IOXUS®

uSTART® v5 Rev B User Manual

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MODEL

- **Model uST12V0375G31-MDA**
  uSTART® Medium Duty Vehicle Class 3 - 6 with 12V Operating System

SAFETY

uSTART® is not a battery, so it must be treated differently than a battery. Please review this important safety information to prevent personal injury or equipment damage. Please note, you must read and comply with all directions and warnings in this manual. Any questions should be discussed with Ioxus prior to starting the installation or service related to the uSTART® module. You can contact IOXUS® at ioxus.com for any updates or additional information.

Do not connect in reverse polarity. uSTART® is protected from up to 28 VDC reverse polarity in Maintenance Mode, but sparks and arcing will occur if a reverse polarity connection is attempted in Run Mode leading to possible injury or equipment damage

Do not connect to an energy source at 48 VDC or above. Do not connect to an energy source capable of constant ≥48 VDC or damage to uSTART® and equipment can occur.

Do not operate in environments where temperatures can exceed +149°F (+65°C). Operation above +149°F (+65°C) will accelerate product wear and will void any warranties.

Failure to install uSTART® properly can lead to damage of the module, which can cause the failure of the unit. This can cause the unit to stop working, or lead to equipment damage or fire. Improper installation voids the warranty, and all risks are assumed by the installer.

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DESCRIPTION

uSTART® is an ultracapacitor based device that enhances vehicle performance. uSTART® improves battery life by maintaining a vehicle's voltage under a wide range of load conditions. It supplies nearly all of the cranking current during engine starts. uSTART® stores a relatively small amount of energy compared with a battery, but it can deliver engine cranking current for a few seconds or power auxiliary loads for a few minutes.

Feature Identification

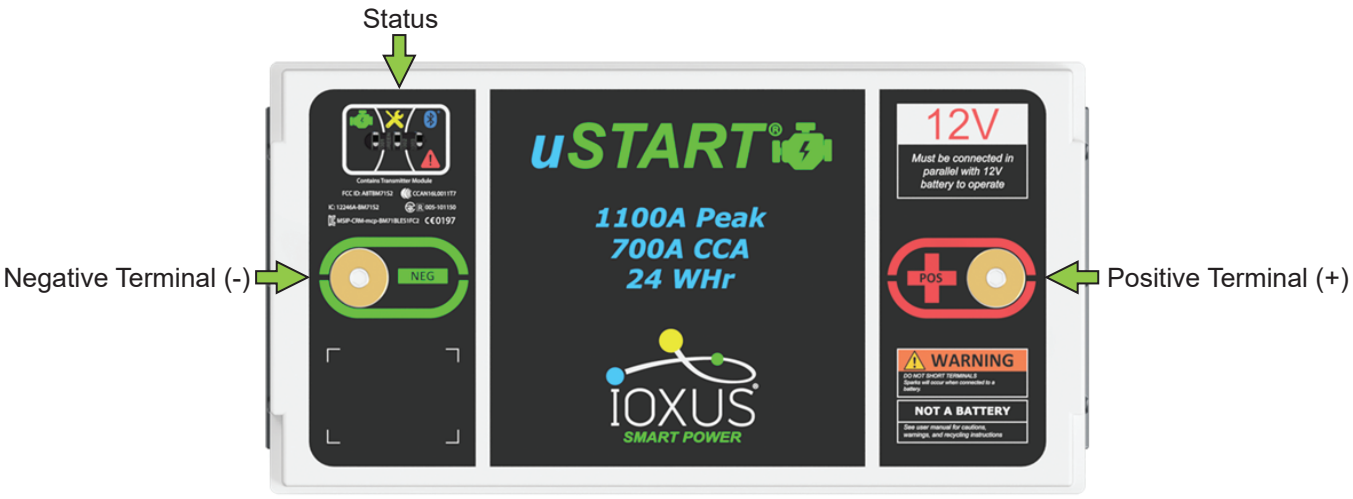

Figure 1 - uSTART® Feature Identification

UNPACKING

Please inspect the shipping carton for signs of damage prior to unpacking. Report any damage to the carton, or the contents, to the carrier immediately. Retain all shipping materials until uSTART® is fully inspected and determined to be operational.

uSTART® should be lifted by the module body. The terminals should not be used for hoisting.

