

TROJAN[®] LITHIUM ONEPACK[™] 48V SERIES

USER'S GUIDE



TR-48-110-M



TR-48-170-M EXTENDED-RANGE



TR-48-170-HP HIGH PERFORMANCE

CONGRATULATIONS

on your purchase from Trojan Battery Company, LLC (“Trojan”), manufacturers of the world’s most trusted batteries. Trojan Lithium-ion batteries are engineered for safety and performance—delivering faster charge times and longer runtimes with virtually zero required maintenance. It’s the next innovation in battery power backed by 100 years of expertise. We’re proud to continue our tradition of delivering clean, long-lasting and reliable batteries to power your world.



THIS USER'S GUIDE

was created by Trojan's application engineers and contains vital information regarding proper care and maintenance of your new battery. Please read through this User's Guide carefully and completely before using your battery. It will help you achieve optimum performance and long life from your new investment. If you have any questions concerning safety precautions or for any assistance in installing or using the battery in your system, contact Trojan's technical support engineers at one of the following numbers, or send us an email through our website at www.trojanbattery.com/tech-support/.

www.trojanbattery.com



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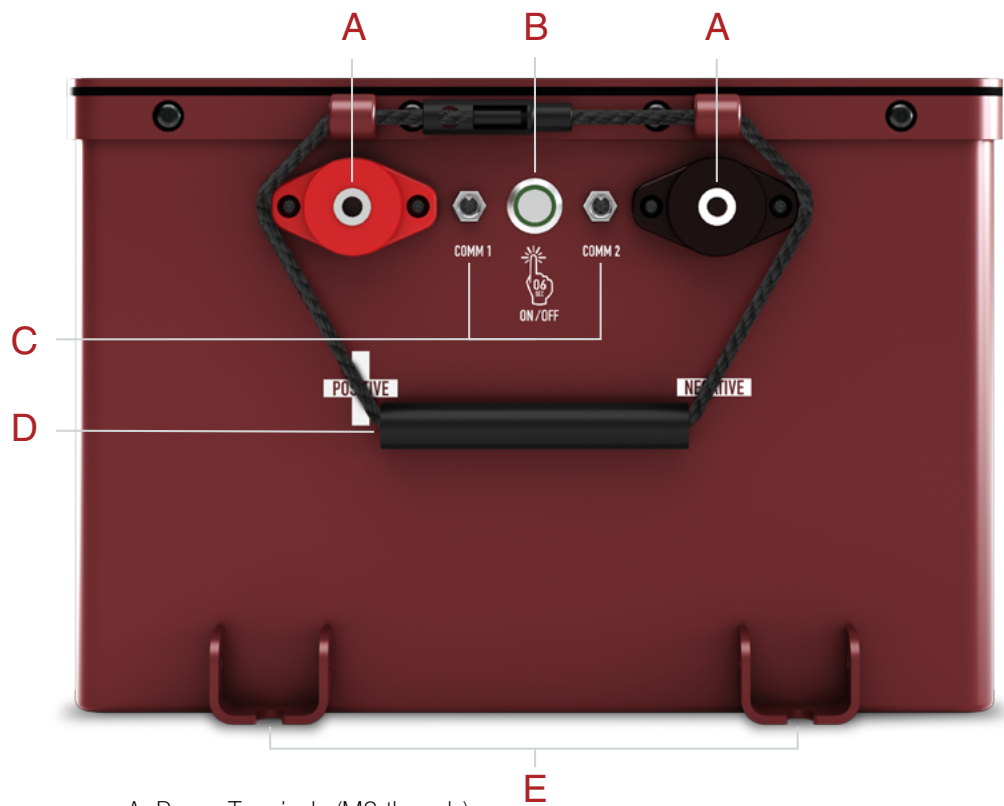
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1 YOUR TROJAN LITHIUM-ION BATTERY

The OnePack™ battery is a deep-cycle lithium-ion battery. Key attributes of the battery include:

KEY ATTRIBUTES			
	TR-48-110-M	TR-48-170-M Extended Range	TR-48-170-HP High Performance
Case Size (LxHxW)	21.4" x 12.6" x 8.6" (544mm x 320mm x 219mm)	21.4" x 12.8" x 10.5" (544mm x 325mm x 266mm)	21.4" x 12.8" x 10.5" (544mm x 325mm x 266mm)
Weight	120 Lbs (54kg)	170 lbs (77kg)	170 lbs (77kg)
Battery Voltage	51.2V	51.2V	51.2V
Capacity*	105Ah	170Ah	170Ah
Terminal Configuration	M8-1.25 Female	M8-1.25 Female	M8-1.25 Female
Communication Port	CAN Bus SAE J1939	CAN Bus SAE J1939	CAN Bus SAE J1939



- A. Power Terminals (M8 threads)
- B. ON/OFF Power Switch
- C. Communications Port 1 & 2
- D. Handle
- E. Mounting Feet

*Temperature, load, state of charge, and battery age can affect battery performance and capacity.

