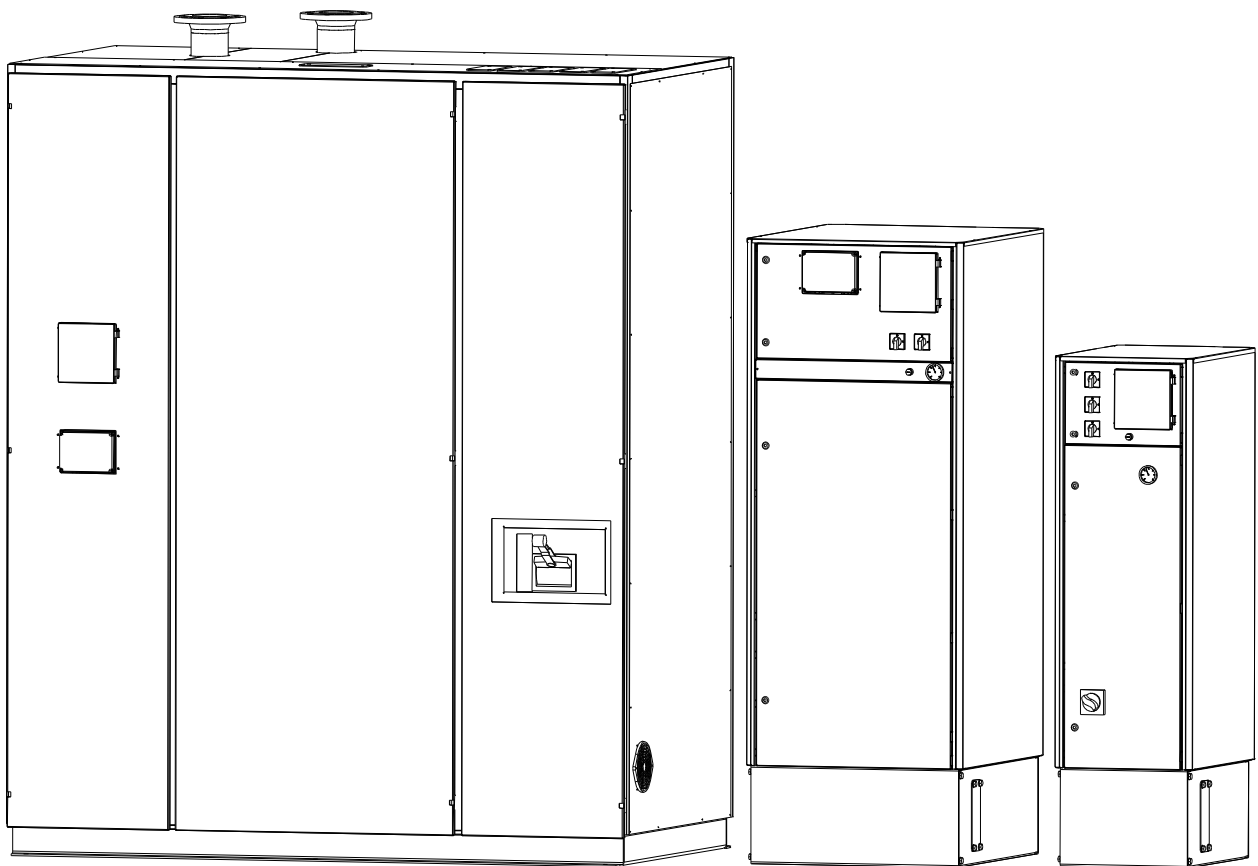


FIL-SPL

Flow-through heater for central heating

with 0 - 10 V EP 15-30 control unit

USER MANUAL



Kaukora LTD.

D106159 r3.0

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1. Important information

Safety information

This appliance is not intended for use by children or persons, whose physical, sensory or mental disabilities or lack of experience and knowledge would prevent the safe use of the appliance, if they are not under the supervision of a person responsible for ensuring their safety or have been training in the proper use of the appliance.

Rights to make any design or technical modifications are reserved.

General

This user manual must be left with the customer.

Note! After the main switch has tripped, ensure that the main switch is reset by first positioning the switch to "0" (off) and then back to "I" (on) position.

Note! When the temperature limiter, dry-boiling preventer or current limit in the main switch are activated, the main switch is tripped.

Note! Always use original or equivalent spare parts.

Note! Check and tighten the boiler's wire connections after 100 operating hours and then at least once a year.

Marking

FIL-SPL is CE marked and fulfills IP20.

The CE marking means that Kaukora ensures that the product meets all regulations that are placed on it based on relevant EU directives. The CE mark is obligatory for most products sold in the EU, regardless where they are made.

Serial number

The serial number can be found from the type plate at the left side of the boiler, on the top right corner.

Note! Always give the product's serial number when reporting a fault.

Inspection of the installation

Current regulations require the heating installation to be inspected before it is commissioned. The inspection must be carried out by a suitably qualified person. Fill in the page for information about installation data.

INSTALLATION INSPECTION	
Description	Notes (fill: OK / YES / NO/ NA / write more info)
Heating medium	
Water circulation system installed accordingly	
Safety valve installed accordingly	
Installations according to HVAC diagram	
System is vented	
Pressure of the system	_____ bar
Plumping installation company:	_____
Telephone:	_____
Installer:	_____
Date:	_____
Signature:	_____
Electrical connections	
Main fuses (of the property)	_____ A
Fuses of FIL-SPL	_____ A
Primary side current transformers installed	conversion ratio: _____
Secondary side current transformers installed	
Current transformer for observation of internal power consumption installed	
Power limitation taken into use	
Electrical installation company:	_____
Telephone:	_____
Installer:	_____
Date:	_____
Signature:	_____
Settings	
Max. number of allowable power steps (Menu 2.1.1 Max)	
Step time (Menu 2.1.2 Time)	
Max. current limit (Menu 2.2.1 Max)	
Miscellaneous	
Serial number	
Currently measured boiler temperature	_____ °C
Functionality tested and approved	
<i>Note! The installation inspection must be filled for meeting requirements for manufacturers guarantee.</i>	

2. Delivery and handling

Transport

The FIL-SPL must be transported and stored vertically in a dry place. The FIL-SPL boiler should be lifted only from the lifting point on top of the boiler.

Physical installation

Mount FIL-SPL boiler on a firm base that can take the weight, preferably on a concrete floor or foundation. The boiler must be mounted in an upright position and bolted on the floor, preferably in a dry and warm space with a floor drain.

A clearance of approximately 300-500 mm must be left behind the boiler for pipe connections and for ventilation. According to safety regulations, at least 1 meter of free space must be left in front of the boiler.

With models from 31.5 to 300 kW, either side of the boiler may be close to a wall. With these models, approximately 1 meter space should be left above the boiler for possibly replacing resistor elements.

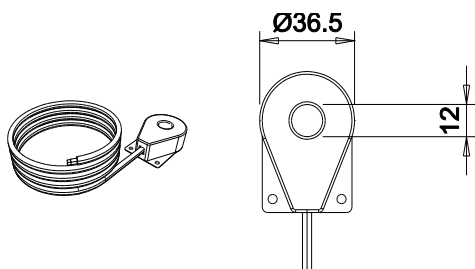
With models from 400 to 1600 kW, there must be left space for possibly replacing resistor elements that are located on one side that is depending on construction. With these models pipe and electrical connections are on the top of the boiler and thus requires space.

Note! When selecting mounting location, bear in mind that pipe installations, control valves and other plumbing arrangements needs also space.

Note! Leave enough space for servicing boiler and external circulation pump.

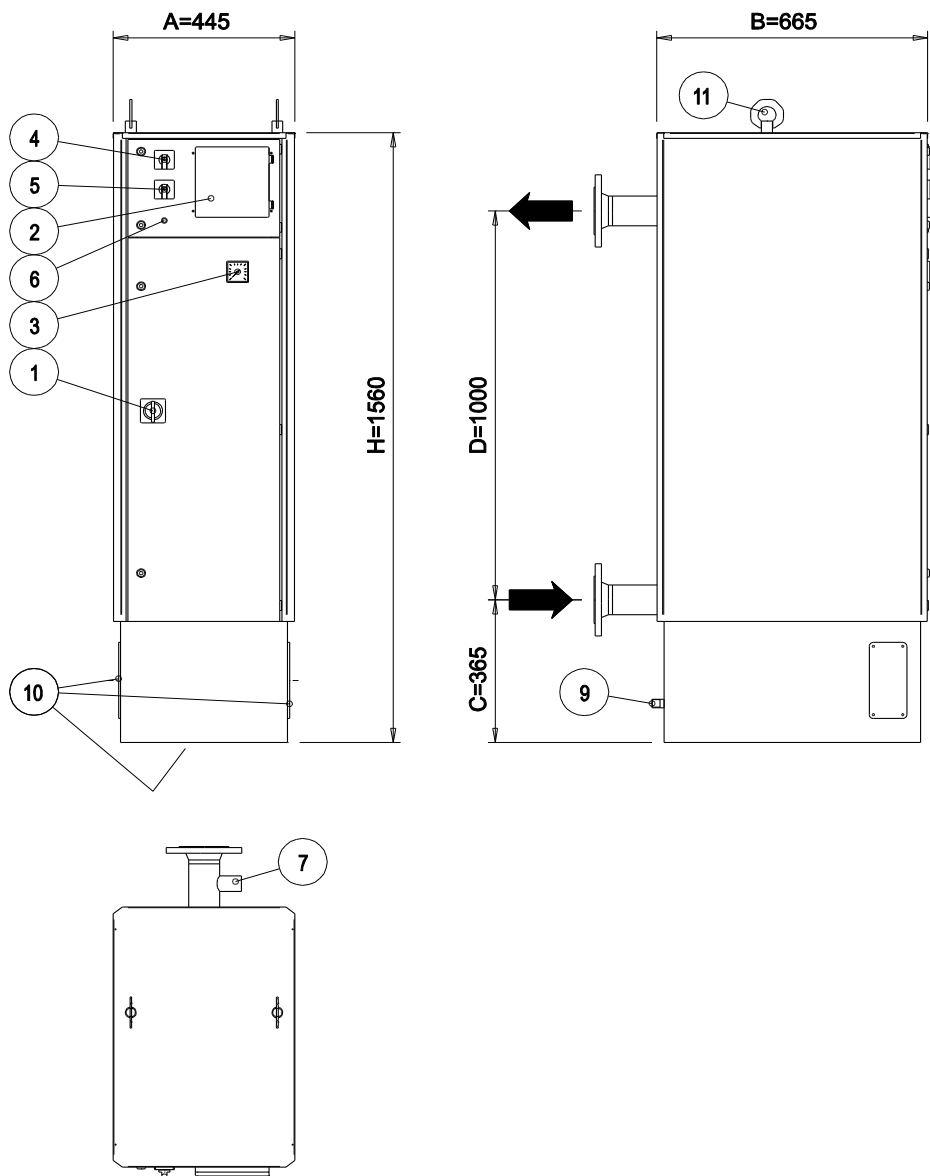
Supplied components

Jäspi current transformers can be ordered as an accessory. The Jäspi current transformers can be used as secondary current transformers for load monitoring of main fuses or for observation of internal power consumption for alarm. If both properties are needed, one set of Jäspi current transformers and one extra Jäspi current transformer must be ordered. The transform ratio of Jäspi current transformers is 300/1.



