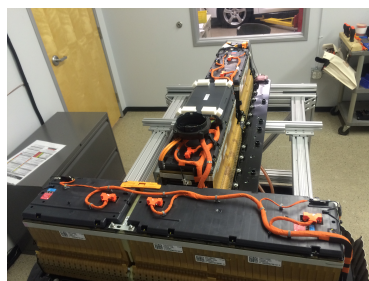


# Battery Pack Laboratory Testing Results

## 2016 Chevrolet Volt - VIN 1377



### Vehicle Details and Battery Specifications<sup>1, 2</sup>

#### Vehicle Details

Base Vehicle: 2016 Chevrolet Volt	VIN: 1G1RC6S51GU131377
Architecture: Plug-In Hybrid Electric	

#### Battery Specifications

Manufacturer: LG Chem	Rated Pack Energy/Capacity: 18.9 kWh / 52.0 Ah
Type: Lithium-ion	Min/Max Cell Voltage: 3.00/4.15 V
Number of Cells: 96	Pack Mass/Volume <sup>3</sup> : 182.8 kg, 140.5 L
Nominal Cell/System Voltage: 3.8/360.0 V	Thermal Management: Active-Liquid Cooled

<sup>1</sup> Vehicle details and battery specifications were either supplied by the manufacturer or derived from a literature review

<sup>2</sup> For full vehicle specifications, see the Baseline Performance Testing Results for this vehicle

<sup>3</sup> 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)	CD Usable Energy Margin <sup>4</sup> (Wh)	CS Usable Energy Margin <sup>4</sup> (Wh)
Baseline	4,008	3/30/2016	48.5	17.3		
ICD 1	33,923	10/12/2016	47.1	16.7		
ICD 2						
ICD 3						
End-of-Test						

<sup>4</sup> The CD and CS Usable Energy margins are defined as the difference between the battery usable energy values obtained from testing and the corresponding targets as defined in the Battery Test Manual for Plug-In Hybrid Electric Vehicles. A negative margin value indicates performance below the target, however it does not necessarily indicate any deficiency in the performance of the battery as it was designed to operate by the vehicle manufacturer.

PHEV Battery Test Results Analysis

Battery test results include those from the Static Capacity Test and the Hybrid Pulse Power Characterization (HPPC) Test, based on test procedures from the United States Advanced Battery Consortium Battery Test Manual For Plug-In Hybrid Electric Vehicles 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 constant current calculated to approximate a 10 kW discharge rate.<sup>5</sup> 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.

