Original Operating Manual
for Standard Liquid-cooled Chillers

(as per DIN EN 378-2 Art.6.4.3.2)

SMARDT-OPK

Manufacturer:	Smardt-OPK Chillers GmbH Bahnhofstraße 74 D-73240 Wendlingen Tel: +49 (0) 7024-79429-0 Fax: +49 (0) 7024-79429-22 info.eu@smardt.com www.smardt.com
Plant description:	Turbo chiller with liquid-cooled condenser
Plant type:	WB140.3HH.2FHNKA.F2BBK.0NX
Medium condenser:	Water
Medium evaporator:	Water

SMARDT

Revision: 180206FS

1 Introduction

Chillers by Smardt-OPK Chillers GmbH are efficient refrigeration plant for chilling media on water basis. The machines are manufactured in our German factory in Wendlingen to match your requirements.

These operating instructions contain basic instructions that must be considered during assembly, operation and maintenance. Therefore, it is essential that the operator has read this manual and that this manual must always be available at the place where the machine is used. Consider the safety instructions, the existing national regulations on accident prevention as well as any internal working, operating and safety regulations.

1.1 Proper Use of the Equipment

Chillers may only be operated with the media specified in the technical data sheet. Consider local accident prevention regulations.

1.2 Non-intended Use of the Equipment

Only use and operate the system for its intended purpose. The machine may only be operated if all safety components are installed and functional. Only original parts acc. BOM to be used. Modifications to the machine may only be carried out by the manufacturer, supplier or customer service.

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2 Hazard Symbols Used

The chiller is equipped with the following warning signs on or near dangerous components in order to point at given hazard:

Danger due to electrical voltage!
Risk of electric shock when touching live parts.

Danger due to hot surfaces!
Temperature is higher than +45 °C (Denaturation of proteins) and can cause burns oft he skin.

Draw-in hazard!
Parts of the body, clothing and other objects can be drawn in by rotating parts.

It is necessary to regularly check, whether the warning signs are still visible in the correct places of the refrigeration plant. Eventually these signs must be renewed. In addition, the respective chapters of these operating instructions refer to given hazards. Therefore, the text passages marked with danger symbols must be read with the greatest attention.

Information that is urgently required to prevent damage to the chiller is indicated by the following symbol and accompanied by information text. These texts must also be read thoroughly. Compliance with the relevant measures must be ensured by the operator.

Additional information

3 Hazards in refrigeration plant

Loading and unloading the refrigeration plant

There is a risk of crushing, shearing, jarring, drop of heavy parts, stumbling, slipping, falling as well as burns by discharging refrigerant when tearing lines.

Transport of the refrigeration plant

There is a risk of crushing, shearing, jarring, drop of heavy parts, stumbling, slipping, falling as well as burns by discharging refrigerant when tearing lines.

Commissioning

There is a risk of cutting, cutting or squeezing with running fans, direct contact with live parts, burns by touching hot parts of the plant and burns by contact with liquid refrigerant.

Automatic operation

There is a risk of cutting, cutting or squeezing with running fans, direct contact with live parts, burns by touching hot parts of the plant and burns by contact with liquid refrigerant.

Fault detection

There is a risk of cutting, cutting or squeezing with running fans, direct contact with live parts, burns by touching hot parts of the plant and burns by contact with liquid refrigerant.

Troubleshooting by service

There is a risk of cutting, cutting or squeezing with running fans, direct contact with live parts, burns by touching hot parts of the plant and burns by contact with liquid refrigerant.

Servicing

There is a risk of cutting, cutting or squeezing with running fans, direct contact with live parts, burns by touching hot parts of the plant and burns by contact with liquid refrigerant.

Cleaning work

There is a risk of cutting, cutting or squeezing with running fans, direct contact with live parts, burns by touching hot parts of the plant and burns by contact with liquid refrigerant.

Soldering

There is a risk by formation of dangerous particles, risk of damage due to leakage of gas bottles, formation of explosive mixtures as well as fire hazard due to outflowing oxygen and sparks.

Welding

There is a risk by formation of dangerous particles, risk of damage due to leakage of gas bottles, formation of explosive mixtures as well as fire hazard due to outflowing oxygen and sparks.

4 Description of chiller and components

Chiller consists of compressor, condenser, expansion valve and evaporator. To improve the ease of servicing, sight glasses, shut-off valves, service valves and if necessary special filter dryers are installed. The chiller is equipped with safety organs, which prevent undue high pressure and freezing.

4.1.1 Compressor

The compressor compresses gaseous refrigerant to a higher pressure and temperature level. Further information about the compressor can be found in the component documentation.

4.1.2 Condenser

Inside the condenser the phase of the refrigerant changes from gas to liquid. The heat rejected during condensation is transferred to an liquid cooling medium. It must be considered to use only the cooling medium listed in the technical data sheet. Regular inspection of the medium is recommended.

4.1.3 Expansion Valve

The expansion valve expands the liquid refrigerant from a high condensing pressure level to a lower evaporation pressure level. Liquid level control or superheat control can be realized with this valve. By using an electric expansion valve the heat exchangers work more efficient and the compressor is protected against liquid slugging.

4.1.4 Evaporator

Inside the evaporator the phase of the refrigerant changes from liquid to gas. Evaporation consumes heat and this heat is revoked from the chilled medium. The temperature of the chilled medium decreases. It must be considered to use only the chilled medium listed in the technical data sheet. Regular inspection of the medium is recommended.

4.1.5 Sight Glass

The sight glass enables visual inspection of the operation conditions. Sight glasses with indicators indicates humidity inside the refrigerant cycle.

4.1.6 Manometer

Manometers show the excess pressure in the refrigerant cycle. A high pressure and a low pressure manometer are installed. The double scale shows the pressure and the relative saturation temperature of the refrigerant.

4.1.7 Filter Dryer

Filter dryers are installed to filter small particles and absorb residual humidity from the refrigerant cycle.

4.1.8 Safety Valves

Pressure limiters and safety relief valves protect the chiller from a undue high pressure. Safety relief valves must be inspected or replaced every 5 years.

Release of Refrigerant
In case of refrigerant release via the valves, keep away from stream. The expanding refrigerant can cause burns after contact to the body

4.1.9 Miscellaneous Components

The piping is made of welded stainless steel, premium refrigeration copper tubes and carbon steel.
Flow sensors, temperature and pressure sensors are used for the chiller control. Shut-off valves facilitate component replacement during servicing. To prevent water condensation on cold components and pipes, the chiller is partly insulated.

5 Functional Description

The chiller cools the chilled medium to a preset setpoint of the evaporator outlet temperature within the limits of its application limits, with constant volume flows via evaporator and condenser.

This setpoint can be changed by means of setpoint shifting. As a result, the desired value can be raised as required and the efficiency of the refrigerating machine can be increased. The setpoint shift can be done manually via the Web Panel or via an external 0-10V signal (equivalent to 0-6 K) from the BMS.

If the evaporator outlet temperature drops below the preset setpoint, the machine automatically restricts the power until the machine is switched off.

6 Proper loading and unloading the chiller

Components of the chiller are mounted as a unit on a sturdy frame. Installations on cross strut frames may only be transported by crane. The following illustration is schematic. In the case of frameless chillers, the crane eyes are provided on the heat exchangers.

6.1 Frameless chillers

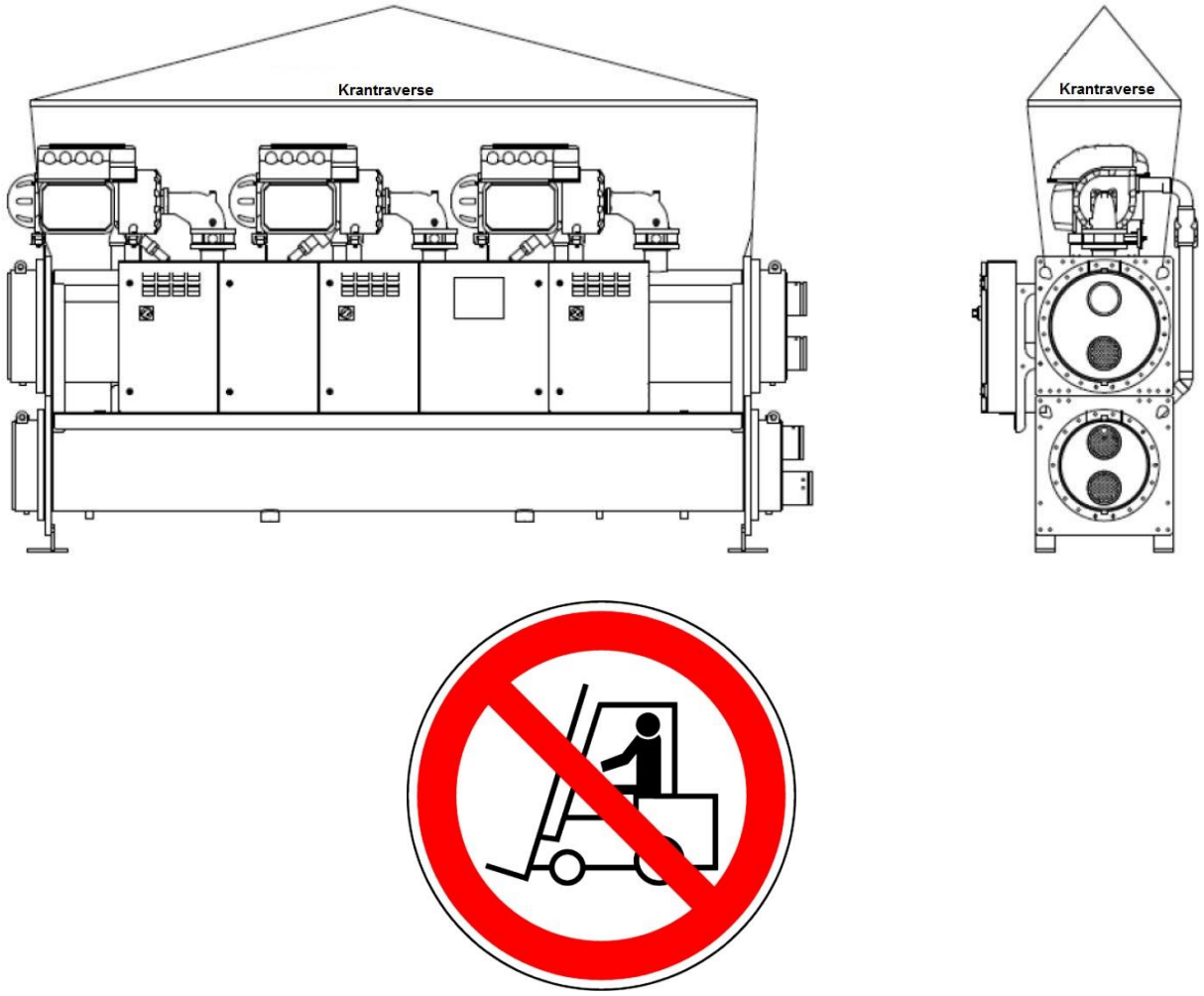

Figure 1. Transportation with crane at frameless design

7 Erection and connection

7.1 Installation of Smart-OPK chillers

The machine must be standing horizontally. If no special spring elements are provided, the machine must be placed on the supplied rubber granulate strips. All components supplied by Smardt-OPK must be placed on a firm, solid foundation (for example concrete foundations, etc.). The maximum permissible ambient temperature at the installation site is 40 ° C.

