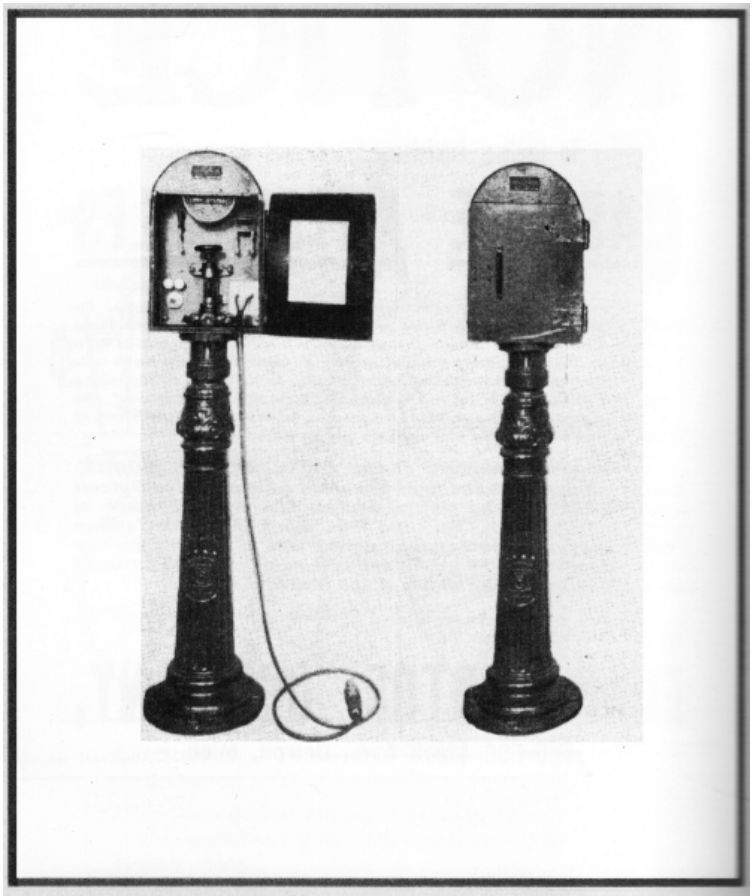
Charging Stations for Electric Vehicles

1914 General Electric Electrant Charging Station



The Electrant, General Electric's public vehicle recharger, invented in 1899 (1914 model shown). *(IEEE Power and Energy magazine's reprint of* Electrical World *magazine 1915)*

Introduction

Charging stations are locations where electric vehicles can be plugged in to have electric energy deposited in their batteries. They are just sources of electric energy, not chargers. Chargers in the vehicles convert the electricity from the station characteristics to the characteristics required by the vehicle's batteries. For example, a level-1/120-volts alternating-current (AC) charging station might deliver electric energy to a vehicle which has a 300-volts direct-current (DC) battery; so the charger in the vehicle converts 120 volts AC to 300 volts DC.

There are three levels of charging:

1. Level-1: ~120 volts & up to 16 amps (up to 1.92 kW AC to DC) (10 to 20 hours to charge a 20-kWh battery)
2. Level-2: ~240 volts & 12-80 amps (2.5-19.2 kW AC to DC) (1 to 8 hours to charge a 20-kWh battery)
3. Level-3: ~480 volts & up to ~125 amps (up to 60 kW DC to DC) (~30 minutes to charge a 20-kWh battery)

Most charging stations are wired, but wireless charging stations (http://www.green.autoblog.com/2011/12/04/future-nissan-leaf-could-be-cheaper-may-have-more-range-wil/) are becoming available.

Most charging stations are powered from the electrical grid, but solar charging stations (http://www.gereports.com/the-solar-powered-electric-vehicle-charging-carport-of-the-future/) are becoming available.

This article lists some of the available charging stations, both for inside use and outside use.

An excellent list of charging stations available for charging is http://www.plugshare.com/ .

