2006 Honda Civic-9329
Hybrid Battery Test Results

HEVAmerica
U.S. Department of Energy Advanced Vehicle Testing Activity

Battery Specifications

Manufacturer: Panasonic
Battery Type: Nickel Metal Hydride
Rated Capacity: 5.5 Ahr
Rated Power: Not Available
Nominal Pack Voltage: 158.4 VDC
Nominal Cell Voltage: 1.2 V
Number of Cells: 132

Vehicle Specifications

Manufacturer: Honda
Model: Civic
Year: 2006
Number of Motors[1]: 1
Motor Power Rating[2]: 15 kW
VIN #: JHMFA36216S019329

HPPC Test

Peak Pulse Discharge Power @ 10s[3]: 12.3 kW
Peak Pulse Discharge Power @ 1s[3]: 17.8 kW
Peak Pulse Charge Power @ 10s[3]: 12.7 kW
Peak Pulse Charge Power @ 1s[3]: 18.8 kW
Maximum Cell Charge Voltage: 1.5 V
Minimum Cell Discharge Voltage: 1.0 V

Static Capacity Test

Measured Average Capacity: 4.95 Ah
Measured Average Energy Capacity: 820 Wh

Vehicle Mileage and Testing Date

Vehicle Odometer: 160,942 mi
Date of Test: January 26, 2009

Analysis Notes:

1. Motor refers to any motor capable of supplying traction power.
2. Motor power rating refers to the manufacturer's peak power rating for the motor(s) supplying traction power.
3. Calculated value based on selected battery voltage limits and at 50% SOC.

Test Results

Test results for the end-of-life battery testing are provided herein. Battery test results include those from the Static Capacity Test and the Hybrid Pulse Power Characterization (HPPC) Test[1].

Static Capacity Test Results

Static capacity test results are summarized in the fact sheet. The test was perfomed on January 26, 2009 with a vehicle odometer reading of 160,942 miles. The measured average C/1-rate capacity was 4.95 Ah compared with the manufacturer's rated capacity of 5.5 Ah. The measured average energy capacity was 820 Wh.

Figure 1 is a graph of battery voltage versus energy discharged. This graph illustrates the voltage values during the constant current discharge versus the cumulative energy discharged from the battery at a C/1 discharge rate.

