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Wärme und Strom: intelligent und zuverlässig.

Condensing combined heat and power plant

MEPHISTO G50

MANUAL

Kraftwerk
Kraft-Wärme-Kopplung GmbH
Am Lindener Hafen 30
30453 Hannover, Germany

Phone: 0511.262 997-0
Fax: 0511.262 997-29

E-mail@kwk.info
www.kwk.info

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1. FOREWORD

With your investment in a Mephisto gas-fired condensing combined heat and power unit (CHP), you have chosen modern technology with high product quality, which excels due to its economic use and environmentally friendly operation.

This manual aims to provide you with the necessary knowledge to understand the technology in the Mephisto combined heat and power unit (CHP), to operate the CHP and to perform minor maintenance work and adjustments yourself. The following section is designed to give you general information on how to operate the Mephisto CHP unit safely.

2. YOUR SAFETY

The Mephisto condensing CHP unit has been equipped with state-of-the-art safety equipment and control functions which will protect you and other users from harm. Even so, you should follow the instructions in this manual to ensure safe, economical, environmentally friendly operation of the CHP unit.

This manual is an integral part of the Mephisto CHP unit. You should keep it ready for use where the CHP unit is installed. As a general rule, the manual is located in the electrical enclosure, where you can also store it when the unit is in operation. Make sure that all persons who operate or service the CHP unit have read this manual. If you have mislaid your manual, you can download a new copy from the Download section on our website at **www.kwk.info**.

2.1 INTENDED USE OF THE MEPHISTO CHP UNIT

The CHP unit

Mephisto condensing CHP units are operated parallel to the network with liquefied gas or Groups H and L natural gas. Operation with biogas and sewage gas is also possible in special models.

Both electricity and heat are generated at the same time. In contrast to conventional power plants, the heat generated alongside the electricity is used in the CHP unit, thus saving valuable primary energy.

The core of the Mephisto is a four-cylinder Otto engine. This combustion engine propels a generator, which converts the mechanical energy into electricity. The waste heat produced is used via heat exchangers to provide hot water and building heating. A (possibly existing) conventional boiler is also used to cover peak heat demand. The electricity generated is either consumed on site or fed into the local network operator's network in exchange for payment.

What you shouldn't do...

- People tend to place drinks on top of the electrical enclosure, but it is not advisable;
  coffee is quickly spilled, causing damage which is costly to repair. The CHP machine room is not suitable for keeping drinks or food warm either. Do not store any food or any other objects whatsoever in the machine room or on the electrical enclosure.
- The CHP unit is designed for operation in dry, frost-proof rooms. Do not expose the CHP unit to any damp or moisture. Do not store the CHP unit outside buildings.
- Do not operate a washing machine or dryer or dry washing in the room where the CHP unit is installed. Lint from the laundry items, detergent dust, gases, steam and vapours can cause damage to the CHP unit.

Installation room and integration

Mephisto CHP units must be installed in an authorised boiler room and must be approved as a heat system by the master chimney sweep responsible. They are integrated into the existing heating system and connected to the power network, the gas supply and a flue gas system. You will find detailed information on their integration in this manual.

- Have a qualified, authorised specialist company carry out the work to install and integrate the CHP unit.

2.2 TARGET GROUP

Mephisto CHP units are complex machines. Their operation and maintenance requires technical knowledge. As a general rule, only caretakers, installation company employees and specially trained professionals come into contact with a CHP unit. Such people usually have the required technical expertise. This manual is intended for this group of people.

2.3 MAINTENANCE WORK AND INTERVALS

If you have signed a comprehensive maintenance contract, this includes all work and spare parts required to ensure safe, optimal operation of the CHP unit. If you wish to perform maintenance tasks yourself, some are described in this manual. You should have **kraftwerk** or an authorised partner carry out complex maintenance tasks which required specific technical expertise.

Regular inspections and maintenance visits are necessary to ensure that the CHP unit runs safely with optimum performance. The maintenance intervals and the type of tasks are described in the Service section of this manual.

- Observe the stipulated maintenance intervals.
- Only remove the protective panels from the CHP unit for maintenance purposes only.
- Only open the CHP unit's electrical enclosure for maintenance purposes and read the optional three-phase current meter if required.
- Consult **kraftwerk** before undertaking any structural changes to the CHP unit and only use unit parts approved by **kraftwerk**.

2.4 LABELLING

The nameplate is located in the top right-hand corner on the rear of the Mephisto CHP unit. The nameplate indicates the relevant technical data on the Mephisto CHP unit, the manufacturer's address and the CE marking.

2.5 PICTOGRAMS AND SYMBOLS USED

Hazard/warning

There are triangular symbols on the Mephisto CHP and in this manual such as this pictogram which indicate threats to your life or danger to health. Please observe these safety instructions.

Information

Here you will find user tips for optimum use of the CHP unit and other useful information. You will also be made aware of possible hazards for the CHP unit that operating errors may cause.

2.6 SAFETY INSTRUCTIONS

2.6.1 General information

Danger to life I Risk of explosion
Due to a potentially explosive atmosphere in the area surrounding the CHP

If you become aware of a pungent smell of gas in the area surrounding the CHP unit (smell of rotten eggs), odourised natural or liquefied gas has leaked into the CHP unit's ambient air. If you run your CHP unit on biogas or digester gas, you should have a gas sensor installed as these gases are virtually odourless.

1. No naked flames. Do not smoke. No lighters.
2. Avoid producing sparks. Do not use any electrical switches. Do not use telephones, connectors or bells either.
3. If you can **hear** gas leaking, leave the building immediately!
4. Close the main gas shut-off device.
5. Open doors and windows.
6. Warn building occupants but do not ring doorbells.
7. Leave the building and prevent others from entering.
8. Call the fire service from a telephone once you are outside the building. Who, where, what?
9. Notify your gas supply company.

- Only have qualified staff carry out maintenance work on the Mephisto CHP unit's gas pipelines.
- We recommend that you have a gas sensor installed.

Danger to life I Risk of fire
Due to combustible substances such as leaking gas or flammable liquids and

No naked flames in the installation room.

What to do in the event of a fire:

Keep calm.

1. Close the main gas shut-off device if possible.
2. Do not use any lifts.
3. Warn building occupants.
4. Leave the building and prevent others from entering.
5. Call the fire service from a telephone once you are outside the building. Who, where, what?
6. Wait for the fire service. Show the fire service the entrances to the building.
7. Only try to extinguish the fire if you won't put yourself in danger.

2.6.2 Installation room

Danger to life
Due to intoxication

Insufficient air supply can lead to dangerous flue gas leaks.

- Ensure that intake air and exhaust air openings are not sealed or reduced in size.
- If the intake air and exhaust air openings are inadequate, take the CHP unit out of operation.

Danger to life I Risk of fire
Due to flammable liquids or materials

- Do not store any flammable liquids or materials directly next to the CHP unit.

Information
Potential frost damage to the CHP unit

- Ensure that the installation room is frost-proof.

2.6.3 Working on the CHP unit

Danger to life I Risk of explosion
Due to flammable gas explosion

- Only an authorised specialist company may connect the gas.
- Only an authorised specialist company may install the CHP unit and put it into operation.

Danger to life
Due to electrical voltage

A high voltage runs through the CHP unit's electrical cables and contacts. If you come into contact with this voltage, it can be fatal.

- Do not touch any exposed or uncovered patches on the cables. Do not touch any electrical contacts.
- Only have a qualified electrician carry out maintenance work on the Mephisto CHP unit's electrical part.
- Only open the CHP unit's electrical enclosure for maintenance purposes.
- Before working on electrical equipment, always follow these instructions:
  - Switch off the system
  - Secure against being switched on again
  - Check that the system is de-energised.
  - It is essential to bear in mind that external power sources (e.g. boiler lockout) cannot be ruled out.

Danger to life
Due to electrical voltage
When working on the frequency converter

A high voltage continues to run through the frequency converter's lines and contacts even after the CHP unit is switched off. If you come into contact with this voltage, it can be fatal.

- Wait 5 minutes for the system to discharge after switching off the CHP unit and before working on the frequency converter.
- Only have a qualified electrician carry out maintenance work on the Mephisto CHP unit's electrical part.
- Only open the CHP unit's electrical enclosure and frequency converter for maintenance purposes.

Health hazard I Serious crushing or tear injuries
Due to the CHP unit starting up automatically

Depending on the operating mode selected, the CHP unit controls can switch the CHP unit off and on automatically. Fast rotating parts can start moving unexpectedly and pull in fingers and other extremities.

- Do not reach into the interior when the CHP unit is in operation.
- Before starting any work on the CHP unit, ensure that you have locked it.
- Only detach the outer panelling and the protective panelling in the interior for maintenance purposes only.

Health hazard I
Hand injuries
Due to sharp edges

- Wear suitable gloves during maintenance and repair work on the CHP unit.

Health hazard !
Risk of burns
Due to very hot components, operating materials and heating water

The CHP unit reaches very high temperatures. If you open the CHP unit's panelling during or shortly after operation, the components in the CHP unit interior will still be very hot. If you touch the hot components on the CHP unit's machine set, you can suffer burns.

- Do not touch the CHP unit interior if the CHP unit is in operation or was in operation until a short time ago.
- Check the temperature of the components concerned before you touch them and carry out work on the CHP unit.

Information
Potential damage to the CHP unit due to poor maintenance or lack of maintenance

- Have maintenance carried out at regular intervals.
- We recommend you conclude a comprehensive maintenance contract.

Information
Potential damage to the CHP unit due to incorrect heating water

The heating water must comply with the guideline values specified in Technical Rule VDI 2035. Deviating from these, the following limit values apply to Mephisto combined heat and power units:

- pH value: 8.0 - 9.0
- Water hardness:
  < 9.0 °dH (≤ 550 kW installed gas capacity)
  < 3.0 °dH (> 550 kW installed gas capacity)
- Electrical conductivity:
  ≤ 400 µS/cm (at 25 °C)
- Compliance with limit values is a prerequisite for concluding a comprehensive maintenance contract.

The heating system's water quality should be checked and documented as per VDI 2035 on a regular basis.

2.7 REGULATIONS

Where applicable, Mephisto condensing combined heat and power units are developed, designed and manufactured in compliance with the following **EC Directives**:

- Machinery Directive 2006/42/EC
- Low Voltage Directive 2014/35/EU
- EMC Directive 2014/30/EU

The following **harmonised standards** have been applied:

- EN ISO 12100 Safety of machinery
- EN 60204-1:2019-06 Safety of machinery - Electrical equipment of machines
- EN 61000- 3-11 and EN 61000- 3-12- Electromagnetic compatibility
- DIN EN ISO 8528-13:2017-03 Power generation units with reciprocating internal combustion engine safety

The following **national standards, guidelines and specifications** have been applied:

- VDE-AR-N 4105:2018-11 Generators connected to the low-voltage distribution network
- DVGW VP 109, Version 1995-04 Ready-to-connect CHP units with a generator driven by a gas engine

The applicable regulations must also be met if the Mephisto is connected to the public gas and electricity supply network.

The local gas supply company's technical guidelines and the German Technical Regulations for Gas Installations (TRGI) apply to gas installation.

A testable grid and plant protection system according to the VDE guideline is implemented by the CHP unit controls.

The CHP unit may only be connected by locally approved specialist companies.

2.8 SAFETY SYSTEMS

The essential safety systems are presented and their mode of operation explained below.

2.8.1 Gas safety

- DIN-DVGW-tested combination gas safety fitting with two independently operating gas solenoid valves, electric gas quantity control valve, zero pressure regulator and gas pressure switch. The CHP unit controller checks on a regular basis that the solenoid valves function correctly during shutdown (if one of the valves is closed, this must cause the electrical power to change direction). If one of the solenoid valves malfunctions, a fault is triggered, the system locked and a fault message sent.
- During shutdown, including a trip-out or power failure, the ignition power supply designed especially for this case provides a sufficiently long run-on ignition time to ensure that no unburned or ignitable mixture accumulates in the CHP unit flue gas conduit.
- The entire flue gas section is purged with fresh air during each start-up and stop process. This prevents an ignitable mixture from accumulating in the flue gas section and also cools the catalytic converter down to prevent any damage during the start-up process.
- An optional gas sensor monitors the room air, thus providing additional safety for the entire power plant, including the boiler. The gas sensor also responds to flue gas leaks.

2.8.2 Electrical safety

- VDE-AR-N 4105 requirements are met.
- Overload protection and a fast short circuit trigger disconnect the generator from the network in the event of an overload or a short circuit incident.
- The generator coil temperature monitoring also prevents the generator from overloading.
- There is an external heating emergency switch in the CHP unit's emergency stop loop and thus has a direct effect on the main contactor and the gas solenoid valves.

2.8.3 Network monitoring

Network and plant protection system as per VDE-AR-N 4105

Mephisto combined heat and power units are fitted with an integrated grid and plant protection system as per VDE-AR-N 4105. The grid and plant protection system is an integral part of the generation system. It acts directly on the integrated circuit breaker and the gas solenoid valves.

Integrated circuit breaker

A combination between the main and delta contactors is used as an integrated circuit breaker. The generator can only feed in energy if there is a delta connection to the network. This ensures the contactor combination is fail-safe – each contactor prevents current flow into the network. The main and delta contactors are monitored regarding their switch position both when turned on and turned off to guarantee fail safety.

The neutral conductor is not connected to the generator in any operating state, so it is not switched by the integrated circuit breaker.

Protection functions

The voltage protection devices monitor the three phase-to-neutral voltages (UN = 230 V) and the three phase-to-phase voltages (UN = 400 V). The frequency protection devices are single-phased.

The grid and plant protection is calibrated and checked during the factory acceptance test. The triggering threshold is permanently programmed up to U> in the factory.

Trigger values

Protection function	Set value
Voltage return protection U<	0.8 U_n
Voltage increase protection U>	1.1 U_n
Voltage increase protection U>>	1.15 U_n
Frequency return protection f<	47.5 Hz
Frequency increase protection f>	51.5 Hz

Voltage return protection U<

Switch-off within 0.2 seconds at 0.8 U_n.

Voltage increase protection U>

Switch-off within 0.2 seconds if the ten-minute mean value exceeds the triggering threshold. The triggering threshold is set to 1.1 U_n in the factory and may only be increased up to 1.15 U_n if there is central grid and plant protection.

Voltage increase protection U>>

Switch-off within 0.2 seconds at 1.15 U_n.

Frequency return protection f<

Switch-off within 0.2 seconds at 47.5 Hz.

Frequency increase protection f>

Triggering within 0.2 seconds at 51.5 Hz.

Island network detection

Island network detection is guaranteed by the three-phase voltage control.

Reverse power monitoring

The system monitors whether the self-generating system delivers electrical power on all three phases. As a result, a single-phase grid failure is detected even more reliably. Moreover, monitoring the total power prevents the CHP unit from remaining connected to the grid when it is not supplying any power.

Connection conditions

The system does not connect until the network voltages are between 0.85 U_N and 1.1 U_N and the network frequency is between 47.5 Hz and 50.5 Hz for 60 seconds.

The system is not switched on again after the grid and plant protection has triggered until a random period between one and ten minutes comes to an end. Manual mode can override delays.

Active power feed-in with overfrequency

If the frequency exceeds 50.2 Hz, the CHP unit controller freezes the present electrical power PM. If the frequency continues to rise, the maximum power output PAmax is reduced with 40% PM per hertz. Overfrequency appears on the display indicating the PAmax and PM.

An equally distributed random value for f> is generated from the serial number at which the grid and plant protection triggers. This value is between 51.5 Hz and the limit frequency at which the minimum power of the CHP is reached.

If the network frequency falls below 50.2 Hz again, PAmax is increased with 10% of the net power per minute. The controller continues to display “overfrequency” and PAmax.

As soon as PAmax has reached the net power, the CHP unit is back in normal mode.

Testing the grid and plant protection

You will find information on testing from page 58 onwards.

2.8.4 Irregular operation monitoring

An internal combustion engine does not run absolutely smoothly due to the necessary compression work. As a result, the electrical power output is not constant either. The Mephisto's controller records the effective value of this power fluctuation as P-irregular.

The irregular value increases steeply if a spark plug fails or there is wear in the valves. The machine switches off automatically if a threshold value is exceeded. This prevents unburned mixture from entering the flue gas section. In the event of slightly increased irregularity, a warning message is sent, so that valve wear is detected before the machine breaks down and the cylinder head can be replaced without unnecessary downtimes.

2.8.5 Flame monitoring

Single spark ignition starts combustion of the fuel in the CHP unit's engine. Each ignition process is continuously monitored by the electronic power monitoring with the aforementioned irregular operation detection. If the single spark ignition was unable to ignite the fuel gas-air mixture, the fuel supply is closed off and the CHP unit is switched off. Every Mephisto CHP unit thus has flame monitoring in accordance with fire regulations.

2.8.6 Other monitoring systems

- Analogue oil pressure monitoring
- Analogue water pressure monitoring
- Speed monitoring
- Continuous temperature monitoring for all key components, including catalytic converter temperature
- Safety temperature delimiter for flue gas temperature
- Safety temperature delimiter for heating circuit feed line

3. MEPHISTO TECHNOLOGY

The technical information applies to the boundary conditions: Return temperature t_{RL} = 35 °C; air temperature t_L = 25 °C; absolute air pressure p_L = 1.013 mbar; calorific value (natural gas) H_i = 8.8 kWh/m³ in normal state; calorific value (liquefied gas) H_i = 25.8 kWh/m³ in normal state; methane number MN = 96 (liquefied gas = 35).

The current, applicable VDEW, VDE, DVGW and DIN regulations are met. Subject to technical changes.

	Mephisto G50 **Natural gas** **Asynchronous + Synchronous**	**Mephisto G50** **Liquefied gas** **Asynchronous + Synchronous**	**Mephisto G50** **Biogas** **Asynchronous + Synchronous**
Model	Mephisto G50 A NG Mephisto G50 S NG	Mephisto G50 A LPG Mephisto G50 S LPG	Mephisto G50 A BG Mephisto G50 S BG
Net output (adjustable)			
Electric, net	20 to 50 kW	20 to 50 kW	20 to 50 kW
Electric, gross	50,6	50,6	50,6
Thermal	63 to 100,7 kW	63,1 to 105,9 kW	65 to 101,0 kW
Gas	79,5 to 144,9 kW_{Hi}	80,5 to 151,5 kW_{Hi}	82,1 to 144,5 kW_{Hi}
Net efficiency			
Electric, effectiv	34,5 %	33 %	34,6 %
Electric, ISO 3046	36,2 %	34,7 %	36,3 %
Thermal, effectiv	69,5 % (ϑ_{Return} = 35 °C)	69,9 % (ϑ_{Return} = 35 °C)	69,9 % (ϑ_{Return} = 35 °C)
Total, effectiv	104,0 % (ϑ_{Return} = 35 °C)	102,9 % (ϑ_{Return} = 35 °C)	104,5 % (ϑ_{Return}= 35 °C)
Energy efficiency class	A++	A++	upon request
Seasonal space heating energy efficiency	153 %	150 %	upon request
CHP coefficient	0,50	0,47	upon request
Primary energy factor (FPE,WV as per DIN SPEC 4701-10/A1:2016-05)	0,19	0,25	upon request

	Mephisto G50 **Natural gas** **Asynchronous + Synchronous**	**Mephisto G50** **Liquefied gas** **Asynchronous + Synchronous**	**Mephisto G50** **Biogas** **Asynchronous + Synchronous**
Primary energy saving	32,40 % The high-efficiency criterion specified in EU Directive 2012/27/EU for CHP systems is met	31,20 % The high-efficiency criterion specified in EU Directive 2012/27/EU for CHP systems is met	upon request
Fuel	Groups H and L natural gas Biomethan	Liquefied gas (propane)	Biogas Sewage gas
Gas connection			
Gas connection rating	144,9 kW H_i = 160,7 kW H_s	151,5 kW H_i = 163,5 kW H_s	144,5 kW H_i = 160,3 kW H_s
Gas connection pressure	20 - 100 mbar	20 - 100 mbar	20 - 100 mbar
Gas flow pressure	≥ 10 mbar	≥ 10 mbar	≥ 10 mbar
Mating dimension	DN 32 (1 ¼ " AG)	DN 32 (1 ¼ " AG)	DN 32 (1 ¼ " AG)
Heating connection			
Heating circuit minimum pressure	1,5 bar	1,5 bar	1,5 bar
Permitted operating pressure	max. 6,0 bar	max. 6,0 bar	max. 6,0 bar
Supply line temperature	max. 90 °C	max. 90 °C	max. 90 °C
Return temperature	max. 70 °C	max. 70 °C	max. 70 °C
Mating dimension	1 ½'' male thread	1 ½'' male thread	1 ½'' male thread
Design flow rate	4,41 m^3/h	4,64 m^3/h	4,43 m^3/h
Residual head for net output	6,2 mWS	5,5 mWS	6,2 mWS
With 40 K spread			
Design flow rate	2,21 m^3/h	2,32 m^3/h	2,21 m^3/h
Residual head for net output	10,3 mWS	10,2 mWS	10,3 mWS

Electrical connection

Pre-fuse NH00 100 A gl (gG) or SLS E-100 A

Supply line H07RN-F 5 x 35 mm2, up to 50 m in length for installation types B to G

Plate heat exchanger

Soldered stainless steel compact heat exchanger for separating the heating system from the CHP engine water circuit

Mephisto G50 Natural gas Asynchronous + Synchronous	Mephisto G50 Liquefied gas Asynchronous + Synchronous	Mephisto G50 Biogas Asynchronous + Synchronous

Pollutant emissions

Mephisto G50 A/S NG, LPG emits 50% below the emission limits specified in the German Technical Instructions on Air Quality Control

Mephisto G50 A/S BG emits the emission limits specified in the German Technical Instructions on Air Quality Control

Combustion intake air

Space-air-dependent operating mode

Flue gas connection

Flue gas conduit D 110, fire resistance class B1 polypropylene pipe made, permitted as a flue gas conduit for condensing heat generators with flue gas temperature up to 120 °C

Flue gas temperature limited max. 100 °C on thermostat

Safety temperature limiter set to 120 °C

Recommended flue gas counter-pressure up to 500 Pa; maximum flue gas counter pressure 800 Pa

Flue gas flow rate: 161 m^3 (in normal state)/h is the same as 208 m^3/h with Tfluegas = 80 °C,
Mephisto G50 A/S LPG upon request

Maximum condensate quantity: 22 l/h, Mephisto G50 A/S LPG upon request

Flue gas heat exchanger

Thermodynamically optimised cast aluminium-silicon heat exchanger

Catalytic converter for natural and liquefied gas operation

With integrated cooling for natural gas and LPG operation

Condensing heat utilisation

The flue gas temperature is a maximum of 15 K above the corresponding return temperature

Condensing heat utilisation above around 55 °C Return temperature

Engine

gas engine Type at G50 A/S NG: MAG 49.4 S313/HMG 434 S 133

gas engine Type at G50 A/S LPG: MAG 49.4 S311/HMG 434 S 133

gas engine Type at G50 A/S BG: MAG 49.4 S315

4-cylinder Otto engine, water-cooled

Displacement: 4.900 cm^3

Coupling

Maintenance-free, plug-in, flexible metal/plastic coupling to compensate for radial, axial and angular misalignment

Mephisto G50 Natural gas Asynchronous + Synchronous	Mephisto G50 Liquefied gas Asynchronous + Synchronous	Mephisto G50 Biogas Asynchronous + Synchronous

Generator

Four-pole asynchronous/synchronous machine for parallel operation on the public grid

Start-up current asynchronous: 52 A (frequency inverter fitted as standard), Start-up current synchronous: 55 A (frequency inverter fitted as standard)

Rated current asynchronous: 94 A, Rated current synchronous: 72 A / 80 A

cos φ asynchronous 0,86 (inductive), cos φ synchronous 1...9 (inductive/capacitive)

Rated power asynchronous: 56 kW, rated power synchronous: 62,5 kW

Rated speed asynchronous: 1.514 min^{-1}, rated speed synchronous: 1.500 min^{-1}

Low voltage certification

Low voltage certification with unit certificate according to VDE-AR-N 4105:2018

Asynchronous: Compensation

Due to the requirements in German code of practice VDE-AR-N 4105:2018-11, operating own generating systems without reactive power compensation is only permitted in exceptional cases. A cos φ of 0.95 is achieved with the standard fixed compensation.

Synchronous: Reactive power control

Control of reactive power according to Q(U) characteristic, cos φ (P) characteristic or fixed cos φ: 1...0.9 (inductive/capacitive)

Feed-in management according to §14 EEG 2021

Reduction of the feed-in power by means of setpoint specification via analog input (0-10 V), bus interface (optional) and digital inputs (for connecting the relay contacts of an on-site ripple control receiver) possible

Controller

Industrial computer with powerful microcontroller MPC555, 32-bit power PC with FPU

Fully automatic operating control

Remote monitoring/operation via LAN or optional mobile data connection

Interfaces to higher-level DDC controls: digital and analogue inputs and outputs; optional communication interfaces CAN bus, RK512, Modbus, LON bus, Profibus DP, BACnet/IP, IEC 104, Profinet

Housing

Sturdy, easily removable, frameless full thermoacoustic enclosure

Machine unit on four steel spring vibration isolators

Optional base on two vibration dampers to isolate noise

Mephisto G50 Natural gas Asynchronous + Synchronous	Mephisto G50 Liquefied gas Asynchronous + Synchronous	Mephisto G50 Biogas Asynchronous + Synchronous

Noise emissions

Mean sound pressure level at 1 m distance: < 60.0 dB(A) as per DIN 45635-11

Mean sound pressure level (standard equipment) at 1 m distance (45°) to chimney outlet: < 51.2 dB(A) as per DIN 45635-11

Third octave band spectra isolation can be provided on request

Dimensions

L×W×H in mm: 2,235 × 1,020 × 1,930 with electrical enclosure

Space requirements

L×W×H in mm: 4,500 × 2,000 × 2,100 without sound insulation base (base height: 250 mm).

We will be happy to provide you with installation and foundation plans on request

Operating weight

asynchronous: 1.850 kg, synchronous: 1.960 kg

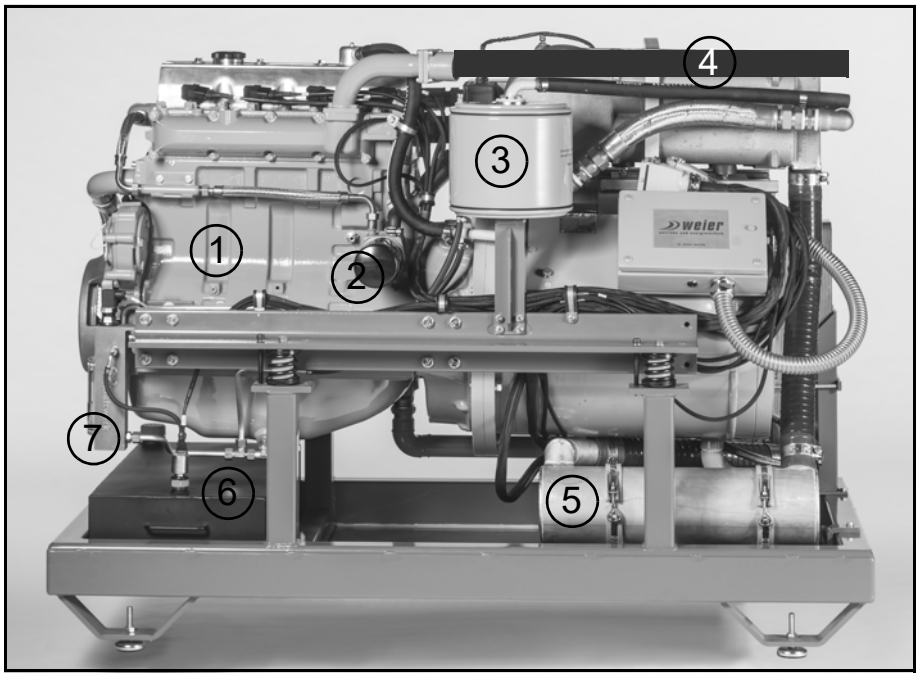
Delivery

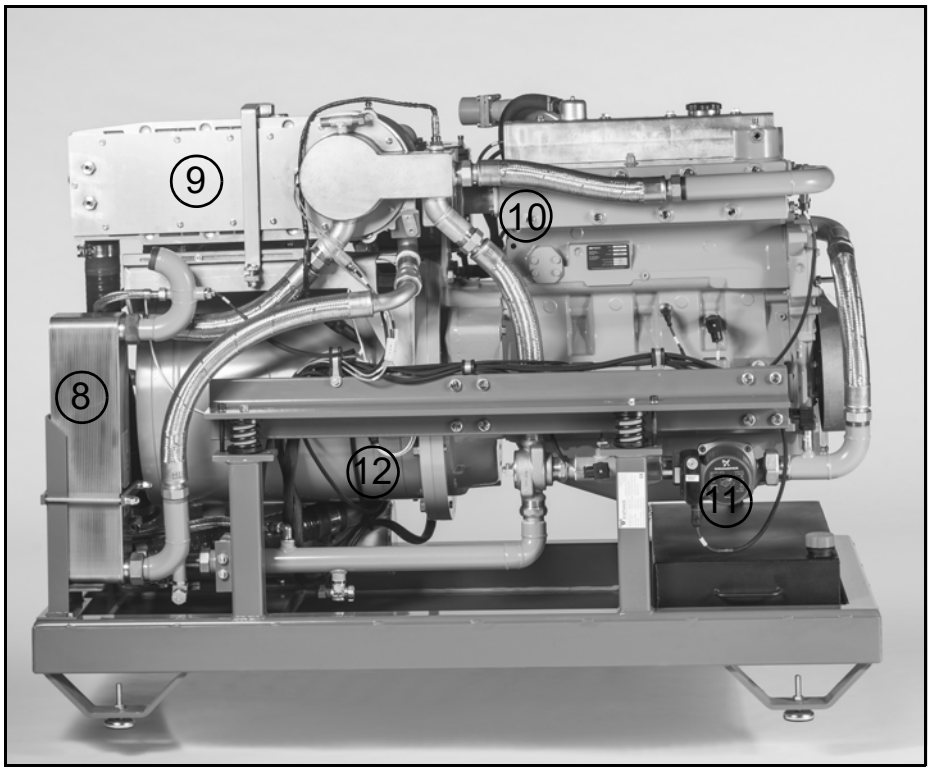
Machine unit, self-supporting: 1,640 mm × 785 mm, asynchronous: 1.240 kg, synchronous: 1.350 kg

Panelling with electrical enclosure and accessories on pallet: 2,000 mm × 1,200 mm, 530 kg

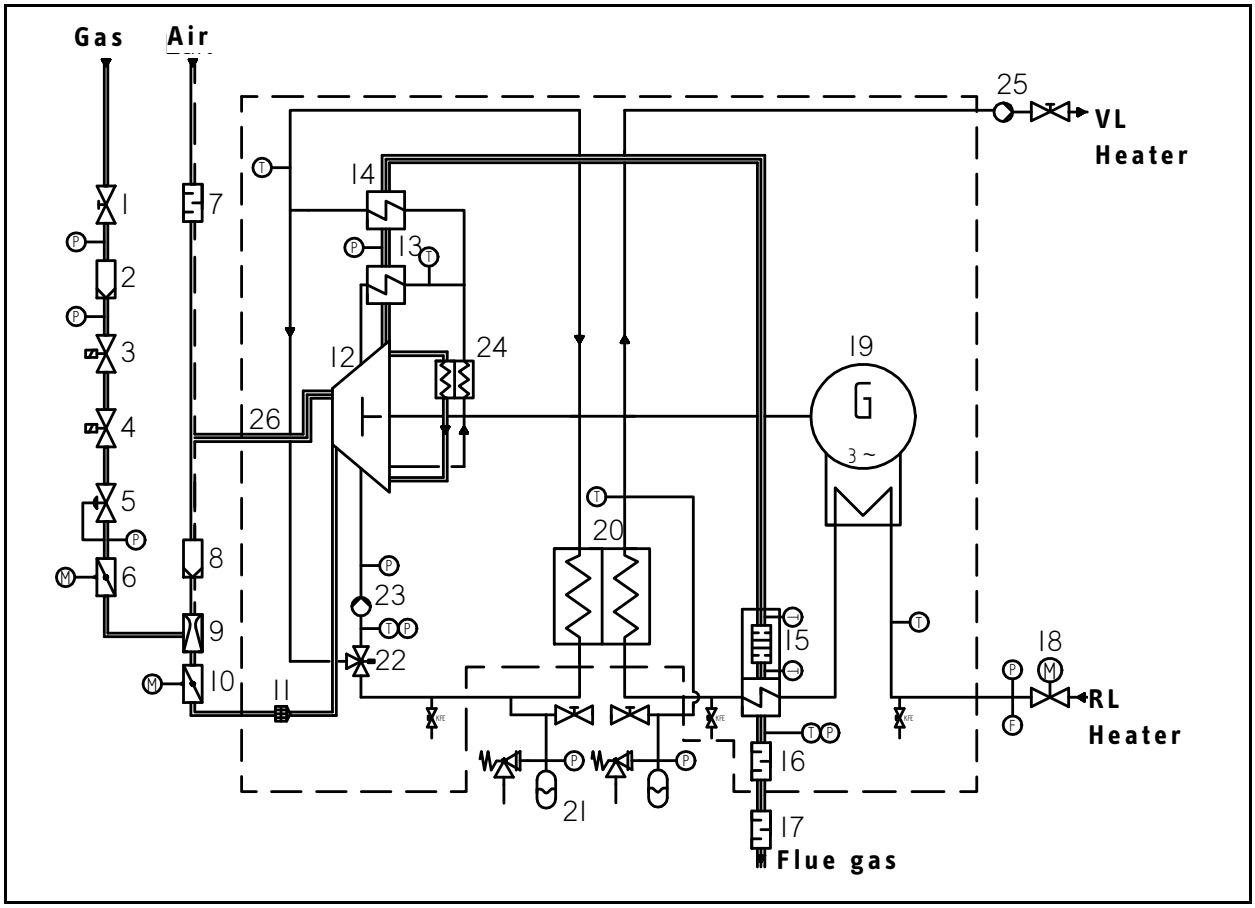
3.1 THE MACHINE UNIT

1. Engine
2. Oil cooler with oil filter
3. Oil separator for the crankcase vent
4. Mixture suction hose
5. Flue gas silencer
6. Oil additive tank
7. Oil level sight glass with switch contacts for controlled oil replenishment
8. Plate heat exchanger
9. Condensing heat exchanger with integrated catalytic converter
10. Water-cooled flue gas manifold
11. Electrical engine water pump
12. Water-cooled generator