Courtesy notice for non-electric vehicles parked in a charging-station space: http://www.evchargernews.com/parkingnotice.htm

Charging-stations types

http://en.wikipedia.org/wiki/Level_1,_2,_and_3_charging#Level_1.2C_2.2C_and_3_charging

Level	Original definition[143]	Coulomb Technologies' definition[144]	Connectors
Level 1	AC energy to the vehicle's on-board charger; from the most common U.S. grounded household receptacle, commonly referred to as a 120 volt outlet.	120 V AC; 16 A (= 1.92 kW)	SAE J1772 (16.8 kW), ordinary household 120 volt outlet
Level 2	AC energy to the vehicle's on-board charger;208 - 240 volt, single phase. The maximum current specified is 32 amps (continuous) with a branch circuit breaker rated at 40 amps. Maximum continuous input power is specified as 7.68 kW (= 240V x 32A*).	208-240 V AC; 12 A - 80 A (= 2.5 - 19.2 kW)	SAE J1772 (16.8 kW), IEC 62196 (44 kW), Magne Charge (Obsolete), Avcon, IEC 60309 16 A (3.8 kW) IEC 62198-2 Type2 same as VDE-AR-E 2623-2-2, also known as the Mennekes connector (43.5 kW)IEC 62198-2 Type3 also known as Scame
Level 3	DC energy from an off-board charger; there is no minimum energy requirement but the maximum current specified is 400 amps and 240 kW continuous power supplied.	very high voltages (300-600 V DC); very high currents (hundreds of Amperes)	Magne Charge (Obsolete) CHAdeMO (62.5 kW),

.* or potentially 208V x 37A, out of the strict specification but within circuit breaker and connector/cable power limits. Alternatively, this voltage would impose a lower power rating of 6.7 kW at 32A.

Water Hose Comparison

http://www.pluginrecharge.com/2009/08/charging-station-levels.html

- Level 1 - a 5/8 inch standard garden hose
- Level 2 - a 3/4 inch garden hose - not much bigger, but lots more flow.
- Level 3 - a 3 inch Fire Hose with a big red truck behind it!

Charging Stations

Level-1/120-volts Charging Stations

Level-1 charging stations are available everywhere by means of ordinary household plugs.

Level-2/240-volts Charging Stations

General Electric WattStation

http://www.geindustrial.com/cwc/Dispatcher?REQUEST=PRODUCTS&pnlid=8&famid=9404&catid=6061&id=WS-WallMount

Feature and benefits:

- **Modern design:** A smart, timeless design – the perfect complement to any EV.
- **Simplicity:** Plug the EV in and let it charge! A green backlit charging icon will illuminate to signal that the EV is in the process of charging. When charging is complete, users simply wrap the cord around the charging station, keeping it organized and out of the way.
- **Reduced Energy Consumption:** Completely shut off power to the WattStation, ensuring zero energy consumption when not in use.
- **Installation:** With easy to install mounting brackets, installation of the WattStation couldn't be easier. A sturdy mounting plate with heavy-duty screws and a key lock keep the WattStation securely in place and prevent unwanted removal from the wall. A step-by-step installation video is available for contractors and homebuilders.
- **Inside or outside:** We've built a charger that is rugged enough to put outdoors. It's NEMA 3R rating means it shrugs off rain and sleet, even a coating of ice.
- **Hard Wired vs. Plug-in Unit:** The WattStation wall mount can either be hard wired for more permanent installations or plugged in for simple removal of the unit. Choose the option that works best for you. It can be installed in new or existing construction.
- **Standards Compliance:** SAE J1772; NEC 625; UL 2231, 2251, 2594; NEMA and NIST; cUL 2594 and 2231.
    - Available on-line at Home Depot: http://www.homedepot.com/h_d1/N-5yc1v/R-203001939/h_d2/ProductDisplay?catalogId=10053&langId=-1&keyword=charging%20station&storeId=10051
    - Available on-line at Amazon: http://www.amazon.com/GE-Energy-WattStation-Wall-Mount/dp/B0069VTGPE/ref=sr_1_1?ie=UTF8&qid=1332102991&sr=8-1

- Available on-line at Best Buy: http://www.bestbuy.com/site/searchpage.jsp;jsessionid=C4E1409F2C24DC43A90EC9FF09594115.bbolsp-app01-22?_dyncharset=ISO-8859-1&_dynSessConf=-1525015296611878629&id=pcat17071&type=page&st=car+charging+station&sc=Global&cp=1&nrp=15&sp=&qp=&list=n&iht=y&usc=All+Categories&ks=960
- Available on-line at Lowes: http://www.lowes.com/SearchCatalogDisplay?Ntt=electric+car+chargers&storeId=10151&N=0&langId=-1&catalogId=10051&rpp=24