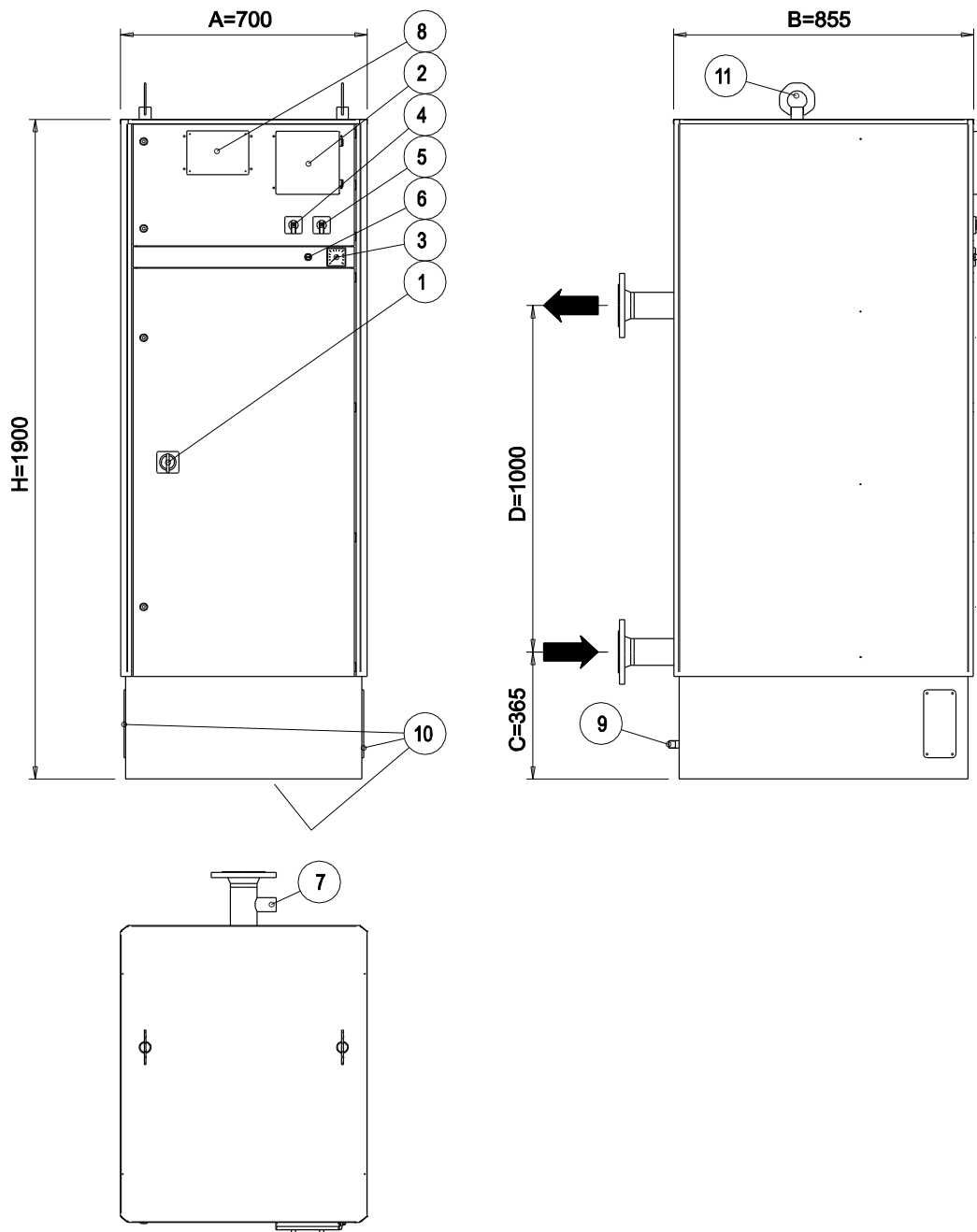
3. Structure and measures of FIL-SPL boilers

Models of 31 - 112 kW



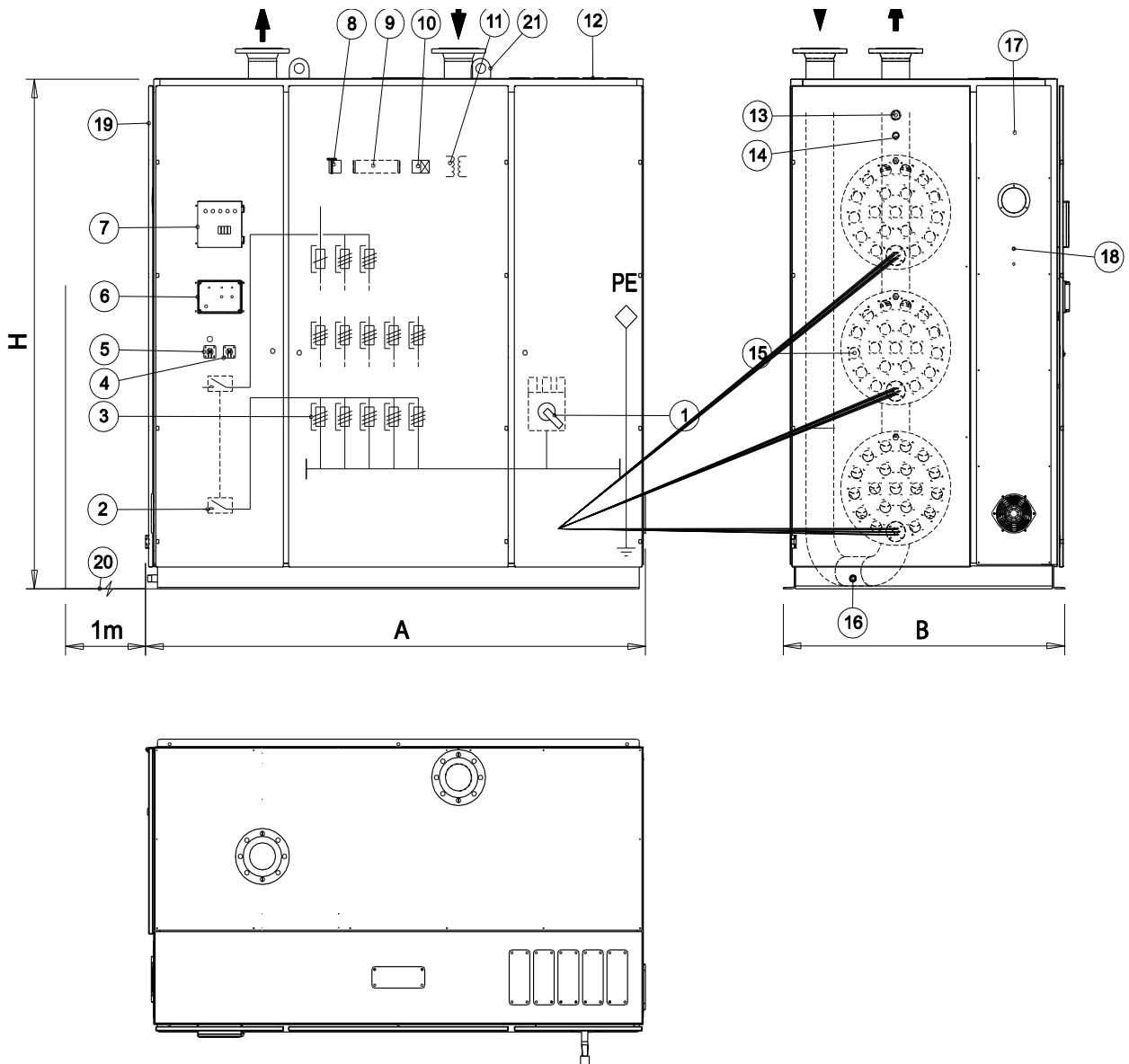
No.	Name
1	Safety main switch (CB + switch disconnector + trip)
2	Control unit
3	Temperature gauge
4	Control voltage switch
5	Heating mode selection switch
6	Temperature limiter
7	Placeholder for sensor of dry-boiling preventer
9	Connection for draining
10	Placeholder for electrical cables
11	Lifting point

Models of 150 - 300 kW



No.	Name
1	Safety main switch (CB + switch disconnecter + trip)
2	Control unit
3	Temperature gauge
4	Control voltage switch
5	Heating mode selection switch
6	Temperature limiter
7	Sensor of dry-boiling preventer
8	Dry-boiling preventing unit
9	Connection for draining
10	Placeholder for electrical cables
11	Lifting point

Models of 400 - 1600 kW



No.	Name
1	Safety main switch (CB + switch disconnecter + trip)
2	Power step contactors
3	Power step fuses
4	Heating mode selection switch
5	Control voltage switch
6	Dry-boiling preventing unit
7	Control unit
8	Backup heating thermostat
9	Connectors
10	Time delay relay
11	Control voltage transformer
12	Placeholder for electrical cables
13	Sensor of dry-boiling preventer

14	Temperature sensors (limiters and thermostat)
15	Heating elements
16	Connection for draining
17	Temperature gauge
18	Thermostat/temperature limiter
19	Door for heating element service
20	Required space for service of heating elements
21	Lifting point
A	2000 mm
B	1150 mm
C	1800 mm for 400...800 kW 2000 mm for 801...1200 kW 2400 mm for 1201...1600 kW

4. Pipe connections

General pipe connections

Pipe installation must be carried out in accordance with current norms and directives.

Maximum of 10 bar safety valve must be installed in the supply pipe before any shut-off valve. The safety valve must be dimensioned so that its blowdown force with steam is equal to the boiler power. The size of the blowdown pipe cannot be reduced from its nominal size and must be positioned so that the steam discharge does not cause any personnel injuries or property damage.

When installing pipes, special attention must be given to the installation of safety valves, expansion installations and possibility for air discharge in the electric boiler discharge pipe. The direction of flow must be marked on the supply and return pipes.

Note! Any high points in the climate system, must be equipped with air vents.

Note! The pipe systems need to be flushed out before the boiler is connected so that any debris cannot damage component parts.

Note! The main switch must not be moved to "I" (on) until the system has been filled with water and water circulation is ensured. Otherwise the temperature limiter, thermostat and the immersion heater etc. can be damaged.