7.2 Clearance

Inspection areas as per drawing must be kept clear. In special cases the clearances can be reduced after consulting SMARDT-OPK.

7.3 Piping Connection

The connection of Smardt-OPK chillers to the existing water network can be established by means of a VICTAULIC or a flange connection. If the heat exchanger can be shut-off from the entire liquid network, a protective device that protects against liquid pressure must be installed in the separated liquid network. The media connections of the heat exchangers must be connected correctly. In order to prevent confusion, signs are attached to the connectors.

A filter with a mesh width of less than 0.5 mm must be provided before the inlets of the heat exchangers.

For the proper installation of such a connection, consult the applicable regulations and component documents for help.

7.4 Flow sensors

Correct installation of the flow sensors is mandatory. The sensors protect the system from serious damage. Incorrect installations reduce the measuring accuracy considerably and thus the protection functions. The correct mounting of the flow sensor is described in the separated component documentation

7.5 Electrical connection

The electrical connection of the machine must be made according to the specifications in the wiring diagrams. The electrical supply lines must be designed and manufactured by a qualified specialist.

Danger due to electrical voltage!
Risk of electric shock when touching live parts.

Danger due to electrical voltage!
After completion of wiring works the connection of powered parts to the PE must be checked.

8 Water Cycle

For operation, the water circuit must be pressurized (system pressure) to prevent air from accumulating in the system. The system pressure shall be determined by the operator according to local conditions. **The maximum operating pressure of the system is 10 bar_g** and must not be exceeded in any operating condition. On-site measures must ensure that an impermissibly high pressure does not occur in the media circuit due to the increase in the volume (for example, by the installation of a diaphragm expansion vessel).

For systems with water, it must be noted that a lot of oxygen is dissolved in the water due to the filling process. Therefore, these systems must be vented several times at the highest pipeline points after filling. The system pressure must be checked and water added after each venting process. The pumps must be taken out of service for venting.

Incorrect Ventilation
If there is still gas in the hydronic system constant flow is not guaranteed. This can lead to damage of the pumps and to automatic shutdown of the chiller.

The water quality has an impact on durability, reliability and efficiency of the plant. Thus the quality of media in chilled water and cooling water circuit has to be checked frequently, especially after mechanical modification of the circuits. Below Table shows benchmarks for quality.

Table 1. Benchmark for Chilled and Cooling Water Qualities

Guideline table	Unit	Unit addition	Regular requirements chilled water	Regular requirements cooling water
Appearance			clear, without sediment	clear, without sediment
Color			pale to yellowish	pale to yellowish
Smell			none to slight	none to slight
pH value (25°C)			7 – 9	7,5 – 9
Elect. conductivity (25°C)	mS/m	LF	< 300	< 220
Alkalies	mol/m^3	Ca, Mg	< 5,4	> 20
Total hardness	°d	H	< 30	< 60
Carbonate hardness at use with hardness stabilizers	°d	KH	< 2	<20
Chloride	g/m^3	Cl	< 150	< 150
Colon-forming units	1/ml	CFU	< 1.000	< 10.000
Legionellae	1/ml	CFU		< 10

Flow Rate
The flow rates specified in the data sheet must not be exceeded. During commissioning the pumps must be adjusted.

Operation of One or More Chillers in One Hydronic Circuit
Hydraulic balancing must be carried out by the customer. Ensure that each chiller is supplied with the required volume flow.

9 Sequence for initial start-up of the chiller

The following procedure must be followed for the first commissioning of the chiller.

1. Establish and inspect the correct voltage supply as specified in the circuit diagram.
2. Check whether isolation valves are open and every pipe branch can be filled
3. Correct filling with specified media. Additive or glycol concentration must be checked and observed. Recommended values for water are given in Check that fuses and breakers haven't tripped
4. The PLC boots the program in automatic mode
5. .
6. Check water pressure
7. Media pumps must be ready for operation and must be adjusted to the required volume flow
8. Turn the main switches to ON
9. Check that fuses and breakers haven't tripped
10. The PLC boots the program in automatic mode

10 Turn on and turn off the chiller

10.1 Commissioning/Re-commissioning

Before switching on the main switch, disconnect the motor protection switch or the fuses to avoid the accidental switching on of the compressor.

10.2 Power supply recovery

When the system is powered up at commissioning, restarting, or blackout, all faults that may be present are acknowledged when the control unit is started up, and the system remains in the condition before the power supply disconnection.

10.3 Switching on by the control switch / automatic operation

After switching on the main switch, the system can be operated via the Web Panel. Check whether the switch(s) of the compressor(s) is in the "off" position. Then, the compressor(s) can be set to standby by setting all switches to automatic.

If the chiller is released by the higher-level control system, the chiller starts its operation.

The cooling machine can be released via a hardware contact to the BMS. If there is no connection to the BMS, the machine must be released by bridging the hardware contact. If the evaporator outlet temperature is higher than the preset setpoint, the system starts automatically.

10.4 Short-time switch-off (main switch remains ON)

Switch off the system using the control switch (All Off). The system has an antifreeze function which, when the set limit value (+2 °C for the medium water) is reached, switches on any accompanying heating systems and requests the medium pump to prevent freezing. A maintenance operation message appears in the Web Panel.

The emergency stop is not intended for the planned shutdown of the system, but is only intended for emergencies. The red operating lever on the control cabinet is operated for this purpose. All chillers from Smardt-OPK also have control cabinet terminals, which enable an external EMERGENCY STOP switch to be connected.

10.5 Shutdown for longer periods (more than 24h)

Switch off the chiller using the control switch (ALL OFF). Then turn off the main switch.

Media w/o Anti-freeze Additives

Media without anti-freeze additives must be drained, as soon as the media-carrying system components are exposed to ambient temperatures below +2 °C. The circuits shall be flushed with glycol. Before re-commissioning, the circuits must be rinsed with water in order to remove glycol residues.

10.6 Emergency Stop

The emergency stop is not intended for the planned shutdown of the system, but is only intended for emergencies. The red operating lever on the control cabinet is operated for this purpose. All chillers from Smardt-OPK also have control cabinet terminals, which enable an external EMERGENCY STOP switch to be connected.

11 Using the Web Panel

The chiller plant is served via touch panel HMIs, the SMARDT Web Panel. Each menu is explained in this section. Furthermore the features of the panel are explained and trained during commissioning.

11.1 Home Screen

In idle mode the screen backlight is off, touching the screen makes the home menu
Figure 1) appear. In the upper left corner the hardware tag is shown below i.e. FLK1. This tag can also be read on a plastic engraved label on the cabinets. The Home Screen shows following information:

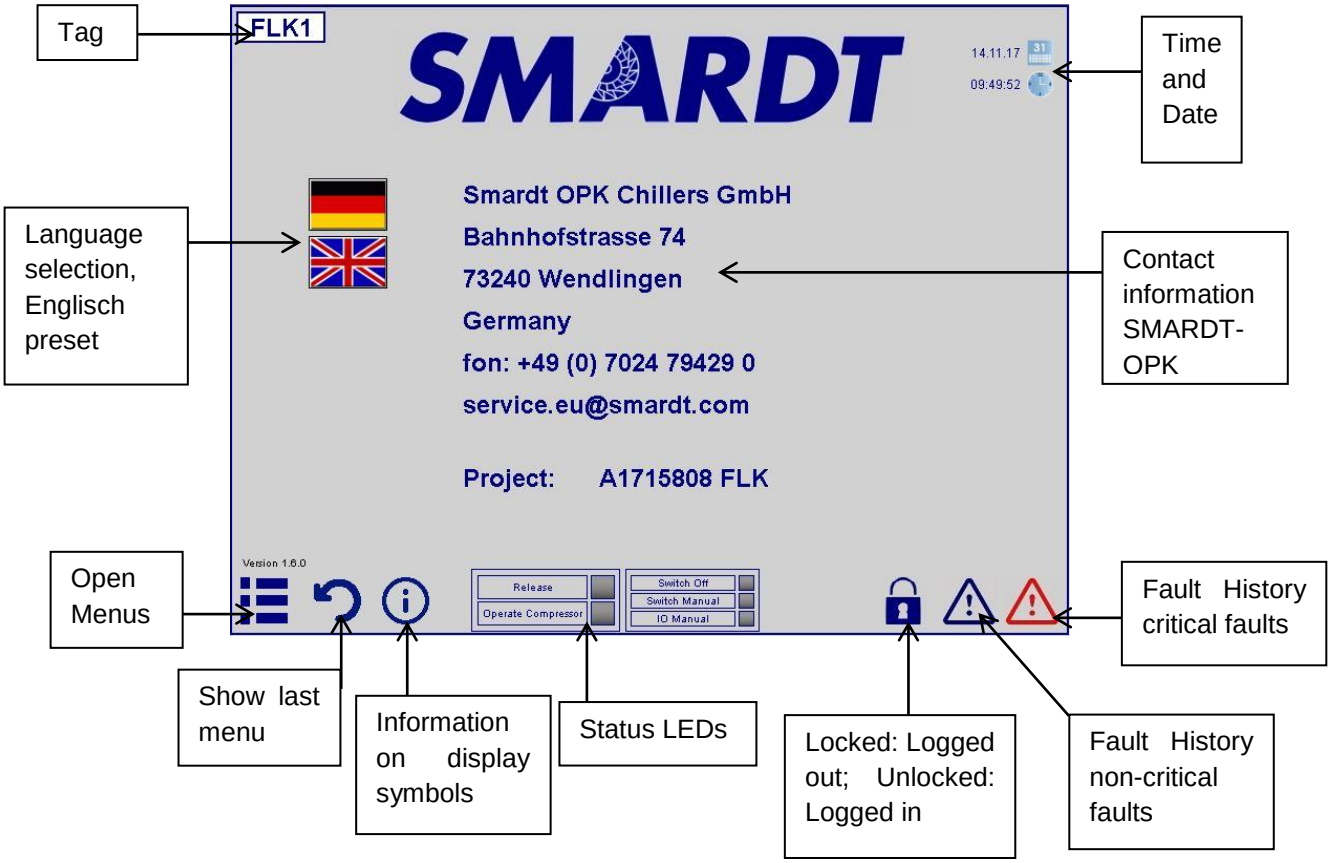

Figure 1. Home Screen

11.2 Login

First step is to click on the information button to learn about the icons on the screen. Afterwards log on to the Web Panel (Figure 2). There are several user profiles which cannot be altered. The intention beyond this profiles is to prevent the adjustment of parameters through non-unauthorized staff. Wrong adjustments can cause malfunction or loss of the plant. Only the SMARDT-OPK service office is allowed to execute adjustments on the deeper program levels.

Costumers login profile is "Betreiber" or "Operator" depending on the selected language (German/Englisch). **The predefined passwort is 1234**. This simple password can be altered.

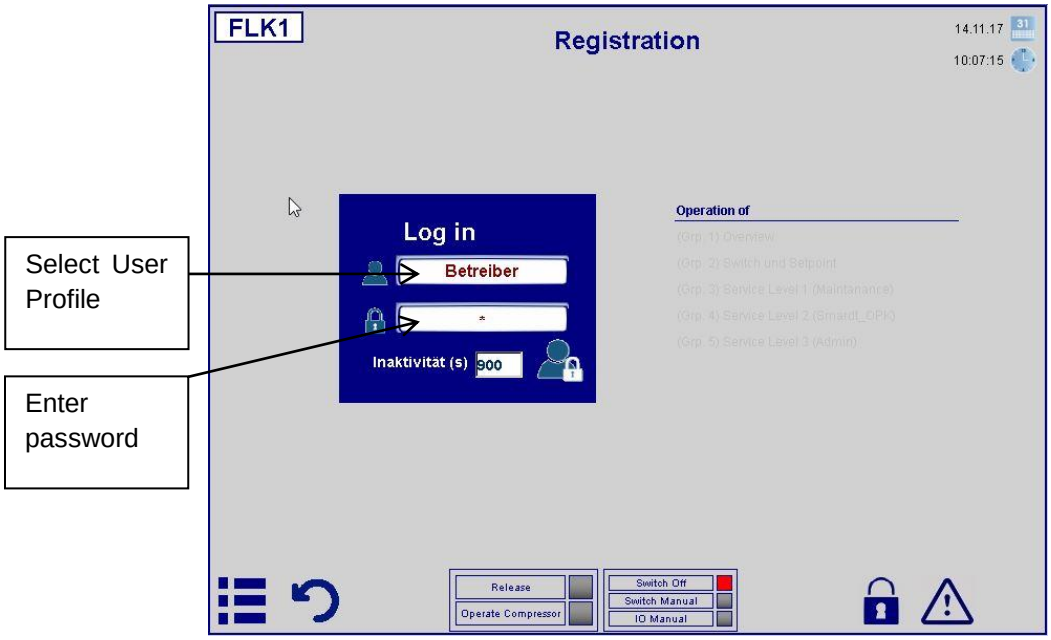

Figure 2. Login Registration

11.3 Open Menus

After login several menus can be selected. By touching a button the associated menus is displayed. See next sections for details on menus.

Accessibility of Deeper Level Menus

With operator rights you cannot access all below menus. The menu description in the following sections just show the extent of possible adjustments.

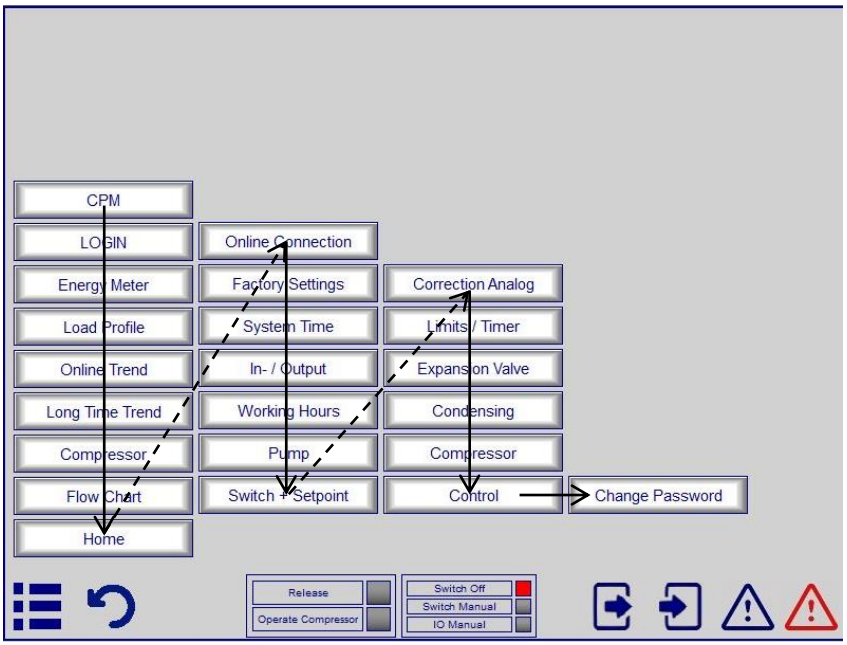

Figure 3. Open Menus Chiller

11.4 CPM

This Menu accesses the panel of the CPM. If you want to go back to the chiller panel it can be displayed by clicking on the button "Chiller 1" or "Chiller 2" (not shown above). By opening the CPM menu the CPM can be operated via the chiller panel. See container plant documentation for details on CPM menu.

11.5 LOGIN

See section 11.2. If the operator is already registered user level can be change (if unlocked).

11.6 Energy Meter

This menu shows (Figure 4) the measured electrical data like voltage for each phase, amps etc. The total tariff shows the consumed energy the meter counted since first power up. This value can only be reset by replacing the meter. The partial energy consumption can be reset by pressing the button

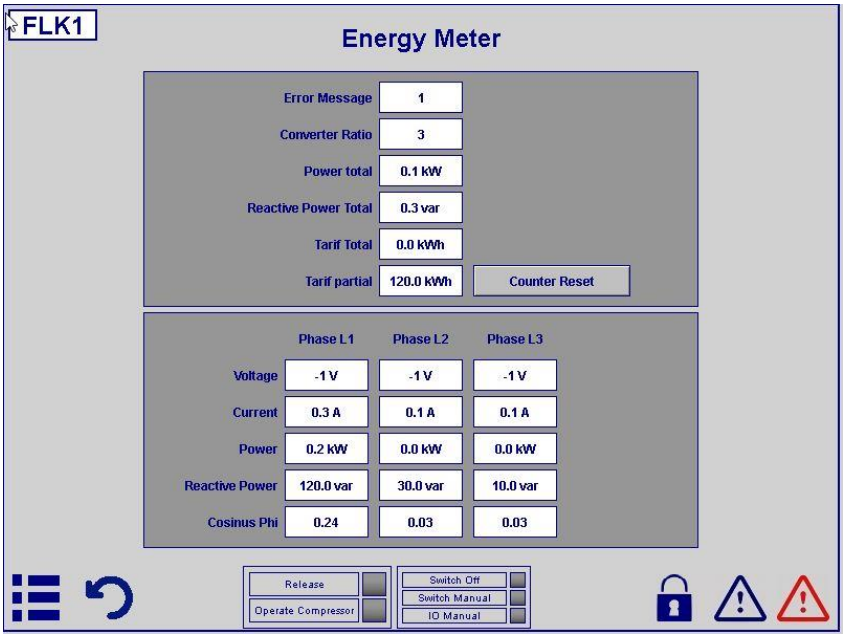

Figure 4. Energy Meter

11.7 Load Profile

The load profile (Figure 5) illustrates the operating hours at staged load conditions. This menu can be used to determine whether the plant runs at good or bad efficiency. The maximum chiller efficiency is achieved during operation between 30 and 70 % load. Ideally the operating hours shall be in this load range. If this is not the case, the staging of the chillers can be adjusted via the CPM controls.

11.8 Trends

The Online and the Off Line Trend is used to display the trends of i.e. Temperatures during operation. The difference between both is, that the Online Trend (Figure 7) shows the current values, plotting the values since the menu is invoked. The trend is not saved to the long time storage. Used for short time observation.

The Off Line Trend (Figure 7) loads the long time data from the onboard storage. Each PLC is equipped with this storage. This trend allows to scroll back to evaluate past values and operation conditions. It takes a little time to load the data, loading procedure is indicated by text message on screen.

