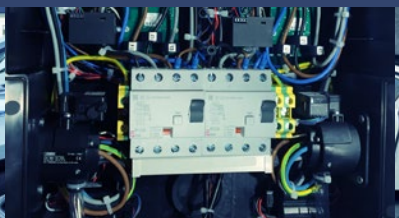
EV CHARGING STATIONS' PROTECTION

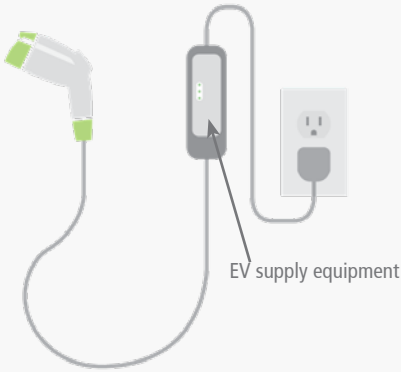

EV Charging Stations

Types of charging stations

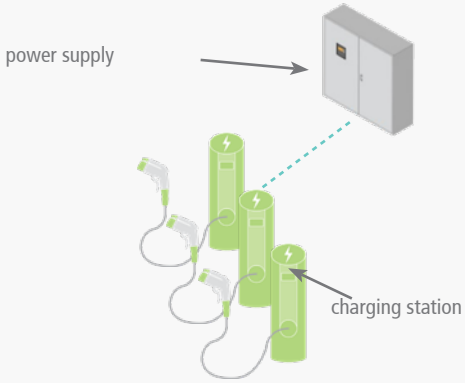
We are entering a new area of e-mobility. One of the most common segments of e-mobility are electric vehicle charging stations. Today, there are several different types of EV charging stations available on the market, and all of them require protection. ETI offers solutions for the protection of all kinds of EV charging stations and we are open to developing solutions that meet special customer requirements.

EV charging stations are divided into two general groups: the ones that run on the alternate current and the ones that use the direct current power supply.

AC charging station



DC charging station



Furthermore, we can separate them according to the charger plug-in connector which depends on the nominal power of the charging station.

Plug-in connector type

Type 1
(very uncommon in Europe)

Type 2

CHAdeMO

CCS

There are 4 types of the most used electric vehicle plug-in connectors currently available on the market. Type 1 and type 2 are intended for alternating current supply, and CHAdeMO and CCS for direct current supply charging station.

Our choice of the most suitable charging stations also depends on what type of charging we will need a charging station for. In residential use, most common are alternating current charging stations which enable slow charging overnight. Direct current charging stations are mostly used in public and utility-scale applications, as they enable fast charging. These charging stations are usually installed in public places and by the highways.

As there are different types of charging stations, there are also different types of protection.

Alternating current charging stations

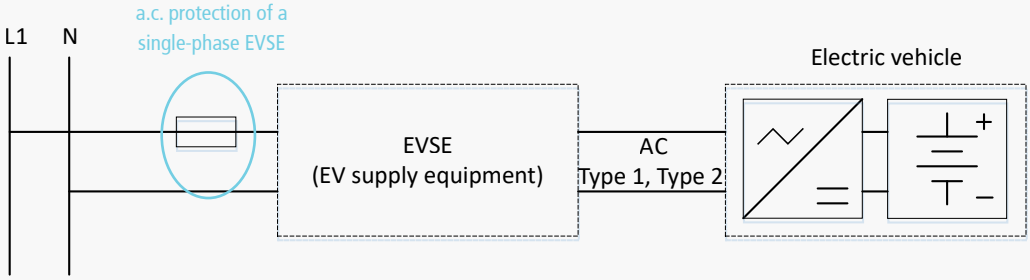
There are two types of alternating current charging stations for residential use, depending on whether they are used in a single-phase or a three-phase system. In general, an a.c. charging station consists of electric vehicle supply equipment (EVSE) and plug-in connector. Protection of EV supply equipment is among basic requirements.

