What to Expect in New Connectors

New Connectors are Coming

J1772-2010 (AC)

CHADEMO (sometimes spelled CHAdeMO) Protocol with the

JARI Connector
Changes in Charging Philosophy

- Until now, chargers carried in car
- Use AC current to charge
- Charger in car would determine amps
- Driver responsible for setting limits
- Car is likely limiting factor

- New Direct DC charging will parallel the present charging system
- DC current used
- Voltage and amperage limits are supplied to charger, which responds.
- Vehicle must tell charger the max current it's batteries can handle.
CHADEMO is protocol from TEPCO

- TEPCO = Tokyo Electric Power Company
- JARI = Japan Automotive Research Institute (they defined the adapter plug)
- CHADEMO = A Charging Protocol for rapid DC charging
- Charger Specifications Level 3 (Direct DC)
  - Input 3 phase 200V in Japan
  - Max DC Output 50kW
  - Max DC Voltage 600V
  - Max DC Current 550A
Chicago Ramifications

- CHADEMO established by Toyota, Mitsubishi, Subaru, Nissan.
- Will likely become De-Facto standard for Level 3 charging.
- Nissan Leafs, Mitsubishi i-MiEV, others will have JARI connectors and use CHADEMO protocols.
- CEVC initial build out including Level 3 had choice of connectors, but JARI was default.
• 600V * 550A = 330 KW (max possible Level 3)
• 500V * 125A = 62.5 KW (max possible in CHADEMO protocol)
• 240V * 70 A = 16.8 KW (max possible in J1772 protocol)
• 240V * 32 A = 7.7 KW (max possible for many J1772 stations)
• 120V * 16 A = 1.9 KW (maximum at home)
Fast Charging limitations

- This **62.5 KW** (CHADEMO) is 33 times what power you would be able to use at home or opportunity charging.

- If your home charger can charge your vehicle in 8 hours, the CHADEMO protocol can charge it in 15 minutes.

- (CHADEMO doesn't work for current battery chemistries to much over 90 % SOC)

- YMMV, may also be locale dependent
Fast Charging Definitions

- SAE, international agencies have not defined Fast Charging.
- California Air Resources Board (CARB) states in their Zero Emissions Vehicle (ZEV) mandate program, lists a certification requirement for fast charging as a ten-minute charge that enables the vehicle to travel 100 miles.
In US, we use SAE Standards

SAE J1772™-2010 defines a standard.

- AC Level 1 117V 16A Max
- AC Level 2 240V 32A or 70A
- DC Level 3 is not SAE Defined, but
- DC Level 3 will likely be CHADEMO protocol
Energy Density by Chemistry

Specific Energy versus Charge Rates for Different Battery Chemistries

![Graph showing energy density vs. charge rate for different battery chemistries.]

- LiCo, LiMnO₂, 4.1V/cell
- LiFePO₄, 3.6V/cell
- NiMH, 1.4V/cell
- Pb Acid, 2.1V/cell
- LiTiO₄, 2.8V/cell
Vehicle Range vs. Pack size

- Sedan EV (~350 Wh/mi)
- Truck EV (~500 Wh/mi)
- Sport Utility Vehicle (~350 Wh/mi)
- Sub-Compact EV (~300 Wh/mi)
- Series Hybrid PHEV (~300 Wh/mi)
Level 2 Charging – How It Works

AC Level 2 Charging

- Charge plug not powered until plugged into and commanded by vehicle
- Supply equipment signals presence of AC input power
- Vehicle detects plug via proximity circuit (prevents drive away while connected)
Level 2 charging

Control Pilot functions begin

- Supply equipment detects PEV
- Supply equipment indicates to PEV readiness to supply energy
- PEV ventilation requirements are determined
- Supply equipment current capacity provided to PEV
- PEV commands energy flow
- PEV and supply equipment continuously monitor continuity of safety ground
- Charge continues as determined by PEV
DC Quick Charge
Connector = JARI

- CHADEMO protocol
JARI Pictures

- External diameter: 9 mm
- Signal terminal external diameter: 1.6 mm
Pins on the JARI connector

- Two Power pins
- Seven control/communication pins
- Two communication pins usually CANbus
- Two pins for EV relay control
- One reference Ground for vehicle isolation monitor
- One proximity or mating detection pin
- One “ready to charge” pin.
## Size Comparison JARI vs J1772

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### JARI Proposal

![Image of JARI connector dimensions](image)
Progression

240V Home Charge Unit