NORDMANN
ENGINEERING

Nordmann AT4

Steam humidifier



SERVICE MANUAL

2559457 EN 1601

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1 Introduction

The present service manual is meant for the Nordmann service technician and assumes a profound knowledge on the Nordmann AT4. It is also assumed that the Service technician has notice of the mounting instructions as well as of the operating instructions of the Nordmann AT4 and that he is familiar with the dangers when working on the unit.

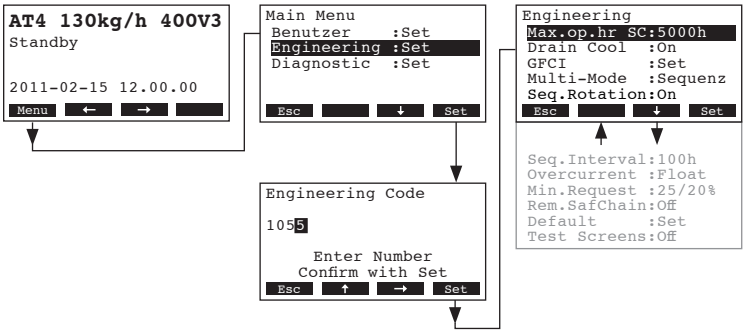
The present service manual includes the following information:

– Description of the settings in the engineering level of the Nordmann AT4 control.
– Information on operational malfunctions
– Information on the humidity control systems
– Information on the water management
– Block diagrams of the control electronics

2 Settings in the engineering level

2.1 Launching the Engineering level

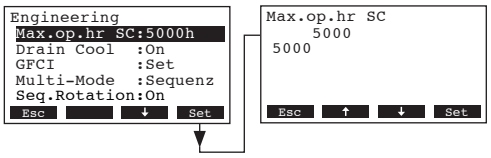
Select the engineering settings menu:
Path: ***Main menu > User > Password entry: 1055 > Engineering***



Press the **<↓>** and **<↑>** keys in order to select the individual settings in the engineering level. Detailed information on the different settings are found in the following chapters.

2.2 Setting the replacement interval time for the steam cylinder

Select "**Max.op.hr SC**" in the engineering menu, then press the **<Set>** key.



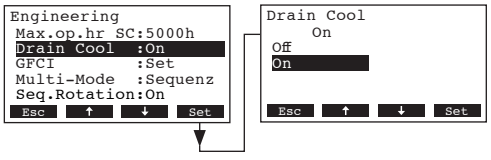
In the upcoming modification dialogue set the desired interval time for the replacement of the steam cylinder in hours (max. operating hours). The interval time to be set depends on the water quality on site. Note: First priority for the determination of the maximum operating hours of the steam cylinder has always the maximum level counts via the level sensor.

Factory setting: **5000 h**

Setting range: **100...8000h**

2.3 Activating/deactivating the drain cooling

Select "**Drain Cool**" in the engineering menu, then press the **<Set>** key.



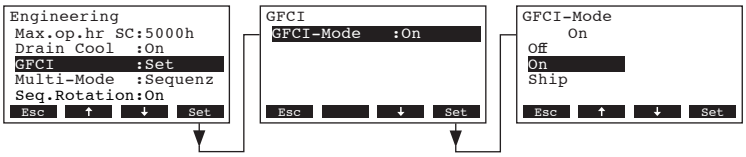
In the upcoming modification dialogue activate (On) or deactivate (Off) the drain cooling function. With activated drain cooling the inlet valve opens during the drain cycle, thus reducing the drain water temperature.

Factory setting: **On**

Options: **On** (Inlet valve opens during drain cycle)
Off (Inlet valve remains closed during drain cycle)

2.4 Setting GFCI operation

Select “**GFCI**” in the engineering menu, then press the **<Set>** key.



In the upcoming modification dialogue select whether or not the Nordmann AT4 is connected to a fault current relay protected mains supply or whether the Nordmann AT4 is operated on a vessel with special requirements concerning fault current measurement.

Factory setting: **On**

Options: **On** (mains supply with fault current relay protection, main contactor is switched off during drain cycle)
Off (mains supply without fault current relay protection, main contactor remains activated during drain cycle)
Ship (mains supply with special requirements concerning fault current measurement, main contactor is switched off during filling and draining cycle)

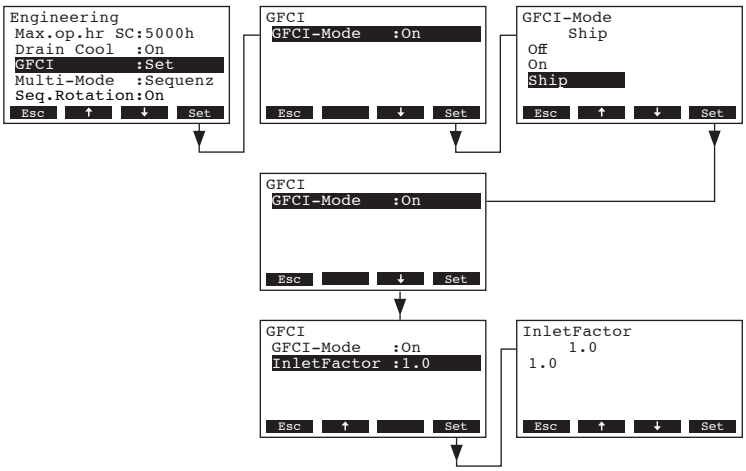
Notes on the function “Ship”

The “Ship” function is used if the Nordmann AT4 is installed on a vessel. On vessels fault currents are monitored much more exactly than elsewhere, since these lead to an increased corrosion of the ship trunk.

Due to the fact that small fault currents can flow via the inlet line to earth/mass also during filling, the main contactor is switched off also during filling cycle with the “Ship” function.

Since no current measurement is possible during filling with deactivated main contactor, the filling time is controlled via the inlet factor.

Select “**Ship**” in the GFCI menu, then press the **<Set>** key.



In the upcoming modification dialogue set the desired inlet factor.

Factory setting: **1** (Filling cycle 30 seconds)

Setting range: **0.5** (Filling cycle 10 seconds) **up to 2.0** (Filling cycle 60 seconds)

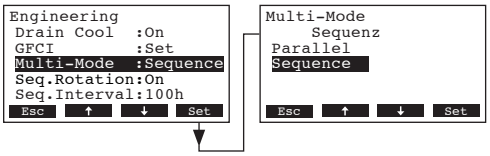
Note: With inlet factor 1 the filling cycle takes 30 seconds then, the inlet valve is closed and the main contactor is activated, in order to check the current rise. If the desired current value is not yet achieved (110% of the nominal current), the main contactor is deactivated again, and another filling cycle of 30 seconds starts.

If the current is always too high after a filling cycle of 30 seconds (InletFactor 1), the filling time can be reduced up to 15 seconds (=> inlet factor 0.5).

Or vice versa if it always takes 2 – 3 filling cycles to reach the desired current value, the filling time can be increased up to 60 seconds (=> inlet factor 2).

2.5 Set Multimode operation for double units

Select "**Multi-Mode**" in the engineering menu, then press the **<Set>** key.



In the upcoming modification dialogue you determine, how the humidity demand is to be distributed on the two cylinders.

