

Electric Vehicle Chargers

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Electric Vehicle Chargers

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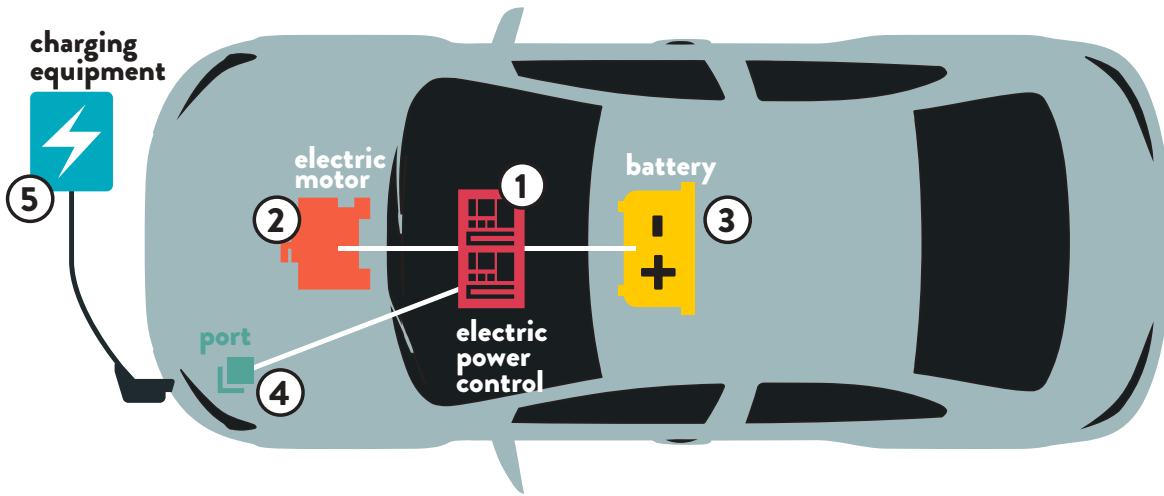
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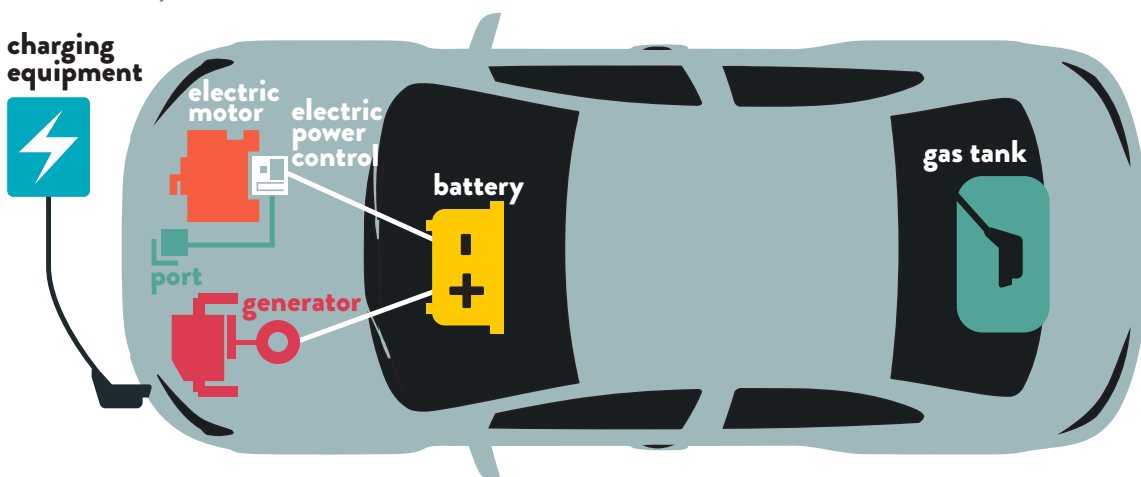
1. EVC Basics

1.1 What is an EV?

Battery Electric Vehicle (BEV)



Plug-In Hybrid Electric Vehicle (PHEV)



1

On board charger and Battery Management System

On board charger and the BMS define the EV's maximum charging power and also manage the charging sequence of the batteries.

4

AC or DC connectors

There are different types of connectors depending on car manufacturers and also geographical place of the vehicle. (same car model have different connector type depending on country)

2

Electric motor(s)

BEVs may have 1 or more electric motors depending on manufacturers decisions.

5

AC or DC charging equipment

All BEVs need to be plugged to electrical power supply. Depending on availability and compatibility of the vehicles this charging equipment can be an AC or a DC charger.