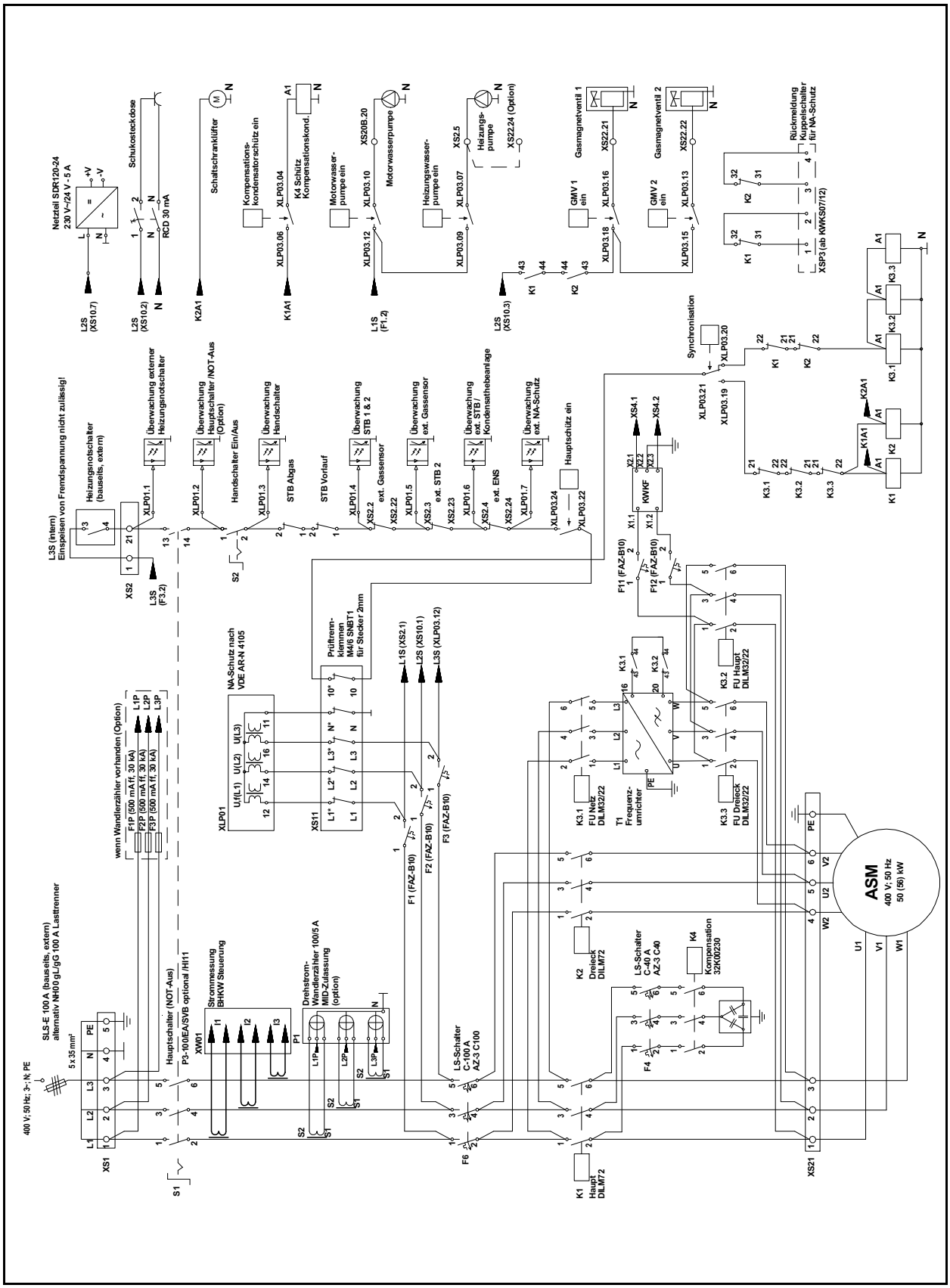


3.2 SYSTEM SCHEMATIC (2023- 03)



1. Ball valve for fuel feed
2. Gas filter
3. Gas solenoid valve with gas pressure monitor
4. Gas solenoid valve
5. Zero pressure regulator
6. Gas control valve
7. Intake silencer
8. Air filter
9. Gas mixer
10. Throttle valve
11. Flame filter
12. Combustion engine
13. Water-cooled flue gas manifold
14. Water-cooled flue gas heat exchanger lid
15. Condensing heat exchanger with integrated catalytic converter
16. Internal flue gas silencer
17. Resonator muffler
18. Electric shut-off valve
19. Water-cooled generator
20. Plate heat exchanger
21. Diaphragm type expansion tank
22. 3-way thermostatic valve
23. Electric engine water pump
24. Oil cooler
25. Heating-side CHP unit pump
26. Crankcase vent return

3.3 EXTENDED MAIN POWER CIRCUIT (2023-01)



3.4 CHP UNIT CONTROLLER COMPONENTS

Computer unit

- 32 analogue inputs, 12-bit resolution
- 8 analogue outputs
- 32 digital inputs
- 32 digital outputs
- Operation on 10 inch touch display
- Loss-proof storage of variables in EEPROM
- Comprehensive interfaces for communication
- All functions and displays also operated in Webgate

Remote monitoring/operation

- Automatic error/fault message on PC
- CHP unit visualisation and operation on PC
- Change to all parameters on PC

Network and plant protection system as per VDE-AR-N 4105

- Three phase-to-neutral voltages
- Three phase-to-phase voltages

Power control and monitoring

- Control via digital PID controller
- CHP unit warm-up phase with minimum elec. power, followed by adjustment to P setpoint
- Three-phase reverse power monitoring
- Measurement of irregularity (spark plug monitoring and cylinder head)
- Calculation of the thermal and electrical work performed, display of the operating hours

Temperature monitoring

- Supply line, return line primary (engine circuit)
- Supply line, return line secondary (heating circuit)
- Housing interior
- Flue gas
- Engine water
- Generator coil

Gas safety

- Two independently switching gas solenoid valves with function control during CHP unit switch-off
- Gas pressure monitor
- Purging of the gas and flue gas section when the system is turned on and off
- Digital input for gas sensor

Engine oil monitoring

- Oil level monitoring by min./max. contact with the oil pan
- Automatic feeding with oil consumption control
- Oil return monitoring with analogue pressure sensor

Ignition control

- Greater spark plug service life thanks to min. burn-off
- Engine is started with increased ignition energy when cold

Speed monitoring

- Delta switch-over after reaching the min. speed during start-up
- Max. speed monitoring during operation (coupling break detection)

3.5 CONTROL TECHNOLOGY

The Mephisto controller should be integrated effectively into the control system for the entire heating system to ensure that the CHP unit operates to an optimal extent on a technical and economical level. For this purpose, there are various options to connect to a higher-level control system that triggers the CHP unit and specifies the target output:

- External control via digital and analogue inputs and outputs (standard)
- External control via LON bus (optional)
- External control via CAN bus (optional)
- External control via RK512 (optional)
- External control via MODBUS (optional)
- External control via Profibus DP (optional)
- External control via BACnet/ IP (optional)
- External control via IEC 104 optional)
- External control via PROFINET (optional)

Mephisto Basic Control

If the heating controller is not designed to incorporate a CHP unit, the Mephisto can undertake different intelligent functions with the Mephisto Basic Control software module featured in the CHP unit controller as standard.

Functions and options in the Mephisto Basic Control standard software module

- CHP unit poweer output and supply line temperature control
- Buffer tank loading determined by two temperature sensors
- Communication with a DDC via a digital input for the CHP request and order
- Analogue input for setpoint power output/temperature specification
- Analogue output for current power output reading
- Three potential-free changeover contacts for operating signal, ready signal and fault signal

Five analogue inputs in the CHP unit for Pt1000 temperature sensors for control or evaluation purposes included. The temperature sensors are not included in the price.

Mephisto Heat Generation Control

If the options in Mephisto Basic Control do not suffice, you can use the optional add-on Mephisto Heat Generation Control. This add-on is integrated into the CHP unit controller if ordered.

The heating hydraulics must be designed as per the power plant hydraulic recommendations in order to use the functions below to an optimal extent. We will be happy to send you our hydraulic recommendations. Please contact: +49 (0)511 262 9970.

Functions and options in the Mephisto Heat Generation Control standard software module.

The range of functions depends on the hydraulic system selected.

- Main circuit supply line temperature control
- Main circuit supply line temperature increase When hot drinking water is required
- A boiler enable, specification of the boiler setpoint output or setpoint temperature
- Regulated buffer tank loading
- Boiler bypass control
- Control of a buffer discharge pump via GENIbus or control of a boiler circuit/local heat mixer using end position contacts
- Current-controlled operation (optional active power meter required)

Five analogue inputs in the CHP unit for Pt1000 temperature sensors are included for control or evaluation purposes. The temperature sensors are not included in the price.

You will find more information in point 4.7 "Control system integration" on page 32.
You will find information on the CHP unit's settings and operation in the section on "Operating" from page 37 onwards.

3.6 MEPHISTO MESSAGE CONCEPT

The CHP unit controller transmits its status to our Webgate via the remote monitoring module on a regular basis. Service personnel can also use it to operate the CHP unit remotely. We recommend fitting every Mephisto CHP unit with a remote monitoring module. It is a prerequisite for concluding a comprehensive maintenance contract.

In the case of multiple module systems, one remote monitoring module is sufficient since all CHP unit modules are interconnected via a data bus. If a MERLIN heating controller (manufacturer: energiekontor Hannover) is installed, it also has a data connection to the Mephisto CHP unit. The remote monitoring module is installed in the heating controller in this case.

Remote monitoring module

The remote monitoring module comprises an OpenVPN gateway and the associated software in the CHP unit controller. The following options are available at present:

- **Mephisto remote monitoring module**
  OpenVPN gateway for remote monitoring and control of all CHP modules at a location via Ethernet LAN. The customer must provide a network connection with the necessary port releases as per specifications.
- Remote monitoring can also be performed via a **mobile data connection** using LTE/HSPA+/GPRS (4G/3G/2G) as an option. The associated mobile phone card is invoiced as part of the full maintenance contract.

Webgate

Webgate displays the CHP unit's operation-relevant data, such as the operating hours or the electrical energy generated, over its entire service life. First and foremost, historical data and the availability specified in full maintenance contracts can thus be evaluated easily.

Webcontrol

The Webcontrol visualisation interface not only allows the user to fully control the CHP unit remotely in real time, but also view and evaluate current and historical technical measurement data (temperatures, currents, outputs, etc.). This provides a tool for project monitoring and system optimisation.

CHP unit fault messages

Various operating states cause the control unit to lock the CHP unit so that the module can no longer start automatically. Such a disruption is triggered, for example, by two fault shut-downs within 20 minutes. The lock must be reset using the remote control or directly on the electrical enclosure after the fault has been eliminated. Also see Section "Warnings and faults" on page 73 for more information.

The CHP unit controller reports faults to the Webgate via the remote monitoring module. The Webgate can then forward the message.

External fault messages

All Mephisto controllers can be equipped with additional digital inputs for external fault messages. Potential-free contacts are connected here.

The external fault messages are transmitted to the Webgate, which can forward them.

3.6.1 Forwarding of fault messages

The Webgate can forward fault messages so that, for example, a maintenance technician receives the fault message from a boiler or a pumping system on their mobile phone, or another fault message system can process the fault message further. The following options are available:

Fault message in an email

This is our preferred forwarding method. It is easy to set up and does not require a dial-in process. An email does not incur any costs either.

The only disadvantage is that fault messages are obviously automatically generated emails, which can be caught in spam filters. The recipient address should therefore not be used for any other purpose and all spam filters must be switched off.

3.6.2 MERLIN heating controllers

If a MERLIN heating controller (manufacturer: energiekontor Hannover) is installed, it usually not only controls and monitors just the CHP unit but also the entire heating system. Moreover, it can be freely programmed for the specific project. It thus obviously features considerably more extensive options to analyse the various potential sources of interference in the heating system compared to the CHP unit controller. However, we won't discuss them here.

CHP unit faults are transmitted to the Webgate as described, which can then forward them. The heating controller can also send the CHP faults directly to another fault message system or a mobile phone as an alternative to forwarding.

4. INSTALLATION

Mephisto CHP units may only be brought into the premises, installed and commissioned by **kraftwerk** or its partner. The CHP unit is normally integrated into the gas, hydraulic and electrical systems by the customer. The customer will also provide a new flue gas system and a sound-absorbing foundation, if required.

4.1 TECHNICAL DATA FOR INTEGRATION

- **Gas**
  - CHP unit connected load:
    Mephisto G50 A/S NG: 144,9 kW_{Hi}
    Mephisto G50 A/S LPG: 151,5 kW_{Hi}
    Mephisto G50 A/S BG: 144,5 kW_{Hi}
  - CHP unit flow rate:
    16.5 m³ in normal state/h ($_{Hi}$= 8.8 kWh/m³ in normal state)
  - CHP unit connection pressure: 20 to 100 mbar
  - CHP unit flow pressure: ≥ 10 mbar
  - Connection to CHP unit: DN 32 ($1^1/_4$" male thread)
- **Flue gas**
  - CHP unit temperature: max. 100 °C
  - Connection to standard external silencer: D110
  - Condensate drain, connection to horizontal flue gas conduit, open discharge in DN 50 drain pipe
  - CHP unit flow rate: 161 m³ I normal state/h
  - Recommended flue gas counter pressure 500 Pa, maximum flue gas counter pressure 800 Pa
  - Minimum chimney cross-section
    Square: 168 x 168 mm
    Round: 188 mm
  - Flue gas conduit: Fire resistance class B1 polypropene pipe, approved for use as flue gas conduit for condensing heat generators up to flue gas temperature of 120 °C, pressure-resistant, condensate-capable, open rear ventilation, typically used for room-air-dependent CHP unit operation
  - Flue gas conduit diameter: at least D110
    Up to 20 m in length; the diameter must be calculated beyond that
  - Check on the cross-section of the supply and exhaust air openings. Minimum supply air cross-section, CHP unit only: 340 cm^2
- **Intake air**
  - Minimum supply air cross-section (CHP unit only): 340 cm^2 °C
  - Temperature in CHP unit installation room: max. 30 °C
  - The combustion air intake is via the supplied intake silencer and it is usually installed under the boiler room ceiling. If the temperature is too high in the CHP unit installation room, we recommend installing vertically with the intake fitting pointing downwards.
- **Electrics**
  - Pre-fuse NH00 100 A gl (gG) or SLS E-100 A
  - Supply line H07RN-F 5 x 35 mm^2, up to 50 m in length for installation types B to G
  - Terminals suitable up to 50 mm^2
- **Heating**
  - Heating circuit minimum pressure: 1.5 bar
  - Permitted operating pressure: max. 6.0 bar
  - Supply line temperature: max. 90 °C
  - Return temperature: max. 70 °C
  - Mating dimension: 1½" male thread
  - Design flow rate:
    Mephisto G50 A/S NG: 4,41 m^3/h
    Mephisto G50 A/S LPG: 4,64 m^3/h
    Mephisto G50 A/S BG: 4,43 m^3/h
  - Residual head for net output:
    Mephisto G50 A/S NG: 6,2 mWS
    Mephisto G50 A/S LPG: 5,5 mWS
    Mephisto G50 A/S BG: 6,2 mWS
  - With 40 K spread:
    Design flow rate:
    Mephisto G50 A/S NG: 2,21 m^3/h
    Mephisto G50 A/S LPG: 2,32 m^3/h
    Mephisto G50 A/S BG: 2,21 m^3/h
    Residual head for net output:
    Mephisto G50 A/S NG: 10,3 mWS
    Mephisto G50 A/S LPG: 10,2 mWS
    Mephisto G50 A/S BG: 10,3 mWS

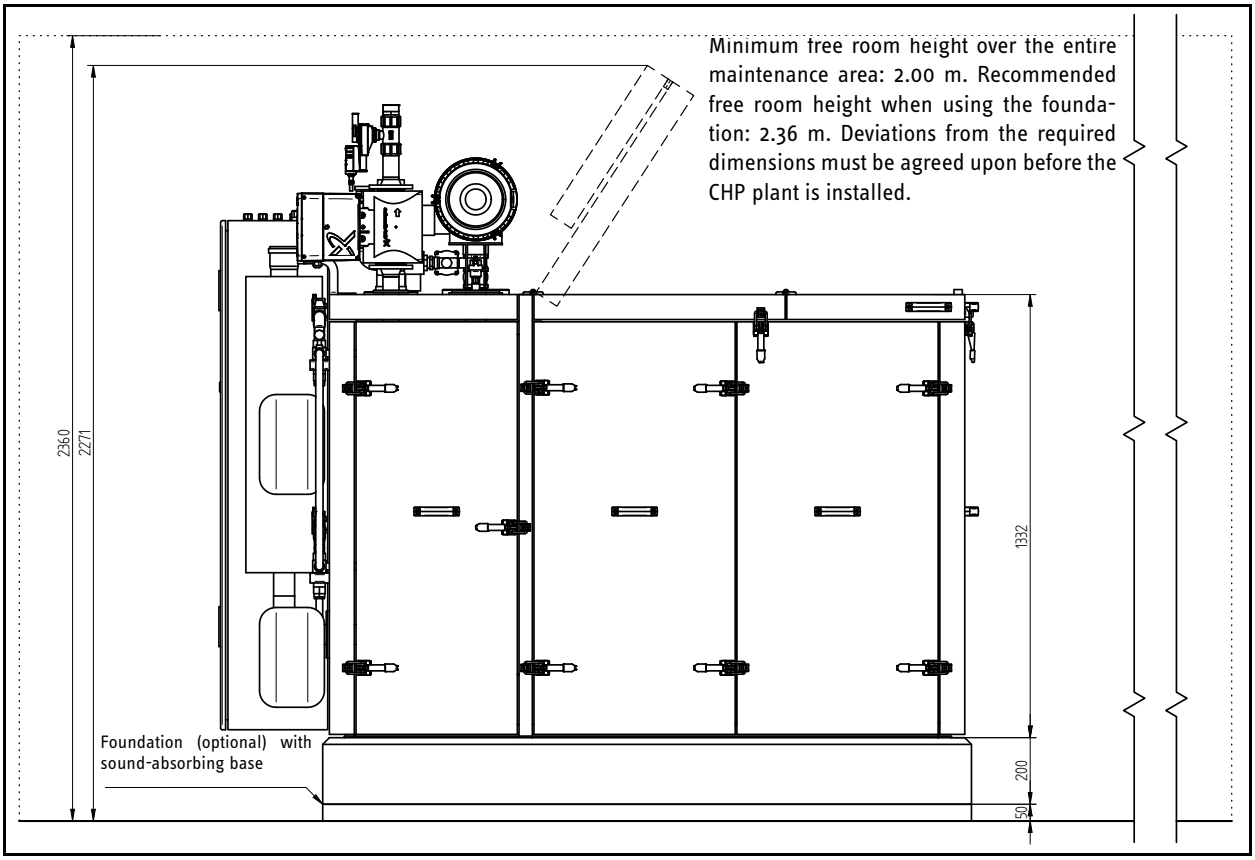
Information
Potential damage to the CHP unit due to incorrect heating water

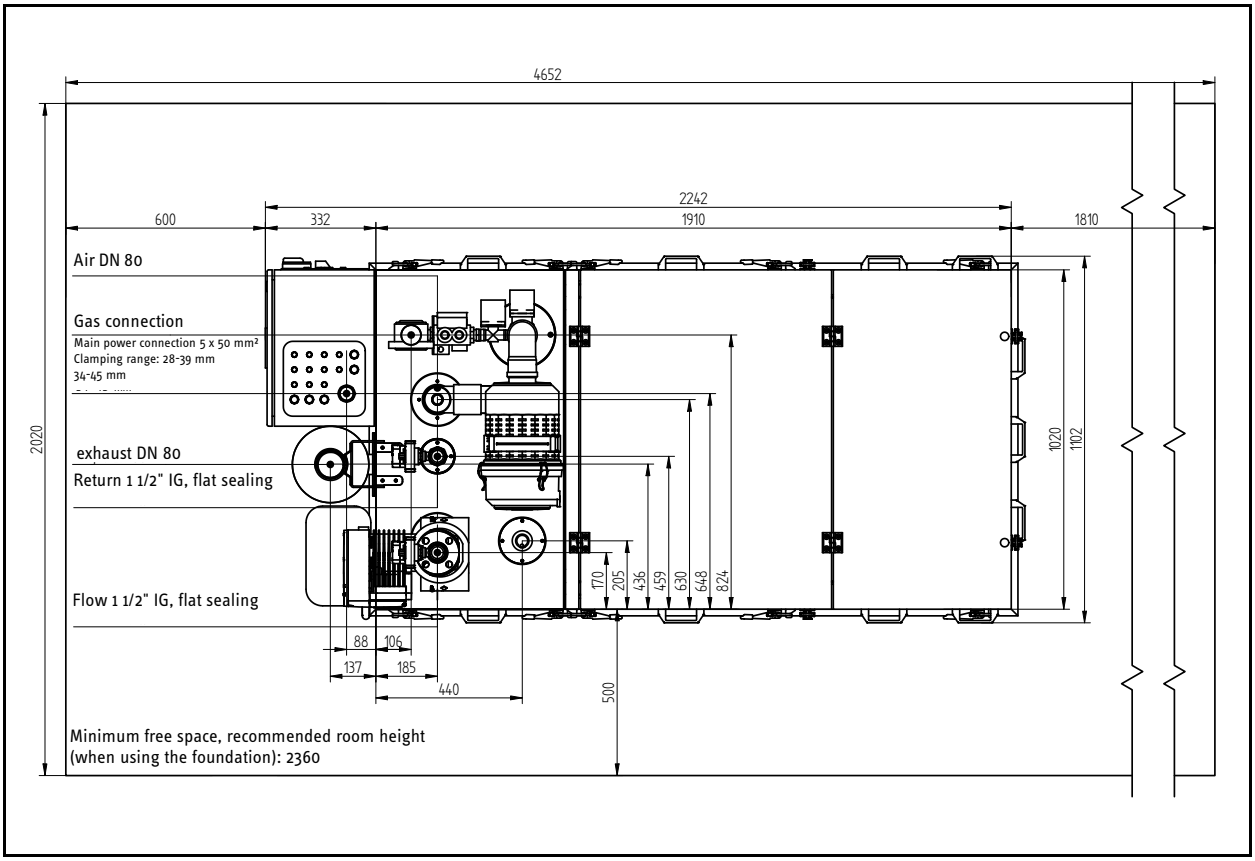
The heating water must comply with the guideline values specified in Technical Rule VDI 2035. Deviating from these, the following limit values apply to Mephisto combined heat and power units:

- pH value: 8.0 - 9.0
- Water hardness:
  < 9.0 °dH (≤ 550 kW installed gas capacity)
  < 3.0 °dH (> 550 kW installed gas capacity)
- Electrical conductivity:
  ≤ 400 µS/cm (at 25 °C)
- Compliance with limit values is a prerequisite for concluding a comprehensive maintenance contract.

The heating system's water quality should be checked and documented as per VDI 2035 on a regular basis.

4.2 INSTALLATION DIMENSIONS (Date: 2020-06) Drawing not to scale.





4.3 INSTALLING THE MEPHISTO

Installation frame

1. First remove the packaging material and the edge guard.
2. Open the panelling cover. You can now detach the side sections and the front section.
3. Remove the accessory parts inside.
4. Undo the 12 screws used to attach the installation frame to the pallet.
5. Align the installation frame at its installation site and anchor it in place; the dowels and countersunk bolts required for this purpose are included in the scope of delivery.

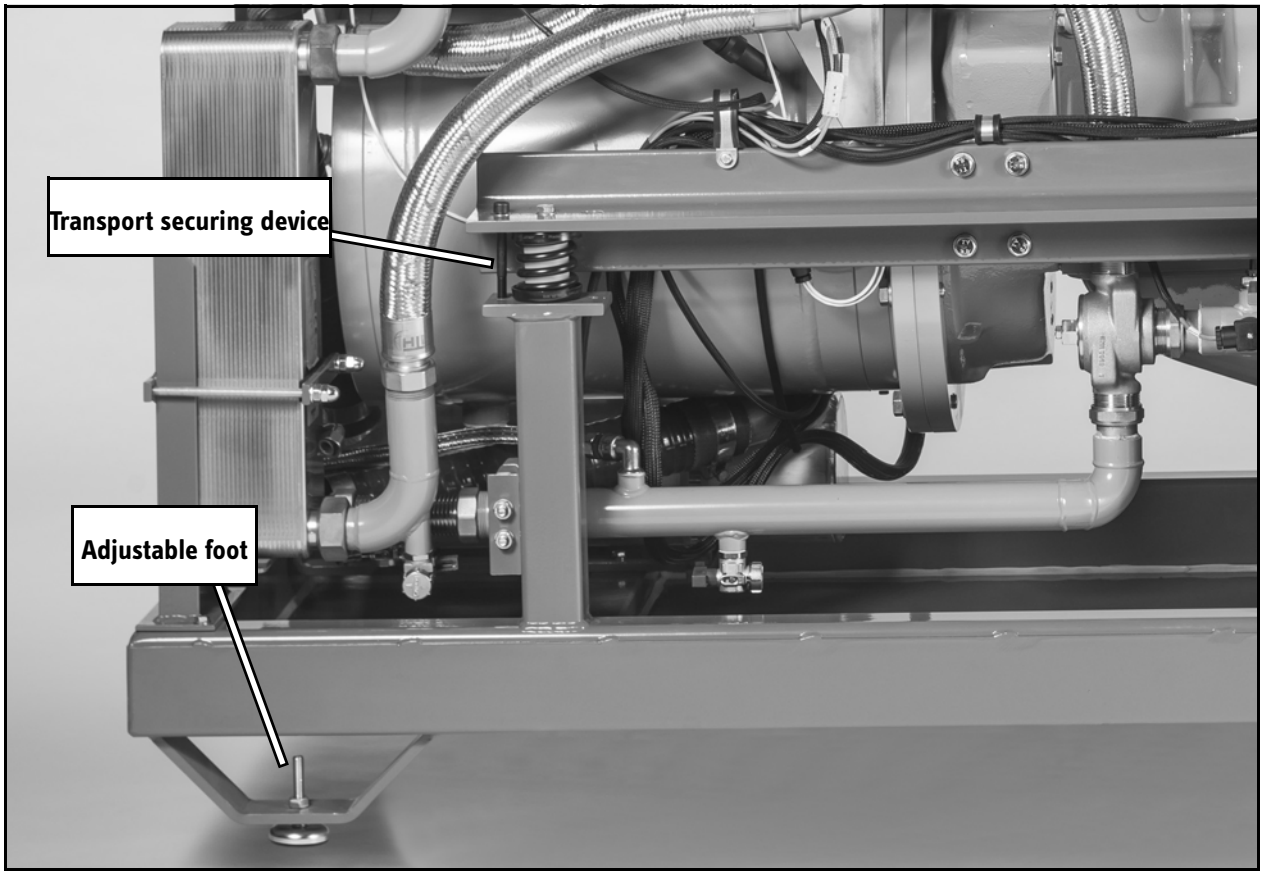
Machine unit

1. Use a lift truck to carry the machine unit into the adjusting frame from the front. Align the machine unit so that same-size gaps are maintained to the sides of the lifting frame and to the rear.
2. Leave the CHP unit in the raised position. Now use a spirit level and the four swivel adjustable feet to level the height of the CHP unit.
3. Set the machine unit down. The machine unit is not bolted to the installation frame.

Information
Potential damage to the CHP unit

- You must remove the machine unit transport securing device as described below. If you put the CHP unit into operation with the transport securing device attached, it can cause serious damage to the machine unit.

4. Remove the transport securing devices (8 M10 bolts) screwed into the machine unit. These are positioned on the right and left next to the vibration isolators.



4.4 CONNECTION LINES

Machine unit to the connection panel + rear panel

The following need to be connected:

- **Heating supply and return lines**

  Treat the supplied Centellen seals for the supply and return lines with Neofermit before connecting the hoses. Do not overtighten the union nuts; otherwise, you will crush the seals.

- **Line from the pressure equalisation tank to the engine water circuit**

  Treat the supplied Centellen seals for the pressure equalisation line with Neofermit before connecting the hoses. Do not overtighten the union nuts; otherwise, you will crush the seals.

- **Mixture suction hose**

  Route the mixture intake hose from the bend under the gas section to the intake manifold. Fit the mixture intake hose on both sides and secure it with hose clamps.

- **Flue gas hose**

  Connect the flue gas hose to the flue gas feedthrough on the housing rear panel. Secure it with a hose clamp.

- **Crankcase ventilation**

  Connect the hose from the crankcase ventilation filter element to the casing air extraction connection under the connection panel.

- **Ventilation line**

  Connect the hose from the catalytic converter housing to the automatic ventilation system under the connection panel.

4.5 INSTALLING THE ELECTRICAL ENCLOSURE

The electrical enclosure is supplied separately and must be place on the two stud bolts on the rear housing panel. Fasten the electrical enclosure to the two stud bolts with the supplied screws, washers, damping washers and nuts, and also use the two additional screws at the bottom of the electrical enclosure.

The electrical enclosure operating unit is positioned to the side since it is easiest to access the operating controls this way. The electrical enclosure is opened at the rear, making it easier to service it.

4.6 ELECTRICAL CONNECTIONS

The electrical connection between the electrical enclosure and the machine unit/gas section is established via three plug-in connectors and a cable harness. The connectors' different sizes ensure that they are protected against reverse polarity and are not inverted.

Two plug-in connectors are fed through the rear housing panel from the machine unit and secured to the rear panel of the electrical enclosure.

The other plug-in connector leads to the gas section and is secured to the rear panel of the electrical enclosure.

The connectors are secured to the connector housing with metal brackets. The cable harness is installed in the electrical enclosure as shown in point 7.1 "Connector and terminal assignment (2024-10)" from page 95.

4.7 CONTROL SYSTEM INTEGRATION

The Mephisto controller should be integrated effectively into the control system for the entire heating system to ensure that the CHP unit operates to an optimal extent on a technical and economical level. For this purpose, there are various options to connect to a higher-level control system that triggers the CHP unit and specifies the target output.

If the heating control system is not designed to interact with a CHP unit, Mephisto can take over the intelligent enabling of the CHP unit and boiler using an optional software module. You will find information about this in point 3.5 "Control technology" on page 24.

You will find information on the CHP unit's settings and operation in the section on Operating from page 37 onwards.

Control option 1: higher-level controller with standard digital and analogue inputs and outputs

The heating controller transmits the start request to Mephisto and indicates the setpoint for the electrical output via two signal inputs. Mephisto has four signal outputs for feedback.

Please ask the external controller's respective manufacturer which cables must be laid to the CHP.

CHP unit request

Health hazard
Due to shut-off delay

Do not use the CHP unit request input as an emergency stop input since you cannot ensure that the expected, immediate shutdown will occur.

- The CHP unit may continue to run for some time and you will suffer laceration or crush injuries.

Digital input for CHP unit request to connect a potential-free switch or relay (contact load 24 V/20 mA). The contact must be closed to request the CHP unit and open to switch it off.

Setpoint output

Analogue 0...20 mA input for the setpoint power specification.
0 mA corresponds to 0 kW; 20 mA corresponds to the maximum electrical output. The CHP unit only adopts the setpoint power specification within the control range. If the control range is exceeded or not reached, the CHP unit operates at its maximum or minimum output. The analogue input can also be configured for 0-10 V.

Actual output

Analogue 0...20 mA output for the actual performance output. 0 mA corresponds to 0 kW; 20 mA corresponds to the maximum electrical output. The analogue output can also be configured for 0-10 V.

CHP unit in operation

Potential-free changeover contact for operation signal. The CHP unit is operating.

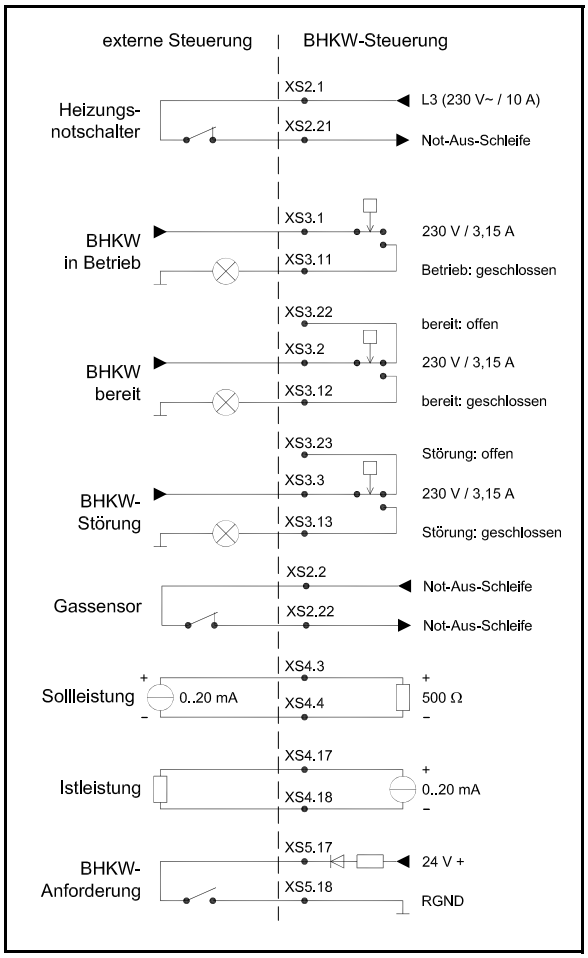
CHP unit ready

Potential-free changeover contact for ready signal. The CHP unit is ready and will start when requested.

CHP unit fault

Potential-free changeover for fault signal. The contact signals that the CHP unit module is malfunctioning or is no longer ready for operation. In this case, closing the request contact does not start the CHP unit module. A fault can only be eliminated on site or via remote control. The contact can be loaded with a maximum of 3.15 A/230 V and can also be used to connect a fault indicator lamp, for example.

Control signals



Nominal output + main circuit supply temperature

Analogue input to XS4.3-4	J5	J6
0...20 mA	*	1-2
0...10 V	*	--

* Only create a ground reference if necessary.

