ADDENDUM #2

1.1 PROJECT INFORMATION

A. Project Number: 2026-11230

B. Project Title: BEB On-Route Charging Infrastructure

C. Project Location: STA's Valley Transit Center at 10501 E 4th Ave, Spokane Valley, WA & Liberty Lake Park & Ride at 22501 E Mission Ave, Liberty Lake, WA

D. Agency: Spokane Transit Authority

1.2 NOTICE TO BIDDERS

A. The following clarifications, changes, additions, and/or deletions are considered as Addendum #2 and are hereby made a party of the contract documents. All bidders are required to base their bid upon the information furnished in this addendum and as required in the contract documents. The Contractor is required to acknowledge Addendum #2 in their company proposal. Failure to acknowledge addendum on the bid form will result in the bid proposal being declared non-responsive.

B. The Bidder shall acknowledge receipt of this Addendum in the appropriate space on the Bid Form.

C. All communications shall be directed to Haley Wilson as listed in the bid documents at hwilson@spokanetransit.com or by telephone at 509-325-6076.

1.3 CLARIFICATIONS / GENERAL

A. The Unit Price section of the bid form is included to address the potential requirement to repave the parking lot(s) or portions of the lot(s) where STA is planning to detour bus service temporarily during construction. Any additional paving work needed due to detours would be in addition to the awarded contract price and performed as a change order.

1.4 REVISIONS/CLARIFICATIONS TO PLANS AND SPECIFICATIONS SECTIONS

A. See attached change narrative and revised plan from Coffman Engineers dated June 16, 2026.

1.5 QUESTIONS / ANSWERS (from Emails and Phone Calls)

Question 01: *The galvanizing and painting notes on the right side of Sht S001 do not tell me exactly what they want. It says all galvanized surfaces Then it says that the steel frames shall be blasted SSPC SP6 which you wouldn't do if you were painting over galv. The painting note says prime and finish paint but not what type of paints.*

Answer 01: General Notes updated on Sheet S-001. See attached.

Question 02: *Will the Contractor be responsible for all terminations including low voltage at equipment, or will the proprietary equipment vendor be providing the terminations?*
Answer 02: Contractor to make all terminations needed for the equipment.

Question 03: *Sheet VTC_E-601 Note 12 & LLPR_E-601 Note 10 ask to provide conduit and cable per ABB specifications. Although general intent is shown on E-601, could you please clarify conduit/cabling/termination requirements for bidding purposes. The drawings reference the ABB specification; however, the ABB specification is not provided within the bid documents.*
Answer 03: ABB install guides are included for reference. Liberty Lake Park & Ride model is HVC 450 PD. Valley Transit Center model is HVC 300PD Kit.

Question 04: *Please confirm there is no Buy America requirement for this project. LLPR drawings Detail1/E-501, Note 2 and Spec Section 260500 Part 1.2.B have Buy America requirement verbiage.*

Answer 04: Confirmed. The project is funded with state and local dollars, there are no federal funding requirements like Buy America. Contractors should disregard Buy America language on the project's plans and specifications.

ATTACHMENTS:

Pre-Bid Meeting Sign-in Sheet

STA Route 9 BEB Charging Addendum #2 Narrative

STA Route 9 VTC Addendum #2 Plans

ABB Installation Manual for HVC 300PD Kit (FOR REFERENCE ONLY)

ABB Installation Manual for HVC 450PD (FOR REFERENCE ONLY)

Pre-Bid Meeting – 2026-11230 BEB ON-ROUTE CHARGING INFRASTRUCTURE
6-10-26

Spokane Transit
328-RIDE • TTY 456-4327
www.spokanetransit.com

SIGN-IN

PLEASE PRINT. ALL INFORMATION IS OPTIONAL.

		NAME	COMPANY	PHONE & EMAIL
6/10	1	Natic Thomas	GGC	509 570 2449 nthomas@gogreenconcrete.com
6/10	2	Orlando Alvarez	P.I.Electric	Orlandoa@pi-electric.com
6/10	3	Matt Vermeul	Coffman	MATTHEW.VERMEUL@COFFMAN.COM
6/10	4	Siri Ashworth	Walker Construction	509.990.9035 sashworth@walkerconstructioninc.com
6/11	5	Anthony Zarate	Colvico	509-879-9284 azarate@Colvicoinc.com
6/11	6	Maime Lipe	Apex Mechanical	360 6008735 estimating@apexmechanical.org
6/17	7	Casey Lawrence	D-McP Construction	(509) 220-8965 Casey@d-mcpc.com
	8			
	9			
	10			

1.1 VALLEY TRANSIT CENTER ‘VTC’

A. SHEET S-001 – GENERAL STRUCTURAL NOTES

1. Revised: Structural notes to remove galvanizing for steel frames and clarify paint requirements.

END OF ADDENDUM 2

GENERAL STRUCTURAL NOTES

GENERAL:

THE STRUCTURAL CONTRACT DRAWINGS AND SPECIFICATIONS REPRESENT THE FINISHED STRUCTURE. THEY DO NOT INDICATE THE METHOD OF CONSTRUCTION. THE STRUCTURE IS DESIGNED TO BE A STABLE UNIT AS A COMPLETED WHOLE. IT IS THE CONTRACTOR'S RESPONSIBILITY TO DESIGN, ERECT AND INSPECT TEMPORARY SHORES, BRACES, ETC. TO SUPPORT THE STRUCTURE AGAINST ALL ANTICIPATED LOADS INCLUDING GRAVITY, WIND AND LATERAL EARTH PRESSURE UNTIL ITS COMPLETION. OBSERVATION VISITS TO THE SITE BY THE STRUCTURAL ENGINEER SHALL NOT INCLUDE INSPECTION OF THESE METHODS OF CONSTRUCTION.

WORKMANSHIP AND MATERIALS SHALL COMPLY WITH THE EDITIONS OF THE INTERNATIONAL BUILDING CODE AND TESTING STANDARDS ACCEPTED BY THE AUTHORITY HAVING JURISDICTION AND APPLICABLE AT THE TIME THE PROJECT WAS PERMITTED.

NOTES AND DETAILS ON THE DRAWINGS TAKE PRECEDENCE OVER THE GENERAL STRUCTURAL NOTES AND TYPICAL DETAILS. WHERE NOTES AND DETAILS ON DRAWINGS AND THESE GENERAL NOTES AND TYPICAL DETAILS ARE IN CONFLICT WITH THE PROJECT SPECIFICATION, THE MOST STRINGENT SHALL APPLY. WHERE NO SPECIFIC DETAILS ARE SHOWN, CONSTRUCTION SHALL CONFORM TO SIMILAR WORK ON THE PROJECT SUBJECT TO REVIEW BY THE ENGINEER. "TYPICAL" DETAILS ARE NOT FLAGGED ON THE DRAWINGS, BUT APPLY UNLESS NOTED OTHERWISE.

FRAMING MEMBERS WHICH ARE NOT DIMENSIONED SHALL BE ASSUMED EQUALLY SPACED BETWEEN DIMENSIONED POINT OF MEMBERS SUBJECT TO REVIEW BY THE ENGINEER.
DO NOT SCALE DRAWINGS.

COORDINATION:

ALL DRAWINGS ARE CONSIDERED TO BE PART OF THE CONTRACT DOCUMENTS. THE CONTRACTOR SHALL BE RESPONSIBLE FOR COORDINATING THE STRUCTURAL DRAWINGS AND SPECIFICATIONS WITH THE DRAWINGS AND SPECIFICATIONS OF ALL OTHER DISCIPLINES, INCLUDING BUT NOT LIMITED TO ARCHITECTURAL, CIVIL, MECHANICAL, ELECTRICAL, FIRE PROTECTION, AND AMONG THE SUBCONTRACTORS PRIOR TO START OF CONSTRUCTION. ANY DISCREPANCIES SHALL BE BROUGHT TO THE ATTENTION OF THE ENGINEER PRIOR TO START OF CONSTRUCTION. ANY WORK PERFORMED IN CONFLICT WITH THE CONTRACT DOCUMENTS OR ANY APPLICABLE CODE REQUIREMENTS SHALL BE CORRECTED BY THE CONTRACTOR AT THEIR OWN EXPENSE AND AT NO EXPENSE TO THE OWNER OR ENGINEER.

THE CONTRACTOR SHALL VERIFY ALL DIMENSIONS, ELEVATIONS AND SITE CONDITIONS PRIOR TO STARTING CONSTRUCTION. RESOLVE ANY DISCREPANCY WITH THE ENGINEER.

COORDINATION SHALL INCLUDE, BUT NOT BE LIMITED TO, VERIFYING THE LOCATION AND WEIGHT OF ALL MECHANICAL AND ELECTRICAL EQUIPMENT, AS WELL AS, THE SIZE AND LOCATION OF ALL MECHANICAL OPENINGS IN ROOFS, FLOORS AND WALLS. UNLESS OTHERWISE NOTED ON THE DRAWINGS, DO NOT PENETRATE ANY STRUCTURAL ELEMENTS SUCH AS BEAMS, COLUMNS, WALLS, HEADERS, JAMBS, SLABS, ETC. WITHOUT PRIOR WRITTEN APPROVAL OF THE STRUCTURAL ENGINEER.

SEE ARCHITECTURAL DRAWINGS AND PROJECT SPECIFICATIONS FOR THE FOLLOWING:

1. SIZE AND LOCATION OF ALL DOOR AND WINDOW OPENING AND THRESHOLD REQUIREMENTS.
2. SIZE AND LOCATION OF ALL NON-BEARING PARTITION WALLS.
3. SIZE AND LOCATION OF ROOF, FLOOR AND WALL OPENINGS.
4. SIZE AND LOCATION OF DEPRESSED AREAS, CHANGES IN ELEVATION, FLOOR AND ROOF DRAINS, SLOPES, SUMPS, CONCRETE CURBS, LEDGES, PADS AND ISLANDS, CHAMFERS, GROOVES, INSERTS, EMBEDDED ITEMS, FINISH REQUIREMENTS, MISCELLANEOUS STEEL, ETC.
5. DIMENSIONS NOT SHOWN ON THE STRUCTURAL DRAWINGS.
6. EXTERIOR WALL SYSTEMS.

SEE MECHANICAL, PLUMBING, ELECTRICAL AND OTHER SPECIALTY DRAWINGS AND PROJECT SPECIFICATIONS FOR THE FOLLOWING:

1. PIPE RUNS, SLEEVES, HANGERS, TRENCHES, WALL, ROOF AND FLOOR OPENINGS, ETC., NOT SHOWN OR NOTED.
2. ELECTRICAL CONDUIT RUNS, BOXES, OUTLETS IN WALLS AND SLABS.
3. ANCHORAGE AND BRACING FOR ELECTRICAL, MECHANICAL, OR PLUMBING EQUIPMENT TO THE STRUCTURE.
4. ANCHOR BOLTS FOR MOTOR MOUNTS.
5. SIZE, WEIGHT AND LOCATION OF MACHINES AND EQUIPMENT BASES.

SHOP DRAWINGS:

SUBMIT SHOP DRAWINGS FOR STRUCTURAL ENGINEER REVIEW PRIOR TO FABRICATION/ERECTION/INSTALLATION.

THE CONTRACTOR SHALL REVIEW AND APPROVE ALL SHOP DRAWINGS PRIOR TO ENGINEERING REVIEW. ENGINEER'S REVIEW IS ONLY FOR GENERAL CONFORMANCE WITH THE DESIGN CONCEPT OF THE PROJECT AND GENERAL COMPLIANCE WITH THE INFORMATION GIVEN IN THE CONTRACT DOCUMENTS. SUBMIT ELECTRONIC COPY FOR ENGINEERING REVIEW THAT INCLUDES CONTRACTOR'S REVIEW COMMENTS. DOCUMENT WILL BE MARKED AND RETURNED ELECTRONICALLY.

THE CONTRACTOR SHALL ALLOW 2 WEEKS FOR ENGINEER'S REVIEW OF SUBMITTALS. COMMENTS OR MARKS ON SUBMITTALS ARE A NORMAL AND EXPECTED PART OF THE SUBMITTAL PROCESS AND SHALL NOT BE USED AS A BASIS FOR CHANGE ORDERS. TIME REQUIRED TO REVISE AND SUBMIT ANY SUBMITTAL SHALL BE CONSIDERED INHERENT TO THE SUBMITTAL REVIEW PROCESS AND SHALL NOT BE DEEMED A CHANGE ORDER.

RE-SUBMITTALS SHALL HAVE ALL REVISIONS CLEARLY IDENTIFIED WITH DRAWINGS CLOUDS AND REVISION DATES. THE STRUCTURAL ENGINEER SHALL NOT BE RESPONSIBLE FOR THE REVIEW OF ANY UNMARKED REVISIONS.

SHOP DRAWINGS SHALL BE SUBMITTED FOR THE FOLLOWING ITEMS IN ADDITION TO ANY SUBMITTAL REQUIREMENTS SPECIFIED ON THESE PLANS OR IN THE PROJECT SPECIFICATIONS:

1. REINFORCING FOR CMU AND CONCRETE.
2. STRUCTURAL STEEL
3. GROUT
4. POST INSTALLED ANCHORS

SPECIAL INSPECTIONS:

THE OWNER WILL EMPLOY AN ICC CERTIFIED SPECIAL INSPECTOR TO PROVIDE INSPECTION OF REQUIRED ITEMS PER IBC CHAPTER 17 AND THE REQUIREMENTS OF THE APPROPRIATE LOCAL JURISDICTION:

SEE SHEET S-002 FOR SPECIAL INSPECTION TABLES.

CODE:

2021 EDITION OF THE INTERNATIONAL BUILDING CODE.

DESIGN LOADS:

PANTOGRAPH ---------- 1000 POUNDS MAX
ROOF SNOW LOAD---------- SEE SNOW LOADS BELOW
ROOF LIVE LOAD---------- 20 PSF

RISK CATEGORY---------- II

SNOW:

GROUND SNOW LOAD ---------- 39 PSF
FLAT ROOF SNOW LOAD ---------- 30 PSF
SNOW EXPOSURE FACTOR (Ce) ---------- 1.0
SNOW LOAD IMPORTANCE FACTOR (Is) ---------- 1.0
THERMAL FACTOR (Ct) ---------- 1.0
SLOPE FACTOR ---------- 1.0

WIND:

BASIC DESIGN WIND SPEED (V - 3 SECOND GUST) ---------- 100 MPH
ALLOWABLE STRESS WIND SPEED (Vasd) ---------- 85 MPH
EXPOSURE CATEGORY---------- B
DIRECTIONALITY FACTOR ---------- Kd = 0.85
GROUND ELEVATION FACTOR ---------- Ke = 1.00
TOPOGRAPHIC FACTOR ---------- Kzt = 1.00

CONCRETE:

CONCRETE CONSTRUCTION SHALL CONFORM WITH THE LATEST EDITION OF ACI 301, "SPECIFICATIONS FOR STRUCTURAL CONCRETE FOR BUILDINGS" AND ACI 318, "BUILDING CODE REQUIREMENTS FOR REINFORCED CONCRETE", SUBMIT MIX DESIGNS FOR EACH CLASS OF CONCRETE. ALL CONCRETE SHALL BE NORMAL WEIGHT CONCRETE UNLESS NOTED OTHERWISE.

CONCRETE CONTAINING SUPERPLASTICIZING ADMIXTURE SHALL HAVE A SLUMP NOT EXCEEDING 3", TO BE FIELD VERIFIED, PRIOR TO ADDING ADMIXTURE, AND NOT EXCEEDING 8" AT PLACEMENT. ADDITION OF WATER TO A MIX WITH INSUFFICIENT SLUMP WILL NOT BE PERMITTED, EXCEPT AS ALLOWED PER ASTM C494.

MECHANICALLY VIBRATE ALL CONCRETE WHEN PLACED, EXCEPT THAT SLABS ON GRADE NEED BE VIBRATED ONLY AROUND UNDER-FLOOR DUCTS, ETC. CAST CLOSURE POUR AROUND COLUMNS AFTER DEAD LOAD IS APPLIED.

MINIMUM CONCRETE MIX DESIGN REQUIREMENTS SHALL BE AS FOLLOWS:

ITEM	MINIMUM CEMENT CONTENT (SACKS/CY)	28 DAY STRENGTH F'c (PSI)	MAX. SIZE AGGREGATE	AIR ENTR.	MAX. SLUMP
FOOTINGS AND FDN. WALLS	5	3000	1 1/2"	5-7%	3"
EXTERIOR SLAB ON GRADE	5 1/2	4000	1"	5-7%	4"

FOUNDATION:

PRESUMPTIVE ALLOWABLE SOIL BEARING PRESSURE = 2,000 PSF PER IBC TABLE 1806.2. BEAR ALL FOOTINGS ON INORGANIC, UNDISTURBED SOIL OR ON CONTROLLED, COMPACTED FILL.

MASONRY:

MASONRY CONSTRUCTION SHALL CONFORM TO CHAPTER 21 OF THE BUILDING CODE AND TMS 402/602.

HOLLOW CONCRETE MASONRY UNITS SHALL CONFORM TO ASTM C90, MEDIUM WEIGHT, RUNNING BOND. UNIT COMPRESSIVE STRENGTH 2000 PSI.

GROUT SHALL CONFORM TO ASTM C476, 2000 PSI MIN. MECHANICALLY VIBRATE GROUT IN VERTICAL SPACES IMMEDIATELY AFTER POURING. PROVIDE CLEANOUTS IF GROUT POUR HEIGHT EXCEEDS 5'-4". MAXIMUM GROUT LIFT SHALL BE 5'-4". FOR GROUT KEYS LEFT BETWEEN LIFTS, SEE REQUIREMENTS OF THE LATEST EDITION OF "THE SPECIFICATION FOR MASONRY STRUCTURES", SECTION 3.5F. ALL UNITS BELOW GRADE SHALL BE SOLID GROUTED. FOR SELF-CONSOLIDATING GROUT, SEE REQUIREMENTS OF THE LATEST EDITION OF "THE SPECIFICATION FOR MASONRY STRUCTURES", UNO.

CONDUIT OR PIPES SHALL NOT OCCUR IN SAME CELL AS REINFORCING BARS.

SPECIFIED COMPRESSIVE STRENGTH f'm SHALL BE 2000 PSI. SPECIAL INSPECTION IS REQUIRED. VERIFICATION OF THE SPECIFIED COMPRESSIVE STRENGTH SHALL BE IN ACCORDANCE WITH IBC SECTION 2105.

UNLESS NOTED OTHERWISE, PLACE CONTROL JOINTS IN MASONRY WALLS AT A MAXIMUM SPACING EQUAL TO THREE TIMES THE WALL HEIGHT, BUT NOT TO EXCEED 40 FEET, ONE-HALF CONTROL JOINT SPACING FROM BUILDING CORNERS, AND A MINIMUM OF 2'-8" FROM THE INSIDE FACE OF OPENINGS.

VERTICAL REINFORCING (APPLIES UNLESS NOTED OTHERWISE):

PROVIDE (1) #5 BAR IN CENTER OF GROUT AT CENTER OF WALL, CONTINUOUS FULL HEIGHT OF WALL WITH ONE BAR AT ALL CORNERS, INTERSECTIONS, WALL ENDS, BEAM BEARINGS, JAMBS AND EACH SIDE OF CONTROL JOINTS AND AT INTERVALS NOT TO EXCEED 32" OC. LAP SPLICES SHALL BE 52 BAR DIAMETERS UNLESS OTHERWISE SPECIFIED IN THE SPLICE SCHEDULE. DOWEL ALL VERTICAL REINFORCING TO THE FOUNDATION WITH DOWELS TO MATCH VERTICAL WALL OR COLUMN REINFORCING.

HORIZONTAL REINFORCING (APPLIES UNLESS NOTED OTHERWISE):

PROVIDE (1) #5 BAR IN MINIMUM 8" DEEP GROUTED CONTINUOUS BOND BEAM AT 32" OC AND AT BOTTOM OF WALL, TOP OF PARAPET, OR TOP OF FREESTANDING WALL. PROVIDE (2) #5 BARS IN MINIMUM 8" DEEP GROUTED CONTINUOUS BOND BEAM AT ELEVATED FLOOR AND ROOF LINES. PLACE THESE BARS CONTINUOUS THROUGH CONTROL JOINTS AT ROOF AND FLOOR LINES AND WRAP MASTIC TAPE FOR 1'-6" EACH SIDE OF CONTROL JOINT. AT OTHER LOCATIONS, DISCONTINUE HORIZONTAL REINFORCING AT CONTROL JOINTS. PROVIDE BENT BARS TO MATCH HORIZONTAL BOND BEAM REINFORCING AT CORNERS AND WALL INTERSECTIONS IN ORDER TO MAINTAIN BOND BEAM CONTINUITY. LAP SPLICES SHALL BE 52 BAR DIAMETERS UNLESS OTHERWISE SPECIFIED IN THE SCHEDULE. STAGGER ALTERNATE SPLICES A MINIMUM OF 48 BAR DIAMETERS.

REINFORCING STEEL:

DEFORMED BARS: ASTM A615 GRADE 40 FOR #3 AND GRADE 60 FOR #4 AND LARGER.

CLEAR CONCRETE COVERAGE (APPLIES UNLESS NOTED OTHERWISE):

CONCRETE CAST AGAINST AND PERMANENTLY EXPOSED TO EARTH---------- 3"
FORMED CONCRETE EXPOSED TO EARTH OR WEATHER---------- 2"
FROM TOP SURFACE OF SLAB ON GRADE---------- 1½"

WELDING:

WELDING OF REINFORCING STEEL IS PROHIBITED. LAP SPLICES IN CONCRETE: UNLESS NOTED OTHERWISE, LAP SPLICES IN CONCRETE BEAMS, WALLS, SLABS AND FOOTINGS SHALL BE CLASS "B" TENSION LAP SPLICES. STAGGER ALTERNATE SPLICES A MINIMUM OF ONE LAP LENGTH.

PROVIDE BENT CORNER BARS TO MATCH AND LAP WITH HORIZONTAL BARS AT CORNERS AND INTERSECTIONS OF FOOTINGS AND WALLS. SPACING SHOWN FOR REINFORCING BARS ARE MAXIMUM ON CENTERS. ALL BARS PER CRSI SPECIFICATIONS AND HANDBOOK. SECURELY TIE ALL BARS IN POSITION PRIOR TO PLACING CONCRETE.

STRUCTURAL STEEL:

ROLLED SHAPES OTHER THAN WIDE-FLANGE SHAPES,
ALL PLATES, BARS AND RODS---------- ASTM A36, Fy = 36 KSI
TUBULAR STEEL---------- ASTM A500, GRADE B, Fy = 46 KSI

FABRICATION AND ERECTION:

LATEST AISC AND AWS CODES APPLY. FABRICATE AND ERECT IN ACCORDANCE WITH LATEST EDITION OF AISC "SPECIFICATION FOR DESIGN, FABRICATION AND ERECTION OF STRUCTURAL STEEL FOR BUILDINGS". SPLICING OF STRUCTURAL MEMBERS IS NOT PERMITTED UNLESS NOTED ON THE DRAWINGS. ALL BEAMS SHALL BE ERECTED WITH THE NATURAL CAMBER UPWARDS.

WELDING:

ALL WELDING SHALL BE BY CERTIFIED WELDERS HAVING CURRENT EXPERIENCE IN TYPE OF WELD SHOWN ON DRAWINGS OR NOTES. CERTIFICATES SHALL BE THOSE ISSUED BY AN ACCEPTED TESTING AGENCY. ALL WELDING SHALL BE IN ACCORDANCE WITH THE LATEST EDITION OF THE AWS D1.1 "STRUCTURAL WELDING CODE - STEEL" OR ALTERNATE AWS CODES AS APPLICABLE. ALL STRUCTURAL WELDING PROCESSES SHALL MEET THE H2 LOW HYDROGEN CRITERIA OF AWS D1.1 ANNEX I UNLESS OTHERWISE NOTED. USE 70XX ELECTRODES OR EQUIVALENT WIRE. SHOP WELDS AND FIELD WELDS SHALL BE SHOWN ON SHOP DRAWINGS. ALL COMPLETE PENETRATION WELDS SHALL BE TESTED AND CERTIFIED BY AN INDEPENDENT TESTING AGENCY. ALL DEFORMED BAR ANCHORS, DOWEL BAR ANCHORS, AND THREADED STUDS SHALL BE END WELDED PER MANUFACTURER'S RECOMMENDATIONS. HEADED STUDS SHALL BE INSTALLED WITH A STUD WELDING GUN. STICK WELDING WILL NOT BE ALLOWED FOR HEADED STUDS. FLARE BEVEL GROOVE WELDS MUST HAVE AN EFFECTIVE THROAT EQUAL TO THE TOTAL SIZE ALLOWED PER AWS D1.1 FIGURE 5.2 FOR THE CONNECTION AND MEMBERS SIZES SHOWN AT EACH CONDITION. ALL WELDS ON EXTERIOR STEEL SHALL BE SEAL WELDS.

BOLTS:

ALL BOLTS, ANCHOR BOLTS, EXPANSION BOLTS, ETC., SHALL BE INSTALLED WITH STEEL WASHERS. TYPE N BOLTS PER LATEST EDITION OF AISC "SPECIFICATION FOR STRUCTURAL JOINTS USING HIGH-STRENGTH BOLTS" AND SHALL BE PRETENSIONED USING THE "TURN OF THE NUT" METHOD AS DEFINED BY AISC UNLESS NOTED OTHERWISE. SIMPSON BOLTS AND ANCHORS MAY BE SUBSTITUTED WITH AN APPROVED ICC RATED PRODUCT.

PAINT:

STEEL FRAMES ARE TO BE PAINTED IN THE SHOP. COORDINATE COLOR WITH SPOKANE TRANSIT AUTHORITY (OWNER). PROVIDE A THREE-COAT SYSTEM CONSISTING OF ZINC PRIMER, EPOXY INTERMEDIATE, AND ALIPHATIC POLYURETHANE FINISH FOR EXTERIOR STRUCTURAL STEEL EXPOSED TO THE WEATHER. CLEAN SURFACE PRIOR TO BLASTING WITH SOLVENT MEETING THE REQUIREMENTS OF SPPC-SP1 CLEAN ALL VISIBLE OILS AND GREASE. REMOVE ALL SHARP EDGES, WELD SPATTER, AND ROUND FINS. BLAST CLEAN SURFACE FOLLOWING THE REQUIREMENTS OF SPPC-SP6. ONCE BLASTING IS COMPLETE APPLY PRIMER AND TOP COAT.

2

POST-INSTALLED ANCHORAGE:

REBAR
HILTI HIT-RE 500 V3
SIMPSON SET-3G
DEWALT PURE 110+
EXPANSION ANCHORS
HILTI KWIK BOLT TZ2
SIMPSON STRONG-BOLT 2
DEWALT POWER-STUD+SD2

ADHESIVE ANCHORS
HILTI HIT-HY 200 V3
SIMPSON SET-3G OR AT-XP
DEWALT PURE 110+

SCREW ANCHORS
HILTI KWIK KH-EZ
SIMPSON TITEN HD
DEWALT SCREW-BOLT+

ANCHORAGE TO GROUT FILLED CMU

EXPANSION ANCHORS
HILTI KWIK BOLT TZ2
SIMPSON STRONG BOLT 2
DEWALT POWER-STUD+SD1
SCREW ANCHORS
HILTI KWIK KH-EZ
SIMPSON TITEN HD
DEWALT SCREW-BOLT+
ADHESIVE ANCHORS
HILTI HIT-HY 270
SIMPSON SET-3G OR AT-XP (AT-XP CANNOT BE USED FOR ANCHORS IN THE TOP OF THE WALL)
DEWALT AC+100 GOLD
REBAR
HILTI HIT-HY 270
SIMPSON SET-3G

POWDER ACTUATED FASTENERS (SHOT PINS) IN CONCRETE OR GROUT FILLED CMU

HILTI X-U AND X-U 15 (0.157")
SIMPSON PDP SERIES (0.145" MIN)

INSTALLATION AND SPECIAL INSPECTION:

ADHESIVE ANCHORS MUST BE INSTALLED IN CONCRETE AGED A MINIMUM OF 21 DAYS (ACI 318-19 17.2.2) AND IN GROUTED MASONRY THAT HAS REACHED IT'S MINIMUM SPECIFIED COMPRESSIVE STRENGTH. ADHESIVE ANCHORS INSTALLED IN HORIZONTAL OR UPWARDLY INCLINED ORIENTATIONS TO RESIST SUSTAINED TENSION LOADS SHALL BE CONTINUOUSLY INSPECTED DURING INSTALLATION BY AN INSPECTOR SPECIALLY APPROVED FOR THAT PURPOSE BY THE BUILDING OFFICIAL (ACI 318-19 26.13.3.2) PROVIDE SPECIAL INSPECTION FOR ALL MECHANICAL AND ADHESIVE ANCHORS PER THE APPLICABLE BUILDING CODE AND PER THE CURRENT ICC-ES REPORT (IBC 2021 TABLE 1705.3 NOTE B).

ANCHOR CAPACITY IS DEPENDENT UPON SPACING BETWEEN ADJACENT ANCHORS AND PROXIMITY OF ANCHORS TO EDGE OF CONCRETE OR CMU. INSTALL ANCHORS IN ACCORDANCE WITH SPACING AND EDGE CLEARANCES INDICATED ON THE DRAWINGS.

EXISTING REINFORCING BARS IN THE CONCRETE OR CMU STRUCTURE MAY CONFLICT WITH SPECIFIC ANCHOR LOCATIONS. UNLESS NOTED ON THE DRAWINGS THAT THE BARS CAN BE CUT, THE CONTRACTOR SHALL REVIEW THE EXISTING STRUCTURAL DRAWINGS AND SHALL UNDERTAKE TO LOCATE THE POSITION OF THE REINFORCING BARS AT THE LOCATIONS OF THE CONCRETE OR CMU ANCHORS, BY HILTI FERROSCAN, GPR, X-RAY OR OTHER MEANS APPROVED BY ENGINEER OF RECORD. DO NOT CUT REBAR, RELOCATE ANCHOR, OR REDUCE EMBEDMENT WITHOUT WRITTEN APPROVAL BY THE ENGINEER OF RECORD.

THREADED RODS FOR ADHESIVE ANCHORS SHALL BE CLEAN THREADED ROD. FOR USE IN INTERIOR LOCATIONS THREADED ROD TO BE ASTM F1554, GRADE 36. THREADED ROD FOR USE IN INTERIOR APPLICATIONS WITH HILTI ADHESIVE TO CONCRETE AND WITH DEWALT ADHESIVE TO GROUTED MASONRY SHALL HAVE A 0.0002-INCH THICK ZINC ELECTROPLATED COATING COMPLYING WITH ASTM B633 SC 1. THREADED ROD USED AT EXTERIOR CONDITIONS OR WHERE THE ANCHOR IS IN CONTACT WITH PRESERVATIVE-TREATED OR FIRE -RETARDANT-TREATED LUMBER SHALL BE EITHER STAINLESS STEEL OR SHALL HAVE A ZINC COATING. STAINLESS STEEL THREADED RODS SHALL CONFORM TO ASTM A193, GRADE B6, B8, OR B8M FOR SIMPSON ADHESIVE PRODUCTS TO MASONRY AND WITH REBAR TO CONCRETE AND SHALL CONFORM TO ASTM F593 (AISI 304 OR 316) FOR HILTI AND DEWALT ADHESIVE PRODUCTS AND FOR SIMPSON ADHESIVE WITH THREADED ROD TO CONCRETE. ZINC COATING ON THREADED RODS SHALL BE HOT-DIPPED IN ACCORDANCE WITH ASTM A153 CLASS C OR D COATING.

PERMIT SET

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JEFFREY N. MITCHELL — STATE OF WASHINGTON — 47708 — STRUCTURAL ENGINEER — PROFESSIONAL ENGINEER
06.16.2026

ROUTE 9 BEB
ON-ROUTE CHARGING
VALLEY TRANSIT CENTER
10501 E 4th Ave, Spokane Valley, 99206

Spokane Transit Authority
1230 W. Boone Avenue
Spokane, Washington 99201

REV	DATE	DESCRIPTION
2	6/16/26	ADDENDUM 2

PROJ. NO. 2026-11230
DRAWN CEP
CHECKED JNM
DATE 05/27/2026

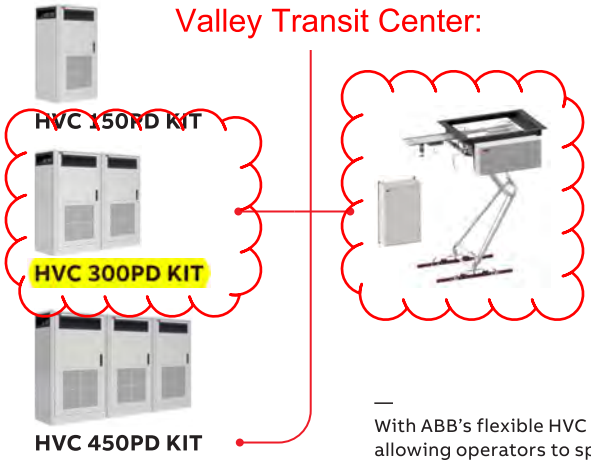
SHEET TITLE:
GENERAL STRUCTURAL NOTES

SHEET NO:
S-001

Opportunity charging 150 kW to 450 kW

A scalable system with future-proof reliability

Charging on existing structure



Charging on route

HVC 150PD

HVC 300PD

HVC 450PD

With ABB's flexible HVC architecture, power capability can be expanded over time, allowing operators to spread out infrastructure investments as their fleet grows.

Technical specifications

Configurations		HVC 150PD	HVC 300PD	HVC 450PD
Maximum output power		150 kW	300 kW	450 kW
Input AC connection		U.S.: 3-phase, 480Y/277 VAC +/- 10 % (60 Hz); Canada: 3-phase, 600Y/347 VAC +/-10% (60 Hz)		
Rated input power		170 kVA	2x 170 kVA	3x 170 kVA
Rated input current		U.S.: 198 A Canada: 168 A	U.S.: 2x 198 A Canada: 2x 168 A	U.S.: 3x 198 A Canada: 3x 168 A
Recommended upstream circuit breaker(s)		1 x 250 A	2 x 250 A	3 x 250 A
Output voltage range		150 – 850 VDC		
Maximum DC output current		250 A	500 A	600 A*
Vehicle connection interface		Inverted crossrail pantograph - OppCharge		
DC connection standard		SAE J3105-1 - IEC 61851-23-1 - ISO 15118		
Environment		Indoor/Outdoor		
Operating temperature		Standard: -10 °C to +50 °C (de-rating characteristic applies); Optional: -35 °C to +50 °C		
Protection		IP54 – IK10 (NEMA 3R)		
Network connection		GSM/3G/4G modem | 10/100 base-T Ethernet		
Compliance and safety		UL 2202: 2018, C22.2 No. 107.1-16, EN 61851-23: 2014, EN 61851-1: 2011, EN 61000-6-3: 2007+A1: 2011		
Dimensions				
Power cabinet (each)	Number of Power Cabinets	1	2	3
	Dimensions (H x W x D)	2030 x 1170 x 770 mm / 79.9" x 46.1" x 30.3"		
	Weight	1340 kg / 2954 lbs		
Charge pole (includes Pantograph & ACM)	Dimensions (H x W x D)	5240 x 1040 x 300 mm / 206.3" x 40.9" x 11.8"		
	Outreach	4670 mm / 183.9" x 30.3"		
	Weight	1706 kg / 3762 lbs		
ACM Control Module KIT	Dimensions (H x W x D)	1600 x1000 x 476.9 mm / 63" x 39.4" x 18.8"		
	Weight	193 kg / 425 lbs		
Pantograph KIT	Dimensions (H x W x D)	(resting position / bolt-hole pattern) 574 x 1300 x 900mm / 22.6"H x 51.2"W x 35.4"D		
	Weight	387 kg / 854 lbs		

* Limited by inverted pantograph contact ratings

ABB E-mobility Inc.
950 W Elliott Road, Suite 101
Tempe, AZ, 85284
United States
Phone: 800-435-7365
E-mail: US-evci@abb.com

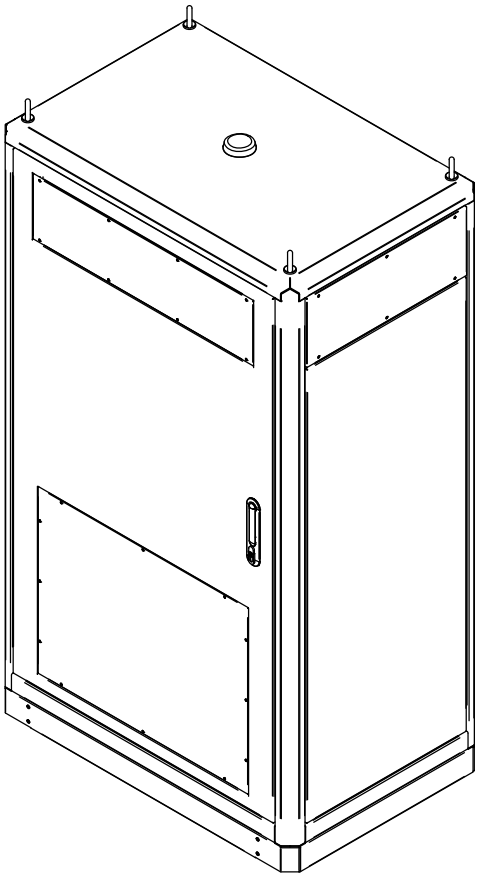
ABB E-mobility Inc.
800 Hymus Boulevard
Saint-Laurent, QC H4S 0B5
Canada
Phone: 800-435-7365
E-mail: CA-evci@abb.com

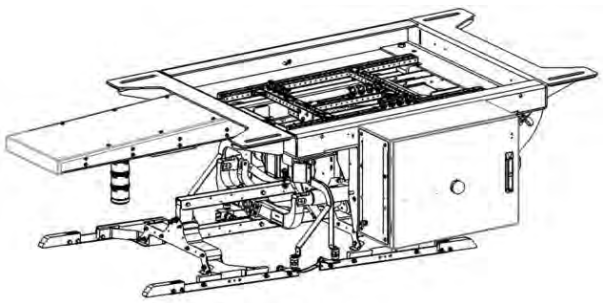
e-mobility.abb.com

9AKK107991A0428F

Installation manual

HVC 150/300 PD Kit (Schunk SLS201.102)





Notice

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Version control

Version	Date	Remarks
001	December 2023	Release
002	February 2024	Update for 300kW version.

Table of Contents

Glossary

AC
Alternating Current.

CAF
Customer Acceptance Form.

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

DC
Direct Current.

GFCI
Ground Fault Circuit Interrupter

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 PD Kit. 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.

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

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 HVC150/300 PD Kit (Schunk SLS 201.102). In this manual, HVC150/300 will be referred to as "HVC150".

The HVC150 PD Kit (Schunk SLS 201.102) is a DC fast charger system for hybrid or electrical buses that are compatible with the OPP Charging standard[1]. It is not permitted to use the HVC150 PD Kit (Schunk SLS 201.102) to charge any other equipment, or to use the HVC150 PD Kit (Schunk SLS 201.102) for any other purposes.
The HVC150 PD Kit (Schunk SLS 201.102) uses high-amperage electric currents. Therefore the installation must be planned carefully, and must be done by certified personnel only (according to local standards[2]). This equipment is intended to be installed in accordance with the National Electrical Code, NFPA 70.

Before installing the HVC150 PD Kit (Schunk SLS 201.102), 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 HVC150 PD Kit (Schunk SLS 201.102), 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 HVC150 PD Kit (Schunk SLS 201.102).

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

[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.

	**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.

	**WARNING** **Pinch Hazard** Identifies a hazard that could result in injuries including the cases in which some body parts may be pinched or crushed.
	**WARNING** **Fall Hazard** Identifies a hazard that could result in injury due unsafe work at height.
	**CAUTION** **Various** Identifies a hazard that could result in damage to the machine, other equipment, and/or environmental pollution.
	**CAUTION** **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.
	**NOTICE** Contains remarks, suggestions or advice.

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 prepare a plan containing instructions on actions to be taken in case of an 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 works.
- All works have to be carried out by qualified personnel. All qualified personnel have to estimate their designated works in order to identify and avoid hazards. They must possess experience and adequate knowledge of: safety regulations and labor medical regulations, accident prevention regulations, guidelines and approved safety regulations, and special instructions concerning possible occurrence of 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

<table>
<tr><td rowspan="2">  </td><td>CAUTION</td></tr>
<tr><td>Heavy equipment
Handling instructions:
1. Use crane or forklift truck when lifting or moving the Power Cabinet and PD Kit construction.
2. Do not drop parts of the HVC150 PD Kit (Schunk SLS 201.102).
3. Do not exceed the tilting angle of 30° while moving or performing works on the Power Cabinet.
4. Read and follow the ABB Guidance on the requirements for safe operation of mobile cranes (ML-03, 9Akk104941D0113).</td></tr>
<tr><td rowspan="2">  </td><td>WARNING</td></tr>
<tr><td>Personal safety (PPE)
Always wear a safety helmet, safety gloves and safety shoes when you perform the work that involves lifting and tilting the equipment.</td></tr>
<tr><td></td><td>WARNING</td></tr>
</table>

	Make sure that personnel cannot be crushed or become trapped during lifting and tilting work.

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 (refer to the guide below).

- It must be carried out within the framework of an effective management system;
- It must be properly planned;
- Its risks have to be assessed;
- Supervision must be performed over it;
- It must be 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** **Hazardous voltage** The HVC150 PD Kit (Schunk SLS 201.102) 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.

1.4.4. Installation safety

	**WARNING** **Personal safety (PPE)** Always wear a safety helmet, safety gloves and safety shoes when you do the lifting and tilting work.
	WARNING

	Visually examine the package for damage. See section Before unpacking on Page 55 and section Before unpacking on Page 83. If there is damage, do not install the system.
	**DANGER** **Hazardous voltage** Instructions: 1. Always switch off the external group switch and the main switch in the cabinet, 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 HVC150 PD Kit (Schunk SLS 201.102). 4. When the system is in an open or dangerous state, do not allow unqualified personnel near it. Instruct and warn people in the vicinity about the potential harmful high voltages. 5. The installation and maintenance personnel must be supplied with their own lighting equipment, since the HVC150 PD Kit (Schunk SLS 201.102) 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 completing installation or service operations.
	**WARNING** Make sure that there is a minimum free space of 1000 mm 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.

	**WARNING** Make sure that there is a minimum free space of 39.37 in in front of the door of the Control Box. Panto Down The minimum space is necessary to allow service personnel to quickly move away from the Control Box if there is an emergency when the door is open.
	**CAUTION** **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.

1.5. Environment and disposal of waste

	**CAUTION**
	Always refer to the local rules and regulations on processing (non-reusable) parts of the HVC150 PD Kit (Schunk SLS 201.102).

1.6. 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 Delftweg 65
2289 BA Rijswijk
The Netherlands

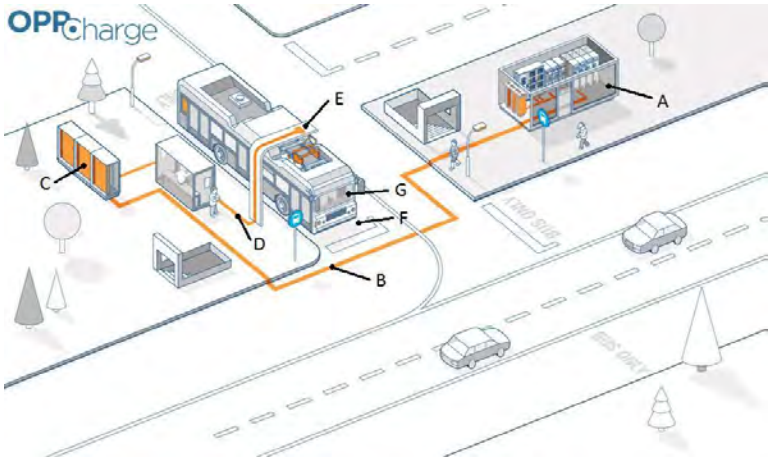
Telephone +31 70 307 62 00

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(s) – 150 kW (HVC 150/300)
D Cables between Power Cabinet and PD Kit in cable conduits
E Pantograph Depot Charger
F Bus stop space for Opportunity Charging (OPP Charge)
G Electric hybrid and/or full electric Bus

The HVC150 PD Kit (Schunk SLS 201.102) 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 150kW. Additional needed components can be ordered separately and are not part of the standard delivery. See section

Accessories on Page 21.

2.1.1. Standard HVC-PD 150/300 kW E-Bus Charger system

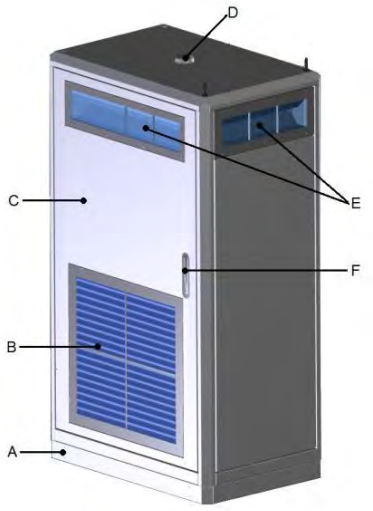
The following parts are provided for this system configuration:
HVC150 PD: HVC150 Primary - ABB6AGC068145 / BAA: ABB6AGC081317
HVC300 PD: HVC150 (Primary + Secondary) - ABB6AGC069046 / BAA: ABB6AGC079436

- HVC150 Primary - 150 kW Power Cabinet[3] - ABB6AGC068145 / BAA: ABB6AGC081317
- HVC150 Secondary - 150kW Power Cabinet[3] - ABB6AGC068146 / BAA: ABB6AGC081322
- 1x PD Kit (ABB6AGCxxxxxx) including:
  - 1x Mounting bracket
  - 1x Control Box Panto Down
  - 1x Schunk SLS 201.102 Pantograph
  - 1x Charge state indicator light
  - 1x WiFi antenna
  - 1x RFID modem
  - Premounted cable set

	NOTICE
	The cables between the Power Cabinet(s) and PD Kit is not part of the order. See section Cable specification list on Page 49 for selecting the right cable type needed between the Power Cabinet(s) and PD Kit.

2.1.2. Power Cabinet

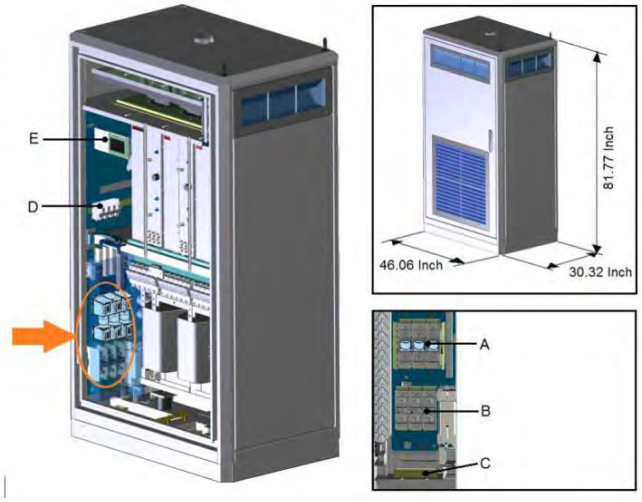
Outside view of the Power Cabinet



A Base cover
B Air outlet
C Door
D 4G Antenna
E Air inlets (also on the left and backside)
F Door handle / lock

[3] For Canada, the HVC 150 CsA (ABB6AGC075925) is delivered. This Power Cabinet is suitable for 600 V AC 3P grid connection.

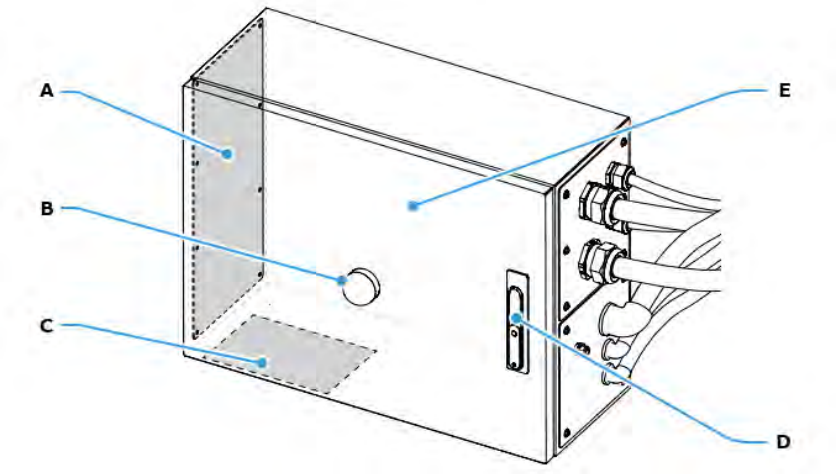
Inside view of the Power Cabinet



A AC Fuses
B AC Power connection
C Guidance plate of the cables
D Data/communication connection
E Display

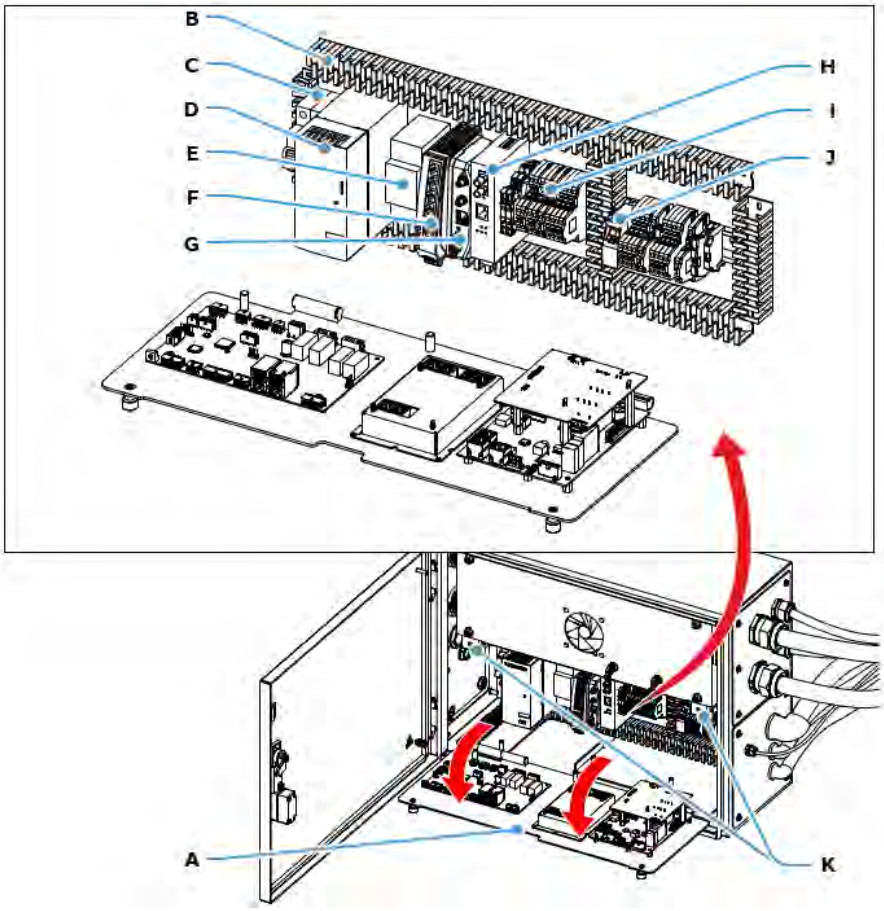
2.1.3. Control Box Panto Down

Outside view of the Control Box Panto Down

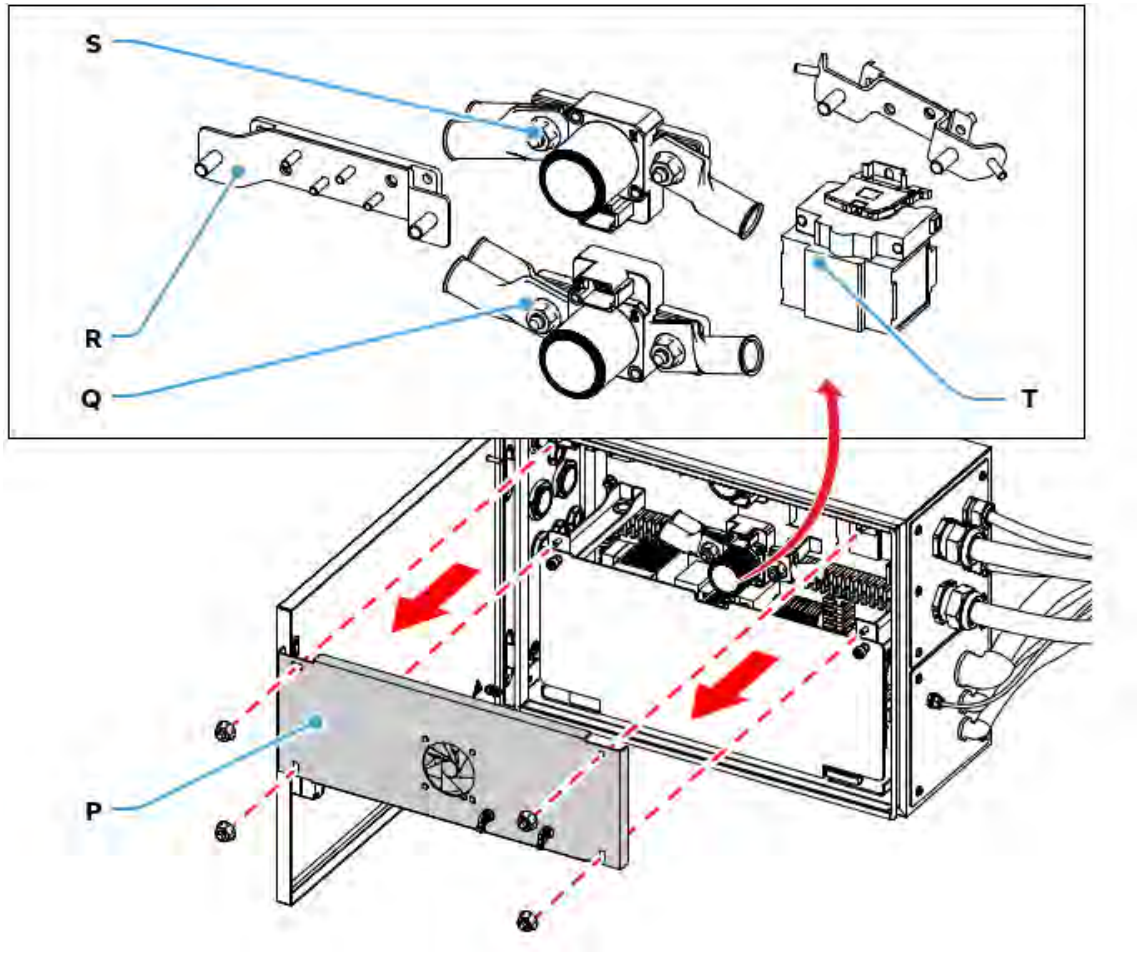


Ref.	Part	Function
A	Input cables sidewall	To Install the Input cable conduits
B	Charging status beacon	To show the EVSE status based on the colours
c	Type plate	To show the identification and technical data of the box
D	Handle lock	To open and close the front door
E	Front door	To access the internal parts of the EVSE

Inside view of the Control Box Panto Down



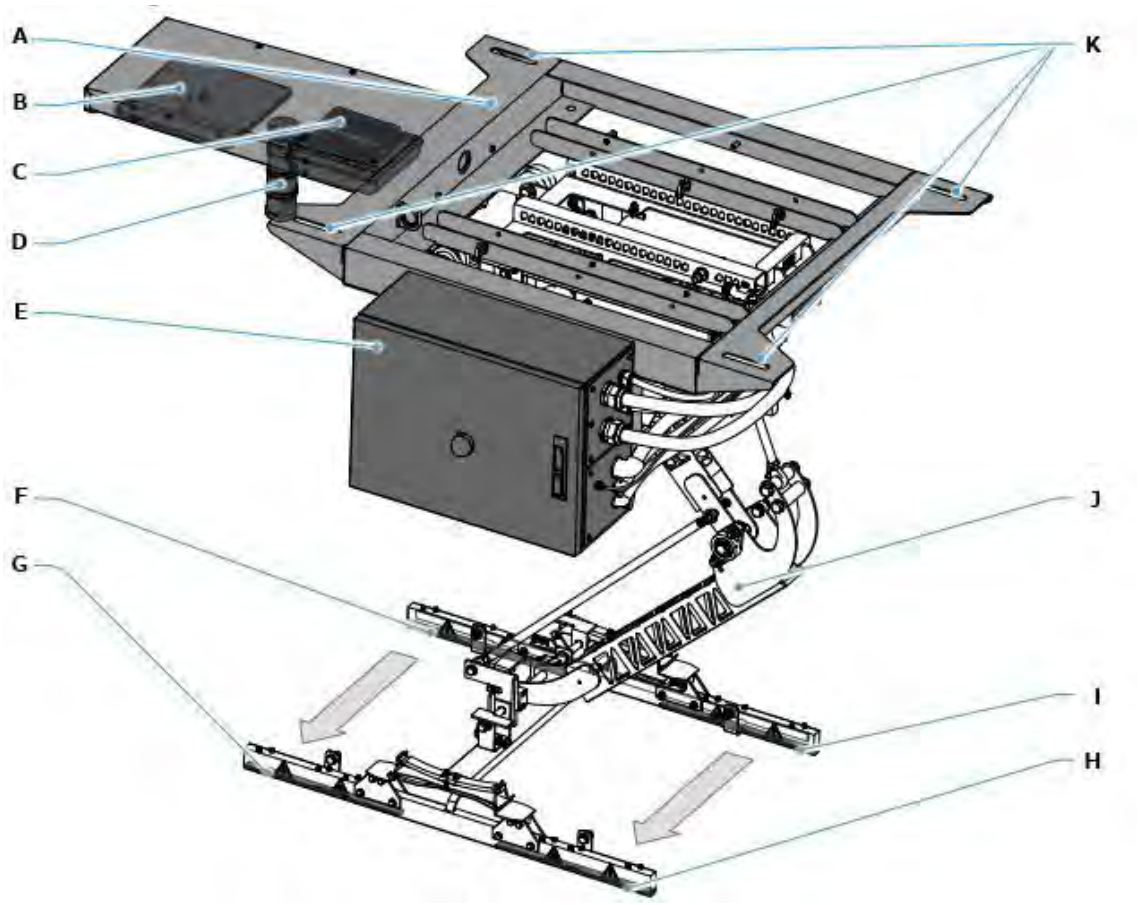
Ref.		Part	Function
A		Internal flip cover	Protection barrier. If opened, It allows access to the internal connection and components
B		Cable conduits	To arrange and protect the cables Inside the box
c	Fl	AC aux. power supply breaker	To turn on/off the PD Control Box depot
D	Gl	24 Vdc power supply	DC SPD protection fuses
E	F2	AC aux. line surge protection device	To connect Interlock, DC guard, Power supply feedback, ext. Emergency button, ext. LED Tower Lights, ext. Charge Stop button
F	U7	Ethernet switch	
G	U5	Wireless modem	To wireless communicate with the EV
H	DI	Ethernet to fiber converter and relay	To convert the communication line from Ethernet to optic fiber
I	X2	Signal screw terminal block	To connect Interlock, DC guard, ext. Emergency button, LED Tower Lights, ext. Charge Stop button
J	X3-2	Ethernet connectors	Standard communication line between Control Box and HVC-200/300/360 power cabinet
K		Internal flip cover fasten points	To lock In place the Internal flip cover



Ref.		Part	Function
P		Internal removable cover	Protection barrier. If removed, it allows access to the Internal connection and components
Q	DC In (-)	Negative input DC busbar	To connect DC negative pole coming from HVC 200/300/360 power cabinet
R	PE In	Protective earth (PE) busbar	Protective earth (PE) coming from HVC 200/300/360 power cabinet
S	DC In (+)	Positive Input DC busbar	To connect DC positive pole coming from HVC200/300/360 power cabinet
T	F3 & F4	DC SPD & fuse	DC output surge protection device and fuse

2.1.4. PD Kit

View of the Pantograph Charger



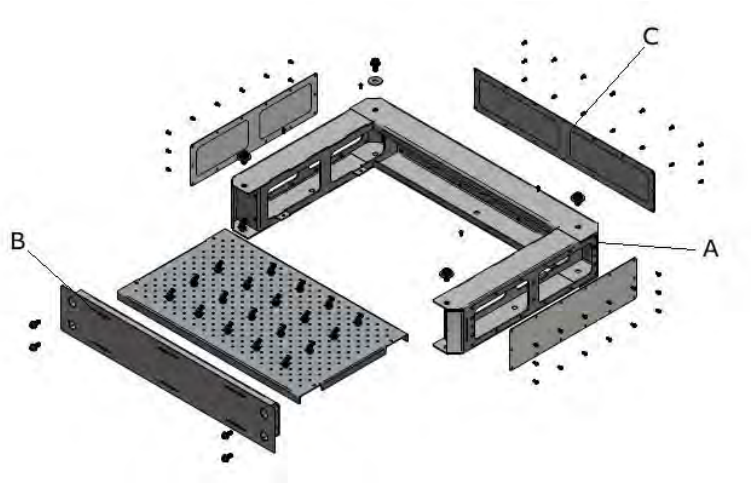
Ref.	Part	Function
A	Depot ceiling bracket	To mount the Pantograph to the depot roof/structure
B	Wireless antenna	Radio antenna
C	RFD unit	Optional device for Radio-Frequency Identification
D	LED tower lights	To show the EVSE status
E	PD Control Box	To connect HVC Power Cabinet and manage the EV charging
F	Protective Earth (PE) contact rail	To perform the contact check (together with the Control Pilot rail) between Pantograph and the EV
G	DC + contact rail	To transfer the current to the EV charging equipment
H	Control Pilot (CP) contact rail	To perform the contact check (together with the PE contact rail) between Pantograph and the EV
I	DC - contact rail	To transfer the current to the EV charging equipment
J	Pantograph	To connect the Electrical Vehicle to the EVSE

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

Metal frame foundation



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. Communication Ethernet cable

The CAN/Ethernet communication between the Power Cabinet and Control Boxes PD is achieved via an Ethernet cable.
If the cable is not supplied by ABB, then gland dimensions listed in section Gland layout of the Control Box Panto Down on Page 89 must be followed. Please note that special precautions should be taken, so that pre-fabricated the cable could pass through the gland (e.g. order cable with M25 gland assembled on it). Another alternative could be to crimp the cable on site after passing through the gland.
Cable length must be defined by the Contractor performing installation during site survey.

Amount	Part number	Description
1	Contact ABB for details	Ethernet (S/FTP, CAT6) with RJ45 connectors

2.2.3. RFID unit

Needed when multiple PD Kits are installed close to each other (distance between each other is lower than 39.37 ft).

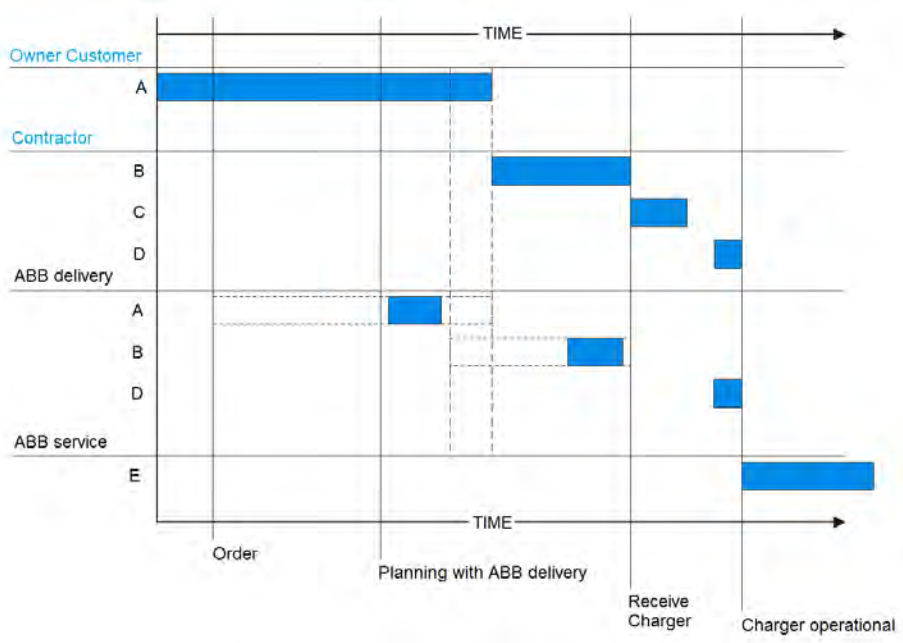
Amount	Part number	Description
1	RFU 630-13101	RFID RFU63x (Sick)
1	SSL-2J04-G10ME (part 6030928)	RFID Ethernet cable 10 m (male connector, M12, 4-pin, straight, D-coded / male connector, RJ45, 8-pin, straight) (Sick)
1	2070427	RFID Power cable 10 m (female connector, M12, 17-pin, straight, A-coded) (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 HVC150 PD Kit (Schunk SLS 201.102) 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 HVC150 PD Kit (Schunk SLS 201.102). In this phase all preparation work must be done before the Contractor can perform the civil and electrical works. See About preparation on Page 24.

B. Construction

The Contractor performs all civil and electrical works. See About construction on Page 37.

C. Placement and Connection

The location is mechanically and electrically ready to receive the HVC150 PD Kit (Schunk SLS 201.102). See About placement and connection on Page 51.

D. Commissioning

The delivery department will bring the HVC150 PD Kit (Schunk SLS 201.102) into operation. See Commissioning preparation on Page 102.

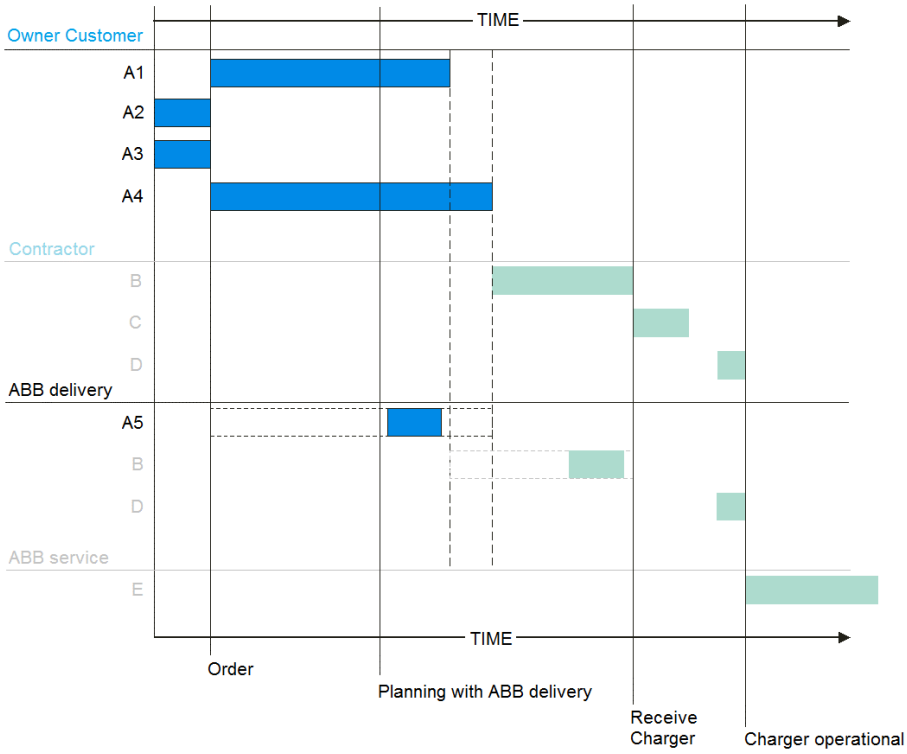
E. Service and Maintenance

The HVC150 PD Kit (Schunk SLS 201.102) is operational. There are various options for service and maintenance. See About Service and Maintenance on Page 105.

