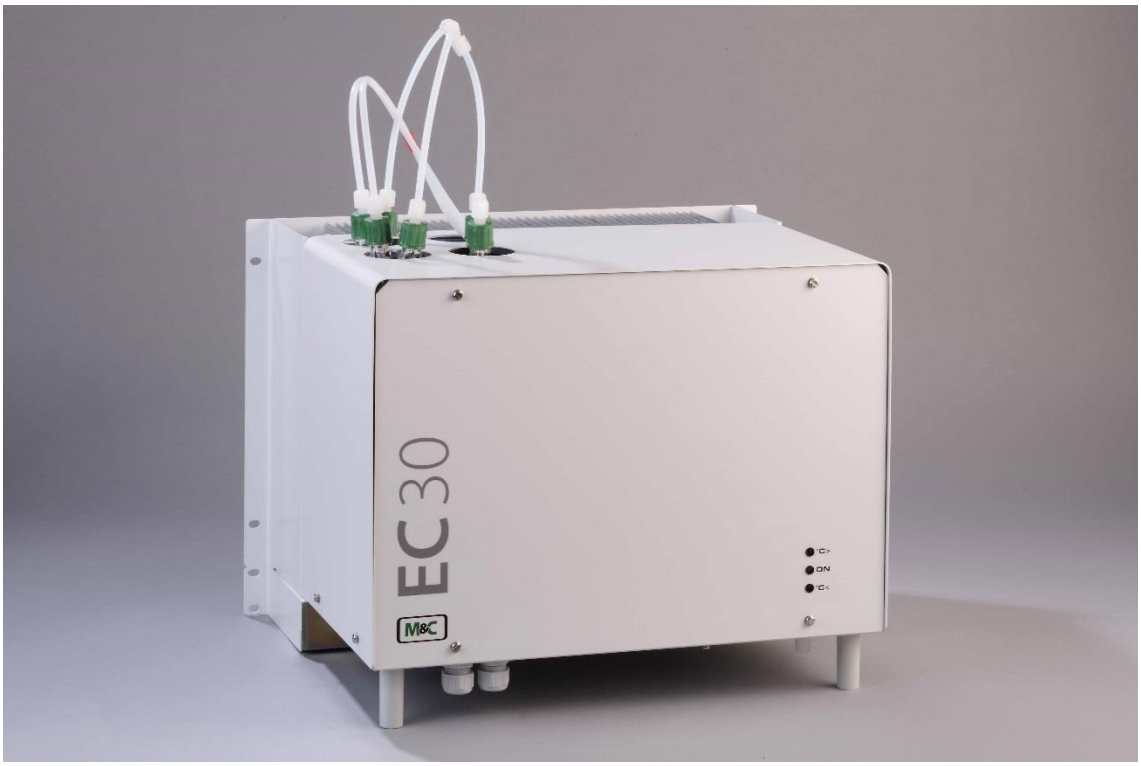
Embracing Challenge

Ultra Low Gas Cooler Series EC®

EC30 and EC-30/FD

Instruction Manual
Version 1.01.00



Content

List of Illustrations

Dear customer,

we have made up this operating manual in such a way that all necessary information about the product can be found and understood quickly and easily.
Should you still have any question, please do not hesitate to contact **M&C** directly or go through your appointed dealer. Respective contact addresses are to be found in the annexe to this operating manual.
Please also contact our homepage **www.mc-techgroup.com** for further information about our products. There, you can read or download the data sheets and operating manuals of all **M&C** products as well as further information in German and English.

Version: 1.01.00

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1 GENERAL INFORMATION

The product described in this operating manual has been examined before delivery and left our works in perfect condition related to safety regulations. In order to keep this condition and to guarantee a safe operation, it is important to heed the notes and prescriptions made in this operating manual. Furthermore, attention must be paid to appropriate transportation, correct storage, as well as professional installation and maintenance work.
All necessary information a skilled staff will need for appropriate use of this product are given in this operating manual.

2 DECLARATION OF CONFORMITY

CE - Certification

The product described in this operating manual complies with the following EU directives:

EMV-Instruction

The requirements of the EU directive 2014/30/EU “Electromagnetic compatibility“ are met.

Low Voltage Directive

The requirement of the EU directive 2014/35/EU “Low Voltage Directive“ are met.
The compliance with this EU directive has been examined according to DIN EN 61010.

Declaration of conformity

The EU Declaration of conformity can be downloaded from the **M&C** homepage or directly requested from **M&C**.

3 SAFETY INSTRUCTIONS

Please take care of the following basic safety procedures when mounting, starting up or operating this equipment:

Read this operating manual before starting up and use of the equipment. The information and warnings given in this operating manual must be heeded.

Any work on electrical equipment is only to be carried out by trained specialists as per the regulations currently in force.

Attention must be paid to the requirements of VDE 0100 (IEC 364) when setting high-power electrical units with nominal voltages of up to 1000 V, together with the associated standards and stipulations.

Check the details on the type plate to ensure that the equipment is connected to the correct mains voltage.

Protection against touching dangerously high electrical voltages:
Before opening the equipment, it must be switched off and hold no voltages. This also applies to any external control circuits that are connected.

The device is only to be used within the permitted range of temperatures and pressures.

Check that the location is weather-protected. It should not be subject to either direct rain or moisture.

The device must not be used in hazardous areas.

Installation, maintenance, monitoring and any repairs may only be done by authorized personnel with respect to the relevant stipulations.

4 WARRANTY

If the equipment fails, please contact **M&C** directly or else go through your **M&C** authorised dealer.
We offer a one year warranty as of the day of delivery as per our normal terms and conditions of sale, and assuming technically correct operation of the unit. Consumables are hereby excluded. The terms of the warranty cover repair at the factory at no cost or the replacement at no cost of the equipment free ex user location. Reshipments must be send in a sufficient and proper protective packaging.

5 USED TERMS AND SIGNAL INDICATIONS

DANGER!

This means that death, severe physical injuries and/or important material damages **will occur** in case the respective safety measures are not fulfilled.

WARNING!

This means that death, severe physical injuries and/or important material damages **may occur** in case the respective safety measures are not fulfilled.

CARE!

This means that minor physical injuries **may occur** in case the respective safety measures are not fulfilled.

CARE!

Without the warning triangle means that a material damage may occur in case the respective safety measures are not met.

ATTENTION!

This means that an unintentional situation or an unintentional status may occur in case the respective note is not respected.

NOTE!

These are important information about the product or parts of the operating manual which require user's attention.

SKILLED STAFF

These are persons with necessary qualification who are familiar with installation, use and maintenance of the product.

6 INTRODUCTION

The patented **M&C EC30** gas cooler with universal unit **EC-F** and **EC-30/FD** with unit **EC-FD** is always to be installed in situations where there is interference from moisture in the gas to be measured, or if the measured components exhibit very high sensitivity to water vapour or if long and expensive heated sampling lines are to be avoided.
Reduction of the gas temperature inside the cooler to a stable and very low dew point effects a condensing out of the sample gas. Dry gas leaves the gas cooler and passes into the analyser after suitable filtration. When installing the **EC30(/FD)** gas cooler on site in a frost-free protective housing, there is no need to use a heated sample line with a high energy consumption as long as the ambient temperature does not fall below a value of -25°C.

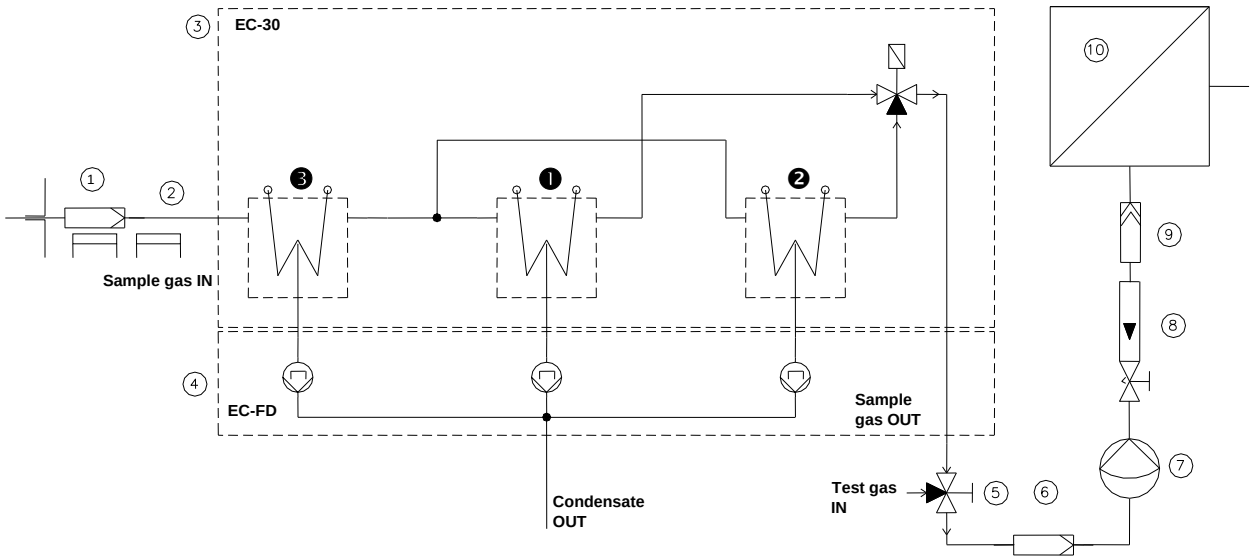
6.1 SERIAL NUMBER

The type plate with the serial number is located at the side panel of the cooler housing (19“ version). Whenever you call **M&C** regarding questions or orders for the spares please give us the serial number of your **EC30**.

7 APPLICATION

The patented **M&C** ultra-low temperature cooler **EC-30(/FD)** finds its applications in the analytical field for reducing the dew point of humid sample gases, providing a stable and very low dew point and reducing aerosol formation in the analyser. By mounting the cooler near to the sample point, costly energy consuming heated sample lines can be avoided. An extremely stable and low gas dew point avoids water vapour cross-sensitivity and volumetric errors.

Figure 1 shows a typical example of an application for installation of an **EC-30** gas cooler unit.



① Filter sample probe **SP...**
② Heated sample line
③ **EC-30/FD** cooler
④ Universal unit **EC-FD**
⑤ 3-way-ball valve
⑥ Super-fine filter **FP...**
⑦ Membrane pump
⑧ Flow meter **FM**
⑨ Aerosol filter **CLF**
⑩ Analyser

❶ Deep cooling stage 1
❷ Deep cooling stage 2
❸ Pre cooling stage

Figure 1 Example of application of EC-30/FD

The gas to be measured is taken from the **EC-30/FD** gas cooler ③ by a gas sample probe ① and cooled down to a dew point of -30°C. Via the universal unit EC-FD ④ the condensate is removed. The super-fine filter ⑥ located afterwards removes solid particles. For increased operating safety of the entire system we recommend installing a super-fine filter ⑥ with a liquid alarm sensor. If required an aerosol filter ⑨ can be installed in front of the flow meter ⑧. The gas thus treated can now be passed into the analyser ⑩. Via the 3-way-ball valve ⑤ it is possible to feed test gas for calibration to the analyser.

