Eldar Shany

Climate control software

For Galileo and Elgal

Version 2.03, 2.04

User manual

Edition 2 – November 2003

P.N. 0700371222

 www.eldarshany.com **Mailto: mail@eldarshany.com**

Galileo Climate control

Index

Introduction

The subject of this manual is ***Eldar-Shany*** software for Climate Control in greenhouses. This software is one of few applications that can be applied with *Galileo* (and Elgal) controller.

The installation and basic operation of the Galileo is widely discussed in the manual **"Galileo Setup".** It is essential to study the Galileo Setup manual and follow its instructions during the installation process. Some parts of the current manual refer to the Setup manual, and will be difficult to understand without this background.

One *Galileo* controller can have two or four appearances of this software, hence operate two or four fully facilitated greenhouses. We call those appearances "Systems".

Most of the controlled components and processes have several appearances in a system. The table below describes the possible numbers of each component:

Components	Appearances	Remark
Windows (Vents)	10	Roof Included. Duplication voided
Thermal/Shading screen	2	Duplication voided
Side wall fans	4	Fans are often electrically grouped. Duplication permitted
Cooling device	4	Duplication permitted
Heating devices	4	Direct ON-OFF. Duplication permitted
Hot water circles	4	3 way valve + pump
CO_2 enrichment devices	4	Duplication permitted
Sprayers/Foggers	4	Duplication permitted
Free auxiliaries	4	Used mostly as air circulators

Besides directly operated components, we also introduce **Processes**. A process is when several components are combined in a program to influence a factor in the greenhouse. The engagement between a process and components is mostly flexible: Components may participate one or more processes or be idle. When a component participates in a process – the process overrides its direct control.

Process	Appearances	Major participants	Mare participants
Cyclic ventilation	4	Fans, Windows	Circulators
Special ventilation	4	Fans, Windows	Circulators
Heating	4	Heating devices	Windows
Cooling	4	Cooling devices, Fans	Windows
CO_2 enrichment	4	CO_2 generators	Windows
Spray	4	Foggers, Circulators	Windows

The processes will be widely described in the chapter of the leading component.

First step: Greenhouse Setup

Before starting to program greenhouse components, several actions should be taken that affect the entire greenhouse. As you will learn, some effect all greenhouses in the controller: meteorology setting and sensor linking, setting sensors groups of a specific greenhouse, and finally link these sensors (up to now – a controller's property) to each one of the greenhouse components and processes.

Meteorology Setting

The program uses methods that enable more balanced work with wind speed and direction. Although sensor values may change rapidly, changes inside greenhouses must be more moderate. It takes time for windows and screens to take effect, and it takes even more time until we can read the results of an action on the internal sensors. In addition, frequent activity causes high component erosion.

Our method for dealing with this is to divide the possible wind speed into 6 stages (0-5). Each client sets the value required for stages changes and 2 timers: one is a minimal time period at a certain speed for switching to a higher stage, and the other is a minimal time period at low wind to switch to a lower stage. The components and processes influenced by wind velocity now refer to these stages, and not to operating speed. Default values are quite safe. If your greenhouse is well build, and can withstand stronger wind – you may want to change these values.

Common wind direction sensors are “swing” up to 20 degrees in each direction. These swings are not desirable for agriculturists using wind direction to control greenhouse windows. A spatial timer enables us to set a measuring interval, assuming that wind speed does not change too quickly.

Please refer to Elgal Setup manual chapter 1 to learn more of meteorological definitions and recommended set values.

To set all meteorology sensors and inputs connection - see the I/O setup chapter in the Hardware part.

Grouping of Sensors

Till now, all sensors were connected and defined by a controller's property. Now, if you have installed more then one sensor of a kind in each chamber, you may want to group them in (the most common) an average group. Creating a group will provide you not only with a more balanced reading, but will also ensure that the group's value will not be effected by a faulty sensor.

Other possible groups are Highest, Lowest and Difference groups. Highest and lowest can be used in case of a crop with very high sensitivity, and a difference group enables cause activation of a component (for example) based on a difference between indoor and outdoor temperatures.

The groups are actually part of the sensors registration tables (Temperature, Humidity and General tables). Using 1 to 20 you can register sensors from the sensor definition table. Numbers 21 to 40 are pre-assigned to groups.

Each group is used for up to 4 sensors. But you can register a group within a group, and thus create a larger group.

Text in controller **Text in PC**	Description	Code	Recommended value
Sns. Group type * Set Group Type	Use the Select button to pick the type of group you want, as explained above. Options are: Average, Lower, Higher, Differ.	5131 #1	Average
Tmp. Sensor No. Tmp. Sensor No.	Pick a sensor from the Temperature sensors table to be the first participant in the group.	5131 #2	
Tmp. Sensor No. Tmp. Sensor No.	Pick a sensor from the Temperature sensors table to be the second participant in the group.	5131 #3	
Tmp. Sensor No. Tmp. Sensor No.	Pick a sensor from the Temperature sensors table to be the 3rd participant in the group.	5131 #4	
Tmp. Sensor No. Tmp. Sensor No.	Pick a sensor from the Temperature sensors table to be the 4th participant in the group.	5131 #5	
Sns. Group type * Set Group Type	Use the Select button to pick the type of group you want, as explained above. Options are: Average, Lower, Higher, Differ.	5132 #1	Average
Hum. Sensor No. Hum. Sensor No.	Pick a sensor from the Humidity sensors table to be the first participant in the group.	5132 #2	
Hum. Sensor No. Hum. Sensor No.	Pick a sensor from the Humidity sensors table to be the second participant in the group.	5132 #3	
Hum. Sensor No. Hum. Sensor No.	Pick a sensor from the Humidity sensors table to be the 3rd participant in the group.	5132 #4	
Hum. Sensor No. Hum. Sensor No.	Pick a sensor from the Humidity sensors table to be the 4th participant in the group.	5132 #5	
Sns. Group type * Set group type	Use the Select button to pick the type of group you want, as explained above. Options are: Average, Lower, Higher, Differ.	5133 #1	Average
Gen. Sensor No. Gen. Sensor No.	Pick a sensor from the General sensors table to be the first participant in the group.	5133 #2	
Gen. Sensor No. Gen. Sensor No.	Pick a sensor from the General sensors table to be the second participant in the group.	5133 #3	
Gen. Sensor No. Gen. Sensor No.	Pick a sensor from the General sensors table to be the 3rd participant in the group.	5133 #4	
Gen. Sensor No. Gen. Sensor No.	Pick a sensor from the General sensors table to be the 4th participant in the group.	5131 #5	

Constant Greenhouse Settings

Defining the system number used by the greenhouse when its data is saved on the PC, the time interval for recording data on the PC, and whether the greenhouse is active or not, are all important actions that we recommend you perform after setting all other components and processes. From here, PC users can access 2 common windows where sensor assignment to that a greenhouse's component and processes is performed. Until now, this was defined as a controller property. For non-PC users, this assignment is performed in each component/process setup menu.

Text in controller **Text in PC**	Description	Code	Recommended value
G.House active? * Yes/No G.House active? Yes/No	Use the Select button or mouse to activate/inactivate the entire greenhouse	532(n)11 #1	
G.H. No. for msg. G.H. No. for messages and data collection.	Important!!! Each system (i.e. Greenhouse, Irrigation, Poultry, Nursery, Open field) connected to the same PC MUST be given a unique system number. Otherwise, data for systems with identical numbers will be written to the same PC file, resulting in nonsense data.	532(n)11 #2	
Info cycle mnt Data collect cycle - minutes	The time interval between data recording sessions on the PC.	532(n)11 #3	20
Int. tmp. tmp. No. (For display) Tmp. Sensor No.	Pick the most representative sensor (usually from sensor groups) to be the one that displays the greenhouse's temperature in the rapid display.	532(n)12 #1	
Int. Hum. Hum. No. (For display) Hum. Sensor No.	Pick the most representative sensor (usually from sensor groups) to be the one that displays the greenhouse's humidity in the rapid display.	532(n)12 #2	
Int. Rad. Gen. No. Rad. Sensor – Gen No.	If the greenhouse is equipped with an internal radiation sensor, which is defined in the General sensors table – type the sensor number here.	532(n)12 #3	
Int. CO2 – Gen. No. CO2 sensor – Gen. No.	If the greenhouse is equipped with a CO2 sensor, which is defined in the General sensors table – type sensor's number here. For a CO2 scanning point on the same controller – type a number from 71 to 80, according to the point. For a CO2 scanning point originating via communication – type the imported number from 31 to 60.	532(n)12 #4	

Sensors for data logging

You can select the sensors that will be visible in the greenhouse information panel from among all the sensors available in the controller. This also includes sensors originating from another controller whose data is transmitted via the communication center.

However, In most cases, you will prefer to see only the sensors that are actually located in a certain greenhouse. For instance: if greenhouse No.1 has 2 dry-wet temperature-humidity cells, and you bind them into group No. 21, you will naturally set all the greenhouse components to operate based on that group, and you will be able to view data from them in all component information screens. Nevertheless, you may still be interested in individual sensors, to ensure that they are balanced. In this case, you will set the following sensors for display: A) 1, B) 2, C) 21. You may wish to see the outdoor sensor, which you can set in D.

The above settings also define the appearance of data in the PC file (see the Data Collection chapter). First 12 columns (after the time column) are reserved for temperature sensors. Defining the above will cause data to appear in the first 4 columns and leave all the other columns blank. Otherwise, of you leave the default setting, you will find data from another greenhouse or simply see some columns showing –9999, since no sensors are assigned to the columns.

According to our concept, here too you can define a division for the Temperature sensors list, Humidity sensors list, and General sensors list. The entered numbers are from the controller's list of Temperature, Humidity and General sensors.

Text in controller **Text in PC**	Description	Code	Recommended value
Clim. Tmp. For info.	Fill the sensor numbers from the Temperature sensors table, in the order you want them to be shows in the information file.	532(n)131 #1 vertical 1-10	2x,external
Clim Hum. For info.	Fill the sensor numbers from the Humidity sensors table, in the order you want them to be shown in the information file.	532(n)132 #1 vertical 1-10	2x, external
Clim Gen. For info.	Fill the sensors numbers from the General sensors table, in the order you want them to be shown in the information file.	532(n)133 #1 vertical 1-10	

Greenhouse Alarms

Three types of greenhouse alarms are available: alarms by sensors, alarms by discrete inputs and controller alarms which are not directly related to the greenhouse, but to general faults that may occur in the controller.

Alarm by sensor:

The sensors you set to receive an alarm from, are the same sensors, and in the same order, as those you chose for information in the previous menu (Information sensors).

The values you set here differ from the alarm values you have set during sensor definition. The values you set there were values that indicate a sensor fault. Now you have to set the value in actual units (degrees, percentages or any other unit). When a

sensor reaches this value – it indicates a problem in the greenhouse, and should activate an alarm.

Alarm by discrete input:

This alarm type indicates a failure in a device in the greenhouse. The device you want to be alerted on trip must be equipped with a dry contact that closes on trip. If the contact is connected to one of the discrete inputs, it can be used to activate an alarm.

Alarm by controller:

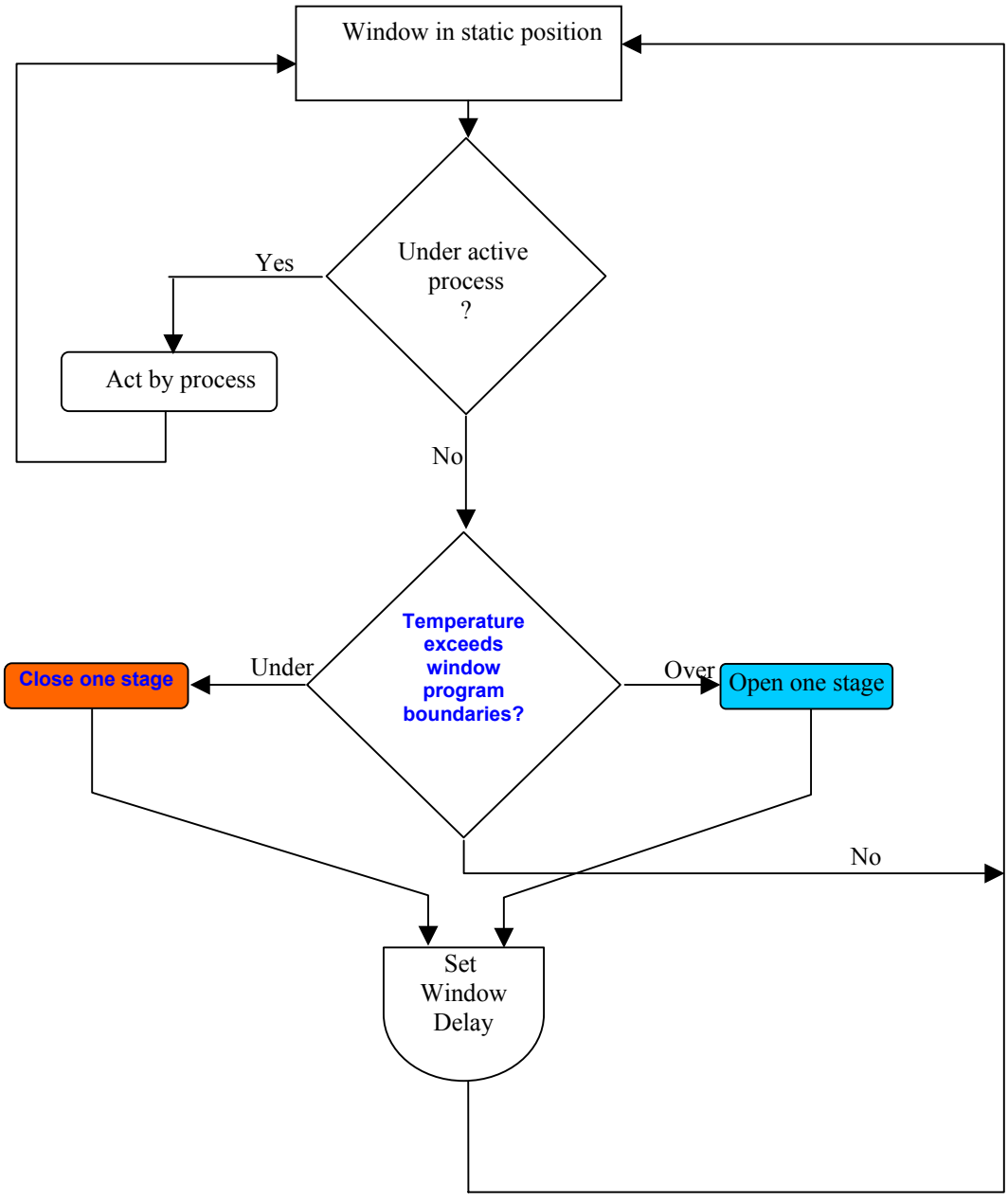
The program continually scans the memory area and checks data integrity. If an error is encountered, the system operator is alerted.

