Baran Electronic Systems

Free Coooling System

FCS

FREE COOLING SYSTEM

User Manual

Revision History

Rev	Date	By	Description
Rev.0	19/07/18	Baran Tech.	Collected the information
Rev.1	20/07/18	Baran Tech.	Updated the photos of parts
Rev.2	27/11/18	Baran Tech.	Modified the connection diagram

CONTENTS

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1. GENERAL INFORMATION

1.1. Introduction

Free cooling is an economical method used to reduce the energy consumed by the cooling systems When outside temperature is lower then inside temperature, the system utilizes the cool outside air as a free cooling source. It must hereby be operated and maintained by trained technicians according to the safety procedures.

1.2. Scope

This manual describes the requirements and procedures to be used during the installation and operation of Baran Technology free cooling systems. Read all instructions carefully before any installation or operation of Baran Technology Free Cooling System.

1.3. Related Publications

Publication Name	Publication Number
FCS Fan Box Installation Procedures	BR-00001
FCS Control Unit Installation Procedures	BR-00002
FCS Free Cooling Firmware	BR-00003

1.4. Important Safety Infomations

This manual contains important instructions that should be strickly followed during installation and operation of the Free Cooling System. This product is designed for Commercial/Industrial use only.

If you have any questions regarding safety standards for this product, please contact:

Baran Electronic Systems
Office Phone: +90 216 466 88 02
Customer Service: +90 216 466 88 03
E-mail: info@baran.tech
Website: www.baran.tech

1.4.1. Voltage Warning

	DANGER Lethal voltages may be present within this unit even when it does not appear to be operational. Observe all cautions and warnings in this document. Failure to do so may result in serious injury or death.

To make the connection of control unit can present a risk of electrical shock and high short-circuit current. The following precautions should be observed when working on fan cabinet and control unit

Remove watches, rings and other metal objects.

Use tools with insulated handles.

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1.4.2. Site Conditions Caution

⚠	CAUTION Conditions at the installation place may impact the safety of personnel and the performance of this product. Adhere to all manufacturer guidelines. If you have any questions regarding the site requirements for this product, please contact Baran Electronic Systems Customer Service.

Operate the control unit an inside or enclosed environment only in an ambient temperature range of -20°C to 60°C. Install it in a clean environment, free from conductive contaminates, moisture, flammable liquids, gases and corrosive substances.

This control unit is designed for use on a properly grounded (earthed) supply and is to be installed and operated by qualified personnel.

1.4.3. Personnel Warnings

Persons installing, operating or exposed to the Free Cooling System should be aware of the following potential hazards.

⚡	DANGER—SHOCK HAZARD Do not touch un-insulated mains connectors or terminals.
⚠	CAUTION—HEAVY Fan cabinets weigh up to 90 kg.
⚠	IMPORTANT Follow manufacturer's published instructions when installing

1.4.4. Personnel Requirements and Trainings

This free cooling system should only be installed and operated by qualified personnel.

The following trainings are recommended for persons will install and operate the Free Cooling System. It is the responsibility of the customer, installer and/or operator to provide training consistent with local laws and standards. Different companies and jurisdictions may use different names and standards for training. Please consult Baran Electronic Systems with any questions about installer or operator requirements.

Trainnings Required for Installation and Operation of Free Cooling

- Qualified electrical safety and ARC/flash training
- Lock out/tag out (LOTO)
- Personal protective equipment (PPE)
- Ergonomics/proper lifting training
- Qualified lifting equipment operator training

All personnel installing and operating the Free Cooling must have completed the above trainings. Follow local laws and policies regarding additional training requirements.

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1.4.5. Abbreviations

FCS	Free Cooling System
FCCU (FCCM)	Free Cooling Control Unit (Free Cooling Control Module)
FCU	Free Cooling Control Unit (Free Cooling Control Module)
Control Unit	Free Cooling Control Unit (Free Cooling Control Module)
Controller	Free Cooling Control Unit (Free Cooling Control Module)
ACCM	Air Conditioner Control Module
ACM	Air Conditioner Control Module
ΔT	Delta T, Temperature Difference
A/C	Air Conditioner
A/Cs	Air Conditioners

2. FREE COOLING SYSTEM

This User Manual is based on standart free cooling system

Free Cooling System is an energy-saving system which is designed for indoor areas. Indoor places are almost cooled by air conditioner(A/C). Free Cooling Systems provides cool outside air to cool inside in lower temperatures by a fan which consumes less energy then AC. To ensure that, the outside temperature must be sufficient to cool inside. Cooler air is transferred from outside to inside through a filter. If cooling by fan will not be sufficient or proper then system activates the A/C units. The excellent software algorithm ensures fan, A/C or both to operate stable thus efficiency and energy saving rise maximum levels.

Fan speed is controlled by the difference of inside and outside temperature (ΔT). If ΔT increases, fan speed increases proportionally, too.

2.1. System Operation Algorithm

System Operation Algorithm is shown in scheme 1. The values in both ends of the arrows are adjustable. These adjustable values define the Start/Stop temperatures of the fan, heater and A/Cs.

System operation is based on the fact that if the outside air temperature is cool enough to cool inside, then it will be profitable to use a fan instead of air conditioner. But the important thing here is the control mechanism that always observes the environmental conditions and decides how to manage.
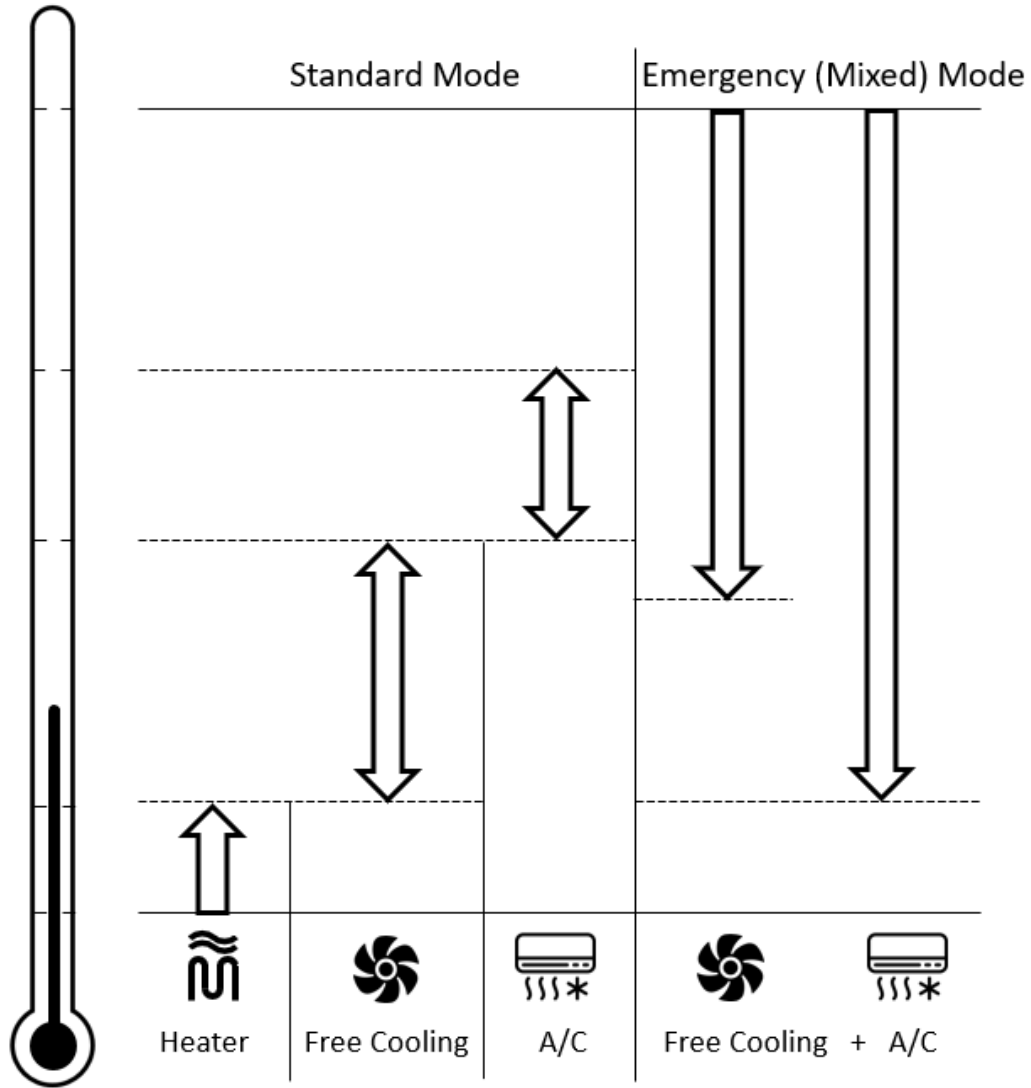
Scheme 1 : Free cooling system operation principle

There are two standard algorithms. **Inside** and **outside temperature related algorithms**.

The first one, the inside temperature related algorithm is the **main** one. This also includes a mixed mode (emergency mode) algorithm as an option. **The second one** is the **outside temperature related algorithm** and is an option for the user.

The operation of the system could be explained generally as follows.

2.1.1. Main (Strandard) Free Cooling Algorithm : Inside Temperature Related Algorithm

The algorithm of this feature could be explained as follows which a general flow diagram could seen in the Scheme 2

1. If inside temperature is very low, the controller operates the heater and when it reaches the set value, controller shuts down the heater.
2. If inside temperature exceeds the room temperature value, then controller operates fan.

At this point, this also needs the environmental conditions to be provided. If the environmental conditions are not provided the controller does not operate fan, waits until the inside temperature reaches A/C1 TURN ON temperature.

Proportional Fan Speed Control

Fan operates between a limit that it can be efficient. And the fan speed is adjusted according to the environmental conditions.
   i.   If inside temperature is a small amount above the threshold (FAN TURN ON) level (and the outside temperature is cooler), the controller operates fan very slow.
   ii.   If inside temperature is big amount above the threshold (FAN TURN ON) level (and the outside temperature is cooler), the controller operates fan very fast.
3. After operating fan, if inside temperature keeps rising and reaches to (FAN TURN OFF) temperature then controller shuts fan down
4. If inside temperature reaches to the turn on point of air conditioner 1 (A/C 1 TURN ON), control unit starts A/C 1.
5. If inside temperature still keeps rising and reaches to the turn on point of air conditioner 2 (A/C 1 TURN ON Temp + " A/C 2 Turn ON/OFF Difference from A/C 1") then controller starts air conditioner 2 (A/C2), too

a. **Inside Temperature Starts to Decrease,**

- If inside temperature decreases and falls below "air conditioner 2 (A/C2) turn off temperature " value (A/C 1 TURN OFF Temp + " A/C 2 Turn ON/OFF Difference from A/C 1"), it shuts air conditioner 2 (A/C2) down.
- If inside temperature keeps decreasing and falls below "air conditioner 1 (A/C1) turn off temperature " value (A/C 1 TURN OFF), it shuts air conditioner 1 (A/C1) down.

b. **Inside Temperature Keeps Increasing, Mixed Mode (Emergency Mode, A/C1, A/C2, Fan)**
- If inside temperature increases and reaches to (Mixed) "Mode Starting Temperature (Emergency Mode) the Mixed Mode is enabled (ON), then system also starts fan to operate with A/C1 and A/C2. The fan is started in addition to the still operating A/Cs
- If inside temperature starts to decrease, the system first shuts down fan at ((Mixed Mode) " Fan Turn OFF Temperature"
- If inside temperature keeps decreasing, system shuts down A/C2 at ((Mixed Mode) A/C TURN OFF Temperature + " A/C 2 Turn ON/OFF Difference from A/C 1") value .
- If inside temperature keeps decreasing, system shuts down A/C1 at (((Mixed Mode) A/C TURN OFF Temperature) value.

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INSIDE TEMPERATURE RELATED ALGORITHM

START ROOM TEMPERATURE

FAN ON

$T_{out} \leq T_i - 0.1$

T_{out}

$T_{out} > T_i - 0.1$

$T_{FO} \leq T_i < T_{A1O}$

$T_i < T_{FO}$

T_i

$T_i \geq T_{A1O}$ (FC)

ALL OFF

FAN OFF AC1 ON

$T_i < T_{A1C}$

T_i

$T_i \geq T_{A1C}$

$T_i < T_{A2O}$

T_i

$T_i \geq T_{A2O}$

AC2 OFF

AC2 ON

AC1 OFF

$T_i < T_{A2C}$

T_i

$T_i \geq T_{A2C}$

$T_i \leq T_{A1Cmix}$

$T_i > T_{A1Cmix}$

T_i

AC2 OFF

$T_i < T_{mix}$

T_i

$T_i \geq T_{mix}$

$T_i \leq T_{A2Cmix}$

$T_i > T_{A2Cmix}$

T_i

FAN ON

FAN OFF

$T_i < T_{mix}$

T_i

$T_i \geq T_{mix}$

$T_i < T_{FCmix}$

T_i

$T_i \geq T_{FCmix}$

MIXED MODE IMPORTANT NOTE

- Once the systems enables the mixed mode, it operates untill the inside temperature decreases to room temperature (< T_{FO}) .

ABBREVIATIONS

T_i : Inside temperature
T_o : Outside temperature
T_{A1O} : A/C1 Turn ON temp.
T_{A1C} : A/C1 Turn OFF temp.
T_{A2O} : A/C2 Turn ON temp.
T_{A2C} : A/C2 Turn OFF temp.
T_{FO} : Fan Turn ON temp.
T_{FC} : Fan Turn OFF temp.
T_{mix} : Mixed Mode Start temp.
T_{FCmix} : Mixed Mode Fan Turn OFF temp.
T_{A2Cmix} : Mixed Mode A/C2 Turn OFF temp.
T_{A1Cmix} : Mixed Mode A/C2 Turn OFF temp

Scheme 2 : Inside Temperature Related Algorithm

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2.1.2. Outside Temperature Related Algorithm

The algorithm of this optional feature could be explained as follows which a general flow diagram could seen in the Scheme 3

If this option is selected (enabled);

While the system is operating on **Main Free Cooling Algorithm** (Inside Temperature Related Algorithm), if the outside temperature exceeds the temperature adjusted in "Air Conditioner" tab in ""If Outside Temperature is higher than ….. switch to A/C automatically" " command then system automatically switches to Air conditioners. The A/Cs operate until the outside temperature decreases 0.5 ^{0}C below this temperature. This feature is developped to avoid numerous numbers of short time switchings of fan and A/Cs in middays. This also prevents high loading of energy lines, early aging of the devices and to be broken frequently.

INSIDE TEMPERATURE
RELATED
ALGORITHM

OUTSIDE TEMPERATURE
RELATED
ALGORITHM

START

ENABLE

DISABLE

Turn ON AC If High
Outdoor Temperature *

* Always priority

$T_o < T_{ohgh}$

T_o

$T_o \geq T_{ohgh}$

ALL OFF

FAN ON

$T_{out} \leq T_i - 0.1$

T_{out}

$T_{out} > T_i - 0.1$

$T_{FO} \leq T_i < T_{A1O}$

T_i

$T_i < T_{FO}$

ALL OFF

$T_i \geq T_{A1O}$

FAN OFF
AC1 ON

ALL OFF
AC1 ON

T_i

$T_i < T_{A2O}$

$T_i \geq T_{A2O}$

AC2 ON

AC2 OFF

$T_i < T_{A2C}$

$T_i \geq T_{A2C}$

T_i

STANDART OPERATION

Inside Temperature Related Algorithm

$< T_{A1C}$

T_{A1C}

$T_i < T_i$

$T_i \geq T_{A2}$

AC1 OFF

AC2 OFF

AC2 ON

$T_i \leq T_{A1Cmix}$

$T_i > T_{A1Cmix}$

T_i

$T_i < T_{A2C}$

$T_i \geq T_{A2C}$

T_i

$T_i < T_{mix}$

T_i

$T_i > T_{A2Cmix}$

AC2 OFF

$T_i \leq T_{A2Cmix}$

$T_i \geq T_{mix}$

FAN ON

FAN OFF

$T_i < T_{mix}$

T_i

T_i

$T_i < T_{FCmix}$

$T_i \geq T_{FCmix}$

$T_i \geq T_{mix}$

**OUTSIDE TEMPERATURE RELATED
ALGORITHM MODE**

IMPORTANT NOTE

- Once the system enables the outside
temperature related algorithm mode, it
needs outside temperature to decrease
$0.5\,^0C$ than the set value (high outdoor
temp) to be disabled ($< T_{ohgh} - 0.5$)

ABBREVATIONS

T_i	: Inside temperature
T_o	: Outside temperature
T_{A1O}	: A/C1 Turn ON temp.
T_{A1C}	: A/C1 Turn OFF temp.
T_{A2O}	: A/C2 Turn ON temp.
T_{A2C}	: A/C2 Turn OFF temp.
T_{FO}	: Fan Turn ON temp.
T_{FC}	: Fan Turn OFF temp.
T_{mix}	: Mixed Mode Start temp.
T_{FCmix}	: Mixed Mode Fan Turn OFF temp.
T_{A2Cmix}	: Mixed Mode A/C2 Turn OFF temp.
T_{A1Cmix}	: Mixed Mode A/C2 Turn OFF temp
T_{ohgh}	: High Outside Temperature

Scheme 3 : Outside Temperature Related Algorithm

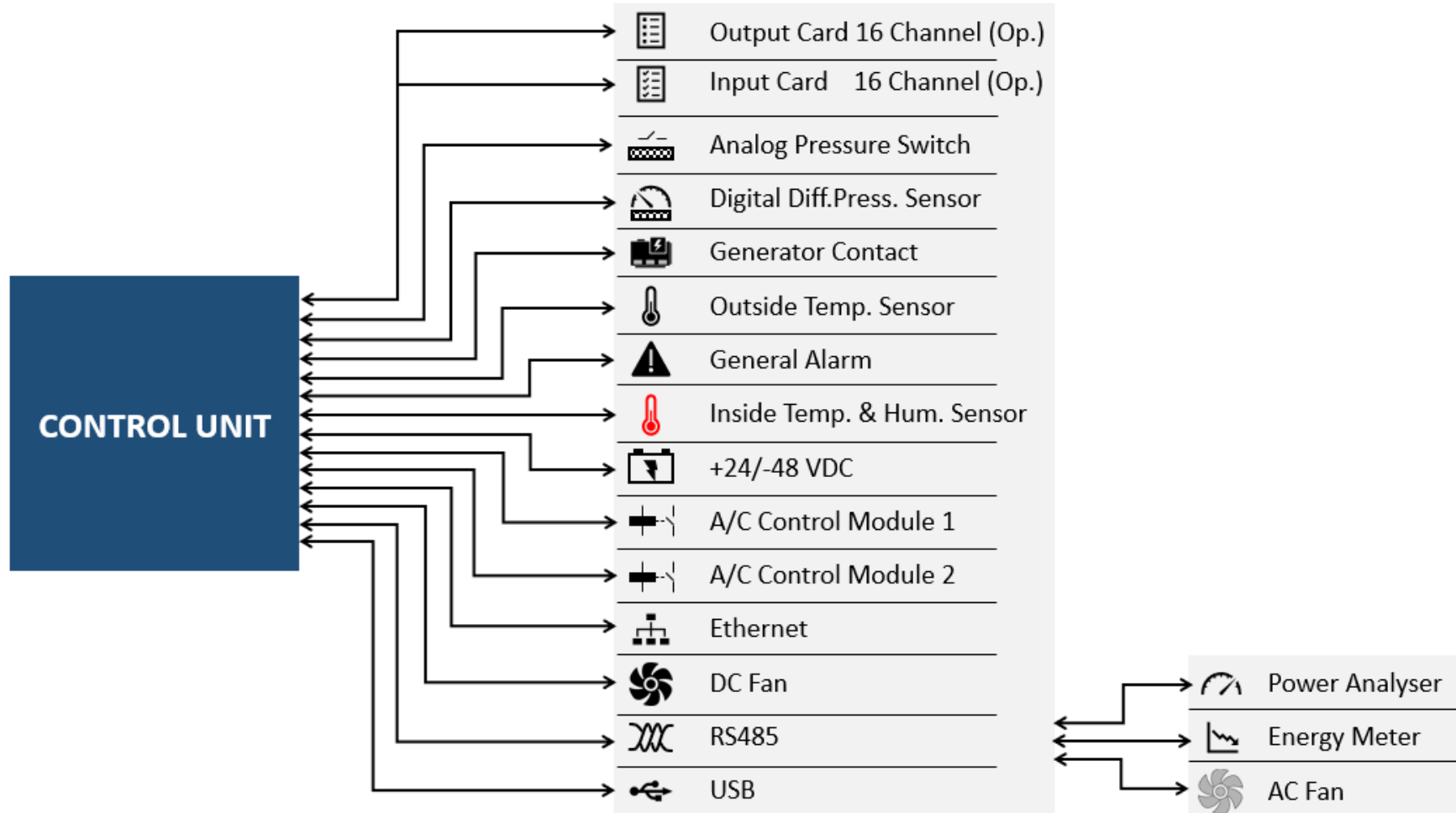Baran Elektronik Sistemleri San. ve Tic. Ltd. Sti.

