

# Nordmann AT4 D

Steam generator



**SERVICE MANUAL**



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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 D. 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 D and that he is familiar with the dangers when working on the unit.

The present service manual includes the following information:

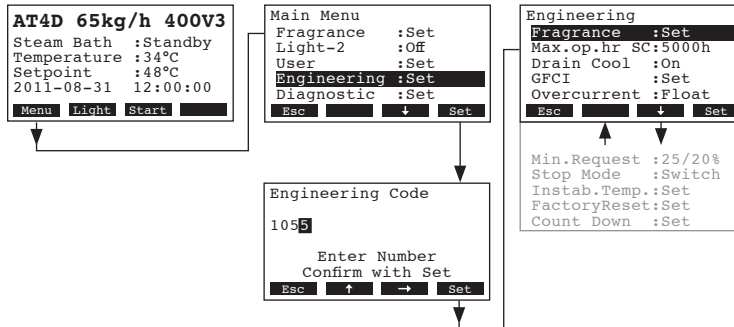
- Description of the settings in the engineering level of the Nordmann AT4 D control.
- Information on operational malfunctions
- Information on the control matrix of the steam bath control
- Information on the water management
- Block diagrams of the control electronics

## 2 Settings in the engineering level

### 2.1 Launching the Engineering level

Select the engineering settings menu:

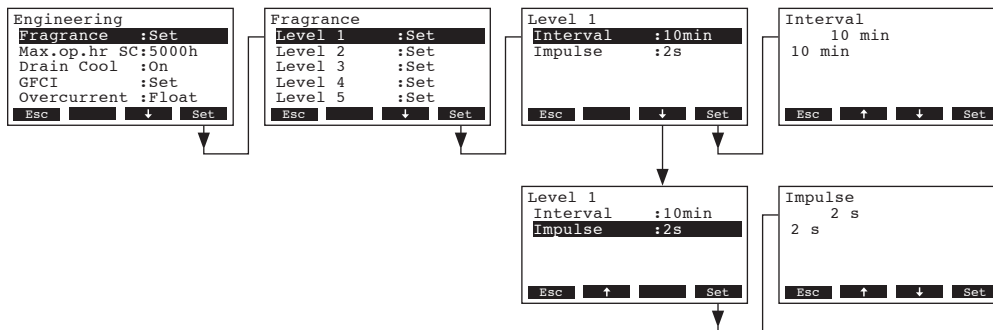
Path: **Main menu > User > Password entry: 1055 > Engineering**



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 intensity levels for the fragrance pumps

Select "**Fragrance**" in the engineering menu, then press the <Set> key. Select the intensity level (levels 1 to 5) whose values you would like to modify, then press the <Set> key.



Set the desired interval time in minutes and the pulse duration in seconds for the selected intensity level.

Setting range interval time: **2...20 minutes**

Setting range pulse duration: **2...10 seconds**

Factory setting:

Level 1 = interval time: 10 minutes, pulse duration: 2 seconds

Level 2 = interval time: 8 minutes, pulse duration: 3 seconds

Level 3 = interval time: 6 minutes, pulse duration: 3 seconds

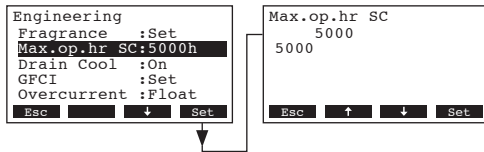
Level 4 = interval time: 4 minutes, pulse duration: 4 seconds

Level 5 = interval time: 3 minutes, pulse duration: 5 seconds

Note: the fragrance pump is active only, if the main contactor of the steam generator is activated and the system is in steam bath operation.

## 2.3 Setting the replacement interval time for the steam cylinder

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

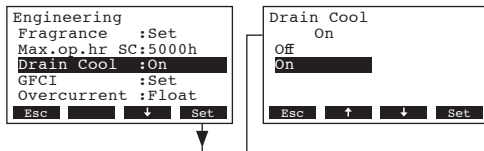


In the upcoming modification dialogue set the desired interval time for the replacement of the steam cylinder in hours (max. operating hours). The interval time to be set depends on the water quality on site. Note: First priority for the determination of the maximum operating hours of the steam cylinder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

Factory setting: **5000 h**  
Setting range: **100...8000 h**

## 2.4 Activating/deactivating the drain cooling

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

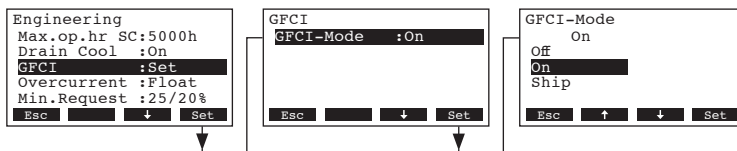


In the upcoming modification dialogue activate (On) or deactivate (Off) the drain cooling function. With activated drain cooling the inlet valve opens during the drain cycle, thus reducing the drain water temperature.

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

## 2.5 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 D is connected to a fault current relay protected mains supply or whether the Nordmann AT4 D 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)

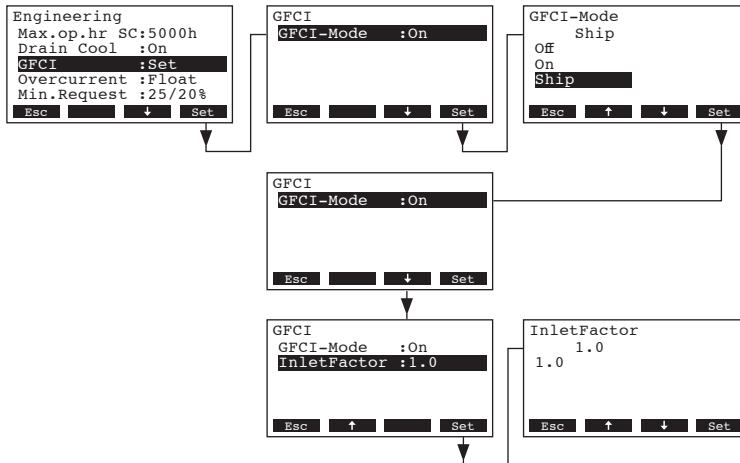
## Notes on the function “Ship”

The “Ship” function is used if the Nordmann AT4 D 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)

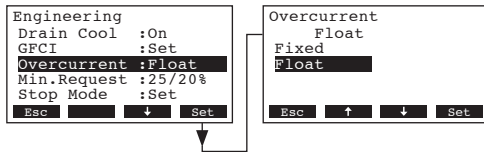
Note: With inlet factor 1 the filling cycle takes 30 seconds then, the inlet valve is closed and the main contactor is activated, in order to check the current rise. If the desired current value is not yet achieved (110% of the nominal current), the main contactor is deactivated again, and another filling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

