Manual of instruction

Temperature control unit TT-188

with Temperature Controller MP-888

CE

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General information

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In case of inconsistencies in the English translation, the German version shall prevail.

Contents

Attachments:

- **Electrical diagram MP-888 EL-000012**

1. General Safety Information

1.1. Safety Symbols

DANGER	
	**Denotes imminent danger.** **Failure to heed the information can result in death or grave personal injury (disability)!**

WARNING	
	**Denotes a dangerous situation.** **Failure to heed the information can result in death or grave personal injury (disability)!**

CAUTION	
	**Denotes a potentially dangerous situation.** **Failure to heed the information can result in property damage as well as minor or moderate personal injury!**

NOTE	
	**Denotes general information, useful advice to users and work recommendations, which, however, do not have any influence on the safety and health of personnel.**

1.2. Range of Application

This general safety information is generally valid for all temperature control units from TOOL-TEMP.

1.3. Intended Use

The TOOL-TEMP temperature control unit is built according to the current state of the art and the generally accepted principles of safety engineering. The temperature control unit is intended solely for the normal use for heating and/or cooling of injection and die casting moulds, extruders, calendars, mixers and other consumers in areas in which there is no risk of explosion.

Any use beyond this shall be deemed to constitute improper use. The manufacturer is not responsible for damage resulting from improper use; the user is solely responsible for such risks. The temperature control unit may not be used under other operating conditions and/or with other media, in deviation from our specifications, without the prior consent of TOOL-TEMP.

Use as intended also entails compliance with the operating, servicing and maintenance conditions stipulated by the manufacturer. The temperature control unit may only be operated, serviced and maintained by personnel who are familiar with these tasks and have been instructed as to the risks.

1.4. Safety Information

1.4.1. General Information

The TOOL-TEMP temperature control unit is safe to operate, but this device can pose danger to life and limb if it is used incorrectly or for a purpose other than that intended. It should be noted that this poses risks to the life and limb of the user or third parties, adverse effects on the equipment and other material assets belonging to the user, and risks to the efficient operation of the equipment.

Start-up (i.e., commencement of intended use) is prohibited until it has been determined that the temperature control unit has been set up and wired in accordance with the Machinery Directive (2006/42/EC). EN 60204-1 (Safety of Machinery) must also be observed.

These operating instructions must be read carefully before turning on and operating the temperature control unit. The information regarding the intended use and foreseeable misuse must be observed. Local safety regulations must also be obeyed.

If the temperature control unit is used in combination with products by other manufacturers, their notices and safety regulations must also be obeyed.

1.4.2. Process Monitoring

In plants in which a temperature control system malfunction leads to endangerment of the operating personnel or destruction of the plant, an independent process monitor that shuts down the plant reliably must be used.

1.4.3. Information for Operators and Personnel

The operator and all persons who are tasked with working on the temperature control unit must obey the fundamental regulations regarding work safety and accident prevention. The operator must ensure that only persons who have read and understood these operating instructions, particularly the chapter on safety, work on the temperature control unit.

WARNING	
	**People with pacemaker should not be allowed to demount or maintain the magnetically coupled pump!**

Any working methods that have a negative effect on the technical safety of the temperature control unit must not be used. The operator must ensure that the temperature control unit is operated only in flawless condition. If necessary, the company using the equipment must obligate the operating personnel to wear protective clothing.

For all tasks having to do with set-up, start-up, operating, modification of operating conditions and operational modes, maintenance, inspection and repair, any shut-down procedures stated to be necessary in the operating instructions must be followed.

1.4.4. Changing the Parameterisation

The parameterisation of the control system may only be carried out by personnel trained by TOOL-TEMP. In particular, no parameters in the device configuration may be changed without consulting TOOL-TEMP.

The relevant accident prevention regulations and the generally accepted principles of safety engineering, occupational medicine and structural engineering must be observed. The national safety regulations must also be obeyed.

1.4.5. Residual risks

Any unauthorised modifications and changes to the temperature control unit as well as unauthorised changes to the parameterisation of the control system are prohibited for reasons of safety.

If the temperature control unit is damaged, it must not remain in use; the defective part must be replaced or repaired immediately. Only original TOOL-TEMP replacement parts may be used. Damage due to use of thirdparty parts voids any and all warranty claims.

DANGER	
	**The temperature control unit must be rendered currentless before it is opened! Press the main switch on the temperature control unit and unplug mains plug!** **Danger due to electrical shock!**

Repair leaks in the temperature control circuit (device, connecting lines, consumers, etc.) immediately.

In temperature control units that use oil as a heat transfer medium, it should be noted that oil is flammable under certain conditions. For this reason, the temperature control unit must not be located in the vicinity of heat sources. The thermal insulation in the device must always be kept clean. Insulation that is soaked with thermal oil poses an increased risk of fire.

Burning thermal oil can be extinguished using a spray foam fire extinguisher, a powder fire extinguisher (avoid with dust-sensitive plants, control systems, EDP, etc.) or a CO_2 fire extinguisher. The appropriate fire extinguisher must be provided by the operator, taking into account the equipment located in the room and the mandatory safety regulations.

The temperature control unit may only be operated when all safety systems are completely installed and intact. The temperature control unit must be protected against sprays and cleaning agents.

Before detaching connecting lines in the temperature control circuit and depending on the outlet temperature, allow the temperature control unit to cool down first and then turn it off. Check that the pump is no longer running.

WARNING	
	**Important - danger of injury in the event of escaping water or oil!**

1.5. Using this Documentation

This documentation contains important information for safe, economical operation and for proper maintenance of the device.

Compliance with this documentation helps to avoid danger, minimise repair costs and downtime, and increase the dependability and service life of the unit/system.

NOTE	
	**The operating instructions should be kept near the corresponding unit and always be accessible to operating and maintenance personnel.**

1.5.1. Additional Documentation

The included documentation is completely correct for the basic versions of units. Components that do not belong to the basic hardware are noted as extra equipment. The corresponding additional documents are included with special versions of devices. Any additional documents supplement and/or replace the descriptions contained in this documentation, which are then either invalid or only conditionally valid.

2. Overview temperature control unit

2.1. Front view

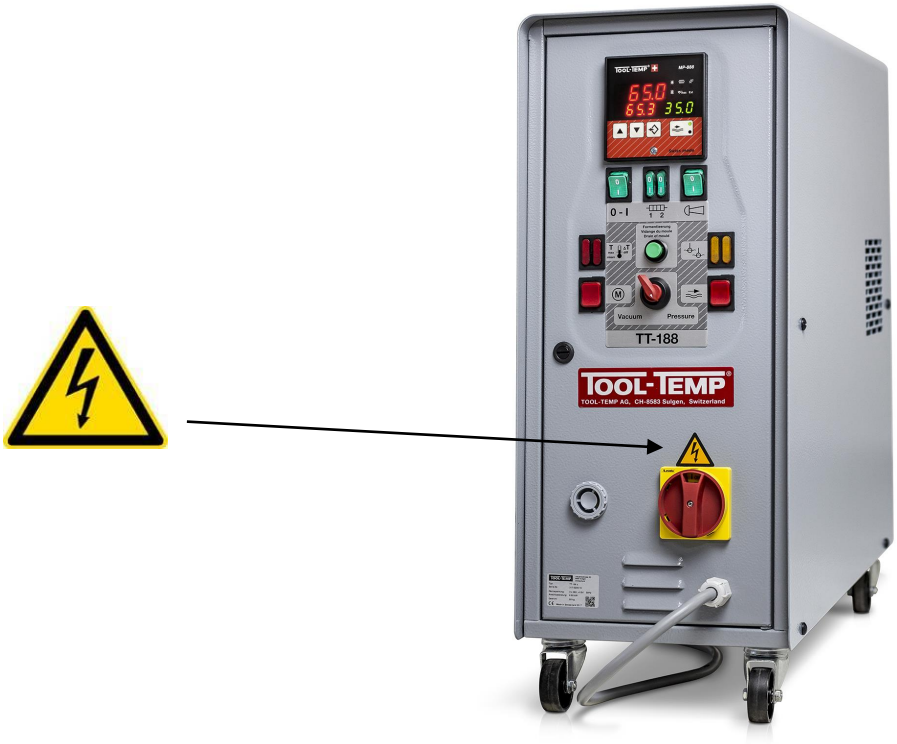
1	**Temperature Controller MP-888**
2	**ON/OFF-Switch unit (green)**
3	**ON/OFF-Switch heating (green)** Water: Switchable in stages 3 kW + 6 kW = 9 kW Oil: 3 kW (OR-circuit)
4	**ON/OFF-Switch horn (green)**
5	**Temperature monitoring internal left (red)** The maximum temperature of the unit is exceeded. The unit switches off. **Control lamp Temperature deviation control right (red)** Difference between desired and actual temperature is too big. Unit continues to run.
6	**Control lamp thermal relay pump (red)** Thermal relay of the pump motor has responded, unit switches off.
7	**Mould drainage (green)** - Cooling the unit below 60°C - Switch the unit off by the green ON/OFF-Switch - Changeover switch for pump operation mode to position „Vacuum“ - Press the green button approx 5 sec.
8	**Change-over switch for pump operation mode (red)** Pressure for pressure operation (normal operation) Vacuum for leakstopper operation and mould drainage
9	**Level control lamp pre-warning left (yellow)** lights + horn Unit continues to run, level has to be corrected **Level control lamp right (yellow)** lights + horn unit switches off
10	**Flow control (red)** Alarm sounds by large changes.
11	**Main switch** Emergency stop
12	**Name plate with following details:** 
13	**Switch cabinet – safety device**
14	**Coverage – safety device**

2.2. Rear view

15	**From mould**	**½“**	**BSP female thread**
16	**Manometer pump pressure**		
17	**To mould**	**½“**	**BSP female thread**
18	**Cooling water inlet with water filter**	**⅜“**	**BSP female thread**
19	**Cooling water outlet**	**⅜“**	**BSP male thread**
20	**Manually refill with overflow**	**1“**	**BSP male thread**
21	**Overflow**		
22	**Drainage**	**⅜“**	**BSP female thread**

2.3. Identification of residual risk on the unit

On the temperature control unit following pictograms are mounted to identify the residual risk.