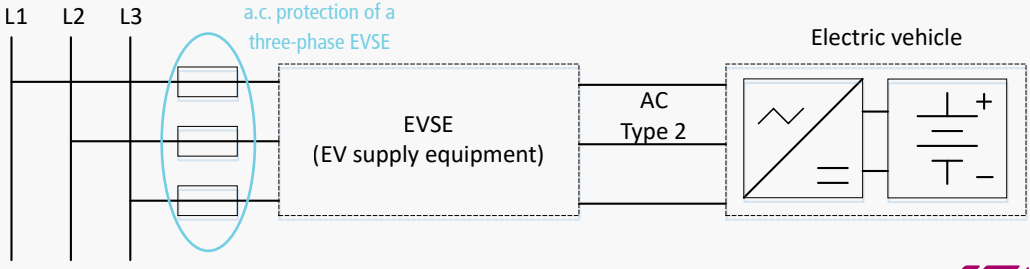
Commonly used values of nominal power and nominal currents for residential use charging stations are shown in the table below:

	P_n	U_n	I_n	Connector type	Use
Single-phase	3.3 kW	230 V	16 A	Type 1, Type 2	Residential
	7.4 kW	230 V	32 A		
Three-phase	11 kW	400 V	16 A	Type 2	
	22 kW	400 V	32 A		
	43 kW	400 V	63 A		

For protection of alternating current EV charging stations we recommend:

- Residual current circuit breakers types eV, B and A
- Residual current circuit breakers with overcurrent protection types B and A
- Miniature circuit breakers
- Cylindrical fuse-disconnectors with cylindrical gG fuse-links
- Surge arresters
- Modular contactors
- DIN rail distribution blocks





Residual current circuit breakers

EFI eV
RCCB, designed especially for protection of EV charging stations

- Meets requirements of standard IEC 60364-7-722 --> Low-Voltage electrical Installations - Requirements for special installations or locations - Supplies for electric vehicles
- Can be used in installations with existing A type residual protection device installed upstream
- Combines the A type RCCB protection with switching off smooth DC residual currents above 6 mA
- Rated conditional short-circuit current: 10 kA
- Rated current: 25 A - 63 A, rated residual operating current: 30 mA
- Supply is possible both from top and bottom terminals

EFI B type
Universal current sensitive RCCB

- Meets requirements of standard IEC/EN 61008-1and IEC/EN 62423 --> additional requirements for type B
- Combines the A type RCCB protection with detection of smooth direct currents and high frequency currents (1kHz)
- Rated conditional short-circuit current: 10 kA
- Rated current: 25 A - 63 A, rated residual operating current: 30, 100, 300 mA
- Supply is possible both from top and bottom terminals
- Instantaneous, short time delay and selective version

EFI-P A type
in 2-pole and 4-pole version

- Meets requirements of standard IEC/EN 61008-1: fault protection (against indirect contact of live parts), additional protection (against direct contact of live parts), fire protection
- Low power dissipation, high mechanical and electrical endurance
- Rated conditional short-circuit current: 10 kA
- Rated current: 16 A - 80 A, rated residual operating current: 30, 100, 300, 500 mA
- Supply is possible both from top and bottom terminals
- Version with neutral conductor on the left side enables the use of standard busbars for connection between RCCB and MCBs
- Reset version for easier identification of the cause of tripping
- Instantaneous, short time delay and selective version

Residual current circuit breakers with overcurrent protection

KZS-4M2p B type
Universal current sensitive RCBO

- Meets requirements of standard IEC/EN 61009-1and IEC/EN 62423 --> additional requirements for type B
- Combines the A type RCCB protection with detection of smooth direct currents and high frequency currents (1kHz)
- Rated conditional short-circuit current: 10 kA
- Rated current: 6 A - 40 A, rated residual operating current: 30, 100, 300 mA

RCBOs KZS A type
in 1-, 2- and 4-module version

- Combine the operation of MCBs and A type RCCBs
- Meet requirements of standard IEC/EN 61009: fault protection (against indirect contact of live parts), additional protection (against direct contact of live parts), fire protection, overload and short-circuit protection
- Rated conditional short-circuit current: 6 kA,10 kA
- Rated current: 6 A - 40 A, rated residual operating current: 30, 100, 300, 500 mA

Miniature circuit breakers

ETIMAT P10
High breaking capacity MCBs

- Meet requirements of standard IEC/EN 61898 and IEC 60947-2
- Number of poles: 1, 1+N, 2, 3, 3+N
- Rated conditional short-circuit current: 10 kA
- Tripping characteristics: B, C, D, K, Z
- Supply is possible both from top and bottom terminals
- Wide range of accessories
- Quick connect and remote control versions available

Cylindrical fuse-disconnectors with cylindrical gG fuse-links

Cylindrical gG fuse-links

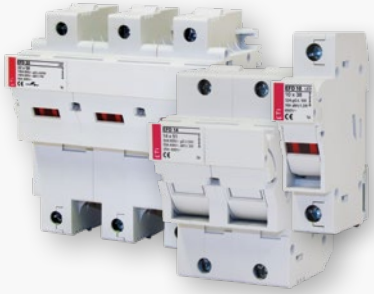
Short circuit and overload protection on a.c. side of EV charging stations.

