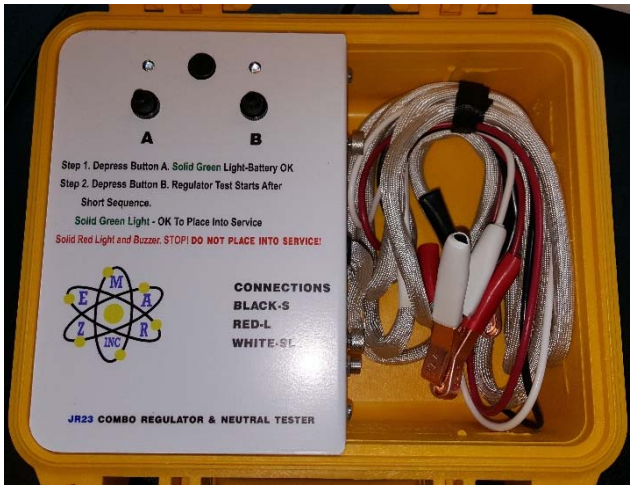
TECHNICAL MANUAL,

JR23

for the:

JR23 Combo Regulator and Neutral Tester

Part Number: 10005-001-A001-02



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Revision Listing

Revision	Date	Description of Changes
A	09/02/2016	Original Issue.
B	12/26/2016	Changed description of the startup sequence to 3 red flashed instead of green for software change. Note added for older software.

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Cennamo Electronics in partnership with ZEMAR, Inc. on the JR23 device.

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1. Cautions and Warnings

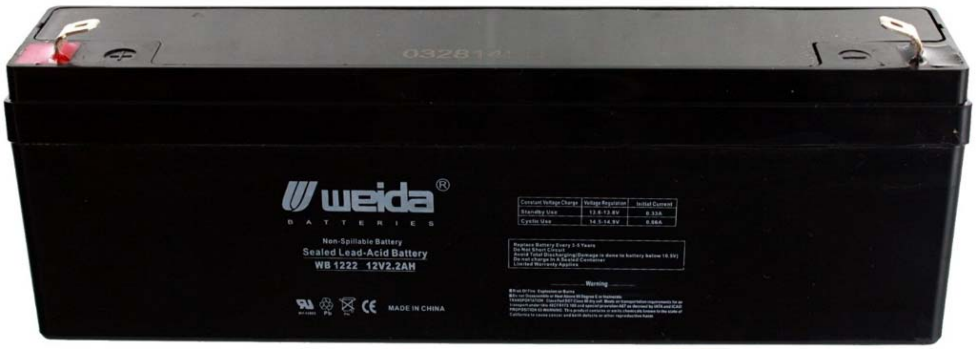
Label Definitions	
⚠WARNING	WARNING indicates a potentially hazardous situation, which, if not avoided, could result in serious injury or death.
⚠CAUTION	CAUTION indicates a potentially hazardous situation, which, if not avoided, could result in minor or moderate injury or property damage.
Note	NOTE indicates items of interest that should be considered.
	Maintenance instructions.

