

Electric Heaters - Power Slices **Operation and Maintenance manual**

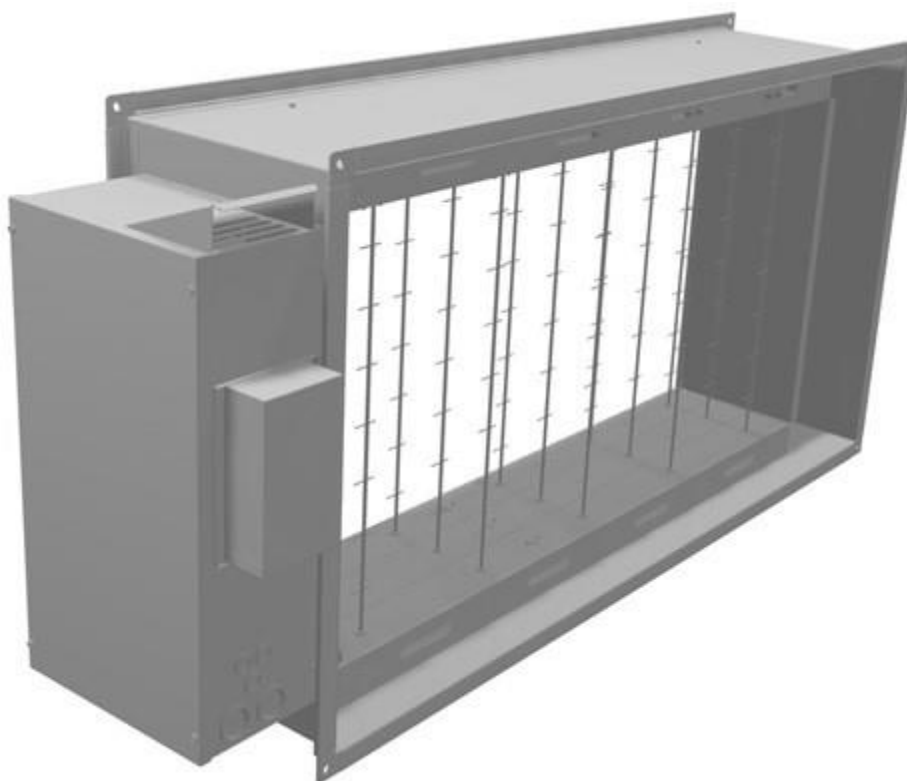


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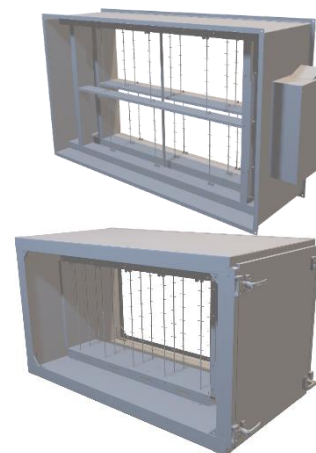
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1 Installation options

For the following AHU ranges: VVS Standard, AVS (with all subranges) and VVSc floor mounted units, the electric heater made of power slices can be applied in two different ways:

1.1 Electric heater in the non-insulated duct

As per default, the electric heaters made of power slices will be available as shown on the rights. All power slices will be simply installed in the short duct with the power junction box on the side.



1.2 Power slices in original AHU casing

If the electric heater needs to be a part of the AHU – in terms of being installed in the body of the unit – an option of full assembly in the original casing will be available.

For this option, the heater and its power junction box will be installed inside the “empty section” of the relevant air handling unit.

For such installation – the power slices will not be installed in the duct. The power slices will be directly mounted to the internal surface of the AHU empty section.

2 Range of the application

2.1 VVS Standard & AVS

For the VVS standard and AVS (with all subranges), the following heating power splits will be available for relevant AHU sizes:

VVS Standard size		21	30	40	55	75	100	120	150	180	230	300	400	500	650
AVS Standard size		8	12	16	20	30	40	55	65	85	100	130	170	230	380
Max number of slices	pcs	2	2	2	3	3	3	3	3	3	3	3	3	3	3
Individual slice capacity	kW	12	18	18	18	24	30	30	36	36	36	36	36	36	36
Max total capacity	kW	24	36	36	54	72	90	90	108	108	108	108	108	108	108

2.2 VVSc compact floor mounted air handling unit

The VVSc compact floor mounted AHUs have electric heater power options as per below table:

VVSc size		21	30	40	55	75	100	120	150
Max number of slices	pcs	1	2	2	2	2	2	2	2
Individual slice capacity	kW	18	18	24	30	30	36	36	36
Max total capacity	kW	18	36	48	60	60	72	72	72

2.3 VVSs suspended compact air handling unit

For the range of VVSs ceiling suspended unit, we have only 5 AHU sizes with heaters availability as listed below:

VVSs size		5	10	15	20	30
Max number of slices	pcs	1	1	2	2	2
Individual slice capacity	kW	10	12	18	18	18
Max total capacity	kW	10	12	36	36	36

2.4 NVS ducted air handling unit

The NVS air handling units are the last where new power split for the electric heaters has been developed:

NVS size		23	39	65	80
Max number of slices	pcs	1	2	3	3
Individual slice capacity	kW	18	18	18	24
Max total capacity	kW	18	36	54	72

3 SSR control

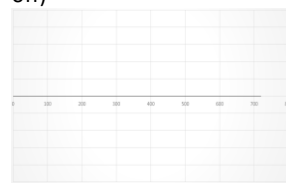
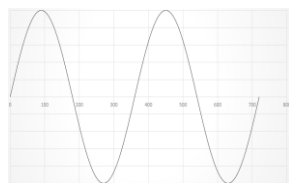
The idea of the SSR power regulation is based on cutting heater supplying voltage phases. See below charts, how the voltage supplying the adjustable power slice changes depending on the required heating demand:

100% heating demand

70% heating demand

30% heating demand

0% heating demand (heater off)



Each time the adjustable power slide reaches its full capacity, its effort is passed to the following slide which starts to run with its full capacity. Any additional heating capacity will be realized by smooth increase of the adjustable power slide heating power.

4 Technical details

4.1 Power and current details

Type	Qty of heaters in one slice	High power		Qty of slices	Total power [kW]
		Power of single heater [kW]	Power of single slice [kW]		
VVS005s	2	5	10	1	10
VVS010s	2	6	12	1	12
VVS015s	3	6	18	2	36
VVS020s	3	6	18	2	36
VVS030s	3	6	18	2	36
VVS021c	3	6	18	2	36
VVS030c	3	6	18	3	54
VVS040c	4	6	24	3	72
VVS055c	5	6	30	3	90
VVS075c	5	6	30	3	90
VVS100c	6	6	36	3	108
VVS120c	6	6	36	3	108
VVS150c	6	6	36	3	108
VVS021	3	6	18	2	36
VVS030	3	6	18	3	54
VVS040	4	6	24	3	72
VVS055	5	6	30	3	90
VVS075	5	6	30	3	90
VVS100	6	6	36	3	108
VVS120	6	6	36	3	108
VVS150	6	6	36	3	108
VVS180	6	6	36	3	108
VVS230	6	6	36	3	108
VVS300	6	6	36	3	108
VVS400	6	6	36	3	108
VVS500	6	6	36	3	108
VVS650	6	6	36	3	108

