GRAIN MANAGEMENT SYSTEM

WS2-GM
Grain Management System

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Table of Contents

List of Figures

List of Tables

Revision Notes

Preliminary Release – February 2017

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1. Overview

The new generation of CMC web server WS2-GM for grain management system was designed to monitor condition of grain in grain storage bins. The CMC grain management system helps to maintain high quality of grain and prevent losses of grain during a long-term storage. System can be easily monitored through web based HMI. User gets notifications when grain condition crosses limits set by user. One system can be built from combination of thermocouple and digital grain temperature sensors. The maximum number of sensors varies based on the selected types of sensors. System can monitor up to 256 bins. Any type of CMC sensor can be connected to the system to improve the monitoring process. The CMC system is intrinsically safe system while using certified bus converter mBC081/83.

When using digital cables only, up to 2048 digital grain temperature cables can be installed on one system. Each digital cable can have up to 21 sensors with length up to 125 FT. When using thermocouple temperature sensors the number of cables depends on types of used thermocouple cable, fully loaded system can read more than 40.000 thermocouple sensors.

The web interface allows a customer to create a system which will correspond with their real facility. Graphical part of the interface makes it very easy to monitor temperature in each bin as well as hazard monitoring. Customer can monitor temperature in multiple points of the bin. Based on the data customer can create graphs of the temperature over a time.

WS2-GM collects data from up to 8 bus converters using RS485 network. Each bus converter can collect data from up to 32 sensors including thermo-couple cards mTC002 and digital grain cable controller card mDC001. Each mTC002 can collect data from up to 168 thermo-couple sensors. Each mDC001 can collect data from up to 8 grain cables and each cable can contain up to 21 sensors. Customer can choose what kind of sensors the system should be built from. For example regular mTS012 temperature sensor which can be used to measure ambient temperature will replace one mDC001 along with up to 168 grain cable temperature sensors.

The system doesn't allow to set alarms and warnings for each sensor in the grain temperature cable. The Hazard Monitoring System is created by setting thresholds for alarms and warnings for each bin only. The system monitors maximum and average values of sensors in the whole bin. Alarms and warnings can be also sent to a customer by email.

On each additional CMC sensor which will be assigned to the system (for example temperature probe mTS012) can be set alarms. This creates variety of different setting and different monitoring points to create the best suitable solution for each facility.

Bus Converters are available for both Industrial/Commercial and Intrinsically Safe hazardous area environments. The wiring system is fully specified and includes field interconnect components. In addition to the web server, the Interface has a Modbus TCP/IP Slave interface for connection to remote PLC and computer systems. Modbus TCP/IP works in bidirectional way – web server can be controlled through the interfaces. This creates limitation on number of units which can connect to the web server through the interface. The number of units which can be connected is limited to 1.

The new generation of web server is able to record and maintain data from all sensors for maximum of two years when system fully loaded with 10 min logging interval.

Caution: This device contains electronic components that can be damaged by static discharge. Proper ESD handling procedures should be observed at all times.

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2. Description of Connections, Switches and Indicators

Figure 1 – Connector, Indicators and Buttons

Table 1: WS2 Connector Description

ID	Label	Description of Connection
POWER SUPPLY		
A	24 VDC	Apply SELV/PELV 24 VDC (min 1.5A), see specs in section 5
B,C	GND	Ground
MODBUS 1		
D	24 VDC	Power connection for the mBC08x Bus converter
E	DATA +	Data High connection for the mBC08x Bus Converters
F	SHIELD/EARTH	Earth Ground connection for the mBC08x Bus Converters
G	DATA -	Data Low connection for the mBC08x Bus converter
H	GND	Ground connection for the mBC08x Bus converter
MODBUS 2		
I	24 VDC	Power connection for the mBC08x Bus converter
J	DATA +	Data High connection for the mBC08x Bus Converters
K	SHIELD/EARTH	Earth Ground connection for the mBC08x Bus Converters
L	DATA -	Data Low connection for the mBC08x Bus converter
M	GND	Ground connection for the mBC08x Bus converter
SWITCHES		
N	ACK	Acknowledge all alarms conditions, turns off Horn and Alarm relays and stops email alerts until a new warning, alarm, or system event occurs FOR ADDITIONAL FUNCTIONALITY SEE “BUTTONS” TABLE BELOW
O	COM	Common connection for ACK and Silence switches
P	SILENCE	Turns off Horn relay if currently active FOR ADDITIONAL FUNCTIONALITY SEE “BUTTONS” TABLE BELOW
ALARM CONTROL		
Q	NC	Normally Closed connection for the Alarm relay
R	COM	Common connection for the Alarm relay
S	NO	Normally Open connection for Alarm relay
HORN CONTROL		
T	NO	Normally Open connection for Horn relay
U	COM	Common connection for Horn relay
V	NC	Normally Closed connection for Horn relay

ETHERNET		
X	Ethernet	Ethernet connection
TERMINATION		
W	TERMINATION	Terminate mBC08x connection OFF ← • → ON Note: Each device at the end of RS485 Modbus line has to have the termination switch on.

INDICATORS

POWER - Indicator of WS2 power

LINK - Indicator of data flow on RS485 line (Modbus). May light continuously, depending on poll rate

STATUS - Indicates problem on the RS485 line

BUTTONS

Combinations of the buttons and their commands

B1	B2	B3	ACK	SILENCE	COMMAND
PRESSED	PRESSED	PRESSED			POWER OFF
PRESSED		PRESSED			REBOOT
PRESSED	PRESSED				STOP
PRESSED					START
	PRESSED	PRESSED			ACQUIRE
	PRESSED				TEST ALM
			PRESSED		ACK
				PRESSED	SILENCE
		PRESSED			IP DEFAULT RECOVERY

Commands functionality description:

Power Off: Turns off web server.

Reboot: Reboots web server.

Stop: Stops Modbus service and disconnects Modbus outputs.

Start: Starts Modbus service and connects Modbus outputs.

Acquire: Sends command to all connected bus converters to acquire connected sensors.

Test ALM: In case Modbus service is running the alarm relay will turn on for 5s. In case the Modbus service is off the relay will turn on and off in 1s intervals five times. For test from interface see section Alarm and Horn Test

Test Horn: In case Modbus service is running the horn relay will turn on for 5s. In case the Modbus service is off the relay will turn on and off in 1s intervals five times. For test from interface see section 4.10.5.1 Alarm and Horn Test

ACK: Acknowledges all alarm conditions, turns off Horn and Alarm relays and stops email alerts until a new warning, alarm, or system event occurs.

SILENCE: Turns off the Horn relay if currently active

IP Recovery: Sets factory default IP address 192.168.1.111

NOTE:

ACK, SILENCE and ACQUIRE buttons have to be hold for at least 1s to function all other buttons have to be hold for 5s

3. External Connections

The WS2 provides connections for mBC08x bus converters, Ethernet, input switches and output alarm.

Caution: This device contains electronic components that can be damaged by static discharge. Proper ESD handling procedures should be observed at all times.

3.1 Ethernet Connection

The WS2 is connected to a single computer or a Local Area Network using standard CAT5 cable.

Figure 2 - Ethernet connection

3.2 Alarm Outputs

Two dry contact relay outputs are provided. They are configured separately and work independently. Although not limited to these uses, one is nominally intended as an alarm output for sensing by a remote system, while the other is intended to operate a horn or Sonalert®. See Section 6: Specifications for contact ratings.

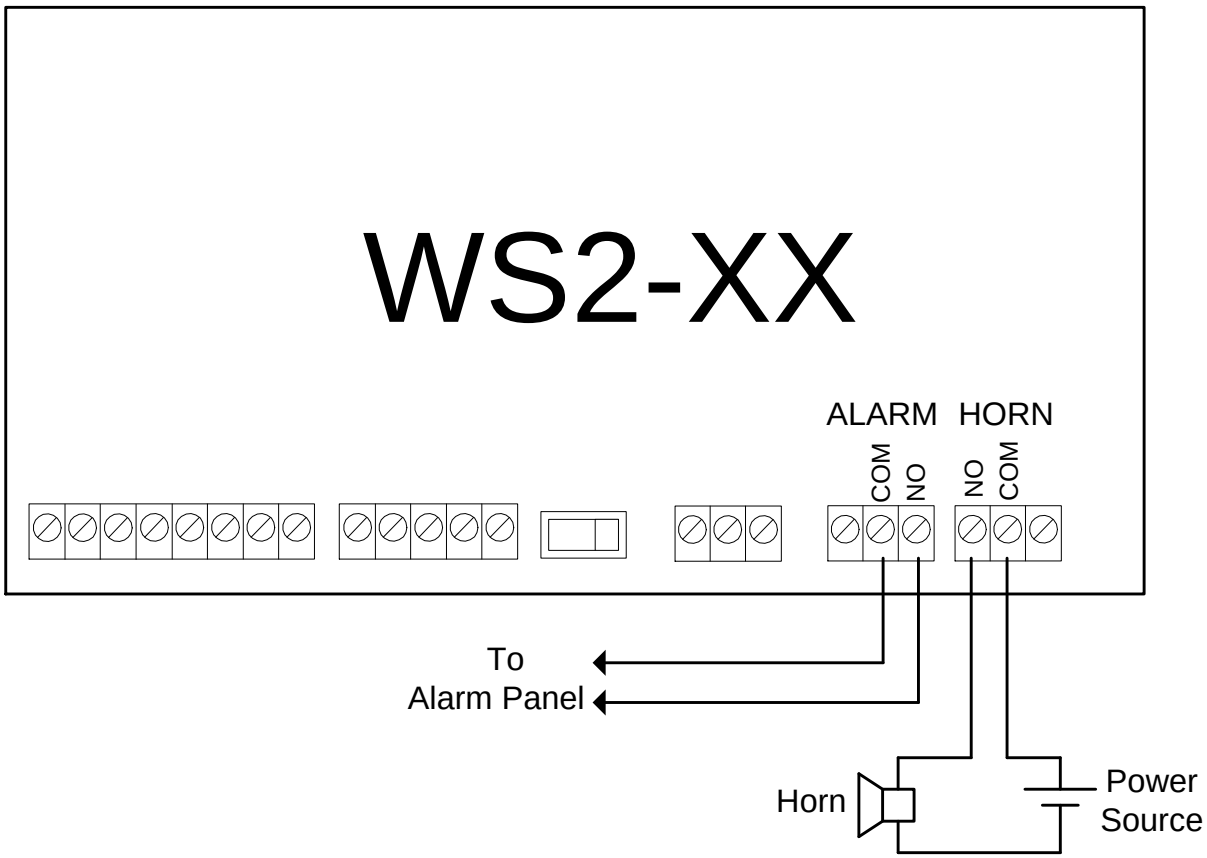


Figure 3 - Suggested Alarm Connection

3.3 Input Switches

Connections are provided to allow the user to acknowledge alarms and silence the horn remotely. The ACK (Alarm Acknowledge) input turns off both relays and suppresses email messages pertaining to any existing warnings, alarms, and system events. The SILENCE (Silence Horn) input turns off the Horn Contact relay only, and does not affect the email system.

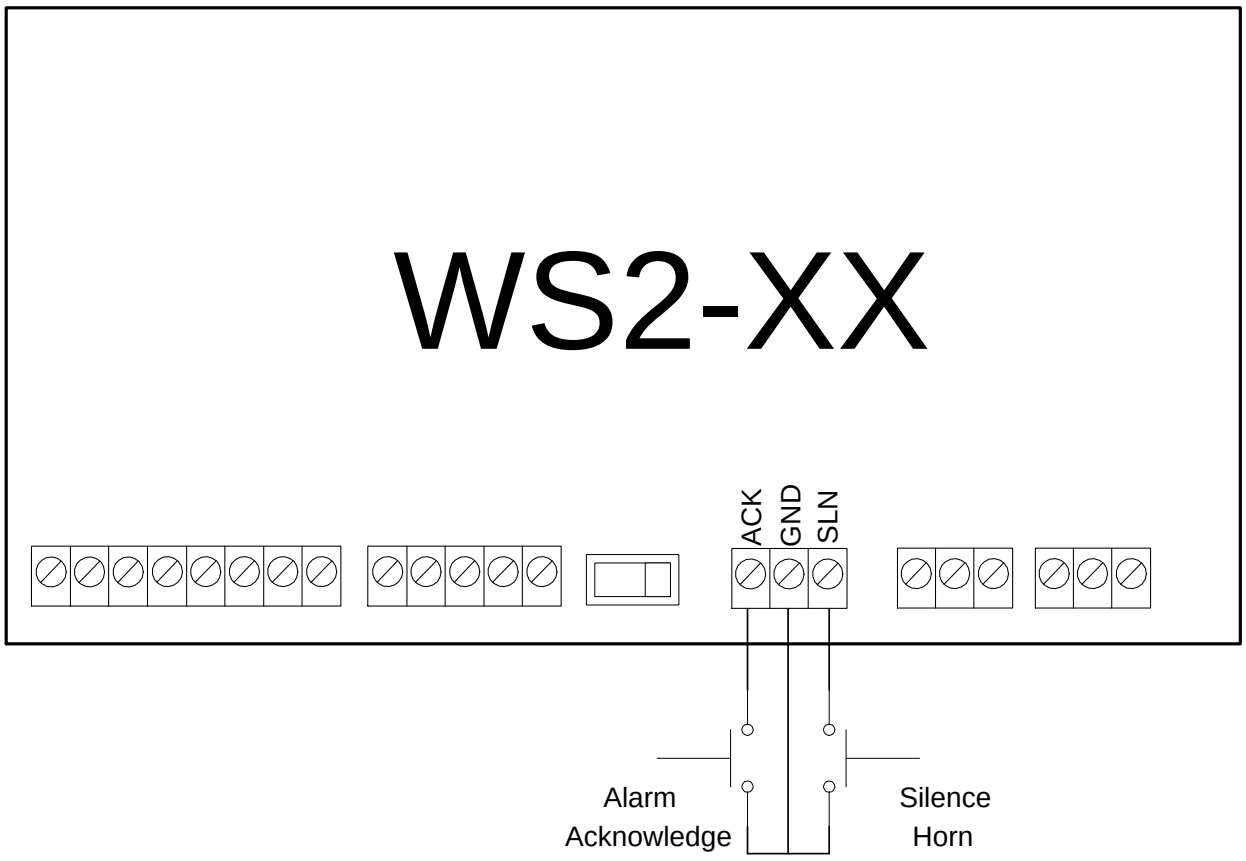
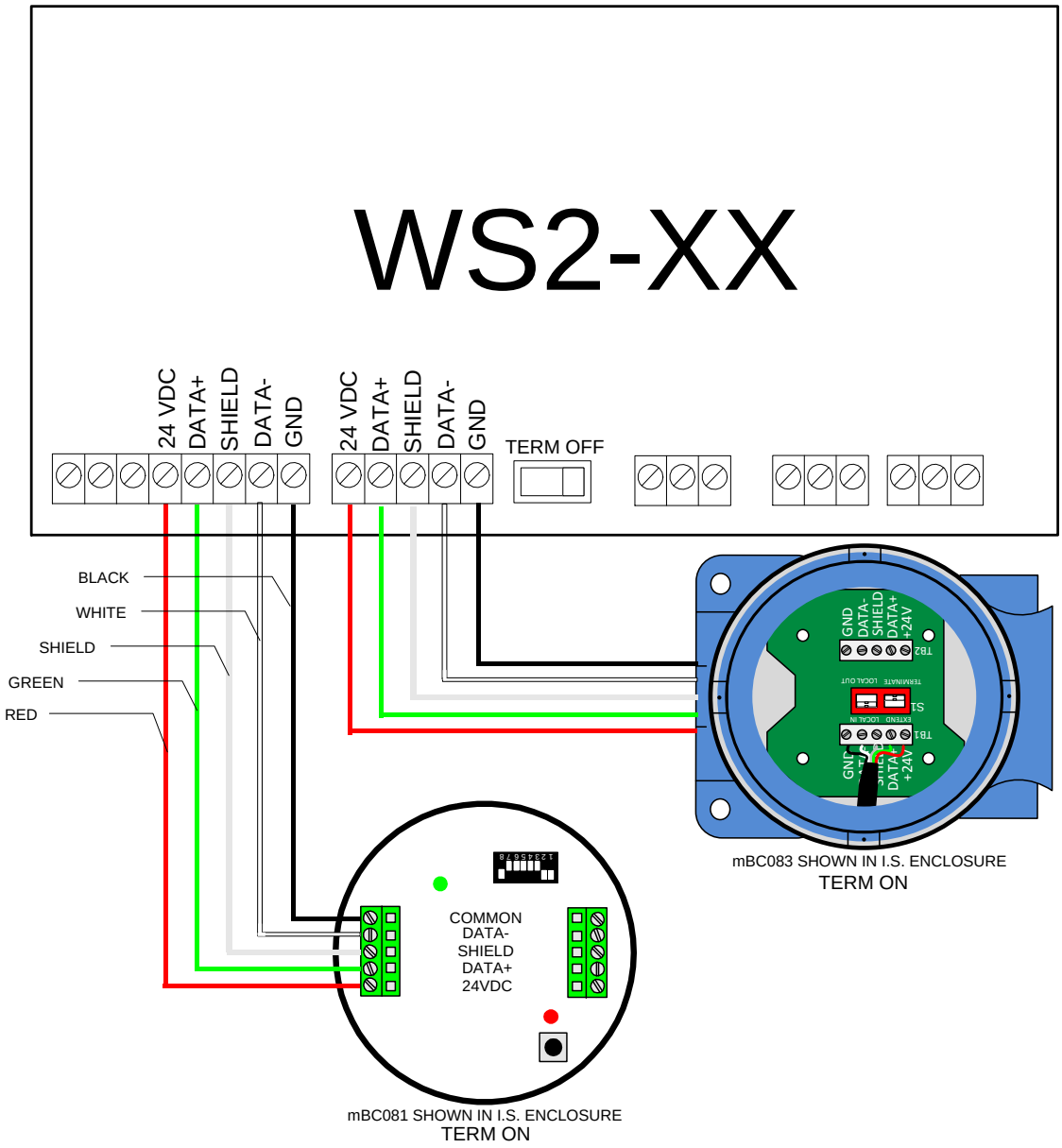


