
INSTALLATION GUIDE

HVC-PD E-Bus Charger

Installation Guide for NA products

Version 1.2



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Version control

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Glossary

AC

Alternating Current.

ACM

ACS Control Module

ACS

Automatic Control System. In this charger system the pantograph.

CAF

Customer Acceptance Form.

Contractor

Entity hired by the owner / site operator to do engineering, civil and electrical installation work.

DC

Direct Current.

Grid provider

Company responsible for the transportation and distribution of electricity.

HMI

Human Machine Interface; the screen on the charger.

HVC

Heavy Vehicle Charger.

Power Cabinet

Intermediate unit that provides 150 kW of DC power to the Charge control set. Gets its power from a power distribution board.

Interlock

The Interlock is an isolated current loop and is a feature that makes the state of two mechanisms or functions mutually dependent.

LAN

A computer network that interconnects computers systems within a limited area.

NOC

ABB Network Operating Centre; remotely checks the correct functioning of the charger.

OPP Charge

Is a trade name of fast charging method for electric vehicles.

Owner

The legal owner of the charger.

Pantograph

The mechanical contact linkage of the charger through which the DC charge power is electrical transported to the electrical vehicle.

PD

Panto Down. A charge system where the pantograph is mounted external from the vehicle.

PE

Protective Earth.

PPE

Personal Protective Equipment. Equipment such as safety shoes, helmet, glasses, gloves.

RCD

Residual-Current Device.

RFID

Radio-Frequency IDentification. RFID is a communication technology by means of radio waves to transfer data over a very short distance between a reader and an electronic tag or card.

Site operator

The entity is responsible for the day to day control of the charger. The site operator can be the owner, but not necessarily.

TOR

Top of Road

User

The owner of an electric vehicle, who uses the Charge Station to charge that vehicle.

WiFi

A technology that allows electronic devices to connect to a wireless LAN (WLAN) network.

1. Introduction

1.1. Preface

This guide describes the planning and physical installation of the HVC-PD E-Bus Charger with a “fold-out” charge Pole at its location.

The HVC-PD E-Bus Charger is a DC fast charger system for hybrid or electrical buses that are compatible with the OPP Charging standard¹. It is not permitted to use the HVC-PD E-Bus Charger to charge any other equipment, or to use the HVC-PD E-Bus Charger for any other purposes.

The HVC-PD E-Bus Charger uses high-amperage electric currents. Therefore the installation must be planned carefully, and must be done by certified personnel only (according to local standards²).

Before installing the HVC-PD E-Bus Charger, read this Installation Guide carefully and attentively. Follow the instructions in this Installation Guide. ABB is not responsible for any damage that has been caused by not or incorrectly following and executing the instruction described in this manual.




1.2. Intended document users

This document is intended to be used by:

- Customers who purchased a HVC-PD E-Bus Charger, or are in the process of ordering and want to know in more detail how it has to be installed.
- Contractors who are responsible for site preparation and/or installation of the HVC-PD E-Bus Charger.






1.3. Signs

The following signs are used on the equipment and in this manual:

	DANGER
	Hazardous voltage Identifies a hazard that could result in severe injury or death through electrocution.
	WARNING
	Various Identifies a hazard that could result in severe injury or death.
	WARNING
	Rotating parts Identifies a hazard that could result in injury due to the presence of rotating or moving parts.

¹ More information on OPP Charge via www.oppcharge.org.

² Local regulations shall take precedence if they list different installation requirements than prescribed in this Installation Manual.

	<p style="text-align: center;">WARNING</p> <p>Pinch Hazard Identifies a hazard that could result in injuries in which some body parts are pinched or crushed.</p>
	<p style="text-align: center;">WARNING</p> <p>Fall Hazard Identifies a hazard that could result in injury due unsafe work at height.</p>
	<p style="text-align: center;">CAUTION</p> <p>Various Identifies a hazard that could result in damage to the machine, other equipment, and/or environmental pollution.</p>
	<p style="text-align: center;">CAUTION</p> <p>Environmental damage Identifies a special indications as well as biddings and prohibitions to avoid damages in the environment. This sign refer to present national regulation according the environment.</p>
	<p style="text-align: center;">NOTICE</p> <p>Contains remarks, suggestions or advice.</p>

1.4. Safety regulations




1.4.1. Owner responsibilities

The owner and site operator are required:

- To operate the charge station with the protective devices installed and to make sure all protective devices are correctly installed after carrying out installation or maintenance.
- To write an emergency plan that instructs people what to do in case of emergency.
- To prepare the site where the charge station will be installed, according to the requirements described in this guide.
- To make sure that there is enough space around the charger to carry out maintenance work.
- To appoint a person responsible for the safe operation of the charge station and for the coordination of all work.
- All works have to be carried out from qualified personnel. All qualified personnel has to estimate their transmitted works, identify and avoid. They must have experience and enough knowledge over: safety regulations and labor medical regulations, accident prevention regulations, guideline and approved safety regulations, and special instruction concerning occurrence of danger (especially remaining risk) possible dangers.

- You are not allowed to modify the charge system without the permission of ABB. The owner is cautioned that changes or modifications not expressly approved by ABB could void the owner's authority to operate the equipment and ABB's warranty policy.
- Neither ABB nor its affiliates shall be liable to the purchaser of this product or third parties for damages, losses, costs or expenses incurred by purchaser or third parties as a result of: an accident, misuse or abuse of this product or unauthorized modifications, repairs or alterations to this product, or failure to strictly comply ABB operating and maintenance instructions.

1.4.2. Tilting and handling

	<p style="text-align: center;">CAUTION</p> <p>Heavy equipment Handling instructions:</p> <ol style="list-style-type: none"> 1. Use crane or forklift truck when lifting or moving the Power Cabinet and pole construction. 2. Do not drop parts of the HVC-PD E-Bus Charger. 3. Do not exceed a tilting of 30° for the Power Cabinet. 4. Read and follow the ABB <i>Guidance on the requirements for safe operation of mobile cranes</i> (ML-03, 9Akk104941D0113).
	<p style="text-align: center;">WARNING</p> <p>Personal safety (PPE) Always wear a safety helmet, safety gloves and safety shoes when you do the lifting and tilting work.</p>
	<p style="text-align: center;">WARNING</p> <p>Make sure that personnel cannot be crushed or become trapped during lifting and tilting work.</p>

Lifting activities

It is a legal requirement that all activities involving lifting equipment are planned and that they are conducted under effective supervision and managed based on the risk, complexity of the activity and the work environment (EU directive 2009/104/EEG, appendix II, chapter 3.2.5).


It is of great importance, regardless of location, that any lifting activity is performed safely, because the activity:

- Carry out within the framework of an effective management system;
- Properly planned;
- Risk has been assessed;
- Supervision is being held; and
- Performed by skilled personnel and with the appropriate means.





All lifting activities must be performed under the ABB *Guidance on the requirements for safe operation of mobile cranes* (ML-03, 9Akk104941D0113).



When applying this Standard, local laws and regulations must be taken into account at all times. In the event of conflicts, local laws and regulations prevail over this Standard.

1.4.3. Electric hazards


	DANGER
	<p>Hazardous voltage</p> <p>The HVC-PD E-Bus Charger conductors under hazardous electrical voltages. The grid terminals on the internal DIN rail may carry hazardous voltages, even if all circuit breakers are switched off.</p>

1.4.4. Installation safety

	WARNING
	<p>Personal safety (PPE)</p> <p>Always wear a safety helmet, safety gloves and safety shoes when you do the lifting and tilting work.</p>
	WARNING
	<p>Visually examine the package for damage. See section <i>Before unpacking</i> on Page 55 and section <i>Before unpacking</i> on Page 87. If there is damage, do not install the system.</p>
	DANGER
	<p>Hazardous voltage</p> <p>Instructions:</p> <ol style="list-style-type: none"> 1. Always switch off the external group switch before performing any installation, disassembly, repair or replacement of components. 2. Do a voltage check and make sure that the electrical power is disconnected from the system. 3. Only ABB certified technicians are permitted to commission the HVC-PD E-Bus Charger. 4. When the system is in an open or dangerous condition, do not allow unqualified persons to go near it. Instruct and warn people about the potential harmful high voltages. 5. The installation and maintenance personnel must supply their own lighting equipment, since the HVC-PD E-Bus Charger has no lights inside the cabinet. 6. Always connect the Protective Earth (PE) first, before connecting the neutral (N) and Phase (P) wiring. 7. Correctly lock the door after installation or service operations.
	WARNING
	<p>Make sure that there is a minimum free space of 39.37 Inch in front of the door of the Power Cabinet. The minimum space is necessary to allow service personnel to quickly move away from the Power Cabinet if there is an emergency when the door is open.</p>

	<p style="text-align: center;">WARNING</p> <p>Make sure that there is a minimum free space of 39.37 Inch in front of the door of the ACS Control Module. The minimum space is necessary to allow service personnel to quickly move away from the ACS Control Module if there is an emergency when the door is open.</p>
	<p style="text-align: center;">CAUTION</p> <p>Warranty Installation and commissioning work must be carried out by certified personnel. The warranty will be void if any work carried out by non-certified personnel. Un-authorized modifications of hardware will void units warranty and service support.</p>

1.5. Environment and disposal of waste

	<p style="text-align: center;">CAUTION</p> <p>Always observe the local rules and regulations with respect to processing (non-reusable) parts of the HVC-PD E-Bus Charger.</p>
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1.6. Cyber Security Disclaimer

This product is designed to be connected to and to communicate information and data via a network interface. It is customer's sole responsibility to provide and continuously ensure a secure connection between the product and customer network or any other network (as the case may be). Customer shall establish and maintain any appropriate measures (such as but not limited to the installation of firewalls, application of authentication measures, encryption of data, installation of anti-virus programs, etc) to protect the product, the network, its system and the interface against any kind of security breaches, unauthorized access, interference, intrusion, leakage and/or theft of data or information.

ABB Ltd and its affiliates are not liable for damages and/or losses related to such security breaches, any unauthorized access, interference, intrusion, leakage and/or theft of data or information.

1.7. Contact information

ABB in your country

Please contact ABB in your country for sales, delivery and service information.

ABB EV Infrastructure global

ABB EV Infrastructure

Address Heertjeslaan 6
 2629 JG Delft
 The Netherlands

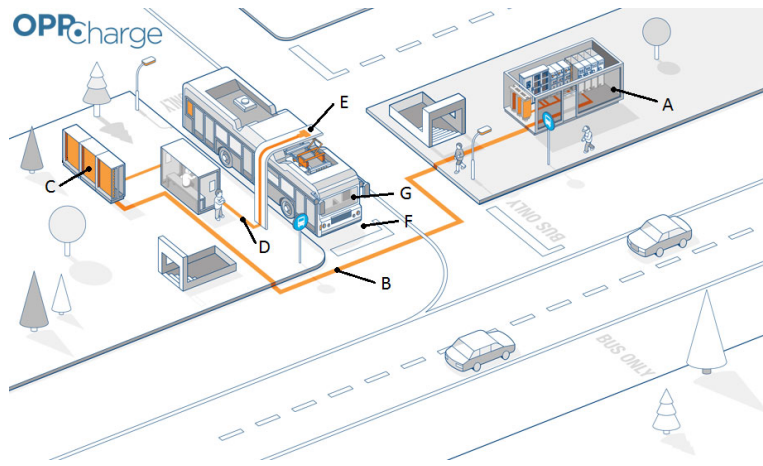
Telephone +31 88 440 46 00

Mail info.evi@nl.abb.com

Write down here your local ABB contact details:

2. Description of the product

2.1. Overview of the system



Example of a complete installation

- A Low voltage power distribution cabinet of the owner
- B Input power cables in cable conduit
- C Power Cabinet – 450 kW (HVC 150 + 2x HVC 150S)
- D Cables between Power Cabinet and charge pole in cable conduits
- E Charge Pole with ACM and ACS
- F Bus stop space for Opportunity Charging (OPP Charge)
- G Electric hybrid and/or full electric Bus

The HVC-PD E-Bus Charger consists out of multiple components and it may require additional parts depending on the project and location of installation which dictates whether these parts are needed.

ABB offers a standard delivery system configurations with a DC charge power of 150, 300 or 450 kW.

Additional needed components can be ordered separately and are not part of the standard delivery. See section *Accessories* on Page 20.

2.1.1. Standard HVC-PD 150 kW E-Bus Charger system

The following parts are provided for this system configuration:

- 1x HVC Panto Down 150 kW primary power cabinet
- 1x fold-out HVC PD charge pole set 150-450kW UL (ABB6AGC100126) or HVC PD charge pole set 150-450kW UL BAA (ABB6AGC100125) including:
 - 1x ACS Control Module (ACM)
 - 1x Pantograph (ACS)
 - 1x Charge state indicator lights with light-sensor
 - 1x Emergency unit
 - 1x WiFi communication unit (for the bus)
 - Pre-mounted cable set for inside the pole
 - Transport and lifting tools

2.1.2. Standard HVC-PD 300 kW E-Bus Charger system

The following parts are provided for this system configuration:

- HVC Panto Down 300 kW set of power cabinets:
 - 1x HVC Panto Down 150 kW primary power cabinet
- 1x HVC Panto Down 150 kW secondary power cabinet 1x fold-out HVC PD charge pole set 150-450kW UL (ABB6AGC100126) or HVC PD charge pole set 150-450kW UL BAA (ABB6AGC100125) including:
 - 1x ACS Control Module (ACM)
 - 1x Pantograph (ACS)
 - 1x Charge state indicator lights with light-sensor
 - 1x Emergency unit
 - 1x WiFi communication unit (for the bus)
 - Pre-mounted cable set for inside the pole
 - Transport and lifting tools

2.1.3. Standard HVC-PD 450 kW E-Bus Charger system

The following parts are provided for this system configuration:

- 1x HVC Panto Down 150 kW primary power cabinet
- 1x fold-out HVC PD charge pole set 150-450kW UL (ABB6AGC100126) or HVC PD charge pole set 150-450kW UL BAA (ABB6AGC100125) including:
 - 1x ACS Control Module (ACM)
 - 1x Pantograph (ACS)
 - 1x Charge state indicator lights with light-sensor
 - 1x Emergency unit
 - 1x WiFi communication unit (for the bus)
 - Pre-mounted cable set for inside the pole
 - Transport and lifting tools

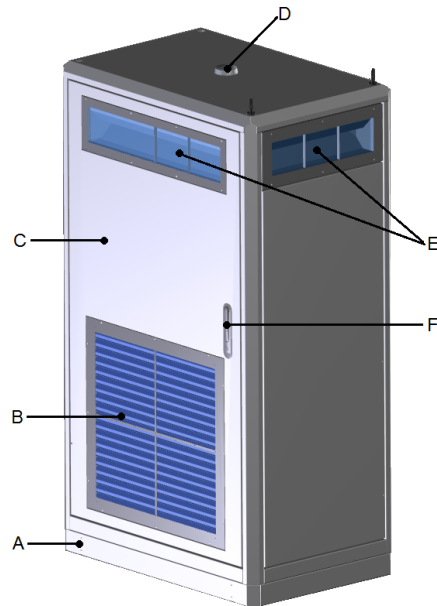


NOTICE

The cables between the Power Cabinet(s) and Charge Pole is not part of the order. See section *Cabling* on Page 49 for selecting the right cable type needed between the Power Cabinet(s) and Charge Pole.

2.1.4. Power Cabinet

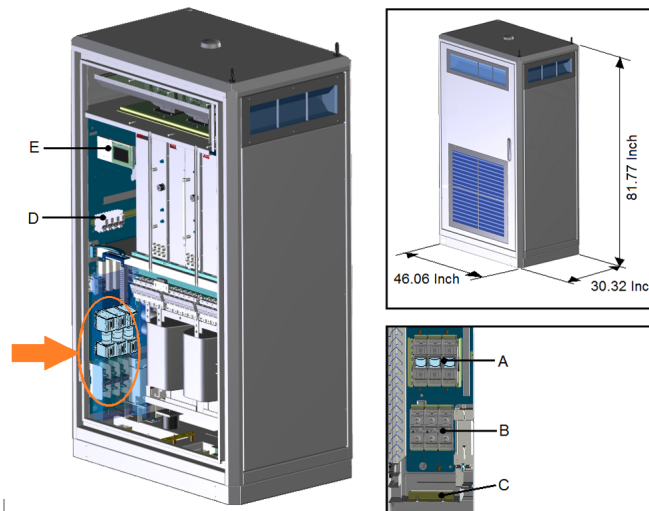
Outside view of the Power Cabinet



- A Base cover
- B Air outlet
- C Door

- D 3G Antenna
- E Air inlets (also on the left and back side)
- F Door handle / lock

Inside view of the Power Cabinet

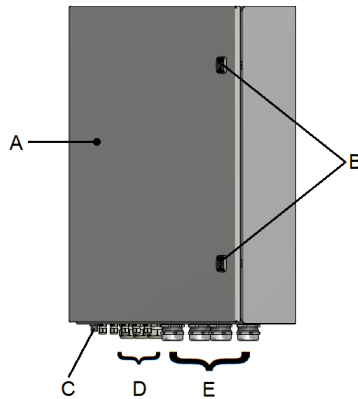


- A AC Fuses
- B AC Power connection
- C Guidance plate of the cables

- D Data/communication connection
- E Display (only present in HVC 150)

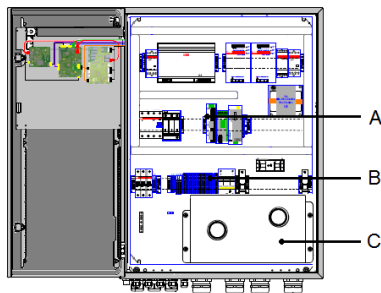
2.1.5. ACS Control Module

Outside view of the ACS Control Module



- A Door
- B Locks
- C WiFi coax connector
- D In- and outputs for cables from Power Cabinet and to pantograph
- E In- and outputs DC power cables

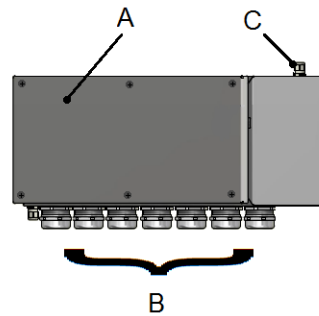
Inside view of the ACS Control Module



- A Communication connection
- B Connection block
- C Protection cover for DC contactors

2.1.6. Junction Box

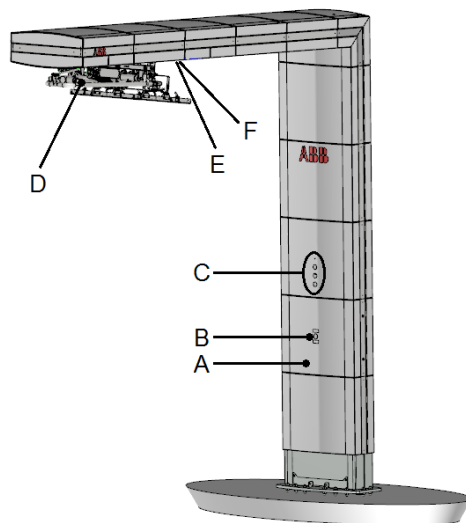
Outside view Junction Box



- A Cover
- B In- and outputs DC power cables
- C Output DC- OVP sensing cable

2.1.7. Charge pole

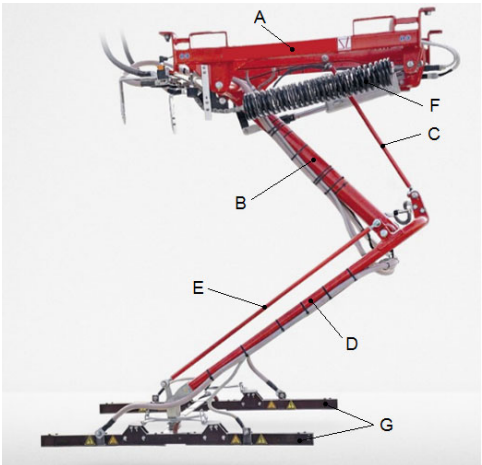
Outside view Charge pole



- A Door
- B Emergency button (EMO)
- C Charge state indicator light with light sensor (beacon)
- D Pantograph (installation specific)
- E WiFi communication unit
- F RFID unit (optional)

View of the pantograph

- A Base frame
- B Lower arm
- C Lower guide rod
- D Upper arm
- E Collector head guidance
- F Tension spring
- G Collector head




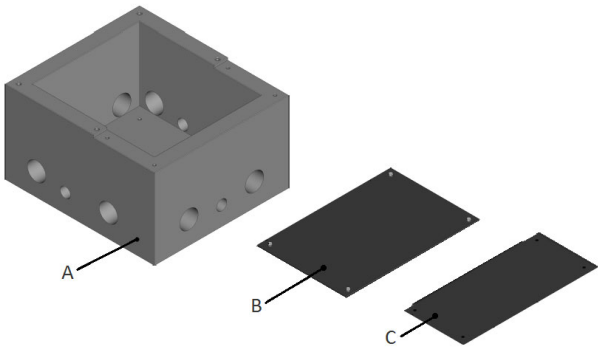
2.2. Accessories

The following parts can be ordered at the time of the initial order or afterwards. Contact ABB Sales department (see *Contact information* on Page 14 for contact details).

2.2.1. Foundation for Power Cabinet (for reference only)

Concrete foundation

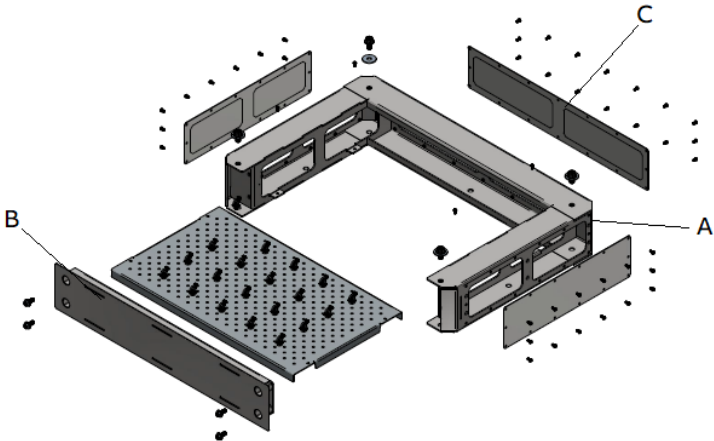
NOTICE	
	Concrete foundations for power cabinet are not sold in NA. Designs are available in Appendix E and must be manufactured by installer, not manufactured by ABB.



- A Foundation
- B Top cover plate
- C Front cover plate

Metal frame foundation

The metal frame foundation can be used to install the Power Cabinet on a solid surface. It also used to provide more cable training and side entry.




- A Foundation
- B Front border cover
- C Rear border cover

Amount	Part number	Description
1	2CEB489802R0001	HPC175-HVC150 MET FOUND KIT 8IN - NAM

2.2.2. Foundation for Charge pole construction

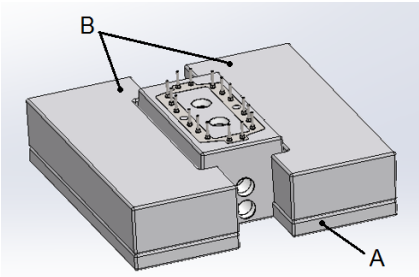
Concrete foundation

The concrete foundation can be used to install the Charge pole construction on soil.



NOTICE

No charge pole foundation in NA. Designs are available in Appendix G and must be manufactured by installer, not manufactured by ABB.



- A Base plate
- B Counter weights

2.2.3. Communication glass fiber cable

The CAN/Ethernet communication between the Power Cabinet and Charge control set is done via a glass fiber cable. This glass fiber cable must be prefabricated and can be ordered separately.


Cable length must be defined by the contractor performing installation during site survey.



- A Protection tube for routing the cable through the conduit
- B Metal finish tulle (clamping area: Ø 0.79 Inch, length 1.97 – 3.15 Inch)
- C Individual optical fibers (length is 59.10 Inch)

Amount	Part number	Description
1	OM3 or greater, prefabricated	OM3, PCF or fiberglass (multimode, 850 nm) optic cable with 8 fibers (4 for spare), with B-FCO(ST®) connectors for each cable.

If glass fiber cable is not supplied by ABB, then gland dimensions listed in section Gland layout of the ACS Control Module on Page 106 must be followed. Please note that special precautions should be taken, so that prefabricated fiber optic cable will pass through the gland (for example order cable with M32 gland assembled on it). Another alternative could be to crimp the fiber optic cable on the site after passing through the gland.

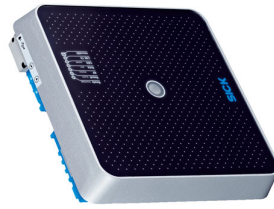


NOTICE

Cable length must be defined by the contractor performing installation during site survey.

2.2.4. RFID unit

Needed when multiple Charge Poles are installed close to each other (distance between each other is lower than 12 m).



Amount	Part number	Description
1	RFU 630-131xx (*)	RFID RFU63x (Sick)
1	SSL-2J04-G10ME (part 6030928)	RFID Ethernet cable 10 m (male connector, M12, 4-pin, straight, D-coded / male connector, RJ45, 8-pin, straight) (Sick)
1	2070427	RFID Power cable 10 m (female connector, M12, 17-pin, straight, A-coded) (Sick)

(*) The RFID unit is available for the following regions:

xx

00 = Europe / Saudi Arabia / South Africa

01 = USA / Canada / Mexico

02 = Australia

03 = India

04 = Brazil

05 = China

06 = Japan

08 = Russia / Belarus

10 = Korea

11 = New Zealand

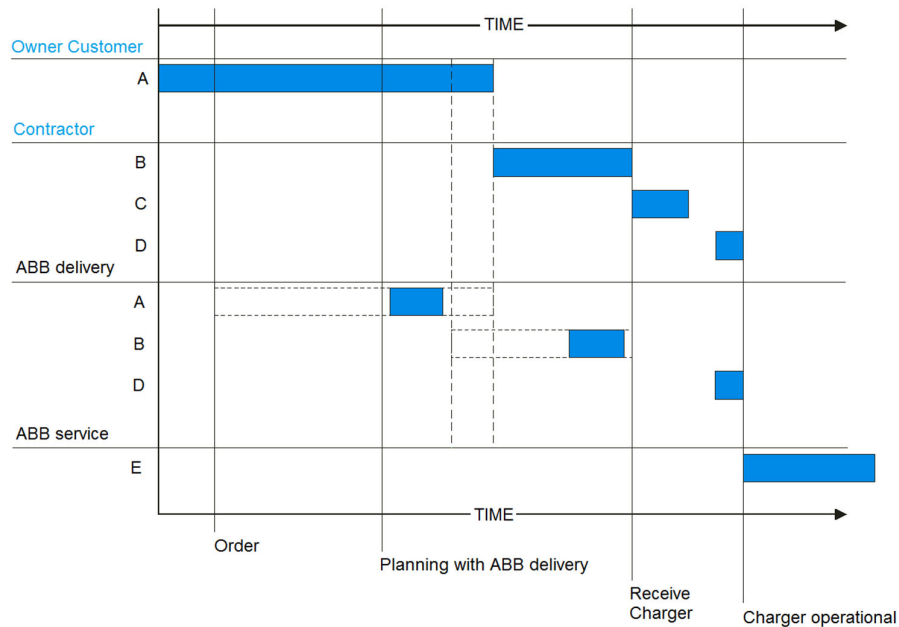
12 = Indonesia

13 = Taiwan

15 = Morocco

2.3. Project planning

Careful project planning is necessary before a HVC-PD E-Bus Charger is purchased and put into operation. The different phases of the full project plan are shown in the figure below:



A. Preparation

The owner / site operator has ordered a HVC-PD E-Bus Charger. In this phase all preparation work must be done before the contractor can do the civil and electrical works. See *About preparation* on Page 25.

B. Construction

The contractor does all civil and electrical works. See *About construction* on Page 38.

C. Placement and Connection

The location is mechanically and electrically ready to receive the HVC-PD E-Bus Charger. See *About placement and connection* on Page 54.

D. Commissioning

The delivery department will bring the HVC-PD E-Bus Charger into operation. See *Commissioning preparation* on Page 121.

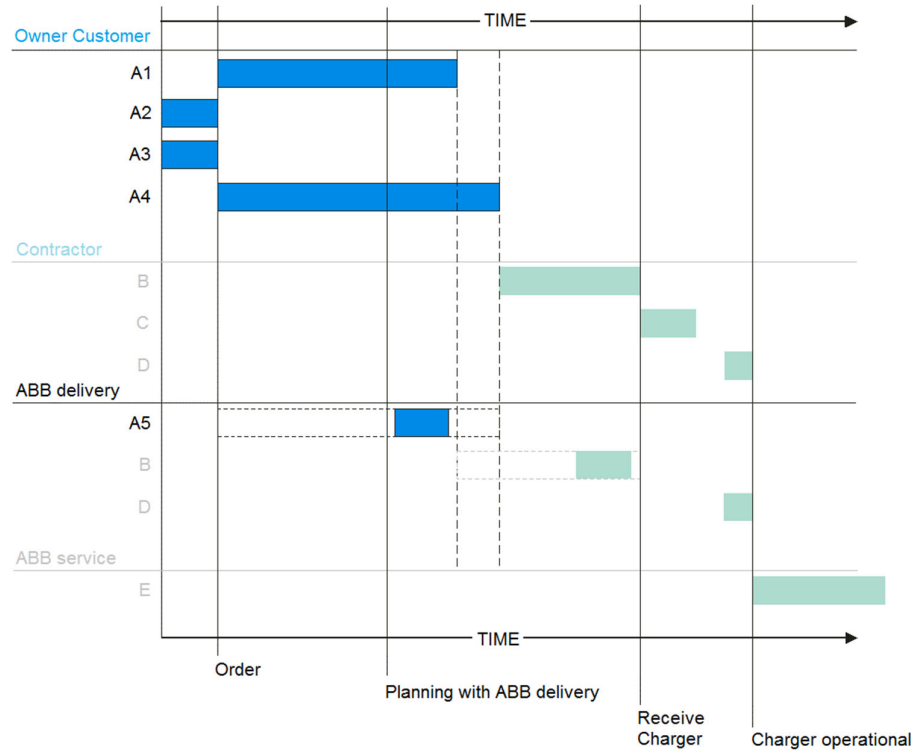
E. Service and Maintenance

The HVC-PD E-Bus Charger is in operation. There are various options for service and maintenance. See *About Service and Maintenance* on Page 123.

3. Preparation

3.1. About preparation

The planning steps for the preparation phase are shown in the figure below:



A1 **Ordering**

Order the HVC-PD E-Bus Charger.

A2 **Engineering**

The owner / site operator selects a contractor to do the civil and electrical installation work. The contractor is responsible for all construction documentation of the site, among other things: drawings, calculations, certifications, licenses and test reports. The location of the HVC-PD E-Bus Charger must be chosen. See section *Location* on Page 27 and section *Geometry of infrastructure* on Page 28.

A3 **Get permits**

Take care of all permits and local regulations. See section *Permits* on Page 26.

A4 **Upgrade grid**

If required, upgrade the electrical grid connection to 3-phase 480/277 V AC or 600/347 V AC. See section *Upgrade grid* on Page 27.

3.2. Permits

The installation of a HVC-PD E-Bus Charger will require a number of permits, depending on national and local laws. This section lists a number of points of attention.

3.2.1. Power connection

The HVC-PD E-Bus Charger requires high current:

- For 150 kW systems:
 - 480/277 V AC 198 A
 - 600/347 V AC 168 A (for Canada version)
- For 300 kW systems:
 - 480/277 V AC 396 A (2 x 198 A)
 - 600/347 V AC 336 A (2 x 168 A for Canada version)
- For 450 kW systems:
 - 480/277 V AC 594 A (3 x 198 A)
 - 600/347 V AC 504 A (3 x 168 A for Canada version)

A normal domestic or small business power connection is not sufficient.

Measure, check and report the position of the cables between the power distribution board and the Power Cabinet and the cables between the Power Cabinet and the ACS Control Module.

Contact your electricity retailer and/or grid owner if a grid upgrade is required. Ask about the work that is needed to upgrade the connection to meet the requirements described in section *Electrical installation* on Page 36.

3.2.2. Construction permit

The installation of the HVC-PD E-Bus Charger requires the following construction work:

- A solid base.
- Work permit.
- Cable conduits for cables between the power distribution board and the Power Cabinet. Usually these cable conduits are installed below ground.
- Cable conduits for cables between the Power Cabinet and ACS Control Module.
- Parking spaces for the bus.
- Signs on the road or next to the road to position the bus.

Contact your local government to obtain information about the necessary permits.

3.2.3. Internet access

The HVC-PD E-Bus Charger requires a connection to the internet. This connection is used for serviceability, remote access by ABB Service department.

There are two options for the internet connection:

- Wireless, which requires coverage to a 3G network at the location. This is the preferred connection. A 3G modem with active SIM card is included with the HVC-PD E-Bus Charger (a customer SIM card is not required).
- Ethernet (RJ45). If there is no 3G signal available, a wired internet connection must be available at the location. For this option, contact ABB Sales department (see *Contact information* on Page 14 for contact details).

3.3. Upgrade grid

The HVC-PD E-Bus Charger can be connected directly to the electrical grid or to an existing customer low voltage power distribution cabinet. In both cases a 198 A, 480/277 V AC or for the Canada version a 168 A, 600/347 V AC, 60 Hz, 3P+GND connection to each Power Cabinet (HVC 150 or HVC 150S) is required. For each Power Cabinet (HVC 150 or HVC 150S) is necessary that meets the following requirements:

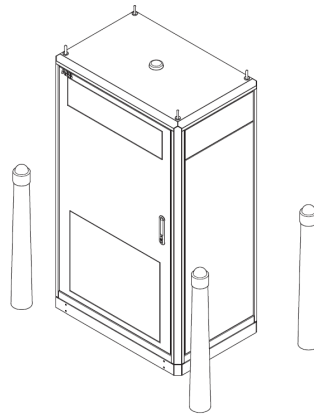
- 3 phase 250 A Circuit Breaker.
- Main switch.
- GND connected to the main GND rail.
- The components used in the HVC-PD E-Bus Charger are suited for a short circuit capacity of 65 kA.
- A TN-C earthing system. Possibly an extra 0.9 Ω earth electrode is required, consult the grid owner.
- EMC filter is required to meet EMC conducted emission class B: Schaffner type FN 3359HV-400-99. When EMC conducted emission class A is required there is no filter required.
- Specifications of the following parts must be determined by your electrical engineer. They depend on local laws, safety and electrical regulations:
 - Adjustable GFCI in the range of 30 mA up to 300 mA. The Power Cabinet has an integrated 300 mA GFCI (Type A) for the power section.
 - UL 1449 Type 1 Surge Protection Device (SPD).

3.4. Location

The location of the HVC-PD E-Bus Charger must meet the following requirements:

- The charging system should not be installed in the hazardous location identified per the standard ANSI/API RP 500-2012: Recommended Practice for Classification of Locations of Electrical Installations at Petroleum Facilities Classified as Class I, Division 1 and Division 2.
- The height is not more than 6561.68 ft above sea level.
- The HVC-PD E-Bus Charger must not be immersed in water, or any other fluid.
- The operational temperature of the HVC-PD E-Bus Charger is between -35 and 45 °C.
 - For locations where the Power Cabinet will be exposed to direct sunlight and high ambient temperatures for most of the day, it is recommended to install protection from direct sunlight. Otherwise, the temperature inside the cabinet might exceed the maximum temperature.
- Do not install or use the HVC-PD E-Bus Charger in areas where there is an explosion hazard. You must provide information about the HVC-PD E-Bus Charger to the fire brigade.
- The protection rating of the housing of the Power Cabinet is IP54 while the ACS Control Module is IP65. Both designed for outdoor use.
- The maximum wind speed the pantograph can still operate is 44.8 mph (8 Bft). The maximum deflection of the Charge Pole at a wind speed of 89.5 mph (14 Bft) is 3.94 Inch.
- The stability of the Charge Pole is calculated using the earthquake zone of Italy (S=12) according to EN 1998.
- It is recommended to provide good lighting around the Charge Pole to increase safety and reduce misalignment.
- It is recommended to indicate the maximum drive-through height (177.17 Inch) for other traffic.

- Design and arrange the location around the HVC-PD E-Bus Charger on a matter that the Charge Pole and the Power Cabinet are hit by a vehicle is as small as possible. For example, there can be installed bollards (see picture below).




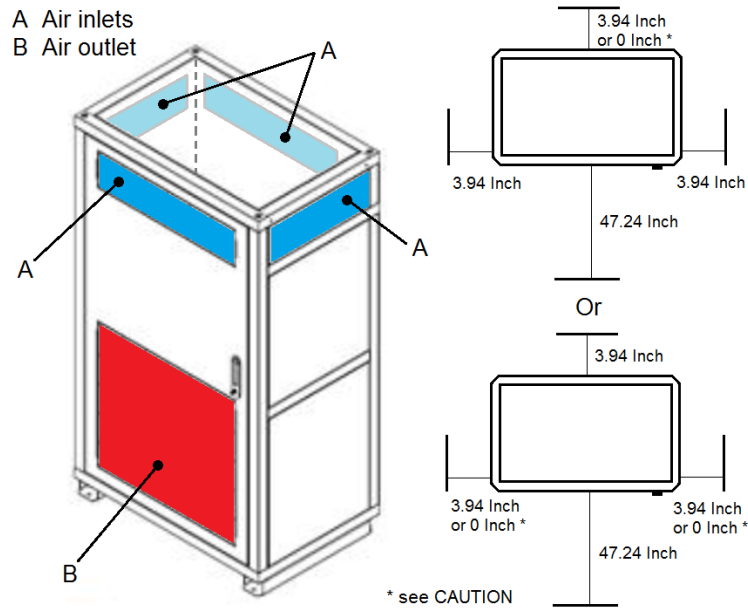
3.5. Geometry of infrastructure

3.5.1. Required space for the Power Cabinet

A single HVC 150 (or HVC 150S) Power Cabinet requires a minimum space of 46.06 x 81.50 Inch (W x D) or 53.94 x 77.56 Inch (W x D). This space is calculated as follows:

- A cabinet footprint of 46.06 x 30.32 Inch.
- The following free space around the cabinet:
 - 3.94 Inch at the rear side or 0 Inch at the rear side when both left and right side have a minimum free space of 3.94 Inch.
 - 3.94 Inch or 0 Inch at the left side, if another Power Cabinet is placed next to it.
 - 3.94 Inch or 0 Inch at the right side, if another Power Cabinet is placed next to it.
 - 47.24 Inch at the front side in order to open the front door. If the cabinet is placed inside a room, consider extra free space in front of the open door (escape way for service people).

	CAUTION
	<p>The cabinet needs at least the opening area of the front and rear side with a minimum free distance of 3.94 Inch. This means that cabinets can stand in a row with one or both side entries blocked (distance on left/right side is 0 Inch).</p> <p>It is also possible that the cabinet can stand back to back (distance on the rear side is 0 Inch). In this case both side entries must have a minimum free distance of 3.94 Inch. If this is not the case, then the air supply is not sufficient.</p>



The HVC 150(S) has air inlets (A) on all sides and air outlet (B) on the front to control the temperature inside the cabinet. Do not install any objects near these air inlets and outlets (see also Caution above). If necessary, take precautions to prevent snow, sand or dust from blocking the inlets and outlets.

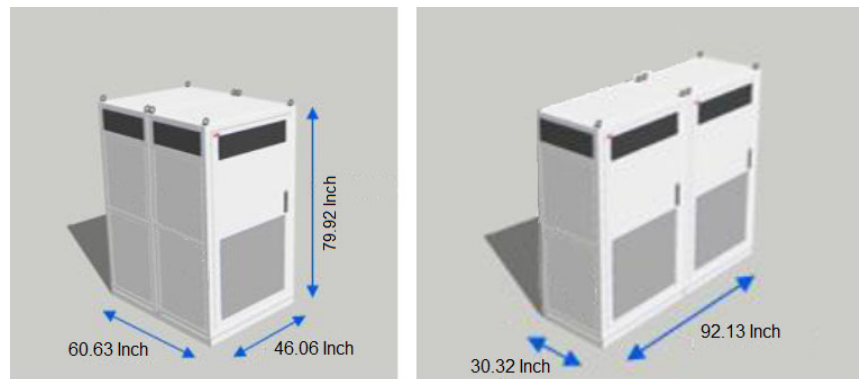
Specifications for inside installation of the Power Cabinet

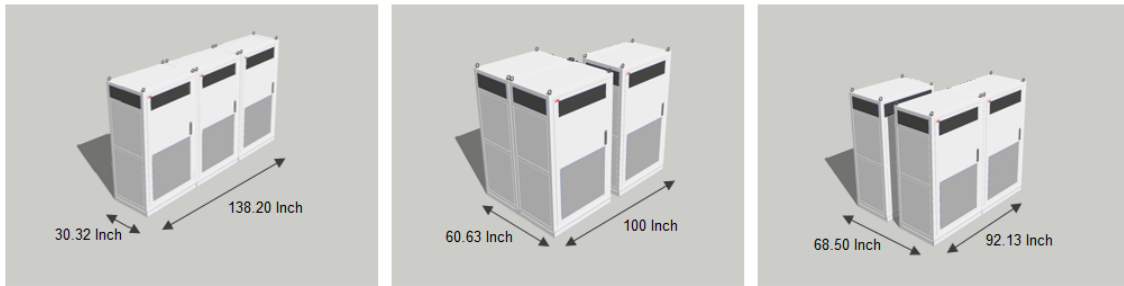
- Airflow required for one cabinet = 853.44 CFM.

Maximum allowed pressure drop = 0,0435113 PSI. If the pressure drop of the room is higher than 0,0435113 PSI an extra fan should be placed. Contact associated Project Manager or Sales representative see *Contact information* on Page 14 for contact details).

3.5.2. Placement of multiple cabinets

There are some possible configurations for the placement of multiple HVC 150 systems, see picture below.





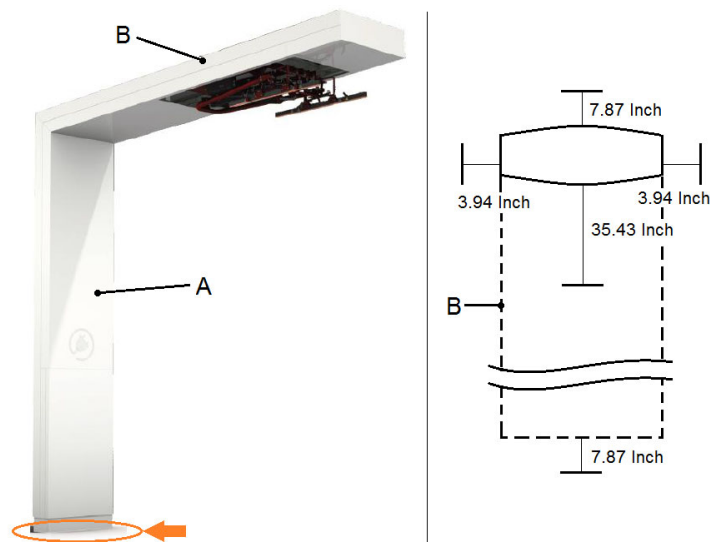
When placing multiple HVC 150 systems, it is necessary to take the following into account:

- Cabinets can be placed side-by-side;
- Cabinets can be placed back-to-back with 7.87 Inch distance (2x 3.94 Inch) or when the sides are free with 0 Inch distance;
- Door on front side must be kept accessible (recommended 47.24 Inch);
- See also *Required space for the Power Cabinet* on Page 28.