## 2.6 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 over current threshold (Float).

Factory setting: **Float**

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

### Notes on settings

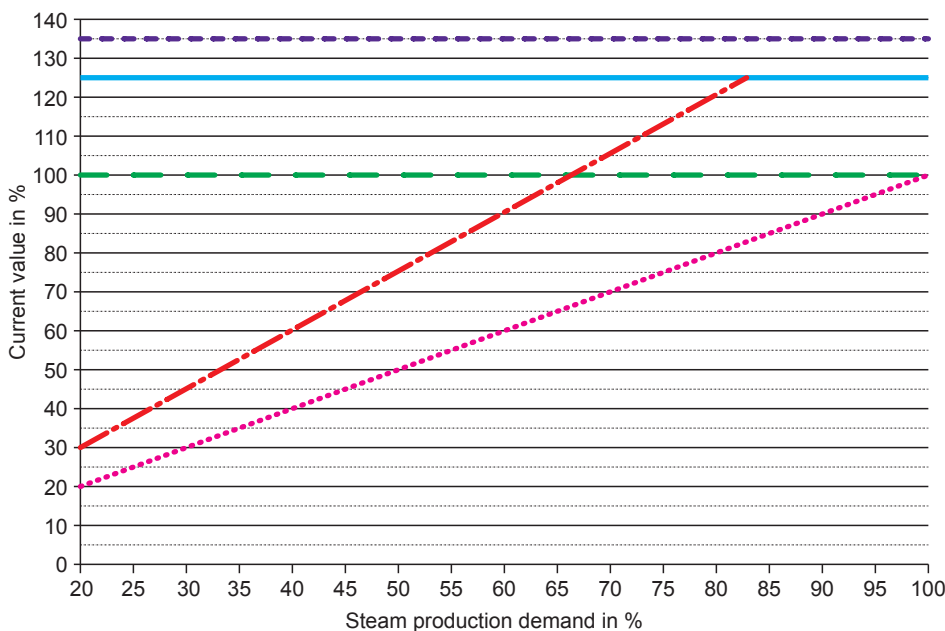
For the heating current monitoring, there are two over current thresholds:

- The threshold for the **excess current** is set to 135% of the maximum nominal current (violet, narrow dashed 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 **over current** 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 (light blue, continuous line in the following diagram).

With the function **Float** the over current threshold (red, dash-dotted line in the following diagram) can be flattened. The function Float allows a faster reaction to changes of the control signal.

Draining characteristics with over current



### Example:

Nominal current at 100% steam production with 400V 10kg/h = 10 A

Actual steam demand 30%

—> Current setpoint value = 3 A

Draining as a result of over current at 4.5 A with setting “float”

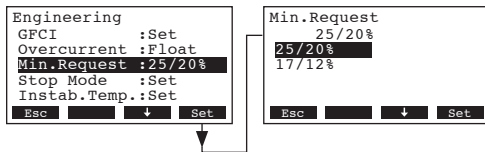
Draining as a result of over current at 12.5 A with setting “Fixed”

- — — — — Nominal current 100%
- ..... Current setpoint value
- . - . - . Draining if current value exceeds the set point value by a factor of 1.5 (setting “Float”)
- Draining if current value reaches 125 % of the maximum nominal current value (setting “Fixed”)
- - - - - Forced draining if current value reaches 135 % of maximum nominal current value



## 2.7 **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

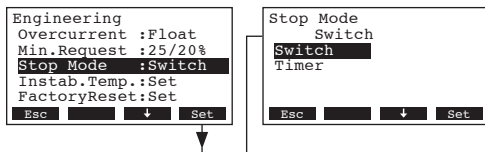
To ensure an optimal current measuring/regulation with electrode based steam generators the hysteresis is set to 25 % (switch on) and 20 % (switch off).

However you can reduce the hysteresis to 17% (switch on) and 12% (switch off).

## 2.8 **Setting the Stop Mode for bathing operation**

With this function you can determine whether or not the **<Stop>** key is suppressed during bathing operation.

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



In the upcoming modification dialogue you determine whether the bathing time is automatically controlled via the set bathing time (setting “Timer”) whilst the **<Stop>** key is suppressed or whether the bathing time can be stopped at any time by pressing the **<Stop>** key (setting “Switch”).

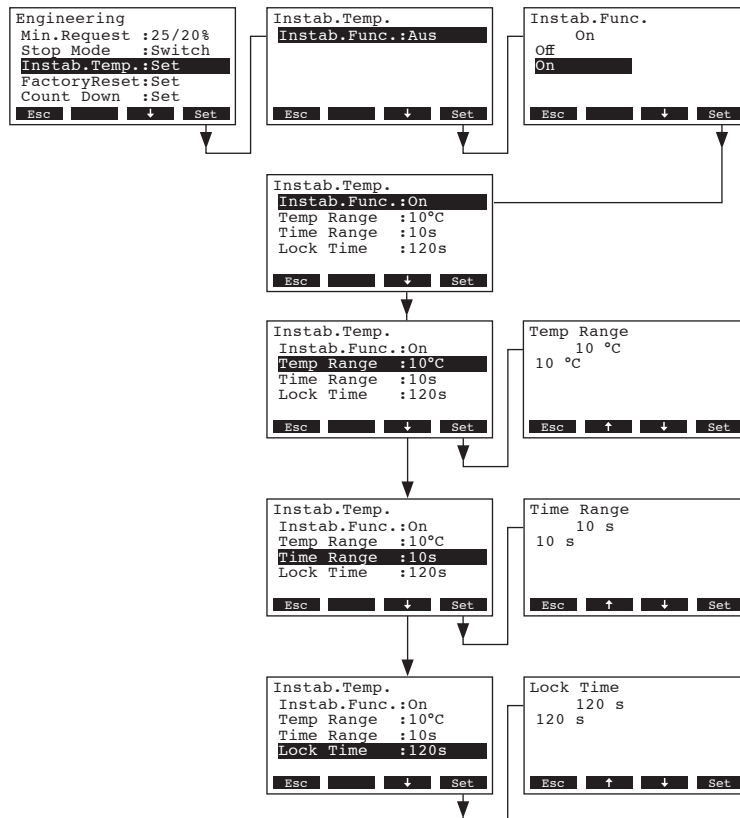
Factory setting: **Switch**  
Options: **Switch** (bathing time can be stopped at any time with the **<Stop>** key)  
**Timer** (the bathing time is automatically controlled via the set bathing time, the **<Stop>** key is suppressed)

## 2.9 Setting-up temperature sensor monitoring function

In order to detect a manipulation on the temperature sensor, the steam bath control features the function "Instab.Func". If this function is activated the temperature curve of the temperature sensor is monitored during steam bath operation. If the temperature decreases by cooling the temperature sensor (e.g. by the use of a cool rag) within a certain time "Time Range" by more than the set temperature value "Temp Range", the steam generator is blocked for a certain time "Lock Time". If the blocking time has elapsed the steam generator is enabled again.