Figure 4 - User Input connections

3.4 Bus Converters

mBC08x bus converters are to be connected using 4-conductor shielded cable as shown in Figure 5.



WIRE COLORS SHOWN ARE FOR BELDEN 8723 - 2 PAIR 22 AWG CABLING
USE WIRE SIZE CALCULATOR AT www.cmciel.com TO DETERMINE REQUIRED WIRE SIZE
CABLE SHIELD SHOULD BE CONNECTED TO GROUND ONLY AT THIS INTERFACE

TERMINATION SWITCH ON BUS CONVERTERS SHOULD BE ON AS THEY ARE THE LAST PHYSICAL DEVICES ON THE RS485 LINE, TERMINATION SWITCH ON WEB SERVER SHOULD BE OFF

Figure 5 - Bus Converter Connections

Note: Only Bus Converters with their address switches set to an address between 1 and 16 will be detected by the WS2.

3.5 DC Power Connection

As and power supply source for WS2 must be used SELV or PELV power supply with output +24 VDC to meet requirements for intrinsically safe bus converters which are powered from the web server. CMC recommends using power supply P/N *DRP-24V48W1AZ.* Always follow instructions provided by the manufacturer of the particular power supply to achieve proper installation.

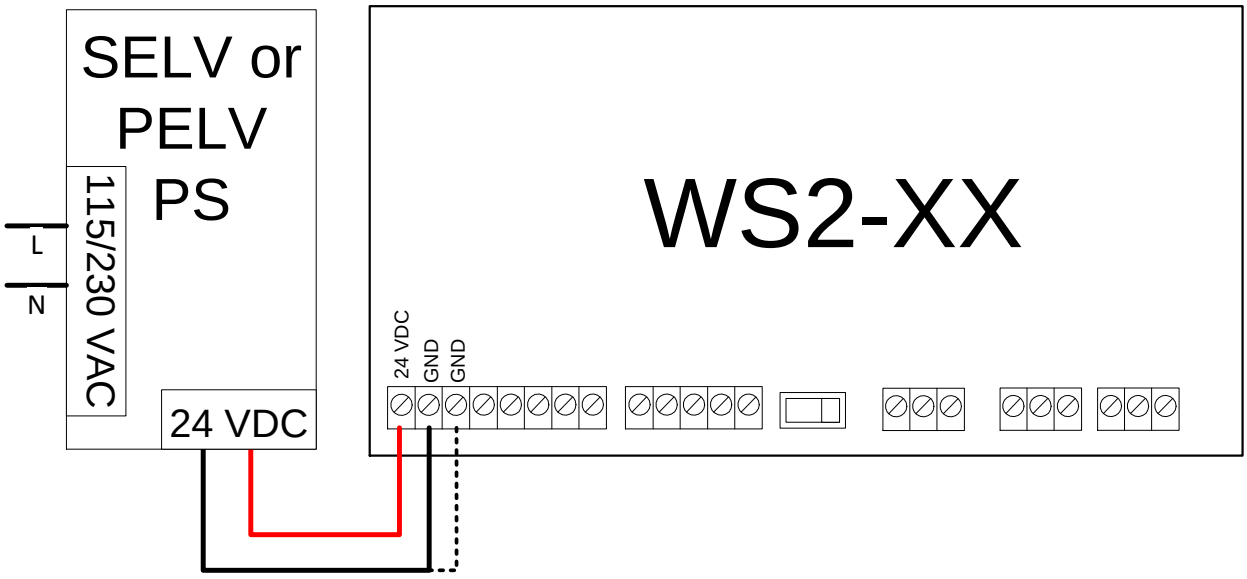


Figure 6 - DC Power Connections

3.5.1 Disconnecting power

When power is disconnected from the web server, it will maintain certain level of power for couple minutes. This is thanks to big capacitors installed on the input for the power supply. These big capacitors are also a reason for a relatively big current (around 2 A) during startup.

Reason for such a behavior is to protect the database. Web server is constantly writing data into its internal hard drive. In case there is a power outage and the web server would drop the power immediately in the middle of record saving, the database will become corrupted. The capacitors provide enough power for the web server to finish the record. Decreasing voltage on the capacitors will create an interrupt which will cause the web server to finish the last record and not to start a new one.

If the **power** is disconnected for some maintenance or installation reasons the web server **should be disconnected** from the power **for at least 5 minutes** to let the capacitors fully discharge. **Otherwise it won't start up**. Unit should be always powered down before disconnecting the power from it. To power the unit down all three buttons on the top side of the web server have to be pressed down for at least 5 seconds. For more information see chapter 2 Description of Connections, Switches and Indicators, section Buttons.

4. Web Server

The web server WS2 provides interface for displaying, configuring alarms and logging the process values being monitored.

4.1 IP Address

The default IP address of the WS2 is 192.168.1.111. When you type 192.168.1.111 into the address bar of your Internet browser, the WS2 will display the login screen. Configuration of the Interface, including the desired IP address, is performed after logging in.

4.2 Login

There is factory default login and password for the first login:

LOGIN – cmcadmin

PASSWORD – P@ssw0rd

Administrators should change these default IDs and passwords during initial configuration of the Interface, and as often thereafter as deemed necessary. Note that login IDs and passwords are case-sensitive.

4.3 Users

5 different types of users can be chosen, each with different set of rules.

4.3.1 System Administrator

All possible rights

4.3.2 IT Administrator

Host Configuration rights, no alarm acknowledgment, no system setup, user rights and settings view

4.3.3 Configuration

Bins configuration only

4.3.4 Basic Plus

Alarms can be acknowledged, no configuration allowed

4.3.5 Basic

Only for observation

4.4 Logging Out

Administrators and users are automatically logged out of the Interface when the browser window containing the Interface is closed.

4.5 Password Reset

When password was forgotten, CMC Industrial Electronics has to be contacted to provide confirmation code for password reset. MAC address of the web server has to be obtained before contacting CMC. CMC will provide confirmation code based on the provided MAC address. Customer can then generate login and password based on this confirmation code.

To obtain the MAC address, enter "/index.php" after your IP address in web browser so the whole address will look like this example: *http://192.168.1.111/index.php*; or click on "System" sign on top of any page on the web server. Following page is going to appear, Figure 8.

On this page the MAC address can be obtained. CMC will then provide the confirmation code which will be entered on the same page. After entering the confirmation code new login and password will be generated. This login and password will be used in regular login page, user will be then asked to enter current password which will be the generated password and then create a new one.

Figure 7: Access to MAC Address link

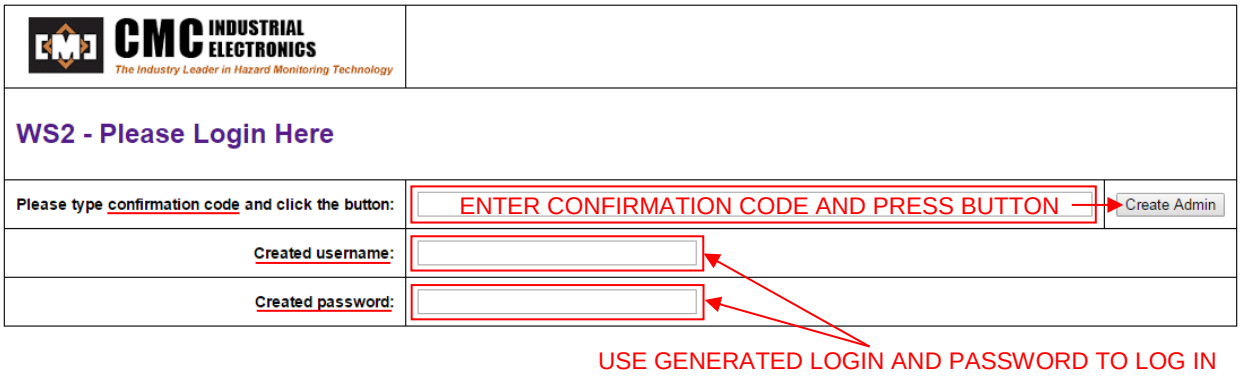


Figure 8: Forgotten Password, MAC Address, New Login and Password

4.6 Dashboard/Tanks

To show dashboard with all setup bins click on Dashboard button or Dashboard -> Tanks in the dropdown menu.

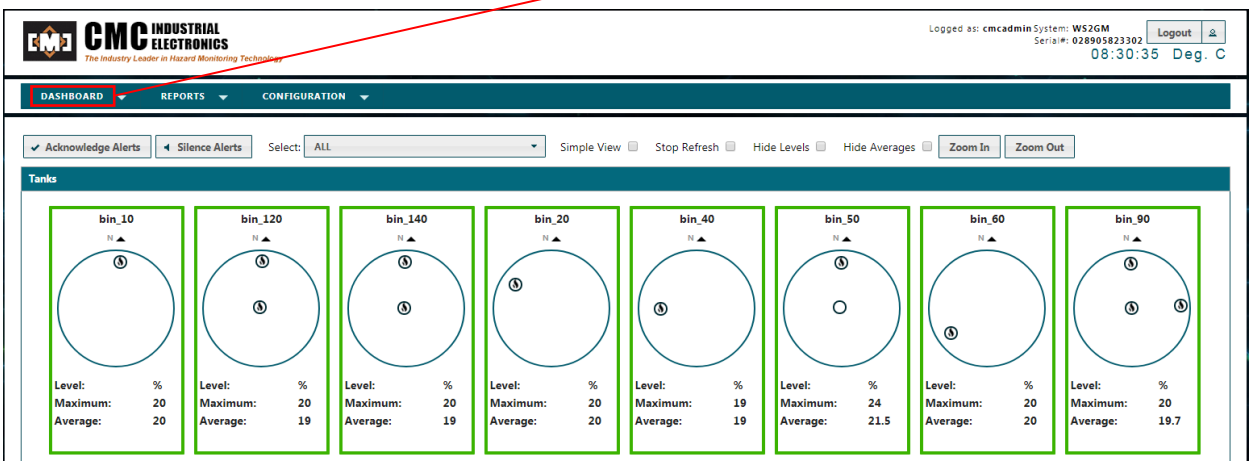


Figure 9 – Dashboard

Each tank on the dashboard shows name of the tank, grain level, maximum and average temperature, active cables and north indicator.

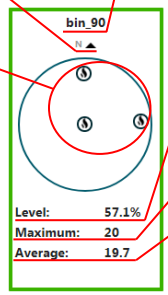


Figure 10: Tank Description

If cursor is placed above any active cable, window with maximum temperature on the cable will appear, see Fig 11.

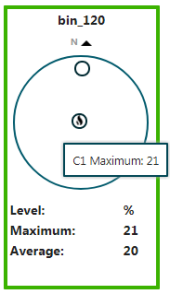


Figure 11: Cursor Maximum Value on Cable

When clicked on any active cable, window with the top view of bin where this cable is located will appear. On the right side of the bin will be level chart with measured overall temperatures in the bin or values of sensors which are bond to the bin, see Fig 12.

Figure 12: Bin Top View

4.6.1 Tank Table View

When clicked on any tank name, all assigned cells will be displayed in Tank Table View, see Fig 14.

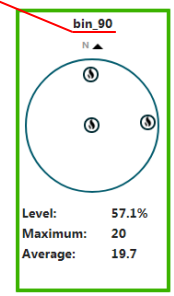


Figure 13: Bin View Access

4.6.1.1 Bin Data Representation

The tank table view is divided into four sections.

First section indicates the name of a bin, level and shows sensors which are assigned to the bin, see Fig 14.

Figure 14: Tank Name and Tank Sensors

The second section allows user to select which bin should be presented. The bin can be selected from a drop down menu as indicated in Fig 15. Another thing in the second section is the **bin level**. The bin level can be manually set by slider which can be dragged by mouse from 0-100%. The level will be calculated to fit in between the cells so the actual set level usually won't match the level which was selected by the user.

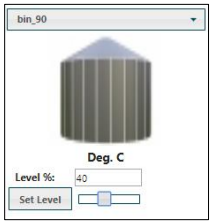


Figure 15: Bin Selection and Bin Level Manual Setup

The third part shows the cables in the bin with the real time temperatures on the sensors. Each cable has 21 sensors in this case. Each green cell represents one temperature sensor in the cable. User can also see temperatures related to certain level of the bin, certain cable in the bin or temperatures related to the whole bin. These data are represented by the blue rectangles described in the Fig 16. Each blue rectangle represents certain calculation. The type of calculation can be chosen by customer using radio button below the picture of bin with cables in the Tank Table View. The selection of calculations is on Fig 17.

