



IIT ROORKEE



NPTEL ONLINE
CERTIFICATION COURSE

Charging Infrastructure

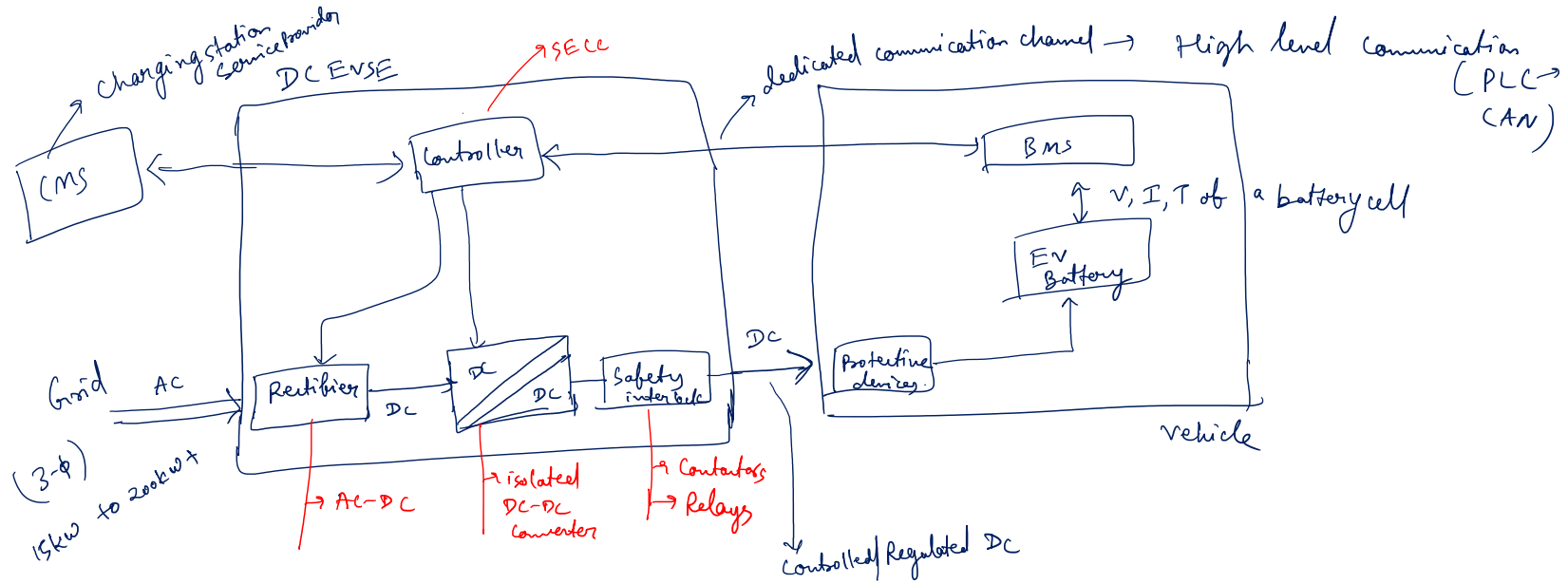
Lecture-4

Review of EV Charger Types and Nomenclatures

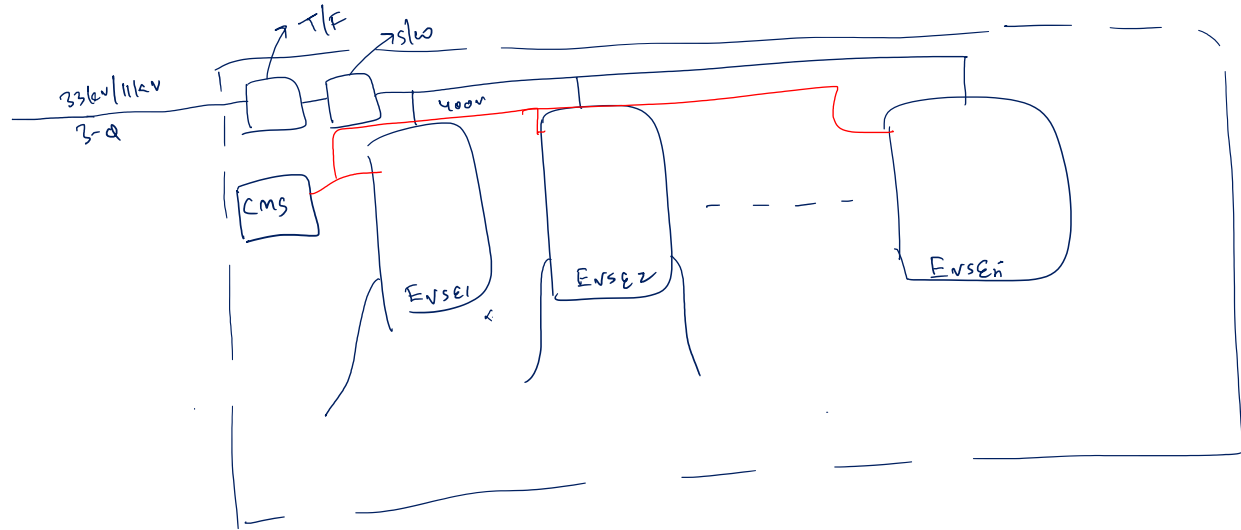
