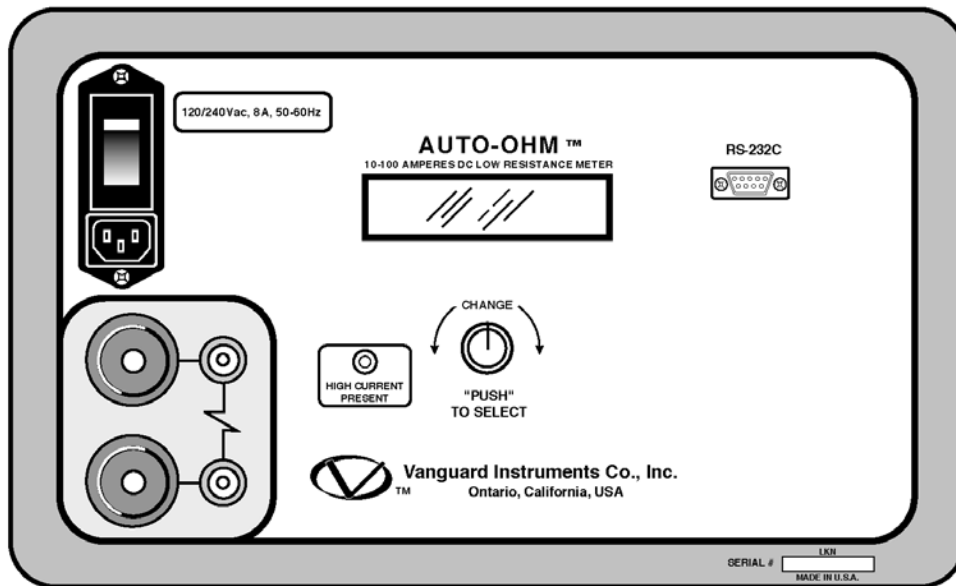

OPERATING INSTRUCTIONS
for the
AUTO-OHM
LOW-RESISTANCE
OHMMETER
Series II
Part Number VIC-60000-S2



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SAFETY SUMMARY

The following safety precautions must be observed during all phases of test set-up, test hookups, testing, and test-lead disconnects.

Do Not Service or Test Alone

Do not perform test procedures or service unless another person is also present who is capable of rendering aid and resuscitation.

Avoid Contact with High Voltage

Because electrical utility station environments contain high voltages and currents, there is always the possibility of personal contact with an unexpected lethal voltage generated by magnetic induction and/or electrostatic leakage from nearby live circuitry. When test units are connected to deenergized ("dead") power lines, regardless of how short they are, always discharge the lines before attaching any test lead. Because of the possibly deadly consequences of physical contact with such high-voltage lines, engineers and technicians must always treat electrical equipment and hookups as though a lethal condition will eventually occur. Therefore, no matter how unlikely it

may seem, never assume anything about the safety of any test setup.

Ensure the safety of personal by checking first-hand to eliminate all possible hazards!

Do Not Modify Test Equipment

Because of the added risk of introducing additional or unknown hazards, do not install substitute parts or perform any unauthorized modification to the Auto-Ohm. To ensure that designed safety features are maintained, it is recommended that all Auto-Ohm repairs be performed at Vanguard Instruments Co. or by an authorized repair-service. Unauthorized equipment modifications can create unknown safety hazards and will void the Auto-Ohm warranty.

Follow Exact Operating Procedures

Any deviation from the operating procedures described in this manual may create one or more safety hazards, damage the unit or cause test result errors; Vanguard Instruments Co. assumes no liability for unsafe or improper use of the Auto-Ohm.

Auto-Ohm Operating Procedures

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1.0 INTRODUCTION

1.1 Applicability

This manual applies to Series II of the Model Auto-Ohm™ (hereafter, Auto-Ohm), identified by Part Number VIC-60000-S2 made by Vanguard Instruments Company. A separate manual applies to Series I (the first design configuration) of the Auto-Ohm.

1.2 Supersedure Notice

This Operator's manual is the basic issue for Series II Auto-Ohm and does not supersede any previously published manual.

