

uSTART® for Terminal Tractors

Sales and Marketing Team

- TRANSPORTATION
- RENEWABLE ENERGY
- UPS / BACK UP
- INDUSTRIAL





What is uSTART®



- uSTART® uses Ioxus ultracapacitors, microprocessors & smart power electronics.

SMART
POWER

- Delivers the proper voltage & current to the truck electrical bus & starter for every engine start. uSTART® keeps the vehicle bus voltage very stable and at a very healthy level.

15 Year
Life

- uSTART® lasts the life of the vehicle – installed like a battery in parallel with one or more batteries or permanently wired into the vehicle.

-40 to
85°C

- Is form factor is flexible – Now shipping in Group 31 form factor, 12V and 24V versions. Many BCI DIN or non-standard battery FFs are possible



Why uSTART® in Terminal Tractors?



**15 year
Life**

**14.7
Month
Payback**

**Save
\$12k per
Tractor**

**GREEN
Bonus!**

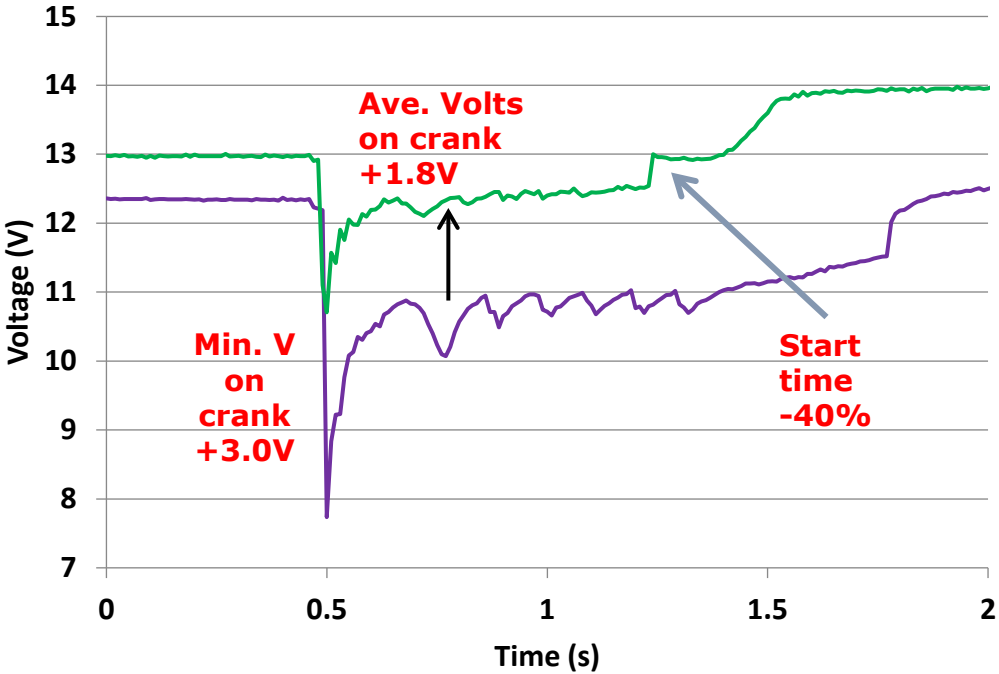
- Tougher than a Battery! Consistent Performance -40°F to +150°F
- Installs exactly like a battery (2 Terminal Plug & Play!)
- Eliminates one of the tractors batteries for the life of the tractor
- Can significantly improve battery life up to 2x*
- Significantly extends starter and other electrical component Life 2X* or more - Stabilizing the vehicle voltage prevents brown out-> increasing starter, alternator, relay and ECM life
- Eliminates Battery Related Road Jumpstart Calls. Jumpstarts are expensive, dangerous & costly each event costing several hundred to several thousand dollars in lost labor and productivity.
- * *Application results may vary*



