# Installation Guide and User Manual

## Model uST12V1100G31-ISA
- **uSTART® Medium Duty Vehicles Class 3 – 6 with 12V Operating System**

## Table of Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
<td>1</td>
</tr>
<tr>
<td>Safety</td>
<td>3</td>
</tr>
<tr>
<td>Description</td>
<td>4</td>
</tr>
<tr>
<td>Feature Identification</td>
<td>4</td>
</tr>
<tr>
<td>Unpacking</td>
<td>4</td>
</tr>
<tr>
<td>Installation</td>
<td>5</td>
</tr>
<tr>
<td>Maintenance Mode</td>
<td>5</td>
</tr>
<tr>
<td>Mounting Location</td>
<td>5</td>
</tr>
<tr>
<td>Pre-Installation Checks</td>
<td>5</td>
</tr>
<tr>
<td>Installation</td>
<td>6</td>
</tr>
<tr>
<td>Wiring Diagrams</td>
<td>7</td>
</tr>
<tr>
<td>Operation</td>
<td>8</td>
</tr>
<tr>
<td>Status</td>
<td>8</td>
</tr>
<tr>
<td>Maintenance Mode</td>
<td>8</td>
</tr>
<tr>
<td>Run Mode</td>
<td>8</td>
</tr>
<tr>
<td>Jump Start Mode</td>
<td>9</td>
</tr>
<tr>
<td>Fault Mode</td>
<td>9</td>
</tr>
<tr>
<td>Flow Charts</td>
<td>9</td>
</tr>
<tr>
<td>Run Mode</td>
<td>10</td>
</tr>
<tr>
<td>Maintenance Mode</td>
<td>11</td>
</tr>
<tr>
<td>Jump Start Mode</td>
<td>12</td>
</tr>
<tr>
<td>Maintenance</td>
<td>13</td>
</tr>
<tr>
<td>Storage</td>
<td>13</td>
</tr>
<tr>
<td>Disposal</td>
<td>13</td>
</tr>
<tr>
<td>Specifications</td>
<td>13</td>
</tr>
</tbody>
</table>
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!**

**ARC FLASH HAZARD**

An arc flash can occur anytime the uSTART™ is connected or disconnected from the battery. uSTART™ must be in Maintenance Mode before servicing.

**WARNING!**

**DO NOT CONNECT IN REVERSE POLARITY**

Do not connect the terminals in reverse (+ to - and/or - to +).

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.

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

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.

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. 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.

<table>
<thead>
<tr>
<th>Mode</th>
<th>GREEN</th>
<th>YELLOW</th>
<th>RED</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maintenance</td>
<td>OFF</td>
<td>SOLID</td>
<td>OFF</td>
<td>uSTART™ is connected to battery. There is no energy at terminals. To switch to Run Mode, press button for 10 seconds.</td>
</tr>
<tr>
<td>Run</td>
<td>SOLID</td>
<td>OFF</td>
<td>OFF</td>
<td>uSTART™ is active. To switch to Maintenance Mode, press button for 10 seconds. To initiate Jump Start Mode, press button for 3 seconds.</td>
</tr>
<tr>
<td>Jump Start</td>
<td>FLASH</td>
<td>FLASH</td>
<td>OFF</td>
<td>uSTART™ is charging for jump start.</td>
</tr>
<tr>
<td>Fault</td>
<td>OFF</td>
<td>OFF</td>
<td>SOLID</td>
<td>uSTART™ is experiencing a fault. Please see user manual for instructions.</td>
</tr>
</tbody>
</table>

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. 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

Run Mode

What Color are the LED's on the uSTART?

Solid Yellow
Press Start Button for 10 seconds

Solid Green
Are the LED's Solid Green?

NO

Yes

uSTART is in Run Mode

Flashing Green and Yellow
Press Start Button for 3 seconds

Figure 5: Run Mode Flow Chart
**Maintenance Mode**

**Figure 6: Maintenance Mode Flow Chart**

1. **Maintenance Mode**
   - What Color are the LED's on the uSTART?
   - **Solid Green**
     - Press Start Button for 10 seconds
   - **Solid Yellow**
     - Are the LED's Solid Yellow?
       - NO
       - Press Start Button for 3 seconds
   - **Flashing Green and Yellow**
     - Press Start Button for 3 seconds
   - uSTART is in Maintenance Mode (safe to handle)
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.

**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