

TestReport003 – eTransit with SBS

Fenton Secondary Battery System – Charging Level 2 Test Results

Report Date: 2023-Oct-28

Vehicle: Prototype1



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1. Test Purpose

To establish real-world charging performance baseline when charging both Ford eTransit and Fenton Secondary Battery System (SBS) using Level2 Charging.

2. Test Setup

- Use standard Ford Depot Charger (Ford Pro AC Charging Station 48A - Gen 1), which is typically installed at transit property depots. (Model: 8EM1314-5CG14-2FA2, Rating: 208/240v, 48A, 60Hz)
- Level2 charging is used. Level2 charging is defined as using 208-240vac to achieve a charging power of ~6-19kW.
- Vehicle under test is a Ford eTransit 2023.
- Secondary Battery System under test is Fenton SBS Revision1.



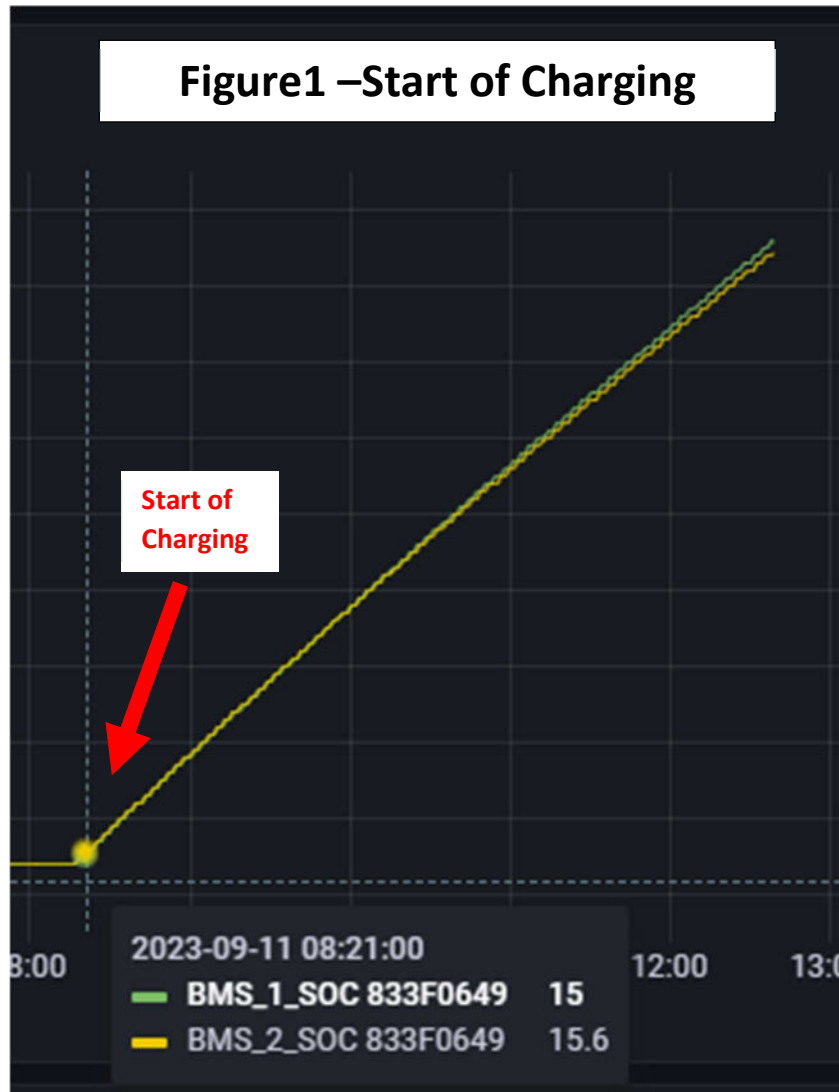
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3. Test Data

- Figure1 shows the start of charging for the Fenton Secondary Battery System (SBS):
 - SOC = State of Charge %
 - BMS = Battery Management System
 - Starting Time = 8:21am
 - Starting SOC for BMS1 = 15%
 - Starting SOC for BMS2 = 15.6%
 - Starting SOC for both batteries = 15.3%