DANGER	
	**The temperature control unit must be rendered currentless before it is opened! Turn off the main switch on the temperature control unit and disconnect the power cord from the wall socket!** **Danger due to electrical shock!**

3. Technical Specifications

Temperature range	up to 90°C with water / up to 150°C with oil	
Temperature control	self-optimizing, electronic microprocessor controller MP-888	
Heating capacity	Water operation: 9 kW, with manual stage switching 3/6 Oil operation: 3 kW	
Pump capacity	motor 0,75 kW Pressure mode: max. 4,5 bar / max. 75 l/min Vacuum mode: vacuum max. 8mH_2O	
Cooling capacity	approx. 35 kW at 90°C	
Filling amount	approx. 6 litres	
Connections	to mould	½“ BSP female thread
	from mould	½“ BSP female thread
	cooling water inlet with water filter	⅜“ BSP female thread
	cooling water outlet	⅜“ BSP male thread
Dimensions (L×W×H)	670 × 260 × 650 mm	
Weight	approx. 55 kg empty	
Category of protection	IP-44	
Electric	In separate switch cabinet, easily accessible from the front	
Colour	silver-grey RAL 7001	
Heat exchanger	low-maintenance	
Noise level(dBA)	< 70 dBA (distance 3 m)	

4. EU – Declaration of conformity

EU - Konformitätserklärung
EU - Declaration of conformity

Hersteller / *manufacturer*

TOOL-TEMP AG
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8583 Sulgen
Switzerland

Hiermit erklären wir, dass die nachfolgend bezeichneten Maschinen
Herewith we declare that the following listed machines

Produktbezeichnung *Designation of the machine*	**Typenbezeichnung** *model or type of machine*	**ab Baujahr** *since year of manufacture*
Temperiergerät *temperature control unit*	TT-22, TT-30/160, TT-44, TT-71, TT-100, TT-108, TT-118, TT-137, TT-138, TT-142, TT-DW160, TT-168, TT-170, TT-180, TT-181, TT-188, TT-248, TT-288, TT-288/2, TT-OIL300, TT-388, TT-388/2, TT-390, TT-390/2, TT-407, TT-409, TT-410, TT-508, TT-510, TT-608, TT-708, TT-1000, TT-1358, TT-1368, TT-1398, TT-1500, TT-1548, TT-SB2C, TT-13502	2016
Wasserkühlgerät *water chiller*	TT-5500, TT-14500, TT-28500, TT-29500, TT-54500, TT-58500, TT-108000, TT-216000, TT-300000	2016

den grundlegenden Anforderungen der Richtlinie 2006/42/EG entsprechen.
meet the basic requirements of the guideline 2006/42/EC.

Richtlinien *directives*	**2014/30/EU**	**(Elektromagnetische Verträglichkeit)** *(Electromagnetic compatibility directive)*
	2014/35/EU	**(Niederspannungsrichtlinie)** *(Low voltage directive)*
Europäische Normen *European Standards*	EN ISO 12100:2010, EN 60204-1:2014, EN 61439-1:2014, EN 61439-2:2014, EN 61000-6-2:2006, EN 61000-6-4:2007	

Ferner erklären wir, dass die speziellen technischen Unterlagen gemäss Anhang VII Teil B der Richtlinie 2006/42/EG erstellt wurden und verpflichten uns diese auf Verlangen den Marktaufsichtsbehörden in schriftlicher oder elektronischer Form zu übermitteln.
Furthermore we declare that the relevant technical documentation according to 2006/42/EC, Appendix VII, Part B has been issued and we commit ourselves to forward the documents on request to the market regulators as written documents or electronically.

Name des Dokumentenbevollmächtigten: *Name of the person which is responsible for the documentation:* Stephan Keller

Adresse der benannten Person: *Address of the nominated person:* Tool-Temp AG, Industriestrasse 30, 8583 Sulgen

Sulgen, 23.03.2017 — Serge Koller

Ort und Datum *Place and date* — **Technischer Leiter** *Technical Director*

Anmerkung: Diese Erklärung entspricht einer Herstellererklärung im Sinne der EG-Maschinenrichtlinie 2006/42/EG, Anhang II B. Etwaige Änderungen an dem oben beschriebenen Erzeugnis lassen die Gültigkeit dieser Erklärung erlöschen.
Remark: This declaration is made in the sense of the EC-General Instruction for the Machinery 2006/42/EC, Appendix II B. After changings at the above described equipment this declaration will expire.

5. Installation

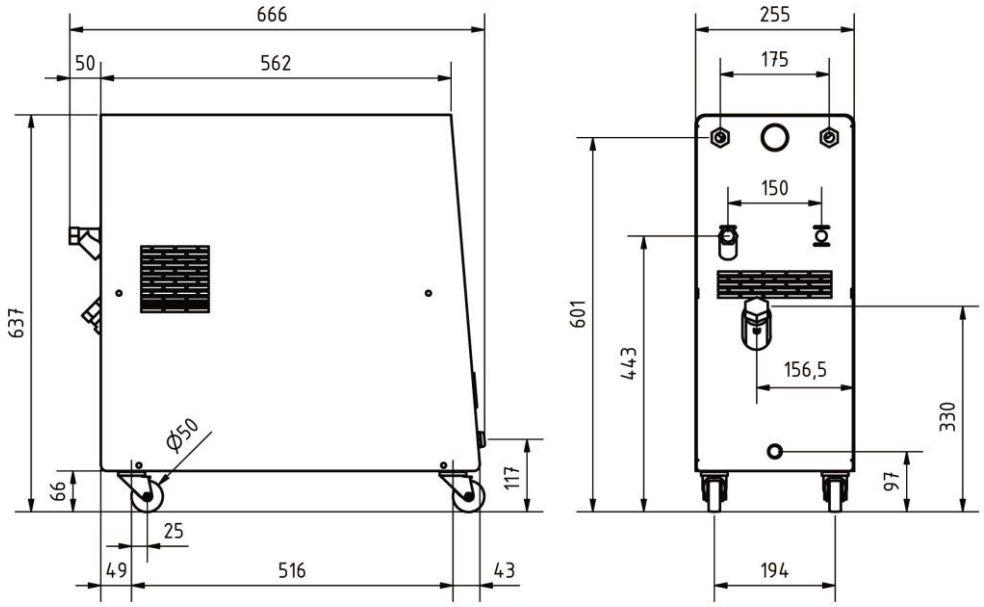
Before starting the unit the electrical and hydraulic connections have to be installed. The installation of the unit has to be done in the order of the following chapters. After the proper installation the unit is ready to use.

DANGER	
	**The temperature control unit must only be operated with water. Do not use solvents or other explosive substances such as petrol, toluene, etc. in the water.**

CAUTION	
	**When starting the unit without the prescribed connections the unit can be damaged.** **Water quality – do not use water with chlorine addition.**

NOTE	
	**Observe the General Safety Information!** **Before installing corresponding chapter of the manual should be read!**

5.1. Installing and dimensions of the temperature control unit



The temperature control unit is designed for an ambient temperature of +10 up to 40°C. Sufficient ventilation must be ensured during set-up. The distance between the temperature control unit and other facilities must be at least 10cm. The ventilation opening must be free.

- Check the unit of completeness and possible damages.
- The unit has to be installed in a suitable location on even ground. It must be stand on feets (castors).
- The unit is not protected against splash water and is not suitable for use in hazardous location. The unit must not be used in the open air.
- The unit must not be transported lying. Lying transport destroy the unit.

WARNING	
	**The temperature control unit can release excess pressure. Danger of injury in the event of escaping steam!** **Never start up the unit without the protection cover!** **Never use the unit in hazardous location!** **Repair leaks immediately!** **Observe local laws during set-up!**

CAUTION	
	**The temperature control unit may be pressurised!** **Only when the pressure gauge shows 0 bar, disconnect hoses!**

5.2. Connections

Before installing the connecting lines between temperature control unit and consumer must be subjected following inspections:

- Verify that channels on the consumers are unobstructed
- Remove fouling, e.g. remove shaving in the lines
- Rust and lime deposits must be removed because the greatly interfere with the heat exchange between consumer and heat transfer medium and increase the pressure drop in the consumer.

For the connecting lines (to and from mould, cooling water inlet and outlet, etc.) the following internal diameters of hoses are recommended:

Thread on the unit	Internal hose-Ø
3/8“	10 mm
1/2“	15 mm
3/4“	20 mm
1“	25 mm
DN32	32 mm

Quick release couplings will give reduced flow. If the recommended tube size cannot be connected to the mould, the connection at the mould should be reduced and not the connection on the temperature control unit. In that way pressure drops can be avoided.

For the cooling water connections it's enough to use pressure- and temperature-resistant rubber hoses. The tap water pressure has to be between 2,0 and 5,0 bar. We recommend to conduct the water from the unit (cooling water outlet) to an unpressurized outlet.