If any parts are determined to be missing or defective an RMA number must be issued prior to returning the unit for repair or replacement. Please contact your salesperson or distributor to request an RMA number.

uSTART® is designed for years of maintenance free operation if handled, installed, and used properly. These handling precautions should be observed:

- uSTART® should not be stacked.
- The only tools to be used on a uSTART® should be properly sized wrenches for the terminals and mounting bolts(hammers, chisels, files or power tools should not be used).
- High Voltage X-Series Module: iMOD102V083ACX-XXB

INSTALLATION

Maintenance Mode

uSTART® will be shipped in *Maintenance Mode*. The solid yellow LED will light while uSTART® is first connected to a battery to show it is in *Maintenance Mode*. uSTART® is now ready to support the vehicle and will automatically enter *Run Mode* when the vehicle starts.

Mounting Location

uSTART® is designed to mount in the same space as a group 31 battery. The typical installation location is in the battery box of a Class 3 – 6 truck. uSTART® must be installed in parallel with at least one battery in order to function and provide energy. If there are two or more batteries in a battery box, one can be removed to make room for uSTART®.

On some truck models the Diesel Particulate Filter After-Treatment System or other exhaust components may be located near the battery box. These systems can generate very high temperatures during operation which may cause uSTART® to exceed +149°F (+65°C). If the vehicle battery box is near the Diesel Particulate Filter After-Treatment System or any part of the exhaust, mount uSTART® in a location far away from it or install heat shielding capable of preventing uSTART® from experiencing +149°F (+65°C) temperatures under worst case conditions.

Pre-Installation Checks

1. Test the vehicle starting and charging system prior to installing uSTART® to isolate any pre-existing problems. Refer to Recommended Practice 129A (RP 129A) of the American Trucking Association (ATA) Technology and Maintenance Council (TMC) for procedures to test cable connections between all starting and charging system components for maximum voltage drop. Repair any issues found before proceeding.
2. Remove the cables from the negative (-) terminal(s) of the vehicle battery(s).
3. Remove the cables from the positive (+) terminal(s) of the vehicle battery(s).
4. All cable terminations and battery terminals should be cleaned thoroughly to remove all oxidation and grease.
5. Test the vehicle battery(s) individually to ensure that they are properly charged. Remove and replace any batteries that are discharged below their specified voltage or failed to meet their CCA rating.
6. If there is no additional space in a vehicle's battery box, remove a battery to make room for uSTART®.
7. Place uSTART® in the desired mounting location.
8. Check that uSTART® positive (+) and negative (-) terminals line up with positive (+) and negative (-) terminals on remaining battery(s) and vehicle positive (+) and negative (-) battery cables.

Installation

In most instances, it is desirable to use existing vehicle cables to connect uSTART® to the vehicle starting and charging systems. If new cables need to be made, the insulation should meet the requirements of SAE J1127, SAE J259, and TMC RP 166. Recommended cable insulations are 125°C rated Cross-Linked Polyethylene (SAE J1127 type SGX) and 125°C rated Thermoset Elastomer (SAE J1127 type SGR where flexibility is required). Selection of cable size is based on voltage drop requirements for a vehicle's starting and charging systems. Refer to TMC RP 105C to determine minimum cable size requirements.

INSTALLATION(cont'd)

Mechanical

It is desirable to install uSTART® electrically closest to the starter or in the location where the starter cable is designed to terminate. However, the unit will perform well even installed remotely. Regardless, it must be installed electrically in parallel with at least one 12V battery using appropriately sized cables and hardware.

Start from a point that all the cables both positive (+) and negative (-) are disconnected and fastened out of the way for installation or not installed in the vehicle yet. Install the battery(ies) and uSTART® in their appropriate locations.

When installing uSTART® it is important to consider the battery hold down being used and how uSTART® relates to any batteries being mounted with it.

uSTART® is designed to be installed using the existing Group 31 battery hardware. Install uSTART® using the existing Group 31 battery hardware and torque specifications. For custom installations please contact IOXUS® Customer Service for additional support.

Electrical

Refer to the Wiring Diagrams section for typical vehicle wiring before and after uSTART® installation. Refer to the Wiring Diagrams section for typical vehicle wiring before and after uSTART® installation.