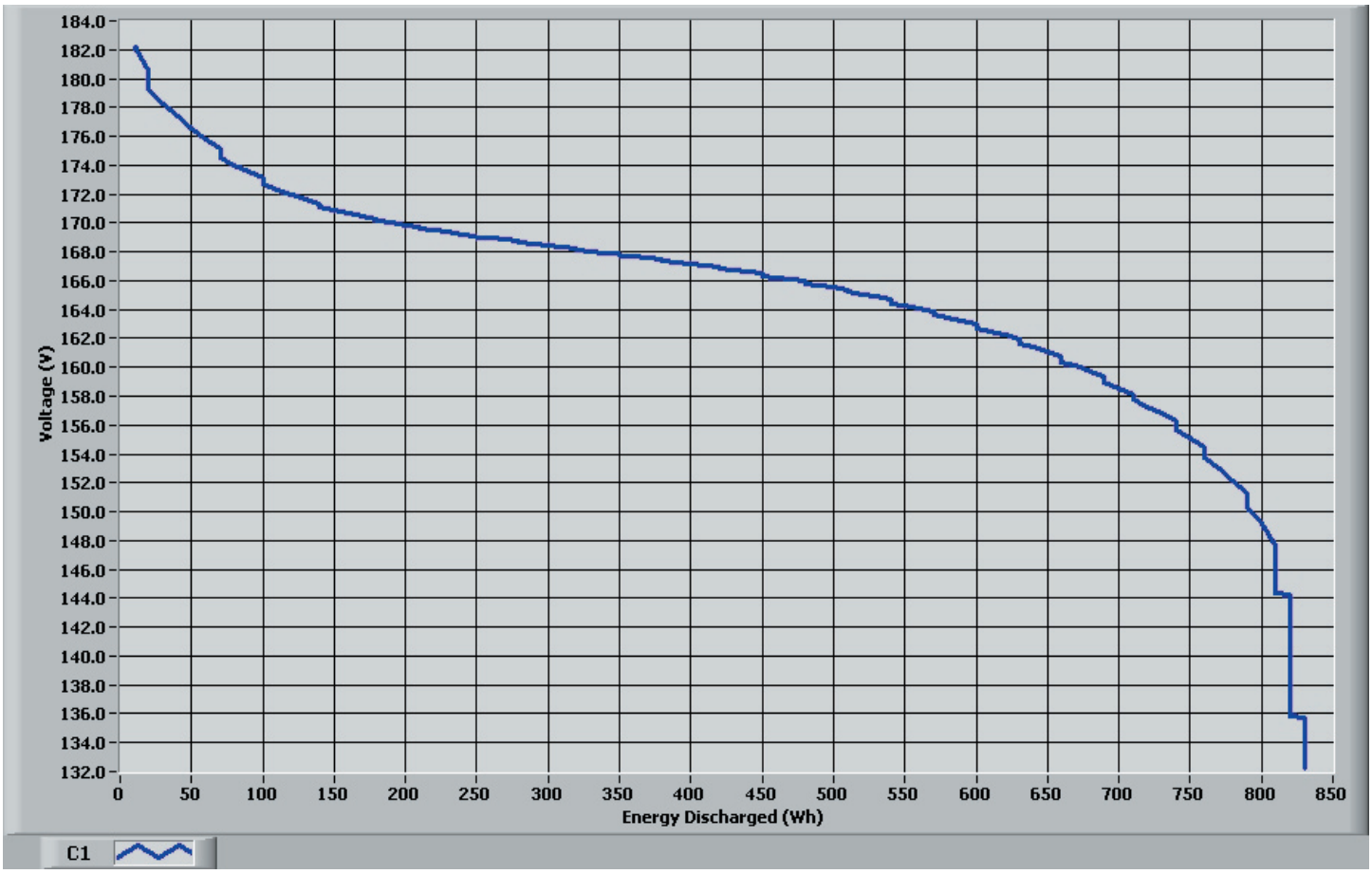

Figure 1
Voltage vs. Energy Discharged

1. Static Capacity and Hybrid Pulse Power Characterization test procedures were performed in accordance with FreedomCAR Battery Test Manual for Power-Assist Hybrid Vehicles, DOE/ID-11069, October 2003 procedures 3.2 and 3.3 respectively.

HPPC Test Results

HPPC test results are summarized in the fact sheet. The peak pulse discharge power at 10 seconds and 1 second into the pulse are 12.3 kW and 17.8 kW at 50% SOC respectively. The peak pulse charge power at 10 seconds and 1 second into the pulse are 12.7 kW and 18.8 kW at 50% SOC respectively. The maximum and minimum cell voltages used for this analysis were 1.5 V and 1.0 V respectively.

Figures 2 and 4 illustrate the battery's charge and discharge pulse resistance graphs which show internal resistance at various depths of discharge. Each curve represents the resistance at the end of the specified pulse interval.

Figures 3 and 5 illustrate the battery's charge and discharge pulse power graphs which show the useable power at various depths of discharge. Each curve represents the pulse power at the end of the specified pulse interval at the cell voltage limits.

Figure 6 is a plot of the battery's HPPC 10 second pulse power as a function of state of charge. The graph shows the power values over the range of state of charge as well as the DOE performance goals of 25 kW discharge power and 20 kW regenerative power for a hybrid minimum power assist battery. The battery does not meet the DOE power performance goals for any battery state of charge range.

