

Auto-Ohm 10

Low Resistance Micro-Ohmmeter

USER'S MANUAL



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SAFETY SUMMARY

FOLLOW EXACT OPERATING PROCEDURES

Any deviation from the procedures described in this user's manual may create one or more safety hazards, damage the Auto-Ohm 10, or cause errors in the test results. Vanguard Instruments Co., Inc. assumes no liability for unsafe or improper use of the Auto-Ohm 10. The following safety precautions must be observed during all phases of test setup, test hookups, testing, and test lead disconnection.

SAFETY WARNINGS AND CAUTIONS

The Auto-Ohm 10 shall be used only by trained operators. All circuit breakers under test shall be off-line and fully isolated.

SERVICE AND REPAIR

- Do not install substitute parts or perform any unauthorized modification to any Auto-Ohm 10 test unit.
- Repairs must 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.

EQUIPMENT RATINGS

IP Rating: The enclosure for the Auto-Ohm 10 has an IP rating of 67.

Pollution Degree: The Auto-Ohm 10 has a pollution rating of 2.

Operating Voltage: The Auto-Ohm 10 is rated for use with an operating voltage of 120V or 240V, auto-ranging $\pm 10\%$ of selected voltage.

Power Cord: The Auto-Ohm 10 is supplied with a 16 AWG, 16A power cord with a NEMA 5-15P plug. Replacement cable shall have the same or better rating and is available through the manufacturer.

VENTILATION REQUIREMENTS

The Auto-Ohm 10 must be operated with the enclosure lid open.

SAFETY SYMBOLS



Indicates that caution should be exercised

CLEANING

To clean the Auto-Ohm 10:

- Disconnect all cables and turn the unit off.
- Use a soft, lint-free cloth to wipe all surfaces clean.
- Avoid getting moisture in openings and connectors.
- Don't use any cleaning products or compressed air.

TABLE OF CONTENTS

CONVENTIONS USED IN THIS DOCUMENT	1
1.0 INTRODUCTION	2
1.1 Product Overview	2
1.2 Technical Specifications	5
1.3 Auto-Ohm 10 Controls and Indicators	6
1.4 PRE-TEST SETUP	7
1.4.1. Operating Voltages	7
1.4.2. Installing the Battery Fuse	7
1.4.3. Replacement Rechargeable Batteries	8
1.4.4. Charging and Turning the Unit On and Off	8
1.4.5. Adjusting LCD Screen Contrast	9
1.4.6. Configuring Power Saving Options	10
1.4.7. Viewing Previous Test Results	13
2.0 OPERATING PROCEDURES	14
2.1 Connection Diagram	14
2.2 Contact Resistance Tests	15
2.2.1. Configuring Contact Resistance Tests	15
2.2.2. Performing a Contact Resistance Test	18
2.3 Performing a Transformer Winding Resistance Test	20
3.0 Upgrading Firmware	22
4.0 Troubleshooting Guide	26

LIST OF TABLES

Table 1. Auto-Ohm 10 Technical Specifications	5
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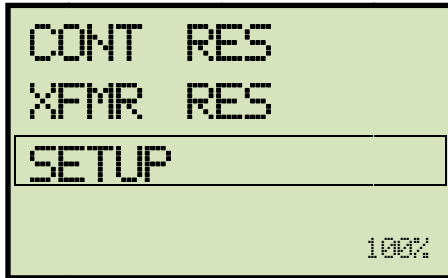
LIST OF FIGURES

Figure 1. Included Cable Set with Alligator Clamps (P/N 8000-0231)	3
Figure 2. Optional 10A Rated Pistol Grip Probe (P/N 8000-0201)	3
Figure 3. Optional 10A Rated Hand Probe (P/N 8000-0225)	4
Figure 4. Optional 5A Rated Hand Probe (P/N 8000-0226)	4
Figure 5. Auto-Ohm 10 Controls and Indicators	6
Figure 6. Battery Fuse in Protective Plastic Box	7
Figure 7. Panasonic Orbtronic 18650 Protected Li-ion Battery	8
Figure 8. Typical Auto-Ohm 10 Connection Diagram	14

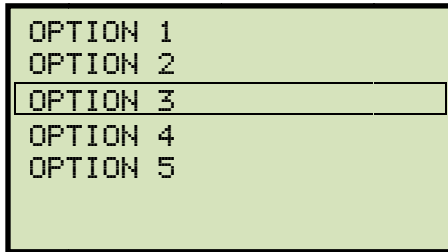
CONVENTIONS USED IN THIS DOCUMENT

This document uses the following conventions:

- A key, switch, or knob on the Auto-Ohm 10 is indicated as **[KEY]**, **[SWITCH]**, **[KNOB]**.
- Menu names are referenced as "MENU NAME"
- Auto-Ohm 10 screen output is shown as:



- When instructions are provided, the menu item that should be selected is outlined with a rectangle as shown below (option 3 should be selected):



- Warning messages are indicated as:



- Important notes are indicated as:



1.0 INTRODUCTION

1.1 Product Overview

The Vanguard Auto-Ohm 10 is a 10-ampere battery powered micro-ohmmeter designed for low-resistance-measuring applications such as the measurement of resistance in circuit breaker contacts, bushing contact joints, and welding joints. The unit is powered by four 3400mAh, 3.7Vdc Li-Ion rechargeable batteries. With these high capacity batteries, up to 2,900 tests per charge (10A/2 second duration) can be performed in the field. The Auto-Ohm 10 features a built-in charger that can charge the batteries when the unit is not in use.

The Auto-Ohm 10 features a rotary knob that is used to select either the "Contact Resistance" or "Transformer Resistance" test mode. The unit's back-lit LCD screen (128 x 64 pixels) is viewable in both direct sunlight and low light level. Resistance readings are displayed on the LCD screen in micro-ohms, milliohms, or ohms.

Contact Resistance Mode

The "Contact Resistance" mode can measure resistance values from 1 micro-ohm to 5,000 Ohms. The user can select from 6 different test currents: 1mA, 10mA, 100mA, 1A, 5A, 10A. The user can also choose from 6 test times: 1 sec, 2 sec, 3 sec, 5 sec, 10 sec, 60 sec. Up to three tests can be pre-configured with any combination of these parameters and executed with a single push of the control switch.

The Auto-Ohm 10 also offers a "Bi-directional" test mode. In this mode, the test current is applied in both directions to the device under test and the readings are recorded. The final test result is the average reading of the bi-directional resistance values. An "Auto" test mode is also available that will start a test once a user applies the test leads to the device under test. The last three readings are displayed on the LCD screen.

Transformer Resistance Mode

In "Transformer Resistance" test mode, the Auto-Ohm 10 can measure the winding resistance of transformers, electric motors, and generators. It provides 4 test currents (100mA, 1A, 5A, 10A) and can measure the winding resistance of a 3-phase 500KVA/12,000V transformer within 1 minute. At the end of a winding resistance test, the Auto-Ohm 10 automatically dissipates the stored energy in the transformer.

