Low valued energy sources UPgrading for buildings and industry uses

LowUP installation and integral handbook for relevant environment 2 (industrial-upgrading solution)

Deliverable D4.7

Lead Beneficiary: EURECAT

December/2019

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www.lowup-h2020.eu

The LowUP project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement n°723930.

Document Information

Grant Agreement: 723930

Project Title: Low valued energy sources UPgrading for buildings and industry uses

Project Acronym: LowUP

Project Start Date: 1 November 2016

Related work package: WP 4: Installation, operation and validation in a relevant environment

Related task(s): Task 4.2: LowUP solutions integration and manufacturing

Lead Organization: ACCIONA

Submission date: 21/01/2020

Dissemination Level: Public

History

Date	Submitted by	Reviewed by	Version (Notes)
20/12/2019	Cristina Castro (EUT)	Konstantinos Kampouropoulos (EUT)	V0.1 First complete version
15/01/2020		Jordi Macià (EUT)	V0.2 Added late received information from partners.
22/01/2020		Jordi Macià (EUT)	V0.3 Added late received information from partners.
04/02/2020	Jordi Macià (EUT)	Silvio Vitali-Nari (ACC), Rafael Socorro (ACC)	Final document

About LowUP

LowUp – Low valued energy sources UPgrading for buildings and industry uses – is developing efficient alternatives to supply heating and cooling for building and industries, based on the use of renewable free energy and heat recovery from non-valuated residual energy sources that are currently wasted. As a result, these technologies will contribute to reducing significantly CO_2 emissions and primary energy consumption, and increase the energy efficiency in buildings.

Led by the Spanish firm ACCIONA, the LowUp project gathers 13 partners (3 large companies, 3 research and technology organisations and 7 SMEs) from 7 European countries. During 48 months, the consortium will develop efficient alternatives to supply heating and cooling for buildings and industries based on renewable free energy as well as non-valuated wasted thermal sources:

- 3 technologies will be developed and demonstrated: one heating and one cooling system for buildings, and one heat recovery system for industrial processes.
- The systems will be demonstrated at 4 demo sites: A Pilot Office building in Seville (Acciona Construcción, Spain), a Waste Water Treatment plant in Madrid (Canal de Isabel II & Acciona Water), a Pulp and Paper mill in Setubal (Portugal, The Navigator Company) and a Student Hall in Badajoz (Spain, University of Extremadura).

For more information, visit: www.lowup-h2020.eu

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Table of Content

Tables

Figures

Executive Summary

This report, D4.7 “LowUP installation and integration handbook for relevant environment 2 (industrial-upgrading solution)”, has been elaborated within the LowUP Project (GA #723930).

Particularly, this deliverable D4.7 is focused on the HP-LowUP solution, which consists of a waste water heat recovery system combined with heat-pump of novel design. For the demonstration and validation of the system, the two developed recovery systems are installed in the waste water treatment plant of Cuenca Baja del Arroyo Culebro (Madrid) and the Navigator Pulp factory (Setubal), while the heat pump system is located at the thermal laboratory of Tecnalia (Guipuzkoa).

The key **objectives** of D4.7 is to collect into a technical handbook all the required engineering information for installers and designers in order to be able to implement the LowUP industrial solutions (HP-LowUP).

As a **result**, this deliverable provides a full description of the sites where the LowUP technologies are installed and tested, as well as it presents all the required technical information to install and operate each one of the systems.

Keywords

Heat recovery systems, highly efficient heat pump, industrial heat recovery, heat pump, sludge.

List of acronyms and abbreviations

WWTP	Wastewater Treatment Plant
AD	Anaerobic digestion
CSTR	Continuously Stirred Tank Reactors
COP	Coefficient of Performance
HP	Heat Pump

1 Introduction

This deliverable D4.7 includes the installation and integration handbook for the relevant environment 2 (industrial solutions) of the LowUP solutions. Along with deliverables D4.2, D4.5 and D4.9 are part of the global understanding of the real systems integration and operation for the developed solution 3 – Industrial environment.

1.1 Motivation and objectives

The main objective of deliverable D4.7 is to recollect into a specific handbook all the procedures for the installation and integration of the industrial upgrading solutions (relevant environment 2) focused on installers and designers, defining the conditions for implementing successfully the LowUP systems and each one of its components.

In this context, the specific objectives for the LowUP installation and integration handbook are the following:

- To integrate in one single document all of the required engineering information for installers and designers for implement the LowUP industrial systems;
- To describe the main features of each site demo, as well as the installation and operation requirements for each site and system (i.e. available surface, hydraulic supplies, etc.).

1.2 Relation to other project tasks

This deliverable (D4.7) is comprised within Task T4.2 in WP4. It is focused on the installation and implementation of the industrial-upgrading solution on its relevant environment.

Moreover, Table 1 describes in more detail the relationships between the tasks reported in D4.7 and the rest of the project.

Table 1: Relation with previous WP4 tasks.

Task / WP	Relationship
T4.1	The aim of this task is to fulfil all the engineering activities, necessary for defining and planning the proper implementation of LowUP concepts at relevant test-site scale. This previous work is required for a proper system integration.
T4.2	Engineering activities devoted to the manufacturing of LowUP (industrial and building) technologies, before their shipping and implementation at relevant test site, according to the integration necessities, as defined in the preliminary lay-outs, as well as on the definition of the procedures for the installation and integration of the LowUP systems in the demo sites. This deliverable D4.7 is clearly connected to D4.9 “LowUP relevant environment 2” and D4.5 “Detail engineering of developed solution 3”.
T4.3	The aim of this task is the implementation of the LowUP solutions at relevant environment. D4.7 is directly connected with D4.2, which sets the plan to follow with the integration process.

2 Presentation of the system

The HP-LowUP concept is based on an effective and reliable heat pump-based system, being 100% thermal powered by residual and rejected low temperature energy sources (below 45ºC), being focused for application at industrial processes with temperatures up to 80 ºC. This temperature upgrading solution is based on the combination of heat recovery technologies, from low valued energy sources like rejected and process waste heat (20 - 45ºC) and high efficiency-high temperature water-to-water heat pump for the production of process heat between 55-80ºC.

As depicted in Figure 1, HP-LowUP system is composed by the following technologies:

- A sludge/wastewater-to-water or water-to-sludge/process water heat exchangers that can be used as a heat recovery system or as a heat delivery system;
- A high efficiency electrically driven heat pump.

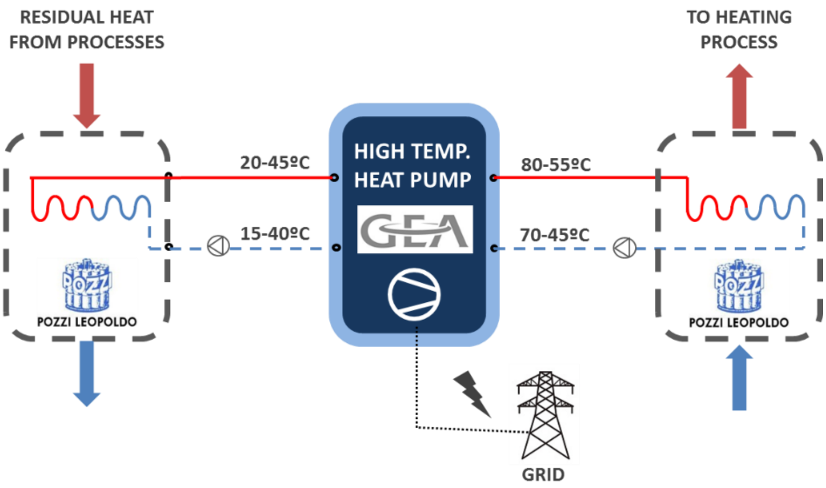


Figure 1: HP-LowUP concept.

These systems are being characterized on different demo sites in order to validate their performance under real operating conditions. The demo sites where the systems are installed are the following:

- Madrid: Heat recovery system integrated by Pozzi.
- Setubal: Heat recovery system integrated by Pozzi.
- Guipuzkoa: Highly efficient heat pump integrated by GEA.

As a demonstrator deliverable, this document aims to describe the installation and integration process carried out in the test sites that have hosted the technologies.

3 Description of LowUP demo sites

The purpose of this section is to give a detailed overview of the different LowUP demo sites, describing in detail each one of them. Additionally, a description of the integrated systems is presented, including their main features, the installation requirements and their risk management plans.

3.1 Madrid demo site: Wastewater treatment plant

3.1.1 Site description

The LowUp Project demonstration system is integrated into the Waste Water Treatment Plant of Cuenca Baja del Arroyo Culebro, at Camino de la Aldehuela a Vaciamadrid, 28909 Getafe, Madrid. The capacity is around 172.800 m^3/d and a population equivalent of 1.3 million people.

Figure 2. WWTP overview in Pinto, Getafe, Spain.

The sewage sludge that is produced in wastewater treatment plant, and the products from the primary and secondary treatments, require to be treated. Anaerobic digestion is a proven technology for sewage sludge treatment as it can achieve a high reduction of the solid matter in the sludge. The sludge is pumped into the anaerobic CSTR, where the digestion takes place, usually at mesophilic temperature (35 – 39 °C). After the anaerobic digestion, the digested sludge is released at a constant temperature around 35ºC so as to be dewatered. At this point, the remaining low exergy heat contained in the sludge is recovered through the Heat Recovery System, developed by Pozzi. HP - LowUP will allow recovering residual energy from outgoing effluent, when the sludge is naturally cooled down by air during the following process of storing and dewatering.

A detailed description related to the process is presented in deliverables D3.1 “Case studies description” and D3.2 “High efficiency heat recovery system for industrial processes”.

3.1.2 System description

The system is composed by three main devices that are integrated in a single unit (skid), whose role is to dissipate the heat and to circulate the clean water.

- Heat recovery unit: Model RHeX-16T, 35-45 kW of thermal power recovered, and needs 1x0.55 kW of electrical power supply, from Pozzi;
- Dry cooler: Model EA65-025037.4 (35 kW) from Stulztecnivel;
- Water pump: Model EL 50-160 (0,75 kW) from Ebara.

The following figure present a concept scheme of the installation, indicating the system´s components and water flows.

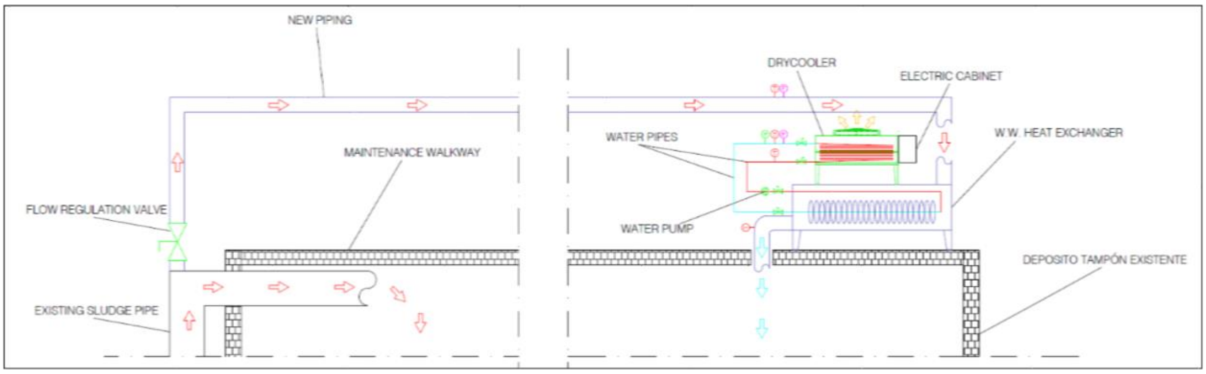


Figure 3. Madrid Demo Site P&ID conceptual diagram.

A detailed description of the system is presented in deliverables D4.5 and D4.9.

The Figure 4 shows the different equipment that composes the skid built by Pozzi.

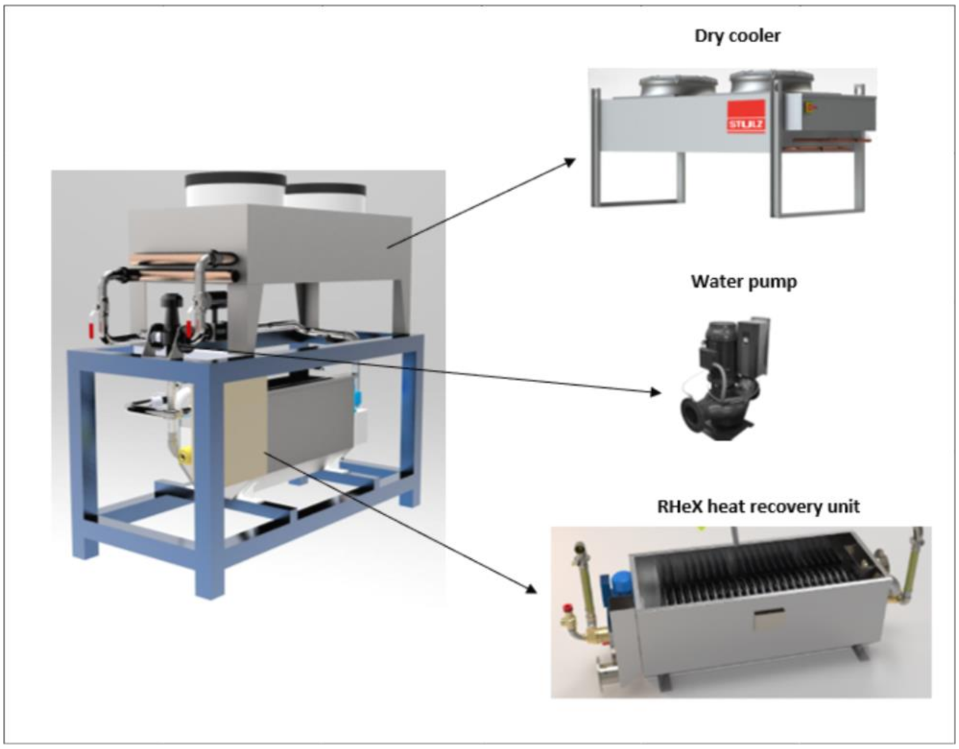


Figure 4. Skid description.

The weight of the skid is 1,1 tones and its dimensions are showed in the following image:

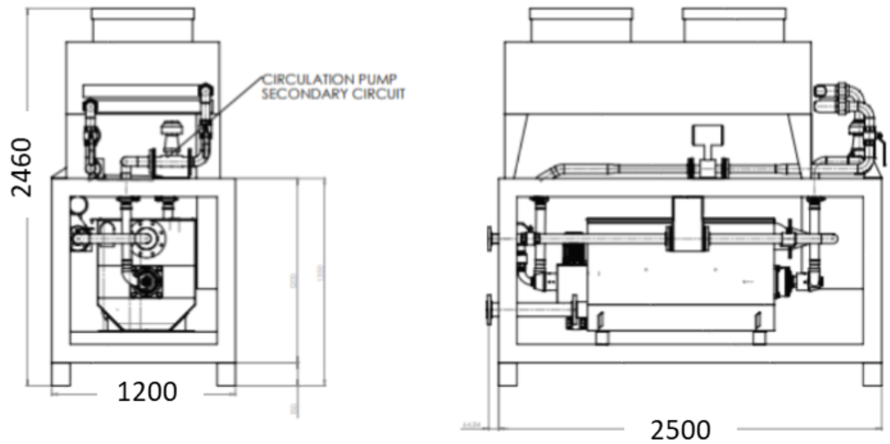


Figure 5. Heat recovery system skid dimensions.

3.1.3 Installation Requirements

For the implementation and installation of the heat recovery system into the water treatment plant of Madrid, there are several aspects that have to be taken into account: available space, stable surface, power and hydraulic supplies.

- **Available space and colocation**

The industrial heat recovery system from Pozzi was installed next to the AD digesters, located near the sludge pipe, in order to recover the available heat at the digester outlet. To integrate the heat recovery system with the reactor, one of the sludge pipes (used for taking samples of the fluid) has been adapted to allow the integration. So, the cut-off valve (Figure 6), which is open only when a sample is required, will keep opened to feed the LowUP system with the sludge. In this case the circulation of the sludge is produced by the gravity force, without the use of a circulating pump (**Note that depending on the sludge properties, the system could need an auxiliary sludge grinding pump due to the high sludge density in order to facilitate the transport from the AD digester to the skid**). The adaptation of the pipe system is considered as a preparation work in order to integrate the system into the plant.

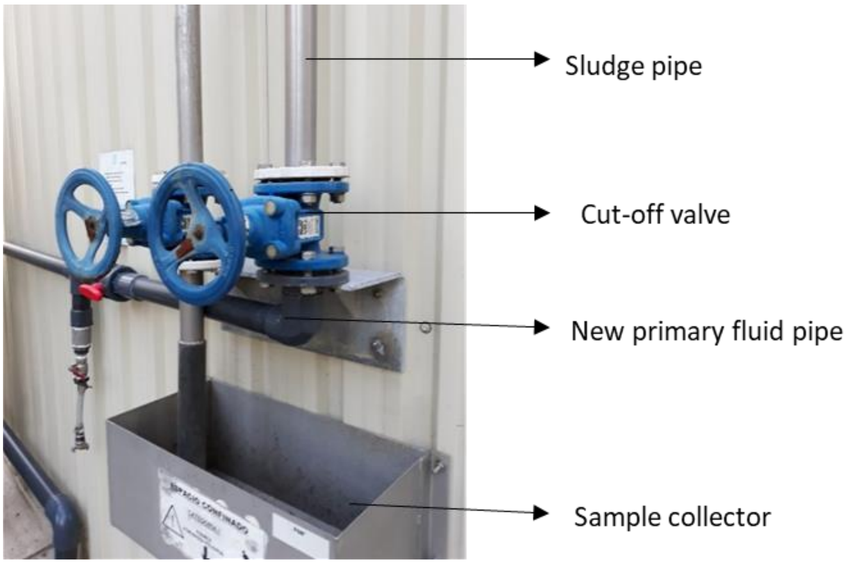


Figure 6. Detail of the system´s connection to the bio digester reactor.

- **Water and sludge supply**

Due to the fact that water will be the secondary fluid, a water supply source will be necessary to fill the secondary circuit. In this case, any regular net water supply will be suitable.

The following table presents the hydraulic connections that are required for the skid´s installation.

Table 2. Hydraulic connections required for Madrid demo site.

	Primary circuit (sludge)	Secondary circuit (water)
Inlet pipe diameter	DN40	DN40
Outlet pipe diameter	DN80	DN40
Type of connection	Collar, Welded; AISI 304L (EN1092-1 TYPE33) PN10 /Lap joint flange, Al-Epoxy coated (EN1092-1 TYPE302)	

- **Structure anchoring**

In terms of structural requirements, it is important to be placed in a flat land to ensure a stable support. It is recommended to be placed on a reinforced ground base and to be levelled by use of concrete foundation slabs (Figure 7):

Figure 7. Foundation slab.

The following figure presents the installed Heat exchanger system in the pilot plant of the project (Madrid).

Figure 8 and Figure 9. Image of heat exchanger, installed in the pilot of Madrid (front view).

- **Electrical connection**

A 3-phase electrical connection is required for the operation of the heat exchanger, of a maximum power of 8 kW.

On the following figure, there is a real picture of the electrical cabinet finished.

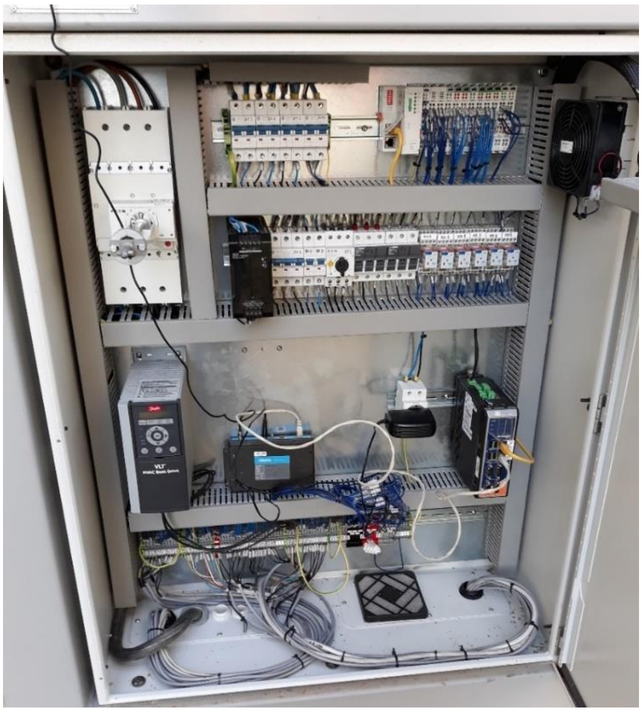


Figure 10. Electrical cabinet – Madrid Demo site.

The detailed electric schemes of the system´s installation are provided in the annex section.

3.1.4 System Operation

A brief summary of the operation of the entire system is presented in the following figure. The liquid flows are indicated in different colours over the image, where red represents the inlet sludge (hot) on the primary circuit, green represents the outlet sludge (cold) in the primary circuit, purple represents the outlet water (hot) in the secondary circuit and blue represents the inlet water (cold) in the secondary circuit.

Figure 11. Liquid flow scheme of heat exchanger.

The following table describes the working parameters and requirements of the system for its proper operation.

Table 3. Operational parameters and requirements for Madrid demo site.

	Primary circuit (sludge)	Secondary circuit (water)
Flow [l/min]	50	85
Temperature inlet RHeX [ºC]	35	20
Temperature outlet RHeX [ºC]	23,8	26,4
Pressure [bar]	Atm.	2

Related to control aspects, the assembly counts with its own PLC which monitors and controls the operation of the device. It only requires to input the desired set points, and it will operate autonomously.

3.2 Setubal demo site: Wastewater treatment plant

3.2.1 Site description

The installation of the HP-LowUP technologies have taken place in the pulp and paper factory company Navigator, located in Mitrena, Setubal. The Pulp factory of Setubal, which is one of the most important in Europe, has a production capacity of 550 thousand tons.

The Navigator company facilities host a small residual water treatment plant, where the treatment of the waste water takes place. The HP-LowUP concept pretends to benefit the plant by recovering the unused low exergy waste heat from the waste waters in order to reuse it in the productive process, increasing thus the energy efficiency of the entire production process. The effluent has a temperature range between 35 and 45°C. The LowUP system is integrated in the factory next to the WWTP, in order to recover the remaining low exergy heat contained in the sludge during the phase just before the water treatment.

The following figure depicts the water treatment area of the Navigator plant:

Figure 12. Left: pulp and paper plant (red area). Right: Wastewater treatment plant.

Further information related to the pilot plant process are available in the deliverables D3.1 “Case studies description” and D3.2 “High efficiency heat recovery system for industrial processes”.

3.2.2 System description

The system is composed by four main devices. The heat recovery unit, a dry cooler for the emulation of the demand profiles of the system, a water pump and a sludge pump. The RHeX unit, the water pump and the dry cooler have been integrated in a single unit (skid), to ease the installation process in the plant, whereas the sludge pump is submerged in the sewage to allow the circulation of the primary fluid. The devices are the following:

- Heat recovery unit: Model RHeX-16T, 35-45 kW of thermal power recovered, and needs 1x0.55 kW of electrical power supply, from Pozzi;
- Dry cooler: Model EA65-025037.4 (35 kW) from Stulztecnivel;
- Water pump: Model EL 50-160 (0,75 kW) from Ebara;
- Sludge pump: Model DW VOX 75 from Ebara. **Main requirements: this pump needs to be submerged in the sludge, for a proper operation of the system. It also be connected to the heat exchanger through a pipe network.**

A concept scheme of the installation is presented as follow:

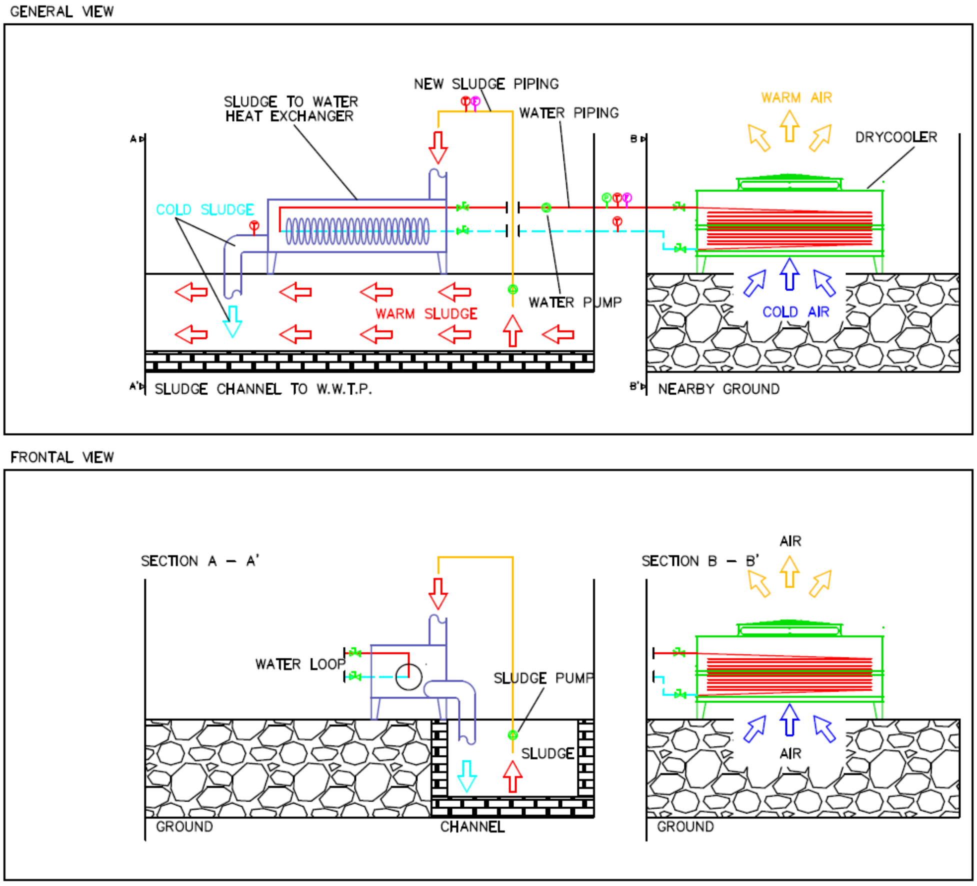


Figure 13. Setubal Demo Site P&ID conceptual diagram.

A more detailed description of the system is provided in deliverable D4.5 and D4.9.

The Figure 14 shows the different equipment that composes the skid built by Pozzi.

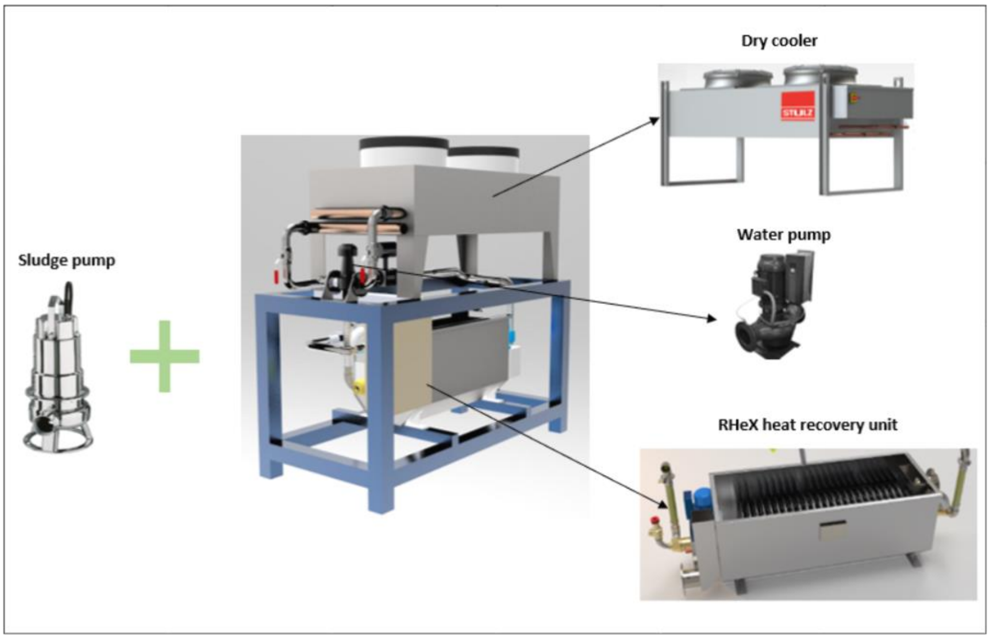


Figure 14. Integration unit and systems of Setubal demo site.

The weight of the skid is 1,1 tones and it dimensions are showed in the following image:

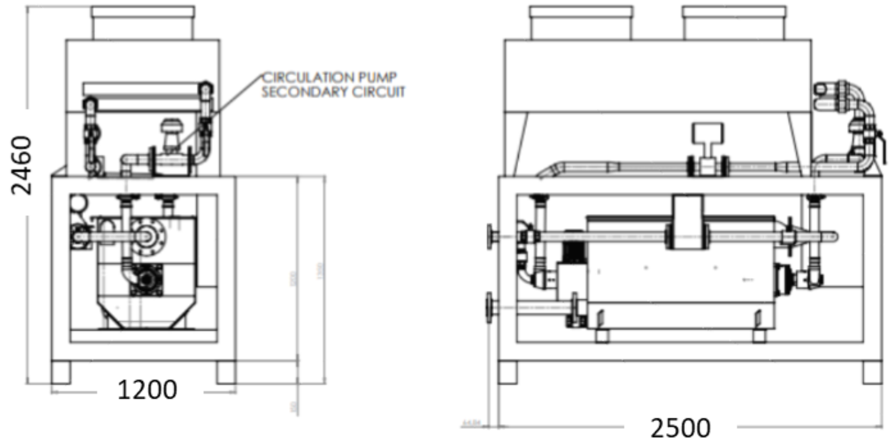


Figure 15. Heat recovery system skid dimensions.

3.2.3 Installation Requirements

For the installation of the heat recovery system in the pulp and paper factory of Setubal, there are main aspects to take into account: available space, stable surface and power and hydraulic supplies.

- **Available space and colocation**

The main difference with the installation carried out in Madrid demo site is that in this case a sludge pump is necessary for the circulation of the primary fluid (sludge). The sludge pump is connected through a flexible pipe with the RHeX heat recovery unit and submerged in the sludge (Figure 16).

Figure 16. Sludge pump before been submerged (left side) and sludge pump connection (right side).

The following image shows the system after the installation.

Figure 17. Heat recovery system and auxiliary systems after their installation in Setubal.

- **Water and sludge supply**

Due to water is the secondary fluid, a water supply source is necessary to fill the secondary circuit. In this case, any water supply point is available, therefore two alternatives are considered:

1. Use the private fireman service from the Navigator Company to fill the installation and to refill it when the pressure drops below 2 bar;
2. Or install a 100 litters' tank, that provide water automatically when the pressure drops below 2 bar.

On the following table all the hydraulic connections required for the skid are specified.

Table 4. Hydraulic connections required for Setubal demo site.

	Primary circuit (sludge)	Secondary circuit (water)
Inlet pipe diameter	DN40	DN40
Outlet pipe diameter	DN80	DN40
Type of connection	Collar, Welded; AISI 304L (EN1092-1 TYPE33) PN10 /Lap joint flange, Al-Epoxy coated (EN1092-1 TYPE302)	

- **Structure anchoring**

To ensure a stable support of the skid, two concrete foundation blocks are built to lift the equipment. This allows anchoring the structure to the ground. On the Figure 17 it can be obeserved the two concrete blocks used to lift the equipment.

- **Electrical connection**

A 3-phase electrical connection of 8 kW is required for a proper working of the system.

On the following figure, there is a real picture of the electrical cabinet finished.

Figure 18. Electrical cabinet – Setubal Demo site.

The electric schemes of the system, are attached on the annex section.

3.2.4 System Operation

A brief summary of the operation of the entire system is presented in the following figure. The liquid flows are indicated in different colours over the image, where red represents the inlet sludge (hot) on the primary circuit, green represents the outlet sludge (cold) in the primary circuit, purple represents the outlet water (hot) in the secondary circuit and blue represents the inlet water (cold) in the secondary circuit.

Figure 19. Operation scheme of LowUP system in Setubal demo site.

On the following table it is described the working parameters and requirements of the system to operate properly:

Table 5. Operational parameters and requirements for Setubal demo site.

	Primary circuit (sludge)	Secondary circuit (water)
Flow [l/min]	30	85
Temperature inlet RHeX [ºC]	40	20
Temperature outlet RHeX [ºC]	22,8	25,9
Pressure [bar]	Atm.	2

Related to control aspects, the assembly counts with its own PLC which monitors and controls the operation of the device. It only requires to input the desired set points, and it will operate autonomously.

3.3 Guipuzkoa demo site: Thermal laboratory

3.3.1 Site description

The thermal lab of Tecnalia, located in Guipuzkoa (Spain) bases its activity in the development, testing, evaluation and optimization of thermal systems, based on sustainable technologies, both existing and emerging. Due to its heating and the dissipation capacity, this thermal lab is suitable to carry out the characterization of the high efficiency Heat Pump, the technology developed by GEA in the frame of the LowUP project. Next figure shows a satellite picture of the Tecnalia facilities in Guipuzkoa and the location where the Heat Pump is installed.

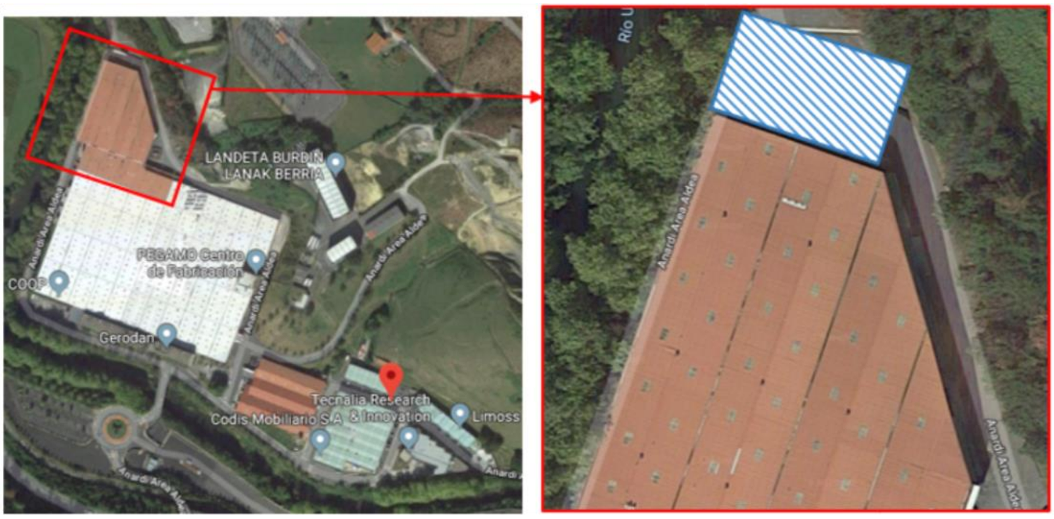


Figure 20. Picture of the place where the HP has been installed.

For more information about the process consult the deliverable D3.1 “Case studies description” and D3.3 “High temperature cost effective heat pump”.

3.3.2 System description

The system is composed by three mainly devices whose role is to boosts efficiently the low thermal level of the wasted source into useful heat for the industrial process, achieving a COP above 6 for a 35K temperature lift. The devices are the following:

- Heat Pump: containerized water-water heat pump (project number. 62049-001-1-01) from GEA;
- Boiler: model WA 250 (Heating capacity 291 kW) from YGNIS;
- Chiller: model EWAH290TZSSB1 (Cooling capacity 288,6 kW) from DAIKIN.

Furthermore, a water accumulator tank of 1000 litres is installed to premix the flows (Model 30 – 1500 AR from IBAIONDO), avoiding in this way that the dissipation of the heat only depends on the chiller. Other auxiliary systems, like water pumps and 3 ways valves, are necessary for a correct operation of the system (see Figure 21).

A concept scheme of the installation is presented as follow:

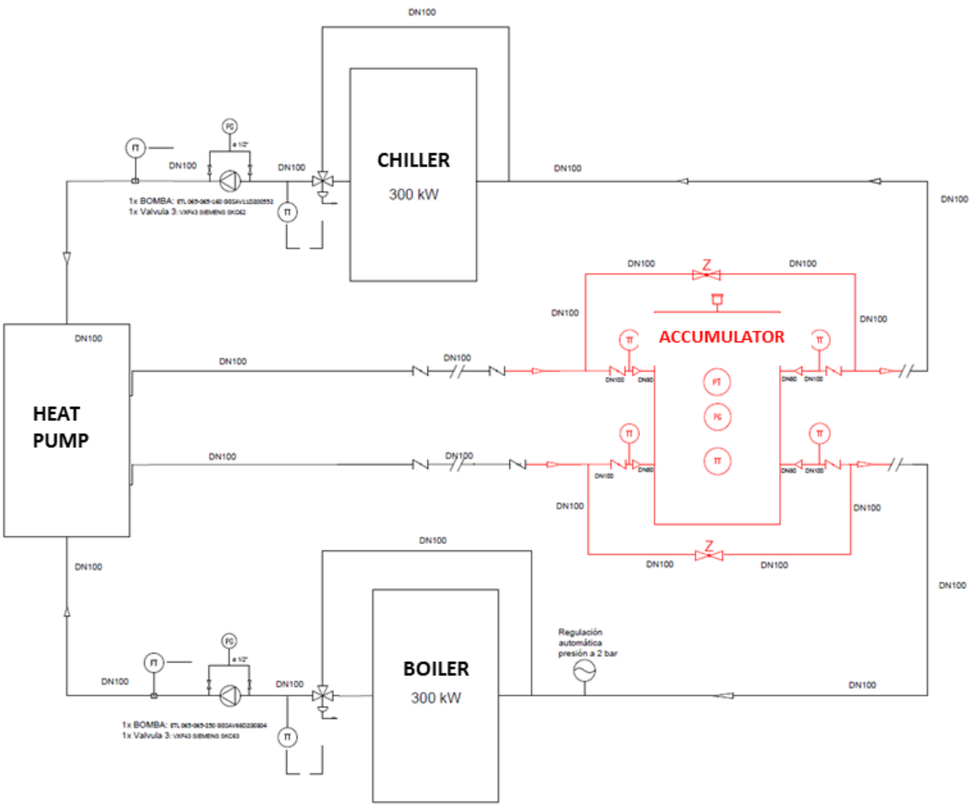


Figure 21. Installation scheme of HP-LowUP concept in Guipuzkoa.

A more detailed description of the system is provided in deliverable D4.5.

The Figure 22 shows the different equipment that composes the test lab at Tecnalia.

Figure 22. Integration unit and systems of Guipuzkoa demo site.

The weight of the container is 12,5 tones and it dimensions are the following:

- External dimensions: 6,1 x 2,5 x 2,9 m
- Internal dimensions: 5,9 x 2,4 x 2,7 m

3.3.3 Installation Requirements

For the installation of the heat recovery system in the thermal laboratory of Tecnalia, there are main aspects to take into account: available space, stable surface and power and hydraulic supplies.

- **Available space and colocation**

Due to the usual activity of the Tecnalia thermal laboratory to test different technologies, the boiler and the chiller are systems that Tecnalia already host in its facilities. These systems have to be integrated with the Heat Pump in order to characterize it, for that the main integration requirement is to hydraulically connected with them. In order to achieve this requirement, and considering the final weight & dimension of the containerized system, the HP is installed outdoors (see blue area in Figure 23), so the water pipe networks will have to cross the wall of the building (see yellow area).

Figure 23. HP integration outdoor in Tecnalia facilities.

All the HP components are integrated in a container, see Figure 24 and Figure 25.

Figure 24. HP container.

Figure 25. HP inside container.

- **Water supply**

The HP container have four hydraulic connections to be connected with the boiler and the chiller. In Figure 26 there is the networking pipes connecting the chiller and the boiler with the HP crossing the wall of the building.

Figure 26. Hydraulic connections and hydraulic pipes networking.

On the following table all the hydraulic connections required for the skid are specified.

Table 6. Hydraulic connections required for Guipuzkoa demo site.

	Chiller circuit	Boiler circuit	Accumulator circuit
Inlet pipe diameter	DN100	DN80	DN100
Outlet pipe diameter	DN100	DN80	DN100
Type of connection	Collar, Welded; AISI 304L (EN1092-1 TYPE33) PN10 /Lap joint flange, Al-Epoxy coated (EN1092-1 TYPE302)		

It is important to isolate the discharges and suction pipes, in this case it has been made with rock wool and finished with aluminium sheeting.

For more specifications about hydraulic connections see the HP P&ID located in the Annex.

- **Structure anchoring**

To ensure a stable support of the container, a robust structural steel base frame is built to lift the equipment. This allows anchoring the structure to the ground. Furthermore, civil foundations must include provisions for the water sewer. On the Figure **27** it can be obeserved the structure built.

Figure 27. Structure prepared to receive the HP-LowUp container.

- **Electrical connection**

The HP container needs to be power supplied with a 3-phase electrical connection. The main electrical supply and control cabinet needs a 220 A supply, and the NH3 extraction system needs a 25 A supply.

For the rest of the equipment of the laboratory, used for the tests, the global maximum intensity is 150A.

On the following figure, there is a real picture of the electrical cabinet finished.

Figure 28. Electrical cabinet – Guipuzkoa Demo site.

The electric schemes of the system, are attached on the annex section.

3.3.4 System Operation

A brief summary of the operation of the entire system is presented in the following figure.

The liquid flows are indicated in different colours over the image, where red represents the inlet sludge (hot) on the primary circuit, green represents the outlet sludge (cold) in the primary circuit, purple represents the outlet water (hot) in the secondary circuit and blue represents the inlet water (cold) in the secondary circuit.

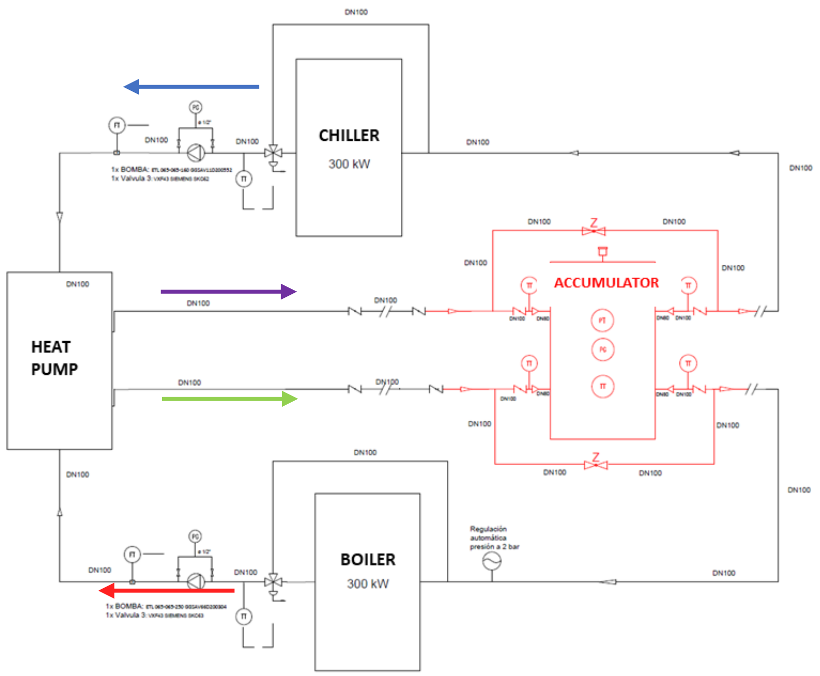


Figure 29. Space requirements for the RHeX system.

An inertia tank connecting both return to the boiler and the chiller in order to reduce the effort of the auxiliary equipment to dissipate and provide heat.

On the following table it is described the working parameters and the requirements of the system to operate properly:

Table 7. Operational parameters and requirements for Guipuzkoa demo site.

	Chiller water	Heating water
Flow [m^3/h]	48,64	27,75
Temperature inlet [ºC]	45	65
Temperature outlet [ºC]	40	75
Pressure [bar]	2	2
Capacity [kW]	280	315

Related to control aspects, each of the elements counts with its own control system, so they can operate autonomously for a given set point. Additionally, all the operating variables are monitored in the SCADA of the laboratory, which allows to operate remotely the equipment. The three-way valve can also be operated from the SCADA, and they count with a PLC that controls the opening degree in order to follow a set point for a given variable in the system.

4 Prevention, safety and legislation

4.1 Heat recovery systems

- **Prevention**

The area where the RHeX is installed has to fulfil some requirements: once running, machine surfaces can become very hot, therefore it is mandatory that proper protecting fences or paddings are available to avoid accidental contact with surfaces and to prevent operators from eventual scorching. However, such protections must allow for maintenance and/or temporary cleaning of the unit, so the following minimum side clearances are required: 0.5m on the short sides, free access to the side where the identification plate is installed, and 0.1m on the opposite side.

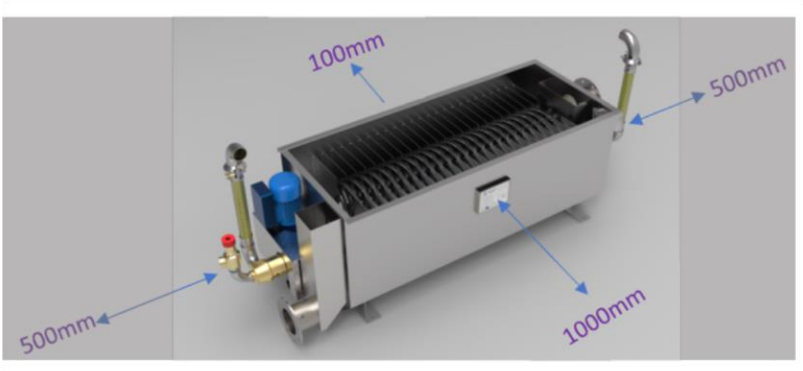


Figure 30. Space requirements for the RHeX system.

As explained before, the assembly of the heat recovery, dry-cooler and water pump is the same for both demos. It is important to install the dry-cooler on the top of the heat recovery with enough space in between for maintenance issues.

- **Safety equipment**

The safety recommendations of each of the systems that compose the assembly can be found in their respective documentation and user handbook. These recommendations must be followed and observed.

4.2 Highly efficient heat pump system

- **Legislation**

The heat pump is manufactured according current EU legislation and norms EN378, EN12900, EN13771 and AD2000. The GEA heat pump is ISO9001 certified. Furthermore, GEA has designed the unit based on data from the simulated operation conditions of the identified project demo sites. The units are in accordance with EN-standards and the requirements under the Pressure Equipment Directive 2014/68/EU.

- **Prevention**

The heat pump is designed for installation in a container with a minimum temperature of 15°C and maximum of 40°C. The heat pump is designed to ensure a maximum 1 bar pressure drop on the secondary medium of hot and cold side.

- **Safety equipment**

Ammonia detection system, composed by:

- 1 x R717 detection sensor;
- 1 x ATEX exhaust fan (combined with the fan for heat extraction);
- Emergency electrical panel, supplied loose, for mounting on the outside of the container wall.

In order to prevent a too low indoor temperature in the container:

- Internal thermal insulation for the container (except floor);
- Heating in the container: 1x2 kW.

For further information about design criteria, safety equipment and standards go to D3.3.

Conclusions

This deliverable gives a full description of the sites where LowUP technologies are installed and tested: the wastewater treatment plant of Cuenca Baja del Arroyo Culebro (Madrid), the pulp and paper plant factory of Navigator (Setubal) and the thermal laboratory of Tecnalia in Guipuzkoa. The demo site in Madrid and Setubal host the Heat recovery systems integrated by Pozzi, while the demo site in Guipuzkoa hosts the highly efficient heat pump system integrated by GEA.

All the systems have been described in detail, explaining the main features and requirements of each one. Regarding these requirements, some previous works to adapt the demo sites have been proposed. These works are mainly: building refurbishment, ground improvement, already installed systems and equipment adaptation, available surface and power and hydraulic supplies.

Furthermore, the deliverable includes all the engineering documentation required for the installation and operation of all the systems, it includes: P&ID schemes, electrical schemes, system drawing, equipment manuals as well as declaration of conformity documents.

Annex

ANNEX 1. RHeX - Madrid

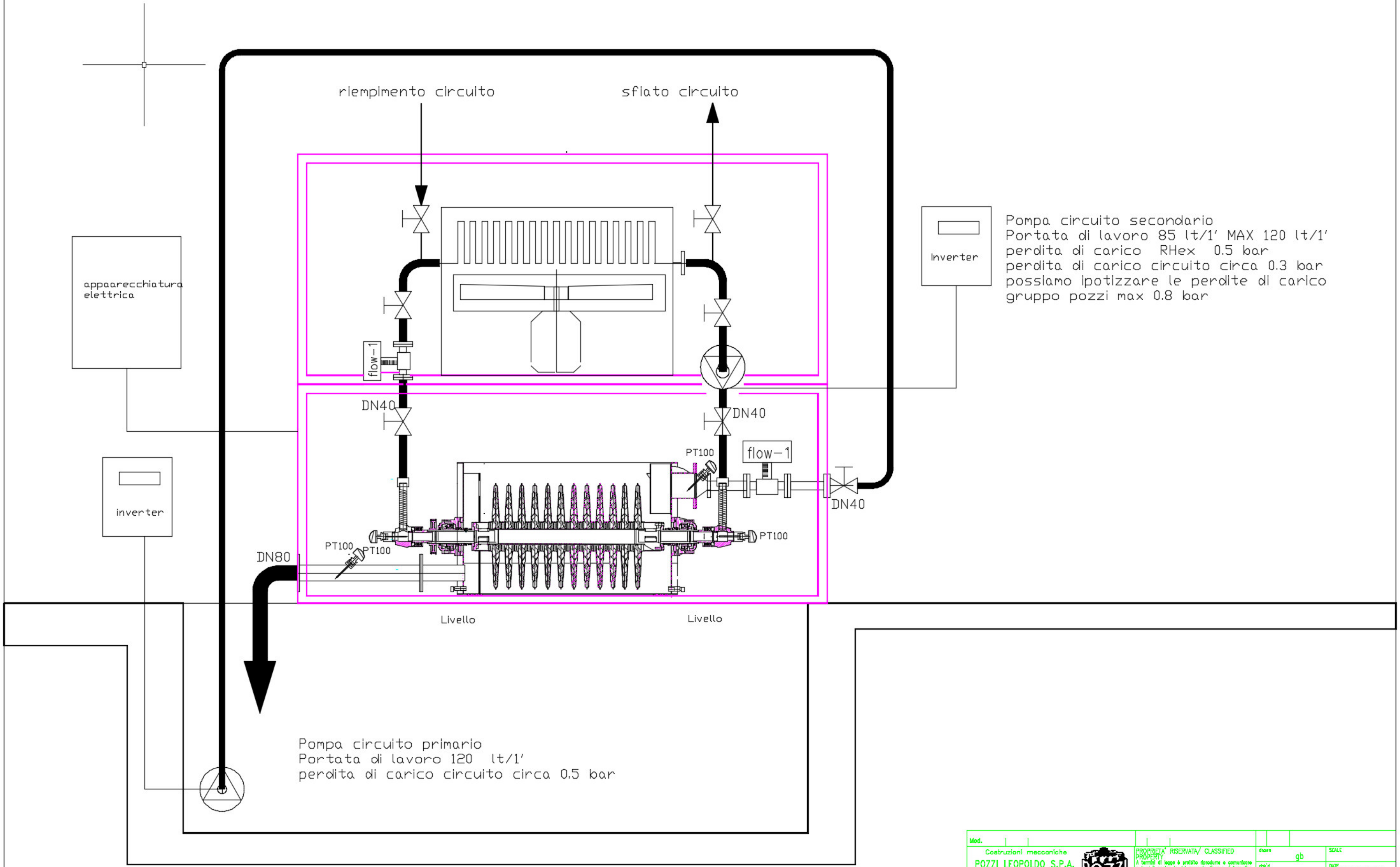
ANNEX 2. RHeX - Setubal

ANNEX 3. HP - Tecnalia

Annex 1

The following documents represents all the engineering documentation requires for the integration and operation of the heat recovery systems hosted in the WWTP of Cuenca Baja del Arroyo Culebro (Madrid):

- P&ID diagram;
- Electrical diagram;
- Skid drawing;
- Equipment manuals;
- Equipment datasheets.



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SCHEME LowUP		101 F Rhex

	Date	Name	SCALE	AutoCAD RELEASE 14 Autodesk.	LowUp – Industrial – V05–A
Dibujado	16/10/2017	CC/SVN	W/S		
Proyectado					
Comprobado					

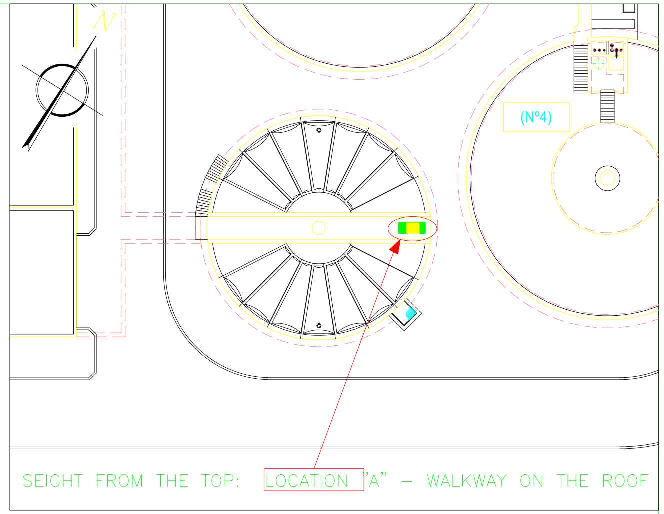
PROYECTO: **LOWUP - H2020 Project**

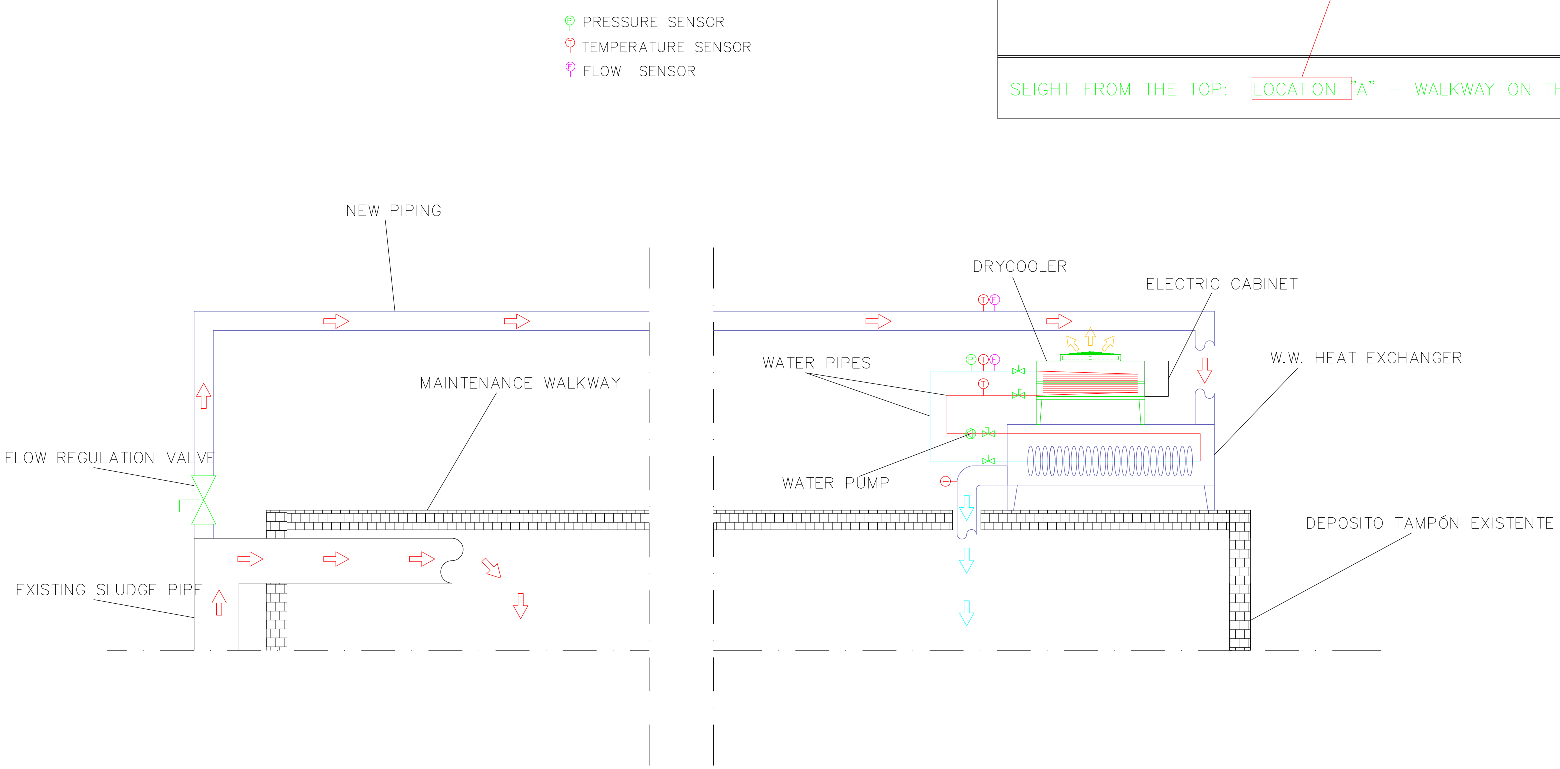
TITULO DEL PLANO: WASTE WATER TREATMENT PLANT – P&ID

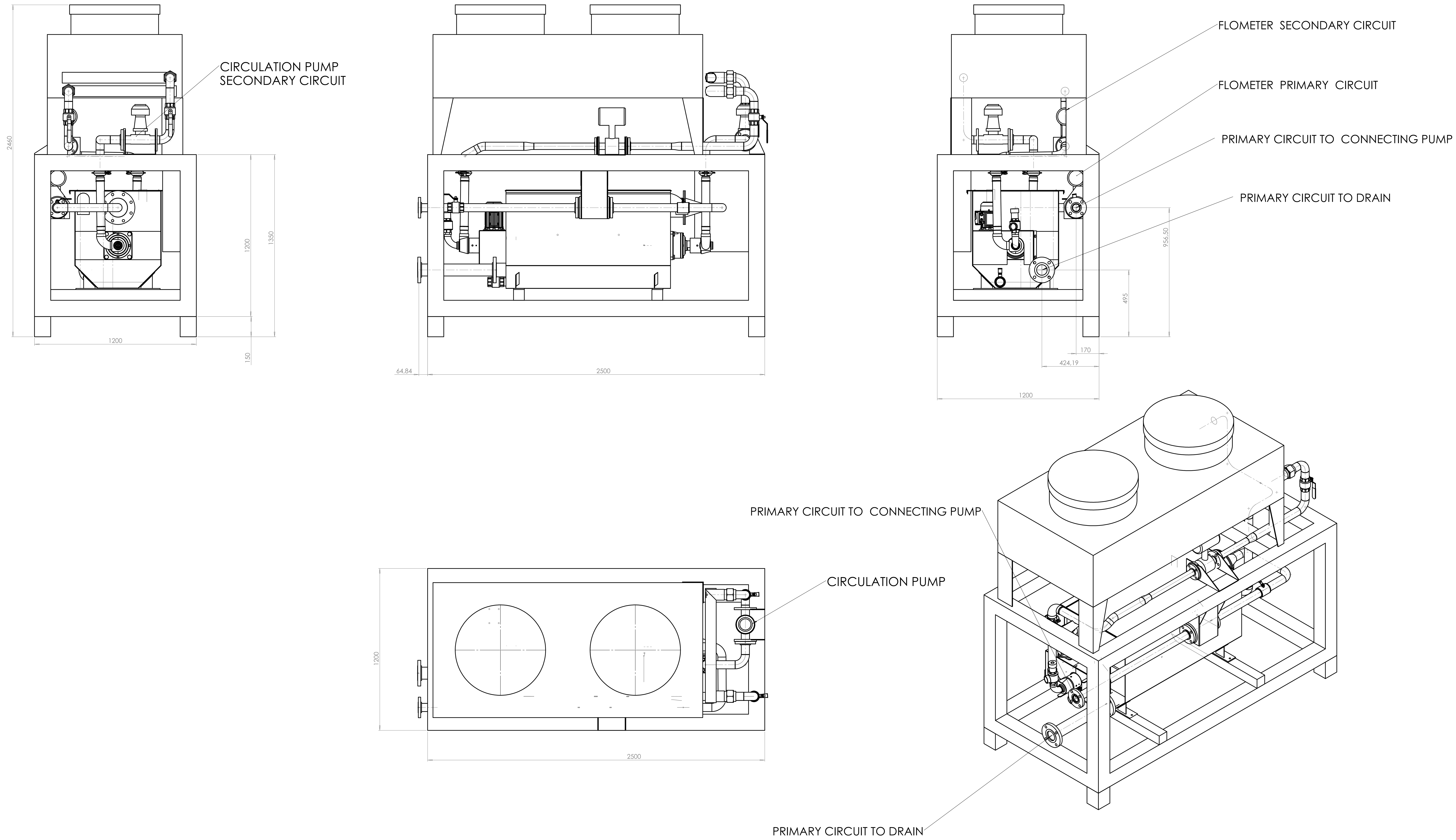
NUMERO DE PLANO: 1 HR

ASUNTO: SCHEMATIC HEAT RECOVERY IMPLANTATION

REFERENCIA: ACCIONA AGUA







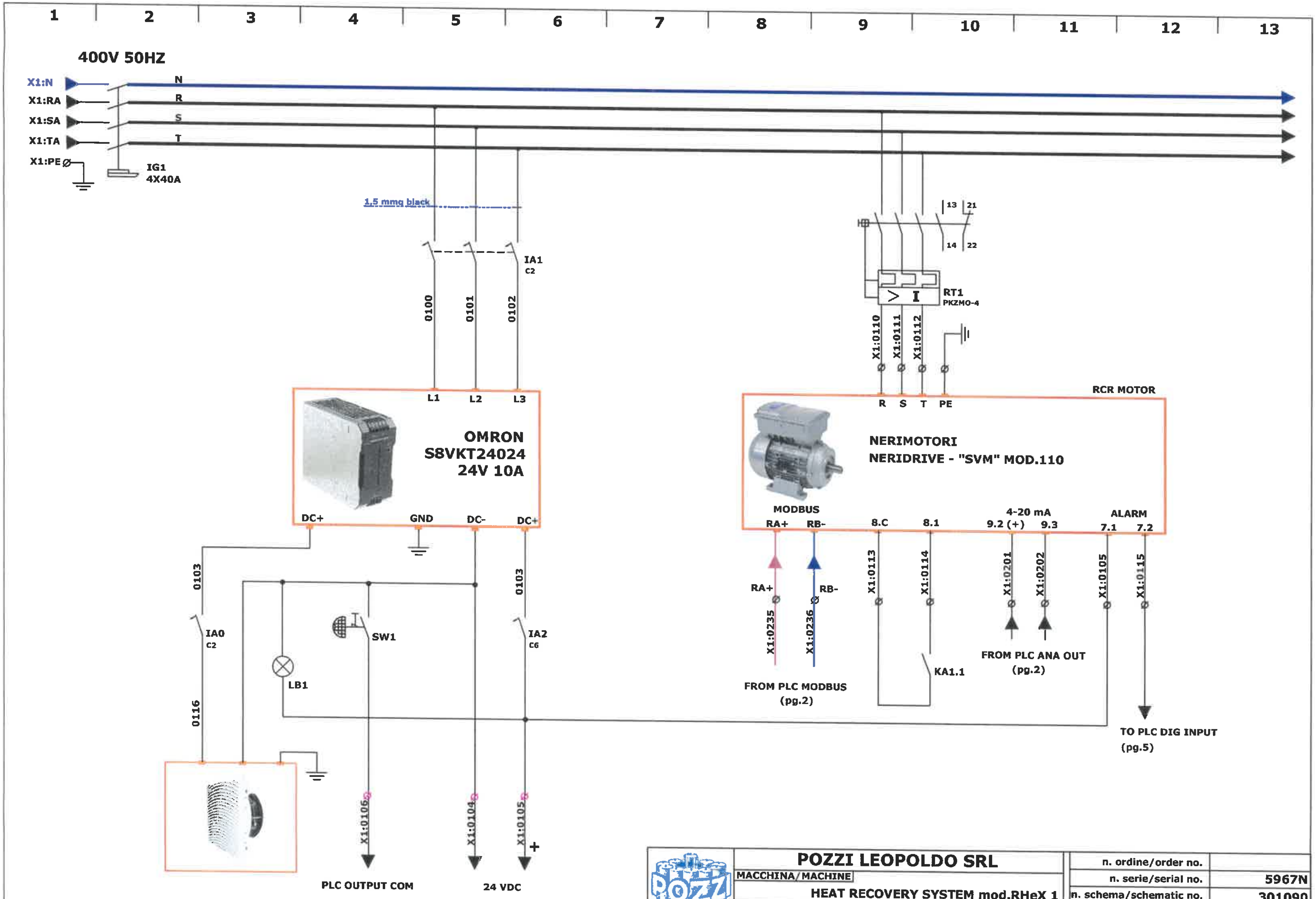
Pozzi LeopoLdo S.r.l
Barlassina (MB)

DISEGNATO
VERIFICATO
data

ASSEMBLY LOW-UP

N. DISEGNO 101F-LOW-UP-01-001 A4

SCALA:1:10 FOGLIO 1 DI 1



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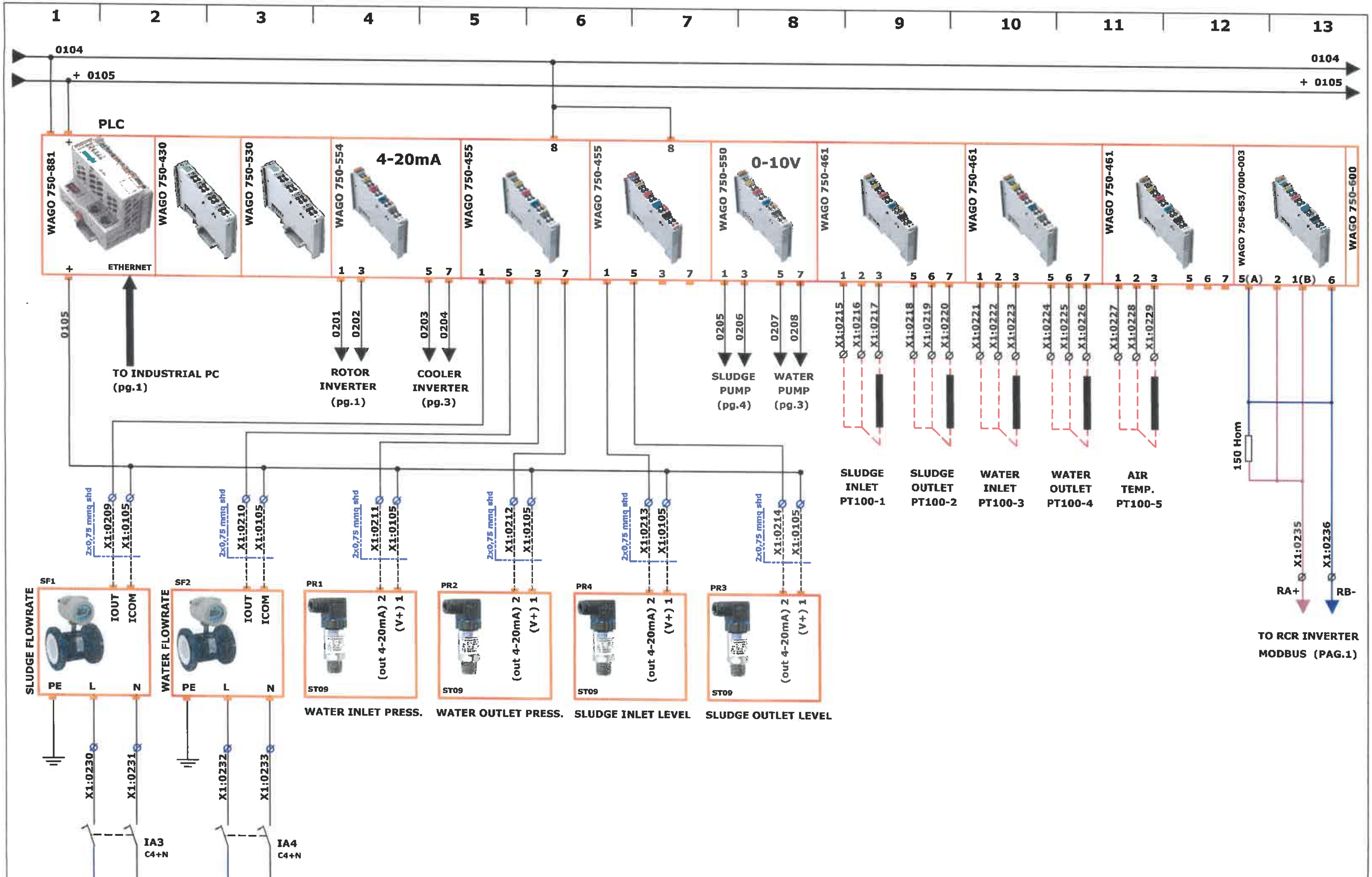

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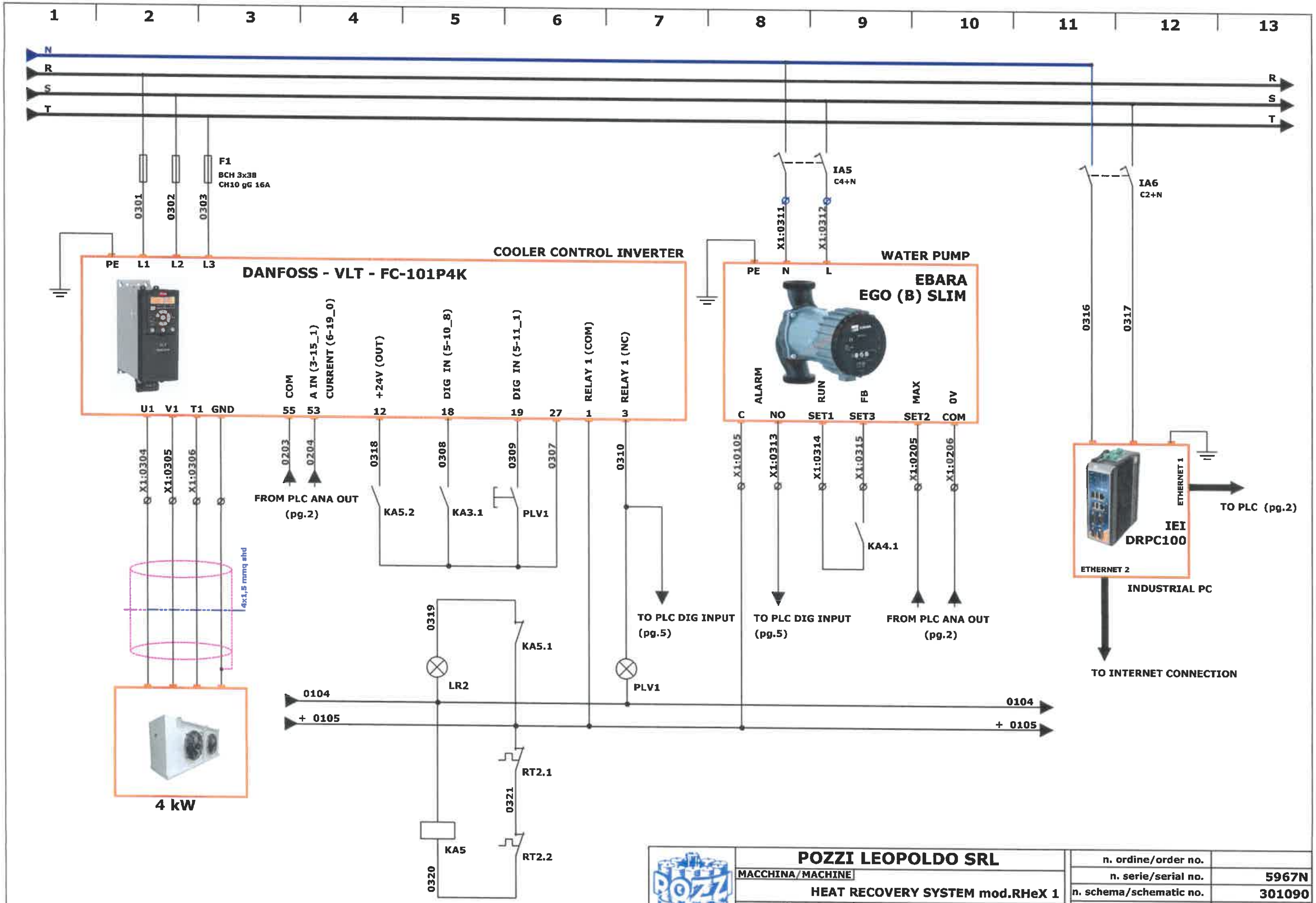

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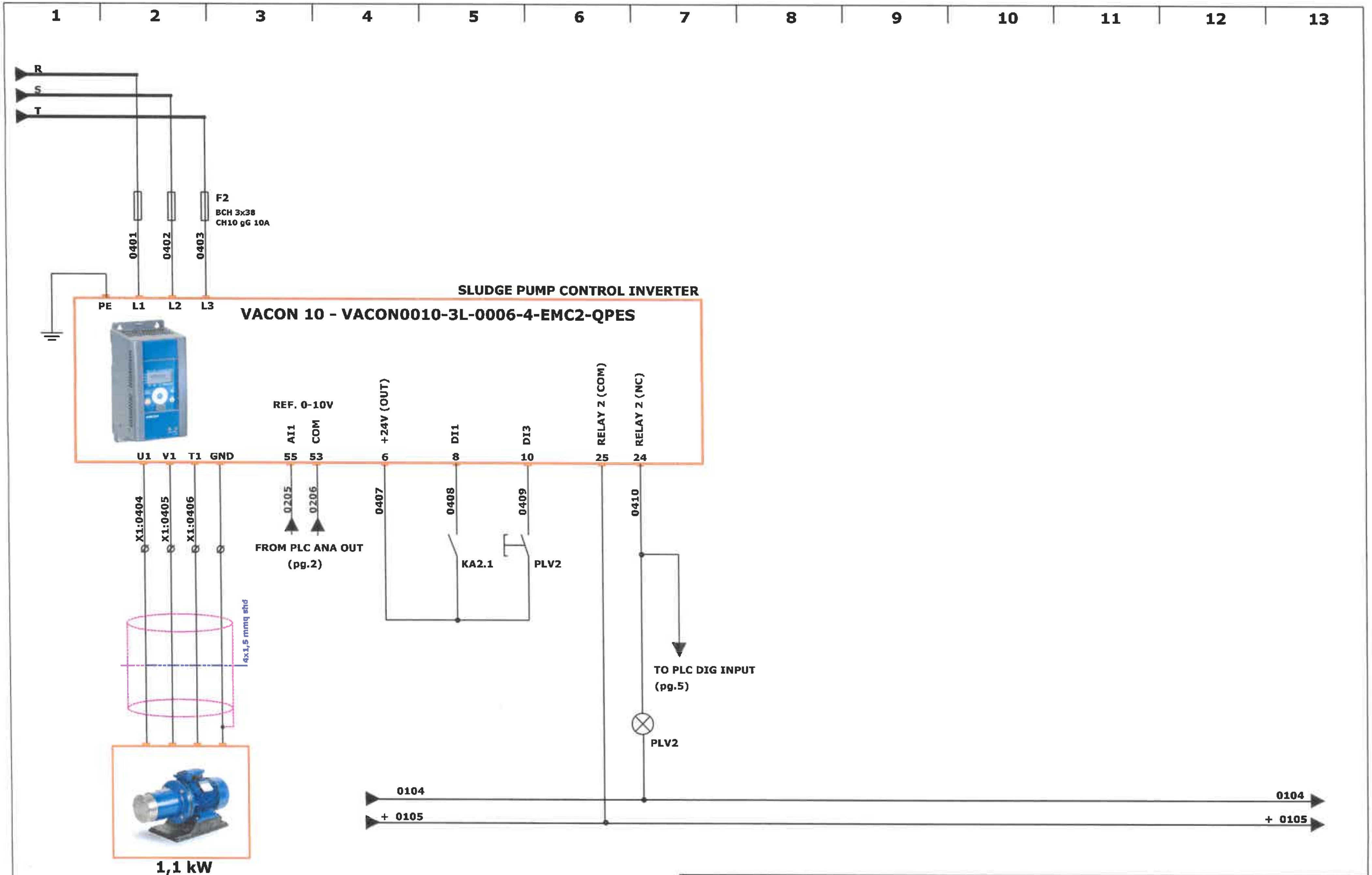

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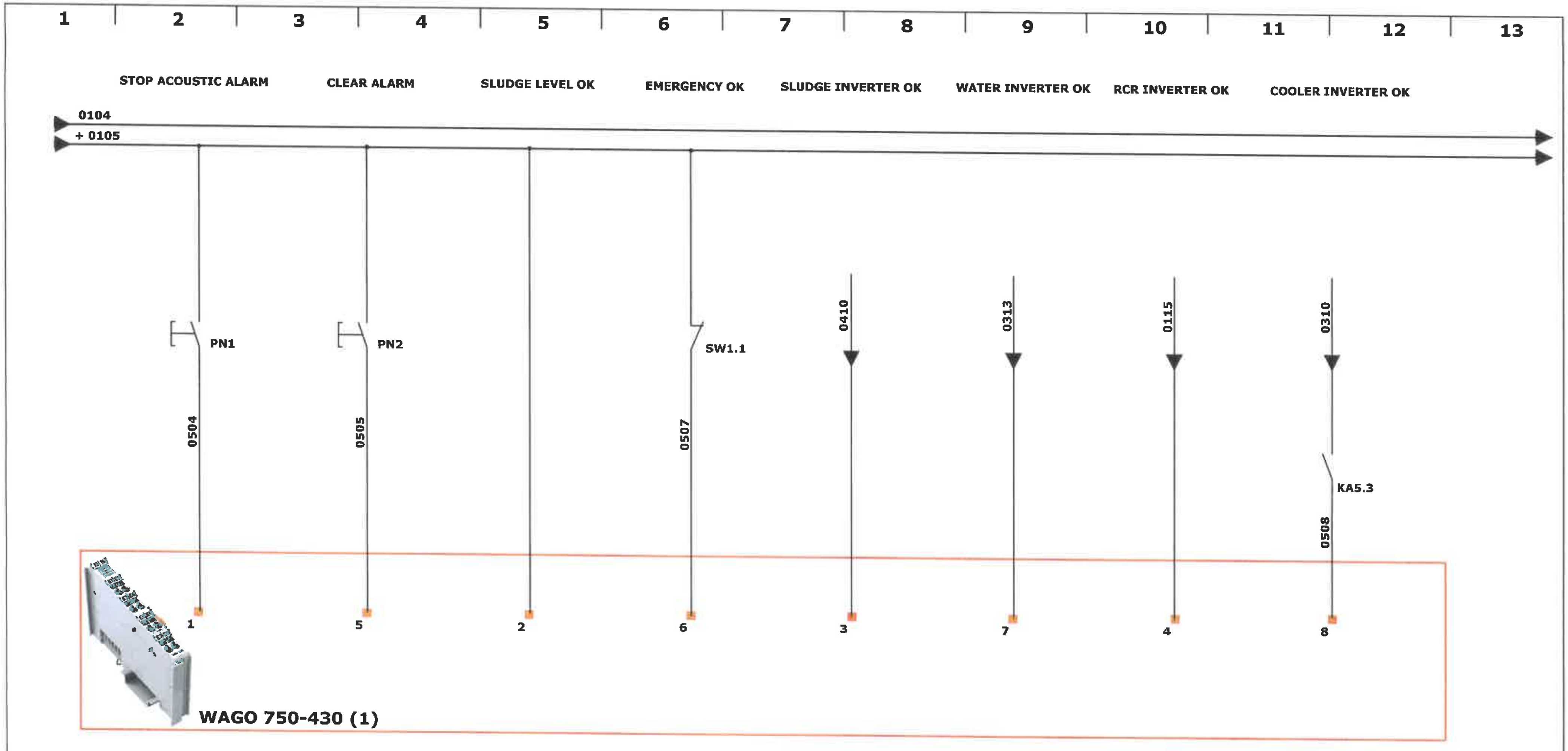

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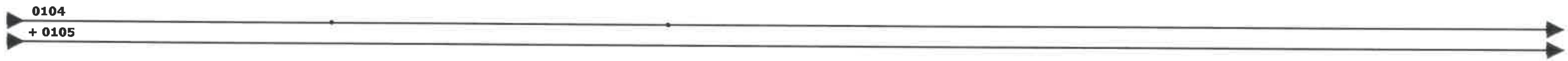

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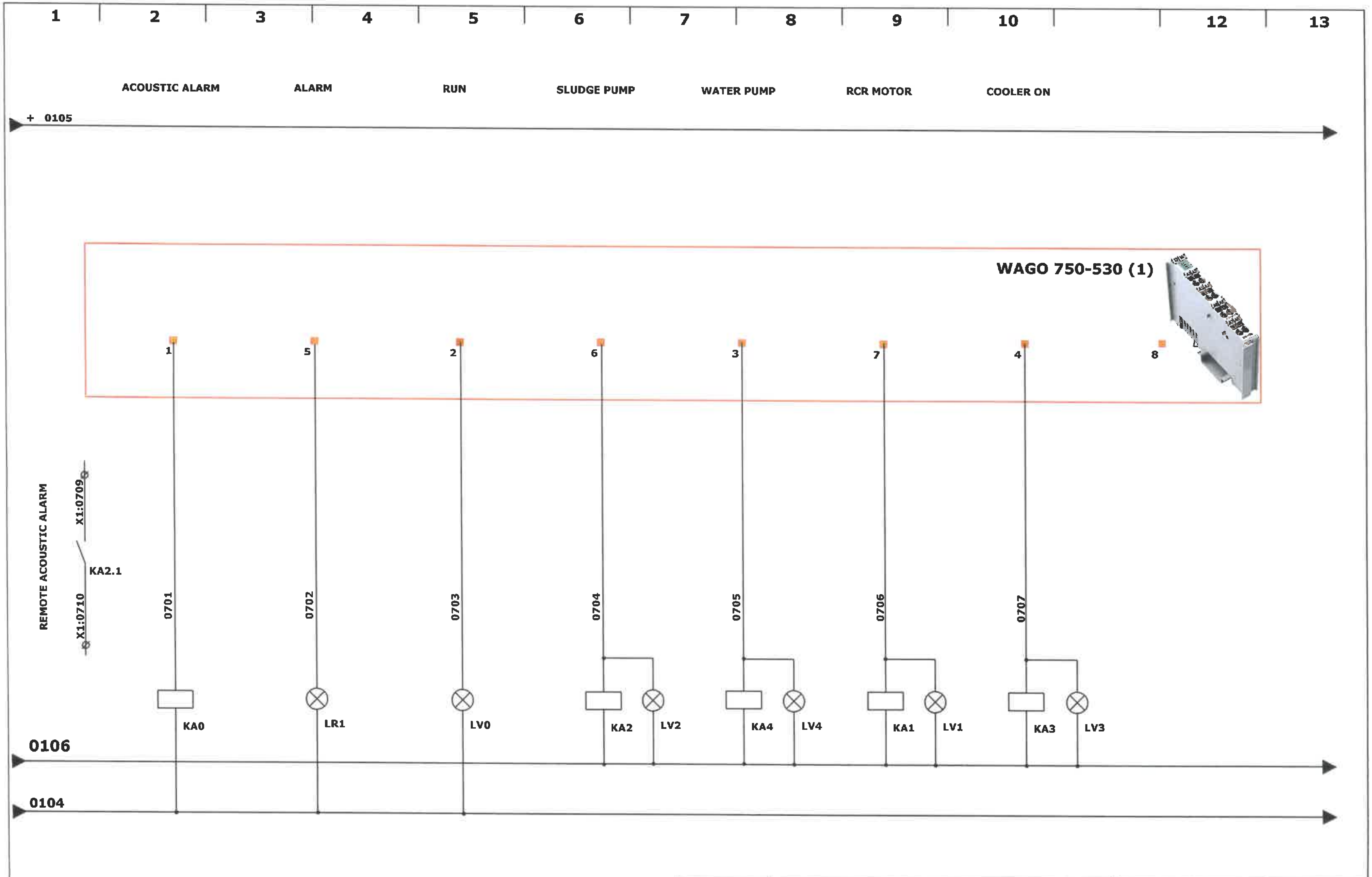

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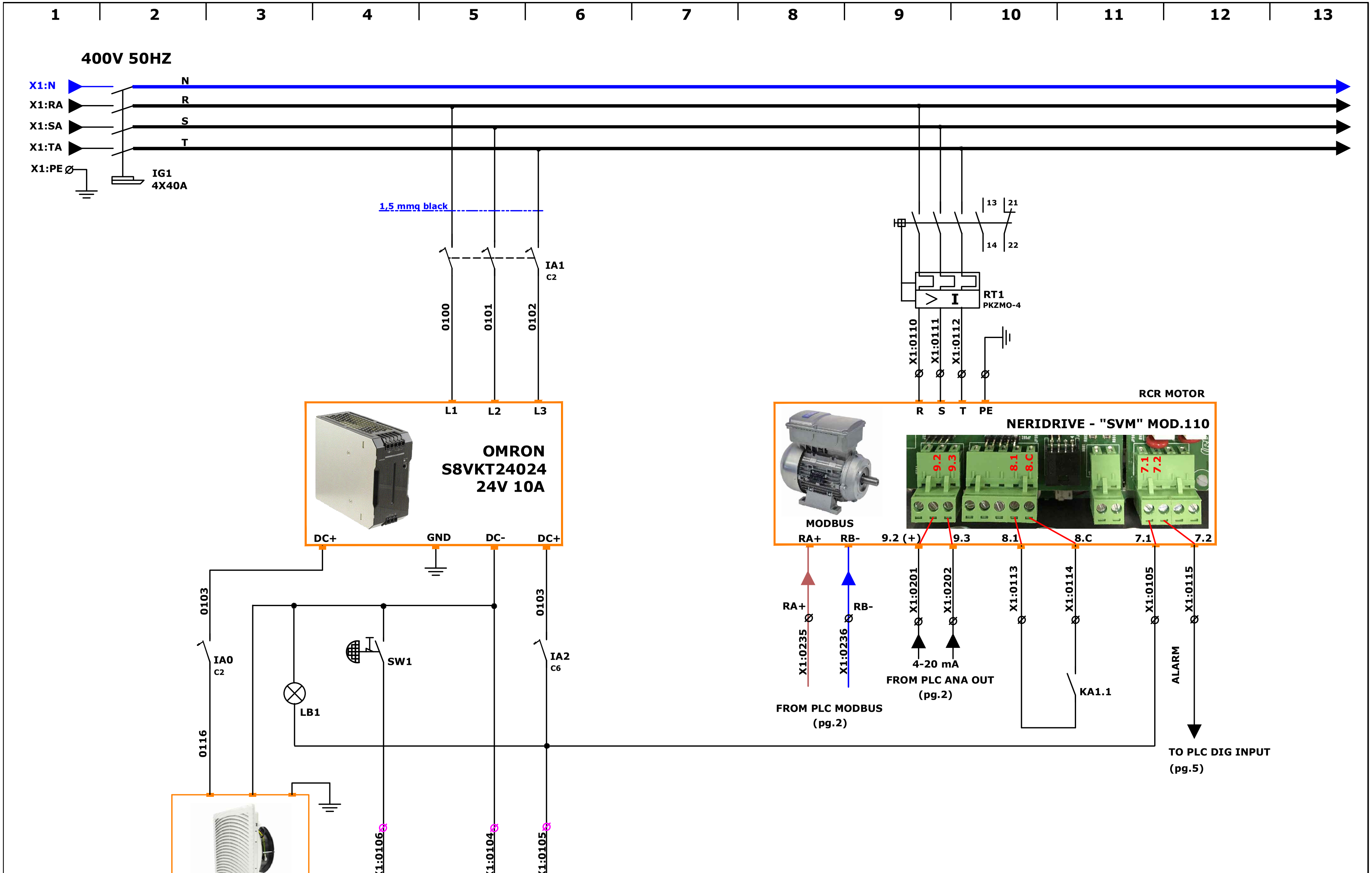

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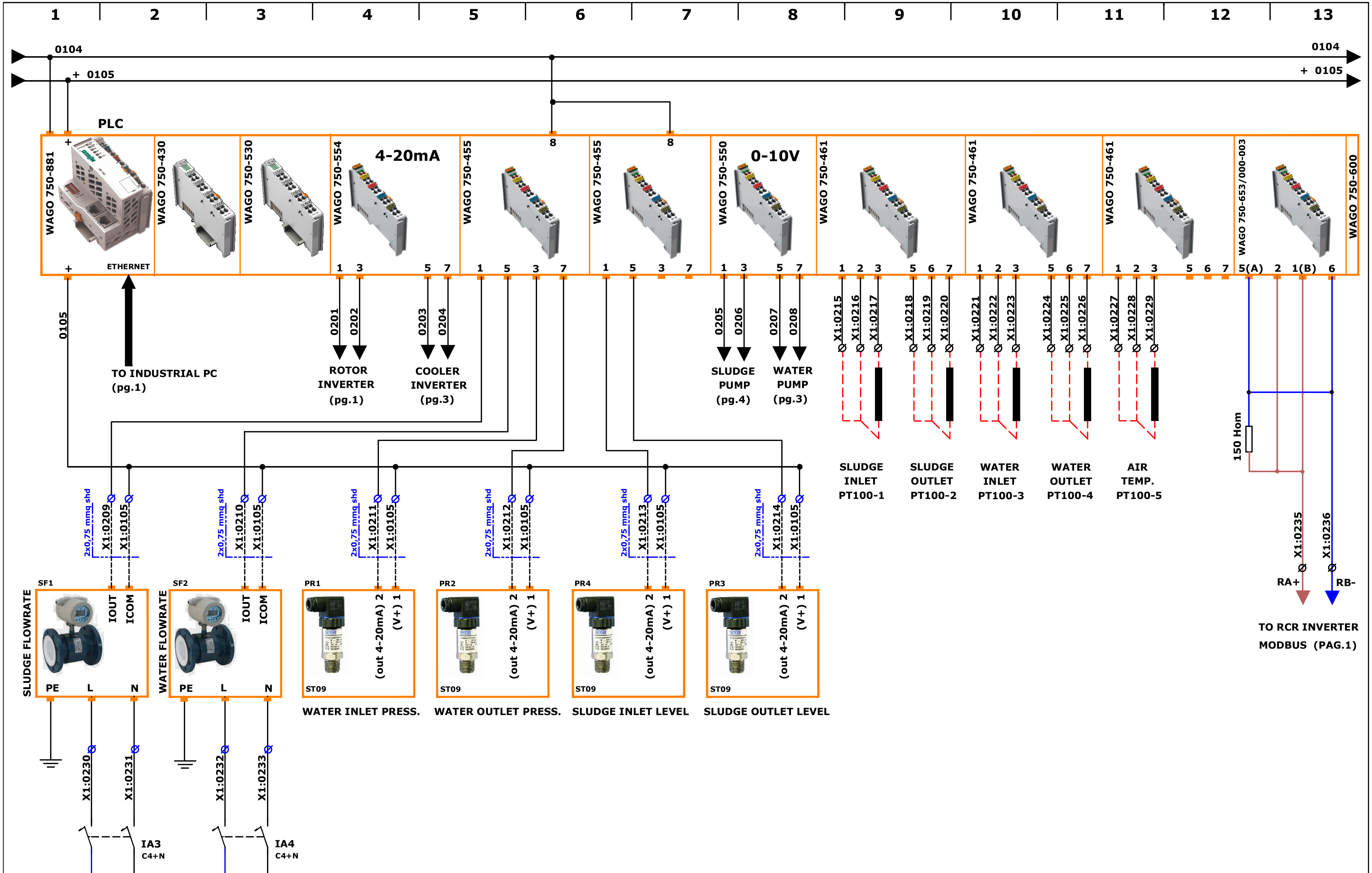

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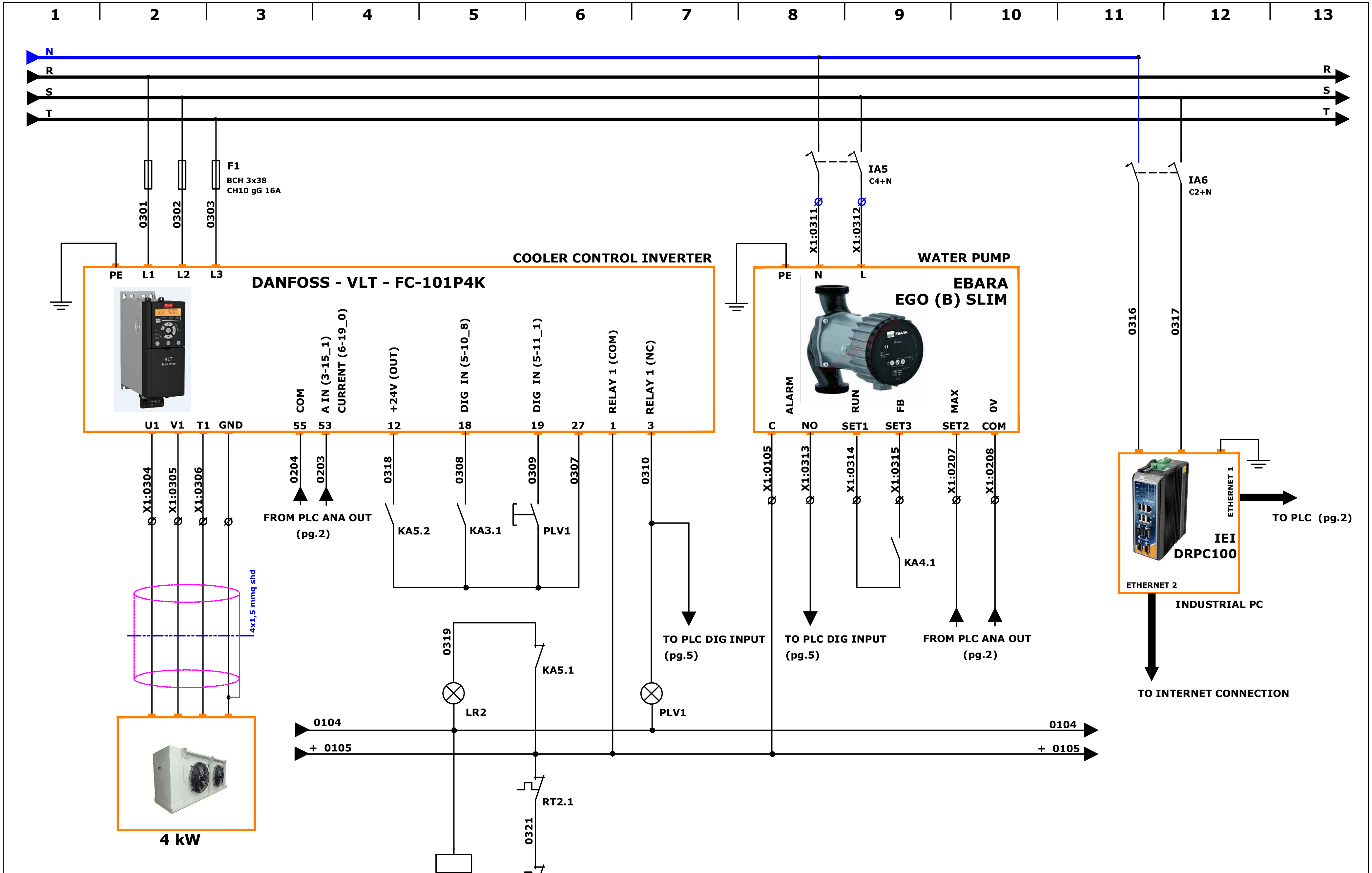

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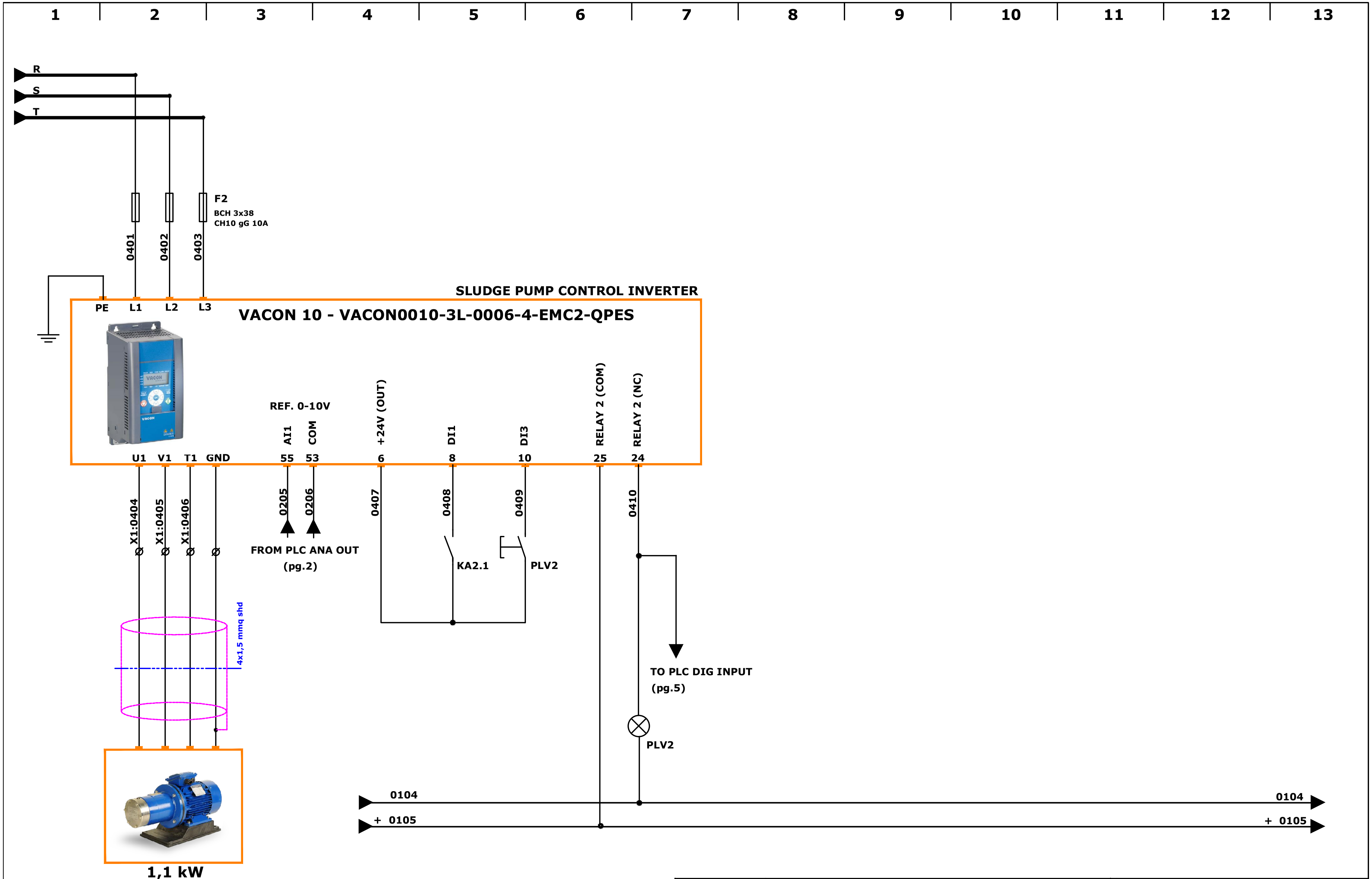

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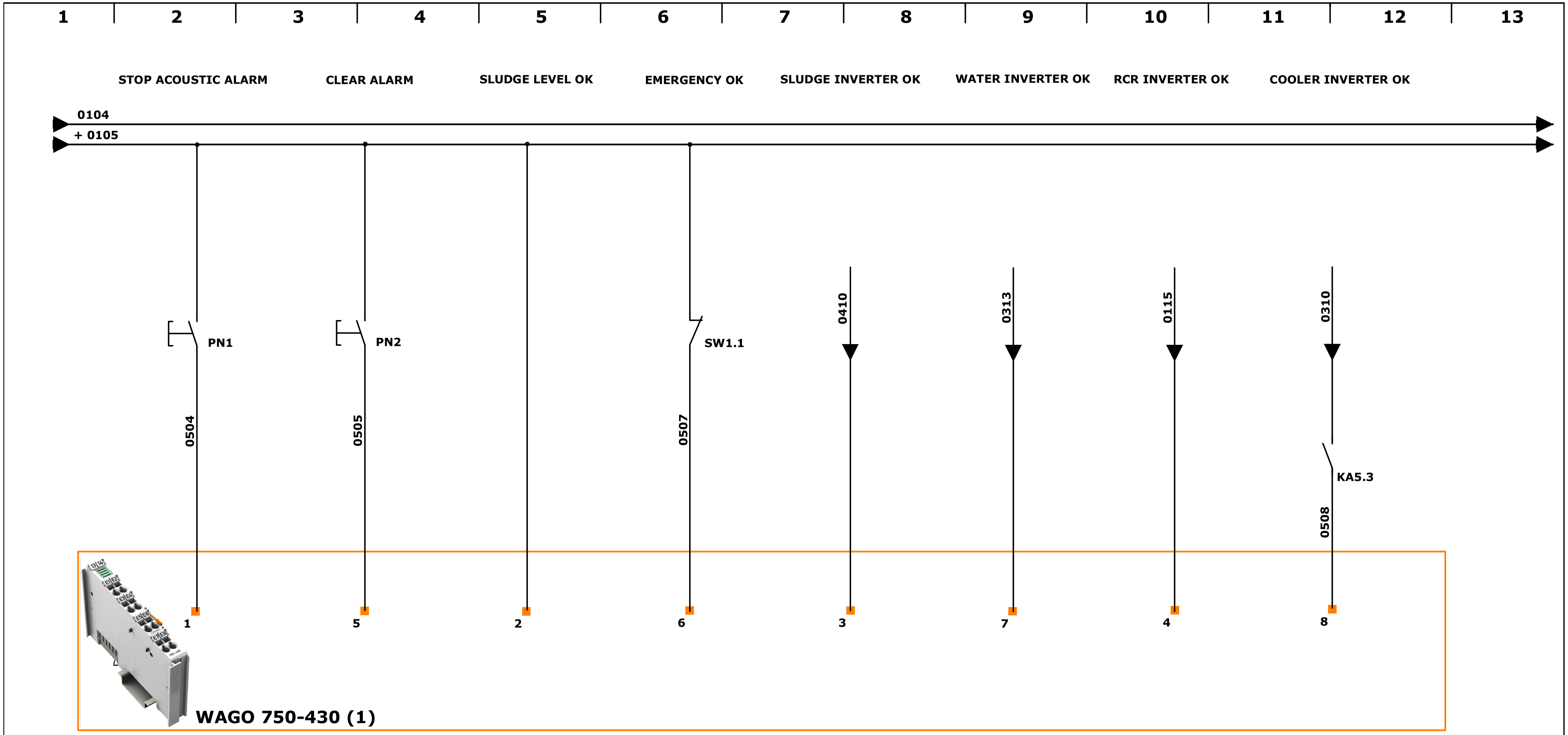

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POZZI LEOPOLDO SRL

MACCHINA/MACHINE

POZZI "LOWUP" PROJECT

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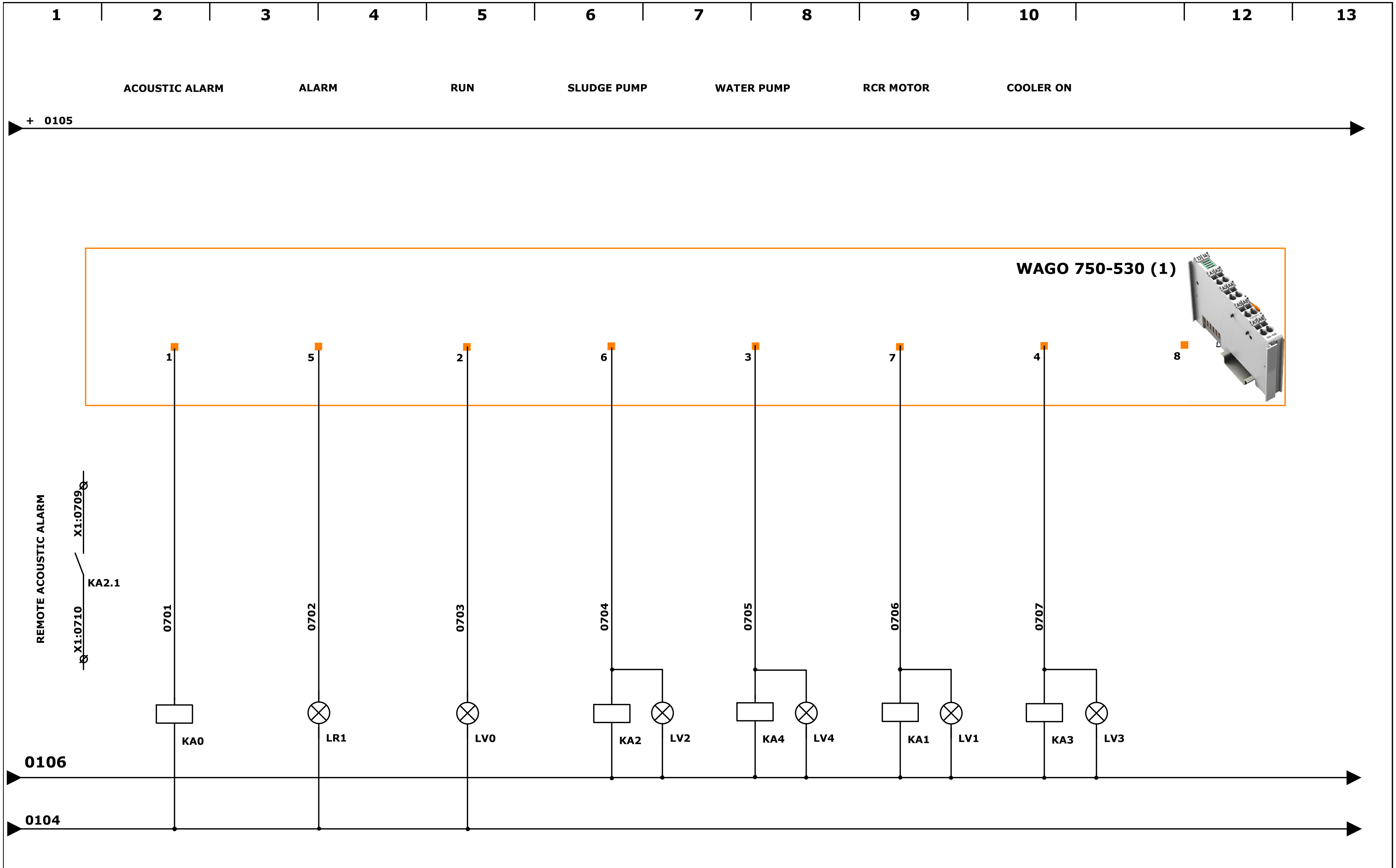

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n. schema/schematic no.	301135
data/date	17/10/2019
n. foglio/sheet no. 9/9	Rev.

2019

RHeX

User Manual

V. 1.3.3

POZZI LEOPOLDO S.R.L. |Via Paganini 14, I-20825 BARLASSINA (MB), ITALY

POZZI LEOPOLDO

POZZI LEOPOLDO S.r.l.

Via Paganini 14

I - 20825 BARLASSINA - MB

ITALY

Tel: +39-0362 90811
Fax : +39-0362 901901
www.pozzi.it
Info@pozzi.it

The RHeX project has received funding by the European Union's Horizon 2020 Research and Innovation Program under Grant Agreement n° 723930.

This Manual is an integral part of:

Machine:	**Rotating Heat Exchanger RHeX**
Type:	**RHeX xx**
Serial Number:	**RH-xxxxN**
Production Year:	**2019**
Electric Power Supply:	**V. 400 ±10% - 50 Hz - 3 ph**
Mechanical Seal Type:	**TuCa (Tungsten Carbide)**
Special High Tank (+H)	**N/A**
Maximum Clean Water Pressure:	**4.5 bar**

THIS MANUAL HISTORY

REVISION	DATE	AUTHOR	COMMENTS
1.3.3	15/01/19	AP	Flex joints expanded
1.3.2	04/11/18	PLAM	Editorial Supervision
1.3.1	03/11/18	AP	Rotor maintenance added
1.3	20/10/18	AP	Maintenance added
1.20	10/09/18	AP	Added 3D renderings
1.10	12/06/18	CF	Added drawing
1.00	05/03/18	AP PLAM	Initial revision from existing docs

POZZI LEOPOLDO

POZZI LEOPOLDO

Declaration of conformity

Dichiarazione di conformità
Déclaration de conformité
Declaración de conformidad
Konformitätserklärung

Noi/We/Nous/Nosotros/Wir: **POZZI LEOPOLDO S.r.l.**
Via Paganini, 14
I-20825 BARLASSINA (MB)

dichiariamo sotto nostra unica responsabilità, che il prodotto,
declare under our sole responsibility that the product,
déclarons sous notre seule responsabilité que le produit,
declaramos, bajo nuestra sola responsabilidad, que el producto,
erklären, in alleiniger Verantwortung, dass dieses Produkt,

Scambiatore di calore rotante tipo:
Rotating heat exchanger type:
Echangeur de chaleur rotatif type:
Intercambiador de calor tipo:
Rotierender Wärmetauscher Typ:

RHeX xx

N° RH – xxxx N

a cui si riferisce questa dichiarazione è conforme alle seguenti norme o documenti normativi
to which this declaration relates is in conformity with the following standards or other normative documents
auquel cette déclaration se réfère est conforme aux normes ou aux documents normatifs
al que esta declaración se refiere es conforme a las normas u otros documentos normativos
auf das sich diese Erklärung bezieht, mit den folgenden Normen oder Richtlinien übereinstimmt

Direttiva/ Directive/ Richtlinie
2006/42 EEC -2014/35 EEC 2014/30 EEC
Norme armonizzate/ Harmonized Standards/ Harmonisierte Normen
EN ISO 12100/1 -EN 12100-2 -EN- ISO 13849 -EN ISO 14121

La sopra citata azienda conserva archiviata la seguente documentazione tecnica a Vostra disposizione:
The above-mentioned company keeps the following technical documentation on file for inspection:
L'entreprise surmentionnée a les documentations techniques suivantes à votre disposition:
La compañía arriba mencionada tiene la siguiente documentación técnica a su disposición:
Die obengenannte Firma hat folgende technische Dokumentationen zur Einsicht bereit:

Fascicolo tecnico della costruzione (parte A+ parte B)
Technical construction booklet (part A + part B)
Dossier technique de construction (partie A + partie B) n. CE 94001
Fasciculo tecnico de la construcción (parte A + parte B)
Technische Lieferung vom Maschinenbau (Teil A + Teil B)

Barlassina, 2019

Flavio Convento
Senior Engineer

POZZI LEOPOLDO S.r.l.
Alberto Pozzi – President

Table of contents

Picture Index

1 Take Over Certificate

Dear Customer,

This RHeX heat recovery unit has been conceived and built according to indications of EC LWA 89/336 CEE - 2006/42/ CEE and 93/68.

Therefore, in order to assess its conformity, an ID plate displaying the CE mark is placed on the machine (see section 4).

The machine, when used according to instructions given by POZZI LEOPOLDO S.r.l., is not dangerous for the operator.

Before installing the machine, we recommend that you carefully read this User Manual and abide by the therein indicated procedures to guarantee operational safety and no risk of serious damage.

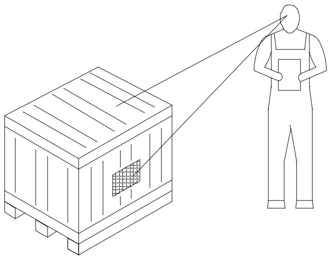
Furthermore, you must follow these guidelines:

- In order to install and put the machine to work, workers using this Manual must have a good knowledge of the machine and of all its components.
- The machine must be installed in an easy-to-reach place with wide lateral clearance required for operation and maintenance.
- The installation site must be well-lit and properly ventilated.
- The machine is provided with an identification plate and without such plate the machine may not be operated.
- The machine cannot be used outside its project characteristics without specific written authorisation issued by the producer.
- The operation of the machine must be supervised by trained operators who must be able to perform the correct proceedings; the operators must be aware of the possible risks involved in running the unit.
- This User Manual remains property of POZZI LEOPOLDO S.r.l. with all rights reserved.
- This Manual is intended only for the user of the machine; no other use is authorised.
- Reproduction in any form of any part of this Manual is forbidden.
- Laws and regulations for workers safety which are effective in the country of final installation of the machine have to be abided; as for Italy, especially the articles contained in D.P.R. 27-04-55 n.547 and D.L. 19-09-94 n.626 and following revisions.

2 General Safety Rules

- Ensure that all power sources are turned off when the machine is not in use. This includes electrical power. Understand the shutdown procedure and use it before inspecting, maintaining, servicing or cleaning the equipment to help prevent anyone from accidentally turning on power to the machine.
- Read the manual for any special operational instructions for each piece of equipment. The technical manual is typically included on a USB flash drive, or as a hard copy if requested.
- Know how the equipment functions and understand the operating processes.
- Know how to shut down the equipment. Stop buttons, emergency stop buttons or cables are located at various locations on the machinery. Activating these stop mechanisms will shut down specific equipment. Know where these stops are located and the equipment they shut down before operating the machinery.
- Understand the equipment safety labels and heed them.
- Wear the appropriate personal protective equipment for the job to be performed (e.g., eye protection, gloves, safety shoes, hard hat). Ensure that nothing you are wearing may get caught in the machine mechanisms.
- When working on or around all equipment, avoid wearing loose clothing, jewellery, unrestrained long hair, or any loose ties, belts, scarves or articles that may be caught in moving parts. Keep all extremities away from moving parts. Entanglement can cause death or severe injury.
- For new equipment, check plant voltage with the voltage specified on the machine plate. Electrical specifications for your machine are printed on the machine serial number tag. A properly grounded electrical receptacle is required for safe operation regardless of voltage requirements.
- Treat this equipment with the respect its power and speed demand. Use it only for its intended purpose.
- Keep the operating zone free of obstacles that could cause a person to trip or fall toward an operating machine. Keep fingers, hands or any part of the body out of the machine and away from moving parts when the machine is operating.
- Any machine with moving parts and/or electrical components can be potentially dangerous no matter how many safety features it contains. Stay alert and think clearly while operating or servicing the equipment. Be aware of operations and personnel in your surroundings.
- Do not perform maintenance on machinery if you are fatigued, emotionally distressed or under the influence of drugs or alcohol.
- Know where the FIRST AID SAFETY STATION is located.
- Know where FIRE EXTINGUISHING EQUIPMENT is located.
- “Horseplay” around machinery at any time is dangerous and unacceptable.
- Never sit or stand on the machine or on anything that might cause you to fall against the machine.
- Rotating and moving parts are dangerous. Keep clear of the operating area. Never put any foreign object into the operating area.
- Use proper lifting and transporting devices for heavy equipment. Some types of equipment can be extremely heavy. An appropriate lifting device should be used.

3 Delivery Inspection



Picture 1: Case inspection.