Text in controller **Text in PC**	Description	Code	Recommended value
Low tmp. below	Sets off an alarm when the temperature sensor's value drops below a set point.	532(n)142 #1 vertical 1-10	10 or higher
High tmp. Above	Sets off an alarm when the temperature sensor's value rises above a set point.	532(n)142 #2 vertical 1-10	40 or lower
Alarm No./when	**Alarm No**. in controller – the digit to the left of the dot. In a PC – the digit to the left of the slash. If an alarm output (and device) were assigned to a climate alarm – write the number of that output. If no output was assigned, you can leave it zero. In this case, the alarm will be displayed on the controller's LCD and on the PC screen (if exist) only. **When** in controller – the digit to the right of the dot. In a PC – the digit to the right of the slash. This also refers to real output activation only. Write <1> to be alerted day and night, <2> for night alerts, <3> for day alerts, and <0> to prevent that sensor from alerting you any time.	532(n)142 #3 vertical 1-10	?/1 Warning! Set 0 to the right of the slash to neutralize the alarm!
Low Hum. below	Sets off an alarm when the Humidity sensor's value drops below a set point.	532(n)143 #1 vertical 1-10	30 - 10
High Hum. Above	Set alarm when the Humidity sensor's value rises above that set point.	532(n)143 #2 vertical 1-10	80 - 100
Alarm No./when	**Alarm No**. in controller – the digit to the left of the dot. In a PC – the digit to the left of the slash. If an alarm output (and device) were assigned to a climate alarm – write the number of that output. If no output was assigned, you can leave it zero. In this case, the alarm will be displayed on the controller's LCD and on the PC screen (if exist) only. **When** in controller – the digit to the right of the dot. In a PC – the digit to the right of the slash. This also refers to real output activation only. Write <1> to be alerted day and night, <2> for night alerts, <3> for day alerts, and <0> to prevent that sensor from alerting you any time.	532(n)143 #3 vertical 1-10	?/1 Warning! Set 0 to the right of the slash to neutralize the alarm!

Low Gen. below	Sets off an alarm when the General sensor's value drops below a set point.	532(n)144 #1 vertical 1-10	30 - 10
High Gen. Above	Sets off an alarm when the General sensor's value rises above a set point.	532(n)144 #2 vertical 1-10	80 - 100
Alarm No./when	**Alarm No**. in controller – the digit to the left of the dot. In a PC – the digit to the left of the slash. If an alarm output (and device) were assigned to a climate alarm – write the number of that output. If no output was assigned, you can leave it zero. In this case, the alarm will be displayed on the controller's LCD and on the PC screen (if exist) only. **When** in controller – the digit to the right of the dot. In a PC – the digit to the right of the slash. This also refers to real output activation only. Write <1> to be alerted day and night, <2> for night alerts, <3> for day alerts, and <0> to prevent that sensor from alerting you any time.	532(n)144 #3 vertical 1-10	?/1 Warning! Set 0 to the right of the slash to neutralize the alarm!
Al. Inp.- Alarm No./when	**Alarm No**. in controller – the digit to the left of the dot. In a PC – the digit to the left of the slash. If an alarm output (and device) were assigned to a climate alarm – write the number of that output. If no output was assigned, you can leave it zero. In this case, the alarm will be displayed on the controller's LCD and on the PC screen (if exist) only. **When** in controller – the digit to the right of the dot. In a PC – the digit to the right of the slash. This also refers to real output activation only. Write <1> to be alerted day and night, <2> for night alerts, <3> for day alerts, and <0> to prevent that sensor from alerting you any time.	532(n)145 #1 vertical 1-10 Mark only the inputs that are relevant to the current greenhouse.	?/1

Chapter 2 - Windows

Windows (or curtains in previous systems) are the most fundamental component of a greenhouse. They are members of the staged family. Their static position can be set at any stage. Elgal software version 2.04 enables constructing of up to10 windows in each greenhouse chamber, including roof windows.



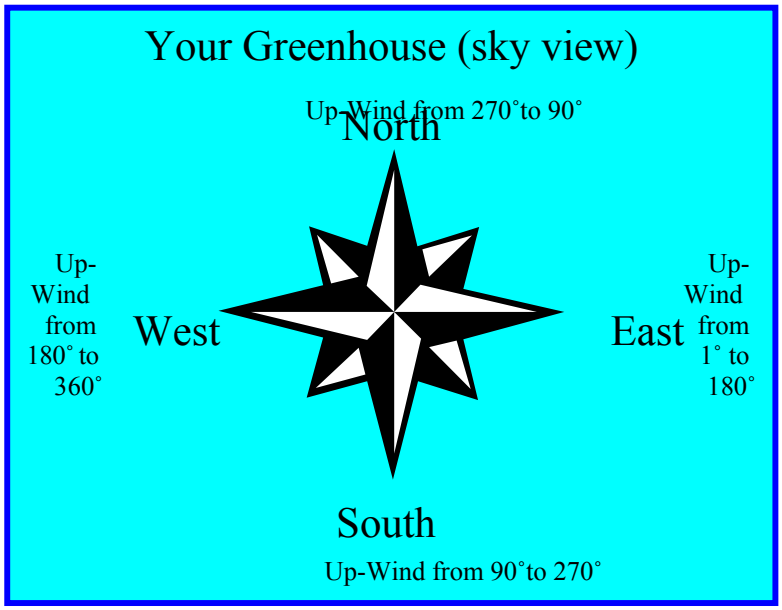
Several processes effect windows. Some processes effect all windows and others only effect those they are set to respond to. The following tables describe the effect of each process on greenhouse windows, where the red arrow indicates the direction (closing or opening) and blue spot indicated that all windows are effected by the process.

Windows setup

Text in PLC Text in PC	Description	PLC code		
Motor Oper. Time Full Window Operating Time- sec	The time measured for full motor opening after adjustment of the upper and lower limit switches.	532(n)251 #1		
No. of Wndw Stages Level No. for Full Opening	Full opening can be divided into up to 10 fractions (stages). A delay is set after each move.	532(n)251 #2		
1'st stg. Time sec. Time for Opening 1st Level – sec	In some greenhouses, the first opening stage partly overlaps the lower, fixed part of the wall. For that stage only, a spatial stroke time can be given. The time remaining from the time defined in the previous parameter is divided equally between the other defined stages.	532(n)251 #3		
Oper. Delay sec. Window Operations Delay - sec	A delay that is set after each window move – up or down – to give time for the sensors to sense the effect of the move. This is the major balance of the greenhouse, which every operator has to study his own characteristics. The delay is sometime canceled or reduced by the program due to spatial conditions.	532(n)251 #4		
Up wind from deg. Wind Direction from: 0-360	The direction of the window is a set at 2 azimuths, indicated as From and To. It is common to set a spectrum of 180 degrees of the effecting side-of-wind. However, a smaller spectrum is acceptable, all according to the greenhouse's structure.	532(n)252 #1		
Up wind to deg. Wind Direction until: 0-360		532(n)252 #2		
Temp Sensor No.	Sensor from the Temperature sensors table or the Sensor groups table based on which the window operates.	532(n)253 #1		
Hum Sensor No.	Sensor from the Humidity sensors table or the Sensor groups table based on which the window operates.	532(n)253 #2		
Gen. Sensor No.	If the window equipped with a potentiometer that indicates its position – list that sensor in the General sensors table and fill in its number in the table here.	532(n)253 #3		
G.sns at Full Open Status Sensor Value at Max. Opening	The value received from the window's potentiometer when the window is fully opened	532(n)26 #1	This function is not	

G.sns diff for Alarm Status Sensor Differ for Alarm	Diversion from expected value that sets off an alarm and performs window calibration once an hour.	532(n)26 #2	not applicable in this version!	
Start adjust time Windows Calibration Start Hour	In windows in which a potentiometer sensor is not used (in most cases), the controller does not have actual information about the current position (stage) of the window. The controller's assumption regarding the current position is based on the actions it has performed since the last closed position. However, manual actions or unperformed actions (due to a power cut-down or motor fail) are not listed. In such cases, we recommend execution of a "Window adjustment" at least twice a day. When a window adjustment action is performed, the window goes all the way down and then climbs back up to the required position.	532(n)21 #1		
End Adjust Time Windows Calibration Stop Hour		532(n)21 #2		
Adjust Cycle Mnt Windows Calibration Cycle - Minutes	To set two adjustment sessions between 12:00 and 19:00, enter 400 minutes here.	532(n)21 #3		

Elgal system is capable of managing your windows according to wind speed and direction if your project is equipped with the proper sensors. All you have to do is to set the window direction in Windows Setup screen as follows:



Important! In case of self-construction, make sure the climate station is facing North. This is the only way to adjust the wind direction sensor.

Wind and Rain Conditions

Once the window direction is defined, the control program no longer monitors the actual wind direction, but rather monitors the flag that indicates whether or not the wind is in the Window Direction. Each window can have its own set for requested levels for each wind level that define whether the wind is Upwind or Downwind. There is also a connected table for levels in rainy condition. The 2 tables are in codes 532(n)271 (No Rain stage) and 532(n)272 (Rainy stage). Each table has sub-tables for upwind and downwind, and each one of them has a set value for the maximum stage at each wind velocity level. In the PC software, it is all in one window, when you click the **Wind/Rain Conditions Setting** from the main window's Information window.

Windows Connecting to Other Components and Process(Additional Conditions)

Text in PLC Text in PC	Description	PLC code	
Oper. with Fans. No. Oper. During Fan Oper. No.	Creates the link between the window and a group of fans. The link refers to the two following parameters. Writing '13' will make the window respond to operating fans group 1 and 3.	532(n)24 #1	
Min. Stg at Vent Min Level During Fan Oper. 0-10	Do not let the window close lower then that level at which the linked fans are on.	532(n)24 #2	
Max. Stg at Vent Max Level During Fan Oper. 0-10	Do not let the window open higher then that level at which the linked fans are on.	532(n)24 #3	
Min. Stg. at V. Proc Min Level During Vent Proc. 0-10	Vent processes, such as circular ventilation and spatial ventilation, will raise the window to the specified level when they are activated. If the window is opened more, due to the temperature, this will have no effect.	532(n)24 #4	
Oper. At Cool No Operate During Misting No. 0-1234	Creates the link between the window and a cooling **process.** The link refers to the following parameter. Writing '24' will make the window respond to cooling processes No. 2 and 4.	532(n)24 #5	
Fix Stage at Cool Window Level During Cooling 0-10	If the window is linked to a cooling process in the previous parameter, it will be set at the required level when the specified cooling process is on.	532(n)24 #6	
Min. Stage at Day Min. Window Level at Day 0-10	Minimum window level for daytime – to maintain a certain air circulation in the greenhouse regardless of the temperature.	532(n)24 #7-8	
Min. Stage at Night Min. Window Level at Night			

Temperature Condition Programming

This is the main setting table of the most basic greenhouse component, yet it is surprisingly simple. In most greenhouses, all you will need to do is set the day temperature, night temperature and the differential. Note that most of the time greenhouse windows will act as slaves of processes. Windows will operate based on the values in this table only when no process is active.

Text in PLC Text in PC	Description	PLC code	
Temp. to Open Day Day Open Temp – Above	The temperature for opening the window during daytime (see controller setup for day and night definition, code 511 #2-3)	532(n)23 #1	
Diff. to Close Day Day – Diff to Close	The differential for balancing window operation during the day.	532(n)23 #2	
Temp to Open – Night Night Open Temp. – Above	The temperature for opening the window at nighttime (see controller setup for day and night definition, code 511 #2-3)	532(n)23 #3	
Diff. to Close Night Night – Diff. to Close	The differential for balancing window operation at night.	532(n)23 #4	
Temp to Open "1"… "3"	An option for defining spatial temperature settings for up to 3 day segments. Defining day segments in controller code 532(n)221, and in PC, is performed in this window.	532(n)23 #5,7,9	
Diff. to Close "1" … "3"	The differential for balancing the window during the day segment.	532(n)23 #6,8,10	
Start Time	Day segment (n) start time	532(n)221 #1	
End Time	Day segment (n) end time	532(n)221 #2	
Temp Sensor No.	An option enabling reference to a spatial sensor during the segment time. Pick a sensor from the Temperature sensors or Groups table.	532(n)221 #3	
Hum. Sensor No.	An option enabling reference to a spatial sensor during the segment time. Pick a sensor from the Humidity sensors or Groups table.	532(n)221 #4	

Avoiding Low Humidity:

The humidity control feature for windows is new in version 2.04A3. This is the opposite method to the cyclic ventilation, and is aimed at avoiding undesirable low humidity that results in high plant transpiration. It is restricted to day segment, and is never activated if day segments are not set properly.