1.3 General Description

The Auto-Ohm micro-ohmmeter is made by Vanguard Instruments Company and features microprocessor-control for measuring very low resistances ranging from 1 micro-ohm to 300 milliohms with high accuracy. The Auto-Ohm is field-portable, rugged, and is easily operated by first-time users having little or no training; it features a one-knob control and an LCD alpha/numeric display of the resistance measured. The one-knob control operation is logical and simple: **Turning the knob** scrolls through a menu of possible options (which display in sequence) **and pressing the knob** activates the selected function. As its name implies, the Auto-Ohm operation is automatic, requiring little more from the user than connecting it to an unknown resistance and selecting what it is to do and how the test results are to be presented. The Auto-Ohm stores the last 3 resistance measurements, which can be displayed during test.

1.4 Functional Description

The Auto-Ohm's operation is based on the electrical relationships described by Ohm's law: $R=V/I$, where I is a known current and V is the dc voltage measured across the

unknown resistance (typically, a circuit-breaker's contacts). Since the current (user selected) through the unknown resistance is known and the voltage across the unknown resistance is read by a precision voltmeter, the resistance read-out is a direct function of the voltage being measured. The voltage is read directly as resistance (translated and displayed on a digital readout). The dc test current is selectable in 2-amp steps, from 10 to 100 amperes. Test current is gradually ramped up and down (automatic function), which virtually eliminates magnetically induced transients through the circuit-breaker current transformers. ***The risk of inductively tripping a circuit breaker (bus differential relay) is virtually non-existent.*** The Auto-Ohm performs all of these functions in one simple process. Voltmeter test leads run separately from the current-bearing test leads to the resistive load; thus, voltages are measured at the terminals of the resistance being tested, eliminating any $I \cdot R$ voltage drop error in the current cables. The Auto-Ohm test voltage is supplied by a DC power supply. A precisely regulated constant-current source ensures measured voltage is a function of the resistance alone, and not affected by current-cable resistance losses. These Auto-Ohm features make very precise micro-ohm measurements possible without having to calculate compensations for current lead resistances errors.

1.5 Furnished Test Accessories

The Auto-Ohm is supplied with one 35-foot test cable with quick disconnect test plugs at the unit end and heavy-duty alligator clamps at the test-load end. ***Heavy-duty welding-type C-clamps are available as optional accessories*** (these C-clamps allow test lead connections to a wide variety of bushing sizes, bus bars, and conductors that require low-resistance test-lead contacts).

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2.0 AUTO-OHM SPECIFICATIONS

Auto-Ohm specifications and leading particulars are listed in Table 1

Table 1. Auto-Ohm Specifications and Leading Particulars

MODEL	Auto-Ohm
PART NUMBER	VIC-60000-S2
TYPE	Special-Purpose Test Equipment, Portable, Low Resistance-Ohmmeter
CONFIGURATION	Second-generation (improved design, superseding original model)
SIZE (inches)	16.8 Wide by 12.6 High by 10.6 Deep
WEIGHT	Less than 21 pounds
RESISTANCE RANGE	1 micro-ohm to 300 milliohms
TEST CURRENT RANGE	10 Amperes to 100 Amperes, Selectable with ± 2 ampere increment
DISPLAY	Backlit LCD, 2-lines high by 16 characters Wide
ACCURACY	± 1 % of Reading, ± 1 Count, ± 2 micro-ohms
OPERATING POWER	8 amps, 90-132 Vac or 200-230 Vac (selectable), 50/60 Hz, With 10A built in circuit breaker
UNIT PROTECTION ...	thermal-overload sensor and cutoff
INTERFACE	RS-232C Connector Port for PC Interface
ENVIRONMENT	Operating: 0°C to 55°C; Storage: -40°C to 65°C
FURNISHED ITEMS ...	One power cord, one 35-ft. test lead cable, one test-cable carrying bag
WARRANTY	One-Year Parts & Labor (Post-Warranty Service Contracts Available)

AUTO-OHM SPECIFICATIONS ARE SUBJECT TO UPGRADES AND TO BEING CHANGED WITHOUT PRIOR NOTICE.

3.0 CONTROLS and DISPLAYS

(See Figure 1 and refer to Table 2.)

The Auto-Ohm controls and displays are shown in the control-panel illustration, Figure 1. Pointing leader lines reference each item with an index number. Each index number is cross-referenced to a functional description in Table 2, which describes the

function and purpose of each item on the control panel. Although the purpose of these controls and the display may seem obvious and intuitive, users should become familiar with them before attempting to use the Auto-Ohm. First-time users should also review and become familiar with the Safety Summary in the front page.