Note: temperature monitoring is activate only during steam bath operation and if the door of the steam bath cabin is closed.

Select "Instab.Temp" in the engineering menu, then press the <Set> key. Select "Instab.Func", then press the <Set> key. In the upcoming display activate the monitoring function (On), then press the <Set> key.



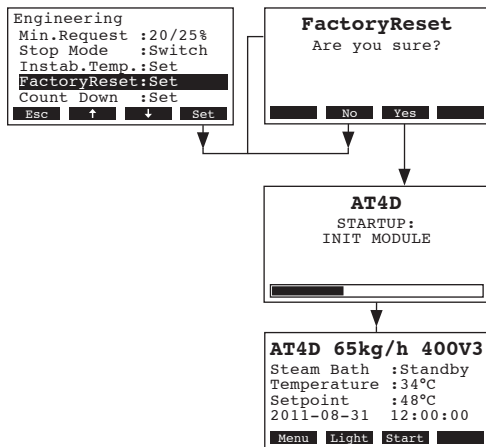
Now, determine the desired settings for the temperature sensor monitoring:

- "Temp Range": Temperature range  
Factory setting: 10 °C  
Setting range: 1...30 °C
- "Time Range": Time span for the temperature monitoring  
Factory setting: 10 seconds  
Setting range: 1...60 seconds
- "Lock Time": Blocking time for steam production  
Factory setting: 120 seconds  
Setting range: 1...600 seconds

## 2.10 *Resetting the control to factory settings*

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

Select “**FactoryReset**” 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.

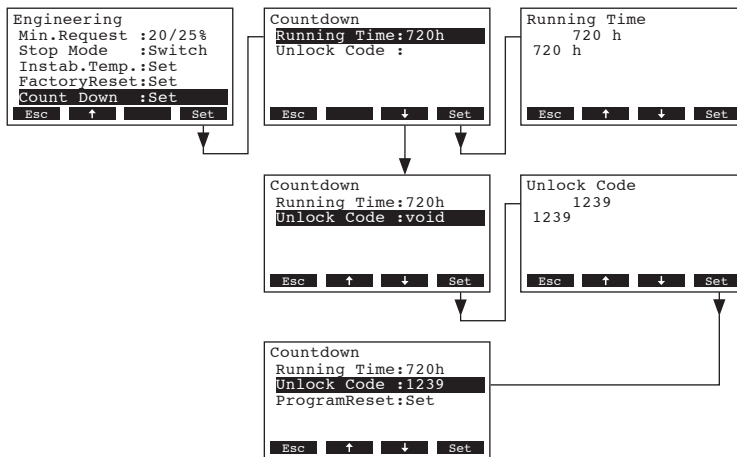
## 2.10 Setting-up countdown function/resetting countdown

Ex factory the countdown function is disabled. In order to activate the countdown function, you determine the countdown time (Running time) first, then you activate the function by entering the unlock code (Unlock Code). As soon as the countdown function is activated, the set countdown time (Running time) is decremented, once the steam generator is switched on (standby operation, keep warm operation or steam operation). If the set running time has elapsed, the unit is blocked and triggers an error (error 15). The countdown function or error 15 can only be deactivated/reset by entering the unlock code.

**Caution!** If the unlock code gets lost the CPU board must be replaced or newly programmed.

### – Activating the countdown function

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

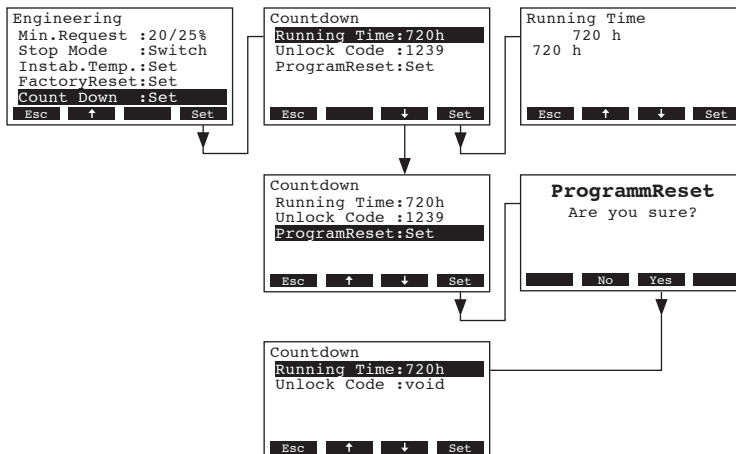


Now, set the desired countdown time (Running Time), then activate the countdown function by entering an unlock code (Unlock Code):

- “**Running Time**”: Operation time in hours (if set time is elapsed the steam generator is blocked)  
Factory setting: **720 h**  
Setting range: **1...2880 h**
- “**Unlock Code**”: Individual unlock code  
Factory setting: **void**  
Setting range: **0...9999**