Actual output

Analogue output to XS4.17-18	J9
0...20 mA	--
0...10 V	1-2

Boiler setpoint setting

Analogue output to XS4.19-20	J10
0...20 mA	--
0...10 V	1-2

Optional analogue input

For a pressure or CO sensor, for example

Analogue input to XS4.15-16	J1	J2	J3	J4
4...20 mA	1-2	1-2	1-2	1-2
0...20 mA	2-3	2-3	*	1-2
0...10 V	2-3	2-3	*	--

* Only create a ground reference if necessary.

Control option 2: Higher-level controller with optional bus systems

The heating controller transmits the start request to Mephisto, the setpoint for the electrical output and, if necessary, the setpoint for the supply line temperature via a bus system. The feedback signals and various machine parameters are transmitted in the same way.

Please ask the external controller's respective manufacturer which cables must be laid to the CHP.

You can obtain further documentation on the optional communication modules from **kraftwerk.** The following communication interfaces can be installed to connect with the controller:

- CAN communications module

  CAN bus connection, 125 kBaud, own data protocol, for use with a MERLIN DDC controller; also suitable to connect multiple CHP unit modules at a location.

- RK512 communications module

  Data protocol RK512 (3964 R), 9,600 Baud, optionally via an RS-232 interface or RS-485 interface

- MODBUS communications module
- LON bus communications module
- Profibus DP communications module
- BACNet/IP communications module
- IEC 104 communications module
- PROFINET communications module

Control option 3:
CHP unit's own controller via an optional software module

Software module:

- Main circuit supply line temperature control
- Main circuit supply line temperature increase When hot drinking water is required
- A boiler enable, specification of the boiler set-point output or setpoint temperature
- Regulated buffer tank loading
- Boiler bypass control
- Control of a buffer discharge pump via GENIbus or control of a boiler circuit/local heat mixer using end position contacts
- Current-controlled operation (optional active power meter required)

The temperature sensors are not included in the price.

You can find more detailed information in point 3.5 "Control technology" on page 24.

Outdoor temperature sensor

- Install PT1000 outdoor sensor on the north face of the building at a height of about 2 m above the ground. Sensor must not be exposed to direct sunlight.
- Lay JY(ST)Y 2 x 2 x 0.8 cable from the outdoor temperature sensor to the CHP unit controller.

Main circuit supply sensor

- Install 1/2" welded coupler in the collective supply line to all heat generators. 1/2" immersion sleeve and associated PT1000 immersion temperature sensor also need to be ordered.
- Lay JY(ST)Y 2 x 2 x 0.8 cable from the main circuit supply sensor to the CHP unit controller.

Hot water request

- Connect a relay coil parallel to the hot water charging pump. Normally open contacts signal the increased heat demand during hot water loading.
- Lay JY(ST)Y 2 x 2 x 0.8 cable from the relay to the CHP unit controller.

Boiler enable

- Lay H07RN-F 5 x 1.5 cable from the boiler controller to the CHP unit controller.
- Lay JY(ST)Y 4 x 2 x 0.8 cable from the boiler controller to the CHP unit controller.

Boiler bypass (optional)

- Lay H07RN-F 5 x 1.5 cable from the actuator to the CHP unit controller.

4.7.1 Multiple module system

In multi-module systems, some parameters must be set to **Bus** in the "Mephisto Heat Generation Control menu (Mephisto Regelung Wärmeerzeugung)". You will find information about this on page 48.

4.8 INCORPORATING SAFETY TECHNOLOGY

Heating emergency switch

- Emergency stop input (230 V, power consumption 6 Watt) to connect a heating emergency switch. A drop in the voltage at this input immediately causes the main and delta contactors to open and the gas solenoid valves to close. Power for the emergency stop loop must be supplied from the CHP unit's electrical enclosure.
  - Use either two heating emergency switches or a common one with separate current paths for the boiler and CHP unit.
  - Lay H07RN-F 5 x 1.5 cable from the heating emergency switch to the CHP unit controller.

Gas sensor (optional)

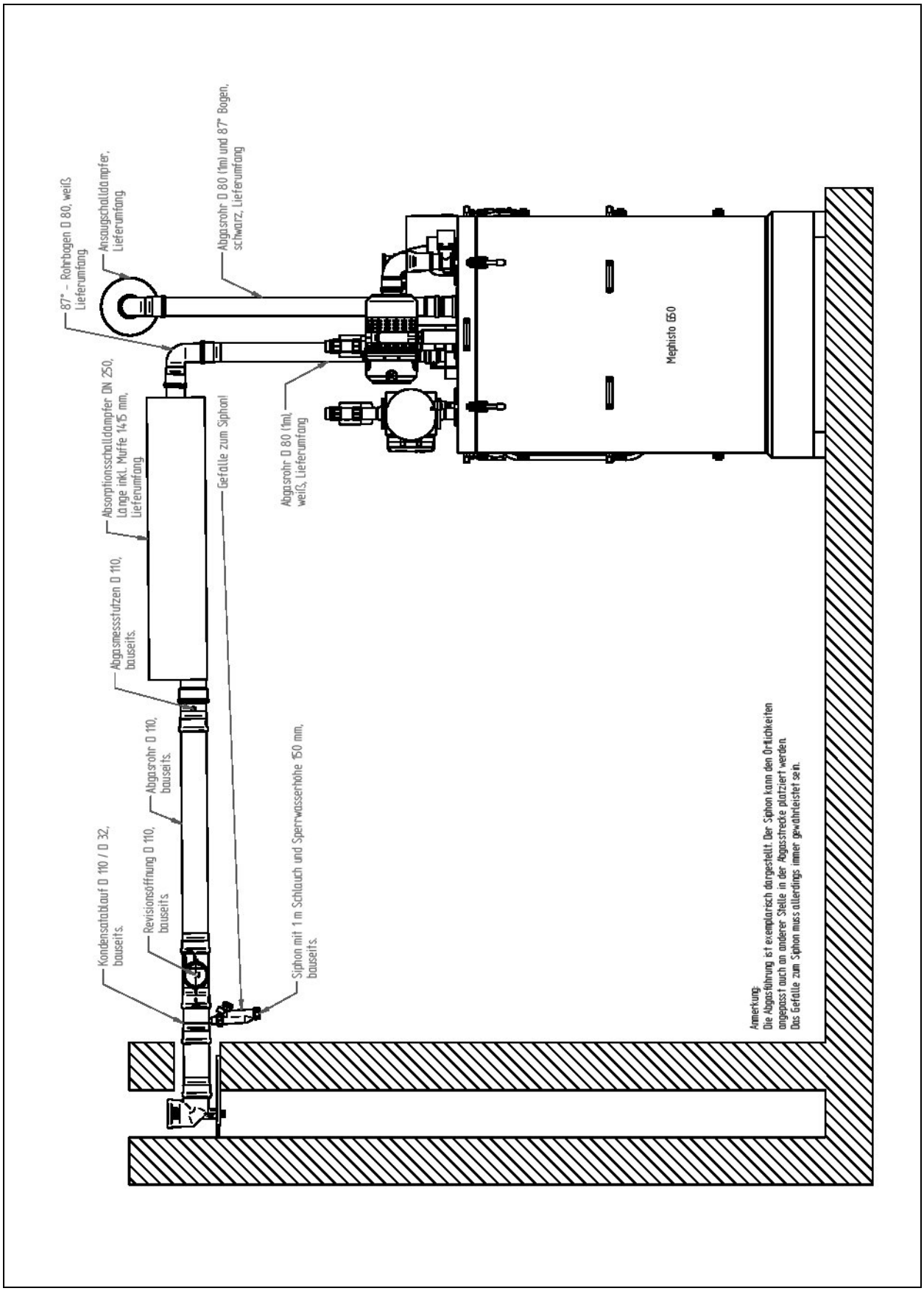
- The gas sensor should not be powered from the CHP unit electrical enclosure.
  - Lay H07RN-F 5 x 1.5 cable from the gas sensor to the CHP unit electrical enclosure.
  - H07RN-F 3 x 1.5 to supply power (230 V) to the gas sensor.

Additional external safety systems

- Additional safety devices provided by the customer, such as pressure monitors or safety temperature limiters, are looped in with XS2.3/23 or XS 2.4/24.

4.9 FLUE GAS ROUTING

Example of flue gas routing diagram; drawing not to scale



4.10 COMMISSIONING

The key tasks are listed with bullet points below. Only staff authorised by **kraftwerk** may commission CHP plants.

Heating water

- Fill and vent secondary circuit with heating water as per the German Technical Rule VDI 2035
- Check it is watertight
- Check that Genibus communication functions correctly
- Check the flow rate and the spread

Engine water

- Check the engine circuit pressure compensation tank system pressure (0.5 bar).
- Fill engine water circuit with tap water, hardness < 14 °dH. Do not use heating water. Filling pressure with cold water 1.4 bar. Vent.
- Check the engine water circuit is watertight

Flue gas conduit

- Check that the flue gas conduit is gas-tight, especially in the housing
- Fill condensate separator with water
- Check that horizontal flue gas conduit slope is correct

Gas supply line

- Check the on-site gas line and the connection hose to the CHP unit for leaks
- Repeat attempted start-up to vent the gas line
- Check gas pressure
- Check gas flow pressure

Other

- Check the mains connection rotating field (clockwise rotating field)
- Fill the oil reservoir tank up to the maximum mark (around 5 litres are already filled in the factory; about another 33 litres of Petro-Canada Sentron LD5000 need to be filled)
- Check the oil level in the engine oil sump and the oil level sensor switching points
- Perform functional test on the integrated grid and plant protection
- Monitor and check the lambda, power and temperature control while in operation
- Check on the cross-section of the supply and exhaust air openings. Minimum supply air cross-section, CHP unit only: 340 cm^2
- Perform flue gas measurement

Frequency converter

- As a general rule, no work is needed on the frequency converter during commissioning.

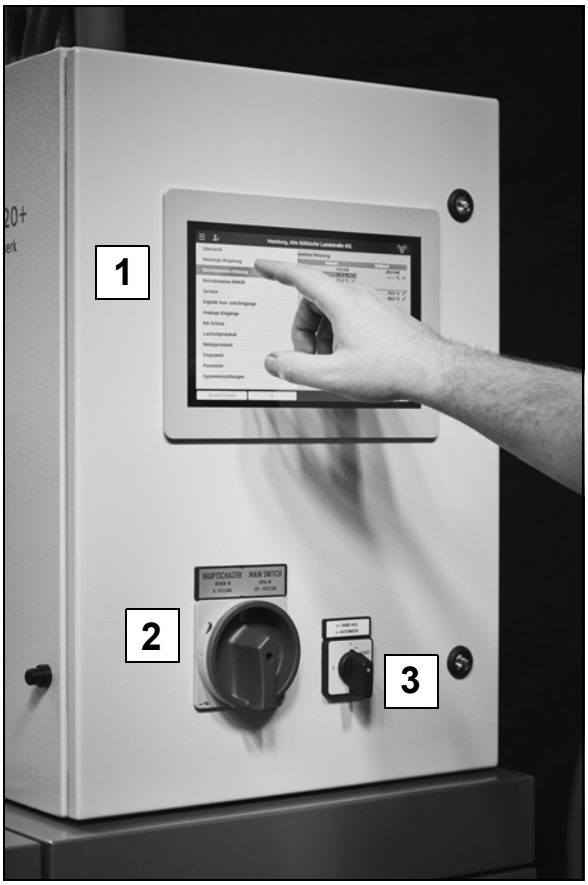
Danger to life
Due to electrical voltage
when working on the frequency converter

A high voltage continues to run through the frequency converter's lines and contacts even after the CHP unit is switched off. If you come into contact with this voltage, it can be fatal.

- Wait 5 minutes for the system to discharge after switching off the CHP unit and before working on the frequency converter.
- Only have a qualified electrician carry out maintenance work on the Mephisto CHP unit's electrical part.
- Only open the CHP unit's electrical enclosure and frequency converter for maintenance purposes.

5. OPERATING

5.1 OPERATING CONTROLS



1 Touch display

The touch display shows the CHP unit's readings and statuses and the controller's parameters. You can control the CHP unit completely remotely using the touch display or the remote monitoring module. The menu navigation is exactly the same in both cases.

2 Main switch with emergency stop function

This switch disconnects the CHP unit from the mains. The system is still live up to the main switch when disconnected.

Information

Potential damage to the CHP unit.

- Only set the main switch to emergency stop in actual emergencies. Proceed as described under "Switching off the CHP unit" on page 38 to switch off the CHP unit in normal situations. If you set the main or manual switch to OFF when the CHP unit is in operation, it can cause damage to the CHP unit.

3 Manual switch

It is sufficient to place the manual switch in the 0 position to block the system for normal servicing purposes on the machine set. The CHP unit cannot go into operation, but the CHP unit controller is fully functional.

The CHP unit is on standby in Setting 1; the Mephisto will start in the pre-selected operating mode.

The images and diagrams in this section serve as an example. The electrical enclosure shown is the one on a Mephisto G20+; the menu values are from a Mephisto G50, based on the program version 2.1.2.

5.2 SWITCHING THE CHP UNIT ON MANUALLY

The CHP unit normally starts automatically. Proceed as follows to switch the CHP unit on manually:

1. Ensure that the emergency stop switch is set to ON and the manual switch is on “1”.
2. Press the Switch on button on the touch display.

5.3 SWITCHING OFF THE CHP UNIT

Proceed as follows to switch off the CHP unit:

1. Press the Switch off button.
2. Set the manual switch to “0” if you wish to stop the CHP unit from starting automatically.
3. The emergency stop switch can normally remain in the ON position. If you carry out service work on live parts, you must set the emergency stop switch to OFF and pull the back-up fuses.

Danger to life
Due to electrical voltage

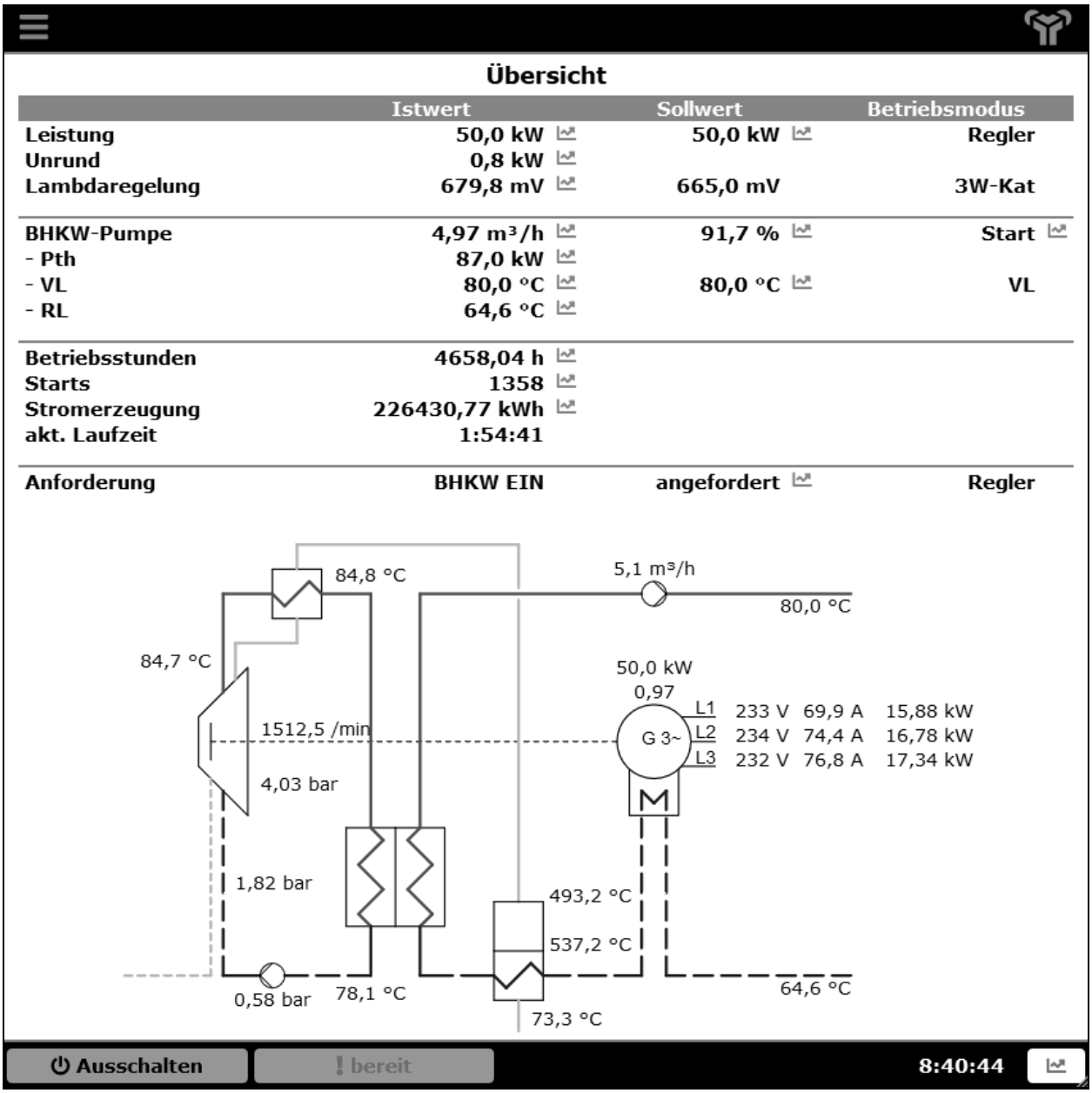
A high voltage runs through the CHP unit’s electrical cables and contacts. If you come into contact with this voltage, it can be fatal.

- Only have a qualified electrician carry out maintenance work on the Mephisto CHP unit’s electrical part.
- Before working on electrical equipment, always follow these instructions:
  - Switch off the system
  - Secure against being switched on again
  - Check that the system is de-energised.
  - It is essential to bear in mind that external power sources (e.g. boiler lockout) cannot be ruled out.

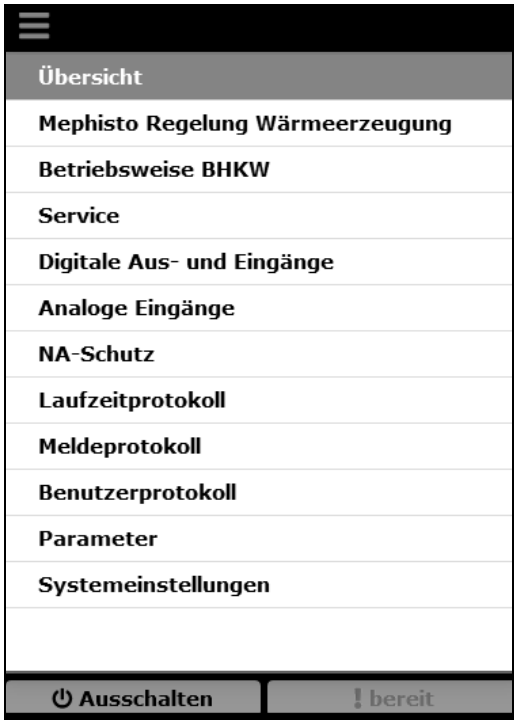
5.4 WEBCONTROL

The CHP unit is operated using the Webcontrol visualisation interface. You can set parameters and view and evaluate current and historical measurement data both on site and by remote control.

The CHP unit system schematic is displayed on the overview page in addition to the table showing the key operating parameters.



5.4.1 Touch display operating controls



You can access all menu options both on the CHP unit display on site and by remote control.

Click on the button to select the menu you require. Click on the pen icon directly next to the parameter to access an adjustable parameter.

	Marks a measured value for display in a diagram or download as CSV file
	Changes an adjustable parameter Parameter changes are documented in the user log, depending on the software version
Einschalten / bereit	The CHP unit is ready to be switched on and can be started by clicking on the button
Einschalten / Warnung	The CHP unit has a warning message active, but can still be started by clicking on the button
Einschalten / Warnung löschen	A warning was active but is no longer unresolved and can be reset by clicking on the button. Warnings are documented in the message log
Ausschalten / bereit	A click on the button switches the CHP unit off
nicht bereit / !	The CHP unit is not ready for operation and cannot be switched on
nicht bereit / Störung	There is a fault and it cannot be reset. The CHP unit is not ready for use
nicht bereit / Störung löschen	A fault interlock was active and must be reset by clicking the button before you can start the CHP unit

5.4.2 Data recording

Mephisto CHP units archive all operating data on their built-in memory card fully automatically.

5 second values are held for 2 weeks

5 minute values are held for 6 Months

1 hour values are held for 2 years

Diagram function

You can access the diagram function to evaluate the stored operating data.

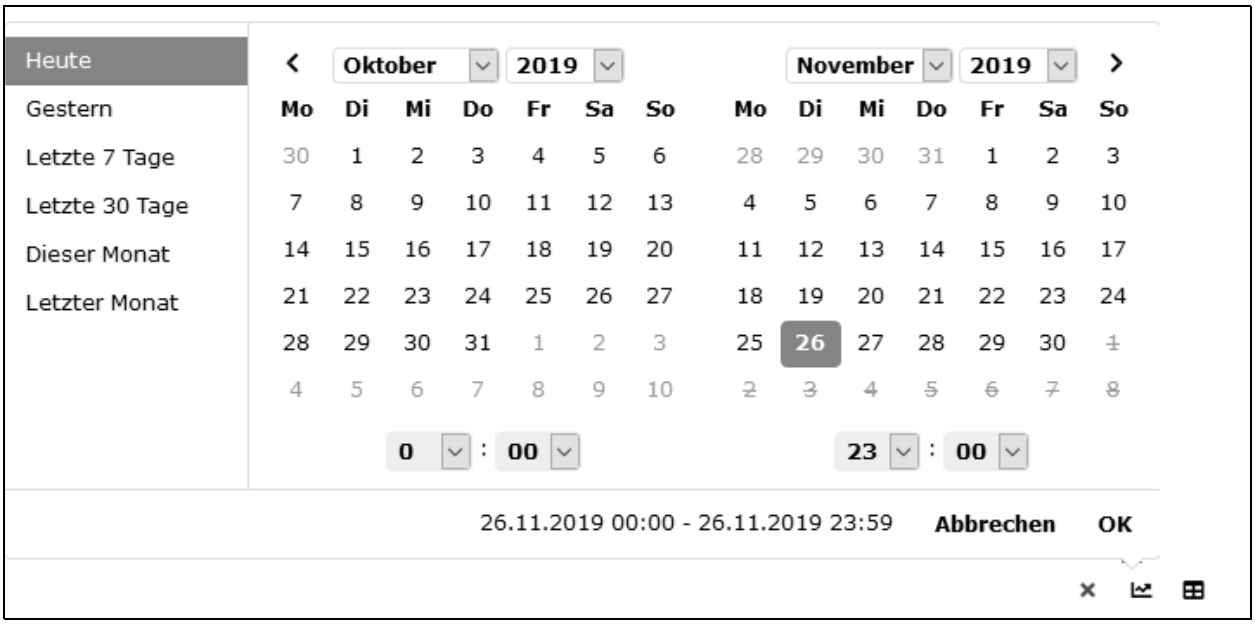
Click on the button to select one or more measured values.

You can select the measured values together from any menu.

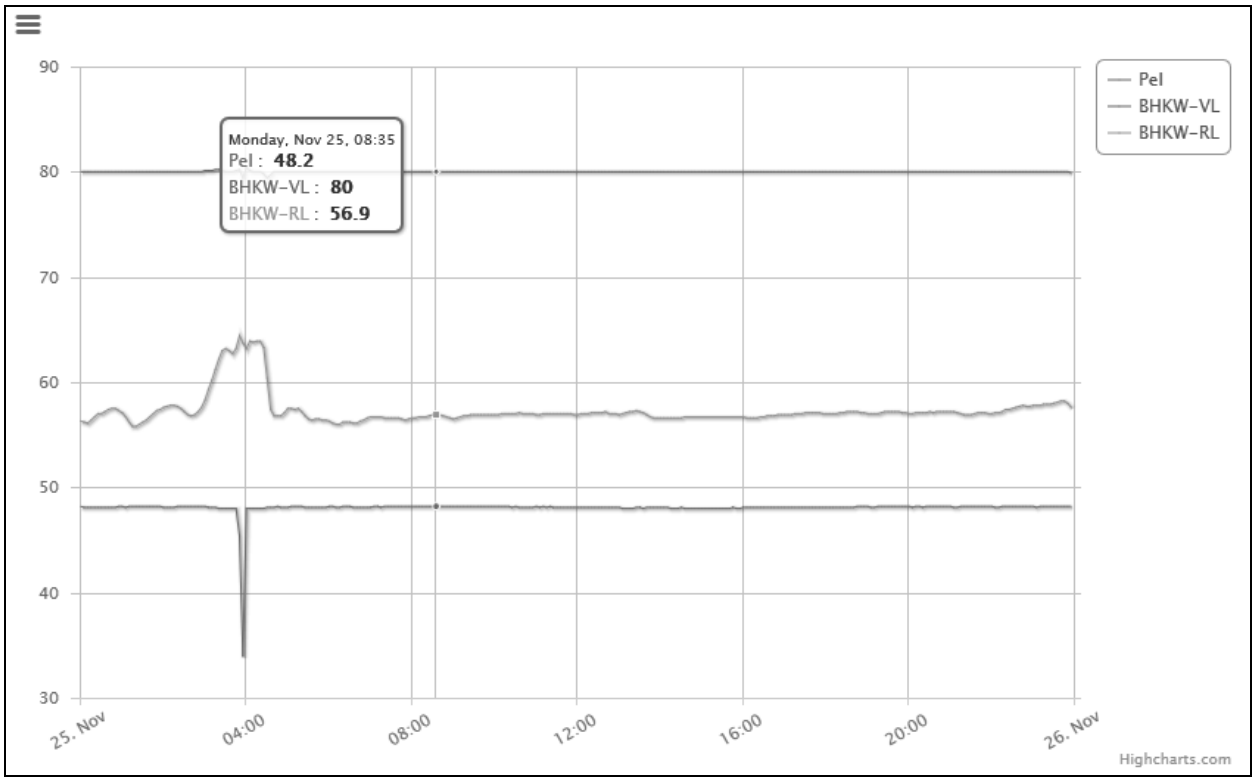
You can discard your selection, display it as a diagram or download it as a CSV file when accessing it via Webgate by clicking on the corresponding button × .

The selected recording period will then open up.

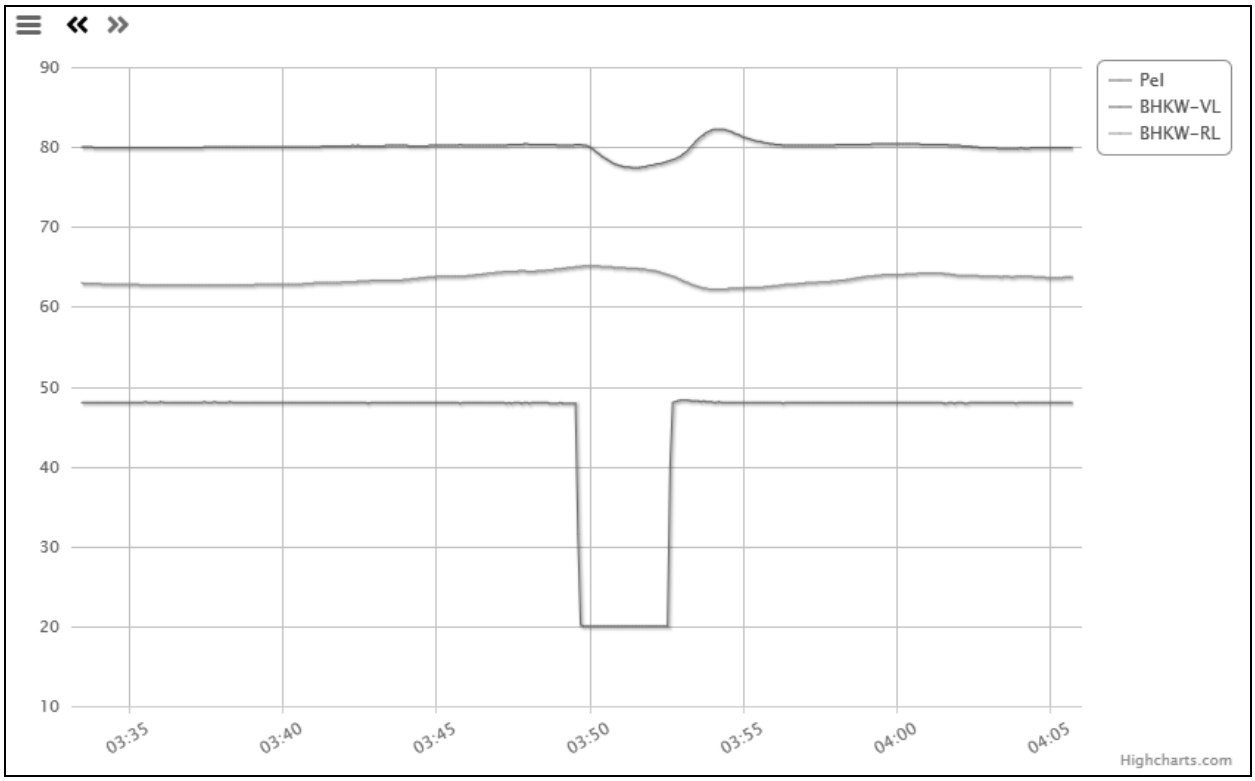
You can select a pre-set period on the left-hand side using the quick selection or set the period manually in the calendar.



Once you have confirmed your selection by clicking on the OK button, the corresponding diagram is displayed or a CSV file is offered for download.

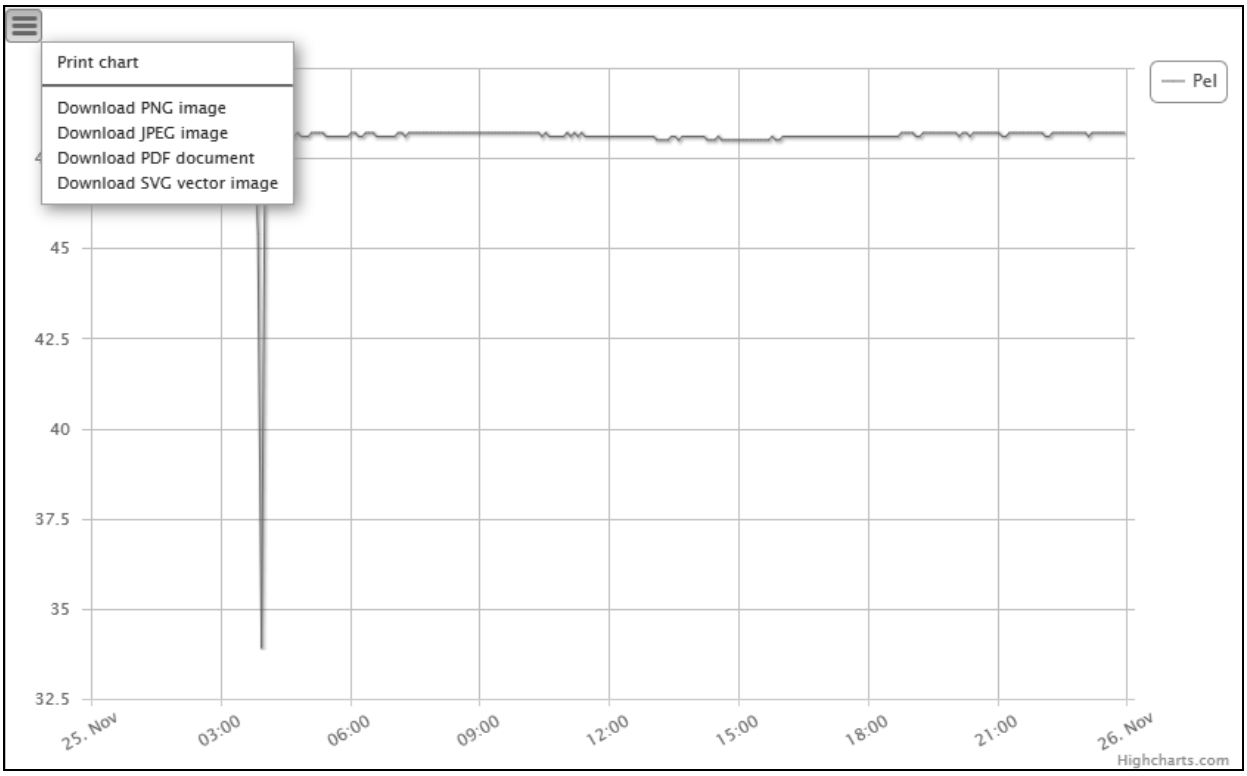


If you select a section of the diagram, it will be enlarged for display.



You can hide or unhide individual measured values using the key in the top right-hand corner. The diagram scaling then automatically adjusts to the selected measured values.

If you access the CHP unit via the Webgate, various options for saving/printing the diagram are available in the menu.



5.4.3 Webgate

The Webgate is a tool used to manage a number of CHP units. You can view all the key information on all the user's CHP modules here at a glance. The CHP units transmit their status, all counter readings and the message log regularly for this purpose. Changes in status are also transmitted.

This allows Mephisto operators, service personnel and all authorised project participants to see the CHP unit's operating status at any time. For example, the CHP unit transmits whether it is ready for operation, when the next maintenance is due, how many hours the CHP unit has operated, how much electrical energy it has generated and similar. This information can be consulted, downloaded and analysed quickly and easily. Moreover, email forwarding can be configured for certain events, such as faults in the CHP unit.

You can switch directly from Webgate to Webcontrol to operate the individual CHP units remotely, view them and analyse them.

5.5 THE MENUS – SCREENS + ADJUSTMENT OPTIONS

All the Mephisto CHP unit module's current values, parameters, statuses, counter readings and other information are displayed in different menus on the touch display. The menus represent the entire CHP unit control system. The following menu screenshots serve as an example and contain data from a Mephisto G50.

5.5.1 Standard equipment + options

The menus displayed depend on whether control options have been selected and, if so, which ones.

Mephisto Basic Control

This software module is integrated into the CHP unit controller as standard (see also point "Mephisto Basic Control menu (Mephisto Regelung Basis)" on page 47.).

The Mephisto Basic Control comprises the following functions:

- CHP unit poweer output and supply line temperature control
- Buffer tank loading determined by two temperature sensors
- Communication with a DDC via a digital input for the CHP request and order
- Analogue input for setpoint power output/temperature specification
- Analogue output for current power output reading
- Three potential-free changeover contacts for operating signal, ready signal and fault signal

Five analogue inputs included in the CHP unit for Pt1000 temperature sensors for control or evaluation purposes.