8 TECHNICAL DATA

Cooler series EC®	**Version EC-30**	**Version EC-30/FD**
Part No.	02K6000 (a)**	02K6010 (a)**
With integrated universal unit:	EC-F to force the ventilation	EC-FD ventilation and condensate removal
Gas connection	tube connector DN 4/6 i./o. d. mm	
Condensate connections	3x tube connector GL25-12 mm	1x tube connector DN 4/6 i./o. d. mm
Material of sample contacting parts	Duran glass, PTFE, PVDF	Duran glass, PTFE, PVDF, Novoprene
Single stream, gas flow rate	90 Nl/hr-250 Nl/hr*	
Gas pressure	max. 3 bar abs.	max. 2 bar abs.
Ambient temperature	+5 to +45 °C	
Storage temperature	-20 to +60°C	
Sample outlet dew point	-30 °C	
Sample inlet temperature	max. 180 °C*	
Sample inlet dew point	max. 80 °C*	
Cooling capacity at 25 °C ambient	max. 860 kJ/hr*	
Main power connection / Power consumption	230V 50Hz 380VA or **Part No. ...-a = 115V 60 Hz 380VA	
Start up time	< 60 min.	
Stagnant space	approx.160 ml	
Δ P at 250 Nl/hr flow rate	5 mbar	
Electrical connection	2,5 mm^2 terminals, 2x PG13,5 cable glands	
Status alarm	2 changeover contacts, potential free contact rating 250V, 3A, 500VA, 50W	
Case protection / Electrical equipment standard	IP20 EN 60529 / EN 61010	
Method of mounting / Case colour	19" rack or wall / case colour RAL 9003	
Dimension / Weight	84 TE x 8 HE x 360 mm / 37 kg	84 TE x 10 HE x 360 mm / 42 kg

* Maximum values in technical datas must be rated in consideration of total cooling capacity at 25 °C ambient temperature and an outlet dew point of -30 °C.

9 DESCRIPTION

The patented **M&C** gas cooler **EC-30(/FD)** is a two stage combination of compressor and Peltier cooler with status alarm and automatic defrosting of the dual deep freezer unit for 100% sample availability. The pre-cooler ❸ of the gas cooler EC- is fitted with a “Jet-Stream“ heat exchanger EC-G which is cooled by a compressor cooling unit with electronic control at a constant temperature of +1°C. Optimum cooling of sample gases and pre-elemination of a larger part of the condensate from the gas is reliably achieved. No external pre-draining is normally needed. The deep freezer ❶ and ❷ is cooled with two modified “Jet-Stream“ heat exchangers EC-30 fitted between two automatic cooling units for a minimum temperature of -30 °C. The special design of the Jet-Stream heat exchanger guarantees optimum dew point reduction to a low, stable value and secures condensate separation. The gas outlets of the heat exchangers are connected to a 3/2 way solenoid valve. An electronic control system EC-30 switches the solenoid valve for simultaneous changeover and automatic defrosting of the heat exchangers EC-30. In order to guarantee the necessary and minimum operation of the gas cooler EC-30, we provide this unit with an accessory module EC-F containing two fans for forced air ventilation and cooling of the compressor unit. Alternative we deliver the cooler with the module EC-FD containing additionally three peristaltic pumps SR-25.1 for automatic removal of condensate.

9.1 ASSEMBLY

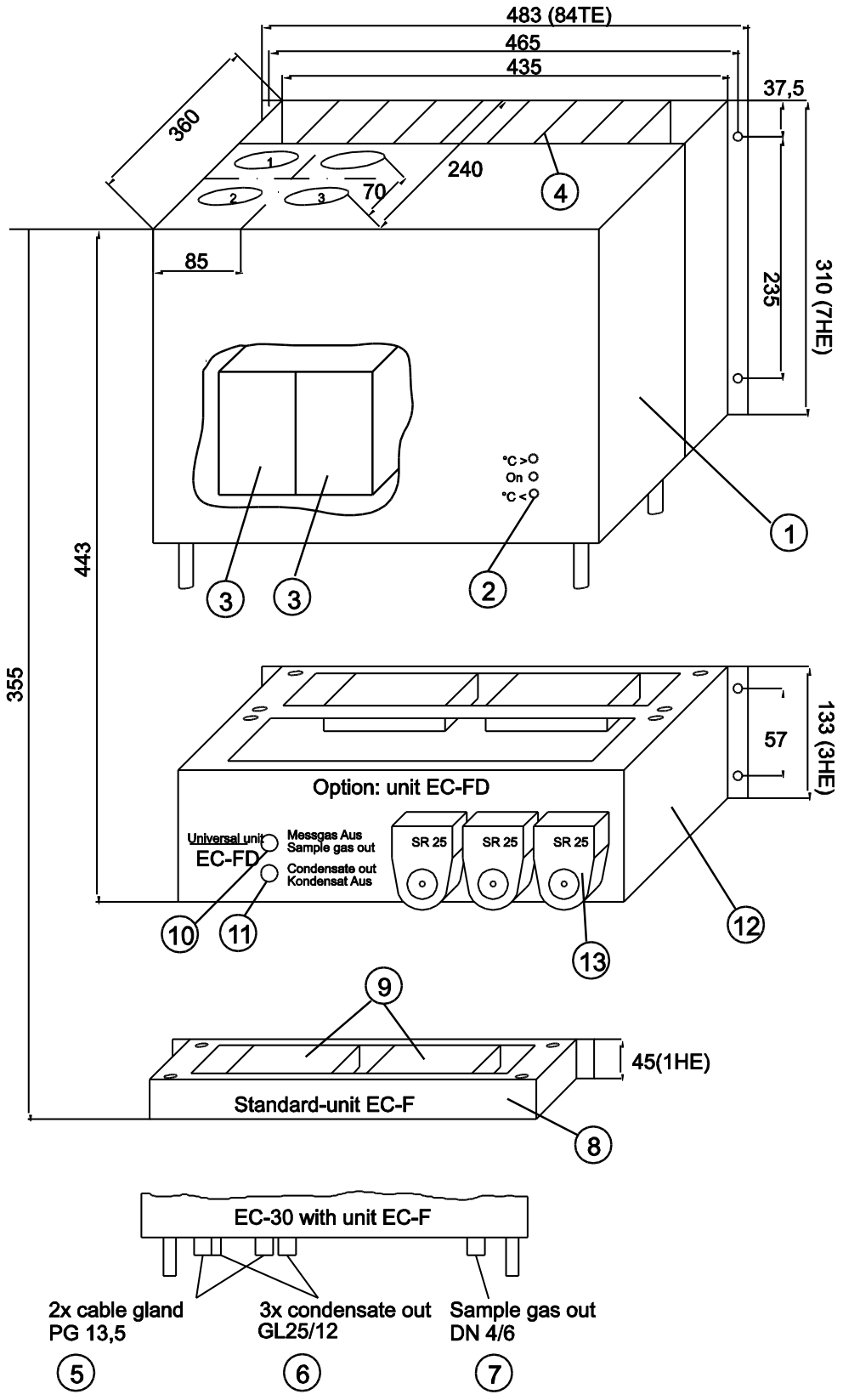


Figure 2 EC-30 with options EC-F and EC-FD

The **EC30** ① is equally suitable for wall installation or mounting in a 19" rack. The versions differ in the positioning of the LED function display ②. While for wall installation the LED function display ② can be fitted into the corresponding cut-outs in the **EC30** front panel, for 19" rack mounting this is done using the cut-outs in the back panel of the casing. This positioning is done at the factory when stating the type of installation of the **EC30** gas cooler. It is relatively simple to subsequently reconfigure it on site at the user location. The location for installation of the LED function display ② is marked correspondingly.
On the upper side of the cooler casing you will see the cut-outs for the heat exchangers of the pre-cooling stage ❸ and for the two low-temperature stages ❶ and ❷. Sample gas enters the pre-cooling stage ❸ at the 4/6 hose connection on the upper part of the heat exchanger. At the rear part of the casing the condenser ④ to remove heat given off in the compressor can be seen. The mains power connector, **EC** automatic control board and **EC30** control board with the contact outputs for the status alarm are located in two plastic housings ③ respectively behind the removable front panel of the **EC30** casing.
On the underside of the casing the following connections are provided as standard: cable glands PG13,5 ⑤ to the plastic housings ③; ⑥ condensate outlets GL25/12 from the heat exchangers ❶, ❷ and ❸; ⑦ sample gas outlet DN4/6.
As standard, the condensate is removed externally with collecting vessels, peristaltic pumps, or by "over-pressure operation", with automatic float condensate traps, as e.g. type AD-... The heat energy from the cooling system is drawn off by a forced-ventilation ④. The required fans ⑨ and large air suction filter elements are provided as standard in universal unit **EC-f** ⑧. This is arranged below the **EC30** casing and is absolutely essential for operation of the cooler unit. Optionally, the universal unit **EC-F** can be replaced by an automatic condensate removal unit **EC-FD** ⑫, which is likewise located below the casing of the cooler. Apart from the above-mentioned condenser forced ventilation, the **EC-FD** unit has three peristaltic pumps of type **SR25.1** ⑬ for automatic condensate removal. This can also be set in underpressure operation (suction operation).
The connections for the sample gas outlet ⑩ and the condensate outlet ⑪ are located in the front panel of the **EC-FD** unit.

10 FUNCTION

The patented **M&C EC30(/FD)** gas cooler is a combined two stage compressor Peltier cooler with status alarm capability. Automatic defrosting of the double-construction low temperature stage ensures 100% availability of the cooler. The pre-cooling stage ❸ (see fig. 1) of the cooler is equipped with a jet stream **EC** heat exchanger made of Duran glass. Figure 3 shows a schematic diagram of the functioning of the heat exchanger.

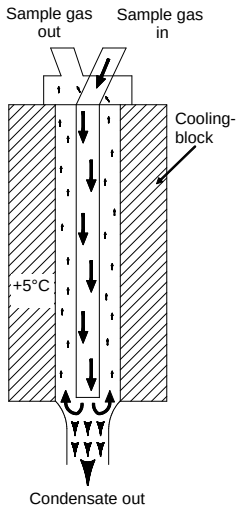


Figure 3 Schematic diagram of functioning of heat exchanger

A decoupled compressor cooler system has a heat-insulated cooling block at a constant temperature of +1°C. Control of the compressor is contactless done by the **EC** automatic control electronics and is therefore not subject to wear. The pre-cooling stage ensures that the greater part of the condensate has already been removed from the gas stream.
The low-temperature stages are provided with two modified jet stream **EC30** heat exchangers made of Duran glass. These are cooled down to a temperature of around -30°C by two completely independent Peltier element cooling systems.
Stages ❶ and ❷ (see fig. 1) of the gas cooler work intermittently at intervals of three hours. While one stage is in operation, the other one is automatically defrosted. All the heat exchangers are easily accessible and are arranged in such a way that they can be removed very simply. Switching over the gas flow is done by a 3/2-way solenoid valve made of PVDF/Viton (see fig. 4). This arrangement excludes any possibility of water vapour being sucked back from the low-temperature stage that is being defrosted.

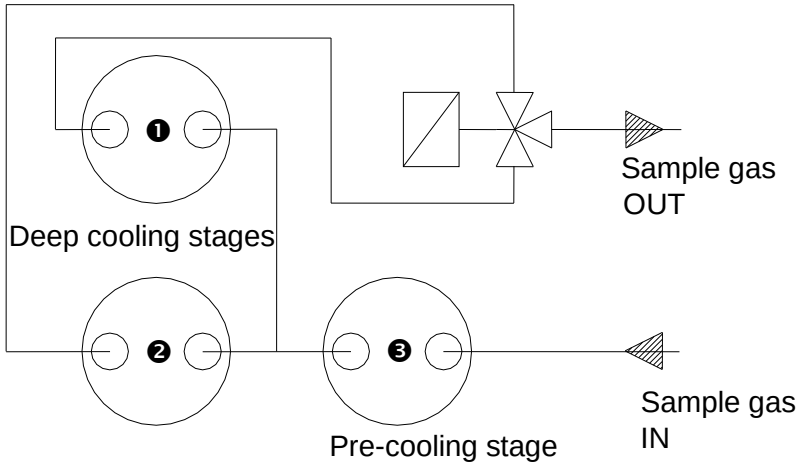


Figure 4 Tubing of the heat exchangers

The EC30 control electronic switches the solenoid valve every three hours and at the same time carries out the alternating defrosting process of the low-temperature heat exchangers.