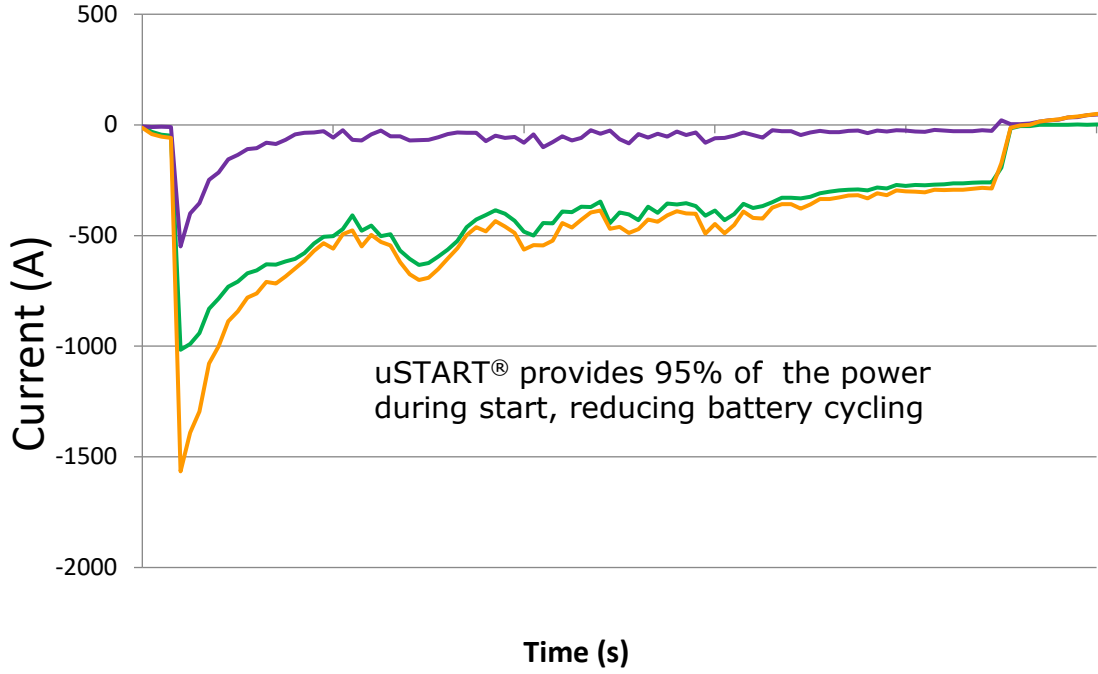
uSTART[®] does the work – Battery is on vacation

uSTART[®] + 1 Battery = Green Line / 2 Batteries = Purple Line

Engine Crank Voltage on Start
w/ & without uSTART[®] 6L diesel



Combined Cranking Current
Battery Vs. uSTART[®] 6L diesel





Terminal Tractor uSTART® Field Trial

- Compares 2 lead batteries to 1 battery plus uSTART®
- Cummins 6.7L Engines
- One month test using GeoTab telematics to collect data

uSTART® Trial Results Summary

- Significant Improvement in every performance indicator w/ uSTART
- Significant improvement in minimum voltage & starting profile
- Strong sustainability benefit



Terminal Tractor Field Trial Key Performance Indicators Tested August 2018

Field data collected comparing two lead acid batteries vs. one lead acid battery and one uSTART®, installed in 6.7L terminal tractor

KPI's compared with and without uSTART® show;

1. Start Time Improvement
2. Minimum Voltage Improvement
3. Cranking Voltage Profile Improvement
4. Open Circuit Voltage



- Picture showing uSTART® installed
- Replacing one original battery
 - Using OEM tie down and cables