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Department of Electrical Engineering



Recap



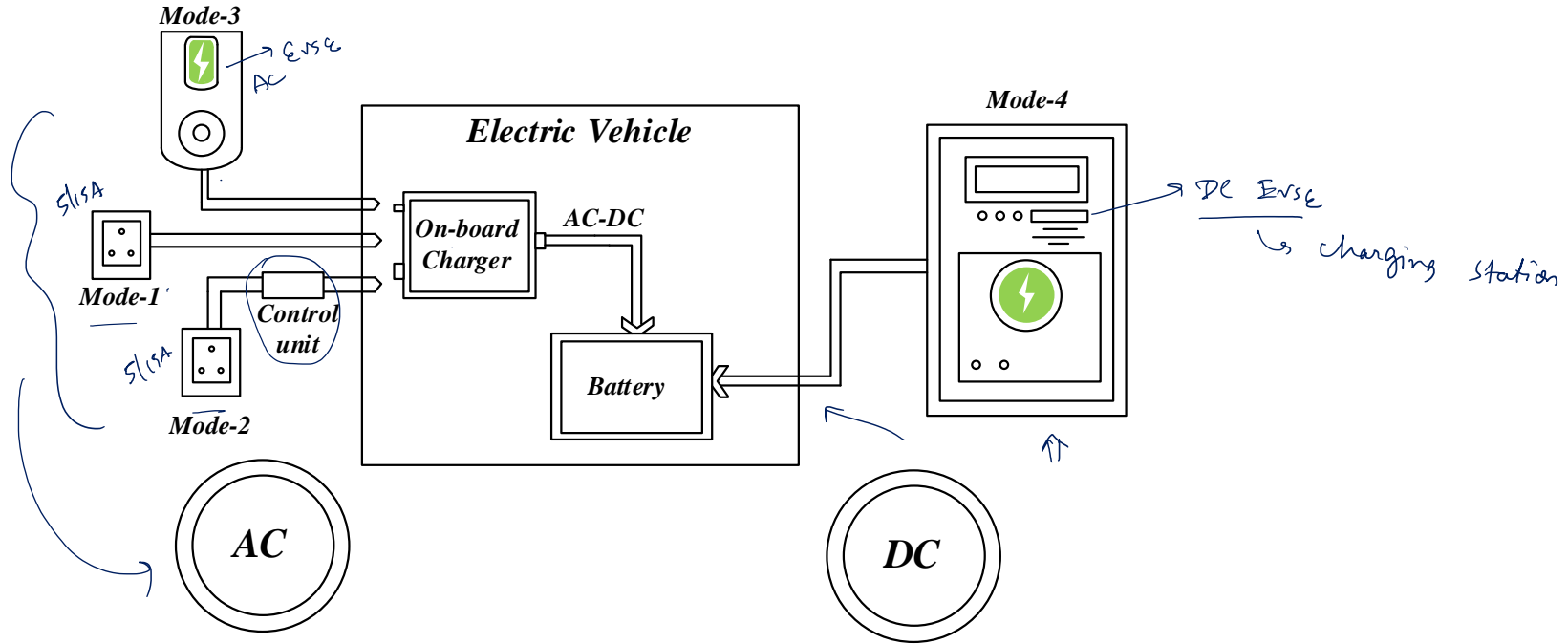
Public Charging Station



$EVSE \rightarrow AC$
 $\rightarrow DC$
 $\rightarrow 1CG$
 $\rightarrow 2CG$
 $\rightarrow 3 \text{ charging socket}$