NVS23	3	6	18	1	18
NVS39	3	6	18	2	36
NVS65	3	6	18	3	54
NVS80	4	6	24	3	72

Low power

Type	Qty of heaters in one slice	Power of single heater [kW]	Power of single slice [kW]	Slices qty	Total power [kW]
VVS005s	2	1,25	2,5	1	2,5
VVS010s	2	1,5	3	1	3
VVS015s	3	2	6	1	6
VVS020s	3	2	6	1	6
VVS030s	3	2	6	1	6
VVS021c	3	2	6	1	6
VVS030c	3	2	6	1	6
VVS040c	4	1,5	6	1	6
VVS055c	5	1,5 / 2,0	9	1	9
VVS075c	5	1,5 / 2,0	9	1	9
VVS100c	6	2	12	1	12
VVS120c	6	2	12	1	12
VVS150c	6	2	12	1	12
VVS021	3	2	6	1	6
VVS030	3	2	6	1	6
VVS040	4	1,5	6	1	6
VVS055	5	1,5 / 2,0	9	1	9
VVS075	5	1,5 / 2,0	9	1	9
VVS100	6	2	12	1	12
VVS120	6	2	12	1	12
VVS150	6	2	12	1	12
VVS180	6	2	12	1	12
VVS230	6	2	12	1	12
VVS300	6	2	12	1	12
VVS400	6	2	12	1	12
VVS500	6	2	12	1	12
VVS650	6	2	12	1	12

High power

Type	Power [kW]	Control box type	L1/L2/L3	L1/L2/L3
			Current 1 [A]	Current 2 [A]
VVS005s	10	1x18	21,6/12,5/12,5	-
VVS010s	12	1x18	26/15/15	-
VVS015s	18	1x18	26/26/26	-
VVS015s	36	2x18	52/52/52	-
VVS020s	18	1x18	26/26/26	-
VVS020s	36	2x18	52/52/52	-
VVS030s	18	1x18	26/26/26	-
VVS030s	36	2x18	52/52/52	-
VVS021	18	1x18	26/26/26	-
VVS021	36	2x18	52/52/52	-
VVS030	18	1x18	26/26/26	-
VVS030	36	2x18	52/52/52	-
VVS030	54	4x18	52/52/52	26/26/26
VVS040	24	2x18	41/41/26	-
VVS040	48	4x18	41/41/26	41/26/41
VVS040	72	4x18	52/52/52	52/52/52
VVS055	30	2x18	52/41/41	-
VVS055	60	4x18	52/52/52	41/41/26
VVS055	90	6x18	78/78/78	52/52/52
VVS075	30	2x18	52/41/41	-
VVS075	60	4x18	52/52/52	41/41/26
VVS075	90	6x18	78/78/78	52/52/52
VVS100	36	2x18	52/52/52	-
VVS100	72	4x18	52/52/52	52/52/52
VVS100	108	6x18	78/78/78	78/78/78
VVS120	36	2x18	52/52/52	-
VVS120	72	4x18	52/52/52	52/52/52
VVS120	108	6x18	78/78/78	78/78/78
VVS150	36	2x18	52/52/52	-
VVS150	72	4x18	52/52/52	52/52/52
VVS150	108	6x18	78/78/78	78/78/78
VVS180	36	2x18	52/52/52	-
VVS180	72	4x18	52/52/52	52/52/52
VVS180	108	6x18	78/78/78	78/78/78
VVS230	36	2x18	52/52/52	-
VVS230	72	4x18	52/52/52	52/52/52
VVS230	108	6x18	78/78/78	78/78/78
VVS300	36	2x18	52/52/52	-
VVS300	72	4x18	52/52/52	52/52/52
VVS300	108	6x18	78/78/78	78/78/78

VVS400	36	2x18	52/52/52	-
VVS400	72	4x18	52/52/52	52/52/52
VVS400	108	6x18	78/78/78	78/78/78
VVS500	36	2x18	52/52/52	-
VVS500	72	4x18	52/52/52	52/52/52
VVS500	108	6x18	78/78/78	78/78/78
VVS650	36	2x18	52/52/52	-
VVS650	72	4x18	52/52/52	52/52/52
VVS650	108	6x18	78/78/78	78/78/78
NVS23	18	1x18	26/26/26	-
NVS39	36	2x18	52/52/52	-
NVS65	54	4x18	52/52/52	26/26/26
NVS80	72	4x18	52/52/52	52/52/52

Low power

L1/L2/L3

Type	Power [kW]	Control box type	Current 1 [A]
VVS005s	2,5	1x18	6,3/6,3/0
VVS010s	3	1x18	7,5/7,5/0
VVS015s	6	1x18	8,7/8,7/8,7
VVS020s	6	1x18	8,7/8,7/8,7
VVS030s	6	1x18	8,7/8,7/8,7
VVS021	6	1x18	8,7/8,7/8,7
VVS030	6	1x18	8,7/8,7/8,7
VVS040	6	1x18	13/7,5/7,5
VVS055	9	1x18	16,2/16,2/8,7
VVS075	9	1x18	16,2/16,2/8,7
VVS100	12	1x18	17,3/17,3/17,3
VVS120	12	1x18	17,3/17,3/17,3
VVS150	12	1x18	17,3/17,3/17,3
VVS180	12	1x18	17,3/17,3/17,3
VVS230	12	1x18	17,3/17,3/17,3
VVS300	12	1x18	17,3/17,3/17,3
VVS400	12	1x18	17,3/17,3/17,3
VVS500	12	1x18	17,3/17,3/17,3
VVS650	12	1x18	17,3/17,3/17,3

4.2 Electrical supply system details

TN system

rated supply voltage

3x400V

insulation rated voltage

400V

rated impulse withstand voltage

2.5 kV

Rated short-time current I_{cw} for individual circuits - effective

value of the periodic component withstood for 1 s, i.e. short-circuit current

expected at switching voltage

6 kA

rated short-circuit current 6 kA

rated coefficient of diversity 0.8

rated frequency 50 Hz $\pm$ 1 Hz

degree of protection IP00

permissible operating temperature 0 x 50 °C

control circuits supply voltage 24 V DC

5 Electrical connection

Connecting power supply should be carried out with a separate switchgear, not supplied with the VTS package.

Connection of the heater should be done in a way to prevent from possibility of switching on the heater when the fan is not switched on. What is more, if the fan stops, the heater's power supply must be turned off as well.

NOTICE! The thermostat must be absolutely installed in the heater control system.

Thermostat functionality is based on the bimetal element properties, resulting in opening the heater control circuit contacts at air temperature near the thermostat up to 65°C. After emergency turn off, the heater turns on automatically once the air temperature goes down by 20°C.

After intended or emergency (caused by overheating) turning off the power supply, the supply-air fan has to operate for some time (0.5–5 min), so as the heater's coils reached their normal temperature.

Overheating thermostat



Functions and application

Protection module of the electric heater protecting it against overheating

Construction

Metal casing

Two screw terminals

bimetallic element with a function of a normally closed contact

Operation parameters

activation temperature: 65 $\pm$ 3°C

hysteresis: 17 $\pm$ 3°C

parameters of bimetallic element voltage: 30VDC permissible load.

