

NBPTD (PANTOGRAPH TOP-DOWN)

HARDWARE AND INSTALLATION MANUAL



PANTOGRAPH CABINET GEN II

EV CHARGING SOLUTIONS

Hardware and Installation Manual

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NBPTDHW01CI Rev. C

ABOUT THIS MANUAL

PURPOSE

This manual contains important instructions for the installation, configuration and use of Power Electronics' Pantograph cabinet. From now on, this manual refers to it with the term, "NBPTD", "cabinet", "unit" or "equipment".

Power Electronics reserves the right to modify product features.

TARGET AUDIENCE

This manual is intended for qualified clients who will install, configure and operate the Power Electronics' Pantograph cabinet.

Only qualified technical personnel validated by Power Electronics may install and start up the equipment.

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REVISIONS CONTROL

DATE (DD/MM/YYYY)	REVISION	DESCRIPTION
23 / 12 / 2022	A	First edition. Introduction. Technical characteristics. Dimensions and weight.
09 / 02 / 2023	B	Preparation for installing the equipment. Cable access and connections. Protections. Interface. Communications
13 / 02 / 2023	C	Cable access and connections.

EN

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ACRONYMS

The terms commonly used in the documentation of Power Electronics' products are listed in the table below.

Please notice this is a general series of terms and it encompasses all our product divisions (industrial, solar, storage, and electric mobility), thus, some of the following expressions may not apply to this particular manual.

ACRONYM	MEANING
AASS	Auxiliary Services
AC	Alternating Current
AI	Analogue Input
AO	Analogue Output
BESS	Battery Energy Storage System
BMS	Battery Manager Solution
CCID	Charge circuit interrupting device
CCL	Charge Current Limit.
CCS	Combined charging system – charging and communications protocol following the standard IEC 61851-23 Annex CC
CHAdeMO	Charging and communications protocol following the standard IEC 61851-23 Annex AA
CPU	Central Processing Unit
DC	Direct Current
DCL	Discharge Current Limit
DI	Digital Input
DSP	Digital Signal Processor
DO	Digital Output
EMS	Energy Management System
EV	Electric Vehicle
FPGA	Programmable device (Field-Programmable Gate Array)
FRU	Field Replaceable Unit
GFDI	Ground Fault Detector Interrupter
GPRS	General Packet Radio Services, a data transmission system
HVAC	Heating, Ventilation, and Air Conditioning
IGBT	Insulated Gate Bipolar Transistor
IMI	Insulation monitoring device
IT	Grid system where the power supply is kept isolated and the electrical equipment system is grounded.
LOTO	Lock Out – Tag Out
MCB	Miniature Circuit Breaker
MCCB	Moulded Case Circuit Breaker
MPCS	Multi Power Conversion System
MID	Measuring Instrument Directive
MV	Medium Voltage. This term is used to refer to high voltage in general
PE	Ground connection
PI	Proportional and Integral
POI	Point Of Interconnection
PPE	Personal Protection Equipment

ACRONYM	MEANING
PV	Photovoltaic energy
RCD	Residual Current Device
RCM	Residual Current Monitor
RFID	Radio Frequency Identification
SOC	State Of Charge – referred to battery
SOH	State Of Health – referred to battery. It compares the actual state of the battery to its initial conditions. It is measured in percentage
STO	Safe Torque Off
TN	Grid system where the power supply is grounded, and the electrical equipment system is brought to the same ground through the neutral connector.
TT	Grid system where both the power supply and the electrical devices are connected to the ground via separate connections
UPS	Uninterruptible Power Supply
VSD / VFD	Variable Speed Drive, Variable Frequency Drive. Both terms are used

SAFETY SYMBOLS

Always follow safety instructions to prevent accidents and potential hazards from occurring.

In this manual, safety messages are classified as follows:



WARNING

Identifies potentially hazardous situations where dangerous voltage may be present, which if not avoided, could result in minor personal injury, serious injury or death.

Be extremely careful and follow the instructions to avoid the risk of electrical shocks.



CAUTION

Identifies potentially hazardous situations, which if not avoided, could result in product damage, or minor or moderate personal injury.

Read the message and follow the instructions carefully.



NOTICE

Identifies important measures to take in order to prevent damage equipment and warranty lost, as well as encouraging good use and environmental practices.

Other symbols used in this manual for safety messages are the following:



Hot surface. Be careful and follow the instructions to avoid burns and personal injuries.



Risk of fire. Be careful and follow the instructions to prevent causing an unintentional fire.



Caution, risk of electric shock. Energy storage timed discharge. Wait for the indicated time to avoid electrical hazards.

SAFETY INSTRUCTIONS

IMPORTANT!

SAVE THESE INSTRUCTIONS

Read carefully all documentation before handling the equipment and pay special attention to safety recommendations to maximize the performance of this product and ensure its safe use and installation.

This document covers the most important and frequent potential causes of damage to equipment or personnel. It is the responsibility of the installer to follow the instructions provided in this manual, follow good electrical practices and identify all warnings and recommendations before starting up and operating the electric vehicle chargers.



WARNING

FIRST CONSIDERATIONS

The operations detailed in this manual can only be performed by qualified personnel.

The condition of qualified personnel referred to in this manual shall be at least the condition that meets the standards, regulations and safety laws applied to the installation and operation of this equipment.

Read and retain the Hardware and Installation Manual for future reference.

Before assembling the equipment, read all instructions, caution signs and other sections of this manual. Failure to follow these warnings can result in severe electrical shock or death. Pay attention at all times to prevent possible accidents.

In addition to the recommendations in this manual, **local and site-specific safety procedures should be observed**. Additionally, local and national electrical regulations must be followed to avoid personal injury and/or equipment damage.

The electric vehicle charging system may cause an ELECTRICAL DISCHARGE if the warnings indicated in this manual are not followed.

Make sure the equipment is completely disconnected from the power supply and grounded before handling or servicing. Otherwise, there is a risk of electric shock. To avoid electrical hazards, disconnect the input supply, ground the equipment, remove control voltages before performing any tasks, and ensure that busbars are completely discharged. Warning and safety labels must be properly affixed to terminals, cabinets, and control panels in accordance with local regulations.

When working on electrical installations, always remember to apply the FIVE GOLDEN RULES:

1. Visible shutdown of all live sources.
2. Mechanical locking of all cutting elements.
3. Verify the absence of voltage by using the appropriate tools for the voltage of the installation.
4. Ground and short-circuit all possible voltage sources.
5. Delimit and mark the work area.

Do not modify the equipment. If you fail to do so, Power Electronics will not assume any liability, and the product warranty will be voided.



WARNING



The housing must be properly closed, otherwise it may not adequately protect people or property from any abnormal situation inside the equipment.

Always follow the instructions in the manual to move and position the equipment. The weight of this equipment can cause injuries, serious injuries and even death if not handled correctly.

The exhaust airflow can reach high temperatures during charging sessions, especially when the outdoor temperature and power demand are high.

Electric shock danger. The steps to isolate the equipment must be carefully followed before performing any task or opening any cover of the equipment. Avoid inappropriate actions that may cause electric shock.

Always wear the appropriate personal protective equipment (PPE) for each task and work in electrical areas with dry hands. Otherwise, you may get an electric shock.

Do not use cables with damaged insulation. Do not subject cables to abrasion, excessive stress, heavy loads or pinching. Otherwise, you may get an electric shock.

Do not supply power to a damaged equipment or with missing parts, even if the installation is complete. Otherwise, you may get an electric shock.

In the event that the equipment stops due to a loss of power, do not do any work on it. The auto-restart function may be enabled, and you may receive an electric shock.



The equipment has capacitors. Wait until the capacitors have discharged before performing any maintenance task.

USE

Do not use this equipment for purposes other than the electric vehicle charging with the modes provided for this product and defined in this manual.

Do not disconnect or connect any terminals while the equipment is running. Otherwise, you may get an electric shock and the equipment may be damaged.

Do not use this product if its enclosure or electric vehicle connector(s) (on both the equipment and vehicle sides) are broken, cracked or otherwise damaged. Otherwise, you may get an electric shock.

CONNECTION TO EARTH

Prevention of electric shock:

- The equipment chassis must be properly grounded to prevent a possible electrical shock if a leakage current flows through the enclosure. Disconnect all power supplies before proceeding with maintenance operations inside the equipment.
- Only connect the grounding device to the equipment's grounding plate. Do not use the enclosure or chassis screws for grounding.
- The protective earth wire must be connected first and last disconnected.

 **CAUTION**

Install the equipment, on a solid, level surface in a location where there is no risk of explosion, flooding, or impact damage. Follow the recommendations on how to build the foundation of this manual. Otherwise, there is a risk of malfunction and even permanent damage.

Never clean the surfaces or the inside of the equipment with abrasive liquids, solvents or cleaning products that could damage it. Water should not be applied under excessive pressure.



Disconnect the input power in case the equipment gets damaged.
Otherwise, it could result in a secondary accident or a fire.

Do not allow lint, paper, wood chips, dust, metallic chips, or other foreign matter into the equipment. Otherwise, a fire or an accident could occur.



After the input power is applied or removed, the equipment will remain hot for a few minutes. Touching internal hot parts could result in skin burns

EN

IMPORTANT RECOMMENDATIONS FOR CHARGING ELECTRIC VEHICLES: **CAUTION**

Follow at all times the charging process described by the electric vehicle manufacturer.

This device should be monitored when used near children.

Do not handle the vehicle or equipment during the loading process (washing of the vehicle, intervention in the vehicle engine compartment, handling of the loading post, etc.).

Do not modify or interfere with the electrical installation while charging the vehicle.
Failure to do so could result in electric shock.

Do not charge the vehicle in the event of water, signs of corrosion or foreign matter on the charger cable connector or vehicle charging socket. Otherwise, there is a risk of fire and electric shock.

Do not attempt to touch the terminals of the charging station connector cable or the vehicle charger socket, nor insert objects into them. Failure to do so could result in electric shock.

Do not attempt to disassemble, repair, alter or modify the charging connector or any part of the charger. The connector is not a user-serviceable device. Contact Power Electronics.

Always be careful with the charger's cable and connector: treat it carefully, do not crush it, immerse it in water, pull it out, or hit it, etc.

Follow the directions given by the vehicle manufacturer regarding the suitability of charging the vehicle when you or the vehicle are exposed to intense rain, heavy electrical storm, or other severe weather.

PERSONAL PROTECTIVE EQUIPMENT (PPE from now on) REQUIRED

The use of PPE in accordance with standards is required to repair and maintain the equipment. Follow applicable instructions at the installation site to comply with national and local regulations.

In the case of tasks with voltage present, it is mandatory to use an Electric Arc Safety Kit (gloves, clothing and face protection).

A detailed example of the PPE used is shown below. The client must specify in his safety instructions (hazard statement and work procedure) which PPE is required and when and how they should be used according to his electric arc studies, the characteristics of the site, the chargers, the installation and the country.

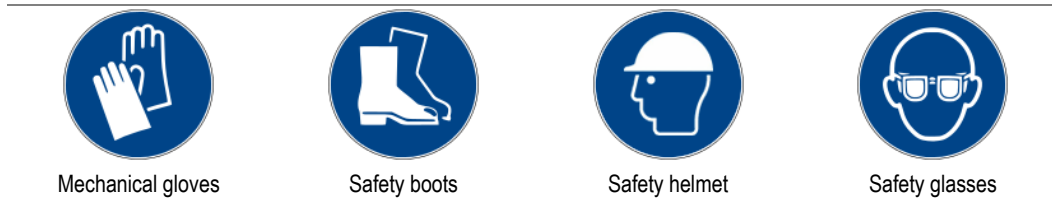
Power Electronics assumes no liability for damage resulting from improper use of the equipment or failure to comply with local or national regulations.

Always follow local regulations / NEC Health & Safety standards.

The following table shows an example of commonly used PPE:

ITEM	DESCRIPTION
Safety glasses	Eye protection according EN 166.
Electric gloves	Gloves with mechanical, dielectric and against arc flash. Class according to voltage. EN 60903; ASTM D120 specifications and NFPA 70E standards.
Safety footwear	S3 class complying with BS EN ISO 20345.
Insulation carpet	Isolation carpet according to IEC 61111. Class according to voltage.
Safety kit arc flash	Arc flash personal protective equipment kit (including arc flash protective face shield & hard hat), fire resistant 40 cal/cm ² .
Padlock set	Padlock and auxiliary elements set to lock out dangerous equipment.
HI-VIS vest	Fr VIS vest 9 cal/cm ² .
MV stool	Medium Voltage insulation stool.
Rescue pole	Insulated body rescue pole.

PPE FOR INSTALLATION



Additional PPE for commissioning and maintenance tasks



The following table shows **the protection class type**, depending on the working voltage.

ELECTRICAL INSULATED GLOVES

Class	AC (V _{AC})	DC (V _{DC})
00	500	750
0	1000	1500
1	7500	11250
2	17000	25500
3	26500	39750
4	36000	54000

ELECTRICAL SAFETY MATTING

Class	AC (V _{AC})	DC (V _{DC})
0	1000	1500
1	7500	11250
2	17000	25500
3	26500	39750
4	36000	54000

EN



NOTICE

PPE should be checked according to the manufacturer's instructions.

The electrical gloves must have thermal, electric and mechanical protection. Some models of gloves have the three kinds of protection, so it is not necessary to combine them with more gloves.

If the gloves only have dielectric protection, it is mandatory to use under fireproof gloves and over gloves cover.



NOTICE

RECEPTION

- Electric vehicle chargers are supplied after passing strict performance tests and are carefully packed for shipment.
- In case of damage to the unit during transportation, notify the shipping agency and Power Electronics (International +34 96 136 136 65 57, USA + 1-415-874-3668) or your nearest agent within 24 hours of receipt of the merchandise.

RECYCLING

Packaging equipment must be recycled. Separate all different materials (plastic, paper, cardboard, wood...) and place them in the corresponding containers. Ensure waste collection is properly managed with a Non-Hazardous Waste Agent.



To guarantee health and natural environmental sources protection, the European Union has adopted the WEEE directive concerning discarded electric and electronic equipment (SEEA).

Waste of electrical and electronic equipment (WEEE) must be collected selectively for proper environmental management.

Our products contain electronic cards, capacitors and other electronic devices that should be separated when they are no longer functional. These WEEEs should be managed accordingly with a Hazardous Waste Agent.