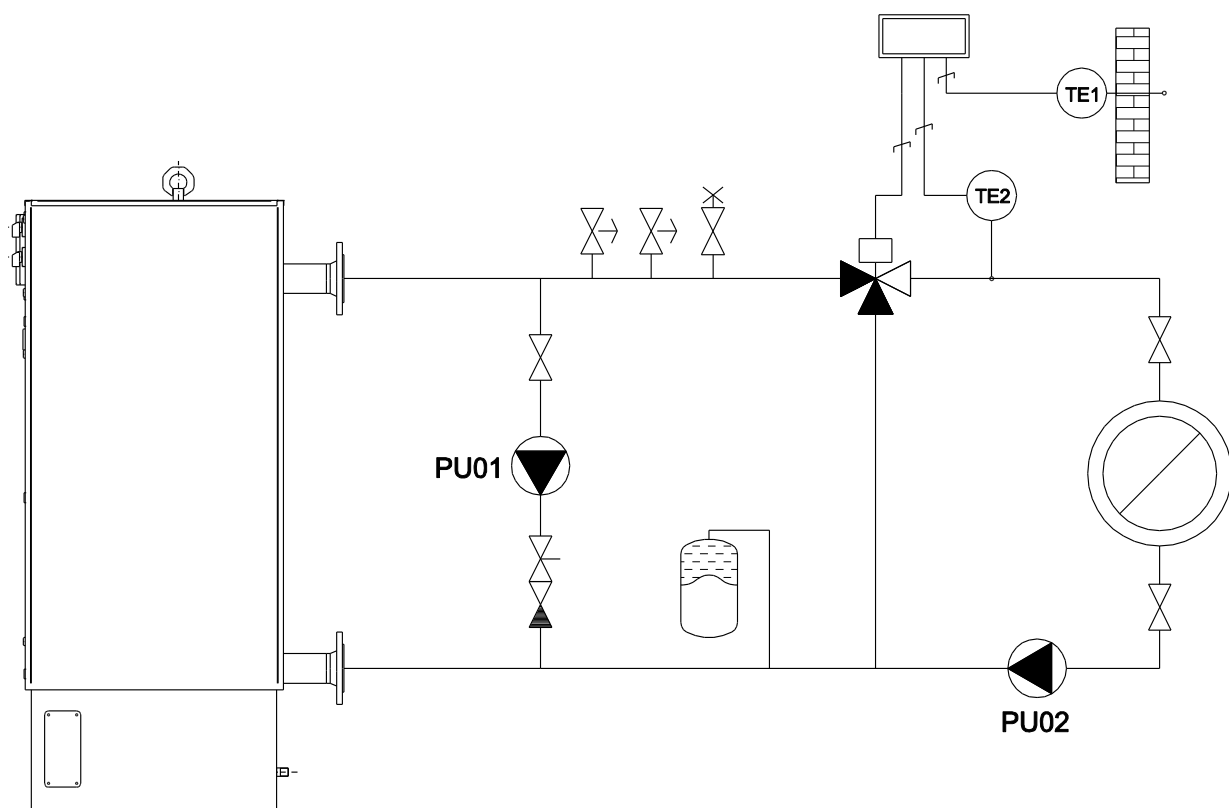
System diagram

The FIL-SPL electrical boiler consists of resistor elements and control unit. The boiler operates on a flow-through principle and thus requires an external system that constantly circulates water in the heater. Recommended external circulation pump can be found from Technical data, Recommended circulation pumps.

Note! The water circulation in the FIL-SPL boiler must be ensured in all possible cases, unless the boiler is intentionally shut down with the main switch.

The boiler can be used directly for heating or indirectly to produce hot water for general use.

Typical applications include industry, apartment blocks, row houses or similar. The boiler is suitable for use as a supplemental/backup heat source for heat pumps.



5. Electrical connections

General

All electrical equipment, except the current sensors are connected and tested at the factory. Internal connections must never be changed.

- Sensor cables to external connections must not be laid closer than 20 cm to high voltage cables
- Models up to 300 kW have 5-wire system for main supply
- Models from 400 to 1600 kW have 4 wire system for main supply and are equipped with integrated control voltage transformer
- Models from 120 kW have integrated dry-boiling preventer
- With models of 31.5 to 300 kW, the main supply can be routed either through a floor drain from the base of the boiler or as a surface installation through the flanged ports on the sides of the boiler
- With models from 400 to 1600 kW the main supply is to be routed on the top of the boiler
- The boiler is to be permanently connected to main supply
- See recommended fuse sizes etc. from Technical data, Electrical properties of FIL-SPL boilers

Note! Electrical installation and service must be carried out under the supervision of a qualified electrician. Cut the current with the main switch before carrying out any servicing. Electrical installation and wiring must be carried out in accordance with the regulations in force.

Main switch

The FIL-SPL boiler has integrated main switch. The main switch operates as an isolator switch if temperature limiter or dry-boiling preventer detects an error or in case of overload.

Note! The main switch must not be moved to "I" (on) until the system has been filled with water and water circulation is ensured. Otherwise the temperature limiter, thermostat and the immersion heater etc. can be damaged.

Note! After the main switch has tripped, ensure that the main switch is reset by first positioning the switch to "0" (off) and then back to "I" (on) position.

Control voltage switch

The control voltage switch is for enabling the control voltage for control unit.

Heating mode selection switch

The heating mode selection switch is for selecting whether normal heating mode or backup heating mode is used. If the heating mode selection switch is on "0" (off) position, the boiler is in disable state.

Note! In backup heating mode only part of the power is available.

External control selection switch

The external control selection switch is used to select whether the boiler is operating independently or is there some external control used to enable heating, e.g. command from heat pump. If the external control mode selection switch is on "0" (off) position, the boiler operates independently.

Fuse for control

There is own fuse for control. The fuse is common to control unit and other controlling components such as temperature limiter, relay controls and backup heating thermostat.

Temperature limiter

The temperature limiter is a safety feature for preventing the boiler of boiling.

Note! Reset the temperature limiter by first removing the shed and the pressing the button using a small screwdriver. Press the button lightly.

Note! Models over 300 kW have double temperature limiters for safety reasons.

Backup heating thermostat

The backup heating thermostat is for controlling heat of the boiler in backup mode. The thermostat is locked to 75 °C in the factory.

Connections

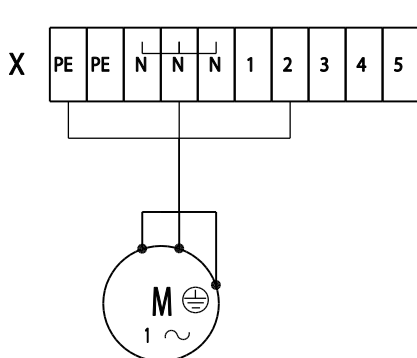
Main supply

The size and type of the supply cable is always determined on a project-specific basis according to the used fuses, the cable lengths, installation method and applicable standards. The main supply is connected directly to the main switch (phases), to neutral connector (neutral) and to equipment grounding (protective earth).

Note! Models from 400 to 1600 kW uses 4-wire connection (neutral is not needed).

Mandatory external circulation pump

The FIL-SPL boiler is a flow through heater, and thus requires an external circulation pump for circulating water in the boiler. While the boiler is enabled and there is possibility to shut off the heating medium circuit (with for example building automation), the water circulation in the boiler must be guaranteed in such cases with external circulation pump and piping (see System diagram as an example). The control voltage of the circulating pump can be taken from X:2 (L), X:N (N) and X:PE (PE).



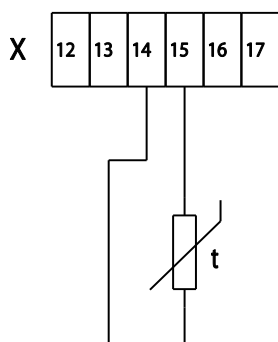
Optional connections

Outdoor temperature control

The temperature of the boiler can be controlled automatically by measuring result of outdoor temperature sensor. The outdoor temperature sensor must be connected to X:14 and X:15. Use only Jäspi outdoor temperature sensor. Locate the temperature sensor in the shade on a wall facing north or north-west for preventing effect of for example morning sun.

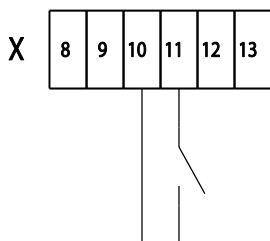
Note! Remember to first enable the property from Menu 4.5 OutdoorComp and to set configurations accordingly from Menu 1.1.1/2 OutdoorComp.

Note! Sensor cables to external connections must not be laid closer than 20 cm to high voltage cables.



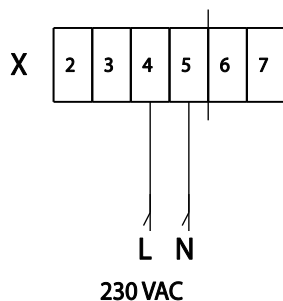
External blocking

The boiler can be forced to disable all electrical power of heating with potential-free closed contact. Connect the switch to X:10 and X:11. This property can be used for example for power company limitations. The heating is blocked while the contact is closed.



External on/off control

The boiler can be remotely enabled or disabled with 230 VAC control voltage. This property can be used for example when the boiler is used as an additional immersion heater within heat pump system. Connect the external control voltage to X:4 (L) and X:5 (N). The heating is enabled while 230 VAC is connected to the X:4-5.

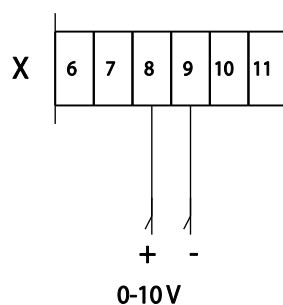


Note! The external on/off control needs to be taken into use with external control selection switch.

Note! Remember to add warning label of external control voltage!

0 - 10 V external control

External analogue inputs (0 - 10 V / 20 - 90 °C) can be used for controlling boiler temperature. Note that external control voltage does not overrule internal settings, and thus for example the max. temperature, that is set, will be overruling. Connect external 0 - 10 V control voltage to X:8 (+) and X:9 (-).



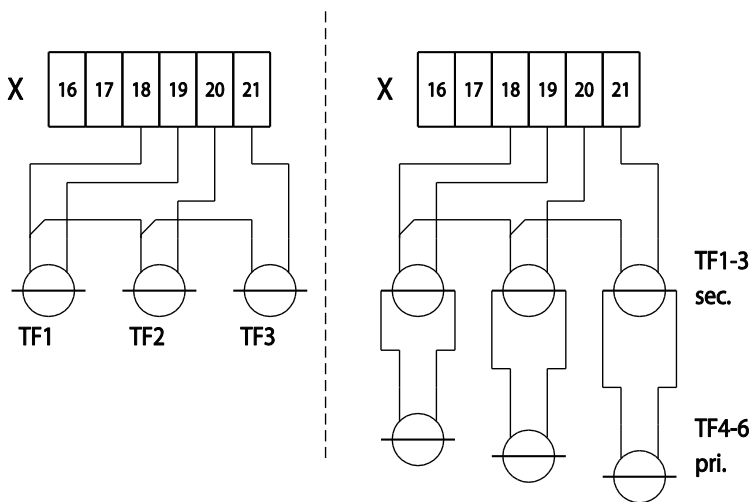
The external 0 - 10 V control property must be enabled from the software, see Menu 4.3 Input for more information. Information about voltage levels versus power steps in different modes can be found from Technical data, External control voltage (input) values and corresponding power steps in different modes.

Load Monitor

Load monitor is used for protecting main fuses of the property. The primary side current transformers must be located near main fuses of the property. Optimum place would be immediately after power meter. Note that primary side current transformers should have suitable conversion ratio. The load monitor uses measured values of Jäspi current transformers (secondary side current transformers) and limits the power of the boiler while one of the phases has overcurrent. Connect the Jäspi secondary side current transformers to X:18 (common), X:19, X:20 and X:21.