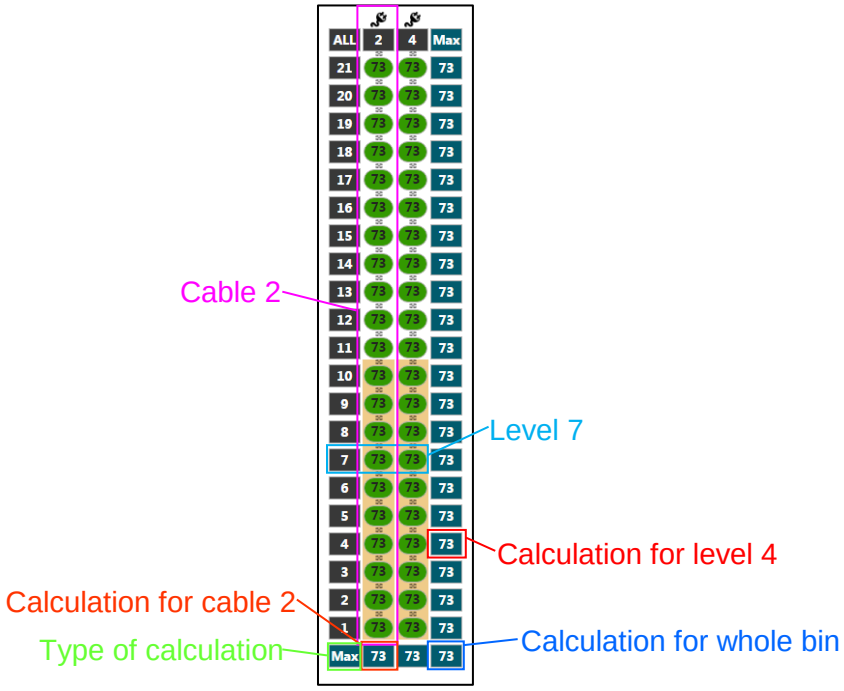


Figure 16: Grain Cable Sensors in Tank Table View

Figure 17: Selection of Calculation Types

Fourth section is section with graphical representation of the measured values. The values which should be presented in graph are selected simply by clicking on the cell which should be shown. User can select sensor cell or any of the calculated cell as is the calculation for whole bin, whole cable or whole level.

When user chooses a type of calculation the blue rectangles will immediately change to represent desired values.

User can select from following calculations, description follows:

- Maximum – Maximum shows the highest temperature at the time in level, cable and bin
- Average – Average shows average temperature at the time in level, cable and bin
- Rate of Rise –TBD
- Deviation –TBD
- Minimum – Minimum shows the lowest temperature at the time in level, cable and bin
- None – If None radio button is selected no data will be presented in the calculation rectangles

On the top part of Tank Table View is shown level of the grain. In the same section will be also shown regular CMC sensors which might be assigned to the bin. Level and one of the sensors in Tank Table View is shown on Fig 13. Assigning of sensors to bin is described in section TBD

Figure 18: Level of Grain in Bin and Assigned Temp Sensor

The level of grain is calculated based on temperature difference between the grain and rest of the bin. This level can be also set manually on the right side of the Tank Table View where is a quick view of the selected bin. Picture of the quick bin view is in Fig 14. On this part of Tank Table View is name of selected bin and used units for temperature representation which is set in section 4.11.3 System Backup, Recent Alerts and Archive Settings.

When clicked on the level or sensor field, graph of it will be shown below the picture of sensors, same graph as described in following text and on Fig 13.

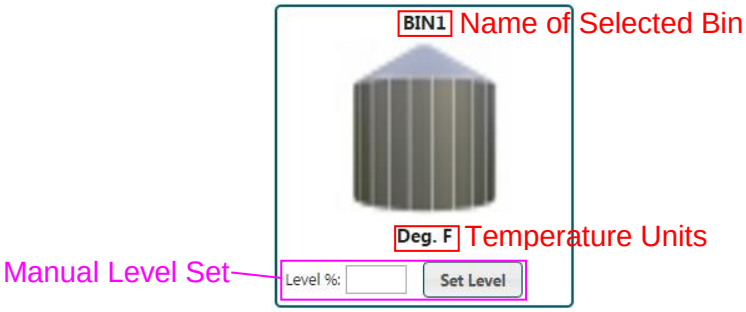


Figure 19: Quick View of Selected Bin

Each assigned cell is shown with its value in a real time. When clicked on any cell, chart of temperature over time will be displayed below the picture of cells, Fig 16. Time frame which can be displayed on the chart is up to 72 hours. Besides of temperature values from each cell (green cell), temperature in each level or temperature in each cable can be shown. These fields are the blue ones on the right side and on the bottom of the bin. Customer can choose if shown temperature will represent Maximum, Average, Rate of Rise, Deviation or Minimum in certain level or cable. This options can be selected by radio buttons below the sensors, as is on Fig 12. TBC

Figure 20

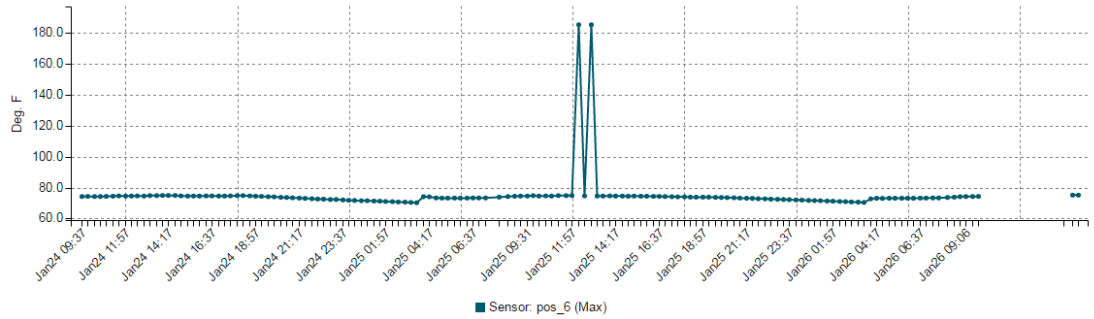

Deg. F
180.0
160.0
140.0
120.0
100.0
80.0
60.0
Jan24 09:37
Jan24 11:57
Jan24 14:17
Jan24 16:37
Jan24 18:57
Jan24 21:17
Jan24 23:37
Jan25 01:57
Jan25 04:17
Jan25 06:37
Jan25 09:31
Jan25 11:57
Jan25 14:17
Jan25 16:37
Jan25 18:57
Jan25 21:17
Jan25 23:37
Jan26 01:57
Jan26 04:17
Jan26 06:37
Jan26 09:06
Sensor: pos_6 (Max)

Figure 21

4.7 Sensor Network View

On “Sensor Network View” page is summarization of condition on whole hazard monitoring system. Status on all connected bus converters can be seen as well as all sensors connected to the network. To see “Sensor Network View” page, click on “Sensor Network View” button.

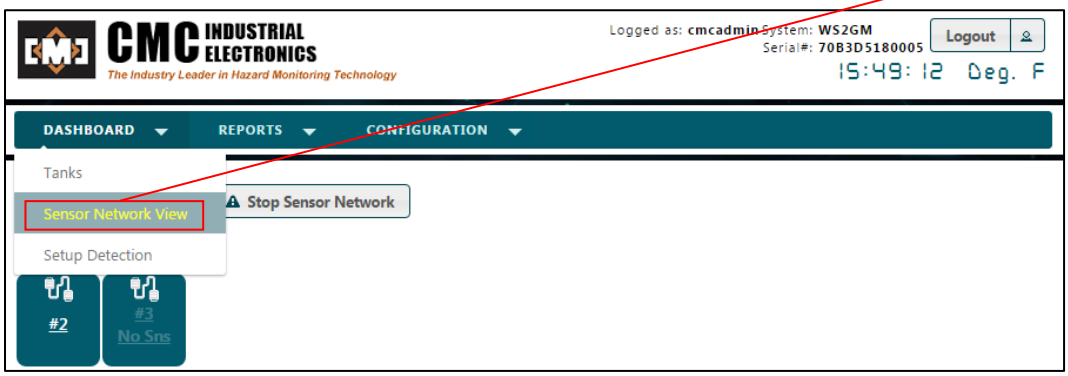


Figure 22: Sensor Network View Access

4.7.1 Modbus Network Control

Both terminals where the bus converters can be connected can be controlled by user. On the top of the page are two buttons, “Start Sensor Network” and “Stop Sensor Network”. By those buttons the sensor network can be activated or disabled. Indication of active Modbus terminal is red LED diode which is installed between the 2 Modbus connectors. If the inputs are activated the red LED will be on.

4.7.2 Bus converter status

On the next section of the page are shown bus converters and their statuses. Status of bus converter is shown in real time on each bus converters icon. When there is another status than “online” the status will be written below number of bus converter and it will be blinking. On following picture is shown 8 bus converters, two online (3, 8), one in fault condition (2) and 5 offline (1, 4, 5, 6, 7).

Following statuses of bus converter can be seen:

- *Online;*
- *Offline;*
- *Bus Data Shorted Low;*
- *Bus Data Shorted High;*
- *No Sensor Present;*
- *Bus Power Overload;*
- *Excessive Bus Error;*
- *Sensor Bus Fault;*
- *Sensor Table Overflow;*
- *Unsupported Sensor Detected;*

- *In Acquire;*
- *RAM Fault;*
- *Parameter Table Fault;*
- *Firmware Fault*.

For further information see manual for mBC081/83.

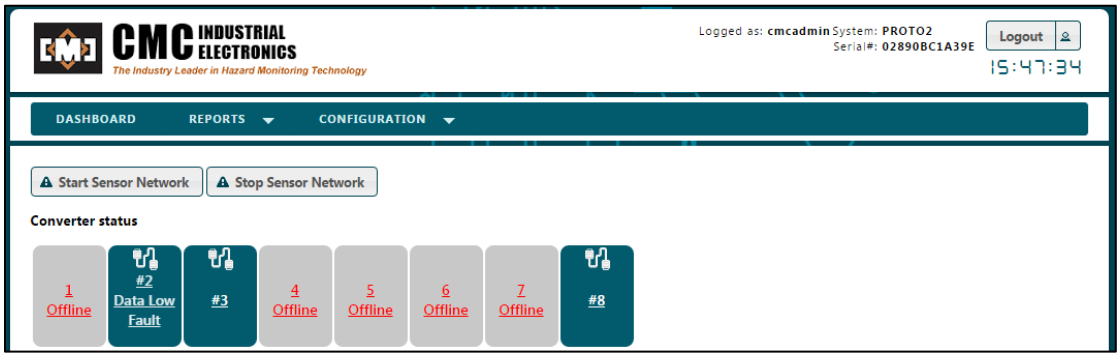


Figure 23: Bus Converters Statuses

4.7.2.1 Converter Sensors Network List

When clicked on the bus converter icon “Sensors Network List” will be shown. These are all the sensors which are physically connected to certain bus converter and the bus converter acquired them. On the top of the window is field for searching sensors by serial ID. List can be saved or emailed in CSV file.

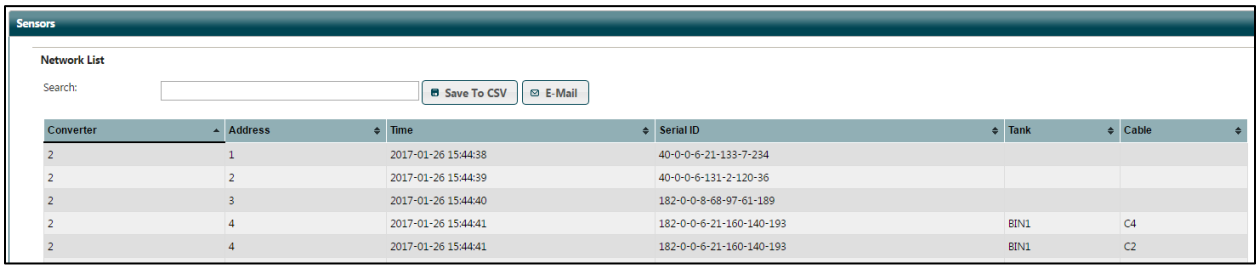


Figure 24: Sensors Network List

On each sensor are shown following information:

- Converter – Bus converter number to which the sensor is connected
- Address – Order number in bus converter table
- Time – Shows date and time when last change on sensor was done (e.g. Sensor was shifted in bus converter table)
- Serial ID – Serial number of sensors
- Tank – Tank to which is the sensor assigned to
- Cable – Cable to which the sensor is assigned to

4.7.2.2 Number of Bus Converters

Each system might have different number of bus converters which will be connected to the web server. To choose the right amount of bus converters go to Configuration->System->Settings and in filed “Number of Converters” choose 1-8.

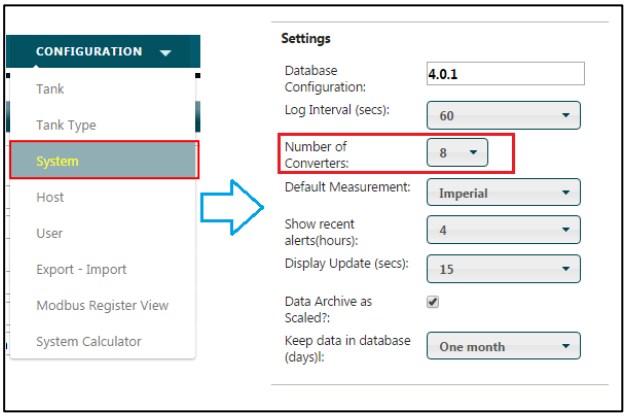


Figure 25: Number of Bus Converters in System

4.7.3 Assigned Sensor List

Assigned Sensor list is divided into three sections:

- Sensor Command
- Faulted Sensors
- List of Sensors

4.7.3.1 Sensor Commands

To be able to read all sensors which are connected to a bus converter the sensors have to be acquired by the system. For this purpose is button “Sensor Command” in window “Assigned Sensor list”.

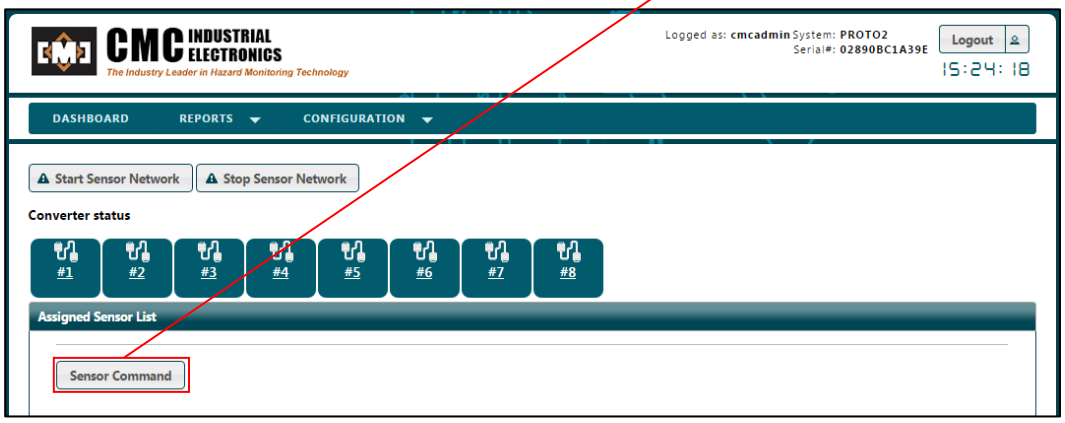


Figure 26: Sensor Command Button

When clicked on the button, message with warning will appear. The reason for the message is that there may be interruption on bus converters which are not acquired when there is heavy data stream. This may cause some alarms to go off. For that reason is better to do acquisition as less as possible.