Table 1. Label Definitions

GENERAL PRECAUTIONS	
⚠WARNING	Failure to follow instructions may cause damage or injury. **Read entire Technical Manual before use. Follow directions explicitly.**
⚠WARNING	Do not operate the JR23 if the cords or battery are damaged. Do not attempt to charge the JR23 with damaged chargers, charger cords, or battery. Replace charging accessories immediately by calling ZEMAR, Inc. for replacement. Return damaged JR23 unit to ZEMAR, Inc. for repair before use.
⚠WARNING	The JR23 is intended for testing on a de-energized distribution voltage regulator. The JR23 is **NOT** to be used on an energized voltage regulator. Use with an energized voltage regulator will result in damage to the device and may result in personal injury and/or death.
⚠WARNING	The JR23 should only be used by personnel trained on voltage regulator operation. This manual assumes the operator of the JR23 is attempting to test a **de-energized** voltage regulator and is trained how to safely handle the equipment.
⚠WARNING	All lead-acid batteries have the potential to emit gasses that may combine into a combustible or explosive mixture. In many cases, it is possible that lead-acid batteries will emit these gasses during normal discharge and charging operations. Do not operate or charge the JR23 where ventilation is restricted. The intent here is to allow sufficient airflow to minimize and dissipate the heat generated by the charger and to diffuse the gasses that may be emitted by the battery. The power consumption of the JR23 is low in normal operation, but charging may produce more risk.
⚠WARNING	DO **NOT** short the positive (+) and negative(-) battery terminals together as this may cause damage to the battery, release of toxic fumes, extreme heat, acid leakage, and/or personal injury.
⚠CAUTION	Lead-acid batteries require special handling and disposal constraints.
⚠CAUTION	Only use supplied battery chargers with the JR23. Replacements can be ordered from ZEMAR, Inc.
⚠CAUTION	Only use suggested battery replacements for the JR23. Refer to **Section 7.2** or contact ZEMAR, Inc. for assistance with replacement batteries.
⚠CAUTION	Ensure the red positive (+) battery cable is connected to the red positive (+) connection of the battery and the black negative (-) battery cable is connected to the black negative (-) connection of the battery to avoid damaging the JR23.
Note	The 12V lead-acid battery is life limited and that life can vary from product to product based on use and storage conditions. It is recommended that the JR23 is stored at room temperature as often as possible; thus lengthening the life of the battery. Lead-acid battery life reduction occurs at higher temperatures and when stored in a discharged state. Attempt to keep the charge of the battery as directed in the recharging instructions of **Section 7.1** to maximize the life of the battery.
	Do not disassemble the tester. Have it checked by ZEMAR, Inc. when necessary
	Call ZEMAR, Inc., Joe Robb at 740-815-0331 for assistance.

Table 2. Cautions, Warnings, and Notes

2. Included Components



1. JR23 Combo Regulator and Neutral Tester (P/N 10005-001-A001-02)
2. Alternating Current (AC) Wall-Mount Charger (P/N 10005-001-A002-01)
3. Direct Current (DC) Adapter (P/N FX-CP21)
4. 12 Volt (V) Battery (P/N WB1222 or BW1222)
    a. Removable/Replaceable

The components above are included with a new JR23 purchase. If your unit was shipped through the mail then the battery is located in the removable battery compartment, but is not attached. Please refer to **Section 7.2**, Battery Replacement, for instructions to connect the battery for use.

3. Reference Documents

3.1 ZEMAR/Cennamo Electronics

10005-001-A001-02 Assembly – JR23
Revision C

3.2 External

None

4. List of Acronyms

Acronym	Description
Ah	Amp-Hour
AC	Alternating Current
DC	Direct Current
FBD	Functional Block Diagram
Inc.	Incorporated
JR23	JR23 Combo Regulator and Neutral Tester
L	Load Connection
P/N	Part Number
S	Source Connection
SL	Source Load Connection
US	United States
V	Volts

Table 3. List of Acronyms

5. System Description

The JR23 Combo Regulator and Neutral Tester, referred to as the JR23, is a self-contained and portable de-energized distribution voltage regulator tester. The primary purpose of the JR23 is a safety device to ensure the voltage regulator is on neutral prior to energizing the regulator. Neutral is typically indicated on the voltage regulator through step "0" on the position indicator with neutral light illuminated in the control. While the voltage regulator has these visual indications of being on neutral, that system can fail and mislead the installer about the true state of the regulator. Failure to ensure the voltage regulator is on neutral can lead to excessive damage and potentially be fatal. Energizing a voltage regulator when not on neutral often leads to explosion of the regulator due to the high circulating currents in the regulator.

While the primary purpose of the JR23 is a safety device to save lives, it also provides other benefits. The JR23 can save time and money by detecting failures of voltage regulators at different stages of ownership. For instance, the JR23 can detect multiple failures of the voltage regulator before it is even unloaded from the truck at initial receipt, prior to loading for transportation to the job site, and then prior to energizing the voltage regulator where it becomes a safety issue. Detecting the failed voltage regulator early prevents the cost and time of handling a failed voltage regulator. The JR23 tests the voltage regulator for the following with a simple automated test.

- On or Off Neutral
  - Place voltage regulator on neutral and verify the internal electrical state matches the visual indications
- Open Internal Windings

When used in accordance with instructions displayed directly on the faceplate of the unit, the JR23 also detects if the system has not been correctly attached for the voltage regulator test. These tests include a detached test lead. **Figure 1** provides the Functional Block Diagram (FBD) for the JR23.

