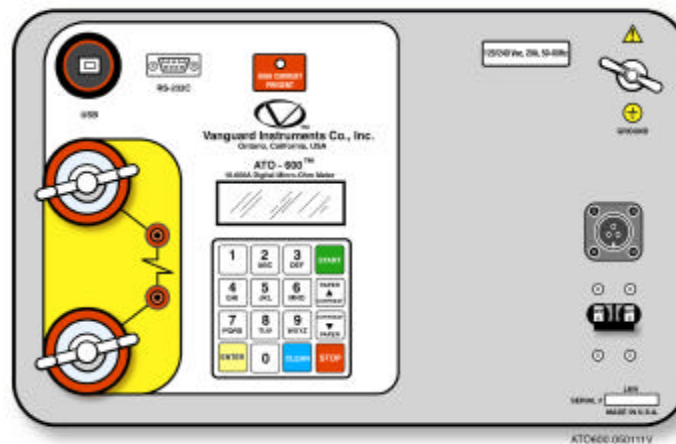
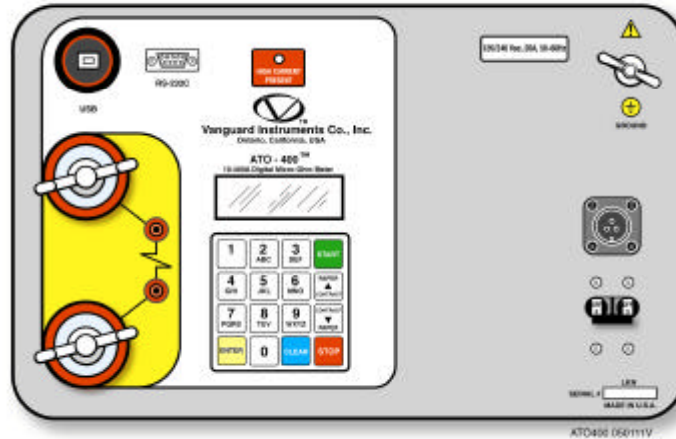

OPERATING INSTRUCTIONS
for the
ATO-400 and ATO-600
10-400/600 Amperes
Digital Micro-Ohm Meters



Vanguard Instruments Company, Inc.
1710 Grevillea Court
Ontario, California 91761

SAFETY SUMMARY

NOTICE

This manual applies to Models ATO-400, and ATO-600. The operating procedures are virtually the same for all models; any differences are clearly described in the step-by-step procedures.

Follow Exact Operating Procedures

Any deviation from the procedures described in this operator's manual may create one or more safety hazards, damage the ATO, or cause errors in the test results; Vanguard Instruments Co., Inc. assumes no liability for unsafe or improper use of the ATO.

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

SAFETY WARNINGS AND CAUTIONS

This device shall be used only by **trained operators**.

All circuit breakers under test shall be off line and fully isolated.

Do Not Modify Test Equipment

Because of the risk of introducing unknown hazards, do not install substitute parts or perform any unauthorized modification to any *Model ATO Test Unit*. To ensure that all designed safety features are maintained, it is recommended that repairs be performed only by Vanguard Instruments Co. factory personnel or by an authorized repair service. Unauthorized modifications can cause serious safety hazards and will nullify the manufacturer's warranty.

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1.0 INTRODUCTION

1.1 Applicability

This manual applies to the Model ATO-400™ and Model ATO-600™ (hereafter, ATO), made by Vanguard Instruments Company, Inc.

1.2 General Description

The ATO-400/600 are third generation micro-ohmmeters made by Vanguard Instruments Company. The ATO-400/600 feature high accuracy microprocessor-controlled measurement of very low resistances, ranging from 1 micro-ohm to 300 milli-ohms. The ATO is field-portable, rugged, and is easily operated by first-time users having a minimum of training. It features a 16-key push button keypad for entering test parameters and control functions and a 4-line by 20-character LCD alpha/numeric readout for displaying control-option menus, measured resistance values, and related data. The operation requires little more than connecting test leads to an unknown resistance and selecting the desired functions and its options. Operators select the test current (10 to 400 amperes for the ATO-400 or 10 to 600 amperes for the ATO-600) and test time (5 to 60 seconds). Measured resistance data is displayed on the ATO's LCD. The measured resistance data can also be stored (up to 63 records of 96 readings each) in FLASH EEPROM memory. Operators can recall the stored resistance measurements and related data at a later time for review or down loading to the PC. Down loading test records is accomplished by using the ATO's built-in RS-232C or USB ports.

1.3 Functional Description

The ATO's operation is based on the electrical relationship 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 measured by a precision voltmeter, the resistance displayed on the LCD is calculated using Ohm's law. The ATO test voltage is supplied by an unfiltered DC power supply. A regulated constant-current source outputs the preset current selected by the user.

The DC test current is selectable from 10 to 400 amperes for the ATO-400 and from 10 to 600 amperes for ATO-600. ***Since the ATO-400 and ATO-600 use unfiltered DC current supplies, there is the possibility of inductively tripping a circuit breaker bus differential relay.*** Each ATO is supplied with a set of current cables and voltage sensing cables. Voltage sensing test cables are separate from the current-carrying test cables 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. These ATO features make very precise micro-ohm measurements possible without having to compensate for current-lead resistance errors.

1.4 Furnished Test Accessories

The ATO is supplied with two 15-foot (#1/0 AWG) test cables with heavy-duty alligator clamps and two 15-foot voltage-sensing cables with alligator clamps. A ground cable and power cord is also included with each ATO.

1.5 Optional Accessories

1. Heavy-duty welding-type C-clamps (Figure 3) 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.
2. An optional shipping case (which holds the ATO and its cables) is also available.



Figure 1 ATO Current Cable



Figure 2 ATO Sensing cable



Figure 3 C-Clamp Cable

ATO-400 / ATO-600 Operating Procedures

2.0 ATO SPECIFICATIONS

2.1 ATO-400 Specifications

ATO-400 specifications and leading particulars are listed in Table 1.0

Table 1.0 ATO-400 Specifications

MODEL	ATO-400
TYPE	Special-Purpose Test Equipment, Portable, Low Resistance-Ohmmeter
CONFIGURATION	Third-generation (improved design, superseding original model)
SIZE (inches)	16.8 Wide by 12.6 High by 10.6 Deep (42.7 Cm x 32 Cm x 30.5 Cm)
WEIGHT	43 pounds (19.5 Kg)
TEST CURRENT RANGE	10 Amperes to 400 Amperes, selectable in 1 ampere steps
RESISTANCE RANGE	1 micro-ohm to 300 milli-ohms
ACCURACY	± 1 % Reading, ± 1 Count
MEMORY	63 records of 96 reading each
DISPLAY	Backlit LCD, 4-lines high by 20 characters wide
CONTROL	Keypad: 10 number keys and 6 function keys
INPUT POWER	20 amps, 90-230 Vac, 50/60 Hz, with built in 25A circuit breaker
UNIT PROTECTION ...	Thermal-overload sensor and cutoff
INTERFACE	RS-232C and USB Ports for PC Interface
ENVIRONMENT	Operating: -10°C to 50°C (15°F to 122°F) Storage: -30°C to 70°C (-22°F to 158°F)
FURNISHED ITEMS ...	One power cord, one ground cable, 15-ft.(#1/0 AWG) current test cables, 15-ft. sensing test cables
WARRANTY	One-Year Parts & Labor (Post-Warranty Service Contracts Available)

ATO-400 SPECIFICATIONS ARE SUBJECT TO UPGRADES AND MAY BE CHANGED WITHOUT PRIOR NOTICE.

ATO-400 / ATO-600 Operating Procedures

2.2 ATO-600 Specifications

ATO-600 specifications and leading particulars are listed in Table 2.0

Table 2.0 ATO-600 Specifications

MODEL	ATO-600
TYPE	Special-Purpose Test Equipment, Portable, Low Resistance-Ohmmeter
CONFIGURATION	Third-generation (improved design, superseding original model)
SIZE (inches)	16.8 Wide by 12.6 High by 10.6 Deep (42.7 Cm x 32 Cm x 30.5 Cm)
WEIGHT	43 pounds (19.5 Kg)
TEST CURRENT RANGE	10 Amperes to 600 Amperes, selectable in 1 ampere steps
RESISTANCE RANGE	1 micro-ohm to 300 milli-ohms
ACCURACY	± 1 % Reading, ± 1 Count
MEMORY	63 records of 96 reading each
DISPLAY	Backlit LCD, 4-lines high by 20 characters wide
CONTROL	Keypad: 10 number keys and 6 function keys
INPUT POWER	20 amps, 90-230 Vac, 50/60 Hz, with built in 25A circuit breaker
UNIT PROTECTION ...	Thermal-overload sensor and cutoff
INTERFACE	RS-232C and USB Ports for PC Interface
ENVIRONMENT	Operating: -10°C to 50°C (15°F to 122°F) Storage: -30°C to 70°C (-22°F to 158°F)
FURNISHED ITEMS ...	One power cord, one ground cable, 15-ft. (#1/0 AWG) current test lead cables, 15-ft. sensing test lead cables
WARRANTY	One-Year Parts & Labor (Post-Warranty Service Contracts Available)

ATO-600 SPECIFICATIONS ARE SUBJECT TO UPGRADES AND MAY BE CHANGED WITHOUT PRIOR NOTICE.