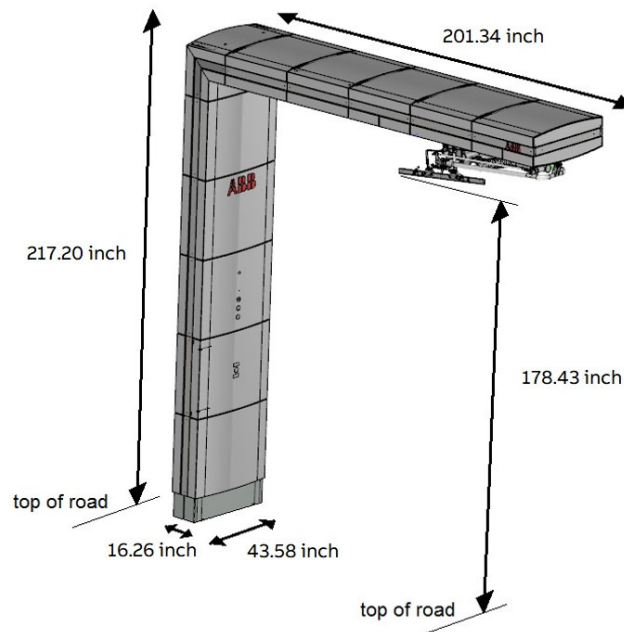
3.5.3. Required space for the Charge pole

The Charge Pole requires a space of 57.91 x 49.80 Inch. This space is calculated as follows:

- An Charge Pole footprint of 41.95 x 14.61 Inch.
- The following free space:
 - 7.87 Inch at the rear side.
 - 3.94 Inch at the left side.
 - 3.94 Inch at the right side.
 - 35.43 Inch at the front side to open the door.



- A Column
B Mast boom



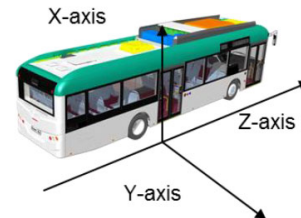
In general:


- No trees (leaves) close to the Charge pole.
- The minimal free space at the front of the mast boom is 7.87 Inch.
- The total free space at the front of the Charge Pole depending on the bus dimensions.
- Height of the pantograph in stand-by mode depends on road- and sideways position, and position on the mast boom. 181.69 Inch can be used as an average.

3.6. Pole position in relation to the bus

It is important that the pole has the good position in relation with the bus, so that the pantograph can make physical contact with the charge interface rails on the roof of the bus. In general the bus has a certain freedom degree to position under the pantograph:

- Z-axis = 23.62 (± 11.81) Inch → longitudinal axis;
- Y-axis = 19.69 (± 9.84) Inch → transversal axis;
- X-axis = 45.28 Inch → vertical axis;
- When the road is horizontal and the top of road (TOR) is flat (no wear);
- Compensation of angles: X-axis $\leq 3.5^\circ$, Z-axis $\leq 2.5^\circ$.



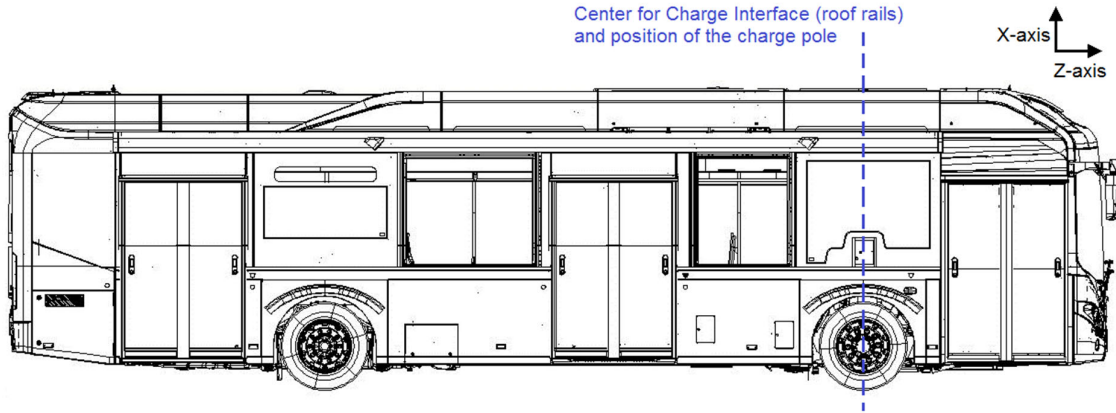
	NOTICE
	<p>Before ordering the Charge pole the correct position of the pantograph within the pole must be calculated by ABB. This is determined during the site survey for placement of the pole and is performed by ABB. Contact ABB Sales department (see <i>Contact information</i> on Page 14 for contact details).</p>

Refer to **Page 100** for **Pantograph setting range adjustment**.

3.6.1. Pole position in relation to the drive direction of the bus

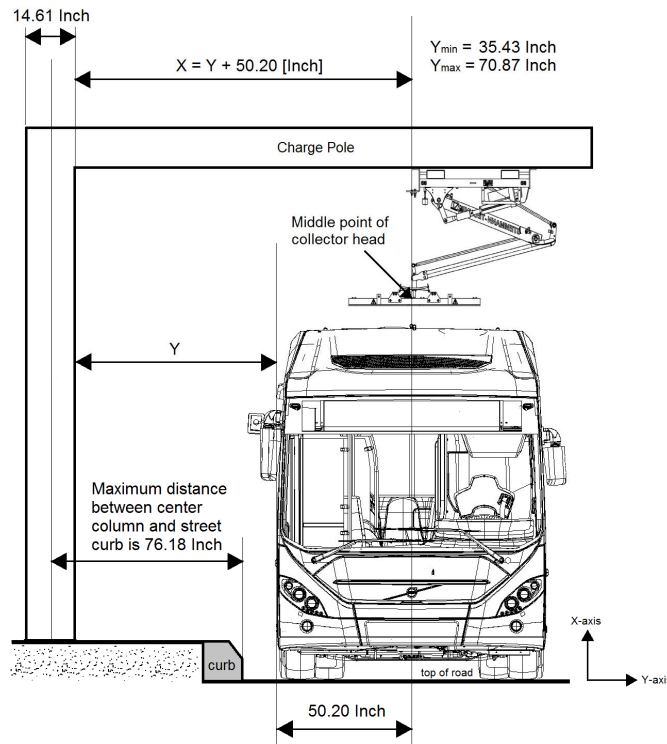
Note: the following example is with respect to a bus which has the contact rails directly above the front wheelbase.

The front wheelbase is exactly below the contact rails on the roof of the bus. So the center of the pole should be in line with the center of the front wheel of the bus.




3.6.2. Pole position in sideways direction of the bus

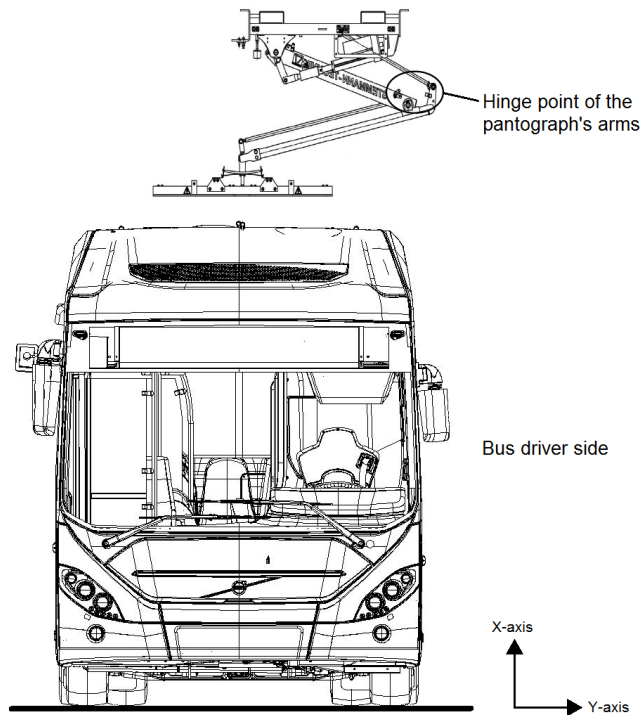
The minimum distance is and the maximum between the front of the pole and side of the bus is 35.43 Inch to 70.87 Inch respectively. The picture below shows how to calculate on an easy matter the position of the pantograph (measured middle of the collector head) within the Charge Pole with respect to the position of the bus. Be aware this is in case the road is flat and doesn't have an angle in the sideways direction of the bus, else the minimum and maximum distance need to be re-calculated. Accurate calculations for the position of the pantograph are described in section *Instruction for pantograph adjustment and alignment* on Page 97.



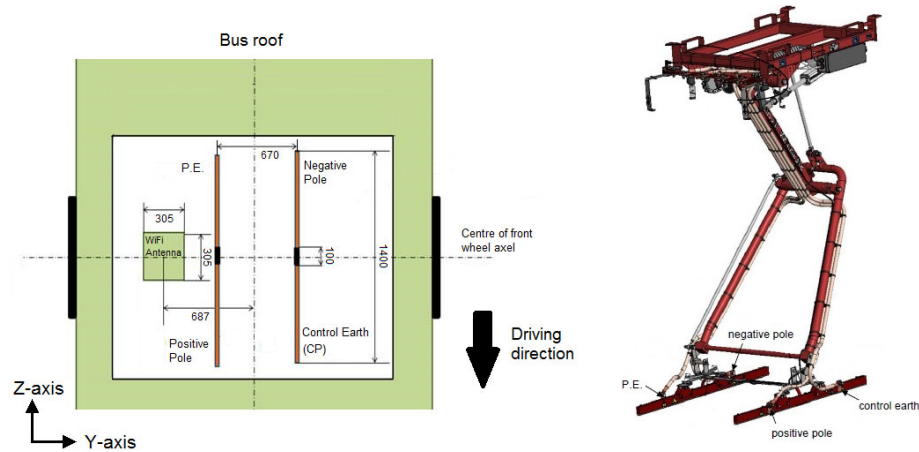
Kneeling of the bus will cause a displacement of the contact rails on top of the bus of about 7.87 Inch, taking 3.5° angle into account with a the height of the bus 129.13 Inch. This should also be taken into account when calculating the position of the Charge Pole with respect to the bus.

	NOTICE
	<p>The pole can be placed on the left side or on the right side (driver side) of the bus. This must be communicated with ABB before ordering the Charge Pole. This will also be noted by ABB during the site survey for the placement of the pole. Contact ABB Sales department (see <i>Contact information</i> on Page 14 for contact details).</p>

The hinge point of the pantograph's arms is always located on the right side of the bus (seen from the front of the bus), shown in the figure that follows:

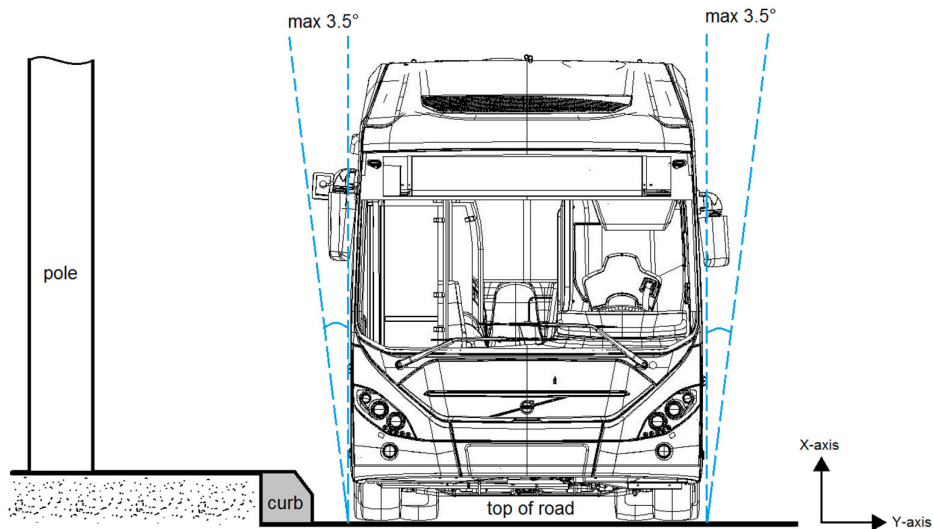


In this case the pantograph's collector heads make the right electrical contact with the contact rails on the roof of the bus, see picture below.



3.6.3. Maximum slope of the road in X-axis

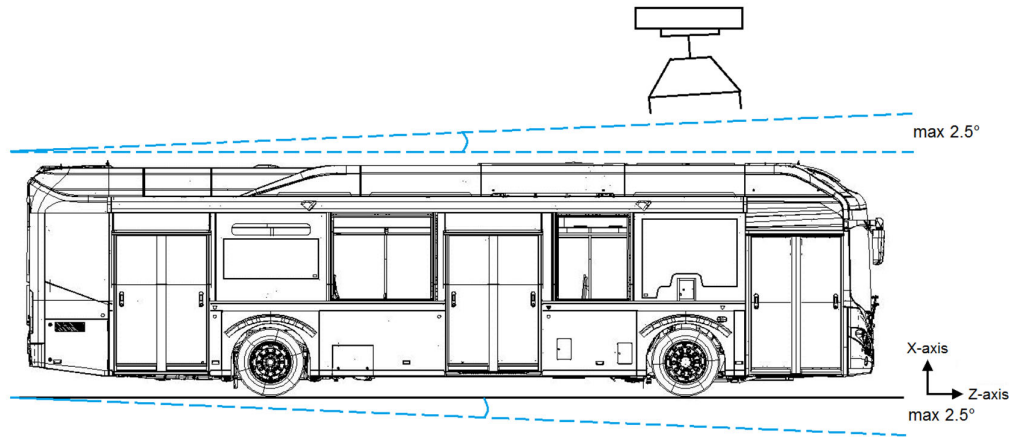
The maximum slope of the road sideways direction is 3.5° , **including** the kneeling of the bus. This will shift the top of the bus 7.87 Inch relative to the center of the bus. So the displacement caused by the road angle should be taken into account calculating the position of the Charge Pole with respect to the bus.




It is possible to adjust the angle in X-axis, see section *Pantograph X-axis angel adjustment* on Page 103.

3.6.4. Maximum slope of the road in Z-axis

In drive direction (Z-axis) of the bus the lower plain of the collector heads should be parallel to the road. See picture below.



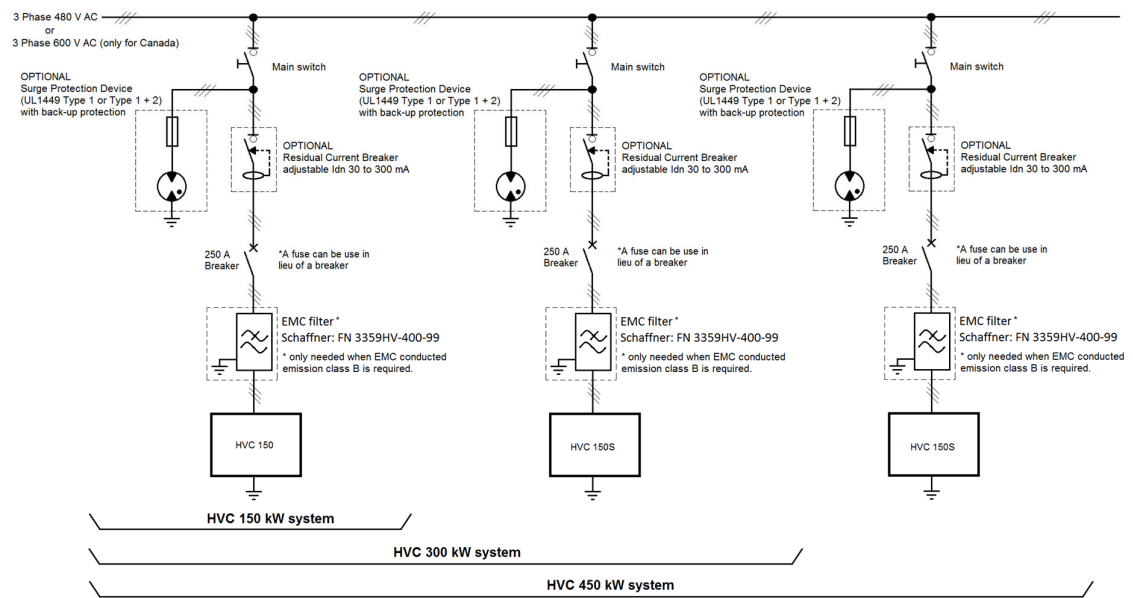
	NOTICE
	<p>The road inclination should be known before the pole is installed on the location. This will also be noted by ABB during the site survey for the placement of the pole. Contact ABB Sales department (see <i>Contact information</i> on Page 14 for contact details).</p>

The installation can handle a road inclination smaller than 2.5° without any modification to the position of the pantograph. When the road inclination is between 2.5° and 6.0° , the position of the pantograph must be adjusted. To adjust the angle in Z-axis, see section *Pantograph Z-axis angle* adjustment on Page 102. The road inclination should not be greater than 5.0° .

3.7. Electrical engineering

3.7.1. Electrical installation


The electrical installation must be completed according to the local safety and electrical regulations and laws. See section *Upgrade grid* on Page 27 for the requirements of the electrical connection. A one line diagram for the electrical connection is shown in the figure that follows. The diameter of the electrical conductor (maximum cross section is 240 mm² = 500 MCM) in the AC power cable depends on the length and method of installation. This must be determined by your contractor.

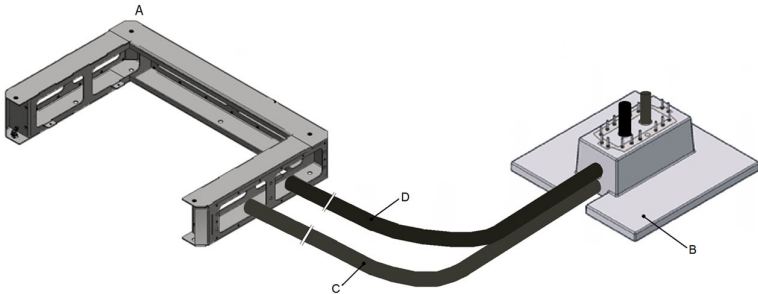


3.8. Civil installation

DC power cables, AC utility power cable, GND wire and data cables must be routed between the Power Cabinet and the Charge control set.


The DC power cables must be installed in separate cable conduit with respect to the AC utility power cable, GND wire and data cables. The maximum allowed cables length between the Power Cabinet and the Charge control set is 492.13 ft.

NOTICE	
	Install per the wiring diagram and in accordance with local, state and NEC guideline.




Example of civil installation for a HVC 150 kW system

- A Foundations of Power Cabinet (for reference only)
- B Foundation of Charge pole (for reference only)
- C Flexible conduit for DC power cables
- D Flexible conduit for AC utility power, GND wire and data cables
- E AC power cables (required individually for each Power Cabinet)

NOTICE	
	Document the location of all the cables in the ground between the Power Cabinet and the Charge control set. The routing of the cables can be found easily in the future, for example, to prevent damage by excavation work.

3.9. Lightning protection

One electrode (ground rod) of maximum 10 Ω must be placed into the earth near the pole foundation. In some cases also additional grounding is required at the Power Cabinet side. This requirement must be determined by the contractor and owner of the site / HVC-PD E-Bus Charger.

NOTICE	
	The implementation of the lightning protection depends on the local laws, safety and electrical regulations. Follow the local, state and NEC code

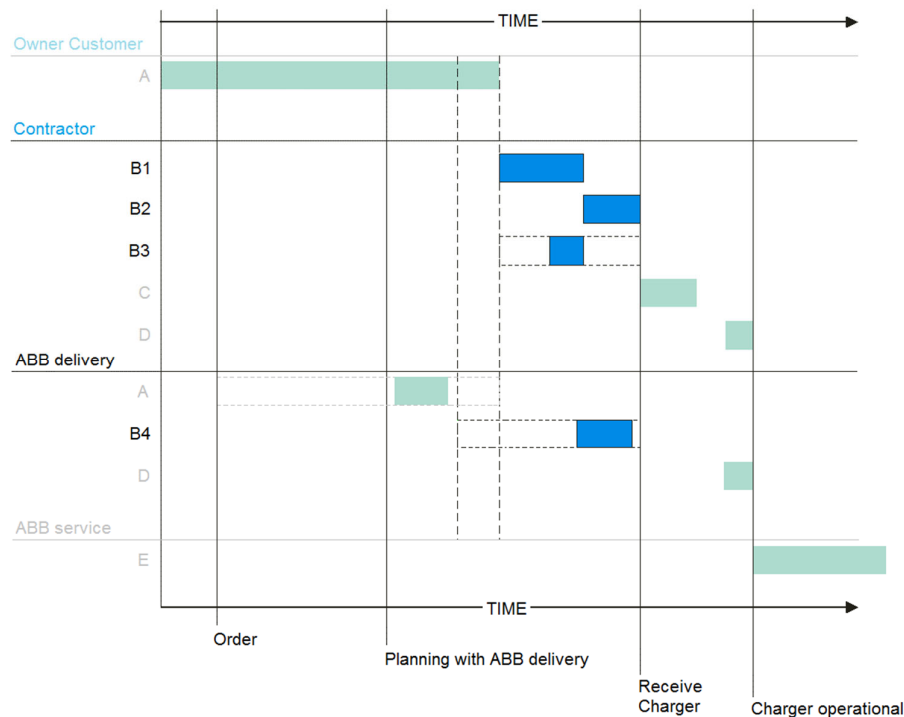
4. Construction

4.1. About construction

The construction phase includes all work required to prepare the location and make it ready for the placement and connection of the HVC-PD E-Bus Charger. The construction phase can start when:

- All engineering work is done.
- All permits are granted.
- The grid connection is available.

The planning steps for the construction phase are shown in the figure below:



B1 Civil engineering works

- Construction of the foundation. See section *Construct foundation of the Power Cabinet* on Page 39 and section *Construct foundation of the Charge pole* on Page 44.
- Installation of the cables. See section *Cabling* on Page 49.
- Construction of the bus stop surrounding. See section *Geometry of infrastructure* on Page 28.

B2 Electrical engineering works

See section *Electrical engineering* on Page 36 and section *Upgrade grid* on Page 27.

B3 Internet access (optional)

This step can be ignored if the location has sufficient 3G coverage. Otherwise an Ethernet (RJ45) connection has to be installed. See section *Internet connection* on Page 53.

B4 Transport

Arrangement for the delivery of the HVC-PD E-Bus Charger with the ABB Delivery department. See *Contact information* on Page 14 for contact details. The delivery time is at least four months.

4.2. Construct foundation of the Power Cabinet**4.2.1. Options**

Use the correct foundation for the type of surface that the Power Cabinet will be installed on:

- **Soil**



Use a concrete foundation to get a firm fixation on soil.

Concrete foundation cannot be ordered separately. It must be manufactured by the customer. For detail drawings of the pre-fabricated concrete foundation see Appendix E *Dimensions concrete foundation Power Cabinet*.

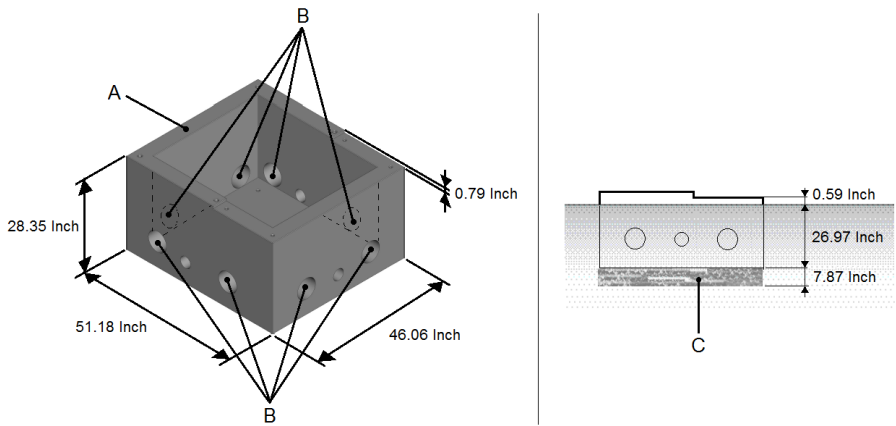
- **Solid floor**




1. Use a metal frame foundation to guide the cables from the cabinet to the cable duct. This foundation can be ordered separately. See section *Foundation for Power Cabinet* on Page 20. For detail drawings see Appendix E *Dimensions metal frame foundation Power Cabinet*.
2. The Power Cabinet is installed directly on a solid floor, through which the floor is accessible from below (related to the feed through of the cables). For detail drawings see Appendix A *Dimensions Power Cabinet*.

The cables must be embedded in the ground with a cable conduit. See section *Cabling* on Page 49 and section *Civil installation* on Page 36.


	NOTICE
	<p>It is advised to install traction wires into the conduits to install the electrical cabling afterwards.</p>
	NOTICE
	<p>Be aware of the bending radius of the AC power input cables when using the metal frame foundation. This metal frame foundation has a height of 7.09 Inch.</p>

4.2.2. Workflow with concrete foundation




	<p>NOTICE</p> <p>Concrete foundation should be designed by the customer. ABB does not sell concrete foundation. For detail drawings see Appendix E <i>Dimensions concrete foundation Power Cabinet</i>.</p>
	<p>WARNING</p> <p>Make sure that personnel cannot be crushed or become trapped while moving the foundation. Be aware that the weight of the concrete foundation is about 2866 lb.</p>
	<p>CAUTION</p> <p>Before you lower the foundation, remove sharp edges of the cable holes (B) in the foundation to protect the cables.</p>

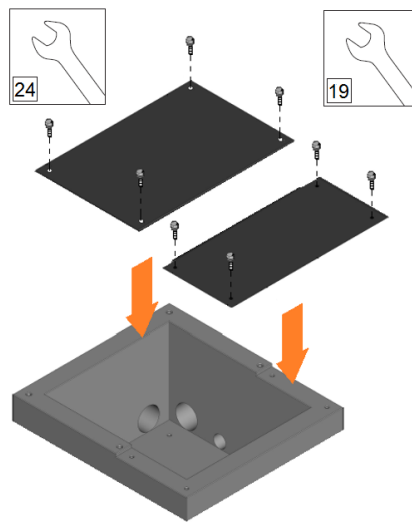
1. Make a hole in the ground with at least a minimum depth of 34.84 Inch, shown in the figure above.
2. Fill the hole with (minimum) 7.87 Inch lean concrete (C), see figure above.
3. Make sure that the conduits are routed to one of the indicated positions (B). The conduits must come out of the foundation with a length of about 9.84 Inch.
4. Make sure that the AC power cable is routed to one of the indicated positions (B).
5. Lower the foundation (A) into the hole.
6. Make sure that the front top surface of the foundation is at least 0.59 Inch above ground level (see figure above).
7. Make sure that the top surface of the foundation is leveled.
8. Route the conduits through one of the eight holes (B).

	<p>NOTICE</p> <p>Make sure that the end of the cable conduits are 11.81 to 19.69 Inch above the top of the foundation.</p>
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9. The conduits must be installed with a curve inside the foundation in order to prevent water from entering the conduits, and seal the space between the conduits and all open holes.
10. Route the AC power cable through one of the eight holes (B). Make sure that a cable length of 39.37 Inch is available above the surface of the foundation for internal routing in the cabinet.

	NOTICE
	This extra cable length is required to connect the AC power cable with the connectors in the Power Cabinet without problems.

11. Place both cover plates on the appropriate place on the foundation.



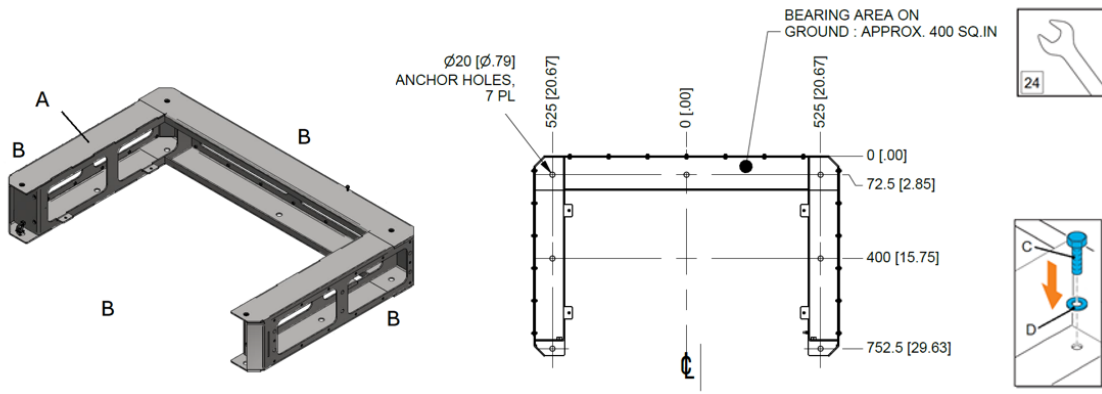
12. Secure the top cover plate with M16 bolts (4x) and the front cover plate with M12 bolts (4x).

	WARNING
	These cover plates are required to prevent people from falling into the foundation.

13. Fill the open space in the ground around the foundation and the channels for the conduits with filling material (e.g. sand). Filling material is packed 2 – 3 times with a packing machine until the desired ground level is obtained. Avoid having filling material inside the foundation.

4.2.3. Workflow with metal frame foundation

4.2.3.1. HPC175-HVC150 MET FOUND KIN 8IN – NAM (2CEB489802R0001)



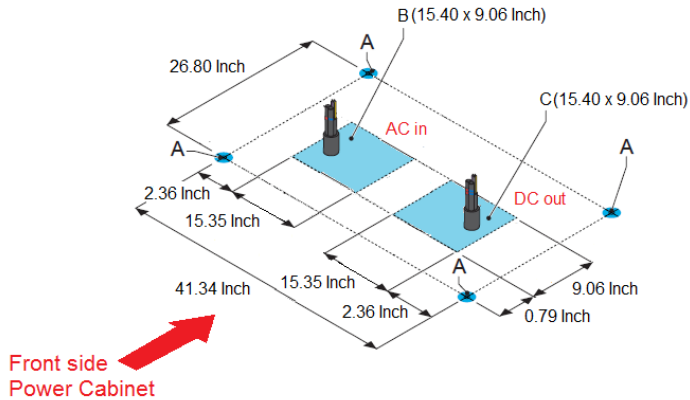
1. Place the frame (A) in the desired position and mark the position of the holes for drilling.
2. Remove the frame.
3. Drill and tap holes at the marked positions. The holes must be suitable for bolt size M16.
4. Route the cables tray through one of the cable openings (B).
5. Align the frame (A) with the tapped holes.
6. Insert the bolts (C) fitted with the washers (D) into the holes (7x).
7. Tighten the bolts.
8. Route the AC power cable through the left cable opening (B). Make sure that a cable length of 39.37 Inch is available above the floor for internal routing in the cabinet.





NOTICE

This extra cable length is required to connect the AC power cable with the connectors in the Power Cabinet without problems.

4.2.4. Workflow mounting Power Cabinet direct on a floor (footprint)



1. Drill and tap holes in the floor at the indicated positions (A). The holes must be suitable for bolt size M16.
2. Make rectangular holes on the indicated positions (B) and (C). For detail drawings bottom view of Power Cabinet see Appendix A *Dimensions Power Cabinet*.
3. Make sure that the AC power cable and other cables comes out of the floor within the marked area (B).
4. Make sure that the DC power cables come out of the floor within the marked areas (C).
5. For the AC and DC power cable, make sure that a cable length of 3.28 ft is available above the floor for internal routing in the cabinet.
6. For the other cables, make sure that a cable length of 9.84 ft is available above the floor for internal routing in the cabinet.

	NOTICE
	This extra cable length is required to connect the cables with the connectors in the Power Cabinet without problems.
	NOTICE
	To prevent dust from entering the tapped holes, it is recommended that you cover them until you are ready to do the placement.

4.3. Construct foundation of the Charge pole (for reference only)

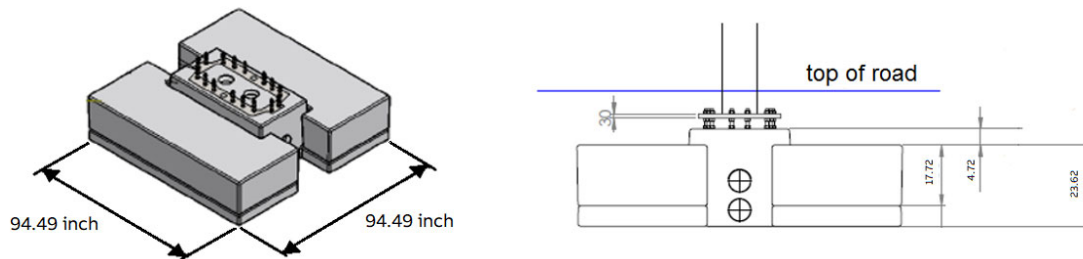
4.3.1. Options


Use the correct foundation for the type of surface that the Charge pole will be installed on:

- **Soil (option 1)**
Use a concrete foundation to get a firm fixation on soil.
A concrete foundation must be designed by local engineer. Refer to Appendix G *Dimensions concrete foundation Pole* for sample design.
- **Soil (option 2)**
Use a tube foundation to get a firm fixation on soil. This tube foundation can be used if there are space restrictions, for example close to a building. Contact the ABB Sales department for more information and possibilities, see *Contact information* on Page 14 for contact details.
- **Solid floor**
The local contractor is responsible to make the calculations if the floor can handle the force of the pole. Contact the ABB Sales department when you want to mount the Charge pole on a concrete floor, see *Contact information* on Page 14 for contact details.

The cables must be embedded in the ground with cable conduits. See section *Cabling* on Page 49 and section *Civil* installation on Page 36.

4.3.2. Workflow with pre-fabricated concrete foundation (for reference only)



	NOTICE
	<p>Be aware that the position footprint relative to the road is very important to make sure the pantograph can function optimally.</p>

1. Preparations

Before the concrete foundation can be installed some measurements have to be taken into account. The Soil conditions are very important for the function of the concrete foundation.

Depending of the soil conditions sand settlement can take place. Because of the heavy construction > 17636.98 lb some preventive actions are **advised**. The time frame in which the soil settlement will be elaborated is depending on:

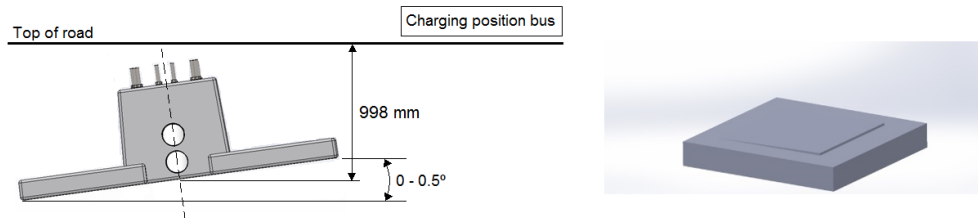
- Sand compaction during installation
- Pavement around the construction
- Wetter conditions (rain, frost, temperature)

Before starting to install the concrete foundation, the pressure of the soil must be measured. It is advisable to install the concrete foundation on a soil pressure ≥ 100 kPa. If the measured soil pressure is more than 100 kPa, no soil compact actions has to be taken. If the concrete foundation will be installed on another ground type than sand (like rock, gravel, clay or peat), take contact with the ABB Sales department, see *Contact information* on Page 14 for contact details.

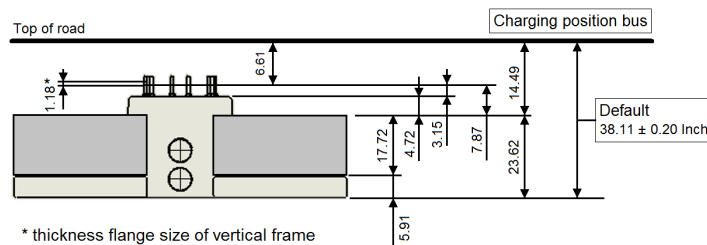
2. Make a hole

Make a hole in the soil on the position where the charging construction will be installed. The hole must be at least 98.43 x 98.43 Inch (the concrete base plate has a foot print of 94.49 x 94.49 Inch). Dig the hole 23.62 Inch deeper than the level of the underside of the concrete base plate. The soil under the base plate has to be compacted in layers of 11.81 Inch with an advised pressure of 100 kPa. Level the soil under the concrete base plate.

Install the concrete base plate and make sure the foundation is level. The allowed tolerance angle with respect to the charging position of the bus must not be greater than 0.5° .



The height relative to the bottom of the concrete base plate has to be determined by the height of the charging position of the bus. The bottom of the concrete base plate must be default **38.11 ± 0.20 Inch** under this level. This value may differ from the current location, so the correct value must be defined by ABB.





NOTICE

Be aware that the correct height to the bottom of the concrete base plate relative to the ground level of the top of road (= charging position of the bus) must be calculated by ABB. Contact ABB Sales department (see *Contact information* on Page 14 for contact details).

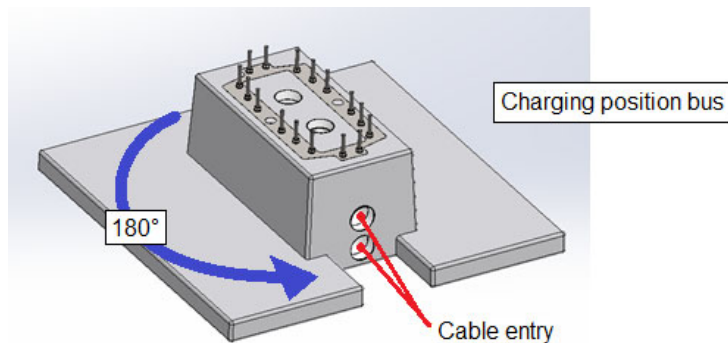
3. Installing the concrete base plate

Preconditions:

4x WLL 3/5.0 tons lifting claws (are not delivered by ABB, use for example Starcon Universal Lifting Claws, art.no. 99.11590082B).

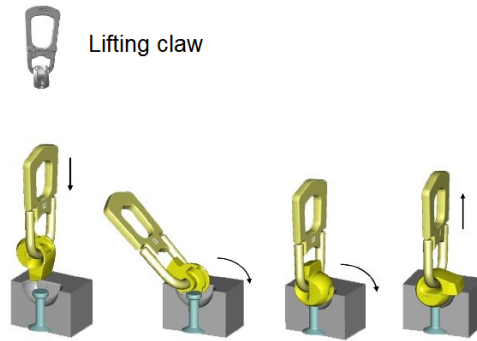
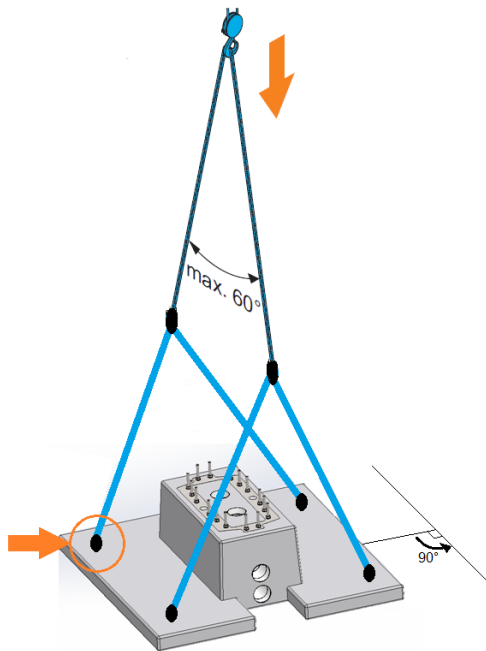
	<p style="text-align: center;">WARNING</p> <p>Make sure that personnel cannot be crushed or become trapped while moving the foundation.</p>
	<p style="text-align: center;">CAUTION</p> <p>Before you lower the foundation, remove sharp edges of the cable holes in the foundation to protect the cables.</p>


The base plate has holes for entering cables into the charging pole construction which are positioned aligned with the road. The base plate must be positioned in the right way to have the cable conduits facing towards the foundation of the Power Cabinet. The base plate can be installed 180 degrees to face the cable entries to the other side.

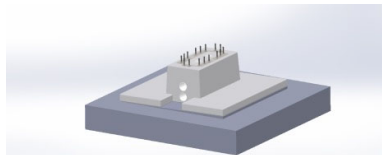


With preparation of the soil the concrete base plate can be installed. There are four bullet head anchors (5 85 DH) pouring in the concrete base plate.

Hoist the base plate with using four lifting claws connected with four slings or chains with sufficient capacity. The weight of the base plate is 7495.72 lb and the foot print is 94.49 x 94.49 Inch.



	NOTICE
	<p>Ensure the concrete base plate is exact perpendicular to the road (or charging position of the bus). Never hoist on the thread end on top the foundation block, only use the hoisting points as indicated.</p>



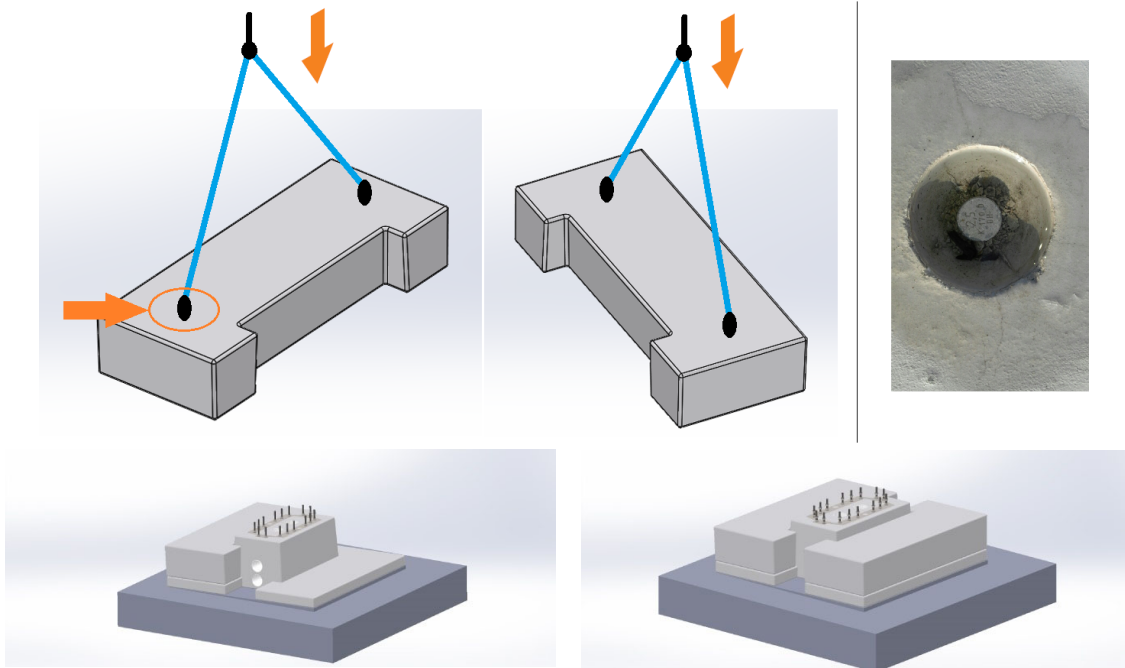
4. Installing the counter weights

Preconditions:

2x WLL 1.5/2.5 tons lifting claws (are not delivered by ABB, use for example Starcon Universal Lifting Claws, art.no. 99.11590081B).