WARNING	
	**To ensure the operational safety is essential to use pressure- and temperature-resistant hoses. Pressure-resistant up to 20 bar / temperature-resistant up to +200°C.** **For reason of safety, the cooling must always be connected!**

NOTE	
	**Process water filter on the return line reduces contamination in the unit, which can cause a unit failure (pollution of the solenoid valve).** **Mark and take down the maximum temperature for which the connections are suitable!**

5.3. Power supply

Compare supply voltage and frequency with the information on the serial plate. Verify the rating of the preliminary fuse according to the information in the electrical diagram. Observe local laws during set-up!

Power cable:

Phases	black / black / black	L1 / L2 / L3
Earth	yellow/green	PE

WARNING	
	**The unit may only be connected by a competent electrician.** **Ensure easy access to means for cutting the power supply (mains adapter or mains connection), the access must be positioned in a distance of 0.6 and 1.9m above the access level.** **Do not connect the power supply until the heating medium hoses are connected!**

5.4. Initial operation - Filling

The temperature control unit has to be connected hydraulically and electrically. Possible block valve must be open.

- Switch on the unit electrically: Turn on the main switch and press the unit ON/OFF-switch
- After switching on the unit the pump starts and fills the system with water, as well as automatically ventilating the machine. In the meantime the yellow lamp lights and the horn sound. The unit can stop and start until the system is completely filled. If only the yellow lamp is lit, the unit is running and no horn sounds, the automatic refilling is running.

5.4.1. Pump rotation check

At the rear side of the unit the direction of rotation can be checked. The unit has been connected to the main supply, hoses must be mounted and heat transfer medium has been filled. Identify the sense of rotation of the motor by switching it on shortly. The sense of rotation must be clockwise as shown by the arrow.
If the sense of rotation is anti-clockwise invert two phases on the electrical connection. This has to be done by a qualified electrician.

5.4.2. Display of pump pressure

The pump pressure is shown on the manometer.

WARNING	
	**The temperature control unit may be pressurised!** **Only when the pressure gauge shows 0 bar, disconnect hoses!**

5.5. Initial operation with heat transfer oil (Oil operation)

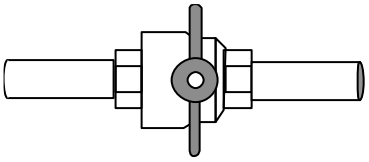
The temperature control unit can also be operated with heat transfer oil. The unit must be prepared accordingly for this operation and after this the unit can be filled manually through the filler neck. A guideline for the required filling amount can be taken from the technical data.

WARNING	
	**The unit may only be changed by a competent electrician.** **The unit hast o be disconnected from the power supply!** **Caution „residual water“ (temperature control unit, consumer, hoses) – water in the oil can lead to dangerous operating conditions. The temperature control unit can be overflow. Risk of injury by escaping oil-water mixture!**

5.5.1. Close the automatic filling

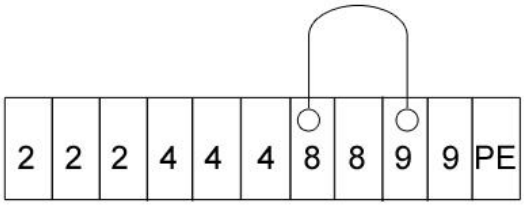
The automatic filling must be closed.

Close the ball valve behind the solenoid valve (Pos.32 /P. 33).



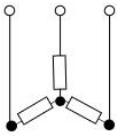
5.5.2. Change stage switching (according to the electrical diagram)

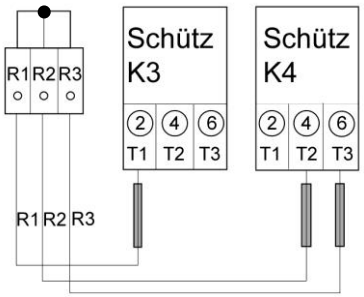
The heat stages has to be reduced to 1 x 3kW by rewiring the terminal block on the inside of the door.
The two switches for the heater are new wired in OR-circuit.



5.5.3. Switching of the heating stages (according to the electrical diagram)

The heater must be wired in star on the contactors.

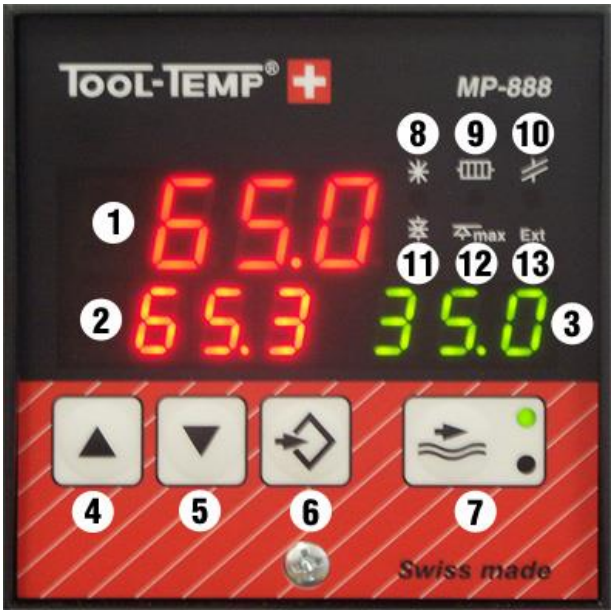




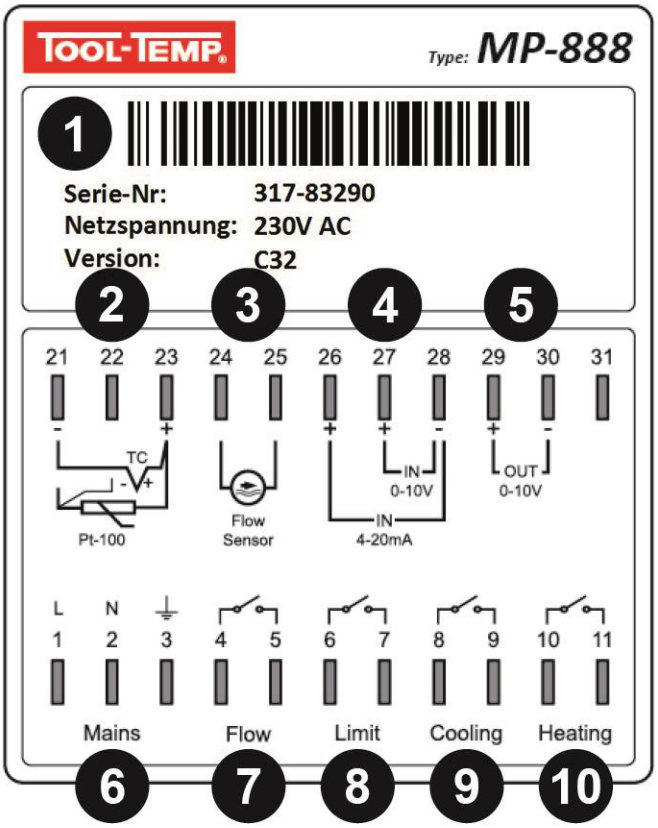
6. Operations

The unit is controlled by the temperature controller MP-888.
The temperature controller MP-888 is a universal controller for all TOOL-TEMP units.

6.1. Overview MP-888



1	**Display of set value**	
2	**Display of actual value**	
3	**Flow control** Display of the current flow in litres/min, English or American gallons/min.	
4	**Up arrow**	Raise of set value
5	**Down arrow**	Reduction of set value
6	**Program button**	
7	**Flow control** Flow control active Alarm flow control	 LED green LED red
8	**LED Cooling** Lights up when the cooling relay is active	
9	**LED Heating** Lights up when the heating relay is active	
10	**LED Sensor failure** Lights up when the sensor is intermitted	
11	**LED Temperature deviation control** Lights up when the difference between set and actual temperature is too high	
12	**LED Maximum temperature** Lights up when the maximum temperature has been reached	
13	**LED External temperature control** Lights up when the set value is applied from extern	



1	**Technical specifications**
2	**Temperature sensor connection** 21+23 Temperature sensor – note + / - 22 Pt-100 compensation
3	**Flow control – encoder signal**
4	**Connection external set point** 26+28 Analog input 4 - 20mA 27+28 Analog input 0 - 10 V
5	**Connection actual value - output** 29+30 Analog output 0 - 10V
6	**Power supply** 1 230V AC 2 Neutral 3 PE
7	**Flow control (alarm)**
8	**Temperature monitoring, temperature deviation alarm**
9	**Cooling (command)**
10	**Heating (command)**

6.2. Parameter settings MP-888 – flow controller 1.5…35 l/min

Each unit requires a different programme setting. For each model is a programme defined that not every parameter must be set manually. In this program the model specific settings are saved.