3.0 CONTROL AND DISPLAY

3.1 ATO-400 Front Panel

The ATO-400 controls and displays are shown in the control-panel illustration, Figure 4. Pointing leader lines reference each item with an index number. Each index number is cross-referenced to a functional description in Table 3, 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 ATO-400. First-time users should also review and become familiar with the Safety Summary on the front page.

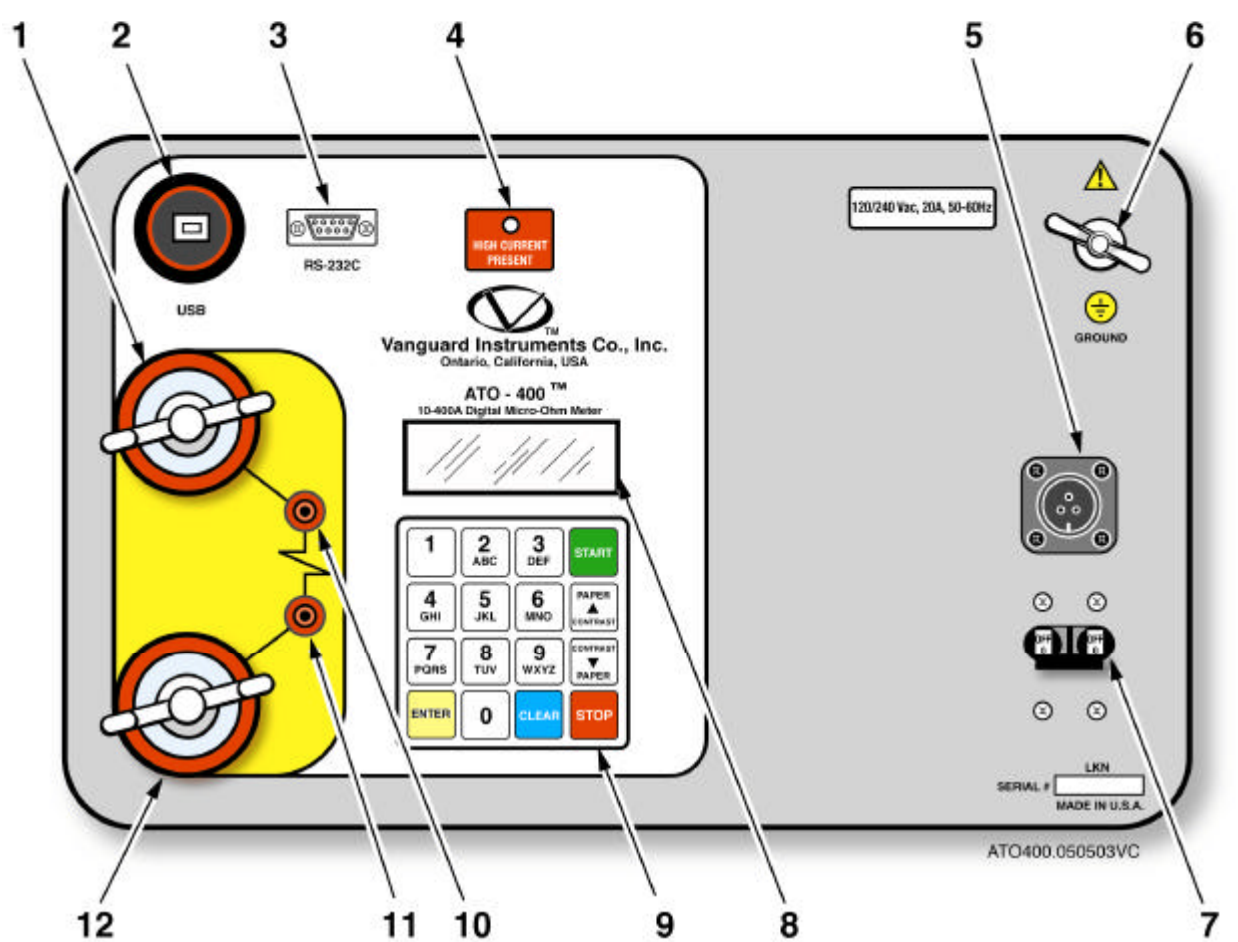


Figure 4 ATO-400 Control-Panel Controls and Display

Table 3.0 Functional Description of ATO-400 Controls and Display

Figure 1 Index #	Adjacent Panel Marking	Functional Description
1 & 12	(Wing Nut)	Current lead connectors.
2	USB	USB connector. USB port is for factory calibration, firmware updates, and interfacing with the software program supplied with each unit.
3	RS-232C	RS-232C interface port; 9-pin connector; female DB type. The data are set to 115,200 baud, 1 start bit, 8 data bits, and no parity bit; <div style="text-align: center;"> <u>PIN</u> <u>SIGNAL</u> 2 Rx 3 Tx 5 Signal Gnd </div> This serial port is for factory calibration, firmware updates, and interfacing with the software program supplied with each unit.
4	HIGH CURRENT PRESENT	LED indicator, red; Lights when test current is flowing through the current test leads.
5	No Marking	Input power connector with third-wire safety ground.
6	GROUND (Wing Nut)	ATO-400 ground stud. Connect ground stud to substation ground using provided cable.
7	No Marking	Circuit breaker, 25A.
8	No marking	LCD; 4-line by 20-character; back-lighted; displays menus of selections, operator entries, and test-measurement results.
9	No marking	Operating key-pad controls, 10 alpha-numeric keys and 6 function keys (START, STOP, CLEAR, ENTER, & CONTRAST/PAPER positioning ? & ?).
10 & 11	(Resistor Symbol)	Voltage-sensing connector jacks (red).

3.2 ATO-600 Front Panel

The ATO-600 controls and displays are shown in the control-panel illustration, Figure 5. Pointing leader lines reference each item with an index number. Each index number is cross-referenced to a functional description in Table 4, 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 ATO-600. First-time users should also review and become familiar with the Safety Summary on the front page.

