2011 Honda CR-Z – VIN 4466

Advanced Vehicle Testing – Beginning-of-Test Battery Testing Results

VEHICLE AND BATTERY DESCRIPTIONS AND SPECIFICATIONS

Vehicle Details

Base Vehicle: 2011 Honda CR-Z
VIN: JHMZF1C67BS004466
Electric Machine[1]: 10 kW (peak), permanent magnet AC synchronous

Battery Description

Manufacturer: Panasonic
Type: Nickel-Metal Hydride
Pack(s) Location: Behind the rear package tray under the trunk floor

Battery Specifications

Number of Cells: 84
Nominal Cell Voltage: 1.2 V
Nominal System Voltage: 100.8 V
Nominal Pack Capacity: 5.75 Ah
Cooling: Active/Cabin Air
Pack Weight: 65 lb

BATTERY LABORATORY TEST RESULTS SUMMARY

Vehicle Mileage and Testing Date

Vehicle Odometer: 3,995 mi
Date of Test: December 30, 2010

Static Capacity Test

Measured Average Capacity: 5.79 Ah
Measured Average Energy Capacity: 600 Wh

HPPC Test

Peak Pulse Discharge Power @ 10 s^2: 9.2 kW
Peak Pulse Discharge Power @ 1 s^2: 13.8 kW
Peak Pulse Charge Power @ 10 s^2: 7.1 kW
Peak Pulse Charge Power @ 1 s^2: 11.4 kW
Maximum Cell Charge Voltage: 1.5 V
Minimum Cell Discharge Voltage: 1.0V

NOTES:

1. Electric machine refers to the electric traction motor.
2. Calculated value based on selected battery voltage limits and at 50% SOC.

Test Results Analysis

Test results for the beginning-of-testing (BOT) 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 on the previous page. The test was performed on December 30, 2010 with a vehicle odometer reading of 3,995 miles. The measured average C/1-rate capacity was 5.79 Ah compared with the manufacturer's rated capacity of 5.75 Ah. The measured average energy capacity was 600 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.