1. Connect the vehicle positive (+) battery cable and Starter Solenoid positive (+) cable to the positive (+) terminal of uSTART®.
2. Connect the vehicle positive (+) battery cable to the positive (+) terminal(s) of the battery(s).
3. Connect the vehicle negative (-) battery cable and Starter Solenoid negative (-) cable to the negative (-) terminal of uSTART®.
4. Connect the vehicle negative (-) battery cable to the negative (-) terminal(s) of the battery(s).
5. The solid yellow LED indicates that uSTART® is in *Maintenance Mode* and connected to a battery.
6. uSTART® is now ready to support the vehicle. uSTART® will automatically enter *Run Mode* when the vehicle starts. The yellow LED flashes in *Run Mode* after a new uSTART® installation while uSTART® ultracapacitors are initially charged. Once the ultracapacitors are charged, *Run Mode* is denoted by a solid green LED.

Wiring Diagrams

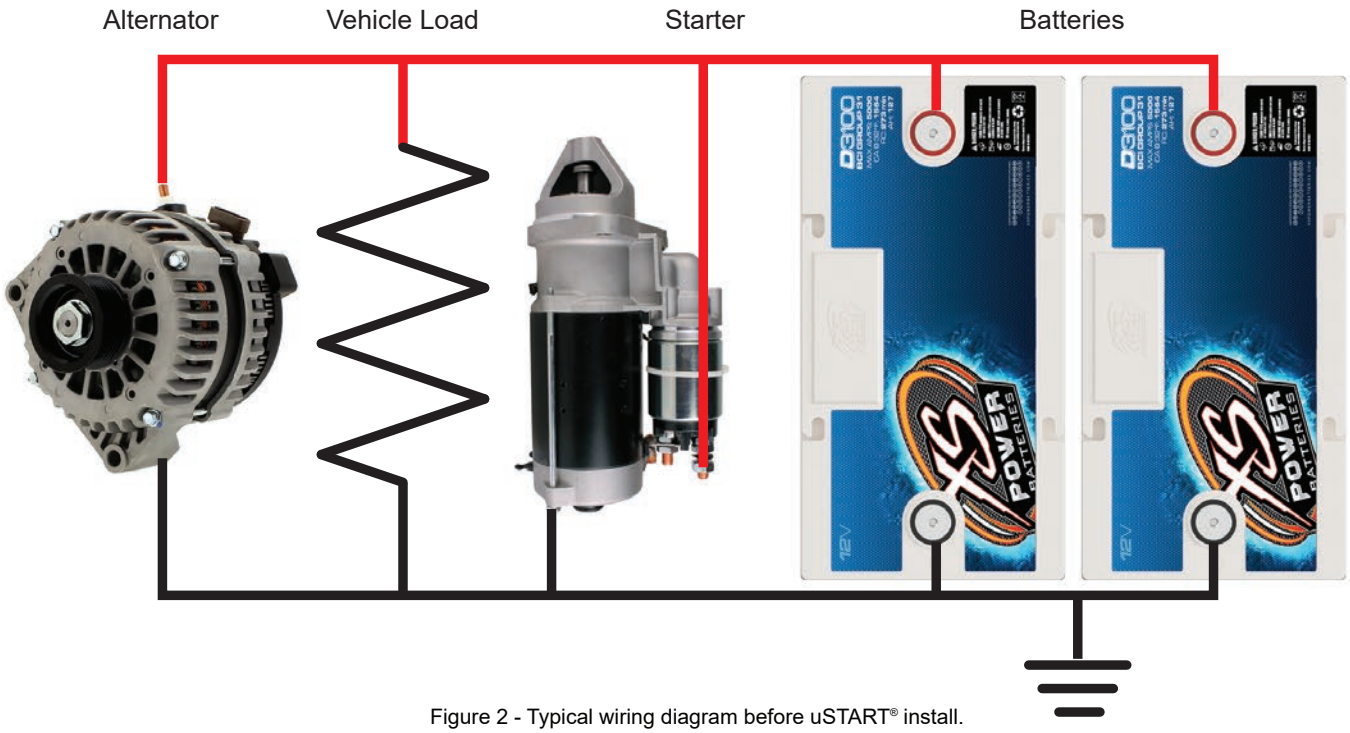

Figure 2 - Typical wiring diagram before uSTART® install.

