal clamps. Voltage-sensing leads are run in the test cables, but don't carry load current; this permits the actual voltage across an EHV transformer winding to be precisely measured.

Any transformer winding is highly inductive; a sudden collapse of its magnetic field will create a voltage that is hazardous to users. After each test a built-in discharge circuit automatically removes the energy stored in the transformer that was being tested.

Table 1. Accu-Trans Specifications

TYPE	Special-purpose, light-weight, precision test meter; measures transformer winding resistance
SIZE (inches)	16.75 W by 10.6 D by 12.6 H
WEIGHT	Less than 20 pounds
OPERATING POWER	90–130 volts, ac, 50–60 Hertz; 3 amps
TEST CURRENT	1 ampere, dc regulated within ± 0.005 %
OPEN-CIRCUIT VOLTAGE	34 volts, dc
FULL-SCALE RANGES	1 to 20 and 200 milliohms, and 2 and 20 ohms
ACCURACY	±0.5 % (±1 count at lsd of display)
METERING	3½-digit (liquid-crystal display) reads resistance in ohms & milliohms (full-scale digital = 1999); D'Arsonval reads current (3 amps full scale)
PROTECTION	Discharge circuit drains stored energy in winding after each test, thus protecting operators and Accu-Trans electronics
OPERATING TIME	Current ramps plateau and stabilize 20 seconds after pressing test button; ramps to zero 3 seconds after button release
STATUS INDICATORS	Three: Test Current Stabilized; Current fails to regulate on load/disconnected test lead; Test current discharging (ramp)
WARRANTY REPAIR	1 year, parts & labor; service contracts available

SPECIFICATIONS ARE SUBJECT TO BEING CHANGED WITHOUT PRIOR NOTICE.

Table 2. Accu-Trans Controls and Indicators

Fig. 1 Index	PANEL MARKING	FUNCTIONAL DESCRIPTION
1	90-130 VAC 50-60 Hz	Power Connector: Input-power/ground cable plugs into this receptacle (3-wire).
2	POWER	Power Switch, toggle: on/off control.
3	5A FUSE	Line Fuse: over-current protection.
4	DC AMPERES	Meter, D'Arsonval: 3 amperes full scale; monitors test current ramp up to 1 amp.
5	RESISTANCE	Meter, LCD, Digital Readout: 1999 at full scale; measures voltage, readout is winding resistance in milliohms & ohms.
6	RANGE SELECT	Rotary Switch, 4-position: Selects (index 5) load resistance range: 20- & 200-milliohm and 2- & 20-ohm ranges.
7	TEST	Pushbutton, momentary contact: Press and hold to start test-current ramping, followed by ohmmeter (index 5) readout.
8	DISCHARGE	Indicator, Red: On/off at 10 Hz rate indicates ramp-down in progress (i.e., it's unsafe to disconnect test leads).
9	FAULT	Indicator, Red: Lights (with solid tone) if current isn't regulated after 20 seconds or a test-current lead is disconnected.
10	READY	Indicator, Red: On/off at 1 Hz rate (with audio tone) indicates 30-second ramp-up has ended and test current is regulated.
11	TEST RESISTANCE	Test Current Jacks: One-ampere test current leads plug into these jacks.
12	TEST RESISTANCE	Test Voltage Jacks: Voltage leads (with no load current) plug into these jacks.