AIS-138 ,
 $\rightarrow ARAI$

Different Modes of an EV Charger



Source: <https://www.niti.gov.in/sites/default/files/2021-08/HandbookforEVChargingInfrastructureImplementation081221.pdf>

Different Modes of an EV Charger

- Based on the modes of charging, the EV chargers are defined as
 - Mode-1: From a regular electrical wall socket. **For AC chargers** *→ home charging*
 - Mode-2: From a regular electrical socket, but equipped with control box with RCD (residual current device) protection arrangement. **For AC chargers** *→ home charging (portable charger)*
 - Mode-3: Using a specific EVSE with specific connectors. **For AC chargers**.
 - Mode-4: Using a specific EVSE with specific connectors. **For DC chargers**.
- SA/IS A →*
- Charging Station*

Different Levels of an EV Charger

- In India, the charging levels are defined as

S. No	Charging Level	Voltage (V)	Power (kW)
1	<u>Level 1 (AC)</u>	<u>230</u>	<u>≤ 3.5 kW</u> = $230 \times 15 = 3450\text{W}$
2	Level 1 (DC)	<u>≥ 48</u> $\rightarrow 72\text{V}$	<u>≤ 15 kW</u> = $72 \times 200 = 14400$
3	<u>Level 2 (AC)</u>	<u>380-400</u>	<u>≤ 22 kW</u>
4	Level 3 (AC)	<u>200-1000</u>	<u>> 22 kW</u>
5	<u>Level 3 (DC)</u>	<u>200-1000</u>	<u>up to 400 kW</u>

Source: <https://e-amrit.niti.gov.in/standards-and-specifications>



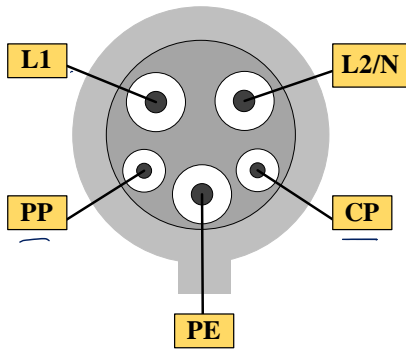
nodes
→ levels

Different AC Charger plugs and Vehicle inlet connectors

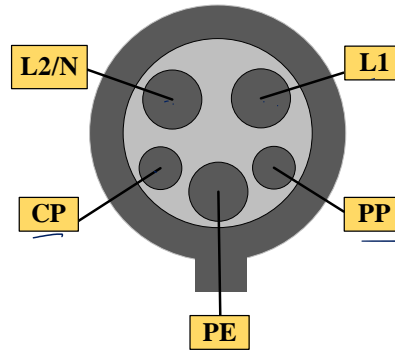


AC Type-1

- Supports single phase AC
- Two AC pins (L1, L2/N), two signals (control pilot, proximity pilot), ^{protective} ~~power~~ earthing
- Uses SAE-J1772 signaling protocol for communications (PWM based)
- Used in US and Japan
- Properly known as SAE-J1772, type-1 or Yazaki connector