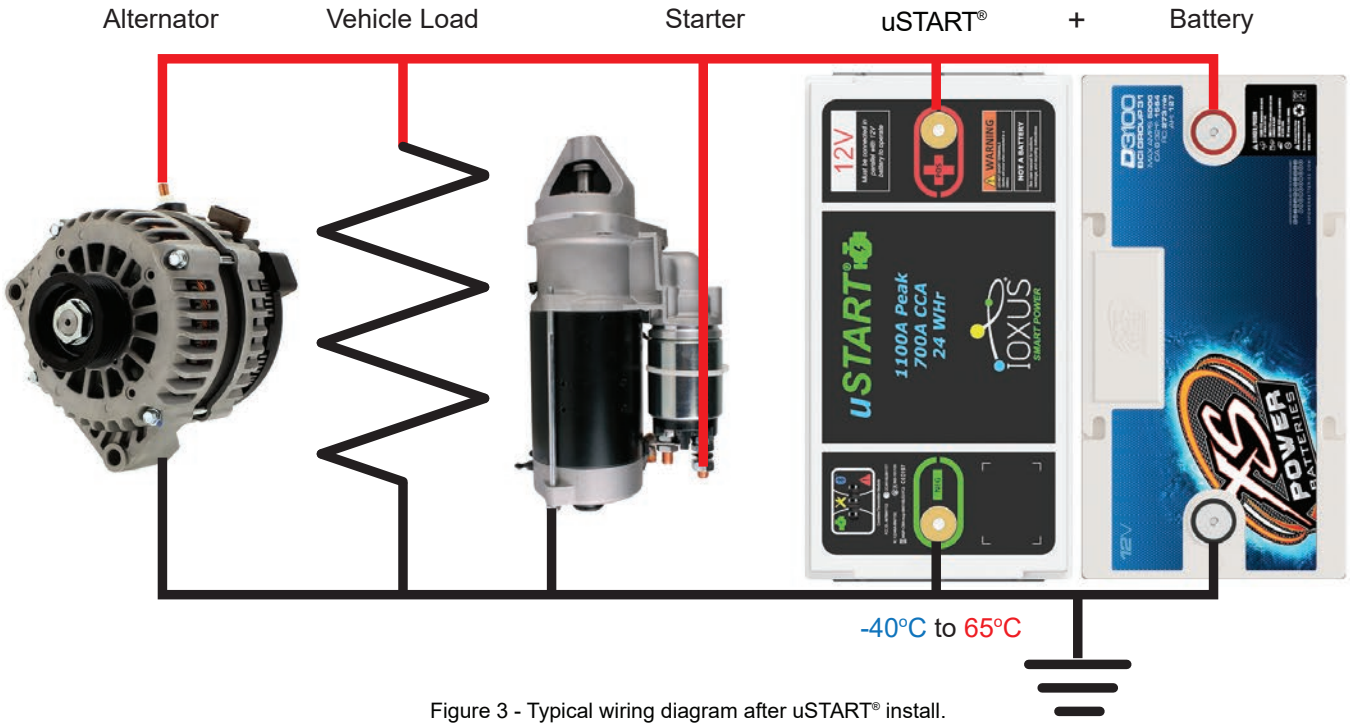

Figure 3 - Typical wiring diagram after uSTART® install.

OPERATION

Status

The Status LEDs indicate uSTART® operation mode. The green and yellow LEDs indicate the mode. The red LED indicates there is an error. The blue LED indicates a Bluetooth connection to the module. Refer to Figure 4 for Status LED states.

MODE	GREEN	YELLOW	RED	DESCRIPTION
Maintenance	OFF	SOLID	OFF	UltraSTART® is connected. There is no energy at the terminals.
Jump Start Charge	SOLID	*FLASH*	OFF	UltraSTART® is charging for the first time.
Run	SOLID	OFF	OFF	UltraSTART® is active.
Standby	OFF	OFF	OFF	UltraSTART® is asleep.
Fault	OFF	OFF	SOLID	UltraSTART® is experiencing a fault. Please see user manual for instructions.

Figure 4 - uSTART® Staus LED States

Maintenance Mode

In *Maintenance Mode*, uSTART® terminals are not energized. It is safe to handle and work on when it is in this mode. uSTART® should always be in *Maintenance Mode* prior to any maintenance.

If uSTART® is connected to a battery, the solid yellow LED indicates that it is in Maintenance Mode. If uSTART® is not connected to a battery it will still have the protections of Maintenance Mode, even when the LEDs are off.