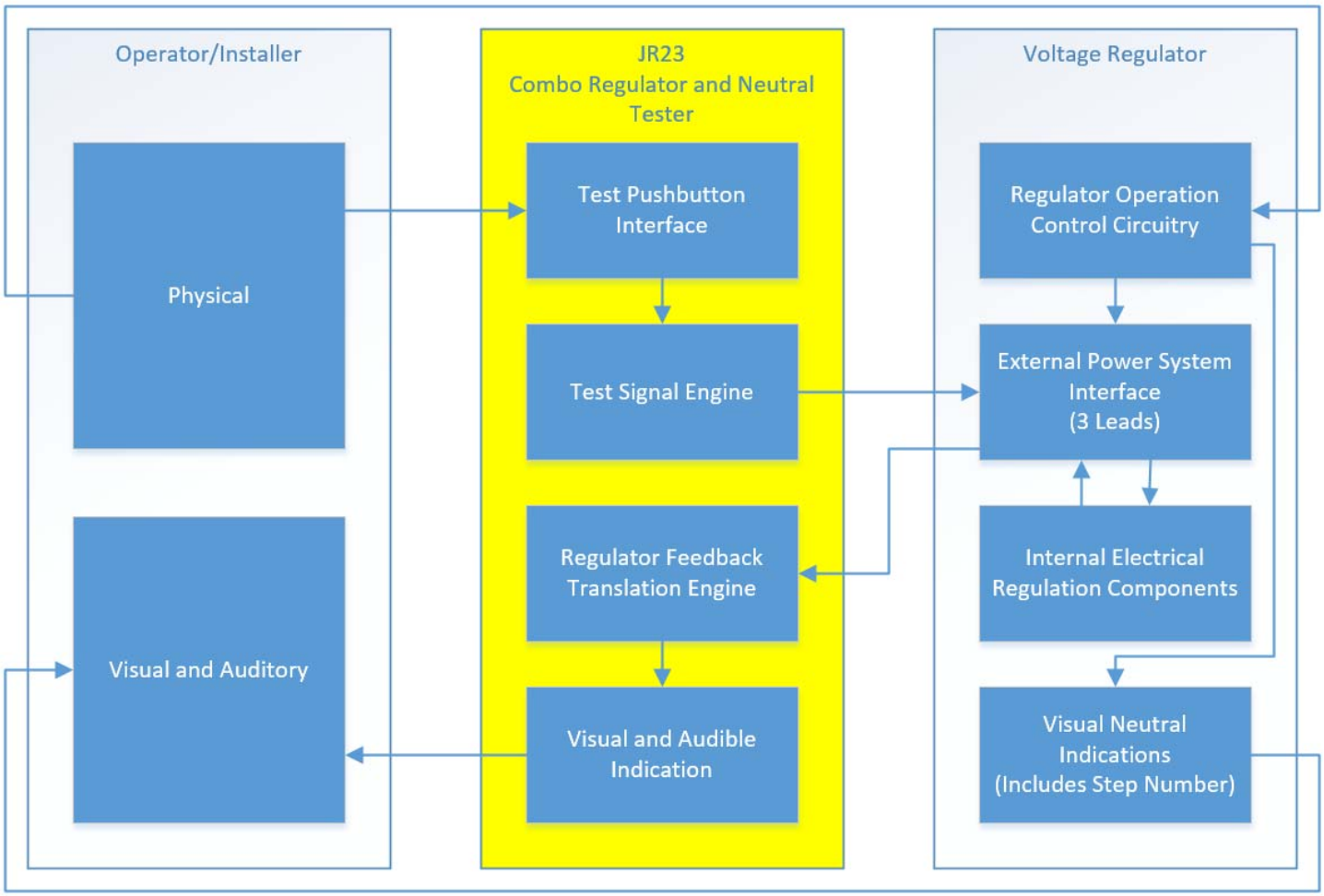


Figure 1. JR23 Functional Block Diagram (FBD)

6. Operation Instructions

The JR23 has a simple operator interface to test a de-energized voltage regulator. Once connected to the voltage regulator, as instructed below, the JR23 takes all of the guesswork out of the testing process by fully automating the test and providing easy, visual, and audible indications of the condition of the regulator.

