**BALTIMORE
AIRCOIL COMPANY**

TRC   TrilliumSeries Adiabatic Condenser
Once Through Mode

SOFTWARE INSTRUCTIONS
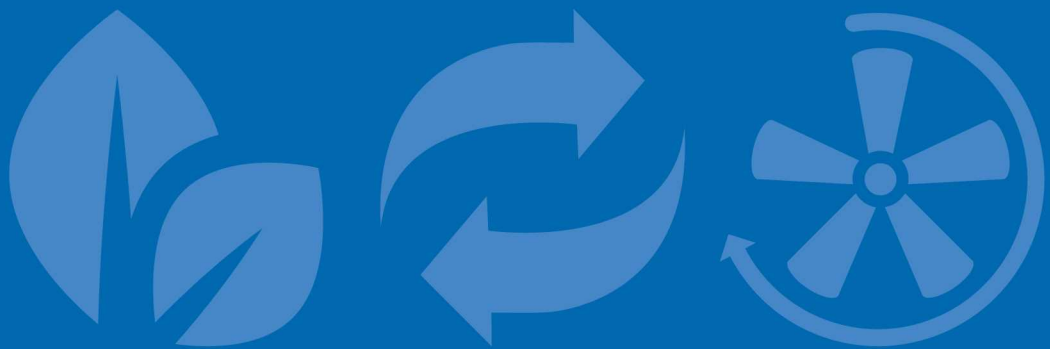
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SOFTWARE INSTRUCTIONS

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SCOPE

Once Through execution

The TRC is a V-shaped dry condenser equipped with **adiabatic pre-coolers (1)** that cool the warm **process fluid (2)** by sensible heat transfer. **Water flows (3)** evenly over evaporative cooling pads located in front of the **dry finned coil (4)**. At the same time **axial (5) fans** draw **air (6)** through the pads where a portion of the water evaporates and cools down the saturated air. This increases the cooling capacity of the incoming air for cooling the process **fluid (7)** inside the coil.
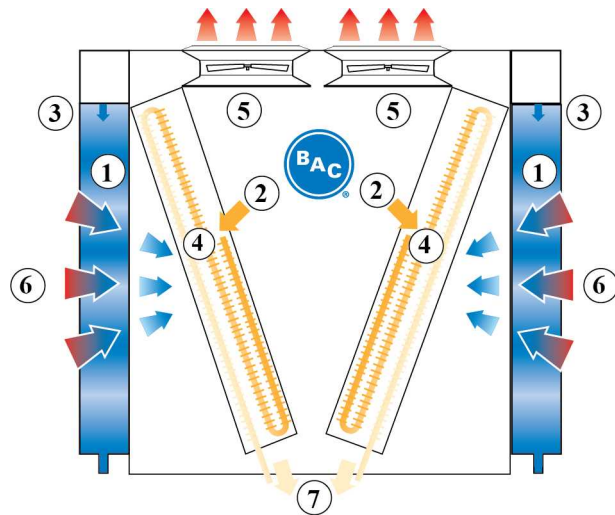
Customer input mode

The PLC controls the fan speed based on a customer provided signal.
The PLC will activate and deactivate the adiabatic pre-coolers, one by one, based on a logical combination of fan speed and an ambient temperature switch point.
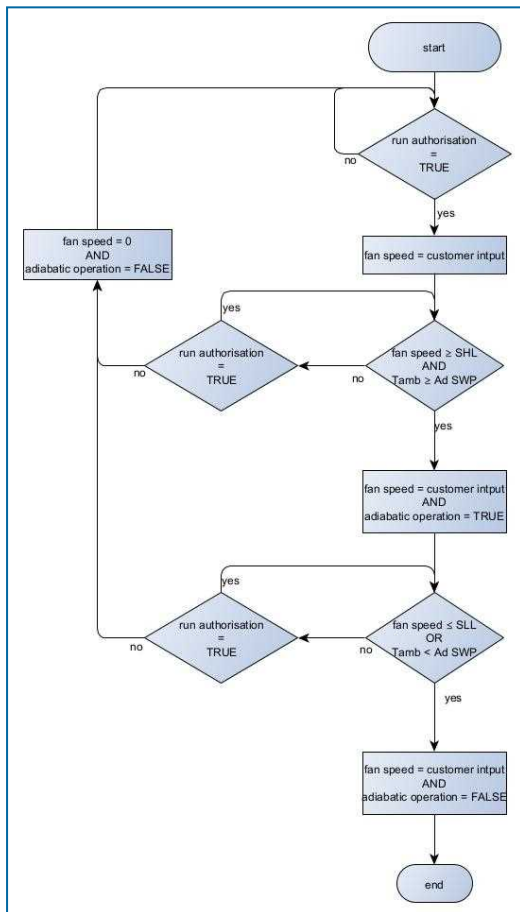
T_{out}: process fluid outlet temperature
T_{sp}: process fluid temperature set point
T_{amb}: ambient dry bulb temperature
SHL: speed high limit
SLL: speed low limit
PID output: calculated signal based on T_{out} and T_{sp}
CR: control range - dT to prevent hunting
Ad SWP: adiabatic switch point - ambient dry bulb temperature at which pre-cooling is allowed