After closing the message buttons for commands for bus converters will appear. There are three commands which can be executed on each bus converter separately. Bus converter, on which the command will be executed, is chosen by converter number from dropdown menu.

- Acquire Sensors – scan sensor bus on chosen bus converter and save the sensors into bus converter table. When “Acquire Sensors” button is hit it will discover and add all new sensors on the bus into the table. In case there are less than 32 sensors, the bus converter will keep the record of the old sensors. This makes the acquisition process faster. In case there are 32 new sensors connected, the whole table will be replaced.

  Note: Current system supports one channel sensors only. This apply on vibration and IR sensors only as they can read multiple values (PEAK and RMS for vibration; AMBIENT and OBJECT for IR)

- Reset Converter – Soft reset of converter is an equivalent to power cycle. Can be used when changing address switch on bus converter.

- Clear Converter – Clears out table of sensor in bus converter. There will be no record of any sensor.

By the button “Acquire All Sensors” will be acquired all sensors which are connected to the web server.

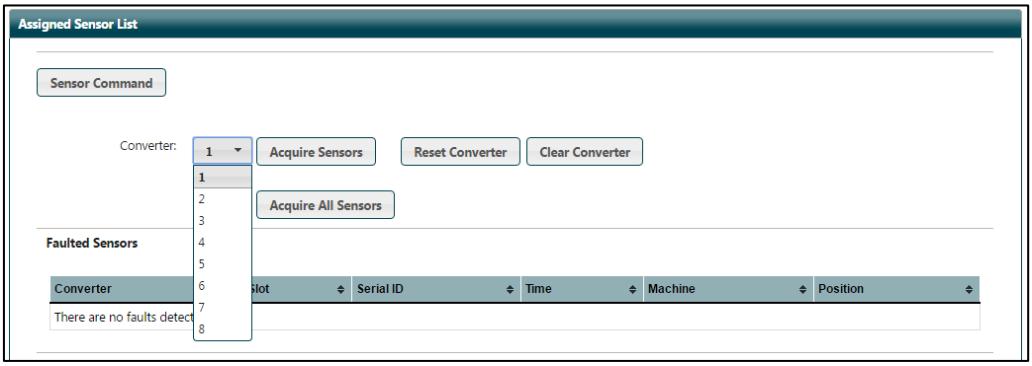


Figure 27: Bus Converters Commands

4.7.3.2 Faulted Sensors

In case there is an assigned sensor, which becomes faulted, it will be listed in the Faulted Sensors list. The list contains following information, see picture below:

- Converter – on which bus converter the faulty sensor is
- Address – Order number in bus converter table
- Serial ID – what is the serial number of the sensor
- Time – what time did the fault appeared
- Tank – on which tank this sensor is assign to
- Cable – to which cable is the sensor

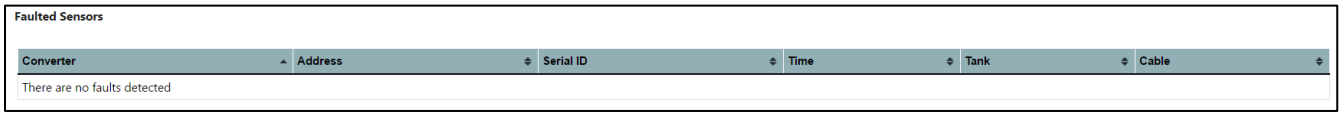


Figure 28: Faulted Sensor Report

4.7.3.3 Tank List

All tanks which are setup can be seen in the list on “Sensor Network View” page, below “Faulted Sensors” list. By checking check box “Show Active Only” it can be chosen if all tanks should be shown or only active ones.

For each tank in the list is shown:

- Tank – Name of the Active/Inactive tank
- Cable – Assigned number to a cable assigned to the bin
- Cable Name – Name of the assigned cable to the bin
- Serial ID – Serial number of a controller mDC001 card which reads the assigned cables
- Active – If cable is active or not
- Note – system messages about sensor (missing sensor)

4.8 Setup Detection

The CMC web server is able to detect devices which are connected to particular controller cards mDC001. This function makes it easier to troubleshoot the system and also to have exact information about cables which are connected. To enter Setup Detection go Dashboard -> Setup Detection.

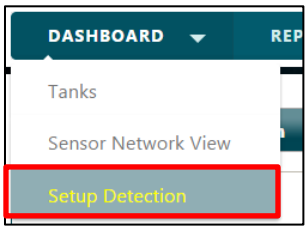


Figure 29: Setup Detection Access

Digital controller auto-search window will open. This window shows simplified information about selected part of the system. User can select which part of the system will be presented. Example of Digital controller auto-search window is on Fig 25.

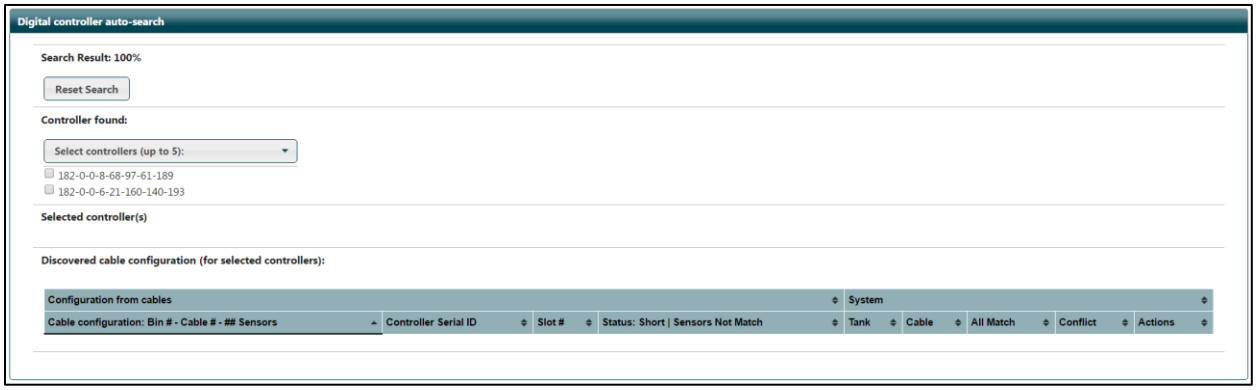


Figure 30: Example of Digital controller auto-search window

4.8.1.1 Search Result

In the first part of the Digital controller auto-search window is indication of progress of the system discovery. System automatically scans all connected parts and the percentage shown in the Search Result part is indication of the search progress. When the indication shows 100% it means all parts were already discovered. The search can be reset at any point by the “Reset Search” button. When this button is pressed it is going to reset the results and start the search again.

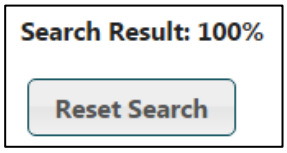


Figure 31: Search Result Example

4.8.1.2 Controller Found

In the next section of Digital controller auto-search window is for presentation of found mDC001 controller cards. When the search scan result is complete list of controller serial number can be presented by clicking on “Select controllers (up to 5)” button. After clicking on the button controllers will be shown as it is on Fig 27. Each controller has check mark beside the serial number. By the check mark can be selected particular controller and discovered cables in selected controllers will be presented as it is in Fig 27.

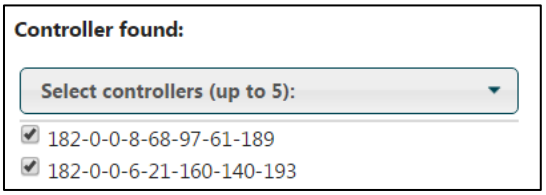


Figure 32: Found and selected controllers

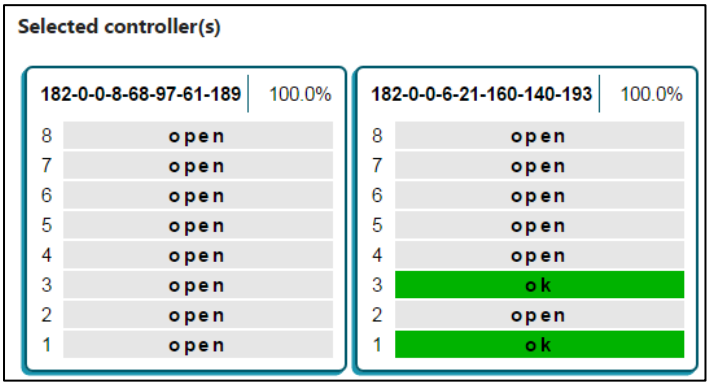


Figure 33: Selected controllers presentation

Up to 5 controllers can be selected to be presented. Each window for one controller shows controllers serial number and percentage of search scan result. If the scan is done the percentage will be 100% as it is on Fig 28. The rest of the window represents 8 slots in mDC001 where the grain cables can be connected.

4.8.1.3 Discovered Cable Configuration

The last section of setup detection is very important for quick setup of the system. To be able to use this quick setup each sensor cable needs to be programmed by EZTester before it is installed into the system. To be able to explain this function, example of the system will be presented:

FACILITY EXAMPLE

Facility with two grain bins need to have installed two grain temperature cables into each bin. Each cable will have 21 sensors. First of all each bin will have to have assigned number which can identify them in the system. Assigned number will be bin #1 and bin #2, these numbers are for identification only. Then cables need to also have assigned numbers and they have to be assigned the bin, these number have to be programmed into the cables by EZTester. Then there will be:

- cable #1 for bin #1
- cable #2 for bin #1
- cable #1 for bin #2
- cable #2 for bin #2

How to program the cables is described in TBD CMC Grain Temperature Cable manual.

Now when the cables are programmed, they need to be properly installed into the correct bins. All sensors might be connected into the same controller card mDC001 or they might all be connected into separate one. This may be different on each installation. Maximum number of cables connected to one mDC001 is 6. When the whole system is ready, all controller cards mDC001 are connected to bus converter and all Grain Temperature Cables are connected, acquisition of sensors needs to be done (4.7.3.1 Sensor Commands). When acquisition is done and all controller cards mDC001 are read, Discover Cable Configuration function can be used. When result is 100% as described in 4.8.1.1 Search Result controllers where the cables are connected to, need to be selected in the Controller found section.

On Fig 29 is shown example of 4 cables connected to two controller cards.

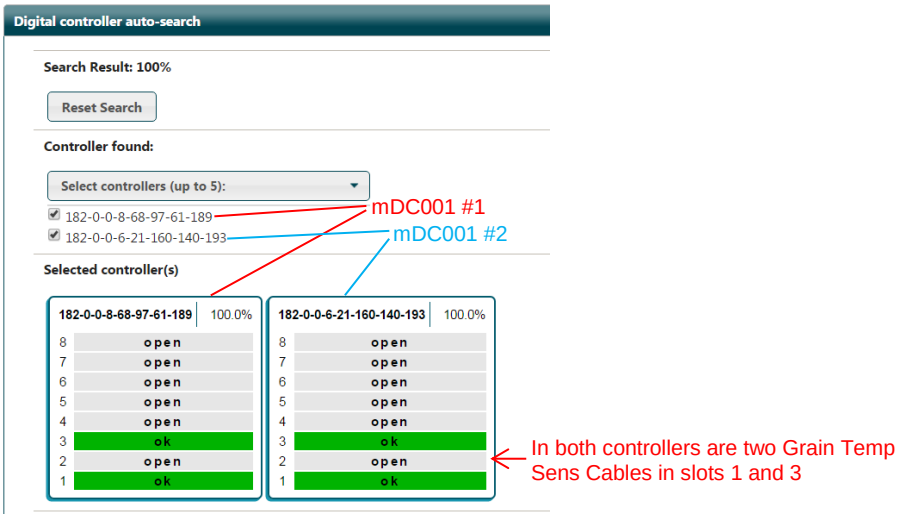


Figure 34: Example of Facility Setting

On the Fig 29 are discovered two mDC001 controller card and each of them has two cables connected into it. Cables in each card are connected to slots 1 and 3 which is indicated by green “ok” fields in the “Selected Controllers” section. The rest of slots are showing “open” which indicates that no cable is connected into those.

In the last section “Discovered Cable Configuration” of “Digital Controller Auto-search” which is shown on Fig 30 user can see following information:

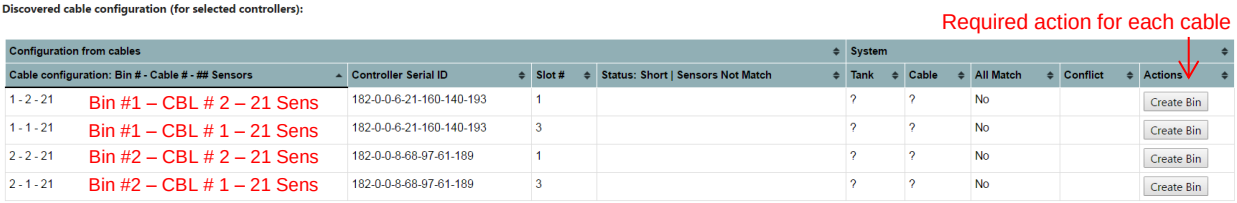


Figure 35: Example of Discovered Cable Configuration

Configuration from Cables

- **Cable Configuration: Bin # - Cable # - ## Sensors** – This data is read from the sensor and all of them can be set on each cable by EZTester. For further information on how to set the cables see CMC Grain Temperature Cable manual.
- **Controller Serial ID** – This filed indicates to which controller card mDC001 is the particular cable connected to.
- **Slot #** – This filed indicates to which slot in particular controller card the cables is connected to.
- **Status: Short | Sensor Not Match** – This filed will indicate problem on the sensor. Problems which can be indicated is short on the temperature cable or on the connector of the mDC001. The second problem which can be indicated is not matching number of sensors read from the cable. Each cable carries information about number of sensors which the cable contains, in case some of the sensors inside the cable doesn’t work it will be indicated in this status.

System

- **Tank** – Name of the tank to which the particular cable is connected to. If “?” is indicated it means that the cable wasn’t assigned to any bin yet.
- **Cable** – Assigned name to the cable. If “?” is indicated it means that the cable wasn’t assigned to any position in the bin yet.
- **All Match** – This indicates if assigned position for sensor matches with actual number of sensor in the cable. Assigning the sensor positions is closely described in section TBD
- **Conflict** – This indicates if the same cells are assigned to two different places. This can occur if user assigns cells manually. If the system is set through Setup Detection this conflict will not occur.
- **Actions** – This part shows recommended actions for user to do to have correct setting. User is required to click on the button in the Actions column. See section 4.8.1.3.1 Actions.