- Sizes 10x38, 14x51, 22x58
- Rated current: 1-100A
- Breaking capacity 100kA
- Version with striker pin indicator available

Cylindrical fuse-switch disconnectors

Modular design. Electronic indication. Made of material resistant to extremely high temperatures.

- Changing of a fuse-link without danger of direct touch of parts under voltage
- Types EFD10, EFD14, EFD22
- Meet requirements of standards IEC 60947-1, IEC 60947-3, UL 4248-1, UL 4248-4, UL 4248-8 and UL 486E
- Modular design – it is possible to assemble multi-pole versions at the building site
- Version with LED or NEON indication available
- Possible to mount auxiliary switch PS EFD for an indication of fuse-links with striker pin



Modular contactors

Modular contactors RD series

Universal AC/DC coil – extra silent. Designed for use in hot environments (T_a up to 70 °C).

- 1 pole, 2 pole and 4 pole version
- Rated currents: 20 A, 25 A, 40 A and 63 A
- Meet requirements of standards EN60947-4-1, EN60947-5-1, EN61095
- Extra silent operation: DC magnet and rectifier enable DC and AC voltage control (24 V AC/DC or 230 V AC/DC)
- Built in MOV (metal oxide varistor) for surge protection
- Can operate in hot environments up to 70 °C at nominal current

Surge protection devices

Surge protection devices (SPDs) ETITEC CM T23 series
ETITEC CM T23 275/20 2+0, ETITEC CM T23 275/20 4+0

- MOV technology
- Fast & reliable Type 2+3 protection against overvoltages due to indirect lightning strikes such as induced voltages.
- 2 poles (L and N protection) in size of 1 module for single phase systems
- 4 poles (L1, L2, L3 and N protection) in size od 2 modules for 3 phase systems
- RC – remote contact for electrical fault signalling as an option, visual indication by default
- Meet requirements of standards EN 61643-11:2012+A11:2018

Control equipment ETIREL

Analog electromechanical time switch APC-D1, APC-DR1
Controls any electrical installation by means of daily program. With battery backup.

- Manual switch with permanent ON position.
- Sealable cover of frontal panel
- Simple dial time setting. Minimum switching time is 15 min.
- 1 module, DIN rail mounting.

EV wall mounted box

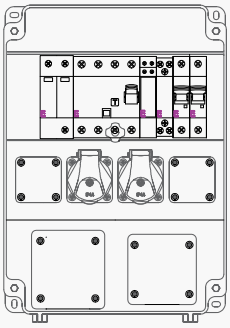
Wall box for mode 2 protection of EV stations for home charging of electrical vehicles (cars and bicycles)
Designed according to requirements of standard IEC 60364-7-722.

- Can be used in installations with existing A type residual protection device installed upstream (EFI eV inside)
- With analog electromechanical time switch and modular contactor for setting the appropriate charging times (e.g. at night)
- Available options: with surge protection, with under/ overvoltage relay, one or two schuko

Compatible with:

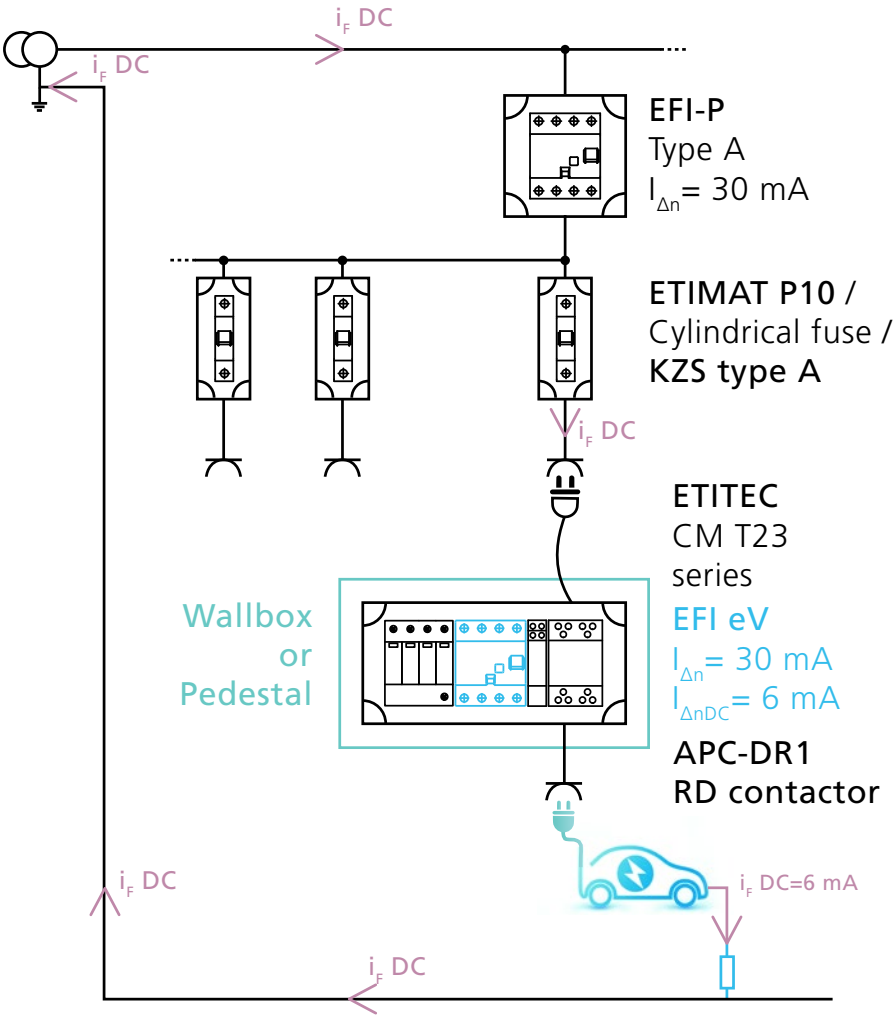
- EV Home charging cable Type 1 and Type 2 to Schuko plug 10/16 A

