

2011 Nissan Leaf – VIN 0356

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



VEHICLE DETAILS, BATTERY DESCRIPTION AND SPECIFICATIONS

Vehicle Details

Base Vehicle: 2011 Nissan Leaf
VIN: JN1AZ0CP5BT000356
Propulsion System: BEV
Electric Machine: 80 kW (peak), Permanent Magnet AC Synchronous, Air Cooled

Battery Description

Manufacturer: Automotive Energy Supply Corporation
Type: Lithium-ion – Laminate type
Cathode/Anode Material: LiMn₂O₄ with LiNiO₂/Graphite
Pack Location: Under Center of Vehicle

Battery Specifications

Number of Cells: 192
Cell Config.: 2 Parallel Strings of 96 in Series
Nominal Cell Voltage: 3.8 V
Nominal System Voltage: 364.8 V
Rated Pack Capacity: 66.2 Ah
Rated Pack Energy: 24 kWh
Maximum Cell Charge Voltage²: 4.2 V
Minimum Cell Discharge Voltage²: 2.5 V
Thermal Mgmt.: Passive, Vacuum-Sealed Unit
Pack Weight: 294 kg

BATTERY LABORATORY TEST RESULTS SUMMARY

Vehicle Mileage and Testing Date

Vehicle Odometer: 6,696 mi
Date of Test: May 5, 2012

Static Capacity Test

Measured Average Capacity: 57.6 Ah
Measured Average Energy Capacity: 21.0 kWh

EVPC Test

Pulse Discharge Power @ 80% DOD³: 201.0 kW
Pulse Charge Power @ 20% DOD³: 71.2 kW

Constant-Power Discharge Test

Capacity Discharged: 56.8 Ah
Energy Discharged: 20.0 kWh

NOTES:

1. Vehicle details, battery description and specifications were either supplied by the manufacturer or derived from a literature review.
2. Maximum cell charge voltage and minimum cell discharge voltage are based on similar battery chemistries from the same battery manufacturer.
3. Calculated power values based on battery charge and discharge voltage limits (see Note 3) at 80% and 20% DOD for discharge and charge power, respectively.

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 Electric Vehicle Power Characterization (EVPC) Test, based on recommended test procedures from the United States Advanced Battery Consortium (USABC) at the time of testing.

Static Capacity Test Results

Static capacity test results are summarized in the fact sheet on the previous page. The test was performed on May 5, 2012 with a vehicle odometer reading of 6,696 miles. The average measured C/3-rate capacity was 57.6 Ah compared with the manufacturer's rated capacity of 66.2 Ah. The average measured energy capacity was 21.0 kWh.

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/3 discharge rate.