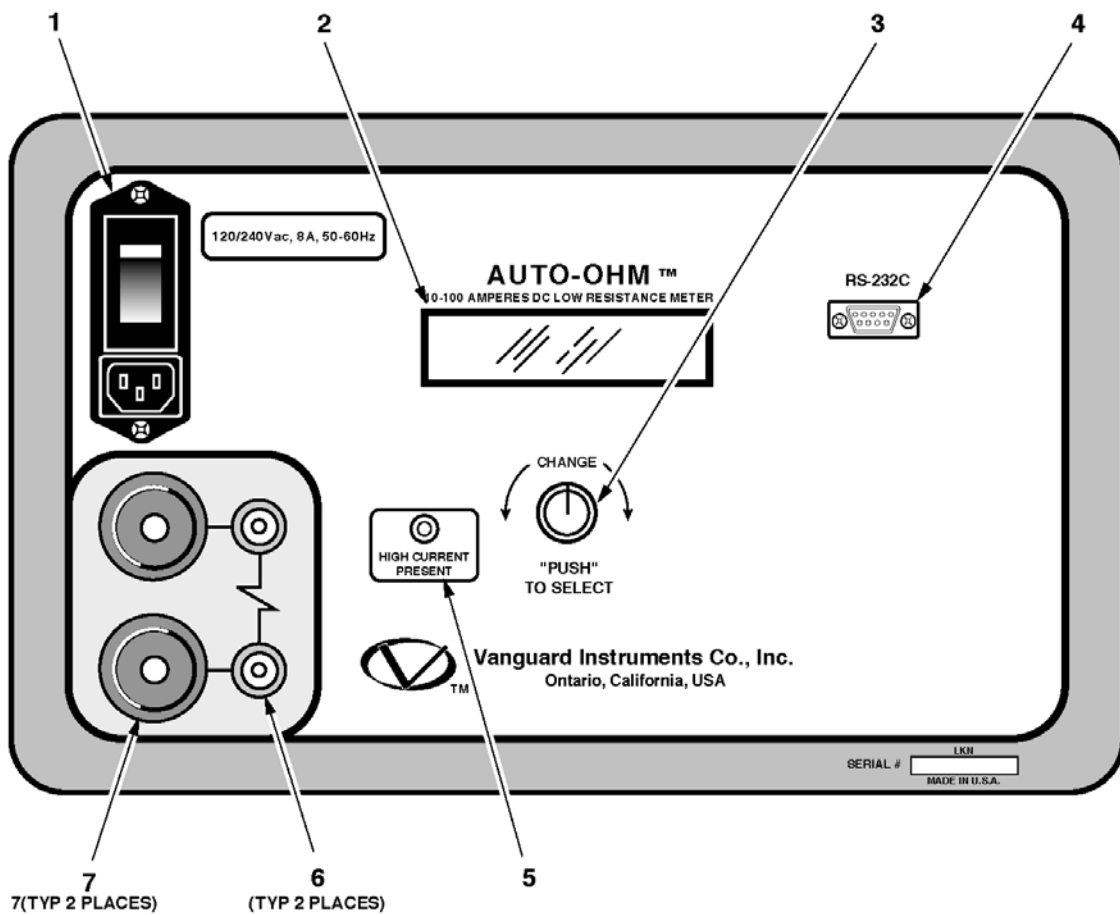


Figure 1. Auto-Ohm Control-Panel Controls and Display

Auto-Ohm Operating Procedures

Table 2. Functional Description of Auto-Ohm Controls and Display

Figure 1 Index #	Adjacent Panel Marking	Functional Description
1	120/240 Vac, 8A, 50- 60 Hz	Input power connector with third-wire safety ground and 10A built-in circuit breaker
2	no marking	LCD; 4-line by 16-character; back-lighted; Displays menus of selections, operator entries, and test-measurement results
3	CHANGE “PUSH” TO SELECT	One-knob control (all Auto-Ohm menus and selections are controlled by this one control knob). <i>Turning this control knob scrolls through different menu options</i> (shown on an LCD), which display. <i>Pressing the knob selects</i> the displayed function, usually producing a new menu of selectable options. See Figure 2 for a summary of the step-by-step operating procedures
4	RS-232C	RS-232C interface port; 9-pin connector; female DB type. The data are set to 19,200 baud, 1 start bit, 8 data bits, and no parity bit; <u>PIN</u> <u>SIGNAL</u> 2 Rx 3 Tx 5 Signal Gnd
5	HIGH CURRENT PRESENT	LED indicator, red; Lights when high test current is going through the test leads.
6	(resistor symbol)	Voltage-sensing connector jacks (red).
7	(None)	Current lead connectors (red); Female jacks for heavy-gauge test cables, which conduct up to 100 amperes of test current.

