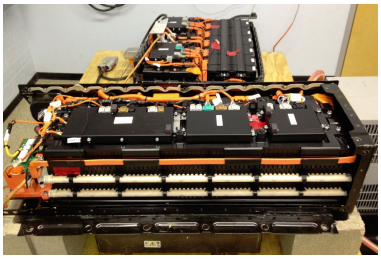
BEV Battery Testing Results

2013 Ford Focus Hatchback - VIN 1700



Vehicle Details and Battery Specifications[1,2]

Vehicle Details

Base Vehicle: 2013 Ford Focus Hatchback	VIN: 1FADP3R40DL251700
Architecture: Electric	

Battery Specifications

Manufacturer: LG Chem	Rated Pack Energy/Capacity: 23.0 kWh / 75.0 Ah
Type: Lithium-ion	Min/Max Cell Voltage: 3.00/4.20 V
Number of Cells: 86	Pack Mass/Volume[3]: 302.6 kg, 268.3 L
Nominal Cell/System Voltage: 3.7/318.2 V	Thermal Management: Active-Liquid Cooled

[1] Vehicle details and battery specifications were either supplied by the manufacturer or derived from a literature review

[2] For full vehicle specifications, see the Baseline Performance Testing Results for this vehicle

[3] Battery pack volume is approximate and is based on the overall rectangular envelope less any significant voids

Battery Laboratory Test Results Summary

Test Number	Vehicle Odometer (Miles)	Date of Test	Measured Average Capacity (Ah)	Measured Average Energy Capacity (kWh)	30s Discharge Power Capability at 80% DOD (kW)	10s Charge Power Capability at 20% DOD (kW)
Baseline	396	3/21/2014	74.3	24.2	140.8	96.7
ICD 1	4,182	7/16/2014	71.2	23.2	152.2	90.4
ICD 2	12,075	5/2/2015	67.1	21.9	111.3	92.9
ICD 3						
End-of-Test						

EV Battery Test Results Analysis

Battery test results include those from the Static Capacity Test and the Electric Vehicle Pulse Power Characterization (EVPC) Test, based on test procedures from the United States Advanced Battery Consortium Electric Vehicle Battery Test Procedure Manual, and pre-released USABC recommended testing practices at the time of testing. These tests were performed for the US Department of Energy Vehicle Technology Office's Advanced Vehicle Testing Activity, which is conducted by the Idaho National Laboratory and Intertek Testing Services, North America.

Static Capacity Test Results

The Static Capacity Test measures the charge and energy capacities of the battery between maximum and minimum pack voltages when discharged at a three-hour ($C_3/3$) constant current rate, based on rated capacity.[4] Pack voltage versus capacity discharged during the Static Capacity Test is shown in Figure 1. Three iterations of the Static Capacity Test are performed at each interval, and the average results from each interval test are shown in the test results summary table on page 1.