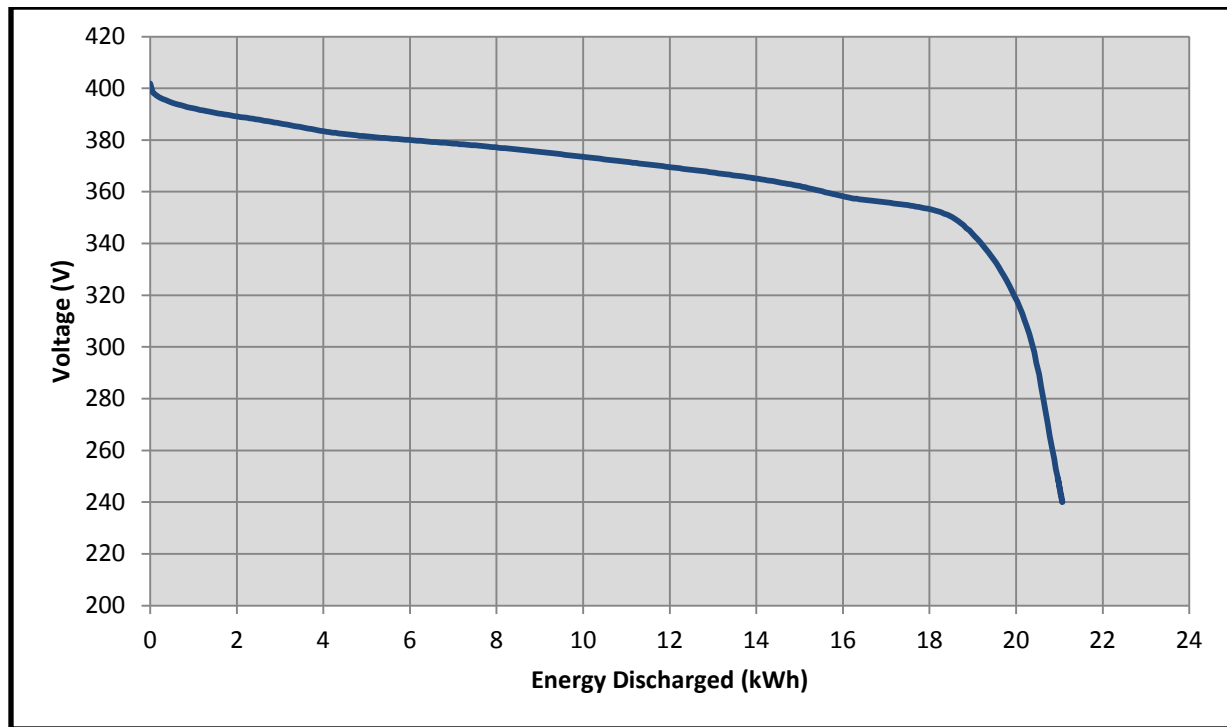


Figure 1: Voltage vs. Energy Discharged

EVPC Test Results

EVPC test results are summarized in the fact sheet on the first page. The peak pulse discharge power is 201.0 kW at 80% depth of discharge (DOD). The peak pulse charge power is 71.2 kW at 20% DOD. The maximum and minimum cell voltages used for this analysis were 4.20 V and 2.50 V, respectively.

Figures 2 and 3 illustrate the battery's charge and discharge pulse resistance graphs which show internal resistance at various DOD. 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 DOD. Each curve represents the pulse power at the end of the specified pulse interval at the cell voltage limits.

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.