Mephisto Heat Generation Control

This optional software module serves as an extension to Mephisto Basic Control (see also point "Mephisto Heat Generation Control menu (Mephisto Regelung Wärmeerzeugung)" on page 48.).

Mephisto Heat Generation Control comprises the following functions:

- Main circuit supply line temperature control
- Main circuit supply line temperature increase When hot drinking water is required
- A boiler enable and nominal boiler output/temperature specification
- Regulated buffer tank loading
- Boiler bypass control
- Electricity-based operation

Additional control functions

One of the following functions can also be activated:

- Control of a buffer discharge pump via GENIbus

or

- Control of a boiler circuit mixer

or

- Control of a local heat mixer

The screen for the Mephisto Basic Control menu is extended to include the specific parameters for the function selected.

We will be happy to provide you with a set-up of controllable hydraulics.

5.5.2 Security levels

There are four access levels with different PINs. The first access level allows the CHP unit to be operated. Service personnel require the second level. The parameters on the third level may only be changed by the manufacturer or briefed, authorised specialists. The factory parameters are only accessible via the fourth access level.

You can view all the menu pages described, but you can only change the parameters after entering a PIN.

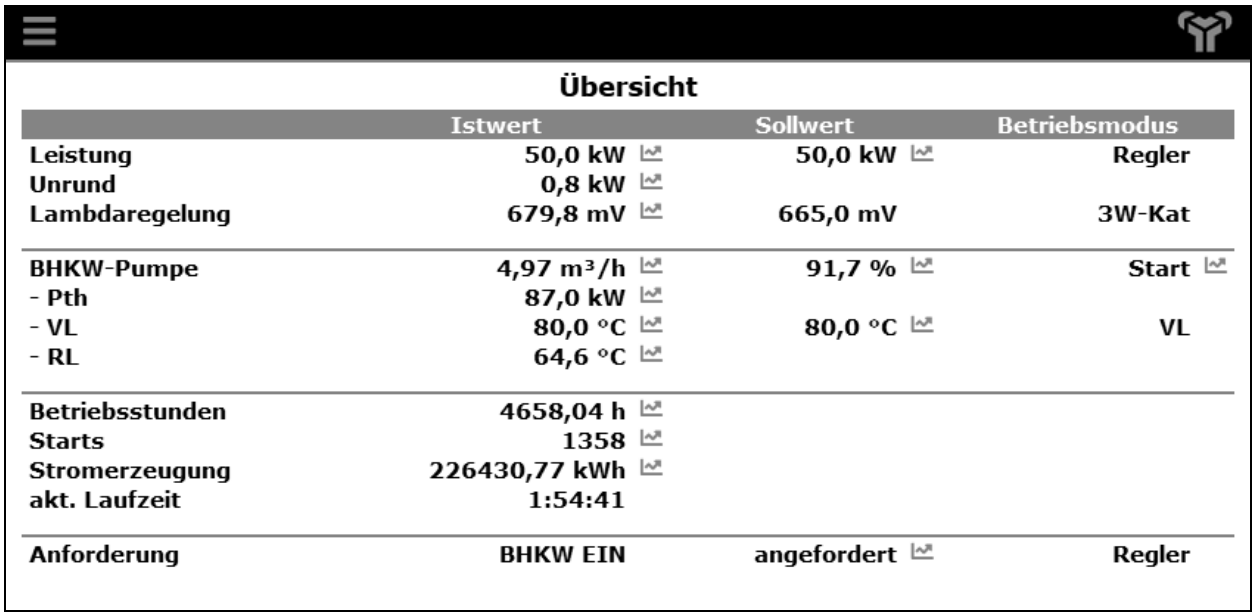
5.6 THE MENU OPTIONS

The menu structure can differ from the one depicted here in individual cases (program version 2.1.2).

Overview menu (Übersicht)

The Overview menu allows you to view and analyse the CHP unit's current operating data and current and historic measurement data. The CHP unit system schematic is displayed on the overview page in addition to the table showing the key operating parameters.

The **actual value (Istwert),** if applicable, the **setpoint (Sollwert)** and, if applicable, the **operating mode (Betriebsmodus)** of the parameters are displayed.



Übersicht

	Istwert	Sollwert	Betriebsmodus
Leistung	50,0 kW	50,0 kW	Regler
Unrund	0,8 kW		
Lambdaregelung	679,8 mV	665,0 mV	3W-Kat
BHKW-Pumpe	4,97 m³/h	91,7 %	Start
- Pth	87,0 kW		
- VL	80,0 °C	80,0 °C	VL
- RL	64,6 °C		
Betriebsstunden	4658,04 h		
Starts	1358		
Stromerzeugung	226430,77 kWh		
akt. Laufzeit	1:54:41		
Anforderung	BHKW EIN	angefordert	Regler

Power (Leistung)
The current power output.

Irregularity (Unrund)
A value to ensure uniformity for the power output; rises sharply if the system runs irregularly.

Lambda control (Lambdaregelung)
The voltage delivered by the lambda control.

CHP unit pump (BHKW-Pumpe)
The CHP unit's current control stage

CHP unit-SL (BHKW-VL)
The CHP unit's heating-side supply line temperature.

CHP unit-RL (BHKW-RL)
The CHP unit's heating-side return temperature.

Operating hours (Betriebsstunden)
The CHP unit module's total operating hours.

Starts
Number of start process by the CHP unit since commissioning.

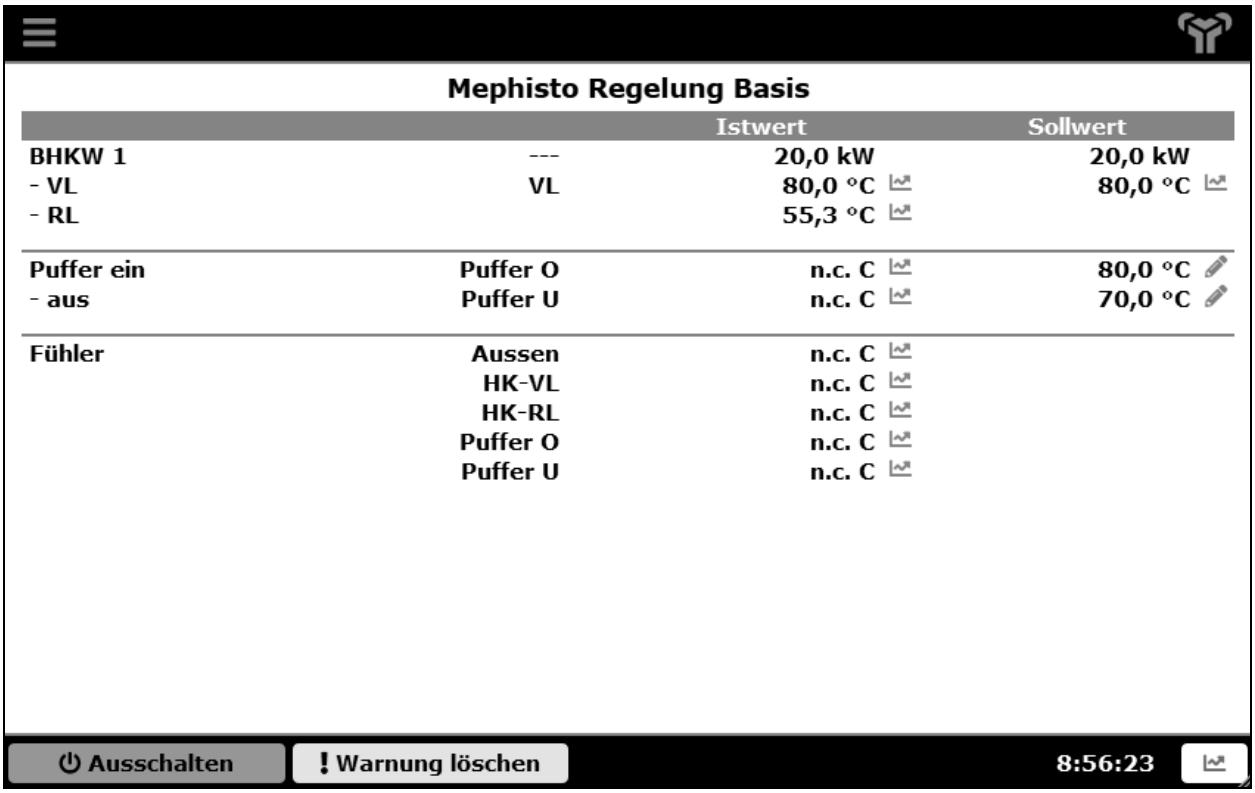
Power generation (Stromerzeugung)
The total electrical energy the CHP unit module has generated.

Curr. runtime (akt. Laufzeit)
The CHP unit's runtime since its last start.

Request (Anforderung)
Status of the CHP unit's operating request depending on the selected operating mode.

Mephisto Basic Control menu (Mephisto Regelung Basis)

The Mephisto Basic Control is a simple buffer storage mode.



CHP unit 1, -SL/-RL (BHKW 1 -VL/-RL)

This is where you can view the CHP unit's current operating status and control mode. The settings are made in point "CHP unit operating mode menu (Betriebsweise BHKW)" on page 52.

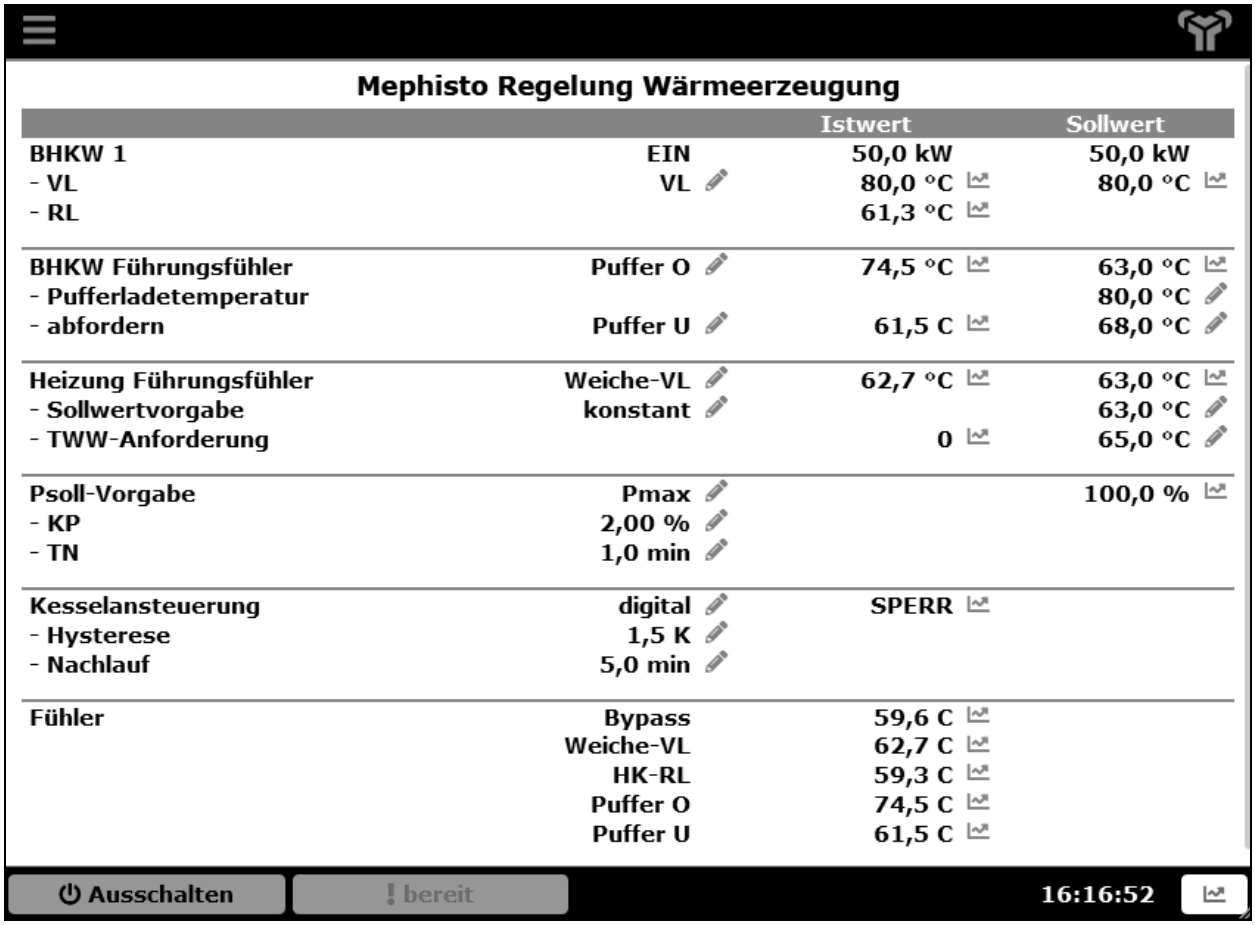
Buffer on,-off (Puffer ein,-aus)

If the temperature in the upper buffer sensor **Buffer U** (**Puffer O**) falls below the setpoint, the start request is generated. If the temperature in the lower buffer sensor **Buffer L** (**Puffer U)** exceeds the setpoint, the start request is cancelled again.

Sensor (Fühler)

The current values for the connected sensors can be see under **Sensors.n.c. (Fühler)** is displayed here for non-connected sensors.

Mephisto Heat Generation Control menu (Mephisto Regelung Wärmeerzeugung)



The upper section of the Mephisto Heat Generation Control menu offers an overview of the current status of all connected CHP units and is then divided into areas:

- CHP unit and heating guide sensors,
- Setpoint output,
- boiler release and
- sensor.

If instructed, the following parameters are also displayed; these are not explained in detail here. However, we will be happy to provide you with supplementary documentation.

- Control of a buffer discharge pump via GENIbus
- Local heating circuit
- Boiler circuit mixer.

CHP unit 1 (BHKW 1)

Status information from up to three CHP unit modules can be shown. A single module system is described here.

To ensure Mephisto responds to the heating control requirements, the following operating modes must be set in CHP unit operating mode menu (Betriebsweise BHKW) on page 52 for CHP unit 1:

- **Control start request (Startanforderung Regler)** for the start request.
- **Stop request =Start (Stopanforderung =Start)**
- **Control setpoint power (Sollleistung Regler)** for the setpoint power specification.
- **Htg pump control (Hzg-Pumpe Regler)** for the supply line temperature control.

If there is more than one module in the system, these operating modes must be parametrised on a **bus** for CHP units 2 and 3.

Guide sensor - Mephisto Heat Generation Control

		Istwert	Sollwert
BHKW Führungsfühler	Puffer O	74,5 °C	63,0 °C
- Pufferladetemperatur			80,0 °C
- abfordern	Puffer U	61,5 C	68,0 °C
Heizung Führungsfühler	Weiche-VL	62,7 °C	63,0 °C
- Sollwertvorgabe	konstant		63,0 °C
- TWW-Anforderung		0	65,0 °C

CHP unit guide sensor (BHKW Führungsfühler)

The control uses this value to determine whether the CHP unit is requested or not. If the CHP unit is connected to a buffer tank, normally the upper buffer sensor **Buffer U (Puffer O)** is used for the CHP unit request.

– Buffer loading temperature (Pufferladetemperatur)

This is where the setpoint temperature at which the CHP unit should load the buffer tank is pre-configured.

- Request (abfordern)

Even if the upper setpoint **Buffer U** (**Puffer O**) has already been reached, the CHP unit remains active until the value measured by the lower buffer sensor **Buffer L** (**Puffer U**) exceeds the preconfigured setpoint. The parameter **Buffer L** (**Puffer U**) must be selected for this purpose.

Heating guide sensor (Heizung Führungsfühler)

The control uses this sensor to determine the required heating output and requires it from the boiler accordingly. This should normally be the sensor in the main circuit flow **MC-SL (HK-VL)** if the boiler release is used. If all heat generators are connected directly to the buffer tank, the upper buffer sensor **Buffer U** (**Puffer O)** can also be used for the boiler release.

- Setpoint setting (Sollwertvorgabe)

There are different modes for the setpoint temperature setting. The resultant setpoint is on the right in the row. The modes are:

Outdoor temp. (Aussentemp.): The supply line setpoint temperature is determined based on the weather. The outside temperature sensor needs to be connected for this purpose.

Constant (konstant) The **nominal SL (Nenn-VL)** is used as a constant setpoint.

Bus: Another controller specifies setpoint via data bus.

AnaIn: Another controller specifies setpoint using a 0...20 mA or 0...10 V signal to XS4.3/4.

- Nominal outside temperature/ - Nominal SL temp/-m-SL (Nenn-Außentemperatur/Nenn-VL-Temp/ -m-VL)

Weather guidance parameters

Hot drinking water request (TWW-Anforderung)

The setpoint is raised to the value set here as a minimum in all cases to meet a possible increased heat demand during domestic hot water loading.

Nominal output - Mephisto Heat Generation Control

		Istwert	Sollwert
Psoll-Vorgabe	Pmax		100,0 %
- KP	2,00 %		
- TN	1,0 min		

Psetpoint specification (Psoll-Vorgabe)
Type of setpoint power specification for the CHP unit. You can select between the following modes of operation here:

Thermal (thermisch): The nominal output is specified based on the thermal output requirement. The CHP unit regulates the output based on the thermal demand for the supplied building.

Pmax: The CHP unit is always requested with full load.

elec/therm (elt/therm): If the main circuit supply line setpoint temperature is not reached, the CHP unit adjusts to net output. If the temperature is exceeded, the CHP unit adjusts the electric power output and thus also thermal output to the electrical requirement of the building being supplied. The prerequisite is a building demand meter or output meter (accessory).

Therm/elmax: Nominal output as **thermal (thermisch)** with "feed-in prevention". The CHP unit regulates the power output based on the thermal demand, but at most based on the electrical demand from the supplied building. The prerequisite is a building demand meter or output meter (accessory).

Electrical (elektrisch): The CHP unit adjusts the electric power output and thus also thermal output to the electrical requirement of the building being supplied. The prerequisite is a building demand meter or output meter (accessory).

Irrespective of the **Psetpoint specification (Psoll-Vorgabe),** the CHP unit and boiler are always enabled based on the heat output currently required from the heating system. This is shown here as a percentage of the total electrical power output from all installed CHP modules.

-KP/-Tn
The CHP unit controller uses the control parameters **KP** and **Tn** via an integrated PI controller to calculate the heat output currently required from the heating system.

Boiler enable - Mephisto Heat Generation Control

		Istwert	Sollwert
Kesselansteuerung	digital	SPERR	
- Hysterese	1,5 K		
- Nachlauf	5,0 min		

Boiler activation (Kesselansteuerung)
This is where the specifications for boiler activation are set.

Deactivated (deaktiviert) – the boiler is not activated.

Digital – if the available CHP power output is not sufficient and the **Boiler activation** (**Kesselansteuerung**) is set to digital, the boiler is **Enabled (NACHL)** ; otherwise it is blocked **BLOCK (SPERR)** after the shut-off delay **DELAY** has elapsed.

Output (Leistung) – if Mephisto also specifies the nominal boiler output, the required boiler output is indicated here as a percentage instead of **ENAB (FREI)**.

Temperature – the boiler is given the heating system's setpoint temperature.

- Hysteresis (Hysterese)
Hysteresis for boiler enable

- Shut-off delay (Nachlauf)
Shut-off delay for the boiler. If an option is provided for hydraulic boiler shut-off by the CHP control, water continues to flow through the boiler during the set time **DELAY (NACHL)** on display.

-Summer delay (Sommer-Verzögerung)
This parameter is displayed if the temperature is determined based on the weather. Set values for boiler enable in summer. If the supply line setpoint temperature is not reached due to a hot water request, the boiler enable can be delayed for longer. The increased enable delay only applies to outside temperatures which are higher than the set temperature. Standard set values are 15 °C and 10 min.

Digital boiler activation (Digitale Kesselansteuerung)

The boiler is enabled as soon as the active guide sensor falls below its setpoint by the pre-set hysteresis and the calculated heat output has reached the required threshold of 200% **ENAB** (**FREI**) on the display . The heating output controller freezes at 200% so that the boiler controller can take over regulation of the main circuit supply line temperature.
If the **setpoint temperature** (**Solltemperatur**) exceeds more than the hysteresis, the CHP unit blocks the boiler **BLOCK** (**SPERR**). The heating output controller now continues to function as normal.

Boiler activation with output setting (Kesselansteuerung mit Leistungsvorgabe)

The analogue setpoint setting for the boiler can also be activated. In this case, the heating output controller is not switched off when the boiler is enabled; it modulates the boiler between 150% and 300% heating output with 0% to 100% boiler output. Both values are adjustable. The analogue setpoint output signal for the boiler can be inverted when emitted to ensure security of supply when the CHP control is switched off. This means that the boiler controller must be set in such a way that the boiler modulates to net output with a signal of 0 V (or 0 mA).

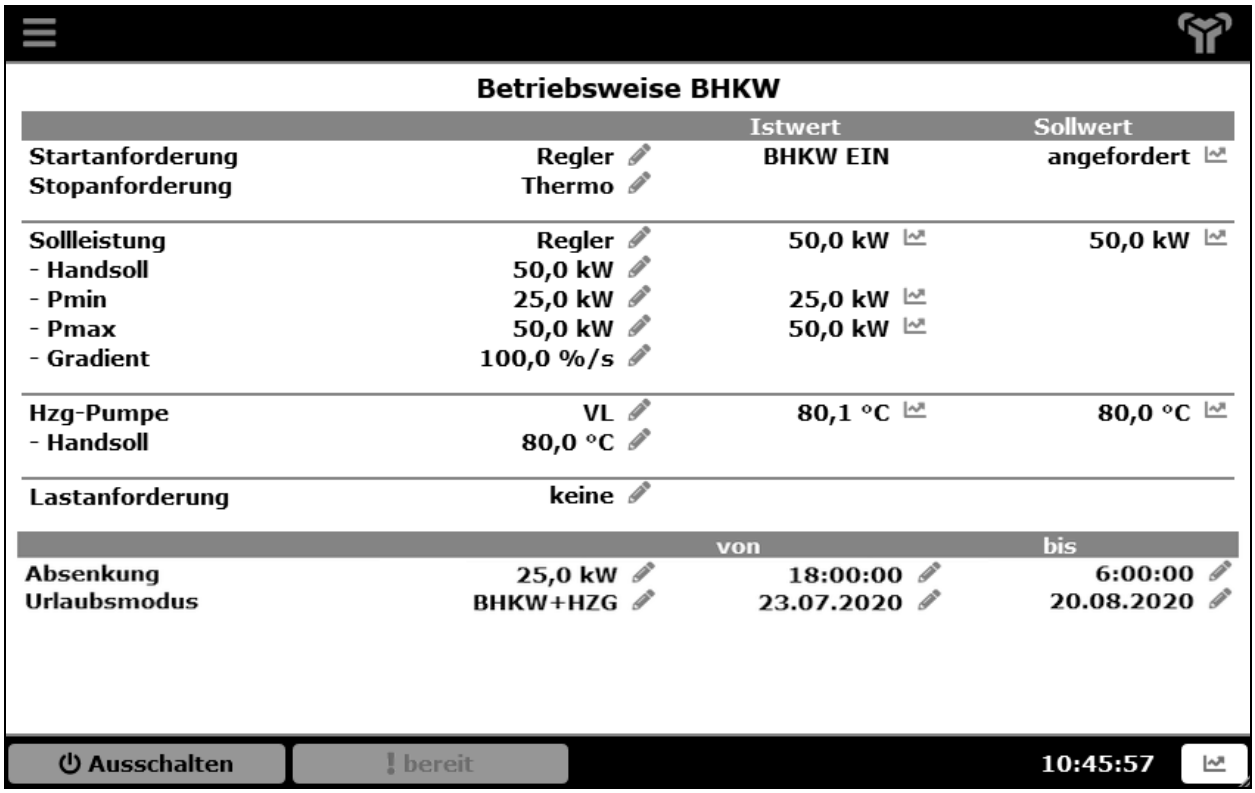
Sensor - Mephisto Heat Generation Control

This is where the values for the connected sensors are displayed.

		Istwert	Sollwert
Fühler	Bypass	59,6 C	
	Weiche-VL	62,7 C	
	HK-RL	59,3 C	
	Puffer O	74,5 C	
	Puffer U	61,5 C	

CHP unit operating mode menu (Betriebsweise BHKW)

This menu's settings specifies how the CHP unit controller should operate the CHP unit.



Start request (Startanforderung)
Stipulates how the CHP unit is requested.

Manual (Hand): the CHP unit only starts when switched on at the machine or via remote control.

Auto: the CHP unit always starts if it has no fault and all temperatures are below the warning values (thermostatic operation).

BUS: the CHP unit accepts start requests from a higher-level controller via the connected data bus. If the bus connection fails, the CHP unit is not requested.

BUS/Auto: works in the same way as the bus, but if the bus connection fails, the CHP unit changes to Auto operating mode.

Regulator (Regler): the CHP unit receives the start request via the Mephisto Heat Generation Control.

Buffer (Puffer): start request by buffer tank sensors.

DigIn: the CHP unit accepts start requests from a higher-level controller via the digital request contact.

OFF (AUS): the CHP unit is locked. The S1 counter is running. (You can find information on the S1 and S2 counters in the Service menu **Ready/Fault (Bereit/Störung)** menu option on page 54).

FAULT (STOER): The CHP unit is in fault interlock mode. The S2 counter is running and a fault is generated.

Stop request (Stopanforderung)
Specifies the condition under which the CHP unit switches off.

=Start: the CHP unit switches off if there is no longer a start request active.

Thermo: the CHP unit continues to run even though there is no longer a start request until it switches off thermostatically. This can optimise the CHP unit's operation during frequent cycles.

Setpoint output (Sollleistung)
The CHP unit controls its electrical output according the following specifications:

Manual (Hand): the CHP unit controller adjusts to the output configured under **ManSetpoint (HandSoll)**.

Auto: the system is set to the maximum CHP unit output.

Bus: a higher-level controller specifies the setpoint via the connected data bus.

Regulator (Regler): the CHP unit receives the setpoint from the Mephisto Heat Generation Control.

Buffer (Puffer): the system is set to the maximum CHP unit output.

AnaIn: a higher-level controller specifies the setpoint via the Setpoint output/HC-FL setpoint input (the temperature specification **AnaIn** cannot be used in this case).

- Mansetpoint (Handsoll):

Setpoint for Manual output setting.

- Pmin, Pmax:

Regulation limits for output regulation. The CHP unit does not regulate the electrical output outside these limits. The output regulation continues to be limited by fixed set parameters, which can be viewed in the Network monitoring menu.

The active setpoint setting is displayed as the **setpoint (Sollwert)**, the actual electrical output under **actual value (Istwert)**. The CHP unit may adjust to a different value, which is shown under **Setpoint (Soll)** in the Overview menu. The output is limited to **Pmin** during the warm-up phase and when the temperature warning value is exceeded, for example. The modulation range is also limited by the control limits **Pmin** and **Pmax**.

Htg pump (Hzg-Pumpe)
The heating side CHP unit pump is regulated in its flow-through in the following ways:

dT: adjustment to constant spread between CHP unit supply and return. The setpoint is set under **ManSetpoint (HandSoll)**.

SL (VL): adjustment to constant CHP unit supply line temperature. The setpoint is set under **ManSetpoint (HandSoll)**.

Bus: a higher-level controller specifies the setpoint via the connected data bus.

Regulator (Regler): the CHP unit receives the setpoint from the Mephisto Heat Generation Control.

Buffer (Puffer): the temperature set under **Buffer (Puffer) on** is applied as a setpoint.

AnaIn: a higher-level controller specifies the setpoint via the **Setpoint output/HC-FL setpoint input (Sollleistung/HK-VL-soll)** (the setpoint output **AnaIn** cannot be used in this case).

- Mansetpoint (Handsoll):

Setpoint for Manual output setting.

The consequential setpoint and the current supply line temperature can be viewed in the **Actual value (Istwert)** and **Setpoint (Sollwert)** columns.

Load request (Lastanforderung)
The external load request may override the start request and the setpoint power specification.

None (keine): contact is ignored

Pmax: When load is requested, the CHP unit is requested with full net power output (**Pmax**).

Lowering (Absenkung): when load is requested, the CHP unit goes into lowering mode.

Setback from/to (Absenkung von/bis)
Lowering mode by load request contact or set time from ... until.

None (keine): no lowering mode

Switch off (Abschalten): the CHP unit is switched off during lowering mode.

Value in kW (Wert in kW): the CHP unit is limited to the pre-set power during lowering mode.

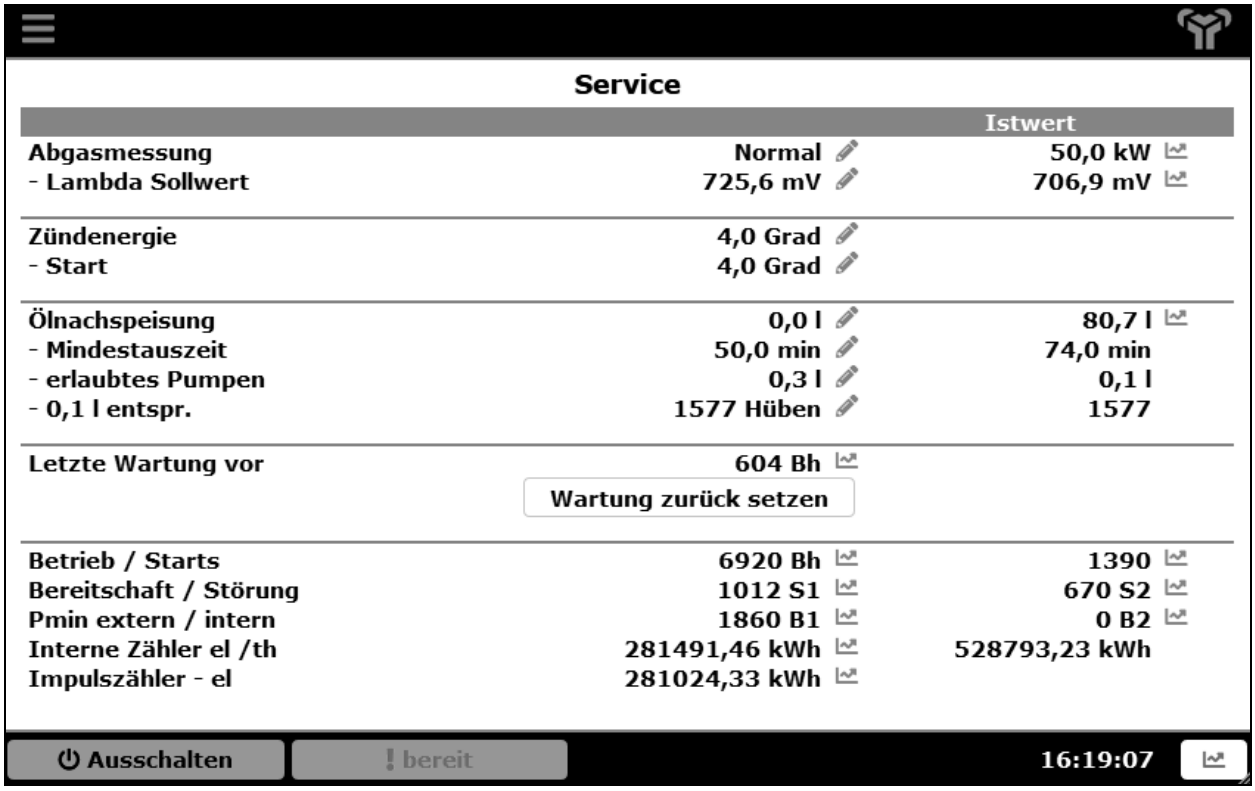
Holiday mode from/until (Urlaubsmodus von/bis)
The CHP unit is put out of operation during a time period.

None (keine): no holiday mode

CHP unit (BHKW): holiday mode for the CHP unit only.

CHP+HTG (BHKW+HZG): holiday mode for the CHP unit and the boiler.

Service menu



Flue gas measurement and Lambda setpoint (Abgasmessung + Lambda Sollwert)

These menu options are required to measure flue gas during maintenance work. This is where the lambda control is calibrated and set.

The operating modes **Normal**, **Pmax** and **Pmin** are set in the flue gas measurement line. The current electrical power output from the CHP unit is displayed next to it.

The lambda control setpoint and actual value are displayed in the line below; the setpoint is set during the flue gas measurement.

How you perform the exhaust gas measurement is explained from page 81.

Ignition energy and start (Zündenergie + Start)

You can set the ignition energy in this menu option. The value in the second column is set during the start and warm-up phase.

As a rule, you merely need to select a different setting here if misfiring occurs.

If you slightly increase the ignition energy, you can delay a pending spark plug change by about one to two weeks. A value that is too high will shorten the service life. After you have replaced the spark plugs, you must reset the ignition energy to the default value; if you don't, the service life of the spark plugs will be reduced.

Adjusting the ignition energy has an impact on the dwell angle. Further settings can be accessed in the Ignition parameters parameters menu (Zündungsparameter) on page 68.

Oil replenishment (Oelnachspeisung)
This menu item displays the amount of oil that is currently being replenished in its first column. The automatic oil replenishment sets this value at 0.2 l if the oil level is too low. In exceptional cases, you can also set this value manually to a value between 0 and 0.5 l.

The second line shows the CHP unit's prior oil consumption. The counter reading is increased accordingly after 0.1 l has been replenished in each case.

Minimum timeout (Mindestauszeit): the minimum timeout is necessary for the pressure equalisation between the oil sight glass and the crankcase. Once oil replenishment is complete, no new replenishment process is started during the minimum timeout. The remaining duration of the minimum timeout is displayed in the second column. The default value is 60 min.

Permitted pumping (erlaubtes Pumpen): after the minimum timeout has elapsed, oil is replenished if the float continues to rest on the MIN contact. However, it is only replenished up to the value configured here. The right-hand column shows how much oil has already been pumped in without the float lifting from the MIN contact. If this counter reaches the **Permitted pumping (erlaubtes Pumpen)** set value, the control triggers the **Warning: Oil level min (Warnung: Oelstand min)** and does not pump automatically any longer. However, the controller will reset the counter if it does not detect an oil minimum for one minute after the minimum timeout has elapsed.

0.1 l equiv. (0,1 l entspr.): this value determines the number of strokes that the oil replenishment pump needs to deliver 0.1 l of oil. The value 1577 applies to the pump used. The second column shows the number of strokes that are still to be pumped in the current cycle.