Factory setting: **Sequence**

Options: **Sequence** (sequential distribution)
Parallel (balanced distribution)

Notes on settings

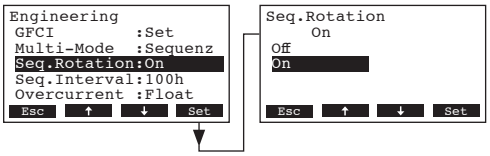
– **Sequence**: the demand is distributed as follows: the first cylinder (Module A) takes 0 – 50% of the demand and the second cylinder (Module B) 51 – 100%. In the operating mode “Sequence” the additional parameters “Seq. Rotation” (see chapter 2.6) and “Seq. Interval” (see chapter 2.7) are available, in order to ensure balanced cylinder operating hours.

– **Parallel**: The demand is distributed evenly on both cylinders, i.e. with a demand of 50 % both cylinders working with 50% demand. In the operating mode “Parallel” the additional parameter “Disable” (see chapter 2.8) is available, in order to disable one of the two cylinders (module A or B).

2.6 Set cylinder rotation for sequential operation

Note: this setting appears only if Multimode operation is set to “Sequence”.

Select “**Seq. Rotation**” in the engineering menu, then press the **<Set>** key.



In the upcoming modification dialogue activate (On) or deactivate (Off) the cylinder rotation for sequential operation.

Factory setting: **On**

Options: **On** (Cylinder rotation activated)
Off (Cylinder rotation deactivated)

Notes on settings

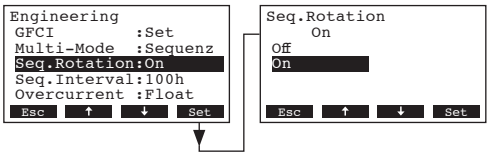
– On: the cylinders alternate in processing the system demand, in order to ensure an even cylinder wear.

– Off: the partitioning of the system demand remains unchanged, cylinder A 0 – 50% and cylinder B 51 - 100%

2.7 Setting the interval time for the cylinder rotation in sequential operation

Note: this setting appears only if Multimode operation is set to “Sequence” and cylinder rotation is activated (On).

Select “**Seq.Interval**” in the engineering menu, then press the **<Set>** key.



In the upcoming modification dialogue set the desired interval time for the cylinder rotation in sequential operating mode.

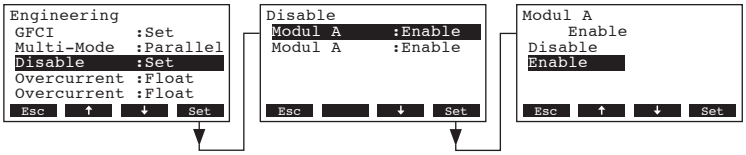
Factory setting: **100**

Setting range: **100 ... 1000 h**

2.8 Disabling a cylinder in parallel operating mode

Note: this setting appears only if Multimode operation is set to “Parallel”.

Select “**Disable**” in the engineering menu, then press the **<Set>** key. Now, select the cylinder to be disabled (Module A or Module B), and press the **<Set>** key.



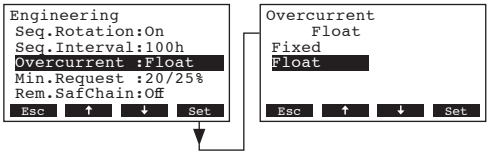
In the upcoming modification dialogue activate or deactivate the selected cylinder.

Factory setting: **Enable**

Setting range: **Enable** (activated) or **Disable** (deactivated)

2.9 Setting the heating current monitoring

Select “**Overcurrent**” in the engineering menu, then press the **<Set>** key.



In the upcoming modification dialogue you determine whether the current monitoring shall take place with a fixed (Fixed) or a floating overcurrent threshold (Float).

Factory setting: **Float**

Setting range: **Float** (floating overcurrent threshold) or **Fixed** (fixed overcurrent threshold)

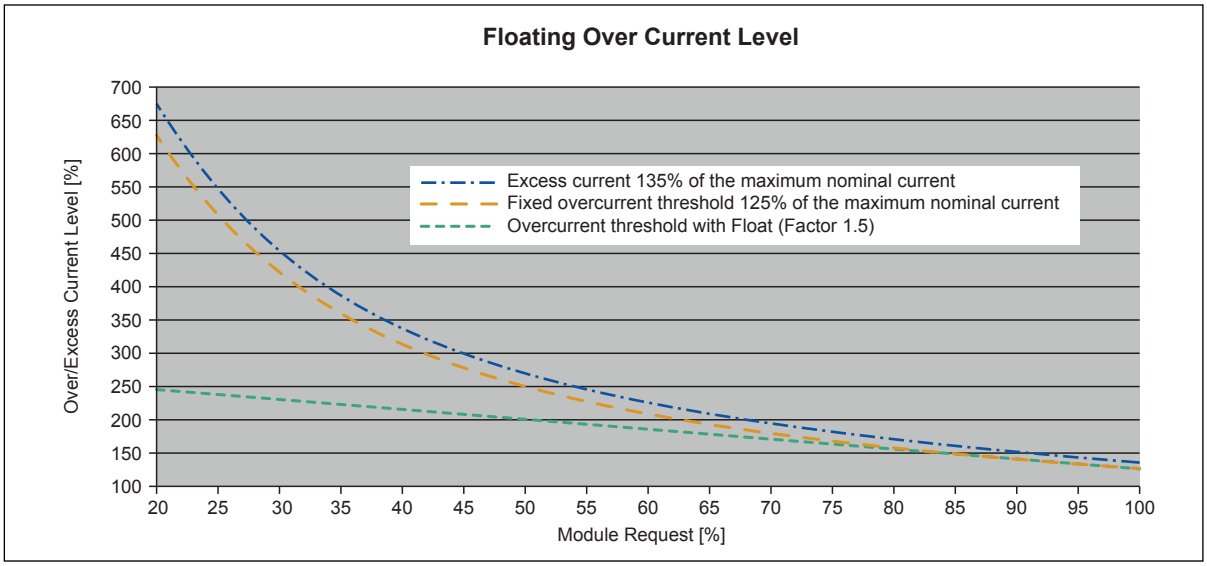
Notes on settings

For the heating current monitoring, there are two overcurrent thresholds:

– The threshold for the excess current is set to 135% of the maximum nominal current (dash-dotted line in the following diagram). This threshold value is fixed and leads always to a draining of the cylinder and to an emergency shut-down (Error E25) when exceeded.

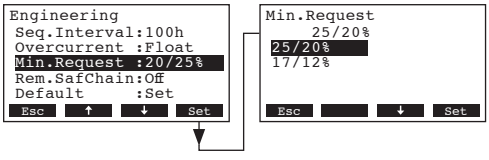
– The threshold for the overcurrent is set to 125% of the maximum nominal current (W24/E24). If this threshold value is exceeded the unit tries to reduce the current under 125 % by repetitive drainings. If after 5 repetitive drainings the current value is still above the threshold value of 125 % the unit goes on error (Error 24).
This threshold is fixed based on the maximum nominal current if **Fixed** is selected (dashed line in the following diagram).

With the function **Float** the overcurrent threshold (dashed line in the following diagram) can be flattened. The solid line in the following diagram represents the float threshold. The function Float allows a faster reaction to changes of the control signal.



2.10 Setting the On/Off hysteresis

Select "**Min.Request**" in the engineering menu, then press the **<Set>** key.