Figure 7 is a plot of the battery's useable energy as a function of power. The x-axis indicates a desired discharge or charge power level and the y-axis indicates the useable energy at that power. The dashed horizontal line shows the DOE Minimum Power Assist HEV energy performance goal of 300 Wh. The dashed vertical line shows the DOE Minimum Power Assist power performance goal of 25 kW. The Civic battery's useable energy curve falls partially above and to the left of the intersection of the DOE energy and power performance goals. The maximum power that can be delivered while meeting the DOE energy performance goal is 12.4 kW at 300 Wh. The battery does not meet the DOE power performance goal for any calculated energy value. This indicates that at the time of testing, the Civic battery performance was below the DOE performance goals.

These tests were performed for DOE's Adacnced Vehicle Testing Activity (AVTA). The AVTA, part of DOE's Vehilce Technology Program, is conducted by the Idaho National Laboratory and Electric Transportation Engineering Corporation.

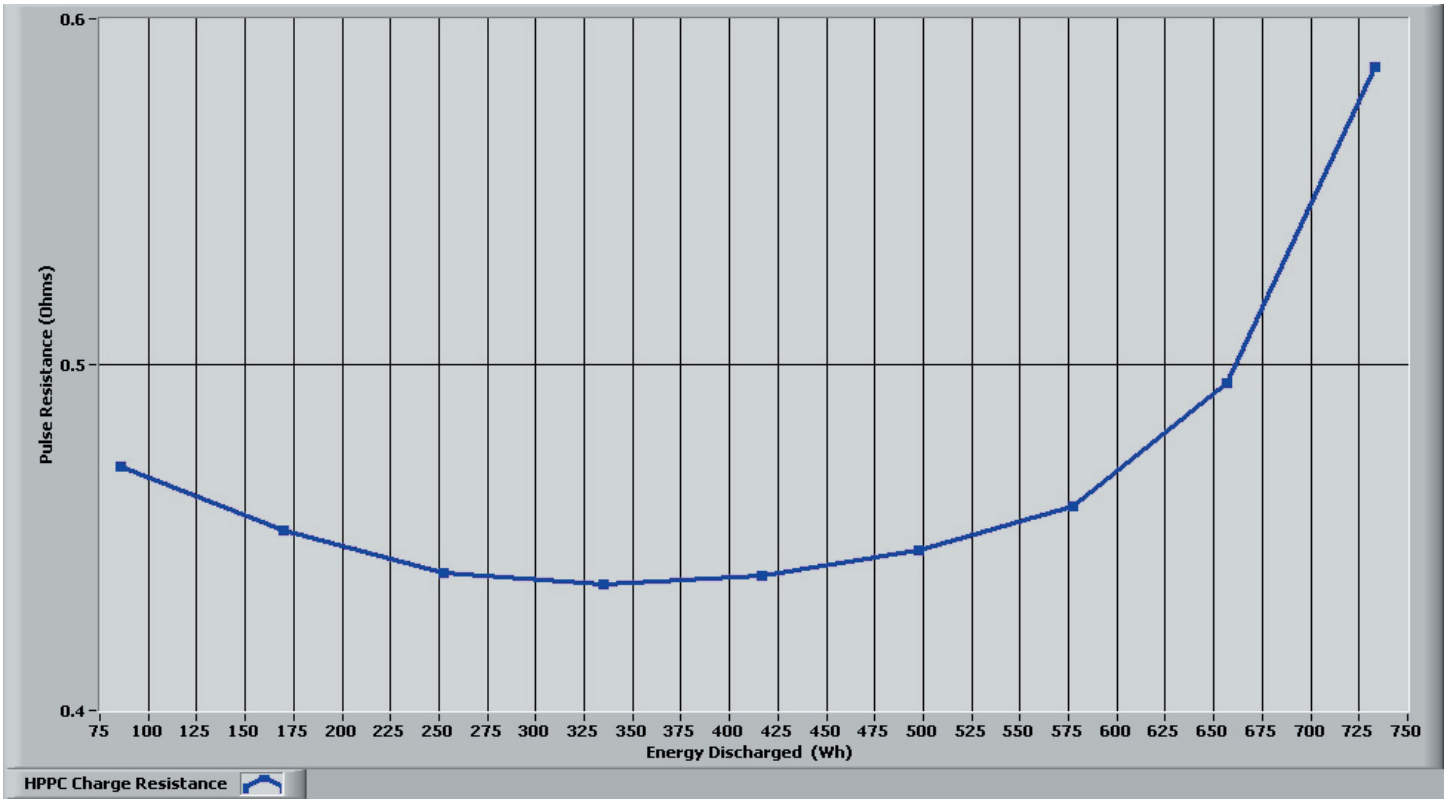

Figure 2
Charge Pulse Resistance vs. Energy Discharged

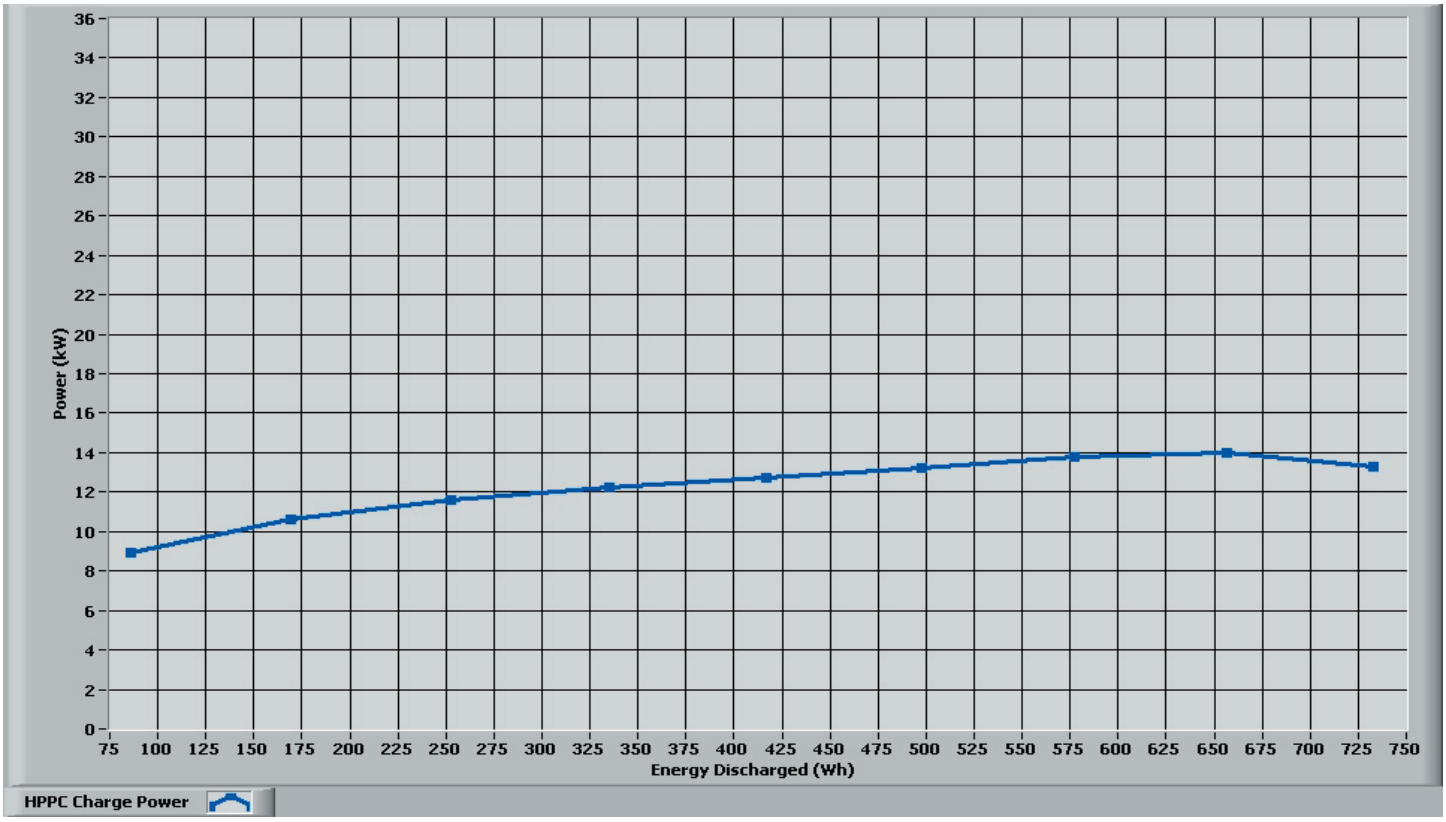

Figure 3
Charge Pulse Power vs. Energy Discharged

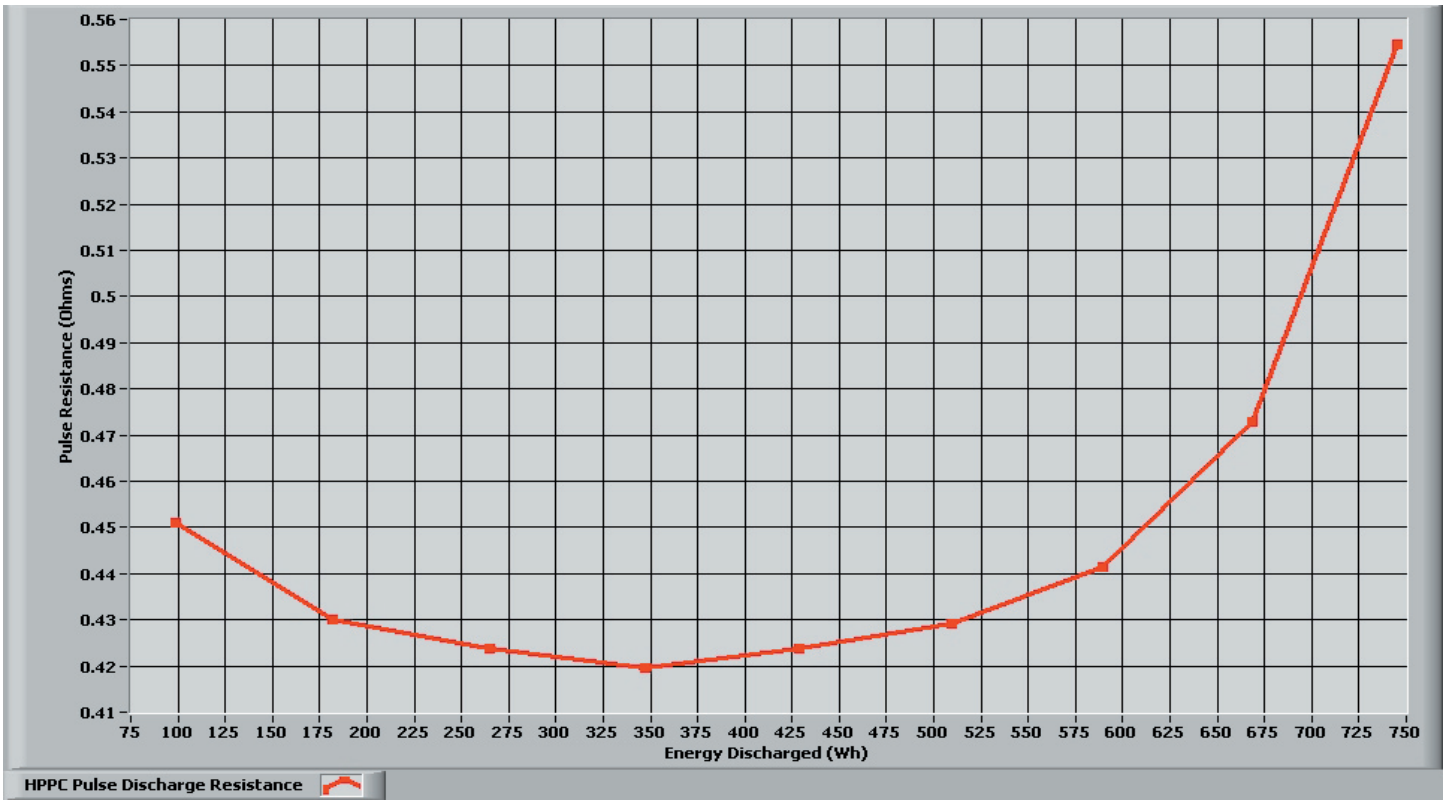

Figure 4
Discharge Pulse Resistance vs. Energy Discharged