2.1.3. Free Cooling System General Structure
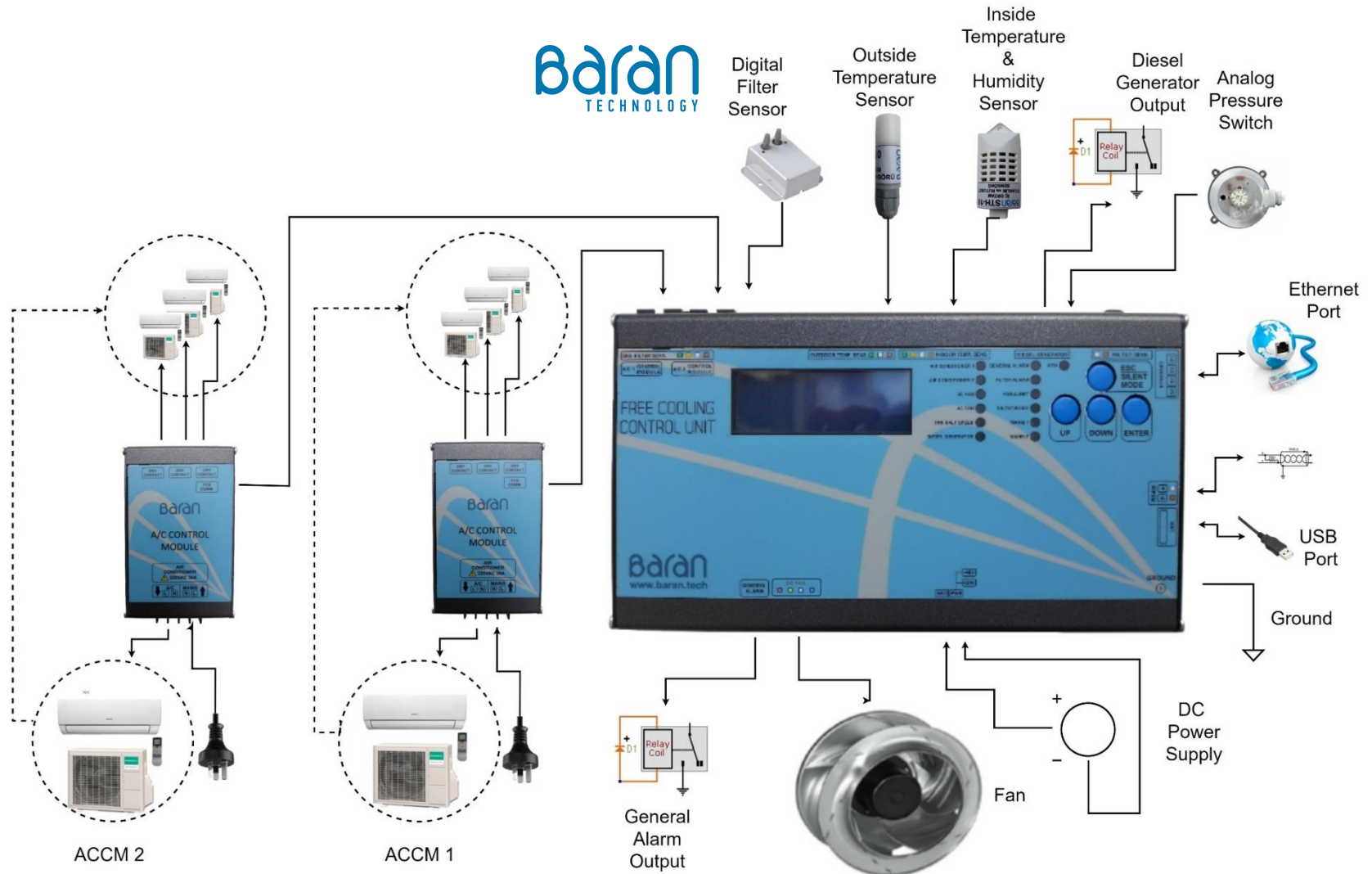
Scheme 4 : Free Cooling System General Structure

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2.1.4.   Control Unit Connection Ports

Scheme 5. Connection Ports

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3. PARTS OF FREE COOLING SYSTEM

3.1. Free Cooling Control Unit (Free Cooling Control Module, FCU)

Free Cooling Control Unit is the main controller. The datas coming from the sensors and peripherals are evaluated by microprocessor in control unit and the commands are sent for the operation.

The operation parameters could be adjusted by using buttons on controller as well as via Graphical User Interface (GUI) or web interface.

The power consumption of the controller is lower then 8 W and the number of the air conditioner control modules could be connected is 2.

For more details refer to datasheet.

3.1.1. LCD Display and Buttons

|	
ESC SILENT MODE	**ESC KEY** If user uses that button when the display is on main screen, system opens return to default menu. System can be returned to default by using the right button combination.
ENT	**ENTER KEY** If user uses that button when the display is on main screen, system opens settings menu.
UP	**UP KEY** If user uses that button when the display is on main screen, system logs will be deleted after the password is entered.
DN	**DOWN KEY** If user uses that button when the display is on main screen, system logs will be deleted after the password is entered.

Password

The default password is 2009.

User can enter the password by using UP, DOWN and ENT buttons as shown in scheme 6.

UP   (Select / Increase)

(Cancel / Back)   ESC ← → ENTER   (Okay / Save)

DOWN (Select / Decrease)

Date/Time
Parameters
Normal Operation
Daytime Ver #

2009

Enter Password

New Settings
Out. Temp. High F/C
Operation ON / OFF

ESC   : Cancel
UP   : Default
DN   : New
ENTER : Modbus Config

DN

New Settings
Out. Temp. High
F/C Operation 23ºC

New Settings
A/C Turn On Temp. 26ºC

New Settings
Fan Turn On Temp   22ºC

New Settings
A/C Turn Off Temp. 23ºC

New Settings
Fan Turn Off Temp   26ºC

New Settings
Mixed Mode Start
Temp.   23ºC

New Settings
Selection of Fan Type DC

New Settings
Mixed Mode Fan Turn Off
Temp.   >>Set

Enter

New Settings
Fan Power Type   190 W
Day rpm   % 100
Night rpm   %51

New Settings
Mixed Mode Fan Turn Off
Temp.   26ºC

New Settings
Indoor – Outdoor
Delta Temp.   2ºC

New Settings
Heater Turn On
Temp.   -5 ºC

New Settings
Heater Turn Off
Temp.   0 ºC

END

Scheme 6. The LCD Operation Map

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3.2. Air Conditioner Control Module (ACCM, ACM)

Air conditioner control module is used to control both split type and DX type air conditioners by the control unit.
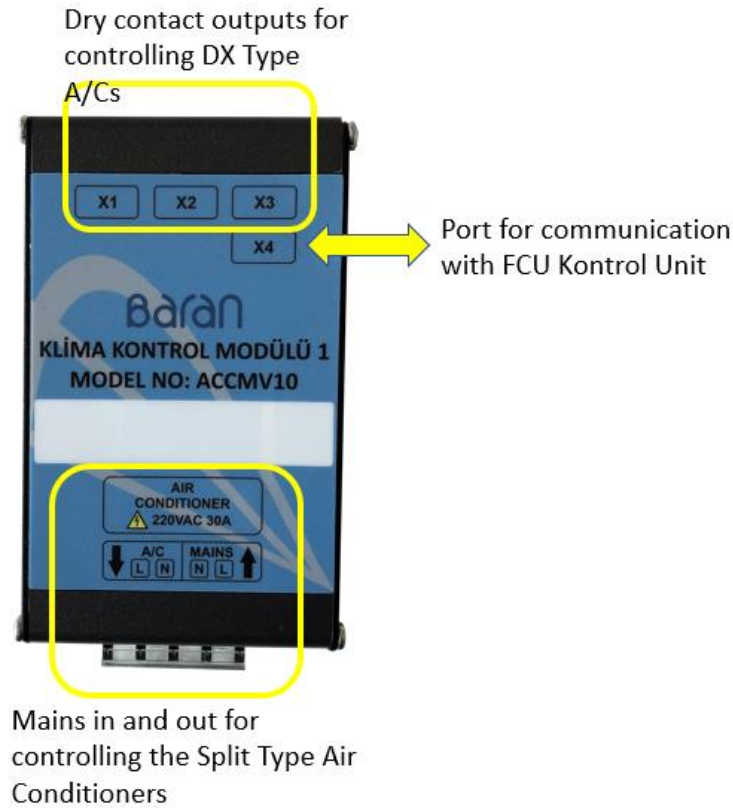
3.2.1. Controlling of Split Type Air Conditioners :

Split type air conditioners are generally medium power consuming devices (compared to DX High Power A/Cs) thus it they can be controlled over the mains. ACCM controls split type air conditioners by switching its relay connected in series to mains of split type A/Cs.

3.2.2. Controlling of DX Type (High Power-High Precision) Air Conditioners :

DX type air conditioners are special designed and high power consuming devices. That's why it is not correct to turn ON/OFF them over the mains. Each device has different turn ON/OFF procedures. For to turn ON/OFF these devices externally, the local/remote input of the control card of DX A/Cs is triggered(activated) by any of the X1, X2 and X3 (dry contact) outputs of ACCM. By activating this input, the DX air conditioner's controller turns ON/OFF internally.

3.3. I/O (Input/Output) Cards

3.3.1. Input Card

Input card is used to add extra alarms to standart FCS . If any of the inputs of the card receives a signal from any sensor (such as fire sensor, smoke sensor, leakage sensor, PIR detector…etc), FCS executes some operations related to this input's defined task.

The details of the operation of the card are explained below (Table 1).

1. Input card has 16 inputs.
2. 4 of the 16 inputs are fixed(predefined by the manufacturer) inputs.
3. Remainin 12 inputs are free to user's disposal. Any kind of sensor with **a dry contact output** could be connected here such as fire sensor, smoke sensor, leakage sensor, PIR detector…etc.
4. If a signal is received in any of the fixed inputs, FCS sends alarm signal on GUI on the screen, sends SNMP Trap and executes the predefined tasks.
5. If a signal is received in any of the free inputs, FCS sends alarm signal on GUI on the screen, sends SNMP Trap . But DOES NOT EXECUTE any task. This feature is not available for the free inputs.

			FEATURE		ACTION TAKEN		
Input	**Status**	**Description**	**Rename on GUI**	**Alarm on GUI**	**SNMP Trap (*)**	**Operation**	**General Alarm Output(*) (250 V/1 A)**
1	Fixed	Fire Alarm Level 1	No	Yes	Yes	Fan OFF	Yes
2	Fixed	Water/Leakage Alarm	No	Yes	Yes	Fan OFF	Yes
3	Fixed	Dust Alarm	No	Yes	Yes	Fan OFF	Yes
4	Fixed	Knock (Vibration) Alarm	No	Yes	Yes	Fan OFF	Yes
5	Free	Free	Yes	Yes	Yes	No	No
6	Free	Free	Yes	Yes	Yes	No	No
7	Free	Free	Yes	Yes	Yes	No	No
8	Free	Free	Yes	Yes	Yes	No	No
9	Free	Free	Yes	Yes	Yes	No	No
10	Free	Free	Yes	Yes	Yes	No	No
11	Free	Free	Yes	Yes	Yes	No	No
12	Free	Free	Yes	Yes	Yes	No	No
13	Free	Free	Yes	Yes	Yes	No	No
14	Free	Free	Yes	Yes	Yes	No	No
15	Free	Free	Yes	Yes	Yes	No	No
16	Fixed	Fire Alarm Level 2	No	Yes	Yes	Fan OFF A/C OFF	Yes

Table 1. Input Card's Technical Features

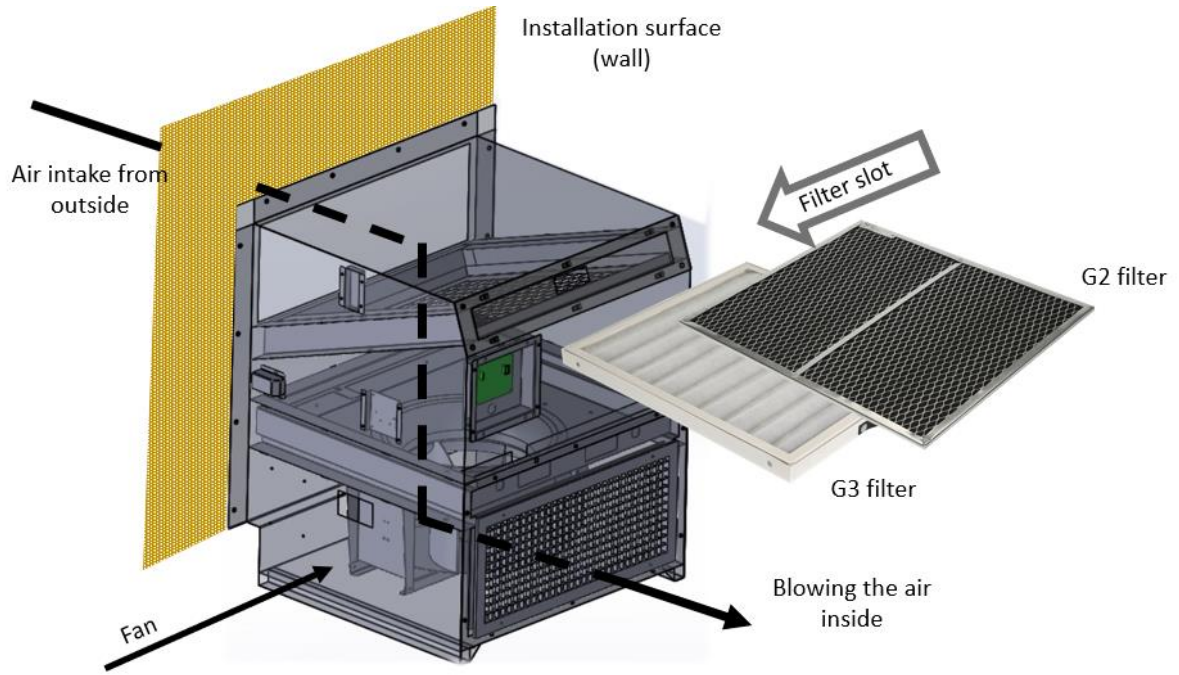* "However SNMP Trap" and "General Alarm" are standart features of FCS, it is written here to explain scenarios.

** " Free" means, user may define and use.

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3.3.2. Output Card

Output card is used to activate (ON/OFF) any device remotely by clicking on the GUI.

The details of the operation of the card are explained below.

1. Output card has 16 outputs.
2. By clicking the output on the GUI, FCS opens/closes the micro switch related to that output.
3. Outputs are microswitches and could be loaded max. 60V/500 ma.
4. If user wants to switch a high load device, then there must be used a drive unit such as relay, contactor to switch the desired device.

Output	Status	Description	FEATURE		ACTION TAKEN	
			Rename on GUI	Max.Load (Vmax/Imax)	Info on GUI	Activate Output (ON/OFF) (Dry Contact)
1	Free	Free	Yes	60V/500ma	Yes	Yes
2	Free	Free	Yes	60V/500ma	Yes	Yes
3	Free	Free	Yes	60V/500ma	Yes	Yes
4	Free	Free	Yes	60V/500ma	Yes	Yes
5	Free	Free	Yes	60V/500ma	Yes	Yes
6	Free	Free	Yes	60V/500ma	Yes	Yes
7	Free	Free	Yes	60V/500ma	Yes	Yes
8	Free	Free	Yes	60V/500ma	Yes	Yes
9	Free	Free	Yes	60V/500ma	Yes	Yes
10	Free	Free	Yes	60V/500ma	Yes	Yes
11	Free	Free	Yes	60V/500ma	Yes	Yes
12	Free	Free	Yes	60V/500ma	Yes	Yes
13	Free	Free	Yes	60V/500ma	Yes	Yes
14	Free	Free	Yes	60V/500ma	Yes	Yes
15	Free	Free	Yes	60V/500ma	Yes	Yes
16	Free	Free	Yes	60V/500ma	Yes	Yes

Table 2. Output Card's Technical Features

* " Free" means, user may define and use.

3.3.3. Alarm Card

Alarm card is used to activate the related output (as dry contact) of the card if any alarm exits on FCS's own peripherals (sensors). The general output on control unit does not deliver the ID of the alarm. But alarm card has individual outputs for each alarm.