Differential pressure control



Functions and application

Fan's pile-up control

Construction

Membrane coupled with mechanical module. If the acceptable pressures difference is exceeded, the membrane undergoes deformation and switches off

casing: plastic

Operation parameters

measurement: 20 – 300 Pa:

rated operational voltage 30VDC

output signal: voltage-free (switching contact)

number of cycles: $<10^6$ cycles

operation conditions: $-30 - +85^{\circ}\text{C}$

protection class: IP44

Recommended pressure control operating position: horizontal. In case of vertical alignment, the set point value is 11Pa higher than the real one.

6 Wiring cable types details

Power cord for electric heaters (voltage 3 ~ 400VAC)

Multi-core, copper conductor - twisted cable

Operating voltage U_0 / U 450 / 750V

Working temperature $-30 - +60^{\circ}\text{C}$

Power cable for the control system (voltage 1 ~ 230VAC)

Multi-core, copper conductor - twisted cable

Working voltage U_0 / U 300 / 500V

Working temperature $-30 - +60^{\circ}\text{C}$

Control cable for the control system (24VDC signals)

Multi-core, copper conductor - twisted cable

Working voltage U_0 / U 300 / 500V

Working temperature $-30 - +60^{\circ}\text{C}$

7 Wiring schematics

High power and low power box contains the same elements – only difference is in the connection of the heaters. Electric heater supply wiring should be let through the fixed panel, at the AHU's back. If the wiring is led through the inspection panel, on the front side, then it should be arranged so as to enable opening the section for maintenance and service operations.

Dashed line ——— CONNECTION MADE BY CUSTOMER

Solid line ————— CONNECTION MADE BY MANUFACTURER

Heater wiring can be divided into two parts:

- 1) Group of cables with connection independent of the type of heater
- 2) Group of cables, the connection of which changes with the type of heater and the components used in the AHU

This division is illustrated in the following two tables:

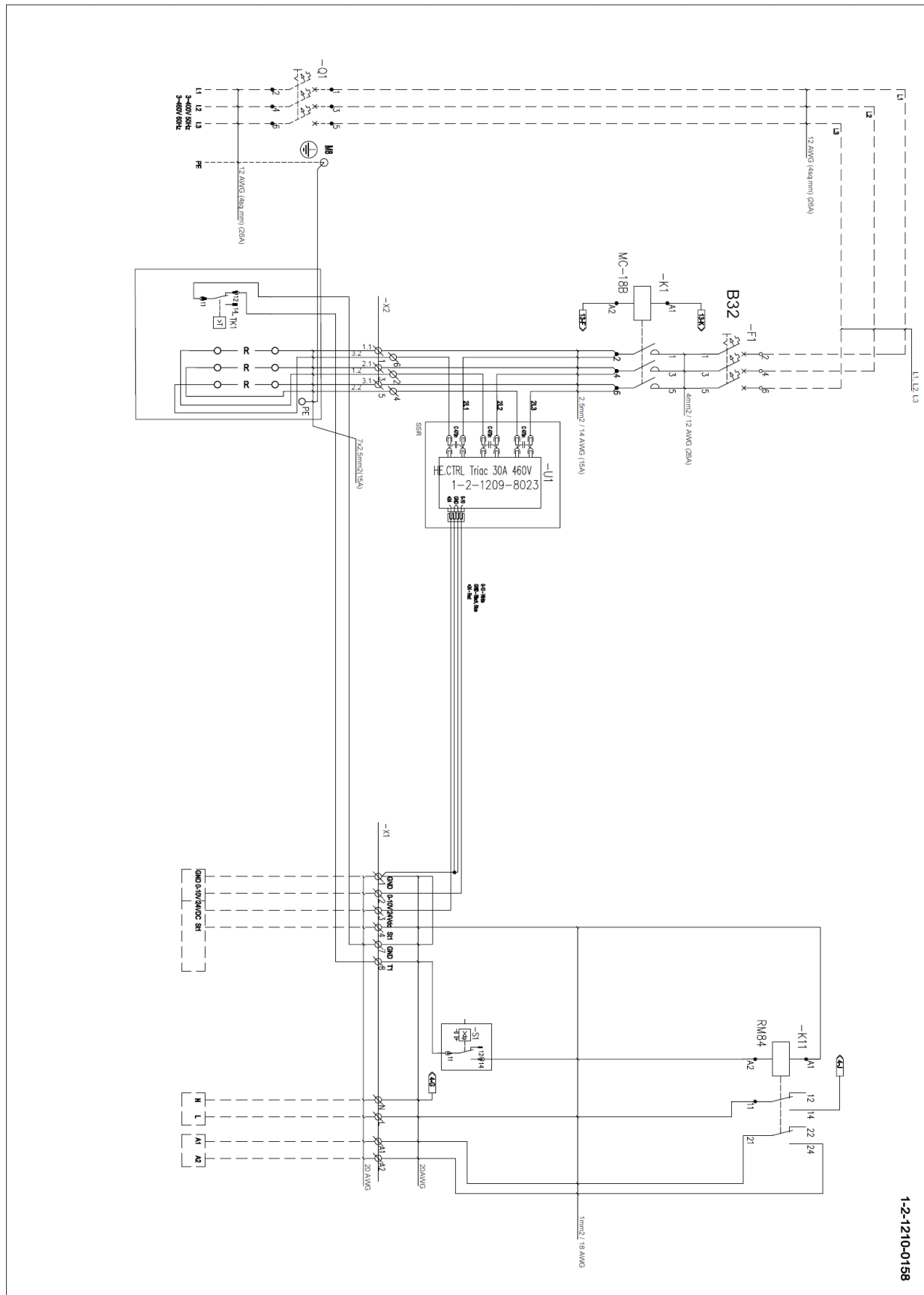
Terminal number	Terminal name	Signal name	Connect to:	Type of control box				Connection terminal on the control box	
1	GND	Ground	->	CBX				G0	
				Compact				G0	
				Other				GND	
3	24VDC	Power 24VDC	->	CBX				G	
				Compact				G	
				Other				+24V DC	
X				Sections quantity					
				1		2		3	
4	St1	Start1	->	CBX	G	CBX	G	CBX	G
				Compact	G	Compact	G	Compact	G
				Other	+24V DC	Other	+24V DC	Other	+24V DC
L	L	Power 230V AC	->	230V AC					
N	N								
A1	A1	Work confirmation	->	CBX				DI2	
				Compact				DI2	
				Other				free voltage contact	
A2	A2			CBX				G0	
				Compact				G0	
				Other				free voltage contact	