Charger Plug



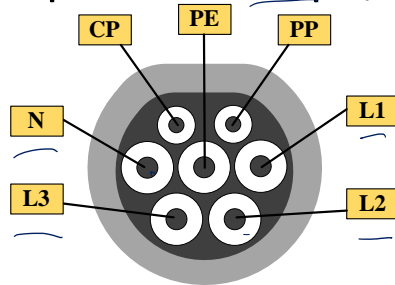
Vehicle Inlet Connector

US

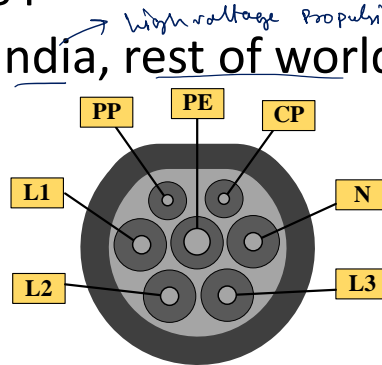
low level communication

AC Type-2

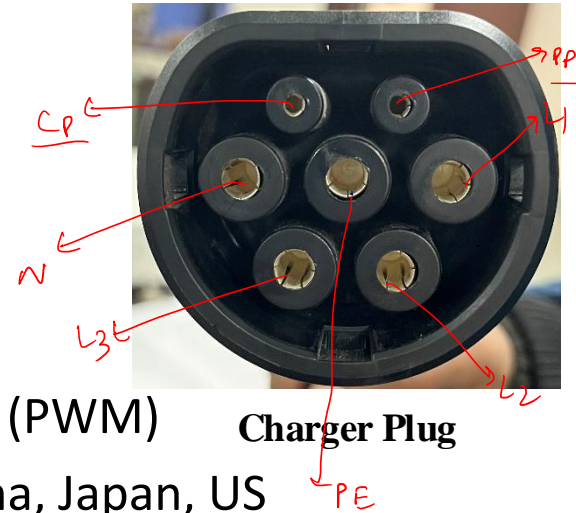
- Both single and three phase AC charging
- Two signal pins, five power pins
- Also called as Mennekes connector
- Connector specifications are given in IEC 62196
- Uses SAE-J1772 signaling protocol for communications (PWM)
- Adopted in Europe, UK, India, rest of world except China, Japan, US



Charger Plug



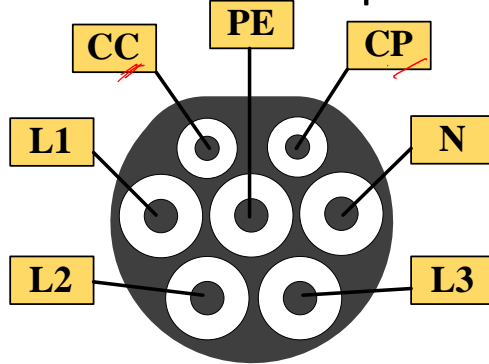
Vehicle Inlet Connector



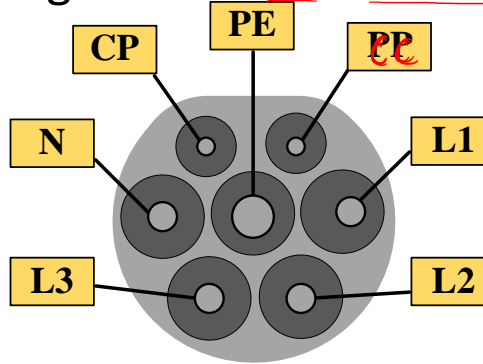
Charger Plug

GB/T AC

- Originated from China
- Formulated by Guobiao Standardization Commission, China
- Two signal pins, five power pins.
- Supports both 1-phase and 3-phase AC.
- The connector specifications is given in GB/T 20234.2 standard.



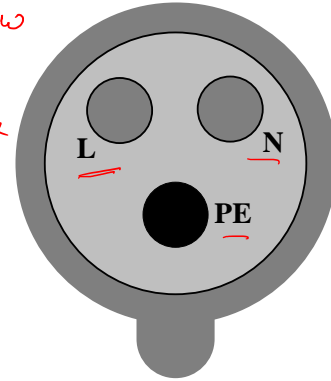
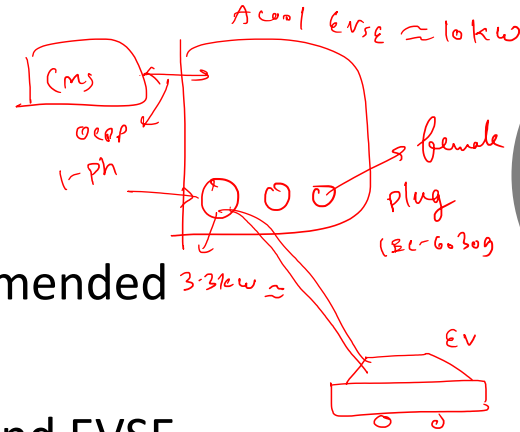
Charger Plug