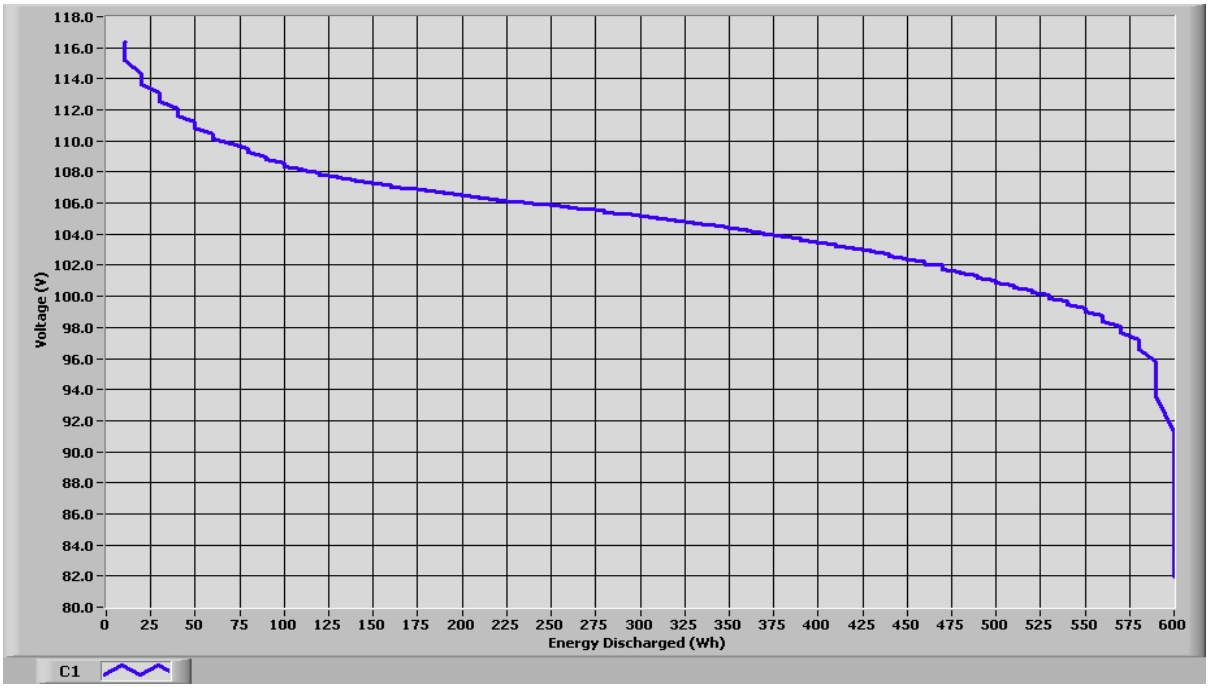

Figure 1: Voltage vs. Energy Discharged

[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 on the first page. The peak pulse discharge power at 10 seconds is 9.2 kW and at one second into the pulse is 13.8 kW, both at 50% state of charge (SOC). The peak pulse charge power at 10 seconds is 7.1 kW and at one second into the pulse is 11.4 kW, both at 50% SOC. The maximum and minimum cell voltages used for this analysis were 1.5 V and 1.0 V, respectively.

Figures 2 and 3 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 4 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 SOC. The graph shows the power values over the range of SOC as well as the DOE Minimum Power Assist HEV battery target performance goals of 25 kW discharge power and 20 kW regenerative power. The battery does not meet the DOE power performance goals for any battery state of charge.

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 HEV power performance goal of 25 kW. The Honda CR-Z battery's useable energy curve falls 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 6.5 kW at 300 Wh. The DOE power performance goal exceeded all energy output capabilities of this battery. The battery does not meet the DOE energy performance goal for any battery state of charge.