The details of the operation of the card are explained below.

1. Alarm card has 16 outputs.
2. All outputs are predefined by the manufacturer. They can not be changed.
3. If any alarm exits, FCS sends alarm signal on GUI on the screen and sends SNMP Trap.

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4. Besides item 3, FCS also activates the related output switch **(as dry contact)** of the alarm card.
5. Outputs are microswitches and could be loaded max. 60V/500 ma.
6. Alarm card and output card are the basicly the same cards, J1 defines for which purpose it will be used.

Output	Status	Description	FEATURE		ACTION TAKEN			
			Rename on GUI	Max.Load (Vmax/Imax)	Alarm on GUI	SNMP Trap (*)	Activate Output (ON/OFF) (Dry Contact)	General Alarm Output(*) (250 V/1 A)
1	Fixed	High Temperature	No	60V/500ma	Yes	Yes	Yes	Yes
2	Fixed	Low Temperature	No	60V/500ma	Yes	Yes	Yes	Yes
3	Fixed	High Volt	No	60V/500ma	Yes	Yes	Yes	Yes
4	Fixed	Low Volt	No	60V/500ma	Yes	Yes	Yes	Yes
5	Fixed	A/C Phase Power 1	No	60V/500ma	Yes	Yes	Yes	Yes
6	Fixed	Maximum Humidity	No	60V/500ma	Yes	Yes	Yes	Yes
7	Fixed	Dew Point	No	60V/500ma	Yes	Yes	Yes	Yes
8	Fixed	Filter Block	No	60V/500ma	Yes	Yes	Yes	Yes
9	Fixed	Poor Heating	No	60V/500ma	Yes	Yes	Yes	Yes
10	Fixed	Poor Cooling	No	60V/500ma	Yes	Yes	Yes	Yes
11	Fixed	Fan Power	No	60V/500ma	Yes	Yes	Yes	Yes
12	Fixed	Fan RPM	No	60V/500ma	Yes	Yes	Yes	Yes
13	Fixed	A/C Phase Power 2	No	60V/500ma	Yes	Yes	Yes	Yes
14	Fixed	Fire Alarm	No	60V/500ma	Yes	Yes	Yes	Yes
15	Fixed	Very High Temperature	No	60V/500ma	Yes	Yes	Yes	Yes
16	Fixed	Free Cooling OFF	No	60V/500ma	Yes	Yes	Yes	Yes

Table 3. Alarm Card's Technical Features

* "However SNMP Trap" and "General Alarm" are standart features of FCS, it is written here to explain scenarios.

3.4. Fan Box

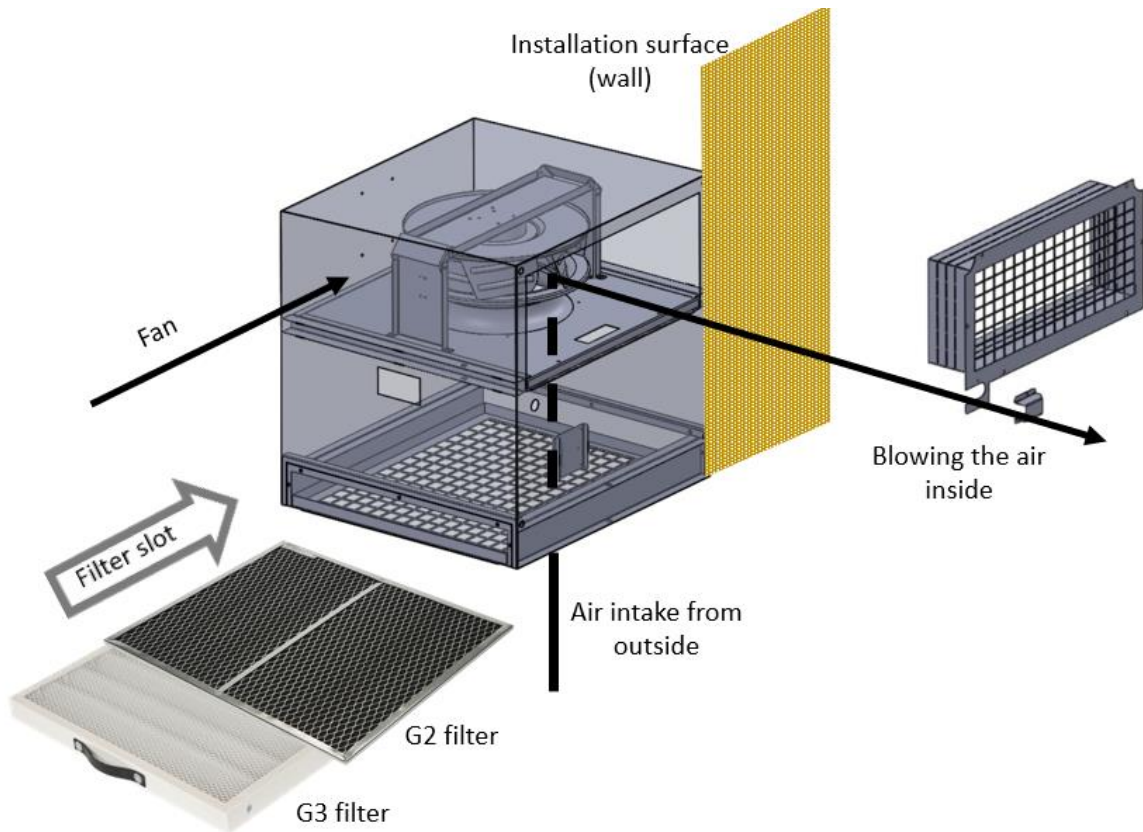Fan box is the metal cabin with fan inside used for transfering, filtering and directing the air.

While transferring the air, also changing direction and level of the air flow is done. The low insertion loss centifugal fans are used for transferring the air. The fan boxes are designed according to the type of the centrifugal fan. However centrifugal fans have a very common use, axiel fans are used for some special solutions.

There are two different types of fan boxes related to the installation location. The **indoor model**, fan box is placed inside the room(shelter) and **outdoor model**, fan box is placed outside the room(shelter)

Installation surface
(wall)

Air intake from
outside

Filter slot

G2 filter

G3 filter

Blowing the air
inside

Fan

Indoor Type

Installation surface
(wall)

Fan

Blowing the air
inside

Filter slot

Air intake from
outside

G2 filter

G3 filter

Outdoor Type

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3.5. Filter

In fan boxes two types of filters are used for filtering the air from dust, leaves, flies, particles..etc. However it can be designed in different standards for different projects but generally the first filter is the rough(the first) filter (G2) which receives the air first. The other filter is the fine (the second) filter (G3).

Rough Filter (G2) : It is located on the entrance of the air inlet of fan box and receives the air first. These filters are in G2 standard and keeps flies, bugs, leaves..etc. They also have a strong dust keeping capability.

They also have low insertion loss causing very low air pressure decrease in the flow path.

Fine Filter (G3) : These filters are the second filter receiveing the air after the first filter. It is designed in G3 standard and keeps fine dusts and particles which passes the first filter. These filters also have low insertion loss causing very low air pressure decrease in the flow path.

The best feature of these filters is that the fibers are changable.

The fiber can be changed by seperating two interlaced wings after unscrewing the screws located on the corners of the frame.

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3.6. Sensors

3.6.1. Inside Temperature and Humidity Sensor

This sensor detects and measures the temperature and humidity of the place to be cooled.To locate the sensor in the correct location is very important for the accuracy of the datas. Refer to the installation manual for the location and the datasheet for technical information.

3.6.2. Outside Temperature Sensor

This sensor detects and measures the temperature of the outside from where the air is taken and blowed inside. To locate the sensor in the correct location is very important for the accuracy of the datas. Refer to the installation manual for the location and the datasheet for technical information.

3.6.3. Digital Differential Pressure Sensor

This sensor compares the pressure difference of air before before and after the filter. This digital sensor sends the pressure difference data real time to the control unit. Refer to the installation manual for the location and the datasheet for technical information.

3.6.4. Analog Pressure Switch

This is a mechanical switch delivers an alarm signal if the pre-adjusted contacts (threshold level) are contacted related to the decrease in air pressure. Refer to the installation manual for the location and the datasheet for technical information.

3.6.5. Water Float Sensor

This sensor is used in high fan power models and is used to prevent the rain drops&particles to go inside. It sends alarm signal if raindops go inside while the fan is operating.

3.7. Fans

There are different types of fans used in free cooling systems such as AC or DC voltage supplied fans, centrifugal or axiel fans.

In the beginning the free cooling systems are developped for telecommunication infrastructure. The power supply in telecommunication infrastructure is 24 VDC or -48 VDC. So the free cooling systems were designed to be supplied by 24 VDC or -48 VDC. After expanding the usage sectors of FCS, high power fans needed and so the AC fans.

Also first demand was for low power and single axis flow thats why the first models were developped on DC motors and axial fans. Later on, following expansion of the demand, high power and flow level change were needed. So centrifugal fans started to be used.

3.8. Panel Board (Optional)

Panel Board is the panel board that free cooling control unit, air conditioner control module(s) are placed in and all cablings are centered.
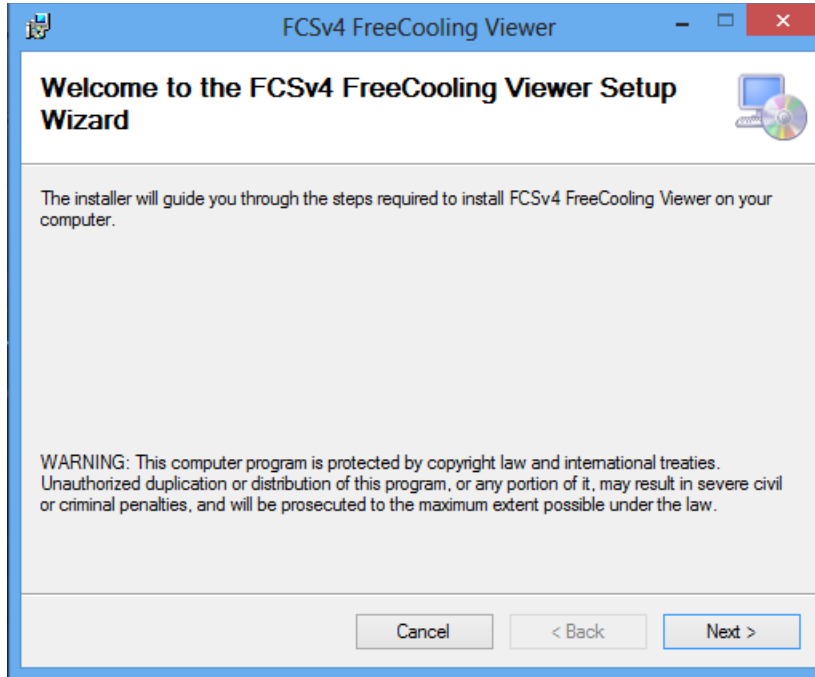
4. GRAPHICAL USER INTERFACE (GUI) / SOFTWARE

4.1 PC Installation
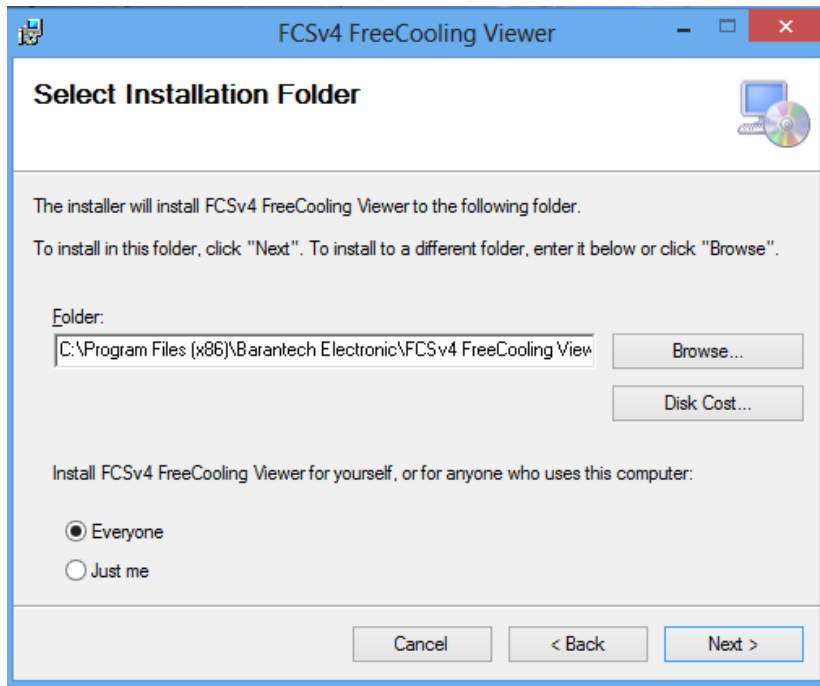Installation CD is available in the control unit packet. User can install the software by this CD.
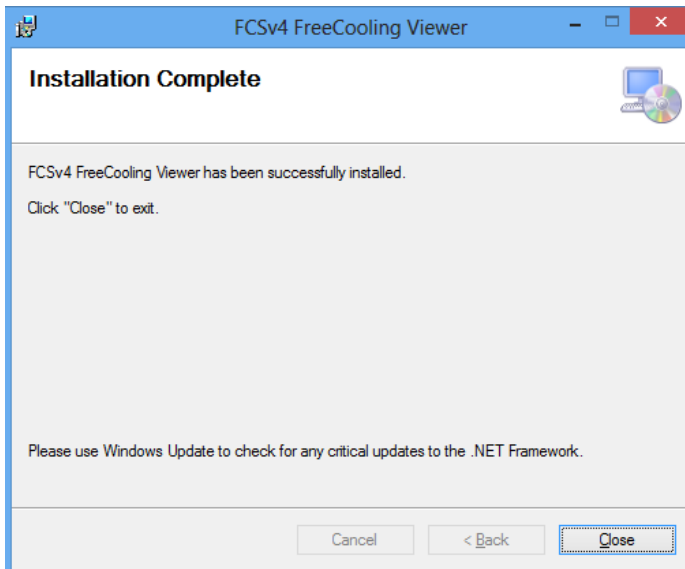
Installation stages;

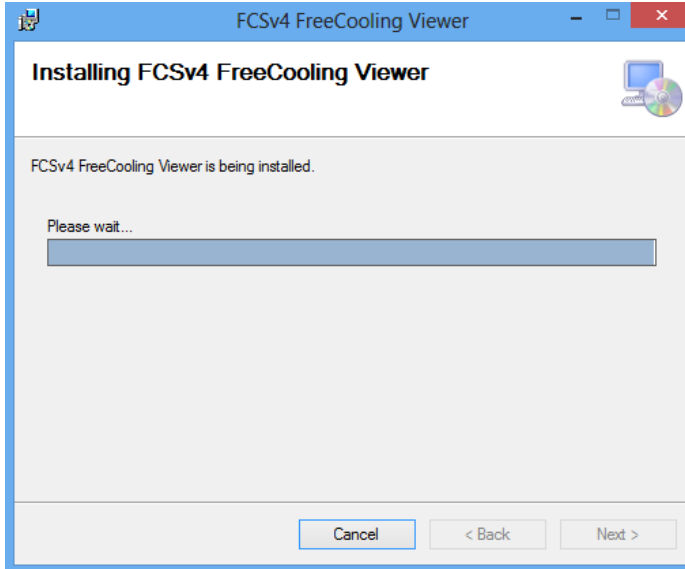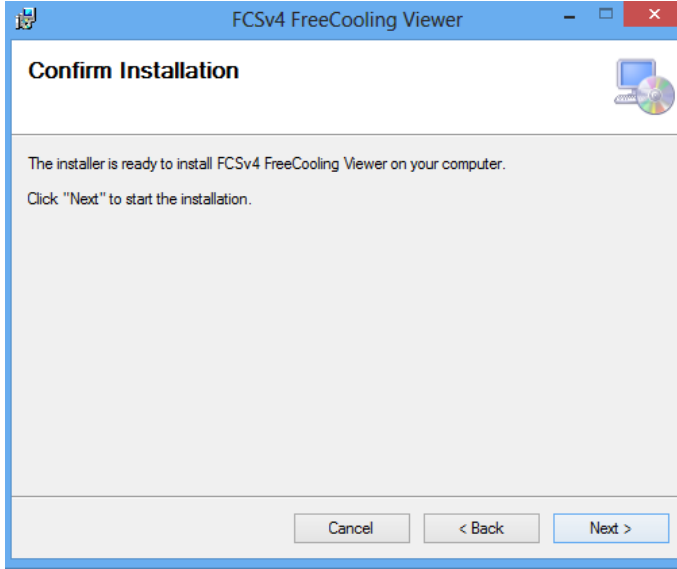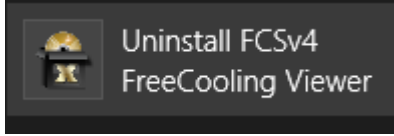FCS v4 Free Cooling Viewer Setup\setup.exe

Next

User should choose the folder for installation and then clicks Next;

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4.2 PC Uninstallation

User should run the Free Cooling Viewer to uninstall the program.

All saved data still stays in the system after uninstalling.

"FCSv4 Free Cooling Viewer v1.0" is a 3.party Windows application that user can easily achieve to manage the FCS system from PC with an interface by using one of the USB, RS232 or Ethernet Connection.

Free Cooling Viewer has ability to;

remote reel time chasing and graphically monitoring

show, change and reset the operating parameters

enable/disable keypad

restart FCS and air-conditioning units

switch FCS to bypass mode

erase data from memory

download data as Excel file.

(fan & air-conditioning operating times, temperature curves..)