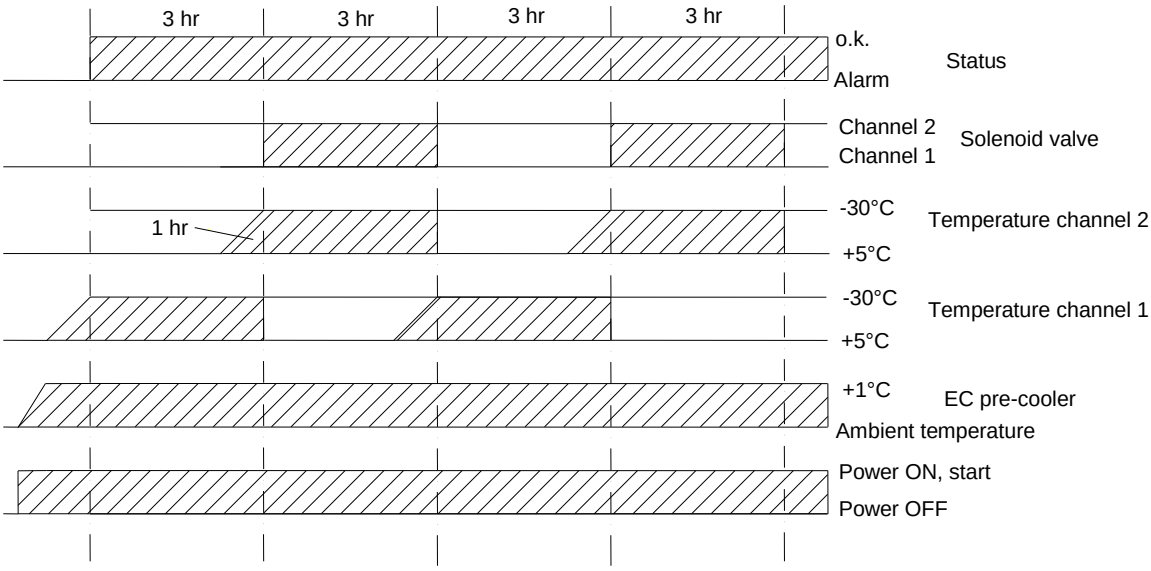


Figure 5 Timing schematic of the switching processes

The heat energy from the cooling system is drawn off by the forced ventilated condenser. The LED function display on the front of the cooler shows the operating status. Alarm warnings for over- and under-temperature are given as a collective status alarm via a relais output with two potential-free changeover contacts.

11 RECEPTION AND STORAGE

The **EC-30(/FD)** gas cooler is a complete pre-installed unit.

- Carefully inspect the EC-30(/FD) and any special accessories included immediately on arrival by removing them from the packing and checking for missing articles against the packing list!
- Check the items for any damage in transit and, if required, inform the shipping insurance company immediately of the damage found!
- The tubing for the heat exchangers is dismounted for shipping and it is separately inside of the package.

NOTE! **The cooler must be stored in a weather-protected frost-free area!**

NOTE! **During transport and when in storage, the cooler has always to stand vertical with the transport feet positioned underneath so that the oil in the closed compressor circuit cannot run out of this compressor case. If the cooler is transported on its back by mistake, it has to stand in the operating position for approx. 24 hours before it is switched on!**

12 INSTALLATION INSTRUCTIONS

The **EC-30(/FD)** cooler is equally suitable for wall mounting or for installation in a 19" rack.

NOTE! **Please state the desired type of mounting when ordering, so that the LED function display can be positioned to match at the factory!**

NOTE! **The operating position for this cooler is exclusively vertical. This is the only way to ensure proper separation and removal of condensate in the heat exchangers. During transport and when in storage, the cooler has always to stand vertical with the transport feet positioned underneath so that the oil in the closed compressor circuit cannot run out of this compressor case.**

The cooler should be kept away from sources of heat and well ventilated when installed, to avoid interfering heat accumulation.

The minimum installation dimensions (fig. 2) must be followed without fail. If the unit is installed outdoors, the cooler must be installed in a housing that is frost-free in winter and adequately ventilated in summer. Avoid locating the unit in direct sunlight.

Unheated gas sample lines have to be run with slope up to the cooler. In that case pre-separation of the condensate is not required.

Connect the heated sample line with sufficient thermal decoupling to the cooler!

13 SUPPLY CONNECTIONS

13.1 HOSE CONNECTIONS

The hoses for the heat exchangers are connected as shown in figure 4.

NOTE! **Do not mix up the hose connections; the inlet and outlet connections of the heat exchangers are marked with arrows;**

Exit hose of the low-temperature stage ❶ (fig. 4) is marked red.

Ensure that the connections are sealed adequately;

To ensure free removal of the condensate, ensure that the listed diameters for the condensate removal lines are not reduced!

Ensure that the connections are sealed adequately by noting the following:

Duran glass heat exchangers with GL connections

- Before assembly, check the GL coupling rings to see if the PTFE/silicon locking rings have been damaged;
- The locking rings should be installed with the PTFE side facing the medium.

PVDF heat exchangers with PVDF tube connectors

- Carefully remove the nuts from the coupling body so that the ferrule that is loose inside the nut will not be lost.
- Push the union nut first, and then the ferrule with the thick bulb facing the nut, onto the 4/6 mm hose.
- Push the hose onto the support nipple in the coupling body and tighten the union nut hand-tight.

NOTE!

When fixing the connectors in the PVDF heat exchanger hold up with a wrench at the pane of the bolt head!

The connection for the gas inlet (see above) is made to the heat exchanger of the pre-cooling stage ❸ (fig. 2). This is marked accordingly with an arrow.

The outlet for gas to be measured, DN 4/6, is located as standard on the universal unit EC-F located on the underside of the cooler casing (fig. 2). When using the automatic condensate removal EC-FD, the connection for the outlet for gas to be measured will be made to the corresponding connector on the front panel of the universal unit (fig. 2).

In the standard configuration, the tubes for removal of condensate are connected directly to the heat exchangers.
These protrude with the 12mm tube connectors above the base plate of the cooler casing (fig. 2).
Condensate removal is done according to the type of operation with:

- Universal unit **EC-FD** with peristaltic pumps for automatic condensate removal;
- Automatic float condensate trap and remover **AD-...** only for over-pressure operation;
- Condensate collector container that has to be drained manually.

13.2 ELECTRICAL CONNECTIONS

WARNING!

When connecting the equipment, please ensure that the supply voltage is identical with the information provided on the model type plate.

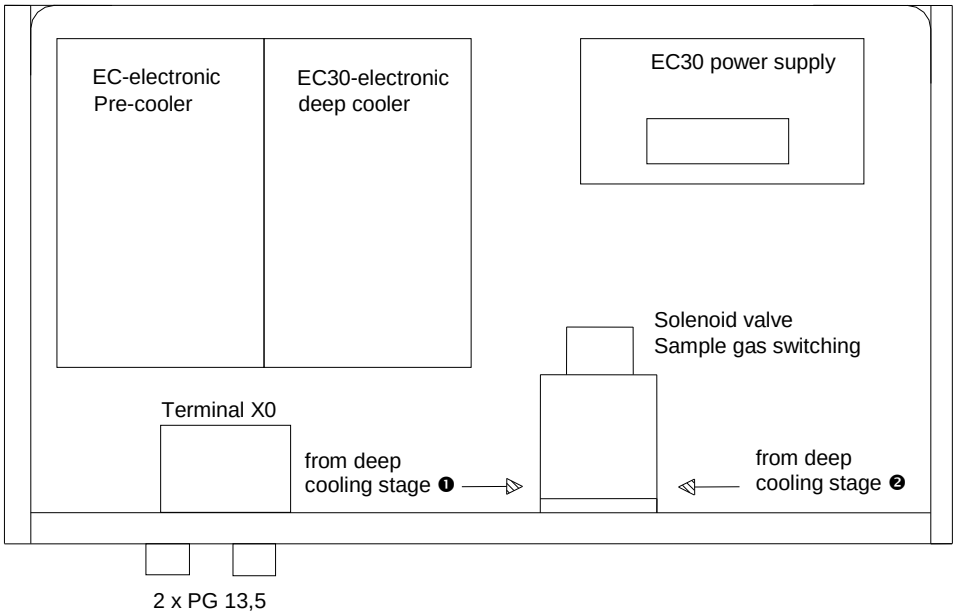
NOTE!

Attention must be paid to the requirements of IEC 364 (DIN VDE 0100) when setting high-power electrical units with nominal voltages of up to 1000 V, together with the associated standards and stipulations.

Check the details on the type plate to ensure that the equipment is connected up to the correct mains voltage.

The main circuit must be equipped with a fuse of $10A_T$ (over current protection); for electrical details see technical data.

Figure 6 shows the location of the terminal X0 behind the front panel of the **EC-30** casing (fig. 2).



Power supply : 230V/50Hz or 115V/60Hz (see type plate)
Status alarm : two potential free changeover contacts
Contact rating : 250V AC, 2A, 500VA or
250V DC, 2A, 50W

Figure 6 Position of terminal X0

Two PG 13,5 cable glands are provided for the cable bushings through the base plate of the cooler casing. Power and alarms have to be connected as shown in the pin configuration in Figure 7 below:

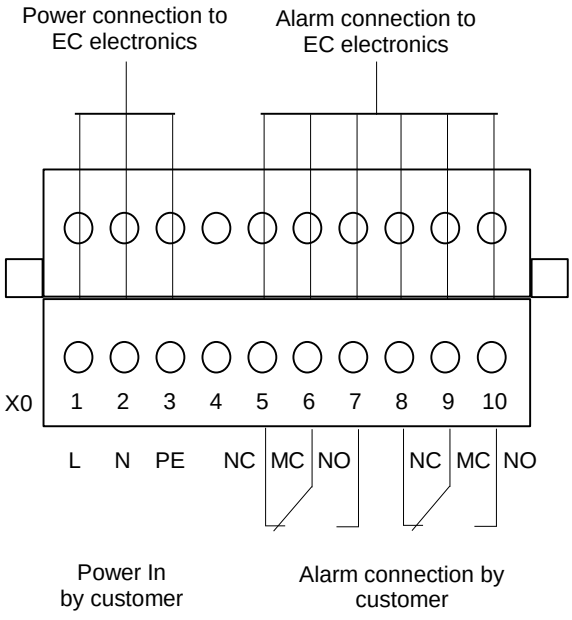


Figure 7 Electrical connections

14 START-UP

The control electronics of the **EC30(/FD)** permit automatic start up of the cooler, which also ensures safe and guaranteed operation regardless of external influences such as a power failure. The error diagnostics guarantee full monitoring and reporting of possible sources of error. The following description is valid for startup of the gas cooler for an ambient temperature > 5°C.

NOTE!

Before starting up the gas cooler, it must be placed in its operating position for at least two hours. The liquid inside the system may has been redistributed, and this could cause problems in operating!

The following steps should be carried out before initial start up:

- Connect the cooler unit to the mains power supply; Check that the equipment is connected to the correct mains voltage, 115V or 230V, as shown on the type plate.
- Lead the status contacts for reporting of low- and excess temperature to the measuring station.