Model: TT-188			**Program: P79**
	Function	**Factory adjusted**	**Description**
P1	Maximum temperature	**150.0°C / 302.0°F** (0.0...400.0°C) (32.0...752.0°F)	If the maximum temperature exceeds, the heating and cooling are inactive and the maximum temperature LED lights up on the controller.
P2	Temperature deviation control (Deviation between set and actual temperature)	**5.0°C / 9.0°F** (0…20.0°C) (0…36.0°F)	The limit determines the maximum deviation from the nominal value, which is still tolerated. If the actual temperature outside the set point window the alarm will sound and the Temperature deviation control LED lights. If the restart lock (P24) is turned on, the temperature deviation control is active only when it reaches the set temperature. A set point changes the start-up lock again.
P3	Flow measurement function	0: Manual **1: Automatic**	If the automatic flow measurement is enabled, after 20s the measured flow is stored and monitoring is enabled. The green LED lights up.
P4	Alarm value flow	**8.0 L** (0.1…999.9 L)	(P3) set to manual Alarm is triggered when the set value is exceeded.
P20	Temperature unit	**1: °C** 2: °F	Change the temperature unit When the unit started the selected unit will be indicated for a short time.
P23	Analog input	**1: Voltage 0-10V** 2: Current 0-20 mA 3: Current 4-20 mA	Analog input for setpoint selection. 0-10 V (switching threshold <0.1V) 0-20 mA (switching threshold <0.5mA) 4-20 mA (switching threshold <0.1mA)
P27	Temperature at 0 V INPUT	**0.0°C / 32°F** (-50.0...399.9°C) (-58.0...751.8°F)	Lower scaling point of the voltage analog input 0 V corresponds to 0°C
P28	Temperature at 0 V INPUT	**400.0°C / 752°F** (-49.9…400.0°C) (-57.8…752.0°F)	Upper scaling point of the voltage analog input 10 V corresponds to 400°C
P29	Temperature at 0/4 mA INPUT	**0.0°C / 32°F** (-50.0...399.9°C) (-58.0...751.8°F)	Lower scaling point of the voltage analog input 4 mA corresponds to 0°C

P30	Temperature at 20 mA INPUT	**400.0°C / 752°F** (-49.9…400.0°C) (-57.8…752.0°F)	Upper scaling point of the voltage analog input 20 mA corresponds to 400°C
P31	Temperature at 0 V OUTPUT	**0.0°C / 32.0°F** (-50.0…399.9°C) (-58.0…751.8°F)	Lower scaling point of the voltage analog output 0 V corresponds to 0°C
P32	Temperature at 10 V OUTPUT	**400.0°C / 752°F** (-49.9…400.0°C) (-57.8…752.0°F)	Upper scaling point of the voltage analog output 10 V corresponds to 400°C
P45	Relation between cooling- and heating capacity	**0** (1...50)	Adjusting of the cooling capacity 0: 2-point cooling (Standard) 1: cooling capacity maximum 50: cooling capacity minimum
P53	Flow unit	0: Flow OFF 1: Impulse (Hz) **2: litres/min** 3: US gallons/min 4: Imperial gallons/min	Flow unit to display 1 US gallon = 3.785 litres 1 Imperial gallon = 4.546 litres
P60	Flow measurement Calibration table	0 = Manual 1 = Small units 1 2 = Medium units 3 = Large units 4 = Reserved **5 = Small units 2** 6 = Reserve	Selection of the calibration table for flow measurement

Navigation in the controller

Enter into the controller and navigate to the different parameter:

- To enter into the programme of the controller, the program button has to be pressed for 3 seconds.
- To move from parameter to parameter, press the programme button.

Setting the parameter value:
With the two arrow buttons the value of the parameters can be adjusted.

Save the parameter settings:

- To save the parameter settings and get back to the control function, the flow button must be pressed.
- To save the parameter settings and move to the next parameter, the programme button must be pressed.

6.3. Parameter settings MP-888 – flow controller 4…65 l/min

Each unit requires a different programme setting. For each model is a programme defined that not every parameter must be set manually. In this program the model specific settings are saved.

Model: TT-188			**Program: P80**
	Function	**Factory adjusted**	**Description**
P1	Maximum temperature	**150.0°C / 302.0°F** (0.0...400.0°C) (32.0...752.0°F)	If the maximum temperature exceeds, the heating and cooling are inactive and the maximum temperature LED lights up on the controller.
P2	Temperature deviation control (Deviation between set and actual temperature)	**5.0°C / 9.0°F** (0…20.0°C) (0…36.0°F)	The limit determines the maximum deviation from the nominal value, which is still tolerated. If the actual temperature outside the set point window the alarm will sound and the Temperature deviation control LED lights. If the restart lock (P24) is turned on, the temperature deviation control is active only when it reaches the set temperature. A set point changes the start-up lock again.
P3	Flow measurement function	0: Manual **1: Automatic**	If the automatic flow measurement is enabled, after 20s the measured flow is stored and monitoring is enabled. The green LED lights up.
P4	Alarm value flow	**8.0 L** (0.1…999.9 L)	(P3) set to manual Alarm is triggered when the set value is fallen short of.
P20	Temperature unit	**1: °C** 2: °F	Change the temperature unit When the unit started the selected unit will be indicated for a short time.
P23	Analog input	**1: Voltage 0-10V** 2: Current 0-20 mA 3: Current 4-20 mA	Analog input for setpoint selection. 0-10 V (switching threshold <0.1V) 0-20 mA (switching threshold <0.5mA) 4-20 mA (switching threshold <0.1mA)
P27	Temperature at 0 V INPUT	**0.0°C / 32°F** (-50.0...399.9°C) (-58.0...751.8°F)	Lower scaling point of the voltage analog input 0 V corresponds to 0°C
P28	Temperature at 0 V INPUT	**400.0°C / 752°F** (-49.9…400.0°C) (-57.8…752.0°F)	Upper scaling point of the voltage analog input 10 V corresponds to 400°C
P29	Temperature at 0/4 mA INPUT	**0.0°C / 32°F** (-50.0...399.9°C) (-58.0...751.8°F)	Lower scaling point of the voltage analog input 4 mA corresponds to 0°C

P30	Temperature at 20 mA INPUT	**400.0°C / 752°F** (-49.9…400.0°C) (-57.8…752.0°F)	Upper scaling point of the voltage analog input 20 mA corresponds to 400°C
P31	Temperature at 0 V OUTPUT	**0.0°C / 32.0°F** (-50.0…399.9°C) (-58.0…751.8°F)	Lower scaling point of the voltage analog output 0 V corresponds to 0°C
P32	Temperature at 10 V OUTPUT	**400.0°C / 752°F** (-49.9…400.0°C) (-57.8…752.0°F)	Upper scaling point of the voltage analog output 10 V corresponds to 400°C
P45	Verhältnis zwischen Kühl- und Heiz-leistung	**0** (1...50)	Anpassung der Kühlleistung 0: 2-Punkt Kühlung (Standard) 1: Kühlleistung maximal 50: Kühlleistung minimal
P53	Flow unit	0: Flow OFF 1: Impulse (Hz) **2: litres/min** 3: US gallons/min 4: Imperial gallons/min	Flow unit to display 1 US gallon = 3.785 litres 1 Imperial gallon = 4.546 litres
P60	Flow measurement Calibration table	0 = Manual **1 = Small units 1** 2 = Medium units 3 = Large units 4 = Reserved 5 = Small units 2 6 = Reserve	Selection of the calibration table for flow measurement

Navigation in the controller

Enter into the controller and navigate to the different parameter:

- To enter into the programme of the controller, the program button has to be pressed for 3 seconds.
- To move from parameter to parameter, press the programme button.

Setting the parameter value:
With the two arrow buttons the value of the parameters can be adjusted.

Save the parameter settings:

- To save the parameter settings and get back to the control function, the flow button must be pressed.
- To save the parameter settings and move to the next parameter, the programme button must be pressed.

6.4. Setting of the temperature – Heating / Cooling

The required temperature on the temperature controller can be adjusted with the arrow buttons.
The heating mode is indicated by the red diode on the temperature controller. The unit can only heat when the 0-1 switch (heating) is active.

The cooling mode is indicated by the green diode on the temperature controller.

6.5. Adjustment of electronic flow control

The electronic flow control measures the actual flow in the medium circuit and displays this value digitally on the controller.
Following unit of flow can be selected: litres per minute, English (imperial) gallons or American (US) gallons. When putting the temperature control unit into service the controller shows the unit of flow on the display for a short moment.
For controlling the minimal flow you can choose between **automatic** and **manual** mode. Standard programmed is automatic mode.

Automatic mode:
In this mode the alarm value of the flow will be determined as follows:

- 20 seconds after having put the unit into operation (and starting the controller) the actual flow will be measured and stored. Based on this data the alarm value for the minimal flow will be calculated. E.g. at 10 l/min the alarm value is at approx. 30% (7 litres) – at 40 l/min at approx. 20 % (32 litres).
- The control of the flow is now active and is visualized after a few seconds by the green LED in the flow control button.
- As soon as the flow has fallen under the alarm value, the alarm is indicated by the red LED in the flow control button. The alarm will be reset by pressing the flow control button.
- The actual flow will be measured and stored. Based on this new data the alarm value will be calculated.

Manual mode:
Using this modus the alarm value of the flow can be adjusted manually.

- On the controller the program step 3 (MP-88) the value must be changed to “0”, respectively program step 400 (MP-988) the value must be changed to “2” (manual).
- In the program step 4 (MP-888) respectively the program step 410 (MP-988) the required value for the alarm value of the minimum flow can be adjusted (factory side 8 l/min).
- The control of the flow only starts, when the flow control button has been pressed and the green LED is lit.
- As soon as the flow has fallen under the alarm value, the alarm is indicated by the red LED.
- Press the flow control button to activate the monitoring. If the cause of the lower deviation is not followed up, follows the alarm again. Minimum flow is defined in program step 4 (MP-888).

6.6. Mould drainage – Changing the consumer

The hydraulic connections to the consumer can be discharged with the mould drainage in the tank.