3. Preparation

3.1. About preparation

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



A1 **Ordering**
Order the HVC150 PD Kit (Schunk SLS 201.102).

A2 **Engineering**
The Owner / Site Operator selects a Contractor to perform the civil and electrical installation works. The Contractor is responsible for all construction documentation of the site, i.a.: drawings, calculations, certifications, licenses and test reports.
The location of the HVC150 PD Kit (Schunk SLS 201.102) must be selected. See section Location on Page 28 and section Geometry of infrastructure on Page 29.

A3 **Get permits**
Make sure that all the permits required by local regulations had been acquired. See section Permits on Page 25.

A4 **Upgrade grid**
If required, upgrade the electrical grid connection to 3-phase 400 V AC. See section Adapting the grid on Page 26.

A5 **Transport foundation(s) on request**
If it is necessary to order the foundation(s), the transport of the foundation(s) must be arranged with the ABB Delivery department. See *Contact information* on Page 14 for contact.

	NOTICE
	It can take a long time to get the necessary permits and to upgrade the electrical grid. Make sure the plan includes the possible occurrence of resulting delays.

3.2. Permits

The installation of a HVC150 PD Kit (Schunk SLS 201.102) 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 HVC150 PD Kit (Schunk SLS 201.102) requires high current:

- For 150 kW systems:
  - 480/277 V AC 230 A
  - 600/347 V AC 163 A (for Canada version)

A 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 Control Box Panto Down.
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 34.

3.2.2. Construction permit

The installation of the HVC150 PD Kit (Schunk SLS 201.102) requires performing the following actions in regard to construction works:

- Obtaining the necessary work permits.
- Construction of a solid base.
- Placing cable conduits for cable connections between the power distribution board and the Power Cabinet. Usually, these cable conduits are installed below ground.
- Placing cable conduits for cable connections between the Power Cabinet and the Control Box Panto Down.
- Designation of parking spaces for the buses to be charged.
- Placing information signs, on the road or on its side, in order to position the buses in the desired manner.

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

3.2.3. Internet access

The HVC150 PD Kit (Schunk SLS 201.102) requires a connection to the internet. This connection is necessary in order to maintain serviceability and grant remote access to the ABB Service department.
There are two available options for the Internet connection:

- Wireless, which requires coverage to a 3G/4G network at the location. This is the preferred connection. A 3G/4G modem with active SIM card is included with the HVC150 PD Kit (Schunk SLS 201.102) (a customer SIM card is not required).
- Ethernet (RJ45). If there is no 3G/4G 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. Adapting the grid

The HVC150 PD Kit (Schunk SLS 201.102) can be connected directly to the electrical grid or to an existing customer low voltage power distribution cabinet. In both cases a 220 A, 480/277 V AC. For each Power Cabinet (HVC 150) the following requirements apply:

- Fuse (type gG or fast-acting J type) 3 x 300 A AC or 3 phase 285 A Ground Fault Circuit Interrupter (GFCI).
- Main switch.
- GND connected to the main GND rail.
- The components used in the HVC150 PD Kit (Schunk SLS 201.102) 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).

The Control Box PD (part of PD Kit) can be connected directly to the electrical grid or to an existing customer low voltage power distribution cabinet. In both cases a 2.2 A, 120 V AC, 60 Hz, 1P+GND connection is required. For each Control Box PD, the following requirements apply:

- 1 phase 16 A type A (30 mA) Ground Fault Circuit Interrupter (GFCI).
- Main switch.
- GND connected to the main GND rail.

- A TN-S earthing system. Possibly an extra 0.9 Ω earth electrode or local GND is required, consult the grid Owner.
- Specifications of the following parts must be determined by your electrical engineer. They depend on local laws, safety and electrical regulations:
    - UL 1449 Type 1 Surge Protection Device (SPD).
- If circuit breaker is used in distribution cabinet, then specification of inrush current of Dual Depot Charge Box must be taken into account during sizing of protection. Maximum inrush current: 100 A < 5 ms.

3.4. Location

The location of the HVC150 PD Kit (Schunk SLS 201.102) must meet the following requirements:

- The charging system should not be installed in a 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 of installation should not exceed not more than 6561.68 ft above sea level.
- The HVC150 PD Kit (Schunk SLS 201.102) must not be immersed in water, or any other fluid.
- The operational temperature of the HVC150 PD Kit (Schunk SLS 201.102) is between -30 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 HVC150 PD Kit (Schunk SLS 201.102) in areas where there is an explosion hazard. You must provide information about the HVC150 PD Kit (Schunk SLS 201.102) to the fire brigade.
- The protection rating of the housing of the Power Cabinet is IP54 while the Control Box Panto Down is IP65. Both designed for outdoor use.
- The maximum wind speed with which the pantograph can still operate is 44.8 mph (8 Bft).
- It is recommended to provide good lighting around the PD Kit to increase safety and reduce misalignment.
- It is recommended to indicate the maximum drive-through height (177.17in) for other traffic.
- Design and arrange the location around the HVC150 PD Kit (Schunk SLS 201.102) so that the probability of PD Kit and the Power Cabinet being hit by a vehicle is as small as possible. E.g. bollards can be installed (see picture below).

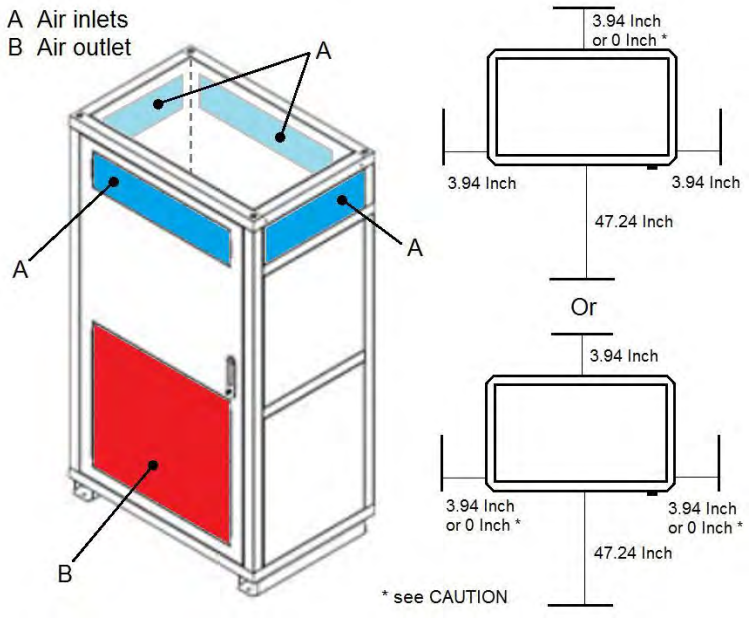
3.5. Geometry of infrastructure

3.5.1. Space required for the Power Cabinet

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

- A cabinet footprint of 46.06 x 30.32in.
- The following free space around the cabinet:
  - 3.94in at the rear side or 0 in at the rear side when both left and right side have a minimum free space of 3.94in.
  - 3.94in or 0in at the left side, if another Power Cabinet is placed next to it.
  - 3.94in or 0in at the right side, if another Power Cabinet is placed next to it.
  - 47.24in 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
	The cabinet needs at least the opening area of the front and rear side with a minimum free distance of 3.94in. This means that cabinets can stand in a row with one or both side entries blocked (distance on left/right side is 0in). It is also possible that the cabinet can stand back to back (distance on the rear side is 0in). In this case both side entries must have a minimum free distance of 3.94in. If this is not the case, then the air supply is not sufficient.



The HVC 150 is equipped with 4 air inlets (A) on all sides of the cabinet and an air outlet (B) at the front to allow airflow inside the cabinet. Do not place any objects that may

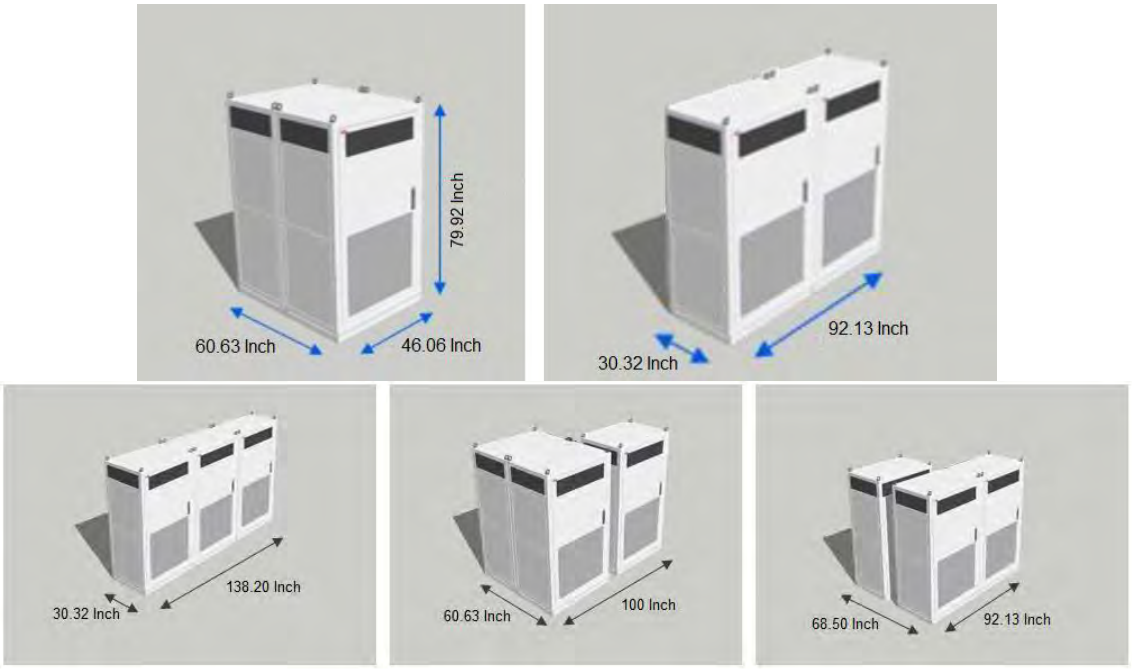
obstruct the airflow near the air inlets or outlet (see also Caution above). If necessary, take precautions to prevent snow, sand or dust from blocking the inlets or outlet.

Specifications for inside installation of the Power Cabinet

- Airflow required for one cabinet = 51206.27 ft^3/h.
- Maximum allowed pressure drop = 300 Pa If the pressure drop of the room is higher than 300 Pa an extra fan should be placed. Contact ABB Sales department (see Contact information on Page 14 for contact details).

3.5.2. Placement of multiple cabinets

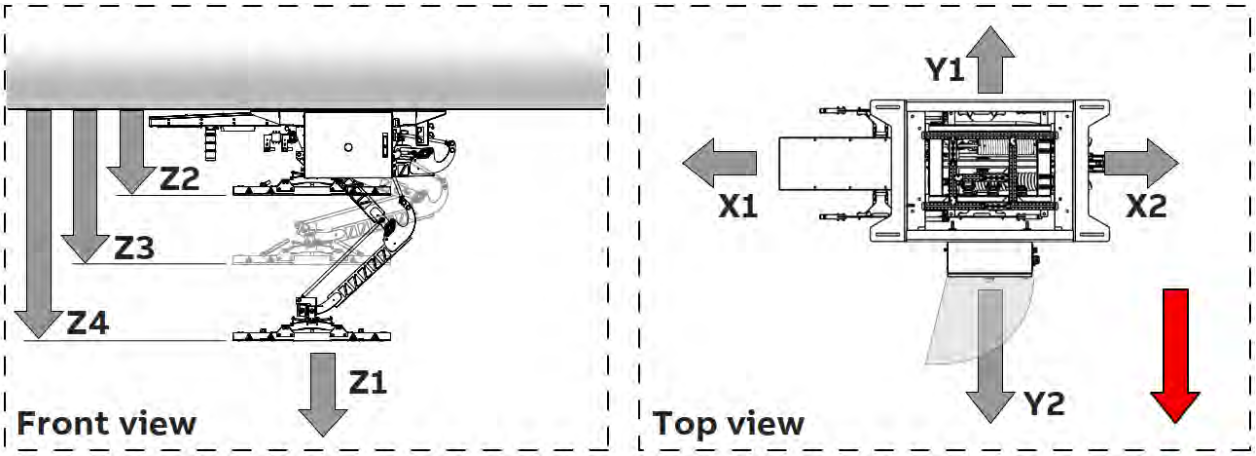
There are some possible configurations for the placement of multiple HVC 150 systems, see picture below.



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 7.87in distance (2x 3.94in) or when the sides are free with 0in distance;
- Door on front side must be kept accessible (recommended 47.24in);
- See also Space required for the Power Cabinet on Page 29.

3.5.3. Space required for the PD Kit



NOTICE
The red arrow indicates the EV travel direction.

Parameter	Description	Specification [mm]
Xl	Space to install/ maintain the equipment	500
X2	Space to install/ maintain the equipment	700
Yl	Space to install/ maintain the equipment	700
Y2	Space to install, open and maintain the equipment	1000
Zl	Space to reach the EV	up to the floor in correspondence of the pantograph
Z2	Height of the contact strips in housed position	688 +-30
Z3	Pantograph upper working position	889
Z4	Pantograph lower working position	2377

NOTICE
The distances are intended as minimum.

3.6. Position of the PD Kit with respect to the bus

The position of the PD kit in relation to the bus is crucial for the physical connection to the charging rails located on top of the bus and ensure the correct operation of the whole charging system.

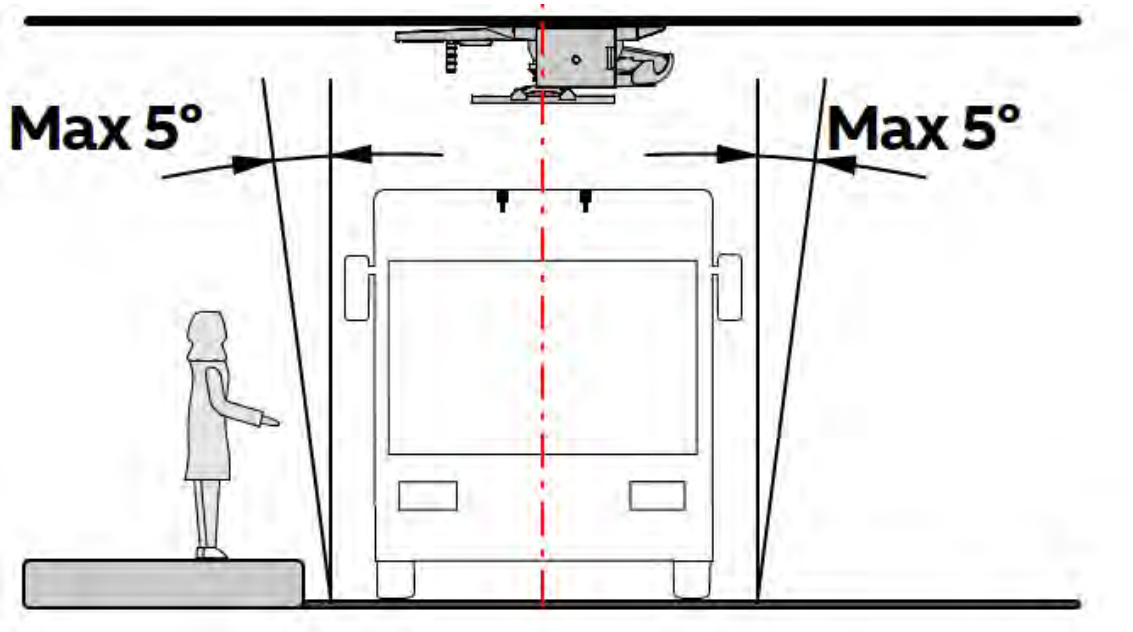
	NOTICE
	The correct positioning of the PD Kit must be evaluated together with ABB E-mobility technical sales support. Contact ABB Sales department

Taking in consideration that the PD Kit should be positioned on the center of on-board contact rails, the EV has the following tolerance to be positioned under the pantograph.

	NOTICE
	The following example is relevant for a bus which has its contact rails located directly above the front wheelbase.

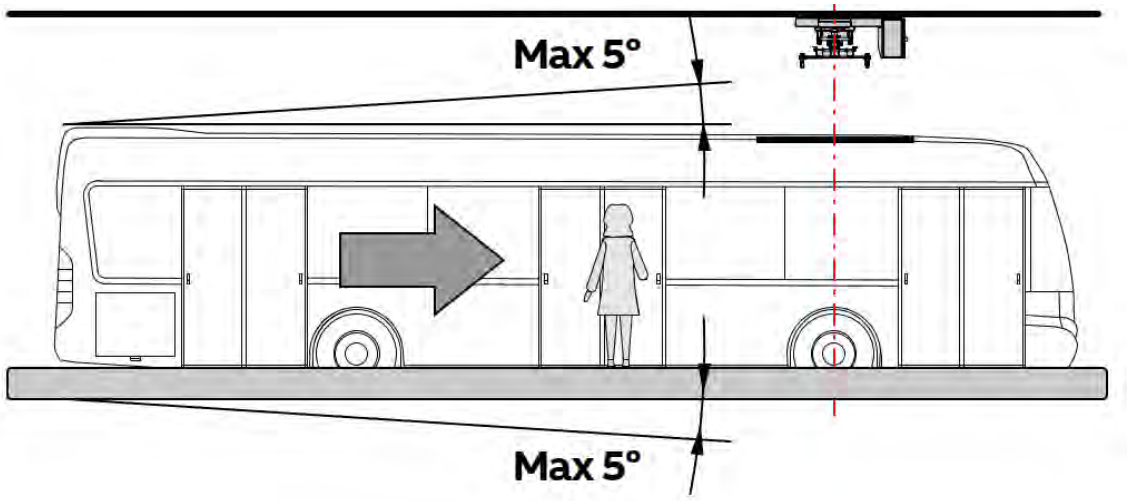
Kneeling of the bus will cause a displacement of the contact rails on top of the bus of about 200 mm (5° angle with a the height of the bus 3280 mm). This should also be taken into account when determining the minimum or maximum distance between pole and bus.

Front view



The installation can handle a road inclination smaller than 5° without any modification to the position of the pantograph.

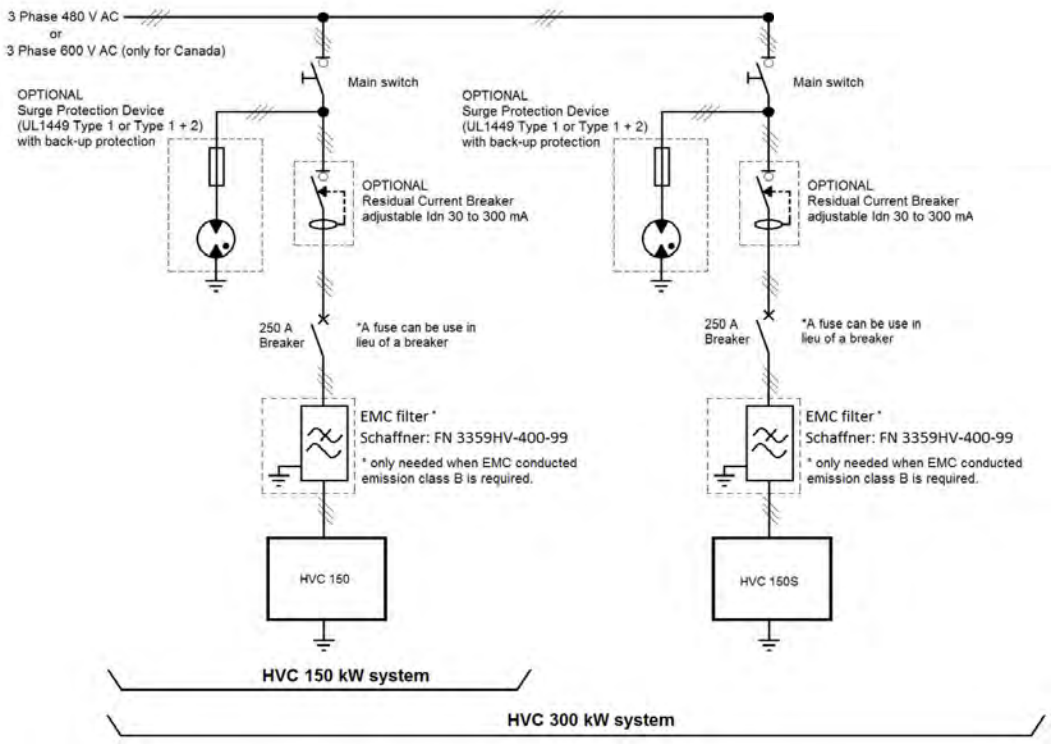
Side view

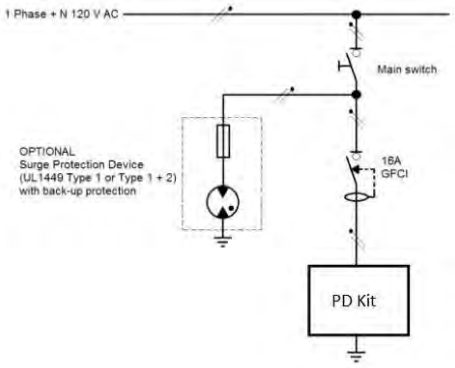


3.7. Electrical engineering

3.7.1. Electrical installation

The electrical installation must be completed according to the local safety and electrical regulations and laws. See section Adapting the grid on Page 26 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 mm^2 = 500 MCM) in the AC power cable depends on the length and method of installation. This must be determined by your contractor.



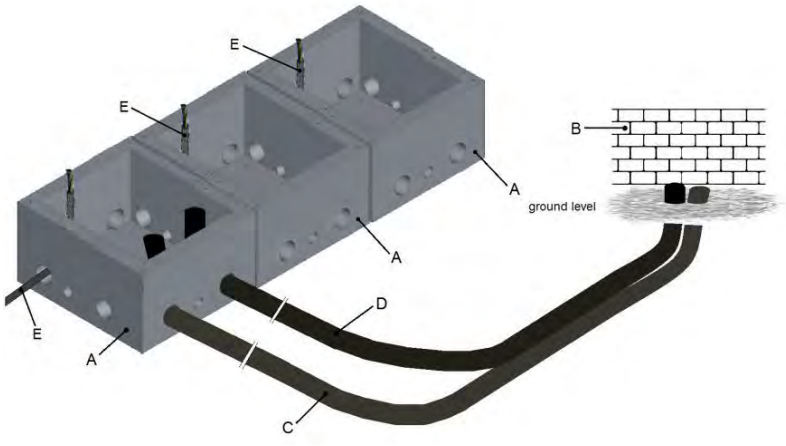


3.8. Civil installation

	NOTICE
	The instruction described in this section assumes that the cables between the Power Cabinet and the PD Kit are placed into the ground. Depending on the location, for example the HVC PD Kit is installed inside, the cables can be installed above the ground. In this case there is needed cable ducts or trays to protect the cables. Check with your local contractor what the installation options are because this is not described in this Installation Guide.

DC power cables, AC utility power cable, GND wire and data cables must be routed between the Power Cabinet and the PD Kit. Therefore two (flexible) cable conduits with an outer diameter of 6.30in must be installed between the foundation of one of the Power Cabinets and the vicinity of the PD Kit (based on individual installation).
The DC power cables must be installed in a separate cable conduit with respect to the AC utility power cable, GND wire and data cables. The maximum length of the cables between the Power Cabinet and the PD Kit is 328.09 ft (492.13 ft if additional conditions are met). Both conduits must be at least 23.62in deep in the ground and must be in one-piece. The AC power cable from the distribution board can also be installed in a cable conduit (not mandatory).

	NOTICE
	It is recommended to place an extra flexible cable conduit with an outer diameter of 40 mm in the cable conduit intended for the AC utility power cable, PE wire and data cables. This extra cable conduit is meant for the glass fiber cable.



Example of civil installation when ACS Control Module is mounted on a wall (450 kW Charge system)

A Foundation of Power Cabinet

B Wall on which the ACS Control Module and Junction Box will be mounted
C Flexible conduit for DC power cables
D Flexible conduit for AC auxiliary power, PE wire and data cables
E AC power cable for Power Cabinet

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

3.9. Lightning protection

One electrode (ground rod) of maximum 10 Ω must be placed in to the earth near the PD Kit. In some cases also additional grounding is required at the Power Cabinet side. This is dependent on the local regulations and should be determined by the contractor.
If the grid is TT based, consult the grid owner. It is possible that an extra 0,9 Ω electrode is required. This requirement must be determined by the contractor.
Consult a local specialist for the options of lightning protection. The PD Kit has to be within the protection angle of the lightning distraction. This requirement must be determined by the owner and a local specialist (according to NFPA 780).
The implementation of the lightning protection depends on the local laws, safety and electrical regulations. This requirement must be determined by the contractor and owner of the site / HVC150 PD Kit (Schunk SLS 201.102).

4. Construction

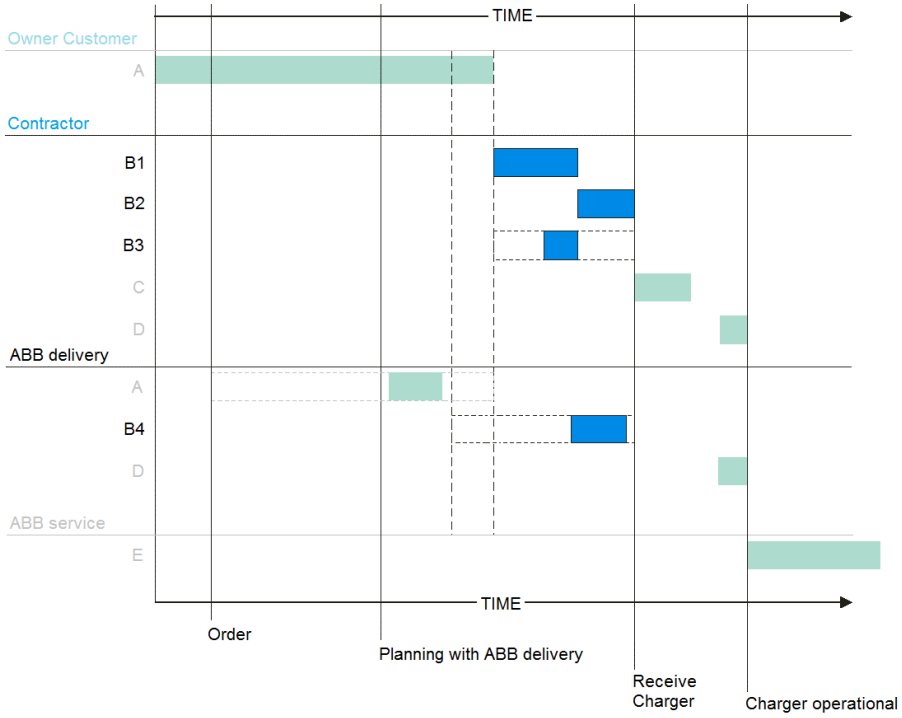
4.1. About construction

The construction phase includes all work required to prepare the location and make it ready for the placement and connection of the HVC150 PD Kit (Schunk SLS 201.102).

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 Constructing foundation of the Power Cabinet on Page 39.
- Installation of the cables. See section Cable routing on page 46.

- Construction of the bus stop surrounding. See section Geometry of infrastructure on Page 29.

B2 **Electrical engineering works**

See section Electrical engineering on Page 34 and section Adapting the grid on Page 26.

B3 **Internet access (optional)**

This step can be ignored if the location has sufficient 3G/4G coverage. Otherwise an Ethernet (RJ45) connection has to be installed. See section *All* cables must have and isolation that are self-extinguishing and flame retardant according to UL VW-1, CSA FT1.

- All cables must be must meet the UL and the RoHS compliance.
- The identity and/or function of the cable must be marked on every 78.74in of the cable and on both ends.

4.1.1. Recommended cable list

The following cables are recommended by ABB, but it is up to the customer to make use of the recommended cables or select there one cables by using section Cable specification list on Page 49.

Cables between Power Cabinets and Control Box Panto Down/ Junction Box

Article code	Functional description	Spec. description	Quantity
SAB BRÖCKSKES CC 600 CY T (2G1.5) / 02781602	Interlock cable	2x2x0.75 mm² (16 AWG) shielded	1
Southwire, PV Wire, 500 MCM Or TF-Kable W-RHH-RHW-2-2000V, W350-1XT, 350 MCM	DC power cable	Single core 185 mm² (350 MCM), see on Page 49 for more information about the correct cable diameter	6
Lapp Kabel® ÖLFLEX Classic 110 H / 10019946	AC Power cable	3x2.5mm² (14 AWG)	1
Prefabricated	Can and Ethernet communication	Cat6 Ethernet cable	1
GND, Lapp Kabel® ÖLFLEX / 4161100	Earth cable from cabinet	cu, 1x16 mm² (6 AWG)	1

Cables between Power Cabinets

Article code	Functional description	Spec. description	Quantity
SAB BRÖCKSKES CC 600 CY T (2G1.5) / 02781602	Interlock cable	2x1.5 mm² (16 AWG) shielded	2
GND, Lapp Kabel® ÖLFLEX / 4161100	Earth cable from cabinet	cu, 1x35 mm² (2 AWG)	2

Internet connection on Page 50.

B4 **Transport**

Arrangement for the delivery of the HVC150 PD Kit (Schunk SLS 201.102) with the ABB Delivery department. See Contact information on Page 14 for contact details. The delivery time is at least four months.

4.2. Constructing foundation of the Power Cabinet

4.2.1. Available 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.
  A concrete foundation should be prepared directly on site. Based on the engineering calculations done with respect to the forces exerted by each cabinet and based on the local requirements (soil/land type, seismic, wind, etc.), concrete can be poured on site to prepare the foundation of the Power Cabinet.

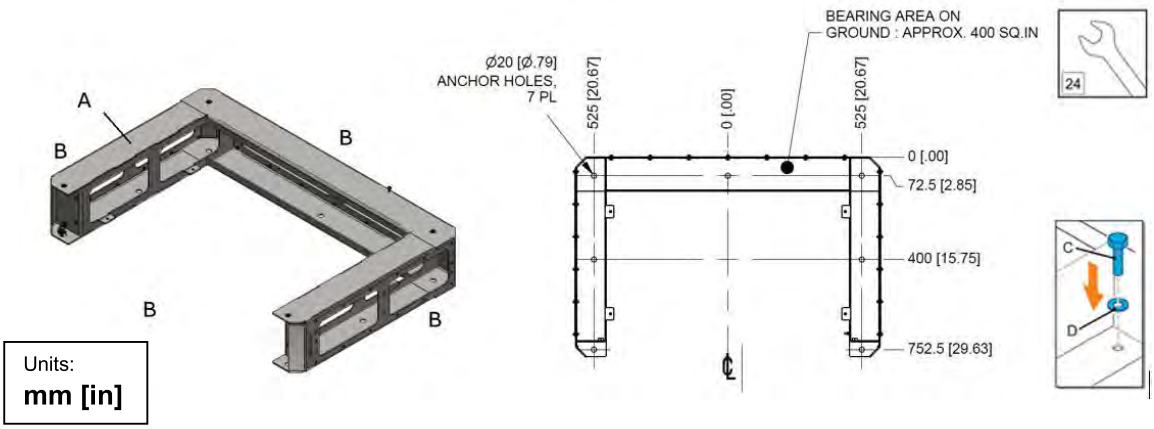
It is required to make sure that there are entry and exit holes for cables from the Power Cabinet to come through.

- **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 Accessories on Page 21. For detail drawings see Appendix E Dimensions metal frame foundation Power Cabinet.
  2. The Power Cabinet can be 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 inside a cable conduit. See section Cable routing on page 46 and section Civil installation on Page 35.

	**NOTICE** It is advised to install traction wires into the conduits to install the electrical cabling afterwards.
	**NOTICE** 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 7.09in.

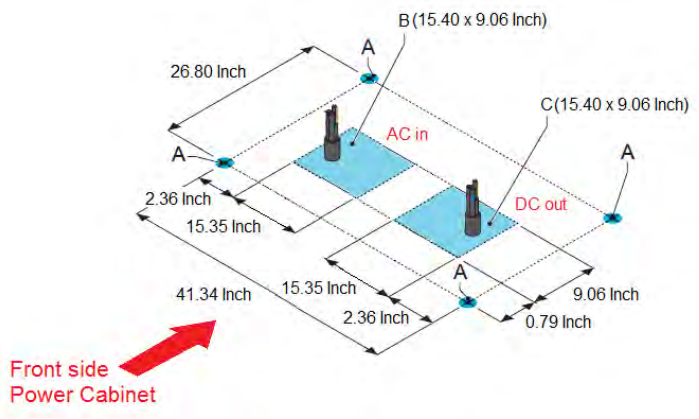
4.2.2. (Optional) Workflow with metal frame foundation



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 or Ø5/8.
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.

4.2.3. 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 or Ø5/8in.
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.

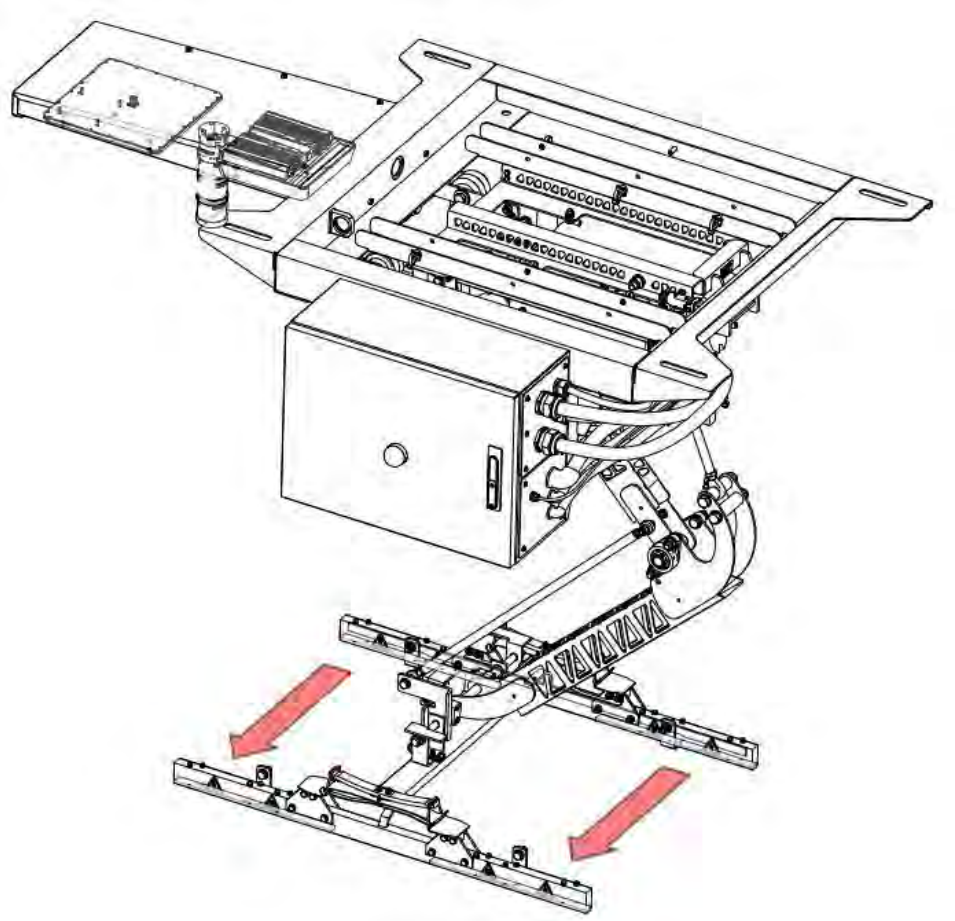
4.3. Ceiling installation of the PD Kit

The PD Kit is mounted using the installation holes on the bracket.

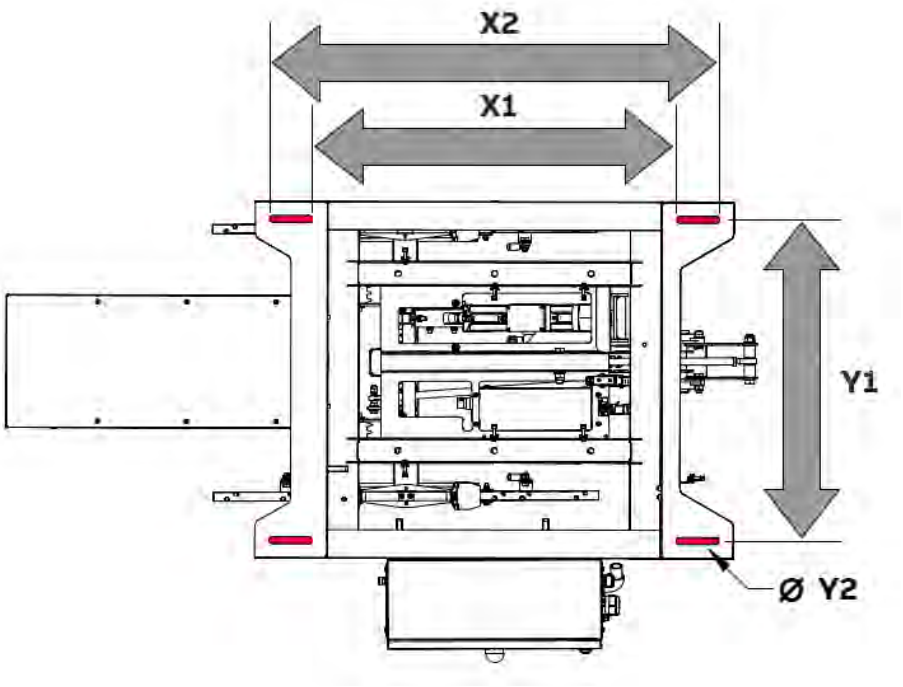
The exact positioning of the PD Kit is dependent on the position of contact rails on the vehicle roof (is therefore necessary to know the on-board charging equipment position of EV).

The roadway must be flat and ideally have a profiled kerb so that the vehicle is always positioned parallel and at a right angle respect to the pantograph.

	CAUTION
	The contact between the pantograph and the EV is only possible in one direction. During the installation make sure that the LED tower lights (A) is on the kerb side (the arrows in the illustration shown the EV travel direction).



Mark the 4 fastening points using the following measurements as a drilling template

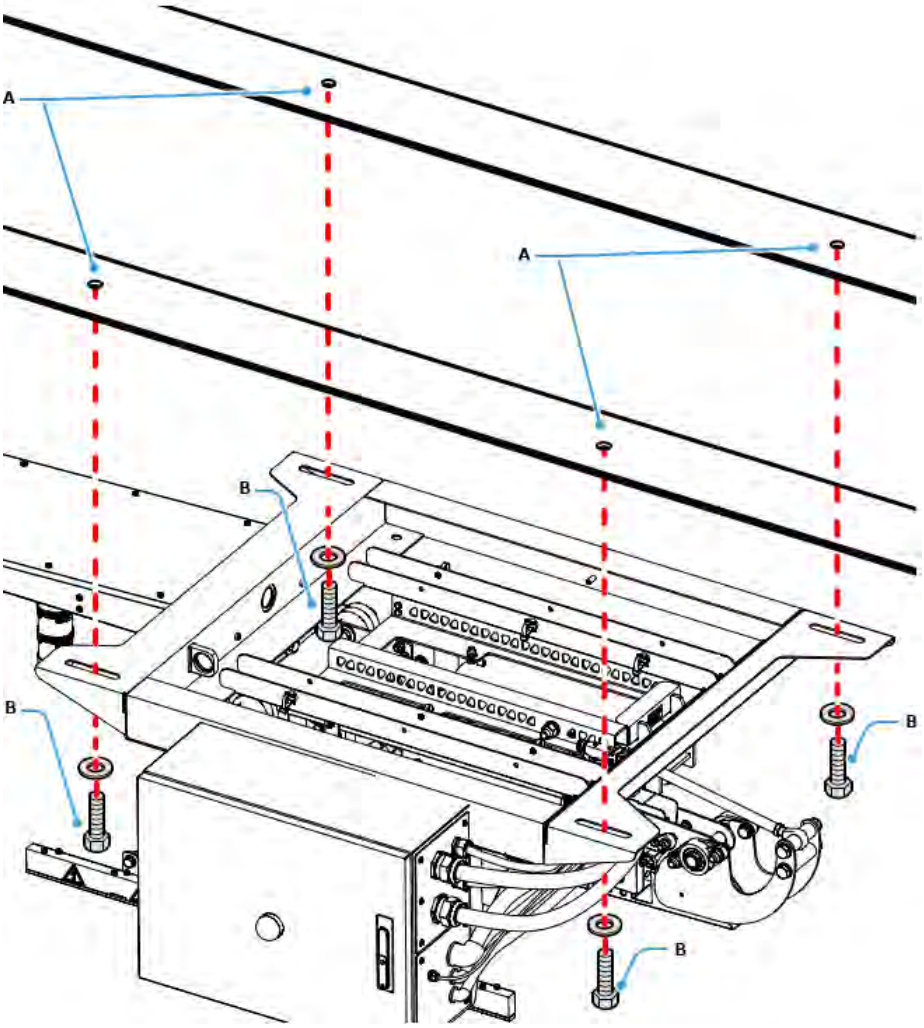


Parameter	Description	Specification [mm]
X1	Minimum space between the two holes of the bracket	1300
X2	Maximum space between the two holes of the bracket	1600
Y1	Space between the two holes of the bracket	900
Y2	Installation holes diameter	20

Depending on the type of anchor chosen, drill the required 4 holes (A) to mount the bracket.

	WARNING
	It is an installer's responsibility to choose appropriate type of anchors. The choice must be based on the type of support (concrete wall, wood or other support) and their ability to support at least 4 times the equipment's weight.

Install the fasteners with the washers (B).
Tighten the fasteners to the correct torque



4.4. Cable routing

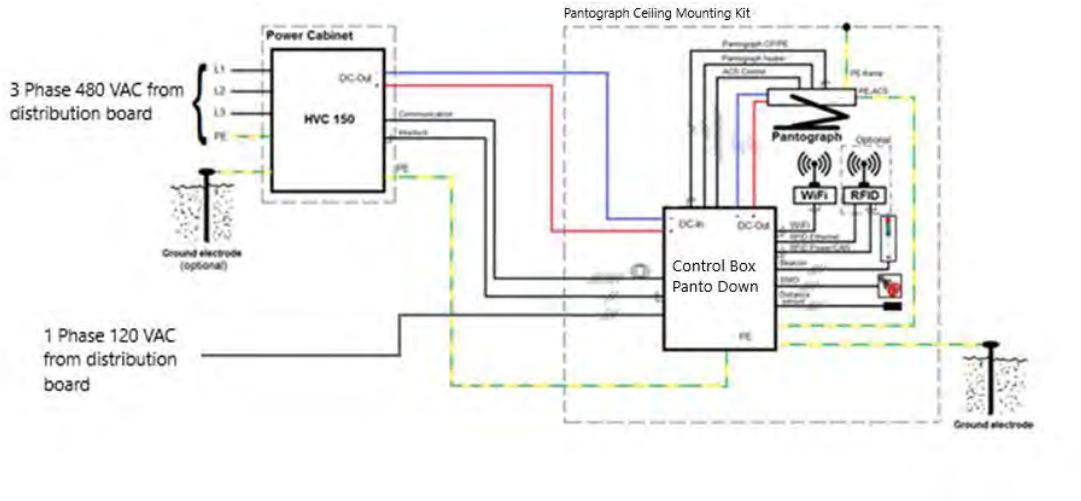
4.4.1. About cable routing

There are various cabling solutions, depending on the installation situation and the cable types used.

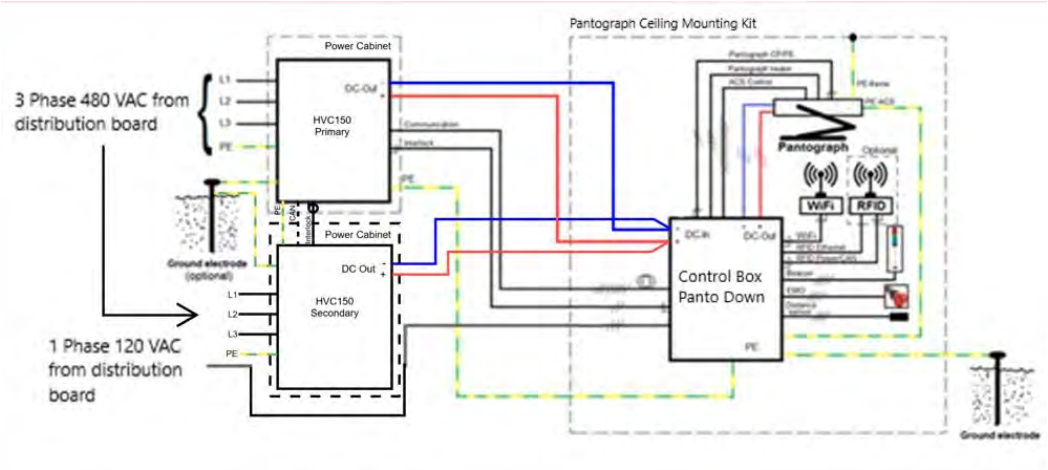
- When the cables are routed below ground, use cables that are suitable for underground installation.
- Based on the circumstances of the individual installation the local Contractor should determine a proper method of guiding the cable connections from the underground conduits to the PD Kit (as it installed above ground level) that will be both safe and functional.
- The identity and/or function must be marked every 78.74in of the cables and on both ends.

	**NOTICE** ABB recommends the use of crimped lugs for cable connections to Power Cabinet and PD Kit. Mechanical lugs can be used at the discretion of the installer and will be provided separately.
	**CAUTION** ABB is not responsible for damage caused to the Charger system due to the use of mechanical lugs, and it is not covered by the warranty.

4.4.2. Charge system configurations



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



Overview of electrical connections of an HVC-PD 300 kW charge system

4.4.3. AC power cable

- Cable type: 3P+GND (optionally 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 must have the same diameter as the phase conductors.

4.4.4. Cables connecting the Primary Power Cabinet and the Control Box Panto Down

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

- DC power cables; 2x for primary 150 kW power cabinet,
- 1x GND cable,
- 1x Interlock cable,
- Cat6 Ethernet communication cable

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

	**NOTICE**
	ABB recommends the use of crimped lugs for cable connections to Power Cabinet and PD Kit. Mechanical lugs can be used at the discretion of the installer and will be separately provided.
	**CAUTION**
	ABB is not responsible for damage caused to the Charger system due to the use of mechanical lugs, and is not covered by the warranty.

4.4.5. Cables connecting the Secondary Power Cabinets and the Control Box Panto Down

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

- DC power cables; 2x for secondary 150 kW power cabinet

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

4.4.6. Cables connecting the Power Cabinets (Primary – Secondary)

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

- 1x GND cable,
- 1x Interlock cable,
- 1x Can cable

4.4.7. Recommended cable list

Tables below provides general specifications for the needed cables. Use these tables to select cables, taking into account local installation environment, 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	3
Cross section range	350 MCM	6 AWG	14 AWG
Min – Max external diameter to fit through gland	0.75 – 1.10in	0.51 – 0.83in	0.24 – 0.47in
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)
Minimum Nominal Voltage Uo/U	600/1000 Vac 900/1500 Vdc	600 Vac	450/750 Vac
Minimum Test Voltage [AC]	6 kV	4 kV	4 kV
Ambient Temperature range	-40ºC to 105ºC, permissible conductor operating temperature +90°C	-40ºC to 105ºC	-40ºC to 105ºC
Core identification		gn/ye or gn	Color for US Acc. to US National Electrical Code and for Canada Acc. to the CEC (Canadian Electric Code)

Data cables

Functional description	Interlock cable	CAN cable
Number of (twisted) pairs	2 x 2	1 x 2
Cross section range	18 – 14 AWG	20 – 18 AWG
Min – Max external diameter to fit through gland	0.20 – 0.39in	*inapplicable*
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
Characteristic impedance	120 Ω ± 10%	120 Ω ± 10%
Minimum Test Voltage [AC]	1.5 kV	1.5 kV
Ambient Temperature range	-40ºC to 80ºC	-40ºC to 80ºC
Core identification	Acc. to DIN 47100	Acc. to DIN 47100

- Important: all cables must be resistant to being placed in the ground, inside a conduit.

- All cables must have and isolation that are self-extinguishing and flame retardant according to UL VW-1, CSA FT1.
- All cables must be must meet the UL and the RoHS compliance.
- The identity and/or function of the cable must be marked on every 78.74in of the cable and on both ends.

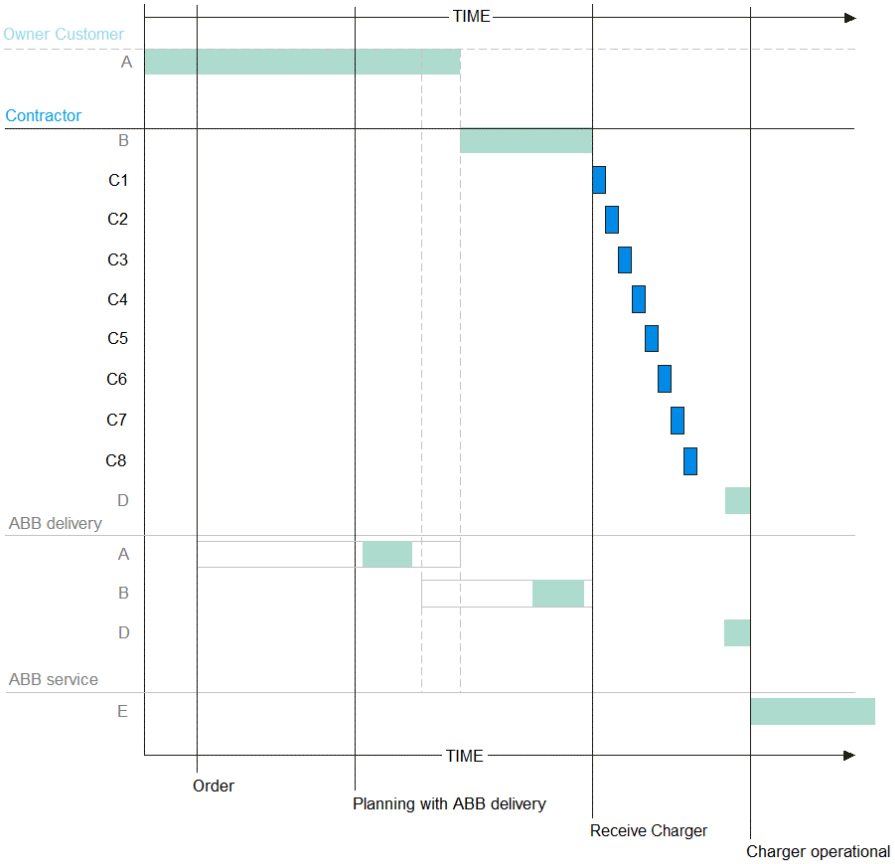
4.5. Internet connection

In most cases the integrated 3G/4G modem is used for wireless internet access. A customer SIM card is not required. If there is no 3G/4G signal available, a standard wired internet connection is required. For this option, contact ABB Sales department (see *Contact information* on Page 14 for contact details).

5. Placement and Connection

5.1. About placement and connection

When the construction phase is finished, the HVC150 PD Kit (Schunk SLS 201.102) 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 Routing the cables on Page 46.

C2 Unpacking on Page 55.

C3 Moving the Power Cabinet with a hoist on page 57 and Installing the Power Cabinet onto a foundation on Page 59.

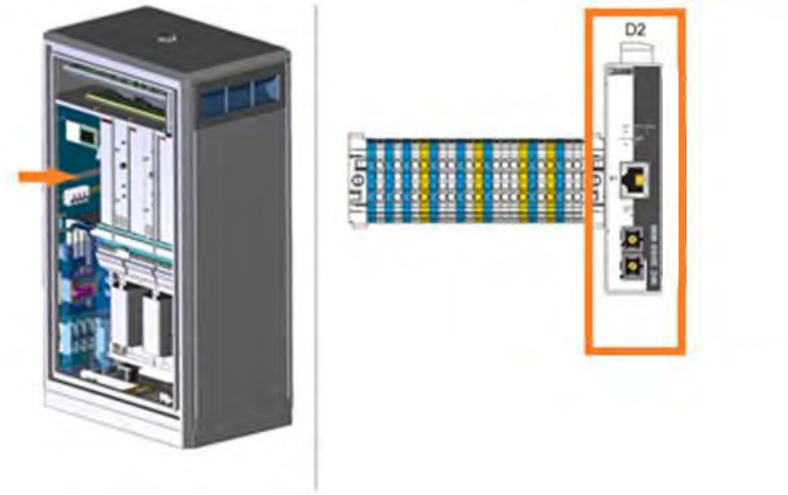
C4 Connecting the AC power cable on Page 68, Connecting the DC power cables to the on Page 73, Connecting AC utility power, Interlock and CAN cables to the Power Cabinet Connecting AC utility power, Interlock and CAN cables on Page 77 and

	NOTICE
	Depending on the distance between the Power Cabinet and the DDCB, two installation options are available. Resort to the

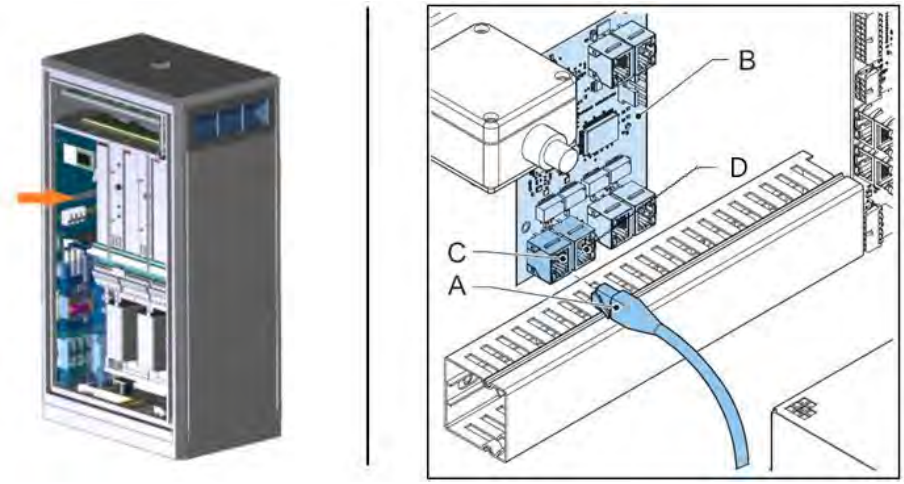
	communication fiber cable method if Ethernet to fiber converter (ETH2FIBER) is present inside the Power Cabinet.

5.1.1. Connecting the fiber cable communication to the Power Cabinet

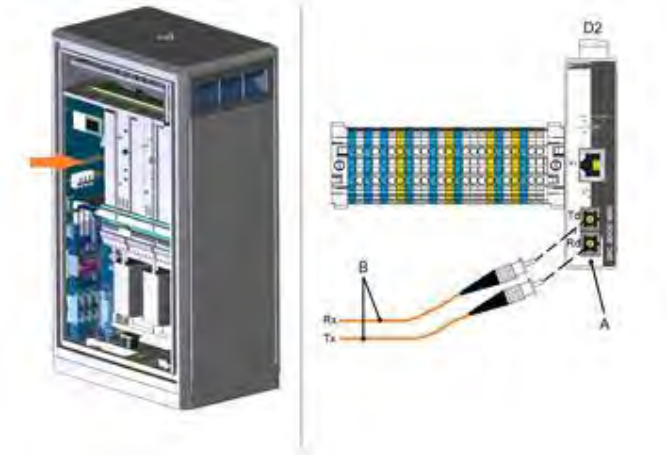
1. Check if the Ethernet to fiber converter (ETH2FIBER) is present inside the Power Cabinet. If not – apply instructions described in (Optional) Connecting the Ethernet cable communication to the Power Cabinet on Page 80.



2. Make sure that the RJ45 slot of the ETH2FIBER converter and J1 (C) or J3 (D) CAN2ETH (B) converter's slot are connected with an Ethernet cable. If not, use an Ethernet cable (A) to connect them.



3. Connect the communication fiber cables.



3.1. Remove the protection covers from the optical connectors.

3.2. Connect the two Ethernet fiber cables (B) onto the module D2 (A):

- Rx (Optical 2) with Td D2;
- Tx (Optical 1) with Rd D2.

3.3. 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 64 mm, otherwise the core of the fiber cable may break.

(Optional) Connecting the Ethernet cable communication to the Power Cabinet on Page 82.

C5 Unpacking the PD Kit components on Page 83.

C6 Mounting the PD Kit on Page 86.

C7 Connect cables to the PD Kit in section Cable connections of the Control Box Panto Down on Page 91.

5.2. Routing the cables

1. Unpack the cables. See
2. Cabl on Page 46 for details on which cables are needed.
3. Route the DC power cables through the 6.30in cable conduit.
4. Route the AC utility power, GND wire and Interlock cable through the other 6.30in cable conduit.
5. Route the communication Ethernet cable through the extra 1.58in cable conduit.
6. For the DC power cables, make sure that a cable length of 39.37in is available above the surface for internal routing in the cabinet.
7. For the other cables, make sure that a cable length of 118.11in is available above the surface 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.

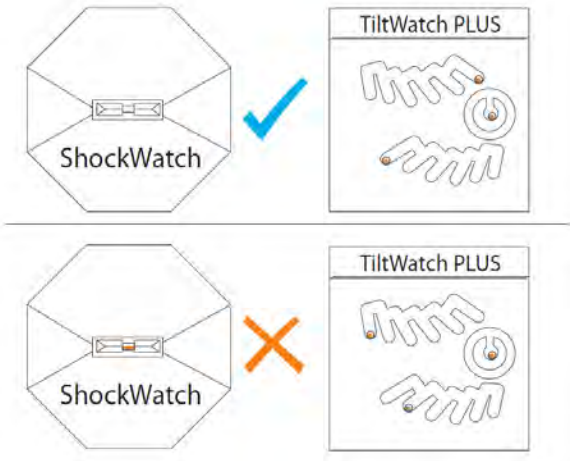
5.3. Unpacking Power Cabinet

5.3.1. Before unpacking

	NOTICE
	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.
	CAUTION
	Do not pollute the environment with plastic and cardboard packaging. Dispose of the packaging elements according the regionally applicable regulations regarding the environment.

Prerequisites:

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

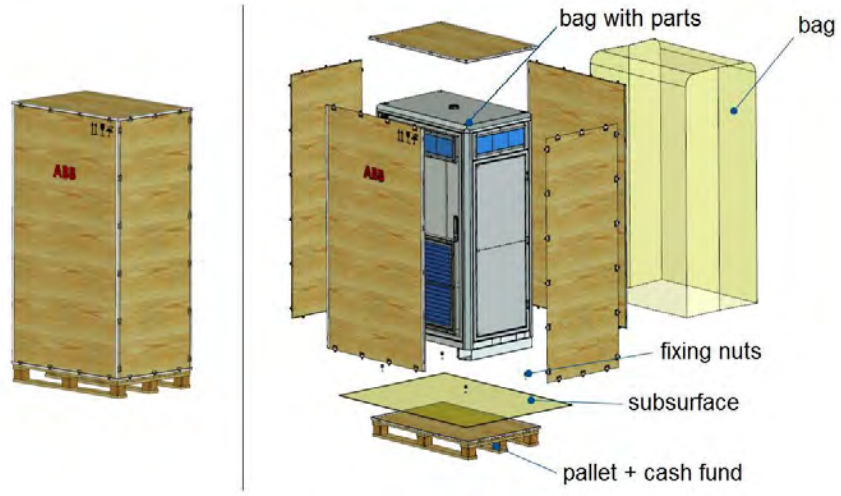


Make sure that the Power Cabinet has not been shaken or tilted over 30°.

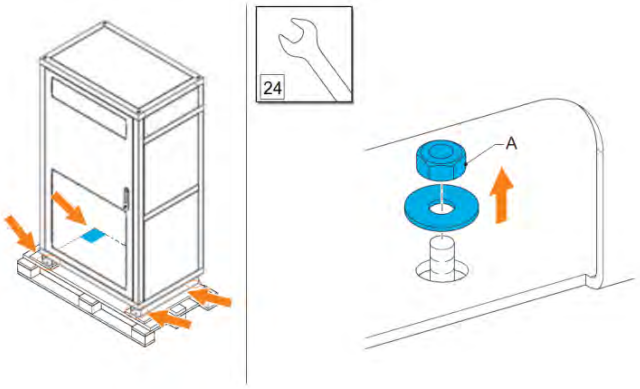
5.3.2. Remove the packaging

Prerequisites

- Tools: spanner (size 24).



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



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

5.4. Moving the Power Cabinet

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 Moving the Power Cabinet with a hoist on Page 57.
- Use a forklift truck to lift the cabinet from the bottom. See Moving cabinet with a forklift truck on Page 58.

Prerequisites:

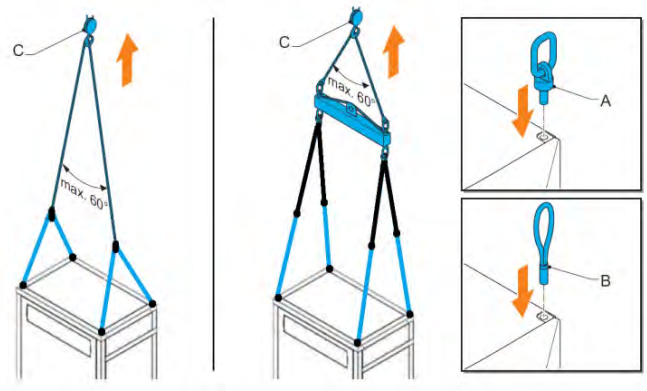
- All packaging material is removed from the Power Cabinet.

- 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.

	**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.
	**CAUTION** **Warranty** Any damage caused during the process of moving the Power Cabinet to its position is not covered by the warranty.
	**CAUTION** Do not use a compressor to clean the Power Cabinet. Use a vacuum cleaner.

1. Use one of the two options to move the Power Cabinet to the foundation.
2. When the Power Cabinet is about 19.69in above the desired location, continue the installation procedure with Installing the Power Cabinet onto a foundation on Page 59.

5.4.1. Moving the Power Cabinet with a hoist



A Swivel eye bolts (standard delivered with the cabinet)

B Lifting loops
C Hoisting equipment

Prerequisites:

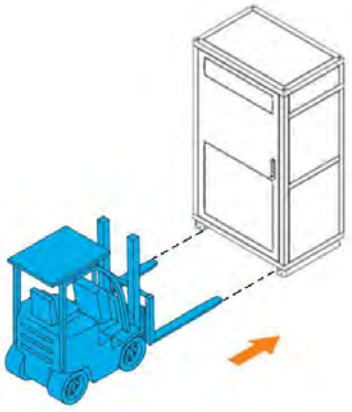
- A minimum of two qualified workers are required: one person to operate the hoisting equipment, the other to guide the Power Cabinet to its location.
- Use M16 swivel eye bolts (A) or M16 bolts with lifting loops (B).

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
	Keep the hoisting angle below 60°.

4. Move the Power Cabinet to the foundation.

5.4.2. Moving cabinet with a forklift truck



Prerequisites:

- A minimum of two qualified workers are required: one person to operate the forklift truck, the other to guide the Power Cabinet to its location.

1. Place wooden slats with a thickness of about 0.39 to 0.59in 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
	The use of the fork slides is mandatory. The distance between the outer side of the forks need to be 36.61in, lifting the cabinet outside the fork slides is **NOT** allowed and will damage the cabinet.

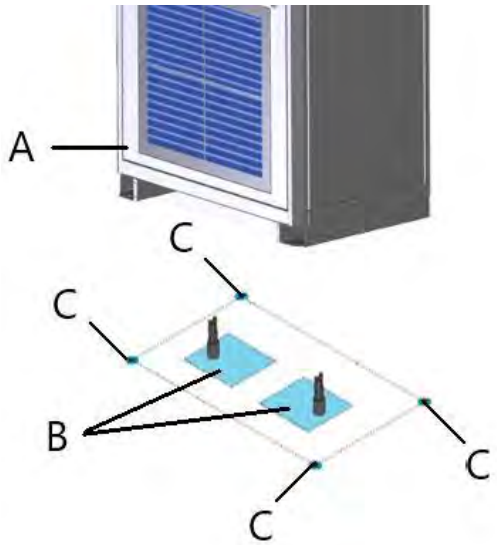
5.5. Installing the Power Cabinet onto a foundation

	**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.

5.5.1. Connecting Power Cabinet to a concrete foundation

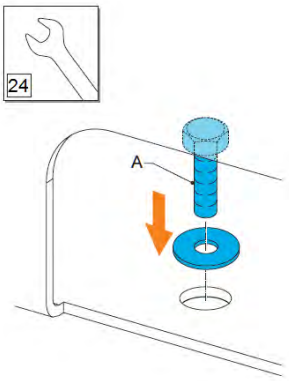
Prerequisites:

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



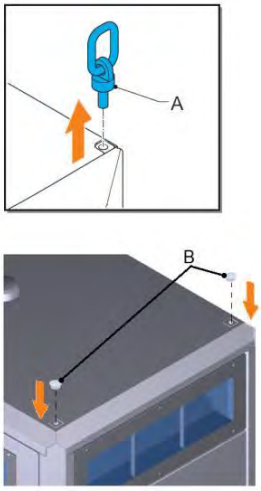
A Power Cabinet
B Entrance to the underground cable duct
C Mounting points

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



	NOTICE
	A minimum of three M16 bolts must be applied to securely mount the Power Cabinet onto the foundation. In case of placing two Power Cabinets next to each other and (3.94in distance) against the wall, one Power Cabinet can be secured by three M16 bolts on to the foundation.

4. Insert the M16 bolts (A) fitted with the washers into the holes in the corners (4x).
5. Tighten the bolt with a tightening torque of 147.51 ft-lb.