Applicable in TN and TT earthing systems



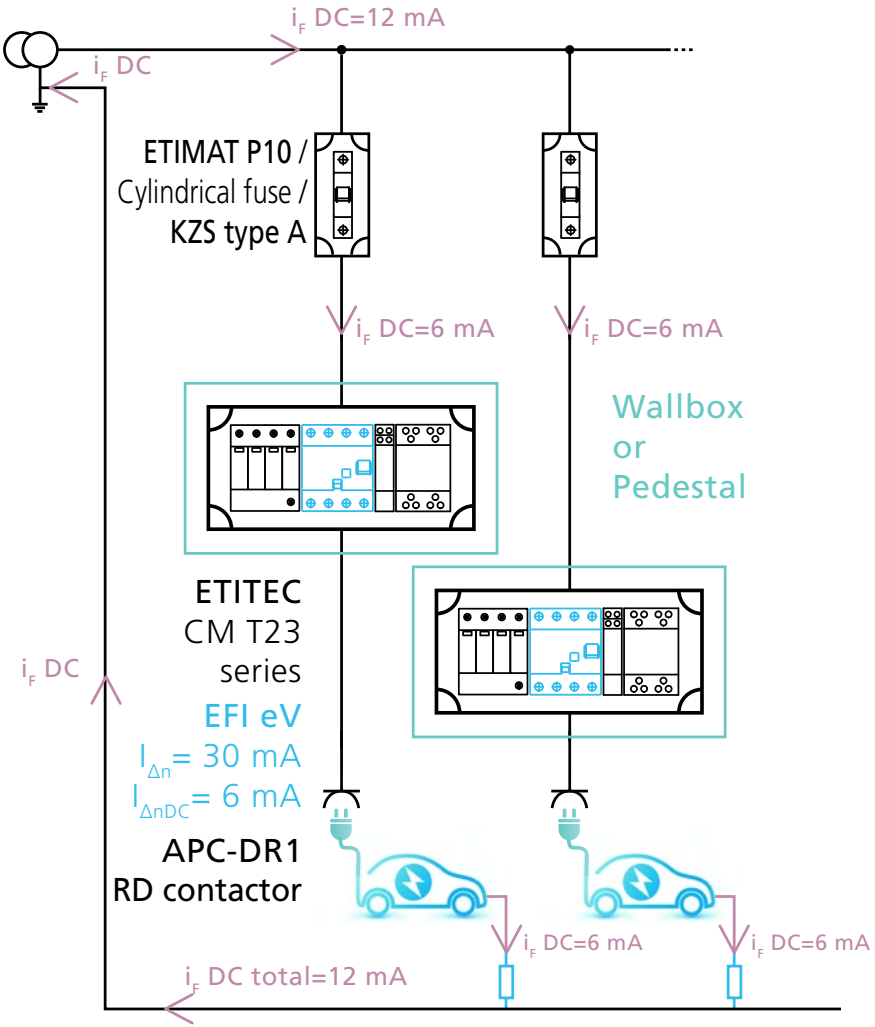
TN-System

If the charging unit is pluged into an existing socket, protected with a Type A RCCB, additional protection against smooth DC residual currents above 6 mA must be provided (IEC 60364-7-722).



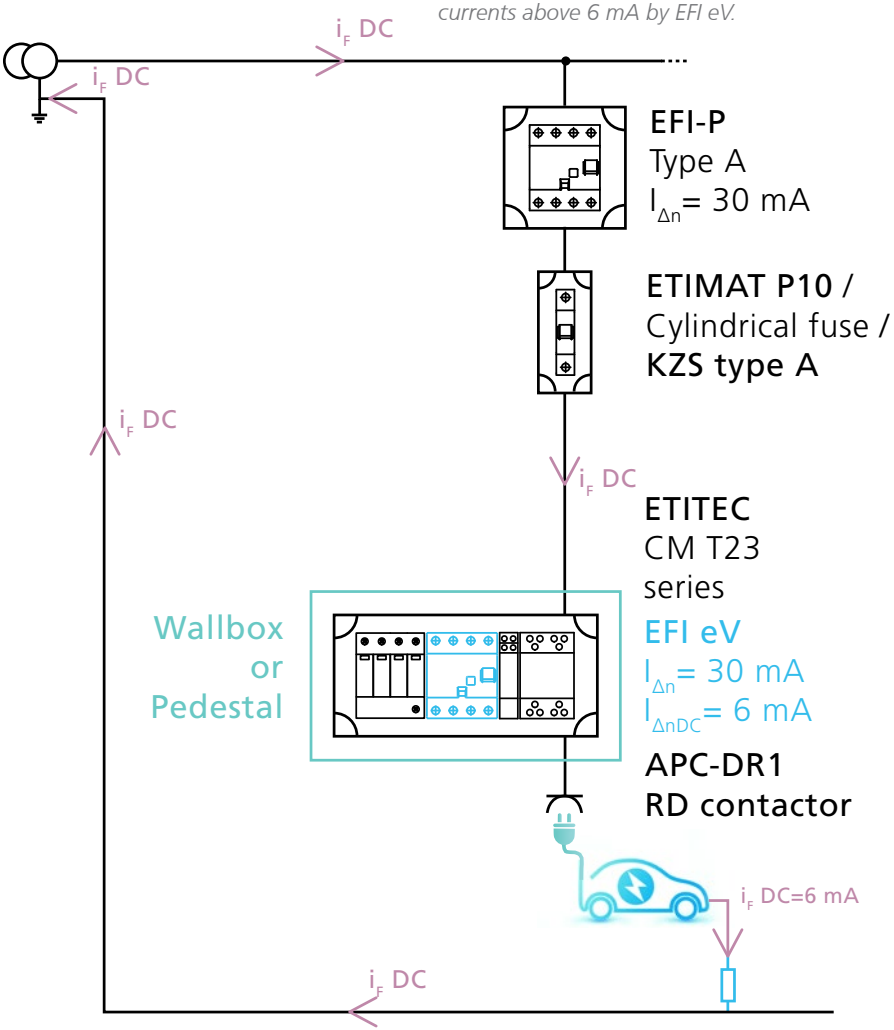
TN-System

If the charging unit has a fixed connection, EFI eV will provide complete protection against residual currents.