In the upcoming modification dialogue you determine the minimum demand for switching the unit on (first value) and off (second value) (On/Off hysteresis).

Factory setting: **25/20%**

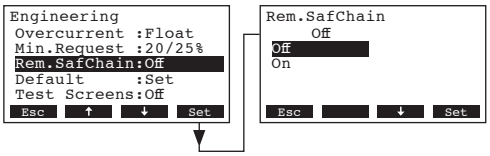
Options: **25/20%**
17/12%

Notes on settings

To ensure an optimal current measuring/regulation with electrode based humidifiers the hysteresis is set to 25 % (switch on) and 20 % (switch off).
However you can reduce the hysteresis to 17% (switch on) and 12% (switch off).

2.11 Activate/deactivate error message for open safety chain

Select “**Rem.SafChain**” in the engineering menu, then press the **<Set>** key.



In the upcoming modification dialogue you determine whether a warning message (Off) or error message (On) appears when the safety chain is open.

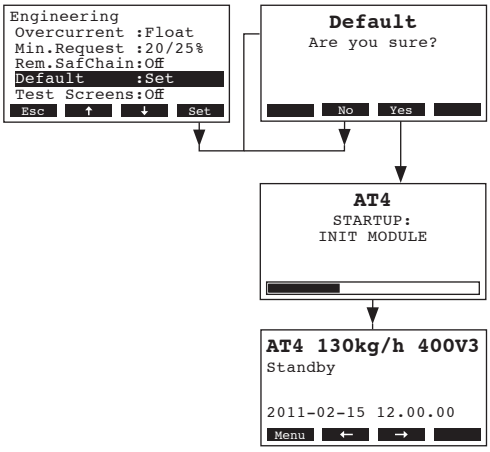
Factory setting: **Off**

Options: **Off** (warning message with open safety chain)
On (error message with open safety chain)

2.12 Resetting the control to factory settings

Caution! When resetting the control to factory settings, any modified settings in the user level are lost.

Select “**Default**” in the engineering menu, then press the **<Set>** key.

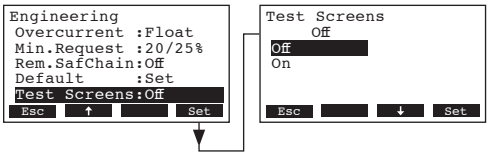


The reset dialogue shows up in the display. Press the **<Yes>** key to **reset the control to factory settings**. The control is reset to factory settings and restarted.
Note: By pressing the **<No>** key the reset procedure can be aborted. The control returns to the engineering menu.

2.13 *Activate/deactivate the test screens*

With this function you can activate the test screens to carry out different function tests. The test screens are not discussed in the service manual.

Select “**Test Screens**” in the engineering menu, then press the **<Set>** key.



In the upcoming modification dialogue switch the test screens on or off.

Factory setting: **Off**

Options: **Off**
On

3 Malfunctions

3.1 Operating malfunctions

W20, E20 Safety chain open

Function: indicates that the safety chain is open.

Procedure: if the safety chain is open the system is blocked and the warning message W20A is shown. By setting the option “Rem.SafChain” in the engineering level to On an open safety chain triggers the Error E20 and the error relay is activated.

Behaviour on activation:

	Warning (with Rem.SafChain: Off)	**Error (with Rem.SafChain: On)**
Display	W20A: Safety Loop Open	E20A: Safety Loop Open
LED display:	red & green flash	Red lights
Fault-Remote:	-	Error Relay
Error-History:	-	-
System:	Unit blocked	Unit blocked
Time delay:	-	-
Reset:	automatic reset	automatic reset

W21, E21 Max. level and no current

Function: indicates that the maximum level sensor has triggered.

Procedure: if the water level reaches the maximum level sensor the warning message W21 is triggered. The maximum level sensor features a software related switch-off delay of 10 seconds.

If during steam production the warning message W21 is active for more than 30 minutes and simultaneously the current is below 1.5 % the corresponding module goes on Error E21.

Behaviour on activation:

	Warning	**Error**
Display	W21A(B): Cyl.Max.Level	E21A(B): Cyl.Max & NoCurr
LED display:	-	Red lights
Fault-Remote:	-	Error Relay
Error-History:	-	E21A(B)
System:	No refilling on the corresponding module	Corresponding module blocked
Time delay:	-	30 minutes
Reset:	automatic reset	Unit Off/On

W22, E22 Maximum filling time and W23, E23 No electrode current

Function: monitoring of the filling cycle

Procedure: if the filling cycle ist not finished within 20 minutes (maximum filling level or reference current not reached) a warning is triggered. If the current is below 1.5 % warning W23 is triggered otherwise warning W22.

The **procedure** is as follows:

- 20 minutes filling -> W22 or W23 active
- 20 minutes filling
- 60 minutes waiting
- 20 minutes filling
- 20 minutes filling
- 60 minutes waiting
- 20 minutes filling -> E22 or E23 active

At the end of a filling cycle of 20 minutes the warning message can change from W22 to W23 or vice versa.

If a module with activated warning W22 or W23 goes on standby the warning message remains existing (advantage: you can see at any time that a module has problems with the water supply).

In addition to the normal monitoring of the maximum filling time the filling cycle is interrupted after 300 seconds for 5 seconds (except with the operating mode Ship).

When the steam production is restarted (main contactor activated) the filling valve is blocked for 60 seconds (awaiting current rise due to the heating up of the water).

Behaviour on activation:

	Warning	**Error**
Display	W22A(B): Max.Fill Time W23A(B): No Current	E22A(B): Max.Fill Time E23A(B): No Current
LED display:	-	Red
Fault-Remote:	-	Error Relay
Error-History:	-	E22A(B) bzw. E23A(B)
System:	corresponding module is filling or waiting	Corresponding module blocked
Time delay:	-	220 minutes (3 hours 40 minutes)
Reset:	automatic reset	Unit Off/On

W24, E24 Electrode current too high

Function: monitoring of the heating current (Phase L1)

Procedure: if a overcurrent is detected the main contactor is switched off immediately, a draining is carried out and the Warning W24 is triggered. Subsequently, the main contactor is activated again. If overcurrent occurs again, the process is repeated. After 15 drainings the error E24 is triggered if the current could not be reduced.

The overcurrent monitoring serves for the recognition of slow rising overcurrents. The threshold of 125 % refers to the actual demand. If the steam demand drops quickly, so called correction drainings are carried out with this function, in order to achieve the new working point faster. The overcurrent is analysed only if the current value determined by the current measurement is valid, i.e. the software related RC element is loaded. It takes up to 8.25 seconds until the overcurrent monitoring can be released.

Behaviour on activation:

	Warning	**Error**
Display	W24A(B): Over Current	E24A(B): Over Current
LED display:	-	Red lights
Fault-Remote:	-	Error Relay
Error-History:	-	E24A(B)
System:	Corresponding module is draining	Corresponding module blocked
Time delay:	-	15 drainings (Time see table)
Reset:	automatic reset	Unit Off/On

Cylinder type	**Draining time**
5xx/8xxx	4 seconds
15xx	6 seconds
23xx	8 seconds
32xx/45xx/65xx	12 seconds

W25, E25 Maximum admissible electrode current exceeded

Function: monitoring of the heating current (Phase L1)

Procedure: if a overcurrent is detected the main contactor is switched off immediately, a draining is carried out and the Warning W25 is triggered. Subsequently, the main contactor is activated again. If overcurrent occurs again, the process is repeated. After 3 drainings the error E25 is triggered if the current could not be reduced.

