

Installation Guide and User Manual

Model uST12V1100G31-ISA

- **uSTART® Medium Duty Vehicles Class 3 – 6 with 12V Operating System**



Table of Contents

Model uST12V1100G31-ISA	1
Safety.....	2
Description	4
Feature Identification	4
Unpacking.....	4
Installation.....	5
Maintenance Mode.....	5
Mounting Location.....	5
Pre-Installation Checks.....	5
Installation.....	6
Wiring Diagrams	11
Operation.....	12
Status.....	12
Maintenance Mode.....	13
Run Mode	13
Jump Start Mode	14
Fault Mode.....	14
Flow Charts	14
Run Mode.....	15
Maintenance Mode.....	16
Jump Start Mode	17
Maintenance.....	18

Troubleshooting..... 18

Storage..... 18

Disposal..... 18

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.

	 WARNING!
	<p>ARC FLASH HAZARD</p> <p>An arc flash can occur anytime the uSTART™ is connected or disconnected from the battery. uSTART™ must be in Maintenance Mode before servicing.</p>

	 WARNING!
	<p>DO NOT CONNECT IN REVERSE POLARITY</p> <p>Do not connect the terminals in reverse (+ to - and/or - to +).</p>

Do not connect in reverse polarity. uSTART® is protected from 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 36 VDC or above. Do not connect to an energy source capable of constant ≥ 36 VDC or damage to uSTART® and equipment can occur.



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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.

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

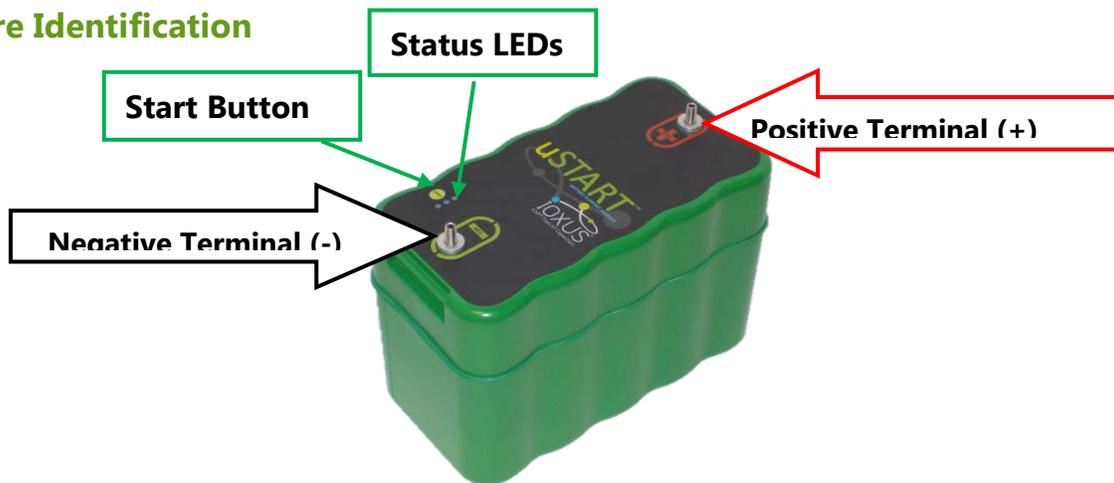


Figure 1: uSTART[®] Feature Identification

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:

- The uSTART[®] should not be stacked

- The only tools to be used on uSTART[®] should be properly sized wrenches for the terminal and mounting bolts (hammers, chisels, files or power tools in general should not be used)
- Do not drop uSTART[®]; internal damage may occur

Installation

Maintenance Mode

WARNING! CONNECTION OF uSTART[®] TO AN ENERGY SOURCE WHEN LIVE VOLTAGE IS PRESENT ON uSTART[®] TERMINALS COULD CAUSE PERSONAL INJURY OR EQUIPMENT DAMAGE!

uSTART[®] will be shipped in **Maintenance Mode**. To enable **Maintenance Mode** from **Run Mode** (**solid green LED**) press the **Start Button** for ten (10) seconds. If uSTART[®] is left in **Run Mode** and disconnected from an energy source, it will stay in **Run Mode**. The **solid yellow LED** will light while uSTART[®] is connected to a battery in **Maintenance Mode** or go out if no energy is supplied to the terminals.