Text in PLC Text in PC	Description	PLC code	
Hum. to Oper. Below Low Hum. to Start Hum. Accumulation	If the humidity in the day segment drops below this point, the greenhouse is status is set as Low Humidity.	532(n)2221 #1	
Hum. Diff. to Stop Hum. Diff. to Stop Hum. Accumulation	The humidity differential that indicates the end of Low Humidity status.	532(n)2221 #2	
Add. to Open Temp Addition to "Window Open Temp." Set Point	Allow the greenhouse temperature to be higher in order to attain higher humidity. This is performed by changing the opening set-point of all the windows.	532(n)2221 #3	
Tmp. Diff. to Cancel Diff. from "Window Open Temp" Set Point to Stop Process	If the temperature exceeds the original window set point in this value – the Low Humidity flag will go down and greenhouse will return to its original setting.	532(n)2221 #4	
Max. Stage/low hum Max Level at "Low Humidity"	When the greenhouse status is set as Low Humidity, based on the segment's definition, the window will not be allowed to open more than this stage.	532(n)2222 #1	

Note! – Fans will not operate when all windows are closed except of vacuum process (strong wind)

Note! – Ventilation processes can operate even if no fans exist at all! In this case, these processes will only effect windows

Chapter 3 - Fans operation and ventilation processes

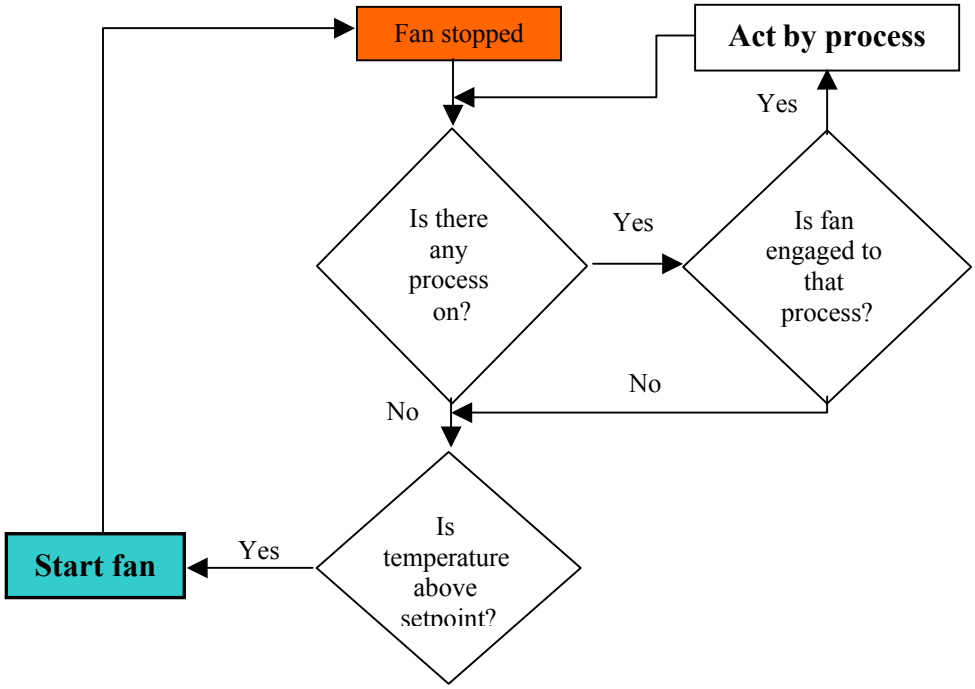
General

In most greenhouses were fans are installed, there are more fans then the system can control. Therefore, the fans are electrically divided to few groups (not more then 4). Each group operated by a single output. . When we refer to fans, we generally mean a group that is operated by a defined output.

Important note!! – Fans can not operate if there is no correlated window opened in the greenhouse. In case your greenhouse doesn't have automatic windows, or the windows you have does not suppose to open with the fan – you must define a virtual window (with outputs definition) and set it to open with fans (code 5322(n)4 #1, and #2, #3 > 0).

The only direct programming for the fans is day and night temperature. We create a type of Participation Table where we create a linkage between the fan and a process. Example: Fans No. 1 and 3 operate with cooling process No. 1, and fans 2 and 4 operate with cooling process No. 2. The same is true for all other processes.

Basic fans operation chart



Fans programming - setup

Text in PLC Text in PC	Description	Menu code	
Fan active? Y/N Fan active? Y/N	Choosing "NO" makes the fan inactive	532(n)313 #1	
Operate at wind stage Wind level to operate fan for vacuum	When the wind speed reach this level – fans group will operate to make greenhouse cover and keep it from tear off.	532(n)313 #2	
Temperature sensor No.	The temperature sensor that this fans group refers to.	532(n)313 #3	
Humidity sensor No.	The humidity sensor that this fans group refers to.	532(n)313 #4	
General sensor No.	The general sensor (in any) that this fans group refers to.	532(n)313 #5	

Fans operation for reducing temperature and at cooling.

Text in PLC Text in PC	Description	Menu code	
Operate temperature at day Day oper. Temp. above	The temperature to start fans group when no process is active.	532(n)3111 #1	
Diff to stop day Day – temp. diff to stop.	A differential to balance the fan operation	532(n)3111 #2	
Operate temperature at night Night oper. Temp. above	The temperature to start fans group when no process active.	532(n)3112 #1	
Diff to stop night Night – temp. diff to stop.	A differential to balance the fan operation	532(n)3112 #2	
Operate at cool No. Oper. During cool proc. No. (0000-1234)	Creates the linkage between each fans group and each cooling process. For example: writing 12 in group 1 column indicates that fans group 1 to participate in cooling process 1 and 2. Writing 24 in group 3 column indicates that fans group 3 to participate in cooling process 2 and 4.	532(n)3113 #1	
Operate temperature at cool Operate Temp. during cooling - above	The temperature to start fans group when cooling process active.	532(n)3113 #2	
Temp. Diff to stop temp. diff to stop. During cooling.	A differential to balance the fan operation	532(n)3113 #3	
Diff. EXT>INT above Temp. diff. – external higher then internal – above	The set difference will become a necessary condition for operating the fan when no process is on. The outdoor temperature must be lower then the indoor temperature by at least this value to enable fan operation. Example: if you enter 4 here, and the fan's temperature is 28, the fan will operate only as long as outdoor temperature is lower the 24.	532(n)3114 #1	0
Low ext. hum below External Hum. To stop fans below	The minimal external humidity to enable fan operation when no process is on. When external humidity drops below this value, fans group will stop.	532(n)3114 #2	40

Link fan to process

Text in PLC Text in PC	Description	Menu code	
At cycle vent No. Operate during cyclic vent No. (0-1234)	Creates the linkage between each fans group and each cyclic ventilation process. For example: writing 12 in group 1 column will indicate fans group 1 to participate in cyclic ventilation process 1 and 2. Writing 24 in group 3 column will indicate fans group 3 to participate in cyclic ventilation process 2 and 4.	532(n)3121 #1	
At spatial vent No. Operate during spatial vent No. (0-1234)	Creates the linkage between each fans group and each spatial ventilation process. For example: writing 12 in group 1 column will indicate fans group 1 to participate in spatial ventilation process	532(n)3121 #2	

	1 and 2. Writing 24 in group 3 column will indicate fans group 3 to participate in spatial ventilation process 2 and 4.		
Before spray No. Operate during vent before spray No. (0-1234)	Creates the linkage between each fans group and each spray process. For example: writing 12 in group 1 column will indicate fans group 1 to participate in spray process 1 and 2. Writing 24 in group 3 column will indicate fans group 3 to participate in spray process 2 and 4.	532(n)3121 #3	
After spray No. Operate during vent after spray No. (0-1234)	Creates the linkage between each fans group and each spray process. For example: writing 12 in group 1 column will indicate fans group 1 to participate in spray process 1 and 2. Writing 24 in group 3 column will indicate fans group 3 to participate in spray process 2 and 4.	532(n)3121 #4	

Fans stop conditions

Text in PLC Text in PC	Description	Menu code	
At spray process Stop during spray process No. 0-1234	Create a stop condition of the marked spray process over the fans group. For example: writing 13 in group 2 will cause that group stop whenever spray 1 or spray 3 are running.	532(n)3122 #1	
At CO2 process No. Stop during CO2 process No. 0-1234	Create a stop condition of the marked CO2 process over the fans group. For example: writing 13 in group 2 will cause that group stop whenever CO2 process 1 or 3 are running.	532(n)3122 #2	
Fault input No. Fault input No. to stop fan operation.	A possibility to engage to a discrete input that indicates that the fan is in fault.	532(n)3122 #3	

Cyclic ventilation - humidity extraction process

Humidity extraction process is based on fans operating and opening the opposite side window for directed air flow inside the greenhouse and out. Therefor, as operator, you will be required to inform the system what kind of behavior you expect from each window when venting processes are on. Look in "More" screen in windows programming screen. However, humidity extracting process is unique in the control system because it can be mounted even if there are no fans at all. In that case, the process will act only on windows. That is the reason why you can not find any reference to humidity in windows programming screen: the right place to do it is here.

When the process is on, it is mostly set to act intermittent by the tow parameters "Operate time" and "Wait time". You must set a nonzero value in "Operate time" to make the process work. Wait time is optional, and the process will act nonstop if you leave it zero. "Min. operate" is for avoiding a very short pulse in case of **process** termination shortly after act start.

The columns are different processes which can be engaged to different fans an windows, or to the same ones for achieving different levels of humidity in different hours.

Cyclic ventilation setup

Text in PLC Text in PC	Description	Menu code	
Tmp. Tmp. Sns. No. Temperature sensor	Reference to temperature sensor (from temperature sensors table) or group to operate by.	532(n)3215 #1	
Hum. Tmp. Sns. No. Humidity sensor	Reference to humidity sensor (from humidity sensors table) or group to operate by.	532(n)3215 #2	
Gen. Tmp. Sns. No. General sensor	Reference to general sensor (from general sensors table) or group to operate by.	532(n)3215 #3	

Operate cyclic ventilation process

Text in PLC Text in PC	Description	Menu code	
Start time Cyclic vent – start time	Process start time	532(n)3212 #1	
End time Cyclic vent – end time	Process end time	532(n)3212 #2	
Hum. To operate above High humidity to operate – above	The humidity set point to operate the process within the time boundaries.	532(n)3212 #3	85
Humidity diff to stop. Hum diff. To stop	The differential in relational humidity percentage – the process stop if the humidity drops below the operate set point at that value. Example: if operate S.P. is 85 and the differential is 5, the process vil operate at RH of 85% and stop at 80%	532(n)3212 #4	5
Gen. Sns. To oper. Below Low gen. Sonsor value to oper. – below	Possibility of reference to the general sensor: you can set only one of the tow parameters.	532(n)3212 #5	
Gen. Sns. To oper. Above High Gen. Sensor value to operate – above		532(n)3212 #6	
Gen. Diff. To stop Gen sensor diff to stop	The differential in degrees refer to the above.	532(n)3212 #7	
Operate time min Work time - minutes	Related fans and windows will be activated for the set time in minutes while process is on.	532(n)3212 #8	
Wait time min	Control over related fans and windows returned to other	532(n)3212 #9	

Wait time - minutes	processes or direct control for the set time. Wait timer on countdown if process is on.		
Minimum operate time min Minimum work time – minutes	When related fans and windows are operated – they will operate for at least the set time, even if conditions no longer demand it.	532(n)3212 #10	

Stop conditions and priorities

Text in PLC Text in PC	Description	Menu code	
Low int. temp. below Int. low temp. to stop – below	Stop the process when the greenhouse internal temperature drops below the set value.	532(n)3213 #1	
Low ext. tmp. Below External low tmp. To stop - below	Stop the process when the external temperature drops below the set value	532(n)3213 #2	
Stop at cool No. Stop during cool no. 0-1234	Give priority to the specified cooling process	532(n)3213 #3	
Stop at spray No. Stop during spray process No. 0-1234	Disable process on the specified spray time.	532(n)3213 #4	
Stop at CO2 No. Stop during CO2 process No.	Disable process on the specified CO2 time. Else they are activated together, unless "maximum window level" in CO2 running process set 0. In that case the cyclic ventilation will be voided.	532(n)3213 #5	

Adjust wait time: wait time and work time can be automatically modified by program due to external temperature.

Text in PLC Text in PC	Description	Menu code	
High ext. temp. above External high temp. – above	Start to reduce the process cycle intervals due to external temperature	532(n)3211 #1	
Dec. wait time mnt. Decrease wait time minutes	The set value will be decreased from wait time once, if external temperature is above the previous parameter at the "on" time start. Else pre-decreased wait time will return to original set.	532(n)3211 #2	
Low ext. temp. – below External low temp. – below	Start to enlarge the process cycle intervals due to external temperature	532(n)3211 #3	
Inc. wait time - min Increase wait time - minutes	The set value will be added to wait time once, if external temperature is above the previous parameter at the "on" time start. Else pre-increased wait time will return to its original set.	532(n)3211 #4	

Operate on heating failure.

An active process can have cycle time change due to heating system failure.