2 SAFETY

ALWAYS	NEVER
Always wear proper personal protective equipment (PPE) (eye protection, gloves and safety toe shoes).	Never wear jewelry or other metal objects when working on or around batteries.
Always use insulated tools when working on batteries.	Never place objects on top of batteries.
Always check connections for proper torque.	Never attempt to charge a battery when the temperature is below 32°F (0°C) or above 131°F (55°C).
Always keep sparks and flames away from batteries. This includes sources of static electricity.	Never store batteries below 30% State of Charge.
Always use short cables of appropriate size to minimize voltage drop.	Never exceed maximum charging currents for the battery's temperature.
Always make sure charger is set as recommended.	Never dispose of batteries as household waste. Use recycling channels in accordance with local, state and federal regulations.
Always charge batteries to 100% SOC before installing.	Never connect or disconnect terminals from batteries without first disconnecting loads.
Always make sure chargers are off or disconnected while working on batteries.	Never attempt to open the battery case.
Always install batteries while powered off.	Never use pressure washers to clean the battery or immerse the battery in water.
Always use team-lift techniques or mechanical assistance when lifting the OnePack.	Never short-circuit the battery terminals.
Always review product warning labels and Trojan OnePack Lithium-Ion battery User's Guide.	Never physically damage the battery (this includes, without limitation): Puncturing, dropping, crushing, burning, penetrating, shaking, hammering, and misconnecting terminals.
	Never lift by the battery terminals.
	Never over-charge or over-discharge the battery.



WARNING! RISK OF FIRE, EXPLOSION OR BURNS. DO NOT DISASSEMBLE, HEAT ABOVE 140°F (60°C) OR INCINERATE.



THE MOST EFFECTIVE FIRE EXTINGUISHER TYPES FOR TROJAN LITHIUM-ION BATTERIES ARE CO₂ OR WATER. SEE SAFETY INSTRUCTIONS.



WARNING!

HOST SYSTEMS POWERED BY LITHIUM-ION BATTERIES, INCLUDING THE TROJAN® ONEPACK LITHIUM-ION BATTERY, MAY BEHAVE DIFFERENTLY THAN WHEN POWERED BY LEAD-ACID BATTERIES. LITHIUM-ION BATTERIES MAY DISCONNECT FROM THE HOST SYSTEM WITHOUT WARNING UNDER A VARIETY OF CONDITIONS IN ORDER TO AVOID INTERNAL DAMAGE ("AUTOMATIC DISCONNECTION"). AUTOMATIC DISCONNECTION WILL RESULT IN TOTAL POWER LOSS.

EXAMPLES OF CONDITIONS THAT CAN LEAD TO AUTOMATIC DISCONNECTION INCLUDE, WITHOUT LIMITATION:

- HIGH VOLTAGE FROM EXTERNAL POWER SOURCES (CHARGERS) OR REGENERATIVE BRAKING
- BATTERY LOW VOLTAGE OR LOW STATE OF CHARGE
- HIGH CURRENT
- EXTERNAL SHORT CIRCUIT
- HIGH OR LOW TEMPERATURES
- SELF DIAGNOSTICS

FOR ADDITIONAL INFORMATION PLEASE SEE SECTION 10.3: "PROTECTION LIMITS: AUTOMATIC DISCONNECTION."

IN EQUIPMENT WITH ESSENTIAL SYSTEMS THAT RELY ON BATTERY POWER (FOR EXAMPLE, LOW-SPEED VEHICLES WITH ELECTRONIC ACCELERATION AND BRAKING SYSTEMS) (EACH AN "AFFECTED APPLICATION"), AN ABRUPT INTERRUPTION OF POWER MAY RESULT IN UNDESIRABLE, UNEXPECTED AND POTENTIALLY DANGEROUS EQUIPMENT BEHAVIOR, INCLUDING BUT NOT LIMITED TO BRAKING LOSS OR IMMEDIATE BRAKING.

USERS AND INSTALLERS OF THE TROJAN® ONEPACK LITHIUM-ION BATTERY MUST UNDERSTAND THE CONSEQUENCES OF INSTALLING LITHIUM-ION BATTERIES IN AN AFFECTED APPLICATION. THE USER AND/OR INSTALLER OF THE ONEPACK BATTERY ("USER AND/OR INSTALLER") ASSUMES ALL RISK AND LIABILITY FOR ANY DAMAGES, INJURIES TO PERSONS OR PROPERTY (INCLUDING BUT NOT LIMITED TO DEATH), OR ACCIDENTS ARISING RELATED TO SUCH USE OR INSTALLATION.

USERS AND/OR INSTALLERS SHOULD CONSULT THE MANUFACTURER OF ANY AFFECTED APPLICATION FOR RISK MITIGATION OPTIONS RELATED TO USE WITH LITHIUM-ION BATTERIES.



WARNING!