⚠**WARNING:** *The JR23 is intended for testing on a de-energized distribution voltage regulator. The JR23 is **NOT** to be used on an energized voltage regulator. Use with an energized voltage regulator will result in damage to the device and may result in personal injury and/or death. The JR23 should only be used by personnel trained on voltage regulator operation. This manual assumes the operator of the JR23 is attempting to test a **de-energized** voltage regulator and is trained how to safely handle the equipment.*

1. Press the A button on the JR23 and ensure the A light illuminates green

   a. If the A light does not illuminate green, the JR23 requires recharging
      i. Follow recharging instructions in **Section 7.1** before proceeding to **Step 2**
   b. If the A light does illuminate green, the JR23 has sufficient charge to test the voltage regulator, proceed to **Step 2**
2. Ensure voltage regulator is de-energized
   a. ⚠**WARNING:** *Use with an energized voltage regulator will result in damage to the device and could result in possible personal injury and/or death*
   b. ⚠**WARNING:** *The operator of the JR23 is required to be trained how to safely handle the voltage regulator*
3. Ensure that the voltage regulator under test is in the neutral positon in accordance with the technical manual of the voltage regulator model
   a. ⚠**WARNING:** *The operator of the JR23 is required to be trained how to safely handle the voltage regulator*
4. Connect the cabling to the Source (S), Load (L), and Source Load (SL) connections on the voltage regulator
   a. Black lead connects to Source (S)
   b. Red lead connects to Load (L)
   c. White lead connects to Source Load (SL)
5. Press the B button on the JR23
6. After the JR23 start up sequence, three (3) B light red[1] light flashes accompanied by three (3) beeps of the buzzer, observe the condition of the B light
   a. Solid green light with no buzzer indicates the regulator is good and on the neutral position

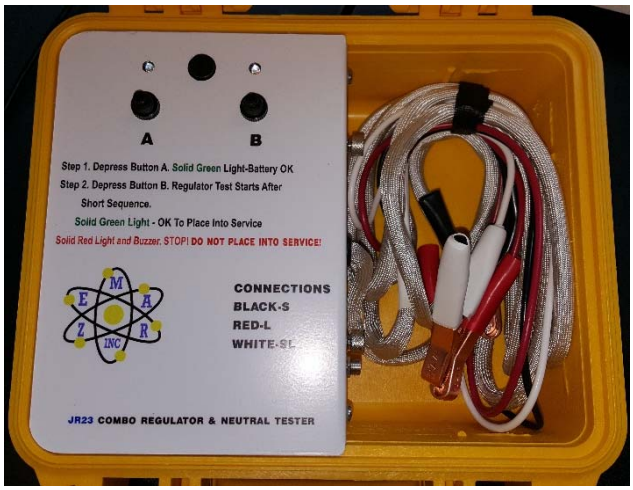
   b. Solid red light with a sounding buzzer indicates the regulator is off the neutral position or the Source (S) lead is disconnected/open

[1] Older software versions had 3 green light flashed instead of red. This was an update based on customer feedback that has no effect on operation. If the unit is flashing green 3 times then it is operating normally. This was the only change in the software. Original shipments up to serial number 0148 contained the older software.

i. ⚠**WARNING:** *Do **NOT** energize the voltage regulator unless the JR23 has confirmed it is in the neutral position as indicated in the Feedback Translation Table,* ***Table 4***

c. Other light combination and buzzer combinations indicate other errors
   i. Refer to the Feedback Translation Table, **Table 4**, regarding JR23 feedback status
   ii. ⚠**WARNING:** *Do **NOT** energize the voltage regulator unless the JR23 has confirmed it is in the neutral position as indicated in the Feedback Translation Table,* ***Table 4***

7. If **Step 6** did not yield passing on neutral positon, troubleshoot the condition and retest the unit starting with **Step 1**, otherwise proceed to **Step 8**
8. Remove cable leads from the voltage regulator and pack up into the appropriate location in the JR23



9. Close the lid and latch the JR23

Table 4 provides the complete list of JR23 light and buzzer feedback combinations for troubleshooting. The A light is only for checking the battery condition and should only illuminate if the A button is pressed and the battery has sufficient charge. If the A light does not illuminate when the A button is pressed then this indicates the battery does not have sufficient charge. Follow recharging instructions in **Section 7.1**.