Terminal Tractor

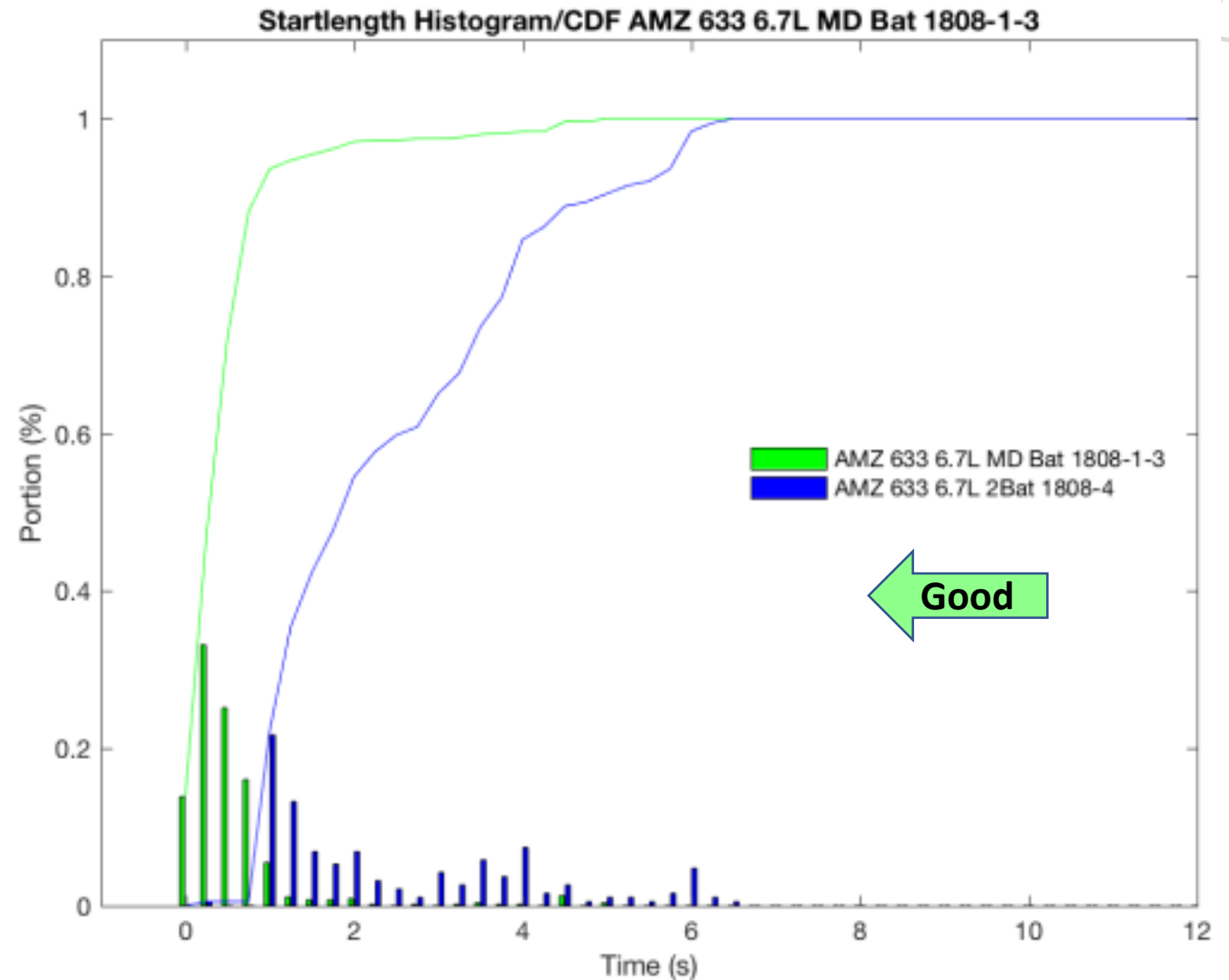
Start Time Improvement

uSTART® Trial Result

- Outstanding Improvement in start time: ~1 second faster start time

uSTART® Benefit