LITHIUM-ION BATTERIES, INCLUDING THE TROJAN® ONEPACK LITHIUM-ION BATTERY, WEIGH SUBSTANTIALLY LESS THAN LEAD-ACID BATTERIES OF COMPARABLE CAPACITY. MANY TYPES OF EQUIPMENT ARE DESIGNED TO UTILIZE THE WEIGHT OF LEAD-ACID BATTERIES TO ACHIEVE THE MANUFACTURER'S INTENDED WEIGHT DISTRIBUTION. IF THE ONEPACK BATTERY INSTALLED AS REPLACEMENT BATTERIES IN EQUIPMENT DESIGNED TO USE LEAD-ACID BATTERIES AS BALLAST, THE WEIGHT DISTRIBUTION OF THE EQUIPMENT COULD BE IMPACTED. THE USER AND/OR INSTALLER OF THE ONEPACK BATTERY IN SUCH EQUIPMENT MUST UNDERSTAND THE CONSEQUENCES OF MODIFIED WEIGHT DISTRIBUTION AND ENSURE THAT STABILITY REMAINS WITHIN A SAFE RANGE FOR THE INTENDED USE. THE PROPER INSTALLATION OF ONEPACK BATTERY MAY REQUIRE ADDITIONAL BALLAST WEIGHTS OR OTHER ADJUSTMENTS OR EQUIPMENT MODIFICATIONS TO ENSURE STABILITY AND SAFE WEIGHT DISTRIBUTION. THE IMPROPER INSTALLATION AND/OR USE OF ONEPACK BATTERY COULD COMPROMISE THE WEIGHT BALANCE AND PHYSICAL STABILITY OF THE EQUIPMENT LEADING TO UNSAFE CONDITIONS. THE USER AND/OR INSTALLER OF THE ONEPACK BATTERY IN SUCH EQUIPMENT ASSUMES ALL RISK AND LIABILITY FOR ANY DAMAGES, INJURIES TO PERSONS OR PROPERTY (INCLUDING BUT NOT LIMITED TO DEATH), OR ACCIDENTS ARISING OUT OF OR RELATED TO DEGRADED STABILITY RESULTING FROM IMPROPER INSTALLATION AND/OR USE OF THE ONEPACK BATTERY.

3 EQUIPMENT NEEDED

Before installation or maintenance of your battery, have the following equipment available:

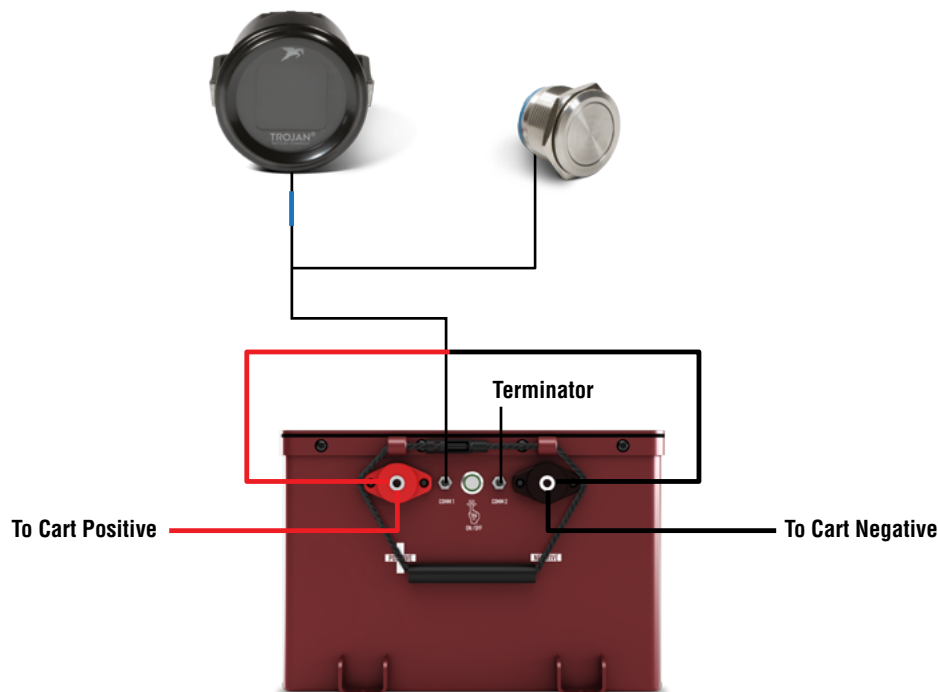
- ▶ Proper personal protective equipment (eye protection, gloves and safety toe shoes)
- ▶ Insulated tools including torque wrench
- ▶ Battery charger
- ▶ Voltmeter (optional)
- ▶ Cables
- ▶ 13mm deep well socket

Team lifting is recommended when installing the battery.