⚠️

CAUTION

Changing the PLC's parameters may result in an undesired operation of the unit such as a hunting phenomenon, premature activation of pre-cooling (hence increased water consumption) or in late pre-cooling activation resulting in fluid outlet temperatures exceeding the design temperature.

Progammable Logic Controllor (PLC)

The PLC with built-in display:

The manual is valid for the following program version:
Software version: T3.3.0.26
Control version: 1.19
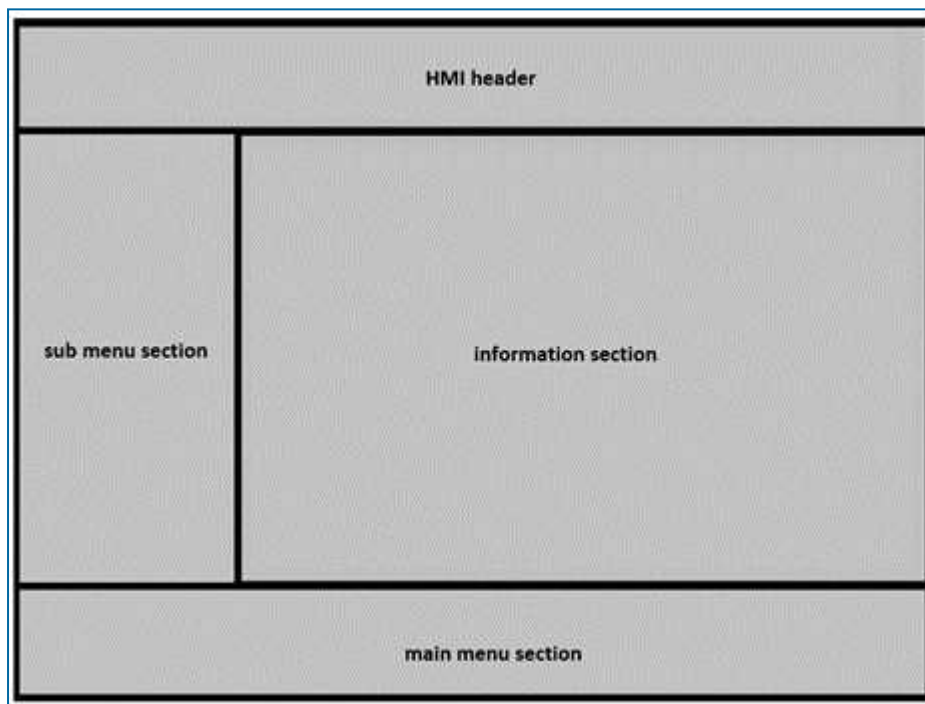
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SOFTWARE

Overview menu

The screen or Human Interface Machine (HMI) is divided into 4 sections:
HMI header (top)
Main menu (bottom)
Sub menu (left)
Information section (right)

Menu	Function
Home	Unit overview, system messages
Fans	Overview Analog data Fan alarms Manuals

Menu	Function
Setpoints	Leaving fluid control Load limiting Maintenance
Input/Output	Temperatures Make up Starts and hours Manual
Alarms	
Settings	Set up Software version Technician

HMI header
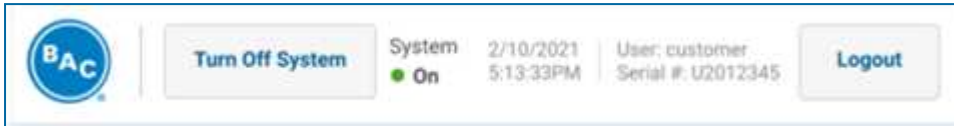
The HMI header contains:
- enable/disable the run authorization
- unit status (on/off)
- system date/time info
- unit serial number
- currently logged on user role and log in / log out button

There are various access levels to choose from:
- User (not password protected)
- Technician: username (Tech) & password (4734)

Home

The main home screen shows information with regard to the overall unit status. The system message can show a number of messages, explained below the picture.