The excess current monitoring serves for the recognition of fast rising overcurrents. The threshold of 135 % refers always to the nominal current of the humidifier and therefore it does not depend on the steam demand. The current value is analysed even if the software related RC element is not yet loaded. Thus it can be ensured that a fast rising current can be switched off, before the fuse is triggered.

Behaviour on activation:

	Warning	**Error**
Display	W25A(B): Excess Current	E25A(B): Excess Current
LED display:	-	Red lights
Fault-Remote:	-	Error Relay
Error-History:	-	E25A(B)
System:	Corresponding module is draining	Corresponding module blocked
Time delay:	-	3 drainings (Time see table)
Reset:	automatic reset	Unit Off/On

Cylinder type	**Draining time**
5xx/8xxx	30 seconds
15xx	40 seconds
23xx	40 seconds
32xx/45xx/65xx	60 seconds

E26 Heating voltage contactor jammed

Function: current monitoring while the contactor is switched off.

Procedure: if during operation with deactivated main contactor a current higher than 1.5 % is registered the error E26 is triggered and the unit is blocked. Error E26 is triggered and the system is blocked too, if during the calibration of the unit (after switching the unit on) a certain current value is exceeded.

Behaviour on activation:

	No Warning	**Error**
Display	-	E26A(B): Req. Off Current
LED display:	-	Red
Fault-Remote:	-	Error Relay
Error-History:	-	E26A(B)
System:	-	Corresponding module blocked and cylinder is draining
Time delay:	-	30 seconds
Reset:	-	Unit Off/On

W27, E27 Foam detection

Function: monitoring of foam formation in the steam cylinder.

Procedure: to detect the formation of foam the current value when the water gets in contact with maximum level sensor (filling end) and the current value when the water looses the contact with the maximum level sensor are set in relation to each other.

This relation is called CurrentDrop:
CurrentDrop = $I_{Sensor\text{-}Off}$ / $I_{Sensor\text{-}On}$

If the CurrentDrop value is less than 0.8, a counter is increased by 1. If the counter has counted up from 0 to 1, a waiting period of 30 minutes starts. During the waiting time the CurrentDrop is not analysed. If the counter counts up to 2, the warning W27 is triggered. If the counter has reached the value of 6 the cylinder is drained and the counter is reset to 0. If within 24 hours 4 drainings occurred the error E27 is triggered.

– CurrentDrop < 0.8:
  —> Counter + 1
– CurrentDrop ≥ 0.8 or filling end with 110% current:
  —> Counter - 1 (not < 0)
– Counter ≥ 2:
  —> W27A(B)
– Counter = 6
  —> cylinder draining
– 4 drainings within 24h
  —> E27A(B)

<u>Reset of Warning W27</u>

If after a draining the CurrentDrop is ≥ 0.8, the warning is reset automatically. The warning message is reset too, if the counter has counted back to 0.

Behaviour on activation:

	Warning	Error
Display	W27A(B): Foam	E27A(B): Foam
LED display:	-	Red lights
Fault-Remote:	-	Error Relay
Error-History:	W27A(B)	E27A(B)
System:	Corresponding module is draining	Corresponding module blocked and cylinder draining
Time delay:	30 minutes	24 hours
Reset:	automatic reset	Unit Off/On

W28, E28 Steam cylinder used

Function: monitoring of the steam cylinder on lime deposits at the electrodes.

Procedure: if a filling cycle ends due to a contact with the max. level sensor a counter is increased by 1. If the filling cycle ends with 110 % current the counter is decreased by 1 (not < 0). Sensor contacts beyond the filling cycles are not counted. If the sensor counter reaches a value of 2400 (4800 with conductivity: <125uS), the warning W28 is triggered. Further 72 hours of operation are possible after the warning message before the error E28 is triggered.

Behaviour on activation:

	Service	Error
Display	W28A(B): Cyl. Maintenance	E28A(B): Cyl. Maintenance
LED display:	Yellow lights	Yellow & Red light
Fault-Remote:	Service Relay	Service & Error Relay
Error-History:	-	E28A(B)
System:	72 h Timer is started	Corresponding module blocked
Time delay:	2400 (4800) Sensor contacts	72 hours warning time
Reset:	User -> Maintenance -> Cyl. Reset	User -> Maintenance -> Cyl. Reset

W29, E29 Max. operating hours of steam cylinder reached

Function: monitoring the steam cylinder on max. operation hours.

Procedure: if the operating hours of the steam cylinder has reached the set maximum value the Warning W29 is triggered. Further 72 hours of operation are possible after the warning message before the error E29 is triggered.

Behaviour on activation:

	Service	**Error**
Display	W29A(B): Cyl. Maintenance	E29A(B): Cyl. Maintenance
LED display:	Yellow lights	Yellow & Red light
Fault-Remote:	Service Relay	Service & Error Relay
Error-History:	-	E29A(B)
System:	72 h Timer is started	Corresponding module blocked
Time delay:	2500/5000 operating hours	72 hours warning time
Reset:	User -> Maintenance -> Cyl. Reset	User -> Maintenance -> Cyl. Reset

W32, E32 Humidity sensor defective

Function: monitoring of the humidity signal at the control input (sensor interruption).

Procedure: the monitoring is active only, if the internal controller (“Int.P” or “Int.PI”) is activated. If the humidity signal drops below the threshold of 3 % steam production is stopped and the warning W32 triggered. If the signal is still below 3 % after 60 seconds error E32 is triggered.

Behaviour on activation:

	Warning	**Error**
Display	W32A(B): HumSensor broken	E32A(B): HumSensor broken
LED display:	-	Red lights
Fault-Remote:	-	Error Relay
Error-History:	-	E32A(B)
System:	Steam production = 0%	Steam production = 0%
Time delay:	-	60 seconds
Reset:	automatic reset	automatic reset

W33, E33 Limit humidity sensor defective

Function: Monitoring of the humidity signal at the limiter input (sensor interruption).

Procedure: the monitoring is active only, if the internal controller (“Int.P” or “Int.PI”) is activated and the **Function** “Limiter” activated. If the humidity signal drops below the threshold of 3 % steam production is stopped and the warning W33 triggered. If the signal is still below 3 % after 60 seconds error E33 is triggered.

Behaviour on activation:

	Warning	**Error**
Display	W33A(B): Lim Sens broken	E33A(B): Lim Sens broken
LED display:	-	Red lights
Fault-Remote:	-	Error Relay
Error-History:	-	E33A(B)
System:	Steam production = 0%	Steam production = 0%
Time delay:	-	60 seconds
Reset:	automatic reset	automatic reset

W34 Module inactive

Function: indicates that a module is blocked.

Procedure: the modules a and B can be blocked by the user. If a module is set to “Inactive” the corresponding module is blocked and the warning W34 is triggered.

Behaviour on activation:

	Warning	**No Error**
Display	W34A(B): Module disable	-
LED display:	-	-
Fault-Remote:	-	-
Error-History:	-	-
System:	corresponding module blocked	-
Time delay:	-	-
Reset:	Engineering -> Module A(B) -> Active	-

E35 Modbus Timeout

Function: monitoring for continuous transmission of the control/limiter signal (demand/humidity) via Modbus.