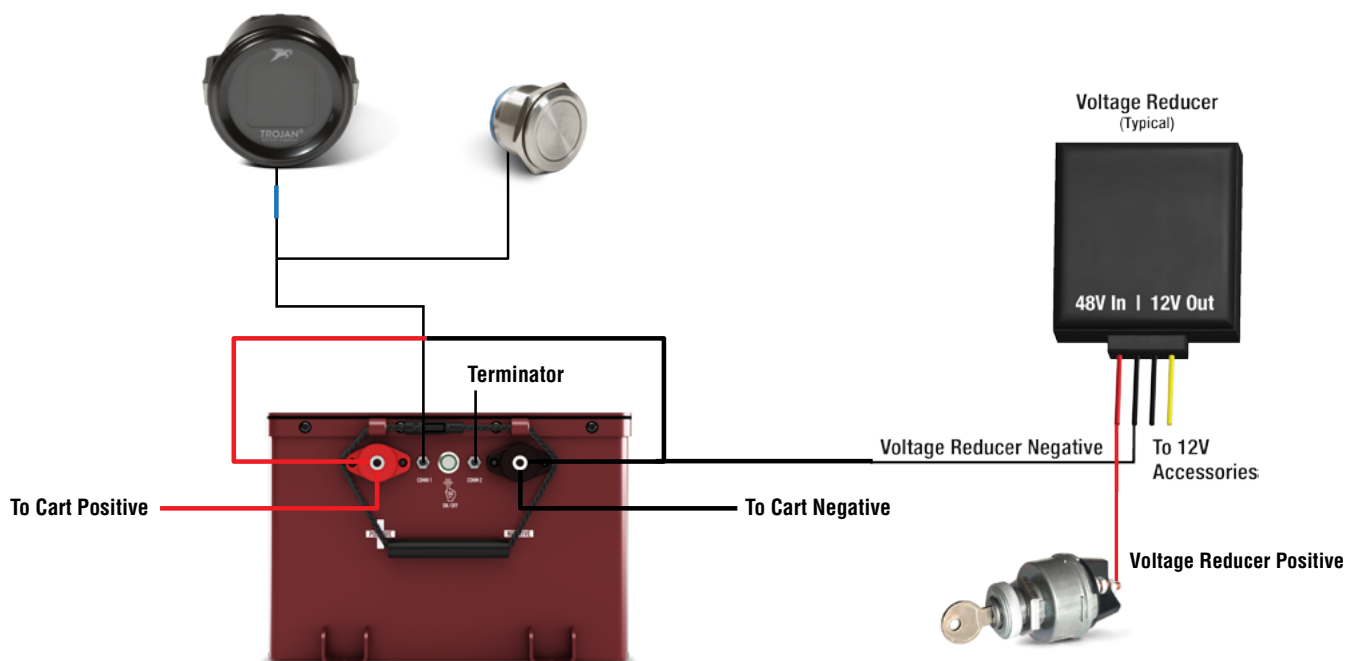
4 BATTERY INSTALLATION

The Lithium-ion battery voltage must be matched to the vehicle where it is installed.

DO NOT CONNECT BATTERIES IN A SERIES OR PARALLEL. SERIES & PARALLEL CONNECTION MAY POSE DANGER TO USER AND/OR INSTALLER AND CAUSE DAMAGE TO THE BATTERY.



4 BATTERY INSTALLATION (CONTINUED)



4.1 INSPECTION AND 12V ACCESSORIES

Check for visible damage including cracks, dents, deformation and other visible abnormalities. The top of the battery and terminal connections should be clean, free of dirt and corrosion, and dry. If any problems are detected with the battery, contact Trojan technical support or your battery distributor. If damage occurred in transit, contact your freight carrier. To prevent damage to 12V accessories in the vehicle, first verify the voltage requirement of accessories like lights or other items in the vehicle. Never connect vehicle accessories directly to the battery. Battery accessories such as Dashboard SOC Gauge Kit (10001373) shall be directly connected to the battery as indicated in [Section 4: "Battery Installation"](#). Lithium-ion batteries are more susceptible to permanent damage from parasitic loads than other battery types. If a continuous load such as a light, USB charger, voltage reducer, GPS or battery state of charge indicator is left connected to the battery for an extended period of time, a low voltage fault will occur. If left in this condition, the battery could become unrecoverable. All vehicle accessories should be wired through the vehicle key switch or another method of disconnecting the equipment from the battery when not in use. Then, if needed, the installer can use a voltage reducer to reduce the battery voltage to 12V or as required. To ensure you install your battery properly and safely, please use the following guidelines.

4.2 TERMINALS AND TORQUE VALUES

Both the positive and negative terminals of the battery are M8-1.25 female threads. Ensure the hardware is tightened to the **proper dry torque of 50-60 in-lbs (5.6-6.8 Nm)**. OVER-TIGHTENING TERMINAL CONNECTIONS CAN CAUSE TERMINAL BREAKAGE, AND LOOSE CONNECTIONS CAN RESULT IN TERMINAL MELTDOWN OR FIRE.

4.3 CORRECT HARDWARE INSTALLATION

If using flat or lock washers, it is very important to ensure the battery cable lug is contacting the top surface of the terminal, and the washer is placed on top of the lug. **DO NOT PLACE A WASHER BETWEEN THE BATTERY TERMINAL**

AND THE LUG, AS THIS WILL CREATE HIGH RESISTANCE AND CAUSE EXCESSIVE HEATING OF THE CONNECTION, WHICH CAN RESULT IN FIRE. If assistance is needed in determining the appropriate hardware configuration, contact Trojan Battery technical support.

4.4 CABLE SIZE

Battery cables should be sized to handle the expected load and be of sufficient length and flexibility to avoid applying undesirable mechanical loads on the battery terminals. Refer to Table 1 for the maximum amperage based on the cable/wire gauge size.



WARNING! SHOCK HAZARD – DO NOT TOUCH UN-INSULATED BATTERY, CABLES, OR TERMINALS. ALL TOOLS SHOULD BE ADEQUATELY INSULATED TO AVOID THE POSSIBILITY OF SHORTING CONNECTIONS. DO NOT LAY TOOLS ON THE TOP OF THE BATTERY.

CABLE/WIRE GAUGE SIZE, AWG (mm ²)	AMPACITY (Amps)
14 (2.08)	20
12 (3.31)	25
10 (5.26)	35
8 (8.36)	50
6 (13.3)	65
4 (21.1)	85
2 (33.6)	115
1 (42.4)	130
1/0 (53.5)	150
2/0 (67.4)	175

TABLE 1

Table values are from NEC Table 310.15(B)16 for copper cables rated at 167°F (75°C), operating at an ambient temperature of no more than 86°F (30°C). Lengths in excess of 6 feet (1829mm) may require heavier gauge wire to avoid unacceptable voltage drop. In parallel battery banks, it is preferable for all cables to be the same length.