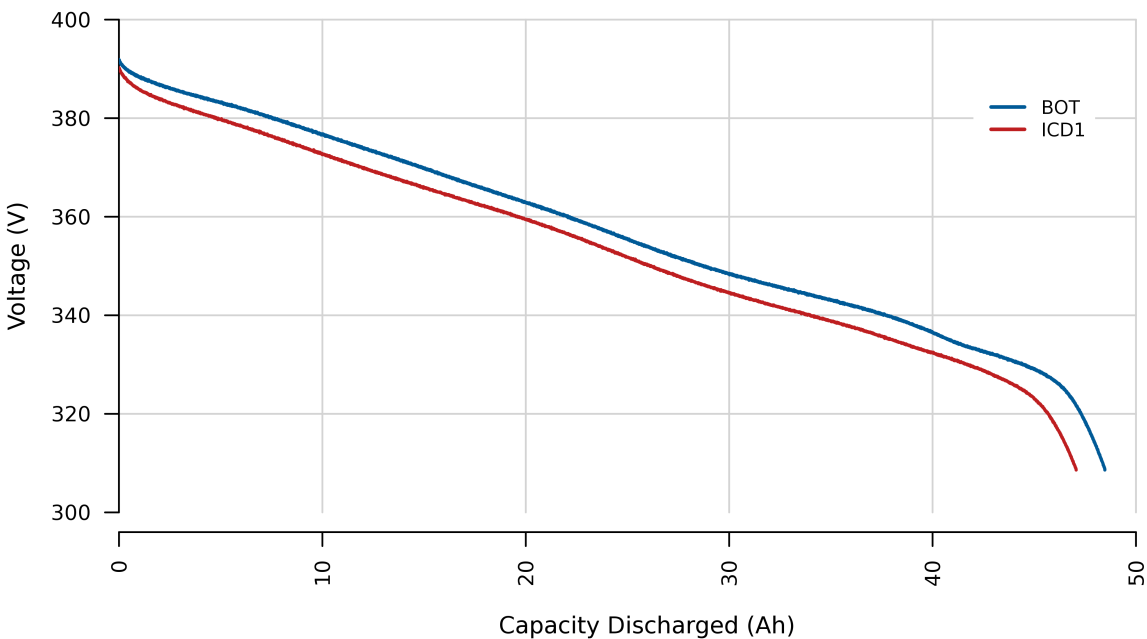


Figure 1. Voltage versus capacity discharged during the static capacity test

Hybrid Pulse Power Characterization Test Results

The HPPC test is performed to characterize the discharge and charge pulse power capability of the battery at each 10-percent depth-of-discharge interval. Numerical results derived from the HPPC test results are summarized in the table on page 1, including comparison of the measured results to the United States Advanced Battery Consortium goals for PHEV batteries. The results from these tests are in relation to the targets for a Maximum PHEV Battery, having an equivalent electric range of 40 miles.

<sup>5</sup> Discharge rate is determined by taking the average of the maximum and minimum voltage values for a particular pack and dividing that value into 10 kW, per the PHEV manual. For this vehicle, the value is 10kW / 343.0 V = 29.15 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.