Table - group of cables with connection independent of the heater type

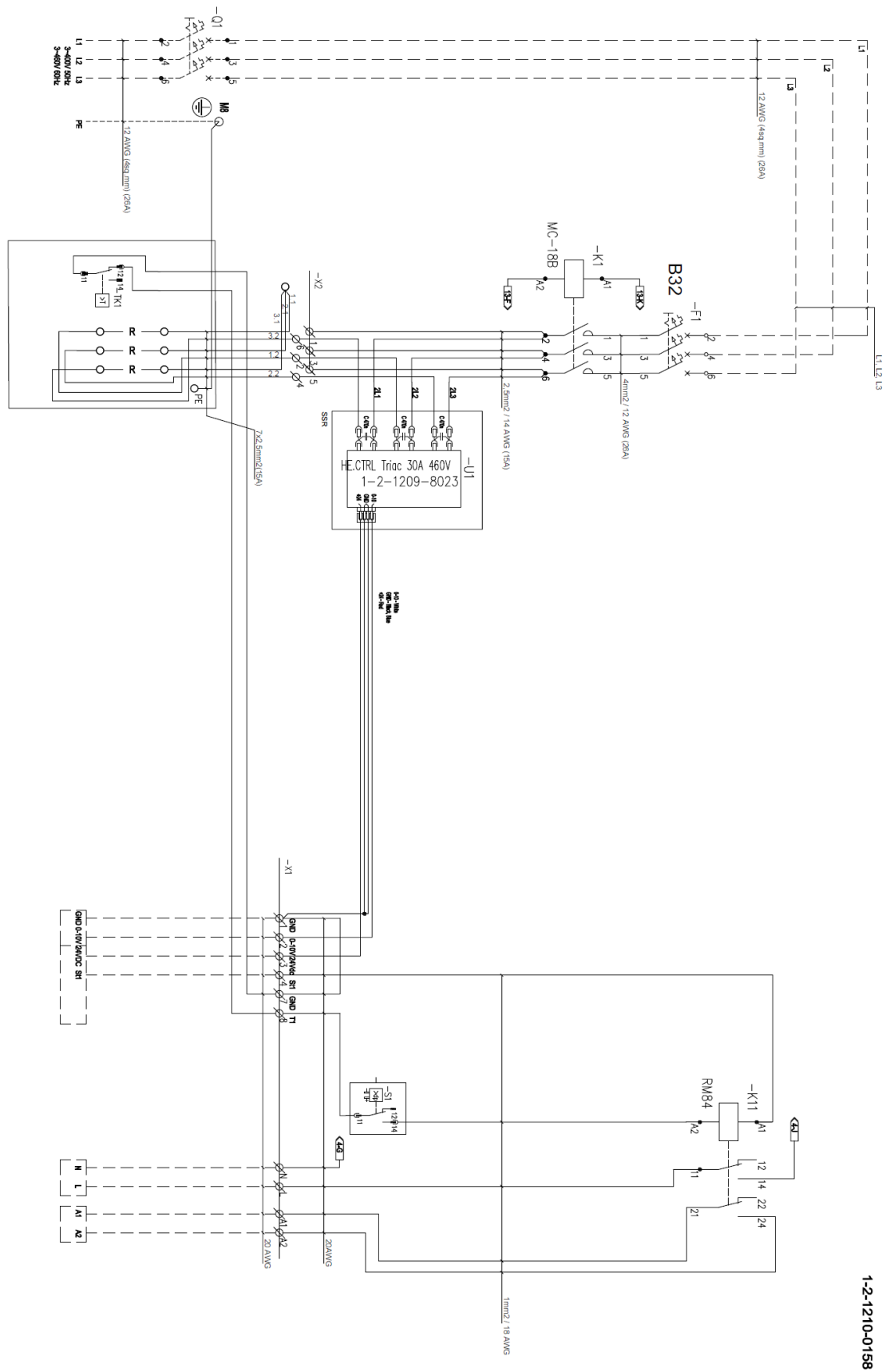
Terminal number	Terminal name	Signal name	Connect to:	Type of control box	Type of heater	Terminal name on the control box		
2	0-10V	Signal 0-10V DC	->	CBX	main	Y1		
					preheater	AO2		
					reheater – AHU with DXH	NO1		
					reheater – AHU with hum.	NO1		
					reheater – other	NO1		
				Compact	main	Y1		
					preheater	AO4		
					reheater – AHU with DXH	Y1		
					reheater – AHU with hum.	AO4		
					reheater – other	AO3		
				Other	all	0-10V DC		
X						Sections quantity		
						1	2	3
5	St2	Start2	->	CBX	main	-	NO1	NO1
					preheater	-	NO3	-
					reheater – AHU with DXH	-	NO1	-
					reheater – AHU with hum.	-	NO3	-
					reheater – other	-	NO3	-
				Compact	main	-	DO1	DO1
					preheater	-	DO6	-
					reheater – AHU with DXH	-	DO1	-
					reheater – AHU with hum.	-	DO6	-
					reheater – other	-	DO6	-
				Other	all	-	+24V DC	+24V DC
6	St3	Start3	->	CBX	main	-	-	NO6
					preheater	-	-	-
					reheater – AHU with DXH	-	-	-
					reheater – AHU with hum.	-	-	-
					reheater – other	-	-	-
				Compact	main	-	-	DO5
					preheater	-	-	-
					reheater – AHU with DXH	-	-	-
					reheater – AHU with hum.	-	-	-
					reheater – other	-	-	-
				Other	all	-	-	+24V DC

Table - group of cables, the connection of which changes depending on the type of heater and components used in the AHU