NOTE!

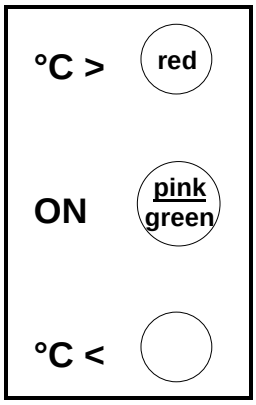
The status contacts must be connected to the external sample gas pump or to a valve in the sample gas line to protect the entire analysis system by immediately cutting off the gas supply in the event of error messages from the cooler!

14.1 FUNCTION SEQUENCE AND LED FUNCTION DISPLAY

Three function display LEDs are provided to give a visualization of the function sequence during start up of the cooler. According to the type of installation, they are located either on the front panel or the back panel of the cooler (fig. 2). The top LED (red) indicates that the temperature set by the **EC** automatic control electronics for the pre-cooler stage has been exceeded or has not been reached. The two-colour (pink/green) LED in the middle shows that the cooler compressor is operating (on/off). The bottom red function display LED gives an alarm if the pre-cooler stage temperature falls too low or if the low-temperature stage temperature is exceeded.

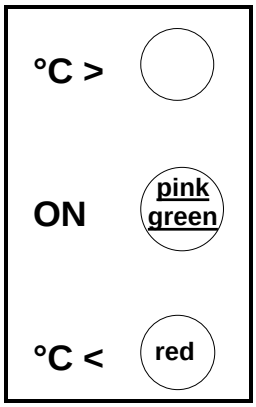
Switching the cooler on

As soon as there is a mains voltage, the top red LED lights up. This indicates that the temperature of the pre-cooler ❸ is min. 3°C above the set temperature of +1°C. The two-coloured LED in the middle lights up as pink once the cooler compressor is in operation.



Switching on the low-temperature stages

After approx. 30 minutes the pre-cooler stage has been cooled down to a temperature below +4°C. The top red LED goes out and the bottom red LED lights up. The low-temperature stage ❶ is activated and starts operating at full power. The cooler compressor is switched of as soon as the pre-cooler stage reaches the controlled temperature of +1°C. The middle LED lights up green. The cooler compressor will be alternately switched on and off by the EC automatic control electronics in a load-dependent cycle. The middle LED will alternately light up pink and green (normal operating functions).

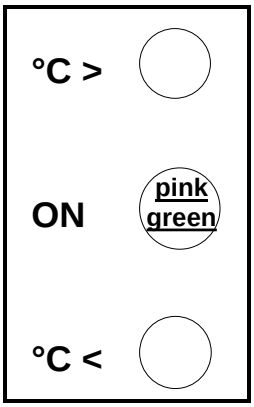


NOTE!

A second meaning of the flashed up bottom red LED and the flashed up green LED in the middle could be that the temperature of the pre-cooling stage is to low (see also chapter 17).

Normal operation

After about 1 hour the low-temperature stage ❶ reaches the alarm threshold value of -25°C. The bottom LED goes out. The status collector alarm contacts are deactivated and control the automatic external release for gas measurement. The EC30 cooler unit is ready for operation. The low temperature stage will be operated without control and will reach approx. -30°C. Normal operating function will be indicated on the front panel by the middle two-coloured LED.



15 CLOSING DOWN

NOTE!

The location for the cooler must remain frost-free, even when the unit has been switched off!

If the cooler unit is put out of operation for a short time no particular measures have to be taken.

We recommend purging the cooler with inert gas or ambient air, while the unit is put out of operation for a longer time.

WARNING!

Aggressive condensate is possible.
Wear protective glasses and proper protective clothing!

16 MAINTENANCE

The safety instructions specific to the plant and process are to be consulted prior to any maintenance work!

WARNING!

Dangerous voltage!
Before opening the housing please disconnect the cooler from the mains supply!

The **EC-30(/FD)** cooler unit does not require any special maintenance intervals.

Depending on the degree of contamination of the ambient air the cooling fins of the condenser have to be cleaned periodically with pressure air and the air suction filter units in the **EC-F / EC-FD** universal unit have to be cleaned or replaced. They are located in a plug-in box underneath the cooler unit. The filter elements are removed as follows:

- Unclamp the plug-in box by turning the quick-lock screw plug 90° to the left;
- Pull out the box;
- Remove the crossbars holding the filter element by pulling with moderate force in the direction of the filter element axis;
- Remove and replace the filter elements.

Reassembly is done in the reverse order.

16.1 MAINTENANCE OF THE PERISTALTIC PUMPS TYPE SR25.1 OF THE EC-30/FD

Before the maintenance work is carried out, it is necessary that the specific safety procedures pertaining to the system and operational process are observed!

DANGER

Dangerous voltage!
It is necessary to take the pump off the mains before any assembly, maintenance and repair work is carried out!

Flexible tube, conveying belt, contact pulleys and contact springs are the only parts of the pump subject to wear. They are easy to change.

16.1.1 CHANGE OF THE PUMP TUBE

CARE!

Aggressive condensate is possible!
Wear protective glasses and proper protective clothing!

NOTE!

If you send back the peristaltic pump to the M&C service for repair, please let us know what kind of condensate has been pumped.
Before sending the pump back clean all parts from dangerous or highly aggressive contaminants.

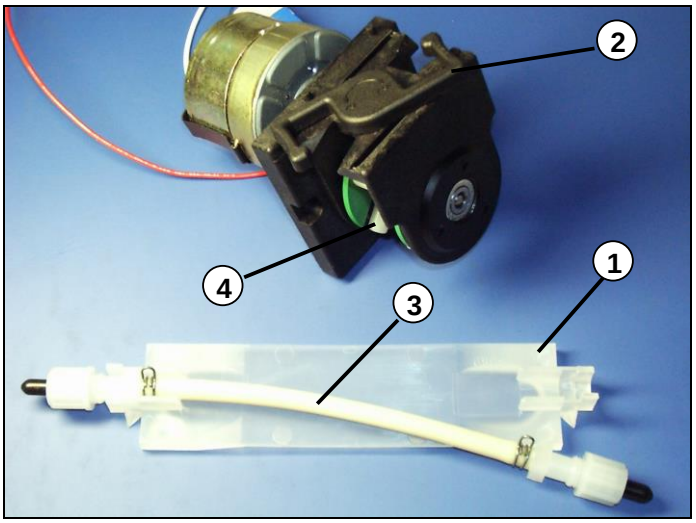


Figure 8 Change of the pump tube

- Take off the cooler of the mains;
- Open hose connectors at the pump;
- Press conveying belt ① at the recessed grips and turn S-bolt ② clockwise up to limit stop;

- Take away conveying belt ① and remove the old hose set ③ from the guides by the hose connectors;
- Press the two contact pulleys ④ and check whether the spring pressure is still sufficient, if not, the contact springs have to be changed;
- Put the new hose set ③ with the hose connectors into the guides of the conveying belt ①;

NOTE!

Only the usage of the original hose set guarantees a perfect function.
Never lubricate the hose.
Before mounting the pump check all parts for impurity and clean if necessary.

- Put the conveying belt ① with the new hose ③ into the dovetail guide of the pump body;
- Press conveying belt at the recessed grips and simultaneously turn the S-bolt ② anticlockwise until it snaps;
- Switch on pump.

16.1.2 CHANGE OF CONTACT PULLEYS AND SPRINGS

- Take off the cooler of the mains;
- Unscrew the nut of the pump head (span of the jaw 5,5);
- Draw the pump head out of the motor shaft; Now the driver can be taken out of the pump head and is ready for maintenance.
- To remove the springs (4 pcs.) of the driver is possible without the aid of any tools. Therefore press the spring together and take it out of the groove in the driver respectively out of the boring in the axle. Now the roller bearing axle can be dismounted and the contact pulleys are ready for change.
- Remounting in reverse order.

NOTE!

While mounting pay attention to the fit of 'rotational axis - driver'.
Use genuine spare parts only!

16.1.3 CLEANING THE PUMP HEAD

- When changing flexible tube or other parts, inspect all parts for dirt before assembling the pump head and clean them if necessary.
- Clean the parts with a dry cloth as far as possible. Solvents should not be used as they can attack the plastics and synthetic rubber parts. If a compressed air line is available, blow out the parts with pressure air.

CARE!

Aggressive sample is possible!
Wear protective glasses and proper protective clothing during disassembly, repair or cleaning!

16.2 REPLACING THE HEAT EXCHANGERS

Removal of the heat exchangers may be necessary to carry out maintenance or repair work. It is possible to replace the heat exchanger ❸ (pre-cooling stage) without switching off the entire cooler. This does not apply to the heat exchangers of the low-temperature stages ❶ and ❷. Icing-up at operating temperatures of -30°C will make it impossible to dismantle the unit. It will take approximately two hours to defrost after switching off the cooler. We recommend the following procedures for replacement of the heat exchangers in the following order:

- Release the GL coupling rings by turning them to the left at the upper gas connections and lower condensate connections to the glass heat exchangers;
- Pull the heat exchangers upwards with rotation out of the cooling block;
- Dry and clean the push-in opening in the aluminium cooling block with a cloth;
- Smear thermal conductivity paste (part no. 90K0115) on the heat exchangers with a thin and equal layer over the whole surface to ensure good conduction of heat. It is best to shut the condensate outlet of the heat exchangers with adhesive tape to prevent any of the thermal conductivity paste from getting into the heat exchanger;
- Lightly push the heat exchangers back into the opening of the cooling block and press to the upper limit stop;
- Remove the adhesive tape and any surplus thermal conductivity paste;
- Reconnect the hoses as shown in the flow diagram (fig. 4).

NOTE! **Do not mix up the hose connections; the outlet hose for the low temperature stage is marked in red!**

- Check the PTFE/Silicon locking rings for damage. In assembly, the locking rings must have the PTFE side facing the medium, otherwise the required degree of sealing cannot be guaranteed!
- Screw on the red GL coupling rings hand tight by turning them to the right.

17 TROUBLE SHOOTING

Troubleshooting is made much easier by the LED function display.

The following table shows possible reasons for error and how to correct them (not applicable for the running-up phase of the cooler).

LED display	Function error and status alarm	Probable cause	Checking / Correction
°C > ○ ON ○ °C < ○	Equipment does not cool;	No mains power;	Check the mains voltage 230V (115V) at terminal X0 (see Fig. 6 and 7); ***If mains voltage OK:*** replace defective **EC** automatic control board.
°C > red ON pink °C < ○	Equipment does not cool or the cooling is insufficient;	Cooling compressor is not running;	Check that the plugs are firmly seated in the sockets for power connection to the compressor; ***If OK:*** Measure the voltage 230V/115V for the compressor at the **EC** automatic control board at pins 21 and 22 (see Fig. 9). ***If not OK:*** Replace the defective **EC** automatic control board; ***If OK:*** Does the red LED **D3** (see Fig. 9) on the **EC** automatic control board lights up for more than one second? (A blocked unit will be switched off by the motor breaker switch); ***If yes:*** Replace the starting condenser; ***If compressor does not run:*** Send cooler in for repair.
°C > red ON pink °C < ○	See above	Cooling compressor runs; over-loading of the cooler unit;	***Check:*** - Is the maximum of 250 l/hr of gas flowing? - Is the ambient temperature max. +45°C? - Are the air suction filters dirty? - Are the fans working? - Are the condenser fins contaminated? ***If OK:*** Check temperature at the **EC** automatic control board (18.2); ***If the temperature is < 4°C (< 0,4V) for a nominal set temperature of +1°C:*** Replace **EC** automatic control board; ***If temperature > 4°C (>0,4V):*** Check PT100 temperature sensor (19.1); ***If not OK:*** Replace sensor; ***If sensor and electronics OK:*** Send cooler in for repair.