4.3 Internet Connection With Ethernet
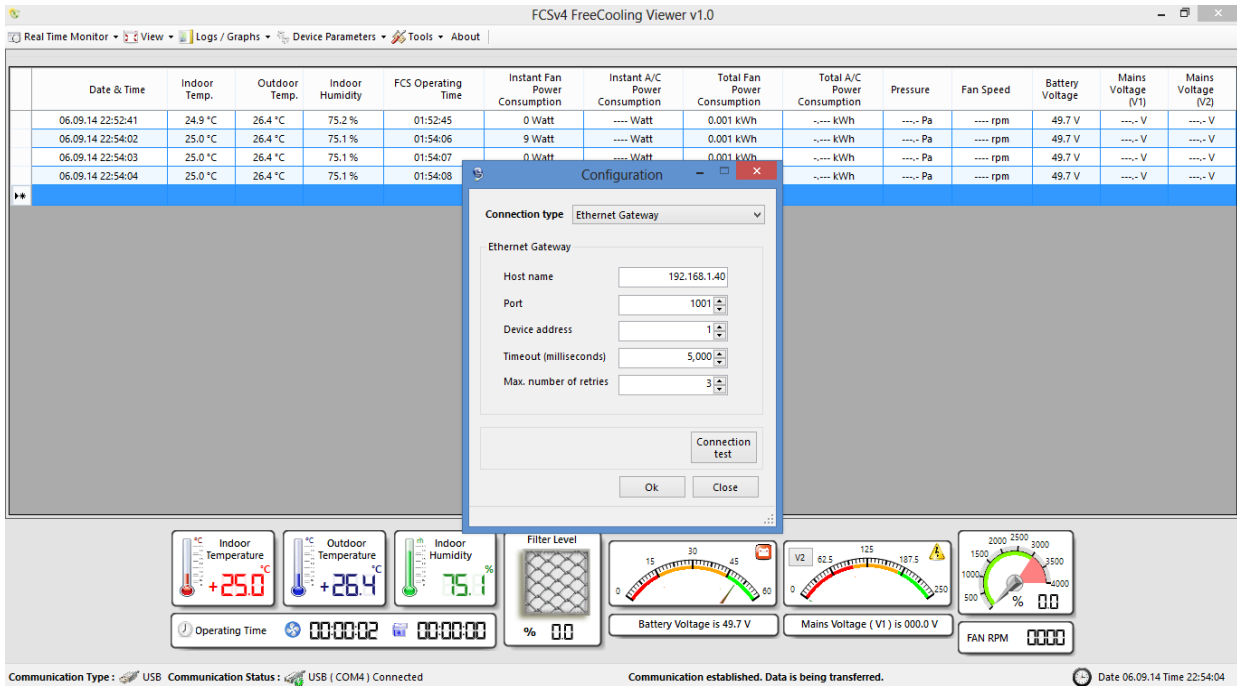
Baran Elektronik Sistemleri San. ve Tic. Ltd. Sti.

After launching Free Cooling Viewer, Tools > Communication Configuration > Connection Type > Ethernet Gateway is selected. Then user can determine the values to communicate with FCS unit and apply this settings by using Connection Test button. After applying the settings, these settings can be saved by using Ok button.

4.4 Connection With USB
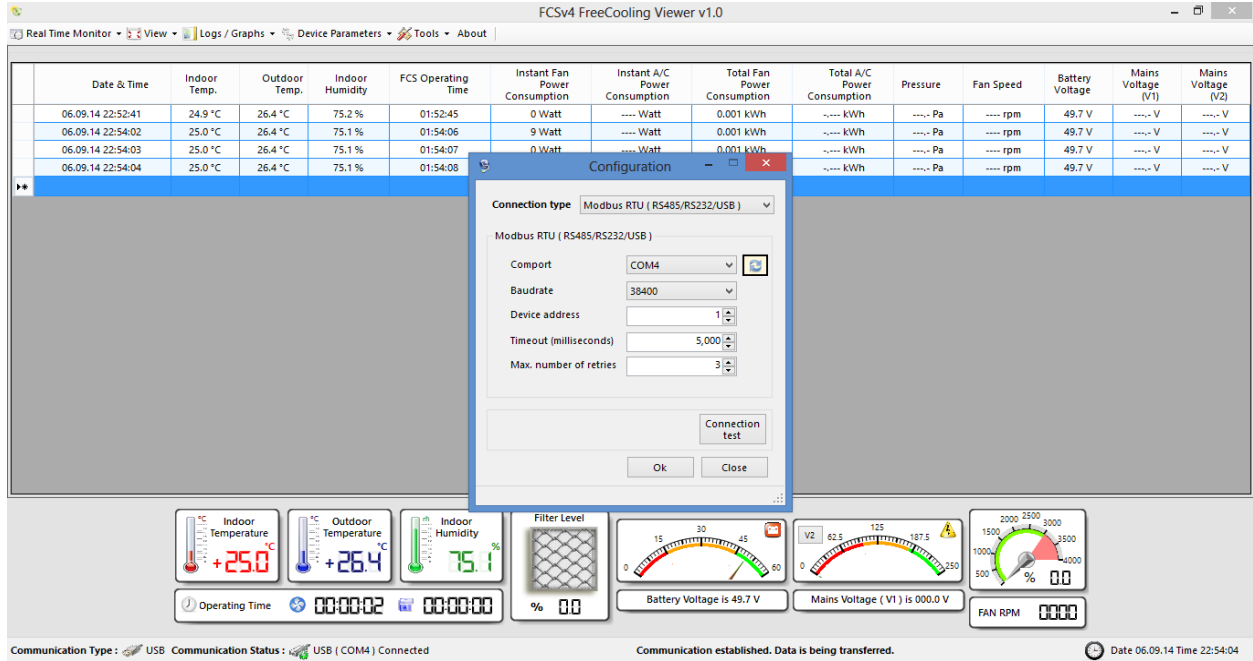
After launching Free Cooling Viewer, Tools > Communication Configuration > Connection Type > Modbus RTU (RS485/RS232/USB) is selected. Then user can determine the values to communicate with FCS unit and apply this settings by using Connection Test button. After applying the settings, these settings can be saved by using Ok button.

4.5 Parameters Setting & Menu

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Real Time Monitor ▾ | View ▾ | Logs / Graphs ▾ | Device Parameters ▾ | Tools ▾ | About
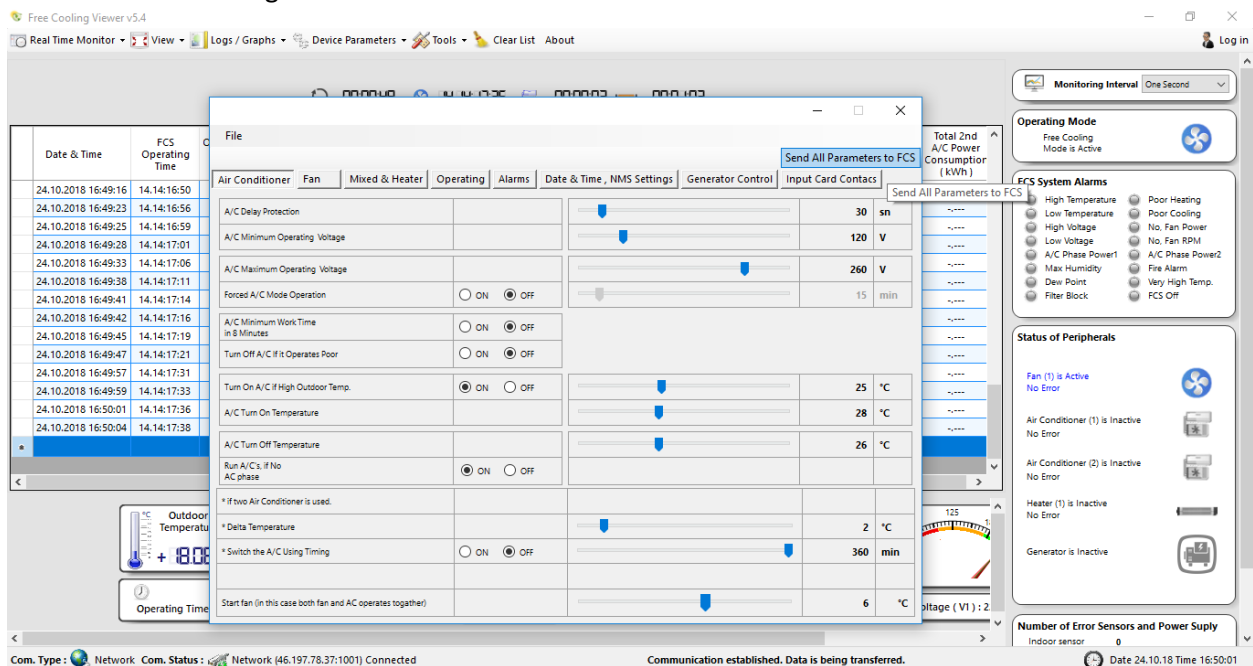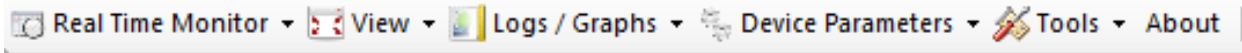
Device control settings can be managed by using this layer. These settings are given below:

4.5.1 Real Time Monitor

The screening of the incoming datas is selected whether by "text monitor" or " graph monitor".

Real Time Monitor ▾
- Text Monitor
- Graph Monitor
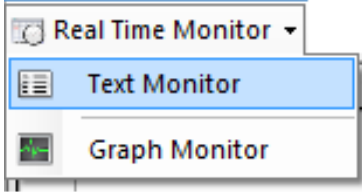
4.5.1.1 Text Monitor

User can monitor the real time data about the station as a flowing list by using this option.

Date & Time	FCS Operating Time	Outdoor Temp.	Indoor Temp.	Indoor Humidity	Pressure	Fan Speed	Instant Fan Power Consumption	Total Fan Power Consumption	Battery Voltage	Mains Voltage (V1)	Mains Voltage (V2)	Instant A/C Power Consumption	Total A/C Power Consumption
25.09.14 15:25:57	7.00:02:23	22.4 °C	21.4 °C	47.1 %	----,- Pa	---- rpm	0 Watt	1,778 kWh	53.6 V	215.9 V	----,- V	---- Watt	-,--- kWh
25.09.14 15:25:58	7.00:02:24	22.4 °C	21.4 °C	47.1 %	----,- Pa	---- rpm	0 Watt	1,778 kWh	53.6 V	215.6 V	----,- V	---- Watt	-,--- kWh
25.09.14 15:25:59	7.00:02:25	22.4 °C	21.4 °C	47.1 %	----,- Pa	---- rpm	0 Watt	1,778 kWh	53.6 V	215.6 V	----,- V	---- Watt	-,--- kWh
25.09.14 15:26:00	7.00:02:26	22.4 °C	21.4 °C	47.1 %	----,- Pa	---- rpm	0 Watt	1,778 kWh	53.6 V	216.1 V	----,- V	---- Watt	-,--- kWh
25.09.14 15:26:01	7.00:02:27	22.4 °C	21.4 °C	47.1 %	----,- Pa	---- rpm	0 Watt	1,778 kWh	53.6 V	215.4 V	----,- V	---- Watt	-,--- kWh
25.09.14 15:26:02	7.00:02:28	22.4 °C	21.4 °C	47.1 %	----,- Pa	---- rpm	0 Watt	1,778 kWh	53.6 V	213.9 V	----,- V	---- Watt	-,--- kWh
25.09.14 15:26:03	7.00:02:29	22.4 °C	21.4 °C	47.1 %	----,- Pa	---- rpm	0 Watt	1,778 kWh	53.6 V	215.6 V	----,- V	---- Watt	-,--- kWh
25.09.14 15:26:04	7.00:02:30	22.4 °C	21.4 °C	47.1 %	----,- Pa	---- rpm	0 Watt	1,778 kWh	53.6 V	215.9 V	----,- V	---- Watt	-,--- kWh
25.09.14 15:26:05	7.00:02:31	22.4 °C	21.4 °C	47.1 %	----,- Pa	---- rpm	0 Watt	1,778 kWh	53.6 V	213.2 V	----,- V	---- Watt	-,--- kWh
25.09.14 15:26:06	7.00:02:32	22.4 °C	21.4 °C	47.1 %	----,- Pa	---- rpm	0 Watt	1,778 kWh	53.6 V	215.8 V	----,- V	---- Watt	-,--- kWh
25.09.14 15:26:07	7.00:02:33	22.4 °C	21.4 °C	47.1 %	----,- Pa	---- rpm	0 Watt	1,778 kWh	53.6 V	213.1 V	----,- V	---- Watt	-,--- kWh
25.09.14 15:26:08	7.00:02:34	22.4 °C	21.4 °C	47.1 %	----,- Pa	---- rpm	0 Watt	1,778 kWh	53.6 V	215.1 V	----,- V	---- Watt	-,--- kWh
25.09.14 15:26:09	7.00:02:35	22.4 °C	21.4 °C	47.1 %	----,- Pa	---- rpm	0 Watt	1,778 kWh	53.6 V	215.8 V	----,- V	---- Watt	-,--- kWh
25.09.14 15:26:10	7.00:02:36	22.4 °C	21.4 °C	47.1 %	----,- Pa	---- rpm	0 Watt	1,778 kWh	53.6 V	215.1 V	----,- V	---- Watt	-,--- kWh
25.09.14 15:26:11	7.00:02:37	22.4 °C	21.4 °C	47.1 %	----,- Pa	---- rpm	0 Watt	1,778 kWh	53.6 V	213.4 V	----,- V	---- Watt	-,--- kWh
25.09.14 15:26:12	7.00:02:38	22.4 °C	21.4 °C	47.1 %	----,- Pa	---- rpm	0 Watt	1,778 kWh	53.6 V	215.8 V	----,- V	---- Watt	-,--- kWh
25.09.14 15:26:13	7.00:02:39	22.4 °C	21.4 °C	47.1 %	----,- Pa	---- rpm	0 Watt	1,778 kWh	53.6 V	216.7 V	----,- V	---- Watt	-,--- kWh
25.09.14 15:26:14	7.00:02:40	22.4 °C	21.4 °C	47.1 %	----,- Pa	---- rpm	0 Watt	1,778 kWh	53.6 V	216.1 V	----,- V	---- Watt	-,--- kWh

4.5.1.2 Graph Monitor

User can observe real time on a graphic by using this option.

Graph Monitor

Copy Image | Save Image As | Un Zoom | Un All Zoom | Print ▾

☑ Inside Temp. ☑ Outside Temp. ☑ Humidity ☑ Pressure ☐ Battery Voltage
☑ Mains1 Voltage ☐ Mains2 Voltage ☑ Fan Rpm ☑ Instant PowercCnsumption ☐ Total PowercCnsumption

— Inside Temp. — Outside Temp. — Humidity — Pressure — Battery Voltage — Mains1 Voltage — Mains2 Voltage — Fan Rpm — Instant PowerConsumption — Total PowerConsumption
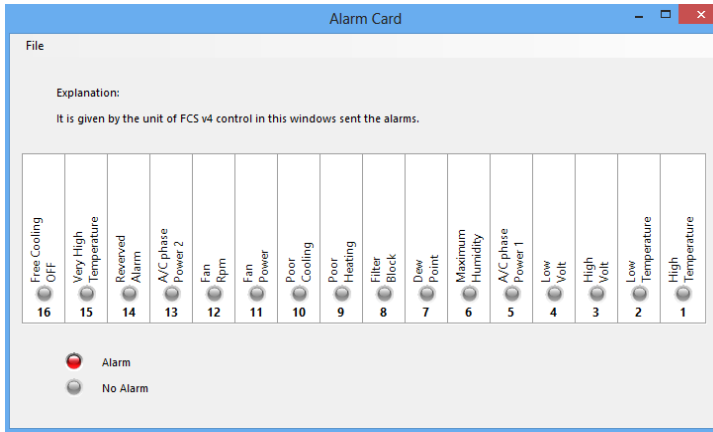
Date : 25.9.2014

4.5.2 View

4.5.2.1 Show All External Plag and Play Cards
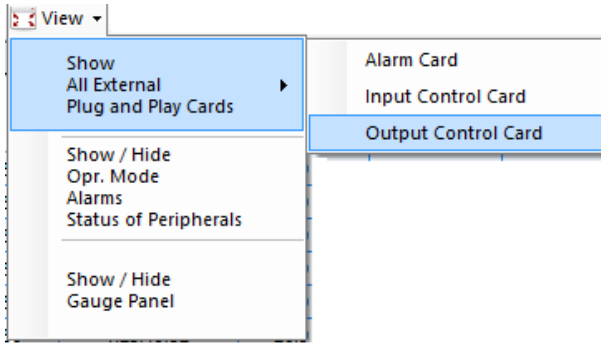
Alarm Card
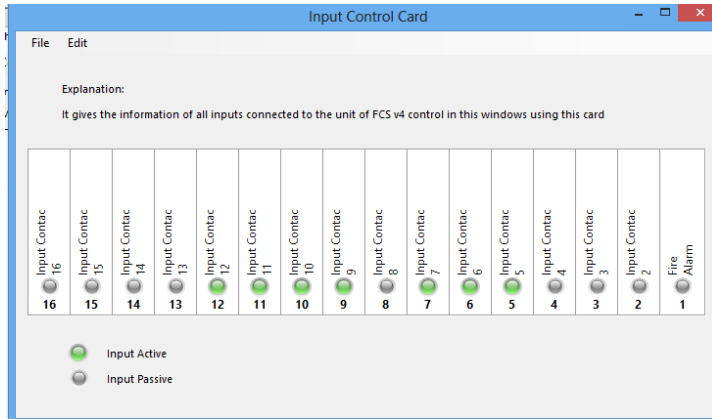
The current situation of the alarm card is monitored.

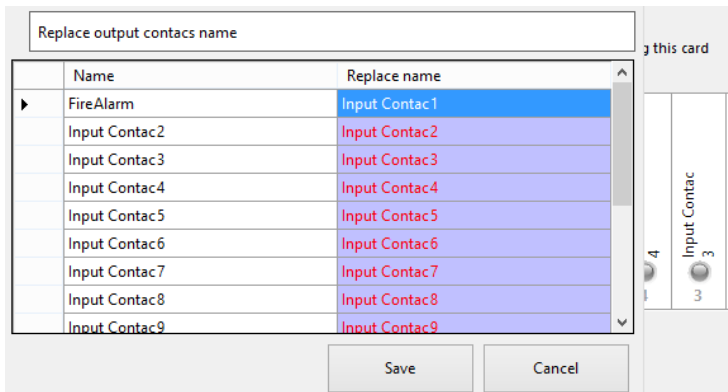
(See also   Section 3.3.3)

Input Card

The current situation of the input card is monitored and the following processes could be executed.

1. File > Import contacts name table; all user-defined input names can be loaded from a saved file.
2. File > Export contacts name table; all user-defined input names can be transferred to external storage devices, PC etc.
3. Edit > Replace name; all inputs can be renamed by user.

(See also   Section 3.3.1)

Output Card

File > Output Control Card (Optional): User can monitor the current situation about the output control card and also can change these outputs.
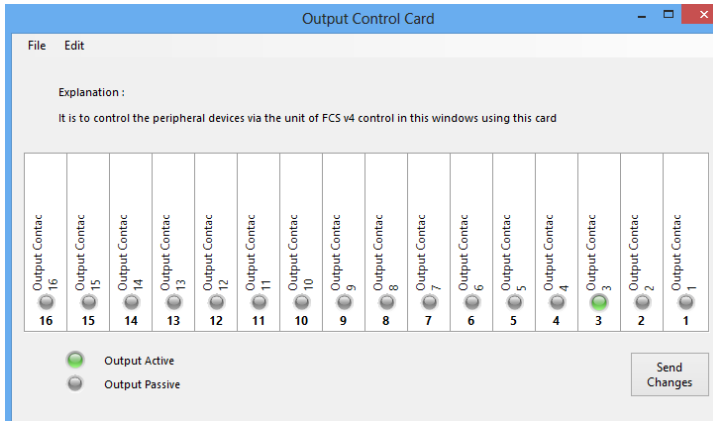
Baran Elektronik Sistemleri San. ve Tic. Ltd. Sti.