B Light	Buzzer	Condition	Action
Solid Green	Off	Voltage regulator is On Neutral position and operational	1. Regulator passed test for On Neutral and is operational
Solid Red	Continuous	Voltage regulator is Off Neutral position or the Source (S) lead is disconnected/open	1. Ensure JR23 leads are all connected as directed then retest 2. Troubleshoot voltage regulator for open Source (S) connection
Flashing Alternate Red then Green	Double Beep with Pause	The Load (L) or Source Load (SL) lead is disconnected/open	1. Ensure JR23 leads are all connected as directed then retest 2. Troubleshoot voltage regulator for open Load (L) or Source Load (SL) connection
Flashing Red	Double Beep with Pause	Battery charge too low for operation	1. Recharge JR23 in accordance with **Section 7.1**

Table 4. Feedback Translation Table

7. Periodic Maintenance

The JR23 Combo Regulator and Neutral Tester is a self-contained testing device which operates on a 12V lead-acid battery. This 12V lead-acid battery requires some periodic maintenance including charging and eventual battery replacement. The following instructions are for those activities.

7.1 Recharging Instructions

The battery in the JR23 is of ample size and recharging is not anticipated to be required more than one (1) time each month; however, as the battery ages the length of time between charging will decrease and eventually the battery will require replacement as described in **Section 7.2**.

Note: *The JR23 should be periodically charged even when not used to maximize battery life. The overall required frequency of charging is highly dependent on the amount of usage of the JR23. On a lightly used or stored device it is still recommended to charge the unit, with the supplied AC wall-mount charger, every six (6) months to ensure the battery level remains adequate to maximize battery life. More frequent use of the JR23 requires more frequent charging.*

Note: *The JR23 will operate for some period of time after the A light will not illuminate green upon test; however, it is always recommended that if the A light does not illuminate green upon test that the JR23 be recharged prior to use. There is an internal protection that will stop the JR23 from operating if the battery level is too low, but the JR23 is not guaranteed to work for any period of time after the A light will not illuminate green upon test. The light and buzzer condition for low battery protection is flashing red with a double beep of the buzzer as described in the Feedback Translation Table,* ***Table 4****.*

Note: *The JR23 comes with a DC charging adapter for vehicle use. This is not intended to be the primary means of charging the JR23 but is provided in the event that charge is needed at the job site prior to operation. The DC adapter will take longer to charge the unit to the appropriate level than the AC wall-mount charger.*

The instructions in the following two (2) sections are for charging the JR23 with the AC wall-mount charger and DC charging adapter, respectively.

7.1.1. AC Wall-Mount Charger

The AC wall-mount charger is the primary means of charging the JR23. The JR23 should be charged when the A light will no longer illuminate upon test or every six (6) months, whichever comes first, as minimum criteria.

⚠**WARNING:** *Do not operate the JR23 if the cords or battery are damaged. Do not attempt to charge the JR23 with damaged chargers, charger cords, or battery. Replace charging accessories immediately by calling ZEMAR, Inc. for replacement. Return damaged JR23 unit to ZEMAR, Ins. for repair before use.*

⚠**WARNING:** *All lead-acid batteries have the potential to emit gasses that may combine into a combustible or explosive mixture. In many cases, it is possible that lead-acid batteries will emit these gasses during normal discharge and charging operations. Do not operate or charge the JR23 where ventilation is restricted. The intent here is to allow sufficient airflow to minimize and dissipate the heat generated by the charger and to diffuse the gasses that may be emitted by the battery. The power consumption of the JR23 is low in normal operation, but charging may produce more risk.*

⚠**CAUTION:** *Only use supplied battery chargers with the JR23. Replacements can be ordered from ZEMAR, Inc.*

Contact ZEMAR, Incorporated (Inc.) for any necessary technical assistance.