To drainage the mould, it will be as follows:

- Cool down the unit below +60°C
- Switch the unit off by the green ON/OFF-switch
- Changeover switch for pump operation mode to position „Vacuum“
- Press the green button „Mould drainage“ till the consumer is empty
- Connections of the heat transfer circuit (to and from mould) can now be removed safely
- Install the connections and restart the unit

WARNING	
	**The temperature control unit may be pressurised!** **Only when the pressure gauge shows 0 bar, disconnect hoses!** **The unit must be drained completely and stored in a dry place at 10 - 40°C while not in use.**

6.7. Leak prevention operation

If the change-over switch for the pump operation mode is in position „pressure“ the pump is operating under pressure and in position „vacuum“ as a leak prevention device. The pump now sucks heating medium through the mould, the temperature control will not be changed.

CAUTION	
	**Leak prevention operation eliminates leaks from the mould area by sucking the medium around the process. The air which is sucked in is automatically vented.** **If the unit works for a longer period in the leak prevention operation, the unit can be damaged!**

NOTE	
	**The unit can only reach the optimal suction if the hose inside diameter in conformity with the nominal value.** **Quick couplings reduce the suction drastically.** **When using non-return flaps or non-return valve, the leak prevention operation is not possible!**

7. Safety and monitoring devices

7.1. Pump

The pump motor is fitted with an overload relay and pre-switch automatic cut-outs.

7.2. Heating – Temperature monitoring

In the temperature controller the maximum temperature (150°C) is limited. Exceeding this temperature the heaters switch off.
A safety thermostat (155°C) with automatic reset protects additionally the system. Exceeding this temperature the unit stops automatically and the indication lamp lights. The unit switches on again when the temperature has been dropped permitted.

WARNING	
	**Do not put the maximum temperature in the controller higher, deeper values are allowed!** **The temperature control unit can excess overpressure – risk of injury from escaping steam!**

7.3. Level control

The unit is mounted with a level switch. If the system loses water, the yellow indication lamp lights and the unit refills automatically until the level is reached, the yellow indication lamp will switch off.
If not enough water is in the unit the pump switches off, the yellow indication lamp lights and the horn sounds. The unit fills automatically and the pump will switch on automatically as soon as the level is high enough.

7.4. Flow control

The electronic flow control measures the actual flow in the heat transfer circuit and displays it digitally on the controller. For controlling the minimal flow you can choose between **automatic** and **manual** mode.

7.5. Temperature deviation control

As soon as the difference between pre-set desired value and the actual value exceeds +/- 5°C, the LED indication lamp lights and the horn sounds, the unit still operates.
This alarm is only activated when the set temperature has been reached the first time. The value of the temperature of the deviation control (factory preset +/- 5°C) and the starting interlock for temperature deviation control (factory preset on) can be adjusted on the controller.

7.6. Acoustic indication of faults (horn)

In order to perceive faults immediately serves a horn.
If the level in the tank drops, the horn rings with a continuous sound (pre-warning). The temperature control unit still operate. The tank volume has to be corrected.
If the level falls below the minimum level in the system, the thermal relay of the motor or the mechanical safety thermostat shuts off, the unit stops and the horn rings with an intermittent sound.
Flow control or temperature deviation control let the horn rings with intermittent sound. The temperature control unit still operate. The alarm can be switched off by pressing the flow control button on the controller or the temperature specification.

WARNING	
	**Switch on the horn again!**

8. Maintenance

Inspection and maintenance have to be done by instructed staff (competent).

The following maintenance intervals may be required subject to use and environment:

Water filter	clean / replace	every month
Pump motor	blow out the fan	every 6 months
Hoses and pipes	check tightness	every 6 months
Pump	check tightness	every 6 months
Bolts and seals	check tightness	every 12 months
Heat transfer oil (only valid for oil units)	change	every 4‘000 working hours

For extreme service there intervals must be shortened accordingly. For temperature control units running with oil, the oil should be changed early, depending on the temperature. Comply with the directives and recommendations of the oil manufacturer!

8.1. Inspection

Before starting the unit has to be checked the general condition of the temperature control unit, the electrical connection and the tightness of the connections and hoses (including the consumer).

8.2. Cleaning

The temperature control unit has to be checked and cleaned periodically. Before maintenance the unit has to be disconnected from the power supply.

8.3. Repair

Established defects must be repaired. To guarantee safety the unit must be repaired with original TOOL-TEMP spare parts only.

WARNING	
	**The temperature control unit must be currentless before opening!** **Press the main switch on the temperature control unit and pull out the mains plug!** **There is a danger of electric shock!** **Caution – risk of injury from leaking hot water or oil!**

CAUTION	
	**Waste oil has to be disposed as prescribed by law. Never let waste oil come into the sewage system or soil.**

9. Out-of-service / transport

Cool the temperature control unit down, mould drainage, turn it off, press the main switch and disconnect the power supply. Disconnect all hoses from the temperature control unit.

The temperature control unit is to be emptied before shipping. The danger of freezing (bursting of pipes or other components) at low temperatures can be reduced. The unit must be transported or stored in the operating position.

CAUTION	
	**Drain the unit to avoid freezing damages!** **Avoid compressed air, blowing out with compressed air can damage the unit!** **Never transport the unit lying – Lying transport will destroy the unit!**

10. Disposal

The temperature control unit must be drained completely and disposed of in accordance with local regulations.
The temperature control unit can also be returned to TOOL-TEMP for disposal.

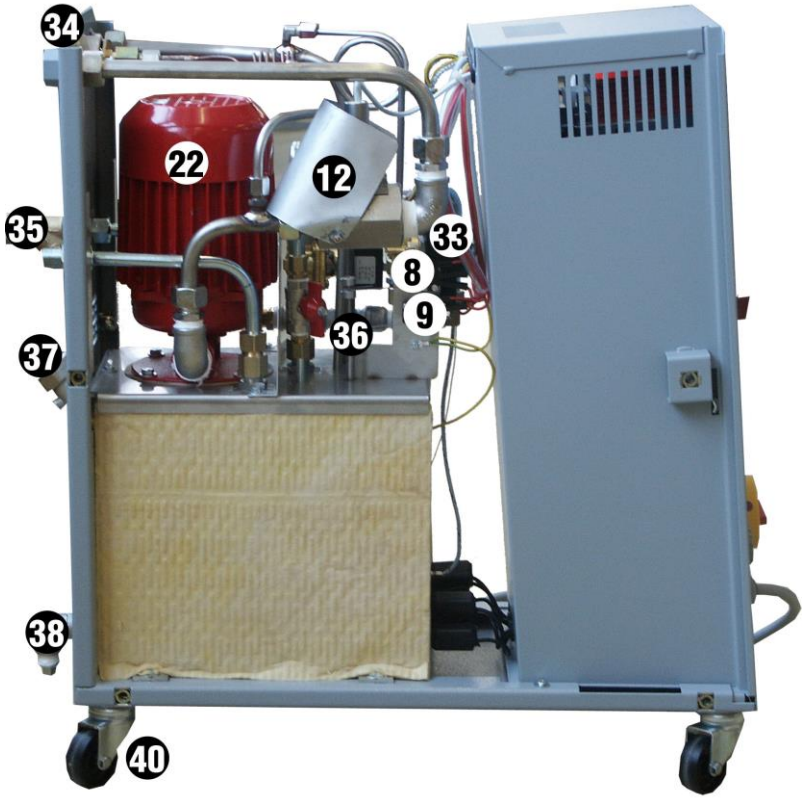
11. Failure corrective action

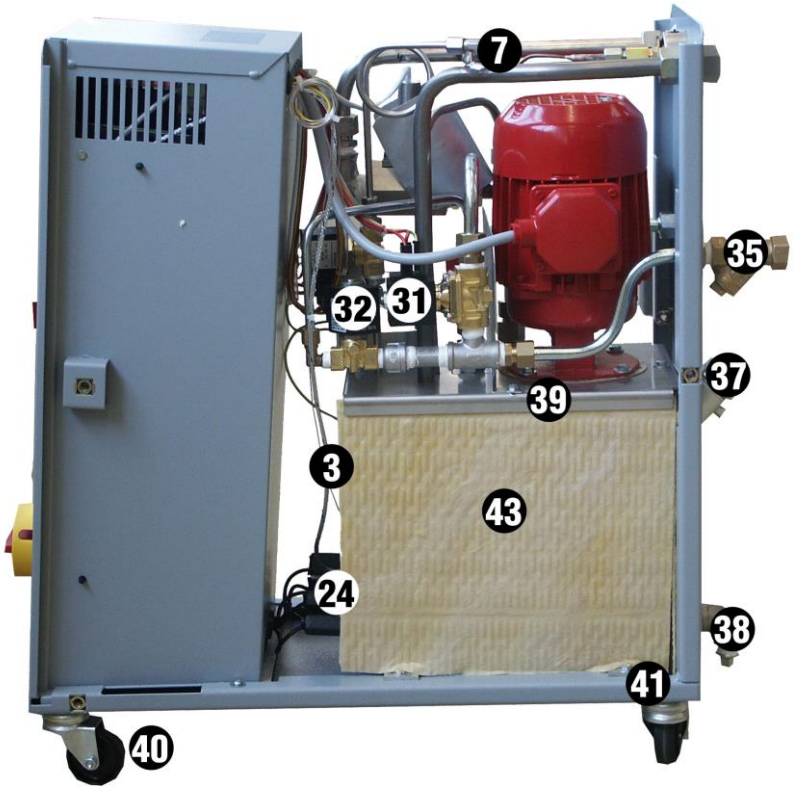
Symbol	Symptom	Probable cause	Correction
0 - I	Green ON/OFF-switch as well as all lamps do not light	• Fuse defective • Possibly transformer or switch defective	• Replace the 5 x 20 mm 1 A fuse • Replace defective parts
M	Red lamp “thermal relay” lights Horn sounds	• Overload relay of the pump motor has responded • Unit switches off (pump) • Possibly 2-phase running	• Let the motor cool down • Open the unit and press the blue button of the overload relay “**motor**” • Check the electrical connection When the motor has cooled down the unit switches on again.
T max intern	Red lamp „temperature monitoring“ lights and the unit switches off Horn sounds	• Maximum temperature of the unit is reached – thermostat has respond	• Try to establish the cause, maybe too low adjustment of the thermostat • Check the controller • Check the contactors
ΔT diff	Control lamp “Temperature deviation control” lights Horn sounds	• Temperature deviation between required and actual temperature is too big	• Check heating contactors and heating resistor • Check the cooling
 	„Flow control“ lights Horn sounds	• Too low flow in the unit • Flow has changed down	• Check heat transfer circuit • Event. remove fast couplings • The alarm can be reset by pressing the flow control button on the controller. • In automatic mode the lower flow value will automatically be taken over as new pre-set flow value.