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4.0 OPERATING VOLTAGES

The Auto-Ohm operating voltages are selectable between 90-130Vac, 50/60Hz or

210-240, 50/60Hz. Voltage selection is set by jumpers on terminal block as shown on Table 3, below.

Table 3. Voltage Selection

VOLTAGE SELECTION	TERMINAL BLOCK JUMPERS
90-130Vac	Brown to blue & yellow to green
210-240Vac	Blue to yellow

5.0 CABLE CONNECTION

(See Figure 2.)

The Auto-Ohm is supplied with 35-foot test cables with quick disconnect test plug at one end and heavy-duty alligator clamps at the other end. Each test cable consists of a current-carrying cable and a voltage-sensing cable. The current-carrying cable is

terminated with a 200-ampere male plug. The sensing cable is terminated with a 25-ampere female plug. Insert current-cable plugs and voltage-sensing cable plugs into respective control-panel jacks (Figure 2). Ensure that ***voltage plugs are inserted into jacks adjacent to companion current jacks.***

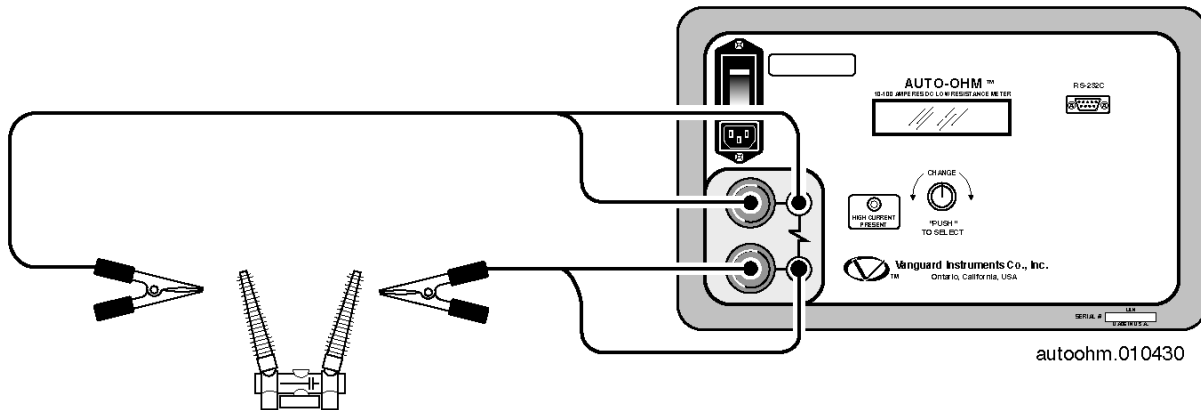


Figure 2. Typical Auto-Ohm Cable Hook-Up Diagram

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6.0 OPERATING THE AUTO-OHM

(See Figure 3. for step-by-step procedures.) The Auto-Ohm is operated by just one dual-function control knob. The operator turns the control knob to scroll through different menu selections on the display. When the desired option appears, it is selected by simply pressing the control knob like a pushbutton. Review Figure 3 before proceeding with the step-by-step procedures that follow.

6.1 STEP-BY-STEP PROCEDURES

6.1.1 Precautions

CAUTION

Do not measure resistance of inductive devices, which can create unsafe high-voltage spikes if the test current is interrupted by a detached test lead (created by collapsing magnetic field). Do not touch or disconnect any test lead that is connected to a device under test while current is being conducted. ***Failure to heed this warning can result in damage to the Auto-Ohm.*** The Auto-Ohm measures low, non-inductive resistances (e.g., breaker contacts and bus-bar junctions); If the resistance of an inductive device is desired, the use of an Instruments designed for that purpose is recommended (such as the Accutrans made by the Vanguard Instruments Company).

6.1.2 Preparations

- Plug the Auto-Ohm power cable into a power outlet.
- Insert current-cable plugs and voltage-sensing cable plugs into respective control-panel jacks (Figure 2). Ensure that voltage plugs are inserted into jacks adjacent to companion current jacks.

- Attach test-cable clamps to opposite terminals of the resistive load being tested.
- To turn on Auto-Ohm power, press the rocker switch to ON (item 1 in Figure 1).