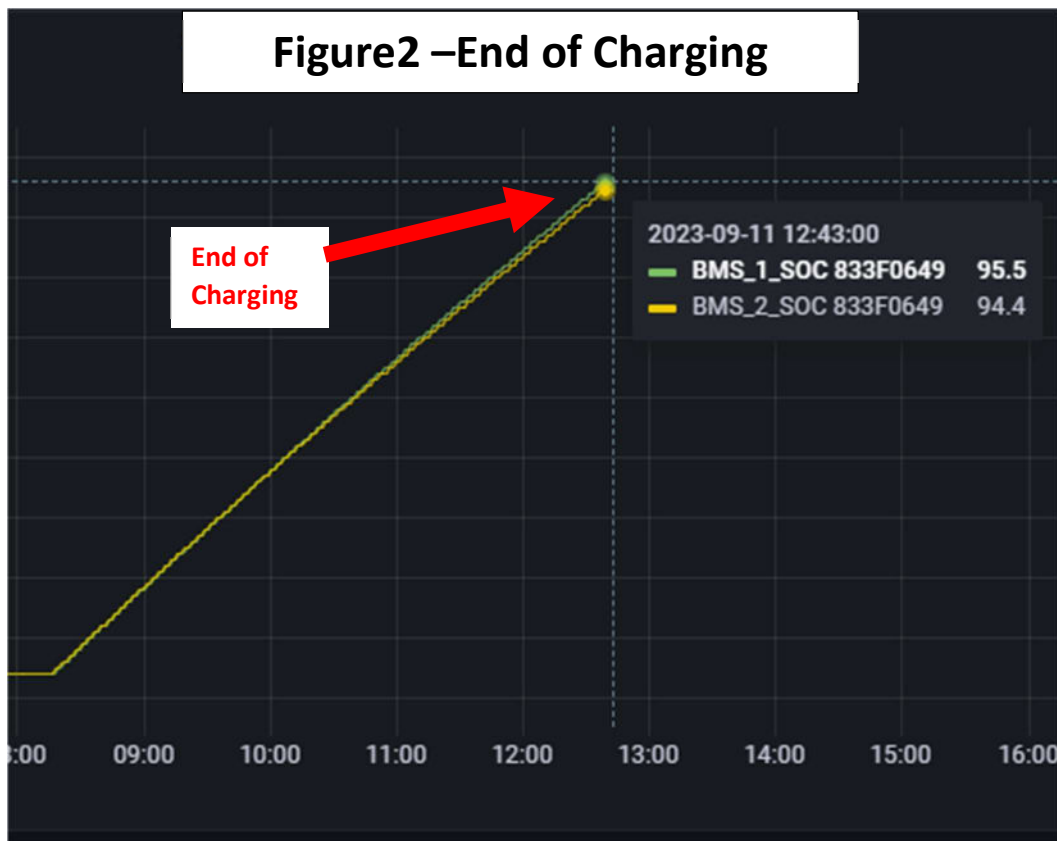
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3. Test Data (Continued)

- Figure2 shows the end of charging for the Fenton Secondary Battery System (SBS):
 - SOC = State of Charge %
 - BMS = Battery Management System
 - Ending Time = 12:43pm
 - Ending SOC for BMS1 = 95.5%
 - Ending SOC for BMS2 = 94.4%
 - Ending SOC for both batteries = 95.0%



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3) Test Data (Continued)

- Figure3 shows the actual charging voltage at the Fenton facility. Please note that the Fenton facility uses 208vac power, so the charging should be ~13% less than a typical installation. The Fenton actual voltage was measuring ~195-200vac, so this is ~17-19% less than a typical installation. This results in slower charging than normal.
 - Minimum Actual Charging Power: $195\text{vac} * 28.7\text{A} = \sim 5.6\text{kW}$
 - Maximum Actual Charging Power: $200\text{vac} * 28.5\text{A} = \sim 5.7\text{kW}$
- Summary is presented in **4. Test Summary** section.

Figure3 – Minimum Actual Charging Power

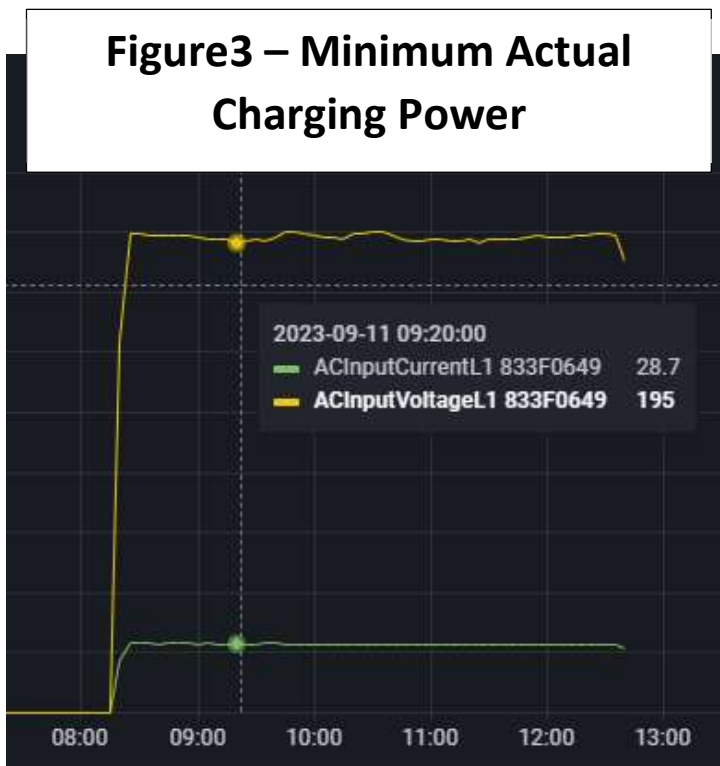
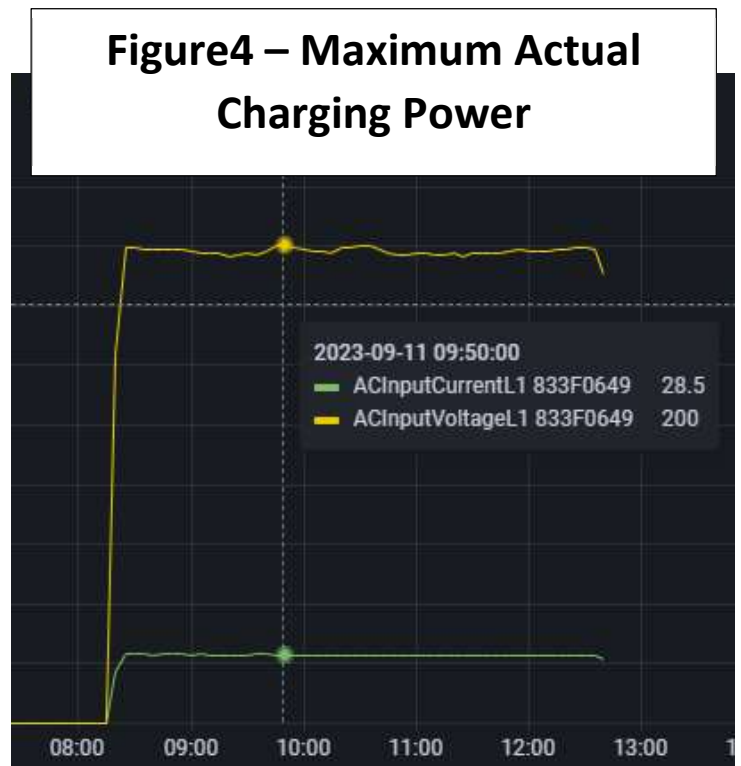