General Electric DuraStation

http://www.geindustrial.com/cwc/Dispatcher?REQUEST=PRODUCTS&pnlid=8&famid=9404&catid=6061&id=Elec-evcs

Features and benefits:

- The cord holder keeps the cord organized and out of the way of parking spaces, sidewalks and streets.
- LEDs display status: Green = Station Active, Blinking Green = Vehicle connected, not charging, Amber = Charging, Red = Fault occurred, manual reset required (disconnecting vehicle will reset in most cases).
- Option for a Radio Frequency Identification (RFID) reader: users will gain charging authorization by waving RFID cards in front of the readers.
- Ethernet network offered for RFID authorization.
- RFID software registers usage of the DuraStation, enabling data collection and monitoring status of communication between RFID and EVSE.
- Vacuum Fluorescent Display (VFD) screen shows greetings, instructions and station messages.
- Nuisance tripping avoidance and auto re−closure.
- Vehicle ground monitoring circuit.
- Single phase metering, displayed on included VFD.
- A building ventilation interface signal can be provided to operate facility and garage fans when required.
- Standards and approvals: SAE J1772; NEC 625; UL 2231, 2251, 2594; cUL 2231, 2594; NEMA and NIST.

This is the dual charging station at Kroger Fuel Station on University City Boulevard in Blacksburg VA.

- Available on-line at Lowes: http://www.lowes.com/SearchCatalogDisplay?Ntt=electric+car+chargers&storeId=10151&N=0&langId=-1&catalogId=10051&rpp=24

Schneider EVlink Indoor Charging Station

http://products.schneider-electric.us/products-services/products/electric-vehicle-charging-stations/indoor-electric-vehicle-charging-station/

Features

- Integral ground fault interrupter set at 5mA that meets the UL definition for people protection
- Automatic recovery and restart after ground fault interrupt or main power loss
- Ground monitor
- User-friendly LEDs to display status like charging, detected fault, power, etc.
- Option to have advanced metering functionality to collect and monitor energy and demand profile data

Specifications

- Input/output current: 30 A
- Input/output voltage: 240 Vac
- Enclosure type: indoor (NEMA 1)
- SAE J1772 compatible
- Cable length: 18 ft.
- Enclosure dimension (in inches): 9.53W x 12.73H x 4.36D
- Cable holder included
- Charging Access: unrestricted

- Available on-line at Home Depot: http://www.homedepot.com/h_d1/N-5yc1v/R-202963679/h_d2/ProductDisplay?catalogId=10053&langId=-1&keyword=charging%20station&storeId=10051
- Available on-line at Lowes: http://www.lowes.com/SearchCatalogDisplay?Ntt=electric+car+chargers&storeId=10151&N=0&langId=-1&catalogId=10051&rpp=24

This is the charging station in the Roper garage in Blacksburg VA.

Schneider EVlink Outdoor Charging Station

http://products.schneider-electric.us/products-services/products/electric-vehicle-charging-stations/outdoor-electric-vehicle-charging-station/

Features

- Integral ground fault interrupter set at 5mA that meets the UL definition for people protection
- Automatic recovery and restart after ground fault interrupt or main power loss
- Ground monitor
- User friendly LEDs to display status like charging, fault, power etc.
    - Available in various options
    - Wall/pedestal
    - Single/dual units
    - Extremely durable RFID key fob authentication
- Option to have advanced metering functionality to collect and monitor energy and demand profile data

Specifications

- Input/output current: 30 A
- Input/output voltage: 208/240 Vac
- Enclosure type: outdoor (NEMA 3R/12)
- SAE J1772 compatible
- Cable length: 18 ft.
- Enclosure dimension (in inches)
    - Wall: 13.11W x 18.11H x 6.45D
    - Pedestal: 13W x 56H x 6.6D
- Cable holder included
- Charging access: unrestricted or restricted

Coulomb ChargePoint Networked Wall-Mount Charging Station

http://www.coulombtech.com/files/CT500-Data-Sheet.pdf

The CT500 charging station is a 7.2 kW single output station designed for single and multi-family homes, apartments and condominium buildings, light commercial and fleet applications for the North American marketplace. The station delivers Level II (208/240V @ 30 A) charging and is compatible with plug-in electric vehicles that comply with the SAE J1772™ plug-in electric vehicle charging standard. The station's small size and flexible interfaces for utility Automatic Meter Infrastructure (AMI) make it an ideal solution for homeowners, utilities, fleet managers, and property managers.