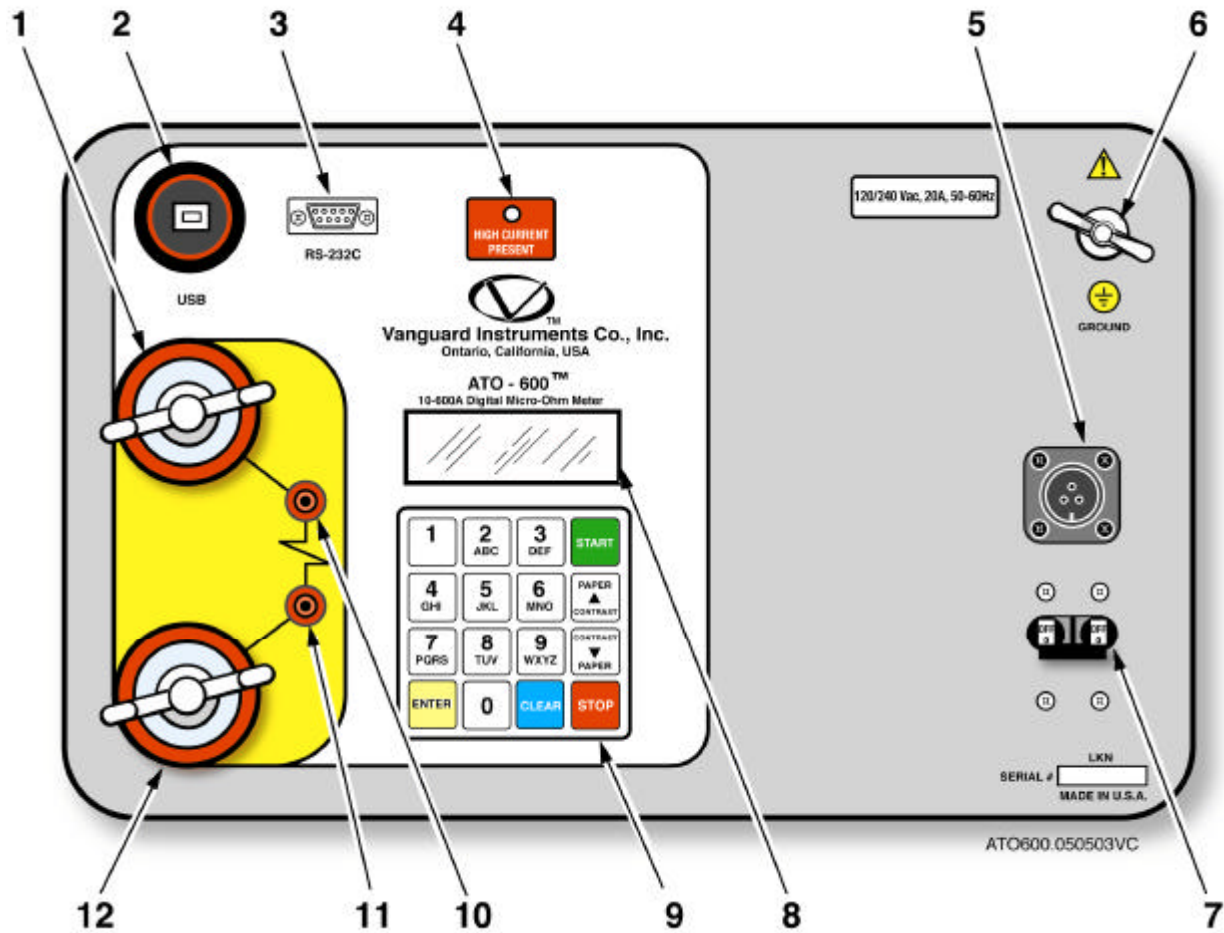


Figure 5 ATO-600 Control-Panel Controls and Display

Table 4.0 Functional Description of ATO-600 Controls and Display

Figure 1 Index #	Adjacent Panel Marking	Functional Description
1 & 12	(Wing Nut)	Current lead connectors.
2	USB	USB connector. USB port is for factory calibration, firmware updates, and interfacing with the software program supplied with each unit.
3	RS-232C	RS-232C interface port; 9-pin connector; female DB type. The data are set to 115,200 baud, 1 start bit, 8 data bits, and no parity bit; <u>PIN</u> <u>SIGNAL</u> 2 Rx 3 Tx 5 Signal Gnd This serial port is for factory calibration, firmware updates, and interfacing with the software program supplied with each unit.
4	HIGH CURRENT PRESENT	LED indicator, red; Lights when test current is flowing through the current test leads.
5	No Marking	Input power connector with third-wire safety ground.
6	GROUND (Wing Nut)	ATO-600 ground stud. Connect ground stud to substation ground using provided cable.
7	No Marking	Circuit breaker, 25A.
8	No marking	LCD; 4-line by 20-character; back-lighted; displays menus of selections, operator entries, and test-measurement results.
9	No marking	Operating key-pad controls, 10 alpha-numeric keys and 6 function keys (START, STOP, CLEAR, ENTER, & CONTRAST/PAPER positioning ? & ?).
10 & 11	(Resistor Symbol)	Voltage-sensing connector jacks (red).

4.0 ATO IMPORTANT FEATURES

4.1 Operating Voltages

The ATO operates with voltages between 90-240Vac, 50/60Hz.

4.2 ATO RS-232C Serial Interface

A built-in, RS-232C port permits the ATO to be interfaced with an IBM-compatible personal computer. An IBM PC software package supplied with each ATO allows the user to retrieve test records stored in the ATO's memory. The software is compatible with Windows XP.

The RS-232C port is also used to calibrate the ATO at the factory.

4.3 ATO USB Interface

A built-in, USB port permits the ATO to be interfaced with an IBM-compatible personal computer. An IBM PC software package supplied with each ATO allows the user to retrieve test records stored in the ATO's memory. The software is compatible with Windows XP.

The USB port is also used to calibrate the ATO at the factory.

4.4 ATO LCD Contrast Adjustment

The purpose of this procedure is to adjust the contrast level of the alpha-numeric characters shown on the LCD display, in order to produce the best readability for the ambient light in the testing area. To darken the LCD contrast, press and hold the Contrast/Paper ? key for more than 1 second. To lighten the LCD contrast, press and hold the Contrast/Paper ? key for more than 1 second. Release the key when desired contrast level is obtained. The ATO saves this LCD contrast setting level in memory.

5.0 ATO CABLE CONNECTION

The ATO is supplied with 15-foot (#1/0 AWG) current-carrying cables and 15-foot voltage-sensing cables. Both cables are terminated with heavy-duty alligator clamps to connect to the device being tested. A typical cable connection for the ATO to a device under test is shown in figure 6 and figure 7. To protect the ATO against static discharge in the substation, always connect the unit's ground stud to the substation ground. It is also highly recommended to ground one side of the circuit breaker bushing during testing to eliminate any static discharge through the ATO.

NOTE

The sense input is not polarity sensitive. The sense cables may be connected to either input without affecting circuit operation.

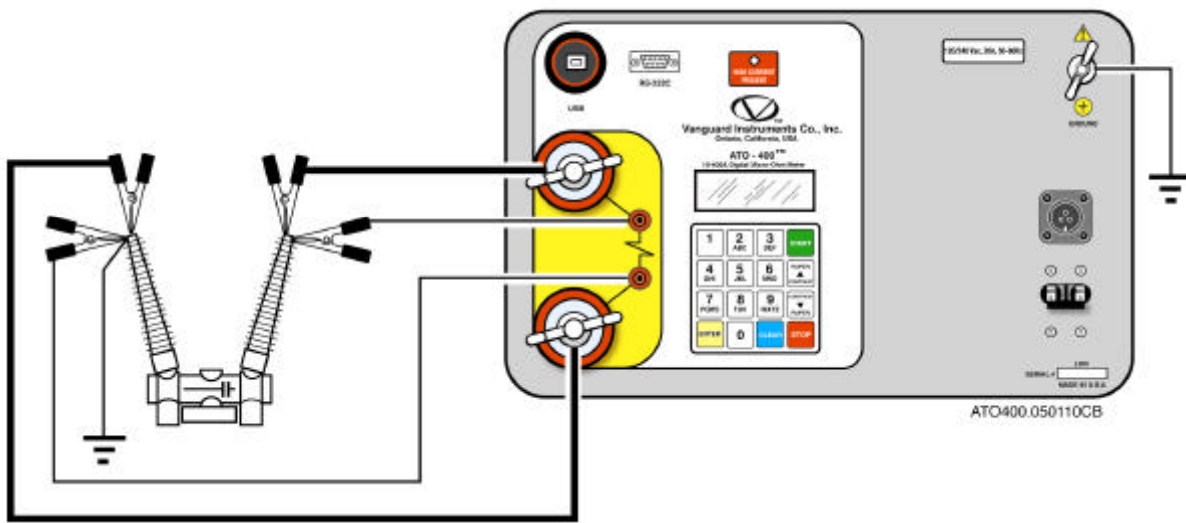


Figure 6 ATO-400 Connection Diagram

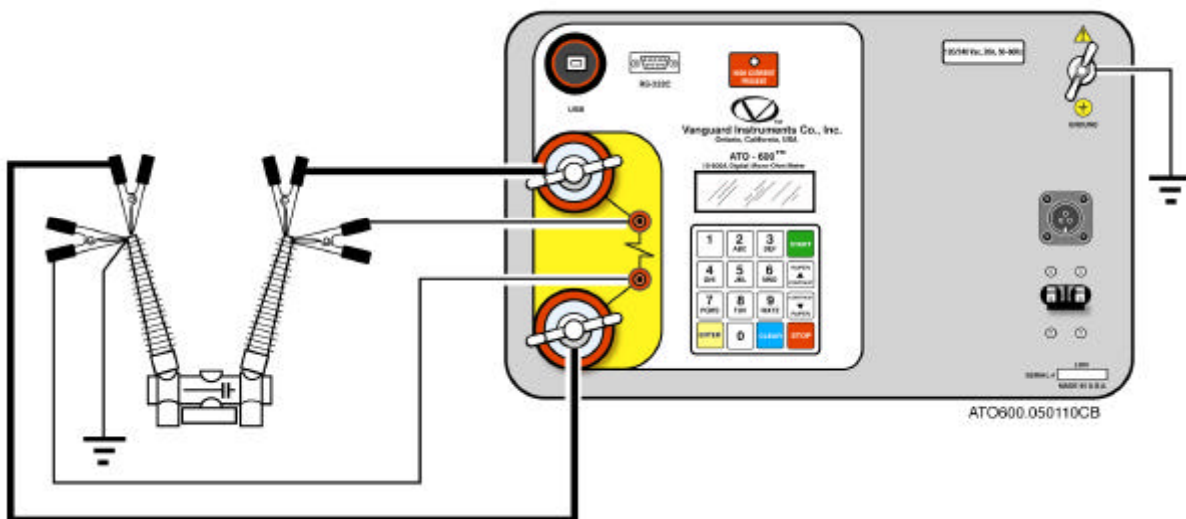


Figure 7 ATO-600 Connection Diagram

6.0 OPERATING PROCEDURES

Review Figure 10 before proceeding with the step-by-step procedures that follow.

6.1 Step-by-Step Procedures

6.1.1 Precautions

Do not measure the resistance of inductive devices. This can generate unsafe high-voltage spikes (created by a collapsing magnetic field) if the test current is interrupted by detaching a test lead during a test. 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 cause injury to the user and or damage to the ATO.*** The ATO measures low, non-inductive resistances (e.g., breaker contacts and bus-bar junctions). If the resistance of an inductive device needs to be measured, then the use of an instrument designed for that purpose is recommended (such as the WRM made by Vanguard Instruments Company).

6.1.2 Preparations

- a. Ground ATO to Substation ground.
- b. Plug the ATO power cable into a power outlet.
- c. Connect the current-cable lugs and the voltage-sensing cable plugs to control-panel (Figures 4 & 5).
- d. Attach the current test-cable clamps to opposite terminals of the resistive load being tested (Figures 6 & 7).
- e. Attach the voltage-sensing clamps to the terminals of the resistive load. The sensing voltage clamps should be inside the current clamps.
- f. Turn on ATO power, by pressing the rocker switch to ON.

6.2 Operating Overview

Procedures for operating the ATO are presented in tabular format, with a different table for each of the operations available. All operations are described in step-by-step sequences. Each step is indexed by number and indicates an operator action, followed by a description of what should be observed on the ATO display to confirm the action. All operations begin with the START menu (shown below):

1. RUN TEST	04/30/05
2. SETUP	12:25:00
3. DIAGNOSTIC	

Figure 8 START Menu

Item 1 (RUN TEST) is a menu of functions and options available for measuring an unknown resistance. Item 2 (SETUP) is for record manipulation in the ATO. Item 2 (SETUP) expands into a menu of support functions. Item 3 (DIAGNOSTIC) is a performance-verification operation for checking key circuit functions.