Water usage disabled	indicates if the water usage mode disabled mode is active or not during this mode, the unit is forced to operate dry
Night quiet mode active	indicates if the night quiet mode disabled mode is active or not during this mode, the maximum fan speed is limited
Night dry mode active	indicates if the night dry mode disabled mode is active or not during this mode, the unit is forced into dry mode overnight
Emergency mode active	indicates if the emergency mode is active or not during this mode, the fan speed is no longer controlled by the PLC but rather fixed at a pre-defined level.

Fans

This menu provides information about parameters and lets you set certain parameters for the fans. You can do this either for all fans simultaneously by selecting the unit on the left, of individually by selecting a specific fan on the right.
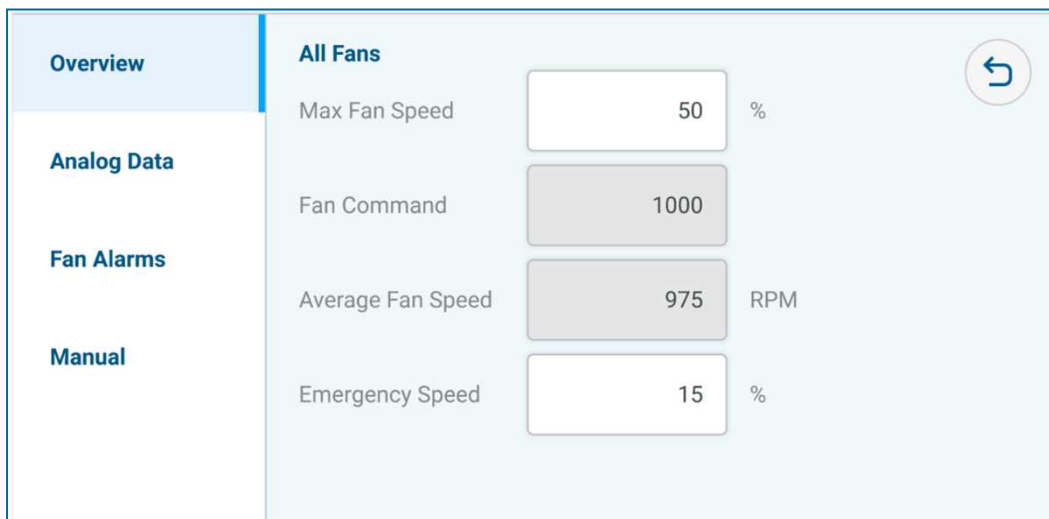

The following sub menu's are available for both all fans & individual fans:

- overview
- analog data
- fan alarms
- manual

Overview

Here you can set the maximum fan speed (the fans will never run faster as the value that is indicated here) as well as the emergency speed (speed at which the fans will run in case of loss of communication).

The 'average fan speed' is only available in the All Fans overview, not when you have selected a specific fan.

Analog data

Fan alarms

This provides an overview of the possible alarms. There are 2 possible statuses. A red dot indicates an alarm is active, a green dot indicates all is well.

Manual

The manual menu allows to override the fan speed, rotation direction and to read out the Modbus address.

To change a Modbus address, refer to Settings, Technician menu.

The Modbus address is only available for a specific fan, not when you have selected "All Fans".
Set manual mode to "off", if normal operation needs to be resumed.

Setpoints

With the parameters that can be set in this menu, the user can finetune the behaviour of the unit.

Customer input control

This menu is only available if the control type in the relevant Settings menu is set to "customer input". This value depends on how the unit is physically configured.

The customer input control mode allows the user to provide an input signal in either an analog way or through the digital bus system to control the unit's capacity between 0% and 100%.
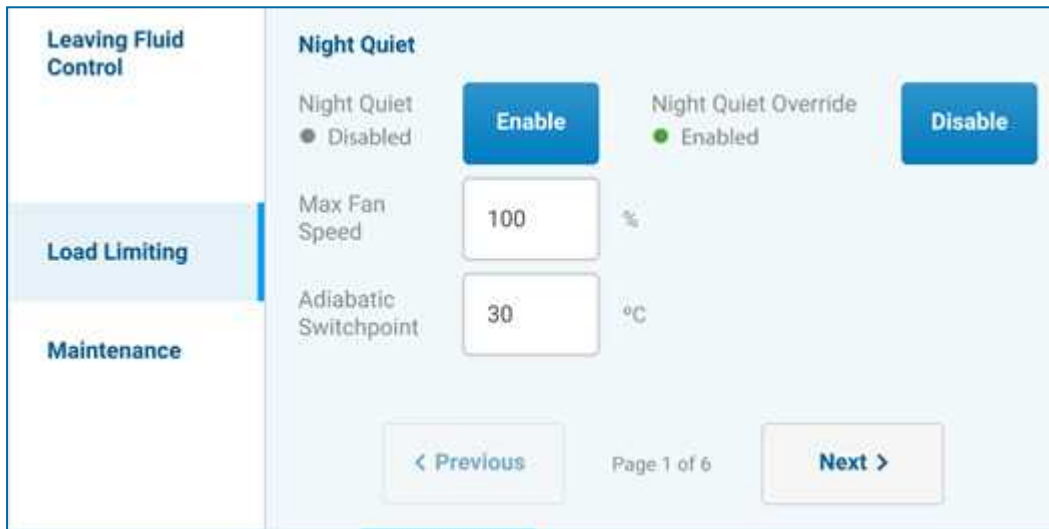