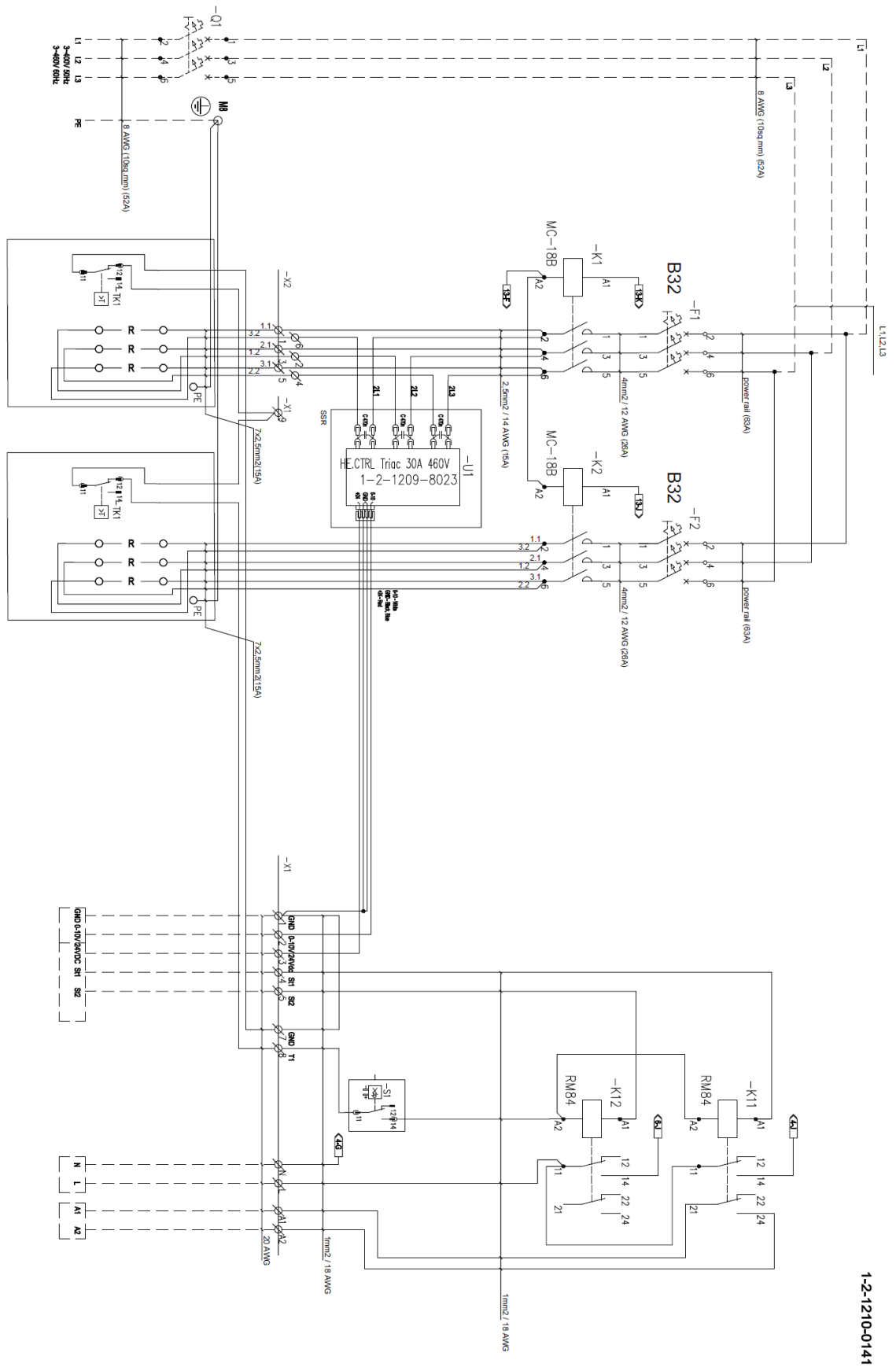
7.1 1x18kW High power



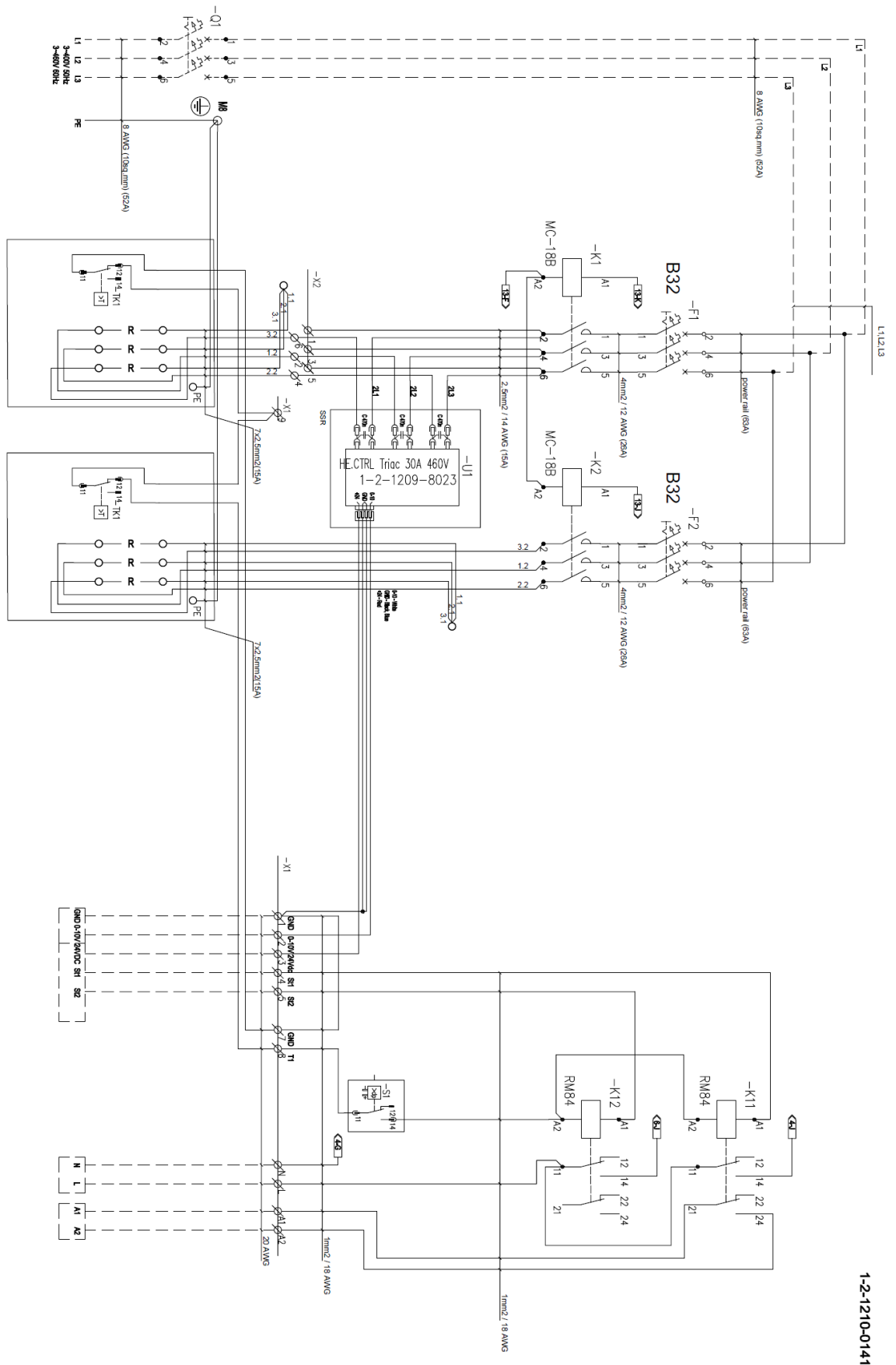
7.2 1x18kW Low power



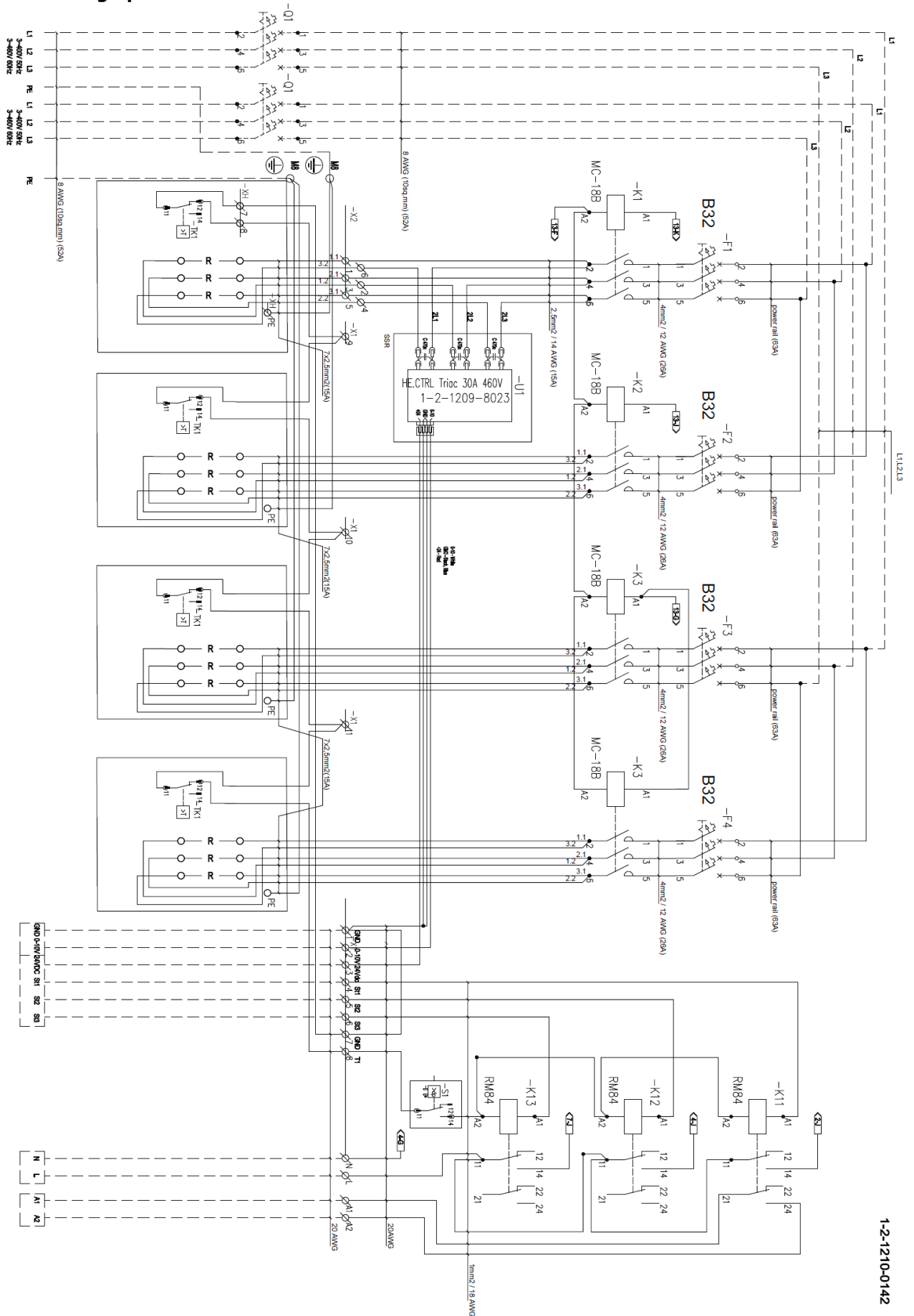
7.3 2x18kW High power



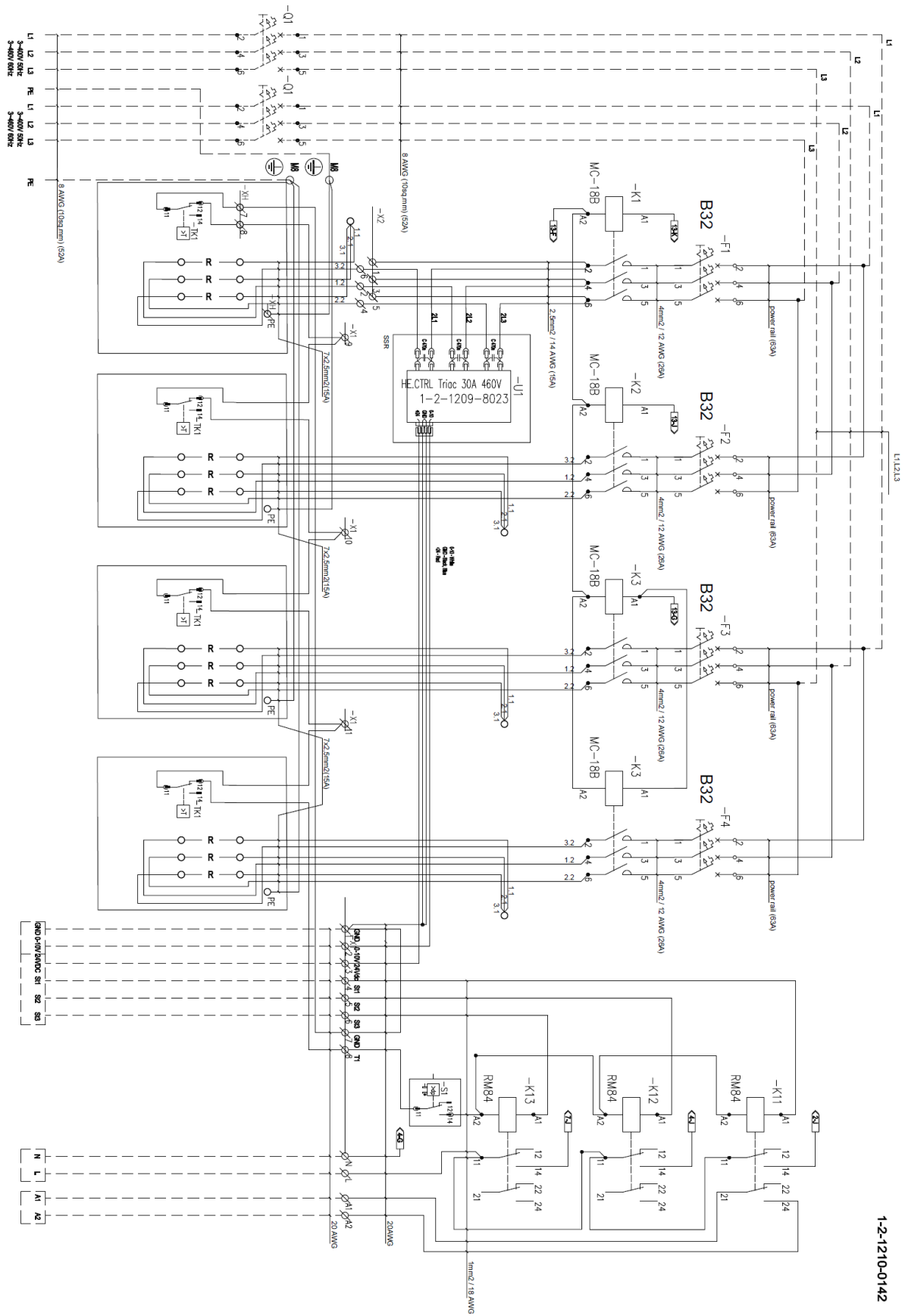
7.4 2x18kW low power



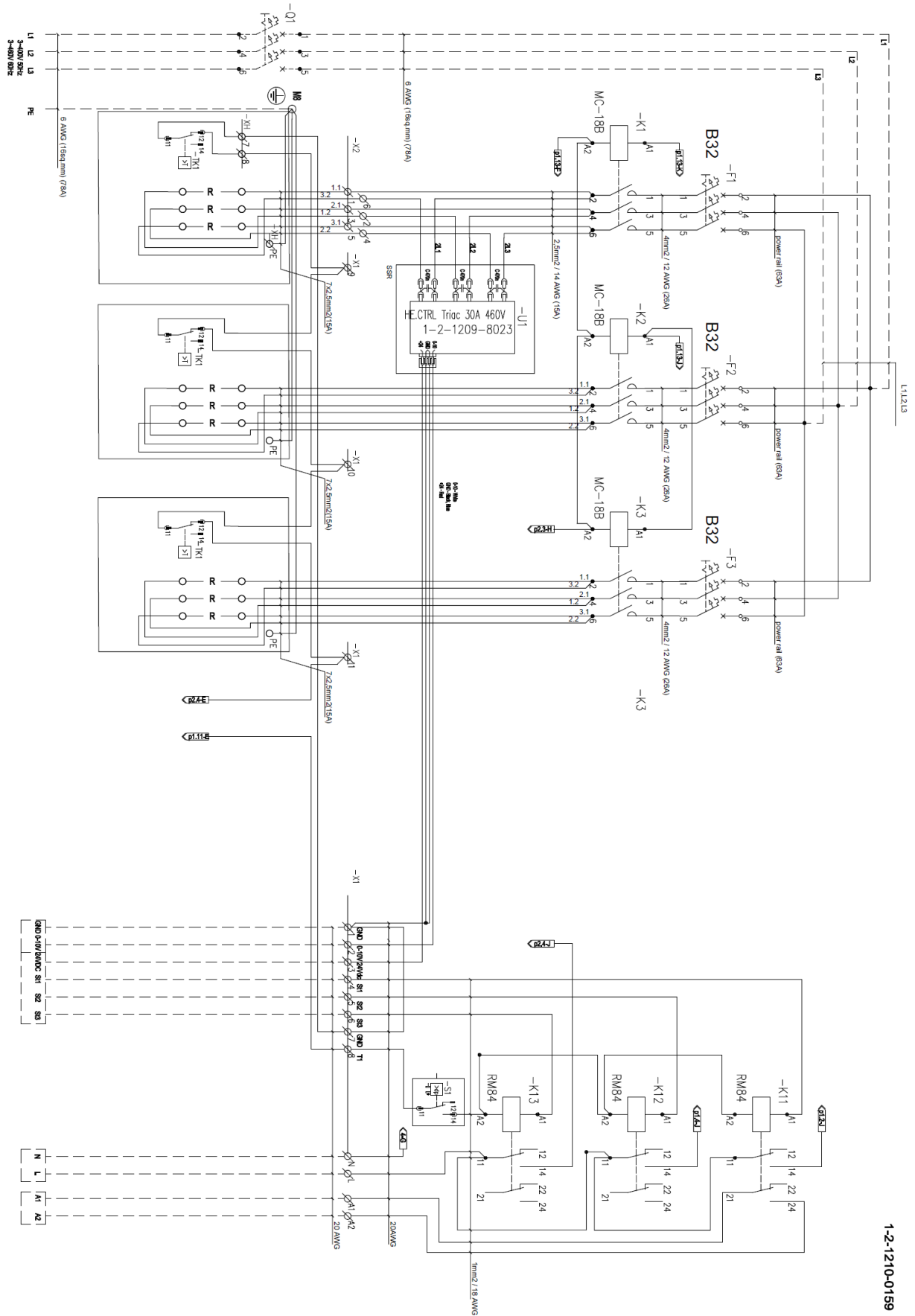
7.5 4x18kW High power