Power Electronics promotes good environmental practices and recommends that all its products sold outside of the European Union, once they reach the end of their life, are separated and the WEEE managed according to the particular country applicable legislation (especially: electronic cards, capacitors and other electronic devices).

If you have any questions about the electric and electronic equipment waste, please contact Power Electronics.



NOTICE

CYBERSECURITY DISCLAIMER

This product is designed to be connected to and to communicate information and data via a network interface. Access to the system is restricted to those employees who legitimately need it for reasons of maintenance and/or updating of the system.

It is the client's sole responsibility for providing and continuously ensuring a secure connection between the product and client network or any other network (as the case may be). Client 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 antivirus 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.

Power Electronics 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.

TORQUE AND SCREW SIZING

The following table shows, broadly speaking, the recommended tightening torque for both mechanical and electrical connections, applicable to all cabinets ^[1, 2]:

SCREW SIZE		RECOMMENDED TORQUE			
METRIC (mm)	ENGLISH (inches)	DIN (Nm)		ASTM (ft*lb)	
		6,9 QUALITY ^[a]	8,8 QUALITY ^[a]	A449 TYPE 1 ^[a]	A325 TYPE 1 ^[a]
M3	1/8	1	1,3	-	
M4	5/32	2,5	3		
M5	3/16	4	6		
M6	1/4	5	8	4	-
M8	5/16	20	20	9	
M10	7/16	40	40	25	
M12	1/2	60	60	38	50 – 58
M14	9/16	100	120	54	-
M16	5/8	150	210	75	99 – 120

[a] For other qualities, follow the screw's manufacturer guidelines.



CAUTION

For all screwing that hold a **particular component** such as a bus, contactor, etc. it will be necessary to **apply the tightening torque indicated by the manufacturer** of the same component.

Screwing should be tightened correctly only when necessary, i.e. when the factory marks are not in place. For small screws that do not have marks, the good electrical praxis will determine if it is loose.

¹ Power Electronics recommends the use of **Zinc Steel quality 8.8 bolts for internal connections** in general, DC and earth connections included.

² Power Electronics recommends the use of **A2-70 stainless bolts for external connections** in general, AC connections included.

1. INTRODUCTION

1

Power Electronics' Pantograph cabinet (NBPTD) allows to provide supply to any pantograph. The cabinet can be connected to any NBSK or NBi.

For further information related to Power Electronics' equipment regarding installation, safety recommendations, transport, storage, other connections, etc., please refer to the corresponding ¹*Hardware and Installation Manual*.

To consult information related to the combiner, please refer to the *Combiner Annex* that corresponds with the project.

The pantograph cabinet is compatible with multiple top-down pantograph manufacturers, designed for an easy and reduced maintenance. This document describes how to install and perform all connections between the top-down pantograph cabinet and the power equipment. It is provided with an external control box.

Connections between the pantograph cabinet and the pantograph are client's responsibility and out of the scope of Power Electronics. Please ask the pantograph manufacturer to provide all necessary instructions.

NOTICE

This document only details the connections that client must perform in the pantograph cabinet. Please, keep in hand the corresponding ¹*Hardware and Installation Manual*, as well as the *Combiner Annex*, and ensure to follow all instructions and recommendations to guarantee a proper equipment installation and correct operation.

The dimensioning of the cables of the station must be checked by a qualified electrician. The client is responsible for the correct sizing and execution of the corresponding connections in accordance with the regulatory requirements applicable in the country of installation.

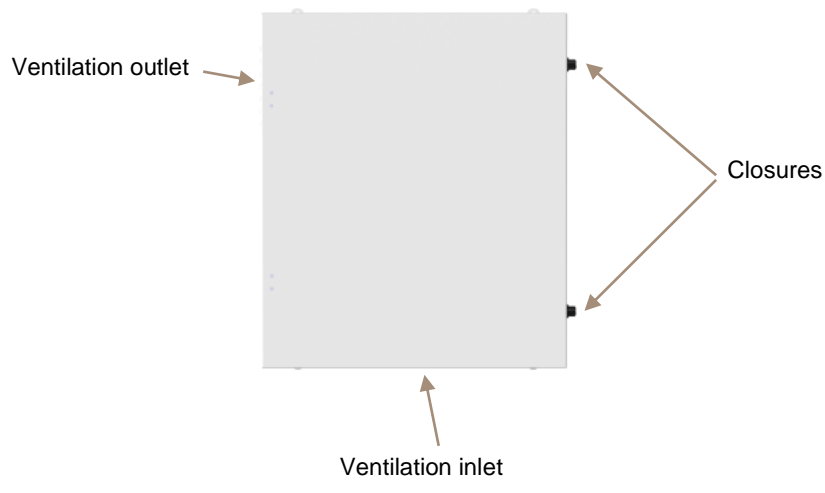
¹ Depending on the project, it can be NBSK station or NBi power cabinet.

Equipment overview

The following sections describe the different components of the equipment:

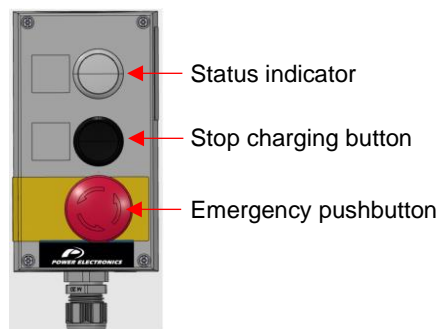
NBPTD Cabinet

The NBPTD is a charging solution where the pantograph is mounted on the infrastructure side. The NBPTD allows to charge electrical buses overnight and during the day for opportunity charging. It is all-in-one safe and automatic charging solution for heavyduty vehicles. The cabinet can be connected to any power cabinet or a NB Station.

**EN**

External control box

The NBPTD is provided with an external box which allows to control it remotely. The external control box shows the status of the NBPTD, allows to start / stop the charging and make an emergency stop.



Regulatory framework

The NBPTD is a device that is connected to the power cabinet or NB Station and provides a DC power supply at a variable voltage of 150 to 1000 V for charging electric vehicles.

Its certification as a product in accordance with current Spanish and US legislation is carried out through the evaluation, where applicable, of compliance with the following standards:

- **IEC 61851** - Conductive charging system for electric vehicles.
 - Part 1: General requirements.
 - Part 23: DC charging station for electric vehicles.
 - Part 24: Digital communication between a DC EV charging station and an electric vehicle for control of DC charging.
- **IEC 61851-21-2:2018** - Electric vehicle requirements for conductive connection to an AC/DC supply. EMC requirements for off-board electric vehicle charging systems.
- **UL 2202**: Electric Vehicle (EV) Charging System Equipment.
- **NEC - Article 625**: Electric Vehicle Charging Systems.
- **FCC part 15 - class A**: Unintentional radiators - industrial application.

2. TECHNICAL CHARACTERISTICS



Depending on the regulation to be followed, the equipment will fulfill different technical characteristics.

NBPTD – IEC / UL

	REFERENCE	VALUES	
OUTPUT DC	Max continuous current [A]	500	
	Max peak current [A] ¹	600	
	Voltage Range [V]	150 -1000	
	Pantograph compatible models ²	Schunk SLS201.106, SLS201.102, Stemmann Fb206.11	
GENERAL	External control box	LED indicator Emergency Stop Button Stop charging button	
	Protection rating	NEMA 3R IP54 IK10 (IK08 ventilation grid)	
	Enclosure	Grey (RAL 7035)	
	Operation Temperature Range [°C/°F]	-30 to 50 / -22 to 122	
	Relative Humidity	4% to 95%	
	Max Height (above sea level)	Without derating: 2000m / 6561ft. Max: 3000m / 9842 ft.	
	Communications	Ethernet (10/100) / Optional F.O.	
	Charge Protocols	OppCharge, OCPP 1.6J	
	Power Box Dimensions (WxDxH) [mm/in]	600 x 300 x 700 / 23.6 x 11.8 x 27.6	
	Power Box Weight (kg)	50	
	Dimensions external control box (WxDxH) [mm/in]	85 x 64 x 154 / 3.35 x 2.52 x 6.06	
	External control box Weight (kg)	1	
	MAX DISTANCES INSTALLATION	Power Box & Pantograph ³	10 m / 33 ft
		Power Box & Power Cabinet/Station	100 m / 328 ft (optional: with F.O. 150 m / 492 ft)
External control box & Power Box		100 m / 328 ft	
REGULATIONS	Regulations	IEC 61851-1, IEC 61851-23, IEC 61851-24, IEC 61851-21-2 UL 2202, FCC Part 15 Class A	
OPTIONAL	Optional	RFID antenna, Wi-Fi antenna	

Be aware that Power electronics is not responsible for the NBPTD input power connection, as well as its installation.

¹ Limited by pantograph.

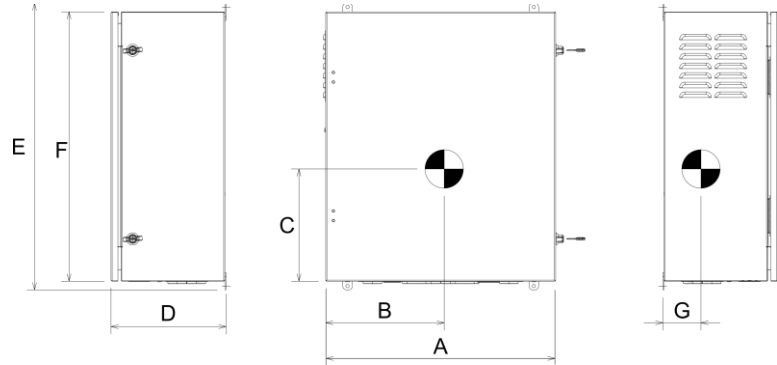
² Consult with Power Electronics for further information.

³ Consult with Power electronics for other distance.

3. DIMENSIONS AND WEIGHT



The dimensions, gravity center and the weight of the NBPTD equipment are detailed below.

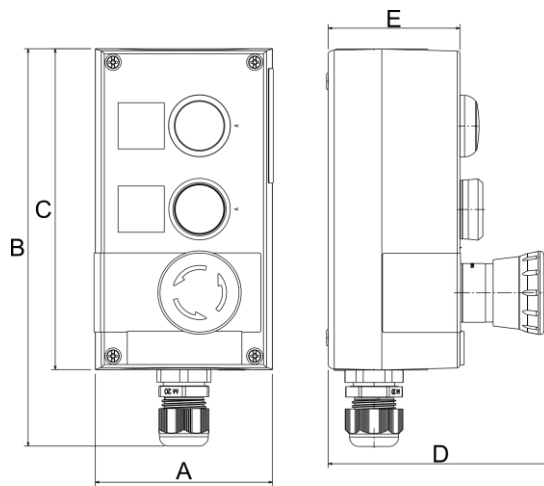


NBPTDDTD001A

	A	B	C	D	E	F	G
mm	600	309	292	300	745	700	99
in.	23.62	12.16	11.49	11.81	29.33	27.56	3.89

The approximate weight for the equipment is 49 kg (7.72 st).

The dimensions and the weight of the external control box are detailed below.



NBPTDDTD005A

	A	B	C	D	E
mm	85	190,7	154	108,2	63,2
in.	3.35	7.51	6.06	4.26	2.49

The approximate weight for the equipment is 1 kg (0.16 st).

4. HANDLING AND TRANSPORTATION

4



CAUTION

Please read the following transport and installation instructions carefully.

Failure to follow transportation and installation instructions could result in damage to the equipment or injury to people.

Reception

The equipment is delivered perfectly packed and checked. Upon receipt, inspect the equipment. In the event of damage to the equipment, notify the logistics agent and Power Electronics 902 40 20 70, (International +34 96 136 65 57), or your nearest agent within 24 hours of receipt. Verify that the goods received correspond to the delivery note, models and serial numbers.

Storage

Whenever possible, the equipment should be unloaded at its place of installation and operation.

If it is necessary to store the equipment, it must be kept in its original packaging and the following rules must be followed to keep it in proper condition:

- Store the equipment in a place protected against harmful elements such as animal entries, excess moisture (inside and outside the equipment), thermal radiation, direct solar radiation, contact with chemicals, corrosive gases, etc.
- Store the equipment on a flat, level surface. Never rest the equipment on wooden beams
- Store equipment away from passageways where it may be damaged
- Keep the covers on during storage.
- Keep the equipment packed until the time of installation.
- The temperature in the storage location must be between -40°C y +60°C and the relative humidity at <95% without condensation.



NOTICE

Standard storage is defined as the expected time period from the time the equipment arrives at its location until its commissioning occurs. It is assumed that this period is less than 6 months. This period is variable according to the weather conditions of the site.

Client is responsible of deciding if the posts are installed within the standard period or otherwise, the installation date is to be defined. In this case, client must take the appropriate measures.

Extended Storage

If the equipment is stored for an extended period of time (6 months or more) before installation for an undefined date, new considerations should be taken, in addition to the recommendations in the previous section "[Storage](#)":

- The equipment shall be protected under cover, by means of an external protector or by the method adapted to the local conditions which prevents condensation and humidity inside the equipment.
- Draining bags shall be included inside the equipment to prevent moisture from damaging electronic components. These shall be replaced when storage conditions require it.
- A clearance shall be left around the equipment so that inspections can be undertaken.
- Periodic inspections should be performed when possible. Proper internal cleanness must also be checked.



WARNING

Tasks shown above are standard and **they are not applicable to all weather conditions**. In those plants where client considers extreme weather conditions, these requisites should be adjusted for each particular case, as well as the maximum storage time for these conditions.

Unpacking

During the unpacking, remove carefully the packaging (do not use sharp tools). After removing the packaging, check the material inside. If you receive replacement parts with the product, please separate and store them in a safe place. They should not be exposed to vibrations, falls or moisture.



NOTICE

Waste disposal is customer's responsibility, and it is **not within Power Electronics' scope**.

Handling and transportation

CAUTION

Follow the handling and transportation requirements described here. Any other method of transport or handling could damage the unit or void the warranty.