If uSTART® is not in *Maintenance Mode* when it is disconnected from a battery, it will automatically switch to *Maintenance Mode* within 7 seconds.

Run Mode

uSTART® is on and actively maintaining the vehicle's voltage while in *Run Mode*. It can support engine cranking currents for a few seconds or support vehicle loads for many seconds to several minutes. It is not safe to handle or work on uSTART® when it is in *Run Mode*.

Run Mode is indicated by a solid green LED.

Standby Mode

If uSTART® is in *Run Mode* and a vehicle's battery charging system has been inactive for more than 1 hour, uSTART® will automatically enter *Standby Mode* in order to reduce energy consumption. If at any time uSTART® detects a significant, rapid change in the voltage level (as will occur during engine start), uSTART® will automatically return to *Run Mode* and support the engine cranking event. It is not safe to handle or work on uSTART® when it is in *Sta*

Standby Mode is indicated by all LED's being off while connected to battery power. uSTART® operation can be confirmed by noting the change to a solid green LED upon engine start, indicating a return to *Run Mode.*

Jump Start Charge Mode

uSTART® will automatically switch from *Maintenance Mode* to *Jump Start Charge Mode* if a vehicle's battery charging system is active for more than 10 seconds.

Jump Start Charge Mode also allows uSTART® to charge up its ultracapacitors from a weak vehicle battery and provide power to jump start the vehicle.

Jump Start Charge Mode can be accessed through the uSTART® App. The green LED will be solid and the yellow LED will flash as uSTART® charges its ultracapacitors. After the charging period finishes, the green LED will be solid, indicating that the vehicle is ready to be started. Start the vehicle immediately for best results. See the uSTART® App User Manual for additional details.

Fault Mode

uSTART® has experienced an abnormal condition, indicated by a solid red LED. See the Troubleshooting section for more information.

Bluetooth Connection

uSTART® is connected via Bluetooth when the blue LED is lit solid. See the uSTART® App User Manual for more details (note that the blue LED may be difficult to see in bright locations, shading the status LED area may help with seeing it).

FLOW CHARTS

The below flow charts can be utilized for the most common scenarios of use: Installation, preparation for service and use during a jump start attempt.