LED display	Function error and status alarm	Probable cause	Checking / Correction
°C > ○ ON green °C < red	Equipment does not cool;	Ambient temperature < -2°C	Ambient temperature must be ≥ +5°C!
	Cooler has been over-cooled (temp. < - 2°C);	Cooling compressor stopped;	Check temperature at **EC** automatic control board (18.2); ***If temperature < -2°C (< -0,2V):*** Check PT100 temperature sensor (19.1); ***If not OK:*** Replace sensor.
		Cooling compressor runs continuously;	Solid-state relay defective; Replace **EC** automatic control board;
°C > ○ ON green pink °C < red	Low-temperature function affected;	Low temperature stages defective	Check the fine fuses in the **EC30** mains supply; ***if o.k.:*** Check the voltage at pins 20/21 and 21/22 of the **EC30** automatic control board (Fig. 15);
		Sensors;	***if voltage > 12V:*** Check the voltage for the **EC30 t**emperature sensors on the **EC30** control board at pins 27/28 and 33/34 (19.2); ***if voltage > 2,83V (> +10°C):*** Replace the relevant sensors;
		Peltier elements;	***if voltage < 2,83V (< +10°C):*** Check the voltage of the Peltier elements at pins 23/26, channel ❶, and pins 29/32, channel ❷ (Fig. 15) ***if voltage for channel thus controlled (LED D16/ D17) > 17 VDC:*** Peltier element is defective; send cooler in for repair;
Heat exchanger frozen up	No gas flow, sample gas pump runs;	Peristaltic pump defective; Gas flow too low	Check peristaltic pump SR25.1 ***if o.k.:*** Raise gas flow to min. 100l/h;

18 EC AUTOMATIC CONTROL BOARD

Figure 7 shows the arrangement of the **EC** automatic control board of the pre-cooling stage ❸ (wiring scheme in Appendix).

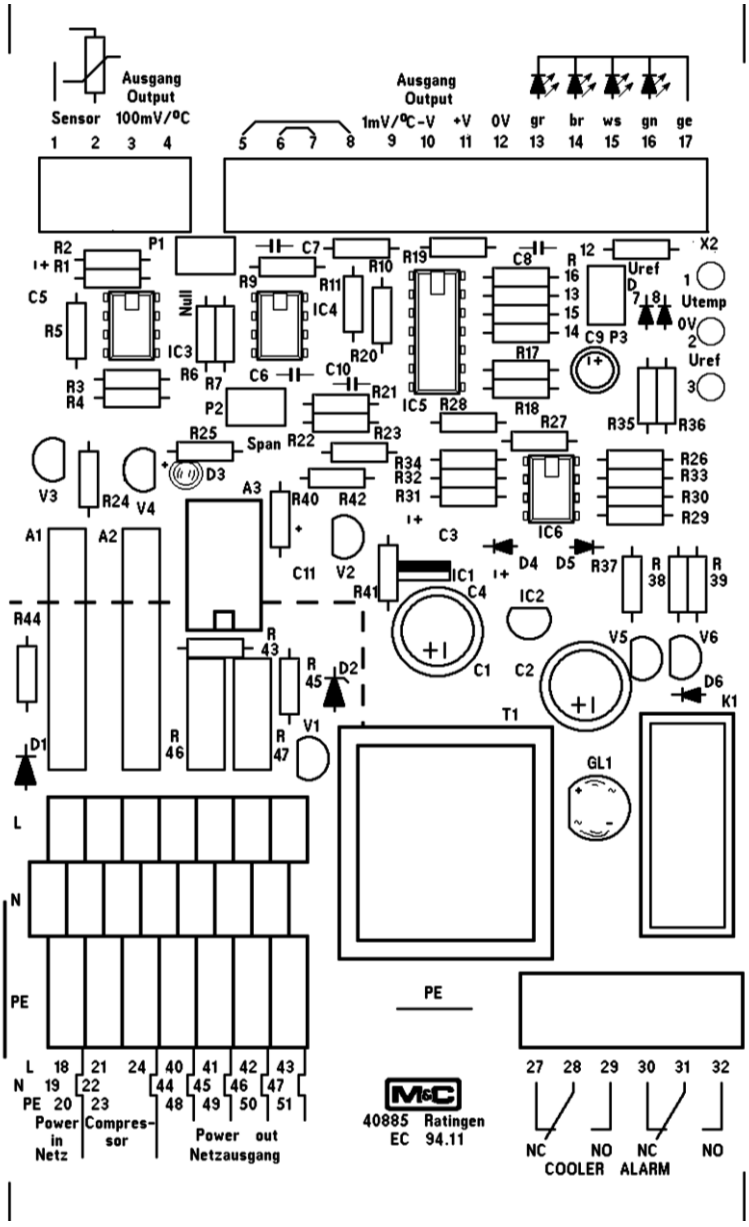
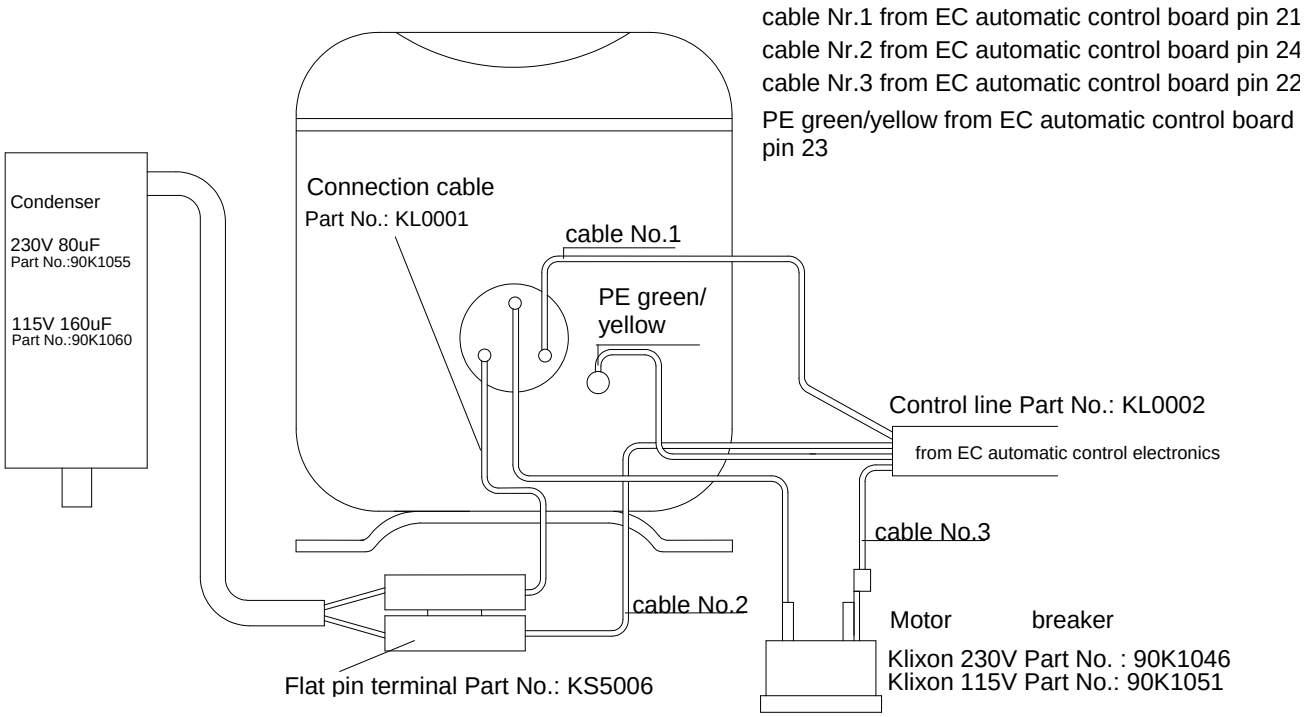


Figure 9 EC automatic control board

18.1 CONNECTING THE COOLING COMPRESSOR

The cooling compressor is connected to the **EC** automatic control board (Fig. 9). Figure 10 shows the connection diagram for the compressor.



Cable no. compressor	1	2	3	PE green/yellow
EC automatic control board	21	24	22	23

Figure 10 Connection diagram for compressor

18.2 TEMPERATURE SETTING FOR THE COOLER

The pre-cooling stage is set at the factory to a regulated temperature of +1°C.

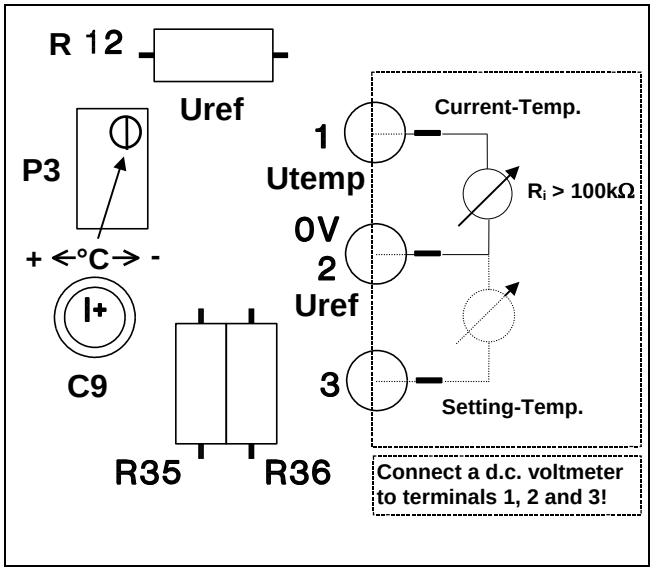


Figure 11 Temperature adjustment

Setting of the regulated temperature is done by trimming potentiometer **P3**, on the **EC** automatic control board of the cooler. The setting range covers temperatures from 0°C to 20°C. Turning it to the right sets a lower temperature, and turning it to the left sets a higher temperature.

Connecting an external voltmeter to plugs 2 and 3 allows the nominal set temperature to be read off and controlled. A voltage value of 0.1V corresponds to a temperature of 1°C.

It is possible to measure and control the current temperature at measuring sockets 1 and 2.

NOTE!

Freezing up in the pre-cooling stage will endanger the operation of the cooler unit. For this reason the cooler temperature must never fall below +1°C!

19 TEMPERATURE SENSORS

The pre-cooling stage temperature sensor ❸ is a PT100 element. STP 35 temperature sensors are available for the low temperature stages ❶ and ❷.

19.1 CHECKING THE TEMPERATURE SENSOR OF THE PRE-COOLING STAGE

There are two methods for checking the PT100 element, as follows:

Voltage method

In order to check the sensor for the cooler currently in operation, the actual voltage at the measuring sockets 1 and 2 of the **EC** automatic control board must be measured as per section 18.2 above. Figure

12 shows the voltage characteristics in relation to temperature. If the measured voltage is inside the shaded area, the sensor is defective and has to be replaced.