Text in PLC Text in PC	Description	Menu code	
Fault input No. Heat fail – failure input No. 0-10	A discrete input that indicates a failure in the heating system.	532(n)3214 #1	
Tmp. To oper. Below Low internal temp. to operate - below	Second necessary condition for cycle change – if the temperature drops down.	532(n)3214 #2	
Tmp. To stop below. Very low internal temp. to cancel - below	Third necessary condition: the temperature should not be too low: not lower then that point	532(n)3214 #3	
Operate time - min Work time - minutes	The spatial interval set for those conditions.	532(n)3214 #4	
Wait time - min Wait time - minutes.		532(n)3213 #5	

Special vent

The main use of special vent is for cleaning the air of spray remains, or drying up cooling device. It is another way to set a vent process, and you can use it if you need vent that will operate on low temperature and stop if temperature rises.

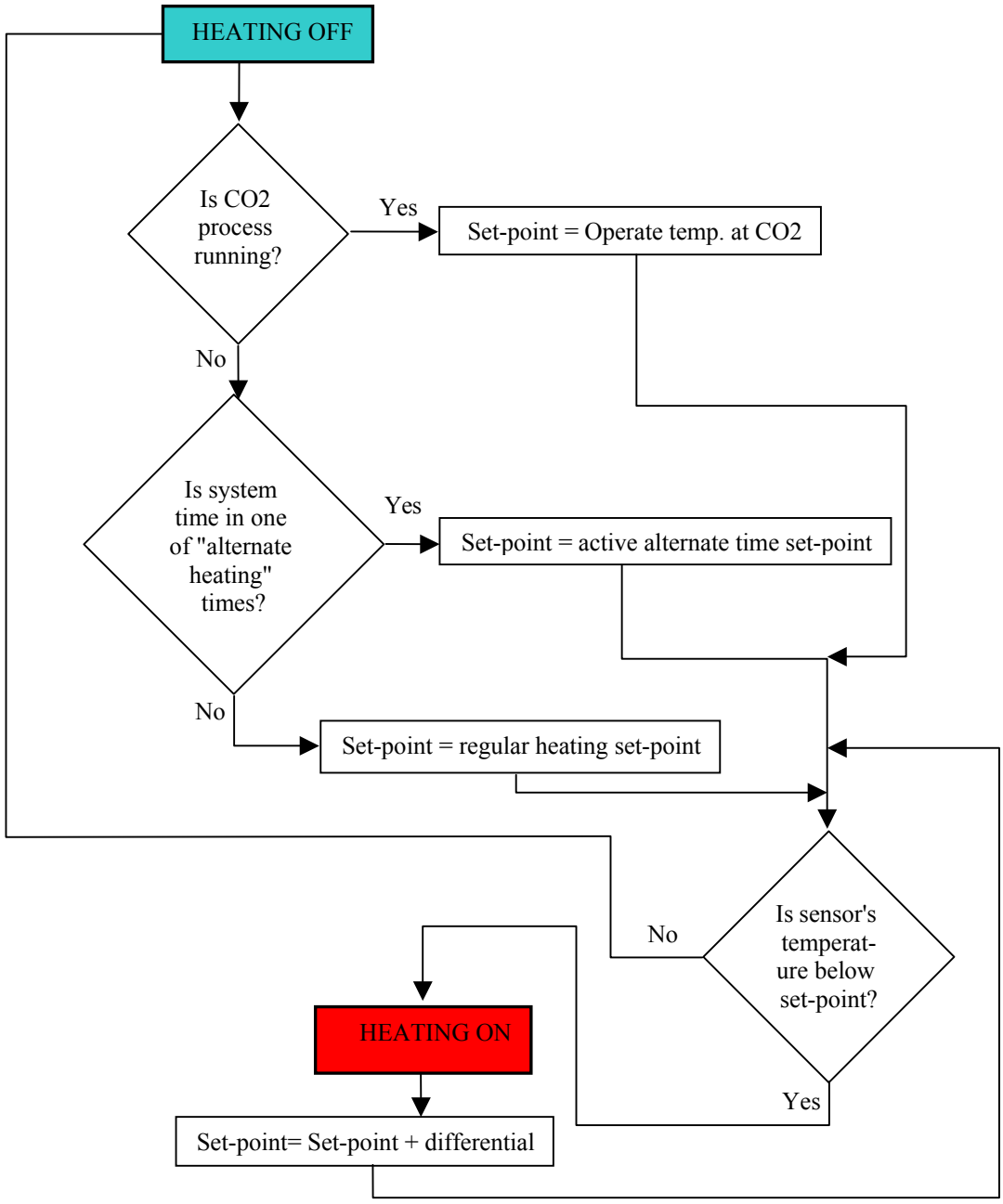
Every column in special vent screen is a unique program(not an output!). to define what outputs are taking part in each, see line "Operate at special vent No" in fans programming screen.

Text in PLC Text in PC	Description	Menu code	
Start time Spatial vent – start time	Start time	532(n)32211 #1	
Operate time mnt Spatial vent – work time - minutes	A count down timer	532(n)32211 #2	
Low int. tmp. Blw: Int. low temp to stop – below	First stop condition: low internal temperature.	532(n)32212 #1	
Low ext. tmp. Blw: External low tmp. To stop - below.	Second stop condition: low external temperature.	532(n)32212 #2	
Low Gen. Sns. Blw. Gen. Sensor – low value to stop below	Third stop condition: low general sensor, such as low radiation.	532(n)32212 #3	
High Gen. Sns. Abv. Gen. Sensor – high value to stop – above.	Fourth stop condition: high general sensor, such as wind speed etc.	532(n)32212 #4	
Stop at cool No. Stop during cooling operation 0-1234)	A stop link to cooling process: writing 14, for example, gives priority to cooling process 1 and 4 over this process.	532(n)32212 #5	
Stop at spray No. Stop during spray proces 0-1234	A stop link to spray process: writing 14, for example, gives priority to spray process 1 and 4 over this process.	532(n)32212 #6	
Stop at CO2 No. Stop during CO2 process No. 0-1234	A stop link to CO2 process: writing 14, for example, gives priority to CO2 process 1 and 4 over this process.	532(n)32212 #7	

Chapter 4 - Heating

Heating is not a stand-alone output, but rather a process. Although each column in the Heating screen refers to a related output, additional operations are always required.
A heating device can be a circulating pump in hot water systems, a direct flame heater, or a pre-heated air blower. But if the application uses a 3-way valve, you must set it in circular heating module.

Heating Operation Chart



Heating Setup:

Text in controller **Text in PC**	Description	Code	Recommended value
Tmp. Sensor No. Temperature sensor No.	The temperature sensor from the Temperature Sensors table to which this heating process refers.	532(n)43 #1	
Hum sensor No. Humidity sensor No.	The humidity sensor from the Humidity Sensors table to which this heating process refers.	532(n)43 #2	
Gen. sensor No. General sensor No.	The general sensor from the General Sensors table to which this heating process refers.	532(n)43 #3	

Heating Programming:

Text in controller **Text in PC**	Description	Code	Recmd value
Heater active? * Heat active? Y/N	Use the Select button to define the active heater.	532(n)41 #1	
Oper. Tmp. Day Day heat operate tmp. Below:	The temperature set point to activate the heater during day time.	532(n)41 #2	16
Oper. Tmp. night Night heat operate tmp. Below:	The temperature set point to activate the heater during night time.	532(n)41 #3	16
Start time tmp. 1 Tmp. 1 – heat oper. hour	Segment 1 Option for different heating temperatures at different hours. The given set-point will override the usual day/night set-point during the time between "start time" and "end time"	532(n)41 #4	
End time tmp. 1 Tmp. 1 – heat stop hour		532(n)41 #5	
Tmp. To oper. Blw 1 Tmp. 1 oper. Heat setpoint – below:		532(n)41 #6	
Start time tmp. 2 Tmp. 1 – heat oper. hour	Segment 2 Option for different heating temperatures at different hours. The given set-point will override the usual day/night set-point during the time between "start time" and "end time"	532(n)41 #7	
End time tmp. 2 Tmp. 1 – heat stop hour		532(n)41 #8	
Tmp. To oper. Blw 2 Tmp. 1 oper. Heat setpoint – below:		532(n)41 #9	
Start time tmp. 3 Tmp. 1 – heat oper. hour	Segment 3 Option for different heating temperatures at different hours. The given set-point will override the usual day/night set-point during the time between "start time" and "end time"	532(n)41 #10	
End time tmp. 3 Tmp. 1 – heat stop hour		532(n)41 #11	
Tmp. To oper. Blw 3 Tmp. 1 oper. Heat setpoint – below:		532(n)41 #12	
Start time tmp. 4 Tmp. 1 – heat oper. hour	Segment 4 Option for different heating temperatures at different hours. The given set-point will override the usual day/night set-point during the time between "start time" and "end time"	532(n)41 #13	
End time tmp. 4 Tmp. 1 – heat stop hour		532(n)41 #14	

Tmp. To oper. Blw 4 Tmp. 1 oper. Heat setpoint – below:		532(n)41 #15	
Tmp. Oper at CO2 CO2 proc. Heat oper. tmp	The requested temperature when CO2 process is on.	532(n)41 #16	
Tmp. Diff to stop. Stop heat tmp. diff	The differential for all heating times. Output stops when the temperature reaches the set-point + differential.	532(n)41 #17	

Stop Conditions:

Text in controller **Text in PC**	Description	Code	Recommended value
Stop at vent No. During fan operation No.	A stop link between heat and fan output. For example: writing '14' here, will make the heating stop whenever fan groups No. 1 and/or 4 are on.	532(n)42 #1	
Stop at spray No. During spray process No.	A stop link between heat and spray process. For example: writing '24' here, will make heating stop when spray process 2 and/or 4 are on.	532(n)42 #2	
If window opened * Stop heating while window is open	Does not allow heating to operate when one or more of the windows are not completely closed.	532(n)42 #3	

Circular Heating in GH 2.04 P7

General characteristics

The new software of 2.04 H7 is a new approach in ES programs that taking into consideration external conditions and determining the heating requirement accordingly.

The system applies 3 PI adjustments so that the program will study greenhouse characteristics and make up for necessary inaccuracy of the user's settings.
In order to achieve the self-correction goal, the program requires the user to fill in many more details about the greenhouse and the heating circles surface and heat conductivity coefficient.

Valves and pumps setup:

Text in PC **Text in controller**	**Explanation**	Address
Water temp. sensor No.	Define a sensor from the temperature sensors table, that monitors the water temperature at the entrance of the heating circle.	
Valve opening time (sec)	Measure the servo-valve's motor full opening time and fill-in.	
Valve closing time (sec)	Measure the servo-valve's motor full closing time and fill-in.	
Shifting steps per valves	Set to 100.	
Valve shift delay	Set delay according to the water temperature sensor respond time to changes in the 3-way valve. To determine this timer do the following: a) Move the valve to manual and wait 10 minutes. b) Record the current read of the water temperature. c) Make a change of 20º in the valve's angle and set a stopwatch. d) Register the stopwatch time when the temperature starts to change (t1). e) Register the stopwatch time when the temperature balances (t2). Set the delay (tp) to: tp = t1+((t2-t1)*0.75)	
Decrease shift delay (sec) per 1.0 deg. Of water temp.	Set to 0.1 – 0.05 of the delay time.	
Minimum shift delay	Se to 0.	
High external temperature to stop circulation pump	The circulation pump is set to constant operation unless the external temperature is absolutely safe from freezing. Set to 20ºC.	
Circulation pump stop delay	Set to 60.	
Stop circulation pump if valve is closed	Set to NO unless 2-way valve used.	
Pipe surface – m2	Calculate the entire surface of the hot water pipes and fill-in	
Water pump flow rate	Fill in according to the pump's specifications	
Pipe heat transfer factor – W/m2*deg	Find the average heat conductivity constant of the cycle pipes and set here. Contact your heating system manufacturer for more details.	
The following parameters are options to limit the minimal temperature of the water returns to the boiler in order to protect the boiler. The control system will then compromise on the heating capacity and let more hot water return to the boiler. In large-scale sites the user is expected to define which greenhouses or cycles are less critical and which are more.		
Return water temp. sensor number	Define a sensor from the temperature sensors table that monitors the greenhouse (or cycle) water exit.	
Return water temp. to decrease heat (below)	Set the minimal temperature that can be returned to the boiler.	
Decrease req. air temp.	Set the percentage of decrease of the required air temperature (hence	

S.P. (%/1ºK of water)	heating capacity) for every degree that is required to increase for returning water temperature. Recommended value: 0-3.	
Max. temp. decrement	Set the maximum decrement from the originally required air temperature for the cycle.	
Return water S.P. to close 4-w valve (below)	Set water temperature which from this point and under the 4-way valve will only do inner circulation. **Note that there will be no heating at this point and lower.**	

Hot water valves calibration: Set a time (preferable mid-day) and a cycle (24 hours) to perform valves calibration. At valve calibration the controller drives the valve full time forwards and backwards and then back to its current required position. This action is required to eliminate a situation where the controller is not synchronized with the actual valves position, and for simple maintenance lubrication.

Circles setup:

	Text in PC Text in controller	Explanation	Address
*	Refer to air temperature sensor No.	Define a sensor from the temperature sensors table (or a group of sensors) to monitor the performances of the cycle and set corrections to its capacity if necessary. This will generally be the greenhouse temperature group or the sensor at the section above the specific circle.	
*	Min. water temp.	The control system will drive the 3-way (or 4-way) valve to provide the required water temperature to supply the required heat capacity. Set limits of the lowest (by default – the required air temperature) and the highest temperature according to the pumps and pipes manufacturers specifications.	
*	Max. water temp.		
**	Water temp. set point delay (sec)	Set to 60-120 seconds.	
*	Air temp. set-point fine tuning boundary (+-)	Set a limit of acceptable deviation, which within, the system will not make any corrections (target range).	
*	High air temp. deviation (from set-point) for heat pause	Set a fault situation indicator, based on the required air temperature, which indicates a fault in the valve's response and stops the circulating pump. Note that frequent activation of this function in daytime may disturb the automation. It is recommended to set a fairly high value (15º or more).	
*	High external radiation to pause heating	The current version has the new method of referring to external radiation on the basic calculation. Set this parameter to 0.	
*	Minimum water temp (snow condition)	Set the snow melt circle (the top circle) to limit the minimum water temperature when snowing to a temperature that will surely obtain snow melting.	
*	Heating percent of greenhouse	All active heating circles must complete to 100%. Divide the circles according to their size or relative influence on the entire greenhouse.	
*	Snow heating percent of greenhouse	When the system detects snow it must activate a different proportion of heat capacity. The top (gutters) circle is required to produce more heat than usual, and this added heat should be reduced from the other active circles.	