For more information refer to the National Electrical Code for correct cable/wire size, which can be located at www.nfpa.org

4.5 VENTILATION

Trojan® Lithium-Ion batteries do not release gas during normal use. There are no specific ventilation requirements for Trojan Lithium-Ion Battery installations, although sufficient airflow should be provided to prevent excessive heat build-up.

4.6 BATTERY ENVIRONMENT

Battery should be stored and installed in a clean, cool and dry place, keeping water, oil and dirt away from the battery. If any of these materials are allowed to accumulate on the battery, tracking and current leakage can occur, resulting in self-discharge and possible short-circuits. Battery chargers should also be installed in well-ventilated, clean areas that are easily accessible. Relative humidity should be <90% and non-condensing.

4.7 TEMPERATURE

The operating temperature range for discharging the Trojan OnePack Lithium-Ion battery is -4°F to 140°F (-20°C to 60°C). Charging the battery below 32°F (0°C) is prohibited, and charging currents must be reduced below 68°F (20°C) and above 113°F (45°C). Attempting to charge the battery at temperatures below 32°F (0°C) will cause the battery to disconnect from the charger and enter an under-temperature alarm, charging will be disabled while the alarm is active.

Refer to Section 10.1: “Charging” for charging current limitations.

Note that battery life diminishes as temperature increases. Useable capacity diminishes as battery temperature decreases.

4.8 BATTERY START-UP

Your battery may be shipped at 50% state of charge (SOC) or lower. Before the first prolonged use, connect the battery to a charger programmed with the recommended charging algorithm and allow the charger to complete a full cycle. Then leave the battery idle overnight. This will set the battery state of charge, ensuring accuracy.

Prior to installation, follow the instructions in Section 6.2: “Initial Charging.”

4.9 ENTERING AND EXITING STORAGE MODE

The Trojan OnePack is equipped with a storage mode that reduces the BMS function to minimal levels so that the battery state of charge is maintained. Storage mode also disables the battery terminals to make installation and handling of the OnePack safer. When at idle, the battery will automatically enter storage mode after 4 hours. To manually enter or exit storage mode, either the ON/OFF Power Switch or the optional dashboard push button can be used. Note: the Trojan SmartBattery® App cannot be used to enter or exit storage mode.

Perform the following steps to turn the battery on using the ON/OFF Power Switch:

- ▶ Verify that the battery is either completely disconnected or correctly connected to the equipment it will be powering.
- ▶ Be sure you are able to see the ON/OFF Power Switch on the side of the battery.
- ▶ **Press and hold** the ON/OFF Power Switch for approximately 6 seconds then release.
- ▶ A green blinking LED light will appear on the ON/OFF Power Switch to indicate the battery is on.

Perform the following steps to turn the battery off and place it in storage mode:

- ▶ **Press and hold** the On/Off switch for approximately 6 seconds then release.
- ▶ The green blinking LED switch light will no longer be illuminated. The battery is off if no illumination is present.

See section 4.10 for more information about the LED status indicator light



Power On/Off: Locate the ON/OFF Power Switch on the side of the battery in-between the power terminals.



Turning On: Press the button, hold for approximately 6 seconds, and release. A green blinking LED light will appear to indicate the battery is on.



Turning Off: Press the button, hold for approximately 6 seconds, and release. Verify that the green LED is no longer blinking.

The battery can also be turned on and off using the dashboard push button accessory. If using the dashboard push button to turn the battery on or off, push and hold the button for 1 second. The SOC gauge display will be your indication that the battery is on or off. The use of the dashboard push button is disabled while the battery is being charged or discharged, or when the battery has been disabled due to low voltage. In these circumstances, the ON/OFF Power switch located on the battery must be used to enter or exit storage mode.

DO NOT ATTEMPT TO TURN THE BATTERY OFF WHILE THE VEHICLE IS IN MOTION.

4.10 ON/OFF PUSHBUTTON INDICATOR LIGHT

The Trojan® OnePack Lithium-Ion battery features a ON/OFF Power Switch with a green ring LED indicator. Below are the following steps to understand your battery's ON/OFF Power Switch functions:

LED BLINK PATTERN	STATUS	DEFINITION	LED BLINK PERIODICITY
1 short green LED blink	Battery Active	Indicates the battery is 'active'	Repeats once every 4 sec
1 long green LED blink	Battery Fault	Indicates the battery has a 'fault'	Repeats once every 3 sec
2 short green LED blinks	CAN Communication	Indicates the CAN communication is active	Repeats once every 1 sec
NO LED blinks	Battery Asleep	Indicates the battery is in storage mode	NA

4.11 CAN BUS

The battery includes a Controller Area Network (CAN) bus communications interface. The two circular M8 DIN connectors are on the side of the battery to enable communication with the battery and support battery accessories such as the Dashboard SOC Gauge Kit (10001373). For normal battery operation, the CAN bus feature is not required. The battery operates and protects autonomously; it does not require any CAN bus communication or external devices such as external controllers. Keep the two black caps installed on the two M8 connectors to protect them from the environment when not used. Trojan's field service can retrieve the battery usage history and view status over the CAN bus interface to help resolve issues or questions. A certified field service technician can update the battery firmware over the CAN bus as needed. The CAN bus interface is galvanically isolated from the internal battery voltages. Therefore, an external power source is required to turn on and power the field side of the isolated CAN bus. Contact Trojan's technical support engineers if you have any questions about the CAN bus interface and its use.