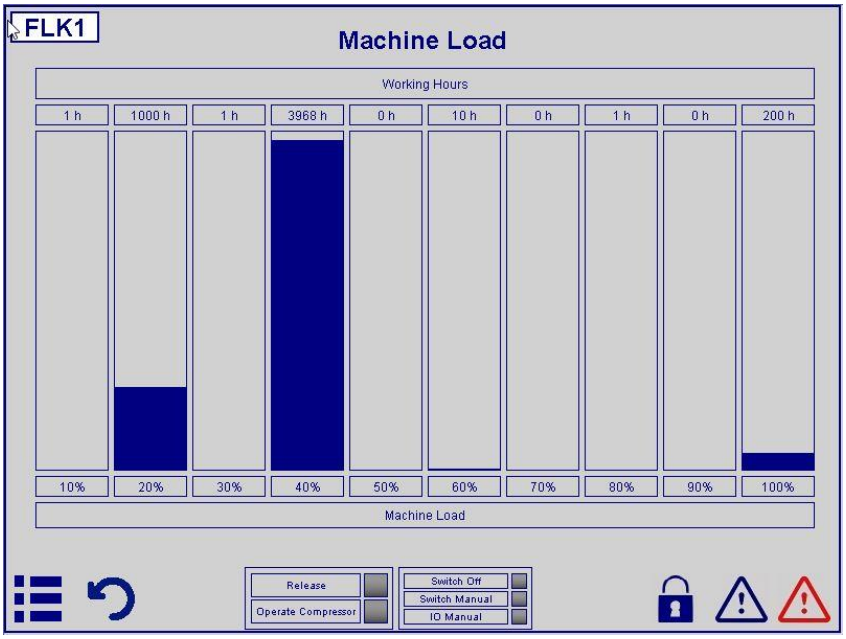

Figure 5. Load Profile

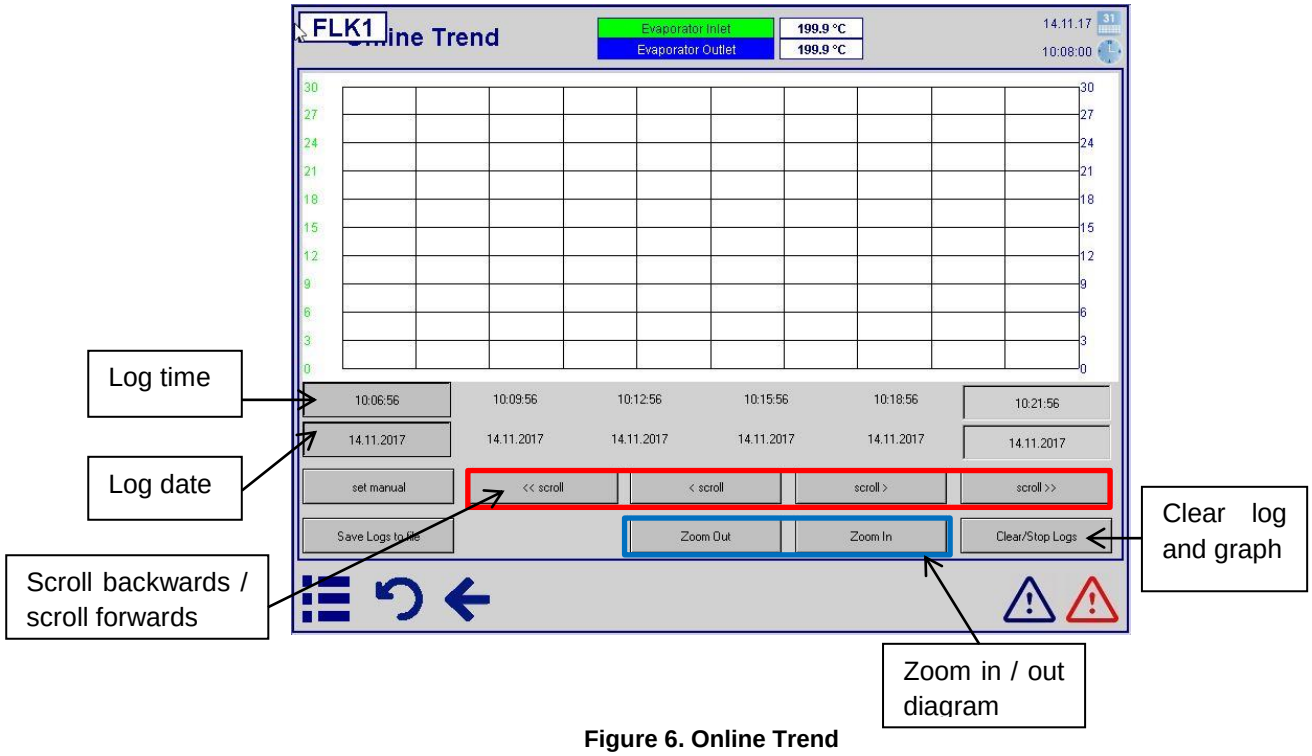

Figure 6. Online Trend

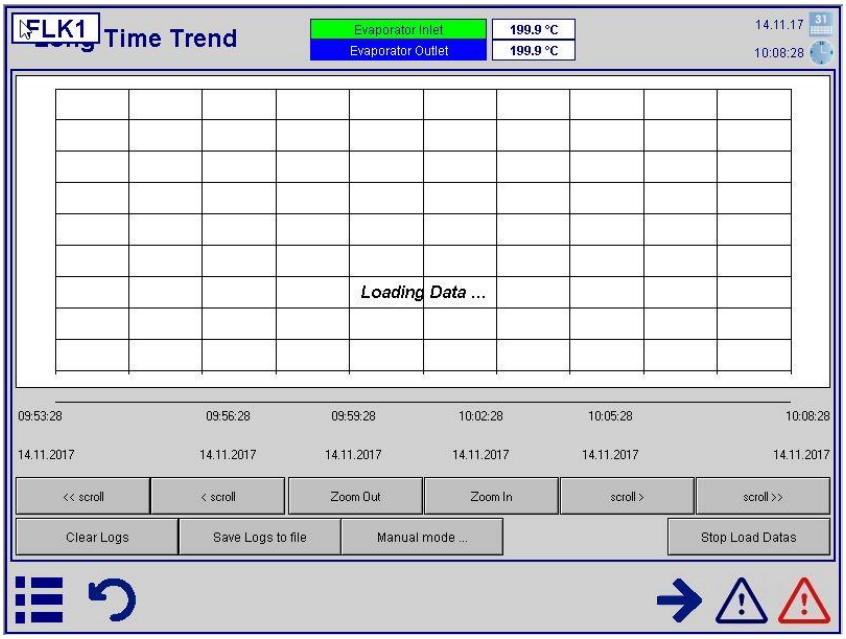

Figure 7. Off Line Trend

11.9 Compressor Menu

The compressor menu shows detailed data about the compressor. The description of each value is neglected in this section since each value has its description in clear words on screen. Important for operator use are the status LED and the message field. For each compressor a separate menu can be invoked. Next menu appears if the arrow is pressed

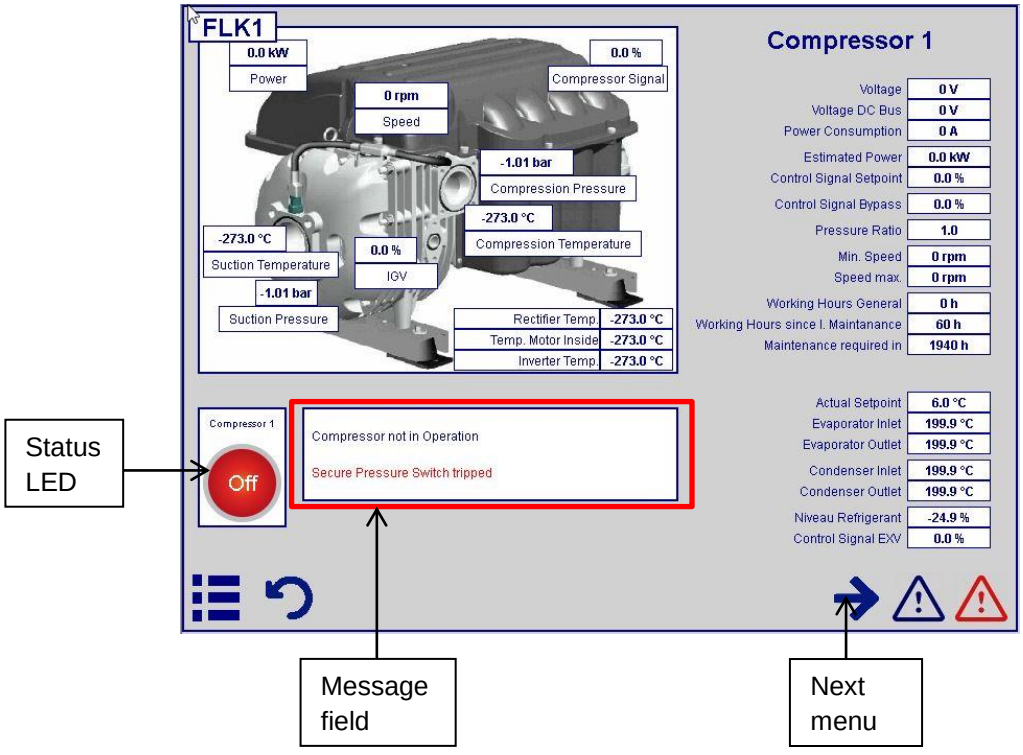

Figure 8. Compressor Menu

The compressor menus can also be accessed by clicking on the interactive compressor symbol on the flow chart menu.

11.10 Flow Chart

This visualization (Figure 9) gives a quick overview on the operation of the chiller. Real time measured values are displayed, different colored symbols indicate the status of the component. By touching the chiller symbols, the individual chiller panels can be accessed, too.