Vehicle Inlet Connector

AC001

- IEC 60309 industrial plug and connector
- Support single-phase supply
- EVSE with 3 independent output are recommended
- Used for 3-Ws or early models of cars
- No dedicated communication between EV and EVSE
- OCPP for communication between EVSE and central management system (CMS)



Charger Plug



Female plug (EVSE)



Male plug (from EV with cable)

Introduced by Department of Heavy Industries, Government of India

<https://heavyindustries.gov.in/sites/default/files/2023-09/Standardization%20of%20protocol.pdf>

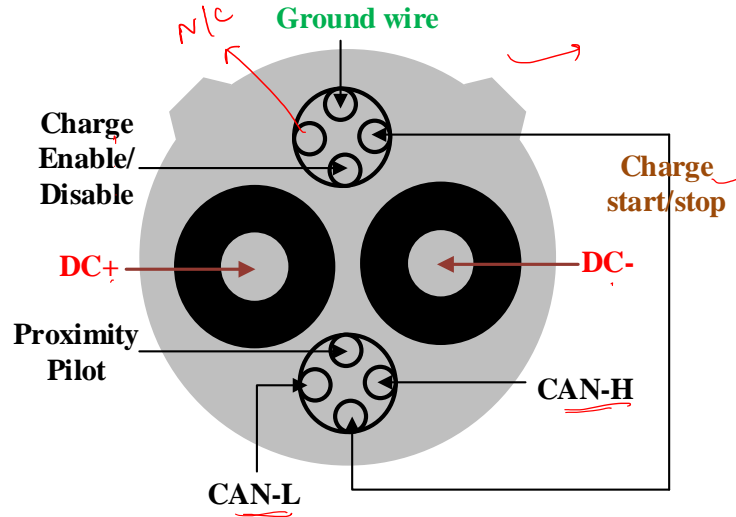
Different DC Charger plugs and Vehicle inlet connectors



DC CHAdeMO

→ Communication
→ Connector

- Adopted in Japan, initiative by Japanese manufacturers: Fuji heavy industries ltd, Toyota, Nissan, Tokyo electric power company, Mitsubishi
- Uses CAN communication
- Used for DC Charging



500V, 125A → 1st

1000V, 400A → 2nd

only DC charging

DC CCS1

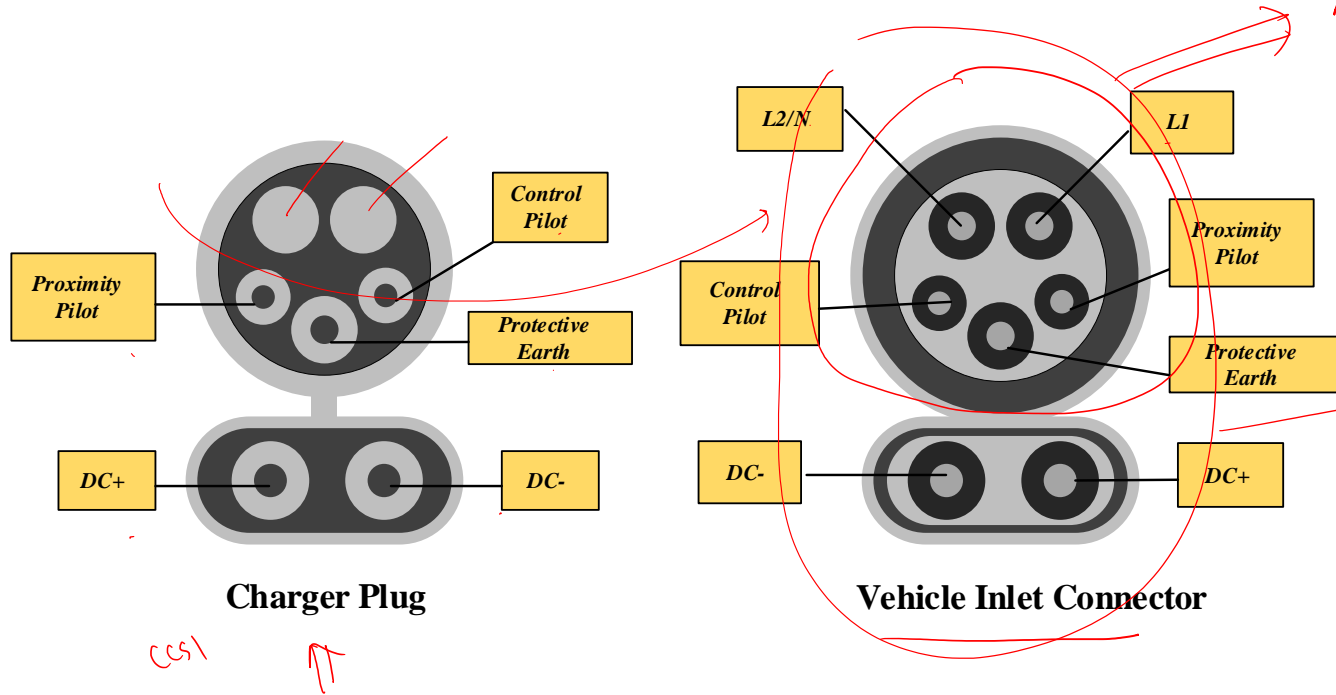
- Combined both AC Type-1 and DC charging
- The Combo AC and DC charging connector comply with the IEC 62196
- PLC communication for DC charging and PWM signaling for AC charging
- Using one vehicle inlet socket, both AC and DC charging can be done
- CCS1 is used in US, JAPAN.