Installation and Startup

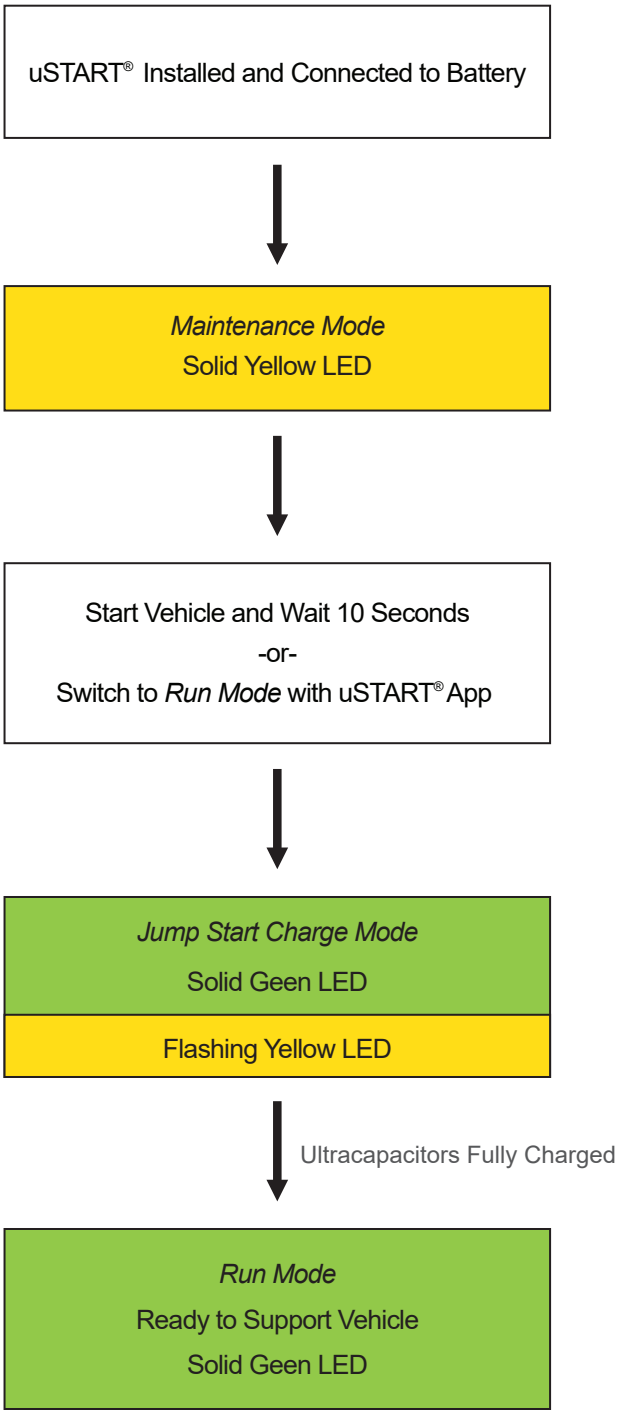

Figure 5 - Installation Flow Chart

Disconnecting uSTART® for Service

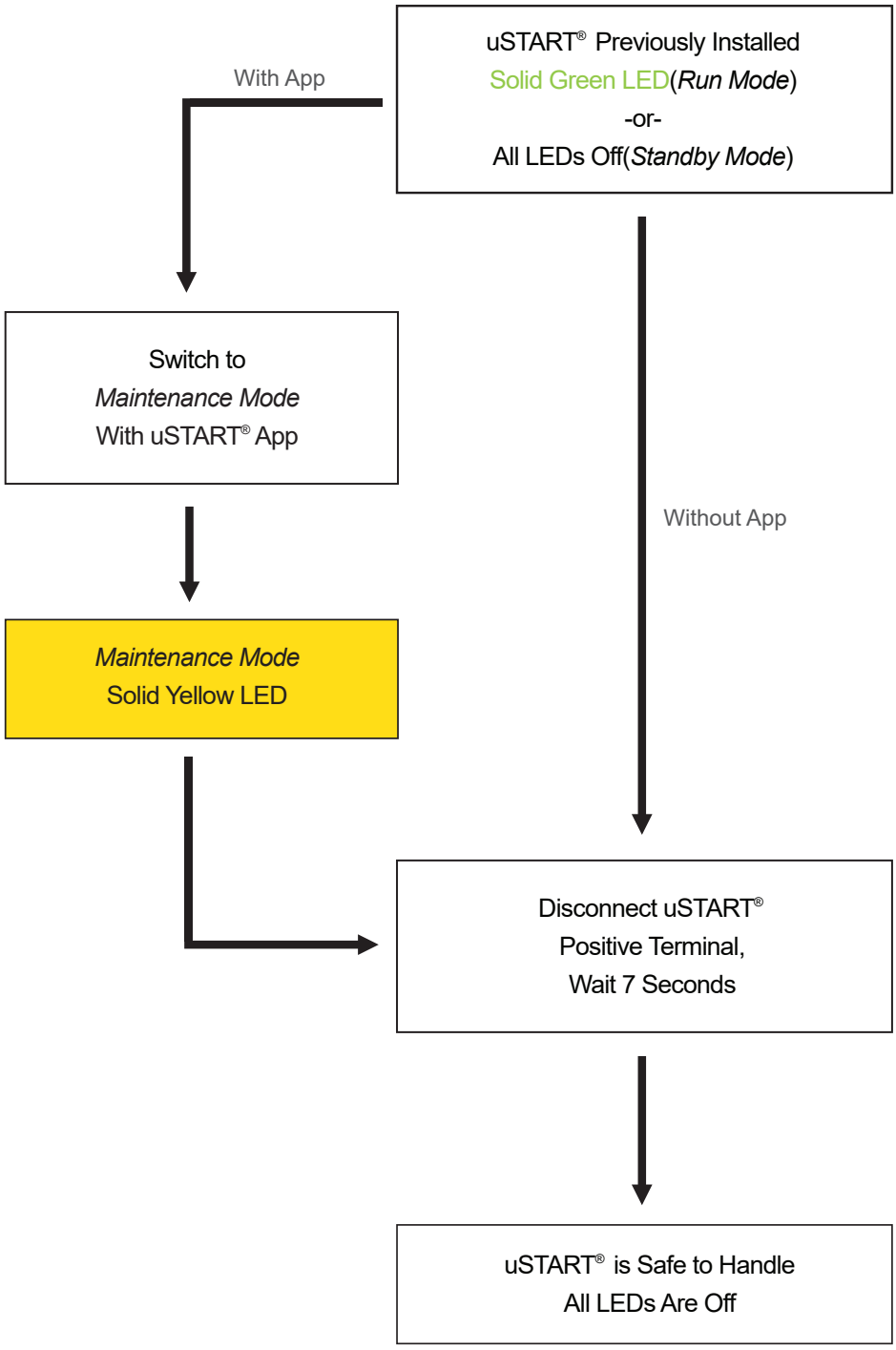

Figure 6 - Service Flow Chart

Using uSTART® to Jump Start a Vehicle(after failed start)