- | |
|--|
| <ol style="list-style-type: none">1. ENTER RECORD ID2. REVIEW RECORD3. RESTORE RECORD4. NEXT PAGE |
|--|

Figure 9 SETUP Menu

The SETUP MENU lists 4 user options:

Item 1 (ENTER RECORD ID) is used to input identification information for each stored data record (see 7.1.7).

Item 2 (REVIEW RECORD) is used to review stored records (see 7.1.8).

Item 3 (RESTORE RECORD) is used to erase or restore test records or to scroll through records in stored memory (see 7.1.9).

Item 4 (NEXT PAGE) is used to set the ATO's real time clock and perform calibration test.

6.2.1 Entering Alpha/Numeric Characters

Entering alpha/numeric characters is done via the keypad (similar to a telephone keypad – see item 9 of Figures 4 & 5). To input characters, press the key once to select the number marked on the key. Press the key a second time to select the first letter marked on the key. Press the key a third time to select the second letter marked on the key. Press the key a fourth time to select the third letter marked on the key.

Additional key presses will repeat the selection cycle (e.g., 2, A, B, C, 2 . . .).

When the character of choice is selected, press the ? key to advance to next character space.

Press the ? key to go back one character space. Press CLEAR to delete a selected character (the cursor must be under the character to be deleted).

Again, press the "ENTER" key to load all character selections and move to the next input screen.

If no information is needed in a particular input screen, press the "ENTER" key and the display will advance to the next screen without entering any data.

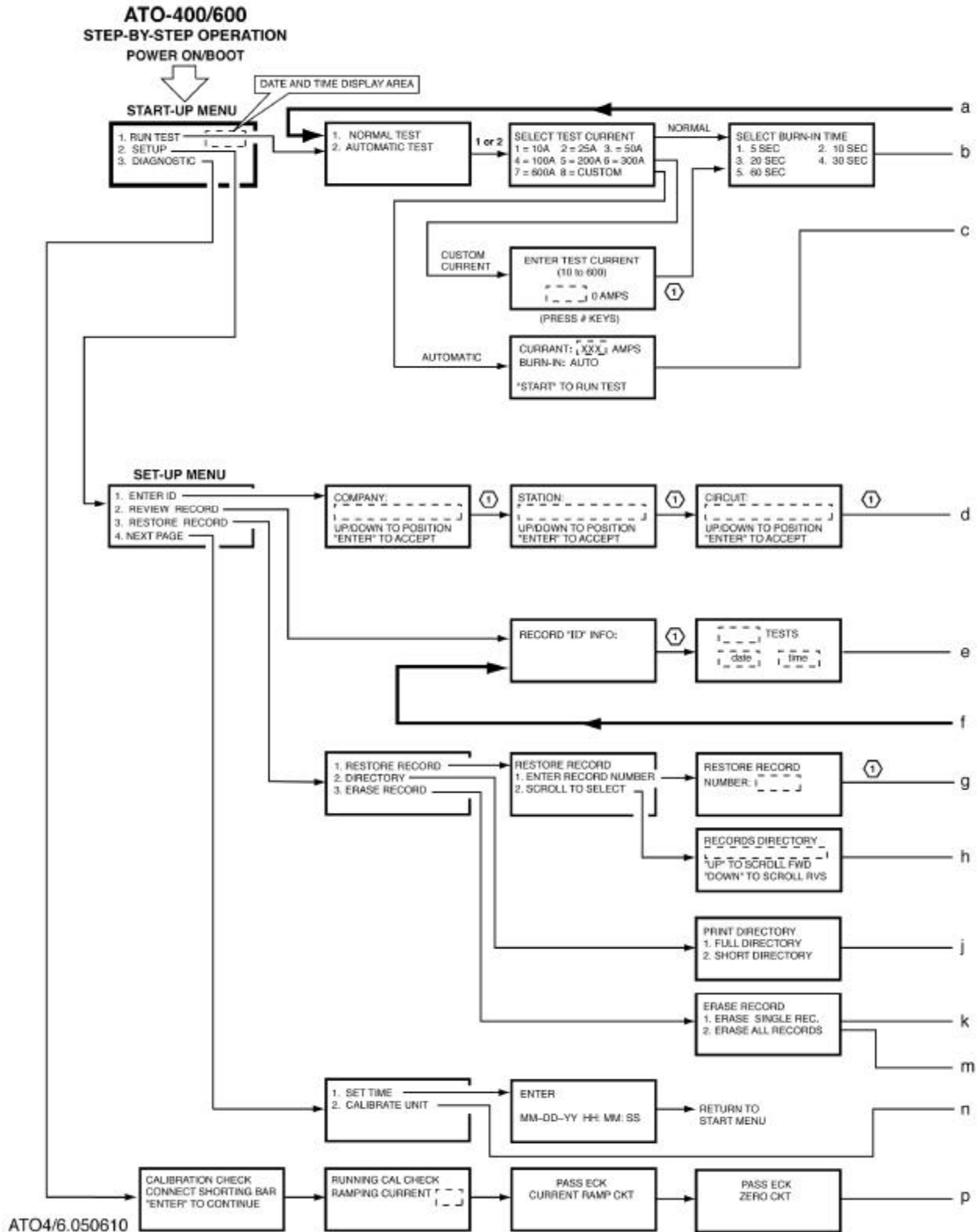
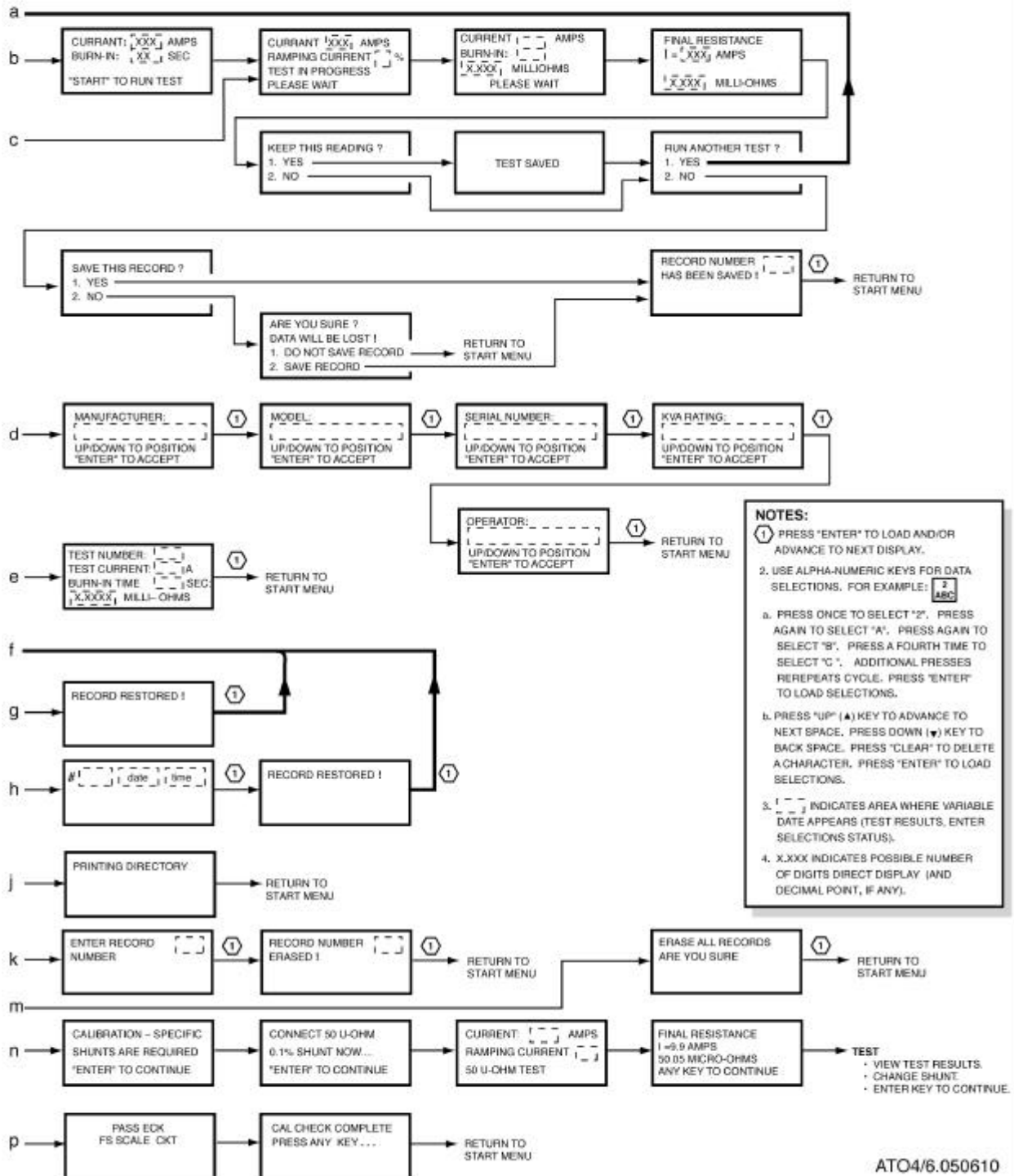


Figure 10 Step-by Step Procedures for for ATO Operations



ATO4/6.050610

6.3 Run Normal Test Procedure

The following procedure describes the steps to measure an unknown resistance.