Figure4 – Maximum Actual Charging Power



3) Test Data (Continued)

Regarding the charging of the Ford eTransit battery, Figure 5 shows test data for two typical charging sessions. The summary is presented in **4. Test Summary**.

Figure5 – Charging Ford @ Level2 Summary

Balancing Session
(best practice to
balance battery cells at
least once per week)

Session1: Balancing Session		
8.4	Hours	<-- Time on Charger
28	%	<-- SOC% Start
100+balance	%	<-- SOC% End
72.0	%	<-- SOC% Delta (Added)
8.6	%/h	<-- SOC% Charge Rate
49.0	kWh	<-- Energy Delta (Added)
5.8	kW	<-- Ave Charging Power

Standard Partial Charge
(~1/3 SOC% to 2/3 SOC%)

Session2: Standard Partial Charging Session		
3.5	Hours	<-- Time on Charger
30	%	<-- SOC% Start
66	%	<-- SOC% End
36.0	%	<-- SOC% Delta (Added)
10.3	%/h	<-- SOC% Charge Rate
24.5	kWh	<-- Energy Delta (Added)
7.0	kW	<-- Ave Charging Power

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4. Test Summary

- Charging the **Fenton Secondary Battery System (SBS)**:
 - Figure 6 shows the summary of charging the SBS system @ level2.
 - We saw the battery SOC% increase ~80% in ~4.4hrs.
 - We saw an Average Charging Power of ~5.5kW.
 - We note that the Fenton Facility had an average Grid Voltage of ~200vac, which would result in an 18% charging speed reduction compared to a typical installation with 240vac power.

Figure6 – Charging SBS @ Level2 Summary

Standard Partial Charging Session		
4.4	Hours	<-- Time on Charger
197.5	VAC	<-- Average Charging Voltage
5.6	kW	<-- Average Charging Power
15.3	%	<-- SOC% Start
95.0	%	<-- SOC% End
79.7	%	<-- SOC% Delta (Added)
18.2	%/h	<-- SOC% Charge Rate
23.9	kWh	<-- Energy Delta (Added)
5.5	kW	<-- Ave Charging Power

Voltage Note: Voltage Range = 195-200vac (This is ~18% lower than typical 240vac charging)
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- Charging the **Ford eTransit** system, we saw:
 - **Partial Charge:**
 - Average Charging Power = 7.0kW
 - SOC% Charge Rate = 10.3%/h
 - This would increase the battery SOC% by ~80% in ~7.7hours.
 - **Balancing Charge:**
 - Average Charging Power = 5.8kW
 - Average SOC Charge Rate = 8.6%/h
 - Balancing takes longer, but it is recommended at least once per week.

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5. Other Fenton Documents

- For real-world testing data of charging both the Ford eTransit 2023 and the Fenton Secondary Battery Systems, please also see these documents:
 - Charging @ Level1: See ***TestReport002-eTransit-w-SBS-ChargingLevel1***
 - DC Fast Charging: See ***TestReport004-eTransit-w-SBS-DC-Fast-Charging***
 - For best practices and recommendations for optimizing performance and getting the most out of your system, please see the ***Best Practices*** document on the website @ fentonmobility.com.

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