To eliminate energy theft and to enhance safety, a card reader option is available for drivers to access and energize the station with a ChargePass™ card. The station's highly visible display guides drivers with instructive messages and can be used to display custom advertisement or greetings for drivers.

Software Application Services

Set pricing and collect fees, provide 24/7 driver assistance, control access, display advertisements, track usage, and diagnose the station remotely using the growing suite of ChargePoint Network on-demand software applications and a web browser.

Smart Card Reader Option

Provide optional driver billing and custom access control, preventing electricity theft and enhancing safety, with an integrated standards-based RFID reader that accepts ChargePass cards.

Intelligent Power Control

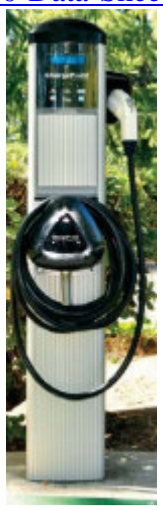
Ensure power is delivered only when a driver is authorized and the EV cord is properly inserted.

Vacuum Florescent Display with Multiple Language Support

Display instructive, advertisement, and greeting messages in many languages on the bright, easy-to-read display.

Coulomb ChargePoint Networked Outdoor Pedestal Charging Station

http://www.coulombtech.com/files/CT2100-Data-Sheet.pdf



The CT2100 family of charging stations are dual output stations designed for public outdoor applications for the North American marketplace. The 7.2 kW output delivers Level II (208/240 V @ 30 A) charging via a standard SAE J1772™ connector and fixed 18-foot cable. The 2 kW output delivers Level I (120 V @ 16 A) charging via a standard NEMA 5-20 receptacle protected behind a locking door. Both outputs can deliver energy simultaneously.

To eliminate energy theft and to enhance safety, drivers access and energize the station with a ChargePass™ card or contactless credit card. The station's highly visible display guides drivers with instructive messages and can be used to display custom advertisement or greetings for drivers.

Software Application Services

Set pricing and collect fees, provide 24/7 driver assistance, control access, display advertisements, track usage, and diagnose the station remotely using the growing suite of ChargePoint Network on-demand software applications and a web browser.

Smart Card Reader

Provide optional driver billing and custom access control, preventing electricity theft and enhancing safety, with an integrated standards-based RFID reader that accepts ChargePass cards, contactless credit cards, and Mifare-based transportation cards.

Intelligent Power Control

Ensure power is delivered only when a driver is authorized and the EV cord is properly inserted.

Locking Door

Protects power insertion point and retains the EV charging cord to prevent theft during charging.

Vacuum Florescent Display with Multiple Language Support

Display instructive, advertisement, and greeting messages in many languages on the bright, easy-to-read display.

Blink Wall-Mount Charging Station

http://www.blinknetwork.com/chargers-residential.html

- Convenient, user-friendly 7" touch color screen displays all you need to know about your EV and Blink charger, including charge status, statistics, and history
    - SAE J1772 connector (http://en.wikipedia.org/wiki/SAE_J1772)- the industry standard and most widely compatible connector used for electric vehicle charging in the United States
- The binary, two-piece design offers maximum installation flexibility to fit any space or need
- Convenient cable management system which allows for long reach and easy storage between uses
- Safe, easy-to-use intuitive docking connector prevents accidental disconnection and de-energizes when not in use or incorrectly connected
- Safe in wet or dry use
- Cable and connector can withstand being driven over by vehicle
- Certified energy and demand metering; supports electric utility EV building when certified to ANSI 12.20 and IEC standards
- Multiple modes of communications are supported, including Wireless IEEE 802.11g, cellular, LAN/Ethernet, and LAN capable Web-based bi-directional delivery and data flow
    - Access to the Blink Network (http://www.blinknetwork.com/network.html) and Blink Membership portal (http://www.blinknetwork.com/membership.html)

Legrand 2 EV Charging Station

http://www.legrand.us/passandseymour/ev-chargers/level%202/l2evse16.aspx#.T2Y8BxFmLjs

- 240V, 16A, 3.8kW
- Supplies full charge in 3-6 hours.
- 24' coiled cord for easy cord management
- RoHS (Reduction of Hazardous Substances) Compliant.
- Status Indicator lights alert users to readiness and faults.
- Compatible with all Plug-In Electric Vehicles (SAE J1772 vehicle plug).
- Weatherproof NEMA 3S rating allows for indoor or outdoor installation.
- Auto-Reset allows charger to re-try after a minor electrical fault. This prevents lockout and low charge situations.