1. Place the JR23 on a stable surface near an AC outlet, ensuring that the AC wall-mount adapter cord can safely reach the unit and open the JR23 case
2. Ensure the JR23 leads are disconnected from any external device
3. Plug the AC wall-mount adapter into a standard United States (US) wall outlet 120V electrical connection
4. Plug the barrel plug end of the AC wall-mount adapter into the charger connection on the side of the JR23

   a. The charge light on the AC adapter should indicate charging unless battery is fully charged already
5. Allow the unit to charge until the AC wall-mount adapter indicator light indicates charged
   a. This can take several hours depending on the battery state of charge
   b. If several hours pass without the battery charging to a sufficient level then the battery likely needs replacement in accordance with **Section 7.2**

6. Remove the barrel plug end of the AC wall-mount adapter from the JR23
7. Remove the AC wall-mount adapter from the 120V electrical connection
8. Recoil the AC wall-mount adapter wire, wrapping it in the Velcro strip attached, and place it back in the JR23 unit for safe keeping
    a. Not a required step
9. Press the A button on the JR23 and ensure the A light illuminates green

    a. If the A light does not illuminate green and the charger indicates a full charge then either the charger or the JR23 is not operating correctly
        i. Press the B button
            1. If the B light flashes double red, the JR23 indicates a low battery and the charger is likely malfunctioning
                a. Reference the Feedback Translation Table, **Table 4**
                b. *Contact ZEMAR, Inc. for any further technical assistance or to order a new charger*
            2. If the B light flashes red then green, the JR23 indicates an open regulator, has passed the low battery test, and the A button/light function is likely malfunctioning
                a. Reference the Feedback Translation Table, **Table 4**
                b. *Contact ZEMAR, Inc. for any further technical assistance*
    b. If the A light does illuminate green, the JR23 has sufficient charge and is ready for use
10. Close the lid and latch the JR23

7.1.2. DC Adapter

The DC adapter is a secondary means of charging the JR23 meant for essential charging when an AC outlet is not available.

⚠**WARNING:** *Do not operate the JR23 if the cords or battery are damaged. Do not attempt to charge the JR23 with damaged chargers, charger cords, or battery. Replace charging accessories immediately by calling ZEMAR, Inc. for replacement. Return damaged JR23 unit to ZEMAR, Ins. for repair before use.*

⚠**WARNING:** *All lead-acid batteries have the potential to emit gasses that may combine into a combustible or explosive mixture. In many cases, it is possible that lead-acid batteries will emit these gasses during normal discharge and charging operations. Do not operate or charge the JR23 where ventilation is restricted. The intent here is to allow sufficient airflow to minimize and dissipate the heat generated by the charger and to diffuse the gasses that may be emitted by the battery. The power consumption of the JR23 is low in normal operation, but charging may produce more risk.*

⚠**CAUTION:** *Only use supplied battery chargers with the JR23. Replacements can be ordered from ZEMAR, Inc.*

Contact ZEMAR, Inc. for any necessary technical assistance.

1. Place the JR23 on a stable surface near a vehicle power adapter, ensuring that the DC adapter cord can safely reach the unit and open the JR23 case
2. Ensure the JR23 leads are disconnected from any external device
3. Plug the DC adapter into 12V vehicle power adapter connection
4. Plug the barrel plug end of the DC adapter into the charger connection on the side of the JR23

5. Allow the unit to charge for at least 15 minutes
6. Remove the barrel plug end of the DC charging connector from the JR23
7. Press the A button with the DC charger removed

   a. Ensure that the A light illuminates green
      i. If the A light does not illuminate green, charge the JR23 at least 15 more minutes by returning to **Step 4**
      ii. Repeat until the A light will illuminate green upon test with the charger removed
         1. If the JR23 does not reach sufficient charge in reasonable time, fully charge with the AC wall-mount adapter in accordance with **Section 7.1.1**
8. Remove the DC adapter from the 12V vehicle power adapter
9. Place the DC adapter back in the JR23 unit for safe keeping
   a. Not a required step
10. The JR23 is ready for immediate use, close the lid and latch
    a. Fully charge the JR23 with the AC wall-mount charger in accordance with **Section 7.1.1** at the next opportunity

7.2 Battery Replacement

The JR23 Combo Regulator and Neutral Tester uses a field replaceable, sealed, 12V, lead-acid battery for operation. Unless damaged or mishandled, the lead-acid battery should not leak any fluids or be hazardous.