*Note! The minimum area of Jäspi current transformer cables must be 1.5 mm² up to 500 m.
Recommendation is to use shielded cable.*

Note! With main fuses (of the property) smaller than 3 x 70 A, the Jäspi current transformers may be used directly for load monitor.



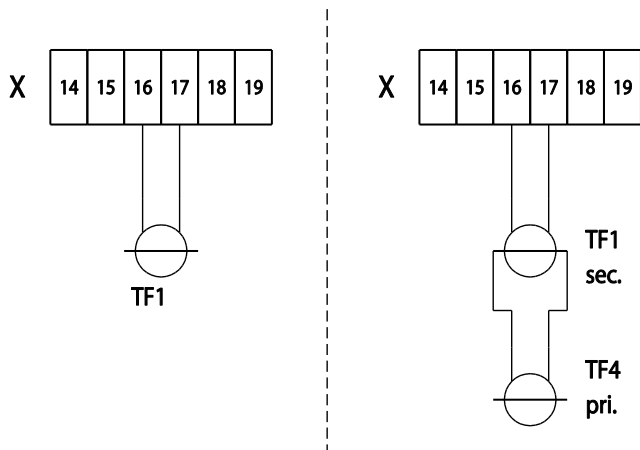
On the left side of the figure above is connection of relatively small main fuses (< 70 A), when Jäspi current transformers (TF1-3) can be used directly (depends on the size of the supply cable). On the right side of the figure is shown the connection when primary side current transformers (TF4-6) are needed and Jäspi current transformers (TF1-3) are used as secondary side current transformers.

The load monitor property must be enabled and configured accordingly in the software. More information can be found from Menu 2.2 Current.

Observation of internal power consumption

Connecting 1 primary side current transformer (with a suitable conversion ratio) and a Jäspi secondary side current transformer to the main supply of electric boiler, allows the control unit to monitor the power consumed by the boiler. The observation enables activation of an alarm in response to an internal lack of power in the boiler. (e.g. contactor, fuse or resistor failure). Connect the Jäspi secondary side current transformer to X:16 and X:17.

Note! With 31.5 kW model, the Jäspi current transformers may be used directly for load monitor.

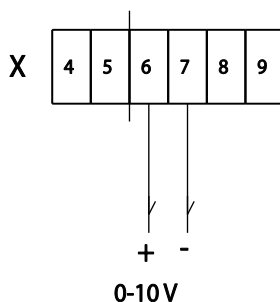


The observation of internal power consumption property must be enabled and configured accordingly in the software. More information can be found from Menu 2.3 Effect factor.

0 - 10 V status output

Status data of the FIL-SPL boiler can be shown out via analog voltage message. Connect status output to X:6 (+) and X:7 (-). As a status, following information can be given:

- Target temperature value
- Measured temperature value
- Currently used power step in 15 steps mode
- Currently used power step in 7 steps mode



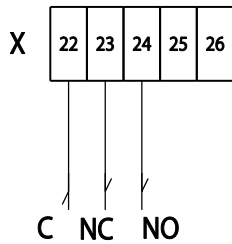
The status output 0 - 10 V property must be enabled and configured accordingly from the software, see Menu 4.4 Output for more information. Information about voltage levels versus status in different modes can be found from Technical data, Status output voltage values and corresponding status data in different modes.

Alarm relay output of control unit

The FIL-SPL boiler can activate a potential free changeover contact when an alarm is detected. Connect an alarm indication to X:22 (common), X:23 (NC), X:24 (NO). During the alarm, the X:22-24 are connected.

The initial cause of an alarm will be identified on the display. Possible issues that generates an alarm:

- Malfunction of the temperature sensor of the boiler
- Issue in observation of internal power consumption (needs accessory)
- Low supply voltage of control unit (nominal - 10 %)



Note! Remember to add warning label of external control voltage!

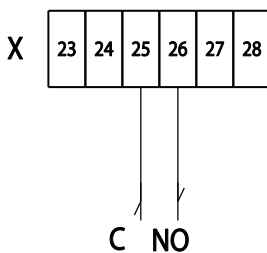
Note! The alarm relay output can have maximum load of 2 A (230 V AC) in total.

Alarm relay output of the main switch

The FIL-SPL boiler has an extra alarm relay in the main switch. If the main switch trips for some reason, the changeover contact in the main switch can be used as an alarm source for example for building automation. Connect the alarm from the main switch to X:25 and X:26 (NO). During the alarm, the X:25-26 are connected.

Possible issues that generates an alarm:

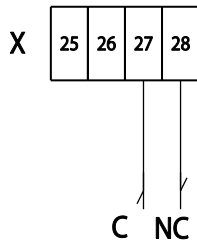
- Overload in the main switch
- Temperature limiter
- Dry-boiling preventer (models from 120 kW to 1600 kW)



Note! Remember to add warning label of external control voltage!

Status output of control unit

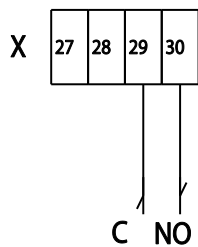
The FIL-SPL boiler can indicate the On/Off status of the control unit. The information can be used for example in building automation. Connect the status information of the control unit to X:27 and X:28 (NC). While the control unit has supply voltage the X:27-28 are connected.



Note! Remember to add warning label of external control voltage!

High temperature alarm in switchboard (only with 800-1600 kW models)

The FIL-SPL boiler automatically starts cooling fans if the temperature of the switchboard increases. However, if the temperature exceeds 50 °C, an alarm will be given. The information can be used for example in building automation. Connect the alarm information of the high temperature in switchboard to X:29 and X:30 (NO). While the alarm is activated the X:29-30 are closed.



Note! Remember to add warning label of external control voltage!

6. Commissioning and adjusting

Preparations

1. Verify that all installation work is done (both piping and electrical)
2. Check that the main switch is in "0" (off) position
3. Check that possible drain valve of the system is fully closed
4. Ensure that in every possible case the water is circulated to the boiler.

Filling and venting

1. Open venting valve of the system
2. Fill the system with water
3. Keep topping up and venting until all air has been removed and the pressure is correct
4. Close venting and filling valves

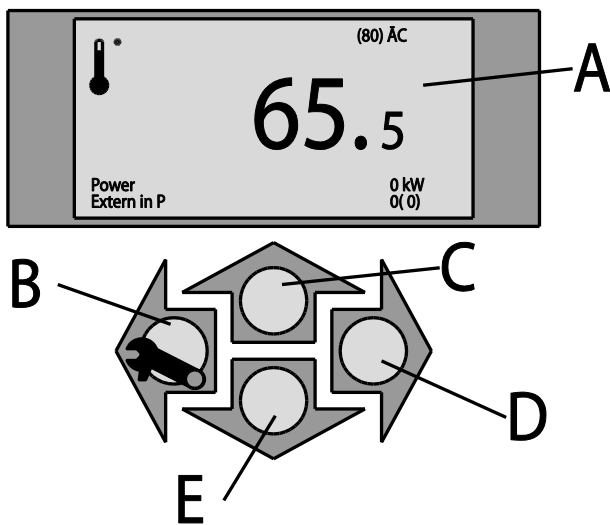
Start-up and inspections

Note! If your power company has requested limitations of power, the power company representative usually wants to make limitation settings.

1. Verify that valves are opened/closed accordingly
2. Verify that the water circulation of the heater is operating
3. Verify that the safety valve(s) operates accordingly
4. Turn the main switch first to "0" (off) position (especially if the main switch has tripped)
5. Start the FIL-SPL boiler by turning the main switch to "I" (on) position
6. Turn the control switch to position "I" (on)
7. Turn the heating mode (normal/backup) selection switch to normal heating mode
8. Turn the external control selection switch according to your system
9. Set control mode and appropriate settings, see more information from Control - Menus
10. Set possible other settings, such as external control, power limitations etc. see more information from Control - Menus
11. Check for possible leaks
12. After the boiler has reached the target temperature, ensure that the power steps are not enabled/disabled unnecessarily i.e. check that the boiler is not fluctuating. More information can be found from Menu 2.1.2 Time.
13. The device is now ready for use.

7. Control

Display unit



A. Display

Instructions, settings and operational information are shown on the display.

B. Back button

The back button is used to:

- Move back in menu (save modifications)
- Move to menu from default screen

C. Move up button

The move up button is used to:

- Move up in the menu
- Increase selected value
- Move to menu from default screen

D. Select button

The select button is used to:

- Select property to be modified
- Move to menu from default screen

E. Move down button

The move down button is used to:

- Move down in the menu
- Decrease selected value
- Move to menu from default screen

Note! Presentation "X (Y)" indicates that "X" is currently measured value and value in parenthesis "(Y)" is the target value.

Menu system

The menu system consists of four main menus; info, service, tests and Setup.

Menu 1 - *Info*

Display of temperature and other operating information and access to the service menu

Menu 2 - *Service*

Advanced settings and access to the test and setup menus.

Menu 3 - *Test Manually*

Advanced tests for maintain and service.

Menu 4 - *Setup*

Advanced setup for controlling the device.

8. Control - Menus

Menu 1 - Info

Overview

Menu 1 - Info			
	Temp	(informative)	
	Setting	(default)	
	OutdoorComp	(while enabled)	
	Step	(informative)	Maxtemp
	AC in	(informative)	Mintemp
	Menu 2 - Service		Curve
			Parallel

Menu 1.1 Temp

Currently measured boiler temperature. Informative reading.

Menu 1.1.1/1 Setting

Target temperature of the boiler. This menu is shown when the outdoor temperature control is disabled.
Settable value:

- Setting range 30 - 99 °C
- Default value 70 °C

The target temperature is set in the control unit. The measured value of temperature sensor, located inside the boiler, is compared to the target value and appropriate power step is taken into use. Hysteresis of the temperature is $\pm 2^{\circ}$. The controller has a P-range of $\pm 3^{\circ}$ C and is constantly adjusting to maintain the set temperature. If the temperature increases or decreases, it is corrected by increasing or decreasing the power output. If the boiler temperature is on the low limit of the P-range, the sensor will send a full power command to the electric boiler.

Menu 1.1.1/2 OutdoorComp

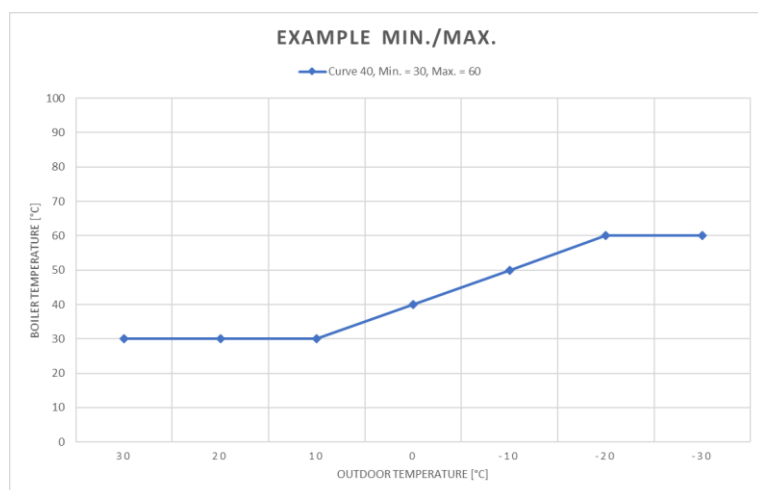
Settings for outdoor temperature control. This menu is shown when the outdoor temperature control is enabled. The menu consists of four submenus.