3

Batteries

Batteries may have different technologies. Most common type is Li-ion batteries which we are using almost in every daily used devices such as mobiles and laptops. Battery capacity has an important effect on range.

1.2 What defines an EV's range?



Weight

Increase in weight reduces the range.



Performance need

Quick accelerations and high speeds consumes more energy and shortens the range.



Battery Capacity

Battery capacity is shown by kWh and determines the total deliverable electric power to the cars engine. Higher capacity provides higher range.



Weather conditions

The general range information shared by car manufacturers is valid for mild weathers (~23C). Extreme cold and hot weathers have an important effect on range. Cold weather has bigger effect on reducing the range”.

1.3 Where to charge EVs?



Home charging

Private Home

Charger installed in the garage.

Condominium

Charger installed in the private parking place indoor or outdoor.



Workplace charging

Workplaces started to offer charging facilities to their employees and visitors (free or paid). Also company EV fleets require charging points for them.



Destination charging

Private or public parking places have started to offer charging services. These facilities may require membership or can be accessible by all EV drivers. Shopping malls, hotels, restaurants are also offering charging services to their customers.



En-route charging

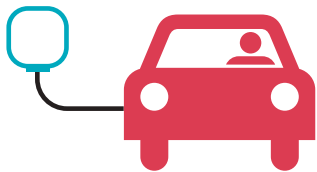
These are generally fast DC chargers which allow EV drivers to charge their cars for an important range in a considerably short time (app. 30 min.)

1. EVC Basics

1.4 Charging EV

Effective charging capacity is determined by the least powerful equipment in the charging system.

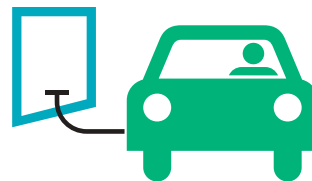
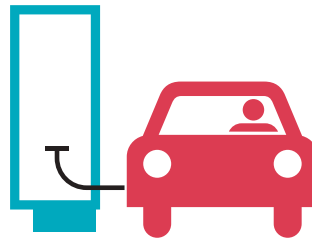
Charging system components are charger, cable and onboard charger of the vehicle.



MODE 1

Domestic socket and extension cord

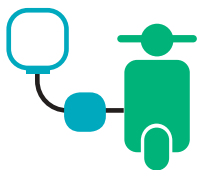
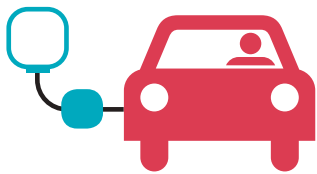
This is an AC charging method generally used by small e-bikes, mopeds. Domestic socket and simple cable used. Prohibited in some countries including USA.



MODE 3

Specific socket on a dedicated circuit

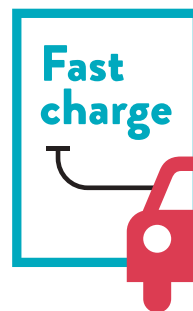
This is an AC charging method which is recommended for everyday charging. Dedicated charging socket with charge monitoring functions. Dedicated charging cable is used.



MODE 2

Domestic socket and special cable with control device

This is an AC charging method where the charge monitoring device placed on the special charging cable.



MODE 4

Direct current (DC) connection for fast charging

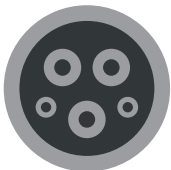
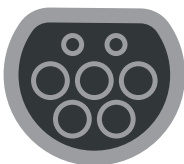
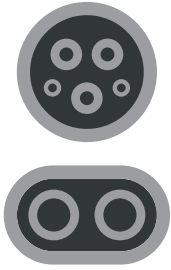
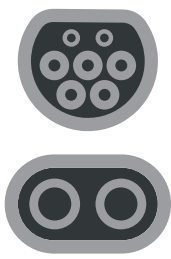
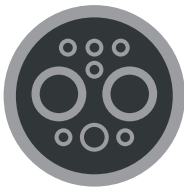
This is a DC charging method where the off-board charger used to charge the batteries fastly. There are different connector types. Most commonly used connectors are CHAdeMO and CCS2 (Combo).