– **Deactivating the countdown function**

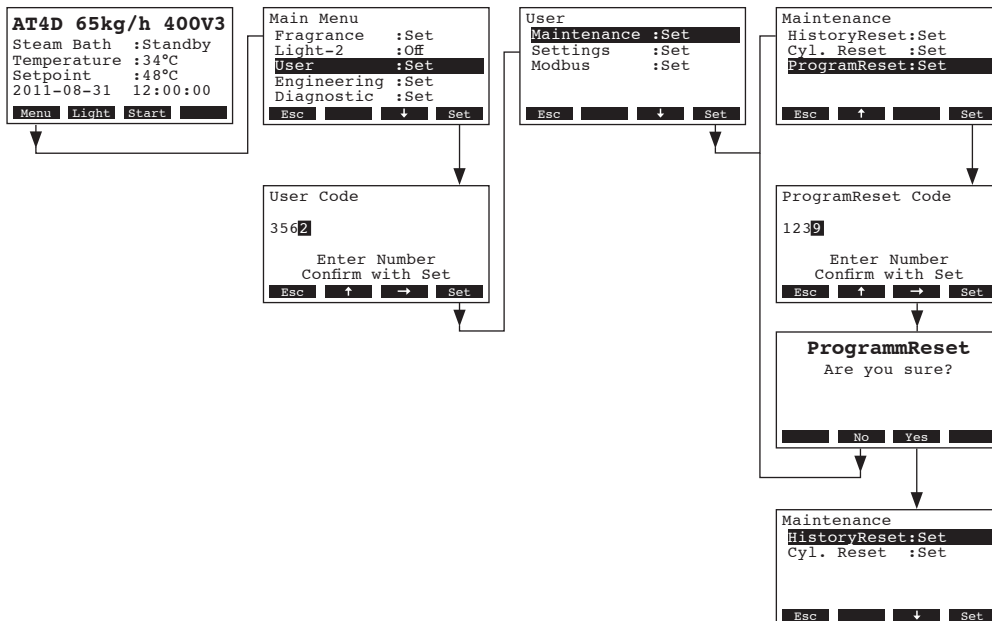
Select “**Countdown**” in the engineering menu, then press the <Set> key.



Select “**ProgramReset**”, then press the <Set> key. Within the reset dialogue press the <Yes> key. The countdown function is deactivated and the unlock code is reset (void).

Note: the menu item “**ProgramReset**” shows up only if the countdown function was activated.

Note: the countdown function may also be deactivated via the menu User --> Maintenance --> ProgramReset. For this purpose the unlock code is needed.



## 3 Malfunctions

### 3.1 Operating malfunctions

#### E13 Maximum heating time exceeded

**Function:** indicates that the maximum heating time has been exceeded.

**Procedure:** this function limits the max. duration of continuous steam bath operation in the operating mode “week timer”.

#### Behaviour on activation:

	No Warning	Error
Display	-	E13: Max.Heating
LED display:	-	Red
Fault-Remote:	-	Error Relay
Error-History:	-	E13
System:	-	Unit blocked
Time delay:	-	According to parameter Max.Heating
Reset:	-	Unit Off/On

#### E14 Steam bath cabin door open too long

**Function:** indicates that the steam bath cabin is open too long during steam bath operation.

**Procedure:** this function monitors the door switch during steam bath operation. If the door is open too long the steam bath operation interrupted until the door is closed again.

#### Behaviour on activation:

	No Warning	Error
Display	-	E14: Door Open
LED display:	-	Red
Fault-Remote:	-	Error Relay
Error-History:	-	E14
System:	-	Unit blocked
Time delay:	-	According to parameter Max.DoorOpen
Reset:	-	automatic reset

### E15 Program fault

**Function:** indicates that the steam generator is blocked via the function "Countdown".

**Procedure:** Error E15 may be reset only if the correct unlock code is entered. If the unlock code gets lost the CPU board must be replaced or newly programmed.

#### Behaviour on activation:

	No Warning	Error
Display	-	E15: Program Fault
LED display:	-	Red
Fault-Remote:	-	Error Relay
Error-History:	-	E15
System:	-	Unit blocked
Time delay:	-	According to parameter Running Time
Reset:	-	automatic reset

### E18 Temperature measuring instable

**Function:** indicates that the drop in temperature in the steam bath cabin is too high.

**Procedure:** In order to detect a manipulation on the temperature sensor the temperature curve of the temperature sensor is monitored during steam bath operation.

If the temperature decreases by cooling the temperature sensor (e.g. by the use of a cool rag) within a certain time "Time Range" by more than the set temperature value, the steam generator is blocked.

The temperature monitoring is activate only during steam bath operation and if the door of the steam bath cabin is closed.

#### Behaviour on activation:

	No Warning	Error
Display	-	E18: Temperat.Instab.
LED display:	-	Red
Fault-Remote:	-	Error Relay
Error-History:	-	E18
System:	-	Unit blocked
Time delay:	-	-
Reset:	-	Automatic reset after blocking time has elapsed

### W20, E20 Maximum temperature switch has triggered

**Function:** indicates that the maximum temperature switch has triggered.

**Procedure:** if the maximum temperature switch has triggered the whole system is blocked and error E20A is displayed.

#### Behaviour on activation:

	No Warning	Error
Display	-	E20: Temp.Fuse
LED display:	-	Red
Fault-Remote:	-	Error Relay
Error-History:	-	-
System:	-	Unit blocked
Time delay:	-	-
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 unit 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 unit	Unit 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 is 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
<b>Display</b>	W22A(B): Max.Fill Time W23A(B): No Current	E22A(B): Max.Fill Time E23A(B): No Current
<b>LED display:</b>	-	Red
<b>Fault-Remote:</b>	-	Error Relay
<b>Error-History:</b>	-	E22A(B) bzw. E23A(B)
<b>System:</b>	Unit is filling or waiting	Unit blocked
<b>Time delay:</b>	-	220 minutes (3 hours 40 minutes)
<b>Reset:</b>	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 over-currents. The threshold of 125 % refers to the maximum nominal current. If however 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
<b>Display</b>	W24A(B): Over Current	E24A(B): Over Current
<b>LED display:</b>	-	Red lights
<b>Fault-Remote:</b>	-	Error Relay
<b>Error-History:</b>	-	E24A(B)
<b>System:</b>	Unit is draining	Unit blocked
<b>Time delay:</b>	-	15 drainings (Time see table)
<b>Reset:</b>	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 over-currents. The threshold of 135 % refers always to the nominal current of the steam generator 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:	Unit is draining	Unit 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 Current without demand

**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:	-	Unit 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 loses the contact with the maximum level sensor are set in relation to each other.