With the concrete base plate in position the counter weights can be installed. These counter weights are needed to keep the charging pole construction up right during extreme weather conditions and to prevent the construction from tilting.

There are two bullet head anchors (2.5 K170D DH) pouring in the counter weights. Hoist the counter weights one by one by using two lifting claws connected to two slings or chains with sufficient capacity. The weight is 2130 kg and the foot print is 94.49 x 37.80 Inch.

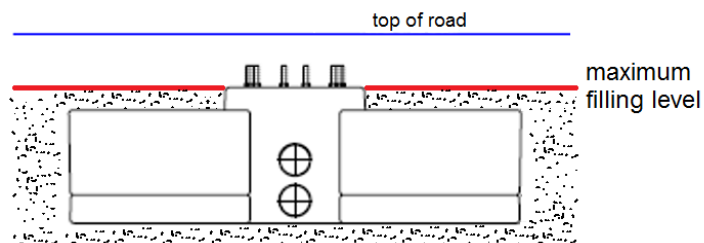


5. Compaction the soil around the concrete foundation

Before filling the gap around the concrete foundation ensure that all:

- Conduits are installed to the concrete base plate.
- The conduits must come out of the holes on the top side of the concrete base plate with a length of about 9.84 inch.
- Cover the conduits to prevent water, sand and/or other materials entering the conduits.
- Place protective cups to cover the bolt (16x).

The gap around the foundation can now be filled with sand in layers of 11.81 Inch each. Between each layer, the soil has to be compacted with an advised pressure of 100 kPa. This sequence has to be repeated until the top side of the concrete base plate has been reached. Normally this will be below the normal ground level. This last height can only be filled after installation of the charging pole construction.





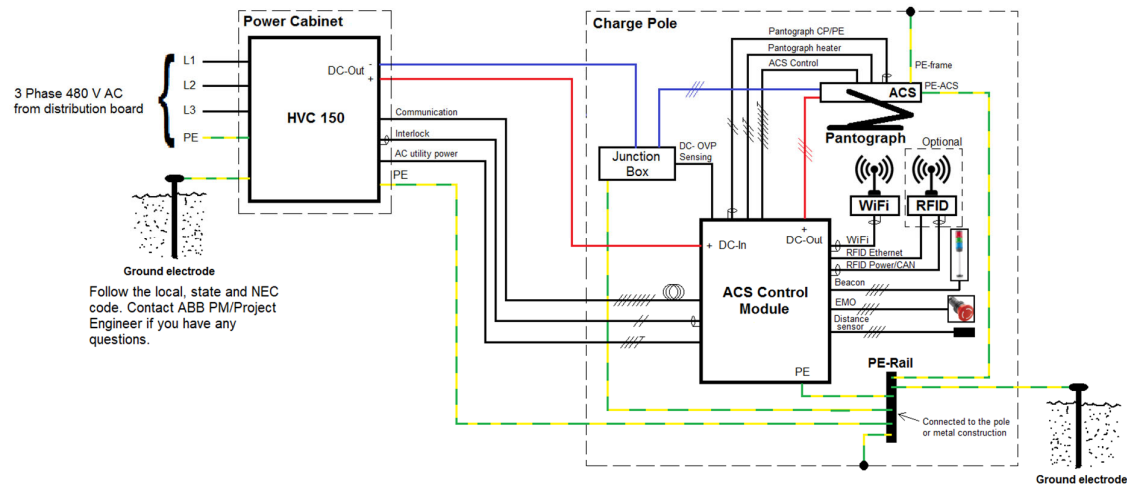
NOTICE

To already fixed the sidewalk around the pole, there can be placed border collar around the top of the foundation to have free access of the bolts.



4.4. Cabling

4.4.1. Charge system configuration



Overview electrical connections of a HVC-PD 150 kW charge system

The diagram illustrates the ACS system architecture, divided into three main sections: Power Cabinets, Charge Pole, and various control and communication modules.

Power Cabinets: This section contains three cabinets: HVC 150 (Primary), HVC 150S (Secondary), and HVC 150S (Secondary). Each cabinet is connected to a 3 Phase 480 V AC from the distribution board (L1, L2, L3, GND). The HVC 150 (Primary) cabinet has a DC-Out terminal. The HVC 150S (Secondary) cabinets have DC-Out terminals. Each cabinet is also connected to a Ground electrode (GND) and has CAN and Interlock lines.

Charge Pole: This section contains the ACS Control Module, Junction Box, and DC-OVP Sensing. The ACS Control Module has DC-In, DC-Out, and GND terminals. The Junction Box is connected to the DC-In and DC-Out of the ACS Control Module. The DC-OVP Sensing is connected to the DC-In of the ACS Control Module.

Control and Communication Modules: This section includes the ACS, Pantograph, WiFi, and RFID modules. The ACS module is connected to the DC-Out of the ACS Control Module and has a GND-ACS terminal. The Pantograph module is connected to the ACS module and has a GND-frame terminal. The WiFi module is connected to the ACS module and has a WiFi terminal. The RFID module is connected to the ACS module and has an RFID terminal. The ACS module also has a Beacon terminal and a Distance sensor terminal.

Grounding and Safety: The system includes a GND-Rail connected to the GND of the ACS Control Module and the GND-ACS terminal of the ACS module. The GND-Rail is connected to the pole or metal construction. The Ground electrode is connected to the GND of the Power Cabinets and the GND-Rail.

Legend: The diagram includes a legend for the various components and their connections, including L1, L2, L3, GND, DC-Out, DC-In, DC-OVP Sensing, ACS, Pantograph, WiFi, RFID, Beacon, Distance sensor, GND-Rail, and Ground electrode.

Page 50 of 146

- 6AGA000008-0619, Electrical diagram HVC-PD 450 kW E-Bus Charger.
- Contact ABB Sales department (see *Contact information* on Page 14 for contact details) to request the electrical diagrams.

4.4.2. AC power cable

- Cable type: 3P+GND (optional shielded).
- The cable shielding (if present) must be attached to the GND Rail at both ends of the cable.
- The diameter of the cable conductor must be determined by your contractor.
- The maximum diameter of the cable conductor is 500 MCM.
- The GND conductor of the power cable should be sized per NEC/ local regulations.

4.4.3. Cables between the Power Cabinets and the ACS Control Module

The following cables are not in the scope of supply of ABB.


- 2x, 4x or 6x DC power cables (depending on system configuration),
- 1x DC- OVP Sensing cable (between Junction Box and ACM)
- 1x GND cable,
- 1x AC utility power cable,
- 1x Interlock cable,
- 4x communication cables; 8x glass fiber (4 fibers are required, 4 are for spare).
 - The 8x glass fiber cable is a special cable that should be sourced locally.

Use local regulations and datasheet of the manufacturer to determine the cable cross section for the DC power cables. Recommended minimum cable cross section is 350 MCM (with a reinforced isolation > 5400 V DC) for a distance until 492.13 ft.

4.4.4. Cables between the Power Cabinets

The following cables are not in the scope of supply of ABB.

- 1x GND cable;
- 1x Interlock cable;
- 1x CAN cable.

	NOTICE
	<p>For detailed information about type of glass fiber cable which are needed, see <i>Communication glass fiber cable</i> on Page 22.</p> <p>For the overview of the grounding of the system, see Appendix J <i>Ground overview of the system</i> on Page 145.</p>

4.4.5. Cable specification list

Tables below provides general specifications for the needed cables. Use these tables to select cables, taking into account local installation conditions, cable length, cable temperature rating, losses and local regulations.

AC and DC power cables

Functional description	DC Power cable	GND cable	AC utility power cable
Number of cores	1	1	4
Cross section	350 – 600 MCM	2 AWG	14 AWG
Min – Max external diameter to fit through gland	0.75 – 1.10 Inch	0.51 – 0.83 Inch	0.20 – 0.39 Inch
Shielding	No	No	No
Conductor	Tinned copper or aluminum conductor, fine wire stranded acc. to VDE 0295 cl.5/IEC Cl.5	Fine strand copper wire acc. to VDE 0295 Cl. 5/ IEC 60228 Cl. 5	Bare copper, fine wired, bunch stranded acc. to VDE 0295 Cl.5/IEC Cl.5
Insulation	Special rubber or PVC (outdoor use, UV-protected, oil resistant)	Special PVC (outdoor use, UV-protected, oil resistant)	Special PVC (outdoor use, UV-protected, oil resistant)
Nominal Voltage Uo/U	600/1000 Vac 900/1500 Vdc	450/750 Vac	450/750 Vac
Test Voltage	6 kV	4 kV	4 kV
Ambient Temperature range	-40°C to 80°C, permissible conductor operating temperature +90°C	-40°C to 70°C	-40°C to 80°C
Core identification		gn/ye	Color Acc. to IEC 60446

Data cables

Functional description	Interlock cable	CAN cable
Number of (twisted) pairs	2 x 2	1 x 2
Cross section	18 – 14 AWG	20 – 18 AWG
Min – Max external diameter to fit through gland	0.20 – 0.39 Inch	<i>inapplicable</i>
Shielding	Yes (tinned copper braid)	Yes (tinned copper braid)
Conductor	Fine strand copper wire	Fine strand copper wire
Insulation	PVC or other material that can be used outdoor and are UV-protected	PVC or other material that can be used outdoor and are UV-protected
Test Voltage	1.5 kV	1.5 kV
Ambient Temperature range	-40°C to 70°C	-40°C to 70°C
Core identification	Acc. to DIN 47100	Acc. to DIN 47100

- Important: all cables must be resistant to being placed in the ground, submerged in conduit.
- All cables must have an isolation that are self-extinguishing and flame retardant according to UL VW-1, CSA FT1.
- All cables must meet the UL and the RoHS compliance.
- The identity and/or function must be marked on every 78.74 Inch of the cables and on both ends.

4.5. Internet connection

ABB requires an internet connection to the HVC-PD E-Bus Charger for remote service operations including, oversight of the product during the warranty period, diagnosis and troubleshooting of issues, and performing software firmware update. If the internet connection to the HVC-PD E-Bus Charger is missing, the product warranty and/or ABB's service level agreement (SLA) may severely impact or even void.

It is the installer's responsibility to ensure reliable internet connection to the HVC-PD E-Bus Charger. Contingency planning and the associated costs are the responsibility of the installer.

There are two options for the internet connection:

- **Internet Cellular network connection**

Connection to the charger using the charger's standard featured hardware with ABB's Charger Connect service offering, is the preferred method. This solution provides internet access via Vodafone's 4G LTE wireless network. Vodafone primarily roams on the AT&T and T-Mobile in the USA, while Rogers in Canada. It is expected that a cellular availability test is performed prior to construction to ensure there is reasonable signal quality to at least one of the above-mentioned operators 4G LTE bands 2 (1900 MHz), 4 (1700/2100MHz), or 12 (700 MHz).

The signal strength must be greater than -85dbm and should be measured with a cellular network signal meter, such as a Squid-4G or Sure Call device. Handheld mobile phones are not recommended for assessing signal strength since they are not reliable measuring devices.

The HVC-PD E-Bus Charger supports SIM cards provided by ABB only. Any other types of SIM cards are not supported.

- **Internet via ethernet connection**

If the cellular connection is not available, ethernet connection must be made to the charger using a shielded 8P+PE ethernet cable with RJ45 connectors. Additional recommendations include:

- Maintain distance of 75 meters or less. Distances over 75 meters require a custom engineered solution.
- Minimum bandwidth: upload 128 kb/s download:4 Mb/s
- 99.9% availability
- 600V rated cable that may route beside input power wires for short distances

Based on the situation, ABB may require additional commissioning fees if ethernet cable method for establishing internet is used (Ethernet cable has to be run through the primary power cabinet).

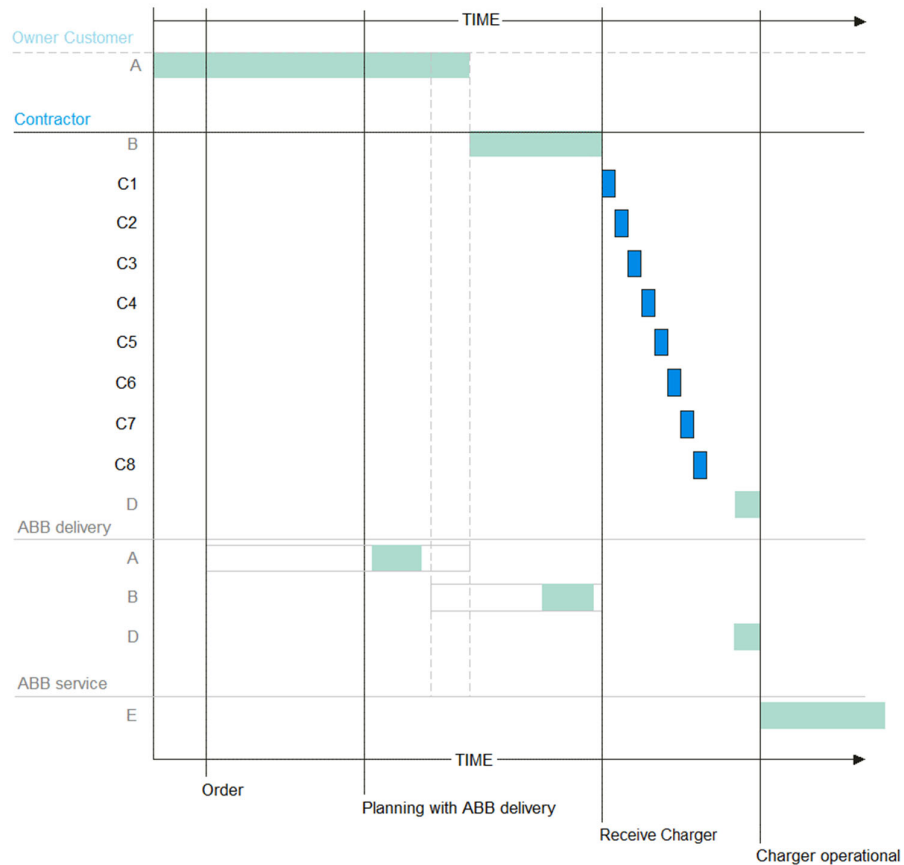
This option will require some customization. Contact ABB Project Engineer for more details.

5. Placement and Connection

5.1. About placement and connection

When the construction phase is finished, the HVC-PD E-Bus Charger can be placed and connected.


The planning steps for the placement and connection phase are shown in the figure below. Usually the procedure can be done within one day.




- C1 *Route the cables on Page 55.*
- C2 *Unpack on Page 55.*
- C3 *Move Power Cabinet to position on Page 57 and Install Power Cabinet onto the foundation on Page 60.*
- C4 *Connect the AC power cable on Page 66, Connect the DC power cables on Page 73, and Connect the communication fiber cables on Page 85.*
- C5 *Unpack the Charge Pole on Page 87.*
- C6 *Move the Charge pole to position on Page 88, Install Charge Pole onto the foundation on Page 90 and Pantograph adjustment on Page 97.*
- C7 *Installation of the cables inside Charge Post on Page 103.*
- C8 *Install cover plates on Page 118 and Grouting of the pole construction on Page 120.*

5.2. Route the cables

1. Unpack the cables. See *Cabling* on Page 49 for details which cables must be used.
2. Route the DC power cables through cable conduit.
3. Route the AC utility power, GND wire and Interlock cable through cable conduit.
4. Route the communication glass fiber cable through cable conduit.



	CAUTION
	<p>To prevent damage to the glass fiber optic cable, a minimum of two persons is required to route the glass fiber cable through the conduit. One person for pulling, the other person to guide the glass fiber cable. Ensure that the glass fiber cable is carefully rolled out before it is pulled through the conduit, and do not use large traction forces, this can damage the glass fiber cable.</p>

5. For the DC power cables, make sure that a cable length of 39.37 Inch is available above the surface for internal routing in the cabinet.
6. For the other cables, make sure that a cable length of 118.11 Inch is available above the surface for internal routing in the cabinet.

	NOTICE
	<p>This extra cable length is required to connect the cables with the connectors in the Power Cabinet without problems.</p>

5.3. Unpack Power Cabinet

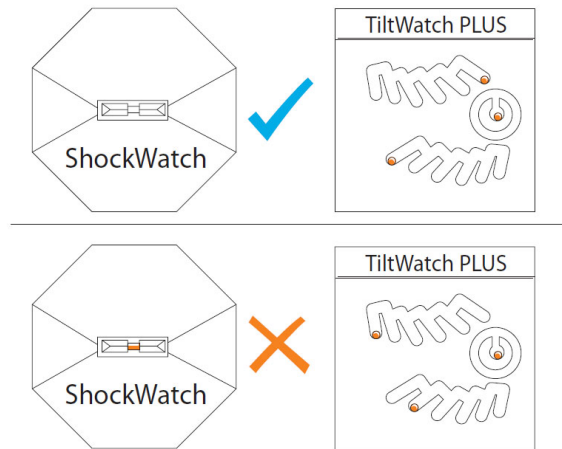
5.3.1. Before unpacking

	NOTICE
	<p>Unloading Power Cabinet The delivery truck only unloads the pallet carrying the Power Cabinet. The delivery truck will not move the Power Cabinet to its final location. The placement of the Power Cabinet to its final location is the responsibility of the contractor. Upon request it is possible to order a truck with a crane.</p>
	CAUTION
	<p>Do not pollute the environment with plastic and cardboard packing. Depollute these things according the regional applicable regulations as well as environment-friendly.</p>

Preconditions:

- All construction work is completed.

- The product is delivered by a transport company at the confirmed date of delivery.

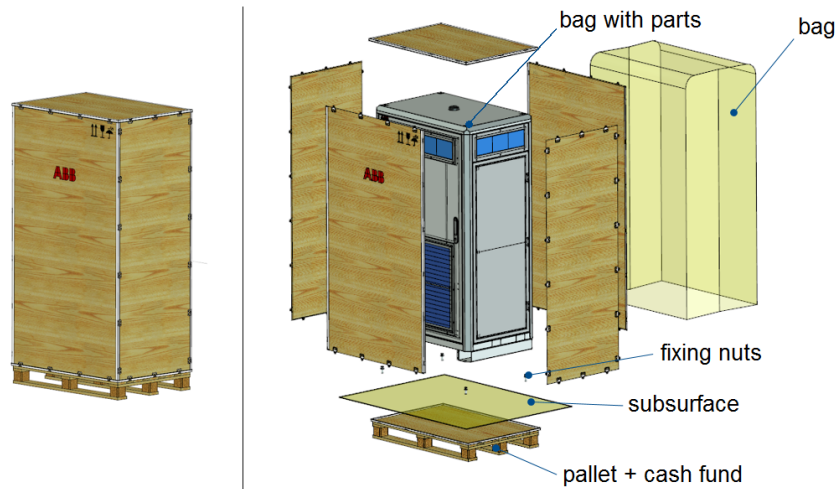


1. Make sure that the Power Cabinet has not been shaken or tilted over 30°.

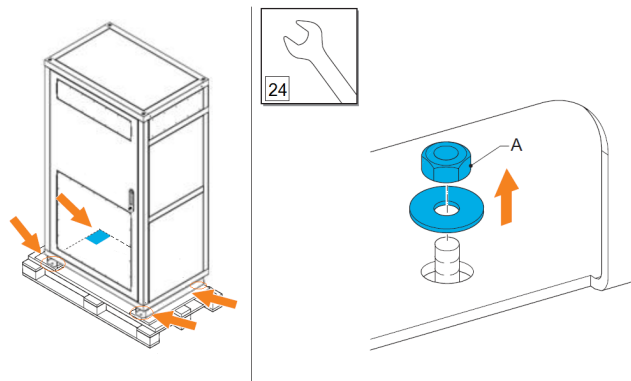
5.3.2. Remove packaging

Preconditions

- Tools: spanner (size 24).



1. Remove the packaging material from the Power Cabinet.
2. Remove the bag which contain the keys, cover caps and mounting material that are attached with tape on one of the lifting eyebolt at the top of the cabinet.
3. Keep this bag with parts in a safe place.



4. Remove the nuts (A) at the four corners.





5.4. Move Power Cabinet to position

There are two options to move the Power Cabinet from the delivery truck to the location.

- Use a hoist to lift the cabinet from the top. See *Move cabinet with a hoist* on Page 58.
- Use a forklift truck to lift the cabinet from the bottom. See *Move cabinet with a forklift truck* on Page 59.

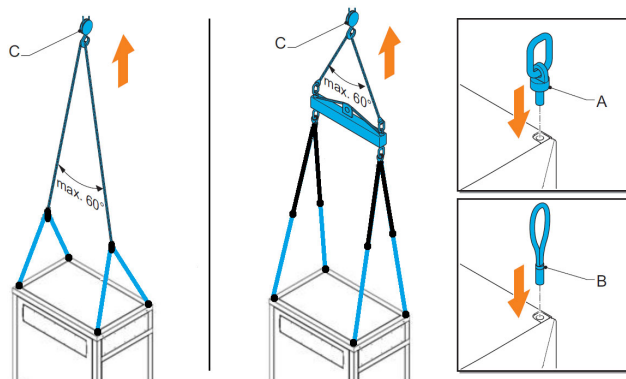
Preconditions:

- All packaging material is removed from the Power Cabinet.
- The two cover plates are removed from the foundation.
- The tapped holes of the foundation are free from dust. If necessary, clean the holes with a vacuum cleaner. Use a thread tap to make sure that the bolts will go in smoothly.

	<p style="text-align: center;">DANGER</p> <p>Make sure that the main switch of the power supply group for the product is set to the OFF position. Do a voltage check to make sure that the electrical power is disconnected from the system. Secure against resetting.</p>
	<p style="text-align: center;">WARNING</p> <p>Make sure that personnel cannot be crushed or become trapped while moving the Power Cabinet.</p>
	<p style="text-align: center;">CAUTION</p> <p>Warranty Damage due to moving the Power Cabinet to its position is not covered by the warranty.</p>
	<p style="text-align: center;">CAUTION</p> <p>Do not use a compressor to clean the Power Cabinet. Use a vacuum cleaner.</p>

1. Use one of the two options to move the Power Cabinet to the foundation.
2. When the Power Cabinet is about 19.69 Inch above its location, continue the installation procedure with *Install Power Cabinet onto the foundation* on Page 60.

5.4.1. Move cabinet with a hoist




- A Swivel eye bolts (standard delivered with the cabinet)
- B Lifting loops
- C Hoisting equipment

Preconditions:

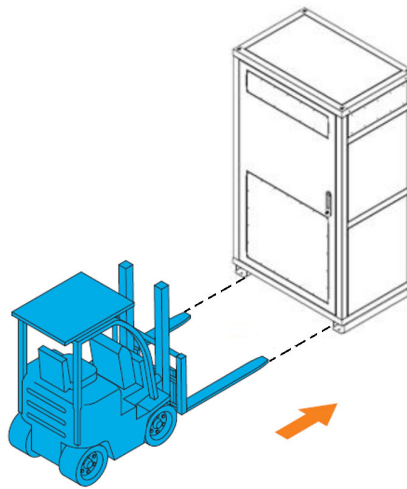
- A minimum of two persons is required: one person to operate the hoisting equipment, the other person to guide the Power Cabinet to its location.
- Use M16 swivel eye bolts (A) or M16 bolts with lifting loops (B).

1. Insert the bolts (A) or (B) into the holes at the opposite corners of the cabinet, if not placed upon delivery.
2. Tighten the bolts.
3. Connect the hoisting equipment (C).

	CAUTION
	<p>Keep the hoisting angle below 60°.</p>


4. Move the Power Cabinet to the foundation.

5.4.2. Move cabinet with a forklift truck



Preconditions:

- A minimum of two persons is required: one person to operate the forklift truck, the other person to guide the Power Cabinet to its location.
1. Place wooden slats with a thickness of about 0.39 to 0.59 Inch and a width equal to the width of the fork of the forklift truck on both forks.
 2. Move the forks of the forklift truck next the gaps at the rear of the Power Cabinet.
 3. Move the Power Cabinet to the foundation.



	NOTICE
	<p>The use of the fork slides is mandatory. The distance between the outer side of the forks need to be 36.61 Inch, lifting the cabinet outside the fork slides is NOT allowed and will damage the cabinet.</p>

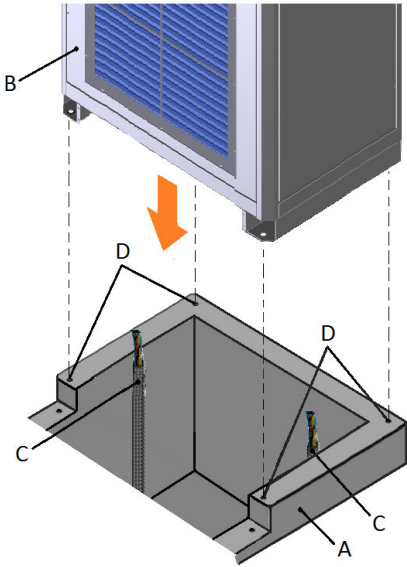
5.5. Install Power Cabinet onto the foundation

5.5.1. Connect Power Cabinet to foundation

Preconditions:

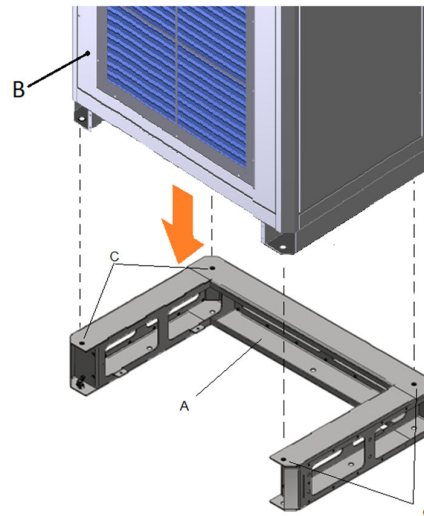
- Tools: spanner (size 24).
- Cover caps (4x) that were removed from the Power Cabinet (bag with parts).
- The Power Cabinet is about 19.69 Inch above its location.

	DANGER Make sure that the main switch of the power supply group for the product is set to the OFF position. Do a voltage check to make sure that the electrical power is disconnected from the system. Secure against resetting.
	WARNING Make sure that personnel cannot be crushed or become trapped while moving the Power Cabinet.



Placement on concrete foundation

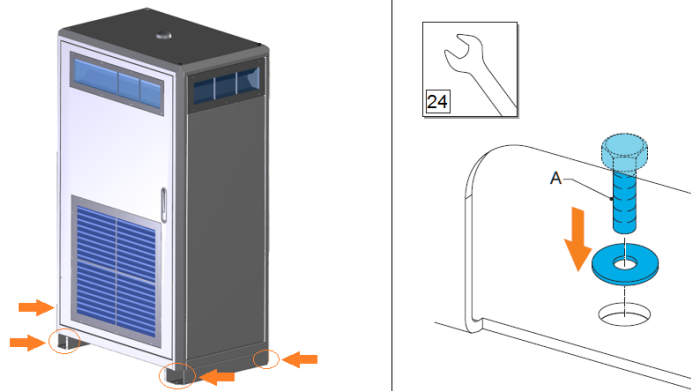
- A Foundation
- B Power Cabinet
- C Cables
- D Tapped holes




Placement on metal frame foundation

- A Foundation
- B Power Cabinet
- C Tapped holes

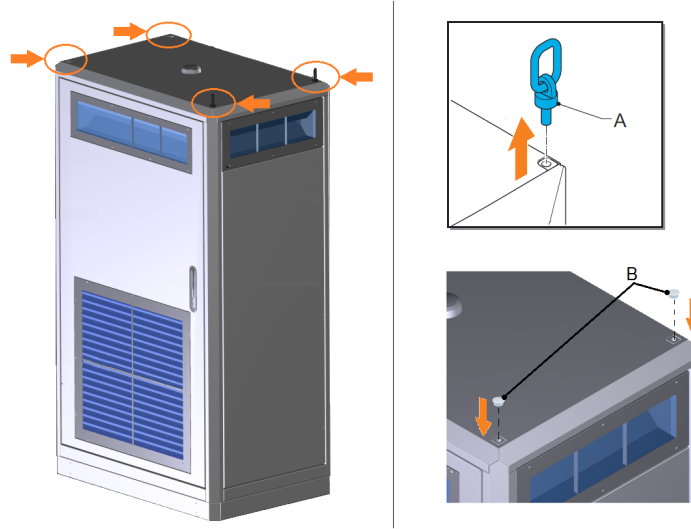
1. Carefully lower the Power Cabinet (B) onto the foundation (A).
2. Make sure that you do not trap the cables (C).
3. Make sure that the cabinet is aligned with the tapped holes (D).



4. Insert the M16 bolts (A) fitted with the washers into the holes in the corners (4x).

	NOTICE
	<p>A minimum of three M16 bolts are need to applied to securely mount the Power Cabinet onto the foundation.</p> <p>In case of placing two Power Cabinets next to each other and (3.94 Inch distance) against the wall, then one Power Cabinet can be secured by three M16 bolts on to the foundation.</p>

5. Tighten the bolts.

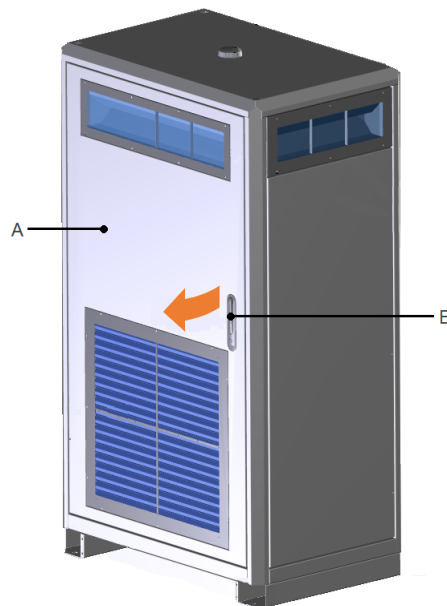


6. Remove the swivel eye bolts or lifting loops (A).
7. Place the cover caps (B) in the holes (4x).

5.5.2. Open the door of the Power Cabinet

Preconditions:

- Key that were removed from the Power Cabinet (bag with parts).

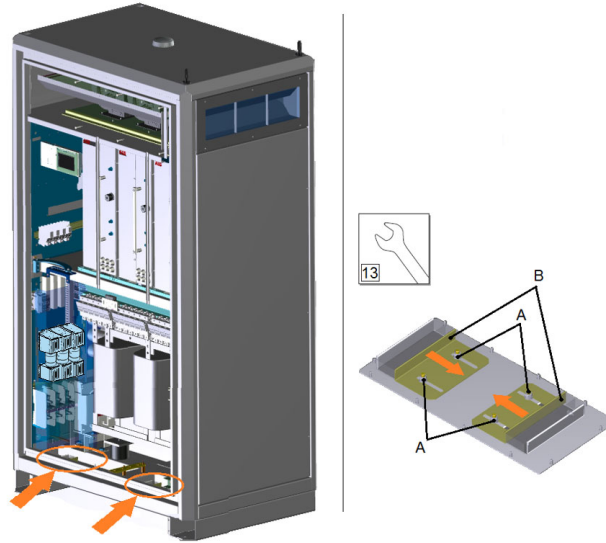


1. Unlock the handle (B)
2. Use the handle (B) to open the door (A).

5.5.3. Move the sliding plate of the guidance plates of the cabinet

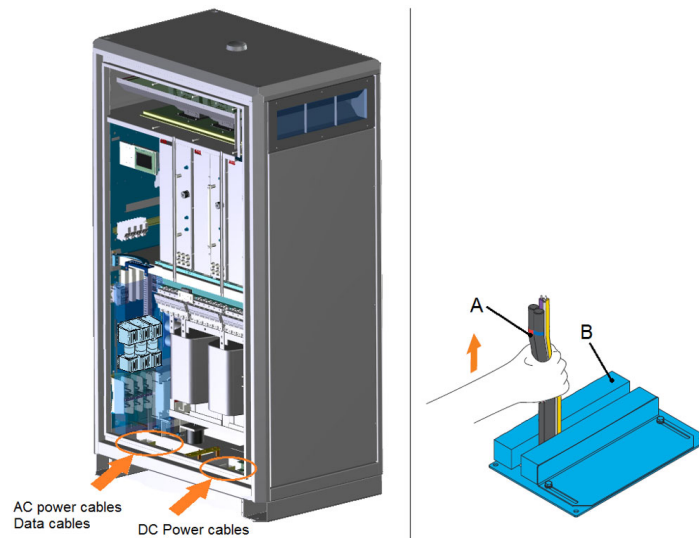
Preconditions:

- Tools: spanner (size 13).



1. Loosen the bolts (A).
2. Move the sliding plate (B) of the 2 guidance plates.

5.5.4. Route cables through guidance plates



1. Route the cables (A) through the right guidance plates (B).
2. Make sure that there is sufficient cable length to reach the connectors at the top of the cabinet.

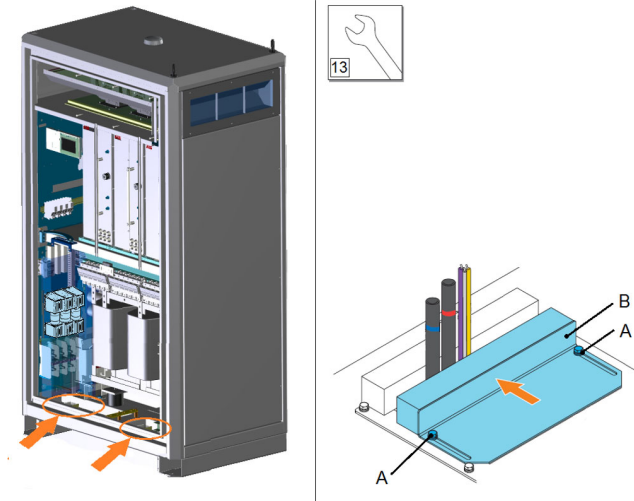
**NOTICE**

A length of 118.11 Inch is required, because the connection of the cables with the connectors in the Power Cabinet is at the middle of the cabinet.

5.5.5. Move sliding plates of the guidance plates of the cabinet

Preconditions:

- Tools: spanner (size 13).

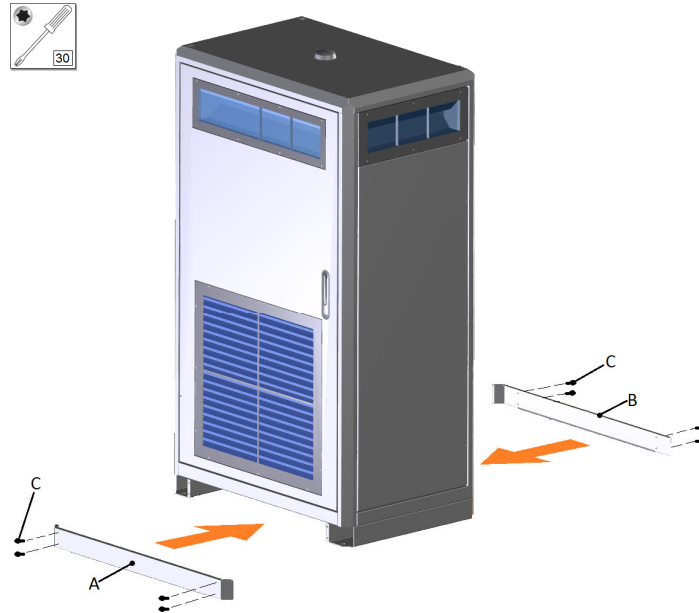


1. Move the sliding plates (B).
2. Tighten the bolts (A).

5.5.6. Install border covers of the Power Cabinet


Preconditions:

- Tools: torx screwdriver (size 2163TX-T30).
- M5 bolts (8x) that were removed from the Power Cabinet (bag with parts).



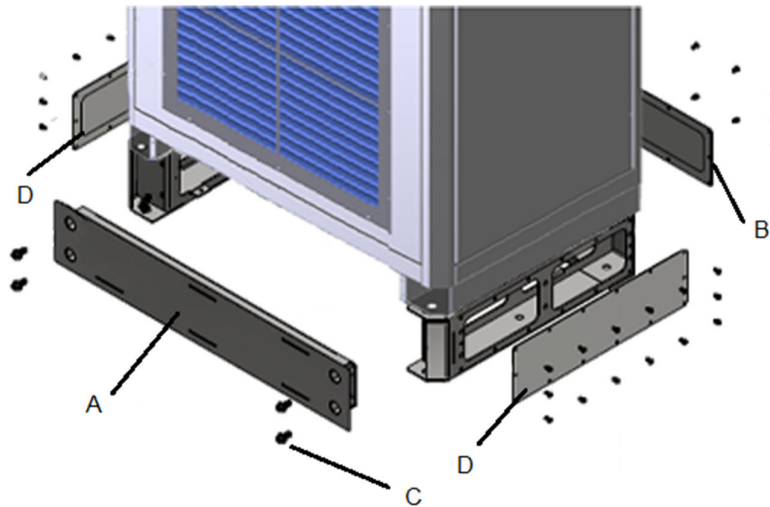
1. Put the front cover (A) against the bottom front of the Power Cabinet by aligning the four bolts at the back side of the front cover (A) with the holes in the bottom front.
2. Put the rear cover (B) against the rear front of the Power Cabinet.
3. Insert the M5 bolts (C) into the holes (8x).
4. Tighten the bolts.

5.5.7. Install border covers of metal frame foundation

	NOTICE
	<p>Only applicable when the Power Cabinet is placed on a metal frame foundation. The supplied front and rear cover on the Power Cabinet are not used in this case.</p>

Preconditions:

- Tools: torx screwdriver (size 2163TX-T30)



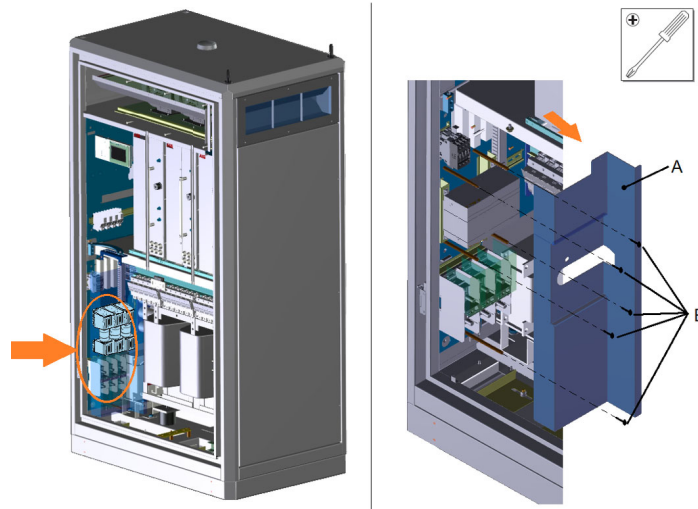
1. Put the front border cover (A) against the front of the Power Cabinet.
2. Put the rear border cover (B) against the rear of the Power Cabinet.
3. Put the side border covers (D) against the sides of the Power Cabinet.
4. Insert the M5 bolts (C) into the holes (8x).
5. Tighten the bolts.

5.6. Connect AC power cable and GND wires Power Cabinets

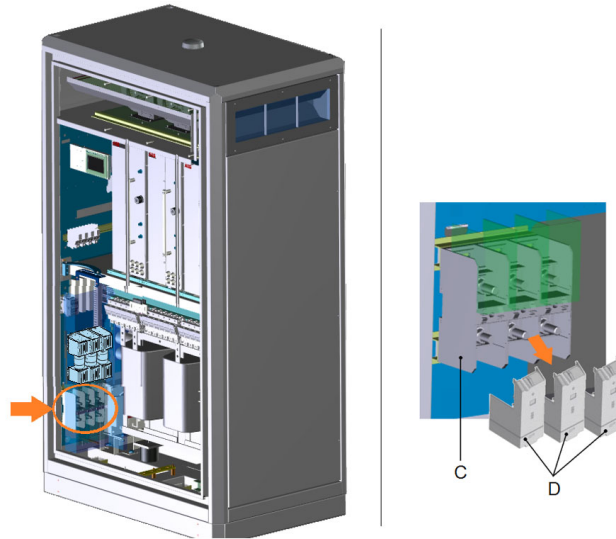
5.6.1. Remove the protection covers

Preconditions:

- Tools: cross-head screwdriver



1. Remove the protection plate (A) by loosening the screws (B).
2. Put the protection plate and screws in a safe location as it will be installed again later on.




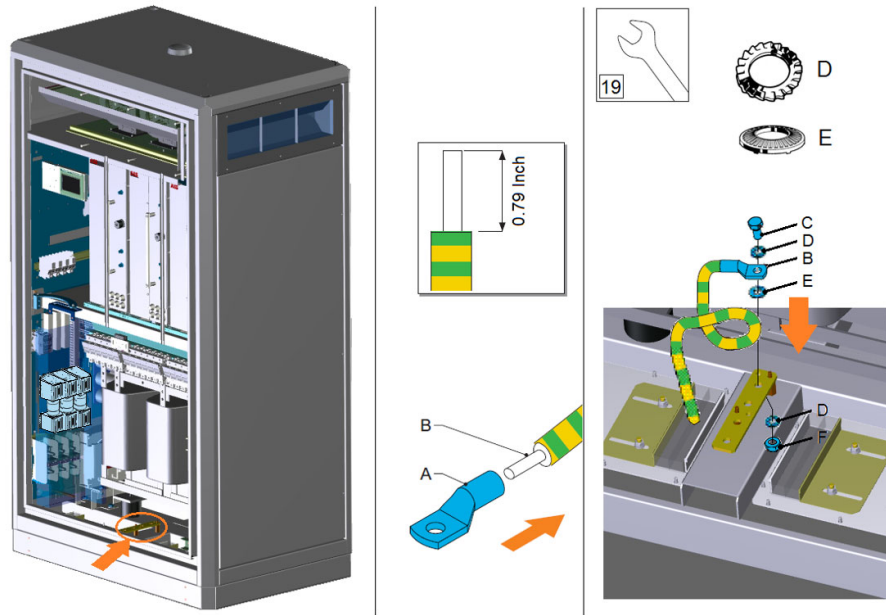
3. Remove the 3 protection covers (D) from the connector blocks (C).
4. Put the protection covers in a safe location as it will be installed again later on.

