DC Fast Charger Fact Sheet: ABB Terra 53 CJ charging a 2015 Nissan Leaf

Description

Testing of the ABB DC fast charger was conducted to quantify its steady-state operational performance characteristics during a single charge of a 2015 Nissan Leaf using the CHAdeMO connector.

DC Fast Charger Specifications

Input Power
480 VAC 3ϕ +/- 10%
50 or 60 Hz
75A RMS maximum

Output Power
CHAdeMO connector
- 50 kW maximum
- 120 A DC maximum
- 10' cable length

J1772 - CCS connector
- 50 kW maximum
- 125 A DC maximum
- 10' cable length

Interfaces
Touch screen Interface
GSM / CDMA modem
10/100Base-T Ethernet

Vehicle Specifications

2015 Nissan Leaf
equipped with CHAdeMO DC fast charge inlet
For more information go to
https://avt.inl.gov/vehicle-make/nissan

Testing Information

Electrical Measurement Points

AC Input:	DC Fast Charger 3-phase inputs measured at input terminal block
DC Output:	DC Fast Charger DC output measured at the CHAdeMO vehicle inlet
Power Meter:	Hioki 3390

Source Power Characteristics During Charge

Nominal frequency	60 Hz
Nominal voltage magnitude	480 VAC 3ϕ
Max. deviation from nominal frequency	0.09%
Max. deviation from nominal voltage magnitude	1.37%
Max. voltage total harmonic distortion (THD)	2.28%
Max. voltage phase unbalance	0.30%