Upon receiving the machine, it is necessary to check that:

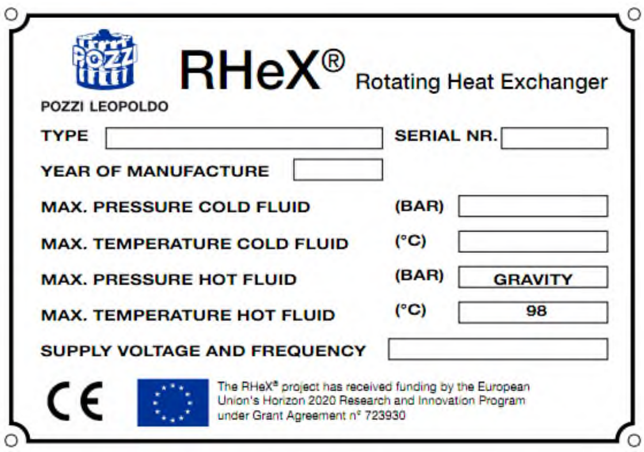
- The wooden case or cardboard box is complete and undamaged;
- The delivery data (delivery address, number of packages, purchase number) referring to transport documents are correct.
- Damage to fragile components must be verified and claimed within 5 days from delivery.

In case of damages or missing parts please inform immediately the forwarding agent, POZZI LEOPOLDO S.r.l. or its agent.

4 Machine Identification

The machine and its details are identified by a serial number shown on a plate on the machine and on page 2 of this Manual.

Note: you have to mention this serial identification number to POZZI LEOPOLDO S.r.l. for all maintenance requests and whenever instructed to do so.



Picture 2: Facsimile of ID plate

5 Warranty

Your heat recovery unit has been tested and inspected as follows:

- Size check of each part.
- All seals on the surfaces of the rotating axle are tested for absence of leakages with an inner pressure of 7 bar.
- Double-check of concentricity and perpendicularity of all assembled pieces with regard to the rotation axis.

In all cases the machine is covered by the following warranty conditions:

1. All POZZI LEOPOLDO S.r.l. products are covered by warranty for twelve months as of delivery date.
2. POZZI LEOPOLDO S.r.l. will solve any anomaly assessed by its technicians, when due to defects in materials or workmanship that can arise within the time limits indicated in the above point 1.
3. For each identified defect the buyer must give written notice to POZZI LEOPOLDO S.r.l. within eight (8) days from discovery.
4. All transport costs and insurance fees related to defective parts and/or repaired parts, or of parts delivered as substitution, included customs duties, must be paid by the customer.
5. The repair or the substitution of defective parts is a complete satisfaction of warranty duties.
6. The warranty does not include any direct and/or indirect damage caused by the machine to the installation where it is mounted.
7. This warranty does not include POZZI LEOPOLDO S.r.l. technicians' manpower, if requested, and any material subject to normal wear and tear.

This warranty does not include those parts that become damaged because of customer's inaccuracy or incorrect use, wrong maintenance and/or damages occurred by transport or any other cause which cannot be referred to material or production defects.

The warranty excludes all cases arising from an incorrect use, wrong application, use with fluids not compatible with the declared material of construction and/or from failure to comply with the rules contained in this Manual.

Warranty claim procedure

All parts subject to a warranty claim shall be sent back to the manufacturer in order to obtain a replacement or a repair, following indications in point 4.

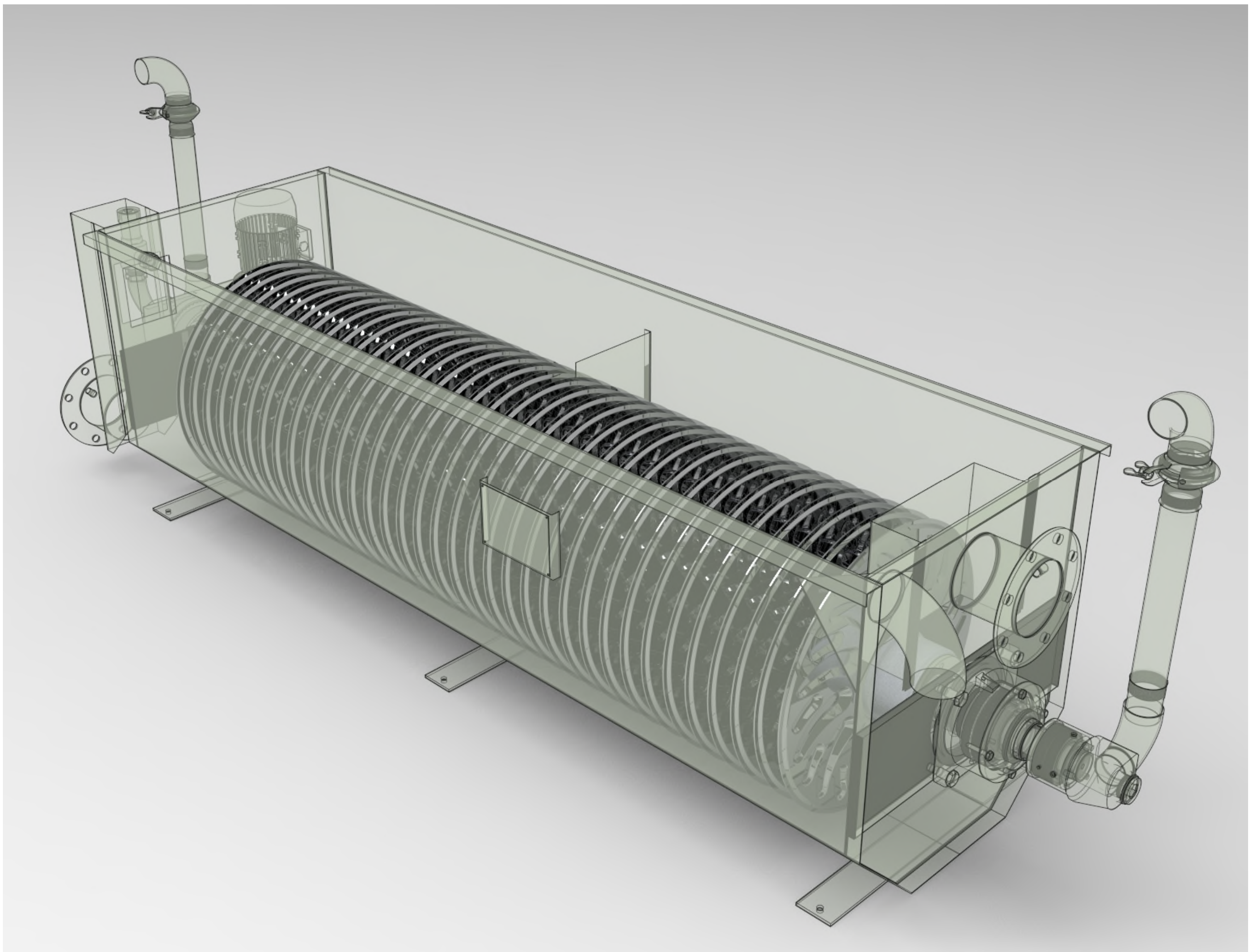
POZZI LEOPOLDO S.r.l. will repair or ship a replacement part under "tentative sale" conditions.

Upon receipt of the damaged part, POZZI LEOPOLDO S.r.l. will issue an analysis report stating whether the part has to be considered either a free replacement under warranty or the sale of a spare part, in which case a bill will be issued to the customer.

POZZI LEOPOLDO S.r.l.

6 Machine Description and Working Principle

6.1 How it is made



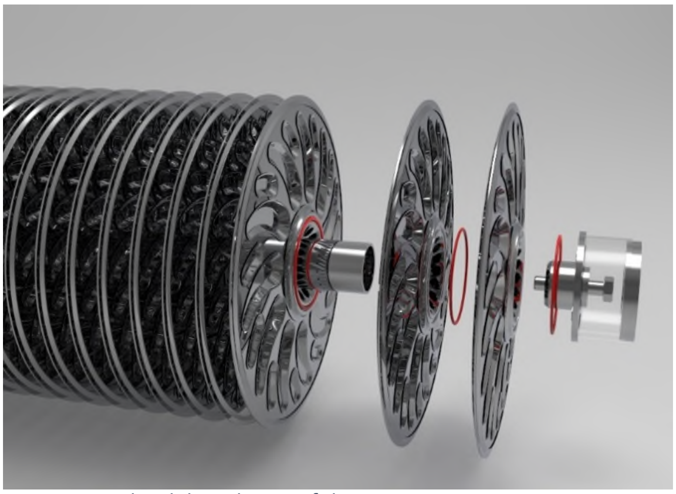
Picture 3: Design of the RHeX.

The RHeX enhanced rotating heat recovery unit is a recent development of the original RCR design; its main purpose as an exchanger is to be able to treat a very polluted stream of effluents minimising the effects of fouling and clogging, which standard heat exchangers are normally subject to.

The patented technology which lies behind RHeX design is based on the idea that the whole of the exchanging surface is constantly kept in rotation and its movement induces a centrifugal action which helps keeping the exchanger clean.

In addition to its anti–fouling action, the shape of the rotating discs, which are the actual exchanging surface of the machine, allows for a positive pushing action exerted on the primary fluid towards the outlet port of the exchanger. This, obviously, reduces the pressure loss on this circuit.

Picture 4: The lenticular disk of RHeX.



Picture 4a: The slid-on design of the RHeX rotor

Furthermore, each of the discs composing the rotor is no longer welded to the next one, whereas in the new RHeX design each disk is simply mounted on a central shaft with interposition of a gasket, allowing substitution in case of damage.

The heat recovery unit consists of:

- One or more ROTATING HEAT EXCHANGING ELEMENT made of AISI 316L stainless steel. The whole ROTOR is electrochemically mirror-polished. The rotation provides for the self-cleaning action of the surfaces.
- One EXTERNAL TANK with protection lid; this and all other parts in contact with the operating fluids are made of AISI 316L stainless steel. The tank has connections for discharge water outlet and inlet, overflow pipe and tank emptying valve.
- Two or more sealing groups and support assemblies to allow the rotation of the rotor
- ROTATING JOINTS for fresh water inlet and outlet connected to the rotor.
- One SAFETY VALVE on the fresh water circuit.
- One MOTOR GROUP consisting of one or two moto-reducers with pulleys and toothed belts.
- One INVERTER to allow for the pre-setting of rotational speed of the machine and of the start – stop ramps.

Note: No start/stop motor device is included in the machine. Only an emergency pushbutton is mounted on the machine.

Warning: The machine will operate as soon as you connect it to electrical power (provided that the emergency pushbutton has been reset).

6.2 Working principle

The exchanger is basically made to treat two streams of counter current fluids; in this Manual we will refer to them as follows:

- **A primary fluid**, flowing outside the rotor of the exchanger (inside the trough of the exchanger). This fluid will be subject to a very low-pressure loss. In fact, gravity will be the sole force used to push this fluid through the exchanger. This fluid can be highly polluted even with mechanical impurities.
- **A secondary fluid**, flowing inside the rotor, counter current to the primary one. This fluid must be free from mechanical impurities which might remain trapped in the rotor due to the separating effect of the centrifugal force generated during rotation. Pressure loss in this case will be dependent on RHeX model, flow-rate and rotational speed.

6.2.1 When RHeX is used as a cooling device

The hot discharge water (primary fluid) which can be contaminated with both chemical and physical pollutants, coming from tanks or directly from discharges of continuous machines, is introduced (as much as possible with a constant flow-rate) in the RHeX tank, through flanged connections.

The flow of discharge waters runs through the tank using gravity only (the height difference between inlet and outlet) and it is flown around the rotor by means of especially shaped deflectors.

The fresh clean water (secondary fluid), coming from the hydraulic network at a max. pressure of 4.5 bar, is fed inside the rotor through the flexible manifold and the rotating joints. The rotor is made of many shell-shaped elements, inside which a canalisation is created so that water circulates in a perfect counter-current flow running against the discharge water.

The rotor is activated by an inverter-controlled moto-reducer; the speed of the elements inside the water causes a turbulent movement which increases the thermal exchange efficiency and avoids the physical pollutants deposit on the exchanger walls.

The clean water, after having run across the rotor, exits from the opposite rotating joint as heated water.

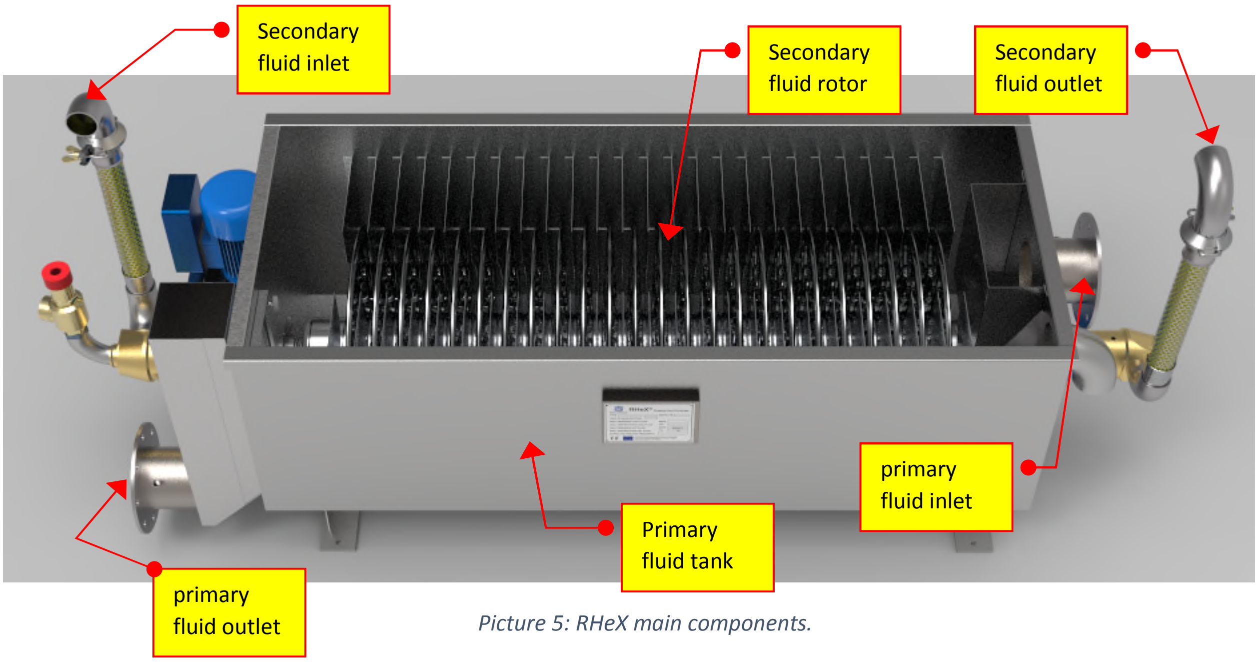
The discharge water, on the contrary, has been cooled off since it has transferred its thermal content to the fresh water. The two circuits have fully opposite, counter-current directions, so to optimize the thermal exchange.

6.2.2 When used as a heating device

The unit can also be used as a heating device, making sure that the clean heating medium flows inside the rotor while the contaminated fluid flows inside the tank.

Heating medium can be water or other fluid with no solid content and with a maximum temperature of 98°C.

Under special circumstances low-pressure steam or overheated water can be used as a heating medium considering that, in this case, the maximum allowed pressure is 0.5 bar.



Picture 5: RHeX main components.

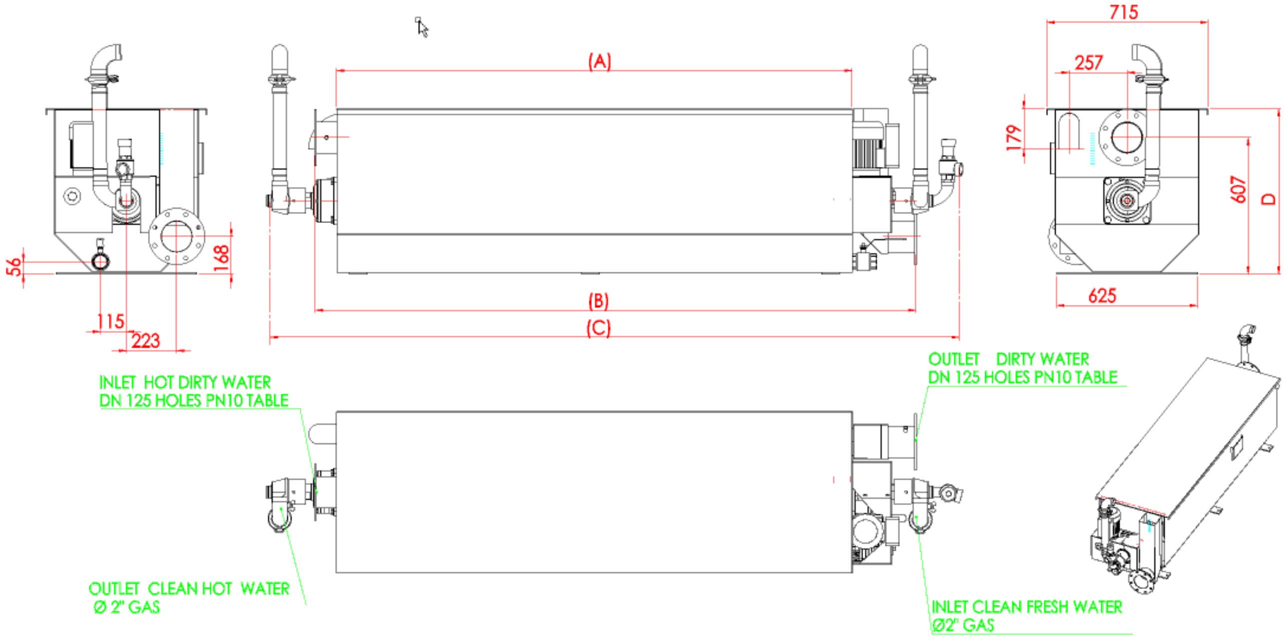
7 Dimensions and ratings

7.1 Dimensions

7.1.1 Dimensions of single-rotor units

The rotating heat exchanger comes in several models depending on the required heat exchanging surface and the ability to cope with transients on the primary circuit.

Apart from size, connections and motors of double-rotor units, all RHeX units share the same constructive details and hydraulic circuits.



Picture 6: Single rotor RHeX models

The following table reports the dimensional characteristics of each single-rotor model:

TYPE	A mm	B mm	C mm	D mm	code	# rotors
RHeX 20	1683	2066	2485	735	120868	1
RHeX 20+H	1683	2066	2485	885	120868H	1
RHeX 30	2288	2671	3090	735	120871	1
RHeX 30+H	2288	2671	3090	885	120871H	1
RHeX 2+	2096	2305	2889	735	120968	1
RHeX 3+	2892	3101	3680	735	120971	1

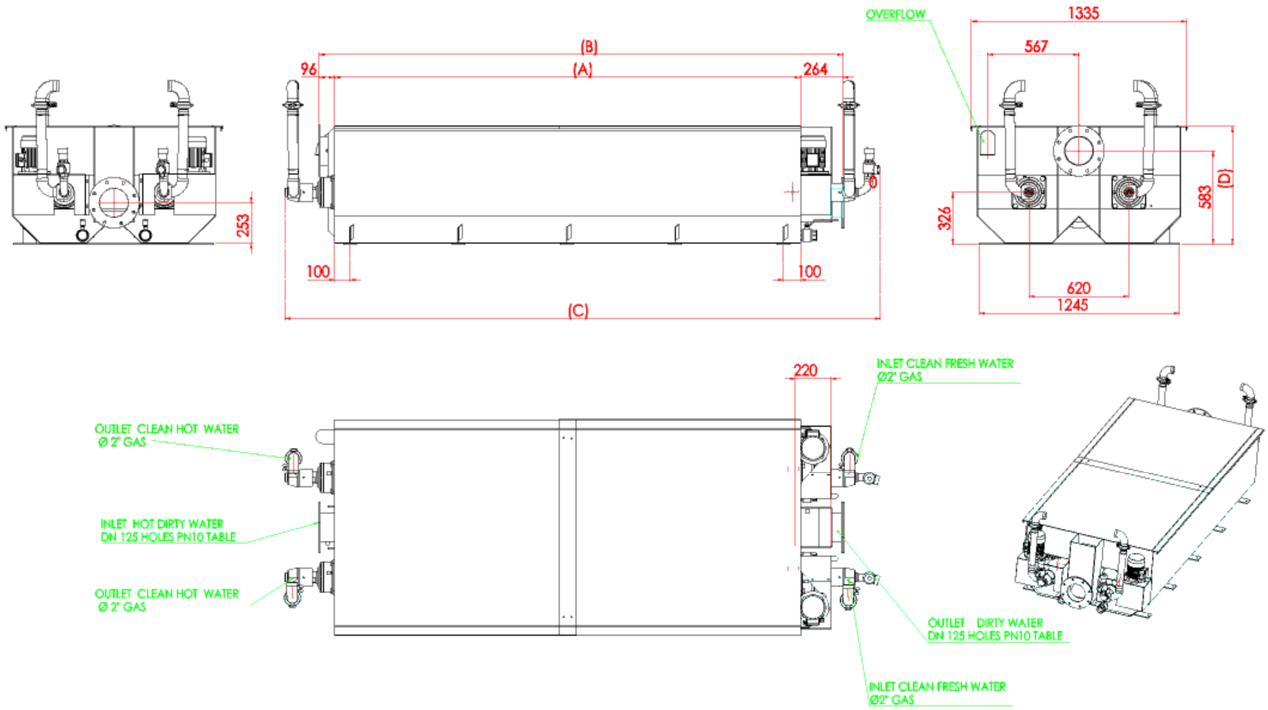
Table 1: RHeX dimensions.

A customised execution, available only on request, provides the RHeX units with an extra high tank.

This option can be ordered as **RHeX-xx+H**; in this case the trough height is increased by 150 mm.

This special design allows the RHeX to cope with high transients on the primary flow by by-passing a portion of the primary flow-rate above the rotor.

7.1.2 Dimensions of double-rotor units



Picture 7: Double-rotor RHeX models

The following table reports the dimensional characteristics of each double-rotor model:

TYPE	A mm	B mm	C mm	D mm	code	# rotors
RHeX 40	1683	2043	2485	735	120872	2
RHeX 40+H	1683	2043	2485	885	120872H	2
RHeX 50	2013	2373	2815	735	120873	2
RHeX 50+H	2013	2373	2815	885	120873H	2
RHeX 60	2288	2648	3090	735	120874	2
RHeX 60+H	2288	2648	3090	885	120874H	2
RHeX 4+	2096	2305	2889	735	120972	2
RHeX 5+	2528	2737	3410	735	120973	2
RHeX 6+	2892	3101	3680	735	120974	2

Table 2: RHeX dimensions.

Also in the case of double-rotor models, a customised execution, available only on request, provides the RHeX units with an extra high tank.

This option can be ordered as **RHeX-xx+H**, in which case the trough height is increased by 150 mm.

This special design allows the RHeX to cope with high transients on the primary flow by by-passing a portion of the primary flow-rate above the rotor.

7.2 Weights

Shipping weights of each RHeX model are as follows:

TYPE	NET weight	GROSS weight	Packing type	code	# rotors
RHeX 20	580 kg	670 kg	case	120868	1
RHeX 30	761 kg	857 kg	case	120871	1
RHeX 40	1210 kg	1450 kg	cage	120872	2
RHeX 50	1366 kg	1621 kg	cage	120873	2
RHeX 60	1521 kg	1786 kg	cage	120874	2
RHeX 2+	656 kg	746 kg	case	120968	1
RHeX 3+	878 kg	974 kg	case	120971	1
RHeX 4+	1342 kg	1582 kg	cage	120972	2
RHeX 5+	1534 kg	1789 kg	cage	120973	2
RHeX 6+	1726 kg	1991 kg	cage	120974	2

Table 3: RHeX weight.

7.3 Hydraulic Ratings: Flow-rate ratings

7.3.1 Primary fluid flow-rate

For each RHeX model a max suggested flow-rate is set; this flow-rate is a safe estimate of a flow which does not result in overflowing [1](with +H models the flow exceeding this data will not go to overflow but will be internally bypassed).

The higher the flow-rate, the higher is the level of fluid towards the primary fluid inlet, finally resulting in overpassing the level of the overflow port.

TYPE	suggested max m^3/h	disks	surface m^2	code	# rotors
RHeX 20	9,6	24	13,2	120868	1
RHeX 30	14,4	35	19,25	120871	1
RHeX 40	19,2	48	26,4	120872	2
RHeX 50	24	60	33	120873	2
RHeX 60	28,8	70	38,5	120874	2
RHeX 2+	12	31	17,05	120968	1
RHeX 3+	17	46	25,3	120971	1
RHeX 4+	22	62	34,1	120972	2
RHeX 5+	28	78	42,9	120973	2
RHeX 6+	32	92	50,6	120974	2

Table 4: RHeX models characteristics.

[1] Action on the removal of baffles or different settings for speed of rotation might be necessary.

Note: Flow-rates, in applications involving continuously fed machines, are generally considered equal to both circuits (primary and secondary); it is, however, possible to choose different flow-rates (included between 0 e Q_{max}) for the two circuits: the choice must be done so to optimize the thermal recovery, by preferring, according to user needs, the maximisation of either the exit temperature or that of the flow-rate of the “cold” secondary fluid.

7.3.2 Secondary fluid flow-rate

The secondary fluid flow is passing in a pressurized circuit; **the maximum allowable flow-rate** is, therefore, determined by the sum of the pressure losses generated against the maximum allowable pressure in the rotor as follows:

Pressure needed at delivery point + pressure loss in the exchanger rotor (see Ch. 7.4.2) < 4.5 bar

7.4 Hydraulic Ratings: Pressure Loss

7.4.1 Primary circuit pressure loss

The primary circuit is gravity fed; the maximum pressure loss is, therefore, determined by the physical height difference between input and output ports (60mm of H_2O column) and the filling coefficient of in and out pipes. Refer to chapter 7.3.1 for suggested maximum flow-rate.

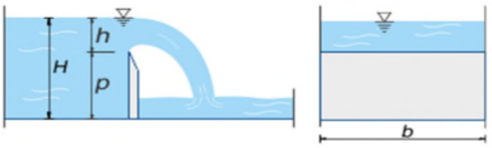
Picture 8: The weir & level device

It has to be noted that the RHeX models have an outlet level-control device which can control the filling level in the tank.

The use of this device is double:

- By lifting the weir blade insert, the overall level in the tank will rise; this is useful when a large unit is used with a rather low flow-rate, thus allowing a better coverage of the rotor disks by the primary fluid.
- Furthermore, the weir blade insert has a series of marks on its right side: these marks give an indication of the primary fluid flow-rate as one reads the plume level passing over the weir blade in the slot.

The flow-rate can be determined as follows:



$$Q = \mu \cdot b \cdot \sqrt{2 \cdot g} \cdot h^{3/2}$$

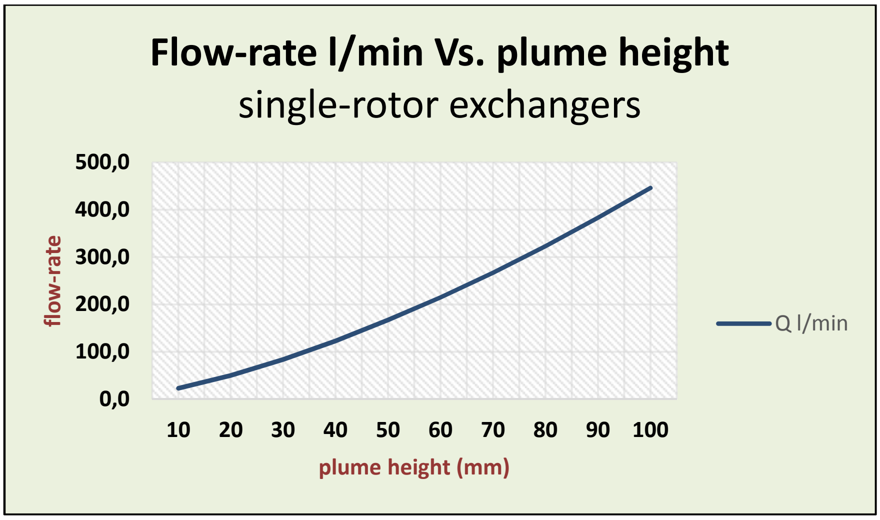
$$\mu = \left(0{,}405 + \frac{0{,}003}{h}\right) \cdot \left(1 + 0{,}55 \cdot \frac{h^2}{H^2}\right)$$

Picture 9: The weir math.

NOTE: The reading is obviously intended only as an indication and is not a precise measurement, but can be very useful during set-up of the exchanger.

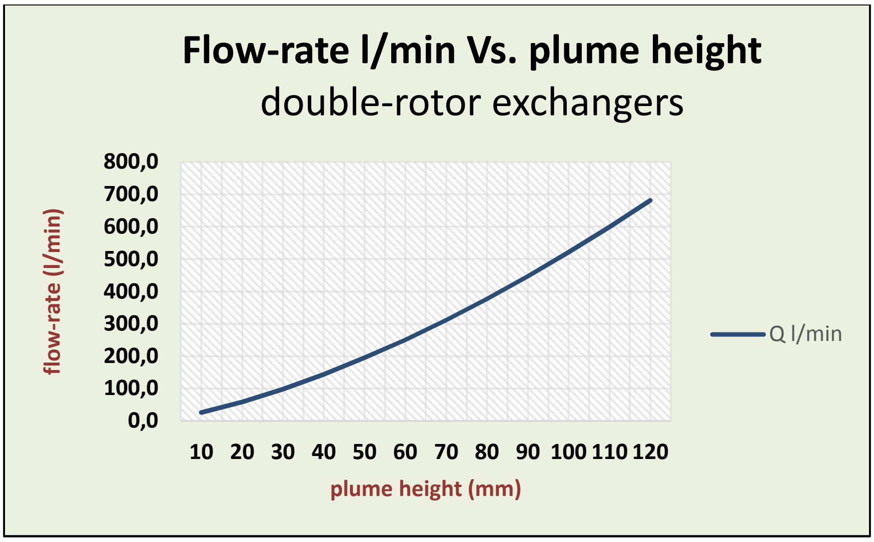
In practice the flow-rate is proportional to the plume height (h) which can be read on the weir scale. A rough estimate of the flow-rate can be read from the following graphs:

FOR SINGLE-ROTOR EXCHANGERS:



Picture 10: Flow-rate measure (single rotor)

FOR DOUBLE-ROTOR EXCHANGERS:

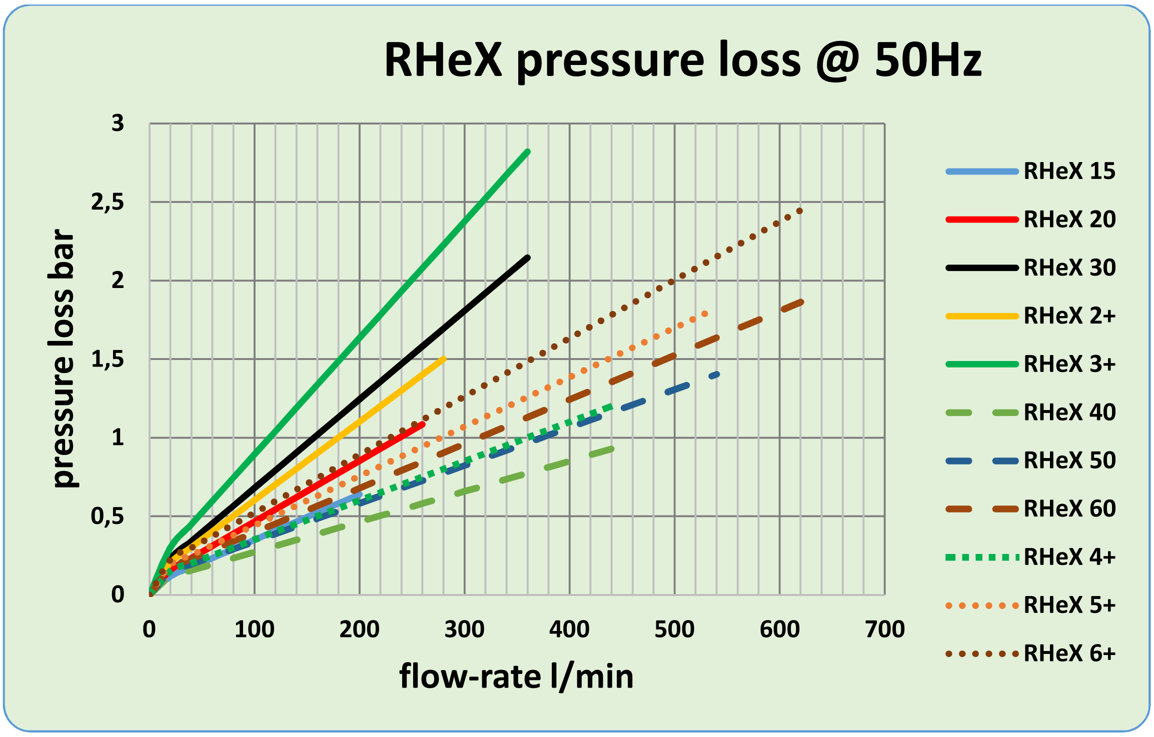


Picture 11: Flow-rate measure (double rotor)

7.4.2 Secondary circuit pressure loss

The rated working pressure of the RHeX rotor is 4.5 bar.

The pressure loss developed in the circuit is dependent on the flow-rate and the rotational speed of the rotor (moto-inverter shipped with 50Hz pre-set frequency), according to the following graph:



Picture 12: Secondary circuit pressure loss (all models)

Warning:

Even transient pressure peaks will damage the rotor.

Care has to be taken that no hammering effect on the rotor arises due to the hydraulic design of the downhill circuit.

When a pipe is suddenly closed at the outlet (downstream), the mass of water before the closure is still moving, thereby building up high pressure and a resulting shock wave. In industrial plumbing this is normally experienced as a loud banging resembling a hammering noise. Water hammer can cause RHeX rotors to break if the pressure is high enough.

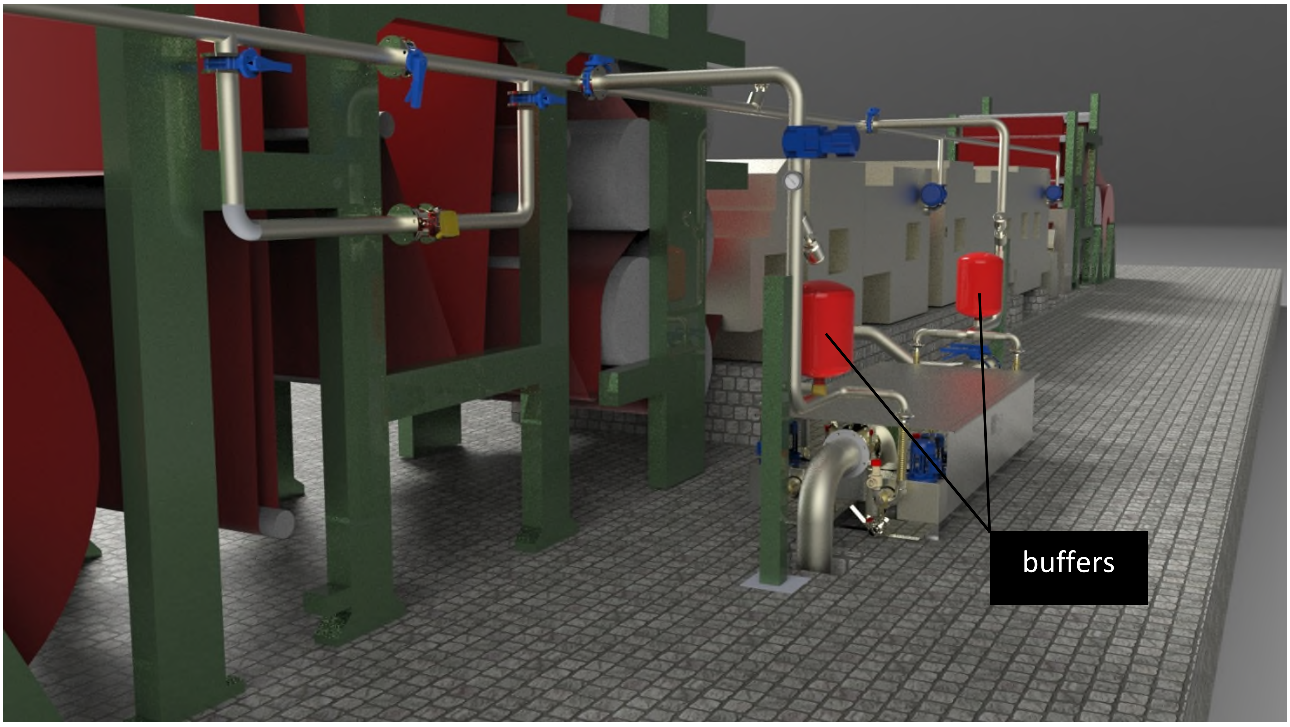
Suddenly closing valves mounted downstream the rotor can produce shock waves with pressure spikes exceeding 20 bars. Air traps or special dampers are sometimes added to RHeX systems to absorb the potentially damaging forces caused by the moving water.

POZZI LEOPOLDO markets specially modified dampers to avoid this effect, see our spares site:

http://www.pozzienergy.it/rcr-eop-20-60/piping-43/

With no downstream valve, or only slow-moving valves mounted in the circuit after the exchanger and with line pressure not exceeding 4.5 bars, no particular care needs to be exerted.

If shut-off valves are to be mounted, the suggested final configuration should be as follows:



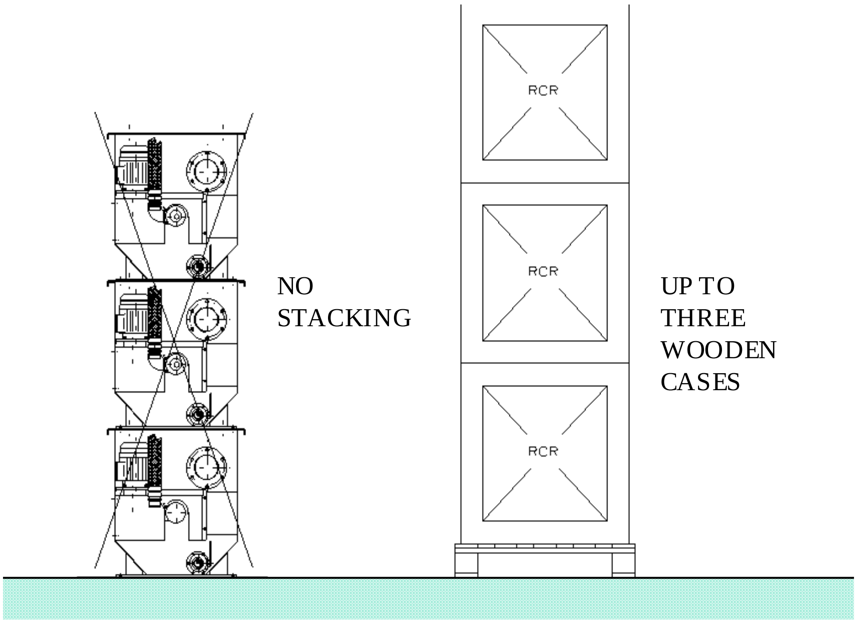
Picture 13: Exchanger with buffers

8 Fitting and commissioning of the unit

8.1 Transport and Storage

Warning: Before transportation and long-term storage, the internal rotor may have to be blocked to avoid damage to the seals. RHeX units are shipped either with a palleted cardboard box packing or in a wooden cage (special request).
Units without a customised wooden cage cannot be stacked one on top of the other. Note that the standard cardboard box supported by a wooden pallet cannot be stacked.

Warning: When the unit is not packed, extreme caution should be paid to the protruding rotating joints and moto-reducer parts.
If stacking is requested, you have to order special wood-case shipping: units enclosed in a proper wooden Pozzi Leopoldo-supplied cage can be stacked on top of each other up to a maximum of three layers.

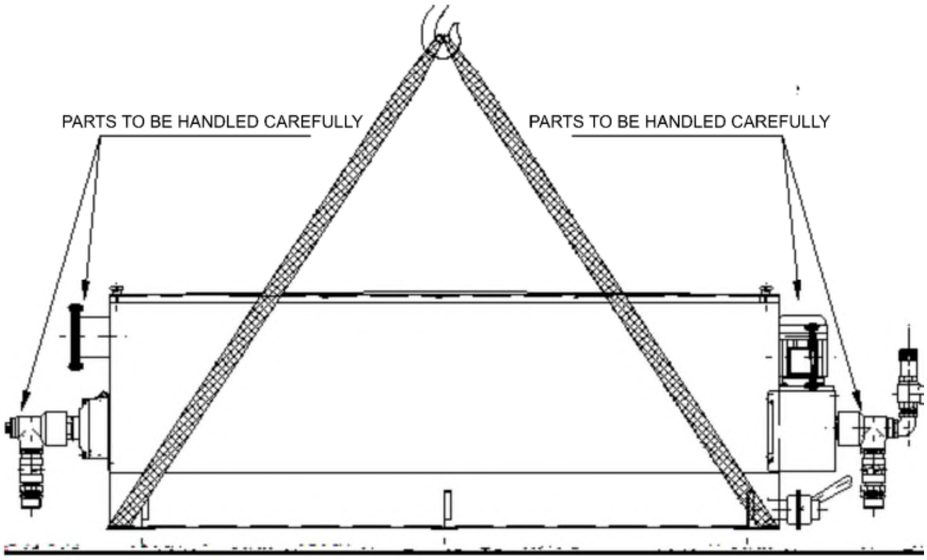


Picture 14: Stacking options.

8.2 Handling

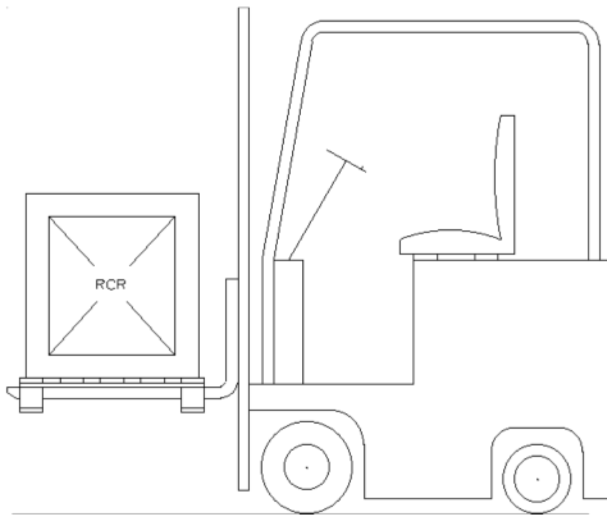
Warning: The machine does not have any handle, hook or protrusion intended for handling or lifting.

The machine must always be handled (and especially lifted) using belts positioned on the bottom of the tank, so that they do not affect rotating and power groups when tensioned, as shown in the following picture:



Picture 15: Handling of the unpacked unit.

If the unit is delivered in a wooden or cardboard case, this can be handled with belts fixed at the two ends or by a fork-lift as shown in the following picture:



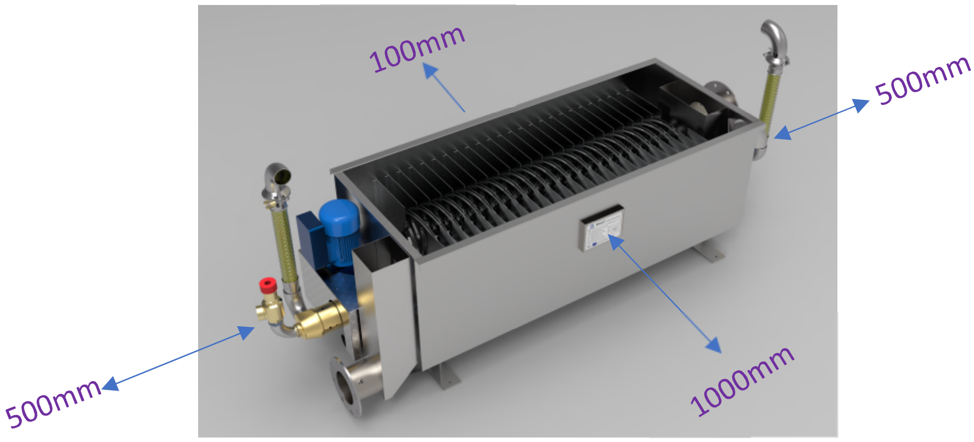
Picture 16: Handling the packaged unit with a forklift.

8.3 Site Requirements

The area where the RHeX is installed has to fulfil few requirements:

Once running, machine surfaces can become very hot, therefore it is mandatory that proper protecting fences or paddings are available to avoid accidental contact with surfaces and to prevent operators from eventual scorching.

However, such protections must allow for maintenance and/or temporary cleaning of the unit, so the following minimum side clearances are required: 0.5m on the short sides, free access to the side where the identification plate is installed, and 0.1m on the opposite side.



Picture 17: RHeX clearances, ID plate must be visible.

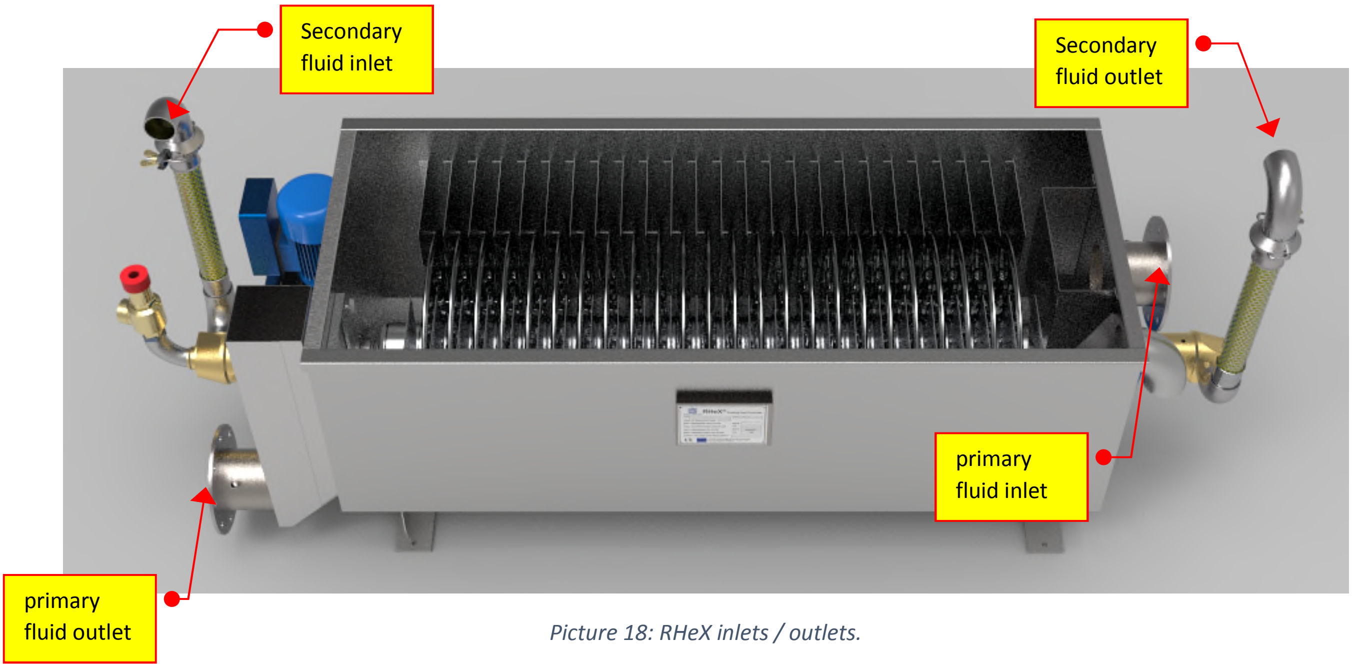
During the installation it is possible to foresee a slight inclination (20-30 mm) towards the primary fluid outlet (i.e., to the side of the moto-reducer). This is to allow for complete drainage of the trough.

Note: The machine is not adequate for outdoor installation. If proper protection for moto-reducer and electrical connection is provided, an outside installation is possible.

Warning: If installed outside, be careful not to expose the unit at temperatures lower than 2°C as icing might damage the unit.

8.4 Connections to fluid networks

The connection to the networks of fluids must be made in order to guarantee that the "HOT" side of the primary fluid stays far from the moto-reducer. The two fluids circulate in a counter current stream, opposite to each other. This means that the secondary fluid ("cold" fluid) comes into the unit from the moto-reducer side and the primary fluid ("hot" fluid) comes into the tank from the opposite side, as shown in the following picture.



Picture 18: RHeX inlets / outlets.

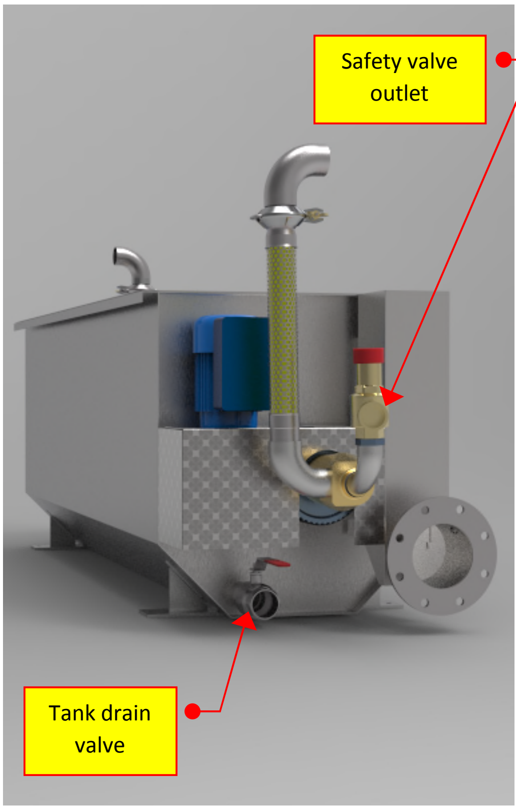
The following table gives the connection specifications for each RHeX type.

TYPE	secondary in	secondary out	primary in	primary out
RHeX 20	Ø2" gas	Ø2" gas	DN125	DN125
RHeX 30	Ø2" gas	Ø2" gas	DN125	DN125
RHeX 40	2 x Ø2" gas	2 x Ø2" gas	DN175	DN175
RHeX 50	2 x Ø2" gas	2 x Ø2" gas	DN175	DN175
RHeX 60	2 x Ø2" gas	2 x Ø2" gas	DN175	DN175
RHeX 2+	Ø2" gas	Ø2" gas	DN125	DN125
RHeX 3+	Ø2" gas	Ø2" gas	DN125	DN125
RHeX 4+	2 x Ø2" gas	2 x Ø2" gas	DN175	DN175
RHeX 5+	2 x Ø2" gas	2 x Ø2" gas	DN175	DN175
RHeX 6+	2 x Ø2" gas	2 x Ø2" gas	DN175	DN175

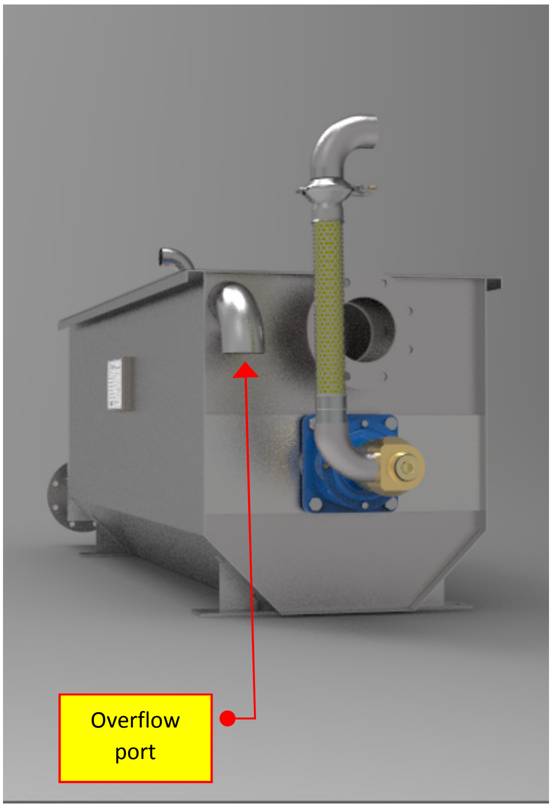
Table 5: Connection table.

8.4.1 Primary Fluid Connections

The primary fluid generally consists of fluid coming out of a continuous process that could be operating while the heat exchanger needs special cleaning or maintenance. Therefore, we recommend that a by-pass circuit is created to allow exclusion of the RCR while permitting plant operation.



Picture 19: RHeX motor side.



Picture 20: RHeX non-motor side.

When the heat exchanger is off-line, its tank can be emptied using the valve (reference in Picture above).

An overflow device (reference in Picture above) is installed into the heat exchanger tank and it is provided for connection to a discharge pit, should overflow conditions arise.

8.4.2 Secondary Fluid Connections

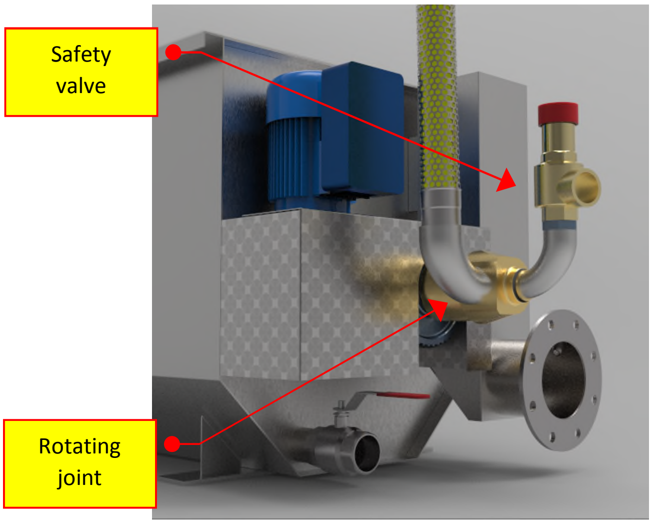
The secondary circuit connects the heat exchanging element (the rotor) to the clean fluid network.

In order to avoid deposits or sedimentations caused by hardness, we suggest that this fluid should be softened and filtered (in case of water).

To protect the rotor from too high an internal pressure, a safety valve is installed on the water inlet of the rotor side.

Note: The safety valve is factory regulated to 4.5 bar and may not be tampered with.

The safety overpressure valve is delivered with the unit (see above picture). If it must be connected to the drain, it should be allowed, in any case, to move freely. Our suggestion is to let it drain to a funnel.



Picture 22: Safety valve and rotary joint.

Warning: In some setups, very quick transient pressure variations may happen. In these cases, the response of the provided safety valve is not fast enough and the machine rotor could fail because of pressure exceeding busting pressure (> 30bar) or long-term fatigue damage. It is therefore necessary to eliminate any pressure peak in order to properly operate the machine.

Note: All quick-acting flow-rate regulations on the secondary circuit have to be carried out upstream the exchanger rotor. For maintenance purposes, we strongly recommend adding a shut off valve before the RHeX and/or a complete bypass circuit.

Warning: To avoid pressure peaks and overpressures inside the rotor, no quick-shutting valves are allowed downstream on the secondary circuit, except slow-moving valves specially approved by POZZI LEOPOLDO S.r.l. for this use.

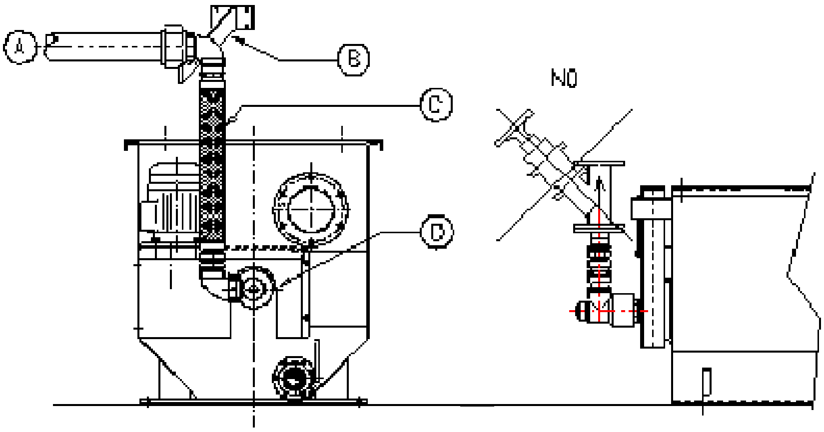
8.4.3 Rotary joints

On each side of the secondary circuit, a rotary joint and a flexible pipe are present. These parts must be handled with care.

Warning: Rotary joints contain fragile components and neither axial nor radial force must be applied to them while operating.

POZZI LEOPOLDO

Note: All units require flexible pipes to be connected to the rotary joints before the unit may start operating. This is to safeguard the life of the RHeX itself.



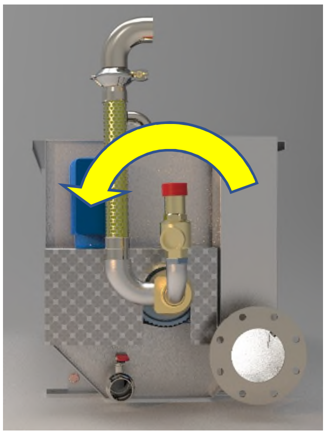
Picture 23: Flex pipe correct installation.

In order to avoid damages to the rotating joints, we recommend that the connections of the secondary circuit are installed according to the above picture, or in a similar manner, so that no pushing or pulling force is exerted by bracket B on the rotary joint D.

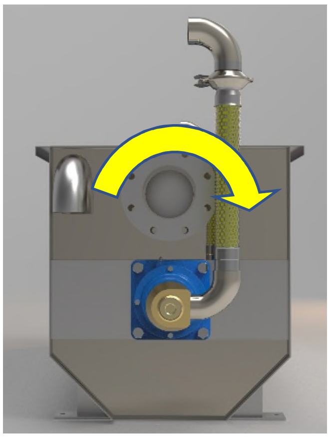
Note: No device must be connected to the rotary joint D except for the flexible pipe C.

Note: The two bends attached to the flexible pipe are part of the RHeX. **Their removal will void any warranty**.

Warning: the flexible pipes **should be operated in tension** so their commissioning is dependent on the rotation direction of the Exchanger (yellow arrows), which is fixed and well indicated with an arrow on the protection carter of the motor. See correct mounting side in the following pictures:

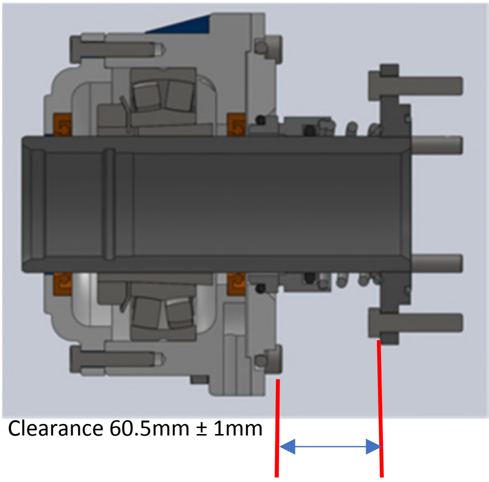


Picture 24: motor side



Picture 25: non-motor side

8.4.4 Mechanical seals



Picture 26: Seal pre-charge clearance

Inside the tank, on both sides of the rotor, a mechanical seal is installed.

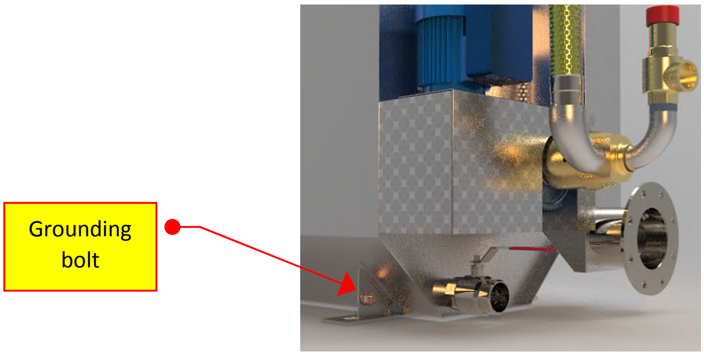
Correct positioning and proper condition of the mechanical seals must be verified before use as transport might have shifted the rotor sideways, altering the seal pre-charge: check that the clearance between the rotor flange and the trough flange is as in this side picture.

Warning: Before starting the rotation of the rotor, you must ensure that the level of water inside the tank is above the mechanical seals in order to avoid irreversible damages on the mechanical seals surfaces.

8.5 Electrical Connections

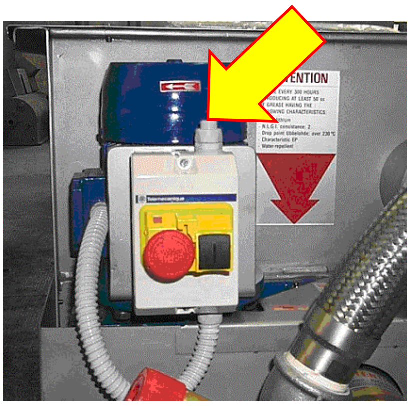
The following steps are required for proper and safe operation:

1. Connect the exchanger to the ground with the special grounding bolt indicated by the specific label; a cable (yellow-green) with a section equal to or bigger than 25 mm² must be used. The bolt is positioned on the foot nearest to the moto-reducer (see following picture).



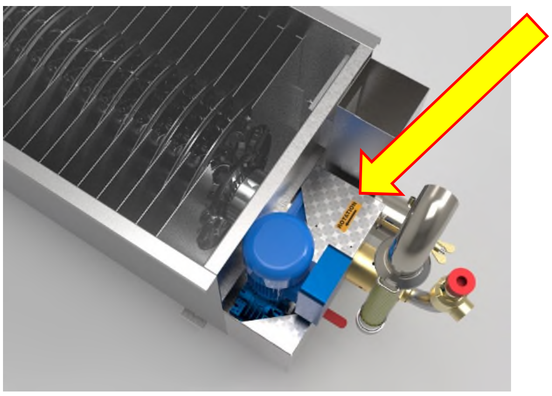
Picture 27: Grounding bolt.

2. Connect the electric power to the emergency push button box as shown in following picture.



Picture 28: Connection box

3. Verify that the axle rotates in the direction shown by the arrow on the belt protection carter (next picture). If the direction is not correct, check the connections you made in the previous step.



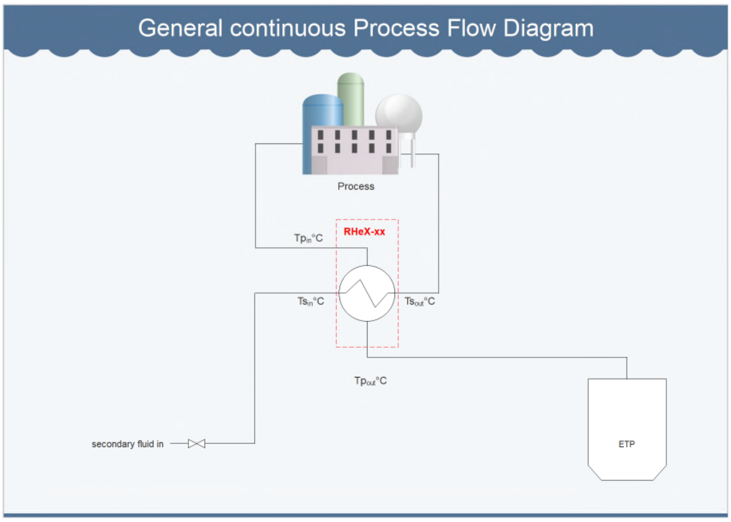
Picture 29: Position of the label indicating rotation direction.

8.6 Start-up

Once connected to fluids networks and electrical power, the exchanger can be put to work either in continuous or discontinuous mode.

8.6.1 Continuous mode

When the unit is connected to a continuous source of primary and secondary fluid, no extra peculiar set up is required apart following instructions at point 8.4.



Picture 30: Continuous process

Flow-rates will be set by the continuous requirement of the process.

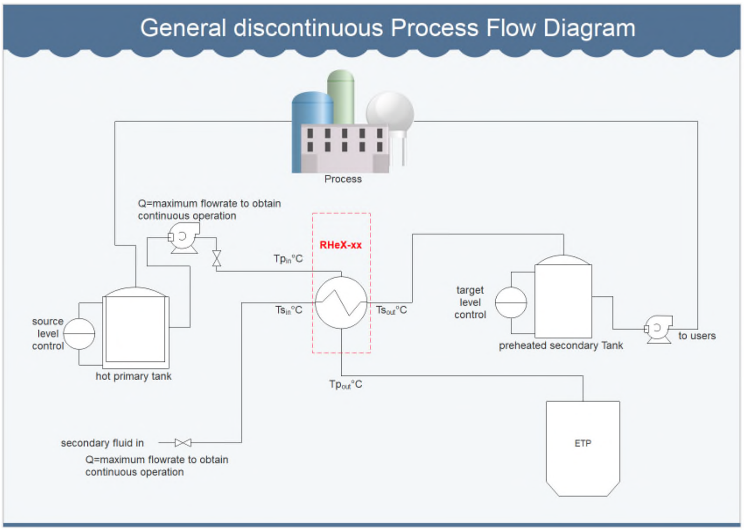
Warning: Motor rotation starts as soon as power is connected.

Warning: Do not apply power, thus starting rotation, without the primary fluid covering the mechanical seals in order not to damage them.

8.6.2 Discontinuous mode

In some discontinuous installations it is possible that the primary fluid is fed to the RHeX from a tank and, conversely, the secondary fluid is stocked downstream the exchanger in a tank.

To maximize the thermal efficiency, continuous functioning is recommended, thus, having a constant flow through the exchanger is a preferred situation.



Picture 31: Discontinuous process

Generally, in this type of installation, the start and stop of the two fluids are governed by the level controls mounted on the buffer tanks according to the following pattern of operation:

- If the hot primary tank goes empty, the exchanger and the feeding pump stop.
- If the preheated secondary tank goes full, the exchanger and the feeding pump stop.

It is therefore important, during initial set up of the plant, to regulate the flows as to reduce to minimum the idle times of the plant.

Warning: Although the RHeX is equipped with a soft-start inverter, to avoid possible damage to its gear/transmission system, it is necessary to limit the number of on-off cycles per hour to a maximum of 10 cycles.
In order to limit the number of start-stop cycles of the motor, avoid, for instance, connecting the exchanger control device to level probes which can be affected by the “wave-effect” in the buffer tanks.

Working of the plant is then completely automatic and it does not require any operator intervention.

Emergency stop of the exchanger rotation can always be achieved through the emergency button shown in Picture 25.

Even when the motor is switched off, thermal exchange will still take place, if the machine itself is not isolated (cut-off) from the primary and secondary circuits.

Note: When the motor is not operating, thermal exchange is considerably reduced and the risk of surface fouling is higher.

Warning: During operation hot primary fluid could flow out the overflow pipe if the relative flow-rate is excessive.

Warning: When temperatures of the primary fluid inlet are > 60°C scorching risks must be prevented by the erection of suitable barriers/fences or proper insulation of the exposed surfaces to avoid accidental contacts with the tank.

Warning: Stickers placed on protection elements remind you of the dangers of electrical shock or moving parts and advise you to disconnect power supply before removing the protection themselves. Should the stickers deteriorate over time, they must be replaced.

8.6.3 Tank baffles

For a thorough description of the baffles inserted in the tank, their purpose and possible geometry modification to adapt the exchanger to the various environments, see under “Extraordinary Maintenance” Chapter **10.6: Baffles**

9 Ordinary Maintenance

Your RHeX exchanger has been built to provide uninterrupted, continuous, service with only minimal maintenance interventions.
Ordinary maintenance schedule will be limited to the operations of tank cleaning and lubrication.

9.1 Tank Cleaning

Before any cleaning operation on the exchanger, the operator must follow these instructions:

- Interrupt the power supply to the machine.
- Prevent the primary fluid (“hot” fluid) from entering the machine, using a by-pass circuit, acting on a deviator or switching off the feeding pump.
- If access to the secondary fluid circuit is required, be sure to interrupt the flow on the secondary circuit as well, by acting on the proper by-pass circuit, or switching off the feeding pump.
- Place a sign indicating that the machine is being cleaned.
- Empty the tank.

Only after having followed all of the above instructions, it is possible to proceed further and remove the protection lid (positioned on top of the trough as a safety device to the rotating parts) by removing the fixing bolts.

9.2 External Cleaning of the Rotor

To remove fouling from the external surface of the rotor we suggest using high temperature, high pressure washer.

Warning: We advise against using mechanical tools for this purpose, as they could damage the polished surface of the rotor.

After having followed instruction at 9.1, proceed with opening the tank draining valve, thus emptying the tank and then wash the rotor disk by disk.

As only a radial section of the exchanging surfaces will be subject to the high-pressure jet, the rotor angular position will have to be fractionally moved in steps to access the whole surface.

Warning: Do not put in continuous rotation the rotor when the tank is empty as this could damage the mechanical seals.

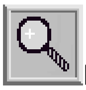
For hard to remove fouling, especially to remove calcium-magnesium carbonate scaling, a chemical washing may be required, by operating the rotor when the tank is filled with the following solution:

Descaling solution
16 parts of water (weight)
4 parts of citric acid (weight)
9 parts of phosphoric acid (weight)
1 ml per litre of wetting agent
anti-foam agent as required

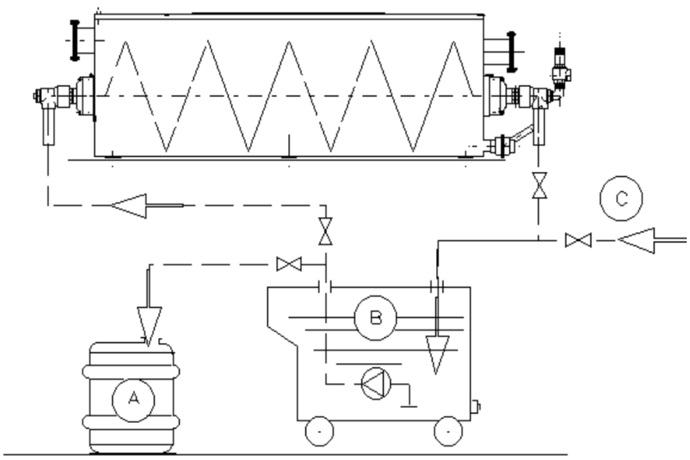
Once again, how often to carry out this procedure depends on the chemical composition of primary fluid and its sedimentation speed. When the exchanger is used with "soft" water (hardness < 5°f) this procedure will never be needed.

9.3 Internal Cleaning of the Rotor

Since visual inspection of the internal parts of the rotor is not possible, fouling on the internal part is only evident when the thermal efficiency decreases as indicated by keeping track of input and output temperatures.

Note: To prevent the build-up of fouling inside the rotor, we recommend using soft water for the secondary fluid.

Should the operator suspect that the described internal scaling has occurred, he may clean the internal part of the rotor using the same descaling solution indicated in section 9.2 by having it circulating with an arrangement similar to the one shown in the following picture:



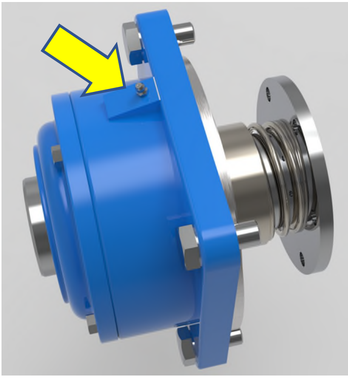
Picture 32: Descaling connections.

A. Eventual descaling solution recovery.
B. Descaling equipment (tank + pump)
C. Water filling inlet (cold or better warm T<50°C)

9.4 Lubrication

9.4.1 Bearings Lubrication

The bearings contained in the side supports need ordinary lubrication.
This must be carried out every **2000 working hours** by a pump acting on the lubrication devices positioned on the supports, adding a minimum of 4cc. See following picture.



Picture 33: Support lubrication nipples.

Use grease with following characteristics:

- Specific gravity: 0,89 kg/dm³
- Drop point (Ubbelohde): > 230°C
- Ashes: 2,81%
- E.P.: 7.000 kg/cm²
- Soap base: Lithium
- NLGI number: 2

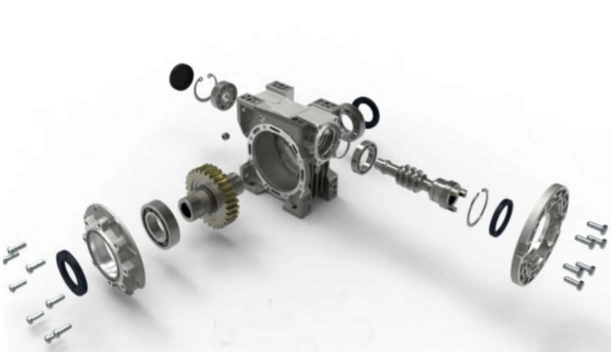
Examples:

- ORVIM 77/ADS (original filling)
- AGIP GR MU EP
- SHELL SUPER GREASE R2
- MOBIL MOBILPLEX 47
- KLUBER CENTOPELX 2EP

9.4.2 Gearbox Lubrication

The gearbox used in the RHeX drive system is a maintenance-free unit which does not require relubrication for the life of the unit.
The units are delivered already filled with synthetic long-life oil: no servicing or refilling within the average operation lifetime of 15,000 hours .
Periodically (every month) check the seal condition and possible evidence of lubricant leakages.
Eliminate by means of a vacuum cleaner any dust accumulation thicker than 5 mm.
If uninstalled or replaced during the life of the product, care has to be taken during re-installation:

- Check mounting stability so that the unit operates without vibrations or overloads.
- Care must be taken to ensure exact positioning and steadiness when handling the units not to generate damages to normal operation of the unit.
- When hoisting, use relevant locations of the housing or eyebolts if provided, or foot or flange holes.
- Never hoist on any moving part (input or output shafts).
- Clean carefully all the surfaces of shafts and flanges paying attention that the product used for cleaning does not come in contact with sealing lips of oil seals to avoid any damage and lubricant leakages.
- The unit may be connected for clockwise or counter-clockwise rotation.
- Stop immediately the unit when unexpected running or noise occurs: consider replacement.
- Bore tolerance F7 is recommended when fitting pulleys, pinions, couplings, etc. on the output shaft.
- It is also recommended not to fit or extract shaft and pulleys with mallets or hammer in order not to damage internal parts, but rather to use the shaft-head threaded bore as reaction to fitting or extraction.
- Belt drives: the force imposed on the shaft due to belt tension must not exceed the maximum permissible radial force of the unit. In our case, the belt is a toothed one so a slight tension is sufficient.
- If painting is needed, please carefully protect oil seals, coupling faces and shafts when re-painting the units.



Picture 34: Gearbox exploded drawing.

POZZI LEOPOLDO

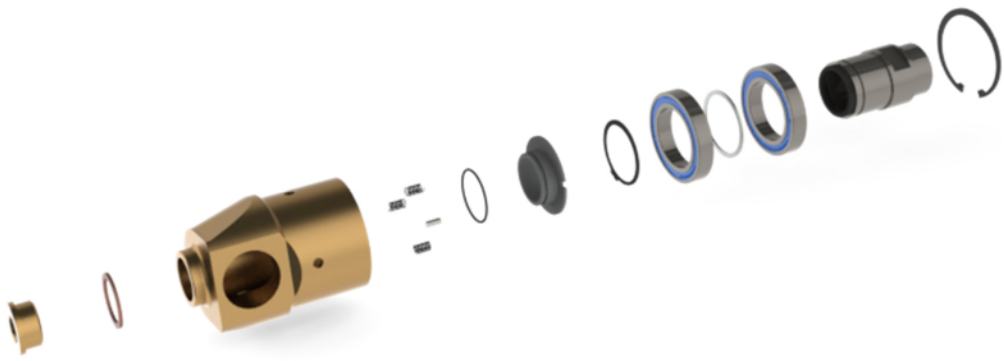
10 Extraordinary maintenance

In the following pages reference is made to spare part numbers as listed in our specific mini-site:

http://www.pozzienergy.it/

under the spares tag. This site provides visual recognition of each necessary spare part, together with its current price and the possibility to create an e-commerce-like system to pre-order the needed components autonomously.
Most of the parts are normally in stock and shipping within 24 hours is possible.

10.1 Rotating Joint care.



Picture 35: Rotating joint (part number 113997)

10.1.1 UN-INSTALLING

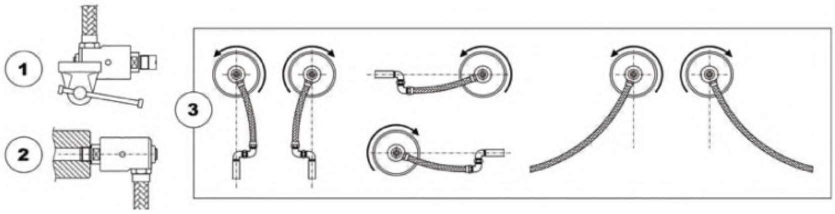
Even if the rotating joints are solid and stout, they must be handled with care. For proper uninstalling we advise to proceed as follows:

- Open the flexible hose clamp to free the rotor hydraulic connection.
- Remove the drive belt.
- Unscrew the joint hub from the rotor shaft using a 60 mm wrench (the unit is tight, you might have to help the operation with an initial hammer blow).
- Once the unit is removed, clamp the rear of the joint in a bench vice and unscrew the flexible hose (picture 34-①).

10.1.2 INSTALLING

- Do not use solid pipe connections but only the supplied flexible pipe (replace if necessary) following above instructions (picture 34-①).
- Install the rotary joint on the shaft with the interposition of a copper washer (picture 34-②).
- Connect the flexible hose to the supply line by tightening the clamp.
- When using flexible hoses in a small space with sharp curves, always use rigid 90° elbows to avoid undue stress.
- Make sure that the orientation of the elbow follows the rotation direction as in (picture 34-③).

- Check that the joint does not rotate eccentric or with excessive wobbling.
- Inspect periodically the joint to ensure the necessary maintenance and detect any leakage.



Picture 36: Rotary joint care.

10.1.3 MAINTENANCE

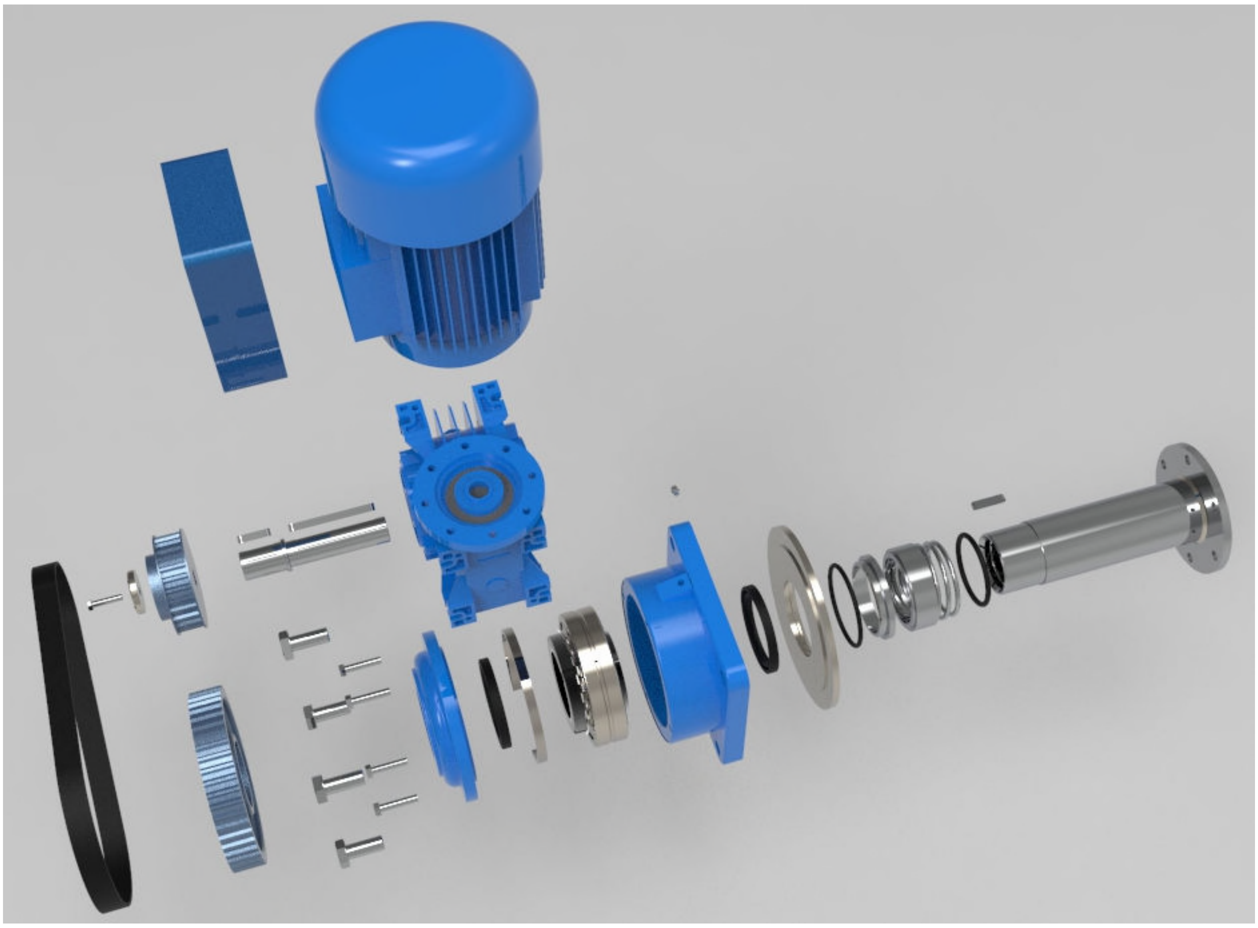
Should any leakage become evident in the rotary joint, proceed immediately with the substitution of the mechanical seal by ordering the spares kit, part number 114026; the kit includes the shaft, bearing assembly and mechanical seal for the unit.

Substitution is quite straightforward (refer to Picture 33):

- Once the unit is removed following instructions at 10.1.1, clamp the rear of the joint in a bench vice and unscrew the flexible hose (Picture 34-①).
- Remove the Seeger ring holding the shaft in place (Picture 33).
- Extract the shaft-bearing assembly.
- Remove the stationary mechanical seal and the series of springs.
- Clean thoroughly the inner chamber of the joint.
- Mount the new stationary ring with its O-ring seal.
- Position the new springs in the provided holes.
- Push in place the new seal-bearing-shaft assembly adding a limited amount of lithium-based grease.
- Lock-in the new Seeger ring.
- Re-install the unit following 10.1.2.

If, during maintenance check, one notices an abnormal wobbling of the brass part of the rotary unit, together with an important leak, most probably a total failure of the support has to be taken into consideration; in this case we suggest the replacement of the whole rotary joint, ordering part number 113997.

10.2 Motor and drive-side support assembly



Picture 37: The drive-side support assembly

Refer to Picture 35 in this section of the Manual.

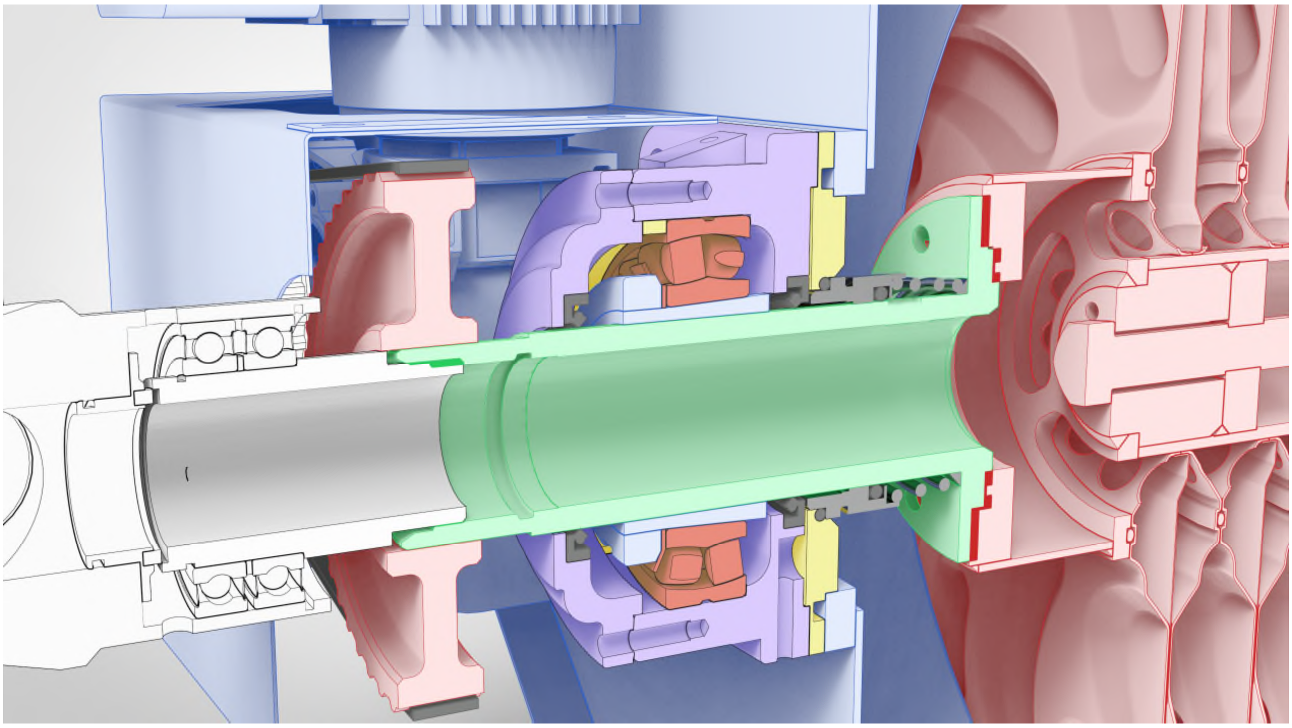
10.2.1 UNINSTALLING

- Verify that you carried out the steps previously indicated, i.e., the motor is disconnected and the tank is empty.
- Remove the protection guard carter.
- Remove the rotary joint following instructions at point 10.1.1.
- Loosen the screws that hold the gearbox as to be able to shift it in order to remove the toothed belt.

Warning: In the next steps, the rotor shaft will become free from its supporting structure, so it is of foremost importance to hold in place the rotor while operating on the supports. This can be done by putting a wood wedge underneath it or by mounting a fly-beam over the tank and latching the rotor to it with a belt.

- Remove the pulley by unscrewing the grub screw on the back of the pulley.

- Remove the cover lid of the support by unscrewing the 4x13mm screws.
- Remove the spacer ring on the inside rim of the support.
- Partly unscrew the threaded ferrule blocking the conical fixing ring of the bearing; unscrew it by 2-3mm.
- Gently push, by tapping it with a hammer, the conical fixing ring in order to free it from the shaft.
- Unscrew the 4x22mm screws that hold the support to the tank and remove the support together with the bearing sliding it on the shaft.
- Set the bearing-support assembly on the bench.
- Remove the flange supporting the mechanical seal, together with the stationary part of the seal and the flange O-ring. Put it on the bench.
- Pull gently to remove the rotating part of the seal from the rotor shaft terminal sleeve.
- Inspect the shaft terminal sleeve for signs of wear & tear.



Picture 38: Moto-reducer side support section

10.2.2 RE-INSTALLING

Note: The two sides of the rotor mount different mechanical seals according to their rotation direction. During installation double-check that you are replacing the mechanical seal with the correct direction of rotation.

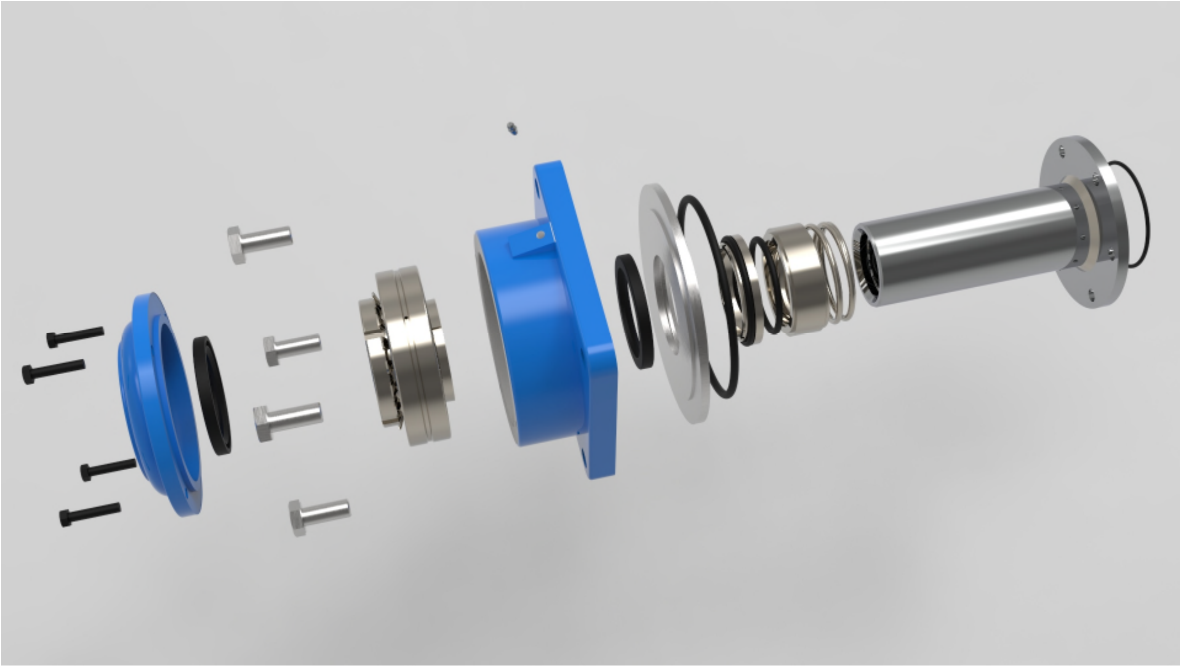
- If the shaft terminal sleeve requires replacement, proceed as follows: remove the 6x17mm screws and remove the sleeve. Replace the sleeve O-ring. Fit the new sleeve and tighten the screws.

- Install the rotating part of the replacement mechanical seal on the sleeve. Help the operation by lubricating the sleeve a little bit. Verify that the ring can move along the shaft.
- On the bench, replace the stationary part of the mechanical seal and the flange O-ring. Carefully fit this assembly to the shaft without pushing against the other side of the mechanical seal.
- On the bench, remove the old bearing and the seal from the support. Clean the support with a solvent. Check that the drain hole is clean and burr-free. Replace the seal. Grease the new bearing. Fit the adapter sleeve, the bearing, the washer and the threaded ring into the support casing.
- Gently fit the support assembly on the shaft sleeve (the drain hole must be on the lower side).
- Match the support flange with the groove on the support casing.
- Push slowly the combined assembly against the rotating part of the seal until the flange matches the wall of the tank.
- Screw the 4x22mm screws holding the support to the tank.
- Tighten the threaded ring of the locking sleeve until the bearing is locked on the shaft. Fold down one tooth of the washer to block it.

Warning: Only the moto-reducer side bearing needs to be locked in position as it works as an axial thrust constrain. The locking position needs to respect the mechanical seal spring pre-load as explained in 8.4.4 (Picture 23). The bearing on the non-reducer side needs to be left free to slide on the shaft, to ensure expansion of the rotor.

- Grease the support. Insert the spacer ring. Replace the seal on the cover and put it on again with the 13 mm screws.
- Re-position the pulley on the shaft and lock it.
- Re-position the toothed belt and screw down the gear-box in order to tighten the belt. Check the alignment between the pulley and the gearbox.
- Re-position the rotary joint and fix it.
- Re-position the motor guard.

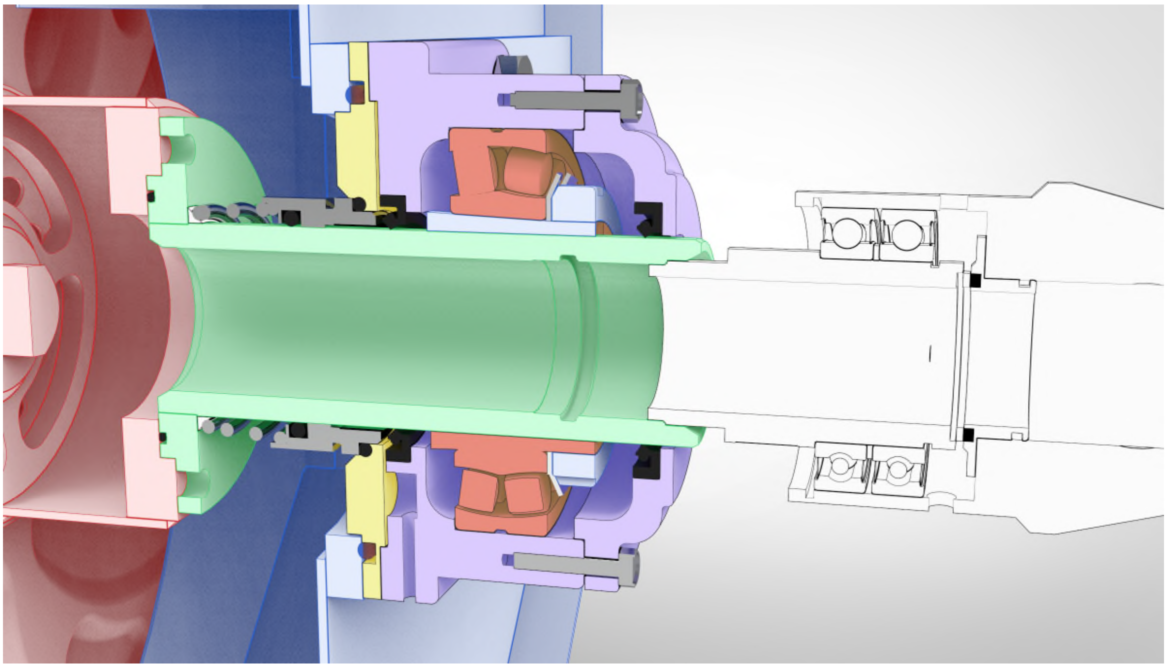
10.3 Non-drive-side support assembly.



Picture 39: The non-drive-side support assembly.

10.3.1 UN-INSTALLING & RE-INSTALLING

- Refer to Picture 37 in this section of the Manual.
- Verify that you carried out the steps indicated, i.e., the motor is disconnected and the tank empty.



Picture 40: Non-drive side section.

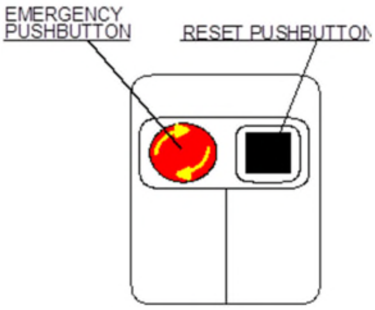
- Proceed as with support motor side **(10.2)**, but **being careful to let the bearing free to slide inside the support to follow rotor expansion caused by thermal action**.
- The threaded bush must be screwed without completely blocking the conical gear.

- Between bearing and lid do not insert a spacer ring, but leave instead a space movement of at least 5 mm.

10.4 Electrical maintenance

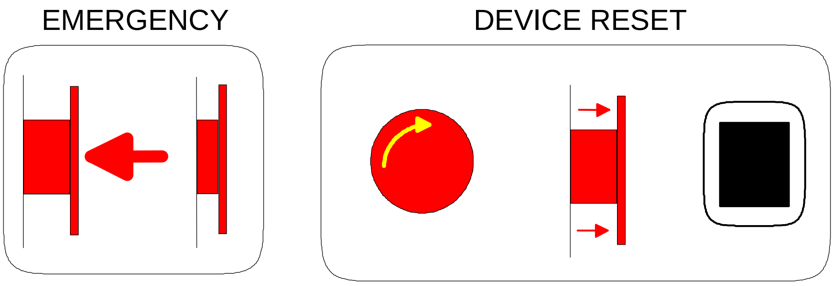
10.4.1 Emergency pushbutton.

On all RHeX exchangers an emergency button is provided.



Picture 41: Emergency pushbutton.

The emergency pushbutton disconnects power supply to the electric motor of the heat exchanger. It may be pushed during emergency situations or during maintenance when, with other safety precautions for operators, it is necessary to disconnect the electric apparatus from mains.



Push the emergency button to stop motor

1. Rotate the button clockwise
2. Gently pull the button to reach the original position
3. Push the reset button (there are two of them for RHeX with two rotors)

10.4.2 Inverter control

All RHeX exchangers are delivered with inverter controls directly mounted on the moto-reducers.

The inverter setup is pre-programmed during shipment, it has fixed speed and starting and stopping ramps.

The pre-programmed settings are normally good for general usage of the exchanger. Special programming parameters can be pre-set during production following customer specifications.

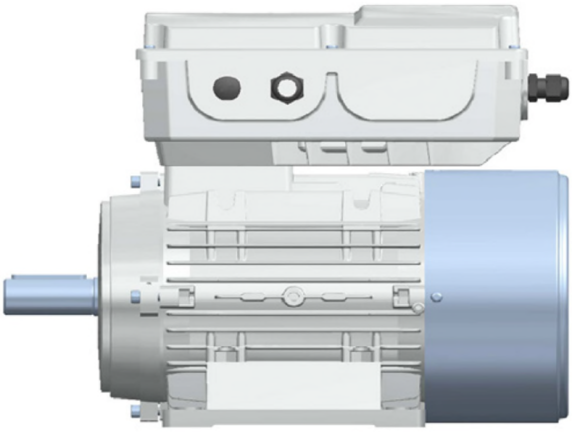
The rotational speed of the exchanger rotor is:

- Proportional to the efficiency of thermal exchange
- Proportional to the pressure losses

Therefore, the pre-set parameters are to be considered a carefully defined compromise, only in case of abnormal operating conditions like:

- Very low flow-rates with respect to rated parameters
- Very high flow-rates with respect to rated parameters
- Particularly viscous primary fluids

It becomes necessary to re-parametrize the inverter.

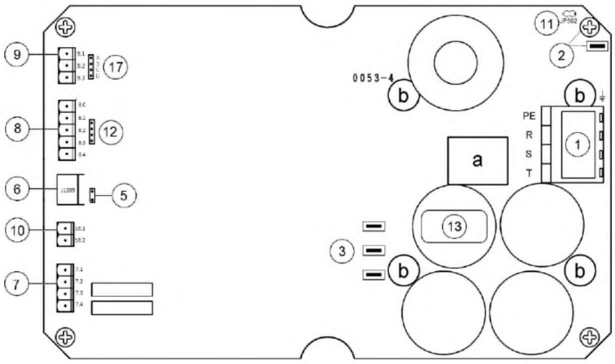


CARATTERISTICHE / *FEATURES*											
INVERTER TIPO ***TYPE***	**Output kW**	**Alimentazione** ***Supply***		**Poli** ***Poles***	**Regolazione frequenza** ***Frequency range*** Hz	**Classe filtro EMC** ***EMI filter***	**Ingressi digitali** ***Digital input***	**Altri Ingressi** ***Other input***	**Uscite Inverter** ***Output Inverter***	**Protezione e allarmi** ***Protection & alarms***
		Tensione ***Voltage*** V	**Frequenza** ***Frequency*** Hz							
MEDIUM	2,20	trifase/*three-phase* 340 ÷ 440	42 ÷ 60	2, 4 , 6 , 8	2 ÷ 159	A/B	6	2	2	plus

Picture 43: The RHeX moto-inverter.

Picture 42: ALS1 prog-pad

In case the Customer needs to change parameters following delivery, it is possible to order the special programming pad (part number ALS1) complete with accessories and programming Manual.

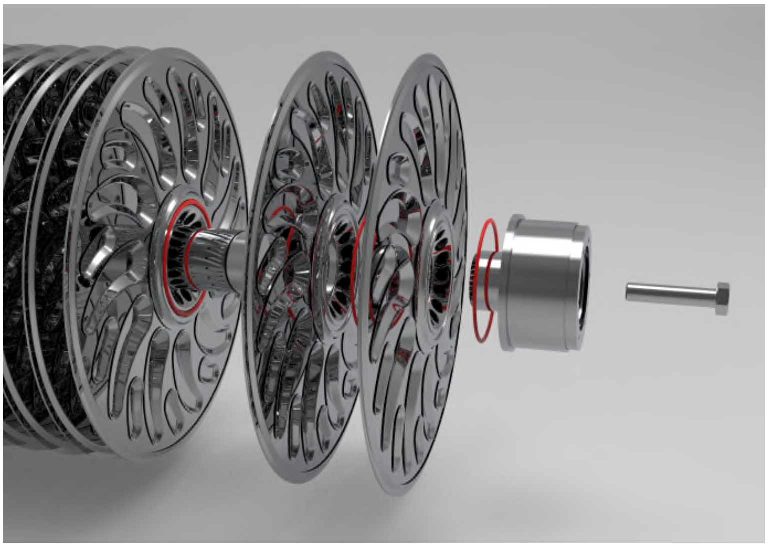


1. power line in
2. Ground (equipotential to PE terminal)
3. motor power out
5. RS 485 terminator
6. RS485 plug
7. Digital out
8. Digital in
9. Analog ref

Picture 44: Inverter board connections

10.5 Rotor maintenance

The RHeX rotor consists of several disks mounted on a shaft with the interposition of a gasket.
The components are kept in place with the help of two bolts, one at each end of the assembly.



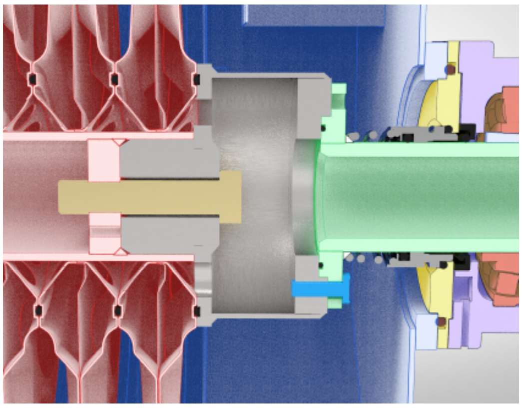
Picture 45: The rotor assembly

Warning: Should the need to dismantle the rotor arise, please note that this is a critical operation which requires particular care and special tooling.

Note: In case of maintenance we suggest changing all the inter-disk gaskets before re-mounting. Complete sets of spare gaskets can be ordered on our www.pozzienergy.it site. DO NOT USE standard gasketing material, but use only original spares. Failure to do so will void warranty.

10.5.1 Dismantling

- Firmly latch the rotor for lifting using a belt strapped around its core in the middle section of its length.
- Apply a slight vertical tension to the strap, sufficient to hold the rotor in place when unlatched from its supporting structure.



Picture 46: Rotor end-cap section.

- Refer to above picture. Remove the rotor from the tank by first removing the (green) shaft sleeves together with the (dark grey, yellow, pink) seal-bearing assembly at each side, as previously mentioned, and carefully lifting it clear of the tank with its baffle structure.
- When packed, the rotor assembly is kept in tension by the elasticity of the several gaskets interposed between each of its composing disks.
- Choose one of the two sides and start dismantling it by straightening the bent washer which keeps the central fixing bolt firmly locked.
- After unscrewing the (gold) central bolt, the (red) disk assembly will follow the (grey) end-cap which keeps the disks pressed together, for just a few centimetres.
- Once the elastic return of the gaskets has finished restoring their original shape, the end-cap sleeve will be easily removed by unscrewing completely the central bolt.
- You can now slide each disk off the shaft.

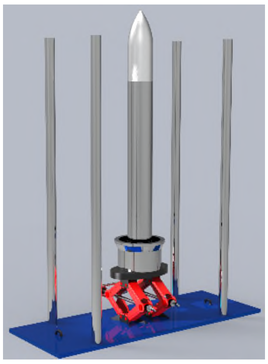
10.5.2 Re-mounting

Remounting the rotor is a critical operation as the positioning of each gasket needs to be precise while sliding the disks next to each other and the pressure needed to close the assembly at the end of the operation can be substantial (2.5-3 tons).

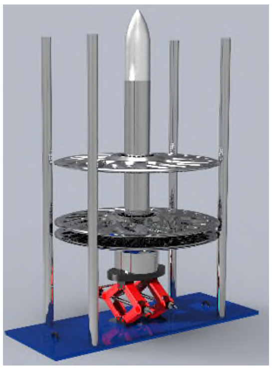
The operation can theoretically be performed with the rotor shaft in a horizontal position, with the help of a special glue, available on our www.pozzienergy.it site, but we strongly discourage to proceed in this way.

A much better and strongly recommended procedure is to procure the special mounting rig that can be obtained from Pozzi for rent, or from its Service Network. This rig has been devised to allow the re-mounting with the shaft in vertical position and to apply the necessary force for locking it.

Picture 47: The mounting rig acting on a 10-disk rotor.



- Start by fitting the vertical guides to the baseplate and by lowering the scissor jacks to their lower position acting on one of the screws end-hooks with the provided crank. The vertical guides are supplied in fast-joining sections, their total length will have to be at least 200mm higher than the total length of the rotor shaft.
- Mount the rotor shaft with only one of the end-caps securely bolted on the lifting plate using the screws provided for the fixing of the shaft sleeves.
- Place the shaft-elongating sleeve on the top of the shaft.



- Continue by sliding the first gasket onto the shaft, accurately positioning it in the provided groove on the shaft end-cap.
- Slide the first disk in position.
- Then slide the second gasket in its groove.
- Continue until all the disks have been positioned along the shaft with their inter-disk gasketing.

- You will notice that the last disk stays on the shaft-elongating sleeve and protrudes from the shaft-end by a measure proportional to the number of fitted disks. This extra length corresponds to the pre-charge of the gaskets and will have to be compressed before being able to fit the top end-cap on the rotor.
- Place the last gasket in the top disk grove.

- Now position the pressing plate on the rig guides checking that the central hole evenly rests on the toroidal section of the last disk.
- Fasten the chains to both sides of the pressing plate and to the base-plate allowing minimum slack and equal number of chain links on both sides.
- You can now crank-up the scissor-jacks compressing the disk-pack until the top plane of the disk is flush with the top of the shaft.

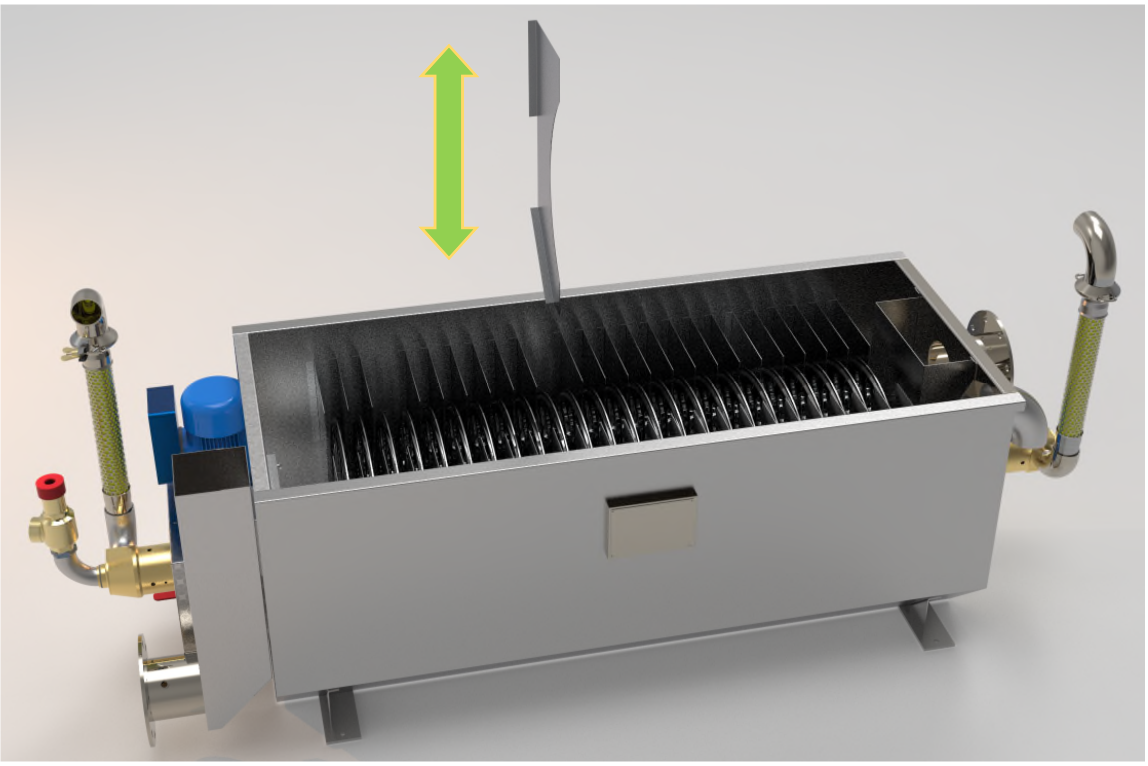
- Now remove the elongation sleeve and replace it with the top end-cap (watch for the correct positioning of the last gasket).
- The end-cap hub is fitted with a torque-pin which has to be properly inserted into the provided hole in the shaft filleted retainer.
- Insert the bent washer and tighten the fixing bolt securing the end-cap in place.
- Bend the washer to block the bolt rotation.

- You can now crank back the scissor-jacks releasing the pressure on the rotor until enough slack is given to the chains for their removal.
- Remove the chains on both sides.
- Remove the pressing plate sliding it over the top of the guide bars.
- Secure the rotor to a lifting device and then remove the screws that fix it to the lower lifting plate.
- You can now lift the rotor free of the rig (you can remove the guiding rods to facilitate the operation).

Warning: Be careful tilting the rotor to the horizontal position: DO NOT hinge the rotor on the outer rim of the bottom disk, use the bottom end-cap as a hinge point.

Once the rotor is in horizontal position it is ready to be mounted back in the trough.

10.6 Baffles



Picture 48: Baffle removal

The inside of the RHeX tank is fitted with baffles which are used to deflect the primary fluid in such a way that it follows, as much as possible, the external geometrical shape of the rotor. This arrangement assures the maximum thermal length to the exchanger.

Under certain conditions this continuous deflection of the primary fluid path might result in an excessive pressure loss, inducing fluid bypass and overflow.

Conditions like excessive specific flow-rate, high primary fluid viscosity or specific weight, very high TDS content might call for a modification of the primary fluid path geometry.

For this reason, RHeX is equipped with removable baffles. Different RHeX models might have “ex works” different number of baffles, i.e., non-completely populated baffle slots.

Each baffle is inserted in a slot holder and can be removed by pulling it vertically.

Selected removal of baffles (1 set every 2 or 3 rows) in a staggered quincunx manner on the two sides of the rotor might solve the problem.

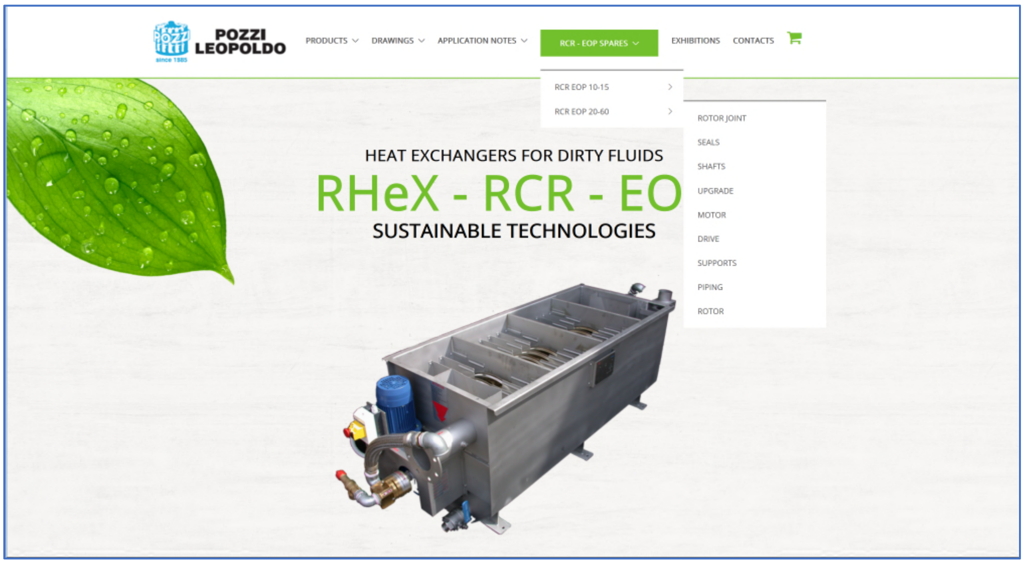
As a general indication, the following applies:

- The higher the number of baffles inserted = better efficiency of exchange
- The higher the number of baffles inserted = higher pressure loss.
- The lower the number of baffles inserted = higher possible flow-rates accepted.
- The lower the number of baffles inserted = loss of efficiency

11 Spare parts

To select and order spare parts refer to the following specially designed website:

http://www.pozzienergy.it

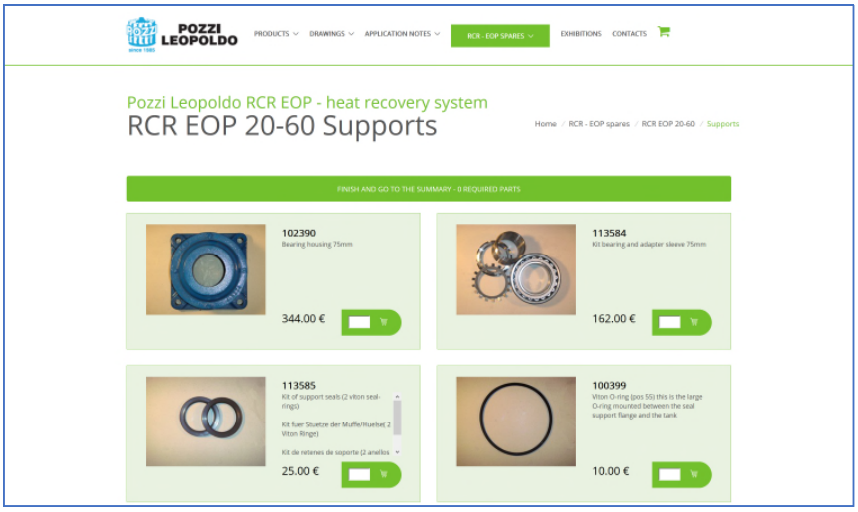


Picture 49: Landing page of the spares site

Browsing the site, you will be able to visually identify and select all necessary spares which are grouped per exchanger model and function.

By adding the selected parts to the cart, the procedure will collect your data, organize them and automatically transfer your tentative order to our customer service. At that point we will send you a formal order confirmation that, once approved, will become your final purchase order.

Necessary spare parts should be readily available. Most spare parts are normally in our stock.



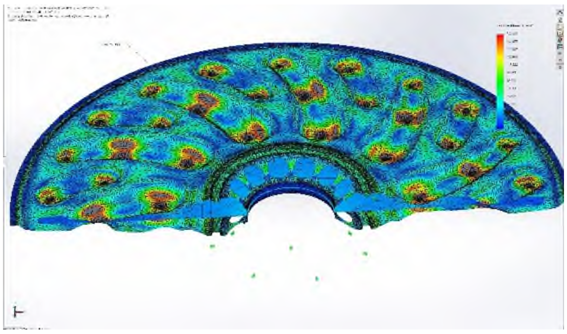
Picture 50: A typical spare part page

12 Credits

The RHeX project has received funding by the European Union's Horizon 2020 Research and Innovation Program under Grant Agreement n° 723930.

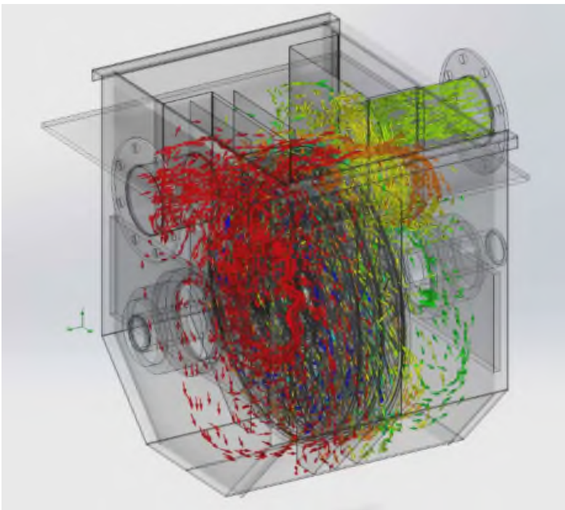
The European funding has allowed a deep computer-simulation engineering effort to the development of RHeX, the next standard self-cleaning exchanger. The new design has been granted an International Patent in 2013.