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.

 **WARNING!**



Improper installation including excessive clamping force can result in damage to the uSTART[®]



Read all instructions prior to attempting installation

Mechanical

It is desirable to install the 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.

Hold down brackets should impart a minimal and consistent pressure of the contact area with a uSTART[®]. The pressure should never exceed 150lbf/in², a design pressure of ~50lbf/in² is desirable.

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

When a choice can be made, the widest battery hold down available should be used (up to 8" wide can be used). This minimizes the pressure and distributes the load on the uSTART[®] helping prevent any damage the battery hold-down can generate, including but not limited to cracking the housing or damaging the top label which does provide a weathertight seal that must be maintained for the electronics inside the module.

When a battery hold-down is smaller than 10 square inches only the minimum torque rating on the table below should be used. Any point loads the battery hold down that could present should be removed or a stiff plate should be used to spread out the load on the battery top.

1. If mounting with a battery under one bracket compare the battery and uSTART[®] height and shim whichever one is appropriate to make even in height within ~1mm. Use a continuous non-porous and high-density water resistant material for any shimming required.
 - a. Any shim under a uSTART[®] must be flat and support the entire bottom of the uSTART[®]
2. Measure the diameter of the battery hold down bolts and look up the installation type and torque specification in the table below.
3. Make sure the hold down brackets used sit flush on the uSTART[®] and the battery (if mounted together)
4. Tighten down the bolts until they just touch the bracket and re-test the bracket to be sure its sitting flush on the uSTART (and battery if mounted together)
5. Torque the battery side to the minimum required torque
 - a. If mounting the uSTART[®] by itself bring both bolts to the minimum required torque rating
6. Again, retest the bracket to be sure it is sitting flush and torque the hold down fasteners to the recommended value.
7. When complete, check installation to be sure the uSTART[®] is not deformed or deflected or bent in any visible or abnormal way.
8. Check the label on the uSTART[®] to be sure the top label has not delaminated in any way and provides a secure seal all the way around. Any bubbles or lifting should be noted and the unit should be removed from the vehicle and returned to be tested and relabeled.
9. Please note that the recommended torque values are not the maximum load the uSTART[®] can handle, but are what is required to secure the unit.
10. Typical uSTART[®] mounting types:

uSTART



a.

Reccomended Bolt Torque 2 bolt installations for 1 uSTART only (1 bolt each side of uSTART [yellow dots])			
Bolt Diamter [in(mm)]	Min (inLbs [Nm])	Reccomended (inLbs [Nm])	Max (inLbs [Nm])
3/16 (5mm)	5 [0.6]	10 [1.1]	28 [3.2]
1/4 (6mm)	7 [0.8]	13 [1.5]	38 [4.3]
5/16 (8mm)	8 [0.9]	16 [1.8]	48 [5.4]
3/8 (10mm)	10 [1.1]	19 [2.1]	59 [6.7]
500-lbs clamping force			

uSTART + Battery



b.

Recommened Bolt Torque Dual Battery Installations uSTART with 1 Battery common bracket (uSTART side only [green dot]) (1 bolt each side of pair)			
Bolt Diamter [in(mm)]	Min (inLbs [Nm])	Recommened (inLbs [Nm])	Max (inLbs [Nm])
3/16 (5mm)	10 [1.1]	19 [2.1]	56 [6.3]
1/4 (6mm)	13 [1.5]	25 [2.8]	75 [8.5]
5/16 (8mm)	16 [1.8]	32 [3.6]	96 [10.8]
3/8 (10mm)	19 [2.1]	38 [4.3]	117 [13.2]
500-lbs clamping force			