4.8.1.3.1 Actions

If physically connected cables are not assigned to desired bins and positions there will be offer of required actions to do so. These actions will be presented as buttons in “Actions” column in Discover Cable Configuration section in Digital Controller Auto-search window. To explain the functionality of this feature same example as was used for previous section be used.

1. Because no cable was assigned to any bin yet there will be required action “Create Bin” for each cable. See Fig 29.

Configuration from cables				System				
Cable configuration: Bin # - Cable # - ## Sensors	Controller Serial ID	Slot #	Status: Short | Sensors Not Match	Tank	Cable	All Match	Conflict	Actions
1 - 2 - 21	182-0-0-6-21-160-140-193	1		?	?	No		Create Bin
1 - 1 - 21	182-0-0-6-21-160-140-193	3		?	?	No		Create Bin
2 - 2 - 21	182-0-0-8-68-97-61-189	1		?	?	No		Create Bin
2 - 1 - 21	182-0-0-8-68-97-61-189	3		?	?	No		Create Bin

Figure 36: Required Actions for Not Assigned Sensors

2. When clicked on “Create Bin” button dialog to choose type of bin will appear, see Fig 32. In this dialog should be chosen such a bin type that will suite the bin where the cable is installed in. In case such a bin type doesn’t exist it can be created in Tank Type Section TBD. When type of bin is selected another dialog will open asking for permission to execute the action of creating a new bin.

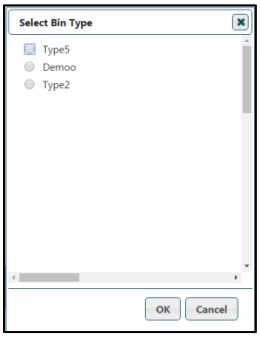


Figure 37: Selection of New Bin Type

3. The system will automatically create a bin where will be automatically assign the sensor on which row the “Create Bin” button was pressed. Bin name will be bin_10 if the cable bin # is 1 and bin_20 is the cable # is 2 and so on. The same thing will be for cable name, if the cable # is 1 the cable name will be C1 and if the cable # is 2 the cable name will be C2 and so on. For better understanding see Fig 33.

Configuration from cables				System				
Cable configuration: Bin # - Cable # - ## Sensors	Controller Serial ID	Slot #	Status: Short | Sensors Not Match	Tank	Cable	All Match	Conflict	Actions
2 - 2 - 21	182-0-0-8-68-97-61-189	1		bin_20	C2	Yes		Not Required
2 - 1 - 21	182-0-0-8-68-97-61-189	3		bin_20	C1	No		Re-Assign Controller

Figure 38: Automatically Assigned Name of Tank and Cable

4.9 Reports

There are two options of reports which can be shown/used:

- Chart
- Data Export

As mentioned in the overview the web server is able to keep records of data for all sensors up to 2 years. These records are created in SQL format and are not that easily accessible. It can take up to couple hours to download 2 years database records. For this reason are here these reports which gives user the opportunity to access recent data quicker and easier.

4.9.1 Chart

TBD

4.9.2 Data Export

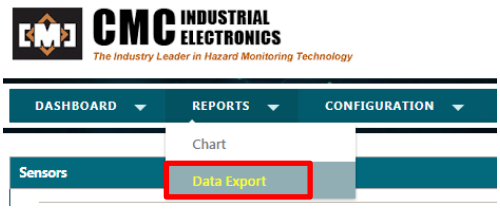


Figure 39: Data Export Access

Go to Reports -> Data Export and following window will open, Fig XX. There are two types of reports which can be presented.

- **<u>Cable Comparison Report</u>** – In this report can be selected bin which will be in the report and time span which should be reported. Than there can be selected delta which will determine how big deviation in the selected time span will be presented. Detail explanation in Fig XX below.

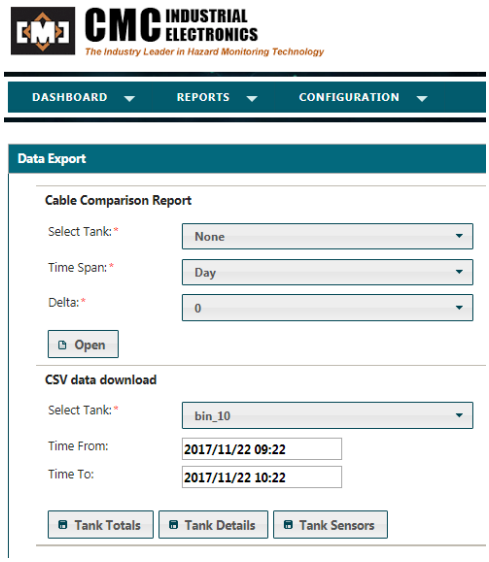


Figure 40

TIME SPAN DELTA

Cable Comparison Report. Created 2017Nov22 09:42 by @ WS2-GM. Parameters: Time Span Week [168 hour(s)], Threshold 3, Units: Deg.F

Bin	Cable	Note	Time	Max	Avg	Dev	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
mDCtest	C2	Back Reading	2017Nov15 09:21	75	75	0	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75							
mDCtest	C2	Recent Reading	2017Nov22 09:30	75	75	0	75	75	75	75	75	75	75	75	75	75	77	75	75	75	75	75	75	77	75	75	75							
mDCtest	C3	Back Reading	2017Nov15 09:21	75	75	0	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	77	75							
mDCtest	C3	Recent Reading	2017Nov22 09:30	75	75	0	75	75	75	75	75	75	75	75	75	75	75	75	77	75	75	75	75	75	75	77	75							
mDCtest	C4	Back Reading	2017Nov15 09:21	77	75	0	75	75	75	75	75	75	75	75	77	75	75	75	75	75	75	75	75	75	75	77	75							
mDCtest	C4	Recent Reading	2017Nov22 09:30	75	75	0	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	77	75	77	73							
mDCtest	C5	Back Reading	2017Nov15 09:21	77	75	0	75	75	75	75	75	75	75	75	77	75	75	75	75	75	75	75	75	75	75	75	75							
mDCtest	C5	Recent Reading	2017Nov22 09:30	75	73	0	75	75	73	73	73	73	73	73	-73	73	73	73	73	73	73	73	73	73	73	73	73							
mDCtest	V1	Back Reading	2017Nov15 09:21	75	75	0	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	77	75							
mDCtest	V1	Recent Reading	2017Nov22 09:30	77	75	0	75	75	75	75	75	75	75	75	77	75	75	75	75	75	75	77	75	75	75	77	75							

Figure 41: Comparison Report (time span = 1 week, delta = 3)

No deviation reported on the delta set to 3. The deviation is reported if the delta is set to 2 as there was a temperature change by 2°.

TIME SPAN DELTA

Cable Comparison Report. Created 2017Nov22 09:41 by @ WS2-GM. Parameters: Time Span Week [168 hour(s)], Threshold 2, Units: Deg.F

Bin	Cable	Note	Time	Max	Avg	Dev	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
mDCtest	C2	Back Reading	2017Nov15 09:21	75	75	0	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75							
mDCtest	C2	Recent Reading	2017Nov22 09:30	75	75	0	75	75	75	75	75	75	75	75	75	75	+77	75	75	75	75	75	75	+77	75	75	75							
mDCtest	C3	Back Reading	2017Nov15 09:21	75	75	0	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	77	75							
mDCtest	C3	Recent Reading	2017Nov22 09:30	75	75	0	75	75	75	75	75	75	75	75	75	75	75	75	+77	75	75	75	75	75	75	77	75							
mDCtest	C4	Back Reading	2017Nov15 09:21	77	75	0	75	75	75	75	75	75	75	75	77	75	75	75	75	75	75	75	75	75	75	77	75							
mDCtest	C4	Recent Reading	2017Nov22 09:30	75	75	0	75	75	75	75	75	75	75	75	-75	75	75	75	75	75	75	75	75	+77	75	77	-73							
mDCtest	C5	Back Reading	2017Nov15 09:21	77	75	0	75	75	75	75	75	75	75	75	77	75	75	75	75	75	75	75	75	75	75	75	75							
mDCtest	C5	Recent Reading	2017Nov22 09:30	75	73	0	75	75	-73	-73	-73	-73	-73	-73	-73	-73	-73	-73	-73	-73	-73	-73	-73	-73	-73	-73	-73							
mDCtest	V1	Back Reading	2017Nov15 09:21	75	75	0	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	77	75							
mDCtest	V1	Recent Reading	2017Nov22 09:30	77	75	0	75	75	75	75	75	75	75	75	+77	75	75	75	75	75	75	+77	75	75	75	77	75							

- CSV Data Download – This report provides detailed information on for selected points. It can show aggregated data in whole bin or it can show data on certain cells. All in desired time span. Select bin which should be reported, select the time range which will be reported and then click on one of three buttons “Tank Totals”, “Tank Details” or “Tank Sensors”. This will download csv file which can be opened in Microsoft Excel and following data will be included in it.
  Tank Totals this will show aggregated data in whole bin.
  Tank Details this will show data for each cell in the selected tank
  Tank Sensors this will show data recorded on additional sensors assigned to the bin

4.10 Configuration

Configuration menu allows user to access any type of configuration which can be done on the system if the user has sufficient rights. Description of each section in dropdown menu follows.

4.10.1 Tank

To access tank configuration click on “Tank” in configuration dropdown menu as is on Fig 34.

Figure 42: Tank Configuration Access

When the tank configuration is selected list of tanks will be presented. If no tanks were configured yet the list will be empty. In case some tanks were already configured the list will look similar as on Fig 35.

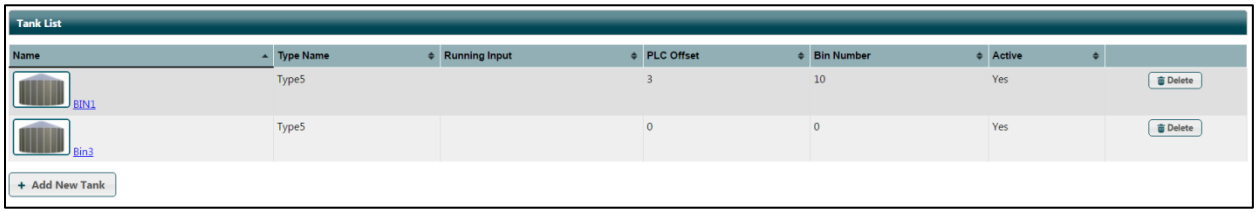


Figure 43: List of Configured Bins

In the tank list are information and active fields which inform about particular bins setting and also allow user to change the current setting of each bin. Below the tank list is button “Add New Tank” which allows the user to create a new bin. Explanation of each section in tank list follows.

4.10.1.1 Name

In the name section is shown picture which is assigned to the particular bin and also the name of the bin. The name is active link to the setting of the bin. For information how to set the bin see section 4.10.1.8 Tank Configuration

4.10.1.2 Type Name

Type name shows selected type of tank for the particular bin. Any desired tank type with desired number of cables can be created by user. For further information see sections 4.11.1 Add New Tank Type and 4.11.2 Available Tank Types.

4.10.1.3 Running Input

Reserved for future use.

4.10.1.4 Output Register

In this field is specified on which register, in the Modbus TCP/IP, will the particular bin be read. For further information about Modbus TCP/IP data structure see appendix 1 – Modbus Communication. By default there is no register assigned to the bin. For each of them the register number has to be manually assigned.

4.10.1.5 Bin Number

Bin number is information for user for better understanding of location of the bin.

4.10.1.6 Active

Shows if the bin is active in the system or not

4.10.1.7 Delete Bin

Last section allow user to delete created bins

4.10.1.8 Tank Configuration

4.10.1.8.1 Tank Configuration – Tank

Example of tank configuration is presented on Figure 36. Following can be configured on each bin:

- Name – Name of bin which will be presented throughout the interface
- Description – Users description of the bin
- Type Name – Type of bin can't be configured. Type of each bin has to be set when new bin is created
- North Label – Orientation of a bin is set by this field
- Output Register – By this number is set register in Modbus which will be assigned to the bin. For further information see Appendix 1 – Modbus Communication
- Bin Number – This is very important number especially in case automatic setting of the system will be used. By automatic setting is meant Setup Detection function, for further information on see section TBD Setup Detection.
- Select Background Color – This color defines color of the bin presented on Dashboard
- Active – By this checkmark can be selected if the bin will be active in the system or not
- Select Image – User can assign any desired picture of the bin into the system

When all configurations are finished "Save" button needs to be pressed to apply all the changes.

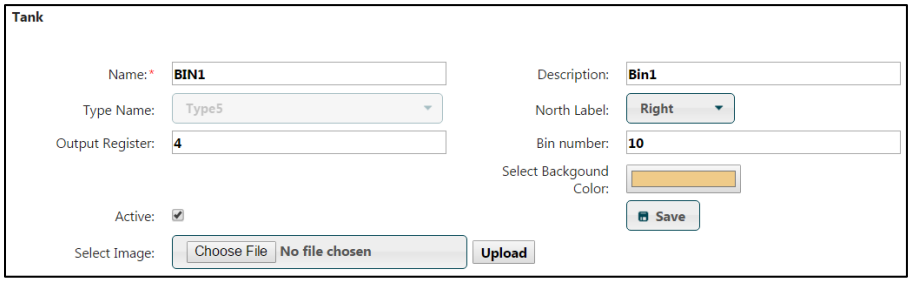


Figure 44: Tank Configuration

4.10.1.8.2 Tank Configuration – Cables

It depends on type of bin how much sensors can be assign to the bin. In example in Fig 37 can be set 5 cables.

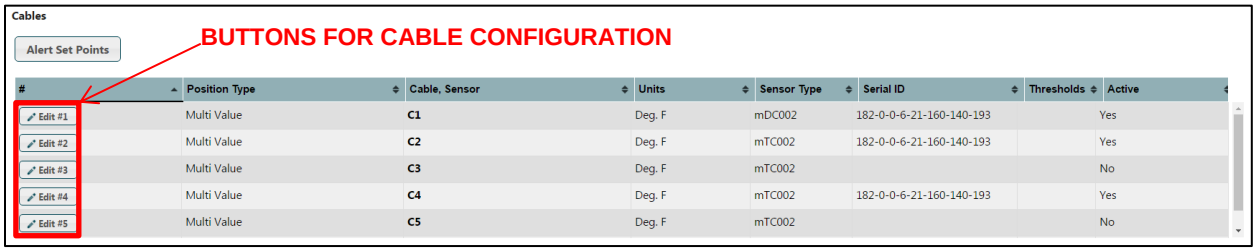


Figure 45: Cables Configuration

On the list of cables are following information about cables setting:

- # - It's a number of sensor cable which should be set in the cable which should be install in particular bin on particular position and connected into particular controller card. The button for each cable in this section is a link into the cable configuration. This configuration is described in section 4.10.1.8.2.2 Cable Configuration
- Position type – TBD
- Cable, Sensor – Name of the particular cable
- Units – Units which the cable is set into
- Sensor Type (Should be controller Card) – Type of Controller Card to which the sensor is connected to
- Serial ID – Serial number of the controller card which the sensor is connected to
- Threshold – Reserved For Future Use
- Active – Indicates if the cable is active in the system or not

By clicking on button "Alert Set Points" window for the bin alerts will open.

4.10.1.8.2.1 Alarm/Warning Setup

Configuration of alarms and warnings contains setting for three different events which can be reported on each bin. On each bin can be reported High Alarm, High Warning and Rate of Rise. In the first part is setting of High Alarm and High Warning as is shown on Fig 38.