Operating mode	determines the balance between energy and water usage. This can be set to either default, energy saver or water saver. Switching these modes will revert the parameters in the table below to their pre-programmed settings.
Signal type	defines the type of input signal. This can be set to either 4-20mA, 0-10V, 10-0V or BMS 0-100%. The current signal is supplied to input card EL3014 channel 2 or contacts X7:27 and X7:28. The voltage signal is supplied to input card EL3174 channel 1 or contacts X7:17 and X7:18. The BMS signal refers to the "CIFanCMD" variable in the BMS communications table.
Adiabatic switchpoint	ambient temperature at which adiabatic operation becomes possible
Run authorization type	source signal to switch the unit between stand-by and active. This can be set to either HMI, digital input or BMS. HMI refers to the button on the top left of the screen, digital input refers to input card EL1008 channel 6 or contacts X5:7 and X5:8 on the terminal strip, BMS refers to the "BMSrunEn" variable in the BMS communication table. The HMI button is always taken into account to enable the unit to run (also when the type is set to digital input or BMS).

Variable	Default	Energy Saver	Water saver
Control range	2.0 °C	0.5 °C	5.5 °C
Adiabatic switchpoint	X	X - 5.5 °C	X
Stage timer	120 sec	60 sec	300 sec

Operating mode pre-programmed parameters

Load limiting

Night quiet mode allows to limit the maximum fan speed. A lower adiabatic switchpoint can be programmed. Also, this can be used to make up for the reduced available thermal performance.

Night quiet	allows to either enable or disable the feature. If enabled, the "max fan speed" and "adiabatic switchpoint" parameters will become active during the times set in the schedule on page 2.
Night quiet override	if enabled, the "max fan speed" and "adiabatic switchpoint" parameters will become active regardless of the schedule on page 2. In addition to the on-screen button, the override can also be enabled with the "NightQuietOverride" variable in the BMS communication table.
Max fan speed	maximum fan speed that needs to observed when "night quiet" mode is active
Adiabatic switchpoint	reduced ambient temperature at which adiabatic operation becomes possible. This second (reduced versus the standard) adiabatic switchpoint allows adiabatic operation at lower ambient temperatures in order to make up for the lower available thermal performance due to the lower fan speed.

Night quiet schedule allows to programme the night hours during which this mode becomes active when enabled at page 1.

Night dry allows to prevent the use of water and hence adiabatic operation between a time on one day and another the next day.

Night dry	allows to either enable or disable the feature. If enabled, no water will be used during the times set in the schedule on page 4.
Night dry override	if enabled, no water will be used regardless of the schedule on page 4. In addition to the on-screen button, the override can also be enabled with the "NightDryOverride" variable in the BMS communication table.

Night dry schedule allows to program the night times during which this mode becomes active when enabled at page 3.

Schedule Dry allows to prevent the use of water and hence adiabatic operation between 2 times on the same day.

Schedule dry	allows to either enable or disable the feature. If enabled, no water will be used during the times set in the schedule on page 6.
Schedule dry override	if enabled, no water will be used regardless of the schedule on page 6. In addition to the on-screen button, the override can also be enabled with the "ScheduleDryOverride" variable in the BMS communication table.

Schedule Dry allows to program the day times during which this mode becomes active when enabled at page 5.

Schedule Dry Schedule

Mon:	06:00 - 21:00	
Tue:	06:00 - 21:00	
Wed:	06:00 - 21:00	
Thu:	06:00 - 21:00	
Fri:	06:00 - 21:00	
Sat:	06:00 - 21:00	
Sun:	06:00 - 21:00	

Sun ▼

06:00 - 21:00

Update Schedule

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Leaving Fluid Control / Load Limiting / Maintenance

Maintenance

Coil clean allows to reverse the fans for a short period of time in order to blow away any dust that might have collected on the coil fins.