File > Import contacts name table; all user-defined input names can be loaded from a saved file.

File > Export contacts name table; all user-defined input names can be transferred to external storage devices, PC etc.

Edit > Replace name; all inputs can be renamed by user.
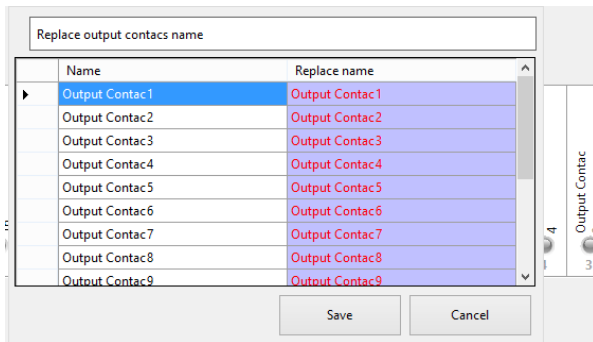
(See also   Section 3.3.2)

4.5.2.2 Show / HIde Opr.Mode Alarms Status of PerIpherals

The feature to select "Operation Mode, Alarms and Status of Peripherals" to be secreened in visual forms on the right side of the screen.

shows if FCS is Active or Passive.

shows all occured alarms. All alarms are optional. If user doesn't want to see some of them, they can be disabled.

shows all active/passive status of peripherals.

shows number of error sensors and power supply

4.5.2.3 Show / Hide Gauge Panel

The feature to select the important parameters to be screened in visual meter forms at the bottom of the screen.

.
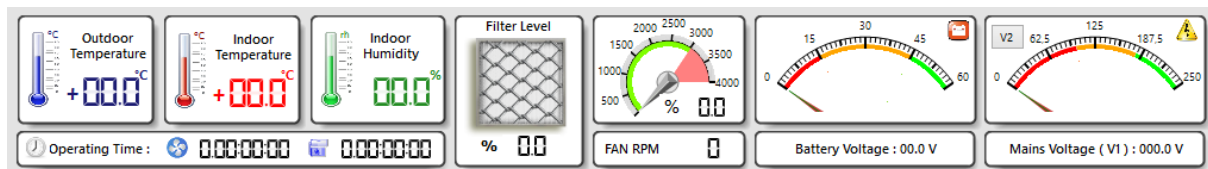
4.5.2.4 View > Show Power Analyser Screen

This feature is designed to place a power meter analyser to FCS and check the power and related parameters. The reference meter is Eastron SDM630 model power analyser. The following

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parameters could be read by connecting the power analyser in series to the circuit and RS485 Port modbus RTU to the RS485 input of the main board

Power Factor (PF)

Total System Power (kWh)

Total System Volt Ampere Reactive Inductive (Var)

Total System Volt Ampere Reactive Capacitive (Var)

4.5.2.5 Show / Hide Site List

   The feature to select the saved "site names " to be screened on the left side of the screen. It ensures to acces sites easily. In the side list section, by pressing Add/Edit button, a new site parameters and the site name could be registered by proceeding " Adding Manual Devices" button.
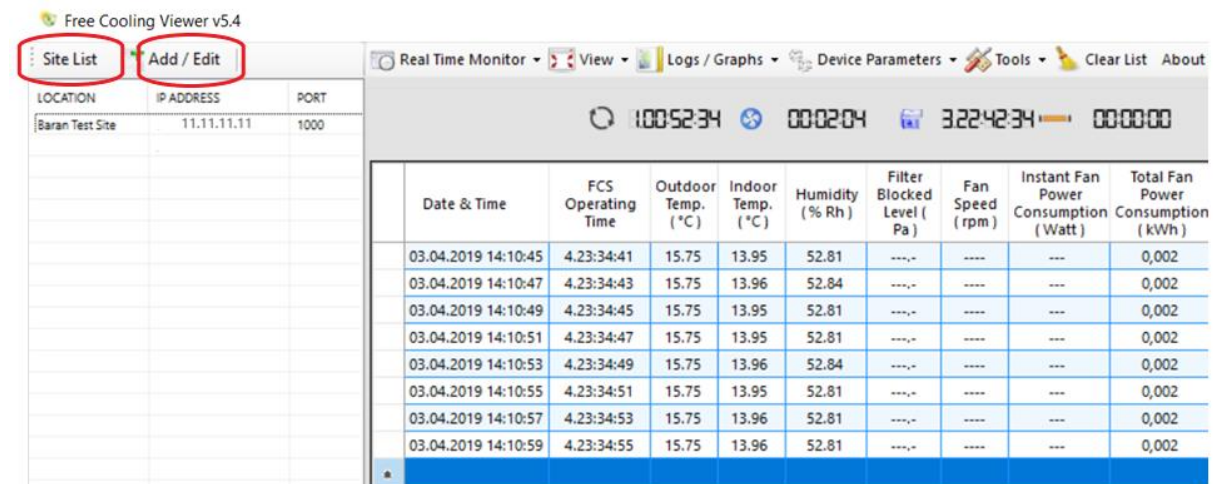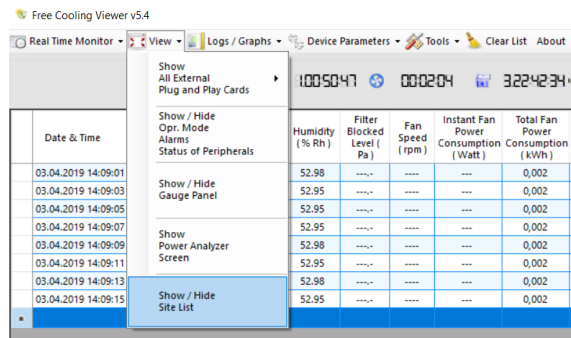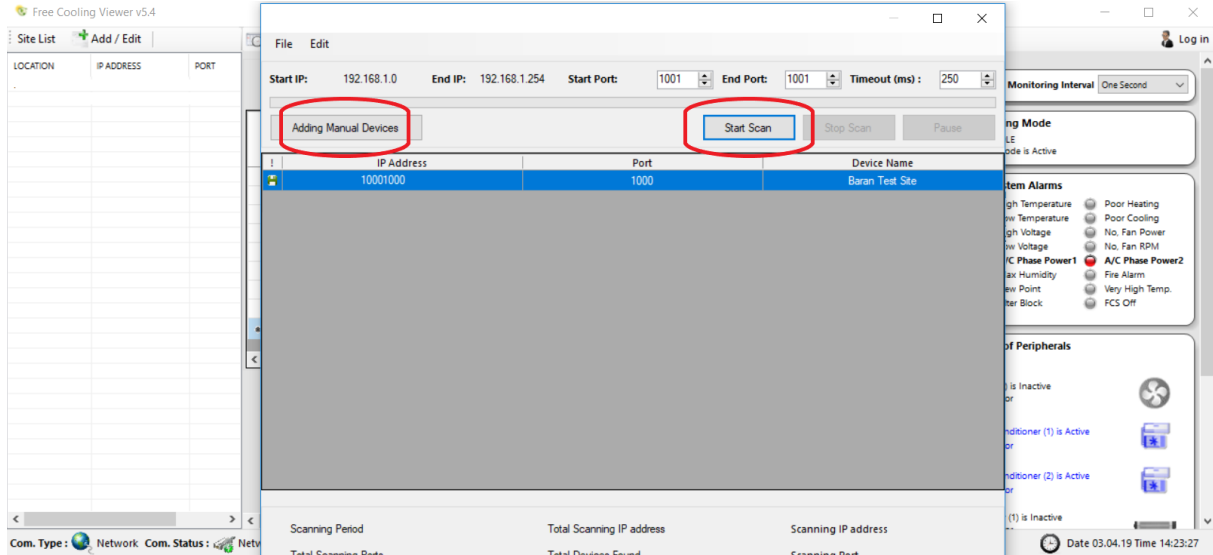
4.5.3. Logs&Graph Menu
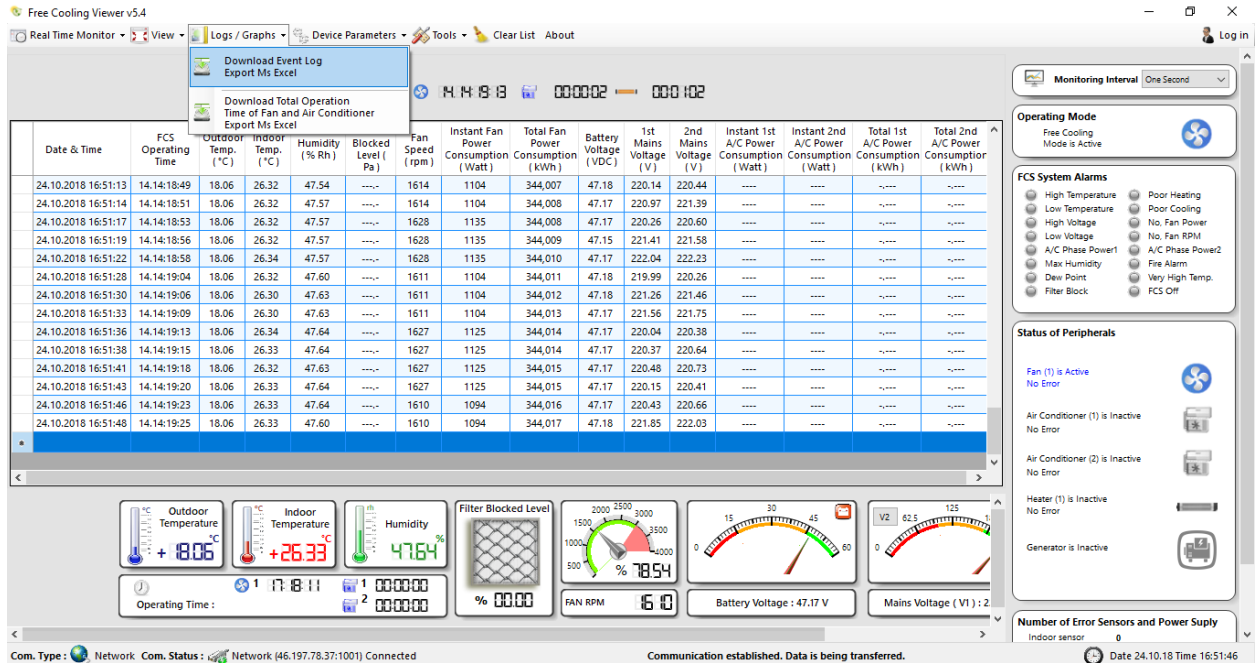
4.5.3.1 Download Event Log Export MS Excel

The event logs could be downloaded (as of that moment) to the computer as MS Excel file. As well as saving the file into "C:\Baran Technology\Free Cooling Viewer v4.6\LOG - EVENT_ALARMS" directory, it also opens the file on the desktop

### 4.5.3.2 Download Total Operation Time of Fan and Air Conditioner Export MS Excel

The "Total Operation Time of Fan and Air Conditioner" logs could be downloaded (as of that moment) to the computer as MS Excel file. As well as saving the file into "C:\Baran Technology\Free Cooling Viewer v4.6\LOG - OPERATING_TIME" directory, it also opens the file on the desktop

Downloading and Reporting data;

Download data from storage
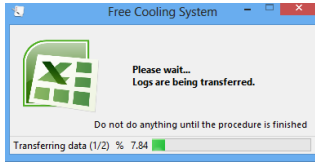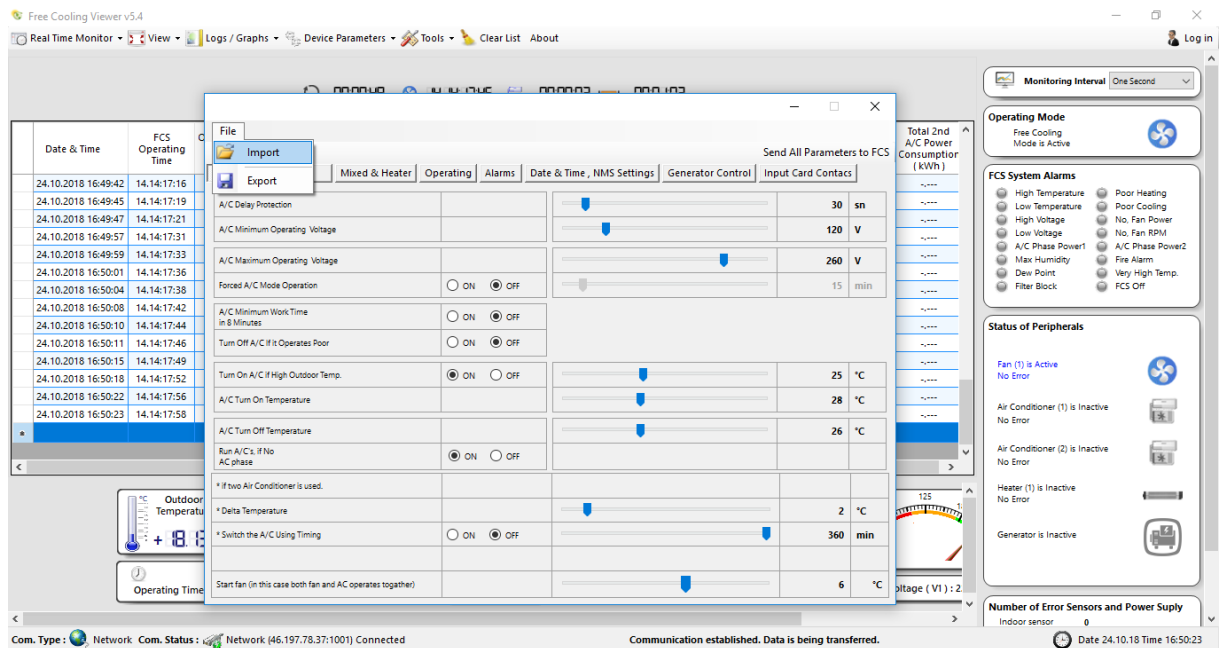

Report downloaded data as Excel file
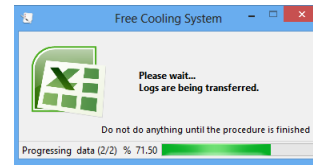
4.5.4 Device Parameters
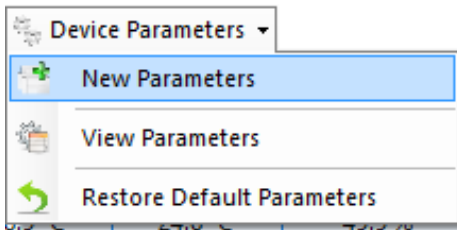
4.5.4.1 New Parameters;

i. Import & Export Datas

The datas which are in appropriate format could be imported in the "New Parameters" Section as well as the datas in "New Parameters" Section could be exported in the same format.

ii. Send All Parameters to FCS

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The new parameter(s) could be saved in the microprocessor by " **Send All Parameters to FCS**" button.

* For the remaining parameters description and settings, please refer to Section 4.6.2 (The Settings of FCS)

4.5.4.2 View Parameters
The valid parameters, status of alarms and devices could be viewed in this section.

4.5.4.3 Restore Default Parameters;

Every FCS is set to factory settings before testing. These setting values are studied at R&D Department according to the average statistics of the that country/region. After installation, there might be fine tuning for that location. If any problem occcurs that user can not adjust the setting, then this feature ensures the factory settings to be adjusted. Factory settings will operate the FCS appropriately until a technician reaches and makes the fine tuning.

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4.5.5 Tools
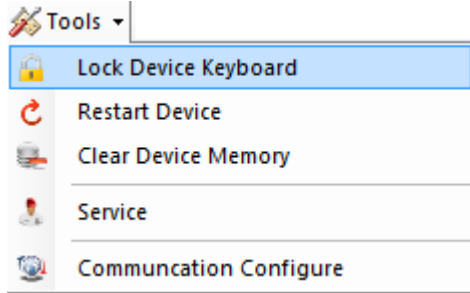
Tools > Back To Normal Operation of FCS : After starting air conditioners or fan manualy for any reason, this feature puts FCS in previous conditions before manual start

Tools > Manual Start ACs : This feature provides the user to check remotely if the ACs operate or not (independent from the system).

Tools > Manual Start Fans   This feature provides to start Fan(s) manually.

*Tools > Clear Instant Alarms:* This feature is used clear instant alarms seen on the right side of the screen.

Tools > Restart Device: Provides restarting the FCS Control unit remotely.

***Tools > Clear Device Memory; All data in FCSv4 memory can be deleted.***

Tools > Restart ACs   This feature is used to reset (only split models) ACs. From time to time, the split A/C models get stuck and needs to reset. The controller interrupts the mains of the ACs for 15 sec. then operates again.

Lock Device Keyboard; FCSv4 keyboard can enable/disable. Thus, System parameters are prevented to change by unauthorized persons on the field. (This option only can be used through the USB connection.)
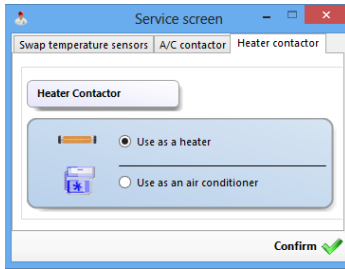
Service; Service settings of FCSv4 is accessible with this option. Service settings are given on the right side;
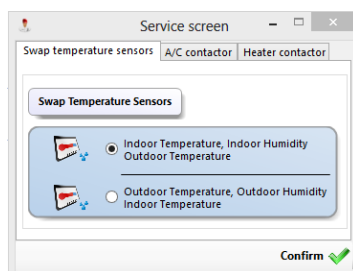
FCSv4 operation system can be optimized according to sensor placements.

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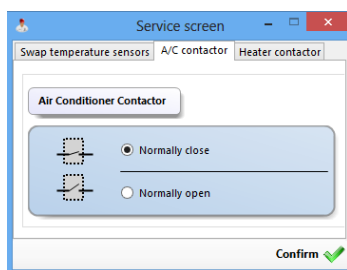
FCSv4 contacts (NC/NO), which controls the air-conditioning units, can be optimized according to system operation.

FCSv4 contacts, which controls heaters, can be optimized as air-conditioning unit or heater.