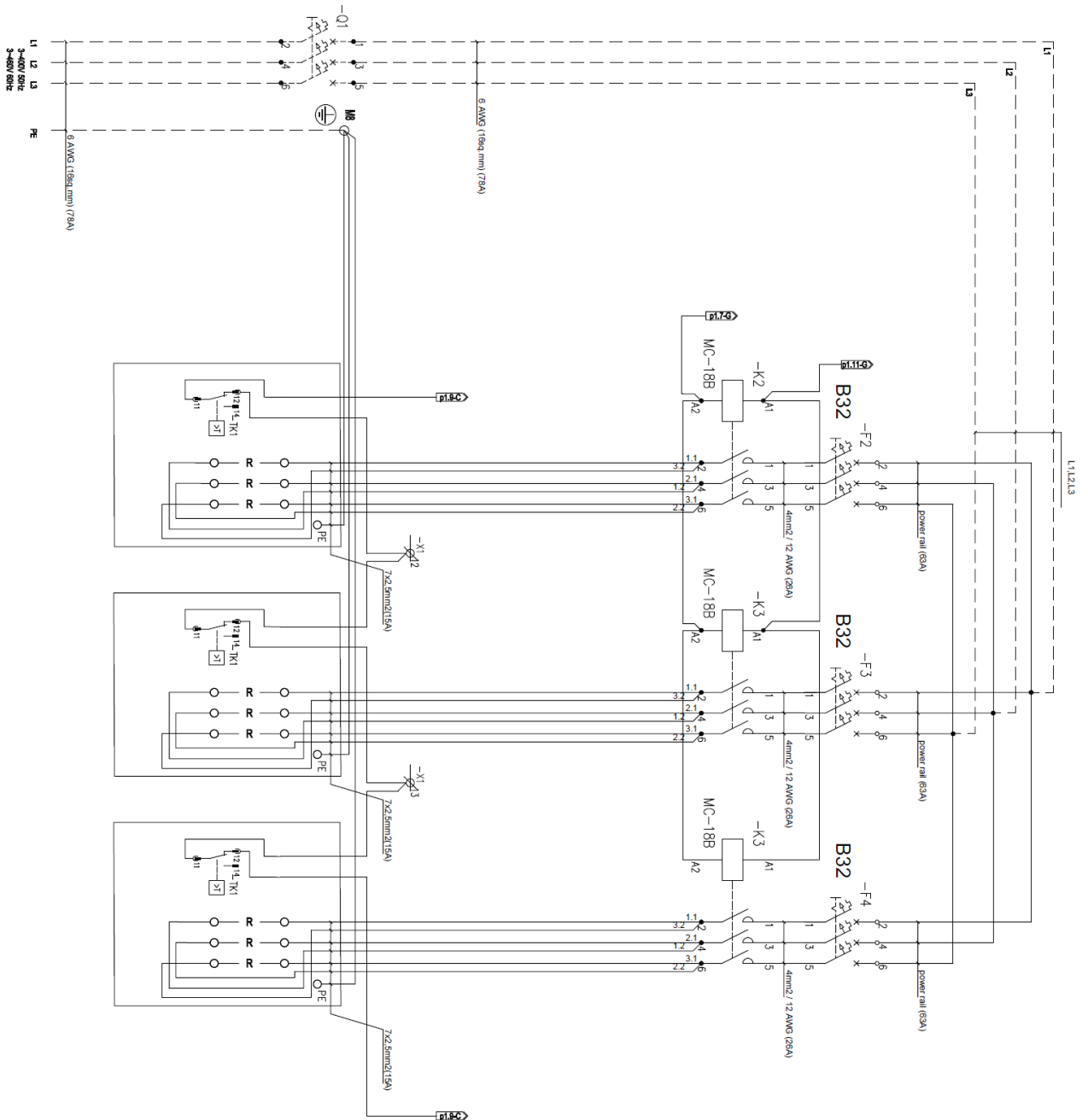


7.6 4x18kW Low power



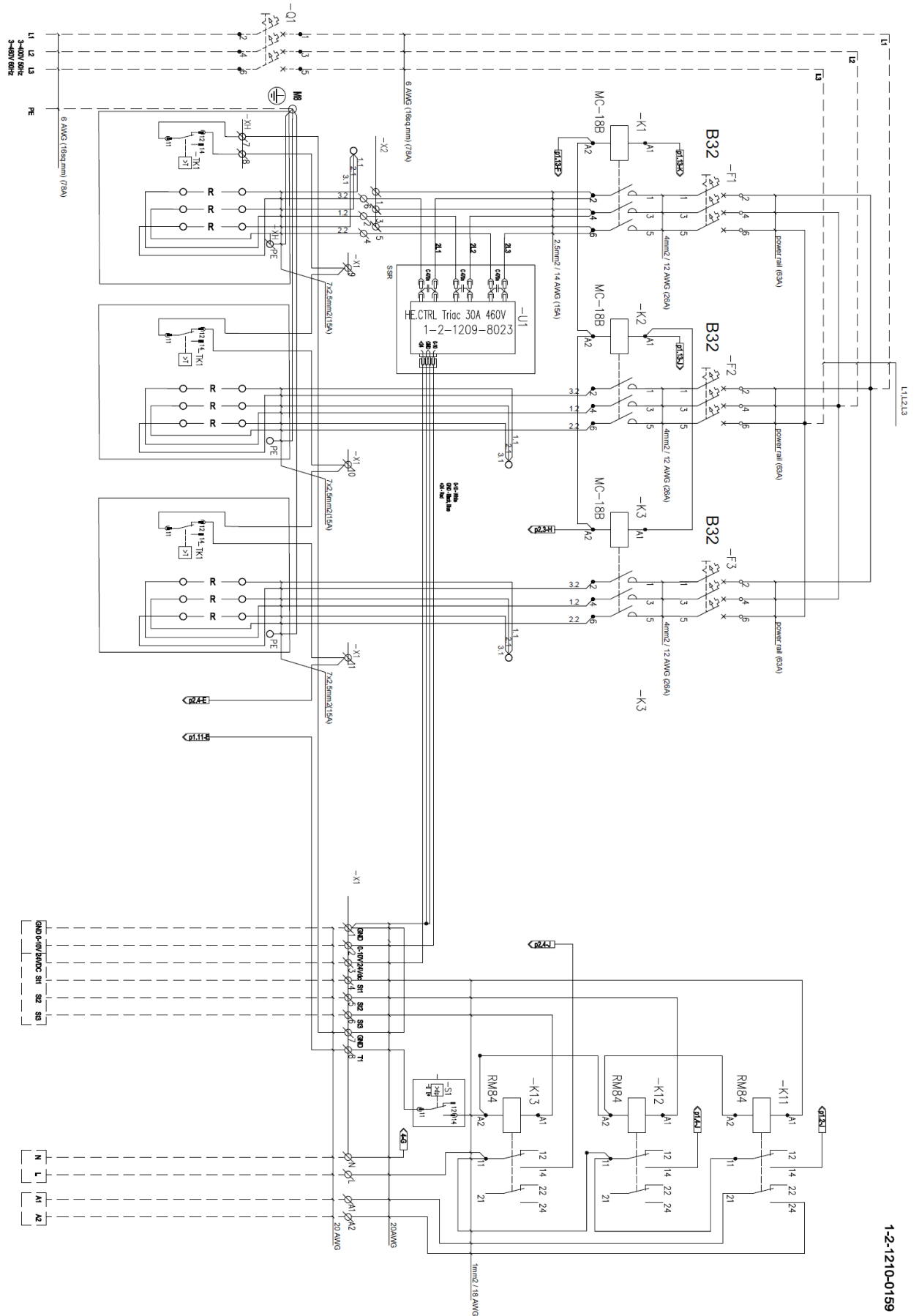
7.7 6x18kW High power

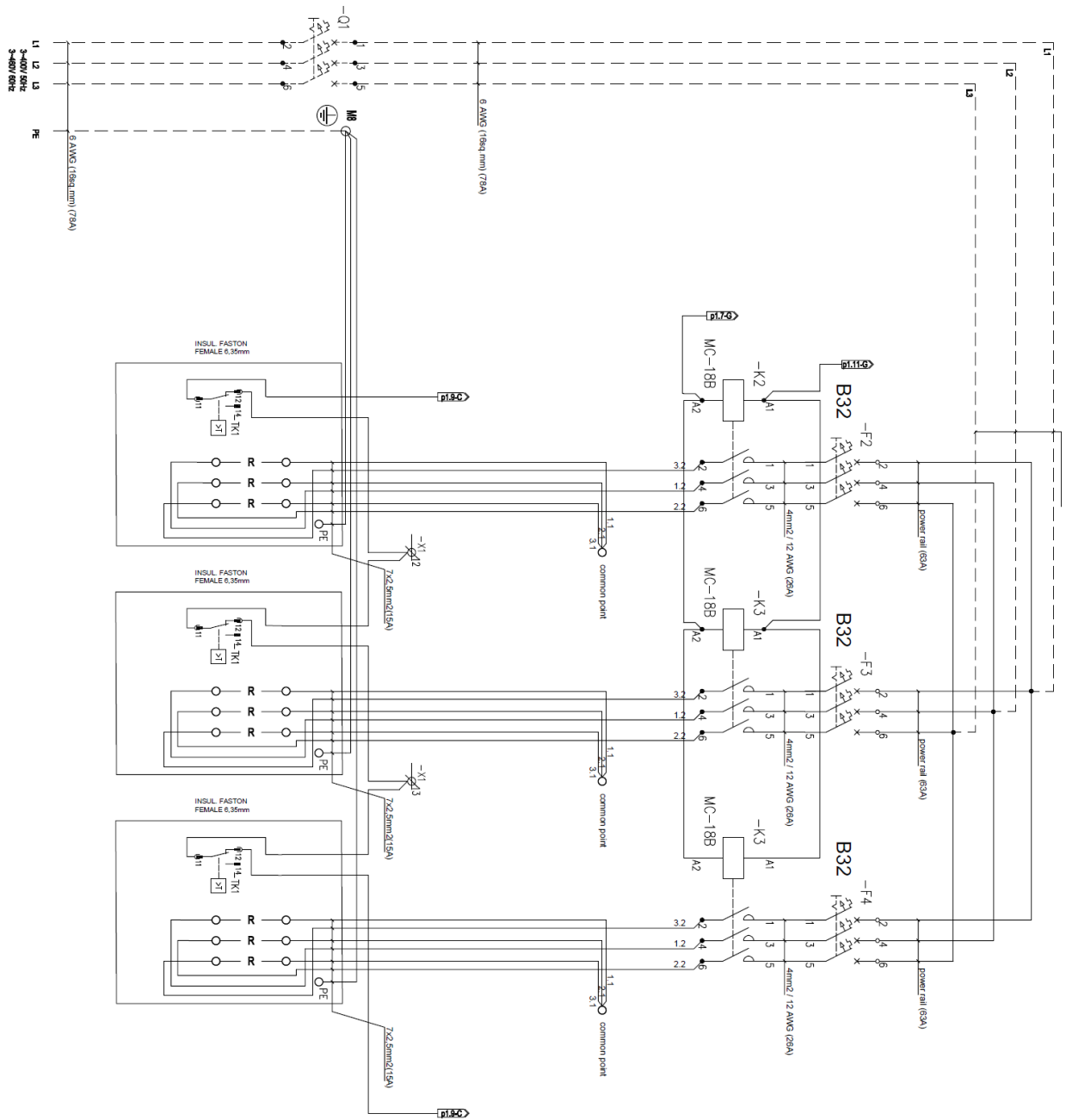




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7.8 6x18kW Low power





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8 Maintenance Procedure

Electric heater consists of bare heating coils. During AHU operation, when the heater does not work, dust may settle onto the heating coils. Once the heater is turned on again, strong contamination may cause smell of burning dust or even preliminary fire danger may appear. Check regularly (every year) and especially before starting a heating period, any electric connections, condition of heating elements and their contamination level. Any possible contamination should be removed with a vacuum cleaner with soft suction nozzle or with compressed air. Regularly check the operation of overheating protection in case of lack of air-flow. Air speed should not be lower than 1,5 m/s.