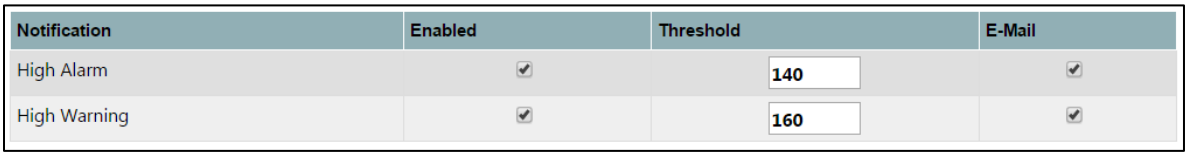


Figure 46: Bin Alarm and Warning Configuration

In this part the system allows user to enable/disable Alarm and Warning, setup thresholds for those and also enable/disable notification by email.

In the second part of this section can be set Hysteresis of the alarm and warning. The hysteresis can be enabled/disabled and value of hysteresis can be set. See Fig 39.

Figure 47: Hysteresis Setting

In the third and last part can be set the Rate of Rise. The Rate of Rise can be enabled/disabled and also email notification can be set. For Rate of Rise needs to be set Δ value which will be monitored and time range (in minutes) when the temperature rise by Δ will occur. See Fig 40.

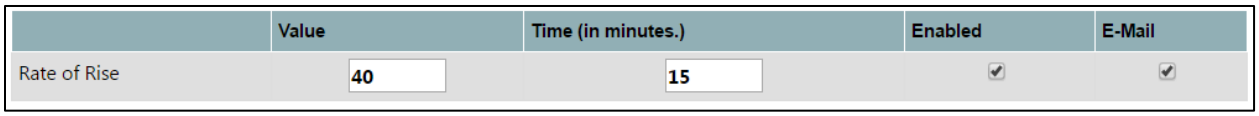


Figure 48: Rate of Rise Setting

4.10.1.8.2.2 Cable Configuration

Two types of controller cards can be connected to the system. The controller cards are mTC002 and mDC001. mTC002 controller card can read data from thermocouple sensors and from certain types of digital sensor cables. mDC001 is designed to read data from digital sensor cables only.

In section 4.8.1.3 Discovered Cable Configuration is described how system can be set without complicated configuration when the digital sensor cables are set properly. This section of manual will describe how to set the system when digital sensors are not configured or if the system contains the thermocouple sensors combined with mTC002.

Each cable which is physically connected into the system can be assign to any existing bin on any position on the bin. In the configuration section above is described setup of one particular bin. This bin has 5 available spots for cables. These cables can contain 3-21 temperature sensors, thermocouple or digital. All depends on intended design of the system and used parts.

To access the cable configuration menu click on “Edit” button for cable which should be configured, see Fig 37.

The cable configuration contains two parts. The first one from the top “General Configuration” (Fig 41) shows Name and Description of the cable, Active and Log checkmarks. All these four fields can be modified. User can modify the name of the cable to desired names. In following example will be described settings of the system when using mTC002 cards. System will have one mTC002 controller card where will be connected 168 thermocouple sensors. It’s assumed that each cable contains 21 sensors and there will be in total 8 cables. Two bins will be created, one with 5 cables and one with three cables. It is important to mention at this point that if user uses digital cables which are set properly, these steps are not necessary. System detect function, described in section 4.8 Setup Detection, can be used instead to create the system in more simple way.

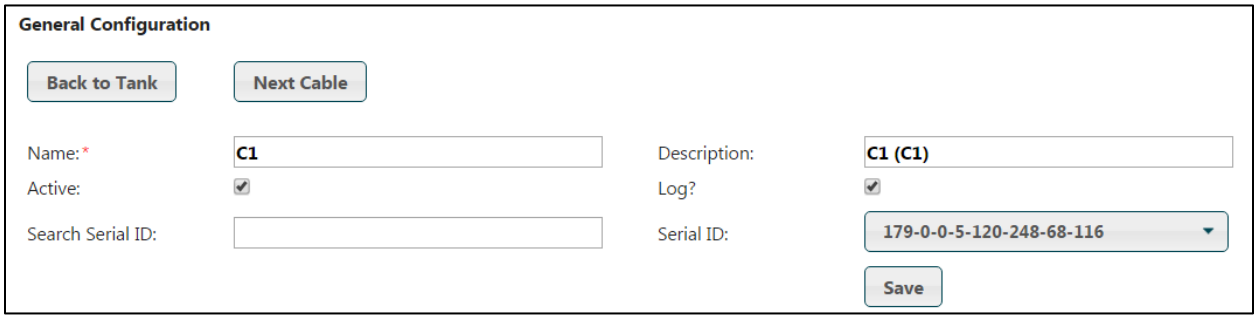


Figure 49: Cable General Configuration

Example of mTC002 System Setup

System contains 1 mBC one mTC002-CC (S/N 179-0-0-5-120-190-30-224) controller card with 8 mTC002-TC thermocouple card. Each thermocouple card has connected 21 sensors and whole system has 168 thermocouple sensors connected. System will be installed in two bins. One bin with 5 cables and second one with 3 cables.

First of all Acquire Sensors command need to be sent to bus converter to which the mTC002 is connected to. This is described in section 4.7.3.1 Sensor Commands.

When acquisition is complete bins need to be created. How to add bins/tanks is described in section 4.10.1.9 Add New Tank. Before tanks are added Tank types with 5 and 3 cables need to be added as well. These steps are described in section 4.11 Tank Type. When creating new bins 3 cable bin type and 5 cable bin type should be selected to follow the requirements described on the beginning of the example. When bins are created the Tank list should look as it is on Fig 42. BIN1 has 5 sensors and BIN2 has 3 sensors.

Figure 50: Example of System with Two Bins

Next step in setting up the system is to assign the cables to position where they are physically installed. When clicked on the link “BIN1” in the first column Tank Configuration window will open, this is described in section 4.10.1.8 Tank Configuration as well as part of the Cable Configuration. This example will continue in Cable Configuration which is not fully covered in the manual above.

When the Cable configuration is open the General Configuration part will be on position of the first sensor in the bin. By default the name will be C1 as well as the description. The cable should be activated and if desired the log can be activated as well, both by checkmarks. In next step the serial number of the mTC002-CC controller card where the cables are connected to have to be selected from the dropdown menu. In this case the serial number is 179-0-0-5-120-190-30-224. When the right card is selected “Save” button needs to be pressed. In case all sensors are connected correctly the sensors raw value should be read in the Real-Time Raw Pin View. All 168 sensors should be read as it is on Fig 43.

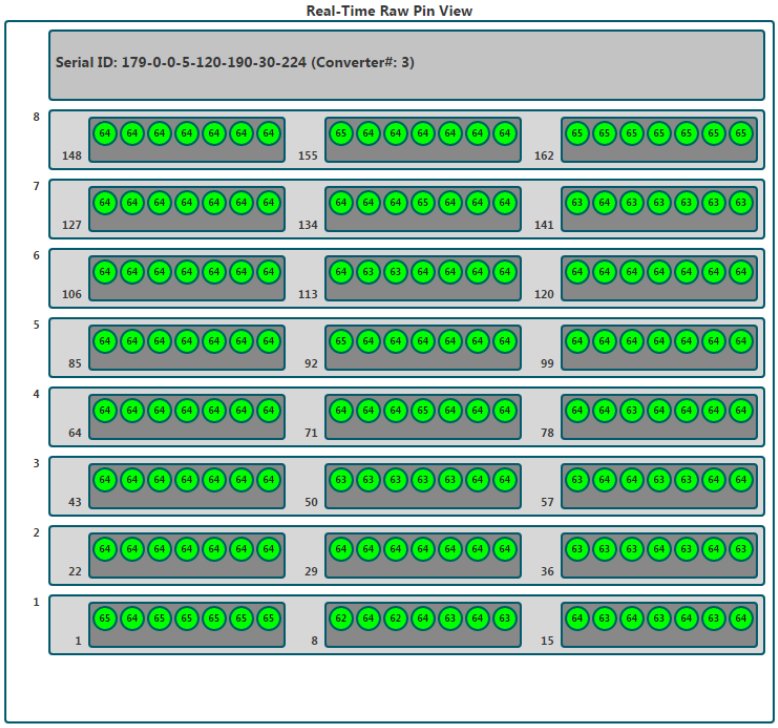


Figure 51: Example of Real-Time Raw Pin View

Sensor which is read at that moment is blinking. It may take couple minutes till the sensors start to be read for the first time. The presented data are raw data only, they are used for further calculation of the system to show temperature in desired units. This layout of the pins corresponds exactly with physical connection to the mTC002 cards.

When all sensors are read, they can be assigned to the cables where they belong so the system can create layout of the bin for its own HMI.

When the Tank Types are created they should correspond with the real layout of the physical bin at the facility so the system can be exact copy of the real situation. In this case we have two bins one with 5 cables and one with 3 cables. The layout is done as it is on Fig 44. User has to know which cable from bin is connected to which socket and which slot in the mTC002-TC card. User also has to know how many sensors is in each cable. In this case each cable has exactly 21 sensors so it always occupies the whole socket.

Connection of cables for this case will be as follows:

BIN1 C1 – Slot 1 in mTC002
BIN1 C2 – Slot 2 in mTC002
BIN1 C3 – Slot 3 in mTC002
BIN1 C4 – Slot 4 in mTC002
BIN1 C5 – Slot 5 in mTC002
BIN2 C1 – Slot 6 in mTC002
BIN2 C2 – Slot 7 in mTC002
BIN2 C3 – Slot 8 in mTC002

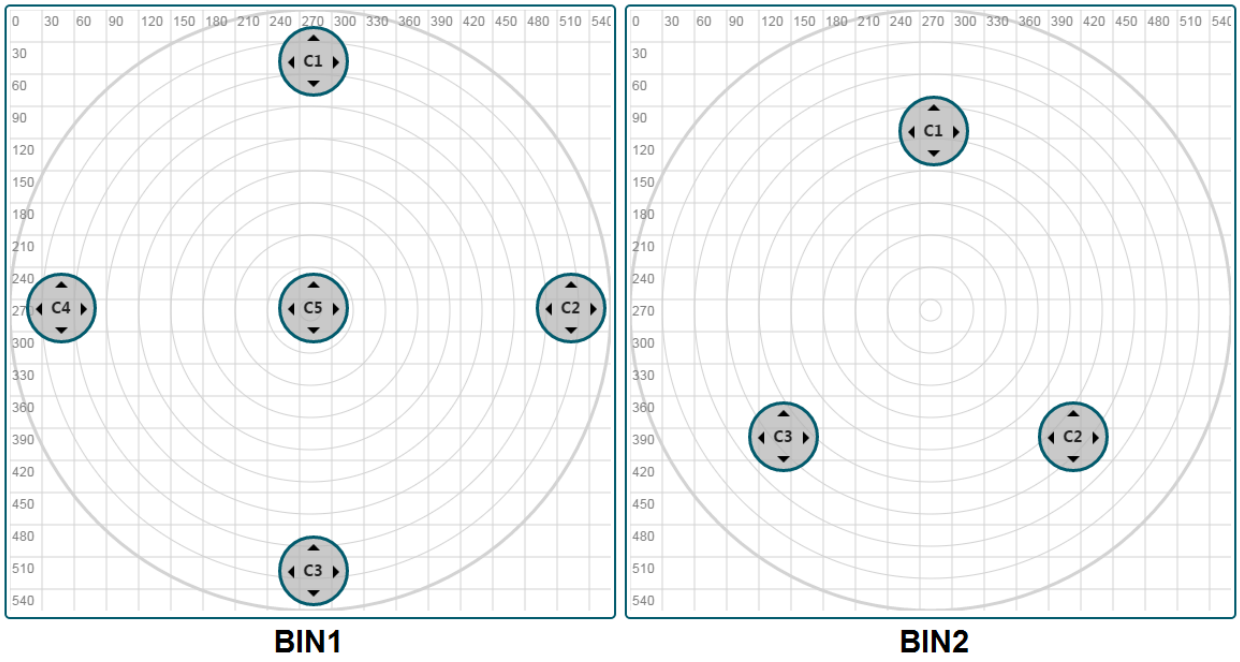


Figure 52: Example of Bins Cable Layout

Following steps will show how to assign the raw pins to the cables.

1. Select cable which should be configured, on the example is selected cable C1 on BIN1
2. Select card from which the sensors are read
3. Select which slot will be selected and on which socket the selection will start, what type of cable is used and how many sensors are in the cable
4. Press “Build” button to build the cable, pin numbers will be presented in the cable view
5. Press “Save” button to save the changes
6. When first cable is set press “Next Cable” button to move to the next sensor and repeat all the steps till all cables in bin are set, then move to another bin

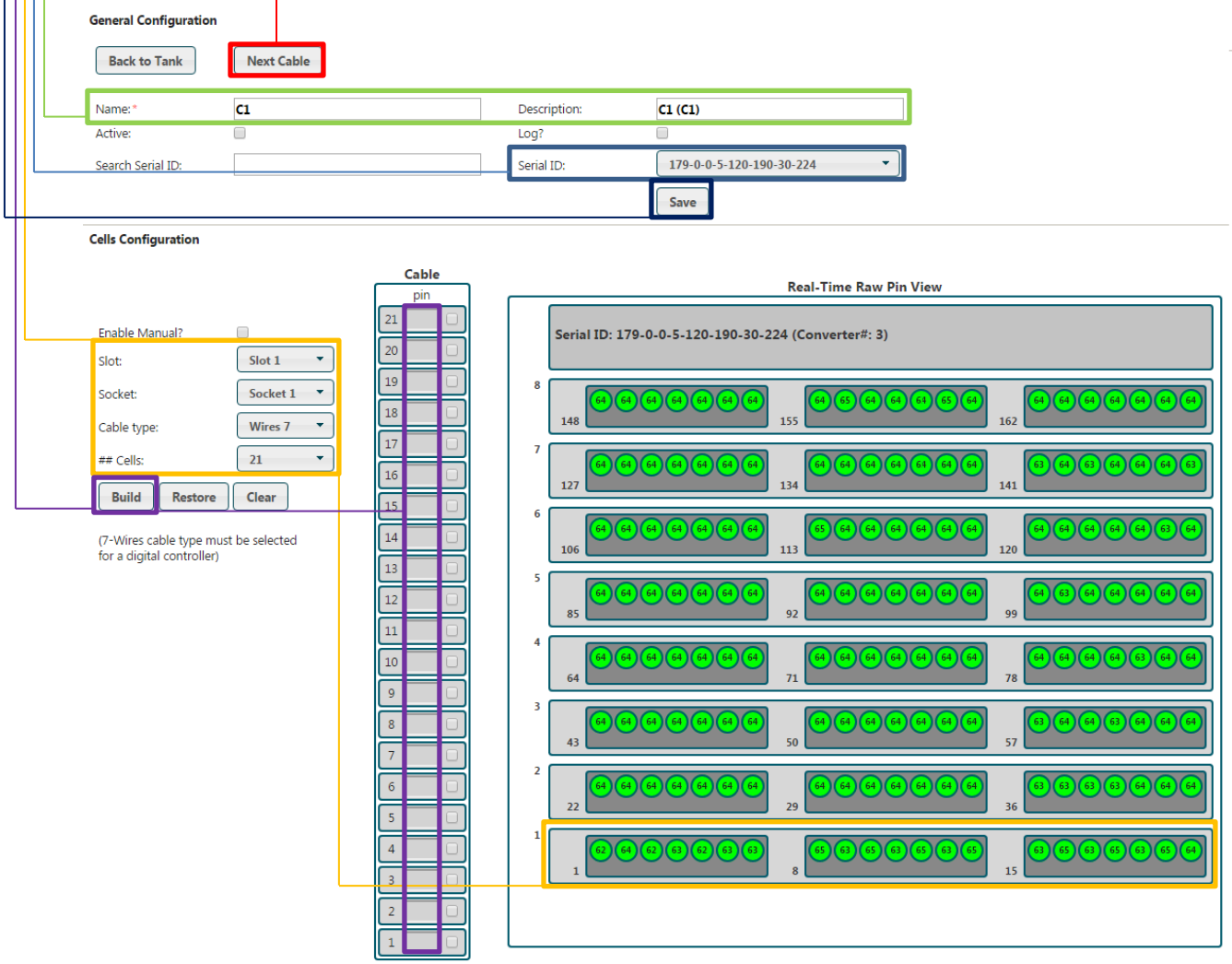


Figure 53: Steps for assigning cables

When all cables are assigned the Bin can be observed as it is described in section 4.6.1 Tank Table View. For alerts setting see section 4.10.1.8.2.1 Alarm/Warning Setup.