Cables and Accessories

The Auto-Ohm 10 is furnished with a 15 ft (4.57m) cable set with alligator clamps (P/N 8000-0231). The test current and voltage sense cables are isolated on the alligator clamps. With this feature, only a single connection is needed to the device under test. Optional 10A rated pistol grip probe (P/N 8000-0201), 10A rated hand probe (P/N 8000-0226), and 5A rated hand probe (P/N 8000-0225) are also available.



Figure 1. Included Cable Set with Alligator Clamps (P/N 8000-0231)



Figure 2. Optional 10A Rated Pistol Grip Probe (P/N 8000-0201)

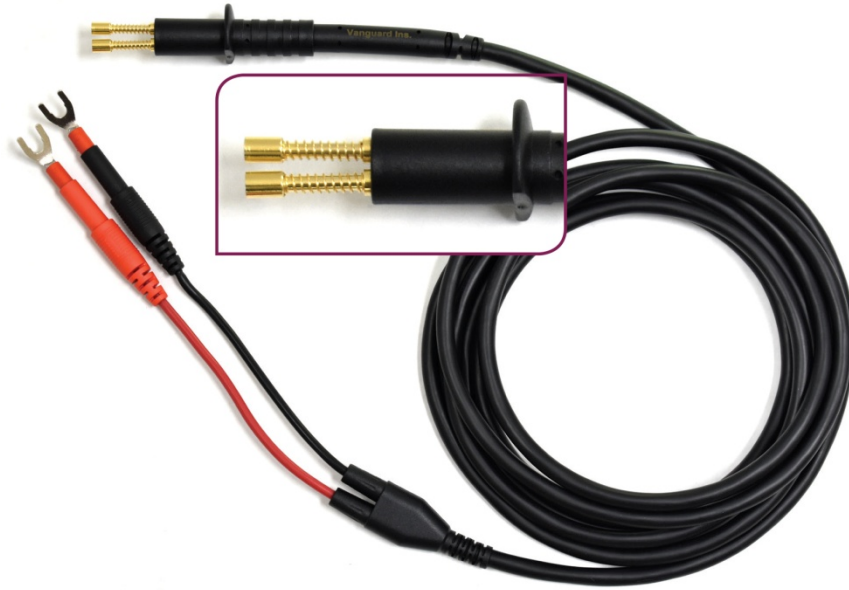


Figure 3. Optional 10A Rated Hand Probe (P/N 8000-0225)

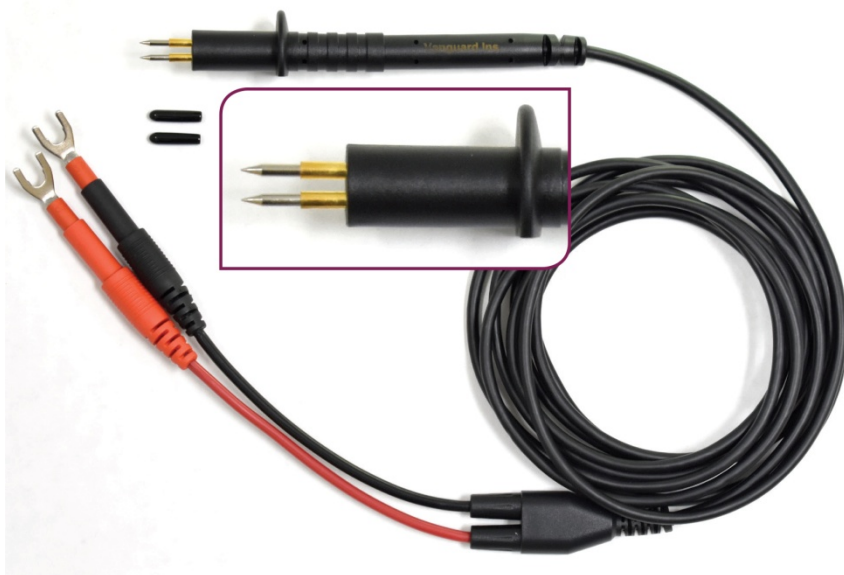


Figure 4. Optional 5A Rated Hand Probe (P/N 8000-0226)

1.2 Technical Specifications

Table 1. Auto-Ohm 10 Technical Specifications

TYPE	Low Resistance Micro-Ohmmeter								
PHYSICAL SPECIFICATIONS	14" W x 8" H x 12" D (36 cm x 19.4 m x 30.4 cm); Weight: 7.8 lbs (3.54 Kg)								
INPUT POWER	100-240 Vac, 50/60Hz								
RESISTANCE READING RANGE AND ACCURACY	Test Current	Display Min	Display Max	Display Unit	Resolution	Accuracy			
		10A	000.0 1.0000 10.000 100.00	999.9 9.9999 99.999 250.00	$\mu\Omega$ m Ω m Ω m Ω	0.1 $\mu\Omega$ 0.1 $\mu\Omega$ 1 $\mu\Omega$ 10 $\mu\Omega$	$\pm 0.2\% \pm 0.2\mu\Omega$ $\pm 0.2\% \pm 0.2\mu\Omega$ $\pm 0.2\% \pm 2\mu\Omega$ $\pm 0.2\% \pm 20\mu\Omega$		
	5A		000.0 1.0000 10.000 100.00	999.9 9.9999 99.999 999.99	$\mu\Omega$ m Ω m Ω m Ω	0.1 $\mu\Omega$ 0.1 $\mu\Omega$ 1 $\mu\Omega$ 10 $\mu\Omega$	$\pm 0.2\% \pm 0.4\mu\Omega$ $\pm 0.2\% \pm 0.4\mu\Omega$ $\pm 0.2\% \pm 4\mu\Omega$ $\pm 0.2\% \pm 40\mu\Omega$		
		1A		00.000 100.00 1,000.0	99.999 999.99 5,000.0	m Ω m Ω m Ω	1 $\mu\Omega$ 10 $\mu\Omega$ 100 $\mu\Omega$	$\pm 0.2\% \pm 2\mu\Omega$ $\pm 0.2\% \pm 20\mu\Omega$ $\pm 0.2\% \pm 200\mu\Omega$	
			100mA		000.0 1,000.0 10,000	999.9 9,999.9 50,000	m Ω m Ω m Ω	10 $\mu\Omega$ 100 $\mu\Omega$ 1m Ω	$\pm 0.2\% \pm 20\mu\Omega$ $\pm 0.2\% \pm 200\mu\Omega$ $\pm 0.2\% \pm 2m\Omega$
				10mA		000.0 10.000 100.00	9.9999 99.999 500.00	Ω Ω Ω	100 $\mu\Omega$ 1m Ω 10m Ω
	1mA				00.000 100.00 1,000.0	99.999 999.99 5,000.0	Ω Ω Ω	1m Ω 10m Ω 100m Ω	$\pm 0.2\% \pm 2m\Omega$ $\pm 0.2\% \pm 20m\Omega$ $\pm 0.2\% \pm 200m\Omega$

NOTE: Stated accuracy for bi-directional current mode

BATTERIES Rechargeable Li-Ion, 3.7Vdc, 3400 mAh, protected (Qty=4)
Charge time: 4 hours

AUTO POWER DOWN Programmable: 1 min, 2 min, 5 min, 10 min

DISPLAY Backlit LCD (128 x 64 pixels), viewable in direct sunlight and low light levels

ENVIRONMENT Operating: -10°C to 50°C (+15°F to +122°F)
Storage: -30°C to 70°C (-22°F to +158°F)
Charging: 0°C to 45°C (+32°F to +113°F)

HUMIDITY (MAX) 90% RH @ 40° C (104° F) non-condensing

ALTITUDE (MAX) 2,000m (6,562 ft) to full safety specifications

CABLES 15 ft (4.57 m) cable set with alligator clamps, power cable, cable bag

OPTIONS 30 ft (9.14 m) cable set, 10 ft (3m) hand probe (5A, P/N 8000-0226), 10 ft (3m) hand probe (10A, P/N 8000-0225), pistol grip probe (10A, P/N 8000-0201), shipping case

WARRANTY One year on parts and labor



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

NOTE

1.3 Auto-Ohm 10 Controls and Indicators

The Auto-Ohm 10's controls and indicators are shown in Figure 5. The purpose of the controls and indicators may seem obvious, but users should familiarize themselves with them before using the Auto-Ohm 10. 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.