Procedure: If the demand or humidity signal is transmitted to the unit via Modbus (SignalSource: Modbus) the signal must be updated in regular intervals. If within 5 seconds no new value is transmitted error E35 is triggered.

Behaviour on activation:

	No Warning	**Error**
Display	-	E35A(B): Modbus Timeout
LED display:	-	Red lights
Fault-Remote:	-	Error Relay
Error-History:	-	-
System:	-	Steam production = 0%
Time delay:	-	5 seconds
Reset:	-	automatic reset

W36, E36 Standby Modus active

Function: Indicates that a standby operation is active (Draining, AntiFreeze or KeepWarm).

Procedure:

– **Standby-Operation “Draining”**

If a module has no demand for 72 hours standby draining is triggered on the corresponding module. During draining the information W36 is shown in the display. In standby mode the draining function is triggered only once (no repetition after 72 additional operating hours without demand).

– **Full Draining**

With full draining the cylinder is completely drained (3 minutes) after 72 hours in standby operation.

– **Partial draining**

With partial draining only a short draining cycle is performed. Subsequently, it is checked whether or not there is a current flow between the electrodes. If still current flows (the electrodes are still in the water), the draining is repeated (max. 20 times). If no current flows, partial draining is terminated. If the safety chain is interrupted no partial draining can be performed (contactor cannot be activated). In this case a full draining is performed automatically.

– **Standby operation “KeepWarm” and “AntiFreeze”**

If a module has no demand the keep warm or anti freeze function is activated. With keep warm function the water in the cylinder is heated with 150 W for a maximum of 72 hours as standard. With anti freeze function the water in the cylinder is heated with 50 W without time limitation.

Behaviour on activation:

	Hinweis	**Error**
Display	W36A(B): StandbyMod.active	E36A(B): Idle Mode Failed
LED display:	-	Red
Fault-Remote:	-	Error Relay
Error-History:	-	E36A(B)
System:	Corresponding module is performing a standby operation	Corresponding module blocked
Time delay:	72h with standby draining	div.
Reset:	-	Unit Off/On

W37 Forced draining

Function: Indicates forced draining is active.

Procedure: If a module has produced steam for 72 hours a forced draining (3 minutes) is performed on the corresponding module. During draining the information W37 is shown in the display. Subsequently, the cylinder is refilled with water and operation continuous. This procedure is repeated every 72 hours of operation (steam production).

Behaviour on activation:

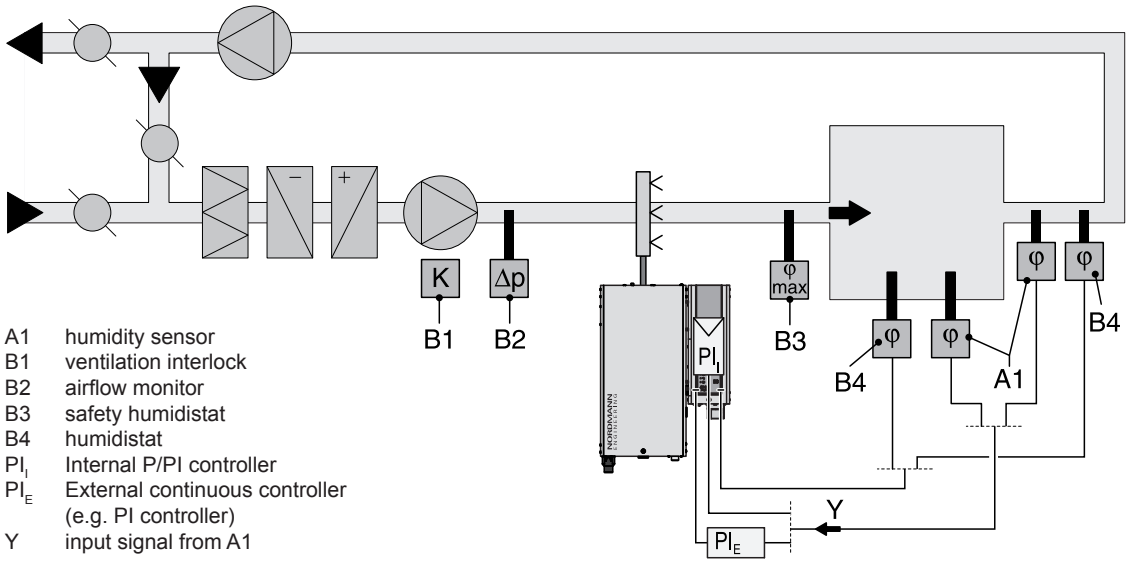
	Warning	**No Error**
Display	W37A(B): Forced Drain	-
LED display:	-	-
Fault-Remote:	-	-
Error-History:	-	-
System:	Corresponding module is draining	-
Time delay:	72 h	-
Reset:	-	-

4 Humidity control systems

4.1 Humidity control system without limitation of the supply air humidity

4.1.1 System 1: Room humidity control

System 1 is suited for **direct room humidification** and **air conditioning systems with mainly recirculated air**. The humidity sensor or humidistat respectively is preferably located in the room itself or in the exhaust air duct.

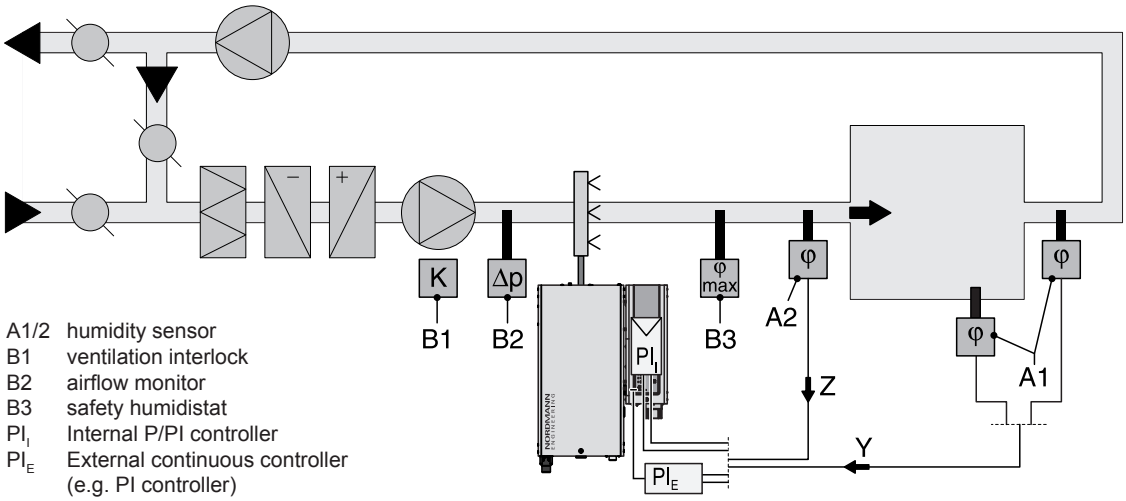


A1 humidity sensor
B1 ventilation interlock
B2 airflow monitor
B3 safety humidistat
B4 humidistat
PI_I Internal P/PI controller
PI_E External continuous controller (e.g. PI controller)
Y input signal from A1