Tools > Service > Change Contacts Status

Tools > Service > Test FC's Routines : This option is used to check if the controller operates well independent of peripherals (sensors).
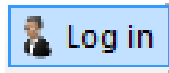
Tools > Service > RS485 Self Test

Communication Configure; "Access point settings" are configured which will provide to connect to the FCSv4 control unit. This connecition can be made through two different points. **Ethernet Gateway** and **Modebus RTU.**

4.5.6 Clear List
Selecting this command clears the datas on the "Text Monitor" mode.

4.5.7 Log in

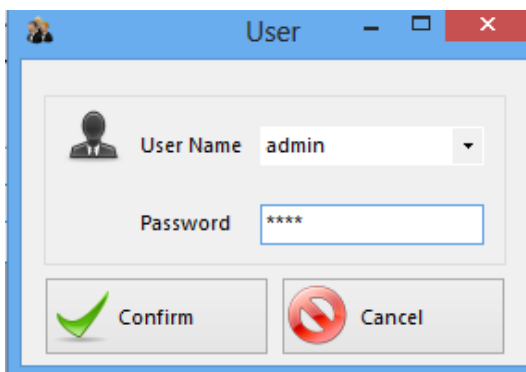Log in; User can access the system as admin. As an admin, user can;

Reset the FCSv4

Delete all data in FCSv4 memory

Change parameters

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7.7. FCS MODBUS CONFIG FCS Modbus Config

Device addr: It's the part that user defines the Modbus address. It can be between 1 – 247.

Baudrate: Communication speed of Modbus is adjusted from here. Baudrate intervals are 4800, 9600, 19200, 38400, 57600, 115200, 230400, 460800.

Connection: If device communication will not be form USB connector, it should be defined from here. External communication ports; GPRS, RS485, Ethernet.
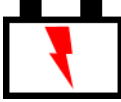
NMS time (Minute): On this screen user can define how often the system is set to send data to the device management system.

4.6 Parameters Descriptions and Settings
User can access the parameters by pressing ENT button when it's on the main screen. FCS operation parameters are defined here.

Alarms

	LOW TEMPERATURE ALARM If inside temperature is lower than the set value (*), system creates this alarm. *Device Parameters > New Parameters > Alarms > Low Temp. Alarm Threshold
	HIGH TEMPERATURE ALARM If inside temperature is higher than the set value (*), system creates this alarm. *Device Parameters > New Parameters > Alarms > High Temp. Alarm Threshold
	VERY HIGH TEMPERATURE ALARM If inside temperature is higher than the (second) set value (*), system creates this alarm. *Device Parameters > New Parameters > Alarms > Very HighTemp. Alarm Threshold
	DEW POINT ALARM Dew point is calculated according to the instant temperature and humidity values. If this calculation results a dew point, then system creates this alarm.
	MAXIMUM HUMIDITY ALARM If inside humidity value is higher than the set value (*), system creates this alarm. * Device Parameters > New Parameters > Alarms > Max. Humidity
	POOR COOLING ALARM If A/C can't decrease inside temperature (at the end of first 60 minutes of operation) below than it has started, system creates this alarm.
	POOR HEATING ALARM If heater can't increase inside temperature (at the end of first 60 minutes of operation) above than it has started, system creates this alarm
	FAN SPEED (RPM) ALARM If fan speed is not at the appropriate level related to the set value (*),system creates this alarm * Device Parameters > New Parameters > Alarms > Max. Humidity

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	FAN POWER ALARM If the conditions for fan to operate are present but fan does not run for any reason, system creates this alarm (eg. connection, fan's fuse damaged..)
	FILTER PRESSURE ALARM If filter pressure is higher than the set value (*), system creates this alarm * For digital differential pressure sensor : Device Parameters > New Parameters > Alarms > Filter Pressure Alarm Threshold * For analog pressure switch : Adjusted as mechanicaly default at the factory.
	LOW BATTERY ALARM If the voltage of the batteries is lower than the set voltage value (*), system creates this alarm. *Device Parameters > New Parameters > Alarms > Low Battery Alarm Threshold
	HIGH BATTERY ALARM If the voltage of the batteries is higher than the set voltage value (*), system creates this alarm. *Device Parameters > New Parameters > Alarms > High Battery Alarm Threshold
	A/C PHASE POWER 1 ALARM If there is no Mains on air conditioner control module 1, system creates this alarm.
	A/C Phase Power 2 Alarm If there is no Mains on air conditioner control module 2, system creates this alarm.
	FCS OFF ALARM If there are sensor failures or if the device is on maintenance mode, system creates this alarm. . In case of this alarm occured, Fee Cooling System turns off itself and A/C units swtitch on the air conditioners.

4.6.2 The Settings of FCS (Listed as in the GUI menu order)

No	Parameter	Status	Unit	Default	Version s4.2, h1.2				Description
					or Earlier		*Later*		
					Min.	Max.	Min.	Max.	
	Device Parameters > New Parameters > Air Conditioner								
1	**A/C delay protection**		s	300	0	300	0	300	In case of frequent power interruption, compressor is disabled during the set time and thus sytem protects A/C.
2	**A/C minimum operating voltage**		V	120	0	120	0	120	System shuts down A/C if mains falls below this voltage thus protects A/C. Minimum operating voltage is adjusted according to A/C features.
3	**A/C maximum operating voltage**		V	245			220	270	System shuts down A/C if mains exceeds this voltage thus protects A/C. Maximum operating voltage is adjusted according to A/C features
4	**Forced A/C mode operation**	ON	Min.	15	0	180	0	180	This feature is a " user defined " version of the following feature "A/C minimum operation time for 8 minutes"

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5	A/C minimum operation time for 8 minutes	ON / OFF		OFF	✓		✓			If A/C starts up after any event, system does not interrupt A/C's operation for next 8 minutes.
6	Turn off if A/C if it opr. poor	ON / OFF		OFF	✓		✓			If cooling performance of A/C is unsatisfactory , system shuts down A/C to save the energy.
7	Turn on A/C mix outdoor temp.	ON	°C	25	18	32	18	36		If outside temperature exceeds the setpoint, Free Cooling mode is disabled and A/C starts .
8	A/C turn on temperature		°C	28	24	32	22	38		The temperature value that A/C will start to operate. If Free Cooling will not be able to cool the room and the temperature reaches this set value, then A/C starts to run.
9	A/C turn off temperature		°C	24	18	26	20	36		After A/C has started to cool, if inside temperature falls to this set value then A/C stops.
10	Run A/C's, if No AC phase	ON / OFF		OFF			✓			If there is no mains, the system switches the A/Cs ON

11	**A/C1 – A/C2 Delta temperature (1)**		°C	5		1	10	This is the temperature difference between the start (ON) temperature of A/C1 and A/C2. This means that the start temperature of A/C2 is the start temperature of A/C1 + (Δt)
12	**Switch the A/C using timing (1)**	ON / OFF	Min.	120		120	240	This feature is used to operate the A/Cs in a shift work. A/C1 operates during the adjusted time then switches to A/C2. After the same duration the system switches to A/C1 again If both A/Cs exceed the settime on continuous operation , the system switches A/C units from active to passive. This feature ensures A/Cs operate equally and stable.

Start fan (in this case both fan A/C operates together)						The indoor-outdoor delta temperature value if FCS operates in mix mode
Device Parameters > New Parameters > Fan						

13	**Fan turn on temperature**		°C	22	15	25	15	25	The inside temperature for fan to start to operate. The fan starts to run if inside temperature reaches the set temperature provided that - Humidity value is lower than the setpoint - There is No dew point alarm - Delta (Δt) temperature is higher then 0.1 oC - Outside temperature is lower then set value (Out Temp High F/C Operation)
14	**Fan turn off temperature**		°C	28	24	32	22	38	The inside temperature for fan to stop to operate. While fan is operating and the inside temperature falls below this set temperature (meaning that the room is cool enough), then fan stops.
15	**Selection of Fan type**	DC / AC		DC	✔		✔		The fan type used in Free Cooling Sysytem
16	**Fan power type**	55 W, …, 380 W	W	190 W	✔		✔		

	Fan speed (Night)		%	100	20	100	20	100	The fan power type used in Free Cooling Sysytem. This is the maximum fan speed in percent (%) according to the used fan spec provided that FCS Working mode is selected as " Night" in Operation Section of GUI
	Fan speed (Daytime)		%	50	20	100	20	100	This is the maximum fan speed in percent (%) according to the used fan spec
17	**Indoor-outdoor delta temperature (ΔT)**		°C	2	2	5	2	5	ΔT is the temperature difference between inside and outside. The fan starts to run with minimum fan speed when inside temperature exceeds 0.1 0C the outside temperature (ΔT=0.1) and speeds up directly proportional to ΔT. Fan reaches its maximum speed at ΔT (set value). All the other conditions for fan to operate must be provided. (See "Fan Turn On Temperature")

18	Critical inside temp max fan speed, no AC	ON / OFF	°C	30	28 35	28 38	If there is no Mains and the inside temperature exceeds the critical level (defined in this feature), then the system operates fan at maximum speed.
19	A/C phase fail fan speed	HALF / MAX		HALF	✓	✓	This feature provides the option to select the fan speed to half if mains fails. Thus it ensures to extend the duration of the backup system
20	Fan with work the A/C mode	ON / OFF		OFF		✓	With this mode, after A/C started to run, according to indoor/outdoor temperature (ΔT), fan can run if it's desired
21	Fan Speed Unit LCD	%RPM / DECIMAL		% RPM		✓	The unit of fan speed shown on LCD could be selected as percent (%) or numeric (Dec).
22	Humidity Algorithm	ON / OFF		OFF		✓	This feature is to enable the adjusting the speed of the fan also according the humidity.Remember that the fan speed is related to temperature and humidity.

23	A/C Phase Fail Fan Off	ON / OFF		OFF			✓		If there is no Mains the system creates this alarm
	A/C Fan count (Quantity of AC fans)								The number of the fans. Necessary for the system to create correct numbers of communication parameters.
	Device Parameters > New Parameters > Mixed&Heater								
24	Mixed mode start temperature		°C	35	34	41	32	45	If the inside temperature exceeds this set temperature, the Mixed Mode starts and AC1&2 and fan operate together.
25	Mixed mode fan turn off temp	Set / Diff.	°C	32	22	35	22	42	In mixed mode, the temperature for fan to stop when it cools the room below this temperature value
26	Mixed mode A/C turn off temp		°C	25	24	32	20	36	If inside temperature exceeds Mixed Mode Start Temperature, A/Cs & fan run together to decrease inside temperature. While cooling inside this is the turn off temperature of A/C1. A/C2 turns off ΔT degrees before A/C1.
27	Heating method	A/C / Heater		A/C	✓		✓		The heater device is selected.
28	Heater turn on temperature		°C	10	2	10	2	10	The start temperature of the heater is adjusted.

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29	Heater turn off temperature		°C	16	14	18	14	18	The stop temperature of the heater is adjusted.
30	If two heater is used, Delta temperature (1)		°C	5			1	10	This is the temperature difference between the start (ON) temperature of the 1st heater and the 2nd heater.
	Device Parameters > New Parameters > Operation								
31	Fan off, outdoor temperature low	ON / OFF	°C	10			-20	10	If outside temperature falls below set value, operation of the fan and air flow stops.
32	Fan off, outdoor temperature high	ON / OFF	°C	45			40	60	If outside temperature exceeds to set value, operation of the fan and air flow stops.
33	Fan off, Maximum indoor humidity	ON / OFF	°C	85	80	95	50	95	If inside humidity exceeds the set value, operation of the fan and air flow stops. With this mode, inside humidity value is held between desired range which devices can work decently.

34	Fan OFF Paramater enable in mixed mode	ON / OFF		OFF		✓	This feature is to enable "Fan OFF" and change the Fan OFF value in mix mode. Spec (*1) in mixed mode. If this feature is selected (ON), this means that while in mixed mode, fan will not turn off at (*1), will turn off at (*2). *1 Device Parameters > New Parameters > Mixed&Heater > Mixed Mode Fan Turn OFF Temperature *2 Device Parameters > New Parameters > Fan > Fan Turn OFF Temperature
35	FCS Working mode	DAYTIME / NIGHT		NIGHT	✓	✓	To reduce the noise caused by the fan at night , "FCS Day&Night Mode " ensures the opportunity to decrease the fan speed determined in " Fan Speed (Night) " if "Night" mode is selected here.
36	Start of the night Stop of the night			20:00 08:00	✓ ✓	✓ ✓	The beginning and the end of the night is defined here.
37	A/C 1, A/C 2 type	STANDARD / INVERTER		INVERTER		✓	The types of Acs are defined .

38	Low batt alarm threshold		V	-44	-46	-42	-46	-42	"Low Battery Alarm Threshold" is adjusted at the factory to "-44 VDC" for supply voltage "-48 VDC" and adjusted to "22 VDC" supply voltage "24 VDC". If the voltage of the batteries falls down to this value, the system sends a "Low Battery Alarm" and stops the fan.
	Low batt alarm threshold (1)		V	+22	+21	+23	+21	+23	
39	High batt. alarm threshold		V	-54	-60	-54	-60	-54	"High Battery Alarm Threshold is adjusted at the factory to "-54 VDC" for supply voltage "-48 VDC", and adjusted to "27 VDC" for supply voltage "24 VDC". If the voltage of the batteries exceeds this value, the system sends " High Battery Alarm" and stops the fan.
	High batt. alarm threshold (1)		V	+27	+27	+30	+27	+30	
40	Low temp. alarm threshold		°C	8	4	12	4	12	The minimum inside temperature value is determined the system to send alarm signal, "Low Temperature Alarm"

This feature also needs an enabling in Device Parameters > New Parameters > Alarms > Low Temp Alarm (ON/OFF) |

41	High temp. alarm threshold		°C	35	25	35	25	40	The maximum inside temperature value is determined the system to send alarm signal, "High Temperature Alarm" This feature also needs an enabling in Device Parameters > New Parameters > Alarms > High Temp Alarm (ON/OFF)
42	Very High temp. alarm threshold		°C	40			35	45	The very high inside temperature value is determined the system to send alarm signal, "Very High Temperature Alarm" This feature also needs an enabling in Device Parameters > New Parameters > Alarms > Very High Temp Alarm (ON/OFF)
	Device Parameters > New Parameters > Alarms								
43	Low voltage alarm	ON / OFF		OFF	✓		✓		If the voltage of the batteries is lower than set value (*), system sends Low Voltage Alarm. * Device Parameters > New Parameters > Operation > Low Battery Alarm Threshold

44	High voltage alarm	ON / OFF		OFF	✓		If the voltage of the batteries is higher than set value (*), system sends Low Voltage Alarm. * Device Parameters > New Parameters > Operation > High Battery Alarm Threshold
45	Low temp. Alarm	ON / OFF		ON	✓	✓	If inside temperature falls below the set value (*), system sends "Low Temperature Alarm". * Device Parameters > New Parameters > Operation > Low Temp. Alarm Threshold
46	High temp. Alarm	ON / OFF		ON	✓	✓	If inside temperature exceeds the set value (*), system sends "High Temperature Alarm". * Device Parameters > New Parameters > Operation > High Temp. Alarm Threshold

47	**Very High temp. alarm**	ON / OFF		ON		✓	If inside temperature exceeds the set value (*), system sends " Very High Temp Alarm". * Device Parameters > New Parameters > Operation > Very High Temp. Alarm Threshold
48	**Max humidity alarm**	ON / OFF		ON	✓	✓	If inside humidity exceeds the set value (*), system sends Max Humidity Alarm. * Device Parameters > New Parameters > Operation > Maximum Humidity (Fan OFF)
49	**Dew-point alarm**	ON / OFF		OFF	✓	✓	Dew point is calculated according to the instant temperature and humidity values. If this calculation results a dew point, then system creates this alarm
50	**Show FCS alarms on LCD**	ON / OFF		ON	✓	✓	When this mode is ON, user can see all alarms on the screen.

51	Filter pressure alarm	OFF						If filter pressure exceeds the set threshold value, system sends Filter pressure alarm.
	Filter pressure alarm threshold	ON	Pa	500	200 500	200 500		Filter pressure alarm threshold (Refer Section 4.6.1)
52	Poor heating alarm	ON / OFF		OFF	✓	✓		This feature is to enable sending "Poor heating alarm" in case of the conditions are met in Section 4.6.1 Alarms > Poor heating alarm
53	Poor cooling alarm	ON / OFF		OFF	✓	✓		This feature is to enable sending "Poor cooling alarm" in case of the conditions are met in Section 4.6.1. Alarms > Poor cooling alarm
54	Fan power alarm	ON / OFF		OFF	✓	✓		This feature is to enable sending "Fan Power Alarm" in case of the conditions are met in Section 4.6.1 Alarms > Fan Power Alarm
55	Fan speed (RPM) alarm	ON / OFF		OFF	✓	✓		This feature is to enable sending "Fan speed (RPM) alarm" in case of the conditions are met in Section 4.6.1 Alarms > Fan speed (RPM)
56	A/C1 phase power alarm	ON / OFF		OFF	✓	✓		In case of absence of A/C1' mains, system sends A/C1 Phase Power Alarm.

57	A/C2 phase power alarm ON all alarms off all alarms	ON / OFF		OFF	✓	✓	In case of absence of A/C1' mains, system sends A/C1 Phase Power Alarm. Used to switch all alarms ON or OFF position in one thick
	Device Parameters > New Parameters > Date & Time, NMS Settings						
58	**Date & Time, NMS Settings**						Date&Time settings are adjusted here.
59	**Automatic Summer-Winter Time**						
60	**Send the NMS data in case of event & alarm**	ON / OFF		ON		✓	This feature is to enable sending NMS data in case of event & alarm occur .
61	**The period of the sending NMS data**		Minute	1440		✓	The period of the sending NMS data is defined.
	Device Parameters > New Parameters > Generator Control	The following features of "Diesel Generator" are designed especially for free cooling in OFF-GRID SITES also fits every type of sites. Refer to explanation and scheme 10-11 in Section 4.6.2.1					
62	**DG Control**	ACTIVE / PASSIVE		PASSIVE	✓	✓	Enables Diesel Generator option.
63	**DG Operation Time**		hh:mm:ss	04:00:00	✓	✓	If it is not expected the generator to operate too much in off-grid sites because of the fuel consumption, the operation time of the generator could be limited.

64	DG Start Low Battery (DC) Threshold		V	-44	✓	✓	Generator runs to charge the batteries if hte voltage falls down to threshold level . When it reaches the required level, generator stops
65	DG Start Low Temperature Threshold		°C	8	✓	✓	If inside temperature falls down to threshold level, generator starts and runs A/C (for heating).
66	DG Start High Temperature Threshold		°C	40	✓	✓	If inside temperature exceeds the threshold level in off-grid sites , generator starts and runs A/C.

Note:

(1) This feature is used for + 24 VDC supply value and two phase systems.

DIESEL GENERATOR OPTION (OFF GRID SITES)

In many off-grid sites with diesel generator, there is a common principle of operating the cooling system algorithm shown as flow chart in scheme 7 -8 .