NOTE

All Auto-Ohm operations begin at the MAIN MENU, which appears after the initial boot-up (after configuration and software revision data display briefly.) The Main Menu display is shown below:



Figure 4. Main Menu

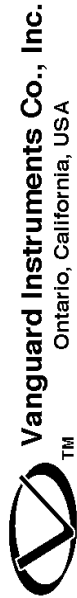
- The main menu displays a list of four options, which appear in sequence as the control knob is turned. The four functions of the Main-Menu list are: RUN TEST, ADJ CONTRAST, 100A CAL. CHECK, and PREVIOUS RESULTS.
- When the option of choice appears in the Main Menu, press (or “Push”) the control knob to enter the selection and start that sequence. The step-by-step operating procedures to follow describe each of the selected options in the order listed above. To run a test, ***turn the control knob*** until RUN TEST appears on the display, ***then press the control knob*** to begin the procedures for running a test.

6.1.3 Run Test Procedure

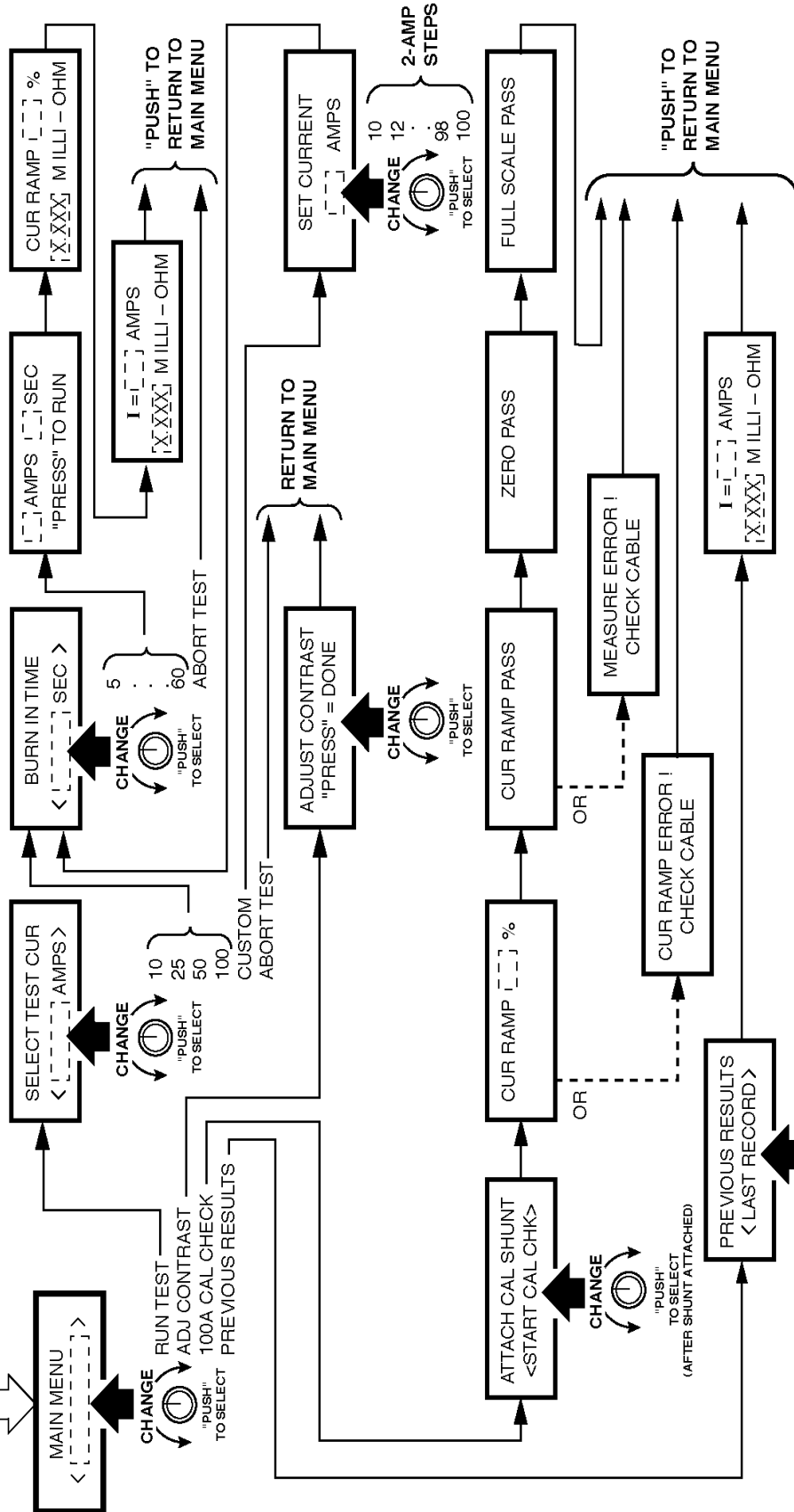
The display (SELECT TEST CURRENT) will appear to the user after the user presses control knob from the RUN TEST menu, (Figure 4).