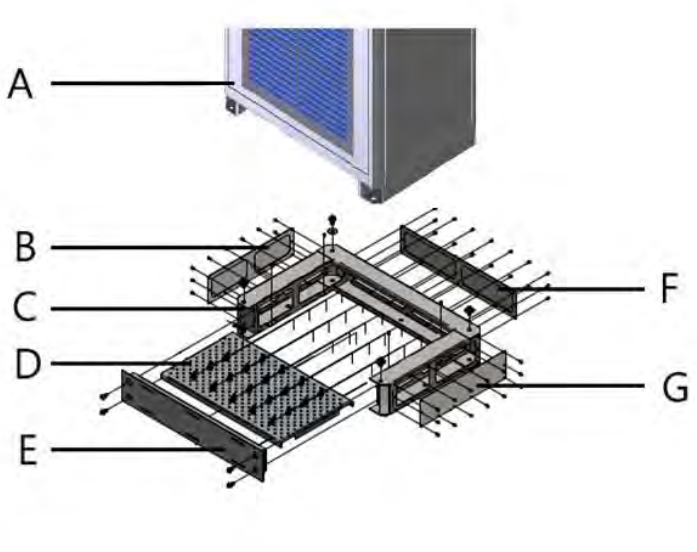


6. Remove the swivel eye bolts or lifting loops (A).

5.5.2. (Optional) Connecting Power Cabinet to a metal frame foundation

Prerequisites:

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

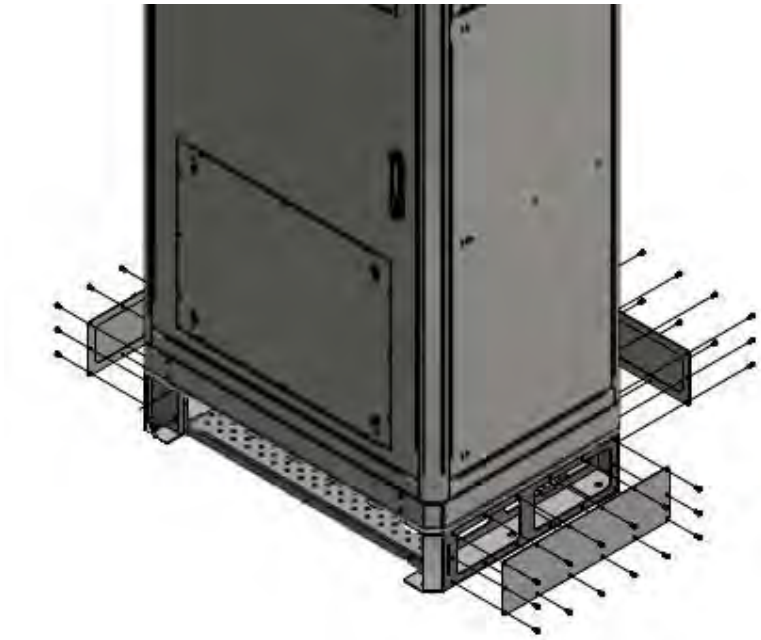


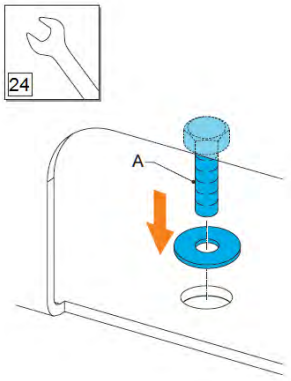
A	Power Cabinet	E	Base front cover
B	Side gland plate	F	Rear gland plate
C	Base structure	G	Side gland plate
D	Base tie-downs plate		

1. Make sure that the tie downs plate (D) is installed prior to moving the Power Cabinet.
2. Carefully lower the Power Cabinet (A) onto the foundation (C).
3. Make sure that you do not trap the cables.
4. Make sure that the cabinet is aligned with the tapped holes.

	NOTICE
	The three gland plates (B, F, G) should be equipped with cable glands which allow to lead the cables inside the Power Cabinet.

5. Install the gland plates with previously prepared cable glands..

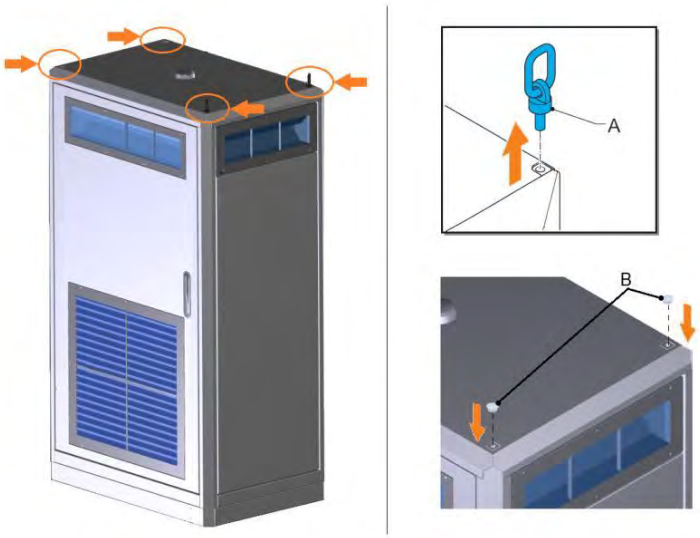




6. Insert the M16 bolts (A) fitted with the washers into the holes in the corners (4x).

	NOTICE
	A minimum of three M16 bolts must be applied to securely mount the Power Cabinet onto the foundation. In case of placing two Power Cabinets next to each other and (3.94in distance) against the wall, one Power Cabinet can be secured by three M16 bolts on to the foundation.

7. Tighten the bolt with a tightening torque of 147.51 ft-lb.

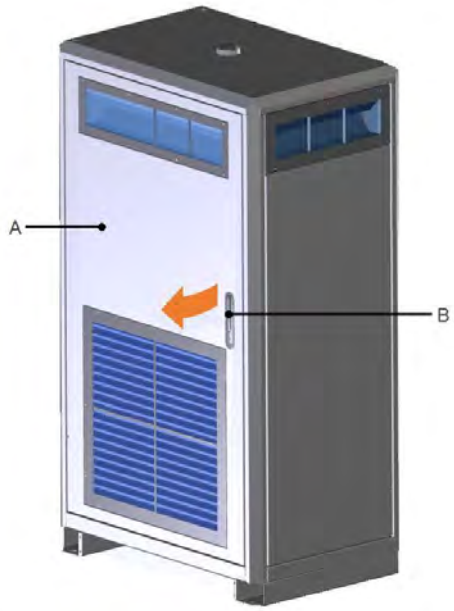


8. Remove the swivel eye bolts or lifting loops (A).
9. Place the cover caps (B) in the holes (4x).

5.5.3. Opening the door of the Power Cabinet

Prerequisites:

- The key previously removed from the Power Cabinet (bag containing parts).



Opening the Power Cabinet's door

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

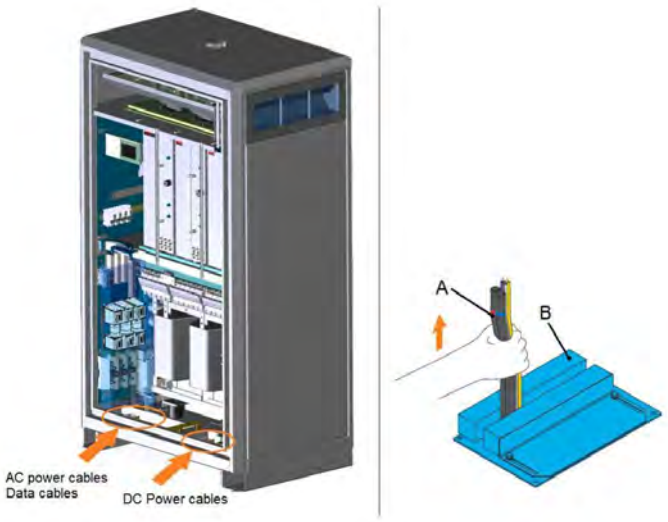
5.5.4. Loosening the sliding plate of the guidance plates

Prerequisites:

- Tools: spanner (size 13).

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

5.5.5. Routing cables through the guidance plates



The method of routing cables through the Power Cabinet's floor

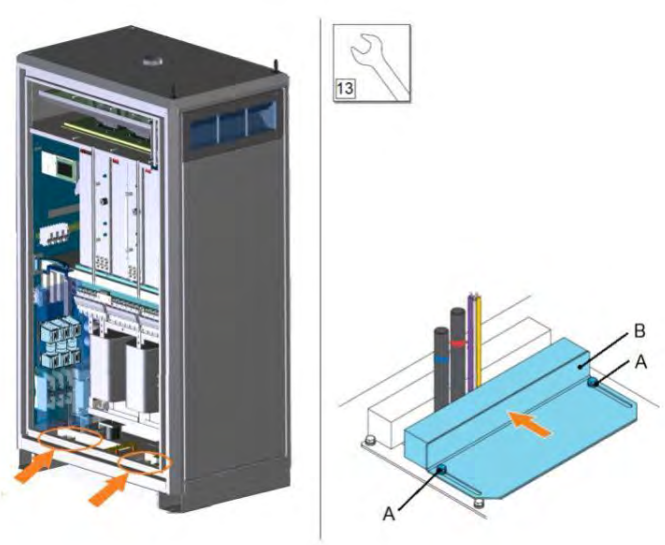
1. Route the cables (A) through the right guidance plates (B).
2. Make sure that there is sufficient cable length to reach the connectors at the top of the cabinet.

	NOTICE
	A minimum length of 118.11in is required, as the cable connectors are located in the middle of the Power Cabinet.

5.5.6. Tightening sliding plates of the guidance plates

Prerequisites:

- Tools: spanner (size 13).



Securing the cables with the guidance plates

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

5.5.7. Installing border covers of the Power Cabinet

	NOTICE
	Only applicable when the Power Cabinet is placed on a concrete foundation.

Prerequisites:

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

Attaching border covers to the Power Cabinet

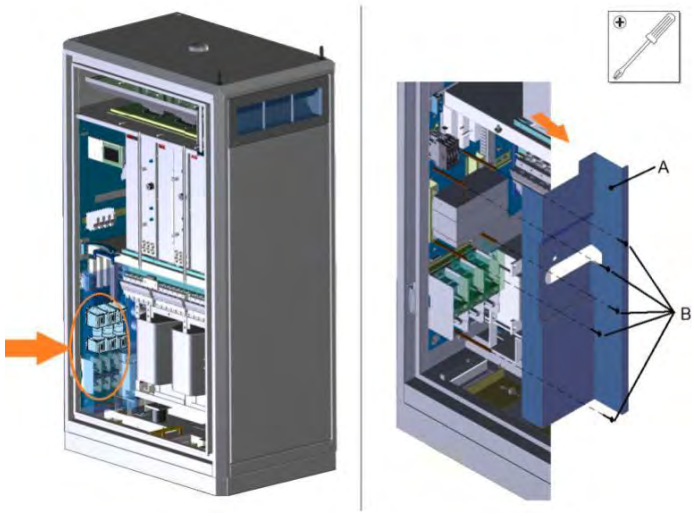
1. Put the front cover (A) against the bottom front of the Power Cabinet by aligning the four bolts at the back side of the front cover (A) with the holes in the bottom front.
2. Put the rear cover (B) against the rear front of the Power Cabinet.
3. Insert the M5 bolts (C) into the holes (8x).
4. Tighten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

5.6. Connecting AC power cable and GND wires to the Power Cabinet

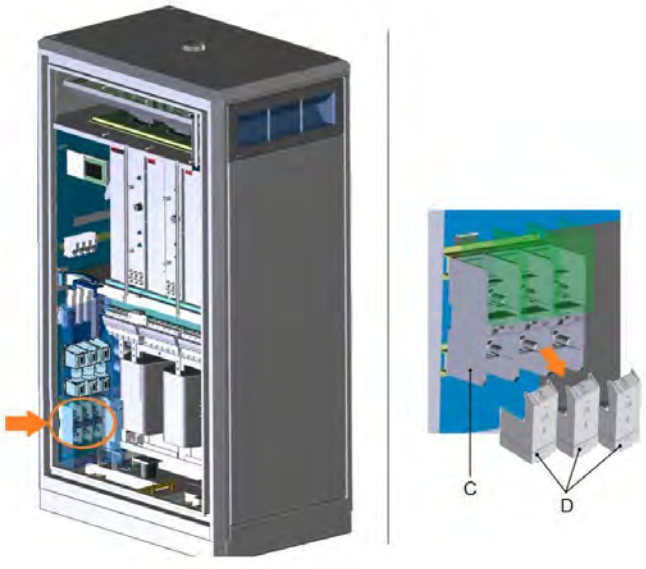
5.6.1. Removing the protection covers

Prerequisites:

- 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.



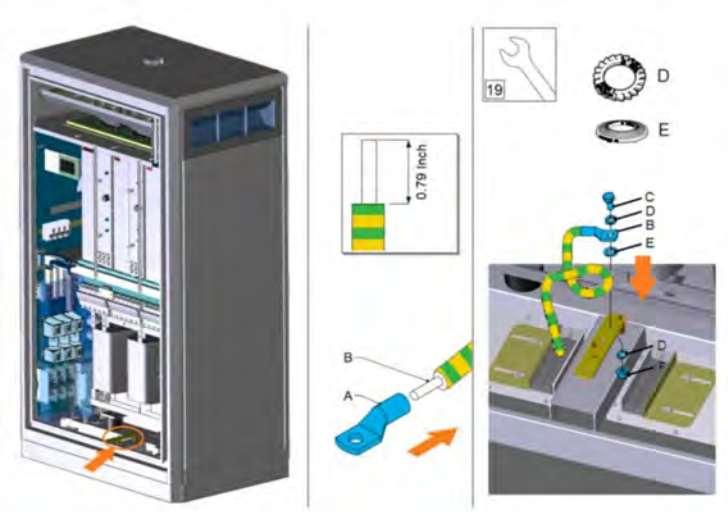
3. Remove the 3 protection covers (D) from the connector blocks (C).
4. Put the protection covers in a safe location as it will be installed back later on.

5.6.2. Connecting the GND wire of the AC power cable

Prerequisites:

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

	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.



1. Make a loop in the GND wire.

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

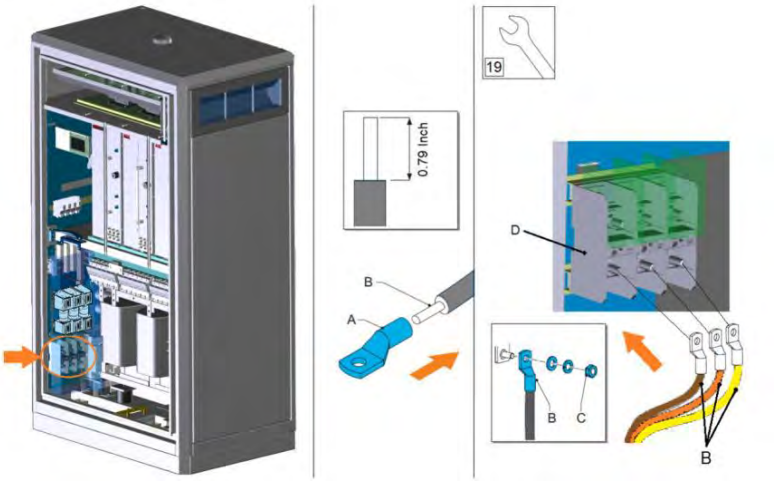
2. Cut the GND wire of the AC power cable to the proper length to reach the GND rail. Do not make the wire routing neither too tight nor too loose.
3. Strip 0.79in of the insulation from the end of the GND wire.
4. Attach a wire end ring (A) to the end of the GND wire (B).
5. Remove the M12 bolt, nut 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. Connecting the AC power cable

Prerequisites:

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

	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.

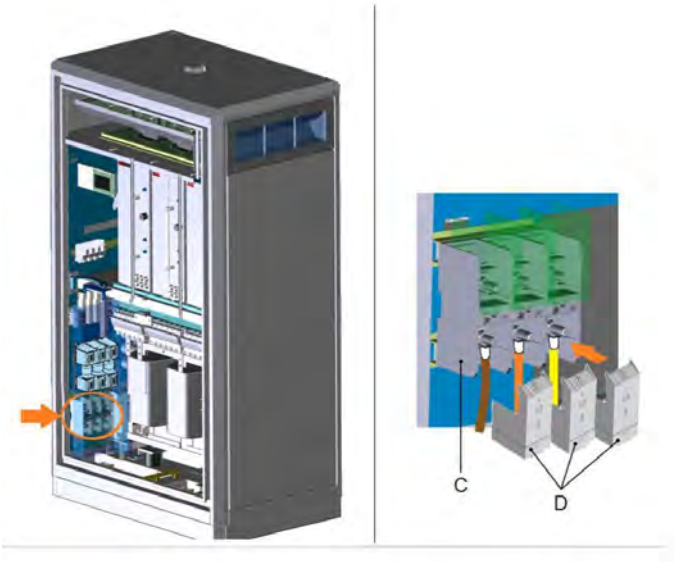


1. Cut the wires of the AC power cable to the proper lengths to reach the connectors. Do not make the wire routing neither too tight nor too loose.
2. Strip the required length of the insulation, specified by the lug used, from the end of the wire (B).
3. Attach cable lugs (A) at the end of the wires.
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 (black),
   L3 (grey or black).
6. Tighten the nuts (C) with a tightening torque of 22 ft-lb.

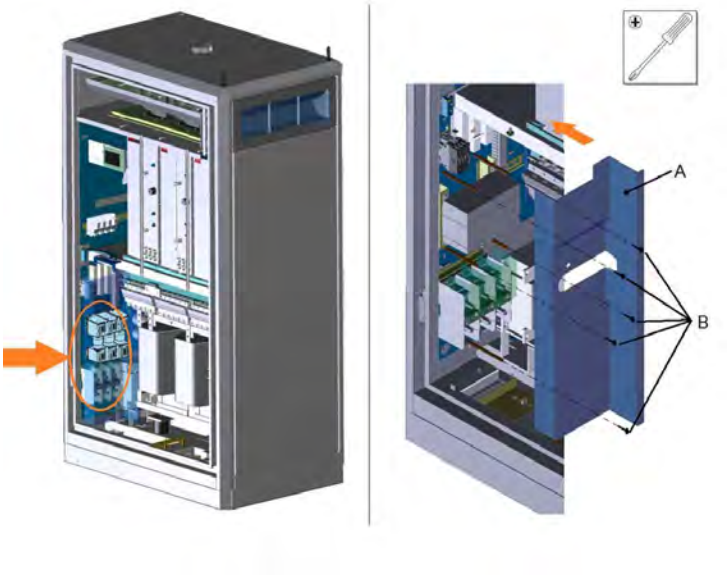
5.6.4. Installing the protection covers

Prerequisites:

- Tools: cross-head screwdriver



1. Take the 3 protection covers (previously removed in Removing the protection covers on Page 68).
2. Place the protection covers (D) back on the connector blocks (C).



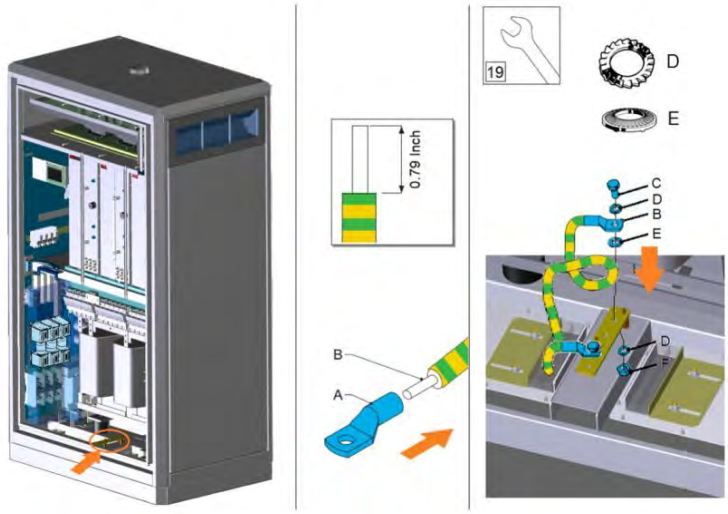
3. Take the protection plate and the screws (previously removed in Removing the protection covers on Page 68).
4. Place the protection plate (A) back over the main switch and connector blocks and secure the plate by the screws (B).

	WARNING
	Leave the main switch 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 *Contact information* on Page 14 for contact details.

5.6.5. Installing lightning protection (optional)

Prerequisites:

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



1. Cut the wire of the lightning protection cable to the proper length to reach the GND rail. Do not make the wire routing neither too tight nor too loose.
2. Strip 0.79in 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.

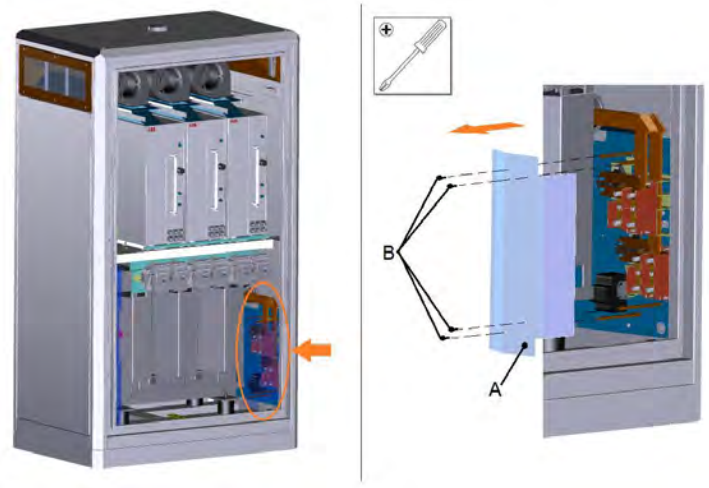
5.7. Connecting the DC power cables to the Power Cabinets

Prerequisites:

- Tools: wire cutter, wire stripper pliers, cable lugs (eg. Cembre A48-M12 cable lug, when using 350 MCM cables) (6x), spanner (size 19), torque wrench (size 19), cross-head screwdriver.

	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.

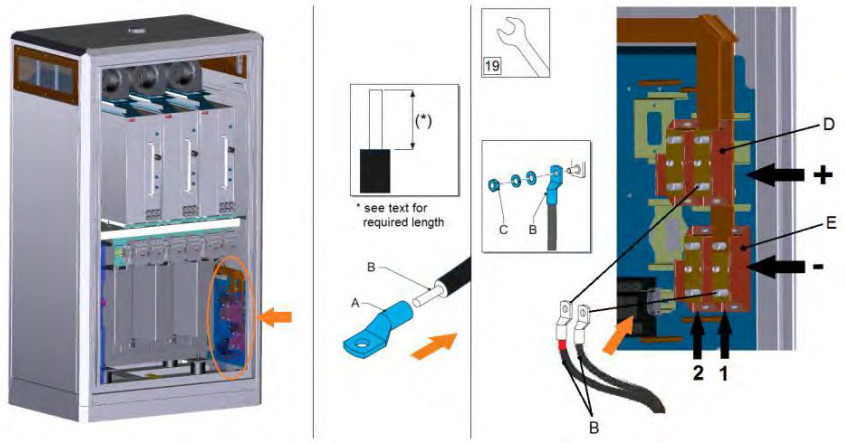
5.7.1. Removing the protection cover



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 back later on.

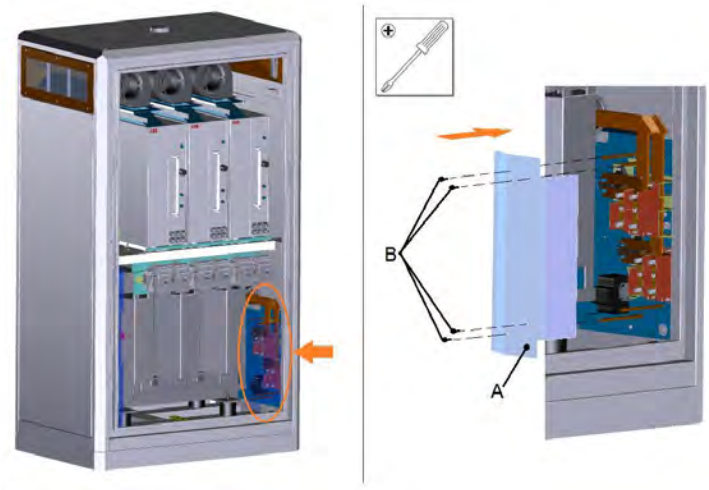
5.7.2. Connecting the DC power cables

	NOTICE
	If the distance between the Power Cabinet and the Control Box Panto down exceeds 328 ft (100 m) two cables should be installed for each connection giving a total of 4 DC cables required to complete this step.



1. Cut the wires of the DC power cable to the proper lengths to reach the connectors. Do not make the wire routing neither too tight nor 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.

5.7.3. Installing the protection cover



1. Take the protection plate
2. Place the protection plate (A) back over the DC connector blocks and secure the plate by the screws (B) (4x).

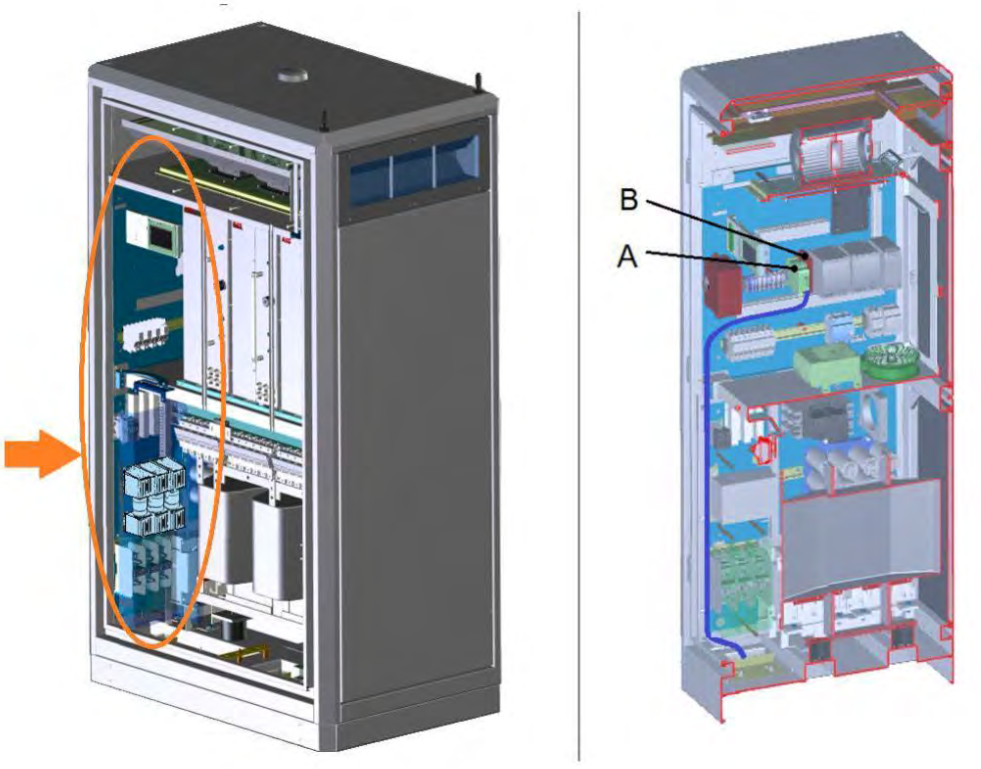
5.8. Connecting AC utility power, Interlock and CAN cables to the Power Cabinet

Prerequisites:

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

	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.

5.8.1. Routing the cables to the terminal blocks



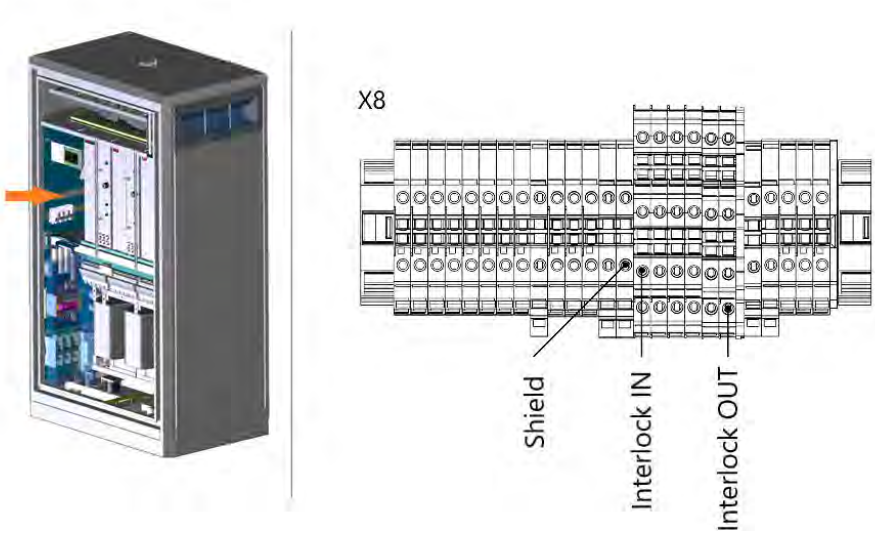
Preferred cable route

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. Connecting the Interlock and CAN communication cables for the HVC 150 kW system

	NOTICE
	The CAN cable connection is only needed for the HVC 300 kW E-Bus Charger.

Interlock cable connections in the **HVC 150 Primary**:



1. Move the cables towards the terminal block X8.
2. Strip 0.43in of the insulation from the ends of **only the White and Brown wires!**
3. Crimp ferrules onto the end of the White and Brown wires.
4. Ensure that the unused wires (green and yellow) are secured so that they cannot touch metal parts.
5. Loosen the connector screws.
6. Insert the wires into the connectors, see table below:

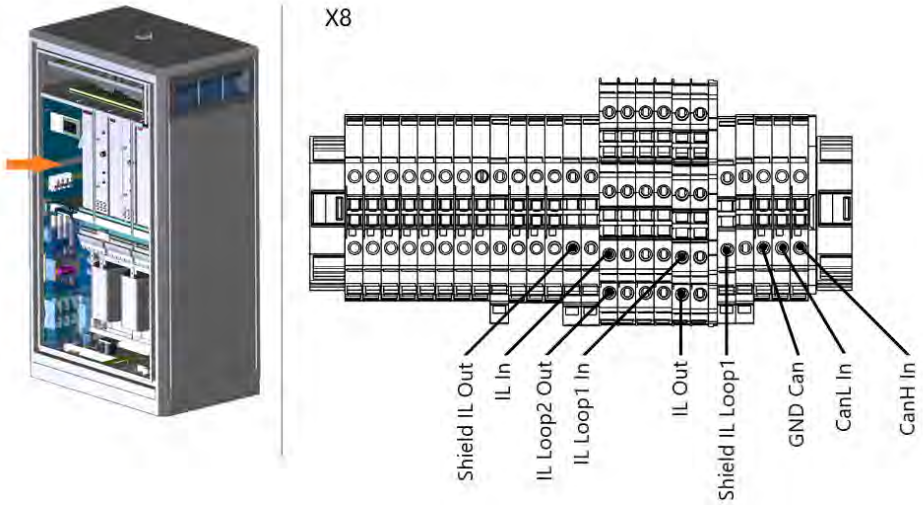
Functional description	Connector	Wire color
Interlock In (ACM)	X8-14	Brown
Interlock Out (ACM)	X8-7	White
Interlock GND (ACM)	X8-Shield (refer to the picture above)	Shield

See also Appendix H *Signal connection diagram*.

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

5.8.3. Upgrading the Interlock connection to the HVC 300 kW system

Interlock and CAN cables connection in the **HVC 150 Primary**:



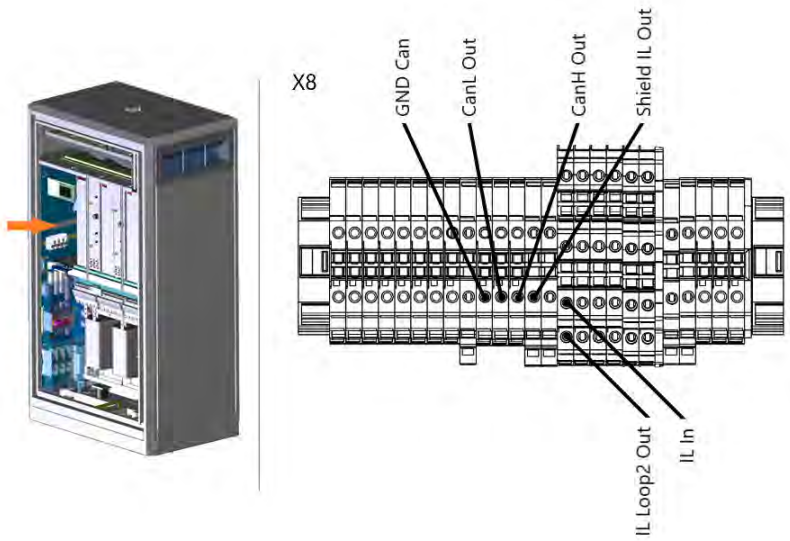
1. Move the cables towards the terminal block X8.
2. Strip 0.43in of the insulation from the ends of **the White and Brown wires only!**
3. Crimp ferrules onto the end of the White and Brown wires.
4. Ensure that the unused wires (Green and Yellow) are protected so that they cannot touch metal parts.
5. Loosen the connector screws.
6. Insert the wires into the connectors, see table below:

Functional description	Connector	Wire number
Interlock In (ACM)	X8-14	Brown
Interlock Loop2 Out (ACM)	X8-15	White
Shield Interlock Out (ACM)	X8-Shield (refer to the picture above)	Shield
Interlock Loop1 In (HVC 150 Secondary)	X8-6	White
Interlock Out (HVC 150 Secondary)	X8-7	Brown
Shield Interlock Loop1 (HVC 150 Secondary)	X8-Shield (refer to the picture above)	Shield
CanH In (HVC 150 Secondary)	X8-1	Brown
CanL In (HVC 150 Secondary)	X8-2	White
GND Can (HVC 150 Secondary)	X8-3	Shield

See also Appendix H *Signal connection diagram*.

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

Interlock and CAN cable connections in **HVC 150 Secondary** :



1. Move the cables towards the terminal block X8.
2. Strip 0.43in of the insulation from the ends of **the White and Brown wires only!**
3. Crimp ferrules onto the ends of the White and Brown wires.
4. Ensure that the unused wires (Green and Yellow) are protected so that they cannot touch metal parts.
6. Loosen the connector screws.
7. Insert the wires into the connectors, see table below:

Functional description	Connector	Wire number
Interlock In (HVC 150 Primary)	X8-14	Brown
Interlock Loop2 Out (HVC 150 Primary)	X8-15	White
Shield Interlock Out (HVC 150 Primary)	X8-Shield (refer to the picture above)	Shield
CanH Out (HVC 150 Primary)	X8-16	Brown
CanL Out (HVC 150 Primary)	X8-17	White
GND Can (HVC 150 Primary)	X8-18	Shield

See also Appendix H *Signal connection diagram*.

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

5.9. Connecting the communication cable inside Power Cabinet

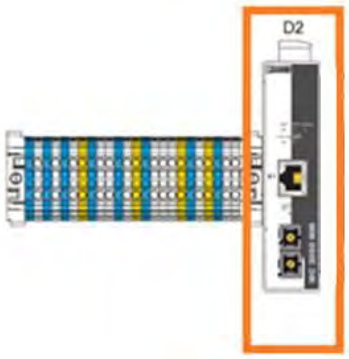
Prerequisites:

- Tools: ty-raps

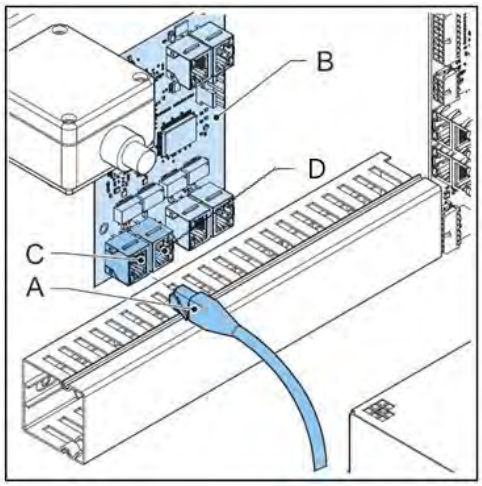
	NOTICE
	Depending on the distance between the Power Cabinet and the DDCB, two installation options are available. Resort to the communication fiber cable method if Ethernet to fiber converter (ETH2FIBER) is present inside the Power Cabinet.

5.9.1. Connecting the fiber cable communication to the Power Cabinet

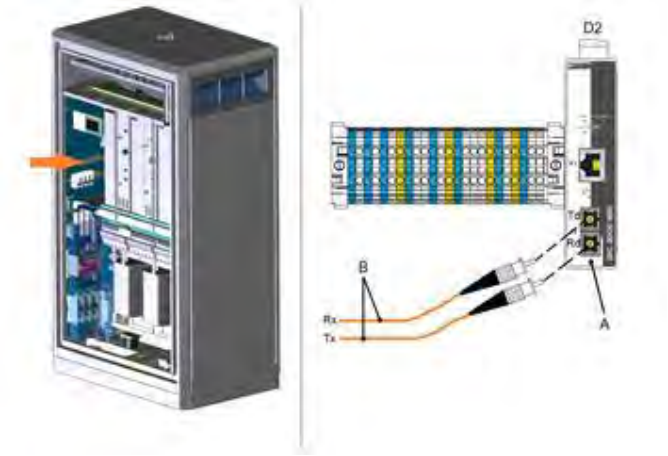
4. Check if the Ethernet to fiber converter (ETH2FIBER) is present inside the Power Cabinet. If not – apply instructions described in *(Optional) Connecting the Ethernet cable communication to the Power Cabinet* on *Page 92*.



5. Make sure that the RJ45 slot of the ETH2FIBER converter and J1 (C) or J3 (D) CAN2ETH (B) converter's slot are connected with an Ethernet cable. If not, use an Ethernet cable (A) to connect them.



6. Connect the communication fiber cables.



6.1. Remove the protection covers from the optical connectors.

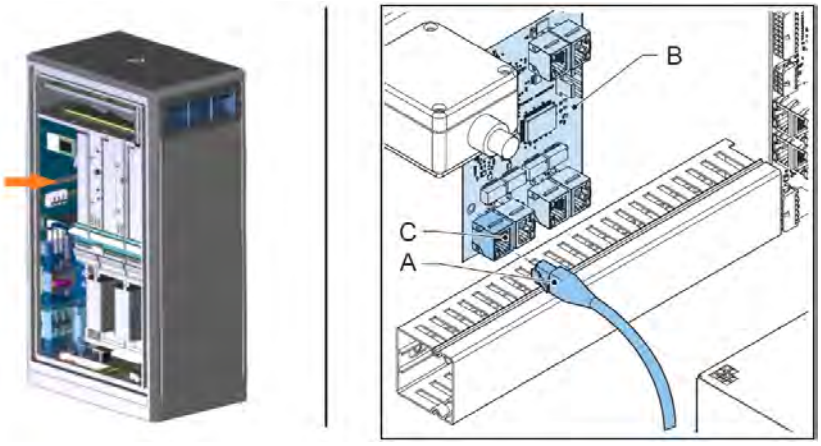
6.2. Connect the two Ethernet fiber cables (B) onto the module D2 (A):

- Rx (Optical 2) with Td D2;
- Tx (Optical 1) with Rd D2.

6.3. 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 64 mm, otherwise the core of the fiber cable may break.

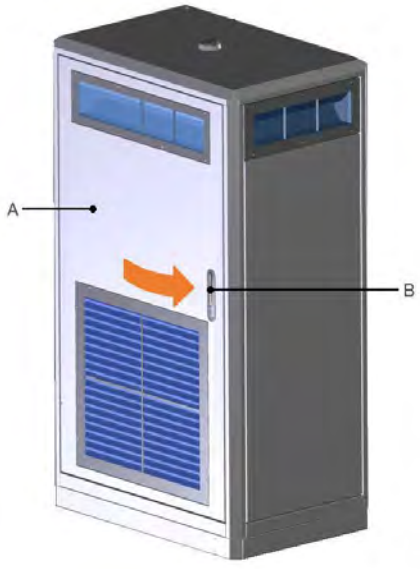
5.9.2. (Optional) Connecting the Ethernet cable communication to the Power Cabinet



Location of the CAN2ETH board

1. Route the Ethernet communication cable (A) to the CAN2ETH board (B).
2. Connect the RJ45 plug to the terminal J1 (C).

5.10. Closing the door of the Power Cabinet



Prerequisites:

- Key that were removed from the Power Cabinet

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

5.11. Unpacking the PD Kit components

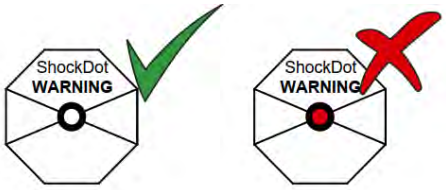
5.11.1. Before unpacking

A transport company delivers the EVSE close to the site. The movement of the EVSE to its final location is their responsibility.

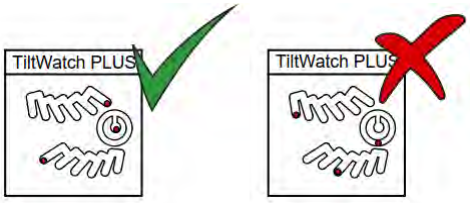
	**NOTICE** If you need to store the equipment before installation, obey the ambient conditions for storage. DO NOT store the equipment in a location exposed to severe weather conditions (e.g. rain, snow or a high level of humidity).
	**CAUTION** You are prohibited from transporting or handling the equipment unless you are authorised to handle it and you comply with the following safety measures!
	**WARNING** Please follow these steps to comply with the applicable Safety measures applicable to the working area including instructions for safe handling of the equipment.
	**DANGER** Handling personnel must wear all appropriate and applicable personal protective equipment (PPE) and follow all the applicable Health and Safety measures applicable to the working area.

- Choose the lifting equipment based on the weight of the equipment
- Check the weight on the transport document before moving the load.
  Check that the lifting equipment for loading/unloading is suitable and is able to move the equipment based on weight, and that is fully able to move into the pallet to provide full support. Lifting operators must comply to all local regulations.
- Check the position of the center of gravity before lifting the equipment in order to avoid overturning.
- Check that the pallet is not damaged. Otherwise please contact the responsible Health and Safety manager for the site to get instructed on how to unload the equipment and move it in a safe way.
- Check If you see any damage on the equipment, through the packaging material. If yes, do not unpack the equipment and contact the manufacturer to give details of the delivery problems.
- Do a check on the transport sensors (if present on the box):

- If the sensor (A) show that a shock was detected



- If the sensors (B) show a tilt that is too high.



Do not refuse the shipment.
Make notation on delivery receipt and inspect for damage.
If damage has occurred, leave item in its original packaging and request immediate inspection from carrier within the applicable time period.

- Check that the working place conditions are safe before handling the load (such as obstacle-free unloading area, proper flooring, safe path and other conditions).
- Ensure that the area is not accessible to unauthorized personnel and the personnel involved in handling the equipment are fully aware of the safety measures and keep sufficient distance away from moving equipment.

	NOTICE
	The manufacturer is not liable for any damages resulting from the improper handling and transportation of the equipment, in particular resulting from non-compliance with these instructions and other applicable regulations and standards (e.g. transport, occupational health and other safety standards).

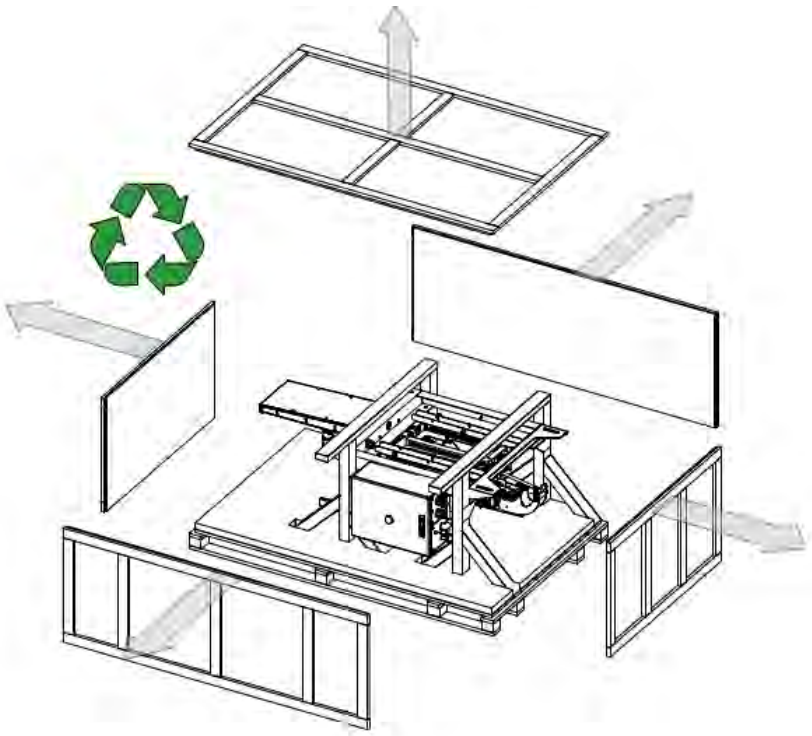
5.11.2. Unpacking

	WARNING
	Packaging elements (wood, cardboard, cellophane, staples, adhesive tape, straps, etc.) may cause cuts and/or injuries if not handled with care. They should be removed with the proper equipment.

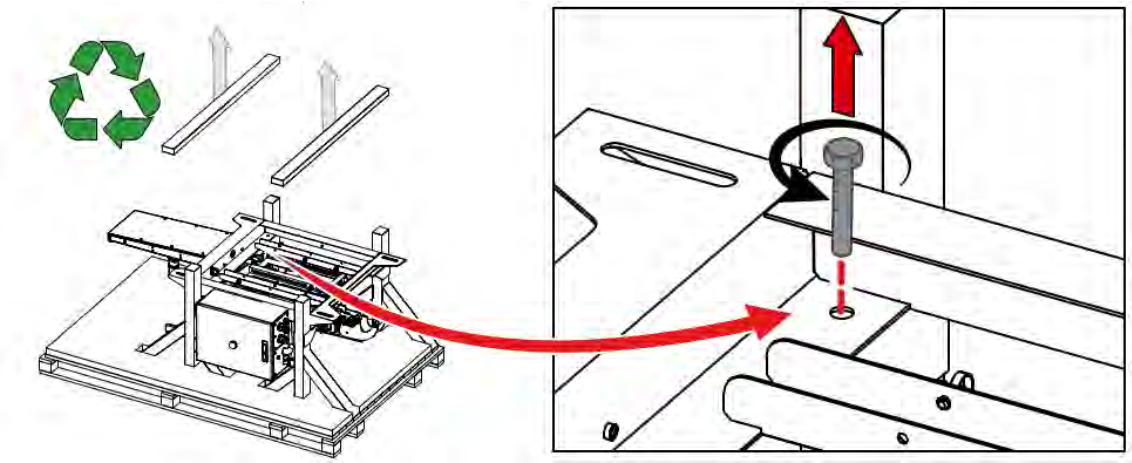
	NOTICE
	The components of the packaging must be disposed in accordance with the regulations in force in the country of installation.

	NOTICE
	If you find damage or the parts are not according to the order, contact the local manufacturer service dept.

- Remove the cover and the wooden walls of the box



- If present, take the bag which contain components supplied with the equipment (keys, cover caps, mounting material, etc..).
- Remove the two wooden crosspieces and the 4 fasteners (between the PD Kit bracket and the structure).



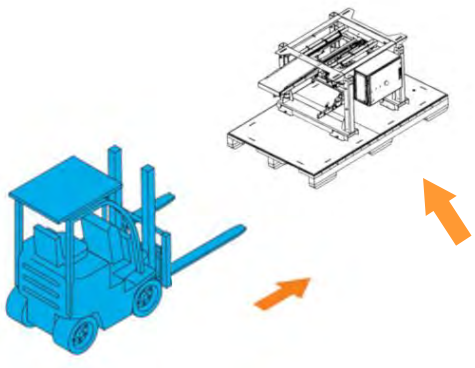
- The PD Kit is ready for lifting. Follow the instructions in the section.

5.12. Mounting the PD Kit

Prerequisites:

- The location is prepared for installation of the PD Kit.
- The location is closed to bystanders and all preparatory safety measures required during the lifting operations have been carried out.
- The PD Kit is detached from the supporting delivery elements and the cover sheet (if present) is removed.
- The structure on which the PD Kit is to be installed (e.g. a concrete ceiling) is prepared (see section *Ceiling installation of the PD* Kit on page 45).
- The work must be carried out by at least two workers. One person to operate the lifting equipment, the other to guide the PD Kit.
- 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 PD Kit.
	**WARNING** Ensure that personnel cannot fall from the platform when working at height.
	**CAUTION** **Warranty** Any damage caused during the process of moving PD Kit to its position is not covered by the warranty.

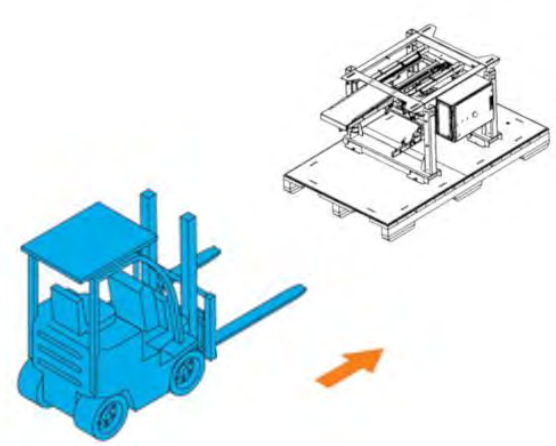


The forklift truck can grab the whole PD Kit from the right and from the front - as indicated by the arrows. The transport legs (2) allows all four sides entry of the forks.

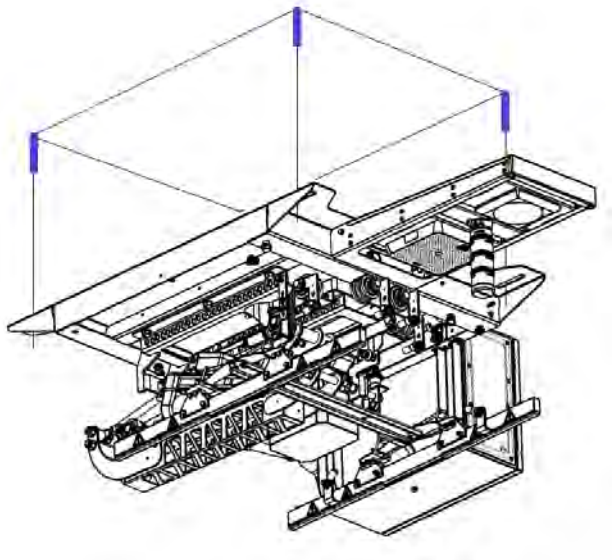
Depending on the circumstances of the installation a proper type of lifting equipment must be utilized. Two options of installation are available.

5.12.1. Mounting the PD Kit onto the ceiling

The PD Kit can be mounted as a whole. In that case, after removing all the packaging and the connections between the Set and the transport supports, it can be moved and installed at the desired location. The device should be lifted by the Support – in a way that will allow free access to the mounting slots.

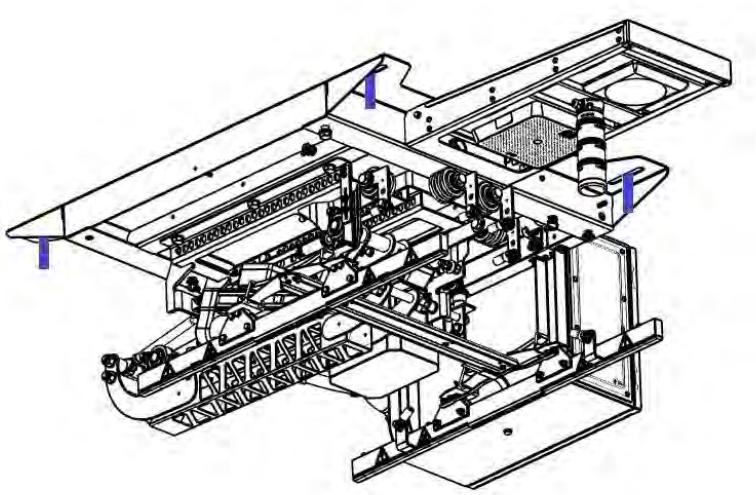


1. Move the PD Kit to the installation location.



2. Carefully lift the PD Kit and align the Support with previously designated and prepared site.

3. Continue lifting the Set until the Support's top surface reaches the surface of the ceiling.

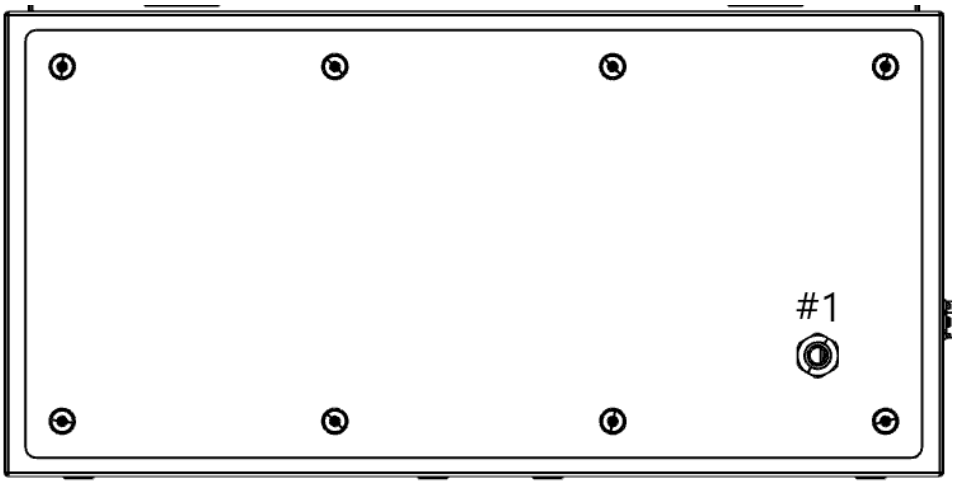


4. Secure the Set with the mounting utilities chosen for the installation.

5.13. Cable connections of the Control Box Panto Down

	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.

5.13.1. Gland layout of the Control Box Panto Down

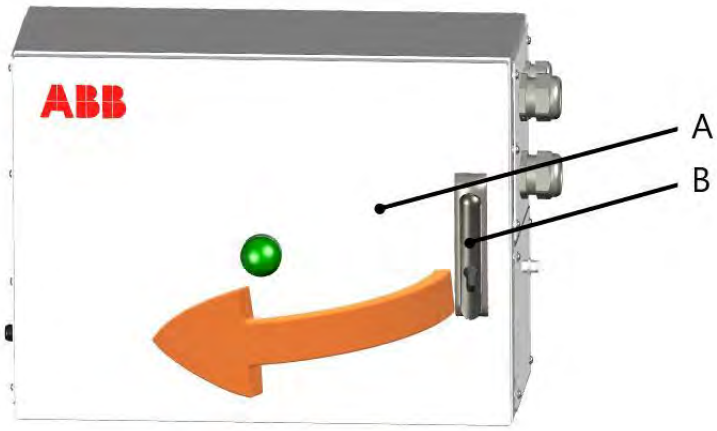


	NOTICE
	The remaining cable glands should be installed according to the local standards. See appendix G - *Recommended positions of cable glands in the Control Box Panto Down* on page 126 – for the suggested locations of the cable glands.

5.13.2. Opening the door of the Control Box Panto Down

Prerequisites:

- Key



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

5.13.3. Connecting the DC power in cables

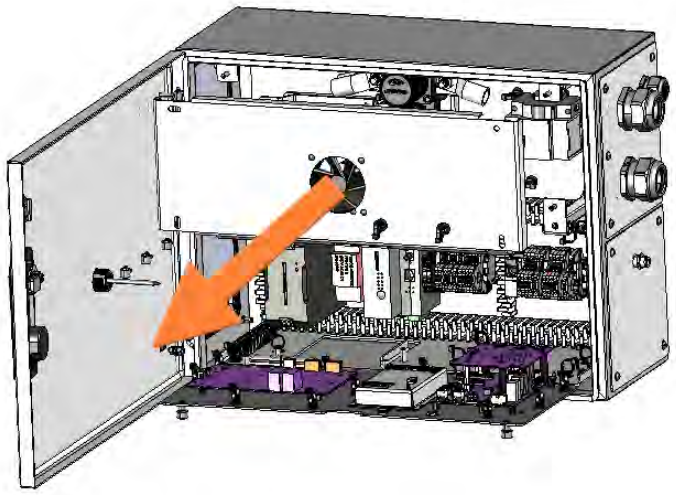
Prerequisites:

- Tools: wire cutter, wire stripper pliers, cable lugs (4x) - preinstalled inside the Control Box, spanner (size13 and 18), torque wrench (size 13 and 18).

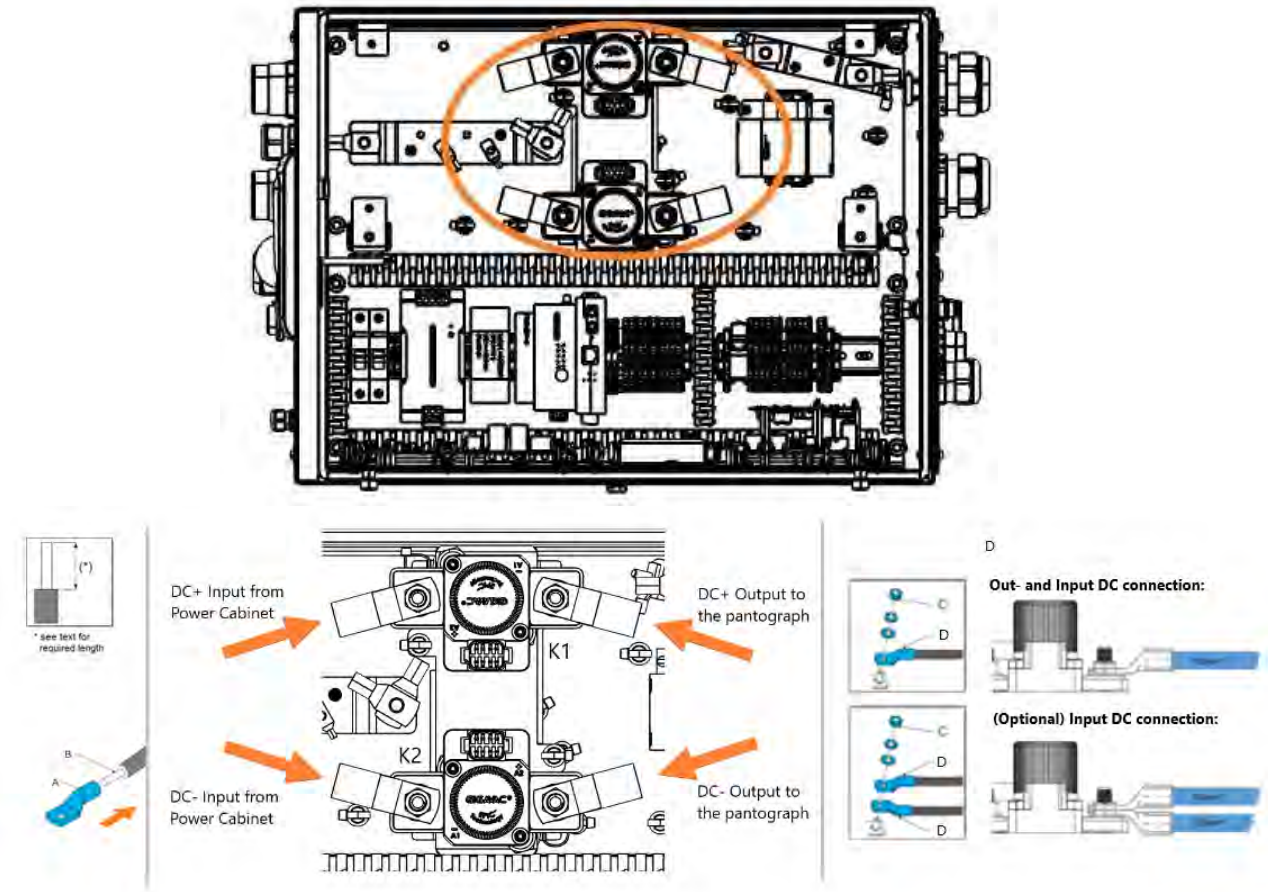
	NOTICE
	Ensure that the DC cables do not hit the PCBAs located on the door of the Control Box while mounting. If these cables hit the PCBAs, the boards can be damaged. It is advised to protect the PCBAs during mounting of the DC cables.

To prevent damage of the PCBAs in the Control Box:

1. Open the door of the Control Box and check the required length.



2. Remove the DC contactor's protection cover. Pay attention to the cables attached to the fan located on the cover. They need to be unplugged while removing the cover.

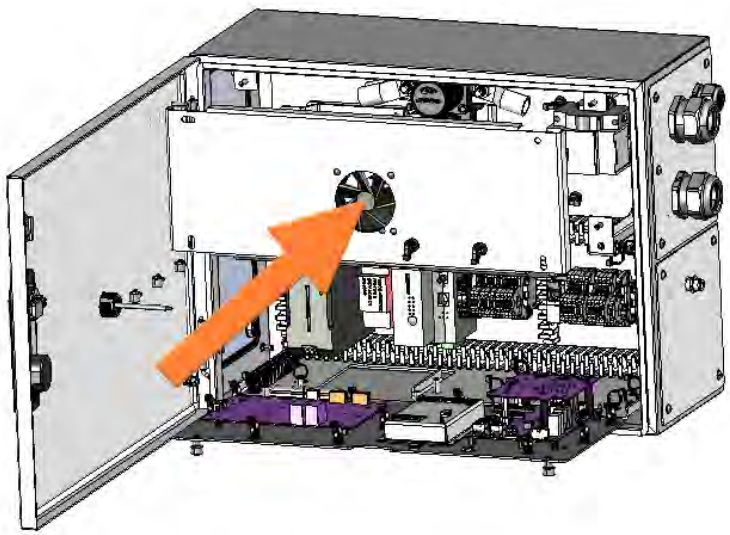


	NOTICE
	Depending on the distance between the Power Cabinet and the Control Box the DC input cables may require to be doubled. Refer to the picture above.

3. Loosen and remove the cable gland's nuts, including the cover caps inside the gland.
4. Slide the cable gland's nuts over the power cables.
5. Strip the insulation on the required length specified by the used lug from the end of the wire (B).
6. Insert the DC power cables into the right cable glands.
7. Remove the nuts and washers (C) from the bolts of the DC contactor connectors and take the attached cable lugs.
8. Attach cable lugs (A) at the ends of the wires. The cable lugs should be attached
9. **If present:** remove the sense wires from the bolts of the DC contactor connectors.
10. Insert the wires (D) onto the correct bolts of the DC contactor connectors, see picture above for the correct connection.
11. 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 not, the system will not function properly.

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

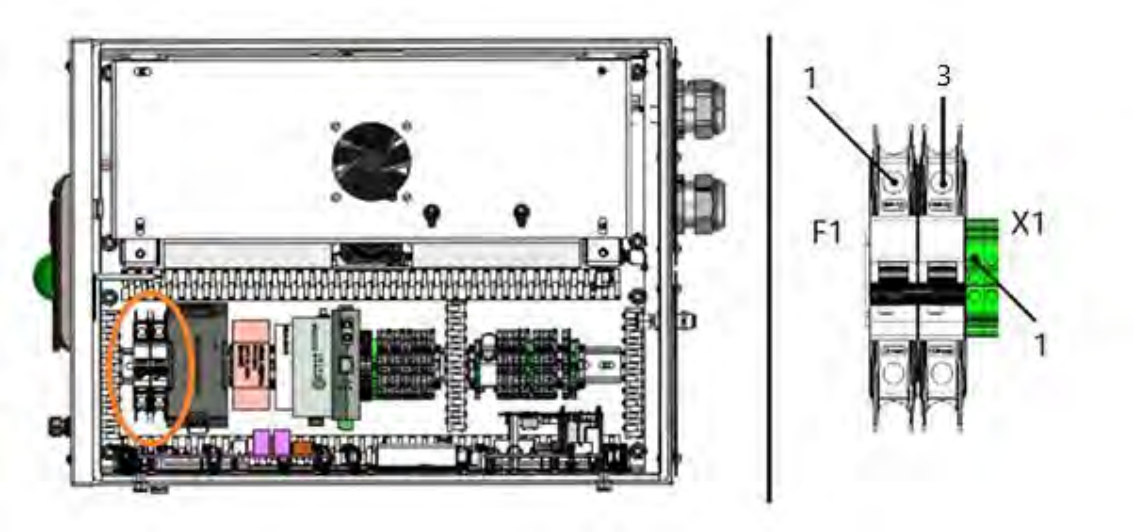


13. Place the protection cover back on the DC contactors. Reconnect the power supply cables of the fan.
14. Manually tighten the screws of the protection cover.
15. Tighten the cable gland's nut to secure the DC power cables.

5.13.4. Connect the AC utility power cable

Prerequisites:

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



1. Loosen and remove the cable gland's nut for the AC utility power cable.
2. Slide the cable gland's nut over the AC utility power cable.
3. Route the AC utility power cable through the gland to the circuit breaker (F1) and terminal block (X1), with sufficient cable length (do not make the cable routing too tight nor too loose).
4. Tighten the nut of the gland to secure the AC utility power cable.
5. Strip the insulation from the AC utility power cable.
6. Cut the wires of the AC utility power cable to the proper length allowing to reach the connectors.
7. Strip 0.43 in of the insulation from the ends of the wires.
8. Crimp ferrules onto the ends of the wires.
9. Loosen the connector screws.
10. Insert the wires into the connectors of the circuit breaker (F1) and the terminal block (X1):

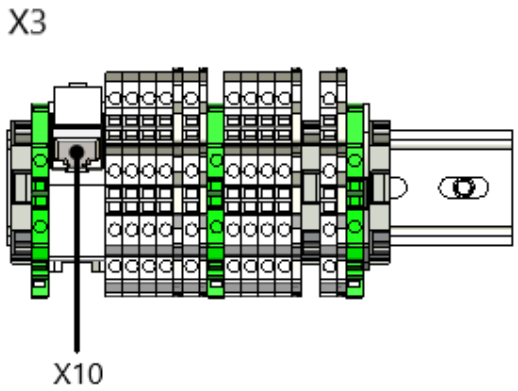
	NOTICE
	Check the connections inside the Control Box (at the bottom of the circuit breaker) to ensure correct connection of the AC utility power cable.

- From left to right:
  F1-1: L1 (black),
  F1-3: N (blue),
  X1-1: PE (green-yellow).

11. Tighten the connector screws of circuit breaker (F1) and terminal block (X1) with a tightening torque of 2.21 ft-lb.

5.13.5. Connect the communication cable from the Power Cabinet

1. Manually remove the cable gland's nut for the communication cable.
2. Remove the rubber seal inside the cable gland.
3. Slide the cable gland's nut over the RJ45 connector of the communication Ethernet cable.
4. Slide the cable gland's rubber seal over the RJ45 connector of the communication Ethernet cable.
5. Insert the communication cable into the cable gland and tighten the cable gland's nut to secure the cable.



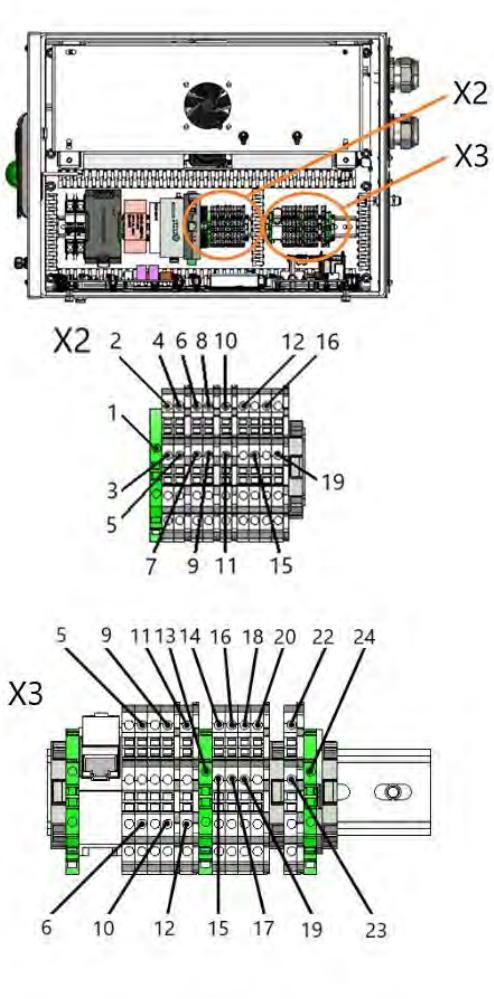
6. Route the communication Ethernet cable to module X10 located on X3 rail.
7. Bind the cables together and secure the loops loosely with a piece of tak-ty or ty-rap.