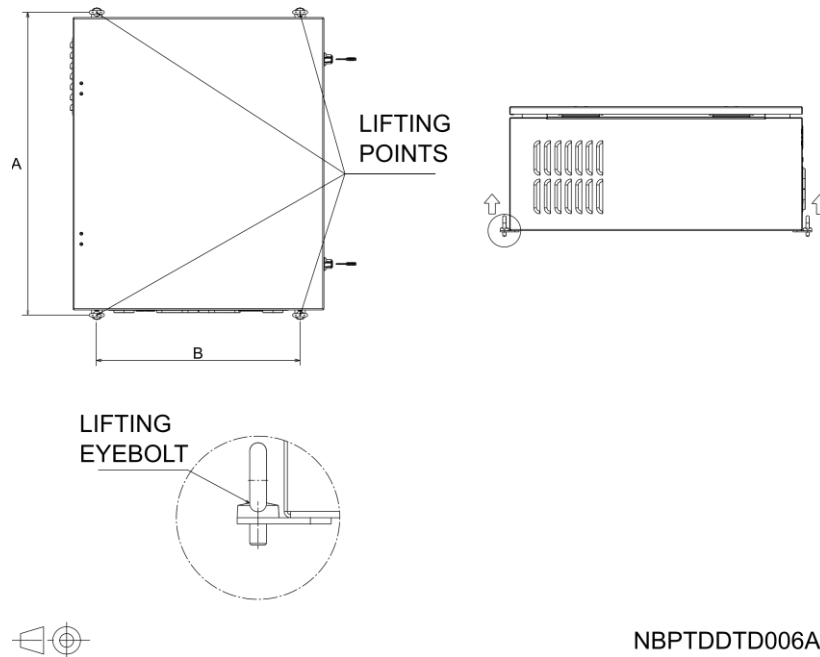
During handling and transport, the goods must not be exposed to moisture, overturned, inverted, inclined or impacted.

Avoid sudden movements and jerking during lifting. Stop the load just before placing it on the ground and then lower the equipment slowly to avoid knocks. Otherwise, the equipment may get damaged.

Each equipment is packed horizontally, in two¹ unassembled parts, in a box. The parts will be separated, wrapped in cell air foam and protected by foam blocks. Externally, the equipment is strapped and shrink-wrapped.

The box is ready to be transported by truck and to be handled by a pallet truck or by a forklift, keeping in mind the load distribution and center of gravity.

For loading/lifting only, the NBPTD is provided with four hoisting eyebolts, the image below shows the location of the hoisting eyebolts. It is recommended to use four M8 eyebolts for hoisting, only in horizontal position.



¹ NBPTD and external control box.



NOTICE

If the methods described here cannot be applied, please contact Power Electronics.

It is important to keep the equipment in the packaging and place them as close as possible to the final location for installation.

Ensure that loading/lifting equipment has a greater capacity than the weight of the charger plus the auxiliary elements and the loading/lifting task is carried out in a way that ensures the stability of the equipment.

5. PREPARATION FOR INSTALLING THE EQUIPMENT

5

Site recommendations

When deciding the location of the equipment and planning its installation, it is recommended to follow a series of guidelines derived from its characteristics.



CAUTION

To guarantee proper electrical installation, it is very important to comply with the bend radius of the cable. The client must ensure the cables enter the equipment perpendicularly and the spacing between them is appropriate.

Avoid corrosive environments that may affect the equipment's proper functioning.



NOTICE

The instructions given in this section must not replace in any way the mandatory regulations of the country in which the equipment will be installed.

Proper installation is absolutely necessary, and it is not within the scope of the manufacturer's responsibility.

The client is responsible for the correct dimensioning and execution of the installation in accordance with current regulations.

Site basis

The charger is designed to be installed on a wall or holder. Accordingly, certain site requirements must be ensured for installation.

- The support surface for the equipment must be perfectly leveled and it must be thick enough to support the equipment.
- The sizing should be appropriate for the weight of the equipment and the characteristics of the soil.
- If required, it must have accesses wide enough to ensure proper wiring passage (the suggested cable access size is shown below).

NOTICE

The equipment is not designed for mobile installations. In case of installing the equipment over a mobile platform, the warranty may be voided.

For further information on this kind of applications, please contact Power Electronics.

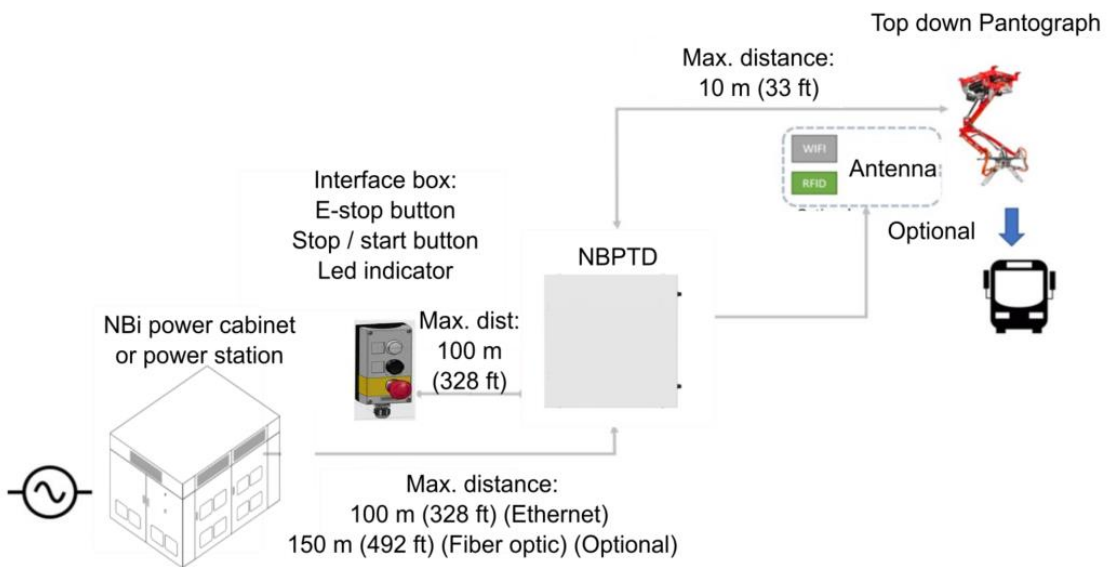
If the equipment is installed on the floor, Power Electronics recommends the design of a support or pedestal to facilitate access. It should be fixed on a flat surface to avoid oscillations. **The design of the support is not included in Power Electronics scope.**

The client is responsible for building a solid concrete base perfectly leveled and elevated with respect to the user's floor height.

See anchor recommendations at the "[Anchoring of the equipment](#)" section.

Maximum distances between the equipment

The maximum distances between the equipment are shown below.



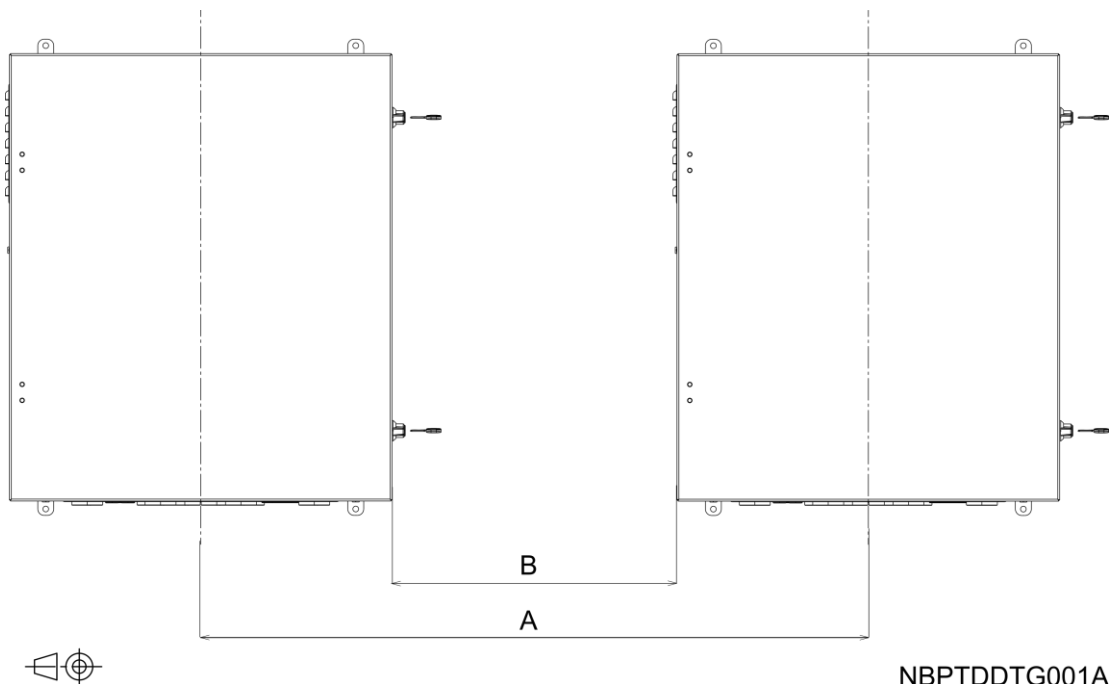
Minimum working distances



CAUTION

When installing the equipment, keep the minimum safety distances. Be aware of all the minimum insulation requirements established by the applicable electrical code, as well as the thermal, safety and accessibility requirements. The safety distances given in this section must not replace in any way the mandatory regulations of the country in which the equipment will be installed.

For proper inspection and correct handling, it is important to leave clearance around the equipment. The following image shows the recommended minimum distances:



	A	B
mm	1600	1000
in.	63	39.37

EN

Anchoring of the equipment

The pantograph cabinet may be installed on a wall.

NOTICE

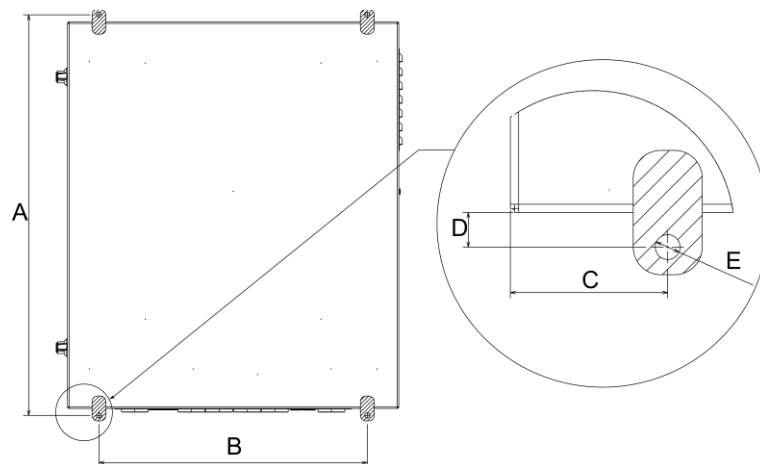
Anchoring must **always be done with screws**. They should not be welded to prevent corrosion problems and, specially, power electronics problems.

Any other anchoring system different from the one mentioned on this document is not allowed and, in that case, the warranty will be voided.

It is the client's responsibility to dimension correctly the anchoring surface (such as a wall), guaranteeing stability towards horizontal actions.

To install the cabinet, the client must use four M8 stainless steel 8.8 screws, fasten them by applying the recommended torque for mechanical connections as specified by the manufacturer (see section ["Torque and screw sizing"](#)).

The holes must be drilled according to the dimensions of the drawing. Check that the equipment is correctly leveled, then fix the rear of the cabinet to the wall with four screws. See the anchoring points in the following picture (rear view).



NBPTDDTD002A

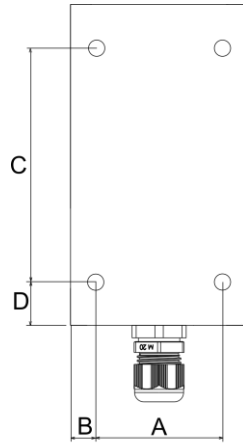
	A	B	C	D	E
mm	725	486	57	12,5	9
in.	28.54	19.13	2.24	0.49	0.35

NOTICE

If installation on pedestal is required, it is the client's responsibility to design the pedestal.

To install the external control box, the client must use four M4 stainless steel 8.8 screws, fasten them by applying the recommended torque for mechanical connections as specified by the manufacturer.

The holes must be drilled according to the dimensions of the drawing. Check that the box is correctly leveled, then fix the rear of the box to the wall with four screws. See the anchoring points in the following picture (rear view).

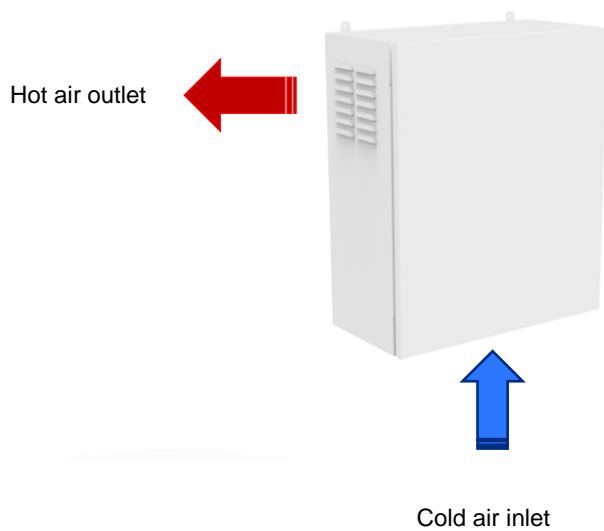


NBPTDDTD007A

	A	B	C	D
mm	71	7	123	15,5
in.	2.79	0.28	4.84	0.61

EN

Ventilation system



CAUTION

Special care must be taken to ensure that there are no external elements near the air inlets and outlets that prevent proper ventilation of the equipment.

6. CABLE ACCESS AND CONNECTIONS

6



WARNING

Before opening any door, the equipment must be completely isolated, without any tension. Make sure to follow the insulation guidelines and all safety instructions indicated in the "[Safety instructions](#)" section. Otherwise, you may get an electric shock. Please use all the indicated PPE. Otherwise, you may get an electric shock.

During the connection, you must ensure the proper cable installation in the terminals of the equipment so that there are no voltage parts accessible in this wiring and the polarity is respected.



CAUTION

To guarantee proper electrical installation, it is very important to comply with the bend radius of the cable. The client must ensure that the trenches are deep enough and consistent with the section "[Site recommendations](#)".



NOTICE

Refer to the recommended tightening torque for mechanical and electrical connections in the "[Torque and screw sizing](#)" section.

Power Electronics is not responsible for damages resulting from an incorrect connection.