⚠**WARNING:** *DO **NOT** short the positive (+) and negative(-) battery terminals together as this may cause damage to the battery, release of toxic fumes, extreme heat, acid leakage, and/or personal injury.*

⚠ **CAUTION:** *Ensure the red positive (+) battery cable is connected to the red positive (+) connection of the battery and the black negative (-) battery cable is connected to the black negative (-) connection of the battery.*

⚠**CAUTION:** *Inspect battery compartment for any signs of fluid leakage and inspect battery case for any signs of physical damage on the removed battery and the replacement battery.*

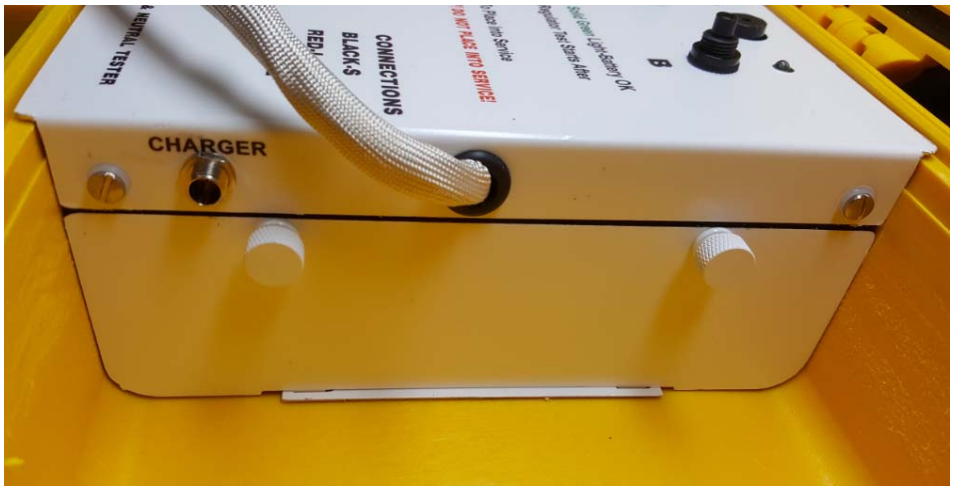
⚠**CAUTION:** *Lead-acid batteries require special handling and disposal constraints. It is recommended to recycle the lead-acid battery.*

Note: *The 12V lead-acid battery is life limited and that life can vary from product to product based on use and storage conditions. It is recommended that the JR23 is stored at room temperature as often as possible; thus lengthening the life of the battery. Lead-acid battery life reduction occurs at higher temperatures and when stored in a discharged state. Attempt to keep the charge of the battery as directed in the recharging instructions of **Section 7.1** to maximize the life of the battery.*

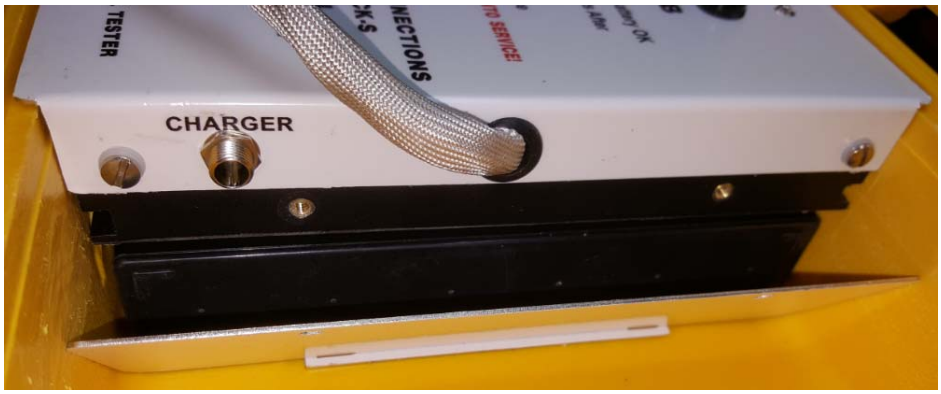
Contact ZEMAR, Inc. for any necessary technical assistance.