- Fast, clean starts extend the life of the starter



Terminal Tractor

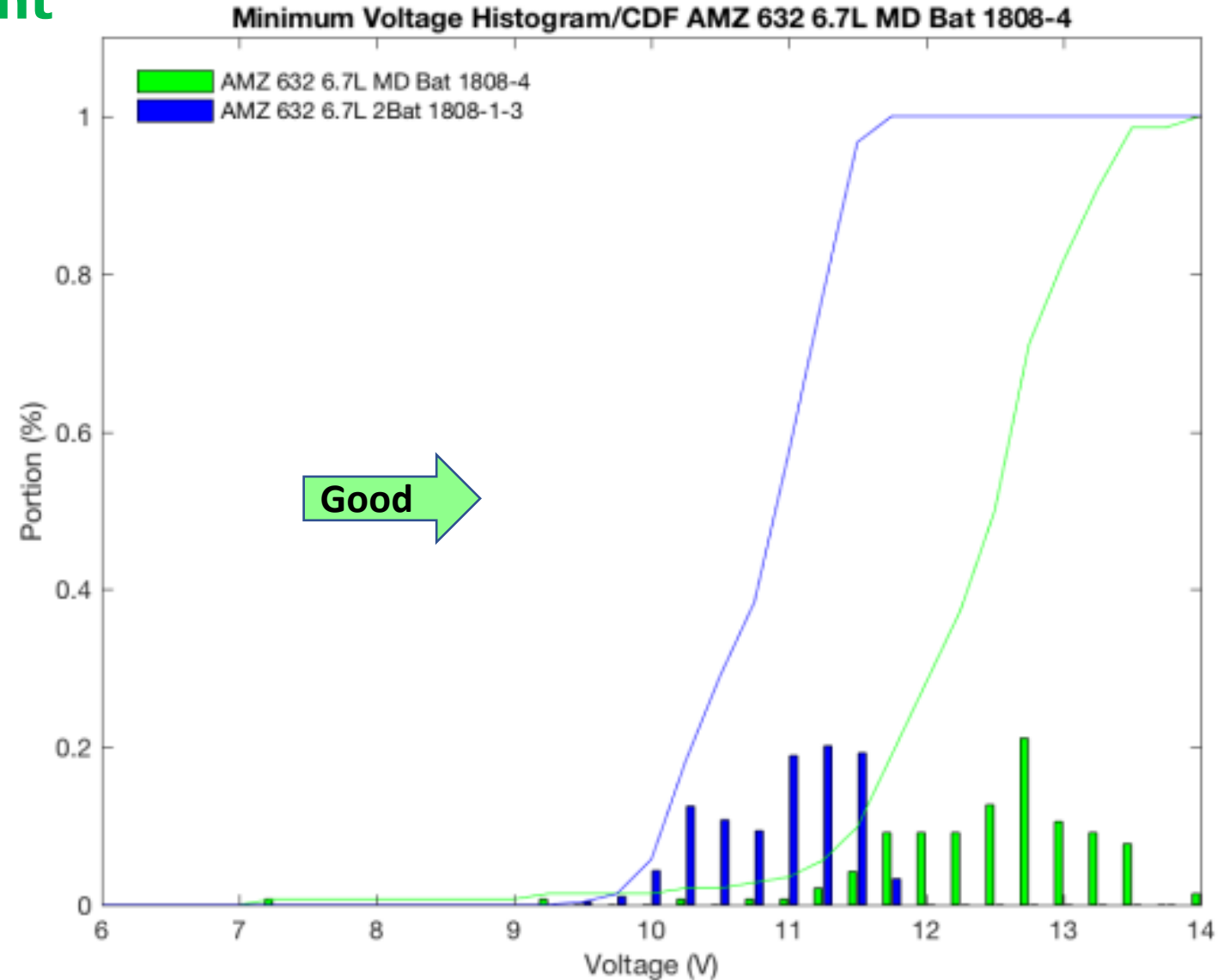
Minimum Voltage Improvement

uSTART® Trial Result

- Significant improvement w/ uSTART® (>1.5V)