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Test Results: Standby Power

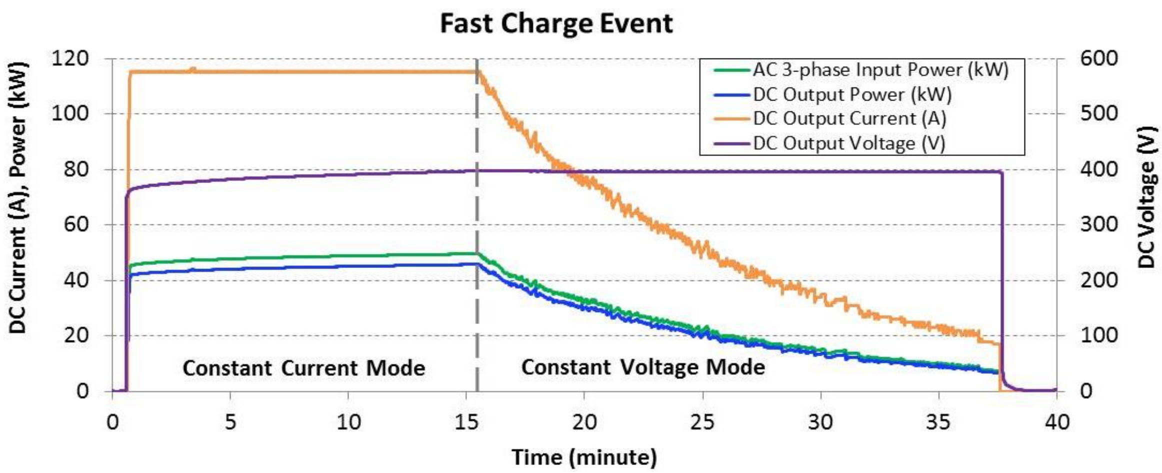
Standby Power Operation

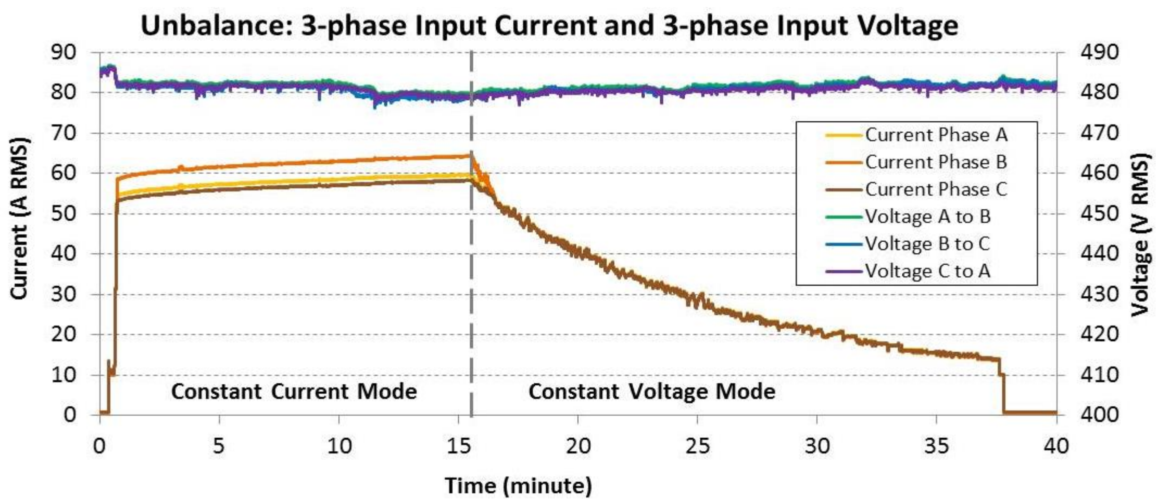
AC power prior to charging	99 watts
AC power at charge completion	150 watts (cooling fan operating)
AC power 5 minutes after charge completion	110 watts

Test Results: Vehicle DC Fast Charging

	AC Input	DC Output
Total energy transferred during charge event	20.1 kWh	18.5 kWh
Maximum measured power	49.7 kW	45.9 kW