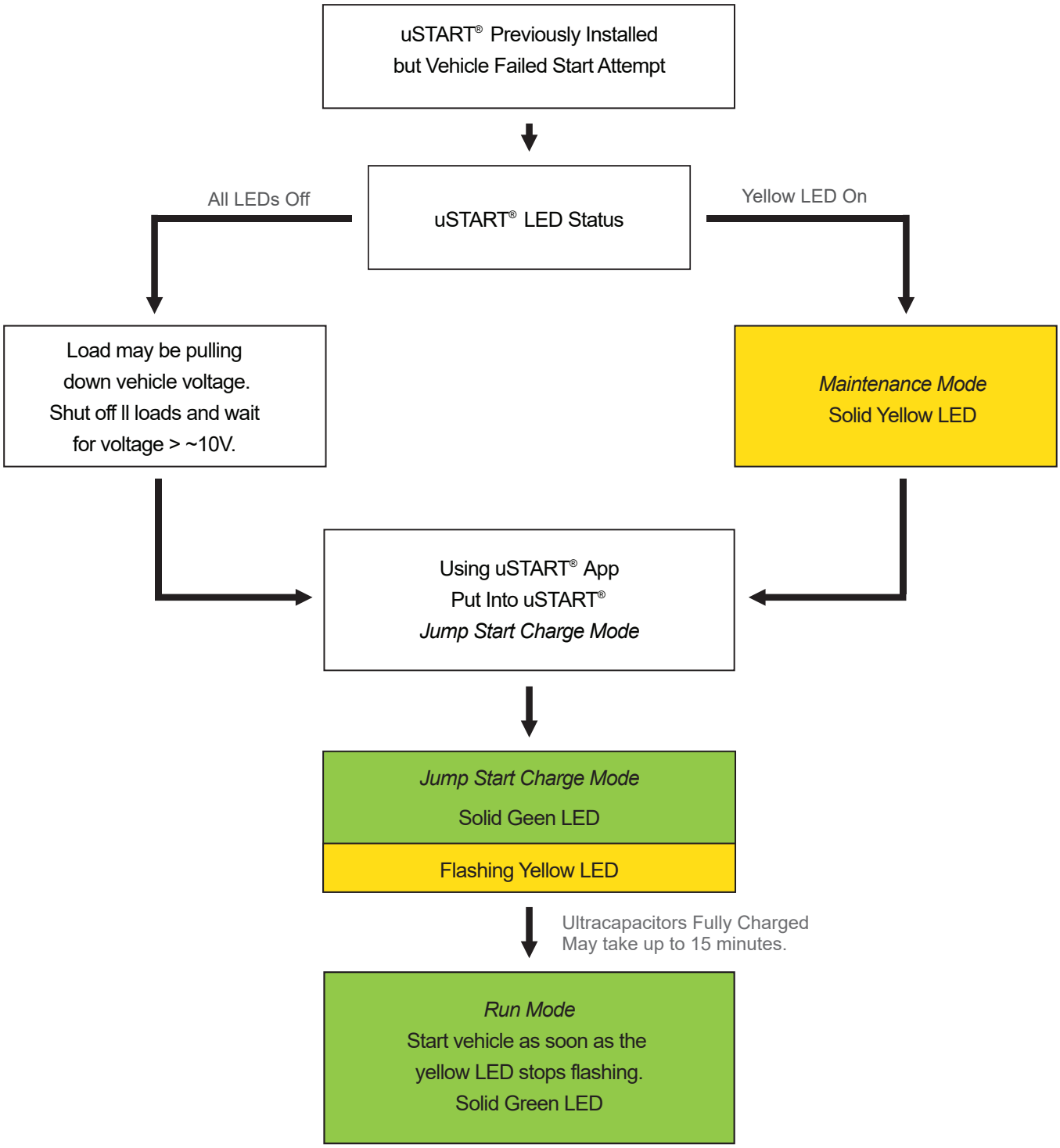

Figure 6 - Service Flow Chart

TROUBLESHOOTING

Condition	Items To Check	Possible Cause	Remedy
Red LED On	1	Over Temperature Protection An environmental condition above 65°C (149°F) will cause uSTART® to enter Fault Mode in order to protect the product. Prolonged operation above 65°C (149°F) will cause reduced lifetime and void the warranty.	Remove uSTART® from the high temperature condition. Allow uSTART® to cool. The fault will clear as soon as uSTART® returns to an internal temperature below 60°C (149°F). If this condition is noted as occurring more than once on a particular vehicle a reflective heat shield may be worth installing between a heat source and the uSTART®.
	2	Over Current Protection High current for extended periods (beyond normal engine cranking times) will cause uSTART® to enter fault mode in order to ensure long term product lifetime is not reduced.	The fault condition will clear within 30 seconds and uSTART® will return to *Run Mode*. Check for loose electrical connections and battery condition. Infrequent activation of Over Current Protection does not pose any concern for uSTART® and can be expected under conditions of very high load, or if uSTART® terminals experience a short circuit (ex. wrench contacts both terminals during installation). If fault mode continues to occur after the steps above, contact IOXUS® Customer Service.
	3	Malfunction Protection uSTART® has detected an abnormal internal condition causing it to enter fault mode.	The fault condition will not automatically clear and the RED LED will remain on. This condition can occur if uSTART® internal measurements are outside of reasonable values or if uSTART® detects malfunctions transferring energy. This could be caused by an internal uSTART® fault or by a poor electrical connection. Check for loose electrical connections and battery condition. Reset power by removing the Negative lead from uSTART® for 30 seconds and then reattaching. uSTART® will enter Maintenance mode. Start the vehicle and observe uSTART® for 1 minute. If the fault persists, contact IOXUS® Customer Service.