See Section 8: "Maximizing the Performance of Your Battery" for technical support information.

5. PREVENTATIVE MAINTENANCE

5.1 INSPECTION

- ▶ Power off battery before inspection.
- ▶ Examine the outside appearance of the battery. The top of the battery, sides, and terminal connections should be clean, dry and free of corrosion.
- ▶ Check battery cables and connections. Replace any damaged cables and tighten any loose connections.
Refer to Section 4.2: “Terminals and Torque Values.”
- ▶ Verify mounting brackets are still securely mounted to both the battery and the vehicle.

5.2 CLEANING

Check the battery for cleanliness at regular intervals and keep terminals and connectors free of corrosion. Terminal corrosion may adversely affect the performance of the battery and present a safety hazard.

- ▶ Power off battery before cleaning.
- ▶ Disconnect the battery from the charging source and the load.
- ▶ Clean the top of battery, sides, and terminals with a damp cloth or non-metallic brush. If the battery is extremely soiled, a household cleaner may be used.
- ▶ Dry with a clean cloth.
- ▶ Keep the area around batteries clean and dry.

6. Charging

6.1 BACKGROUND

The Trojan OnePack Lithium battery may be used in applications where lead-acid batteries have previously been utilized. Best charging results are obtained by using an appropriate Trojan-recommended charger and charging profile (algorithm). Refer to documentation on your specific charger for more information. Charging due to regenerative braking should also be reduced in environments below 68°F or above 113°F. Vehicles that use regenerative braking at cold temperatures may force the battery to shut off if too much current is applied back into the battery.

6.2 INITIAL CHARGING & CHARGING PROFILES

Unless your dealer has charged your battery prior to delivery, it will be received at partial state of charge.

Prior to installation, fully charge the battery to 100% SOC and allow to rest a minimum of 5 hours in storage mode, or 9 hours after charging cycle completes.

The Trojan OnePack Lithium battery should be charged using a lithium-ion charging profile with a voltage setting between 54.7V – 56.0V. Use of a compatible charging profile is required to obtain a fully balanced battery pack. Using charging profiles designed for lead-acid or other battery types may result in a sudden voltage increase that will cause permanent damage to the battery BMS and render the battery inoperative.

For a list of compatible chargers and charging profiles, visit www.trojanbattery.com.

Batteries regularly charged with equipment not optimized for lithium-ion batteries may become imbalanced and is not recommended. See Section 6.4: “Balancing” for additional information.

6.3 CHARGING PROCEDURES

- ▶ Verify that the battery is correctly hooked up to the charger with the positive wire on the positive (+) terminal and the negative wire on the negative (–) terminal.
- ▶ Ensure the charger is set to run the appropriate profile.
- ▶ If the charger will not run until it detects battery voltage, be sure that the batteries are turned on.
- ▶ Start charging, following the charger manufacturer's instructions.
- ▶ After the charge has completed, the charger may be shut off and disconnected, or if it remains in a “maintenance mode” within the recommended charging range, it can remain connected to the battery indefinitely.

6.4 BALANCING

One function of a lithium-ion battery BMS is to maintain balance between each group of cells within the battery. This allows the battery to deliver full capacity without any cells experiencing an over or under-voltage condition. Balancing is performed when a parallel group of cells reach a specified threshold voltage corresponding to nearly 100% state of charge (SOC). At that point, the highest-charged cells “bleed down” a small amount to enable the remaining groups of cells to “catch up.” Balancing may cause small changes in state of charge up to 2%.

Using a charger not designed for use with a lithium-ion battery may result in an imbalance between cells over time that requires charging maintenance to recover. Recovery of an imbalance condition requires one or more charging cycles to 100% state of charge using a lithium-ion specific charger or charging algorithm. Failure to do so may result in a battery lockout condition.

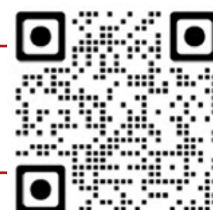
6.5 CHARGING AT TEMPERATURES BELOW 68°F (20°C)

Maximum charging currents must be reduced at temperatures below 68°F (20°C). Measures need to be taken to ensure that charging currents do not exceed the values shown on the product datasheet. As mentioned previously, charging is prohibited below 32°F (0°C). Charging due to regenerative braking should also be reduced in environments below 68°F. Vehicles that use regenerative braking at cold temperatures may force the battery to shut off if too much current is applied back into the battery.

6.6 CHARGING AT TEMPERATURES ABOVE 113°F (45°C)

Maximum charging currents must be reduced at temperatures above 131°F (45°C). Measures need to be taken to ensure that charging currents do not exceed the values shown on the product datasheet. As mentioned previously, charging is prohibited above 131°F (55°C). Charging due to regenerative braking should also be reduced in environments above 113°F. Vehicles that use regenerative braking at hot temperatures may force the battery to shut off if too much current is applied back into the battery.

**Use Only with Compatible Lithium-Ion
Chargers. Scan for Approved List.**



6.7 CHARGING FROM 0% STATE OF CHARGE

If the battery is discharged to 0% state of charge, voltage to the battery terminals will be disabled and the battery will enter into storage mode. The battery should be recharged as soon as possible. Failure to do so may render the battery permanently unusable.