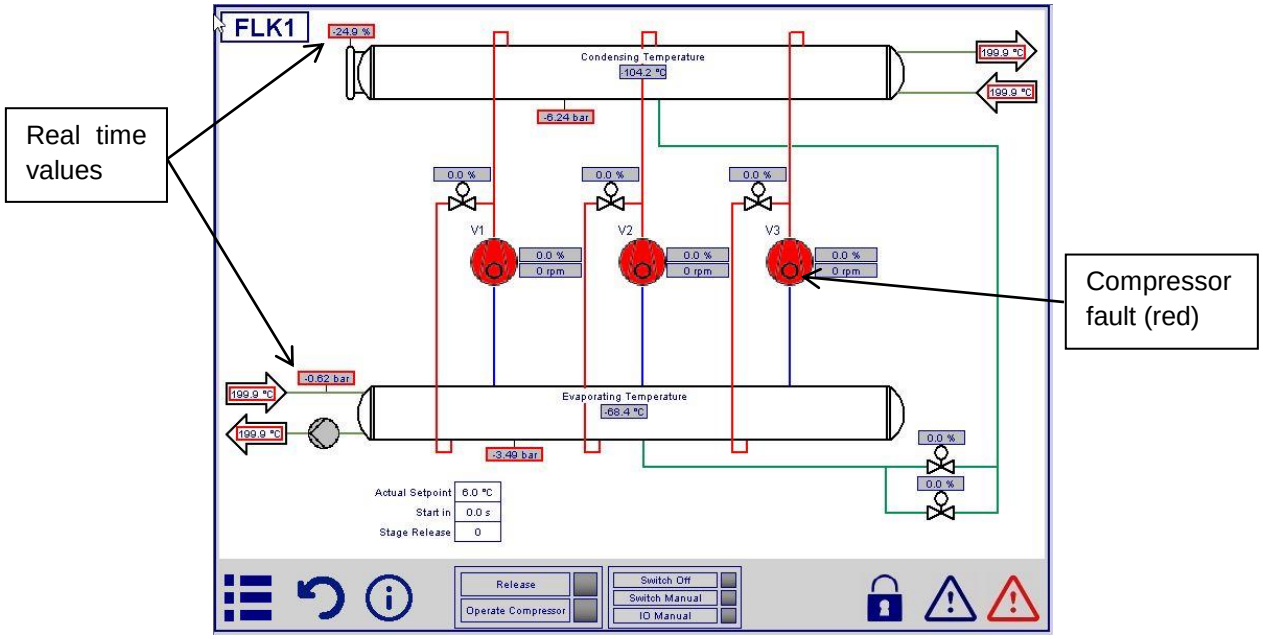

Figure 9. Flow Chart Chiller

11.11 Home

Touching this button will bring you back to the Home Screen, see section 11.1.

11.12 Online Connection

This menu (Figure 10) enables online connection between the chiller plant and the SMARDT-OPK service office. Since the plant is equipped with remote access hardware, the SMARDT-OPK service department can log on to the chiller plant and do some adjustments and troubleshooting for severe faults. Since the connection is not online permanently in favor of data security, the connection must be activated manually. The buttons are self-explaining. Furthermore a timeout value can be typed in, so the connection is terminated automatically. This time out shall be determined together with the SMARDT-OPK service department to avoid forced logout during troubleshooting.

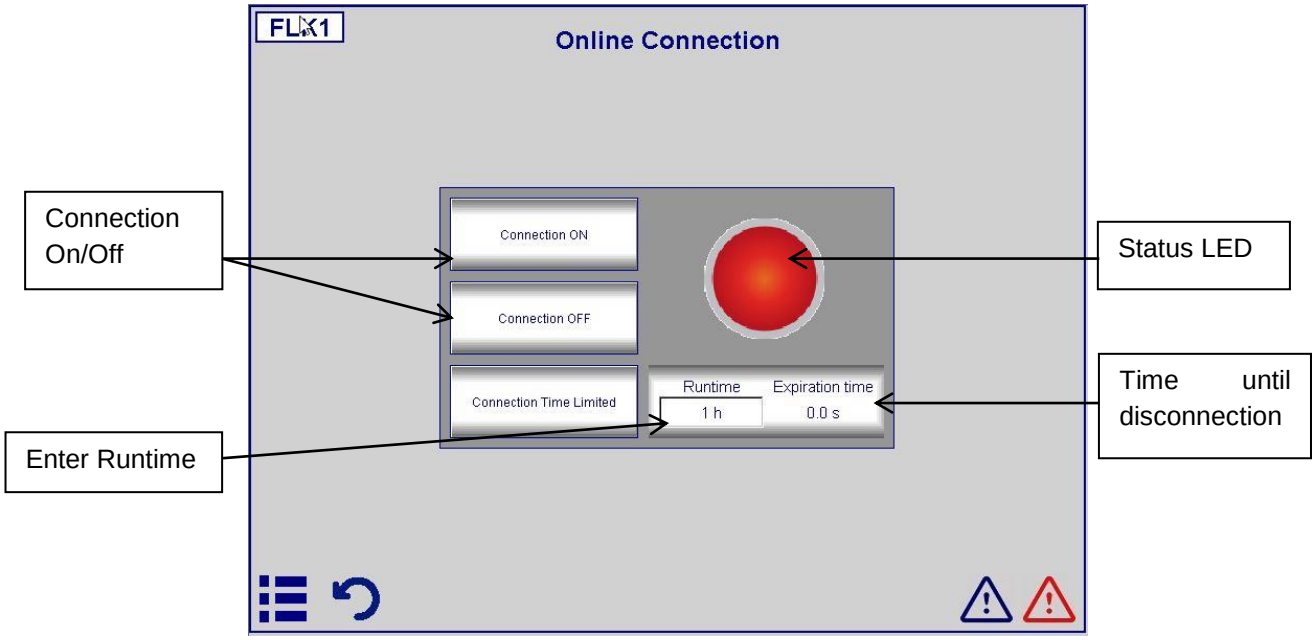

Figure 10. Online Connection

11.13 Factory Settings

If any changes were done to the software, these values must be stored to the ROM. This can be done by invoking the Factory Settings (Figure 11) and to press the "Store Values" button. If changes appear to have negative effects on efficiency and operation in general, the factory settings can be reloaded by pressing the "Restore Values".

11.14 System Time

This menu (Figure 12) sets the system time and date. Press the entry field, alter the time if required and store the new time/date by pressing "OK". Consider required format, i.e. time in HH:MM.

11.15 Input / Output

This menu (Figure 13) visualizes the all inputs and outputs available on the M90 PLC platina. Status LEDs indicate the status of each input / output. The values mustn't be altered. Each input / output description can be found in the wiring diagram making it easy to determine faulty connections and the respective field device.