Powerline communication

ISO 15118 / DIN SPEC 70121 / IEC 61851
↓
PLC

SAE J1772

DC CCS1



Accomodate Type 1 charges AC

to facilitate DC charging

CCS1



DC CCS2

- Combined both AC Type-2 and DC charging
- The combo AC and DC charging connector comply with the IEC 62196
- PLC communication for DC charging and PWM signaling for AC charging
- Using one vehicle inlet socket, both AC and DC charging can be done.
- CCS2 is accepted in Europe, India and UK → *by high population system*
- The communication is compliant with IEC 61851, ISO 15118, DIN SPEC 70121. → *Germany*

↓
PLC

1000V, 500A

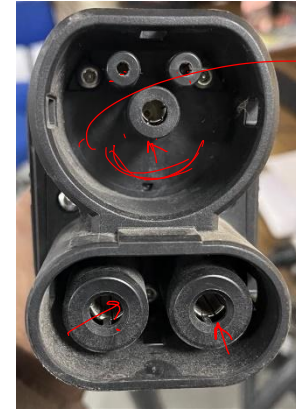
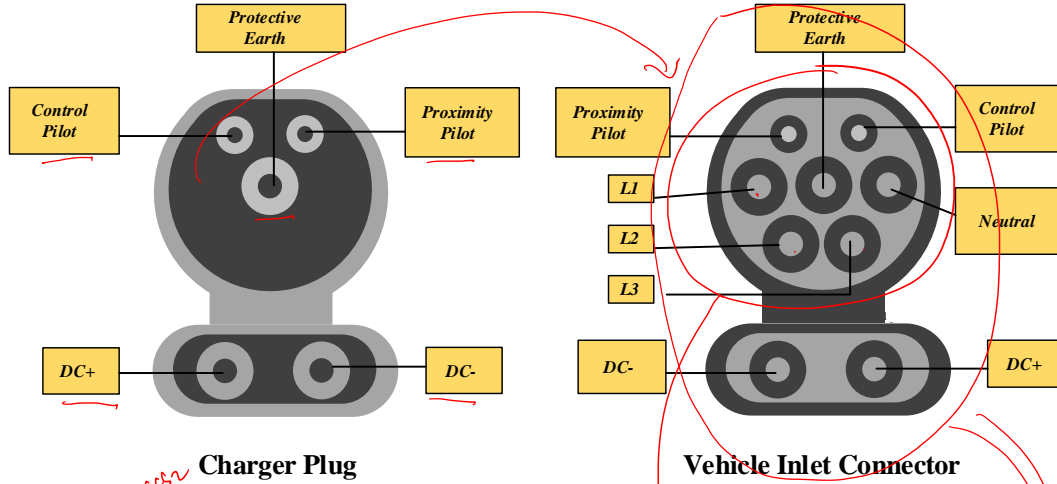
↓
A1S-138 - Part-2