	On board charger	Cable	Chargepoint	Effective charging cap.
	11 kW	22 kW (Mode 3)	22 kW	11 kW
	22 kW	7,4 kW (mode 3)	22 kW	7,4 kW

	Level 1 (AC)	Level 2 (AC)	Fast Charging (DC)	Ultra Fast charging (DC)
	Up to 3,7 kW	7-22 kW	60 kW	120+ kW
	5-16 hrs	1-5 hrs	20-75 mins	10-45 mins
	10-20 km range per hour	30-120 km range per hour	250-500 km range per hour	~1000 km range per hour

Connector Types

Connectors varies by region, by charging current and also by car manufacturer

	N. America	Japan	EU and the rest of markets	China
AC	 J1772 (TYPE1)	 J1772 (TYPE1)	 TYPE2	 GB/T
DC	 CCS1	 CHAdeMO	 CCS2	 GB/T

2.1 EVC 02

Wall mounted



Wall Mounted
CE Marking
Smart Application
Smart Home Integrated



Free standing



Single outdoor Double outdoor

Build



Main Unit

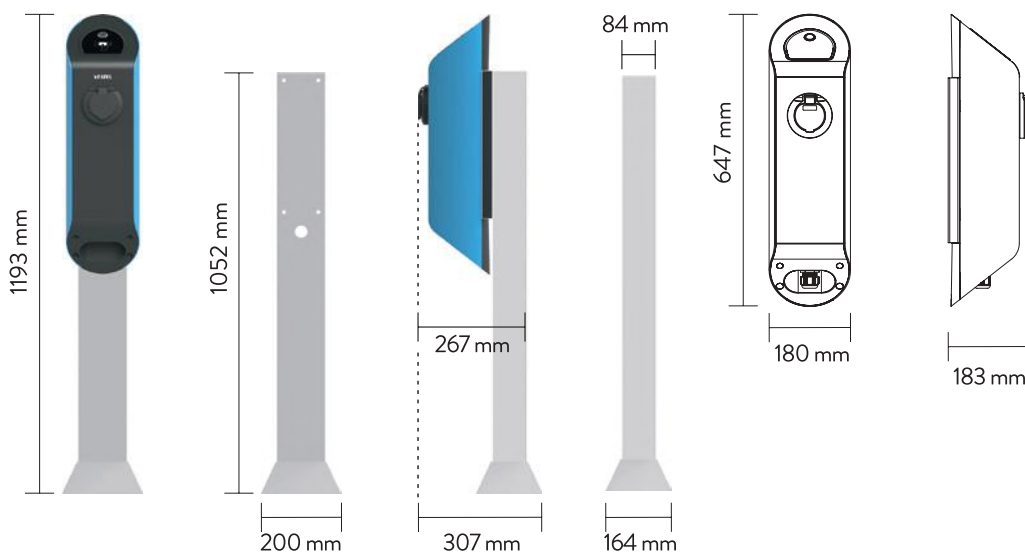
Full Aluminium Housing
IP54 Rating
IEC 61851 Safety Class I

IEC 62196 Electric Vehicle Socket
Standard White Colour



Outdoor Stand

Rectangular Extrusion Metal Sheet
Galvanized Coating
Anti-Corrosion Painting



Main Features

Part	Type	EVC02-AC3	EVC02-AC7	EVC02-AC11	EVC02-AC22
 Electrical	Power	3,7 kW max	7,4 kW max	11 kW max	22 kW max
	Voltage	230V AC	230V AC	400V AC	400V AC
		50/60 Hz	50/60 Hz	50/60 Hz	50/60 Hz
	Current	1 x 16A max	1 x 32A max	3 x 16A max	3 x 32A max
 Mechanical	Socket type	IEC 62196 Type 2 EU			
	Weight (Net)	10,7 kg	10,7 kg	11,2 kg	11,2 kg
	Dimension (HxWxD)mm	647 x 180 x 184			
	Material	Full Metal Body			
 Enviromental	IP Rating	IP54			
	IK Rating	IK10			
	Humidity	5%-95% Relative Humidity, non-condensing			
	Operating Temperature	-30°C to +50°C			
	Storage Temperature	-40°C to +80°C			
	Operating Altitude	0-3000m			
	Storage Altitude	0-5000m			

Optional Features

Part	Option	Type
 Connectivity	Wi-Fi	802.11n 1x1
	GSM	3G/2G
	Network Protocol	OCPP 1.6 (with GSM)
	Multi-standard RFID	ISO 14443 A/B, ISO 15693
 Authorization	NFC	ISO/IEC 18092, ISO/IEC 21481
	Smart App	Android&IOS (connected models)
 Safety	Built-in RCD	RCD type A + DC leakage sense
 Interface	Shuttered Socket	IEC 62196 Type 2
	Built-in cable	IEC 62196 Type 1 / Type 2 Tethered Plug
 Body	Colour	white, blue,orange