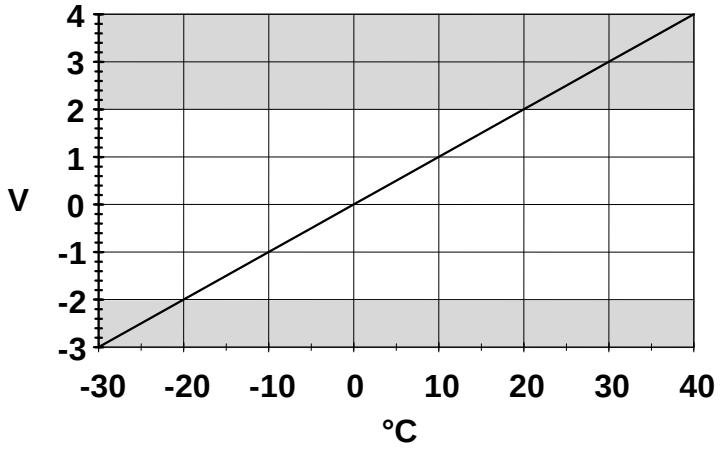


Figure 12 Voltage in relation to the temperature of the cooling stage

Resistance method

In this case the sensor must be disconnected from pins 1 and 2 at the **EC** automatic control board (Fig. 9) and removed from the cooling block. When measuring the resistance of the PT100 element, this must be proportional to the ambient temperature. The resistance-temperature characteristics are shown in Figure 13 below.

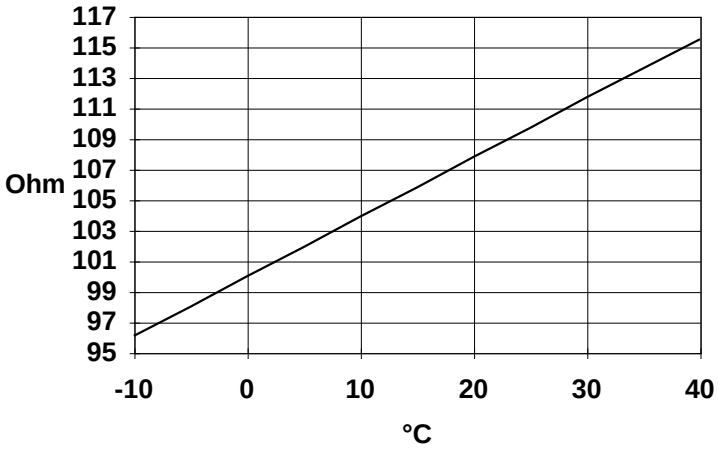


Figure 13 Resistance-temperature characteristics of the PT100 temperature sensor

19.2 CHECKING THE TEMPERATURE SENSOR OF THE DEEP COOLING STAGE

In order to check the sensors for the low-temperature stages ❶ and ❷, the voltage at the **EC30** control board should be measured between pins 27 and 28 (fig. 15) for channel 1 and between pins 33 and 34 for channel 2. Figure 14 allocates a corresponding voltage value for a given temperature value. This should be compared with the measured voltage value.

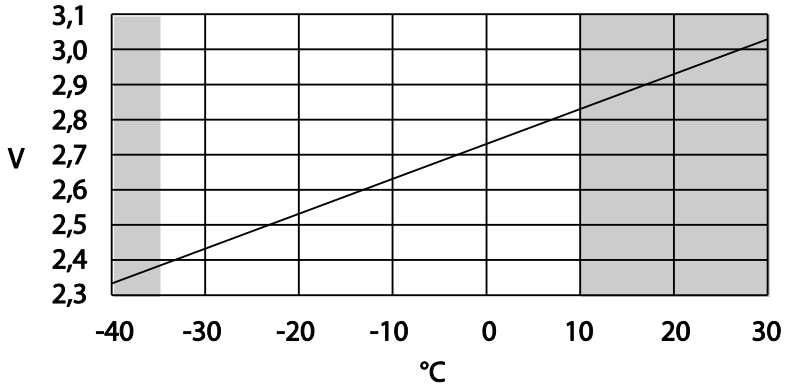
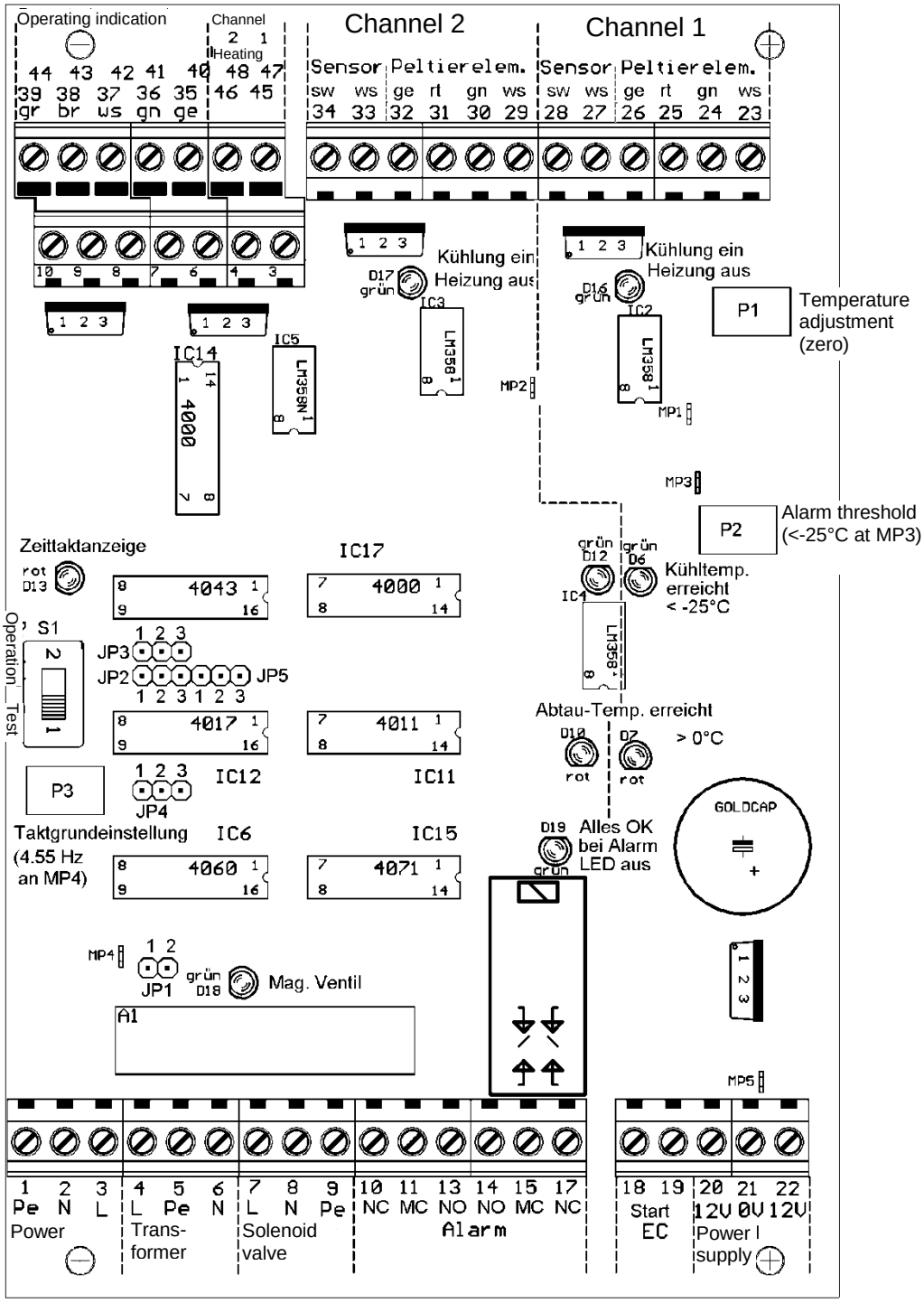


Figure 14 Sensor voltage as function of temperature

If the measured voltage is inside the shaded area, the sensor is defective and has to be replaced.

20 EC CONTROL BOARD

Figure 15 shows the layout of the **EC30** control board (wiring diagram in appendix).



Voltage at MP1, MP2, MP3 measured against MP5 (V):	1	2	3	4	5	6	7	8
Corresponding temperatures in °C	+30	+20	+10	0	-10	-20	-30	-40

Voltage at MP1, MP2, MP3 measured against MP5 (V):	1	2	3	4	5	6	7	8
Corresponding temperatures in °C	+30	+20	+10	0	-10	-20	-30	-40

Figure 15 EC30 control board

20.1 FUNCTION SEQUENCE OF THE EC30 CONTROL ELECTRONICS

Nine LEDs are available for error diagnosis of the **EC30** control electronics to display all the logic and alarm functions.

NOTE!

Do not change any settings that had been made at the factory!

- **With the potentiometer P1 the temperature (zero point) is adjusted (measuring points M1, M2)**
- **Potentiometer P2 figures the alarm < -25°C (measuring point M3).**
- **P3 is used to set the automatic time cycle (measuring point M4)**
- **The switch S1 is used for factory-made tests. It must always be set in the higher position, 'operation'.**

NOTE!

It is essential to check the setting of switch S1 prior to initial start-up.

Start up is done by applying a voltage to the cooler unit:

- LEDs **D7** and **D10** light up red;
- LED **D16** lights up green;
- The temperature of the low-temperature stages is > +0°C.

Once the pree-cooling stage ❸ has reached +4°C after about half an hour:
Cooler stage ❶ is activated;

After a short time the temperature of the low-temperature stage ❶ < 0°C:

- LED **D7** goes out.

After 1 hour total the temperature of the low-temperature stage ❶ < -25°C:

- LED **D6** lights up green;
- LED **D19** - status all o.k.- lights up green;
- The status alarm contact is deactivated;
- LED **D13** - timing cycle active - blinks red.

It is now ready for cooler operation. The sample gas flows through the pre-cooling stage ❸ and the low-temperature stage ❶, after which an external release is done by the status alarm contact, so that the external sample gas pump or a solenoid valve in the sample gas line can be controlled by the alarm contact. After additional two hours, low-temperature stage ❷ will likewise be activated:

- LED **D17** lights up green.

After a short time the temperature of the low-temperature stage ❷ < 0°C:

- LED **D10** goes out.

After half an hour the temperature of the low-temperature stage ❷ is < -25°C:

- LED **D12** lights up green;

Three hours after low-temperature stage ❶ was ready for operation, the solenoid valve will be switched over to channel 2:

- LED **D18** - solenoid valve channel 2 selected - lights up green;
- LED **D16** - cooling ON channel 1 - goes out.

The sample gas flows through the pre-cooling stage ❸ and low-temperature stage ❷. This cycle will be changed automatically every three hours.

In the event of a brief (mains) power failure:

- The current cycle status will be stored;
- All LEDs go out;
- The status alarm contact is activated;
- The flow of sample gas is cut off externally, in case the sample gas pump or a solenoid valve in the sample gas line are to be controlled by an alarm contact.

When the mains power is restored:

- The controller starts up automatically;
- The status alarm contact is deactivated;
- The status alarm contact will release the flow of sample gas externally, in case the sample gas pump or a solenoid valve in the sample gas line are controlled by an alarm contact.

In the event of a prolonged power failure, the controller will start up automatically like it happens for a new start. Release is only done when the temperature is < -25°C.

21 SPARE PARTS LIST

Wear, tear and replacement part requirements depend on specific operating conditions.
The recommended quantities are based on experience and are not binding.