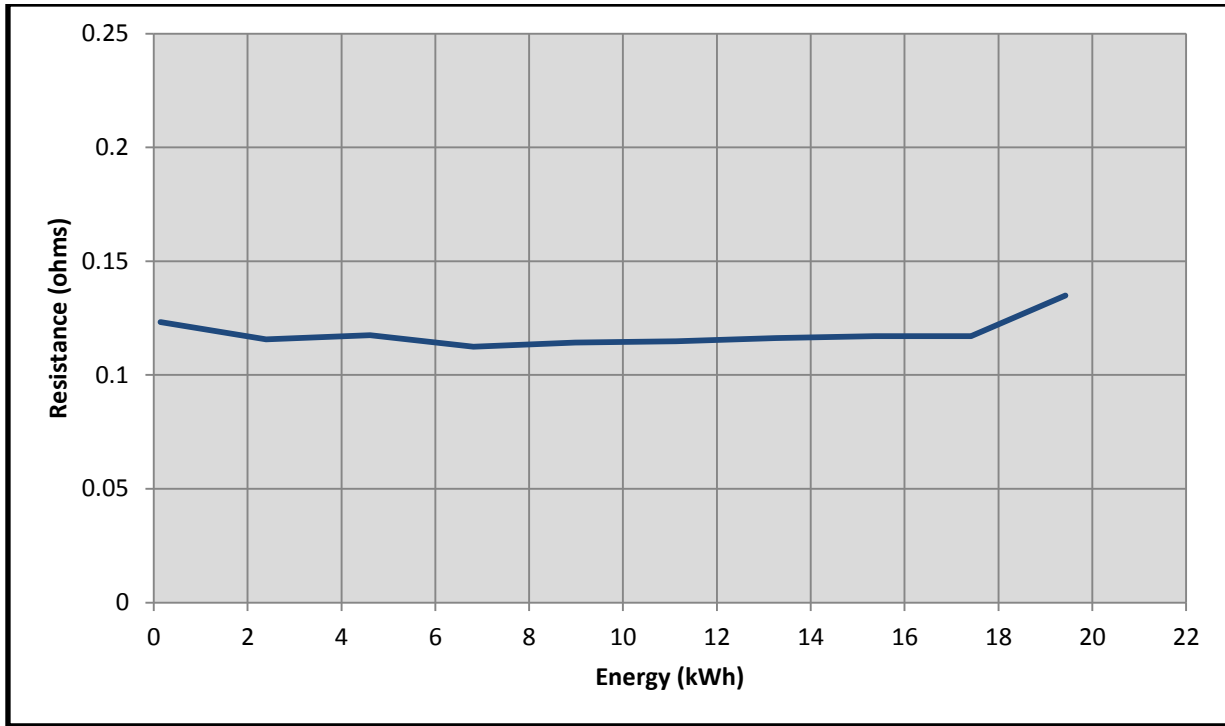


Figure 2: Charge Pulse Resistance vs. Energy Discharged

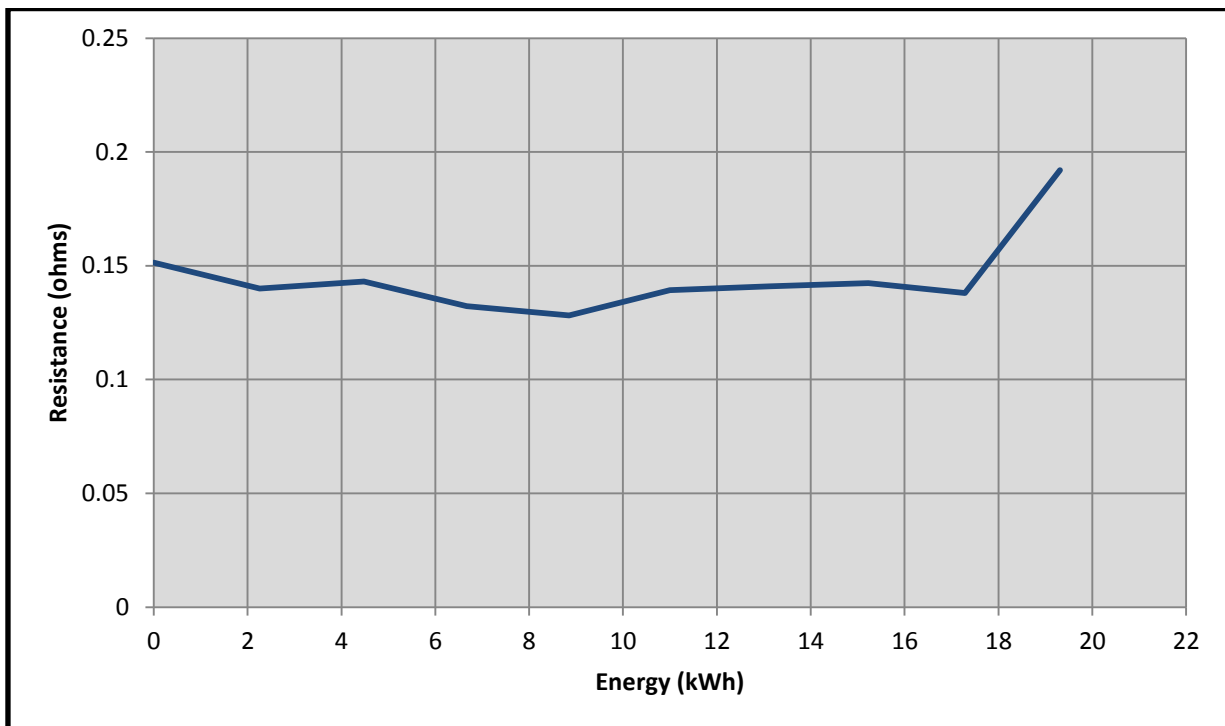


Figure 3: Discharge Pulse Resistance vs. Energy Discharged