Accurate finite-elements analysis has allowed a dramatic improvement of the structural rigidity and the pressure resistance of the disks, while the novel teardrop shape of the reinforcing dimples has proven to enhance the dynamic flow pattern of the fluid in the exchanger.



Picture 51: Finite elements static analysis.

Particle-motion and thermal analysis have refined the exchanger physical details to improve heat transfer while minimizing boundary layer conditions and increasing the dynamic shear stresses near the surfaces in order to enhance the self-cleaning action of rotation.



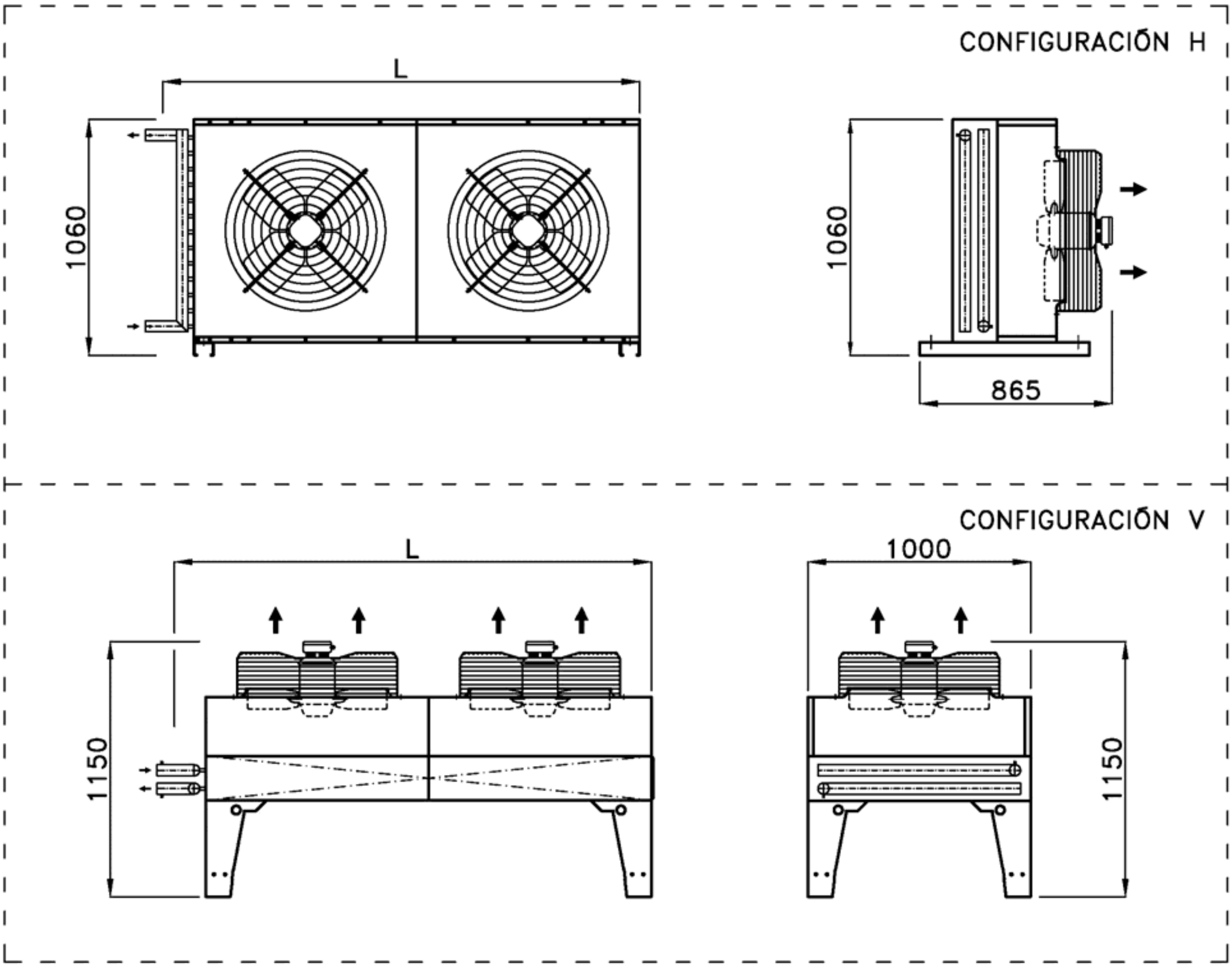
Picture 52: Particle motion analysis.

Selección de aero-refrigerantes.

22-feb-18

Referencia:	Nº Ref:
Altitud sobre nivel del mar, (m): 0 Presión atmosférica, (kPa) .....: 101,325 Refrigerante: **Agua** % en peso: Temp. entrada del refrigerante, (ºC) : 30 Temp. salida del refrigerante, (ºC) ...: 26 Temp. del aire ambiente, (ºC) ....: 20 Caudal de refrigerante, (l/h) ....: 7.565 Potencia a disipar, (kW) ....: 35,0	**Modelo: EA65-025037.4** Caudal de aire, (m3/h) .: 26000 Presión sonora, (dB(A)): 62 (1) Consumo eléctrico, (W): 1.900 Diámetro de colectores: 54 Pérdida de carga, (kPa): 35,6 Peso en carga, (kg) .....: 290 F. ensuciamiento (m2.K/W): 0,0000
Dimensiones - Cota L, (mm) ....: 2145	

1) A 10 metros de distancia, en campo libre.



EBARA ESPAÑA BOMBAS, S.A.
Pol.La Estación. C/Cormoranes,6
Tel.916 923 630, Fax 916 910 818
28320 Pinto(Madrid), ESPAÑA
http://www.ebara.es

GRUPO MOTOBOMBA

· Modelo : **EL 50-160**
· Motor : **1450-0,75 kW**
· Fluido : Agua dulce, limpia, temperatura ambiente
· Tensión : 400V III+N, 50Hz

Cliente: CTM - SR. JOAN FARNÓS
Oferta:
Proyecto: **ELINE 7,2@10 VARIADOR**
Comentario: **EESE-JJ18020601**
Rev.:
Responsable:

Fecha: 23/**02/2018**

Pos.	Referencia	Ud.	Descripción	P.Unidad	P.V.Neto
10		2	Bomba centrífuga inline sencilla de rotor seco EBARA modelo **EL 50-160** , ejecución hierro fundido, con rodete en **hierro fundido** ; cierre mecánico sencillo según DIN 24960 (carbón/cerámica/NBR) ; accionada mediante motor eléctrico de **0,75** Kw, eficiencia IE2, trifásico, **1450** rpm , **220/400V** , 50 Hz , TEFC, aislamiento clase 'F' , forma constructiva B5, protección IP55. Alimentación variador: Tensión trifásica 400 V. Con variador de velocidad montado en la bomba y transductor de presión diferencial, 4-20 mA, tienen que determinar el rango de medida que les interesa en el transductor: (0-0,6 / 1 / 1,6 / 2,5 / 4 / 6 / 10) bar	1.613	3.226

TOTAL ... 3.226

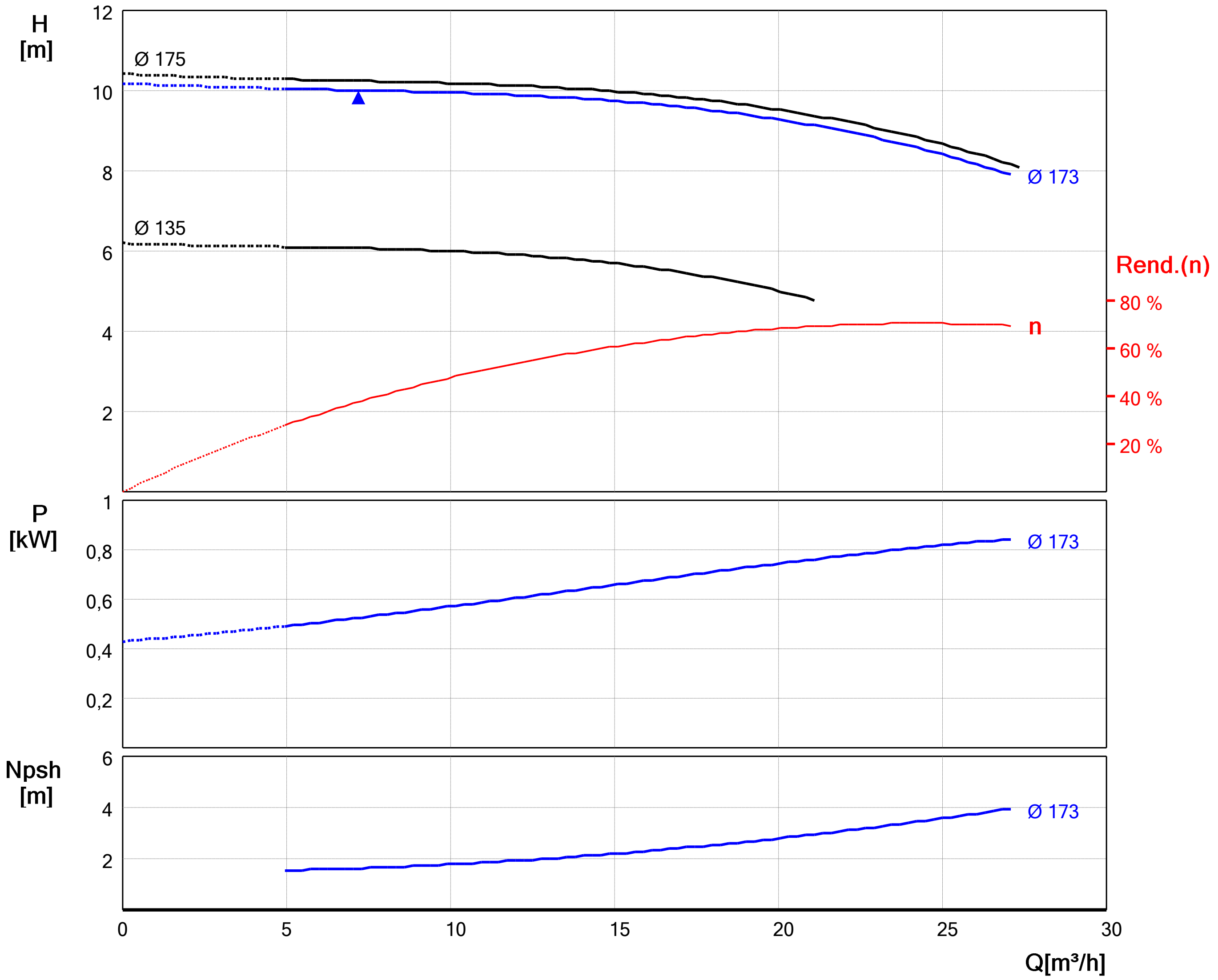
Condiciones de Venta
Portes, Embalajes e impuestos no incluidos.
Plazo entrega: (a confirmar en el momento del pedido).
Validez de la oferta: 1 mes.
Forma de pago: según ley 15/2010. Puesta en marcha: no incluida.
Sujeto a nuestras condiciones generales de venta, salvo pacto en contra por escrito y firmado.

EBARA ESPAÑA BOMBAS, S.A.
Pol.La Estación. C/Cormoranes,6
Tel.916 923 630, Fax 916 910 818
28320 Pinto(Madrid), ESPAÑA
http://www.ebara.es

GRUPO MOTOBOMBA

· Modelo : **EL 50-160**
· Motor : **1450-0,75 kW**
· Fluido : Agua dulce, limpia, temperatura ambiente
· Tensión : 400V III+N, 50Hz

Cliente:	CTM - SR. JOAN FARNÓS			Página:	**2 / 3**
Oferta:		Rev.:		Fecha:	23/**02/2018**
Proyecto:	**ELINE 7,2@10 VARIADOR**	Responsable:			
Comentario:	**EESE-JJ18020601**			Referencia:	



Datos de trabajo solicitados

Caudal	**7,20**	m³/h
H.M.T.	**10,00**	m.c.a.
Frecuencia	**50 Hz**	
Variador frecuencia	**Si**	
Nº Polos	**4**	
Tipo de fluido	**Agua dulce limpia**	
Temperatura fluido	**Ambiente, 20ºC**	

Datos punto de trabajo proporcionado

Caudal	**7,20**	m³/h
H.M.T.	**10,01**	m.c.a.
Potencia absorbida	**0,53**	kW
NPSH requerido	**1,63**	m.c.a.
Rendimiento	**37,33**	%
R.p.m.	**1450**	
Diámetro del impulsor	**173**	mm

Datos de la Electrobomba

Tipo	**ELINE**	
Tipo de construccion	**Vertical in-line**	
Presión nominal	**Hasta 10 bar**	
Temperatura fluido	**-10ºC/+120ºC**	
Peso aproximado	**45**	**Kg**
Nivel sonoro	**45**	**dB**
Potencia motor selec.	**0,75**	kW

Datos de materiales

Cuerpo	**GG-25**
Impulsor	**GG-20**
Eje	**AISI 316**
Cierre mecánico	**Carbón/Cerámica/NBR**

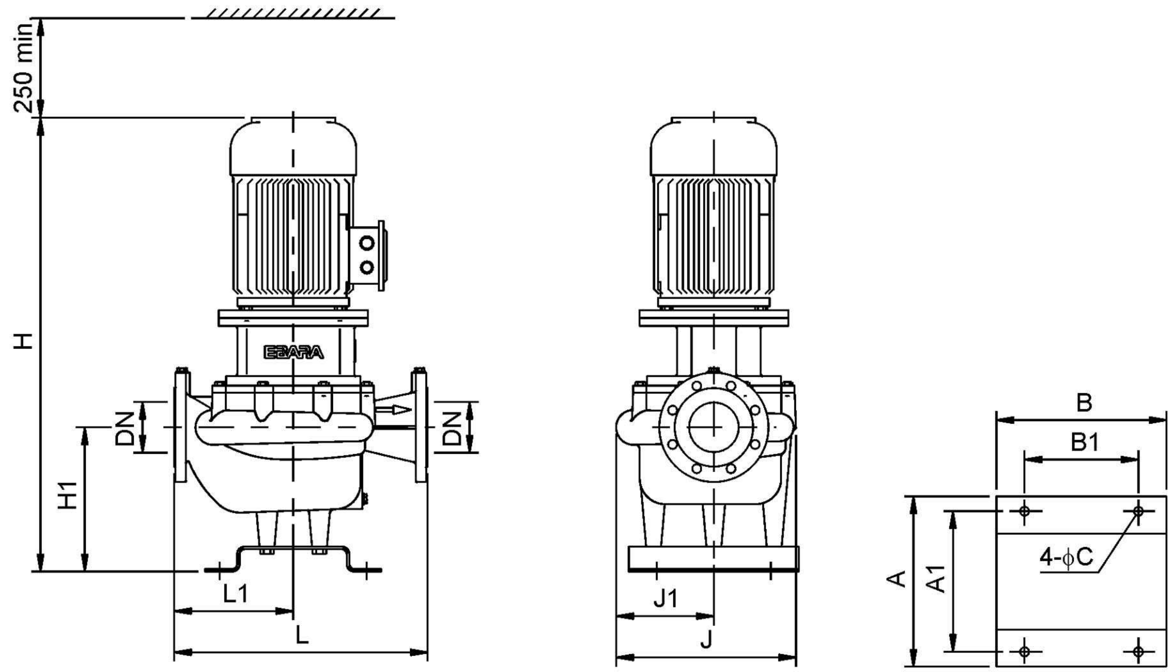
EBARA ESPAÑA BOMBAS, S.A.
Pol.La Estación. C/Cormoranes,6
Tel.916 923 630, Fax 916 910 818
28320 Pinto(Madrid), ESPAÑA
http://www.ebara.es

GRUPO MOTOBOMBA

· Modelo : **EL 50-160**
· Motor : **1450-0,75 kW**
· Fluido : Agua dulce, limpia, temperatura ambiente
· Tensión : 400V III+N, 50Hz

Cliente:	CTM - SR. JOAN FARNÓS			Página:	**3 / 3**
Oferta:		Rev.:		Fecha:	23/**02/2018**
Proyecto:	**ELINE 7,2@10 VARIADOR**	Responsable:			
Comentario:	**EESE-JJ18020601**			Referencia:	

DIMENSIONES GRUPO MOTOBOMBA (mm)



Dimensiones	
DN	50
H1	145
H	535
L1	190
L	350

Bridas

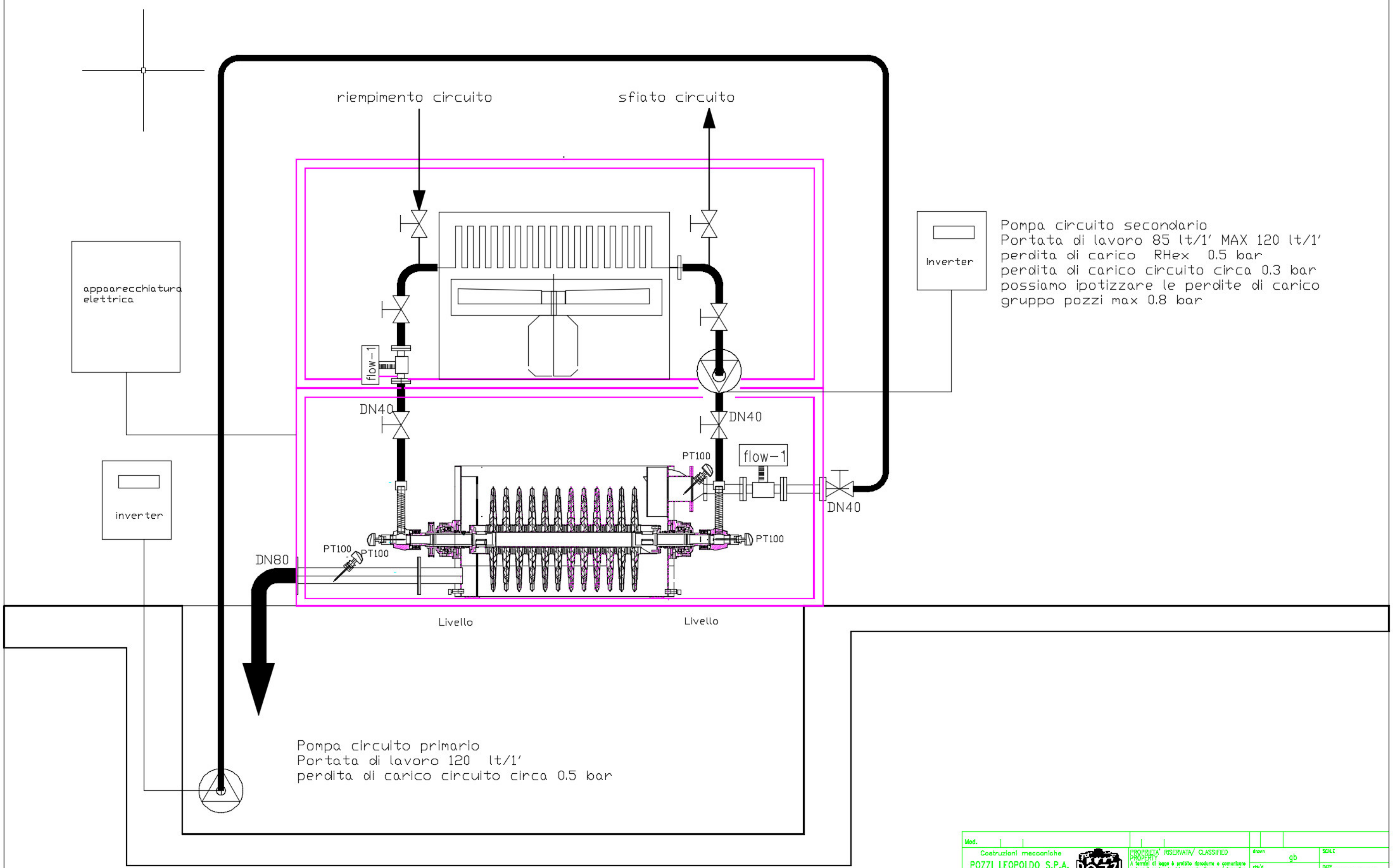
DIN 2532 / PN 10

Dimensiones	
J1	135
J	255
A1	250
A	300
B1	200
B	300
C	15

Annex 2

The following documents represents all the engineering documentation requires for the integration and operation of the heat recovery systems hosted in the WWTP of the Navigator Pulp factory (Setubal):

- P&ID diagram;
- Electrical diagram;
- Skid drawing;
- Equipment manuals;
- Equipment datasheets.



Mod.

Costruzioni meccaniche
POZZI LEOPOLDO S.P.A.
Agliate di Carate Brianza
Milano Italy

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chk'd		DATE	04/07/2006
replace		replaced	
from dwg.	h		

RHex

SCHEME LowUP

JOB/CUSTOMER

101 F Rhex

	Date	Name	SCALE		
Dibujado	16/10/201	ACC/SVN	W/S	AutoCAD RELEASE 14 Autodesk	LowUp – Industrial – V04
Proyectado					
Comprobado					

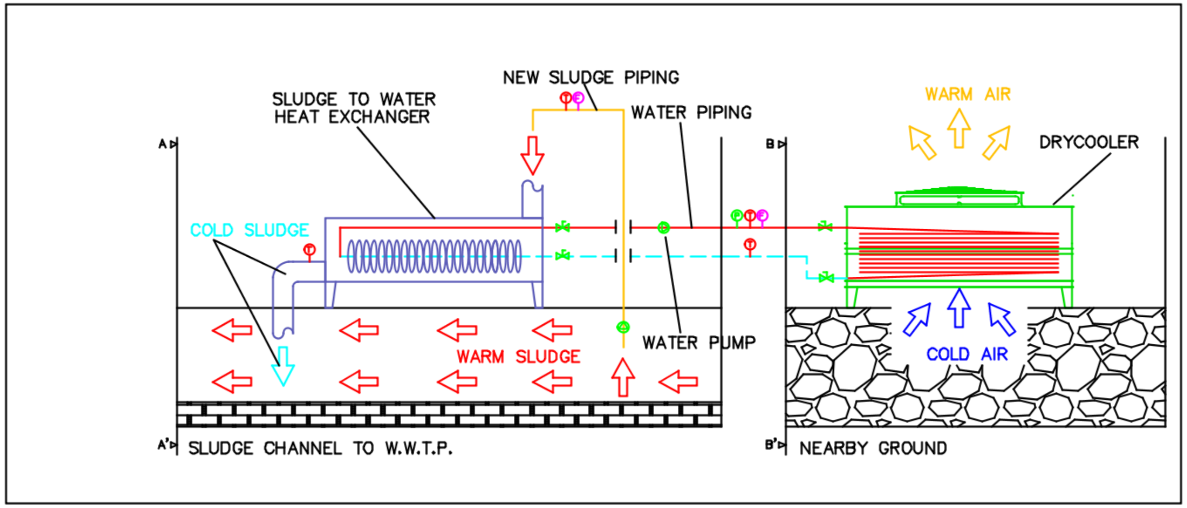
PROYECTO : **LOWUP - H2020 Project**

TITULO DEL PLANO : IMPLANTATION AT NAVIGATOR SETTINGS — NUMERO DE PLANO : 2 HR

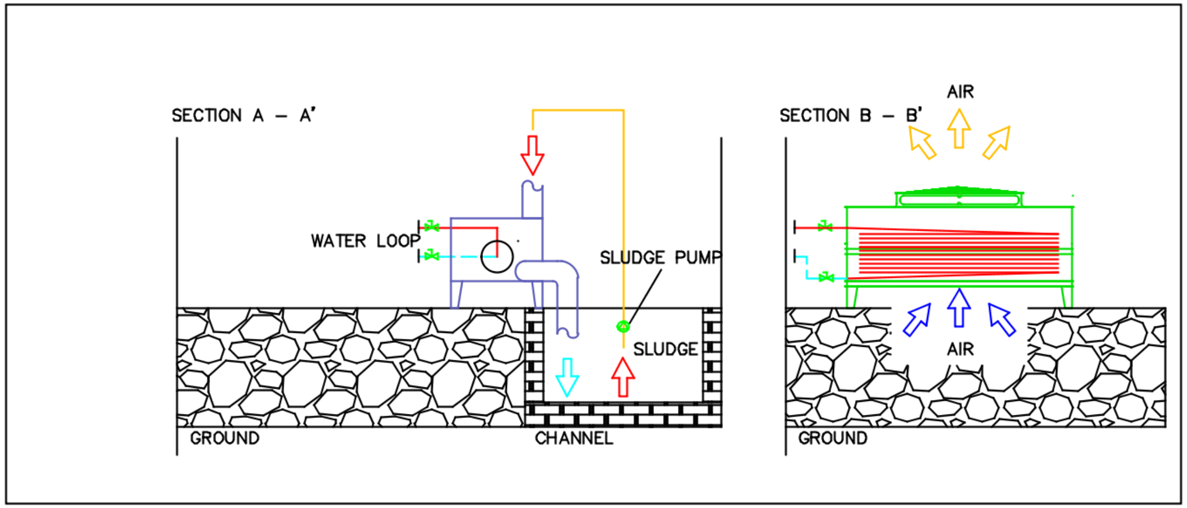
ASUNTO : CONNECTION AND PLACEMENT – DRAFT VERSION — REFERENCIA : NAVIGATOR – PT

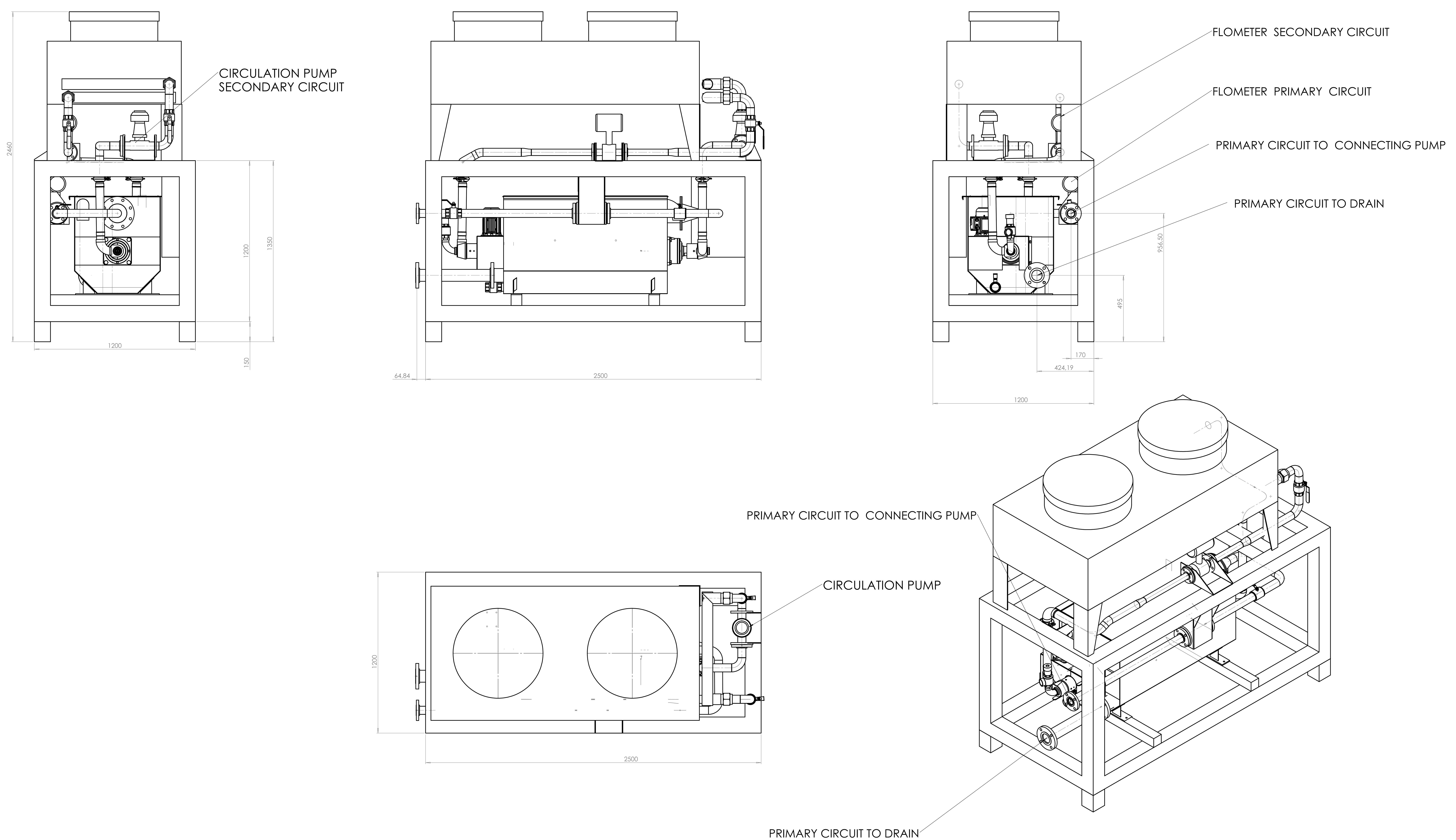
PRESSURE SENSOR
TEMPERATURE SENSOR
FLOW SENSOR

GENERAL VIEW



FRONTAL VIEW





Pozzi LeopoLdo S.r.l
Barlassina (MB)

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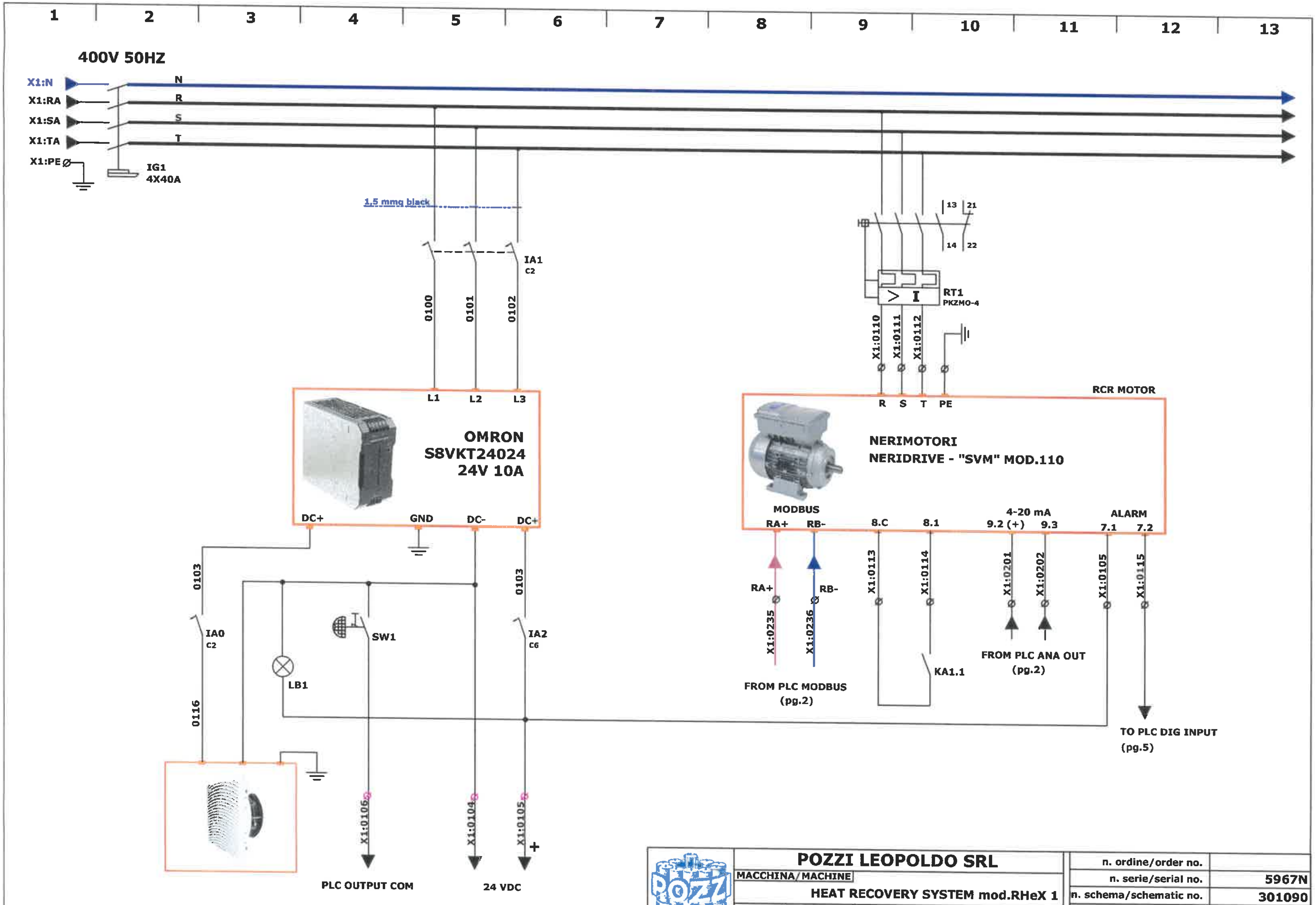
DISEGNATO
VERIFICATO
data

ASSEMBLY LOW-UP

N. DISEGNO 101F-LOW-UP-01-001 A4

SCALA:1:10
FOGLIO 1 DI 1



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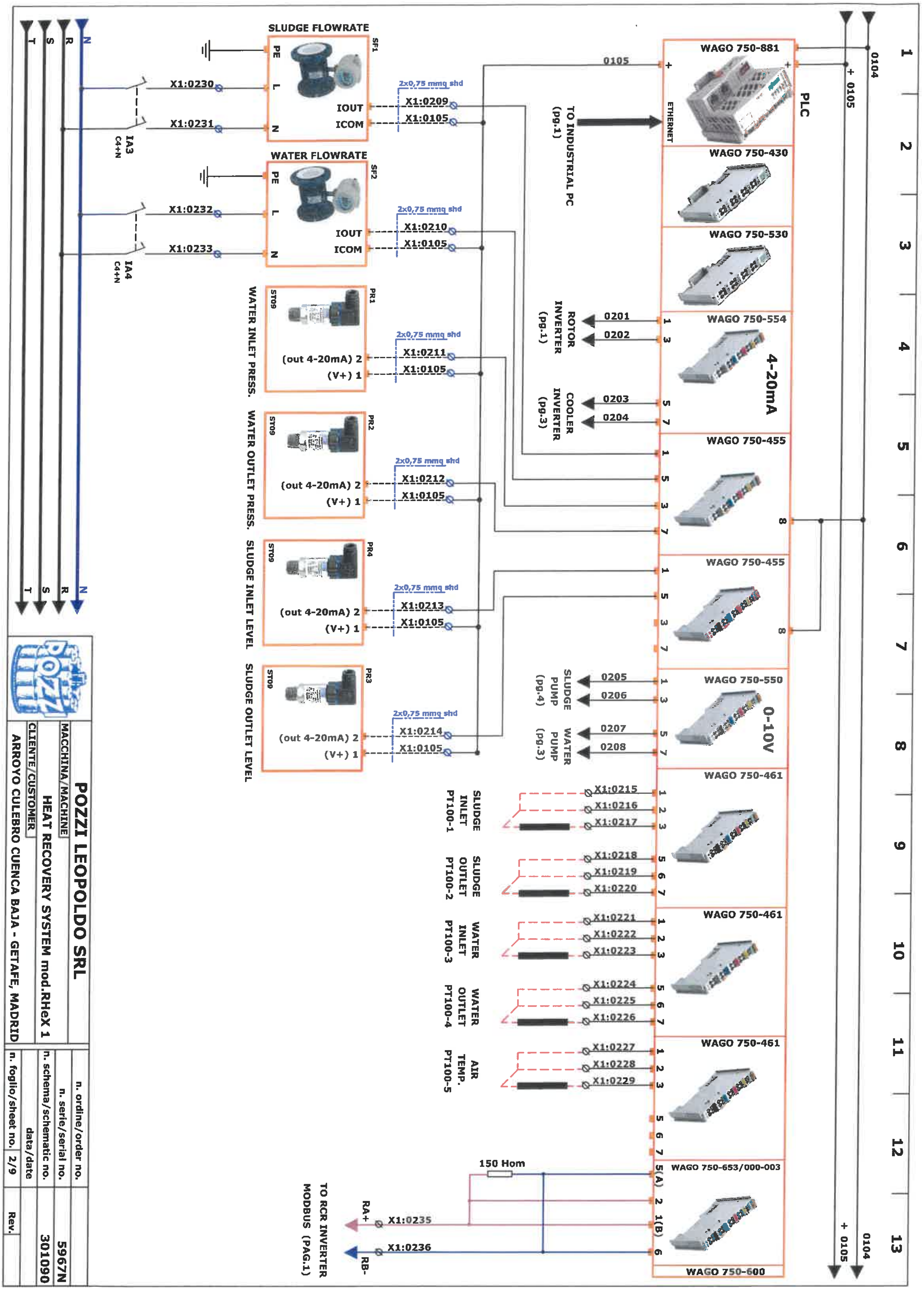
MACCHINA/MACHINE	HEAT RECOVERY SYSTEM mod.RHeX 1	n. serie/serial no.	5967N
		n. schema/schematic no.	301090
CLIENTE/CUSTOMER	ARROYO CULEBRO CUENCA BAJA - GETAFE, MADRID	data/date	22/06/2018
		n. foglio/sheet no. 1/9	Rev.



SLUDGE FLOWRATE
SF1
PE
L
N
IOUT
ICOM
X1:0230
X1:0231
IA3
C4+N
2x0,75 mmq shd
X1:0209
X1:0105
WATER FLOWRATE
SF2
X1:0232
X1:0233
IA4
C4+N
X1:0210
WATER INLET PRESS.
ST09
PR1
(out 4-20mA) 2
(V+) 1
X1:0211
WATER OUTLET PRESS.
PR2
X1:0212
SLUDGE INLET LEVEL
PR4
X1:0213
SLUDGE OUTLET LEVEL
PR3
X1:0214
N
R
S
T
WAGO 750-881
ETHERNET
PLC
0105
0104
+ 0105
TO INDUSTRIAL PC (pg.1)
WAGO 750-430
WAGO 750-530
WAGO 750-554
4-20mA
ROTOR INVERTER (pg.1)
0201
0202
COOLER INVERTER (pg.3)
0203
0204
WAGO 750-455
WAGO 750-455
WAGO 750-550
0-10V
SLUDGE PUMP (pg.4)
0205
0206
WATER PUMP (pg.3)
0207
0208
WAGO 750-461
SLUDGE INLET PT100-1
X1:0215
X1:0216
X1:0217
SLUDGE OUTLET PT100-2
X1:0218
X1:0219
X1:0220
WAGO 750-461
WATER INLET PT100-3
X1:0221
X1:0222
X1:0223
WATER OUTLET PT100-4
X1:0224
X1:0225
X1:0226
WAGO 750-461
AIR TEMP. PT100-5
X1:0227
X1:0228
X1:0229
WAGO 750-653/000-003
150 Hom
5(A)
1(B)
RA+
X1:0235
RB-
X1:0236
TO RCR INVERTER MODBUS (PAG.1)
WAGO 750-600
1
2
3
4
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POZZI LEOPOLDO SRL
MACCHINA/MACHINE
HEAT RECOVERY SYSTEM mod.RHeX 1
CLIENTE/CUSTOMER
ARROYO CULEBRO CUENCA BAJA - GETAFE, MADRID
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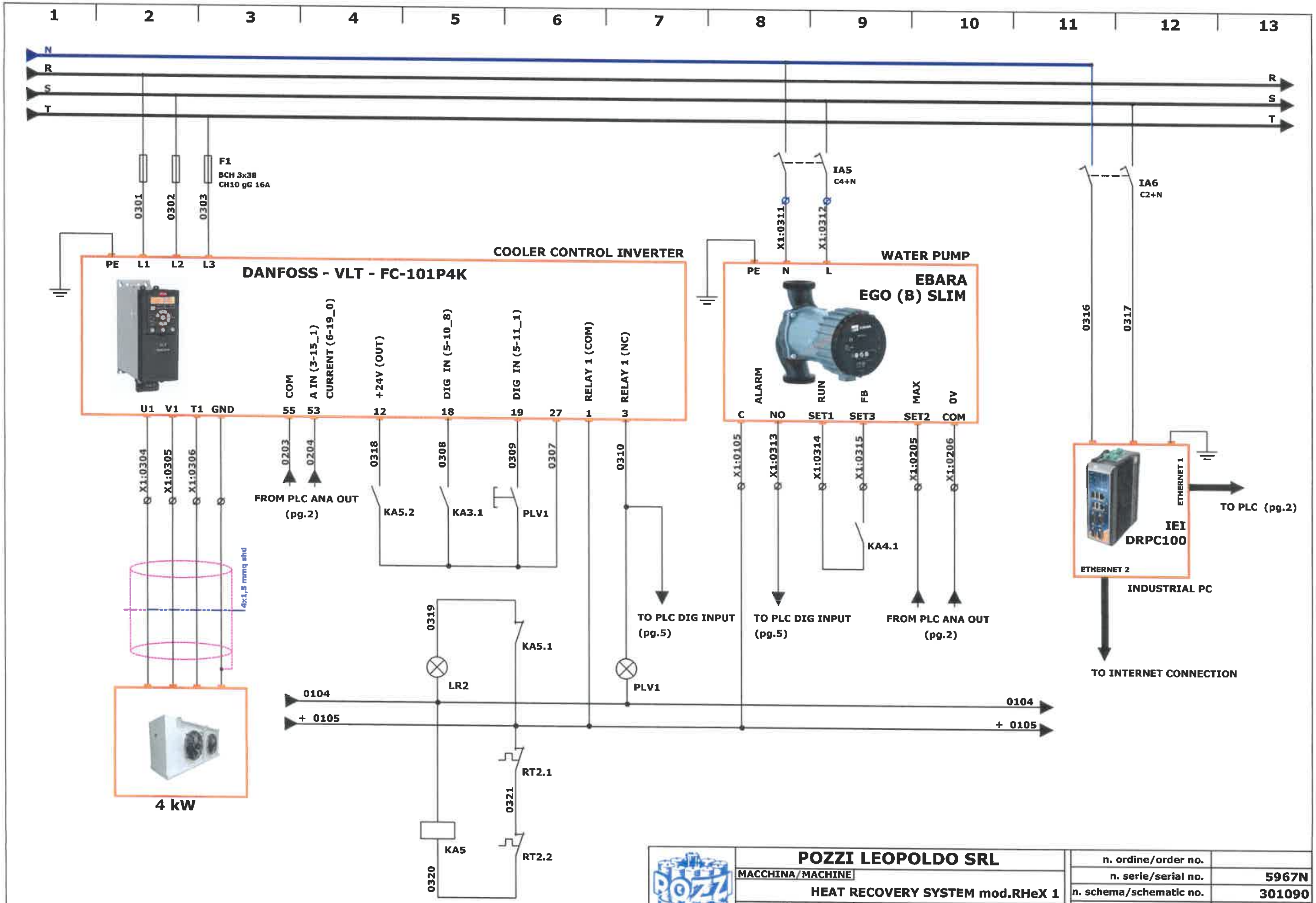
n. serie/serial no. 5967N
n. schema/schematic no. 301090
data/date
n. foglio/sheet no. 2/9
Rev.



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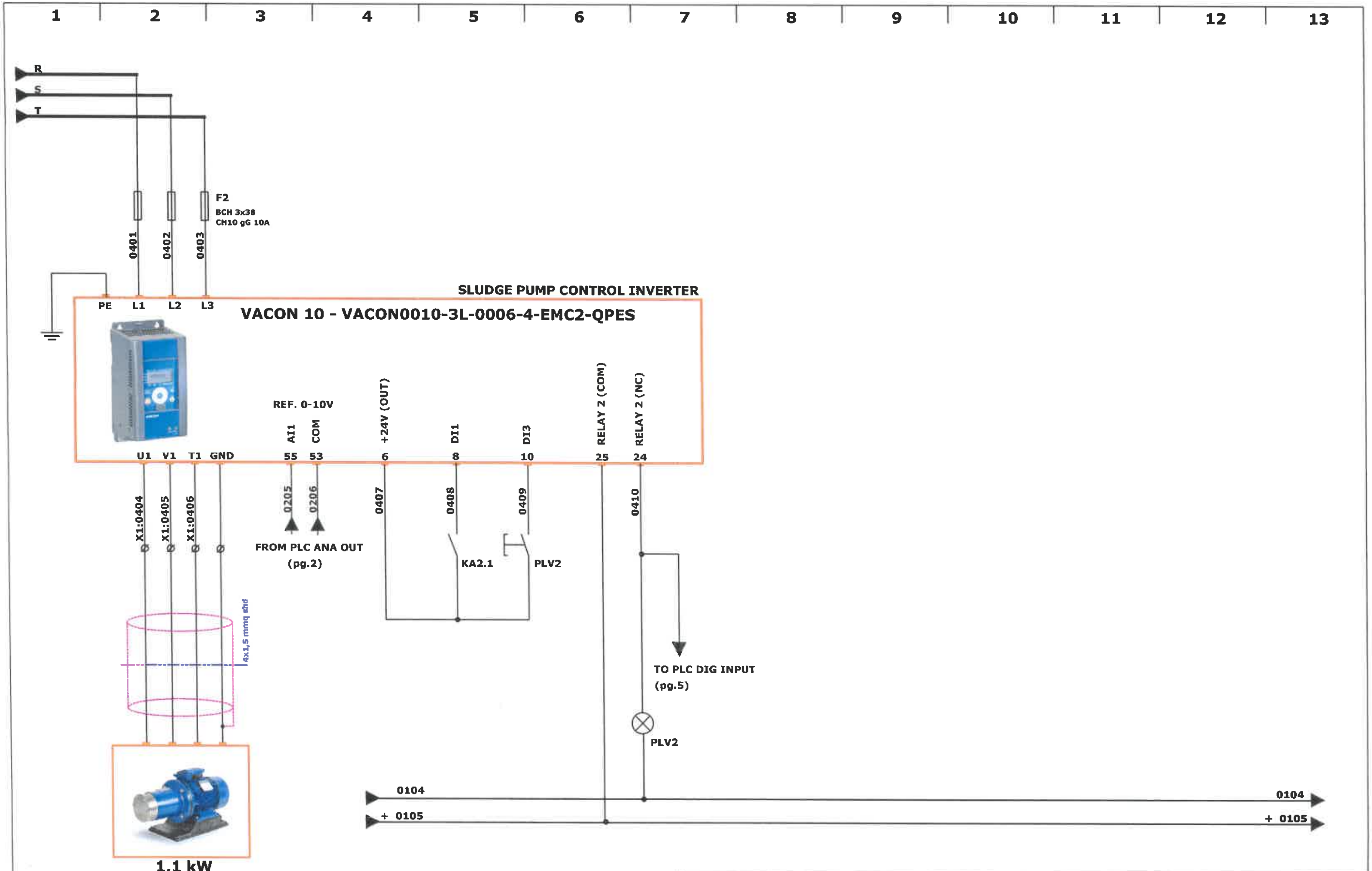

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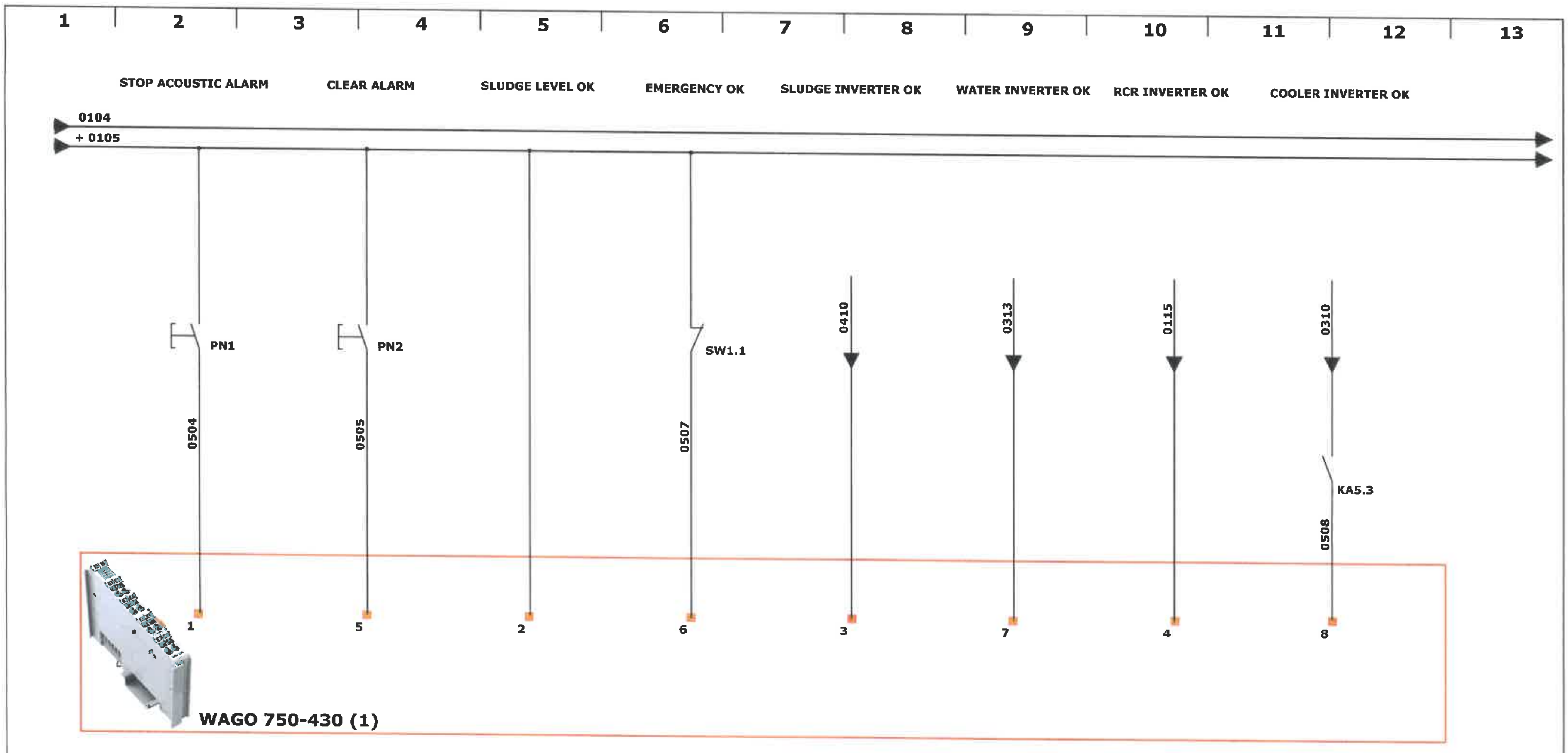

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HEAT RECOVERY SYSTEM mod.RHeX 1	n. schema/schematic no.	301090
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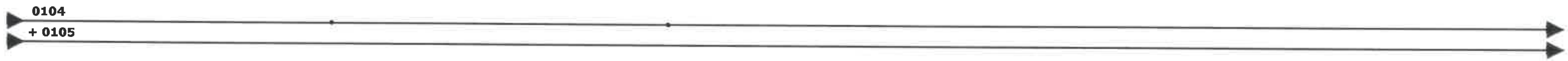

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	HEAT RECOVERY SYSTEM mod.RHeX 1	n. schema/schematic no.	301090
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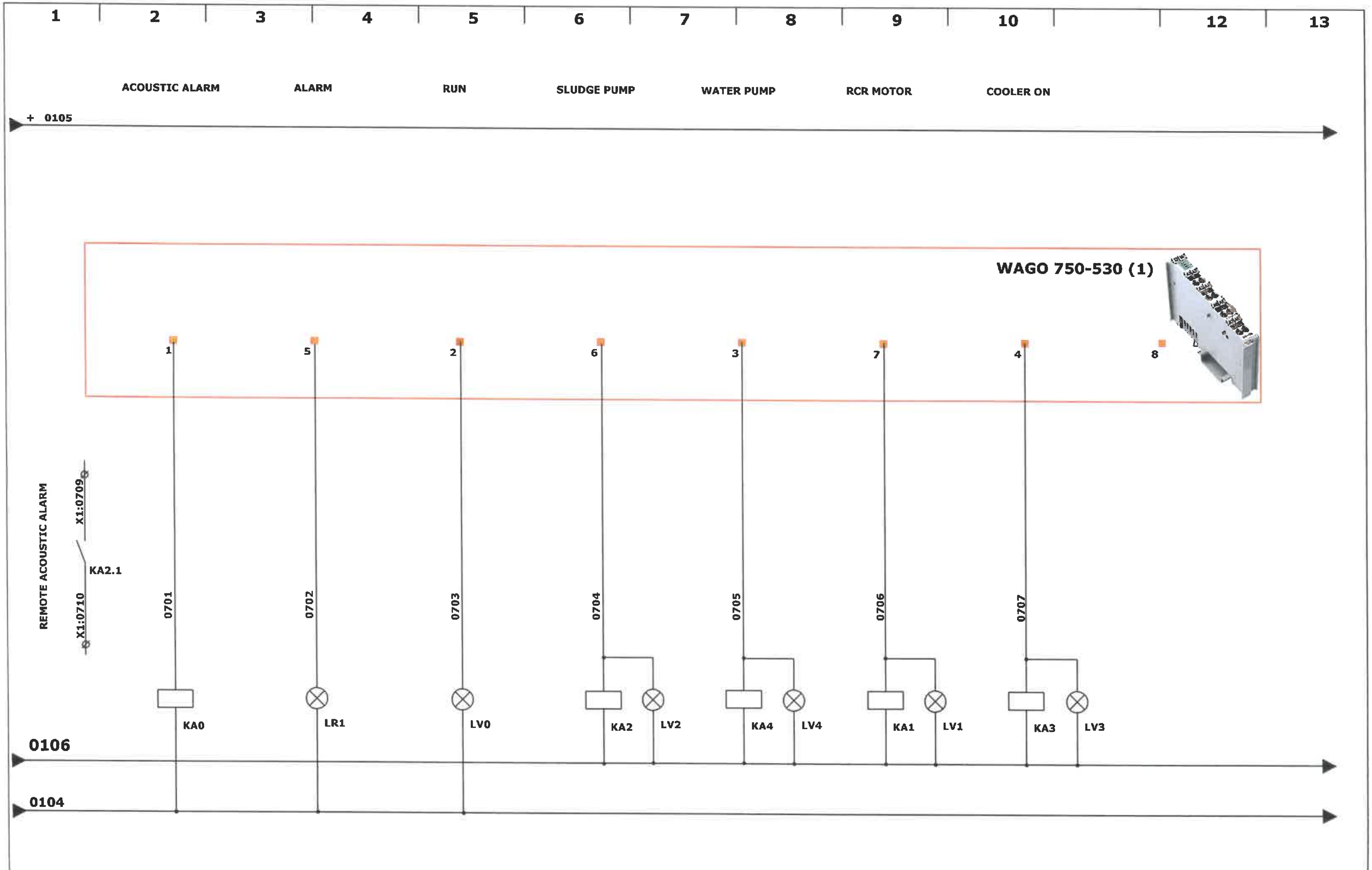

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HEAT RECOVERY SYSTEM mod.RHeX 1		n. schema/schematic no.	301090
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MACCHINA/MACHINE	HEAT RECOVERY SYSTEM mod.RHeX 1	n. serie/serial no.	5967N
		n. schema/schematic no.	301090
CLIENTE/CUSTOMER	ARROYO CULEBRO CUENCA BAJA - GETAFE, MADRID	data/date	
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HEAT RECOVERY SYSTEM mod.RHeX 1		n. schema/schematic no.	301090
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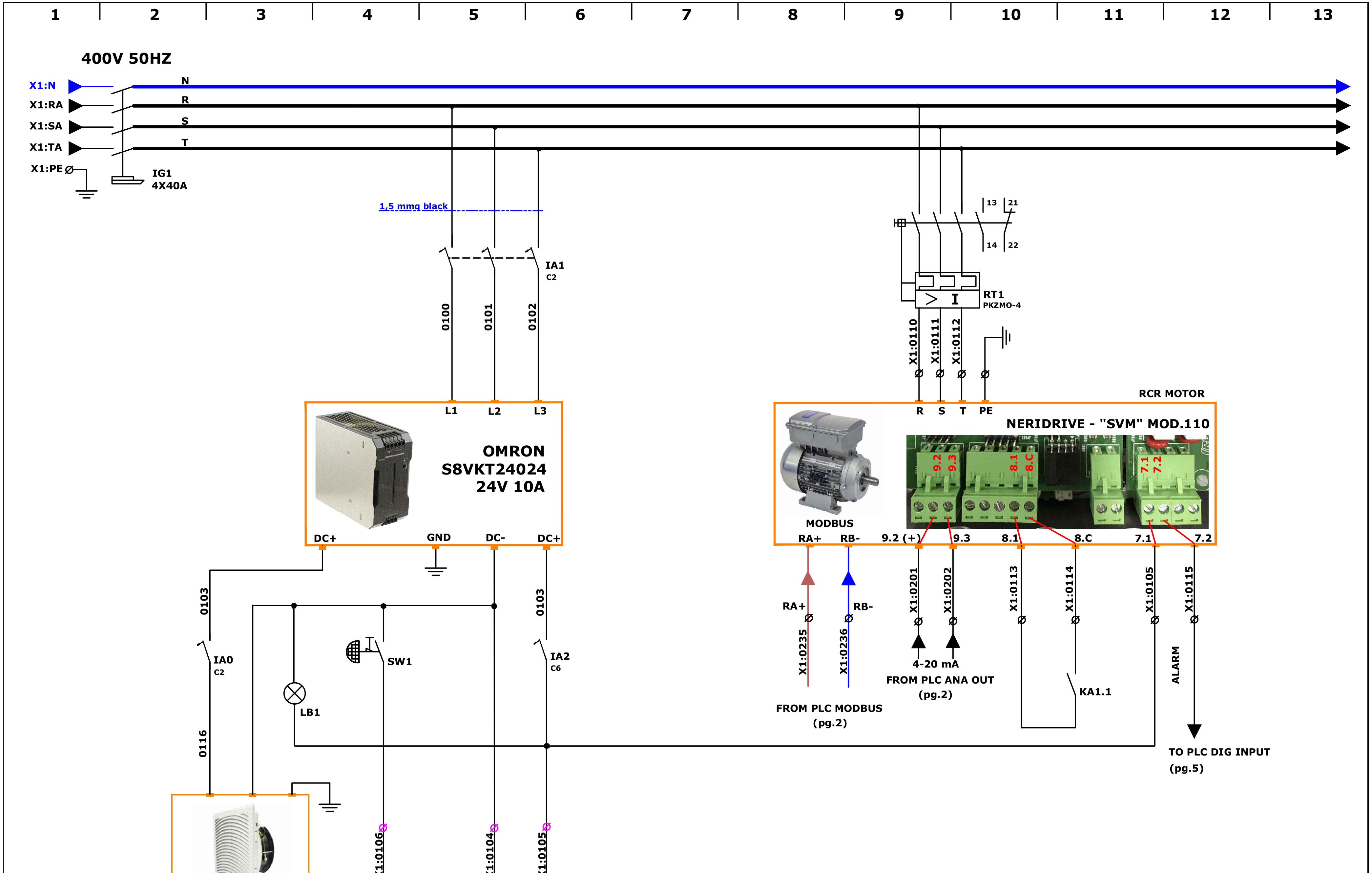

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CLIENTE/CUSTOMER		n. schema/schematic no.	301135
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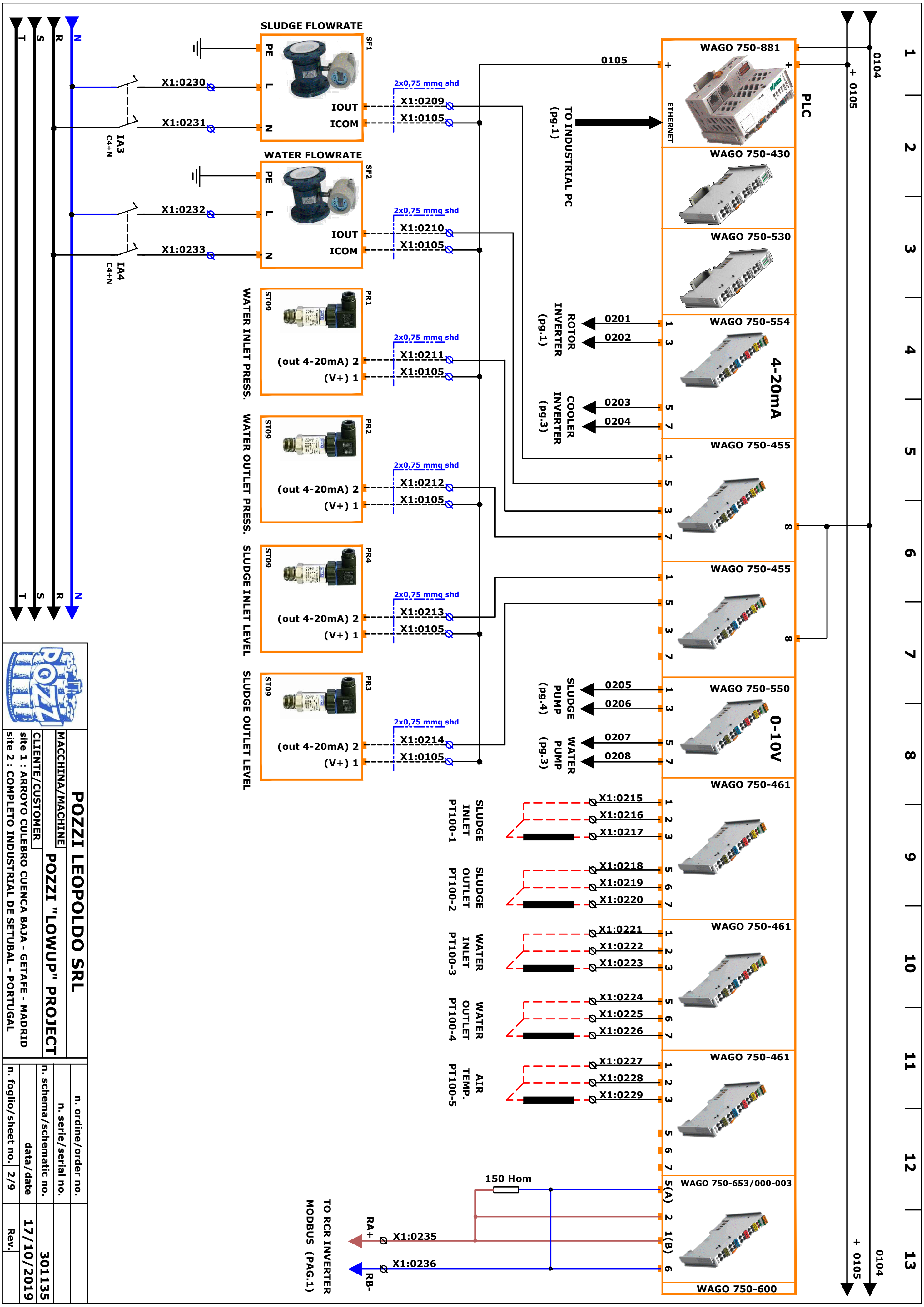

SLUDGE FLOWRATE
WATER FLOWRATE
SF1
SF2
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N
IOUT
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X1:0230
X1:0231
X1:0232
X1:0233
IA3 C4+N
IA4 C4+N
2x0,75 mmq shd
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X1:0105
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X1:0212
X1:0213
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PR4
PR3
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WATER OUTLET PRESS.
SLUDGE INLET LEVEL
SLUDGE OUTLET LEVEL
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0105
TO INDUSTRIAL PC (pg.1)
ETHERNET
WAGO 750-881
PLC
WAGO 750-430
WAGO 750-530
WAGO 750-554
4-20mA
0201
0202
ROTOR INVERTER (pg.1)
0203
0204
COOLER INVERTER (pg.3)
WAGO 750-455
WAGO 750-455
WAGO 750-550
0-10V
0205
0206
SLUDGE PUMP (pg.4)
0207
0208
WATER PUMP (pg.3)
WAGO 750-461
X1:0215
X1:0216
X1:0217
SLUDGE INLET PT100-1
X1:0218
X1:0219
X1:0220
SLUDGE OUTLET PT100-2
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X1:0221
X1:0222
X1:0223
WATER INLET PT100-3
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X1:0225
X1:0226
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WAGO 750-461
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X1:0228
X1:0229
AIR TEMP. PT100-5
150 Hom
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5(A)
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TO RCR INVERTER MODBUS (PAG.1)
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POZZI LEOPOLDO SRL
MACCHINA/MACHINE
POZZI "LOWUP" PROJECT
CLIENTE/CUSTOMER
site 1 : ARROYO CULEBRO CUENCA BAJA - GETAFE - MADRID
site 2 : COMPLETO INDUSTRIAL DE SETUBAL - PORTUGAL
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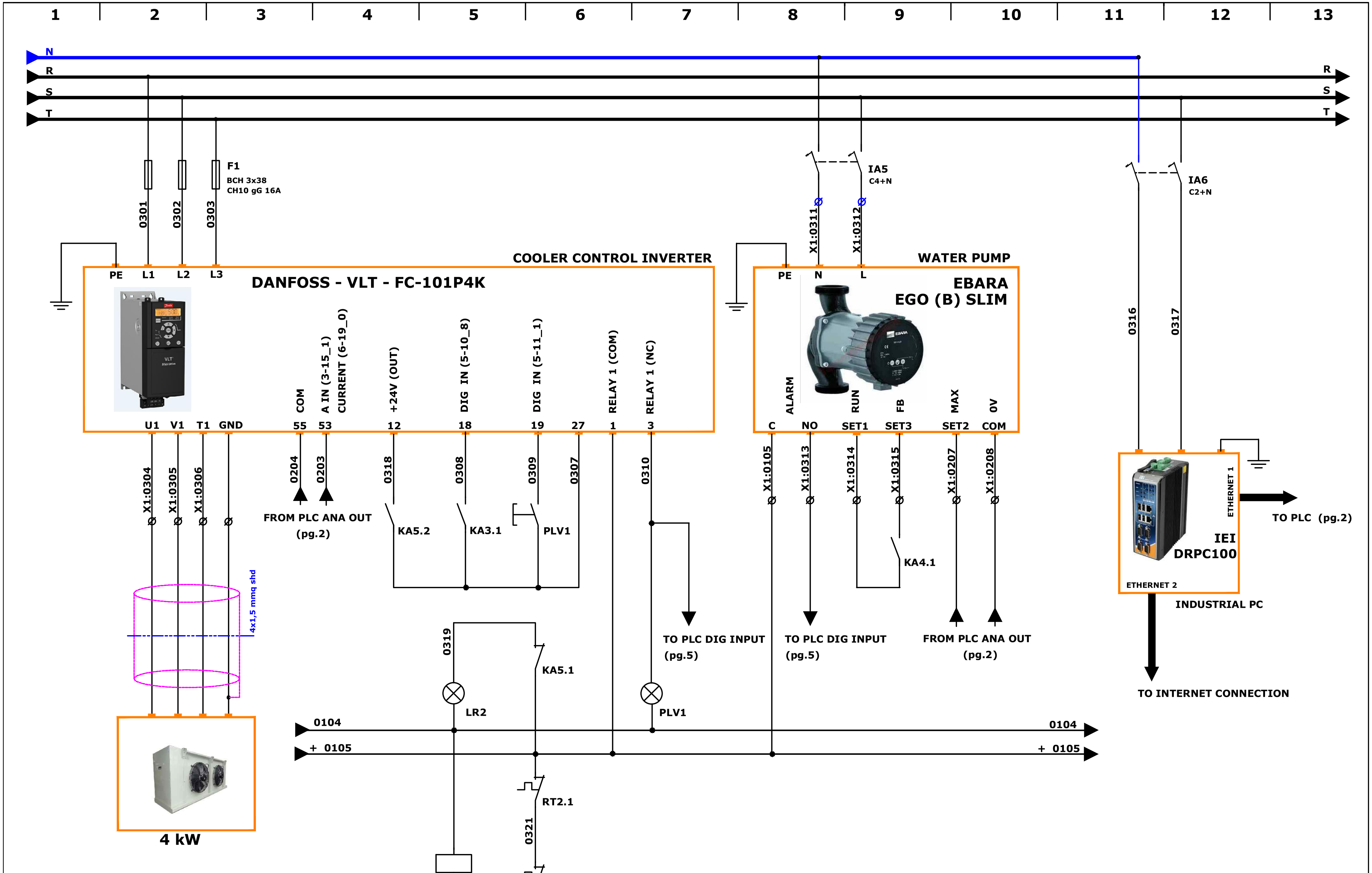
n. schema/schematic no. 301135
data/date 17/10/2019
n. foglio/sheet no. 2/9
Rev.



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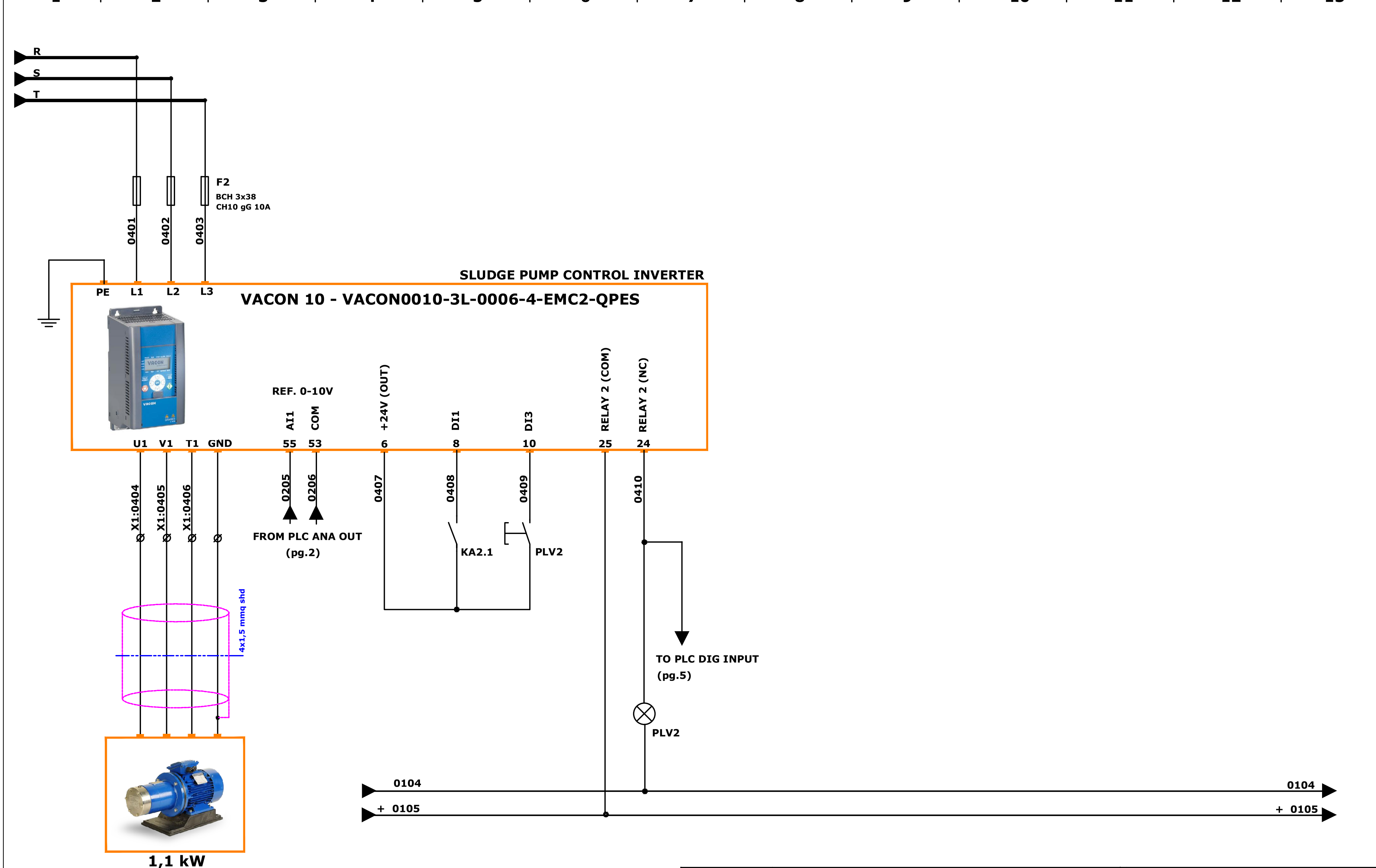

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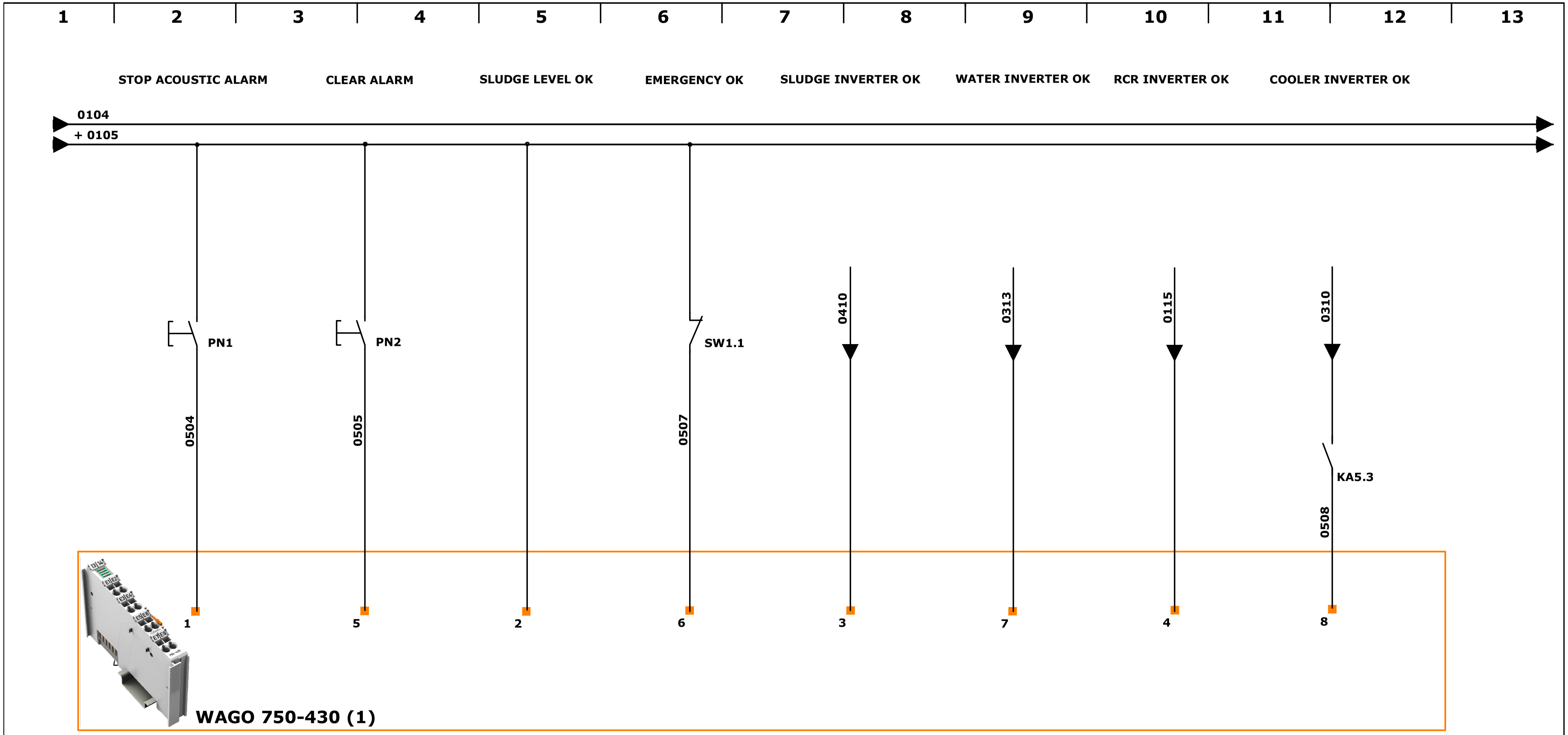

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site 2 : COMPLETO INDUSTRIAL DE SETUBAL - PORTUGAL	n. foglio/sheet no. 5/9	Rev.

1	2	3	4	5	6	7	8	9	10	11	12	13

POZZI LEOPOLDO SRL

MACCHINA/MACHINE

POZZI "LOWUP" PROJECT

CLIENTE/CUSTOMER

site 1 : ARROYO CULEBRO CUENCA BAJA - GETAFE - MADRID
site 2 : COMPLETO INDUSTRIAL DE SETUBAL - PORTUGAL

n. ordine/order no.	
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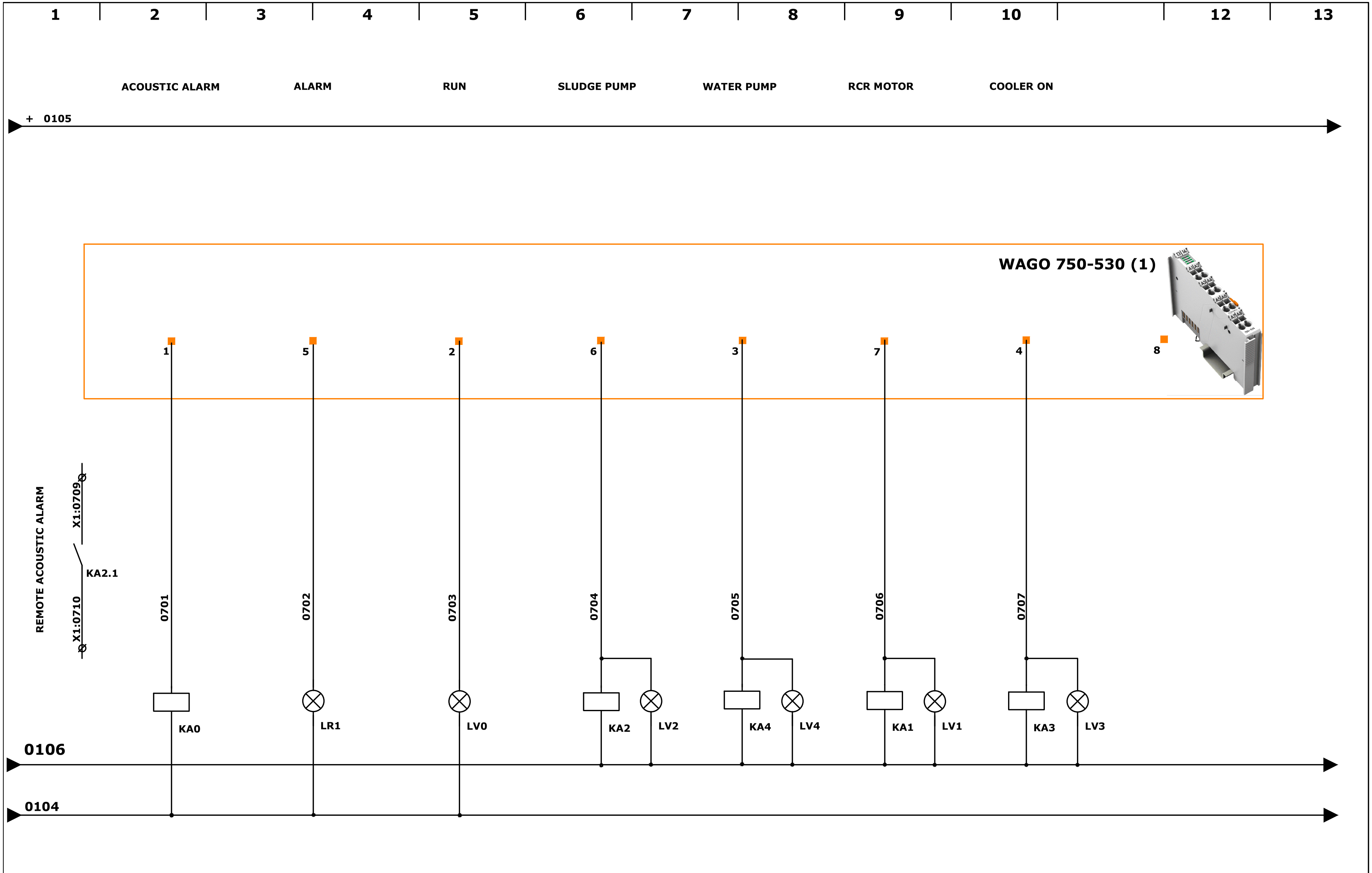

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CLIENTE/CUSTOMER	n. schema/schematic no.	301135
site 1 : ARROYO CULEBRO CUENCA BAJA - GETAFE - MADRID	data/date	17/10/2019
site 2 : COMPLETO INDUSTRIAL DE SETUBAL - PORTUGAL	n. foglio/sheet no. 7/9	Rev.

1	2	3	4	5	6	7	8	9	10		12	13

POZZI LEOPOLDO SRL	n. ordine/order no.		
MACCHINA/MACHINE POZZI "LOWUP" PROJECT	n. serie/serial no.		
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CLIENTE/CUSTOMER site 1 : ARROYO CULEBRO CUENCA BAJA - GETAFE - MADRID	data/date	17/10/2019	
site 2 : COMPLETO INDUSTRIAL DE SETUBAL - PORTUGAL	n. foglio/sheet no. 8/9	Rev.	

1	2	3	4	5	6	7	8	9	10		12	13

POZZI LEOPOLDO SRL

MACCHINA/MACHINE

POZZI "LOWUP" PROJECT

CLIENTE/CUSTOMER

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n. ordine/order no.	
n. serie/serial no.	
n. schema/schematic no.	301135
data/date	17/10/2019
n. foglio/sheet no. 9/9	Rev.

2019

RHeX

User Manual

V. 1.3.3

POZZI LEOPOLDO S.R.L. |Via Paganini 14, I-20825 BARLASSINA (MB), ITALY

POZZI LEOPOLDO

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The RHeX project has received funding by the European Union's Horizon 2020 Research and Innovation Program under Grant Agreement n° 723930.

This Manual is an integral part of:

Machine:	**Rotating Heat Exchanger RHeX**
Type:	**RHeX xx**
Serial Number:	**RH-xxxxN**
Production Year:	**2019**
Electric Power Supply:	**V. 400 ±10% - 50 Hz - 3 ph**
Mechanical Seal Type:	**TuCa (Tungsten Carbide)**
Special High Tank (+H)	**N/A**
Maximum Clean Water Pressure:	**4.5 bar**

THIS MANUAL HISTORY

REVISION	DATE	AUTHOR	COMMENTS
1.3.3	15/01/19	AP	Flex joints expanded
1.3.2	04/11/18	PLAM	Editorial Supervision
1.3.1	03/11/18	AP	Rotor maintenance added
1.3	20/10/18	AP	Maintenance added
1.20	10/09/18	AP	Added 3D renderings
1.10	12/06/18	CF	Added drawing
1.00	05/03/18	AP PLAM	Initial revision from existing docs

Declaration of conformity

Dichiarazione di conformità
Déclaration de conformité
Declaración de conformidad
Konformitätserklärung

Noi/We/Nous/Nosotros/Wir: **POZZI LEOPOLDO S.r.l.**
Via Paganini, 14
I-20825 BARLASSINA (MB)

dichiariamo sotto nostra unica responsabilità, che il prodotto,
declare under our sole responsibility that the product,
déclarons sous notre seule responsabilité que le produit,
declaramos, bajo nuestra sola responsabilidad, que el producto,
erklären, in alleiniger Verantwortung, dass dieses Produkt,

Scambiatore di calore rotante tipo:
Rotating heat exchanger type:
Echangeur de chaleur rotatif type:
Intercambiador de calor tipo:
Rotierender Wärmetauscher Typ:

RHeX xx

N° RH – xxxx N

a cui si riferisce questa dichiarazione è conforme alle seguenti norme o documenti normativi
to which this declaration relates is in conformity with the following standards or other normative documents
auquel cette déclaration se réfère est conforme aux normes ou aux documents normatifs
al que esta declaración se refiere es conforme a las normas u otros documentos normativos
auf das sich diese Erklärung bezieht, mit den folgenden Normen oder Richtlinien übereinstimmt

Direttiva/ Directive/ Richtlinie
2006/42 EEC -2014/35 EEC 2014/30 EEC
Norme armonizzate/ Harmonized Standards/ Harmonisierte Normen
EN ISO 12100/1 -EN 12100-2 -EN- ISO 13849 -EN ISO 14121

La sopra citata azienda conserva archiviata la seguente documentazione tecnica a Vostra disposizione:
The above-mentioned company keeps the following technical documentation on file for inspection:
L'entreprise surmentionnée a les documentations techniques suivantes à votre disposition:
La compañía arriba mencionada tiene la siguiente documentación técnica a su disposición:
Die obengenannte Firma hat folgende technische Dokumentationen zur Einsicht bereit:

Fascicolo tecnico della costruzione (parte A+ parte B)
Technical construction booklet (part A + part B)
Dossier technique de construction (partie A + partie B) n. CE 94001
Fasciculo tecnico de la construcción (parte A + parte B)
Technische Lieferung vom Maschinenbau (Teil A + Teil B)

Barlassina, 2019

Flavio Convento
Senior Engineer

POZZI LEOPOLDO S.r.l.
Alberto Pozzi – President

POZZI LEOPOLDO

Table of contents

Picture Index

1 Take Over Certificate

Dear Customer,

This RHeX heat recovery unit has been conceived and built according to indications of EC LWA 89/336 CEE - 2006/42/ CEE and 93/68.

Therefore, in order to assess its conformity, an ID plate displaying the CE mark is placed on the machine (see section 4).

The machine, when used according to instructions given by POZZI LEOPOLDO S.r.l., is not dangerous for the operator.

Before installing the machine, we recommend that you carefully read this User Manual and abide by the therein indicated procedures to guarantee operational safety and no risk of serious damage.

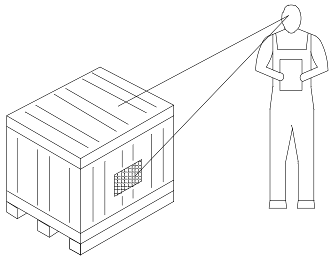
Furthermore, you must follow these guidelines:

- In order to install and put the machine to work, workers using this Manual must have a good knowledge of the machine and of all its components.
- The machine must be installed in an easy-to-reach place with wide lateral clearance required for operation and maintenance.
- The installation site must be well-lit and properly ventilated.
- The machine is provided with an identification plate and without such plate the machine may not be operated.
- The machine cannot be used outside its project characteristics without specific written authorisation issued by the producer.
- The operation of the machine must be supervised by trained operators who must be able to perform the correct proceedings; the operators must be aware of the possible risks involved in running the unit.
- This User Manual remains property of POZZI LEOPOLDO S.r.l. with all rights reserved.
- This Manual is intended only for the user of the machine; no other use is authorised.
- Reproduction in any form of any part of this Manual is forbidden.
- Laws and regulations for workers safety which are effective in the country of final installation of the machine have to be abided; as for Italy, especially the articles contained in D.P.R. 27-04-55 n.547 and D.L. 19-09-94 n.626 and following revisions.

2 General Safety Rules

- Ensure that all power sources are turned off when the machine is not in use. This includes electrical power. Understand the shutdown procedure and use it before inspecting, maintaining, servicing or cleaning the equipment to help prevent anyone from accidentally turning on power to the machine.
- Read the manual for any special operational instructions for each piece of equipment. The technical manual is typically included on a USB flash drive, or as a hard copy if requested.
- Know how the equipment functions and understand the operating processes.
- Know how to shut down the equipment. Stop buttons, emergency stop buttons or cables are located at various locations on the machinery. Activating these stop mechanisms will shut down specific equipment. Know where these stops are located and the equipment they shut down before operating the machinery.
- Understand the equipment safety labels and heed them.
- Wear the appropriate personal protective equipment for the job to be performed (e.g., eye protection, gloves, safety shoes, hard hat). Ensure that nothing you are wearing may get caught in the machine mechanisms.
- When working on or around all equipment, avoid wearing loose clothing, jewellery, unrestrained long hair, or any loose ties, belts, scarves or articles that may be caught in moving parts. Keep all extremities away from moving parts. Entanglement can cause death or severe injury.
- For new equipment, check plant voltage with the voltage specified on the machine plate. Electrical specifications for your machine are printed on the machine serial number tag. A properly grounded electrical receptacle is required for safe operation regardless of voltage requirements.
- Treat this equipment with the respect its power and speed demand. Use it only for its intended purpose.
- Keep the operating zone free of obstacles that could cause a person to trip or fall toward an operating machine. Keep fingers, hands or any part of the body out of the machine and away from moving parts when the machine is operating.
- Any machine with moving parts and/or electrical components can be potentially dangerous no matter how many safety features it contains. Stay alert and think clearly while operating or servicing the equipment. Be aware of operations and personnel in your surroundings.
- Do not perform maintenance on machinery if you are fatigued, emotionally distressed or under the influence of drugs or alcohol.
- Know where the FIRST AID SAFETY STATION is located.
- Know where FIRE EXTINGUISHING EQUIPMENT is located.
- “Horseplay” around machinery at any time is dangerous and unacceptable.
- Never sit or stand on the machine or on anything that might cause you to fall against the machine.
- Rotating and moving parts are dangerous. Keep clear of the operating area. Never put any foreign object into the operating area.
- Use proper lifting and transporting devices for heavy equipment. Some types of equipment can be extremely heavy. An appropriate lifting device should be used.

3 Delivery Inspection



Picture 1: Case inspection.

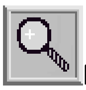
Upon receiving the machine, it is necessary to check that:

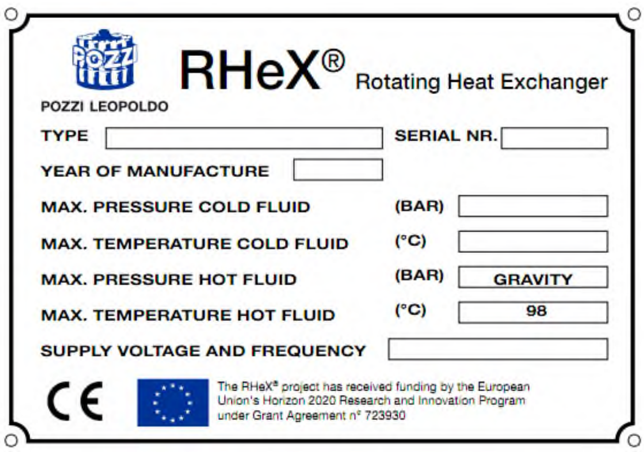
- The wooden case or cardboard box is complete and undamaged;
- The delivery data (delivery address, number of packages, purchase number) referring to transport documents are correct.
- Damage to fragile components must be verified and claimed within 5 days from delivery.

In case of damages or missing parts please inform immediately the forwarding agent, POZZI LEOPOLDO S.r.l. or its agent.

4 Machine Identification

The machine and its details are identified by a serial number shown on a plate on the machine and on page 2 of this Manual.

**Note:** you have to mention this serial identification number to POZZI LEOPOLDO S.r.l. for all maintenance requests and whenever instructed to do so.



Picture 2: Facsimile of ID plate

5 Warranty

Your heat recovery unit has been tested and inspected as follows:

- Size check of each part.
- All seals on the surfaces of the rotating axle are tested for absence of leakages with an inner pressure of 7 bar.
- Double-check of concentricity and perpendicularity of all assembled pieces with regard to the rotation axis.

In all cases the machine is covered by the following warranty conditions:

1. All POZZI LEOPOLDO S.r.l. products are covered by warranty for twelve months as of delivery date.
2. POZZI LEOPOLDO S.r.l. will solve any anomaly assessed by its technicians, when due to defects in materials or workmanship that can arise within the time limits indicated in the above point 1.
3. For each identified defect the buyer must give written notice to POZZI LEOPOLDO S.r.l. within eight (8) days from discovery.
4. All transport costs and insurance fees related to defective parts and/or repaired parts, or of parts delivered as substitution, included customs duties, must be paid by the customer.
5. The repair or the substitution of defective parts is a complete satisfaction of warranty duties.
6. The warranty does not include any direct and/or indirect damage caused by the machine to the installation where it is mounted.
7. This warranty does not include POZZI LEOPOLDO S.r.l. technicians' manpower, if requested, and any material subject to normal wear and tear.

This warranty does not include those parts that become damaged because of customer's inaccuracy or incorrect use, wrong maintenance and/or damages occurred by transport or any other cause which cannot be referred to material or production defects.

The warranty excludes all cases arising from an incorrect use, wrong application, use with fluids not compatible with the declared material of construction and/or from failure to comply with the rules contained in this Manual.

Warranty claim procedure

All parts subject to a warranty claim shall be sent back to the manufacturer in order to obtain a replacement or a repair, following indications in point 4.

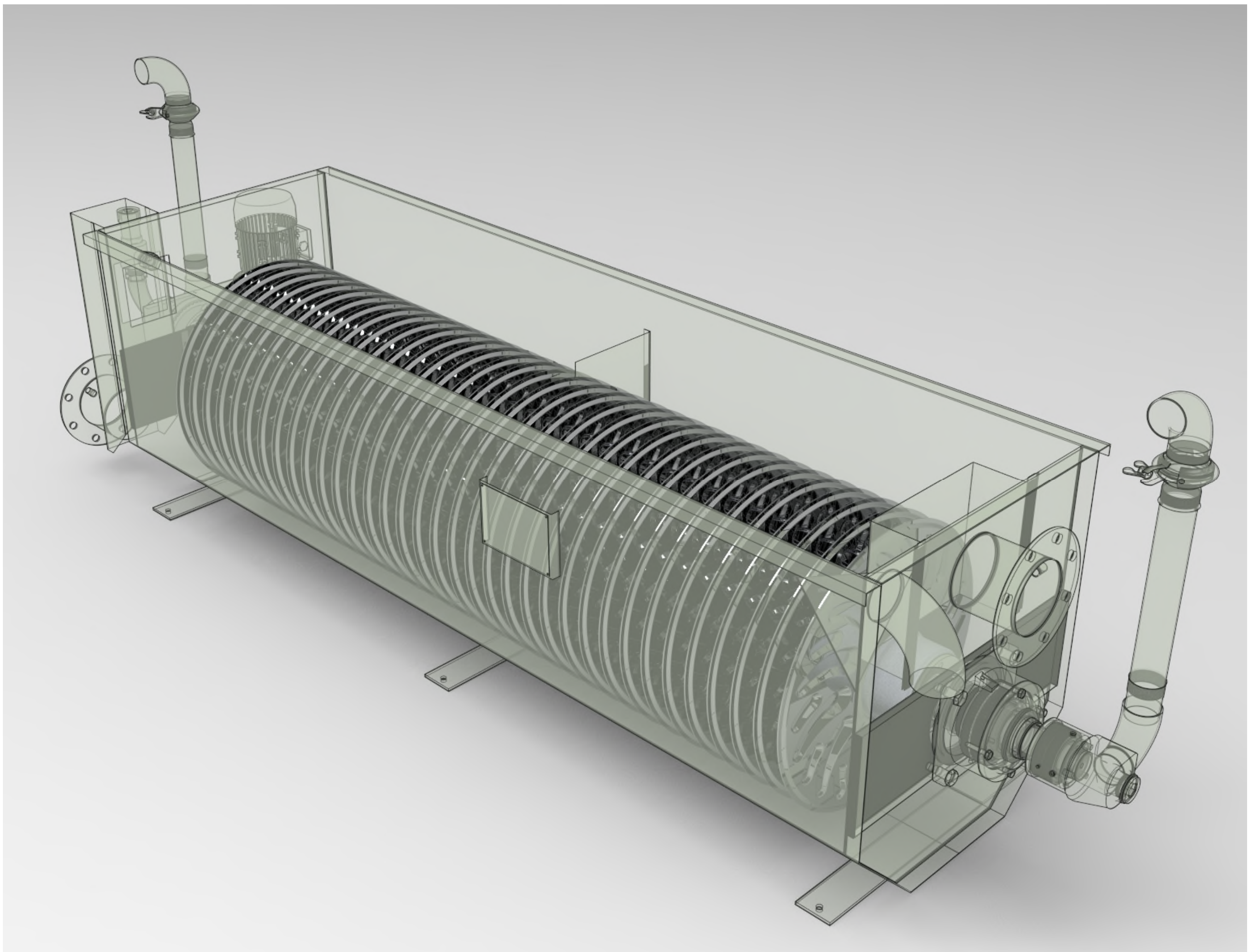
POZZI LEOPOLDO S.r.l. will repair or ship a replacement part under "tentative sale" conditions.

Upon receipt of the damaged part, POZZI LEOPOLDO S.r.l. will issue an analysis report stating whether the part has to be considered either a free replacement under warranty or the sale of a spare part, in which case a bill will be issued to the customer.

POZZI LEOPOLDO S.r.l.

6 Machine Description and Working Principle

6.1 How it is made



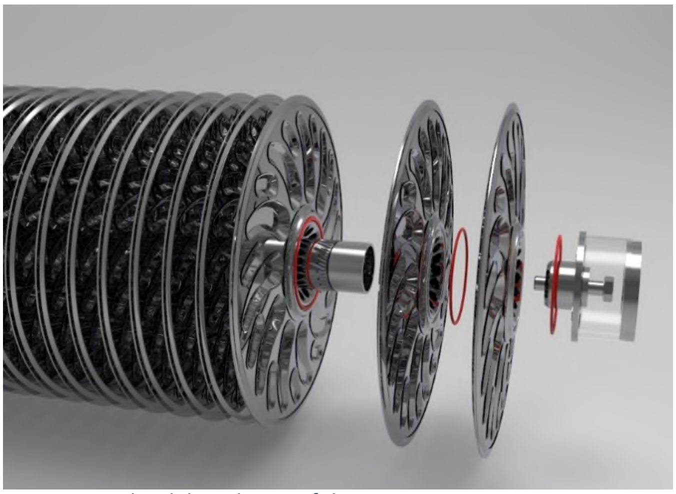
Picture 3: Design of the RHeX.

The RHeX enhanced rotating heat recovery unit is a recent development of the original RCR design; its main purpose as an exchanger is to be able to treat a very polluted stream of effluents minimising the effects of fouling and clogging, which standard heat exchangers are normally subject to.

The patented technology which lies behind RHeX design is based on the idea that the whole of the exchanging surface is constantly kept in rotation and its movement induces a centrifugal action which helps keeping the exchanger clean.

In addition to its anti–fouling action, the shape of the rotating discs, which are the actual exchanging surface of the machine, allows for a positive pushing action exerted on the primary fluid towards the outlet port of the exchanger. This, obviously, reduces the pressure loss on this circuit.

Picture 4: The lenticular disk of RHeX.



Picture 4a: The slid-on design of the RHeX rotor

Furthermore, each of the discs composing the rotor is no longer welded to the next one, whereas in the new RHeX design each disk is simply mounted on a central shaft with interposition of a gasket, allowing substitution in case of damage.

The heat recovery unit consists of:

- One or more ROTATING HEAT EXCHANGING ELEMENT made of AISI 316L stainless steel. The whole ROTOR is electrochemically mirror-polished. The rotation provides for the self-cleaning action of the surfaces.
- One EXTERNAL TANK with protection lid; this and all other parts in contact with the operating fluids are made of AISI 316L stainless steel. The tank has connections for discharge water outlet and inlet, overflow pipe and tank emptying valve.
- Two or more sealing groups and support assemblies to allow the rotation of the rotor
- ROTATING JOINTS for fresh water inlet and outlet connected to the rotor.
- One SAFETY VALVE on the fresh water circuit.
- One MOTOR GROUP consisting of one or two moto-reducers with pulleys and toothed belts.
- One INVERTER to allow for the pre-setting of rotational speed of the machine and of the start – stop ramps.

Note: No start/stop motor device is included in the machine. Only an emergency pushbutton is mounted on the machine.

Warning: The machine will operate as soon as you connect it to electrical power (provided that the emergency pushbutton has been reset).

6.2 Working principle

The exchanger is basically made to treat two streams of counter current fluids; in this Manual we will refer to them as follows:

- **A primary fluid**, flowing outside the rotor of the exchanger (inside the trough of the exchanger). This fluid will be subject to a very low-pressure loss. In fact, gravity will be the sole force used to push this fluid through the exchanger. This fluid can be highly polluted even with mechanical impurities.
- **A secondary fluid**, flowing inside the rotor, counter current to the primary one. This fluid must be free from mechanical impurities which might remain trapped in the rotor due to the separating effect of the centrifugal force generated during rotation. Pressure loss in this case will be dependent on RHeX model, flow-rate and rotational speed.

6.2.1 When RHeX is used as a cooling device

The hot discharge water (primary fluid) which can be contaminated with both chemical and physical pollutants, coming from tanks or directly from discharges of continuous machines, is introduced (as much as possible with a constant flow-rate) in the RHeX tank, through flanged connections.

The flow of discharge waters runs through the tank using gravity only (the height difference between inlet and outlet) and it is flown around the rotor by means of especially shaped deflectors.

The fresh clean water (secondary fluid), coming from the hydraulic network at a max. pressure of 4.5 bar, is fed inside the rotor through the flexible manifold and the rotating joints. The rotor is made of many shell-shaped elements, inside which a canalisation is created so that water circulates in a perfect counter-current flow running against the discharge water.

The rotor is activated by an inverter-controlled moto-reducer; the speed of the elements inside the water causes a turbulent movement which increases the thermal exchange efficiency and avoids the physical pollutants deposit on the exchanger walls.

The clean water, after having run across the rotor, exits from the opposite rotating joint as heated water.

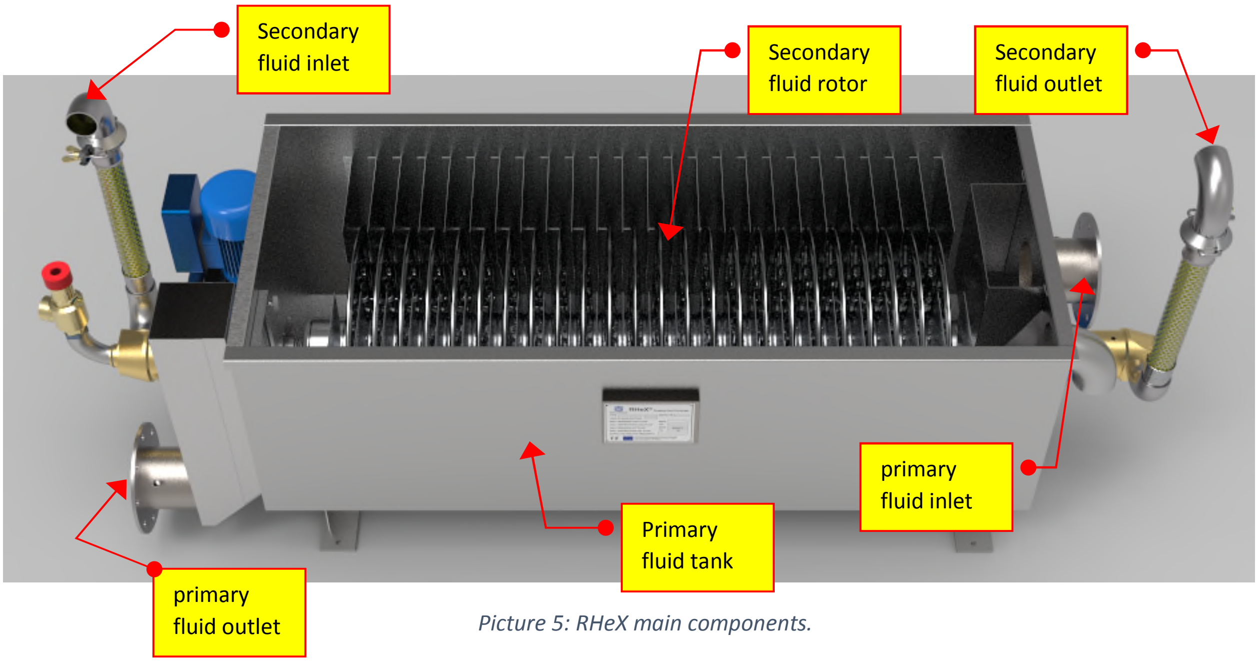
The discharge water, on the contrary, has been cooled off since it has transferred its thermal content to the fresh water. The two circuits have fully opposite, counter-current directions, so to optimize the thermal exchange.

6.2.2 When used as a heating device

The unit can also be used as a heating device, making sure that the clean heating medium flows inside the rotor while the contaminated fluid flows inside the tank.

Heating medium can be water or other fluid with no solid content and with a maximum temperature of 98°C.

Under special circumstances low-pressure steam or overheated water can be used as a heating medium considering that, in this case, the maximum allowed pressure is 0.5 bar.



Picture 5: RHeX main components.

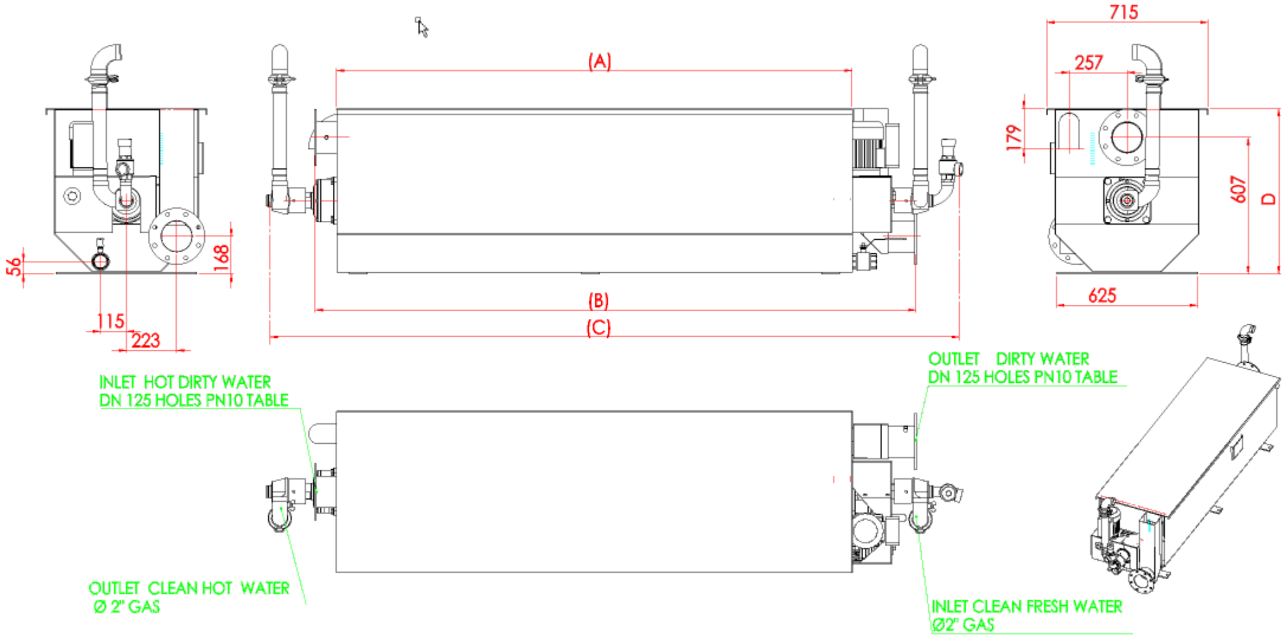
7 Dimensions and ratings

7.1 Dimensions

7.1.1 Dimensions of single-rotor units

The rotating heat exchanger comes in several models depending on the required heat exchanging surface and the ability to cope with transients on the primary circuit.

Apart from size, connections and motors of double-rotor units, all RHeX units share the same constructive details and hydraulic circuits.



Picture 6: Single rotor RHeX models

The following table reports the dimensional characteristics of each single-rotor model:

TYPE	A mm	B mm	C mm	D mm	code	# rotors
RHeX 20	1683	2066	2485	735	120868	1
RHeX 20+H	1683	2066	2485	885	120868H	1
RHeX 30	2288	2671	3090	735	120871	1
RHeX 30+H	2288	2671	3090	885	120871H	1
RHeX 2+	2096	2305	2889	735	120968	1
RHeX 3+	2892	3101	3680	735	120971	1

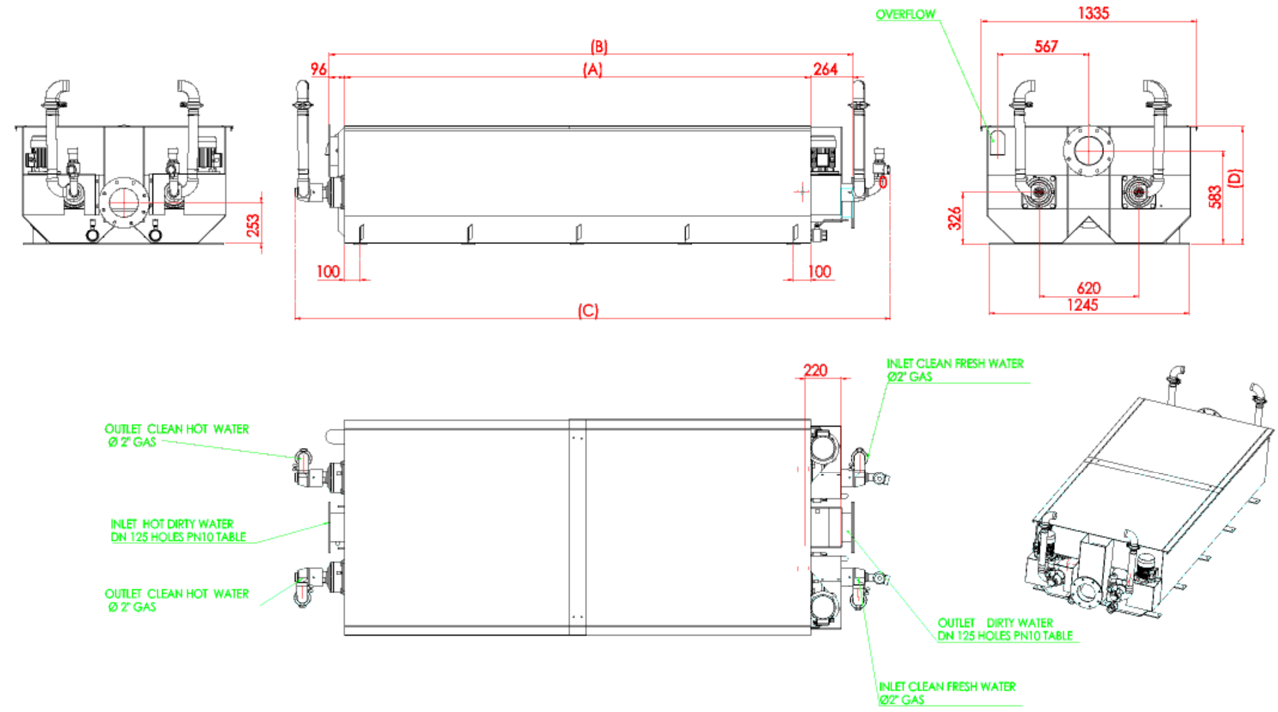
Table 1: RHeX dimensions.

A customised execution, available only on request, provides the RHeX units with an extra high tank.

This option can be ordered as **RHeX-xx+H**; in this case the trough height is increased by 150 mm.

This special design allows the RHeX to cope with high transients on the primary flow by by-passing a portion of the primary flow-rate above the rotor.

7.1.2 Dimensions of double-rotor units



Picture 7: Double-rotor RHeX models

The following table reports the dimensional characteristics of each double-rotor model:

TYPE	A mm	B mm	C mm	D mm	code	# rotors
RHeX 40	1683	2043	2485	735	120872	2
RHeX 40+H	1683	2043	2485	885	120872H	2
RHeX 50	2013	2373	2815	735	120873	2
RHeX 50+H	2013	2373	2815	885	120873H	2
RHeX 60	2288	2648	3090	735	120874	2
RHeX 60+H	2288	2648	3090	885	120874H	2
RHeX 4+	2096	2305	2889	735	120972	2
RHeX 5+	2528	2737	3410	735	120973	2
RHeX 6+	2892	3101	3680	735	120974	2

Table 2: RHeX dimensions.

Also in the case of double-rotor models, a customised execution, available only on request, provides the RHeX units with an extra high tank.

This option can be ordered as **RHeX-xx+H**, in which case the trough height is increased by 150 mm.

This special design allows the RHeX to cope with high transients on the primary flow by by-passing a portion of the primary flow-rate above the rotor.

7.2 Weights

Shipping weights of each RHeX model are as follows:

TYPE	NET weight	GROSS weight	Packing type	code	# rotors
RHeX 20	580 kg	670 kg	case	120868	1
RHeX 30	761 kg	857 kg	case	120871	1
RHeX 40	1210 kg	1450 kg	cage	120872	2
RHeX 50	1366 kg	1621 kg	cage	120873	2
RHeX 60	1521 kg	1786 kg	cage	120874	2
RHeX 2+	656 kg	746 kg	case	120968	1
RHeX 3+	878 kg	974 kg	case	120971	1
RHeX 4+	1342 kg	1582 kg	cage	120972	2
RHeX 5+	1534 kg	1789 kg	cage	120973	2
RHeX 6+	1726 kg	1991 kg	cage	120974	2

Table 3: RHeX weight.

7.3 Hydraulic Ratings: Flow-rate ratings

7.3.1 Primary fluid flow-rate

For each RHeX model a max suggested flow-rate is set; this flow-rate is a safe estimate of a flow which does not result in overflowing [1](with +H models the flow exceeding this data will not go to overflow but will be internally bypassed).

The higher the flow-rate, the higher is the level of fluid towards the primary fluid inlet, finally resulting in overpassing the level of the overflow port.

TYPE	suggested max m^3/h	disks	surface m^2	code	# rotors
RHeX 20	9,6	24	13,2	120868	1
RHeX 30	14,4	35	19,25	120871	1
RHeX 40	19,2	48	26,4	120872	2
RHeX 50	24	60	33	120873	2
RHeX 60	28,8	70	38,5	120874	2
RHeX 2+	12	31	17,05	120968	1
RHeX 3+	17	46	25,3	120971	1
RHeX 4+	22	62	34,1	120972	2
RHeX 5+	28	78	42,9	120973	2
RHeX 6+	32	92	50,6	120974	2

Table 4: RHeX models characteristics.

[1] Action on the removal of baffles or different settings for speed of rotation might be necessary.

Note: Flow-rates, in applications involving continuously fed machines, are generally considered equal to both circuits (primary and secondary); it is, however, possible to choose different flow-rates (included between 0 e Q_{max}) for the two circuits: the choice must be done so to optimize the thermal recovery, by preferring, according to user needs, the maximisation of either the exit temperature or that of the flow-rate of the “cold” secondary fluid.

7.3.2 Secondary fluid flow-rate

The secondary fluid flow is passing in a pressurized circuit; **the maximum allowable flow-rate** is, therefore, determined by the sum of the pressure losses generated against the maximum allowable pressure in the rotor as follows:

Pressure needed at delivery point + pressure loss in the exchanger rotor (see Ch. 7.4.2) < 4.5 bar

7.4 Hydraulic Ratings: Pressure Loss

7.4.1 Primary circuit pressure loss

The primary circuit is gravity fed; the maximum pressure loss is, therefore, determined by the physical height difference between input and output ports (60mm of H_2O column) and the filling coefficient of in and out pipes. Refer to chapter 7.3.1 for suggested maximum flow-rate.

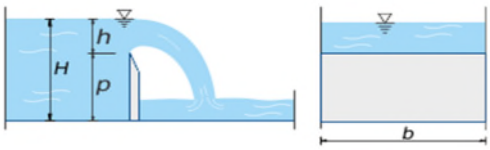
Picture 8: The weir & level device

It has to be noted that the RHeX models have an outlet level-control device which can control the filling level in the tank.