	Left yellow lamp „level control“ lights, unit works	• Not enough heat transfer medium in the circuit • Level switch defective • Automatic filling defective or not connected	• Cool the unit below 60°C • Search leakage and repair it
	Right (and left) yellow lamp „level control“ lights, unit switches off	• Not enough heat transfer medium in the circuit • Level switch defective	• Cool the unit below 60°C • Search leakage and repair it • Replace defective parts
	The required temperature will not be reached, heating lamp on the controller lights	• Solenoid valve of the water cooling system not closed or defective • Maybe to big consumer • Heating defective • Contactor of heating defective	• Clean the solenoid valve, check signal to valve and function, repair or replace it • Contact the supplier • Measure resistance of heating • Replace contactor
	Lamp „cooling“ lights, unit is not cooling	• Cooling water inlet or outlet is closed • Filter is dirty • Solenoid valve defective	• Check water supply check counter pressure on cooling water outlet • Clean filter • Check solenoid valve

12. Components and spare parts

12.1. Overview components and spare parts



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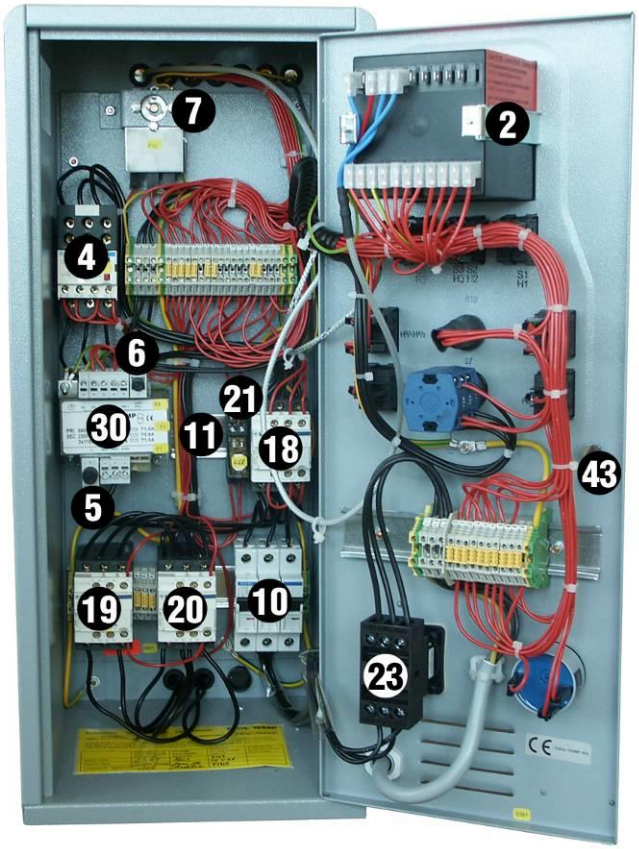
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12.2. List components and spare parts

	Art.-Nr.	ELD-Code	Description	Comment
1	Fa0800326 Fa0800328	N 1	Digital temperature controller MP-888 Digital temperature controller MP-888	new revised
2	Fa0900003		Fixing clips for controller MP-888	As a pair incl. straining screw
3	Wa1000030	B 1	Temperature probe FeKo	cable length 1100 mm, with angle plug 6.3 mm
4	Gb0700602 Gb0700601 Gb0700800	F 1	Motor protection relay 1.6 – 2.5A Motor protection relay 1.0 – 1.6A Motor protection relay 2.5 – 4.0A	 575 – 600V 60Hz 200 – 230V 50/60Hz
5	Gl0200003 Gl0200001	F 7	Fuse 1A primary T1, 6.3 x 32 mm Fuseholder big	Packing of 10 pieces
6	Gl0200000 Gl0200002	F 8	Fuse 1A secondary T1, 5 x 20 mm Fuseholder small	Packing of 10 pieces
7	Gf0101200	F 10	Capillary pipe thermostat 80°C – 370°C	
8	Gf0100001	F 15	Level switch for level control	Unit off
9	Gf0100001	F 15/2	Level switch for level control	Auto. filling
10	Gl0400500 Gl0400610	F 23 F 47	Automatic cutout 20A, 3-poles Automatic cutout 40A, 3-poles	 200 – 240V 50/60Hz
11	Gl0200005 Gl0200006	F 27-/2	Fuse 6.3A, 6.3 x 32 mm Fuse clip 6.3A, WK 10mm^2 (F27)	200 – 240V 50/60Hz 200 – 240V 50/60Hz
12		F 64	Sensor flow measurement	Type A (4.0…65 l/min) Type B (1.5…35l/min)
13	Gk0300400	H 4/1 H 4/2	Lamp level control – unit off Lamp level control – auto. filling	Double indication lamp (yellow)
14	Gk0300100	H 6	Indication lamp motor overload (red)	
15	Gk0300500	H 7 H 20	Lamp safety thermostat Lamp temperature deviation control	Double indication lamp (red)
16	Gg0300000	H 15	Horn	
17	Gk0300100	H 63	Indication lamp flow control failure (red)	
18	Gb0101210	K 1	Contactor 32A pump motor (main contactor)	

19	Gb0101210	K 3	Contactor 32A	heating
20	Gb0101210	K 4	Contactor 32A	heating
21	Gb0706021	K 68	Mini-relay 8-poles, complete with base	Flow disturbance
22		M 1	Pump type E with pump motor 0.75kW Pump type E with pump motor 0.75kW Pump type E with pump motor 0.75kW Pump type E with pump motor 0.75kW Pump type E with pump motor 0.75kW	380 – 415V 50Hz 200 – 230V 50Hz 380V 60Hz 200 – 230V 60Hz 440 – 480V 60Hz 575 – 600V 60Hz
23	Gk0701801 Gk0700800	Q 1	Main switch 40A Main switch 63A	without locking 200 – 230V 50/60Hz
24	Gm0100800 Gm0100700 Gm0100900 Gm0101000 Gm0101100 Db0200500	R 1/2/3	Heating 3000 Watt Heating 3000 Watt Heating 3000 Watt Heating 3000 Watt Heating connection clip Seal for heating	3 x 380 – 415 V / 50 Hz 3 x 200 – 230 V / 50/60 Hz 3 x 440 – 480 V / 60 Hz 3 x 575 – 600 V / 60 Hz 2 pieces, with shrinkdown plastic tubing
25	Gk0300700	S 1 / H 1	Switch "ON-OFF" unit (green)	
26	Gk0300600	S 2 / H 2 S 3 / H 3	Double switch (green)	heating
27	Gk0300701	S 5 / H 5	Switch "ON-OFF" (green)	horn
28	Gk0200100 Gk0200200	S 7	Switch VAC/pressure device Switch VAC/pressure device	with 3 switching levels complete only front part
29	Gk0500100	S 10	Press button green	mould drain
30	Gc0100600 Gc0100820 Gc0100700	T 1	Transformer 70VA Transformer 70VA Transformer 80VA	380 – 415V 50Hz 440 – 480V 60Hz 575 – 600V 60Hz 200 – 230V 50/60Hz
31	Df0200000 Df0200901 Df0200600	Y 1	Solenoid valve R3/8“ Repair kit for solenoid valve 3/8“ Trip coil 230V 50/60Hz	water cooling Composed of: membrane, spring, plug Ø 12 mm

32	Df0200110 Df0200910 Df0200600	Y 3	Solenoid valve R1/4“ (18bar) Repair kit for solenoid valve R1/4“(18bar) Trip coil 230V 50/60Hz	filling Composed of: spring and plug Ø 12 mm
33	Df0200100 Df0200910 Df0200600	Y 15	Solenoid valve R1/4“(18bar) Repair kit for solenoid valve R1/4“(18bar) Trip coil 230V 50/60Hz	mould drain Composed of: spring and plug Ø 12 mm
34	De0701600 De0701201		Manometer -1 bis 6 bar Fixing clips for manometer Ø 40 mm	Ø 40 mm 70 x 35 x 2 mm
35	De0100400		Water filter R3/8“, with mesh bottom	cooling water inlet
36	Wd0100000		Float	Complete with rod and 4 set collars
37	Ca2000500		Screw cap refill pipe 1“	
38	De0300200		Drain angle 90°	for tank drain
39	Db0500200		Seal for tank cover	length 900 mm
40	Dc0100000		Steering rollers Ø 50 mm	central fixing
41	Bb0300000 Bb0300001		Screw fastener (complete) Insert for screw fastener	bayonet screwing and cage cage
42	Bb0300100		Door locking	electrical cabinet door
43	Wf0100000		Isolation set	

