Fuji Electric Corp. of America

DC Quick Charging for Electric Vehicles

May 1, 2013
## Introduction of Fuji Electric

**Fuji Electric Co., Ltd.**

- **President**: Michihiro Kitazawa
- **Sales (Consolidated)**: $8.9 Billion (March, 2012)
- **Employee (Consolidated)**: 26,128 (March, 2012)

Handling Productions: Energy, Industrial Systems, Social Systems, Power Electronics, Power Semiconductor, Photoconductive drums, Solar cells, Magnetic disk, etc.

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**Fuji Electric FA Component & Systems Co, Ltd.**
Fuji Electric – Global Sales Breakdown

**Components**

**Power Electronics**
- Inverters
- Motors
- Uninterruptible power supply systems (UPSs)
- Electric equipment for railcars
- Chargers for EVs, powertrains for EVs
- Power conditioners

**Electronic Devices**
- Power semiconductors
- Photoconductive drums
- Solar cells
- Magnetic disks

**ED&C Components**
- Magnetic contactors
- Molded-case circuit breakers
- Earth-leakage circuit breakers
- Push buttons and indicator lights

**Vending Machines**
- Food/beverage vending machines
- Currency handling systems

**Plant**

**Energy**
- Thermal/geothermal power generation facilities
- Hydroelectric power generation facilities
- Nuclear power-related equipment
- Radiation control systems

**Industrial Systems**
- Industrial drive systems
- Measurement systems
- Industrial power supply systems
- Air conditioning equipment for data centers

**Social Systems**
- Power transmission and distribution systems
- Power receiving and distribution substation equipment
- Watt-hour meters
- Energy monitoring systems
- New energy systems

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**Legend**

- Energy
- Industrial Systems
- Social Systems
- Power Electronics
- Electronic Devices
- ED&C Components
- Vending Machines

Innovating Energy Technology
Fuji Electric Corp. of America
# Specifications

<table>
<thead>
<tr>
<th>Item</th>
<th>Detail Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>25kW</td>
</tr>
<tr>
<td>Model</td>
<td>FRCA25C</td>
</tr>
<tr>
<td>Standards</td>
<td>CHAdeMO Rev0.9, UL2202, UL2231-1 &amp; 2, CSA C22.2, FCC</td>
</tr>
<tr>
<td>Network</td>
<td>ChargePoint™</td>
</tr>
<tr>
<td>Output</td>
<td>Voltage Range: 50 to 500 VDC</td>
</tr>
<tr>
<td></td>
<td>Current Range: Max 62A</td>
</tr>
<tr>
<td></td>
<td>Maximum Power: 25kW</td>
</tr>
<tr>
<td></td>
<td>Efficiency: More than 90%</td>
</tr>
<tr>
<td>Input</td>
<td>Rated Voltage: 208Y/120 Volts Three Phase 4 Wire 60Hz</td>
</tr>
<tr>
<td></td>
<td>Rated Current: 80A</td>
</tr>
<tr>
<td></td>
<td>Required Power Capacity: 28kVA</td>
</tr>
<tr>
<td>Weight: lbs (kg)</td>
<td>820 lbs (370 kg)</td>
</tr>
<tr>
<td>Dimension: inch (mm)</td>
<td>W27&quot; x D39&quot; x H74&quot; (W676 x D978 x H1875 mm)</td>
</tr>
<tr>
<td>Environment</td>
<td>Installation: Outdoor: NEMA3R and IP44</td>
</tr>
<tr>
<td></td>
<td>Operating Temperature: -10°C to 40°C</td>
</tr>
<tr>
<td></td>
<td>Operating Humidity: 30 to 90% RH (non-condensing)</td>
</tr>
<tr>
<td></td>
<td>Altitude: Less than 1000m</td>
</tr>
<tr>
<td></td>
<td>Storage Temperature: -20°C to 50°C</td>
</tr>
<tr>
<td></td>
<td>Storage Humidity: 30% to 90%, non-condensing</td>
</tr>
</tbody>
</table>
What is Quick charging?