The use of this device is double:

- By lifting the weir blade insert, the overall level in the tank will rise; this is useful when a large unit is used with a rather low flow-rate, thus allowing a better coverage of the rotor disks by the primary fluid.
- Furthermore, the weir blade insert has a series of marks on its right side: these marks give an indication of the primary fluid flow-rate as one reads the plume level passing over the weir blade in the slot.

The flow-rate can be determined as follows:



$$Q = \mu \cdot b \cdot \sqrt{2 \cdot g} \cdot h^{3/2}$$

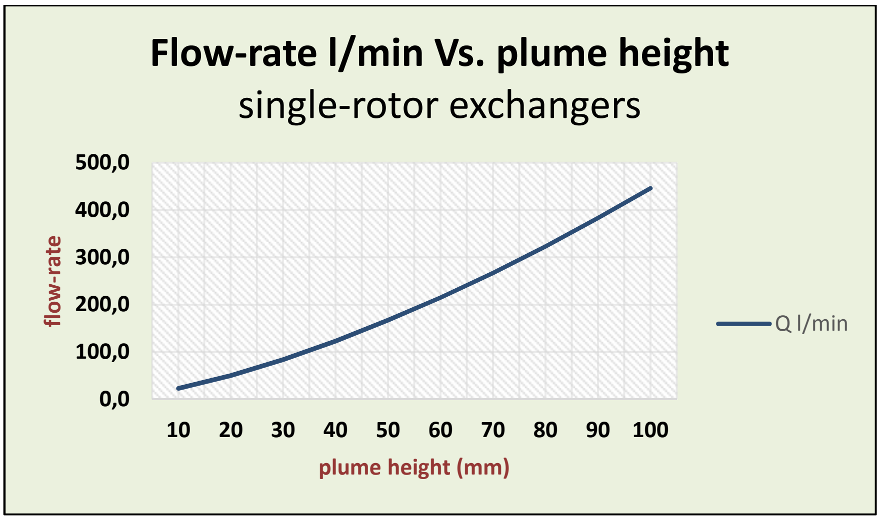
$$\mu = \left(0{,}405 + \frac{0{,}003}{h}\right) \cdot \left(1 + 0{,}55 \cdot \frac{h^2}{H^2}\right)$$

Picture 9: The weir math.

NOTE: The reading is obviously intended only as an indication and is not a precise measurement, but can be very useful during set-up of the exchanger.

In practice the flow-rate is proportional to the plume height (h) which can be read on the weir scale. A rough estimate of the flow-rate can be read from the following graphs:

FOR SINGLE-ROTOR EXCHANGERS:



Picture 10: Flow-rate measure (single rotor)

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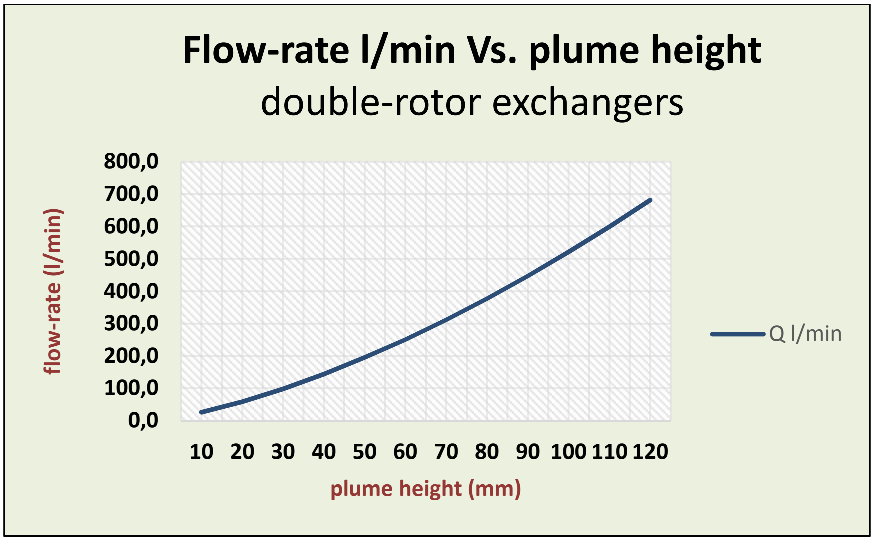
FOR DOUBLE-ROTOR EXCHANGERS:

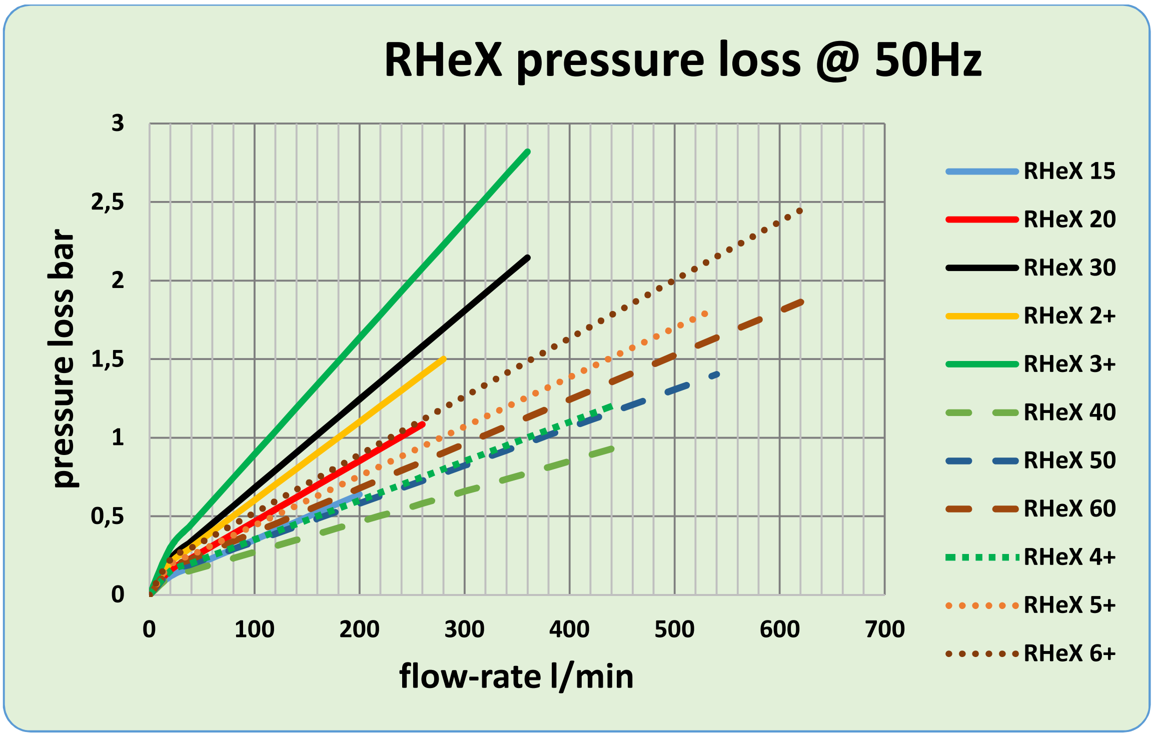


Picture 11: Flow-rate measure (double rotor)

7.4.2 Secondary circuit pressure loss

The rated working pressure of the RHeX rotor is 4.5 bar.

The pressure loss developed in the circuit is dependent on the flow-rate and the rotational speed of the rotor (moto-inverter shipped with 50Hz pre-set frequency), according to the following graph:



Picture 12: Secondary circuit pressure loss (all models)

Warning:

Even transient pressure peaks will damage the rotor.

Care has to be taken that no hammering effect on the rotor arises due to the hydraulic design of the downhill circuit.

When a pipe is suddenly closed at the outlet (downstream), the mass of water before the closure is still moving, thereby building up high pressure and a resulting shock wave. In industrial plumbing this is normally experienced as a loud banging resembling a hammering noise. Water hammer can cause RHeX rotors to break if the pressure is high enough.

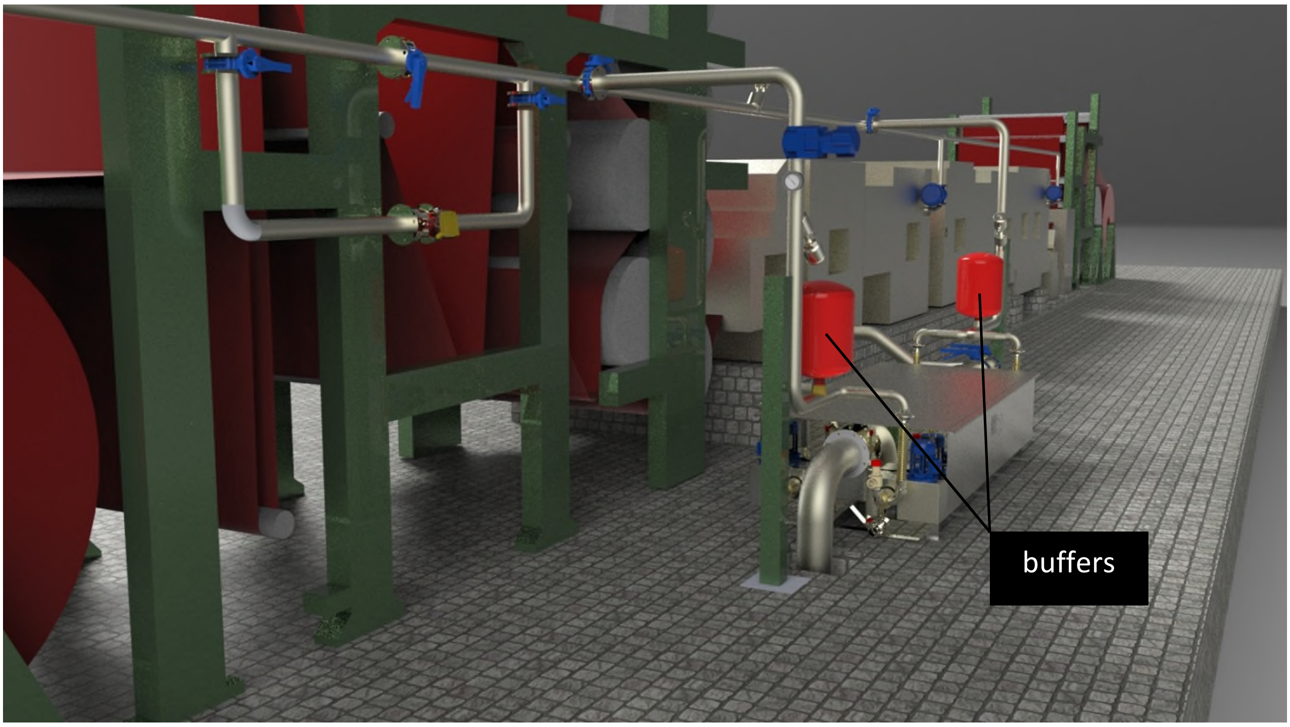
Suddenly closing valves mounted downstream the rotor can produce shock waves with pressure spikes exceeding 20 bars. Air traps or special dampers are sometimes added to RHeX systems to absorb the potentially damaging forces caused by the moving water.

POZZI LEOPOLDO markets specially modified dampers to avoid this effect, see our spares site:

http://www.pozzienergy.it/rcr-eop-20-60/piping-43/

With no downstream valve, or only slow-moving valves mounted in the circuit after the exchanger and with line pressure not exceeding 4.5 bars, no particular care needs to be exerted.

If shut-off valves are to be mounted, the suggested final configuration should be as follows:



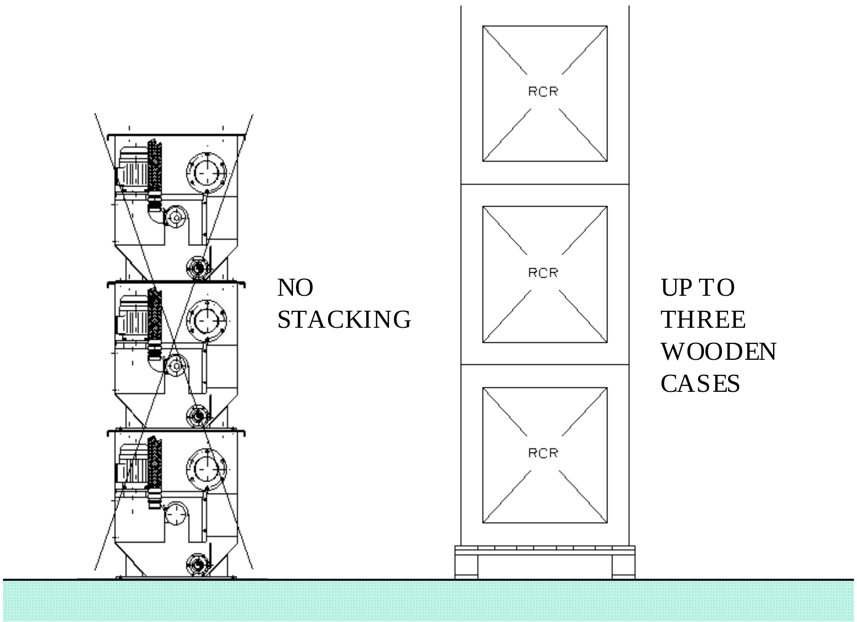
Picture 13: Exchanger with buffers

8 Fitting and commissioning of the unit

8.1 Transport and Storage

Warning: Before transportation and long-term storage, the internal rotor may have to be blocked to avoid damage to the seals. RHeX units are shipped either with a palleted cardboard box packing or in a wooden cage (special request).
Units without a customised wooden cage cannot be stacked one on top of the other. Note that the standard cardboard box supported by a wooden pallet cannot be stacked.

Warning: When the unit is not packed, extreme caution should be paid to the protruding rotating joints and moto-reducer parts.
If stacking is requested, you have to order special wood-case shipping: units enclosed in a proper wooden Pozzi Leopoldo-supplied cage can be stacked on top of each other up to a maximum of three layers.

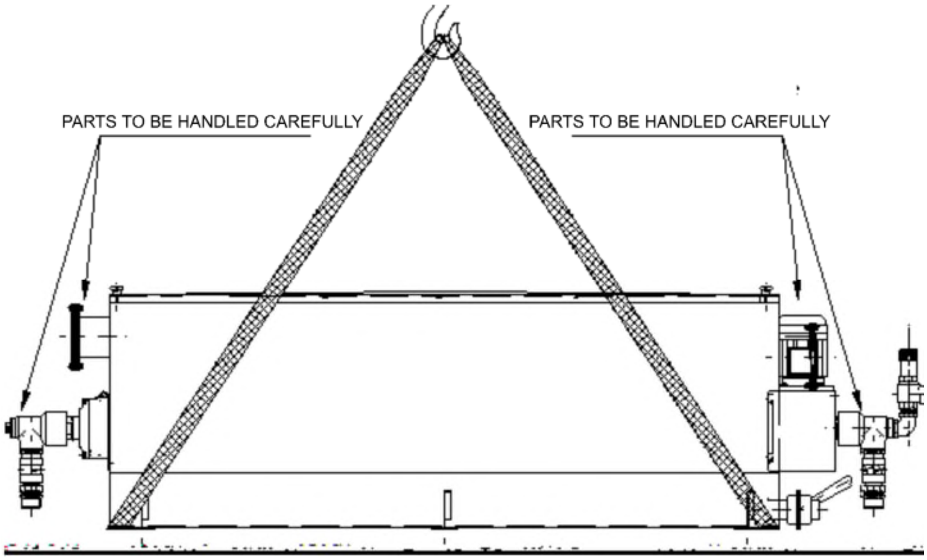


Picture 14: Stacking options.

8.2 Handling

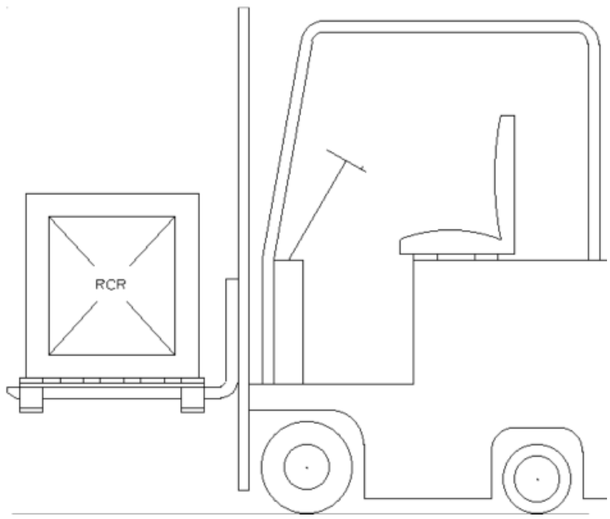
Warning: The machine does not have any handle, hook or protrusion intended for handling or lifting.

The machine must always be handled (and especially lifted) using belts positioned on the bottom of the tank, so that they do not affect rotating and power groups when tensioned, as shown in the following picture:



Picture 15: Handling of the unpacked unit.

If the unit is delivered in a wooden or cardboard case, this can be handled with belts fixed at the two ends or by a fork-lift as shown in the following picture:



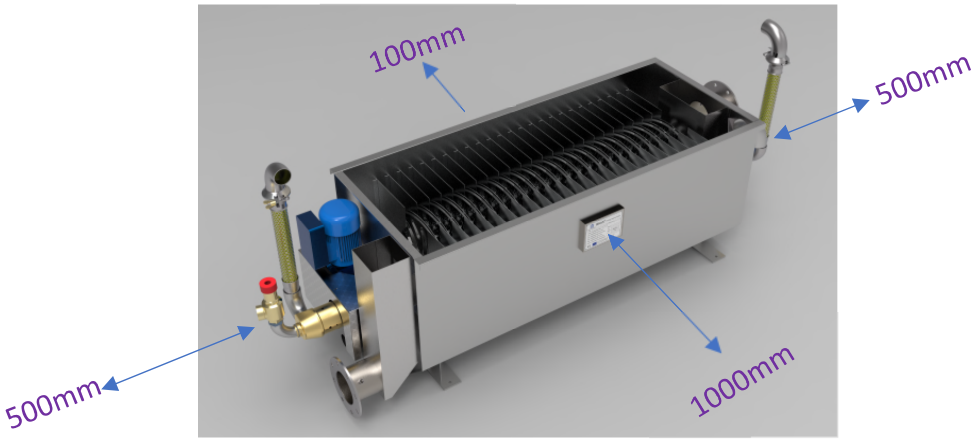
Picture 16: Handling the packaged unit with a forklift.

8.3 Site Requirements

The area where the RHeX is installed has to fulfil few requirements:

Once running, machine surfaces can become very hot, therefore it is mandatory that proper protecting fences or paddings are available to avoid accidental contact with surfaces and to prevent operators from eventual scorching.

However, such protections must allow for maintenance and/or temporary cleaning of the unit, so the following minimum side clearances are required: 0.5m on the short sides, free access to the side where the identification plate is installed, and 0.1m on the opposite side.



Picture 17: RHeX clearances, ID plate must be visible.

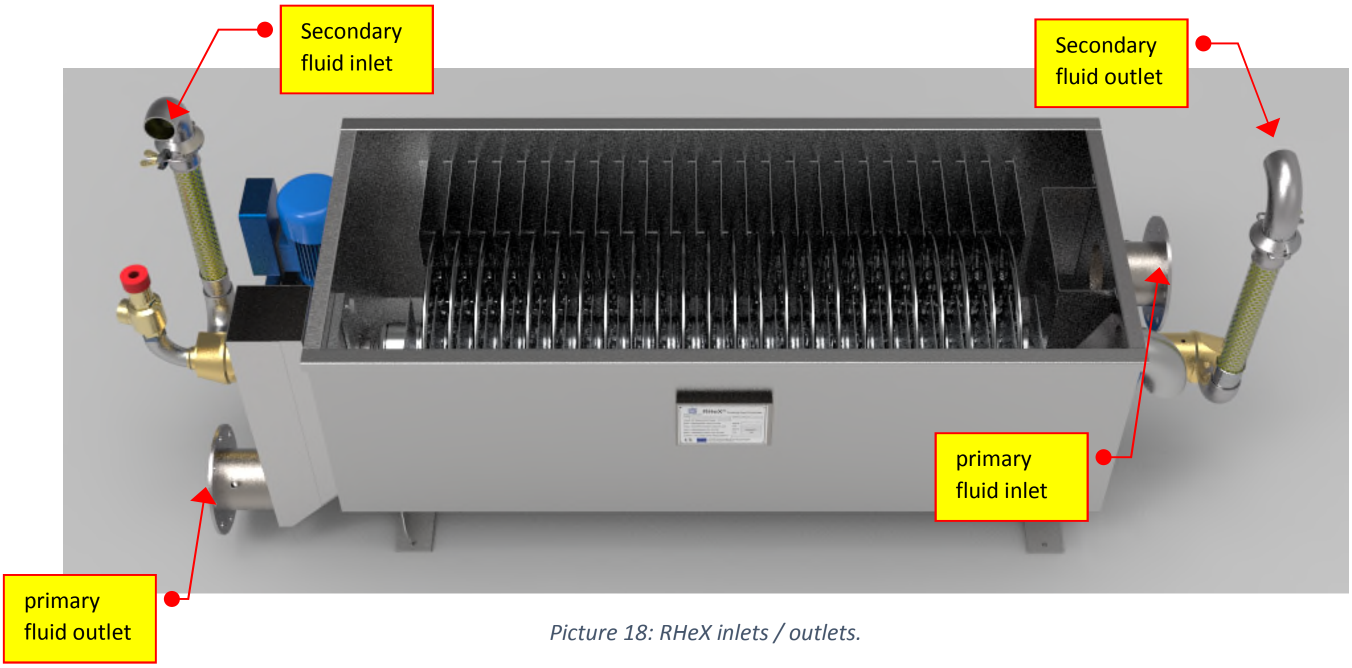
During the installation it is possible to foresee a slight inclination (20-30 mm) towards the primary fluid outlet (i.e., to the side of the moto-reducer). This is to allow for complete drainage of the trough.

Note: The machine is not adequate for outdoor installation. If proper protection for moto-reducer and electrical connection is provided, an outside installation is possible.

Warning: If installed outside, be careful not to expose the unit at temperatures lower than 2°C as icing might damage the unit.

8.4 Connections to fluid networks

The connection to the networks of fluids must be made in order to guarantee that the "HOT" side of the primary fluid stays far from the moto-reducer. The two fluids circulate in a counter current stream, opposite to each other. This means that the secondary fluid ("cold" fluid) comes into the unit from the moto-reducer side and the primary fluid ("hot" fluid) comes into the tank from the opposite side, as shown in the following picture.



Picture 18: RHeX inlets / outlets.

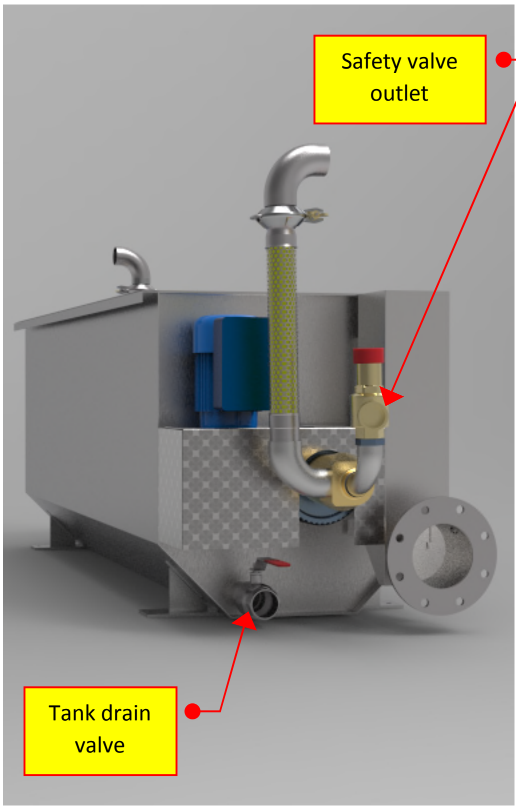
The following table gives the connection specifications for each RHeX type.

TYPE	secondary in	secondary out	primary in	primary out
RHeX 20	Ø2" gas	Ø2" gas	DN125	DN125
RHeX 30	Ø2" gas	Ø2" gas	DN125	DN125
RHeX 40	2 x Ø2" gas	2 x Ø2" gas	DN175	DN175
RHeX 50	2 x Ø2" gas	2 x Ø2" gas	DN175	DN175
RHeX 60	2 x Ø2" gas	2 x Ø2" gas	DN175	DN175
RHeX 2+	Ø2" gas	Ø2" gas	DN125	DN125
RHeX 3+	Ø2" gas	Ø2" gas	DN125	DN125
RHeX 4+	2 x Ø2" gas	2 x Ø2" gas	DN175	DN175
RHeX 5+	2 x Ø2" gas	2 x Ø2" gas	DN175	DN175
RHeX 6+	2 x Ø2" gas	2 x Ø2" gas	DN175	DN175

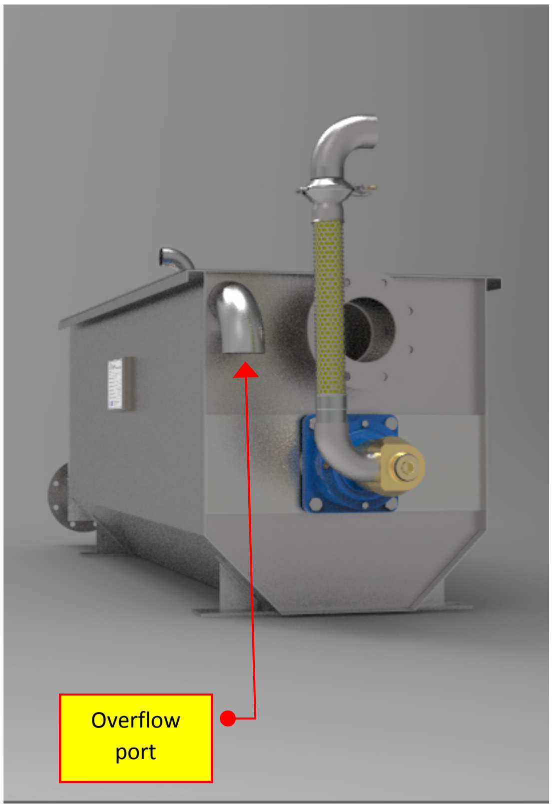
Table 5: Connection table.

8.4.1 Primary Fluid Connections

The primary fluid generally consists of fluid coming out of a continuous process that could be operating while the heat exchanger needs special cleaning or maintenance. Therefore, we recommend that a by-pass circuit is created to allow exclusion of the RCR while permitting plant operation.



Picture 19: RHeX motor side.



Picture 20: RHeX non-motor side.

When the heat exchanger is off-line, its tank can be emptied using the valve (reference in Picture above).

An overflow device (reference in Picture above) is installed into the heat exchanger tank and it is provided for connection to a discharge pit, should overflow conditions arise.

8.4.2 Secondary Fluid Connections

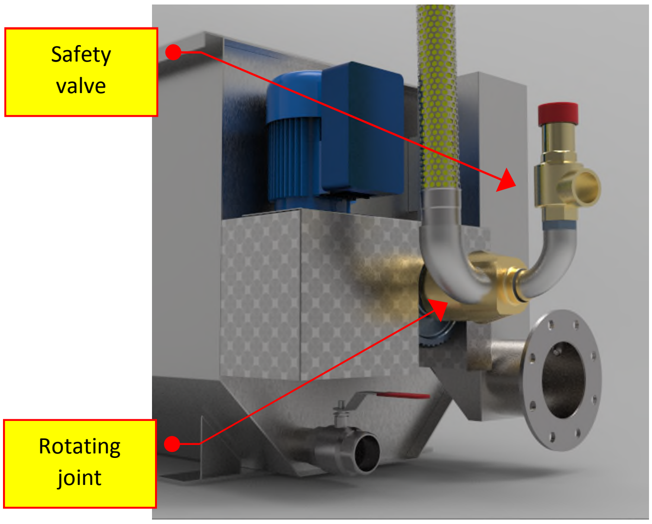
The secondary circuit connects the heat exchanging element (the rotor) to the clean fluid network.

In order to avoid deposits or sedimentations caused by hardness, we suggest that this fluid should be softened and filtered (in case of water).

To protect the rotor from too high an internal pressure, a safety valve is installed on the water inlet of the rotor side.

Note: The safety valve is factory regulated to 4.5 bar and may not be tampered with.

The safety overpressure valve is delivered with the unit (see above picture). If it must be connected to the drain, it should be allowed, in any case, to move freely. Our suggestion is to let it drain to a funnel.



Picture 22: Safety valve and rotary joint.

Warning: In some setups, very quick transient pressure variations may happen. In these cases, the response of the provided safety valve is not fast enough and the machine rotor could fail because of pressure exceeding busting pressure (> 30bar) or long-term fatigue damage. It is therefore necessary to eliminate any pressure peak in order to properly operate the machine.

Note: All quick-acting flow-rate regulations on the secondary circuit have to be carried out upstream the exchanger rotor. For maintenance purposes, we strongly recommend adding a shut off valve before the RHeX and/or a complete bypass circuit.

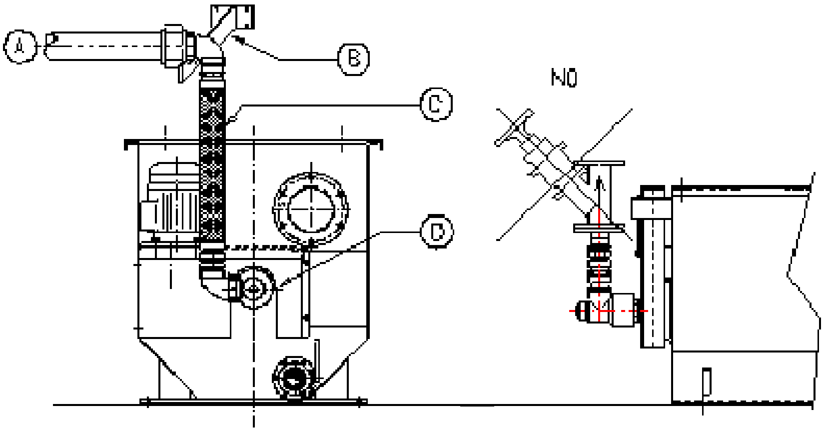
Warning: To avoid pressure peaks and overpressures inside the rotor, no quick-shutting valves are allowed downstream on the secondary circuit, except slow-moving valves specially approved by POZZI LEOPOLDO S.r.l. for this use.

8.4.3 Rotary joints

On each side of the secondary circuit, a rotary joint and a flexible pipe are present. These parts must be handled with care.

Warning: Rotary joints contain fragile components and neither axial nor radial force must be applied to them while operating.

Note: All units require flexible pipes to be connected to the rotary joints before the unit may start operating. This is to safeguard the life of the RHeX itself.



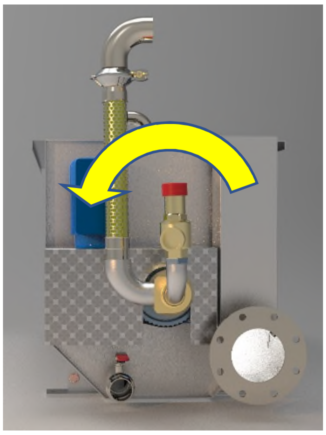
Picture 23: Flex pipe correct installation.

In order to avoid damages to the rotating joints, we recommend that the connections of the secondary circuit are installed according to the above picture, or in a similar manner, so that no pushing or pulling force is exerted by bracket B on the rotary joint D.

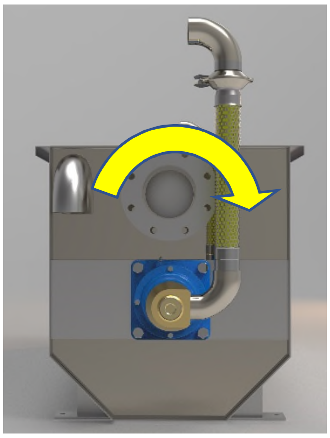
Note: No device must be connected to the rotary joint D except for the flexible pipe C.

Note: The two bends attached to the flexible pipe are part of the RHeX. **Their removal will void any warranty**.

Warning: the flexible pipes **should be operated in tension** so their commissioning is dependent on the rotation direction of the Exchanger (yellow arrows), which is fixed and well indicated with an arrow on the protection carter of the motor. See correct mounting side in the following pictures:

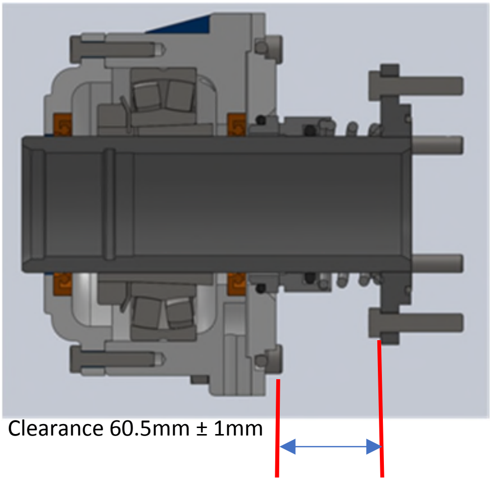


Picture 24: motor side



Picture 25: non-motor side

8.4.4 Mechanical seals



Picture 26: Seal pre-charge clearance

Inside the tank, on both sides of the rotor, a mechanical seal is installed.

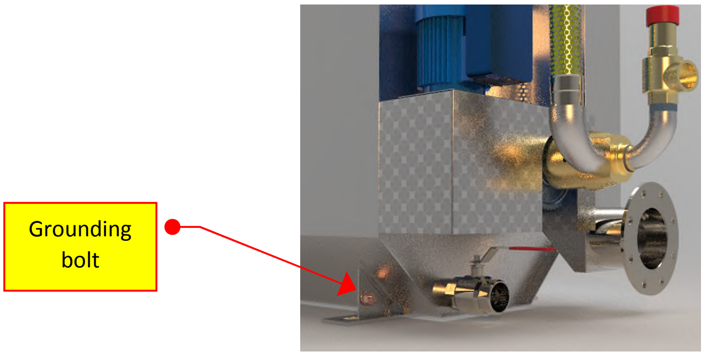
Correct positioning and proper condition of the mechanical seals must be verified before use as transport might have shifted the rotor sideways, altering the seal pre-charge: check that the clearance between the rotor flange and the trough flange is as in this side picture.

Warning: Before starting the rotation of the rotor, you must ensure that the level of water inside the tank is above the mechanical seals in order to avoid irreversible damages on the mechanical seals surfaces.

8.5 Electrical Connections

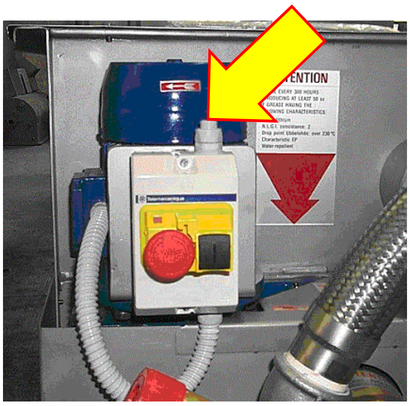
The following steps are required for proper and safe operation:

1. Connect the exchanger to the ground with the special grounding bolt indicated by the specific label; a cable (yellow-green) with a section equal to or bigger than 25 mm² must be used. The bolt is positioned on the foot nearest to the moto-reducer (see following picture).



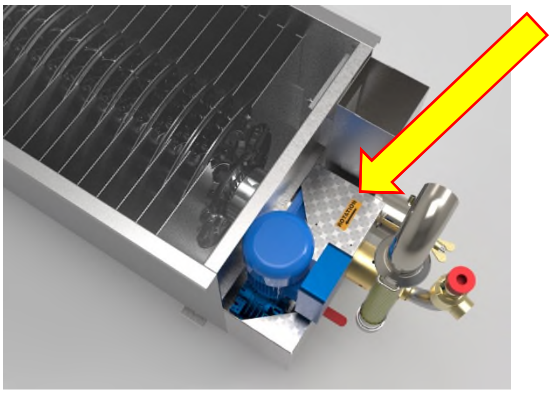
Picture 27: Grounding bolt.

2. Connect the electric power to the emergency push button box as shown in following picture.



Picture 28: Connection box

3. Verify that the axle rotates in the direction shown by the arrow on the belt protection carter (next picture). If the direction is not correct, check the connections you made in the previous step.



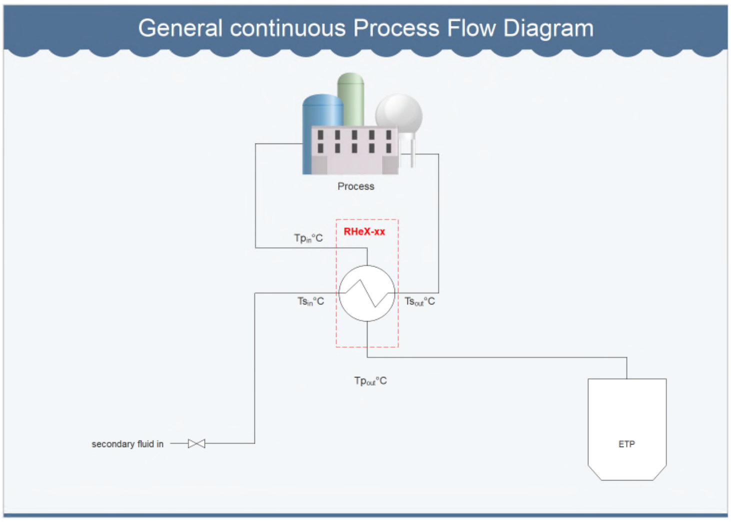
Picture 29: Position of the label indicating rotation direction.

8.6 Start-up

Once connected to fluids networks and electrical power, the exchanger can be put to work either in continuous or discontinuous mode.

8.6.1 Continuous mode

When the unit is connected to a continuous source of primary and secondary fluid, no extra peculiar set up is required apart following instructions at point 8.4.



Picture 30: Continuous process

Flow-rates will be set by the continuous requirement of the process.

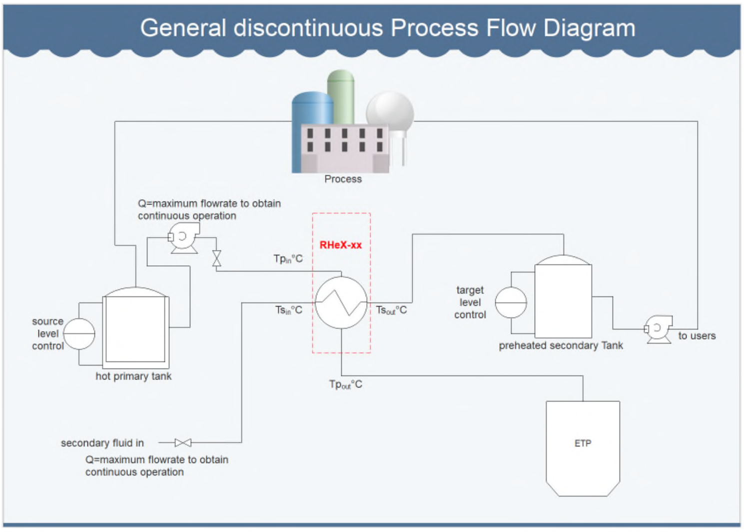
Warning: Motor rotation starts as soon as power is connected.

Warning: Do not apply power, thus starting rotation, without the primary fluid covering the mechanical seals in order not to damage them.

8.6.2 Discontinuous mode

In some discontinuous installations it is possible that the primary fluid is fed to the RHeX from a tank and, conversely, the secondary fluid is stocked downstream the exchanger in a tank.

To maximize the thermal efficiency, continuous functioning is recommended, thus, having a constant flow through the exchanger is a preferred situation.



Picture 31: Discontinuous process

Generally, in this type of installation, the start and stop of the two fluids are governed by the level controls mounted on the buffer tanks according to the following pattern of operation:

- If the hot primary tank goes empty, the exchanger and the feeding pump stop.
- If the preheated secondary tank goes full, the exchanger and the feeding pump stop.

It is therefore important, during initial set up of the plant, to regulate the flows as to reduce to minimum the idle times of the plant.

Warning: Although the RHeX is equipped with a soft-start inverter, to avoid possible damage to its gear/transmission system, it is necessary to limit the number of on-off cycles per hour to a maximum of 10 cycles.
In order to limit the number of start-stop cycles of the motor, avoid, for instance, connecting the exchanger control device to level probes which can be affected by the “wave-effect” in the buffer tanks.

Working of the plant is then completely automatic and it does not require any operator intervention.

Emergency stop of the exchanger rotation can always be achieved through the emergency button shown in Picture 25.

Even when the motor is switched off, thermal exchange will still take place, if the machine itself is not isolated (cut-off) from the primary and secondary circuits.

Note: When the motor is not operating, thermal exchange is considerably reduced and the risk of surface fouling is higher.

Warning: During operation hot primary fluid could flow out the overflow pipe if the relative flow-rate is excessive.

Warning: When temperatures of the primary fluid inlet are > 60°C scorching risks must be prevented by the erection of suitable barriers/fences or proper insulation of the exposed surfaces to avoid accidental contacts with the tank.

Warning: Stickers placed on protection elements remind you of the dangers of electrical shock or moving parts and advise you to disconnect power supply before removing the protection themselves. Should the stickers deteriorate over time, they must be replaced.

8.6.3 Tank baffles

For a thorough description of the baffles inserted in the tank, their purpose and possible geometry modification to adapt the exchanger to the various environments, see under "Extraordinary Maintenance" Chapter **10.6: Baffles**

9 Ordinary Maintenance

Your RHeX exchanger has been built to provide uninterrupted, continuous, service with only minimal maintenance interventions.
Ordinary maintenance schedule will be limited to the operations of tank cleaning and lubrication.

9.1 Tank Cleaning

Before any cleaning operation on the exchanger, the operator must follow these instructions:

- Interrupt the power supply to the machine.
- Prevent the primary fluid ("hot" fluid) from entering the machine, using a by-pass circuit, acting on a deviator or switching off the feeding pump.
- If access to the secondary fluid circuit is required, be sure to interrupt the flow on the secondary circuit as well, by acting on the proper by-pass circuit, or switching off the feeding pump.
- Place a sign indicating that the machine is being cleaned.
- Empty the tank.

Only after having followed all of the above instructions, it is possible to proceed further and remove the protection lid (positioned on top of the trough as a safety device to the rotating parts) by removing the fixing bolts.

9.2 External Cleaning of the Rotor

To remove fouling from the external surface of the rotor we suggest using high temperature, high pressure washer.

Warning: We advise against using mechanical tools for this purpose, as they could damage the polished surface of the rotor.

After having followed instruction at 9.1, proceed with opening the tank draining valve, thus emptying the tank and then wash the rotor disk by disk.

As only a radial section of the exchanging surfaces will be subject to the high-pressure jet, the rotor angular position will have to be fractionally moved in steps to access the whole surface.

Warning: Do not put in continuous rotation the rotor when the tank is empty as this could damage the mechanical seals.

For hard to remove fouling, especially to remove calcium-magnesium carbonate scaling, a chemical washing may be required, by operating the rotor when the tank is filled with the following solution:

Descaling solution
16 parts of water (weight)
4 parts of citric acid (weight)
9 parts of phosphoric acid (weight)
1 ml per litre of wetting agent
anti-foam agent as required

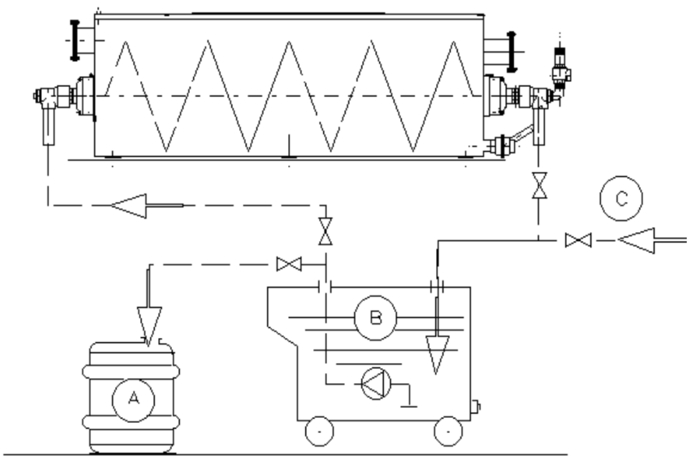
Once again, how often to carry out this procedure depends on the chemical composition of primary fluid and its sedimentation speed. When the exchanger is used with “soft” water (hardness < 5°f) this procedure will never be needed.

9.3 Internal Cleaning of the Rotor

Since visual inspection of the internal parts of the rotor is not possible, fouling on the internal part is only evident when the thermal efficiency decreases as indicated by keeping track of input and output temperatures.

Note: To prevent the build-up of fouling inside the rotor, we recommend using soft water for the secondary fluid.

Should the operator suspect that the described internal scaling has occurred, he may clean the internal part of the rotor using the same descaling solution indicated in section 9.2 by having it circulating with an arrangement similar to the one shown in the following picture:



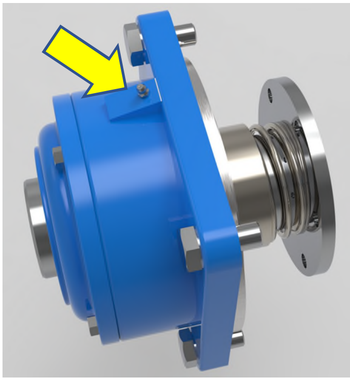
Picture 32: Descaling connections.

A. Eventual descaling solution recovery.
B. Descaling equipment (tank + pump)
C. Water filling inlet (cold or better warm T<50°C)

9.4 Lubrication

9.4.1 Bearings Lubrication

The bearings contained in the side supports need ordinary lubrication.
This must be carried out every **2000 working hours** by a pump acting on the lubrication devices positioned on the supports, adding a minimum of 4cc. See following picture.



Picture 33: Support lubrication nipples.

Use grease with following characteristics:

- Specific gravity: 0,89 kg/dm^3
- Drop point (Ubbelohde): > 230°C
- Ashes: 2,81%
- E.P.: 7.000 kg/cm^2
- Soap base: Lithium
- NLGI number: 2

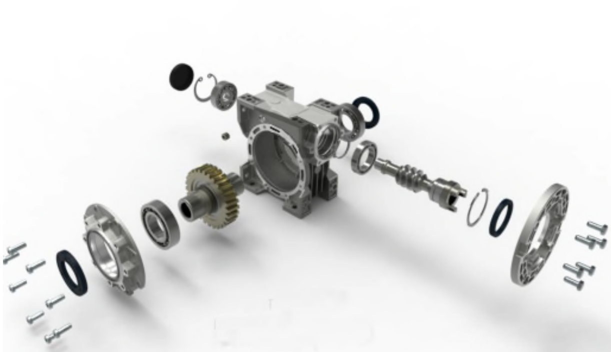
Examples:

- ORVIM 77/ADS (original filling)
- AGIP GR MU EP
- SHELL SUPER GREASE R2
- MOBIL MOBILPLEX 47
- KLUBER CENTOPELX 2EP

9.4.2 Gearbox Lubrication

The gearbox used in the RHeX drive system is a maintenance-free unit which does not require relubrication for the life of the unit.
The units are delivered already filled with synthetic long-life oil: no servicing or refilling within the average operation lifetime of 15,000 hours .
Periodically (every month) check the seal condition and possible evidence of lubricant leakages.
Eliminate by means of a vacuum cleaner any dust accumulation thicker than 5 mm.
If uninstalled or replaced during the life of the product, care has to be taken during re-installation:

- Check mounting stability so that the unit operates without vibrations or overloads.
- Care must be taken to ensure exact positioning and steadiness when handling the units not to generate damages to normal operation of the unit.
- When hoisting, use relevant locations of the housing or eyebolts if provided, or foot or flange holes.
- Never hoist on any moving part (input or output shafts).
- Clean carefully all the surfaces of shafts and flanges paying attention that the product used for cleaning does not come in contact with sealing lips of oil seals to avoid any damage and lubricant leakages.
- The unit may be connected for clockwise or counter-clockwise rotation.
- Stop immediately the unit when unexpected running or noise occurs: consider replacement.
- Bore tolerance F7 is recommended when fitting pulleys, pinions, couplings, etc. on the output shaft.
- It is also recommended not to fit or extract shaft and pulleys with mallets or hammer in order not to damage internal parts, but rather to use the shaft-head threaded bore as reaction to fitting or extraction.
- Belt drives: the force imposed on the shaft due to belt tension must not exceed the maximum permissible radial force of the unit. In our case, the belt is a toothed one so a slight tension is sufficient.
- If painting is needed, please carefully protect oil seals, coupling faces and shafts when re-painting the units.



Picture 34: Gearbox exploded drawing.

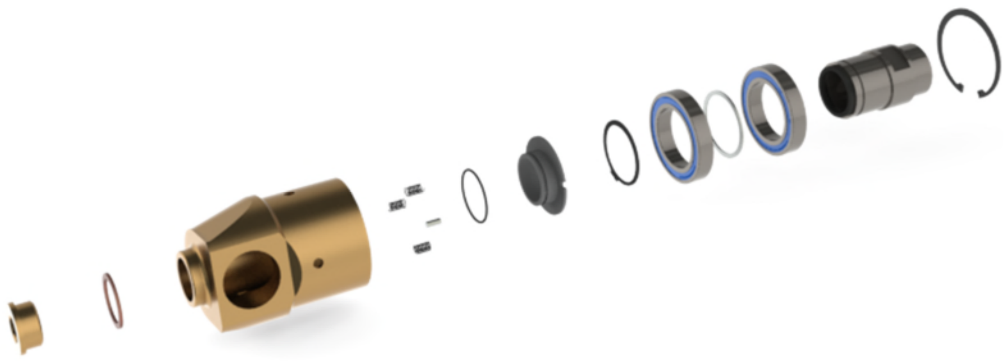
10 Extraordinary maintenance

In the following pages reference is made to spare part numbers as listed in our specific mini-site:

http://www.pozzienergy.it/

under the spares tag. This site provides visual recognition of each necessary spare part, together with its current price and the possibility to create an e-commerce-like system to pre-order the needed components autonomously.
Most of the parts are normally in stock and shipping within 24 hours is possible.

10.1 Rotating Joint care.



Picture 35: Rotating joint (part number 113997)

10.1.1 UN-INSTALLING

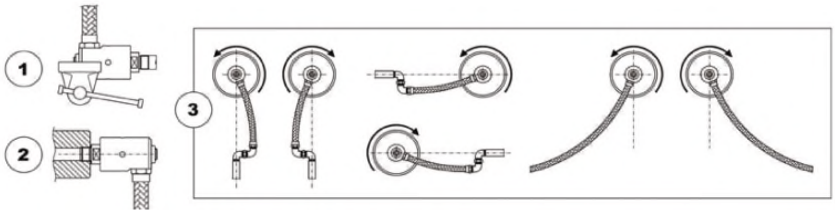
Even if the rotating joints are solid and stout, they must be handled with care. For proper uninstalling we advise to proceed as follows:

- Open the flexible hose clamp to free the rotor hydraulic connection.
- Remove the drive belt.
- Unscrew the joint hub from the rotor shaft using a 60 mm wrench (the unit is tight, you might have to help the operation with an initial hammer blow).
- Once the unit is removed, clamp the rear of the joint in a bench vice and unscrew the flexible hose (picture 34-①).

10.1.2 INSTALLING

- Do not use solid pipe connections but only the supplied flexible pipe (replace if necessary) following above instructions (picture 34-①).
- Install the rotary joint on the shaft with the interposition of a copper washer (picture 34-②).
- Connect the flexible hose to the supply line by tightening the clamp.
- When using flexible hoses in a small space with sharp curves, always use rigid 90° elbows to avoid undue stress.
- Make sure that the orientation of the elbow follows the rotation direction as in (picture 34-③).

- Check that the joint does not rotate eccentric or with excessive wobbling.
- Inspect periodically the joint to ensure the necessary maintenance and detect any leakage.



Picture 36: Rotary joint care.

10.1.3 MAINTENANCE

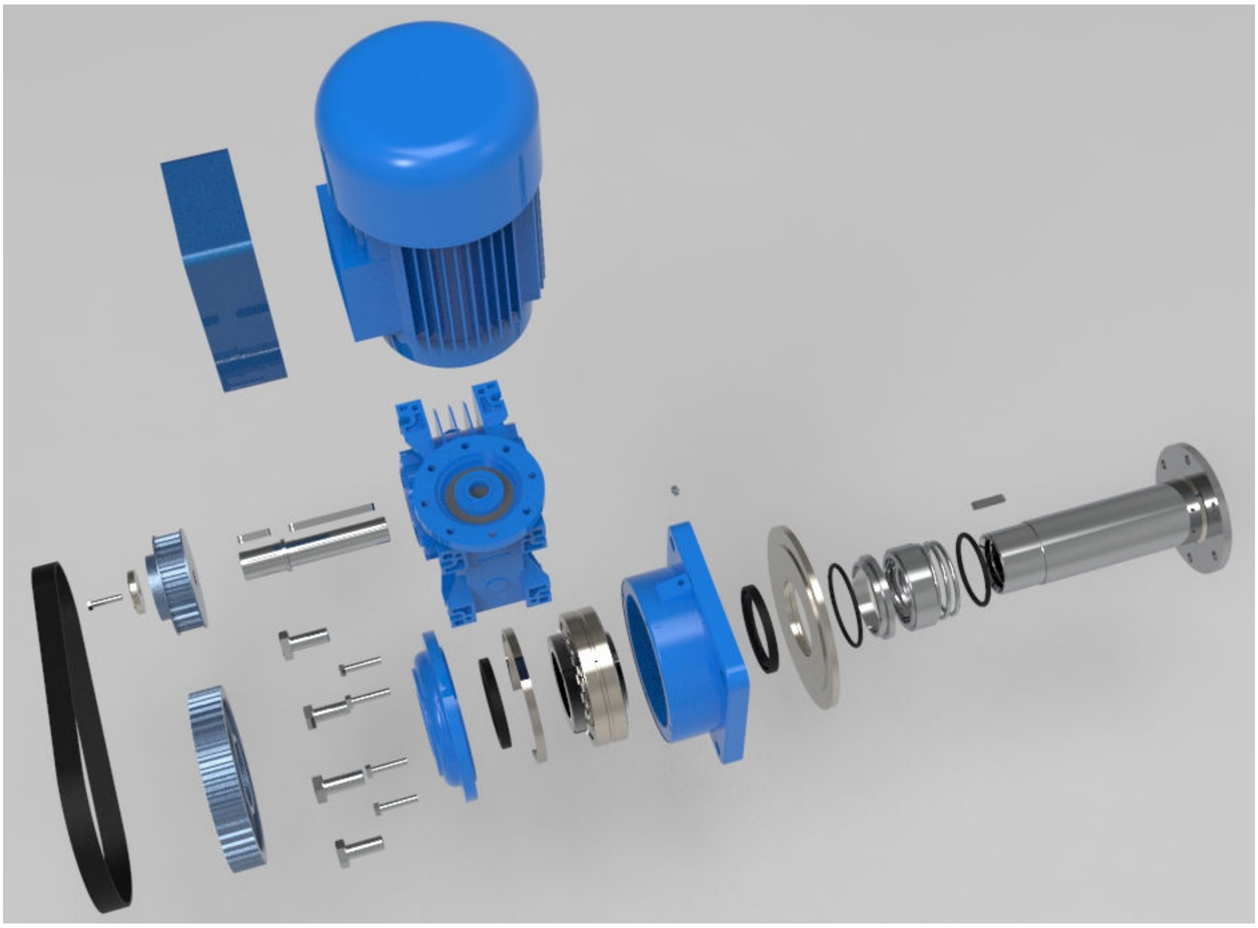
Should any leakage become evident in the rotary joint, proceed immediately with the substitution of the mechanical seal by ordering the spares kit, part number 114026; the kit includes the shaft, bearing assembly and mechanical seal for the unit.

Substitution is quite straightforward (refer to Picture 33):

- Once the unit is removed following instructions at 10.1.1, clamp the rear of the joint in a bench vice and unscrew the flexible hose (Picture 34-①).
- Remove the Seeger ring holding the shaft in place (Picture 33).
- Extract the shaft-bearing assembly.
- Remove the stationary mechanical seal and the series of springs.
- Clean thoroughly the inner chamber of the joint.
- Mount the new stationary ring with its O-ring seal.
- Position the new springs in the provided holes.
- Push in place the new seal-bearing-shaft assembly adding a limited amount of lithium-based grease.
- Lock-in the new Seeger ring.
- Re-install the unit following 10.1.2.

If, during maintenance check, one notices an abnormal wobbling of the brass part of the rotary unit, together with an important leak, most probably a total failure of the support has to be taken into consideration; in this case we suggest the replacement of the whole rotary joint, ordering part number 113997.

10.2 Motor and drive-side support assembly



Picture 37: The drive-side support assembly

Refer to Picture 35 in this section of the Manual.

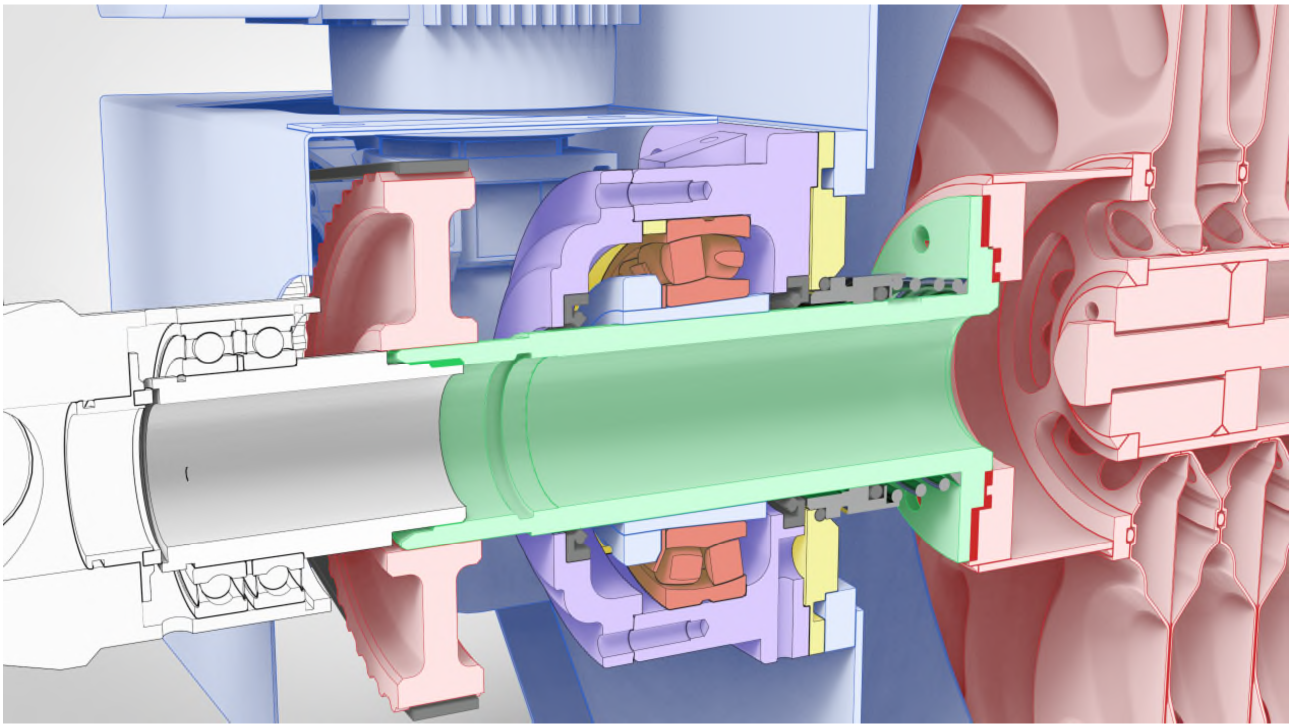
10.2.1 UNINSTALLING

- Verify that you carried out the steps previously indicated, i.e., the motor is disconnected and the tank is empty.
- Remove the protection guard carter.
- Remove the rotary joint following instructions at point 10.1.1.
- Loosen the screws that hold the gearbox as to be able to shift it in order to remove the toothed belt.

Warning: In the next steps, the rotor shaft will become free from its supporting structure, so it is of foremost importance to hold in place the rotor while operating on the supports. This can be done by putting a wood wedge underneath it or by mounting a fly-beam over the tank and latching the rotor to it with a belt.

- Remove the pulley by unscrewing the grub screw on the back of the pulley.

- Remove the cover lid of the support by unscrewing the 4x13mm screws.
- Remove the spacer ring on the inside rim of the support.
- Partly unscrew the threaded ferrule blocking the conical fixing ring of the bearing; unscrew it by 2-3mm.
- Gently push, by tapping it with a hammer, the conical fixing ring in order to free it from the shaft.
- Unscrew the 4x22mm screws that hold the support to the tank and remove the support together with the bearing sliding it on the shaft.
- Set the bearing-support assembly on the bench.
- Remove the flange supporting the mechanical seal, together with the stationary part of the seal and the flange O-ring. Put it on the bench.
- Pull gently to remove the rotating part of the seal from the rotor shaft terminal sleeve.
- Inspect the shaft terminal sleeve for signs of wear & tear.



Picture 38: Moto-reducer side support section

10.2.2 RE-INSTALLING

Note: The two sides of the rotor mount different mechanical seals according to their rotation direction. During installation double-check that you are replacing the mechanical seal with the correct direction of rotation.

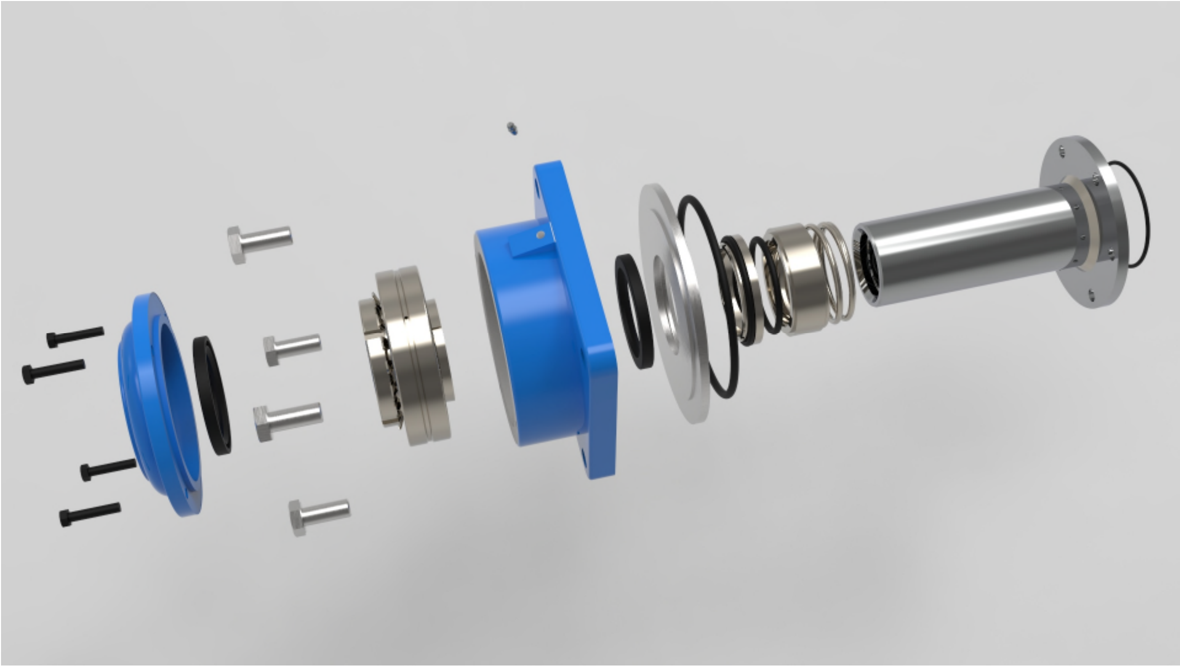
- If the shaft terminal sleeve requires replacement, proceed as follows: remove the 6x17mm screws and remove the sleeve. Replace the sleeve O-ring. Fit the new sleeve and tighten the screws.

- Install the rotating part of the replacement mechanical seal on the sleeve. Help the operation by lubricating the sleeve a little bit. Verify that the ring can move along the shaft.
- On the bench, replace the stationary part of the mechanical seal and the flange O-ring. Carefully fit this assembly to the shaft without pushing against the other side of the mechanical seal.
- On the bench, remove the old bearing and the seal from the support. Clean the support with a solvent. Check that the drain hole is clean and burr-free. Replace the seal. Grease the new bearing. Fit the adapter sleeve, the bearing, the washer and the threaded ring into the support casing.
- Gently fit the support assembly on the shaft sleeve (the drain hole must be on the lower side).
- Match the support flange with the groove on the support casing.
- Push slowly the combined assembly against the rotating part of the seal until the flange matches the wall of the tank.
- Screw the 4x22mm screws holding the support to the tank.
- Tighten the threaded ring of the locking sleeve until the bearing is locked on the shaft. Fold down one tooth of the washer to block it.

Warning: Only the moto-reducer side bearing needs to be locked in position as it works as an axial thrust constrain. The locking position needs to respect the mechanical seal spring pre-load as explained in 8.4.4 (Picture 23). The bearing on the non-reducer side needs to be left free to slide on the shaft, to ensure expansion of the rotor.

- Grease the support. Insert the spacer ring. Replace the seal on the cover and put it on again with the 13 mm screws.
- Re-position the pulley on the shaft and lock it.
- Re-position the toothed belt and screw down the gear-box in order to tighten the belt. Check the alignment between the pulley and the gearbox.
- Re-position the rotary joint and fix it.
- Re-position the motor guard.

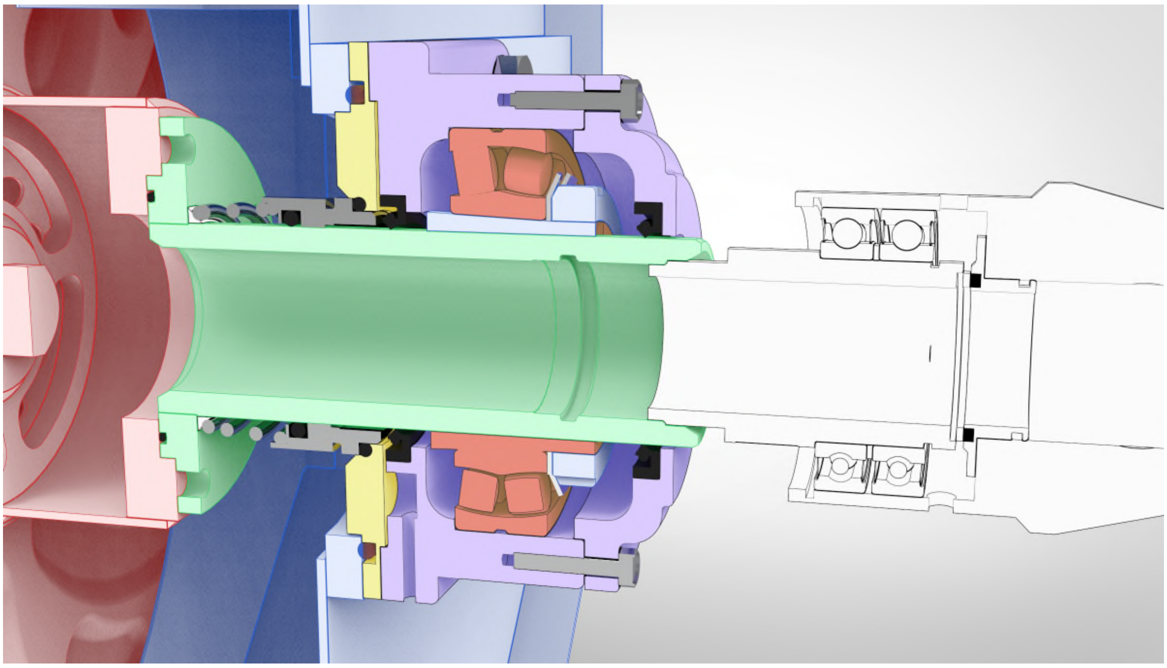
10.3 Non-drive-side support assembly.



Picture 39: The non-drive-side support assembly.

10.3.1 UN-INSTALLING & RE-INSTALLING

- Refer to Picture 37 in this section of the Manual.
- Verify that you carried out the steps indicated, i.e., the motor is disconnected and the tank empty.



Picture 40: Non-drive side section.

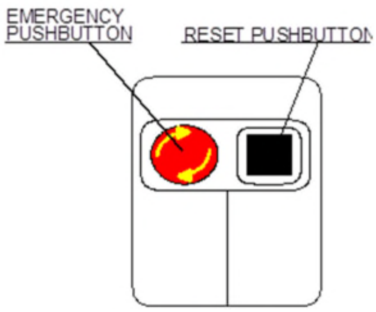
- Proceed as with support motor side **(10.2)**, but **being careful to let the bearing free to slide inside the support to follow rotor expansion caused by thermal action**.
- The threaded bush must be screwed without completely blocking the conical gear.

- Between bearing and lid do not insert a spacer ring, but leave instead a space movement of at least 5 mm.

10.4 Electrical maintenance

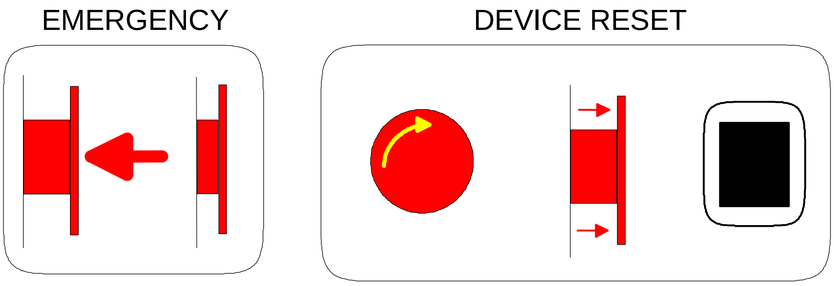
10.4.1 Emergency pushbutton.

On all RHeX exchangers an emergency button is provided.



Picture 41: Emergency pushbutton.

The emergency pushbutton disconnects power supply to the electric motor of the heat exchanger. It may be pushed during emergency situations or during maintenance when, with other safety precautions for operators, it is necessary to disconnect the electric apparatus from mains.



Push the emergency button to stop motor

1. Rotate the button clockwise
2. Gently pull the button to reach the original position
3. Push the reset button (there are two of them for RHeX with two rotors)

10.4.2 Inverter control

All RHeX exchangers are delivered with inverter controls directly mounted on the moto-reducers.

The inverter setup is pre-programmed during shipment, it has fixed speed and starting and stopping ramps.

The pre-programmed settings are normally good for general usage of the exchanger. Special programming parameters can be pre-set during production following customer specifications.

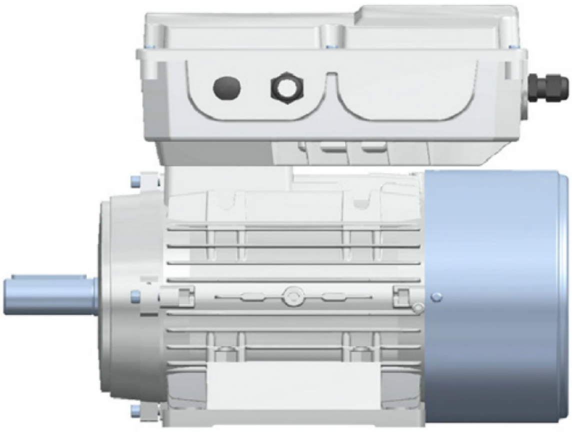
The rotational speed of the exchanger rotor is:

- Proportional to the efficiency of thermal exchange
- Proportional to the pressure losses

Therefore, the pre-set parameters are to be considered a carefully defined compromise, only in case of abnormal operating conditions like:

- Very low flow-rates with respect to rated parameters
- Very high flow-rates with respect to rated parameters
- Particularly viscous primary fluids

It becomes necessary to re-parametrize the inverter.

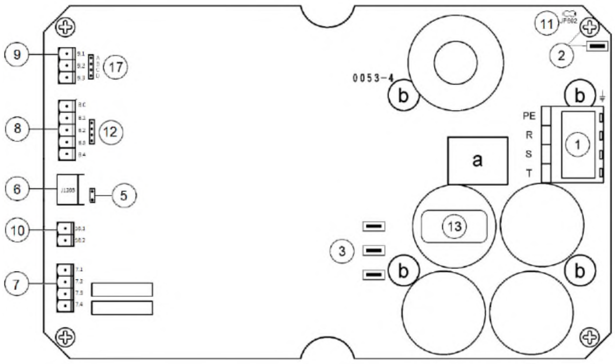


CARATTERISTICHE / *FEATURES*										
INVERTER TIPO *TYPE*	**Output kW**	**Alimentazione *Supply***		**Poli *Poles***	**Regolazione frequenza *Frequency range*** Hz	**Classe filtro EMC *EMI filter***	**Ingressi digitali *Digital input***	**Altri Ingressi *Other input***	**Uscite Inverter *Output Inverter***	**Protezione e allarmi *Protection & alarms***
		Tensione *Voltage* V	**Frequenza *Frequency*** Hz							
MEDIUM	2,20	trifase/*three-phase* 340 ÷ 440	42 ÷ 60	2, 4 , 6 , 8	2 ÷ 159	A/B	6	2	2	plus

Picture 43: The RHeX moto-inverter.

Picture 42: ALS1 prog-pad

In case the Customer needs to change parameters following delivery, it is possible to order the special programming pad (part number ALS1) complete with accessories and programming Manual.

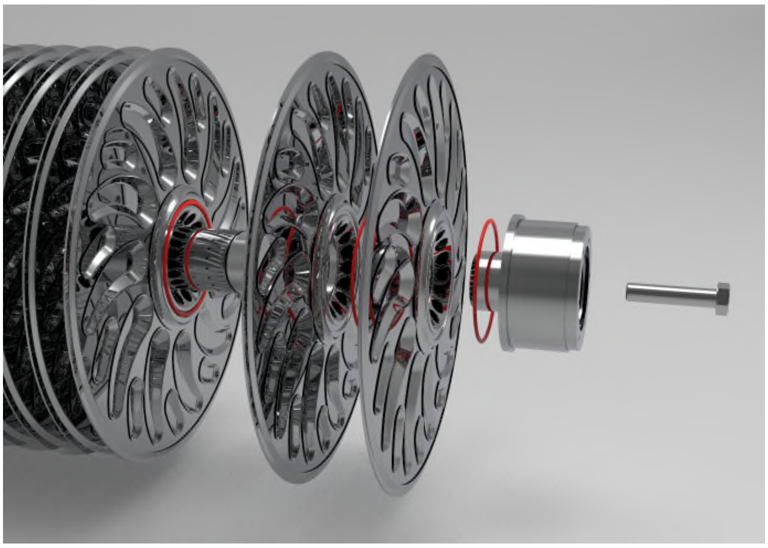


1. power line in
2. Ground (equipotential to PE terminal)
3. motor power out
5. RS 485 terminator
6. RS485 plug
7. Digital out
8. Digital in
9. Analog ref

Picture 44: Inverter board connections

10.5 Rotor maintenance

The RHeX rotor consists of several disks mounted on a shaft with the interposition of a gasket.
The components are kept in place with the help of two bolts, one at each end of the assembly.



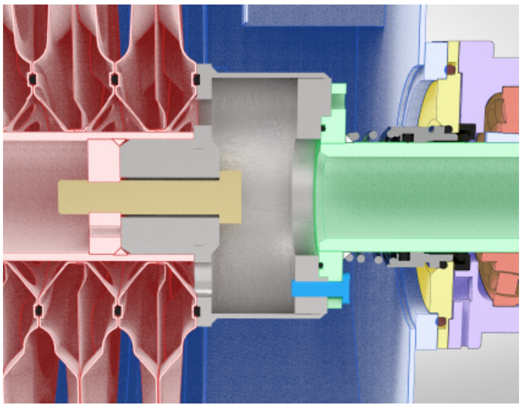
Picture 45: The rotor assembly

Warning: Should the need to dismantle the rotor arise, please note that this is a critical operation which requires particular care and special tooling.

Note: In case of maintenance we suggest changing all the inter-disk gaskets before re-mounting. Complete sets of spare gaskets can be ordered on our www.pozzienergy.it site. DO NOT USE standard gasketing material, but use only original spares. Failure to do so will void warranty.

10.5.1 Dismantling

- Firmly latch the rotor for lifting using a belt strapped around its core in the middle section of its length.
- Apply a slight vertical tension to the strap, sufficient to hold the rotor in place when unlatched from its supporting structure.



Picture 46: Rotor end-cap section.

- Refer to above picture. Remove the rotor from the tank by first removing the (green) shaft sleeves together with the (dark grey, yellow, pink) seal-bearing assembly at each side, as previously mentioned, and carefully lifting it clear of the tank with its baffle structure.
- When packed, the rotor assembly is kept in tension by the elasticity of the several gaskets interposed between each of its composing disks.
- Choose one of the two sides and start dismantling it by straightening the bent washer which keeps the central fixing bolt firmly locked.
- After unscrewing the (gold) central bolt, the (red) disk assembly will follow the (grey) end-cap which keeps the disks pressed together, for just a few centimetres.
- Once the elastic return of the gaskets has finished restoring their original shape, the end-cap sleeve will be easily removed by unscrewing completely the central bolt.
- You can now slide each disk off the shaft.

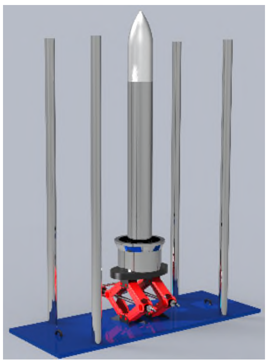
10.5.2 Re-mounting

Remounting the rotor is a critical operation as the positioning of each gasket needs to be precise while sliding the disks next to each other and the pressure needed to close the assembly at the end of the operation can be substantial (2.5-3 tons).

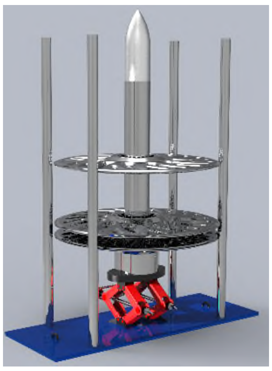
The operation can theoretically be performed with the rotor shaft in a horizontal position, with the help of a special glue, available on our www.pozzienergy.it site, but we strongly discourage to proceed in this way.

A much better and strongly recommended procedure is to procure the special mounting rig that can be obtained from Pozzi for rent, or from its Service Network. This rig has been devised to allow the re-mounting with the shaft in vertical position and to apply the necessary force for locking it.

Picture 47: The mounting rig acting on a 10-disk rotor.



- Start by fitting the vertical guides to the baseplate and by lowering the scissor jacks to their lower position acting on one of the screws end-hooks with the provided crank. The vertical guides are supplied in fast-joining sections, their total length will have to be at least 200mm higher than the total length of the rotor shaft.
- Mount the rotor shaft with only one of the end-caps securely bolted on the lifting plate using the screws provided for the fixing of the shaft sleeves.
- Place the shaft-elongating sleeve on the top of the shaft.



- Continue by sliding the first gasket onto the shaft, accurately positioning it in the provided groove on the shaft end-cap.
- Slide the first disk in position.
- Then slide the second gasket in its groove.
- Continue until all the disks have been positioned along the shaft with their inter-disk gasketing.

- You will notice that the last disk stays on the shaft-elongating sleeve and protrudes from the shaft-end by a measure proportional to the number of fitted disks. This extra length corresponds to the pre-charge of the gaskets and will have to be compressed before being able to fit the top end-cap on the rotor.
- Place the last gasket in the top disk grove.

- Now position the pressing plate on the rig guides checking that the central hole evenly rests on the toroidal section of the last disk.
- Fasten the chains to both sides of the pressing plate and to the base-plate allowing minimum slack and equal number of chain links on both sides.
- You can now crank-up the scissor-jacks compressing the disk-pack until the top plane of the disk is flush with the top of the shaft.

- Now remove the elongation sleeve and replace it with the top end-cap (watch for the correct positioning of the last gasket).
- The end-cap hub is fitted with a torque-pin which has to be properly inserted into the provided hole in the shaft filleted retainer.
- Insert the bent washer and tighten the fixing bolt securing the end-cap in place.
- Bend the washer to block the bolt rotation.

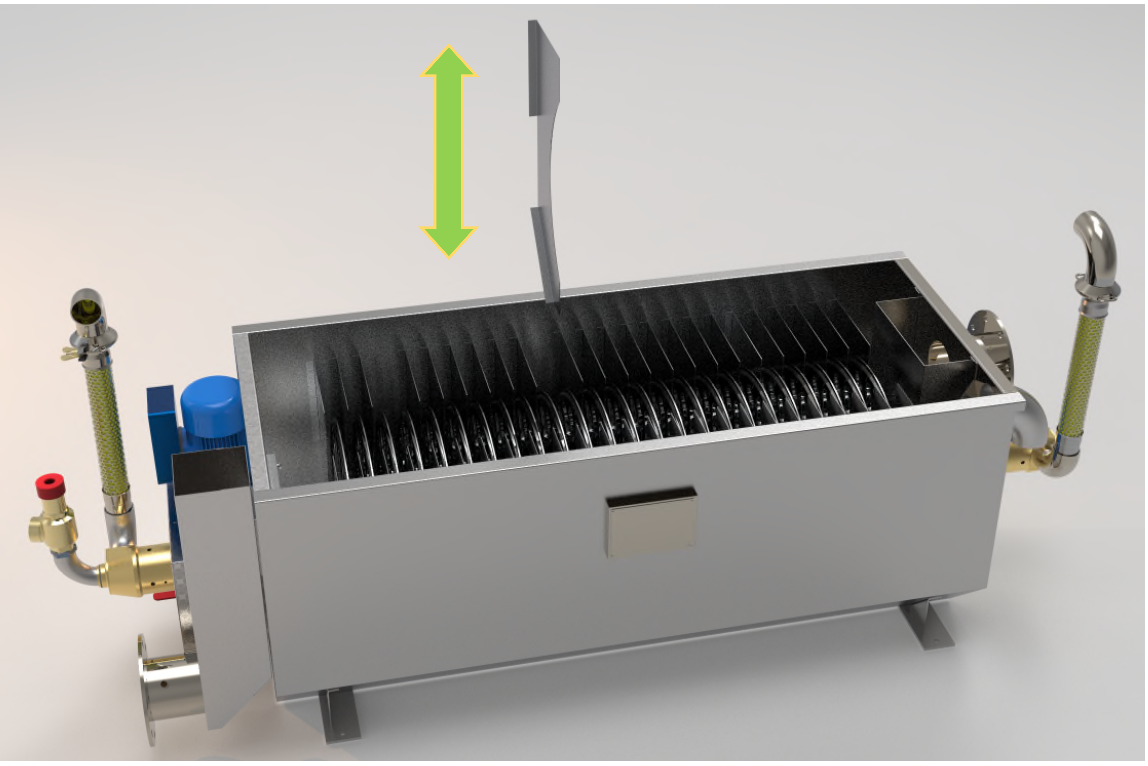
- You can now crank back the scissor-jacks releasing the pressure on the rotor until enough slack is given to the chains for their removal.
- Remove the chains on both sides.
- Remove the pressing plate sliding it over the top of the guide bars.
- Secure the rotor to a lifting device and then remove the screws that fix it to the lower lifting plate.
- You can now lift the rotor free of the rig (you can remove the guiding rods to facilitate the operation).

Warning: Be careful tilting the rotor to the horizontal position: DO NOT hinge the rotor on the outer rim of the bottom disk, use the bottom end-cap as a hinge point.

Once the rotor is in horizontal position it is ready to be mounted back in the trough.

POZZI LEOPOLDO

10.6 Baffles



Picture 48: Baffle removal

The inside of the RHeX tank is fitted with baffles which are used to deflect the primary fluid in such a way that it follows, as much as possible, the external geometrical shape of the rotor. This arrangement assures the maximum thermal length to the exchanger.

Under certain conditions this continuous deflection of the primary fluid path might result in an excessive pressure loss, inducing fluid bypass and overflow.

Conditions like excessive specific flow-rate, high primary fluid viscosity or specific weight, very high TDS content might call for a modification of the primary fluid path geometry.

For this reason, RHeX is equipped with removable baffles. Different RHeX models might have “ex works” different number of baffles, i.e., non-completely populated baffle slots.

Each baffle is inserted in a slot holder and can be removed by pulling it vertically.

Selected removal of baffles (1 set every 2 or 3 rows) in a staggered quincunx manner on the two sides of the rotor might solve the problem.

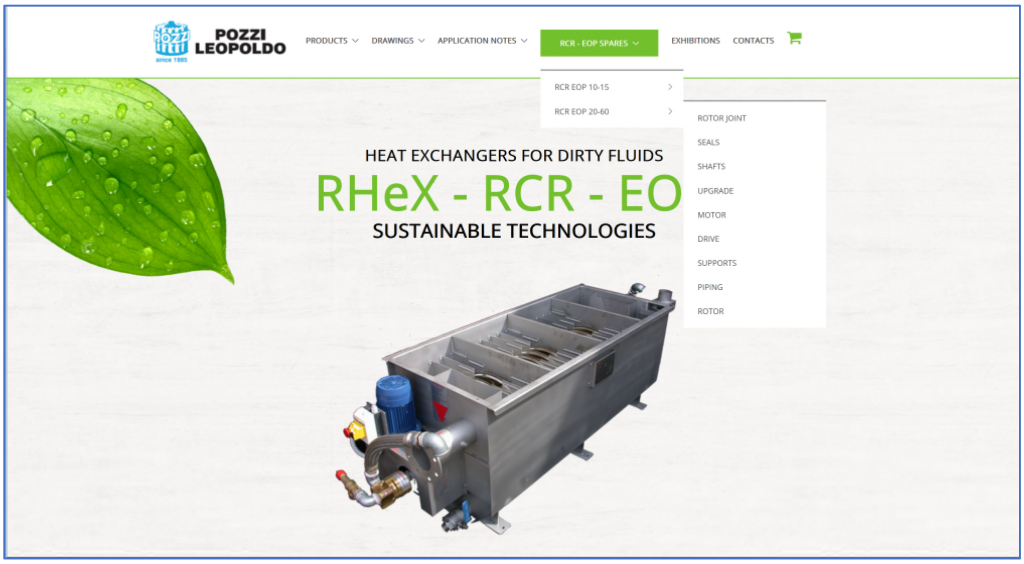
As a general indication, the following applies:

- The higher the number of baffles inserted = better efficiency of exchange
- The higher the number of baffles inserted = higher pressure loss.
- The lower the number of baffles inserted = higher possible flow-rates accepted.
- The lower the number of baffles inserted = loss of efficiency

11 Spare parts

To select and order spare parts refer to the following specially designed website:

http://www.pozzienergy.it

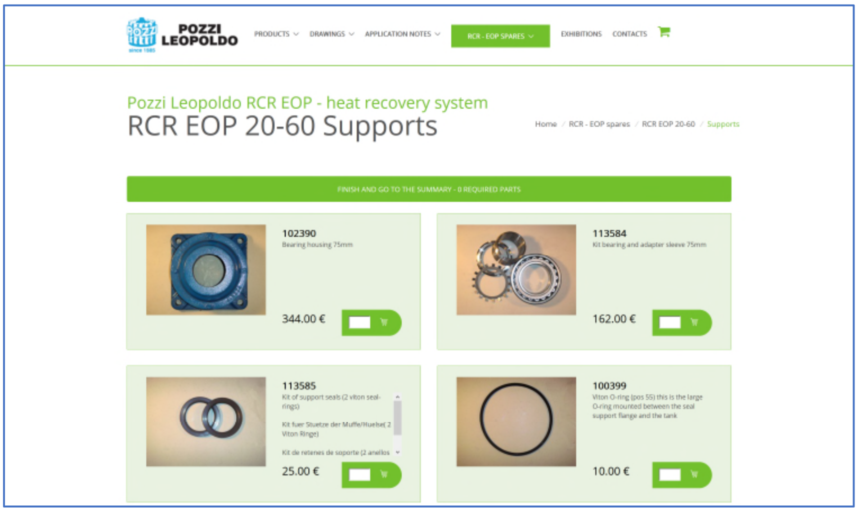


Picture 49: Landing page of the spares site

Browsing the site, you will be able to visually identify and select all necessary spares which are grouped per exchanger model and function.

By adding the selected parts to the cart, the procedure will collect your data, organize them and automatically transfer your tentative order to our customer service. At that point we will send you a formal order confirmation that, once approved, will become your final purchase order.

Necessary spare parts should be readily available. Most spare parts are normally in our stock.



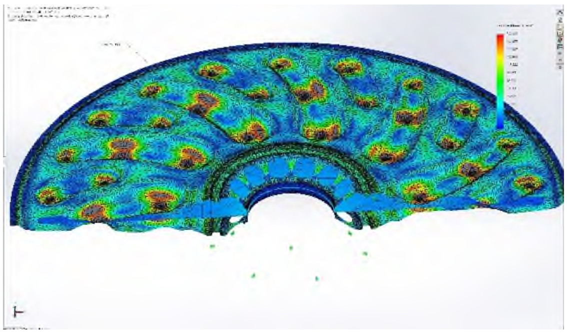
Picture 50: A typical spare part page

12 Credits

The RHeX project has received funding by the European Union's Horizon 2020 Research and Innovation Program under Grant Agreement n° 723930.

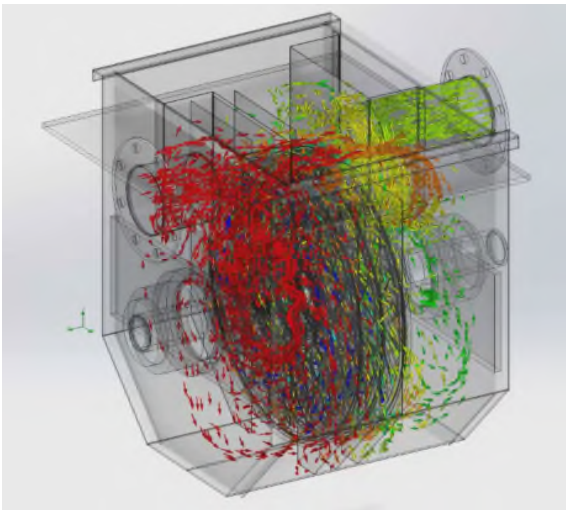
The European funding has allowed a deep computer-simulation engineering effort to the development of RHeX, the next standard self-cleaning exchanger. The new design has been granted an International Patent in 2013.

Accurate finite-elements analysis has allowed a dramatic improvement of the structural rigidity and the pressure resistance of the disks, while the novel teardrop shape of the reinforcing dimples has proven to enhance the dynamic flow pattern of the fluid in the exchanger.



Picture 51: Finite elements static analysis.

Particle-motion and thermal analysis have refined the exchanger physical details to improve heat transfer while minimizing boundary layer conditions and increasing the dynamic shear stresses near the surfaces in order to enhance the self-cleaning action of rotation.



Picture 52: Particle motion analysis.

Selección de aero-refrigerantes.

22-feb-18

Referencia:

Nº Ref:

Altitud sobre nivel del mar, (m): 0

Presión atmosférica, (kPa) .....: 101,325

Refrigerante: **Agua**

% en peso:

Temp. entrada del refrigerante, (ºC) : 30

Temp. salida del refrigerante, (ºC) ...: 26

Temp. del aire ambiente, (ºC) ....: 20

Caudal de refrigerante, (l/h) ....: 7.565

Potencia a disipar, (kW) ....: 35,0

Modelo: EA65-025037.4

Caudal de aire, (m3/h) .: 26000

Presión sonora, (dB(A)): 62 (1)

Consumo eléctrico, (W): 1.900

Diámetro de colectores: 54

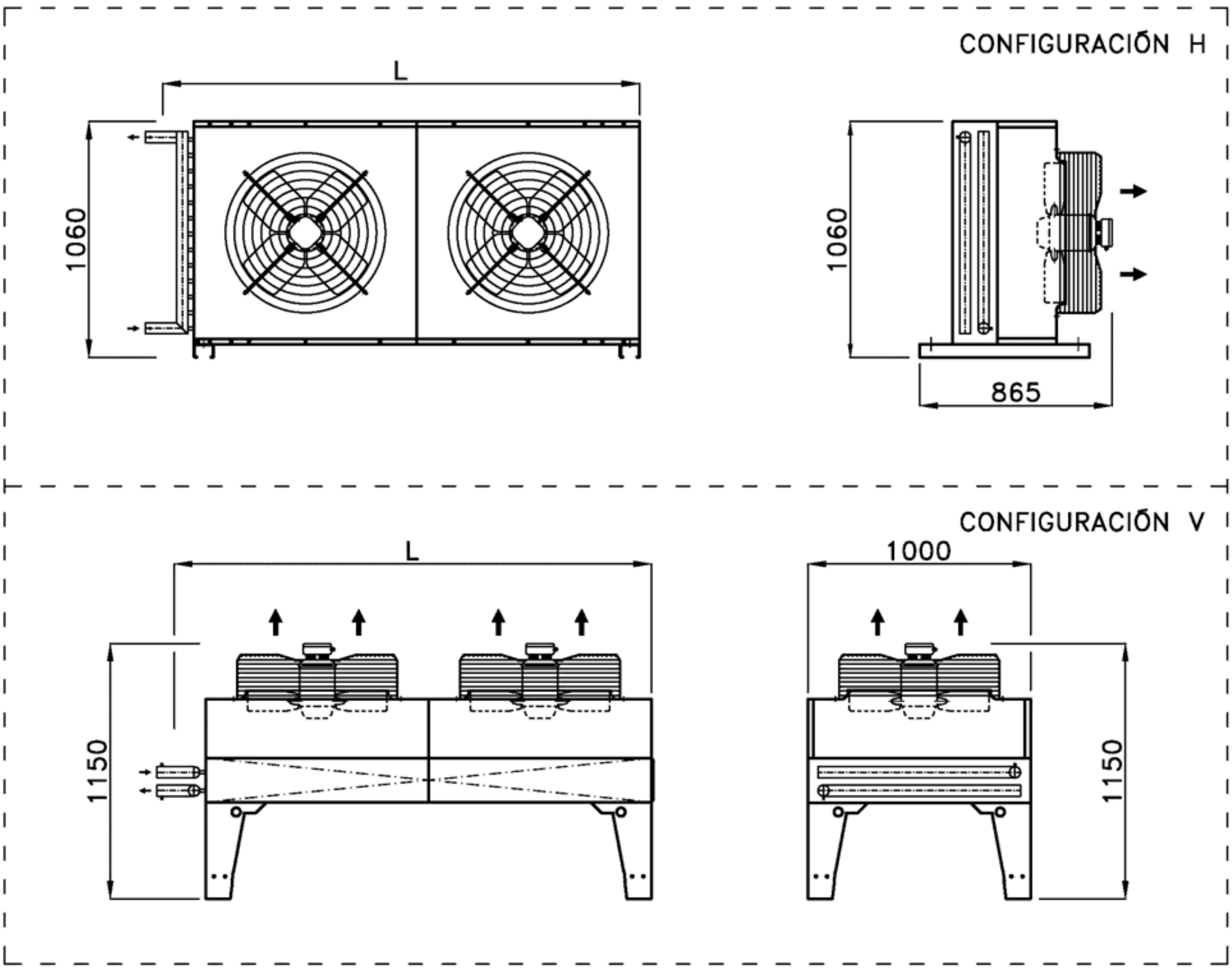
Pérdida de carga, (kPa): 35,6

Peso en carga, (kg) .....: 290

F. ensuciamiento (m2.K/W): 0,0000

Dimensiones - Cota L, (mm) ....: 2145

1) A 10 metros de distancia, en campo libre.



EBARA ESPAÑA BOMBAS, S.A.
Pol.La Estación. C/Cormoranes,6
Tel.916 923 630, Fax 916 910 818
28320 Pinto(Madrid), ESPAÑA
http://www.ebara.es

GRUPO MOTOBOMBA

· Modelo : **EL 50-160**
· Motor : **1450-0,75 kW**
· Fluido : Agua dulce, limpia, temperatura ambiente
· Tensión : 400V III+N, 50Hz

Cliente: CTM - SR. JOAN FARNÓS
Oferta:
Proyecto: **ELINE 7,2@10 VARIADOR**
Comentario: **EESE-JJ18020601**
Rev.:
Responsable:

Fecha: 23/**02/2018**

Pos.	Referencia	Ud.	Descripción	P.Unidad	P.V.Neto
10		2	Bomba centrífuga inline sencilla de rotor seco EBARA modelo **EL 50-160** , ejecución hierro fundido, con rodete en **hierro fundido** ; cierre mecánico sencillo según DIN 24960 (carbón/cerámica/NBR) ; accionada mediante motor eléctrico de **0,75** Kw, eficiencia IE2, trifásico, **1450** rpm , **220/400V** , 50 Hz , TEFC, aislamiento clase 'F' , forma constructiva B5, protección IP55. Alimentación variador: Tensión trifásica 400 V. Con variador de velocidad montado en la bomba y transductor de presión diferencial, 4-20 mA, tienen que determinar el rango de medida que les interesa en el transductor: (0-0,6 / 1 / 1,6 / 2,5 / 4 / 6 / 10) bar	1.613	3.226

Simple

TOTAL ... 3.226

Condiciones de Venta

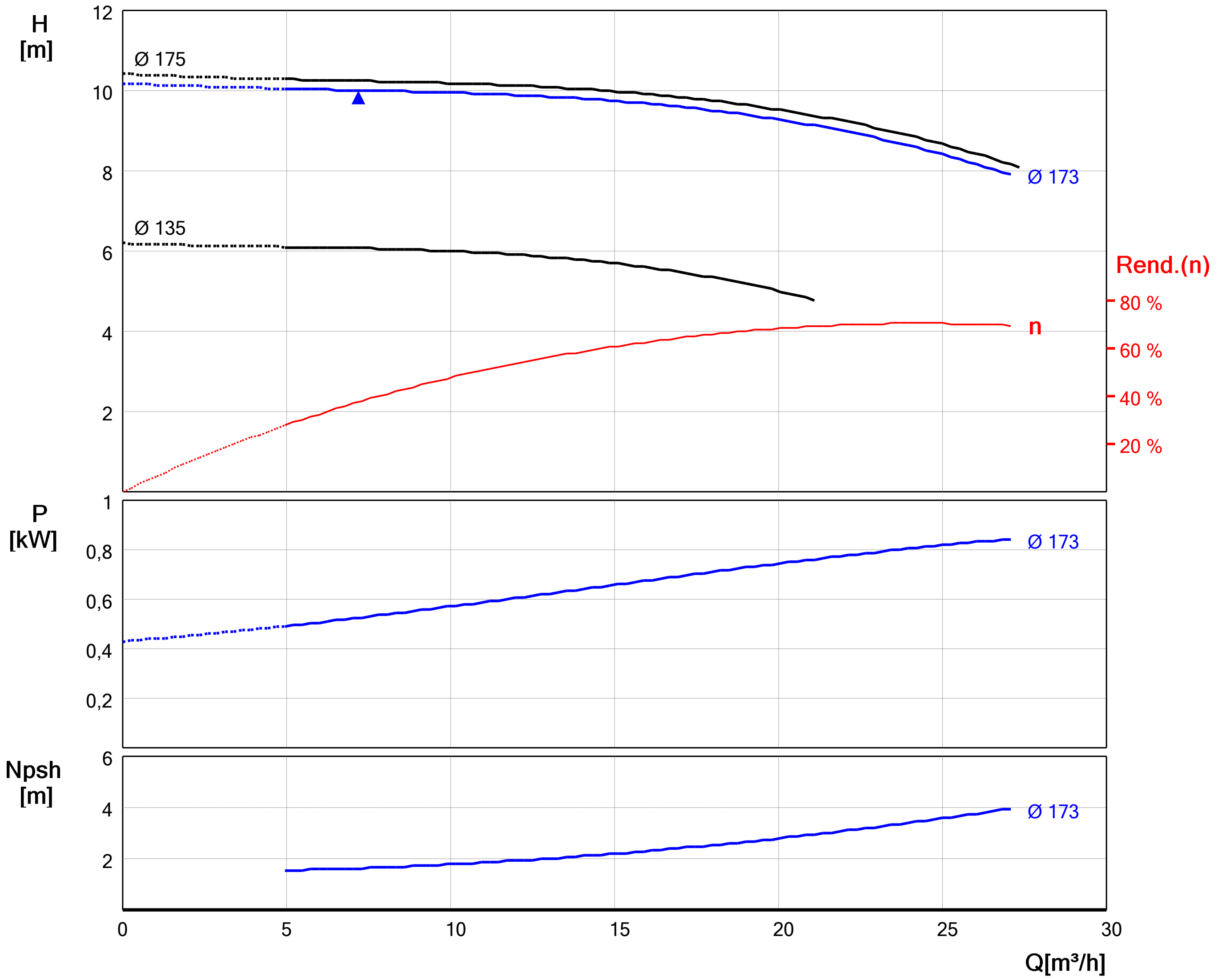
Portes, Embalajes e impuestos no incluidos.
Plazo entrega: (a confirmar en el momento del pedido).
Validez de la oferta: 1 mes.
Forma de pago: según ley 15/2010. Puesta en marcha: no incluida.
Sujeto a nuestras condiciones generales de venta, salvo pacto en contra por escrito y firmado.

EBARA ESPAÑA BOMBAS, S.A.
Pol.La Estación. C/Cormoranes,6
Tel.916 923 630, Fax 916 910 818
28320 Pinto(Madrid), ESPAÑA
http://www.ebara.es

GRUPO MOTOBOMBA

· Modelo : **EL 50-160**
· Motor : **1450-0,75 kW**
· Fluido : Agua dulce, limpia, temperatura ambiente
· Tensión : 400V III+N, 50Hz

Cliente:	CTM - SR. JOAN FARNÓS			Página:	2 / 3
Oferta:		Rev.:		Fecha:	23/**02/2018**
Proyecto:	**ELINE 7,2@10 VARIADOR**	Responsable:			
Comentario:	**EESE-JJ18020601**			Referencia:	



Datos de trabajo solicitados			**Datos punto de trabajo proporcionado**		
Caudal	**7,20**	m³/h	Caudal	**7,20**	m³/h
H.M.T.	**10,00**	m.c.a.	H.M.T.	**10,01**	m.c.a.
Frecuencia	**50 Hz**		Potencia absorbida	**0,53**	kW
Variador frecuencia	**Si**		NPSH requerido	**1,63**	m.c.a.
Nº Polos	**4**		Rendimiento	**37,33**	%
Tipo de fluido	**Agua dulce limpia**		R.p.m.	**1450**	
Temperatura fluido	**Ambiente, 20ºC**		Diámetro del impulsor	**173**	mm

Datos de la Electrobomba			**Datos de materiales**	
Tipo	**ELINE**		Cuerpo	**GG-25**
Tipo de construccion	**Vertical in-line**		Impulsor	**GG-20**
Presión nominal	**Hasta 10 bar**		Eje	**AISI 316**
Temperatura fluido	**-10ºC/+120ºC**		Cierre mecánico	**Carbón/Cerámica/NBR**
Peso aproximado	**45**	**Kg**		
Nivel sonoro	**45**	**dB**		
Potencia motor selec.	**0,75**	kW		

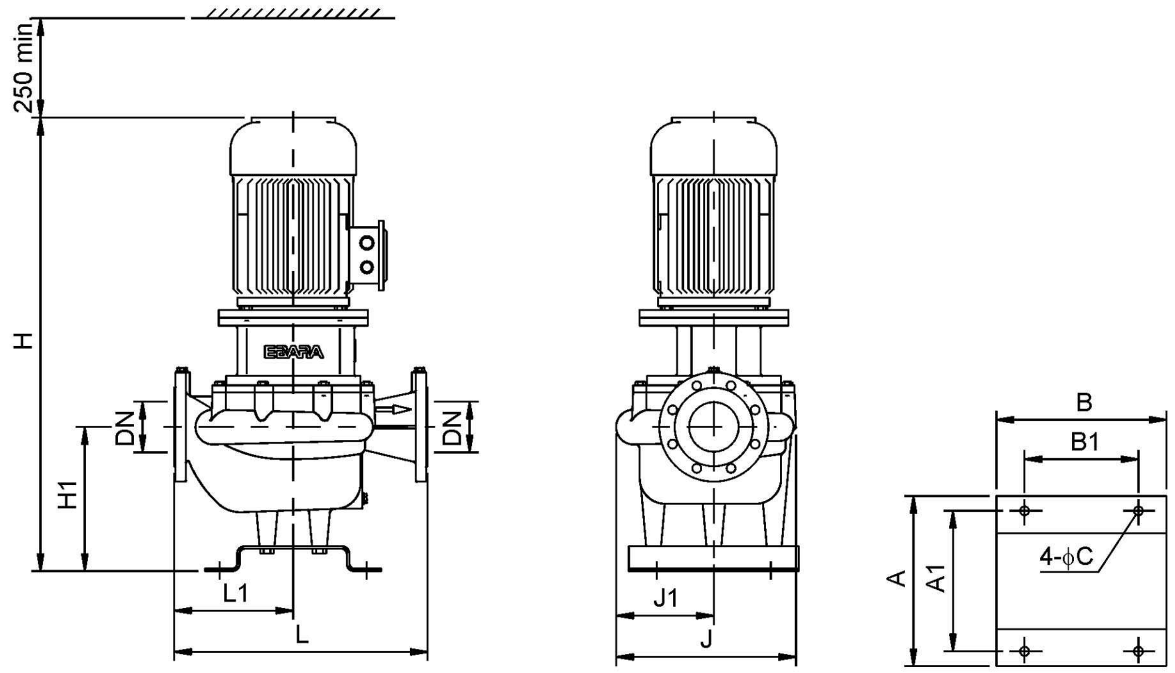
EBARA ESPAÑA BOMBAS, S.A.
Pol.La Estación. C/Cormoranes,6
Tel.916 923 630, Fax 916 910 818
28320 Pinto(Madrid), ESPAÑA
http://www.ebara.es

GRUPO MOTOBOMBA

· Modelo : **EL 50-160**
· Motor : **1450-0,75 kW**
· Fluido : Agua dulce, limpia, temperatura ambiente
· Tensión : 400V III+N, 50Hz

Cliente:	CTM - SR. JOAN FARNÓS			Página:	**3 / 3**
Oferta:		Rev.:		Fecha:	23/**02/2018**
Proyecto:	**ELINE 7,2@10 VARIADOR**	Responsable:			
Comentario:	**EESE-JJ18020601**			Referencia:	

DIMENSIONES GRUPO MOTOBOMBA (mm)



Dimensiones	
DN	50
H1	145
H	535
L1	190
L	350

Dimensiones	
J1	135
J	255
A1	250
A	300
B1	200
B	300
C	15

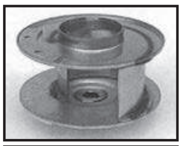
Bridas

DIN 2532 / PN 10

DW - DW VOX

ELECTROBOMBA SUMERGIBLE PARA AGUAS FECALES Acero Inox. AISI 304

Bomba sumergible para aguas fecales fabricada en Acero Inoxidable AISI 304. Diseñada para evacuación de líquidos con contenidos filamentosos o sólidos en suspensión en aplicaciones tanto industriales como domésticas. Adecuada para su utilización en servicios sanitarios (WC) en comunidades, hoteles, restaurantes, etc. Aguas cargadas con sólidos de diámetro máximo Ø 50 mm, aguas de lavado, pluviales, residuales, pozos negros y fosas sépticas. Equipos de depuración de agua y achique de locales inundados.



***Modelo DW:** Impulsor monocanal (Paso 50 mm)*

***Modelo DW VOX:** Impulsor vórtex (Paso 50 mm)*

***Modelo DW:** Con Rosca*

***Modelo DW VOX:** Con Rosca (DNM 2”)*

***Modelo DWF:** Con brida*

***Modelo DWF VOX:** Con brida (DNM 50)*

PRESTACIONES

- Temperatura máx. del líquido vehiculado: 50ºC.
- Máximo paso de sólidos: 50 mm.

MATERIALES

- Cuerpo de impulsión, impulsor, carcasa y tapa de motor: Ac. Inox AISI 304.
- Eje motor: Ac. Inoxidable AISI 303.
- Cierre mecánico: Doble cierre mecánico en cámara de aceite:
  - Superior: Carbón/Cerámica/NBR
  - Inferior: SiC/SiC/NBR
- Cable: 10 m con enchufe tipo Schuko.
- Disponible en versiones: **M: Monofásica**
  M A: Con regulador de nivel

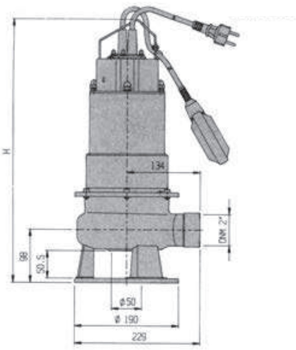
DATOS TÉCNICOS

- Motor asíncrono, 2 polos.
- Aislamiento Clase F.
- Protección IP68.
- Monofásica 230V ± 10% 50 Hz.
- Trifásica 400V ± 10% 50Hz.
- Condensador y protección termoamperimétrica de rearme automático incorporados (monofásica).

CONEXIONES

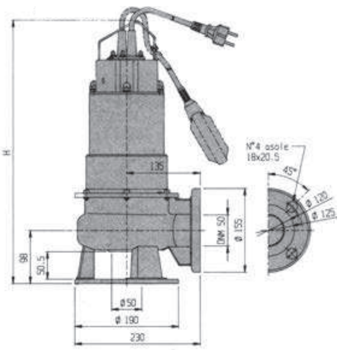
- Brida: Aspiración: Ø 50.
  DNI: 50 PN 10.
- Rosca: Aspiración: Ø 50.
  DNI: 2".

DW
DW VOX



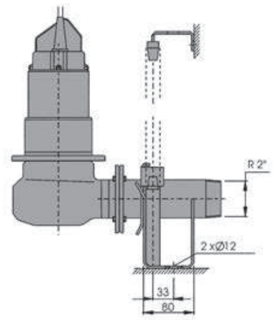
Con soporte y boca roscada.

DWF
DWF VOX



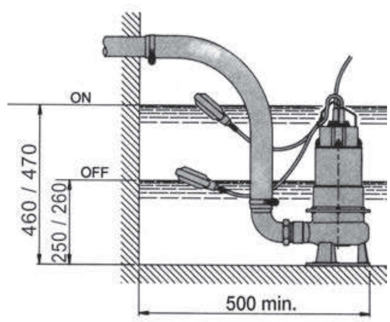
Con soporte y brida DN50.

DWF
DWF VOX

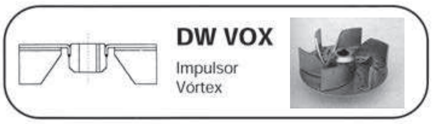


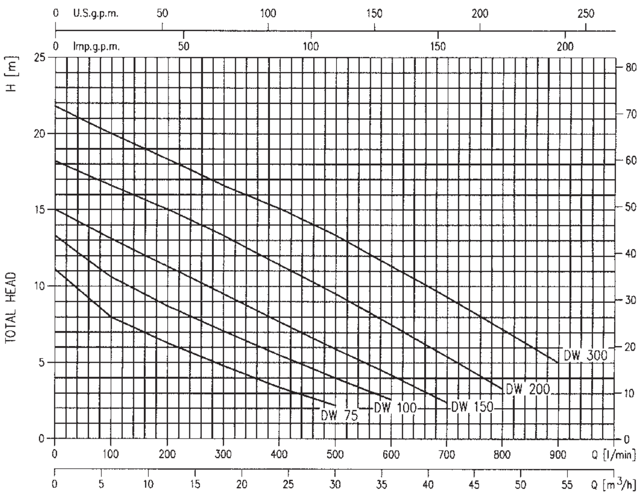
Kit de descarga “Ac. Inoxidable”.

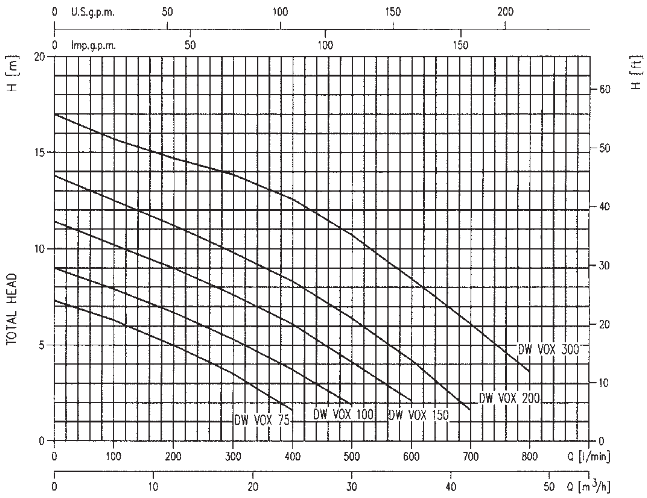
DW
DW VOX



CURVAS DE CARACTERÍSTICAS *(según ISO 9906 / 2)*







3

TABLA DE CARACTERÍSTICAS

Modelo Monofásica 230V 50Hz	Modelo Trifásica 400V 50Hz	kW	CV	Condensador µF	Condensador Vc	Int. absorbida (A) 1~ 230V	Int. absorbida (A) 3~ 400V	Max. paso de sólidos (mm)	l/min m³/h	100 6	200 12	300 18	400 24	500 30	600 36	700 42	800 48	900 54
										H=Altura manométrica total (m)								
DW M 75	DW 75	0,55	0,75	20	450	3,9	1,5	50		8	6,3	4,8	3,4	2,2	-	-	-	-
DW M 100	DW 100	0,75	1	25	450	5,9	2,1	50		10,6	8,7	7,1	5,5	4	2,6	-	-	-
DW M 150	DW 150	1,1	1,5	31,5	450	7,3	2,8	50		13,1	11,3	9,5	7,7	5,9	4,2	2,4	-	-
-	DW 200	1,5	2	-	-	-	3,6	50		16,6	15	13,3	11,4	9,5	7,5	5,4	3,3	-
-	DW 300	2,2	3	-	-	-	5,0	50		20	18,3	16,6	15,1	13,3	11,3	9,3	7,2	5
DW VOX M 75	DW VOX 75	0,55	0,75	20	450	3,9	1,4	50		6,3	5	3,5	1,6	-	-	-	-	-
DW VOX M 100	DW VOX 100	0,75	1	25	450	5,8	2,1	50		7,9	6,7	5,3	3,7	1,9	-	-	-	-
DW VOX M 150	DW VOX 150	1,1	1,5	31,5	450	7,3	2,8	50		10,2	9	7,6	6,1	4,1	2,1	-	-	-
-	DW VOX 200	1,5	2	-	-	-	3,3	50		12,5	11,2	9,8	8,3	6,4	4,2	1,6	-	-
-	DW VOX 300	2,2	3	-	-	-	4,4	50		15,7	14,7	13,9	12,6	10,7	8,4	6,1	3,6	-

Bombas DW *(Monocanal con rosca)*

Modelo de bomba	código	Potencia kW	Potencia CV	Tipo	Tensión	P.V.P. €
DW M 75	1589030021	0,55	0,75	Manual	MONOF.	**818**
DW M 75 A	1589031221	0,55	0,75	Autom.	MONOF.	**848**
DW 75	1589030004	0,55	0,75	Manual	TRIF. 400V	**818**
DW M 100	1589050021	0,75	1	Manual	MONOF.	**950**
DW M 100 A	1589051221	0,75	1	Autom.	MONOF.	**979**
DW 100	1589050004	0,75	1	Manual	TRIF. 400V	**950**
DW M 150	1589070021	1,1	1,5	Manual	MONOF.	**1.128**
DW M 150 A	1589071221	1,1	1,5	Autom.	MONOF.	**1.165**
DW 150	1589070004	1,1	1,5	Manual	TRIF. 400V	**1.128**
DW 200	1589080004	1,5	2	Manual	TRIF. 400V	**1.165**
DW 300*	1589090004	2,2	3	Manual	TRIF. 400V	**1.320**

* Equipada con espaciador en hierro fundido.