A battery at 0% state of charge may interfere with the operation of battery chargers with voltage-sensing protection and prevent the charge cycle from starting. If the battery is at 0% state of charge and will not charge, use the following steps to recover the battery:

- ▶ Plug in the charger and connect it to the battery.
- ▶ Power on the battery using the ON/OFF Power Switch following the procedure in [Section 4.8: “Battery Start-Up.”](#) Note that the battery will not turn on using the dashboard push button accessory.
- ▶ The battery will remain powered on for 5 minutes to allow for the charging cycle to begin. If it does not begin, verify power to the charger and the connection to the battery and repeat this process.
- ▶ Depending on the battery voltage, it may be necessary to repeat these steps until regular charging resumes.

6.8 OTHER CHARGING INFORMATION

- ▶ **Chargers which utilize an automatic desulfation or equalization mode are not recommended.**
- ▶ Depending upon the initial state of charge and the size of the load, even small quiescent loads such as motor controllers and on-board chargers can fully discharge batteries in as little as a few days. For instance, a 25mA load amounts to 0.6Ah discharge per day. Be sure to understand the quiescent loads in your application and set an appropriate charging interval. If the batteries will not be used for extended periods of time, turn them off.
- ▶ It is not recommended to use power outlets controlled by switches, peak shaving controllers or that rely solely on non-continuous power sources such as solar or wind generation to charge batteries. Interruption of the charge cycle may prevent the battery from reaching full state of charge or prolong charging times.

7. STORAGE AND SHIPPING

A fully charged OnePack can be safely stored in climate-controlled conditions for up to one year (12 months) while in storage mode. It is recommended that the battery state of charge is checked every 4-6 months. Temperatures exceeding 77°F (25°C) will cause the battery to self-discharge faster and will require more frequent checks.

The following tips will help ensure that your batteries emerge from storage in good condition:

- ▶ Never put the battery into prolonged storage if the state of charge is below 30%.
- ▶ Prior to long-term storage of the battery, fully charge the battery. Storing a discharged battery can result in permanent damage or decreased run time.
- ▶ Store in a cool and dry location, protected from the elements.
- ▶ Place the **battery in storage mode** to eliminate potential parasitic loads that may discharge the battery. When batteries are taken out of storage, they should be given an initial charge prior to use as outlined in [Section 6: “Charging.”](#)



IF YOU SHIP THIS BATTERY, YOU MUST COMPLY WITH STATE, FEDERAL AND INTERNATIONAL LAWS, RULES, REGULATIONS AND REQUIREMENTS REGARDING LITHIUM BATTERIES. YOU MUST UTILIZE A QUALIFIED SHIPPING AGENT PROPERLY CERTIFIED FOR HAZARDOUS MATERIALS (“HAZMAT”) SHIPMENTS.



8. MAXIMIZING THE PERFORMANCE OF YOUR BATTERY

- ▶ Follow all the procedures in this User’s Guide for proper installation, maintenance and storage.
- ▶ If you have any questions or concerns about battery care, please contact Trojan’s technical support engineers at 800-423-6569 Ext. 3045 or +1-562-236-3045 before a problem develops.

8.1 STATE OF CHARGE

The Trojan OnePack battery features an advanced state of charge reporting function that provides users a digital state of charge display either through the optional state of charge gauge, or through the Trojan SmartBattery® App. The reported state of charge is dependent on multiple factors and may vary +/- 5%.

It is safe to use the Trojan OnePack battery at states of charge from 1% to 100% however to optimize performance of the battery, it is recommended to charge before reaching 20% state of charge. When operating below 20% state of charge, high discharge currents may cause a drop in voltage, resulting in a temporary loss of battery power. Vehicles that are carrying more than 2 passengers, have been modified for high speeds, or have oversized tires are more likely to experience this. When the battery reaches 10% state of charge or less, the gauge will simply read “Low” and users should connect the battery to a charger as soon as possible.

To ensure the accuracy of the state of charge gauge, the Trojan OnePack resets the state of charge periodically. If your battery state of charge gauge fails to show at least 95% state of charge after a complete charging cycle with a compatible charger, disconnect it from the charger and reconnect, allowing the charge cycle to run again then allow the battery to sit without being used or charged overnight (minimum of 5 hours). This will allow the battery to reset the reported state of charge.

9. WHAT TO EXPECT FROM YOUR TROJAN LITHIUM-ION BATTERY

- ▶ Your Trojan OnePack Lithium-Ion battery will deliver rated capacity when it is new. No “break-in” period is required.
- ▶ When operating batteries at low temperatures, they will deliver less than the rated capacity.
- ▶ When operating batteries at high temperatures, battery life will be reduced.
- ▶ The life of a battery is difficult to predict and will vary by application, frequency of usage and load characteristics.

9.1 QUIESCENT LOADS

Some vehicles, especially those with voltage reducers, radios and GPS units installed will continue to drain a small amount of power from the battery, even with the key switch in the Off position or the vehicle placed in Tow Mode. This is called a quiescent load and can consume 5-10% of the battery’s capacity per day even when not in use. Quiescent loads will vary from vehicle to vehicle.