**Level 2 AC Charging**
- 1Φ 208V
- 1Φ 240V
- 3-6 kW
- 3-6 kW
- 16-24 kWh

- 208V AC is sent through the charger to the Vehicle
- The On-Board Charger converts the AC to DC
- DC Charging is limited to the Power of the On-Board Charger

**DC Quick Charging**
- 3Φ 208V
- 300-500V DC + CAN
- 25-50 kW
- 16-24 kWh

- 3 phase 208V AC is Converted to DC.
- DC is sent directly to the EV Battery.
- BMS commands charging current via CAN
Example A – Popular EV Auto Manufacturer

Charging from 30% SOC to 77% SOC at 25kW and 50kW

Both Chargers at or below 25kW

Less than 7 minutes Additional Charge Time

Power (kW)

Time (minutes)

25kW Charger

50kW Charger

Property of Fuji Electric Corp. of America
Study Conducted by Larry Butkovich, GM of EV Systems Dept. for FEA
### Deciding Factor: SPEED

**Fast**
DC Charging will dominate for public use. Speed is the most important factor for fast/public applications (i.e. public parking, fleets, etc).

### Deciding Factor: COST

**Private**
AC Charging will dominate for private use (particularly for at-home charging). Cost is the most important factor for slow/private applications (i.e. residential use).

### DC NOT LIKELY

- DC Quick Chargers will be unlikely for residential use due to high cost and power restrictions; May be cost prohibitive for small offices
- DC NOT LIKELY

### AC NOT LIKELY

- AC Charging units will be inconvenient for Public use due to the long charging times; For Public applications, SPEED is the primary factor

### Applications for AC Charging
- Primary purpose is for residential homes, most likely to be used by the majority of consumers
- Charging will typically be done overnight due to long charging time
- Level I and II chargers may be found in non-residential locations (ex. Workplace Charging) for EV owners to use

### Applications for DC Quick Charging
- Most convenient charging option, offering EV owners an 80% charge in under 60 minutes
- Ideal for public parking, retail locations, fleets, rental cars, etc.
- Ability to charge many cars each day due to short charging time; Best option for any public charging infrastructure
How is Quick Charging Installed?

**Level 1 and Level 2 Charging**
- Single Phase Power Supply
- Limited Ability to Control Usage
- Potential for Smart Grid / Demand Response to manage charge times in evening
- Distributed infrastructure. Many potential points to upgrade
- Difficult to plan infrastructure upgrades to meet increased demand (rely on permitting house surveys to find high EV adoption locations)

**DC Quick Charging**
- Three Phase Power Supply
- PFC on Charger. Balanced loading
- Able to plan infrastructure upgrades with planned installations in high traffic areas
- Network statistics can track usage trends and allow for demand response and tiered billing to create incentive to increase usage during off peak hours
- Drivers are more likely to be “topping off” and will be more flexible around charging times
- Power for 25kW Charger is easier to accommodate with out infrastructure upgrades than 50kW Charger
ChargePoint Network

- Nationwide Network of EV Chargers
- Provides Search Capability for Chargers in an Area
- Provides Access Control
- Provides Payment Option
- Provides Usage Data (for owner and driver)
- Uses RFID Card for Access and Payment
• First DC Quick Charger on ChargePoint Network

• Full features of ChargePoint Network integrated into the operation of the charger

• Utilizing existing Vending Machine network gateway interface to integrate ChargePoint Network.

• Gateway is network agnostic and capable of future improvements and network integration through simple programming.
Evoasis San Juan Capistrano Residence Inn Station

121 Miles
ICE = 2hr
EV @ L2 = 2hr + 4hr (charge)
EV @ L2 = 6hr

55 Miles
EV @ L3 = 1hr
Charge
EV @ L3 = 0.5hr

67 Miles
EV @ L3 = 1hr
EV @ L3 = 2.5hr
Evoasis San Juan Capistrano Usage to Date

- Installed November 2012
- First Public DC Quick Charger on ChargePoint Network
- Free Until 2013
- Around $15 per charge for 2013
- Typical Charge Time 20-30 minutes
- Average Charger Output 17kW
- ½ way between San Diego and LA (pathway charging)
Thank You!
Questions?