ELECTROBOMBA SUMERGIBLE PARA AGUAS FECALES Acero Inox. AISI 304


Bombas DWF *(Monocanal con brida)*		Potencia				P.V.P.
Modelo de bomba	**código**	**kW**	**CV**	**Tipo**	**Tensión**	**€**
DWF M 75	1588030021	0,55	0,75	Manual	MONOF.	**990**
DWF M 75 A	1588031221	0,55	0,75	Autom.	MONOF.	**1.023**
DWF 75	1588030004	0,55	0,75	Manual	TRIF. 400V	**990**
DWF M 100	1588050021	0,75	1	Manual	MONOF.	**1.043**
DWF M 100 A	1588051221	0,75	1	Autom.	MONOF.	**1.175**
DWF 100	1588050004	0,75	1	Manual	TRIF. 400V	**1.043**
DWF M 150	1588070021	1,1	1,5	Manual	MONOF.	**1.343**
DWF M 150 A	1588071221	1,1	1,5	Autom.	MONOF.	**1.391**
DWF 150	1588070004	1,1	1,5	Manual	TRIF. 400V	**1.343**
DWF 200	1588080004	1,5	2	Manual	TRIF. 400V	**1.391**
DWF 300*	1588090004	2,2	3	Manual	TRIF. 400V	**1.567**

* Equipada con espaciador en hierro fundido.


Bombas DW VOX *(Vórtex con rosca)*		Potencia				P.V.P.
Modelo de bomba	**código**	**kW**	**CV**	**Tipo**	**Tensión**	**€**
DW VOX M 75	1599030021	0,55	0,75	Manual	MONOF.	**818**
DW VOX M 75 A	1599031221	0,55	0,75	Autom.	MONOF.	**848**
DW VOX 75	1599030004	0,55	0,75	Manual	TRIF. 400V	**818**
DW VOX M 100	1599050021	0,75	1	Manual	MONOF.	**950**
DW VOX M 100 A	1599051221	0,75	1	Autom.	MONOF.	**979**
DW VOX 100	1599050004	0,75	1	Manual	TRIF. 400V	**950**
DW VOX M 150	1599070021	1,1	1,5	Manual	MONOF.	**1.128**
DW VOX M 150 A	1599071221	1,1	1,5	Autom.	MONOF.	**1.165**
DW VOX 150	1599070004	1,1	1,5	Manual	TRIF. 400V	**1.128**
DW VOX 200	1599080004	1,5	2	Manual	TRIF. 400V	**1.165**
DW VOX 300*	1599090004	2,2	3	Manual	TRIF. 400V	**1.320**

* Equipada con espaciador en hierro fundido.


Bombas DWF VOX *(Vórtex con brida)*		Potencia				P.V.P.
Modelo de bomba	**código**	**kW**	**CV**	**Tipo**	**Tensión**	**€**
DWF VOX M 75	1598030021	0,55	0,75	Manual	MONOF.	**990**
DWF VOX M 75 A	1598031221	0,55	0,75	Autom.	MONOF.	**1.023**
DWF VOX 75	1598030004	0,55	0,75	Manual	TRIF. 400V	**990**
DWF VOX M 100	1598050021	0,75	1	Manual	MONOF.	**1.043**
DWF VOX M 100 A	1598051221	0,75	1	Autom.	MONOF.	**1.175**
DWF VOX 100	1598050004	0,75	1	Manual	TRIF. 400V	**1.043**
DWF VOX M 150	1598070021	1,1	1,5	Manual	MONOF.	**1.343**
DWF VOX M 150 A	1598071221	1,1	1,5	Autom.	MONOF.	**1.391**
DWF VOX 150	1598070004	1,1	1,5	Manual	TRIF. 400V	**1.343**
DWF VOX 200	1598080004	1,5	2	Manual	TRIF. 400V	**1.391**
DWF VOX 300*	1598090004	2,2	3	Manual	TRIF. 400V	**1.567**

* Equipada con espaciador en hierro fundido.

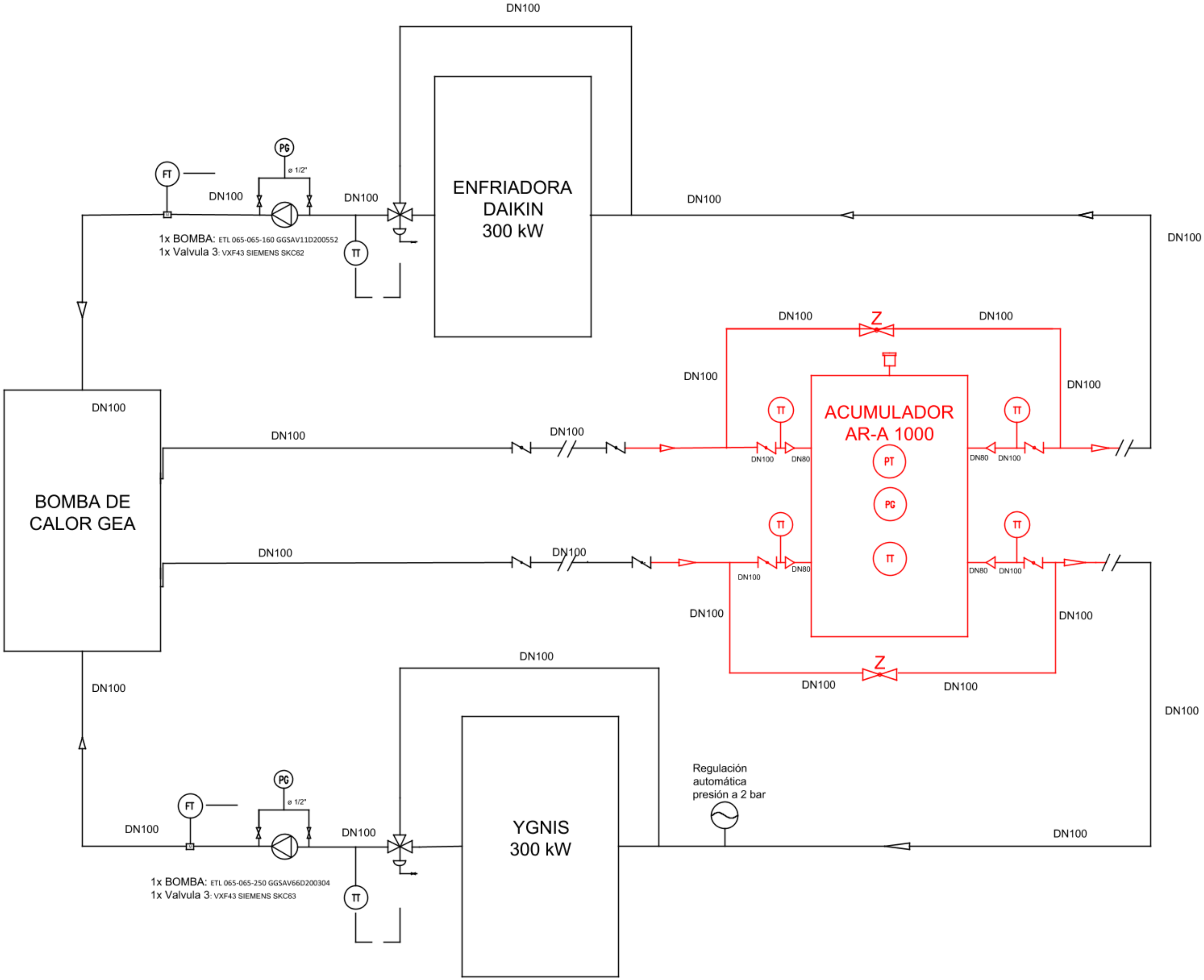
Kit de descarga en Ac. Inoxidable

	código	**P.V.P. €**
Kit de descarga	623SW02602000	**292**

Annex 3

The following documents represents all the engineering documentation requires for the integration and operation of the highly efficient heat pump system hosted in the thermal laboratory of Tecnalia (Gipuzkoa):

- P&ID diagram;
- Electrical diagram;
- Skid drawing;
- HP Spare part list;
- Equipment manuals;
- Equipment datasheets.


DN100
ENFRIADORA
DAIKIN
300 kW
FT
PG
ø 1/2"
DN100
DN100
DN100
TT
1x BOMBA: ETL 065-065-160 GGSAV11D200552
1x Valvula 3: VXF43 SIEMENS SKC62
DN100
DN100
Z
DN100
DN100
DN100
ACUMULADOR
AR-A 1000
PT
PG
TT
TT
TT
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DN100
DN80
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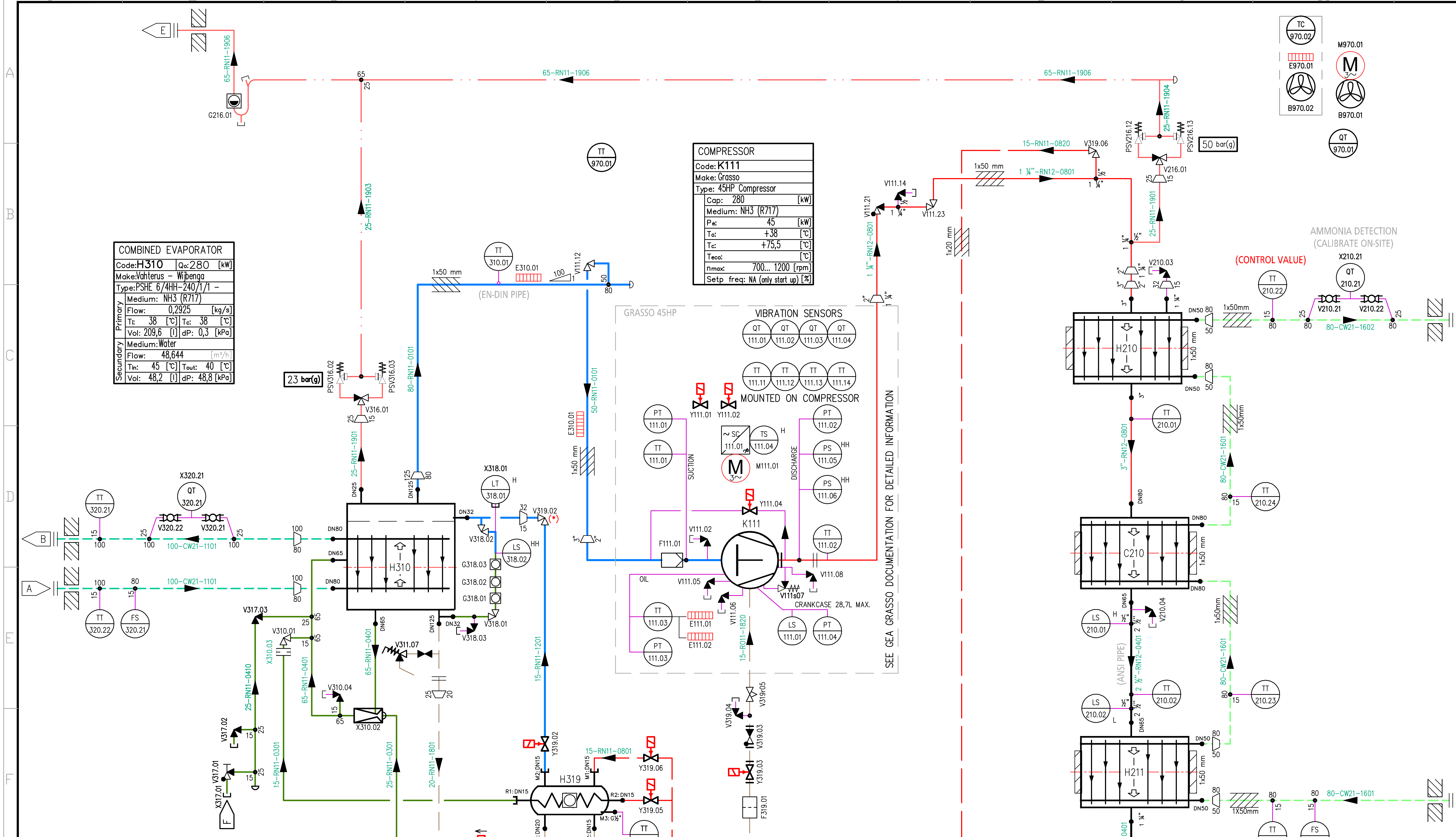
DN80
DN100
BOMBA DE
CALOR GEA
DN100
DN100
DN100
DN100
DN100
DN100
Z
DN100
DN100
DN100
DN100
YGNIS
300 kW
Regulación
automática
presión a 2 bar
FT
PG
ø 1/2"
DN100
DN100
DN100
TT
1x BOMBA: ETL 065-065-250 GGSAV66D200304
1x Valvula 3: VXF43 SIEMENS SKC63



IMPORTANT NOTE:
FOR THE OPERATION TEMPERATURE OF THIS EQUIPMENT THE ALLOWED CHLORIDE CONTENT IN THE WATER SHOULD BE BELOW 10 PPM. IF THE CLORIDE CONTENT IS TOO HIGH THE RESULT WILL BE STRESS CRACK CORROSION AND RISK OF LEAKING HEAT EXCHANGERS.

REMARKS:
* :THE ENTERING WATER TEMPERATURE AND FLOW ON THE CONDENSER SHOULD BE CONSTANT. IF NOT, MEASURES HAVE TO BE TAKEN ON THE WATERSIDE TO ENSURE THIS. THE CONTROLS/SOFTWARE ON THE HEATPUMP IS PREPARED FOR THIS.

LINE CODE: 100-RNII-####

100: DIAMETER RCII: LINE TYPE ####: LINE NUMBER

RN	REFRIGERANT NH_3	11	CARBON STEEL DIN-EN
CO	COOLANT OIL	12	CARBON STEEL ASTM
CW	COOLANT WATER	21	STAINLESS STEEL 304L

LEGENDA INSTRUMENTATION CODES

LOCAL CONTROLE — REMOTE CONTROLE

F	FLOW	X	UNCLASS. VARIABLES
G	GAUGING POS. / LENGTH	D	DIFFERENCE
L	LEVEL	I	INDICATING
M	MOISTURE / HUMIDITY	C	CONTROLLING
P	PRESSURE	T	TRANSMITTING
Q	QUALITY / DETECTION	S	SWITCHING
S	SPEED / FREQUENCY		
T	TEMPERATURE		

DESUPERHEATER

Code: H210		Qo: 25	[kW]
Make: Vahterus – Wijbenga			
Type: PSHE 3HH-66/1/1 – PS:			
Primary	Medium: NH3 (R717)		
	Flow: 0,2107 [kg/s]		
	Ti: 105 [°C]	Tc: 77 [°C]	
	Vol: 12,3 [l]	dP: 0,2 [kPa]	
Secundary	Medium: Water		
	Flow: 27,56 [m³/h]		
	Tin: 73,9 [°C]	Tout: 75 [°C]	
	Vol: 5,1 [l]	dP: 23,5 [kPa]	

CONDENSOR

Code: C210		Qo: 252	[kW]
Make: Vahterus – Wijbenga			
Type: PSH 4HH-114/1/1 PS: 60			
Primary	Medium: NH3 (R717)		
	Flow: 0,3036 [kg/s]		
	Ti: 75,5 [°C]	Tc: 77 [°C]	
	Vol: 26,1 [l]	dP: 0,1 [kPa]	
Secundary	Medium: Water		
	Flow: 27,703 [m³/h]		
	Tin: 65,4 [°C]	Tout: 74,2 [°C]	
	Vol: 18,4 [l]	dP: 42 [kPa]	

SUBCOOLER

Code: H211		Qo: 13	[kW]
Make: Vahterus – Wijbenga			
Type: PSHE 3HH-44/1/1 – PS:			
Primary	Medium: NH3 (R717)		
	Flow: 0,284 [kg/s]		
	Ti: 75,5 [°C]	Tc: 67,5 [°C]	
	Vol: 5,4 [l]	dP: 0,2 [kPa]	
Secundary	Medium: Water		
	Flow: 27,417 [m³/h]		
	Tin: 65 [°C]	Tout: 65,4 [°C]	
	Vol: 3,4 [l]	dP: 48,2 [kPa]	

(*) Locked in open position

CLIENT
GEA PTC

WATER FLOW WILL BE CONTROLED BY GEA WITH ON/OFF AND VARIABLE SPEED OF WATER PUMPS (DELIVERY PUMPS, VSD AND POWER SUPPLY BY OTHERS)

INSTALLATION ID : 62049-001-S01-1-01		MEDIUM : NH3	
DESIGN PRESSURE HP/LP : 50 / 23 [bar(g)]		CONTENTS : ± 50	[kg]
DESIGN TEMPERATURE HP/ LP : 0/ +80 (sat);150 / 0/+43 [°C]		CE–PED CATEGORY : IV	
DESIGN PRESSURE/ TEMPERATURE WATER CIRCUIT : 6 [bar(g)] / 0/+90 [°C]			
		RECOMMENDED OIL/CHARGE: CPI-Cp-1009-100 / 26	[L]

INTERFACE CONNECTIONS

REF.	DESCRIPTION	SIZE mm	TYPE ** = counter flange/collar supplied
A	COLD WATER IN +45°C , 48,64 m³/h	DN100 ø114,3 x 2,0	COLLAR, WELDED, 304L (EN1092-1 TYPE33) PN10 / LAP JOINT FLANGE, AL-EPOXY COATED (EN1092-1 TYPE02) **
B	COLD WATER OUT +40°C, 48,64m³/h	DN100 ø114,3 x 2,0	COLLAR, WELDED, 304L (EN1092-1 TYPE33) PN10 / LAP JOINT FLANGE, AL-EPOXY COATED (EN1092-1 TYPE02) **
C	HOT WATER OUT +75°C, 27,75 m³/h	DN80 ø88,9 x 2,0	COLLAR, WELDED, 304L (EN1092-1 TYPE33) PN10 / LAP JOINT FLANGE, AL-EPOXY COATED (EN1092-1 TYPE02) **
D	HOT WATER IN +65°C, 27,75 m³/h	DN80 ø88,9 x 2,0	COLLAR, WELDED, 304L (EN1092-1 TYPE33) PN10 / LAP JOINT FLANGE, AL-EPOXY COATED (EN1092-1 TYPE02) **
E	SAFETY VALVES BLOW OFF	DN65 ø76,1 x 2,9	WELDING NECK FLANGE, PN16, P250GH (DIN2633) **
F	FILLING CONNECTION	BSP ½" ø21,34 x 2,77	Thread + blind nut

Rev	Revision Description	Creator	Approver	Date (yyyy-mm-dd)
F	AS BUILT	P.HENDRIKS	K.HOFMANN	2017-11-08
E	GENERAL UPDATE	P.HENDRIKS	K.HOFMANN	2017-08-22

Client: LOWUP - SPAIN
Project: Water-water heat pump 1 45 HP compresso
Order no. initial: 1-01
Order no. actual: 1-01
Scale: N/A
Weight: N/A
Sheet: 1/1
Format: A2

GEA engineering for a better world
PTC REFRIGERATION PROCESSES
THE NETHERLANDS

Title: P&ID
ID No: 62049-001-S01
Rev: F

ACAD FILENAME : N:\ESC\Project Execution\62049–001–ESP–LowUp\2) Mechanical Engineering\b) PID\~62049–001–S01.dwg

PLOTDATE: 30-11-2017

0	1	2	3	4	5	6	7	8	9

engineering for
a better world

PTC REFRIGERATION PROCESSES

ELECTRICAL DRAWINGS

62049-001

MADE FOR:

LowUp (ESP)

ADDITIONAL INFORMATION:

Water-Water Heat Pump (1x45HP)

GEA Refrigeration Netherlands N.V.
European Skid Center

AS BUILT	
Signature:	Date

◀ 2 ▶

AS BUILT	EK	17/11/17	8	Drawn by:	LowUp (ESP)	Location: E01	Drawingnumber (group): HP_1C
Revision description	Name	Date	Rev.				
Location:	Name	EK		Description	FRONTPAGE	Ordernumber: 62049-001	Page: 1
	Last change.	30-Nov-17					

CONTENTS

0	1	2	3	4	5	6	7	8	9

CONTENTS

0	1	2	3	4	5	6	7	8	9

CONTENTS

◀2.a

2.c▶

CONTENTS

Information wire colors, cross and clambs

Main power circuits:

Tension : 3x400VAC + N
Min. cross section : 1,5mm²
L1 : Black
L2 : Black
L3 : Black
N : Light Blue

Tension : 230VAC+N
Min. cross section : 1,5mm²
L : Brown
N : (light) Blue
Switched : Black

Protection(earth) circuits:

Min. cross section : 1,5mm²
: Yellow/Green

Control current circuits:

Tension : 230VAC
Min. cross section : 0,75mm²
L : Brown
N : (light) Blue

Tension : 24VAC
Min. cross section : 0,75mm²
L : Red
N : Light Blue
Tension : 24VDC
Min. cross section : 0,75mm²
+24VDC : Marine Blue
-0VDC : Blue / White

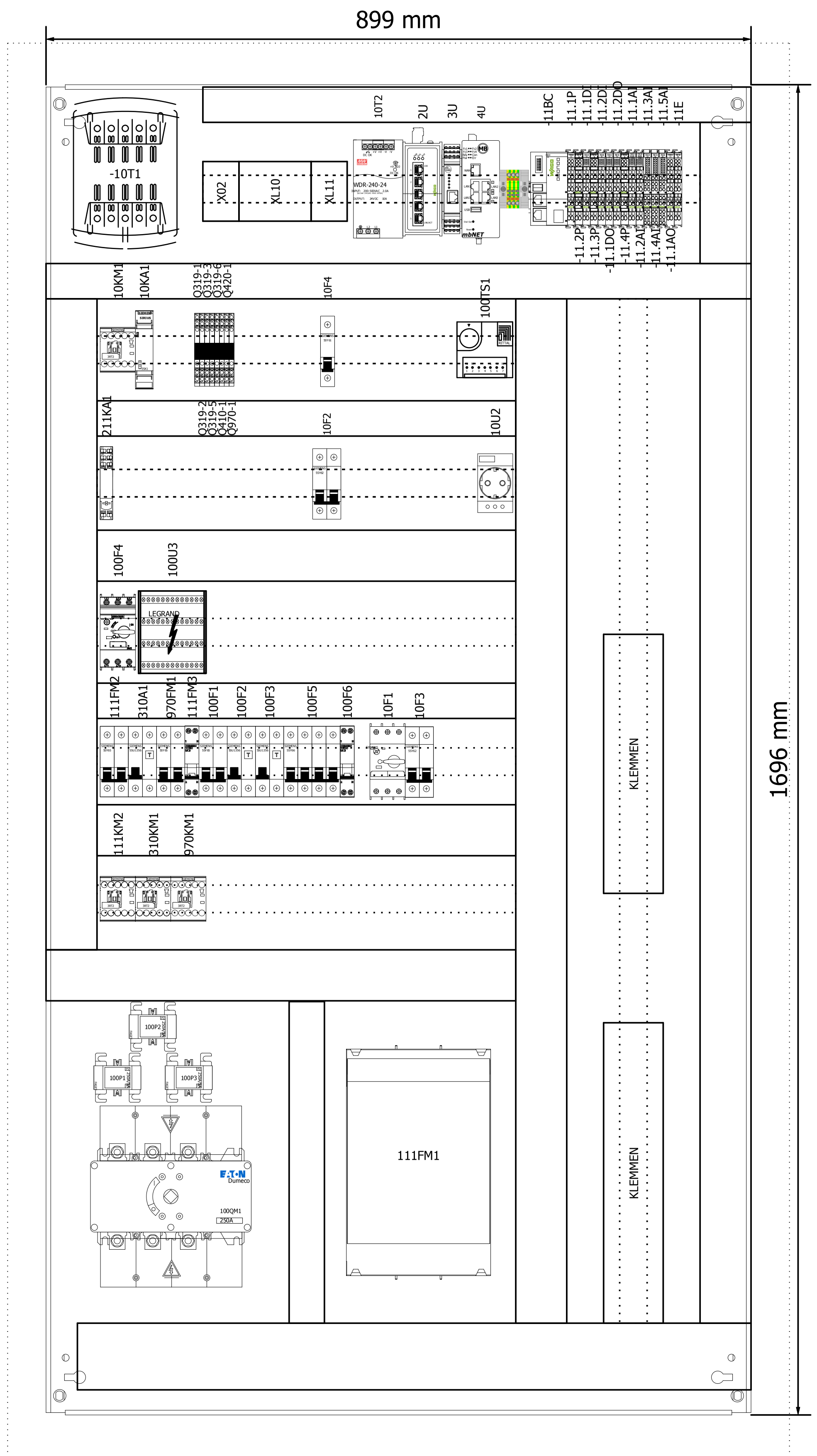
Tension : VCC external sourch
Min. cross section :1mm²
All : Orange

Tension : Analogous
Min. cross section : 0,75mm²
All : White

Terminal codes:

-X1 φ_1 = Main current 400V/690VAC
-X2 φ_1 = Main / Control current 230VAC
-X3 φ_1 = 24VAC/DC
-X4 φ_1 = Potential free
-X5 φ_1 = Analogous
-X1 φ_{PE} = Earthclamp

All switchgear Siemens / Schneider (or equivalent)

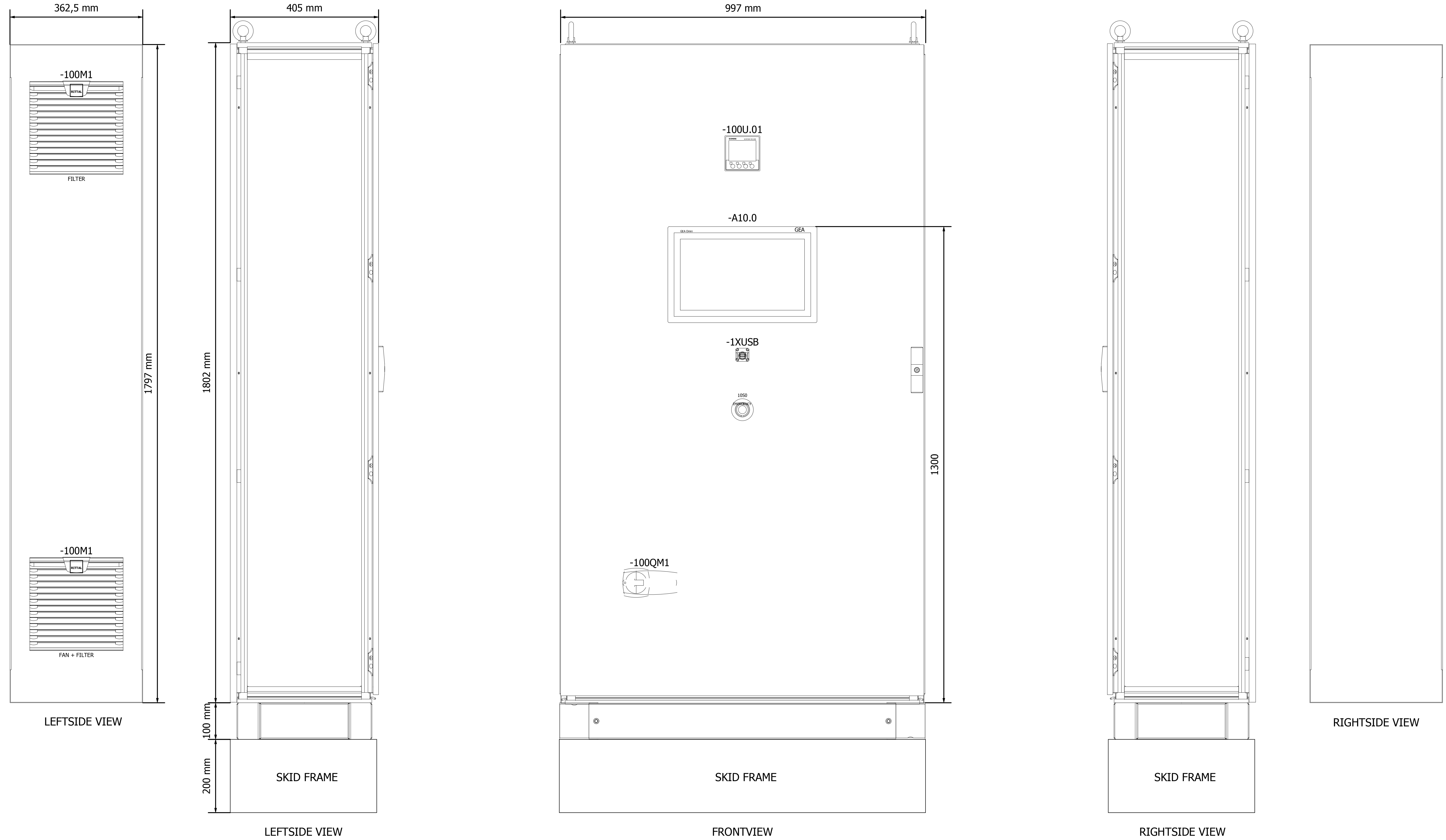


MOUNTINGPLATE

◀4 9.1▶

AS BUILT	EK	17/11/17	8	Drawn by:	LowUp (ESP)	GEA	Location: E01	Drawingnumber (group): HP_1C
Revision description	Name	Date	Rev.					
Location: TS8284.600	Name	EK		Description	PANEL VIEW		Ordernumber: 62049-001	Page: 9
	Last change.	30-Nov-17						

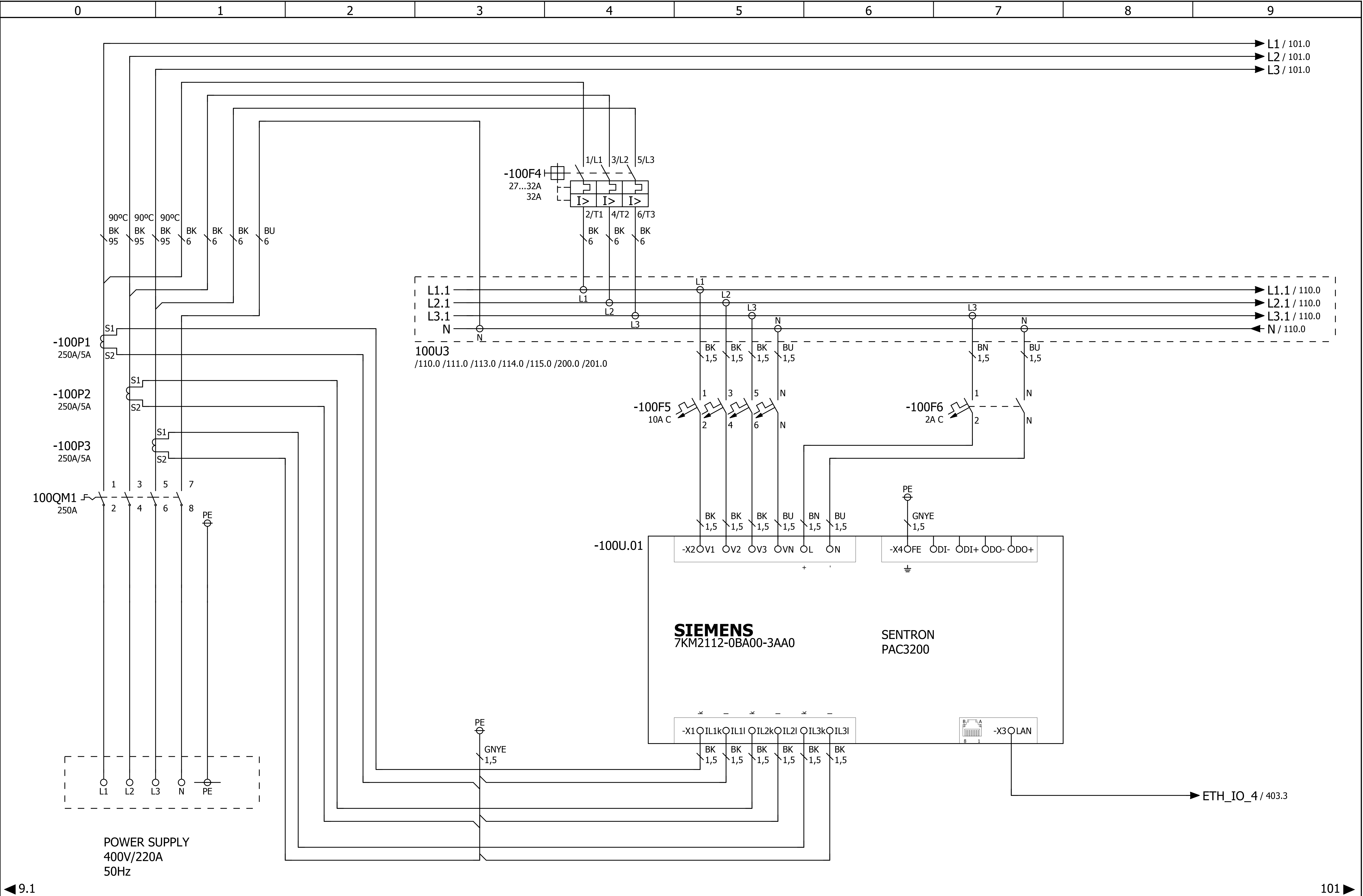
0	1	2	3	4	5	6	7	8	9



◀9

100▶

AS BUILT	EK	17/11/17	8	Drawn by: LowUp (ESP)		Location: E01	Drawingnumber (group): HP_1C
Revision description	Name	Date	Rev.				
Location: TS8284.600	Name	EK		Description DOOR VIEW	GEA	Ordernumber: 62049-001	Page: 9.1
	Last change.	30-Nov-17					



◀9.1 101▶

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Revision description	Name	Date	Rev.				
Location:	Name	EK		Description: MC MAINSWITCH	GEA	Ordernumber: 62049-001	Page: 100
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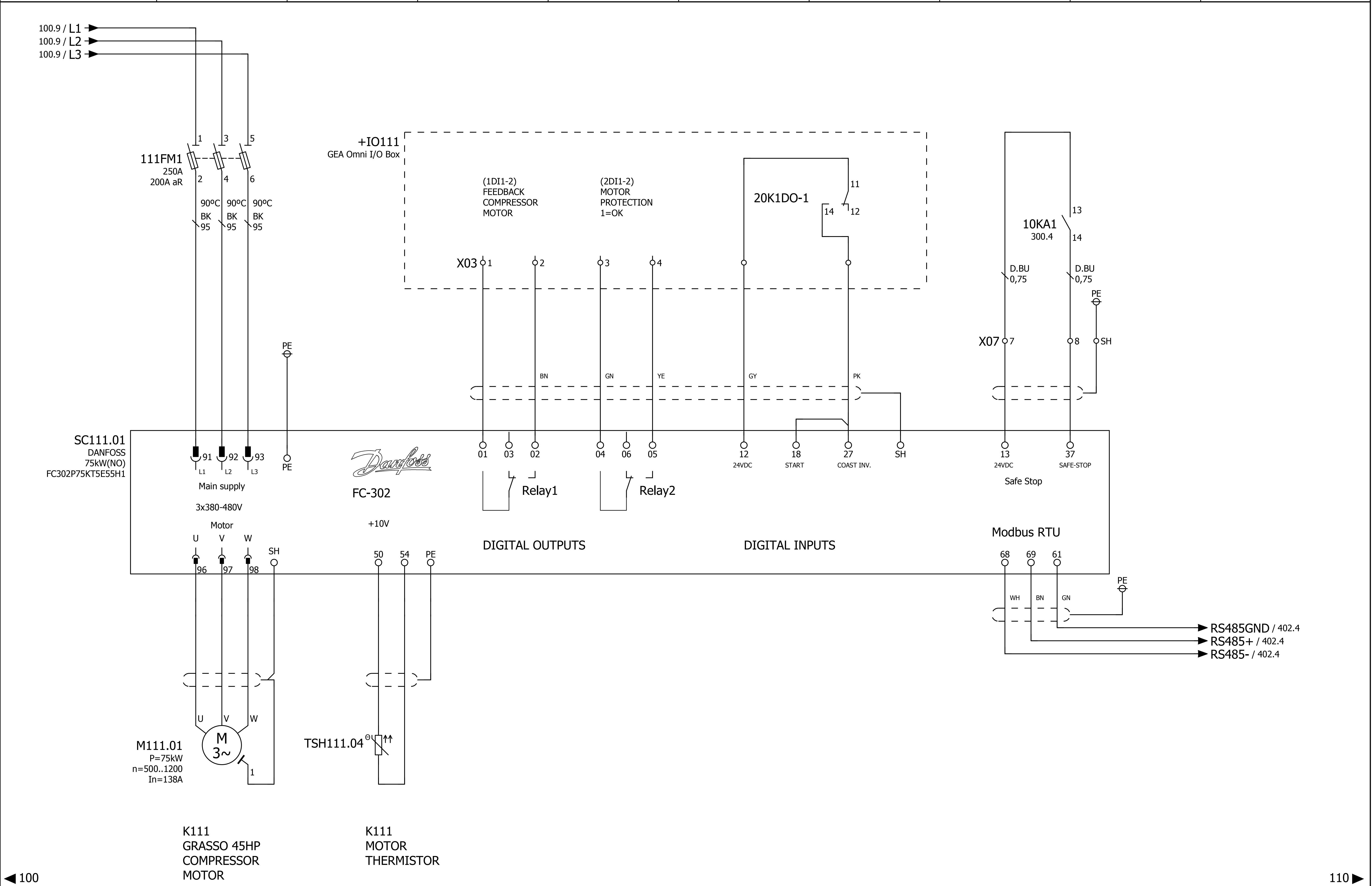

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110▶

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Revision description	Name	Date	Rev.					
Location:	Name	EK		Description	MC COMPRESSOR K111		Ordernumber: 62049-001	Page: 101
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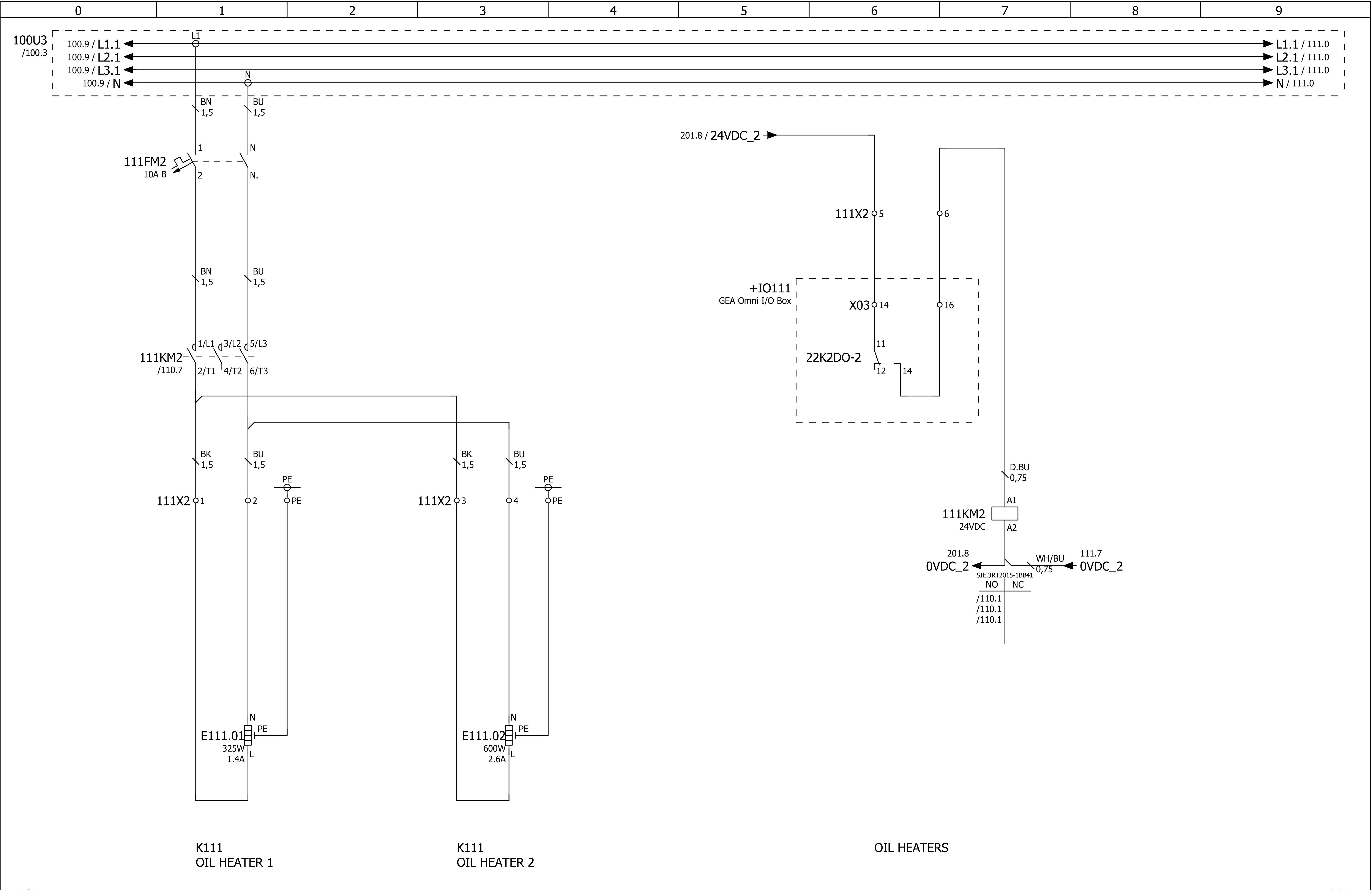

◀ 101

111 ▶

AS BUILT	EK	17/11/17	8	Drawn by: LowUp (ESP)		Location: E01	Drawingnumber (group): HP_1C
Revision description	Name	Date	Rev.				
Location:	Name	EK		Description MC K111 HEATERS		Ordernumber: 62049-001	Page: 110
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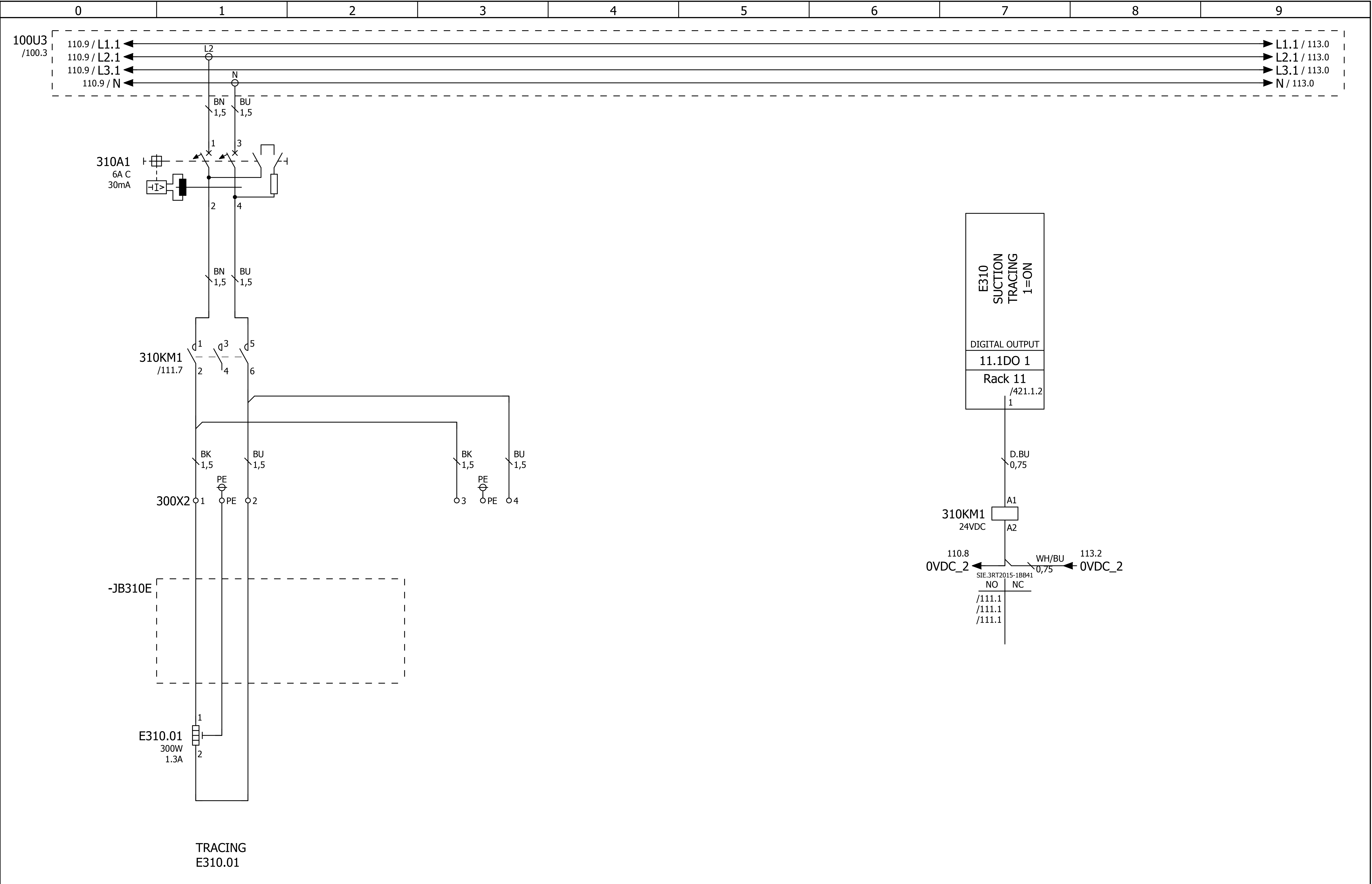

◀ 110

113 ▶

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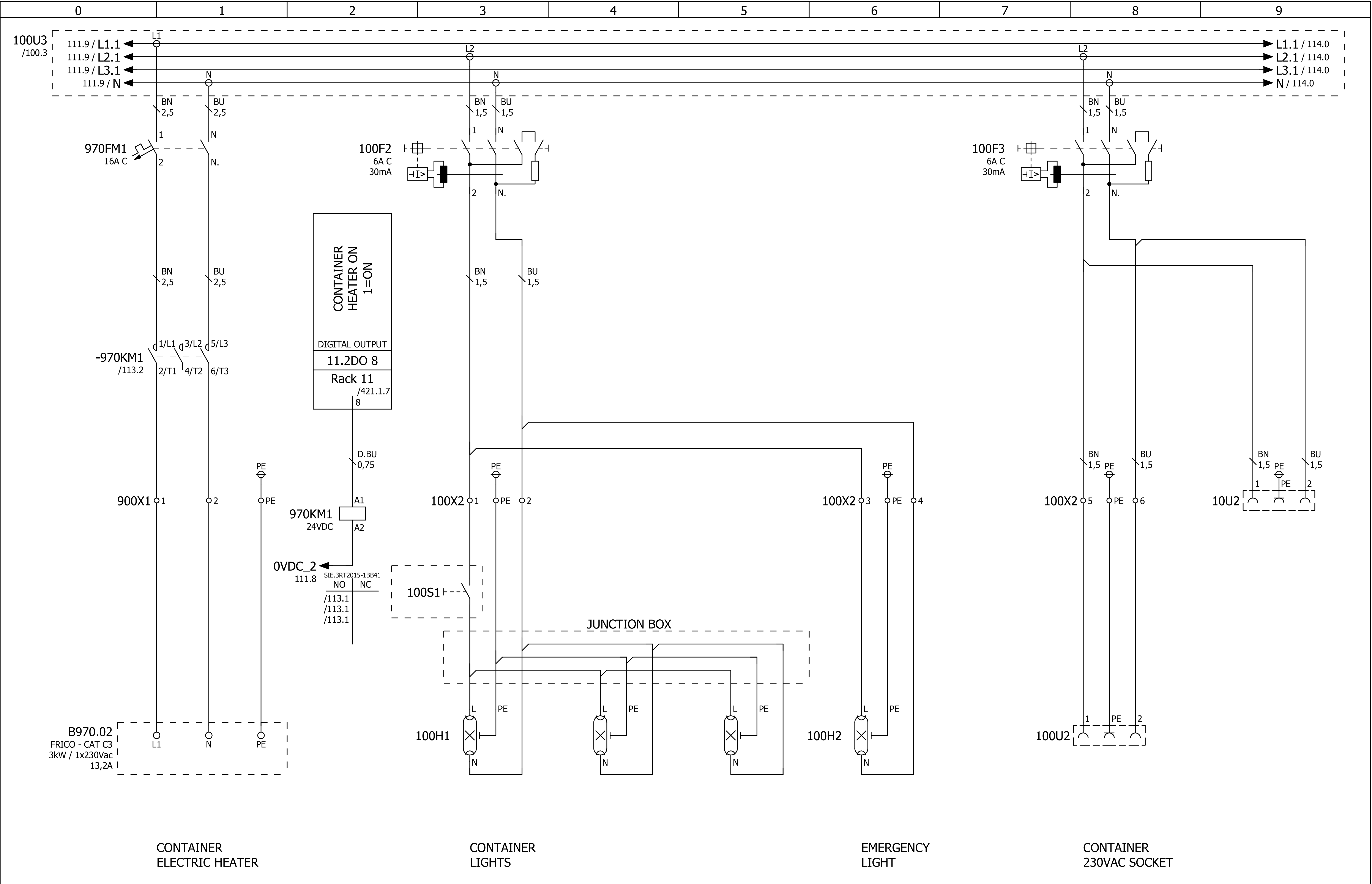
Revision description	Name	Date	Rev.				
Location:	Name	EK		Description	MC E310 SUCTION TRACING	Ordernumber: 62049-001	Page: 111
	Last change.	30-Nov-17					



◀111 114▶

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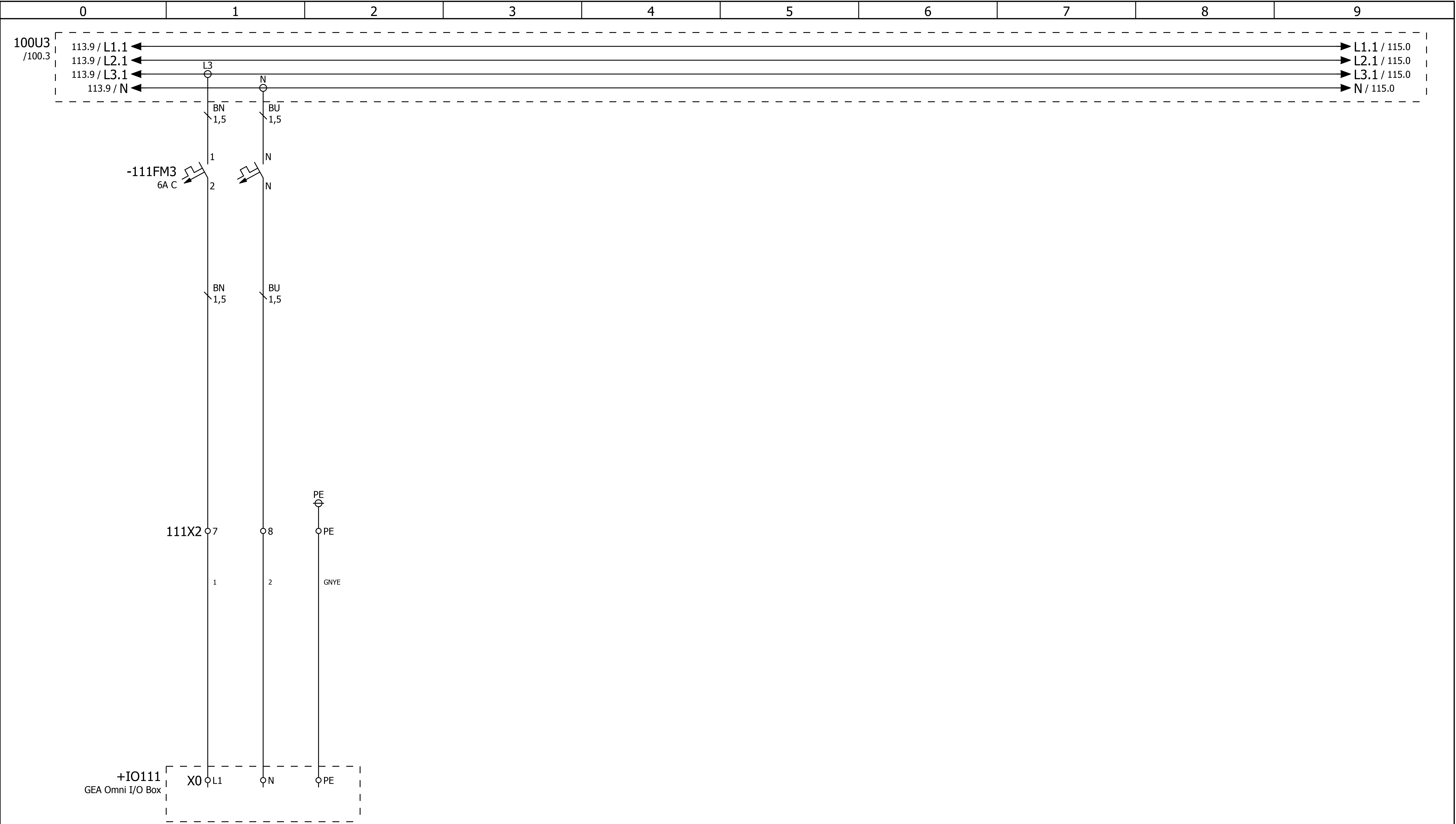
Revision description	Name	Date	Rev.				
Location:	Name	EK		Description: MC CONTAINER FACILITES		Ordernumber: 62049-001	Page: 113
	Last change.	30-Nov-17					

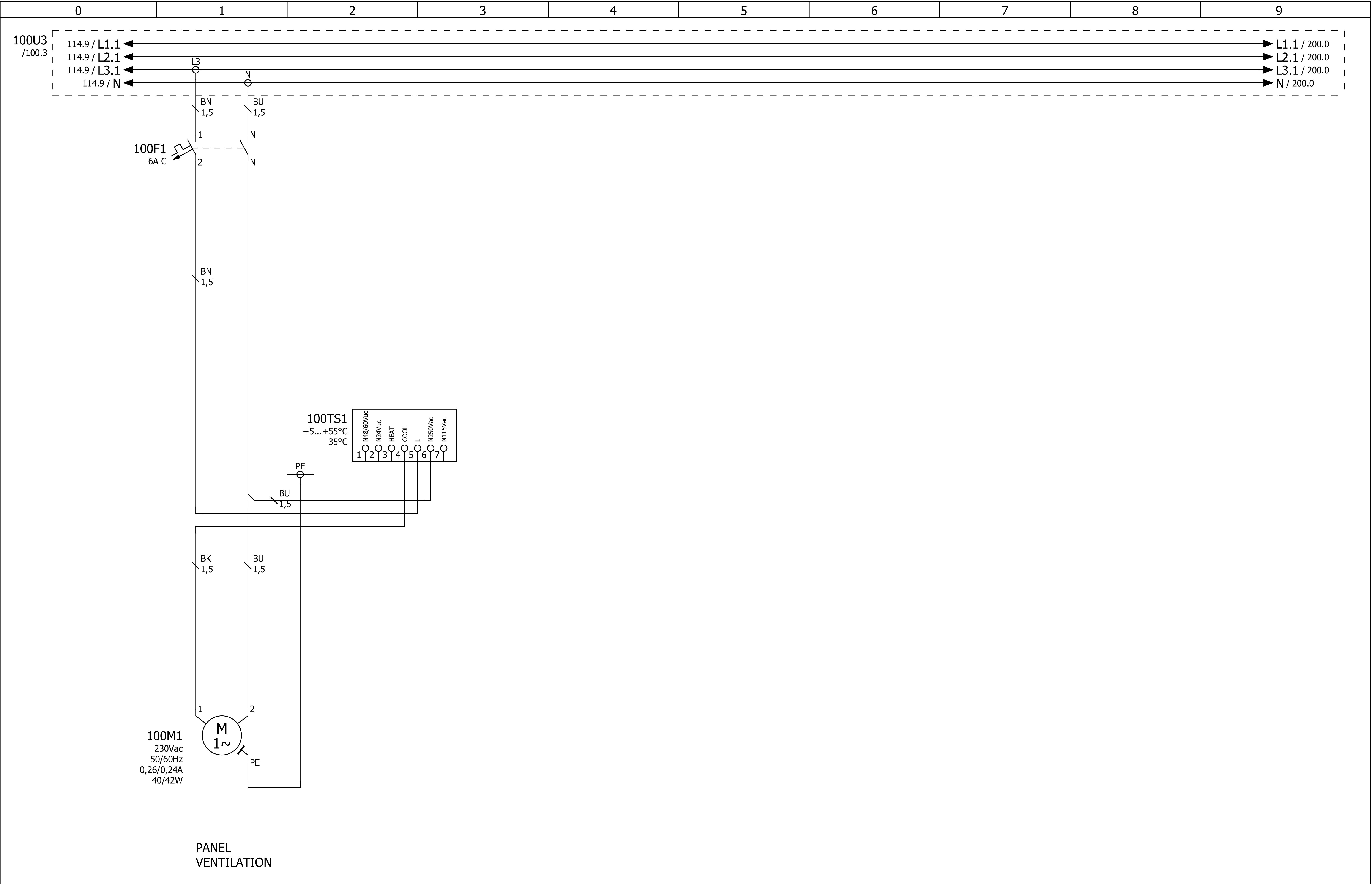


POWER SUPPLY

◀ 113

115 ▶

AS BUILT	EK	17/11/17	8	Drawn by:	LowUp (ESP)	Location: E01	Drawingnumber (group): HP_1C
Revision description	Name	Date	Rev.				
Location:	Name	EK		Description	MC OMNI IO BOX POWER SUPPLY	Ordernumber: 62049-001	Page: 114



PANEL
VENTILATION

◀114

200▶

AS BUILT	EK	17/11/17	8	Drawn by: LowUp (ESP)	GEA	Location: E01	Drawingnumber (group): HP_1C
Revision description	Name	Date	Rev.				
Location:	Name	EK		Description MC PANEL VENTILATION		Ordernumber: 62049-001	Page: 115
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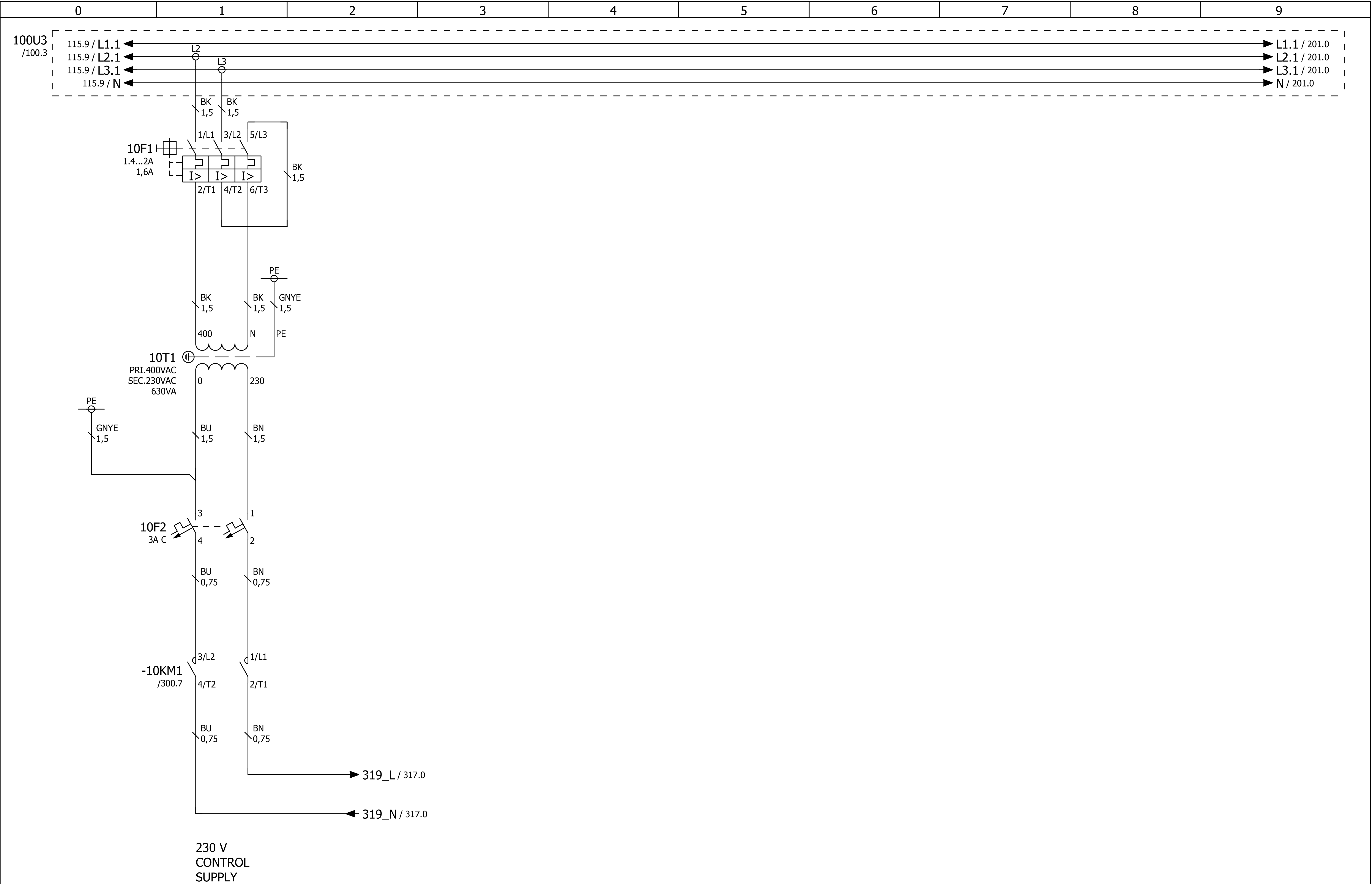

◀115

201▶

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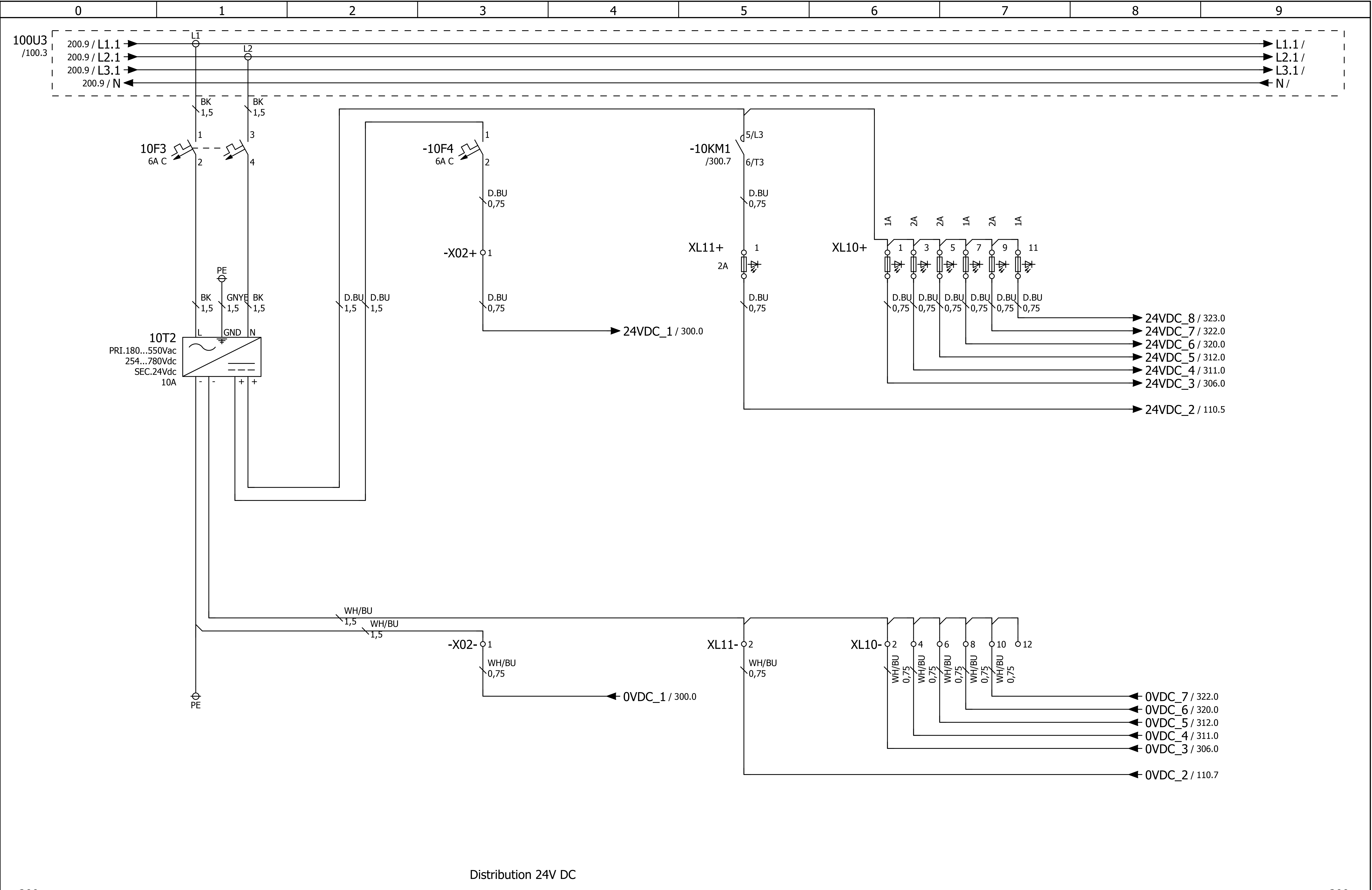
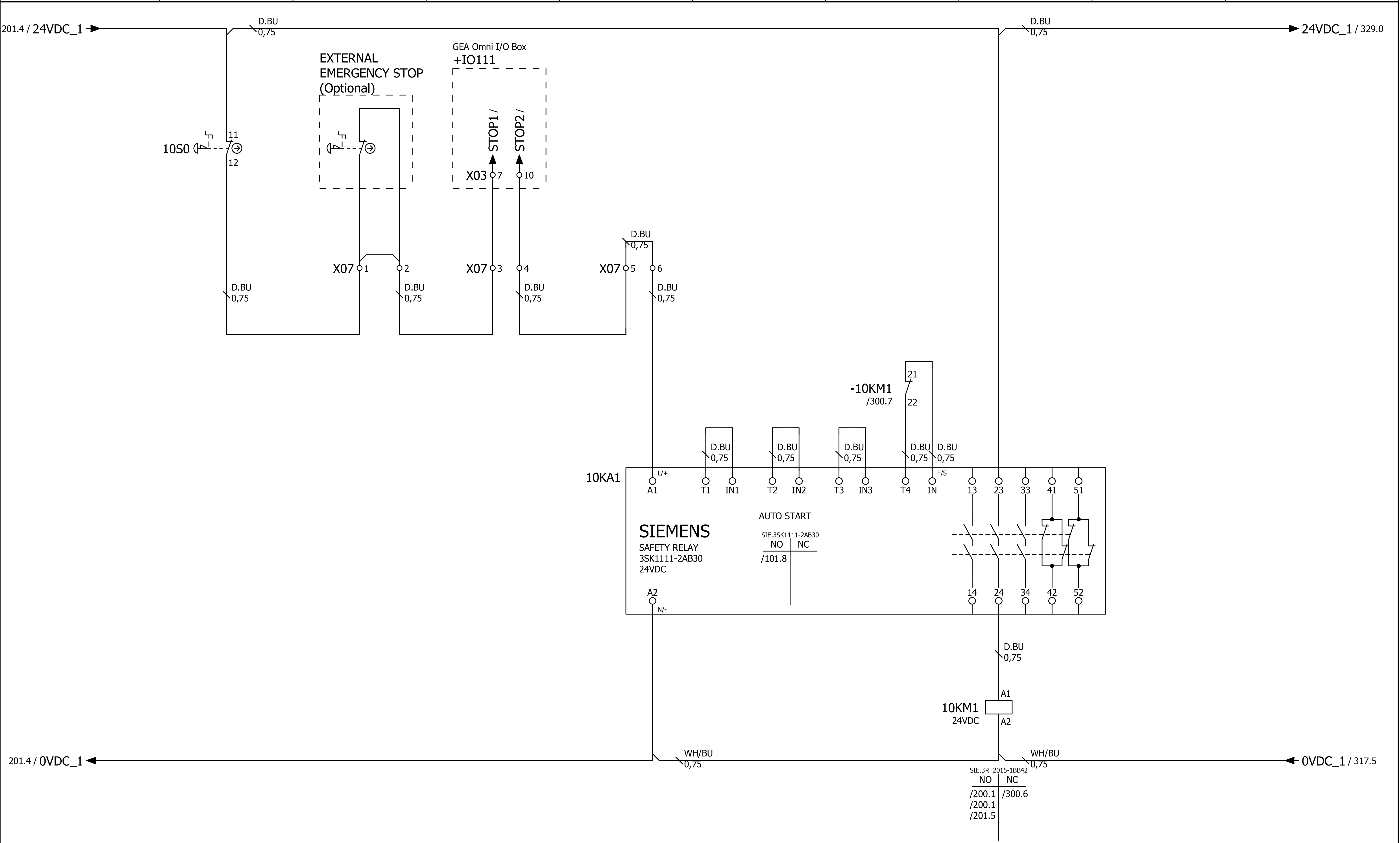
Revision description	Name	Date	Rev.				
Location:	Name	EK		Description: MC CONTROL CURRENT 230VAC		Ordernumber: 62049-001	Page: 200
	Last change.	30-Nov-17					



Distribution 24V DC

◀200 300▶

AS BUILT	EK	17/11/17	8	Drawn by: LowUp (ESP)	Location: E01	Drawingnumber (group): HP_1C
Revision description	Name	Date	Rev.			
Location:	Name	EK		Description: MC CONTROL CURRENT 24VDC	Ordernumber: 62049-001	Page: 201



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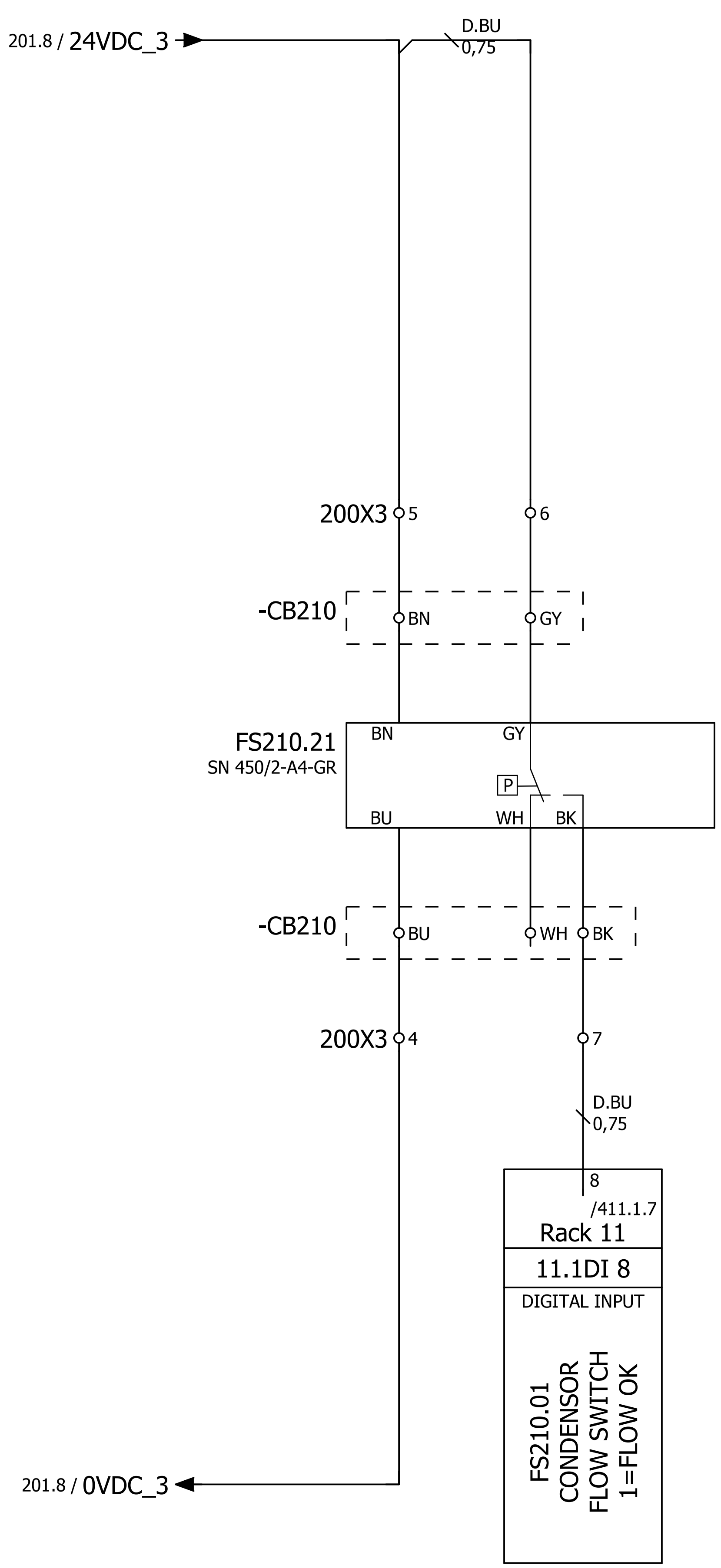
Revision description	Name	Date	Rev.			
Location:	Name	EK		Description	CC EMERGENCY STOP	Ordernumber: 62049-001
	Last change.	30-Nov-17				

Drawingnumber (group): HP_1C

Page: 300

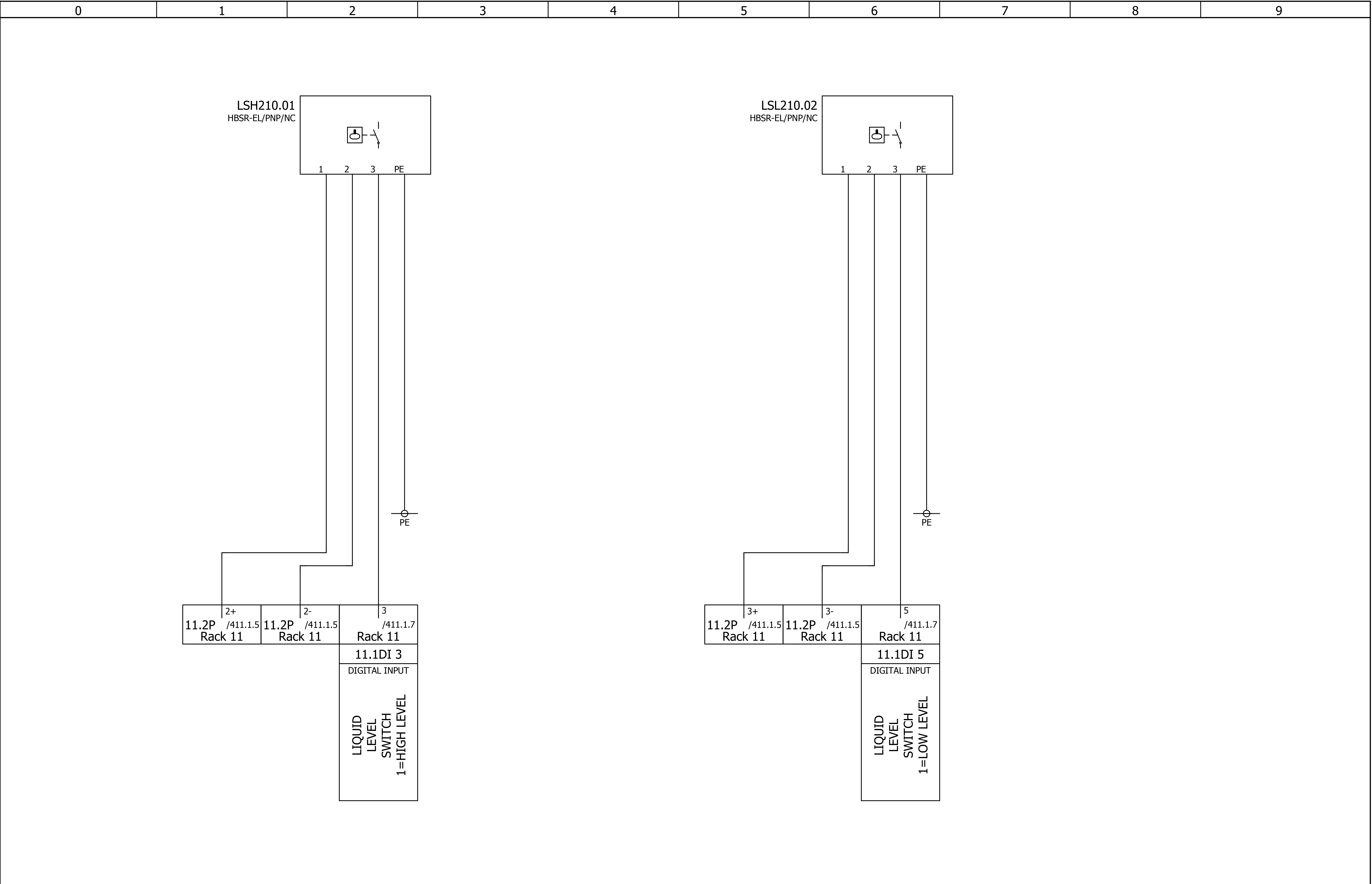


◀ 300

FLOW SWITCH

307 ▶

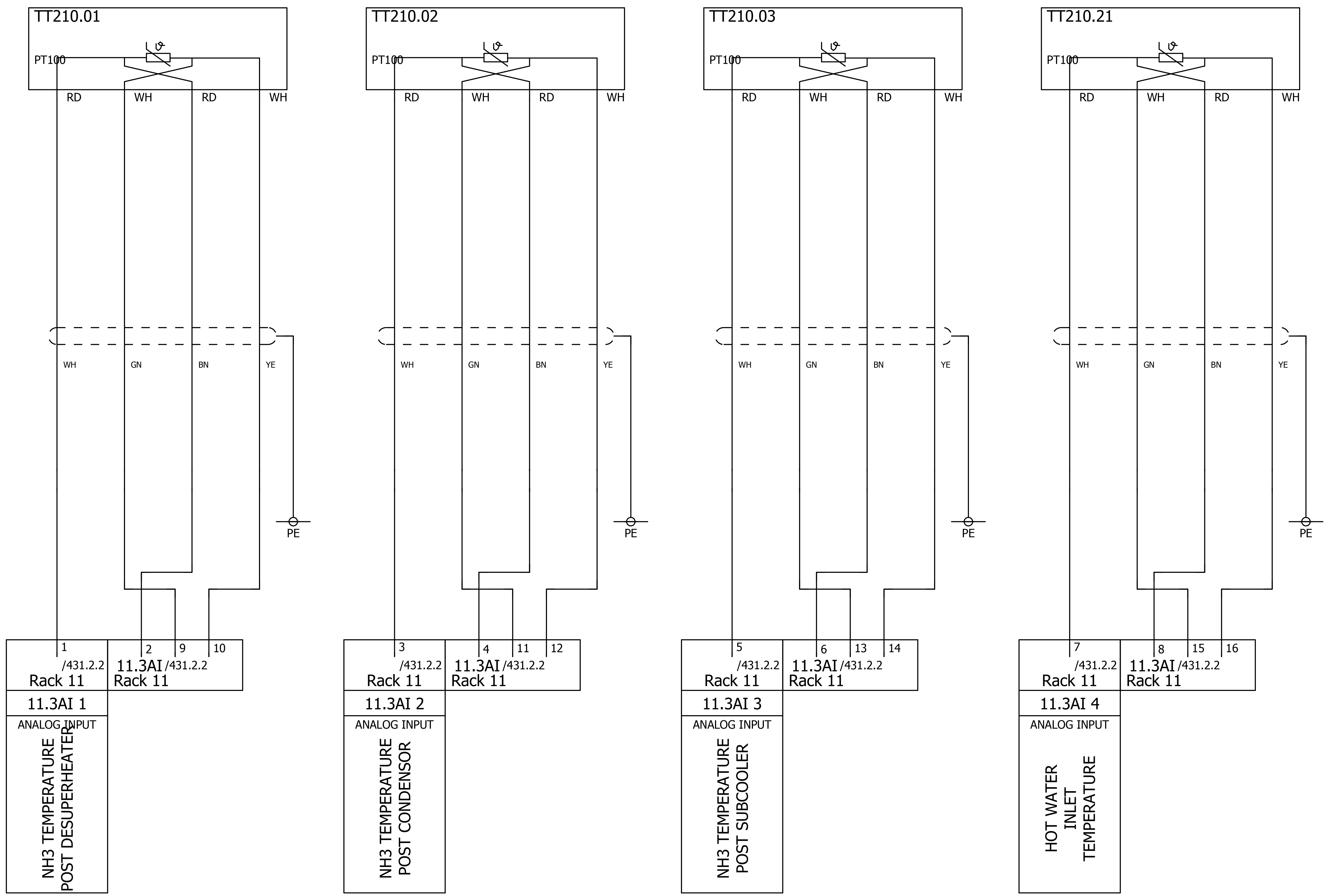
AS BUILT	EK	17/11/17	8	Drawn by: LowUp (ESP)	Location: E01	Drawingnumber (group): HP_1C
Revision description	Name	Date	Rev.			
Location:	Name EK	Last change. 30-Nov-17		Description CC CONDENSOR FLOW SWITCH FS210.21	Ordernumber: 62049-001	Page: 306



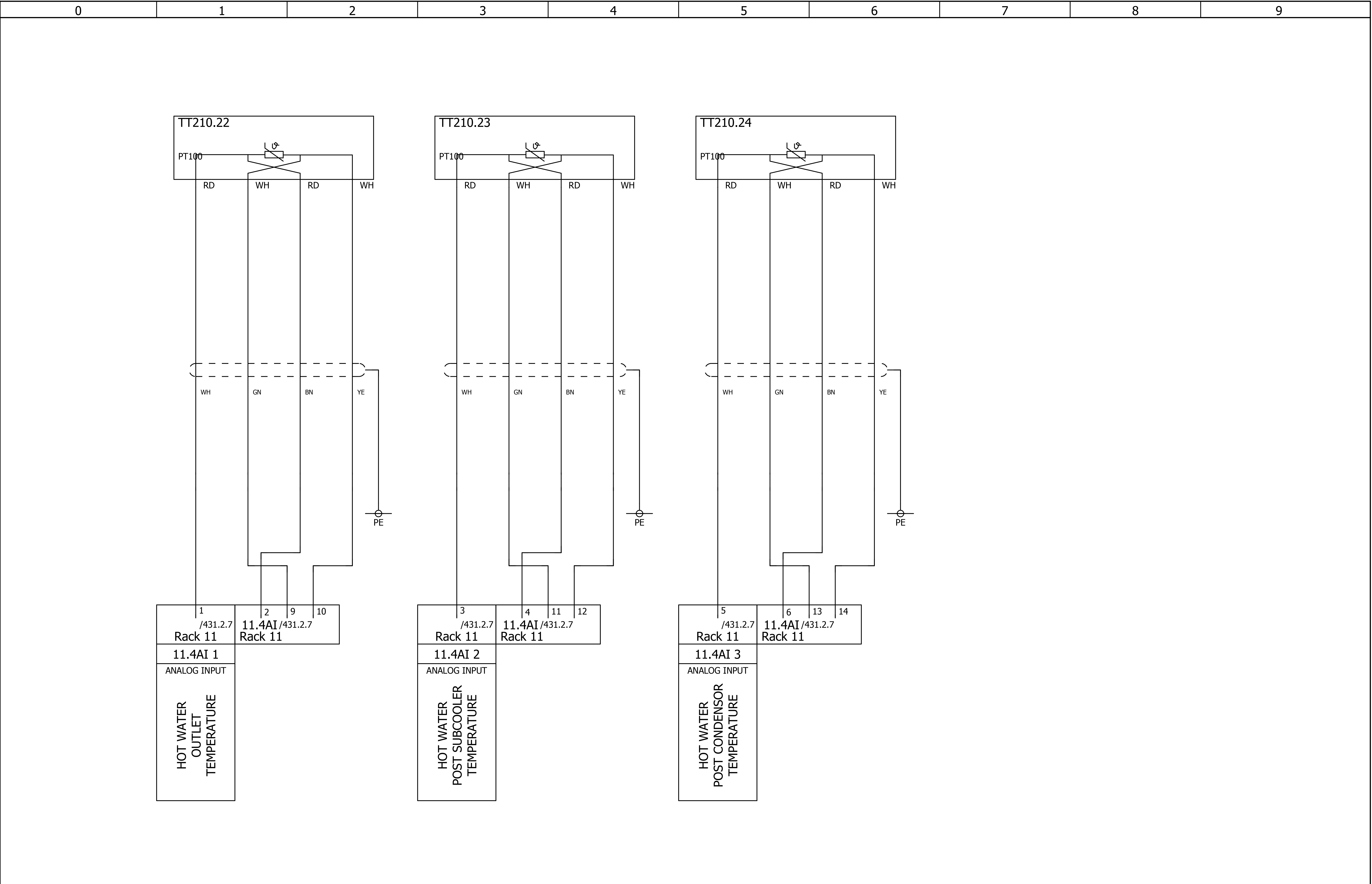
◀306

308▶

AS BUILT	EK	17/11/17	8	Drawn by: LowUp (ESP)	Location: E01	Drawingnumber (group): HP_1C
Revision description	Name	Date	Rev.			
Location:	Name	EK		Description: CC CONDENSOR LEVEL SWITCHES	Ordernumber: 62049-001	Page: 307
	Last change.	30-Nov-17				


TT210.01
PT100
RD WH RD WH
WH GN BN YE
PE
1 /431.2.2 Rack 11
2 9 10 11.3AI /431.2.2 Rack 11
11.3AI 1
ANALOG INPUT
NH3 TEMPERATURE POST DESUPERHEATER
TT210.02
PT100
RD WH RD WH
WH GN BN YE
PE
3 /431.2.2 Rack 11
4 11 12 11.3AI /431.2.2 Rack 11
11.3AI 2
ANALOG INPUT
NH3 TEMPERATURE POST CONDENSOR
TT210.03
PT100
RD WH RD WH
WH GN BN YE
PE
5 /431.2.2 Rack 11
6 13 14 11.3AI /431.2.2 Rack 11
11.3AI 3
ANALOG INPUT
NH3 TEMPERATURE POST SUBCOOLER
TT210.21
PT100
RD WH RD WH
WH GN BN YE
PE
7 /431.2.2 Rack 11
8 15 16 11.3AI /431.2.2 Rack 11
11.3AI 4
ANALOG INPUT
HOT WATER INLET TEMPERATURE

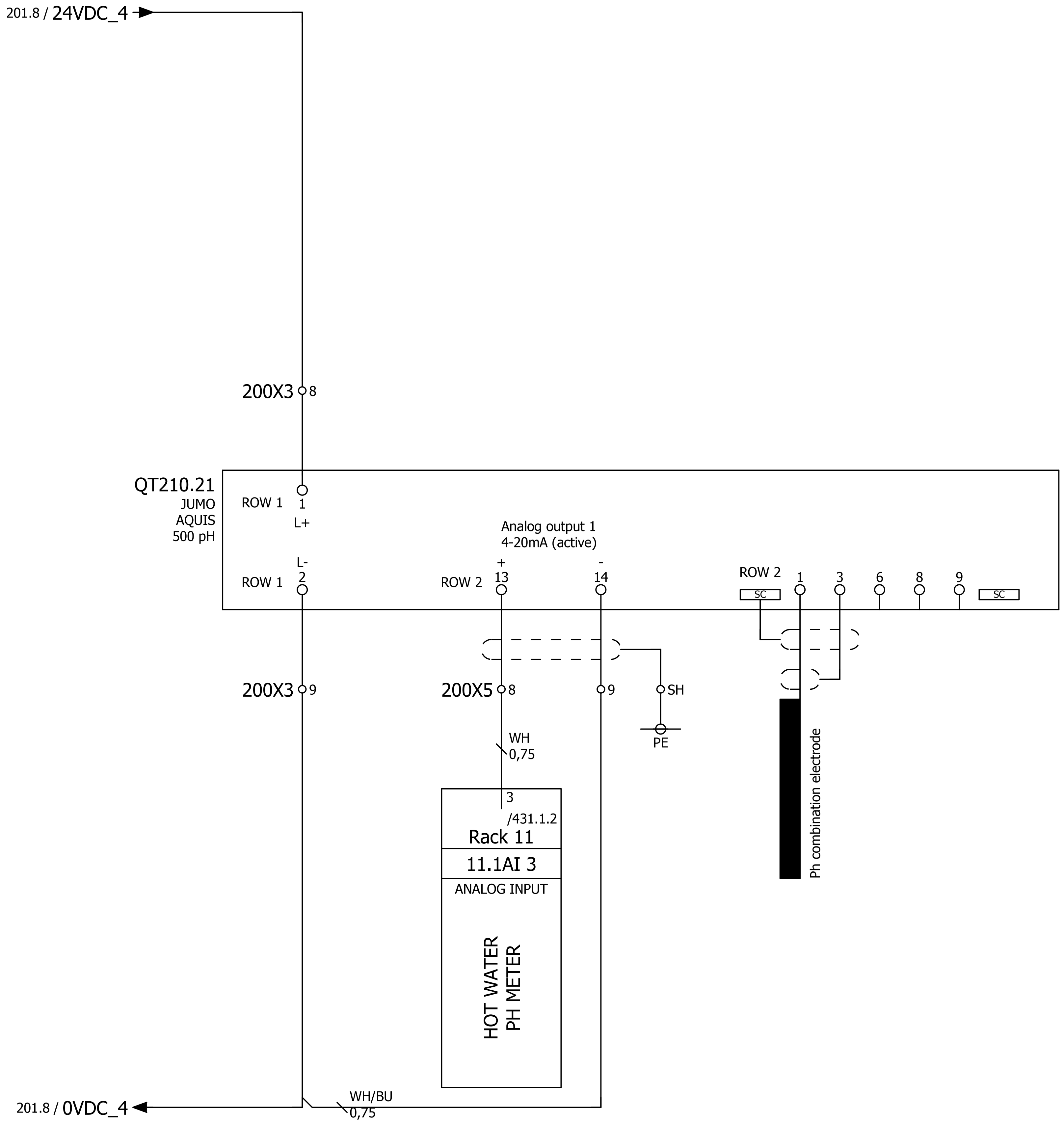
◀307 309▶

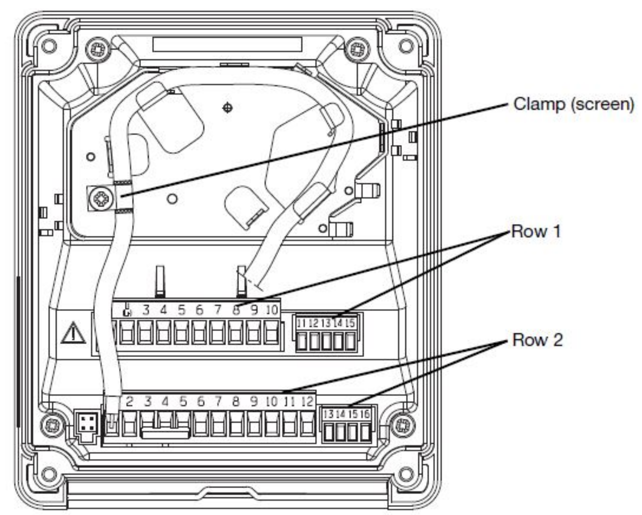


◀308

311▶

AS BUILT	EK	17/11/17	8	Drawn by: LowUp (ESP)	GEA	Location: E01	Drawingnumber (group): HP_1C
Revision description	Name	Date	Rev.				
Location:	Name	EK		Description: CC CONDENSOR TEMPERATURES		Ordernumber: 62049-001	Page: 309
	Last change.	30-Nov-17					



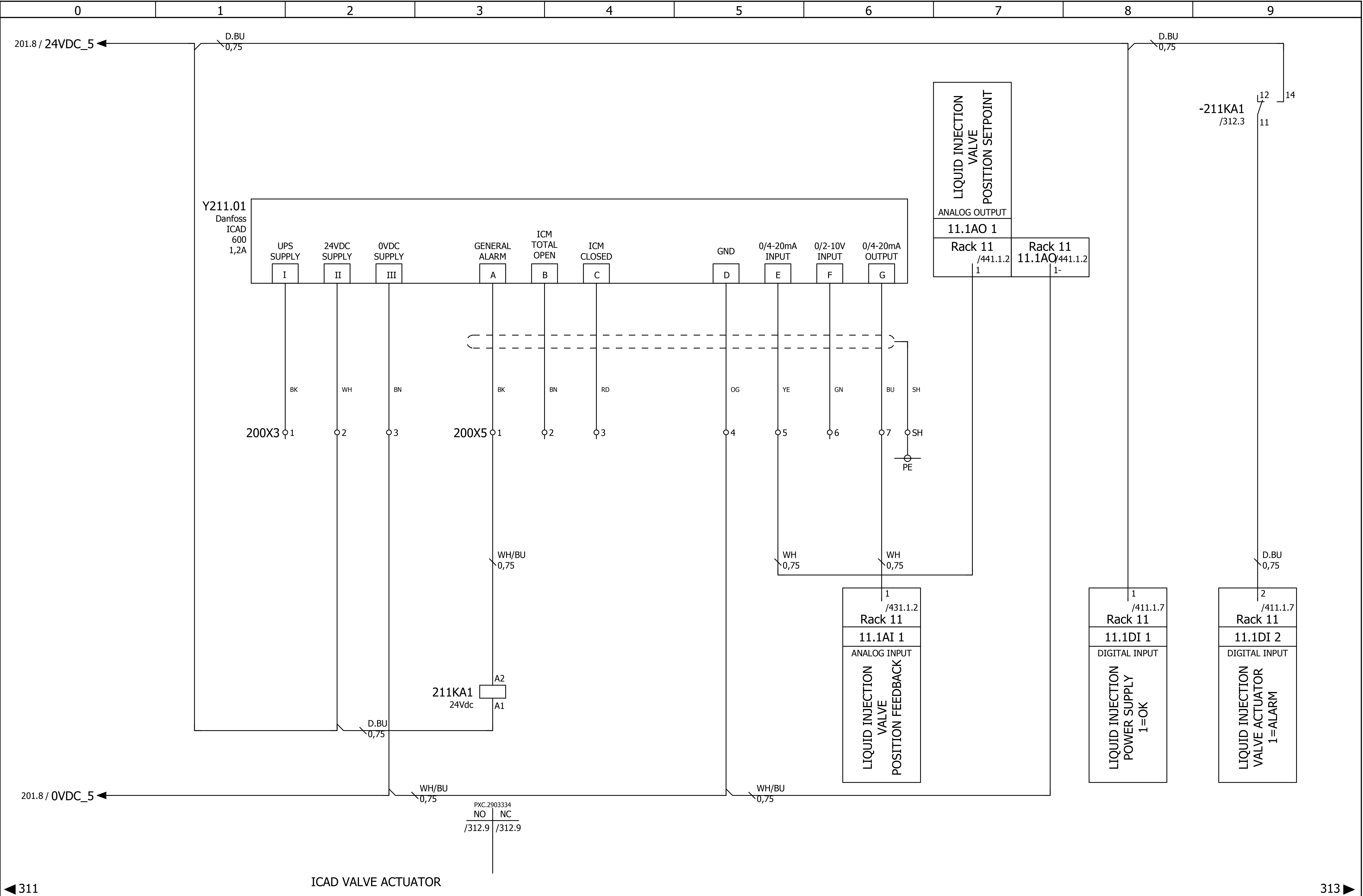


Q210.21
NH3 DETECTION

◀ 309

312 ▶

AS BUILT	EK	17/11/17	8	Drawn by:	LowUp (ESP)	Location: E01	Drawingnumber (group): HP_1C
Revision description	Name	Date	Rev.				
Location:	Name	EK		Description	CC HOT WATER NH3 DETECTION	Ordernumber: 62049-001	Page: 311
	Last change.	30-Nov-17					



◀311 313▶

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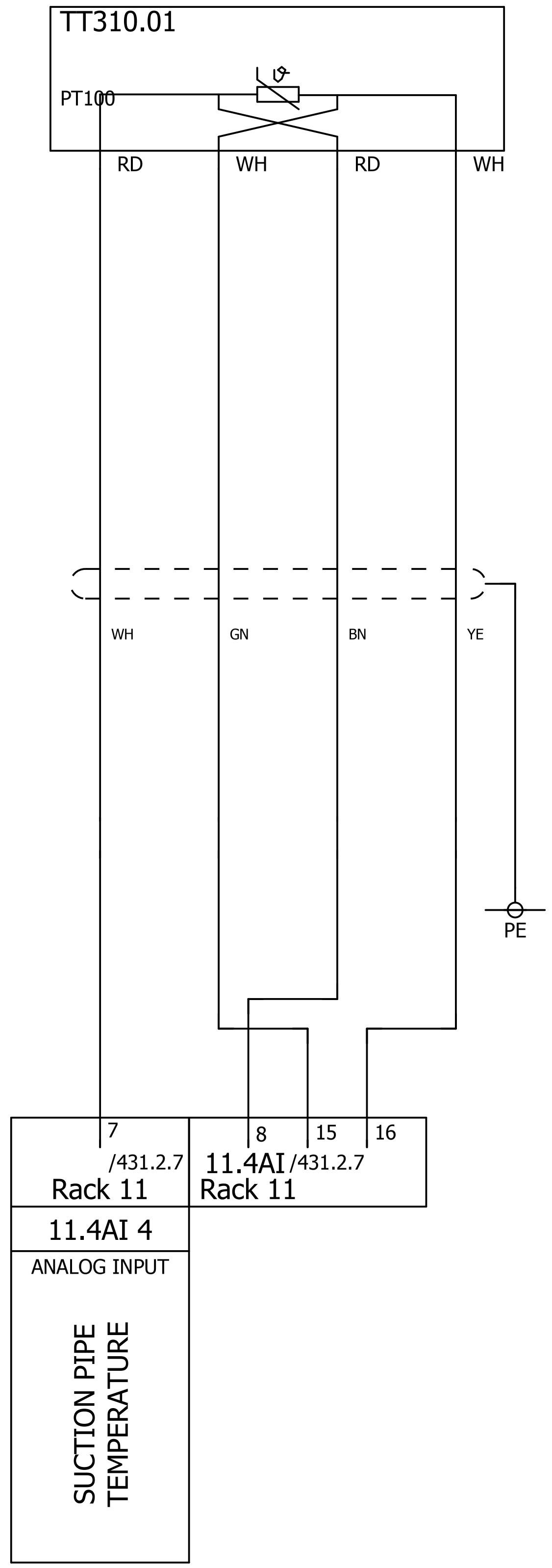
Revision description	Name	Date	Rev.				
Location:	Name	EK		Description: CC EXPANSION VALVE Y211.01		Ordernumber: 62049-001	Page: 312
	Last change.	30-Nov-17					

0	1	2	3	4	5	6	7	8	9



◀312

316▶

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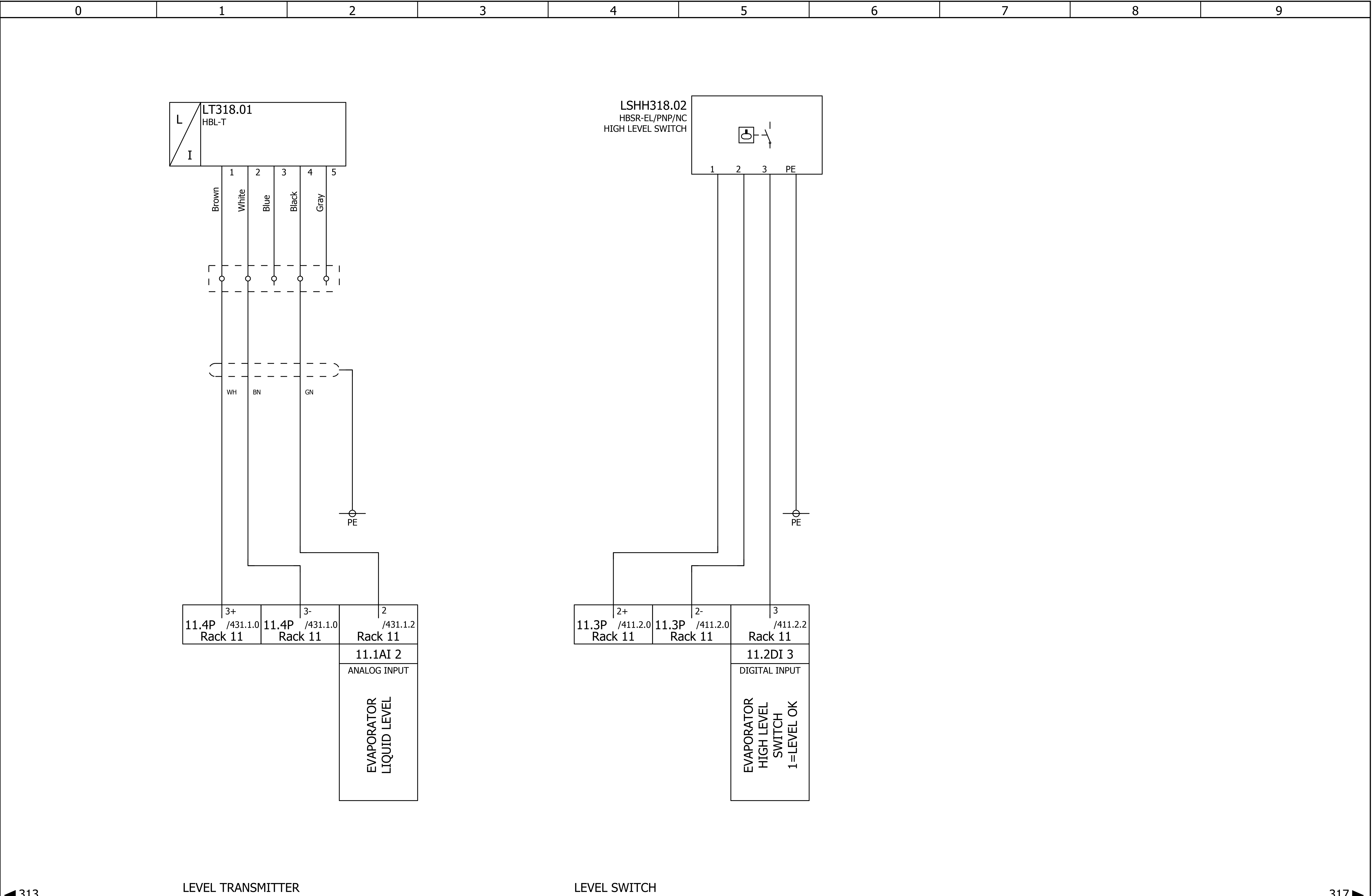
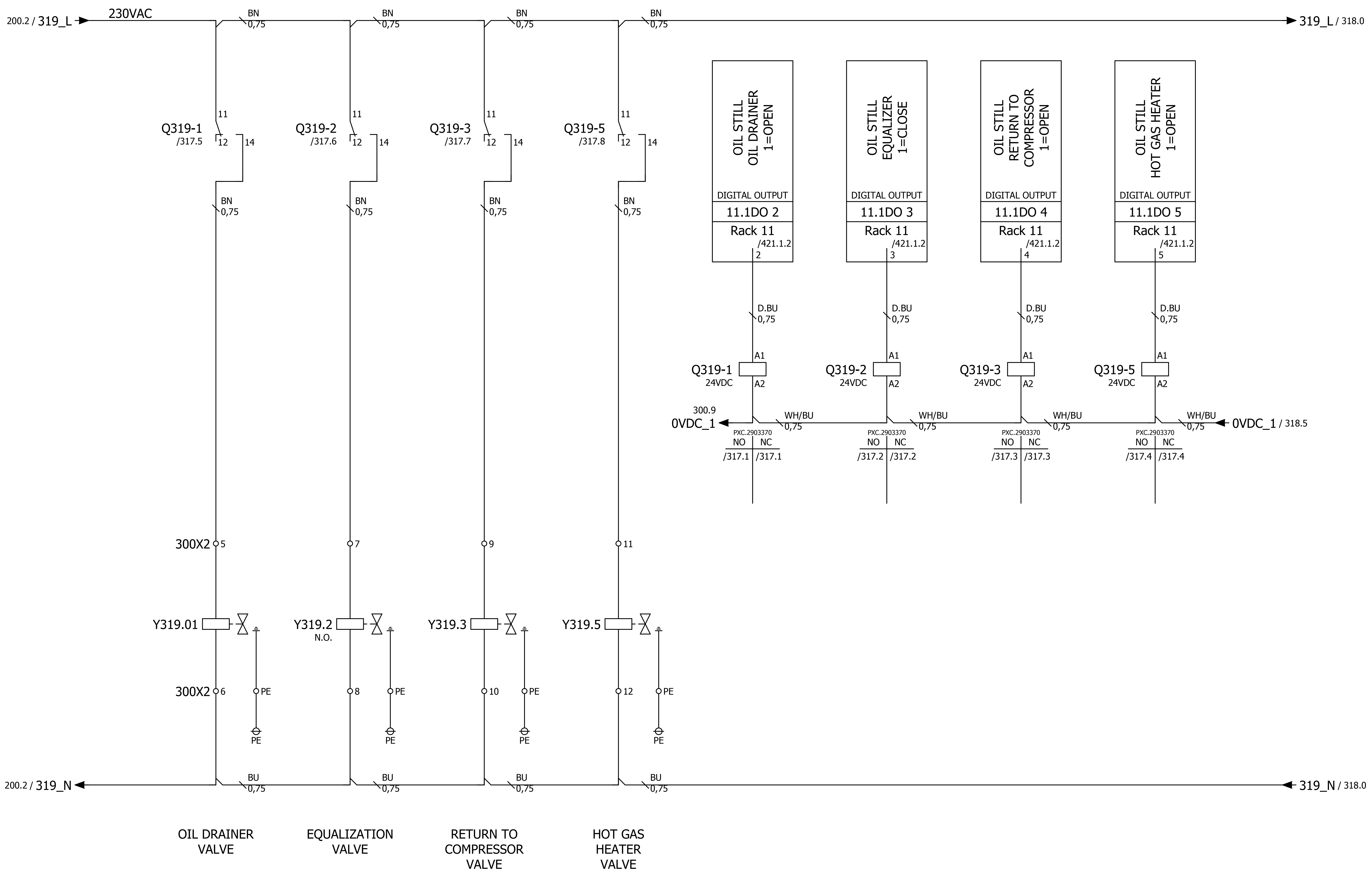
Revision description	Name	Date	Rev.				
Location:	Name	EK		Description	CC EVAPORATOR TEMPERATURES	Ordernumber: 62049-001	Page: 313
	Last change.	30-Nov-17					



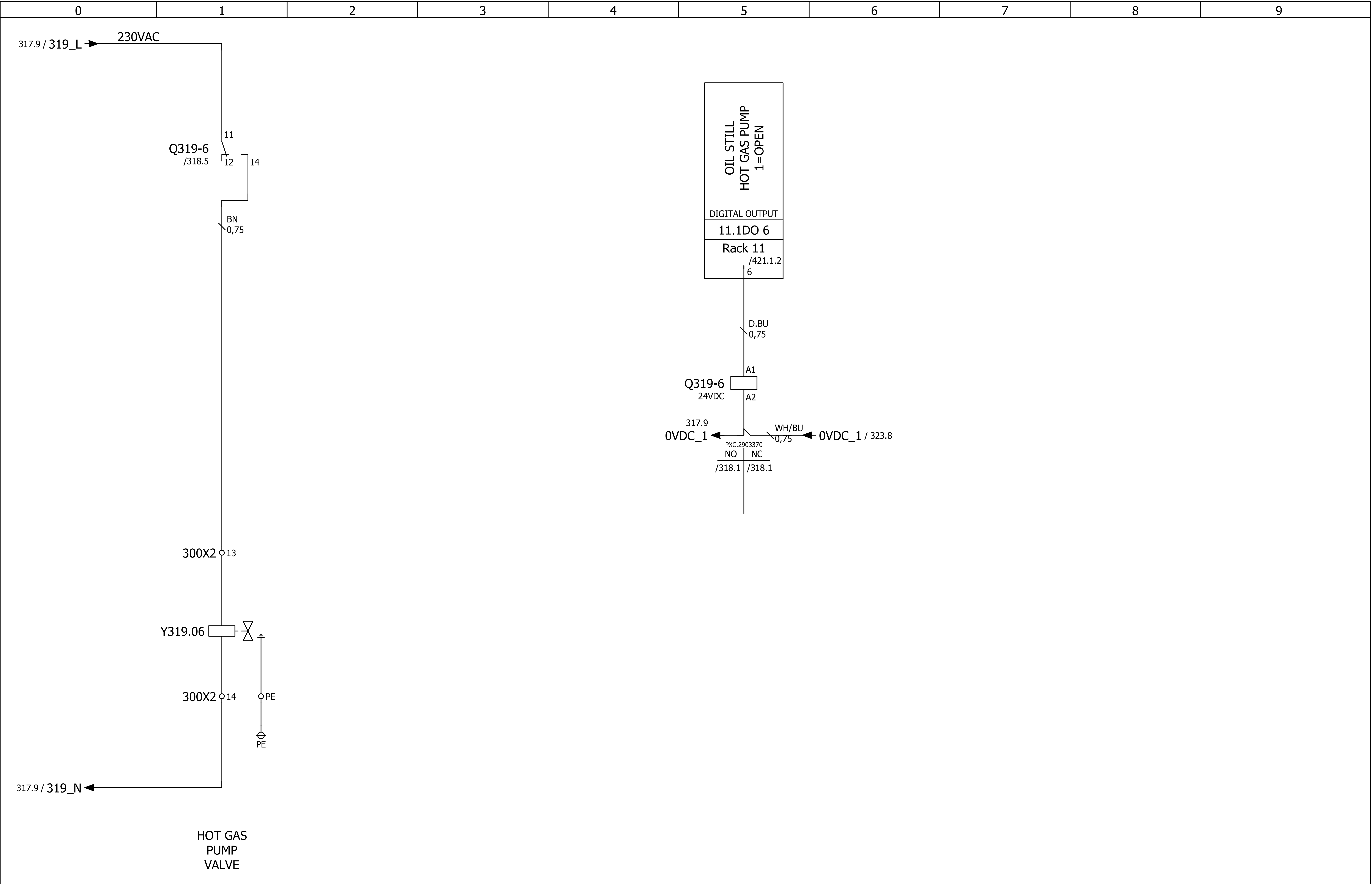
◀313 317▶

AS BUILT	EK	17/11/17	8	Drawn by:	LowUp (ESP)	GEA	Location: E01	Drawingnumber (group): HP_1C
Revision description	Name	Date	Rev.					
Location:	Name	EK		Description	CC		Ordernumber: 62049-001	Page: 316
	Last change.	30-Nov-17			LEVEL EVAPORATOR LT/LS318			



316 | 318

AS BUILT	EK	17/11/17	8	Drawn by: LowUp (ESP)	Location: E01	Drawingnumber (group): HP_1C
Revision description	Name	Date	Rev.			
Location:	Name	EK		Description CC OIL STILL H319	Ordernumber: 62049-001	Page: 317
	Last change.	30-Nov-17				



◀ 317

319 ▶

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Revision description	Name	Date	Rev.				
Location:	Name	EK		Description	CC OIL STILL H319	Ordernumber: 62049-001	Page: 318
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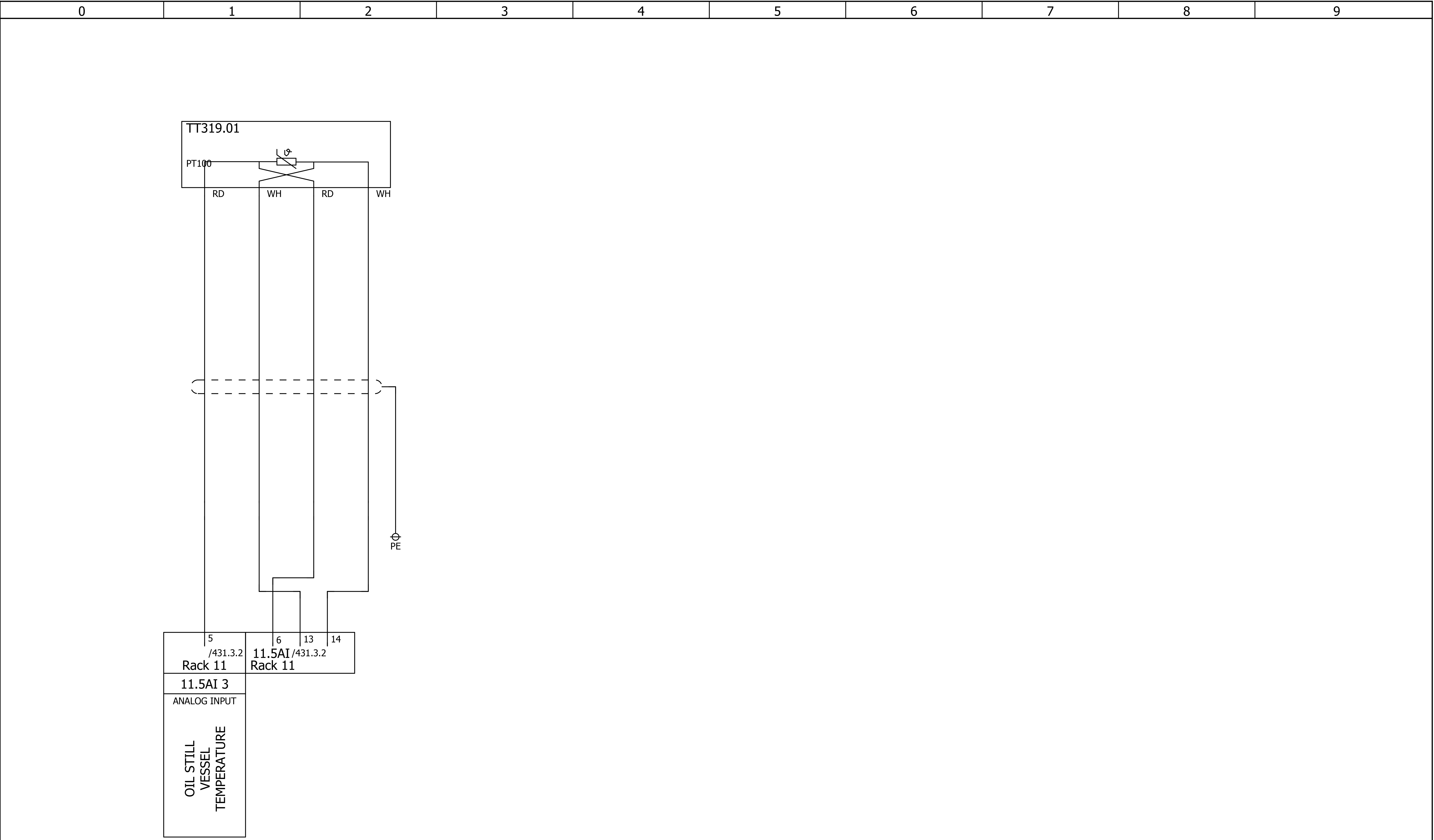
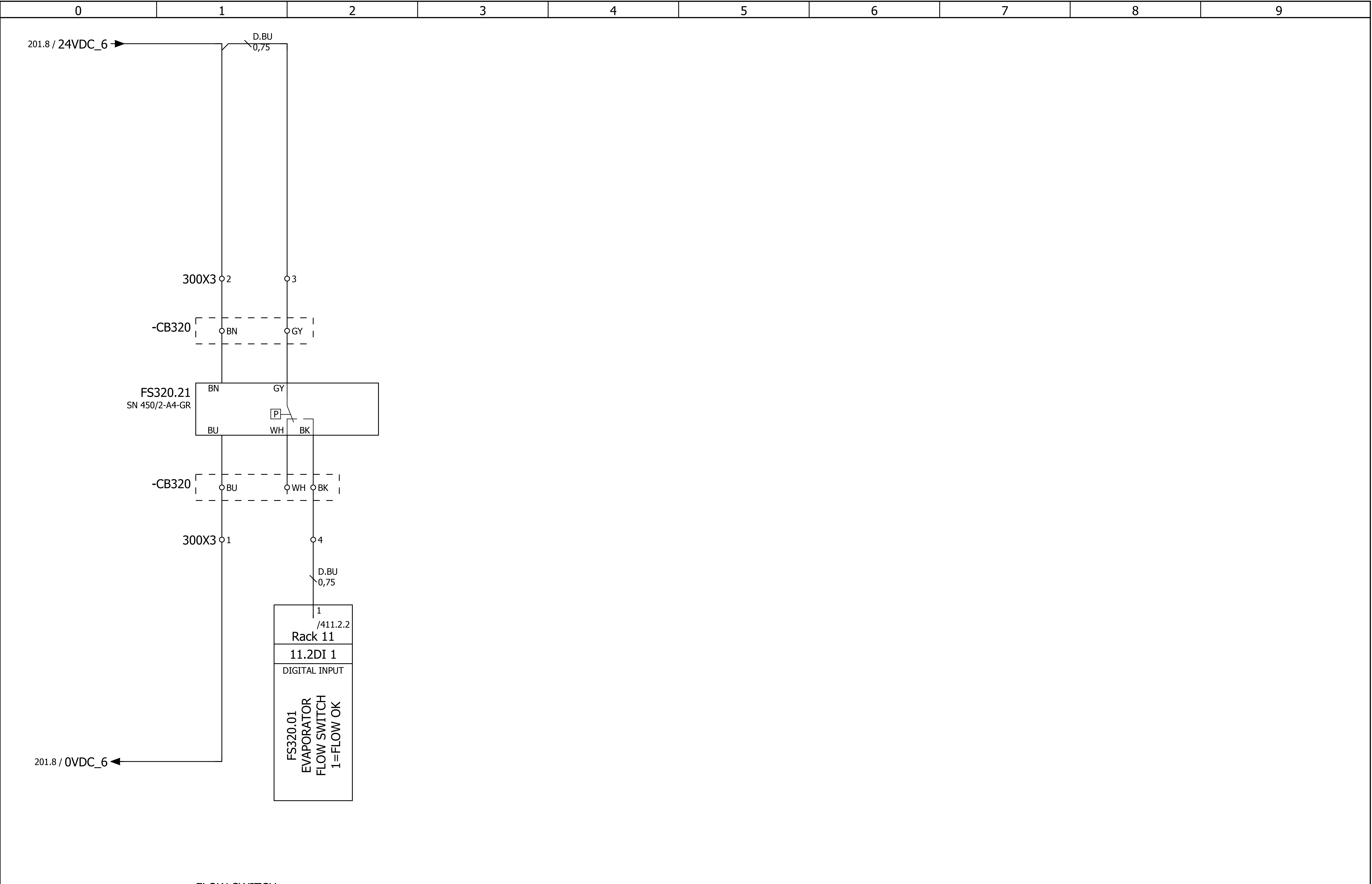