Control your charging station via Drive Green App. You can remotely start, stop or delay your charging session via home network. (see details in drive green section)



2.2 EVC 04



Highlights



Best in Class Flame Retardant 5VA Plastic Housing



Remote control
via Drive Green app



Remote Diagnostics
over OCPP



Remote SW update
via USB or OCPP



Dynamic Load Management
via Ethernet, Wi-Fi, RS485 or OCPP



Control your charging station via Drive Green App. You can remotely start, stop or delay your charging session via home network. (see details in drive green section)

Linky

EVC 04 series can manage the TIC signal from Linky electric meters in order to manage on-peak, off-peak hours charging automatically. This helps to reduce the charging cost.

Main Features

Part	Type	EVC04-AC7	EVC04-AC22
 Electrical	Power	7.4 kW max	22 kW max
	Voltage	230V AC, 50/60 Hz, 1-Phase	400V AC, 50/60 Hz, 3-Phase
	Current	1 x 32A max	3 x 32A max
	Power Level Control	10-13-16-20-25-30-32A	
	Socket Type	IEC 62196 Type 2 EU	
	Authorization	Built-in RFID Reader (ISO 14443 A/B and ISO 15693)	
	Protection	Built-in DC 6mA RCD function	
 Mechanical	Certification	CE, IEC 61851-1, IEC 61851-22, IEC 60950-1, IEC 60950-22	
	Material	PC Plastic, 5VA Flame Retardant	
	Dimension (HxWxD) mm	460x315x135	
	Weight (Net)	4.8 Kg	5.0 Kg
 Environmental	IP Rating	IP54	
	IK Rating	IK10*	
	Operating Temperature	-35°C to +55°C	
	Storage Temperature	-40°C to +80°C	
	Humidity	5%-95% Relative Humidity, non-condensing	
	Altitude	0-4000m	

Optional Features

Part	Option	Type
 Connectivity	Ethernet	RJ45 - 10/100 Mbps
	Serial Interface	Modbus / M-Bus over RS485
	Wi-Fi	802.11 a/b/g/n
	LTE	4G/3G/2G
	Network Protocol	OCPP 1.6 JSON
 Authorization	Multi-standard RFID	ISO 14443 A/B, ISO 15693, ISO 19092, LEGIC, FeliCA
	NFC	ISO 14443 A/B, ISO 15693, IEC 18092
 Safety	Built-in RCCB	Type-A High Immunity
 Interface	Shuttered Socket	IEC 62196 Type 2
	Built-in Cable	IEC 62196 Type 1 / Type 2 Tethered Plug
	Display	4.3" TFT LCD Display
	Measurement	Built-in MID Meter
 Body	Pole Mount	Rectangular or Oval

* IK08 for display



2.3 EVC 05

Highlights



Vandal-proof metal body



Easy Installation & Service



**Remote Diagnostics
over OCPP**



**Remote SW update
over OCPP**



**Dynamic Load Management
via Ethernet, Wi-Fi, RS485 or OCPP**



10.1" Touchscreen Display

Main Features

Part	Type	EVC05-AC22
 Electrical	Power	Dual 22kW output (Total 44kW)
	Voltage	400V AC, 50/60 Hz, 3-Phase
	Current	Dual 3x32A
	Power Level Control	10-13-16-20-25-30-32A
	Socket Type	2 x IEC 62196 Type 2 EU
	Authorization	Built-in RFID Reader (ISO 14443 A/B and ISO 15693)
	Connectivity	Ethernet: RJ45 - 10/100 Mbps
		Serial: Modbus / M-Bus over RS485
		Internal USB 2.0 port
	Protection	Built-in DC 6mA RCD function
		Built-in RCCB Type A High Immunity
		Built-in MCB 40A Type C
 Mechanical	Material	Full Metal Body
	Dimension (HxWxD) mm	1500x550x180
	Weight (Net)	TBD
 Environmental	IP Rating	IP65 (Sockets IP54)
	IK Rating	IK10
	Operating Temperature	-35°C to +55°C
	Storage Temperature	-40°C to +80°C
	Humidity	5%-95% Relative Humidity, non-condensing
	Altitude	0-4000m