Gas cooler EC-30(/FD)					
(C) Consumable parts **(R) Recommended spare parts** **(S) Spare parts**					
		Recommended quantity being in operation [years]			
Part No.	**Indication**	**C/R/S**	**1**	**2**	**3**
02 K 9105	Spare heat exchanger EC-G pre-cooling stage EC30 with GL connections, Material: Duran glass Connections: Sample gas: 2x GL18-8mm, Condensate: 1x GL25-12mm·	R	1	1	1
02 K 9150	EC-G-90° jet stream heat exchanger material: Duran glass	R	1	1	1
02 K 9200	EC-SS jet stream heat exchanger material: stainless steel	R	1	1	1
02 K 9250	EC-SS/NPT jet stream heat exchanger material: stainless steel Connections: sample gas in and out 1/4“NPTi condensate out 3/8“ NPTi	R	1	1	1
02 K 9300	EC-PV jet stream heat exchanger material: PVDF	R	1	1	1
90 K 6001	Jet stream heat exchanger type EC-G30 for deep cooling stage, material: Duran glass.	R	1	1	1
90 K 6003	Heat exchanger EC30-PV for the deep cooling stage.	R	1	1	1
90 K 0115	EC thermal conductivity paste 50 g (-40°C to 140°C)	R	1	1	2
90 K 1002	Temperature sensor PT100 for EC automatic control electronics from model nos.: 95.....	R			
90 K 6055	Temperature sensor for EC30	R	-	-	-
90 K 1007	EC automatic control board complete for PT100 and contactless compressor control from model nos.: 95.....	R	-	1	1
90 K 0035	Fan (M1/2 - 230V 50Hz) with option EC-F/FD	C	-	2	2
90 K 0040	Fan (M1/2 - 115V 60Hz) with option EC-F/FD	C	-	2	2
90 K 6045	Fan 80 for EC-30	C	-	2	2
90 K 1035	Solid-state-Relais "RE2" ASP-204	R	-	1	1
90 K 1010	LED function display with connecting cable	R	-	-	1
90 K 1015	Cooler aggregate complete with compressor, vaporizer and condenser for EC-30; refrigerant R134A, power: 230 V, 50 Hz standard	R	-	-	-
90 K 1014a	Cooler aggregate complete with compressor, vaporizer and condenser for EC-30; refrigerant R404A, forced ventilated, power: 115 V, 60 Hz	R	-	-	-
90 K 1014	Cooler aggregate complete with compressor, vaporizer and condenser for EC-30; special quantity of refrigerant R134A for forced ventilation, power: 230 V, 50 Hz with option EC-F/FD	R	-	-	-
90 K 0130	Filter cloth EC-F with option EC-F	C	2	4	6
90 K 0135	Filter cloth EC-FD with option EC-FD	C	2	4	6
90 K 1046	Bimetal switch Klixon 230V	R	-	1	1
90 K 1051	Bimetal switch Klixon 115V	R	-	1	1
90 K 1055	Capacitor for compressor 80µF-230V	R	-	1	1
90 K 1060	Capacitor for compressor 160µF-115V	R	-	1	1
90 K 6035	Peltier element EC30	T	-	-	-
90 K 6030	Fine fuse 4AT 5x20	R	2	4	6

22 APPENDIX

- Sample outlet dew point (ambient temperature 20°C) depending on heat exchanger material, inlet dew point and gas flow rate
- Circuit diagram EC automatic control board, drawing number : **2300 - 5.04.2**
- Circuit diagram EC30 (from 9/98), drawing number: **2389 - 5.01.3**
- Circuit diagram EC-30-control electronic, drawing number: **2389 - 5.02.3**
- Wiring plan automatic condensate removal unit EC-FD, drawing number : **2300-5.05.0**

Further product documentation can be seen and downloaded from our home page: www.mc-techgroup.com

- Instruction manual peristaltic pump **SR 25.1**, Document: **3-7.1-MD**;
- Condensate vessel **TG**, **TK**, Document: **3-6.3.1**
- **GL**-connectors, Document: **3-5.1.1**
- Universal unit **EC-D** and **EC-FD**, Document: **3-4.4**
- Automatic liquid drain **AD-SS**, Document: **3-6.2.3**
- Automatic liquid drain **AD-P**, Document: **3-6.2.1**