5.6.2. Connect the GND wire of the AC power cable

Preconditions:

- Tools: wire cutter, wire stripper pliers, cable lug, spanner (size 19), torque wrench (size 19).

	DANGER
	<p>Make sure that the main switch of the power supply group for the product is set to the OFF position. Do a voltage check to make sure that the electrical power is disconnected from the system. Secure against resetting.</p>



1. Make a loop in the GND wire.

	NOTICE
	<p>For safety, it is recommended to make a loop in the GND wire so it is longer than the phase wires. This loop makes sure that the GND wire is not the first wire that is disconnected if the Power Cabinet is moved by a collision.</p>

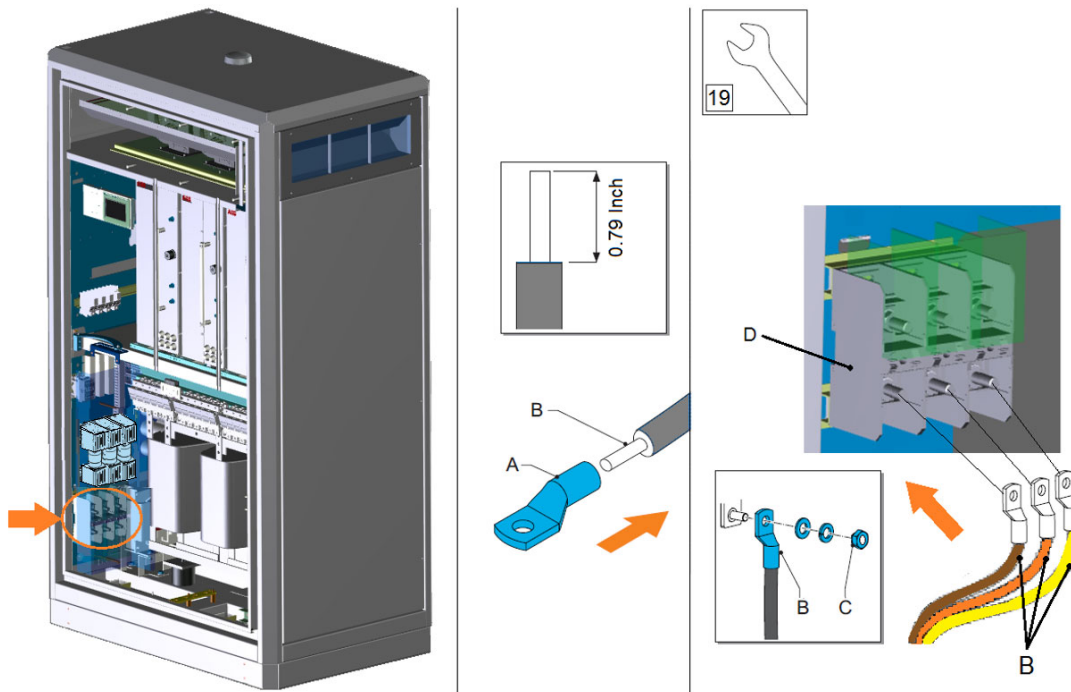
2. Cut the GND wire of the AC power cable to the correct length to reach the GND rail. Do not make the wire routing too tight, or too loose.
3. Strip 0.79 Inch of the insulation from the end of the GND wire
4. Attach a cable lug (A) to the end of the GND wire (B).
5. Remove the M12 bolt, nut and washers from the GND rail.
6. Fit the bolt (C) with toothed washer (D), the GND wire (B) and the contact washer (E).
7. Insert the bolt fitted with the GND wire into the GND rail.
8. Screw from the bottom of the GND rail a toothed washer (D) and a nut (F) on the bolt (C)
9. Tighten the bolt/nut connection with a tightening torque of 22 ft-lb.

5.6.3. Connect the AC power cable

Preconditions:

- Tools: wire cutter, wire stripper pliers, spanner (size 19), torque wrench (size 19).

	DANGER
	<p>Make sure that the main switch of the power supply group for the product is set to the OFF position. Do a voltage check to make sure that the electrical power is disconnected from the system. Secure against resetting.</p>

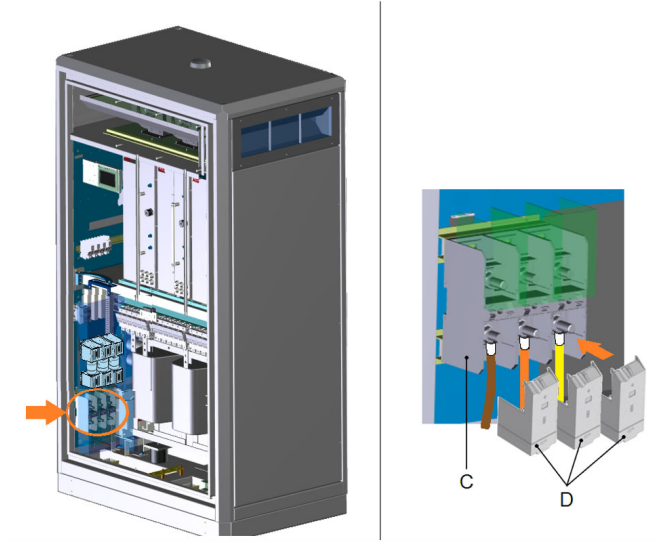


1. Cut the wires of the AC power cable to the correct lengths to reach the connectors. Do not make the wire routing too tight, or too loose.
2. Strip the insulation on the required length specified by the used lug from the end of the wire (B).
3. Attach cable lugs (A) at the end of the wires.
4. Remove the nuts and washers (C) from the bolts (M12) of connector block (D).
5. Insert the 3 wires (B) with the nuts and washers onto the bolts of connector block (D).
 - From left to right:
 - L1 (brown),
 - L2 (orange),
 - L3 (yellow).
6. Tighten the nuts (C) with a tightening torque of 22 ft-lb.

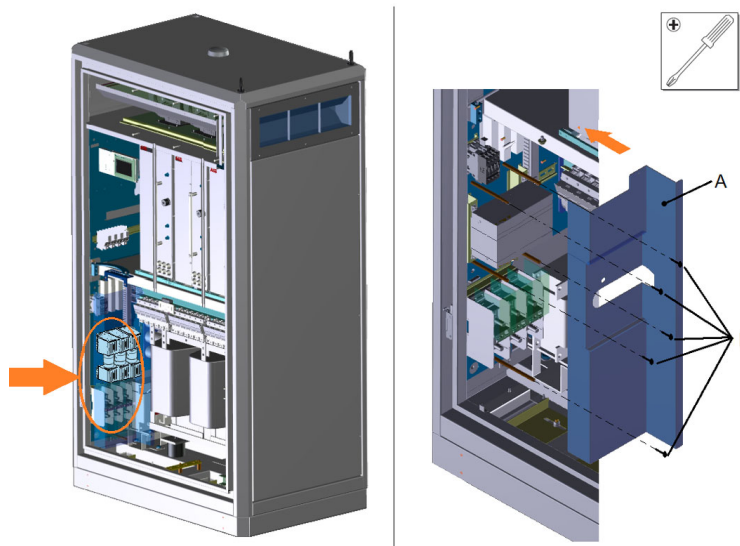
5.6.4. Install the protection covers

Preconditions:


- Tools: cross-head screwdriver



1. Take the 3 protection covers that was removed in *Remove the protection covers* on Page 66.
2. Place the protection covers (D) back on the connector blocks (C).



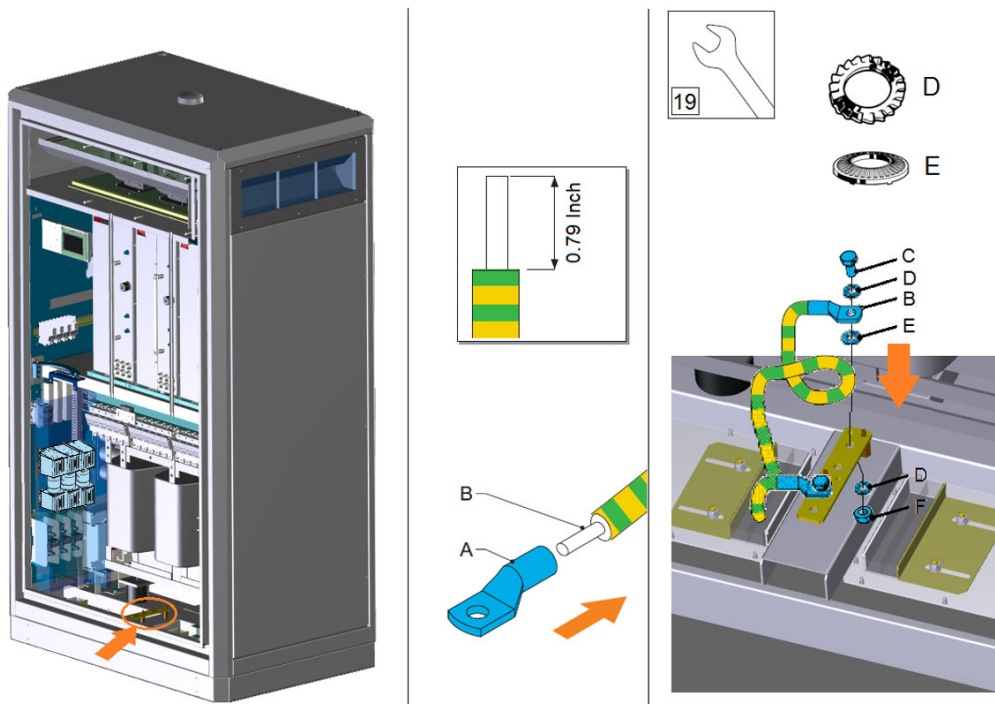
3. Take the protection plate and the screws that were removed in *Remove the protection covers* on Page 66.
4. Place the protection plate (A) back over the main switch and connector blocks and secure the plate by the screws (B).

	<p style="text-align: center;">WARNING</p> <p>Leave the main switch switched off. The Power Cabinet is not ready for use yet. If there is no appointment for commissioning yet, contact the ABB Delivery department to make an appointment for commissioning. See <i>Contact information</i> on Page 14 for contact details.</p>
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5.6.5. Install lightning protection (optional)


Preconditions:

- Tools: wire cutter, wire stripper pliers, cable lug, spanner (size 19), torque wrench (size 19).



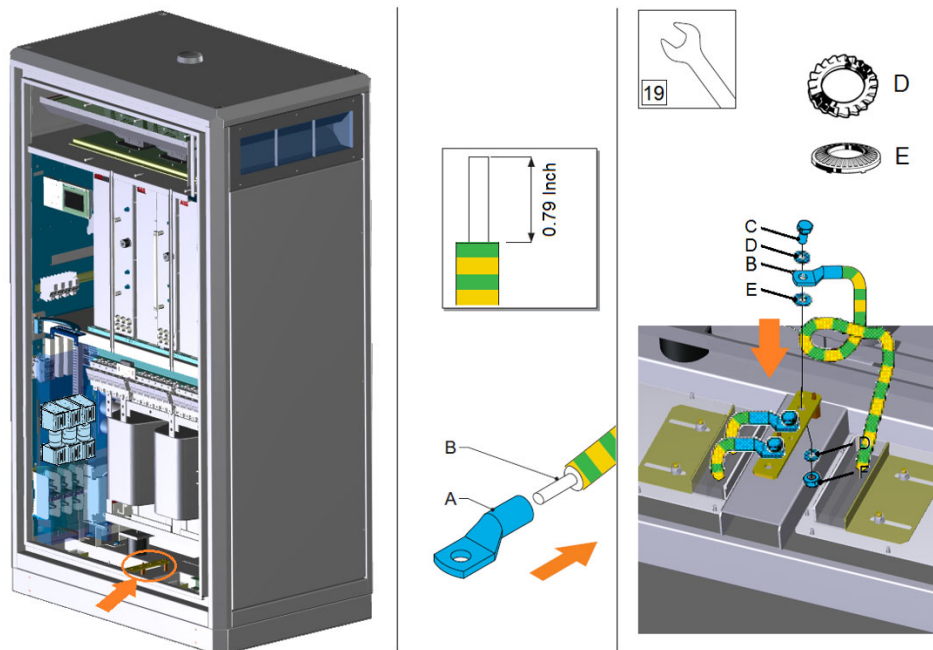
1. Cut the wire of the lightning protection cable to the correct length to reach the GND rail. Do not make the wire routing too tight, or too loose.
2. Strip 0.79 Inch of the insulation from the end of the wire.
3. Attach a wire end ring (A) to the end of the lightning protection wire (B).
4. Remove the M12 bolt, nut and washers from the GND rail.
5. Fit the bolt (C) with toothed washer (D), the lightning protection wire (B) and the contact washer (E).
6. Insert the bolt fitted with washers and the lightning protection wire into the GND rail.
7. Screw from the bottom of the GND rail a toothed washer (D) and a nut (F) on the bolt (C)
8. Tighten the bolt/nut connection with a tightening torque of 22 ft-lb.

5.6.6. Connect the GND wire to the Charge pole

	NOTICE
<p>The GND wire to the Charge pole is only connected within the HVC 150 Power Cabinet, see for more details section <i>Cabling</i> on Page 49.</p>	

Preconditions:

- Tools: wire cutter, wire stripper pliers, cable lug, spanner (size 19), torque wrench (size 19).

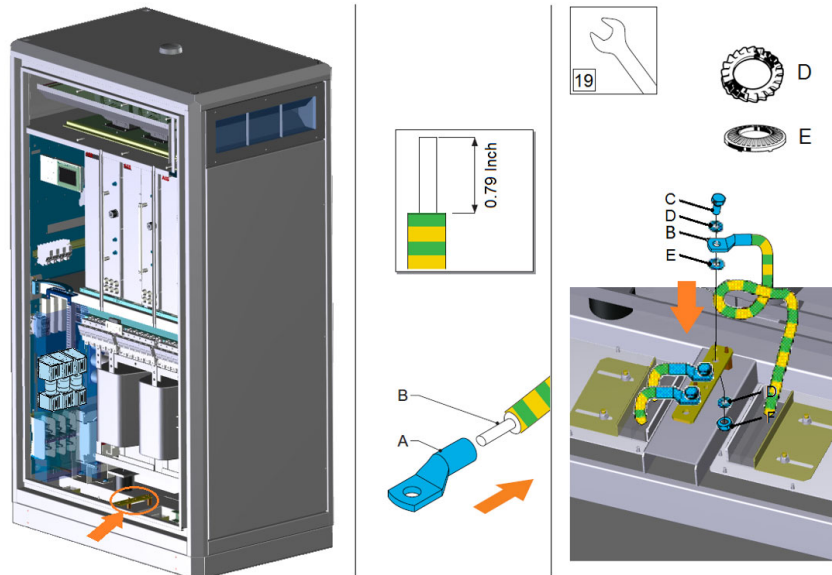


1. Cut the GND wire of the power cable to the correct length to reach the GND rail. Do not make the wire routing too tight, or too loose.
2. Strip 0.79 Inch of the insulation from the end of the GND wire.
3. Attach a wire end ring (A) to the end of the GND wire (B).
4. Remove the M12 bolt, nut and washers from the GND rail.
5. Fit the bolt (C) with toothed washer (D), the GND wire (B) and the contact washer (E).
6. Insert the bolt fitted with the GND wire into the GND rail.
7. Screw from the bottom of the GND rail a toothed washer (D) and a nut (F) on the bolt (C)
8. Tighten the bolt/nut connection with a tightening torque of 22 ft-lb.

5.6.7. Connect the GND wire between the Power Cabinets

Preconditions:

- Tools: wire cutter, wire stripper pliers, cable lug, spanner (size 19), torque wrench (size 19).




Both GND wire connection must be made between the HVC 150 and the first HVC 150S and between both HVC 150S, see also section *Cabling* on Page 49:

1. Cut the GND wire of the power cable to the correct length to reach the GND rail. Do not make the wire routing too tight, or too loose.
2. Strip 0.79 Inch of the insulation from the end of the GND wire.
3. Attach a wire end ring (A) to the end of the GND wire (B).
4. Remove the M12 bolt, nut and washers from the GND rail.
5. Fit the bolt (C) with toothed washer (D), the GND wire (B) and the contact washer (E).
6. Insert the bolt fitted with the GND wire into the GND rail.
7. Screw from the bottom of the GND rail a toothed washer (D) and a nut (F) on the bolt (C)
8. Tighten the bolt/nut connection with a tightening torque of 22 ft-lb.

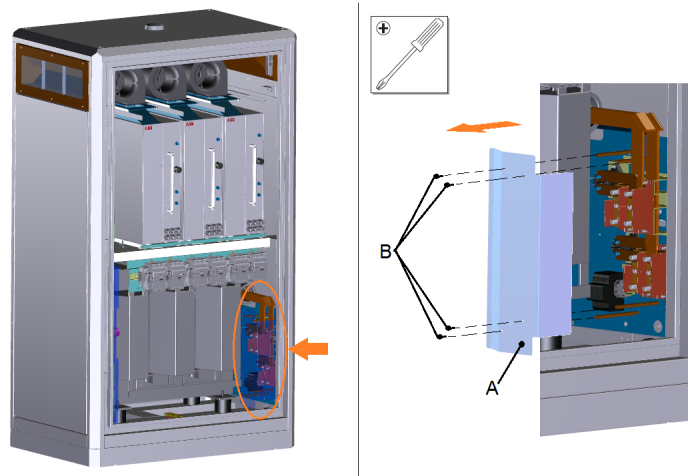
5.7. Connect the DC power cables Power Cabinets

Preconditions:

- Tools: wire cutter, wire stripper pliers, cable lugs (6x), spanner (size 19), torque wrench (size 19), cross-head screwdriver.

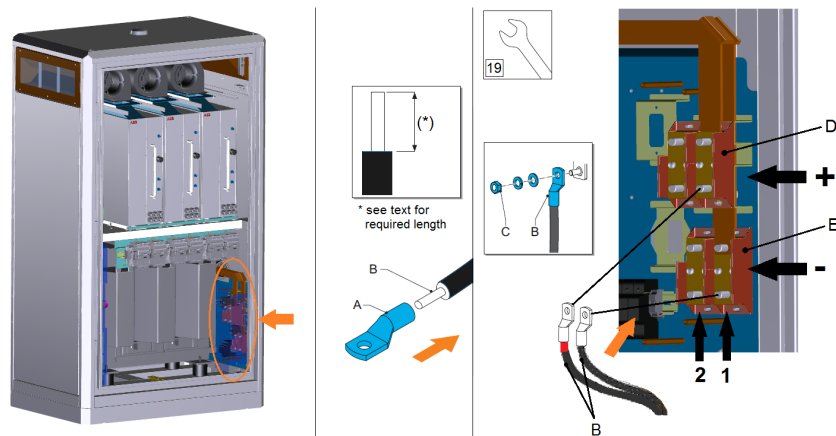
	DANGER
	<p>Make sure that the main switch of the power supply group for the product is set to the OFF position. Do a voltage check to make sure that the electrical power is disconnected from the system. Secure against resetting.</p>

Remove the protection cover



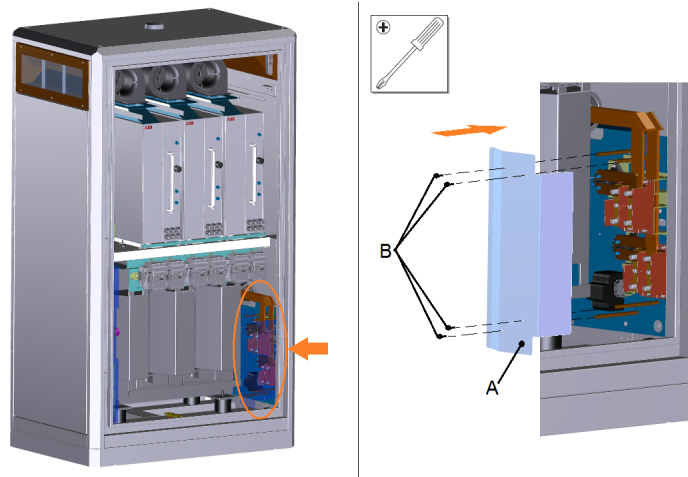
1. Remove the protection plate (A) by loosening the screws (B) (4x).
2. Put the protection plate and screws in a safe location as it will be installed again later on.

5.7.1. Connect the DC power cables



1. Cut the wires of the DC power cable to the correct lengths to reach the connectors. Do not make the wire routing too tight, or too loose.
2. Strip the insulation on the required length specified by the used lug from the end of the wire (B).
3. Attach cable lug (A) at the end of the wires.
4. Remove the nuts and washers (C) from the bolts (M12) of connector block (D) and (E).
5. Insert the DC+ wire (marked by red heat-shrink) with the nuts and washers onto the bolts of pin 1 of the connector block (D).
6. Insert the DC- wire with the nuts and washers onto the bolts of pin 1 of the connector block (E).
7. Tighten the nuts (C) with a tightening torque of 22 ft-lb.

5.7.2. Install the protection cover




1. Take the protection plate that was removed in *Remove the protection covers* on Page 74.
2. Place the protection plate (A) back over the DC connector blocks and secure the plate by the screws (B) (4x).

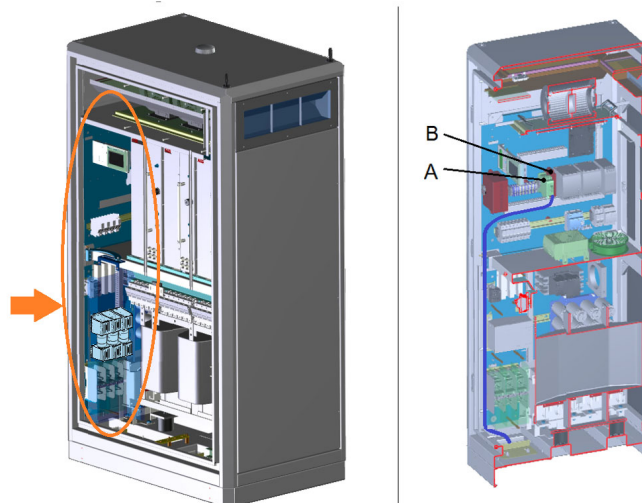
5.8. Connect AC utility power, Interlock and CAN cables Power Cabinet

Preconditions:

- Tools: wire cutter, wire stripper pliers, screwdriver, ferrules, crimp pliers.

	DANGER
	<p>Make sure that the main switch of the power supply group for the product is set to the OFF position. Do a voltage check to make sure that the electrical power is disconnected from the system. Secure against resetting.</p>


5.8.1. Route the cables to the terminal blocks

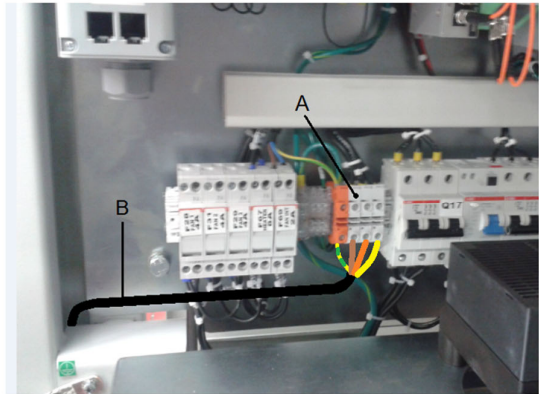
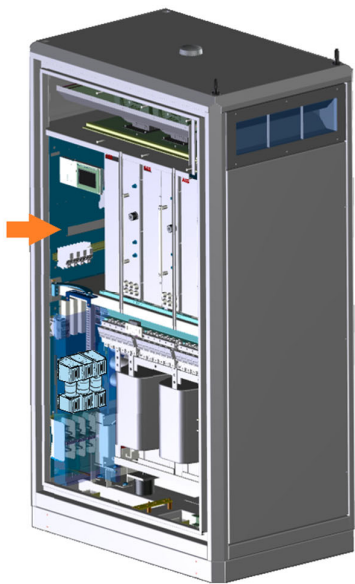


Preferred cable route

1. Route the AC utility cable to the terminal block (A). Refer to the figure for the preferred cable route inside the cabinet (only within the HVC 150).
2. Route the Interlock cable(s) to the terminal block (B). Refer to the figure for the preferred cable route inside the cabinet.
3. Route the CAN cable to the terminal block (B). Refer to the figure for the preferred cable route inside the cabinet.

5.8.2. Connect the AC utility power cable

	NOTICE
	The AC utility power cable for the ACS Control Module is only connected within the HVC 150 Power Cabinet, see for more details section Cabling on Page 49.



- A Terminal block
B AC utility power cable

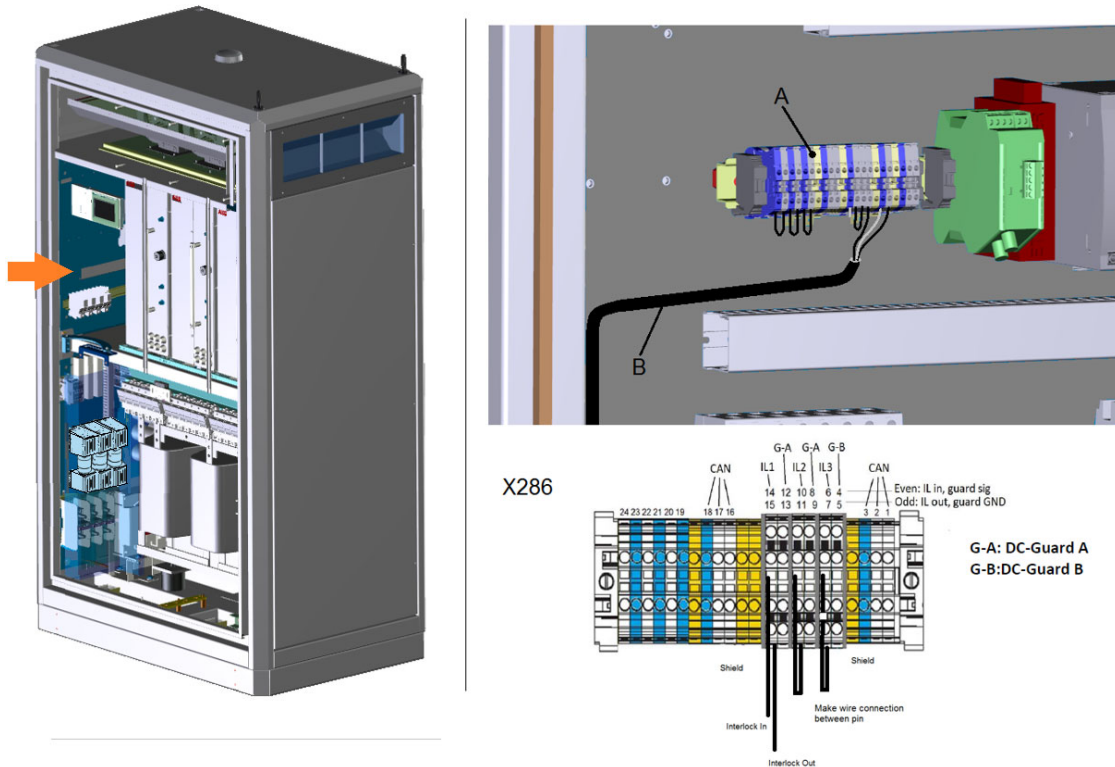
1. Move the cable towards the terminal block (A).
2. Strip 0.43 Inch of the insulation from the ends of the wires.
3. Crimp a ferrule onto the end of the wire.
4. Loosen the connector screws.
5. Insert the wires into the connectors, see table below:

Functional description	Connector	Wire color
PE	X341-1	Green/yellow
L1	X341-2	Brown
L2	X341-3	Orange
L3	X341-4	Yellow

6. Tighten the connector screws with a tightening torque of 1.0 ft-lb.

5.8.3. Connect the Interlock cable for the HVC 150 kW system

Interlock cable connection in the **primary HVC 150**:



- A Terminal block
B Interlock cable from/to ACS Control Module (ACM)

1. Move the cable towards the terminal block (A).
2. Strip 0.43 Inch of the insulation from the ends of **only the White and Brown wire!**
3. Crimp a ferrule onto the end of the White and Brown wire.
4. Ensure that the unused wires, the Green and Yellow wire, are protected so that they cannot touch metal parts.
5. Make a wire connection between pin X286-6 and X286-7 and pin X286-10 and X286-11.
6. Loosen the connector screws.
7. Insert the wires into the connectors, see table below:

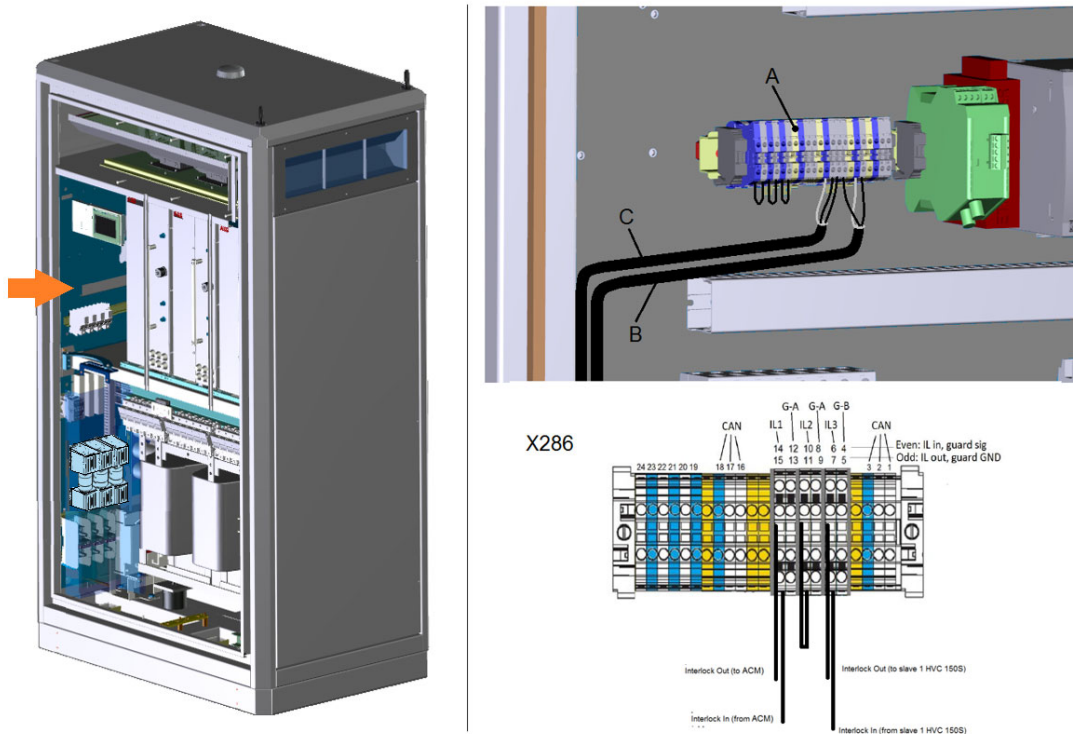
Functional description	Connector	Wire number
Interlock In	X286-15	Brown
Interlock Out	X286-14	White
Interlock GND	X286	Shield
Interlock loop	X286-6	Black
Interlock loop	X286-7	Black
Interlock loop	X286-10	Black
Interlock loop	X286-11	Black

See also Appendix H *Signal connection diagram*.

8. Tighten the connector screws with a tightening torque of 1.0 ft-lb.

5.8.4. Upgrade the Interlock connection to the HVC 300 kW system

Interlock cable connection in the **primary HVC 150**:



- A Terminal block
- B Interlock cable from/to ACS Control Module (ACM)
- C Interlock cable from/to secondary 1 HVC 150S

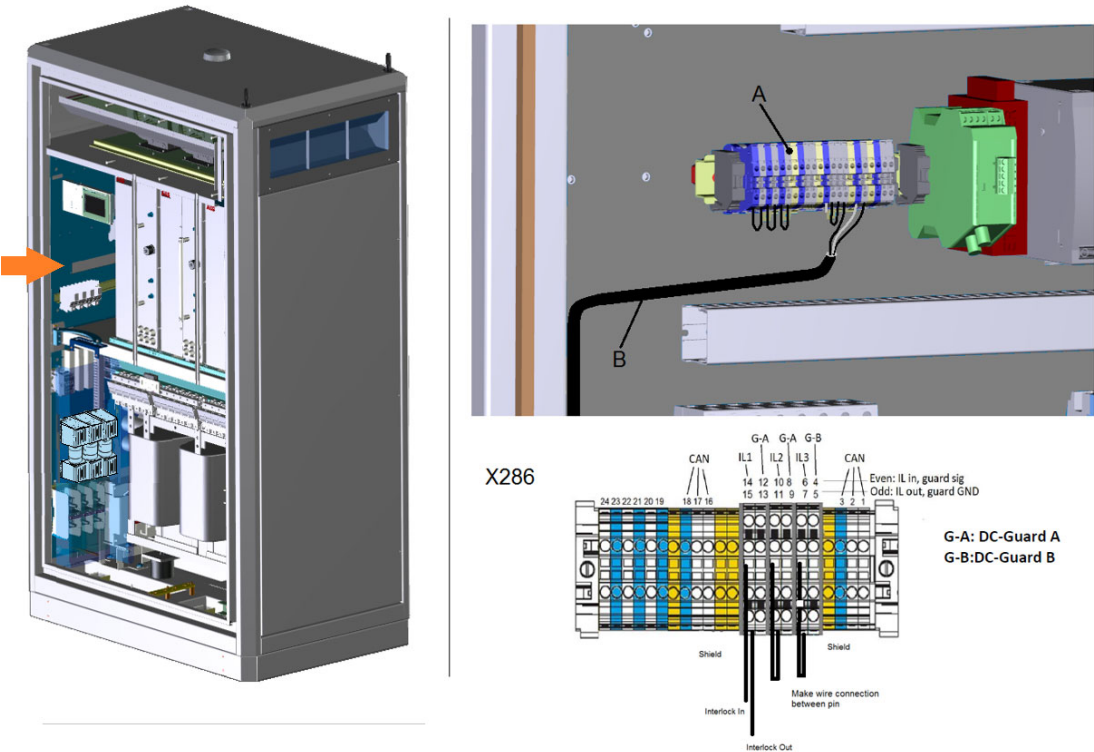
1. Move the cables towards the terminal block (A).
2. Strip 0.43 Inch of the insulation from the ends of **only the White and Brown wire!**
3. Crimp a ferrule onto the end of the White and Brown wire.
4. Ensure that the unused wires, the Green and Yellow wire, are protected so that they cannot touch metal parts.
5. Loosen the connector screws.
6. Remove the wire connection between pin X286-6 and X286-7, if present.
7. Insert the wires into the connectors, see table below:

Functional description	Connector	Wire number
Interlock In (ACM)	X286-15	Brown
Interlock Out (ACM)	X286-14	White
Interlock GND (ACM)	X286	Shield
Interlock In (secondary 1 HVC 150S)	X286-6	White
Interlock Out (secondary 1 HVC 150S)	X286-7	Brown
Interlock GND (secondary 1 HVC 150S)	X286	Shield
Interlock loop	X286-10	Black
Interlock loop	X286-11	Black

See also Appendix H *Signal connection diagram*.

8. Tighten the connector screws with a tightening torque of 1.0 ft-lb.

Interlock cable connection in **secondary 1 HVC 150S**:



- A Terminal block
B Interlock cable from/to primary HVC 150

1. Move the cables towards the terminal block (A).
2. Strip 0.43 inch of the insulation from the ends of **only the White and Brown wire!**
3. Crimp a ferrule onto the end of the White and Brown wire.
4. Ensure that the unused wires, the Green and Yellow wire, are protected so that they cannot touch metal parts.
5. Make a wire connection between pin X286-6 and X286-7 and pin X286-10 and X286-11.
6. Loosen the connector screws.
7. Insert the wires into the connectors, see table below:

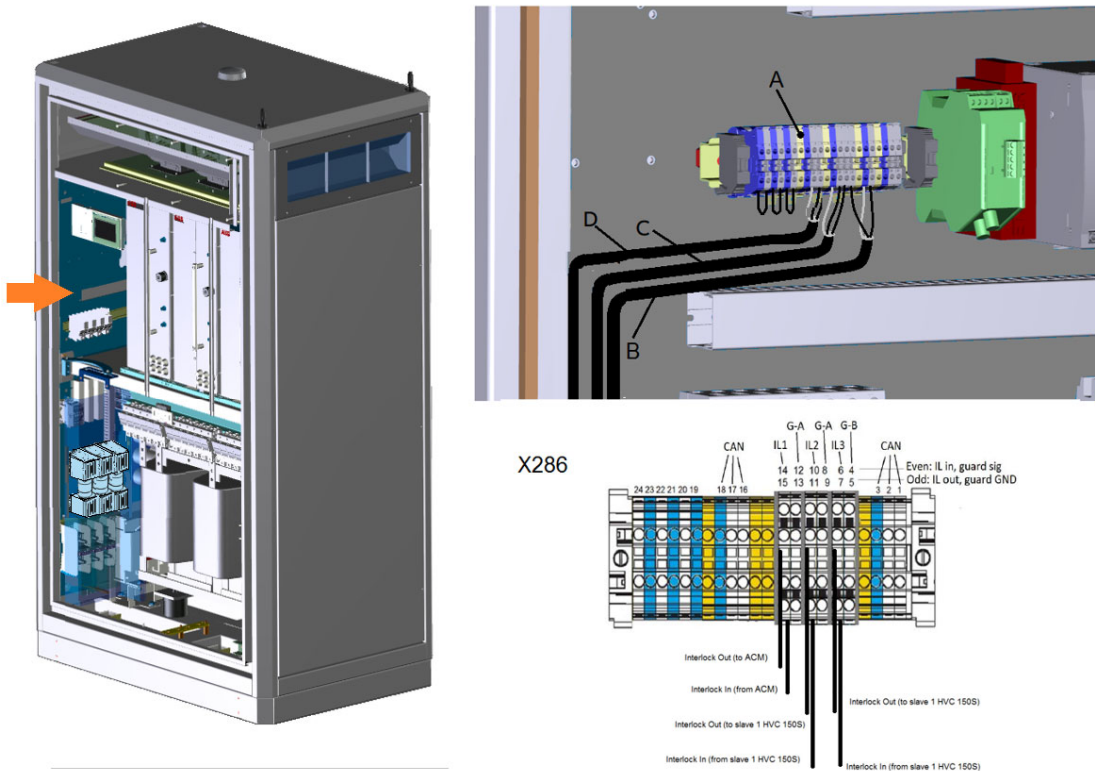
Functional description	Connector	Wire number
Interlock In (primary HVC 150)	X286-14	Brown
Interlock Out (primary HVC 150)	X286-15	White
Interlock GND (primary HVC 150)	X286	Shield
Interlock loop	X286-6	Black
Interlock loop	X286-7	Black
Interlock loop	X286-10	Black
Interlock loop	X286-11	Black

See also Appendix H *Signal connection diagram*.

8. Tighten the connector screws with a tightening torque of 1.0 ft-lb.

5.8.5. Upgrade the Interlock connection to the HVC 450 kW system

Interlock cable connection in **secondary 1 HVC 150S**:



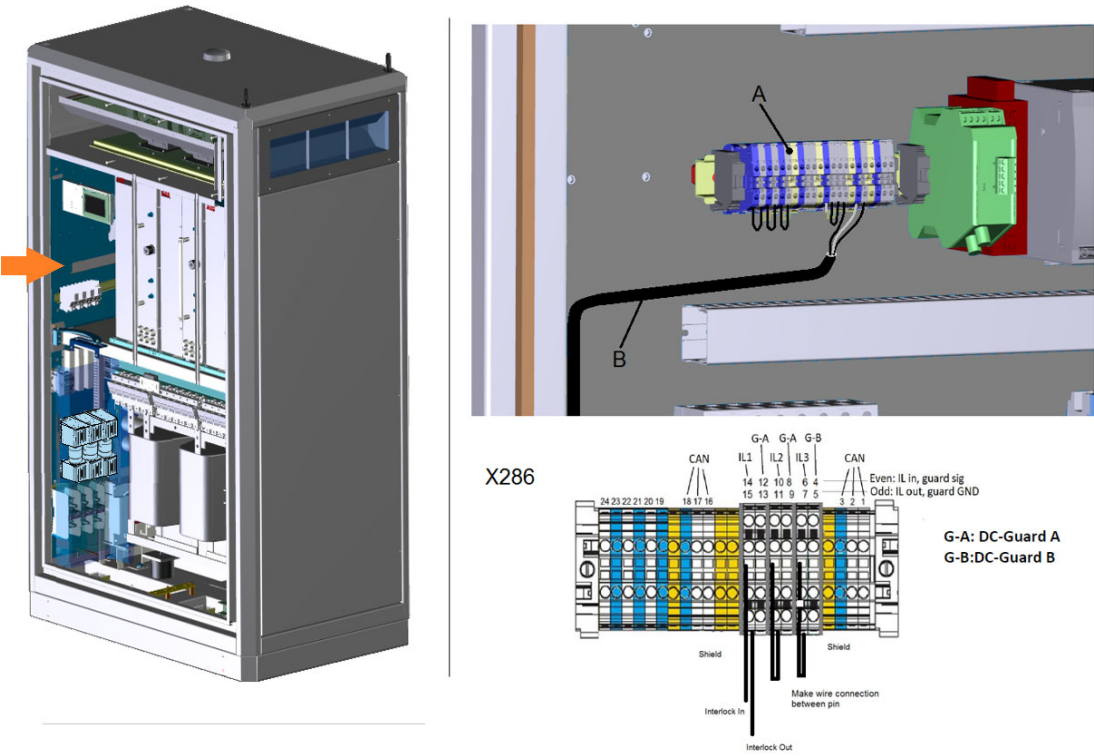
- A Terminal block
- B Interlock cable from/to primary HVC 150
- C Interlock cable from/to secondary HVC 150S
- D Interlock cable from/to secondary HVC 150S

1. Move the cables towards the terminal block (A).
2. Strip 0.43 Inch of the insulation from the ends of **only the White and Brown wire!**
3. Crimp a ferrule onto the end of the White and Brown wire.
4. Ensure that the unused wires, the Green and Yellow wire, are protected so that they cannot touch metal parts.
5. Loosen the connector screws.
6. Remove the wire connection between pin X286-6 and X286-7 and pin X286-10 and X286-11, if present.
7. Insert the wires into the connectors, see table below:

Functional description	Connector	Wire number
Interlock In (ACM)	X286-15	Brown
Interlock Out (ACM)	X286-14	White
Interlock GND (ACM)	X286	Shield
Interlock In (secondary 1 HVC 150S)	X286-6	White
Interlock Out (secondary 1 HVC 150S)	X286-7	Brown
Interlock GND (secondary 1 HVC 150S)	X286	Shield
Interlock Out (secondary 1 HVC 150S)	X286-10	Black
Interlock GND (secondary 1 HVC 150S)	X286-11	Black

See also Appendix H *Signal connection diagram*.