Maximum measured current	64.4 A RMS	116.5 A DC

Constant Current Mode		Constant Voltage Mode	
DC current	115.4 A	DC voltage	397 V DC
Average AC to DC Efficiency	92.3%	Range of Efficiency	79.8% to 92.8%
Avg. Power Factor	-0.984	Range of Power Factor	-0.50 to -0.990
Avg. Current THD	11.0%	Range of Current THD	9.3% to 30.7%
Avg. Phase Current Unbalance	6.1%	Range of Current Unbalance	0.02% to 2.1%





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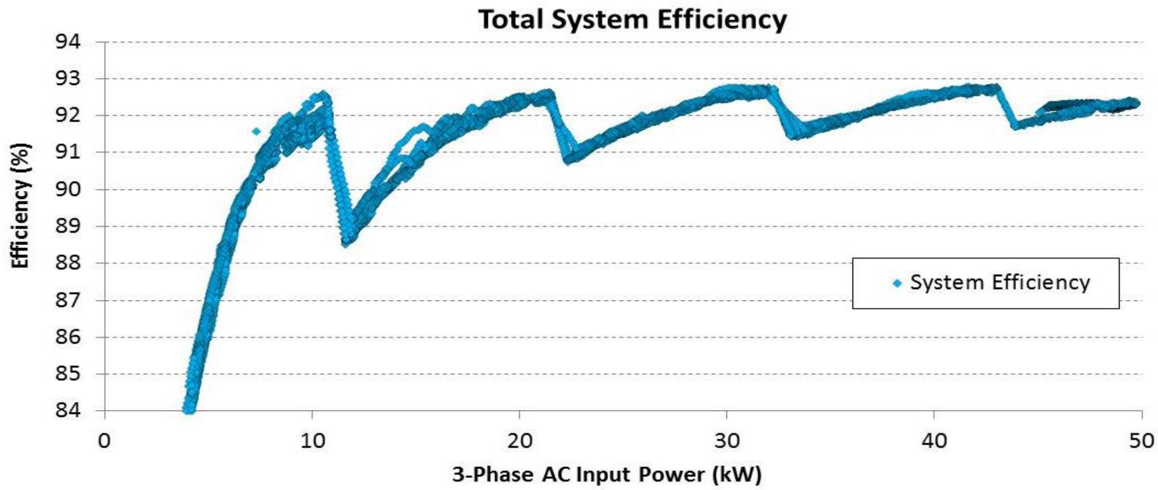