Optional Features

Part	Option	Type
 Connectivity	Wi-Fi	802.11 a/b/g/n
	LTE	4G/3G/2G
	PLC HLC	ISO 15118
	Network Protocol	OCPP 1.6
 Authorization	Multi-standard RFID	ISO 14443 A/B, ISO 15693, ISO 19092
	NFC	ISO 14443 A/B, ISO 15693, IEC 18092
 Safety	RCCB closure unit	Auto / Remote Reclosure unit
 Interface	Shuttered Socket	IEC 62196 Type 2
	Lock-Cover Socket	IEC 62196 Type 2
	Shuko Socket	Type E / F (with magnetic locked cover)
	Display	10.1" TFT LCD Display with touchscreen (IK8)
	Measurement	Built-in MID Meter (Eichrecht Conformity)

Available in Q1 2021



2.4 EVC 03

DC fast charger

Highlights



Vandal-proof metal body



Remote SW update
via USB or OCPP



Easy Installation & Service



Dynamic Load Management
via Ethernet, Wi-Fi, RS485 or OCPP



Remote Diagnostics
over OCPP



Upgrade Ready





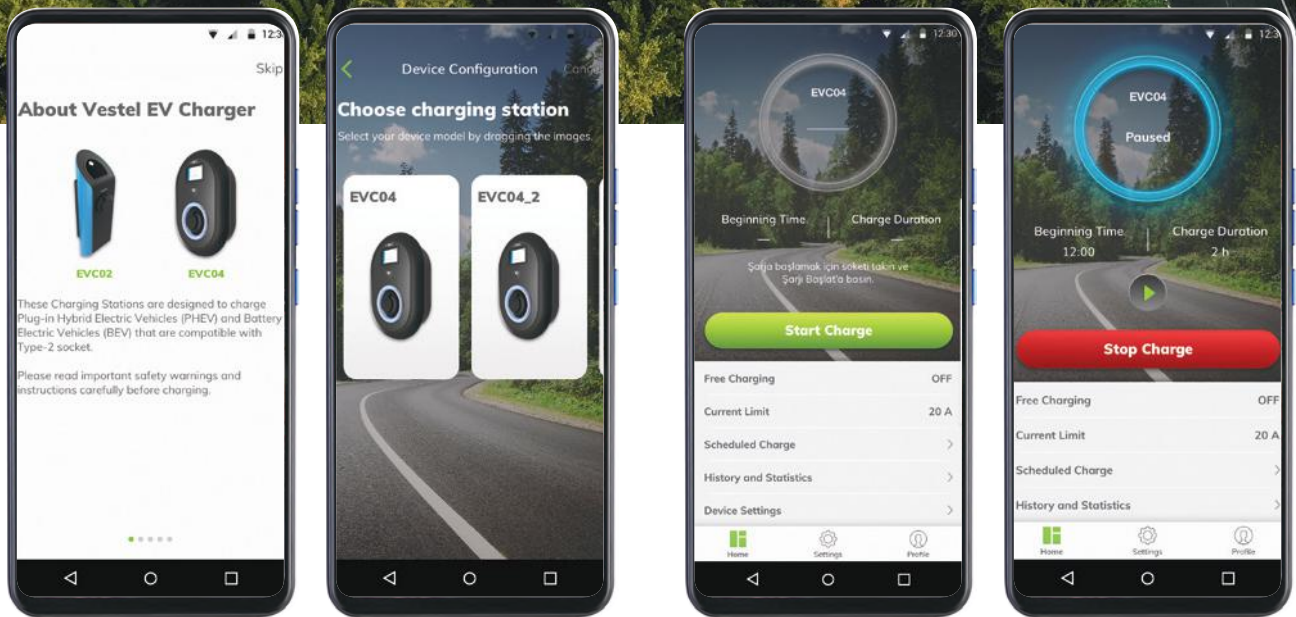
Outlets

Type	CCS	CHAdeMO	Type 2 Tethered	Type 2 Socket
Power	60/120 kW options	60 kW options	43 kW max	22 kW max
Voltage	150-1000V DC	150-500V DC	400V AC 50/60 Hz	
Current	200A max	125A max	3 x 64A max	3 x 32A max
Interface Type	IEC 62196-1/3, IEC 61851-1/23/24		IEC 62196-1/2, IEC 61851-1/22	
	ISO 15118-1/2/3, DIN70121		CHAdeMO rev 1.2	