8. Tighten the connector screws with a tightening torque of 1.0 ft-lb.
Interlock cable connection in **secondary 2 HVC 150S**:



- A Terminal block
B Interlock cable from/to secondary 1 HVC 150S


1. Move the cables towards the terminal block (A).
2. Strip 0.43 Inch of the insulation from the ends of **only the White and Brown wire!**
3. Crimp a ferrule onto the end of the White and Brown wire.
4. Ensure that the unused wires, the Green and Yellow wire, are protected so that they cannot touch metal parts.
5. Make a wire connection between pin X286-7 and X286-8.
6. Loosen the connector screws.
7. Insert the wires into the connectors, see table below:

Functional description	Connector	Wire number
Interlock In (secondary 1 HVC 150S)	X286-4	Brown
Interlock Out (secondary 1 HVC 150S)	X286-6	White
Interlock GND (secondary 1 HVC 150S)	X286-5	Shield
Interlock loop	X286-7	Black
Interlock loop	X286-8	Black

See also Appendix H *Signal connection diagram*.

8. Tighten the connector screws with a tightening torque of 1.3 N·m.

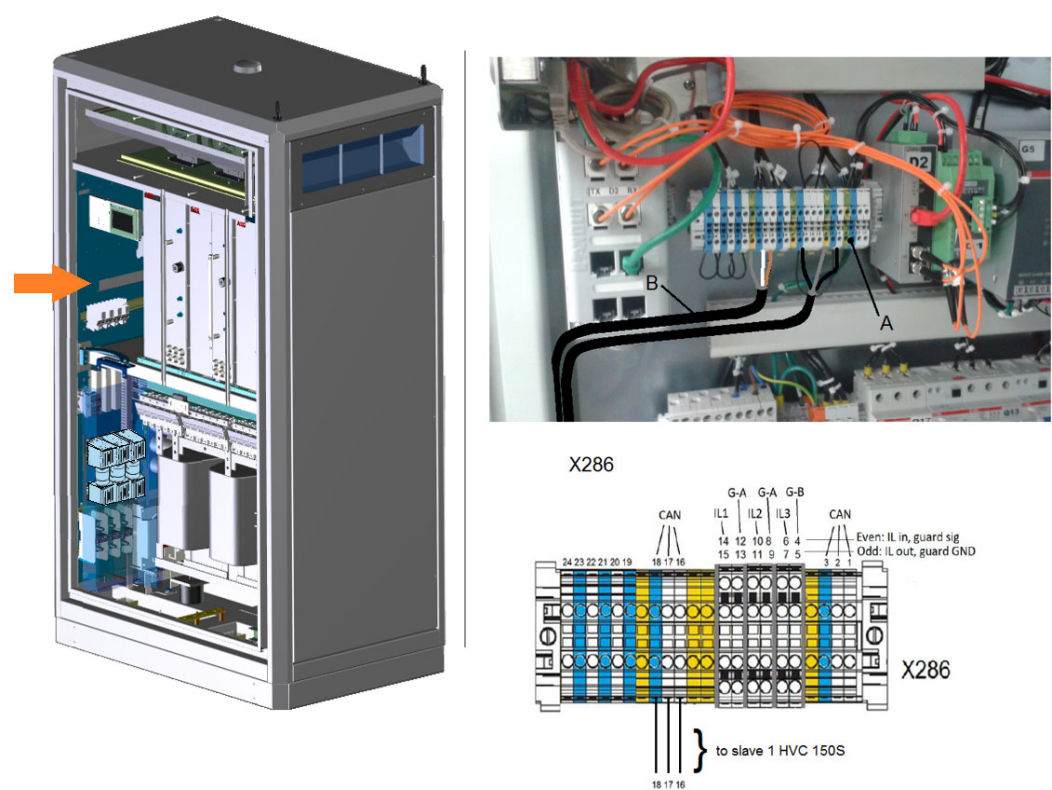
5.8.6. Connect the CAN cable



NOTICE

The CAN cable connection is only needed for the HVC 300 kW and 450 kW E-Bus Charger, see for more details section *Cabling* on Page 49.

CAN cable connection in **secondary 2 HVC 150S** (in case of a HVC 450 kW system):



- A Terminal block
B CAN cable to secondary 1 HVC 150S

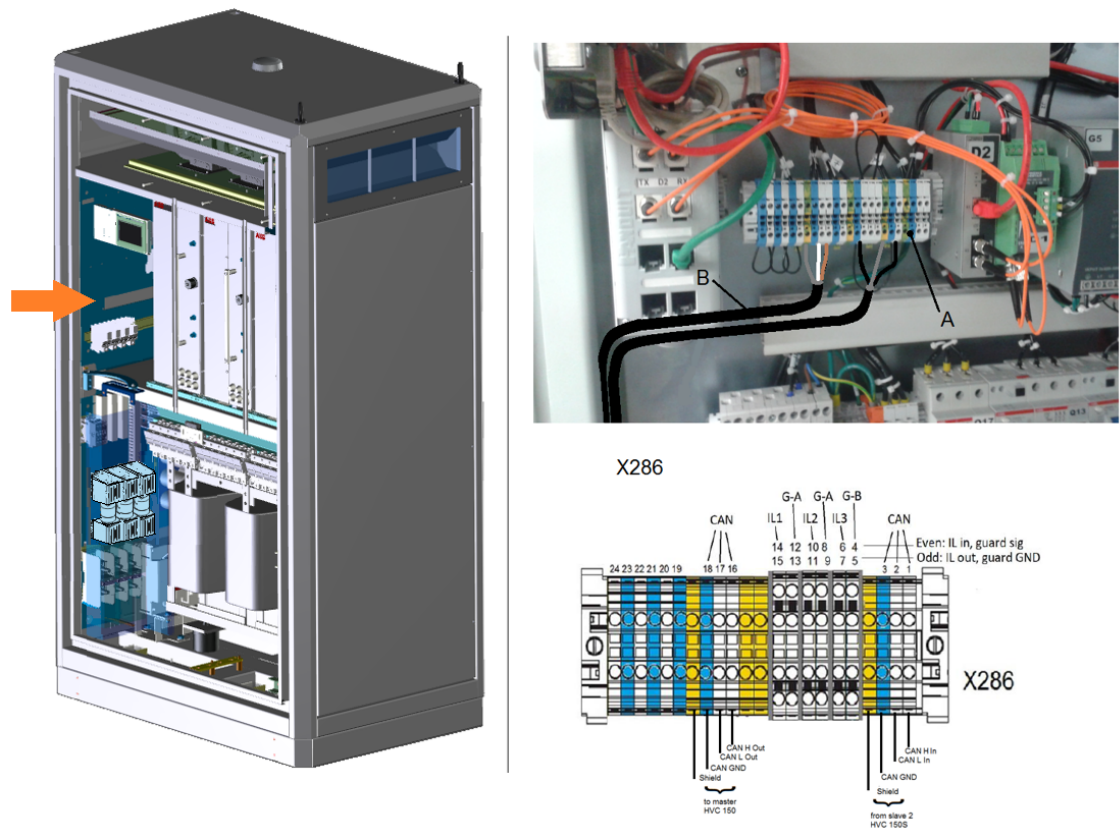
1. Move the cable towards the terminal block (A).
2. Strip 0.43 of the insulation from the ends of the wires.
3. Crimp a ferrule onto the end of the wire.
4. Loosen the connector screws.
5. Insert the wires into the connectors, see table below:

Functional description	Connector	Wire color
CAN H Out	X286-10	Brown
CAN L Out	X286-11	White
CAN GND	X286-12 or Shield Can Out	Shield

See also Appendix H *Signal connection diagram*.

6. Tighten the connector screws with a tightening torque of 1.0 ft-lb.

CAN cable connection in **secondary 1 HVC 150S**:



- A Terminal block
B CAN cable to primary HVC 150
C CAN cable from secondary 2 HVC 150S (in case of a HVC 450 kW system)

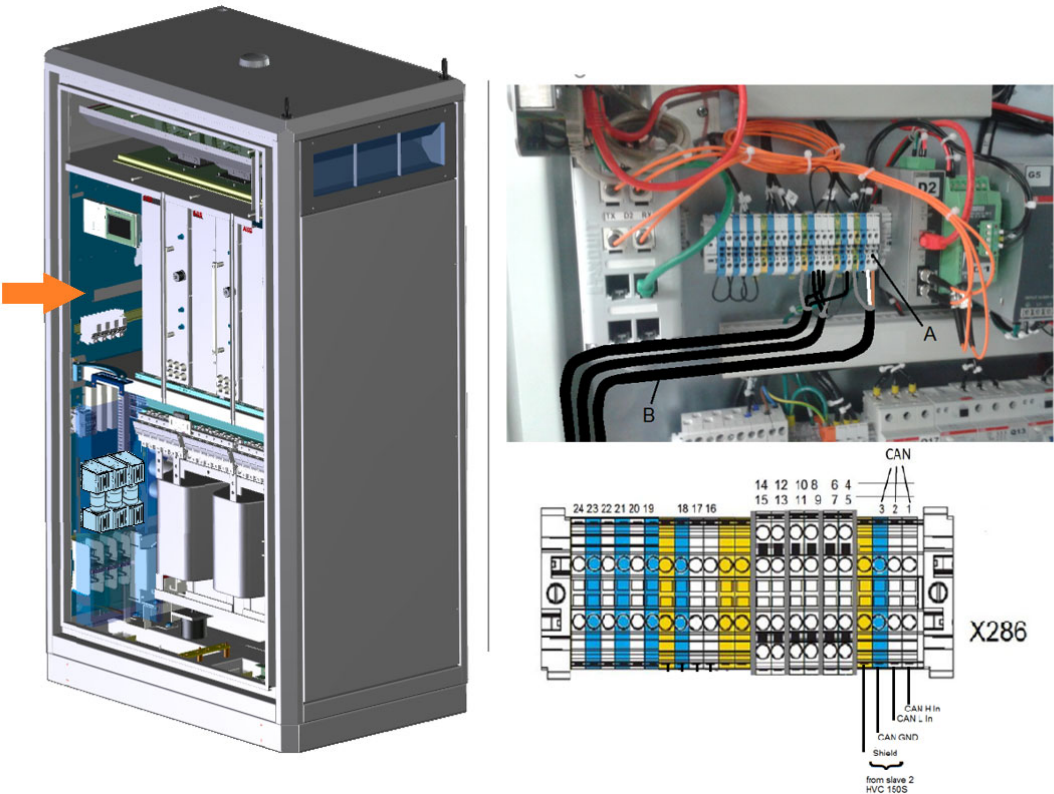
1. Move the cable towards the terminal block (A).
2. Strip 0.43 Inch of the insulation from the ends of the wires.
3. Crimp a ferrule onto the end of the wire.
4. Loosen the connector screws.
5. Insert the wires into the connectors, see table below:

Functional description	Connector	Wire color
CAN H In (to primary HVC 150)	X286-1	Brown
CAN L In (to primary HVC 150)	X286-2	White
CAN GND (to primary HVC 150)	X286-3 or Shield Can In	Shield
CAN H Out (from secondary 2 HVC 150S)	X286-16	Brown
CAN L Out (from secondary 2 HVC 150S)	X286-17	White
CAN GND (from secondary 2 HVC 150S)	X286-18 or Shield Can Out	Shield

See also Appendix H *Signal connection diagram*.

6. Tighten the connector screws with a tightening torque of 1.0 ft-lb.

CAN cable connection in **primary HVC 150**:



- A Terminal block
B CAN cable from secondary 1 HVC 150S

1. Move the cable towards the terminal block (A).
2. Strip 0.43 Inch of the insulation from the ends of the wires.
3. Crimp a ferrule onto the end of the wire.
4. Loosen the connector screws.
5. Insert the wires into the connectors, see table below:

Functional description	Connector	Wire color
CAN H In	X286-1	Brown
CAN L Out	X286-2	White
CAN GND	X286-3 or Shield Can In	Shield

See also Appendix H *Signal connection diagram*.

6. Tighten the connector screws with a tightening torque of 1.0 ft-lb.

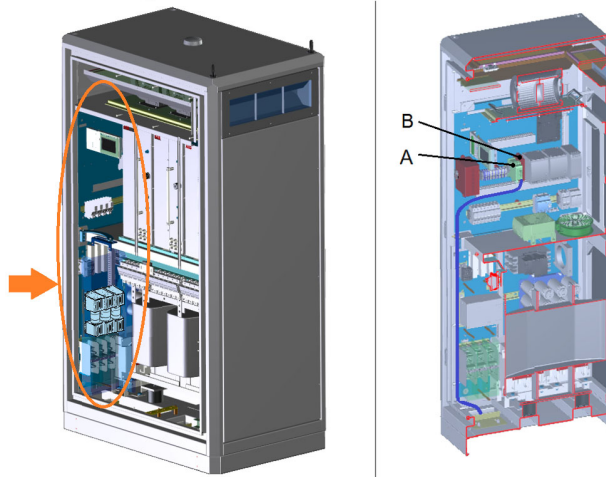
5.9. Connect the communication cable Power Cabinet



NOTICE

The communication fiber cables to the ACS Control Module are only connected within the primary HVC 150 Power Cabinet, see for more details section Cabling on Page 49.

5.9.1. Route the cable to the terminal blocks



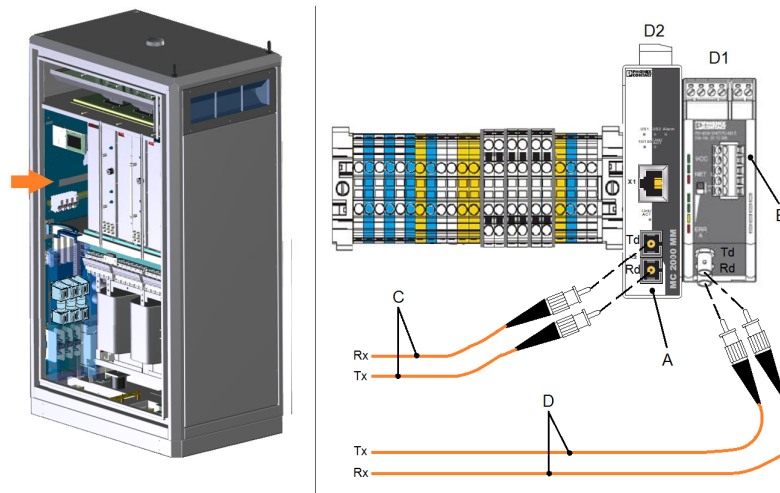
Preferred cable route

1. Route the communication fiber cable to module D1 (B) and D2 (A). Refer to the figure for the preferred cable route inside the cabinet (only within the HVC 150).


5.9.2. Connect the communication fiber cables

Preconditions:


- Tools: tak-ty or ty-raps



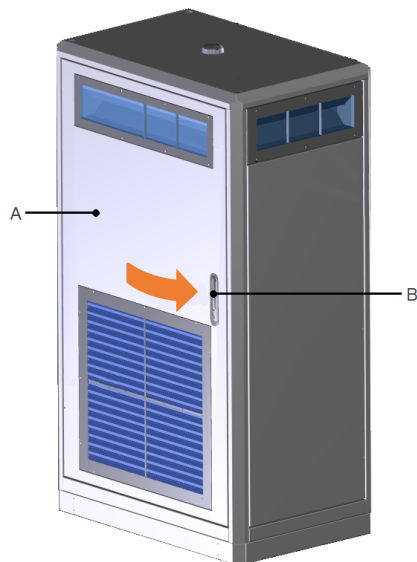
1. Remove the protection covers from the optical connectors.
2. Connect the two Ethernet fiber cables (C) onto the module D2 (A):
 - Rx with Td D2;
 - Tx with Rd D2.
3. Connect the two CAN bus fiber cables (D) onto module D1 (B):
 - Rx with Td D1;
 - Tx with Rd D1.

	NOTICE
Four fiber cables are not connected. Those fiber cables are meant for spare.	

4. Bind the cables together and secure the loops loosely with a piece of tak-ty or ty-rap.

	CAUTION
Make the loop bend radius of the fiber cables not smaller than 2.52 Inch, otherwise the core of the fiber cable may break.	

5.10. Close the door of the Power Cabinet



Preconditions:

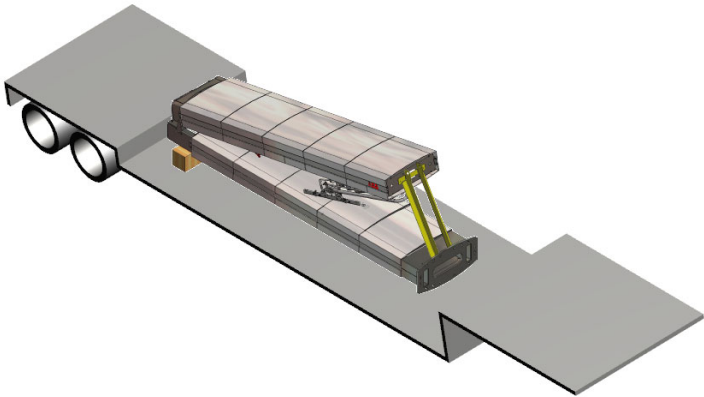
- Key that were removed from the Power Cabinet

1. Close the door (A).
2. Lock the handle (B).

5.11. Unpack the Charge Pole

5.11.1. Before unpacking

The Charge Pole is delivered on trailer.



NOTICE	
	Unloading Charge control set The delivery truck only unloads the Charge Pole and pallet carrying the parts of the Charge Pole. The delivery truck will not move the Charge Pole set to its final location. The placement of the Charge Pole to its final location is the responsibility of the contractor. Upon request it is possible to order a truck with a crane.
	CAUTION Do not pollute the environment with plastic and cardboard packing. Depollute these things according the regional applicable regulations as well as environment-friendly.

Preconditions:

- All construction work is completed.
 - The product is delivered by a transport company at the confirmed date of delivery.
 - Equipment to set the pole in the right position during installation (in all directions).
 - Crane to lift the frame of the pole. The minimum load is about 3761 lb and minimum height required about 23 ft.
 - Mobile elevated work platform to tighten the bolts between horizontal and vertical frame, plate work installation and adjustment of the Pantograph. Required height about 19.69 ft.
1. Check the delivery goods and boxes for damages.
 2. Check that all cable connections on the pantograph and Wi-Fi communication unit are tight.

WARNING	
	Make sure that the painted seal on the pantograph electrical connectors are not damaged. Is this not the case, contact ABB Delivery department (see <i>Contact information</i> on Page 14 for contact details).





5.11.2. Remove packaging

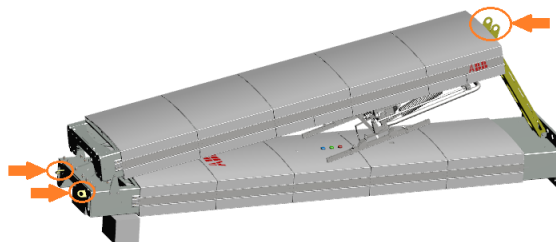
1. Remove the packing foil from the Charge Pole (if present).
2. Open the top side of the wooden box with the plate work.
3. Keep the bag with bolts and nuts to assemble the pole in a safe place.

5.12. Move the Charge pole to position

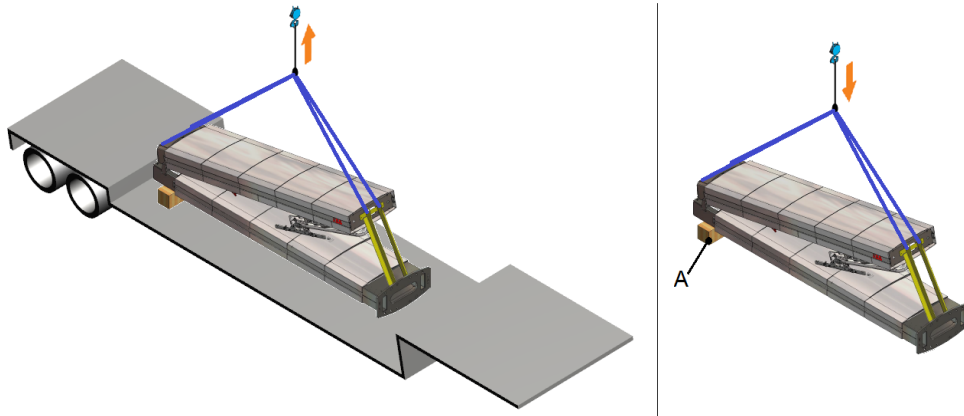
Preconditions:

- The location is prepared for placing the Charge Pole.
- The location is closed to bystanders and all preparatory safety measures required during the lifting operations have been carried out.
- The Charge Pole is made unsecured on the trailer and the cover sail (if present) are removed.
- The protective cups to cover the bolts of the foundation are removed and the bolts are free from dust. If necessary clean the bolts with a vacuum cleaner or brush.
- The work must be carried out by at least two persons. One person to operate the hoisting equipment, the other to guide the Charge Pole.
- Tools: spanner (size 36).

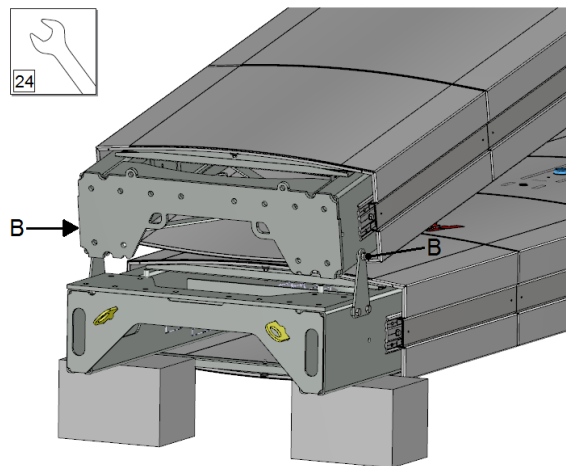
	DANGER Make sure that the main switch of the power supply group for the product is set to the OFF position. Do a voltage check to make sure that the electrical power is disconnected from the system. Secure against resetting.
	WARNING Make sure that personnel cannot be crushed or get stuck while moving the parts of the Charge Pole.
	WARNING Make sure that personnel cannot be falling from the platform when working at height.
	CAUTION Warranty Damage due to moving the Charge Pole to its position is not covered by the warranty.



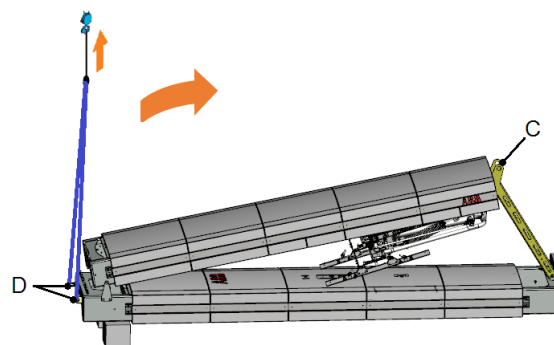
1. Connect the hoisting equipment to the lifting points on the Charge Pole.



2. Lift the Charge Pole by using slings and place the Charge Pole beside the trailer. In order not to damage the Charge Pole, use a wooden beam (A) on which the end of the pole can rest.



3. Loosening the nut/bolt (B) (2x) (but do not remove those) on both side of the mast boom, so that the mast boom can freely rotated.




4. Remove the hoisting equipment only from transport holder (C).
5. Lift the Charge Pole up by using slings which are only connected to the lifting points (D).

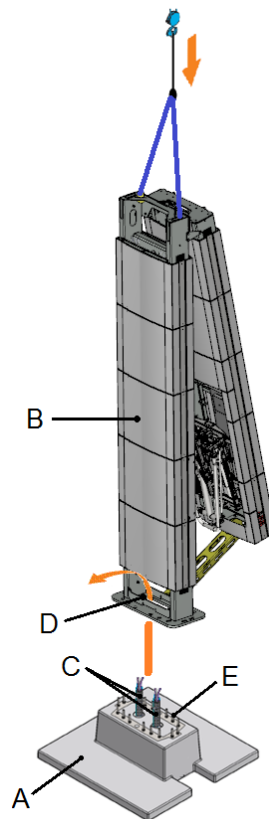
6. Move the Charge Pole to the foundation.

5.13. Install Charge Pole onto the foundation

Preconditions:

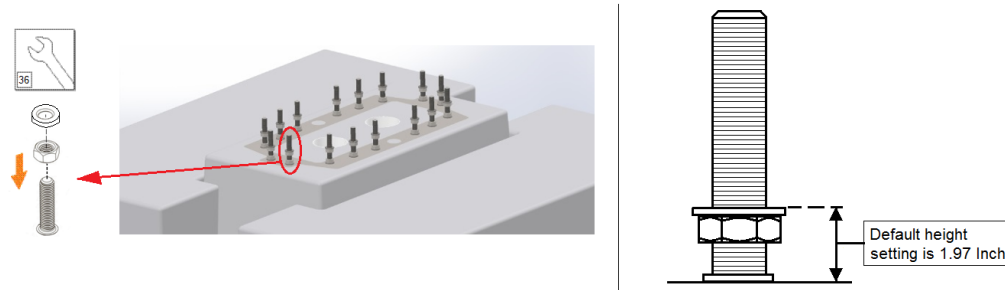
- Tools: mobile elevated work platform, spanner (size 36), torque wrench (size 36).

	<p style="text-align: center;">DANGER</p> <p>Make sure that the main switch of the power supply group for the product is set to the OFF position. Do a voltage check to make sure that the electrical power is disconnected from the system. Secure against resetting.</p>
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Installation on concrete foundation


- | | |
|-----------------------------------|----------------------|
| A Foundation (for reference only) | D Opening for cables |
| B Charge Post | E Bolts (16x) |
| C Conduit with cables | |



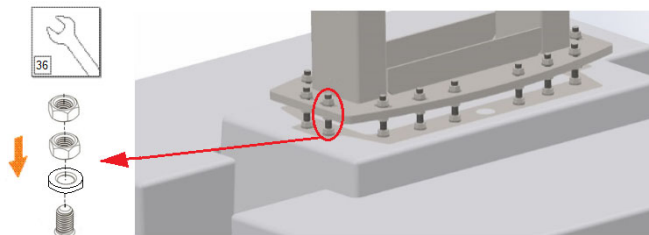
1. It is possible to choose to lubricate the bolts first or not with copper fat.

	NOTICE
	<p>There are a number of reasons for using copper fat:</p> <ul style="list-style-type: none"> • It is corrosion resistant; • Less torque must be used on the nut to develop the same force on the bolt. • Less friction damage to the M24-wire on the bolt and nut, leaving the galvanized wire surface intact which promotes corrosion resistance.

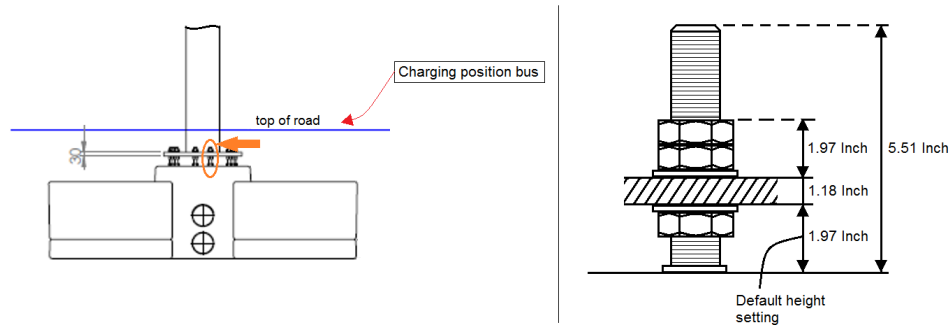
2. Screw the M24 (or equivalent) nuts onto the bolts and place on each nut the 0.32 Inch thick washers (16x). The default height between the top of the washer and foundation must be 1.97 Inch.


	NOTICE
	<ul style="list-style-type: none"> • Do not use the 0.12 Inch thick washers supplied with the foundation. • The nuts need to be leveled relative to the concrete foundation, else you would compensate the sand settlement angle.

3. Carefully position the Charge Pole (B) above the foundation (A).
4. Pull the cables through the opening (E).
5. Lower the Charge Pole onto the foundation, aligned above the bolts (F).
6. Check whether the Charge Post is properly aligned with the road or curb.



7. Screw the first M24 nuts fitted with the washers on the bolts (16x, rotate slightly).



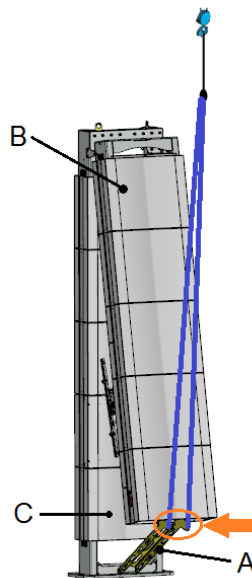
	NOTICE
	<p>Be aware that the correct height to the bottom side of the foot print of the vertical frame relative to the ground level of the top of road (= charging position of the bus) must be calculated by ABB. Contact ABB Sales department (see <i>Contact information</i> on Page 14 for contact details).</p>

8. Tighten the nuts with a tightening torque of 590.05 ft-lb when no copper fat is used, and with a tightening torque of 390.91 ft-lb when copper fat is used.
9. Screw the second M24 nuts on the bolts (16x)
10. Tighten the upper nuts.
11. Remove the hoisting equipment from the Charge Pole.

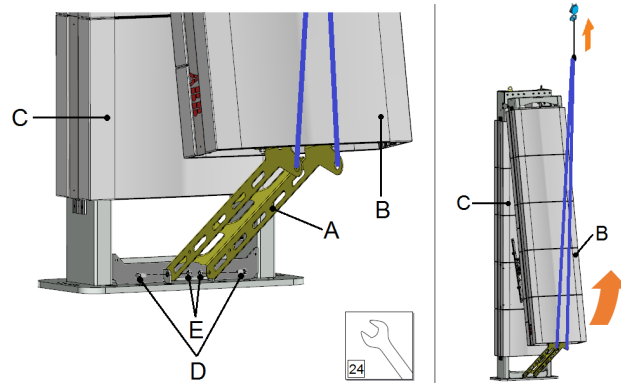
5.14. Install mast boom onto column

Preconditions:

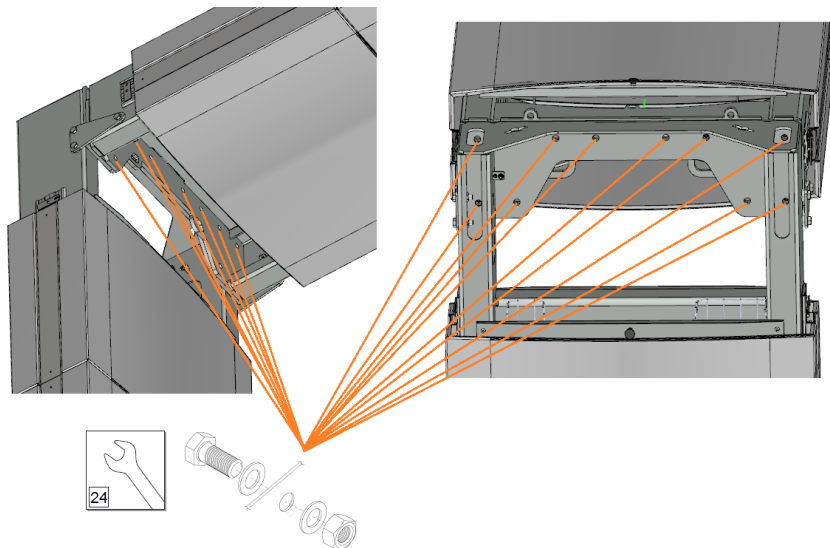
- Tools: mobile elevated work platform, torx screwdriver (size 2163TX-T30), spanner (size 17 and 24), torque wrench (size 24).



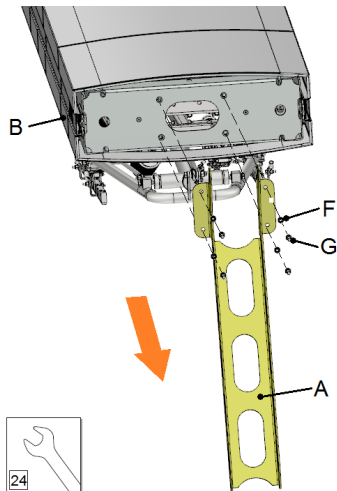
1. Connect the hoisting equipment to the lifting points on the mast boom (B) position of the transport holder (A).



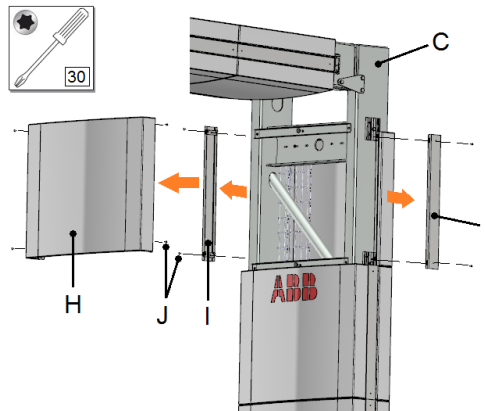
2. Remove the bolts (D) and nuts (E) (2x) which secured the transport holder (A) with the column (C) of the Charge Pole.
3. Lift up the mast boom (B) until it touches the column (C) horizontally.



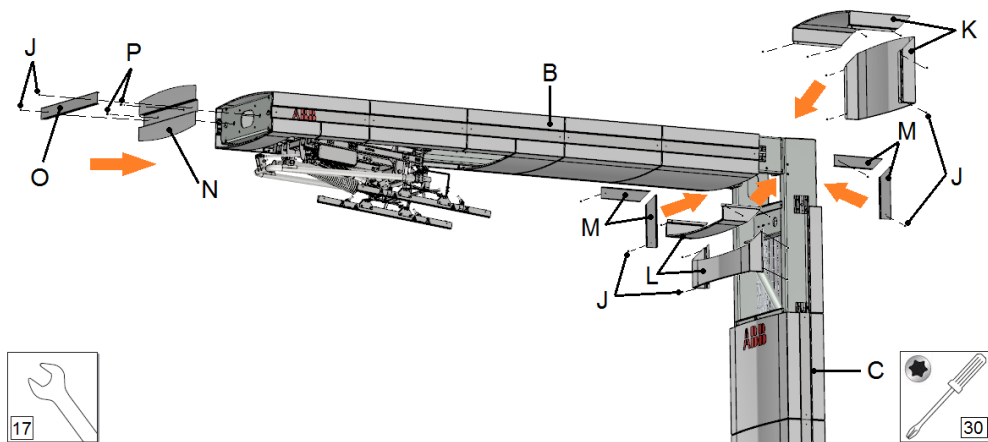
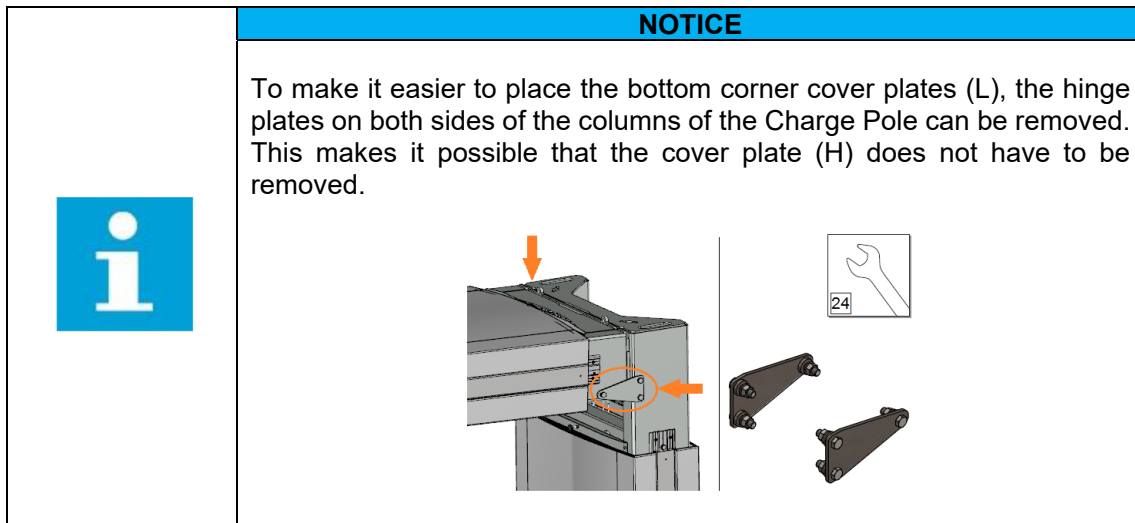
4. Mount the mast boom (B) onto the column (C) by using 12x M16 bolt + washer / washer + nut connection. Use 12 pieces bolts of M16 x 60 (THVZ) Class 8.8, and THVZ washers and nuts. A torque of 169.64 ft-lb has to be applied.



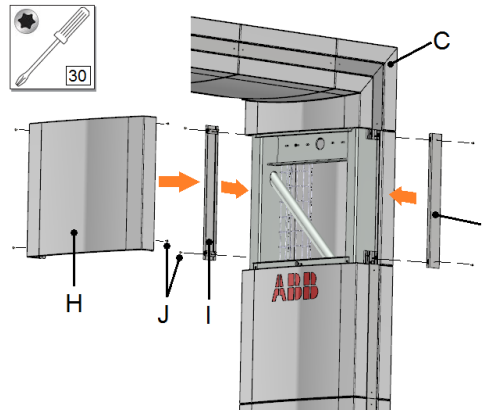
5. Release the slings from the transport holder (A).
6. Remove the transport holder (A) from the mast boom (B) by removing the bolts (G) and washers (F) (4x).



7. Remove on both side the U-profiles (I) by detaching the two M6 bolts (J).
8. Remove the cover plate (H) by detaching the M6 bolts (J).
9. Put the cover plate, U-profiles and bolts in a safe location as it will be installed again later on.





10. Place the top corner cover plates (K) (2x) onto the Charge Post, and tighten the M6 bolts (J) (8x).
11. Place the bottom corner cover plates (L) (2x) onto the Charge Post, and tighten the M6 bolts (L) (8x).
12. Place the corner U-profiles (M) (4x) on both side of the Charge Post, and tighten the M6 bolts (8x).
13. Place the front cover plate (N) onto the end of the mast boom (B).
14. Use M10 x 30 THVZ bolts (P) (2x) in combination with a M10 THVZ washers (2x) to fix the front cover plate (N).
15. Place the Front U-profile (O) onto the front cover plate (N).
16. Screw the Front U-profile (O) tight with M6 bolts (J) (2x).



17. Place back the cover plate (H) and tighten the M6 bolts (J) (4x).
18. Place back the U-profiles (I) on both side, and tighten the M6 bolts (J) (4x).

5.15. Pantograph adjustment

	WARNING
	Make sure that personnel cannot be falling from the platform when working at height.
	CAUTION
	Remove the ty-raps that secure the cables to the Pantograph from the cable hooks located near the Pantograph. Check whether the cables are stuck anywhere or can catch on something before the Pantograph is shifted. While shifting the pantograph, keep in mind that cables will not be damaged.

Preconditions:

- Tools: mobile elevated work platform, measuring tool, level tool, torx screwdriver (size 2163TX-T30), spanner (size 19), allen key (size 6), cutter.

5.15.1. Instruction for pantograph adjustment and alignment

The pole has been designed for a pass thru (distance from the contacts rails of the retracted pantograph to the top of the road) of 179.92 +/- 2 inch and a bus rails high of 131.89 +/- 5.9 Inch. Otherwise there are chances the pole do not comply with local traffic regulations or the pantograph can work out of its linear zone.

The pole is delivered with the pantograph at its maximum reach (end of the horizontal section).

After the pole has been erected, the pantograph has to be positioned where it be needed for an effective operation.

Information required to preposition the pantograph during the installation process:

- Distance in millimeters between the contact points of the pantograph and top of road in retracted state;
- Road inclination (perpendicular to the bus drive direction) = (Positive if right of the bus driver is lower);
- Tilting or kneeling of the bus (if applicable): (Positive if right side of the bus, from driver's perspective goes down);
- Distance in millimeters from the curb to the front cover of the pole;
- Regarding to which side of the bus the pole has been erected, introduce the gathered information to the related table to obtain the distance in millimeters the pantograph need to be moved inwards.

Use the tables below to select, based on the required information above, the right adjustment values for the pantograph.