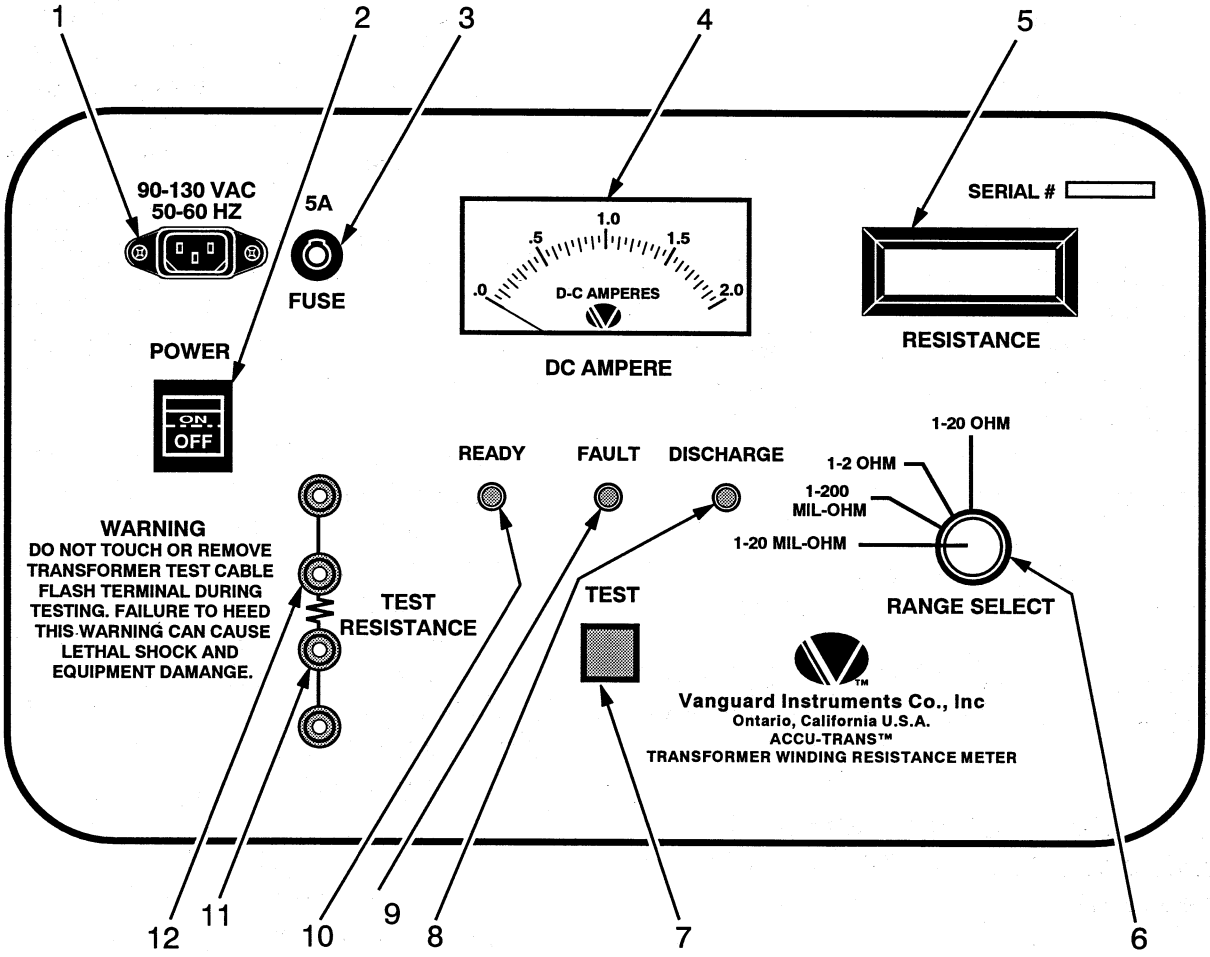


Figure 1. Accu-Trans Front-Panel Controls and Indicators

3.0 OPERATING PROCEDURES

1. Precautions

WARNING

Do not touch or remove transformer test cables from terminals during testing. Failure to heed this warning can cause lethal shock and equipment damage.