NOTE

The red HIGH CURRENT PRESENT indicator will flash while test current is applied to the resistive load.

Table 5.0 Run Test Procedure (Measure an Unknown Resistance)

STEP	ACTION	ATO DISPLAY
5-1	Begin RUN TEST procedure: Press key # 1 on START MENU. A menu of test options appears.	<div style="border: 1px solid black; padding: 5px;"> <p>1.NORMAL TEST 2. AUTOMATIC TEST</p> </div>
5-2	Select Normal Test by pressing key #1. “SELECT TEST CURRENT” menu appears.	<div style="border: 1px solid black; padding: 5px;"> <p>SELECT TEST CURRENT: 1. 10A 2. 25A 3. 50A 4. 100A 5. 200A 6. 300A 7. 400A 8. CUSTOM</p> </div> <p>Or</p> <div style="border: 1px solid black; padding: 5px;"> <p>SELECT TEST CURRENT: 1. 10A 2. 25A 3. 50A 4. 100A 5. 200A 6. 300A 7. 600A 8. CUSTOM</p> </div>
5-3	Select a test current: Press key a (1 to 7) for the desired test current. The SELECT BURN-IN TIME menu appears. Go to step 5-4. For this example, a 600A test current was selected. For a user-defined (CUSTOM) test current, press key # 8 and go to step 5-3a.	<div style="border: 1px solid black; padding: 5px;"> <p>SELECT BURN-IN TIME: 1. 5 SEC 2. 10 SEC 3. 20 SEC 4. 30 SEC 5. 60 SEC</p> </div>
5-3a	Custom test current levels (in 1 amp steps) are entered via the keypad. When finished entering the value press the “ENTER” key and go to step 5-4. For this example, we entered 95A test current. NOTE “INVALID ENTRY” will appear on the display if an invalid value is entered.	<div style="border: 1px solid black; padding: 5px;"> <p>ENTER TEST CURRENT (10 to 100) 95 AMPS</p> </div> <p>or</p> <div style="border: 1px solid black; padding: 5px;"> <p>ENTER TEST CURRENT (10 to 200) 95 AMPS</p> </div>

Table 5.0 Run Test Procedure (Measure an Unknown Resistance Continued)

STEP	ACTION	ATO DISPLAY
5-4	<p>Select burn-in time by pressing key (1 -5) that corresponds to the desired burn-in time (see display on step 5-3). A display of selected test current and burn-in time appears.</p> <p style="text-align: center;">NOTE</p> <p>A 5-second burn-in time was selected in this example.</p>	<div style="border: 1px solid black; padding: 5px; text-align: center;"> <p>CURRENT: 600 AMPS BURN-IN: 5 SEC “START” TO RUN TEST</p> </div>
5-5	<p>Press the START key to run a resistance measurement test. The ramping current and percent of ramp level displays with the notice TEST IN PROGRESS. When the test current has ramped up to the specified level (current is at 100%), the test result display appears automatically.</p>	<div style="border: 1px solid black; padding: 5px; text-align: center;"> <p>CURRENT: 600 AMPS RAMPING CURRENT 10% TEST IN PROGRESS PLEASE WAIT</p> </div>
5-6	<p>Automatic, no operator action required. Current, burn-in time, and resistance measurement changes appear on the display during burn-in. At the end of the burn-in time,-the current returns to zero.</p>	<div style="border: 1px solid black; padding: 5px; text-align: center;"> <p>CURRENT: 600.4 AMPS BURN-IN: 5 SEC 200.3 MICRO-OHMS PLEASE WAIT</p> </div>
5-7	<p>Automatic, no operator action required. At the end of the burn-in time the final resistance measurement displays. Press the “ENTER” key to go to next display.</p>	<div style="border: 1px solid black; padding: 5px; text-align: center;"> <p>FINAL RESISTANCE I= 600.4 AMPS 200.3 MICRO-OHMS</p> </div>
5-8	<p>The “KEEP THIS READING?” menu displays on the LCD.</p>	<div style="border: 1px solid black; padding: 5px; text-align: center;"> <p>KEEP THIS READING? 1. YES 2. NO</p> </div>
5-9	<p>If the test resistance measurement is to be stored in the meomory, press key #1 (YES). If the test is not to be stored in memory, then press key #2 (NO).</p>	<div style="border: 1px solid black; padding: 5px; text-align: center;"> <p>TEST SAVED</p> </div>

Table 5.0 Run Test Procedure (Measure an Unknown Resistance Continued)

STEP	ACTION	ATO DISPLAY
5-10	"RUN ANOTHER TEST?" displays.	<div style="border: 1px solid black; padding: 5px;"> <p>RUN ANOTHER TEST? 1. YES 2. NO</p> </div>
5-11	If another test is required, press key #1 (YES). The SELECT TEST CURRENT menu will appear. Go to step 5-12. If another test is <i>not</i> required, then press key #2 (NO) and go to step 5-15.	<div style="border: 1px solid black; padding: 5px;"> <p>SELECT TEST CURRENT: 1. 10A 2. 25A 3. 50A 4. 100A 5. 200A 6. 300A 7. 400A 8. CUSTOM</p> </div>
5-12	Return to step 5-2 to setup for another test Repeat the sequence from step 5-2 to step 5-10.	Step 5-2 thru 5-10 displays repeat.
5-13	"SAVE THIS RECORD?" displays when another test was not selected in step 5-12. The test record contains all the readings taken in this test.	<div style="border: 1px solid black; padding: 5px;"> <p>SAVE THIS TEST RECORD? 1. YES 2. NO</p> </div>
5-14	To save this record, press key #1 (YES). If the test record is <i>not</i> to be saved, press key #2 (NO) and go to step 5-16. <p style="text-align: center;">NOTE</p> A test record is saved in Flash EEPROM. A record number will be automatically assigned to the record by the ATO. (The Test record was assigned #2 in this example).	<div style="border: 1px solid black; padding: 5px;"> <p>RECORD NUMBER 2 HAS BEEN SAVED!</p> </div>
5-15	When the record is saved the RECORD NUMBER "x" shows on display. Press ENTER to return to the START MENU.	<div style="border: 1px solid black; padding: 5px;"> <p>1. RUN TEST 04/11/05 2. SETUP 12:24:01 3. DIAGNOSTIC</p> </div>
5-16	Pressing key #2 (NO) on SAVE THIS TEST RECORD (see step 5-14) causes the ARE YOU SURE? prompt (shown at right).	<div style="border: 1px solid black; padding: 5px;"> <p>ARE YOU SURE? DATA WILL BE LOST! 1. DO NOT SAVE RECORD 2. SAVE RECORD</p> </div>

Table 5.0 Run Test Procedure (Measure an Unknown Resistance Continued)

ITEM	ACTION	ATO DISPLAY
5-17	If key #1 is pressed, the test record will be erased from memory and the display returns to the "START MENU". If key #2 is pressed, the test record will be saved in Flash EEPROM. The test record number assigned to this record will be displayed. Exit the RECORD SAVED display by pressing ENTER, which returns the display to the START MENU.	<div style="border: 1px solid black; padding: 5px;"><p>1. RUN TEST 04/11/05 2. SETUP 12:24:01 3. DIAGNOSTIC</p></div>

This ends the RUN NORMAL TEST procedure.

6.4 Run Automatic Test Procedure

Automatic Test Mode allows the user to initiate a test by applying the sense cables across the resistive load. This feature is handy when the user wants to take multiple resistance readings of the same load or of different loads in the same current path.

The burn-in time for Automatic Test is set for 5 seconds. The resistance reading is stored in the ATO’s working memory. The user can save up to 96 readings per test record. The ATO Flash EEPROM can store 63 test records.

The following procedure describes the steps to measure an unknown resistance using the Automatic Test Mode.

NOTE

The current cables should be connected across the resistive load to establish the current path. Removing and reconnecting one or both sense cables starts a new test.