	Deutsch	Englisch	Französisch	Italienisch
B 1	Thermoelement intern	internal thermocouple	thermocouple interne	termocoppia interna
F 1	Thermorelais Pumpe 1	overload relay pump 1	relais thermique pompe 1	interruttore a soccorritore termico pompa 1
F 7	Feinsicherung 1A primär I1	fuse 1A prim. I1	fusible verre 1A prim. I1	fusibile fino 1A primario I1
F 7/1	Leitungsschutzschalter 2A	automatic cut-off 2A	disjoncteur 2A	interruttore 2A
F 8	Feinsicherung 1A sekundär T1	fuse 1A sec. T1	fusible verre 1A sec. T1	fusibile fino 1A secondario T1
F 10	einstellbarer Sicherheitsthermostat	safety thermostat adjustable	thermostat de sécurité ajustable	termostato di sicurezza regolabile
F 15	Niveaukontrolle (Gerät aus)	level control (unit off)	contrôle de niveau (appareil arrêt)	controllo livello (spegne centralina)
F 15/2	Niveaukontrolle (auto.Auffüllung)	level control (automatic filling)	contrôle de niveau (remplissage automatique)	controllo livello (riempimento automatico)
F 23	Leitungsschutzschalter 20A	automatic cut-off 20A	disjoncteur 20A	interruttore 20A
F 47	Leitungsschutzschalter 40A	automatic cut-off 40A	disjoncteur 40A	interruttore 40A
F 64	Sensor Durchflussmessung	flow sensor	capteur contrôle de débit	sensore del controllo di flusso
H 1	Lampe Gerät EIN/AUS	unit ON/OFF lamp	lampe MARCHE/ARRET	lampada centralina ACCESO/SPENTO
H 2	Lampe Heizung 1	heater 1 lamp	lampe chauffage 1	lampada riscaldamento 1
H 3	Lampe Heizung 2	heater 2 lamp	lampe chauffage 2	lampada riscaldamento 2
H 4/1	Lampe Niveaukontrolle (Gerät aus)	level control lamp (unit off)	lampe contrôle du niveau (appareil arrêt)	lampada controllo livello (centralina spento)
H 4/2	Lampe Niveaukontrolle (auto. Auffüllun	level control lamp (automatic filling)	lampe contrôle du niveau (remplissage automatiq	lampada controllo livello (riempimento automatico)
H 5	Lampe Hupe	horn lamp	lampe klaxon	lampada segnale acustico
H 6	Lampe Motorschutzrelais	overload relay lamp	lampe relais thermique	lampada termocoppia motore
H 7	Lampe Sicherheitsthermostat	safety thermostat lamp	lampe thermostat de sécurité	lampada termostato di sicurezza
H 15	Hupe	horn	klaxon	segnale acustico
H 20	Lampe Grenzw ert	limit contact lamp	lampe valeur limite	lampada valore limite
H 63	Lampe Durchfluss Störung	lamp flow control failure	lampe contrôle de débit alarme	lampada difetto flusso
K 1	Schütz Pumpenmotor 1 (Hauptschütz)	contactor pump motor 1 (main contactor)	contacteur moteur pompe 1 (relais générale)	relais motore pompa 1 (relais generale)
K 3	Schütz Heizung 1	contactor heater 1	contacteur chauffage 1	relais riscaldamento 1
K 4	Schütz Heizung 2	contactor heater 2	contacteur chauffage 2	relais riscaldamento 2
K 68	Relais Durchfluss Störung	relay flow control failure	relais contrôle de débit alarme	relais difetto flusso
M 1	Motor Pumpe 1	motor pump 1	moteur pompe 1	motore pompa 1
N 1	Temperaturregler	electronic temperature controller	régulateur électronique de température	regolatore temperatura
Q 1	Hauptschalter	main sw itch	interrupteur générale	interruttore generale
R 1	Heizung 1	heater 1	chauffage 1	riscaldamento 1
R 2	Heizung 2	heater 2	chauffage 2	riscaldamento 2
R 3	Heizung 3	heater 3	chauffage 3	riscaldamento 3
S 1	Schalter Gerät "EIN-AUS"	sw itch unit "on/off"	interrupteur appareil "marche/arrêt"	interruttore centralina "acceso/spento"
S 2	Schalter Heizung 1	sw itch for heater 1	interrupteur chauffage 1	interruttore riscaldamento 1
S 3	Schalter Heizung 2	sw itch for heater 2	interrupteur chauffage 2	interruttore riscaldamento 2
S 5	Schalter Hupe	sw itch for horn	interrupteur klaxon	interruttore segnale acustico
S 7	Wendeschalter Pumpe	change-over sw itch for pump	inverseur de marche de la pompe	invertitore di marcia per pompa
S 10	Drucktaster Formentleerung	press button for mould drainage	bouton-poussoir pour vidange du moule	pulsante svuotamento stampo
T 1	Trafo Steuerung	transformer for electric control	transformateur de commande	trasformatore di comando
Y 1	Magnetventil Wasserkühlung	solenoid valve for w ater cooling	électrovanne eau de refroidissement	valvola magnetica raffreddamento acqua
Y 3	Magnetventil Auffüllung	solenoid valve for automatic filling	électrovanne remplissage automatique	valvola magnetica riempimento automatico
Y 15	Magnetventil Formentleerung	solenoid valve for mould drainage	electrovanne vidange du moule	valvola magnetica svuotamento stampo

Datum/Date	Gezeichnet	Geprüft
20.4.15	Ba	

TOOL-TEMP®
Industriestrasse 30
CH-8583 Sulgen
Schweiz / Switzerland / Suisse / Svizzera
Tel. +41 (0)71 644 77 77

Elektroschema
Wiring diagram
Schéma électrique
Schema elettrico

VERSION
1

EL-000012
3x200-230V, 50Hz
3x200-240V ,60Hz
3x380-415V, 50Hz/3x380V,60Hz
3x440-480V, 60Hz

TT-188

3/9kW, MP-888

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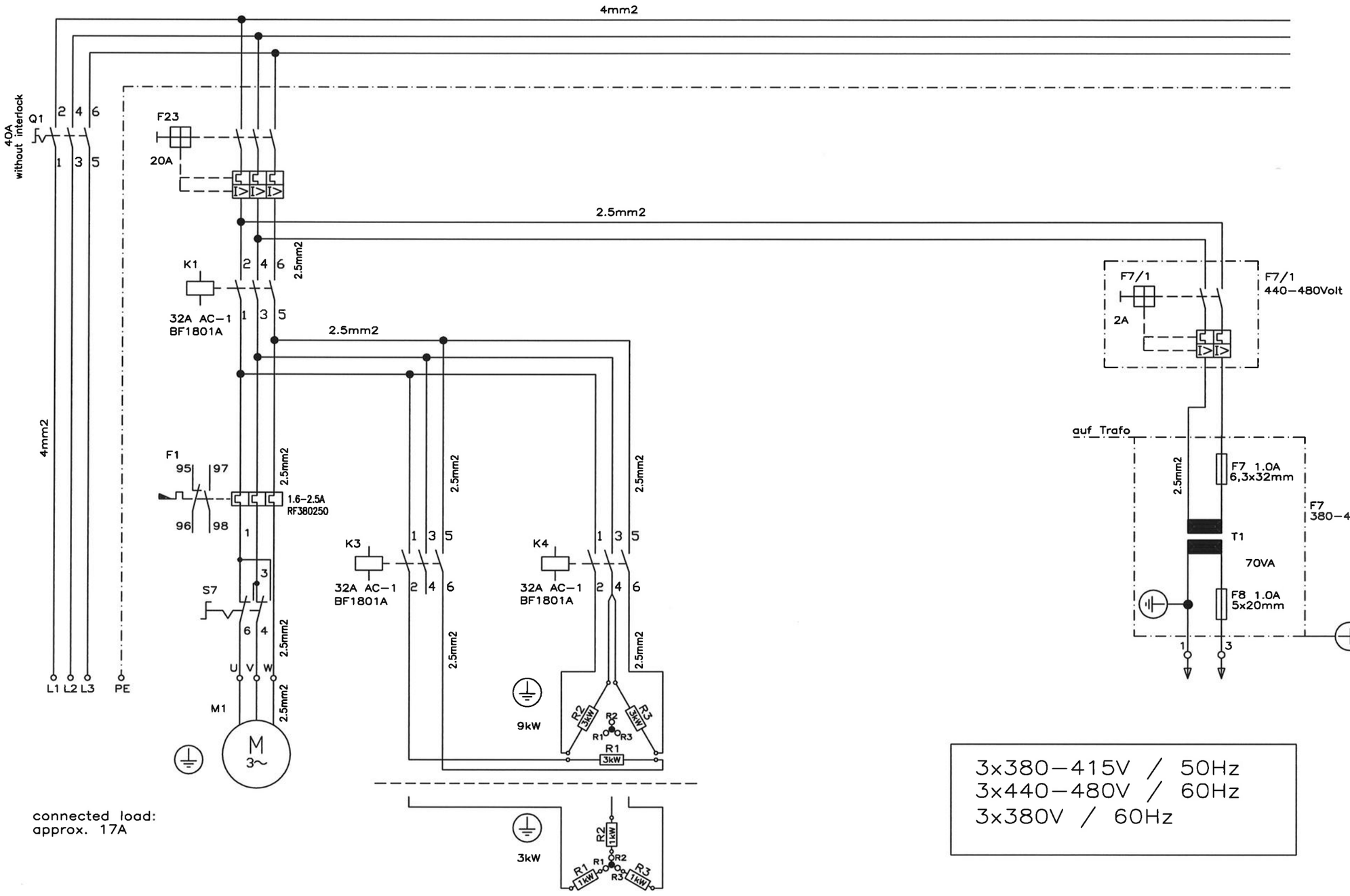

connected load:
approx. 17A

For 3x380-415V, heater model 420V
For 3x440-480V, heater model 480V

3x380-415V / 50Hz
3x440-480V / 60Hz
3x380V / 60Hz

Datum/Date	Gezeichnet	Geprüft
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Elektroschema
Wiring diagram
Schéma électrique
Schema elettrico