PI and coefficient correction:

The current version enables 2 methods of temperature balance:

A: Slow greenhouse coefficient correction.

B: Constant PI operation of each circle towards its air temperature.

In both cases the system uses the external conditions and basic greenhouse constants to do basic calculation of the required energy capacity.

When PI defined “not active” – the system operates a sophisticated method to correct the given greenhouse thermal conductivity coefficient. The method checks the goal achievement whenever there are no extreme changes in the external conditions. If the external and internal conditions weren’t changed in an extreme manner, and still there is a gap between the required and the current greenhouse temperature – the system will calculate the mistake and change the greenhouse coefficient.

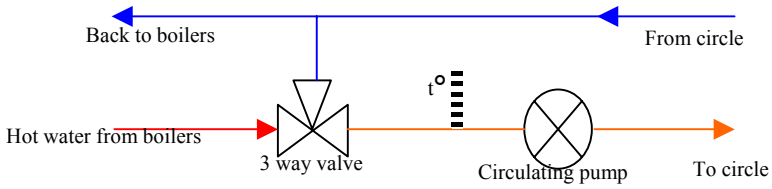
When PI is activated – the system is constantly measuring the difference between the required and the current greenhouse temperature. The PI output is the required correction in air temperature, and you have to give a multiplier to determine the exponent in water temperature.

The PI parameters for each heating circle are:

	Text in PC **Text in controller**	Explanation	Address
***	Air temp. stability check time – minutes.	Set a timer to check the internal temperature stability. The proposed value is a function of the greenhouse volume compared to the total heat production capacity. It can vary between 15 to 45 minutes, and is a subject to be studied by the user on each greenhouse specifically.	
####	Proportional coefficient – Kp	Set to a value from 0.1 to 1 (recommended value 0.7)	
####	Integral coefficient – Ki	Set to a value from 0.1 to 1 (recommended value 0.1-0.3)	
####	Water temp. º per 1º air Influence rate air:water	Set the influence rate of the PI result, as received in air temperature required correction, on the required water temperature change.	

The parameters that are general to the entire greenhouse are:

	Text in PC **Text in controller**	Explanation	Address
*	Greenhouse surface area *1000 m^2	Type the calculated greenhouse surface in 1000 m^2 (0.1 hectare) units	
**	Surface heat transfer factor W/ m^2 *degree	Type the thermal conductivity constant of the material your greenhouse is made of, as provided by the manufacturer. Should your greenhouse consist of more than one material – you may calculate the average or ignore the sidewalls and consider the roof only.	
**	Surface infiltration factor	The average radiation infiltration constant of the material your greenhouse is made of, as provided by the manufacturer. Should your greenhouse consist of more than one material – ignore the sidewalls and consider the roof only.	
**	Wind chill factor coefficient	When this parameter set to 1 (recommended) The system continuously calculates the effective external temperature according to a wind-chill table. You may reduce the wind effect on the temperature or totally eliminate it by setting this parameter to any value from 1 to 0.	
##	External radiation for heat calculation - %	Set what percentage of the radiation read finally effects the greenhouse temperature. The recommended value is 85%-98%. Note that regardless of the type of your solar radiation sensor, the system will always calculate the radiation in W/ m^2. In daylight the system will attempt to keep the heat production capacity in accordance with the added solar energy.	
*	Activate PID control	A YES/NO parameter. See explanation at the top of the page.	



General tips:

Regardless of the type of control you prefer to use, you must understand that to base an accurate energy balance on greenhouse constants calculation is impossible. There are enormous effects like angles, dust, opened cracks and above all the thermal conductivity that is not constant but exponential.

When you first install this software to a controller and plan to run your heating system you will enter the known parameters that will be of use for the program to do an approximate primary calculation.

Your first few heating nights are the nights that you have to study your greenhouse and tune the corrective parameters. Follow the next procedure step by step:

- Set all the constant parameters (marked as * on the left column) according to given data.
- Set all coefficients (marked as ** on the left column) according to our recommendations or according to your primary knowledge.
- Check the "Required water temperature" to see if you get a value which is suitable to your assessments. Do some small changes to the ** parameters (one at a time) until you reach the target.
- Make timely changes to timers (***) according to your observation of greenhouse response time.
- Make timely changes to multipliers (###) according to your observation of overshoot and undershoot.

In order to determine what is considered to be a "stable condition" for the slow constants correction, please define:

	Text in Controller **Text in PC**	Explanation	Address
***	Significant change check timer – minutes	Set time to register external sensors and compare with previous registry. *Recommended value: 15*	
*	Wind chill significant change – degree	Set what is considered to be significant change in external air temperature **after wind chill calculation**. Set a value that undoubted, is influences the inner temperature in a way that requires a change in water temperature of more than 2ºC. *Recommended value: 4*	
*	Ext. radiation significant change	Set what is considered to be significant change in external radiation. Set a value that undoubted influences the inner temperature in a way that requires a change in water temperature of more than 2ºC. *Recommended value: 30 W/m^2.*	

Main circle.

In a large-scale project where one center of boilers serves many greenhouses, other controller will probably conduct the general heat management. However, we enable you to control one server circle in each greenhouse. This server circle may control the main circle of the entire project, or just a local circle that takes the water from the main circle and serves the other circles in the greenhouse.

Set the additional temperature from the highest required water temperature between the 4 circles.

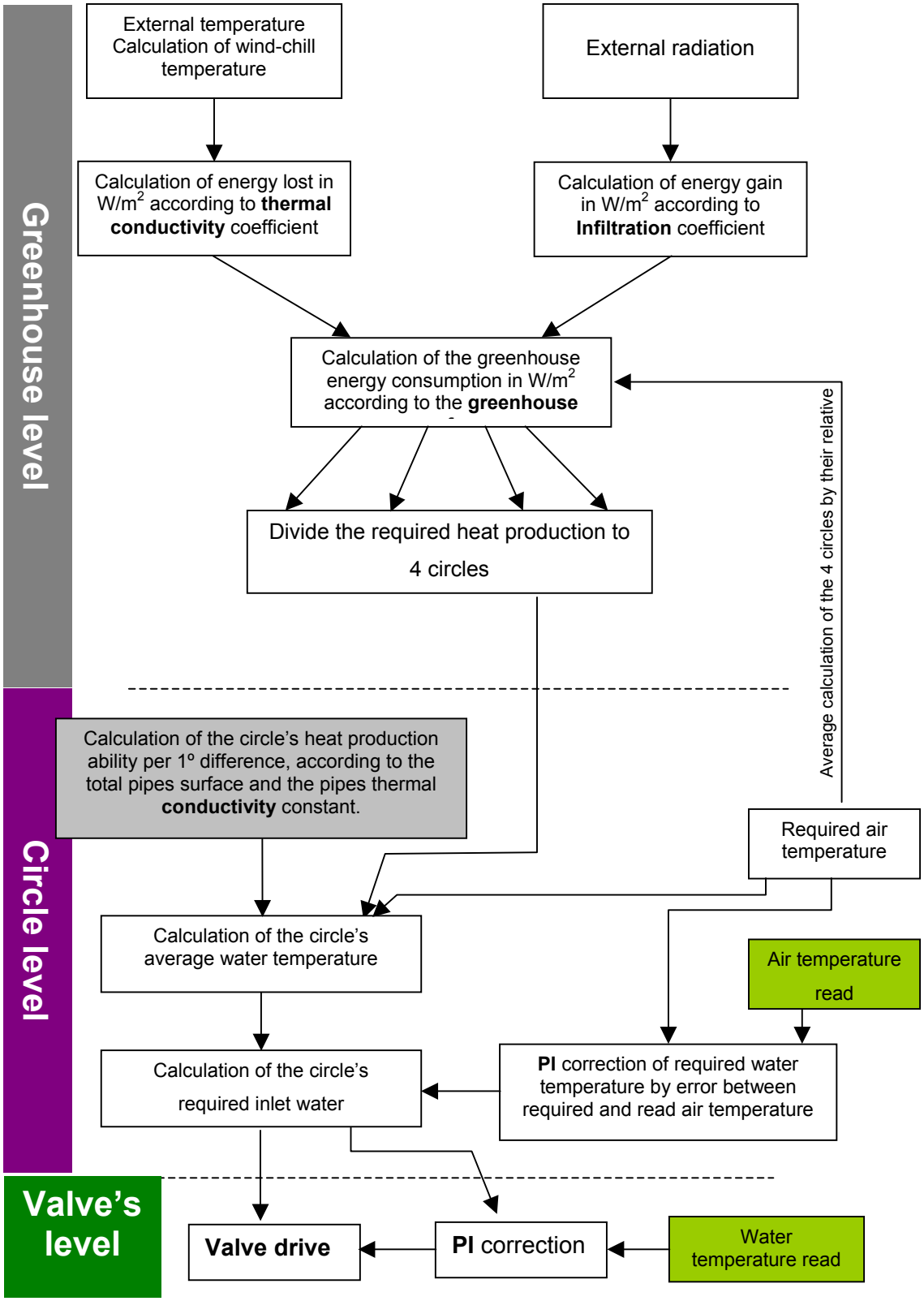
Greenhouse temperature control:

2.04P7 heating program enables you to set 2 overriding day segments for different required temperatures. These segments override the basic day or night temperatures that must be set. The shifting between day and night and to and from a segment can be gradated.

Although this version enables to set required temperature to each circle separately, we recommend not to do so unless it really makes sense. In most cases the temperature in one chamber is the same. Setting a different temperature to circles may cause difficulty balancing the greenhouse if there is even the smallest co-influence.

Text in PC **Text in controller**	**Explanation**	Address
Daytime air temperature set-point	Set the required temperature in daytime, according to day and night setting in the controller setup.	
Gradual S.P. shift HH:MM (+-)	Set timer to start and end the gradual change. *The recommended value is 15 minutes for each 1ºC*	
Nighttime air temperature set-point	Set the required nighttime temperature, according to day and night setting in the controller setup.	
Gradual S.P. shift HH:MM (+-)	Set timer to start and end the gradual change. *The recommended value is 15 minutes for each 1ºC*	
Segment 1 start hour	Set start hour for overriding segment 1.	
Segment 1 stop hour	Set stop hour for overriding segment 1.	
Segment 1 air temperature set point	Set required temperature for overriding segment 1.	
Gradual S.P. shift HH:MM (+-)	Set timer to start and end the gradual change. *The recommended value is 15 minutes for each 1ºC*	
Segment 2 start hour	Set start hour for overriding segment 2.	
Segment 2 stop hour	Set stop hour for overriding segment 2.	
Segment 2 air temperature set point	Set required temperature for overriding segment 2.	
Gradual S.P. shift HH:MM (+-)	Set timer to start and end the gradual change. *The recommended value is 15 minutes for each 1ºC*	

Flow chart:


Greenhouse level
External temperature Calculation of wind-chill temperature
External radiation
Calculation of energy lost in W/m2 according to thermal conductivity coefficient
Calculation of energy gain in W/m2 according to Infiltration coefficient
Calculation of the greenhouse energy consumption in W/m2 according to the greenhouse
Divide the required heat production to 4 circles
Average calculation of the 4 circles by their relative
Circle level
Calculation of the circle's heat production ability per 1° difference, according to the total pipes surface and the pipes thermal conductivity constant.
Required air temperature
Calculation of the circle's average water temperature
Air temperature read
Calculation of the circle's required inlet water
PI correction of required water temperature by error between required and read air temperature
Valve's level
Valve drive
PI correction
Water temperature read