Table 6.0 Run Automatic Test Procedure (Measure an Unknown Resistance)

STEP	ACTION	ATO DISPLAY
6-1	Begin RUN TEST procedure: Press key #1 on START MENU.	<div style="border: 1px solid black; padding: 5px;"> <p>1.NORMAL TEST 2. AUTOMATIC TEST</p> </div>
6-2	<p>Select Automatic test by pressing key #2. The “SELECT TEST CURRENT” menu appears. Press key 1 to 7 for desired test current. For this example, 100A test current was selected.</p> <p>For a user-defined (CUSTOM) test current, press key # 8 and go to step 6-3.</p> <p style="text-align: center;">NOTE</p> <p>Burn-in time is set for 5 seconds in Automatic Test.</p>	<div style="border: 1px solid black; padding: 5px;"> <p>SELECT TEST CURRENT: 1. 10A 2. 25A 3. 50A 4. 100A 5. 200A 6. 300A 7. 400A 8. CUSTOM</p> </div> <p style="text-align: center;">or</p> <div style="border: 1px solid black; padding: 5px;"> <p>SELECT TEST CURRENT: 1. 10A 2. 25A 3. 50A 4. 100A 5. 200A 6. 300A 7. 600A 8. CUSTOM</p> </div>
6-3	<p style="text-align: center;">NOTE</p> <p>For this example, 100A custom test current was selected.</p>	<div style="border: 1px solid black; padding: 5px;"> <p>ENTER TEST CURRENT (10 to 400) 100 AMPS</p> </div> <p style="text-align: center;">or</p> <div style="border: 1px solid black; padding: 5px;"> <p>ENTER TEST CURRENT (10 to 600) 100 AMPS</p> </div>
6-4	The Auto test mode START menu will display the selected test current.	<div style="border: 1px solid black; padding: 5px;"> <p>CURRENT: 100 AMPS BURN-IN: AUTO “START” TO RUN TEST</p> </div>

Table 6.0 Run Test Procedure (Measure an Unknown Resistance Continued)

STEP	ACTION	ATO DISPLAY
6-5	Press the START key to run a resistance measurement test. Percent of ramp level displays with the notice TEST IN PROGRESS. When the test current has ramped up to the specified level (current is at 100%), the test result displays automatically.	<div style="border: 1px solid black; padding: 5px; text-align: center;"> <p>AUTO TEST MODE RAMPING CURRENT 10% TEST IN PROGRESS PLEASE WAIT</p> </div>
6-6	Automatic, no operator action required. Current, burn-in time, and resistance measurement changes appear on the display during burn-in. At the end of the burn-in time, the current returns to zero.	<div style="border: 1px solid black; padding: 5px; text-align: center;"> <p>AUTO TEST MODE BURN-IN: AUTO 500.5 MICRO-OHMS PLEASE WAIT</p> </div>
6-7	Automatic, no operator action required. At the end of the burn-in time the final resistance displays. To initiate another test, disconnect then reconnect one or both sense cables, steps 6-5 to 6-7 will be repeated (without having to press the START key in step 6-5). To end Automatic test mode, press the STOP key.	<div style="border: 1px solid black; padding: 5px; text-align: center;"> <p>FINAL RESISTANCE I= 100 AMPS 500.5 MICRO-OHMS AUTO TEST MODE</p> </div>
6-8	Pressing the STOP key will end the Automatic test mode and the "SAVE THIS RECORD" message is displayed.	<div style="border: 1px solid black; padding: 5px; text-align: center;"> <p>SAVE THIS RECORD? 1. YES 2. NO</p> </div>
6-9	To save this record, press key #1 (YES). If the test record is <i>not</i> to be saved, press key #2 (NO) and go to step 6-11. NOTE A test record is saved in Flash EEPROM. A record number will be automatically assigned to the record by the ATO. (The Test record was assigned #2 in this example).	<div style="border: 1px solid black; padding: 5px; text-align: center;"> <p>RECORD NUMBER 2 HAS BEEN SAVED!</p> </div>
6-10	When a record is saved (the record # assigned shows on display), press ENTER to return to the START MENU.	<div style="border: 1px solid black; padding: 5px; text-align: center;"> <p>1. RUN TEST 04/11/05 2. SETUP 12:24:01 3. DIAGNOSTIC</p> </div>

Table 6.0 Run Test Procedure (Measure an Unknown Resistance Continued)

STEP	ACTION	ATO DISPLAY
6-11	Pressing key #2 (NO) on SAVE THIS TEST RECORD (see step 6-8) causes the ARE YOU SURE? prompt to be displayed (shown at right).	<div style="border: 1px solid black; padding: 5px;"> <p>ARE YOU SURE? DATA WILL BE LOST!</p> <p>1. DO NOT SAVE RECORD</p> <p>2. SAVE RECORD</p> </div>
6-12	If key #1 is pressed, the test record will be erased from the memory and the display returns to the "START MENU". If key #2 is pressed, the test record will be saved in Flash EEPROM. The test record number assigned to this record will be displayed. Exit the RECORD SAVED display by pressing ENTER, which returns to the START MENU.	<div style="border: 1px solid black; padding: 5px;"> <p>1. RUN TEST 04/11/05</p> <p>2. SETUP 12:24:01</p> <p>3. DIAGNOSTIC</p> </div>

This ends the RUN AUTOMATIC TEST procedure.

6.5 Enter Record ID Procedure

This procedure allows the user to enter the equipment identification data to the test record.

Table 7.0 Enter Record ID Procedure (test-record, site, and equipment identification)

STEP	ACTION	ATO DISPLAY
7-1	<p>Press key # 2 on the START MENU to go to the SETUP MENU shown at right. Note: Setup options 2 thru 4 go to the following procedural tables: 2. REVIEW RECORD procedures in Table 8.0 3. RESTORE RECORD Procedures in Table 9.0 4. NEXT PAGE procedures in Table 12.0.</p>	<div style="border: 1px solid black; padding: 5px;"> <p>1. ENTER RECORD ID 2. REVIEW RECORD 3. RESTORE RECORD 4. NEXT PAGE</p> </div>
7-2	<p>On the SETUP MENU, press key #1 (ENTER ID) to begin entering identification data beginning with the “COMPANY” input screen. Note: See Section 7.1.4 for instructions on entering alpha/numeric characters with the keypad.</p>	<div style="border: 1px solid black; padding: 5px;"> <p>COMPANY: UP/DOWN TO POSITION “ENTER” TO ACCEPT</p> </div>
7-3	<p>Enter the utility COMPANY name using the alpha/numeric keypad. Press “ENTER” to load the entered characters and advance to the “STATION” input screen.</p>	<div style="border: 1px solid black; padding: 5px;"> <p>STATION: UP/DOWN TO POSITION “ENTER” TO ACCEPT</p> </div>
7-4	<p>Enter the utility STATION name using the alpha/numeric keypad. Press “ENTER” to load the entered characters and advance to the “CIRCUIT” input screen.</p>	<div style="border: 1px solid black; padding: 5px;"> <p>CIRCUIT: UP/DOWN TO POSITION “ENTER” TO ACCEPT</p> </div>
7-5	<p>Enter the test CIRCUIT name using the alpha/numeric keypad. Press “ENTER” to load the entered characters and advance to the “MANUFACTURER” input screen.</p>	<div style="border: 1px solid black; padding: 5px;"> <p>MANUFACTURER: UP/DOWN TO POSITION “ENTER” TO ACCEPT</p> </div>
7-6	<p>Enter the test item’s MANUFACTURER name using the alpha/numeric keypad. Press “ENTER” to load the entered characters and advance to the “MODEL” input screen.</p>	<div style="border: 1px solid black; padding: 5px;"> <p>MODEL: UP/DOWN TO POSITION “ENTER” TO ACCEPT</p> </div>

Table 7.0 Enter Record ID Procedure (continued)

STEP	ACTION	ATO DISPLAY
7-7	Enter the test item's MODEL using the alpha/numeric keypad. Press "ENTER" to load the entered characters and advance to the "SERIAL NUMBER" input screen.	<div style="border: 1px solid black; padding: 5px;"> <p>SERIAL NUMBER:</p> <p>UP/DOWN TO POSITION "ENTER" TO ACCEPT</p> </div>
7-8	Enter the test item's SERIAL NUMBER using the alpha/numeric keypad. Press "ENTER" to load the entered characters and advance to the "KVA RATING" input screen.	<div style="border: 1px solid black; padding: 5px;"> <p>KVA RATING:</p> <p>UP/DOWN TO POSITION "ENTER" TO ACCEPT</p> </div>
7-9	Enter the test item's KVA RATING using the alpha/numeric keypad. Press "ENTER" to load the entered characters and advance to the "OPERATOR" input screen.	<div style="border: 1px solid black; padding: 5px;"> <p>OPERATOR:</p> <p>UP/DOWN TO POSITION "ENTER" TO ACCEPT</p> </div>
7-10	Enter the test OPERATOR name, using the alpha/ numeric keypad. Press "ENTER" to load the entered characters and return to the START MENU display.	<div style="border: 1px solid black; padding: 5px;"> <p>1. RUN TEST 06/11/04</p> <p>2. SETUP 12:26:01</p> <p>3. DIAGNOSTIC</p> </div>

This completes the ENTER ID procedure.

6.6 Review Record Procedure

This procedure describes the steps for reviewing a test record residing in the ATO’s working memory. The user can view the record on the LCD display.

This feature is useful when the user wants to review a test record stored in the ATO’s Flash EEPROM in the field or in the office.

NOTE

To review a test record stored in Flash EEPROM, the user must first restore the test record from Flash EEPROM to working memory (see paragraph 7.1.9 Restore Record Procedures).

Table 8.0 Review Record Procedure

STEP	ACTION	ATO DISPLAY
8-1	On the START MENU, press key #2 (SETUP) to select the SETUP MENU (shown at right).	<div style="border: 1px solid black; padding: 5px;"> <p>1. ENTER ID 2. REVIEW RECORD 3. RESTORE RECORD 4. NEXT PAGE</p> </div>
8-2	Press key #2 (REVIEW RECORD). The user can scroll through the test record by using the ^ and ? keys.	<div style="border: 1px solid black; padding: 5px;"> <p>RECORD ID INFO: 1710 VIC ABC</p> </div>
8-3	Part of the selected record’s ID appears displaying the record number, MANUFACTURER, and MODEL. Press the “ENTER” key to display the number of tests in the record, the date, and the time of the selected tests.	<div style="border: 1px solid black; padding: 5px;"> <p>2 TESTS 04/11/05 17:27:00</p> </div>
8-4	Pressing the “ENTER” key will list all test data: Test current, burn-in time, and the measured resistance value. NOTE The test record in this example contains 2 tests.	<div style="border: 1px solid black; padding: 5px;"> <p>TEST NUMBER: 1 TEST CURRENT: 100A BURN - IN TIME: 5 Sec 500.3 MICRO-OHMS</p> </div>
8-5	Press ? key to advance to next test. Press ? key to return to previous test.	<div style="border: 1px solid black; padding: 5px;"> <p>TEST NUMBER: 2 TEST CURRENT: 50A BURN - IN TIME: 5 Sec 500.1 MICRO-OHMS</p> </div>
8-6	Press STOP to return to START MENU.	Display returns to START MENU.