1. If the battery voltage level decreases below a threshold level then DG starts for to charge the batteries. DG stops when the required battery voltage level is achived (Turn ON DG If Battery Voltage (VDC) is lower than…)
2. If the inside temperature level exceeds a threshold level then DG starts operate the air conditioners. DG stops when the required inside temperature level is achived. (Turn ON DG If Temperature is higher than …)
3. If the inside temperature level decreases below a threshold level then DG starts operate the air conditioners for heating. DG stops when the required inside temperature level is achived. (Turn ON DG If Temperature is lower than…)
4. If it is intended to limit the DG operation time because of the fuel consumption then the operation time can be adjusted with "DG Non-stop Running Time" command
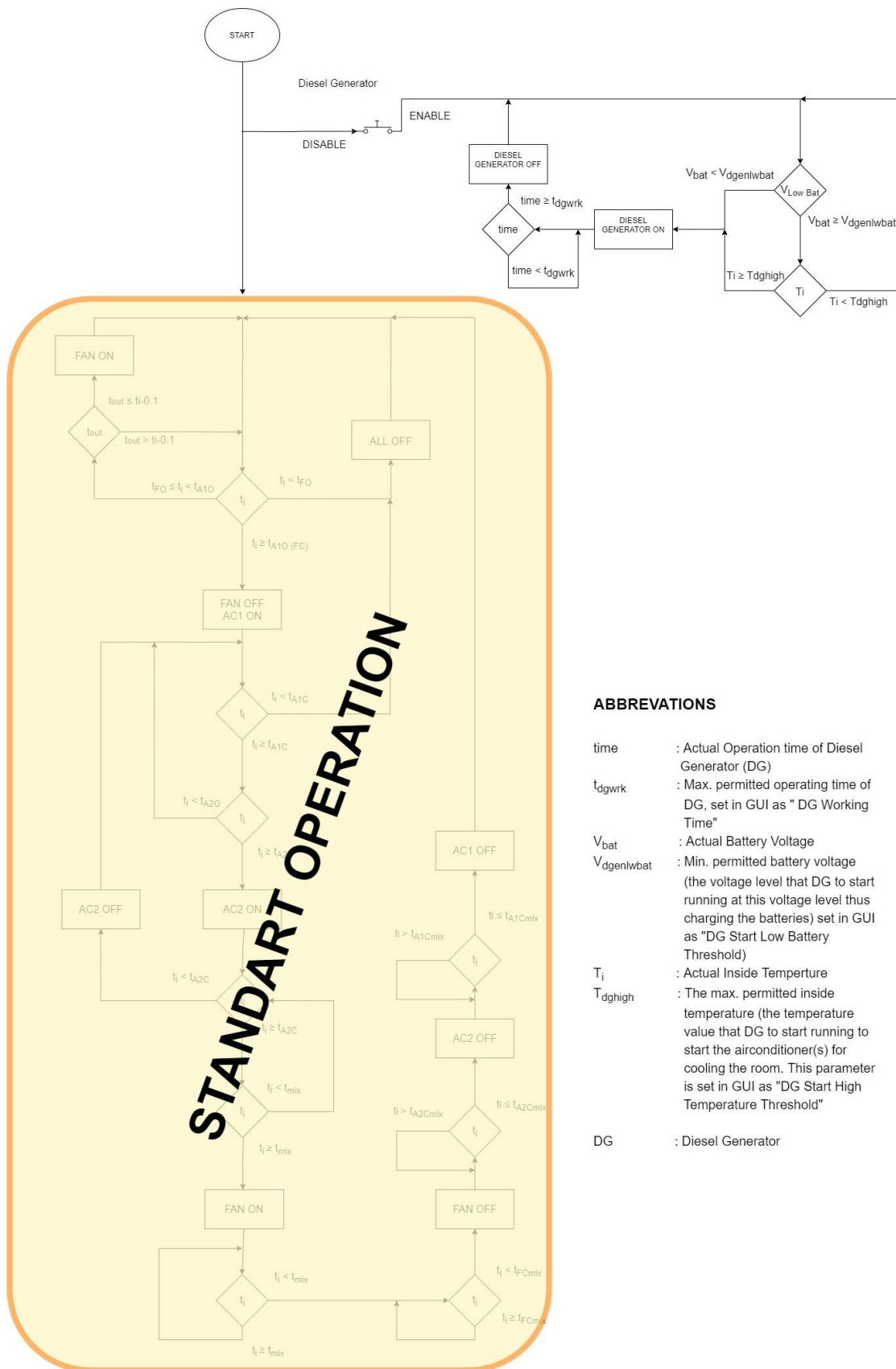
Scheme 7 : Operation Algorithm of FCS in Off-Grid Sites with Diesel Generator

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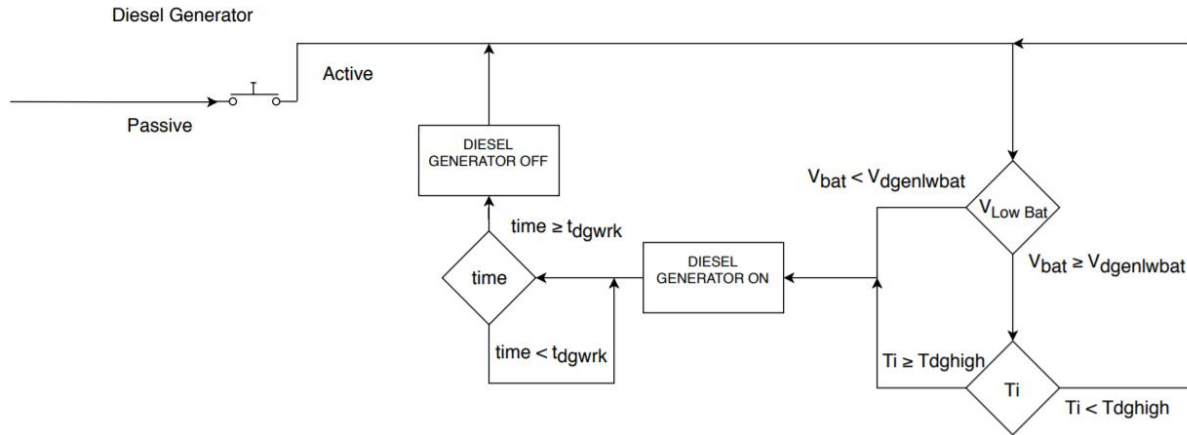
Scheme 8 : Operation Algorithm of FCS in Off-Grid Sites with Diesel Generator (Detailed)

Abbreviations

time   : Actual Operation time of Diesel Generator (DG)

tdgwrk   : Max. permitted operating time of DG, set in GUI as " DG Working Time"

Vbat   : Actual Battery Voltage

Vdgenlwbat   : Min. permitted battery voltage(the voltage level that DG to start running at this voltage level thus charging the batteries) set in GUI as "DG Start Low Battery   Threshold)

Ti   : Actual Inside Temperture

Tdghigh   : The max. permitted inside temperature (the temperature value that DG to start running to start the airconditioner(s) for cooling the room. This parameter is set in GUI as "DG Start High Temperature Threshold"

DG   : Diesel Generator

5. PERIODIC MAINTENANCE

The only part of the free cooling system needs to be periodically replaced is the filter. In the site visit, other parts including fan should be checked.

Timeframe : It depends on the environmental and climate conditions of the site's location.

The site visit may be planned related to the filter cloggines alarm received from digital differential pressure sensor or analog pressure switch.

5.1. Filter Replacement

1. Turn OFF free cooling fan by switching to air conditioners.
2. Remove the filter cover by unscewing screws as shown below.
3. Slide out two filters . Be careful, it may cause injury if it drops down.
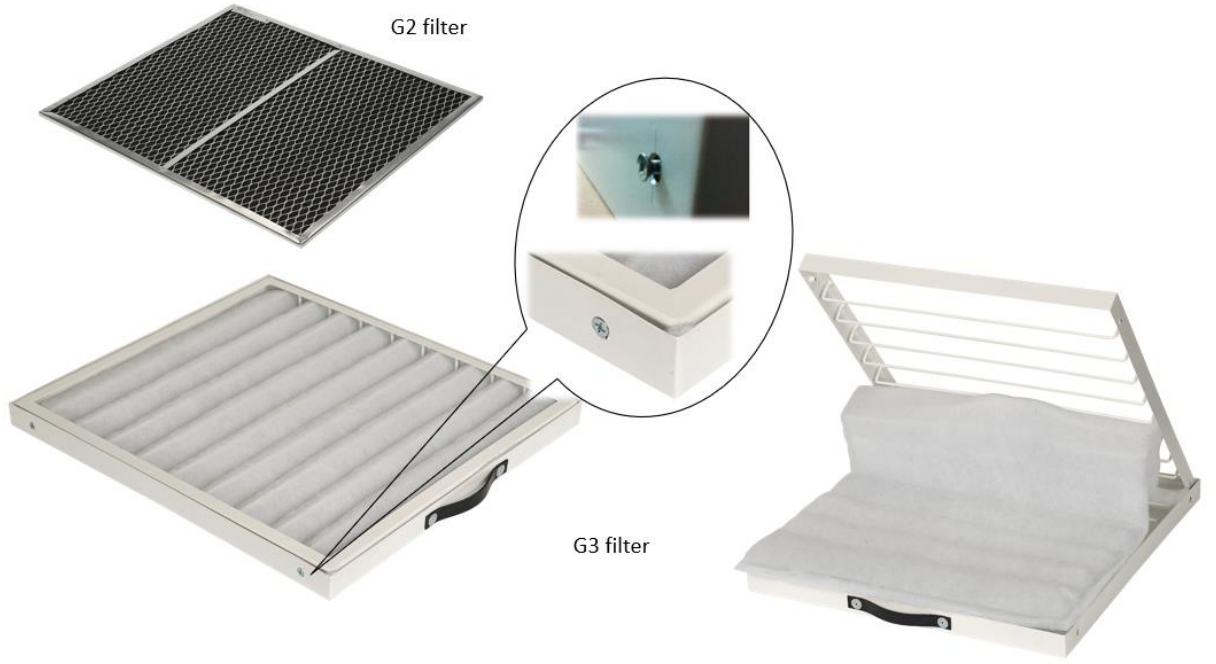

4. After removing the filters ,

    The G2 filter,
-   If you have a spare, replace with new one,
-   If you don't have, wash it and get it dried well. If you place it before well dried, water drops may cause defect on fan motor and other equipments in the room.

    The G3 filter

-   Unscrew 4 screws located on the corners of the frame
-   Seperate two interlaced wings
-   Change the fiber
-   Close the wings by interlacing well
-   Screw 4 screws
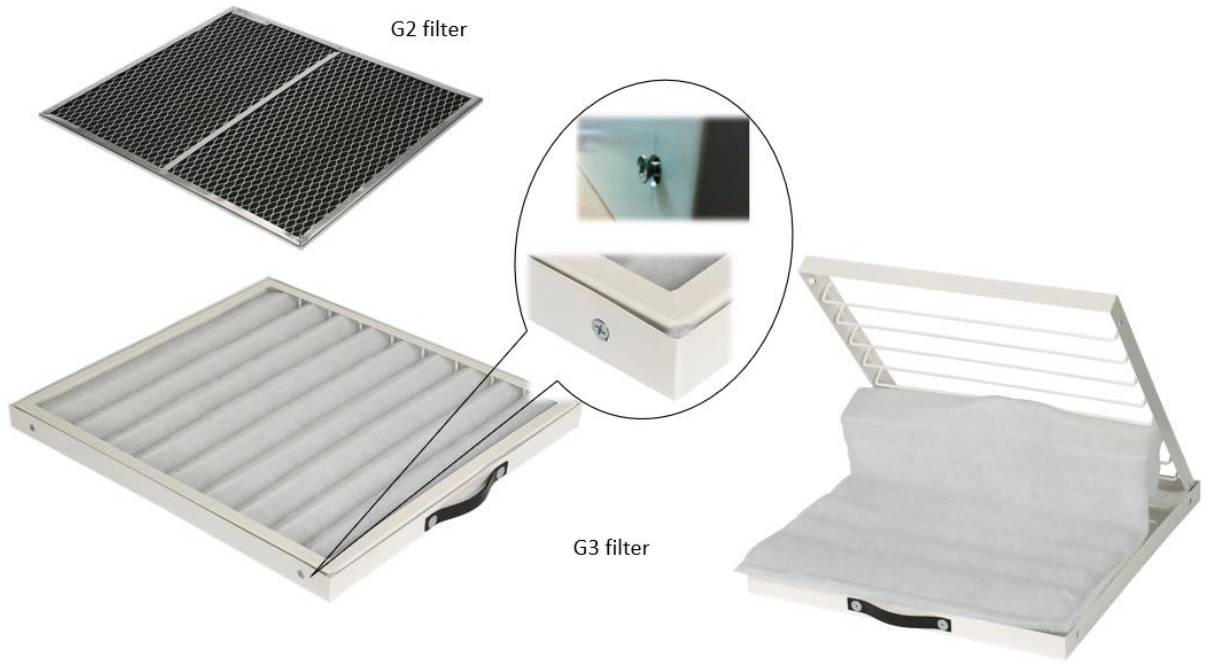
5. Place two filters in the slot.
6. Replace the filter cover and fix by screwing the screws.

5.2. Filter Replacement for VANDAL PROOF TYPE FAN BOXES

Paying attention to followings, unscrew the philips head screws indicated with arrows.
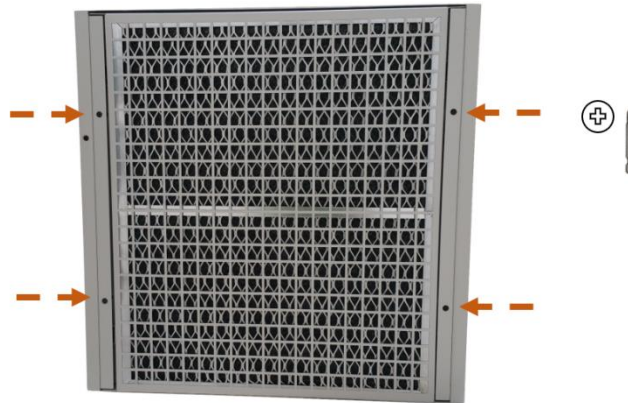
1. The screws are positioned on the left/right of the outer hole axis② when fully fastened.

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2. When it is started to be unscrewed, the head of the screw moves to the axis of the outer hole①.
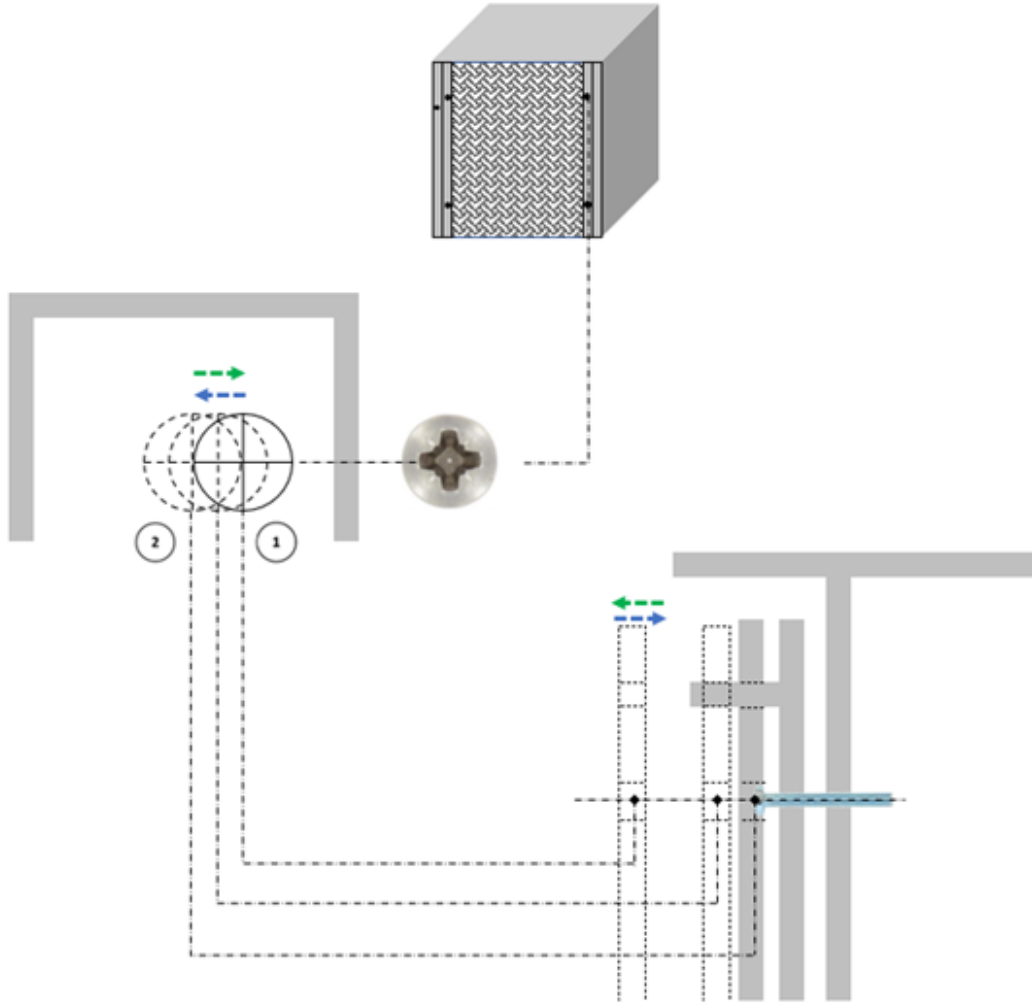
3. While unscrewing, it is advised not to completely detached the screw from its hole for the easiness of the next steps. Stop unscrewing when the *filter fastening bar* gets free to be taken out easily.
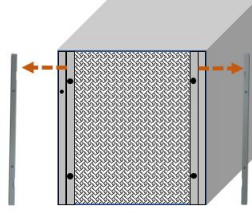
4. Slide the filter fastening bars right/left and remove them.

5. Remove the filter plate grill. Be carefull not to drop otherwise heavy parts may damage and you may get injured.

6. After removing the filters ,

    The G2 filter,

    -   If you have a spare, replace with new one,
    -   If you don't have, wash it and get it dried well. If you place it before well dried, water drops may cause defect on fan motor and other equipments in the room.