The dimensioning of the input power cable of the charging point must be checked by a qualified electrician. The installer is responsible for the correct sizing and execution of the corresponding connections in accordance with the regulatory requirements applicable in the country of installation.

The installer is responsible for choosing and installing the communication cables.

The installer is responsible for the correct sizing and execution of the corresponding ground networks in accordance with the regulatory requirements applicable in the country of installation.

Power, ground, auxiliary and communication cables are not included in Power Electronics' scope.

MATERIAL WITHIN CLIENT'S RESPONSIBILITY:

The following cables and elements are not provided by Power Electronics, they are client's responsibility.

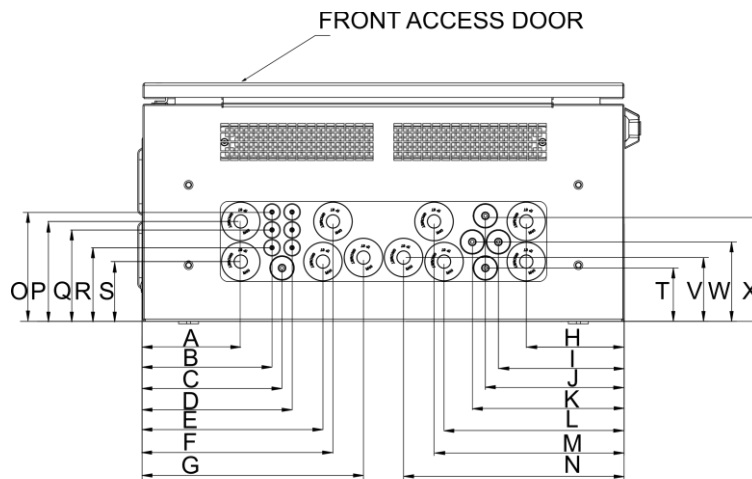
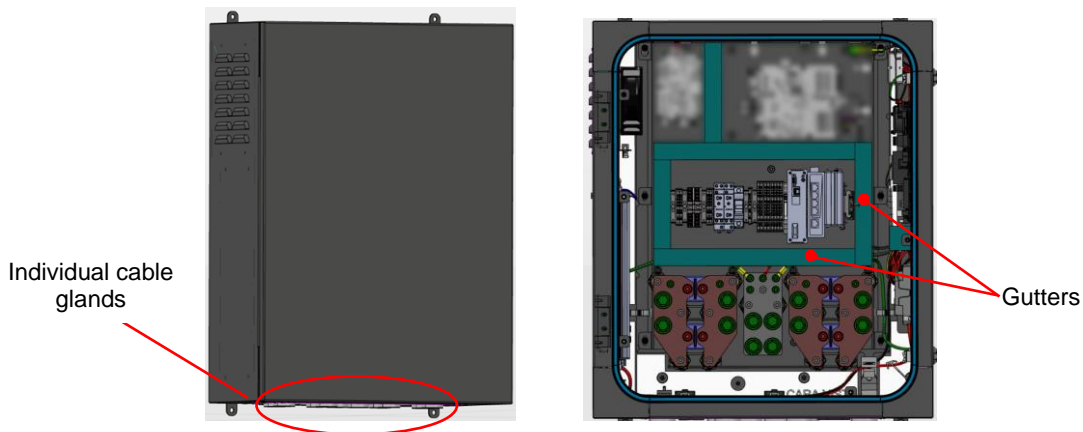
- DC input and DC output power cables and terminal lugs.
- Ground input and output cable and terminal lug to site local ground system.
- Ethernet cable (CAT5e) with RJ45 terminals and multimode optical fiber.
- Auxiliary power supply cables.
- All cable for connecting the pantograph and WI-FI antenna and RFID antenna.

EN

Several factors can influence the choice of cable, including the distance between the distribution board and the power cabinet, the maximum input current, and the installation mode.

Access

Cables must enter in the pantograph cabinet from the bottom plate. Once cables have been inserted, they must be directed towards each corresponding terminal. It is strongly advised to use the gutters for a neat wiring.

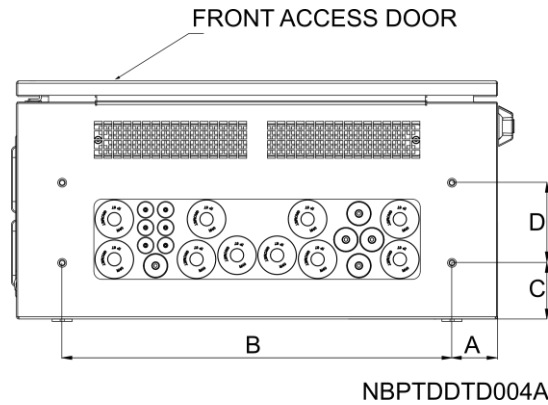


NBPTDDTD003A

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
mm	122	161	173,5	186	224,5	237	275	122	156,8	173	189,3	224,5	237	275
in.	4.84	6.38	6.87	7.36	8.88	9.37	10.87	4.8	6.17	6.81	7.45	8.84	9.33	10.83

	O	P	Q	R	S	T	U	V	W
mm	136,5	124,5	114	91,5	74,5	66,5	79,5	99	139,5
in.	5.37	4.9	4.49	3.6	2.93	2.62	3.13	3.9	5.49

Four inserted nuts are prepared to allow the installation of a protective cover for the power cables. This protection must be installed using four M6 screws. The location of these screws is shown below (bottom-up view).



	A	B	C	D
mm	57	486	70	100
in.	2.24	19.13	2.76	3.94

EN



NOTICE

The client is responsible for designing and installing the protective cover for the power cables.



WARNING

Before connecting the DC (+), DC (-) and PE cables, ensure no voltage is present. Then, remove the protective polycarbonate and perform the connections. Once finished, install back the polycarbonate.

Otherwise, you may get an electric shock.

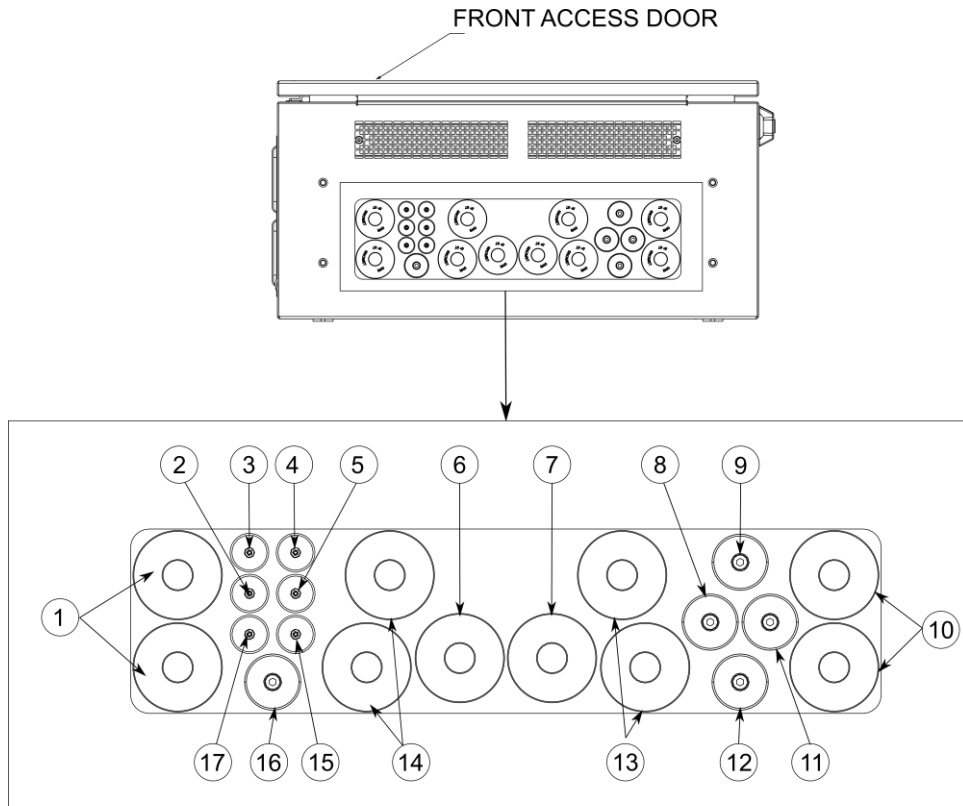


CAUTION

The distance between the cabinet and the pantograph cannot exceed 10 m (32.8 ft), which is the maximum length of the cables that connect both equipment to each other.

Cable access plate

The following images show the standard cable entry plate. Only the amount of cable glands needed for the project must be used. It is configured as follows (bottom-up view).



NBPTDDTC001AI

REF.	DESCRIPTION
1	DC + from power cabinet or NB Station.
2	Ethernet connection.
3	Optical fiber connection.
4	RFID Ethernet network.
5	Power to RFID.
6	PE from power cabinet or NB Station.
7	PE to pantograph.
8	Control supply 24Vdc pantograph.
9	Control pilot.
10	DC – to pantograph.
11	Actuator control (Pantograph signals).
12	Signals from external control box.
13	DC – from power cabinet or NB Station.
14	DC + to pantograph.
15	Spare.
16	Auxiliary power input.
17	Wi-Fi Antenna connection.

Connections

This section details the input and output connections that must be performed in the equipment. There are several factors that can influence the choice of cable, including the distance between the power cabinet or NB Station and the pantograph cabinet, the maximum input current and the installation mode.

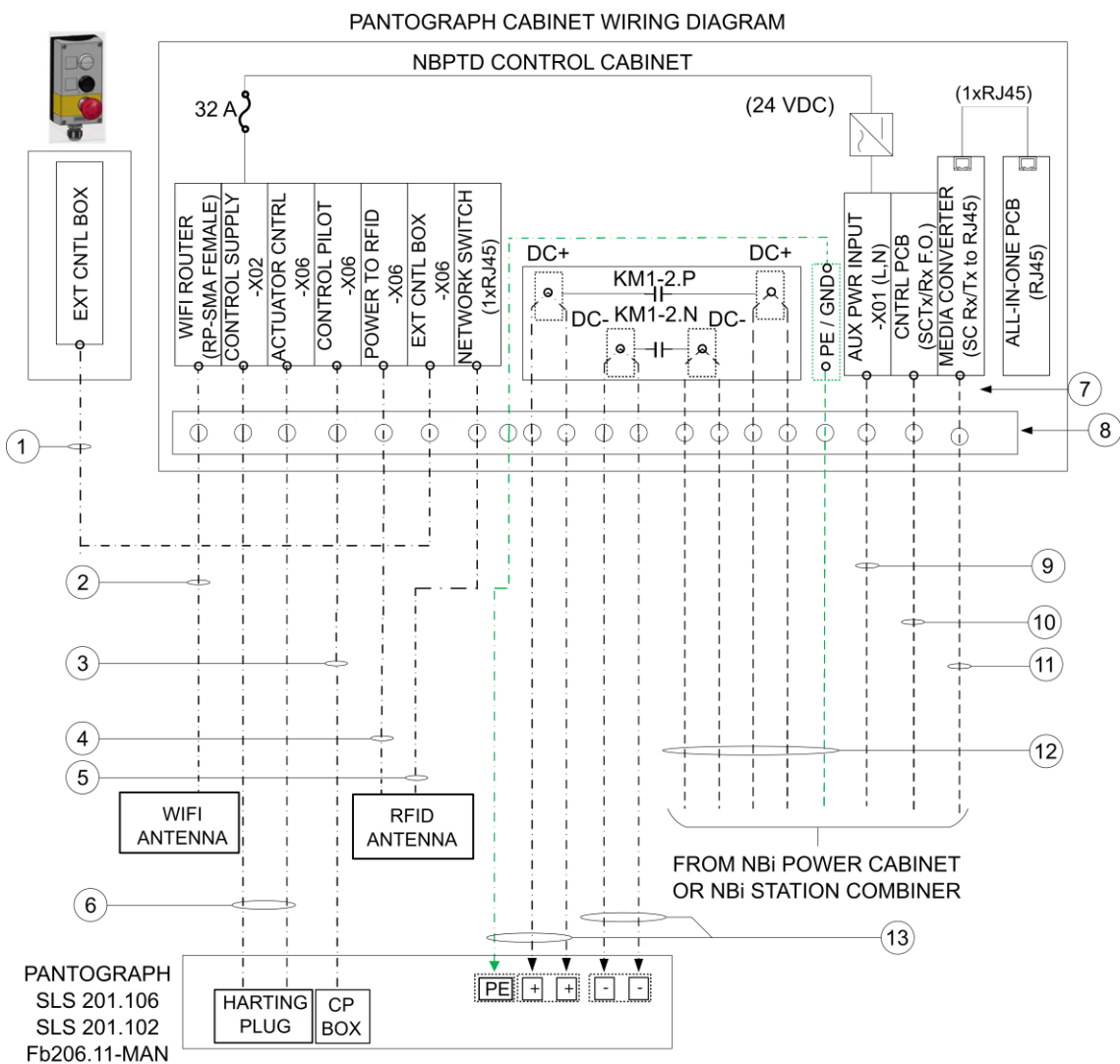
NOTICE

The dimensioning of the cables must be checked by a qualified electrician. The installer is responsible for the correct sizing and execution of the corresponding connections in accordance with the regulatory requirements applicable in the country of installation.

To guarantee proper insulation, it is very important that the cable diameter is within the tolerable range of the cable gland.

As mentioned previously, in section [“Cable access and connections”](#), cables must enter in the pantograph cabinet from the bottom; each cable must be passed through the respective gland, and then be directed towards the corresponding terminal.

The connections between the equipment are shown below.