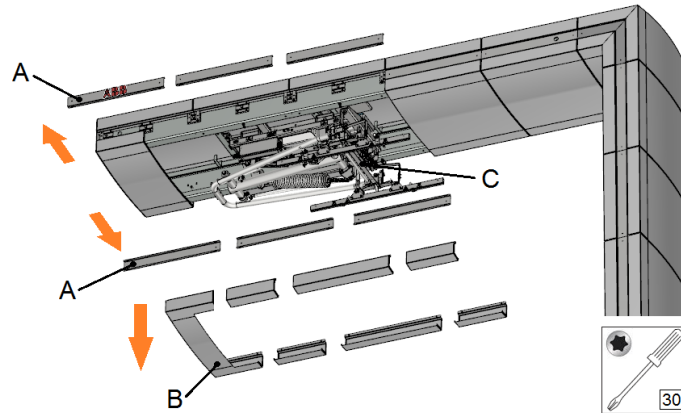
POLE ON THE RIGHT - DRIVERS POINT OF VIEW																
Inclination + Kneeling (Angles in degrees)																
	740.75	3.5	3	2.5	2	1.5	1	0.5	0	-0.5	-1	-1.5	-2	-2.5	-3	-3.5
Curb width (mm)	400	1569	1541	1513	1484	1456	1428	1400	1372	1344	1315	1287	1259	1231	1203	1175
	450	1519	1491	1463	1434	1406	1378	1350	1322	1294	1265	1237	1209	1181	1153	1125
	500	1469	1441	1413	1384	1356	1328	1300	1272	1244	1215	1187	1159	1131	1103	1075
	550	1419	1391	1363	1334	1306	1278	1250	1222	1194	1165	1137	1109	1081	1053	1025
	600	1369	1341	1313	1284	1256	1228	1200	1172	1144	1115	1087	1059	1031	1003	975
	650	1319	1291	1263	1234	1206	1178	1150	1122	1094	1065	1037	1009	981	953	925
	700	1269	1241	1213	1184	1156	1128	1100	1072	1044	1015	987	959	931	903	875
	750	1219	1191	1163	1134	1106	1078	1050	1022	994	965	937	909	881	853	825
	800	1169	1141	1113	1084	1056	1028	1000	972	944	915	887	859	831	803	775
	850	1119	1091	1063	1034	1006	978	950	922	894	865	837	809	781	753	725
	900	1069	1041	1013	984	956	928	900	872	844	815	787	759	731	703	675
	950	1019	991	963	934	906	878	850	822	794	765	737	709	681	653	625
	1000	969	941	913	884	856	828	800	772	744	715	687	659	631	603	575
	1050	919	891	863	834	806	778	750	722	694	665	637	609	581	553	525
	1100	869	841	813	784	756	728	700	672	644	615	587	559	531	503	475
	1150	819	791	763	734	706	678	650	622	594	565	537	509	481	453	425
	1200	769	741	713	684	656	628	600	572	544	515	487	459	431	403	375
	1250	719	691	663	634	606	578	550	522	494	465	437	409	381	353	325
	1300	669	641	613	584	556	528	500	472	444	415	387	359	331	303	275
	1350	619	591	563	534	506	478	450	422	394	365	337	309	281	253	225
	1400	569	541	513	484	456	428	400	372	344	315	287	259	231	203	175
	1450	519	491	463	434	406	378	350	322	294	265	237	209	181	153	125
	1500	469	441	413	384	356	328	300	272	244	215	187	159	131	103	75
	1550	419	391	363	334	306	278	250	222	194	165	137	109	81	53	25
	1600	369	341	313	284	256	228	200	172	144	115	87	59	31	3	-25
	1650	319	291	263	234	206	178	150	122	94	65	37	9	-19	-47	-75
	1700	269	241	213	184	156	128	100	72	44	15	-13	-41	-69	-97	-125
	1750	219	191	163	134	106	78	50	22	-6	-35	-63	-91	-119	-147	-175
	1800	169	141	113	84	56	28	0	-28	-56	-85	-113	-141	-169	-197	-225
	1850	119	91	63	34	6	-22	-50	-78	-106	-135	-163	-191	-219	-247	-275
	1900	69	41	13	-16	-44	-72	-100	-128	-156	-185	-213	-241	-269	-297	-325

Inclination conversion table	
Degrees	% incl
-1.8	-3.1%
-1.5	-2.6%
-1.2	-2.1%
-0.9	-1.6%
-0.6	-1.0%
-0.3	-0.5%
0	0.0%
0.3	0.5%
0.6	1.0%
0.9	1.6%
1.2	2.1%
1.5	2.6%
3.7	6.5%

POLE ON THE LEFT - DRIVERS POINT OF VIEW																
		Inclination + Kneeling (Angles in degrees)														
	987.25	3.5	3	2.5	2	1.5	1	0.5	0	-0.5	-1	-1.5	-2	-2.5	-3	-3.5
Curb width (mm)	400	1759	1787	1815	1844	1872	1900	1928	1956	1984	2013	2041	2069	2097	2125	2153
	450	1709	1737	1765	1794	1822	1850	1878	1906	1934	1963	1991	2019	2047	2075	2103
	500	1659	1687	1715	1744	1772	1800	1828	1856	1884	1913	1941	1969	1997	2025	2053
	550	1609	1637	1665	1694	1722	1750	1778	1806	1834	1863	1891	1919	1947	1975	2003
	600	1559	1587	1615	1644	1672	1700	1728	1756	1784	1813	1841	1869	1897	1925	1953
	650	1509	1537	1565	1594	1622	1650	1678	1706	1734	1763	1791	1819	1847	1875	1903
	700	1459	1487	1515	1544	1572	1600	1628	1656	1684	1713	1741	1769	1797	1825	1853
	750	1409	1437	1465	1494	1522	1550	1578	1606	1634	1663	1691	1719	1747	1775	1803
	800	1359	1387	1415	1444	1472	1500	1528	1556	1584	1613	1641	1669	1697	1725	1753
	850	1309	1337	1365	1394	1422	1450	1478	1506	1534	1563	1591	1619	1647	1675	1703
	900	1259	1287	1315	1344	1372	1400	1428	1456	1484	1513	1541	1569	1597	1625	1653
	950	1209	1237	1265	1294	1322	1350	1378	1406	1434	1463	1491	1519	1547	1575	1603
	1000	1159	1187	1215	1244	1272	1300	1328	1356	1384	1413	1441	1469	1497	1525	1553
	1050	1109	1137	1165	1194	1222	1250	1278	1306	1334	1363	1391	1419	1447	1475	1503
	1100	1059	1087	1115	1144	1172	1200	1228	1256	1284	1313	1341	1369	1397	1425	1453
	1150	1009	1037	1065	1094	1122	1150	1178	1206	1234	1263	1291	1319	1347	1375	1403
	1200	959	987	1015	1044	1072	1100	1128	1156	1184	1213	1241	1269	1297	1325	1353
	1250	909	937	965	994	1022	1050	1078	1106	1134	1163	1191	1219	1247	1275	1303
	1300	859	887	915	944	972	1000	1028	1056	1084	1113	1141	1169	1197	1225	1253
	1350	809	837	865	894	922	950	978	1006	1034	1063	1091	1119	1147	1175	1203
	1400	759	787	815	844	872	900	928	956	984	1013	1041	1069	1097	1125	1153
	1450	709	737	765	794	822	850	878	906	934	963	991	1019	1047	1075	1103
	1500	659	687	715	744	772	800	828	856	884	913	941	969	997	1025	1053
	1550	609	637	665	694	722	750	778	806	834	863	891	919	947	975	1003
	1600	559	587	615	644	672	700	728	756	784	813	841	869	897	925	953
	1650	509	537	565	594	622	650	678	706	734	763	791	819	847	875	903
	1700	459	487	515	544	572	600	628	656	684	713	741	769	797	825	853
	1750	409	437	465	494	522	550	578	606	634	663	691	719	747	775	803
	1800	359	387	415	444	472	500	528	556	584	613	641	669	697	725	753
	1850	309	337	365	394	422	450	478	506	534	563	591	619	647	675	703
	1900	259	287	315	344	372	400	428	456	484	513	541	569	597	625	653
	1950	209	237	265	294	322	350	378	406	434	463	491	519	547	575	603
	2000	159	187	215	244	272	300	328	356	384	413	441	469	497	525	553
	2050	109	137	165	194	222	250	278	306	334	363	391	419	447	475	503
	2100	59	87	115	144	172	200	228	256	284	313	341	369	397	425	453
	2150	9	37	65	94	122	150	178	206	234	263	291	319	347	375	403
	2200	-41	-13	15	44	72	100	128	156	184	213	241	269	297	325	353
	2250	-91	-63	-35	-6	22	50	78	106	134	163	191	219	247	275	303
	2300	-141	-113	-85	-56	-28	0	28	56	84	113	141	169	197	225	253

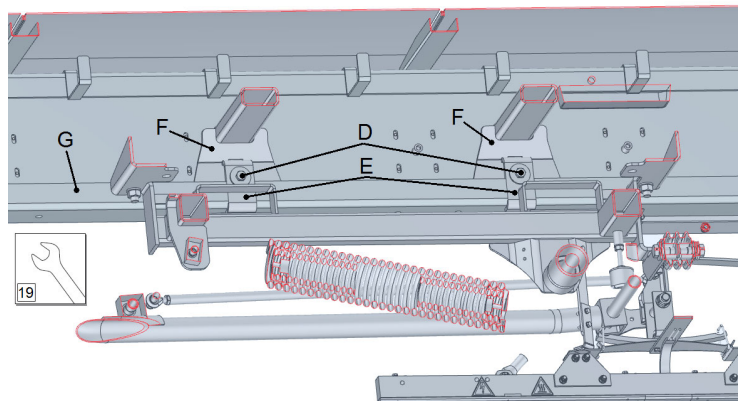
The previous calculations has been thought as a first iteration to position the pantograph, but have to be physically checked with the bus. Errors could come from the verticality of the pole mounting, measurement of the road inclination, tilting or distance from the TOR to retracted pantograph. During the commission it is necessary to fine tune this positioning.

5.15.2. Pantograph setting range adjustment

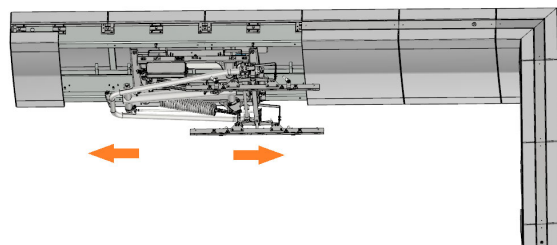


1. Determine how many cover plates (B) should be removed around the pantograph (C). If no cover plates need be removed, go to step 5.
2. Remove on both side the U-profiles (A) by detaching the two M6 bolts.
3. Remove the cover plates (B) by detaching the M6 bolts.
4. Put the cover plates, U-profiles and bolts in a safe location as it will be installed again later on.


When the cover plates (B) are removed, the bolts for moving the pantograph is accessible from below.

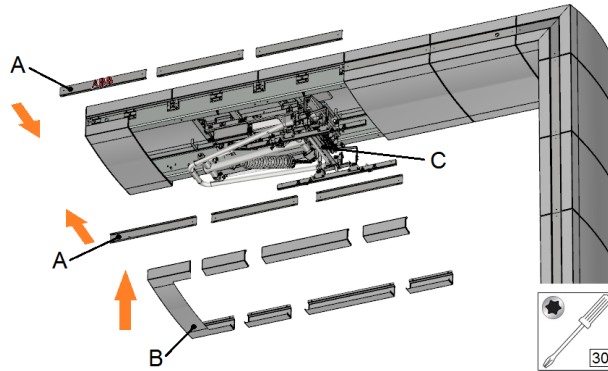


5. The pantograph is suspended in the C-profile of the frame (G) by two suspended-plates (with slide bearings) (F) on each side of the pantograph. The pantograph is locked by clamping plates (E) on each side of the C-profile frame (G). From below, the lock can be loosened by loosening the M12 bolts (D) (4x).




6. Place the pantograph in the correct position, see also section *Instruction for pantograph adjustment and alignment* on Page 97, by moving the pantograph over the C-profile (by hand or with help of the present tensioning straps).
7. Lock the pantograph by tighten the M12 bolts (D) (4x) of the clamping plates (E).


	NOTICE
	<p>The tensioning straps must not be removed after the pantograph has been adjusted. Eventual corrections can still be made during commissioning. The tensioning straps are removed after commissioning.</p>

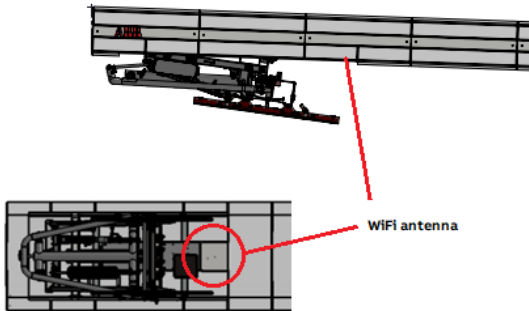


8. When removed, place back the cover plates (B) so that only the pantograph and the WiFi antenna are free of access, and tighten the M6 bolts.

	NOTICE
	<p>Additional cover plates are included in the supplied wooden crate. The additional cover plates can be used to properly sealed the bottom side of the horizontal frame of the Charge Pole, after the pantograph has been placed in the correct position.</p>

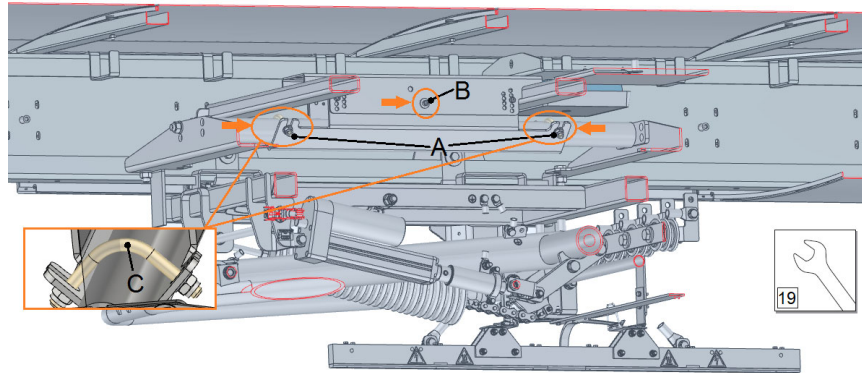
8. Place back the U-profiles (A) on both side, and tighten the M6 bolts.

	NOTICE
	<p>Make sure there are no cover plates directly under the WiFi communication unit. This can disrupt the communication with the bus or possibly make it impossible.</p>



5.15.3. Pantograph Z-axis angle adjustment

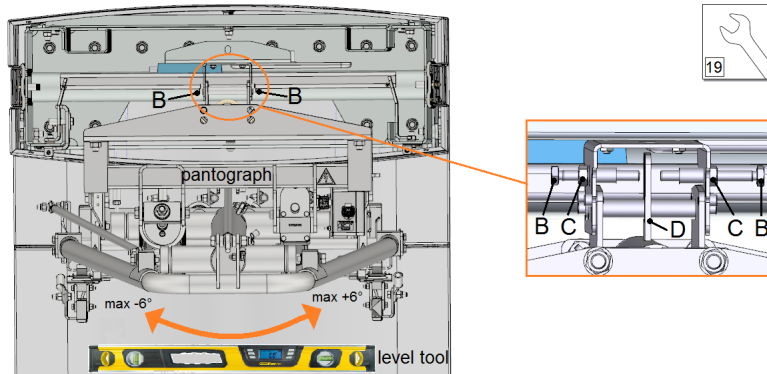
The pantograph can be adjusted for road inclination (Z-axis) between the 0° and 6.0°, see also section *Maximum slope of the road in Z-axis* on Page 35.



The angle setting of the pantograph is done by twisting the pantograph over its suspension system.

1. Loosening M12 nuts (A) (4x) on both side of the two V-shape bolts (C) so the pantograph can rotate freely.

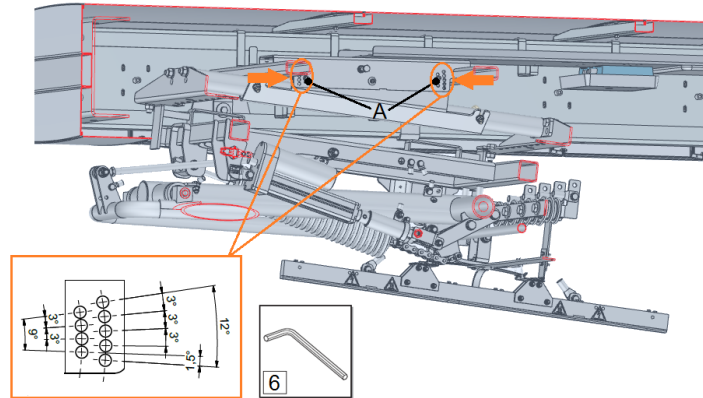
	WARNING
	<p>Don't remove the nuts (A) of the two U-bolts (C). Otherwise the pantograph can fall down.</p>



2. Loosening lock nuts (C) (2x) on both side of the locking bolts (B).
3. Turn both bolts (B) outwards (but do not remove those), so that the pantograph can freely rotated.
4. Adjust the pantograph with help of the included level tool in the correct angle position.
5. Tighten the locking bolts (B) (2x) hand tight until the bolts hit the stopper plate (D). In this way the locking bolts (B) locked the pantograph in the right angle position.
6. Tighten lock nuts (C) (2x).
7. Tighten M12 nuts (A) (4x).


5.15.4. Pantograph X-axis angel adjustment

The pantograph can be adjust at respect to the slope of the road in sideways direction (X-axis) between -6.0° to 6.0° in steps of 1.5° , see also section *Maximum slope of the road in X-axis* on Page 34.



1. Remove the M8 bolts (A) on each side of the suspension (4x).
2. Put the bolts (A) in a safe location as it will be installed again later on.
3. Rotate the pantograph to the correct angle position.
4. Install the M8 bolts in the new angle position slots.
5. Tighten M8 bolts (A) (4x).

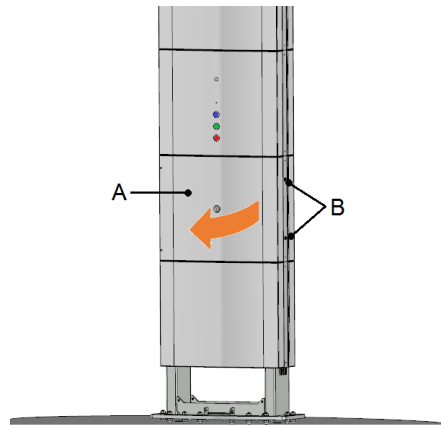
5.16. Installation of the cables inside Charge Post

	DANGER
	<p>Make sure that the main switch of the power supply group for the product is set to the OFF position. Do a voltage check to make sure that the electrical power is disconnected from the system. Secure against resetting.</p>

5.16.1. Open the door and remove cover plate

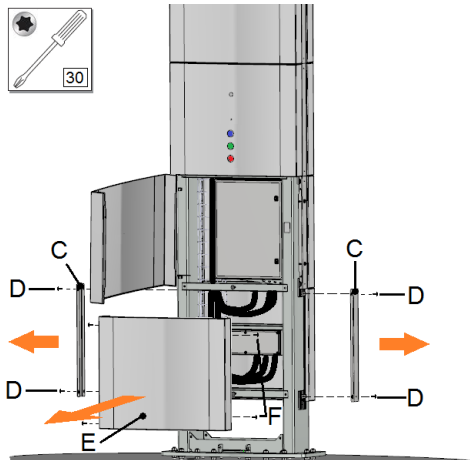
Preconditions:

- Key that was removed from the Charge Pole.
- A minimum of two persons is required.
- Tool: torx screwdriver (size 2163TX-T30).



1. Open the door (A) of the Charge Pole by unlocking the two lockers (B).

Steps 2 to 4 are only required when the lower front cover plate is delivered assembled onto the pole. Normally the lower front cover plate (E) and both U-profiles (C) are delivered separately with the pole.

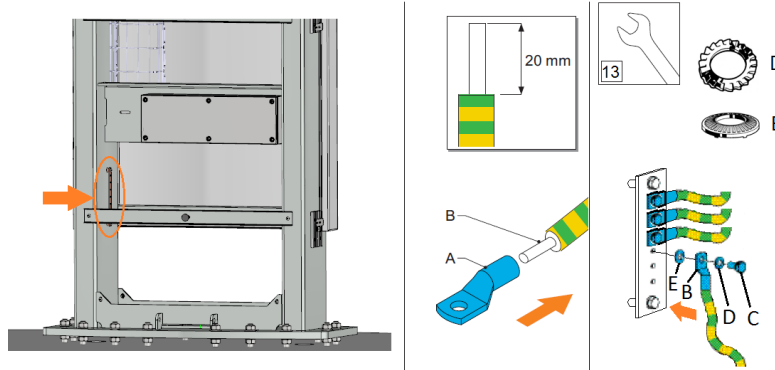


2. Remove on both side the U-profiles (C) by detaching the two M6 bolts (D).
3. Remove the cover plate (E) by detaching the M6 bolts (F).
4. Put the cover plate, U-profiles and bolts in a safe location as it will be installed again later on.

5.16.2. Connect GND wires of the Power Cabinet

Preconditions:

- Tools: wire cutter, wire stripper pliers, cable lug, spanner (size 13), torque wrench (size 13).

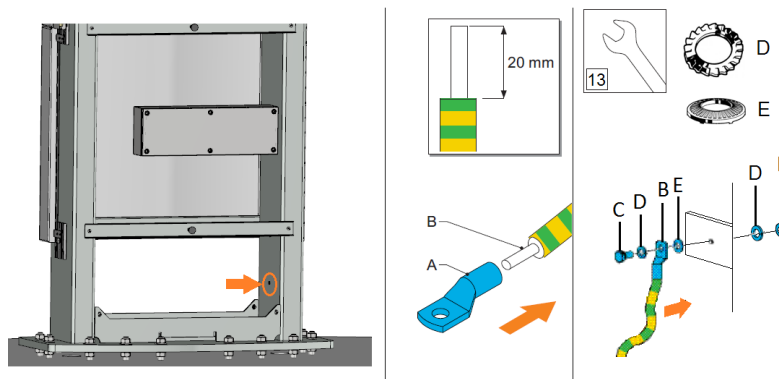


1. Cut the GND wire to the correct length to reach the GND rail. Do not make the wire routing too tight, or too loose.
2. Strip 0.79 Inch of the insulation from the end of the wire.
3. Attach a cable lug (A) to the end of the GND wire (B).
4. Remove the M8 bolt and washers from the GND rail.
5. Fit the bolt (C) with toothed washer (D), the GND wire (B) and the contact washer (E).
6. Insert the bolt fitted with the GND wire into the GND rail.
7. Tighten the bolt with a tightening torque of 11 ft-lb.

5.16.3. Install lightning protection

Preconditions:

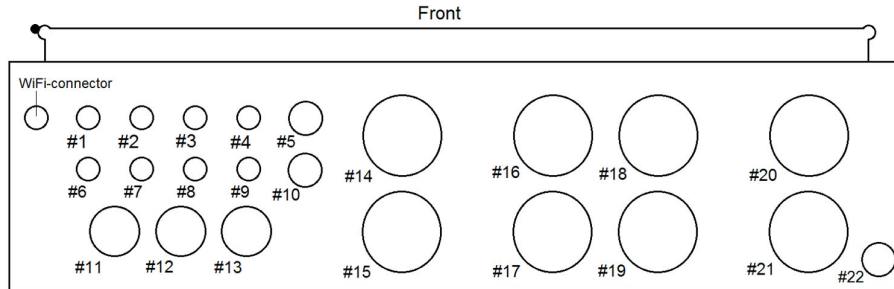
- Tools: wire cutter, wire stripper pliers, cable lug, spanner (size 13), torque wrench (size 13).



1. Cut the wire of the lighting protection cable to the correct length to reach the lighting protection connection. Do not make the wire routing too tight, or too loose.
2. Strip 0.79 Inch of the insulation from the end of the wire.
3. Attach a cable lug (A) to the end of the lightning protection wire (B).
4. Remove the M8 bolt, nut and washers from the lightning protection connection.
5. Fit the bolt (C) with toothed washer (D), the lightning protection wire (B) and contact washer (E).
6. Insert the bolt fitted with the lightning protection wire into the lightning protection connection.

7. Screw at the back side of the lighting protection connection a toothed washer (D) and a nut (F) on the bolt (C).
8. Tighten the bolt with a tightening torque of 11 ft-lb.

5.16.4. Gland layout of the ACS Control Module

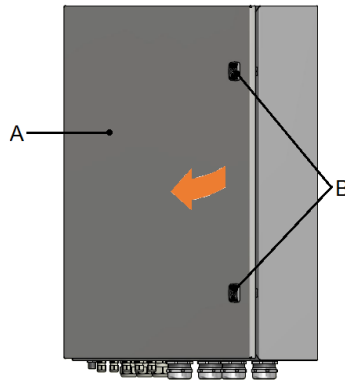


Gland #	Clamping range ØF	Cable
1	5 – 10 mm (0.20 – 0.39 Inch)	AC utility power
2	5 – 10 mm (0.20 – 0.39 Inch)	Pantograph heater
3	5 – 10 mm (0.20 – 0.39 Inch)	Interlock
4	5 – 10 mm (0.20 – 0.39 Inch)	Pantograph CP/PE
5	10 - 17 mm (0.39 – 0.67 Inch)	RFID Ethernet
6	5 – 10 mm (0.20 – 0.39 Inch)	EMO switch
7	5 – 10 mm (0.20 – 0.39 Inch)	Beacon
8	5 – 10 mm (0.20 – 0.39 Inch)	<i>Not used</i>
9	5 – 10 mm (0.20 – 0.39 Inch)	Temperature sensor
10	10 - 17 mm (0.39 – 0.67 Inch)	RFID Power cable
11	13 – 21 mm (0.51 – 0.83 Inch)	Communication (fibers)
12	13 – 21 mm (0.51 – 0.83 Inch)	ACS Control
13	13 – 21 mm (0.51 – 0.83 Inch)	PE (GND)
14	27 – 35 mm (1.07 – 1.38 Inch)	DC+ In (from HVC 150, primary)
15	27 – 35 mm (1.07 – 1.38 Inch)	DC+ In (from HVC 150S, secondary 1)
16	27 – 35 mm (1.07 – 1.38 Inch)	DC+ Out (to pantograph)
17	27 – 35 mm (1.07 – 1.38 Inch)	DC+ Out (to pantograph)
18	27 – 35 mm (1.07 – 1.38 Inch)	DC+ Out (to pantograph)
19	27 – 35 mm (1.07 – 1.38 Inch)	<i>Not used</i>
20	27 – 35 mm (1.07 – 1.38 Inch)	DC+ In (from HVC 150S, secondary 2)
21	27 – 35 mm (1.07 – 1.38 Inch)	<i>Not used</i>
22	10 - 17 mm (0.39 – 0.67 Inch)	DC- OVP Sensing

5.16.5. Open the door of the ACS Control Module

Preconditions:

- Key



1. Unlock the locks (B).
2. Open the door (A).

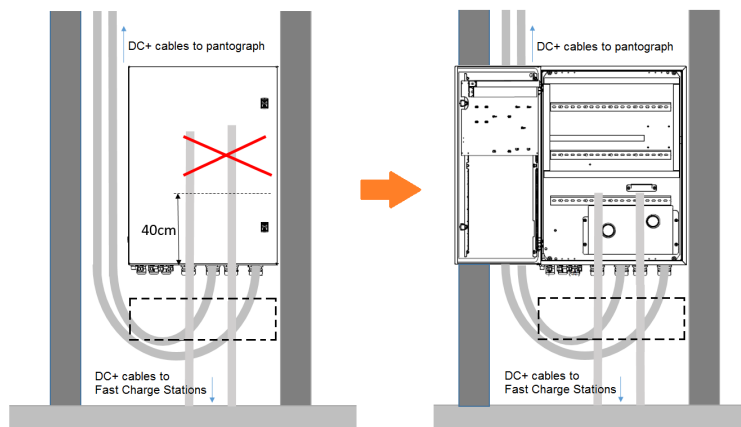
5.16.6. Connect the DC+ power input cables

Preconditions:

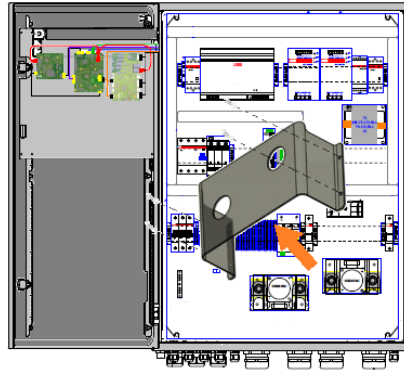
- Tools: wire cutter, wire stripper pliers, cable lugs (3x), spanner (size 18), torque wrench (size 18).

	NOTICE
<p>Ensure that the DC cables during mounting do not hit the PCBAs on the door of the ACS Control Module. When these cables hit the PCBAs, the PCBAs can be damaged. It is advised to protect the PCBAs during mounting of the DC cables.</p>	

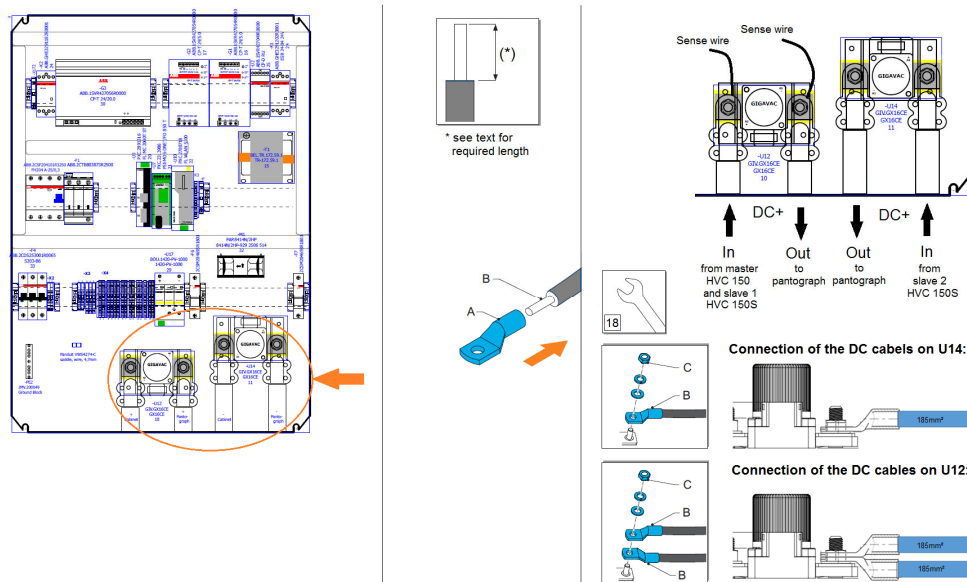
To prevent damage of the PCBAs in the ACS Control Module:



1. Cut the DC cables at 15.75 Inch from the bottom side of the ACS Control Module.
2. Open the door of the ACS Control Module and check the required length.



3. Remove the DC contactor's protection cover.

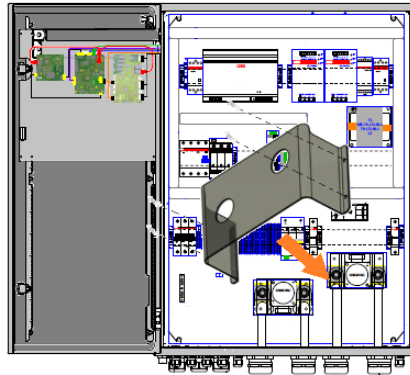


4. Loosen and remove the cable gland's (#14, #15 and #20) nuts, including the cover caps inside the gland, for the DC+ power cables.
5. Slide the cable gland's nuts over the DC power cables.
6. Strip the insulation on the required length specified by the used lug from the end of the wire (B).
7. Insert the DC+ power cables into the right cable gland (#14, #15 and #20, see picture above and section *Gland layout of the ACS Control Module* on Page 106).
8. Attach cable lug (A) at the end of the wires.
9. Remove the nuts and washers (C) from the bolts of the DC contactor connectors.
10. **If present:** remove the sense wires from the bolts of the DC contactor connectors.
11. Insert the wires (B) onto the correct bolts of the DC contactor connectors, see picture above for the correct connection.
12. Insert the sense wires back onto the bolts of the DC contactor connectors.

**NOTICE**

Make sure that the sense wires are placed back on the DC contactor connectors. If this is not the case, then the system will not function.

13. Tighten the nuts (C) with a tightening torque of 22 ft-lb.

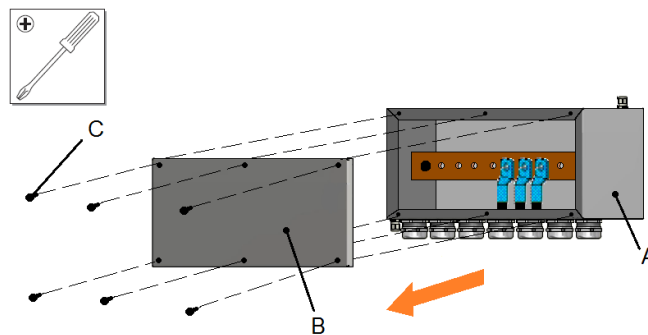


14. Place the protection cover back on the DC contactors.
 15. Hand tighten the screws of the protection cover.
 16. Tighten the cable gland's nut to secure the DC power cables.

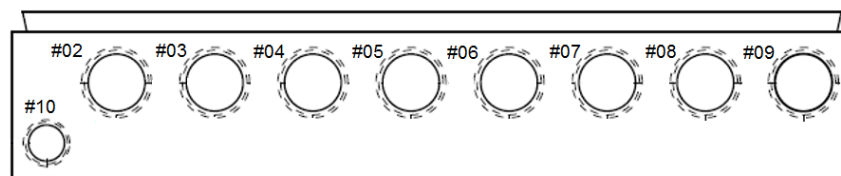
5.16.7. Connect the DC- power input cables in Junction Box

Preconditions:

- Tools: wire cutter, wire stripper pliers, cable lugs (3x), spanner (size 18), torque wrench (size 18), cross-head screwdriver.

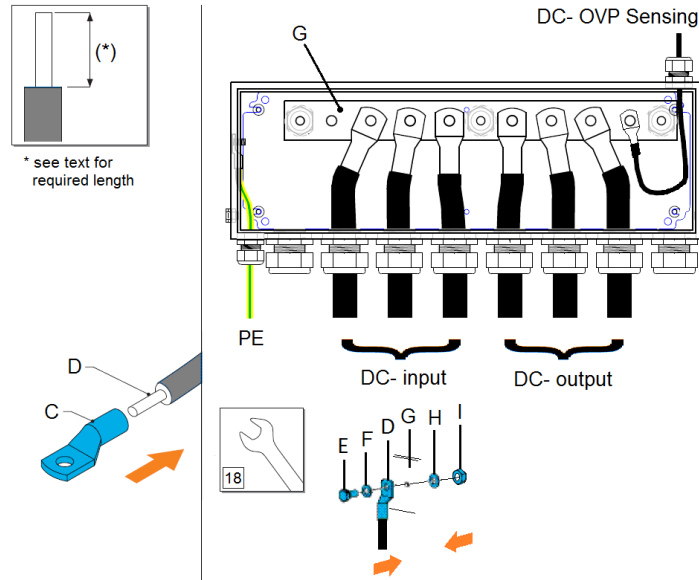


- Loosen the screws (C) (6x) of the Junction Box (A).
- Remove the cover (B) from the Junction Box (A).

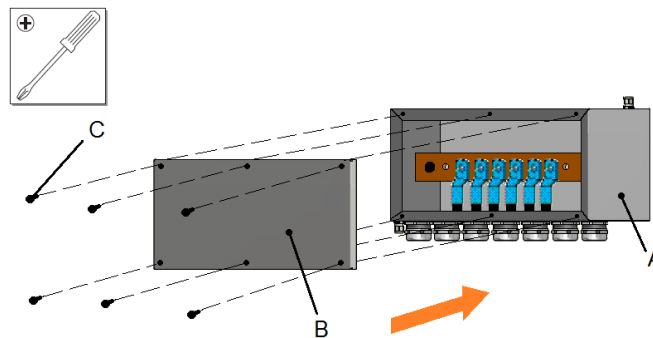


Bottom view

3. Loosen and remove the cable gland's (#03 - #05) nuts for the DC power cables.
4. Slide the cable gland's nuts over the DC power cables.
5. Strip the insulation on the required length specified by the used lug from the end of the DC power cables.
6. Insert the DC- input power cable(s) into the cable gland (#03, #04 and #05, see picture above).



7. Attach cable lug (C) at the end of the wires (D).
8. Remove the M12 bolts, washers and nuts from the bus-bar (G).
9. Fit the bolt (E) with flat washer (F) and the wire (D) (6x).
10. Insert the bolt fitted with the wire into the bus-bar (G) (6x).
11. Secure the bolt (E) onto the bus-bar (G) with the spring washer (H) and the nut (I) (6x).
12. Tighten the bolts (E) and nuts (I) with a tightening torque of 59 ft-lb.
13. Tighten the cable gland's nut to secure the DC power cables.



15. Place the cover (B) back onto the Junction Box (A).



WARNING

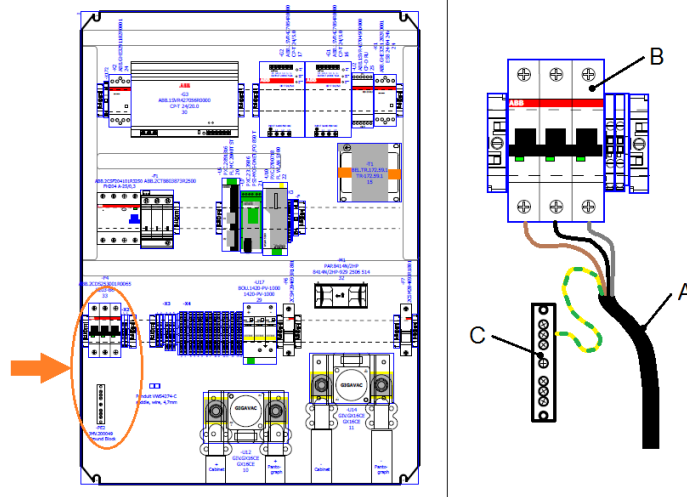
If the GND braided wire between the cover and cabinet is disconnected during the installation of the DC- power cables, make sure that the GND braided wire of the cover is electrically connected to the cabinet.

16. Tighten the screws (C) (6x) to secure the Junction Box.

5.16.8. Connect the AC utility power cable from Power Cabinet

Preconditions:

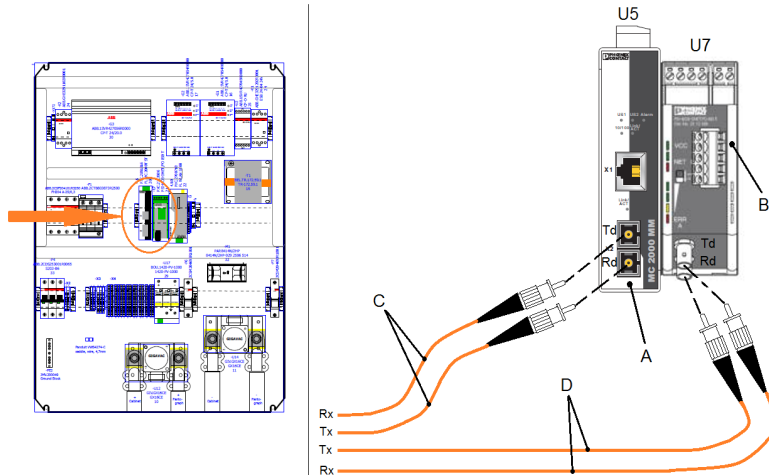
- Tools: wire cutter, wire stripper pliers, screwdriver, ferrules, crimp pliers.



- Loosen and remove the cable gland's (#1) nut for the AC utility power cable.
- Slide the cable gland's nut over the AC utility power cable.
- Route the AC utility power cable (A) through gland #1 to the circuit breaker (B), with sufficient cable length (do not make the cable routing too tight, or too loose).
- Tighten the nut of the gland to secure the AC utility power cable.
- Strip the insulation from the AC utility power cable (A).
- Cut the wires of the AC utility power cable (A) to the correct lengths to reach the connectors. Make sure the GND wire is longer than the other wires.
- Strip 0.43 Inch of the insulation from the ends of the wires.
- Crimp a ferrule onto the end of the wire.
- Loosen the connector screws.
- Insert the GND wire (green/yellow) into the one of the free connectors of GND-rail (C).
- Tighten the connector screw of GND-rail (C).
- Insert the other 3 wires into the connectors of circuit breaker (B).
 - From left to right:
 - L1 (brown),
 - L2 (black),
 - L3 (grey).
- Tighten the connector screws of circuit breaker (B) with a tightening torque of 2.2 ft-lb.

5.16.9. Connect the communication cable from the Power Cabinet

1. Route the communication fiber cables to module U5 (A) and U7 (B).



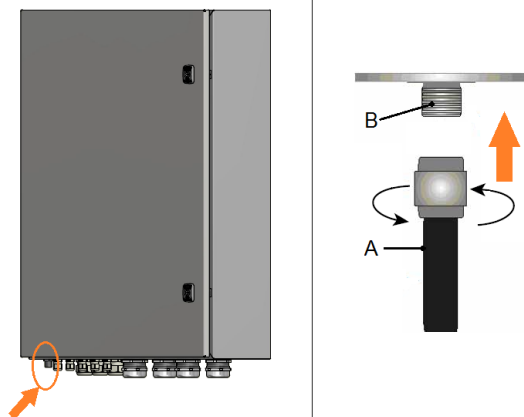
2. Remove the protection covers from the optical connectors.
3. Connect the two Ethernet fiber cables (C) onto module (A):
 - Rx with Td U5;
 - Tx with Rd U5.
4. Connect the two CAN bus fiber cables (D) onto module (B):
 - Rx with Td U7;
 - Tx with Rd U7.
5. Bind the cables together and secure the loops loosely with a piece of tak-ty or ty-rap.



CAUTION


Make the loop bend radius of the fiber cables not smaller than 2.52 Inch, otherwise the core of the fiber cable may break.

5.16.10. Connect the WiFi cable



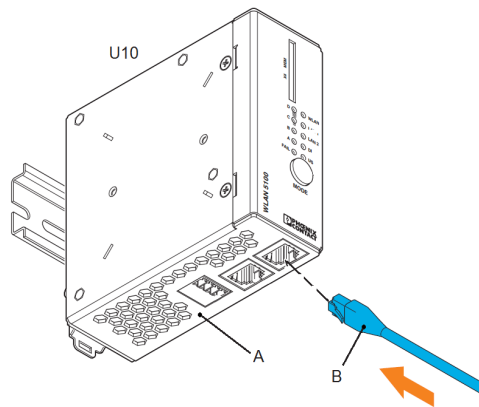
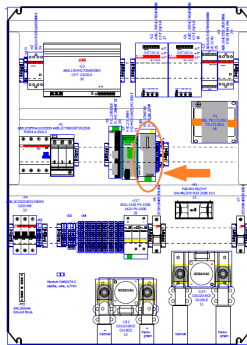
1. Route the WiFi cable (A) to the WiFi connector (B).
2. Insert the WiFi type N-plug into the WiFi connector (B).
3. Hand tighten the WiFi plug.

5.16.11. Connect the RFID cables

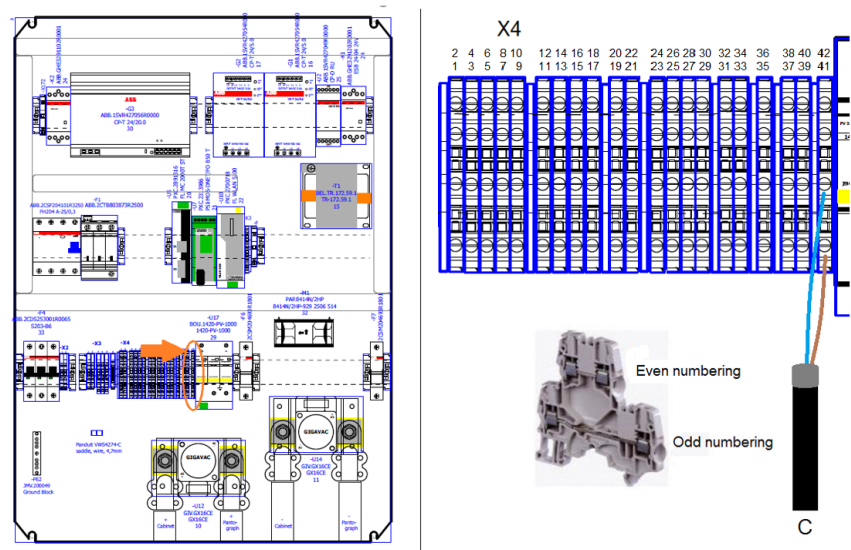
	<p style="text-align: center; background-color: #00a0e3; color: white; margin: 0;">NOTICE</p> <p style="margin: 5px 0;">This section is not required if the RFID module is not present.</p>
---	--

Preconditions:

- Tools: wire cutter, wire stripper pliers, screwdriver, ferrules, crimp pliers.
1. Loosen and remove the cable gland's (#5 and #10) nuts for the RFID Ethernet and the RFID Power cables respectively.
 2. Slide the cable gland's nuts over the RFID Ethernet and RFID Power cable.