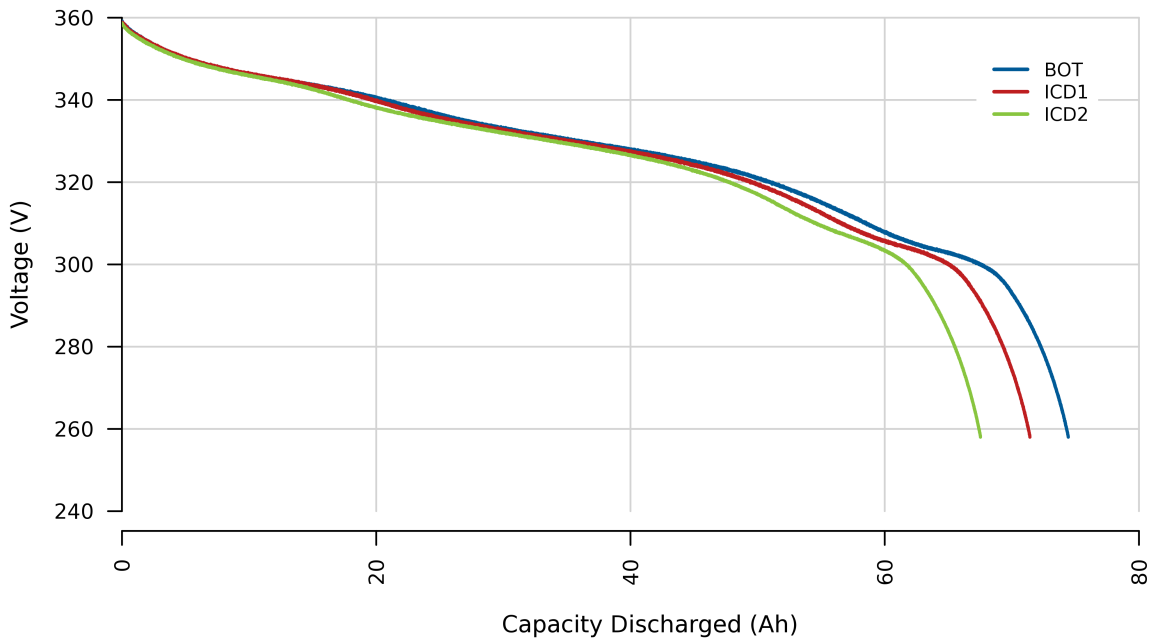


Figure 1. Voltage versus capacity discharged during the static capacity test

Electric Vehicle Pulse Power Characterization Test Results

The EVPC test is performed to characterize the discharge and charge pulse power capabilities of the battery at each 10-percent depth-of-discharge interval. Numerical results derived from the EVPC test results are summarized in the table on page 1. The results from these tests can be compared to targets for EV batteries set by the USABC.

[4] Discharge rate is determined by dividing the rated capacity by three hours (75.0 Ah/3hr = 25.0 A).

Figures 2 and 3 illustrate the battery charge and discharge calculated pulse resistance, which indicate internal resistance at each 10-percent depth-of-discharge interval.