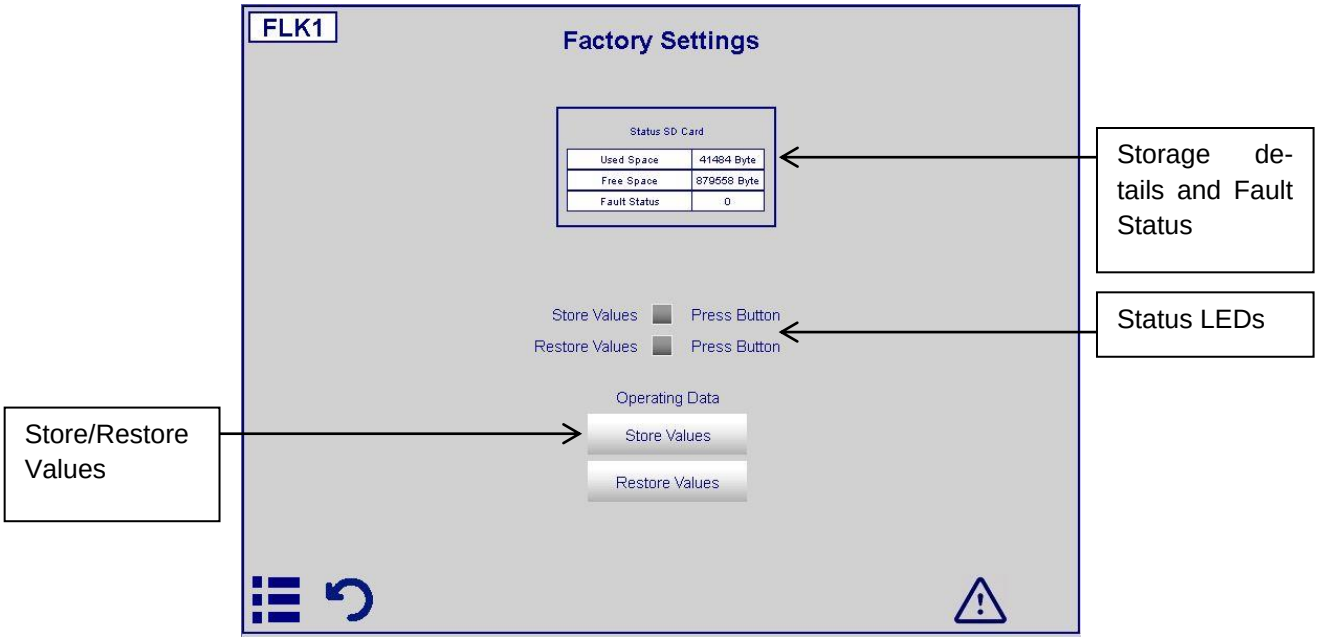

Figure 11. Factory Settings

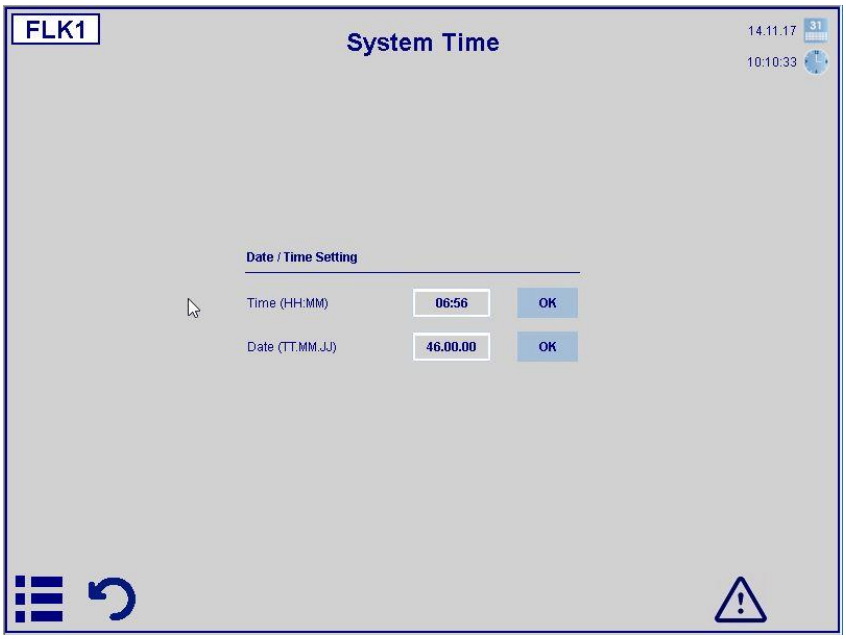

Figure 12. System Time

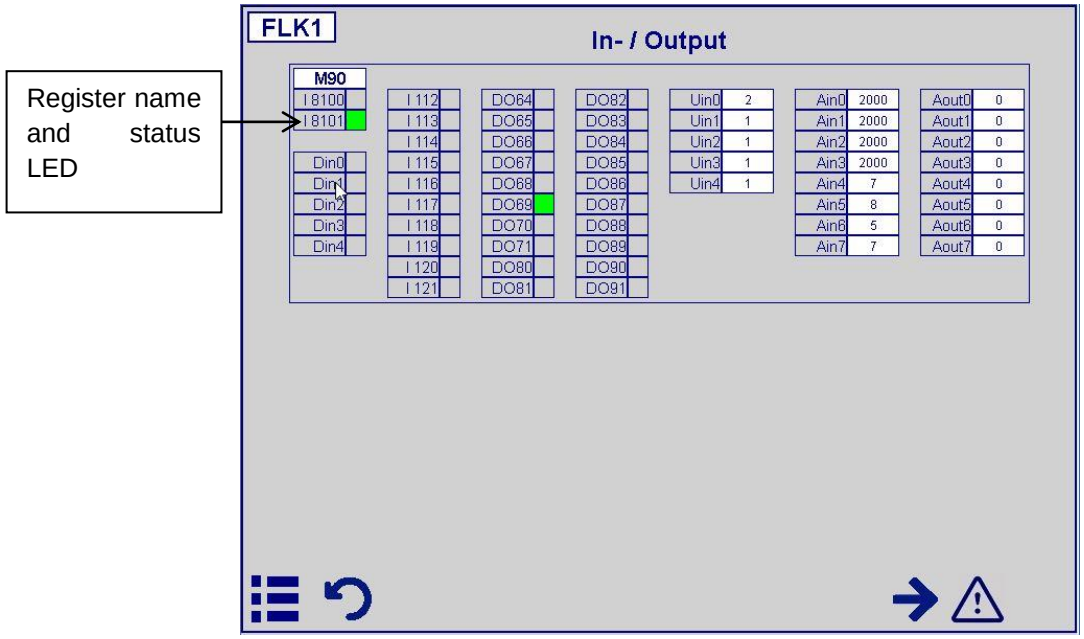

Figure 13. Input / Output

11.16 Working Hours

The menu (Figure 14) shows the working hours for each compressor. Each compressor table shows the operating hours since the last counter reset and the count of start-ups. The Backup entry is for internal use only. You can type in a time period in hours upon the controller returns a maintenance message (shown: Message returned either after 1.000 operating hours **OR** after 10.000 start-ups, whatever comes first).

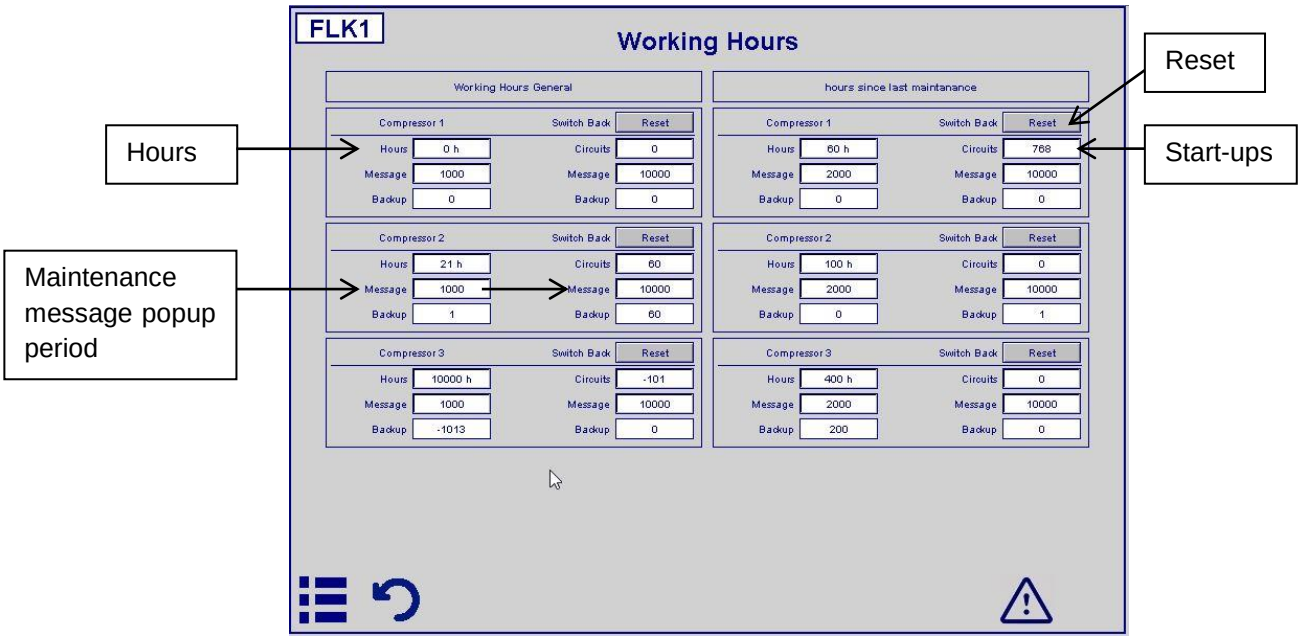

Figure 14. Working Hours

11.17 Pumps

Each chiller is equipped with its own chilled water pump. Before chiller startup the chiller requests pump operation. If the pump has started the chiller gets operation feedback. Request and feedback is essential for chiller operation. If one of the signals fail the chiller won't start. The pump status can be seen on the associated screen (Figure 15). Modes are AUTO (recommended), HAND and OFF. The menu included working hours of the pump and such. Details below.

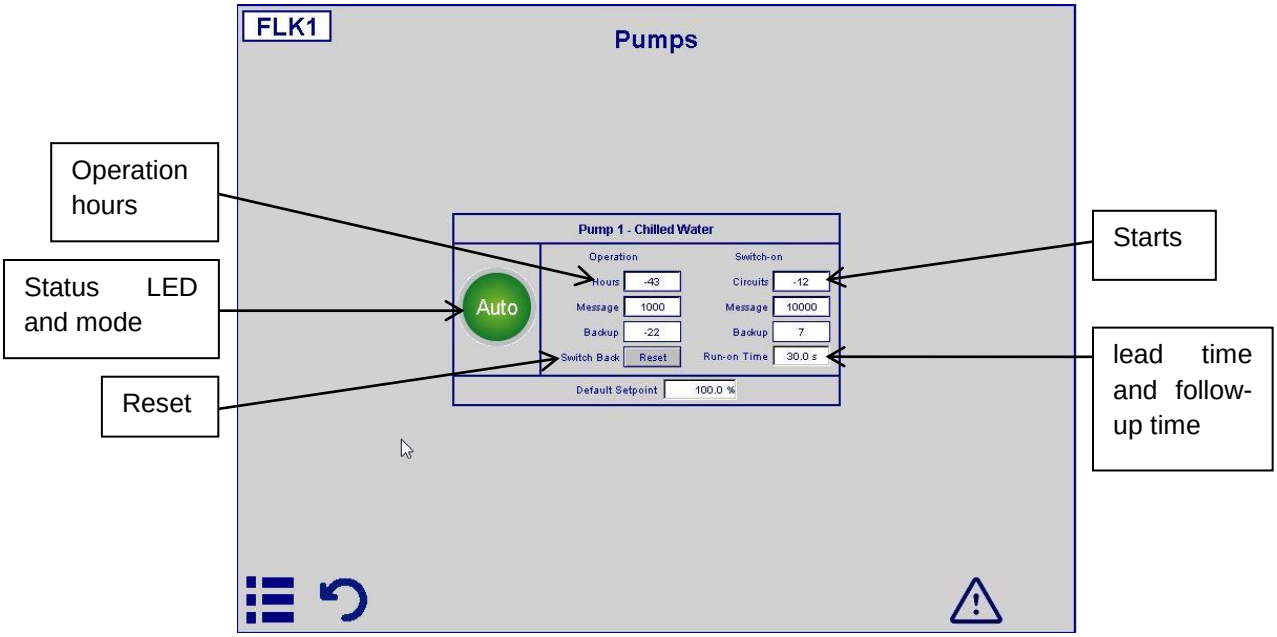

Figure 15. Pumps

11.18 .Switch / Setpoint

This menu contains switches to open/close breakers for compressors, pumps and the chiller in general. Modes are AUTO (recommended), HAND and OFF. Status LEDs indicate modes. The Setpoint for the chilled water outlet temperature is preset in the menu, i.e. 6 °C. The setpoint thrust from the BMS via 0…10 VDC signal adds 0…+6 K to the setpoint. This is also shown on screen. If setpoint thrust signal fails, the chiller relies on the preset setpoint. Instead of pressing every individual switch, all switches can be set on automatic or to off by pressing the associated buttons on the bottom of the screen.

11.19 Correction Analog

The menus (Figure 17) show correction factors for analog field devices like PT1000 temperature sensors and such. This allows calibration and pairing sensors. This shall only be done if measurement inaccuracies endanger reliable operation. These values shall only be altered by SMARDT-OPK service department. This section is just for information. There are two different menus, one for the CPM, one for each chiller (FLK1).