Main Features

Part	Type	CCS	CHAdeMO	Type 2 Tethered	Type 2 Socket
 Electrical	Authorization	Built-in RFID Reader (ISO 14443 A/B and ISO 15693)			
	Connectivity	Ethernet, 802.11ac Wi-Fi, LTE (4G), OCPP 1.6			
	Display	10.1" TFT LCD Display with touch screen			
	Protection	Residual current sensing, Insulation monitoring, Over current, Over voltage, Under voltage, Short circuit, Over temperature, Surge & Lightning protection			
 Mechanical	Material	Full Metal Panel Body			
	Cable Length	3.5m	3.5m	3.5m	-
	Cooling	Forced Air Cooling Fan			
	Dimension (HxWxD)mm	1980 x 820 x 825			
	Weight (Net)	TBD			
 Environmental	IP Rating	IP54			
	IK Rating	IK10			
	Operating Temperature	-35°C to +55°C			
	Storage Temperature	-40°C to +80°C			
	Humidity	5%-95% Relative Humidity, non-condensing			
	Altitude	0-4000m			

2.5 Drive Green

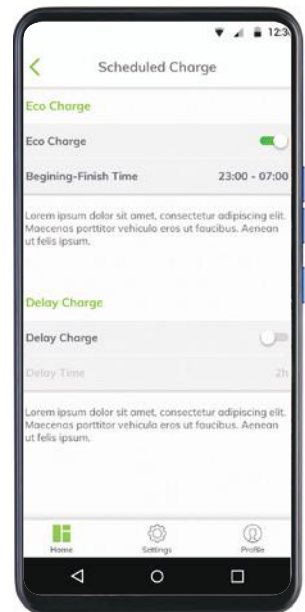
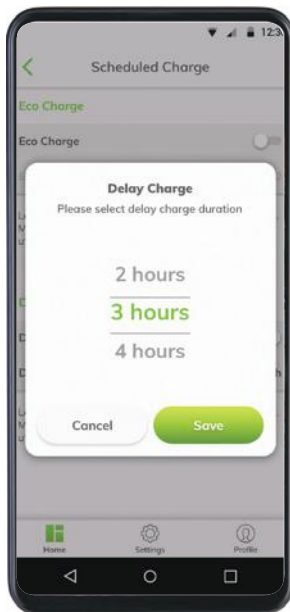


Configuration

Based on your device properties you can select bluetooth or Wi-Fi configuration.

Charging

You can start, pause or stop your charging session via Drive Green.



Delay charging

It is possible to delay the charging session by setting the delay time. Even you plug your car to the charger, the charging starts after the delay period. It is always possible to start charging whenever you want.

Eco charge

It is possible to set Eco Charge hours in order to charge the EV while the electricity costs are less. You can set the off-peak hours and your EV will be charged only during off-peak.



Date/Time	Power Consumption (kWh)
Today 23:05	160 kWh
Yesterday 22:05	160 kWh
12.05.2020 22:05	160 kWh
19:42 18.05.2020	160 kWh
08.05.2020 19:00	160 kWh
05.05.2020 19:00	160 kWh
01.05.2020 19:00	160 kWh
25.04.2020 19:00	160 kWh
23.04.2020 19:00	160 kWh
20.04.2020 19:00	160 kWh
15.04.2020 19:00	160 kWh
10.04.2020 19:00	160 kWh



Drive Green is the mobile application designed to configure, control and monitor Vestel smart charger.

Charging history

It is possible to monitor last 10 charging sessions and also brief data on daily, monthly and yearly usages.

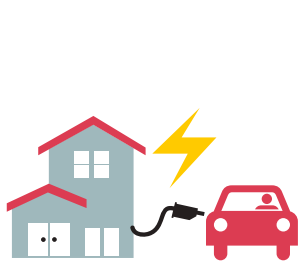
3. Load Management

Why do we need load management?

Load management is important in order to;

- » Reduce installation and operation cost
- » Increase charging network efficiency
- » Prevent network overloading and blackouts

3.1. Individual Installations



Static management

A power limit can be set and the charger won't go above the power limit.



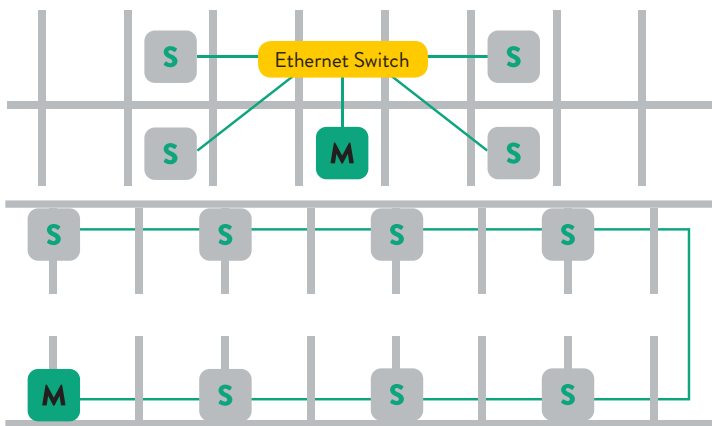
Dynamic Load management

Thanks to dedicated power optimizer option our chargers can manage the power limit based on the available power. When the household appliances consumes more the charger consumes less and don't overload the main switch.