Last maintenance before (Letzte Wartung vor)
This menu option shows the hours of operation since the last maintenance. Re-set this counter after every maintenance. To do so, click on the **Re-set maintenance** button.

Operation / Starts (Betrieb / Starts)
This is where the CHP unit's hours of operation are displayed, including the hours of test operation in the factory. The second column lists the number of starts.

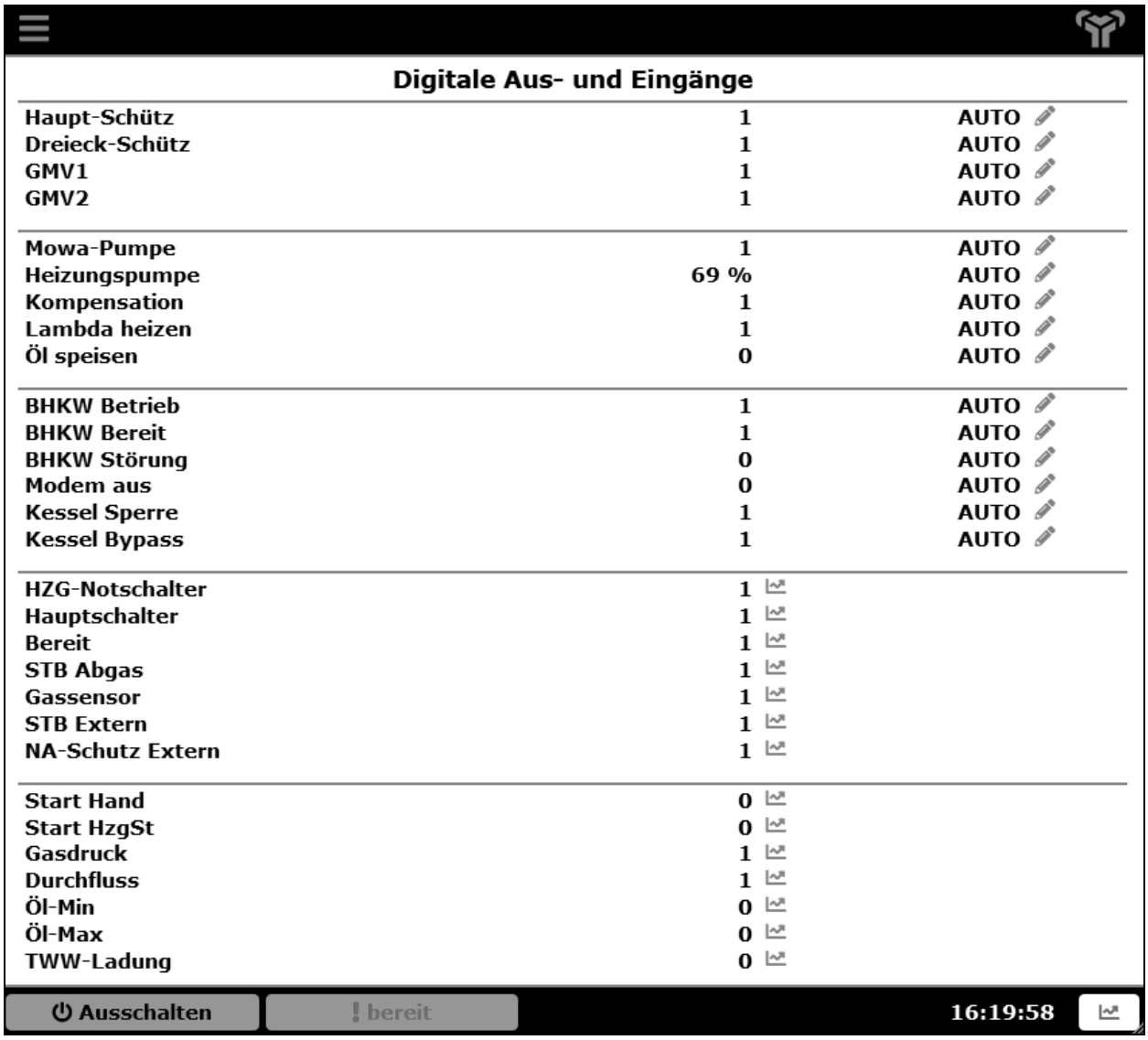
Standby / Fault (Bereitschaft / Störung)
This menu option displays the hours when the CHP unit was not running. The standby counter in the first column (S1) counts operational downtimes during which the CHP unit was available. You can find an overview in Section 5.7.3 Availability counter on page 74. The fault counter in the second column (S2) counts times during which the CHP unit was not available.

Pmin extern / intern
B1: operating hours during which the CHP unit ran with a reduced power output because the heating temperatures became too high.
B2: is counted when temperatures inside the CHP unit have exceeded the warning value.

Internal meter el/th (Interne Zähler el/th)
This is where the electrical (el) and thermal (th) energy generated so far is shown.

Pulse counter - el (Impulszähler - el)
The impulse counter records the reading of an optional counter.

Digital inputs and outputs menu (Digitale Aus- und Eingänge)



This is where the current switching status of the digital outputs (relays) is displayed. The signal status of the digital inputs (switches) is displayed next to it, on the right.

A **0** means the **switching contact is in the idle state** and a **1** means **switched.**

There are three switch options:

OFF (AUS) The output is permanently switched off.

AUTO The output is switched to automatic by the control program.

ON (EIN) The output is permanently switched on.

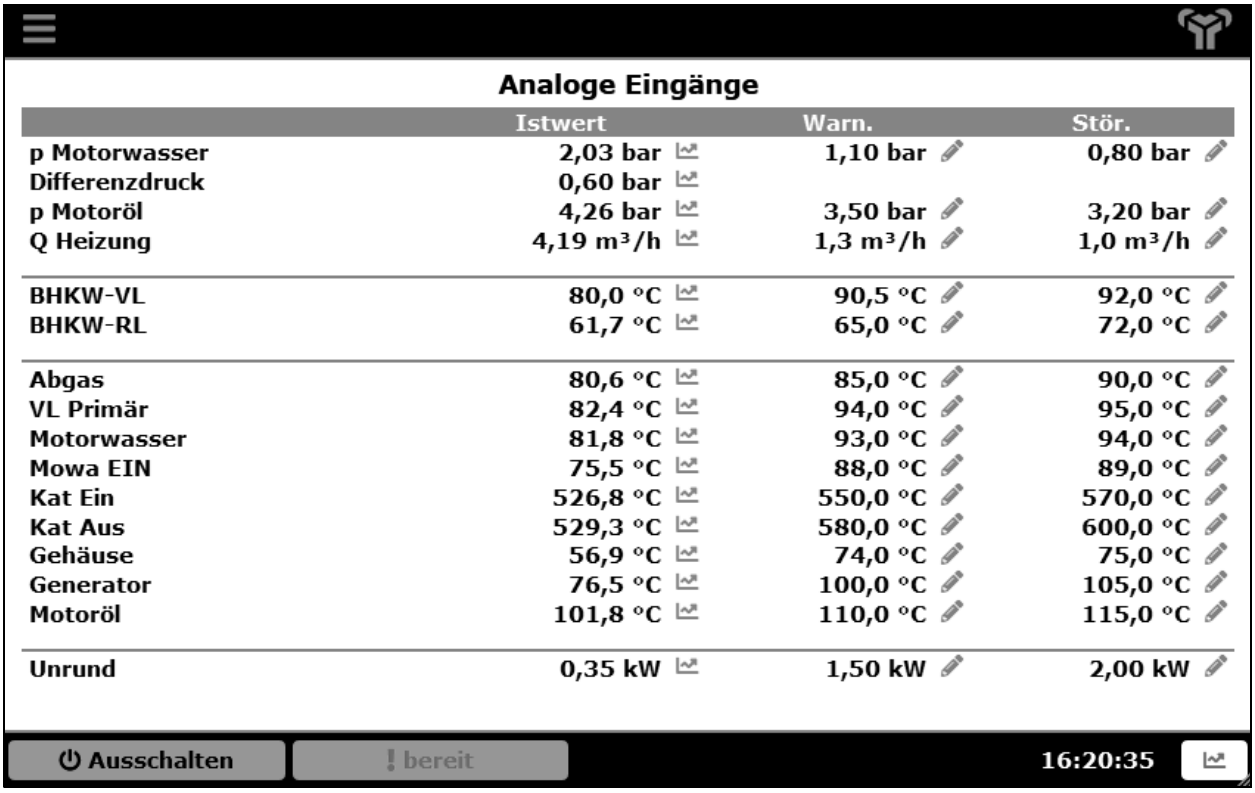
These manual software switches are always set to AUTO after a reset.

Please observe the following special characteristics:

- The contactors and GSVs are switched off in the event of a network error. The main contactor is set to **AUTO** during this process so that the generator is not switched on uncontrolled when the network returns.
- The pumps run at all times during CHP unit operation. The indicator is set to **1**. If the **P-EnWa-fault (P-mowa-stör)** fault is active, the pumps are switched off. The indicator is set to **0**.
- The compensation can only switch on again when its minimum timeout (60 s) has elapsed after the last switch-off.
- The oil replenishment pump is only switched on once when set to **ON (EIN)**. After that, it is switched to **AUTO** again.
- The modem is switched off for just 5 seconds when it is switched to **OFF (AUS)** manually. After that, it is switched to **AUTO** again.

Analogue inputs menu (Analoge Eingänge)

This menu page shows the current values for the oil and engine water pressures, all relevant CHP unit temperatures and irregularity.



n.c. for “not connected” will appear if a sensor breaks or the measurement range is exceeded. **s.c.** for “short circuit” will appear if a measurement input has a short circuit. The **Warn.** and **Fault (Stör.)** columns contain the warning and fault thresholds for the value concerned. They can also be changed here.

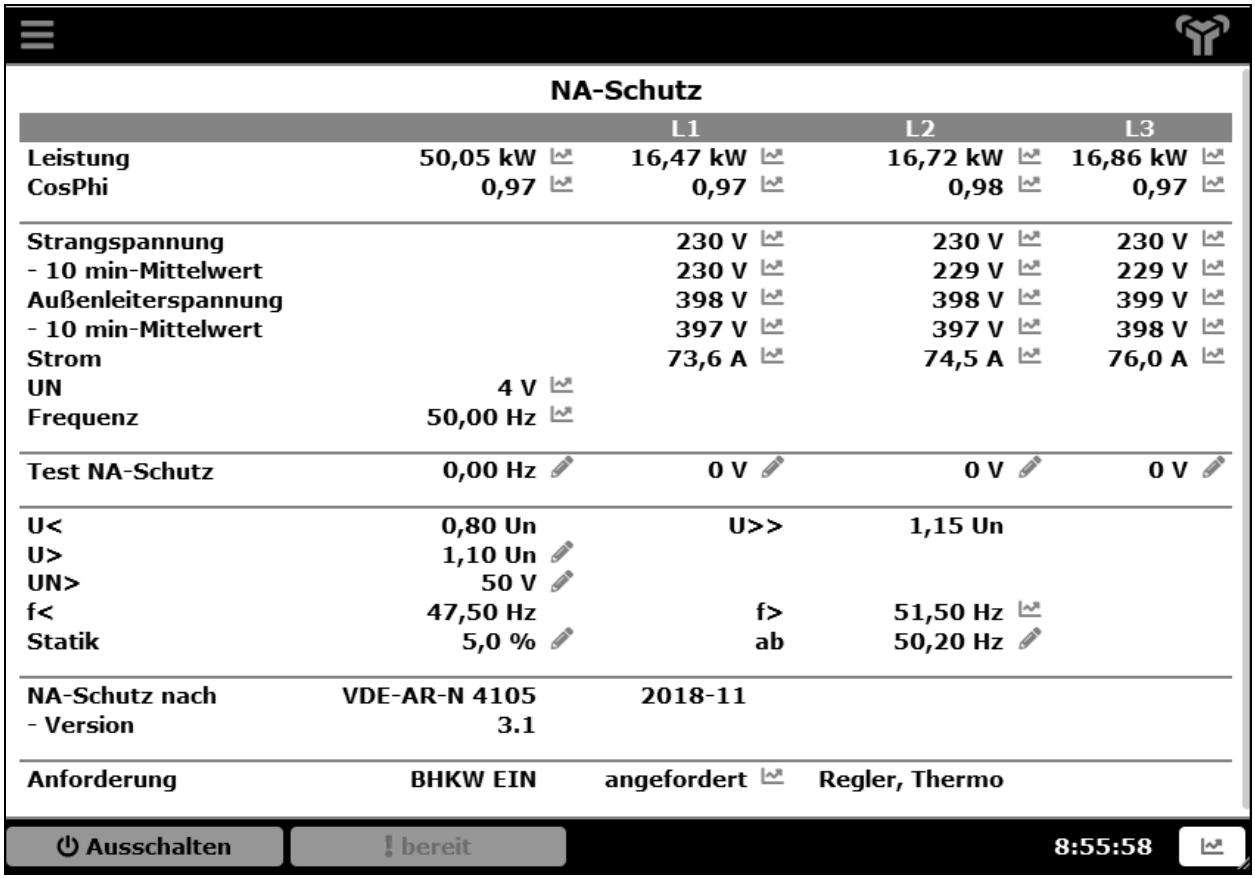
If the value falls below a pressure sensor’s warning threshold, an entry is made in the message log, but the CHP unit remains in operation. If the measured value falls below the fault threshold, the CHP unit is switched off and an entry is made in the message log. If the temperature falls below the fault threshold twice within 20 minutes of operation, a fault is triggered that must be reset manually.

If a temperature exceeds its warning threshold, then the system automatically regulates to the lowest power output; if the fault threshold is exceeded, the CHP unit switches off. As these processes are normal for the heating supply and return lines, no further action is taken. A relevant warning message is entered in the message log for all other temperatures.
If the fault threshold is exceeded twice within 20 minutes of operation, a fault is generated that must be reset manually.

If a warning threshold is exceeded or not reached, a **W** is displayed; if a fault threshold is exceeded or not reached, an **F** is displayed.

If an **irregularity (Unrund)** which is strongly smoothed here exceeds the warning threshold, a warning is entered in the message log. The CHP unit will switch off if the fault threshold is exceeded. If an **irregularity (Unrund)** exceeds the fault threshold twice within 20 minutes of operation, a fault is triggered that must be reset manually.

Grid and plant protection menu (NA-Schutz)



The network monitoring threshold values are permanently programmed up to U> as per VDE-AR-N 4105:

- Voltage return protection U<: 0.8 U_n
- Voltage increase protection U>>: 1.15 U_n
- Voltage increase protection U>: 1.1 U_n

  This value can be changed in agreement with your distribution network operator.
- Frequency return protection f<: 47.5 Hz
- Frequency increase protection f>: 51.5 Hz

  If 50.2 Hz is exceeded, the random value f> is displayed here (see also point “Active power feed-in with over-frequency” on page 13.).

Testing the grid and plant protection

Grid and plant protection test based on simulation of changes in measured values

Grid and plant protection-circuit breaker functional chain should be tested during commissioning to ensure it works correctly. You can do this in the Grid and plant protection menu.

The top half of the screen shows the current measured values for the network voltage and frequency.

You can select and change the offset for **U**, **UN** or **f**. This offset value is added to the actual measured values within the program. If the value manipulated in this way reaches a limit, the grid and plant protection triggers and opens the circuit breaker. The value measured at the time of triggering is entered at the corresponding point in the trigger log (in the **Minimum** or **Maximum** columns).

Testing the grid and plant protection in a terminal block

The grid and plant protection can also be tested with externally connected voltages if you have a suitable three-phase test generator. The XS11 test terminal strip with terminals which can be disconnected along its length is provided for this purpose. Testing with a single-phase, non-synchronised test generator is not possible since the monitoring system for the interlinked phase-to-phase voltages would trigger immediately in such a case.

Procedure:

1. Use a screwdriver to disconnect the longitudinal bridges for U_{L1}, U_{L2}, U_{L3} and U_N
2. Connect the test generator to the **upper** measuring sockets via 2 mm test plugs
3. Select the **Grid and plant protection menu (NA-Schutz)** and configure test generator so that the displayed measured values are within the permitted limits and a normal three-phase network is simulated
4. Change voltage or frequency as required for the test objective
5. The grid and plant protection will trigger as soon as a threshold value is exceeded
6. The 230 V power supply from the circuit breaker can be disconnected at the fifth test terminal to measure the trigger time
7. To finish, switch off the test generator, disconnect test plugs and close the longitudinal bridges again.

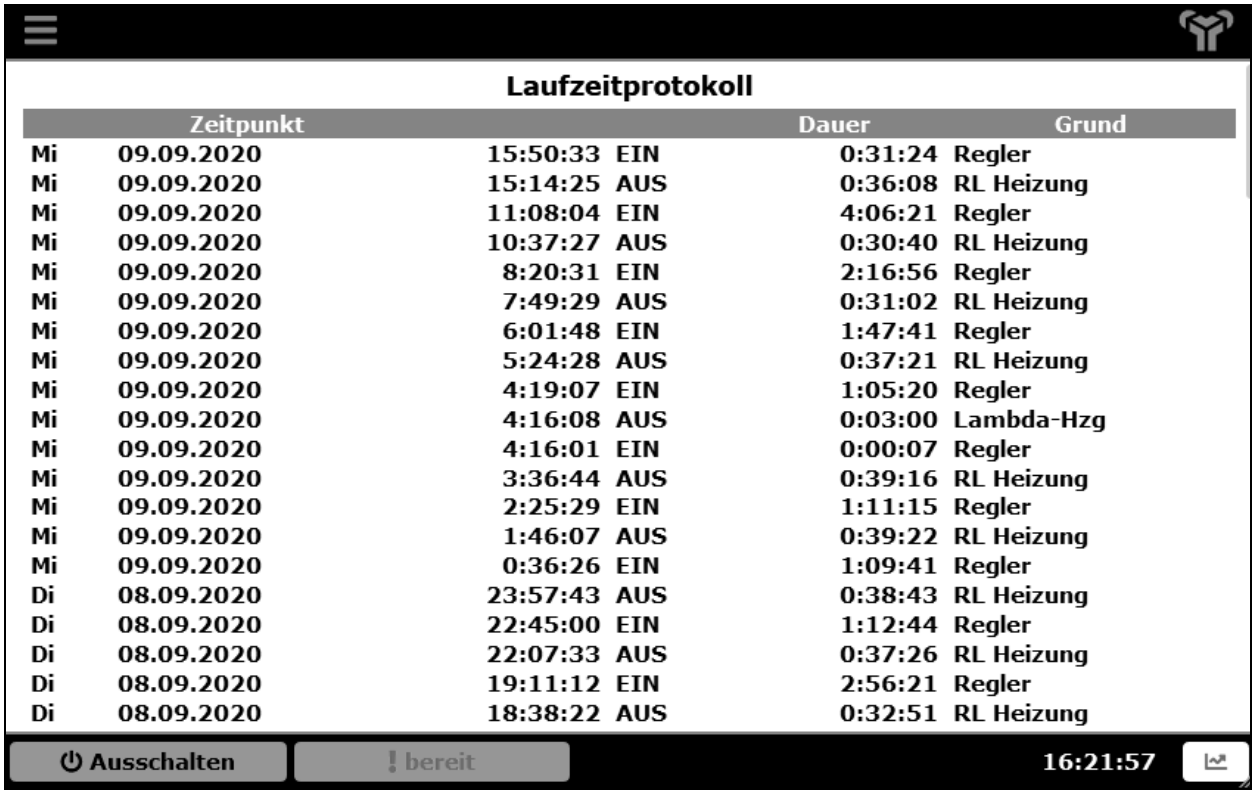
Testing the mains monitoring by pulling the CHP unit pre-fuse

Caution
Potential damage to the CHP unit

- We strongly advise against this testing method as it may cause damage. We do not accept any liability or warranty for any such damage.

Runtime log menu (Laufzeitprotokoll)

An entry is made in the top line of the runtime log every time the CHP unit starts and stops. The older entries are moved down one line at a time. The last 1,000 switching operations can be viewed overall.



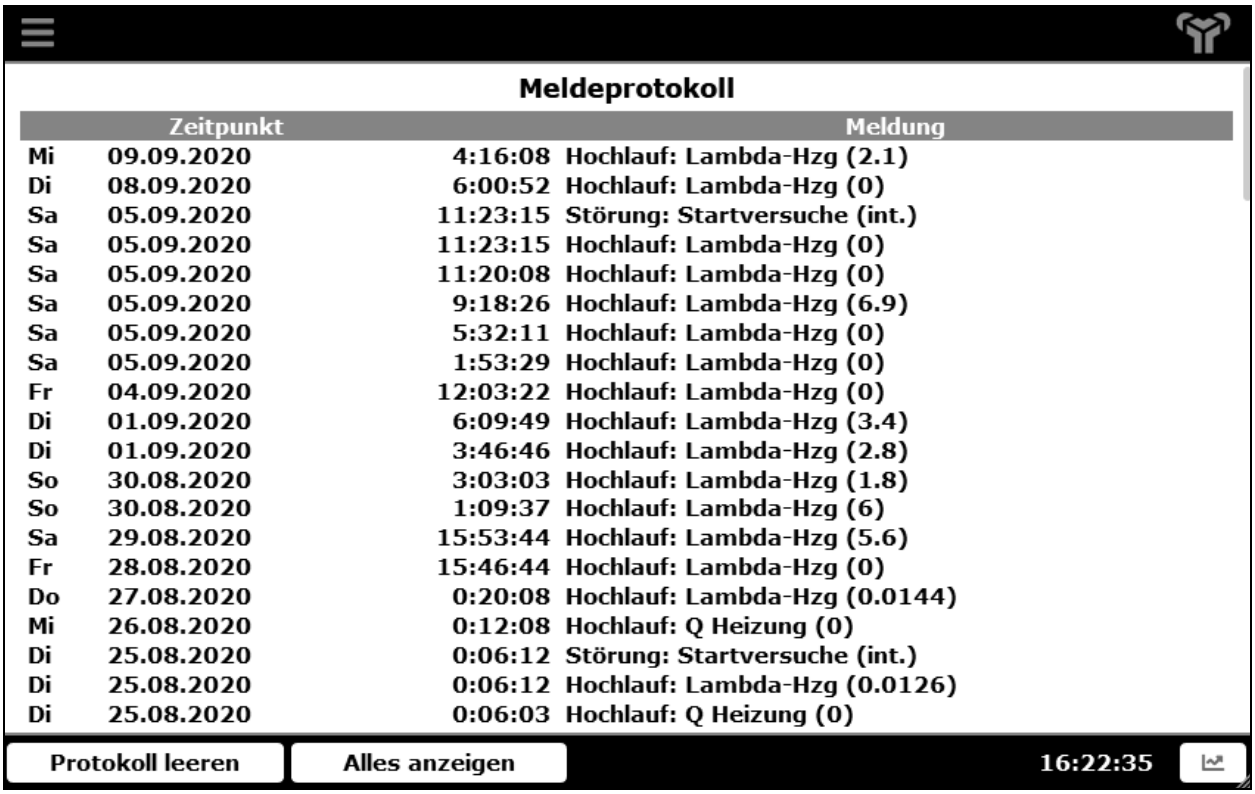
The entries have the following meaning:

1. Column: Day of change in state
2. Time column: Date of change in state
3. Column: Time of the change in state and state of the module, **OFF (AUS)** or **ON (AN)** entered
4. Duration column: duration of the state in hh:mm:ss; the upper line is constantly updated
5. Reason column: reason for the change in state

Message log menu (Meldeprotokoll)

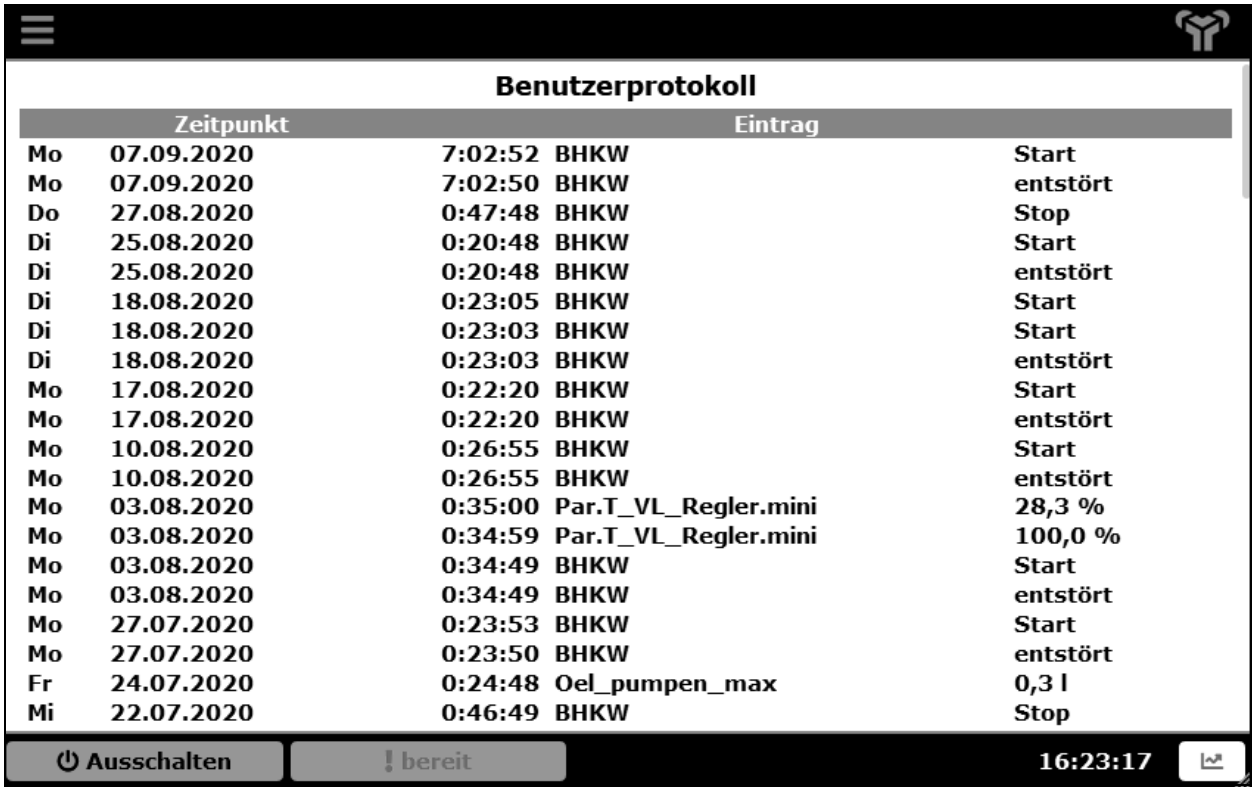
All warning and fault messages and other events are recorded in the message log. The current entry is written at the top of the message log. The last 1,000 messages operations can be viewed overall. If you click on the buttons below the log, you can empty the log and also display it again.

The first columns contain the day of the week and the date of the fault or warning. The middle columns contain the time and the name of the message. The value in brackets at the end of the line contains additional information as necessary.



User log menu (Benutzerprotokoll)

All changes are recorded in a user log. In this way, it is possible to trace when a parameter was changed and which one. You need the Partner access level to see who made a change.



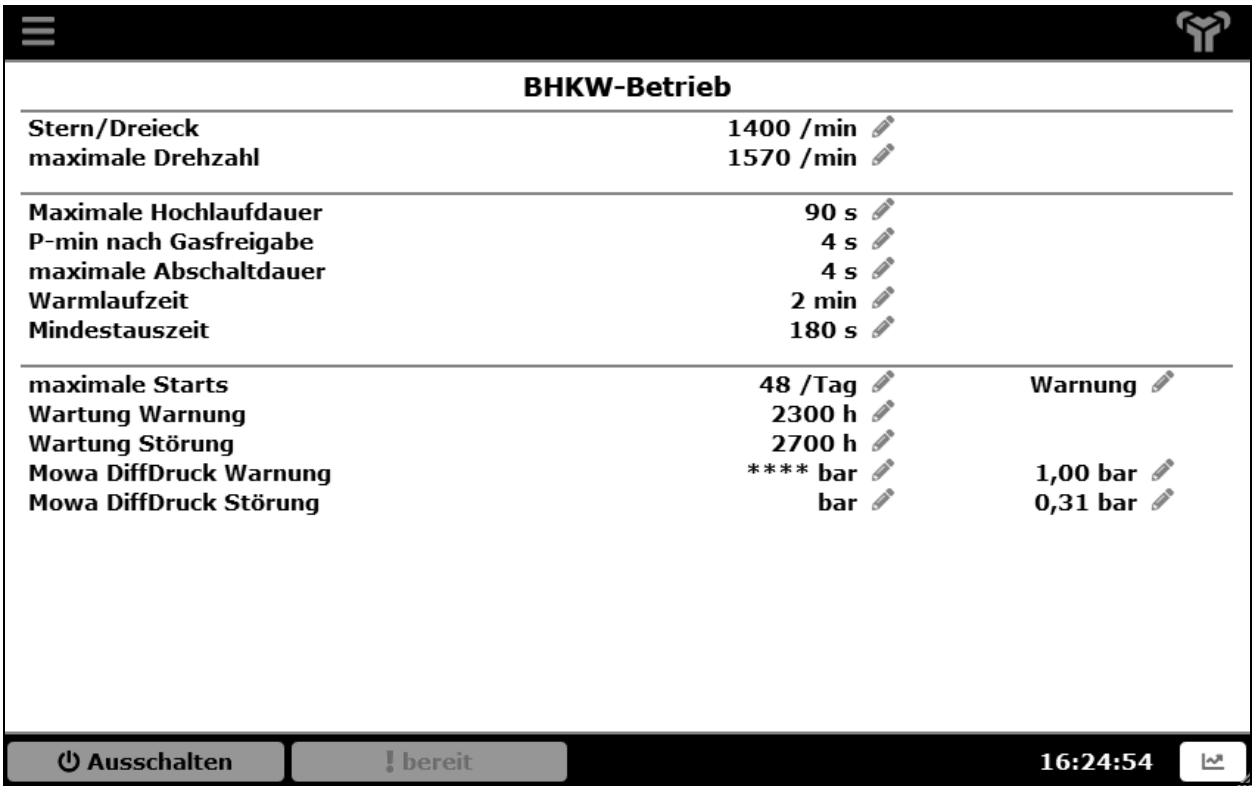
Parameters menu (Parameter)

You can use this menu to access the menus described below.

Parameter
BHKW-Betrieb
Lambda- und Leistungsregelung
Heizungspumpenregelung
Zündungsparameter
Analoge Eingänge intern
Analoge Ein- und Ausgänge extern

CHP unit operation parameters menu (BHKW-Betrieb)

You can use this menu to set different parameters to operate the CHP unit.



Phase-to-neutral/delta (Stern/Dreieck)

The gas engine is brought up to operating speed with the help of the asynchronous machine and the phase-to-neutral/delta switchover. This is where the speed at which the CHP unit switches to delta operation at start-up is set.

Switching takes place after the set speed has been reached and fifty revolutions of the crankshaft have been detected. The oil max. contact must not be engaged and the oil pressure must be above its fault value.

Maximum speed (maximale Drehzahl)

This is where the engine speed is limited. If the pre-set speed is exceeded, the CHP unit switches off and a fault is emitted.

The motor speed limit is a safety system which switches the CHP unit off in the event of a coupling breakage, for example.

Maximum ramp-up time (Maximale Hochlaufdauer)

If it is not possible to switch to delta operation in the time configured here, an error message is emitted with Ramp-up time exceeded given as the reason.

P-min after gas release (P-min nach Gasfreigabe)

This is where you can set the time that elapses after the CHP unit has started up until the power output (irregular and P < 0) is monitored.

Maximum shut-down time (maximale Abschaltdauer)

You use this menu option to set the time after which the CHP unit must not supply any power after being switched off. If this time is exceeded, a fault is emitted, the second gas solenoid valve closes and the CHP unit is switched off.

Warm-up time (Warmlaufzeit)

The CHP unit with a minimum power output. Once the pre-set warm-up time has elapsed, it runs with the currently configured power.

Minimum timeout (Mindestauszeit)
This menu option is used to set the minimum time that the CHP unit remains switched off.

This time is required, among other things, to reduce the motor load due to frequent starting and stopping processes.

The CHP unit can be started manually during the minimum off time.

Maximum starts (maximale Starts)

This is where the maximum starts per day are set and you also set whether the CHP unit issues a warning if they are exceeded or the CHP unit is blocked for the rest of the day.

Maintenance warning (Wartung Warnung)
This is where the warning values for the maintenance intervals are set.

Fault maintenance (Wartung Störung)
This is where the fault values for the maintenance intervals are set.

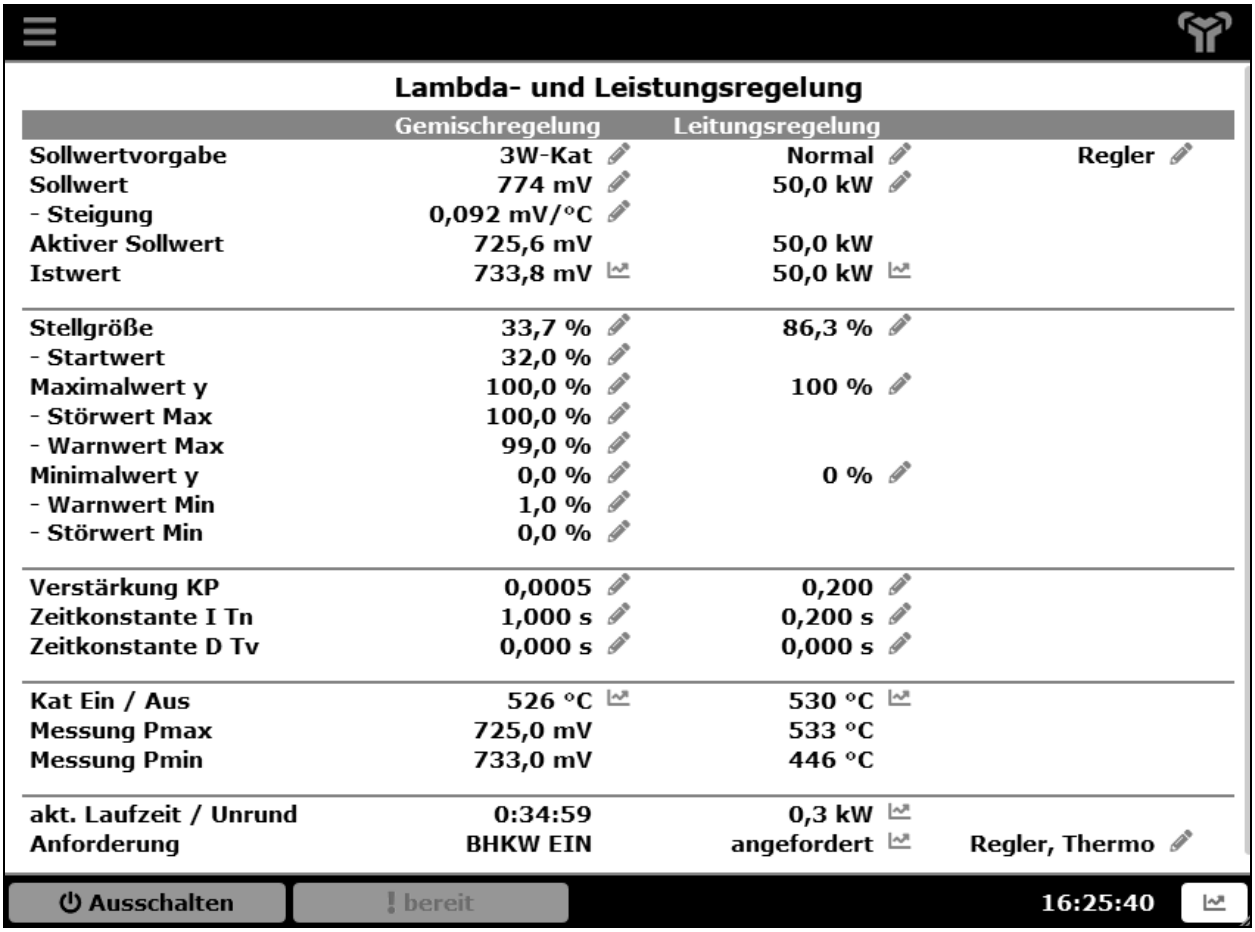
EnWa DiffPress warning (Mowa DiffDruck Warnung)
This is where the relevant warning values are shown.