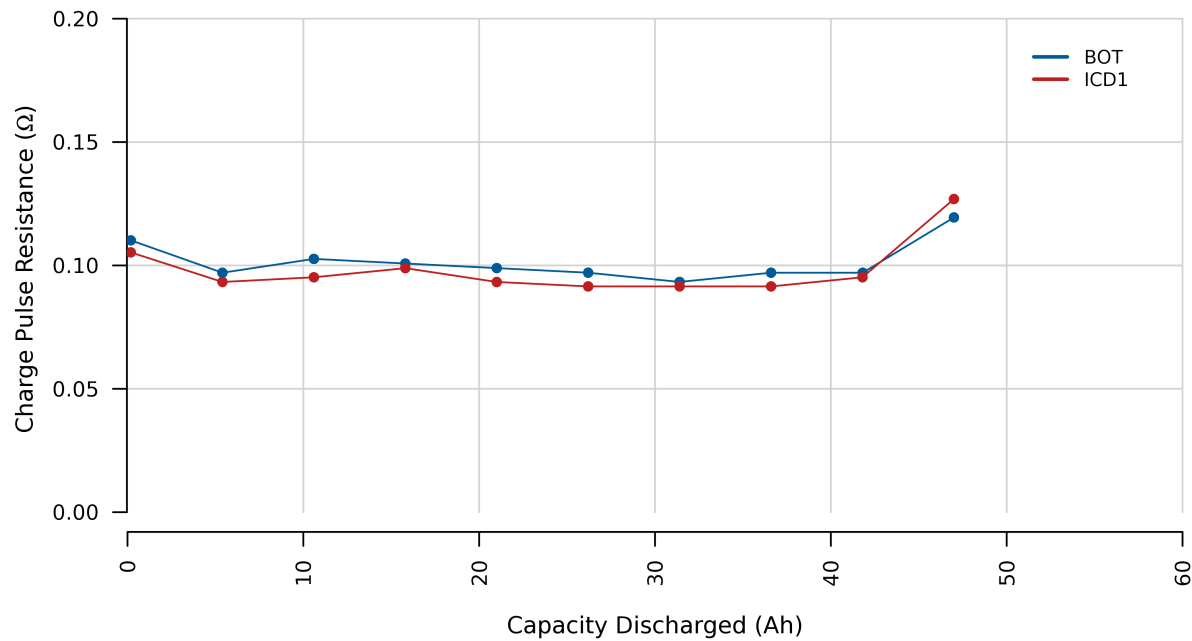


Figure 2. Ten-second charge pulse resistance versus capacity discharged

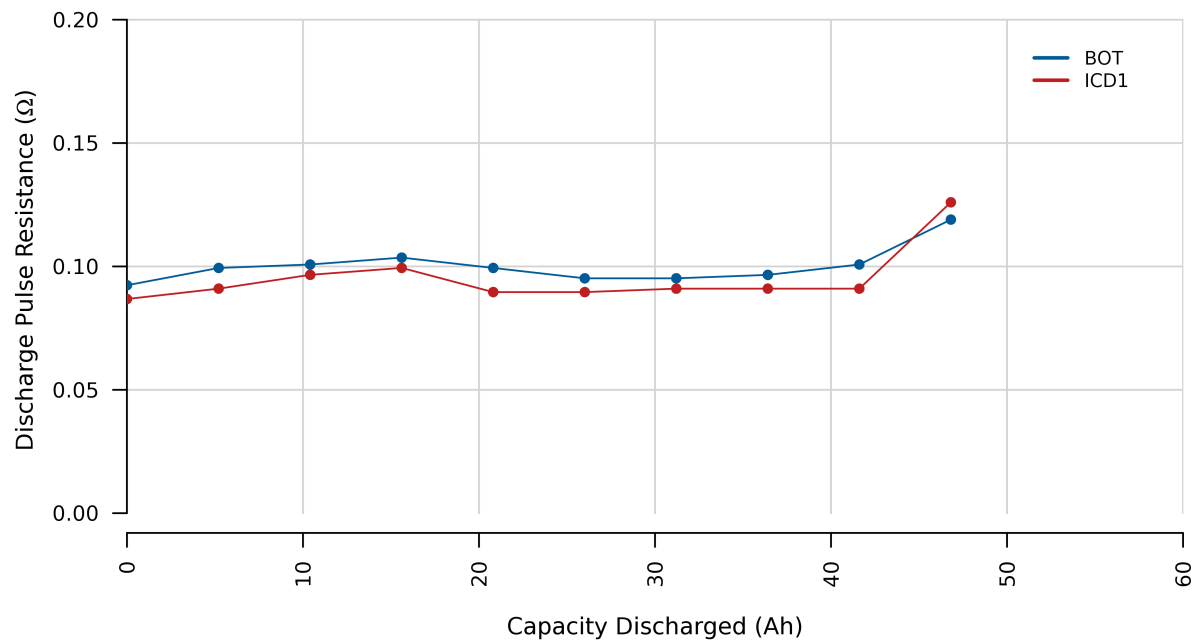


Figure 3. Ten-second discharge pulse resistance versus capacity discharged

Figure 4 shows the battery’s 10-second charge and discharge pulse power capabilities as a function of energy discharged. The Maximum PHEV battery target performance goals of 38 kW discharge power and 25 kW charge power are shown as a dashed line. Note that the axes are scaled such that the charge and discharge pulse power goals align.

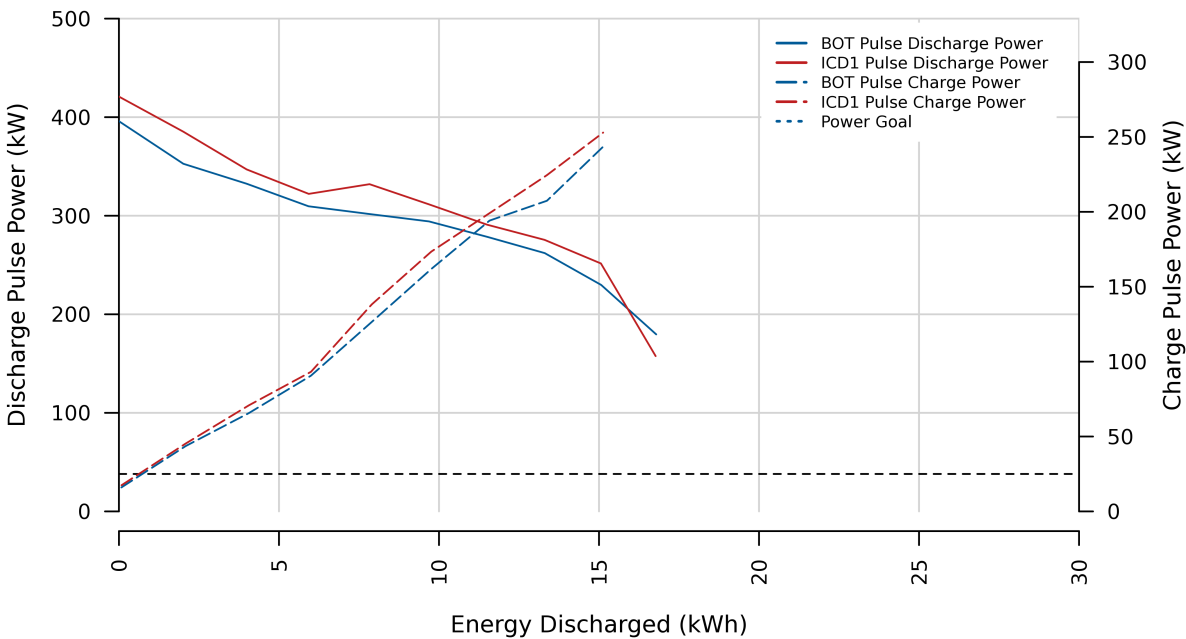


Figure 4. Discharge and charge power capability versus energy discharged