Sample outlet dew point (ambient temperature 20°C) depending on gas flow rate

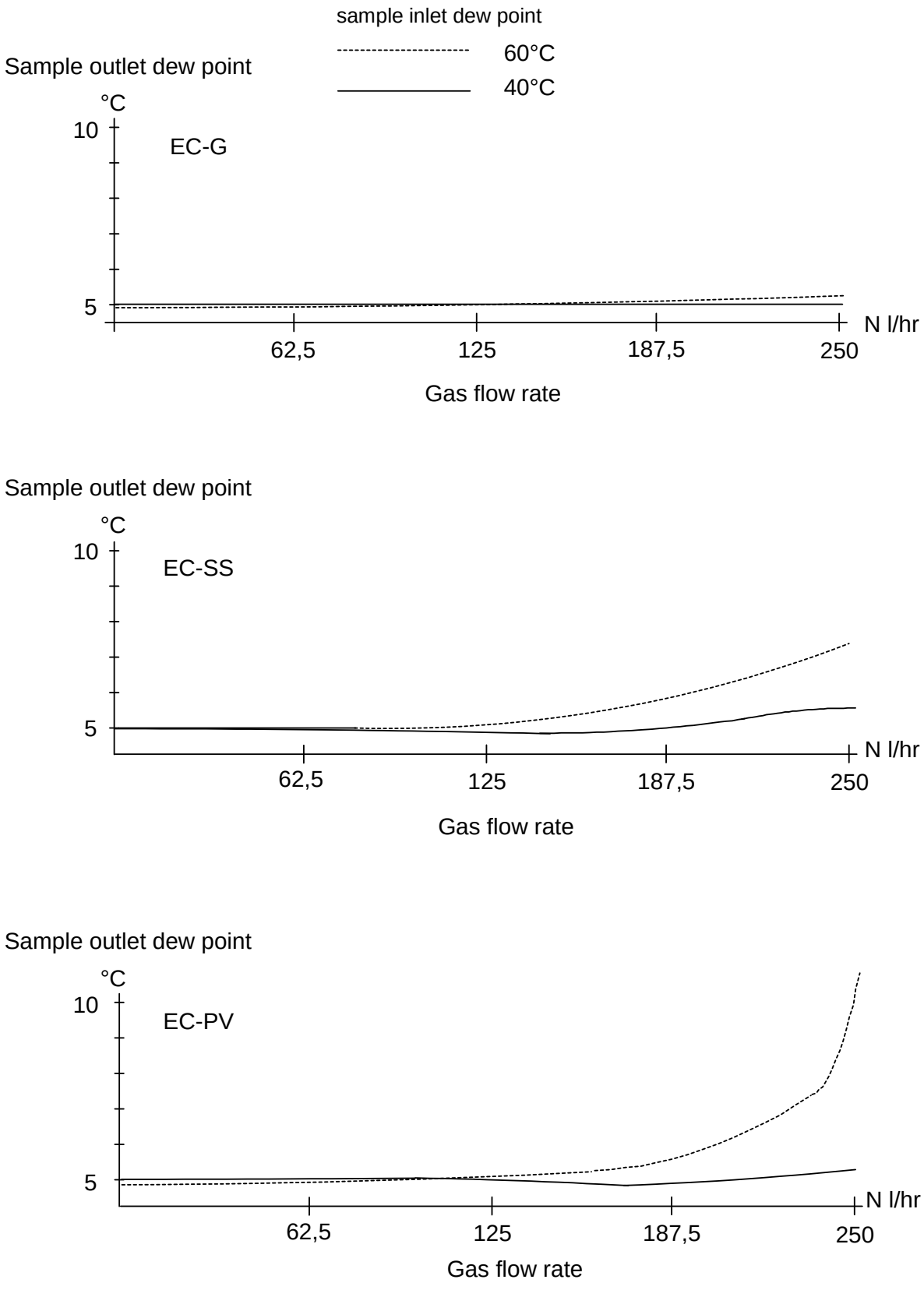


Figure 16 Sample outlet dew point

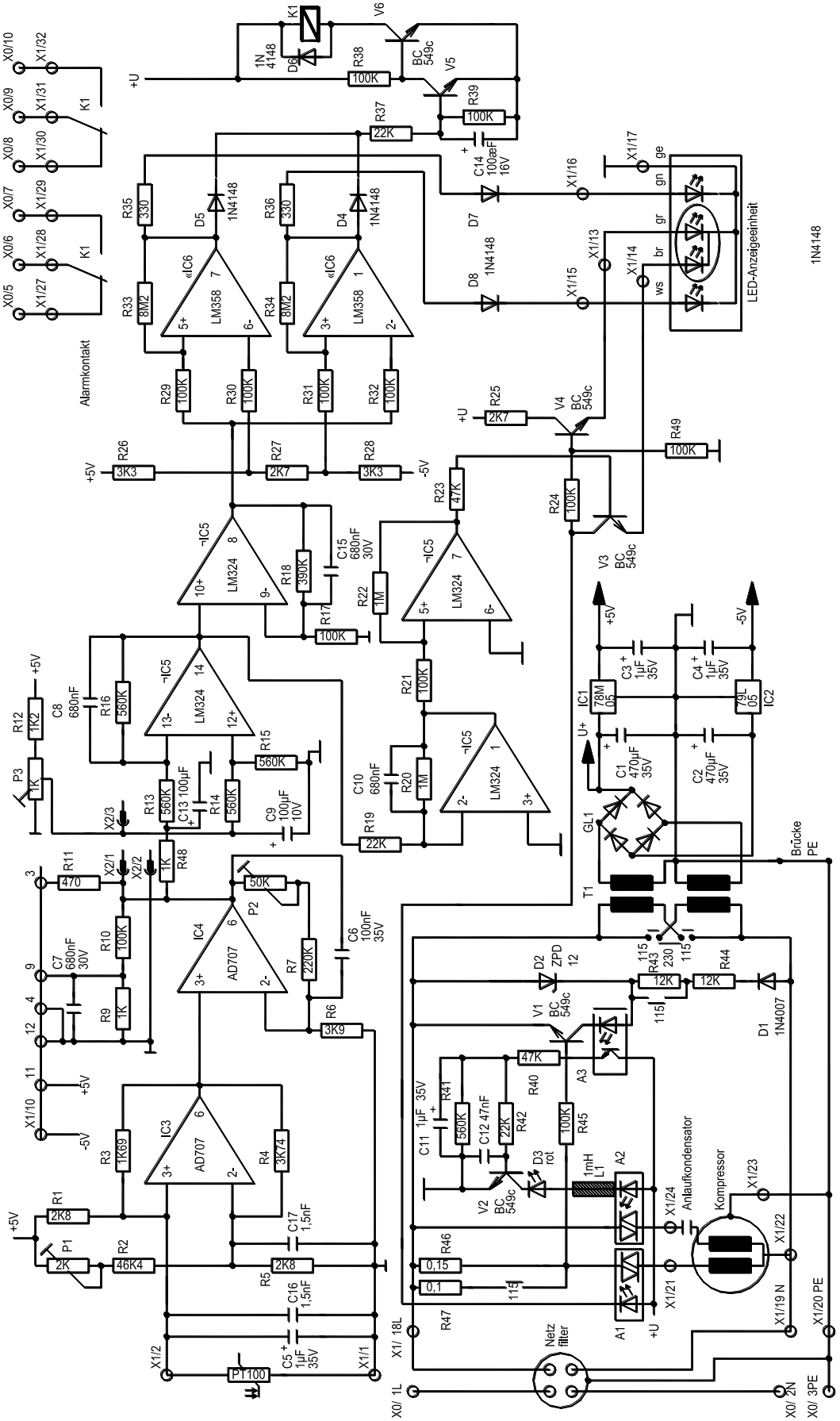


Figure 17 Circuit diagram EC automatic control board

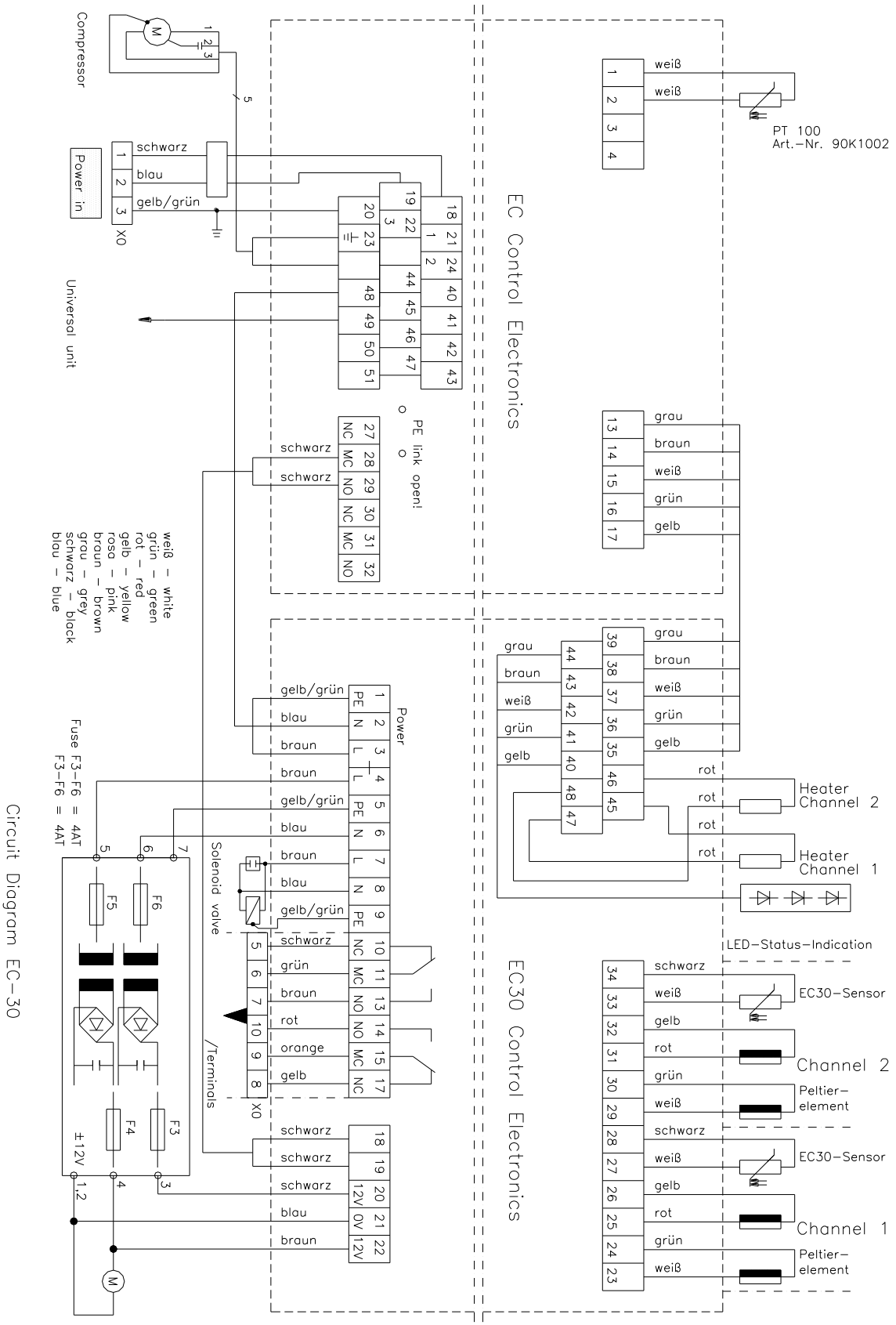


Figure 18 Circuit Diagram EC-30

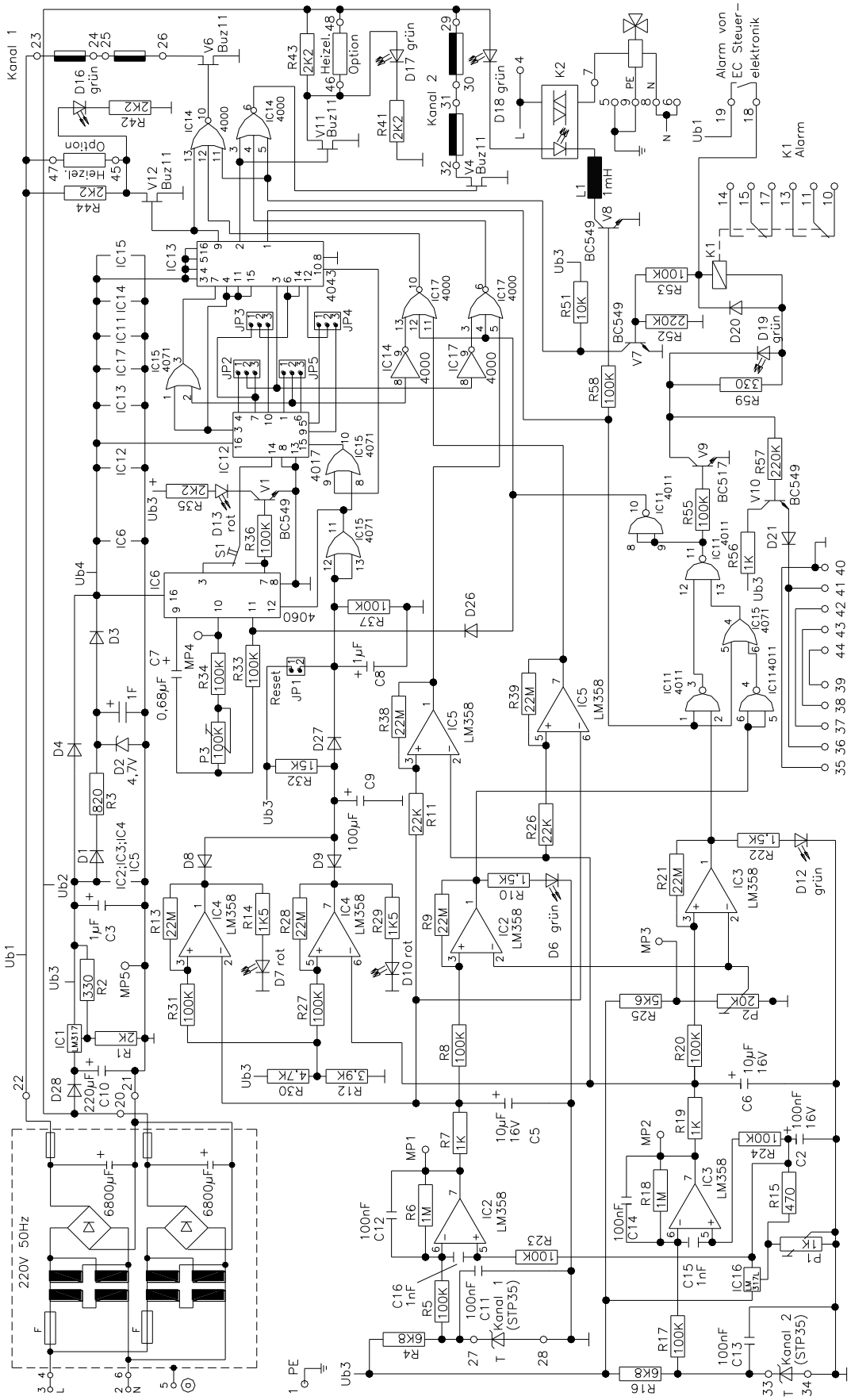


Figure 19 Circuit diagram control electronic EC-30

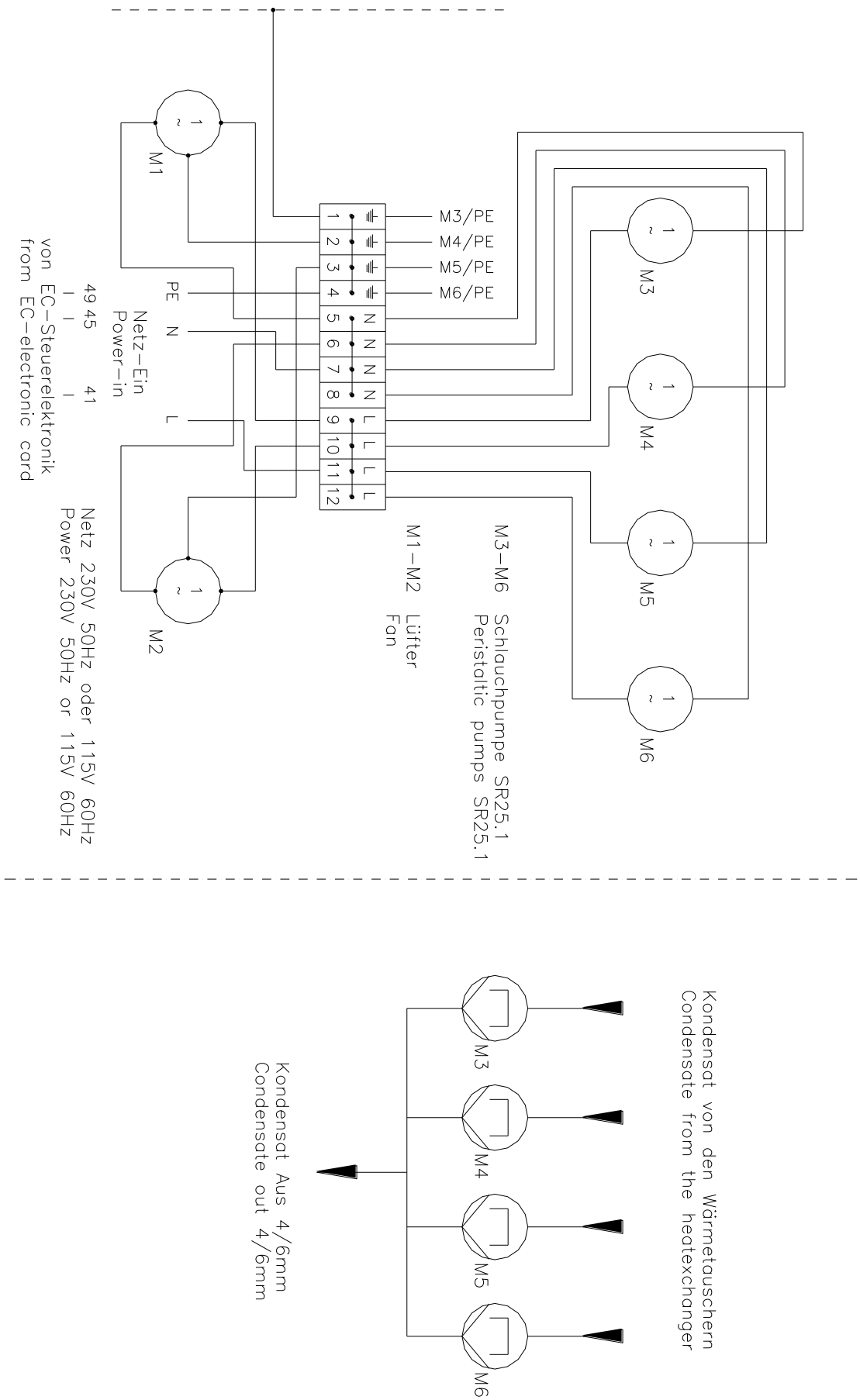


Figure 20 Wiring plan automatic condensate removal unit EC-FD