3. Route the RFID Ethernet cable through gland #5 to module U10 (A).
4. Insert the RJ45 connector (B) of the Ethernet cable into the Ethernet port X2 of module U10 (A)
5. Tighten the nut of the gland to secure the RFID Ethernet cable.



- 6. Route the RFID Power cable (C) through gland #10 to connector block X4, with sufficient cable length (do not make the cable routing too tight, or too loose).
- 7. Tighten the nut of the gland to secure the RFID Power cable.
- 8. Strip the insulation from the cable.
- 9. Strip 0.43 Inch of the insulation from the ends of **only the Brown and Blue wire!**
- 10. Crimp a ferrule onto the end of the Brown and Blue wire.
- 11. Cut the other wires, **except the Brown and Blue wire**, at the end of the striped insulation of the cable.
- 12. Loosen the connector screws.
- 13. Insert the wires into the correct connectors, see table below:

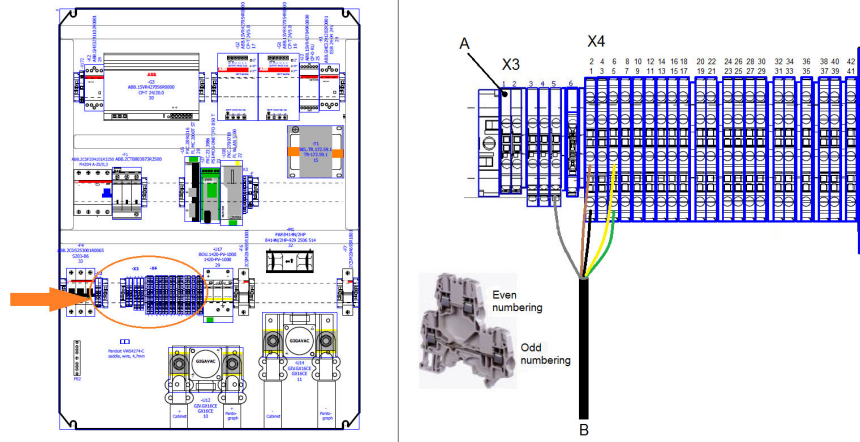
Functional description	Connector	Wire color
24 V RFID	X4-41	Brown
GND RFID	X4-42	Blue

- 14. Tighten the connector screw with a tightening torque of 1.0 ft-lb.

5.16.12. Connect the Interlock cable from the Power Cabinet

Preconditions:

- Tools: wire cutter, wire stripper pliers, screwdriver, ferrules, crimp pliers.



1. Loosen and remove the cable gland's (#3) nut for the Interlock cable.
2. Slide the cable gland's nut over the Interlock cable.
3. Route the cables through the gland to the connector blocks (A), with sufficient cable length (do not make the cable routing too tight, or too loose).
4. Tighten the nuts of the gland to secure the Interlock cable.
5. Strip the insulation from the Interlock cable (B).
6. Cut the wires of the Interlock cable (B) to the correct lengths to reach the connectors
7. Strip 0.43 Inch of the insulation from the end of wires.
8. Crimp a ferrule onto the end of the wires.
9. Loosen the connector screws.
10. Insert the wires into the correct connectors, see table below:

Functional description	Connector	Wire number
Ext Interlock In	X4-1	White
Ext Interlock Out	X4-2	Brown
DC Guard A	X4-5	Green
DC Guard GND	X4-6	Yellow
Interlock GND	X3-4	Shield

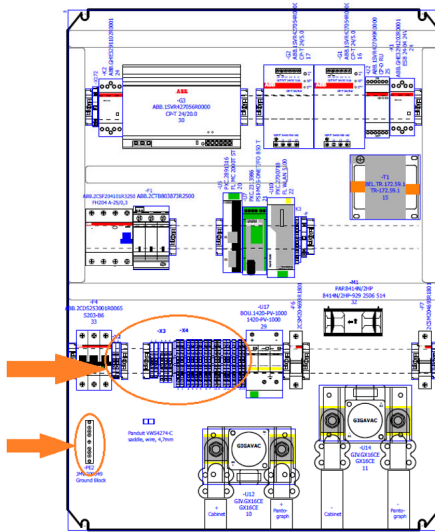
See also Appendix H *Signal connection diagram*.

12. Tighten the connector screws with a tightening torque of 1.0 ft-lb.

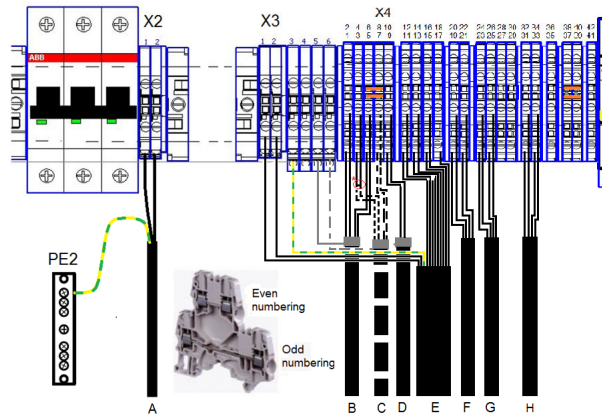
5.16.13. Connect the other cables to the ACS Control Module

Preconditions:

- Tools: wire cutter, wire stripper pliers, screwdriver, ferrules, crimp pliers.




Overview of the terminal block



- | | | | |
|---|-------------------------|---|-----------------------|
| A | Pantograph heater cable | E | EMO cable |
| B | Interlock cable | F | Beacon cable |
| C | Pantograph CP/PE cable | G | Distance sensor cable |
| D | ACS Control cable | | |

- Loosen and remove the cable gland's nuts (see for overview *Gland layout of the ACS Control Module* in Page 106) for the cables.
- Slide the cable gland's nut over the cables.
- Route the cables through the right glands to the connector blocks (X2, X3 and X4), with sufficient cable length (do not make the cable routing too tight, or too loose).
- Tighten the nuts of the glands to secure the cables.
- Strip the insulation from the cables.
- Cut the wires of the cables to the correct lengths to reach the connectors
- Strip 0.43 Inch of the insulation from the ends of the wires.
- Crimp a ferrule onto the end of the wire.

NOTICE	
	<p>Only for the Interlock cable Use only the White and Brown wire. Ensure that the unused wires, the Green and Yellow wire, are protected so that they cannot touch metal parts.</p>

- Loosen the connector screws.
- Insert the GND wire from the Pantograph heater cable into the one of the free connectors of GND-rail (PE2).
- Tighten the connector screw of GND-rail (PE2).
- Insert the other wires into the correct connectors, see table below:

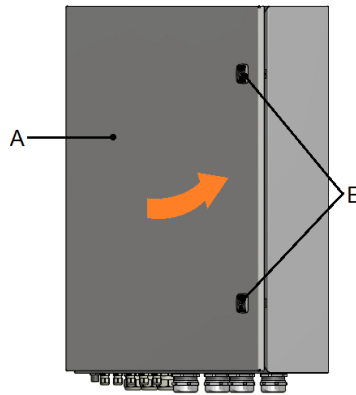
X2		Pantograph heater cable	
1		Wire 1	ACS L Heater
2		Wire 2	ACS N Heater
PE2		GND (green/yellow)	GND
X3	X4	Interlock / DC Guard cable	
5		Shield	GND
	1	White	Interlock In
	2	Brown	Interlock Out
	3		DC Guard A
	4		DC Guard GND
X3	X4	Next Interlock / next DC Guard cable (only for sequential mode)	
6			
	5		Next Interlock In
	6		Next Interlock Out
	7		Next DC Guard A
	8		Next DC Guard GND
X3	X4	Pantograph CP/PE cable	
4		Shield	GND
	9	Wire 1	CP
	10	Wire 2	PE
X3	X4	ACS Control cable	
1		Wire 1	ACS +24V
2		Wire 2	ACS -24V
3		GND (green/yellow)	GND
	11	Wire 3	ACS Extend/Retract Out
	12	Wire 4	ACS Magn Reed In
	13	Wire 5	ACS Supply/Retract Out
	14	Wire 6	ACS Retracted In
	15	Wire 7	ACS Magn Supply Out
	16	Wire 8	ACS GND B
	17	Wire 9	ACS Extended In
X4		EMO cable	
19		Wire 1	EMO S1
20		Wire 2	EMO S1
21		Wire 3	EMO S2
22		Wire 4	EMO S2
X4		Beacon cable	
23		Wire 1	Beacon PCB1 OUT1
24		Wire 2	Beacon PCB1 OUT2
25		Wire 3	Beacon PCB3 OUT3
26		Wire 4	Beacon PCB4 +24V
X4		Distance sensor cable	
31		Wire 1	Distance Sensor +24V
33		Wire 2	Distance Sensor NO/NC
32		Wire 3	Distance Sensor GND
34		Wire 4	Distance Sensor Analog out

13. Tighten the connector screws with a tightening torque of 1.0 ft-lb.

5.16.14. Close the door of the ACS Control Module

Preconditions:

- Key

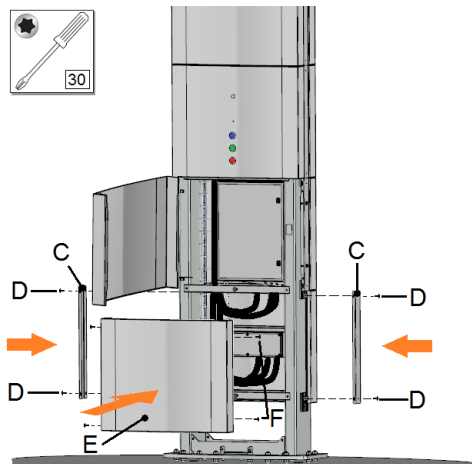


1. Close the door (A).
2. Close the locks (B).

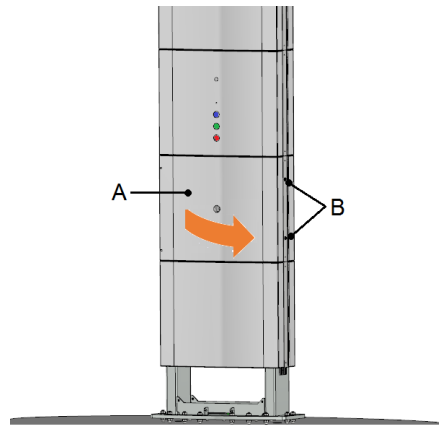
5.16.15. Place back cover plate and close door of the Charge Pole

Preconditions:

- Key.
- A minimum of two persons is required.
- Tool: torx screwdriver (size 2163TX-T30).



1. Place back the cover plate (E) and tighten the M6 bolts (F) (4x).
2. Place back the U-profiles (C) on both side, and tighten the M6 bolts (D) (4x).

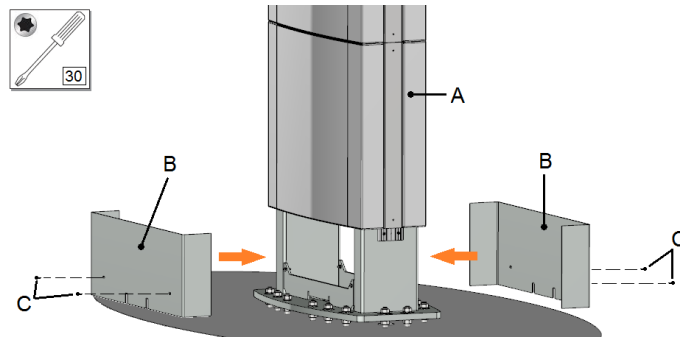


3. Close the door (A) of the Charge Pole
4. Locking the two lockers (B).

5.17. Install cover plates

Preconditions:

- Packing foil are removed from the plate work.
- Tools: torx screwdriver (size 2163TX-T30).



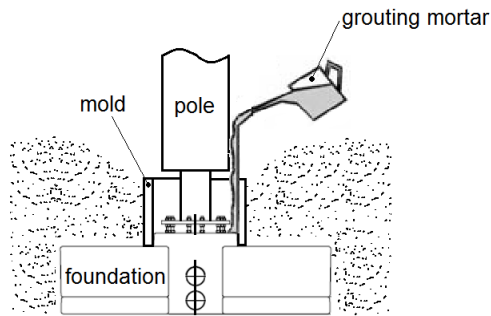
1. Put the two U-profile cover plates (B) against the bottom of the column (A).
2. Insert the M6 bolts (C) into the holes (4x).
3. Tighten the bolts.

5.18. Grouting of the pole construction


Preconditions:

- All construction work on the pole is completed.
- The Site Acceptance Test (SAT) is completed.
- Tools: non-shrink pour mortar (recommended Maxit EXM721), mixing tool, bucket or caster.

To protect the wire anchors from rusting by means of sealing and to prevent wear of foundation (foreign objects such as sand, ground, etc entering into cable ducts), the space between the foot print of the vertical frame and the concrete foundation has to be filled with non-shrink grout.



1. Place a mold around the foot print of the column. The border collar suggested in *Workflow with pre-fabricated concrete* foundation on Page 44 can be used as mold. Make sure the mold is sealed watertight.
2. Prepare the grouting mortar.

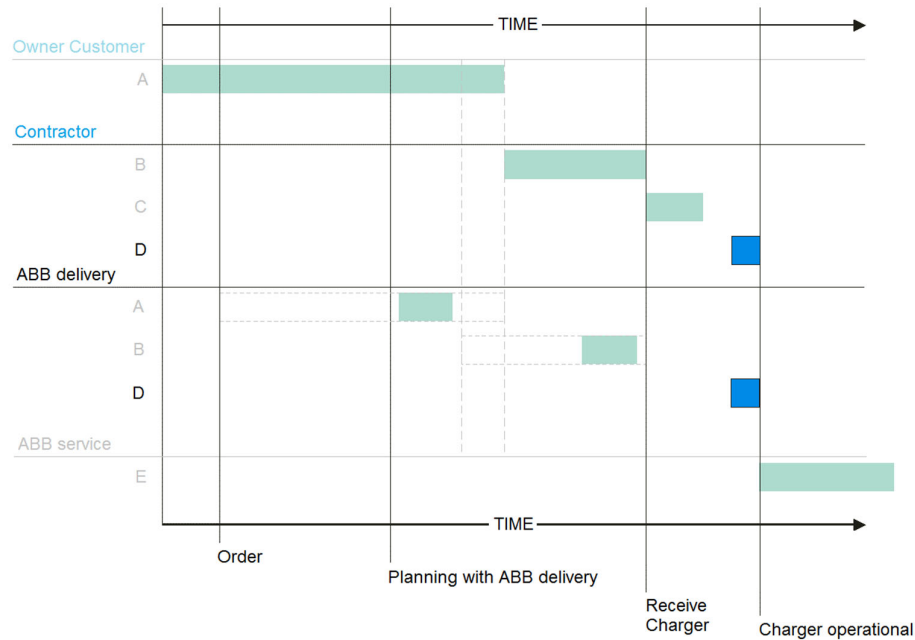
	NOTICE
	<p>Read and follow the instruction manual of the used grouting mortar.</p>

3. Pour the mortar in the mold around the foot print of the column.
4. Fill the space with mortar up to the upper edge of the foot print of the column.
5. Allow the mortar to cure before filling up the gap around the pole with sand.

6. Commissioning

6.1. Commissioning preparation

Commissioning is the last phase necessary to get the HVC-PD E-Bus Charger into operation. The planning steps for the commissioning phase are shown in the figure below.




D Commissioning

The commissioning of the HVC-PD E-Bus Charger need to be performed by a service engineer from the ABB Delivery department and/or a certified local ABB service engineer. Both will need the support from the local contractor. Local contractor must be perform the megger test of the conductors and provide ABB with the test report prior to commissioning.

Before the service engineer can start, the following conditions must be met:

- All installation work is done.
- Grid power is available.
- A local technician is present for assistance and to switch the power on.
- Mobile elevated work platform available to check all the connections on the pantograph.
- An electric or hybrid bus available to perform the functional tests.

	CAUTION
	<p>Warranty</p> <p>It is not permitted to move the whole or parts of the HVC-PD E-Bus Charger after the commissioning. If the whole or parts of the HVC-PD E-Bus Charger is moved without contacting the ABB Service department, the warranty will be considered void.</p>

6.2. Customer Acceptance Form (CAF)

After the commissioning is completed, the owner / site operator will sign the Customer Acceptance Form (CAF). In certain circumstances ABB will be represented by a project engineer.

The CAF contains information about:

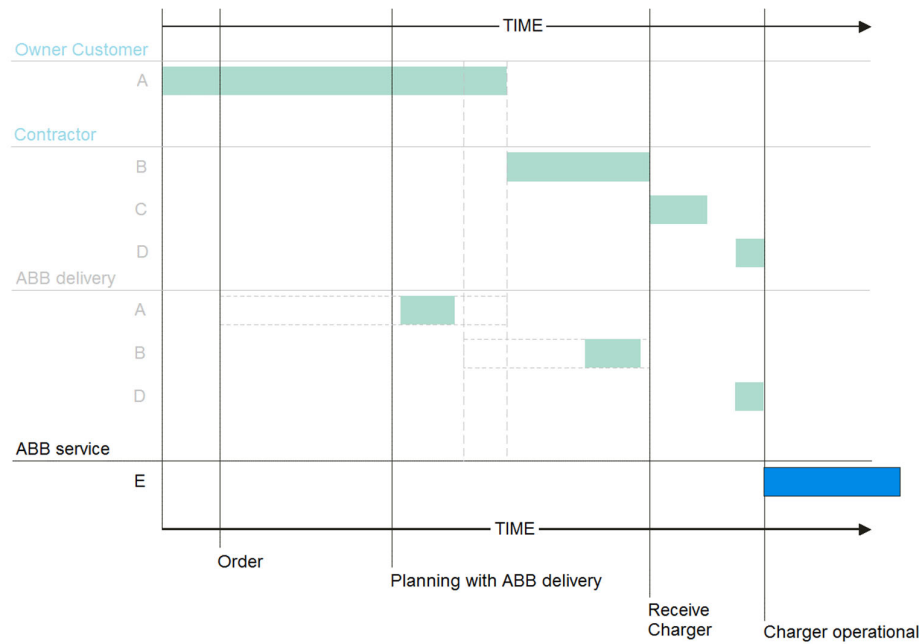
- the project (number, location, charger type),
- a checklist about the delivery,
- the commissioning SAT checklist,
- list of remaining items.

After the CAF has been signed, the customer support will be handled by the ABB Service department.

If there are any remaining items, they can be noted on the CAF document, together with the agreed solution and the expected date of completion.


7. Service and Maintenance

7.1. About Service and Maintenance



E Service and Maintenance

Maintenance is done according to the maintenance schedule. This is outside of the scope of this document.



	DANGER
	<p>Any service and maintenance work on pantograph and/or charger system has to be only executed on powered-off device.</p> <p>Make sure that the main switch of the power supply group for the product is set to the OFF position. Do a voltage check to make sure that the electrical power is disconnected from the system. Secure against resetting.</p>

7.2. Cleaning of the cabinet

The Power Cabinet and Charge pole is powder coated. This coating must be kept in good condition.

Clean the Power Cabinet and Charge pole three times a year in the following way:

- Remove rough dirt by spraying with low-pressure tap water.
- Apply a neutral or weak alkaline cleaning solution and let it soak.
- Remove dirt by hand with a non-woven nylon hand pad.
- Rinse thoroughly with tap water.
- Optionally, apply wax on the front for extra protection and gloss.
- Do a check on the coating for damage.

	NOTICE When the HVC-PD E-Bus Charger is exposed to rain, it is sufficient to clean it twice a year.
	CAUTION Do not apply high-pressure water jets. Water may leak into the Power Cabinet. If a high-pressure water jet has been used, make sure that the inside of the Power Cabinet is dry. <ul style="list-style-type: none">- Only use cleaning agents with a pH value between 6 and 8.- Do not use cleaning agents with abrasive components.- Do not use abrasive tools.

8. Technical Specification

8.1. Electrical specification complete 150 kW system

Input	
Supply voltage	3-phase: GND, L1, L2, L3
Input voltage range	480/277 V AC $\pm 10\%$
Input frequency range	600/347 V AC $+10\%/-15\%$ (Canada version)
Input frequency range	60 Hz $\pm 1\%$
Maximum power dissipation	170 kVA
Power factor ($\cos \varphi$)	≥ 0.95 (> 0.97 at full load)
Standby power consumption	60 W for 1x HVC cabinet 30 W for the ACM
Efficiency	94% and 96% in power spectrum between 20% and 100% of full power
Nominal input current	198 A AC
Earth Leakage Current Protection	163 A AC (Canada version)
Earth Leakage Current Protection	AC 300 mA (GFCI integrated in HVC150(S)) AC 30 mA (GFCI integrated in ACS Control Module)
Short Circuit Capacity	65 kA
DC output	
Maximum output power	150 kW
Output voltage range	150 – 850 V DC
Maximum output current	225 A DC

8.2. Electrical specification complete 300 kW system

Input	
Supply voltage	3-phase: GND, L1, L2, L3
Input voltage range	480/277 V AC $\pm 10\%$
Input frequency range	600/347 V AC $+10\%/-15\%$ (Canada version)
Input frequency range	60 Hz $\pm 1\%$
Maximum power dissipation	348 kVA
Power factor ($\cos \varphi$)	≥ 0.95 (> 0.97 at full load)
Standby power consumption	120 W for 2x HVC cabinets 30 W for the ACM
Efficiency	94% and 96% in power spectrum between 20% and 100% of full power
Nominal input current	396 A AC
Earth Leakage Current Protection	326 A AC (Canada version)
Earth Leakage Current Protection	AC 300 mA (GFCI integrated in HVC150(S)) AC 30 mA (GFCI integrated in ACS Control Module)
Short Circuit Capacity	65 kA
AC power connection	240 mm ² = 500 MCM (max) (in both HVC 150 and 150S)
DC output	
Maximum output power	300 kW
Output voltage range	150 – 850 V DC
Maximum output current	450 A DC

8.3. Electrical specification complete 450 kW system

Input	
Supply voltage	3-phase: GND, L1, L2, L3
Input voltage range	480/277 V AC $\pm 10\%$
Input frequency range	600/347 V AC $+10\%/-15\%$ (Canada version)
Input frequency range	60 Hz $\pm 1\%$
Maximum power dissipation	510 kVA
Power factor (cos φ)	94% and 96% in power spectrum between 20% and 100% of full power
Standby power consumption	180 W for 3x HVC cabinets 30 W for the ACM
Efficiency	93 % - 95 % (dependent on load)
Nominal input current	576 A AC
Earth Leakage Current Protection	489 A AC (Canada version)
Earth Leakage Current Protection	AC 300 mA (GFCI integrated in HVC150(S)) AC 30 mA (GFCI integrated in ACS Control Module)
Short Circuit Capacity	65 kA
AC power connection	240 mm ² = 500 MCM (max)
DC output	
Maximum output power	450 kW
Output voltage range	150 – 850 V DC
Maximum output current	600 A DC

8.4. Mechanical data

Mechanical specification Power Cabinet

Dimensions (H x W x D)	82.36 x 46.06 x 30.32 Inch (Including swivel eye bolts)
Weight	2954.19 lb
Volume	114114.40 in ³
Dimensions including packaging (H x W x D)	88.58 x 47.24 x 31.50 Inch
Weight including packing	3086.47 lb
Weight concrete foundation	2866.00 lb
Mechanical impact protection	IK10
Housing	Stainless steel 430

Mechanical specification ACS Control Module

Dimensions (H x W x D)	33.13 x 24.04 x 8.66 Inch
Weight	108.03 lb
Volume	6102.37 in ³
Dimensions including packaging (H x W x D)	15.75 x 39.76 x 29.53 Inch
Weight including packing	123.46 lb
Mechanical impact protection	IK10
Housing	Stainless steel 304 (316 for close to the sea)

Mechanical specification Charge pole

Dimensions footprint (W x D)	43.58 x 16.26 Inch
Height	225.00 Inch
Outreach of mast boom	201.34 Inch
Weight	3761.09 lb
Dimensions during transport (H x W x D)	73.50 x 216.89 x 49.61 Inch
Weight packing for plates	1984.16 lb (including plates)
Total weight concrete foundation	20172.30 lb (=9920.80 lb + 2 x 5125.75 lb)
Mechanical impact protection	IK10
Housing	Aluminum

8.5. Environment

Environment specification Power Cabinet

Ingression protection	IP54
Temperature range – Operation	-35 °C to +45 °C
Temperature range – Storage	-10 °C to +70 °C
Humidity	5 % to 95 %, RH – non-condensing
Airflow	1450 m³/h
Pressure drop	300 pA
Altitude	6561.68 ft (max.)
Storage conditions	Indoors, dry

Environment specification ACS Control Module

Ingression protection	IP65
Temperature range – Operation	-35 °C to +45 °C
Temperature range – Storage	-10 °C to +70 °C
Humidity	5 % to 95 %, RH – non-condensing
Altitude	6561.68 ft (max.)
Storage conditions	Indoors, dry

Environment specification Charge pole

Ingression protection	IP54
Temperature range – Operation	-35 °C to +45 °C
Temperature range – Storage	-10 °C to +70 °C
Humidity	5 % to 95 %, RH – non-condensing
Altitude	6561.68 ft (max.)
Maximum operational wind speed	44.7 mph (8 Bft)
Maximum deflection	89.5 mph (14 Bft)
Storage conditions	Indoors, dry



CAUTION

Warranty

Warranty will be considered void when the HVC-PD E-Bus Charger is damaged while badly stored at the customer's location.

8.6. Certifications

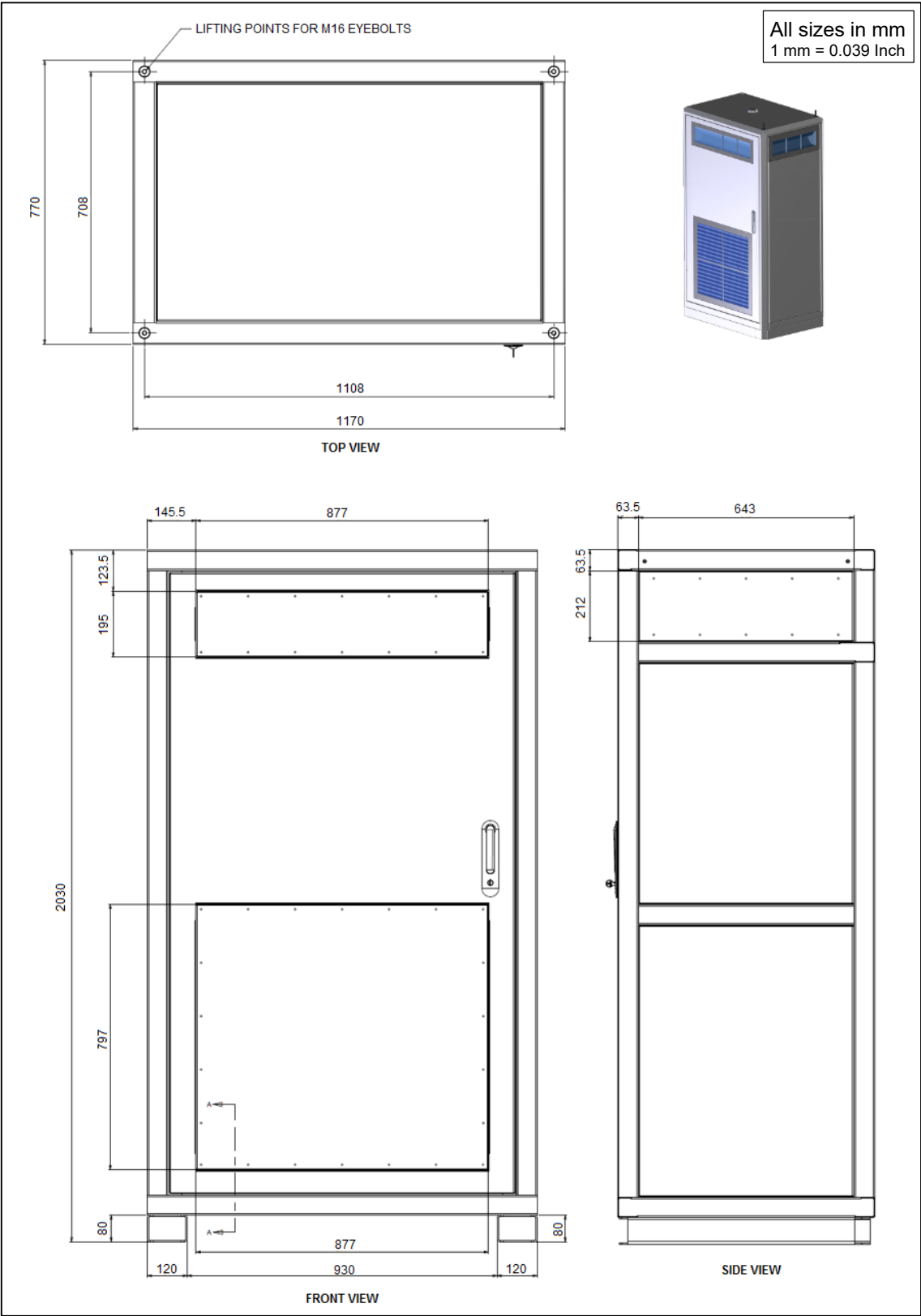
Certifications for complete system

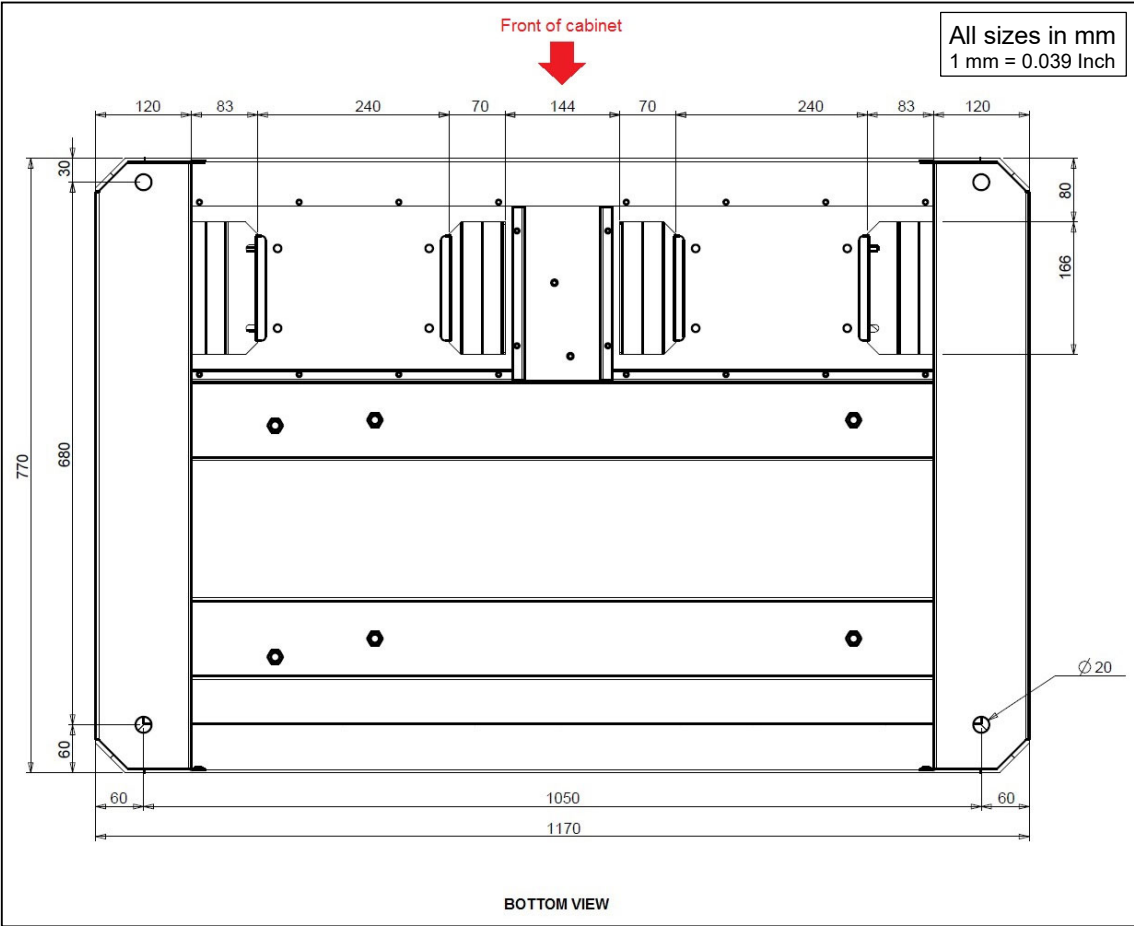
UL 2202	HVC 150: Certificate No. TU 72180445 ACM Certificate No. TU 72180799 02
CSA C22.2 No. 107.1—16	HVC150 Certificate No. CA 972180446 01 ACM Certificate No. CA 72180446 02
Class of protection	1 with GND connection

9. Appendix

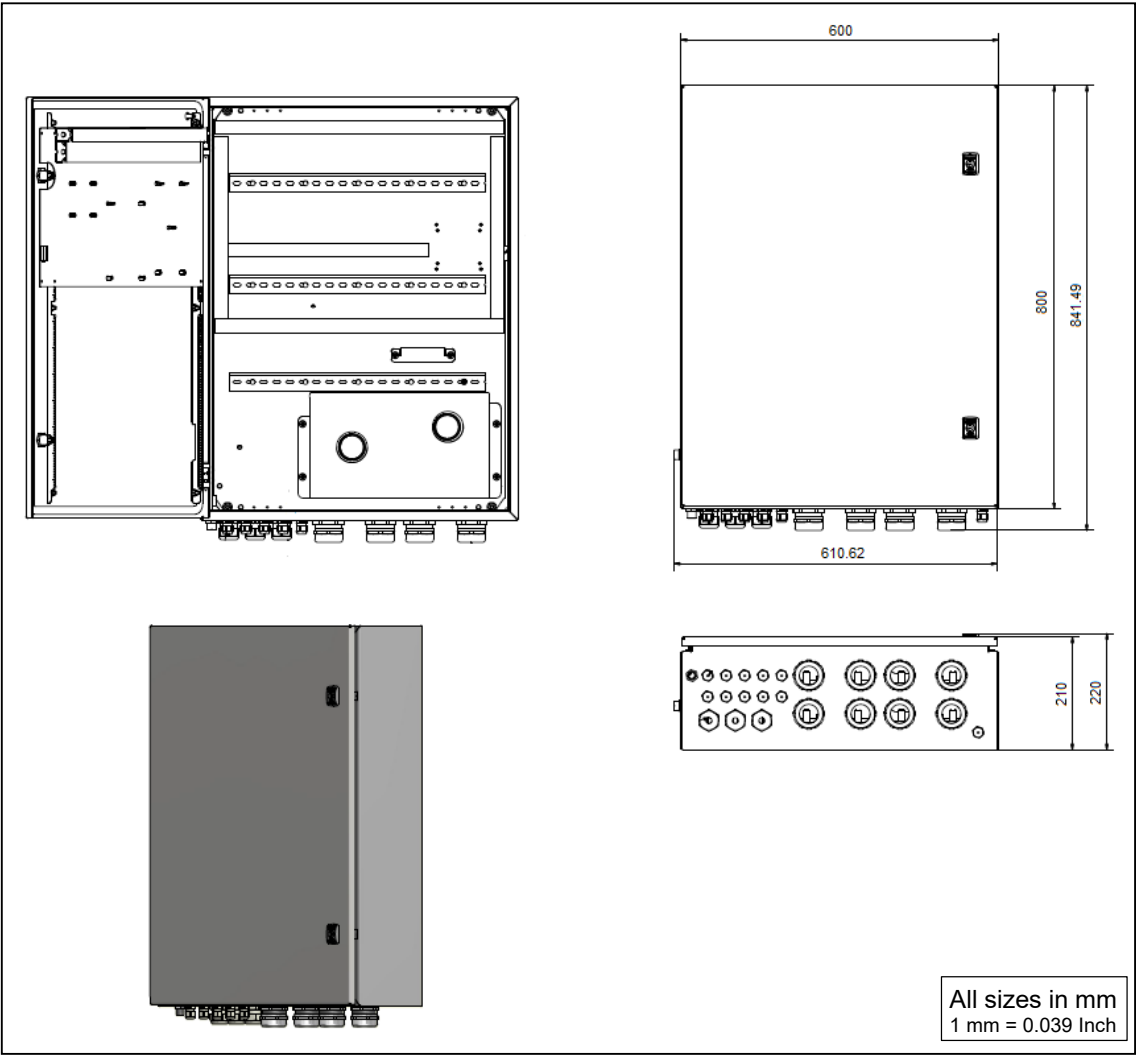
- A Dimensions power cabinet
- B Dimensions ACS Control Module
- C Dimensions Junction Box
- D Dimensions Charge pole
- E Clearance and vertical working range of the pantograph
- F Dimensions Concrete Foundation Power Cabinet
- G Dimensions Metal Foundation Power Cabinet
- H Dimensions Concrete Foundation Pole
- I Power Cabinet – Outline with Foundation
- J Signal connection diagram
- K Ground overview of the system