Maxtemp is the maximum allowable boiler temperature ie. cuts the curve at high end (programmable temperature limiter). See example figure “example min./max.” below.

- Setting range 30 - 95 °C
- Default value 80 °C

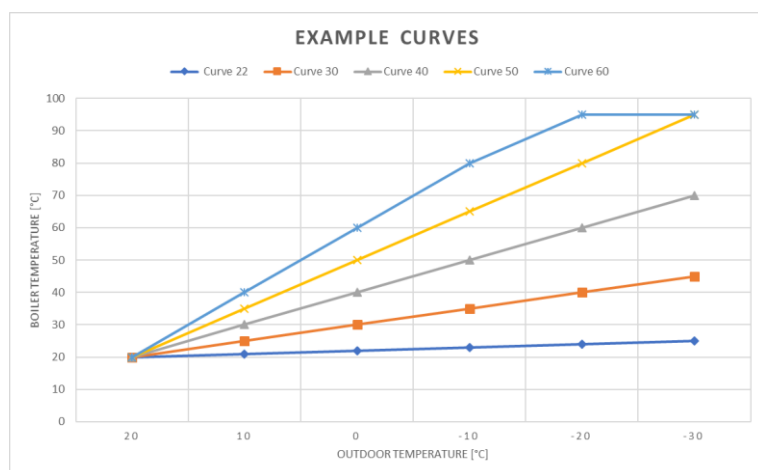
Mintemp is the minimum allowable boiler temperature ie. cuts the curve at low end. See example figure “example min./max.” below.

- Setting range 0 - 50 °C
- Default value 10 °C



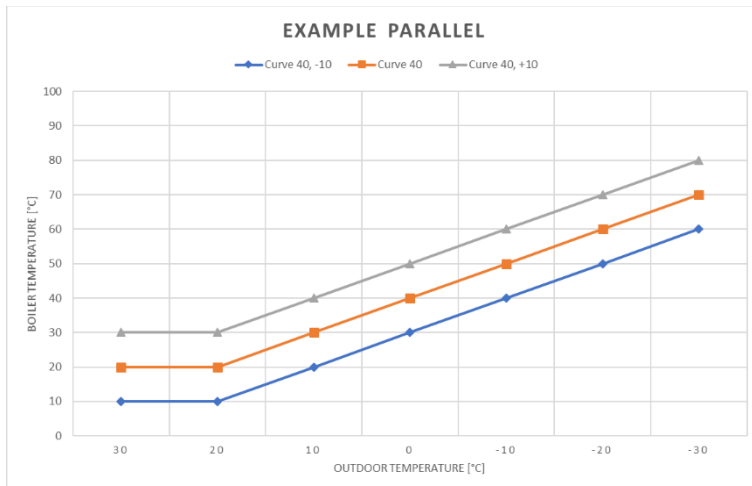
Curve is the heating curve of the boiler. The curve name is the value of the curve at 0 °C. The boiler temperature is adjusted against heating curve that indicates heating requirement at different outdoor temperatures. See figure “example curves” below.

- Setting range 22 - 60 °C
- Default value 40 °C



Parallel is parallel adjusting of the heating curve of the boiler. The value is simply added to or subtracted from the curve values. With this way, user can achieve fine adjusting for heating curve. See figure “example parallel” below.

- Setting range (-20) - 20 °C
- Default value 0 °C



Menu 1.2 Step

Currently used power step, maximum usable power step in parenthesis. Informative reading.

Menu 1.3 AC in

Currently measured input voltage in percentages compared to 230 V AC. Informative reading.

Menu 2 - Service

Overview

Menu 2 - Service	Step	(informative)
	Max	
	Time	
	Current	(informative)
	Max	
	Marginal	
	Effect factor	
	S.time test	
	Menu 3 - Test manually	
	Menu 4 - Setup	

Menu 2.1 Step

Currently used power step. Informative reading.

Menu 2.1.1 Max

Maximum number of allowable power steps. Settable value:

- Setting range for models 112 kW and below 0 - 7
- Default value 7
- Setting range for models 112 kW and above 0 - 15
- Default value 15

Note! This setting prevents the boiler to use higher power steps i.e. limits the power of the boiler.

Menu 2.1.2 Time

Used step time for increasing power i.e. at least this time is spent between enabling next power step.

Settable value:

- Setting range 20 - 250 s
- Default value 90 s

Note! Too short step time can cause constant fluctuation.

Fluctuations can be eliminated by decreasing or increasing the step time, depending on the pump capacity and water volume. Sufficient flow in the boiler at all times ensures stable control.

Menu 2.2 Current

Currently measured highest phase current of main fuses. Configure Menu 2.2.1 Max and Menu 2.2.2 Marginal for using load monitor property. Informative reading.

Menu 2.2.1 Max

Maximum current limit related to 0 - 5 A current transformers. Settable value:

- Setting range 1.0 - 5.0 A
- Default value 5.0 A

Note! The primary side current transformers must be installed near main switch or main fuses of the property because total power consumption of the whole property is to be monitored.

The value to be used is dependent on conversion ratio of primary side current transformer and main fuses of the property. Calculation:

$$\frac{\text{Size of main fuse}}{\text{Conversion ratio of primary side current transformers}} = \text{Value to be used}$$

Calculation example: Main fuses of the property 3 x 400 A, used primary side current transformers 500/5.

$$\frac{400}{\left(\frac{500}{5}\right)} = \frac{400}{100} = 4$$

With this example, the value 4.0 should be set as maximum current limit.

Menu 2.2.2 Marginal

The current marginal determines how much below current limit the measured current must be for enabling next power step. Setting correct value eliminates unnecessary enable/disable of power steps for achieving longer lifetime of components. Settable value:

- Setting range 0.1 - 1.0 A
- Default 1.0 A

Note! The setting values are indicative as many issues affects to the accuracy, such as accuracy of used current transformers.

The value to be used is dependent on lowest power step of used FIL-SPL, phase-to-neutral voltage and conversion ratio of primary side current transformers. Calculation:

$$\frac{\text{Lowest power step [W]}}{3 \times \text{Phase Voltage} \times \text{Conversion ratio of primary side current transformers}} = \text{Value to be used}$$

Calculation example: Lowest power step 10 kW, phase-to-neutral voltage 230 V, used primary side current transformers 500/5.

$$\frac{10000}{3 \times 230 \times \left(\frac{500}{5}\right)} = \frac{10000}{3 \times 230 \times 100} = \frac{10000}{69000} = 0.145$$

With this example the value 0.2 should be set as a current marginal.

Menu 2.3 Effect factor

The effect factor is used by observation of internal power consumption for an alarm. The control unit observes power consumption when increasing power steps. If multiple power step increases are done without affecting measured power, the control unit will give notice "Error in power measurement" on the display and activate the alarm relay. Settable value:

- Setting range 0 - 400 A
- Default 0 A

Note! If power consumption differs from zero while increasing power steps, the control unit assumes that everything is operating as it should.

The value to be used is dependent on conversion ratio of primary side current transformer and phase-to-neutral voltage. Calculation:

$$\frac{3 \times \text{Phase Voltage} \times \text{Conversion ratio of primary side current transformers}}{1000} = \text{Value to be used}$$

Calculation example: Phase-to-neutral voltage 230 V, used primary side current transformers 250/5.

$$\frac{3 \times 230 \times \left(\frac{250}{5}\right)}{1000} = \frac{3 \times 230 \times 50}{1000} = \frac{34500}{1000} = 34.5$$

With this example the value 35 should be set as effect factor.

Menu 2.4 S.time test

The step time test is for bypassing configured step time and possible start up delay for service or maintenance tests. If step time test is enabled, the device will return automatically to disabled after eight minutes. Settable value:

- Setting range yes - no
- Default no

Note! With this property the starting delay (two hours after power cut) can be bypassed and full power can be taken into use.

Menu 3 - Test manually

Overview

Menu 3 - Test manually

Contactor 1
Contactor 2
Contactor 3
Contactor 4
Alarm
0 - 10 V

Menu 3.1 Contactor 1

Force control of contactor 1. Enable contactor 1 by setting value to "1" and disable by setting value to "0".

Settable value:

- Setting range 0 - 1
- Default 0

Menu 3.2 Contactor 2

Force control of contactor 2. Enable contactor 2 by setting value to "1" and disable by setting value to "0".

Settable value:

- Setting range 0 - 1
- Default 0

Menu 3.3 Contactor 3

Force control of contactor 3. Enable contactor 3 by setting value to "1" and disable by setting value to "0".

Settable value:

- Setting range 0 - 1
- Default 0

Menu 3.4 Contactor 4

Force control of contactor 4. Enable contactor 4 by setting value to "1" and disable by setting value to "0".

Settable value:

- Setting range 0 - 1
- Default 0

Menu 3.5 Alarm

Force control of alarm relay. Activate alarm by setting value to "1" and deactivate by setting value to "0".

Settable value:

- Setting range 0 - 1
- Default 0

Menu 3.6 0 – 10 V

Force control of 0 - 10 V status output. Drive 0 - 10 V status output to tenth of the value shown on the display. Settable value:

- Setting range 0 - 100, (even steps: 0, 2, 4...)
- Default 0

Menu 4 - Setup

Overview

Menu 4 - Setup	Language
	Model
	Input
	Output
	OutdoorComp

Menu 4.1 Language (selected language)

The actual reading of Menu 4.1 is currently selected language. The language of the control unit can be selected here. Settable value:

- Russian
- Suomi
- English
- Svenska

Menu 4.2 Model

Selection of available power steps. Accessing this setup: After power on, within first minute, navigate to this setup and press select button for 6 s. Settable value:

- Setting range 7, 15, 30
- Default is selected at the factory according to real power steps installed to the boiler.

Note! Model must not be configured higher than factory setting! Otherwise the control unit cannot enable/disable power steps accordingly and illegal behavior will occur. Strong recommendation is not to modify this setup at all.

Menu 4.3 Input

Setting of 0 - 10 V control voltage input. More information about voltage levels can be found from Technical data, External control voltage (input) values and corresponding power steps in different modes. Settable value:

- Setting range:
 - "--" Disabled (not used)
 - "Power" Boiler temperature control, 0 V means minimum power step and 10 V maximum power step
 - "Power Inv" Boiler temperature control, 0 V means maximum power step and 10 V minimum power step
 - "Temp" Boiler temperature control, 0 V means 20 °C, 11.5 V means 99 °C
- Default --

Note! With 0 - 10 V control, the power of the boiler is increased or decreased after the control unit notices two-degrees difference between target and measured values.