Electrical

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

1. Apply a thin coat of No-Al-Ox or similar anti-oxidizing compound for aluminum to the terminal pads of the uSTART® before installing any cables
2. Connect the vehicle positive (+) battery cable and Starter Solenoid positive (+) cable to the positive (+) terminal of uSTART®.
3. Connect the vehicle positive (+) battery cable to the positive (+) terminal(s) of the battery(s).
4. Connect the vehicle negative (-) battery cable and Starter Solenoid negative (-) cable to the negative

- (-) terminal of uSTART®.
5. Connect the vehicle negative (-) battery cable to the negative (-) terminal(s) of the battery(s).
 6. The **solid yellow LED** indicates that uSTART® is in **Maintenance Mode** and connected to a battery.
 7. Press and hold the **Start Button** for ten (10) seconds until the **green LED** light is **solid** and the **yellow LED** light **flashes**. uSTART® is now in **Run Mode**. The **yellow LED** only **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** only.

Wiring Diagrams

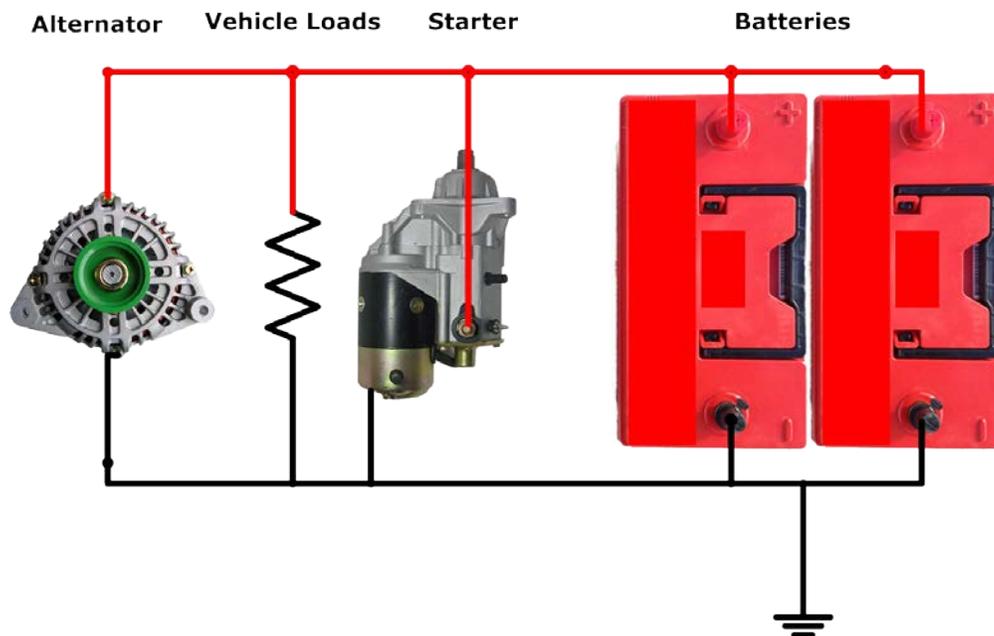


Figure 2: Typical wiring diagram before uSTART® install

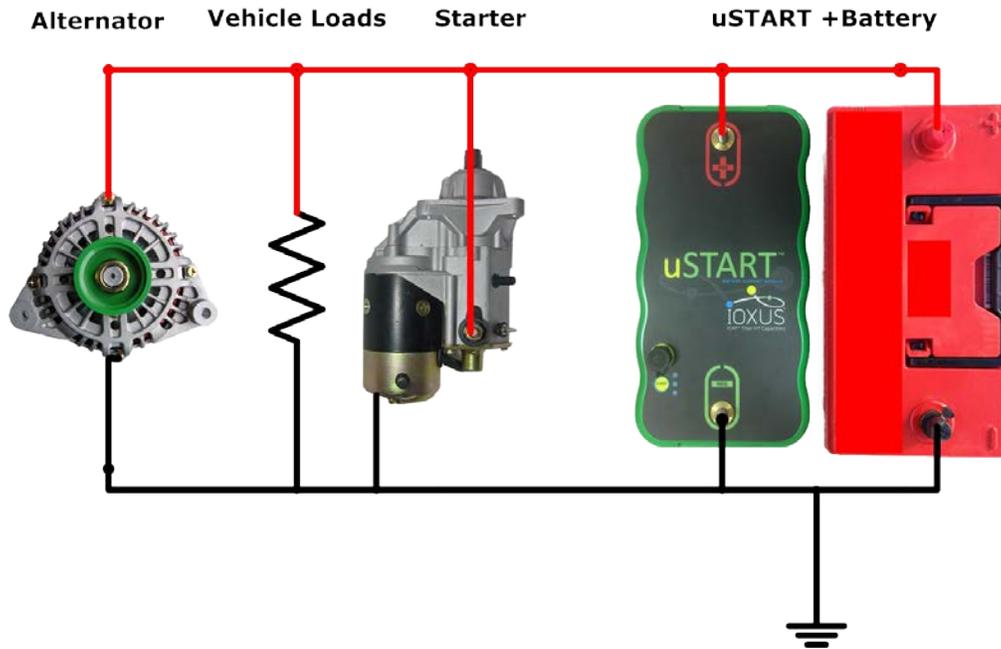


Figure 3: Typical wiring diagram after uSTART® install

Operation

Status

The three (3) **Status LEDs** indicate the uSTART®'s operation mode. The **green** and flashing **yellow LEDs** indicate the mode. The **red LED** indicates there is an error. Refer to Figure 4 for **Status LED** states.

Mode	GREEN	YELLOW	RED	Description
Maintenance	● OFF	● SOLID	● OFF	uSTART™ is connected to battery. There is no energy at terminals. To switch to Run Mode , press button for 10 seconds .
Run	● SOLID	● OFF	● OFF	uSTART™ is active. To switch to Maintenance Mode , press button for 10 seconds . To initiate Jump Start Mode , press button for 3 seconds .
Jump Start	✱ FLASH	✱ FLASH	● OFF	uSTART™ is charging for jump start.
	✱ FLASH	● SOLID	● OFF	uSTART™ is ready for jump start. Start the vehicle immediately.
Fault	● OFF	● OFF	● SOLID	uSTART™ is experiencing a fault. Please see user manual for instructions.