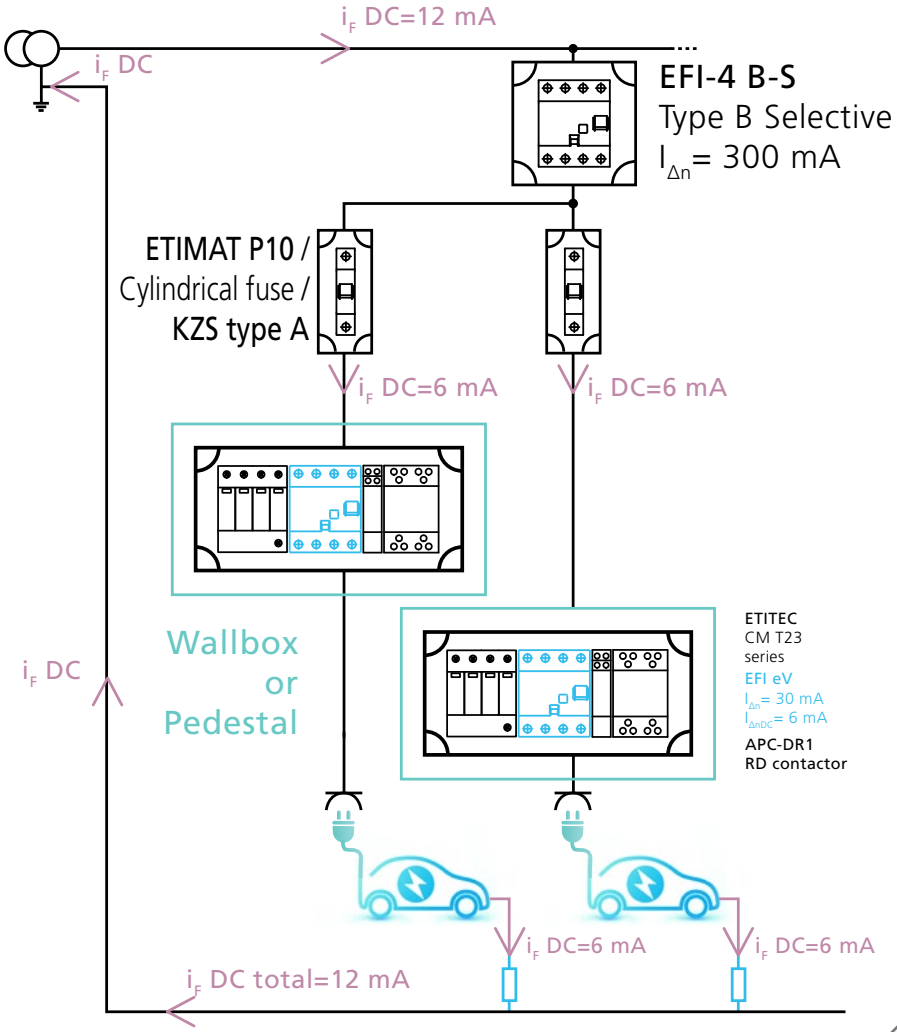
TT-System

In these systems, switch-off times must comply to stricter rules so even the charging units with fixed connection require a Type A RCCB, which needs to be additionally protected against smooth DC residual currents above 6 mA by EFI eV.



TT-System

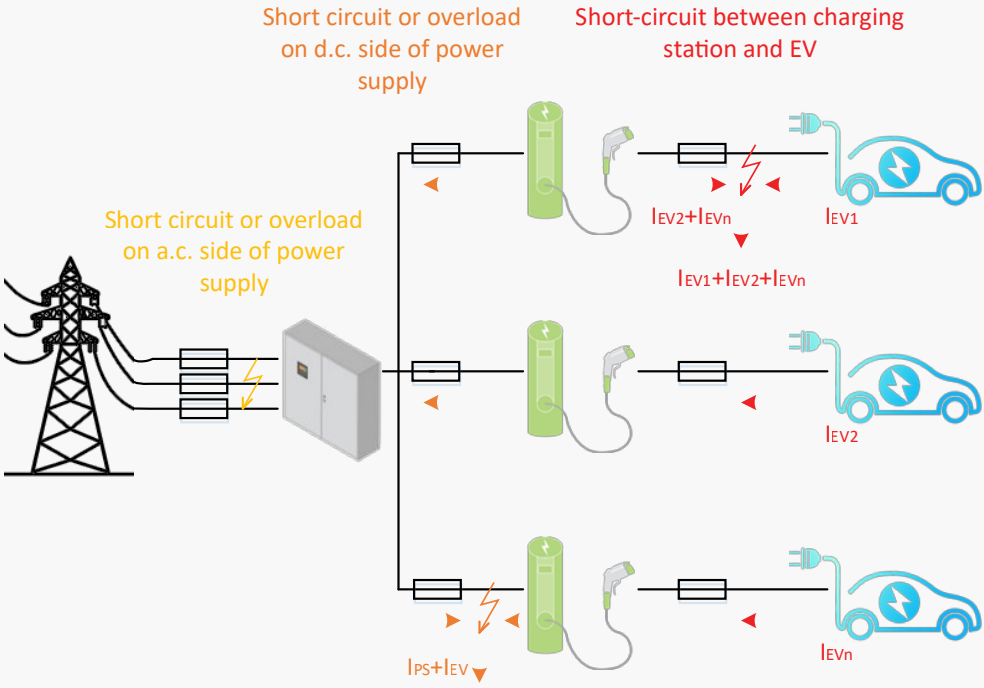
If more charging units are in use, the first RCCB must be a Type B device to protect from the sum of all smooth DC residual currents. Each charging plug socket must also be protected with EFI eV.