◀ 318

320 ▶

AS BUILT	EK	17/11/17	8	Drawn by:	LowUp (ESP)	Location: E01	Drawingnumber (group): HP_1C
Revision description	Name	Date	Rev.				
Location:	Name	EK		Description	CC OIL STILL TEMPERATURE R319	Ordernumber: 62049-001	Page: 319
	Last change.	30-Nov-17					

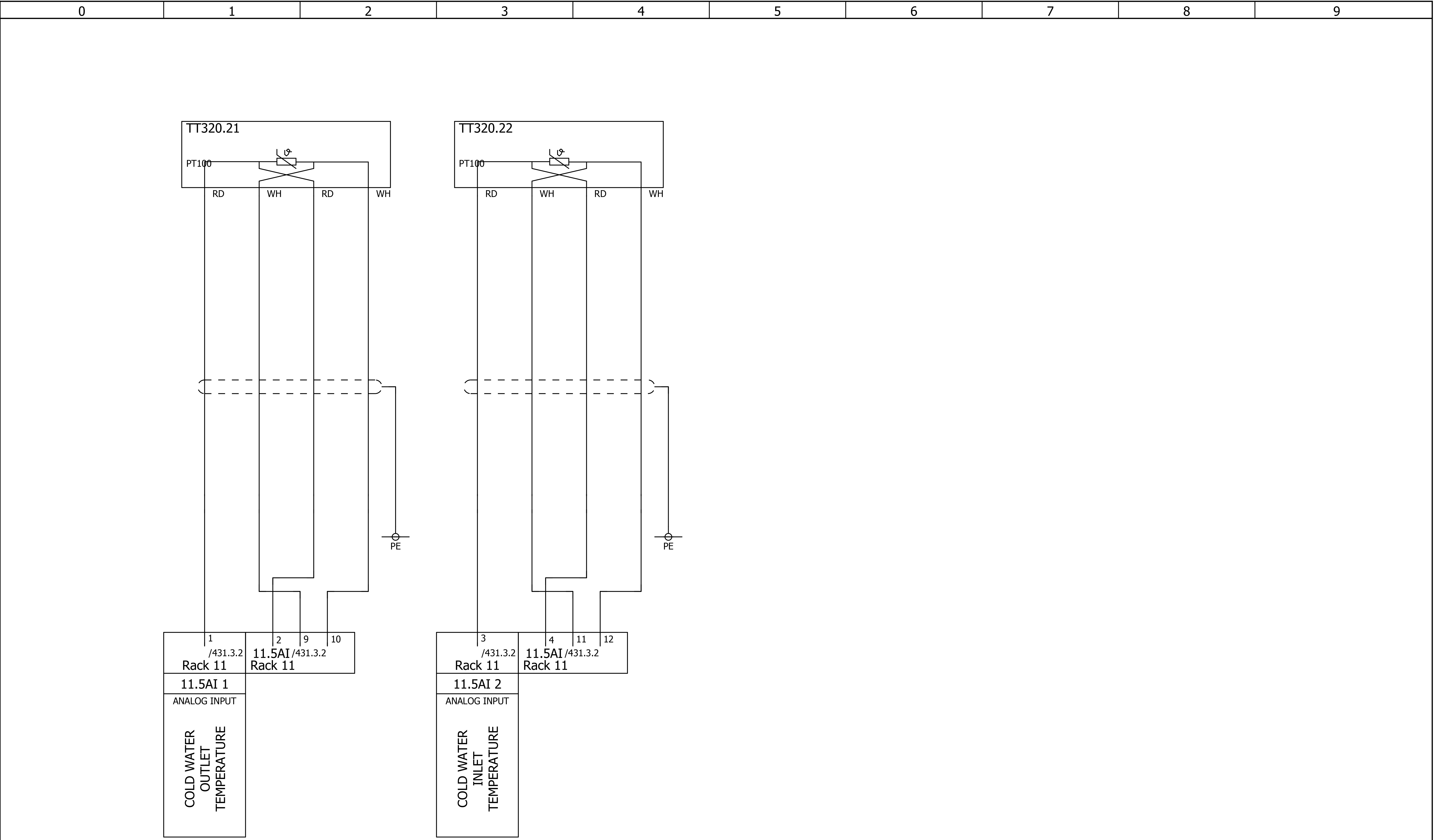


◀319

FLOW SWITCH

321▶

AS BUILT	EK	17/11/17	8	Drawn by:	LowUp (ESP)	Location: E01	Drawingnumber (group): HP_1C
Revision description	Name	Date	Rev.				
Location:	Name	EK		Description	CC EVAPORATOR FLOW SWITCH FS320.21	Ordernumber: 62049-001	Page: 320
	Last change.	30-Nov-17					



◀ 320

322 ▶

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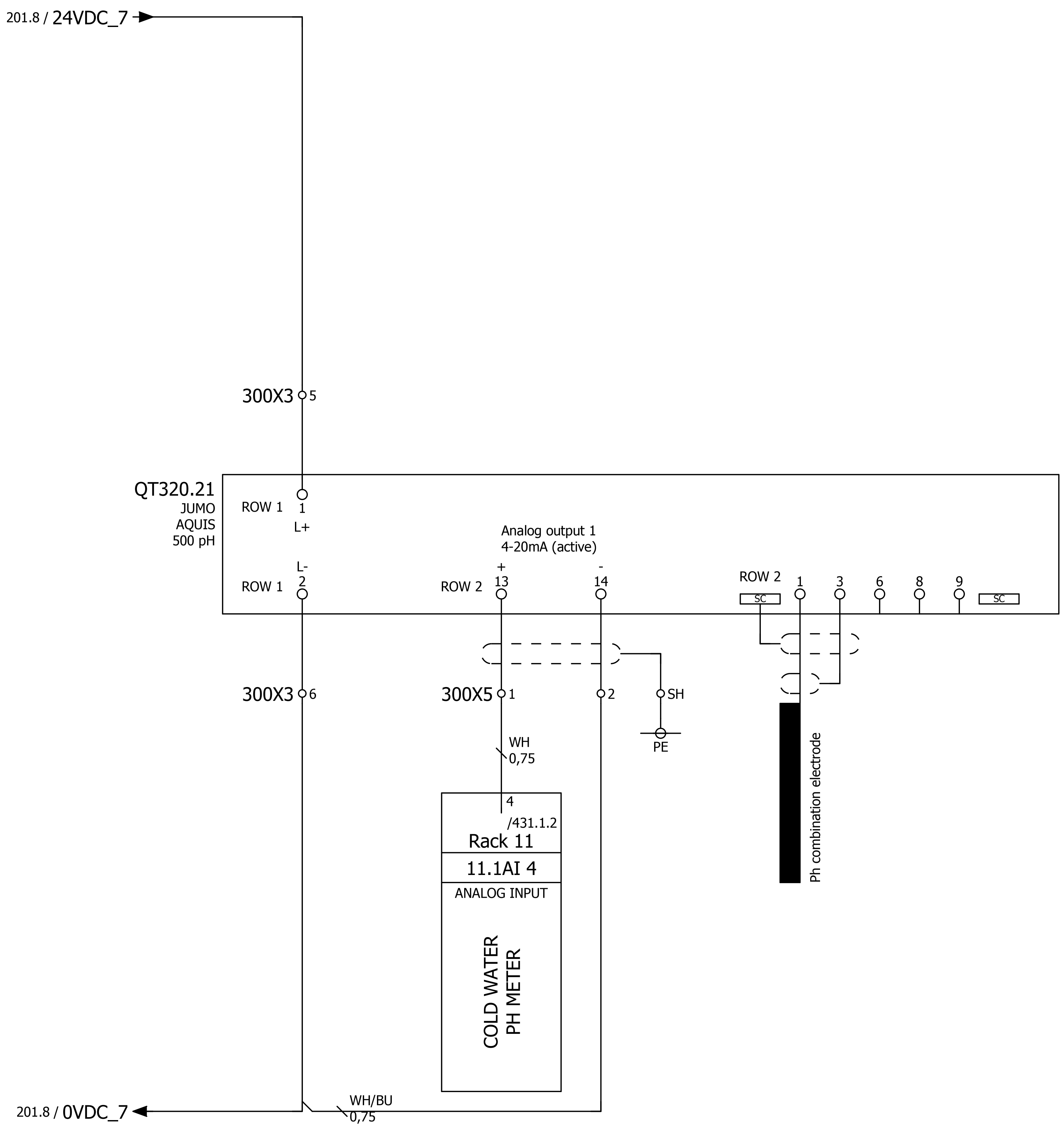
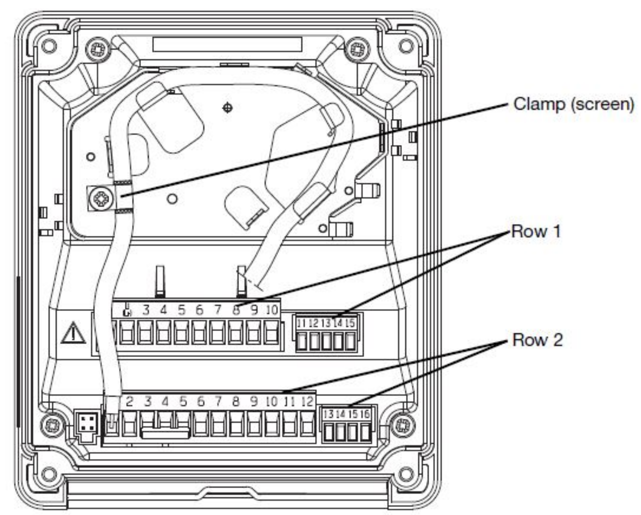
Revision description	Name	Date	Rev.				
Location:	Name	EK		Description: CC COLD WATER TEMPERATURES		Ordernumber: 62049-001	Page: 321
	Last change.	30-Nov-17					



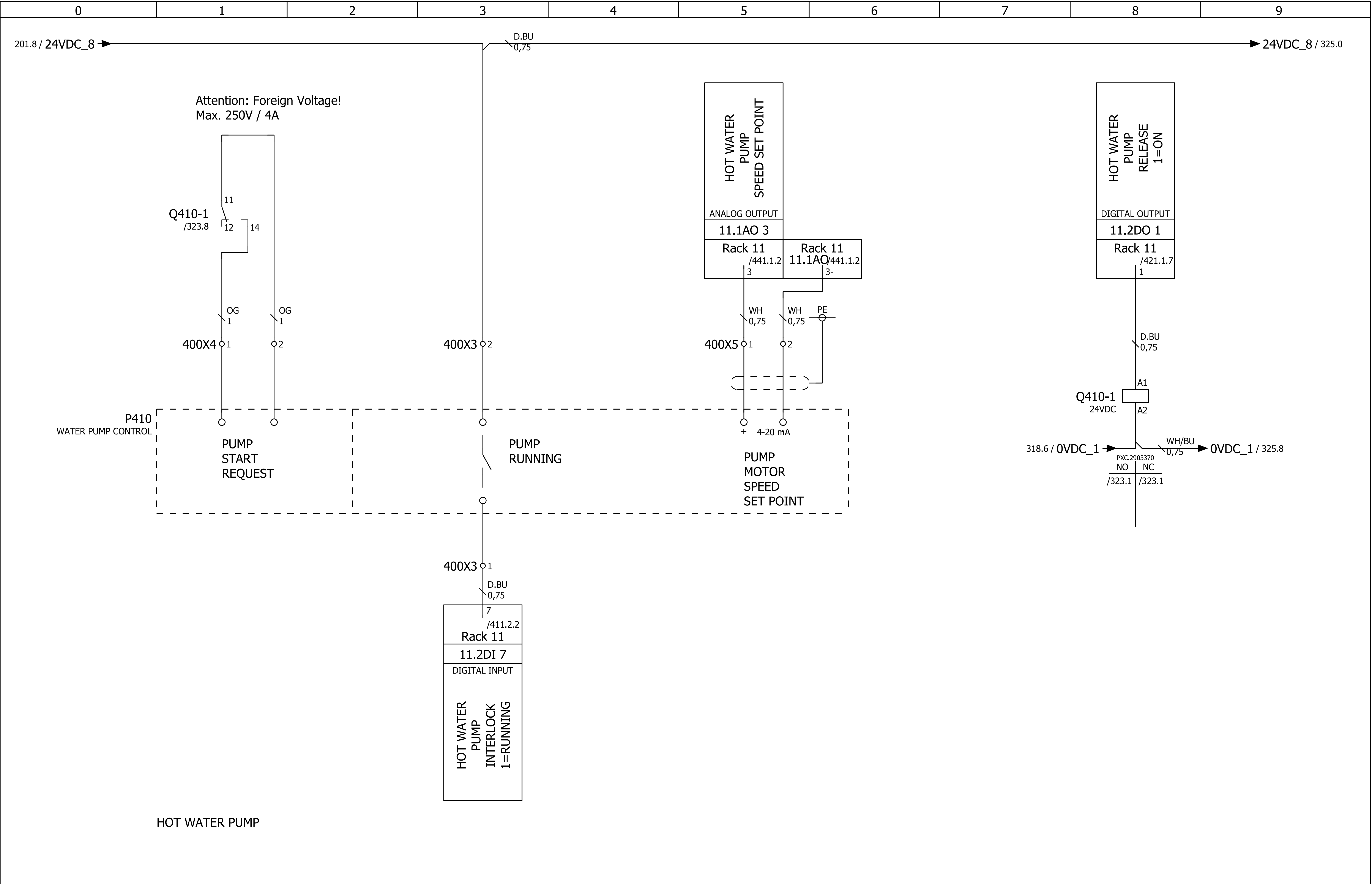


Q320.21
NH3 DETECTION

◀321

323▶

AS BUILT	EK	17/11/17	8	Drawn by:	LowUp (ESP)	Location: E01	Drawingnumber (group): HP_1C
Revision description	Name	Date	Rev.				
Location:	Name	EK		Description	CC COLD WATER NH3 DETECTION	Ordernumber: 62049-001	Page: 322
	Last change.	30-Nov-17					



◀322

324▶

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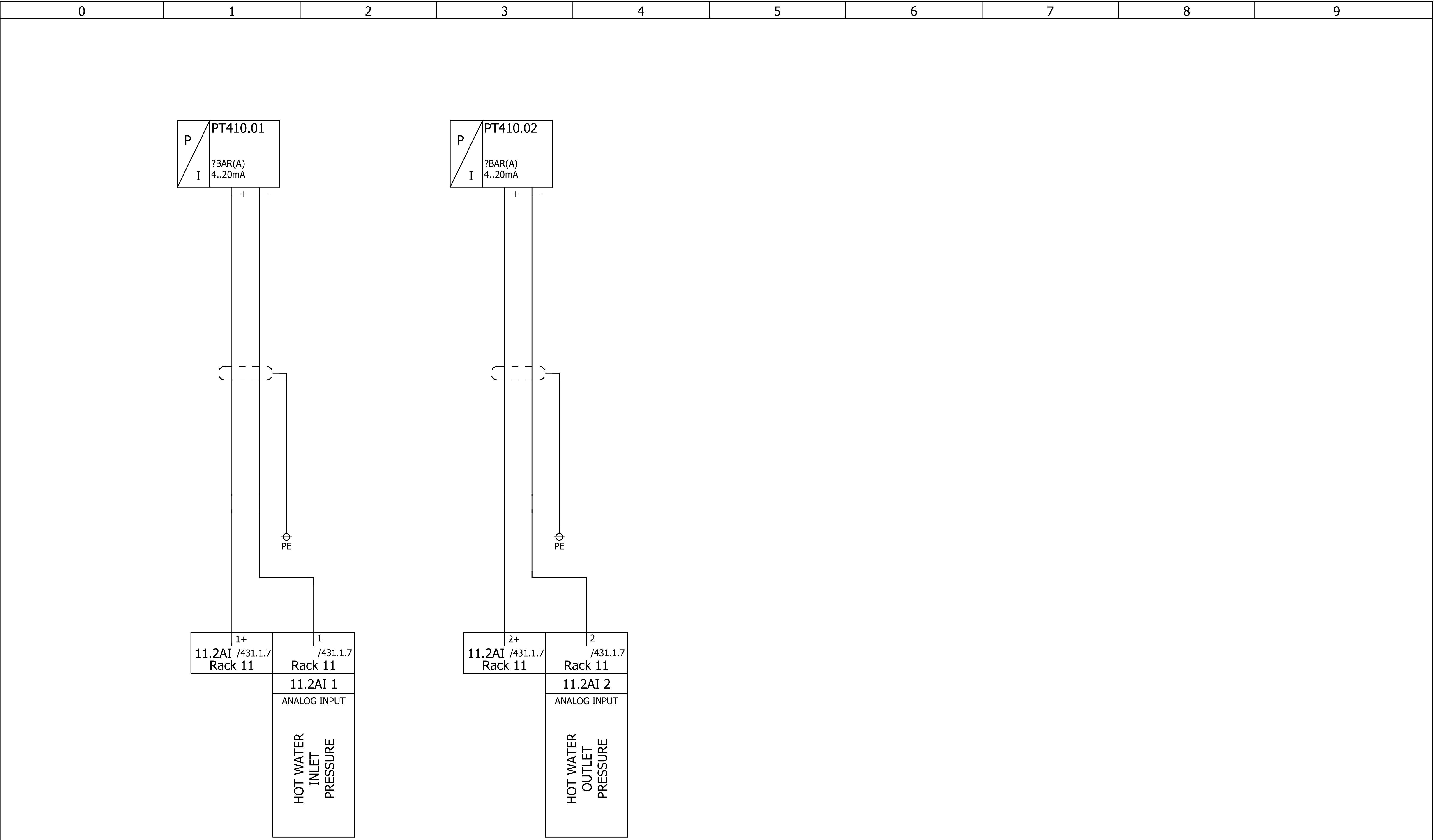
Revision description	Name	Date	Rev.			
Location:	Name	EK		Description CC HOT WATER PUMP INTERFACE	Ordernumber: 62049-001	Page: 323
	Last change.	30-Nov-17				



◀323

325▶

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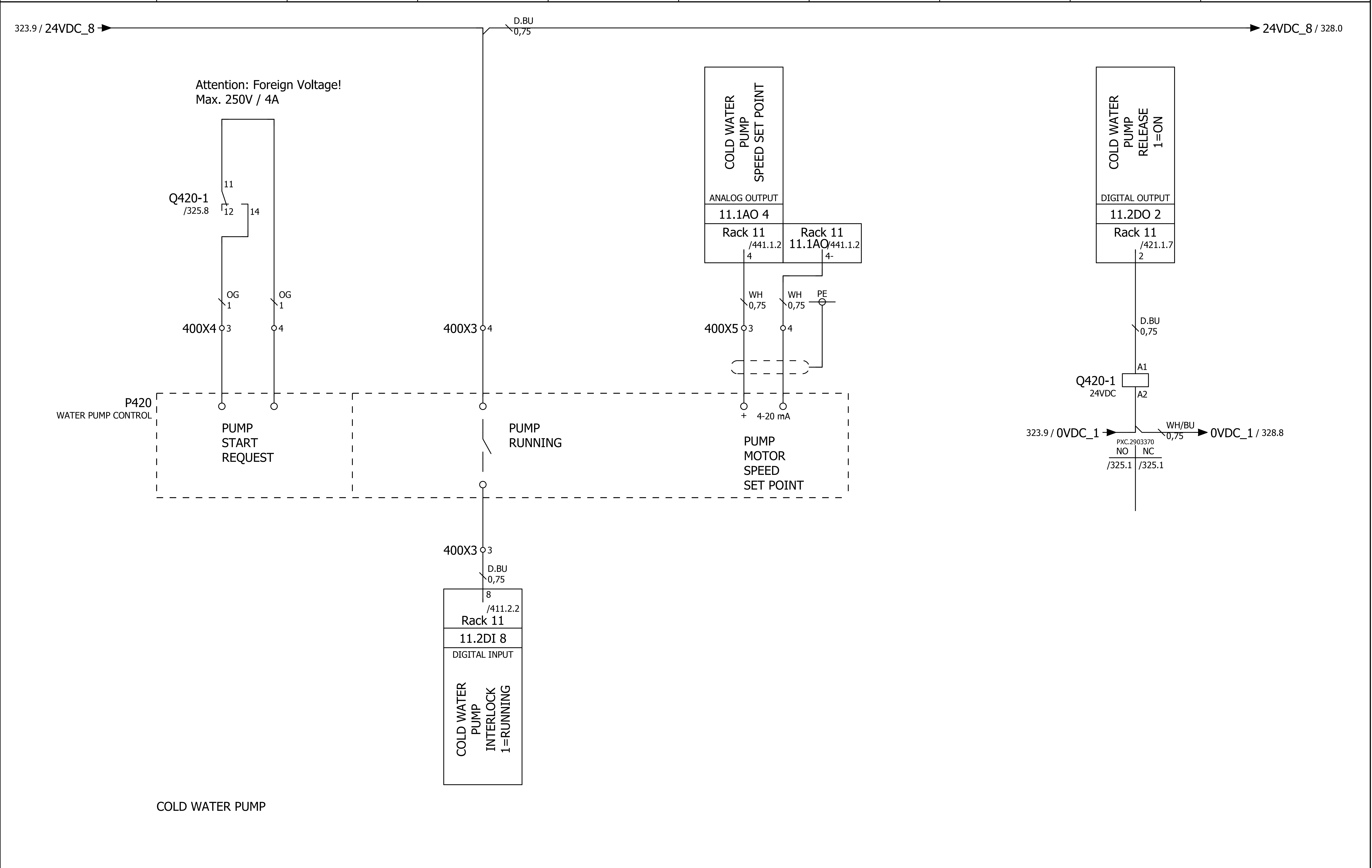
Revision description	Name	Date	Rev.				
Location:	Name	EK		Description	CC HOT WATER PRESSURE TRANSMITTERS	Ordernumber: 62049-001	Page: 324
	Last change.	30-Nov-17					



COLD WATER PUMP

◀324

326▶

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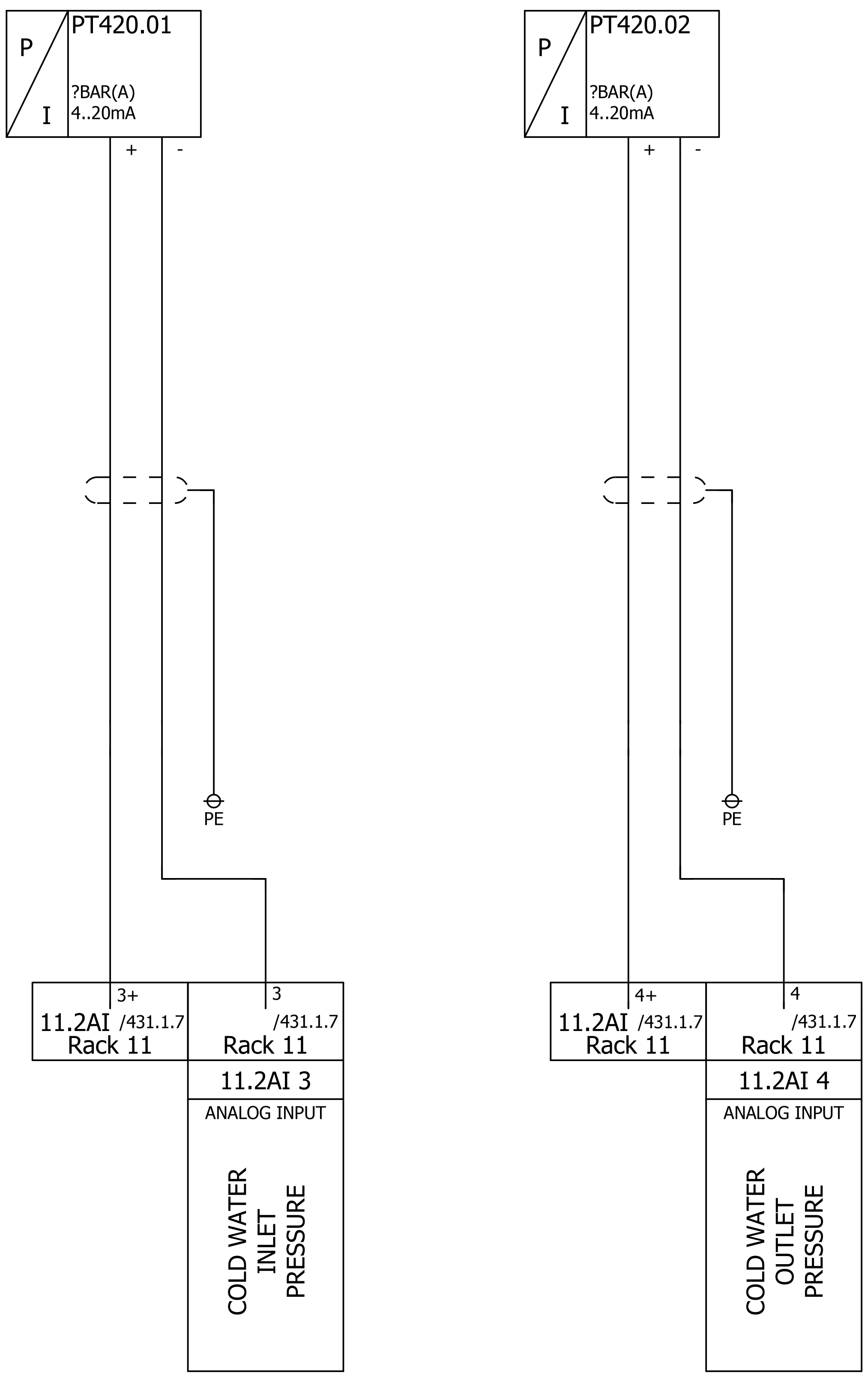
Revision description	Name	Date	Rev.				
Location:	Name	EK		Description	CC COLD WATER PUMP INTERFACE	Ordernumber: 62049-001	Page: 325
	Last change.	30-Nov-17					



◀325 327▶

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Revision description	Name	Date	Rev.				
Location:	Name	EK		Description	CC COLD WATER PRESSURE TRANSMITTERS	Ordernumber: 62049-001	Page: 326
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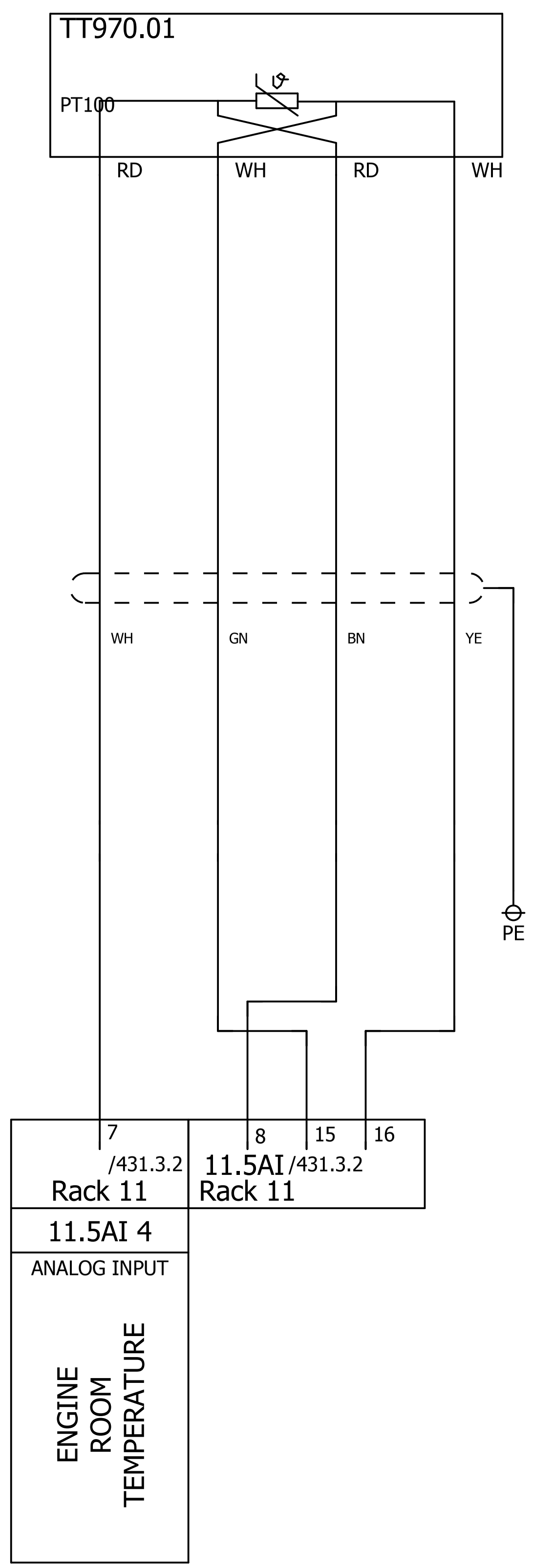
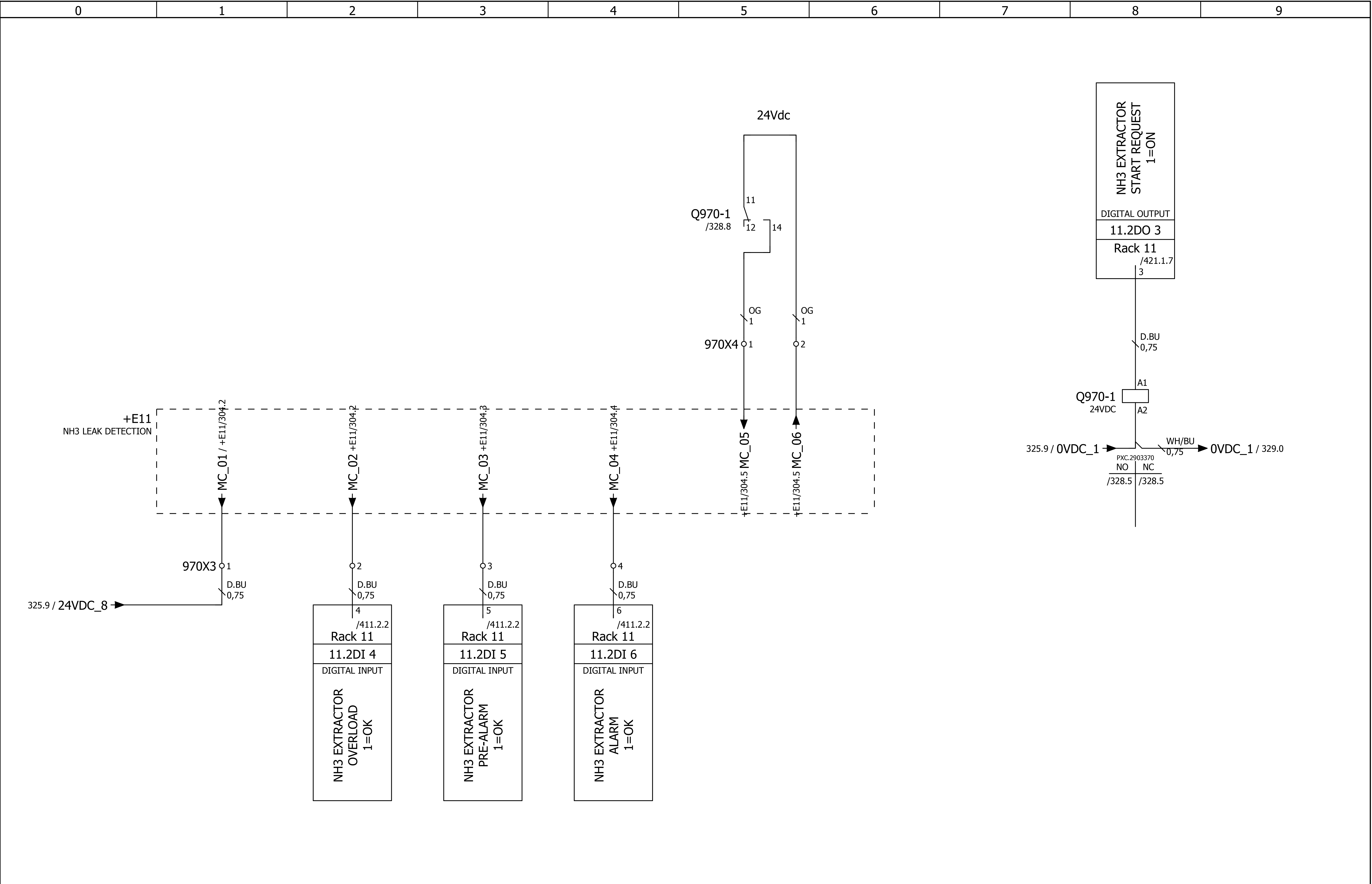


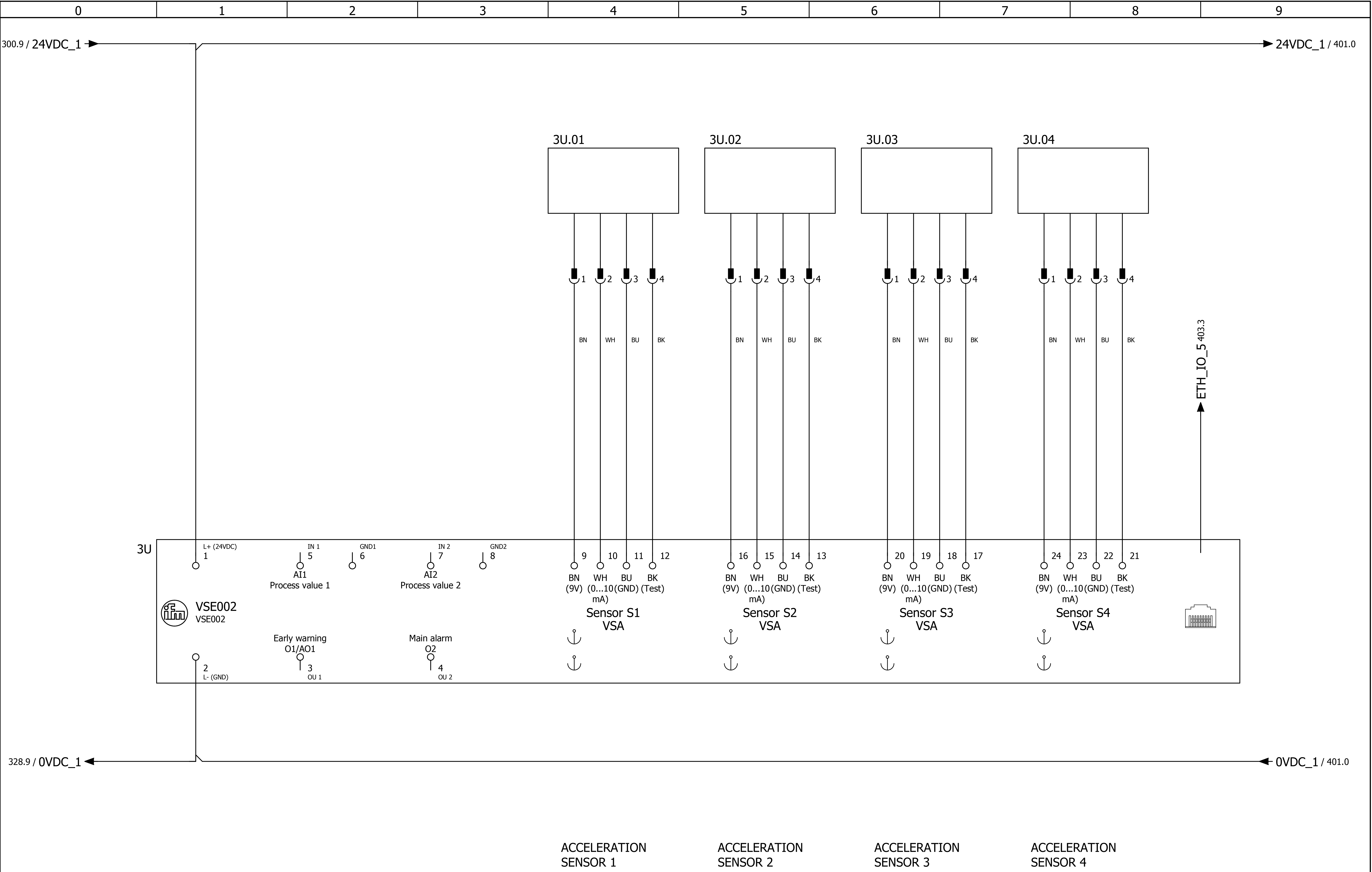
◀326
328▶

AS BUILT	EK	17/11/17	8	Drawn by:	LowUp (ESP)	GEA	Location: E01	Drawingnumber (group): HP_1C
Revision description	Name	Date	Rev.					
Location:	Name	EK		Description	CC ENGINE ROOM TEMPERATURE TT970		Ordernumber: 62049-001	Page: 327
	Last change.	30-Nov-17						



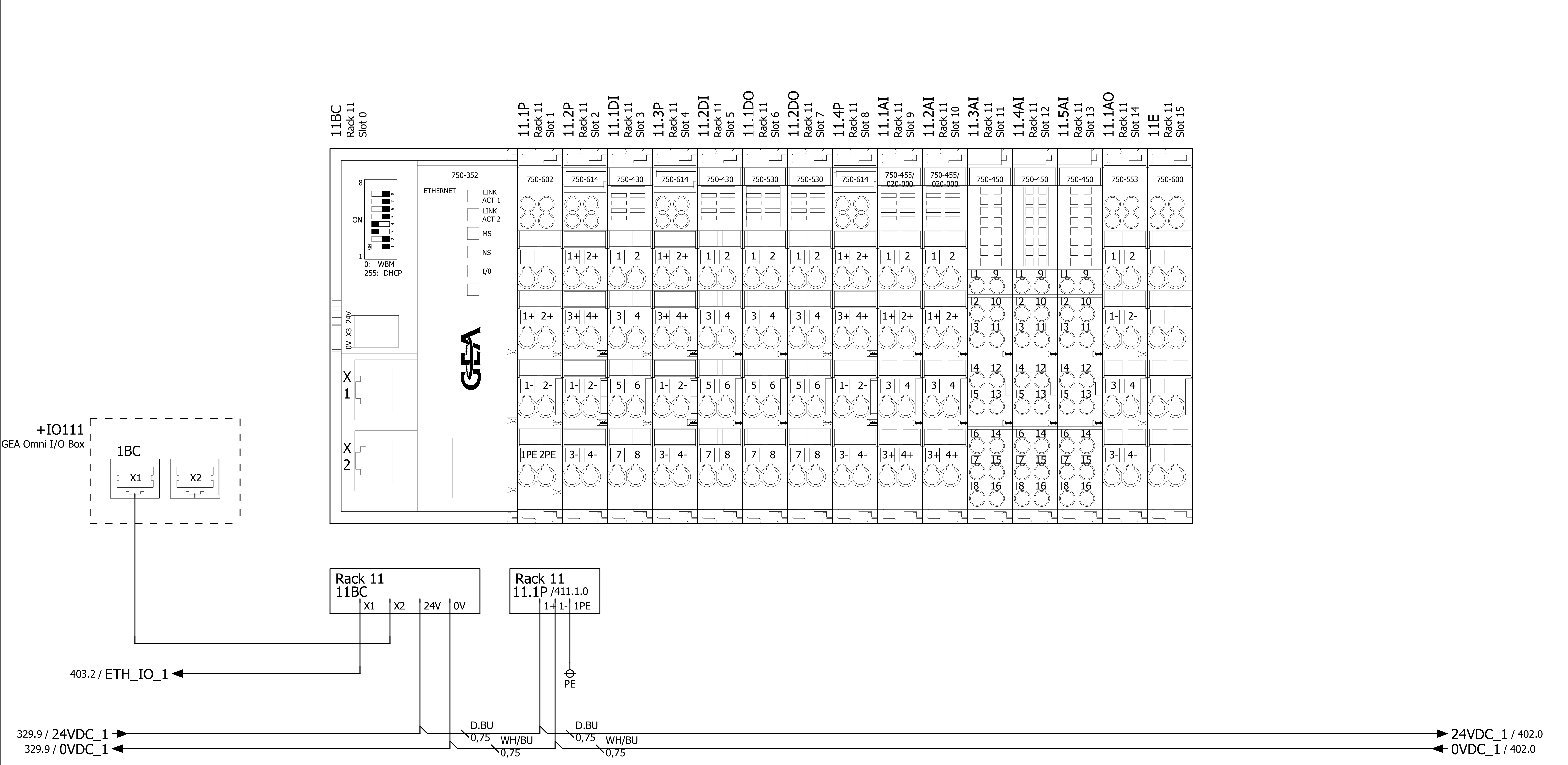
◀327 329▶

AS BUILT	EK	17/11/17	8	Drawn by:	LowUp (ESP)	Location: E01	Drawingnumber (group): HP_1C
Revision description	Name	Date	Rev.				
Location:	Name	EK		Description	CC NH3 DETECTION INTERFACE	Ordernumber: 62049-001	Page: 328
	Last change.	30-Nov-17					



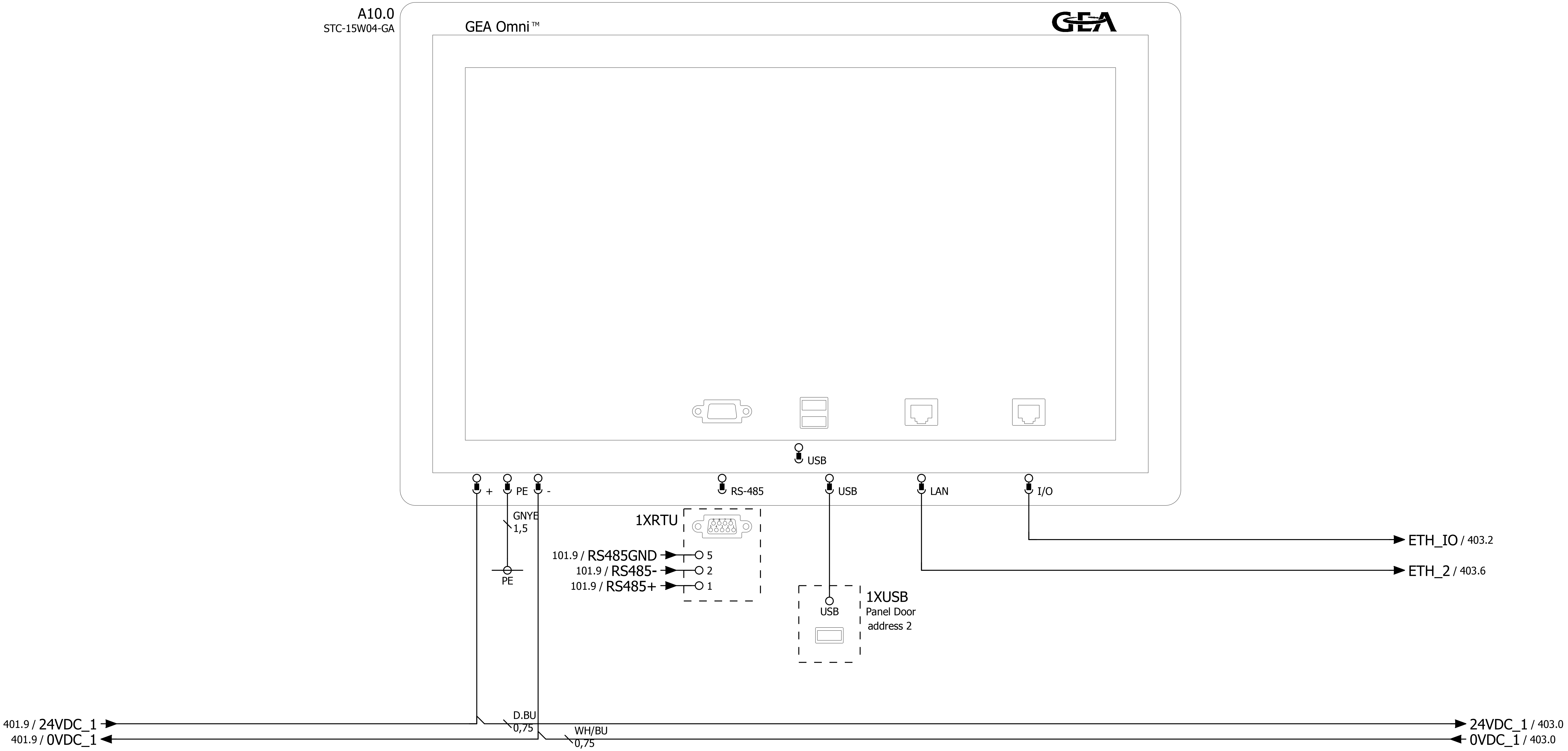
◄328 401►

AS BUILT	EK	17/11/17	8	Drawn by: LowUp (ESP)	Location: E01	Drawingnumber (group): HP_1C
Revision description	Name	Date	Rev.			
Location:	Name	EK		Description CC VIBRATION MONITORING	Ordernumber: 62049-001	Page: 329
	Last change.	30-Nov-17				



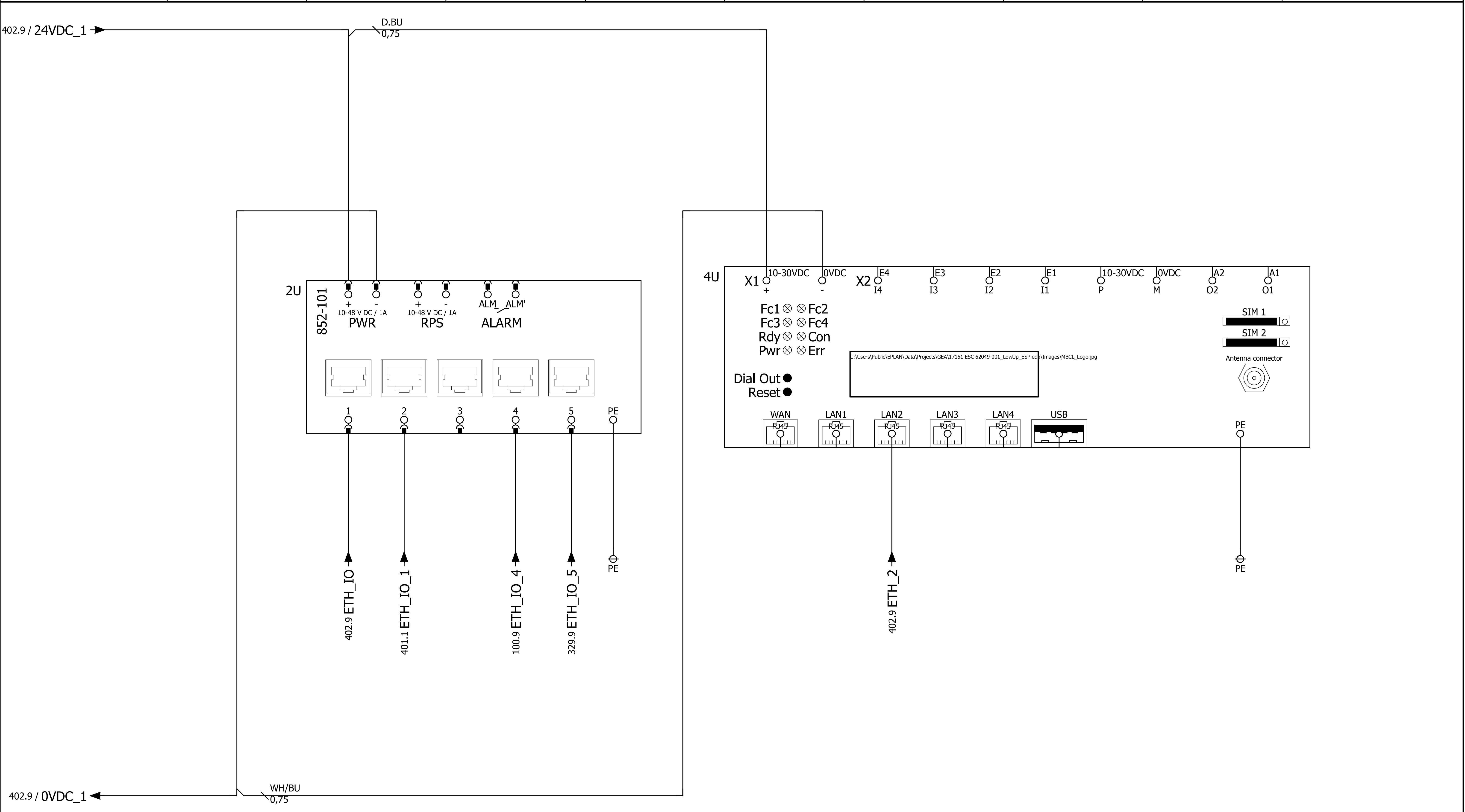
◀ 329 | 402 ▶

AS BUILT	EK	17/11/17	8	Drawn by:	LowUp (ESP)	Location: E01	Drawingnumber (group): HP_1C
Revision description	Name	Date	Rev.				
Location:	Name	EK		Description	CC OMNI CONTROL OVERVIEW	Ordernumber: 62049-001	Page: 401
	Last change.	30-Nov-17					



◀401
403▶

AS BUILT	EK	17/11/17	8	Drawn by: LowUp (ESP)		Location: E01	Drawingnumber (group): HP_1C
Revision description	Name	Date	Rev.				
Location:	Name	EK		Description: CC OMNI CONTROL OVERVIEW		Ordernumber: 62049-001	Page: 402
	Last change.	30-Nov-17					

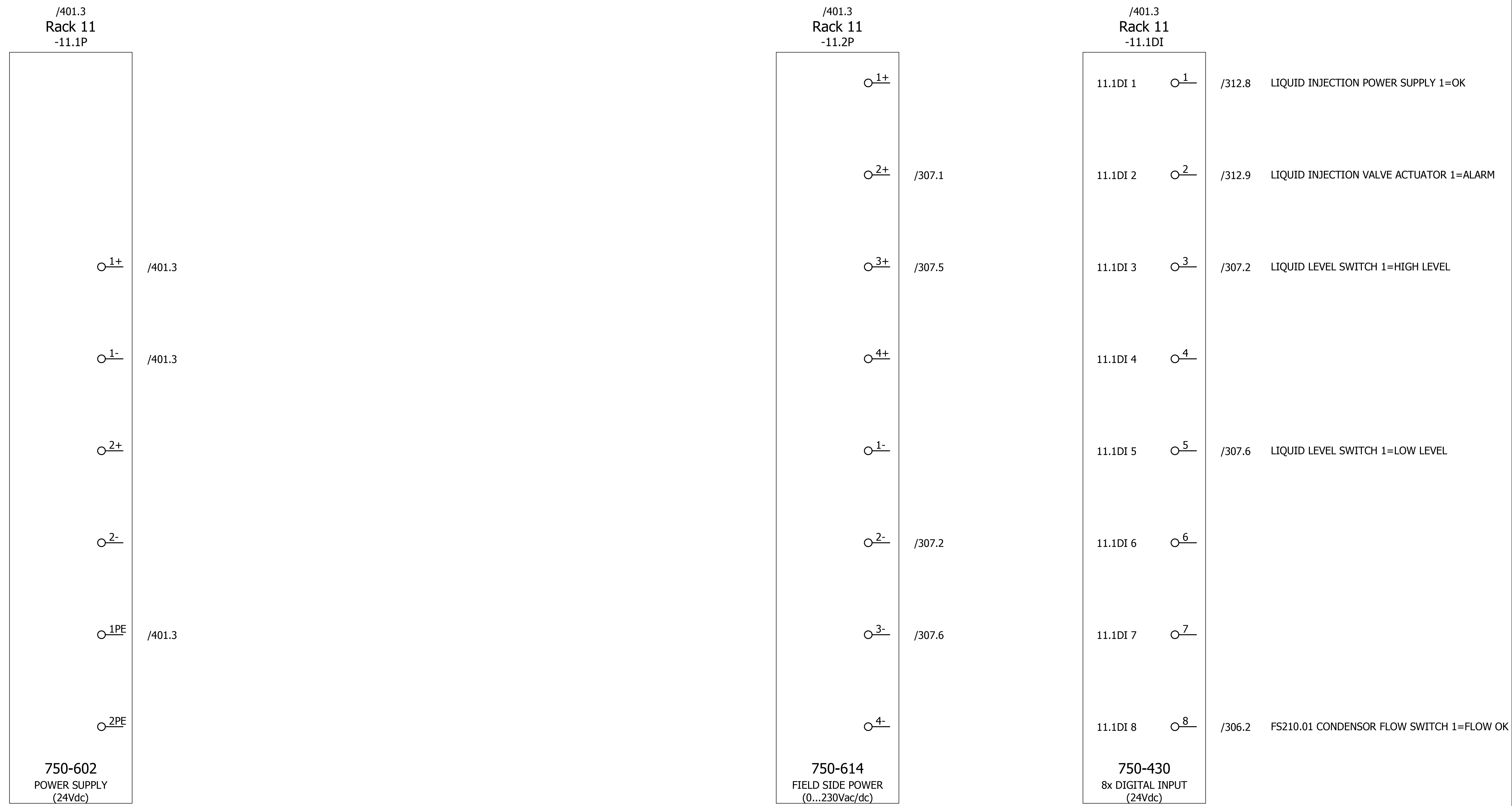


402

411.1

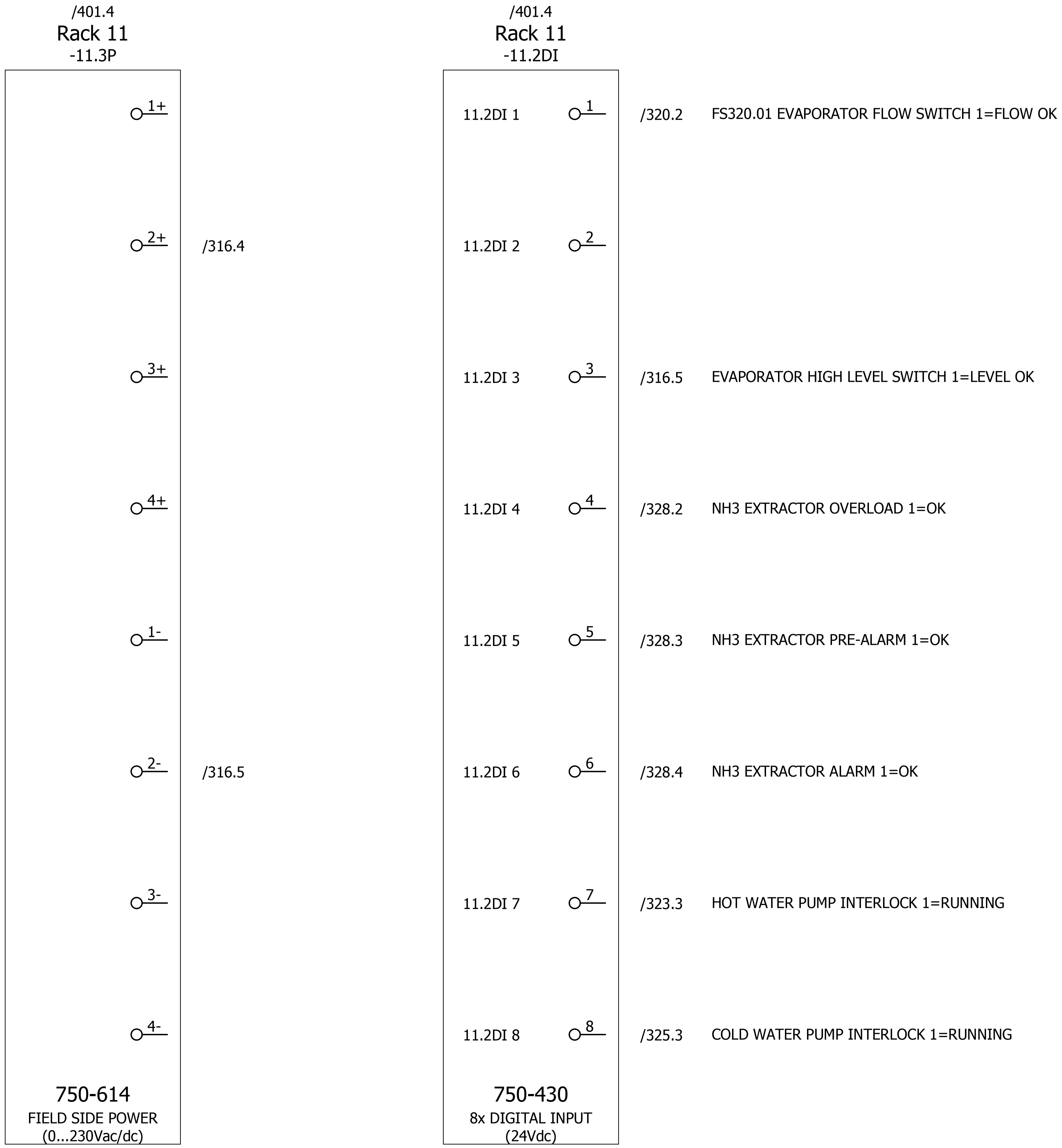
AS BUILT	EK	17/11/17	8	Drawn by: LowUp (ESP)	Location: E01	Drawingnumber (group): HP_1C
Revision description	Name	Date	Rev.			
Location:	Name	EK		Description CC OMNI CONTROL OVERVIEW	Ordernumber: 62049-001	Page: 403
	Last change.	30-Nov-17				

0	1	2	3	4	5	6	7	8	9



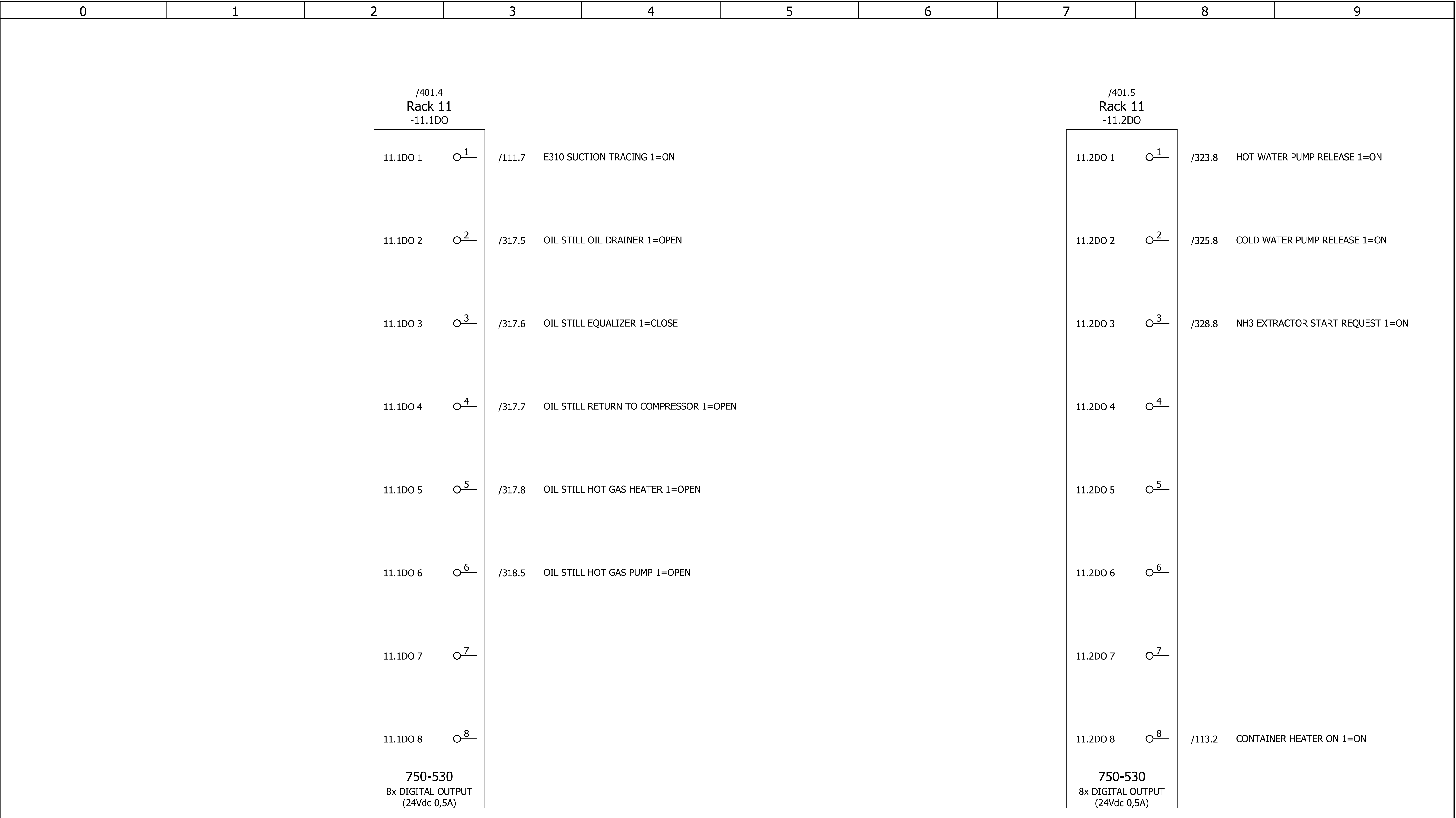
◀403 411.2▶

AS BUILT	EK	17/11/17	8	Drawn by:	LowUp (ESP)	Location: E01	Drawingnumber (group): HP_1C
Revision description	Name	Date	Rev.				
Location:	Name	EK		Description	CC DIGITAL INPUTS 11.1DI	Ordernumber: 62049-001	Page: 411.1
	Last change.	30-Nov-17					



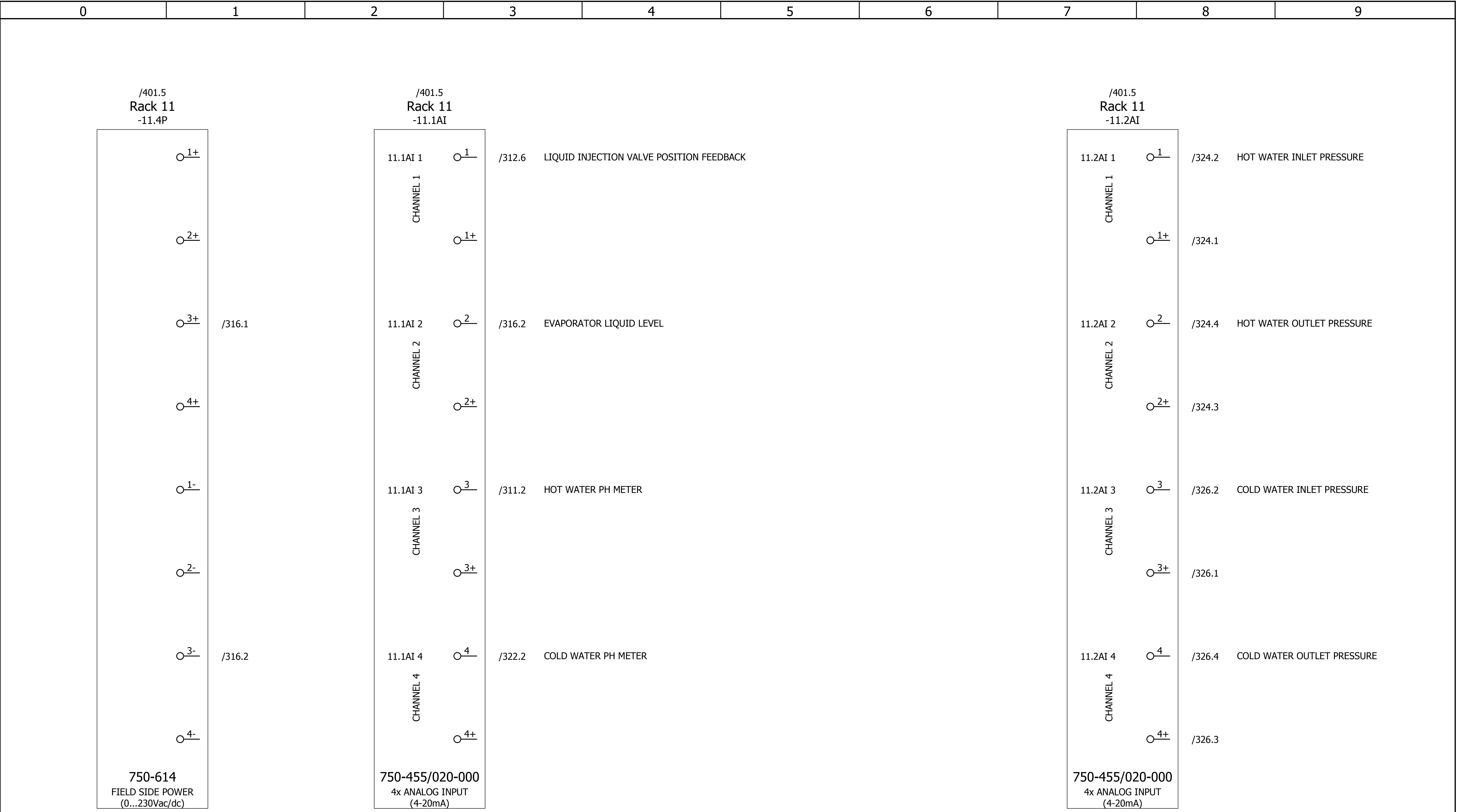
◀411.1 421.1▶

AS BUILT	EK	17/11/17	8	Drawn by: LowUp (ESP)	GEA	Location: E01	Drawingnumber (group): HP_1C
Revision description	Name	Date	Rev.				
Location:	Name	EK		Description: CC DIGITAL INPUTS 11.2DI		Ordernumber: 62049-001	Page: 411.2
	Last change.	30-Nov-17					



◀411.2 431.1▶

AS BUILT	EK	17/11/17	8	Drawn by: LowUp (ESP)	Location: E01
Revision description	Name	Date	Rev.		Drawingnumber (group): HP_1C
Location:	Name	EK		Description: CC DIGITAL OUTPUT 11.1DO / 11.2DO	Ordernumber: 62049-001
	Last change.	30-Nov-17			Page: 421.1



◀421.1

431.2▶

AS BUILT	EK	17/11/17	8	Drawn by:	LowUp (ESP)	Location: E01	Drawingnumber (group): HP_1C
Revision description	Name	Date	Rev.				
Location:	Name	EK		Description	CC ANALOG INPUT 11.1AI / 11.2AI	Ordernumber: 62049-001	Page: 431.1
	Last change.	30-Nov-17					

0	1	2	3	4	5	6	7	8	9

/401.6
Rack 11
-11.3AI

Channel	Input	Terminal	Reference	Signal
CHANNEL 1	11.3AI 1	1	/308.1	NH3 TEMPERATURE POST DESUPERHEATER
		2	/308.1	
		9	/308.2	
		10	/308.2	
CHANNEL 2	11.3AI 2	3	/308.3	NH3 TEMPERATURE POST CONDENSOR
		4	/308.3	
		11	/308.4	
		12	/308.4	
CHANNEL 3	11.3AI 3	5	/308.5	NH3 TEMPERATURE POST SUBCOOLER
		6	/308.5	
		13	/308.6	
		14	/308.6	
CHANNEL 4	11.3AI 4	7	/308.7	HOT WATER INLET TEMPERATURE
		8	/308.7	
		15	/308.8	
		16	/308.8	

750-450
4x ANALOG INPUT
(RTD)

/401.6
Rack 11
-11.4AI

Channel	Input	Terminal	Reference	Signal
CHANNEL 1	11.4AI 1	1	/309.1	HOT WATER OUTLET TEMPERATURE
		2	/309.1	
		9	/309.2	
		10	/309.2	
CHANNEL 2	11.4AI 2	3	/309.3	HOT WATER POST SUBCOOLER TEMPERATURE
		4	/309.3	
		11	/309.4	
		12	/309.4	
CHANNEL 3	11.4AI 3	5	/309.5	HOT WATER POST CONDENSOR TEMPERATURE
		6	/309.5	
		13	/309.6	
		14	/309.6	
CHANNEL 4	11.4AI 4	7	/313.1	SUCTION PIPE TEMPERATURE
		8	/313.1	
		15	/313.2	
		16	/313.2	

750-450
4x ANALOG INPUT
(RTD)

◀431.1

431.3▶

AS BUILT	EK	17/11/17	8	Drawn by:	LowUp (ESP)
Revision description	Name	Date	Rev.		
Location:	Name	EK		Description	CC
	Last change.	30-Nov-17			RTD ANALOG INPUT 11.3AI / 11.4AI

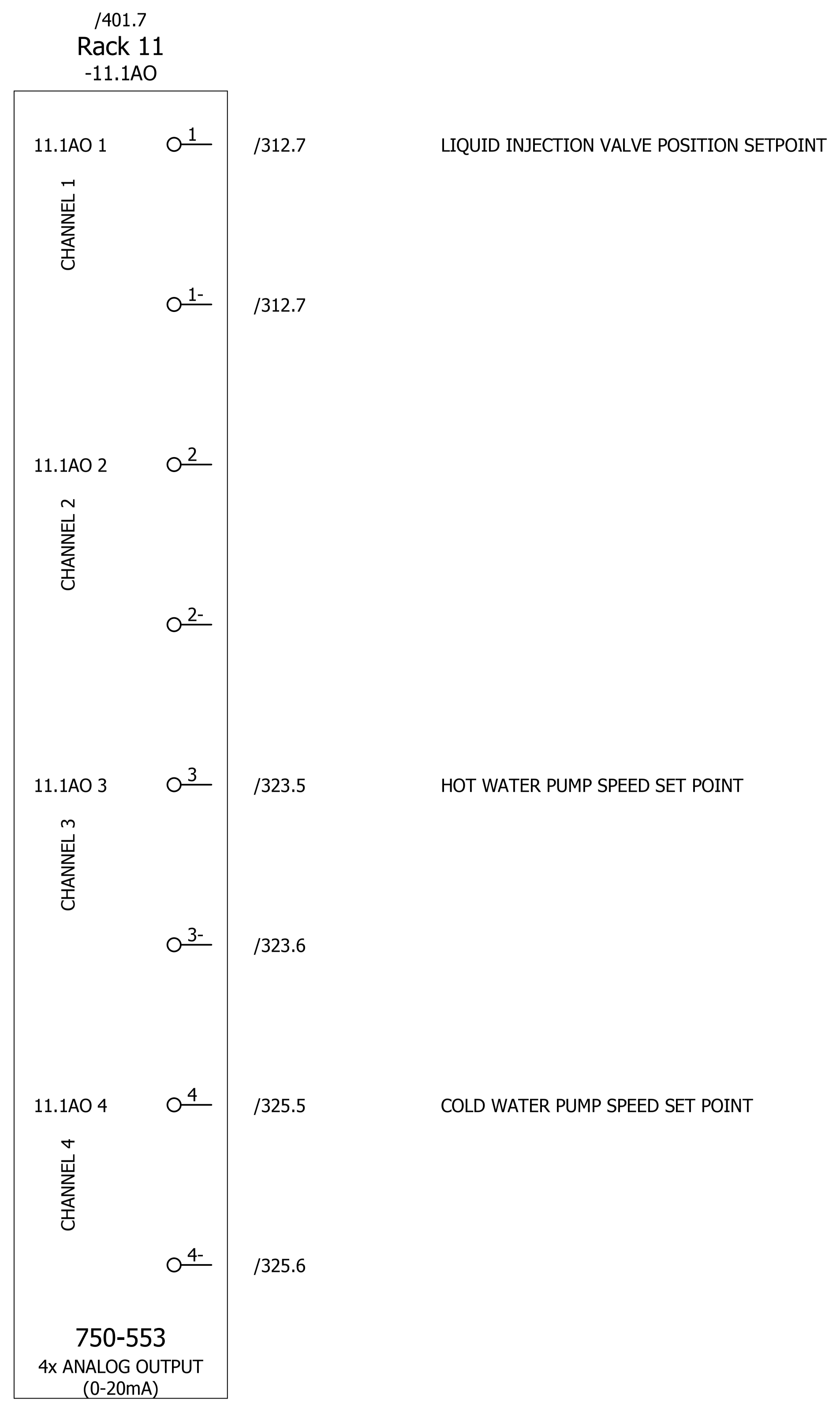
Location: E01	Drawingnumber (group): HP_1C
Ordernumber: 62049-001	Page: 431.2

/401.6
Rack 11
-11.5AI

Channel	Terminal	Reference	Description
11.5AI 1 / CHANNEL 1	1	/321.1	COLD WATER OUTLET TEMPERATURE
	2	/321.1	
	9	/321.2	
	10	/321.2	
11.5AI 2 / CHANNEL 2	3	/321.3	COLD WATER INLET TEMPERATURE
	4	/321.3	
	11	/321.4	
	12	/321.4	
11.5AI 3 / CHANNEL 3	5	/319.1	OIL STILL VESSEL TEMPERATURE
	6	/319.1	
	13	/319.2	
	14	/319.2	
11.5AI 4 / CHANNEL 4	7	/327.1	ENGINE ROOM TEMPERATURE
	8	/327.1	
	15	/327.2	
	16	/327.2	

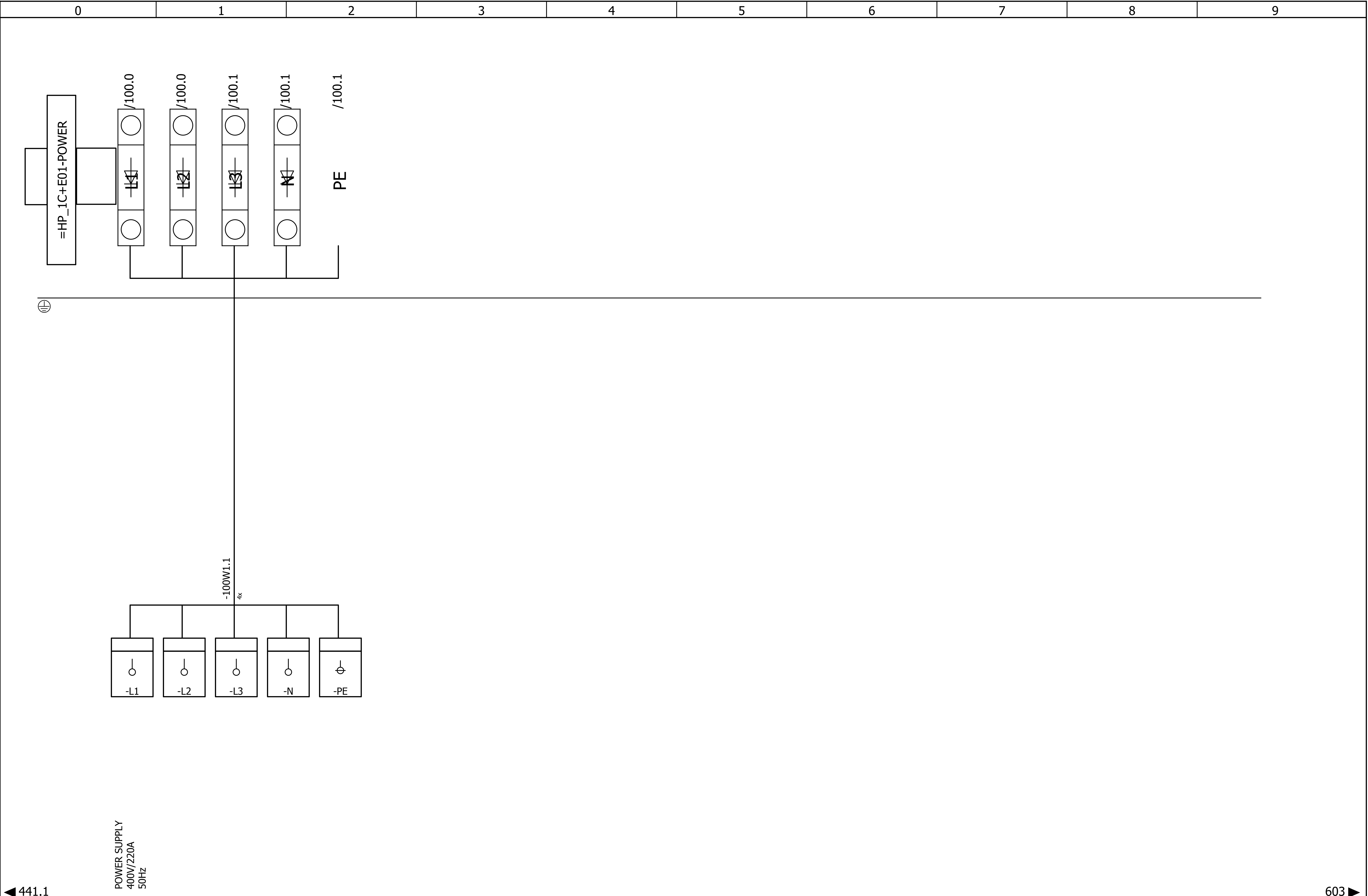
750-450
4x ANALOG INPUT
(RTD)

◀431.2 441.1▶



/401.7
Rack 11
-11.1AO
11.1AO 1
CHANNEL 1
1
/312.7
LIQUID INJECTION VALVE POSITION SETPOINT
1-
/312.7
11.1AO 2
CHANNEL 2
2
2-
11.1AO 3
CHANNEL 3
3
/323.5
HOT WATER PUMP SPEED SET POINT
3-
/323.6
11.1AO 4
CHANNEL 4
4
/325.5
COLD WATER PUMP SPEED SET POINT
4-
/325.6
750-553
4x ANALOG OUTPUT
(0-20mA)

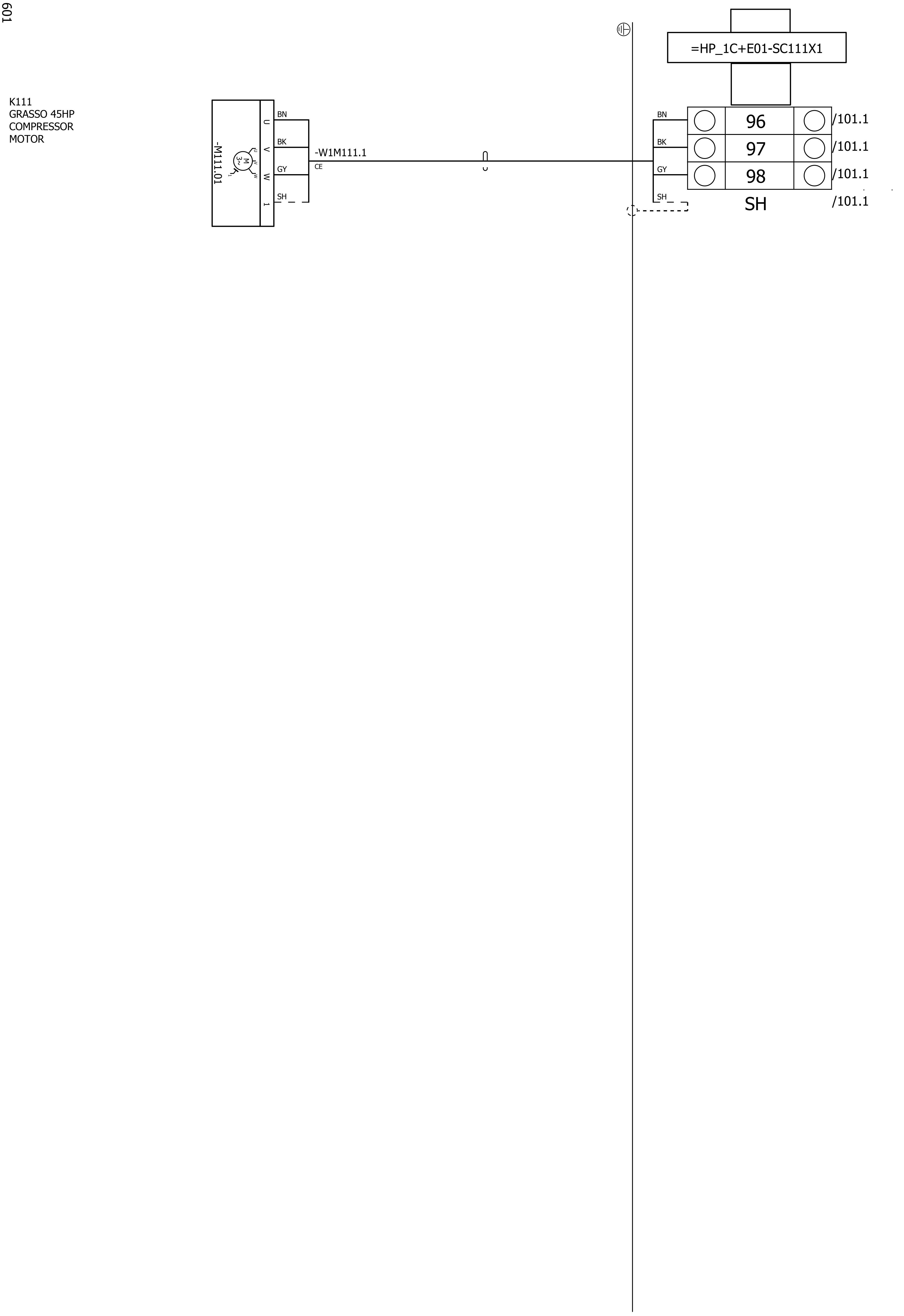
◀431.3 601▶



◀441.1

603▶

AS BUILT	EK	17/11/17	8	Drawn by: LowUp (ESP)	GEA	Location: E01	Drawingnumber (group): HP_1C
Revision description	Name	Date	Rev.				
Location:	Name	EK		Description =HP_1C+E01-POWER		Ordernumber: 62049-001	Page: 601
	Last change.	30-Nov-17					



◄601

AS BUILT	EK	17/11/17	8
Revision description	Name	Date	Rev.
Location:	Name	EK	
	Last change.	30-Nov-17	

Drawn by: LowUp (ESP)

Description: =HP_1C+E01-SC111X1

Location: E01

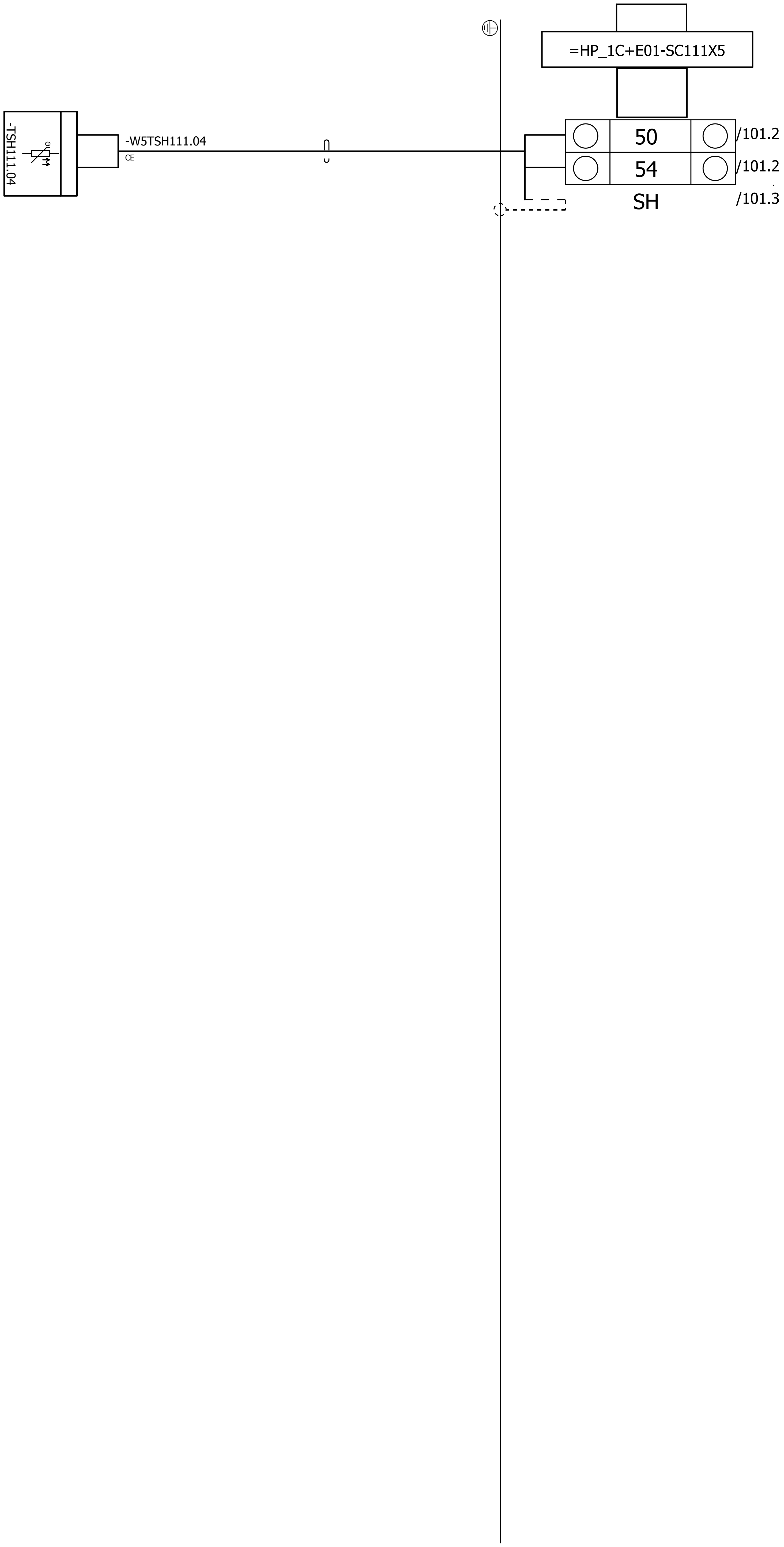
Ordernumber: 62049-001

Drawingnumber (group): HP_1C

Page: 603

604►

K111
MOTOR
THERMISTOR



AS BUILT	EK	17/11/17	8
Revision description	Name	Date	Rev.
Location:	Name	EK	
	Last change.	30-Nov-17	

Drawn by: LowUp (ESP)

Description =HP_1C+E01-SC111X5

Location: E01

Ordernumber: 62049-001

Drawingnumber (group): HP_1C

Page: 604

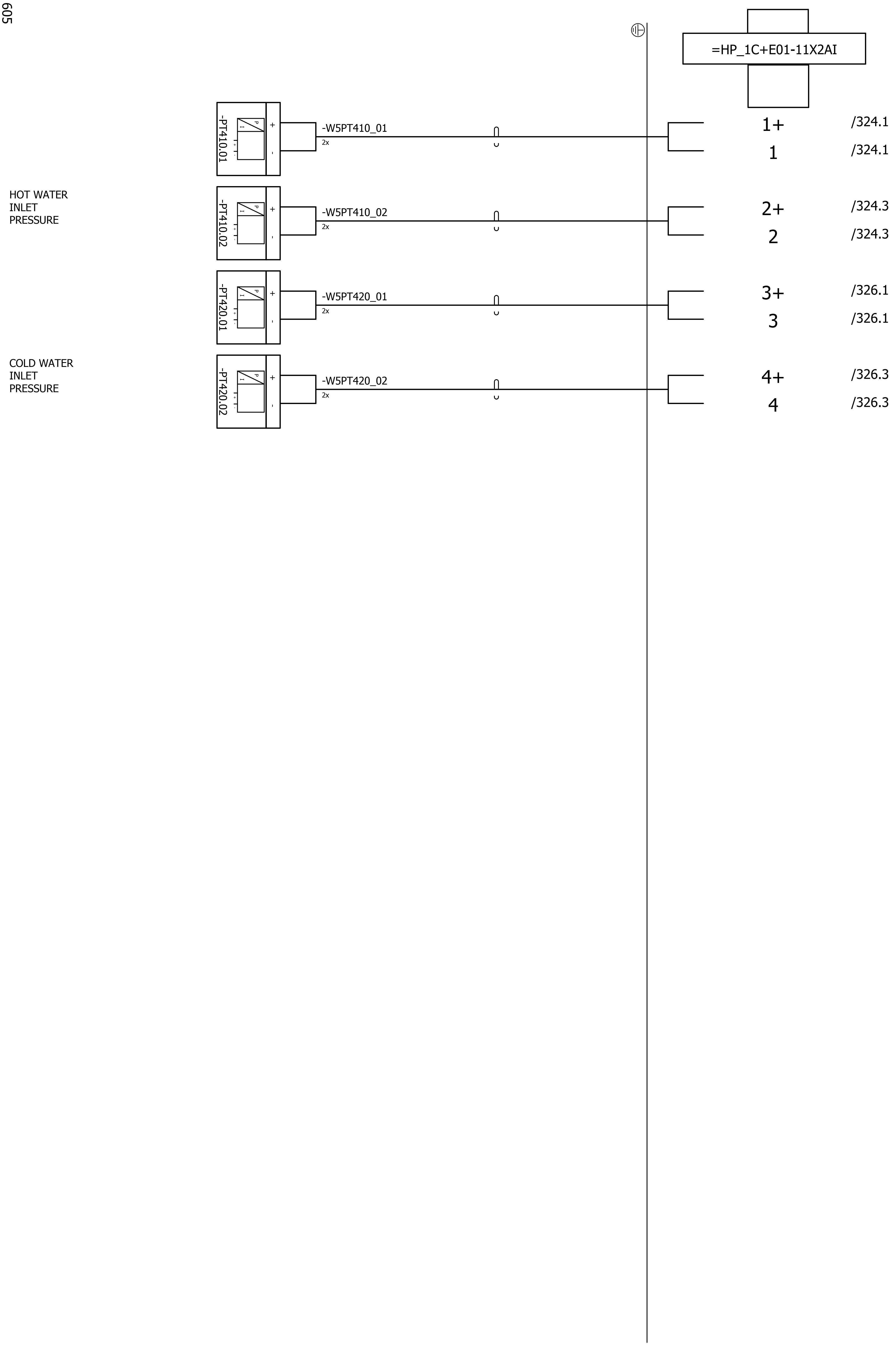
Safe Stop

◀604

606▶

AS BUILT	EK	17/11/17	8	Drawn by:	LowUp (ESP)	Location: E01	Drawingnumber (group): HP_1C
Revision description	Name	Date	Rev.				
Location:	Name	EK		Description	=HP_1C+E01-X07	Ordernumber: 62049-001	Page: 605
	Last change.	30-Nov-17					

◄605



AS BUILT	EK	17/11/17	8	Drawn by: LowUp (ESP)
Revision description	Name	Date	Rev.	
Location:	Name	EK		Description: =HP_1C+E01-11X2AI
	Last change.	30-Nov-17		

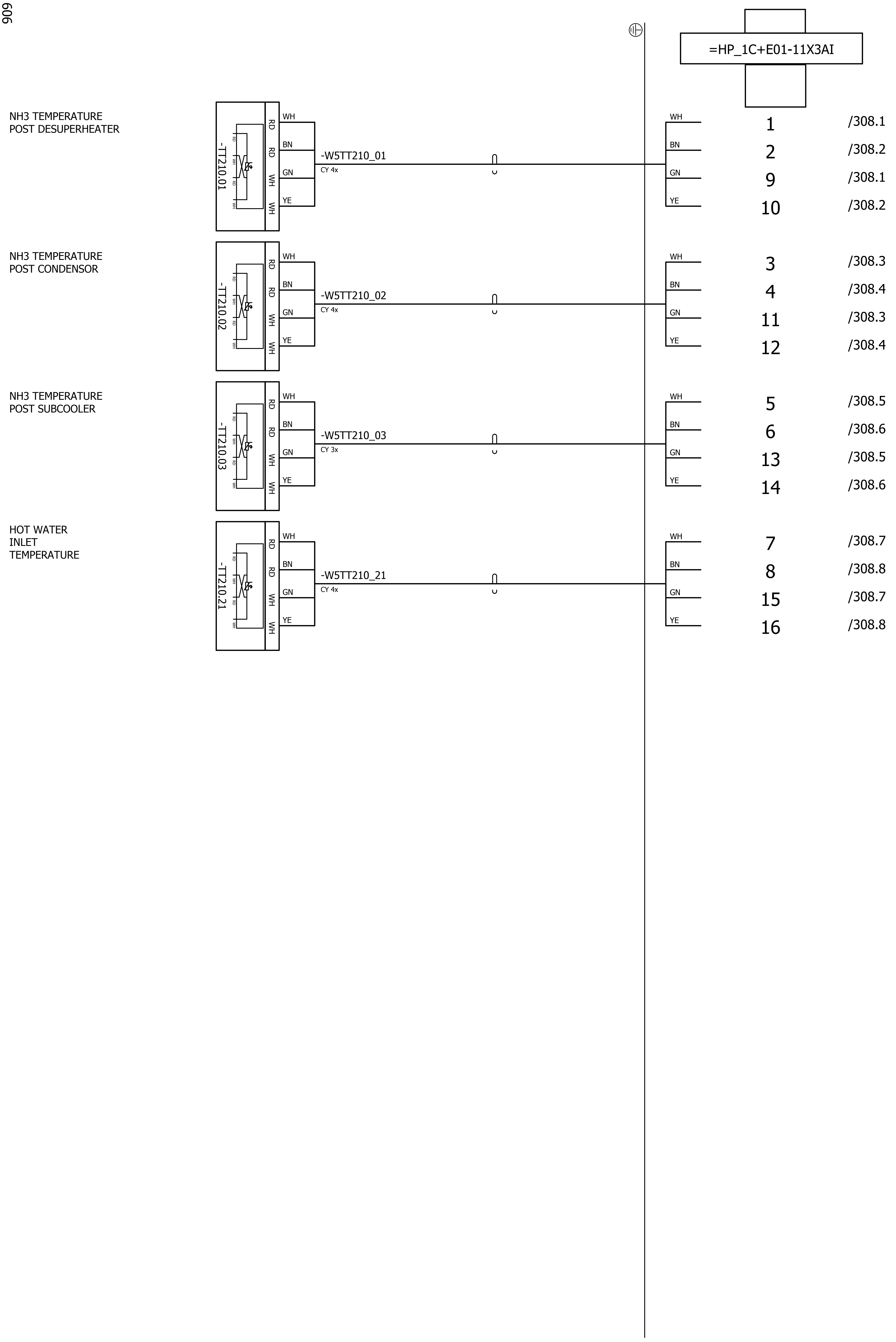
Location: E01

Ordernumber: 62049-001

Drawingnumber (group): HP_1C

Page: 606

607►



◄606

608►

AS BUILT | EK | 17/11/17 | 8

Revision description | Name | Date | Rev.

Location: | Name | EK | Last change. 30-Nov-17

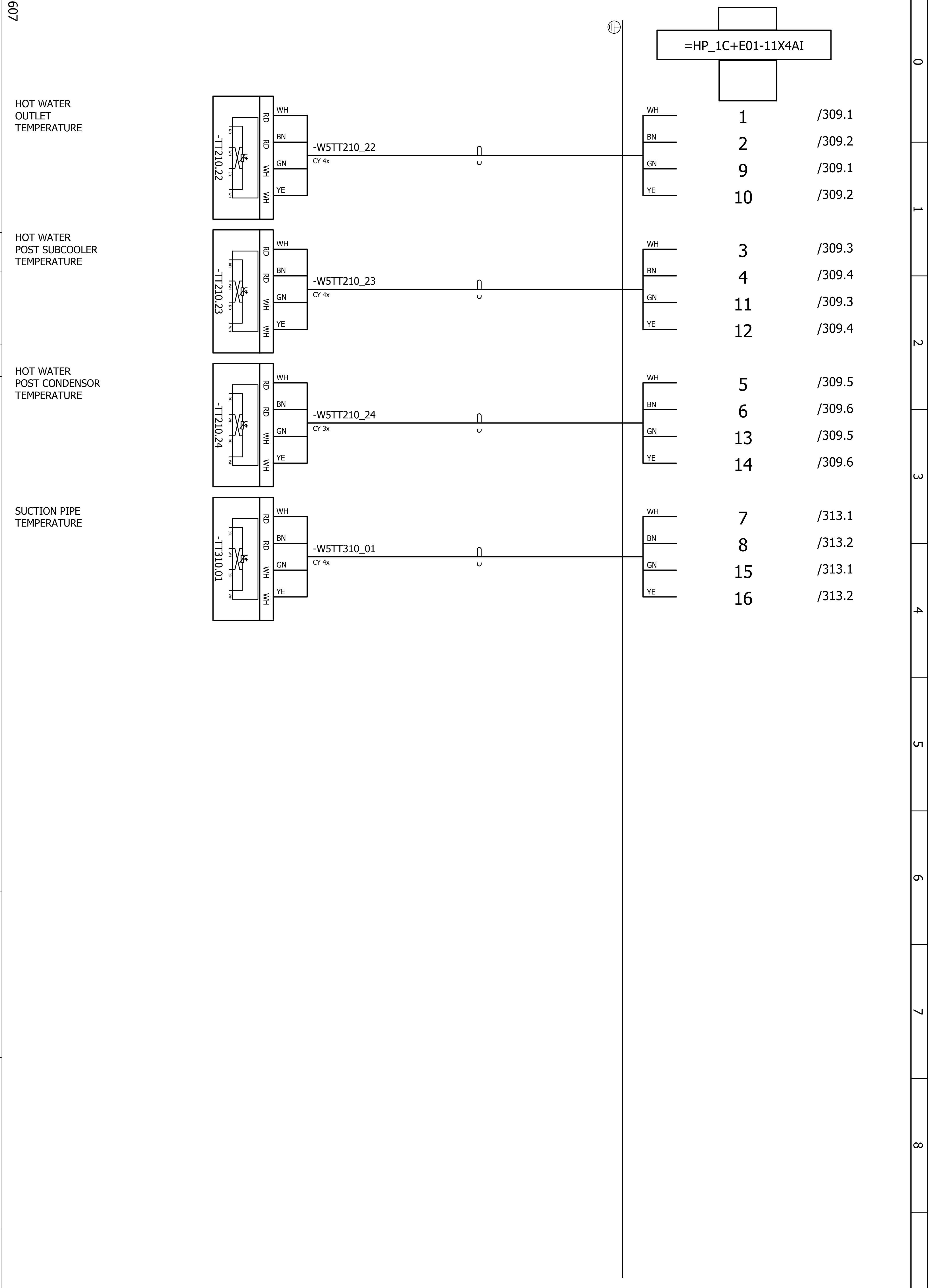
Drawn by: LowUp (ESP)

Description: =HP_1C+E01-11X3AI

Location: E01

Ordernumber: 62049-001

Drawingnumber (group): HP_1C



◄607

AS BUILT | EK | 17/11/17 | 8

Revision description | Name | Date | Rev.

Drawn by: LowUp (ESP)

Location: | Name EK | Description =HP_1C+E01-11X4AI

Last change. 30-Nov-17

GEA

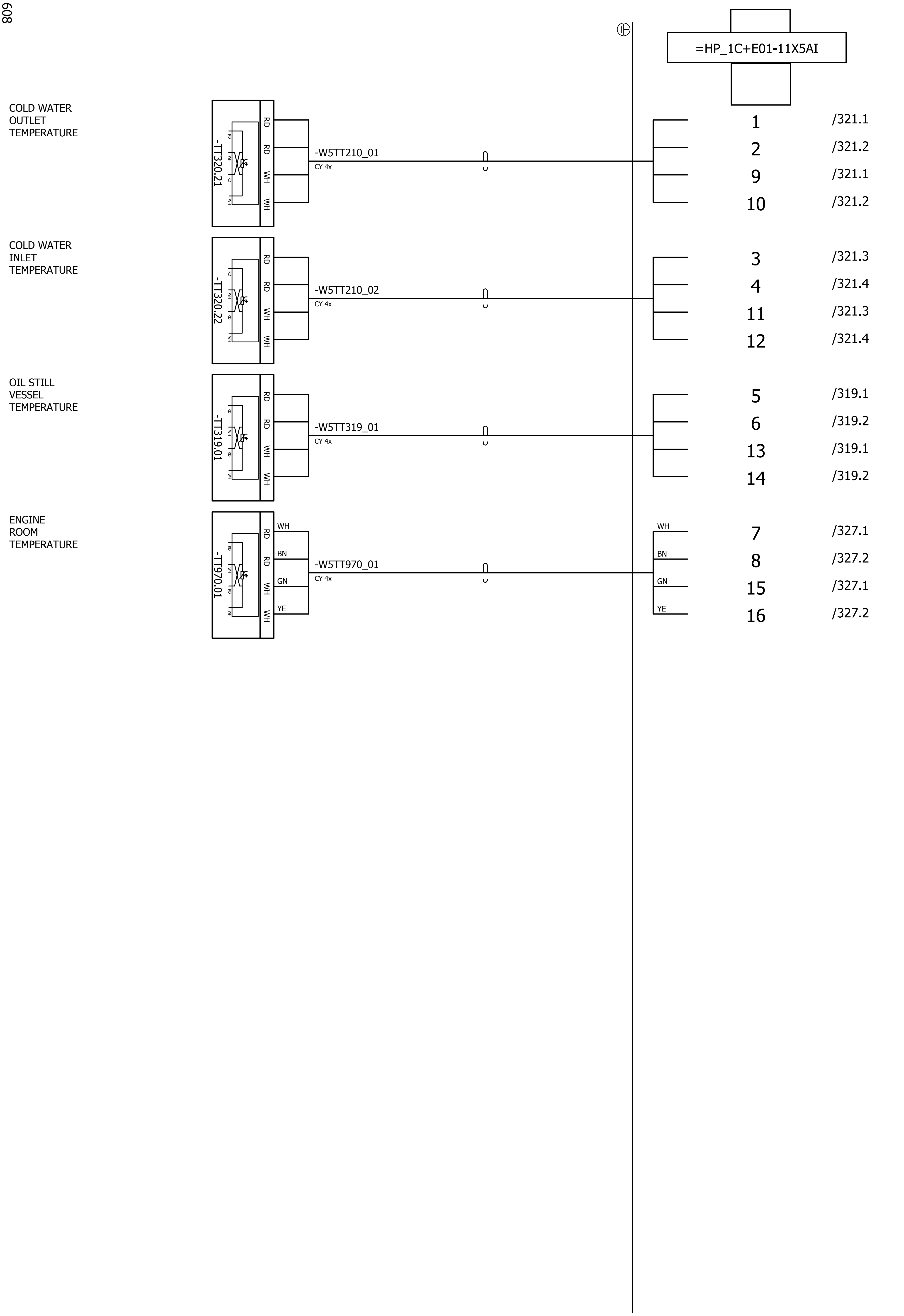
Location: E01

Ordernumber: 62049-001

Drawingnumber (group): HP_1C

Page: 608

609►



AS BUILT	EK	17/11/17	8
Revision description	Name	Date	Rev.
Location:	Name	EK	
	Last change.	30-Nov-17	

Drawn by: LowUp (ESP)

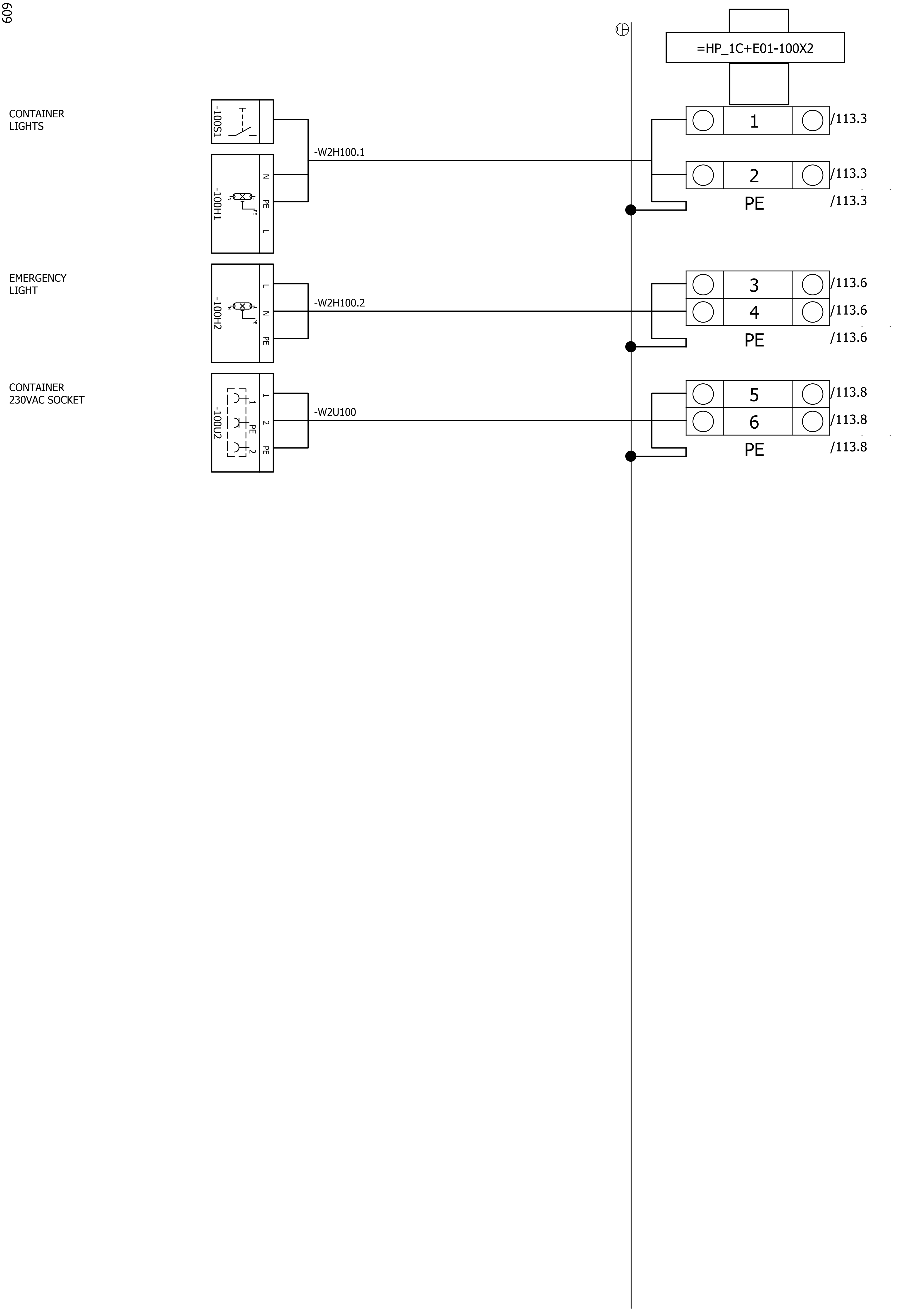
Description: =HP_1C+E01-11X5AI

Location: E01

Ordernumber: 62049-001

Drawingnumber (group): HP_1C

◄609



AS BUILT		
EK	17/11/17	8
Name	Date	Rev.
Revision description		
Name	EK	
Last change.	30-Nov-17	
Location:		

Drawn by: LowUp (ESP)

Description: =HP_1C+E01-100X2

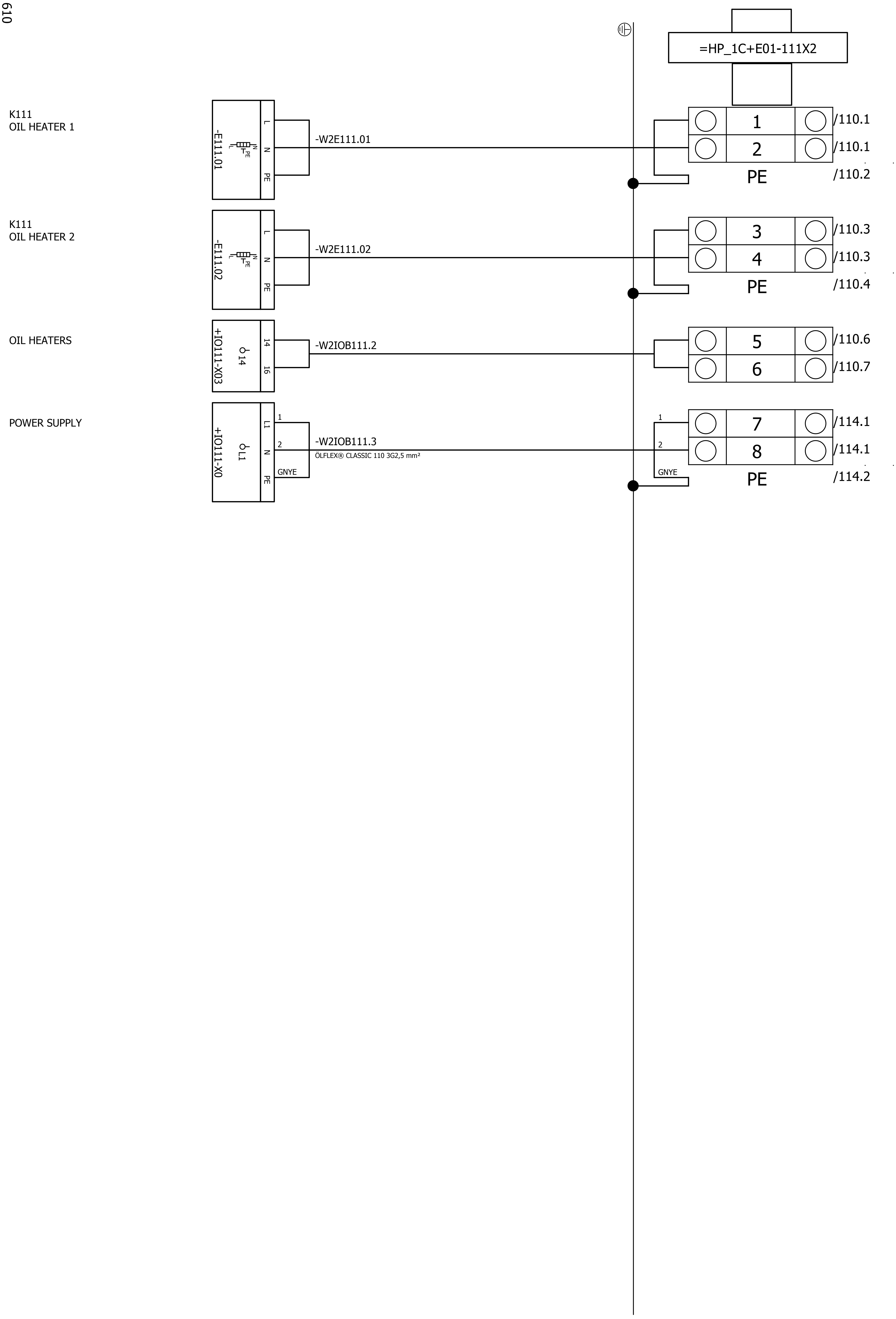
Location: E01

Ordernumber: 62049-001

Drawingnumber (group): HP_1C

Page: 610

611►



◄610

612►

AS BUILT | EK | 17/11/17 | 8

Revision description | Name | Date | Rev.