400kw

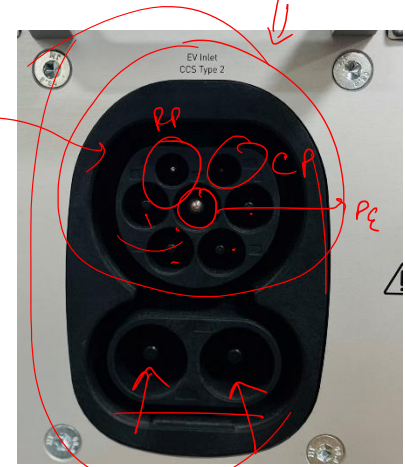
50kw / 60kw

IS-17017-2-3
→ CCS2 & Chademo

DC CCS2



Charger Plug

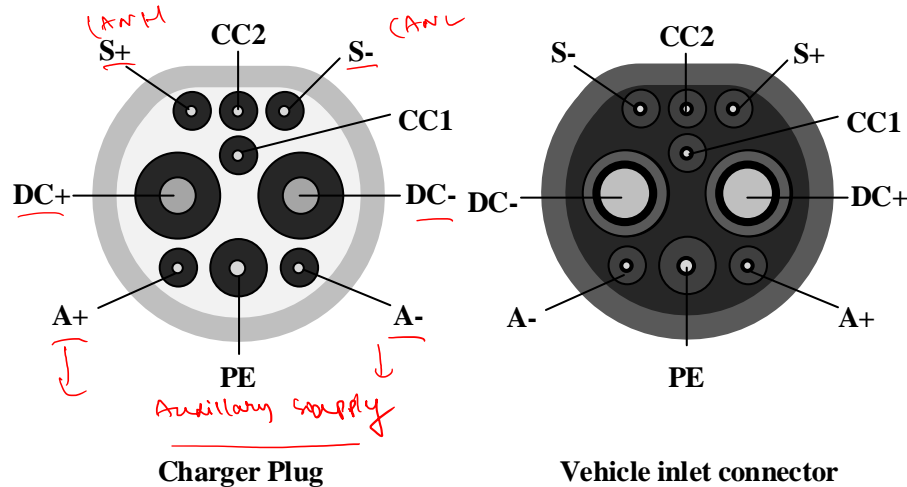


Vehicle Inlet Connector

AC Type 2 connector
DC charging

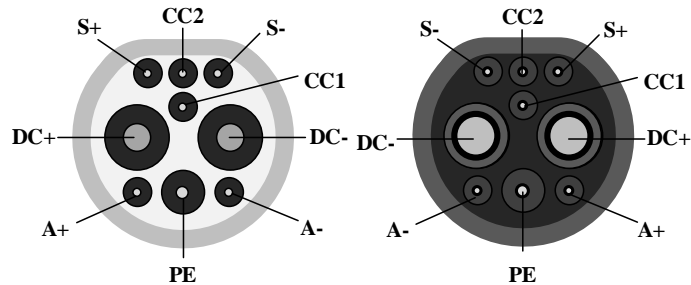
DC GB/T

- Originated from China
- Uses CAN communication
- Voltage: 1500V and Current: 800A
- Uses GB/T 20234.3 connector



BEVC-DC001

- Input: 3-phase AC
- Output: Supports up to a maximum of 10kW for 48V system and 15 kW for 72V systems ≈ 200A ≈ 200A
- Communication is derived from IEC 61851-24 and GB/T 27930 (application layer)
- Uses CAN communication
- GB/T 20234.3 Connector with 5 m Cable



Charger Plug

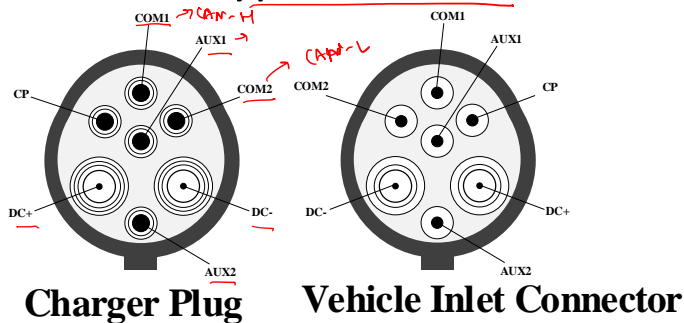
Vehicle inlet connector

Introduced by Department of
Heavy Industries, Government
of India

<https://heavyindustries.gov.in/sites/default/files/2023-09/Standardization%20of%20protocol.pdf>