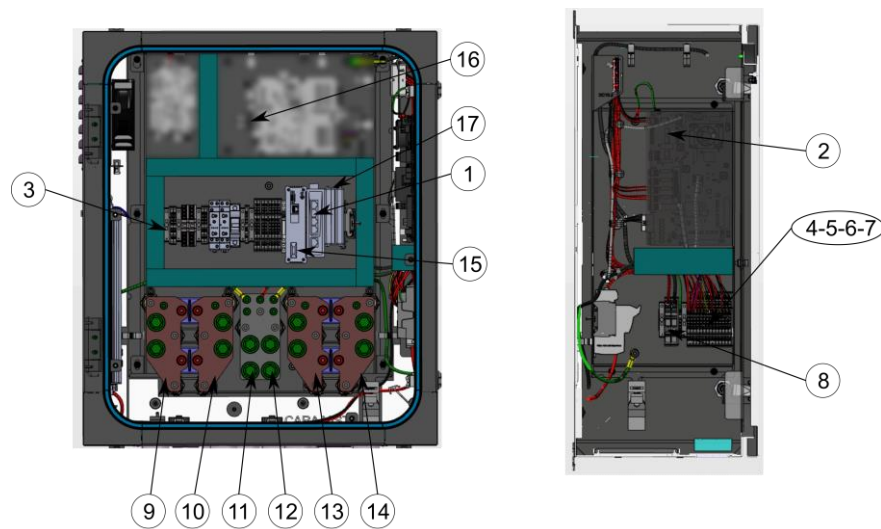
NBPTDDTC003BI



The table below shows the **recommended cable size** for the connections between the equipment. Installer must dimension the wiring taking into consideration the particularities of the project.

REF.	DESCRIPTION	CABLE GLAND REFERENCE
1	EXTERNAL CONTROL BOX 10 x 0,75 mm ² (10 x 18 AWG).	12
2	WIFI ANTENNA Sencity Spot - L (manufactured by Hüber + Suhner) (Optional). COAX CABLE RADOX RF-142 (optional).	17
3	CONTROL PILOT: 2 x 2,5 mm ² (2 X 14 AWG) (Shielded cable).	9
4	RFID ANTENNA ARU 3400 (manufactured by Kathrein) (optional). POWER SUPPLY CABLE 52010358 R-CC3-10DC (optional).	Antenna
5	RFID ETHERNET CABLE 52010360 R-CC3-10-ETH RRU / ARU (optional).	4
6	LINEAR CONTROL ACTUATOR 9 x 0,75 mm ² (9 x 18 AWG). CONTROL 24Vdc SUPPLY 3G2,5mm ² (3G14 AWG).	11-8
7	(2xSC) (2xSC).	-
8	ENTRY GLAND PLATE AND CABLE GLANDS.	-
9	AUXILIARY POWER INPUT. 230 / 277 Vac, 2 x 2,5 mm ² (2 x 14 AWG).	16
10	CHARGE PT. CONTROL INTERFACE (Low Level, Power Control). 2 x Optical fibers (Tx & Rx), Type (GOF) MM / OM3 50 / μm, SC – type connectors.	2-3 (depends on the optional communication).
11	ETHERNET INTERFACE (High Level Communications). 1 x CAT5E / 6, RJ45 Ethernet cable (standard). Optional: fiber upgrade. 2 x Optical fibers (Tx & Rx), type (GOF) MM / OM3 50 / 125 μm, SC – type connectors.	
12	DC CONDUCTORS & LUGS (from power cabinet or NB Station). 2 x Positive, 2 x Negative, single conductor cables, 1000 Vdc rated, 185 mm ² (350 MCM) max conductor size. 1 x PE / GND conductor, 185 mm ² (350 MCM) max conductor size.	1-6
13	DC CONDUCTORS & LUGS (to pantograph power terminals). 2 x Positive, 2 x Negative, single conductor cables, 1000 Vdc rated, 185 mm ² (350 MCM) max conductor size. 1 x PE / GND conductor, 185 mm ² (350 MCM) max conductor size.	10-7

The next figure shows the location of each terminal and its reference, note that this numbering is referenced throughout the document.



NBPTDDTC002A

EN

REF.	DESCRIPTION
1	Ethernet communications (RJ45) to RFID reader.
2	Ethernet communications (RJ45) from the corresponding power cabinet.
3	Auxiliary power input (230 Vac) from the corresponding power cabinet (X01).
4	Actuator control (Pantograph signals) (X06).
5	Control pilot to pantograph (X06).
6	Power supply RFID reader (X06).
7	External signals from external control box (X06).
8	Control supply (X02) to pantograph.
9	DC+ input from the corresponding power cabinet.
10	DC+ output to pantograph.
11	PE input from the corresponding power cabinet.
12	PE output to pantograph.
13	DC- input from the corresponding power cabinet.
14	DC- output to pantograph.
15	Optical fiber communications from the corresponding power cabinet.
16	Optical fiber communications from the combiner cabinet.
17	Wi-Fi antenna connection.

DC input power connections

Input from power cabinet or NB Station.

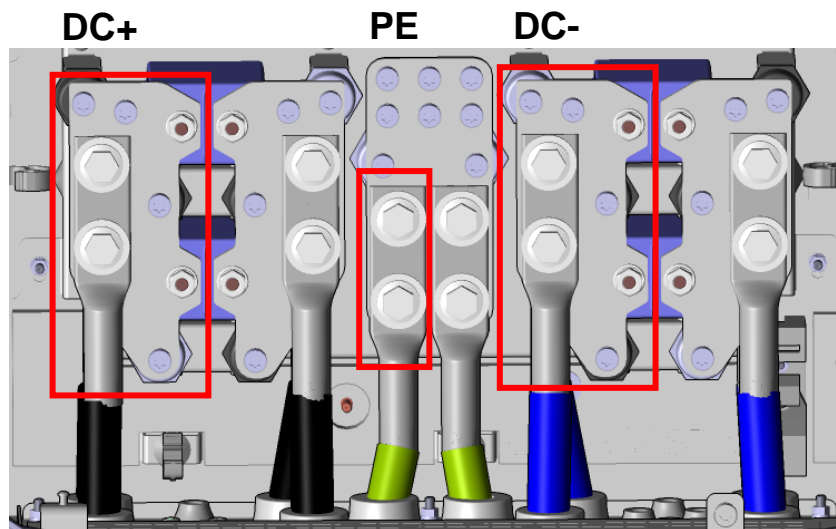
Cable size:

The table below shows the recommended cable size for the connections between power cabinet or NB Station and NBPTD. Installer must dimension the wiring taking into consideration the minimum and maximum diameter, as well as the particularities of the project. It is recommended copper cable 0.6 / 1 kV 90°C.

INPUT POWER SUPPLY					
	RECOMMENDED SECTION	N° CABLES / POLE	CABLE GLAND	MINIMUM DIAMETER	MAXIMUM DIAMETER
DC+	150 / 185 mm ² (300 / 350 MCM)	2	M40 (1-1/2")	19 mm (0.75 in.)	28 mm (1.1 in.)
DC-	150 / 185 mm ² (300 / 350 MCM)	2	M40 (1-1/2")	19 mm (0.75 in.)	28 mm (1.1 in.)
PE	150 / 185 mm ² (300 / 350 MCM)	1	M40 (1-1/2")	19 mm (0.75 in.)	28 mm (1.1 in.)

Connections:

The DC input power connections (DC+/DC-, PE) are directly connected to the M10 Nema 2-hole lug as shown in the following images.

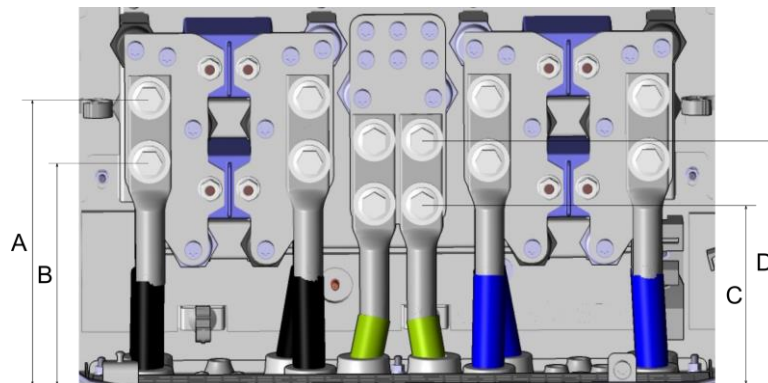


NOTICE

The cable terminals are single / standard crimp barrel length. The installer must consider the bending radius of the input power connections when performing the crimping.

The dimensioning of the input power cable of the charging point must be checked by a qualified electrician. The installer is responsible for the correct sizing and execution of the corresponding connections in accordance with the regulatory requirements applicable in the country of installation

The following picture shows the distances from gland plate to power terminals.

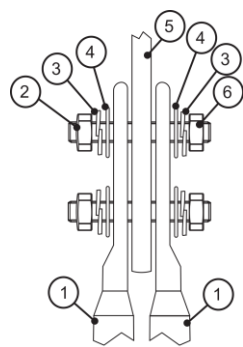
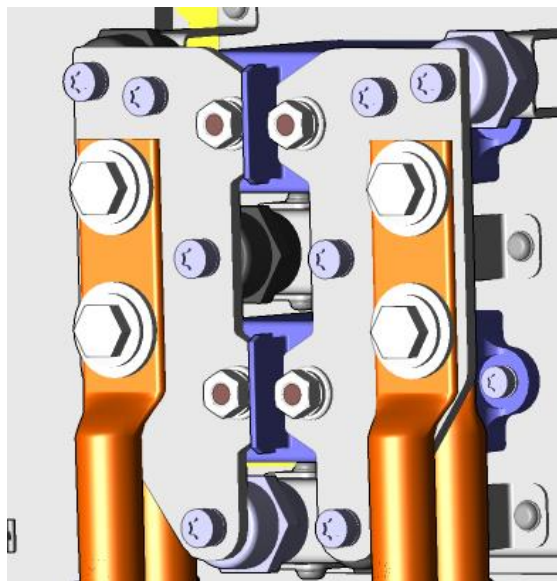


NBPTDDTD008A

	A	B	C	D
mm	203,7	159,3	122	166,5
in.	8.02	6.27	4.8	6.56

EN

The following figure shows the correct connection:



FSITG0089A

REF.	ELEMENT
1	Terminal lug
2	M10 (3/8-16") bolt
3	Spring washer
4	Fender washer
5	Plate
6	M10 (3/8-16") nut

Note: If the terminal is a single-hole terminal, it is recommended to connect it to the upper hole in the busbar, so that the contact area is maximized.

The ground plate is made of tin plated aluminum. The following recommendations must be taken into account for the correct ground connection:

- Before connecting the cable, clean the contact surfaces with a clean cloth and ethanol cleaner. Once cleaned, apply conductive grease.
- It is recommended to use Ø11 mm (7/16") copper, aluminum or copper-clad aluminum terminal lugs with a maximum width of 45 mm (1-3/4").
- Use M10 (3/8-16") bolts and nuts and apply the recommended torque according to the quality (See ["Torque and screw sizing"](#)).
- Use a spring washer and a fender washer between the nuts or bolts head and the busbar or terminal lug.

DC output power connections

Output to pantograph.

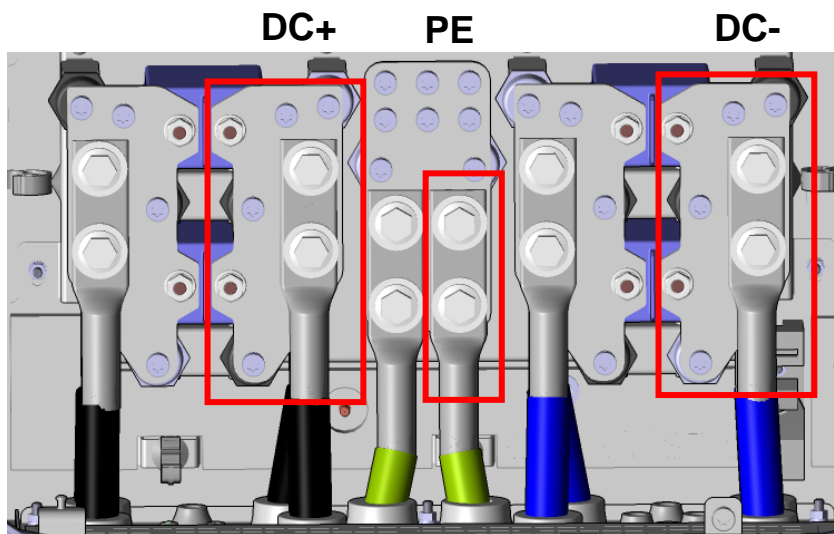
Cable size:

The table below shows the recommended cable size for the connections between NBPTD and pantograph. Installer must dimension the wiring taking into consideration the minimum and maximum diameter, as well as the particularities of the project. It is recommended copper cable 0.6 / 1 kV 90°C.

INPUT POWER SUPPLY					
	RECOMMENDED SECTION	N° CABLES / POLE	CABLE GLAND	MINIMUM DIAMETER	MAXIMUM DIAMETER
DC+	150 / 185 mm ² (300 / 350 MCM)	2	M40 (1-1/2")	19 mm (0.75 in.)	28 mm (1.1 in.)
DC-	150 / 185 mm ² (300 / 350 MCM)	2	M40 (1-1/2")	19 mm (0.75 in.)	28 mm (1.1 in.)
PE	150 / 185 mm ² (300 / 350 MCM)	1	M40 (1-1/2")	19 mm (0.75 in.)	28 mm (1.1 in.)

Connections:

The DC output power connections (DC+/DC-, PE) are directly connected to the M10 Nema 2-hole lug as shown in the following images.

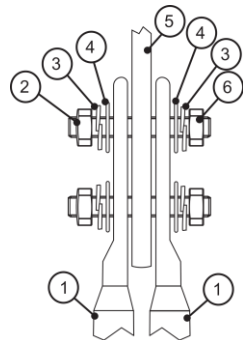
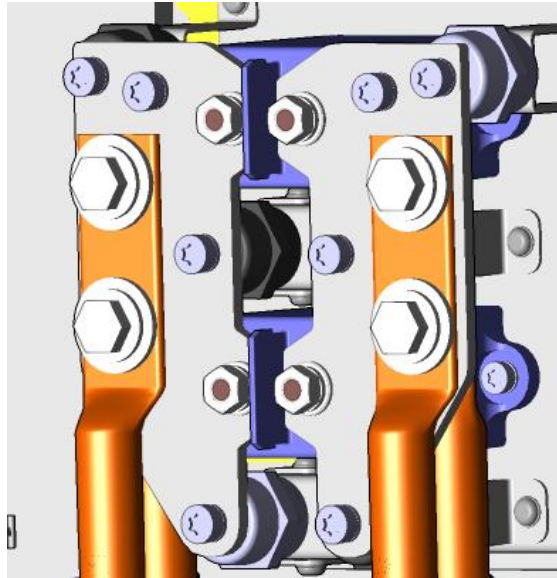


NOTICE

The cable terminals are single / standard crimp barrel length. The installer must consider the bending radius of the input power connections when performing the crimping.