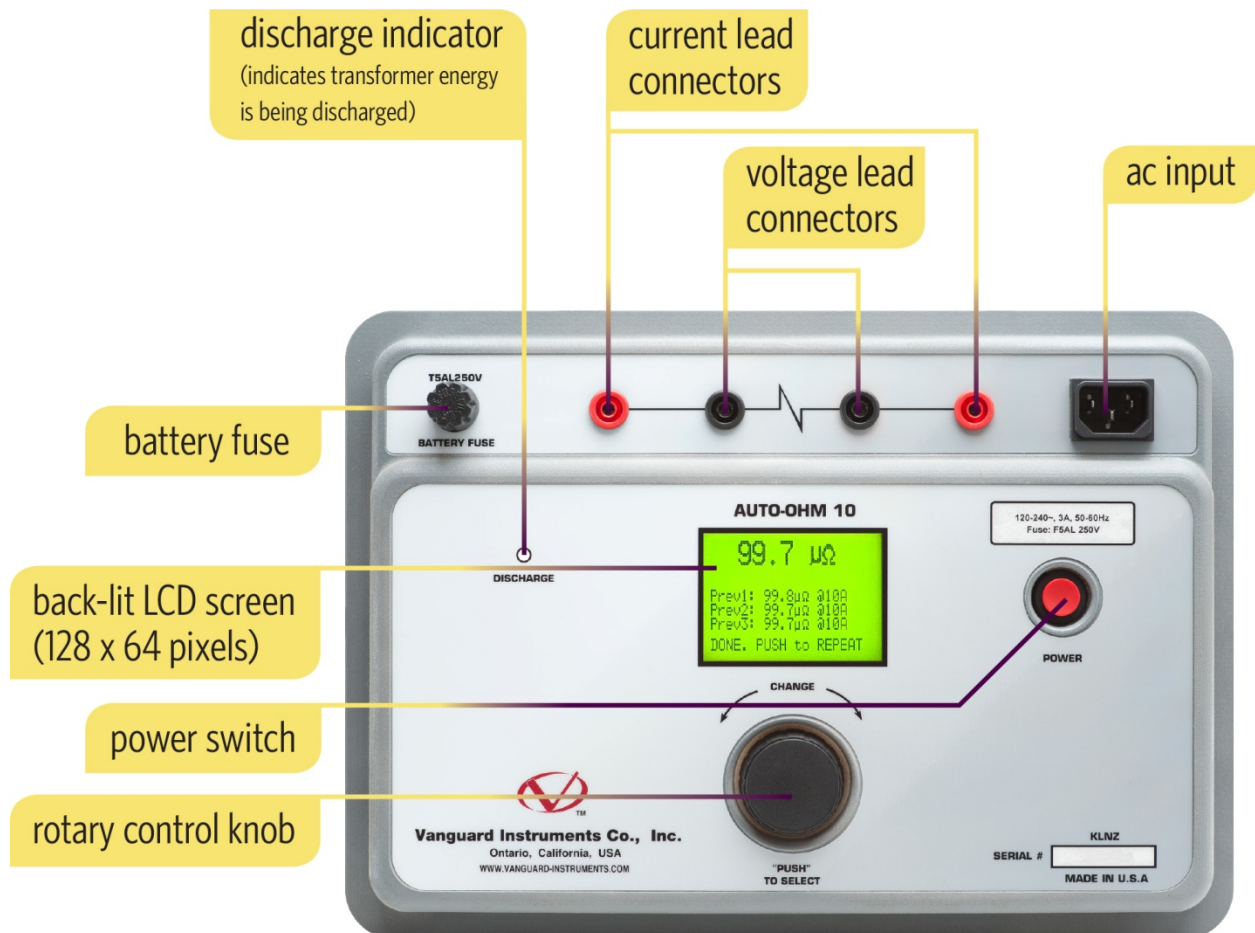


Figure 5. Auto-Ohm 10 Controls and Indicators

1.4 PRE-TEST SETUP

1.4.1. Operating Voltages

The Auto-Ohm 10 operates on voltages between 100-240 Vac, 50/60 Hz.

1.4.2. Installing the Battery Fuse

The Li-ion battery inside the AutoOhm-10 contains various safety mechanisms which disconnect the battery on abnormal conditions. Additionally, the battery includes a 'GasGauge' controller which keeps an accurate record of the Bat % state and other essential battery health/safety data.

The Battery Fuse on the front panel is intended to offer added safety and/or comply with relevant shipping regulations. However, removing this fuse (even momentarily, with unit either on or off) will cause the GasGauge to lose all its battery charging information. Battery information is restored on charging up the battery to 100%.

Upon receiving a new unit, it is essential to first install the Battery Fuse and connect AC power to completely charge the battery before using. Note that the unit will initially display "BAT% DATA LOST" – this is normal and clears once fully charged.

The battery fuse is stored in a plastic box secured on the foam of the Auto-Ohm 10's shipping case. The unit will not turn on if the battery fuse is not installed. Please install the battery fuse by inserting it in the receptacle labeled "BATTERY FUSE" on the Auto-Ohm 10's front panel. The replacement part number for the fuse is Littelfuse 0313005.ID (Rating: T5AL250V, 5A, slow acting, low breaking capacity; Size: 6.3 mm x 32 mm cartridge fuse).

**NOTE**

We highly recommend removing the fuse for long-term storage or shipping of the Auto-Ohm 10.



Figure 6. Battery Fuse in Protective Plastic Box

1.4.3. Replacement Rechargeable Batteries

The Auto-Ohm 10 is powered by four protected Li-ion 3400 mAh rechargeable batteries. Only Panasonic Orbtronic 18650 protected Li-Ion batteries should be used in the Auto-Ohm 10. Please visit the link below for detailed battery information:

<https://www.orbtronic.com/protected-3400mah-18650-li-ion-battery-panasonic-ncr18650B-orbtronic>



Figure 7. Panasonic Orbtronic 18650 Protected Li-ion Battery

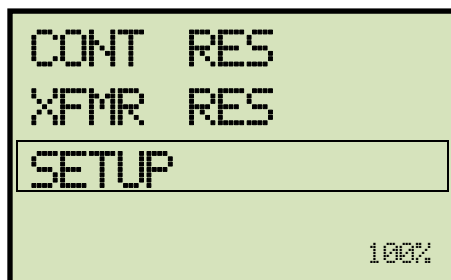
1.4.4. Charging and Turning the Unit On and Off

On connecting AC power (with unit previously off), the Auto-Ohm 10 immediately turns on and goes into 'Charging Mode', with "Charging xx%" displayed. Once charging is complete, the unit will display "Charged 100%" and go to a low-power state (it can be left on continuously). Pressing the **[POWER]** button exits Charging mode and enables the unit to be used normally.