Coil Clean

Coil Clean ● Disabled	**Enable**		Coil Clean Duration	120	Sec.
Cleaning High Limit Temp	30	℃	Time Between Coil Clean	18	Hrs.
Cleaning Low Limit Temp	20	℃	Coil Clean Start Time	15:30	24-Hr. Time

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Leaving Fluid Control / Load Limiting / Maintenance

Coil clean	allows to either enable or disable the feature. If enabled, the fans will do a daily cycle at a 100% fan speed in reverse direction at the time programmed.
Cleaning high limit temperature	maximum ambient temperature at which the coil cleaning cycle can start. Since the fans run in reverse, they will push warm ambient air over the coils in summer.

Cleaning low limit temperature	minimum ambient temperature at which the coil cleaning cycle can start. Since the fans run a maximum fan speed, there would be an undercooling and/or coil freezing risk if allowed to become too low.
Coil clean duration	time in seconds the coil cleaning cycle lasts
Time between coil clean	number of hours between coil cleaning cycles
Coil clean start time	time of the day when the coil cleaning cycle will start

Pad clean allows to force adiabatic operation for a period of time to rinse any dust that might have collected on the pads.

Pad clean	allows to either enable or disable the feature. If enabled, the pads will be rinsed at the time programmed.
Pad clean duration	time in seconds the pad cleaning cycle lasts.
Time between pad cleans	number of hours between pad cleaning cycles
Pad clean start time	time of the day when the pad cleaning cycle will start, preferably set in the afternoon to take advantage of the increased cooling effect during the warmest period of the day.

Input & Output

With the parameters that can be set in this menu, the user can read the current status of all available in- and out puts. In addition, some output signals can be forced in a certain position to overrule the default programming.

Temperatures

Leaving fluid temperature	process fluid temperature
Outside air temperature	ambient dry bulb temperature
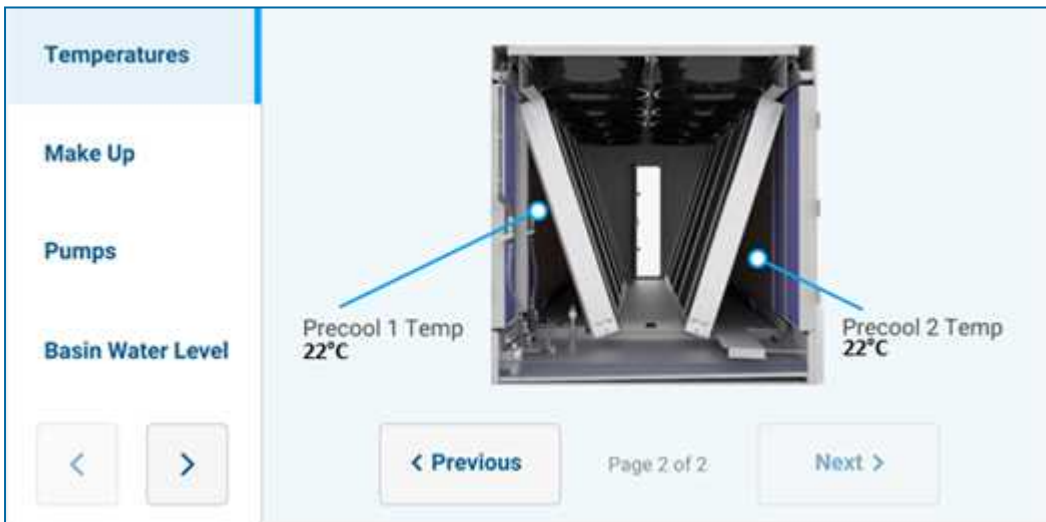
Precool 1/2 temp	depressed dry bulb behind the adiabatic pre-cooler section.

This screen will only be visible if the relevant sensors are installed.

Make up

Precooler 1/2	indicates which pre-cooler will start first (lead) or last (lag)
Make-up valve 1/2	indicates the state of each valve (open/closed)

Starts and hours

In this menu the starts and amounts of operating hours can be consulted. Pressing the reset button shall reset the starts and hours for the corresponding device.

A reset can only be done with access level Technician or higher.

Precooler 1	number starts and amount of operating hours
Precooler 2	number starts and amount of operating hours

Starts and Hours

MUP1 (Make Up Valve 1)	Starts: 1	Hours: 0.0	Reset
MUP2 (Make Up Valve 2)	Starts: 0	Hours: 0.0	Reset

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MUP1	number starts and amount of operating hours for make-up valve 1
MUP2	number starts and amount of operating hours for make-up valve 2

Alarms

This menu allows to get an overview of and clear any existing alarms. All active alarms are displayed with a red font, inactive alarms are displayed in a black font.
For a detailed overview of the different alarms, see chapter 5.