Menu 4.4 Output

Setting of 0 - 10 V status voltage output. More information about voltage levels and status data content can be found from Technical data, Status output voltage values and corresponding status data in different modes. Settable value:

- Setting range:
 - "--" Disabled (not used)
 - "Power" Status data of currently used power step
 - "Temp" Currently measured boiler temperature
 - "T.calc" Target boiler temperature
- Default --

Menu 4.5 OutdoorComp

Selection whether outdoor temperature control is enabled or disabled. With this property, the control unit adjusts power steps automatically according to measured outdoor temperature and selected temperature curve.

- Setting range:
 - "no" Disabled (not used)
 - "yes" Enabled, the boiler is automatically controlled by outdoor temperature
- Default no

Note! For taking outdoor temperature control property into use, the outdoor sensor must be installed and appropriate temperature curve settings must be set from the Menu 1.1.1/2 OutdoorComp.

9. Service

Service actions

Note! Servicing should only be carried out by persons with the necessary expertise. Only qualified electricians are permitted to service internal boiler parts and open the cover.

Note! When replacing components on FIL-SPL only replacement parts from Kaukora may be used.

As the boiler operation is fully automatic, servicing and operating is very easy. However, each user must thoroughly familiarize themselves with the boiler controls, such as: boiler temperature control, temperature limiter, thermostats and control switches.

Regular tests and checks:

- Test the function of the dry-boiling preventer (models from 120 kW to 1600 kW)
 - Check that the indicator light "TOIMINTA" lit as green
 - Press "KOESTUS" button and keep it pressed down
 - Within 10 seconds, the indicator light "TOIMINTA" should go off and indicator light "HÄLYTYS" should lit as red
 - Keep the "KOESTUS" button pressed until the main switch trips. Now you can release the "KOESTUS" button
 - Reset the main switch by first positioning the switch to "0" (off) and then back to "I" (on) position.
- The safety valve of the system must be inspected four times a year
 - Test the safety valve by turning the knob. Small amount of outflow water should run at the time, approximately one liter per inspection
 - The test of safety valve is extremely important for preventing the valve of seizing up
- The water pressure of the system should be monitored to remain stable. Variations in the pressure are allowed only when temperature of the water changes
- Check and retighten line connections of the boiler after 100 hours of operation and after that at least once a year

Backup mode

The backup mode is used in event of operational interference. The backup mode is activated by turning the heating mode selection switch to backup mode. The backup mode operates only with partial power, only power step 2 is enabled. In backup heating mode the backup heating mode thermostat controls the temperature of the FIL-SPL boiler.

10. Disturbances in comfort

Troubleshooting

Note! The FIL-SPL boiler might have an external control voltage that the main switch does not turn off.

Basic actions

Note! After power cut there is two hours time delay before full power is taken into use.

Note! The dry-boiling preventer (models from 120 kW to 1600 kW), temperature limiter or overload will trip the main switch.

Note! After the main switch has tripped, ensure that the main switch is reset by first positioning the switch to "0" (off) and then back to "I" (on) position.

- Check for possible power cut
- Check each main fuse of the property
- Check each supply fuse of the FIL-SPL boiler
- Check internal fuses, note that only qualified electricians are permitted to service internal boiler parts and open the cover
- Check if the dry-boiling preventer has triggered (models from 120 kW to 1600 kW). If the dry-boiling preventer is triggered, the indicator light "HÄLYTYS" will lit as red and indicator light "TOIMINTA" will be off
 - Reset the dry-boiling preventer by pressing "VIRITYS" button, the indicator light "TOIMINTA" will lit as green and indicator light "HÄLYTYS" will be off
 - If resetting is not operating, ensure that there is water in the system
 - If both indicator lights "HÄLYTYS" and "TOIMINTA" are off and the device has power, check the 50 mA fuse of the dry-boiling preventer. Replace only with 5 x 20 mm class tube fuse of type "50 mA T" that meets IEC127 standard
 - If replacing the fuse does not solve the issue, there is a system malfunction in the dry-boiling preventer. Use only original spare part as a replacement
 - Reset the main switch according to instructions below
- Check if the temperature limiter has triggered
 - Check that the circulation pumps are operating accordingly
 - Reset the temperature limiter by pressing the button
 - Reset the main switch according to instructions below
 - If the temperature limiter trigs again (after cooling down), the limiter may be damaged. Use only original spare part as a replacement
- Check if the main switch has tripped. To reset the main switch, first position the switch to "0" (off) and then back to "I" (on) position
 - If the main switch trips again, re-check dry-boiling preventer and temperature limiter
 - If the dry-boiling preventer (models from 120 kW to 1600 kW) and temperature limiter are operating accordingly, the main switch may be damaged. Use only original spare part as a replacement
- Check pressure of the system and possible leaks
- If the control unit is damaged, the FIL-SPL boiler can be used in backup mode, more information is available on Backup mode.

11. Accessories

Jäspi current transformers (200 018)

Jäspi current transformers are for load monitoring of main fuses. The same type of current transformers can be used also for observation of internal power consumption.

Jäspi outdoor temperature sensor (200 035)

Jäspi outdoor temperature sensor is to be used when the outdoor temperature control is enabled.

12. Technical data

Technical specifications

FIL-SPL electrical boilers	
Electrical	
Rated voltage, models 31.5 - 300	400 V 3 N AC 50 Hz
Rated voltage, models 400 - 1600	400 V 3 AC 50 Hz
Voltage of control unit (internally connected)	230 V 1 N AC 50 Hz \pm 10 %
Power	See Electrical properties of FIL-SPL boilers
Maximum current	See Electrical properties of FIL-SPL boilers
Recommended fuse	See Electrical properties of FIL-SPL boilers
IP class	IP 20
Delay for full power after power cut (longer than 30 s)	2 h
Secondary side current of Jäspi current transformer	0 - 5 A
Power steps	
Models 31.5 - 112	7 steps
Models 150 - 1600	15 steps
General	
Operating temperature	0...35 °C
Design temperature	110 °C
Maximum structural pressure	10 bar
Operating temperature (environment)	10 - 40 °C
Operating temperature (boiler)	30 - 99 °C
Cut-off temperature, temperature limiter	105 °C
Pipe connections	
Models 31.5 - 105	DN 50
Models 112 - 225	DN 65
Models 300 - 500	DN 80
Models 600 - 1000	DN100
Models 1200 - 1600	DN125
Volume	
Models 31.5 - 105	85 l
Model 112	130 l
Models 150 - 300	200 l
Models 400 - 600	480 l
Models 700 - 900	750 l
Models 1000 - 1600	1000 l

Electrical properties of FIL-SPL boilers

In the table below is presented model, power, nominal current consumption, recommended fuse, and informative cabling. Note that the size and type of the supply cable is always determined on a project-specific basis according to the cable lengths, installation method and applicable standards.

Model	Power [kW]	Supply	In [A]	Fuse [A]	Supply cable <i>informative</i>
FIL-SPL 31.5	31.5	230 / 400 V 3L + N + PE AC 50 Hz	46	3 x 63	4 x 16 + 16 mm ²
FIL-SPL 42	42		61	3 x 80	4 x 25 + 16 mm ²
FIL-SPL 52	52.5		76	3 x 100	4 x 50 + 25 mm ²
FIL-SPL 70	70		101	3 x 125	4 x 70 + 35 mm ²
FIL-SPL 84	84		121	3 x 160	4 x 70 + 35 mm ²
FIL-SPL 105	105		152	3 x 200	4 x 95 + 50 mm ²
FIL-SPL 112	112		162	3 x 200	4 x 95 + 50 mm ²
FIL-SPL 150	150		217	3 x 250	4 x 120 + 70 mm ²
FIL-SPL 180	180		260	3 x 315	4 x 185 + 95 mm ²
FIL-SPL 225	225		325	3 x 400	4 x 150 + 70 mm ²
FIL-SPL 300	300		433	3 x 500	4 x 185 + 95 mm ²
FIL-SPL 400	400	400 V 3L + PE AC 50 Hz	577	2 x (3 x 400)	-
FIL-SPL 500	500		722	2 x (3 x 500)	-
FIL-SPL 600	600		866	2 x (3 x 630)	-
FIL-SPL 700	700		1010	2 x (3 x 630)	-
FIL-SPL 800	800		1155	3 x (3 x 500)	-
FIL-SPL 900	900		1299	3 x (3 x 630)	-
FIL-SPL 1000	1000		1443	3 x (3 x 630)	-
FIL-SPL 1200	1200		1732	4 x (3 x 630)	-
FIL-SPL 1600	1600		2309	6 x (3 x 500)	-

External control voltage (input) values and corresponding power steps in different modes.

The function must be selected from the setup menu. Note that the max. setting values are overruling, i.e. if maximum number of power steps has been limited to 5, the control unit will not enable power steps above 5 even though the external control voltage indicates higher power.

Power Model 15		Power Model 7		Power Inv. Model 15		Power Inv. Model 7		Temp.	
[V]	[Pwr step]	[V]	[Pwr step]	[V]	[Pwr step]	[V]	[Pwr step]	[V]	[°C]
0,00	0	0,00	0	0,00	15	0,00	7	0,00	20,00
0,70	1	1,50	1	0,60	14	1,30	6	1,50	30,00
1,40	2	2,80	2	1,30	13	2,60	5	2,90	40,00
2,00	3	4,00	3	1,90	12	3,90	4	4,00	50,00
2,60	4	5,20	4	2,50	11	5,20	3	5,80	60,00
3,20	5	6,50	5	3,20	10	6,50	2	7,30	70,00
4,00	6	8,00	6	3,90	9	8,00	1	8,70	80,00
4,60	7	10,00	7	4,50	8	10,00	0	10,00	90,00
5,20	8			5,10	7			11,50	99,00
5,90	9			5,70	6				
6,50	10			6,30	5				
7,20	11			6,90	4				
7,80	12			7,50	3				
8,50	13			8,20	2				
9,20	14			9,00	1				
9,80	15			10,00	0				

Maximum current of 0 - 10 V external control voltage is 1 mA.

Status output voltage values and corresponding status data in different modes.

The function must be selected in the setup menu.

Power Model 15		Power Model 7		Temp.		T.calc (temp.)	
[V]	[Pwr step]	[V]	[Pwr step]	[V]	[°C]	[V]	[°C]
0,00	0	0,00	0	4,00	20,00	4,00	20,00
0,70	1	1,40	1	5,00	30,00	5,00	30,00
1,40	2	2,80	2	6,00	40,00	6,00	40,00
2,00	3	4,10	3	7,00	50,00	7,00	50,00
2,60	4	5,60	4	8,00	60,00	8,00	60,00
3,20	5	7,00	5	9,00	70,00	9,00	70,00
4,00	6	8,40	6	10,00	80,00	10,00	80,00
4,60	7	10,00	7				
5,20	8						
5,90	9						
6,50	10						
7,20	11						
7,80	12						
8,50	13						
9,20	14						
9,80	15						

Maximum current of 0 - 10 V status output is 1 mA.

Temperature sensor resistance values in different temperatures

The temperature sensors are negative temperature coefficient resistor. In the table below is presented resistor values of the sensors at different temperatures.