This relation is called CurrentDrop:

$$\text{CurrentDrop} = I_{\text{Sensor-Off}} / I_{\text{Sensor-On}}$$

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)

### Reset of Warning W27

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:**

	<b>Warning</b>	<b>Error</b>
<b>Display</b>	W27A(B): Foam	E27A(B): Foam
<b>LED display:</b>	-	Red lights
<b>Fault-Remote:</b>	-	Error Relay
<b>Error-History:</b>	W27A(B)	E27A(B)
<b>System:</b>	Unit is draining	Unit blocked and cylinder draining
<b>Time delay:</b>	30 minutes	24 hours
<b>Reset:</b>	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
<b>Display</b>	W28A(B): Cyl. Maintenance	E28A(B): Cyl. Maintenance
<b>LED display:</b>	Yellow lights	Yellow & Red light
<b>Fault-Remote:</b>	Service Relay	Service & Error Relay
<b>Error-History:</b>	-	E28A(B)
<b>System:</b>	72 h Timer is started	Unit blocked
<b>Time delay:</b>	2400 (4800) Sensor contacts	72 hours warning time
<b>Reset:</b>	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
<b>Display</b>	W29A(B): Cyl. Maintenance	E29A(B): Cyl. Maintenance
<b>LED display:</b>	Yellow lights	Yellow & Red light
<b>Fault-Remote:</b>	Service Relay	Service & Error Relay
<b>Error-History:</b>	-	E29A(B)
<b>System:</b>	72 h Timer is started	Unit blocked
<b>Time delay:</b>	2500/5000 operating hours	72 hours warning time
<b>Reset:</b>	User -> Maintenance -> Cyl. Reset	User -> Maintenance -> Cyl. Reset

### W32, E32 No temperature signal from temperature sensor

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

**Procedure:** If the temperature drops below the threshold of 3% or exceeds the threshold of 97% (100% - 3%) the steam production is stopped and Warning W32 is triggered. If, after 60 seconds, the signal is still below 3% or above 97% error E32 is triggered.

#### Behaviour on activation:

	Warning	Error
Display	W32A: Sensor void	E32A: Sensor void
LED display:	-	Red
Fault-Remote:	-	Error Relay
Error-History:	-	E32A
System:	Steam production = 0%	Steam production = 0%
Time delay:	-	60 seconds
Reset:	automatic reset	automatic reset

### E35 Modbus Timeout

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

**Procedure:** If the demand or temperature 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 unit. 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:

	Remark	Error
<b>Display</b>	W36A(B): StandbyMod.active	E36A(B): Idle Mode Failed
<b>LED display:</b>	-	Red
<b>Fault-Remote:</b>	-	Error Relay
<b>Error-History:</b>	-	E36A(B)
<b>System:</b>	Unit is performing a standby operation	Unit blocked
<b>Time delay:</b>	72h with standby draining	div.
<b>Reset:</b>	-	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 unit. 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:	Unit is draining	-
Time delay:	72 h	-
Reset:	-	-



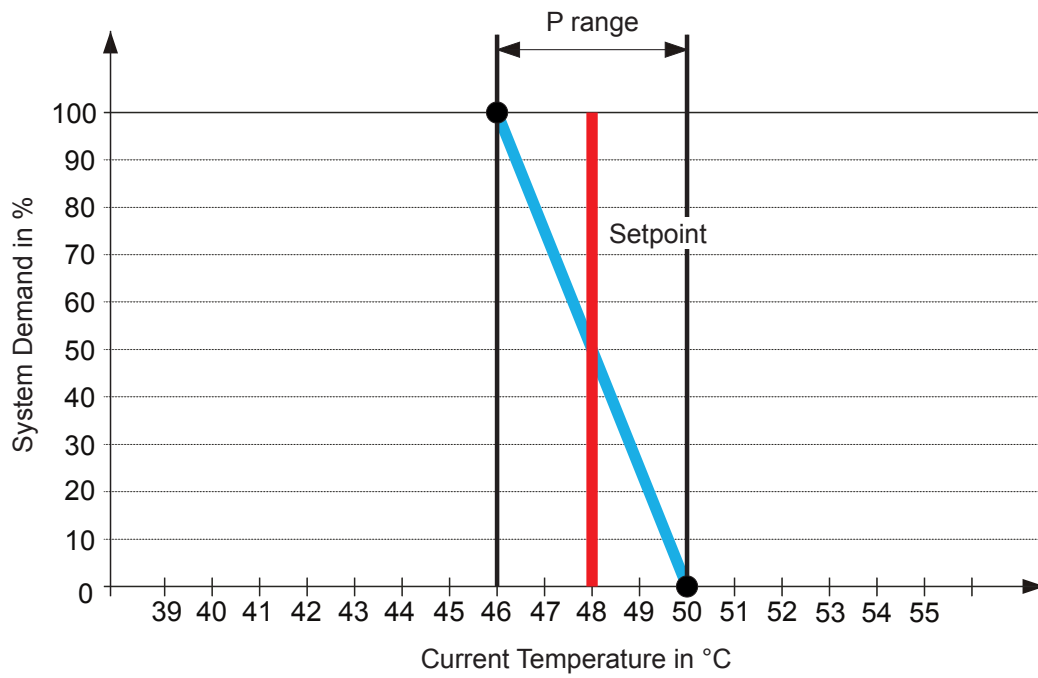
# 4 Control matrix Steam bath control / Principle diagram P-regulation

## 4.1 Control matrix Steam bath control

	2-Fan-mode		1-Fan mode		Flap control (0-10V Output)	Cabin light (Light-1)	Effect light (Light-2)	Fragrance pump-1	Fragrance pump-2	Bench heating (Relay-8)	Music (active when temperature reached) (Relais-9)
	Supply Fan (Fan 2)	Exhaust Fan (Fan 1)	3-step Fan Control								
<b>Standby:</b>	0% (OFF)	Off while light_ON if Light 1 or Light 2 is on → ON	Off while light_ON if Light 1 or Light 2 is on → ON	Off while light_ON if Light 1 or Light 2 is on → Step 1	0.0V (open)			OFF	OFF	OFF	OFF
<b>Standby (AntiFreeze):</b> Steam generator anti-freeze active	Automatic: Anti Freeze SetUp: Heat power: 20W	Off while light_ON if Light 1 or Light 2 is on → ON	Off while light_ON if Light 1 or Light 2 is on → ON	Off while light_ON if Light 1 or Light 2 is on → Step 1	0.0V (open)			OFF	OFF	OFF	OFF
<b>Keep Warm:</b> Cabin-Keep warm control active	Automatic: AT4-Steam controller Note: Min. request is inactive SetUp: Temp set point: 30 °C Max. Heat Time 2Std	OFF	OFF	OFF	6.7V (almost closed)			OFF	OFF	ON	OFF
<b>Warm up:</b> $t_{set} < (t_{set} - P_{Baud} / 2)$	100% (On)	Pre-purge: 2 minutes On SetUp: Warm up	Pre-purge: 2 minutes On SetUp: Warm up	Step-1 (low)	6.7V (almost closed)			OFF	OFF	ON	OFF
<b>Bathing:</b> $t_{set} \geq (t_{set} - P_{Baud} / 2)$	Automatic: AT4-Steam controller SetUp: - P o Pt-controller - Set point ( $t_{set}$ ) - P and I- proportion - Min. capacity - Power Limit - Floating over current	SetUp: Fan during bathing: - No one - Supply - Exhaust - Supply and exhaust In bathing operation the supply and exhaust fan are controlled depending on the set temperature (steam bath operation) or the set humidity (caldarium operation) and the set hysteresis.	SetUp: Fan during bathing: - No one - Supply - Exhaust - Supply and exhaust In bathing operation the supply and exhaust fan are controlled depending on the set temperature (steam bath operation) or the set humidity (caldarium operation) and the set hysteresis.	Temperature regulated by difference $t_{set} - t_{ht}$ Step-1 (low) Step-2 (medium) Step-3 (full)	Temperature regulated by difference $t_{set} - t_{ht}$ 0.0V (open) 2.2V (slightly closed) 4.4V (half closed) 6.7V (almost closed)	Automatic: On 5 Min extension after finishing bathing SetUp: Cabin light-1	Automatic: On 5 Min extension after finishing bathing SetUp: Cabin light-2	Interval or external fragrance pump: Interval: On-Off External: On SetUp: Fragrance pump-1 Arroma level-1 Note: the fragrance pump is active only, if the main contactor of the steam generator is activated and the system is in bathing operation.	Interval or external fragrance pump: Interval: On-Off External: On SetUp: Fragrance pump-2 Arroma level-2 Note: the fragrance pump is active only, if the main contactor of the steam generator is activated and the system is in bathing operation.	ON	ON
<b>Drying: Only with 1-Fan mode or 2-Fan mode</b>	0% (Off)	ON SetUp: Drying time	ON SetUp: Drying time	Step-3 (full) SetUp: Drying time	0.0V (open)			OFF	OFF	OFF	OFF