EnWa DiffPress fault (Mowa DiffDruck Störung)
This is where you can switch between whether the flow-through should be monitored by differential pressure **DiffPress (DiffDruck)** or by flow **Switch** (**Schalter**). The relevant fault values are specified below.

Lambda and power control menu parameters (Lambda- und Leistungsregelung)

This menu shows the lambda control values and parameters in the Mixture control column and the power control values in the right-hand column.

The table shows typical setting values for 3-way operation of the catalytic converter (lambda=1).



Setpoint setting (Sollwertvorgabe)

This is where you can select the type of lambda control in the Mixture control column: **3W Cat, Lean (3W-Kat, Mager)** or **Broadband (Breitband)** (a broadband sensor is required for this).

The power control can be set to **Normal**, **Pmin** or **Pmax**.

Setpoint (Sollwert)

You can change the setpoint settings here to perform measurements, for example.

The left-hand column displays the setpoint to which control is adjusted when the setpoint is set to **Lean (Mager)**.

The left-hand column displays the setpoint to which control is adjusted in the **Manual (Hand)** setting in the **P-specification (P-Vorgabe)** menu option in the CHP unit operating mode menu.

- Gradient (Steigung)

The gradient in the straight line with which the lambda sensor voltage is adapted to the flue gas temperature.

Active setpoint, actual value (Aktiver Sollwert, Istwert)

These menu options display the current values.

Due to the lambda sensor's pressure sensitivity, the lambda sensor signal's actual value fluctuates by 25 mV in lambda=1 mode.

Controlled variable (Stellgröße)

Lambda control's actual correcting variable

- Start value (Startwert)

The CHP units runs in uncontrolled mode with a fixed start value for the lambda control until the heated lambda sensor is at operating temperature (start delay/warm-up time: normally 2 minutes). The power control adjusts to **Pmin** until then. CHP unit warm-up is displayed in the Overview menu during this time.

Maximum value y, Minimum value y (Maximalwert y, Minimalwert y)
This is where the lower and upper control limits for the lambda and power output control are displayed.

- **Fault value Max/Min (Störwert Max/Min),**
- **Warning value Max/Min (Warnwert Max/Min)**

This is where the fault or warning values for the lambda control are set. If the lambda control controlled variable falls below or exceeds the set fault values, a fault shutdown occurs or a warning is issued.

Boost KP (Verstärkung KP), Time constant I Tn (Zeitkonstante I Tn), Time constant D Tv (Zeitkonstante D Tv)
These menu options are used to adjust the PID controller for lambda and power control.

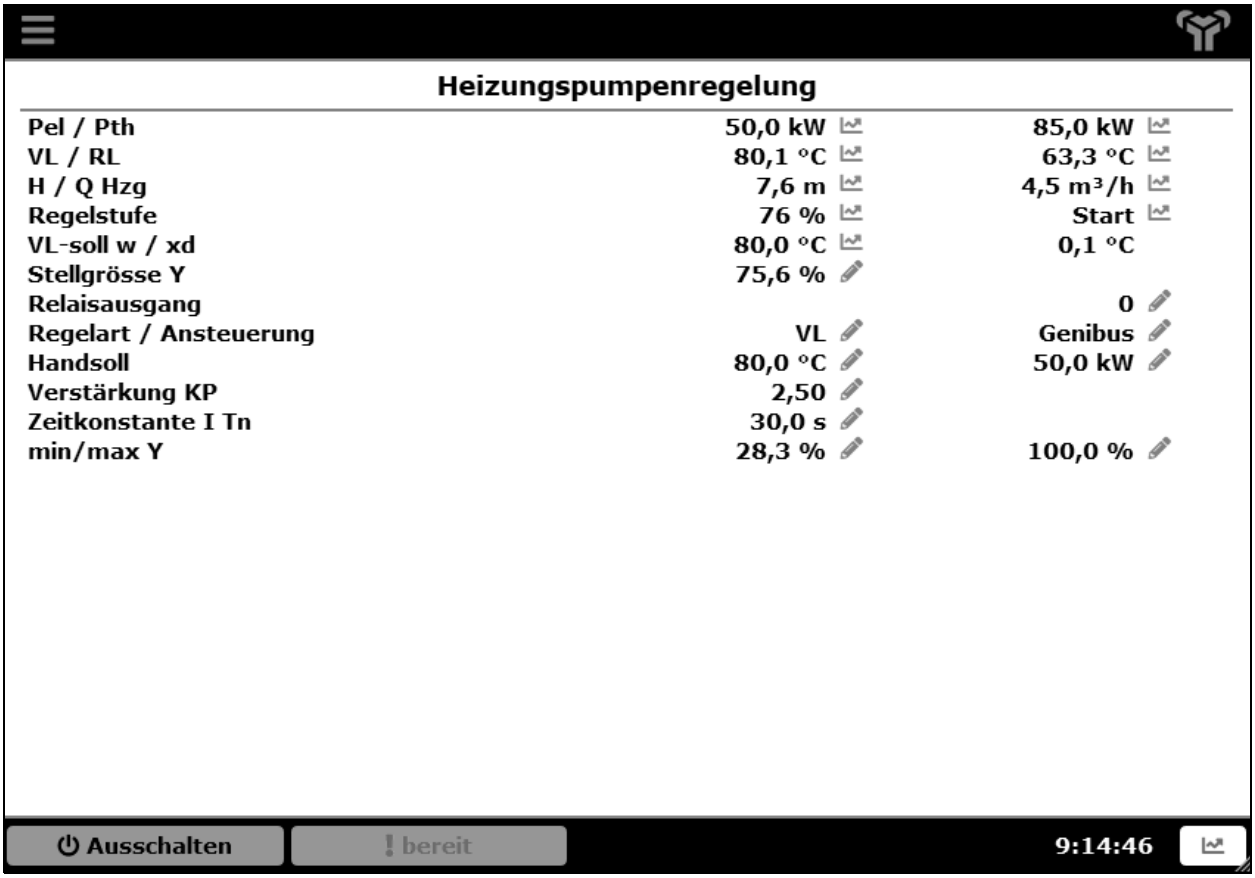
Cat on/off (Kat Ein/Aus)
The flue gas temperatures upstream from (E) and downstream from (A) the catalytic converter are displayed in this row. The flue gas temperatures indicate how well the three-way catalytic converter is functioning.

Measurement (Messung) Pmax, Measurement (Messung) Pmin
This is where the current lambda setpoint value and the catalytic converter inlet temperatures are displayed for Pmax and Pmin during the flue gas measurement.

Curr. runtime/irregular (akt. Laufzeit/Unrund)
The duration of the runtime and the irregular value are displayed here.

Request (Anforderung)
Status of the CHP unit's operating request depending on the selected operating mode.

Heating pump control parameters menu (Heizungspumpenregelung)



Pel / Pth, SL / RL
These menu options indicate the current values.

H / Q Htg (Hzg)
"H" indicates the pressure head and "Q" the heating pump flow-through.

Control stage (Regelstufe)
Feedback from the heating pump.

SL-setpoint w / xd (VL-soll w/xd)
Current setpoint for the supply line temperature. The value xd indicates the current control deviation between the setpoint and the supply line temperature.

Controlled variable Y (Stellgrösse Y)
Controlled variable used to activate the heating pump.

Relay output (Relaisausgang)
The output can be permanently switched **OFF (AUS)** or **ON (EIN)**. The control program automatically switches to **AUTO**.

These manual software switches are always set to **AUTO** after a reset.

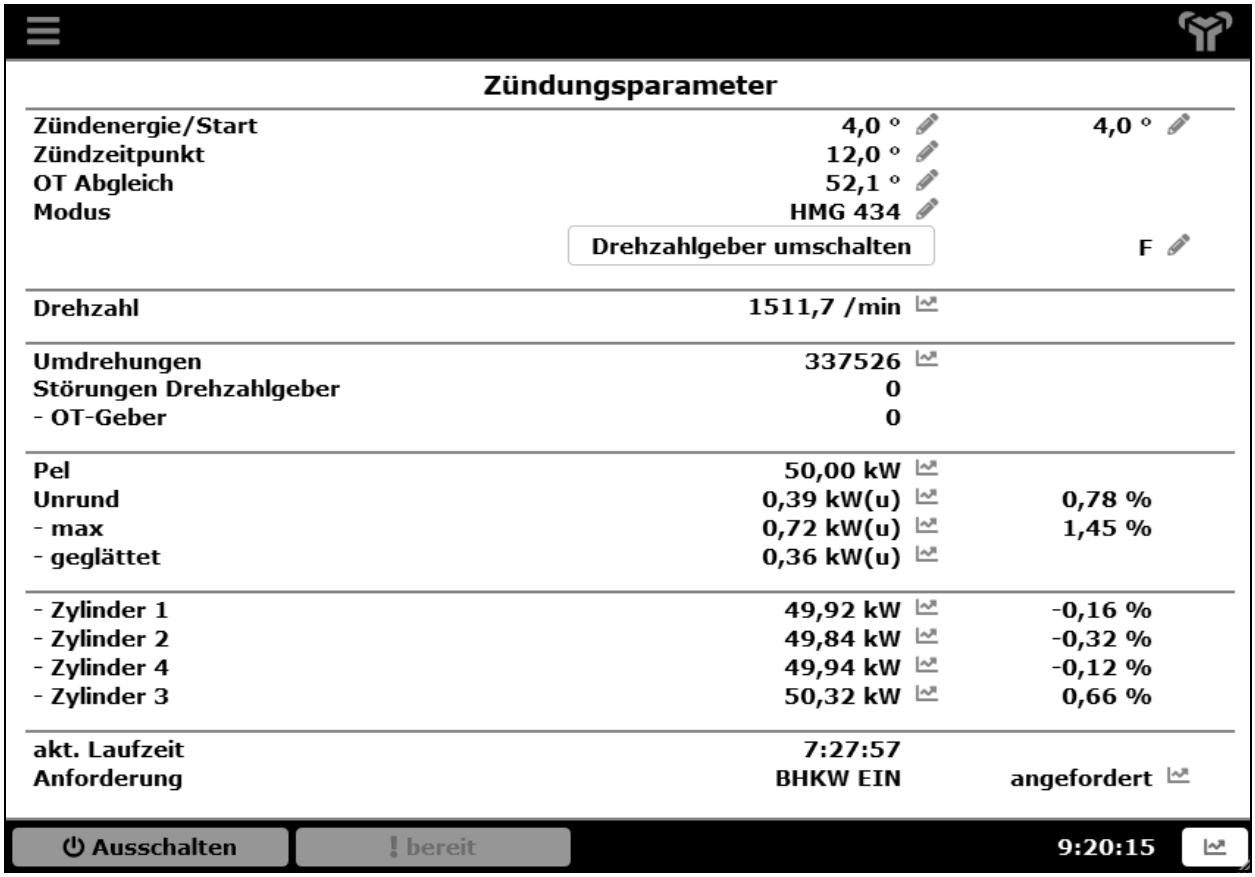
Control type/activation (Regelart/Ansteuerung)
You can choose different types of control. You will find detailed information on the types in the description of the **Htg pump (Hzg-Pumpe)** parameter in the CHP unit operating mode menu (Betriebsweise BHKW) on page 52.

Man. setpoint (Handsoll)
This is where you can configure the setpoint for the **dT** or **SL (VL)** control type.

Boost KP, Time const.I Tn (Verstärkung KP, Zeitkonst.I Tn)
These menu options parametrise the heating pump controller's PI controller.

min/max Y
This is where the pump's control range is set. With built-in flow monitoring, the minimum speed is automatically increased until the minimum through-flow is reached.

Ignition parameters parameters menu (Zündungsparameter)



Ignition energy/start, ignition timing (Zündenergie/Start, Zündzeitpunkt)
The basic settings for ignition energy and ignition angle must be adjusted to the gas quality concerned by authorised specialist personnel with a great deal of experience.

Setting the ignition energy as low as possible ensures that the spark duration and thus the electrode burn-off on the spark plugs and their wear can be reduced.

TDC adjustment (OT Abgleich)
The TDC adjustment is set when the CHP unit is commissioned. It is also set after servicing tasks such as cylinder head replacement.

Mode (Modus)
Selection of engine type

Speed (Drehzahl)
This is where the current engine speed is shown.

Revolutions (Umdrehungen)
This is where the number of revolutions since the last time the CHP unit was started is shown.

Speed sensor faults (Störungen Drehzahlgeber)
This menu option shows the number of faults in signal processing in the ignition system.

- TDC encoder (OT-Geber)
Trigger signal faults.

Pel
Electrical power output.

Irregularity (Unrund)

The current irregularity value.

- max
The maximum irregularity value in the last 2 sec.

- smoothed (geglättet)
The highly smoothed irregularity value. This value is used to monitor irregularity.

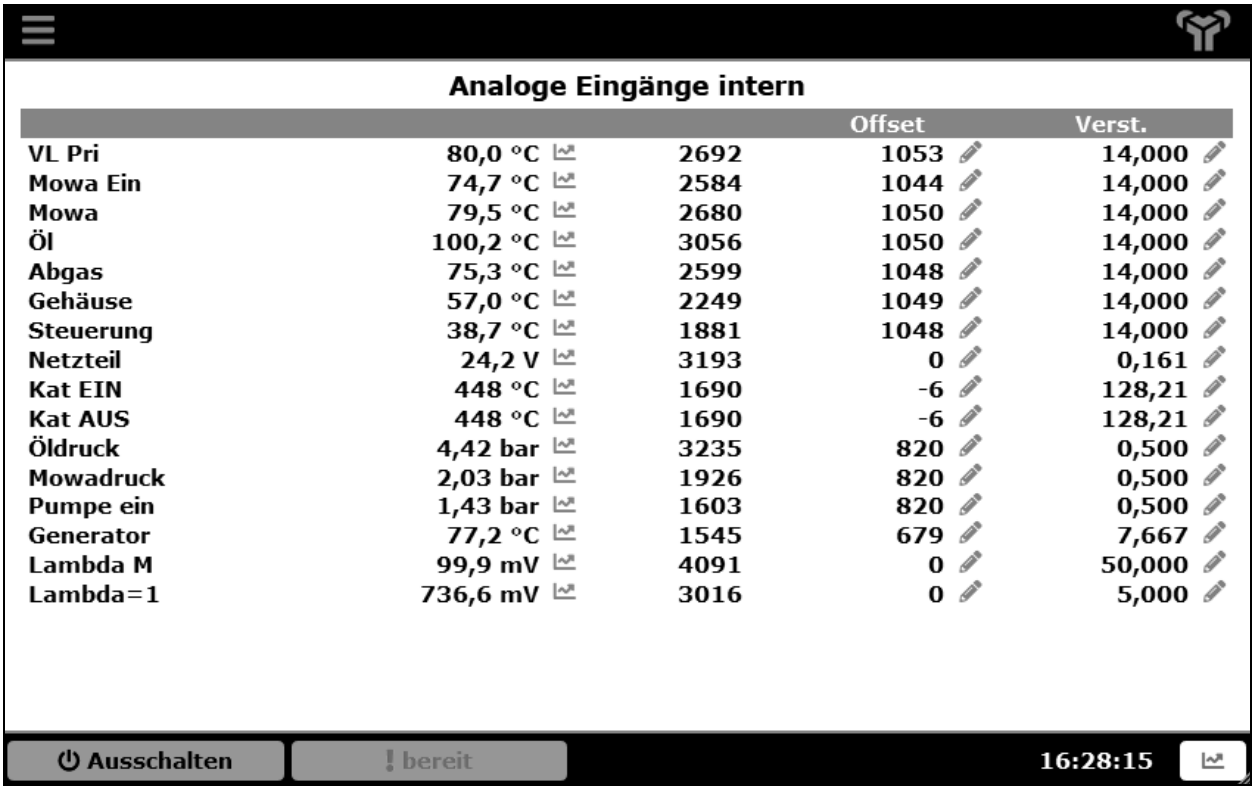
Cylinder (Zylinder)
Instantaneous power for each individual cylinder. The right column shows the cylinders' deviations from each other.

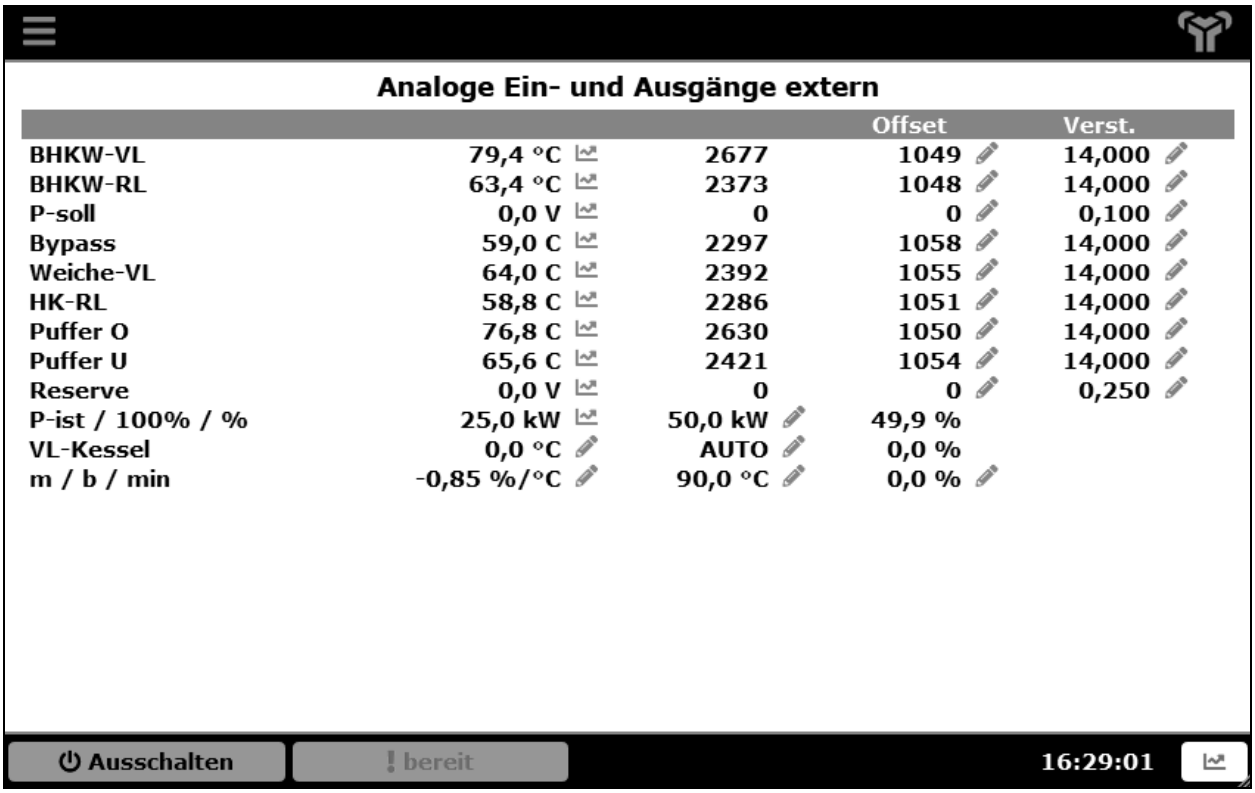
Curr. runtime (akt. Laufzeit)
The CHP unit's runtime since its last start.

Request (Anforderung)
Status of the CHP unit's operating request depending on the selected operating mode.

Analogue inputs intern (Analoge Eingänge intern) + Analogue inputs extern (Analoge Ein- und Ausgänge extern) parameter menus

These menus display the current measured values. The analogue inputs are parametrised using the offset and boost. The analogue inputs are calibrated in the factory before the first test run. Changing the values on site is unnecessary under normal circumstances. The connected sensors' names can be changed on the PC.





System settings menu (Systemeinstellungen)

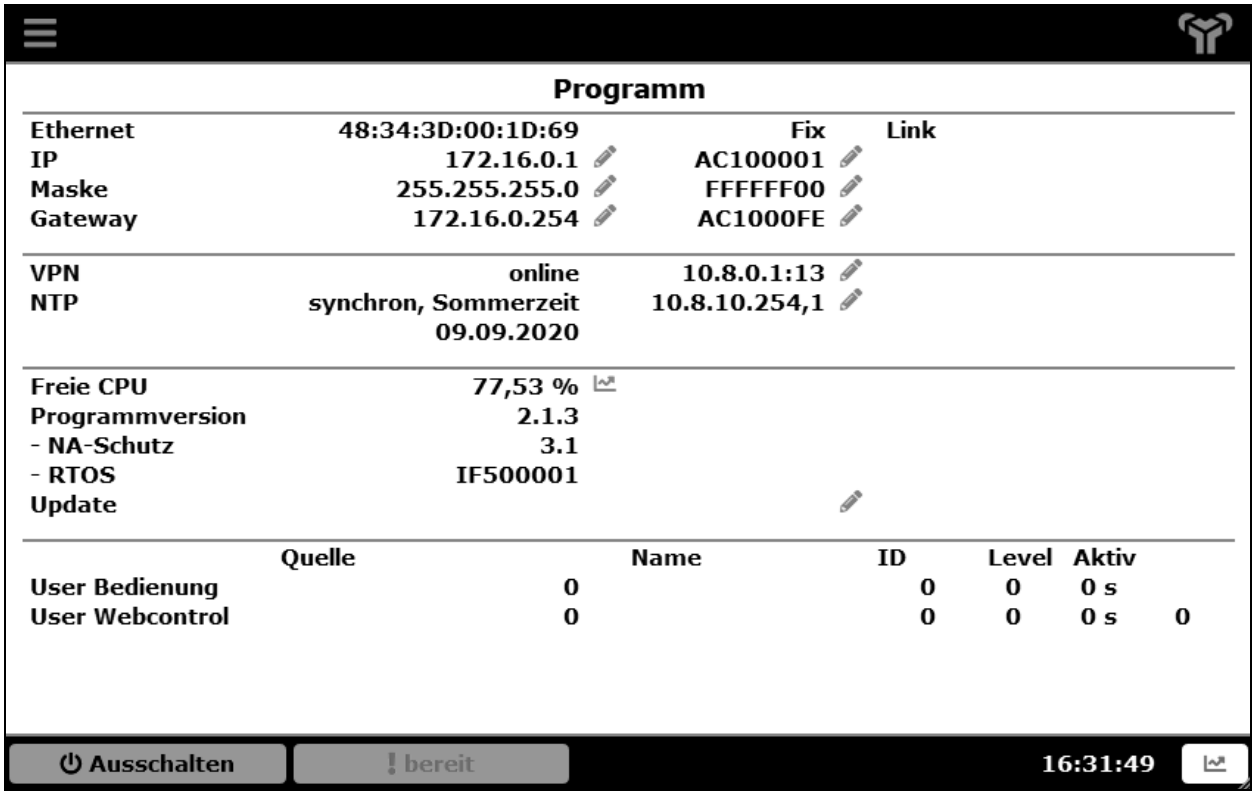
You can use this menu to access the menus described below.

PIN system settings menu (Geheimzahl)

You must enter a PIN as soon as you try to modify a parameter which requires access authorisation. You will find information on the different security levels on page 44.

Program system settings menu (Programm)

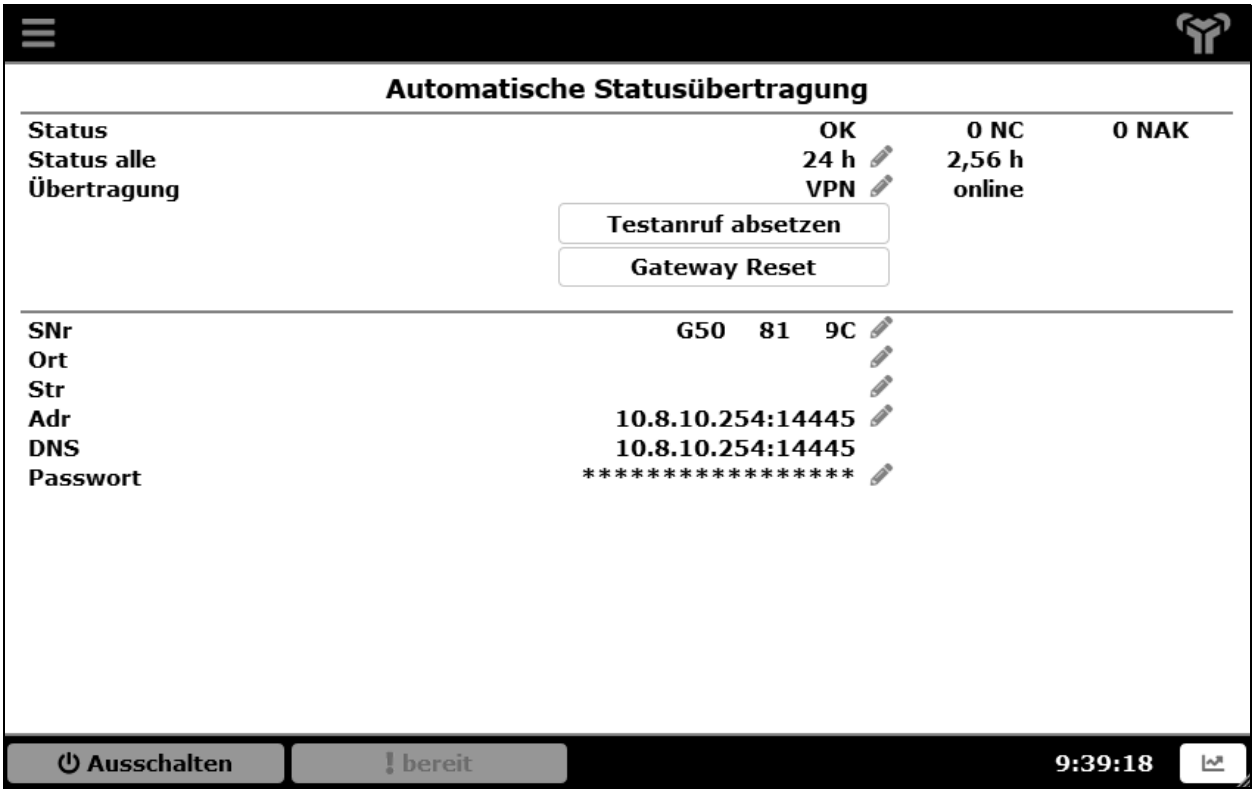
This menu is used to display information about the installed program.



Automatic status transmission system settings menu (Automatische Statusübertragung)

This menu is used to make the basic settings for data transmission.

All settings should be correctly configured in the factory.



Status

Transmission status

NC and NAK error counters

Status all (Status alle)

The controller automatically transmits the CHP unit's status to the fault message server at the interval configured here.

Transmission (Übertragung)

The type of transmission

SNo (SNr)

Module serial number.

Place, Str, Adr (Ort, Str, Adr)

This is where the address of the **kraftwerk** fault message server is given.

DNS

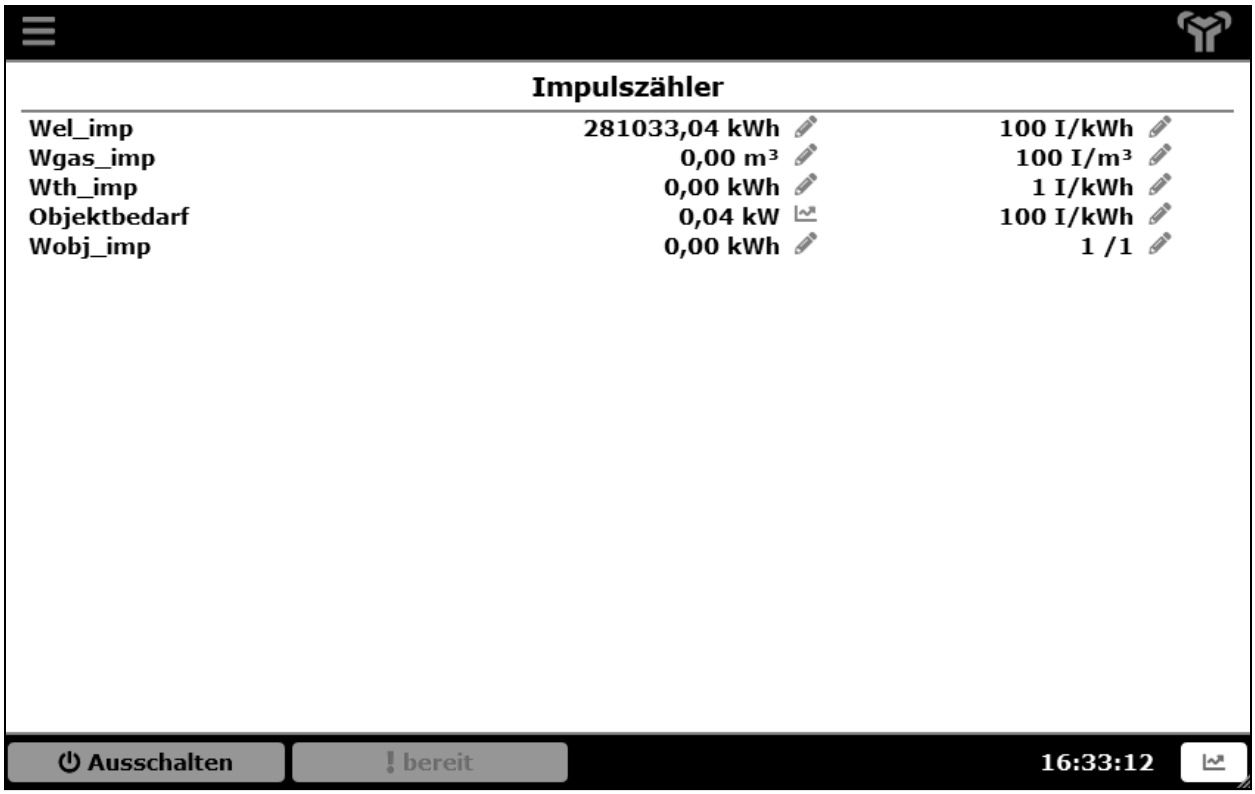
If the address set under **Adr** can be resolved correctly, then the result of the name resolution is shown here. This is usually the same address as the one under **Adr**.

Password (Passwort)

Password to log onto the **kraftwerk** fault message server

Pulse counter system settings menu (Impulszähler)

You can use this menu to parametrise pulse counters and view counter readings.



5.7 WARNINGS AND FAULTS

5.7.1 Warnings

Warnings provide notification of deviations from normal values and do not require immediate action. They give notification of incidents such as dirty components and a low water or oil level, or they remind you that maintenance is due. Warnings are written into the Message log menu and are transmitted via the remote monitoring module. They do not need to be confirmed or acknowledged and remain in the message log until they are deleted; if the warning still applies when deleted, it is entered again.

The CHP unit remains in operation when warnings are active. Only malfunctions cause the CHP unit to shut down automatically and make immediate intervention necessary. An example: the Engine water pressure warning indicates that there is little water in the engine circuit and it should be topped up.

The messages transmitted when the supply and return temperatures are exceeded are a special case. In such a case, the CHP unit automatically reduces its power output. These normal adjustment processes are displayed with the message Heating return > Warning value or Heating supply > Warning value in the Overview menu.

5.7.2 Faults

Faults are triggered if network faults occur twice within 20 minutes or fault values are exceeded, for example. Faults cause the CHP unit to switch off and block. Automatic start-up is no longer possible. The fault message is written into the Message log menu and is transmitted via the remote monitoring module. A fault requires intervention; the CHP unit can only be switched on again once the cause of the fault has been eliminated and the fault has been reset. After you have reset the fault, you must wait for about ¼ hour to ensure that the CHP unit starts correctly and resumes normal operation.

The Not ready message which appears in the Overview menu is a special case. This message is transmitted if a fault value is exceeded or a error persists for longer than 20 minutes. The CHP unit will not operate. It will not start up automatically again until the error has disappeared or has been eliminated. The CHP unit is also Not ready if the manual switch is turned off.

5.7.3 Availability counter

The Service menu on page 54 shows the hours when the CHP unit is not running in the **Ready/Fault** parameter.

Causes:
(Standby counter S1, software version 2.1.2):

Operation-related	Heating supply line
	Heating return line
	Maximum starts per day reached
	Flow-through Heating side
	Htg pump
	Buffer pump
Safety chain	Heating emergency switch
	Manual switch
	STD flue gas
	Gas sensor
	External safety system
	External grid and plant protection
Gas pressure	Gas pressure
Optional	Flue gas damper
	CO sensor
Faults	2nd network error in 20 min
	2nd ext. fault in 20 min
Attempted starts (ext.)	Attempt. start
Grid and plant protection	U1 max
	U1 min
	U2 max
	U2 min
	U3 max
	U3 min
	Network asymmetry
	Network frequency max
	Network frequency min
	U1 (10 min.)
	U2 (10 min.)
	U3 (10 min.)
	Revolving field
	U12 max
	U12 min
	U23 max
	U23 min
	U31 max
	U31 min
	U12 (10 min.)
	U23 (10 min.)
	U31 (10 min.)