4.2 Humidity control system with limitation of the supply air humidity

4.2.1 System 2: Room humidity control with continuous limitation of the supply air humidity

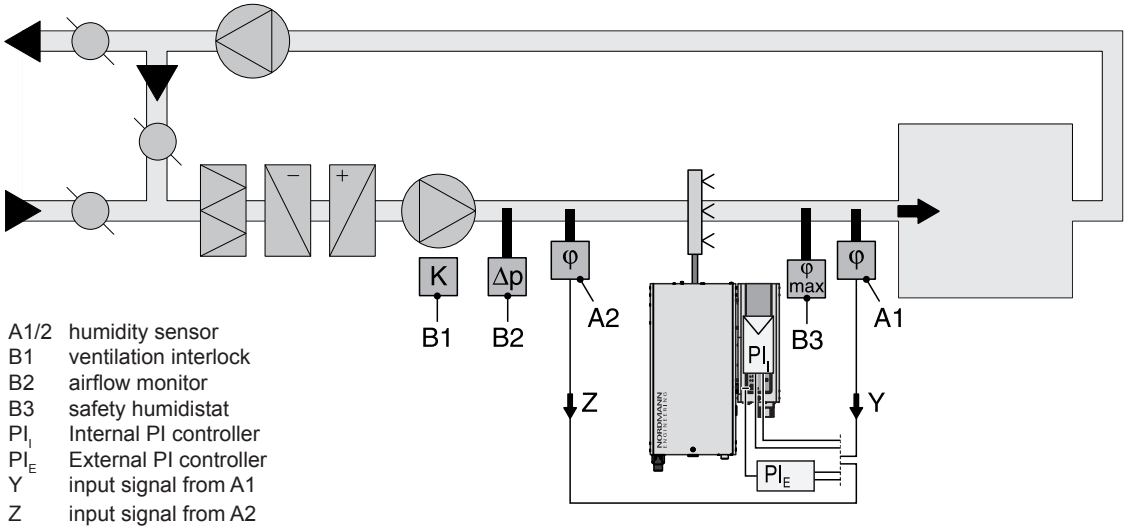
System 2 is suited for air conditioning systems with a **large portion of supply air**, **low supply air temperature**, **post-humidification**, or **variable airflow volume**. If the supply air humidity exceeds the preset value, the continuous limitation is effected prior to the room humidity control.
The humidity sensor (A1) is preferably located in the exhaust air duct or in the room itself. The humidity sensor (A2) for the limitation of the supply air humidity is located in the supply air duct after the steam distribution pipe. This control system requires a continuous controller with the option to connect a second humidity sensor.
Attention! The continuous limitation of the supply air humidity is no substitute for the safety humidistat.



A1/2	humidity sensor
B1	ventilation interlock
B2	airflow monitor
B3	safety humidistat
PI_I	Internal P/PI controller
PI_E	External continuous controller (e.g. PI controller)
Y	input signal from A1
Z	input signal from A2

4.2.2 System 3: Supply air humidity control with continuous output limitation

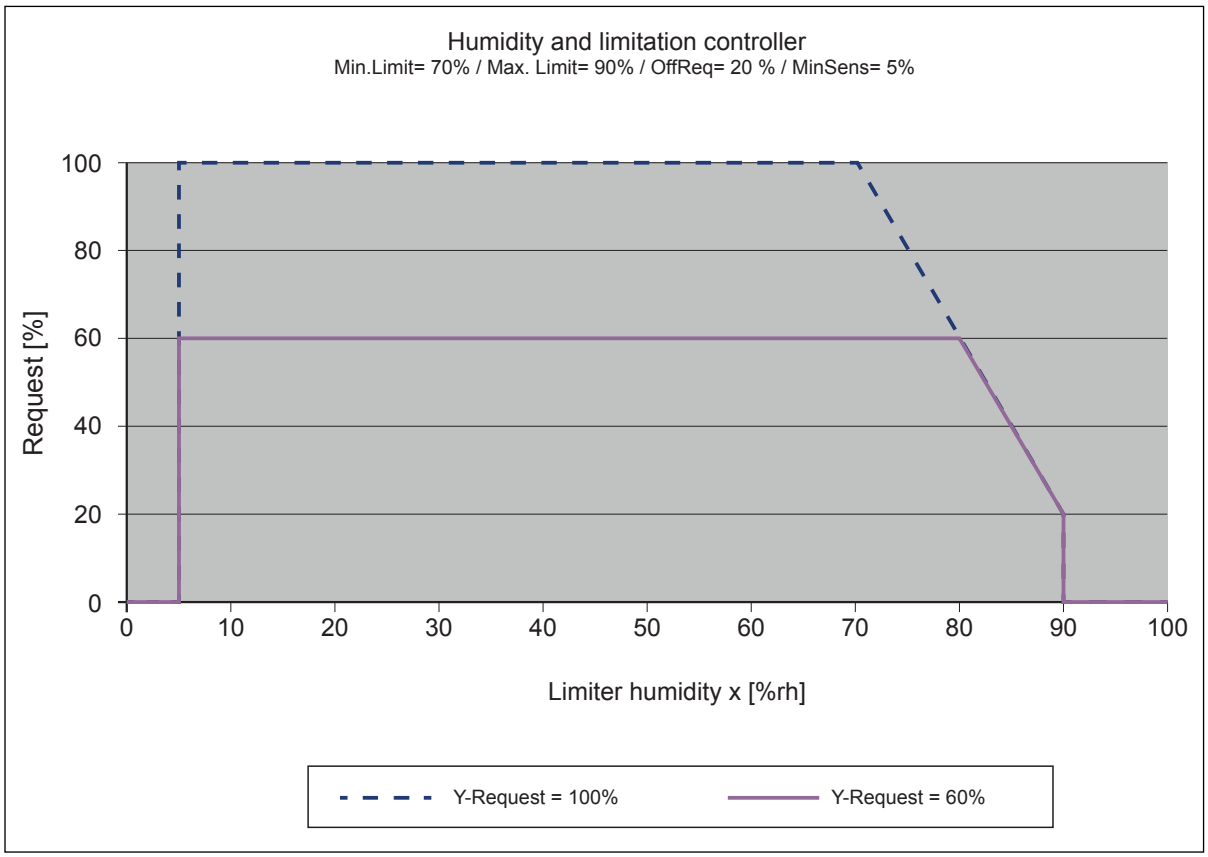
Supply air humidity control (humidity sensor installed in supply air duct) should be used only where room humidity control is impracticable for technical reasons. Such systems always require a PI-controller. The humidity sensor (A1) is located in the supply air duct after the steam distribution pipe. The humidity sensor (A2) for the continuous output limitation is located in the supply air duct before the steam distribution pipe. Such a system requires a PI-controller with the option to connect a second humidity sensor.



A1/2	humidity sensor
B1	ventilation interlock
B2	airflow monitor
B3	safety humidistat
PI_I	Internal PI controller
PI_E	External PI controller
Y	input signal from A1
Z	input signal from A2

4.3 Notes on humidity control systems with limitation of the supply air humidity

For the better comprehensibility of the humidity control systems with limitation of the supply air humidity the following diagram is to be referred.



Example:

– Limitation range min. 70% / max. 90%

– 100% calculated demand of the controller based on the humidity signal and the desired humidity value.