## 4.2 Principle diagram P-regulation

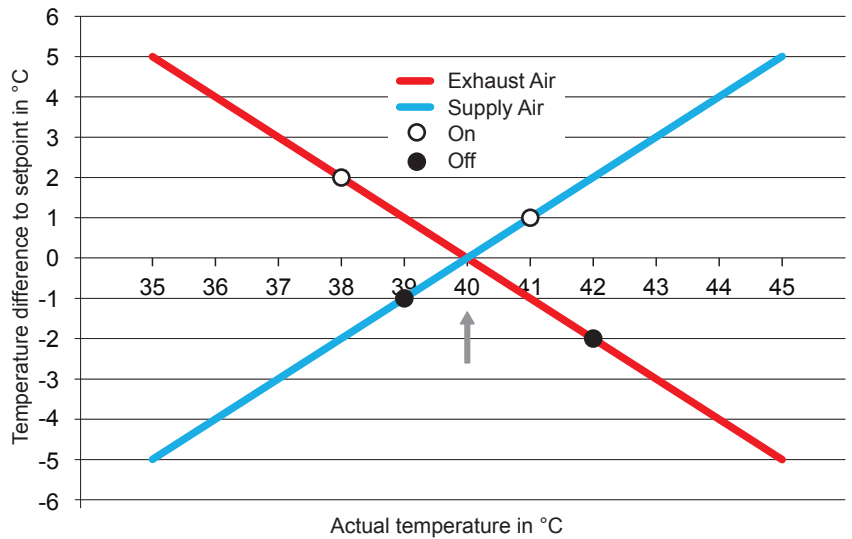
Example: Setpoint 48°C / P range 4°C / Temperature range 25° - 55°C



### 4.3 On/Off hysteresis of the supply and the exhaust fan (2-fan operation)

In order to achieve an optimum steam formation in the steam bath cabin when operating the Nodmann AT4 D with a supply and a exhaust fan (2-fan mode) the ON and Off switching points can be individually set with the hysteresis value in °C (steam bath operation) or %rh (caldarium operation). The fans are switched off when the temperature/humidity drops below the septpoint value by the half of the set hysteresis value and are switched on when the temperature/humidity exceeds the setpoint value by the half of the set hysteresis value.

Supply Air	Exhaust Air	Setpoint
-5	5	40 °C
-4	4	
-3	3	
-2	2	
-1	1	
0	0	
1	-1	
2	-2	
3	-3	
4	-4	
5	-5	



Example with setpoint value 40°C:

Hysteresis Exhaust fan 4°C: The exhaust fan switches off if the temperature is 2 °C below the setpoint value and switches on if the temperature is 2 °C above the setpoint value.

Hysteresis supply fan 2 °C: The supply fan switches off if the temperature is 1 °C below the setpoint value and switches on if the temperature is 1 °C above the setpoint value.

**Note:** If the supply fan is controlled with the “RLS” option dependent on the heating voltage (supply fan is running, when the heating voltage contactor is switched on) **all software settings of the supply fan are without function.**

## 5 Water management

### 5.1 The SC system of the Nordmann AT4 D

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

The SC system of the Nordmann steam generators 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 ( $\text{CaCO}_3$ ) is present in solve form, i.e. as ions  $\text{Ca}^{++}$  and  $\text{CO}_3$ . 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 ( $\text{H}_2\text{CO}_3$ ) contained in the water, and the so-called lime carbonic acid equilibrium. Carbonic acid is a reaction product of carbon dioxide ( $\text{CO}_2$ ) with water ( $\text{H}_2\text{O}$ ). 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  $60^\circ\text{C}$ .

A additional point, which influences the precipitation of lime in an electrode steam generator 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.

## **5.2     *The use of softened water for the operation of the Nordmann AT4 D***

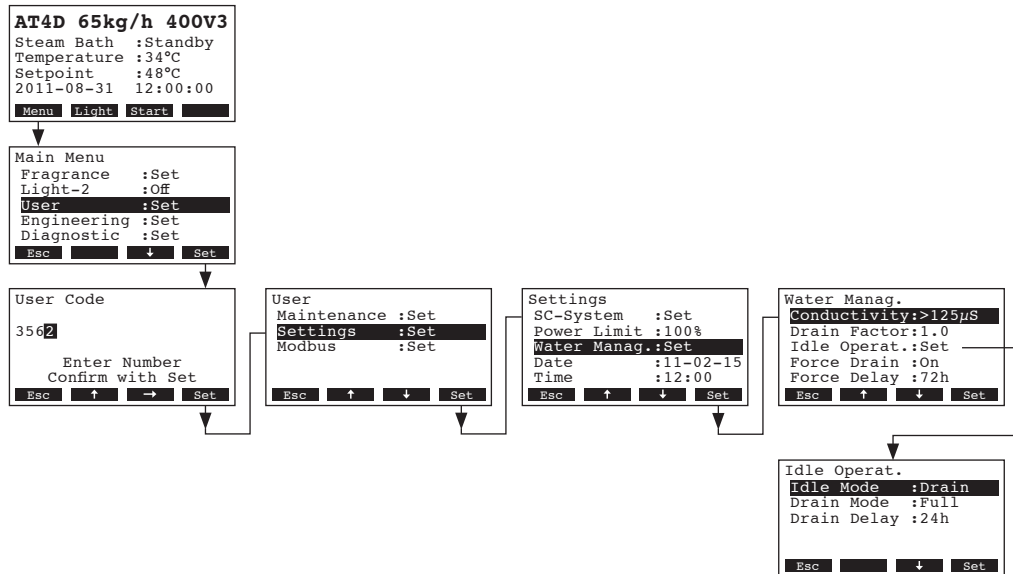
The use of softened water is not recommended for Nordmann AT4 D. Instead of the expected cylinder service interval increase, most likely functioning problems will appear.