DC Connector for LEVs

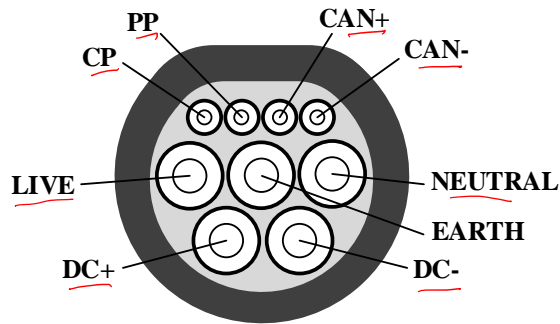
- Input: 3-phase AC
- Output: Supports up to maximum of 12 kW upto 120V DC → 120V, 100A
- The plug gets accepted by Bharat charging alliance (BCA) and incorporated in IS-17017-2-6 standard →
- Communication using CAN communication as per IS-17017-25
- Also called as Type-6 connector



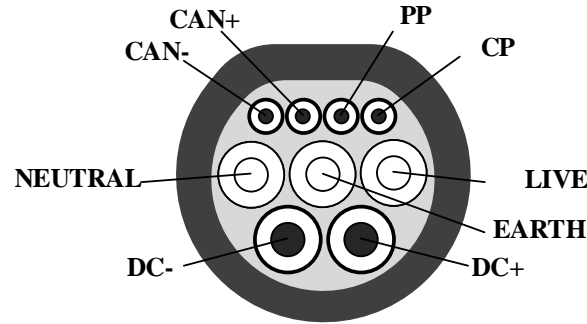
<https://evstory.in/bharat-charge-alliance-promoted-lev-dc-charging-standard-gains-stronghold/>

Combined AC and DC connector for LEVs

- Input: 3-phase AC
- Output: Supports up to maximum of 12 kW up to 120V DC; 7 kW up to 240V AC 1-ph
32A
- Incorporated in IS-17017-2-7, supports both AC and DC charging systems for LEVs
- Communication using CAN communication as per IS-17017-31
- Also called as Type-7 connector 2w





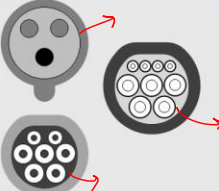







Charger Plug



Vehicle Inlet Connector

Region-wise Chargers Used

Type of Charging	North America	Japan	EU & rest of the market	China	India
AC					
Plug Name	Type 1	Type 1	Type 2	GB/T	IEC-60309, Type 2 Type-7
DC					
Plug Name	CCS1	CHAdeMO	CCS2	GB/T	GB/T, CCS2, CHAdeMO, Type-6, Type-7

HV → 4w_s

→ CCS 2
→ CHAdeMO

→ LV → 2w_s, 3w_s

Summary of the Chargers

Sl. No.	Particulars	CCS	CHAdeMO	GB/T	<u>BHARAT</u>
1.	Region	Originated in <u>USA</u> but adopted <u>Worldwide</u>	Originated in <u>Japan</u> , adopted <u>worldwide</u>	<u>China</u>	India
2.	Charging connector	<u>SAE J1772/IEC 62196-2</u>	<u>CHAdeMO</u>	<u>GB/T-20234</u>	GB/T-20234, IEC-60309, <u>IS17017-2</u>
3.	Communication	PLC	CAN	CAN	CAN, PLC
4.	Type of Charging	<u>AC and DC</u>	DC	<u>AC and DC</u>	<u>AC and DC</u>

→ Dc001, Ac001
 → AIS-138 - Port-1, Port-2 → CCS2, CHAdeMO
 → BIS → IS17017-2 | Sec 2 → AC
 Sec 3 → DC
 Sec 6 → AC (LEV)
 Sec 7 → AC (LEV)
 Sec 24 → CAN (CHAdeMO)
 Sec 25 → CAN (Type-6)
 Sec 31 → CAN (Type-7)
 ISO-15118 → CCS2 (PLC)

H.V. → CCS2, AC Type 2
 L.V. → Dc001, Type-6/Type-7

→ Dc001
 → Ac001
 → IS-17017-2-2

Thank You