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

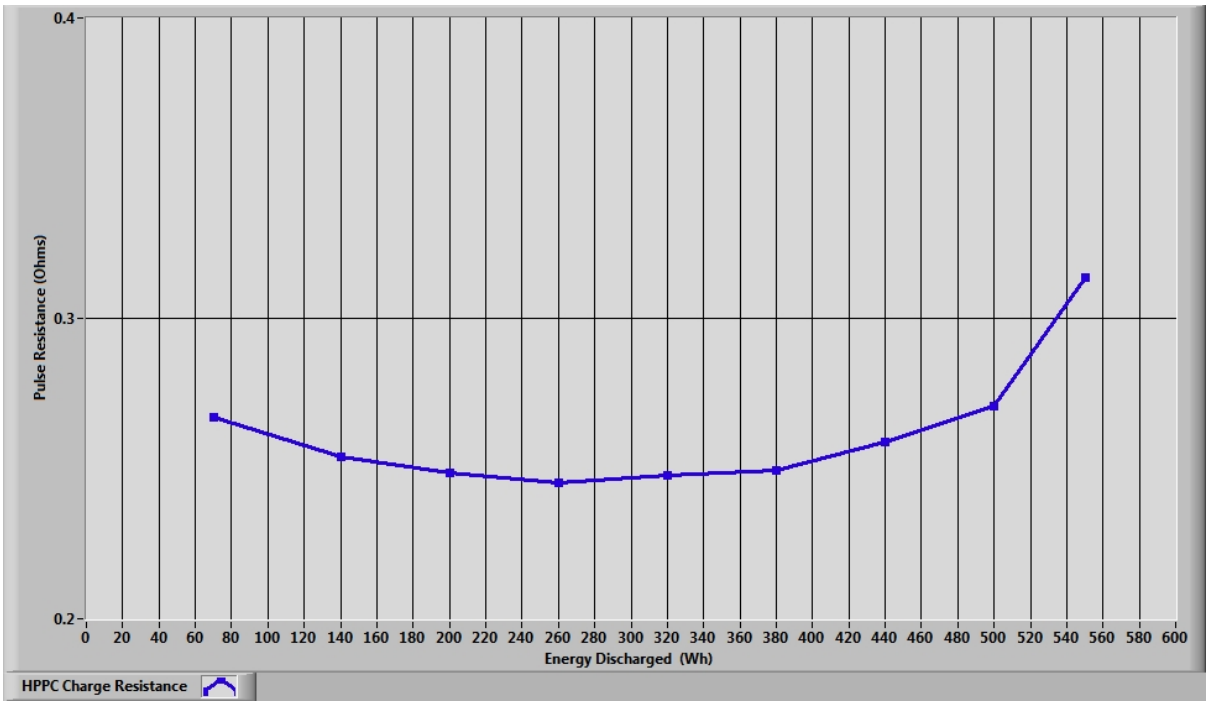

Figure 2: Charge Pulse Resistance vs. Energy Discharged