The S2 fault counter counts the number of times when the CHP unit is not available.

6. SERVICE

6.1 REGULAR MAINTENANCE TASKS

The stipulated maintenance tasks and intervals are essential for safe, fault-free operation of the Mephisto G50 CHP unit module. The manufacturer or an instructed maintenance firm must carry them out to ensure that warranty claims can be made if necessary.

The regular maintenance interval is 2,000 hours of operation and the first maintenance visit is required after 1,000 hours of operation.

Subject to technical changes.

Information

Potential damage to the CHP unit due to poor maintenance or lack of maintenance

- Observe the maintenance intervals
- Only have authorised firms carry out maintenance work
- We recommend you conclude a comprehensive maintenance contract

Do the following every time you visit the site:

- Perform visual inspection for leaks in flexible hoses, screw connections, the gas pipeline, flue gas conduit, condensate pipeline, oil refill device and similar.
- Perform visual inspection on the electrical system, sensors and lines
- Check oil level in the engine and oil reservoir tank; refill with oil if necessary
- Check engine water pressure and heating water circuit (optional); refill with water and ventilate if necessary
- Clean dirt filter
- Check trap; clean if necessary
- Check neutralisation system (if installed); clean and replace granulate if necessary
- Log all activities

Initial maintenance after 1,000 hours of operation:

- Change engine oil
- Replace engine oil filter
- Check valve clearance and adjust if necessary
- Replace valve lid gasket and gaskets for the valve lid screws (insert valve lid gasket with oil).
- Check the pressure equalisation tank; correct if necessary
- Check and tighten three-phase terminals

Regular maintenance interval every 2,000 hours of operation:

- Change engine oil
- Replace engine oil filter
- Check intake air filter; replace if necessary
- Replace valve lid gasket and gaskets for the valve lid screws (insert valve lid gasket with oil).
- Check valve clearance and adjust if necessary
- Check the pressure equalisation tank; correct or replace if necessary
- Lubricate generator bearings
- Take flue gas measurement; reset lambda control or replace catalytic converter if necessary

Every 10,000 hours of operation also:

- Check discharge pressure; replace cylinder head if necessary
- Replace spark plugs
- Check engine water pump; replace if necessary
- Clean gas filter element; replace if necessary
- Check plate heat exchanger and flue gas heat exchanger (water-side) and clean if necessary
- Check flue gas heat exchanger (flue gas-side) and clean if necessary
- Inspect lambda sensor; replace if necessary

Every 18,000 hours of operation also:

- Remove old generator bearing grease
- Check generator bearings for damage; replace if necessary
- Check coupling element for damage; replace if necessary

Every 36,000 hours of operation also:

- Check oil consumption and discharge pressure; replace engine if necessary
- Check seals on the flue gas conduit; replace if necessary
- Check and tighten three-phase terminals

6.2 CARRYING OUT MAINTENANCE WORK

All maintenance tasks must be carefully recorded. Warranty claims can only be made if all mandatory maintenance tasks and intervals have been fulfilled and documented.

Only simple maintenance tasks are described below. Only trained staff may carry out extensive, complex maintenance tasks.

Health hazard
Serious crushing or tear injuries
Due to the CHP unit starting up automatically

Depending on the operating mode selected, the CHP unit controls can switch the CHP unit off and on automatically. Fast rotating parts can start moving unexpectedly and pull in fingers and other extremities.

- Do not reach into the interior when the CHP unit is in operation.
- Before starting any work on the CHP unit, ensure that you have locked it.
- Only detach the outer panelling and the protective panelling in the interior for maintenance purposes only.

Health hazard/hand injuries
Due to sharp edges

- Wear suitable gloves during maintenance and repair work on the CHP unit.

Caution
Risk of impact

The gas pressure springs on the CHP unit housing lid lose pressure after a while. As a result of the loss in pressure, the gas pressure springs may no longer provide enough force to hold the CHP unit panelling housing lid open. The housing lid may fall suddenly and hit you.

- Check the pressure in the gas pressure springs in older systems. Replace them if necessary.

Switching off the CHP unit

Proceed as follows to switch off the CHP unit:

1. Press the Switch off button.
2. Set the manual switch to “0” if you wish to stop the CHP unit from starting automatically.
3. The emergency stop switch can normally remain in the ON position. If you carry out service work on live parts, you must set the emergency stop switch to OFF and pull the back-up fuses.

Danger to life
Due to electrical voltage

A high voltage runs through the CHP unit’s electrical cables and contacts. If you come into contact with this voltage, it can be fatal.

- Only have a qualified electrician carry out maintenance work on the Mephisto CHP unit’s electrical part.
- Before working on electrical equipment, always follow these instructions:
  - Switch off the system
  - Secure against being switched on again
  - Check that the system is de-energised.
  - It is essential to bear in mind that external power sources (e.g. boiler lockout) cannot be ruled out.

6.2.1 Visual inspection

Health hazard/risk of burns
Due to very hot components.

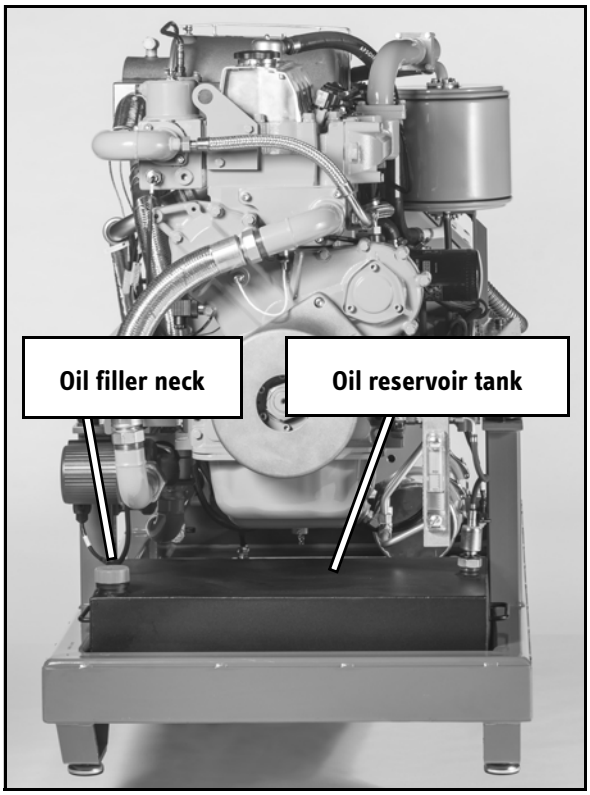
Note that most components will be very hot if you carry out visual checks when the CHP unit is in operation or shortly after it has stopped operation. If you touch these components, you may suffer burns.

- Wear suitable protective clothing and gloves.

- Open housing lid when the machine is running or at operating temperature. If there is rising, moist, warm air, this indicates flue gas leaks. If this is the case, you can locate the leak using a cold mirror, for example.
- Switch off the CHP unit at the controller and set the manual switch to “0”. Proceed as described in point 6.2 "Carrying out maintenance work"on page 76.
- Remove the side panels.
- Check the floor pan for oil and water residues.
- Locate any leaks and seal them.
- You can usually seal leaks from the union nuts on the water-carrying reinforced hoses by tightening them with a plier wrench.
  Caution! Do not tighten too firmly since this may crush the Centellen seal.
- Leaks from the rings around the oil-carrying hoses cannot be repaired. Replace the hose in such a case.
- You can usually seal leaks from the union nut on the oil-carrying line by tightening the nut with a plier wrench. As these are conical metal sealing surfaces, you must tighten the union nut firmly.
- Check all electrical system parts and the sensors for damage to the insulation, fused terminals, etc.

6.2.2 Checking the oil level and refilling if necessary

- Switch off the CHP unit at the controller and set the manual switch to “0”.
- Check the oil level in the oil reservoir tank. The maximum capacity is 38 litres; you should refill with oil at the latest when the oil level has fallen to about 6 litres.
  Info: The oil in the engine is replenished automatically from the oil reservoir tank and does not need to be refilled manually.
- Unscrew the lid from the oil reservoir tank. The oil dipstick is attached to the lid.
- Top up the oil if necessary. To do so, place a funnel in the oil filler neck and fill with new oil (Petro-Canada Sentron LD 5000).



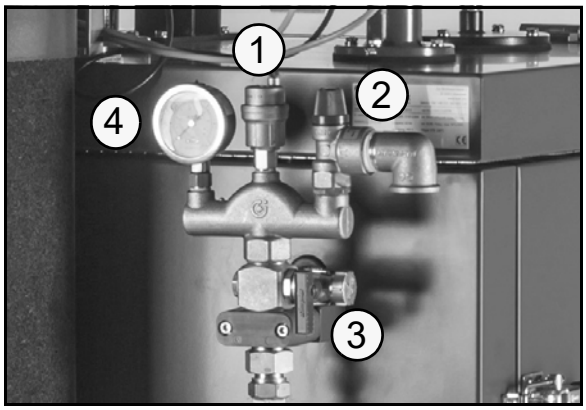
6.2.3 Checking the engine water pressure, refilling engine water

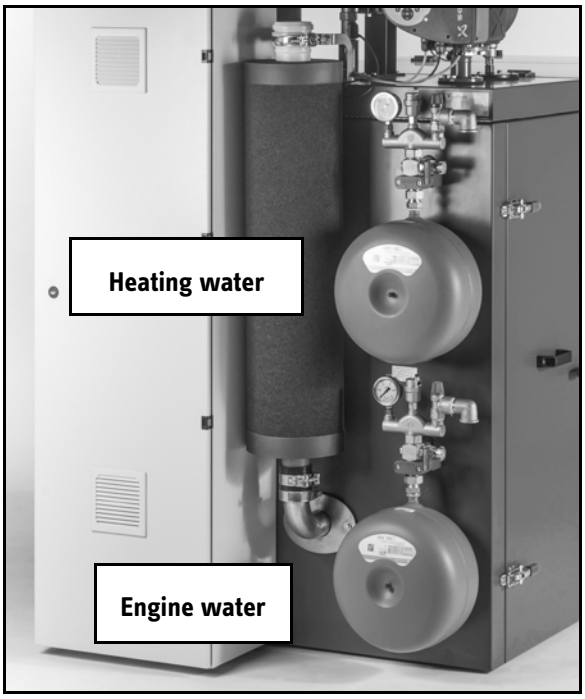
Health hazard/risk of burns
Due to hot engine water

When filling engine water, observe the water pressure on the pressure gauge on the equalising tank. If you fill up with too much engine water, the pressure in the circuit will rise. If the water pressure exceeds the safety valve opening pressure, the safety valve on the rear wall of the CHP unit opens and hot engine water will blow out and can cause burns.

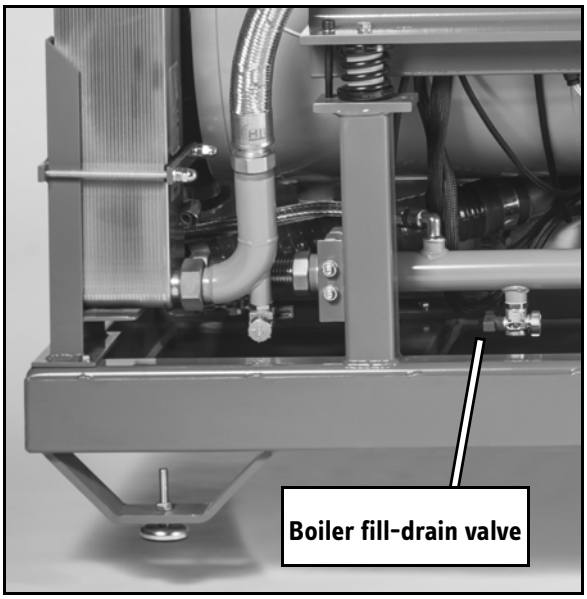
- When filling up the engine water, ensure that the water pressure in the engine water circuit does not exceed the safety valve opening pressure.
- The safety valve (4) opening pressure can be found on the CHP unit's nameplate. This is a standard maximum of 2.5 bar.

There are usually two safety component assemblies on the module rear in accordance with DIN EN 12828:2014-07. Each has an expansion vessel, automatic ventilation system (1), safety valve (2), boiler fill-drain valve (3), pressure gauge (4) and the filling device for the engine water circuit. The lower safety component assembly is connected to the engine water circuit and is fitted as standard. The upper safety component assembly, if present, is connected to the heating circuit. This is available as an option.





Read the engine water pressure on the expansion vessel's pressure gauge. The pressure should be 1.8 bar at operating temperature and 1.4 bar when cold.



Top up the engine water if necessary.

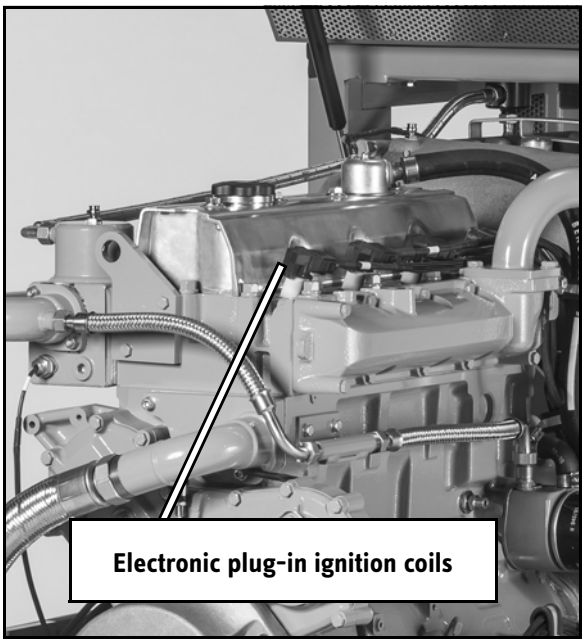
- Switch off the CHP unit at the controller and set the manual switch to "0".
- You need a pump canister to top up the water. You can acquire one from **kraftwerk**. Fill the pump cannister with tap water.

- You can use either the boiler fill-drain valve on the safety component assembly (4 on left of photo) or the boiler fill-drain valve next to the plate heat exchanger (“Boiler fill-drain valve” in photo above). The CHP unit may continue to run when you refill near the plate heat exchanger. Unscrew the safety closure.
- Screw the pump cannister hose into position. Next apply pressure to the pump cannister and only then open the boiler fill-drain valve.
- Open the valve on the pump cannister hose until the pressure gauge indicates 1.4 bar (cold state) or 1.8 bar (at operating temperature). You may need to apply pressure onto the pump cannister occasionally.
- You can also read the engine water pressure on the module controller touch screen to check. This measurement reading is significantly more precise than the one on the pressure gauge.
- Close the boiler fill-drain valve, release the remaining pressure from the pump cannister and only then unscrew the pump cannister hose. Screw the safety closure back on.

6.2.4 Replacing spark plugs

The spark plugs must be replaced every 10,000 hours of operation. If misfiring occurs, the spark plugs must be changed earlier. The value Irregularity indicates misfiring.

The spark plugs are located on top of the engine.



- Switch off the CHP unit at the controller and set the manual switch to “0”.
- Open the CHP unit housing lid.
- Pull out the electronic plug-in ignition coils.
- Unscrew the spark plugs with a 16 mm spark plug socket.
- Clean the thread.
- Screw in the new spark plugs. Tighten the spark plugs with a torque wrench with a torque of 20 Nm.
- Fit the electronic plug-in ignition coils. Make sure you put them in the right order. Spark plug no. 1 is the first one as seen from the front of the CHP unit; no. 4 is the rear one.

6.2.5 Checking the plug-in ignition coils

Danger to life due to high voltage
Risk of an electric shock

The electronic plug-in ignition coils are live when the CHP unit is in operation. If you touch live contacts, you will get an electric shock. An electric shock can cause serious internal injuries.

- The CHP unit must be switched off before you check the electronic plug-in ignition coils.

Switch off the CHP unit at the controller and set the manual switch to "0".

- Pull out the electronic plug-in ignition coils.
- Check the electronic plug-in ignition coils for scorch marks and check the insulation for any damage. Replace damaged components.

6.2.6 Lubricate generator bearings

The generator bearings must be replaced every 2,000 hours of operation. The two lubrication nipples are located on top of the generator, at the front and rear.

Use a hand lever grease gun to lubricate. You can obtain one from **kraftwerk**. The grease gun must be de-aerated. 15 cm^3 of grease must be refilled, which is equivalent to 10 presses of the kraftwerk grease gun.

Enter details of the task into the re-lubrication log.

6.2.7 Removing generator bearing grease

The old generator bearing grease must be removed from the front and rear outer bearing caps every 18,000 hours of operation or after nine re-lubrications.

The generator must be dismounted for this purpose.

- Undo the first of four screws on the outer bearing cap and replace with a piece of threaded rod. This prevents the inner bearing cap from twisting, which could cause damage to the generator.
- Unfasten the three other screws. Mark the position of the outer bearing cap in relation to the generator and only then pull off the outer bearing cap over the threaded rod.
- Remove the old generator bearing grease from the outer bearing cap.
- Replace the outer bearing cap over the threaded rod. In doing this, make sure that the mark you made previously is in the correct position; otherwise, you may cause damage to the generator. Fasten the three screws firmly into place again by hand.
- Unscrew the threaded rod and fasten the last screw firmly into place again. Tighten the four screws with a torque of 80 Nm.
- Repeat the above steps on the other side.
- Lubricate the generator bearings as described in the previous step.

6.2.8 Flue gas measurement

You need enter and change values in the Service menu to measure the exhaust gas values. The Service menu is described in the Operating section on page 54.

- Flue gas measurement is carried out both while the CHP unit is under full power Pmax and under low power Pmin. The CO and NO_x content must comply with German Technical Instructions on Air Quality Control. Before taking the flue gas measurement, you must ensure that heat consumption is sufficient to run the CHP unit at Pmax. The activated CHP unit's warm-up phase must be complete. After changing to Pmin or Pmax, you must wait about ten minutes until the operating status has stabilised. Ensure you switch off the flue gas measuring device pump during this time.
- You need a flue gas measuring device capable of detecting CO and NO_x levels to measure the flue gas. Connect it to the flue gas measuring socket on the flue gas system.
- Select the **Pmax** operating mode in the Flue gas measurement line in the Service menu and press OK to confirm.
- Enter a value under Lambda setpoint in the line or adjust it with the up/down buttons. You need to press OK to confirm. Adjust the value so that CO and NO_x comply with the requirements of the German Technical Instructions on Air Quality Control and are present in roughly the same proportions.
- Repeat the same steps for the **Pmin** operating mode.

Mephisto G50 λ=1-Operation with three-way catalytic converter	
Limit values as per German Technical Instructions on Air Quality Control	
CO emissions	**NO_X emissions**
300 mg/m³ in normal state	250 mg/m³ in normal state

- Set the operating status to Normal again in the Flue gas measurement row.

6.2.9 Tightening the three-phase terminals

Danger to life
Due to electrical voltage.

A high voltage runs through the CHP unit's electrical cables and contacts. If you come into contact with this voltage, it can be fatal.

- Only have a qualified electrician carry out maintenance work on the Mephisto CHP unit's electrical part.
- Before working on electrical equipment, always follow these instructions:
  - Switch off the system
  - Secure against being switched on again
  - Check that the system is de-energised.
  - **! It is essential to bear in mind that external power sources (e.g. boiler lockout) cannot be ruled out.**

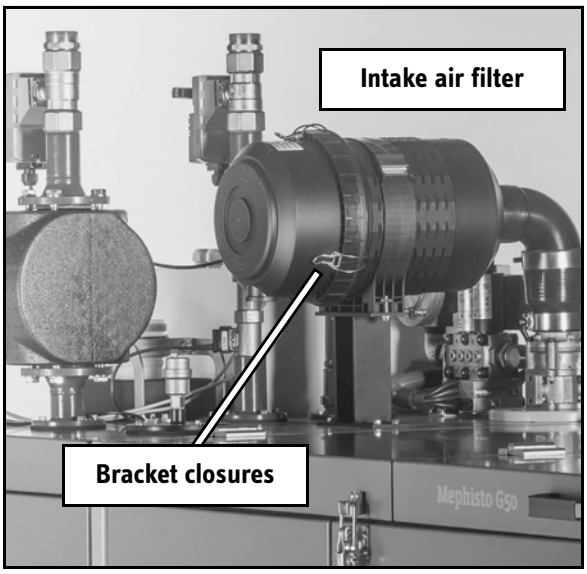
You must check all screw terminal connections for live conductors and protective conductors in the electrical enclosure during the first maintenance after 1,000 hours of operation.

- Switch off the CHP unit at the controller and set the manual switch to "0".
- Set the main switch to OFF.
- Disconnect the CHP unit by switching it off or pulling the pre-fuse clearly marked CHP unit in the sub-division. Secure the CHP unit pre-fuse against re-connection.
- Open the electrical enclosure and check that the main current terminals XS1 are no longer live.
- Tighten the terminals with a suitable screwdriver and observe the stipulated torques:
  - K4 (capacitor contactor): 1.2 Nm
  - If necessary P1 (optional counter): 1.4 Nm
    Do not re-tighten pulse/bus outputs
  - F6 (engine protection switch): 3.0 Nm
  - S1 (main switch): 3.0 Nm
  - T1 (frequency converter): 3.0 Nm
  - K1 (mains contactor): 3.3 Nm
  - K2 (delta contactor): 3.3 Nm
  - K3.1, K3.2 and K3.3 (inverter contactors): 3.3 Nm

- Close the electrical enclosure again.
- Unscrew the generator terminal box; you will find it behind the panelling on the generator, next to the electrical enclosure.
  - XS21 (generator terminals): 10.0 Nm
  - Do not tighten the sensor terminals.
- Screw the generator terminal box shut again.
- Re-switch or re-set the CHP unit pre-fuse in the subdivision and put the CHP unit into operation again.

6.2.10 Changing the intake air filter

The intake air filter housing is located on the CHP unit's housing. The air filter comprises two part.



- Open the three bracket closures.
- Remove the lid.
- Remove the outer air filter element. Check it. If it is very dirty, replace it.
- Then remove the second, inner filter element from its bracket. Also check it and replace it if it is very dirty.
- Replace the two filter elements.
- Fit the lid. Ensure that the yellow valve on the lid is facing upwards.
- Close the three bracket closures again.

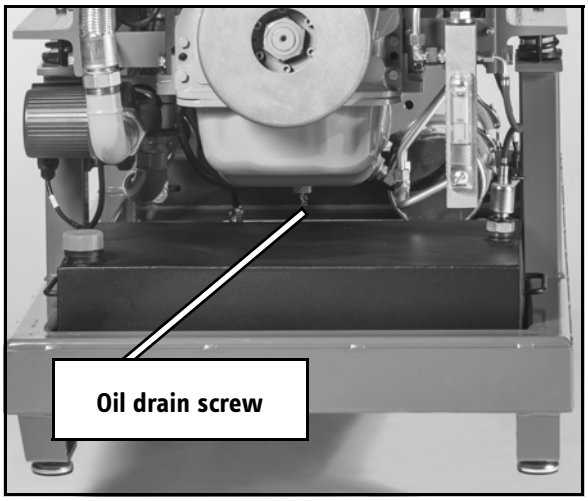
6.2.11 Changing the engine oil and replacing the engine oil filter

Health hazard/risk of burns
Due to hot engine oil

The engine oil should be changed at the highest possible operating temperature. You may get burned when you drain the hot engine oil and unscrew the oil filter.

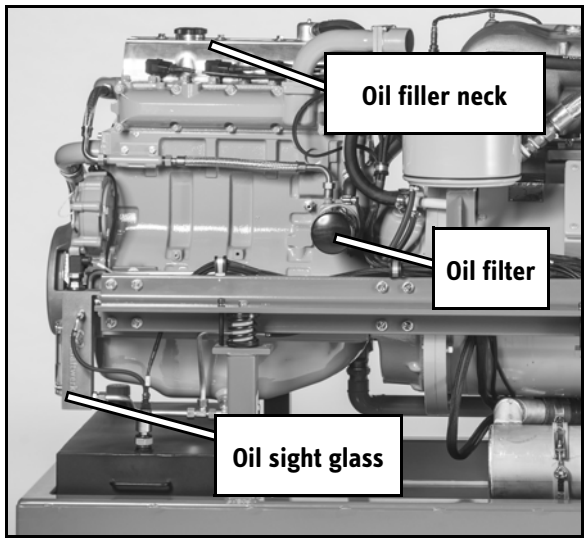
- Make sure that your hands do not come into contact with the hot engine oil.
- Wear suitable protective clothing and gloves.

It is recommended to change the engine oil while the engine is hot due to operation since hot oil reduces the draining time. The oil drain valve is located beneath the engine. You require a hose with a special thread. You can acquire one from **kraftwerk**.



- Switch off the CHP unit at the controller and set the manual switch to “0”.
- Unscrew the cap from the oil drain valve.
- Position a 15 l collection pan beneath the end of the hose.
- Only then screw the hose thread onto the valve.
- Open the drain screw and also oil filler neck so that the oil can flow out more effectively. Let the oil drain into the collection pan.
  Once the oil has drained, a oil level of about 1 cm will remain in the oil sight glass as this part is below the sight glass connection.
- Unscrew the hose again.
- Screw the cap back onto the oil drain valve.

You should change the engine oil filter before you refill the oil. The oil filter is next to the oil sight glass.



- Position a 1 l collection pan beneath the oil filter.
- Loosen the oil filter with a strap spanner or an oil filter spanner and unscrew it. Allow the oil filter to drain into the collection pan.
  Caution! Ensure that the old oil filter gasket is not stuck to the engine.
- Coat the seal of the new oil filter with oil and fasten the new oil filter into place by hand.

Now top up the oil again. The oil filler neck is on the valve lid.

- Open the oil filler neck and insert a funnel. Fill with new oil (Petro-Canada Sentron LD 5000). Quantities: 10.5 l without oil filter change, 11 l with oil filter change.
  Caution! The oil is slow to rise in the sight glass.
- Connect the oil filler neck again.
- Wait for about 10 minutes until the oil has distributed and then start up the CHP unit. Check that the new oil filter does not leak after the CHP unit has been operating for about 5 minutes.
- Dispose of the old oil correctly.

6.2.12 Checking and adjusting valve clearance

Information
Possible performance loss in the CHP unit

Set the valve clearance precisely for all cylinders. Valve clearances that have not been set will cause a drop in the CHP unit's performance.

- You must use a feeler gauge to adjust the valve clearance.
- Check the valve clearance setting.

Information
Possible damage to the CHP unit or leakage

Tighten the counter nuts on the cylinder head cover with a torque of 7 Nm. If you do not, the cylinder head cover can become damaged or leak.

Check and adjust the valve clearance when the system is cold. The correct valve clearance is **0.40 mm for the inlet valves and 0.50 mm for the outlet valves.** Check the valve clearances of a cylinder while the piston is at top dead centre of its compression stroke.
Cylinder 1 is the first cylinder as seen from the front of the CHP unit with cylinder 4 being the last.

- Switch off the CHP unit at the controller and set the manual switch to "0".
- Detach the cylinder head lid.
- Cylinder 1: Turn the crankshaft in the direction of travel until the valves on Cylinder 4 change (outlet valve is closed, intake valve is opened). You can now measure the valve clearance for Valves 1 and 2 and adjust them if necessary.
- Measure the valve clearance with a feeler gauge between the toggle lever and the end of the valve stem. If the valve clearance deviates from the specified value, loosen the counter nut and use the adjusting screw to adjust the valve clearance, so it is correct. The feeler gauge must fit tightly between the toggle lever and the end of the valve stem.
- Once the valve is adjusted, tighten the counter nut again.

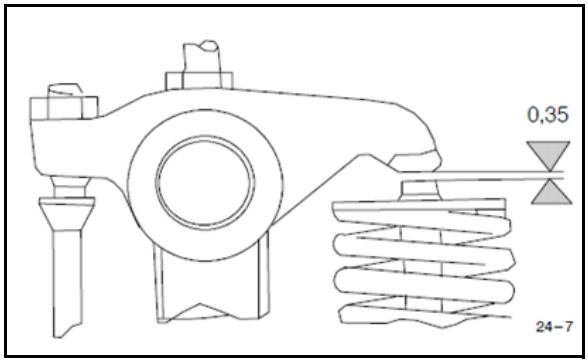


Diagram from Sisudiesel workshop manual

- Cylinder 2: Turn the crankshaft half a turn in the direction of travel so that the valves on Cylinder 3 switch. Check and measure the valve clearance for Valves 3 and 4 as described previously.
- Continue working in the order of ignition:
  Order of ignition: 1-2-4-3
  Valve switch in the cylinder: 4-3-1-2

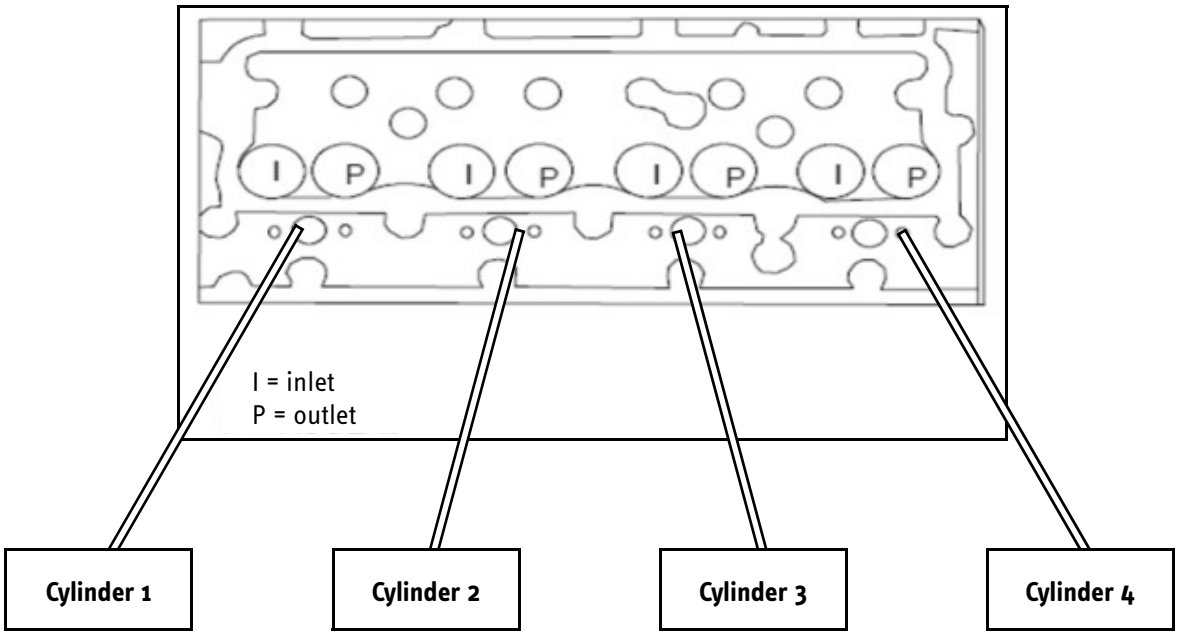


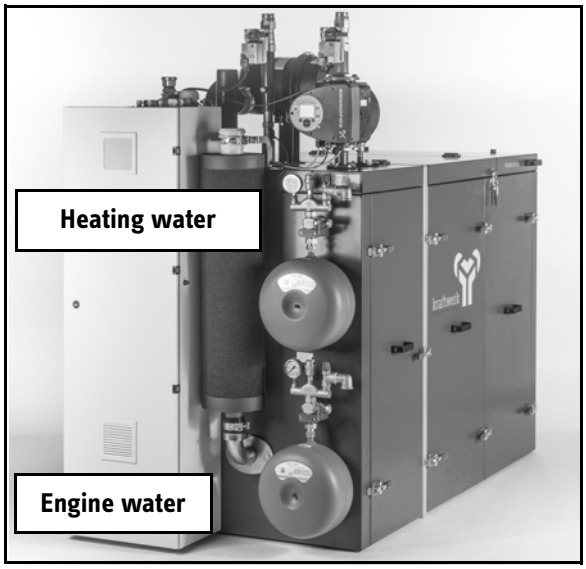
Diagram from Sisudiesel workshop manual

6.2.13 Check/correct system pressure in pressure equalisation tanks

There are usually two pressure equalisation tanks on the rear of the module. The lower pressure equalisation tank is connected to the engine water circuit and is fitted as standard. The upper pressure equalisation tank, if present, is connected to the heating circuit. This is available as an option.

First carry out a knock test. If the pressure equalisation tank sounds hollow, the diaphragm is OK; if it sounds full, the diaphragm is probably damaged and you need to replace the pressure equalisation tank.

There are two methods to check and, if necessary, correct the system pressure. If you have already drained the engine water or heating water due to other maintenance work, you do not need to dismantle the pressure equalisation tank (method 1); otherwise, you do (method 2).



Method 1 – the engine water/heating water has been drained:

The CHP unit is off.

- Leave the pressure equalisation tank on the CHP unit.
- Unscrew the valve cap from the centre of the pressure equalisation tank.
- Connect a tank filler with a pressure gauge to the valve and set the pressure:
  Heating water pressure equalisation tank 1.0 bar
  Engine water pressure equalisation tank 0.5 bar
- Remove the tank filler again and screw the valve cap back onto the valve.

Method 2 – the engine water/heating water has not been drained. You need to remove the pressure equalisation tank:

Health hazard/risk of burns
Due to hot engine water

The engine water contained in the expansion vessel can be very hot.

- Ensure that you do not come into contact with the engine water.
- Wear suitable protective clothing.

- Switch off the CHP unit at the controller and set the manual switch to “0”.
- Undo the union nut above the pressure equalisation tank with a spanner or plier wrench and remove the pressure equalisation tank. Pressure is maintained because the valves on both sides close automatically when you unscrew the nut.
- **Caution!** The valve is located in the screw joint above the pressure equalisation tank. Hold the screw joint or the valve away from your body. The water will come out under high pressure.

  Empty the pressure equalisation tank by holding the valve in the screw joint with a screwdriver handle or similar until no more water flows out. Collect the engine water/heating water that comes out in a container.
- Unscrew the valve cap from the centre of the pressure equalisation tank.

  Connect a tank filler with a pressure gauge to the valve and set the pressure:
  Heating water pressure equalisation tank 1.0 bar
  Engine water pressure equalisation tank 0.5 bar
- Remove the tank filler again and screw the valve cap back onto the valve. Re-install the pressure equalisation tank.