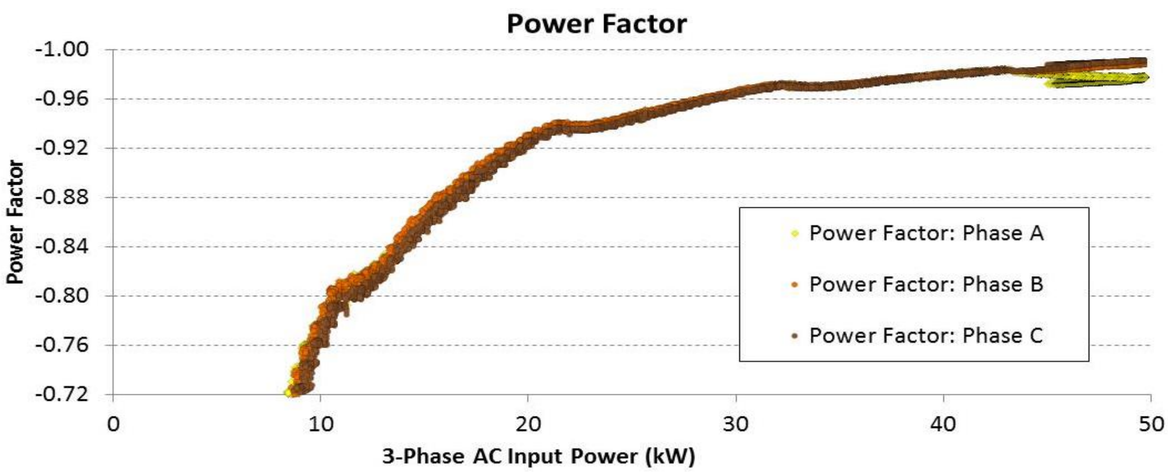

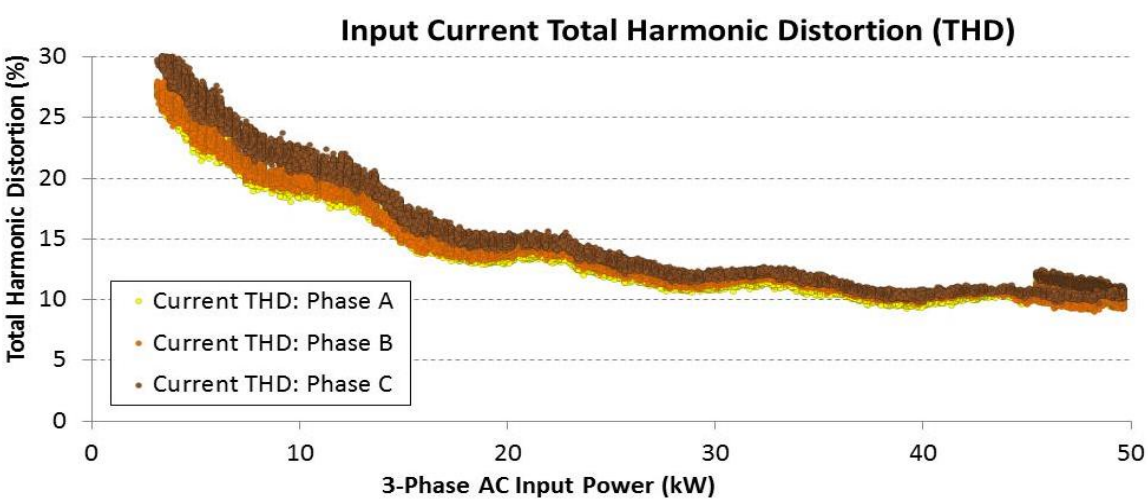

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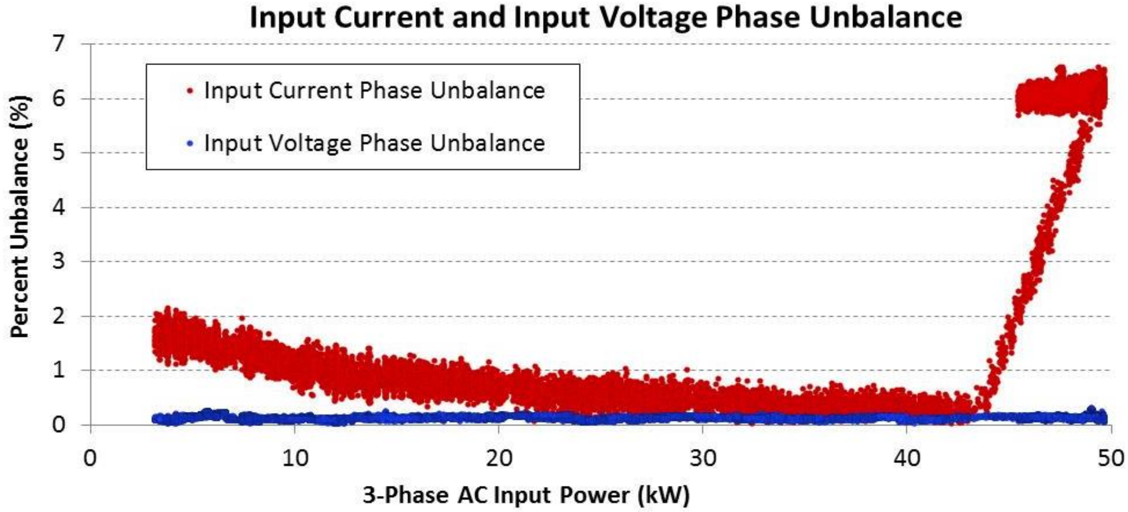