Location: | Name | EK

Last change. 30-Nov-17

Drawn by: LowUp (ESP)

Description =HP_1C+E01-111X2

Location: E01

Ordernumber: 62049-001

Drawingnumber (group): HP_1C

Page: 611

◄611

AS BUILT

Revision description

Location:

Name	Date	Rev.
EK	17/11/17	8

Name: EK

Last change: 30-Nov-17

Drawn by: LowUp (ESP)

Description: =HP_1C+E01-200X3

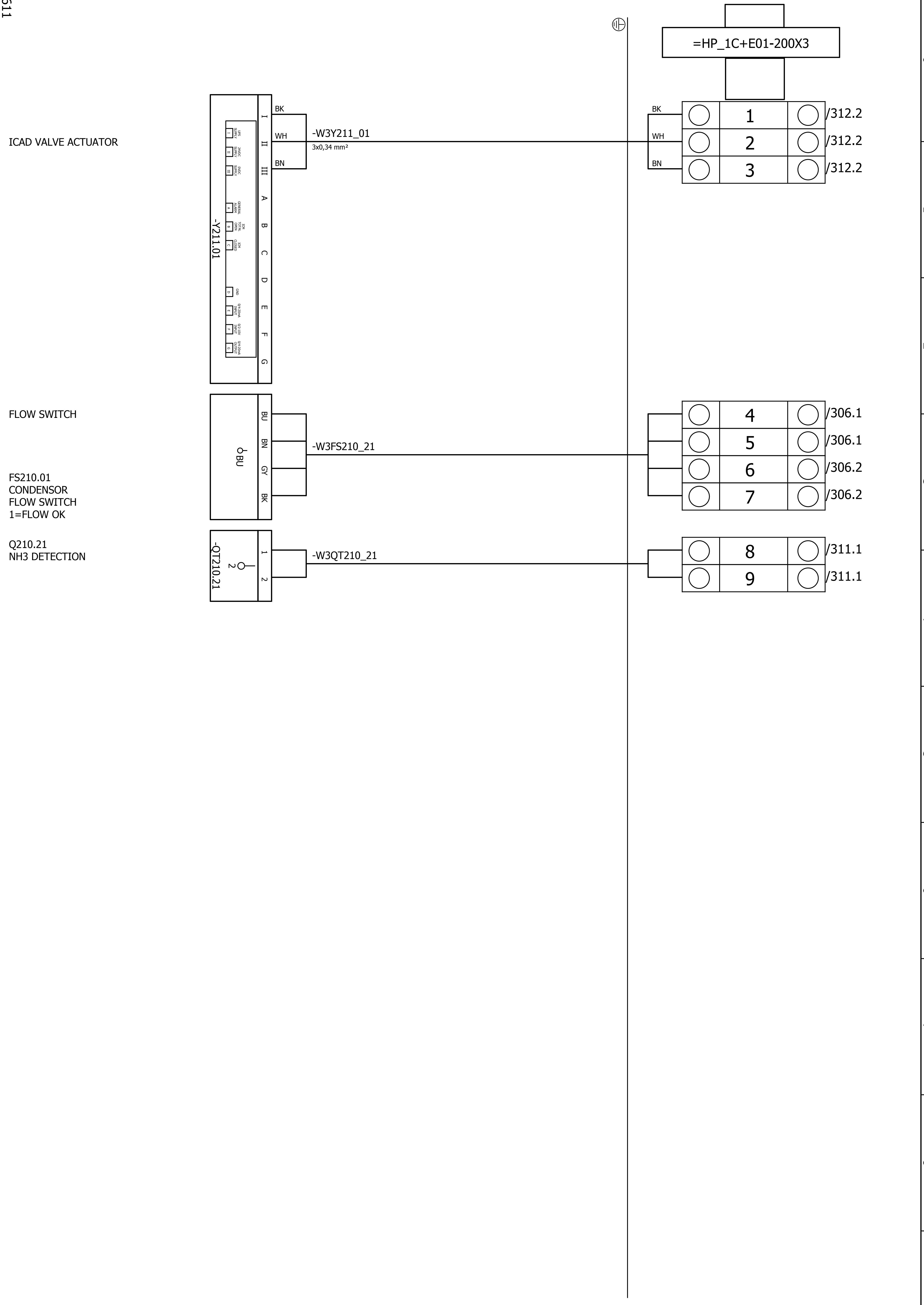
Location: E01

Ordernumber: 62049-001

Drawingnumber (group): HP_1C

Page: 612

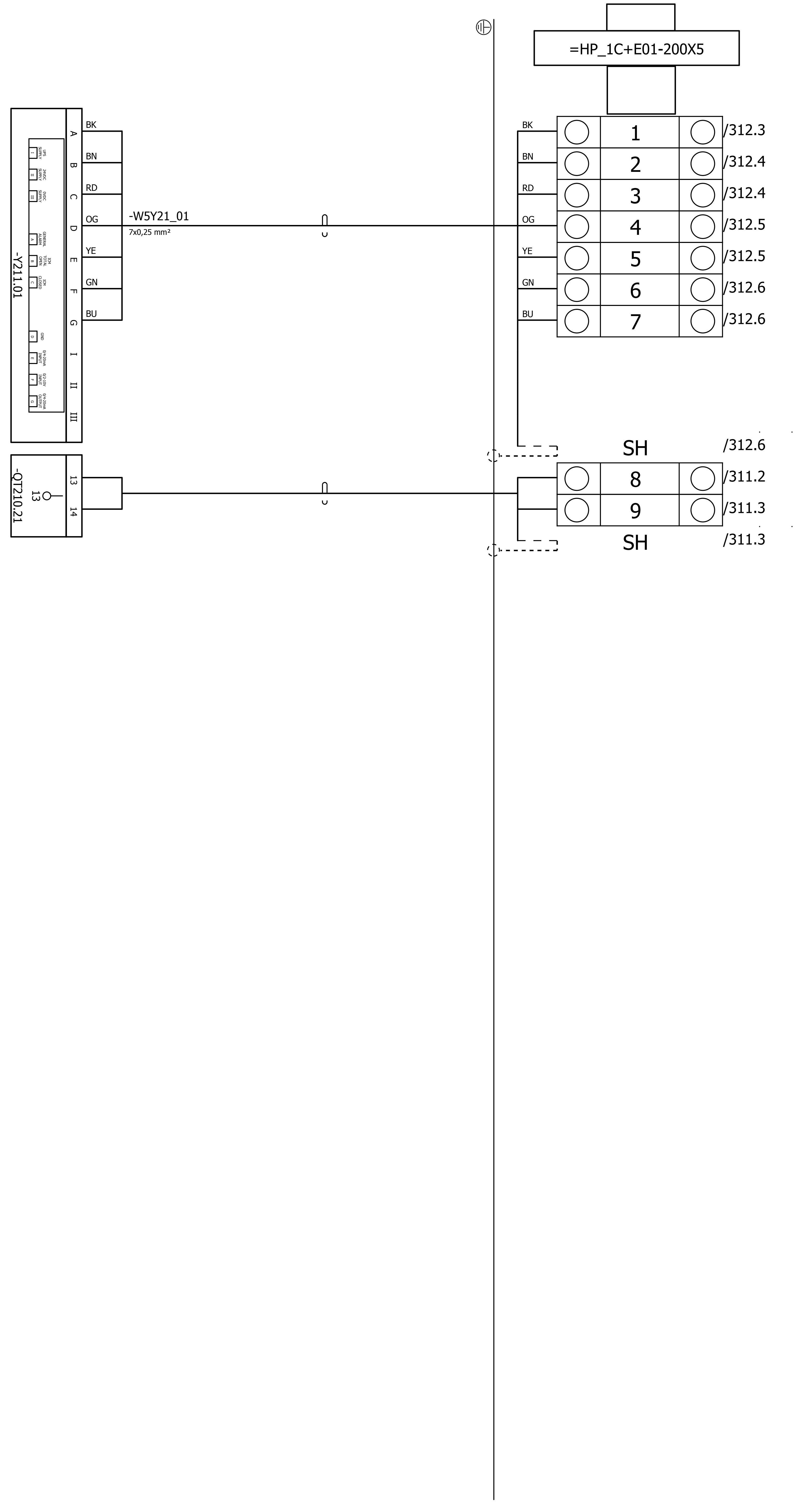
613►



ICAD VALVE ACTUATOR

LIQUID INJECTION
VALVE
POSITION FEEDBACK

LIQUID INJECTION
VALVE
POSITION FEEDBACK
HOT WATER
PH METER



0 1 2 3 4 5 6 7 8 9

AS BUILT	EK	17/11/17
Revision description	Name Date	Rev. 8
Location:	Name EK	Last change. 30-Nov-17

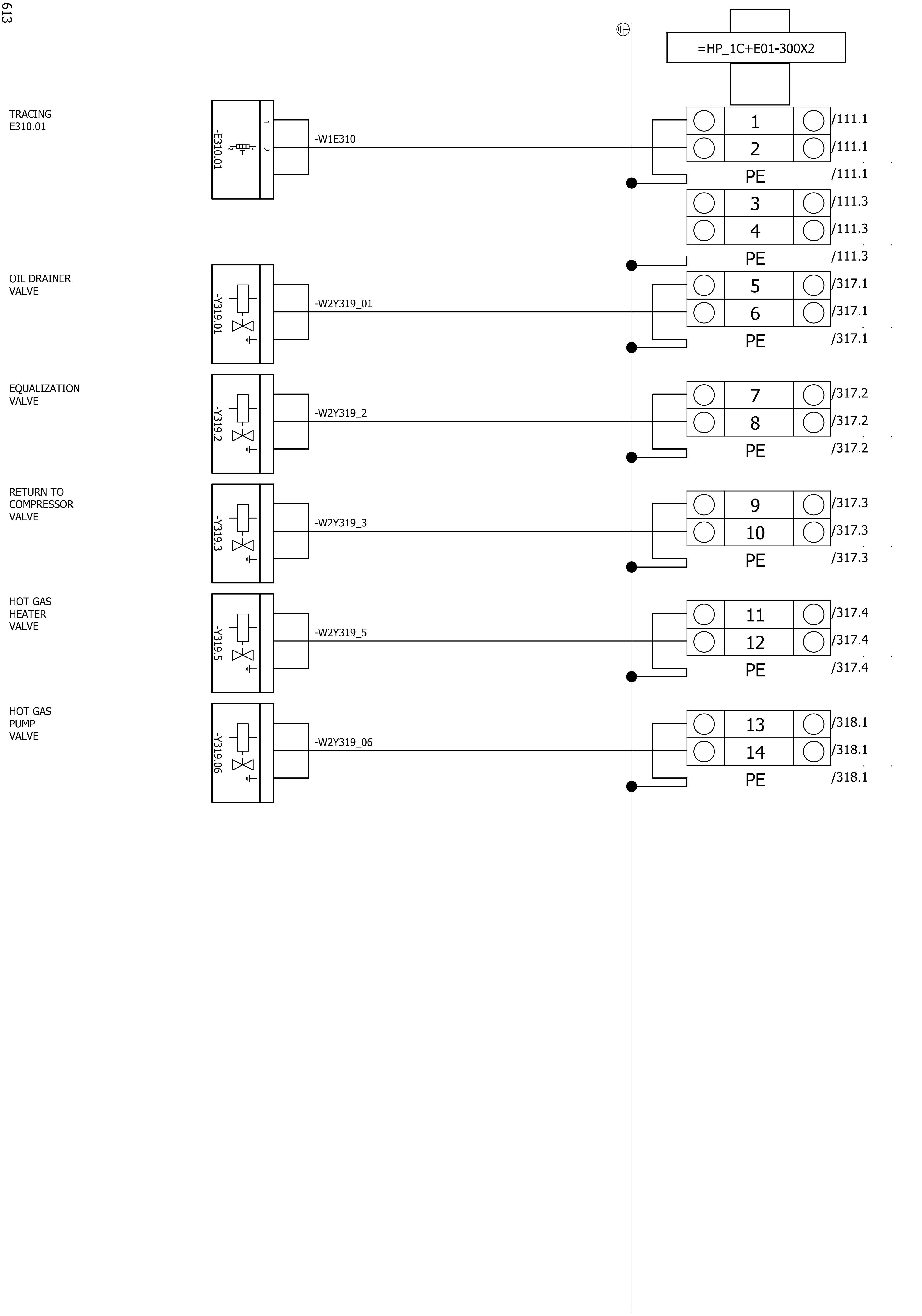
Drawn by: LowUp (ESP)

Description: =HP_1C+E01-200X5

Location: E01

Ordernumber: 62049-001

Drawingnumber (group): HP_1C



◀613

AS BUILT | EK | 17/11/17 | 8 | Drawn by: LowUp (ESP)

Revision description | Name | Date | Rev.

Location: | Name EK | Last change. 30-Nov-17

Description: =HP_1C+E01-300X2

Location: E01

Ordernumber: 62049-001

Drawingnumber (group): HP_1C

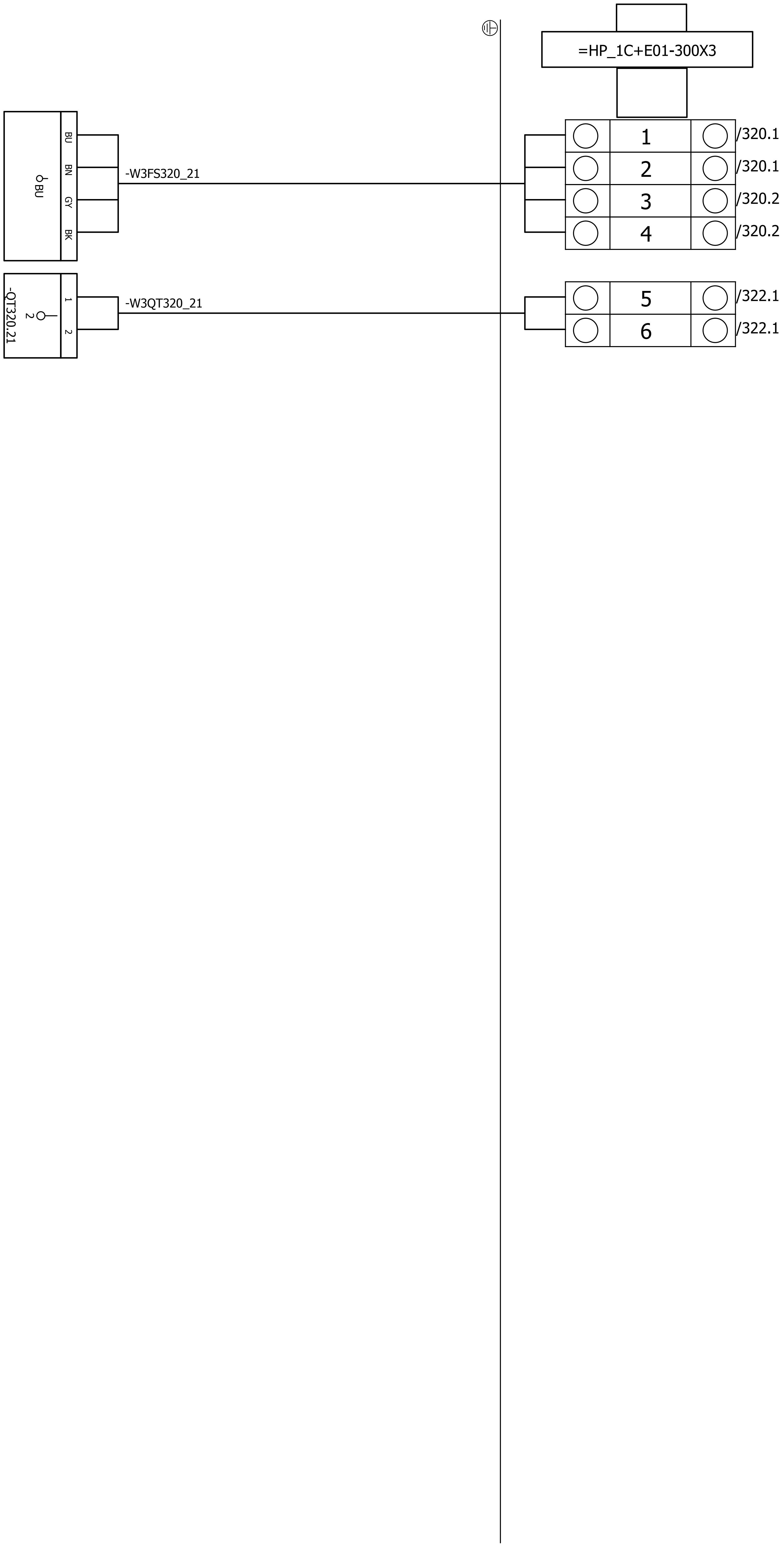
Page: 614

615▶

FLOW SWITCH

FS320.01
EVAPORATOR
FLOW SWITCH
1=FLOW OK

Q320.21
NH3 DETECTION



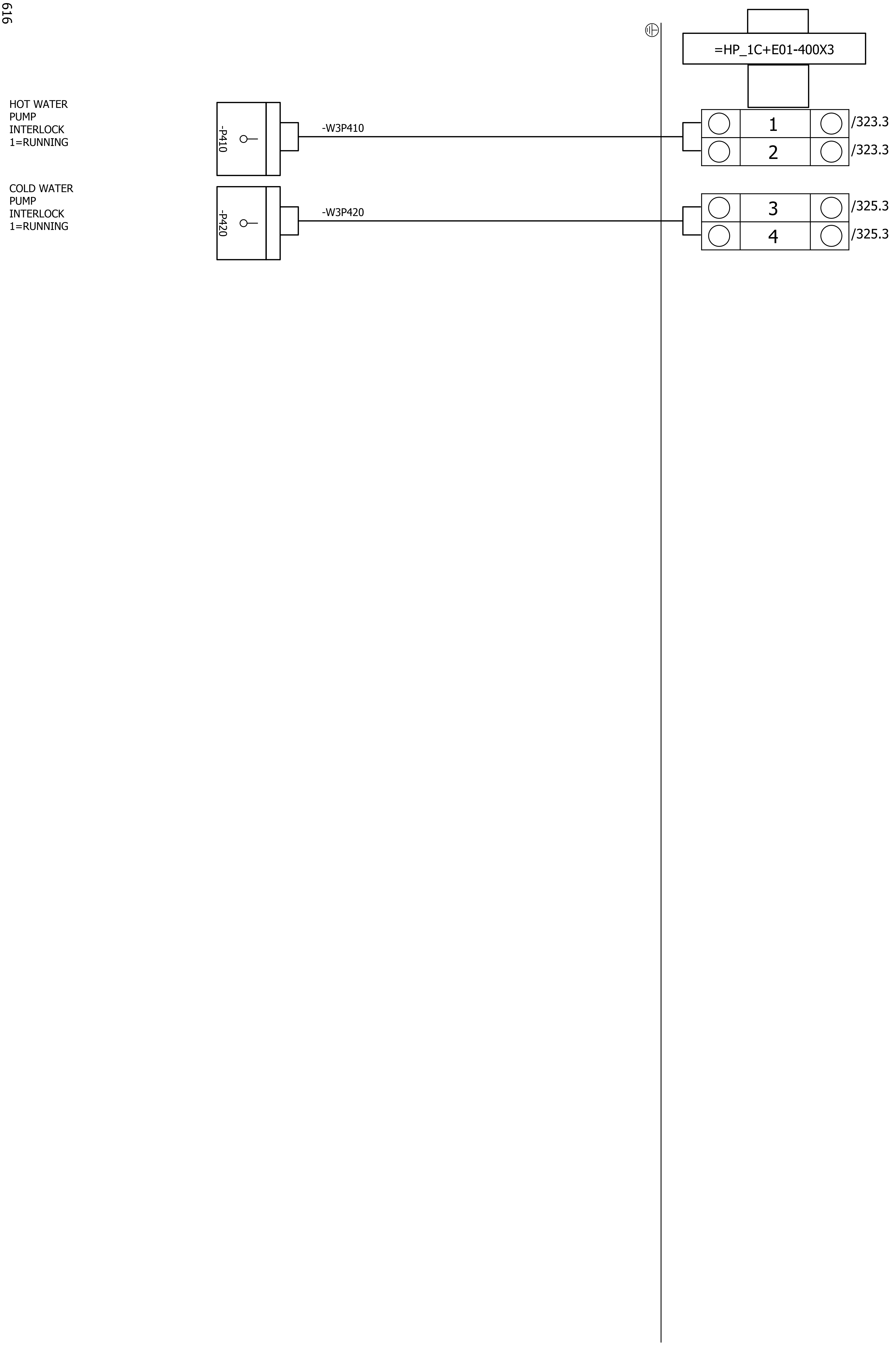
◄614

616►

◀615

617▶

AS BUILT	EK	17/11/17	8	Drawn by:	LowUp (ESP)		Location: E01	Drawingnumber (group): HP_1C
Revision description	Name	Date	Rev.					
Location:	Name	EK		Description	=HP_1C+E01-300X5		Ordernumber: 62049-001	Page: 616
	Last change.	30-Nov-17						



◄616

AS BUILT	EK	17/11/17	8
Revision description	Name	Date	Rev.
Location:	Name	EK	
	Last change.	30-Nov-17	

Drawn by: LowUp (ESP)

Description: =HP_1C+E01-400X3

Location: E01

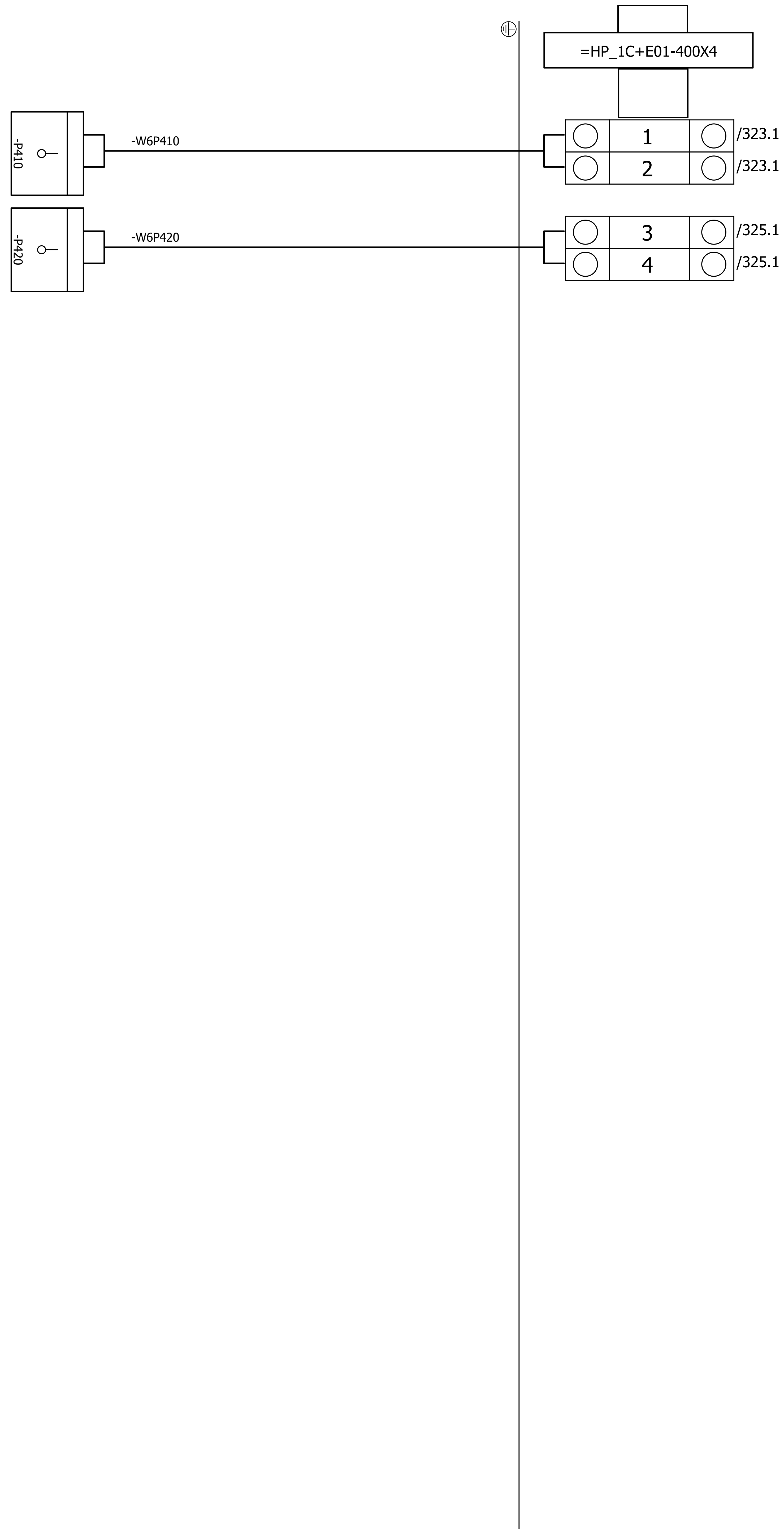
Ordernumber: 62049-001

Drawingnumber (group): HP_1C

Page: 617

618►

PUMP
START
REQUEST



◄617

619►

AS BUILT	EK	17/11/17	8
Revision description	Name	Date	Rev.
Location:	Name EK	Last change. 30-Nov-17	

Drawn by: LowUp (ESP)

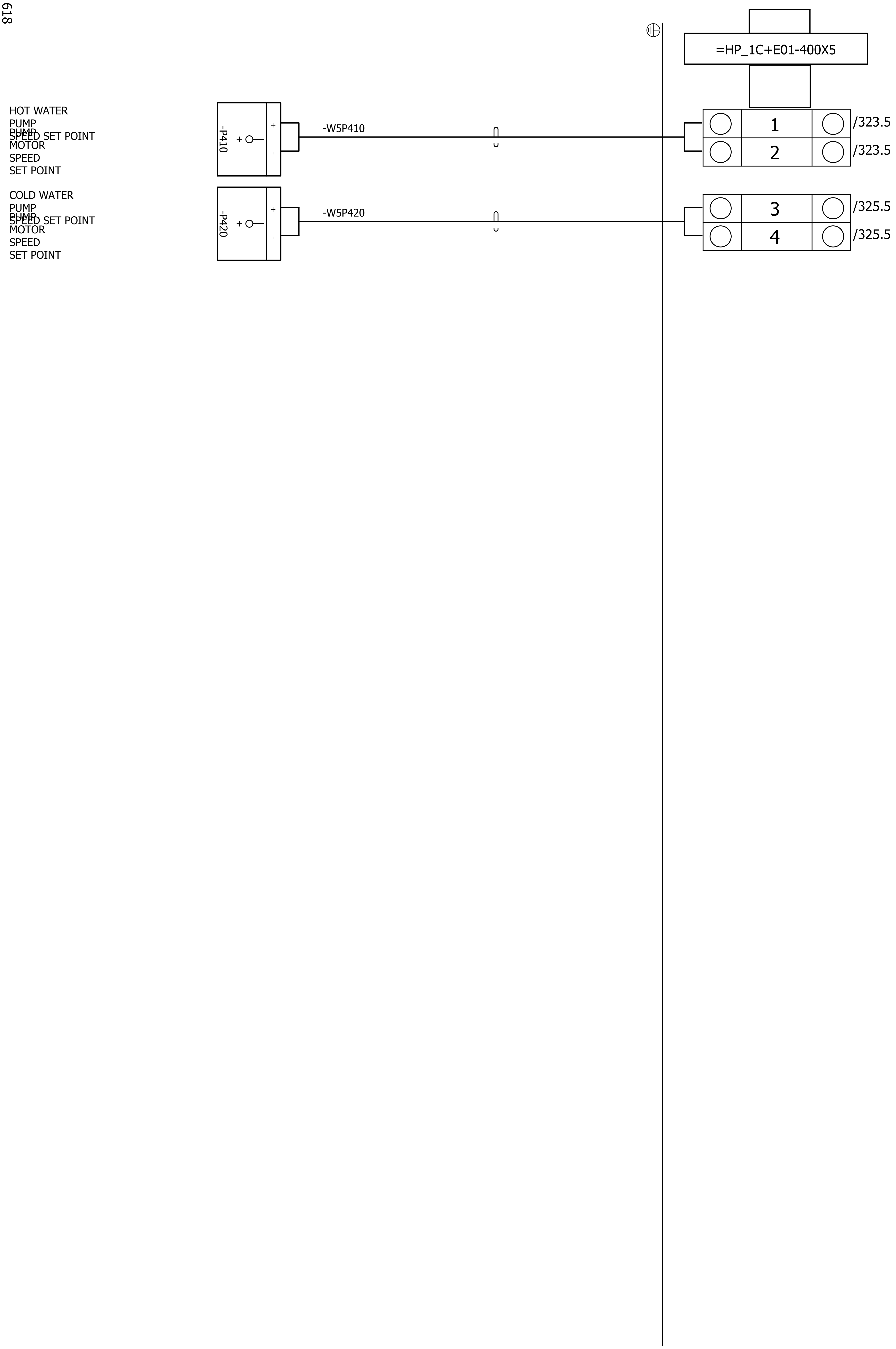
Description =HP_1C+E01-400X4

Location: E01

Ordernumber: 62049-001

Drawingnumber (group): HP_1C

Page: 618



◄618

AS BUILT	EK	17/11/17	8
Revision description	Name	Date	Rev.
Location:	Name	EK	
	Last change.	30-Nov-17	

Drawn by: LowUp (ESP)

Description: =HP_1C+E01-400X5

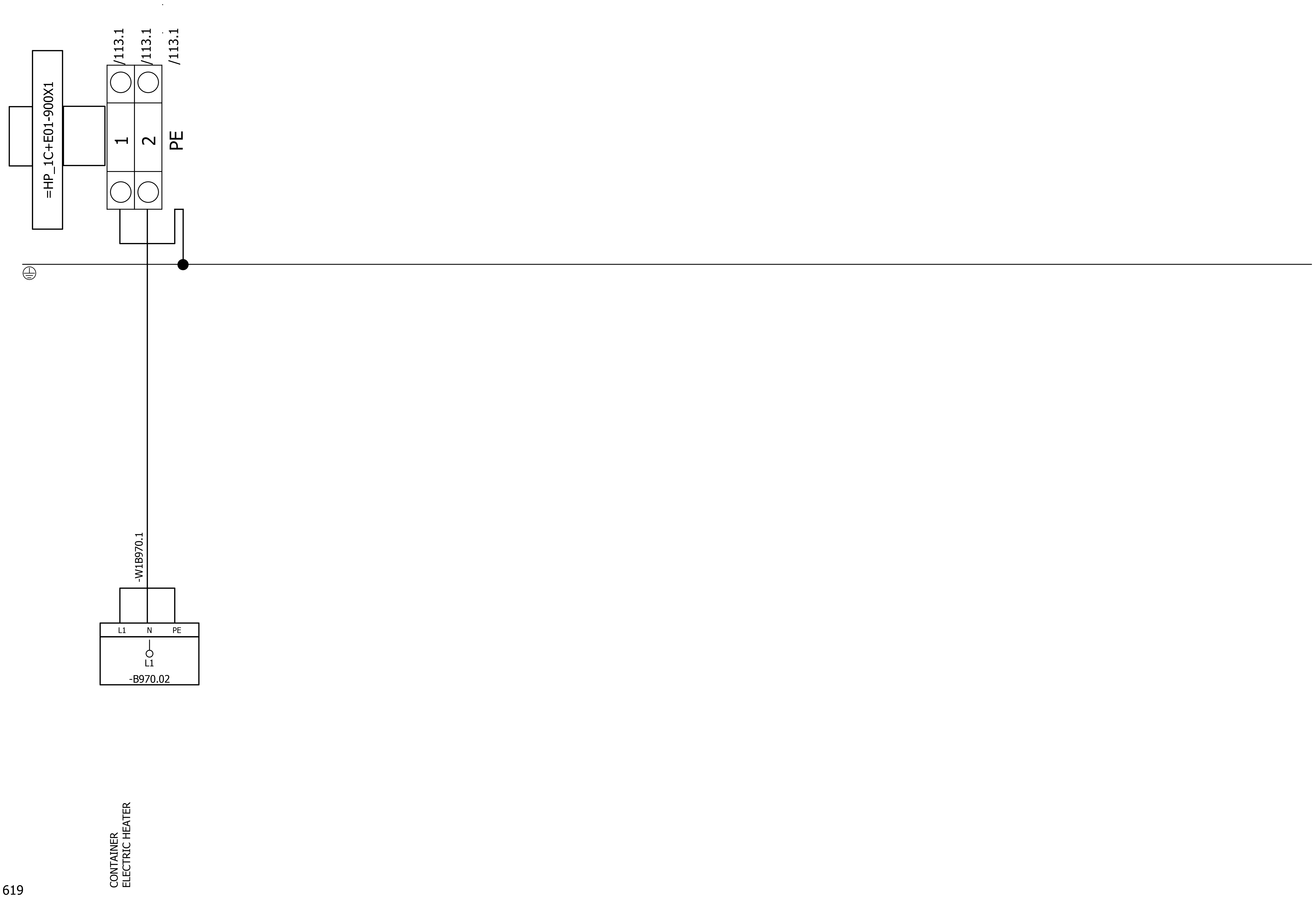
GEA

Location: E01

Ordernumber: 62049-001

Drawingnumber (group): HP_1C

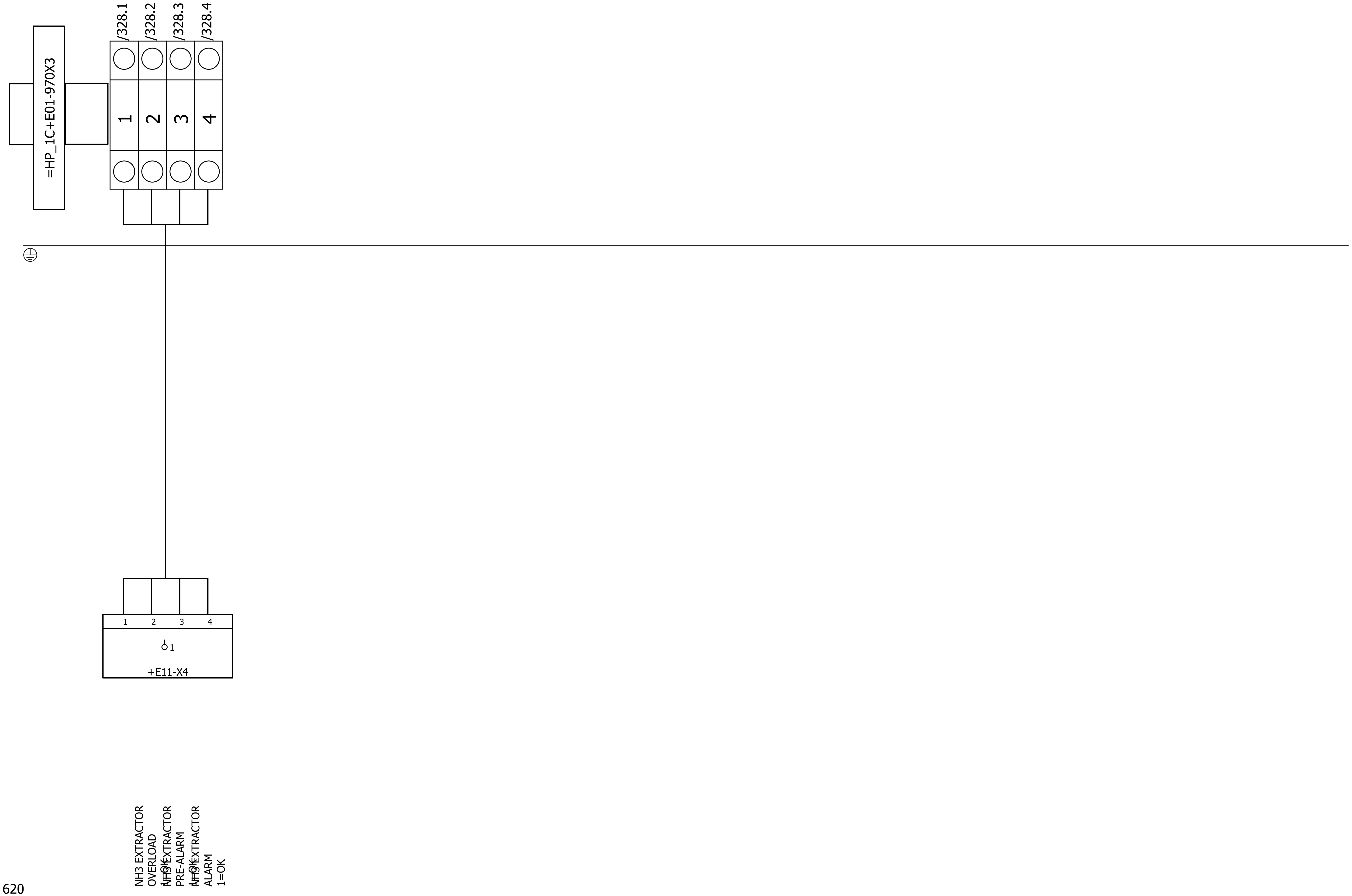
620►



◀619

621▶

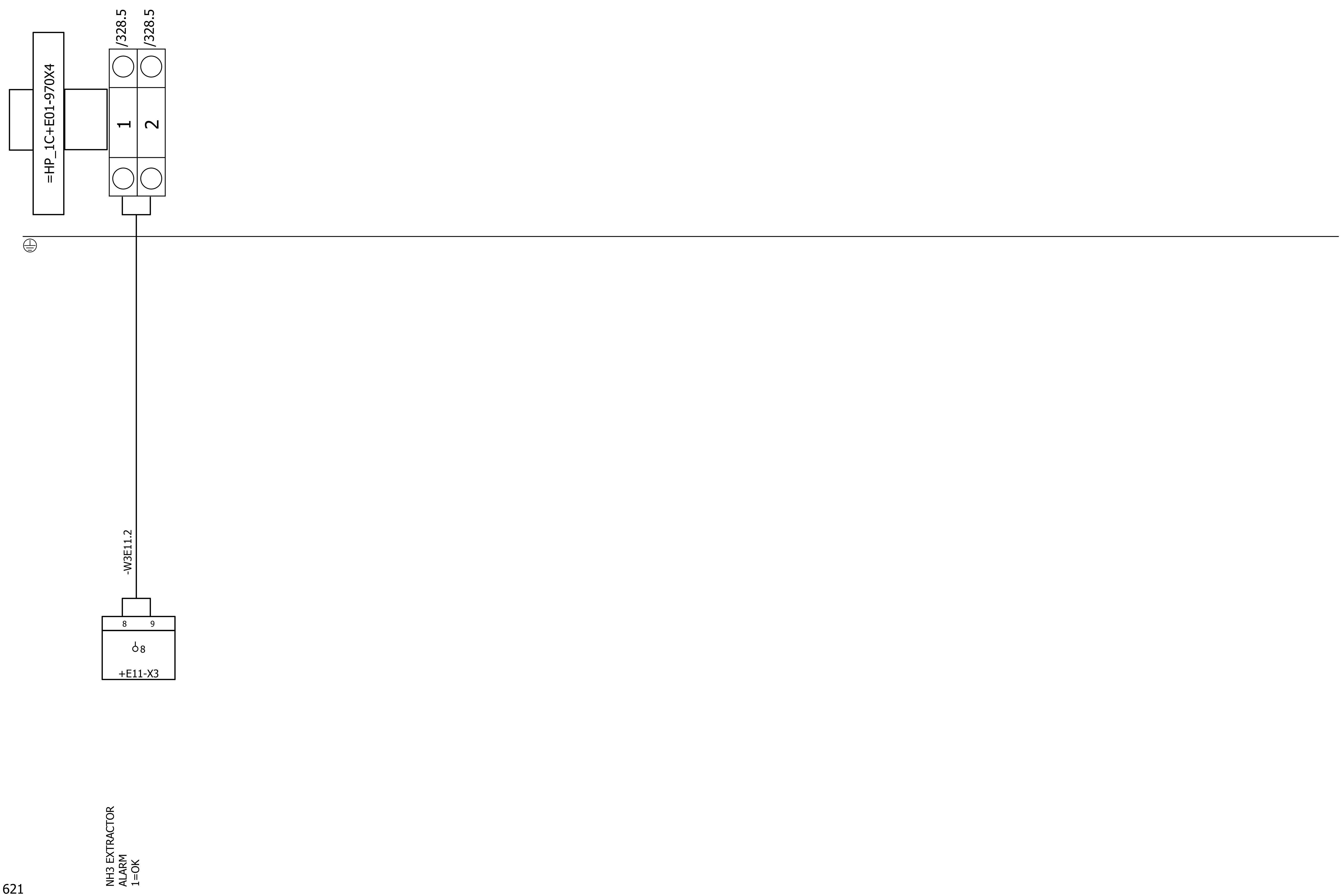
AS BUILT	EK	17/11/17	8	Drawn by: LowUp (ESP)	GEA	Location: E01	Drawingnumber (group): HP_1C
Revision description	Name	Date	Rev.				
Location:	Name	EK		Description =HP_1C+E01-900X1		Ordernumber: 62049-001	Page: 620
	Last change.	30-Nov-17					



◀620

622▶

AS BUILT	EK	17/11/17	8	Drawn by:	LowUp (ESP)	GEA	Location: E01	Drawingnumber (group): HP_1C
Revision description	Name	Date	Rev.					
Location:	Name	EK		Description	=HP_1C+E01-970X3		Ordernumber: 62049-001	Page: 621
	Last change.	30-Nov-17						



◀621 1400▶

AS BUILT	EK	17/11/17	8	Drawn by:	LowUp (ESP)	Location: E01	Drawingnumber (group): HP_1C
Revision description	Name	Date	Rev.				
Location:	Name	EK		Description	=HP_1C+E01-970X4	Ordernumber: 62049-001	Page: 622
	Last change.	30-Nov-17					

Parts list

Device tag	Order number	Type number	Quantity	Designation	Supplier	Page
	D7273	35X15	2	DIN RAILS 35MM H=15MM	PHOENIX CONTACT	+E11/9.3;/9.
	D7272	35X7,5	8	DIN RAILS 35MM H=7,5MM	PHOENIX CONTACT	+E11/9.4;/9.
	65x85	65x85	7	CABLE CHANNEL 65x85 (WxH)	HAGER	/9.3.../9.6
	45x85	45x85	5	CABLE CHANNEL 45x85 (WxH)	HAGER	/9.3;/9.4
		85x85	1	CABLE CHANNEL 85X85 (WXH)	HAGER	/9.3
A10.0	STC-15W04-GA	STC-15W04-GA	1	TOUCHSCREEN PANEL PC, 15,6", IP65	ADLINK	/402.2
310A1	5SU1356-7KK06	5SU1356-7KK06	1	FI/LS-PROTECTOR TYPE A (PSE/SSF), 6A C, 30mA, 1+N-POLE, 6KA	Siemens AG	/111.1
11.1AI	750-455/020-000	750-455/020-000	1	ANALOG INPUT MODULE, 4 x 24Vdc, 4...20mA, 12 bits, SINGLE ENDED	WAGO	/401.5
11.2AI	750-455/020-000	750-455/020-000	1	ANALOG INPUT MODULE, 4 x 24Vdc, 4...20mA, 12 bits, SINGLE ENDED	WAGO	/401.5
11.3AI	750-450	750-450	1	ANALOG INPUT MODULE, 4 x RTD, 16 bits	WAGO	/401.6
11.4AI	750-450	750-450	1	ANALOG INPUT MODULE, 4 x RTD, 16 bits	WAGO	/401.6
11.5AI	750-450	750-450	1	ANALOG INPUT MODULE, 4 x RTD, 16 bits	WAGO	/401.6
11.1AO	750-553	750-553	1	ANALOG OUTPUT MODULE, 4 x 24Vdc, 0...20mA, 12 bits	WAGO	/401.7
11BC	750-352	750-352	1	ETHERNET FIELDBUS COUPLER, 10/100 Mbit/s	WAGO	/401.1
CAB	TS 8084.500	TS 8084.500	1	BAYING SYSTEM ENCLOSURE TS 8, RAL 7035, 1000x1800x400 mm INCL. MP, 1 DOOR	RITTAL	/9.1.0
CAB	TS 8184.235	TS 8184.235	2	SIDE PANEL FOR TS 1800 X 400mm RAL 7035.	RITTAL	/9.1.0
CAB	TS 8601.000	TS 8601.000	1	BASE/PLINTH.COMP.FRONT & REAR,100MM HIGH 1000MM WIDTH	RITTAL	/9.1.0
CAB	TS 8601.040	TS 8601.040	1	BASE/PLINTH COMP. SIDE , 100mm HIGH 400mm DEPTH	RITTAL	/9.1.0
CAB	PS 4124.000	PS 4124.000	1	WIRING PLAN POCKET, FOR DOORWIDTH 1000 mm	RITTAL	/9.1.0
CAB	TS 8802.105	TS 8802.105	1	SECTION FOR CABLE ENTRY, REAR W=1000 FOR TS, SE, CM, TP	RITTAL	/9.1.0
11.1DI	750-430	750-430	1	DIGITAL INPUT MODULE, 8 x 24Vdc, 3,0ms	WAGO	/401.3
11.2DI	750-430	750-430	1	DIGITAL INPUT MODULE, 8 x 24Vdc, 3,0ms	WAGO	/401.4
11.1DO	750-530	750-530	1	DIGITAL OUTPUT MODULE, 8 x 24Vdc, 0,5A	WAGO	/401.4

◀622 1400.a▶

Parts list

Device tag	Order number	Type number	Quantity	Designation	Supplier	Page
11.2DO	750-530	750-530	1	DIGITAL OUTPUT MODULE, 8 x 24Vdc, 0,5A	WAGO	/401.5
11E	750-600	750-600	1	END MODULE	WAGO	/401.7
10F1	3RV1421-1BA10	3RV1421-1BA10	1	TRANSFORMER PROTECTION SWITCH S0, 1.4...2A N ,SCREW	Siemens AG	/200.1
10F2	5SY6203-7	5SY6203-7	1	CIRCUIT BREAKER 400V 6KA, 2-POLE C, 3A	Siemens AG	/200.1
10F3	5SY6206-7	5SY6206-7	1	CIRCUIT BREAKER 400V 6KA, 2-POLE C, 6A	Siemens AG	/201.1
10F4	5SY6106-7	5SY6106-7	1	CIRCUIT BREAKER 230/400V 6KA, 1-POLE C, 6A	Siemens AG	/201.3
100F1	5SY6506-7	5SY6506-7	1	CIRCUIT BREAKER 230V 6KA, 1+N-POLE C, 6A	Siemens AG	/115.1
100F2	5SU1356-7KK06	5SU1356-7KK06	1	FI/LS-PROTECTOR TYPE A (PSE/SSF), 6A C, 30mA, 1+N-POLE, 6KA	Siemens AG	/113.3
100F3	5SU1356-7KK06	5SU1356-7KK06	1	FI/LS-PROTECTOR TYPE A (PSE/SSF), 6A C, 30mA, 1+N-POLE, 6KA	Siemens AG	/113.8
100F4	3RV2021-4EA10	3RV2021-4EA10	1	MOTOR PROTECTION SWITCH S0, 27...32A SCREW	Siemens AG	/100.4
100F5	5SY6610-7	5SY6610-7	1	CIRCUIT BREAKER 400V 6KA, 3+N-POLE C, 10A	Siemens AG	/100.5
100F6	5SY6002-7	5SY6002-7	1	CIRCUIT BREAKER 230V 6KA, 1+N-POLE C, 2A	Siemens AG	/100.7
111FM1	SV 9344.110	SV 9344.110	1	NH FUSE-SWITCH-DISCONNECTOR 250A/3P DIN1 690V, MOUNT.PL.	RITTAL	/101.1
111FM1	3NE3225	3NE3225	3	SITOR FUSE-LINK aR SIZE 1 200A, 1000VAC, FRONT INDICATOR	Siemens AG	/101.1
111FM2	5SY6510-6	5SY6510-6	1	CIRCUIT BREAKER 230V 6KA, 1+N-POLE B, 10A	Siemens AG	/110.1
111FM3	5SY6006-7	5SY6006-7	1	CIRCUIT BREAKER 230V 6KA, 1+N-POLE C, 6A	Siemens AG	/114.1
970FM1	5SY6516-7	5SY6516-7	1	CIRCUIT BREAKER 230V 6KA, 1+N-POLE C, 16A	Siemens AG	/113.1
10KA1	3SK1111-2AB30	3SK1111-2AB30	1	SIRIUS SAFETY RELAY STANDARD SERIES DEVICE, SPRING	Siemens AG	/300.4
211KA1	2903334	RIF-1-RPT-LDP-24DC/2X21	1	RIF 1 RELAY+SOCKET 24Vdc 2xCHANGE OVER PUSH-IN	PHOENIX CONTACT	/312.3
KLEMMEN			0			/9.6
10KM1	3RT2015-1BB42	3RT2015-1BB42	1	CONTACTOR 3KW AC-3 3P S00 24VDC 1NC SCREW	Siemens AG	/300.7
111KM2	3RT2015-1BB41	3RT2015-1BB41	1	CONTACTOR 3KW AC-3 3P S00 24VDC 1NO SCREW	Siemens AG	/110.7
310KM1	3RT2015-1BB41	3RT2015-1BB41	1	CONTACTOR 3KW AC-3 3P S00 24VDC 1NO SCREW	Siemens AG	/111.7

◀1400 1400.b▶

Parts list

Device tag	Order number	Type number	Quantity	Designation	Supplier	Page
970KM1	3RT2015-1BB41	3RT2015-1BB41	1	CONTACTOR 3KW AC-3 3P S00 24VDC 1NO SCREW	Siemens AG	/113.2
100M1	SK 3241.100	SK 3241.100	1	ENCLOSURE (COOLING) FAN 230Vac/230...250m³/h 255mm	RITTAL	/115.1
100M1	SK 3240.200	SK 3240.200	1	ENCLOSURE OUTLET FILTER 255mm	RITTAL	/115.1
MP			0			/9.0
P420			0			/325.1
11.1P	750-602	750-602	1	POWER SUPPLY MODULE 24Vdc	WAGO	/401.3
11.2P	750-614	750-614	1	POTENTIAL DISTRIBUTION MODULE 4 x 0...230Vac/dc	WAGO	/401.3
11.3P	750-614	750-614	1	POTENTIAL DISTRIBUTION MODULE 4 x 0...230Vac/dc	WAGO	/401.4
11.4P	750-614	750-614	1	POTENTIAL DISTRIBUTION MODULE 4 x 0...230Vac/dc	WAGO	/401.5
100P1	4M2406N	RM60N-E3A 250/5A	1	MEASURING TRANSFORMER 250/5	FAGET	/100.0
100P2	4M2406N	RM60N-E3A 250/5A	1	MEASURING TRANSFORMER 250/5	FAGET	/100.0
100P3	4M2406N	RM60N-E3A 250/5A	1	MEASURING TRANSFORMER 250/5	FAGET	/100.1
PE			0			/100.3;/100.
PE	0800886	E/NS 35 N	2	END CLAMP E/NS 35 N	PHOENIX CONTACT	/9.5
PE	3209536	PT 2,5-PE	3	GROUND MODULAR TERMINAL BLOCK PT 2,5-PE	PHOENIX CONTACT	/9.5
PE	3030417	D-ST 2,5	1	END COVER D-ST 2,5	PHOENIX CONTACT	/9.5
Q319-1	2903370	RIF-0-RPT-LDP-24VDC/21	1	RIF 0 RELAY+SOCKET 24Vdc 1xCHANGE OVER PUSH-IN	PHOENIX CONTACT	/317.5
Q319-2	2903370	RIF-0-RPT-LDP-24VDC/21	1	RIF 0 RELAY+SOCKET 24Vdc 1xCHANGE OVER PUSH-IN	PHOENIX CONTACT	/317.6
Q319-3	2903370	RIF-0-RPT-LDP-24VDC/21	1	RIF 0 RELAY+SOCKET 24Vdc 1xCHANGE OVER PUSH-IN	PHOENIX CONTACT	/317.7
Q319-5	2903370	RIF-0-RPT-LDP-24VDC/21	1	RIF 0 RELAY+SOCKET 24Vdc 1xCHANGE OVER PUSH-IN	PHOENIX CONTACT	/317.8
Q319-6	2903370	RIF-0-RPT-LDP-24VDC/21	1	RIF 0 RELAY+SOCKET 24Vdc 1xCHANGE OVER PUSH-IN	PHOENIX CONTACT	/318.5
Q410-1	2903370	RIF-0-RPT-LDP-24VDC/21	1	RIF 0 RELAY+SOCKET 24Vdc 1xCHANGE OVER PUSH-IN	PHOENIX CONTACT	/323.8
Q420-1	2903370	RIF-0-RPT-LDP-24VDC/21	1	RIF 0 RELAY+SOCKET 24Vdc 1xCHANGE OVER PUSH-IN	PHOENIX CONTACT	/325.8

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Parts list

Device tag	Order number	Type number	Quantity	Designation	Supplier	Page
Q970-1	2903370	RIF-0-RPT-LDP-24VDC/21	1	RIF 0 RELAY+SOCKET 24Vdc 1xCHANGE OVER PUSH-IN	PHOENIX CONTACT	/328.8
100QM1	1814410	DMV250N/4	1	DUMECO MAIN-/LOADSWITCH 0-1 90° 4P 250A DMV250N/4	EATON	/100.0
100QM1	1050243	4K10K3H400	1	OPERATING SHAFT DUMECO 160-250-400 10x10mm/400mm	EATON	/100.0
100QM1	1818113	1818113	1	HANDLE + TRANSIT K3DB/P DUMECO BLUE/RED	EATON	/100.0
100QM1	1314735	1314735	2	PROTECTIVE COVER DUMECO 250	EATON	/100.0
10S0	ZB4BS844	ZB4BS844	1	RED Ø40 EMERGENCY STOP, Ø22 MOUNT	SCHNEIDER ELECTRIC	/300.1
10S0	ZB4BZ102	ZB4BZ102	1	BODY WITH 1NC CONTACT	SCHNEIDER ELECTRIC	/300.1
10S0	ZBY9320		1	marked legend Ø60 for emergency stop - EMERGENCY STOP	SCHNEIDER ELECTRIC	/300.1
SC111.01			0			/101.0;/101.
10T1	044267	044267	1	TRANSFORMER PRI.230/400V±15V/SEC.115/230VAC 630VA	LEGRAND	/200.1
10T2	WDR-240-24	WDR-240-24-10A	1	PSU 180...550Vac-254...780Vdc/24Vdc-10A	MEANWELL	/201.1
100TS1	SK 3110.000	SK 3110.000	1	CABINET THERMOSTAT +5...+55°C / 230V/24V	RITTAL	/115.2
2U	852-101	852-101	1	INDUSTRIAL-SWITCH, 5-PORT, 100BASE-TX	WAGO	/403.2
3U	VSE002	VSE002	1	DIAGNOSTIC ELECTRONICS FOR 4 x VIBRATION SENSORS TYPE VSA / VSP	IFM electronic GmbH	/329.1
3U.01			0			/329.4
3U.02			0			/329.5
3U.03			0			/329.6
3U.04			0			/329.7
4U	MDH 859 EU	MDH 859 EU	1	MBNET INDUSTRIAL ROUTER, 1xWAN, 4xLAN	MB connect line GmbH	/403.5
10U2	2964898	SD-D/SC/LA	1	DIN 230Vac FEMALE RECEPTACLE SD-D/SC/LA (GREEN)	PHOENIX CONTACT	/113.9
100U.01	7KM2112-0BA00-3AA0	7KM2112-0BA00-3AA0	1	PMD SENTRON PAC3200 96 LCD POWER MONITOR ACDC TEK	Siemens AG	/100.4
100U3	004885	004885	1	DISTRIBUTION TERMINAL BLOCK 13 INFEEDS 4P 40A DIN	LEGRAND	/100.3
X02			0			/9.4

Parts list

Device tag	Order number	Type number	Quantity	Designation	Supplier	Page
XL10			0			/9.4
XL11			0			/9.4
1XRTU			0			/402.4
1XUSB	1411904	CUC-V06-F1PGY-UBA/UBBB	1	PANEL MOUNTING FRAME SET, USB TYPE A EXT. TYPE B INT.	PHOENIX CONTACT	/402.5
1XUSB	1652606	VS-08-SD-F	1	PROTECTIVE COVER FOR PANEL MOUNTING FRAME	PHOENIX CONTACT	/402.5
1XUSB	1654853	VS-04-2X2X26C7/7-SDA/SDB/1,0	1	PATCHCABLE CABLE USB, TYPE A TO TYPE B, 1m	PHOENIX CONTACT	/402.5
100F1	088706	P1-25/V/SVB-SW/N	1	P1-25/V/SVB-SW/N MAINSWITCH 25A 3-POLE + N 400Vac	EATON	+E11/9.5
970F2	3210185	PT 2,5-TG	1	DISCONNECT TERMINAL BLOCK PT 2,5-TG (COMPONENT)	PHOENIX CONTACT	+E11/301.1
970F2	0800886	E/NS 35 N	2	END CLAMP E/NS 35 N	PHOENIX CONTACT	+E11/301.1
970F2	3036819	P-FU 5X20 LED 24	1	FUSE PLUG P-FU 5X20 LED 24	PHOENIX CONTACT	+E11/301.1
970F2	3211003	D-PT 2,5-MT	1	END COVER DISCONNECT TERMINAL BLOCK D-PT 2,5-MT	PHOENIX CONTACT	+E11/301.1
970F2	D4514	5X20 2A/T	1	FUSE 5X20 2A/T	INELVÉ	+E11/301.1
970FA1	5SY6206-7	5SY6206-7	1	CIRCUIT BREAKER 400V 6KA, 2-POLE C, 6A	Siemens AG	+E11/100.6
970FM1	3RV2011-1AA10	3RV2011-1AA10	1	MOTOR PROTECTION SWITCH S00, 1,1...1,6A,SCREW	Siemens AG	+E11/100.3
970FM1	3RV2901-1E	3RV2901-1E	1	TRANSVERSE AUX. SWITCH, SCREW 3RV2, 1NO+1NC	Siemens AG	+E11/100.3
970H1	8WD4420-5AD	8WD4420-5AD	1	SIGNALLING COLUMN STEADY LIGHT LED YELLOW, 24V AC/DC	Siemens AG	+E11/302.2
970H2	8WD4420-5DB	8WD4420-5DB	1	SIGNALLING COLUMN ROTATING-BEACON RED 24 VAC/DC	Siemens AG	+E11/302.4
970H3	8WD4308-0DA	8WD4308-0DA	1	SIGNAL COLUMNS BASE WITH TUBE	Siemens AG	+E11/302.8
970H3	8WD4408-0AA	8WD4408-0AA	1	SIGNALLING COLUMN CONNECT ELEMENT SCREW WITH COVER, PIPE MOUNTING	Siemens AG	+E11/302.8
970H3	8WD4420-5AE	8WD4420-5AE	1	SIGNALLING COLUMN STEADY LIGHT LED TRANSP, 24V AC/DC	Siemens AG	+E11/302.8
970H4	8WD4420-0EA2	8WD4420-0EA2	1	SIGNALLING COLUMN BUZZER, SOUNDS SETTABLE 24VAC/DC	Siemens AG	+E11/302.7
970H5	ZB4BV033	ZB4BV033	1	GREEN PILOT LIGHT HEAD Ø22 PLAIN LENS FOR INTEGRAL LED	SCHNEIDER ELECTRIC	+E11/303.2
970H5	ZB4BVB3	ZB4BVB3	1	GREEN LIGHT BLOCK W. BODY/FIXTURE COLLAR INTEGRAL LED 24V	SCHNEIDER ELECTRIC	+E11/303.2

Parts list

Device tag	Order number	Type number	Quantity	Designation	Supplier	Page
970H6	ZB4BV043	ZB4BV043	1	RED PILOT LIGHT HEAD Ø22 PLAIN LENS FOR INTEGRAL LED	SCHNEIDER ELECTRIC	+E11/303.2
970H6	ZB4BVB4	ZB4BVB4	1	RED LIGHT BLOCK WITH BODY/FIXTURE COLLAR INTEGRAL LED 24V	SCHNEIDER ELECTRIC	+E11/303.2
970KA1	2903334	RIF-1-RPT-LDP-24DC/2X21	1	RIF 1 RELAY+SOCKET 24Vdc 2xCHANGE OVER PUSH-IN	PHOENIX CONTACT	+E11/301.8
970KA2	2903334	RIF-1-RPT-LDP-24DC/2X21	1	RIF 1 RELAY+SOCKET 24Vdc 2xCHANGE OVER PUSH-IN	PHOENIX CONTACT	+E11/301.8
970KA3	2903308	RIF-2-RPT-LDP-24DC/4X21	1	RIF 2 RELAY+SOCKET 24Vdc 4xCHANGE OVER PUSH-IN	PHOENIX CONTACT	+E11/302.1
970KA4	2903308	RIF-2-RPT-LDP-24DC/4X21	1	RIF 2 RELAY+SOCKET 24Vdc 4xCHANGE OVER PUSH-IN	PHOENIX CONTACT	+E11/302.3
970KA4A	2903334	RIF-1-RPT-LDP-24DC/2X21	1	RIF 1 RELAY+SOCKET 24Vdc 2xCHANGE OVER PUSH-IN	PHOENIX CONTACT	+E11/302.4
970KA5	2903308	RIF-2-RPT-LDP-24DC/4X21	1	RIF 2 RELAY+SOCKET 24Vdc 4xCHANGE OVER PUSH-IN	PHOENIX CONTACT	+E11/302.5
970KA6	2903334	RIF-1-RPT-LDP-24DC/2X21	1	RIF 1 RELAY+SOCKET 24Vdc 2xCHANGE OVER PUSH-IN	PHOENIX CONTACT	+E11/303.1
970KM1	3RT2015-1BB41	3RT2015-1BB41	1	CONTACTOR 3KW AC-3 3P S00 24VDC 1NO SCREW	Siemens AG	+E11/303.3
970KT1	3RP1513-1AP30	3RP1513-1AP30	1	TIME RELAY 5S-100S 24VAC/DC ON-DELAY 1CO	Siemens AG	+E11/302.0
970P1	ZB4BA2	ZB4BA2	1	PUSHBUTTON HEAD BLACK Ø22		+E11/302.2
970P1	ZB4BZ102	ZB4BZ102	1	BODY WITH 1NC CONTACT	SCHNEIDER ELECTRIC	+E11/302.2
970P2	ZB4BA2	ZB4BA2	1	PUSHBUTTON HEAD BLACK Ø22		+E11/302.6
970P2	ZB4BZ101	ZB4BZ101	1	BODY WITH 1NO CONTACT	SCHNEIDER ELECTRIC	+E11/302.6
100Q1	088706	P1-25/V/SVB-SW/N	1	P1-25/V/SVB-SW/N MAINSWITCH 25A 3-POLE + N 400Vac	EATON	+E11/100.0
100Q1	022298	ZVV-TO	3	INTERLOCK EXTENSION FOR P1 SW.DISCONN.	EATON	+E11/100.0
100Q1	027044	ZAV-TO	3	SHAFT EXTENSION FOR P1 SW.DISCONN.	EATON	+E11/100.0
100Q1	D0273	SUPPORT MAINSWITCH D0273	1	BRACKET FOR COMPENSATING MAINSWITCH HEIGHT	INELVÉ	+E11/100.0
970S1	ZB4BS844	ZB4BS844	1	RED Ø40 EMERGENCY STOP, Ø22 MOUNT	SCHNEIDER ELECTRIC	+E11/301.5
970S1	ZB4BZ102	ZB4BZ102	1	BODY WITH 1NC CONTACT	SCHNEIDER ELECTRIC	+E11/301.5
970S1	ZBY9320		1	marked legend Ø60 for emergency stop - EMERGENCY STOP	SCHNEIDER ELECTRIC	+E11/301.5
970S4	ZB4BD2	ZB4BD2	1	SELECTOR SWITCH HEAD Ø22 90° 0-1 STAY PUT	SCHNEIDER ELECTRIC	+E11/303.5

Parts list

Device tag	Order number	Type number	Quantity	Designation	Supplier	Page
970S4	ZB4BZ101	ZB4BZ101	1	BODY WITH 1NO CONTACT	SCHNEIDER ELECTRIC	+E11/303.5
9SCH114	MAS0605030R5	MAS0605030R5	1	Wall mounted, 600x500x300	ELDON	+E11/9.0
9SCH114	2822484	AW41	4	WALL MOUNTING BRACKETS MAS/MAD		+E11/9.0
9SCH114	CABLE GLAND 20 MM CLICK	CABLE GLAND 20 MM CLICK	1	CABLE GLAND 20 MM CLICK	INELVÉ	+E11/9.0
9SCH114	Lapp 53112686	CABLE GLAND 16 MM CLICK	9	CABLE GLAND 16 MM CLICK	INELVÉ	+E11/9.0
9SCH114	54113010	54113010	2	SKINTOP DV-M 10x8mm BLINDPLUG M16 FOR INSERT CABLEGLAND	LAPP	+E11/9.0
970T1	WDR-120-24	WDR-120-24-5A	1	PSU 180...550Vac-254...780Vdc/24Vdc-5A	MEANWELL	+E11/100.6

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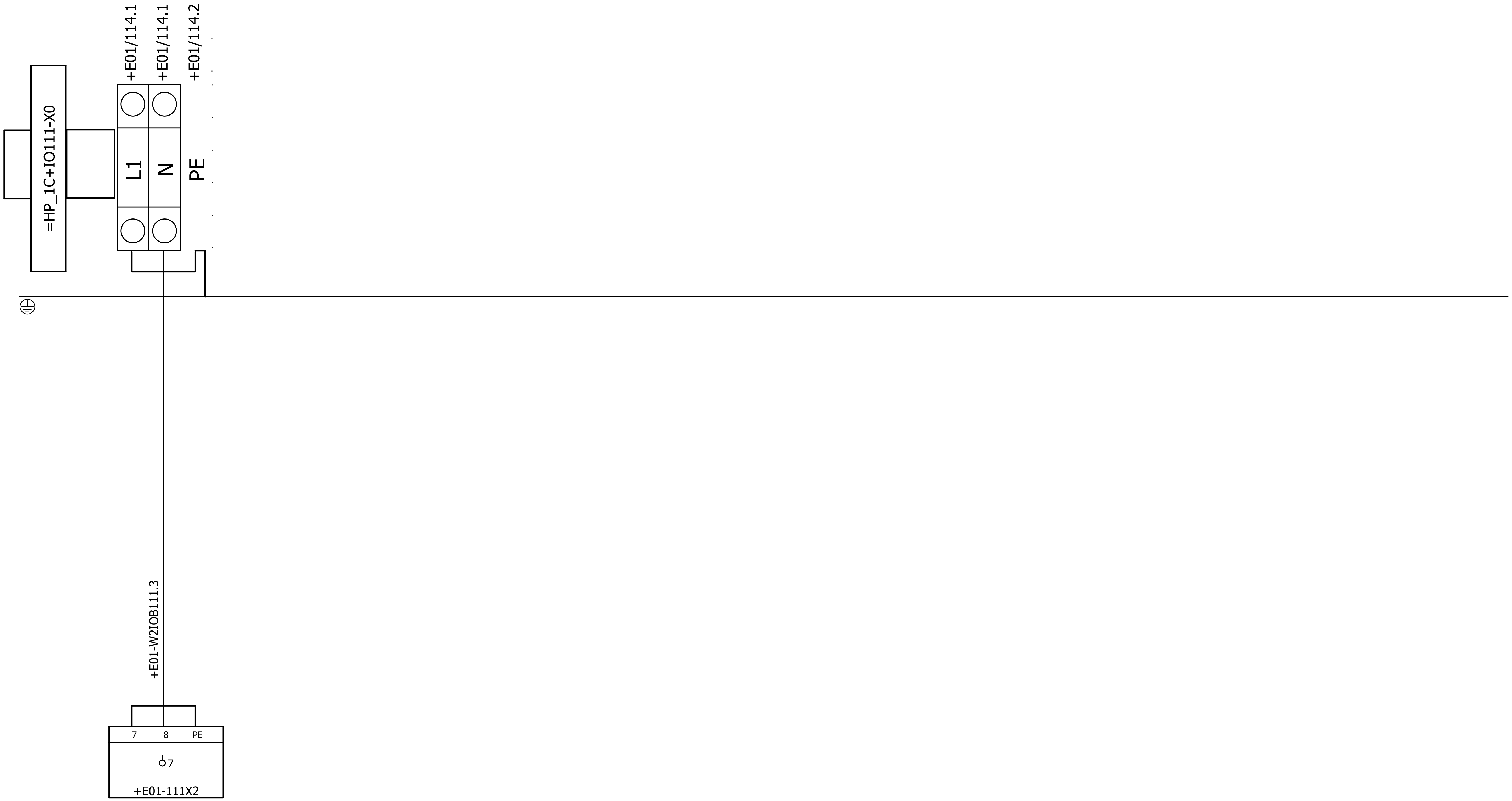
+IO111/601 ▶



POWER SUPPLY

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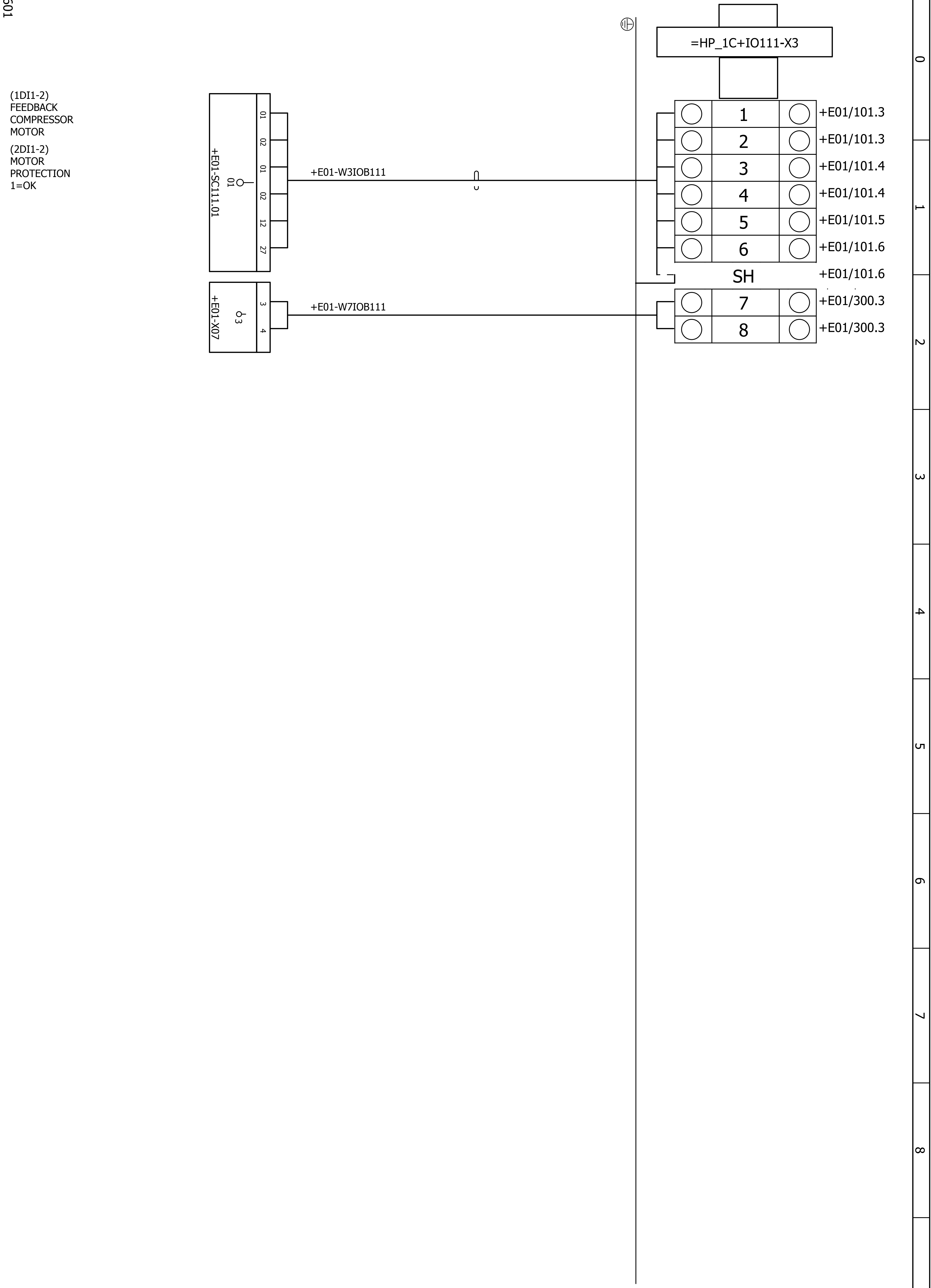
602 ▶

AS BUILT	EK	17/11/17	8	Drawn by:	LowUp (ESP)	GEA	Location: IO111	Drawingnumber (group): HP_1C
Revision description	Name	Date	Rev.					
Location:	Name	EK		Description	=HP_1C+IO111-X0		Ordernumber: 62049-001	Page: 601
	Last change.	30-Nov-17						



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603▶

AS BUILT | EK | 17/11/17 | 8

Revision description | Name | Date | Rev.

Location: | Name | EK | Last change. 30-Nov-17

Drawn by: LowUp (ESP)

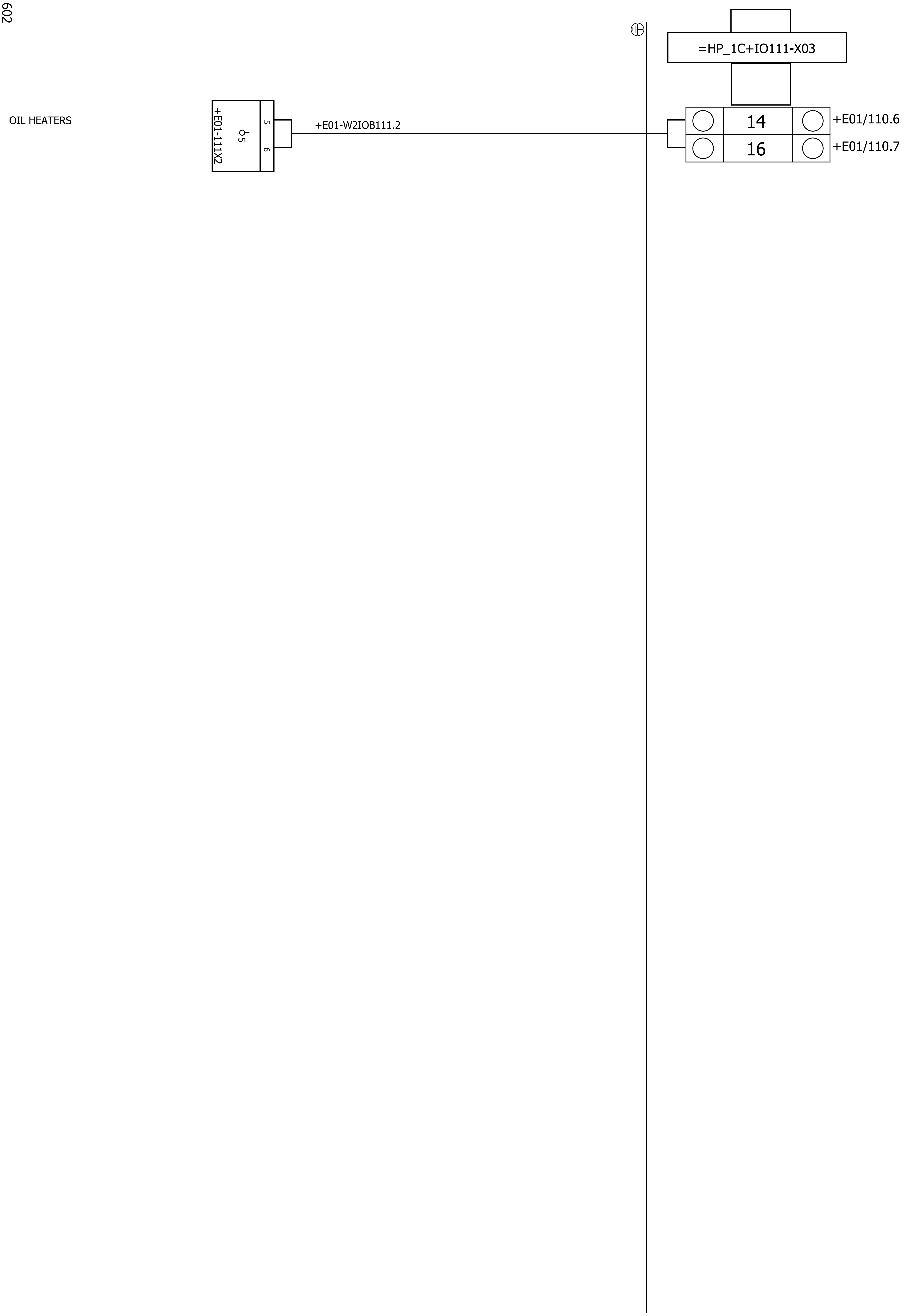
Description =HP_1C+IO111-X3

Location: IO111

Ordernumber: 62049-001

Drawingnumber (group): HP_1C

Page: 602



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+E11/1►

AS BUILT
Revision description
Location:

EK	17/11/17	8	Drawn by: LowUp (ESP)
Name	Date	Rev.	
Name	EK		Description =HP_1C+IO111-X03
Last change.	30-Nov-17		

Location: IO111
Ordernumber: 62049-001
Drawingnumber (group): HP_1C
Page: 603

0	1	2	3	4	5	6	7	8	9

engineering for
a better world

PTC REFRIGERATION PROCESSES

ELECTRICAL DRAWINGS

62049-001

MADE FOR:

LowUp (ESP)

ADDITIONAL INFORMATION:

NH3 Leak Detection

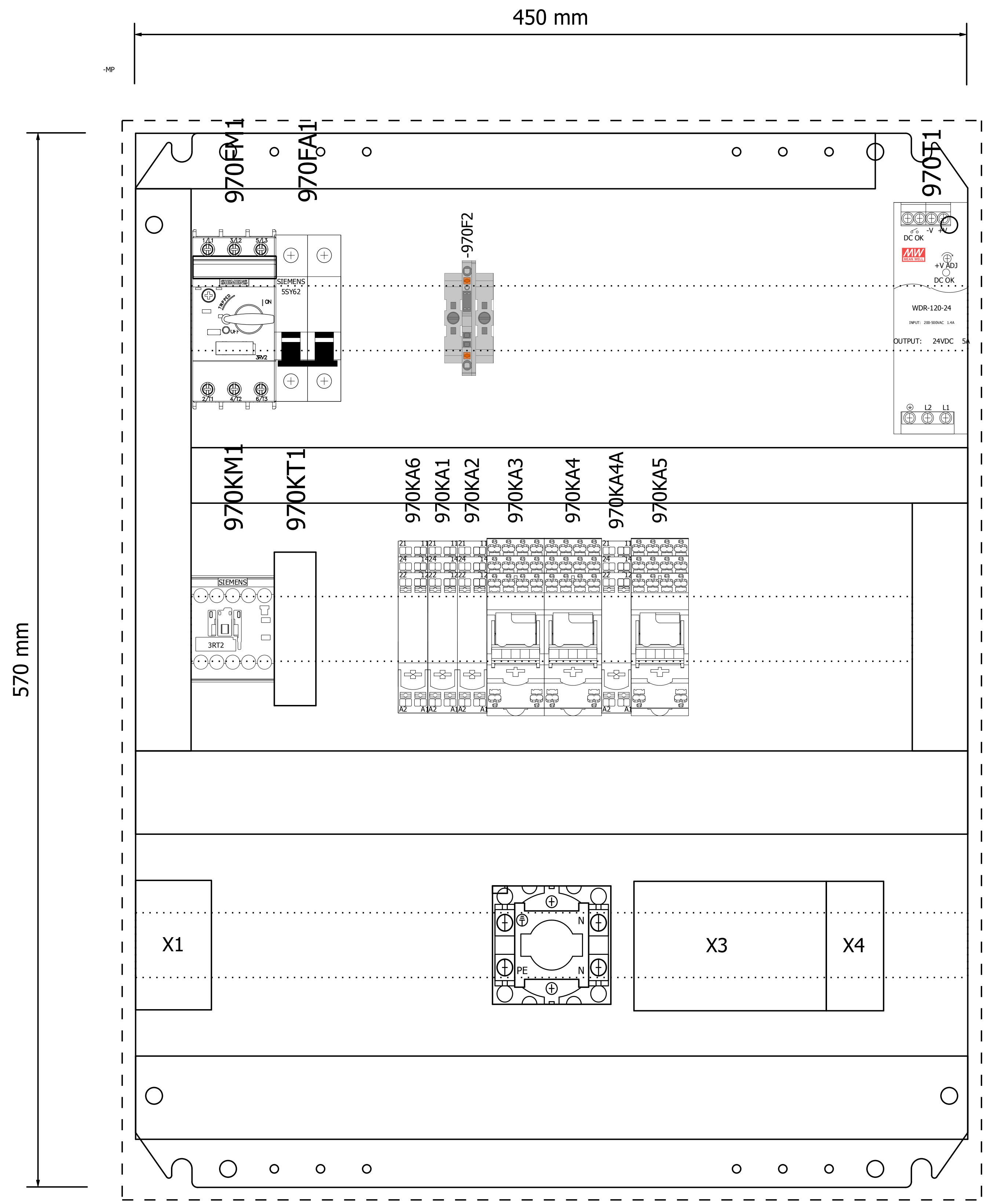
GEA Refrigeration Netherlands N.V.
European Skid Center

AS BUILT	
Signature:	Date

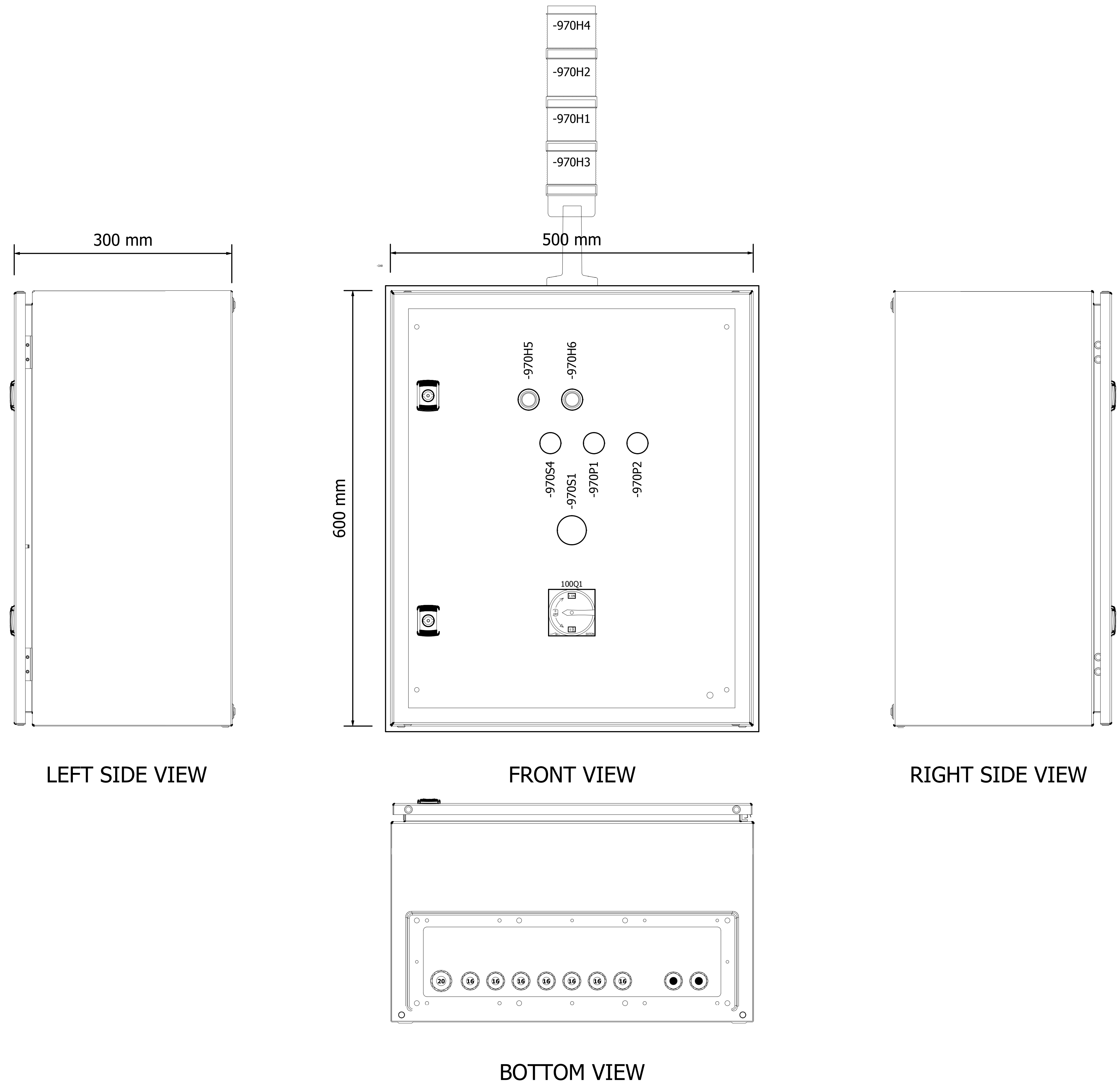
◀ +IO111/603

9 ▶

AS BUILT	EK	17/11/17	8	Drawn by:	LowUp (ESP)	Location: E11	Drawingnumber (group): HP_1C
Revision description	Name	Date	Rev.				
Location:	Name	EK		Description	FRONT PAGE	Ordernumber: 62049-001	Page: 1
	Last change.	30-Nov-17					

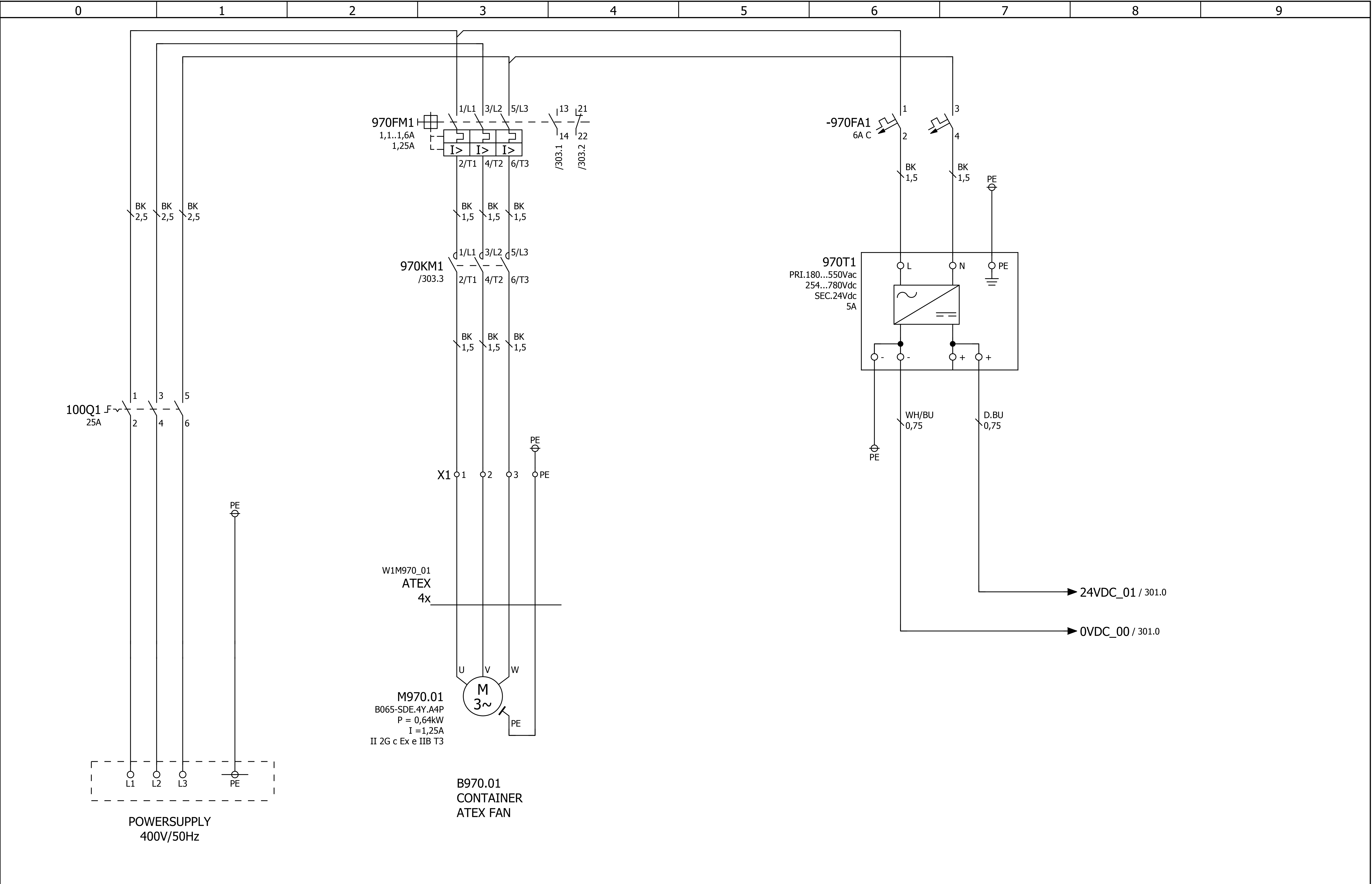


AS BUILT	EK	17/11/17	8	Drawn by:	LowUp (ESP)	GEA	Location: E11	Drawingnumber (group): HP_1C
Revision description	Name	Date	Rev.					
Location: TS8284.600	Name	EK		Description	PANEL VIEW		Ordernumber: 62049-001	Page: 9
	Last change.	30-Nov-17						



◀9 100▶

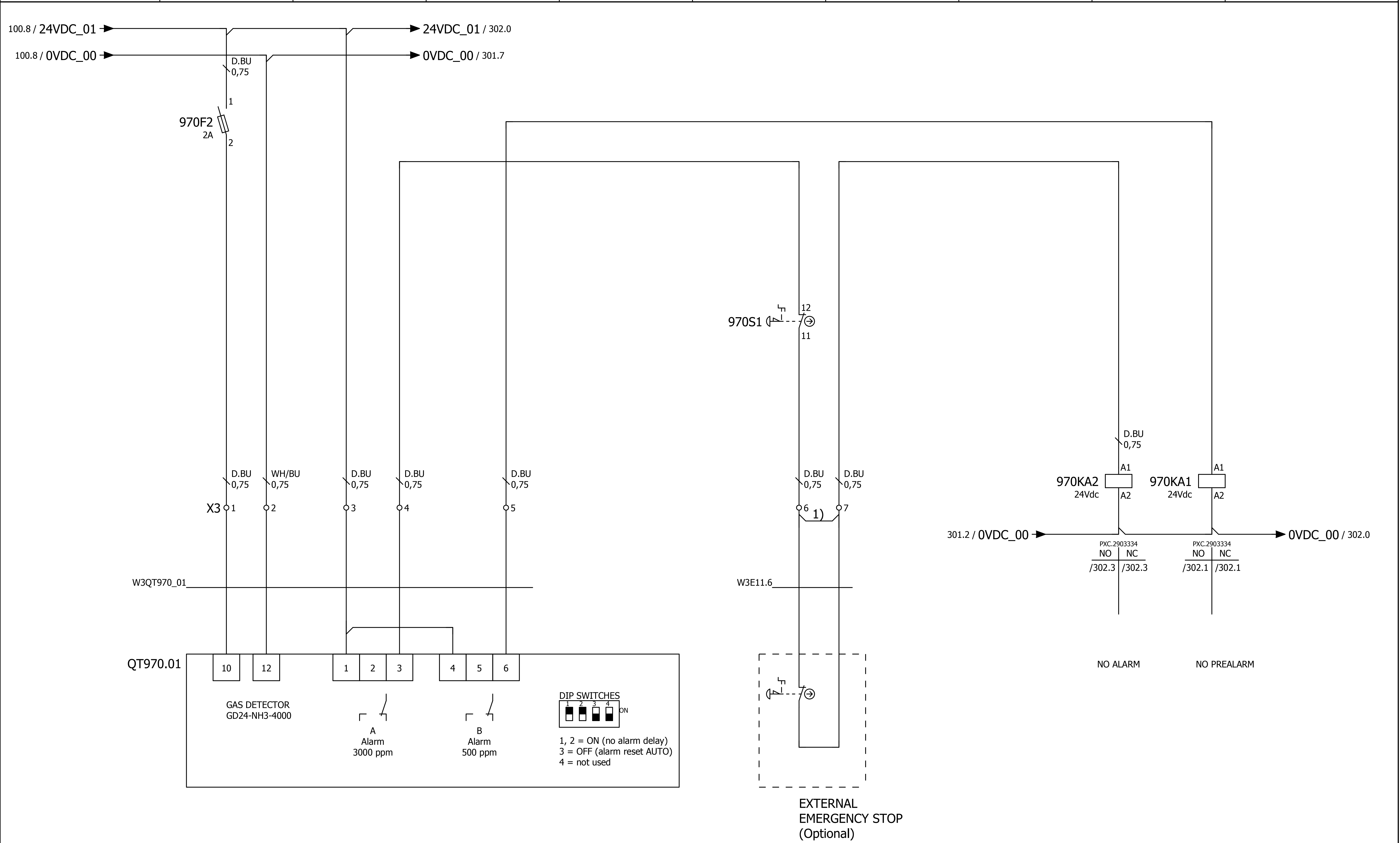
AS BUILT	EK	17/11/17	8	Drawn by: LowUp (ESP)	Location: E11	Drawingnumber (group): HP_1C
Revision description	Name	Date	Rev.			
Location: TS8284.600	Name	EK		Description DOOR VIEW	Ordernumber: 62049-001	Page: 9.1
	Last change.	30-Nov-17				



◀9.1

301▶

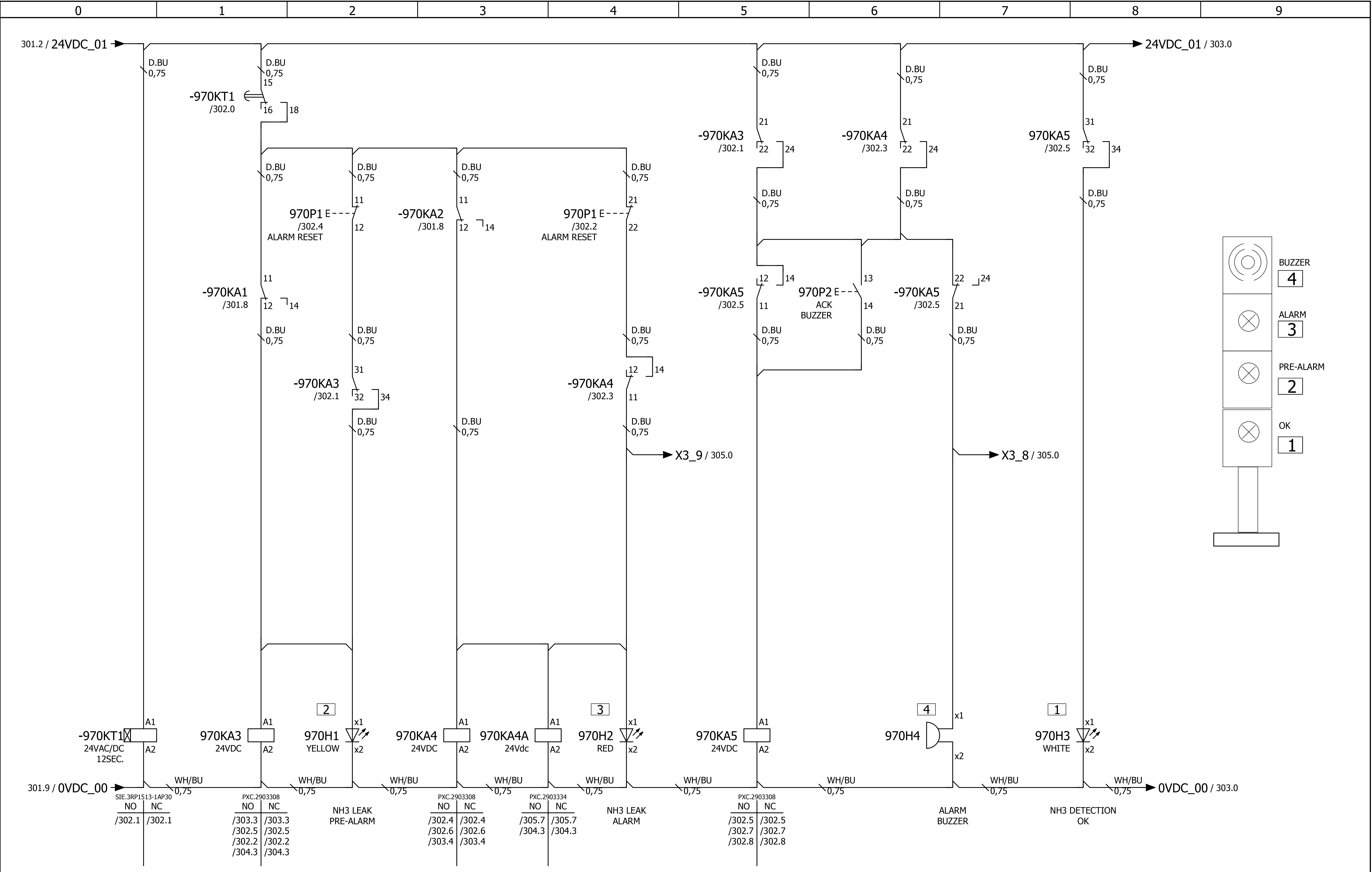
AS BUILT	EK	17/11/17	8	Customer: LowUp (ESP)		Location: E11	Drawingnumber (group): HP_1C
Revision description	Name	Date	Rev.				
Location:	Name	EK		Description: MC ATEX FAN		Ordernumber: 62049-001	Page: 100
	Last change.	30-Nov-17					



1) Disconnect if required

◀100 302▶

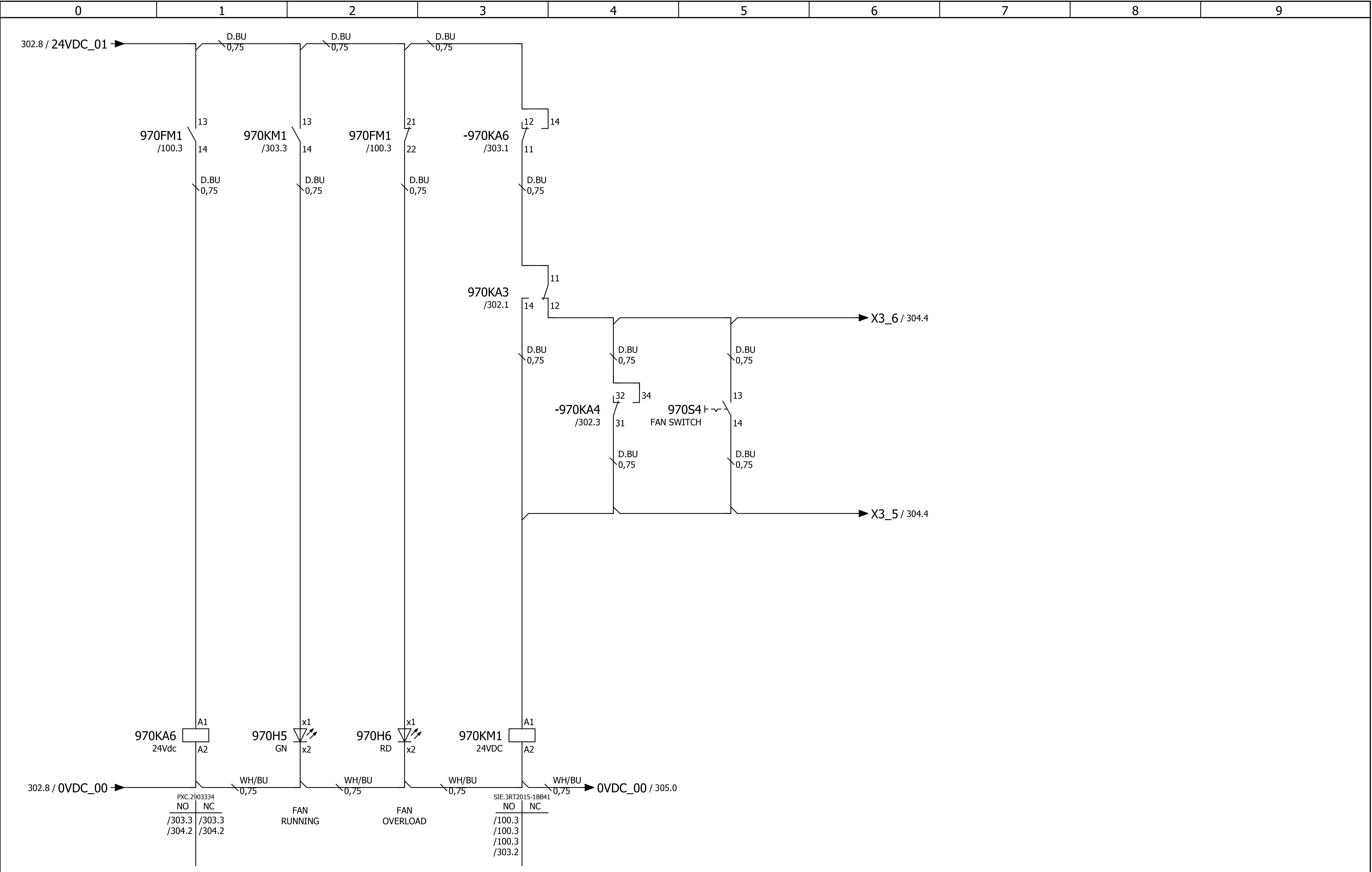
AS BUILT	EK	17/11/17	8	Customer: LowUp (ESP)	GEA	Location: E11	Drawingnumber (group): HP_1C
Revision description	Name	Date	Rev.				
Location:	Name	EK		Description: CC NH3 DETECTOR		Ordernumber: 62049-001	Page: 301
	Last change.	30-Nov-17					



◀301

303▶

AS BUILT	EK	17/11/17	8	Customer:	LowUp (ESP)	Location: E11	Drawingnumber (group): HP_1C
Revision description	Name	Date	Rev.				
Location:	Name	EK		Description	CC NH3 ALARMS	Ordernumber: 62049-001	Page: 302
	Last change.	30-Nov-17					



◀302

304▶

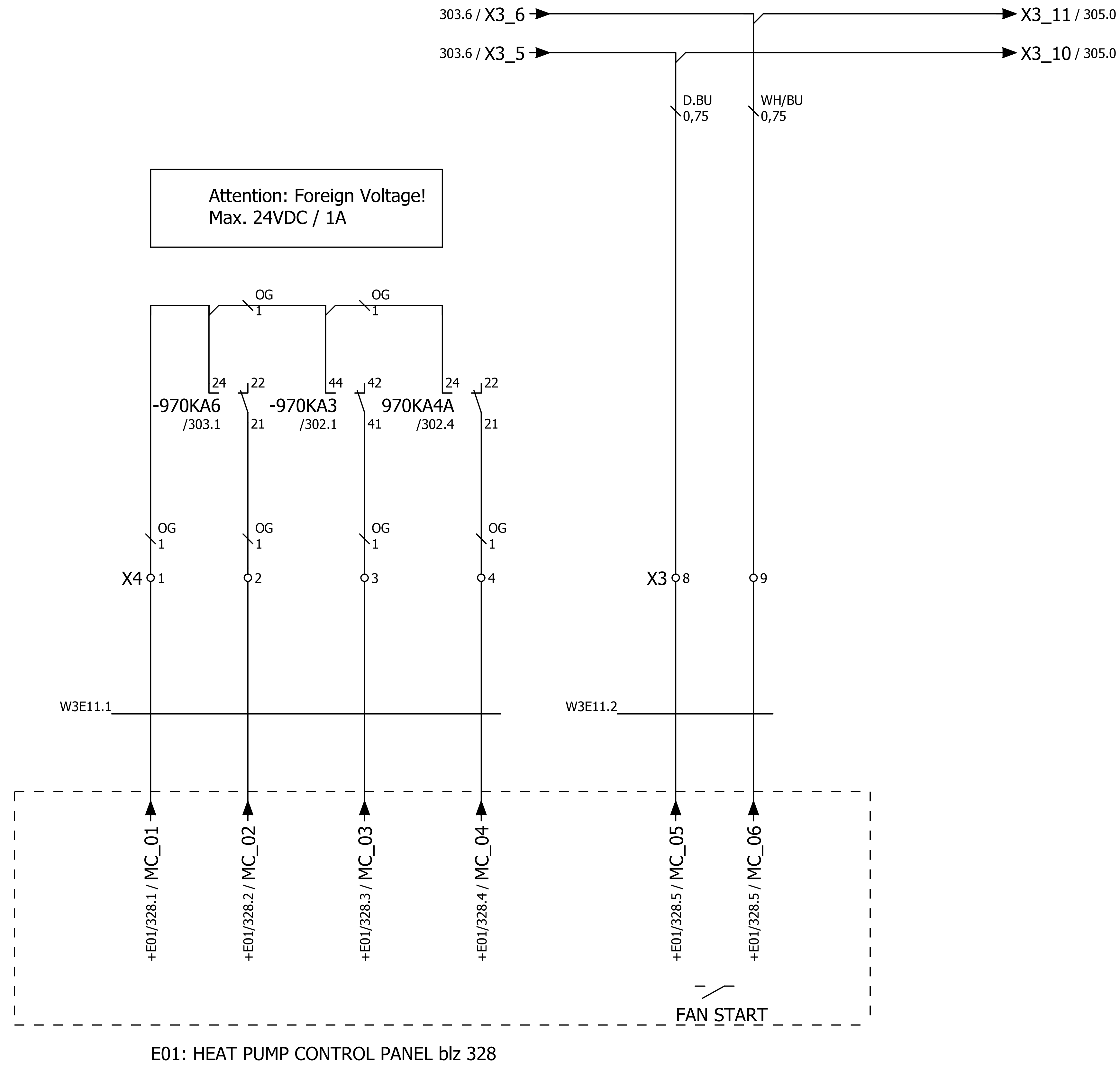
AS BUILT	EK	17/11/17	8	Customer:	LowUp (ESP)
Revision description	Name	Date	Rev.		
Location:	Name	EK		Description	CC EXTRACTOR
	Last change.	30-Nov-17			

Location: E11

Ordernumber: 62049-001

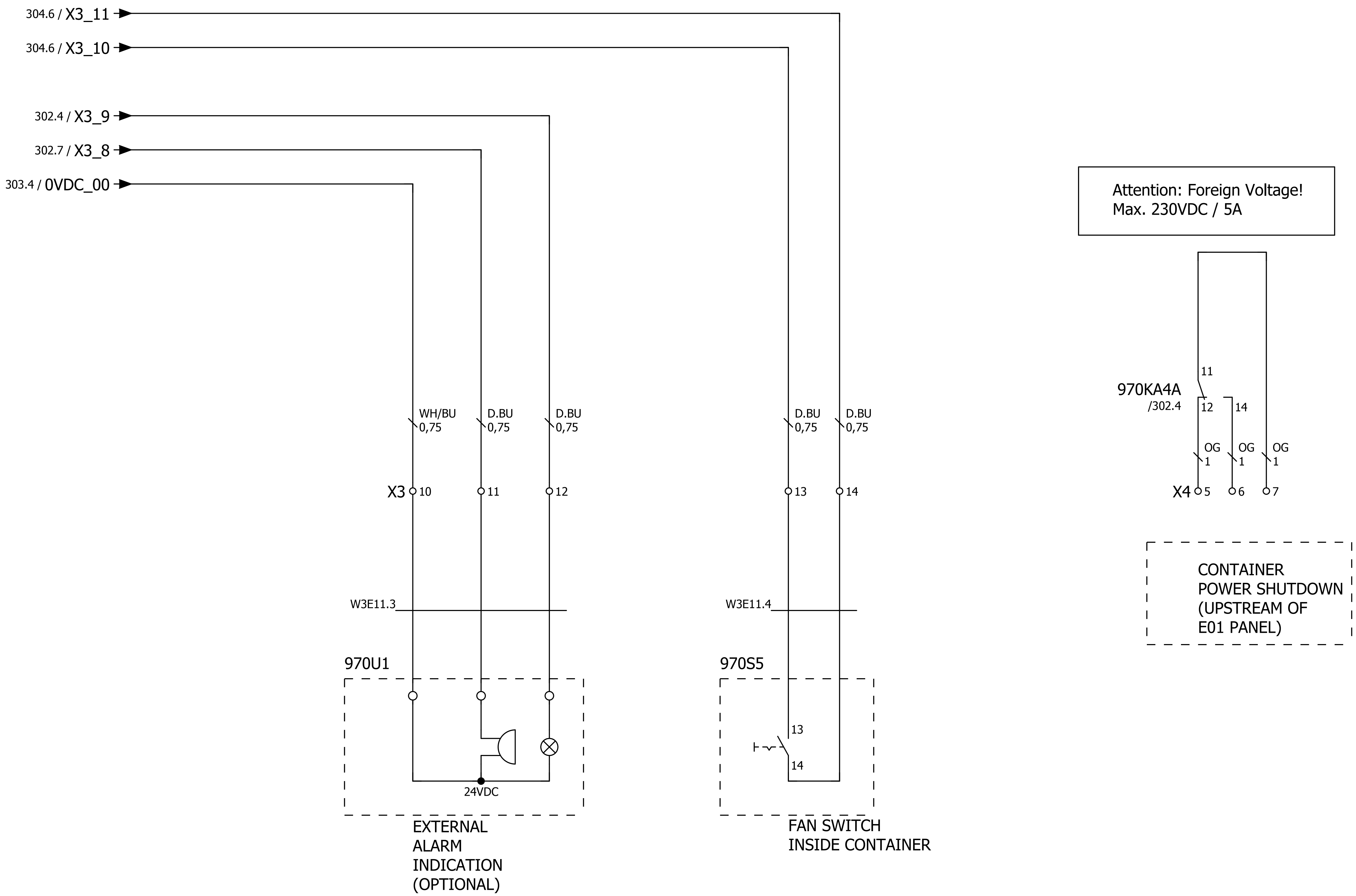
Drawingnumber (group): HP_1C

Page: 303



◀303 305▶

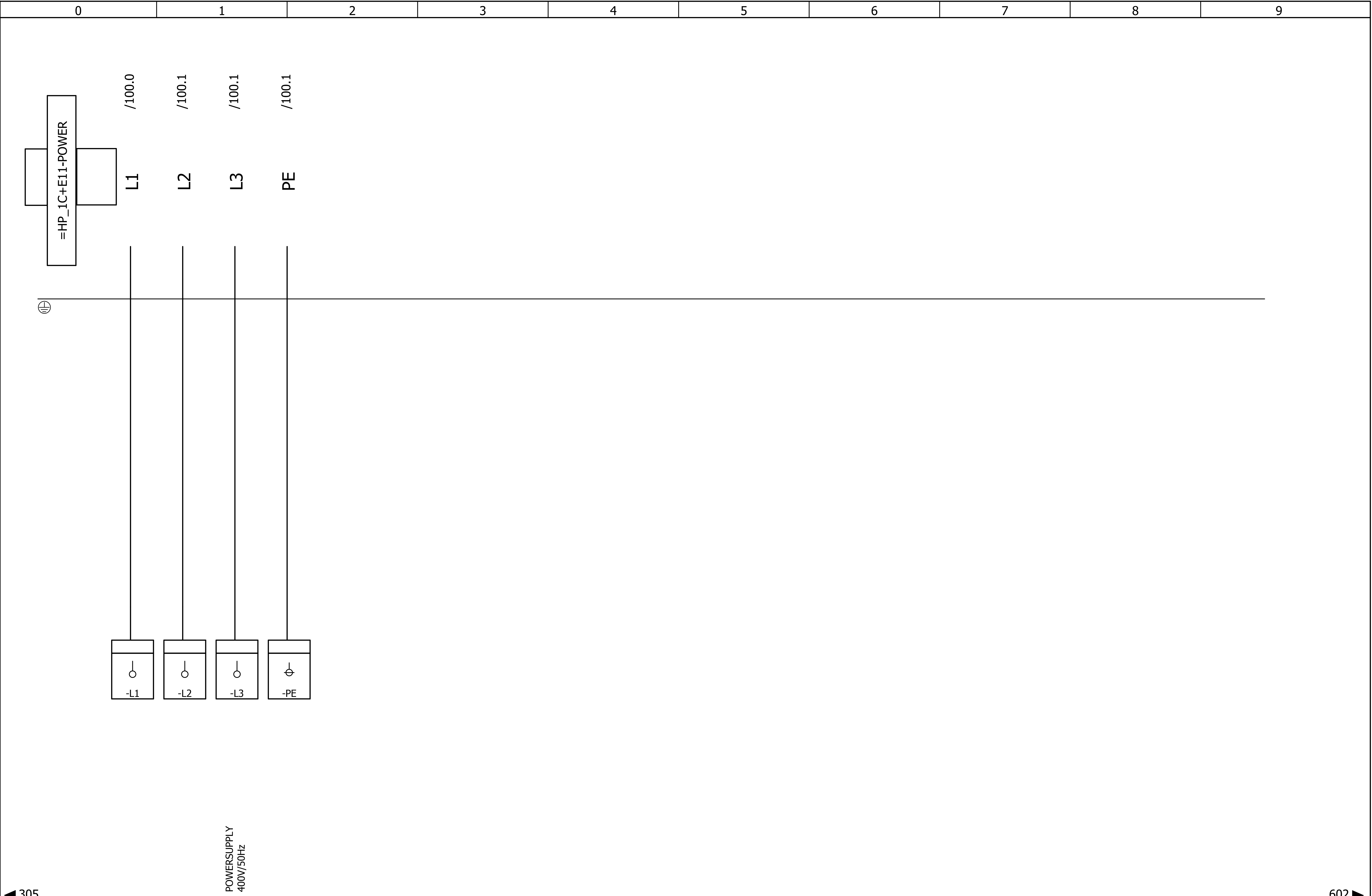
AS BUILT	EK	17/11/17	8	Customer:	LowUp (ESP)	GEA	Location: E11	Drawingnumber (group): HP_1C
Revision description	Name	Date	Rev.					
Location:	Name	EK		Description	MAIN CONTROL INTERFACE		Ordernumber: 62049-001	Page: 304
	Last change.	30-Nov-17						



◀304

601▶

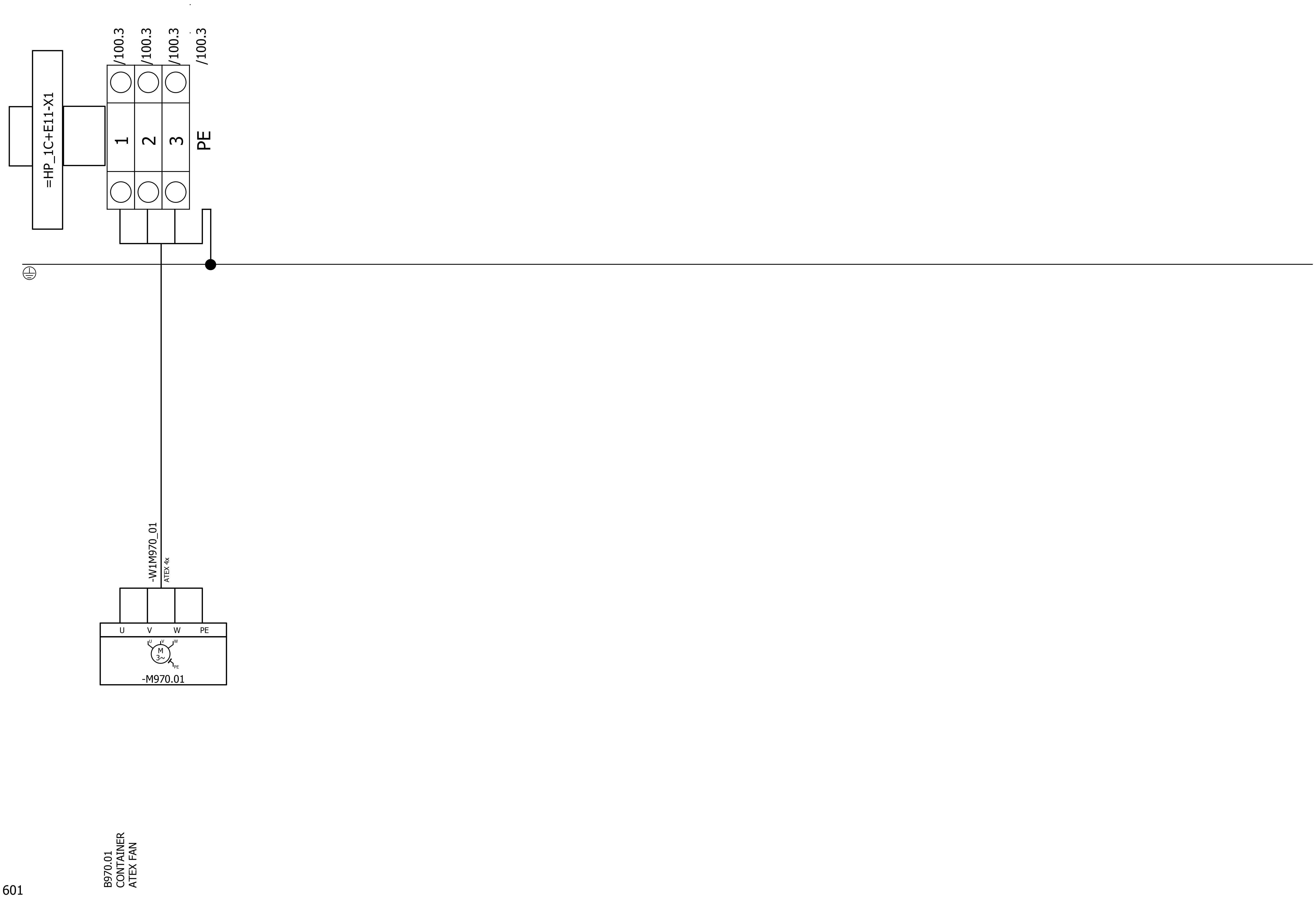
AS BUILT	EK	17/11/17	8	Customer:	LowUp (ESP)	Location: E11	Drawingnumber (group): HP_1C
Revision description	Name	Date	Rev.				
Location:	Name	EK		Description	AUX INTERFACE	Ordernumber: 62049-001	Page: 305
	Last change.	30-Nov-17					



◀305

602▶

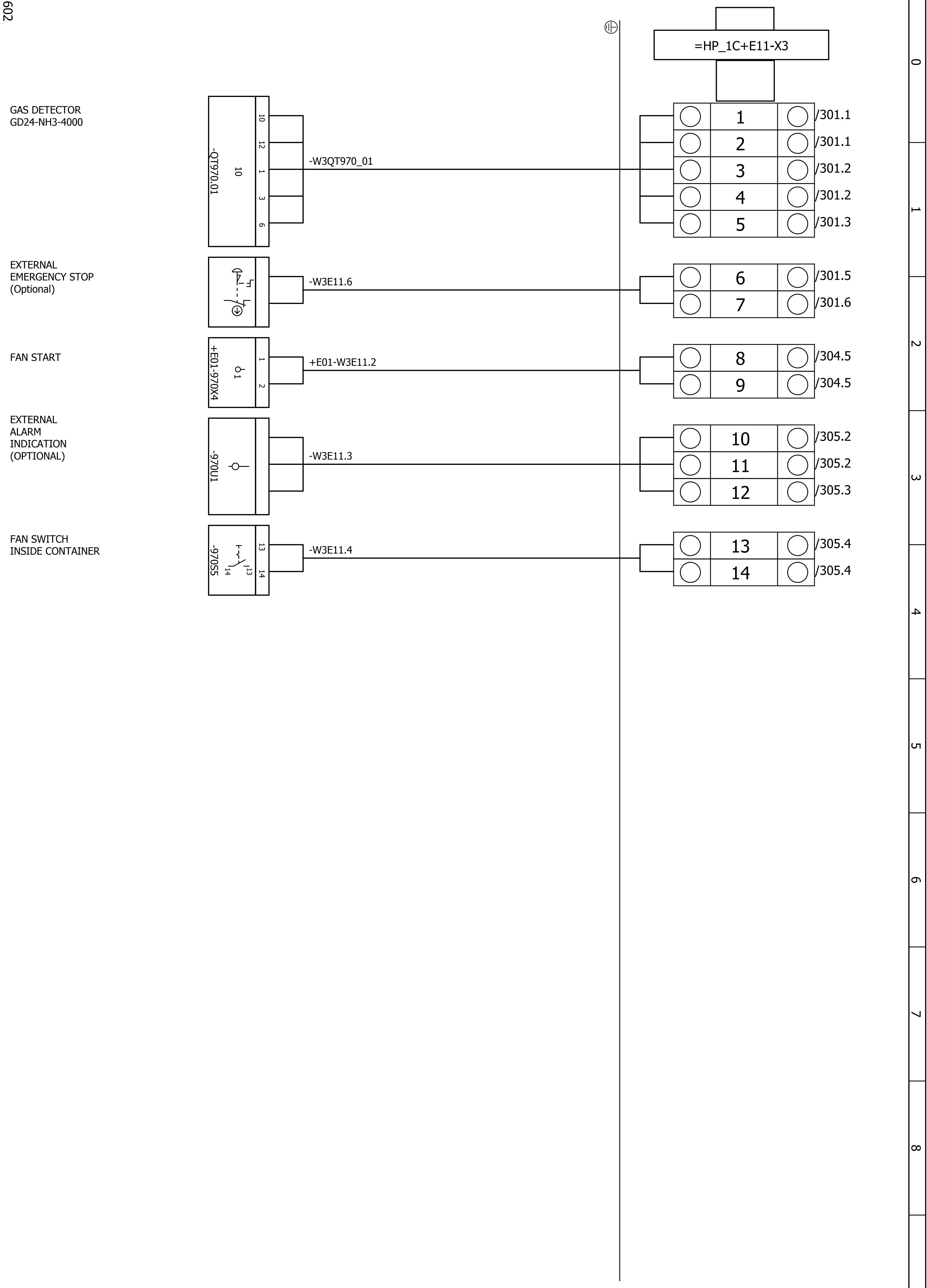
AS BUILT	EK	17/11/17	8	Drawn by: LowUp (ESP)	Location: E11	Drawingnumber (group): HP_1C
Revision description	Name	Date	Rev.			
Location:	Name	EK		Description =HP_1C+E11-POWER	Ordernumber: 62049-001	Page: 601
	Last change.	30-Nov-17				



◀601

603▶

AS BUILT	EK	17/11/17	8	Drawn by: LowUp (ESP)	GEA	Location: E11	Drawingnumber (group): HP_1C
Revision description	Name	Date	Rev.				
Location:	Name	EK		Description =HP_1C+E11-X1		Ordernumber: 62049-001	Page: 602
	Last change.	30-Nov-17					



◄602

604►

AS BUILT

Revision description

Location:

Name	Date	Rev.
EK	17/11/17	8

Name: EK

Last change. 30-Nov-17

Drawn by: LowUp (ESP)

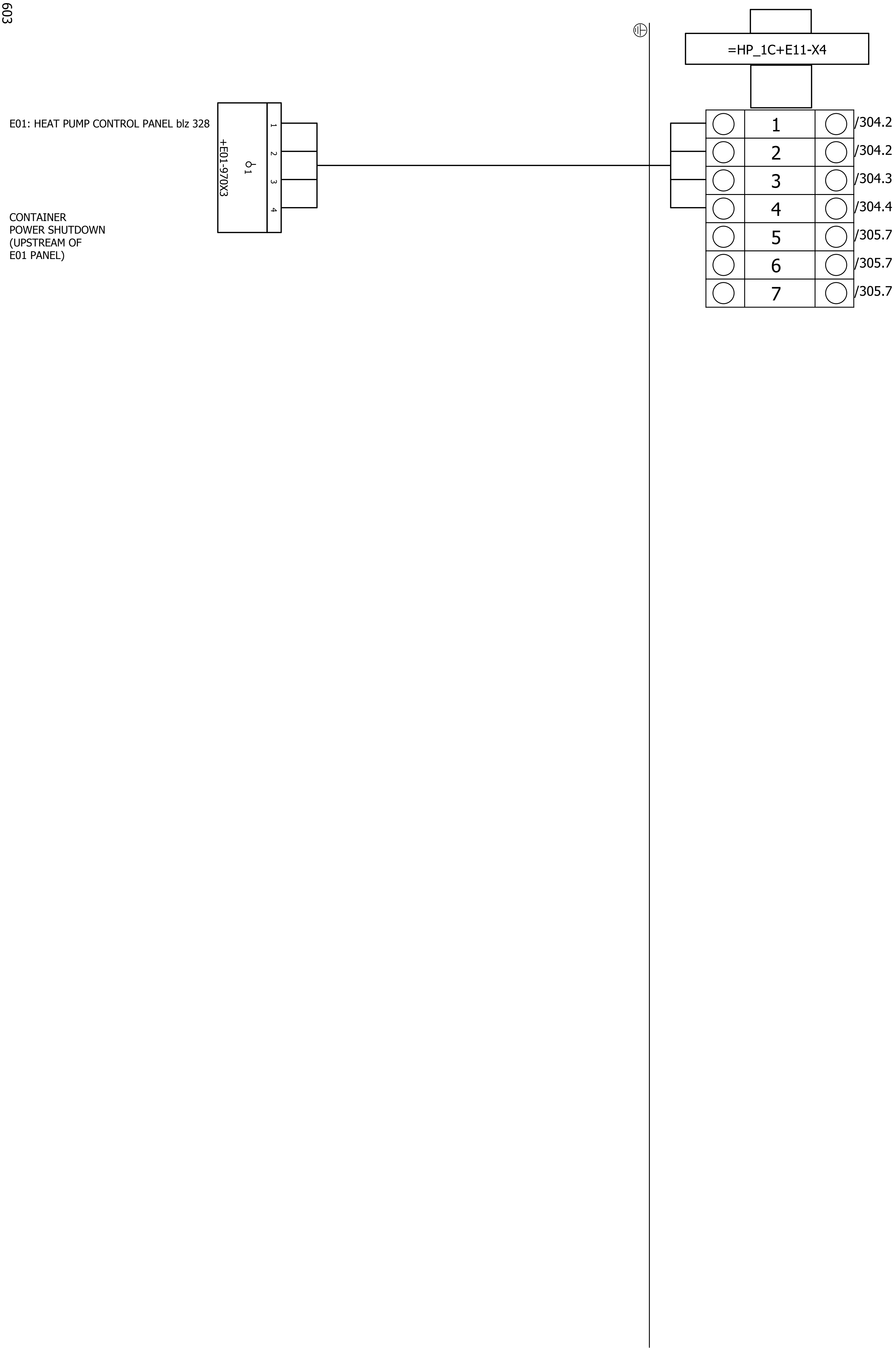
Description: =HP_1C+E11-X3

Location: E11

Ordernumber: 62049-001

Drawingnumber (group): HP_1C

Page: 603



◄603

AS BUILT	EK	17/11/17	8
Revision description	Name	Date	Rev.
Location:	Name	EK	
	Last change.	30-Nov-17	

Drawn by: LowUp (ESP)

Description =HP_1C+E11-X4

Location: E11

Ordernumber: 62049-001

Drawingnumber (group): HP_1C

Page: 604

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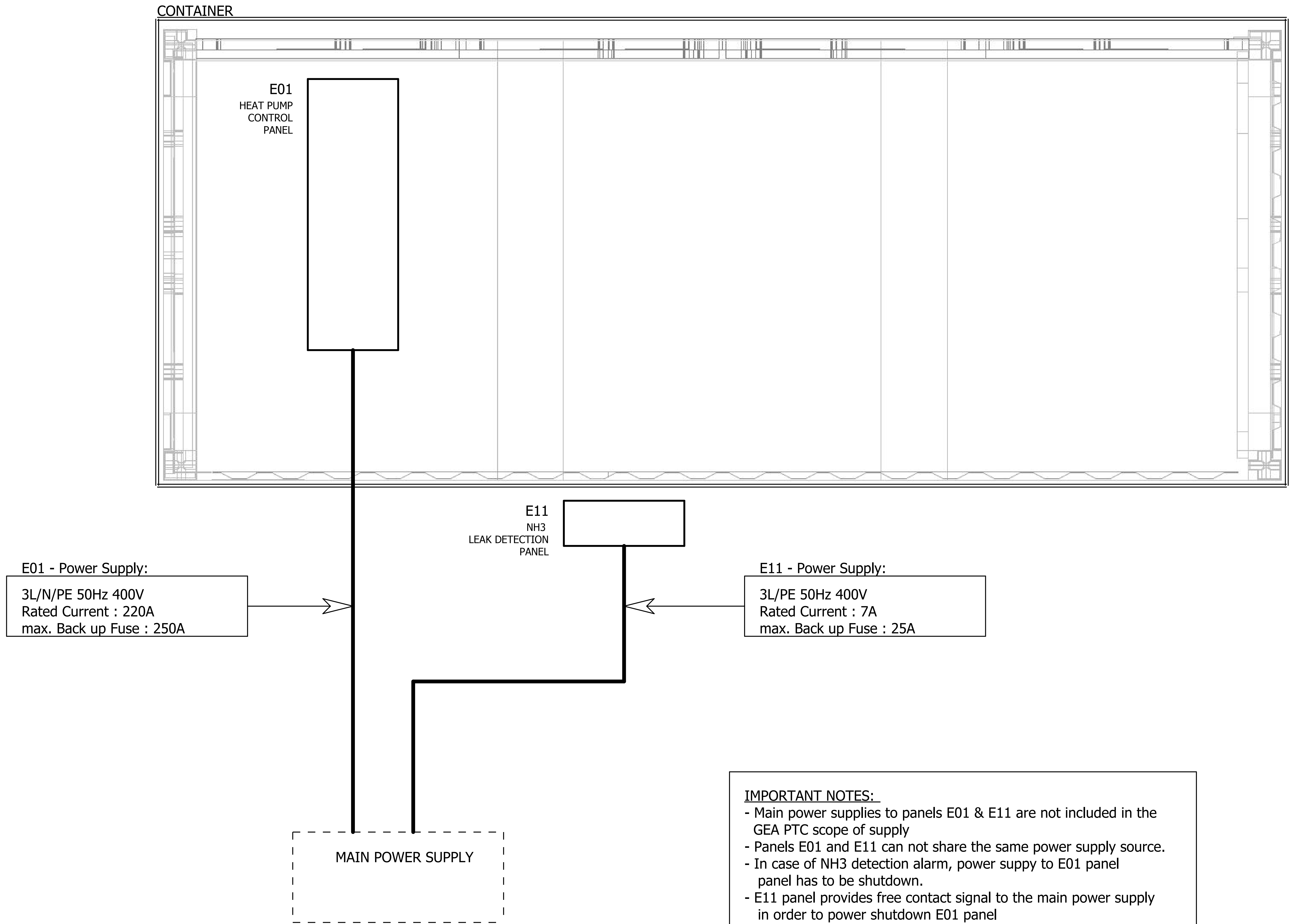

IMPORTANT NOTES:
- Main power supplies to panels E01 & E11 are not included in the GEA PTC scope of supply
- Panels E01 and E11 can not share the same power supply source.
- In case of NH3 detection alarm, power suppy to E01 panel panel has to be shutdown.
- E11 panel provides free contact signal to the main power supply in order to power shutdown E01 panel

◀ +E01/1 ▶

RFC	LVA	30/09/16	5	Customer:	LowUp (ESP)	Location: MCC	Drawingnumber (group): HP_1C
Revision description	Name	Date	Rev.				
Location:	Name	LVA		Description	CONTAINER - POWER SUPPLIES	Ordernumber: 62049-001	Page: 10
	Last change.	14-Nov-17					

62049-001-1-01

Installation and Operation Manual

LowUP
(Containerized) Water-Water Heat Pump

Object	Containerized Heat Pump
Project no.	62049-001-1-01
Date	October 2017
Version	v1.0
Made by	P. Hendriks

LEGAL NOTICE
This publication has been written in good faith. However, **GEA** cannot be held responsible, neither for any errors occurring in this publication nor for their consequences.