This completes the Review Record Procedure.

6.7 Restore Record Procedure

This procedure describes the steps to recall a test record stored in the ATO Flash memory to working memory.

Table 9.0 Restore Record Procedure

STEP	ACTION	ATO DISPLAY
9-1	On the START MENU, press key #2 (SETUP) to display the SETUP MENU.	1. ENTER ID 2. REVIEW RECORD 3. RESTORE RECORD 4. NEXT PAGE
9-2	On the SETUP MENU, press key #3 (RESTORE RECORD) to display a menu of options (Restore Record, Directory, Erase Record).	1. RESTORE RECORD 2. DIRECTORY 3. ERASE RECORD
9-3	Press key #1 (RESTORE RECORD) to display a menu of restore records options. Option 1 allows a user to restore a record when the record's number is known, Option 2 allows the user to scroll through the stored records to select the correct one.	RESTORE RECORD 1. ENTER RECORD NUMBER 2. SCROLL TO SELECT
9-4	OPTION 1: Press key #1 (ENTER RECORD NUMBER) to display a prompt to enter the record number to restore.	RESTORE RECORD NUMBER:
9-5	When the record's number has been entered, press the "ENTER" key to restore the selected record. A confirmation "RECORD RESTORED !" indicates that the record has been restored. Press "ENTER" key will then return to the REVIEW RECORD options menu (resume the procedure at step 8-2 in Table 8.0).	RECORD RESTORED!
9-6	OPTION 2: Press key #2 (SCROLL TO SELECT) in the RESTORE RECORD menu to display the Records Directory.	RECORDS DIRECTORY "UP TO SCROLL FWD "DWN" TO SCROLL RVS
9-7	In the Records Directory, use the ? and ? keys to scroll through the directory listings of the test records. When the test record of interest displays, press the "ENTER" key to restore the test record.	#1 04/11/05 17:27:00 1710 VIC

Table 9.0 Restore record Procedure (continued)

STEP	ACTION	ATO DISPLAY
9-8	The "RECORD RESTORED!" message is displayed. Press the "ENTER" key again to return to the REVIEW RECORD menu (resume the procedure at step 8-2 in Table 8.0).	<div style="border: 2px solid black; padding: 10px; text-align: center;">RECORD RESTORED!</div>

This completes the Restore Record Procedure.

6.8 Erase Test Record Procedure

This procedure describes the steps to delete a single test record or all the test records stored in the ATO Flash EEPROM.

Table 10.0 Erase Test Record Procedure

STEP	ACTION	ATO DISPLAY
10-1	On the RESTORE RECORD display (step 9-2), press key #3 (ERASE RECORD) to display the ERASE RECORD menu of options (shown at right).	<div style="border: 1px solid black; padding: 5px;"> <p>ERASE RECORD 1. ERASE SINGLE RECORD 2. ERASE ALL RECORDS</p> </div>
10-2	On the ERASE RECORD menu display, press key #1 to erase a single record.	<div style="border: 1px solid black; padding: 5px;"> <p>ERASE RECORD NUMBER: XX</p> </div>
10-3	Enter the record number to be deleted then press the “ENTER” key to confirm. Press the “ENTER” key again to return to the main menu. NOTE Press the “STOP” key to abort.	<div style="border: 1px solid black; padding: 5px;"> <p>RECORD NUMBER: XX ERASED!</p> </div>
10-4	Press key #2 to erase all the stored records in EEPROM. NOTE Press the “STOP” key to abort.	<div style="border: 1px solid black; padding: 5px;"> <p>ERASE ALL RECORDS! Are you SURE? “ENTER” TO CONTINUE</p> </div>
10-5	Press the “ENTER” key to confirm.	<div style="border: 1px solid black; padding: 5px;"> <p>ERASING RECORDS PLEASE WAIT</p> </div>
10-6	Press the “ENTER” key to return to the main menu.	<div style="border: 1px solid black; padding: 5px;"> <p>RECORDS ERASED!</p> </div>

6.9 Computer Control

A PC program is provided with each ATO allowing the user to download the test records stored in ATO Flash EEPROM to a PC. Test records can be stored on any media the PC is capable of handling. This allows the user to store and archive test records for reviewing at any time. Test records can also be printed from the PC through any printer to which it has access.

Downloading test records is accomplished by using the ATO's RS-232C or USB port.

NOTE

The ATO will interface with a PC when a command is received through the ATO's RS-232C or USB port.

6.10 Set ATO Clock Procedure

This procedure allows the user to set the ATO real time clock.

Table 11.0 Set ATO Real Time Clock Procedure

STEP	ACTION	ATO DISPLAY
11-1	Press key # 2 on the START MENU to go to the SETUP MENU shown at right.	<div style="border: 1px solid black; padding: 5px;"> <p>1. ENTER RECORD ID 2. REVIEW RECORD 3. RESTORE RECORD 4. NEXT PAGE</p> </div>
11-2	On the SETUP MENU, press key #4 (NEXT PAGE).	<div style="border: 1px solid black; padding: 5px;"> <p>1. SET TIME 2. CALIBRATE UNIT</p> </div>
11-3	Press key #1 to select "SET TIME".	<div style="border: 1px solid black; padding: 5px;"> <p>ENTER MM-DD-YY HH:MM:SS —</p> </div>
11-4	Enter month, date, year, hour, minute, and second.	<div style="border: 1px solid black; padding: 5px;"> <p>ENTER MM-DD-YY HH:MM:SS 05/10/05 20:05:00</p> </div>
11-5	After the date and time is entered, the ATO will return to the START MENU.	<div style="border: 1px solid black; padding: 5px;"> <p>1. RUN TEST 04/11/05 2. SETUP 12:26:01 3. DIAGNOSTIC</p> </div>

6.11 Calibration Test Procedure

This procedure describes the steps to verify the ATO measurement accuracy and generates a calibration report. Five different calibration shunts are required for this test: 50micro-ohm, 100 micro-ohm, 500 micro-ohm, 1000 micro-ohm, 1900 micro-ohm. These test shunts shall be 0.1% accuracy or better.

Table 12.0 Calibration Test Procedure

STEP	ACTION	ATO DISPLAY
12-1	Press key # 2 on the START MENU to go to the SETUP MENU shown at right.	<div style="border: 1px solid black; padding: 5px;"> 1. ENTER RECORD ID 2. REVIEW RECORD 3. RESTORE RECORD 4. NEXT PAGE </div>
12-2	On the SETUP MENU, press key #4 (NEXT PAGE).	<div style="border: 1px solid black; padding: 5px;"> 1. SET TIME 2. CALIBRATE UNIT </div>
12-3	Press key #2 to select “CALIBRATE UNIT”.	<div style="border: 1px solid black; padding: 5px;"> CALIBRATION-SPECIFIC SHUNTS ARE REQUIRED! “ENTER” TO CONTINUE </div>
12-4	Press “ENTER” key to continue.	<div style="border: 1px solid black; padding: 5px;"> CONNECT 50 ? -OHM 0.1% SHUNT NOW.... “ENTER” TO CONTINUE </div>
12-5	Connect the 50 micro-ohm shunt to ATO. Press “ENTER” key to start test.	<div style="border: 1px solid black; padding: 5px;"> CURRENT: 10.0 AMP BURN IN: 02 SEC 50 ? -OHM TEST </div>
12-6	The ATO will measure the 50 ? -ohm shunt using 10A test current. Observe test results on LCD.	<div style="border: 1px solid black; padding: 5px;"> FINAL RESISTANCE I= 9.9 AMPS 50.5 MICRO-OHM ANY KEY TO CONTINUE </div>
12-7	Press “ENTER” key to continue. The ATO will measure 50 ? -ohm shunt using 100A test current.	<div style="border: 1px solid black; padding: 5px;"> CURRENT: 100.0 AMP BURN IN: 02 SEC 50 ? -OHM TEST </div>
12-8	Observe test results. Press “ENTER” key to continue.	<div style="border: 1px solid black; padding: 5px;"> FINAL RESISTANCE I= 100.0 AMPS 50.4 MICRO-OHM ANY KEY TO CONTINUE </div>

Table 12.0 Calibration Test Procedure (Continued)