VERSION
1

EL-000012

TT-188
3x380-415V / 50Hz
3x380-480V / 60Hz
3x380V / 60Hz

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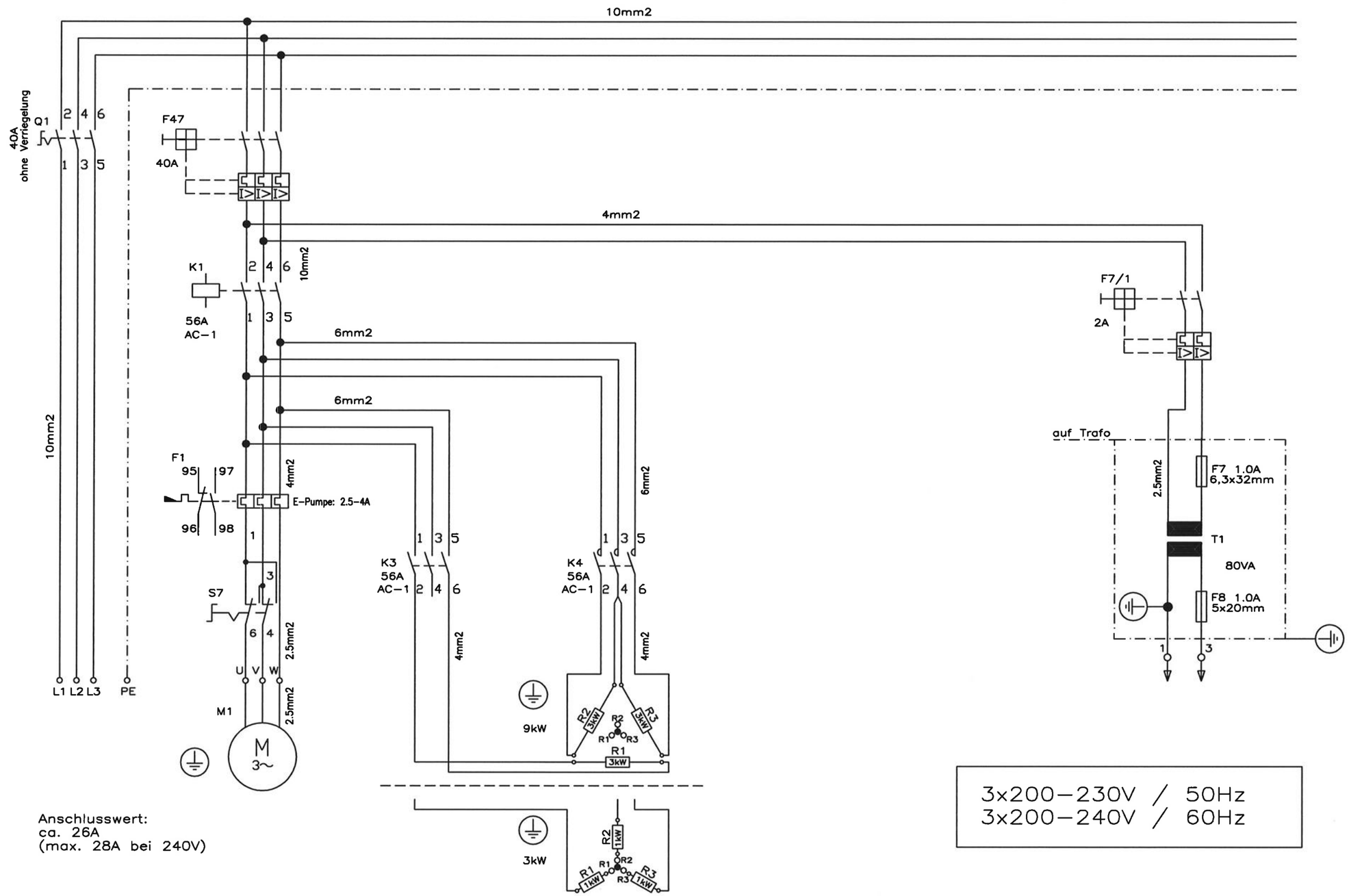
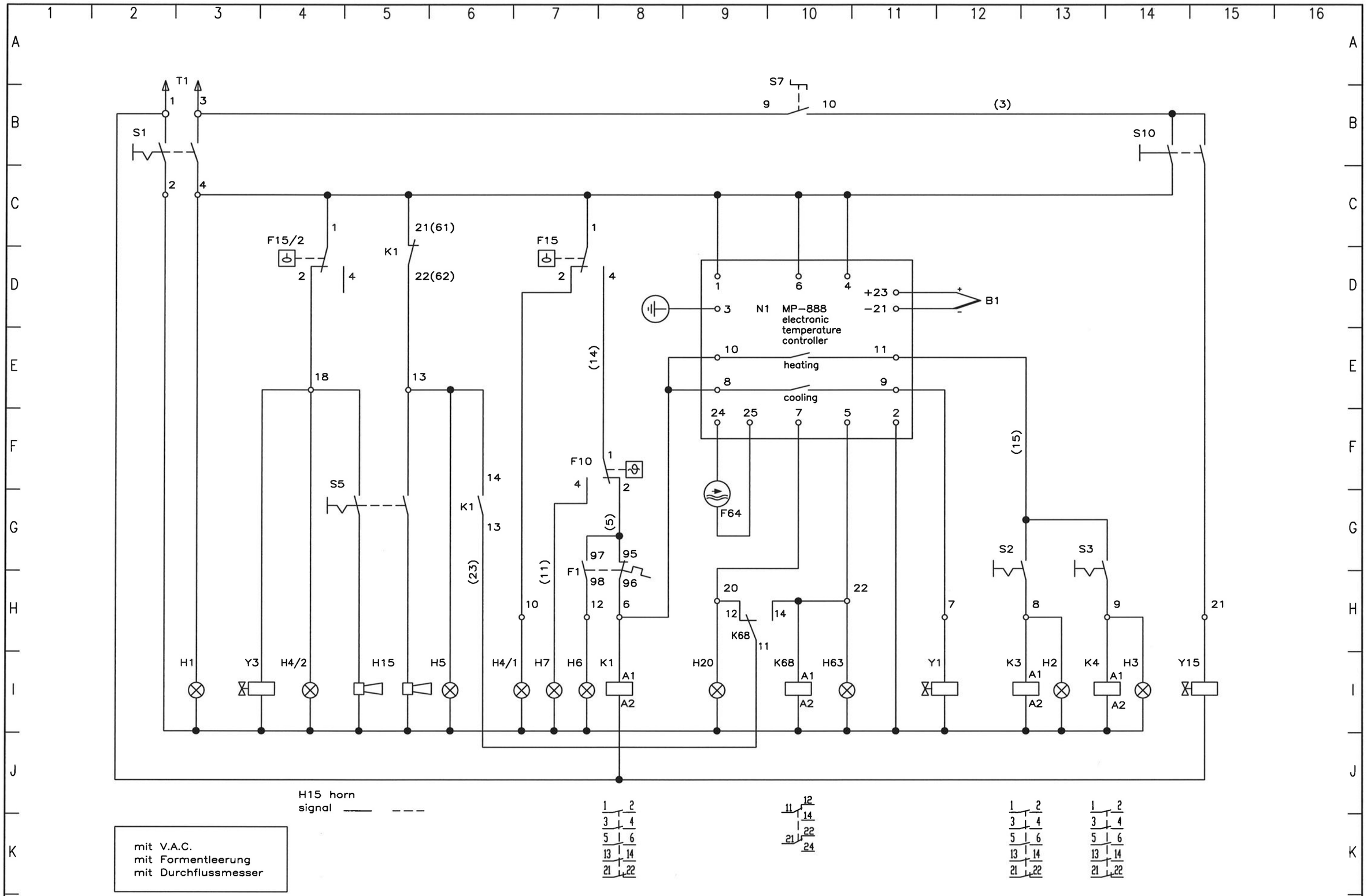


Anschlusswert:
ca. 26A
(max. 28A bei 240V)

230V–Heizung bei 3x200–240V

3x200–230V / 50Hz
3x200–240V / 60Hz

Datum/Date	Gezeichnet	Geprüft					
20.4.15	Ba		TOOL-TEMP® Industriestrasse 30 CH-8583 Sulgen Schweiz / Switzerland / Suisse / Svizzera Tel. +41 (0)71 644 77 77	Elektroschema Wiring diagram Schéma électrique Schema elettrico	VERSION 1	EL-000012	TT-188 3x200-230V / 50Hz 3x200-240V / 60Hz	Seite/Page No. 3 Total 4



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Elektroschema
Wiring diagram
Schéma électrique
Schema elettrico

VERSION
1

EL-000012

TT-188
3x380-415V / 50Hz /3x380V,60Hz
3x440-480V / 60Hz
3x200-230V / 50Hz
3x200-240V / 50Hz

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