SYMBOLS USED

Danger

Stands for an immediate danger which leads to heavy physical injuries or to the death.

Warning

Stands for a possibly dangerous situation which leads to heavy physical injuries or to the death.

Caution!

Stands for a possibly dangerous situation which could lead to light physical injuries or to damages to property.

Hint!

Stands for an important tip whose attention is important for the designated use and function of the device.

SAFETY INSTRUCTIONS

Hint!

This manual must be carefully read and understood prior to installing and servicing the (containerized) heat pump (package).

Safety

This manual is written with great care, but the contractor/installer is held responsible to examine this information and to take care of possible additional and/ or deviated safety measures.

Safety instructions

It is the task of the contractor/installer to inform and explain to his client the operation of the (containerized) heat pump. Do respect all federal, state or local safety regulations/legislations during installing, connecting and operating this heat pump compressor (package).

Construction changes

Warning

In compliance with the regulations of the Pressure Equipment Directive it is mandatory that no changes be made to the construction of pressurized parts.

Commissioning, service and maintenance

Danger

Any handling on a refrigeration or heat pump plant should be done accordance with the plant manual by qualified refrigeration engineers with the correct personal safety equipment

Installer oriented information

The heat pump (package) is filled with nitrogen to prevent penetration of moisture. Therefore, keep the compressor closed until the heat pump (package) is being installed.

Table of Contents

1 BASICS

1.1 Importance of the documentation

This operating manual is part of the technical documentation. It contains advice for operating the (containerized) heat pump safely, properly and economically. The observance of the operating manual helps in avoiding dangers, reducing repair costs and downtimes, and increasing the reliability and durability of the heat pump.

This operating manual is directed at the users of the (containerized) heat pump and is specifically intended for the operating company and its operating and maintenance personnel. This operating manual must be read prior to transport, installation, commissioning, maintenance, repair, disassembly/disposal. It is imperative to strictly observe the instructions and information given!

All work explained in this operating manual must only be carried out by technical personnel.

This operating manual must be supplemented with instructions based on prevailing national regulations regarding industrial safety, health protection and environmental protection.

In addition to this operating manual and the mandatory accident prevention regulations applicable for the respective place of installation, the accepted technical regulations for safe work according to good professional practices must also be observed.

The operating manual is part of the total product. The entire documentation, consisting of this operating manual as well as all supplied additional instruction, must always be kept easily accessible at the place of installation of the (containerized) heat pump. The complete set of documentation must also accompany the heat pump if it is sold.

1.2 Requirements for personnel, obligation to exercise due care

Qualification
All work explained in this manual (assembly, electrical connection, commissioning, operation, etc.) may only be carried out by trained technical personnel who observe the relevant technical regulations.

Technical personnel are representatives of the unit manufacturer and persons who, as a result of their technical training, experience and personal instruction in training measures, have sufficient knowledge of:

- applicable international and national standards,
- applicable occupational safety regulations,
- applicable accident prevention regulations,
- applicable environmental protection regulations,
- the construction and functioning of the unit,
- recognized technical regulations for safe work according to good professional practice.

The technical personnel must:
- be able to assess the work assigned to them, recognize and avoid possible dangers,
- be authorized by those responsible for the safety of the system to carry out the requisite work and activities.

⚠ **Caution!**

No arbitrary changes may be made to the control or other components belonging to the unit. Maintenance work may only be done by authorized service staff.

Special requirements for the electrical technicians
Work on electrical components and modules may only be carried out by an **electrical technician** according to the rules relevant to electrical engineering. Furthermore the operator has to take care that the electrical systems, tools and fixtures are operated according to the rules relevant to electrical engineering and applicable standards and serviced properly.
- In principle it is prohibited to carry out work on parts under voltage.

- Fuses may only be replaced and not repaired or bypassed.
- Only the fuses specified in the electrical circuit diagram may be used.
- A two-pole voltage tester must be used to ensure that the parts are de-energized.
- The power supply as well as the unit casing must be sufficiently grounded and tagged with a suitable label.
- Deficiencies noticed in the electrical systems/modules/tools and fixtures must be corrected immediately. If an acute danger exists before then, the heat pump must not be operated in the defective condition.

Minimum age
The minimum age for the operation of the (containerized) heat pump and installation is 18 years. All persons involved in the assembly and installation of the (containerized) heat pump and the system must get themselves trained at regular intervals and/or familiarize themselves with the current technical data of the unit. The training and instructions is to be conducted at least once a year, unless some other interval has been agreed upon with the manufacturer.

Obligation to exercise due care
The statutory regulations for meeting the obligation to exercise due care are to be observed.
Meeting the obligation to exercise due care according to the current level of technology requires that everything that is
- technically possible (use of accepted technological rules) and
- Economically reasonable be done to prevent damage in a protectively safe manner.

1.3 HEAT PUMP OPERATING LIMITS

⚠ **Caution!**

1.3.1 DESIGN CONSIDERATIONS

- The heat pump is designed for installation in a plant room with a minimum temperature of 15^{0}C and maximum of 40°C.
- Condensation can occur on the outside surface of the suction pipe and evaporator, in case of high plant room temperature and low suction temperature.
- Check if design pressures are compatible with the refrigeration or water/glycol circuits connected to the heat pump.
- The heat pump is designed to ensure a maximum 1 bar pressure drop on the secondary medium of hot and cold side.

The heat pump design is based on constant water temperature and flow. Changing flow and temperature should be limited as stated below, and will result in different capacities.
- Maximum rise and drop in inlet water temperature is 2K per minute.
- Maximum entering water temperature, on the evaporator side, must not be higher than the corresponding temperature of the pressure setting of the safety valve, including “safety chain” if applicable.
- Flow may vary max. 10% per minute.
- Allowed flow is between 0,5 – 1,1 x design flow

Hint!

If these conditions are exceeded the heat pump will not be able to operate. Precautions, like buffer vessels and/or control valves, should be incorporated in the plant design on the water side to ensure these conditions.

1.3.2 HEAT EXCHANGERS

Hint!

Observe the chapter "Vahterus" of the instructions for the heat exchangers!

FLUIDS

The materials of construction are based on a data provided by the customer. If the fluids and temperatures differ from those specified in the data sheet and name plate, it is the customer's responsibility to ensure that there is no corrosion risk. You can also contact GEA for material and flow director material validation; otherwise it is the customer ´s responsibility.

Caution!

If the used plate material is AISI 316/AISI 316L/ 1.4404, (GEA PTC Standard) the water must have pH in between 7 to 10 and the chloride content <50 ppm. This is valid for open as well as closed systems. Of course attention must be paid to take sufficient preventions against calcium scaling.

FLOW RATES

Operating flow rates should be maintained as close as possible to the design flow rates. Significantly lower flow-rates, especially on the process side, may result in unpredictable thermal performance as well as premature fouling due to sedimentation.

1.3.3 WATER CIRCUIT PRESSURE

The hot water circuit should be designed to work at a minimum working pressure. This working pressure will guarantee that the water remains below the boiling point, avoiding liquid hammer, stress corrosion and calcium scaling. The water circuit should be design according to the following values:

TEMPERATUUR / VERZADIGDDE DRUK VAN WATER *TEMPERATURE / SATURATED PRESSURE OF WATER*		
Maximale persgastemperatuur (primair medium) *Maximum hot gas temperature (primery medium)*	Verzadigde druk van water bij tprimair *Saturated pressure of water at $t_{primary}$*	Aanbevolen overdruk in secundaire systeemzijde *Recommended system overpressure secondary side* *Pg = Psat + ~100 -100*
[$t_{primary}$ in °C]	P_{sat} [kPa] abs.	[kPa] overdruk /overpressure
100	100	**100** (= 200 kPa abs.)
110	143	**150**
120	196	**200**
130	270	**300**
140	361	**400**
150	475	**500**
160	618	**650**

Figure 1: Temperature / Saturated pressure of water

If the minimum working pressure is not guaranteed, the heat exchangers can be damaged.

1.3.4 5HP COMPRESSOR OPERATING LIMITS FOR HEAT PUMPS

Hint!

Also observe the operation manual for the compressor!

Heat pump compressors operate at relatively high pressures. During stand-still, the saturated suction temperature entering the heat pump compressor is often higher than the temperature of the compressor and machine room. The refrigerant (ammonia) will therefore condense. Liquid ammonia within the compressor will cause extra wear on valves, cylinder liners and bearings. Condensing of refrigerant will also occur in the dry suction line to the compressor.
During start-up and running condensation can also occur in the suction line especially if:

- The suction pressure fluctuates into a higher risk area as identified below
- The heat pump evaporating temperature is higher than the machine room temperature

Therefore, special measures have to be taken for heat pump applications, which are different when compared to refrigeration applications.

For more detail we refer to the specific compressor documentation.

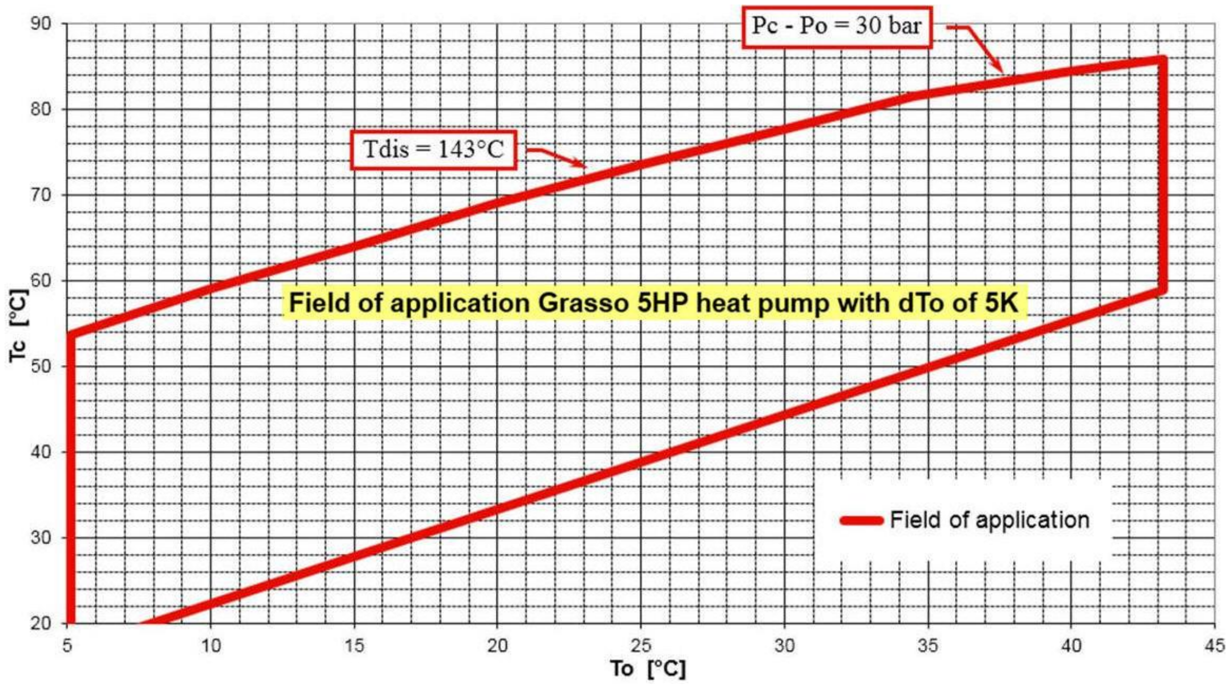

Figure 2 GEA Grasso 5HP Field of Application

1.4 Specified use

The heat pump must only be operated up to a maximum discharge pressure in accordance with the type plate.

Do not change the setting values of the safety pressure switch. This would endanger the operating safety of the unit.
If the switch-off value is set higher than 0.9 x maximum operating pressure (see EN378-2) of the high pressure section of the system, this may result in the bursting of the tank of this section of the system.

The operating regime stipulated by the manufacturer, especially for the starting phase of the unit, must be observed.

Operating parameters must be monitored and must remain within the specified limits.

The unit has been designed and manufactured for a special application under defined conditions of use. Unauthorized structural modifications are not allowable. We assume no liability for any resulting damage or injury. In the interest of further development, GEA reserves the right to technical modifications. The unit described here meets the current state of the art at the time of the printing of this operating manual.

The manufacturer must be consulted in all cases as to the permissibility of the modification if there is any change of the application or the conditions of use.

The refrigerant circuit must be designed so that a constant volume flow on the evaporator and condenser is always ensured.

If the volume flow is reduced on the high pressure side, this can lead to boiling of the secondary refrigerant which could lead to leakages in the heat exchangers.

If the water flow is reduced or obstructed, there is a discharge pressure increase followed by the compressor switching off.

Do not make any modifications to the container (if applicable) and the heat pump control system. These may impair the safety and functionality of the heat pump. They will also invalidate the guarantee.

The pressure equipment described here must not be used for any purpose other than the purpose specified here. If the pressure equipment is not used according to the regulations, the safe use of the equipment is not guaranteed. The supplier/installer or the operator – and not the manufacturer – is responsible for all personal injury and damage to property resulting from improper use.

The pressure equipment is not designed for dynamic loads. If there is a risk of lightning strikes, the pressure equipment must be earthed. The supplier/installer must record instructions for regular inspection of the pressure equipment in his operating manual and define the behavior of the end user in the event of damage. In order to prevent burns or frostbite, the pressure receptacle must not be touched during operation. This can be prevented by respective safety measures. Respective warning signs must be affixed. Refrigeration systems must be equipped with safety valves according to EN 378. The foundation must provide sufficient rigidity.

The supplier/installer must carefully install the accessories for the pressure equipment. The pressure equipment must not be damaged during installation and must be painted after installation. The pressure equipment must only be filled with the refrigerant specified in the contract. The pressure equipment must be installed in the heat pump or the system in such a way that no vibration or pulse is transferred to the pressure equipment. The contacts must be installed when de-energized.

Specified use includes observance of this manual and all supplied operating manuals as well as compliance with the maintenance and service intervals and conditions stipulated therein. Warranty claims and authorization for operation become void if the equipment is not used for its proper purpose.

2 MANUFACTURER INFORMATION

GEA Refrigeration Netherlands N.V. is a company within GEA, the Refrigeration Technology Segment of the GEA Group and provides its customers around the world with high quality components and services for refrigeration and process technology applications.

Locations:
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3 INSTALLATION AND PREPARATIONS FOR USE

This installation and operation manual is made by GEA to describe the installation and operation of a (containerized) heat pump.

For compressor preparations it is recommended to read the IMM documentation from GEA Grasso.

3.1 INSTALLATION

3.1.1 Heat pump compressor package

⚠ **Warning**

The compressor is not charged with oil, therefore, DO NOT start the compressor before it has been installed and prepared according to Grasso's instructions.

This section contains instructions for the proper installation of a (containerized) compressor. Before the compressor (package) is ready for the initial startup, the installation instructions in the following paragraphs must be followed:

1. The containerized heat pump should be levelled and securely supported by a preferred concrete foundation.
2. All piping (f.e. blow off lines, should be completed.
3. The system and the compressor are to be pressure tested for leaks (see. Leak test of compressor and system)
4. The system should be evacuated to remove air and moisture.
5. The electric wiring should be completed as per wiring diagrams. Do not energize the main power control cabinet until oil is added and the direction of rotation has been checked.
6. The compressor is to be filled with the correct type and amount of lubricating oil and has to be pre-lubricated (Refer IMM GEA Grasso 5HP Section 4.5, Page 49) before the first start.
7. The system should be charged with the correct amount of refrigerant and correct amount of oil. (see order specific drawings)
8. The control cabinet should be energized to check the package controls.

3.1.2 Basic information for installation

⚠ **Caution!**

During installation make sure that leaking operating materials do not reach the soil, groundwater or surface water (Federal Water Act WHG). Follow the legal regulations at the site of installation (e.g. for Germany: German Federal Water Act WHG).

Hint!

In case the container is also supplied by GEA. Please check the local regulations for installing the container close to other buildings in relation to fire.

3.1.3 Foundation

All foundation calculations, the selection of materials and the soil analysis are the owner’s responsibility. Prior to installation, a plan must be created for proper and professional installation.

Electrical connections and connections for operating media must be made. In addition to the installation surface of the (containerized) heat pump package, it must be ensured that sufficient space is available during maintenance work on the pipes as well as for operation.

Install the heat pump/container on a leveled surface. The difference from the horizontal must not be more than 0.3%. Provide enough space for maintenance work. Due to its own weight, the (containerized) heat pump stands securely on the installation surface. Please make there is no subsidence occurs in the foundation and that the heat pump/container will be completely supported

The pipes for the secondary refrigerant and cold water must be decoupled using expansion joints where vibration dampers are used.

The welding seams must be inspected in accordance with the Pressure Equipment Directive after welding work by the customer or operator on pipe line connections and flanges.

3.1.4 Moving & lifting instructions

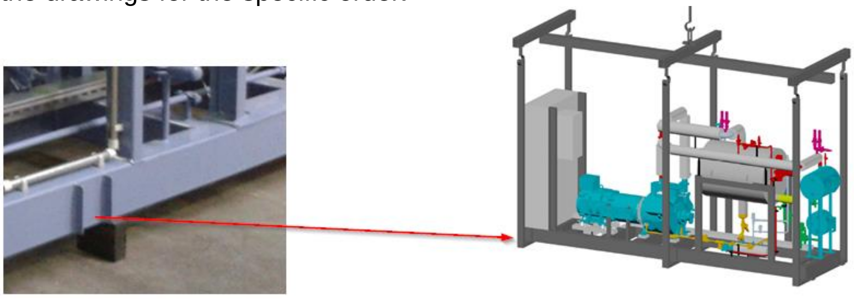
⚠ **Caution!**

It is prohibited to strap the heat pump to any fittings or pipes or to the eyebolts/ lugs on the compressor, electric motor, container or switching cabinet. A hoisting instruction for the specific unit is always delivered/available from our engineering department (see also enclosed drawings in documentation package).

For loose component or compressor package weights, refer either to the relevant component type plate or package lay-out or to the supplier’s document. For bare compressor weights, see "Product Information". The overall weights will always be supplied for each specific order.

Heat pump unit (compressor)

The heat pump is a high-quality product which must be handled with extreme care during transport. Protect the equipment from impacts and put it down carefully. When transported by crane, the heat pump must have the same position (frame downwards) as in operation. Do not use any other lifting points than those specially provided for this purpose. The heat pump package can be lifted with a lifting belt as indicated as below. Please be carefully with the lifting belts crushing parts. While lifting a spreader/cross-arm is advised. The weight of unit will be provided on the drawings for the specific order.



Moving the Container (if applicable)

⚠ **Warning**

It is not allowed to lift the container with the heat pump inside with the top lift sling method.

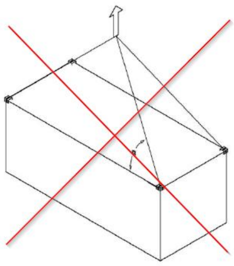


Figure 3: Top lift sling configuration

The allowed lifting methods for the container are the bottom lift sling configuration and the fork lift configuration. Minimum “a” anlge is 60°.

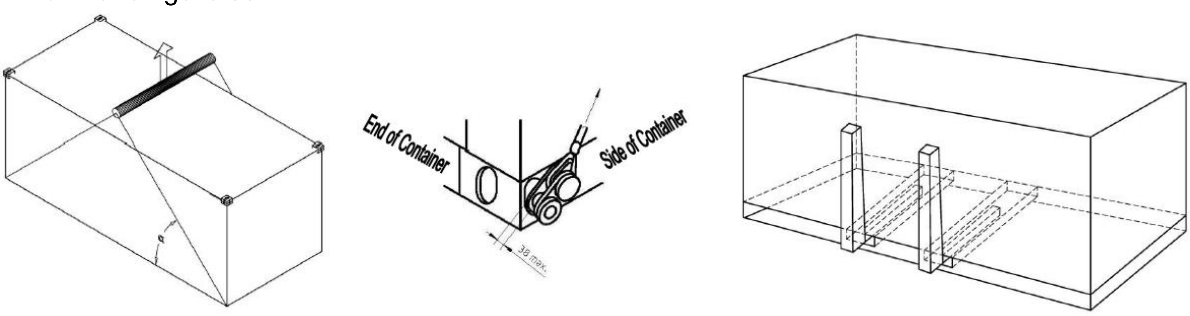


Figure 4: Bottom lift sling method & Fork lift method

⚠ Warning

The container may not be transported with NH3 in the heat pump

⚠ Caution!

- **Every precaution must be taken while moving the package to its final location. Pushing, pulling or climbing on any package component or piping, can easily create damage.**
- **After every movement of the heat pump compressor package the coupling/drive should be aligned and a leak test should be performed**

3.1.5 Storage

The compressor (package) is filled with dry nitrogen. Keep the system closed until the package is installed. If the compressor (package) is stored, it should be kept at all times in a dry location to prevent corrosion damage. If the compressor (package) is to be stored for a prolonged period of time, it should be checked weekly to ensure that the holding charge of dry nitrogen remains above atmospheric pressure.

Turn the shaft of the compressor at least once every four weeks (approx. 10 revolutions).

Long-term storage
With a standstill of the compressor for more than 16 weeks prior to start-up, there is a danger that the shaft seal may stick on the shaft and therefore be damaged on start-up. For this reason the removal and cleaning of the shaft seal is prescribed to guarantee its subsequent functionality:

Container Storage (if applicable)
If the container will be stored for a long period it must be prevented that water/dirt/dust/insects and other influences from outside can get into the container. Penetrations should be covered in proper way.

3.1.6 Connecting to system pipework

⚠ Caution!

All mechanical connections must be made according to the P+I diagram which is valid for the project. The P+I diagram is part of the product documentation.

⚠ Caution!

All electrical connections must be made according to the circuit diagram which is valid for the project. The circuit diagram is part of the product documentation.

⚠ Caution!

The blow-off piping should be installed according local regulations.

Check that components which have been removed for transport, separately supplied components and components provided by the client are firmly attached. Check that all screws are tight.

The protective gas filling of the heat pump must be purged by opening the vent valves on the suction side before the connection of the pipes.

All pipe connections must be made in such manner that the transmission of thermal expansion and vibration to the heat pump is limited as far as possible.

Bellows-type expansion joints made of steel, or flexible metal hoses can be used for refrigerant and oil lines, bellows-type expansion joints made from rubber can be used for water connections. All pipe connections must be provided with anchor points immediately next to the heat pump.

Hint!

In principle, all the connections must be made in accordance with the P+I diagram applying to the respective project. Attach the pipes to the heat pump in such a way that it does not impose any additional static or dynamic loads. All the pipes and systems to be connected must be checked for leaks when the work is complete.

Water pipes

⚠ Caution!

Please take in account an overflow/expansion device in a closed water circuit to handle the expanding medium due to temperature difference.

The pipes must be flushed before connecting. This is carried out to remove soiling, foreign particles and welding residue from the system.

Charging and draining must be possible.

After the (containerized) heat pump has been aligned, it can be connected up to process/system. The piping system for the system connections must be installed on site by the plant engineer.

Please refer to the drawing in the supplied documentation for the dimensions and position of the water connections to the evaporator and condenser (with or without sub cooler/desuperheater).

The evaporator must be connected to a closed circuit on the pressure side of the pump.

Arrange a dirt collector immediately upstream of the evaporator and condenser (recommended mesh size 0.9 mm).

The volume flow of the connected processes/systems should be kept at a constant level.

Check the water quality.

3.1.7 Electrical connection

⚠ Danger

Contact with live components is prohibited. Produce the earth connection according to the supplied drawings.

The heat pump has been designed for plug-in and reliable automatic operation.

All connections must be carried out according to the current installation regulations.

Connections to the heat pump must be flexible and free of loads.

Before starting work, make sure that all parts to be connected are de-energized, e.g. by removing the main fuse in all phases or installing a jumper wire. The insulation resistance of the electrical tools and fixtures and wiring is to be checked. The connection may only be undertaken if this value lies in the allowable range.

Connections and almost all external connections are pre-wired at the factory.

The electrical consumers and sensor must be connected according to the circuit diagram. All electrical connections must be made according to the circuit diagram.

3.1.8 Earthing connections

Warning

Ensure that the product is properly grounded before start-up. Connect the earth connection. The necessary mounting hardware and cables are not included in scope of supply. See general assembly drawing for the position of the earth connections.

Hint!

The cross-section of the ground wire must be at least 10 mm². Alternatively, two separately installed and separately connected ground wire must be used, ensuring the minimum cross-section in the sum.

To avoid leakage current flowing through the components, disconnect all litz-wires when arc welding. After all installation functions are completed, reconnect the litz-wires and ground the package to earth.

3.1.9 Separately delivered components

Hint!

Check whether the sets/parts/components belonging to this heat pump are supplied loose! (Refer to order data and packing list)

Mount these separately delivered sets, components and/or parts, according to the instructions as supplied with this heat pump. The compressor (package) will be delivered with loose components. If ordered, the pH sensors will also be delivered loose. If ordered, the pH sensors will also be delivered loose.

Hint!

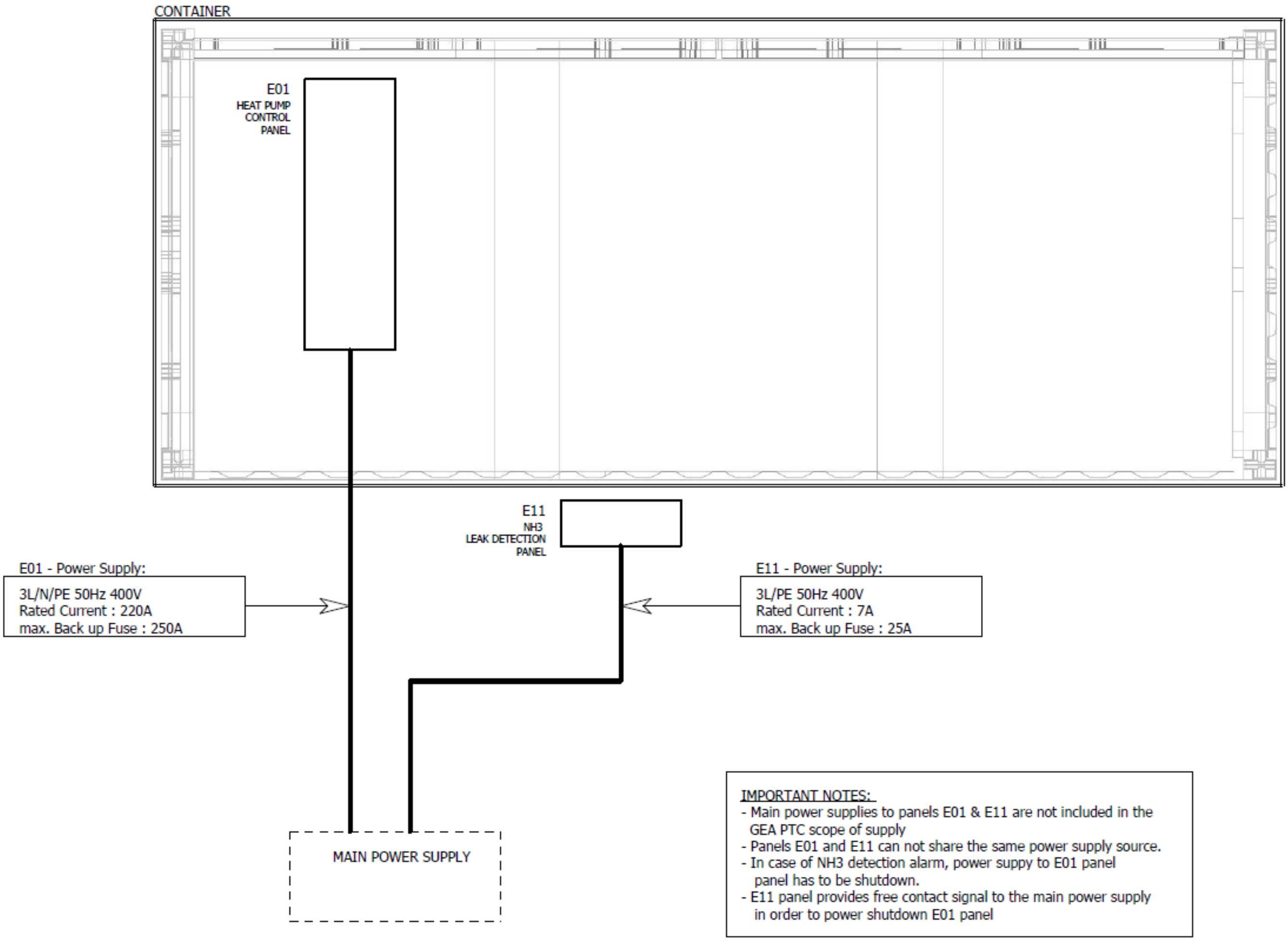
pH sensors are sensitive components and need to be handled carefully and calibrated on site.

3.1.10 Container (if applicable)

The extract fan needs to be equipped with proper sized ducting to extract ammonia in case of a leakage. The ducting should designed and placed according local regulations.

The emergency panel (supplied loose) needs to be placed on the outside of the container and connected again to the electrical cabinet.

The cabling to the heat pump and container should be connected as indicated below:



3.2 PREPARATION FOR USE HEAT PUMP

3.2.1 Measures for heat pumps

Please refer to chapter 1.3 Heat pump operation limits and from GEA Grasso documentation 1.3.1.

3.2.2 Leak test of compressor and system

The compressor (package) has been pressure tested prior to leaving the factory. In case an additional leak test is required, this test is should be carried out with dry nitrogen.

Hint!

DO NOT add oil to the compressor prior to pressure testing

A system leak test should be carried out over 24 hours to ensure that the system is tightly sealed. Record during the pressure test, the pressure, ambient temperature and outside temperature.During the initial 6 hours a pressure drop of 2% is permissible. With respect to temperature variations, no further pressure loss should be detected in the remaining 18 hours.

3.2.3 EVACUATION OF THE SYSTEM

After the pressure test has been completed, the system must be evacuated and undergo a vacuum test for 3 hours.
Evacuation is used to remove air and moisture from the installation.
A vacuum pump must be used for evacuation.
All valves within the refrigerant circuit must be opened.
The permissible increase in pressure is 6.66 torr over a period of 3 hours.

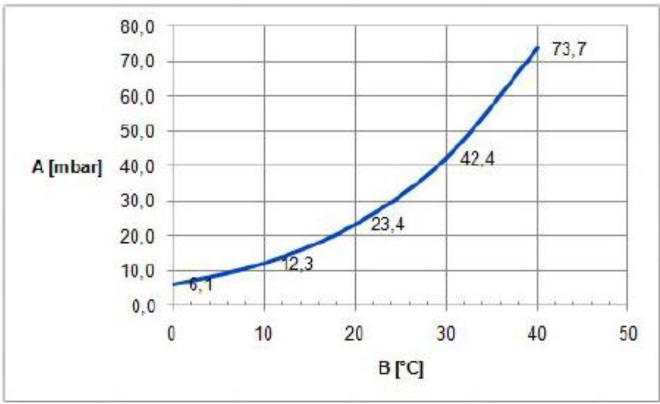


Figure 5: Vacuum required to remove moisture from refrigeration system (A: Vacuum, B: Room/wall temperature)

Measured values have to be checked and recorded hourly after reaching the required vacuum. After the vacuum test, the pressure compensation must be carried out with NH3.

3.2.4 Initial oil charge

⚠ **Caution!**

Check the oil grade to be charged!
See contract/project or recommendation of GEA. Only charge with fresh, unused oil. The vacuum present in the heat pump before pressure compensation may be utilized for charging the package with oil. A separate oil charging pump is required after the pressure compensation and for refilling with oil.
The connection of the oil draining or oil charging stop valve (090 - see Grasso manual) must be connected with the oil charging container.

Before charging with oil, switch the valves to the operating position.
Open the stop valve (090) until the oil level has reached the top third of the sight glass assembly in the compressor crankcase.
When charging with oil for the first time, oil must also be charged via the oil pre-lubrication valve on the reciprocating compressor.
The installation and maintenance instruction for the reciprocating compressor which is part of the product documentation is to be observed for this.

⚠ **Caution!**

Due to the use of selected components, the refrigerating machine oils tend to absorb more moisture. Therefore, when charging a compressor the oil should be allowed to come into contact with air for a short time only. The contents of an opened drum have to be used up within one working day, provided the drum is properly closed between charging.

3.2.5 PRE-LUBRICATION OIL SYSTEM

Pre-lubrication is necessary in situations listed below, in order to provide sufficient lubricating oil at locations where this is most needed (oil pump, bearings, pistons en piston rings) to ensure that any risk on 'dry running' is minimized or even better eliminated. Dry-running of oil pump bearings pistons and piston rings will initiate and after initiation worsen the wear of the parts mentioned and eventually even damage the crank shaft and cylinder liners or even more parts.

When pre-lubrication?

1. Before initial start-up
2. Before start-up after overhauling compressor
3. Before start-up after renewal of oil
4. Before start-up after standstill period of more than 3 months

Pre-lubrication procedure

Location pre-lubrication valve, refer Figure 15, Page 42/ Figure 16, Page 43

1. Top up crankcase to the minimum required oil level
2. Connect oil filling pump to stop valve and top up oil to 50-75% level (Hand operated oil filling pump can be supplied by Grasso)

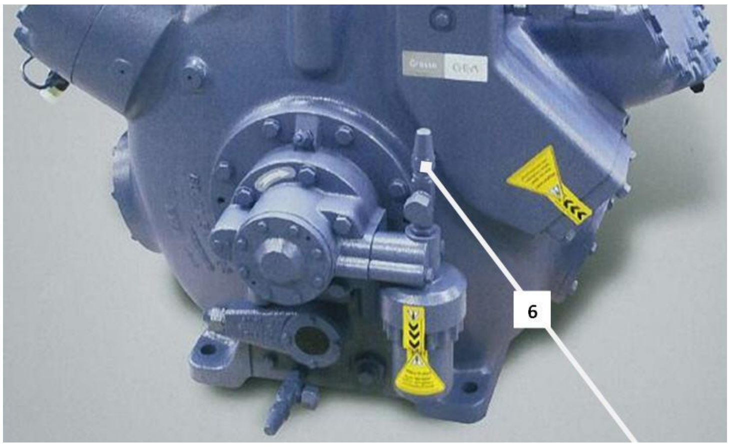


Figure 6: Pre-lubrication valve (6)

3.2.6 Checking the direction of rotation of the drive motor

⚠ **Warning**

The coupling must not yet connect motor and compressor!
Otherwise the coupling adaptor needs to be removed.

- Secure the electric switchgear so as to prevent the compressor drive motor from being switched on accidentally.
- When checking the direction of rotation of the compressor driving motor pay attention to the conditions for switching the compressor on.

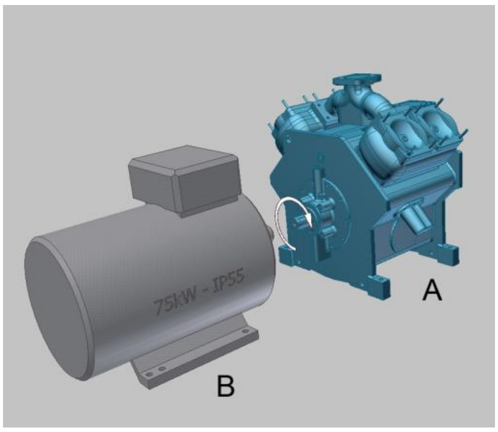


Figure 7: Motor direction of rotation
(A: Compressor, B: Motor)

Hint!

It is essential that the manufacturer's information e.g. for lubrication of the motor is observed before start-up of the compressor drive motor.

- Check that the required direction of rotation complies with the direction of the arrow on the compressor or the details in the compressor documentation.
- If the direction of rotation of the motor is wrong, it should be corrected while the electric switchgear is secured to prevent the motor from being switched on accidentally. Then the motor must work at least 1 hour unencumbered and free from errors. This is important in order to dry out residual moisture in the motor (caused during transport or storage).
- The coupling protection must be in place during this start-up period as required by the labour safety regulations.
- After checking the direction of rotation of the drive motor, the coupling may be connected with the motor.

3.2.7 Mounting the coupling

1. The electric switchgear is secured to prevent it from being switched on accidentally.
2. Mount the coupling while observing the instructions of the separate documentation provided.
3. The values for radial and angular deviations given in the coupling documentation must be checked and corrected if necessary. The axis distance between the compressor drive motor and the compressor must be checked.

⚠ Caution!

Observe the maintenance instruction! Regrease the coupling at the prescribed intervals if scheduled in the maintenance instruction for the coupling!

3.2.8 (OPTIONAL) AMMONIA PH DETECTION (WATER CIRCUITS)

⚠ Caution!

In both the water circuit there is a PH sensor connection (supplied loose) to detect ammonia leakage in the water. These need to be installed and calibrated according the supplier documentation. (JUMO or Endress & Hauser)

3.2.9 PREPARTIONS FOR CONTAINER (IF APPLICABLE)

The ammonia leakage detection in the container should be tested on site.

Also the electrical connections to the emergency panel should be checked if they are connected according the electrical drawings.

Check if the earthing is done according electrical drawings

All outgoing pipes should be connected according P&I Diagram and local regulations.

3.2.10 Initial refrigerant charge

⚠ Warning

Whenever work is carried out on the parts of the refrigeration circuit carrying refrigerant or oil, extreme caution is required since hazards can be caused by the escape of refrigerant.

Hint!

In order to charge the refrigerant, the compressor must be ready for operation.

Hint!

Only use dry ammonia acc. to ISO no. D15 11014 that contains less than 30 ppm of water!

For the amount of ammonia fill, refer to the Technical Specifications.

Filling connections:

After the lubricant has been filled, the refrigerant circuit can be charged with refrigerant through the refrigerant draw-in valve(s). The refrigerant draw-in valve is shown on the supplied P+I diagram of the heat pump (see order-dependent documentation).

Hint!

Goggles and protective gloves must be worn to prevent accidents

Filling procedure for refrigerant:

1. Equipment required: NH3 filling cylinder, scales, special NH3 filling hose line with cylinder connection at one end and stop valve at the other.
2. Connect the hose line to the cylinder and vent during heat pump unit evacuation, for example.
3. Connect the stop valve hose to the heat pump refrigerant draw-in valve by means of an adapter
4. Determine the cylinder weight
5. Open the heat pump refrigerant draw-in valve.
6. Open the cylinder valves and admit refrigerant circuit. Monitor the change in weight of the cylinder. Leave the refrigerant draw-in valve open until the required amount is in the refrigerant circuit or pressure compensation has been produced. If more refrigerant is needed, it can only be topped up after the initial commissioning.
7. Close refrigerant draw-in valve and stop valve hose, separate the hose from the heat pump and lift up the hose to make liquid refrigerant flow back into the cylinder, then close cylinder valve.
8. Prior to disconnecting the filling hose from the cylinder, and respecting all relevant safety rules, carefully drain the gas contents of the hose into the water tank.
9. The refrigerant filling procedure is complete.

The filling level of the heat pump can be checked at the sight glass of the evaporator. In the operating state when the compressor is running, the level should be visible in the middle of the sight glass. (see also the maintenance instructions for the filling characteristics).

4 START-UP

4.1 Important information for start-up

Warning

Contact with live componentsif prohibited

Hint!

GEA offers comprehensive support for the start-up of the heat pump. For contact details, please refer to the chapter “MANUFACTURER INFORMATION”

Warning

The start-up of the heat pump must be only be carried out by trained and qualified personnel who are familiar with the contents of the operating manual for the installed equipment. The safety regulations for the refrigeration plant must always be observed in order to prevent damage to the unit and injury to operating personnel.

By the time the heatpump is delivered to the customer, the following work will have been carried out:

- Complete installation of the cooling system and in particular:
    - Cleaning and drying of the refrigerant and oil circuits
    - Leak test with air
    - Evacuation of the refrigerant circuit and filling with protective gas (nitrogen) to a pressure of 0.3 to 0.5 bar (above atmospheric)
- Electrical wiring and testing
- Factory setting of the setting values on the control cabinet
- Factory setting of the safety and monitoring devices
- Works trial runs (at the request of the client)

The following points must be observed before commencing with the start-up:
- Checking of the exterior condition of the equipment (check of insulation, transport damage, inert gas filling…)
- Check that all electrical work has been carried out in accordance with the standards (e.g. protective earth, insulation, shielding, and covers). If necessary, an earth connection must be provided.
- The area around the machine in which the startup is carried out must be marked and secured against the access of unauthorized persons.
- Sufficient lighting of the working area must be ensured to prevent personal injury and material damage.
- Check the operating and functional capability of the machine room equipment (air extraction and ventilation).
- Personal protection gear (work clothing, work boots, gloves) must be worn during all work on the equipment. There is a danger of impact and stumbling against protruding parts on the equipment (e.g. valve caps). There is also a danger of cut wounds on sharp edges and rough surfaces. All activities must, therefore, be carried out with particular attention.
- Suitable hearing protection must be worn in order to protect against damage to hearing or deafness.
- Thermal hazards resulting in injury due to burns or freezing may occur on contact with parts of the system which are at a very high or very low temperature. Personal protective equipment must be worn.
- Suitable tools or special tools must be used.
- Checking of the direction of rotation of the driving motor
    - Before start-up, i.e. before you connect the voltage supply to the heat pump switching cabinet, check that the coupling between the drive motor and compressor is disconnected. Otherwise, the coupling intermediate piece must be disassembled in accordance with the assembly instructions.
    - It is essential to ensure that the compressor drive motor cannot be started inadvertently.
    - Check that the required direction of rotation complies with the direction of the arrow on the compressor or the details in the compressor documentation.

- In "MANUAL" operation mode, the compressor drive motor is started in a star-delta connection and is then switched off.
- Change the direction of rotation of the motor if this is not correct!
- The electrical switchgear must then be secured again to prevent it from being switched on inadvertently. Mount the coupling while following the instructions of the separate documentation.
- The values for radial and angular deviations given in the coupling documentation must be checked and corrected if necessary. If necessary, align the electric motor.

Danger

Solid mounting of the coupling protection must be checked. Start-up must not be carried out with the coupling protection mounted.

- Pipes and pipe sections must be secured to ensure sufficient mechanical strength. The pipes and equipment parts of the heat pump must not be stepped on.
- Operating media (nitrogen, oil, refrigerant) can escape. Preventive measures must be taken to collect and dispose of them in an environmentally responsible manner (e.g. using an oil pan). Personal breathing protection must be kept ready in the event of a ammonia leak. The safety data sheets of the oil and refrigerant used must be read prior to commencing start-up work. Familiarize yourself with the evacuation plan of the installation location.
- Check the protective gas filling (a positive pressure ≥ 0.2 bar must be present)

Hint!

If defects are found, notify GEA and proceed according to their instructions. Please already take pictures and collect information for better support.

4.2 Initial commissioning

The compressor must only be switched on when the heat pump has been correctly connected and charged with operating materials. The activities described in this chapter "Start-up" must be carried out in the prescribed sequence. The heat pump and container electrical equipment is operated via the control panel (Touch Panel) of the control. After the set points have been entered, both automatic and manual operation are possible.

The software of the controller and operation via the terminal are described separately in the operating manual for the control system. Remedy and acknowledge existing fault messages.

4.3 Start-up after long standstill periods

1. Inserting the main fuse
2. Switching on the control unit according to the operating manual.
3. Checking all parameters on the control unit display. See parameter list.
4. Checking the settings of all control and safety devices.

4.4 Restarting after approx. 1 year standstill

1. Change the oil filter inserts (see maintenance instruction).
2. Switch on the oil heater at least one hour before starting the heatpump.
3. Open the stop valve on the suction side and the pressure side (or check valves which can be shut off).
4. If fitted: Open the manual stop valve of the refrigerant injection.
5. Remove all non-condensable gases are removed by venting. To this end, check the condensing pressure and temperature (see parameter list).
6. Check the oil collection sump and empty if necessary.
7. Switch on the compressor and observe the operating instructions of the electrical switchgear. Make a heat pump function checkout for testing the sensor and actor technologies (ready for operation and indicating precision).

5 OPERATING THE HEAT PUMP

5.1 Important information for the operator

The heat pump must be only be operated by trained and qualified personnel who are familiar with the contents of the operating manuals. The safety regulations for the refrigeration plant must always be observed in order to prevent damage to the compressor unit and injury to operating personnel.

Hint!

The heat pump is operated via the control panel. In the event that the control is contained in the scope of delivery, the operating personnel must have knowledge of the contents of the complete documentation for the control. The documentation for the controller is part of the product documentation.

5.2 Requirements for switching on

The heat pump has been designed for automatic operation; the control controls the switching of the compressor and its capacity adjustment.
There is no need for constant adjustment and observation of the system in automatic operation. The necessary steps for switching on the heat pump are given in the documentation of the control.
If the heat pump is controlled manually, it must be operated from the refrigerator room. In particular, the repair and maintenance instructions must be complied with.

The following prerequisites must be fulfilled for switching on the heat pump:
1. The main current must be available and switched on.
2. The heat pump must be sufficiently filled with refrigerant and oil.
3. The valves must be in their operating positions.
4. The cooling and cold water pumps must be in operation.
5. The cold water supply of the oil cooler must be guaranteed. (if fitted)
6. The oil must be sufficiently heated by the oil heater in the compressor crankcase.
7. The rated current limitation has been set according to the motor rating.

→The heat pump can be switched on according to the operating manual of the control

5.3 Communication

**Refer to the Omni™ Panel Data Report for reference to Communication addresses for I/O data, analog data, custom parameters, warning and shutdown annunciations, and keypad information relative to this contract.

5.4 Equipment protocol

Hint!

Owners and operators of refrigeration equipment with filling levels of more than 3kg of refrigerant are required to keep an equipment protocol under EN378 Part 2. The technical customer service at GEA offers support in maintaining the equipment protocol. The equipment protocol needs to be stored for at least five years after manufacture and presented to the relevant authorities upon request.

The equipment protocol needs to include the following information:
1. Service and maintenance work
2. Proof of a regular leak tightness test
3. Type and quantity of filled or recovered refrigerant including quantity balance If recovered refrigerant is used then the
   - Analytical findings

   and
   - Source of the recovered refrigerant need to be given
4. Quantity and type of the filled and recovered oil including quantity balance
5. Changes to and replacement of components
6. Regular and routine inspections with results and dates
7. Longer shut-down periods

8. Identification of the company of the technical staff that carried out the servicing/ maintenance.

Hint!

Following documents, which are part of product documentation or the operating manual, may be used for keeping the equipment protocol:

1. Maintenance check list
2. Measurement protocol operating parameter (template)
3. Data sheet oil filling (template)
4. Data sheet refrigerant fill up (template)

5.4.1 Operating parameters for refrigerant circuit (template)

User						
Refrigerant						
Type of oil						
Chiller - Type / Manufacturer Serial No. / Year						
Compressor - Type / Manufacturer Serial No. / Year						
Date / Time						
Run hours	OH					
Rating class	%					
Speed	min^{-1}					
P_{suc} suction pressure	bar					
t_0 evaporating temperature	°C					
P_{dis} discharge pressure	bar					
t_C condensation temperature	°C					
T_{dis} compression end temperature	°C					
T_{suc}-t_0 overheating [1)]	K					
P_{oil} oil difference pressure	bar					
T_{oil} oil temperature (piston housing)	°C					
I_{mot} compression motor current	A					
t_{W1} Heating agent inlet temperature	°C					
t_{W2} Heating agent outlet temperature	°C					
t_{K1} Secondary refrigerant inlet temperature	°C					

t_{K2} Secondary refrigerant outlet temperature	°C					
Oil level in compressor 2)						
Refrigerant status in 3)the sight glasses						
Remarks						
Service technician						

Notes:

1) Measure suction gas temperature with a suitable sensor at the compressor suction tube
2) Oil level must be visible
3) Normal condition: clear and free of bubbles

5.4.2 Data sheet oil filling (template)

User	
Refrigerant	
Type of oil	
Chiller - Type / Manufacturer **Serial number/ year**	
Compressor - Type / Manufac-turer **Serial number/ year**	

Date	**Running hours**	**Filled recov-ered oil quantity in l**	**Absorbed oil quan-tity in l**	**Remarks (e.g. quantity balance, findings of oil analy-sis)**	**Service techni-cian**

5.4.3 Data sheet refrigerant filling (template)

User	
Refrigerant	
Type of oil	
Chiller - Type / Manufacturer **Serial No. / Year**	
Compressor - Type / Manufac-turer **Serial No. / Year**	

Date	**Running hours**	**Removed refriger-ant quan-tity in l**	**Refriger-ant quan-tity intake in l**	**Remarks (e.g. quantity balance)**	**Service techni-cian**

6 CLEANING MAINTENANCE AND REPAIR

6.1 Important information for service personnel

Hint!

Read all safety instructions in this operating manual. Familiarize yourself with the local conditions of the heat pump installation site. Adhere to all legal and local regulations of health, work and fire protection, the safety regulations for refrigeration systems as well as the regulations which must be heeded concerning the gases to be compressed. Please read this operating manual carefully and completely prior to working on the heat pump. Familiarize yourself with the special features of the heat pump.

⚠ Caution!

There is an increased danger of slipping due to contact of operating media with the floor!

The heat pump and (if applicable) container must only be serviced by appropriately qualified personnel. For all maintenance work, you must comply with the maintenance instructions.
The maintenance certification is issued and signed following the inspection and maintenance by authorized fitters. This serves as evidence for the maintenance work which has been carried out.
During the guarantee period these confirmed maintenance certificates are also a prerequisite for any claims under the guarantee provided by manufacturer.
The responsible certified specialist company must be informed if any repairs are required.
All maintenance and service tasks have to be carried out with care to preserve the functionality of the heat pump.
Guarantee claims will not be valid if the customer failed to follow the maintenance instructions.

6.2 Cleaning the heat exchanger

6.2.1 Mechanical cleaning

Mechanical cleaning is a maintenance measure in order to ensure the continuous safe operation of the heat pump.
Components from the heat pump (e.g. suction filters, heat exchangers) can be removed for manual mechanical cleaning. To do so, follow the instructions listed in the corresponding component documentation. After completion of the cleaning work, correctly mount the component and check it for leakages.

6.2.2 Chemical cleaning

The chemical cleaning of the heat exchangers must only be carried out by an experienced specialist company. At the same time, the manufacturer's instructions must be observed.

6.3 Maintenance

The heat pump must only be serviced by appropriately qualified operating personnel. For all maintenance work, you must comply with the maintenance checklist. The maintenance checklist is part of the product documentation and contains the maintenance to be carried out and the specified maintenance intervals. Moreover, all health & safety and fire prevention regulations and the safety regulations for refrigeration systems must also be observed.
The maintenance checklist contains all the maintenance instructions and certifications for the first 10 years of performance of the heat pump.
The maintenance certificates are completed and signed as part of the inspection and maintenance by authorized fitters as evidence of the work done. During the warranty period, these confirmed maintenance certificates also serve as a precondition for possible warranty claims to GEA. We advise you to sign a long-term service agreement with a qualified firm authorized by GEA to carry out the necessary service and maintenance work.
Our service department is at your disposal whenever you need assistance in selecting a partner suitable for you. Contact the service department if repairs are necessary.

⚠ Warning

Please observe the maintenance instruction given in the manufacturer's technical documentation for individual components! The service and maintenance work and maintenance intervals are directly matched to the components used. The manufacturers' instructions are binding and must be observed by the client in order to comply with the guarantee!

6.3.1 General instructions

⚠ Danger

Contact with live components is prohibited.
Maintenance work on the running heat pump is not allowable.

Work involving intervention in the refrigerant circuit must only be carried out by qualified engineers in accordance with the guarantee conditions.
The heat pump must be switched off before being dismantled. Before beginning the work, ensure that all components subject to maintenance/servicing are de-energized (e.g.by removing the main fuse or installation of a short-circuit jumper).
The refrigerant must be removed from the relevant parts of the system. This work must be carried out with great care, taking into account the safety regulations, so that the maintenance personnel are not injured by the refrigerant or by the refrigerating machine oil present in the system.
Parts of the system under pressure must be completely drained before opening. While carrying out the repair, always ensure that there is complete pressure compensation between the relevant pressurized spaces and the surrounding air.
During cleaning, repair or maintenance work, the heat pump or its components must be protected against the entry of moisture in order to prevent impairment of the function of the components.

The chief principle must be to keep air and moisture entering the heat pump to an absolute minimum. All foreign substances must be kept away or eliminated, such as

- welding residues,
- sealing remnants,
- auxiliary materials such as grease, oil or solvents.

Welding and soldering work may only be performed with the operators consent. The requisite protective measures must be defined. These include:

- personal protective measures during the opening of the respective part of the system,
- complete draining of the respective part of the system,
- cleaning with the appropriate cleaning agents,
- concentration measurements,
- ensuring sufficient ventilation and venting,
- Performance of all welding work with the use of forming gas.

If lines that carry gas have to be opened for maintenance work, these lines must be in a gas-free state.

6.3.2 Repair work

Modifications and repair work may only be carried out by qualified persons or persons with suitable training with the manufacturer's consent and must strictly comply with the rules set out in the maintenance instruction for the components concerned.

Hint!

The following maintenance notes must be observed:
Only spare parts made by the original component manufacturer may be used for repairs and for replacing wearing parts. These are available from the spare parts department.

6.3.3 Repair information

Important features of the technology and production process must be taken into account when repairing the plant:

– Complete sealing of all devices and pipes.
– Dryness and cleanliness of the entire plant.
– Use of welding methods causing only a minimum amount of dirt to collect in the plant.
– Pipes bent on a pipe-bending machine only using refrigerating oil.
– If repairing the piping system from your own stocks, we recommend that you use a pipe with NBK surface quality (annealed and descaled, mechanically or chemically descaled after annealing).
– When carrying out repairs to piping systems, care should be taken to maintain the original piping routes.
– Only pipes of sufficient material quality, which are certified according to DIN-EN 10216-2 should be used.

6.3.4 Repairing, inspection and servicing the compressor

Hint!

Carry out the work on the compressor in accordance with the compressor maintenance manual. This is supplied with all the project related documentation but also available for download from our website. Actions described for example, Dismantling the compressor suction filter or oil filter replacement.

6.3.5 Checking the earth connection

Check the function of the earth connection frequently (see the general assembly drawing and the indications on the product). Only a specialist company must be commissioned with inspections.

6.3.6 Insulation

Check the insulation (if present) on components, containers and piping for damage. Damaged insulation must be replaced. The insulation strength must be selected according to the temperature and humidity at the place of installation. Details on the insulation can be found in the P+I diagram.

⚠ Caution!

No screw connections must be used under the insulation if the piping is insulated. The pipes must be welded.

6.3.7 Oil draining, oil filling and oil change

Importance of the oil change

Aged oil demonstrates an increasing loss of lubricity. Because of this, all rotating components of the compressor are endangered. The filter elements become prematurely clogged and must be cleaned and replaced at shorter intervals. The oil in the compressor unit/heat pump requires changing:

– if the operating time of the oil charge has reached the technically specified oil change interval.

⚠ Warning

Time periods for oil quality analysis / oil change
Oil quality analysis / Oil change when using ammonia as the refrigerant after 5,000 operating hours or at the latest after 1 year.

– if the oil becomes unacceptably contaminated due to a major accident (e.g. water penetration into the refrigerant circuit).

The degree to which oil in refrigeration plants has aged must be checked by analysis and comparison of the data with those of fresh oil. Oil ageing can also be judged from the darkening of the oil color and the deposits found in the oil filters. If the degree of ageing cannot be assessed reliably by laboratory analysis and the results of visual examination, it is advisable to change the oil at the following intervals (see maintenance checklist). The assessment of the condition of the refrigerating machine oil by means of a general visual inspection (contamination) or laboratory analysis must be carried out:

– after 5000 operating hours
  or
– at the end of one year's operation
  or
– after remedying major damage
  or
– in case of extreme darkening of the oil color or opacity of the oil.

6.3.8 Oil change, maintenance work

Take oil samples for analysis and comparison with the fresh oil data at regular intervals. Check the coloration of the oil visually and assess the degree of contamination.
Depending on the results, the user must decide whether to approve the postponement of filling the oil until the next assessment date or whether to have the oil changed.
Inadmissibly damp oil must be removed from the compressor unit/heat pump immediately.

6.3.9 Changing the oil

(See also installation and maintenance instruction for compressor)

1. The heat pump must be run for at least half an hour to reach its operating temperature before the oil can be changed.
2. First shut down the heat pump as described in the operating instructions.
3. Close the stop valves of the compressor side and the compressor pressure side and evacuate the compressor.
4. Subsequently, drain the used oil through the oil draining/oil charging valves and dispose it **(Caution! hazardous waste!).** Once this has taken place close the valve again.
5. Clean the interior of the compressor crankcase with a lint-free cloth. Subsequently, mount the covers on the crankcase again using new gaskets.
6. The filter insert of the oil pressure filter must be replaced.
7. Charge the compressor crankcase above the oil charging valve with fresh oil of the indicated amount. Check the fill levels at the sight glass during this.
8. Evacuate the compressor using a vacuum pump.
9. Open the suction side and pressure side stop valves again.
10. Then check all components for leakages. Then perform a complete pressure compensation with the pressure line followed by a repeated leakage test of the heat pump. The oil charge oil and start-up of the heat pump must be accomplished in accordance with the operating instructions.

6.3.10 Used Oil

Refrigeration machine oil drained from the circuit is no longer suitable for use in refrigeration plants. It has to be stored or transported in appropriately labelled containers in accordance with the legal provisions. The operator is responsible for its proper disposal.

Hint!

For permissible types of oil, please refer to the technical information entitled "Lubricating oils". Oil removed from the compressor must not be re-used. Always use fresh oil from sealed containers! Do not mix with other types of oil.

6.3.11 Draining the oil

It may be necessary to drain the oil:
– to inspect or repair the compressor
  and
– if there is too much oil in the circuit.

The oil must be drained in accordance with points 1 to 6 of the chapter entitled "changing the oil". The oil must be drained through the filling hose and into a container suitable for waste oil.

6.3.12 Draining refrigerant circuit

Open the oil drain stop valve **carefully** to drain any existing oil out of the evaporator. Pay attention to the safety rules of working with the refrigerant ammonia!

Danger

Keep the safety equipment handy (protective breathing mask)! Working only together with a 2nd person!

6.3.13 Refrigerant side evacuation

The purpose of evacuating the system is to remove air and moisture from the refrigerant circuit.
Evacuation is required:

- After intervention in the refrigerant circuit and elimination of leaks,
- Before start-up/restarting.

Evacuate the heat pump using a vacuum pump. The compressor must not be used for evacuation.
During evacuation, all affected parts of the circuit should be at least at room temperature as cold parts hinder the removal of moisture.
If there is still any moisture in the heat pump, this will lead to a rise in pressure. Evacuation must continue until the pressure no longer increases. For pressure compensation, it is necessary for the ambient temperature to remain constant.

6.3.14 Maintenance of the compressor drive motor

Hint!

The compressor drive motor must be maintained in accordance with the "Motor documentation".

Maintenance of the compressor drive motor includes the following activities:

- Lubrication of the motor

Lubrication intervals and quantities according to the "Motor documentation" or "Type plate".

- Cleaning of the motor (externally)

Select a suitable cleaning agent according to the "Motor documentation".

7 DECOMMISIONING

7.1 Shut down in event of dangerous situations

The safety equipment of the heat pump complies with EN 378.
By means of automatic monitoring of the individual operating parameters, the control unit detects hazardous situations in good time and automatically switches off the heat pump.
The cause of the fault is then displayed on the control unit and can then be corrected.
Among other things, the concept of this series of heat pump is based upon low maintenance refrigerant circuits that are as well sealed as possible. However, residual risks remain, especially due to possible leaks or escaping refrigerant or rotating drive parts.

Hint!

The EMERGENCY STOP switch in the switching cabinet is used to switch off the heat pump quickly whenever necessary.

Leaking refrigerant can be detected with a gas detector (only included in the scope of delivery if the container is also in GEA's scope). This detector can be integrated into the automatic safety chain.
Please consult the safety regulations within this documentation for information about what to do in the case of leaking refrigerant.

7.2 Taking out of service for a period <48 hours

Hint!

The obligation to label the plant as "Plant not in operation" must be observed!

If the heat pump is shut down for a period <48 hours, the following activities must be performed:

1. Switch off the compressor in accordance with the operating instruction for the electrical switchgear.
2. If necessary, shut down all ancillary drives.
3. Removing the main fuse.
4. Shut off the secondary refrigerants (water/glycol supply).
5. Ensure that the venting slots of the electric motors are covered under all circumstances!

➔ System has been taken out of service

Hint!

If the heat pump is shut down temporarily, the valves do not need to be operated; they remain in their operating positions. If there is a possibility of the temperature in the evaporator rising above the cooling water temperature, the cooling water supply must be interrupted or the stop valve on the compressor suction side must be closed.
The stop valve on the suction side of the compressor must also be closed if it is possible that the temperature in the evaporator could rise above the ambient temperature of the heat pump.

7.3 Taking out of service for a period >48 hours

Hint!

The obligation to label the plant as "Plant not in operation" must be observed!

If the heat pump is taken out of service for a period (>48 hours), the following activities must be performed:

1. Switch off the compressor in accordance with the operating instruction for the electrical switchgear.
2. Switch off all ancillary drives.
3. Switch off the main switch of the three-phase electric system.
4. Close the stop valve (or closable check valves) on the suction side and the pressure side.
5. Shut off the secondary refrigerant, heating agent or cooling water.
6. Shut off the cooling medium supply to the oil cooler. (if present)
7. Close the manual stop valve of the refrigerant injection.
8. Switch off the oil heater.
9. Ensure that the vent slits of the electric motors are covered **under all circumstances**!

➔ The system has been taken out of service.

7.4 Measures during shutdowns

Even though the heat pump is under overpressure, check the moisture content of the refrigerant and refrigerating machine oil in case it is shut down for a period longer than half a year. The moisture content must not differ substantially from the initial values.

7.5 Monthly measures during shutdown

1. Check that the heat pump is constantly under overpressure. Check the heat pump for leaks using a leak detector.
2. Manually rotate the compressor shaft (10 rotations).

7.6 Four weeks before restarting

1. Check the moisture content and ageing condition of the refrigerating machine oil. Analyze the oil for this purpose. Compare the results of the analysis with the values for fresh oil. We recommend an oil change after 1 year (ammonia as refrigerant (see Maintenance Instructions).
2. Check the insulation resistance of the drive motors (see the operating manual for the electric motor).
3. Check the heat pump for leak tightness.

7.7 Decommissioning, disposal

Preparatory measures

Hint!

The information in the chapter "Decommissioning" must be observed.

Hint!

Care must be taken during disposal and devaluation that the various materials are separated and taken for recycling. Disposal of component remains and components in the domestic refuge or on refuse tips is not permitted. The legal regulations applicable to the place of installation regarding the disposal of electrical equipment must be taken into account. Dismantled components must be disposed of correctly and according to legal requirements.

- The dismantling and disposal of the package/heat pump must be carried out in such a way that:
  - the plant is free of voltage and is protected against unintentional reconnection of the voltage.
  - Accidents to persons are prevented,
  - material damage is prevented,
  - uncontrolled escape of refrigerant or oil is prevented.
- Disposal and decommissioning work must only be carried out by personnel who are qualified according to EN 13313.
- Components may be under elevated pressure and the pressure must be released before opening them.
- In case of contact with refrigerant or operating media, their hazardous properties (e.g. toxicity, inflammability) must be taken into account (see also the safety data sheet for the refrigerant). Personal protective equipment compliant with EN 378-3 must be worn.
- National regulations (e.g. EN 378-4, Section 6) must be observed for the reclamation and disposal of refrigerants.
- National regulations (e.g. EN 378-4, Appendix A) must be observed for the reclamation and disposal of operating media (oil).
- No unauthorized persons must be within the installation area of the plant during decommissioning, as they could come into contact with refrigerant.
- All components of the plant which are not to be re-used, as well as refrigerant and operating media, must be stored in suitable separate containers.
- They must be treated as waste and disposed of safely.

Hint!

Re-use of operating media is not possible!

Parts list

AS BUILT

Code	Description	Manufacturer-Supplier	Type-size	Articlenumber(s) / remark	Order no.	Purch.no.
Group 110					*Sheet*	
E111.01	Heater	Grasso	Heater 220-240V/-50-60Hz/325W			616404315
E111.02	Heater	Grasso	Heater 220-240V/50-60Hz/600W			616404315
F111.01	Filter	Grasso	Suction Filter			616404315
K111	**Compressor (piston)**	Grasso	45HP Compressor			616404315
LS111.01	Level switch	Grasso	Oil level switch crankcase 24V			616404315
M111.01	Electrical motor	WEG	75kW Motor 315S/M			616404315
PT111.01	Pressure transmitter	Danfoss	Suction Pressure 0-30 Bar			616404315
PT111.02	Pressure transmitter	Danfoss	Discharge Pressure 0-60 Bar			616404315
PT111.03	Pressure transmitter	Danfoss	Oil Pressure 0-30 Bar			616404315
PT111.04	Pressure transmitter	Danfoss	Crankcase Pressure 0-30 Bar			616404315
PSHH111.05	Pressure switch	Grasso	Pressure Switch Beta 4 - 170 Bar R717 Extern			616404315
PSHH111.06	Pressure switch	Grasso	Pressure Switch Beta 4 - 170 Bar R717 Intern			616404315
QT111.01	Vibration sensor	IFM Electronic	VIBRATION SENSOR VSA005 DIAGNOSTIC ELECTRONICS VSE002 PARAMETER-SW VES004	S: 85365019 - G: S: 90318080 - G: S: 85234920 - G:		616404802
QT111.02	Vibration sensor	IFM Electronic	VIBRATION SENSOR VSA005 MAGNETIC MOUNT E30096	S: 85365019 - G: S: 85051100 - G:		616404802
QT111.03	Vibration sensor	IFM Electronic	VIBRATION SENSOR VSA005	S: 85365019 - G:		616404802
QT111.04	Vibration sensor	IFM Electronic	VIBRATION SENSOR VSA005	S: 85365019 - G:		616404802
SC111.01	Frequency converter	Danfoss	FREQUENCY CONVERTER, FC302 P55K75kW - NO380 - 500 VAC IP55, RFI Class A1/B, Modbus TCP MCA 122	S: FC-302P55KT5P55H2XGX - G:		616404732
TT111.01	Temperature transmitter	Grasso	Suction Temperature sensor PT1000			616404315
TT111.02	Temperature transmitter	Grasso	Discharge Temperature sensor PT1000			616404315
TT111.03	Temperature transmitter	Grasso	Oil Temperature sensor PT100			616404315

Parts list — AS BUILT

Code	Description	Manufacturer-Supplier	Type-size	Articlenumber(s) / remark	Order no.	Purch.no.
Group 110						***Sheet***
TSH111.04	Thermistors	WEG	Thermistors			616404315
TT111.11	Temperature transmitter	Grasso	PT1000-2A (Grasso Standard), 7500 mm			616404315
TT111.12	Temperature transmitter	Grasso	PT1000-2A (Grasso Standard), 7500 mm			616404315
TT111.13	Temperature transmitter	Grasso	PT1000-2A (Grasso Standard), 7500 mm			616404315
TT111.14	Temperature transmitter	Grasso	PT1000-2A (Grasso Standard), 7500 mm			616404315
V111.02	Service valve	Grasso	Service valve			616404315
V111.05	Service valve	Grasso	Service valve			616404315
V111.06	Service valve	Grasso	Service valve			616404315
V111s07	Overflow valve	Grasso	Overflow valve 50 bar			616404315
V111.08	Service valve	Grasso	Service valve			616404315
V111.12	Valve	Danfoss	SVA-S 50 D ANG STOP VALVE CAP	S: 148B5701 - G: 40159844	1-01	616404612
V111.14	Valve	Danfoss	Service valve snv-st G1/2-W1/2 L=125mm (i-pack 30st) Blind nut g1/2 accessory/gasket	S: 148B4219 - G: 10040319 S: 148H3450 - G: 10040321		616404613
V111.21	Check valve	Danfoss	CHV-X 32 A ANG CHECK VALVE	S: 148B5537 - G: 40159806		616404612
V111.23	Valve	Danfoss	SVA-L 32 A ANG STOP VALVES CAP	S: 148B5561 - G:		616404612
Y111.01	Capactiy control valve	Grasso	Solenoid valve NC 24V-DC	S: 1316221 - G:		616404315
Y111.02	Capactiy control valve	Grasso	Solenoid valve NC 24V-DC	S: 1316221 - G:		616404315
Y111.04	Solenoid valve	Grasso	By pass solenoid valve DN15 NC			616404315
Group 210						***Sheet***
C210	**Condenser**	Vahterus - Wijbenga	PSH 4HH-114/1/1 PS:60, TS:0/150°C			616404358
FS210.21	Flow switch	Cematic-Electric B.V.	Flow switch SN 450/2-A4-GR, G1/2 in. , L=80mm, 24V DC	S: P11081/4 - G: 10045910		616404619
H210	**Desuperheater**	Vahterus - Wijbenga	PSHE 3HH-66/1/1 - PS:60 BAR - TS:0-150°C - AISI 316L Plates			616404339

Parts list

AS BUILT

Code	Description	Manufacturer-Supplier	Type-size	Articlenumber(s) / remark	Order no.	Purch.no.
Group 210					***Sheet***	
LSH210.01	Level switch	Hamapo B.V.	LEVEL SWITCH HBSR-PNP/NC-6, 3/4 BSPP, 24 V AC/DC	S: HBSR-PNP/NC-6 - G:		
LSL210.02	Level switch	Hamapo B.V.	LEVEL SWITCH HBSR-PNP/NC-6, 3/4 BSPP, 24 V AC/DC	S: HBSR-PNP/NC-6 - G:		
QT210.21	pH meter	Jumo Meet- & Regeltechniek B.V.	tecLine pH electrode 00321035 SS Process fitting 00302474	S: 201020/51-18-04-22-120/837 - G: S: 202831/105-26 - G:		616404746
TT210.01	Temperature transmitter	Endress & Hauser	TT, TR10, INCL. NECK (80MM), W/O CONV, PT100, -50/150°C, G1/2 IN, L=70 (DN65)	S: TR10-ABA1CASAC3000 - G: 40163067		616404615
TT210.02	Temperature transmitter	Endress & Hauser	TT, TR10, INCL. NECK (80MM), W/O CONV, PT100, -50/150°C, G1/2 IN, L=70 (DN65)	S: TR10-ABA1CASAC3000 - G: 40163067		616404615
TT210.03	Temperature transmitter	Endress & Hauser	TT, TR10, INCL. NECK (80MM), W/O CONV, PT100, -50/150°C, G1/2 IN, L=50 (DN25, DN32)	S: TR10-ABA1CAS1C3000 - G: 40148614		616404615
TT210.21	Temperature transmitter	Endress & Hauser	TT, TR10, INCL. NECK (80MM), W/O CONV, PT100, -50/150C, G1/2 IN, L=80 (DN80)	S: TR10-ABA1CAS4C3000 - G: 40163090	1-01	616404615
TT210.22	Temperature transmitter	Endress & Hauser	TT, TR10, INCL. NECK (80MM), W/O CONV, PT100, -50/150C, G1/2 IN, L=80 (DN80)	S: TR10-ABA1CAS4C3000 - G: 40163090	1-01	616404615
TT210.23	Temperature transmitter	Endress & Hauser	TT, TR10, INCL. NECK (80MM), W/O CONV, PT100, -50/150C, G1/2 IN, L=80 (DN80)	S: TR10-ABA1CAS4C3000 - G: 40163090	1-01	616404615
TT210.24	Temperature transmitter	Endress & Hauser	TT, TR10, INCL. NECK (80MM), W/O CONV, PT100, -50/150C, G1/2 IN, L=80 (DN80)	S: TR10-ABA1CAS4C3000 - G: 40163090	1-01	616404615
V210.03	Valve	Danfoss	Service valve snv-st G1/2-W1/2 L=125mm (i-pack 30st) Blind nut g1/2 accessory/gasket	S: 148B4219 - G: 10040319 S: 148H3450 - G: 10040321		616404613
V210.04	Valve	Danfoss	Service valve snv-st G1/2-W1/2 L=125mm (i-pack 30st) Blind nut g1/2 accessory/gasket	S: 148B4219 - G: 10040319 S: 148H3450 - G: 10040321		616404613
V210.21	Ball valve	Tyco Valves & Controls	BALL VALVE F120 1 INCH (DN25) BSPP SS MANUAL HANDLE 2-PIECE	S: 120025T12RCPL00 - G: 40156442		616404620
V210.22	Ball valve	Tyco Valves & Controls	BALL VALVE F120 1 INCH (DN25) BSPP SS MANUAL HANDLE 2-PIECE	S: 120025T12RCPL00 - G: 40156442		616404620

Parts list

AS BUILT

Code	Description	Manufacturer-Supplier	Type-size	Articlenumber(s) / remark	Order no.	Purch.no.
Group 210					***Sheet***	
X210.21	Transmitter / controller	Jumo Meet- & Regeltechniek B.V.	JUMO AQUIS 500 pH, AC-DC 20..30V,48..63Hz, 00484318 Cable & Plug, 00307298	S: 202560/20-888-000-310-000-25/000 - G: S: 202990/02-92-5-13 - G:		616404746
Group 210					***Sheet***	
F211.01	Filter	Danfoss	ICFF 20 BUILT ON ICF VALVE STATION			
H211	**Subcooler**	Vahterus - Wijbenga	PSHE 3HH-44/1/1 - PS:60 BAR - TS: 0-150°C - AISI 316L Plates			616404340
V211.01	Valve	Danfoss	ICFS 20 BUILT ON ICF VALVE STATION			
V211.02	Service valve	Danfoss	SNV-ST G1/2 MAN STOP NEEDLE VALVE Blind nut g1/2 accessory/gasket	S: 148B3778 - G: 40047260 S: 148H3450 - G: 10040321		616404612
V211.03	Valve	Danfoss	ICFS 20 BUILT ON ICF VALVE STATION			
X211.01	Valve Station	Danfoss	VALVE STATION COMPLETE ICF 20-4-14A DN20, ICFS-ICFF-ICM-ICFS ICM20-A - Kalrez O-Rings replacement module for T>75C	S: 027L3095 - G: 40050213 S: 027H1176 - G:		616404612
Y211.01	Expansion valve	Danfoss	ACTUATOR ICAD 600A wo Cable Cable set 10 m, ICAD 600/900/1200	S: 027H9120 - G: 40162544 S: 027H0427 - G: 40114626		616404612
Group 210					***Sheet***	
G216.01	Sight glass	Hansen - Wijbenga	FAS-SIGHT GLASS D18 - M26x1,5 FAS RVS WELD SOCKET FOR SIGHT GLASS D18	S: D00000D18 - G: 40163102 S: D0000LD18RVS - G: 40163105		616404616
PSV216.12	Safety valve	GEA AWP	SVAA FL DN15/25 K PS63 50-63 - Setting: 50bar(g) KIT S+M+D DIN-FL PS63 3.1 + TÃœV	S: 45650F10A5A10000 - G: 40163123 S: 26300F12A5A00000 - G: 40163124 S: 9202 - G: 40160541		616404627
PSV216.13	Safety valve	GEA AWP	SVAA FL DN15/25 K PS63 50-63 - Setting: 50bar(g) KIT S+M+D DIN-FL PS63 3.1 + TÃœV	S: 45650F10A5A10000 - G: 40163123 S: 26300F12A5A00000 - G: 40163124 S: 9202 - G: 40160541		616404627
V216.01	Change over valve	GEA AWP	WVR FL DN15 K PS63 G-FL R1 F S+M+D WVR/SV DN15/25 PS63	S: 24020F10A5A30100 - G: 40160537 S: 15752K10.5/02103 - G: 40163128		616404627

Parts list

AS BUILT

Code	Description	Manufacturer-Supplier	Type-size	Articlenumber(s) / remark	Order no.	Purch.no.
Group 310					***Sheet***	
E310.01	Electrical tracing	Coolmark B.V.	Tracing 64W/m 20QVR2-CT Aansluitkit univ. CE16-05-EUR Verwarmingslint eindafwerkset	S: 704-5020 - G: 40162814 S: 704-9007 - G: 10031970 S: 704-9020 - G: 10031973		616404614
H310	**Evaporator / Separator**	Vahterus - Wijbenga	PSHE 6/4HH-240/1/1 - PS: 25 BAR - TS: 0/100°C	S: 359198032 - G:		616404357
TT310.01	Temperature transmitter	VDH Products B.V.	Temperatuuropnemer SM800 2mtr	S: 910.010002 - G: 01202100		616404618
V310.01	Valve	Danfoss	Service valve snv-st G1/2-W1/2 L=125mm (i-pack 30st)	S: 148B4219 - G: 10040319		616404613
V310.04	Valve	Danfoss	Service valve snv-st G1/2-W1/2 L=125mm (i-pack 30st) Blind nut g1/2 accessory/gasket	S: 148B4219 - G: 10040319 S: 148H3450 - G: 10040321		616404613
X310.02	Injector	GEA Refrigeration Germany	Injector 65-B for BluGenium (0407170001)	S: 2381600 - G:		616404626
X310.03	Orifice		Orifice 1,6 mm			
Group 310					***Sheet***	
V311.07	Oil drain valve (quick closing)	Danfoss	SVA-S 15 + QDV 15 DN15 Fitting for hose connection - G3/4inch	S: 148h3310 - G: 40052001 S: 148h3451 - G: 40162710		616404612
Group 310					***Sheet***	
PSV316.02	Safety valve	Danfoss	SAFETY VALVE SFA 15-50 T225 DN15/20, PN40, -50/+100°C, SET PRES. 23 BAR(g) Nipples + gaskets set for 25D/ND20 DSV1/SFA 15	S: 148F4013 - G: S: 148F3037 - G:		616404628
PSV316.03	Safety valve	Danfoss	SAFETY VALVE SFA 15-50 T225 DN15/20, PN40, -50/+100°C, SET PRES. 23 BAR(g) Nipples + gaskets set for 25D/ND20 DSV1/SFA 15	S: 148F4013 - G: S: 148F3037 - G:		616404628
V316.01	Change over valve	Danfoss	CHANGE OVER VALVE DSV1 D25/ND20, DUAL STOPVALVE+KIT	S: 148F3005 - G: 40051572		616404628
Group 310					***Sheet***	
V317.01	Check valve	Danfoss	SCA-X 15 A ANG STOP VALVE	S: 148B5209 - G: 40159679		616404612
V317.02	Service valve	Danfoss	Service valve snv-st G1/2-W1/2 L=125mm (i-pack 30st) Blind nut g1/2 accessory/gasket	S: 148B4219 - G: 10040319 S: 148H3450 - G: 10040321		616404613
V317.03	Valve	Danfoss	SVA-S 25 D ANG STOP VALVE CAP	S: 148B5401 - G: 40159760		616404612

Parts list

AS BUILT

Code	Description	Manufacturer-Supplier	Type-size	Articlenumber(s) / remark	Order no.	Purch.no.
Group 310					*Sheet*	
X317.01	Welding nipple	GEA Grenco, s-Hertogenbosch	WELD NIPPLE G1/2 INCH R HEX BLIND CAP G1/2 INCH R	S: 09722204 - G: 09722204 S: 80117021 - G: 80117021		616404613
Group 310					*Sheet*	
G318.01	Sight glass	Hansen - Wijbenga	FAS-SIGHT GLASS D18 - M26x1,5 FAS RVS WELD SOCKET FOR SIGHT GLASS D18	S: D00000D18 - G: 40163102 S: D0000LD18RVS - G: 40163105		616404616
G318.02	Sight glass	Hansen - Wijbenga	FAS-SIGHT GLASS D18 - M26x1,5 FAS RVS WELD SOCKET FOR SIGHT GLASS D18	S: D00000D18 - G: 40163102 S: D0000LD18RVS - G: 40163105		616404616
G318.03	Sight glass	Hansen - Wijbenga	FAS-SIGHT GLASS D18 - M26x1,5 FAS RVS WELD SOCKET FOR SIGHT GLASS D18	S: D00000D18 - G: 40163102 S: D0000LD18RVS - G: 40163105		616404616
LTH318.01	Level transmitter	Hamapo B.V.	LEVEL TRANSMITTER HBL-T wire-6, 3/4 BSPP, 4..20mA, 24 V AC/DC, PN100, IP65. L=600 Mm Threated sleeve 1in G 3/4 in BSPP for HBLT level transmitter	S: HBL-T wire-6 - G: S: BS/ADAP/8/6 - G:		616404617
LSHH318.02	Level switch	Endress & Hauser	LEVEL SWITCH HBSR-PNP/NC-6, 3/4 BSPP, 24 V AC/DC	S: HBSR-PNP/NC-6 - G:		
V318.01	Valve	Danfoss	SVA-S 32 D ANG STOP VALVE CAP	S: 148B5501 - G: 40159792		616404612
V318.02	Valve	Danfoss	SVA-S 32 D ANG STOP VALVE CAP	S: 148B5501 - G: 40159792		616404612
V318.03	Valve	Danfoss	Service valve snv-st G1/2-W1/2 L=125mm (i-pack 30st) Blind nut g1/2 accessory/gasket	S: 148B4219 - G: 10040319 S: 148H3450 - G: 10040321		616404613
X318.01	Welding socket	GEA Grenco, s-Hertogenbosch	AKSWELD. SOKKET FOR AKS41 1"	S: 027F1010 - G: 10023743		616404612
Group 310					*Sheet*	
F319.01	Filter	Danfoss	FILTER FA-15 incl. 1/2" WELD. FLNG.	S: 006-0052 - G: 10000652		616404612
G319.02	Sight glass	GEA AWP	SIGHT GLASS SGL 475 , DN15 , DIN BW ends, -60C/+150C, PN25, W/O BALL	S: 47500C10A5A20000 - G: 40059422		616404621
H319	**Oil collecting vessel**	HS-Cooler	K12-FE-410 L170			616404539
TT319.01	Temperature transmitter	Endress & Hauser	Omnigrad T - TST310-B8A1A4G4B1A - PT100 - Insertion length: 60 - G1/2	S: TST310-B8A1A4G4B1A - G:		616404965

Installationno **63164-010**

Orderno. latest rev. **1-01** **LowUp- Spain**

New build orderno. **1-01** **Water-water heat pump 1 45 HP compresso**

Parts list

AS BUILT

Code	Description	Manufacturer-Supplier	Type-size	Articlenumber(s) / remark	Order no.	Purch.no.
Group 310					***Sheet***	
V319.01	Valve	Danfoss	SVA-S 20 D STR STOP VALVE CAP	S: 148B5311 - G: 40159733		616404612
V319.02	Valve	Danfoss	SVA-S 15 D ANG STOP VALVE CAP	S: 148B5201 - G: 40159671		616404612
V319.03	Check valve	Danfoss	CHECK VALVE NRVA15 Incl. FLANGES, GASKETS & BOLTS NRVA 15-20 SPRING 0,30 BAR	S: 020-2000 - G: 00627798 S: 020-2307 - G: 40046894		616404612
V319.04	Service valve	Danfoss	Service valve snv-st G1/2-W1/2 L=50mm (i-pack 30st) BLIND NUT G1/2 ACCESSORY +GASKET	S: 148B4218 - G: 10040318 S: 148H3450 - G: 10040321		616404613
V319r05	Regulating valve	Danfoss	REG-SA 15 D STR	S: 148B5228 - G: 40159690		616404612
V319.06	Valve	Danfoss	SVA-L 15 D ANG STOP VALVE CAP	S: 148B5241 - G: 40159702		616404612
Y319.01	Solenoid valve	Danfoss	SOLENOID VALVE EVRST-15 W/O COIL 3/4 WELD PN 50bar Coil evr 230v 50hz 12w connection box	S: 032F3085 - G: 10011097 S: 018F6801 - G: 10000322		616404612
Y319.02	Solenoid valve	Danfoss	VALVE BODY CVH PILOT DN15 weld PILOT VALVE EVM (NC), PN65bar Coil 220/230VAC 50Hz 12W for EVR/A/T/EVM-NC/NO	S: 027F1090 - G: 10039465 S: 032F8011 - G: 40047078 S: 018F6801 - G: 10000322		616404612
Y319.03	Solenoid valve	Danfoss	SOLENOID VALVE EVRA3 AC/DC W/O MAN OPERATION, FLANGES AND COIL FLANGES DN15 FOR EVRA/T 3, 10, 15, W/O GASKET, NUTS&BOLTS Coil 220/230VAC 50Hz 12W for EVR/A/T/EVM-NC/NO	S: 032F3050 - G: 10001147 S: 027N1115 - G: 00696103 S: 018F6801 - G: 10000322		616404612
Y319.05	Solenoid valve	Danfoss	VALVE BODY CVH PILOT DN15 weld PILOT VALVE EVM (NC), PN65bar Coil 220/230VAC 50Hz 12W for EVR/A/T/EVM-NC/NO	S: 027F1090 - G: 10039465 S: 032F8011 - G: 40047078 S: 018F7301 - G: 10000322		616404612
Y319.06	Solenoid valve	Danfoss	VALVE BODY CVH PILOT DN15 weld PILOT VALVE EVM (NC), PN65bar Coil 220/230VAC 50Hz 12W for EVR/A/T/EVM-NC/NO	S: 027F1090 - G: 10039465 S: 032F8011 - G: 40047078 S: 018F6801 - G: 10000322		616404612
Group 320					***Sheet***	
FS320.21	Flow switch	Cematic-Electric B.V.	Flow switch SN 450/2-A4-GR, G1/2 in. , L=80mm, 24V DC	S: P11081/4 - G: 10045910		616404619
QT320.21	pH meter	JUMO MEET - & REGELTECHNIEK	tecLine pH elektrode 00321035 SS Process fitting 00302474	S: 201020/51-18-04-22-120/837 - G: S: 202831/105-26 - G:		616404746
TT320.21	Temperature transmitter	Endress & Hauser	TT, TR10, INCL. NECK (80MM), W/O CONV, PT100, -50/150C, G1/2 IN, L=100 (DN100, DN125)	S: TR10-ABA1CAS5C3000 - G: 40148577		616404615

Parts list — AS BUILT

Code	Description	Manufacturer-Supplier	Type-size	Articlenumber(s) / remark	Order no.	Purch.no.
Group 320					***Sheet***	
TT320.22	Temperature transmitter	Endress & Hauser	TT, TR10, INCL. NECK (80MM), W/O CONV, PT100, -50/150C, G1/2 IN, L=100 (DN100, DN125)	S: TR10-ABA1CAS5C3000 - G: 40148577		616404615
V320.21	Ball valve	Tyco Valves & Controls	BALL VALVE F120 1 INCH (DN25) BSPP SS MANUAL HANDLE 2-PIECE	S: 120025T12RCPL00 - G: 40156442		616404620
V320.22	Ball valve	Tyco Valves & Controls	BALL VALVE F120 1 INCH (DN25) BSPP SS MANUAL HANDLE 2-PIECE	S: 120025T12RCPL00 - G: 40156442		616404620
X320.21	Transmitter / controller	JUMO MEET - & REGELTECHNIEK	JUMO AQUIS 500 pH, AC-DC 20..30V,48..63Hz, 00484318 Cable & Plug, 00307298	S: 202560/20-888-000-310-000-25/000 - G: S: 202990/02-92-5-13 - G:		616404746
Group 970					***Sheet***	
B970.01	Ventilation	Rucon Systemair B.V.	AW 650 D6-2-EX, Max. 10940 m³/h, 790RPM, 400V/3Ph/50Hz 1077W, 1,78A, IP44, II 2G c Ex e IIB T3	S: 5972 - G:		616404747
B970.02	Blower heater	Technische Unie den Bosch	0 t/m 280m3/Hr			
E970.01	Heater	Technische Unie den Bosch	FRICO LUCHTVERHITTER CAT C3, 230V/1Ph/50Hz/3KW	S: 1525088 - G:		616404745
M970.01	Ventilation motor	Rucon Systemair B.V.	790RPM, 400V/3Ph/50Hz 1077W, 1,78A, IP44, II 2G c Ex e IIB T3			616404747
QT970.01	Ammonia detection	ECR Nederland	GS24-NH3-4000, 12-24V AC/DC, 0 - 4000PPM, IP54	S: N501-4070 - G:		616404748
TT970.01	Temperature transmitter	Sensor Data B.V.	Temp. transmitter roomtemp. HM3 w/o converter (PT100)	S: 101802 - G: 10046253		616404744
TC970.02	Thermostat	Frico	5-35 °C, included delivery heater CAT 3			

TECHNICAL SPECIFICATIONS (data referred to EN14511)

MODEL		EWAH290TZSSB1
COOLING PERFORMANCE		
Capacity - Cooling	kW	288.6
Capacity control - Type		Stepless
Capacity control - Minimum capacity	%	18.7
Unit power input - Cooling	kW	96.96
EER Cooling Efficiency [kW/kW]		2.977
ESEER [kW/kW]		4.740
IPLV.IP [kW/kW]		5.640
CASING		
Colour *		IW
Material *		GPSS
DIMENSIONS		
Height	mm	2537
Width	mm	2258
Length	mm	3183
WEIGHT		
Unit Weight	kg	2559.4
Operating Weight	kg	2608.9
WATER HEAT EXCHANGER		
Type *		PHE
Fluid		Ethylene glycol 30%
Fouling Factor	m2°C/W	0.00e+00
Water Volume	l	49.5
Water temperature in	°C	12.00
Water temperature out	°C	7.00
Water flow rate	l/s	15.82
Water pressure drop	kPa	22.6
Insulation material *		CC
AIR HEAT EXCHANGER		
Type *		MCH
FAN		
Type *		DPT
Drive *		On/Off
Diameter	mm	800
Nominal air flow	l/s	0
Air Temperature	°C	35.0
Quantity	No.	6
Speed	rpm	0
Motor input	kW	0.000
COMPRESSOR		
Type		Inverter Driven Single Screw
Oil charge	l	14
Quantity	No.	1
SOUND LEVEL* **		
Sound Power - Cooling	dB(A)	101
Sound Pressure level@1m distance - Cooling	dB(A)	82
REFRIGERANT CIRCUIT		
Refrigerant type		R1234ze
Refrigerant charge	kg	41.4
N. of circuits	No.	1
PIPING CONNECTIONS		
Evaporator water inlet/outlet	mm	66.5

DAIKIN

ELECTRICAL SPECIFICATIONS

MODEL		EWAH290TZSSB1
POWER SUPPLY		
Phases	No.	3
Frequency	Hz	50.0
Voltage	V	400
Voltage tolerance Minimum	%	-10%
Voltage tolerance Maximum	%	10%
UNIT		
Maximum inrush current	A	0
Nominal running current cooling	A	157.22
Maximum running current	A	236
Maximum current for wires sizing	A	0
FANS		
Nominal running current cooling	A	0
COMPRESSORS		
Phases	No.	3
Voltage	V	400
Voltage tolerance Minimum	%	-10%
Voltage tolerance Maximum	%	10%
Maximum running current	A	0
Starting method		INV

Fluid: WaterAllowed voltage tolerance ± 10%. Voltage unbalance between phases must be within ± 3%. Maximum starting current: starting current of biggest compressor + current of the compressor at 75% maximum load + fans current for the circuit at 75%.Nominal current in cooling mode is based on the calculation conditions; compressors + fans current.Maximum running current is based on max compressor absorbed current in its envelope and max fans absorbed current.Maximum unit current for wires sizing is based on minimum allowed voltage.Maximum current for wires sizing:(compressors full load ampere + fans current) x 1,1. Electrical data are subject to modification without notice. Please refer to unit nameplate data

SOUND LEVELS

	Sound pressure level at 1 m from the unit (rif. 2 x 10-5 Pa)									Power db (A)
MODEL	63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz	**db(A)**	
EWAH290T ZSSB1	81.8	78.8	78.8	81.8	75.8	71.8	63.8	56.8	**81.7**	**101.1**

Unit performances are referred to ideal running conditions that are reproducible in laboratory test environment in accordance to recognized industry standards (i.e. EN14511). Weights and dimensions are indicative –For specific values referto certified drawing issued by factory. Data are referred to unit with standard options only. For specific information about additional options refer to databook.* IW: Ivory White - GPSS: Galvanized and Painted Steel Sheet - PHE: Plate Heat Exchanger - S&T: Single Pass Shell & Tube.* CC: Closed Cell - HFP: High efficiency fin and tube type - DPT: Direct Propeller Type - DOL: Direct On Line - VFD: Inverter - BRS: Brushless. If red contact factory.*** Value are referred to:evaporator 12/7°C, air ambient 35°C, full load operation. For aircooled Eurovent certified units,sound power level ismeasured in accordance with ISO9614 and Eurovent 8/1 and certified by Eurovent.Sound pressure level is calculated from sound power level.Eurovent certification refers to the overall sound power level only.Sound pressure in frequency bands is for information only and not consideredbinding. For other units,sound pressure level is measured in accordance with ISO3744.Sound power level is calculated from sound pressure level.**

WA: De 233 a 6.977 kW

La solución para demandas de agua sobrecalentada en un amplio rango de potencias

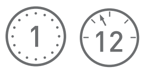
La caldera presurizada **WA** es la solución perfecta para producir agua sobrecalentada. Está construida en acero de gran calidad P265 GH con retorno automático de llama por el tubo hogar.

Su diseño frontal está constituido por una puerta pivotante para garantizar la estanqueidad en el cierre mediante tornillos de fácil ajuste y facilitar así el acceso a su interior para labores de limpieza.

Esta caldera se fabrica en varias presiones según las necesidades de la instalación.

En el Manual de Instalación, Uso y Mantenimiento de WA, se puede encontrar toda la información de esta caldera.

- Cuerpo de **acero** con gran volumen de agua.
- **Notable rendimiento** gracias a los tubos de humo con espirales de acero aleado en su interior.
- Caldera de **2 pasos de humos**.
- **Mayor duración** del refractario de la puerta y **menores tensiones en las bridas** gracias a que la temperatura de los gases en la entrada de los tubos no supera los 900ºC frente a los 1.200ºC habituales en sistemas clásicos.
- Recirculación de inquemados para la eliminación de hollín y **mantenimiento de alto rendimiento**.
- Apta para trabajar con gas, gasóleo y gas propano.



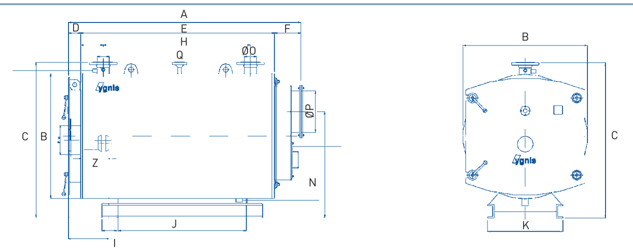
*Presión opcional máxima: 12 bar.

Caldera de agua sobrecalentada para gas o gasóleo 2 pasos de humo

Tabla de características

		MODELOS WA																
		200	250	350	450	550	650	750	850	1000	1250	1600	2000	2500	3200	4000	5000	6000
Pot. útil	Th/h	200	250	350	450	550	650	750	850	1000	1250	1600	2000	2500	3200	4000	5000	6000
Pot. útil	kW	233	291	407	523	640	756	872	988	1163	1453	1860	2325	2907	3721	4651	5814	6977
Rendimiento	%	88																
Vol. Agua	dm³	242	345	375	620	690	1065	1120	1110	1330	1716	2065	3063	3615	4245	6750	8470	10120
Pérdida de carga sobre el agua Δt 20ºC	mmca	90	120	150	100	150	200		150	220	170	200	150	200			300	400
Sobrepresión en el hogar	mmca	9-11	15-20	15-30	20-40		25-35	40-50	45-55		50-60		55-65		70-80	60-70	55-65	60-70
Presión de servicio	Kg/cm²	Peso de la caldera sin agua Kg																
4		590	740	900	1200	1300	1600	1700	1800	2500	2900	3250	4300	5250	6800	9000	11000	13800
6		660	880	920	1240	1340	1660	1755	1885	2525	3050	3970	4570	5550	7250	9550	11620	14480
8		720	930	950	1290	1400	1730	1810	2025	2725	3210	4250	4845	5900	7600	9950	12150	15100
10		820	960	990	1390	1525	1855	1890	2060	2855	3385	4590	5185	6250	8150	10350	12700	15750
12		840	1000	1040	1410	1695	2025	2050	2160	2940	3615	4890	5485	6620	8550	10800	13250	16800
Categoría		I								II								
Tipo de combustible		Gas natural (G20), gasóleo y gas propano (G31)																
PVP a consultar																		

Dimensiones



Modelos	A	B	C	D	E	F	H	J	K	N	ØO	ØP	ØQ
	mm												DN
WA 200	1664	910	1285	108	1306	250	800	700	600	842	80	220	2''
WA 250	1754	995	1348		1396			800		884		270	
WA 350	1954	995			1596		1000	950	638				
WA 450	1816	1200	1530		1458		900	800	700	1035	100	320	
WA 550	2006				1648		1100	1000					
WA 650	2319	1300	1630	128	1902	289	1350		788	1130		350	
WA 750	2399				1982		1450	1100	750				
WA 850	2397	1350	1680		1980			1160	800	1150	125	400	
WA 1000	2507	1460	1810	158	2060		1500	1240	900	1270			
WA 1250	2767	1550	1905		2320		1700	1500	950	1312	150	500	DN65
WA 1600	3079	1650	2055		2572	349	1950	1700	1000	1402		550	DN100
WA 2000	3451	1800	2225		2944		2200	1900	1030	1552	200		DN125
WA 2500	3783	1900	2305		3276		2450	2000	1200	1592		650	
WA 3200	4033	2000	2430		3526		2800	2450	1300	1655		750	
WA 4000	4307	2300	2730		3800			2400	1420	2020		850	
WA 5000	4397	2550	2980		3890		3000	2500	1570	2270	250	900	DN150
WA 6000	4602	2700	3180		4095		3200	2700	1770	2470		1000	

INDUSTRIAS

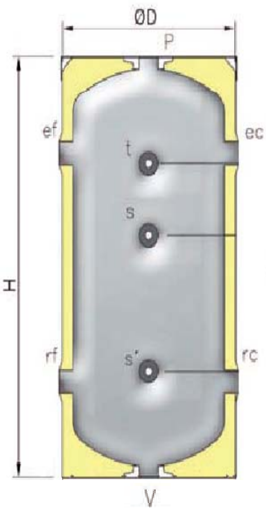
IBAIONDO S.A.

CARACTERISTICAS TECNICAS

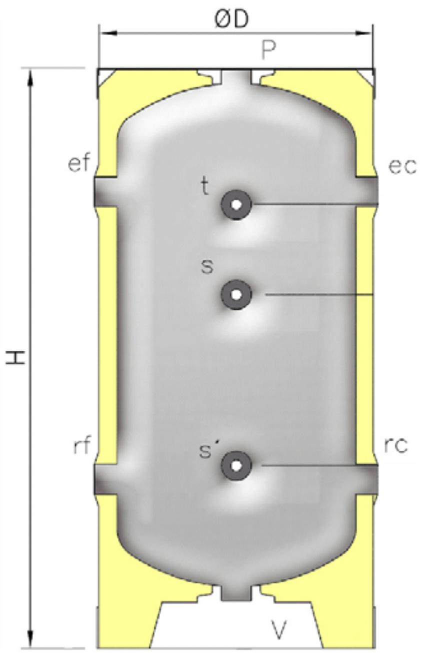
30 – 1500 AR

- **Modelo:** 30 – 1500 AR
- **Uso:** Acumuladores de inercia en Instalaciones de refrigeración y bombas de calor
- **Volumen:** 30 – 1.500 Litros
- **Material:** Acero
- **Presión Máxima de Servicio:** 6 Bar
- **Presión de Prueba**: 9 Bar
- **Presión de precarga:** -- Bar
- **Temperatura Min / Max**: +7ºC / +90ºC
- **Dimensiones:** Según tabla
- Aislamiento térmico externo consistente en la inyección directa de espuma rígida de poliuretano, exenta de CFC
- **Acabado**: Acabado exterior mediante lámina de aluminio gofrado
- Los manguitos van protegidos con embellecedores y tapones
- **Embalaje:** Pallet individual y foam (flejado)
- Etiqueta personalizada
- Garantía: 3 años
- Diseñado y fabricado según Directiva de Equipos a Presión 97/23/CE (Articulo 3.3)

- ef-ec Conexiones
- rf-rc Conexiones
- t Termómetro
- s Sonda
- v Desagüe
- p Purga aire



30 -50 AR



100 -1500 AR

AR	30	50	100	200	300	500	750	1000	1500
Capacidad (Lts)	30	50	100	200	300	500	750	1000	1500
ØD: Diámetro ext.(mm)	310	410	460	650	650	700	910	950	1.160
H: Altura Total (mm)	615	560	970	1.090	1.555	1.915	1.945	2.250	2.280
er /ec: entradas	1”	1”	1 ¼”	1 ½”	2"	3"	3"	3"	3"
ur / uc: salidas	½”	½”	1 ¼”	1 ½”	2"	3"	3"	3"	3"
p: purga superior	½”	½”	1 ¼”	1 ¼”	1 ¼”	1 ¼”	1 ¼”	1 ¼”	1 ¼”
v: vaciado	½” **(*)**	½” **(*)**	1 ¼”	1 ¼”	1 ¼”	1 ¼”	1 ¼”	1 ¼”	1 ¼”
t: toma termómetro	½”	½”	½”	½”	½”	½”	½”	½”	½”
s: toma termostato	½”	½”	½”	½”	½”	½”	½”	½”	½”
s´: toma auxiliar	½”	½”	½”	½”	½”	½”	½”	½”	½”
A (mm)	105	145	282	350	350	385	390	555	530
B (mm)	105	145	305	370	370	460	445	630	605
C (mm)	305	330	590	660	1.125	1.390	1.435	1.610	1.610
D (mm)	510	415	740	810	1.275	1.540	1.585	1.760	1.760
E (mm)	510	415	760	835	1.300	1.615	1.635	1.835	1.835

(*) En caso de necesitar vaciar el depósito, dispone de un manguito de ½” (Conexión V s/ esquema) en su parte inferior y el cual se expide de fabrica taponado. La tapa negra termoconformada inferior es ciega para estos modelos.