Available on-line at Home Depot: http://www.homedepot.com/h_d1/N-5yc1v/R-203013921/h_d2/ProductDisplay?catalogId=10053&langId=-1&keyword=charging%20station&storeId=10051

Leviton Home Charging Station

http://toyota.leviton.com/product-info

Features and Benefits:

- Compatible with all Charging Station Standards and Recommended Practices, including SAE J1772™, NEC 625, UL 2231 and UL 2594
- Built-in communication verifies proper connection before charging can commence
- "Auto-Reclosure" feature enables charging to restart following a minor fault, thereby reducing the chance of having an undercharged battery
- Cord connected installation is ideal for indoor applications and capable of being converted to a "hard-wired" installation if required
- Weatherproof NEMA Type 4 enclosure
- "Wrap-around cord management for easy storage between uses
- Ground monitor interrupter circuit for safety
- Industry leading 10-year limited warranty
- Assembled in the USA

Available on-line at Home Depot: http://www.homedepot.com/h_d1/N-5yc1v/R-202950823/h_d2/ProductDisplay?catalogId=10053&langId=-1&keyword=charging%20station&storeId=10051

Available on-line at Amazon: http://www.amazon.com/Leviton-EVB22-3PM-Evr-Green-Charging-Station/dp/B004G6ZSZG/ref=sr_1_2?ie=UTF8&qid=1332103058&sr=8-2

EV Solutions AeroVironment Charging Dock

http://evsolutions.avinc.com/products/at_home/

- Industry-approved SAE J1772 connector
- Outdoor-rated NEMA 4 enclosure
- Auto restart in event of power outage
- Breakaway safety cable and integrated stowage
- Auto short circuit and ground fault shutoff
- Protection against “live power”
- Optional pedestal mount
- Optional communication module

This is the one at all Nissan dealers in the United States and is the one recommended by Nissan.

EV Solutions AeroVironment Commercial Charging Station

http://evsolutions.avinc.com/products/retail_commercial/

- Industry-approved SAE J1772 connector
- Outdoor-rated NEMA 4 enclosure
- Auto restart in event of power outage or ground fault
- Multiple network communication options
- Breakaway safety cable, integrated cable stowage
- Point of Sale (POS) options
- Wired and wireless communication compatibility

EVoCharge EVoReeL Charging Station

http://www.evocharge.com/Level2_EVoCharge_specification_sheet.pdf

SPECIFICATION EVoReeL2

Vehicle Connector SAE J1772
Voltage 240 VAC, Single Phase Frequency 50/60 Hz
Current Output 30A maximum; 16A, 24A, 30A Settings (Field Selectable)
16A maximum; 8A, 12A, 16A Settings (Field Selectable)
Operating Temperature -30°C to 50°C (-22°F to 122°F)
Storage/Transit Temperature -40°C to 60°C (-40°F to 140°F)
Dimensions 0.36m x 0.33m x 0.27m (14.3" x 13.1" x 10.7")*
Weight 16.2 kg (35.8 lbs)*
Cord Length 7.62m (25.0ft)
Enclosure NEMA 3R; Indoor/Outdoor Rated
Mounting Wall, Pedestal, and Ceiling Options
CCID Automatic Supervisory Circuit: Auto-Test & Reset; 20mA max trip level
Ground Fault Retry 4 Retries @ 15 Minute Intervals per UL-2231
Charge Status Indicators Power ON/OFF, Ready, Charging, Fault, Security Lock
Commercial Payment Method Commerce and Card Reader Capability
Firmware Upgrades Remote and In-Field Reprogramming
Diagnostics Automatic and Downloadable
Communication System Smart Charger Capable (remote access scheduling and monitoring)
Cable Management System Retractable Reel