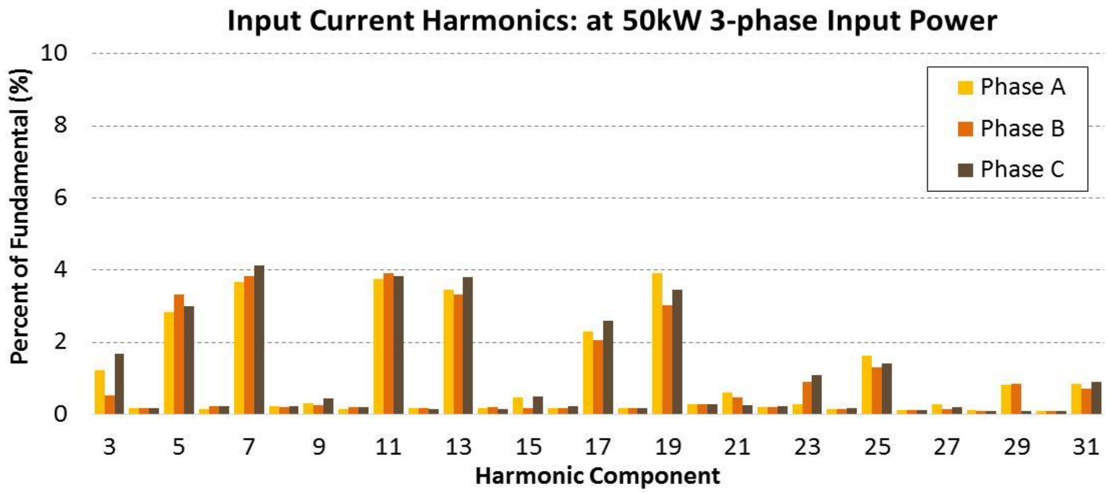

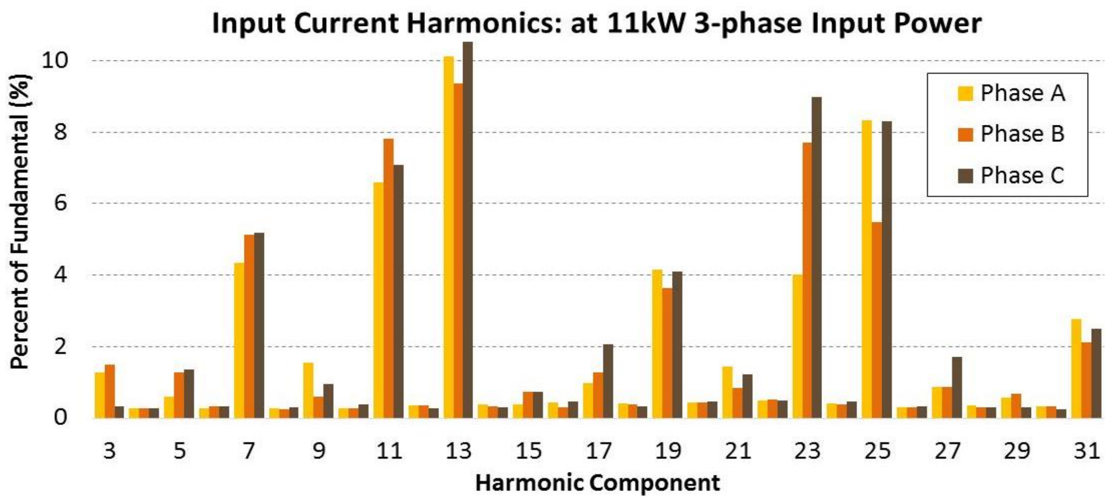

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Definitions:

Efficiency - Efficiency is the useful power output divided by the total power input. In order to minimize the total amount of energy needed to complete a given task it is desirable for the efficiency to be as close to 100% as possible.

Power Factor - In the presence of a stiff voltage source, power factor is a measure of how much of the current is being utilized to perform work. Since the electrical infrastructure is limited in the amount of current it can deliver, power factor is a way to determine how efficiently the electrical infrastructure is being utilized. Ideally the power factor should be as close to 1 as possible.

Total Harmonic Distortion (THD) - In power systems, the voltage and current waveforms are both 60 Hz sinusoidal waveforms. The total harmonic distortion (THD) is a measure of the amount of distortion that is present in the sinusoidal wave form. Excessive amounts of THD in current wave forms can cause many problems in a power system such as overheating transformers, motors, and capacitors among other things. Ideally the THD should be as close to zero as possible.

Phase Unbalance - In a balanced three phase system the individual phases of a three phase voltage or current source have the same magnitude and are 120 degrees out of phase with each other. When a system is not balanced it is said to be unbalanced. The voltage and current unbalance in these test results were calculated using the following equations (from the Hioki 3390 Power Analyzer Instruction Manual).

Current Unbalance

$$Iunb_{123} = \sqrt{\frac{1-\sqrt{3-6\beta}}{1+\sqrt{3-6\beta}}} \times 100$$

$$\beta = \frac{I_{12}^4 + I_{23}^4 + I_{31}^4}{(I_{12}^2 + I_{23}^2 + I_{31}^2)^2}$$

I_{12}, I_{23}, and I_{31} are fundamental rms currents (between lines)

Voltage Unbalance

$$Uunb_{123} = \sqrt{\frac{1-\sqrt{3-6\beta}}{1+\sqrt{3-6\beta}}} \times 100$$

$$\beta = \frac{U_{12}^4 + U_{23}^4 + U_{31}^4}{(U_{12}^2 + U_{23}^2 + U_{31}^2)^2}$$

U_{12}, U_{23}, and U_{31} are fundamental rms voltages (between lines)