EN

The following figure shows the correct connection:



FSITG0089A

REF.	ELEMENT
1	Terminal lug
2	M10 (3/8-16") bolt
3	Spring washer
4	Fender washer
5	Plate
6	M10 (3/8-16") nut

Note: If the terminal is a single-hole terminal, it is recommended to connect it to the upper hole in the busbar, so that the contact area is maximized.

The ground plate is made of tin plated aluminum. The following recommendations must be taken into account for the correct ground connection:

- Before connecting the cable, clean the contact surfaces with a clean cloth and ethanol cleaner. Once cleaned, apply conductive grease.
- It is recommended to use Ø11 mm (7/16") copper, aluminum or copper-clad aluminum terminal lugs with a maximum width of 45 mm (1-3/4").
- Use M10 (7/16") bolts and nuts and apply the recommended torque according to the quality (See "[Torque and screw sizing](#)").
- Use a spring washer and a fender washer between the nuts or bolts head and the busbar or terminal lug.

Auxiliary power supply

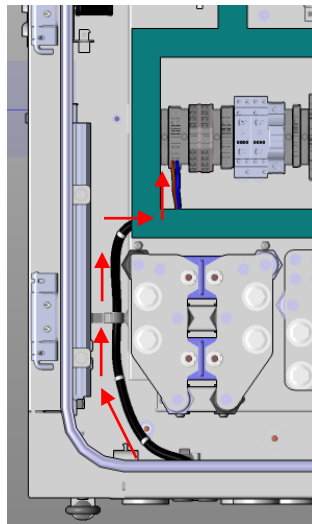
Input from power cabinet or NB Station (230 / 277 Vac 50 Hz).

AUXILIARY POWER SUPPLY (L + N)			
MINIMUM RECOMMENDED SECTION	CABLE GLAND	MINIMUM DIAMETER	MAXIMUM DIAMETER
2 x 2,5 mm ² (2 x 14 AWG)	M25 (1")	9 mm (0.35 in.)	16 mm (0.63 in.)

It is recommended wiring cable 0,6 / 1kV 70°C with 2,5 mm² crimp connectors.

Connections:

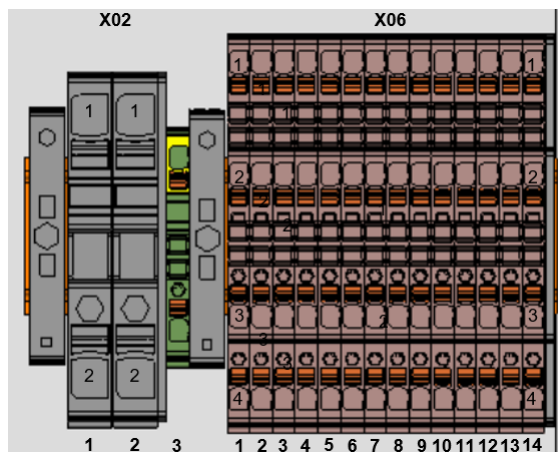
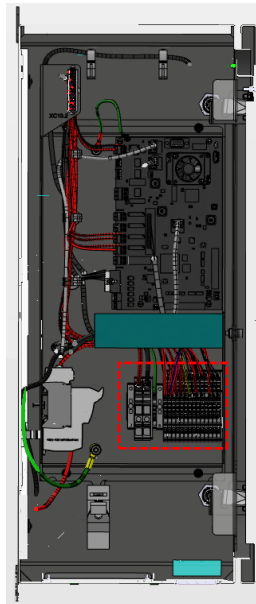
The auxiliary power supply is directly connected to the -X01 terminal block. The following image shows the cable routing and connection.



EN

Pantograph and external control box connections

The following images show the terminal block distribution of the NBPTD. The terminal block is located on the right-side panel.

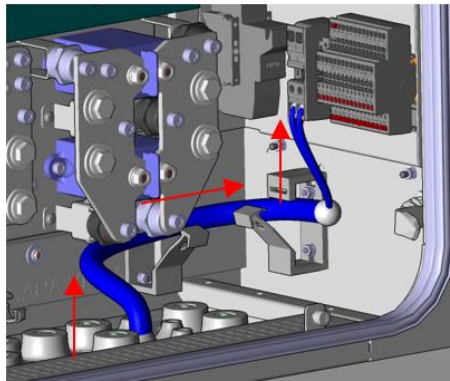


Connections:

The control supply 24 Vdc pantograph is directly connected to the X02 terminal block. The following image shows the cable routing and connection.

24 VDC PANTOGRAPH

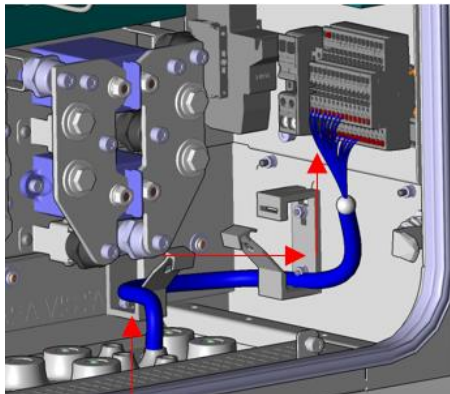
RECOMMENDED SECTION	CABLE GLAND	MINIMUM DIAMETER	MAXIMUM DIAMETER
3G2,5 mm ² (3G14 AWG)	M25 (1")	9 mm (0.35 in.)	16 mm (0.63 in.)



The actuator control (pantograph signals) is directly connected to the X06 terminal block. The following image shows the cable routing and connection.

PANTOGRAPH SIGNALS

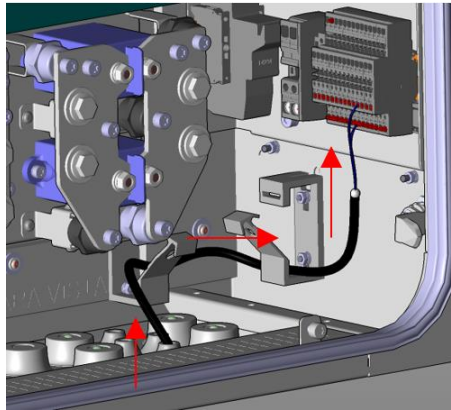
RECOMMENDED SECTION	CABLE GLAND	MINIMUM DIAMETER	MAXIMUM DIAMETER
9 x 0,75 mm ² (9 x 18 AWG)	M25 (1")	9 mm (0.35 in.)	16 mm (0.63 in.)



EN

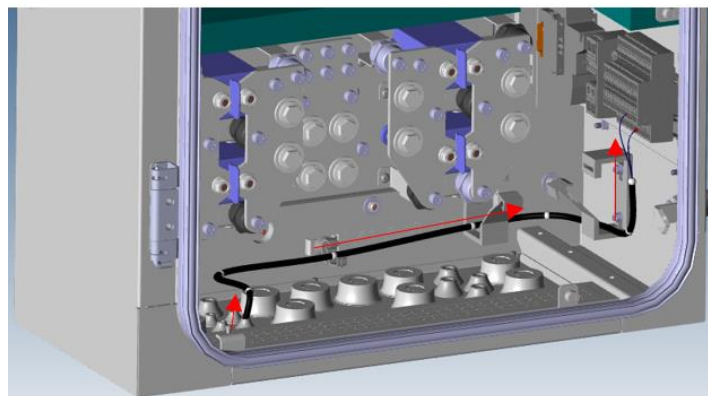
The control pilot is directly connected to the X06 terminal block. The following image shows the cable routing and connection.

CONTROL PILOT			
RECOMMENDED SECTION	CABLE GLAND	MINIMUM DIAMETER	MAXIMUM DIAMETER
2 x 2,5 mm ² (2 x 14 AWG)	M25 (1")	9 mm (0.35 in.)	16 mm (0.63 in.)



The RFID power supply (optional) is directly connected to the X06 terminal block. The following image shows the cable routing and connection. Power Electronics recommends 52010358 R-CC3-10-DC RRU / ARU with M12 female connector and flexibles wires (manufactured by Kathrein).

24 VDC RFID			
RECOMMENDED SECTION	CABLE GLAND	MINIMUM DIAMETER	MAXIMUM DIAMETER
2 x 0,75 mm ² (2 x 18 AWG)	M16 (5/8")	3,5 mm (0.13 in.)	10 mm (0.39 in.)



NOTICE

The RFID power supply cable is not included in Power Electronics' scope.

The NBPTD cabinet is compatible with multiple top-down pantographs from different manufacturers. The following tables show the connections to different pantographs.

NOTICE

Consult the Installation manual of the pantograph provided by each manufacturer.

The following tables show the maximum and recommended wire size. **The installer is responsible for choosing the sizing of the cables following the pantograph manufacturer installation manual.**

The following table summarizes the pin connection to the SLS 201.106 pantograph provided by Schunk.

DESCRIPTION	FROM	HARNESS ID	PIN	WIRE SIZE	TERMINAL BLOCK
Request Raise	Harting Connector	Pantograph signals	B1	0,75 mm ² (18 AWG)	X06:4:3
Request Lower			B2	0,75 mm ² (18 AWG)	X06:5:3
Error Ack (DI)			B5	0,75 mm ² (18 AWG)	X06:3:3
Error (DO)			B6	0,75 mm ² (18 AWG)	X06:3:4
+24 V control supply			B7	0,75 mm ² (18 AWG)	X06:1:3
Feedback Raised < max 100 mA DC1			B8	0,75 mm ² (18 AWG)	X06:4:4
Feedback Lowered < max 100 mA DC1			B10	0,75 mm ² (18 AWG)	X06:5:4
0 V / GND			B11	0,75 mm ² (18 AWG)	X06:1:4
Signal cable	CP Box on Pantograph	Control Pilot		2,5 mm ² (14 AWG)	X06:8:3
Grounding / Signal Shield				2,5 mm ² (14 AWG)	X06:8:4
24 V+ RFID (Optional)	RFID Connector	Power Supply RFID	1	0,75 mm ² (18 AWG)	X06:9:3
24 V- / GND RFID (Optional)			2	0,75 mm ² (18 AWG)	X06:9:4
24 V+	Harting Connector	Pantograph Control Supply	A1	2,5 mm ² (14 AWG)	X02:1:2
24 V- / GND			A2	2,5 mm ² (14 AWG)	X02:2:2
PE			GND	2,5 mm ² (14 AWG)	X02:3:2

EN

The following table summarizes the pin connection to the SLS 201.102 pantograph provided by Schunk.

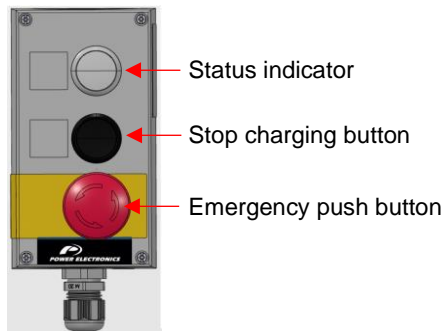
DESCRIPTION	FROM	HARNESS ID	PIN	MAX WIRE SIZE	TERMINAL BLOCK		
+24 V to S1 Mag Sw	Harting Connector	Pantograph signals	3	0,75 mm ² (18 AWG)	X06:1:3		
GND			4	0,75 mm ² (18 AWG)	X06:1:4		
Wait Position			5	0,75 mm ² (18 AWG)	X06:2:3		
Feedback Raised < max 100 mA DC1			6	0,75 mm ² (18 AWG)	X06:4:4		
Feedback Lowered < max 100 mA DC1			7	0,75 mm ² (18 AWG)	X06:5:4		
Request Raise			8	0,75 mm ² (18 AWG)	X06:4:3		
Request Lower			9	0,75 mm ² (18 AWG)	X06:5:3		
GND			10	0,75 mm ² (18 AWG)	X06:2:4		
Signal cable			CP Box on Pantograph	Control Pilot		2,5 mm ² (14 AWG)	X06:8:3
Grounding / Signal Shield						2,5 mm ² (14 AWG)	X06:8:4
24 V+ RFID (Optional)	RFID Connector	Power Supply RFID	1	0,75 mm ² (18 AWG)	X06:9:1		
24 V- / GND RFID (Optional)			2	0,75 mm ² (18 AWG)	X06:9:2		
24 V+	Harting Connector	Pantograph Control Supply	1	2,5 mm ² (14 AWG)	X02:1:2		
24 V- / GND			2	2,5 mm ² (14 AWG)	X02:2:2		

The following table summarizes the pin connection to the Fb206.11-MAN pantograph provided by Stemmann.

DESCRIPTION	FROM	HARNESS ID	PIN	WIRE SIZE	TERMINAL BLOCK
Request Raise	Harting Connector	Pantograph signals	B1	0,75 mm ² (18 AWG)	X06:4:3
Request Lower			B2	0,75 mm ² (18 AWG)	X06:5:3
+24 V control supply			B7	0,75 mm ² (18 AWG)	X06:1:3
Feedback Raised < max 100 mA DC1			B8	0,75 mm ² (18 AWG)	X06:4:4
Feedback Lowered < max 100 mA DC1			B10	0,75 mm ² (18 AWG)	X06:5:4
0 V / GND			B11	0,75 mm ² (18 AWG)	X06:1:4
Signal cable	CP Box on Pantograph	Control Pilot		2,5 mm ² (14 AWG)	X06:8:3
Grounding / Signal Shield				2,5 mm ² (14 AWG)	X06:8:4
24 V+ RFID (Optional)	RFID Connector	Power Supply RFID	1	0,75 mm ² (18 AWG)	X06:9:3
24 V- / GND RFID (Optional)			2	0,75 mm ² (18 AWG)	X06:9:4
24 V+	Harting Connector	Pantograph Control Supply	A1	2,5 mm ² (14 AWG)	X02:1:2
24 V- / GND			A2	2,5 mm ² (14 AWG)	X02:2:2
PE			GND	2,5 mm ² (14 AWG)	X02:3:2

EN

To control the equipment remotely, it is provided with an external control box.