3.2. Cluster Installations

2 different Master/Slave clusters



Star

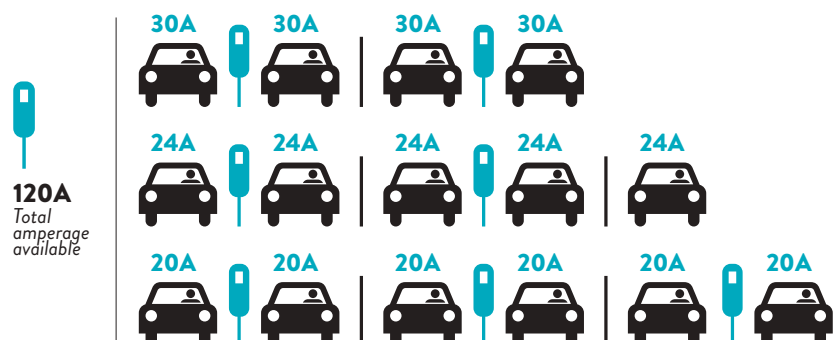
In star network topology all chargers connected to the master via a switch.

Daisy Chain (Serial)

In case of an in-line network topology all chargers connected to each other with in-out connections. The master station is positioned at one end of the line.

Different scenarios

Equally shared : All available power is distributed equally to all EVs connected. This is more suitable for workplace or condominium chargings where the cars are parked for a considerable period of time.





First-In, First-Out (FiFo)

This type of load management is more oriented for fleets in order to let them have more fully charged EVs when they need. The available power is redistributed and when a new EV arrives it waits until an EV finishes its charge or leaves the charging point.

EVSE\T _P	G _M =120A					G _M =80A	
	T ₁	T ₂	T ₃	T ₄	T ₅	T ₆	
1	32A	32A	32A	32A	16A ↓	6A	6A
2	32A	32A	32A	32A	32A	32A	32A
3	32A	32A	32A	32A	32A	32A	32A
4	32A	24A	24A	18A	32A	32A	6A
5	32A	24A	6A	6A	8A	24A	6A

* T_P: Time Period, G_M = Maximum Grid allocated for the chargers. Available maximum current for each EVSE in a certain T_P is indicated in black color. Charging current which is drawn by EV is indicated in Blue color. An EV drawing less current is indicated by "↓" symbol.

Combined load management

Combined load management is a combination of FiFo and Equally shared methods. A percentage of total power allocated for EV charging cluster can be set and this percentage of total power distributed to all EVs according to FiFo and the remaining power will be delivered as equally shared principal to all EVs.

F%=50	G _M =120A						G _M =80A		G _M =29A	G _M =30A
EVSE\T _p	T ₁	T ₂	T ₃	T ₄	T ₅	T ₆	T ₇	T ₈	T ₉	T ₁₀
1	32A	32A 🚗	32A 🚗	32A 🚗	20A ⬇️ 🚗	6A ⬇️ 🚗	6A 🚗	8A	🚗	6A 🚗
2	32A	32A 🚗	32A 🚗	32A 🚗	32A 🚗	32A 🚗	32A 🚗	32A 🚗	11A 🚗	6A 🚗
3	32A	32A 🚗	32A 🚗	32A 🚗	32A 🚗	32A 🚗	26A 🚗	28A 🚗	6A 🚗	6A 🚗
4	32A	24A	24A 🚗	12A 🚗	24A 🚗	32A 🚗	8A 🚗	10A 🚗	6A 🚗	6A 🚗
5	32A	24A	12A	12A 🚗	12A 🚗	18A 🚗	8A 🚗	10A 🚗	6A 🚗	6A 🚗

* T_P: Time Period, G_M = Maximum Grid allocated for the chargers. Available maximum current for each EVSE in a certain T_P is indicated in black color. Charging current which is drawn by EV is indicated in Blue color. A EV drawing less current is indicated by "↓" symbol.