Figure 5. Select 10A Menu



AUTO-OHM
POWER ON / BOOT



LEGEND OF SYMBOLS

- CHANGE INDICATES THAT KNOB MUST BE TURNED TO SELECT TEST OPTION (DISPLAYED). "PUSH" STARTS SELECTED ACTION.
- "PUSH" TO SELECT INDICATES AREA ON DISPLAY WHERE OPERATOR'S OPTIONS APPEAR (MENU IS LISTED JUST RIGHT OF KNOB SYMBOL).
- [] INDICATES DISPLAY AREA WHERE VARIABLE DATA APPEAR (MENU SELECTIONS OR NUMERICAL DATA).
- X.XXX INDICATES NUMBER OF DIGITS TO BE DISPLAYED (WITH DECIMAL POINT, IF ANY).

Figure 3. Step-by-Step Procedures for Auto-Ohm Operation

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a. This screen prompts the user to select the desired test current. Test current options are: 10, 25, 50, 100, CUSTOM, and ABORT TEST. If any of the 10 through 100 amperes options is the choice, turn the control knob until that current level displays, then press the knob to enter that choice (in which case go to step d). If a smaller increment of current is desired, select CUSTOM (figure 6) and press the control knob and go to the next step. The SET CUSTOM CURRENT menu is shown in Figure 7.



**SELECT TEST CUR
<CUSTOM>**

Figure 6. Select Custom Current Menu

b. This menu allows the user to select any test current from 10 to 100 amperes



**SELECT TEST CUR
<50 AMPS>**

Figure 7. Custom Current Menu

c. Custom current is defaulted for 50AMPS (mid point) in this menu. Turn the control knob until the current of choice displays; then press the control knob to set the desired current. The display will now show the BURN IN TIME menu (Figure 8).

NOTE

Selecting ABORT TEST causes the display to return to the Main Menu.



**BURN IN TIME
<5 SEC>**

Figure 8. Burn-In Time Menu

d. This menu selects the amount of time the burn-in current will be run through the test load just before its resistance is measured.

Burn-in time range is from 5 to 60 seconds (in 5-second steps). *The default burn-in time is set for 5 seconds.* Turn the control knob until the desired burn-in time appears in the display, then press the control knob to enter that time. Go to the next step.



**50 AMPS 5 SEC
"PRESS" TO RUN**

Figure 9. Test Current & Burn-In Time

e. This display (above) shows the current and time that have been selected. If these are as the user intended, then press the control knob to accept the selections and begin the burn-in and measurement sequence. Go to the next step.



CUR RAMP: 20%

Figure 10. Current Ramp Menu

f. This display (above) shows the current ramp percentage (of the test-level current). The Auto-Ohm will ramp test current from 0 (zero) amperes to the desired test current level in 3 seconds. The test current is gradually ramped up and down (an automatic function), which virtually eliminates magnetically induced transients through the circuit breaker current transformers. When ramp stabilizes at 100%, the next display appears automatically.



**BURNING IN: 02
120.1 MICRO-OHM**

Figure 11. Burn-In Menu

g. This display shows the resistance reading and the remaining burn-in time of the test.

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**I=100 AMPS
120 MICRO-OHM**

Figure 12. Test Current & Resistance Readings

h. The Auto-Ohm then ramps the test current back to zero. Figure 12 shows the final resistance measurement and the test current at which the resistance was measured.

i. After the result is examined, press the control knob and observe that the display returns to the MAIN MENU. From the Main Menu another test can be run; or if this completes the testing requirements, turn off power to the Auto-Ohm, disconnect test leads and power cable, and stow them. This completes the procedure for performing the RUN TEST procedure.