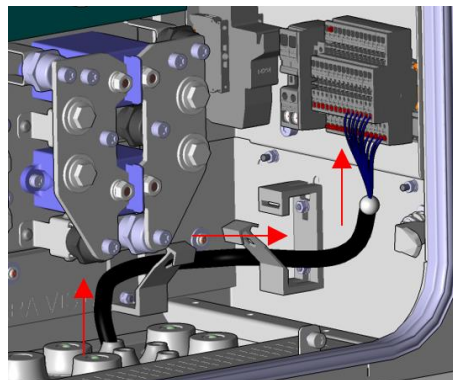


Connections:

The external signals are directly connected to the X06 terminal block. The following image shows the cable routing and connection.

EXTERNAL SIGNALS

RECOMMENDED SECTION	CABLE GLAND	MINIMUM DIAMETER	MAXIMUM DIAMETER
10 x 0,75 mm ² (10 x 18 AWG)	M25 (1")	9 mm (0.35 in.)	16 mm (0.63 in.)



DESCRIPTION	CONNECTION POINT	WIRE SIZE	TERMINAL BLOCK
Emergency Stop	S10:11	0,75 mm ² (18 AWG)	X06:10:3
	S10:12	0,75 mm ² (18 AWG)	X06:10:4
	S10:21	0,75 mm ² (18 AWG)	X06:11:3
	S10:22	0,75 mm ² (18 AWG)	X06:11:4
Start / Stop	S12:13	0,75 mm ² (18 AWG)	X06:12:3
	S12:14	0,75 mm ² (18 AWG)	X06:12:4
LED	H1:X1 Red	0,75 mm ² (18 AWG)	X06:13:3
	H1:X2 Green	0,75 mm ² (18 AWG)	X06:13:4
	H1:X4 GND	0,75 mm ² (18 AWG)	X06:14:4

Communication connection

NOTICE

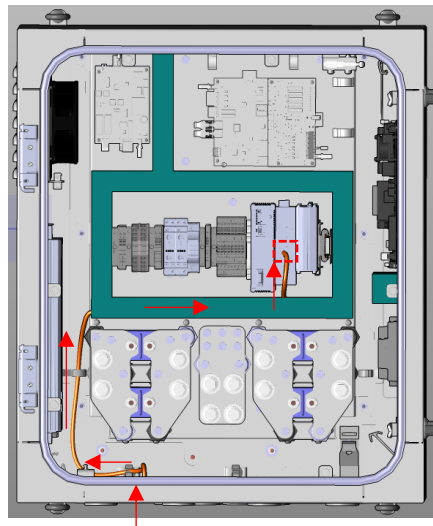
All communication cables are not included in Power Electronics' scope.

Ethernet: Optional external RFID system connection (manufactured by Kathrein.ARU 3400).

- **Recommended cable size:** 52010360 R-CC3-10-ETH RRU / ARU – M12 male connector and RJ45 connector (manufactured by Kathrein) – Switch port 4.
- **Maximum cable diameter:** 9 mm (cable gland M16).

Connection:

The installation of communications cable must be done as follows through the interior of the unit until it reaches the Ethernet switch located on the front panel.



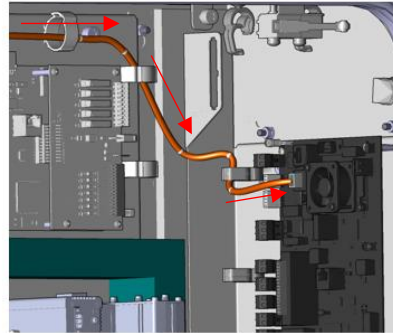
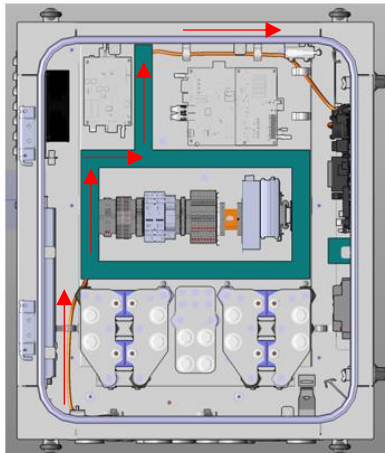
EN

Ethernet: For high level communications protocols.

- **Recommended cable size:** Ethernet CAT 5E UTP - RJ45 connector.
- **Maximum cable diameter:** 9 mm (cable gland M16).

Connection:

The installation of communication cable must be done as follows through the interior of the unit until it reaches the All in one board located on the right-side panel.

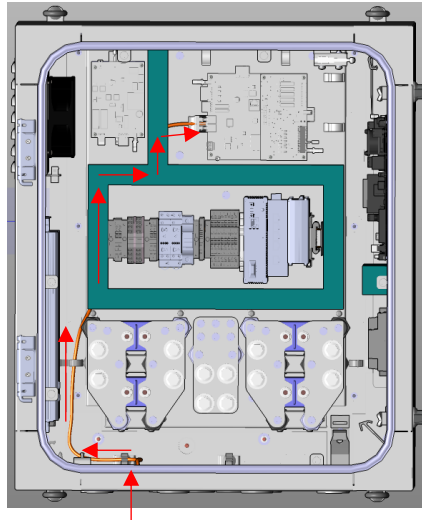


Optional Optical fiber (GOF): Optional High level communications protocols from combiner cabinet.

- **Recommended cable size:** Duplex multi – mode OM3 (50 / 125 micron) 2 x SC Connectors.
- **Maximum cable diameter:** 9 mm (cable gland M16).

Connection:

The installation of communications cable must be done as follows through the interior of the unit until it reaches the DC protocols board located on the front panel.



! NOTICE

This case only applies if the optional Optical Fiber communication has been selected.

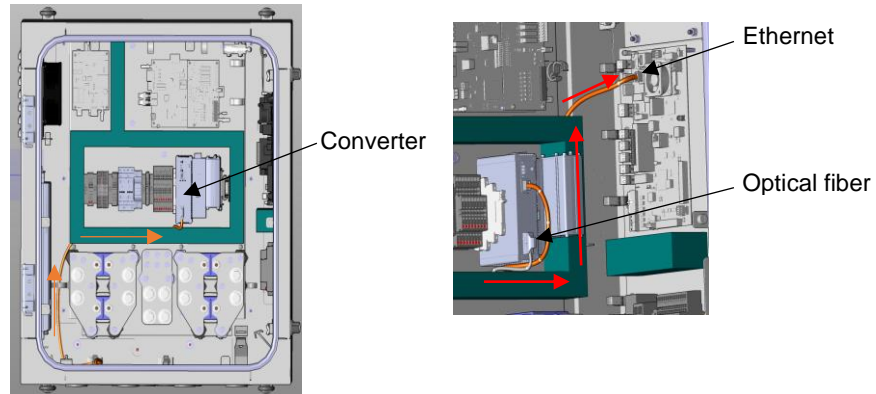
EN

Optional Optical fiber (GOF): Optional for high level communications protocols.

- **Recommended cable size:** Duplex multi – mode OM3 (50 / 125 micron) 2 x SC Connectors.
- **Maximum cable diameter:** 9 mm (cable gland M16).

Connection:

The installation of communication cables must be done as follows, through the interior of the unit until it reaches the OF-Ethernet converter located on the front panel. In this case, the Ethernet cable must be installed as shown below. The orange arrows show the Optical fiber cable routing and the red arrows show the Ethernet cable routing.



NOTICE

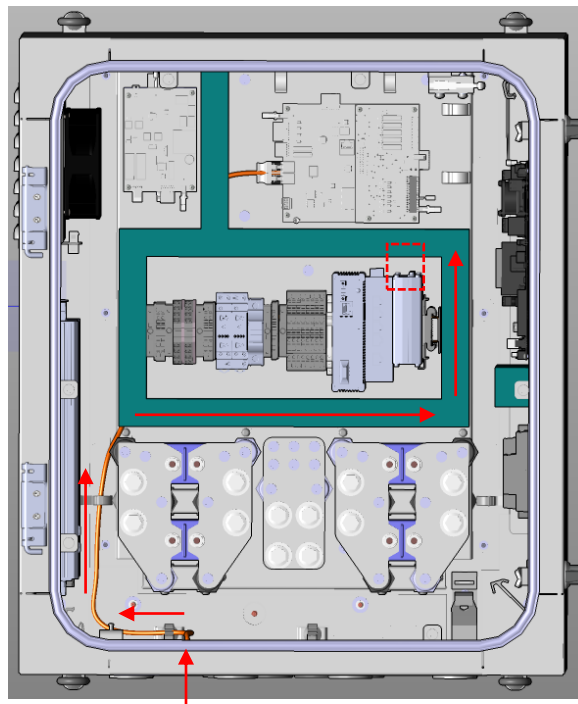
This case only applies if the optional Optical Fiber communication has been selected.

Optional Wi-Fi antenna: The Router contains an input for the connection of the external Wi-Fi antenna (Huber + Suhner Sencity Spot-L).

- **Recommended cable size:** RADOX RF-142 coaxial cable with SMA male connector and N type connector (manufactured by Huber + Suhner).
- **Maximum cable diameter:** 9 mm (cable gland M16).

Connection:

The installation of communication cable must be done as follows, through the interior of the unit until it reaches the router located on the front panel.



EN

7. PROTECTIONS



The equipment is equipped with fuses. The characteristics of the fuses are described in the table below.

	Rated current (I_n)	Nominal voltage (U_n)
AC fuses	32 A	690 Vac
DC fuses	1 A	1000 Vdc



WARNING

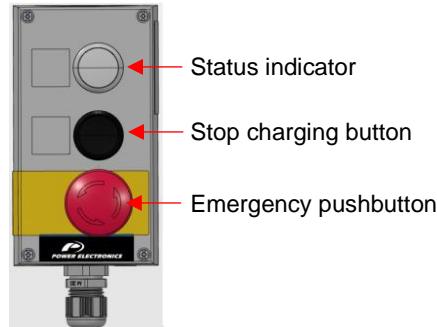
Before opening the pantograph cabinet door, power supply from the Station must be removed. User must open and lock the DC switch disconnectors at the corresponding power cabinet. Refer to the *COMBINER ANNEX* that corresponds with your project for further details. Otherwise, you may get an electric shock.

8. INTERFACE

8

LEDs and controls

The following control elements and indicator can be found in the external control box:



- **Emergency Stop pushbutton:** Allows stopping the equipment in case of an emergency.
- **Start / Stop button:** Allows stopping a charging.
- **Status indicator:** Shows the charger status using a color code.

Possible status and colors of the indicator are as follows:

STATUS	LED	DESCRIPTION
Charging	Green	The communication between the vehicle and the pantograph is correctly working. The equipment is charging.
Failure	Red	There is some failure activated or the equipment is not available.
Available	Off	The charger is in stand-by (no vehicle charging). The pantograph is ready to start the charging process.

NOTICE

Do not use the emergency pushbutton to perform regular stops on the equipment. It should only be used when an emergency occurs. Otherwise, longevity of the main components could be shortened and result in equipment damage.

EN

9. COMMUNICATIONS

9

The equipment requires several communications to work and to interact with the chargers or clients.

Communication wiring connection must be made by the client.



WARNING

Before opening any door, the equipment must be completely isolated, without any tension. Make sure to follow the insulation guidelines and all safety instructions indicated in the "[Safety instructions](#)" section. Please use all the indicated PPE.

Otherwise, you may get an electric shock.

Ethernet communication

There is an Ethernet connection for communication with the main control board of the power cabinet (NBi Station or power cabinet) and the OCPP server. It allows monitoring the state of the charge and perform some actions.

Ethernet communications will be made with CAT 5E UTP cable and RJ45 connector.

Optical fiber communication

The equipment requires, for power regulation, an optical fiber communication between the protocols and FPGA boards from the power cabinet to the pantograph cabinet.

Optical fiber communications between the pantograph cabinet and the power cabinet will be made with two tracks cables (Rx and Tx), both with SC connectors in each side.

The recommended optical fiber is PCF 200 μm .

Wi-Fi

For the correct operation and integration of the pantograph with Power Electronics pantograph cabinet, the recommended Wi-Fi antenna from manufacturer Huber+Suhner (Sencity Spot-L) must be installed. The client is responsible for its installation and must refer to the information provided by the manufacturer.

The equipment is equipped with a Wi-Fi router to facilitate user access to the equipment. This connection requires that the device and the user are connected to the same WI-FI network.

10. LOTO PROCEDURE

10

The aim of the lockout / tagout or LOTO procedure is to protect the user towards unintended reconnections and to avoid risks associated with the control of energy sources.

That is, about isolating, lockout and tagout the dangerous energy sources to avoid accidents / incidents mainly derived from dangerous movements, unexpected energizations or stored energy discharges.

For this, the energy sources must be isolated, locked with the appropriate devices, possible residual energies must be eliminated and, finally, the absence of energies must be verified.



EN



NOTICE

LOCKOUT / TAGOUT (LOTO)

Lockout / tagout standards establish procedures to protect personnel from hazardous energy sources on equipment during service and maintenance.

Lockout/tagout disables equipment from producing hazardous amounts of electrical energy, allowing service and maintenance personnel to safely perform their jobs. Employees must be trained to understand and follow the hazardous energy control procedures.

Use only lockout/tagout devices authorized for particular equipment.

Lockout / tagout devices must be durable, standardized and individual.

PPE is required according to standards while executing LOTO actions. Refer to section "[Safety instructions](#)" for further information and recommendations.



CAUTION

The shutdown of the equipment must only be carried out by personnel qualified. Read these instructions and all safety recommendations carefully. Otherwise, the equipment could get damaged and personnel get seriously injured.

The instructions in this manual do not replace or local or national regulations. It is the user's responsibility to comply with all safety standards that apply at the installation site.

Equipment statuses

Before working with the equipment, it is convenient to define two possible statuses.

NBPTD STATUSES	
STATUS 1	<ul style="list-style-type: none"> • Proper state for carrying the power revision. • Equipment running (no action required from safe stop).
	Check points for absence of voltage: No measuring in Status 1.
STATUS 2	<ul style="list-style-type: none"> • Proper state for carrying out the dead revision. • The equipment is completely stopped, isolated, discharged and locked. • Follow the complete process from “LOTO actions” subsection. Make sure there is no independent auxiliary supply coming from outside the charger.
	Check points for absence of voltage: Follow the complete process.



CAUTION

The absence of voltage must be verified once an equipment has been isolated, with the necessary means and PPE.

In addition, the equipment specific diagrams of the installation should be reviewed.

Even the multimeters have scheduled revisions, it is convenient always to check the multimeter is working fine before taking any measure, especially to prove dead. This might be damaged and show false values. Use a commercial proving unit to check it.