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 steam generator.
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 D) settings.

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

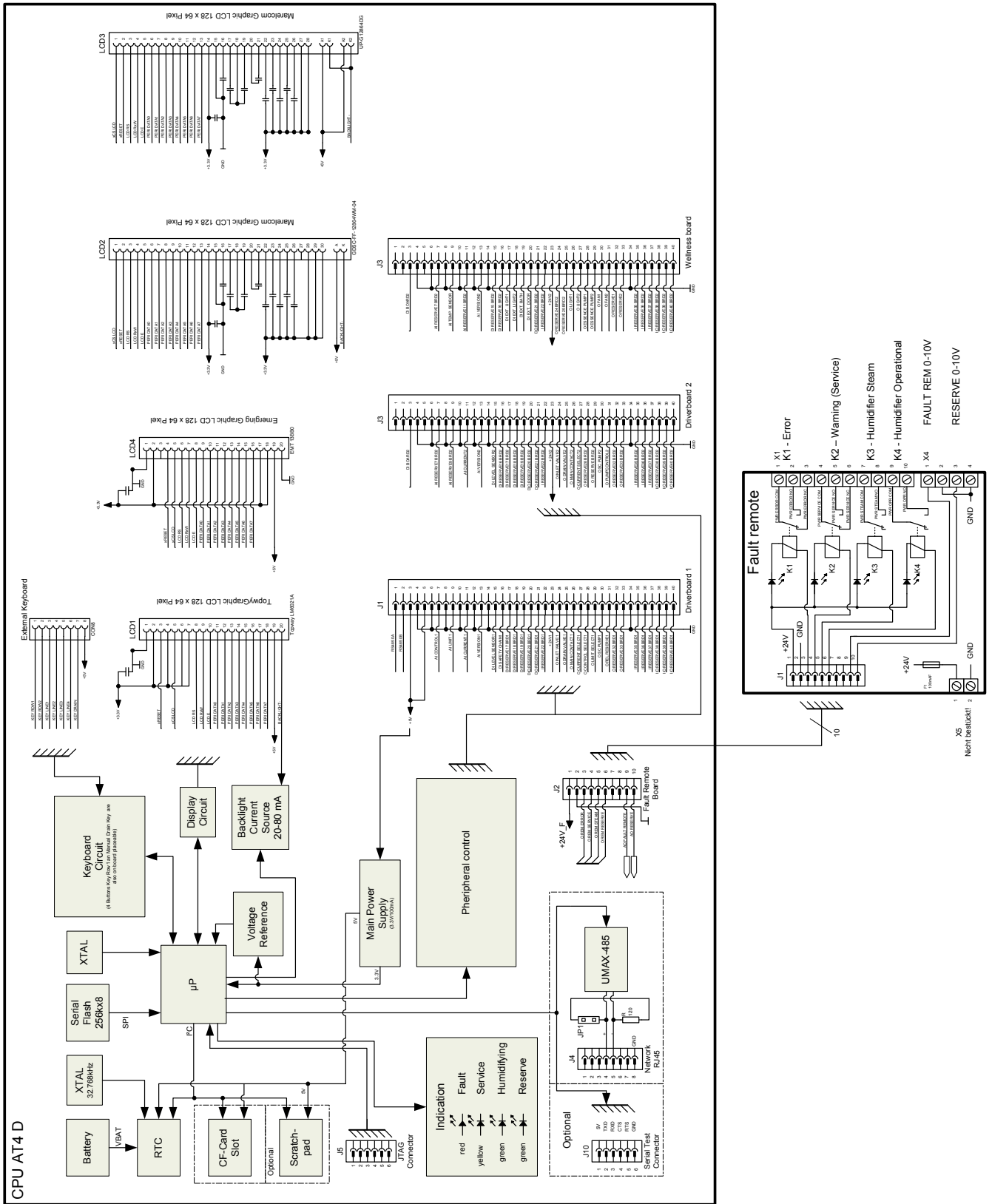


Description	Parameter	Settings/Notes
Conductivity	Conductivity	>125µS
Drain factor	Drain Factor	1.5...2.0 Drain factor must be increased if foam formation occurs
Standby operating mode	Idle Mode	Drain
Drain mode	Drain Mode	Full
Standby drain delay	Drain Delay	24h
Forced draining	Force Drain	On Please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