Download to USB	pressing the download button (USB stick with down arrow icon) will verify if a USB storage device is present in the PLC and download the alarm log (a progress bar will indicate the status of the process).
Information	pressing the Information button (lower case 'i' in a circle) will display the alarm detail page of the selected alarm where the trigger criteria, release criteria and the trouble shooting steps can be consulted (press the back button in the top right corner to return).
Acknowledge current	pressing the 'single checkmark' will clear the selected alarm
Acknowlegde all	pressing the 'multi-checkmark' will clear all active alarms and change the text from a red to a black font. A pop-up window will ask for a confirmation first

Settings

With the parameters that can be set in this menu, the user can configure the behaviour of the unit.

SET UP

Language	determines the interface language
Units	determines the units of measurements for the different variables. This can be set to either SI or imperial
Date format	determines in what order the day, month and year are shown. This can be set at MM/DD/YYYY, DD/MM/YYYY or YYYY/MM/DD
Date	allows to change the current date (in the format chosen above).

24 hour time	allows to change the current time
Daylight savings	enable or disable daylight savings time
BMS protocol	select and configure the BMS bus system
Touchscreen	calibrate the screen

For more information on your BMS protocol, check the Protocols Manual.

IP address	set the correct value (in IPv4 format)
Subnet mask	set the correct value (in IPv4 format)
Default gateway	set the correct value (in IPv4 format)

SOFTWARE VERSION

Software version	indicates the current version
Control version	indicates the current version
TwinCAT version	indicates the current version
TwinCAT HMI server version	indicates the current version
OS version	indicates the current version
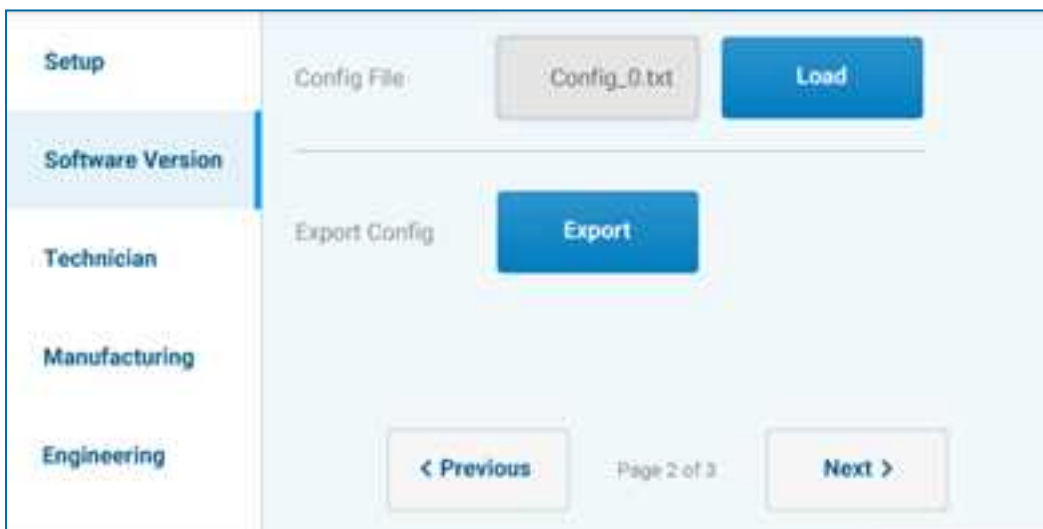
Config file	load a config file from a USB storage device. The file needs to be a text file stored as "E:\BAC\Config\…"
Export config	export the current settings

ALARMS AND WARNINGS OVERVIEW

Alarms overview

An overview of all the possible alarms

Outside air temperature sensor

Parameter	Condition
Trigger criteria	The unit shall issue the alarm when any of the following are true: • Outside Air Temperature < -30 °C for 3 consecutive seconds • Outside Air Temperature > 60 °C for 3 consecutive seconds • EL3208-0010 Channel 2 cable break detected
Release criteria	The unit shall release the alarm when any of the following is true: • Outside Air Temperature ≥ -27 °C for 3 consecutive seconds AND Outside Air Temperature ≤ 57 °C for 3 consecutive seconds • EL3208-0010 Channel 2 cable break is not detected
Troubleshooting	• Check Outside Air Temperature sensor installation • Check Outside Air Temperature sensor and wiring
General alarm DO	True
Effect	Disable Water = True

Precooler 1 Temperature Sensor Alarm

The following shall be displayed only if the Precooler Temperature Sensor is Enabled.