All Auto-Ohm 10 functions are available on either AC or Battery power. The unit will also operate on AC power with a completely discharged battery.

If the unit is operated under AC power, holding down the **[POWER]** button for two seconds will reboot the unit and put it in charge mode. If the unit is on battery power, holding down the **[POWER]** button for two seconds will turn it off. To turn the unit back on when on battery power, push and release the **[POWER]** button.

The current battery charge percentage level is displayed at the bottom right corner of the "START-UP" menu as shown below:

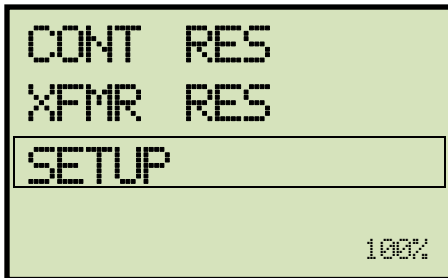


This text also toggles and displays the current power source (will display "BAT" when on battery power and "AC PWR" when on AC power).

1.4.5. Adjusting LCD Screen Contrast

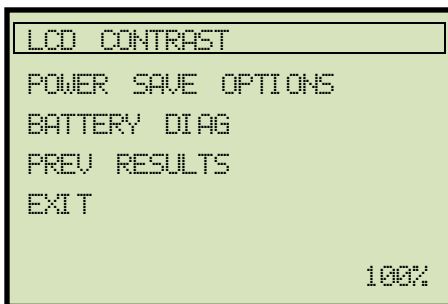
Follow the steps below to adjust the screen contrast:

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



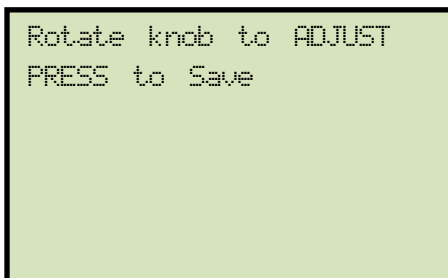
Turn the **[CONTROL KNOB]** clock-wise until "SETUP" is highlighted, and then press the **[CONTROL KNOB]**.

- b. The following screen will be displayed:



The "LCD CONTRAST" option should be highlighted. Press the **[CONTROL KNOB]**.

- c. The following screen will be displayed:



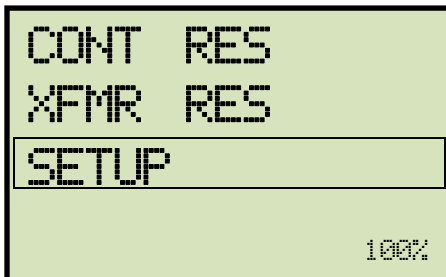
Rotate the **[CONTROL KNOB]** clock-wise or counter clock-wise to increase or decrease the screen contrast, respectively.

- d. Press the **[CONTROL KNOB]** to save the screen contrast settings and return to the "START-UP" Menu.

1.4.6. Configuring Power Saving Options

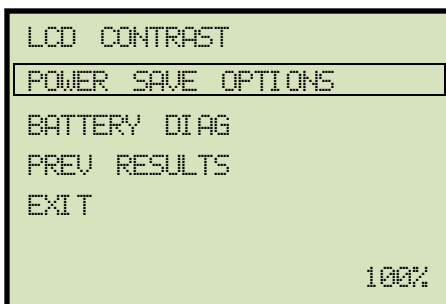
The Auto-Ohm 10 offers power saving options to help conserve battery power. Follow the steps below to configure the power saving options:

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



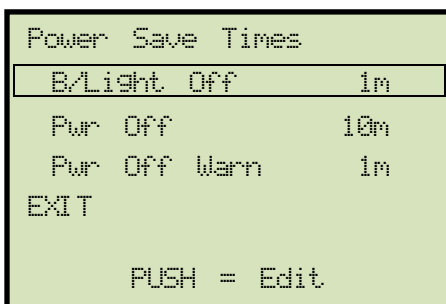
Turn the **[CONTROL KNOB]** clock-wise until "SETUP" is highlighted, and then press the **[CONTROL KNOB]**.

- b. The following screen will be displayed:



Turn the **[CONTROL KNOB]** clock-wise until "POWER SAVE OPTONS" is highlighted, and then press the **[CONTROL KNOB]**.

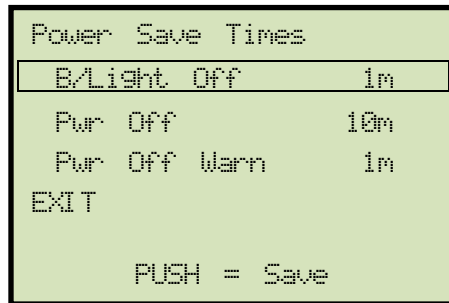
- c. The following screen will be displayed:



Configuring Back-light Options

The Auto-Ohm 10 can turn off the screen's back-light after a preset time if no activity is detected. To change the preset time:

1. Turn the **[CONTROL KNOB]** clock-wise until "B/Light Off" is highlighted and then press the **[CONTROL KNOB]**.
2. The following screen will be displayed (the selected time value will be blinking):



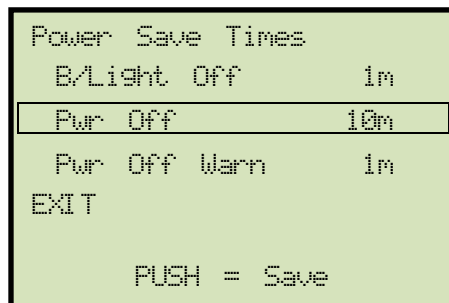
Turn the **[CONTROL KNOB]** clock-wise or counter-clockwise to cycle through the time value options (1m, 2m, 5m).

3. When the preferred backlight turn off time is displayed, press the **[CONTROL KNOB]**.

Configuring Power Off Options

The Auto-Ohm 10 can turn off the power after a preset time if no activity is detected. To change the preset time:

1. Turn the **[CONTROL KNOB]** clock-wise until "Pwr Off" is highlighted and then press the **[CONTROL KNOB]**.
2. The following screen will be displayed (the selected time value will be blinking):



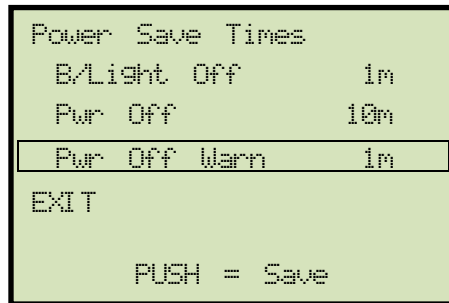
Turn the **[CONTROL KNOB]** clock-wise or counter-clockwise to cycle through the time value options (1m, 2m, 5m, 10m).