Additionally

During this maintenance step, you should also check and clean the connecting hose from the pressure equalisation tank to the plate heat exchanger about every 10,000 hours of operation.

- The CHP unit is off and the engine water has been drained.
- Detach the hose in the engine compartment and flush it thoroughly with water. If the hose is clogged, replace it.

6.3 CONSUMABLES, WEAR AND SPARE PARTS

Only original parts approved by **kraftwerk** may be used in order to be able to assert any warranty claims.

We maintain a webshop for service employees and service partners. You can register at **https://mephisto.parts**.

6.4 CHP UNIT CONTROLLER MESSAGES

The messages from the CHP control unit are described below. The messages are recorded in the Message log menu; the current message pending action is also displayed in the Overview menu. The message's long text is in the top line; if not identical, the short text is in the line below. Both can be displayed. The following tables are displayed in software version 1.2.13. There may be deviations, depending on the program version.

These messages may precede the following ones:

Preceding message on the CHP unit controller	Meaning
`Warning (Warnung): ...`	A warning is pending. The CHP unit is still operating
`Not ready (Nicht bereit): ...`	The CHP could not start for 20 minutes due to a pending error. The reason is entered here
`Sensor short circuit (Sensorkurzschluss): ...`	There has been a short circuit in a sensor
`Sensor defective (Sensor defekt): ...`	A sensor is defective
`Run-up (Hochlauf): ...`	An error occurred during run-up time
`Network error (Netzfehler): ...`	An error has occurred in the network
`Fault (Störung): ...`	A fault has occurred. The CHP unit is no longer running and is locked. It must be re-activated by hand.
`Fault: Sensor (Störung: Sensor)...`	There has been an error with a sensor for 20 minutes

CHP unit controller message	Meaning
`2nd temperature fault 2nd temp ft (2te Temperaturstörung 2te Tempst)`	A temperature fault value has been exceeded for the second time within 20 minutes
`2nd ext. fault in 20 min 2nd ext. f (2ter ext. Fehler in 20 min 2ter ext-F)`	An external fault has occurred for the second time within 20 minutes
`2nd int. fault in 20 min 2nd int f (2ter int. Fehler in 20 min 2ter int-F)`	An internal fault has occurred for the second time within 20 minutes

CHP unit controller message	Meaning
2nd network error in 20 min 2nd net er (2ter Netzfehler in 20 min 2ter Netzf)	A network fault has occurred for the second time within 20 minutes
Flue gas damper (Abgasklappe)	If flue gas damper fitted: flue gas damper malfunction
Flue gas temperature Flue gas temp (Abgastemperatur Abgastemp)	The temperature at the flue gas heat exchanger outlet is above the fault value set in the Analogue inputs menu
Igniter signal failure Igniter (Ausfall Zündgeber-Signale Zündgeber)	The inductive speed sensor signal is malfunctioning
CO sensor	The CO sensor has triggered
Revolving field (Drehfeld)	Revolving field incorrect
Speed max Speed max (Drehzahl max Drehz. max)	The engine speed has exceeded the maximum value specified in the CHP unit operation menu
Speed min Speed min (Drehzahl min Drehz. min)	The engine speed has fallen below the minimum value for the phase-to-neutral/delta switchover specified in the CHP unit operation menu
Speed sensor malfunctioning Sp sensor mal (Drehzahlgeber gestört N-Geber st)	The inductive speed sensor signal is malfunctioning
Delta contactor defective Contactor def. (Dreieckschütz defekt Schütz def.)	Contactor defective
Flow-through heating side Q-heating (Durchfluss Heizungsseite Q-Heizung)	Heating-side flow-through too low
Engine water circuit flow-through Flow-through (Durchfluss Motorwasserkreis Durchfluss)	Although the engine water pump is running, the flow monitor in the engine water circuit has not detected any flow-through

CHP unit controller message	Meaning
EGP (ENS) (obsolete)	The external grid and plant protection has triggered or the key switch has been turned off
External grid and plant protection Ext GP prot (Externer NA-Schutz Ext NA-Sch)	
External safety system Ext safety (Externe Sicherheits- einrichtung Ext Sicher)	A fault has occurred in an external safety system
Fault relay driver 1 Relay dr. 1 (Fehler Relaistreiber 1 Relaistr 1)	The fault detection in the relay driver has triggered
Fault relay driver 2 Relay dr. 2 (Fehler Relaistreiber 2 Relaistr 2)	
Fault relay driver 3 Relay dr. 3 (Fehler Relaistreiber 3 Relaistr 3)	
Fault relay driver 4 Relay dr. 4 (Fehler Relaistreiber 4 Relaistr 4)	
Gas pressure (Gasdruck)	The gas pressure in the gas regulation section is below the value set on the gas pressure regulator
Gas solenoid valve defective GSV defective (Gas-Magnetventil defekt GMV defekt)	One of the gas solenoid valves did not shut off when the CHP unit was switched off
Gas sensor (Gassensor)	The gas sensor has triggered
Housing temperature Housing temp (Gehäusetemperatur Gehäusetemp)	The temperature in the housing is above the warning or fault value set in the Analogue inputs menu
Generator temp. Gen. temp (Generatortemp. Gener-temp)	The generator's winding temperature is above the fault value set in the Analogue inputs menu

CHP unit controller message	Meaning
Manual switch Man. swch. (Handschalter Handsch.)	Power is no longer present downstream from the manual switch
Main contactor defective Contactor def. (Hauptschütz defekt Schütz def.)	Contactor defective
Heating emergency switch Htg emer swch. (Heizungsnotschalter Hzgnotsch.)	Power is no longer present downstream from the heating emergency switch
Htg pump (Heizungspumpe Hzg-Pumpe)	Fault in the heating-side CHP unit pump
Heating return line RL heating (Heizungs-Rücklauf RL-Heizung)	The temperature of the water coming out of the heating system is above the warning or fault value specified in the Analogue inputs menu
Heating supply line SL heating (Heizungs-Vorlauf VL Heizung)	The temperature of the water coming out of the CHP unit is above the warning or fault value specified in the Analogue inputs menu
Catalytic converter off Cat off (Katalysator-Aus Kat-Aus)	The flue gas temperature downstream from the catalytic converter is above the warning or fault value specified in the Analogue inputs menu
Catalytic converter on Cat on (Katalysator-Ein Kat-Ein)	The flue gas temperature upstream from the catalytic converter is above the warning or fault value specified in the Analogue inputs menu
No speed sensor signal Speed sensor off (Kein Drehzahlgeber-Signal N-Geber aus)	The inductive speed sensor signal is malfunctioning
No TDC encoder signal TDC encoder off (Kein OT-Geber-Signal OT-Geber au)	The inductive speed sensor signal is malfunctioning
Lambda control max Lambda max (Lambdaregelung max Lambda max)	The lambda control's controlled variable is outside the control range defined in the CHP unit operation menu. As a result, the engine is running too lean

CHP unit controller message	Meaning
Lambda control min Lambda min (Lambdaregelung min Lambda min)	The lambda control's controlled variable is outside the control range defined in the CHP unit operation menu. As a result, the engine is running too rich
Maximum starts per day reached Max Starts (Maximale Starts/Tag erreicht Max Starts)	The maximum permitted starts per day have been reached. The CHP unit may not start again on the same day if this has been configured.
Maximum output limited Pmax lmtd. (Maximalleistung begrenzt Pmax begr.)	Set maximum output < data sheet output
Engine oil temperature Oil temp (Motoröltemperatur Öltemp)	The engine oil temperature is above the warning or fault value specified in the Analogue inputs menu (Sensor only fitted as standard in G26/34)
Engine protection switch Engine protection (Motorschutzschalter Motorschutz)	The engine protection switch has triggered
Engine water pressure EnWa pressure (Motorwasserdruck Mowadruck)	The pressure in the primary cooling circuit has fallen below the warning or fault value specified in the Analogue inputs menu.
Engine water on EnWa On (Motorwasser-Ein Mowa-Ein)	The temperature of the cooling water before entering the engine is above the warning or fault value specified in the Analogue inputs menu
Engine water temp. EnWa temp (Motorwassertemp. Mowatemp)	The temperature of the cooling water coming out of the engine is above the warning or fault value specified in the Analogue inputs menu
Network asymmetry Network asymm (Netzasymmetrie Netzasymm)	The maximum neutral point displacement voltage value Un has been exceeded
Network frequency max f net max (Netzfrequenz max f-Netz max)	The maximum network frequency value f has been exceeded

CHP unit controller message	Meaning
Network frequency min f net min (Netzfrequenz min f-Netz min)	The minimum network frequency f value has not been reached
Oil pressure (Öldruck)	The oil pressure in the engine has fallen below the warning or fault value specified in the Analogue inputs menu.
Oil level max (Ölstand max)	The maximum contact in the oil level monitoring system has triggered during operation
Oil level min (Ölstand min)	The CHP unit has replenished the maximum delivery rate of engine oil set in the Service menu without the Oil level min signal disappearing during the minimum timeout set in the same menu.
Oil level min and max Oil min-max (Ölstand min und max Öl min-max)	Oil level monitoring minimum and maximum contacts are both activated at the same time: sensor error or water in the engine oil
TDC encoder malfunctioning TDC encoder mal (OT-Geber gestört OT-Geber st)	The inductive speed sensor signal is malfunctioning
P < 0	The CHP unit's total electrical power output is less than zero, i.e. the generator is consuming power
P1 < 0	The electrical power supplied by the CHP unit on the specified phase is less than zero
P2 < 0	
P3 < 0	
Parameter error Parameters (Parameterfehler Parameter)	An error occurred when reading the parameters in the EEPROM
p-diff EnWa max p-diff EnWa (p-Diff Mowa max p-Diff Mowa)	Differential pressure in the engine water pump too high: engine water circuit dirty
p-diff EnWa min p-diff EnWa (p-Diff Mowa min p-Diff Mowa)	Differential pressure in the engine water pump too low: engine water pump defective
Primary circuit SL Prim SL (Primärkreis-VL Prim-VL)	The temperature of the cooling water coming out of the flue gas manifold is above the warning or fault value specified in the Analogue inputs menu
Buffer pump (Pufferpumpe)	Fault in the buffer tank unloading pump

CHP unit controller message	Meaning
Irregularity (Unrund)	The value to ensure uniformity for the power output is above the warning or fault value specified in the Analogue inputs menu
Attempted starts Attempt. start (Startversuche Startvers)	The start-up process has failed twice in succession
STD flue gas (STB Abgas)	The flue gas safety·temperature·delimiter·STD has triggered
Synchroniser Synchron (Synchronisiergerät Synchron)	Applicable to G34 with frequency converter start only: Synchronisation failed
U1 max	The voltage in the specified phase has exceeded the maximum value
U2 max	
U3 max	
U1 min	The voltage in the specified phase has fallen below the minimum value
U2 min	
U3 min	
U1 (10 min.)	The 10-minute mean voltage in the specified phase has exceeded the maximum value
U2 (10 min.)	
U3 (10 min.)	
U12 max	The voltage between the specified phases has exceeded the maximum value
U23 max	
U31 max	
U12 min	The voltage between the specified phases has fallen below the minimum value
U23 min	
U31 min	
U12 (10 min.)	The 10-minute mean voltage between the specified phases has exceeded the maximum value
U23 (10 min.)	
U31 (10 min.)	

CHP unit controller message	Meaning
Overcurrent I1 Overcurrent (Überstrom I1 Überstrom)	The generator's overcurrent protection has triggered
Overcurrent I2 Overcurrent (Überstrom I2 Überstrom)	
Overcurrent I3 Overcurrent (Überstrom I3 Überstrom)	
Maintenance due Maintenance (Wartung fällig Wartung)	The warning or fault value specified in the CHP unit operation menu has been exceeded

7. APPENDIX

7.1 CONNECTOR AND TERMINAL ASSIGNMENT (2024-10)

Clamp	XS1		XS2			XS3		
term	Mains connection / compensation		Safety chain, power supply			Relay outputs		
Signal	400 V		230 V			pot.-free (230 V / 3,15 A)		
object	Main switch / compensation		ext. emergency stop / heating pump / etc.			external relay outputs		
Type	Terminal block		Three-level clamp			Three-level clamp		
Contact No.	Connection/Signal		Connection/Signal			Connection/Signal		
	L1	L1 network	1	L3->	ext. heating emergency switch *	1	C	Relay outputs 1
	L2	L2 network	21	L3<-	ext. heating emergency switch *	11	NO	CHP in operation
	L3	L3 network	PE			21		n.c.
	N	N network	2	L3->	ext. gas sensor *	2	C	Relay outputs 2
	PE	PE network	22	L3<-	ext. gas sensor *	12	NO	CHP ready
	1'	ext. reactive power compensation L1*	PE			22	NC	CHP not ready
	2'	ext. reactive power compensation L2*	3	L3->	ext. STB / condensate lifting system*	3	C	Relay outputs 3
	3'	ext. reactive power compensation L3*	23	L3<-	ext. STB / condensate lifting system*	13	NO	CHP plant malfunction
	PE	ext. reactive power compensation PE*	PE			23	NC	CHP not disturbed
			4	L3->	ext. NA protection *	4	C	Relay outputs 4
			24	L3<-	ext. NA protection *	14	NO	Boiler lock
			PE			24	NC	Boiler release
			5	L1	ext. heating circuit pump for CHP	5	C	Relay outputs 5
			25	N	ext. heating circuit pump for CHP	15	NO	Boiler bypass on
			PE			25	NC	Boiler bypass closed
			6	L1	ext. capacitor contactor ***	6	C	Relay outputs 6
			26	N	ext. capacitor contactor ***	16	NO	Mixer control / shut-off valve *
			PE			26	NC	
			7	L1	ext. gas sensor	7	C	Relay outputs 7
			27	N	ext. gas sensor	17	NO	Mixer/cooler control shut-off valve *
			PE			27	NC	
			8	L1	ext. buffer discharge pump	8	C	Relay outputs 8
			28	N	ext. buffer discharge pump	18	NO	Buffer discharge pump / gas blower / exhaust flap / shut-off valve *
			PE			28	NC	
			9	L1	ext. shut-off valves **			
			29	N	ext. shut-off valves *			
			PE					

* Not applicable for G8/G50, because Capacitor integrated in control cabinet

* If connected, then remove bridge

** Clamps only for G26/G34/G50

*** internal capacitor contactor G8/G50 free at G50 synchronous

* Optional function

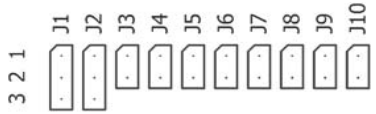
APPENDIX

Clamp	XS4	XS5	XS6 (optional)	FÜM
term	external sensors/actuators	external communication	Fault reporting module	VPN router
Signal	24 V	BUS / 24 V	24 V	Ethernet / Mobile
object	external sensors/actuators	Computer card	Computer card	Remote monitoring module
Type	Transfer module	Transfer module	Transfer module	RJ45
Contact No.	Connection/Signal	Connection/Signal	Connection/Signal	Connection/Signal

XS4				XS5			XS6 (optional)			FÜM	
1	+	Flow sensor*	-2,5...+2,5 V	1	+	+5 V, flow sensor	1	+	Alarm input DI 20*	LAN1	Network connection CHP1
2	-			2	-	GND, flow sensor	2	-			
3	+	ext. analog input 1	0..20mA: J6: 1-2	3	+	CAN-H	3	+	Alarm input DI 21*	LAN2	Network connection CHP2
4	-	Target power/HK-VL-target	0..10 V: J6: n.c.	4	+	CAN-L	4	-			
5	+	ext. Pt1000 sensor 1	900...1500 Ω	5	-	CAN-GND	5	+	Alarm input DI 22*	LAN3	Network connection CHP3 Laptop
6	-	outside temperature		6	+	CAN-H	6	-			
7	+	ext. Pt1000 sensor 2	900...1500 Ω	7	+	CAN-L	7	+	Alarm input DI 23*	WAN	On-site Internet / Bus connection Modbus-TCP
8	-	main circuit flow		8	-	CAN-GND	8	-			
9	+	ext. Pt1000 sensor 3	900...1500 Ω	9	+	RS485-A (GENIBUS-A) ***	9	+	Alarm input DI 24*	Ant. Main	Main antenna for mobile data connection
10	-	main circuit return		10	+	RS485-B (GENIBUS-B) ***	10	-			
11	+	ext. Pt1000 sensor 4	900...1500 Ω	11	-	RS485-GND (GENIBUS-Y) ***	11	+	Alarm input DI 25 */**	Ant. Aux	Additional antenna to improve reception
12	-	buffer temp. Top		12	+	RS485-A (Modbus-A)	12	-			
13	+	ext. Pt1000 sensor 5	900...1500 Ω	13	+	RS485-B (Modbus-B)	13	+	Alarm input DI 26 */**	24 V	Power supply
14	-	buffer temp. Bottom		14	-	RS485-GND (Modbus-GND)	14	-			
15	+	ext. analog input 2 /	4..20 mA: J1/J2/J3/J4: 1-2	15		reserved	15	+	Alarm input DI 27 */**	WiFi	WLAN antenna connection
16	-	Heating pressure	0..20 mA: J1/J2: 2-3, J3: n.c., J4: 1-2 0..10 V: J1/J2: 2-3, J3: n.c., J4: n.c.	16			16	-			
17	+	ext. analog output 1	0..20mA: J9: n.c.	17	+	ext. start request CHP *				RS232	Serial connection to the CHP computer
18	-	electrical actual power	0..10 V: J9: 1-2	18	-						
19	+	ext. Analogausgang 2	0..20mA: J10: n.c.	19	+	Feed-in management 0 % *				RS485	Connection RiCo large display
20	-		0..10 V: J10: 1-2	20	-	/ Load request / DHW load **					
				21	+	Feed-in management 0 / 30 % *					
				22	-	/ Pulse gas meter**					
				23	+	Feed-in management 60 % *					
				24	-	/ Impulse heat meter **					
				25	+	Feed-in management 100 % *					
				26	-	/ Impulse object current meter **					

Jumper overview power board

ATTENTION! For G50, G8 & from G225882061 the circuit board is rotated by 180°



* Reserved at G50

** Pressure measurement heating (option)

* Digital input

** Optional function

*** Bus connection CHP/boiler/ Buffer discharge pump

* Digital input

** not for IF555-5 (Touch panel)

Clamp term	XLP01 Power board	XLP02 Power board	XLP03 Power board	XLP04 Power board
Signal object	230 V Safety chain / mains voltage measurement	pot.-free (230 V / 3,15 A) external relay outputs	24 V, 230 V internal relay outputs	24 V 24 V supply / actuators
Type	Connectors 16 pin.	Connectors 24 pin.	Connectors 24 pin.	Connectors 16 pin.

Contact No.	XLP01 Signal/Connection			XLP02 Signal/Connection			XLP03 Signal/Connection			XLP04 Signal/Connection		
1	L3	Monitoring ext. heating emergency switch	1	NO	Relay outputs 8	1	-	LPGND	1	-	LPGND*
2	L3	Monitoring main switch	2	NC	Relay outputs 8	2	+	+ 24 V Power supply modem	2	+	24 V (200 mA)*
3	L3	Monitoring hand switch	3	C	Relay outputs 8	3		n.c.	3	-	LPGND*
4	L3	Monitoring STB 1	4	NO	Relay outputs 7	4	NO	L3, Switching output contactor K4, compensation ***	4	+	24 V (200 mA)*
5	L3	Monitoring ext. gas sensor	5	NC	Relay outputs 7	5	NC	L3, Switching output contactor K4, compensation ***	5	-	LPGND, option LON/RS485 converter
6	L3	Monitoring ext. STB 2	6	C	Relay outputs 7	6	C	L3 of K1A1 ***	6	+	24 V, option LON/RS485 converter
7	L3	Monitoring ext. NA protection	7	NO	Relay outputs 6	7	NO	L1, Switching output CHP heating pump	7	+	Digital pulse input electric meter
8		n.c.	8	NC	Relay outputs 6	8	NC	L1, Switching output CHP heating pump	8	-	RGND
9	N	Monitoring on terminals 1-7	9	C	Relay outputs 6	9	C	L1 of F1	9	+	Digital input manual start switch
10		n.c.	10	NO	Boiler bypass on	10	NO	L1, Switching output engine water pump	10	-	RGND
11	N*	Mains voltage measurement	11	NC	Boiler bypass off	11	NC	L1, Switching output engine water pump	11	-	LPGND, Gas control system
12	L1*	Mains voltage measurement	12	C	Boiler bypass	12	C	L1 of F1	12	+	24 V, Gas control system
13		n.c.	13	NO	Boiler lock	13	NO	L2, Switching output gas solenoid valve 2	13	-	LPGND, Connector board KWKSxx/xx
14	L2*	Mains voltage measurement	14	NC	Boiler release	14	NC	L2, Switching output gas solenoid valve 2	14	+	24 V, Connector board KWKSxx/xx
15		n.c.	15	C	Boiler lock/release	15	C	L2 of XLP03.18 via F2	15	-	LPGND, from power supply
16	L3*	Mains voltage measurement	16	NO	CHP plant malfunction	16	NO	L2, Switching output gas solenoid valve 1**	16	+	24 V, from power supply
			17	NC	CHP plant malfunction	17	NC	L2, Switching output gas solenoid valve 1 **			
			18	C	CHP plant malfunction	18	C	L2 of XS10.3 via F2			
			19	NO	CHP ready	19	NO	L3, Switching output delta contactor K2			
			20	NC	CHP ready	20	NC	L3, switching output star contactor K3*			
			21	C	CHP ready	21	C	L3 of XLP03.22 via F3			
			22	NO	CHP in operation	22	NO	L3, Switching output main contactor K1			
			23	N	RC elements	23	NC	L3, Switching output main contactor K1			
			24	C	CHP in operation	24	C	L3 of XS2.24 via F3			

* Inverter contactors K3.1, K3.2, K3.3 for G50

** Gas solenoid valve compact module for G8

*** 60 V excitation voltage for G50 Synchron

* PIN 1 - 4 optionally assigned

Clamp	XS10	XS11	XS20.A	XS20.B
term	int. power supply	Test disconnect terminals	Sensor wiring harness	Ignition harness
Signal	230 V	230 V	12 V, 24 V, analog / digital inputs	24 V, 230 V, digital inputs and outputs
object	Power supply, pumps, gas solenoid valves, ...	Mains voltage measurement	Machine set	Machine set
Type	Three-level clamp	Series disconnect terminal	Connectors 42 pin.	Connectors 24 pin.

Contact No.	Signal/Connection			Signal/Connection			Signal/Connection			Signal/Connection			Signal/Connection		
	1	L2	from security F2	L1	from security F1		1	-	Pt 1000, AGND	30	-	AGND Lambda sensor	1	+	Ignition pulse 1st cylinder
	2	L2	Safety socket	L2	from security F2		2	-	Pt 1000, AGND	31	-	RGND Engine oil level	2	+	24 V, ignition *
	3	L2	Gas solenoid valve 1 + 2	L3	from security F3		3	-	Pt 1000, AGND	32	-	reserved (RGND Engine oil level)	3	+	24 V, Oil refill pump
	4	L2	L2	L1*	L1, Mains voltage measurement		4	-	Pt 1000, AGND*	33	-	AC/Gnd, NW sensor	4	+	PWM-IST Motor Water Pump **
	5	L2	L2	L2*	L2, Mains voltage measurement		5	-	Pt 1000, AGND	34	PE	PE, shield KW sensor	5	+	Ignition pulse 2st cylinder
	6	L2	L2	L3*	L3, Mains voltage measurement		6	-	Pt 1000, AGND	35	-	AC/Gnd, KW sensor	6	-	ZGND, ignition
	7	L2	Power supply G16+/G20+/G22/G50*	N	N of XS10.20		7	-	Pt 1000, AGND	36	+	12 V, Lambda sensor heating	7	-	LPGND, Oil refill pump
	8	L2	L2	N*	N, Mains voltage measurement		8	+	Pt 1000, Primary circuit flow	37	+	mV, Lambda sensor	8	-	PWM-GND Engine water pump **
	9	L2	L2	10	L3, Main contactor control		9	+	Pt 1000, Engine water inlet	38	+	24 V, Engine oil level min.	9	+	Ignition pulse 3st cylinder
	10	L2	L2	10*	L3, Main contactor control		10	+	Pt 1000, Engine water outlet	39	+	24 V, Engine oil level max.	10		n.c.
	11	L2	L2				11	+	Pt 1000, engine oil*	40	+	AC signal, KW sensor	11		n.c.
	12	L2	L2				12	+	Pt 1000, T exhaust	41	PE	shield NW sensor	12		n.c.
	13	N	by XS1				13	+	Pt 1000, T Housing air	42	+	AC signal, KW sensor	13	+	Ignition pulse 4st cylinder
	14	N	Safety socket				14	+	Pt 1000, T CHP feed line				14	-	ZGND, Ignition pulse
	15	N	RC elements Relay 9 -15				15	-	Pt 1000, AGND				15		n.c.
	16	N	Digital inputs (monitoring)				16	-	NiCrNi, AGND				16	N	N, Engine water pump
	17	N	Heating circuit pump				17	-	NiCrNi, AGND				17	+	PWM-SOLL Engine water pump **
	18	N	N				18	+	24 V, Oil pressure sensor				18		n.c.
	19	N	Power supply				19	+	24 V, Engine water pressure sensor 1				19	-	RGND, Flow/leakage switch**
	20	N	Mains voltage measurement				20	+	24 V, Engine water pressure sensorr 2*				20	L1	Engine water pump
	21	N	Contactor K1.A2, K2.A2, K3.A2**				21	-	reserved (Pt 1000, AGND) **				21	+	reserved (Ignition pulse 6st cylinder)***
	22	N	Gas solenoid valvee				22	+	Pt 1000, T Return CHP				22		n.c.
	23	N	Engine water pump				23	+	NiCrNi, T Catalyst entry				23	+	24 V, Flow/leakage switch**
	24	N	N				24	+	NiCrNi, T Catalyst leak				24	PE	reserved (PE)
	25	PE	Power supply + STB				25	-	4 - 20 mA, Oil pressure sensor				PE	PE	Engine water pump
	26	PE	Schuko socket				26	-	4 - 20 mA, Engine water pressure sensor 1						
	27	PE	Control cabinet fan				27	-	4 - 20 mA, Engine water pressure sensor 2*						
	28	PE	XS22				28	+	reserved (Pt 1000, generator) **						
	29	PE	XS20A + XS20B				29	-	GND, Lambda sensor heating						

* Power supply for G26/G34 at L3 via F4 and Q1.HIA.3+4

** Terminal A2 on K1, K2, K3.1, K3.2, K3.3 at G50

* if installed

** optional generator bearing temperature

* Bridge FS1-FS2 plugged +24 V

* Bridge FS1-FS3 plugged +12 V

** if installed

*** NW adjustment for G16+/G20+/G22

Clamp term	XS21			XS22						X1 bis X5 **		
Signal object	generator wiring harness			Connection plate wiring harness						Ignition box		
Type	400 V, 24 V			24 V, 230 V						24 V, High voltage		
	Generator / Winding sensor			Gas control system / pumps / sensors						Ignition coils		
	Connectors 12 pin.*			Connectors 24 pin.						Power strips		
Contact No.	Signal/Connection			Signal/Connection			Signal/Connection			Signal/Connection		
	1	L1	U1 generator	1	+	0..5 V Gas flow control valve *	30		n.c.	X1.1	+	U primary, Ignition coil 1. cylinder
	2	L2	V1 generator	2	-	RGND Gas flow control valve	31		n.c.	X1.2	+	n.c. (ignition pulse 1st cylinder over 1 kW)
	3	L3	W1 generator	3	+	0..5 V Throttle valve drive *	32		n.c.	X1.3	+	24 V, Ignition coil 1. cylinder*
	4	L1	W2 generator **	4	-	RGND Throttle valve drive	33		n.c.	X1.4	-	n.c. (ZGND)
	5	L2	U2 generator **	5	+	24 V, Gas pressure switch	34		n.c.	X1.5	-	n.c. (RGND Ignition pulse)
	6	L3	V2 generator **	6	-	RGND Gas pressure switch	35		n.c.	X2.1	+	U primary, Ignition coil 2. cylinder
	7	L1	U3 generator * / **	7	+	Stepper Motor Throttle1 1+ **	36	-	RS485-GND (GENIBUS-Y) ***	X2.2	+	n.c. (ignition pulse 2st cylinder over 1 kW)
	8	L2	V3 generator * / **	8	-	Stepper Motor Throttle1 1- **	37	+	RS485-A (GENIBUS-A) ***	X2.3	+	24 V, Ignition coil 2. cylinder*
	9	L3	W3 generator * / **	9	+	Stepper Motor Throttle1 2+ **	38	+	RS485-B (GENIBUS-B) ***	X2.4	-	n.c. (ZGND)
	N	N	Neutral conductor ***	10	-	Stepper Motor Throttle1 2- **	39		n.A.	X2.5	-	n.c. (RGND Ignition pulse)
	PE	PE	Protective conductor	11	+	Stepper Motor Lambda 1+ **	40	+	flow, flow sensor**	X3.1	+	U primary, Ignition coil 3. cylinder
	+Err		Excitation machine ***	12	-	Stepper Motor Lambda 1- **	41	-	GND, flow sensor **	X3.2	+	n.c. (ignition pulse 3st cylinder over 1 kW)
	-Err		Excitation machine ***	13	+	Stepper Motor Lambda 2+ **	42	+	+5 V, flow sensor **	X3.3	+	24 V, Ignition coil 3. cylinder*
				14	-	Stepper Motor Lambda 2- **	PE	PE	Gas pressure switch, pump	X3.4	-	n.c. (ZGND)
				15	+	PWM-SOLL Heating circuit pump **				X3.5	-	n.c. (RGND Ignition pulse)
				16	-	PWM-GND Heating circuit pump **				X4.1	+	U primary, Ignition coil 4. cylinder
				17	+	24 V, Gas flow control valve				X4.2	+	n.c. (ignition pulse 4st cylinder over 1 kW)
				18	-	LPGND, Gas flow control valve				X4.3	+	24 V, Ignition coil 4. cylinder*
				19	+	24 V, Throttle valve drive				X4.4	-	n.c. (ZGND)
				20	-	LPGND, Throttle valve drive				X4.5	-	n.c. (RGND Ignition pulse)
				21	L2	Gas solenoid valve GMV1				X5.1	+	Ignition pulse 1.cylinder
				22	L2	Gas solenoid valve GMV2				X5.2	+	Ignition pulse 2.cylinder
				23	N	GMV1, GMV2				X5.3	+	Ignition pulse 3.cylinder
				24	L1	Heating circuit pump für BHKW **				X5.4	+	Ignition pulse 4.cylinder
				25	N	Heating circuit pump **				X5.5	-	RGND Ignition pulse
				26		n.c.				X5.6	PE	PE, Screw ignition box
				27		n.c.				X5.7	+	ZGND
				28		n.c.				X5.8	+	24 V
				29	+	PWM-IST Heating circuit pump **				X5.PE	PE	PE

* Winding tapping not required for G22, G50

** not applicable for G50 Synchron

*** at G50 Synchron

* J7 or J8 open: 0..20 mA

* J7 or J8 closed: 0..5 V

** standard on Mephisto G8

*** from G225882061

* Bridge FS1-FS2 plugged +24 V

* Bridge FS1-FS3 plugged +12 V

** Ignition box omitted for G8/G26/G34/G50

7.2 DECLARATION OF CONFORMITY

EU-Konformitätserklärung
(Gemäß MRL 2006/42/EG Anhang II 1.A)

kraftwerk

CE

Der Hersteller

Kraftwerk Kraft-Wärme-Kopplung GmbH
Am Lindener Hafen 30
30453 Hannover
Tel.: 0511 262 997 0

erklärt hiermit in alleiniger Verantwortung, dass Blockheizkraftwerke vom Typ

MEPHISTO G8, G16+, G20+, G22, G26, G34, G35 und G50

EU-Baumustergeprüft sind

- nach Gasgeräteverordnung (EU) 2016/426 (EU-Baumusterprüfbericht: ET 642 2023 B7)
- nach DIN EN 50465:2020-09 (EU-Baumusterprüfbericht: ET 642 2023 E8)

durch die notifizierte Stelle

DVGW CERT GmbH, Josef-Wirmer Straße 1-3, D-53123 Bonn
Kennnummer: 0085 EU-Baumusterprüfbescheinigung: CE-0085DN0501

konform sind mit folgenden **EG-/EU-Richtlinien:**

- Maschinenrichtlinie 2006/42/EG
- Niederspannungsrichtlinie 2014/35/EU
- EMV-Richtlinie 2014/30/EU

folgende **harmonisierte Normen** wurden angewandt:

- DIN EN ISO 12100:2011-3 Sicherheit von Maschinen
- DIN EN 60204-1:2019-06 Sicherheit von Maschinen - Elektrische Ausrüstung von Maschinen
- DIN EN IEC 61000-3-11:2021-03 Elektromagnetische Verträglichkeit (EMV) Teil 3-11
- DIN EN 61000-3-12:2012-06 Elektromagnetische Verträglichkeit (EMV) Teil 3-12
- DIN EN ISO 8528-13:2017-03 Stromerzeugungsaggregate mit Hubkolben-Verbrennungsmotor - Sicherheit
- DIN EN 60335-1:2020-8 Sicherheit elektrischer Geräte für den Hausgebrauch oder ähnliche Zwecke
- DIN EN 60335-2-102:2016-09 Teil 2-102: Besondere Anforderungen für Gas-, Öl- und Festbrennstoffgeräte mit elektrischen Anschlüssen

folgende **nationale Richtlinien** wurden angewandt:

- VDE-AR-N 4105:2018-11 Erzeugungsanlagen am Niederspannungsnetz
- DVGW VP 109, Ausgabe 1995-04 Anschlussfertige BHKW mit gasmotorisch angetriebenem Generator

Diese Erklärung wird verantwortlich für den Hersteller abgegeben durch:

Hannover, 20. Dezember 2023

Dipl.-Ing. Jörn Laue
Geschäftsführer

Dipl.-Ing. Gunther Duensing
Geschäftsführer

kraftwerk Kraft-Wärme-Kopplung GmbH | Am Lindener Hafen 30, 30453 Hannover | Tel.: 0511 262 997-0 | mail@kwk.info | www.kwk.info

mail@kwk.info
www.kwk.info