2. Procedure (See Figure 1.)

a. Plug in power cable to outlet to connect ac power and safety ground (index 1).

b. Plug current and voltage cable plugs into jacks (indexes 11 & 12) on front panel.

c. Connect test-cable clamps to two transformer terminals of winding to be measured.

d. Turn on Accu-Trans power (index 2).

e. Select suitable resistance on SELECT RANGE switch (refer to index 6); if range isn't known, run trial tests starting at 20-ohm range and select next-lower scale for succeeding tests, until meter (index 5) reads in upper part of full scale.

f. Press and hold down TEST pushbutton switch (index 7): verify meter (index 4) shows test current ramping up to 1 amp, then after 30 seconds READY indicator lights and a steady 1 Hz tone sounds. Note that FAULT indicator lights if any test lead is not connected or test current fails to regulate. When READY indicator lights, resistance can be accurately read on meter (index 5); read resistance meter.

g. Release TEST button: observe test current ramps down on meter (index 5) during discharge, DISCHARGE indicator lights and a 10 Hz tone sounds. When current is ramped to zero, DISCHARGE indicator (index 8) lights and a 10 Hz tone sounds to show it's safe to disconnect test leads from transformer winding.

h. Further winding resistances may be read by repeating steps through g.

NOTICE

When transformer windings are 3-phase wye or 1-phase hookups, measurements are direct and resistance is read from the meter. However, 3-phase delta windings are series-parallel networks that require calculations to compensate for the shunting series windings. Refer to Appendix A for the preferred method of calculating delta winding resistances.

4.0 CALIBRATION PROCEDURE

4.1 Adjust Accu-Trans Current

1. Attach Accu-Trans clamps to short (about 4 inches) copper bar. Keep probes as close together as possible.
2. Plug probe leads in 4 sense terminals on Accu-Trans.
3. Connect ammeter in series with the top TEST RESISTANCE jack of the Accu-Trans meter.
4. From Accu-Trans panel, select 1-20 milliohm scale.
5. Turn on Accu-Trans power.
6. Press TEST switch: wait for READY indicator to light and periodic 1-Hz tone sound, indicating data is ready to read.
7. Adjust pot R13 for 1 amp test current.
8. Adjust analog current meter to 1 amp.

This completes the current-adjust procedure.

4.2 Zero Digital meter

1. Short sensing jacks with banana plug jumper wire. (Note: sensing jacks are the middle two plugs).
2. Repeat steps 1–6 as described above.
3. Observe digital readout.
4. If readout is not 00.00, make small change to pot R69, repeat steps 1–3.
5. If readout is 00.00, this ends the Zero-adjust procedure.

4.3 Set 1-20 Milliohm Scale

1. Clamp Accu-Trans probes on 10-milli-ohm shunt.
2. Select 1-20 milliohm scale with panel selector.
3. Press TEST switch and wait for READY indicator to light.
4. Adjust pot R80 to display 10.00.

This completes 1-20 Milliohm Scale Adjust procedure.

4.4 Adjust 1-2 Ohm Scale

1. Clamp Accu-Trans probes on 1.5-ohm shunt.
2. Select 1-2 ohm scale.
3. Press TEST switch and wait for READY indicator to light.
4. Adjust pot R58 to display 1.500

This ends 1-2 Ohm Scale adjust procedure.

4.5 Adjust 1-20 ohm scale

1. Clamp Accu-Trans probes across 15-ohm shunt.
2. Select 1-20 Ohm scale.
3. Depress TEST switch; wait for READY indicator to light.
4. Adjust pot R60 to display 15.00.

This completes the 1-20 Ohm Adjust Procedure.

APPENDIX A
How to Calculate Delta Winding Resistances

This appendix contains step-by-step operator instructions for calculating the resistances of individual windings in series-parallel configurations used in 3-phase delta transformers, when using the Accu-Trans meter. Operators must use a voltmeter to measure voltages across each of three windings while one of the windings is energized by the Accu-Trans driver. From these voltage readings, the resistances of each individual winding can be calculated by using formula provided at the end of this appendix.