Load management via OCPP

A Charge Point Management Platform (Backend) can also be used to use load management. Depending on the dynamic load management support on backend system, different use case scenarios can be realized. Vestel EVC products support OCPP 1.6J and can work with different backend platforms.

4. Electric Vehicle Glossary of Terms

EV (Electric Vehicle): A broad category that includes all vehicles that are fully powered by Electricity or an Electric Motor.

BEV (Battery Electric Vehicle): Also known as an “All-electric” vehicle BEV’s utilize energy that is stored in rechargeable battery packs. BEV’s sustain their power through the batteries and therefore must be plugged into an external electricity source in order to recharge.

EVD: Electric Vehicle Driver

Regenerative Braking: A method of braking used by EV in which energy from the braking of the vehicle is stored and used.

ICE (Internal Combustion Engine): An ICE is powered by combustible fuel, often petroleum or natural gas products.

ICEV (Internal Combustion Engine Vehicle): All vehicles that are powered by Fossil Fuels are ICEVs.

HEV (Hybrid Electric Vehicles): An HEV utilizes a dual system of electric propulsion and an internal combustion engine.

PHEV (Plug-in Hybrid Electric Vehicles): PHEVs contain a battery that is able to be charged with an external electric power source, PHEV’s are a mixture of all electric vehicles and ICEV’s.

NEV (Neighborhood Electric Vehicle): BEV’s that are limited to streets with lower speed limits, typically around 45mph. NEV’s are all-electric and can be recharged using a standard outlet.

EREV (Extended-range electric vehicles): Vehicles that have the ability to run on a gasoline engine if the battery gets low

EVb (Electric Vehicle Battery): A battery that is used to power the movement of a BEV.

AC (Alternating Current): A charge of electricity that regularly changes direction, which is the kind of power that comes from the power plant to homes and businesses.

DC (Direct Current): A charge of electricity that flows in one direction and is the type of power that comes from a battery.

AER (All-Electric Range): The range any EV is able to reach solely using electricity.

Range Anxiety: Worry or stress that is caused due to the fear that an electric car will run out of battery power before the destination is reached.

kW (Kilowatt): A unit of electric power.

EVC (Electric Vehicle Charger): Infrastructure designed to supply power to EVs. EVC can charge a wide variety of EVs including BEVs and PHEVs.

Level 1 Charging: Charging your EV using a common household outlet up to 120v. Level 1 is the slowest method of charging and can take up to 24 hours or more to full charge your EV.

Level 2 Charging: Charges your EV at 240v using an installed outlet. Level 2 chargers are the most recommended chargers to EV owners. Depending on your EV model and charger, Level 2 can give you vehicle 5x as quickly as Level 1 which translates to up to 26 miles per hour of charging.



Level 3 Charging: Also known as DC charging, the fastest method of charging for all EVs. It can fully charge an EV battery in about half an hour. Level three chargers are currently rare as they're very expensive and require more power.

JEVS G105-1993: Also known as CHAdeMO, it is a method developed to quickly charge Electric Vehicles through the use of a special adapter that delivers up to 62.5 kW. This is used in Japan.

SAE J1772: The standard North American electrical connection for Electric Vehicles. Generally works with Level 1 and Level 2 systems.

IEC 62196: it is a type of connectors that is used to charge Electric Vehicles in Europe.

Combined Charging System: Another method to quickly charge electric vehicles through a special electric connection. CCSs often use the SAE J1772, which is the North American electrical standard for Electric Vehicles.

Charge Circuit Interrupting Device (CCID): A safety protection component within an EVSE that reduces the chance of a person getting an electric shock.

V2G (Vehicle-to-grid): A system that allows Electric Vehicles to communicate with the power grid to manage the flow of electricity in either direction.

GHG (Green House Gas): A gas such as Carbon Dioxide that contributes to global warming through the absorption of infrared radiation.

Off Peak Charging: Charging your electrical vehicle at certain lowest cost off-peak hours.

Battery Management System: An electronic system within the Vehicle that manages and protects the battery.

LIB (Lithium-ion battery): Also known as a Li-ion, it is a common rechargeable battery.

VRLA battery (valve-regulated lead-acid battery): A rechargeable lead-acid battery.

NiMH (Nickel Metal Hydride): A less reliable rechargeable battery.

Molten Salt Battery: A type of battery that utilizes molten salts as an electrolyte.



VESTEL

Organize Sanayi Bolgesi, 45030
Manisa/Turkey

Phone: 90 - 236 233 25 82

Fax: 90 - 236 233 25 84

vesteltrade@vestel.com.tr
www.vestelinternational.com

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