Red LED Blink	1	Energy Storage Protection Abnormality detected with ultracapacitor cell voltage management.	This condition will clear as soon as ultracapacitor cell voltage management returns to normal parameters. uSTART® will reduce ultracapacitor charge voltage maximum limit as long as the condition persists which will result in less energy storage, but this will not impact engine cranking performance. If the condition persists for more than 24 hours, uSTART®may enter ERROR Mode.
	1	Energy Storage Protection uSTART® will enter *Standby Mode* after 1 hour without vehicle operation in order to conserve electrical energy.	This is a normal condition. uSTART® will enter *Run Mode* automatically when the vehicle is started or a high load is applied

TROUBLESHOOTING(cont'd)

Condition	Items To Check	Possible Cause	Remedy
No LED On	2	uSTART® Problem uSTART® has stopped functioning.	Check for loose electrical connections and battery condition. Turn off the vehicle and ensure the battery and uSTART® are connected in parallel as shown in Figure 3. Measure the voltage at the battery terminals. If the voltage is less than 11.5V, the battery should be charged. Measure the voltage at the uSTART® terminals. Confirm the voltage measurements at the battery terminals and uSTART® terminals are similar (within 0.2V). If the battery terminal voltage is not similar to the uSTART® terminal voltage there is a problem in the wiring between the battery and uSTART®. Disconnect the uSTART® Negative lead for 30 seconds and then reconnect. If the Yellow LED does not light, contact IOXUS® Customer Service.

MAINTENANCE

Terminals should be periodically checked for oxidation or loose connections and cleaned or tightened as necessary. No other maintenance is required. Poor electrical connections can cause performance problems with uSTART®. Prior to removal or system maintenance, ensure that uSTART® is in *Maintenance Mode*. uSTART® can be cleaned while in *Maintenance Mode* by use of a cloth and simple soap and water solution. Avoid the use of hoses or pressurized sprays.

STORAGE

uSTART® can be stored in its original packaging, in a dry place for up to four (4) years. Observe the maximum storage temperature as stated in the product specifications.

DISPOSAL

Do not incinerate, crush, or dispose of in trash. Do not recycle with lead-acid batteries. Please recycle according to local codes and regulations for electronic waste.

Specifications

Please see data sheet for specifications.

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