Figure 4: uSTART® Status LED States

The **Start Button** performs different functions depending on uSTART® operation mode. The button may be pressed and held for periods of one (1), three (3), or ten (10) seconds to access different functions. Refer to Flow Charts (Figure 5, Figure 6, and Figure 7) for **Start Button** actions.

Maintenance Mode

In **Maintenance Mode**, uSTART® has no energy at its terminals. It is safe to handle and work on when it is in this mode. The uSTART® should always be put into **Maintenance Mode** prior to any maintenance.

If the uSTART® is connected to a battery, the **solid yellow LED** indicates that it is in **Maintenance Mode**. If the uSTART® is not connected to a battery it will still be in **Maintenance Mode**, but the LEDs will be **off**.

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**. Immediately after installation, **Run Mode** is indicated by a **solid green LED** and a **flashing yellow LED** while uSTART® charges its ultracapacitors for the first time.

Jump Start Mode

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

Jump Start Mode is entered by pressing and holding the **Start Button** for three (3) seconds while uSTART® is in **Run Mode**. The **green LED** will **flash** and the **yellow LED** will **flash** as uSTART® charges its ultracapacitors. After the charging period the **green LED** will **flash** and the **yellow LED** will light **solid** indicating that the vehicle is ready to be turned on. Start the vehicle immediately.

Jump Start Mode can be canceled by pressing the **Start Button** for three (3) seconds during the charging period.

Fault Mode

uSTART® has experienced a fault, indicated by a **solid red LED**. See Troubleshooting section for more information. Please contact your salesperson or distributor to request an RMA number.

Flow Charts

The below flow charts can be utilized to move through the different modes of uSTART®. The flow charts are separated by mode and navigate through each mode separately. For example, if **Run Mode** is desired, use the **Run Mode** flow chart.