STEP	ACTION	ATO DISPLAY
12-9	Connect the 100 micro-ohm shunt to ATO. Press "ENTER" key to start test.	<div style="border: 1px solid black; padding: 5px;"> <p>CONNECT 100 ? -OHM 0.1% SHUNT NOW.... "ENTER" TO CONTINUE</p> </div>
12-10	The ATO will measure the 100 ? -ohm shunt using 10A test current.	<div style="border: 1px solid black; padding: 5px;"> <p>CURRENT: 10.0 AMP BURN IN: 02 SEC 100 ? -OHM TEST</p> </div>
12-11	Observe test results. Press the "ENTER" key to continue.	<div style="border: 1px solid black; padding: 5px;"> <p>FINAL RESISTANCE I= 10.0 AMPS 100.1 MICRO-OHM ANY KEY TO CONTINUE</p> </div>
12-12	The ATO will measure the 100 ? -ohm shunt using 100A test current.	<div style="border: 1px solid black; padding: 5px;"> <p>CURRENT: 100.0 AMP BURN IN: 02 SEC 100 ? -OHM TEST</p> </div>
12-13	Observe test results. Press "ENTER" key to continue.	<div style="border: 1px solid black; padding: 5px;"> <p>FINAL RESISTANCE I= 100.0 AMPS 100.1 MICRO-OHM ANY KEY TO CONTINUE</p> </div>
12-14	Connect the 500 micro-ohm shunt to ATO. Press "ENTER" key to start test.	<div style="border: 1px solid black; padding: 5px;"> <p>CONNECT 500 ? -OHM 0.1% SHUNT NOW.... "ENTER" TO CONTINUE</p> </div>
12-15	The ATO will measure the 500 ? -ohm shunt using 10A test current.	<div style="border: 1px solid black; padding: 5px;"> <p>CURRENT: 10.0 AMP BURN IN: 02 SEC 500 ? -OHM TEST</p> </div>
12-16	Observe test results. Press "ENTER" key to continue.	<div style="border: 1px solid black; padding: 5px;"> <p>FINAL RESISTANCE I= 10.0 AMPS 500.1 MICRO-OHM ANY KEY TO CONTINUE</p> </div>

Table 12.0 Calibration Test Procedure (Continued)

STEP	ACTION	ATO DISPLAY
12-17	The ATO will measure the 500 Ω -ohm shunt using 100A test current.	<div style="border: 1px solid black; padding: 5px;"> <p>CURRENT: 100.0 AMP BURN IN: 02 SEC 500 Ω -OHM TEST</p> </div>
12-18	Observe test results. Press “ENTER” key to continue.	<div style="border: 1px solid black; padding: 5px;"> <p>FINAL RESISTANCE I= 100.0 AMPS 500.1 MICRO-OHM ANY KEY TO CONTINUE</p> </div>
12-19	Connect the 1000 micro-ohm shunt to ATO. Press “ENTER” key to start test.	<div style="border: 1px solid black; padding: 5px;"> <p>CONNECT 1000 Ω -OHM 0.1% SHUNT NOW.... “ENTER” TO CONTINUE</p> </div>
12-20	The ATO will measure 1000 Ω -ohm shunt using 10A test current.	<div style="border: 1px solid black; padding: 5px;"> <p>CURRENT: 10.0 AMP BURN IN: 02 SEC 1000 Ω -OHM TEST</p> </div>
12-21	Observe test results. Press “ENTER” key to continue.	<div style="border: 1px solid black; padding: 5px;"> <p>FINAL RESISTANCE I= 9.8 AMPS 1000.1 MICRO-OHM ANY KEY TO CONTINUE</p> </div>
12-22	The ATO will measure the 1000 Ω -ohm shunt using 100A test current.	<div style="border: 1px solid black; padding: 5px;"> <p>CURRENT: 100.0 AMP BURN IN: 02 SEC 1000 Ω -OHM TEST</p> </div>
12-23	Observe test results. Press “ENTER” key to continue.	<div style="border: 1px solid black; padding: 5px;"> <p>FINAL RESISTANCE I= 99.9 AMPS 1000.1 MICRO-OHM ANY KEY TO CONTINUE</p> </div>
12-24	Connect the 1900 micro-ohm shunt to ATO. Press “ENTER” key to start test.	<div style="border: 1px solid black; padding: 5px;"> <p>CONNECT 1900 Ω -OHM 0.1% SHUNT NOW.... “ENTER” TO CONTINUE</p> </div>

Table 12.0 Calibration Test Procedure (Continued)

STEP	ACTION	ATO DISPLAY
12-25	The ATO will measure the 1900 Ω -ohm shunt using 10A test current.	<div style="border: 1px solid black; padding: 5px;"> <p>CURRENT: 10.0 AMP BURN IN: 02 SEC 1900 Ω -OHM TEST</p> </div>
12-26	Observe test results. Press “ENTER” key to continue.	<div style="border: 1px solid black; padding: 5px;"> <p>FINAL RESISTANCE I= 9.9 AMPS 1900.1 MICRO-OHM ANY KEY TO CONTINUE</p> </div>
12-27	The ATO will measure the 1900 Ω -ohm shunt using 100A test current.	<div style="border: 1px solid black; padding: 5px;"> <p>CURRENT: 100.0 AMP BURN IN: 02 SEC 1900 Ω -OHM TEST</p> </div>
12-28	Observe test results. Press “ENTER” key to continue.	<div style="border: 1px solid black; padding: 5px;"> <p>FINAL RESISTANCE I= 99.9 AMPS 1900.1 MICRO-OHM ANY KEY TO CONTINUE</p> </div>
12-29	The ATO returns to the START MENU.	<div style="border: 1px solid black; padding: 5px;"> <p>1. RUN TEST 04/11/05 2. SETUP 12:26:01 3. DIAGNOSTIC</p> </div>

6.12 Diagnostic Check Procedure

This procedure describes the steps to perform the diagnostic check on the ATO.

Table 13.0 Diagnostic Check Procedure

STEP	ACTION	ATO DISPLAY
13-1	The diagnostic check is a functional verification self-test of the ATO . This procedure begins by pressing key #3 on the START MENU, which displays a calibration check prompt to attach the test leads to a shorting bar (See Figure 11).	<div style="border: 1px solid black; padding: 5px; text-align: center;"> <p>DIAGNOSTIC CHECK</p> <p>CONNECT SHORTING BAR</p> <p>“ENTER” TO CONTINUE</p> </div>
13-2	When the test leads are attached to a shorting bar, press the “ENTER” key to start the self-test process. The self-test feature checks ramping current and displays a percent of ramp level as it ramps to full current. When the ramp reaches full current, the remaining self-check functions automatically sequence without operator control. If any circuit fails (does not pass), then do not use the ATO unit to measure any resistance until the problem has been corrected.	<div style="border: 1px solid black; padding: 5px; text-align: center;"> <p>RUNNING DIAG CHECK...</p> <p>RAMPING CURRENT: xx%</p> </div>
13-3	Automatic, no operator action required.	<div style="border: 1px solid black; padding: 5px; text-align: center;"> <p>RUNNING DIAG CHECK...</p> <p>CURRENT RAMP CKT</p> <p>“PASS”</p> </div>
13-4	Automatic, no operator action required.	<div style="border: 1px solid black; padding: 5px; text-align: center;"> <p>RUNNING DIAG CHECK...</p> <p>ZERO CKT CHECK</p> <p>“PASS”</p> </div>
13-5	Automatic, no operator action required.	<div style="border: 1px solid black; padding: 5px; text-align: center;"> <p>RUNNING DIAG CHECK...</p> <p>FSCALE CKT CHECK</p> <p>“PASS”</p> </div>
13-6	Automatic, no operator action required.	<div style="border: 1px solid black; padding: 5px; text-align: center;"> <p>RUNNING DIAG CHECK...</p> <p>MEAS CKT CHECK</p> <p>“PASS”</p> </div>
13-7	Automatic, no operator action required.	<div style="border: 1px solid black; padding: 5px; text-align: center;"> <p>RUNNING DIAG CHECK...</p> <p>RAMPING CURRENT: xx%</p> </div>

Table 13.0 Calibration Check Procedure (Continued)

STEP	ACTION	ATO DISPLAY
13-8	Automatic, no operator action required.	<div style="border: 1px solid black; padding: 5px; text-align: center;">DIAG CHECK COMPLETE PRESS ANY KEY</div>
13-9	Press any key to end DIAG CHECK.	Display returns to START MENU.

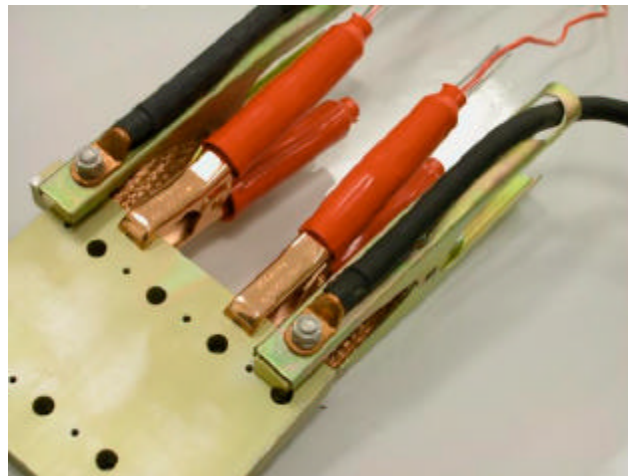


Figure 11 Diagnostic Test Cable Connection

APPENDIX A

Troubleshooting Guide

Item	Symptom	Possible Problem	Solution
1	Reading is incorrect.	1. Poor connection at the test clips.	1. Check connections to ensure teeth of voltage-sensing and current clips are firmly in contact with the device under test. 2. Verify that the sense cables are connected on the inside of the current cables. See Figures 6 & 7.
2	“Cable Error” Message.	1. No test current going through the device under test. 2. Sensing cables problem.	1. Check current cable connections to the device under test. 2. Check sensing cable connections. 3. Run Calibration Test.



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