Direct current charging stations

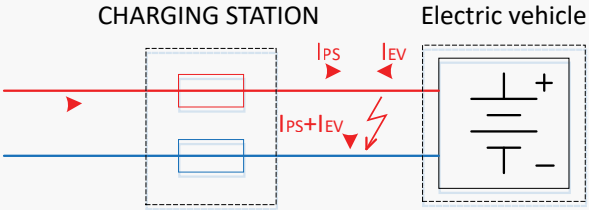
Direct current charging stations have a different and more complex architecture, as three different types of faults can be expected:

- short-circuit or overload on a.c. side of power supply
- short-circuit or overload on d.c. side of power supply
- short-circuit between charging station and EV



Why should we protect both of poles in d.c. system, positive and negative?

In case of electric fault we should take into account that short-circuit is supplied from two sides. From d.c. power supply and from electric vehicle battery. Short-circuit current will flow through the close path of cable. Because of different locations of faults and consequently different forms of short-circuits, protection of both poles is recommended.



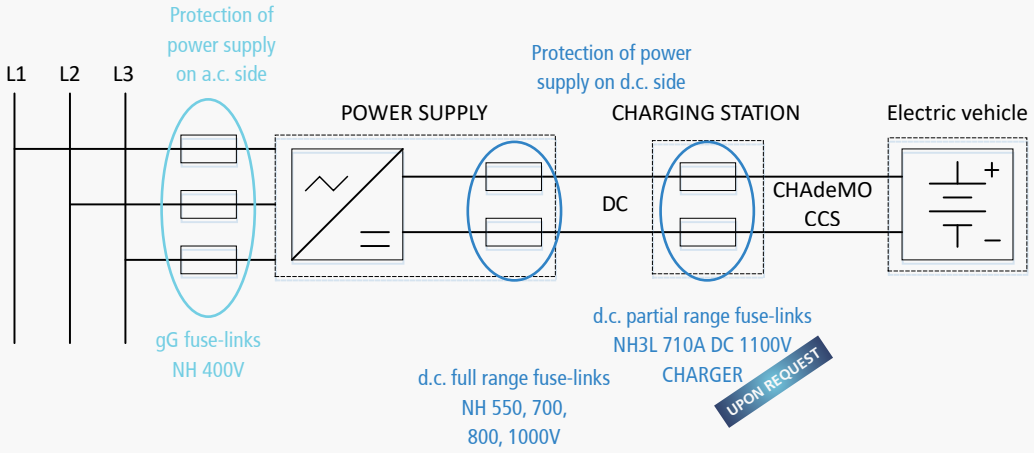
EV chargers in direct current charging stations consist of d.c. power supply, charging station, and plug-in connector. Protection is needed on a.c. side of power supply, d.c. side of power supply and in d.c. charging station.

Commonly used values of nominal power and nominal currents for public and utility-scale use charging stations are shown in the table below:

	a.c. input			d.c. output			
	U_n	I_n	P_n	U_n	I_n	Connector type	Use
Direct current	400V	63-100 A	50 kW	400-500 V	100-125 A	CHAdeMO	Public
		250 A	120 kW	300-500 V	300-350 A	CCS	Utility
		250 A	240 kW	600 V	400 A		
		250 A	350 kW	900 V	400 A		

For a direct current EV charging station we recommend:

- NH gG fuse-links
- NH d.c. full range / d.c. partial range fuse-links



NH fuses

NH gG fuse-links

Short circuit and overload protection on a.c. side of EV charging stations.