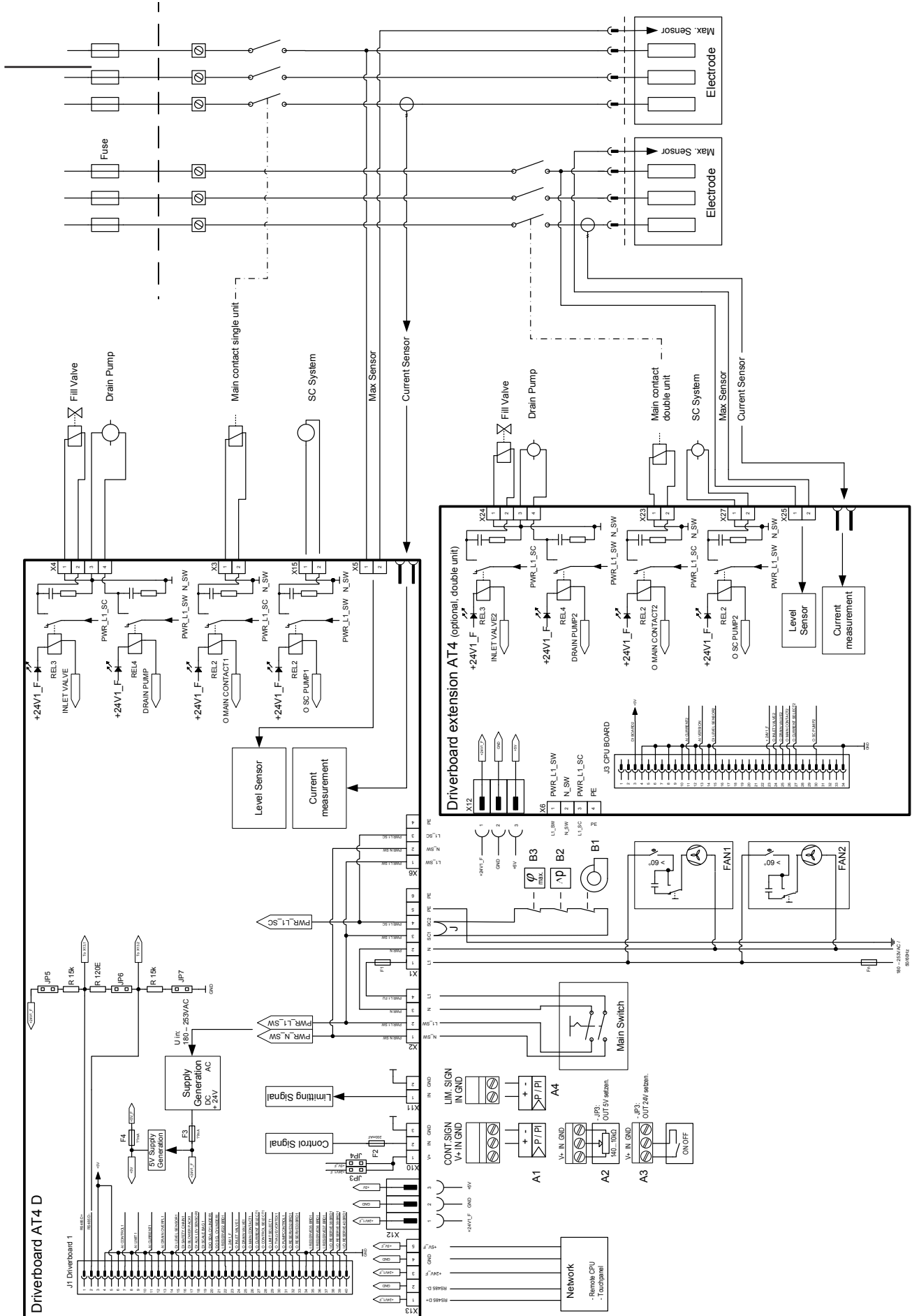
Note: the Nordmann AT4 D increases drain cycle automatically if water with high conductivity is used. Therefore high waste water quantities must be expected.

# 6 Block diagrams

## 6.1 Block diagram CPU



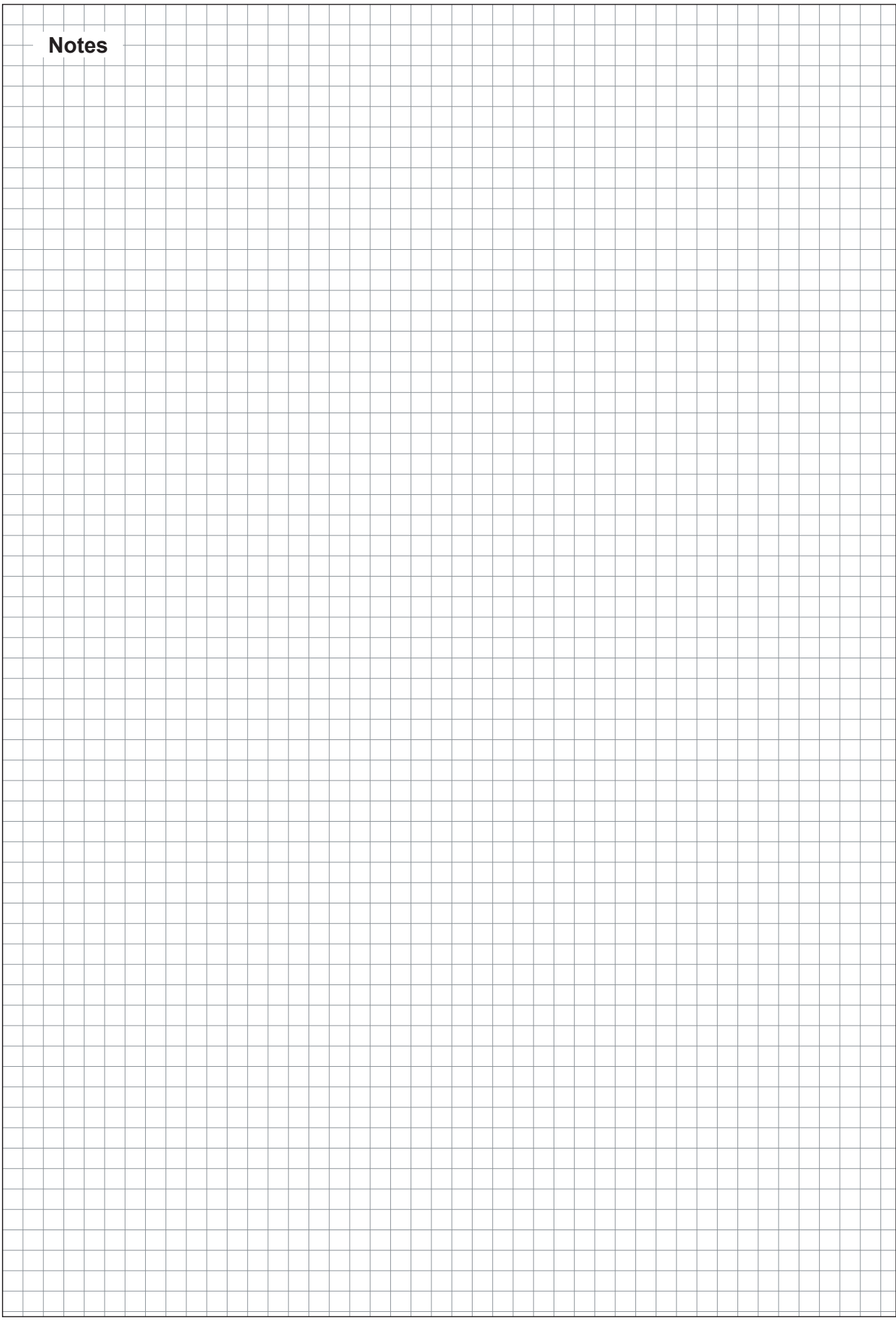
## 6.2 Block diagram power board







**Notes**







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