Phase A:

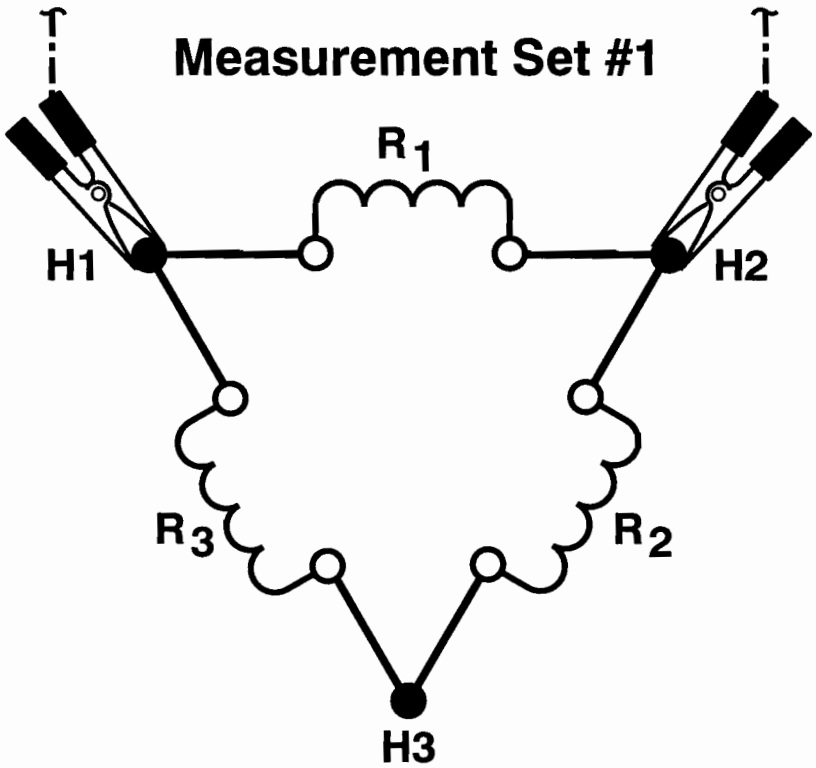
1. Connect Accu-Turn test-lead probes to transformer winding terminals H1 and H2 (phase A) as shown in figure (Measurement Set #1) below.

2. Turn Accu-Trans POWER switch to ON and press TEST pushbutton.

3. Record absolute DC voltage readings (disregard polarity) measured across following transformer terminals when ready to test:

   $V_{A(H1H2)}$, $V_{A(H2H3)}$, $V_{A(H1H3)}$

   (Note: Voltage subscripts denote transformer winding phase driven and, parenthetically, terminals across which voltages are measured.)



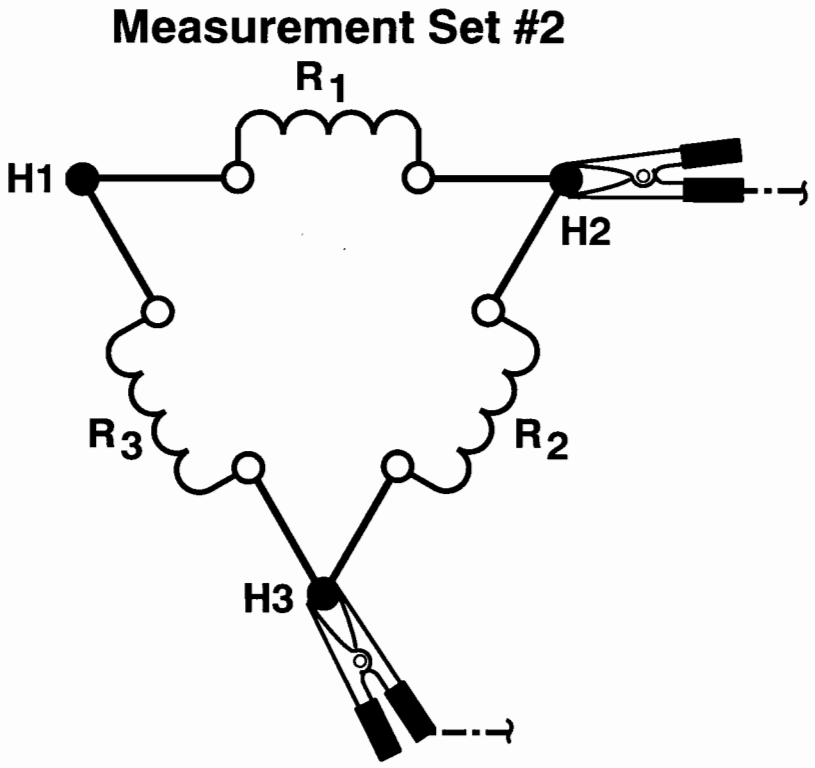
Phase B:

1. Connect Accu-Turn test-lead probes to transformer winding terminals H2 and H3 (phase B) as shown in figure (Measurement Set #2) below.

2. Turn Accu-Trans POWER switch to ON and press TEST pushbutton.

3. Record absolute DC voltage readings (disregard polarity) measured across following transformer terminals when ready to test:

   $V_{B(H1H2)}$, $V_{B(H2H3)}$, $V_{B(H1H3)}$



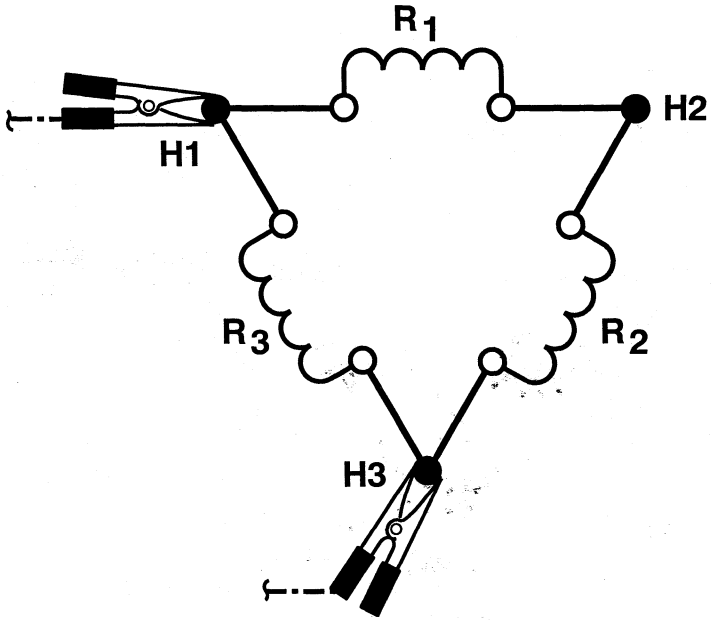
Phase C:

1. Connect Accu-Turn test-lead probes to transformer winding terminals H1 and H3 (phase C) as shown in figure (Measurement Set #3) below.

2. Turn Accu-Trans POWER switch to ON and press TEST pushbutton.

3. Record absolute DC voltage readings (disregard polarity) measured across following transformer terminals when ready to test: $V_{C(H1H2)}$, $V_{C(H2H3)}$, $V_{C(H1H3)}$

Measurement Set #3



Calculate Phase A resistance (denoted R_1) with the following equation:

$$R_1 = \frac{V_{A(H1H2)} * V_{C(H1H3)} - V_{A(H1H3)} * V_{C(H1H2)}}{V_{C(H1H3)} - V_{A(H1H3)}}$$

Calculate Phase B resistance (denoted R_2) with the following equation:

$$R_2 = \frac{V_{B(H1H2)} * V_{A(H2H3)} - V_{A(H1H2)} * V_{B(H2H3)}}{V_{B(H1H2)} - V_{A(H1H2)}}$$

Calculate Phase C resistance (denoted R_3) with the following equation:

$$R_3 = \frac{V_{B(H2H3)} * V_{C(H1H3)} - V_{C(H2H3)} * V_{B(H1H3)}}{V_{B(H2H3)} - V_{C(H2H3)}}$$

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