To limit these types of loads, it is important that all vehicle accessories are wired through a switched power source that is disconnected with the vehicle's key-switch. Note that the battery accessories (SOC gauge & dashboard pushbutton) will not be wired through the vehicle's key switch. See [Section 4: "Battery Installation"](#) for further information.

For installations with a quiescent load, it is recommended that the battery is disconnected from the vehicle or placed into storage mode before extended periods of inactivity. This can be done by using the ON/OFF Power Switch on the side of the battery or the dashboard push button accessory. To prevent over discharge, the Trojan OnePack Lithium-Ion battery uses a automatic sleep feature that puts the battery into storage mode after **4 hours of inactivity**. If the battery capacity drops below 25% SOC while inactive, it will enter into storage mode after 1 hour of inactivity. To wake the battery from storage mode, use the ON/OFF Power Switch on the side of the battery or the dashboard push button accessory.

See [Section 4.8: "Battery Startup"](#) for additional information.

10. ELECTRICAL SPECIFICATIONS

10.1 CHARGING

CHARGING SPECIFICATIONS			
Recommended Charging Voltage	54.7 - 56.0V		
Charge Voltage Cutoff	58.4V		
Peak Charge Current (max.)	250A for 0.5 seconds		
Charge Current (max. continuous) @ Temperature			
	TR-48-110-M	TR-48-170-M	TR-48-170-HP
< 32°F (0°C)	0A	0A	0A
32°F to 50°F (0°C - 10°C)	31.5A	51.3A	51.3A
50°F to 68°F (10°C - 20°C)	52.5A	85.5A	85.5A
68°F to 113°F (20°C - 45°C)	105A	171A	171A
113°F to 131°F (45°C - 55°C)	21A	34.2A	34.2A
> 131°F (55°C)	0A	0A	0A

10.2 DISCHARGING

DISCHARGING SPECIFICATIONS			
Performance and System Specifications @ 77°F (25°C)			
	TR-48-110-M	TR-48-170-M	TR-48-170-HP
Maximum Continuous Discharge Current	180A	200A	300A
Maximum Pulse Discharge Current (30 sec)	300A	300A	425A
Maximum Instantaneous Discharge Current (2 sec)	525A	525A	750A
Maximum Instantaneous Discharge Current (0.2 sec)	500A	525A	1000A

10.3 PROTECTION LIMITS: AUTOMATIC DISCONNECTION

As outlined in the following table, the Trojan OnePack Lithium-Ion battery will automatically shut down under excessive use conditions in order to prevent damage to the battery and connected equipment. This will generally result in total loss of power to equipment. Systems must be implemented, and precautions must be taken to ensure that sudden loss of power does not result in hazardous system behavior.



AS NOTED IN SECTION 2: “SAFETY,” THE SYSTEM INSTALLER/ USER ASSUMES ALL RESPONSIBILITY AND LIABILITY FOR ANY DAMAGES THAT MAY OCCUR DUE TO SUDDEN LOSS OF POWER.

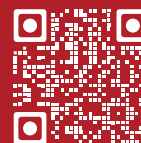
PROTECTIVE SHUTOFF AND RESTART CONDITIONS					
	SHUTOFF		RESTART		OTHER RESTART CONDITIONS
Over Voltage	Any cell voltage > 3.74V	48V Battery Voltage > 59.8V	All cell voltages < 3.64V	48V Battery Voltage < 58.2V	Load attached and discharging
Low Voltage	Any cell voltage < 2.53V	48V Battery Voltage < 40.5V	All cell voltages > 2.63V	48V Battery Voltage > 42.1V	Charger attached and charging
Short Circuit Current	800A instantaneously		No automatic restart		Wait 2 minutes then press ON/OFF Power Switch on side of the battery.
Over Temperature Discharge	140°F (60°C)		131°F (55°C)		
Over Temperature Charge	131°F (55°C)		122°F (50°C)		
Under Temperature Discharge	-4°F (-20°C)		14°F (-10°C)		
Under Temperature Charge	32°F (0°C)		41°F (5°C)		
Automatic Sleep	No use for 4 hours or 1 hour if the battery state of charge is lower than 25%		No automatic restart		Use the ON/OFF Power Switch on the side of the battery or the dashboard push button accessory to manually wake up the battery.

11. BATTERY RECYCLING

The Trojan OnePack Lithium-Ion battery is recyclable and should not be disposed as household or landfill waste. If you need assistance in recycling your battery, contact your dealer or Trojan's technical support engineers as outlined at the front of this manual.

12. BATTERY ABBREVIATIONS

A	Ampere	°F	Degrees Fahrenheit
Ah	Ampere-hour	M8	8mm terminal
AWG	American Wire Gauge	SOC	State of Charge
BMS	Battery Management System	T	Temperature
°C	Degrees Celsius	V	Volt
DOD	Depth of Discharge	VDC	Volts DC



The new Trojan SmartBattery App provides the status of your battery at your fingertips.

NOTES

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TROJAN BATTERY COMPANY

would like to thank you for selecting our battery.

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TECHNICAL SUPPORT

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technical@trojanbattery.com

Do not mix with lead-acid batteries when recycling

FAILURE TO ABIDE BY THE CARE AND MAINTENANCE REQUIREMENTS OUTLINED HEREIN MAY RESULT IN VOIDING THE WARRANTY, AS APPLICABLE.

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12380 CLARK STREET, SANTA FE SPRINGS, CA 90670

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800.423.6569 +1.562.236.3000

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