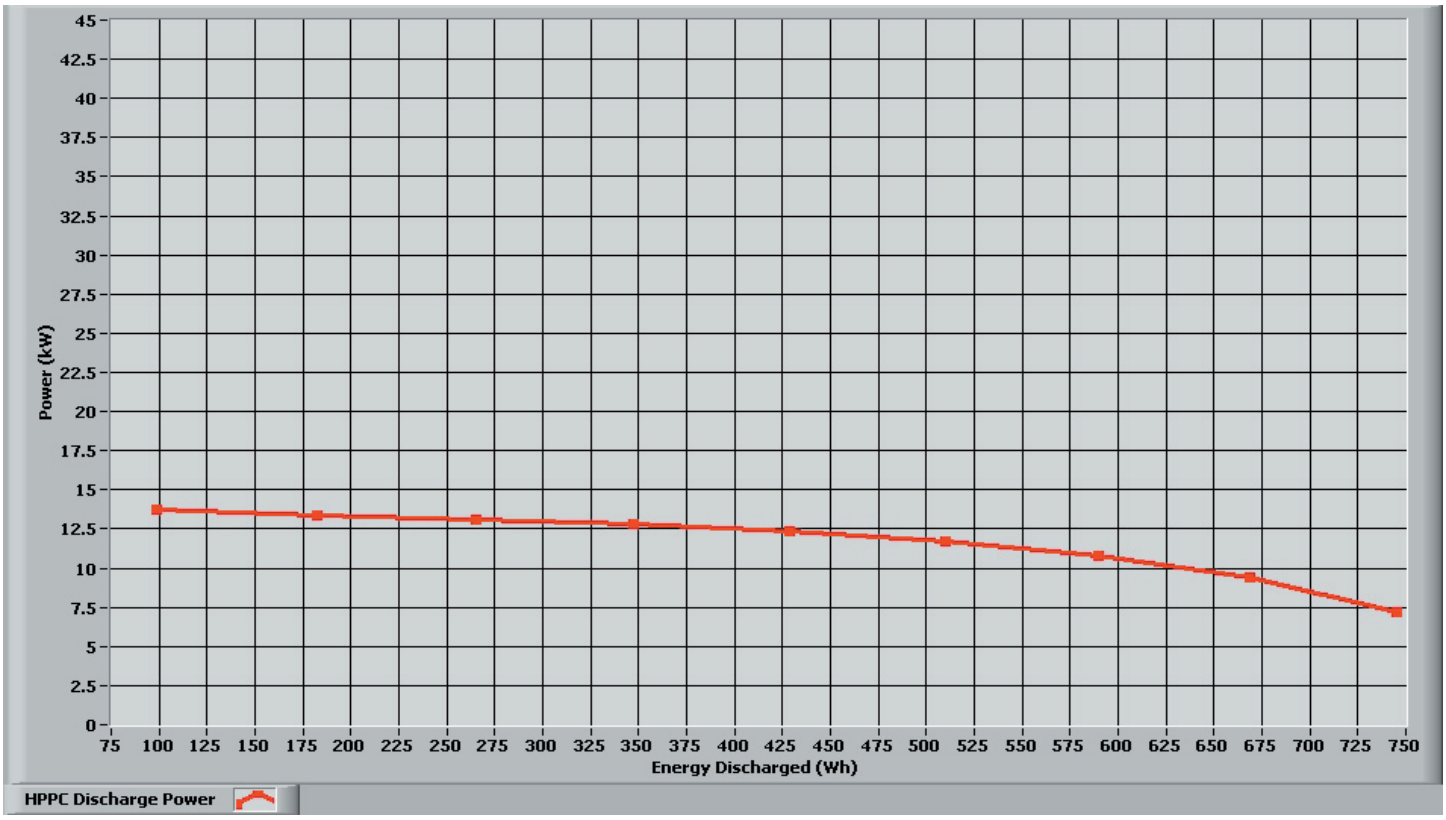

Figure 5
Discharge Pulse Power vs. Energy Discharged

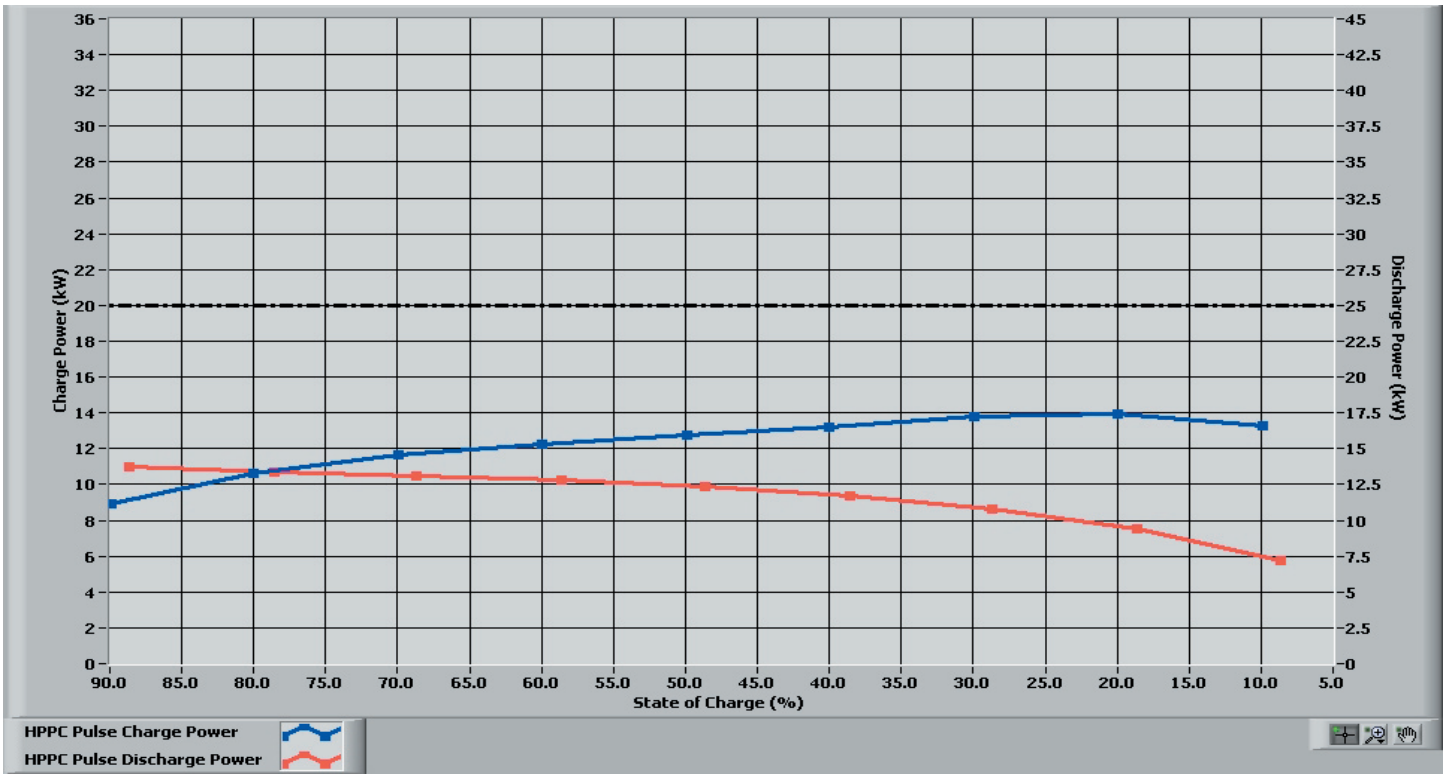

Figure 6
Peak Power Values with DOE Performance Goals

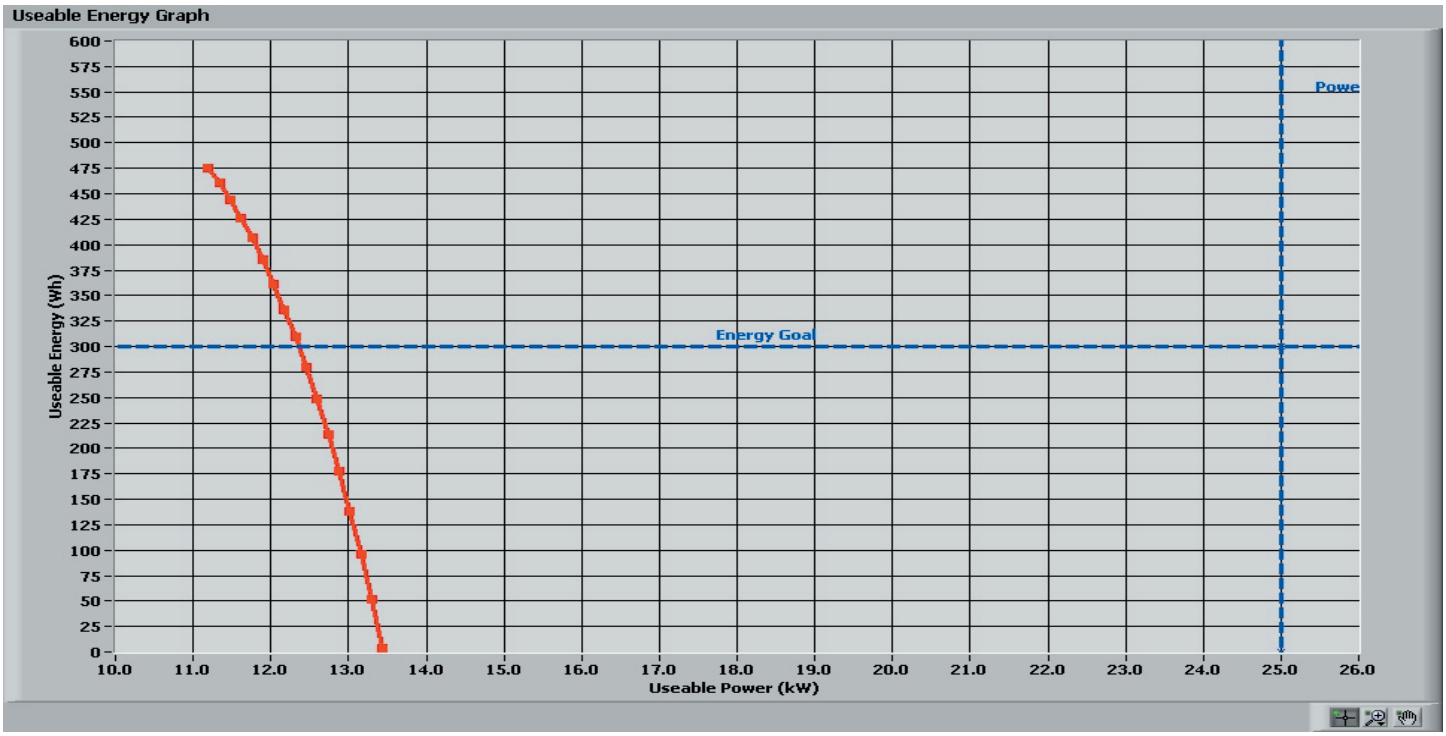

Figure 7
Useable Energy