5.13.6. Remaining connections of the Control Box

Prerequisites:

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

X2	Interlock / DC Guard cable
1	GND
4	Interlock In
5	Interlock Out
2	DC_Guard_A
3	DC_Guard_GND
X2	**External beacon cable**
12	Beacon BLUE
15	Beacon RED
16	Beacon +24V
19	Beacon GREEN
X2	**External EMOs**
6	Ext EMO 1+
7	Ext EMO 1-
8	Ext EMO 2+
9	Ext EMO 2-
X2	**External Stop button**
10	Stop+
11	Stop-



1. Loosen and remove the cable gland's nuts (see for overview *Gland layout of the Control Box Panto Down* in Page 99) for the cables.
2. Slide the cable gland's nut over the cables.
3. Route the cables through the right glands to the connector blocks (X2), with sufficient cable length (do not make the cable routing too tight, or too loose).
4. Tighten the nuts of the glands to secure the cables.
5. Strip the insulation from the cables.
6. Cut the wires of the cables to the correct lengths to reach the connectors
7. Strip 0.43 in of the insulation from the ends of the wires.
8. Crimp ferrules onto the ends of the wires.

	NOTICE
	**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.

9. Loosen the connector screws.
10. Insert the wires of the cables listed below into the corresponding terminal block.
11. Tighten the connector screws of terminal blocks.
12. Insert the other wires into the correct connectors, refer to the table above.

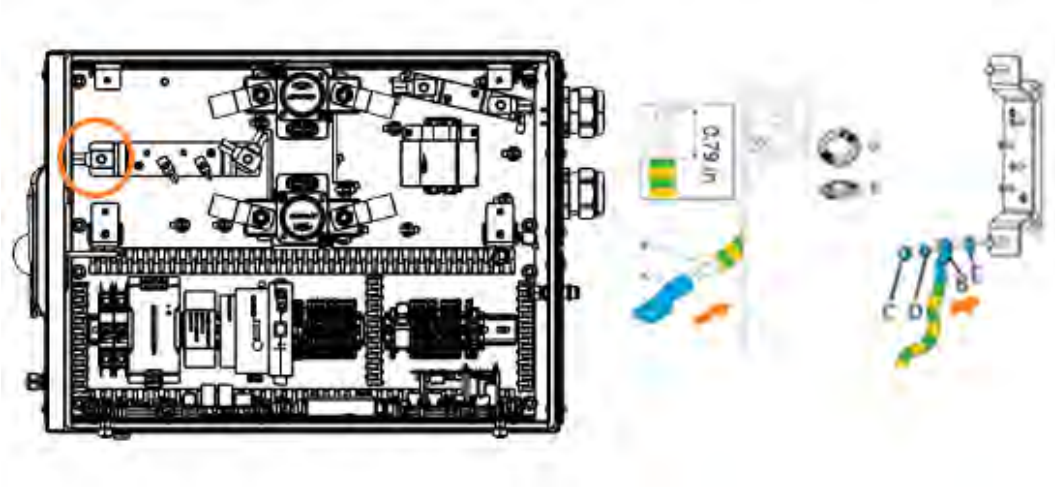
	NOTICE
	In case an external Emergency Stop Button (EMO) is to be connected, it is necessary to remove the jumpers connecting terminal blocks X2-6 and X2-7 (for EMO 1) or X2-8 and X2-9 (for EMO 2).

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

5.13.8. Connecting GND wire from the Power Cabinet

Prerequisites:

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



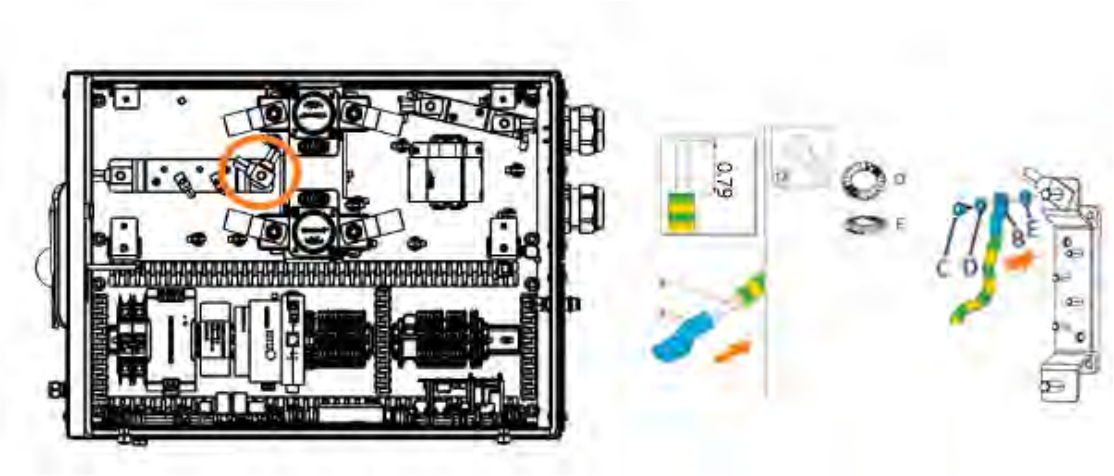
1. Loosen and remove the cable gland's nut for the Power Cabinet GND wire.
2. Slide the cable gland's nut over the Power Cabinet GND wire.
3. Cut the GND wire to the proper length to reach the GND rail (shown in the picture above). Do not make the wire routing neither too tight nor too loose.
4. Strip 0.79in of the insulation from the end of the wire.
5. Attach a wire end ring (A) to the end of the GND wire (B).
6. Remove the M10 nut and washers from the GND rail.
7. Fit the contact washer (E), the GND wire (B) and the toothed washer (D) over the rail's bolt.
8. Secure the wire with M10 nut (C).
9. Tighten the nut with a tightening torque of 22 ft-lb.
10. Tighten the cable gland's nut to secure the Power Cabinet GND wire.

5.13.9. Connecting GND wire of the External Grounding

- GND may be connected from locally available ground connection in the vicinity of the PD Kit.
- GND may be routed from Power Cabinet or distribution board via cable conduits.

Prerequisites:

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

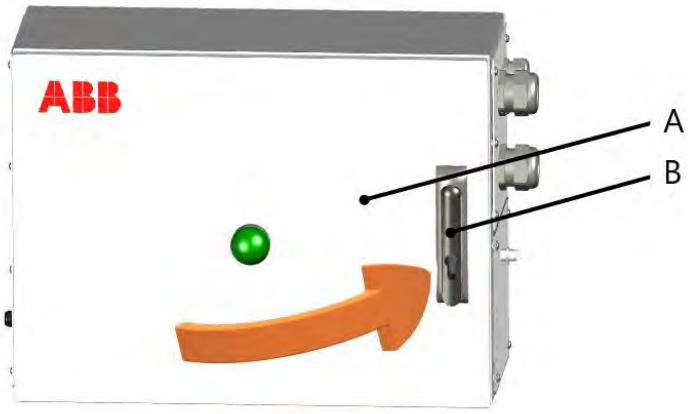


1. Loosen and remove the cable gland's nut for the External Grounding GND wire.
2. Slide the cable gland's nut over the External Grounding GND wire.
3. Cut the GND wire to the proper length to reach the GND rail (shown in the picture above). Do not make the wire routing neither too tight nor too loose.
4. Strip 0.79in of the insulation from the end of the wire.
5. Attach a wire end ring (A) to the end of the GND wire (B).
6. Remove the M10 nut and washers from the GND rail.
7. Fit the contact washer (E), the GND wire (B) and the toothed washer (D) over the rail's bolt.
8. Secure the wire with M10 nut (C).
9. Tighten the nut with a tightening torque of 22 ft-lb.
10. Tighten the cable gland's nut to secure the External Grounding GND wire.

5.13.10. Closing the door of the Control Box

Prerequisites:

- Key



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

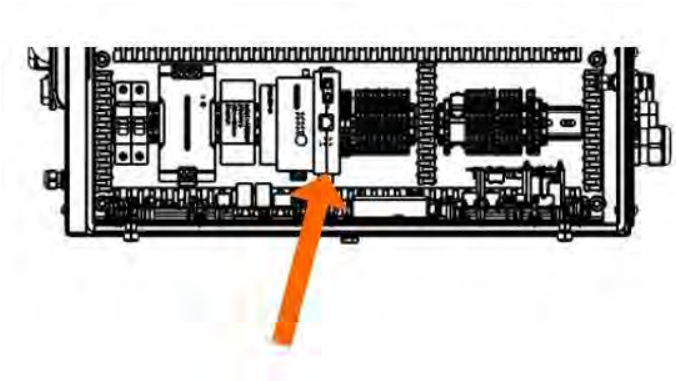
5.14. Long Distance Kit

5.14.1. About Long Distance Kit

In case of distance between Power Cabinet HVC150 and Control Box PD more than 100m (up to 150m) Long Distance Kit is needed.
Using Long Distance Kit communication is realized by fiber.
Needed fiber to ethernet converters are already in Control Box PD and in Power Cabinet HVC150 NA variant.
Necessary is to make reconnections in Control Box PD.

5.14.2. Reconnections

In Control Box PD is needed to add Ethernet cable between Ethernet to fiber converter (marked -D1, plug X1) and RJ45 connection terminal (marked -X10) on DIN rail (marked -X3) - see picture below.



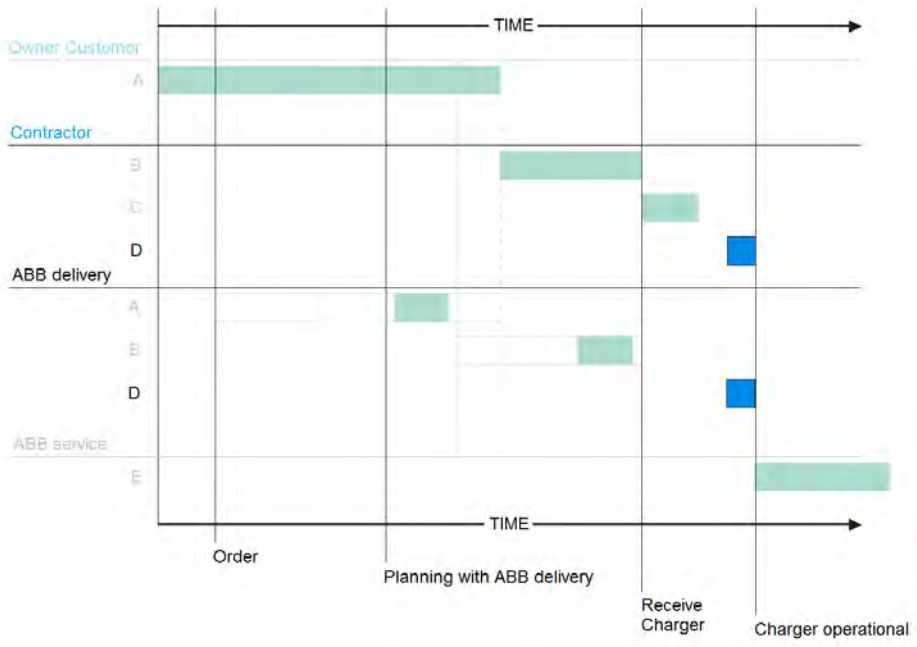
To ensure communication between Power Cabinet HVC150 and Control Box PD external fiber is needed.
Fiber should be connected to converter -D1, plug -X2 in Control Box PD and to converter -D2, plug -X2 in Power Cabinet HVC150, refer to section **5.9.1.**

The fibers between in Power Cabinet HVC150 and outlet always connect an output terminal to an input terminal. Do not connect terminals that are the same, for example an output terminal to an output terminal.

6. Commissioning

6.1. Commissioning preparation

Commissioning is the last phase necessary to get the HVC150 PD Kit (Schunk SLS 201.102) into operation.
The planning steps for the commissioning phase are shown in the figure below.



D **Commissioning**

The commissioning of the HVC150 PD Kit (Schunk SLS 201.102) needs 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.
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.
- Boom is lift available to check all the connections on the pantograph.
- An electric or hybrid bus is available to perform the functional tests.

	CAUTION

Warranty

It is not permitted to move the entirety or any elements of the HVC150 PD Kit (Schunk SLS 201.102) after the commissioning. If the entirety or any parts of the HVC150 PD Kit (Schunk SLS 201.102) are moved without contacting the ABB Service department, the warranty will be considered void.

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.

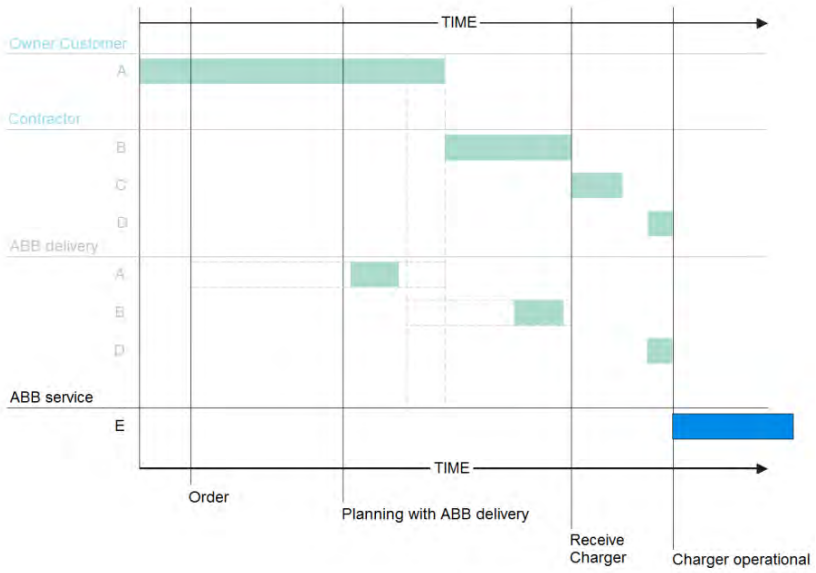
The CAF contains information about:

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

After the CAF is 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, which is outside of the scope of this document.

7.2. Cleaning the cabinet

The Power Cabinet and PD Kit are powder coated. This coating must be kept in good condition.
Clean the Power Cabinet and PD Kit 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 manually with a non-woven nylon hand pad.
- Rinse thoroughly with tap water.
- (Optionally) Apply wax on the front for extra protection and gloss.
- Check the coating for any damage.

	**NOTICE** When the HVC150 PD Kit (Schunk SLS 201.102) 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. - 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

Electrical specification - Power Cabinet

Input	
Supply voltage	3-phase: GND, L1, L2, L3
Input voltage range	480/277 V AC ± 10% 600/347 V AC +10%/-15% (Canada version)
Input frequency range	60 Hz ± 1%
Maximum power dissipation	170 kVA
Power factor (cos φ)	≥ 0.95 (> 0.97 at full load)
Standby power consumption	60 W for 1x HVC cabinet
Efficiency	94% and 96% in power spectrum between 20% and 100% of full power
Maximum input current	198 A AC
Nominal input current	198 A AC
Earth Leakage Current Protection	AC 300 mA (RCD integrated in HVC150(S)) AC 30 mA (RCD integrated in Control Box)
Short Circuit Capacity	65 kA
AC power connection	240 mm^2 = 500 MCM (max)
DC output	
Maximum output power	150 kW
Output voltage range	150 – 850 V DC
Maximum output current	250 A DC

8.2. Electrical specification complete 300 kW system

Input	
Supply voltage	3-phase, 400 V AC: PE, L1, L2, L3
Input voltage range	480 V AC ± 10%
Input frequency range	60 Hz ± 1%
Maximum power dissipation	340 kVA (2x 170 kVA)
Power factor (cos φ)	≥ 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
Maximum input current	396 A AC (2x 198 A AC)
Nominal input current	396 A AC (2x 198 A AC)
Earth Leakage Current Protection	AC 300 mA (RCD integrated in HVC150(S)) AC 30 mA (RCD integrated in ACS Control Module)
Short Circuit Capacity	65 kA
AC power connection	240 mm^2 (max) (in both HVC 150 and 150S)
DC output	
Maximum output power	300 kW
Output voltage range	150 – 850 V DC
Maximum output current	400 A DC (limited by PD Control Box)

8.3. Electrical specification – PD Kit

DC Input	
Supply voltage	1 Phase AC: L, N, PE
Input voltage range	115…230V AC ± 10%
Input frequency range	50-60 Hz ± 4%
Maximum input current	1.6A AC
Nominal input current	0.6A AC
AC power connection	4 mm2 (max)
DC output main	
Maximum output power	350 kW
Output voltage range	150 – 1000 V DC
Maximum output current variants (depends on pantograph)	400 A DC

8.4. Mechanical data

Mechanical specification - Power Cabinet

Dimensions (H x W x D)	82.36 x 46.06 x 30.32in (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 31.50in
Weight including packing	3086.47 lb
Weight concrete foundation	2866.00 lb
Mechanical impact protection	IK10
Housing	Stainless steel 430

Mechanical specification - PD Kit

Dimensions (H x W x D)	95.24 x 50.79 x 26.89 in (Pantograph housed) 95.24 x 50.79 x 93.58 in (Pantograph extended)
Weight	881.85 lb
Volume	130073.37 in^3
Mechanical impact protection	IK10
Housing	Stainless steel 304 (316 for close to the sea)

8.5. Environment

Environment specification - Power Cabinet

Ingression protection	IP54
Temperature range – Operation	-35 ºC to +45 °C
Temperature range – Storage	-10 ºC to +70 °C
Humidity	5 % to 95 %, RH – non-condensing
Airflow	51206.27 ft^3/h
Pressure drop	300 Pa
Altitude	6561.68 ft (max.)
Storage conditions	Indoors, dry

Environment specification – PD Kit

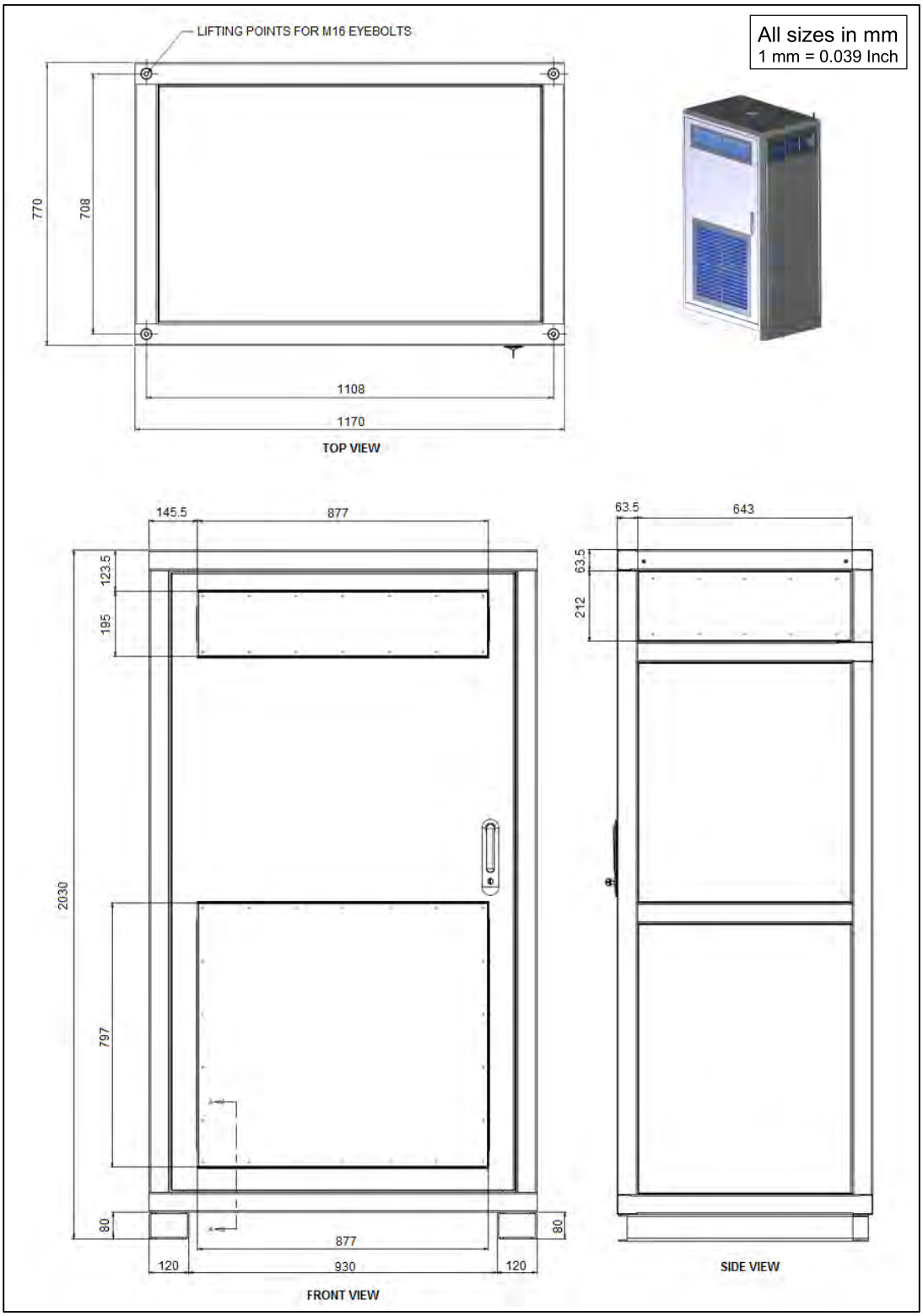
Ingression protection	IP65
Temperature range – Operation	-30 ºC to +45 °C
Temperature range – Storage	-10 ºC to +70 °C
Humidity	5 % to 95 %, RH – non-condensing
Altitude	6561.68 ft (max.)
Storage conditions	Indoors, dry

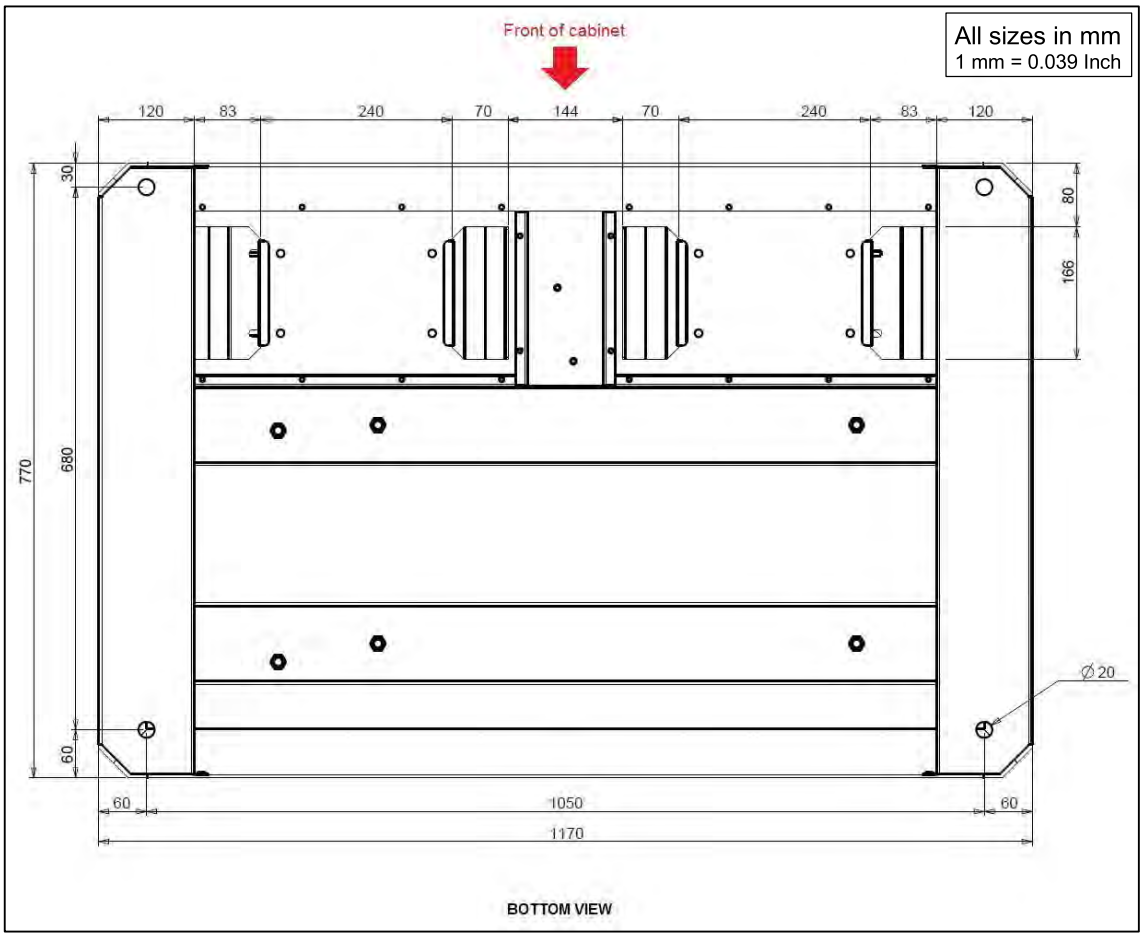
CAUTION

Warranty
Warranty will be considered void when the HVC150 PD Kit (Schunk SLS 201.102) is damaged while badly stored at the customer's location.

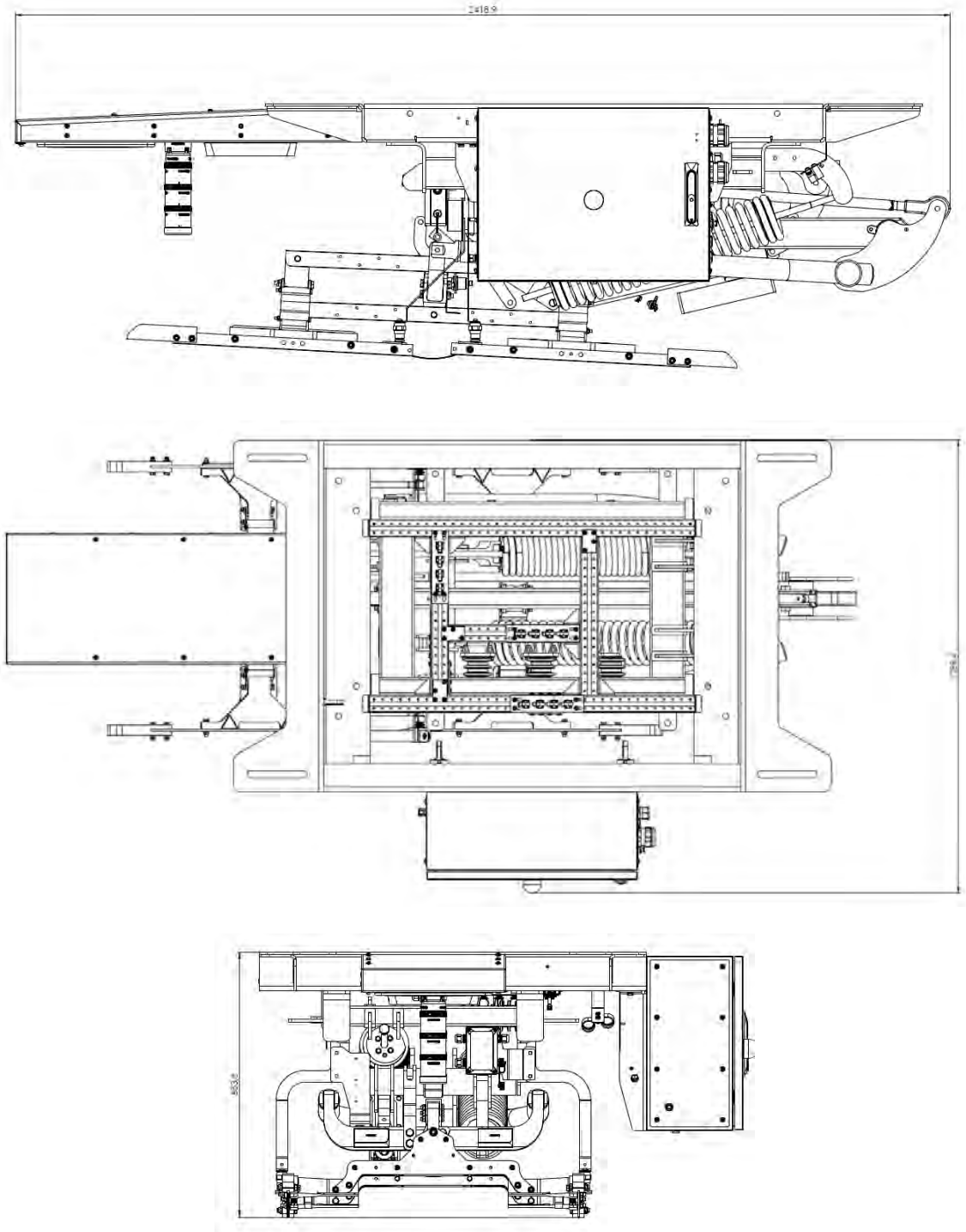
9. Appendices

A. Dimensions of the Power Cabinet



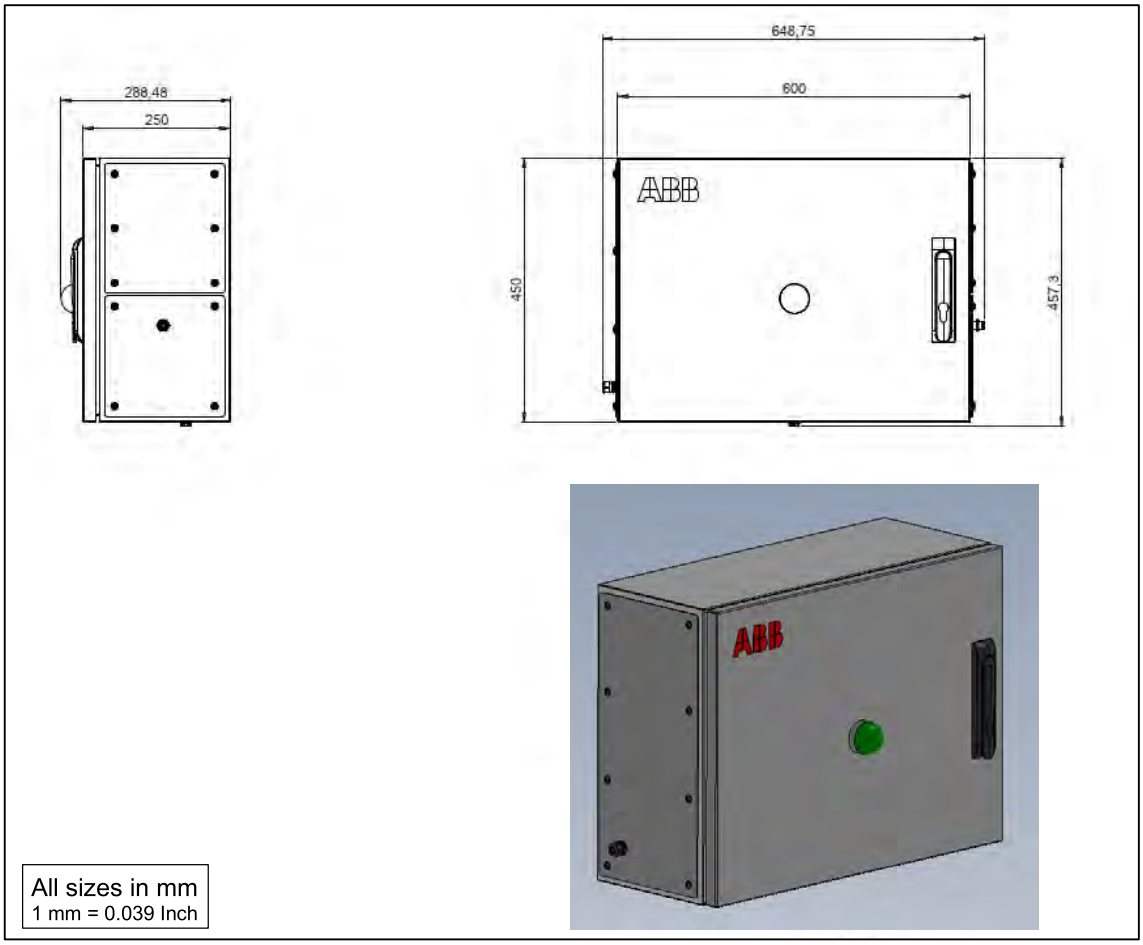

Front of cabinet
All sizes in mm
1 mm = 0.039 Inch
120
83
240
70
144
70
240
83
120
30
80
166
770
680
60
Ø 20
60
1050
60
1170
BOTTOM VIEW

B. Dimensions of the PD Kit

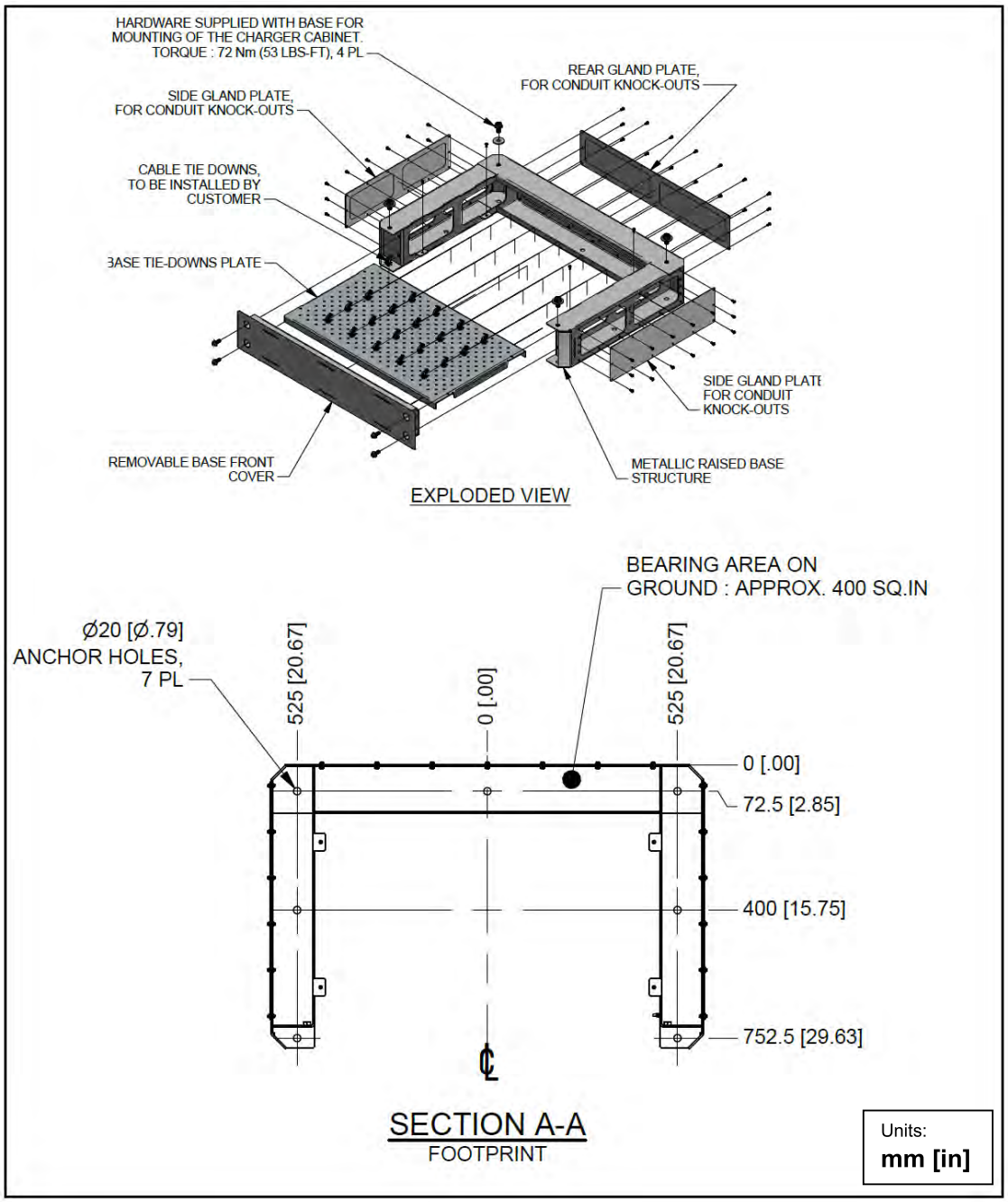


Units:	Weight:
mm	**881.84 lbs**

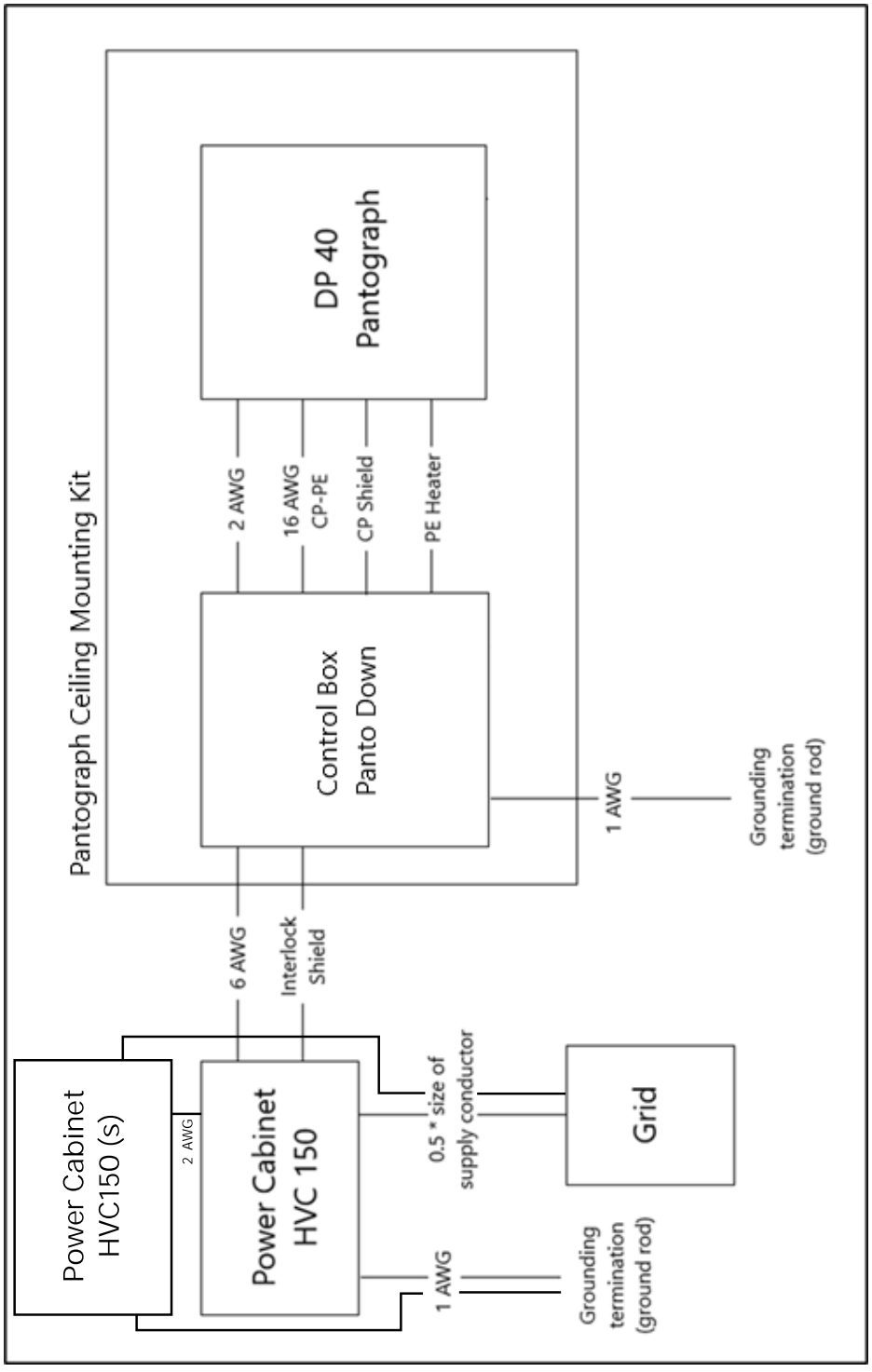
C. Dimensions of the Control Box Panto Down



D. Dimensions of the Metal Foundation - Power Cabinet

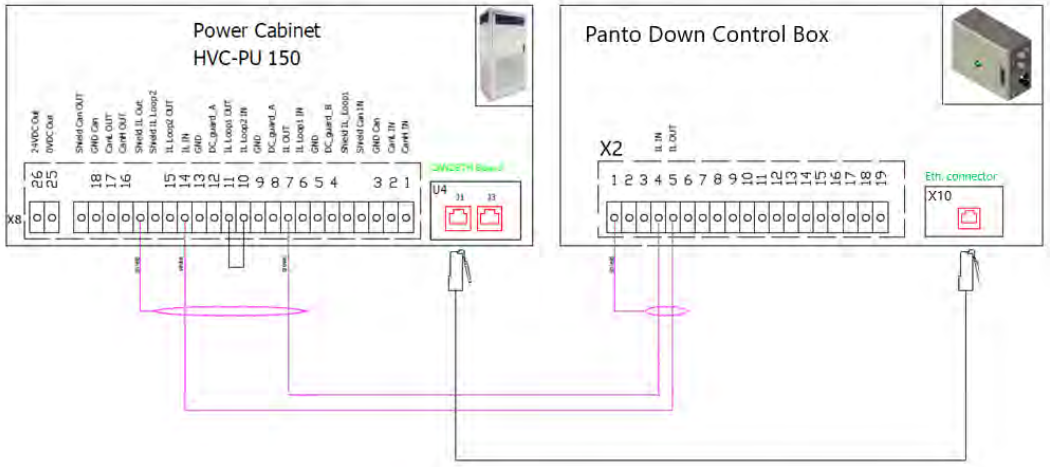


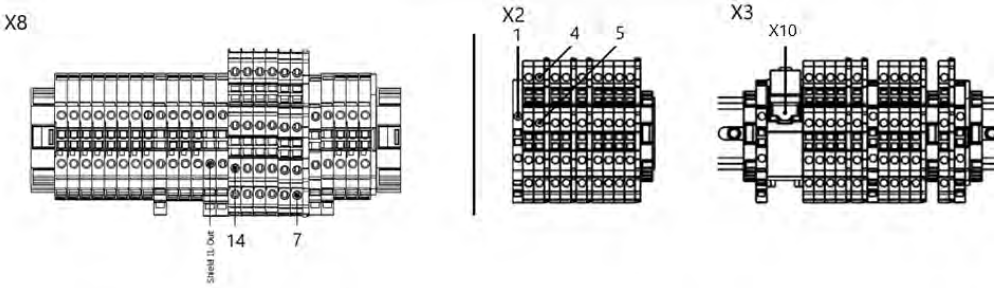
E. Ground overview



F. Signal connection diagram

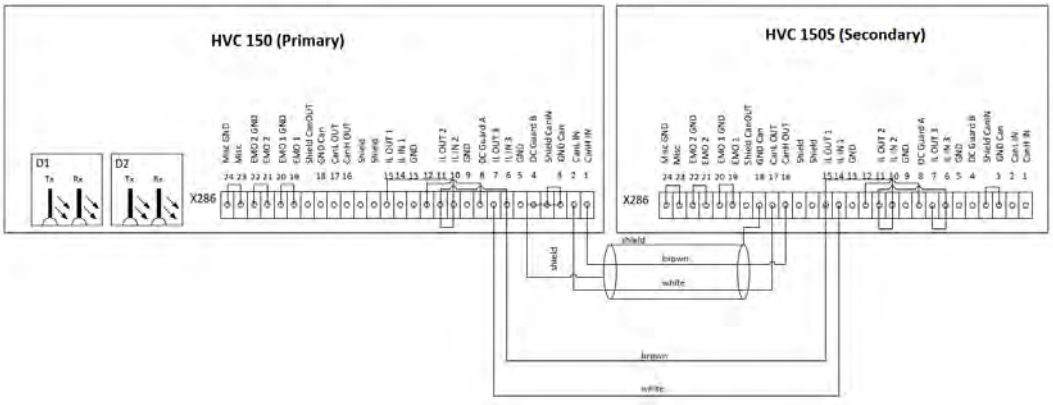
For Primary 150 kW Power Cabinet





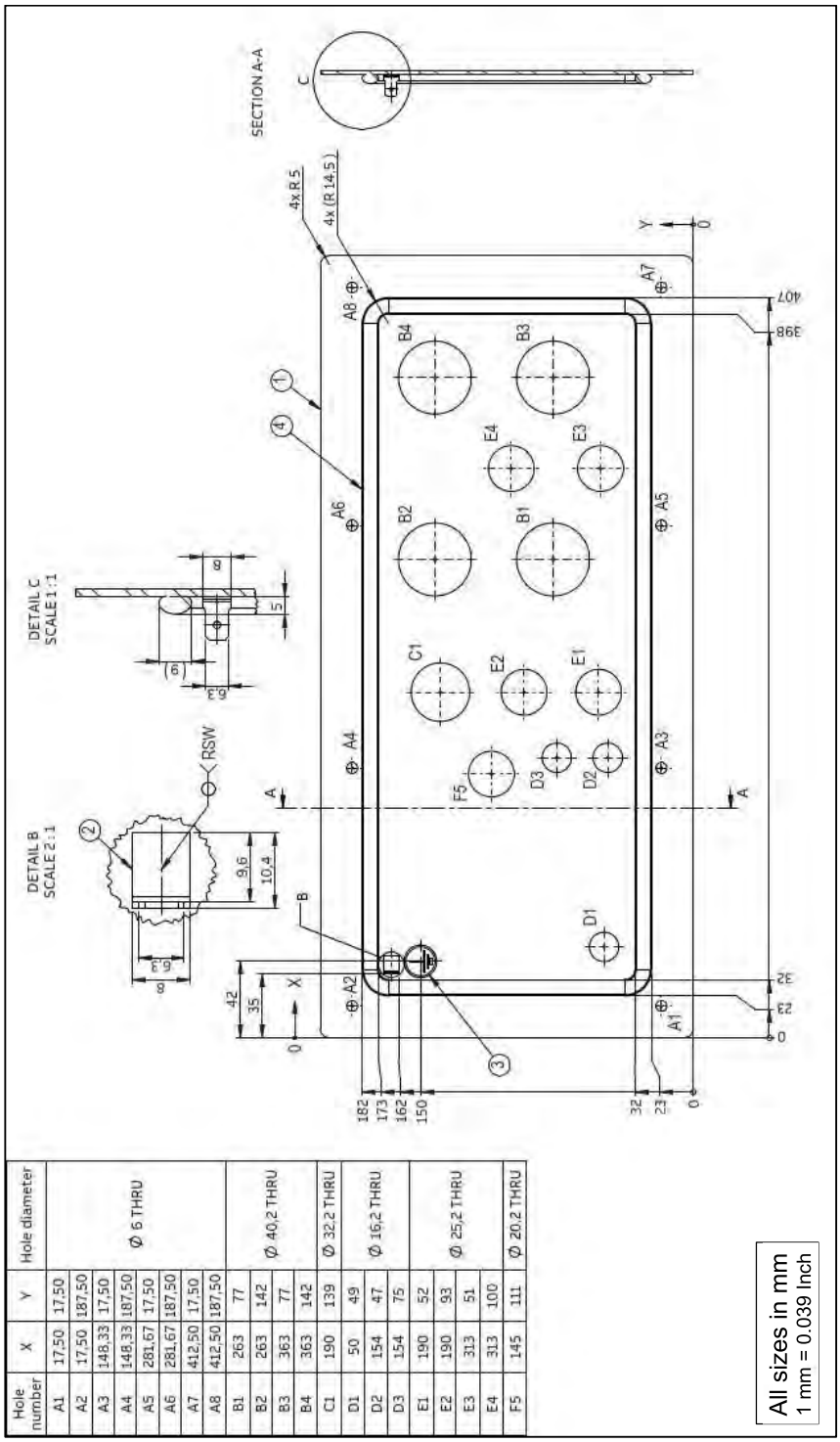
HVC 150			ACS Control Module
X8		Interlock cable	X2
7			5
14			6
U4		Ethernet cable	X3
J1			X10

Additional connections between Power Cabinets for HVC300 PD (300 kW)



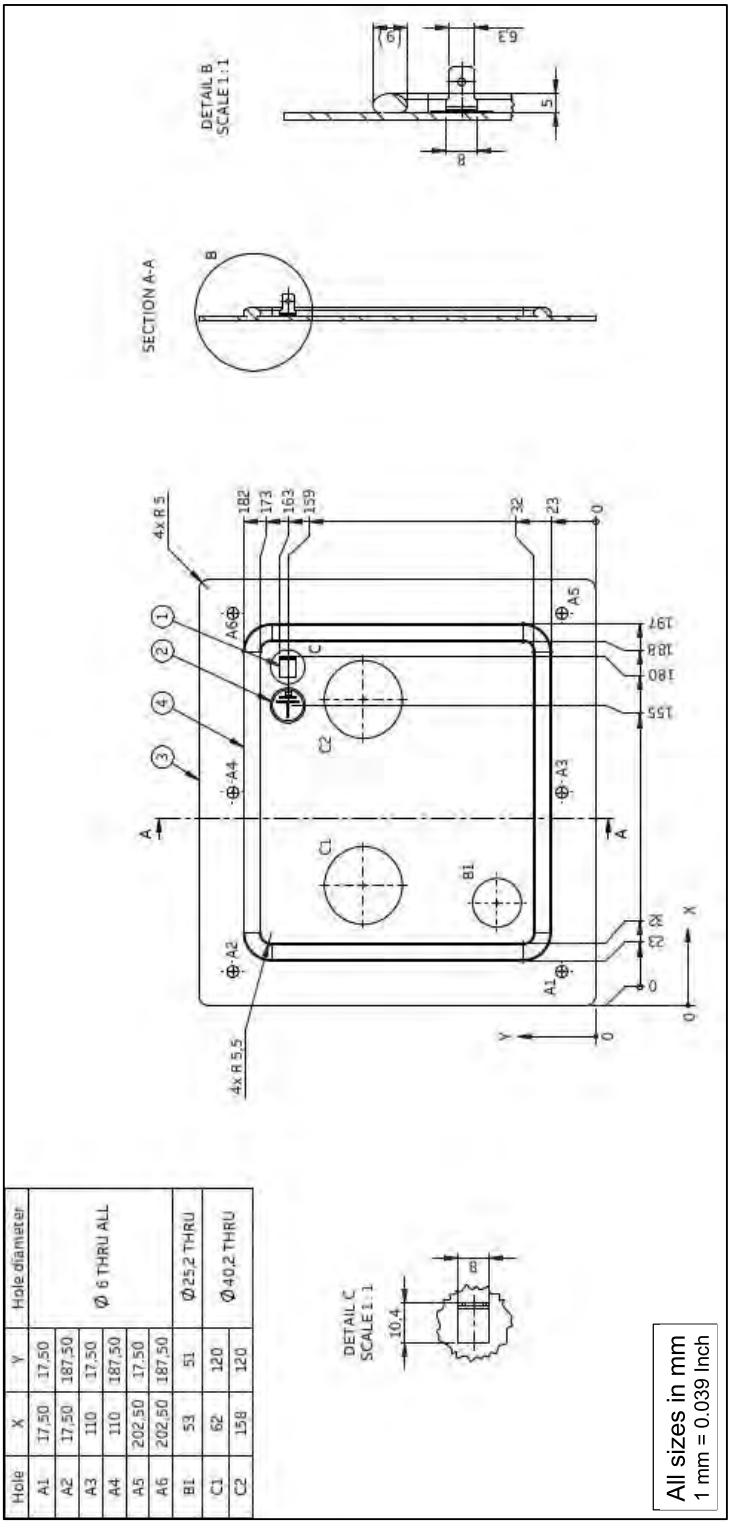
G. Recommended positions of cable glands in the Control Box Panto Down

Left side plate (as seen from inside of the Control Box)



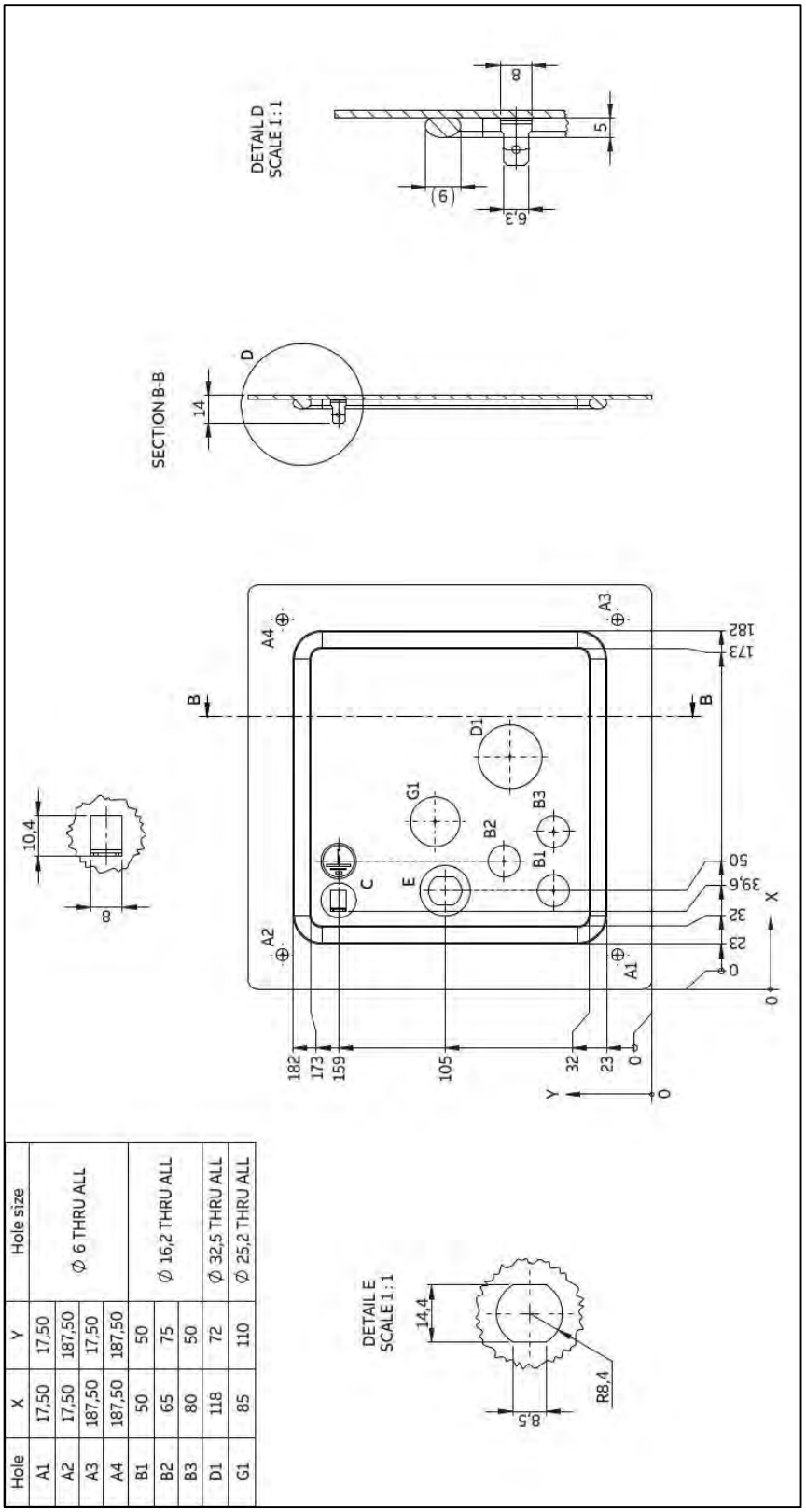
Hole number	X	Y	Hole diameter
A1	17,50	17,50	Ø 6 THRU
A2	17,50	187,50	
A3	148,33	17,50	
A4	148,33	187,50	
A5	281,67	17,50	
A6	281,67	187,50	
A7	412,50	17,50	
A8	412,50	187,50	
B1	263	77	Ø 40,2 THRU
B2	263	142	
B3	363	77	
B4	363	142	
C1	190	139	Ø 32,2 THRU
D1	50	49	Ø 16,2 THRU
D2	154	47	
D3	154	75	
E1	190	52	Ø 25,2 THRU
E2	190	93	
E3	313	51	
E4	313	100	
F5	145	111	Ø 20,2 THRU

Top right side plate (as seen from inside of the Control Box)



Hole	X	Y	Hole diameter
A1	17,50	17,50	Ø 6 THRU ALL
A2	17,50	187,50	
A3	110	17,50	
A4	110	187,50	
A5	202,50	17,50	
A6	202,50	187,50	
B1	53	51	Ø 25,2 THRU
C1	62	120	Ø 40,2 THRU
C2	158	120	

Bottom right side plate (as seen from inside of the Control Box)



Hole	X	Y	Hole size
A1	17,50	17,50	Ø 6 THRU ALL
A2	17,50	187,50	
A3	187,50	17,50	
A4	187,50	187,50	
B1	50	50	Ø 16,2 THRU ALL
B2	65	75	
B3	80	50	
D1	118	72	Ø 32,5 THRU ALL
G1	85	110	Ø 25,2 THRU ALL

NOTES

Opportunity charging 150 kW to 450 kW

A scalable system with future-proof reliability

Charging on existing structure

HVC 150PD KIT

HVC 300PD KIT

HVC 450PD KIT

Charging on route

Liberty Lake P&R:

HVC 150PD

HVC 300PD

HVC 450PD

With ABB's flexible HVC architecture, power capability can be expanded over time, allowing operators to spread out infrastructure investments as their fleet grows.

Technical specifications

Configurations		HVC 150PD	HVC 300PD	HVC 450PD
Maximum output power		150 kW	300 kW	450 kW
Input AC connection		U.S.: 3-phase, 480Y/277 VAC +/- 10 % (60 Hz); Canada: 3-phase, 600Y/347 VAC +/-10% (60 Hz)		
Rated input power		170 kVA	2x 170 kVA	3x 170 kVA
Rated input current		U.S.: 198 A Canada: 168 A	U.S.: 2x 198 A Canada: 2x 168 A	U.S.: 3x 198 A Canada: 3x 168 A
Recommended upstream circuit breaker(s)		1 x 250 A	2 x 250 A	3 x 250 A
Output voltage range		150 – 850 VDC		
Maximum DC output current		250 A	500 A	600 A*
Vehicle connection interface		Inverted crossrail pantograph - OppCharge		
DC connection standard		SAE J3105-1 - IEC 61851-23-1 - ISO 15118		
Environment		Indoor/Outdoor		
Operating temperature		Standard: -10 °C to +50 °C (de-rating characteristic applies); Optional: -35 °C to +50 °C		
Protection		IP54 – IK10 (NEMA 3R)		
Network connection		GSM/3G/4G modem | 10/100 base-T Ethernet		
Compliance and safety		UL 2202: 2018, C22.2 No. 107.1-16, EN 61851-23: 2014, EN 61851-1: 2011, EN 61000-6-3: 2007+A1: 2011		
Dimensions				
Power cabinet (each)	Number of Power Cabinets	1	2	3
	Dimensions (H x W x D)	2030 x 1170 x 770 mm / 79.9" x 46.1" x 30.3"		
	Weight	1340 kg / 2954 lbs		
Charge pole (includes Pantograph & ACM)	Dimensions (H x W x D)	5240 x 1040 x 300 mm / 206.3" x 40.9" x 11.8"		
	Outreach	4670 mm / 183.9" x 30.3"		
	Weight	1706 kg / 3762 lbs		
ACM Control Module KIT	Dimensions (H x W x D)	1600 x1000 x 476.9 mm / 63" x 39.4" x 18.8"		
	Weight	193 kg / 425 lbs		
Pantograph KIT	Dimensions (H x W x D)	(resting position / bolt-hole pattern) 574 x 1300 x 900mm / 22.6"H x 51.2"W x 35.4"D		
	Weight	387 kg / 854 lbs		

* Limited by inverted pantograph contact ratings

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INSTALLATION GUIDE

HVC-PD E-Bus Charger

Installation Guide for NA products

Version 1.3

Notice

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Version control

Version	Date	Remarks
1.0	20-5-20201	First release
1.1	23-09-2021	Changed figures cabinet and added notice for WiFi device
1.2	30-06-2022	Updated based on NA requirements
1.3	12-06-2024	Par. 5.15.4 Add threadlocker glue.

Table of Contents

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 standard[1]. 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 standards[2]).

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.

	**WARNING** **Pinch Hazard** Identifies a hazard that could result in injuries in which some body parts are pinched or crushed.
	**WARNING** **Fall Hazard** Identifies a hazard that could result in injury due unsafe work at height.
	**CAUTION** **Various** Identifies a hazard that could result in damage to the machine, other equipment, and/or environmental pollution.
	**CAUTION** **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.
	**NOTICE** Contains remarks, suggestions or advice.

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

	**CAUTION** Heavy equipment Handling instructions: 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 30º for the Power Cabinet. 4. Read and follow the ABB *Guidance on the requirements for safe operation of mobile cranes* (ML-03, 9Akk104941D0113).
	**WARNING** **Personal safety (PPE)** Always wear a safety helmet, safety gloves and safety shoes when you do the lifting and tilting work.
	**WARNING** Make sure that personnel cannot be crushed or become trapped during lifting and tilting work.

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** **Hazardous voltage** 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.

1.4.4. Installation safety

	**WARNING** **Personal safety (PPE)** Always wear a safety helmet, safety gloves and safety shoes when you do the lifting and tilting work.
	**WARNING** Visually examine the package for damage. See section *Before unpacking* on Page 55 and section *Before unpacking* on Page 87. If there is damage, do not install the system.
	**DANGER** **Hazardous voltage** Instructions: 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** 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.

	**WARNING** 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.
	**CAUTION** **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.

1.5. Environment and disposal of waste

	**CAUTION** Always observe the local rules and regulations with respect to processing (non-reusable) parts of the HVC-PD E-Bus Charger.

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

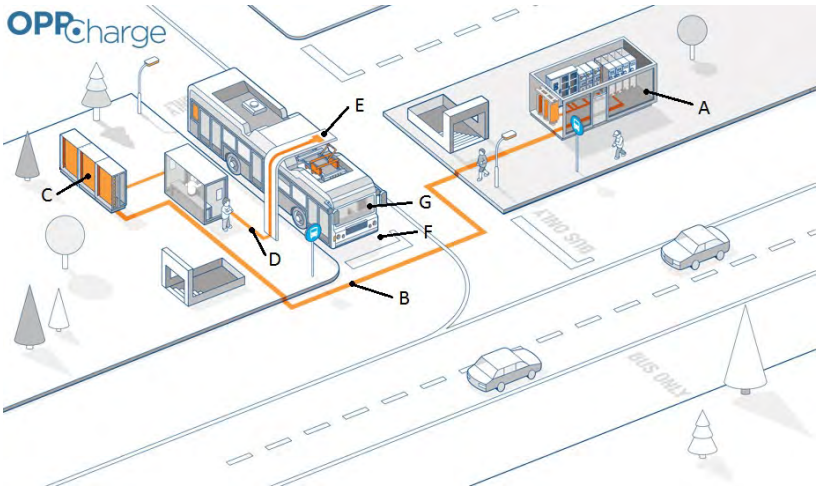
Telephone +31 88 440 46 00

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:

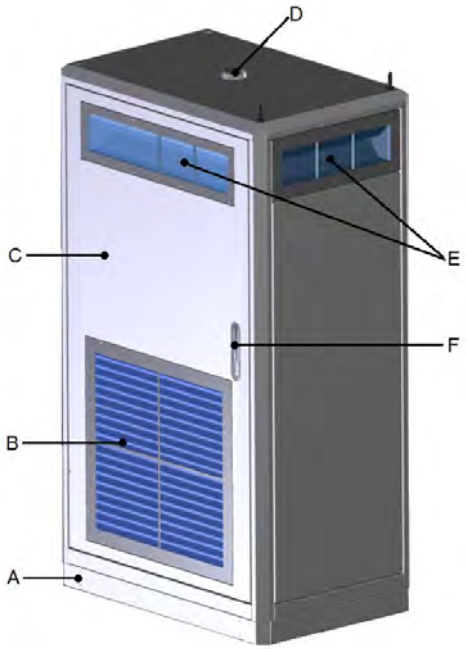
- 1x HVC Panto Down 150 kW primary power cabinet
- 1x fold-out HVC PD charge pole set 150-450kW UL (ABB6AGC100126) or HVC PD charge pole set 150-450kW UL BAA (ABB6AGC100125) including:
  - 1x ACS Control Module (ACM)
  - 1x Pantograph (ACS)
  - 1x Charge state indicator lights with light-sensor
  - 1x 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.