NOTE

For a “100A test current and 5-second burn-in test” test, the user can use the “Quick Test” command as follows:

1. From the RUN TEST menu, hold the “PUSH” control knob for 2 seconds then release it. The Auto-Ohm will beep twice to acknowledge the Quick Test command.
2. Press, then release, the “PUSH” control knob. The Auto-Ohm will run a 100A test with a 5- second burn in time.

6.1.4 Contrast Adjustment

The purpose of this procedure is to adjust the darkness level of the alpha-numeric characters shown in the display to produce the best readability for the ambient light in the testing area. This begins by selecting

ADJ CONTRAST on the Main Menu (refer to paragraph 6.1.2 e).

**MAIN MENU
<ADJ. CONTRAST>**

Figure 13. Select Adjust Contrast Menu

a. Press knob to select “ADJ. CONTRAST” mode. The following menu will be shown.

**ADJUST CONTRAST
“PRESS”= DONE**

Figure 14. Contrast Menu

b. Turn the control knob until the contrast is suitable for the best operator. When the contrast is best suited for the operator, press the control knob; the display returns to the Main Menu. This ends the contrast-adjustment procedure.

6.1.5 Auto-Ohm Cal Check

The purpose of the Calibration Check is to verify that the Auto-Ohm is operating within acceptable specifications by running a functional check on the Auto-Ohm electronics. From the MAIN MENU, turn knob to display <100A CAL CHECK> on the LCD (see Figure 15).

**MAIN MENU
<100A CAL CHECK>**

Figure 15. 100A Cal Check Menu

a. When this prompt appears, press the control knob to begin the calibration check. The following display appears.

**ATTACH SHORT BAR
<START CAL CHK>**

Figure 16. Attach Short Bar Prompt

b. Attach the test leads on an unused bus bar (several inches apart, the spacing is not critical, since this is a functional check). Press the control knob to start test.

c. This display shows the current ramping status. When test current ramps to 100 %, this display is automatically replaced by the following test-result display.

**CURRENT RAMP CIRCUIT
"PASS"**

Figure 17. Current-Ramp Circuit Pass Message

d. The above status display indicates the current ramped properly; if so, go to the step f. If the current did not ramp properly (test failed) the display below appears; if so, go to the next step.

**CUR RAMP ERROR!
CHECK CABLES**

Figure 18. Cur Ramp Error Message

e. If message shown above displays, press the control knob to abort the test (restart the Cal Check when the problem is corrected).

**ZERO CIRCUIT CHECK
"PASS"**

Figure 19. Zero Circuit Test Message

f. The Auto-Ohm checks the "ZERO" circuit. The "PASS" message displays as shown above.

**FSCL CIRCUIT CHECK
"PASS"**

Figure 20. Full-Scale Circuit Test Message

g. The "MEASURE CIRCUIT" is tested next. The "PASS" message displays is shown below:

**MEASURE CIRCUIT CHCK
"PASS"**

Figure 21. Measure Circuit Test Message

h. The Auto-Ohm calibration complete message appears as shown on the following display:

**CAL CHECK DONE!
PRESS KEY.....**

Figure 22. Cal Check Complete Message

This completes the Calibration Check procedure. Press the control knob to return to the Main Menu.

6.1.6 Display Previous Results

The purpose of this procedure is to let an operator view the last 3 reading stored in the Auto-Ohm. This procedure begins at the Main Menu, when PREVIOUS RESULTS is selected (Figure 23).

**MAIN MENU
<PREV RESULTS>**

Figure 23. Previous Results Menu

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a. Press control knob to select this mode. The user now can select any of the last three reading to be displayed. To select the reading, turn the control knob to one of the menus.

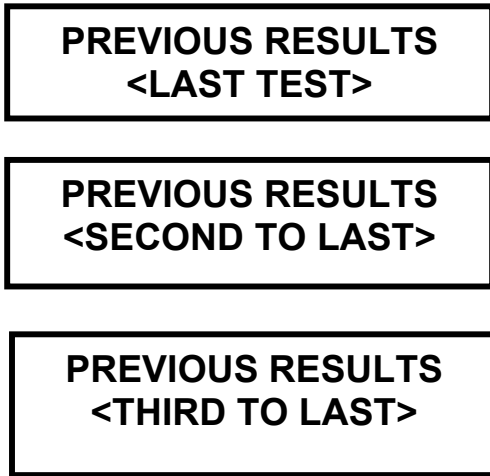


Figure 24. Select Reading Menus

b. When one of the prompts above displays, press the control knob to display reading.