3. When the preferred power off time is displayed, press the **[CONTROL KNOB]**.

Configuring Power Off Warning Time Options

The Auto-Ohm 10 will display a power turn off warning after a preset time if no activity is detected. To change the preset time:

1. Turn the **[CONTROL KNOB]** clock-wise until "Pwr Off Warn" is highlighted and then press the **[CONTROL KNOB]**.
2. The following screen will be displayed (the selected time value will be blinking):



```
Power Save Times
  B/Light Off      1m
  Pwr Off          10m
  Pwr Off Warn    1m
  EXIT
  PUSH = Save
```

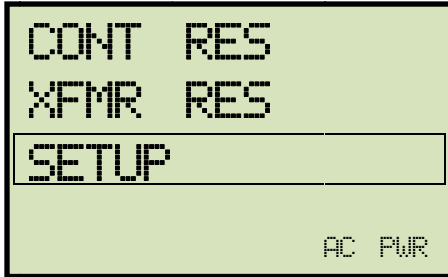
Turn the **[CONTROL KNOB]** clock-wise or counter-clockwise to cycle through the time value options (10s, 30s, 1m, 5m).

3. When the preferred power off warning time is displayed, press the **[CONTROL KNOB]**.
- d. Once you have configured the power save times, turn the **[CONTROL KNOB]** clock-wise until "EXIT" is highlighted, and then press the **[CONTROL KNOB]**.

1.4.7. Viewing Previous Test Results

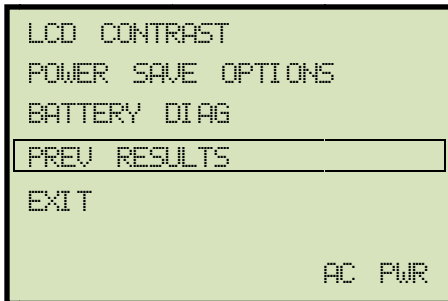
Follow the steps below to view the test results from the last six tests performed:

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



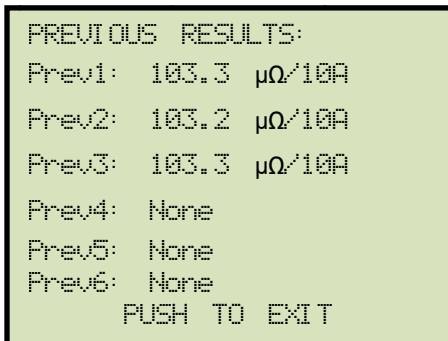
Turn the **[CONTROL KNOB]** clock-wise until "SETUP" is highlighted, and then press the **[CONTROL KNOB]**.

- b. The following screen will be displayed:



Turn the **[CONTROL KNOB]** clock-wise until "PREV RESULTS" is highlighted, and then press the **[CONTROL KNOB]**.

- c. The following screen will be displayed:



NOTES

1. "Prev1" is the most recent test performed.
2. All previous values are lost if the unit is turned off.

Press the **[CONTROL KNOB]** to return to the "START-UP" menu or turn it clock-wise to delete all previous results from the memory.

2.0 OPERATING PROCEDURES

2.1 Connection Diagram

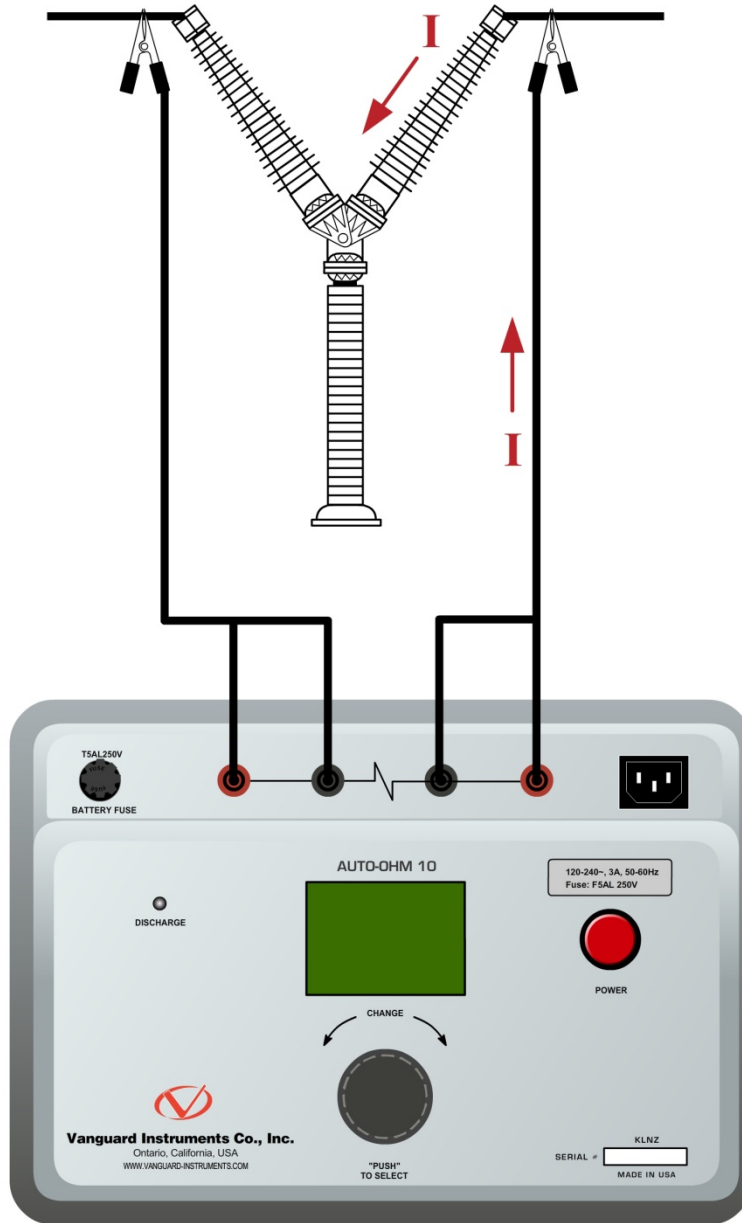


Figure 8. Typical Auto-Ohm 10 Connection Diagram

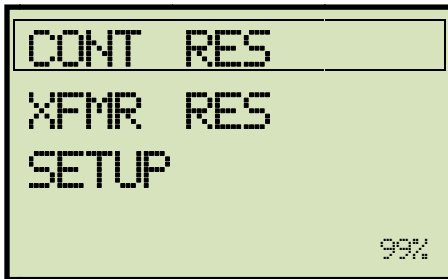
2.2 Contact Resistance Tests

The Auto-Ohm 10's contact resistance test mode allows the user to configure the parameters for up to three tests that can then be used to quickly perform tests. The test parameters can also be changed as needed.