A. Dimensions Power Cabinet

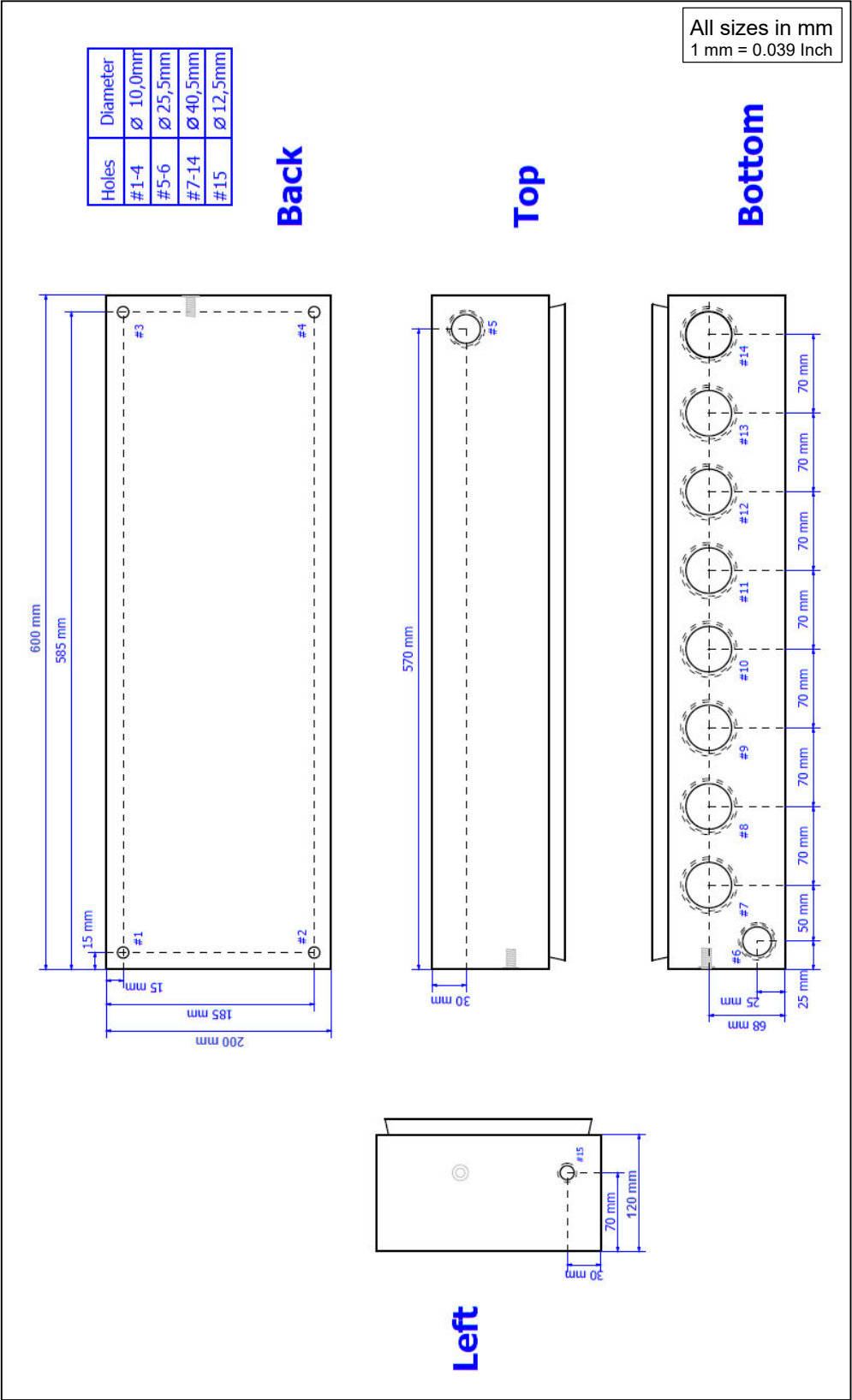




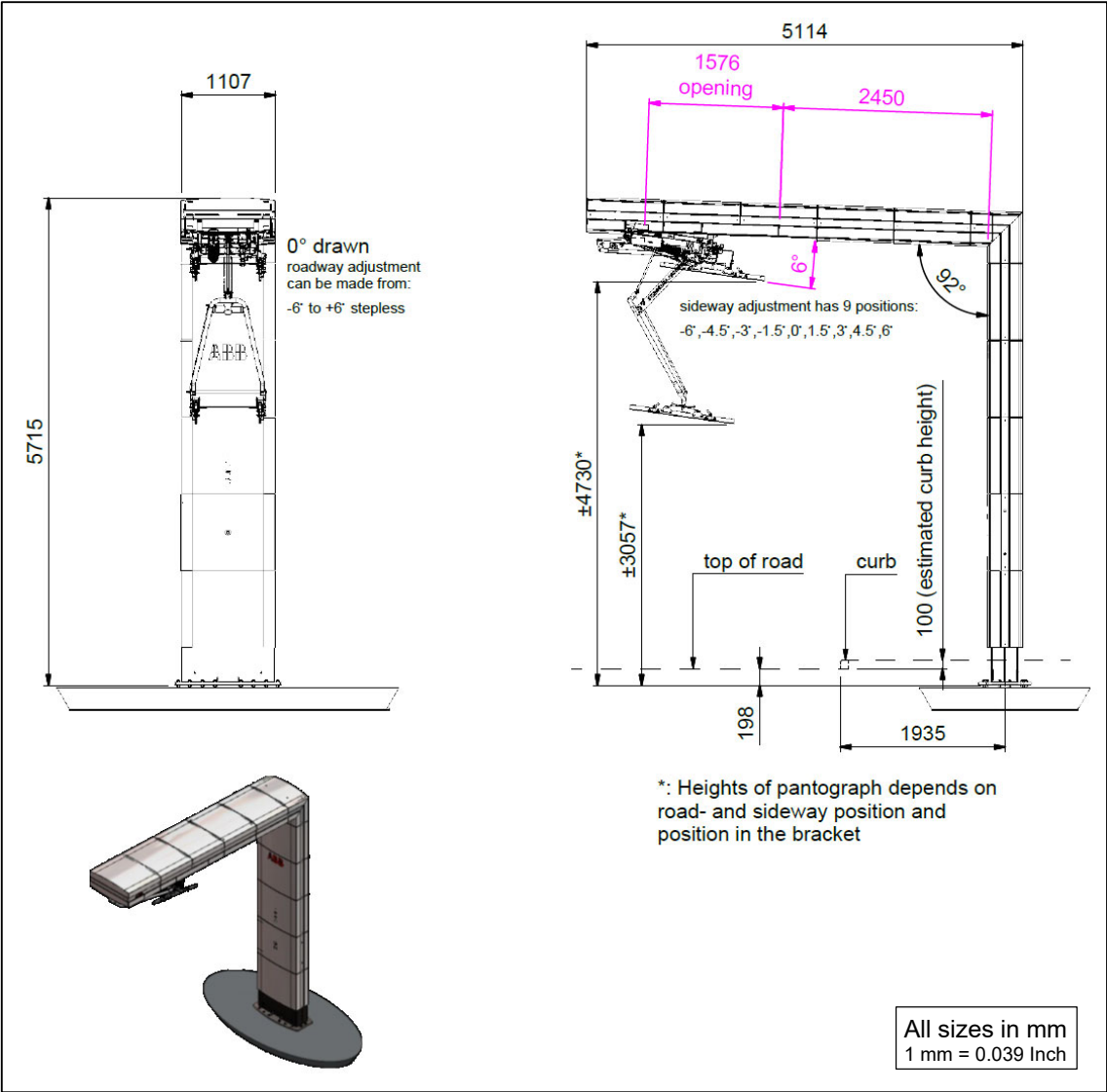
B. Dimensions ACS Control Module



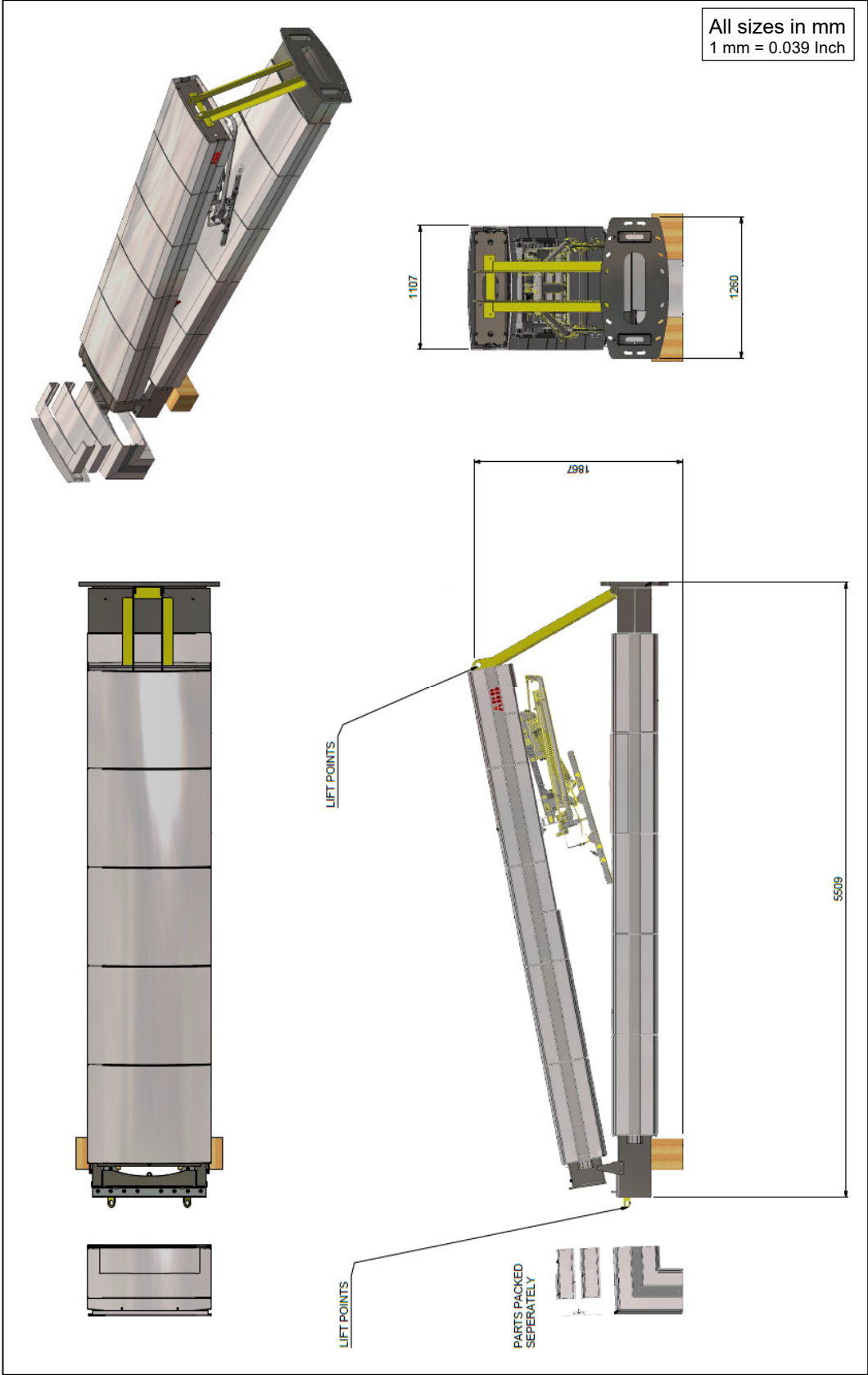
C. Dimensions Junction Box



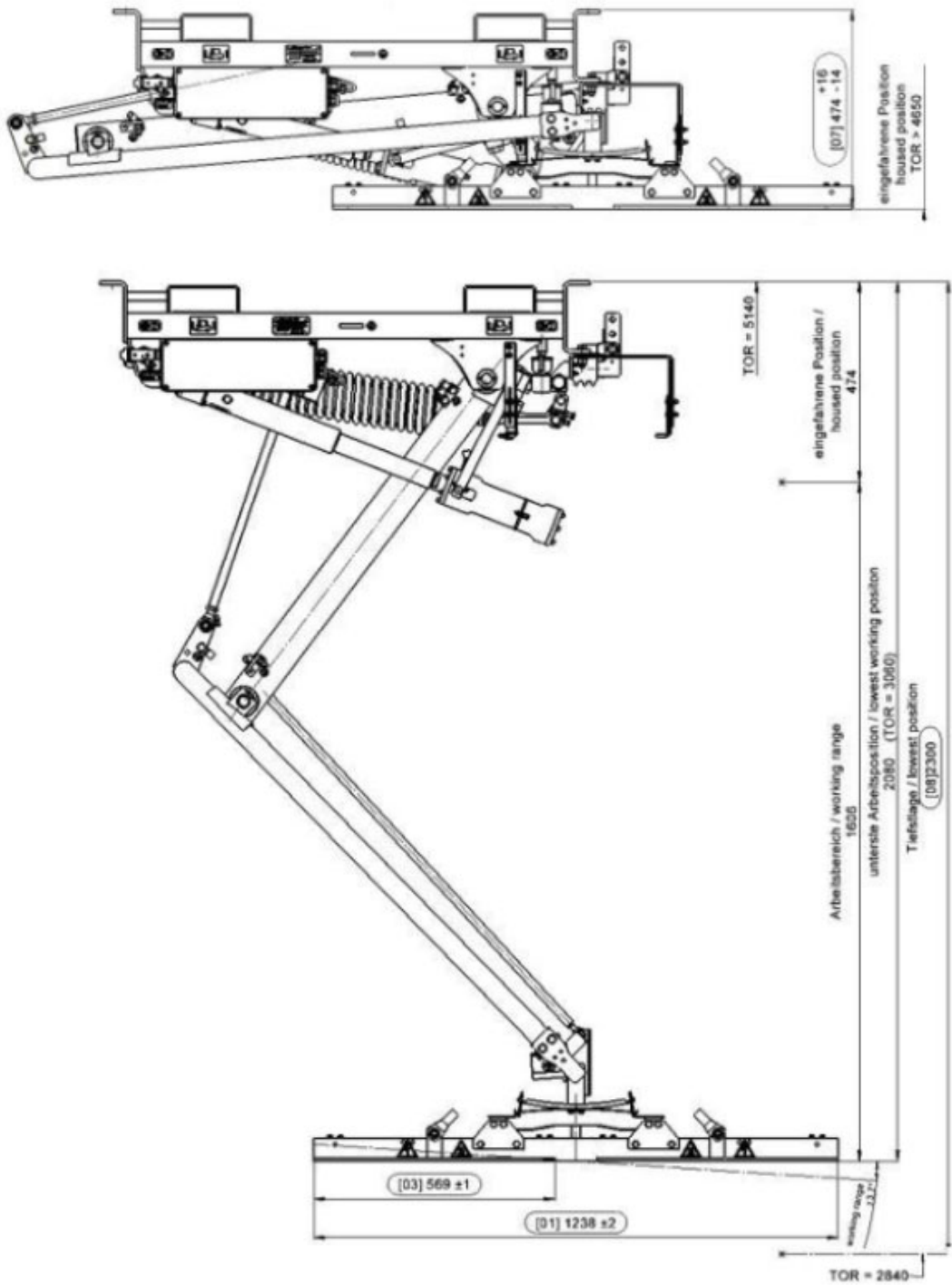
D. Dimensions Charge pole



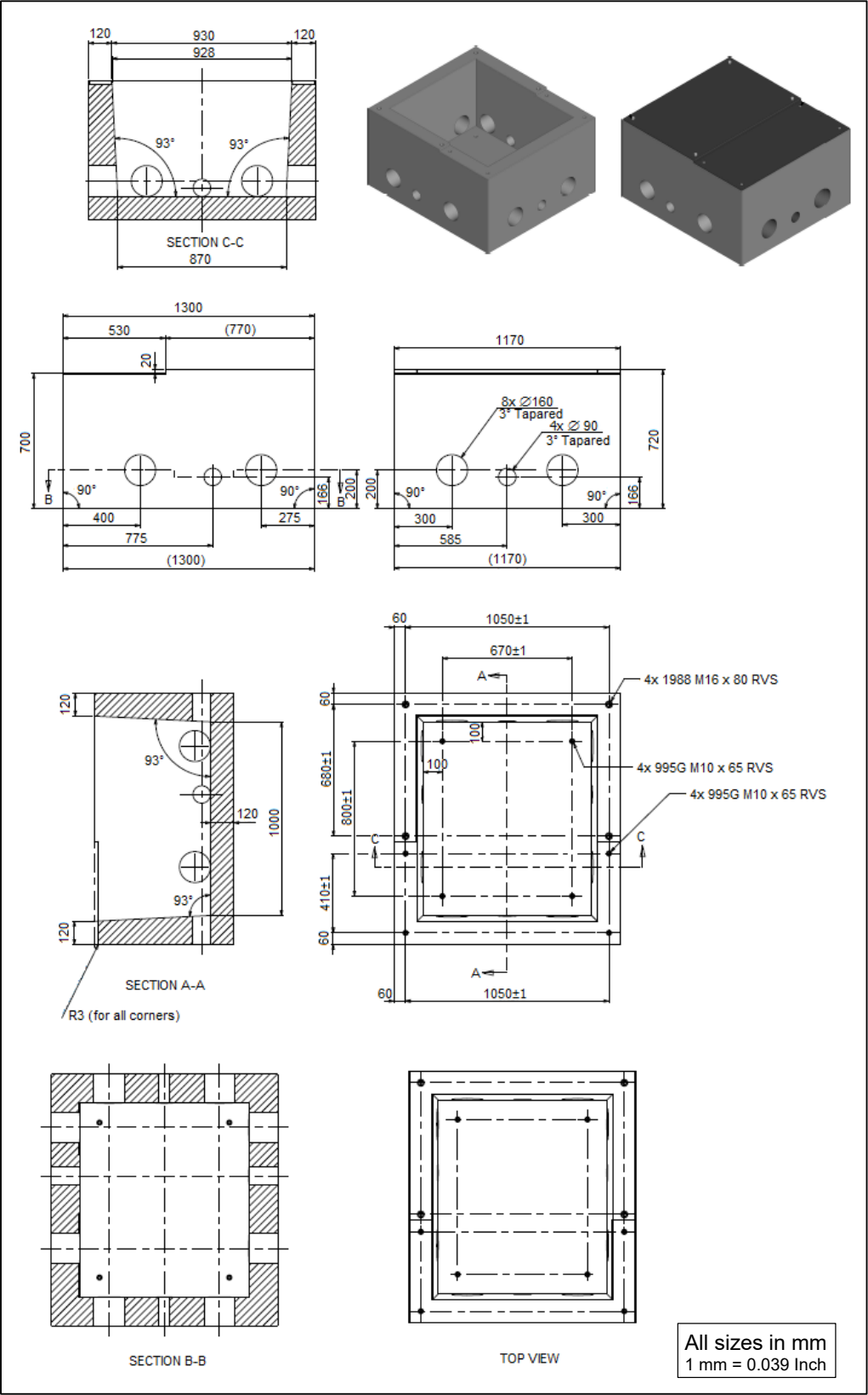
During transport

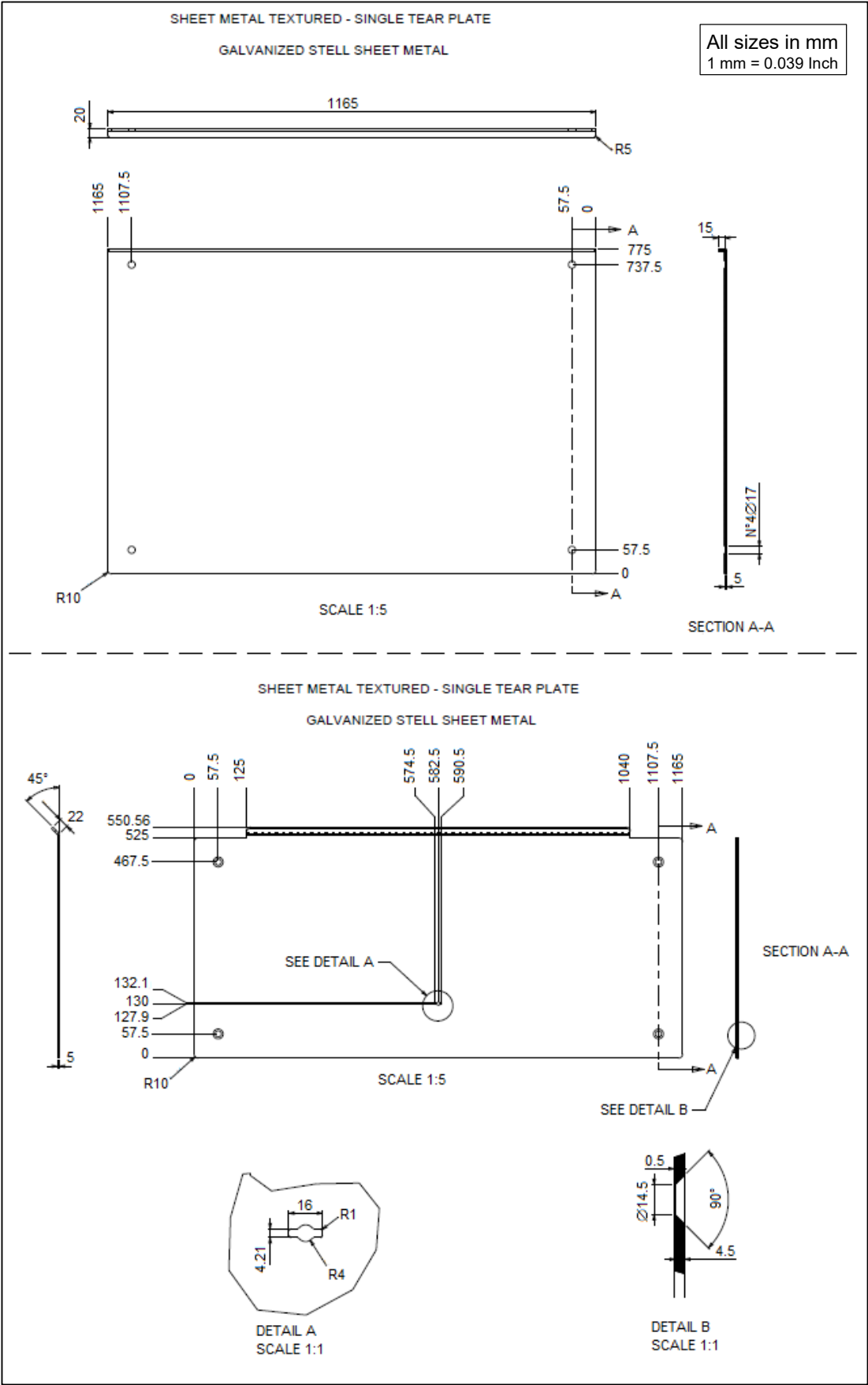


E. Clearance and vertical working range of the pantograph



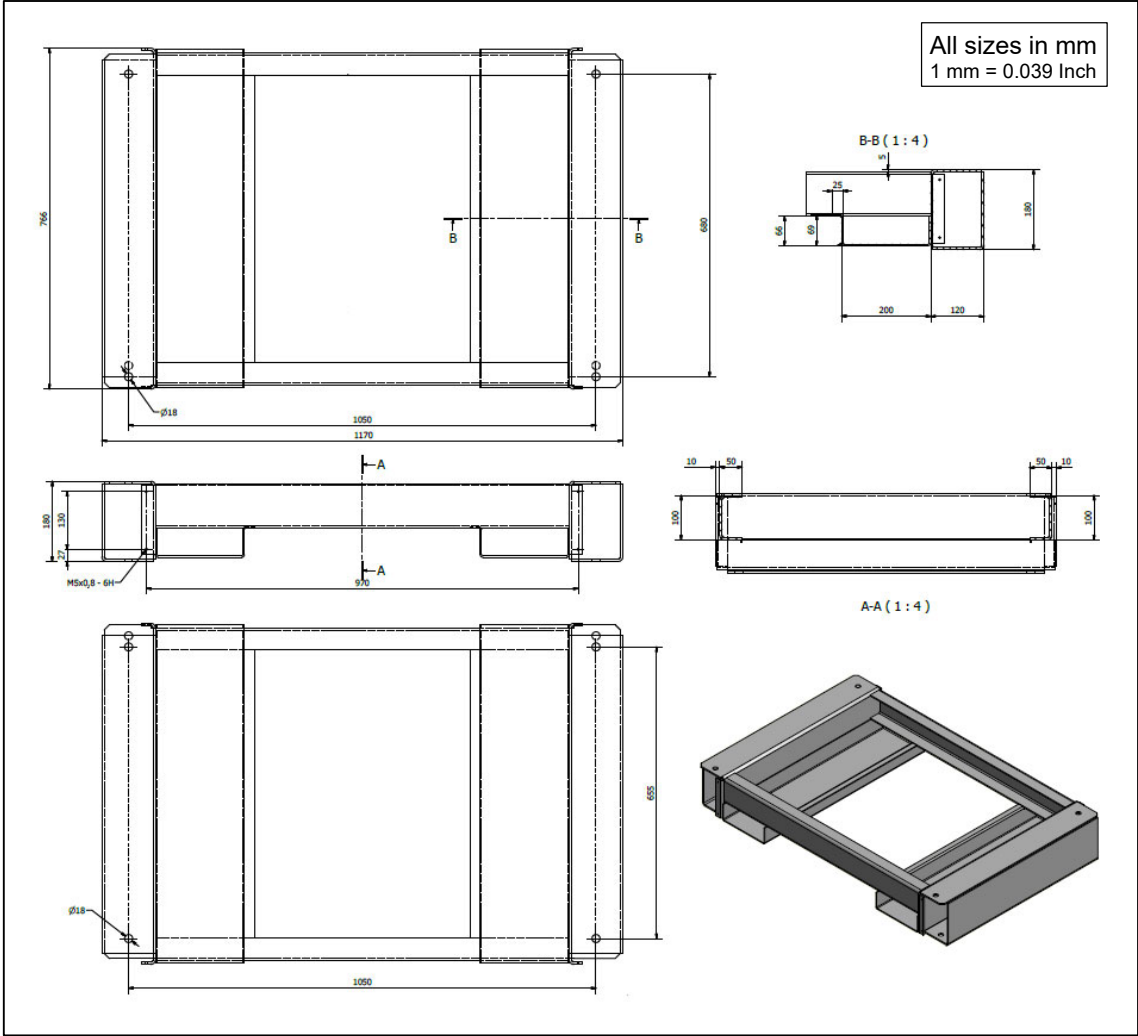
F. Dimensions Concrete Foundation Power Cabinet



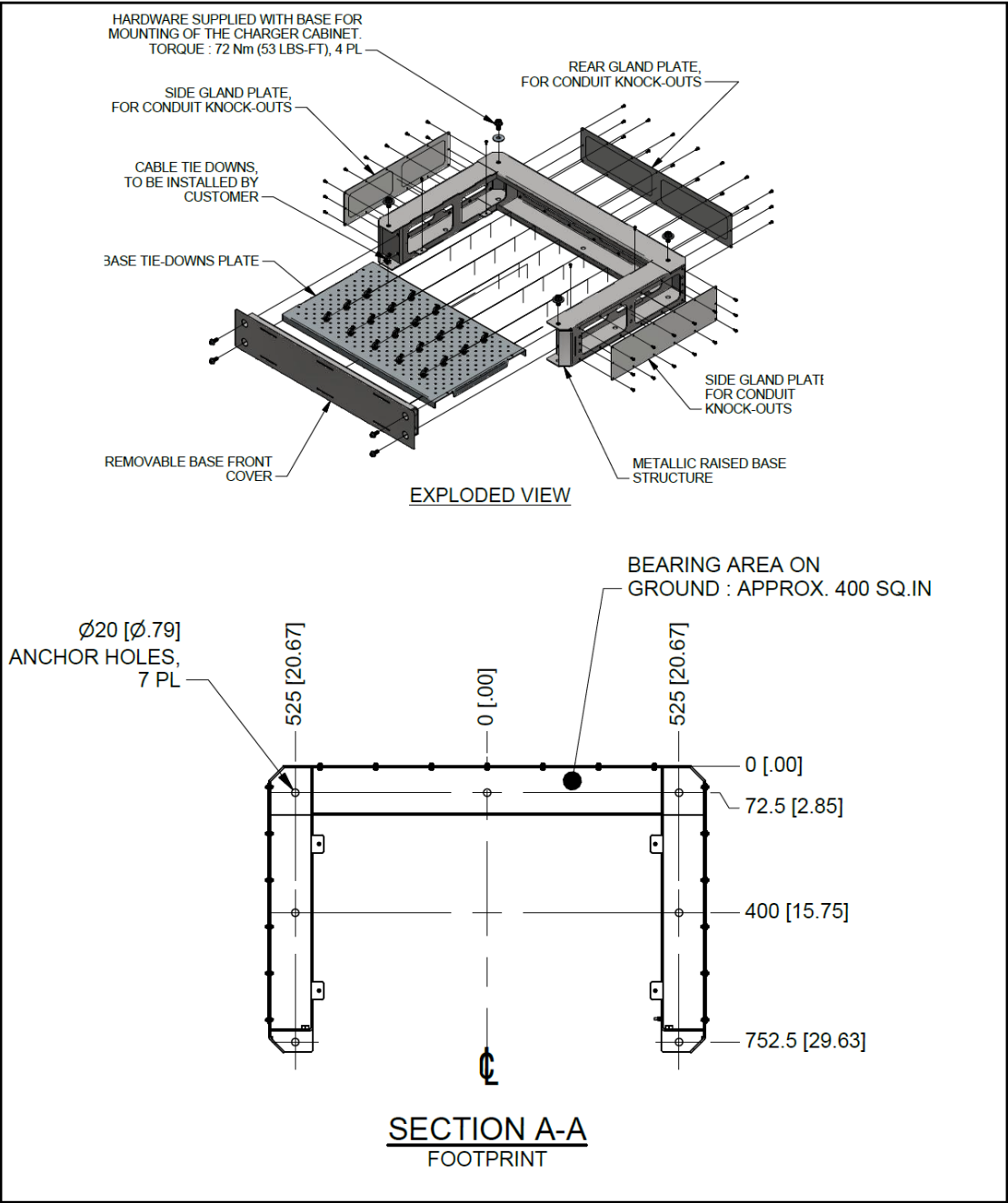


G. Dimensions Metal Foundation Power Cabinet

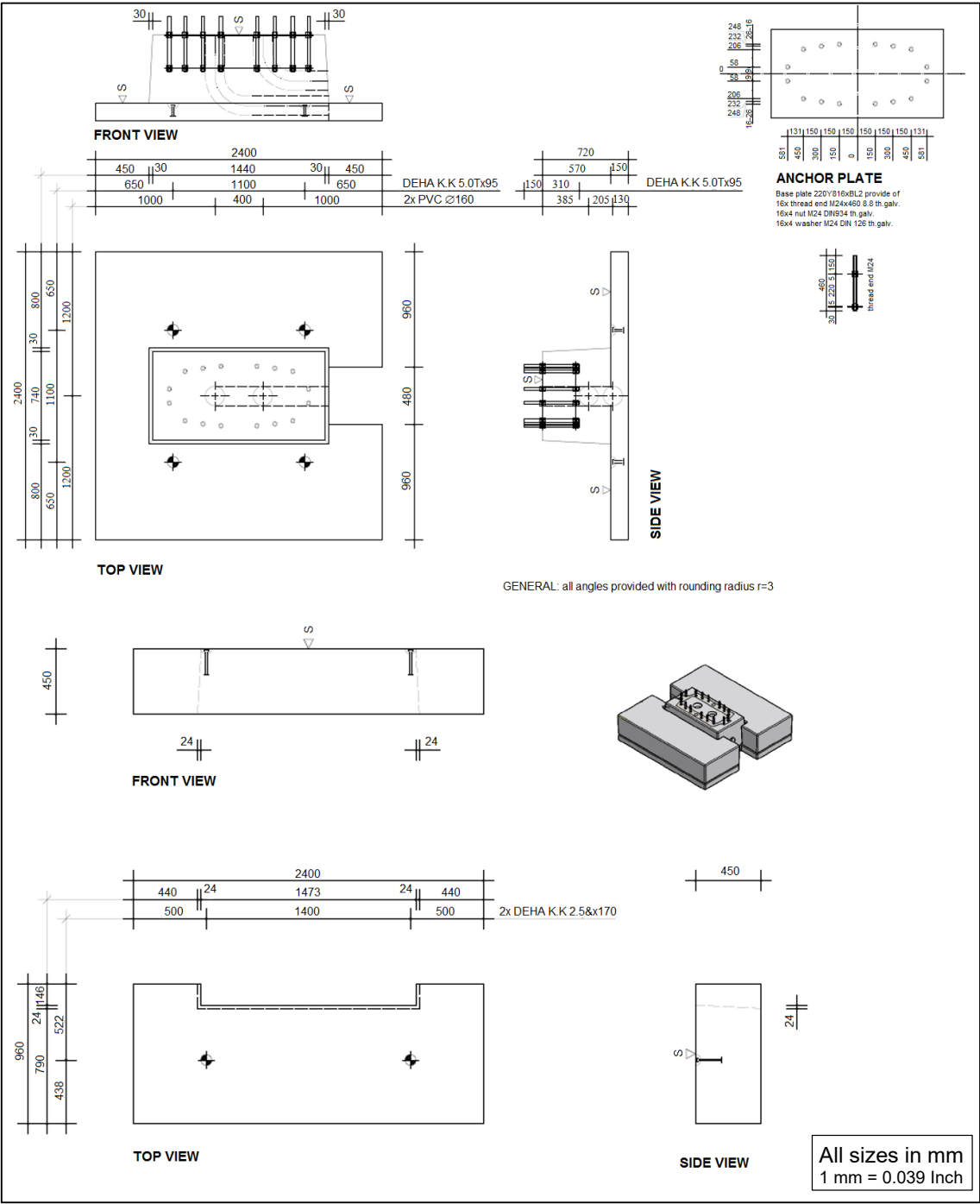
HxC power cabinet metal foundation (4EPY420133R1)



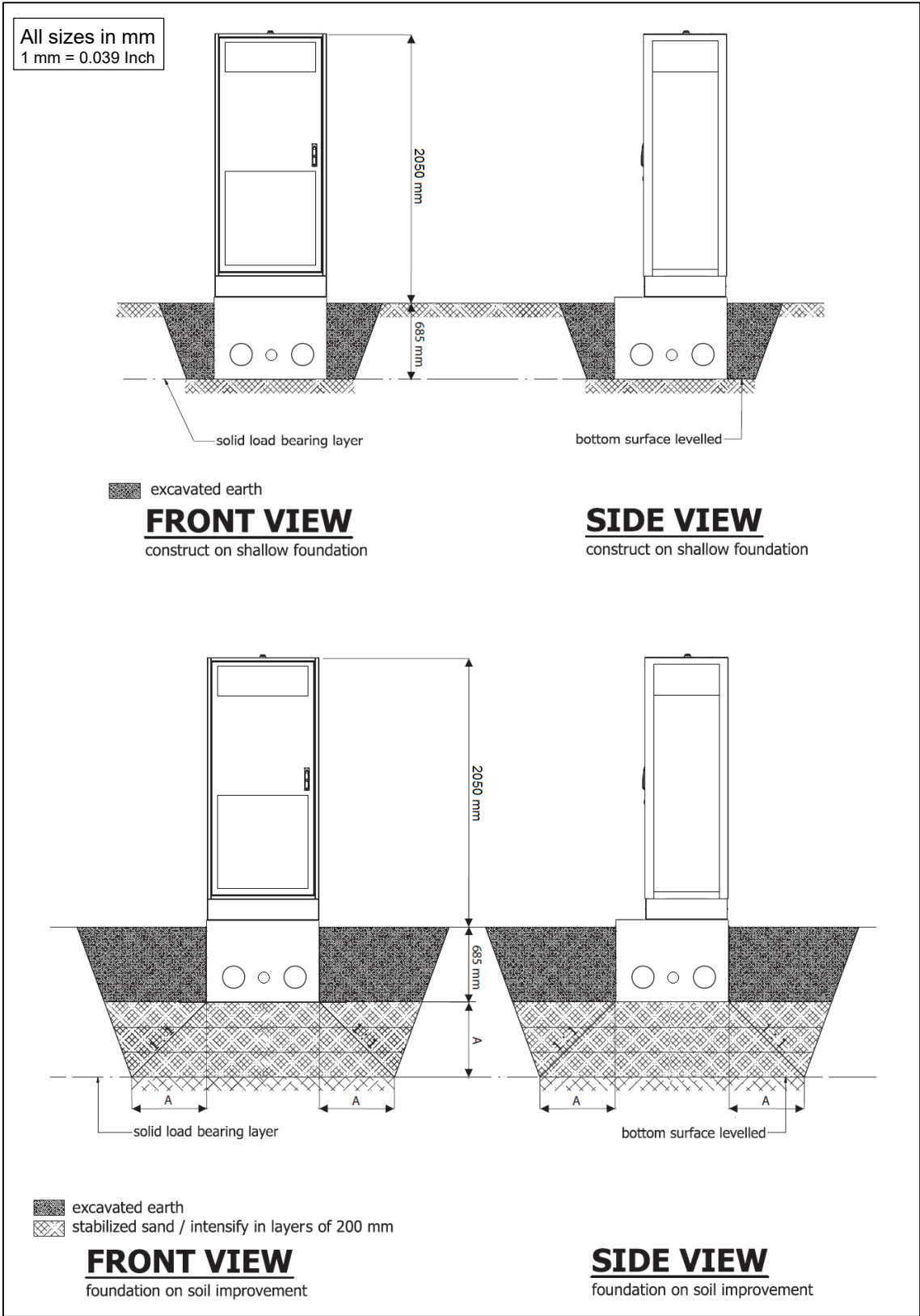
HPC175-HVC150 MET FOUND KIN 8IN – NAM (2CEB489802R0001)



H. Dimensions Concrete Foundation Pole

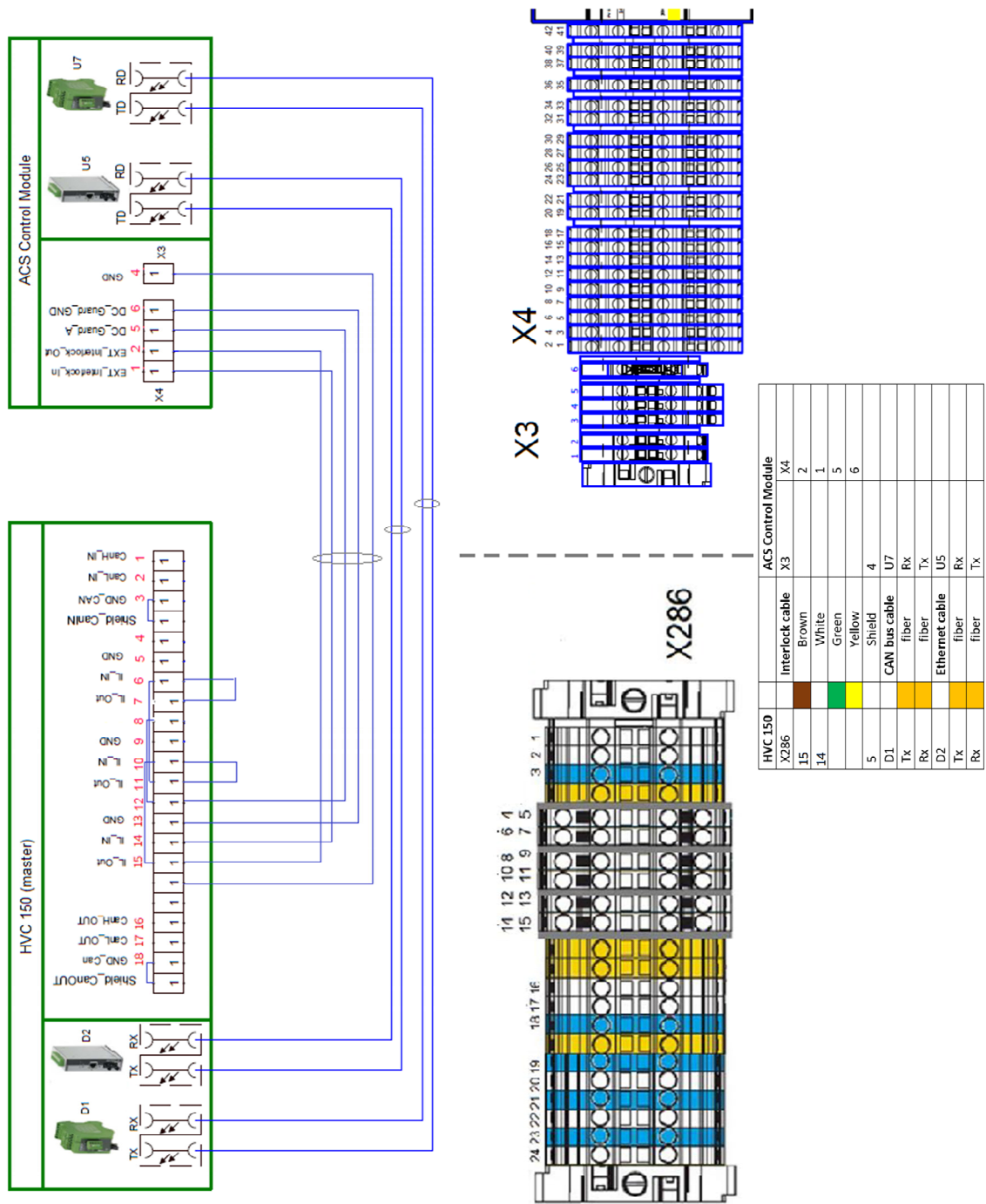


I. Power Cabinet – Outline with Foundation

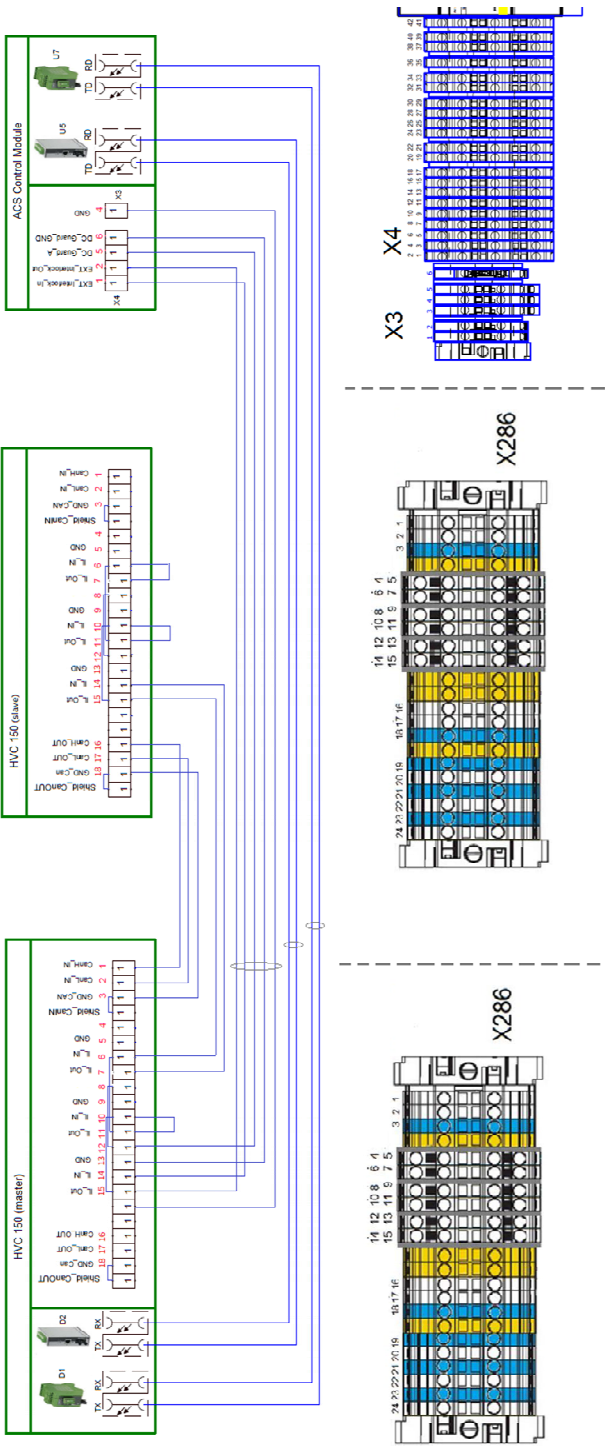


J. Signal connection diagram

For HVC 150 kW system

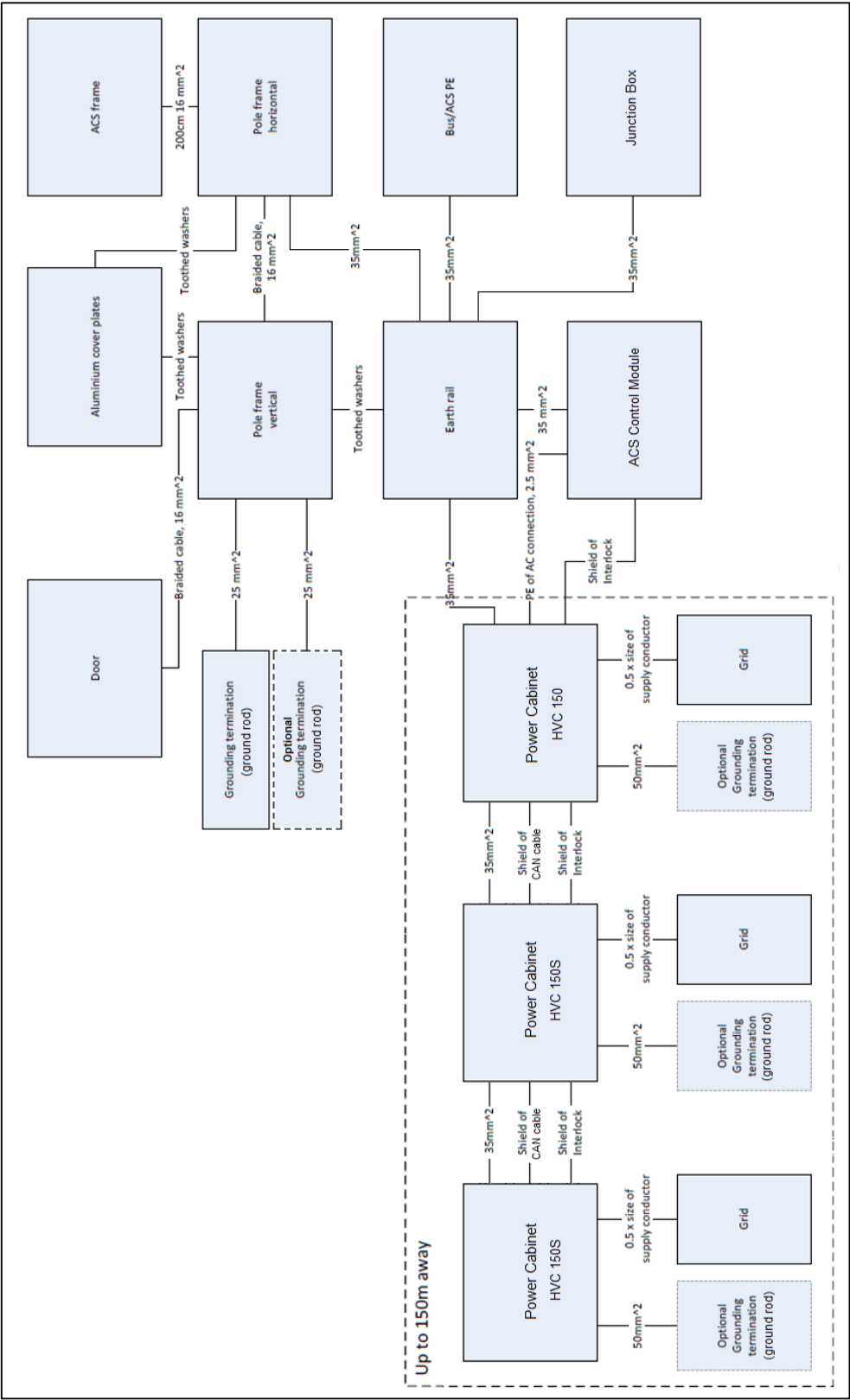


For HVC 300 kW system



HVC 150	HVC 150S	ACS Control Module
X285	X286	
1	Brown	
2	White	
3	Shield	
X286	Interlock cable	X3
	Brown	2
	White	1
	Green	5
	Yellow	6
	Shield	
6	Brown	4
7	White	
	Shield	
D1	CAN bus cable	U7
Tx	fiber	Rd
Rx	fiber	Td
D2	Ethernet cable	U5
Tx	fiber	Rd
Rx	fiber	Td

K. Ground overview of the system



NOTES



A series of horizontal lines for taking notes, consisting of 28 lines.