When replacement is required due to period of time in-between charge requirements being unacceptable, or the battery is unable to maintain a charge for the JR23 to operate, use the following instructions to remove and replace the battery. The battery is a common size, voltage, and current rating. The part number shipped with the JR23 is likely WB1222 or BW1222, but there are several others with the same attributes. As long as it is a 12V, lead-acid, 2.2 Amp-Hour (Ah), battery with the same dimensions (7” (L) X 1.38” (W) X 2.5” (H)), it will fit and operate the JR23. Feel free to contact ZEMAR, Inc., 5209 N. St. Rt. 60 NW, McConnelsville, OH 43756, 740-815-0331, for assistance.

1. Place the JR23 on a stable surface and open the JR23 case
2. Ensure the JR23 leads are disconnected from any external device
3. Move the cables from the internal storage area to gain access to the battery compartment

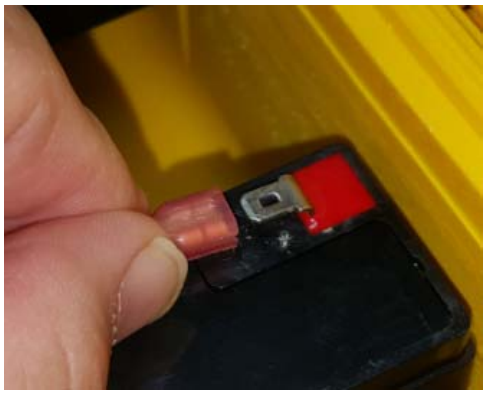


4. Remove the two thumb screws
5. Remove the battery cover



6. Tilt the JR23 so that the battery slides out of the battery compartment

7. Carefully remove the battery cables from the battery terminals, ensuring not to pull the battery cables from inside the JR23 battery compartment



a. ⚠**WARNING:** *DO **NOT** short the positive (+) and negative(-) battery terminals together as this may cause damage to the battery, release of toxic fumes, extreme heat, acid leakage, and/or personal injury*
b. Cable connections to the battery click into place and may require some force to remove from the battery terminals
    i. Wiggling the connection back and forth may help remove
    ii. If they cannot be removed by hand then use a pair of needle nose plyers and grip the connector on the thin part (diameter) of the plastic neck
    iii. ⚠**CAUTION:** *DO **NOT** pull on bare wire at any point*
        1. Pulling on bare wire may damage the cable
c. *Contact ZEMAR, Inc. for any further technical assistance*

8. Remove the battery and recycle or dispose of it properly
    a. ⚠**CAUTION:** *Lead-acid batteries require special handling and disposal constraints*
        i. It is recommended to recycle the lead-acid battery
9. Place new battery in the JR23 with the positive end of the battery toward the top and the negative end toward the bottom as shown on the label in the JR23 battery compartment
    a. Similar to pictures in **Step 6** and **Step 7**
10. Reconnect the battery cables

a. ⚠**CAUTION:** *Ensure the red positive (+) battery cable is connected to the red positive (+) connection of the battery and the black negative (-) battery cable is connected to the black negative (-) connection of the battery*
b. Similar to pictures in **Step 6** and **Step 7**

11. Slide battery fully back into the battery compartment until it stops
12. Replace the battery cover
13. Reinstall the thumb screws
14. Fully charge the JR23 with the AC wall-mount adapter as instructed in **Section 7.1.1**

8. Technical Support

ZEMAR, Inc. hopes your purchase leads to many years of improving the safety of distribution voltage regulator installation as well as saving both time and money by catching any regulator malfunctions before costly transportation and storage.

The JR23 Combo Regulator and Neutral Tester was designed to be an easy to use interface which tests a de-energized distribution voltage regulator to ensure safety and operation. Significant effort was put into ensuring the device not only provides this interface, but also guards against connection errors, inadequate battery levels, and has an easily replaceable battery. Equipment long term reliability was considered throughout the design cycle based on the circuit designer's experience in reliability and failure analysis in the aviation industry. Although this experience drove design choices which significantly improve expected reliability in the field, interfaces were also designed to fail-safe in the event that a failure does happen in the JR23 circuitry.

In the event the JR23 appears not to operate as described in this manual, please contact ZEMAR, Inc. for technical assistance immediately. ZEMAR, Inc. will work with you to troubleshoot the condition and get your unit back to operational status.