2.2.1. Configuring Contact Resistance Tests

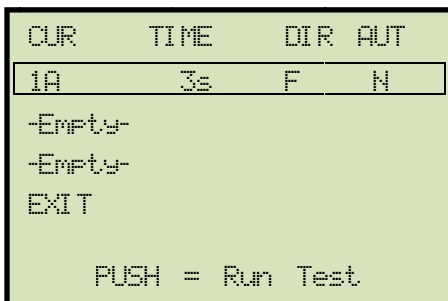
Follow the steps below to configure the parameters for the contact resistance tests:

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



The "CONT RES" option should be highlighted, but if it is not, turn the **[CONTROL KNOB]** clock-wise until it is highlighted. Then, press the **[CONTROL KNOB]**.

- b. The following screen will be displayed



The first pre-configured test will be highlighted. In the example above, the first test has been pre-configured and there are two empty slots available for configuring additional tests. If you would like to edit the currently highlighted test, push and hold the **[CONTROL KNOB]** for 2 seconds. If you would like to configure one of the other tests, turn the **[CONTROL KNOB]** clock-wise or counter clock-wise until the test is highlighted and then press and hold the **[CONTROL KNOB]** for 2 seconds.



NOTE

You can press the **[POWER]** button at any time to cancel the test parameter editing process. Any changes made will **NOT** be saved.

- c. The following screen will be displayed:

```

CUR    TIME    DIR  AUT
1A     3s     F    N
-Empty-
-Empty-
(Sel Test Current)

      PUSH = Run Test

```

The first test parameter, the test current, will start blinking (shown in **BOLD** above). To change the test current, turn the **[CONTROL KNOB]** clock-wise or counter clock-wise. Available options are 1mA, 10mA, 0.1A, 1A, 5A, and 10A. When the desired test current is displayed, press the **[CONTROL KNOB]**.

- d. The following screen will be displayed:

```

CUR    TIME    DIR  AUT
1A     3s     F    N
-Empty-
-Empty-
(Sel Test Duration)

      PUSH = Run Test

```

The test duration will now be selected and will start blinking. Available options are 1s, 2s, 3s, 5s, 10s, and 60s. Turn the **[CONTROL KNOB]** clock-wise or counter clock-wise to change the test duration and then press the **[CONTROL KNOB]**.

- e. The following screen will be displayed:

```

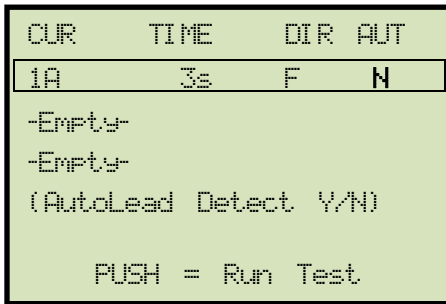
CUR    TIME    DIR  AUT
1A     3s     F    N
-Empty-
-Empty-
(CurDir: Fw/Rew/Both)

      PUSH = Run Test

```

The current direction value will be selected and will start blinking. Turn the **[CONTROL KNOB]** clock-wise or counter clock-wise to select the current direction. The Auto-Ohm 10 can apply the test current in the forward, reverse, or both directions. When the preferred direction is displayed, press the **[CONTROL KNOB]**.

- f. The following screen will be displayed:



CUR	TIME	DIR	AUT
1A	3s	F	N

-Empty-
-Empty-
(AutoLead Detect Y/N)
PUSH = Run Test

The "AutoLead Detect" mode option will be selected. In this mode, the Auto-Ohm 10 will start a test once a user applies the test leads to the device under test. If you would like to enable this option, turn the **[CONTROL KNOB]** until "Y" is displayed. If you do not want to enable this option, turn the **[CONTROL KNOB]** until "N" is displayed. Press the **[CONTROL KNOB]**. Press and hold the **[CONTROL KNOB]** for 2 seconds to save the test parameters. The following screen will be displayed momentarily:



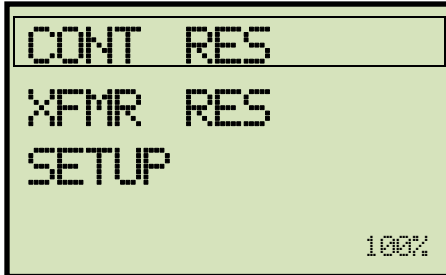
Test Saved

Then the configured tests will be displayed again allowing the user to perform a test.

2.2.2. Performing a Contact Resistance Test

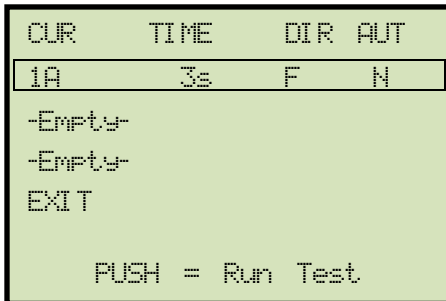
Follow the steps below to perform a contact resistance test:

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



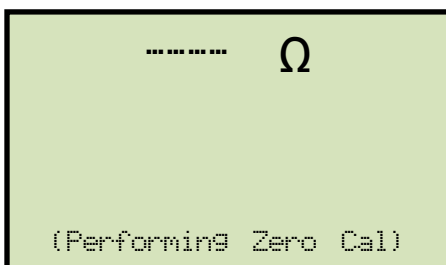
The "CONT RES" option should be highlighted, but if it is not, turn the **[CONTROL KNOB]** clock-wise until it is highlighted. Then, press the **[CONTROL KNOB]**.

- b. The following screen will be displayed:

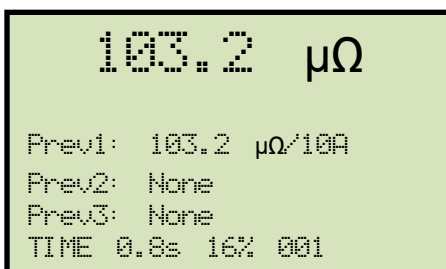


Turn the **[CONTROL KNOB]** until the desired pre-configured test is highlighted (If you need to make any changes to the test parameters, please see section 2.2.1). Then press the **[CONTROL KNOB]**.

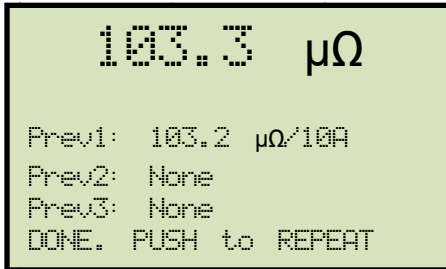
- c. The following screen will be displayed temporarily:



Then the following screen will be displayed:



The initial resistance reading is displayed at the top of the screen along with the elapsed test time at the bottom of the screen. Also, the previous three test results are displayed below the current test results. After the test time has elapsed, the final results will be displayed:



You can repeat the test by pushing the **[CONTROL KNOB]** or turn the **[CONTROL KNOB]** counter clock-wise to exit. You will be returned to the screen displaying the pre-configured contact resistance tests.



NOTES

Micro-ohmmeters measure voltages at the microvolt level. Every connection made, unless they are of identical metals which is impossible in practice, creates an unwanted thermoelectric EMF voltage of the order of many microvolts that varies with temperature gradients. Each of these unwanted voltages increases the error in the measured resistance.