    The G3 filter

    -   Unscrew 4 screws located on the corners of the frame
    -   Seperate two interlaced wings
    -   Change the fiber
    -   Close the wings by interlacing well
    -   Screw 4 screws

G2 filter

G3 filter

7. Place two filters in the slot.
8. Replace filters back performing vice versa the steps you have done for removing the filters.
9. The Replacement Order of the Filters:
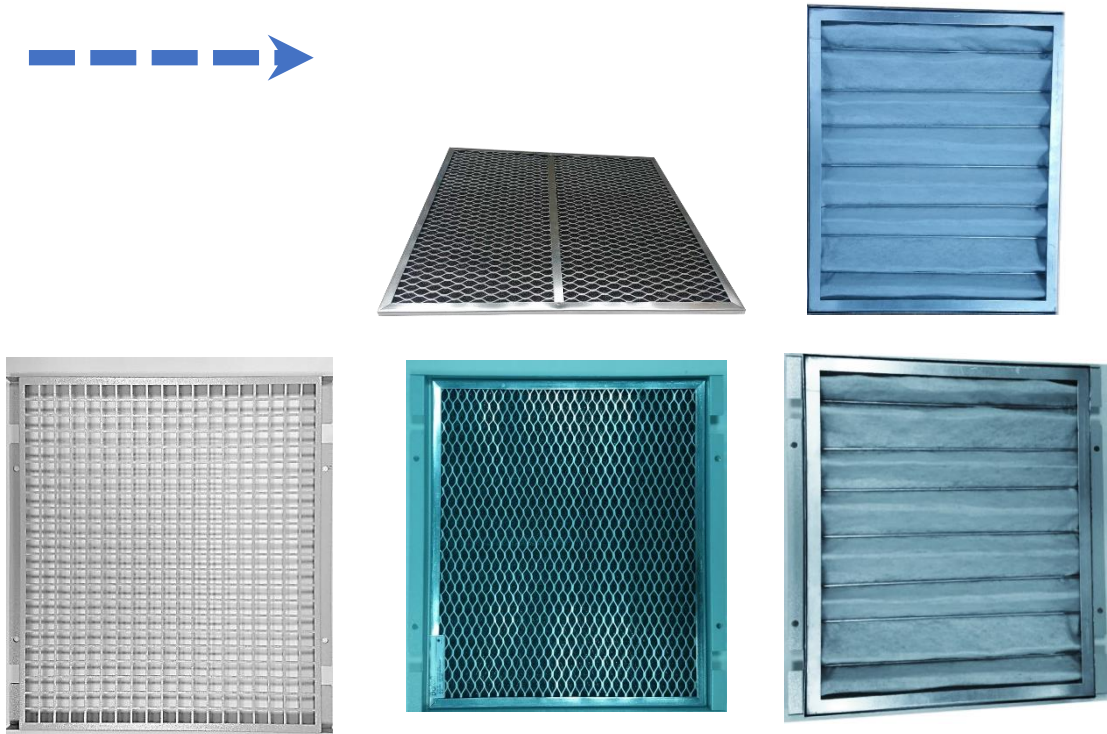
6. MAINTENANCE - REPAIR

! SWITCH OFF the energy/electricity of fan box and control unit before starting maintenance or repair! It may cause mortal injuries, please be sure that energy/electricity is SWITCHED OFF

6.1. Removing Fan (Motor)

1. Remove the air inlet grill and the cable protection cap by unscrewing the screws lightened with yellow arrows. ①
2. Lay down the air inlet grill and disconnect the connectors water float sensor (optional) ②
3. Unscrew two screws on the fan plate and remove them③
4. Slide out the fan plate until half④
5. Before releasing the fan plate, disconnect the connectors located at the bottom left of the plate.⑤
6. Push the security pin located inside the fan plate 2-3 mm upward by bending forward your hand as shown with yellow arrow⑥
7. Please be carefull not to damage the fan flange located under the fan. Any strike may damage the precise distance between the fan and the flange.This may cause important defects and damages.Release the fan plate from the slot with two persons.⑦
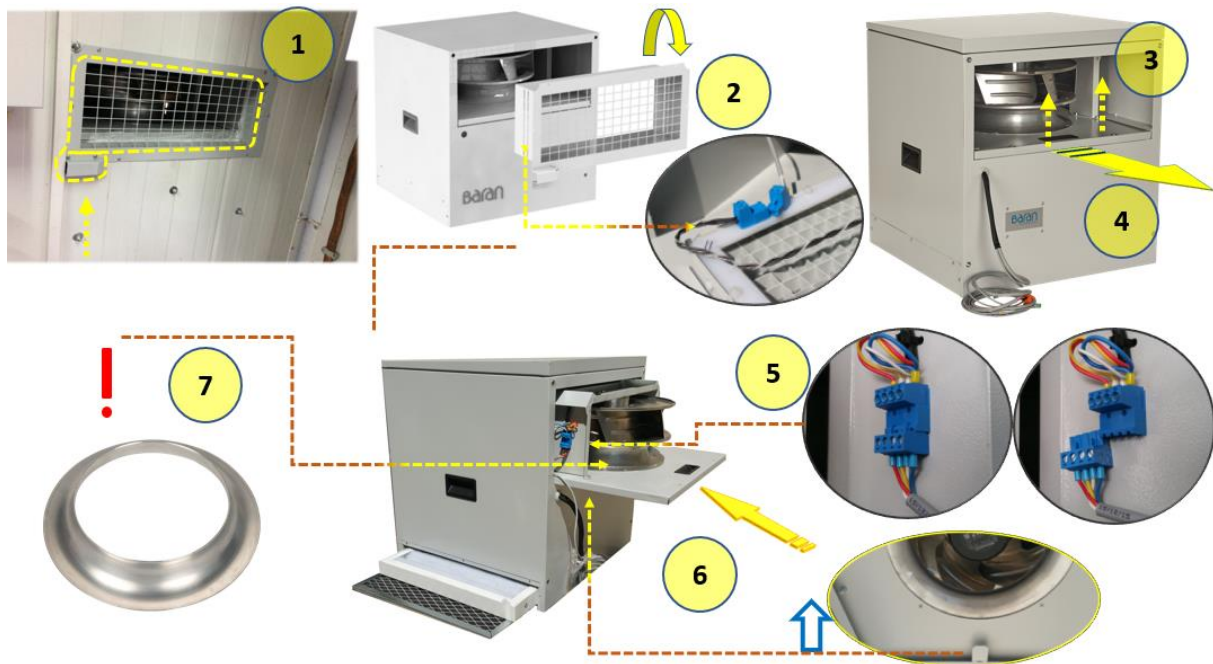
8. Leave the fan plate smoothly on a flat place. Fan staddle is fixed to fan plate with 6 bolts-nuts (3 left,3 right). Seperate the fan staddle and the fan plate by removing the bolts.⑧

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9. Remove the fan cable and the connector from the fan staddle, release fan by unscewing 4 screws at the top of the staddle. ⑨
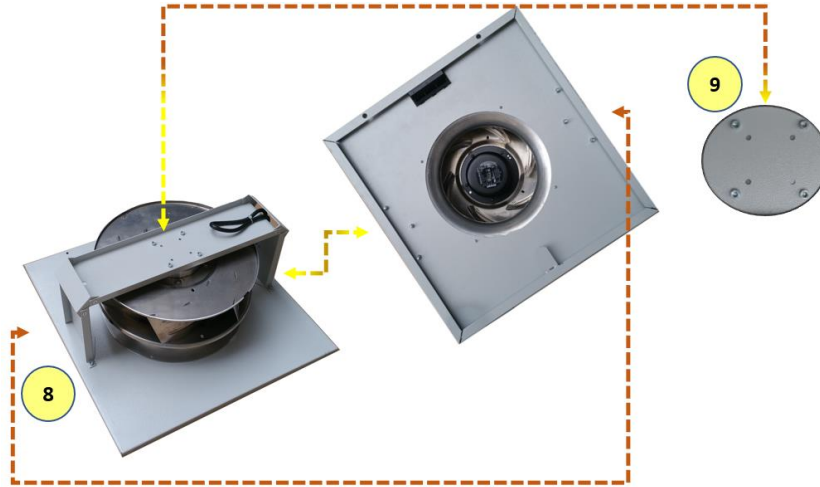
6.2. Removing The Digital Differential Pressure Sensor / Analog Pressure Switch

In outdoor models, they can be reached via two ways whether from top or bottom.

Reaching from the top;

- First perform the steps ①②③④⑤⑥⑦ in Removing Fan (Motor)

Reaching from the bottom;

- Remove the filters as in filter replacement
-
Now, proceed as follows,

For Removing The **Digital Differential Pressure Sensor**

10. Pressure sensor is placed on a plate located at the left inside the fan box. Check the location of the pressure sensor⑩
11. Remove the tube of the pipe labelled as "OUT" smoothly. Don't forget that the pipe labelled as "IN" should always be empty.⑪
12. Disconnect the connector⑫
13. Remove the digital difference pressure sensor by unscrewing the screws, 2 right and 2 left.⑬

For Removing The **Analog Pressure Switch**

10. Pressure switch is placed on a plate located at the left inside the fan box. Check the location of the pressure sensor.⑩
11. Remove the tube of the bottom (grey) pipe smoothly.The upper pipe should always be empty⑪

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12. To disconnect the cable connection of the pressure switch, unscrew the screw on the top cover, release cover and remove the spade terminals of the cable carefully.⑫
13. Remove the pressure switch by unscrewing the screw on the corners.⑬
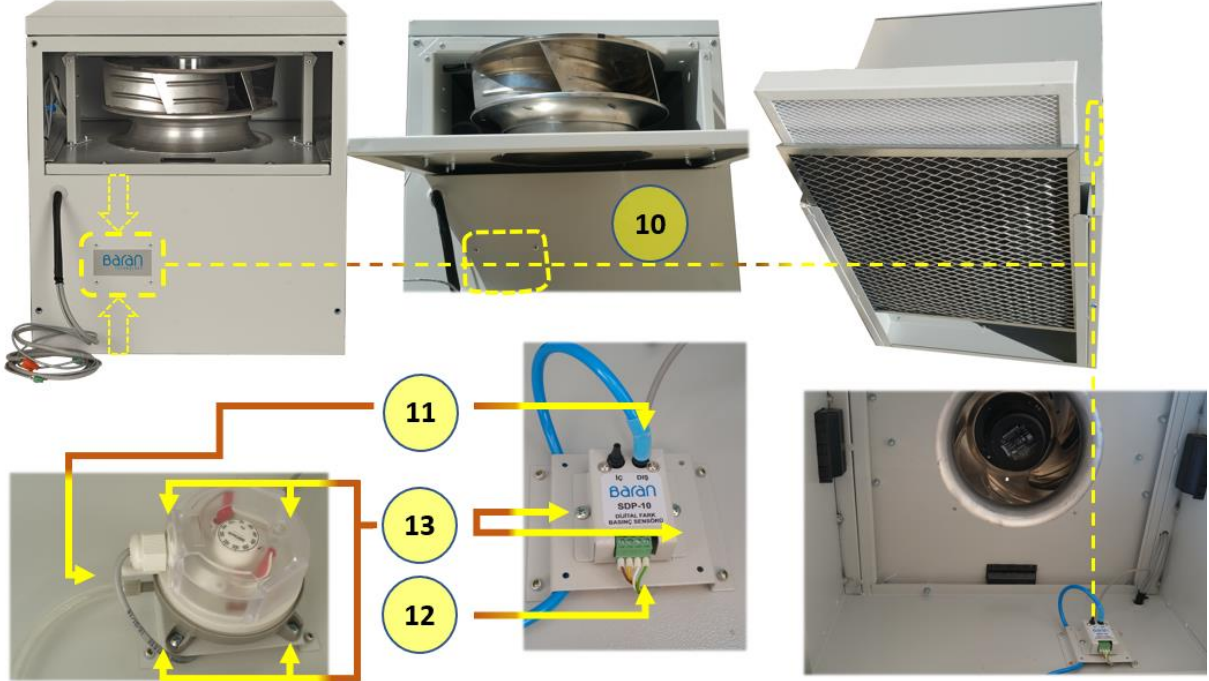
7. TROUBLESHOOTING

In Free Cooling Systems, there are information, error, alarm and fault leds(indicators) on control unit, GUI and web interface.

The descriptions of the colored leds and finding the solution (if they point an error or a faul) are explained below.

Information Leds

INFO LEDS	LED	COLOR	DESCRIPTION
AIR CONDITIONER 1	🟢	GREEN	Air conditioner 1 is running.
	⚪	NOT LIGHTING	Air conditioner 1 is not running.
AIR CONDITIONER 2	🟢	GREEN	Air conditioner 2 is running.
	⚪	NOT LIGHTING	Air conditioner 2 is not running.
DC FAN	🟢	GREEN	DC Fan is running.
	⚪	NOT LIGHTING	DC Fan is not running.
AC FAN	🟢	GREEN	AC Fan is running.
	⚪	NOT LIGHTING	AC Fan is not running.
FAN HALF SPEED	🟠	ORANGE	Fan is running at half speed because Mains is lost. (The feature in Fan Menu " If Mains Lost, Operate Fan at Max/Half Speed" must have been selected as HALF for this led to be active."
	⚪	NOT LIGHTING	Fan is running at max. speed.
DIESEL GENERATOR	🟢	GREEN	Diesel Generator is running.
	⚪	NOT LIGHTING	Diesel Generator is not running.

Error And Fault Leds

ERROR AND FAULT LEDS	LED	IDENTIFYING THE PROBLEM	SOLUTION		
GENERAL ALARM	🔴 RED	This led lights up if any of the 15 standart alarms gets active.	First it should be defined which alarm causes the general alarm led to light up.This may be defined in 3 different ways. Then the problem of the real alarm should be fixed.	**Control Unit LCD** : The source of the alarm could be seen on the 4th line of LCD.(For this, "Show Alarms On LCD" feature in Alarm Menu of GUI/Web Interface shoul have been enabled. Otherwise, alarms can't be seen on LCD. **GUI/Web Interface**: In the main screen, it is indicated with RED led.	The Alarms in Alarm menu of GUI/Web Interface should NOT be Disabled for this feature to be active.
	⚪ NOT LIGHTING	No Alarm			
FILTER ALARM	🔴 RED	Filter cloggness is above the threshold level	Filter needs to be replaced or cleaned.		
	⚪ NOT LIGHTING	Filter cloggness is below the threshold level.			
FAN ALERT	🔴 RED	Fan hız alarmı. Fanın çalışması için tüm şartlar olmasına rağmen fan dönmüyor. Fan speed alarm. The fan is not turning in spite of every condition for fan to is present.	"Clear Instant Alarms " command is performed in Tools menu of GUI/Web Interface.	If the alarm is not cleared and the fan is not turning call the technical service of Baran Technology.	
	⚪ NOT LIGHTING	No problem related to fan speed.			
ERROR AND	LED	IDENTIFYING THE PROBLEM	SOLUTION		

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FAULT LEDS					
SILENT MODE	GREEN	"Night Mode is active. Fan speed is decreased to Night Speed			
	NOT LIGHTING	Fan is running at daytime speed.			
MAINS 1	GREEN	The Mains of the A/C1 (air conditioner control module 1) is present.			
	RED	The Mains of the A/C1 (air conditioner control module 1) is lost	Breakers and other components of Mains should be checked	If there is no problem with Mains, then air conditioner control module might be defected	
MAINS 2	GREEN	The Mains of the A/C2 (air conditioner control module 2) is present.			
	RED	The Mains of the A/C2 (air conditioner control module 2) is lost	Breakers and other components of Mains should be checked	If there is no problem with Mains, then air conditioner control module might be defected	

8. SPARE PARTS

No	Spare Part No	Name	Brand	Model	Note	Picture
1	SPDB001	Panel Board (Metal)	Baran	MDB-10		
2	SPDB002	Free Cooling Control Module (Unit)	Baran	FCCMV07		
3	SPDB003	Air Conditioner Control Module	Baran	ACCMV10		
4	SPDB004	InsideTemperature and Humidity Sensor (with cable)	Baran	STH-10	Cable Length : 1 m 4x0,22 LiYY Cable	
5	SPDB005	Outside Temperature Sensor (with cable)	Baran	STX-10	Cable Length : 1,5 m 2x0,22 Li2YY Cable	
6	SPDB006	Circuit Breaker (Panel Board)	Siemens	FSW16A	10 A	
7	SPDB007	Circuit Breaker (Panel Board)	Siemens	FSW01A	01 A	
8	SPDB008	InsideTemperature and Humidity Sensor Cable (with conn.)	Baran	STHC-900	Cable Length : 9 m 4x0,22 LiYY Cable	
9	SPDB009	Outside Temperature Sensor Cable (with conn.)	Baran	STXC-900	Cable Length : 8,5 m 2x0,22 Li2YY Cable	
10	SPB001	Digital Differential Pressure Sensor Tube	EuroFlex	SDP-H140	Diameter :6mm x 4 mm Length :1,4 m	
11	SPB002	Fan Box	Baran	FBX208CO/ VP		
12	SPB003	Air Inlet Grill	Baran	ATI-35		
13	SPB004	Air Outlet Hood	Baran	ATO-30 / VP		

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14	SPB005	G2 Filter (Black)	MGT	BR-KF0-450/535/10-G2	
15	SPB006	G3 Filter Fiber Changable (White)	Başak	FG3C-30	
16	SPB007	Water Float Sensor	N/A	N/A	
17	SPB008	Changable Filter Fiber	Baran	FBR-30	90 cm x 55 cm
18	SPB009	Digital Differential Pressure Sensor (with cable)	Baran	SDP-10	Cable Length:65 cm 4x0,22 LiYY Cable
19	SPB010	Fan	GP Motor	RB3E355/120C	
20	SPB011	Fan Control Module	Baran	DFM12	For AC fan
21	SPB012	Fan Control Module	Baran	DFM12	For DC fan
22	SPB013	Fan Flange	Baran	FLNG-C30	
23	SPB014	Handle (Big)	Atos Kilit	TK09.35	
24	SPB015	Handle (Small)	Atos Kilit	TK19.35	
25	SPB016	Digital Differential Pressure Sensor Cable (with conn.)	Baran	SDP-C65	Cable Length :65 cm 4x0,22 LiYY Cable
26	SPB017	Pako Lock	N/A	N/A	
27	SPB018	Membran	Baran	PLSTK-10	
28	SPB019	Louver	Baran	LVR-30	
29	SPB020	Conic bolt(Yellow)	N/A	N/A	
30	SPB021	Square Grid	N/A	N/A	
31	SPB022	Aluminium Label (ID)	Baran	APLT-30	
32	SPB023	Fan Box Legs	N/A	N/A	

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9. TERMS OF WARRANTY

FCS device is not covered by warranty in the following cases

The valid of this guaranty is 2 years

Wrong connection failures

Any damage in case of a lightning strike

Any damage in case of any ground failure

Any damage when mains voltage and DC supply voltage are not in the operation range

Any damage that may occur as a result of exposure to throwing, hitting, crushing etc.

When service and maintenance performed by unauthorized persons

When the mounting is made by unauthorized persons

Opening the cover of the device when it's still under the warranty