4.10.1.9 Add New Tank

Below the tank list is a button “Add New Tank”. By this button new tank can be added to the system. When clicked on the button dialog to select bin type will appear. In this dialog is chosen what type the new bin will be. On the Fig 46 are available two types of tanks from which user can choose. The number of possible available tank types is not restricted and depends on user.

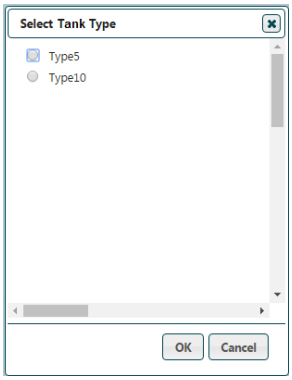


Figure 54: Select Machine Type for a New Tank

The tank type is selected by a radio button and confirmed by “OK” button. After that the same configuration steps as in Tank Configuration section 4.10.1.8.1 are required.

4.11 Tank Type

Tank types need to be created to allow user choose the right type for a new tank. For that reason the tank types need to be created in advance.

Figure 55: Tank Type Access

When clicked on Configuration -> Tank Type three sections will be presented, “Add New Tank Type”, “Available Tank Types” and “Type tank cable locations”. The three sections are described below.

4.11.1 Add New Tank Type

When new tank type should be entered Name of the tank type needs to be assigned, Description of the tank is optional. In the dropdown menu besides “## Cables” user can set how many cables can be set for the tank. After all filed are set “Save” button needs to be pressed to create the new type.

Figure 56: Add New Tank Type

4.11.2 Available Tank Types

When a new tank type is created it will show in the Available Tank Types list as it is on Fig 49.

Figure 57: List of Available Tank Types

In the Available Tank Types list is presented:

- Type Name – Name of each tank type
- Type ID – Shows the order how the types were created
- ## Cables – Shows how many cables is in the particular tank type
- Type Description – Custom description of tank type
- Enabled – By enable checkmarks is controlled if the tank type will be available

In the first column is “Select” button, marked red in Fig 49. When this button is pressed, in the section Type tank cable locations will be shown how the cables in that particular bin are located. See Fig 50.

Above in the table with list of sensors is a button “Update Layout Existing Bins”, marked green on Fig 49. When this button is pressed all bins which were previously created from the listed tank types will be updated to have the same setup. Otherwise they will stay the same.

4.11.3 Type tank cable location

In this section is set what location of each cable in the selected bin will be. Example of tank type with 10 cables is on Fig 50.

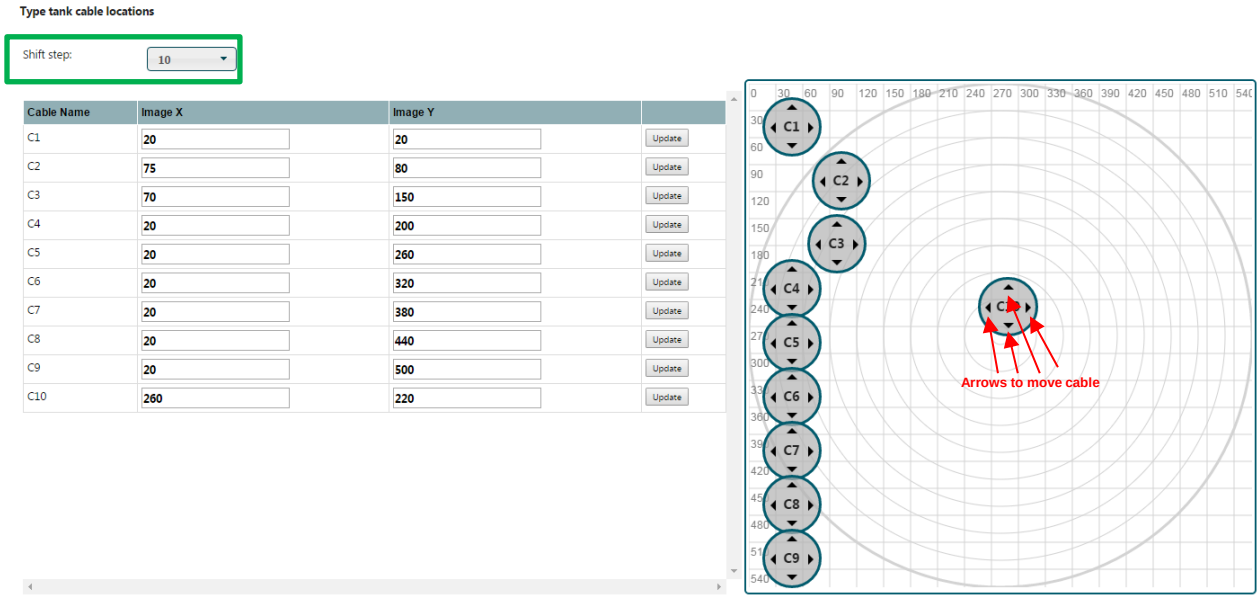


Figure 58: Example of Tank Type with 10 Cables

Each cable can be manually moved to desired location using arrows on each cable. The arrows allow moving the cable in 4 directions**.** After pressing the arrow in desired direction the cable will move by a step set in the Shift Step dropdown menu, marked green in Fig 50. The new position of cable is automatically saved and can be confirmed by selecting another cable.

Location of cables can also be set by the X and Y coordinates. On the Fig 50 is 10 cables C1-C10, each of them has two fields for the coordinates. To make the coordinates to take an action on the picture of the bin the “Update” button has to be pressed on the particular cable. On the picture of the bin is a grid which represents the values of coordinates to make the orientation easier. The grid starts in the left top corner.

4.12 System

To access System Configuration click Configuration -> System. In System Configuration is setup of E-mail Server configuration, setup of system backup and configuration of Industrial Network.

Figure 59: System Configuration Access

4.12.1 SMTP (Outgoing e-mail) Server Setup

First part of System Configuration is for e-mail setup. Example of the SMTP server setting is on Fig 52. In the example is a private CMC SMTP server. Each customer has to have their own SMTP server to allow them to have all e-mail notifications work properly.

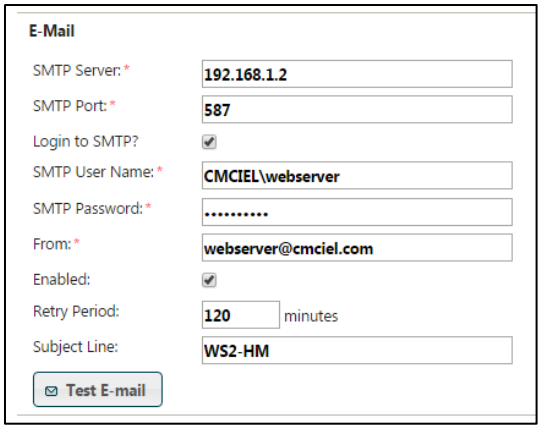


Figure 60: Example of SMTP Server Setup

To setup the SMTP server properly following information need to be provided:

- **SMTP Server** – IP address of accessible SMTP Server
- **SMTP Port** – To have correct e-mail notification functionality 587 port should be used as it requires outgoing emails only
- **Login to SMTP?** – Check for SMTP server user authentication, usually required
- **SMTP User Name** – User name for SMTP server authentication
- **SMTP Password** – Password for SMTP server authentication
- **From** – E-mail from which the e-mails will be received
- **Enabled** – Checkmark for e-mail notification enabling
- **Retry Period** – Time period in which another e-mail will be resent in case a sent e-mail was not confirmed as delivered

- **Subject Line** – Subject in sent e-mail

4.12.2 System Backup

Second part of System Configuration is System Backup. System Backup saves all data about the system with records of all data on each sensor for up to 2 years. To create a backup file click on “Create Backup” button, see Fig 53. It may take a while till the backup file is created, depends on how much data is being proceed. If the backup file is done and “Refresh” button is pressed the backup file will be listed in the list of backup files as it is shown on Fig 53. The backup file is special compressed MySQL file which requires special application to decode the recorded data.

Blank backup file can be created as a template to set or create the application which will work with the recorded MySQL data. The blank backup file can be created by clicking on “Create Schema Backup” button.

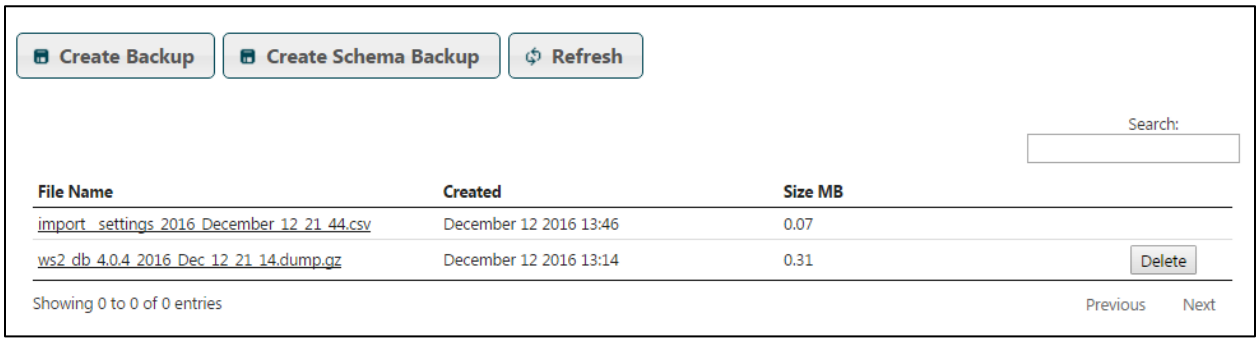


Figure 61: System Backup

4.12.3 System Backup, Recent Alerts and Archive Settings

Third part of the System Configuration contains fields where customer can configure the way how the data of backup file and archive file will be recorded.

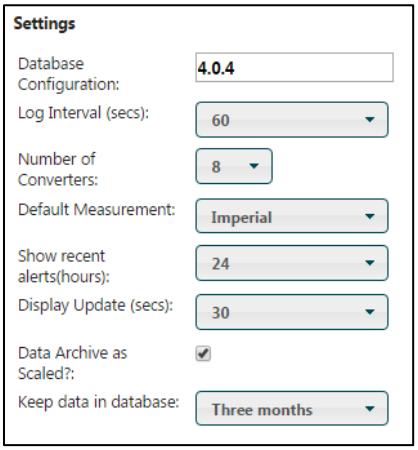


Figure 62: Backup, Recent Alerts and Archive Settings

This section has following fields:

- **Database Configuration** (Backup) – The first release of WS2 has version 4.0.4, this field can’t be configured

- **Log Interval (secs)** (Backup) – Must be active to see data in bins. This field also sets how often will be recorded data of each sensor. Here is very important to mention that this interval is applied if no alarms or warnings appear. This interval is applied only if condition of sensor will stay the same. In case some event which triggers alarm or warning the record will happen immediately regardless to the interval settings. It is important to set the interval in optimal way so there will be no huge amount of useless data created
- **Number of Converters** (Backup) – Number of converters which will be recorded. Here is also important to mention that the number of bus converters which will be recorded shouldn't be more than number of bus converters which are actually used to avoid creating of unnecessary data.
- **Default Measurement** (Backup) – Here is assigned in which way backup data will be recorded, Imperial or SI
- **Show Recent Alerts (hours)** (Recent Alerts) – This setting affects Recent Alerts list which is described in section Recent Alert History TBD. In this field can be set how long the recent alerts should be shown. If set for 24, alerts older than 24 hours won't be listed.
- **Display Update (secs)** (Recent Alerts) – This field will set how often the recent alert list will be updated
- **Data Archived as Scaled?** (Archive) – By this checkmark user can choose if the archived data will be scaled or not
- **Keep Data in Database** (Archive) – By the drop down menu user can choose from how long time data for archive should be created. This refers to the section Archive TBD

After any changes in the setting in this section "Save" button has to be pressed to activate the changes.

4.12.4 Level Calculation Settings

TBD

4.12.5 Industrial Automation Setting

The last part of System Configuration is Industrial Automation Setting. In this section user can turn on/off the industrial Modbus over TCP/IP communication channel. This channel provides data for further use for PLC and so on.

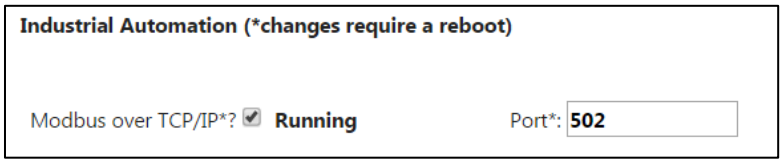


Figure 63: Industrial Automation Setting

Further description follows:

- **Modbus over TCP/IP** – By this checkmark is selected that the protocol which used to provide sensor network data will be Modbus TCP/IP. This protocol will use port which

is defined in the “Port*” field. Besides the checkmark on the right side will be shown label “Running”. This label will be presented in case this protocol was turned on and it is running at the moment, see Fig 55. When the protocol is selected, “Save” button has to be pressed to confirm the setting plus in this case the web server needs to be rebooted.

4.13 Host Configuration

To access host configuration click Configuration -> Host. In the host settings can be controlled the RS485 line which connects the bus converters; The system can be rebooted; All network information is set in this section; Time and date can be set; Share folders can be set; Information about the web server performance is presented.

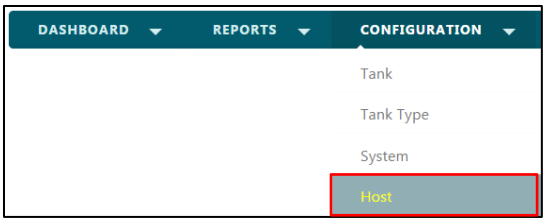


Figure 64: Host Configuration Access

4.13.1 Reboot System and Sensor Network Control

On the top of Host Configuration window are three buttons. By the first “Reboot System” button the web server can be rebooted. Rebooting of the system is necessary for example when Industrial Automation communication protocol is changed or if some IP Network Setting changes are done.