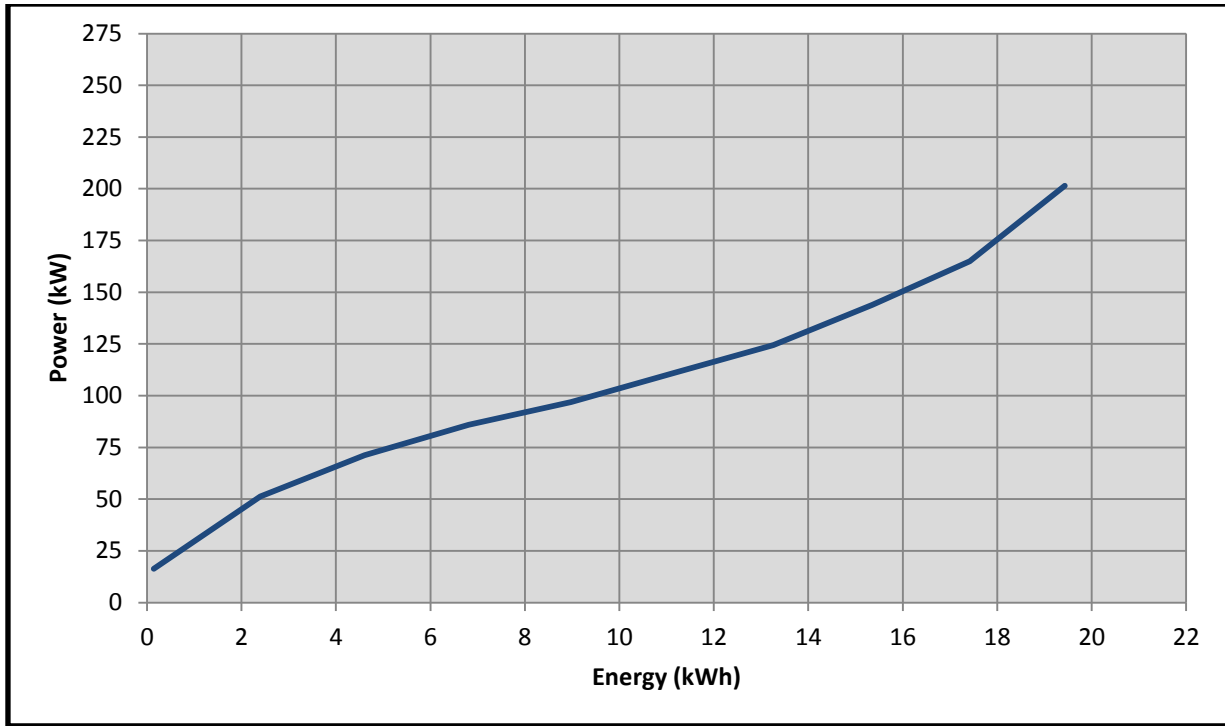


Figure 4: Charge Pulse Power vs. Energy Discharged

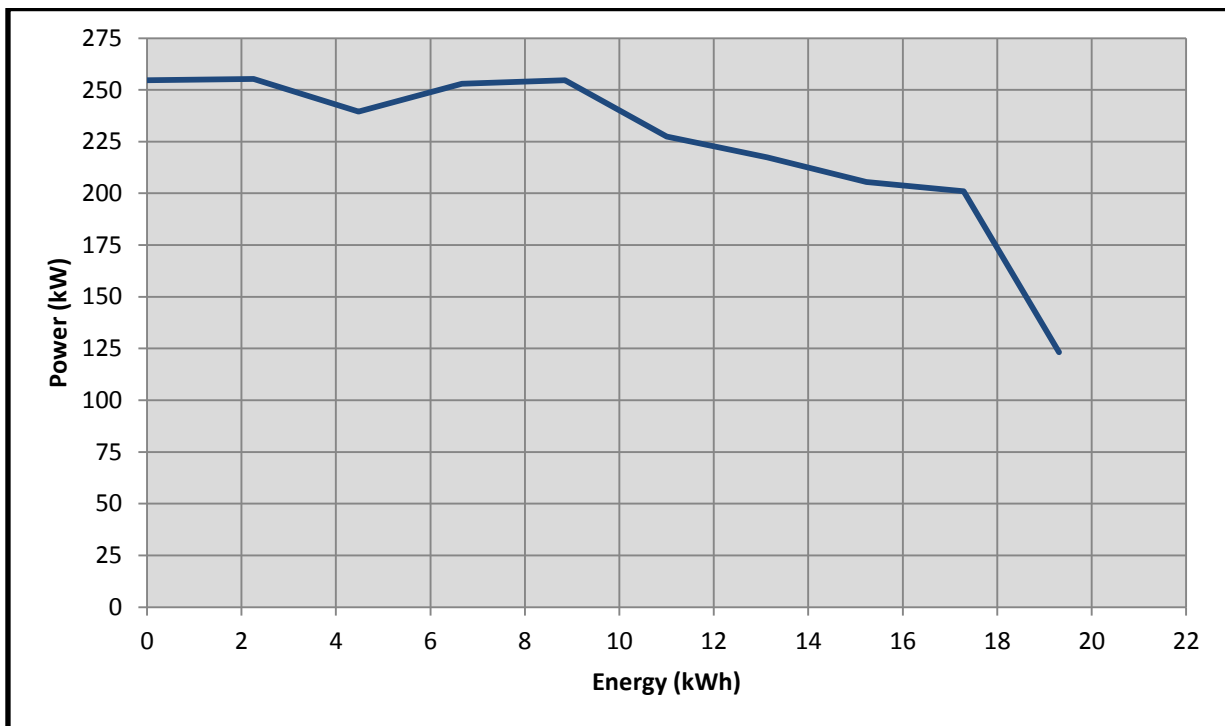


Figure 5: Discharge Pulse Power vs. Energy Discharged