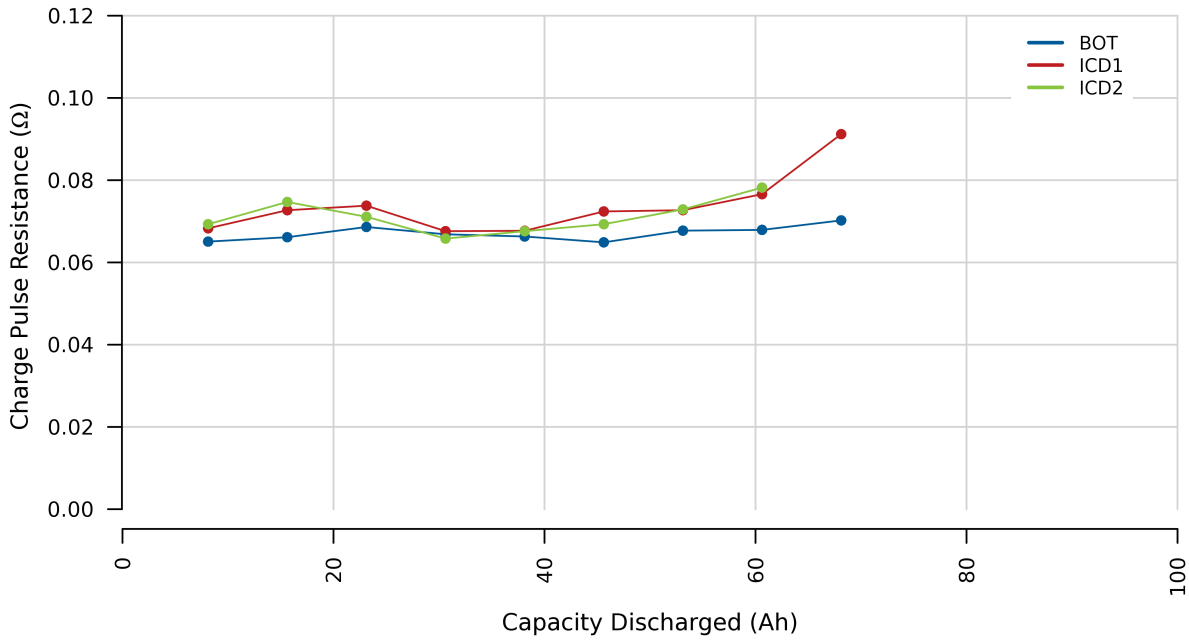


Figure 2. Ten-second charge pulse resistance versus capacity discharged

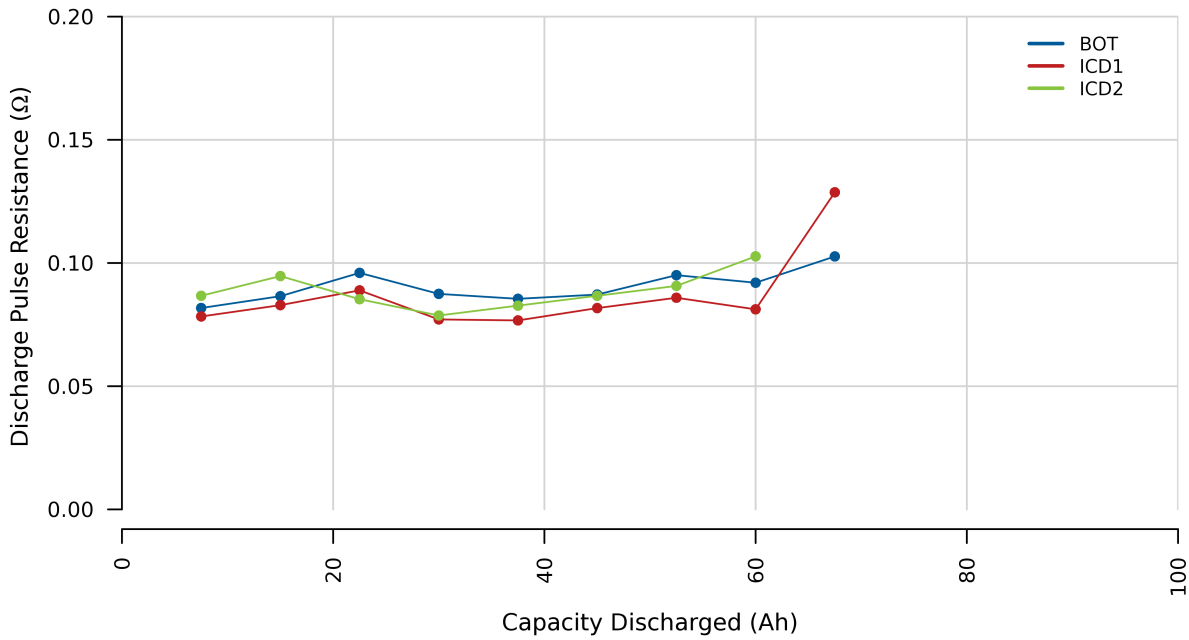


Figure 3. Thirty-second discharge pulse resistance versus capacity discharged

Figure 4 shows the battery's 10-second charge power capabilities as a function of capacity discharged. Figure 5 shows the 30-second discharge pulse power capabilities as a function of capacity discharged.