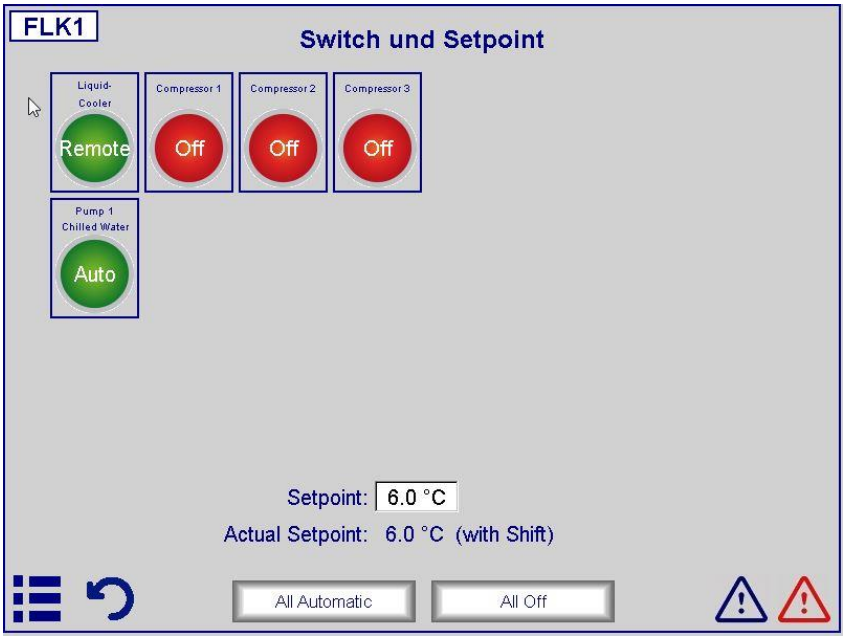

Figure 16. Switch / Setpoint

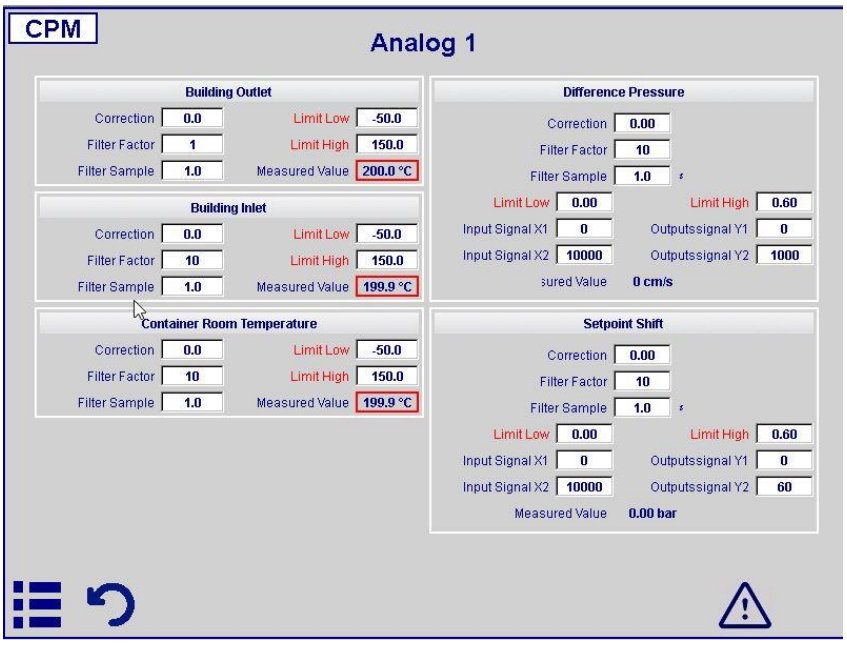

Figure 17. Analog Correction

11.20 Limits/Timer

Limits and timers can be adjusted in the menu shown in Figure 18. The values are set during commissioning or after unit modification and shall only be altered by the SMARDT-OPK service department and define the limits of use and avoid damage during operation. Thus the individual entry fields are not described in detail.

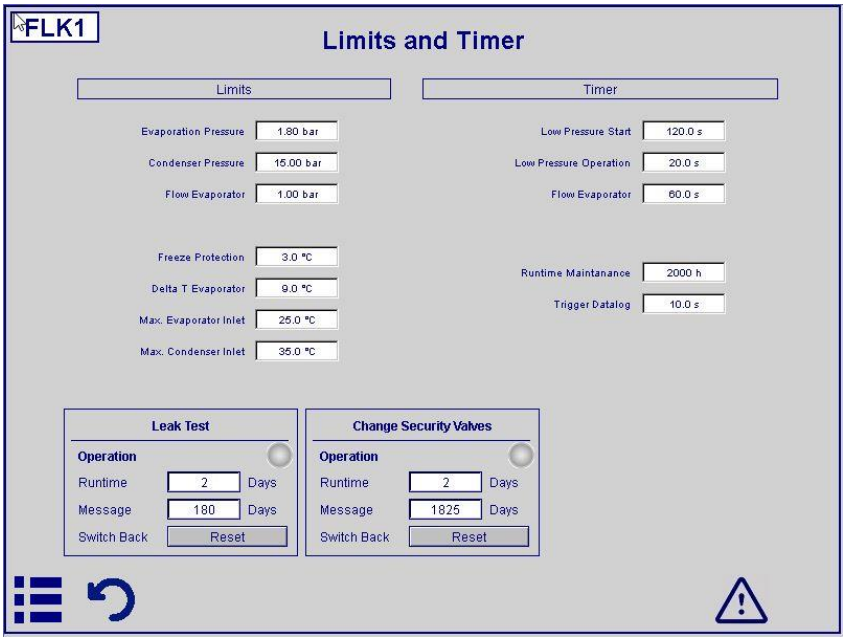

Figure 18. Limits/Timer

11.21 Expansion Valve Menu

The control menu for the refrigerant expansion valve comprises the coefficients of the implemented PID controller and indirectly controls the level of liquid refrigerant in the condenser. The values are set during commissioning or after unit modification and shall only be altered by the SMARDT-OPK service department.

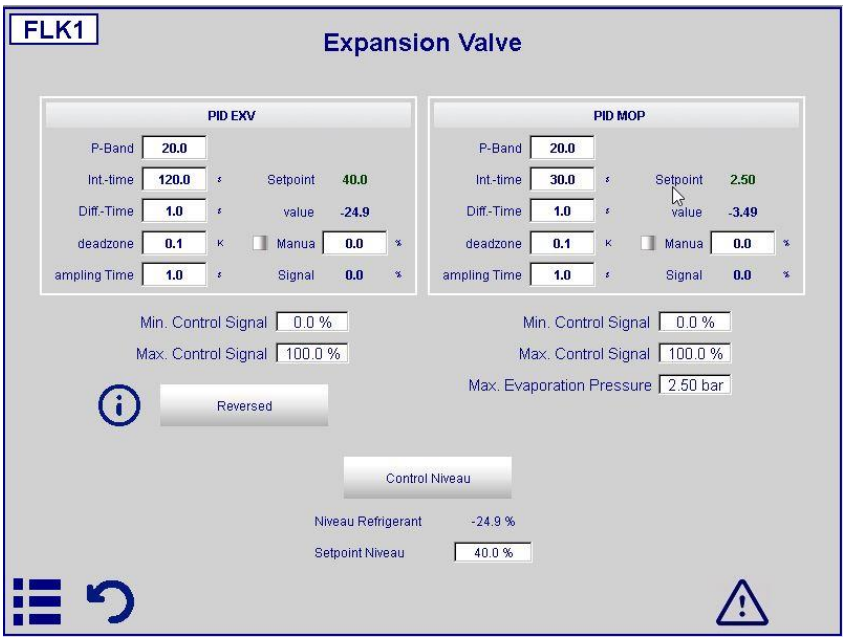

Figure 19. Expansion Valve Menu

11.22 Condensing

The condensing control menu for the condensing pressure/temperature comprises coefficients of the implemented PID controller. The compressor needs at least a minimum pressure ratio of 1.4 to work

properly. The condensing pressure is kept as low as possible which means the maximum chiller efficiency (plant optimization must be executed separately). In case of too cold cooling media inlet temperatures, the condensing pressure can be kept high artificially to retain the in operation. The values are set during commissioning or after unit modification and shall only be altered by the SMARDT-OPK service department.

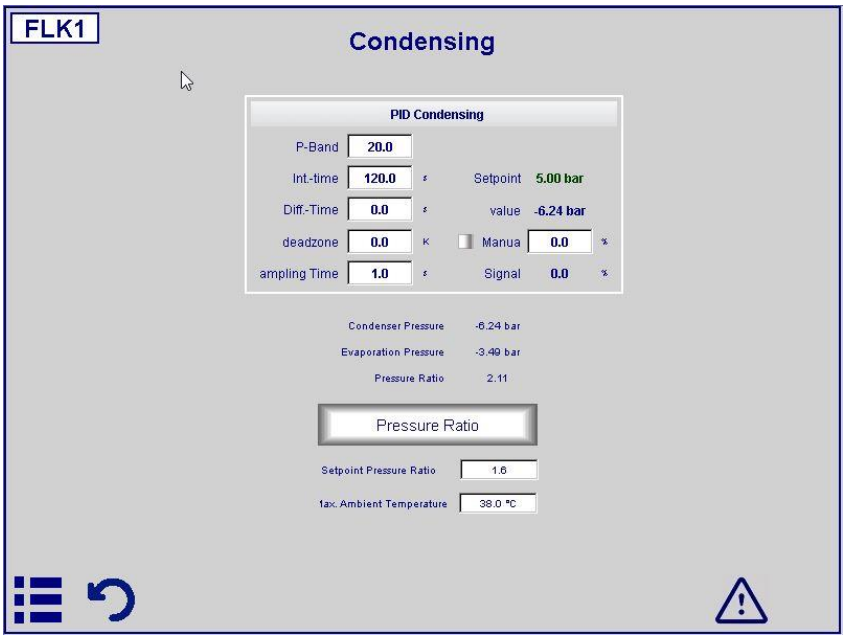

Figure 20. Condensing

11.23 Compressor Control Menu

Additionally to the superficial compressor menu (section 11.9), there is a compressor control menu (Figure 21). The menu comprises coefficients of the implemented PID controller for the compressor and its staging valve as well as the component limitation values.