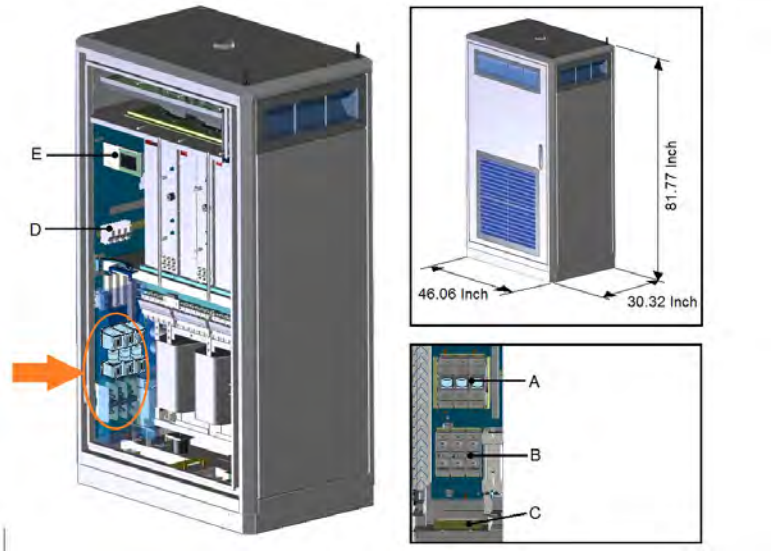
2.1.4. Power Cabinet

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

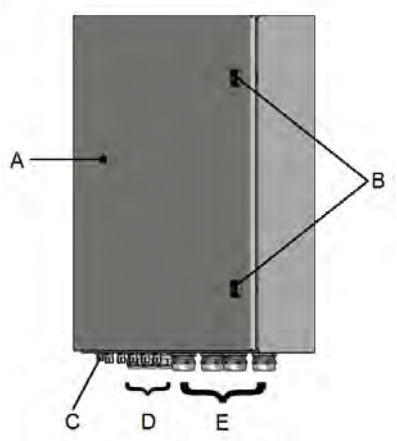
Inside view of the Power Cabinet



A AC Fuses
B AC Power connection
C Guidance plate of the cables
D Data/communication connection
E Display (only present in HVC 150)

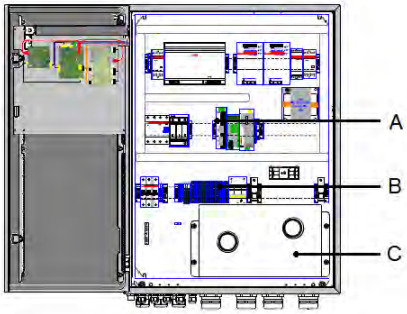
2.1.5. ACS Control Module

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

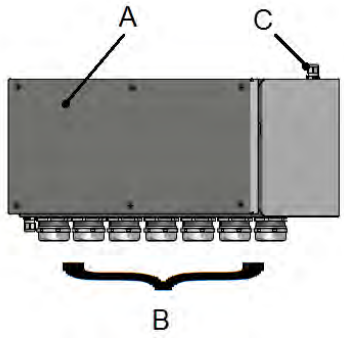
Inside view of the ACS Control Module



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

2.1.6. Junction Box

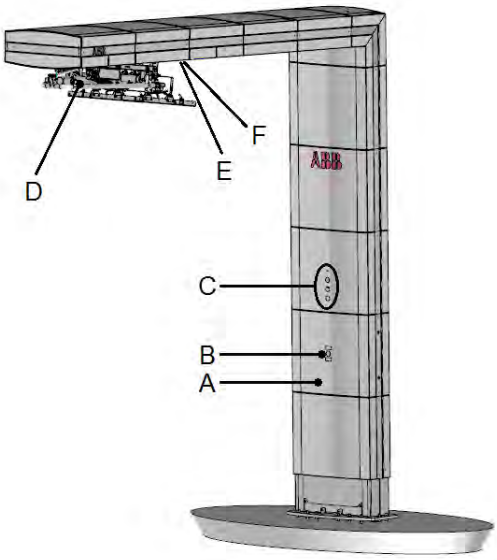
Outside view Junction Box



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

2.1.7. Charge pole

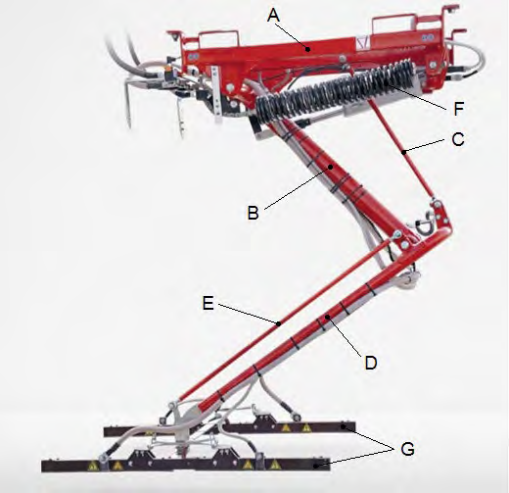
Outside view Charge pole



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



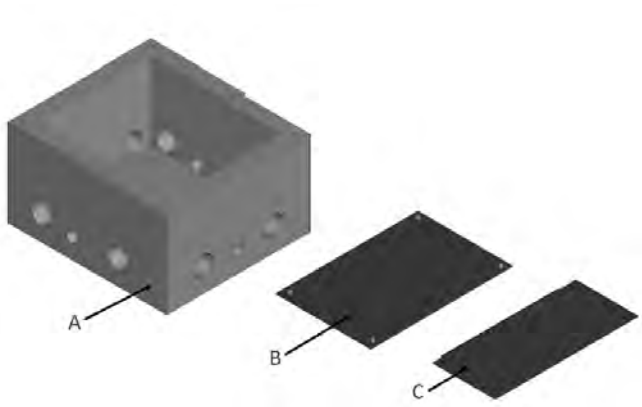
2.2. Accessories

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)

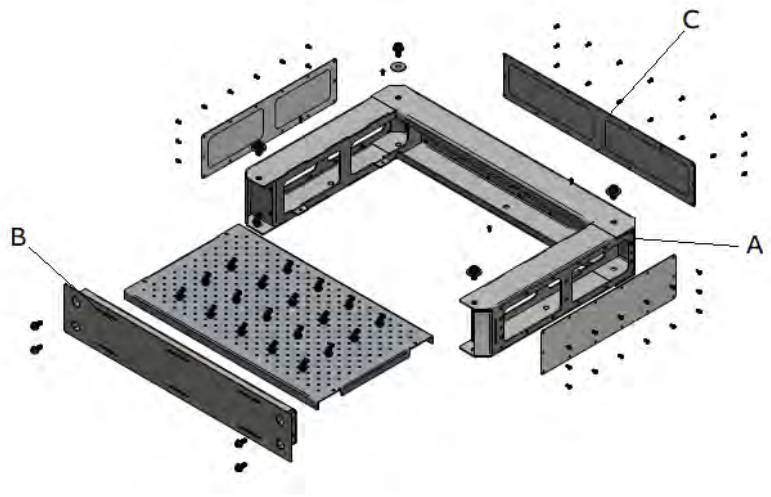
Concrete foundation

	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.



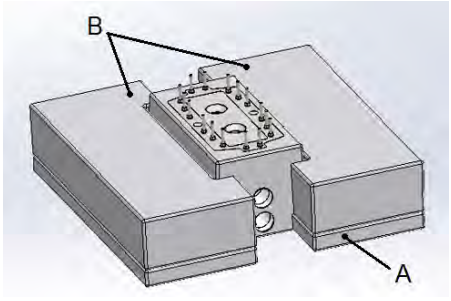
A Foundation
B Front border cover
C Rear border cover

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).

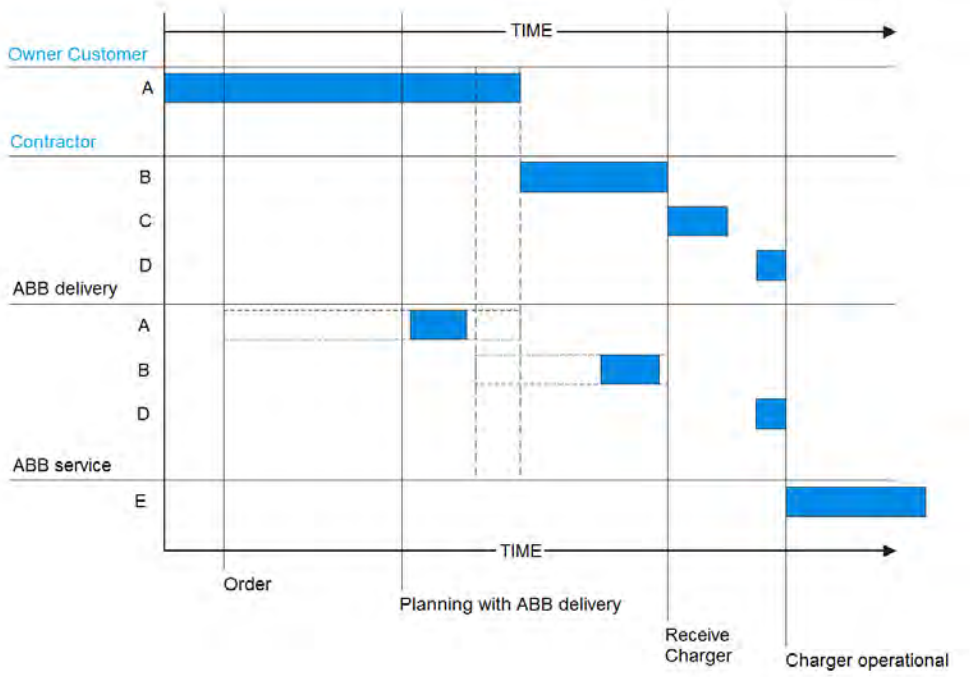
Amount	Part number	Description
1	RFU 630-131xx (*)	RFID RFU63x (Sick)
1	SSL-2J04-G10ME (part 6030928)	RFID Ethernet cable 10 m (male connector, M12, 4-pin, straight, D-coded / male connector, RJ45, 8-pin, straight) (Sick)
1	2070427	RFID Power cable 10 m (female connector, M12, 17-pin, straight, A-coded)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

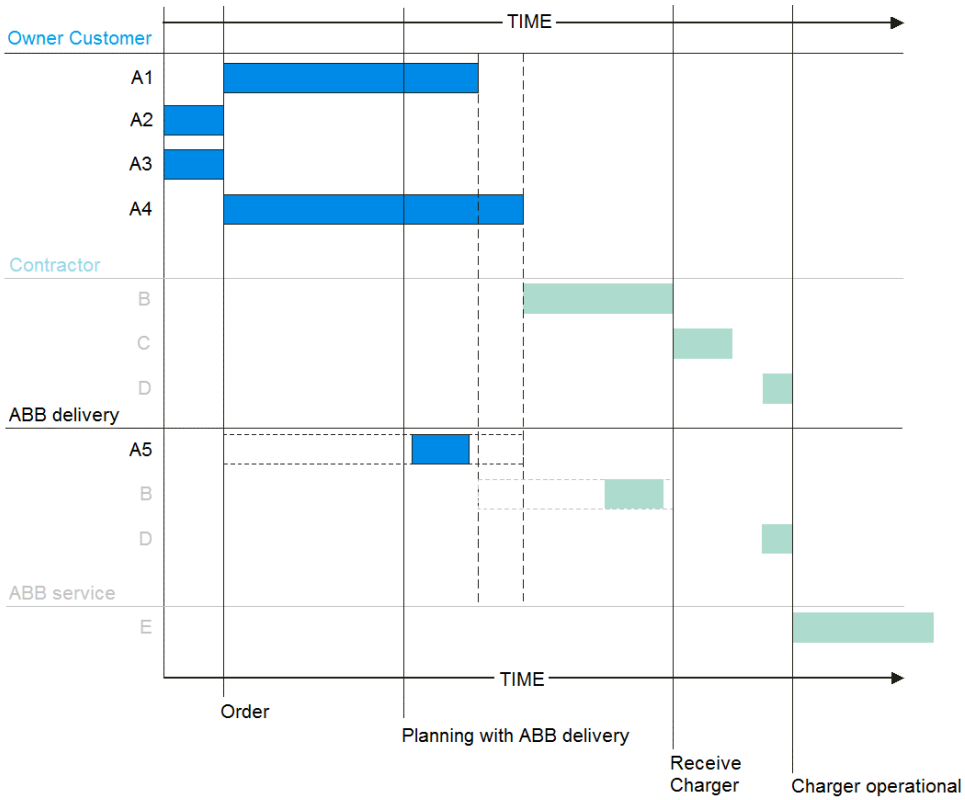
D. Commissioning
The delivery department will bring the HVC-PD E-Bus Charger into operation. See *Commissioning preparation* on Page 121.

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 ºC.
    - 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).

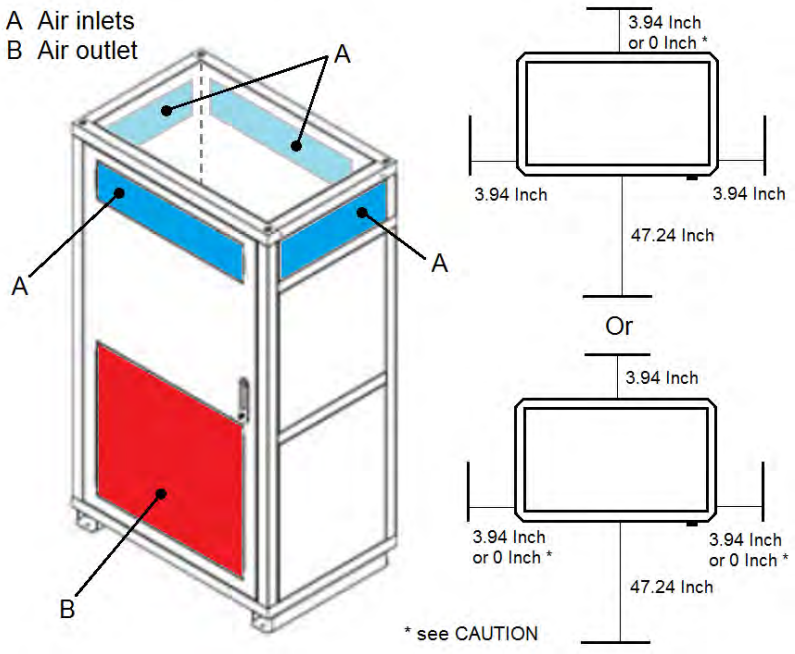
3.5. Geometry of infrastructure

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
	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). 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.



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.

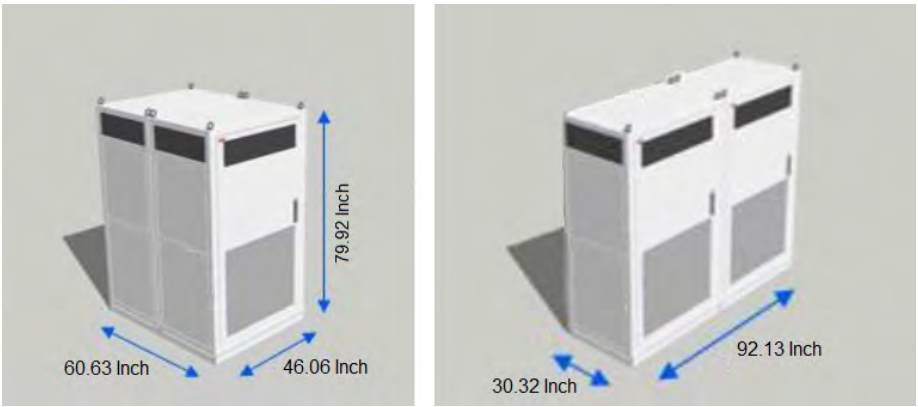
Specifications for inside installation of the Power Cabinet

- 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.



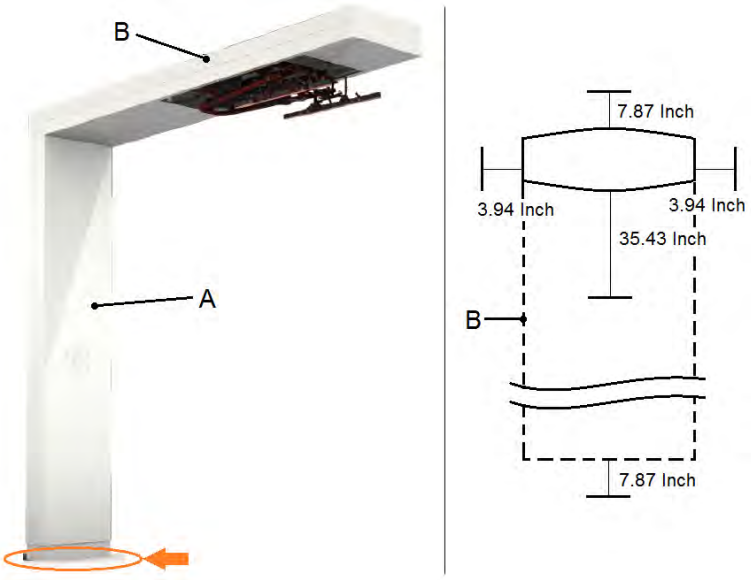
When placing multiple HVC 150 systems, it is necessary to take the following into account:

- 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.

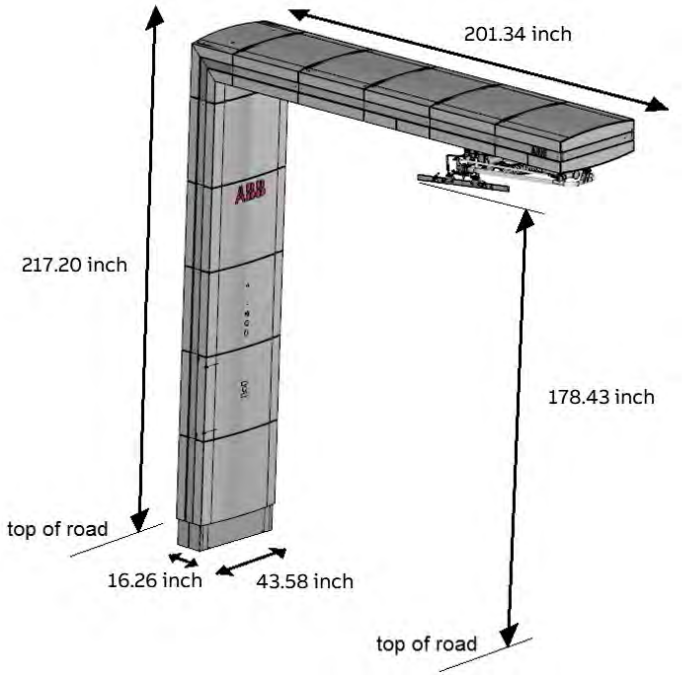
3.5.3. Required space for the Charge pole

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



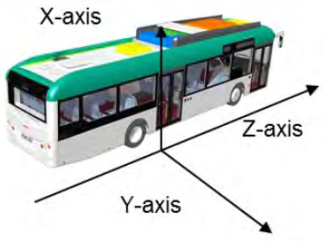
In general:

- 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 sideway 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 ≤ 3.5º, Z-axis ≤ 2.5º.

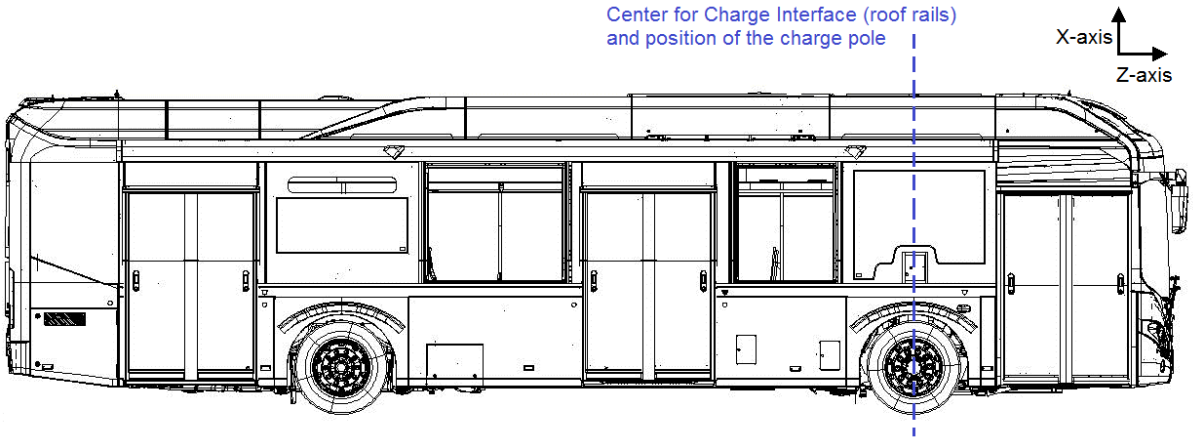


	NOTICE
	Before ordering the Charge pole the correct position of the pantograph within the pole must be calculated by ABB. This is determined during the site survey for placement of the pole and is performed by ABB. Contact ABB Sales department (see *Contact information* on Page 14 for contact details).

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

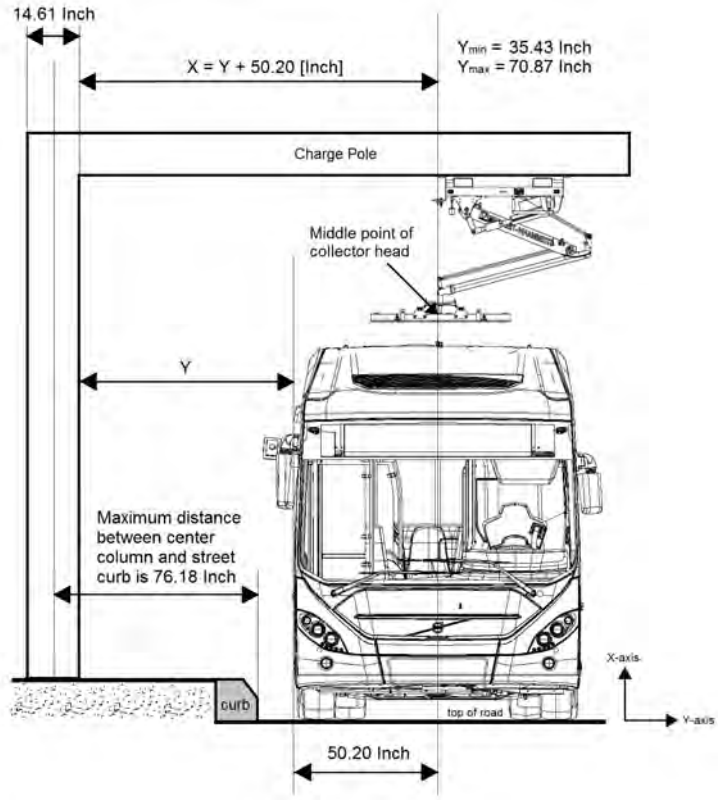
3.6.1. Pole position in relation to the drive direction of the bus

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

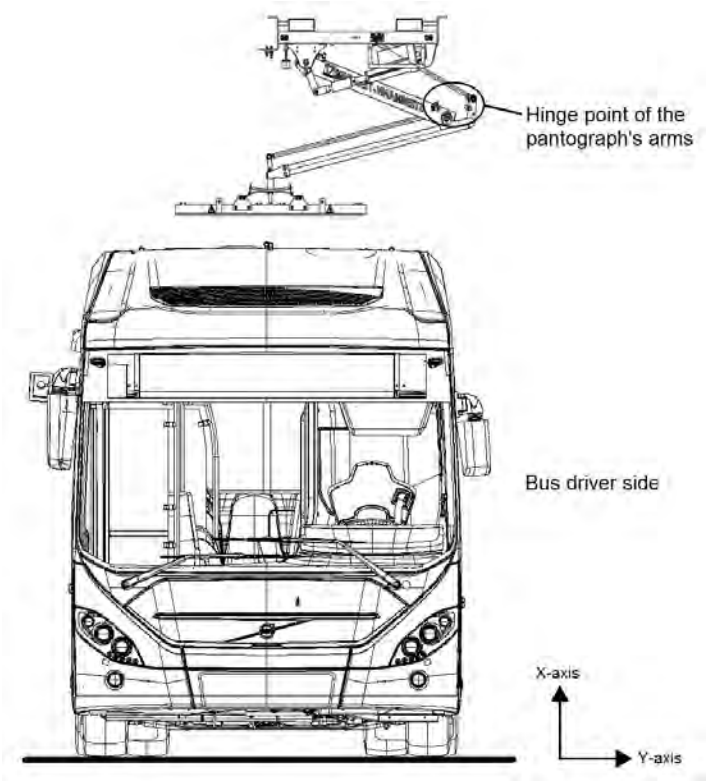
The minimum distance is and the maximum between the front of the pole and side of the bus is 35.43 Inch to 70.87 Inch respectively. The picture below shows how to calculate on an easy matter the position of the pantograph (measured middle of the collector head) within the Charge Pole with respect to the position of the bus. Be aware this is in case the road is flat and doesn't have an angle in the sideway 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.



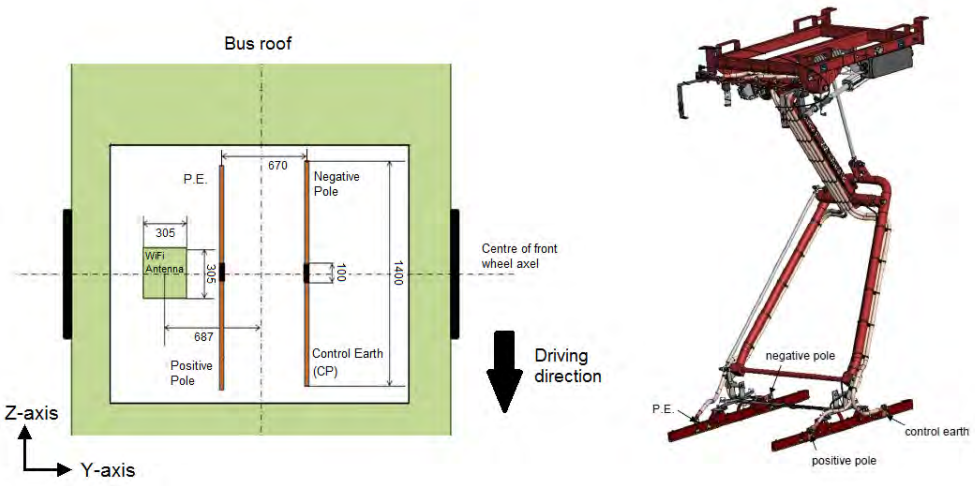
Kneeling of the bus will cause a displacement of the contact rails on top of the bus bus of about 7.87 Inch, talking 3.5º angle into account with a the height of the bus 129.13 Inch. This should also be taken into account when calculating the position of the Charge Pole with respect to the bus.

	NOTICE
	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 *Contact information* on Page 14 for contact details).

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:

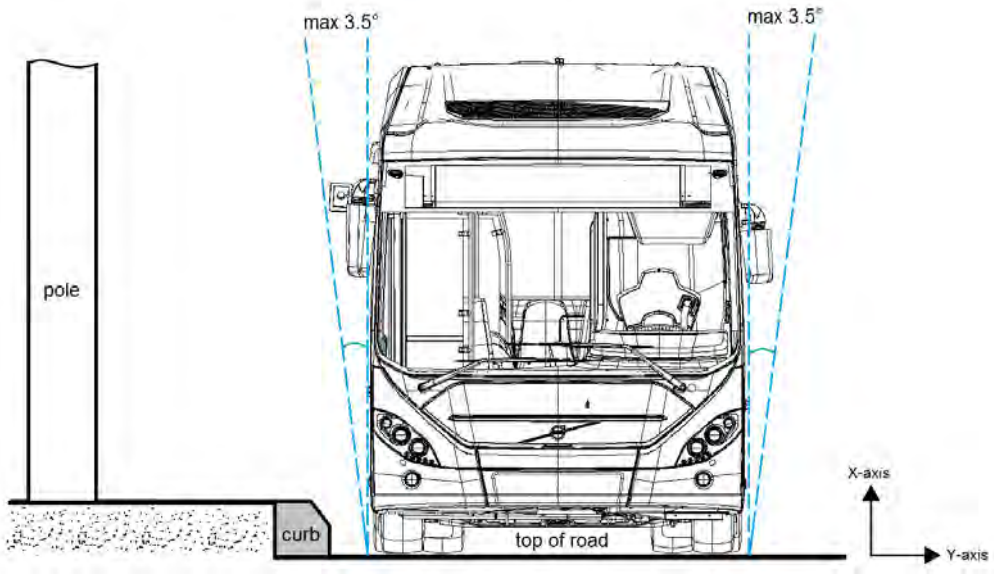


In this case the pantograph's collector heads make the right electrical contact with the contact rails on the roof of the bus, see picture below.



3.6.3. Maximum slope of the road in X-axis

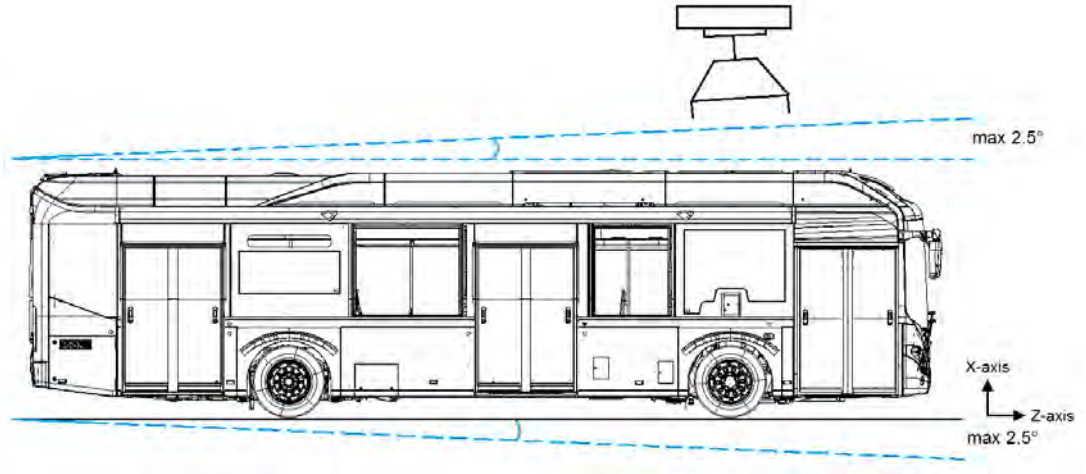
The maximum slope of the road sideways direction is 3.5º, **including** the kneeling of the bus. This will shift the top of the bus 7.87 Inch relative to the center of the bus. So the displacement caused by the road angle should be taken into account calculating the position of the Charge Pole with respect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



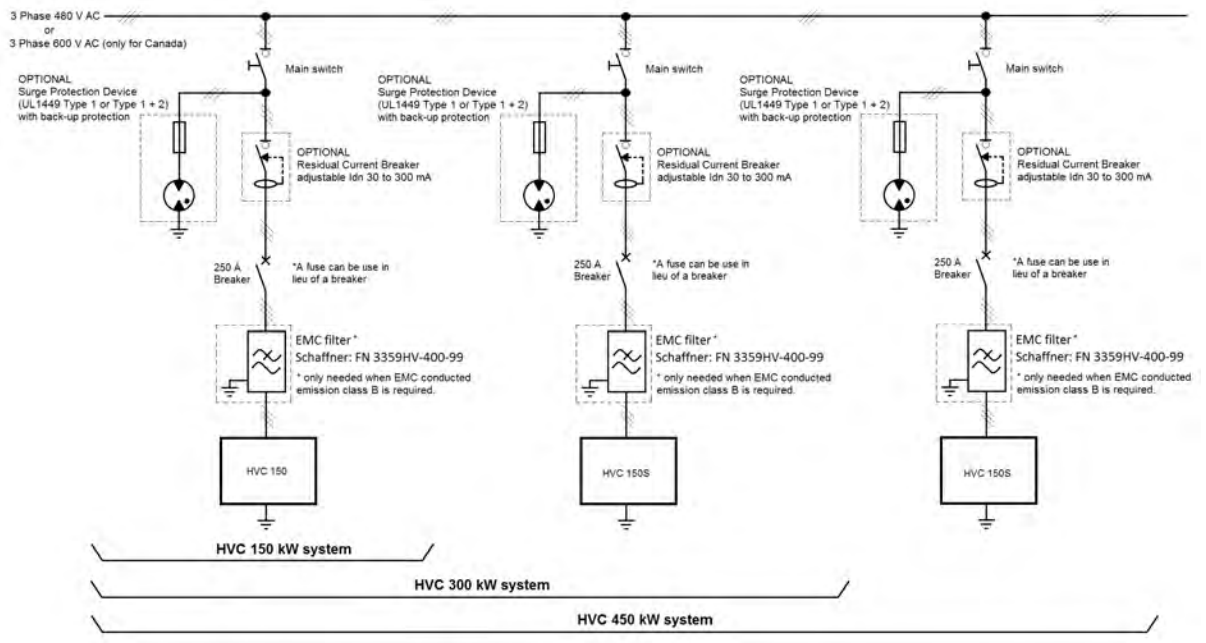
	NOTICE
	The road inclination should be known before the pole is installed on the location. This will also be noted by ABB during the site survey for the placement of the pole. Contact ABB Sales department (see *Contact information* on Page 14 for contact details).

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

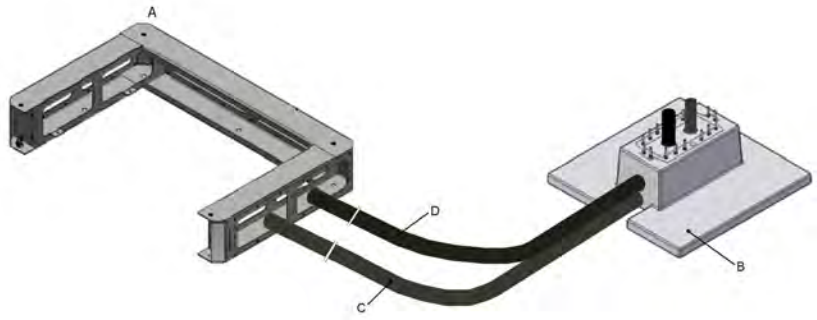
The electrical installation must be completed according to the local safety and electrical regulations and laws. See section *Upgrade grid* on Page 27 for the requirements of the electrical connection. A one line diagram for the electrical connection is shown in the figure that follows. The diameter of the electrical conductor (maximum cross section is 240 mm^2 = 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

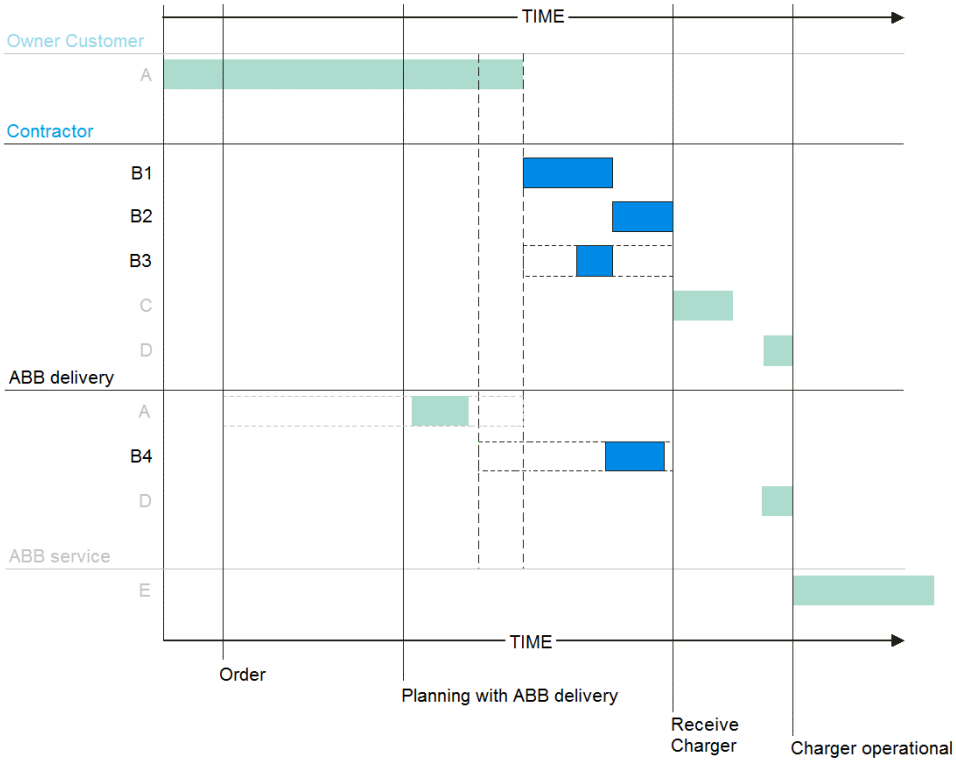
4. Construction

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:

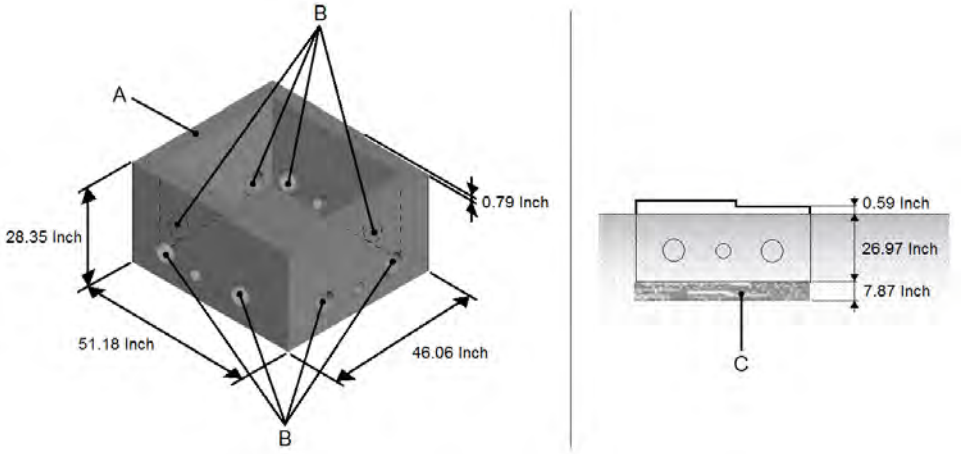
- **Soil**
  Use a concrete foundation to get a firm fixation on soil.
  Concrete foundation cannot be ordered separately. It must be manufactured by the customer. For detail drawings of the pre-fabricated concrete foundation see Appendix E *Dimensions concrete foundation Power Cabinet*.

- **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** It is advised to install traction wires into the conduits to install the electrical cabling afterwards.
	**NOTICE** 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.

4.2.2. Workflow with concrete foundation



	NOTICE
	Concrete foundation should be designed by the customer. ABB does not sell concrete foundation. For detail drawings see Appendix E *Dimensions concrete foundation Power Cabinet*.
	WARNING
	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.
	CAUTION
	Before you lower the foundation, remove sharp edges of the cable holes (B) in the foundation to protect the cables.

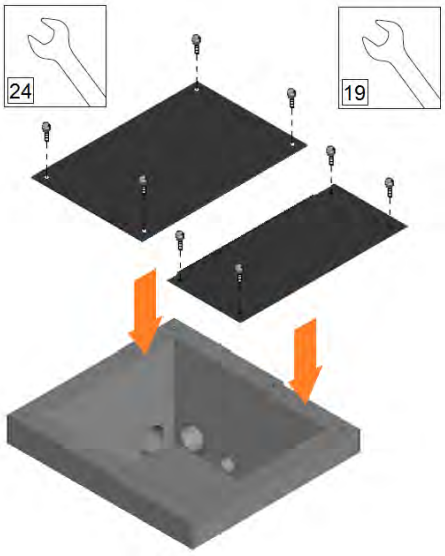
1. Make a hole in the ground with at least a minimum depth of 34.84 Inch, shown in the figure above.
2. Fill the hole with (minimum) 7.87 Inch lean concrete (C), see figure above.
3. Make sure that the conduits are routed to one of the indicated positions (B). The conduits must come out of the foundation 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).

	NOTICE
	Make sure that the end of the cable conduits are 11.81 to 19.69 Inch above the top of the foundation.

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.



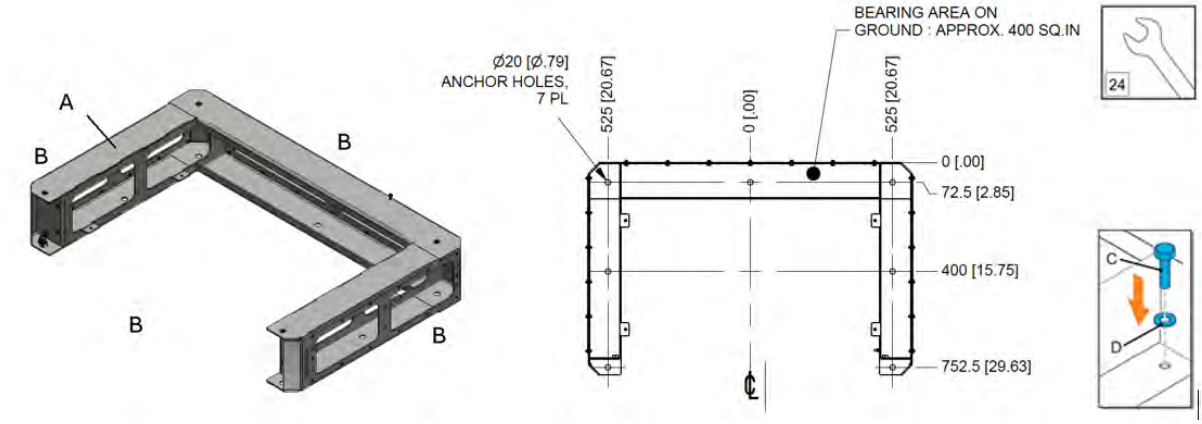
12. Secure the top cover plate with M16 bolts (4x) and the front cover plate with M12 bolts (4x).

	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

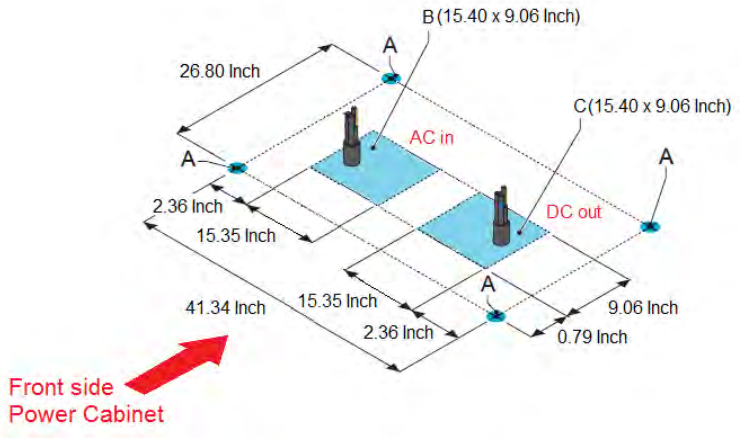
4.2.3.1. HPC175-HVC150 MET FOUND KIN 8IN – NAM (2CEB489802R0001)



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)

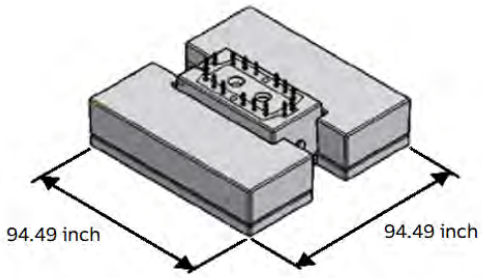
4.3.1. Options

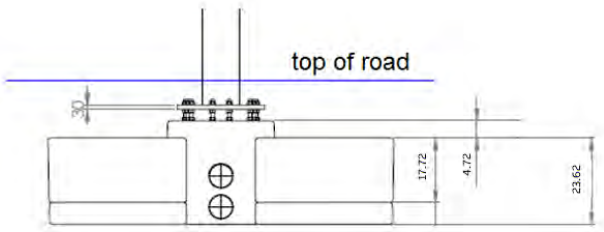
Use the correct foundation for the type of surface that the Charge pole will be installed on:

- **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
	Be aware that the position footprint relative to the road is very important to make sure the pantograph can function optimally.

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.

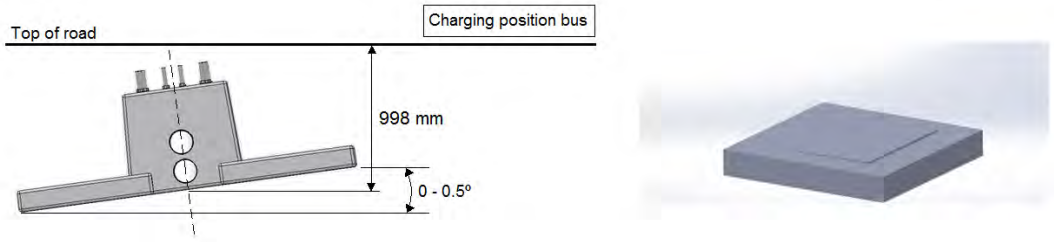
Depending of the soil conditions sand settlement can take place. Because of the heavy construction > 17636.98 lb some preventive actions are **advised**. The time frame in which the soil settlement will be elaborated is depending on:

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

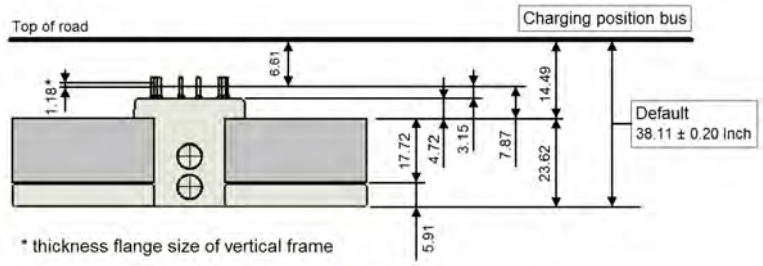
Before starting to install the concrete foundation, the pressure of the soil must be measured. It is advisable to install the concrete foundation on a soil pressure ≥ 100 kPa. If the measured soil pressure is more than 100 kPa, no soil compact actions has to be taken.
If the concrete foundation will 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 were 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 0.5º.



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.



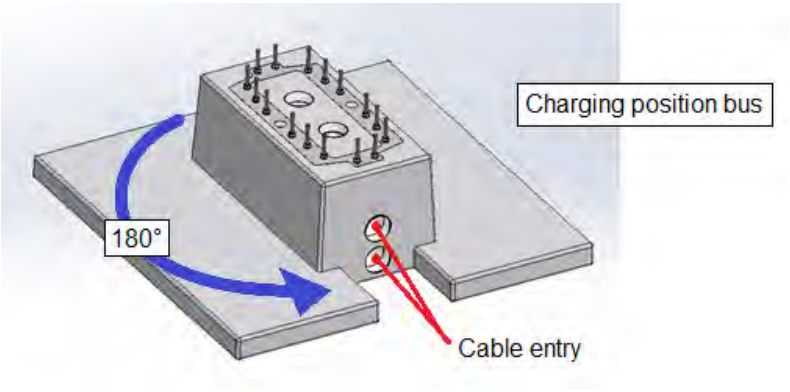
	NOTICE
	Be aware that the correct height to the bottom of the concrete base plate relative to the ground level of the top of road (= charging position of the bus) must be calculated by ABB. Contact ABB Sales department (see *Contact information* on Page 14 for contact details).

3. Installing the concrete base plate

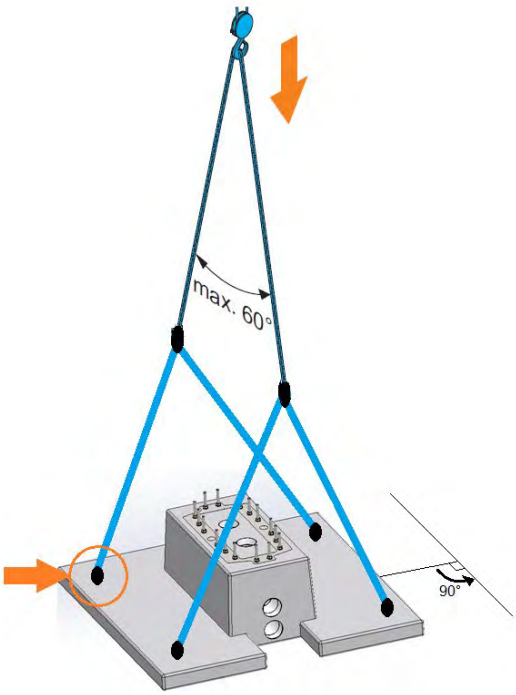
Preconditions:
4x WLL 3/5.0 tons lifting claws (are not delivered by ABB, use for example Starcon Universal Lifting Claws, art.no. 99.11590082B).

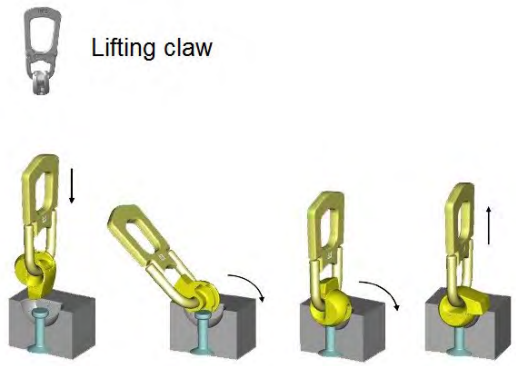
	**WARNING** Make sure that personnel cannot be crushed or become trapped while moving the foundation.
	**CAUTION** Before you lower the foundation, remove sharp edges of the cable holes in the foundation to protect the cables.

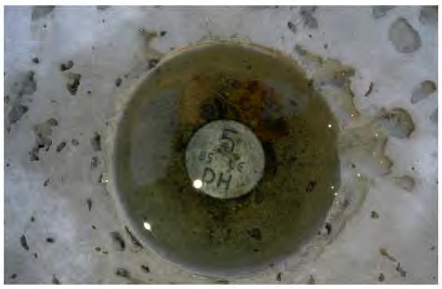
The base plate has holes for entering cables into the charging pole construction which are positioned aligned with the road. The base plate must be positioned in the right way to have the cable conduits facing towards the foundation of the Power Cabinet. The base plate can be installed 180 degrees to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



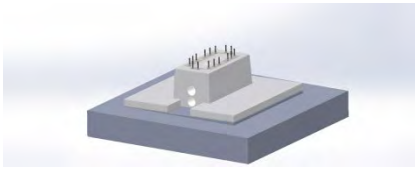
With preparation of the soil the concrete base plate can be installed. There are four bullet head anchors (5 85 DH) pouring in the concrete base plate.
Hoist the base plate with using four lifting claws connected with four slings or chains with sufficient capacity. The weight of the base plate is 7495.72 lb and the foot print is 94.49 x 94.49 Inch.







	NOTICE
	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.

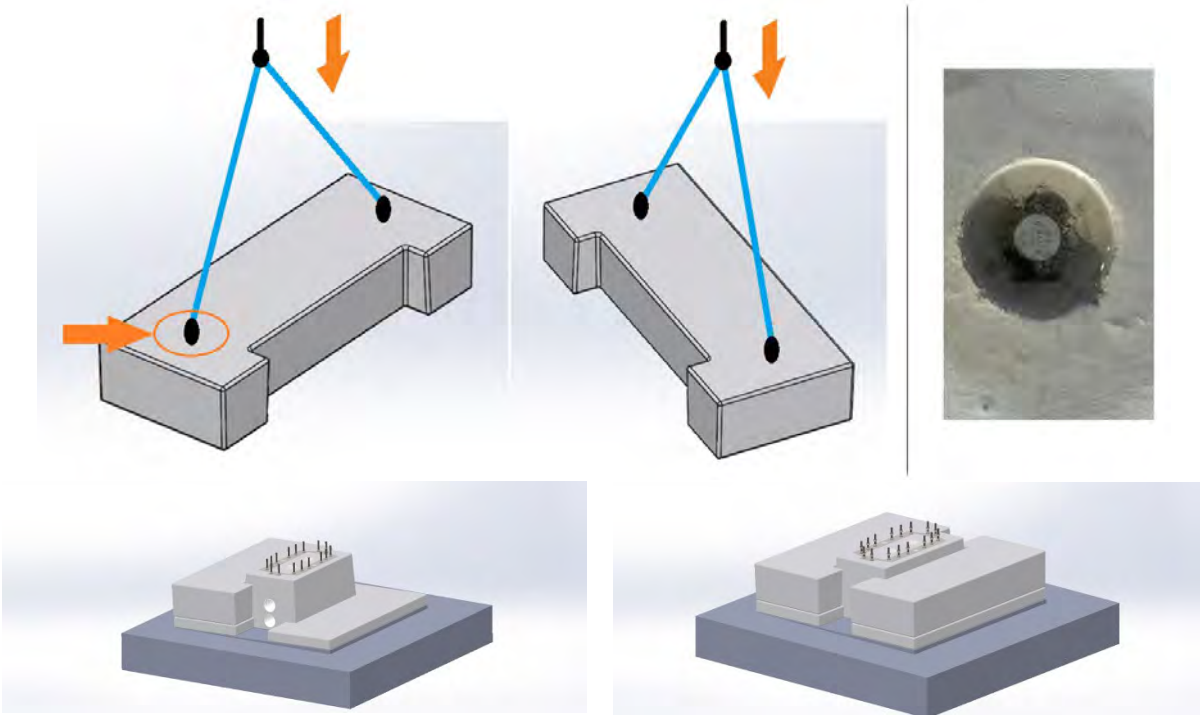


4. Installing the counter weights

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.

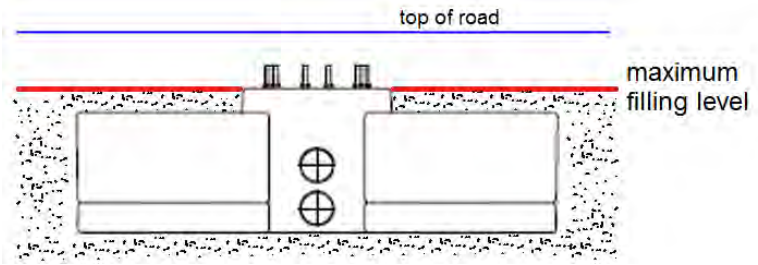


5. Compaction the soil around the concrete foundation

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.

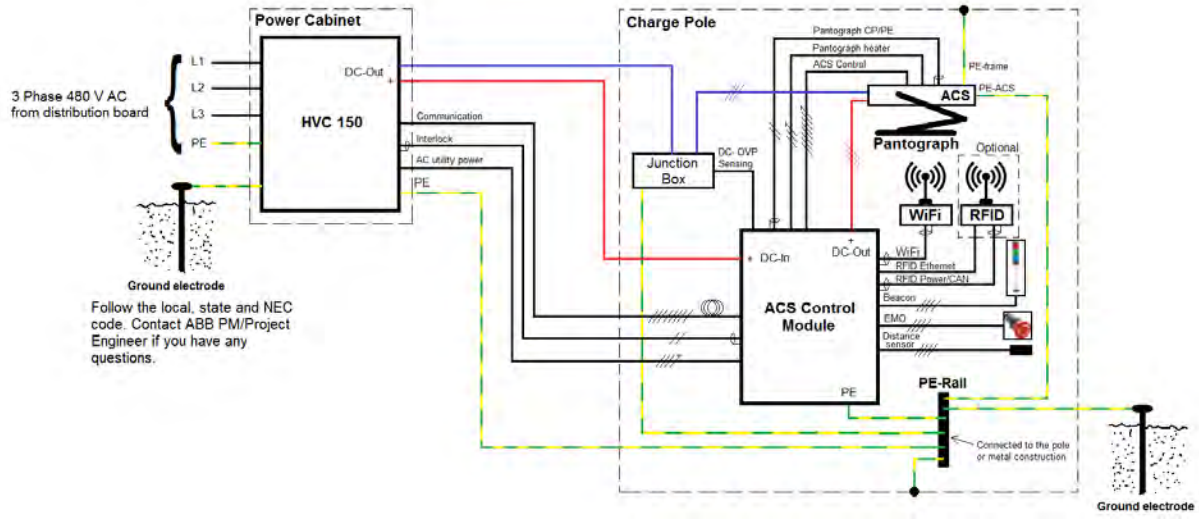


NOTICE

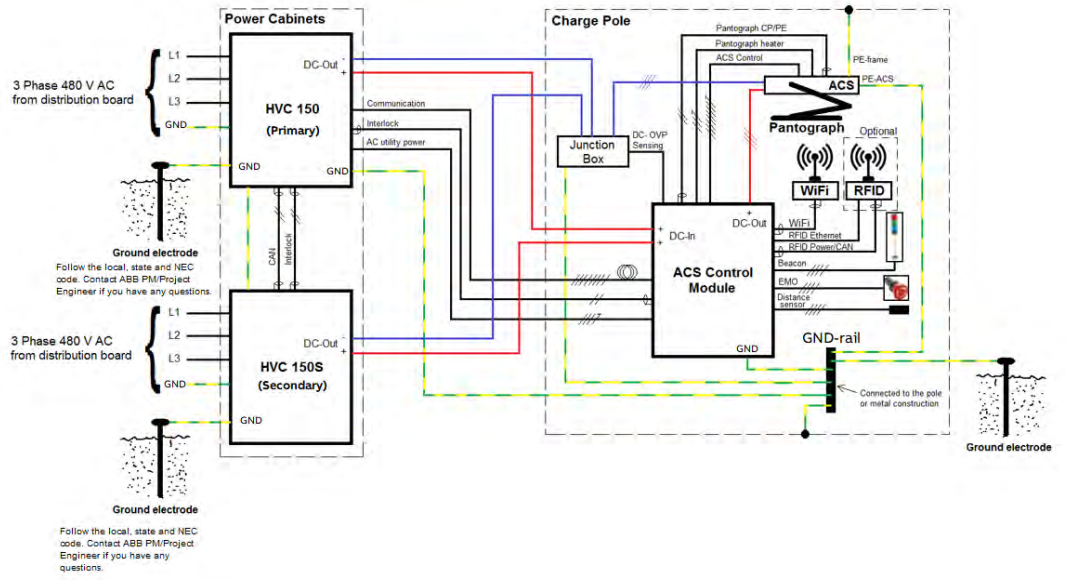
To already fixed the sidewalk around the pole, there can be placed border collar around the top of the foundation to have free access of the bolts.

4.4. Cabling

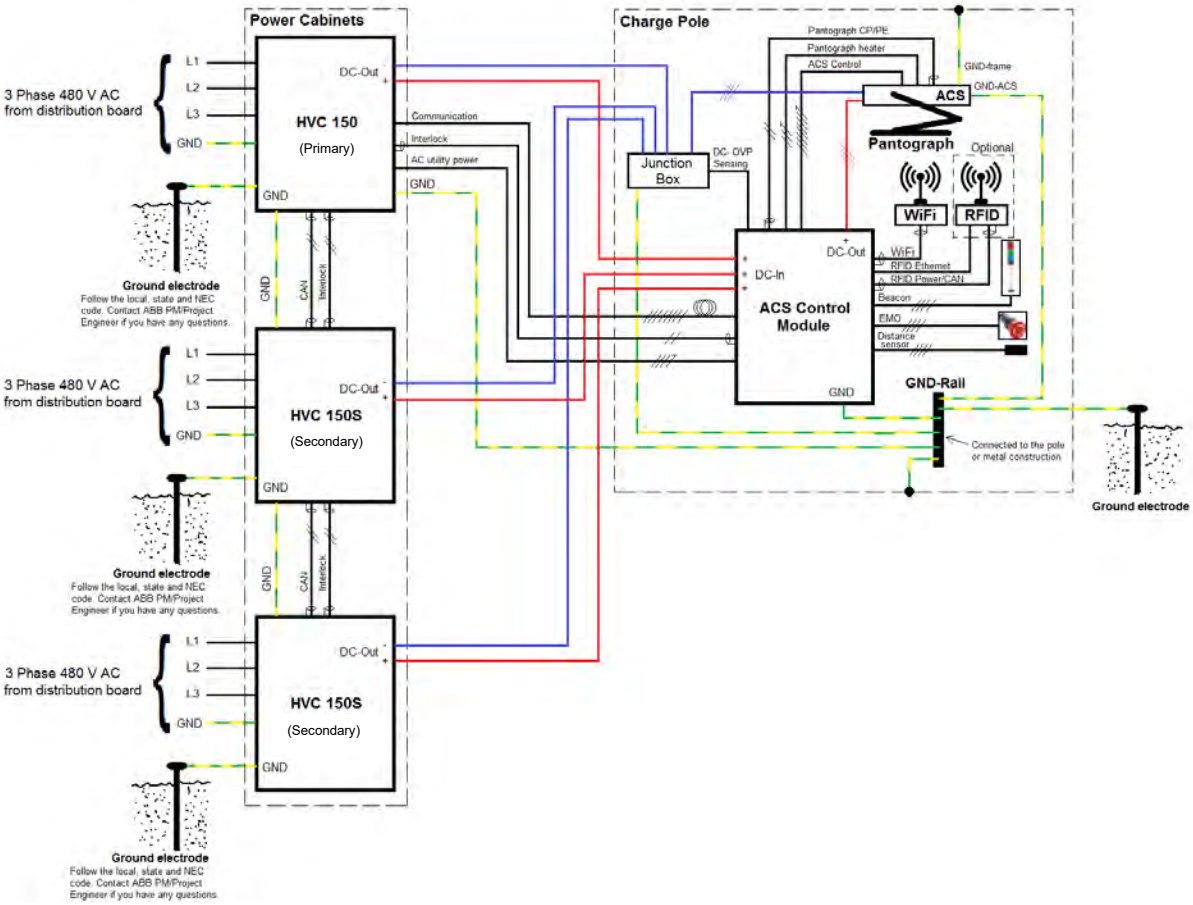
4.4.1. Charge system configuration



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



Overview electrical connections of a HVC-PD 300 kW charge system



Overview electrical connections of a HVC-PD 450 kW charge system

Separated electrical diagrams for the different HVC-PD Charge systems are available (Ask associated PM or sales representative if required):

- 6AGA000008-0617, Electrical diagram HVC-PD 150 kW E-Bus Charger,
- 6AGA000008-0618, Electrical diagram HVC-PD 300 kW E-Bus Charger,

- 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
	For detailed information about type of glass fiber cable which are needed, see *Communication glass fiber cable* on Page 22. For the overview of the grounding of the system, see Appendix J *Ground overview of the system* on Page 145.

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	-40ºC to 80ºC, permissible conductor operating temperature +90°C	-40ºC to 70ºC	-40ºC to 80ºC
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	*inapplicable*
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	-40ºC to 70ºC	-40ºC to 70ºC
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 and 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.

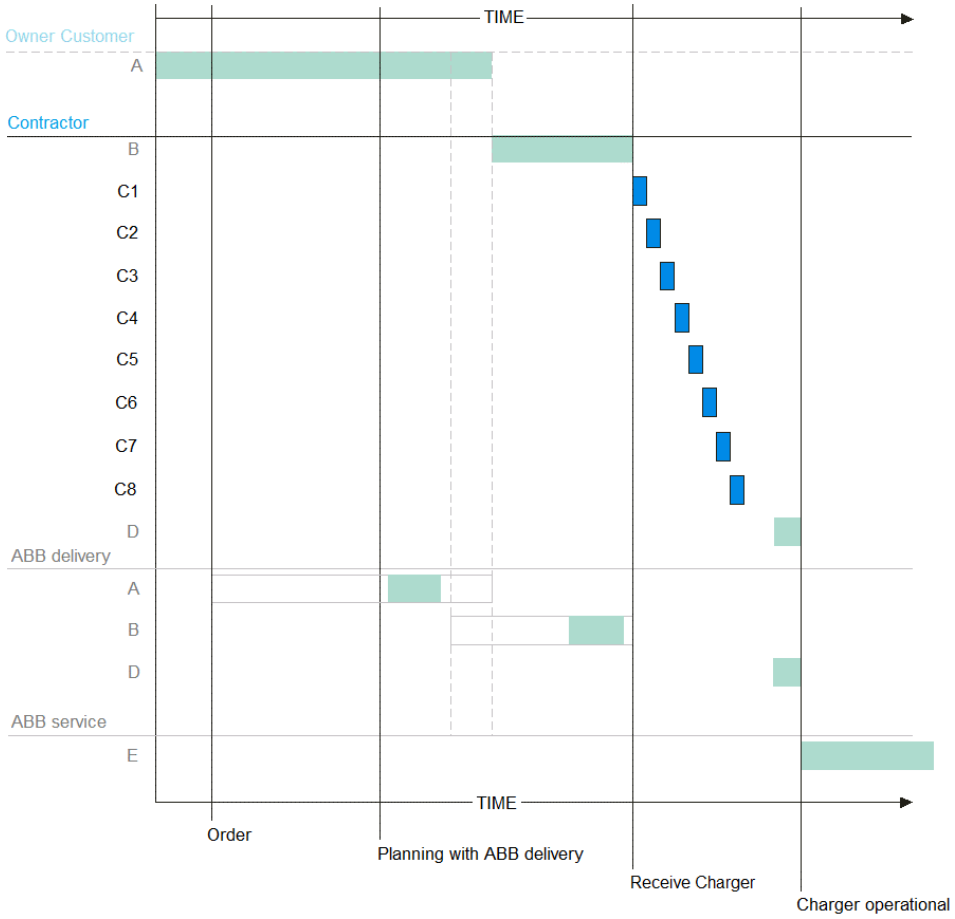
- **Internet via ethernet connection**
  If the cellular connection is not available, ethernet connection must be made to the charger using a shielded 8P+PE ethernet cable with RJ45 connectors. Additional recommendations include:
  - Maintain distance of 75 meters or less. Distances over 75 meters require 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
	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.

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

5.3. Unpack Power Cabinet

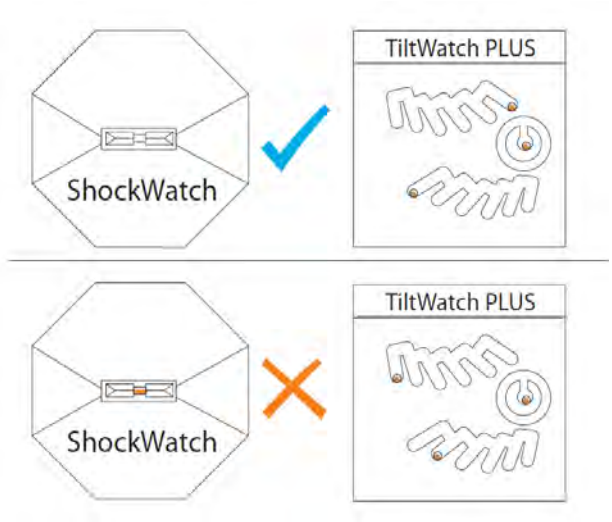
5.3.1. Before unpacking

	NOTICE
	**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.
	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.

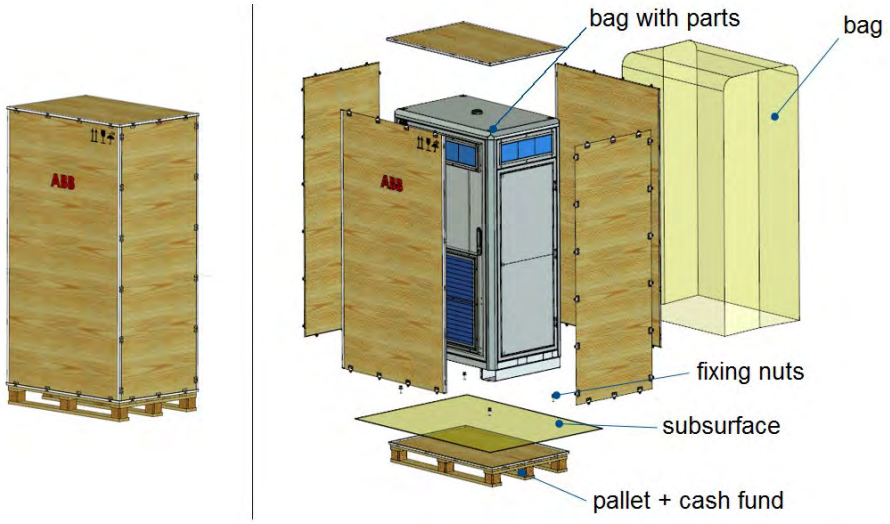


1. Make sure that the Power Cabinet has not been shaken or tilted over 30º.

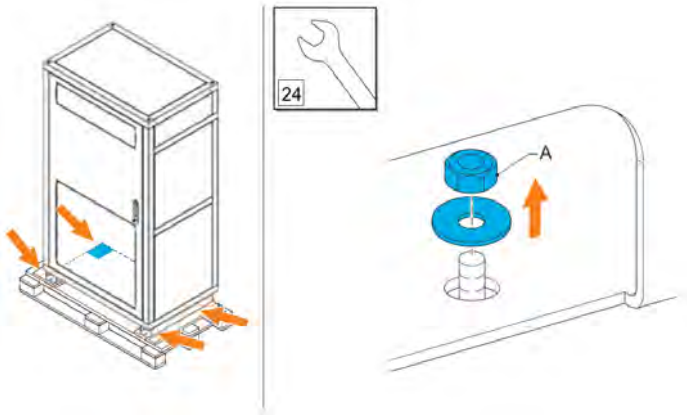
5.3.2. Remove packaging

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.

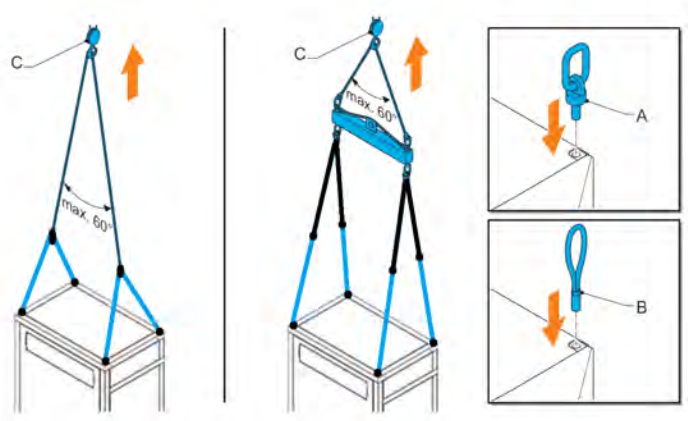
Preconditions:

- 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.