- Various NH standard sizes
- Breaking capacity up to 120kA
- KOMBI indication visible on the top and centre of the fuse-link
- Possible to mount NVS5 microswitch
- Version with striker pin indicator available

NH d.c. fuse-links

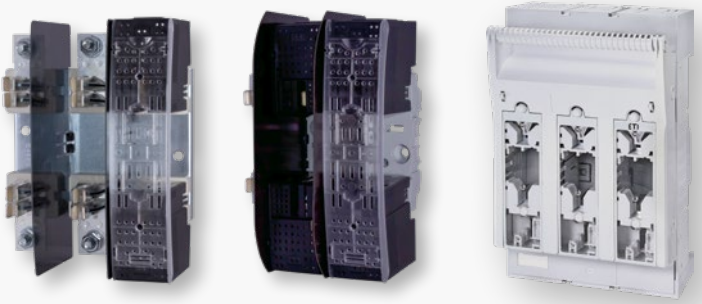
Short circuit and overload protection on d.c. side of EV charging stations

- Full-range or limited range characteristics
- Different voltage ranges depend on customer requirements 550, 700, 800, 1000, 1500V d.c.
- Upon request possible to develop solutions by customer requirements

NH fuse bases

Various types of NH fuse bases with all necessary accessories

- PK fuse bases with ceramic insulation
- PT plastic fuse bases
- Horizontal fuse-switch disconnectors type KVL for AC and DC applications



ETI group

www.etigroup.eu

PARENT COMPANY

ETI D.O.O.
Obrezija 5, 1411 Izlake, Slovenia
Phone: +386 3 5657 570
E-mail: eti@eti.si
http://www.etigroup.eu
http://www.eti.si

ASSOCIATED COMPANIES

ITALWEBER S.P.A.
Via Enrico Fermi 40/42, 20090 Assago, Italy
Phone: +39 02 939 771
E-mail: info@italweber.it
http://www.italweber.it

SUBSIDIARIES

ETI PROPLAST D.O.O.
Obrezija 5, 1411 Izlake, Slovenia
Phone: +386 3 56 57 590
E-mail: etiproplast@eti.si
http://www.etiproplast.si

ETI ELEKTROTECHNIK GMBH
Dorfwiesenweg 13, 63828 Kleinkahl, Germany
Phone: +49 6024 6397-0
E-mail: contact@eti-de.de
http://www.eti-de.de

ETI POLAM SP. Z O.O.
Ul. Jana Pawla II 18, 06100 Pułtusk, Poland
Phone: +48 23 691 93 00
E-mail: etipolam@etipolam.com.pl
http://www.etipolam.com.pl

ETI SARAJEVO D.O.O.
Hifzi Bjelevca 13, 71 000 Sarajevo, BiH
Phone: +387 33 77 52 50
E-mail: etisa@bih.net.ba
http://www.eti.ba

ETI ELEKTROELEMENT S.R.O.
Pacelická 2773/1
9300 Praha - Horní Počernice
Phone: +420 226 203 490
E-mail: info@etielektroelement.cz

ETI UKRAINE, LTD
Ul. Akademika Tupoleva 19,
04128 Kiev, Ukraine
Phone: +380 44 494 21 80
E-mail: office@eti.ua
http://www.eti.ua

ETIBALTUS, UAB
Tilzes 41a, 47187 Kaunas, Lithuania
Phone: +370 37 261 582
E-mail: info@etibaltus.lt
http://www.etibaltus.lt

ETI B
Zvečanska 56/17
11000 Beograd,Serbia
Phone: +381 (0)11 3961 688
E-mail: miodrag.stojkovic@etib.rs
http://www.etib.rs

ETI HU ELEKTROTECHNIKAI, KFT.
Rokolya utca 25, 1131 Budapest, Hungary
Phone: +36 1 238 0784
E-mail: eti@eti-hu.hu
http://www.eti-hu.hu

ETI RUSSIA
St. Ugreshskaya d. 2, Moscow, Russia
Tel: +7 (495) 665-34-80
E-mail: info@etirus.ru
http://www.etimoskva.ru

ETI ROMANIA S.R.L.
Str. Doina, Nr. 17, Sector 5, Bucharest, Romania
Phone: +40 (0)21 317 1743
E-mail: eti.electrice@gmail.com
http://www.etigroup.ro

ETI ELEKTROELEMENT D.O.O.
For technical engineering and store of electrotechnical products
Ulica grada Vukovara 235/V,
10000 Zagreb, Croatia
http://www.eti.si/hr

ETI PROSTIK D.O.O.
Obrezija 5, 1411 Izlake,
Slovenia
Phone:+386 3 56 57 463
E-mail: etiprostik@eti.si

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