Boiler temperature (NTC22K)	
Temperature	Resistance
[°C]	[kΩ]
0	66,00
10	42,00
20	27,00
30	18,00
40	12,00
50	9,00
60	6,00
70	4,20
80	3,10
90	2,30
100	1,80
110	1,30

Outdoor temperature sensor (151R)	
Temperature	Resistance
[°C]	[Ω]
-30	1883
-25	1443
-20	1115
-15	868
-10	681
-5	538
0	428
5	342
10	276
15	224
20	182
25	151
30	123
35	102

Recommended circulation pumps

The water circulation inside the boiler must be ensured with an external pump. Recommended pump types versus different FIL-SPL models.

Model	Pump
FIL-SPL 31.5 - 300 kW	UPS 25 - 80 F
FIL-SPL 400 kW	UPS 32 - 50 F
FIL-SPL 500 kW	UPS 32 - 60 F
FIL-SPL 600 kW	UPS 32 - 60 F
FIL-SPL 700 kW	UPS 40 - 60/4 F
FIL-SPL 800 kW	UPS 40 - 60/4 F
FIL-SPL 900 kW	UPS 40 - 60/4 F
FIL-SPL 1000 kW	UPS 40 - 60/2 F
FIL-SPL 1200 kW	UPS 40 - 60/2 F
FIL-SPL 1600 kW	UPS 50 - 60/4 F

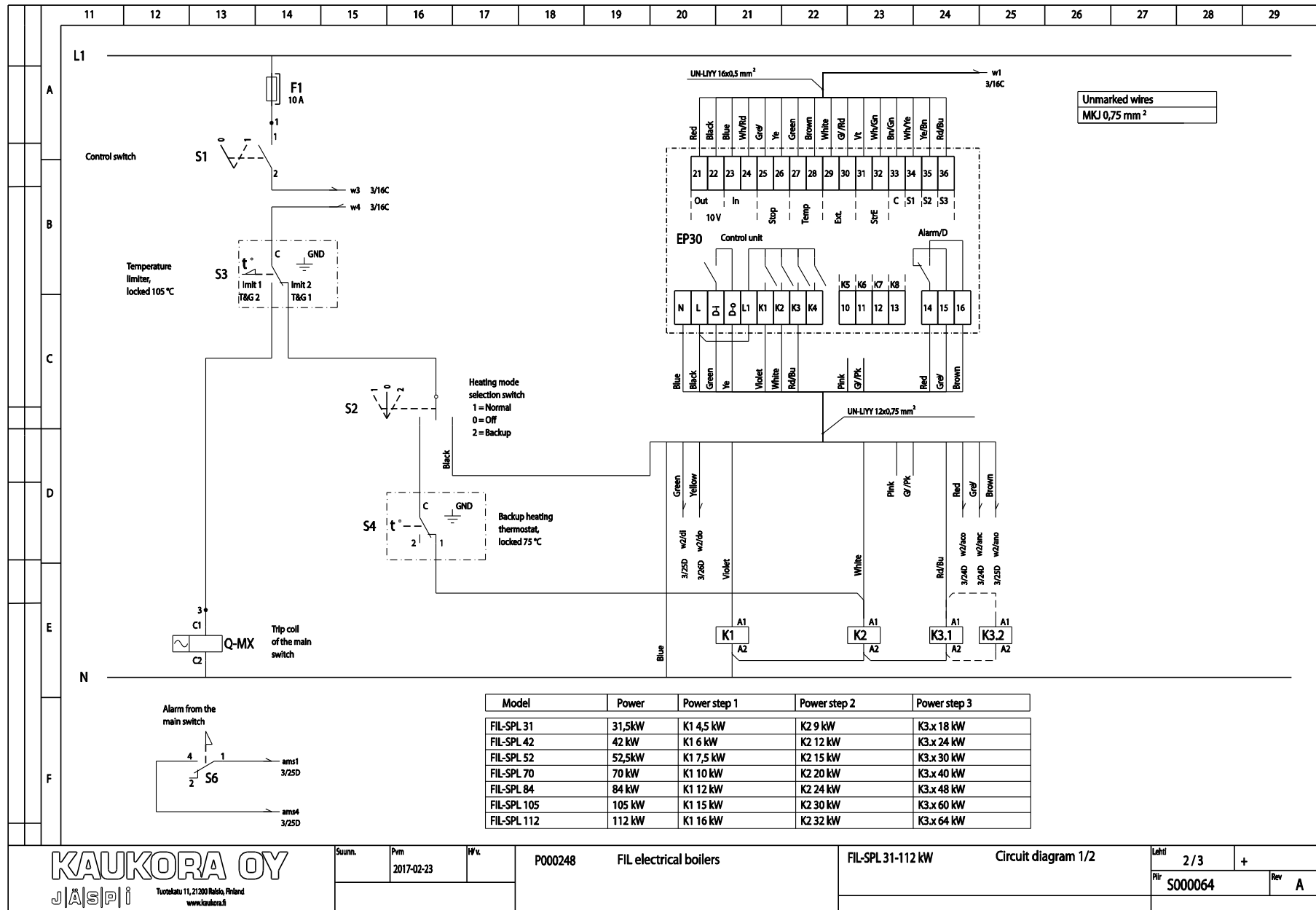
Pressure drop table

The table below presents the pressure drop with different FIL-SPL models.

Model	Min. flow [l/s]	Nom. flow [l/s] @ Temp. Rise 20 °C	Flow speed [m/s]	Pressure drop [Pa]	Pressure drop [mm H ₂ O]
FIL-SPL 31.5	0,2	0,4	0,2	46	5
FIL-SPL 42	0,3	0,5	0,3	81	8
FIL-SPL 52	0,4	0,6	0,3	125	13
FIL-SPL 70	0,5	0,8	0,4	223	23
FIL-SPL 84	0,6	1,0	0,5	324	33
FIL-SPL 105	0,8	1,3	0,6	507	52
FIL-SPL 112	0,9	1,3	0,4	204	21
FIL-SPL 150	1,1	1,8	0,5	364	37
FIL-SPL 180	1,4	2,2	0,6	525	54
FIL-SPL 225	1,7	2,7	0,8	821	84
FIL-SPL 300	2,3	3,6	0,7	380	39
FIL-SPL 400	3,1	4,8	0,6	553	56
FIL-SPL 500	3,8	6,0	0,8	867	88
FIL-SPL 600	4,6	7,2	0,9	1247	127
FIL-SPL 700	5,3	8,4	1,1	1695	173
FIL-SPL 800	6,1	9,6	1,2	2218	226
FIL-SPL 900	6,9	10,7	1,4	4207	429
FIL-SPL 1000	7,6	11,9	1,0	2126	217
FIL-SPL 1200	9,2	14,3	1,2	3064	312
FIL-SPL 1600	12,2	19,1	1,6	3630	370

Electrical circuit diagrams, models of 31 - 112 kW

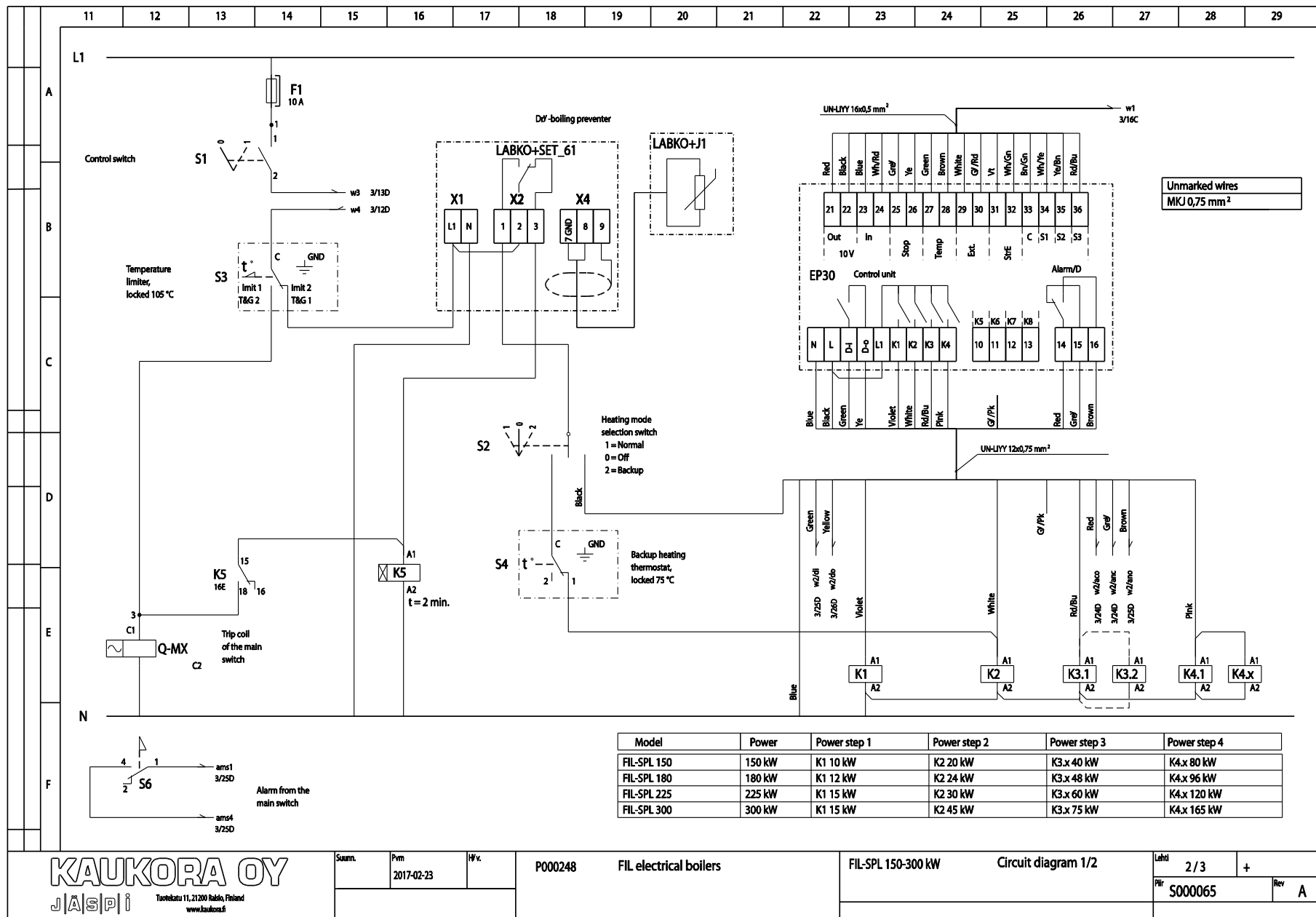
	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
A		L1, L2, L3	PE	N	GROUP	NAMING	Model:	31,5 kW	42 kW	52,5 kW	70 kW	84 kW	105 kW	112 kW	PHASE				
						Supply	400 V 3 N AC 50 Hz (3 L + N + PE)												
					Q1	Main switch Nominal current Supply fuse		63 A 46 A 3x63 A	80 A 61 A 3x80 A	100 A 76 A 3x100 A	125 A 101 A 3x125 A	160 A 121 A 3x160 A	160 A 152 A 3x200 A	200 A 162 A 3x200 A	L1-3				
B					F10	Power step 1 (control K1)		4,5 kW 10 A 1,5 mm ²	6 kW 16 A 1,5 mm ²	7,5 kW 16 A 6 mm ²	10 kW 20 A 6 mm ²	12 kW 25 A 6 mm ²	15 kW 35 A 10 mm ²	16 kW 35 A 10 mm ²	L1-3				
						Step 1 total:		4,5 kW	6 kW	7,5 kW	10 kW	12 kW	15 kW	16 kW					
C					F21	Power step 2 (control K2)		9 kW 16 A 2,5 mm ²	12 kW 25 A 6 mm ²	15 kW 35 A 10 mm ²	20 kW 35 A 10 mm ²	24 kW 50 A 10 mm ²	30 kW 63 A 16 mm ²	32 kW 63 A 16 mm ²	L1-3				
						Step 2 total:		9 kW	12 kW	15 kW	20 kW	24 kW	30 kW	32 kW					
D																			
					F31	Power step 3 (control K3.1)		9 kW 16 A 2,5 mm ²	12 kW 25 A 6 mm ²	30 kW 63 A 16 mm ²	40 kW 80 A 16 mm ²	24 kW 50 A 10 mm ²	30 kW 63 A 16 mm ²	32 kW 63 A 16 mm ²	L1-3				
					F32	Power step 3 (control K3.2)		9 kW 16 A 2,5 mm ²	12 kW 25 A 6 mm ²	-	-	24 kW 50 A 10 mm ²	30 kW 63 A 16 mm ²	32 kW 63 A 16 mm ²	L1-3				
						Step 3 total:		18 kW	24 kW	30 kW	40 kW	48 kW	60 kW	64 kW					
E																			
F					F1	Control		10	10	10	10	10	10	10	L1				
<div>KAUKORA OY</div> <div>J A S P i</div> <div>Tuuskaranta 11, 21200 Rauma, Finland</div> <div>www.kaukora.fi</div>					Summ.	Pvm	HW	P000248 FIL electrical boilers			FIL-SPL 31-112 kW Main diagram			Lehti 1 / 3		+			
						2017-02-23								P# S000064		Rev A			