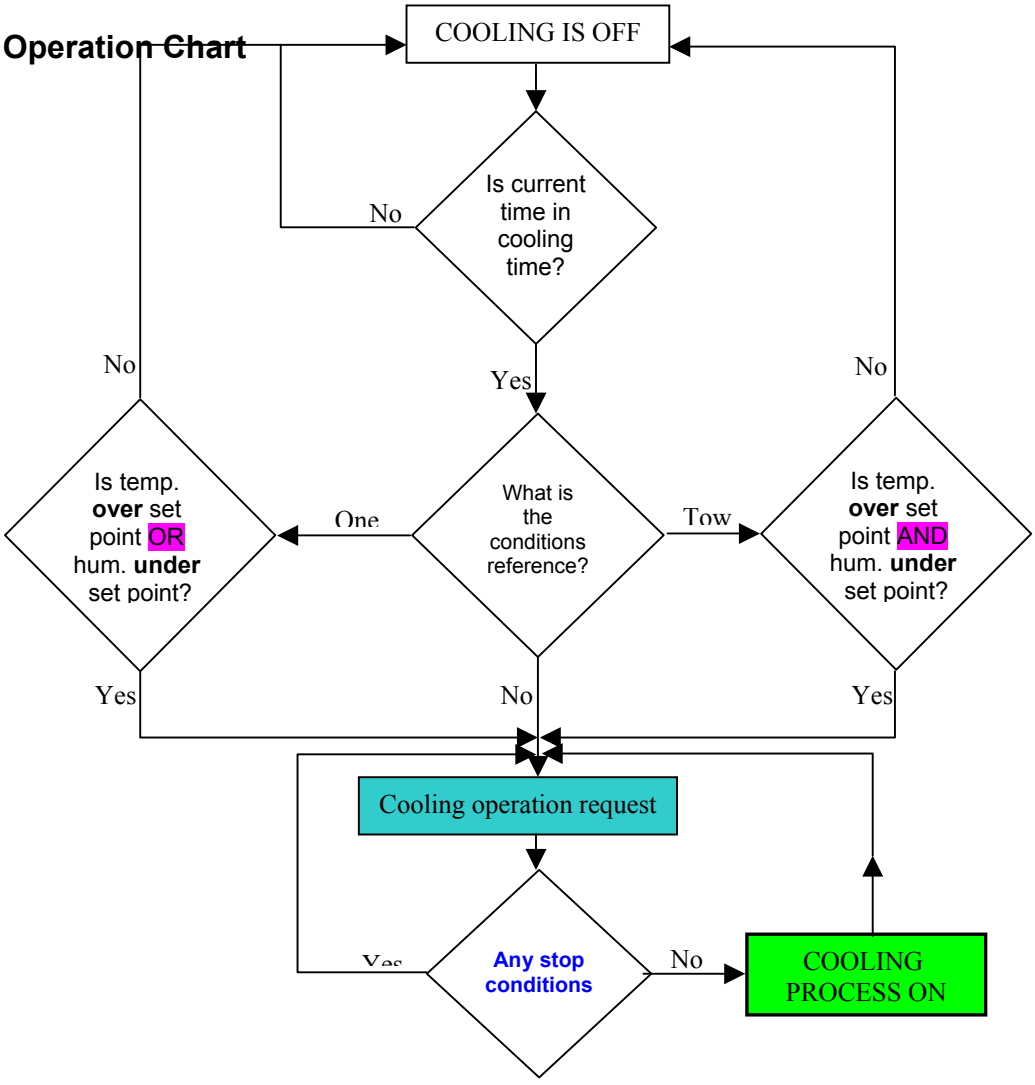
Chapter 5 - Cooling (Misting)

Two major cooling devices are common in greenhouses: one is a wet pad mounted on one of the greenhouse's wall. Wet pad operation must be connected to fans and windows, to ensure directed airflow. The second cooling device is a system of sprinklers or water jets mounted above the plants.

Regardless of the device – the function is always temperature reduction. When opening windows, laying screens or operating fans are not enough to reduce the temperature – the cooling process is used for this purpose.

To avoid confusion with the misting function in the irrigation system, we shell refer to this function as Cooling and the module in the irrigation system will be referred to a Misting. Your cooling device will be defined as misting in the irrigation system if it depends on the watering main system (required operation of water pumps, or must stop irrigation though.). In any other case, defining it as a cooling device within the climate system provides you with a much larger variety of operation options.

Cooling Operation Chart



Cooling Setup:

Text in controller **Text in PC**	Description	Code	Recommended value
Opr. Cool combination Oper. Cool No. 0-1234	The link between the process and the related cooling outputs (the output that operates the device).	532(n)94 #1	Any combination of the digits 1-4
Oper. Tmp. Sensor No. Temp. sensor to operate	A temperature sensor from the Temperature Sensors table referred to for process operation (the process stops when the sensor reading is lower than the set point).	532(n)94 #2	Greenhouse sensors group
Oper. Hum. Sensor No. Hum. Sensor to operate	A humidity sensor from the Humidity Sensors table referred to for process operation (the process stops when the sensor reading is higher than the set point).	532(n)94 #3	
Stop Tmp. Sensor No. Temp. sensor to stop	It is possible to refer to another sensor (such as an outdoor sensor) for stopping conditions.	532(n)94 #4	
Stop Hum. Sensor No. Hum. Sensor to stop		532(n)94 #5	

Cooling Programming:

Text in controller **Text in PC**	Description	Code	Recommended value
Start time Start time	Start cooling time HH.MM	532(n)91 #1	
End time End time	End cooling time HH.MM	532(n)91 #2	16
Tmp. To oper. above High temp. to operate- above	The temperature set point for activating the cooling process	532(n)91 #3	16
Tmp. Diff. To stop Temp. diff to stop	The differential in centigrade for stopping the process	532(n)91 #4	
Hum. To oper. below Low Humidity to operate - below	The relational humidity for operating the process	532(n)91 #5	
Hum. Diff. To stop Hum. Diff to stop	The differential in RH percents for stopping the process	532(n)91 #6	
Cool conditions * Operate condition	Use the Select button to choose the suitable mode of operation: **No conditions** = operate by time only. Does not refer to sensors. **1 condition** = within time boundaries, it is enough that either temperature or humidity condition will set the process to have it operate. Use this method if you want the cooling process to function when humidity increases, even if the temperature is not high. **2 conditions** = Within time boundaries, both temperature and humidity must set the process to have it operate. Use this method if you want high humidity to stop the cooling condition.	532(n)91 #7	

Stop Conditions:

Even when you set the process to act by time only, or ignore one or more of the parameter in the table above, you can still set some conditions for stopping the process. If necessary, you can even refer to different sensors for this purpose.

Text in controller **Text in PC**	Description	Code	Recommended value
Tmp. To stop - below Low temp. to stop - below	Stop the process when the greenhouse's (or other reference sensor) temperature drops below this set-point.	532(n)92 #1	
Hum to stop - above Hum. To stop - above	Stop the process when the greenhouse's (or other reference sensor) humidity rises above this set point.	532(n)92 #2	
Very high tmp. – above High temp. to stop - above	May indicate a non-functioning device. Stop process if unable to chill down, and let the windows open and do what they can.	532(n)92 #3	
Low ext. tmp. - Below Outside temp. to stop - below	Stop the process when the outdoor temperature drops below this set point.	532(n)92 #4	
High ext. hum. – above Outside Hum to stop - above	Stop the process when outdoor humidity rises above this set point. (Cooling my not be efficient any more)	532(n)92 #5	
Alarm input No. Fail input to stop cool oper.	A discrete input that indicates electrical failure in the cooling device. Continuing running of the process may be harmful.	532(n)92 #6	

Pulsing Programming:

Some of the cooling devices must run intermittently. Sprinklers, for instance, cannot run constantly, because this would cause flooding of the area. The program enables you to adjust the pulses according to how far the temperature is from the set point.

Text in controller **Text in PC**	Description	Code	Recommended value
Oper. Time sec Oper time - sec	"ON" timer	532(n)931 #1	Non zero
Wait time sec Wait time sec	"OFF" timer	532(n)931 #2	Zero for wet pad,
Tmp diff from setup Temp diff to change cycle - below	The difference between the greenhouse temperature and the set-point, used to decide that a change is required.	532(n)92 #1	
Inc. oper. %1 deg. Increase work time - %/1deg	The percentage for increasing the "ON" time of the device (from the original time) for each 1 degree centigrade of difference +.	532(n)92 #2	
Max oper. Time sec Maximum work time - sec	Upper limit for "ON" time change.	532(n)92 #3	
Dec. wait time %/1 deg Decrease wait time %/1 deg	The percentage decreasing the "OFF" time of the device (from the original time) for each 1 degree centigrade of difference +.	532(n)92 #4	
Min. wait time - sec Minimum wait time - sec	Lower limit for "OFF" time change.	532(n)92 #5	

Chapter 6 - Thermal Screen

Thermal screens are used for 2 different functions:

During daytime, between latitude 35° north to 35° south, spreading thermal screen is the best way to control radiation and keep temperatures low.

At nighttime, when heat is needed, Thermal screen helps to save energy by reducing the chamber volume.

Each greenhouse chamber can have 2 Thermal screens. They may be either on different levels (each is covering the whole greenhouse area), or covering a part of the greenhouse each. In some sites screens are applied externally over the greenhouse roof. Most shading devices are not the perfect solutions because they have only 2 efficient positions. Partial spreading of thermal screens is not efficient because it does not affect the entire area. Like windows and servo-valves, thermal screens belong to the "stepping" kind of outputs. They use one output for spreading and another for rolling.

Thermal Screen Setup:

Text in controller **Text in PC**	Description	Code	Recommended value
Full oper. Sec Motor oper. Time for full spread secs.	Measure time it takes to fully spread/roll the screen. The results in seconds.	532(n)76 #1	
Full oper. Stage Stages of operation 1-4	Division into several steps is important to prevent sudden rolling, when differences are encountered between the air above and beneath the screen.	532(n)76 #2	2-4
Oper. Delay sec. Delay bet. Levels during roll up secs.	Delay between the steps in seconds.	532(n)76 #3	120
Tmp. Sensor No. Temperature sensor No.	The temperature sensor from the Temperature Sensors table to which this screen refers.	532(n)76 #4	2
Hum sensor No. Humidity sensor No.	The humidity sensor from the Humidity Sensors table to which this screen refers.	532(n)76 #5	4
Radiation sensor * Radiation sensor	Pressing the Select button in the controller or selecting it with the mouse in a PC, will change the control of the screen between the external and internal radiation sensor. Note - do not operate according to a sensor located beneath the screen.	532(n)76 #6	External

Lay for Shading

Text in controller **Text in PC**	Description	Code	Recommended value
Tmp. To lay abv. Temp. to spread screen above	Temperature to lay screen – above (to operate by outdoor temperature – refer to outdoor temperature in setup 53276 #4)	532(n)71 #1	32
Tmp. To roll blw. Tmp. To roll-up screen below	Roll the screen when temperature drops under this value.	532(n)71 #2	28
Rad. To lay abv. Rad. To spread screen above	Radiation value in selected sensor for spreading the screen.	532(n)71 #3	1200 (PAR) 700(W/m2)
Rad. To lay blw. Rad. To roll-up screen below	Radiation value in selected sensor for rolling the screen.	532(n)71 #4	900 (PAR) 550(W/m2)
Oper according * Operates by	Work by temperature and ignore radiation. Work by radiation and ignore temperature. Work by 2 conditions will require both temperature and radiation to be above set point for screen spreading, and will roll if one of them drops below roll set point.	532(n)71 #5	4
Cond. Delay sec. Delay before screen status change sec.	That delay timer is set whenever the screen moves due to measured conditions.	532(n)71 #6	60

Lay by Time, Roll by Time:

Overrides all conditions. You can define certain hours that the screen will be forced to a certain position. In case of a conflict between lay and spread – spread will have priority.

Text in controller **Text in PC**	Description	Code	Recommended value
Start laying time (Spread) Start time	The beginning of the unconditioned lay time.	532(n)72 #1	
End laying time (Spread) End time	The end of the unconditioned lay time.	532(n)72 #2	
Start roll time (Roll) Start time	The beginning of the unconditioned roll time.	532(n)73 #1	
End roll time (Roll) End time	The end of the unconditioned roll time.	532(n)73 #2	

Screen Roll-up During Process:

Forces the screen to roll when the process is active. Entering the process number in the screen column will cause the screen to roll regardless of weather conditions, as long as the selected process is on. The combination <1234> is a link between the screen and all 4 possible processes (for instance, spray process 1, 2, 3 and 4) of one kind.

Text in controller **Text in PC**	Description	Code	Recommended value
At spray proc. No. Roll up during spray proc. No 0-1234	Roll due to spray process.	532(n)75 #1	
At CO2 proc. No. Roll up during CO2 proc. NO 0-1234	Roll due to CO2 process.	532(n)75 #2	
At vent. Process * Roll up during vent process Yes/No	Option controlled by the Select key: Selecting Yes will cause the screen to roll on all cyclic and spatial ventilation process.	532(n)75 #3	
At fan operation Roll up during fans operation 0-1234	In some greenhouses the screen is installed in such a way that it may be damaged by fan operation when it is laid. Marking a fan group will result in screen rolling even when fans are operated by a process.	532(n)71 #4	
At wind level above Roll up during high wind level above 0-5	This spatial feature is for screens that are installed outside greenhouse chambers, usually above the roof. It this case, you may want to roll it to protect it from tear off.	532(n)71 #5	0=non
Cond. Delay sec. Delay before screen status change sec.	That delay timer is set whenever the screen moves due to conditions.	532(n)71 #6	60

Lay Screen to Preserve Heat:

laying the screen at night can help save heating energy. Despite its name, this function is totally independent of the heating process. It can be useful even if there is no heating device at all, simply because it reduces chamber volume.