At the start of every test, the AutoOhm-10 attempts to reduce thermal EMF errors by shorting out the current leads whilst measuring the initial offset or 'zero offset' voltage on the voltage leads. However, certain dissimilar metal combinations and surface oxidation results in other errors which vary according to the direction of the applied test current – these can only be effectively reduced by testing in both current directions.

For best accuracy and consistency in contact resistance measurements, it is recommended to always:

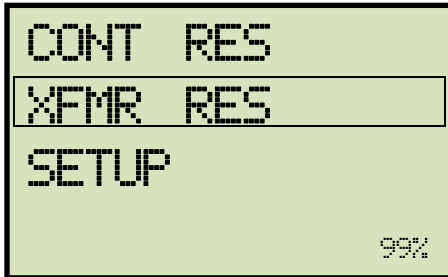
1. Select current direction as 'Both'. This will perform a test at Forward and then Reverse current directions and display the average. This is the very best mode for obtaining high accuracy measurements. Only use single current modes when measurement speed is more important than accuracy.
2. Use the highest current possible for the resistance being measured (although always check that the resistance being measured can handle that current and will not undergo significant resistance change from self-heating)

2.3 Performing a Transformer Winding Resistance Test

In "Transformer Resistance" test mode, the Auto-Ohm 10 can measure the winding resistance of transformers, electric motors, and generators. At the end of a winding resistance test, the Auto-Ohm 10 automatically dissipates the stored energy in the transformer. The "DISCHARGE" LED will be illuminated while the energy is being discharged.

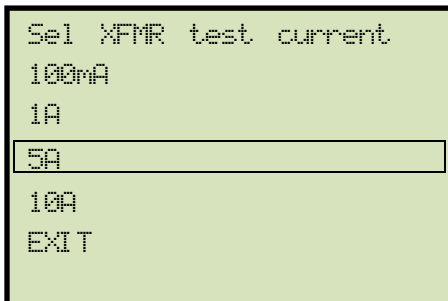
Follow the steps below to perform a transformer winding resistance test:

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



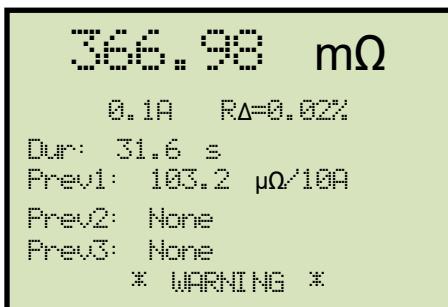
Turn the **[CONTROL KNOB]** clock-wise until "XFMR RES" is highlighted on the screen, and then press the **[CONTROL KNOB]**.

- b. The following screen will be displayed:



Select the test current by turning the **[CONTROL KNOB]** clock-wise until the desired test current is highlighted. In the above example, we are selecting 1A. Press the **[CONTROL KNOB]**.

- c. The following screen will be displayed:



The initial resistance reading is displayed at the top. The second line displays the selected test current and the change in resistance. The third line displays the elapsed

time. The next three lines display the last three test results. When the reading is stable, press the **[CONTROL KNOB]**.

- d. The following screen will be displayed:

```
345.57 mΩ
0.1A RA=0.01%
Dur: 129.5 s
Prev1: 103.2 μΩ/10A
Prev2: None
Prev3: None
DONE. LEFT to EXIT
```

You can press the **[CONTROL KNOB]** to run the test again or turn it counter clockwise to exit.



WARNING

1. The Auto-Ohm 10 has a built-in discharge circuit that discharges the energy in the transformer after performing a test. Always wait for the "DISCHARGE" LED to turn off before removing the test leads from the transformer bushings.
2. Do NOT remove the Auto-Ohm 10 test leads while conducting a transformer resistance test.

3.0 Upgrading Firmware

The Auto-Ohm 10's firmware is user-upgradeable. The firmware version is displayed during the start-up sequence when the unit is powered on:

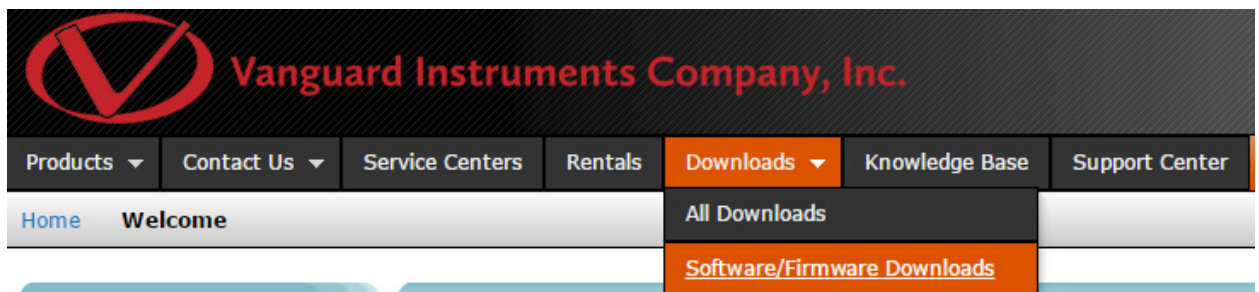


Follow the steps below to download and install the latest Auto-Ohm 10 firmware:

- a. Visit the Vanguard web site at <http://www.vanguard-instruments.com>. Login to your account using the login form on the left side of the page:

If you do not have an account, click on the "Create new account" link below the login area to create your free account. Please note that your account will need to be approved first before it can be used to download any software or firmware. This is usually done within 30 minutes of creating your account.

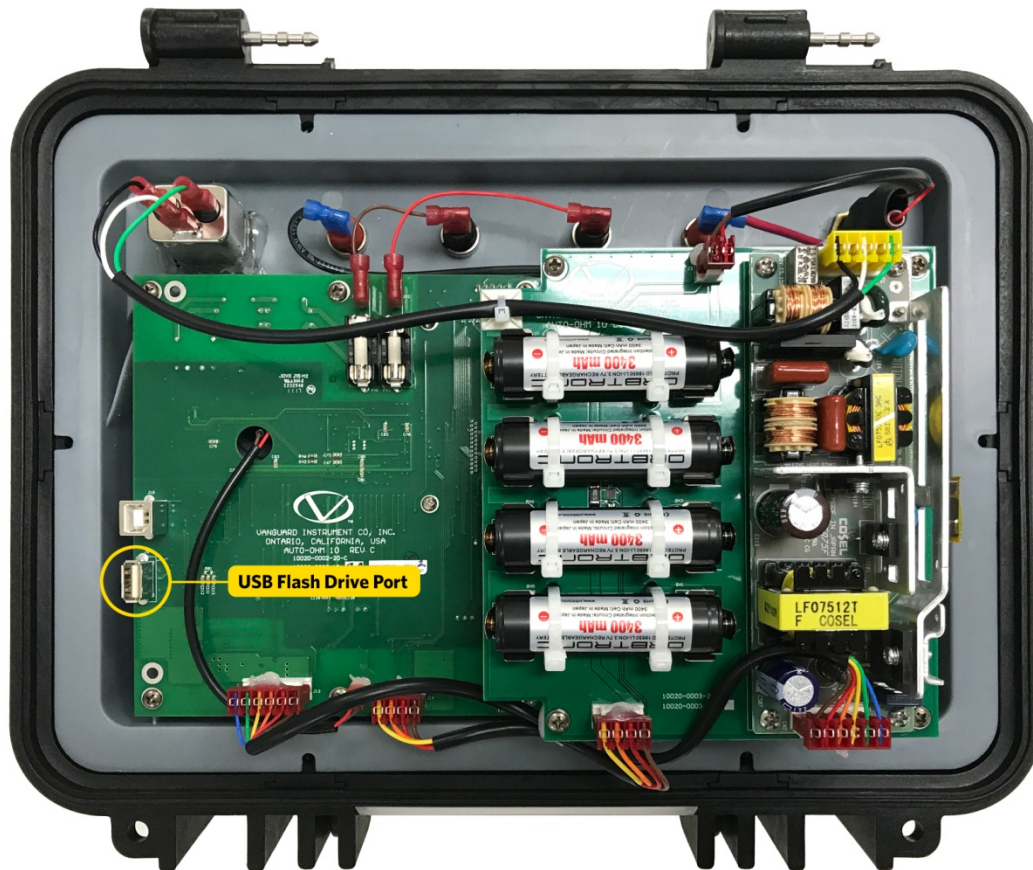
- b. After logging in to your account, hover your mouse over the "Downloads" link at the top of the page and click on the "Software/Firmware Downloads" link:



- c. All Vanguard products will be listed along with any compatible firmware and software. Scroll down the page to find the Auto-Ohm 10 listing and then click on the firmware link to save the firmware file.
- d. Once the download is complete, navigate to the folder where the file was downloaded and extract the compressed ZIP file (you may need to use a ZIP extraction application such as WinZip, 7-Zip, etc.). Once extracted, you should see the file "aohm10.hex". This is the firmware file.
- e. Copy the file "aohm10.hex" to the root folder of a USB Flash drive.
- f. Remove the 6 screws from the Auto-Ohm 10 front panel and lift the front panel out of the base:



- g. Flip the Auto-Ohm 10 front panel over to reveal the USB flash drive port:

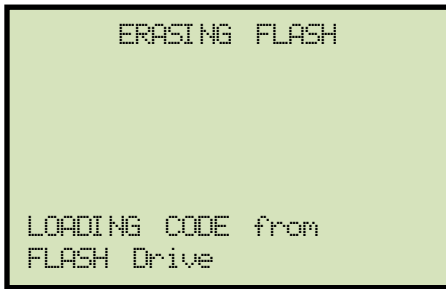


- h. Insert the USB Flash drive you prepared in step "e" into the Auto-Ohm 10's USB Flash drive port.
- i. Flip the Auto-Ohm 10 over again and reseal in the base, but do not insert the screws.
- j. While holding down the **[CONTROL KNOB]**, press and release the **[POWER]** button. Continue holding down the **[CONTROL KNOB]**.
- k. The Auto-Ohm 10 will go through the initial starting sequence and then the following screen will be displayed momentarily:

```

START HANDSHAKE
  OR
Insert THUMB Drv
  
```

Then the following screen will be displayed:



You can now release the **[CONTROL KNOB]**.

- l. The Auto-Ohm 10 will continue with the upgrade process, and once complete, the "START-UP" menu will be displayed.
- m. Once the upgrade is complete, turn off the unit by holding down the **[POWER]** button for two seconds.
- n. Remove the flash drive from the Auto-Ohm 10's USB Flash drive.
- o. Re-seat the Auto-Ohm 10 front panel in the base and re-screw the 6 screws removed in step "f".

4.0 Troubleshooting Guide

Displayed Message	Explanation	Probable cause (for Error/Fault messages only)	Solution
AC PWR... xx%	Unit operating on AC power. Battery charged to xx%		
BAT... xx%	Unit operating on Battery power. Battery charged to xx%		
CHARGING xx%	Unit is in charging mode. Battery currently charged to xx%		
CHARGED 100%	Charging completed, battery is fully charged		
Voltage Err Chk Leads / Try again	Anomaly detected on Voltage leads	<ul style="list-style-type: none"> - Voltage leads not connected - initial zero offset too high - measured Voltage too high - excessive measurement noise 	<ul style="list-style-type: none"> - Check all leads are correctly connected - Use original leads & firm connections - For long leads, twist Voltage leads together to reduce induced noise
Current Err Chk Leads / Reduce I	Anomaly detected on Current output (Actual output current not equal to set current for whatever reason)	<ul style="list-style-type: none"> - Current leads not connected - Resistance too high for set current 	<ul style="list-style-type: none"> - Check all leads correctly connected - Reduce current
> xx Ω	Resistance too high. xx value displayed is the max resistance possible for the selected current		<ul style="list-style-type: none"> - Check all leads correctly connected - Reduce current
---- Ω	Performing measurement / Result not ready		
[Fwd] xxA	Stated current being output in Forward direction		
[Rev] xxA	Stated current being output in Reverse direction		
(Performing Zero Cal)	Displays at start of every test –unit is measuring zero offset on Voltage inputs to reduce errors from thermal EMF		
BAT% READ FLT... CHK FUSE, Est: xx%	Unable to communicate with bat GasGauge controller. Bat % shown is then only a rough estimate.	Battery Fuse missing / Blown.	Check/replace fuse – once cleared, 'BAT% DATA LOST' (see below) will then show. If message persists contact factory

BAT% DATA LOST... CHARGE NOW, Est: xx%	Bat GasGauge controller data has been lost. Bat % shown is then only a rough estimate.	Battery fuse was removed at some point.	A full charge to 100% clears this
Charging ERROR: *AC PWR FLT*	AC Power removed during charging		Confirm AC power is OK. Try to charge again
Charging ERROR: *BAT% READ FLT*	Unable to communicate with bat GasGauge controller	Battery Fuse missing / Blown	Check/replace fuse. If message persists contact factory
Charging ERROR: (any of these below) *CHARGE OVER-V FLT* *CHARGE OVER-I FLT* *CHARGE UNDER-I FLT*	Internal charger fault	Internal charger fault	Try to charge again. If message persists contact factory
Charging ERROR: (any of these below) *BAT TEMP <0C FLT* *BAT TEMP >45C FLT*	Battery temperature outside limits	Battery temperature must be 0-45°C (32-113°F) for safe charging	Move unit to different/more appropriate location. Try to charge again
Deep Disch detected! -attempting recovery	Battery voltage detected as excessively low. Unit attempting a special low current charge cycle to recover battery	Battery was deeply discharged (should never occur in normal use), or is faulty/ reached end-of-life	Allow time for unit to complete recovery cycle
Charging Fault: *Unable to Charge* Unable to recover Bat from deep disch after >1Hr. Bat may need replacement!	Unable to recover battery even after the deep discharge recovery cycle	Battery is faulty/ reached end-of-life	Try to charge again. If message persists replace battery
Charging Fault: *Unable to Charge* Bat not reached full charge after >8 Hours. Bat may be near end-of-life	Unable to fully charge battery	Battery is faulty/ reached end-of-life	Try to charge again. If message persists replace battery



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