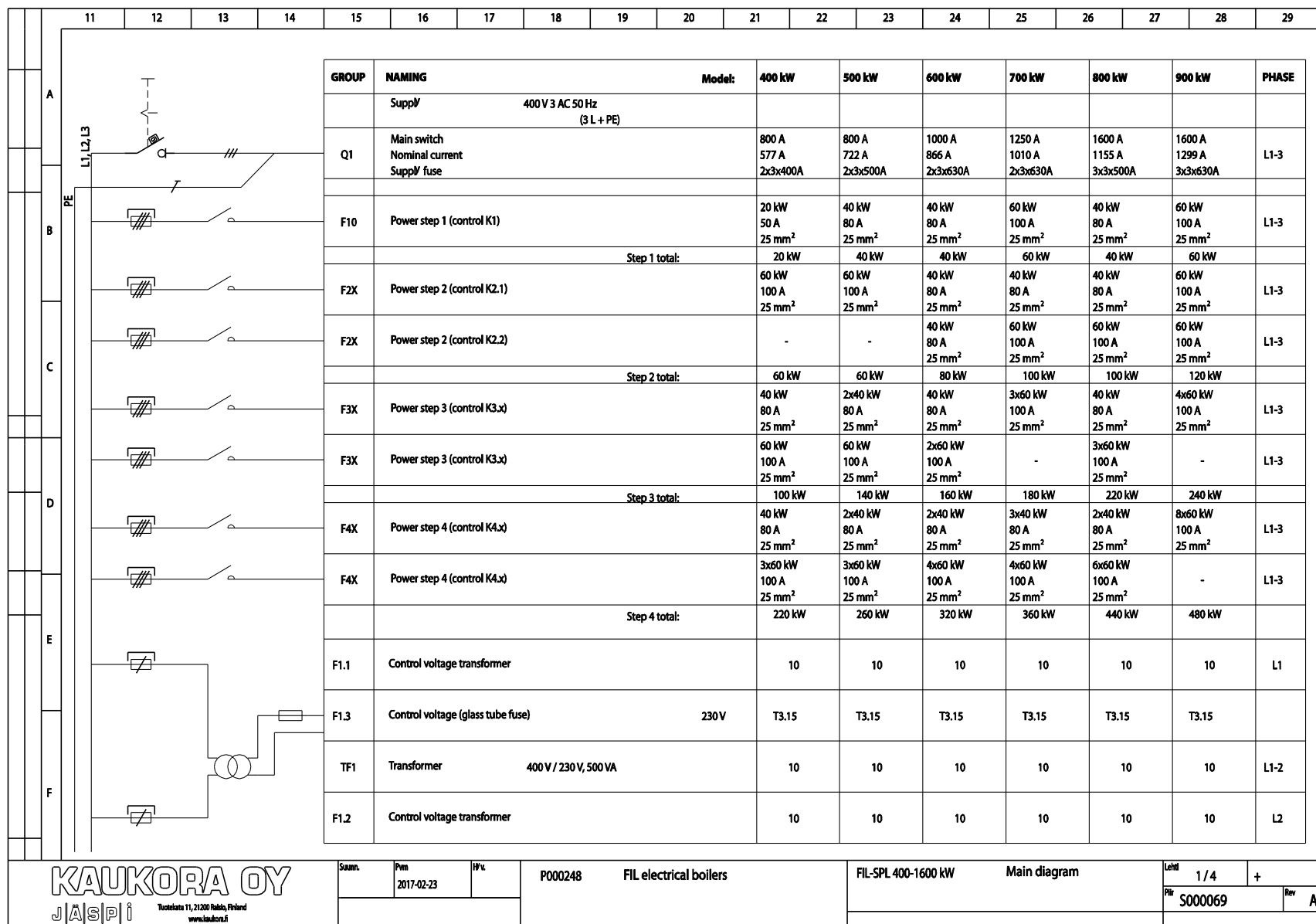
Electrical circuit diagrams, models of 150 - 300 kW

	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
A					Q1	Main switch Nominal current Supply fuse	400 V 3 N AC 50 Hz (3 L + N + PE)	250 A 217 A 3x250 A	400 A 260 A 3x315 A	400 A 325 A 3x400 A	630 A 433 A 3x500 A	L1-3							
B																			
C					F20	Power step 2 (control K2)	20 kW 35 A 10 mm²	24 kW 50 A 10 mm²	30 kW 63 A 16 mm²	45 kW 80 A 25 mm²	L1-3								
D					F32	Power step 3 (control K3.2)	-	24 kW 50 A 10 mm²	30 kW 63 A 16 mm²	45 kW 80 A 25 mm²	L1-3								
E					F44	Power step 4 (control K4.4)	-	24 kW 50 A 10 mm²	30 kW 63 A 16 mm²	45 kW 80 A 25 mm²	L1-3								
F					F1	Control	10	10	10	10	L1								

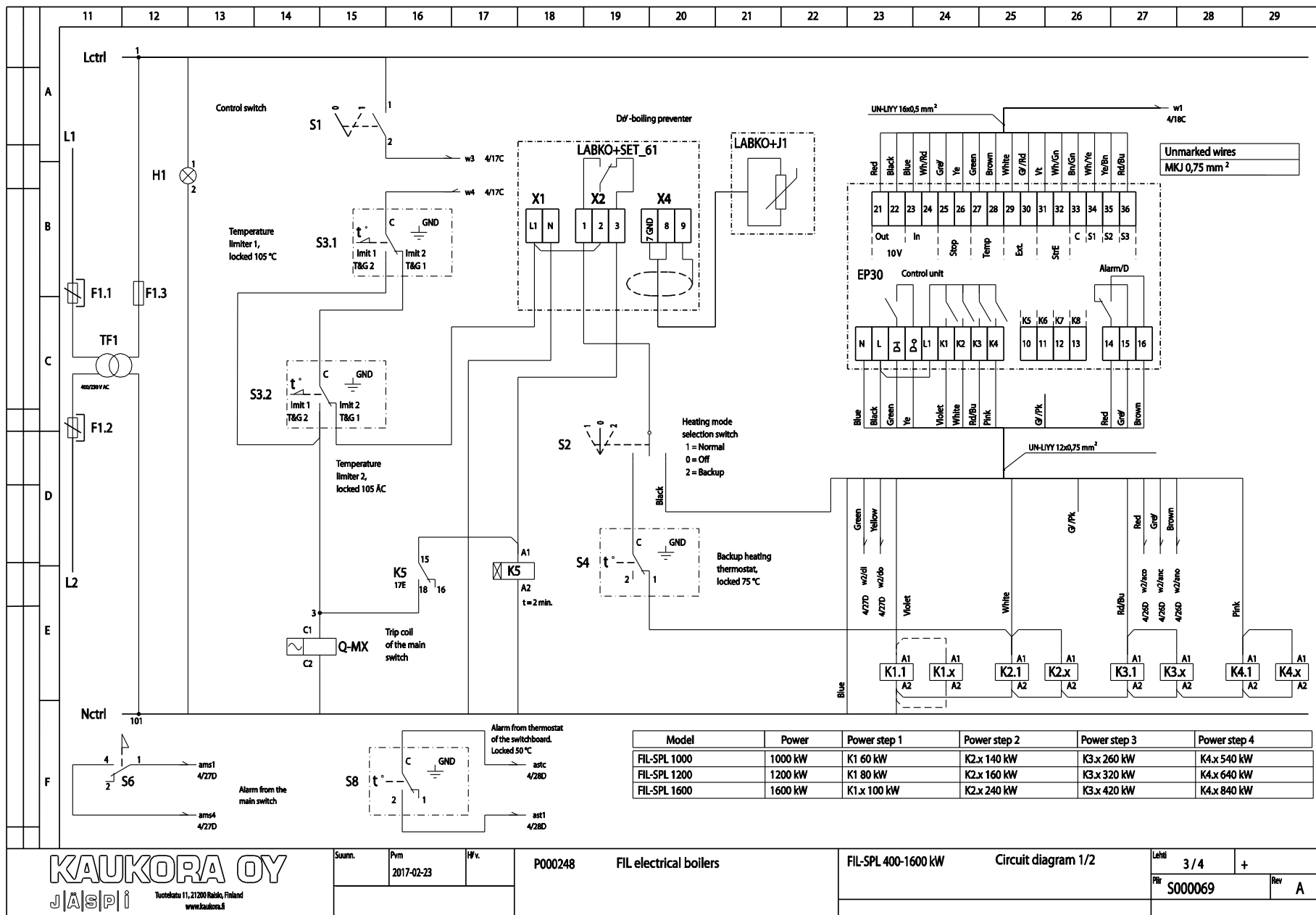
Kaukora Oy J A S P i Tuusinkatu 11, 21200 Rauma, Finland www.kaukora.fi	Siunni.	Pvm 2017-02-23	W/v.	P000248	FIL electrical boilers	FIL-SPL 150-300 kW	Main diagram	Lehti 1 / 3	+	Pir S000065	Rev A
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Electrical circuit diagrams, models of 400 - 1600 kW



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