Text in controller **Text in PC**	Description	Code	Recommended value
Start laying time Start time	Lay time.	532(n)74 #1	Sunset
Stop laying time End time	The end of lay for heat.	532(n)74 #2	Sunrise
Roll delay SEC. Delay bet. Roll-up pulses at the end of proc. SEC	At the end of the night, it is common to find high humidity caged above the screen, while below the screen the temperature is high and the humidity is low. Opening the screen at normal speed might cause dew on the leaves. This parameter enables you to set a spatial delay to prevent damage.	532(n)74 #3	600

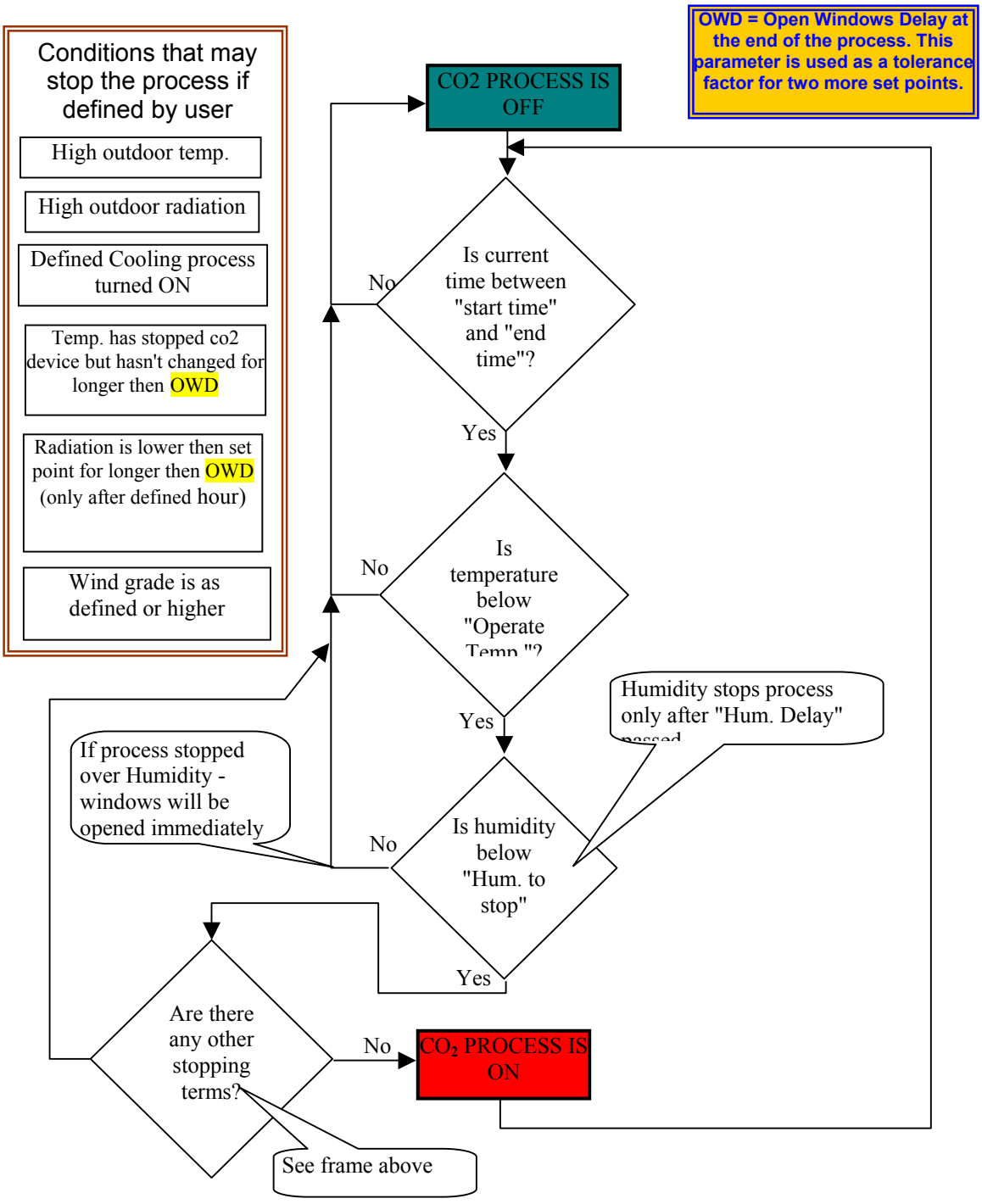
Chapter 7 - CO_2 Enrichment

Enriching the greenhouse space with CO_2 is widely used for improving agricultural results. While photosynthesize, the plant consume CO_2. The natural concentration of CO_2 In the air is around 450 PPM (Parts Per Million). Most crops, would get benefit if we raise the concentration to 800 PPM (consult your Agronomist about the exact rate).

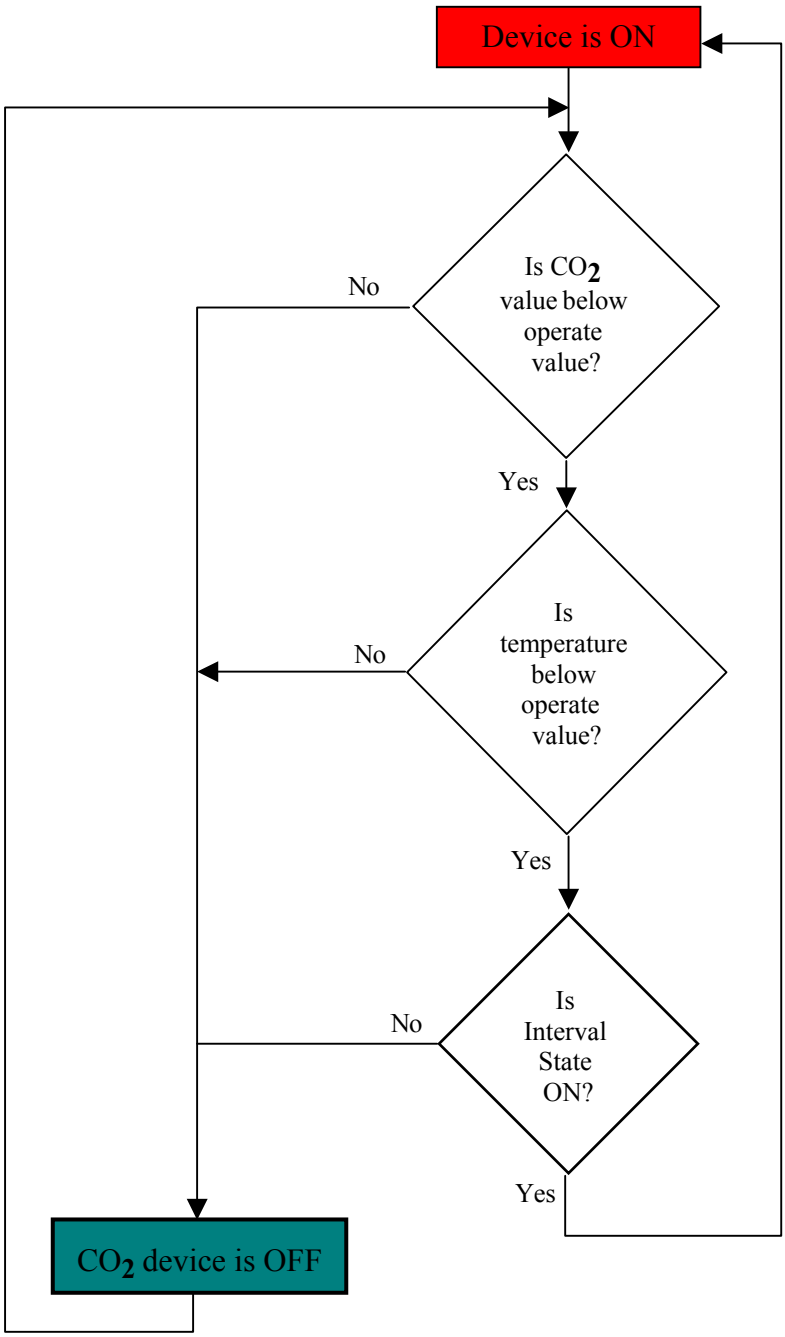
The devices that commonly used divided to cold or hot applying. Cold applying is simply a valve that let vaporized CO_2 Flow in. The hot device is a CO_2 generator. The CO_2 obtained by burning condensed carbonate gas while providing the proper rate of Oxygen. That gas applied, either directly or through heat exchanger.

The CO_2 process is the most complex process in the climate control scheme, since it must respond to many environmental conditions. The correct amount of CO_2 that can be consumed by the plant variate according to the radiation and the age of the plant. During the process, we must deal with side effects, such as increasing greenhouse temperature and humidity.

Process flow chart



CO_2 DEVICE OPERATION FLOW CHART
(Only when process is ON)



Major CO_2 Process Programming

Text in controller Text in PC	Orientation	Description	Code	Recommended value
Start time Process operation hour		The process will not set-on if the hour is earlier then the hour the user defined.	532(n)51 #1	
End time Process stop hour		The process will stop when the controller clock reaches this hour.	532(n)51 #2	
Temperature to start Process operation temp	Below	The process can not start above this temperature.	532(n)51 #3	30
Dif. To stop outp. CO2 Output stop temp. diff		CO2 device stops when temperature is above this value + operate temp. f the temperature remains between these boundaries for longer then OWD - the process will be stopped.	532(n)51 #4	2
Dif. To stop proc. Process stop temp. diff.		Differential to stop the entire process. Must be higher then the output diff.	532(n)51 #5	4
Minimal operate radiation Process operate radiation	Above	The process stops if radiation is lower then the value the user defines here for longer then OWD.	532(n)51 #6	
CO2 ppm-oprate CO2 enrichment value	Below	CO2 device can be ON only if CO2 sensor's value is lower then the value the user defined here, or if it remains zero (in case of sensor absence).	532(n)51 #7	
PPM differential To stop CO2 enrichment stop diff.		CO2 device stops when CO2 sensor's reading is higher then <operate co2 ppm + ppm differential>.	532(n)51 #8	100
Maximum window stage Maximum window level		Window can open up to this stage whenever the process is active.	532(n)51 #9	
Open window delay OWD Window open delay at procedure end		The time that windows remain closed after the end of the process (in minutes).	532(n)51 #10	10

Stop and Delay conditions

Text in controller Text in PC	Orientation	Description	Code	Recommended value
Humidity to stop Process stop humidity	Above	The process stops if humidity is higher then "Hum. To stop" for longer then "Hum. delay". If this happens, OWD is ignored and windows immediately open.	532(n)52 #1	
Delay before stop (mnt) Process stop hum. delay			532(n)52 #2	10
High ext. temp. High external temperature	Above	The goal of this parameter is to predict a coming greenhouse temperature rise to a higher temperature by reading the external temperature.	532(n)53 #1	
High ext. rad. High external radiation	above	The goal of this parameter is to predict a coming greenhouse temperature rise to a high temperature by reading the external radiation.	532(n)53 #2	

CO_2 Output Operation

Text in controller Text in PC	Orientation	Description	Code	Recmd value
Operate time sec Output work time - sec	Above	In systems with an "on line" sensor (without scanner), any non-zero value in "work time" is good, and the wait time can remain zero. When working with a scanner, you must first find the approximate proportion between operate time and wait time which is unique to every greenhouse, and depends on the greenhouse volume, enrichment method (warm or cold gas) and the plants stage. We recommend calculation of a factor of 10-30%(+) for future change in consumption on the operate time, because automatic PID can only reduce that value and not increase it.	532(n)541 #1	Non zero (not null)
Wait time sec Output wait time - sec			532(n)541 #2	
PPM diff. For setup Enrichment diff. To change cycle	Above	The diversion of the sampled CO2 value from the requested value change the "Operate time"(decrease) and "Wait time"(increase).	532(n)542 #1	50-150
Decrease opera. %/100P Decrease work time		When changes must be performed – the reduction is by the value (%) entered here, and will not be reduced again before a new sampling cycle occurs.	532(n)542 #2	5-20
Min. Oper. Time sec Minimum work time		The limit of correction.	532(n)542 #3	2
Inc. Wait time %/100 Increase wait time		When changes must be performed – the wait time is added to the value (%) entered here, and will not be increased again before a sampling cycle occurs.	532(n)542 #4	5-20
Max. wait time sec Maximum wait time - sec		The limit of correction.	532(n)542 #5	2

CO_2 constants

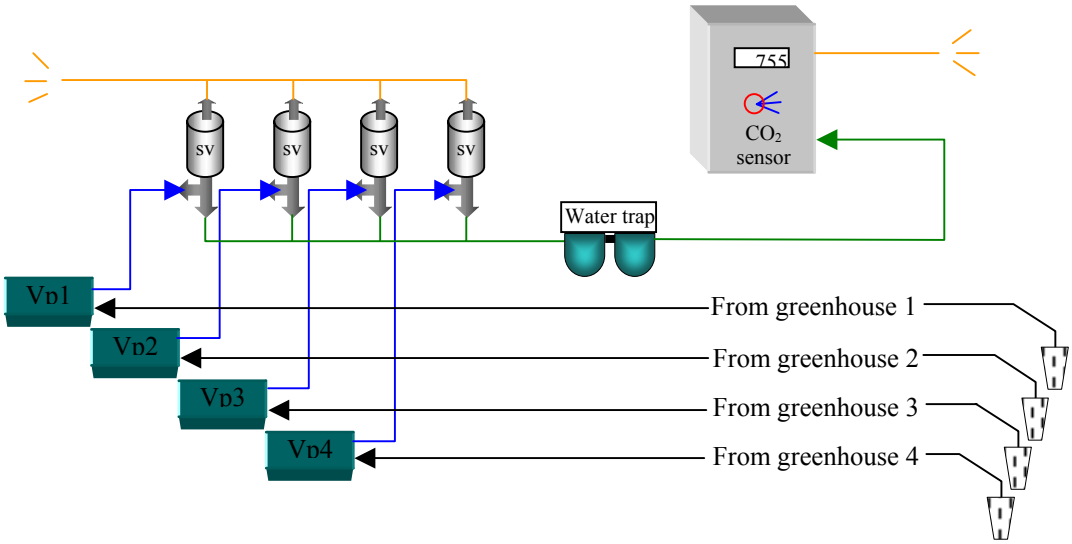
Text in controller Text in PC	Orientation	Description	Code	Recommended value
Wind lvl to stop High wind level to stop process		At such a wind level, CO_2 process will no longer be effective in some greenhouses because of air vibrations and perhaps a vacuum process.	532(n)552 #1	4
Refer to rad. from Reference to radiation from hour		Earlier than this time, radiation readings will not effect the process.	532(n)552 #2	
Critic temp. High critic temperature	above	Different from <operate temp.+diff>. Here, the process is stopped and OWD is ignored if temperature is over user definition.	532(n)552 #3	35
Restart delay minute Restart process delay		The limit of correction.	532(n)552 #4	10
Stop in cool No. Stop in misting process No.		Give priority to certain cooling process over the CO2 process.	532(n)552 #5	

CO_2 Scanner

A high quality CO_2 sensor, with accuracy of up to 30 PPM, is an expansive device. The scanner module in Elgal 2000 enables you to use one sensor in a site of up to 10 different greenhouse chambers.