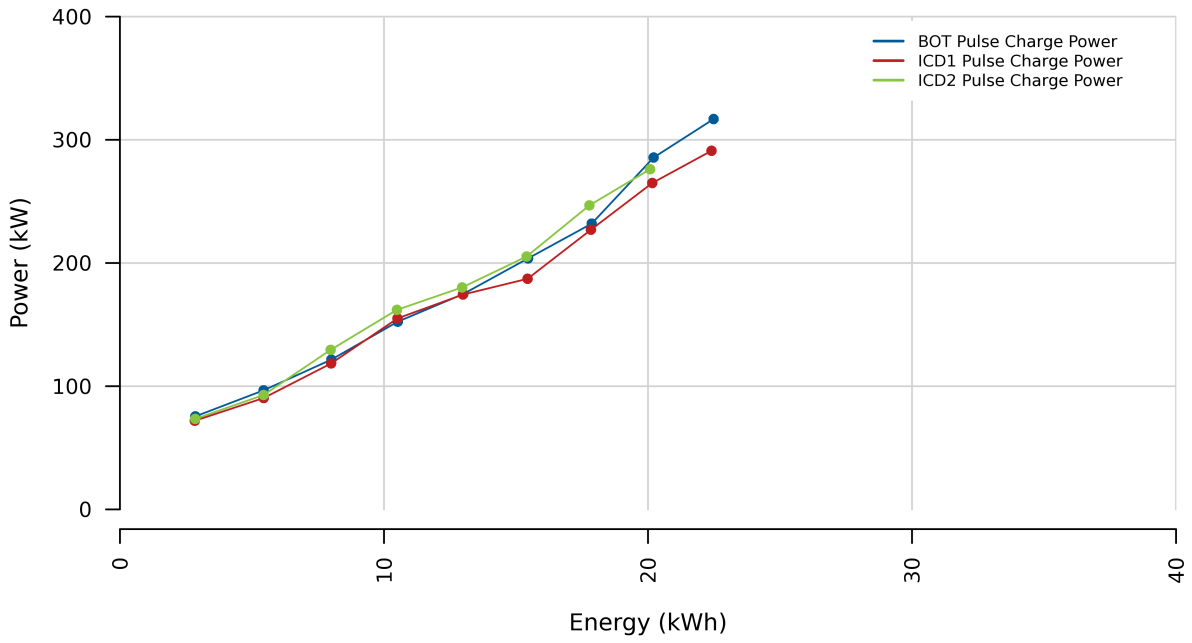


Figure 4. Charge power capability versus energy discharged

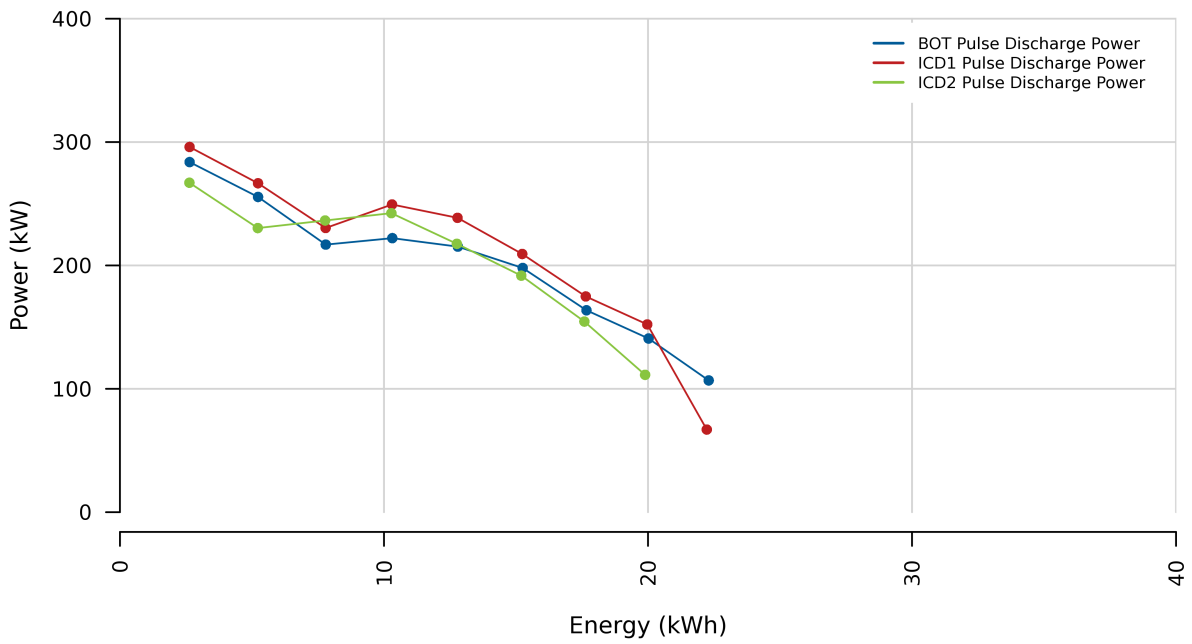


Figure 5. Discharge power capability versus energy discharged