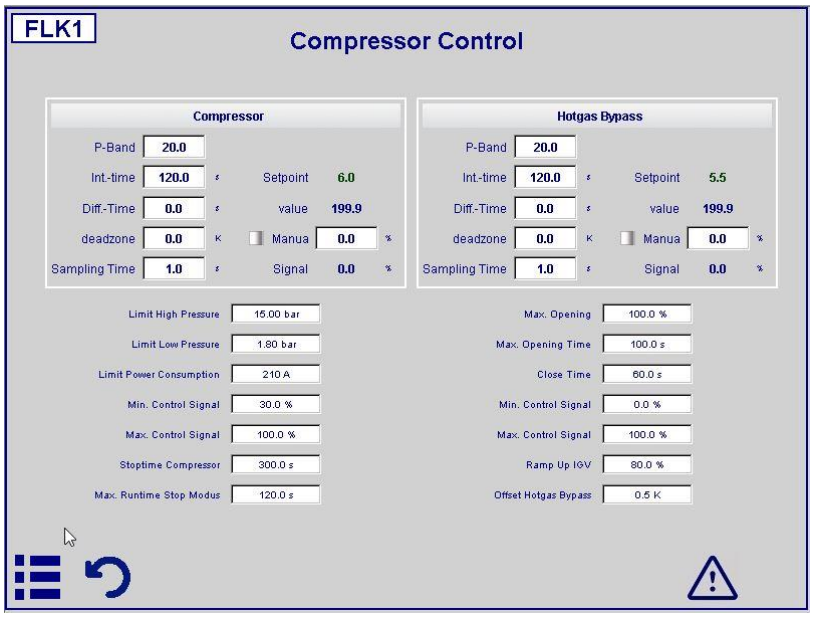

Figure 21. Compressor Control Menu

The values are set during commissioning or after unit modification and shall only be altered by the SMARDT-OPK service department. Bad adjustments, even in small extents, can cause the compressor not to start and even be destroyed. The oil-free magnetic bearing technology in combination with sophisticated internal electrical instrumentation the compressor needs to be operated and maintained by trained experts.

11.24 Control

This menu contains the parameters for the general controls (Figure 22). The parameters control the loading and unloading of the chiller. The parameter is set during initial commissioning and depends on the bulding system with its hydronic circuits and consumer characteristics. Adjustment is necessary after modification of the bulding system, the hydronic circuits or the consumer characteristics. The values are set during commissioning or after unit modification and shall only be altered by the SMARDT-OPK service department.

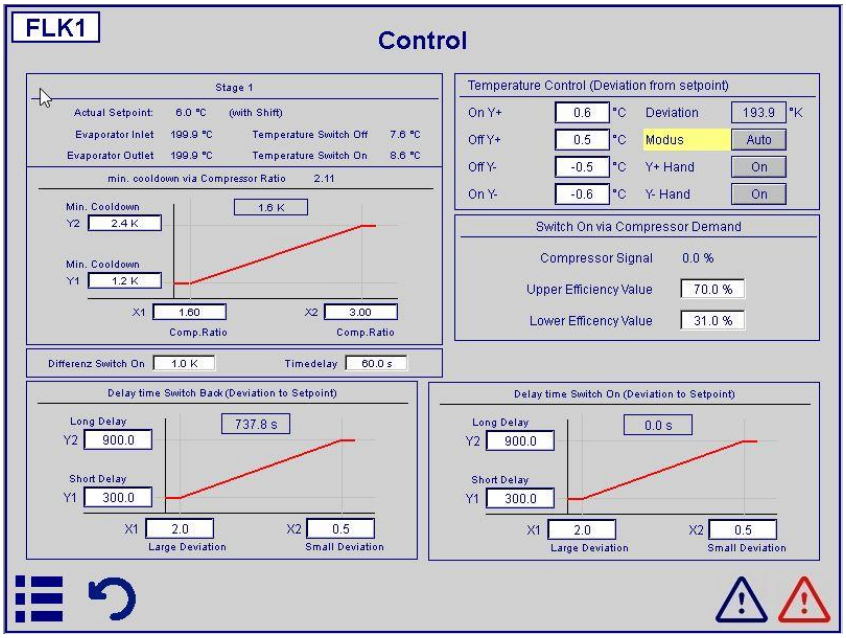

Figure 22. Control Chiller3

11.25 Change Password

Last but not least the menu for password changes. Passwords allow only numbers. The entry field are self-explaining and are not shown in this section. For each SMARDT-OPK chiller an individual password can be set.

12 Remote Connectivity

The Web Panel has an integrated miniwebbrowser that allows online access to the Panel from external computers and even Smartphones. The smartphone version must be bought in the respective app shops, the computer version is freeware, but requires separate license activation by SMARDT-OPK. A prerequisite for access is the integration of the plant in the data network.

On a computer with Windows-based operating system the installation of SBC MicroBrowser Application is necessary:

1. Download app from the support page
   https://www.sbc-support.com/en/product-index/micro-browser-app-for-windows/
2. Copy to Windows PC and start "SBC_MicroBrowser.exe", no installation needed
3. Click the link for registration and register on licensing server
4. Confirm the license in the received email
5. Enter the received license code and the app is ready for use

Access to the plant from the computer:

1. Start the program
2. Click the "+" button
3. Enter the desired name of the Web Panel in the Name column
4. Enter the assigned web address of the control and start page
5. Confirm with "Enter"
6. Click the "Connect" button
7. Connection is established.

The plant can be controlled remotely via the software. All settings, which can be made on the plant panels, can be carried out on the computer. Several Web Panel web addresses can be stored in the software so that several Smardt-OPK chillers can be operated and monitored via a computer.

13 Maintenance instructions

Maintenance Intervals
The maintenance cycles indicated in the logbook of the refrigeration system must be observed.

Annual maintenance facilitates reliable and energy-efficient operation of the system. This maintenance should be carried out by a qualified specialist.

If maintenance is not carried out by Smardt-OPK, the following things must be checked at least.

Tabelle 1. Wartungsintervalle

Table 2. Maintenance

Maintenance work	**Interval min.**		
Functional check safety devices	Yearly		
Check terminals in control cabinet	Yearly		
Check mechanical components in the control cabinet	Yearly		
Check the refrigerant cycle for oil spills (not applicable for chillers with Danfoss Turbocor compressors)	Along with leakage test (see below)		
Observe the properties of cold and cooling water and restore if necessary	Annually or after modifications to the hydraulic network		
Check expansion vessel	Annually or after modifications to the hydraulic network		
If present, check the function of the heaters	Annually or after modifications to the hydraulic network		
Druck Flüssigkeitsnetz prüfen, ggf. wiederherstellen	Annually or after modifications to the hydraulic network		
Check pressure drop via heat exchanger and clean if necessary	Annually or after modifications to the hydraulic network		
Clean filters	Annually or after modifications to the hydraulic network		
If oil is present, perform acid test (except for scroll compressor applications)	Yearly		
Check for unusual operating noise	Quarterly		
Tightness test In accordance with Article 4 of Regulation (EC) No 1516/2007.	Charge CO_2 equivalent	Interval with leakage detection system	Interval without leakage detection system
	5 .. 50 t	yearly	biannual
	50 .. 500 t	semiannual	yearly
	from 500 t	quarterly	quarterly

14 Troubleshooting

If a fault occurs, it is displayed on the Web Panel of the chiller. The following table provides an overview of the possible faults, the causes and how they can be fixed.

Type of fault	Compo-nent	Fault cause	Determination	Rectification
High pressure fault	Pressure switch	Flow cooling medium too low	Check cycle, i.e. pumps, filters, butterfly valves	Fix cause in the cycle
		Inlet temperature cooling media too high	Check temperature cooling medium	Provide cooling medium with design temperature
		Condenser soiled	Temperature difference be-tween cooling water outlet and condensing temperature max. 5 K	Service
		Carrier gas inside condenser	Not possible	Service
Low pressure failure	Low pres-sure sensor	Refrigerant loss due to leakage	Indication, no subcooling and bubbles visible in the sight glass	Service
		Refrigerant flow insufficient due to faulty valve	Not possible	Service
		Refrigerant flow insufficient due to dirty strainer	Strainer dirty if temperature before the strainer is higher than after	Service
		Evaporator soiled	Temperature difference be-tween chilled water outlet and evaporation temperature max. 5 K	Service
Discharge temperature too high	Electr. motor protection Temperature sensor	Heat rejection at condenser too low	Temperature difference be-tween cooling water outlet and condensing temperature max. 5 K	Service
		Insufficient lubrication	Check oil level	Service
		Suction gas temperature too high	Check suction gas temperature	Service
Antifreeze monitoring activated	PLC	Flow over evaporator too low	Check cycle, i.e. pumps, filters, butterfly valves	Fix cause in the cycle
		Inlet temperature chilled media too high	Check inlet temperature, measure outlet temperature and determine the temperature difference	Increase cooling load or deny release
Flow deficien-cy	Flow sensor	Bad installation of sensor	Consider installation require-ments according to manual	Install sensor according to manual
		Bad calibration of the sensor	Check parameters	Service
		Flow too low	Check cycle, i.e. pumps, filters, butterfly valves	Fix cause in the cycle
		Wrong media	Check media and conditions	Replace or recondition media
		lead fracture	Electr. check of cable, LED's not flashing	Replace cable
Temperature decrease to high	PLC	Flow chilled medium too low	Check cycle, i.e. pumps, filters, butterfly valves	Fix cause in the cycle, adjust flow
		Capacity too high	Not possible	Service
Overcurrent error	Automatic fuse	Fused component consumes an undue current	Check component with help of wiring diagram	Specialist for electrical engineering
	Circuit breaker	Compressor consumes an undue current	Check component with help of wiring diagram	Specialist for electrical engineering
		Fuse defective	Check component with help of wiring diagram	Specialist for electrical engineering
		Contactor defective	Check component with help of wiring diagram	Specialist for electrical engineering
		Cables loose	Check component with help of wiring diagram	Specialist for electrical engineering
		Two-phase operation	Check component with help of wiring diagram	Specialist for electrical engineering

Type of fault	Compo-nent	Fault cause	Determination	Rectification
Electronic error	Dafoss Turbocor compressor	Intern fault of the turbo com-pressor	Not possible	Switch off the compressor for 2 minutes using the motor protection switch. Troubleshooting max. 2 times, then inform service
Preservation operation / frost protec-tion operation	PLC	Evaporation temperature in the evaporator below 3 °C. Cold water pump is requested and must start immediately, other-wise there is the risk of frost damage	Check evaporation pressure	Switch on the chilled water pump and increase chilled water inlet temperature