	**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.
	**CAUTION** **Warranty** Damage due to moving the Power Cabinet to its position is not covered by the warranty.
	**CAUTION** Do not use a compressor to clean the Power Cabinet. Use a vacuum cleaner.

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:

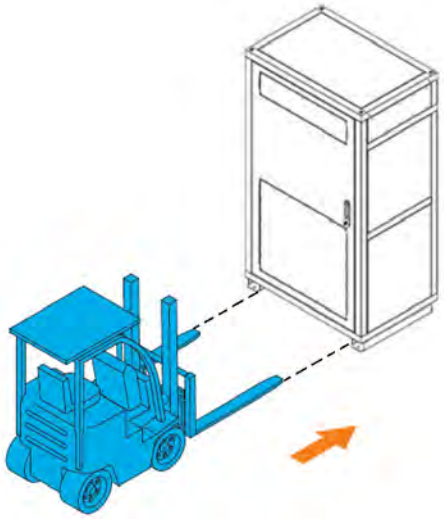
- A minimum of two persons is required: one person to operate the hoisting equipment, the other person to guide the Power Cabinet to its location.
- Use M16 swivel eye bolts (A) or M16 bolts with lifting loops (B).

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
	Keep the hoisting angle below 60º.

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
	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.

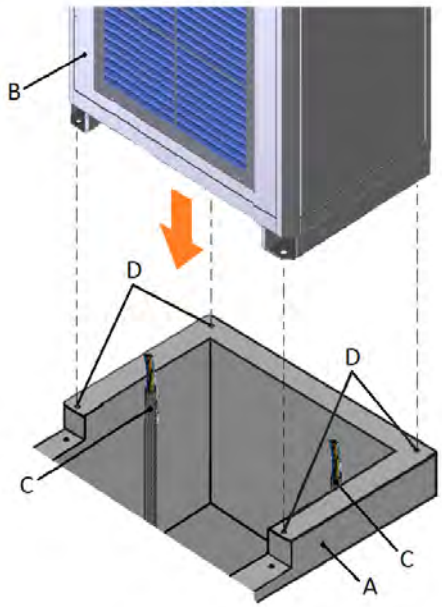
5.5. Install Power Cabinet onto the foundation

5.5.1. Connect Power Cabinet to foundation

Preconditions:

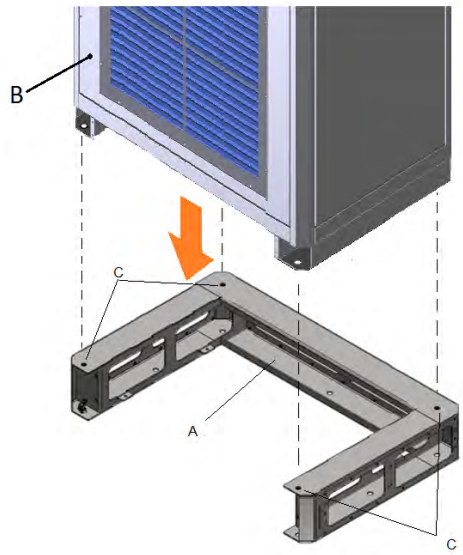
- Tools: spanner (size 24).
- Cover caps (4x) that were removed from the Power Cabinet (bag with parts).
- The Power Cabinet is about 19.69 Inch above its location.

	**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

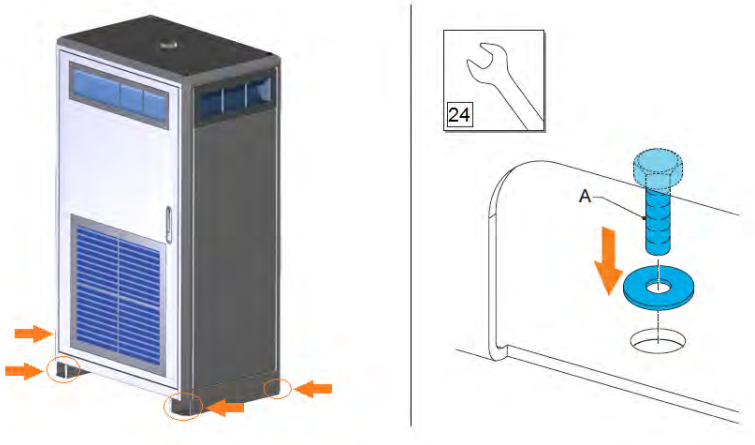
A Foundation
B Power Cabinet
C Cables
D Tapped holes



Placement on metal frame foundation

A Foundation
B Power Cabinet
C Tapped holes

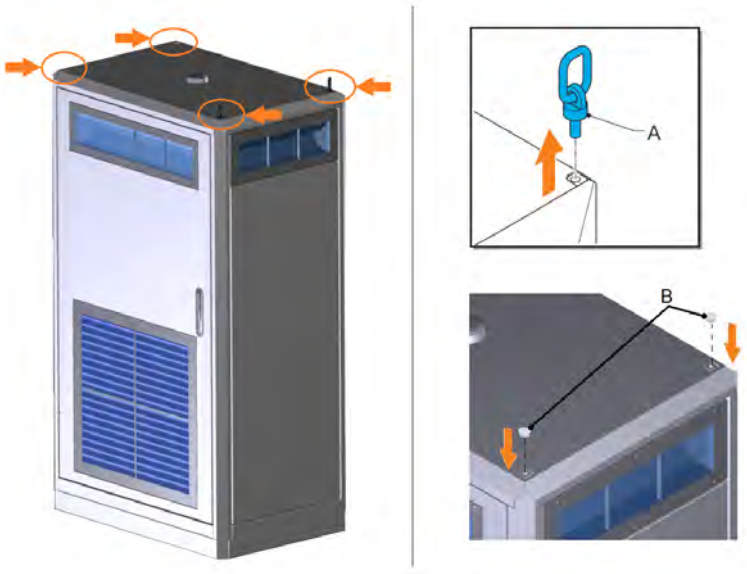
1. Carefully lower the Power Cabinet (B) onto the foundation (A).
2. Make sure that you do not trap the cables (C).
3. Make sure that the cabinet is aligned with the tapped holes (D).



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

	NOTICE
	A minimum of three M16 bolts are need to applied to securely mount the Power Cabinet onto the foundation. 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.

5. Tighten the bolts.

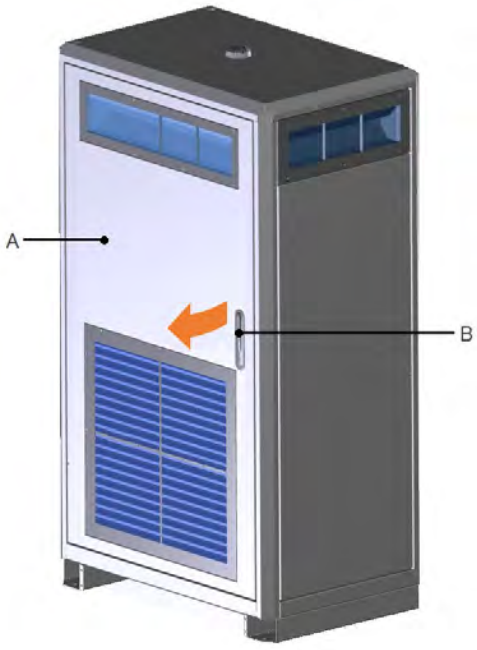


6. Remove the swivel eye bolts or lifting loops (A).
7. Place the cover caps (B) in the holes (4x).

5.5.2. Open the door of the Power Cabinet

Preconditions:

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

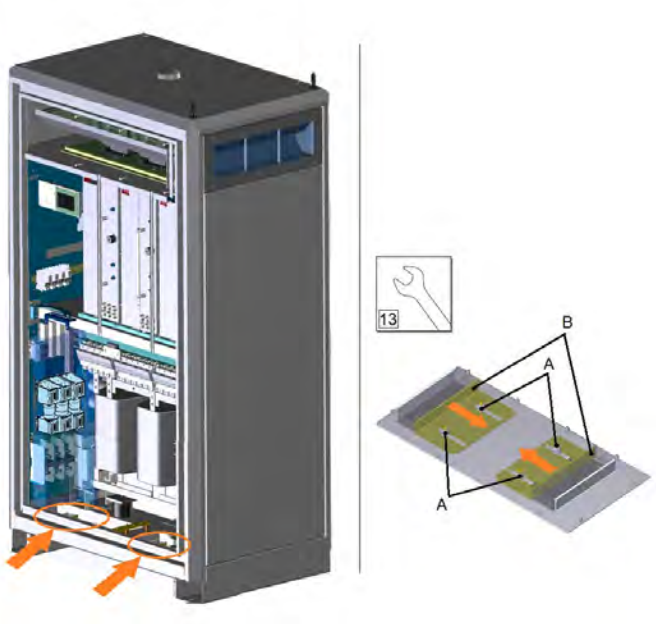


1. Unlock the handle (B)
2. Use the handle (B) to open the door (A).

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

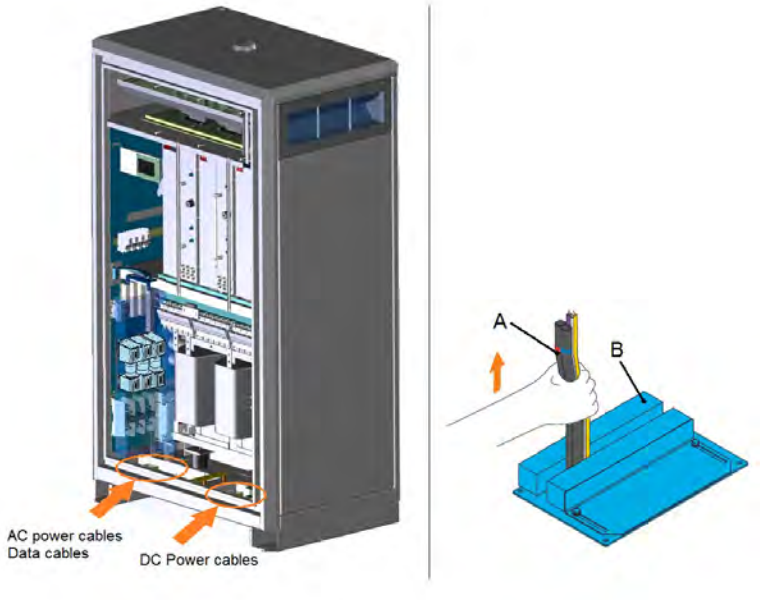
Preconditions:

- 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



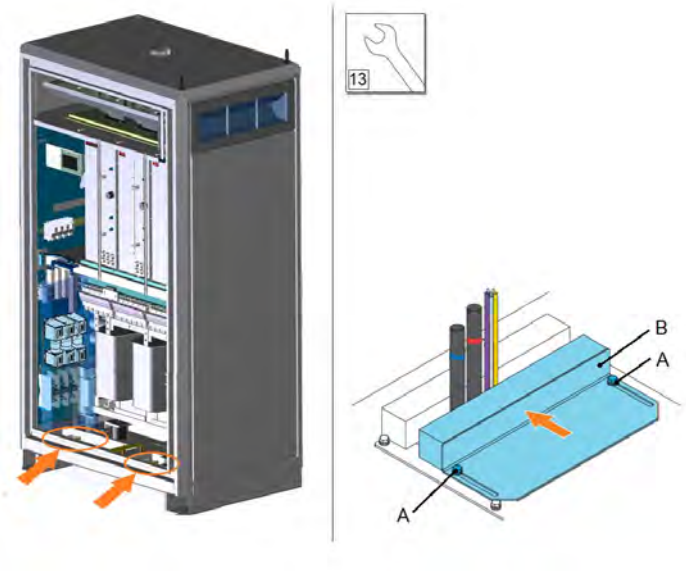
1. Route the cables (A) through the right guidance plates (B).
2. Make sure that there is sufficient cable length to reach the connectors at the top of the cabinet.

	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).

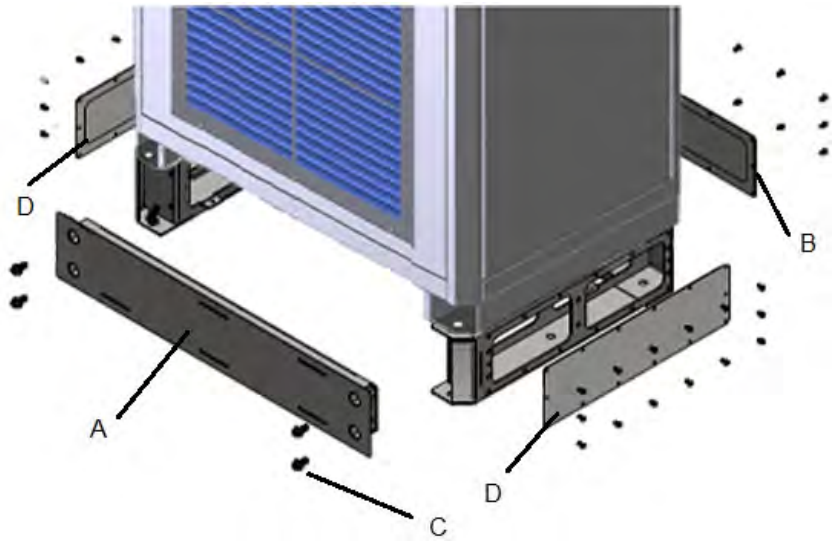
1. Put the front cover (A) against the bottom front of the Power Cabinet by aligning the four bolts at the back side of the front cover (A) with the holes in the bottom front.
2. Put the rear cover (B) against the rear front of the Power Cabinet.
3. Insert the M5 bolts (C) into the holes (8x).
4. Tighten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

5.5.7. Install border covers of metal frame foundation

	NOTICE
	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.

Preconditions:

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



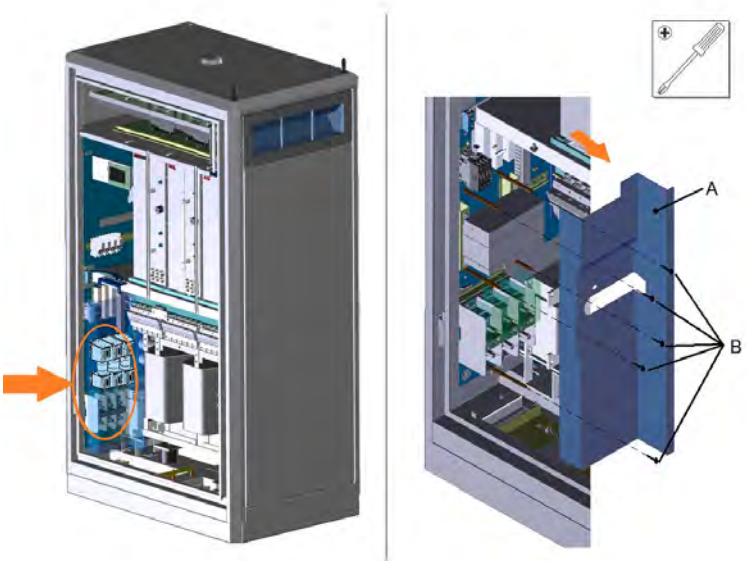
1. Put the front border cover (A) against the front of the Power Cabinet.
2. Put the rear border cover (B) against the rear of the Power Cabinet.
3. Put the side border covers (D) against the sides of the Power Cabinet.
4. Insert the M5 bolts (C) into the holes (8x).
5. Tighten the bolts.

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.

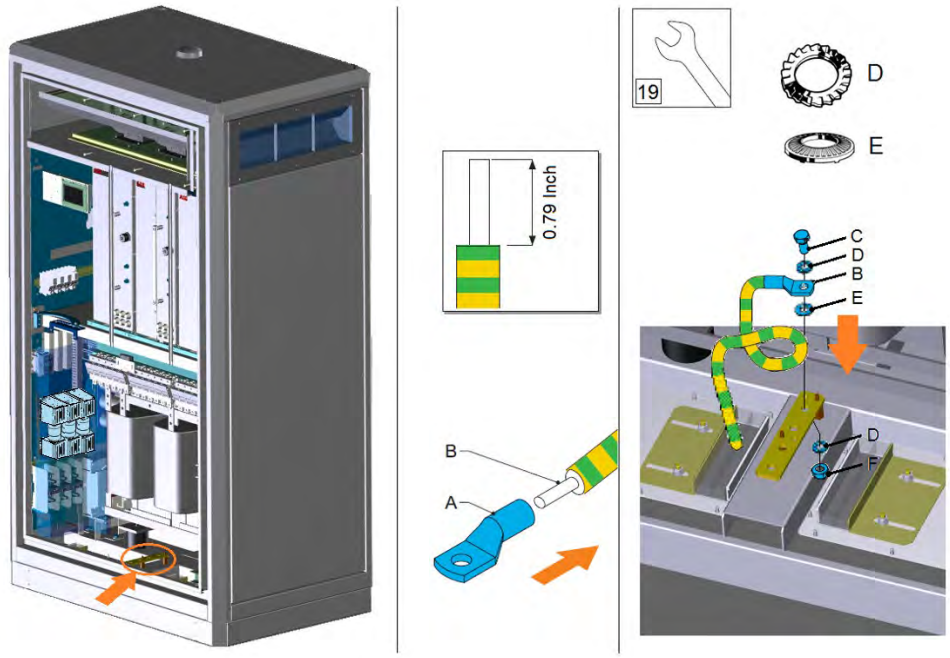
3. Remove the 3 protection covers (D) from the connector blocks (C).
4. Put the protection covers in a safe location as it will be installed again later on.

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
	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.



1. Make a loop in the GND wire.

	NOTICE
	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.

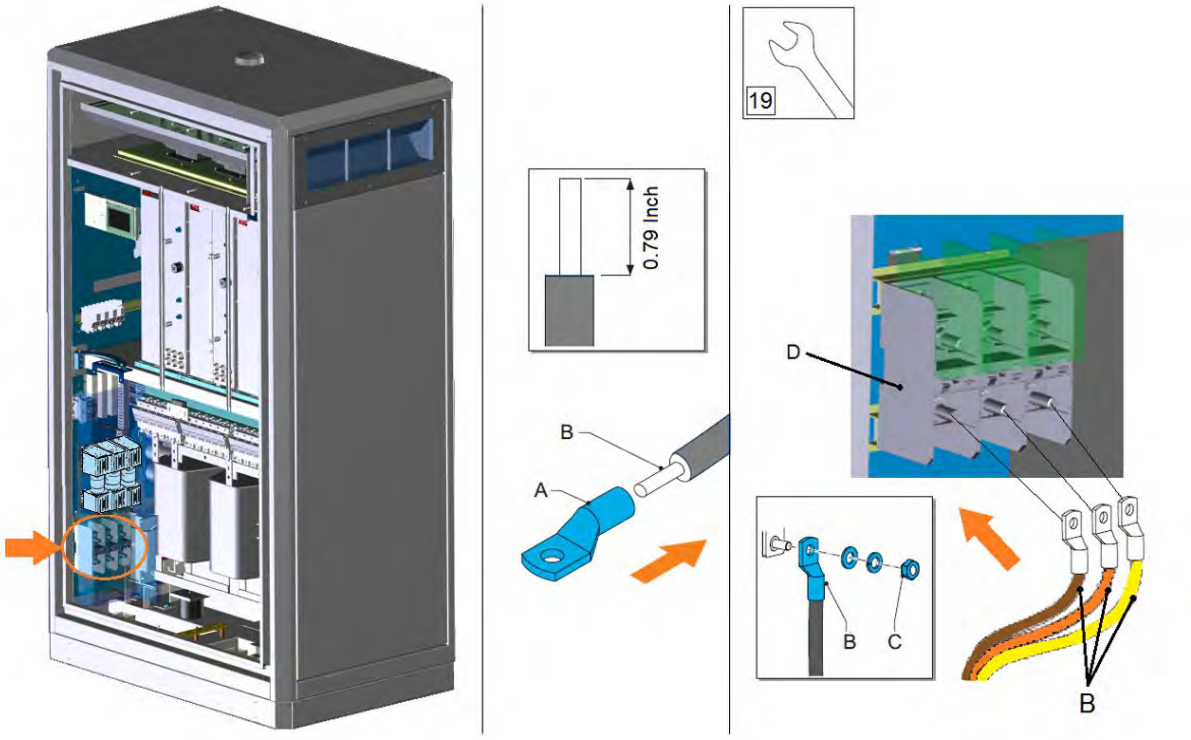
2. Cut the GND wire of the AC power cable to the correct length to reach the GND rail. Do not make the wire routing too tight, or too loose.
3. Strip 0.79 Inch of the insulation from the end of the GND wire
4. Attach a cable lug (A) to the end of the GND wire (B).
5. Remove the M12 bolt, nut and washers 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
	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.

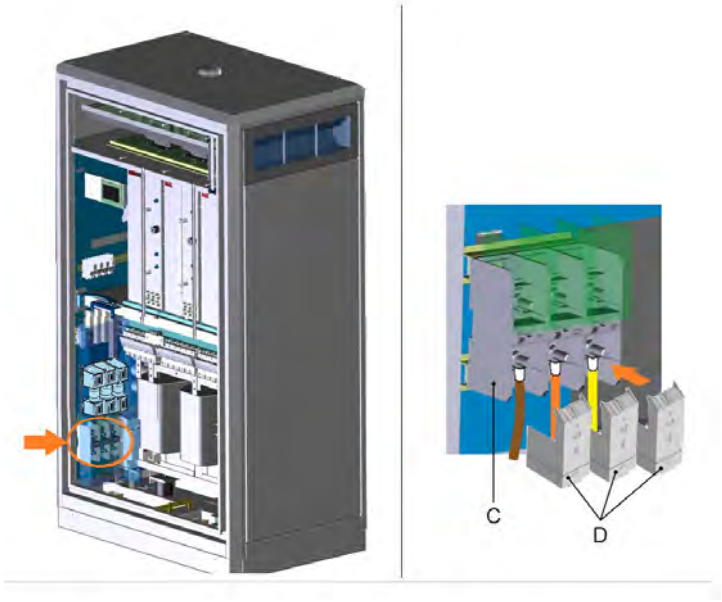


1. Cut the wires of the AC power cable to the correct lengths to reach the connectors. Do not make the wire routing too tight, or too loose.
2. Strip the insulation on the required length specified by the used lug from the end of the wire (B).
3. Attach cable lugs (A) at the end of the wires.
4. Remove 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.

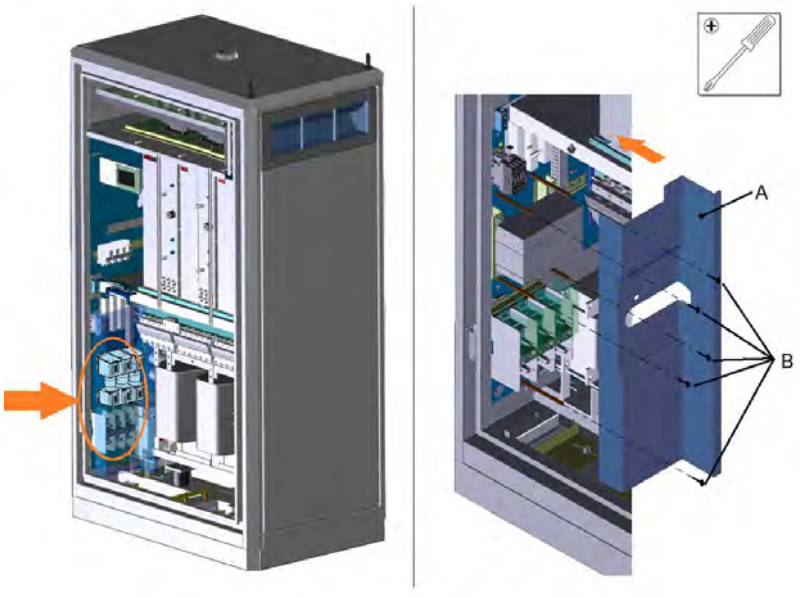
5.6.4. Install the protection covers

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).



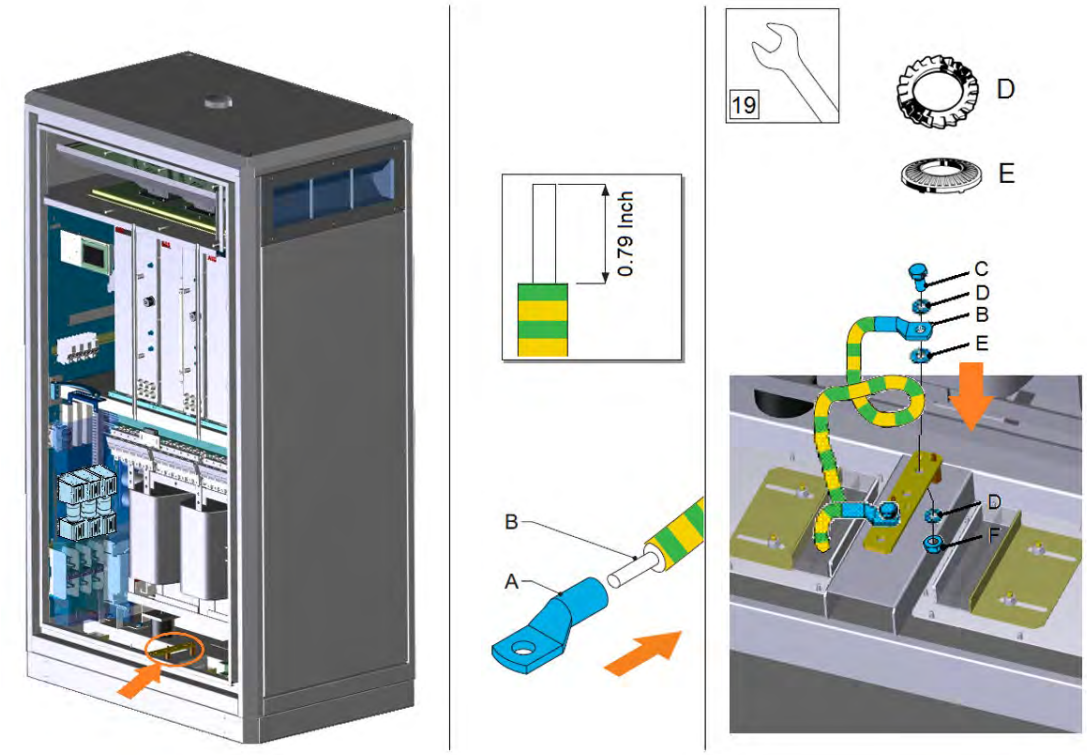
3. Take the protection plate and the screws that were removed in *Remove the protection covers* on Page 66.
4. Place the protection plate (A) back over the main switch and connector blocks and secure the plate by the screws (B).

	WARNING
	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 *Contact information* on Page 14 for contact details.

5.6.5. Install lightning protection (optional)

Preconditions:

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



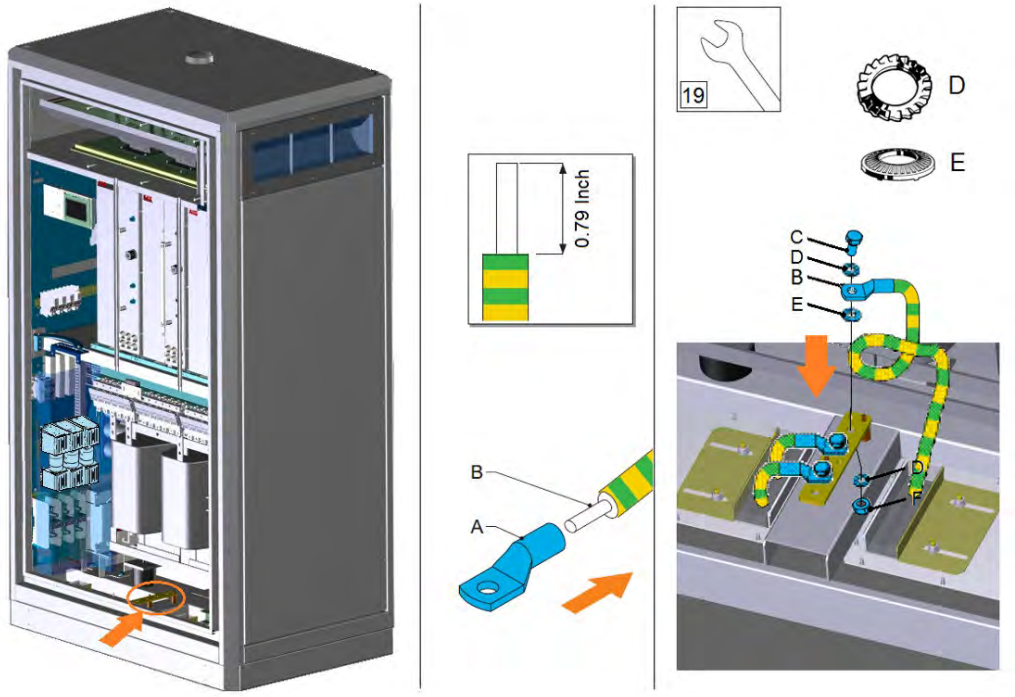
1. Cut the wire of the lightning protection cable to the correct length to reach the GND rail. Do not make the wire routing too tight, or too loose.
2. Strip 0.79 Inch of the insulation from the end of the wire.
3. Attach a wire end ring (A) to the end of the lightning protection wire (B).
4. Remove 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
	The GND wire to the Charge pole is only connected within the HVC 150 Power Cabinet, see for more details section *Cabling* on Page 49.

Preconditions:

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

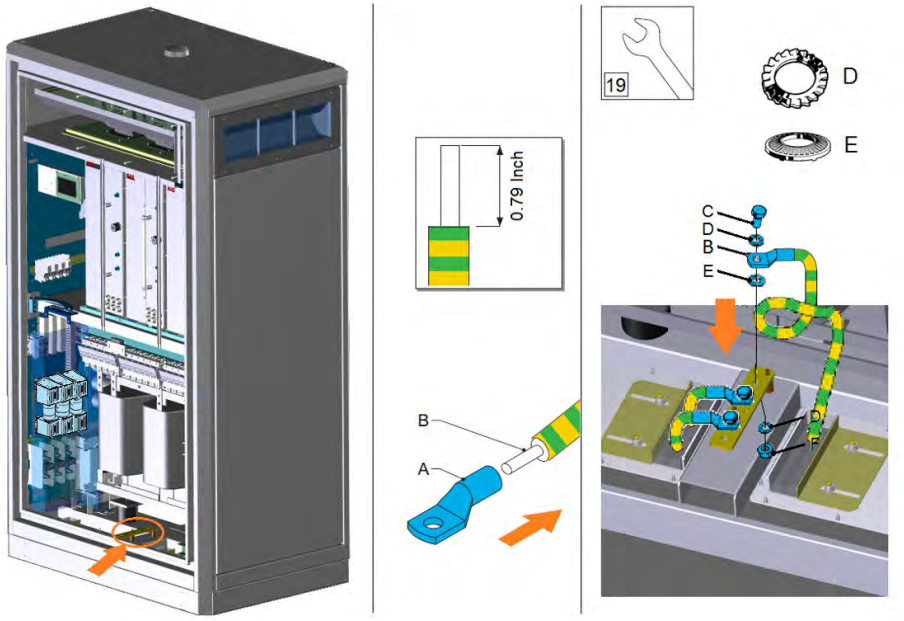


1. Cut the GND wire of the power cable to the correct length to reach the GND rail. Do not make the wire routing too tight, or too loose.
2. Strip 0.79 Inch of the insulation from the end of the GND wire.
3. Attach a wire end ring (A) to the end of the GND wire (B).
4. Remove the M12 bolt, nut and washers 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.

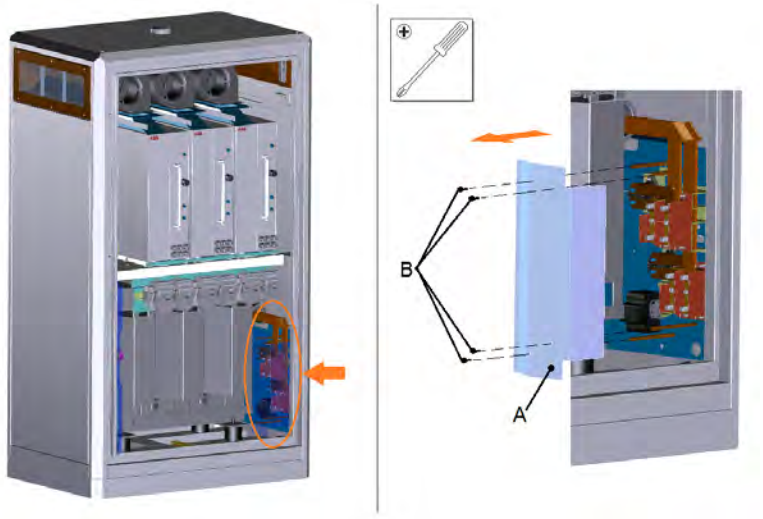
5.7. Connect the DC power cables Power Cabinets

Preconditions:

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

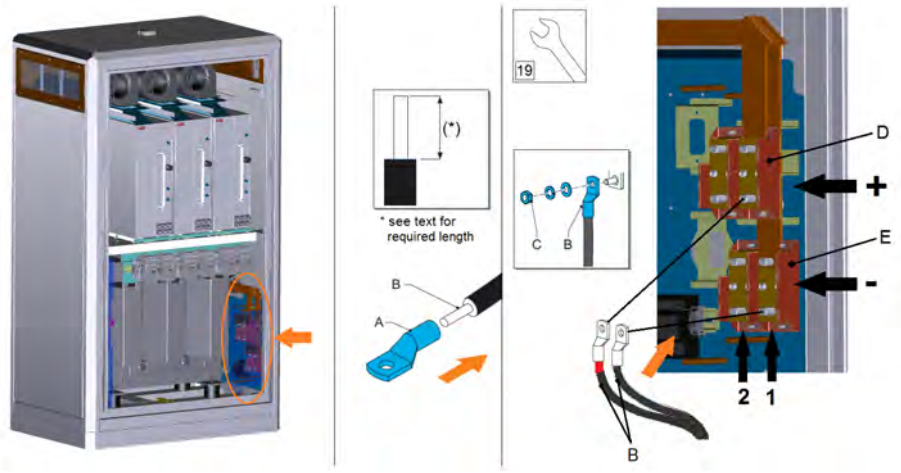
	DANGER
	Make sure that the main switch of the power supply group for the product is set to the OFF position. Do a voltage check to make sure that the electrical power is disconnected from the system. Secure against resetting.

Remove the protection cover



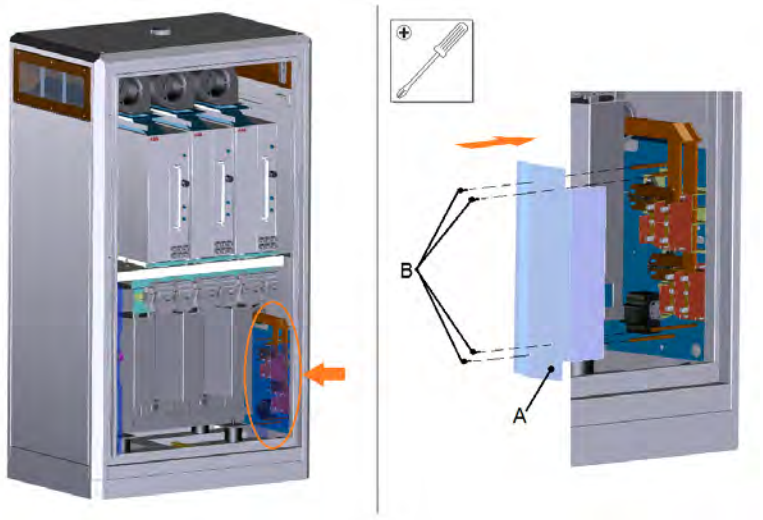
1. Remove the protection plate (A) by loosening the screws (B) (4x).
2. Put the protection plate and screws in a safe location as it will be installed again later on.

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).

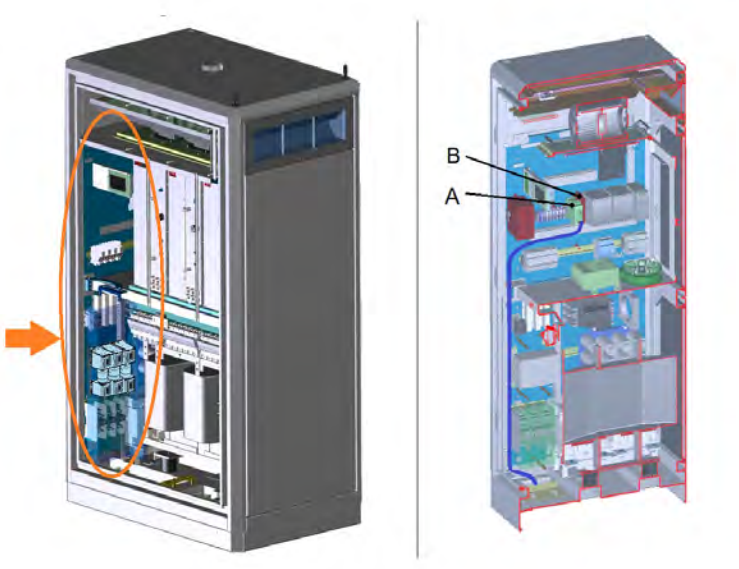
5.8. Connect AC utility power, Interlock and CAN cables Power Cabinet

Preconditions:

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

	DANGER
	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.

5.8.1. Route the cables to the terminal blocks

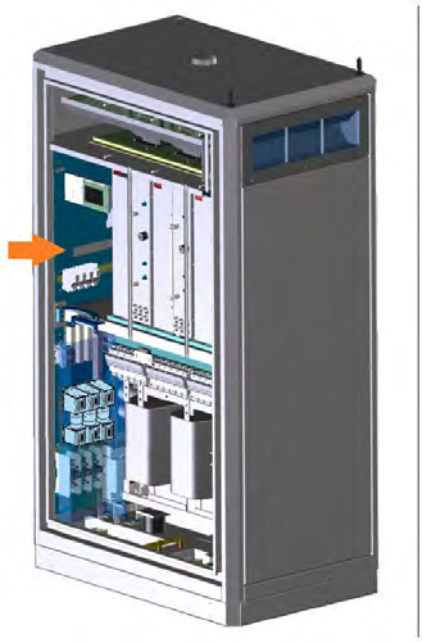


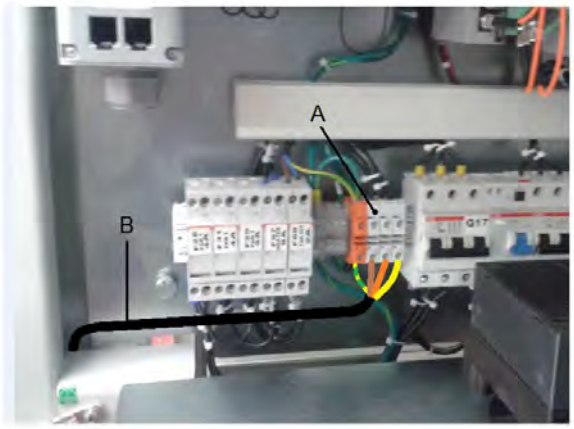
Preferred cable route

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

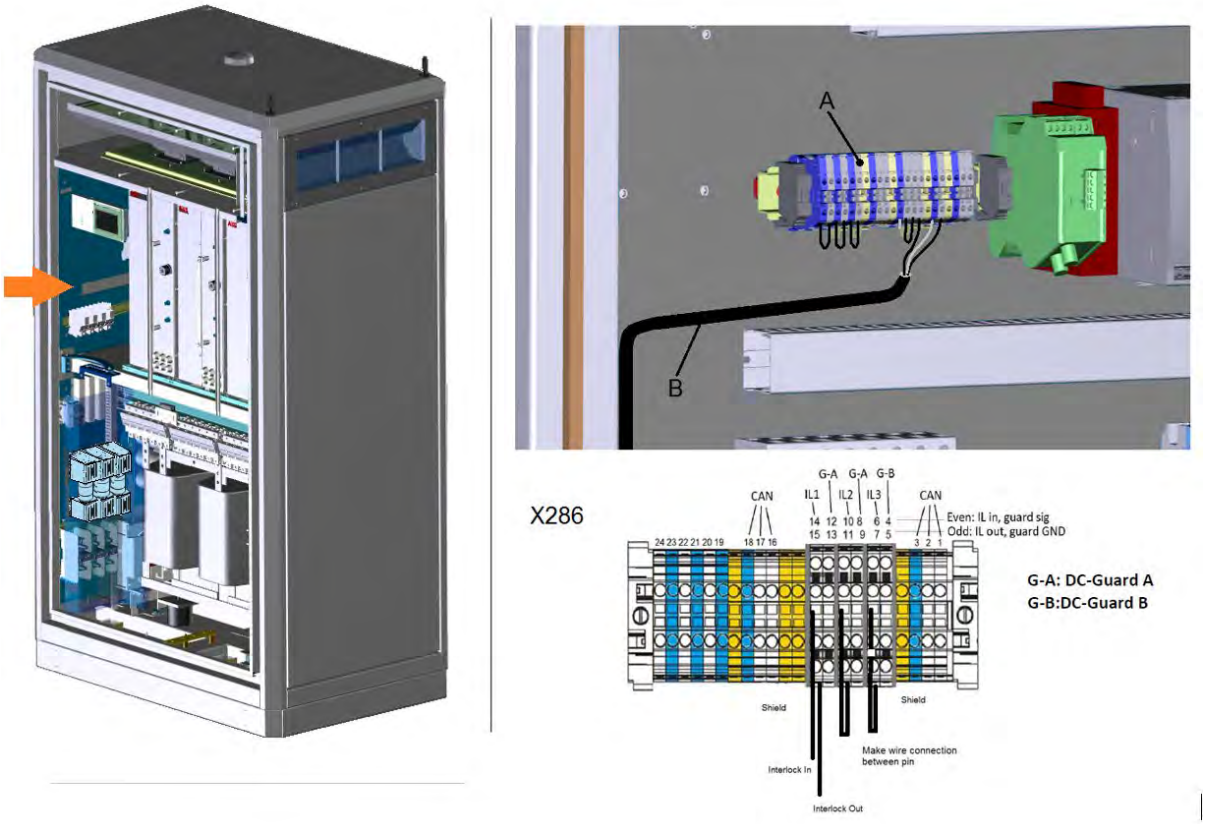
1. Move the cable towards the terminal block (A).
2. Strip 0.43 Inch of the insulation from the ends of the wires.
3. Crimp a ferrule onto the end of the wire.
4. Loosen the connector screws.
5. Insert the wires into the connectors, see table below:

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:

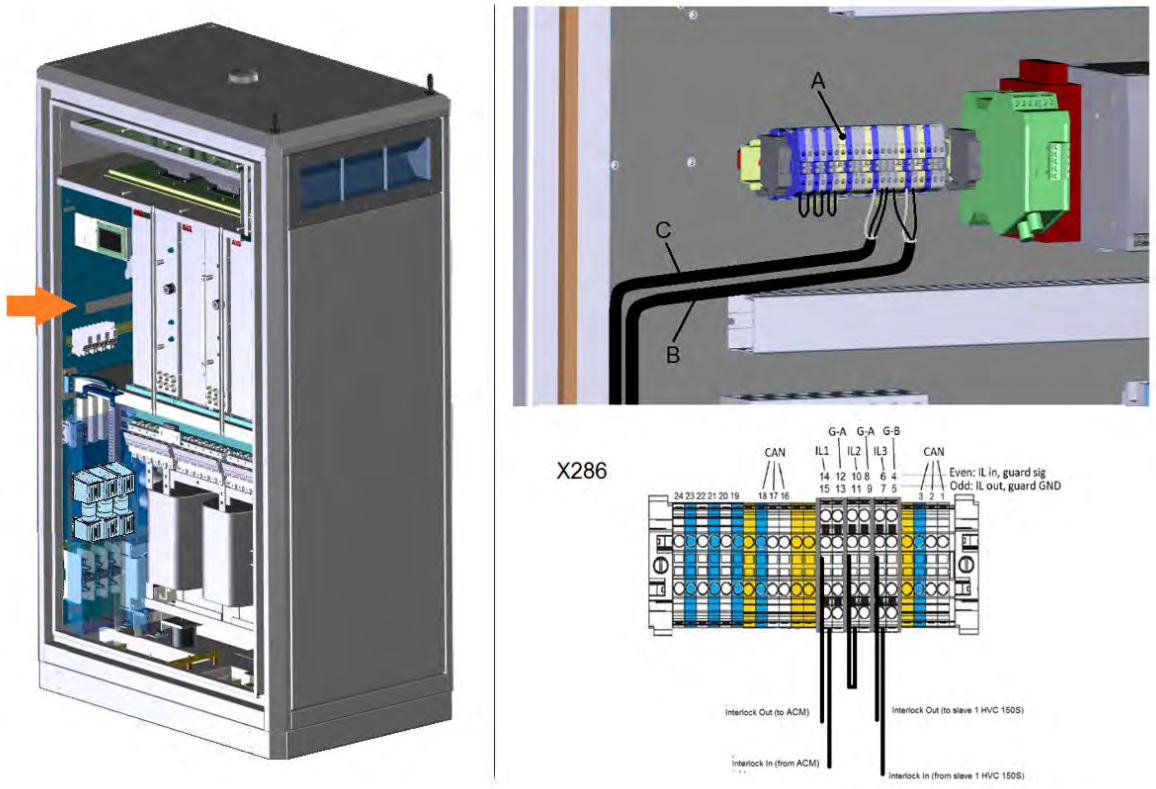
Functional description	Connector	Wire number
Interlock In	X286-15	Brown
Interlock Out	X286-14	White
Interlock GND	X286	Shield
Interlock loop	X286-6	Black
Interlock loop	X286-7	Black
Interlock loop	X286-10	Black
Interlock loop	X286-11	Black

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

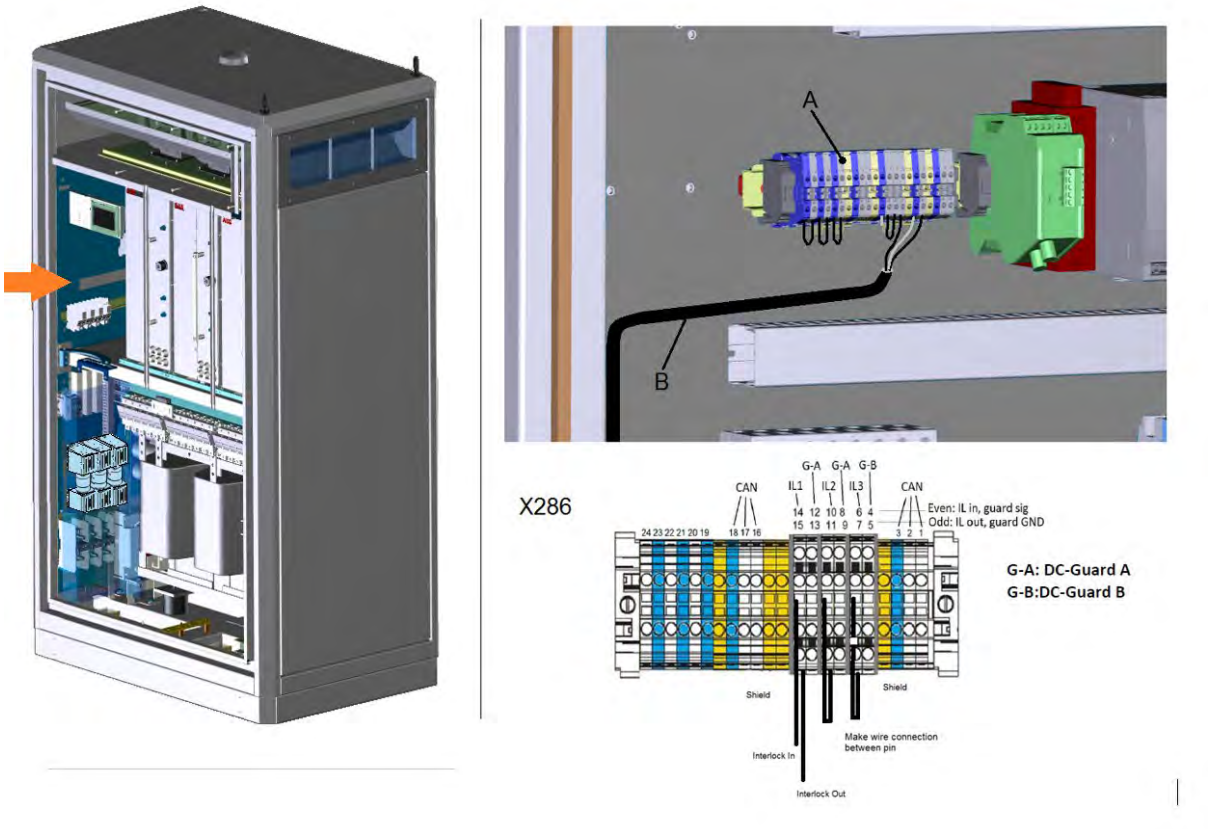
1. Move the cables towards the terminal block (A).
2. Strip 0.43 Inch of the insulation from the ends of **only the White and Brown wire!**
3. Crimp a ferrule onto the end of the White and Brown wire.
4. Ensure that the unused wires, the Green and Yellow wire, are protected so that they cannot touch 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:

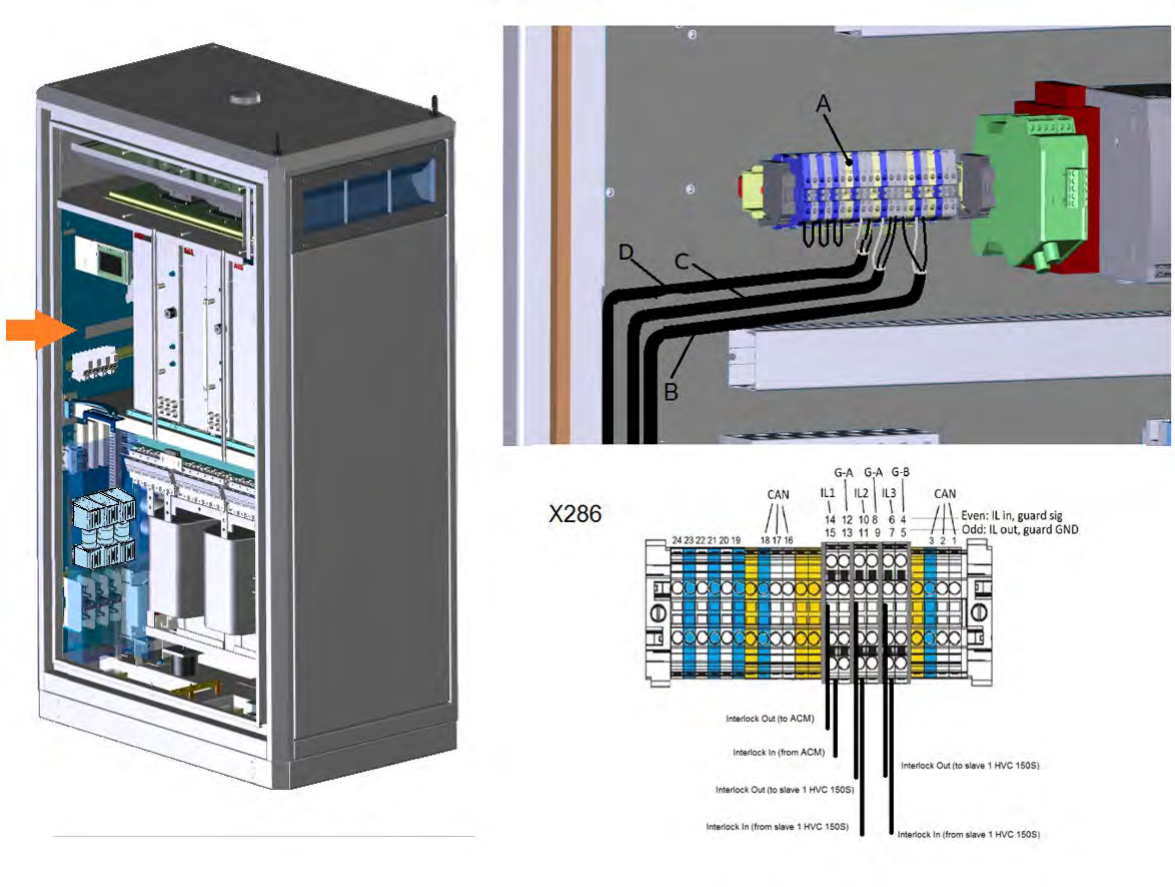
Functional description	Connector	Wire number
Interlock In (primary HVC 150)	X286-14	Brown
Interlock Out (primary HVC 150)	X286-15	White
Interlock GND (primary HVC 150)	X286	Shield
Interlock loop	X286-6	Black
Interlock loop	X286-7	Black
Interlock loop	X286-10	Black
Interlock loop	X286-11	Black

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

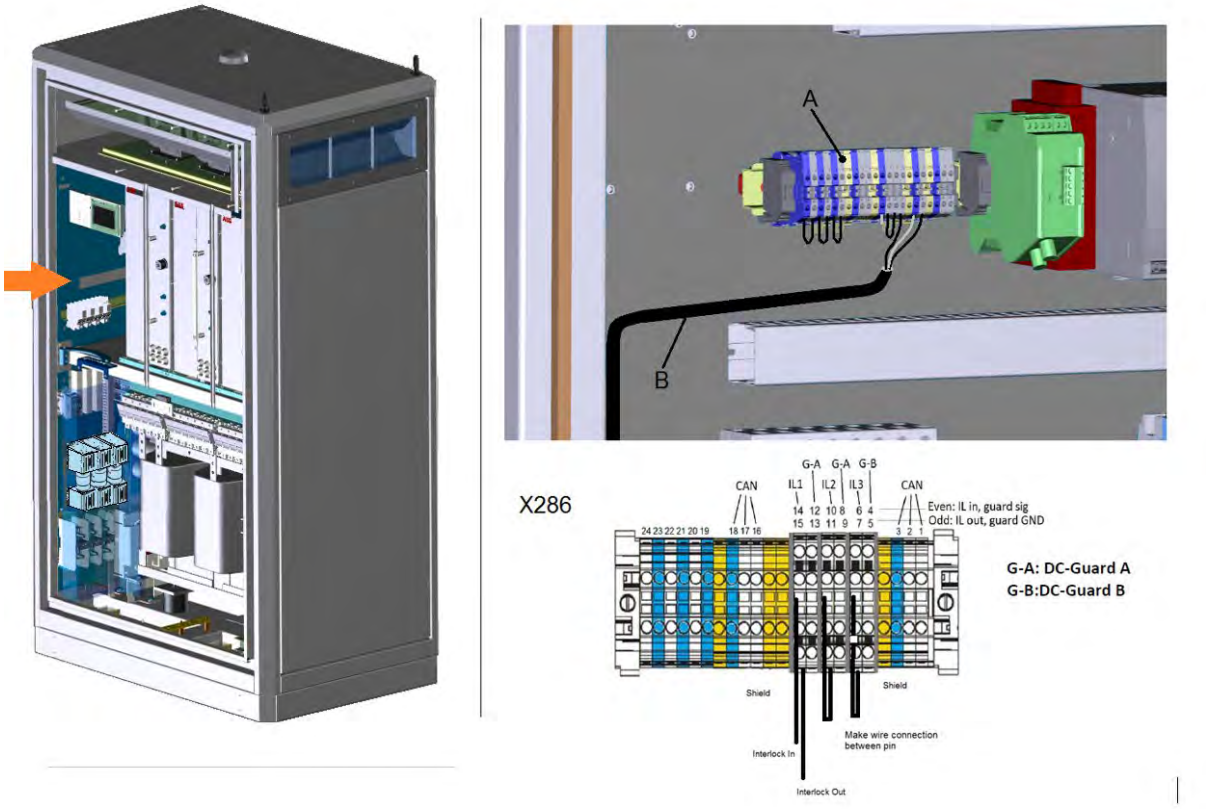
1. Move the cables towards the terminal block (A).
2. Strip 0.43 Inch of the insulation from the ends of **only the White and Brown wire!**
3. Crimp a ferrule onto the end of the White and Brown wire.
4. Ensure that the unused wires, the Green and Yellow wire, are protected so that they cannot touch 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

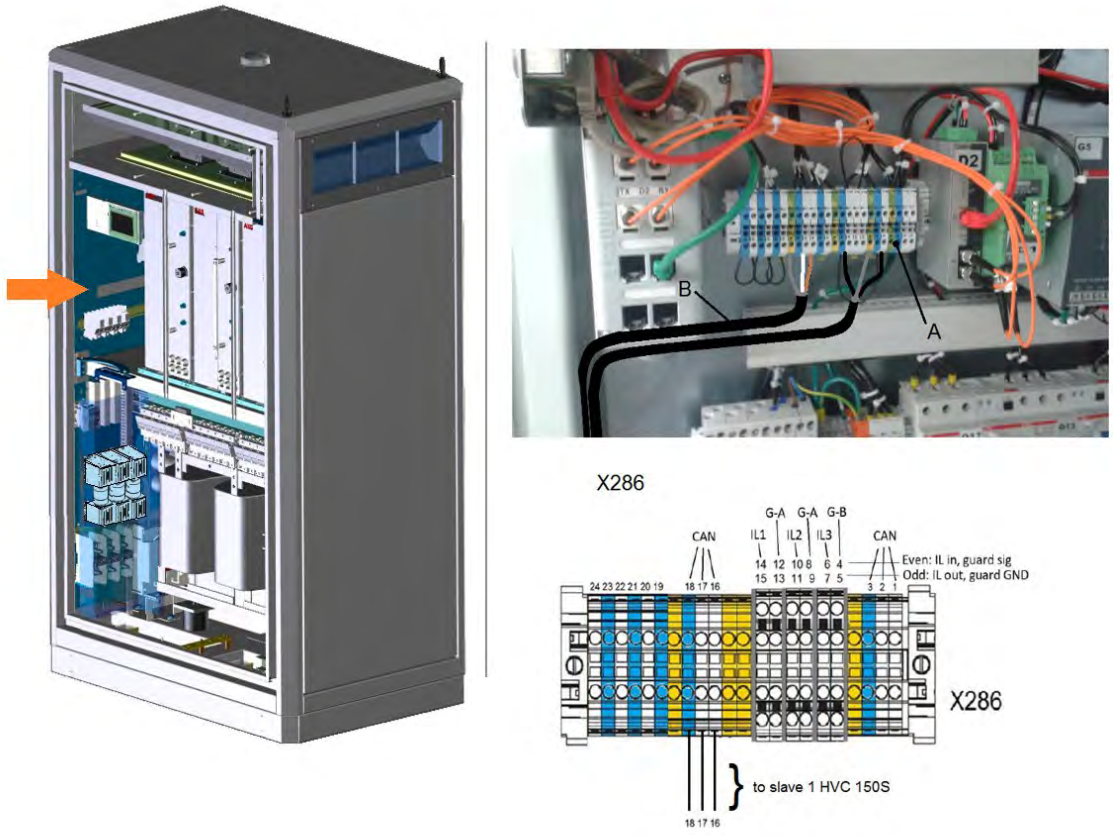
See also Appendix H *Signal connection diagram*.

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

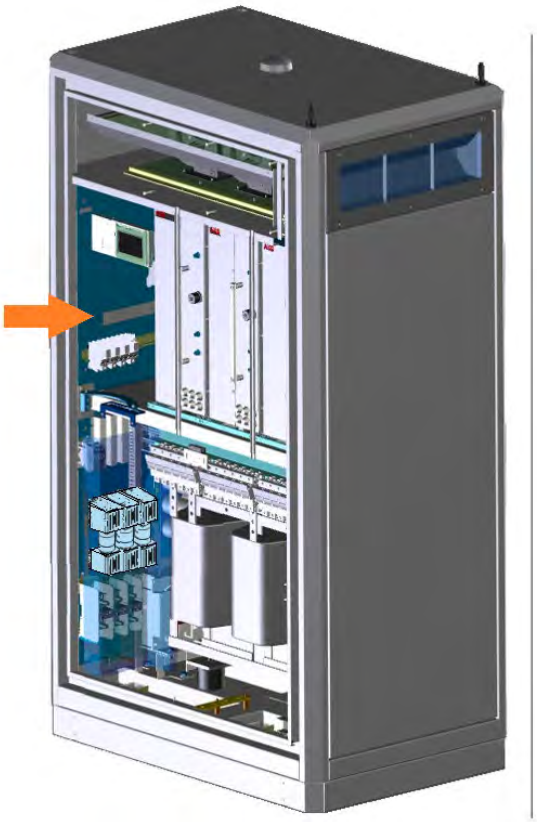
1. Move the cable towards the terminal block (A).
2. Strip 0.43 of the insulation from the ends of the wires.
3. Crimp a ferrule onto the end of the wire.
4. Loosen the connector screws.
5. Insert the wires into the connectors, see table below:

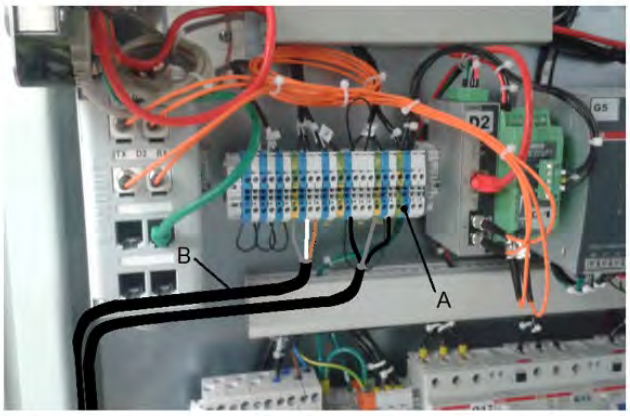
Functional description	Connector	Wire color
CAN H Out	X286-10	Brown
CAN L Out	X286-11	White
CAN GND	X286-12 or Shield Can Out	Shield

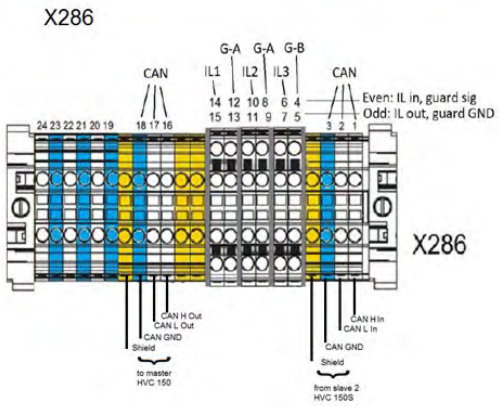
See also Appendix H *Signal connection diagram*.

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)

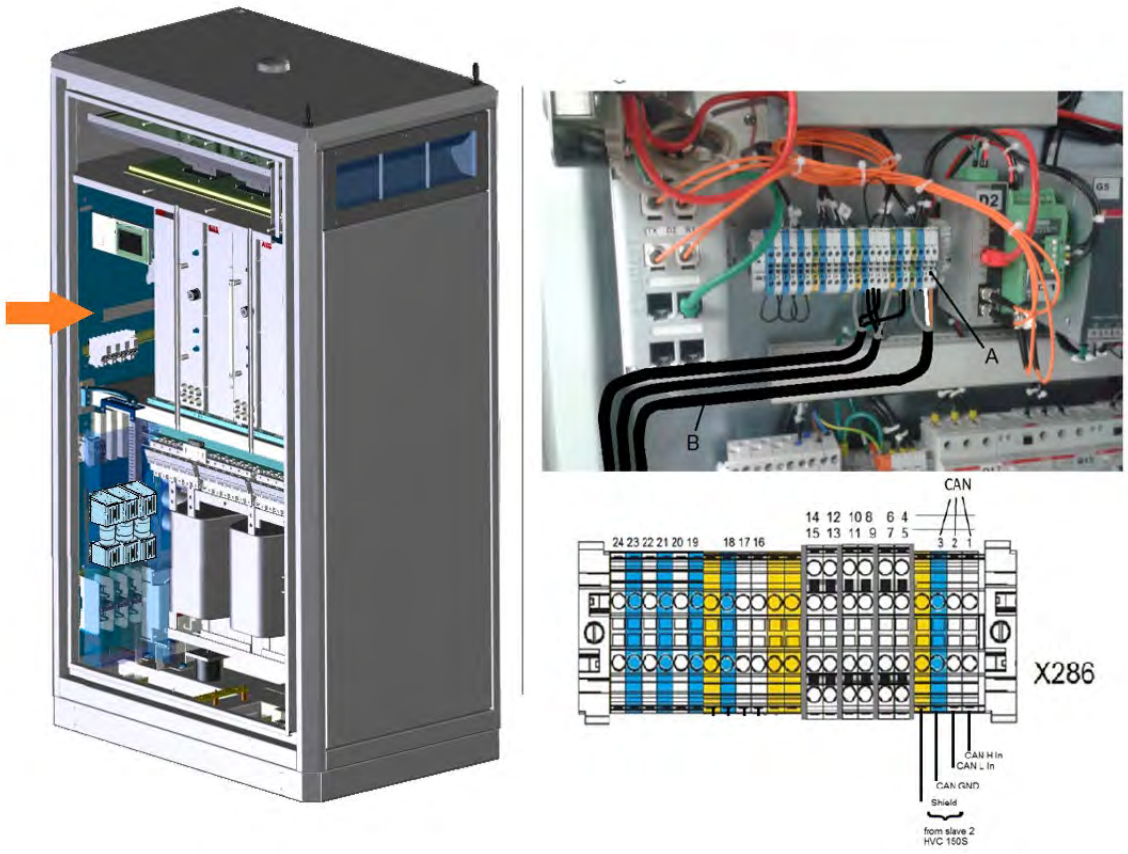
1. Move the cable towards the terminal block (A).
2. Strip 0.43 Inch of the insulation from the ends of the wires.
3. Crimp a ferrule onto the end of the wire.
4. Loosen the connector screws.
5. Insert the wires into the connectors, see table below:

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

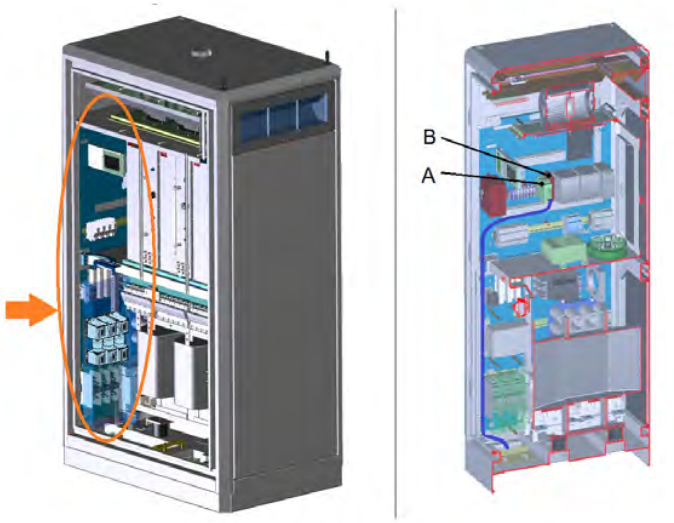
See also Appendix H *Signal connection diagram*.