Run Mode

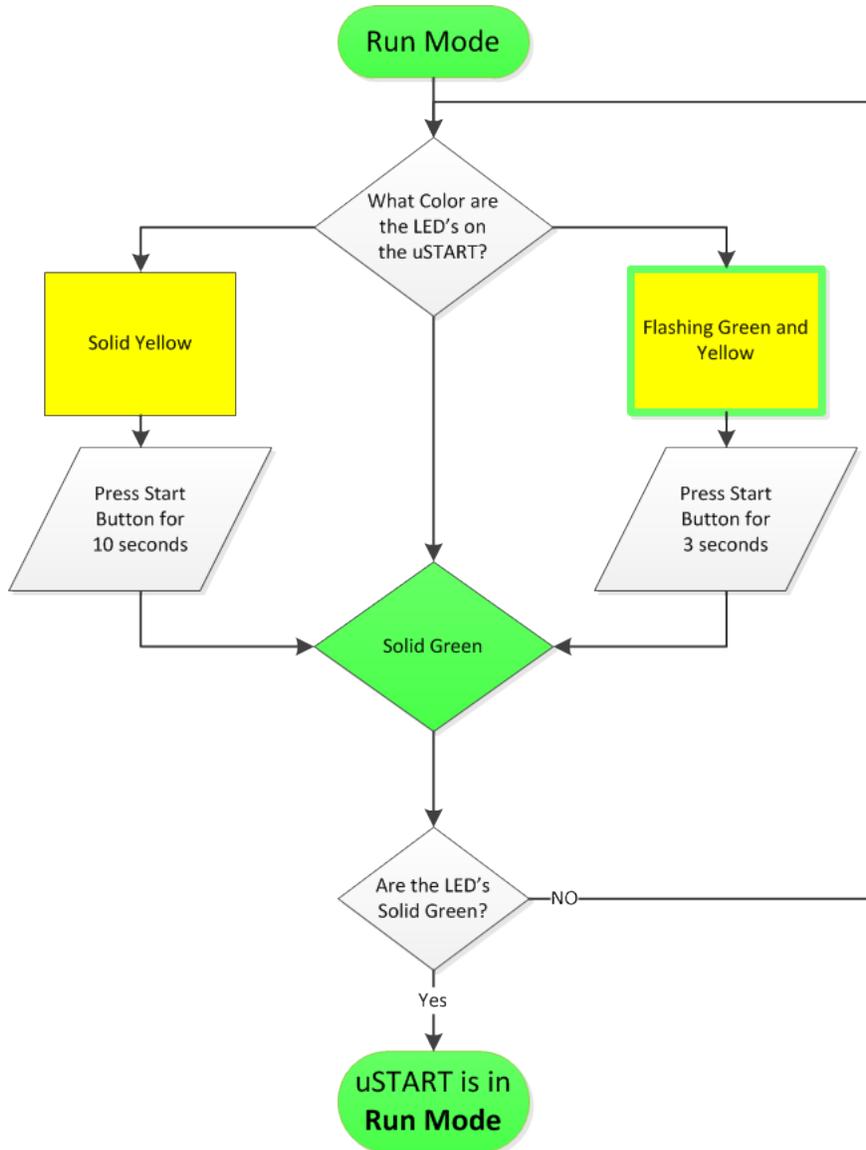


Figure 5: Run Mode Flow Chart

Maintenance Mode

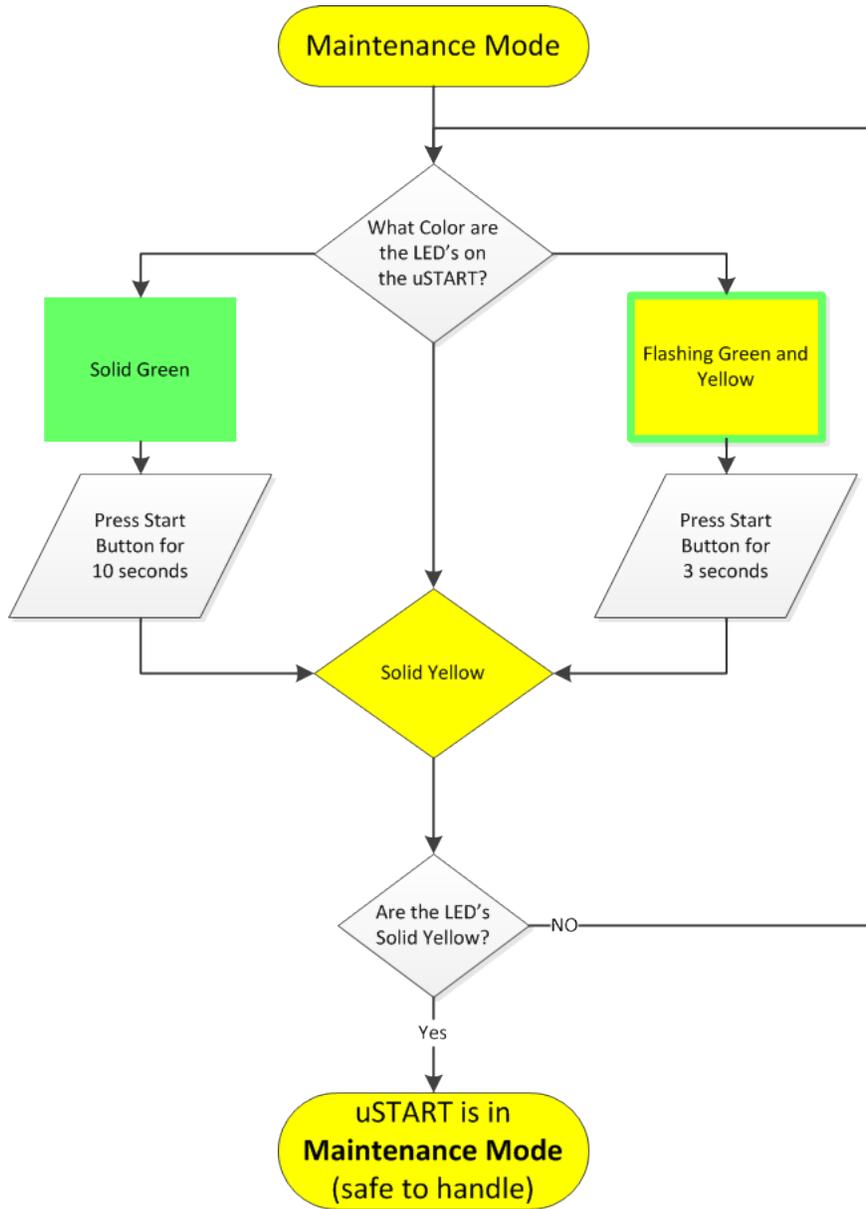


Figure 6: Maintenance Mode Flow Chart

Jump Start Mode

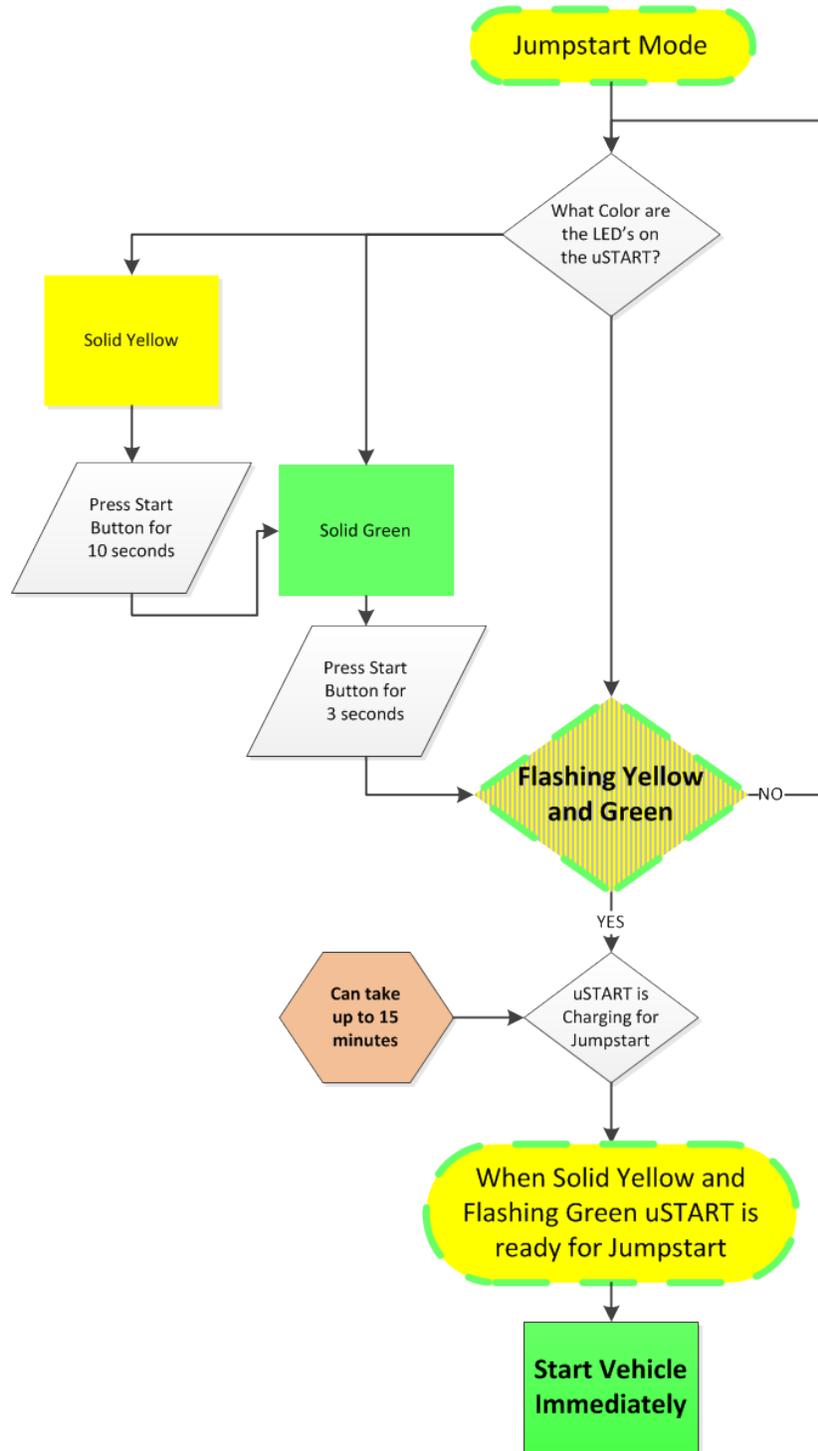


Figure 7: Jump Start Mode Flow Chart

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.

Troubleshooting

1. If uSTART[®] does not enter **Run Mode** or is not switching between modes correctly, perform a **Start Button** check:
 - a. Hold the **Start Button** down for 30 seconds.
 - b. If the **solid red LED** does not light after 30 seconds, the **Start Button** is not functioning properly. please contact your salesperson or distributor to request an RMA number if the issue persists after this check.
2. If the **solid red LED** is lit perform the following checks
 - a. Check that the **Start Button** is not being depressed by an object.
 - b. Check that the temperature of the uSTART[®] is below +149°F (65°C) by measuring the temperature of the negative terminal, if the temperature is above +149°F (65°C) then allow the module to cool off and reevaluate.
 - i. Please ensure the uSTART[®] is not located in an environment that exceeds +149°F (65°C), add insulators, reflectors or ventilation as needed.
3. Check that uSTART[®] terminal connections are tight and free of corrosion.
4. Allow 1 hour for the **solid red LED** to clear (turn off) following vehicle engine off.
5. Please contact your salesperson or distributor to request an RMA number if the issue persists after these checks.

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.



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Specifications

Please see data sheet for specifications.