Use appropriate equipment for DC power measures.

It is responsibility of the technical personnel to have their tools calibrated and in good conditions.

Always wear the PPE according to electric risk and to the current Health and Safety regulations.

LOTO actions

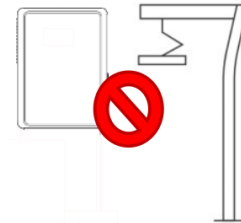
This section shows the LOTO actions that must be carried out, as part of the safety actions, every time the equipment is started or stopped.

It is responsibility of the client to carry out maneuvers at the low voltage facility network and on the post to guarantee a safe scenario for maintenance and operation routines inside the charger.

Follow the indications on "[Commissioning](#)" or "[Safe stop](#)" sections before applying any LOTO action.

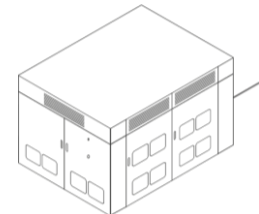
Disconnect the charging process following the safe stop instructions or wait until all charging sessions are finished.

Then, limit the access to the pantograph, so no one can start a new charging process. Ensure to carry out these two actions in all the posts/pantographs included in the project.



Follow the safe stop and LOTO actions for the power cabinet or NB Station and pantograph cabinet.

Verify the disconnectors are locked on that equipment.



To confirm the absence of voltage, please follow the "[check points for absence of voltage](#)".

After all these actions, status 2 is reached on pantograph cabinet.

EN



CAUTION

Auxiliary supply must be disconnected last and connected first when possible.



Electric shock hazard. Auxiliary supply power layout is a characteristic of each plant and may vary from one installation to another. Check the latest electrical schematics of the plant and make sure no voltage is present by confirming with a multimeter.

Before any maintenance operation, verify that **the equipment is completely stopped** before maneuvering any cutting element. This applies to elements with load-breaking capacity (circuit breakers and switches) as well as those with no capacity (disconnectors). **Under no circumstances** any of these components must be **manually** operated when the equipment is energized.

Remove LOTO actions

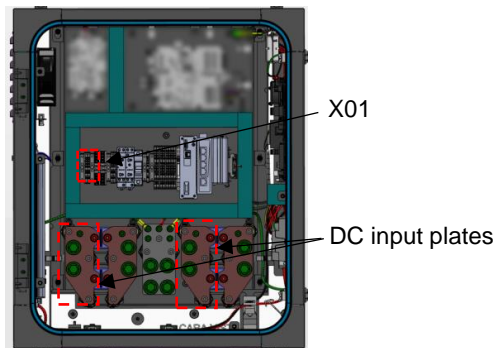
Follow the LOTO actions in the inverse order.

Check points for absence of voltage

Follow this procedure as last LOTO actions to reach status 2 in the equipment.

CHECK POINTS FOR ABSENCE OF VOLTAGE

1. Wear the appropriate PPE based on the electrical arc studies and the risk assessment carried out by the client.
2. Ensure the correct operation of the multimeter.
3. Once the equipment is stopped, wait until the different storage buses are discharged (4 or 5 min).
4. Remove polycarbonate to be able to measure voltage in the power plates.
5. Check that there is no voltage in the DC input plates and X01 terminal block (230 Vac).



6. There will be no voltage in the equipment.

CAUTION

The absence of voltage must be verified once an equipment has been isolated, with the necessary means and PPE.

In addition, the charger specific diagrams of the installation should be reviewed.

Even the multimeters have scheduled revisions, it is convenient always to check the multimeter is working fine before taking any measure, especially to prove dead. This might be damaged and show false values. Use a commercial proving unit to check it.

Use appropriate equipment for DC power measures.

It is responsibility of the technical personnel to have their tools calibrated and in good conditions.

Always wear the PPE according to electric risk and to the current H&S regulations.

EN

11. COMMISSIONING

11



CAUTION

Commissioning may only be carried out by personnel authorized by Power Electronics.

Read these instructions and all safety recommendations carefully. Failure to do so could result in damage to the equipment and serious injury to personnel.

Make sure that no voltage is present at the power terminals. Make sure that no voltage source can be unexpectedly connected.

The instructions in this manual do not replace local or national regulations. It is the responsibility of the user to comply with all applicable safety standards at the installation site.

The following steps describe the process for installing the cabinet and using it for the first time.

Visual inspection: unpackage the equipment and ensure that all components are in good conditions and have not suffered any damage in transit.



Disconnect the external power supply (DC and auxiliary power supply 230 Vac) before starting with the installation.
Check the absence of voltage and open the disconnecter at the NB Station or power cabinet.



Perform the anchoring of the equipment:
Make the holes according to the measurements given in the technical drawings.
Check "[Anchoring of the equipment](#)" section.



Make the cable access and connections without voltage, starting by the ground connection.
Make sure connections and tightening torque are correct.
Check "Torque and screw "[Torque and screw sizing](#)" and "[Cable access and connections](#)" sections.



Verify the selectivity of the external protections to the equipment and control parameters.
Provide power to the external power supply and verify boards and power source light up.



Configure the communications (if required).
Check "[Communications](#)" section.



Make sure all doors are properly sealed and locked.



If all previous steps are successful, provide voltage and start the charger.

EN

12. SAFE STOP

12

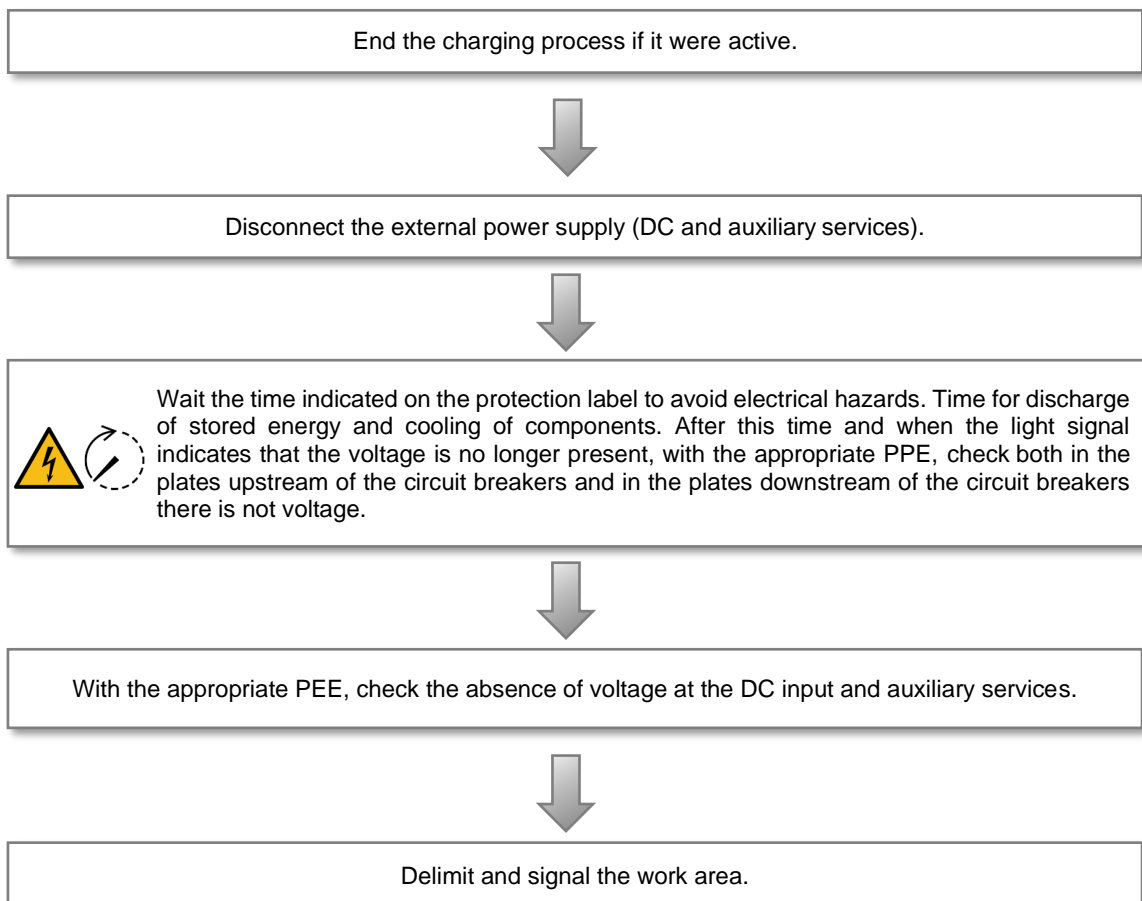


CAUTION

The shutdown of the equipment must only be carried out by personnel qualified. Read these instructions and all safety recommendations carefully. Otherwise, the equipment could be damaged and seriously injured personnel.

The instructions in this manual do not replace or replace local or national regulations. It is the user's responsibility to comply with all safety standards that apply at the installation site.

The following steps describe the process to follow for disconnecting the pantograph and pantograph cabinet.



13. EMERGENCY STOP AND RESTART

13

The following steps must be taken to activate the emergency stop, and subsequent restart, of the equipment:

1. Press the emergency stop pushbutton, located on the front side of the external control box.
2. Verify that the reason for the hazard or emergency has been resolved.
3. Reset the emergency pushbutton manually after verifying that everything is correct.
4. Verify the equipment has been successfully restarted.



NOTICE

Do not use the emergency stop pushbutton to perform regular stops on the charger. It should only be used when an emergency occurs.

Otherwise, longevity of the main components could be shortened and result in equipment damage.

EN

14. MAINTENANCE

14

The NBPTD has been developed based on a revolutionary design concept that significantly simplifies the tasks and reduces preventive and corrective maintenance times. Nonetheless, there are some actions and revisions required.

Equipment statuses

Before detailing the maintenance procedure, it is convenient to define 2 possible statuses to carry out the maintenance tasks. For more information, consult "[Equipment statuses](#)" section.



CAUTION

Maintenance tasks must only be performed by qualified personnel and approved by Power Electronics. Otherwise, the equipment may get damaged, and personnel could suffer severe injuries.

Use the necessary PPE according to the electrical risk and the Health and Safety regulations



WARNING

Before opening any door, be sure to follow insulation guidelines and all safety instructions. Failure to do so may result in electric shock.

Make sure to follow the insulation guidelines and all safety instructions before opening any door or handling the equipment internally. Otherwise, you may get an electric shock.

To carry out maintenance tasks or any activity inside the charger, the user must verify that there is no voltage present in the equipment, as well as carry out the procedure of a [safe stop](#). Always apply the [five golden rules](#) to ensure that there are no dangerous tensions.

In addition to the recommendations given in this manual, local safety procedures and those specific to the installation site must be taken into account. Also, local and national electrical regulations must be followed to avoid personal injury and/or damage to the equipment.

Failure to comply with safety instructions and electrical codes may void the warranty.



NOTICE

For maintenance tasks, open and lock the disconnecter located next to the auxiliary power supply (X1) to remove the 230 Vac supply.

The protective polycarbonate must be kept in place, to ensure isolation from the 1000 V input.

Checklist

The list of tasks detailed below should be carried out annually. The time of each task is an estimate.

MAINTENANCE	TIME
GLOBAL OPERATION TIME	1 h and 30 min

POWER TEST (STATUS 1)		TIME (MINUTES)	OK
1	Environmental conditions – Visual check.	5	
2	Enclosure state – Visual check.	5	
3	Remote access - Connection with a PC.	5	
4	Ventilation system and absence of vibrations - Visual and auditory check.	5	

The following tasks must be performed with the equipment completely off (no voltage at all, stopped, uncharged and isolated):

DEAD TEST (STATUS 2)		TIME (MINUTES)	OK
1	Internal cleaning.	15	
2	Filters - Visual check and replacement.	15	
3	Doors condition.	10	
4	Cables and conductors - Visual and manual check.	10	
5	External and internal tightening torques - Manual check.	10	
6	Control circuit and protections - Manual check.	10	

EN

Power revision (status 1)

1. Environmental conditions

Verify that the equipment environment complies with the specifications. Verify that the humidity is adequate.



CAUTION

This task should be carried out annually. However, it should be done more frequently if climate conditions require so. **This also affects tasks 1 and 2 of the dead revision (state 2).**

Also, in installations with a high level of contamination, it may be necessary to carry out this task more frequently. The review criteria are the following:

- Whenever pruning, mowing, grazing or similar tasks are carried out in the vicinity of the equipment, which may produce the presence of plant or animal debris suspended in the air.
 - When, due to human activities, climatic or biological reasons, the presence of solid remains in the air susceptible to accumulate on the filters is detected in the area. In this case, it will be enough to inspect the equipment that due to their location have been more exposed, and if dirt is detected in them, the inspection will be generalized to the rest of the equipment at the plant.
-

2. Enclosure state

Check the enclosure is in good general state and no traces of corrosion or impacts are present. Check the posts anchoring.

3. Remote access

Verify that the equipment can be accessed remotely. If it exists, verify the connection with a PC.

4. Ventilation system and absence of vibrations

Verify that there are no abnormal noises or oscillations in the ventilation system.

Dead revision (status 2)

1. Internal cleaning

Check that the equipment does not show signs of dust, moisture, oxidation or presence of animals. If dust is found in the control electronics, use a specific vacuum cleaner for electronic boards. Otherwise, the electronic components may be damaged.

2. Filters

Visual inspection of air filters. Use a set of screwdrivers to access the filters and take them off. Check that they are clean and unobstructed. Clean them if they are dirty. It is not necessary to replace the air filters unless they show signs of saturation.

3. Doors condition

Check that each door closes correctly, seals and closures are in good condition. Check hinges, gaskets, closures and doors.

4. Cables and conductors

Visual inspection of cables and terminals. Check the cables are in good condition and sealed. Check that the connectors and terminals are correctly inserted and there are no visual signs of overheating.

5. External and internal tightening torques

Check the accessible connections of the Low Voltage circuit and **retighten correctly only if necessary**. To do so, check that all tightening marks are in place. In the case of small screws that do not have marks, good electrical practice will determine if a screw is loose.

Pay special attention to the input connections of the equipment, check the torque and **retighten**.

6. Control circuit and protections

Check if overvoltage protectors are operational.

Visually check the fuses to guarantee they are not blown.

Check the good condition of the control boards, as well as its connections.



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