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



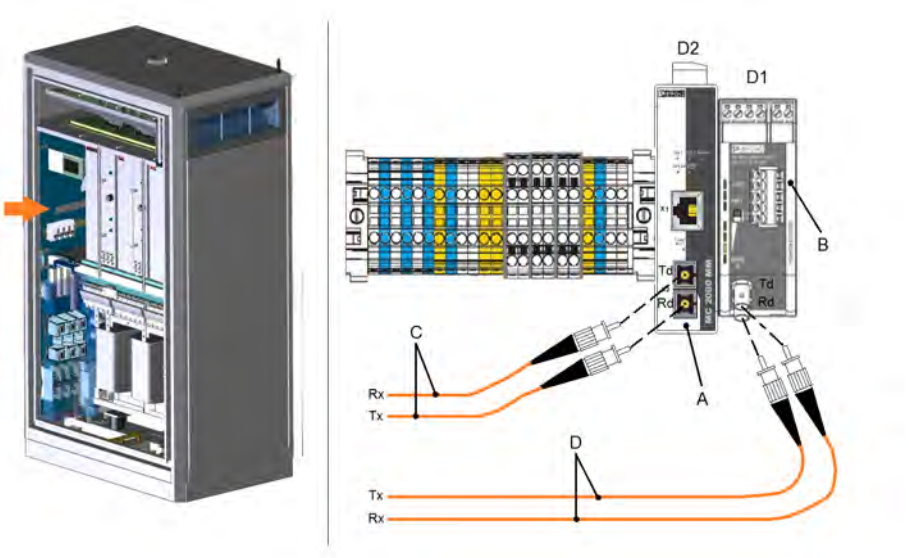
Preferred cable route

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



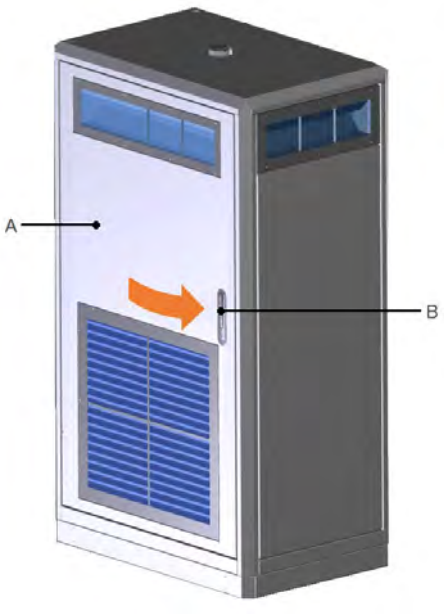
1. Remove the protection covers from the optical connectors.
2. Connect the two Ethernet fiber cables (C) onto the module D2 (A):
   - Rx with Td D2;
   - Tx with Rd D2.
3. Connect the two CAN bus fiber cables (D) onto module D1 (B):
   - Rx with Td D1;
   - Tx with Rd D1.

	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



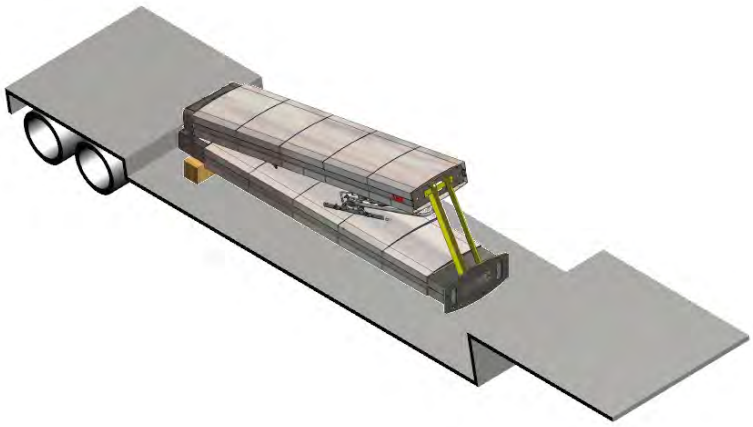
Preconditions:
- Key that were removed from the Power Cabinet

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.

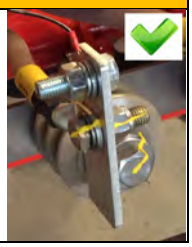


	NOTICE
	Unloading Charge control set The delivery truck only unloads the Charge Pole and pallet carrying the parts of the Charge Pole. The delivery truck will not move the Charge Pole set to its final location. The placement of the Charge Pole to its final location is the responsibility of the contractor. 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 *Contact information* 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.

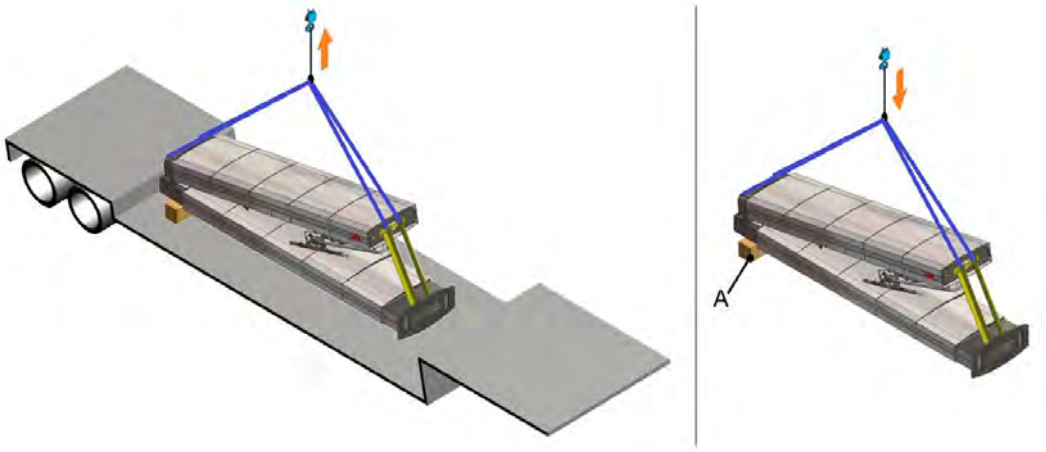
5.12. Move the Charge pole to position

Preconditions:

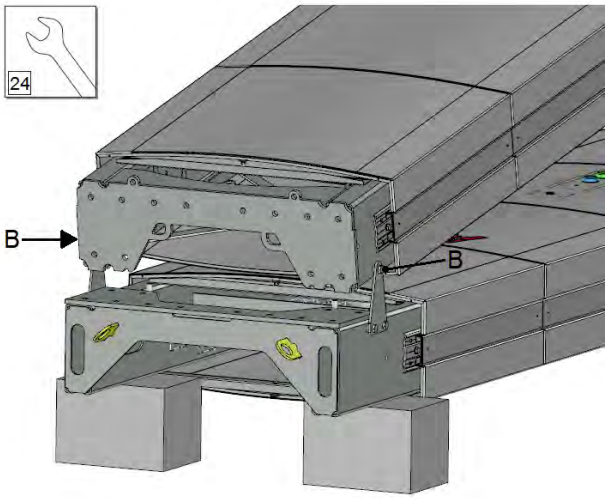
- The location is prepared for placing the Charge Pole.
- The location is closed to bystanders and all preparatory safety measures required during the lifting operations have been carried out.
- The Charge Pole is made unsecured on the trailer and the cover sail (if present) are removed.
- The protective 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.

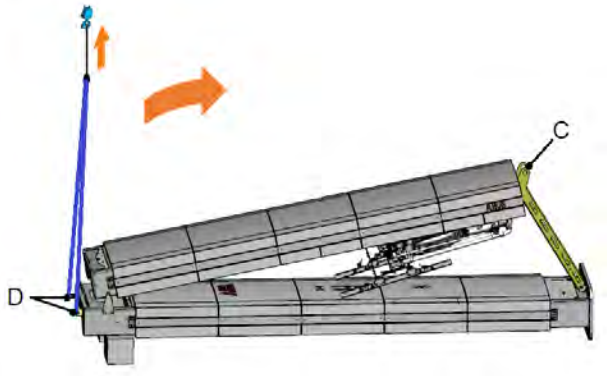
1. Connect the hoisting equipment to the lifting points on the Charge Pole.



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).

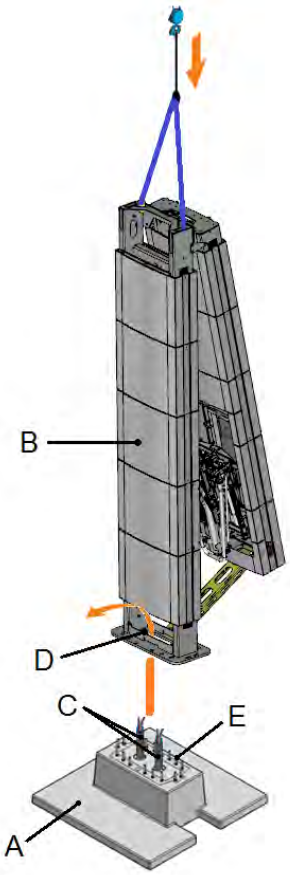
6. Move the Charge Pole to the foundation.

5.13. Install Charge Pole onto the foundation

Preconditions:

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

	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.



Installation on concrete foundation

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

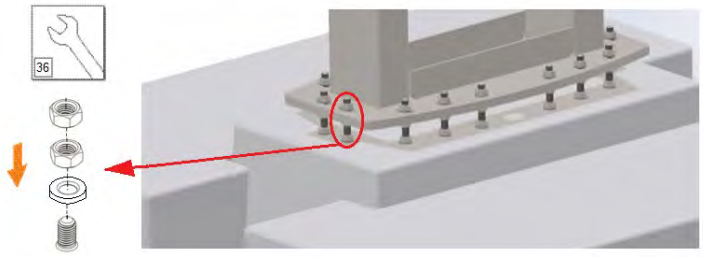
1. It is possible to choose to lubricate the bolts first or not with copper fat.

	NOTICE
	There are a number of reasons for using copper fat: • 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.

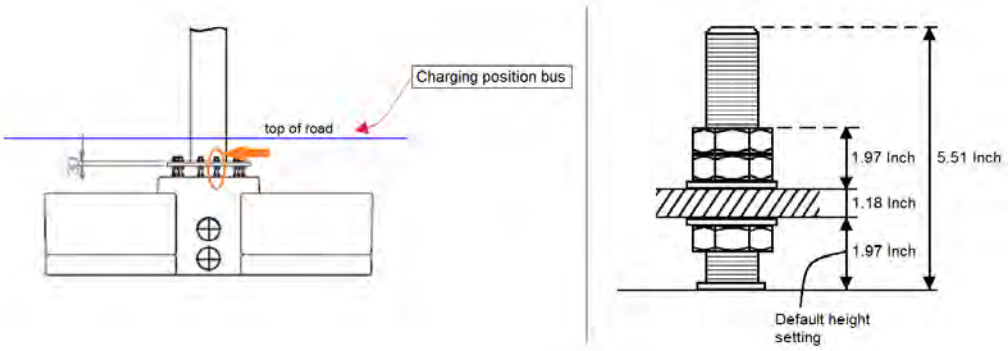
2. Screw the M24 (or equivalent) nuts onto the bolts and place on each nut the 0.32 Inch thick washers (16x). The default height between the top of the washer and foundation must be 1.97 Inch.

	NOTICE
	• 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).



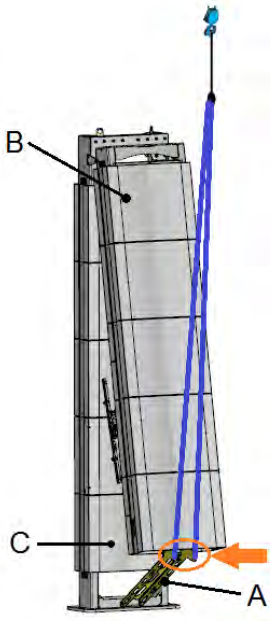
	NOTICE
	Be aware that the correct height to the bottom side of the foot print of the vertical frame relative to the ground level of the top of road (= charging position of the bus) must be calculated by ABB. Contact ABB Sales department (see *Contact information* on Page 14 for contact details).

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.

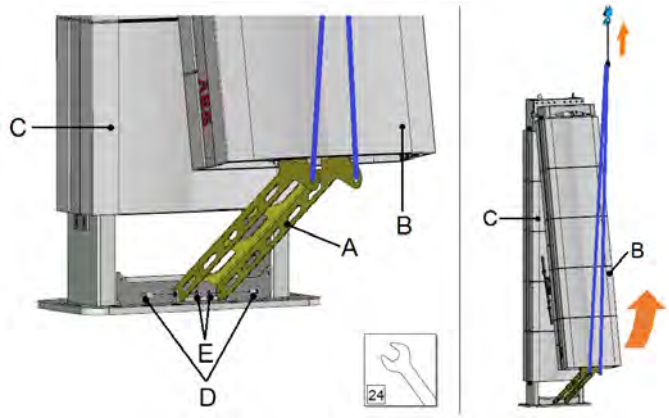
5.14. Install mast boom onto column

Preconditions:

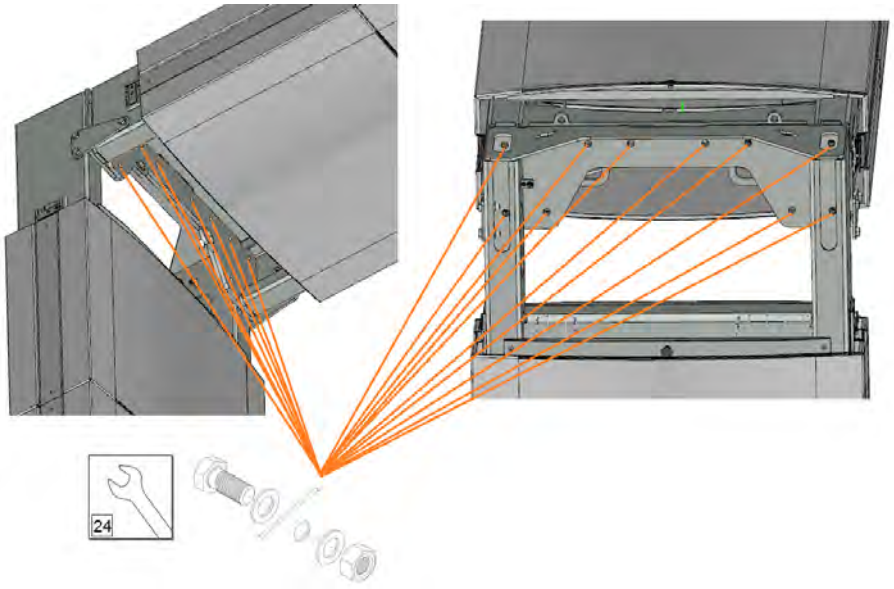
- Tools: mobile elevated work platform, torx screwdriver (size 2163TX-T30), spanner (size 17 and 24), torque wrench (size 24).



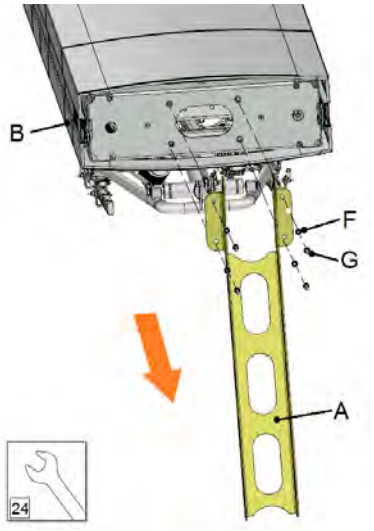
1. Connect the hoisting equipment to the lifting points on the mast boom (B) position of the transport holder (A).



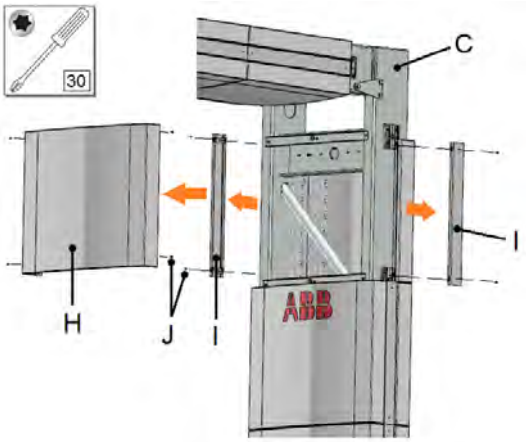
2. Remove the bolts (D) and nuts (E) (2x) which secured the transport holder (A) with the column (C) of the Charge Pole.
3. Lift up the mast boom (B) until it touches the column (C) horizontally.



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.



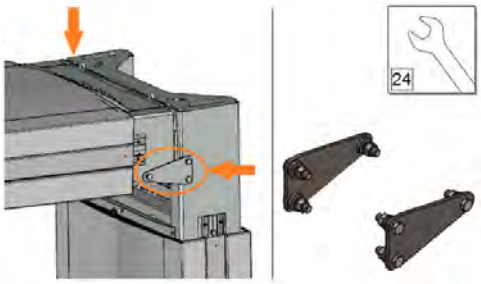
5. Release the slings from the transport holder (A).
6. Remove the transport holder (A) from the mast boom (B) by removing the bolts (G) and washers (F) (4x).

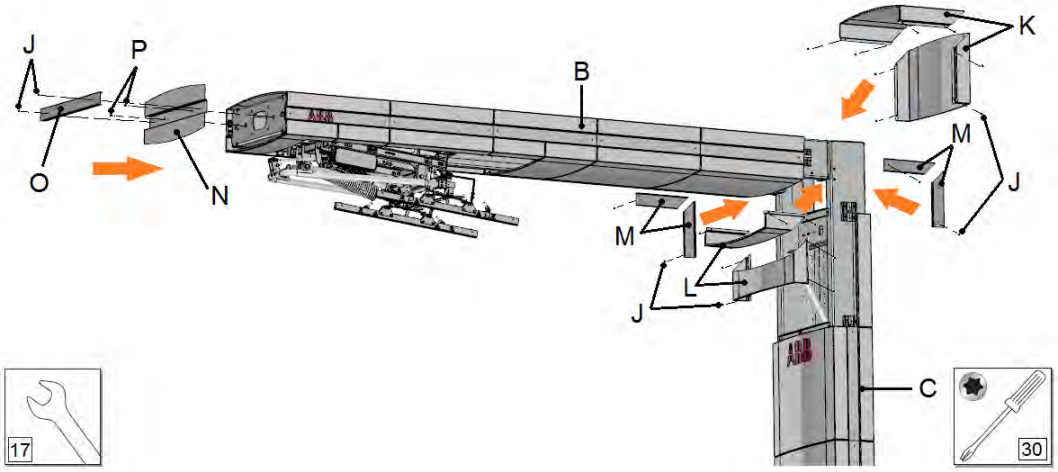


7. Remove on both side the U-profiles (I) by detaching the two M6 bolts (J).
8. Remove the cover plate (H) by detaching the M6 bolts (J).
9. Put the cover plate, U-profiles and bolts in a safe location as it will be installed again later on.

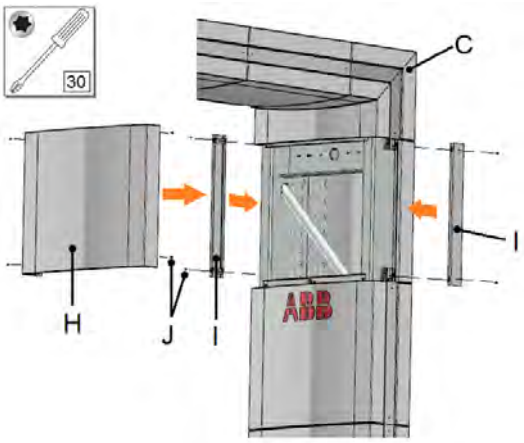
NOTICE

To make it easier to place the bottom corner cover plates (L), the hinge plates on both sides of the columns of the Charge Pole can be removed. This makes it possible that the cover plate (H) does not have to be removed.





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.

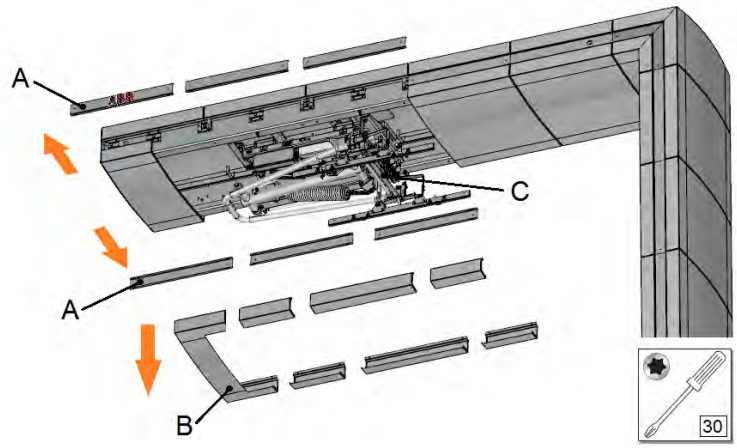
POLE ON THE RIGHT - DRIVERS POINT OF VIEW																
		Inclination + Kneeling (Angles in degrees)														
	740.75	**3.5**	**3**	**2.5**	**2**	**1.5**	**1**	**0.5**	**0**	**-0.5**	**-1**	**-1.5**	**-2**	**-2.5**	**-3**	**-3.5**
Curb width (mm)	**400**	1569	1541	1513	1484	1456	1428	1400	1372	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

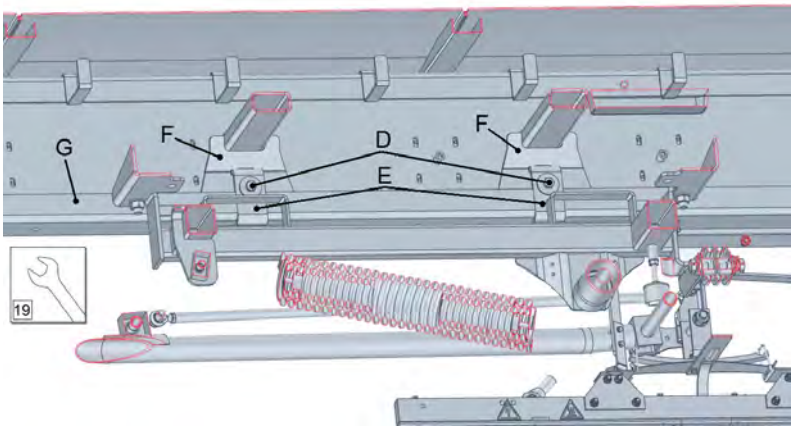
The previous calculations has been thought as a first iteration to position the pantograph, but have to be physically checked with the bus. Errors could come from the verticality of the pole mounting, measurement of the road inclination, tilting or distance from the TOR to retracted pantograph. During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

5.15.2. Pantograph setting range adjustment

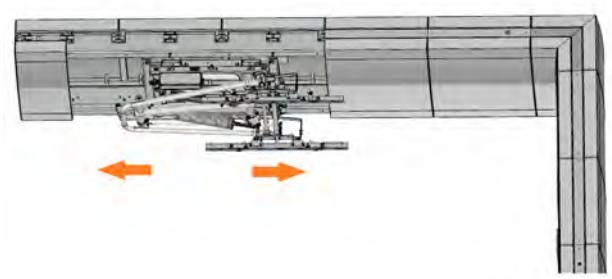


1. Determine how many cover plates (B) should be removed around the pantograph (C). If no cover plates need be removed, go to step 5.
2. Remove on both side the U-profiles (A) by detaching the two M6 bolts.
3. Remove the cover plates (B) by detaching the M6 bolts.
4. Put the cover plates, U-profiles 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.

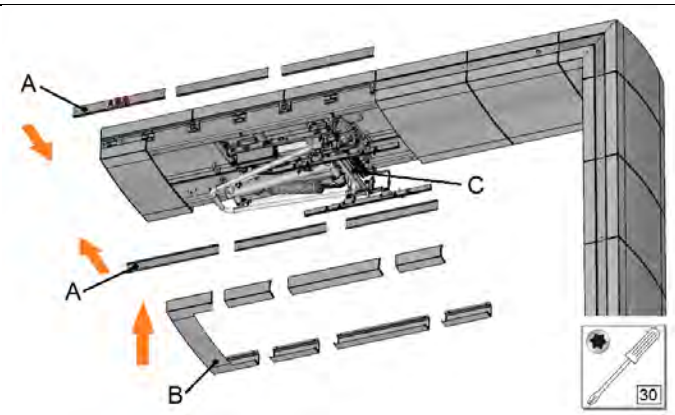


5. The pantograph is suspended in the C-profile of the frame (G) by two suspended-plates (with slide bearings) (F) on each side of the pantograph. The pantograph is locked by clamping plates (E) on each side of the C-profile frame (G). From below, the lock can be loosened by loosening the M12 bolts (D)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

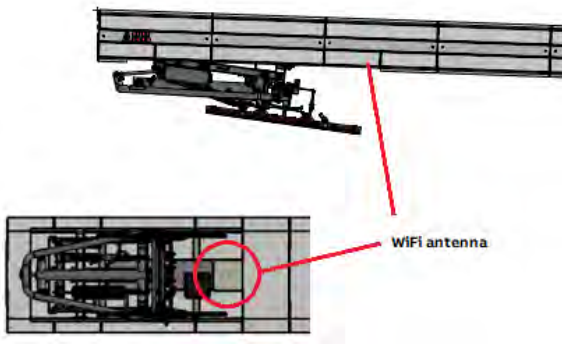


8. When removed, place back the cover plates (B) so that only the pantograph and the WiFi antenna are free of access, and tighten the M6 bolts.

	NOTICE
	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.

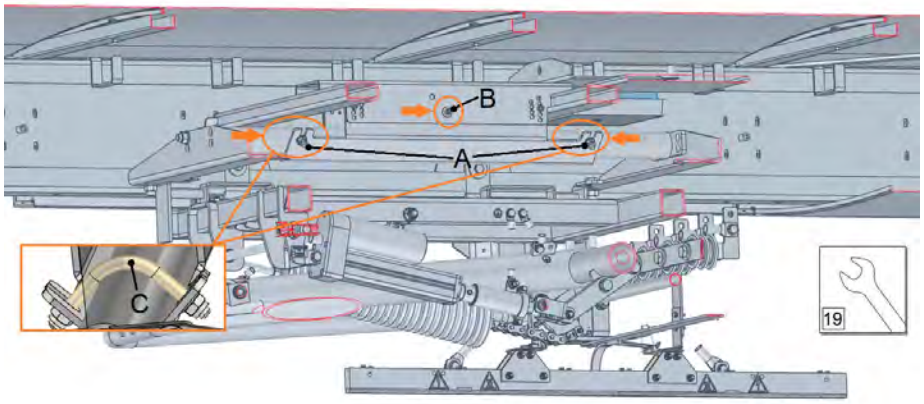
8. Place back the U-profiles (A) on both side, and tighten the M6 bolts.

	NOTICE
	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.



5.15.3. Pantograph Z-axis angle adjustment

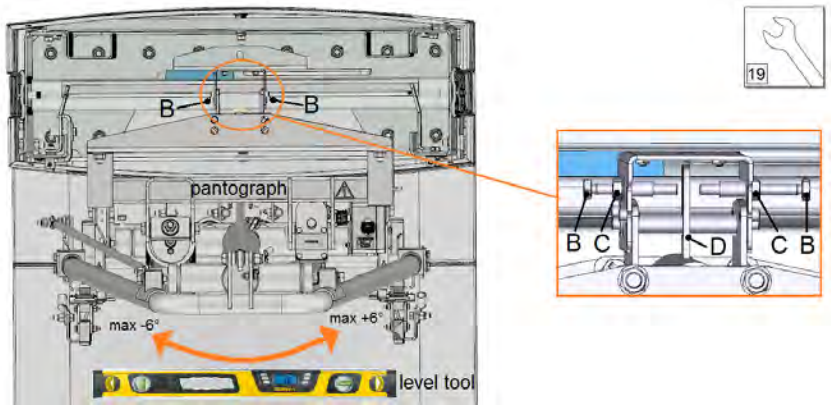
The pantograph can be adjust for road inclination (Z-axis) between the 0º and 6.0º, see also section *Maximum slope of the road in Z-axis* on Page 35.



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.

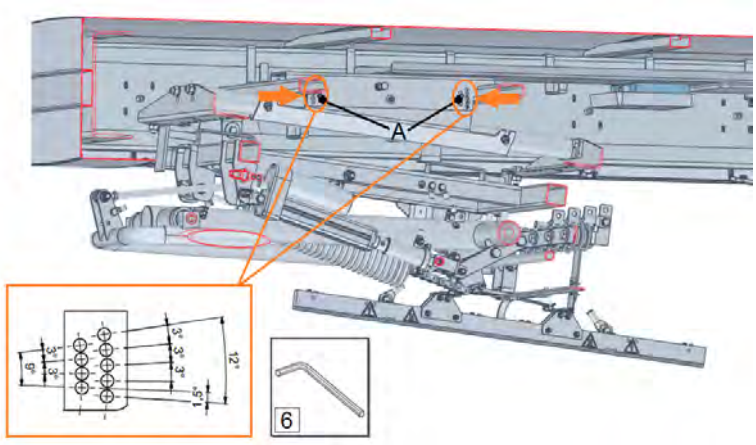
	WARNING
	Don't remove the nuts (A) of the two U-bolts (C). Otherwise the pantograph can fall down.



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 sideway direction (X-axis) between -6.0º to 6.0º in steps of 1.5º, 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. Apply threadlocker glue (e.g. Loctite 241 or 243 - Blue type) to the M8 bolts and install them in the new angle position slots.
5. Tighten M8 bolts (A) (4x).

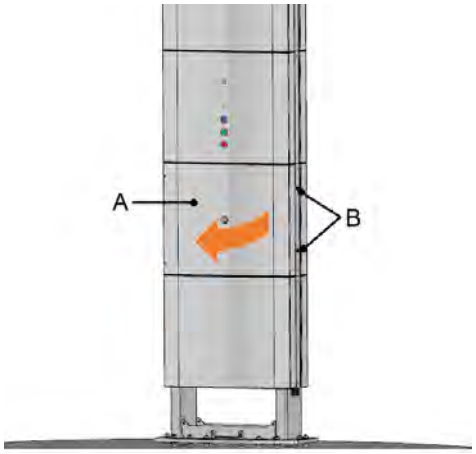
5.16. Installation of the cables inside Charge Post

	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.

5.16.1. Open the door and remove cover plate

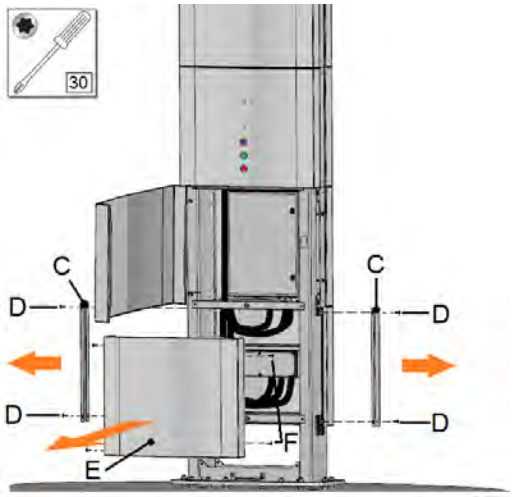
Preconditions:

- 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.

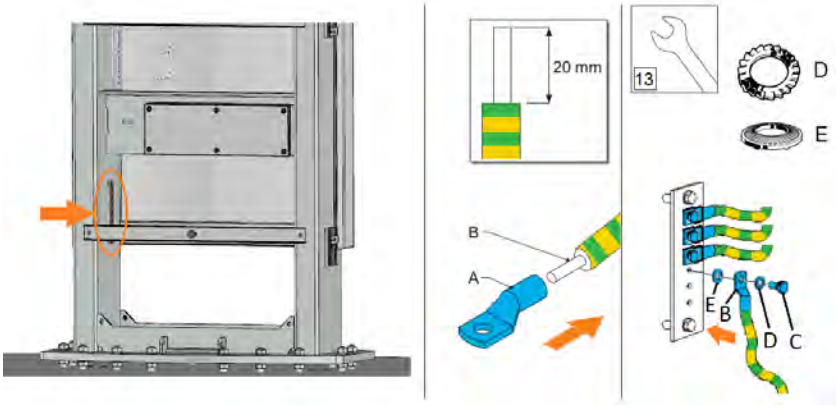


2. Remove on both side the U-profiles (C) by detaching the two M6 bolts (D).
3. Remove the cover plate (E) by detaching the M6 bolts (F).
4. Put the cover plate, U-profiles and bolts in a safe location as it will be installed again later on.

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).

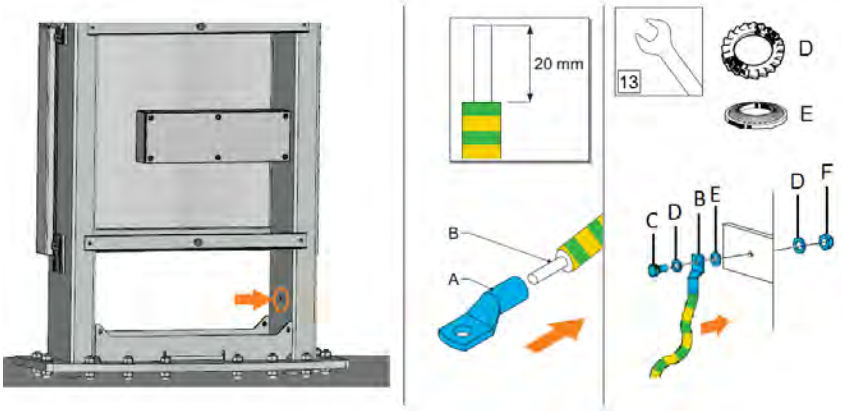


1. Cut the GND wire to the correct length to reach the GND rail. Do not make the wire routing too tight, or too loose.
2. Strip 0.79 Inch of the insulation from the end of the wire.
3. Attach a cable lug (A) to the end of the GND wire (B).
4. Remove the M8 bolt and washers from the GND rail.
5. Fit the 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:

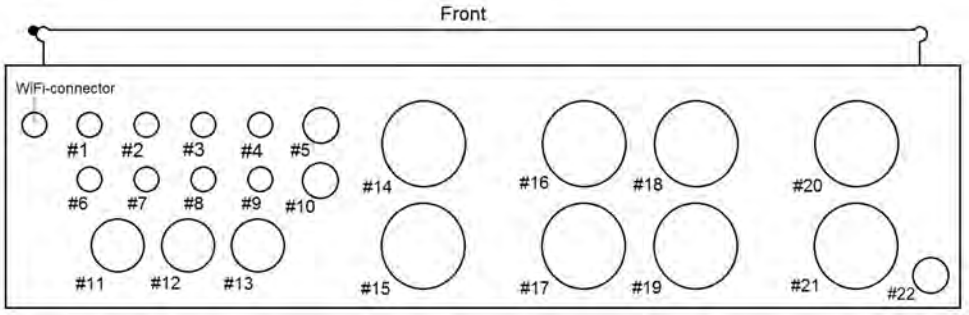
- Tools: wire cutter, wire stripper pliers, cable lug, spanner (size 13), torque wrench (size 13).



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 lighting protection wire (B).
4. Remove the M8 bolt, nut and washers from the lighting protection connection.
5. Fit the bolt (C) with toothed washer (D), the lighting protection wire (B) and contact washer (E).
6. Insert the bolt fitted with the lighting protection wire into the lighting 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

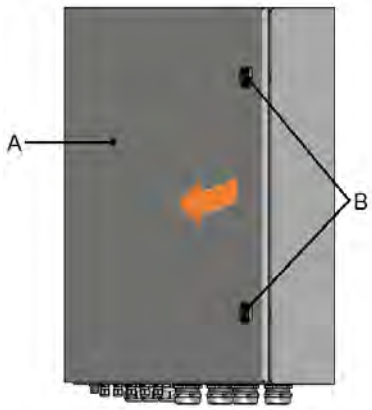


Gland #	Clamping range ØF	Cable
1	5 – 10 mm (0.20 – 0.39 Inch)	AC utility power
2	5 – 10 mm (0.20 – 0.39 Inch)	Pantograph heater
3	5 – 10 mm (0.20 – 0.39 Inch)	Interlock
4	5 – 10 mm (0.20 – 0.39 Inch)	Pantograph CP/PE
5	10 - 17 mm (0.39 – 0.67 Inch)	RFID Ethernet
6	5 – 10 mm (0.20 – 0.39 Inch)	EMO switch
7	5 – 10 mm (0.20 – 0.39 Inch)	Beacon
8	5 – 10 mm (0.20 – 0.39 Inch)	*Not used*
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)	*Not used*
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)	*Not used*
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).

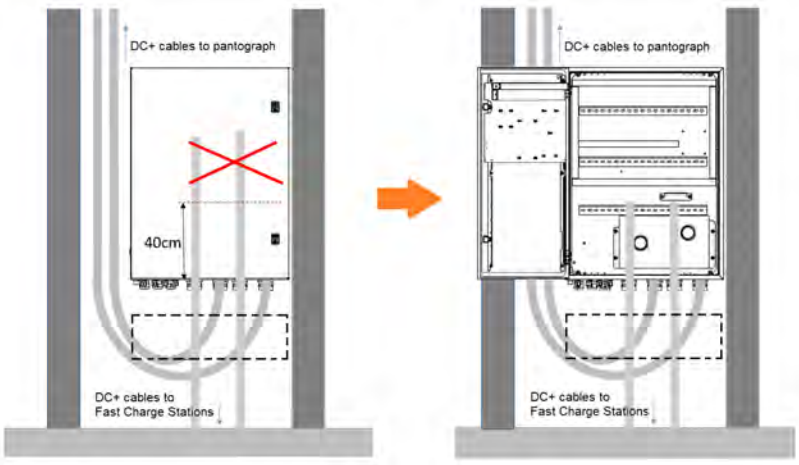
5.16.6. Connect the DC+ power input cables

Preconditions:

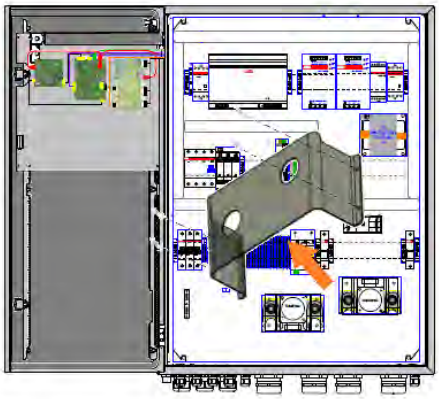
- Tools: wire cutter, wire stripper pliers, cable lugs (3x), spanner (size18), torque wrench (size 18).

	NOTICE
	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 PBCAs can be damaged. It is advised to protect the PCBAs during mounting of the DC cables.

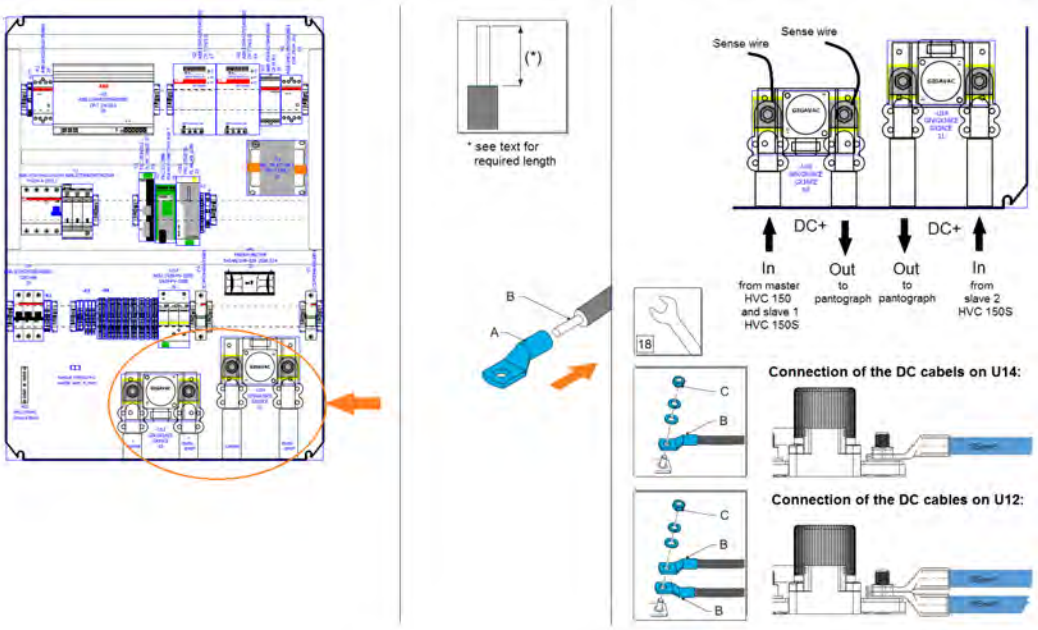
To prevent damage of the PCBAs in the ACS Control Module:



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.



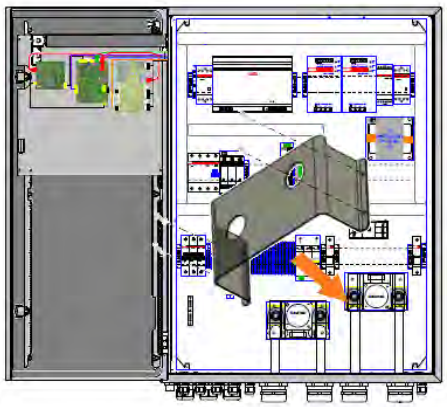
3. Remove the DC contactor's protection cover.



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.

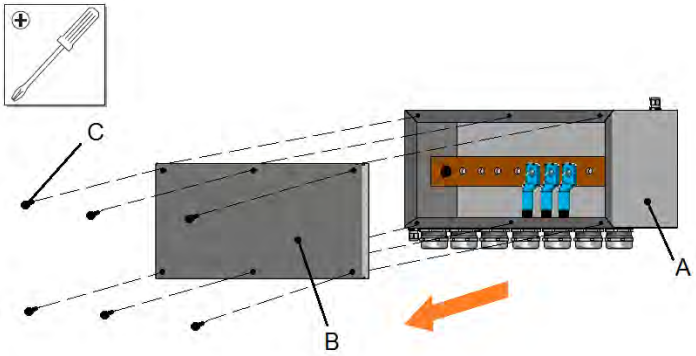


14. Place the protection cover back on the DC contactors.
15. Hand tighten the screws of the protection cover.
16. Tighten the cable gland's nut to secure the DC power cables.

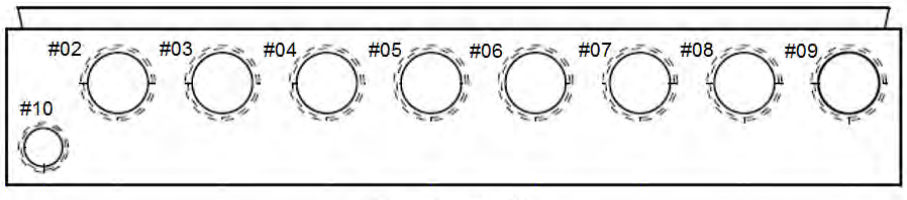
5.16.7. Connect the DC- power input cables in Junction Box

Preconditions:

- Tools: wire cutter, wire stripper pliers, cable lugs (3x), spanner (size18), torque wrench (size 18), cross-head screwdriver.

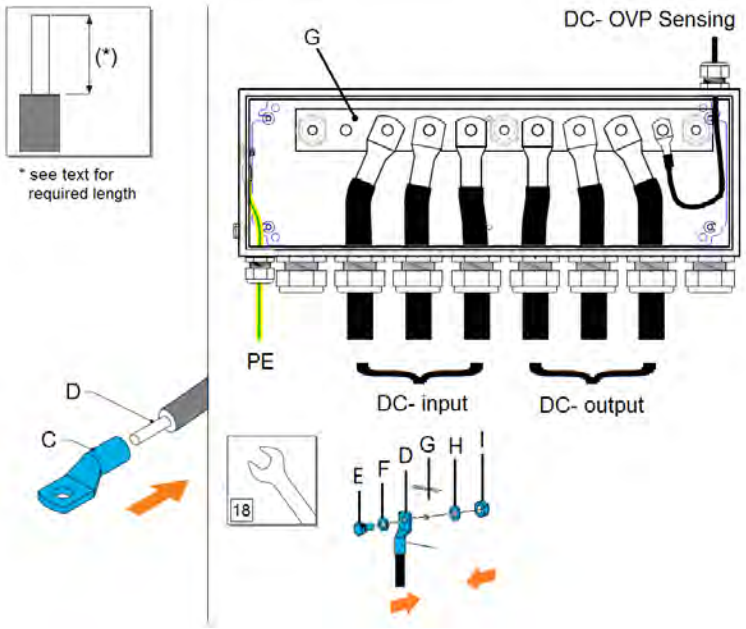


1. Loosen the screws (C) (6x) of the Junction Box (A).
2. Remove the cover (B) from the Junction Box (A).

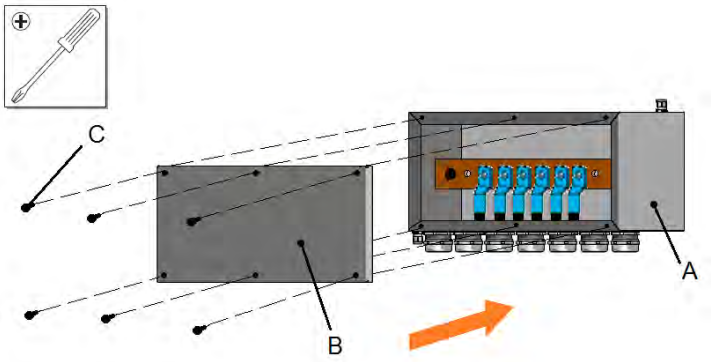


Bottom view

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).

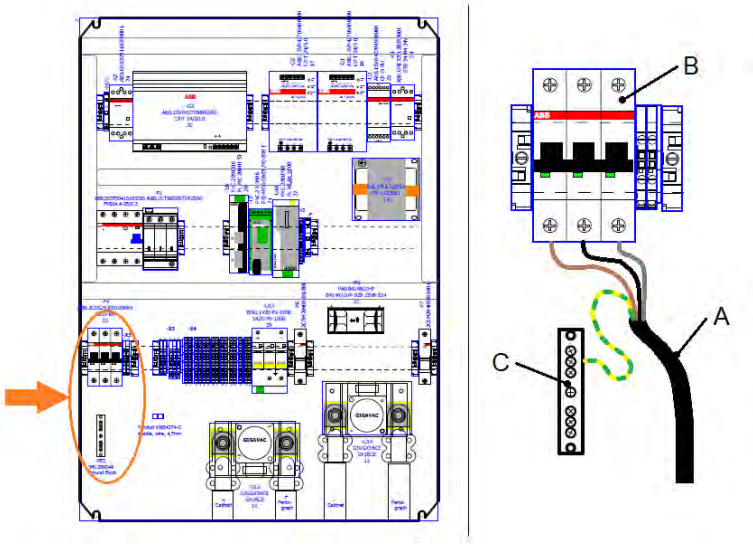
	WARNING
	If the GND braided wire between the cover and cabinet is disconnected during the installation of the DC- power cables, make sure that the GND braided wire of the cover is electrically connected to the cabinet.

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

5.16.8. Connect the AC utility power cable from Power Cabinet

Preconditions:

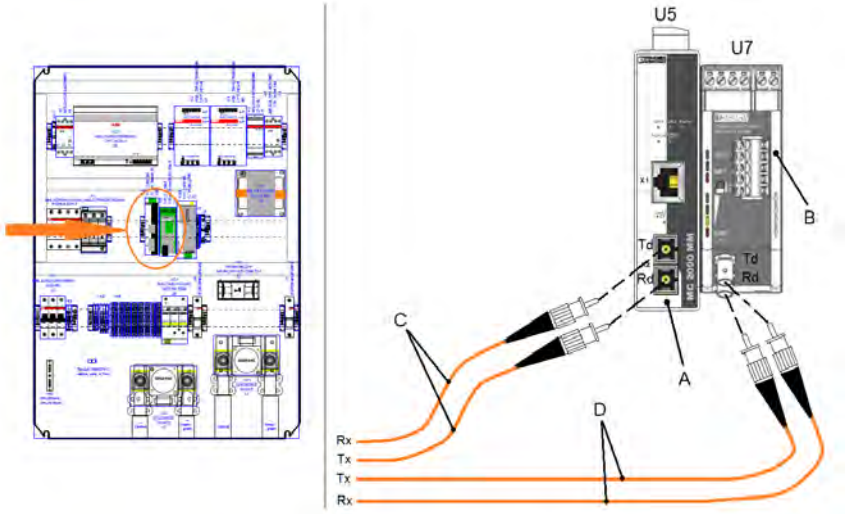
- Tools: wire cutter, wire stripper pliers, screwdriver, ferrules, crimp pliers.



1. Loosen and remove the cable gland's (#1) nut for the AC utility power cable.
2. Slide the cable gland's nut over the AC utility power cable.
3. 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).
4. Tighten the nut of the gland to secure the AC utility power cable.
5. Strip the insulation from the AC utility power cable (A).
6. 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.
7. Strip 0.43 Inch of the insulation from the ends of the wires.
8. Crimp a ferrule onto the end of the wire.
9. Loosen the connector screws.
10. Insert the GND wire (green/yellow) into the one of the free connectors of GND-rail (C).
11. Tighten the connector screw of GND-rail (C).
12. Insert the other 3 wires into the connectors of circuit breaker (B).
    - From left to right:
      L1 (brown),
      L2 (black),
      L3 (grey).
13. 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.

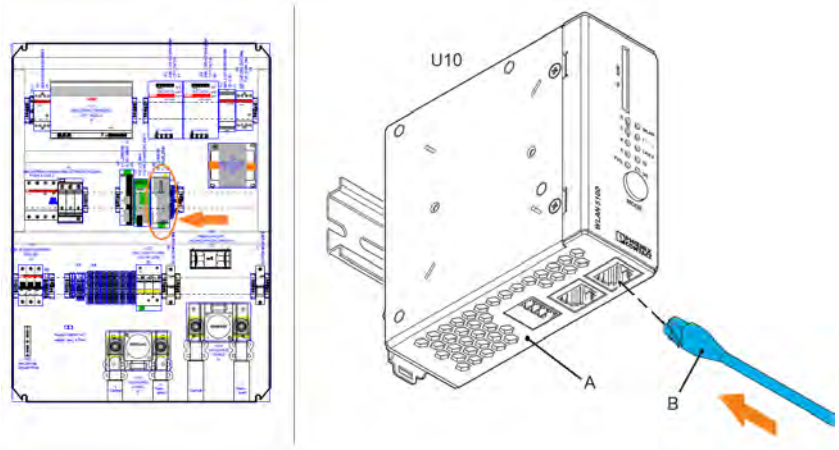
5.16.11. Connect the RFID cables

	NOTICE
	This section is not required if the RFID module is not present.

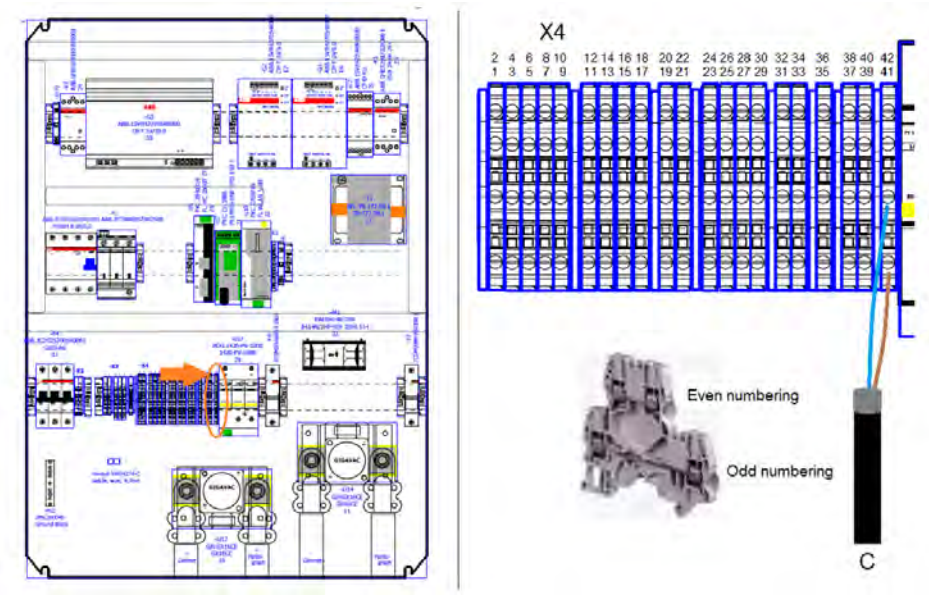
Preconditions:

- 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:

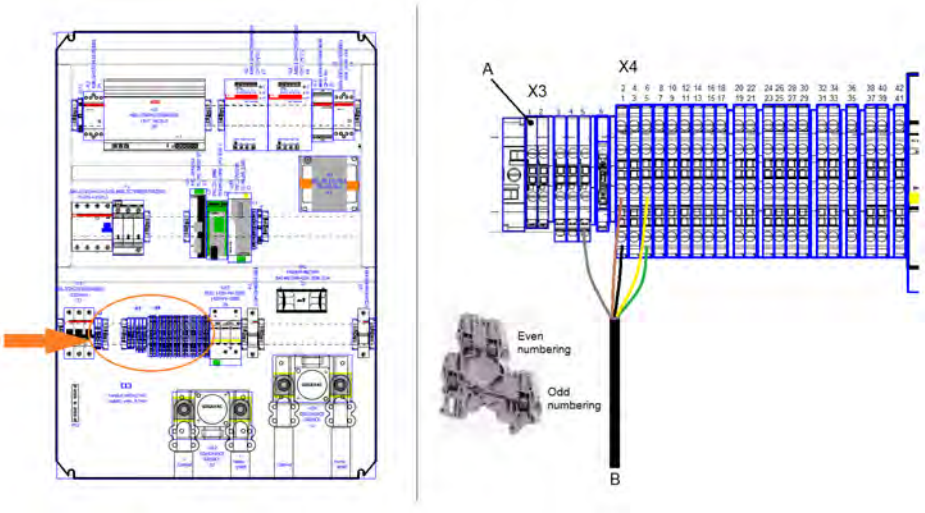
Functional description	Connector	Wire color
24 V RFID	X4-41	Brown
GND RFID	X4-42	Blue

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

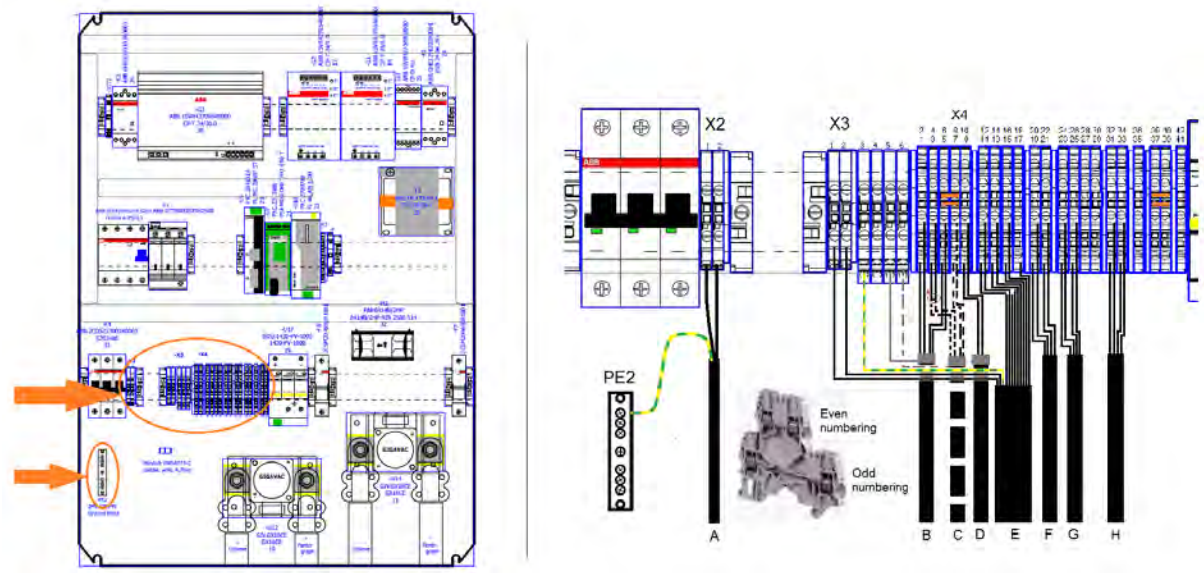
See also Appendix H *Signal connection diagram*.

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		

1. Loosen and remove the cable gland's nuts (see for overview *Gland layout of the ACS Control Module* in Page 106) for the cables.
2. Slide the cable gland's nut over the cables.
3. 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).
4. Tighten the nuts of the glands to secure the cables.
5. Strip the insulation from the cables.
6. Cut the wires of the cables to the correct lengths to reach the connectors
7. Strip 0.43 Inch of the insulation from the ends of the wires.
8. Crimp a ferrule onto the end of the wire.

NOTICE

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.

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

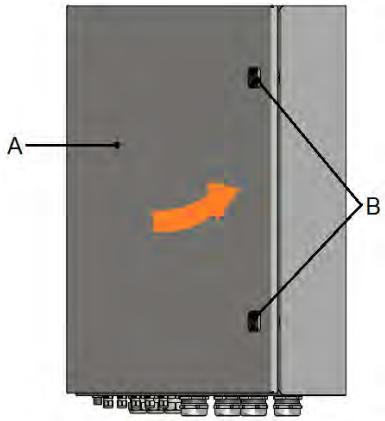
X2		**Pantograph heater cable**	
1		Wire 1	ACS L Heater
2		Wire 2	ACS N Heater
PE2		GND (green/yellow)	GND
X3	X4	**Interlock / DC Guard cable**	
5		Shield	GND
	1	White	Interlock In
	2	Brown	Interlock Out
	3		DC_Guard_A
	4		DC_Guard_GND
X3	X4	**Next Interlock / next DC Guard cable (only for sequential 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

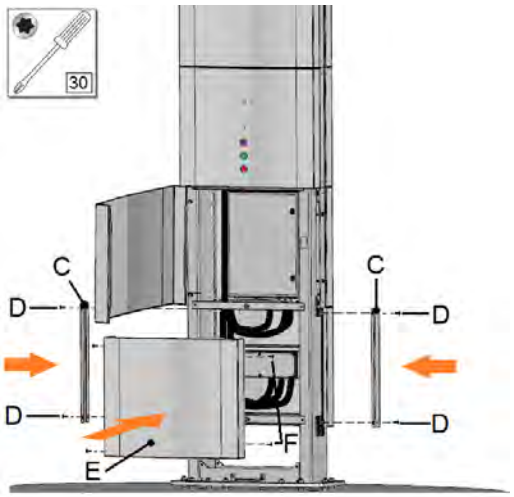


1. Close the door (A).
2. Close the locks (B).

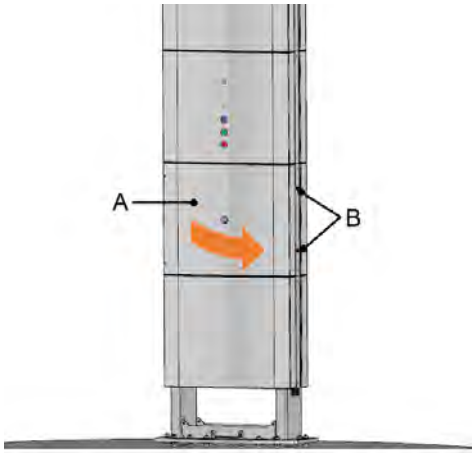
5.16.15. Place back cover plate and close door of the Charge Pole

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).

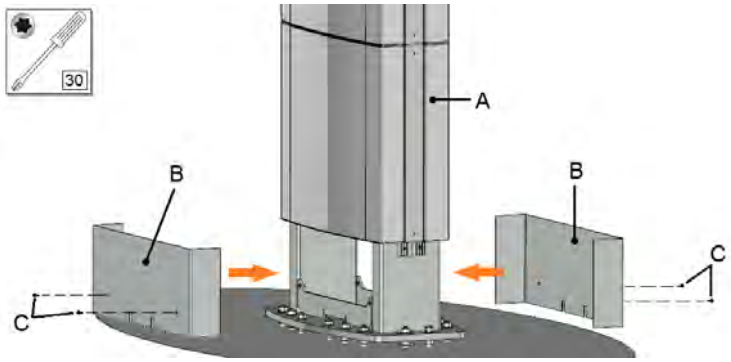


3. Close the door (A) of the Charge Pole
4. Locking the two lockers (B).

5.17. Install cover plates

Preconditions:

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



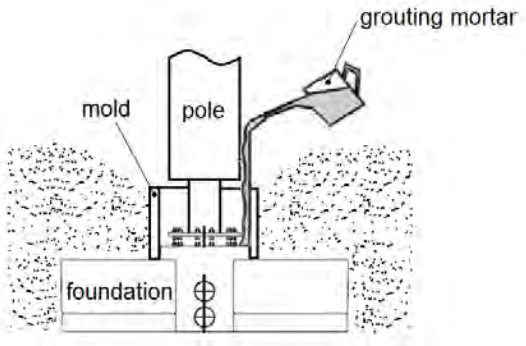
1. Put the two U-profile cover plates (B) against the bottom of the column (A).
2. Insert the M6 bolts (C) into the holes (4x).
3. Tighten the bolts.

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.

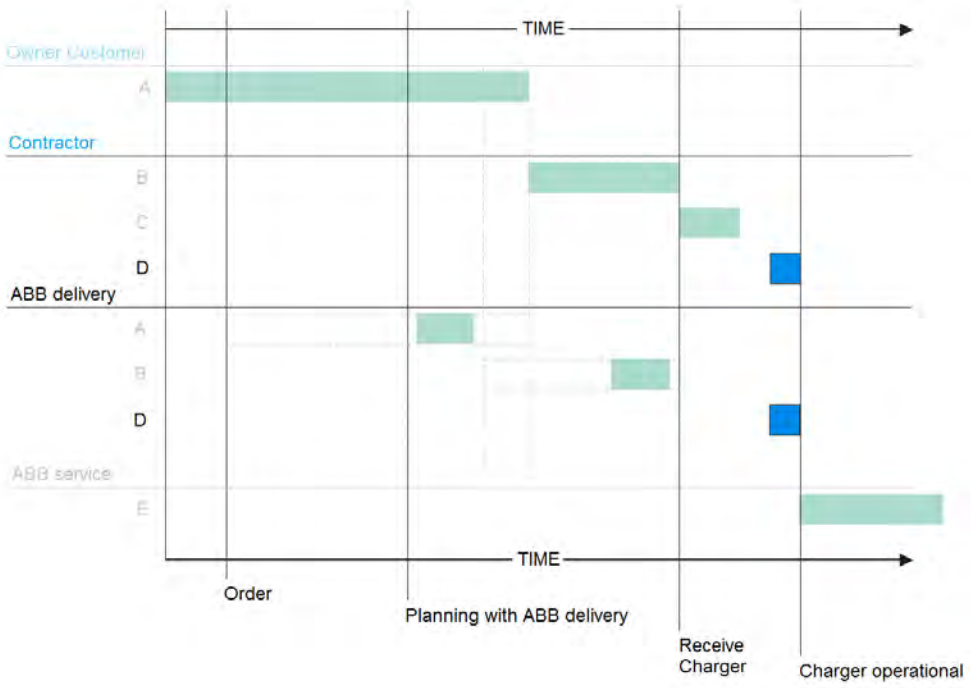
	NOTICE
	Read and follow the instruction manual of the used grouting mortar.

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
	**Warranty** 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.

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.

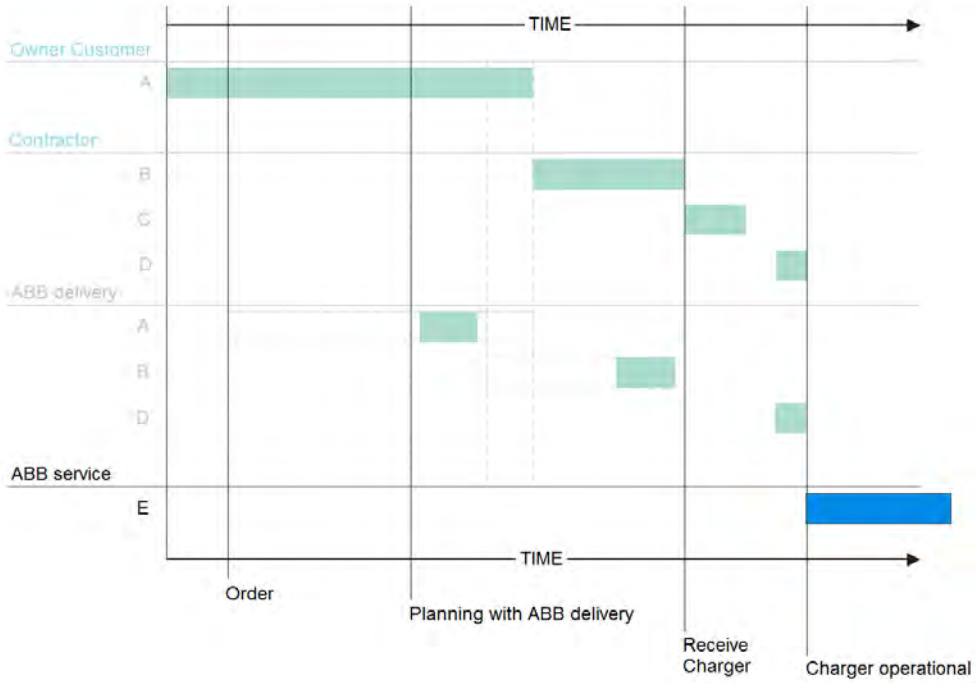
The CAF contains information about:

- 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 the maintenance schedule. This is outside of the scope of this document.

	DANGER
	Any service and maintenance work on pantograph and or charger system has to be only executed on powered-off device. 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.