– 80% rh measured supply air humidity from the limiter input

The outcome of this is an effective unit capacity of 60%

5 Water management

5.2 The SC system of the Nordmann AT4

Lime deposition in steam air humidifier is a well-known process that can't be avoided if tap water is used for air humidification. Lime scaling on steam cylinder walls, valves and heating electrodes prevent reliable operation of the air humidifier, if the humidifier is not regularly maintained.

The SC system of the Nordmann humidifiers does not prevent lime scaling, however it does lead to substantially longer operation cycles because the lime deposit at surfaces is drastically reduced.

How does it come to lime scaling?

Calcium occurs in the environment only in bound form as constituent of minerals. Calcium is a shining silver-white, soft metal, which reacts with water strongly. It is the relevant element for the formation of lime.

In water lime ($CaCO_3$) is present in solve form, i.e. as ions Ca++ and CO_3. Even with small physical changes of the water such as heating up or swirling lime precipitates.

An important role on binding and precipitation of lime plays the carbonic acid (H_2CO_3) contained in the water, and the so-called lime carbonic acid equilibrium. Carbonic acid is a reaction product of carbon dioxide (CO_2) with water (H_2O). In the water a lime carbonic acid equilibrium prevails, if it contains even so much carbon dioxide that it does not precipitates lime but no lime can be solved. If carbon dioxide is withdrawn from such a water, lime precipitation occur.

Since the solubility of gas decreases with increasing water temperature, the carbon dioxide escapes when the water is heated up. Through this intervention into the lime carbonic acid equilibrium lime precipitates and settles in the steam cylinder. The lime precipitation increases very strongly with water temperatures higher than 60°C.

A additional point, which influences the precipitation of lime in an electrode steam air humidifier is the current flow in the water. Due to the electron activity in the water resulting from the current flow, the molecular structure of the lime is disturbed. Therefore no lime wafers can build up in the zone where the current flows and the lime is precipitated only as small particles.

SC pump system from Nordmann Engineering

The SC system prevents the deposit of lime at solid surfaces and supports the formation of fine-grained particles by the following effects:

– enrichment of the water with carbon dioxide by supply of air into the steam cylinder. The increased portion of carbonic acid permits an improved solution of calcium ions.

– the swirling of water leads to increased molecular mobility. Lime precipitated during the warming up process is kept floating thus reducing the lime accumulation on surfaces.

– the agitation of the water favours the formation of small lime particles and prevents the deposits of lime wafers.

During operation the lime particles are flushed out of the steam cylinder with the regular draining cycles. Therefore, the water drain line should be generously dimensioned when using the SC system to prevent clogging. The siphon in the drain line should be freely accessible to facilitate cleaning since increased lime deposits could occur.

5.3 The use of softenend water for the operation of the Nordmann AT4

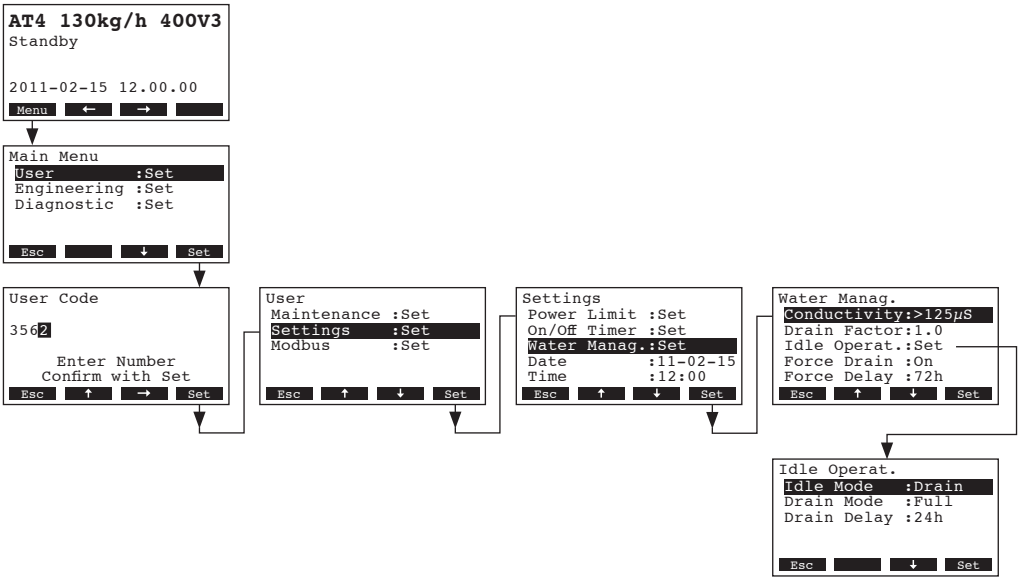
The use of softened water is not recommended for Nordmann AT4. Instead of the expected cylinder service interval increase, most likely functioning problems will appear.

By the softening process, the Calcium and Magnesium ions representing the hardness of the water are replaced by sodium ions. Due to the evaporation of the water, the content of the sodium ions increases and the sodium chloride will be dissolved at the boiling temperature of 100 °C in form of sludge. The sludge at the bottom of the cylinder clogs the outlet of the cylinder and stops the automatic drainage of the water. Finally, foam and sparks will appear in the cylinder. The result will be completely defective electrodes.

Instruction for the use of softened water

1. The hardness of the raw tap water must be below 500 ppm per litre.
2. The conductivity must be below 800 µS/cm.
3. Never use completely softened water! The softened water must be mixed with raw tap water to get either a hardness above 150 ppm per litre or not less than 1/3 of the raw tap water hardness.
4. Sodium salt concentration may be very high during start up or recreation cycle of a water softener. Therefore a constant flow of softened water is required and this may not be possible if the water softener is only designed for the humidifier.
5. Resulting pH-value must be between 7.0 and 8.0. Higher pH-value may be the reason for foam.
6. Water softener salt must be from good quality. Low cost products will have a negative impact of the work performance.
7. Check correct cylinder (see operating instructions Nordmann AT4) settings.

8. Check installation of the humidifier and steam distribution according to the mounting instructions Nordmann AT4.
9. The drain water quantity of the Nordmann AT4 must be increased. Check the following water management settings in the user settings level of the Nordmann AT4 control and set them to the following values:

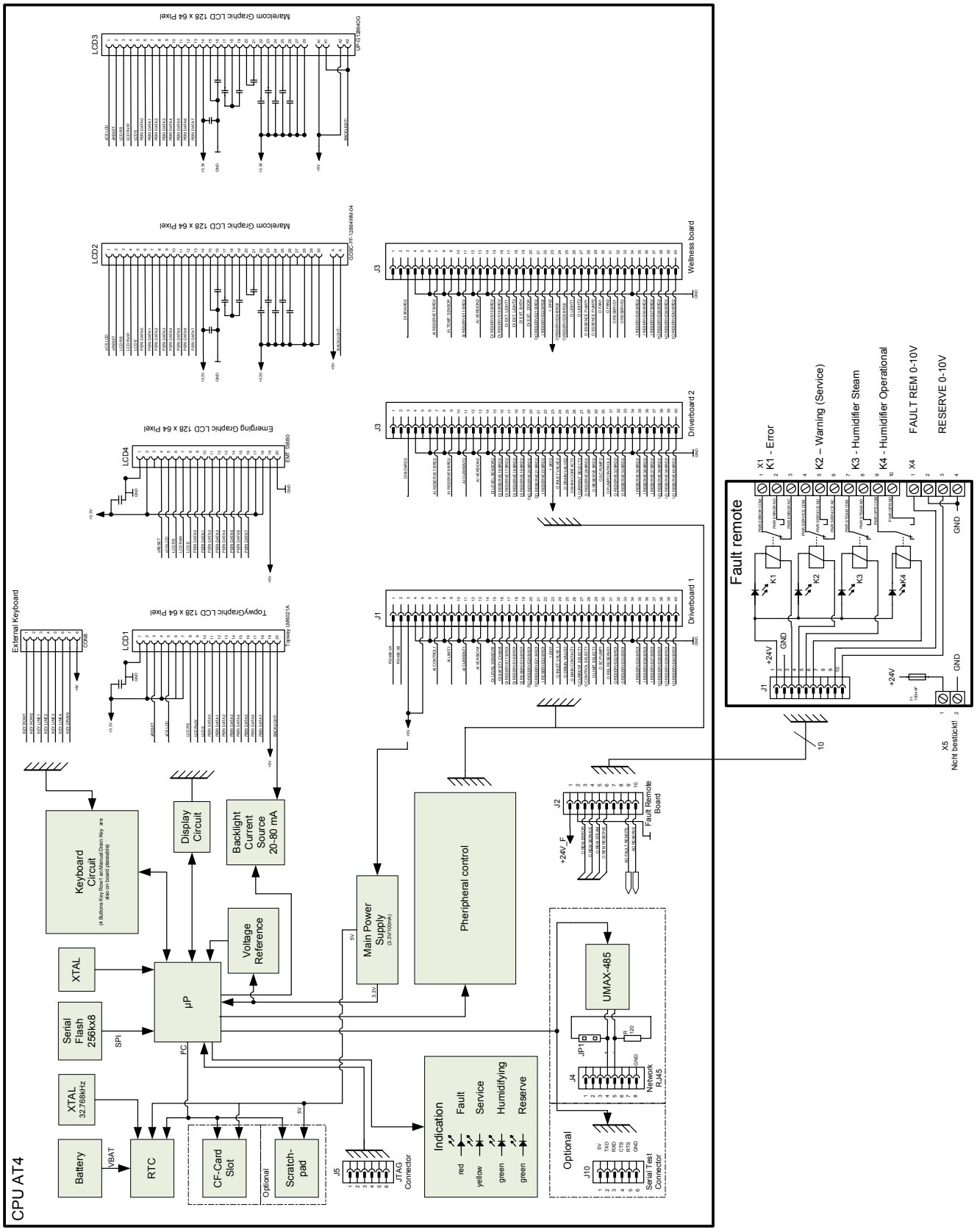


Description	Parameter	Settings/Notes
Conductivity	Conductivity	>125µS
Drain factor	Drain Factor	1.5...2.0 Drain factor must be increased if foam formation occurs
Standby operating mode	Idle Mode	Drain
Drain mode	Drain Mode	Full
Standby drain delay	Drain Delay	24h
Forced draining	Force Drain	On Please be aware of the steam loss if forced draining is activated
Forced draining delay	Force Delay	72h

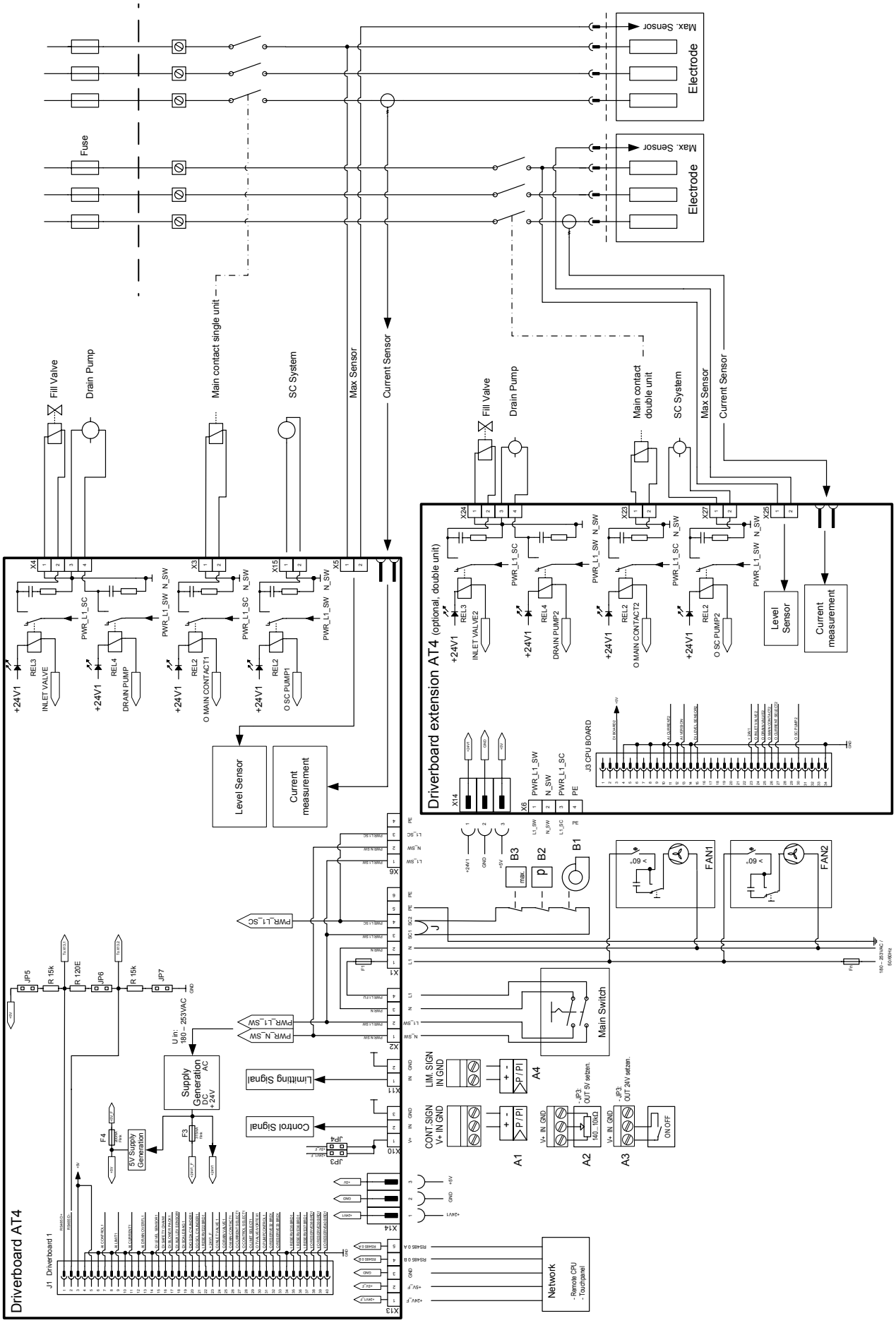
Note: the Nordmann AT4 increases drain cycle automatically if water with high conductivity is used. Therefore high waste water quantities must be expected.

6 Block diagrams

6.1 Block diagram CPU



6.2 Block diagram power board



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