Figure 25. Test Record Readout

c. The above display shows the recorded test resistance (120.2 Micro-ohms) and the test current level (100 amps) at which it was measured. When the displayed record of resistance is reviewed and noted, press the control knob to return to the Main Menu. This ends the PREVIOUS RESULTS procedure.

This concludes the operating procedures for all Auto-Ohm functions.

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APPENDIX A

Auto-Ohm Troubleshooting Guide

Item	Symptom	Possible Problem	Solution
1	Reading is incorrect.	1. Poor connection at the test clips. 2. Broken sensing leads.	1. Check connections to ensure teeth of voltage-sensing and current clips are firmly in contact with the device under test. 2. Inspect sensing cables.
2	No Test Current. (Current % read zero) and resistance reading=0	1. No test current going through the device under test. 2. Drive circuit not working	1. Check Connection to the device under test. 2. Run Calibration Test.
3	Have test current but resistance reading = 0.	1. Broken sensing leads. 2. Reverse sensing leads.	1. Inspect sensing leads.

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APPENDIX B

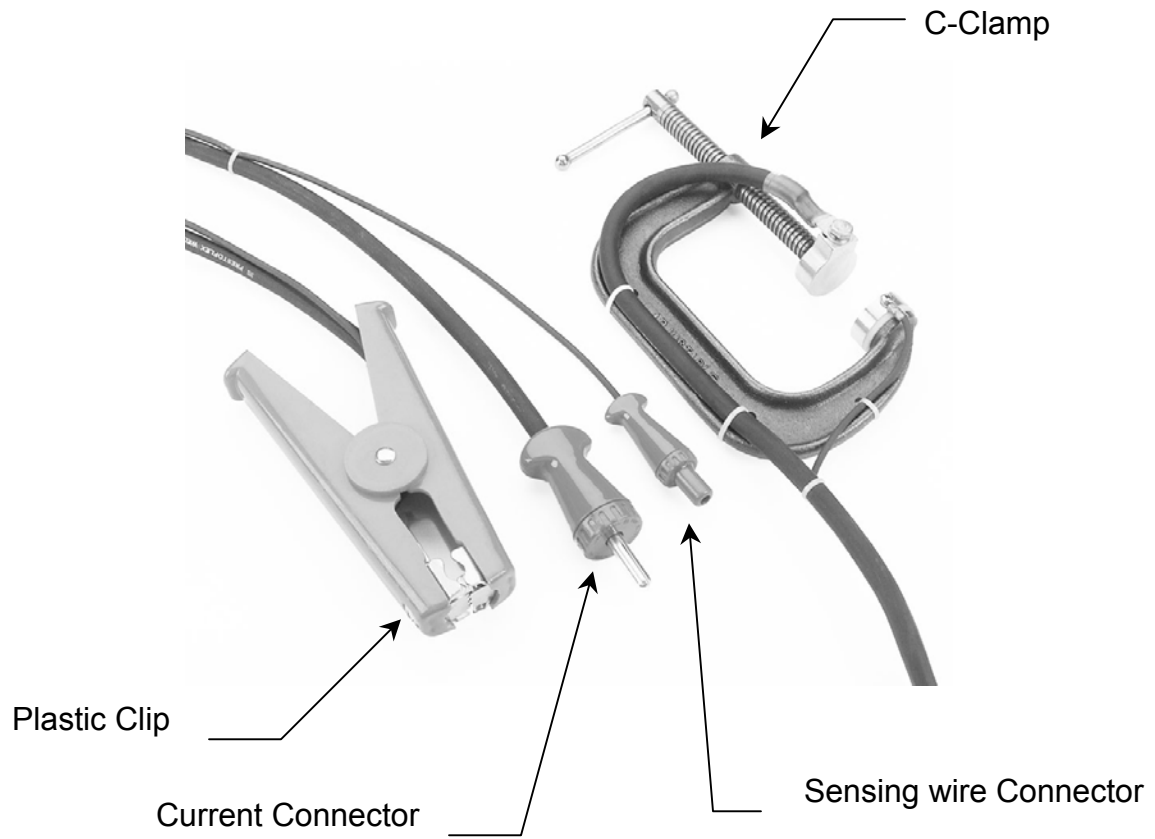


Illustration of plastic quick-disconnect clip, C-clamp, Current Connector, and Sensing-wire connectors



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