uSTART® Benefit

- Eliminate expensive jump starts
- Extend life of starter



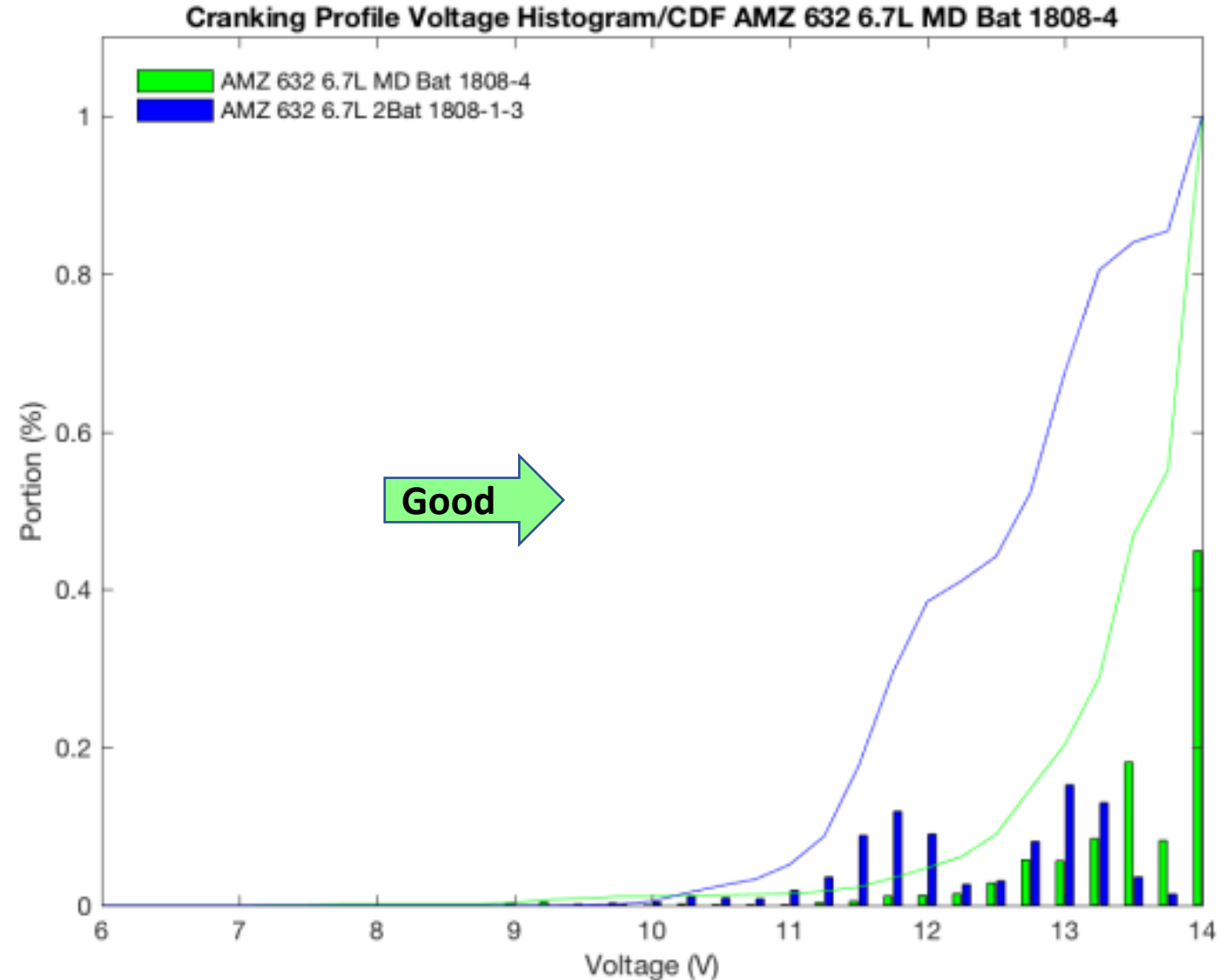
Vehicle Cranking Voltage Profile Improvement

uSTART® Trial Result

- Significant Improvement w uSTART (>1V)
- 95% of Cranking Voltage above 12V w/ uSTART - 45% below without

uSTART® Benefit

- Higher bus voltage prevents low voltage starts from damaging starter and other components
- Higher bus voltage prevents brownouts of ECMs and contactor/relay wear



Battery Open Circuit Voltage Comparison

uSTART[®] Trial Result

- As expected
- No negative impact introduced by uSTART[®]