Parameter	Condition
Trigger criteria	The unit shall issue the alarm when any of the following are true: • Precooler Temp Sensor is enabled • Precooler 1 Temperature > 60 °C • Precooler 1 Temperature < -30 °C • EL3208-0010 Channel 4 cable break detected
Release criteria	The unit shall release the alarm when all of the following is true: • Precooler Temp Sensor is disabled • Precooler 1 Temperature ≤ 57 °C • Precooler 1 Temperature ≥ -27 °C • EL3208-0010 Channel 4 cable break undetected
Troubleshooting	• Check Precooler 1 Temperature sensor installation • Check Precooler 1 Temperature sensor and wiring
General alarm DO	True
Effect	N/A

Precooler 2 Temperature Sensor Alarm

The following shall be displayed only if the Precooler Temperature Sensor is Enabled.

Parameter	Condition
Trigger criteria	The unit shall issue the alarm when any of the following are true: • Precooler Temp Sensor is enabled • Precooler 2 Temperature > 60 °C • Precooler 2 Temperature < -30 °C • EL3208-0010 Channel 4 cable break detected
Release criteria	The unit shall release the alarm when all of the following is true: • Precooler Temp Sensor is disabled • Precooler 2 Temperature ≤ 57 °C • Precooler 2 Temperature ≥ -27 °C • EL3208-0010 Channel 4 cable break undetected
Troubleshooting	• Check Precooler 1 Temperature sensor installation • Check Precooler 1 Temperature sensor and wiring
General alarm DO	True
Effect	N/A

Entering Fluid Temperature Sensor Alarm

The following shall be displayed only if the Entering Fluid Temperature Sensor is Enabled.

Parameter	Condition
Trigger criteria	The unit shall issue the alarm when any of the following are true: • Entering Fluid Temperature Sensor is enabled • Entering Fluid Temperature > 90 °C • Entering Fluid Temperature < -50 °C • EL3208-0010 Channel 3 cable break detected
Release criteria	The unit shall release the alarm when all of the following is true: • Entering Fluid Temperature Sensor is disabled • Entering Fluid Temperature ≤ 87 °C • Entering Fluid Temperature ≥ -47 °C • EL3208-0010 Channel 3 cable break undetected
Troubleshooting	• Check Entering Fluid Temperature sensor installation • Check Entering Fluid Temperature sensor and wiring
General alarm DO	True
Effect	N/A

Relative Humidity Sensor Alarm

The following shall be displayed only if the Relative Humidity Sensor is Enabled.

Parameter	Condition
Trigger criteria	The unit shall issue the alarm when any of the following are true: • Humidity sensor = Enabled • OARH Current ≤ 3 mA
Release criteria	The unit shall release the alarm when all of the following is true: • Humidity sensor = Disabled • OARH Current > 3.7 mA
Troubleshooting	• Check Humidity sensor installation • Check Humidity sensor and wiring
General alarm DO	True
Effect	N/A

All fans offline / Emergency stop alarm

Parameter	Condition
Trigger criteria	The unit shall issue the alarm when any of the following are true: • All fans time out Modbus communications
Release criteria	The unit shall release the alarm when any of the following is true: • Any fan regains Modbus communications
Troubleshooting	• Check Emergency Stop button • Check Fan Modbus wiring between control panel and fan 1
General alarm DO	True
Effect	Disable Water = True

Low customer input current alarm

Parameter	Condition
Trigger criteria	The unit shall issue the alarm when all of the following are true: • Control Type = Customer Input • Customer Input Type = 4 – 20 mA • Customer Input Current Signal (EL3014-2) ≤ 3 mA
Release criteria	The unit shall release the alarm when any of the following is true: • Control Type = Customer Input AND Customer Input Type = 4 – 20 mA AND Customer Input Current Signal (EL3014-2) > 3 mA • Control Type ~= Customer Input • Customer Input Type ~= 4 – 20 mA
Troubleshooting	• Check Customer Input wiring • Verify proper software setup
General alarm DO	True
Effect	Emergency Mode = Active

Fan X offline

Parameter	Condition
Trigger criteria	The unit shall issue the alarm when all of the following are true: • Fan X times out Modbus communications
Release criteria	The unit shall release the alarm when any of the following is true: • Fan X regains Modbus communications
Troubleshooting	Check Fan X's circuit breaker in control panel
General alarm DO	True
Effect	N/A

Fan X DV-link undervoltage

Parameter	Condition
Trigger criteria	Triggered by fan X
Release criteria	Released by fan X
Troubleshooting	• Check power supply to unit • Contact BAC support
General alarm DO	True
Effect	N/A