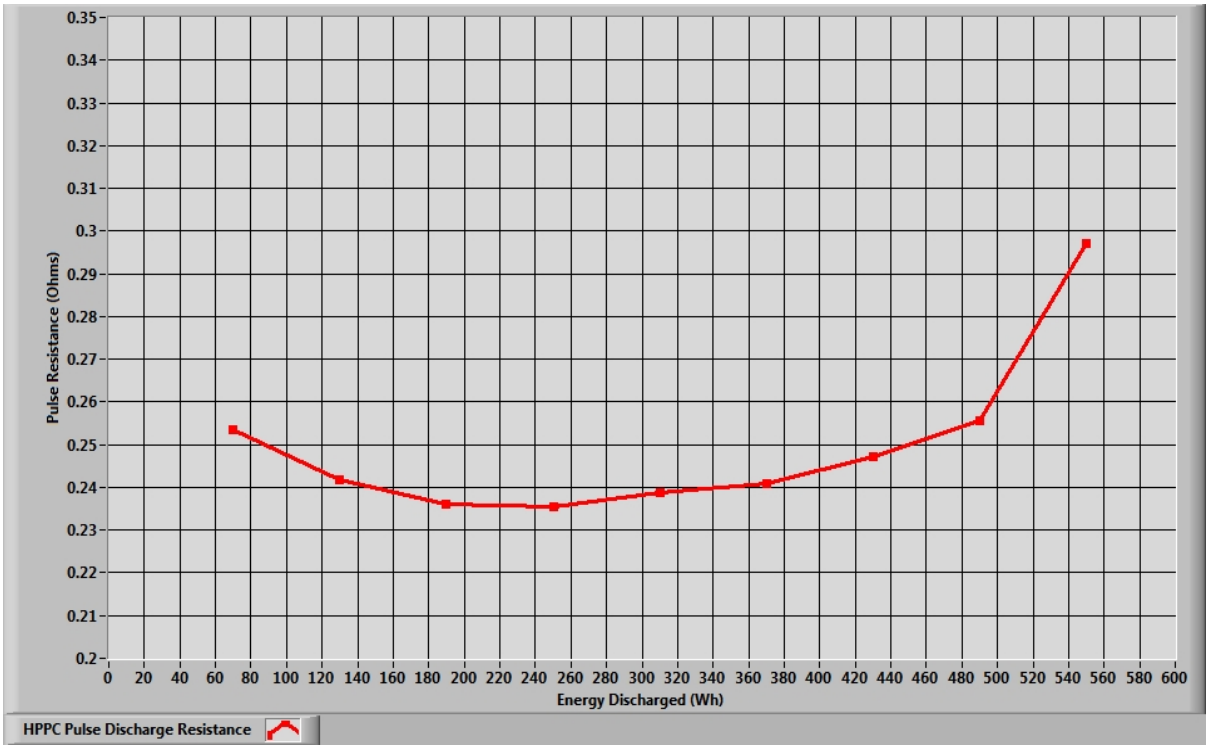

Figure 3: Discharge Pulse Resistance vs. Energy Discharged

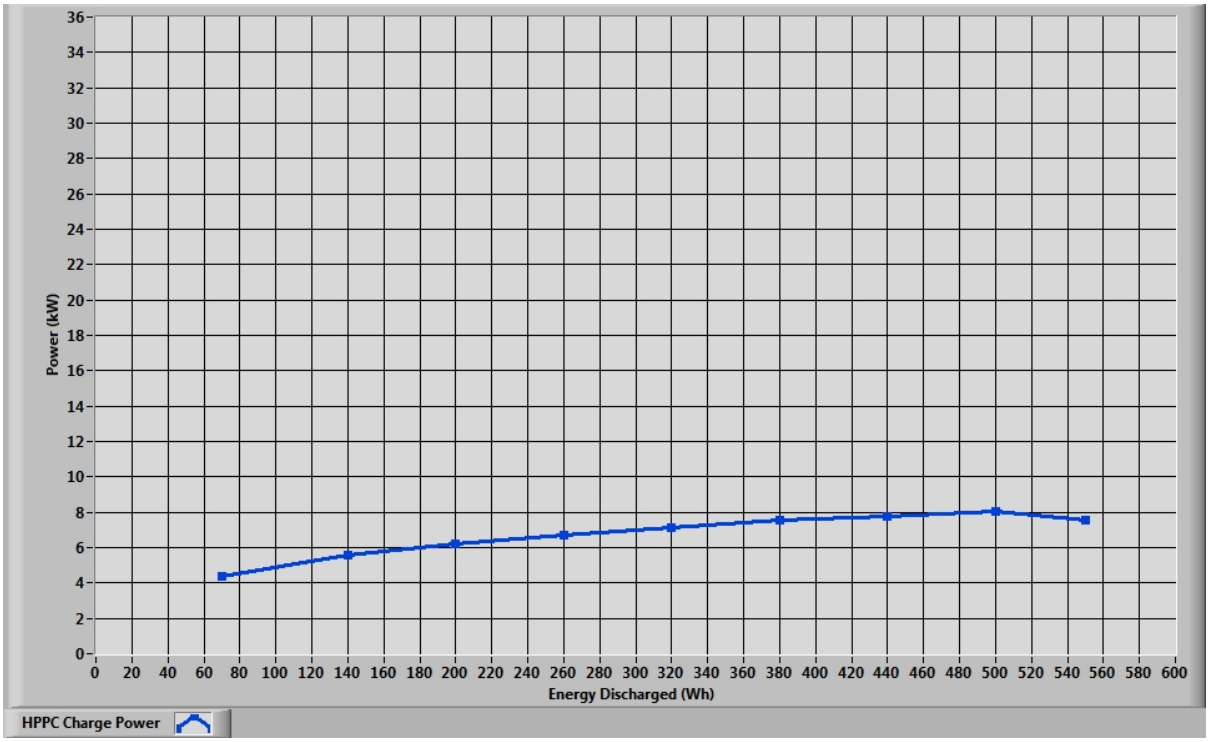