Pep Charging Station

http://pepstations.com/

Eaton Charging Station

http://www.eaton.com/Electrical/USA/ProductsandServices/ElectricalDistribution/ElectricVehicleChargingSolutions/Level2ChargingStation/index.htm

Movie about Eaton charging station: http://www.youtube.com/watch?v=cWg-M7ritXM

This is the charging station with credit card actuation at the Virginia Museum of Transportation (303 Norfolk Avenue SW, http://www.vmt.org/) in Roanoke Virginia and the charging station with RFID actuation at Hotel Floyd (120 Wilson Street, http://hotelfloyd.com/) in Floyd VA.

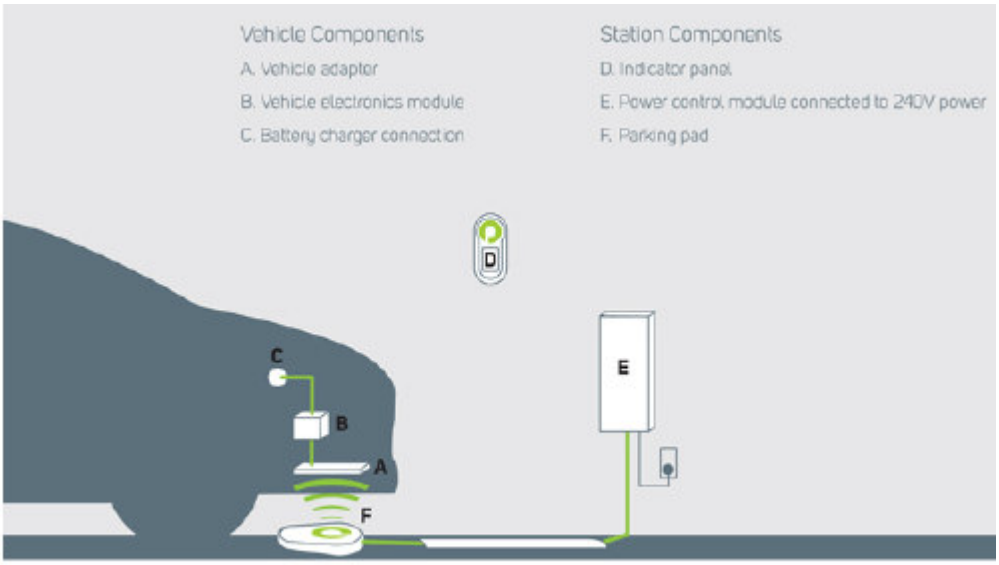
Clipper Creek Charging Station
http://www.clippercreek.com/

EV-Charge America Charging Station
http://www.ev-chargeamerica.com/electric-vehicle-charging-stations.html

Level-1 & level-2

Evatran Plugless Charging Station

http://www.pluglesspower.com/



Each Plugless Power charging system consists of these simple components, which can be tailored for different configurations based on your needs.

Sold and installed by Sears: http://green.autoblog.com/2012/01/14/sears-evatran-reach-agreement-for-wireless-ev-charging-stations/

Level-3/480-volts Charging Stations

Schneider EVlink Fast-Charging Station

http://products.schneider-electric.us/products-services/products/electric-vehicle-charging-stations/fast-charging-electric-vehicle-charging-station/

Features

- Charges 80% of the battery in less than 30 minutes
- Intuitive, easy-to-use station
- Extremely durable RFID key fob authentication

Specifications

- GPRS communication
- Advanced services for optimum management and maintenance
- Designed for sheltered outdoor use
- Charging access: restricted or pay-per-use

Blink DC Fast Charger

http://products.schneider-electric.us/products-services/products/electric-vehicle-charging-stations/fast-charging-electric-vehicle-charging-station/