Fan X position sensor calibration error

Parameter	Condition
Trigger criteria	Triggered by fan X
Release criteria	Released by fan X
Troubleshooting	Contact BAC Support
General alarm DO	True
Effect	N/A

Fan X speed limit exceeded

Parameter	Condition
Trigger criteria	Triggered by fan X
Release criteria	Released by fan X
Troubleshooting	• Contact BAC Support
General alarm DO	True
Effect	N/A

Fan X motor blocked

Parameter	Condition
Trigger criteria	Triggered by fan X
Release criteria	Released by fan X
Troubleshooting	• Inspect Fan X and ensure there are no obstructions
General alarm DO	True
Effect	N/A

Fan X motor hall sensor error

Parameter	Condition
Trigger criteria	Triggered by fan X
Release criteria	Released by fan X
Troubleshooting	• Contact BAC Support
General alarm DO	True
Effect	N/A

Fan X motor overheating

Parameter	Condition
Trigger criteria	Triggered by fan X
Release criteria	Released by fan X
Troubleshooting	• Contact BAC Support
General alarm DO	True
Effect	N/A

Fan X fan bad (general error)

Parameter	Condition
Trigger criteria	Triggered by fan X
Release criteria	Released by fan X
Troubleshooting	• Contact BAC Support
General alarm DO	True
Effect	N/A

Fan X communication error

Parameter	Condition
Trigger criteria	Triggered by fan X
Release criteria	Released by fan X
Troubleshooting	• Check Fan X communication wiring • Check Fan X communication shielding • Contact BAC Support
General alarm DO	True
Effect	N/A

Fan X output stage overheating

Parameter	Condition
Trigger criteria	Triggered by fan X
Release criteria	Triggered by fan X
Troubleshooting	• Contact BAC Support
General alarm DO	True
Effect	N/A

Fan X phase failure

Parameter	Condition
Trigger criteria	Triggered by fan X
Release criteria	Released by fan X
Troubleshooting	• Check power supply to unit • Contact BAC Support
General alarm DO	True
Effect	N/A

Fan X Over Voltage

Parameter	Condition
Trigger criteria	Triggered by fan X
Release criteria	Released by fan X
Troubleshooting	• Check power supply to unit • Contact BAC Support
General alarm DO	True
Effect	N/A

Fan X Watchdog Failure

Parameter	Condition
Trigger criteria	Triggered by fan X
Release criteria	Released by fan X
Troubleshooting	Contact BAC Support
General alarm DO	True
Effect	N/A

Fan X Hardware Overcurrent

Parameter	Condition
Trigger criteria	Triggered by fan X
Release criteria	Released by fan X
Troubleshooting	Contact BAC Support
General alarm DO	True
Effect	N/A

Fan X MCdsp Dead

Parameter	Condition
Trigger criteria	Triggered by fan X
Release criteria	Released by fan X
Troubleshooting	Contact BAC Support
General alarm DO	True
Effect	N/A

6 FURTHER ASSISTANCE & INFORMATION

More information

REFERENCE LITERATURE

- Eurovent 9-5 (6) Recommended Code of Practice to keep your Cooling System efficient and safe. Eurovent/Cecomaf, 2002, 30p.
- Guide des Bonnes Pratiques, Legionella et Tours Aéroréfrigérantes. Ministères de l'Emploi et de la Solidarité, Ministère de l'Economie des Finances et de l'Industrie, Ministère de l'Environnement, Juin 2001, 54p.
- Voorkom Legionellose. Minsterie van de Vlaamse Gemeenschap. December 2002, 77p.
- Legionnaires' Disease. The Control of Legionella Bacteria in Water Systems. Health & Safety Commission. 2000, 62p.
- Hygienische Anforderungen an raumlufttechnische Anlagen. VDI 6022.

INTERESTING WEBSITES

Baltimore Aircoil Company	www.BaltimoreAircoil.com
BAC Service website	www.BACservice.eu
Eurovent	www.eurovent-certification.com
European Working Group on Legionella Infections (EWGLI)	EWGLI
ASHRAE	www.ashrae.org
Uniclima	www.uniclima.fr
Association des Ingénieurs et techniciens en Climatique, Ventilation et Froid	www.aicvf.org
Health and Safety Executive	www.hse.gov.uk

ORIGINAL DOCUMENTATION

This manual is originally made in English. Translations are provided for your convenience. In the event of discrepancies, the English original text shall prevail over the translation.

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We offer tailored services and solution for BAC cooling towers and equipment.
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