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. - 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 ± 10%
Input frequency range	600/347 V AC +10%/-15% (Canada version)
Input frequency range	60 Hz ± 1%
Maximum power dissipation	170 kVA
Power factor (cos φ)	≥ 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 ± 10%
Input frequency range	600/347 V AC +10%/-15% (Canada version)
Input frequency range	60 Hz ± 1%
Maximum power dissipation	348 kVA
Power factor (cos φ)	≥ 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 ± 10%
Input frequency range	600/347 V AC +10%/-15% (Canada version)
Input frequency range	60 Hz ± 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 ºC to +45 ºC
Temperature range – Storage	-10 ºC to +70 ºC
Humidity	5 % to 95 %, RH – non-condensing
Airflow	1450 m^3/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 ºC to +45 ºC
Temperature range – Storage	-10 ºC to +70 ºC
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 ºC to +45 ºC
Temperature range – Storage	-10 ºC to +70 ºC
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

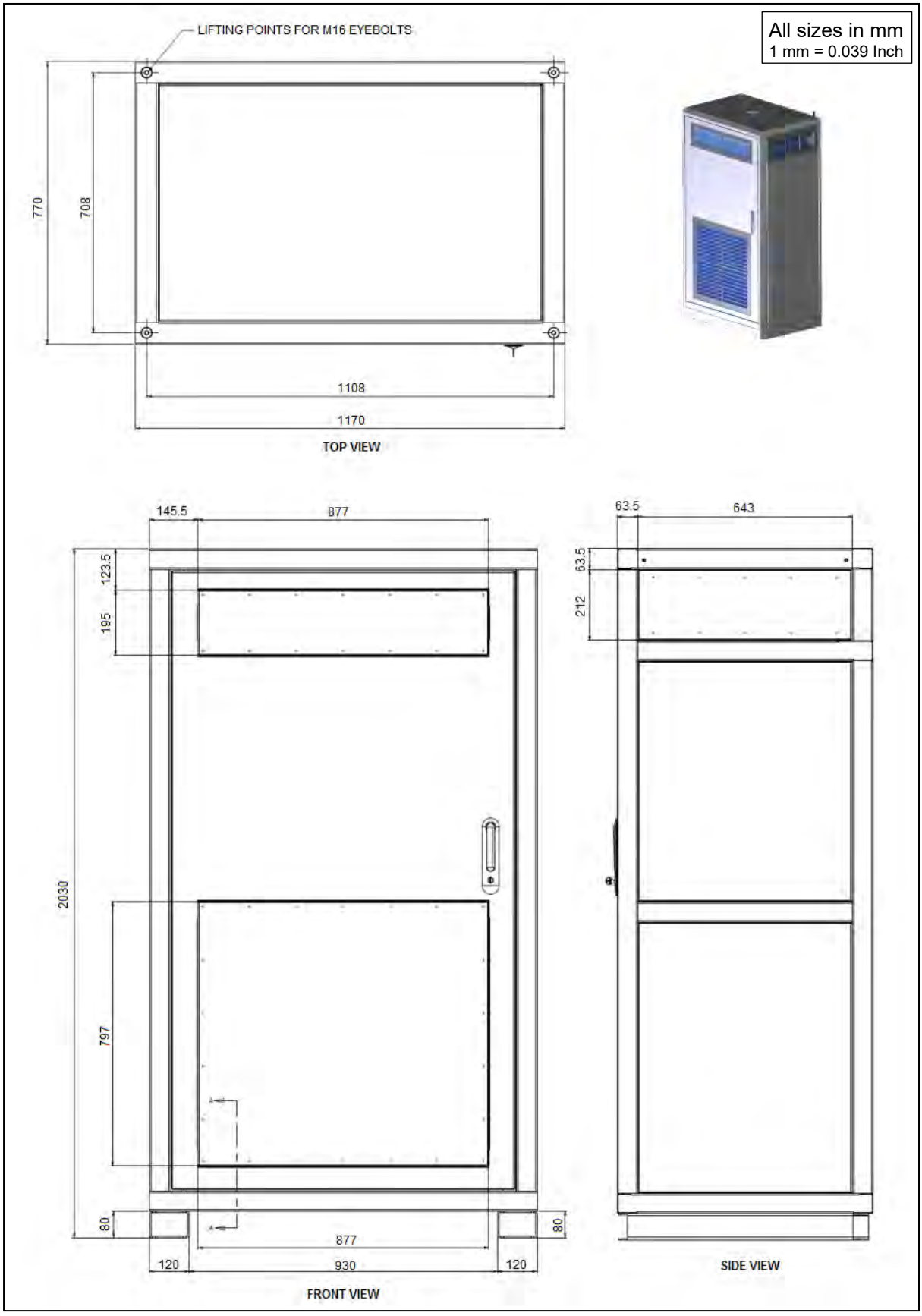
Certifications for complete system

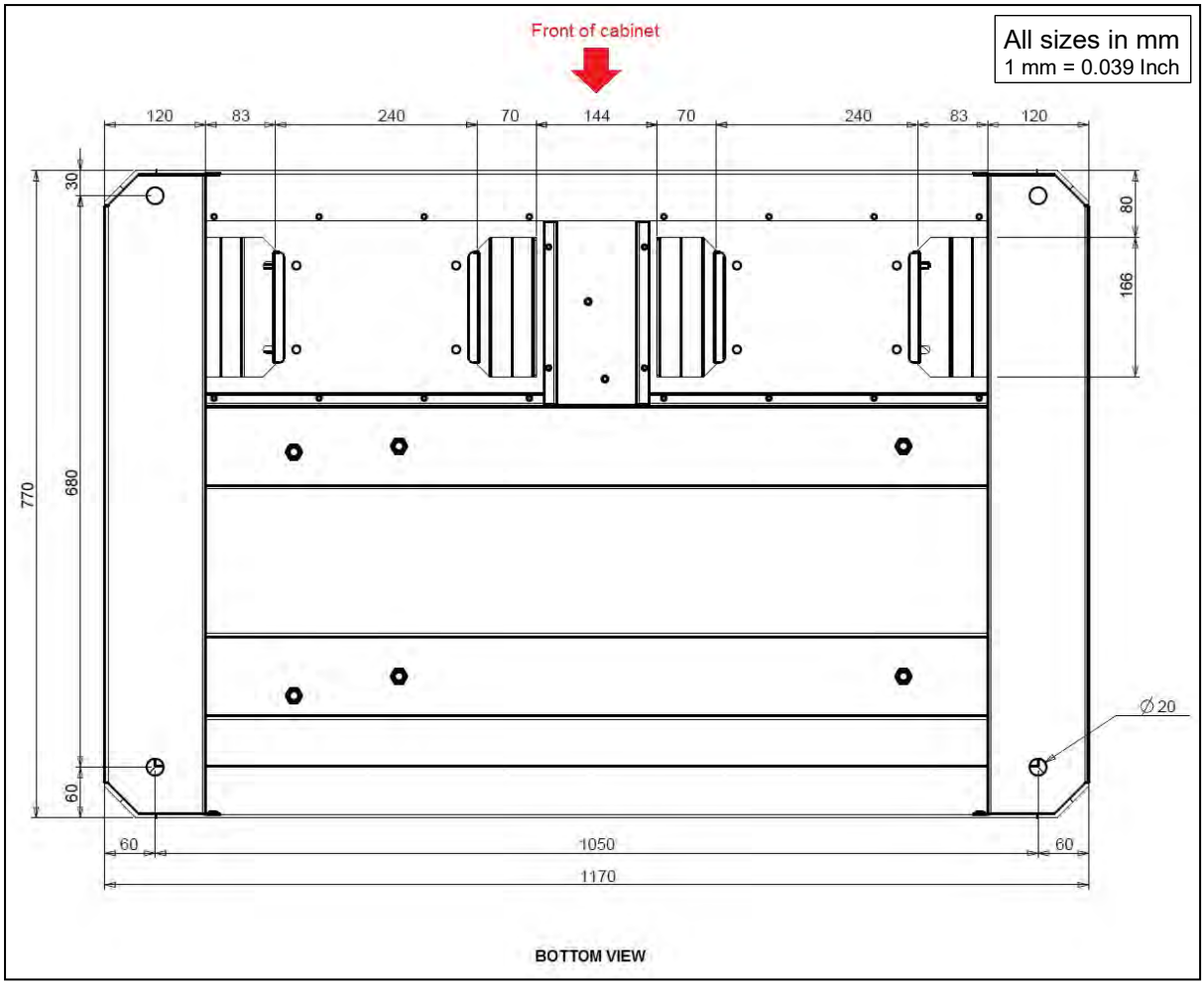
UL 2202	HVC 150: Certificate No. TU 72180445
	ACM Certificate No. TU 72180799 02
CSA C22.2 No. 107.1—16	HVC150 Certificate No. CA 972180446 01
	ACM Certificate No. CA 72180446 02
Class of protection	1 with GND connection

9. **Appendix**

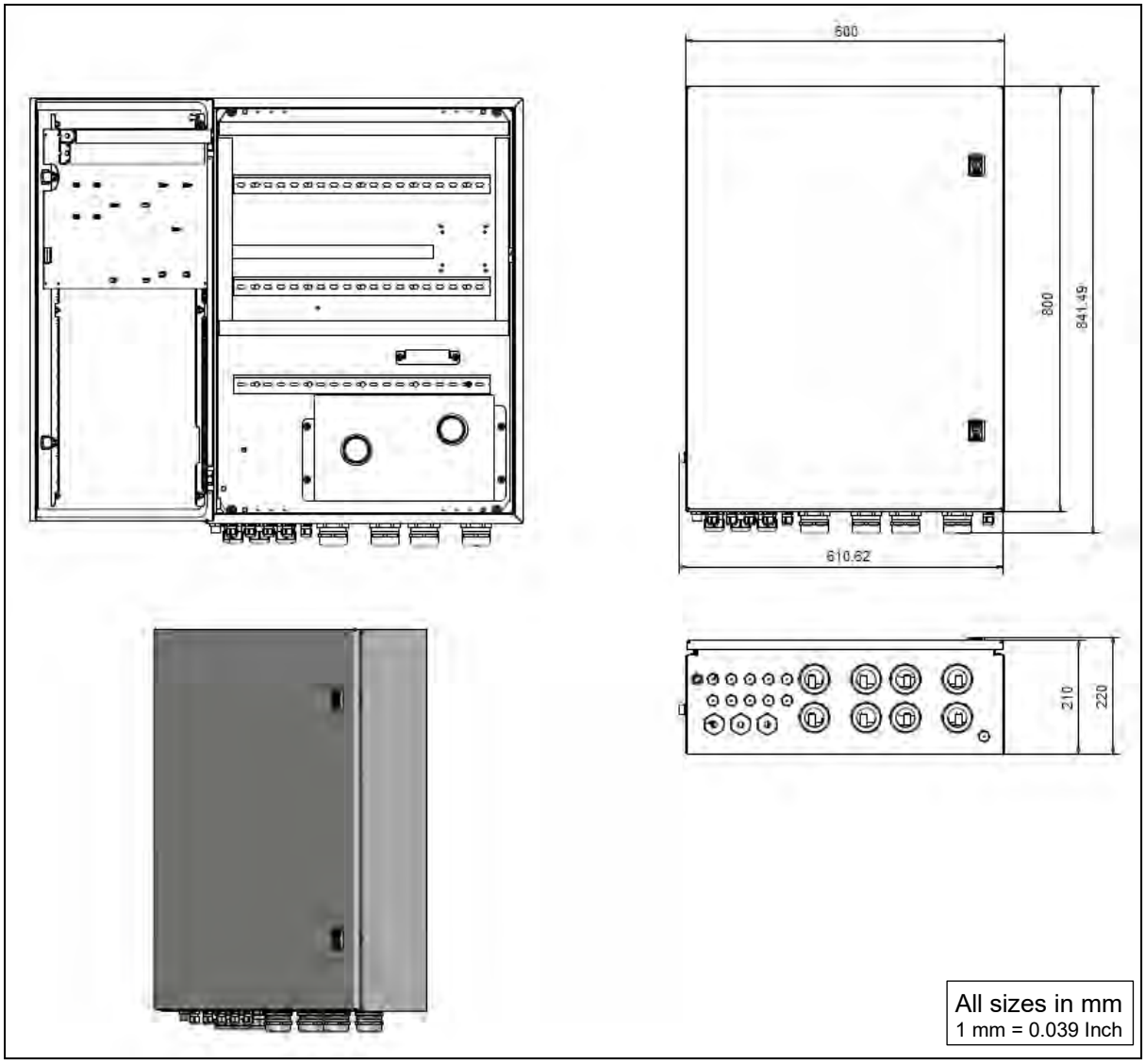
A Dimensions power cabinet
B Dimensions ACS Control Module
C Dimensions Junction Box
D Dimensions Charge pole
E Clearance and vertical working range of the pantograph
F Dimensions Concrete Foundation Power Cabinet
G Dimensions Metal Foundation Power Cabinet
H Dimensions Concrete Foundation Pole
I Power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

A. Dimensions Power Cabinet

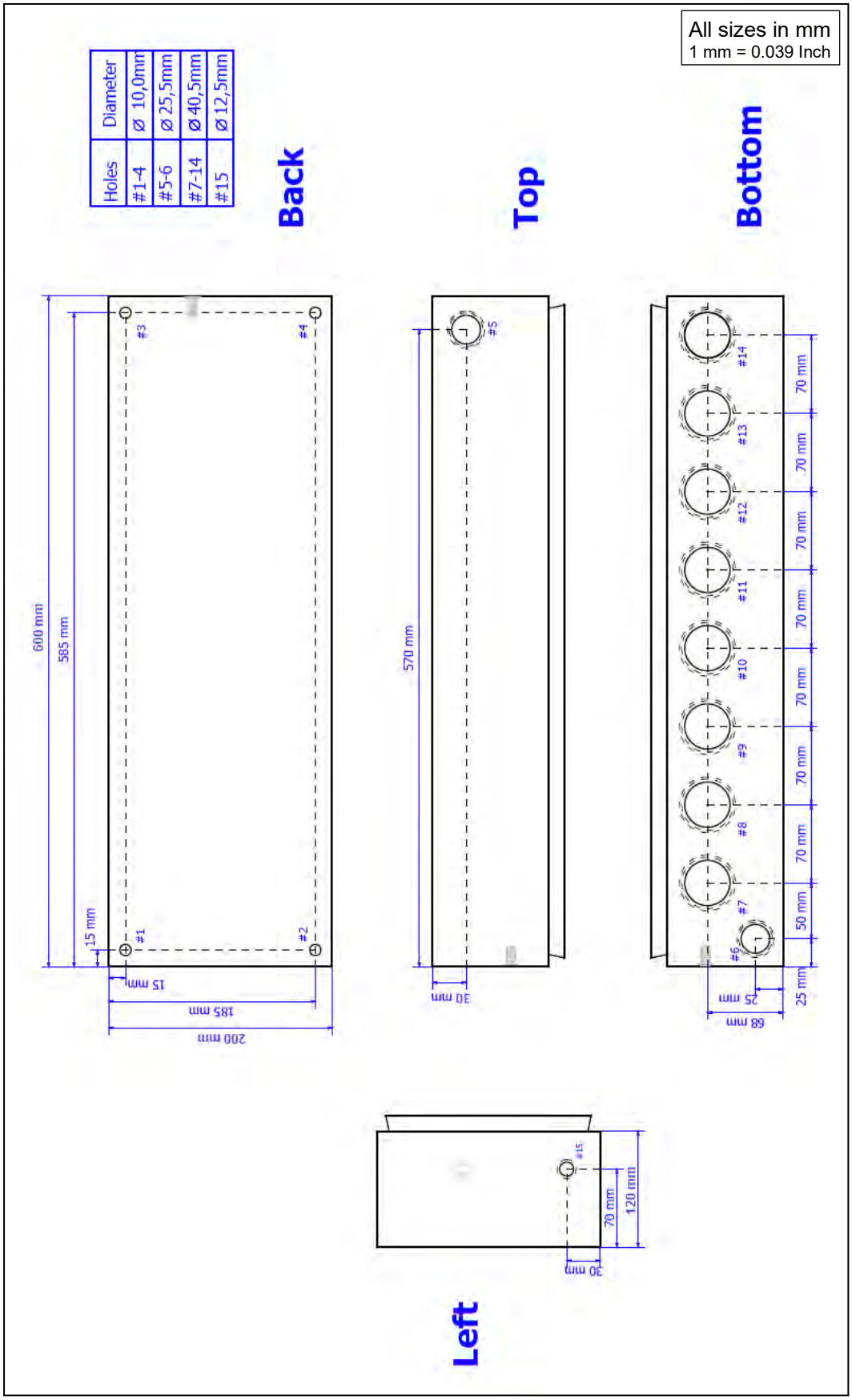



Front of cabinet
All sizes in mm
1 mm = 0.039 Inch
120
83
240
70
144
70
240
83
120
30
80
166
770
680
60
Ø 20
60
1050
60
1170
BOTTOM VIEW

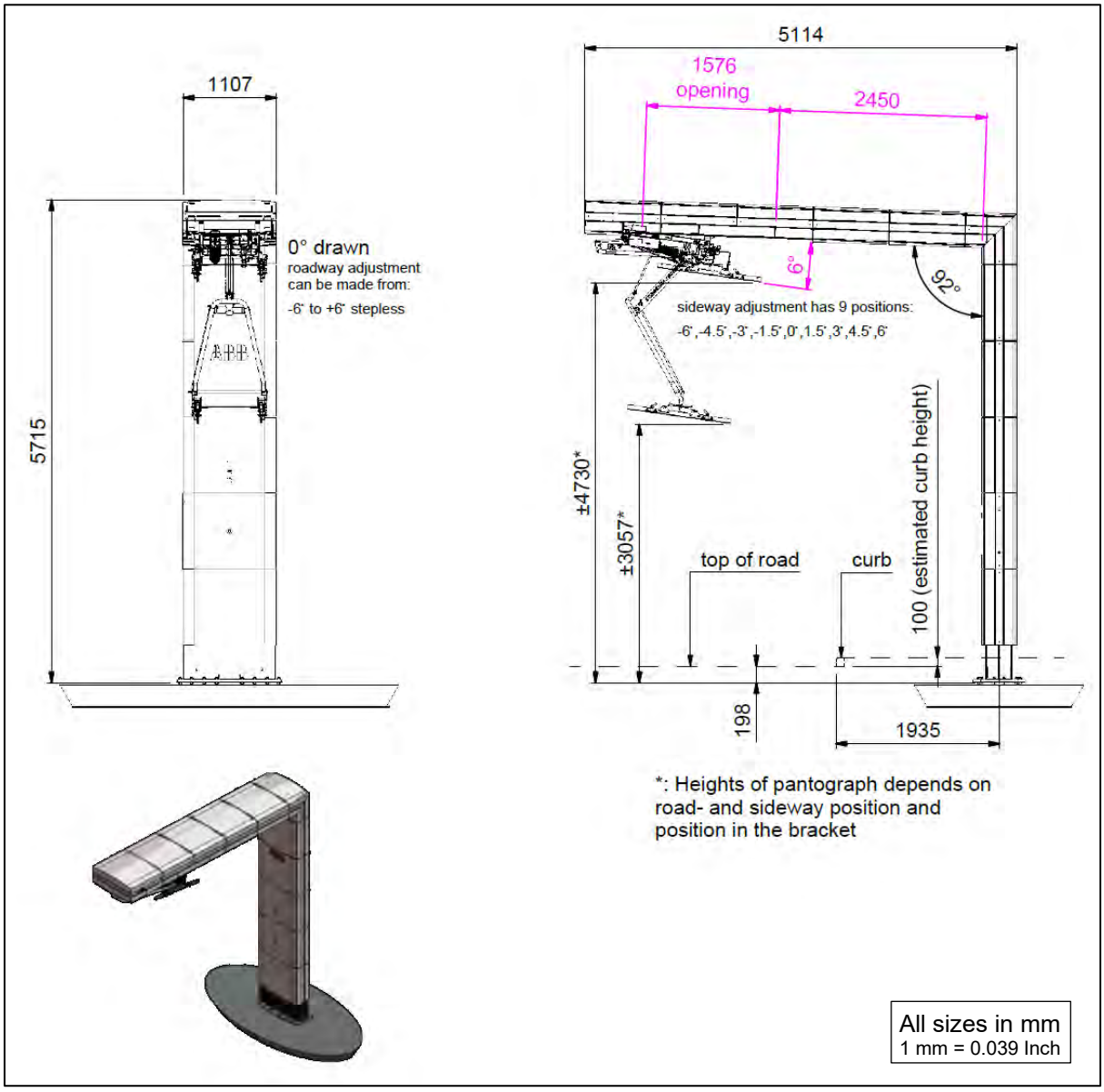
B. Dimensions ACS Control Module



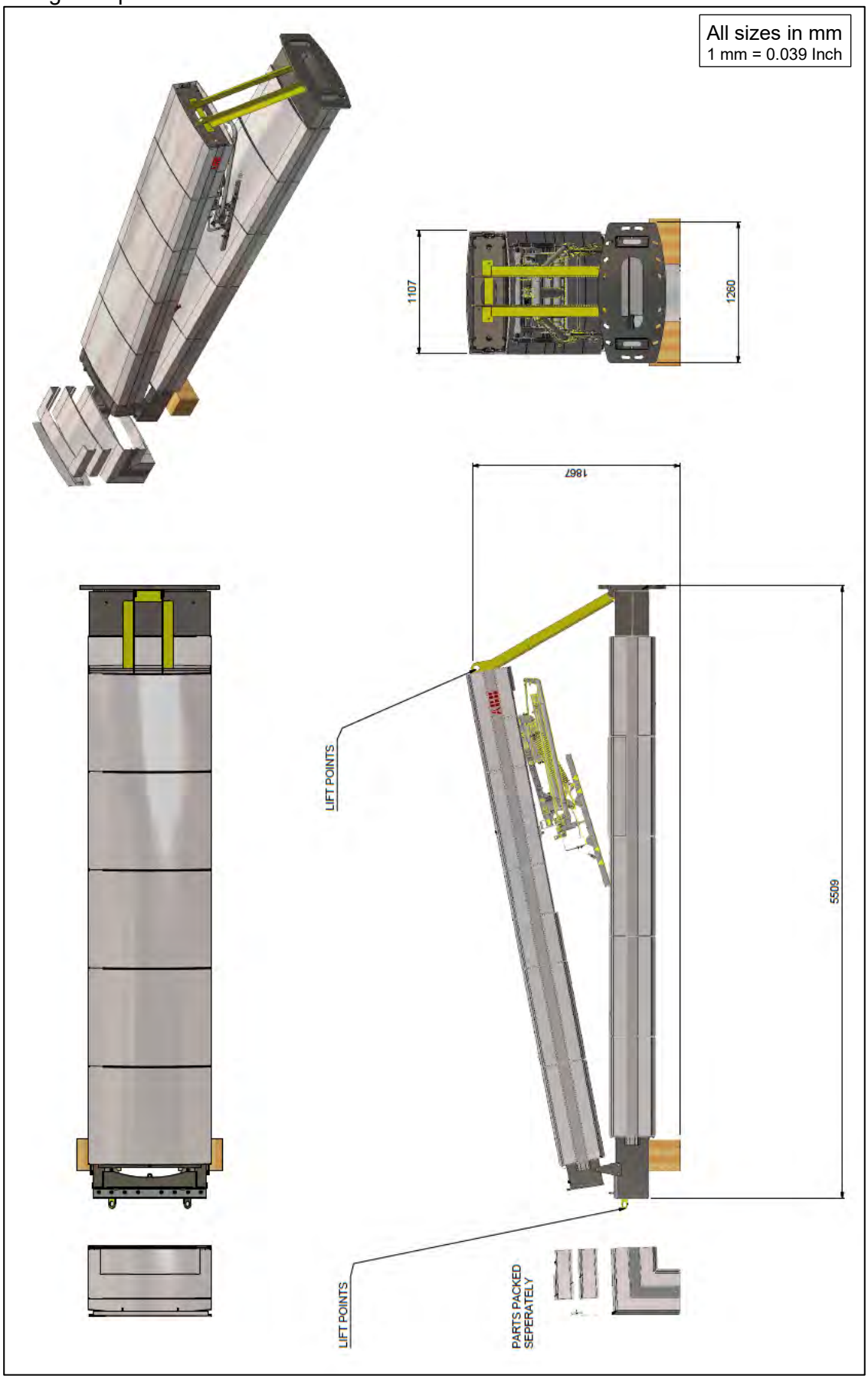
C. Dimensions Junction Box



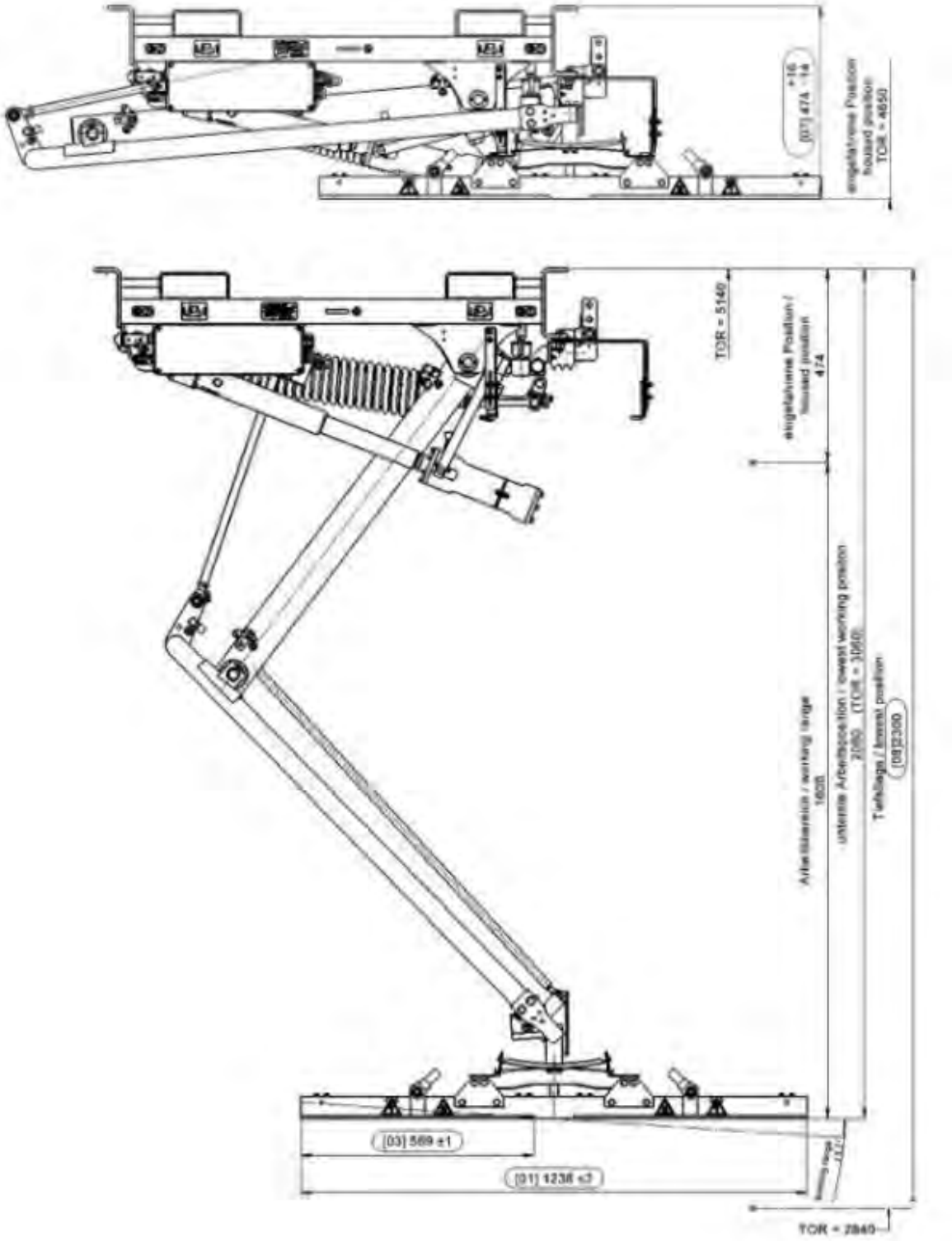
D. Dimensions Charge pole



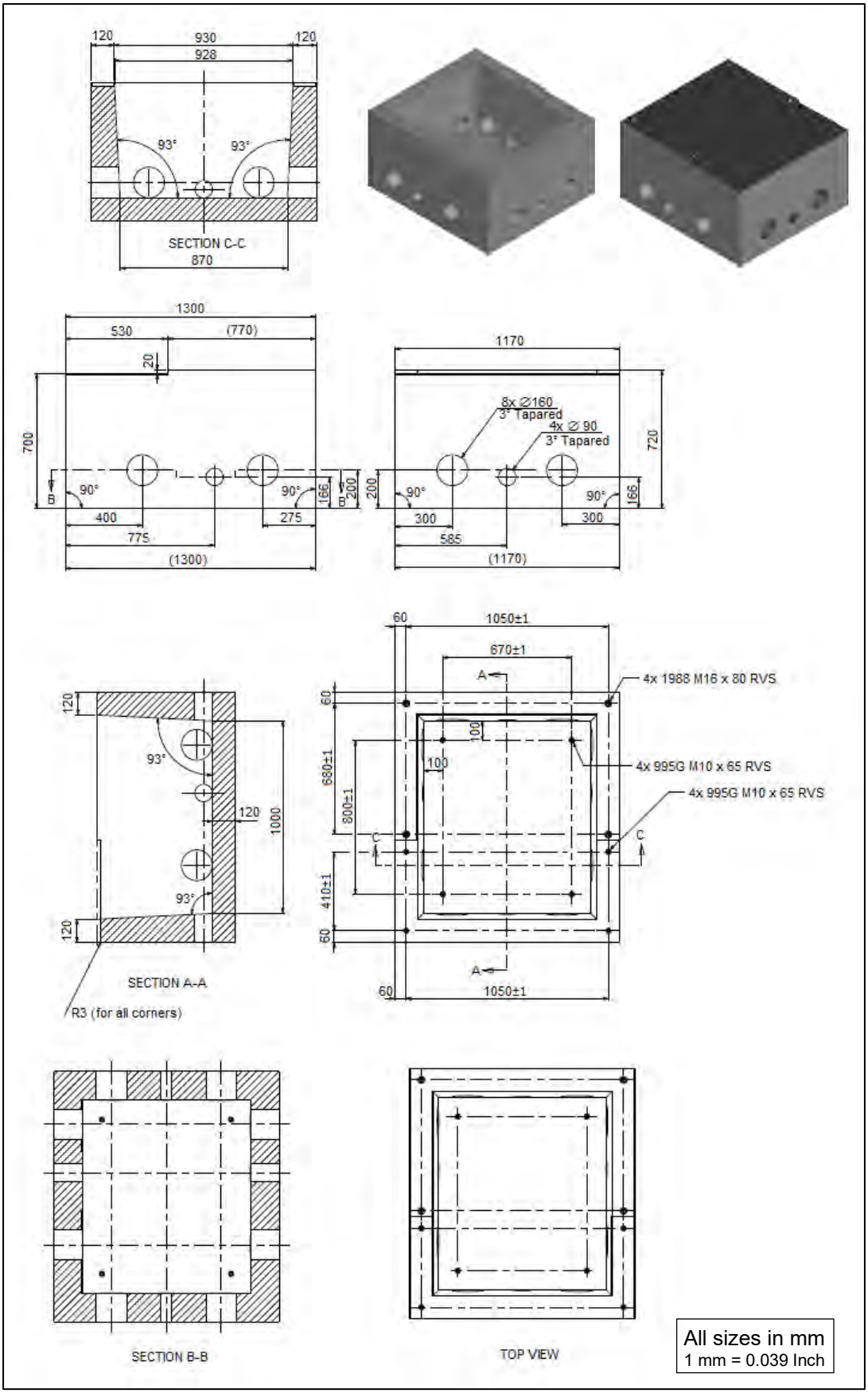
During transport



E. Clearance and vertical working range of the pantograph



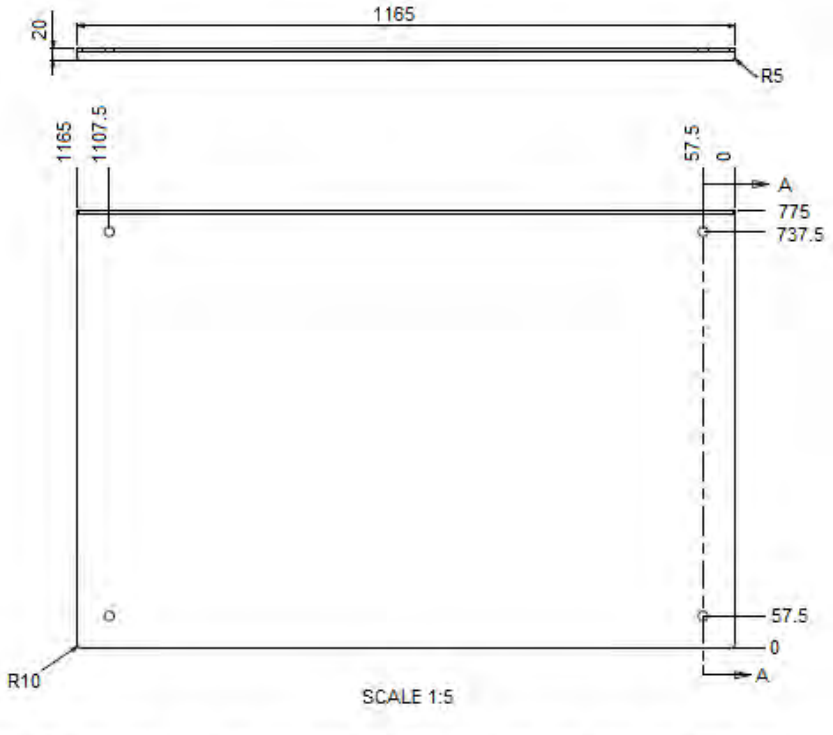
F. Dimensions Concrete Foundation Power Cabinet



SHEET METAL TEXTURED - SINGLE TEAR PLATE

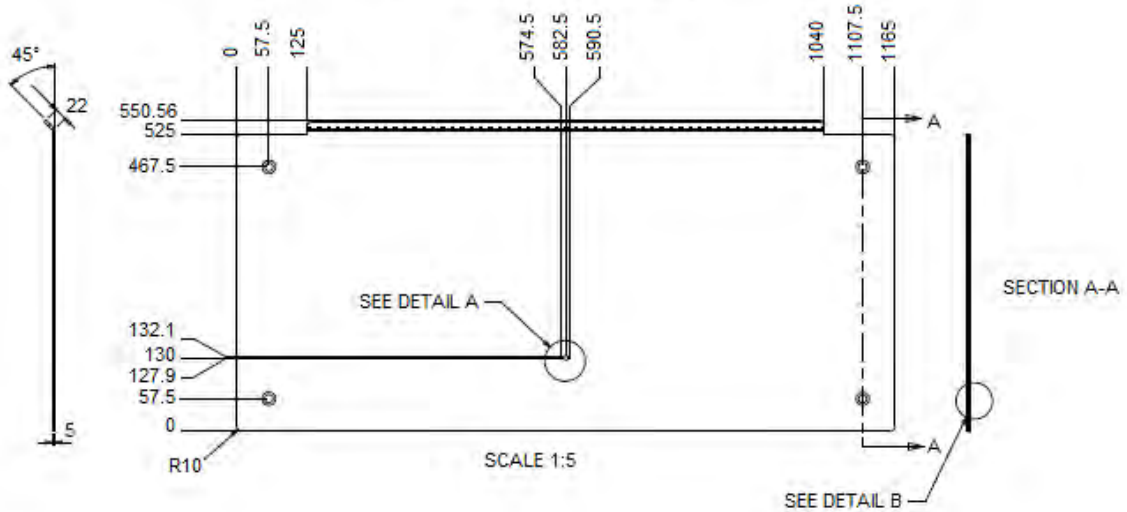
GALVANIZED STELL SHEET METAL

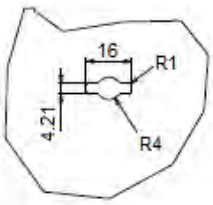
All sizes in mm
1 mm = 0.039 Inch



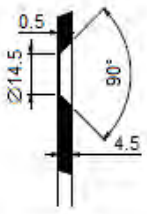
SHEET METAL TEXTURED - SINGLE TEAR PLATE

GALVANIZED STELL SHEET METAL





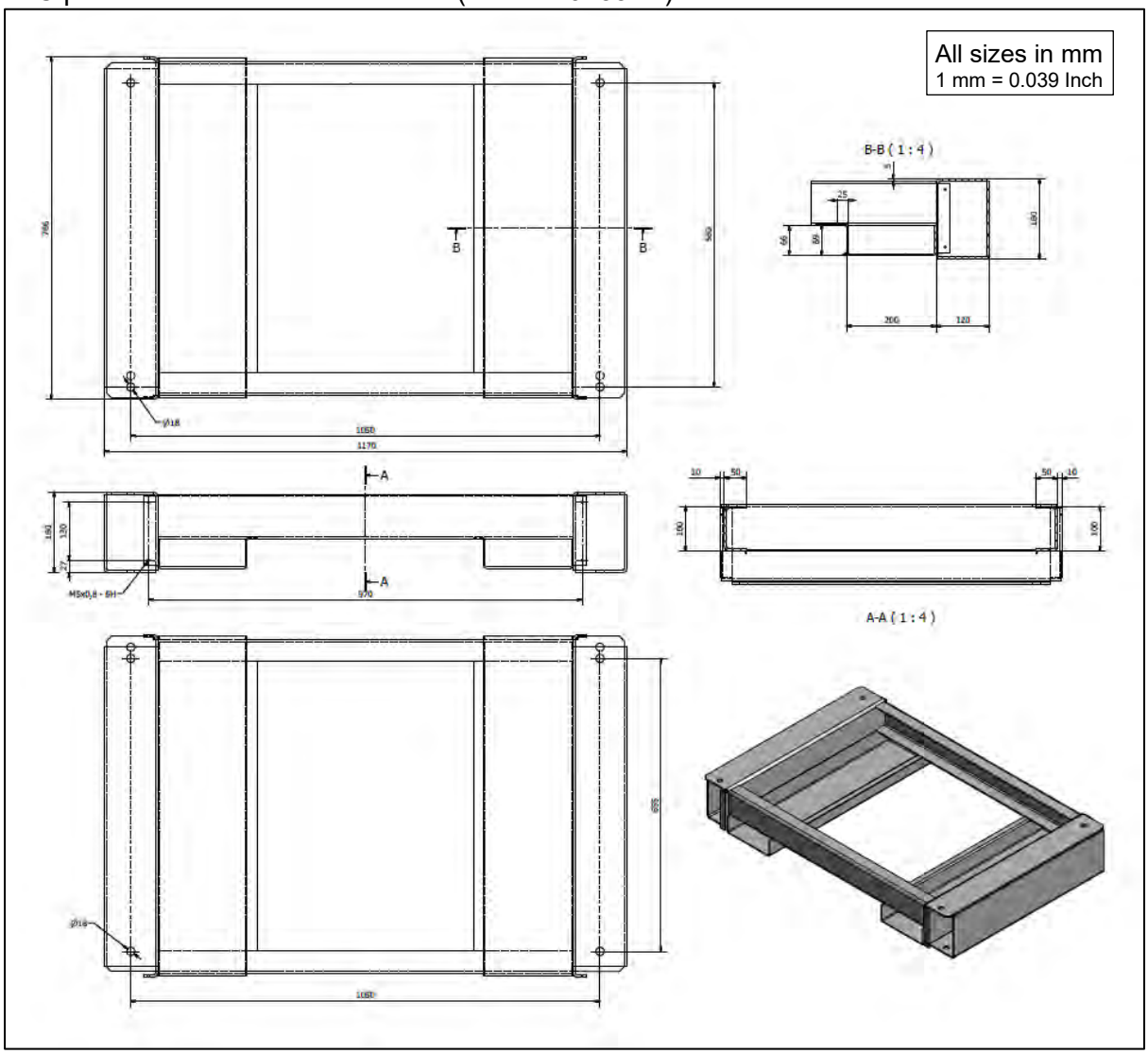
DETAIL A
SCALE 1:1



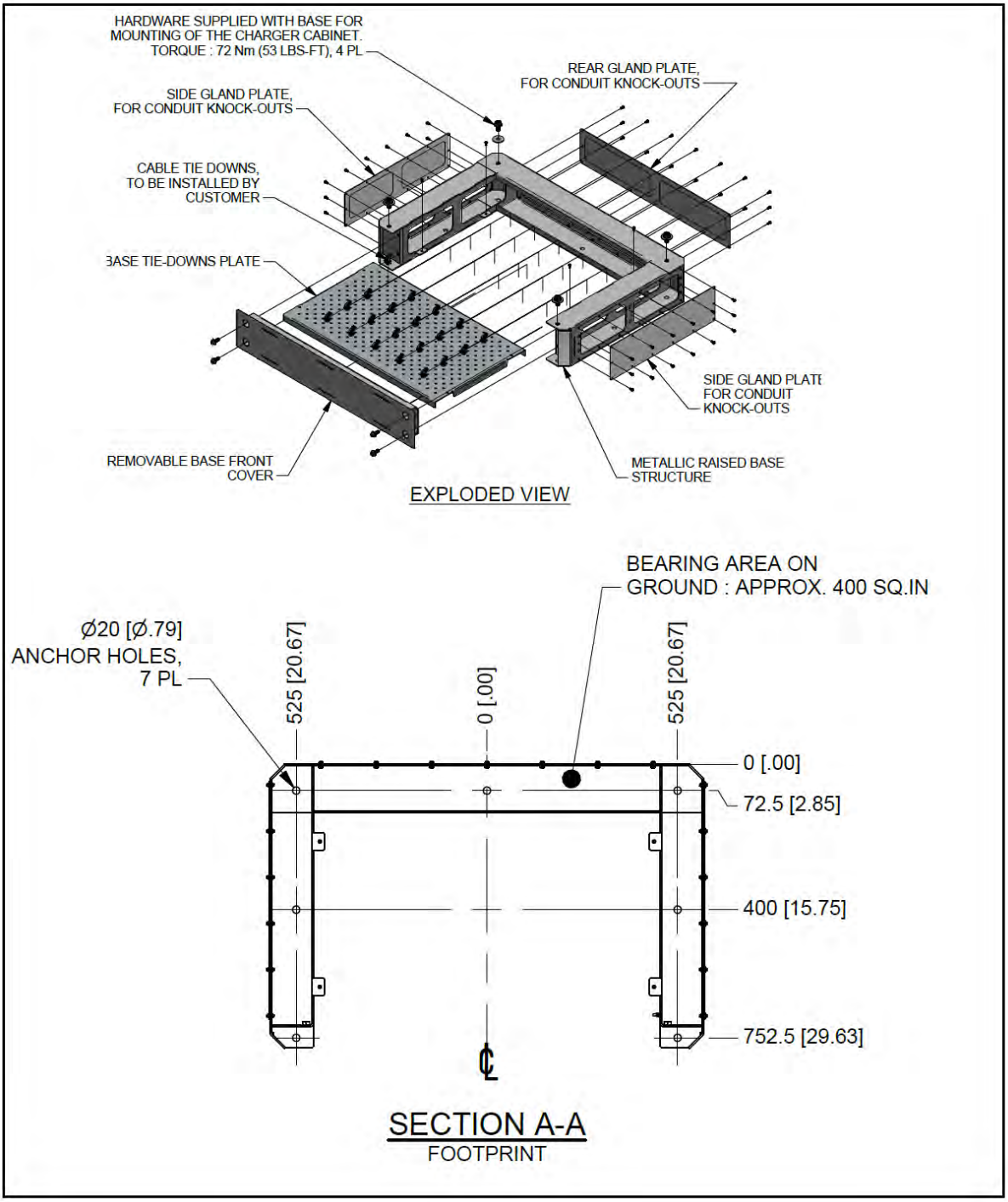
DETAIL B
SCALE 1:1

G. Dimensions Metal Foundation Power Cabinet

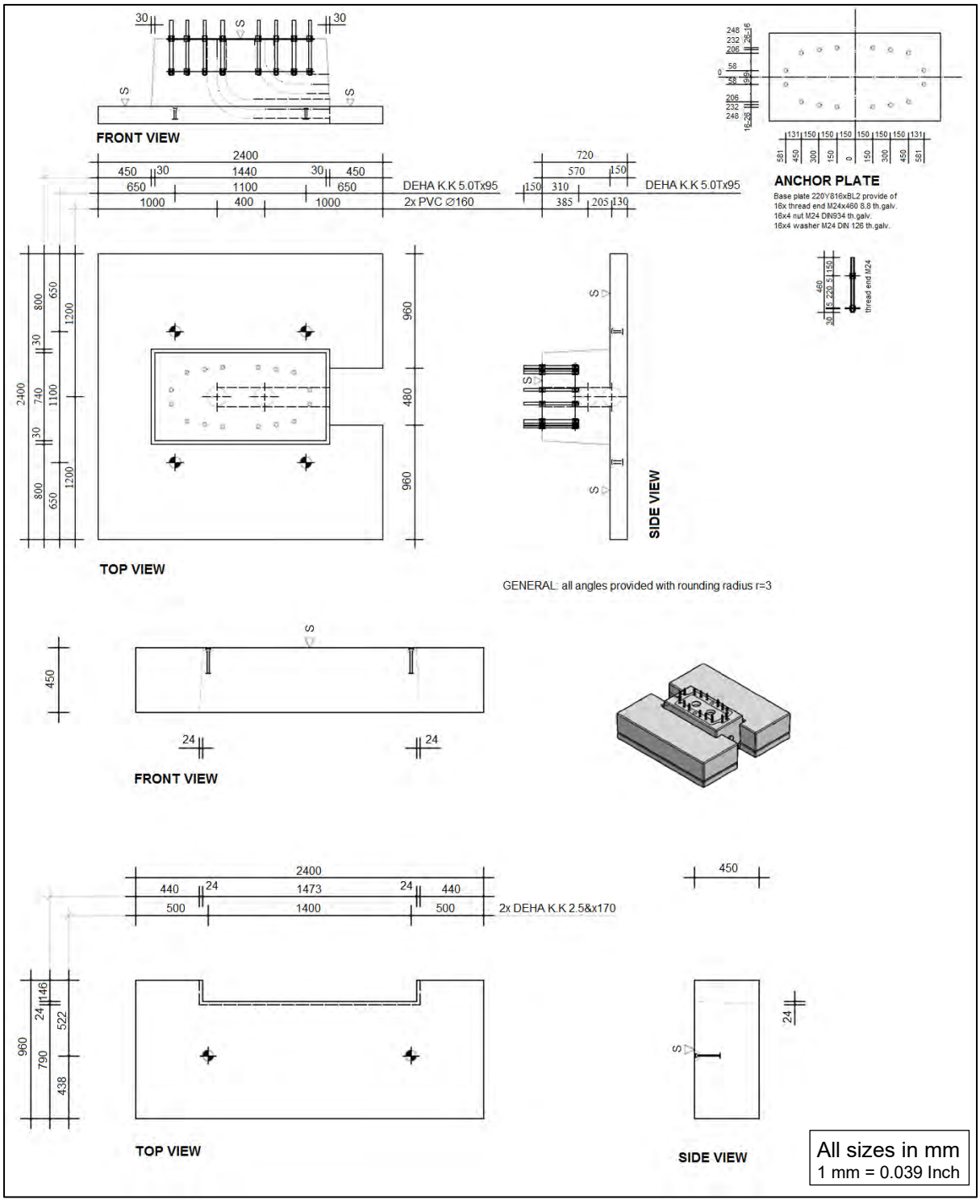
HxC power cabinet metal foundation (4EPY420133R1)



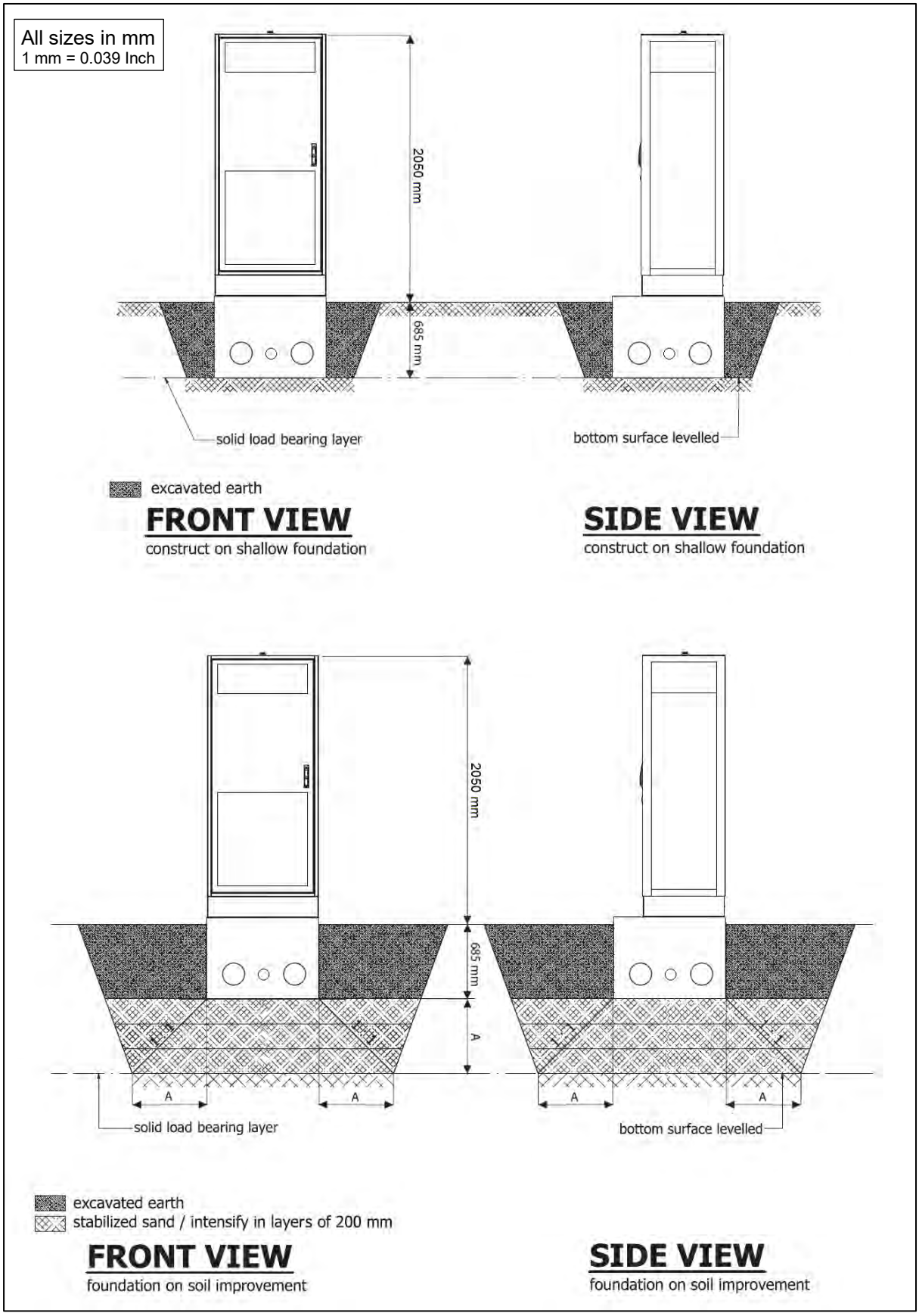
HPC175-HVC150 MET FOUND KIN 8IN – NAM (2CEB489802R0001)


HARDWARE SUPPLIED WITH BASE FOR MOUNTING OF THE CHARGER CABINET. TORQUE : 72 Nm (53 LBS-FT), 4 PL
REAR GLAND PLATE, FOR CONDUIT KNOCK-OUTS
SIDE GLAND PLATE, FOR CONDUIT KNOCK-OUTS
CABLE TIE DOWNS, TO BE INSTALLED BY CUSTOMER
BASE TIE-DOWNS PLATE
SIDE GLAND PLATE FOR CONDUIT KNOCK-OUTS
REMOVABLE BASE FRONT COVER
METALLIC RAISED BASE STRUCTURE
EXPLODED VIEW
BEARING AREA ON GROUND : APPROX. 400 SQ.IN
Ø20 [Ø.79] ANCHOR HOLES, 7 PL
525 [20.67]
0 [.00]
525 [20.67]
0 [.00]
72.5 [2.85]
400 [15.75]
752.5 [29.63]
SECTION A-A
FOOTPRINT

H. Dimensions Concrete Foundation Pole

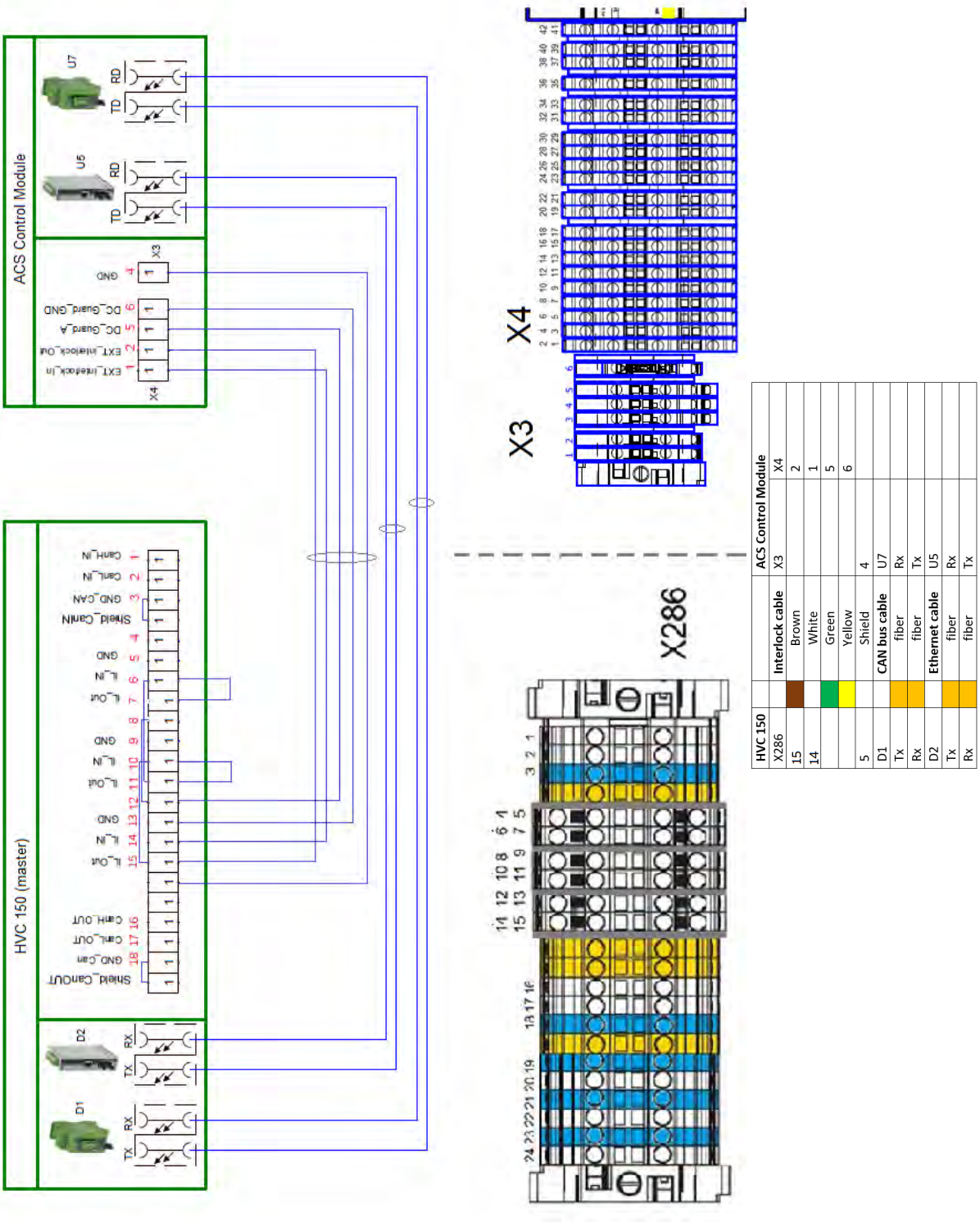


I. Power Cabinet – Outline with Foundation



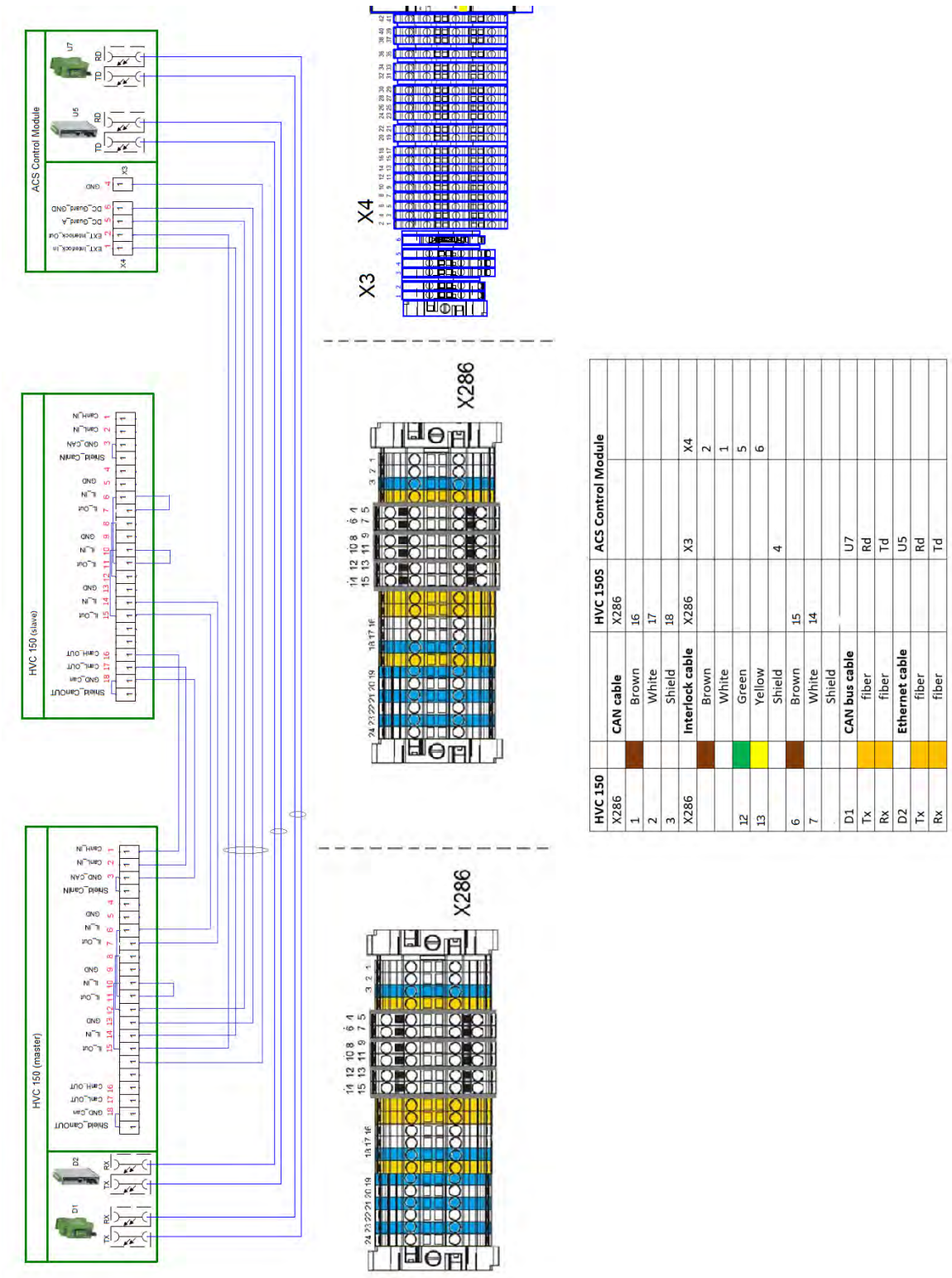
J. Signal connection diagram

For HVC 150 kW system



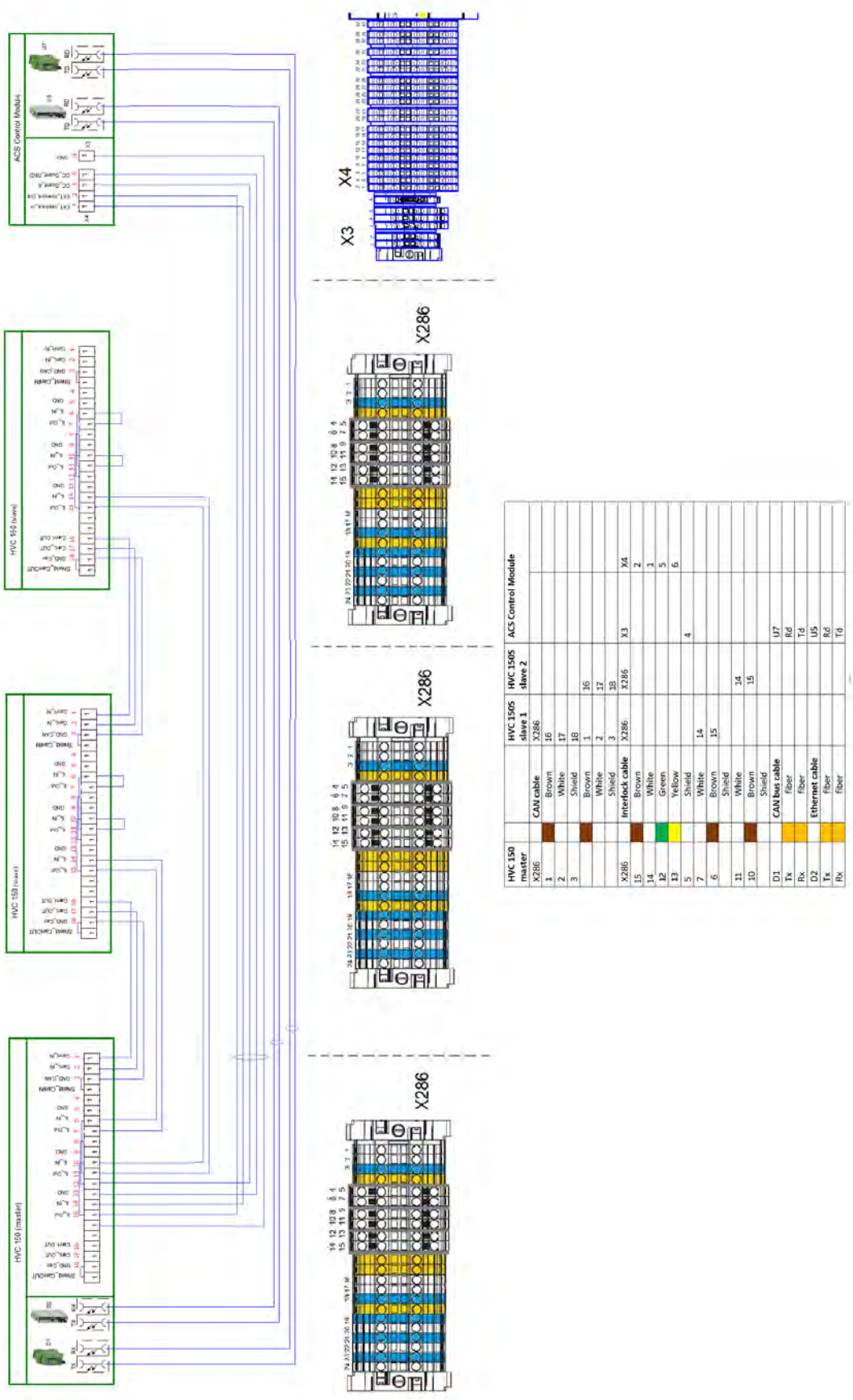
HVC 150		ACS Control Module	
X286	**Interlock cable**	X3	X4
15	Brown		2
14	White		1
	Green		5
	Yellow		6
5	Shield	4	
D1	**CAN bus cable**	U7	
Tx	fiber	Rx	
Rx	fiber	Tx	
D2	**Ethernet cable**	U5	
Tx	fiber	Rx	
Rx	fiber	Tx	

For HVC 300 kW system



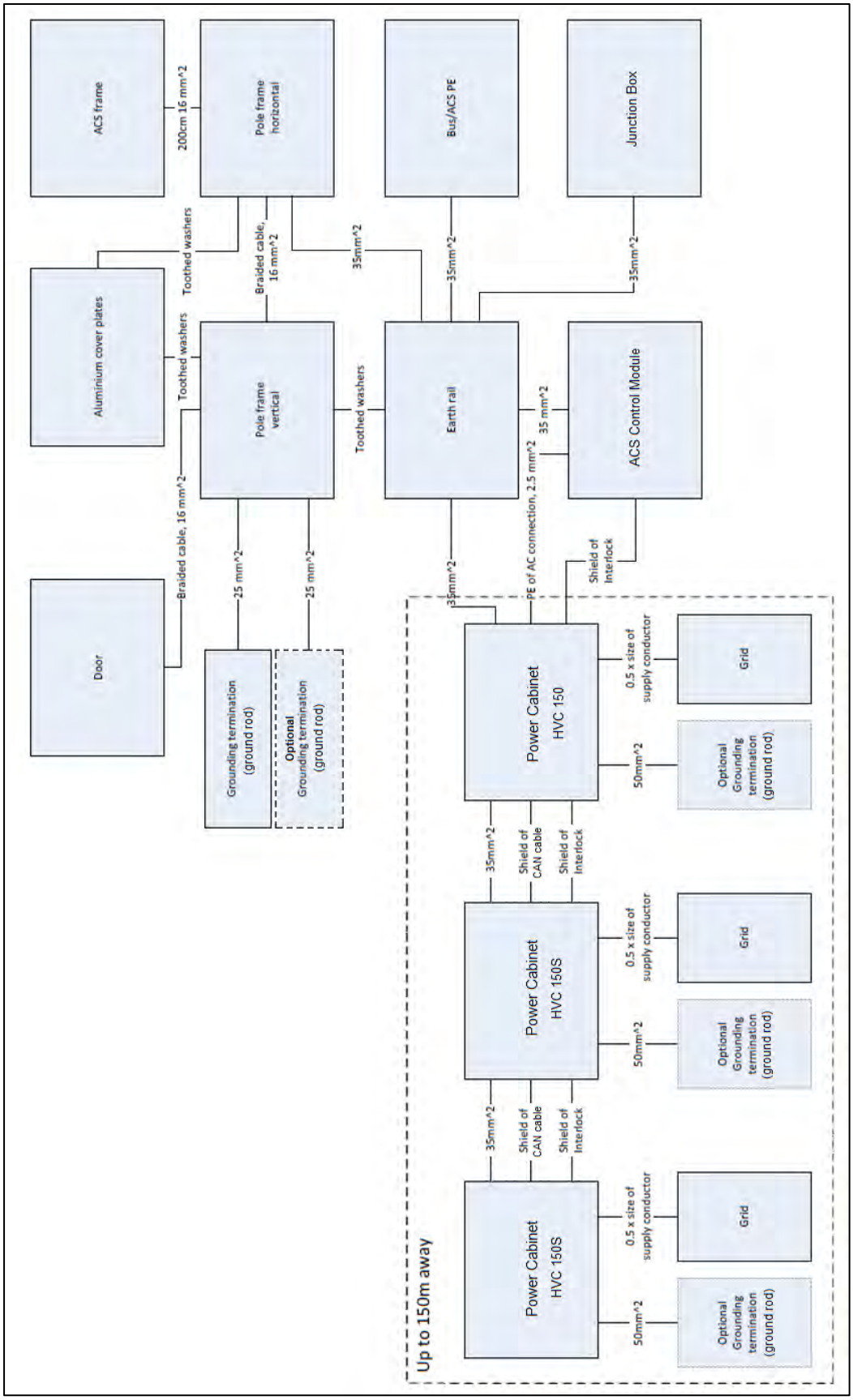
HVC 150		HVC 150S	ACS Control Module
X286	**CAN cable**	X286	
1	Brown	16	
2	White	17	
3	Shield	18	
X286	**Interlock cable**	X286	X3
	Brown		X4
	White		2
12	Green		1
13	Yellow		5
	Shield		6
	Brown	15	4
6	White	14	
7	Shield		
	CAN bus cable		U7
D1	fiber		Rd
Tx	fiber		Td
Rx	**Ethernet cable**		U5
D2	fiber		Rd
Tx	fiber		Td
Rx			

For HVC 450 kW system



HVC 150 master			HVC 150S slave 1	HVC 150S slave 2	ACS Control Module	
X286		CAN cable	X286			
1		Brown	16			
2		White	17			
3		Shield	18			
		Brown	1	16		
		White	2	17		
		Shield	3	18		
X286		Interlock cable	X286	X286	X3	X4
15		Brown				2
14		White				1
12		Green				5
13		Yellow				6
5		Shield			4	
7		White	14			
6		Brown	15			
		Shield				
11		White		14		
10		Brown		15		
		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