Figure 4: Charge Pulse Power vs. Energy Discharged

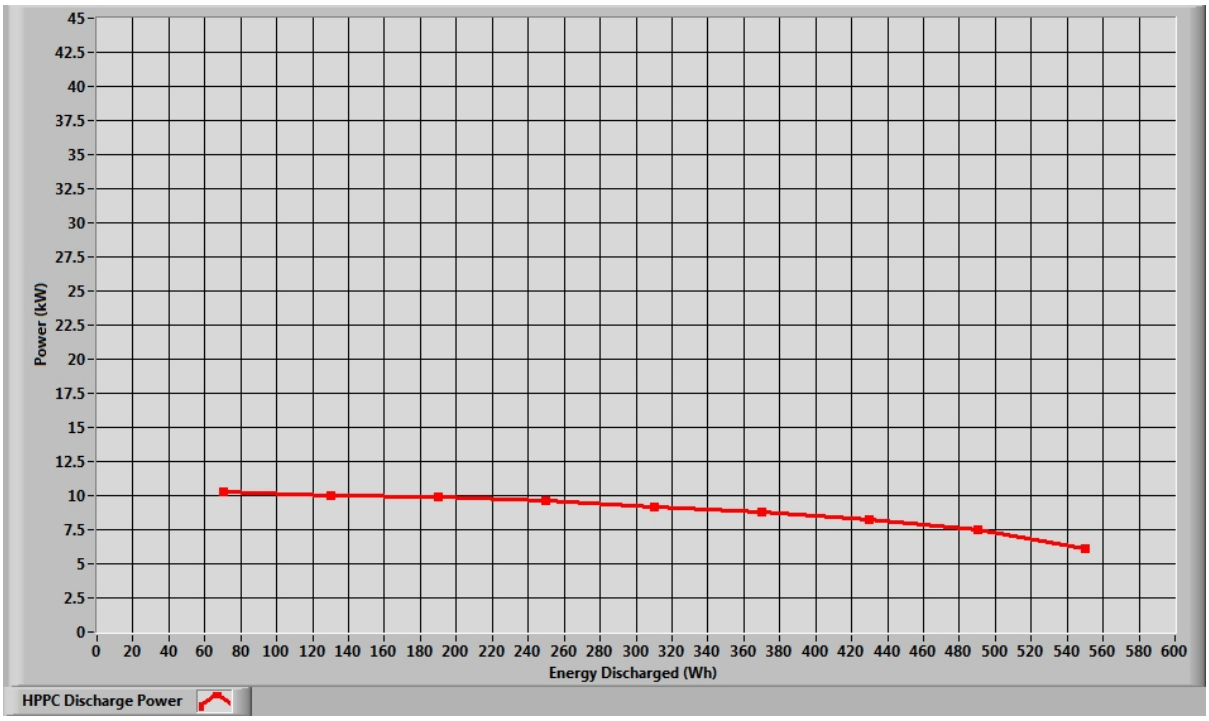

Figure 5: Discharge Pulse Power vs. Energy Discharged