- Mobile-phone based payment options, and credit card payments
- Advertising revenue and messaging opportunities via the DC Fast Charger's 42" daylight readable, color LCD display and sound system available through the Blink Advertising Network
- Convenient 10" LCD touch screen display with intuitive and user-friendly interface for safe and easy charging
- Easily programmable start/stop timing
- Beacon light and window for increased visibility
- Exterior treatment and graphics fully customizable for rebranding
- Dual ports for increased user access and availability
- Simplified 2-piece design; separate Grid Power Unit (GPU containing the power electronics) and charging station for ease of installation
- The Blink DC Fast Charger is outfitted with a CHAdeMO compliant EV connector; the most widely used connector for fast-charge-capable electric vehicles worldwide
- Long reach cable configuration
- Safe, easy-to-use docking connector which prevents accidental disconnection and de-energizes when not in use or incorrectly connected
- Safe in wet or dry use
- Cable and connector can withstand being driven over by vehicle.
- Certified energy and demand metering; supports electric utility EV building when certified to ANSI 12.20 and IEC standards
- Web-based information delivery
- Multiple modes of communications are supported, including Wireless IEEE 802.11g, cellular, LAN/Ethernet, and LAN capable Web-based bi-directional delivery and data flow
- Access to the Blink Network and Blink Membership portal

Movie about Blink Fast Charger: http://www.youtube.com/watch?feature=player_embedded&v=pBoE7utFy1s

Coulomb-ChargePoint/Aker-Wade Fast Charging Station

http://www.coulombtech.com/blog/tag/aker-wade/

"Coulomb Technologies and Aker Wade Power Technologies today announced an agreement to deploy Level III networked fast charging stations for electric vehicles worldwide. The Level III charging stations will be capable of fully charging battery electric vehicles in less than half an hour. The Level III fast charging stations will be co-developed, distributed, marketed and supported by both companies. Designed in accordance with the TEPCO Level III specifications the charger will be qualified for use with several electric vehicle brands including the Nissan Leaf and the Mitsubishi i-Miev."

EV Solutions AeroVironment Fast Charging Station

http://evsolutions.avinc.com/products/fleets/

- Built-in security and safety measures
- Supports and extends battery life
- Intuitive plug-and-charge interface
- Outdoor-rated enclosure
- Multiple network communication options
- Point-of-Sale (POS) options
- Wired and wireless communication compatibility
- Optional dual port configuration

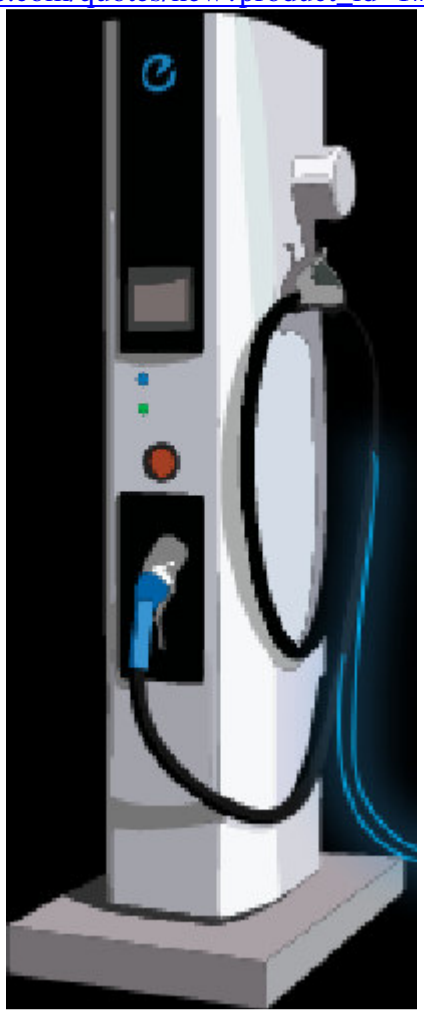
Eaton DC Quick Charger

http://www.eaton.com/Electrical/USA/ProductsandServices/ElectricalDistribution/ElectricVehicleChargingSolutions/DCQuickCharger/index.htm

Movie about how to use the Eaton DC Quick Charger:
http://www.eaton.com/Electrical/USA/ProductsandServices/ElectricalDistribution/ElectricVehicleChargingSolutions/DCQuickCharger/index.htm

Nissan Quick Charging Station

http://nissanqc.com/quotes/new?product_id=1#CableOptions



Charging Stations Available for Charging

- An excellent list of charging stations available for charging is http://www.plugshare.com/
- EV Charger Sharing Protocol: http://www.evchargernews.com/chargingprotocol.htm

L. David Roper, http://arts.bev.net/roperldavid/
http://www.roperld.com/science/LEAFRoper.pdf
roperld@vt.edu , March 2012