By the second “Start Sensor Network” and third “Stop Sensor Network” buttons can be controlled the Modbus RS485 line where bus converters are connected. This function is mostly used for power cycling the bus converters along with the whole sensor network.

Figure 65: Reboot System and Sensor Network Control Buttons

4.13.2 IP Network Settings

In IP Network Setting section are set all necessary network information for correct functionality of web server in a network. If any changes are done on the IP Network Settings the system needs to be rebooted. For this reason the “Reboot System” button is placed above the Host Configuration window.

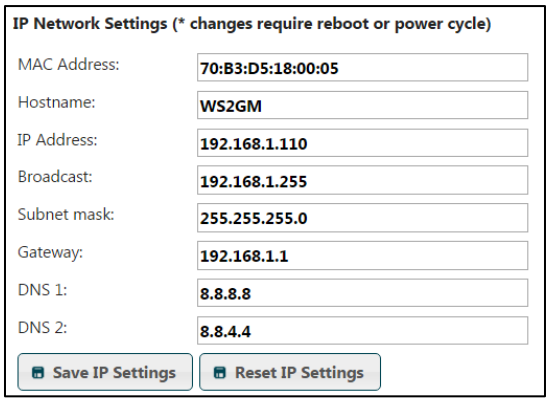


Figure 66: IP Network Settings

In the IP Network Settings are following fields:

- **MAC Address** – MAC address of the web server
- **Hostname** – Assigned hostname of the web server
- **IP Address** – IP address of the web server
- **Broadcast** – Broadcast IP address of the web server
- **Subnet mask** – Subnet mask of the web server
- **Gateway** – Gateway IP address
- **DNS 1** – DNS 1 server IP address
- **DNS 2** – DNS 2 server IP address

To save the set IP Network Settings press “Save IP Settings” button. If default IP settings should be set press “Reset IP Settings” and all IP Network Settings will be set to default values.

4.13.3 Date and Time Settings

In this section is set time and date of the web server. It can be synchronized from Internet or it can be set manually.

In the first part is current time and current time zone which is set on the web server, see Fig 59.

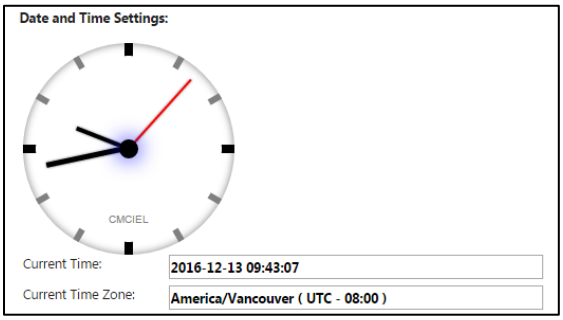


Figure 67: Host Current Time and Time Zone

In the second section are filed which are set in case the time and date should be set manually. The desired time and date is set and then “Set Host Time Manually” is pressed, this will set the time and date chosen by user.

In case the time should be set from the internet the “Set Time From Internet” button has to be pressed.

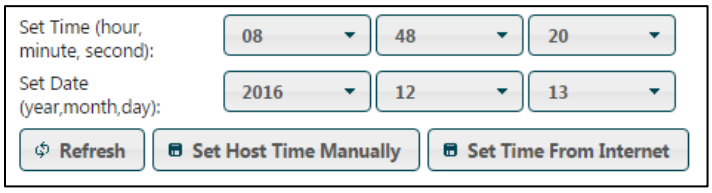


Figure 68: Host Time and Date Setup

In the last part is a field to choose a time zone which the web server should be se to. User can set the desired time zone and then press the “Set Zone” button to set it.

Figure 69: Host Time Zone Setup

4.13.4 Share Folders

To have easier access to files which are on web server there is an option to have shared folder which can be access from computer without the need of using web browser. For example from windows these files can be accessed from windows explorer.

To create the access to the folders which are listed below User Name and Password for those has to be created. This is done in the Share Folder(s) section. The User Name is “ws2share” by default and can’t be modified. Password can be chosen. When the password is set the “Save” button needs to be pressed.

Figure 70: Share folders User Name and Password

When the password is saved user can go for example to windows explorer as is on Fig 63 and type in IP address of the web server in this format \\192.168.1.115. Dialog for login will open. Saved user name and password has to be entered to access the folder shown on the Fig 62.

User with rights to configure a host can change the password to access the shared folder and save them. However the newly set password will take a place in case the PC where the password was changed from will be rebooted or different user will be logged into the computer. Otherwise the old password will be working and no login dialog for login will be opening.

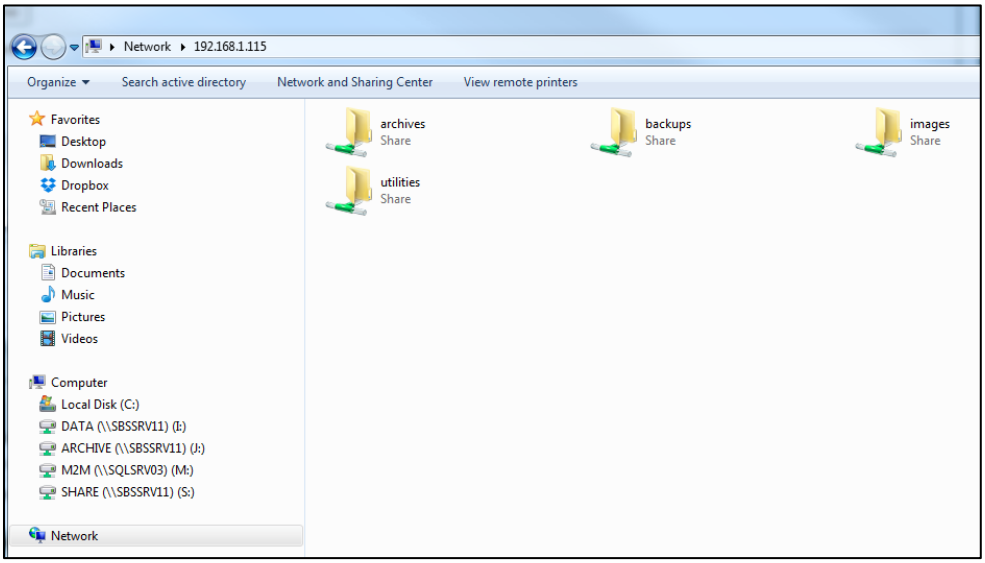


Figure 71: Shared Folders Accessed from Windows Explorer

This feature allows customer to access certain files without need of using web browser. As it is visible on Fig 53 the shared folders contain *archives, backups, images* and *utilities*. Regards to the archives, backups and utilities the same files can be accessed from web browser and this feature may make it easier to access from the windows explorer. Regards to the images, these pictures can't be easily accessed from the web browser and it is most likely the only possible way how to obtain the images of machines, either the default ones or the custom ones. To obtain the machine images may be needed if user needs to create a same configuration with the same types of machines on another web server.

4.13.5 Host Information

By default there will be no information presented about host until clicked on "Show Host Info" button. When the button is pressed following information is presented:

- **CPU usage** – In a graph is presented usage of CPU in % at a time. Range of the graph is automatically scaled. Example of graph is on Fig 64 where maximum range for the usage is 51.7%. Below the graph is also presented temperature of the CPU.

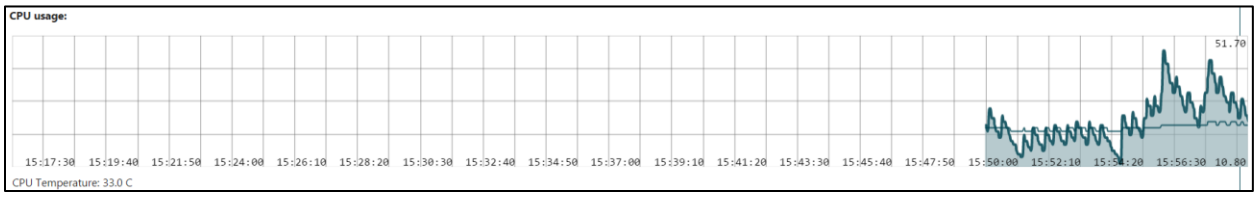


Figure 72: CPU Usage Graph Example

TBC

4.14 Modbus Register View

Modbus Register View is very useful tool which helps to user with setting of the Modbus registers structure. In appendix 1 – Modbus Communication is described how each register for bin and sensor look like but this tool will help to see which bin and sensor is assigned to which register. This will make it very easy for programmers who will program additional devices, as PLC, which functionality will depend on data provided from Grain Management System through Modbus.

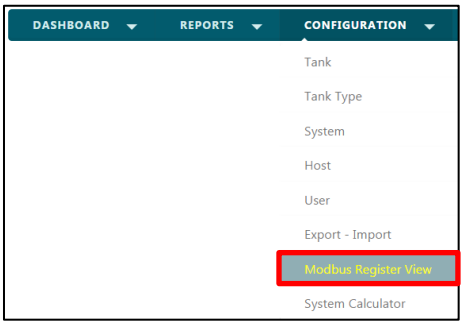


Figure 73: Modbus Register View Access

On Fig 66 is example of assigned register to one bin and one sensor. The color code is the same as in the tables for register structures in the appendix 1 – Modbus Communications. Red is for system registers, blue is for bins registers and green is for sensors registers. Description of each column follows.

MODBUS Ouput (RAW Readings)

## Register Address	Output Register	State	Max	Average	Bin Name	Sensor Name
0	0	19627 [Watchdog]				
1	1	0 [Reserved]				
2	1	32768 [Flags:] [Level: 0]	240	235	bin_20	
770	1	32867 [Flags:] [Units: 99]	2375		bin_20	Amb_Bin2

Figure 74: Example of Modbus Register View

- **## Register Address** – It presents the raw number of register in Modbus structure, to be in the exact number of register in Modbus, 40001 has to be added to the number
- **Output Register** – This presents number of register which user assigned. For Bins and sensors it is always in range 1-256
- **State** – Indicates state of the System, Bin or Sensor, for further information see appendix 1 – Modbus Communications. In this case there is incrementing watchdog timer on register 0, No flags and 0 level on bin assigned to register 2 and no flag and °C units for sensor assigned to register 770.
- **Max** – Shows maximum value in Bins and on Sensors, it depends on the setting of system and sensor in which way the value will be represented. In this case the bin is represented in °C with one decimal so max temperature in bin is 24°C. Sensor is also read in °C and it shows two decimals, max temperature on sensor is 23.75°C.
- **Average** – Average temperature is presented for bin only. The representation is the same as for max temperature in °C and with one decimal number, reads 23.5°C.
- **Bin Name** – Presents a name assigned to the particular bin
- **Sensor Name** – Presents a name of the sensor which is assigned to particular bin

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5. Specifications

Description	Characteristics
Power Supply	
Voltage	24VDC SELV/PELV
Current	Peak 2A (48VA)
	Avg. 0.4A (12VA)
Ethernet	
10BaseT	RJ-45 jack
Bus Converter Communication	
Standard	RS485 differential
Distance	500m (1640ft.)
Termination	120Ω
Environment	
Temperature	0 to 50C (32 to 122°F)
Relative Humidity	0 to 70% non-condensing
Dimensions	
Depth	76.2 cm (3.0 in)
Width	17.9 cm (7.05 in.)
Height	10.0 cm (3.93 in)
Industrial Interfaces	Modbus

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6. Appendix 1 - Modbus Communications

The WS2 communicates with a host computer or PLC using the Modbus/TCP protocol. The Modbus slave address for the WS2 is 1. The memory has been configured to simulate a PLC with 16 bit registers. These registers are divided into three sections, System, Bins and Sensors. More detailed description of each section follows.

Table 2: System Registers

SYSTEM		
Register	**Register Output set by User**	**Description**
0 (40001)	N/A	Watchdog Timer
1 (40002)	N/A	Reserved

Table 3: Bin Registers

<table>
<tr><th colspan="3">BINS</th></tr>
<tr><th>Register</th><th>Register Output set by User</th><th>Description</th></tr>
<tr><td>2-769
(40003-40770)</td><td>1-256</td><td>Each bin has reserved 3 16bit registers:
1st register contains state of the bin
2nd register contains maximum value for the bin
3rd register contains average value for the bin</td></tr>
<tr><td colspan="3">1st bin register structure
<table>
<tr><td colspan="6">Flags</td><td>Bin Level 0-21</td></tr>
<tr><td>0x8000</td><td>0x4000</td><td>0x0800</td><td>0x0400</td><td>0x0200</td><td>0x0100</td><td>0x0000-0x00FF</td></tr>
<tr><td>Data Online</td><td>Rate of Rise</td><td>High Alarm</td><td>High Warning</td><td>N/A</td><td>N/A</td><td>Tank Level</td></tr>
</table>

0x8000 is set when there is bin online data
0x4000 is set when Rate of Rise alarm is triggered
0x0800 is set when High Alarm is triggered
0x0400 is set when High Warning is triggered
0x0200 Not Used
0x0100 Not Used
Indicates level of the grain in bin 0-21 (cells/sensors)
</td></tr>
<tr><td colspan="3">2nd bin register structure
Second register carries maximum temperature in the bin. The data is real temperature value multiplied by 10. Temperature is presented in units which are set in the System settings of the web server.</td></tr>
<tr><td colspan="3">3rd bin register structure
Second register carries average temperature in the bin. The data is real temperature value multiplied by 10. Temperature is presented in units which are set in the System settings of the web server.</td></tr>
</table>

Table 4: Sensor Registers

<table>
<tr><th colspan="3">SENSORS</th></tr>
<tr><th>Register</th><th>Register Output set by User</th><th>Description</th></tr>
<tr><td>770-1537
(40771-41538)</td><td>1-256</td><td>Each sensor has reserved 3 16bit registers:
1st register contains state of the sensor
2nd register contains value of the sensor
3rd register Not used</td></tr>
<tr><td colspan="3">1st sensor register structure
<table>
<tr><td colspan="6">Flags</td><td>Sensor Units</td></tr>
<tr><td>0x8000</td><td>0x4000</td><td>0x0800</td><td>0x0400</td><td>0x0200</td><td>0x0100</td><td>0x0000-0x00FF</td></tr>
<tr><td>Data Online</td><td>Rate of Rise</td><td>High Alarm</td><td>High Warning</td><td>Low Warning</td><td>Low Alarm</td><td>ID of sensor units</td></tr>
</table>

0x8000 is set when there is sensor online data
0x4000 is set when Rate of Rise alarm is triggered
0x0800 is set when High Alarm is triggered
0x0400 is set when High Warning is triggered
0x0200 is set when Low Warning is triggered
0x0100 is set when Low Alarm is triggered
Indicates ID of units of the particular sensor
</td></tr>
<tr><td colspan="3">2nd sensor register structure
Second register carries value of the particular sensor. The data contains converted value as it was set in the sensor configuration. The value is multiplied by multiples of 10 depends on how many decimals is set in sensor configuration. If the sensor is set to have 2 decimals the value is multiplied by 100.</td></tr>
<tr><td colspan="3">3rd Not Used</td></tr>
</table>