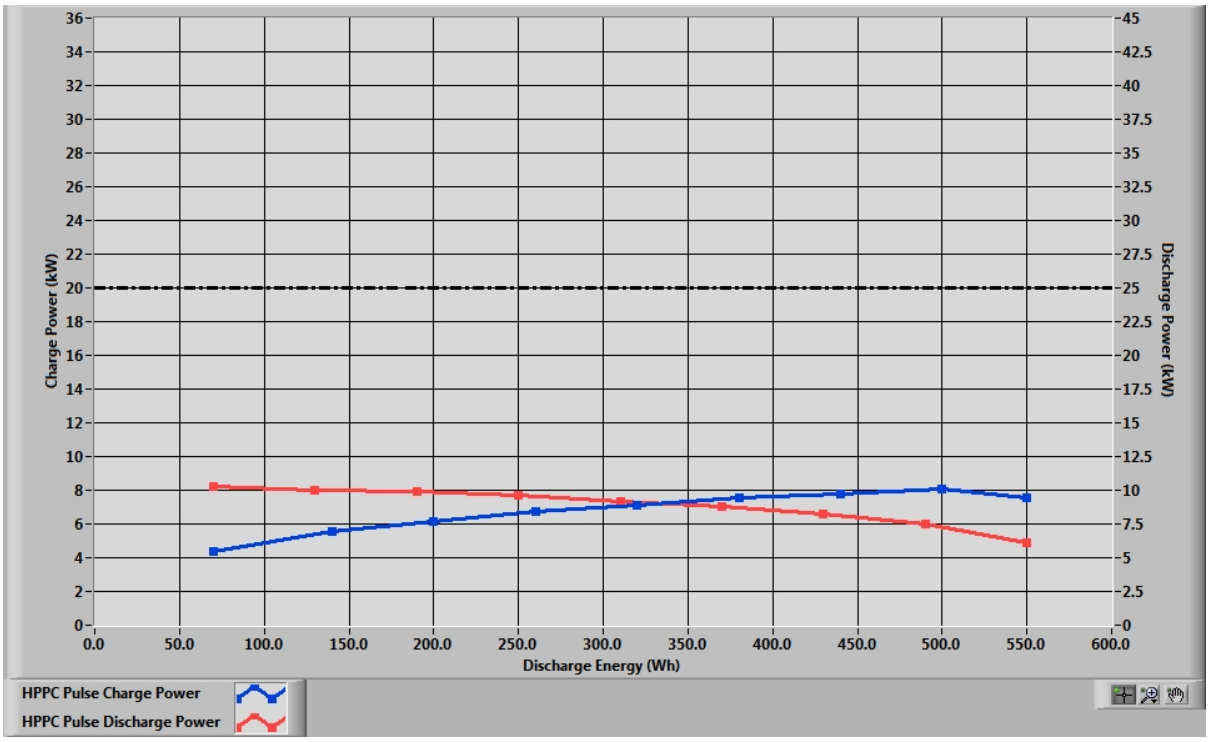

Figure 6: Peak Power Values with DOE Performance Goals

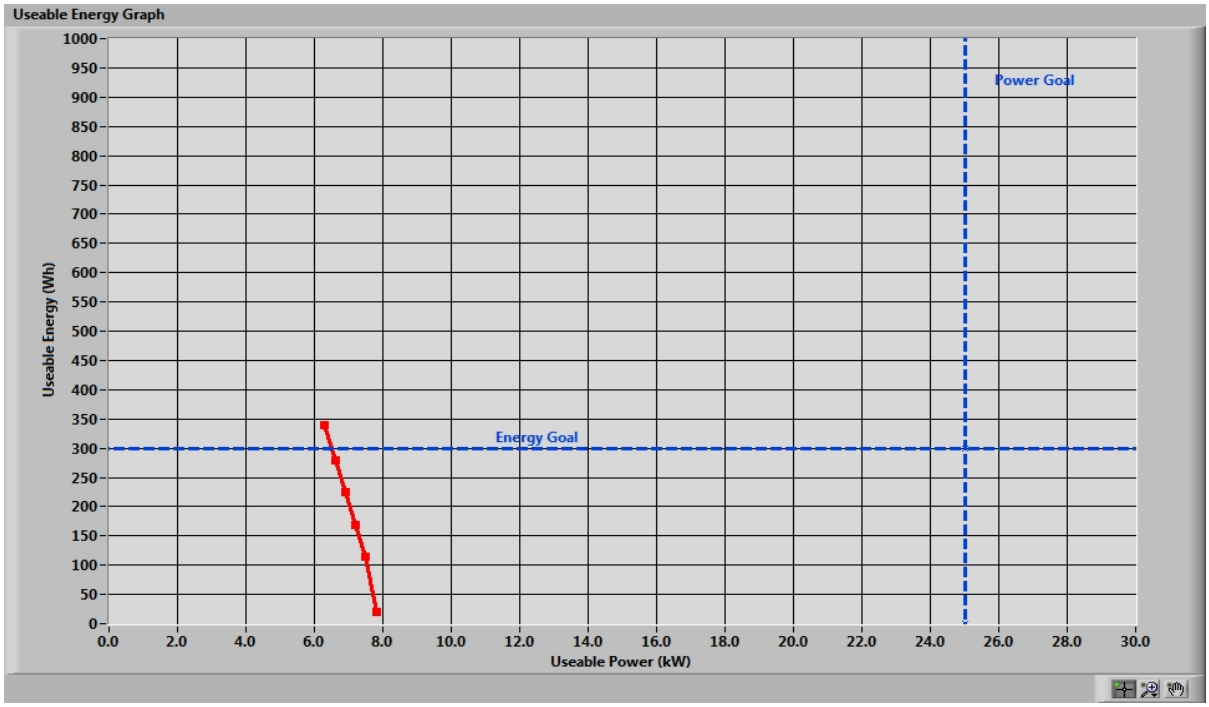

Figure 7: Useable Energy