The physical device is a simple solenoid valve (for a distance of up to 50m) or a valve + suction pump (for distance of 50-150m, or for a quicker respond in shorter distance). To that device you connect 8mm hose and a filter on its end.

The module in the program is operating the sampled points outputs in a circular mode, storing each point's value in a different memory address. The program, after a proper setting, can relate those address to the concerned greenhouse.



CO_2 scanner setup:

Text in controller **Text in PC**	**Description**	Code	Recmd value
CO_2 mux. Exist *	Select "Exist" using the Select button.	71 #8	
CO_2 gen. Sns. No. CO_2 sensor – Gen sensor No.	Pick the general sensor from general sensors table that the CO_2 sensor connected to.	5151 #1	
Sample points No. Scanning points No. (0-10)	Set the number of existing points in your system	5151 #2	
Sample start time Start operation time	Activation of scanner hour.	5151 #3	
Sample end time End operation time	Inactivation of scanner hour.	5151 #4	
Sample active * Measure point active	Define for each one of the 10 possible points weather it is active or not.	5152 #1	
Reading time sec. Point scan time (secs.)	Set the scanning time on every cycle for each one of the active points. The length of the sampling hose and the private pump absence are the factors you have to consider. Take notice that it takes 20 seconds for the sensors to clear the influence of the old gas and display the new sample.	5152 #2	1 min. or more

The scanner module will transmit each point's value as received at the end of the sampling. The value registers in the 'CO_2 scanner points' table, and saved there until the next read received or until midnight (see memory initialization in Galileo Setup).

Engaging the results of the samples to the corresponding greenhouse:

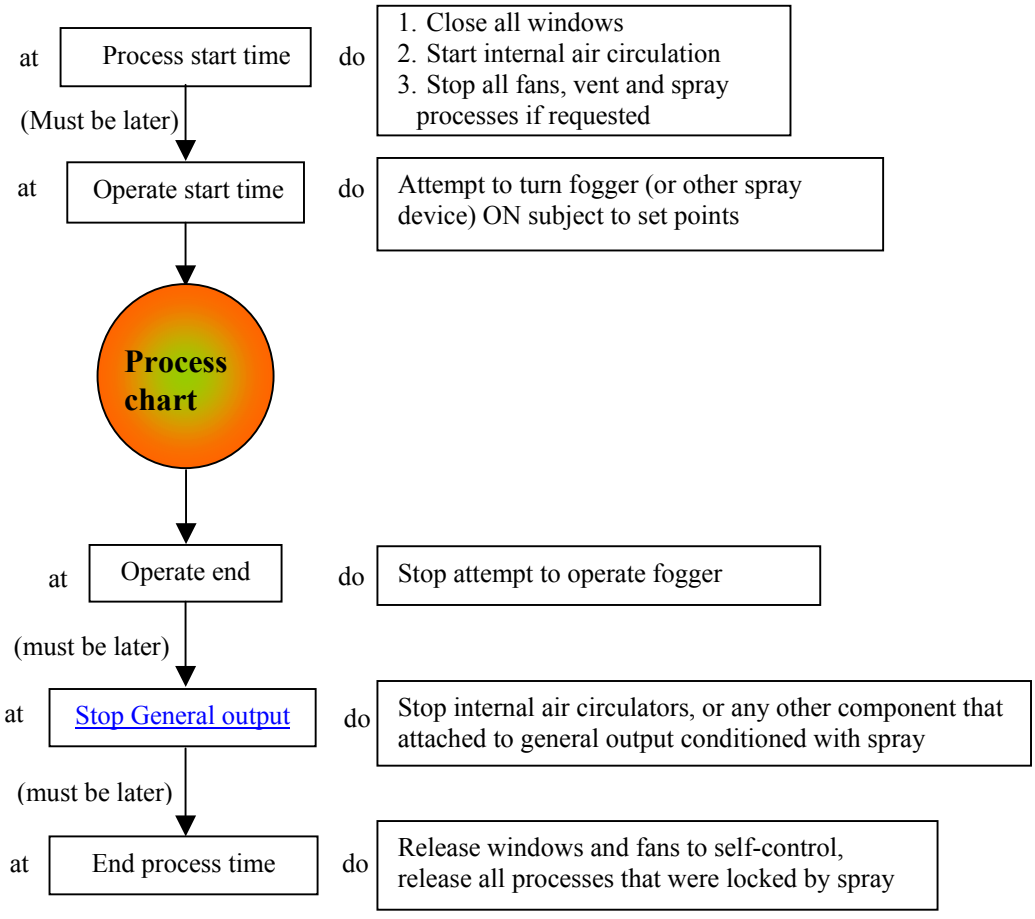
Local greenhouses	**Greenhouse in another controller**
Greenhouses on the controller that hosts the scanner can read the CO_2 points from 'general sensors table' in numbers 71 to 80. Set the accordingly point as the greenhouse's CO_2 sensor (code 532(n)551 #3. For instance: A local greenhouse that represented through the third point – set 73 in "CO_2 sensor – general sensor No.".	The value must be transferred via the communication table in the PC. Read the instructions of sensors "Selling" and "Buying" in chapter 5 of the Elgal Setup manual book.

Chapter 8 - Spray Process

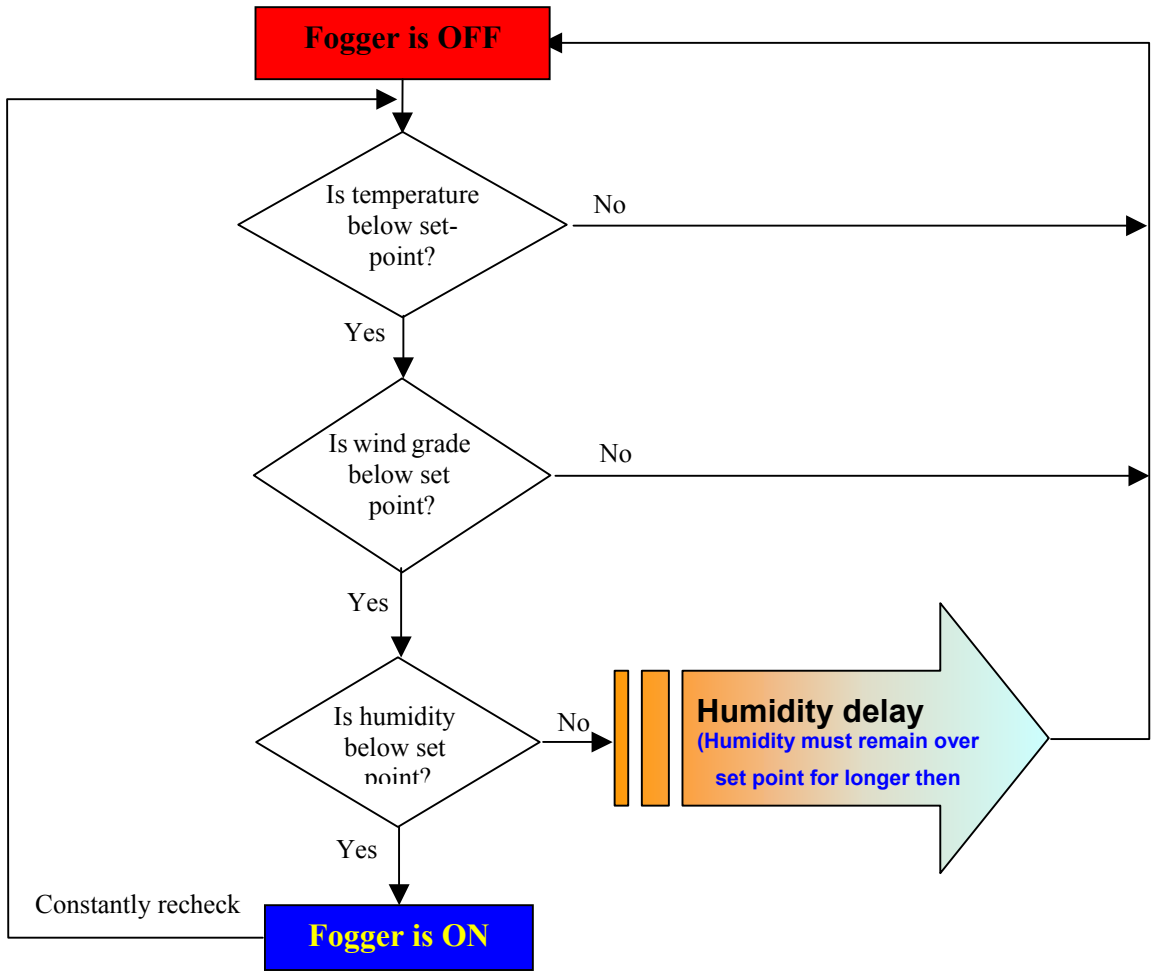
The spray process is different from all other greenhouse processes since it is not activated as a result of any readable value, and also not defined for a certain time every day, but specifically programmed to perform a one-time-task whenever the operator decide it is necessary.

However, when spaying is requested, the operator must always examine internal and external conditions, bring windows to desired state, stop or suspend other processes, operate circulators etc. Therefore, spraying is a process and not a single output operating program.

Spray Process Envelope
(Method is valid when date set on)



Spray Chart



Spray Setup:

Text in controller Text in PC	Description	Code	Recommended value
Max. window stage Temperature sensor No.	All windows will not open more then this stage while the process is on	532(n)65 #1	0
tmp. sensor No. temp. sensor No.	The temperature sensor from the Temperature Sensors table to which this Spray process refers.	532(n)65 #2	
Hum sensor No. Humidity sensor No.	The humidity sensor from the Humidity Sensors table to which this Spray process refers.	532(n)65 #3	

Spray Programming:

Text in controller Text in PC	Description	Code	Recommended value
Man.overriding? * Spray active? Y/N	Use the Select button to manually operate the Sprayer (single time).	532(n)61 #1	
Start proc. date Process start date dd:mm	Real date limits of process operation	532(n)61 #2	
End proc. date Process end date dd:mm		532(n)61 #3	
Start proc. .time Process start time hh:mm	**Process Envelope** See chart above	532(n)61 #4	
Start output time Output start time hh:mm		532(n)61 #5	
Stop output time Output end time hh:mm		532(n)61 #6	
End air mix time Air mix (free outp.) end time hh:mm		532(n)61 #7	
End proc. time Process end time hh:mm		532(n)61 #8	

Stop conditions:

Text in controller Text in PC	Description	Code	Recommended value
Tmp. To stop above High tmp. To stop process above	When the greenhouse temperature rises above this set point, it will cause process termination and free the greenhouse to temperature reducing processes.	532(n)62 #1	40
Wind level to stop High wind level to stop process above	Enables reference to the wind level as a parameter of process efficiency, and stop it at a high level.	532(n)62 #2	5
Hum. To stop above High Hum. To stop process above	A maximal set point for humidity. If the greenhouse reaches this level – the humidity delay is set. The process stops if the humidity stays high until the end of the delay timer countdown.	532(n)62 #3	
Hum delay mnt. High Hum. Delay minutes		532(n)62 #4	5
Fault input No. Fail input No. to stop spray	An input (such as empty chemical tank indicator) that stops the process.	532(n)62 #5	

Ventilation before and after spray - the purpose of this function is to prepare the greenhouse for long time closing required for the spray process. You can reduce the greenhouse temperature and humidity lower then the usual just before process starts, assuming that it rises quickly during the spray process, because all windows and fans are closed.

The other side of the function is basically to enable people to enter the greenhouse safely. This is the “Ventilation After Spray”.

Text in controller **Text in PC**	Description	Code	Recommended value
Oper. Time mnt Vent before fogging - min	The time before the spray process hour for operating the fans.	532(n)63 #1	20
Tmp. To stop - below Low temp to stop vent - below	Indicates that the function is no longer necessary. Attention! Due to a programming mistake, the decimal point is missing in the controller. Write 100 to stop ventilation at 10 degrees.	532(n)63 #2 532(n)64 #3	10(100)
Wait for vent - mnt Vent delay after fogging - mnt	A delay (if needed) to provide time for the chemical action before starting ventilation.	532(n)64 #1	10
Oper. Time - mnt Vent after fogging - min	The estimated time needed to clear the air.	532(n)64 #2	20

Chapter 9 - Free Output/Air Circulators

General outputs are powerful tools for almost anything you require in a greenhouse and can't get from all other ordinary components. They can be operated based on time schedules, temperature, humidity or external inputs such as radiation or wind speed meters. You can switch all greenhouses to a different power source based on a reading on an Ampere-meter. You can set it to operate constantly or intermittent. In addition, you can bind a general output to any other process in a positive or negative way. This mean that every process can make it work, or stop it, or leave it as it is, all based on your settings.

The most common use for general output is **Internal air circulators.** This is also the only case in which a general output is explicitly referred to in another process, the spray process. Spray process activates its linked free outputs according to a spatial program.

When a free output is assigned to a process (either way), the process activation result overrides any other condition that may be set for this free output. In case of a conflict between “operate” and “stop” links, the result cannot be forecast.

For PC users: unlike all other greenhouse components, free outputs cannot be observed in the greenhouse status window, and cannot be accessed from the window. To view or program a free output, click <Main> in the menu bar, and <Free/Air Mixer> in the pull-down menu.

Free Output Setup:

Text in controller **Text in PC**	Description	Code	Recmd value
Tmp. Sensor No. Temperature sensor No.	The temperature sensor from the Temperature sensors table to which this free output refers.	532(n)84 #1	
Hum Sensor No. Humidity sensor No.	The humidity sensor from the Humidity sensors table to which this free output refers.	532(n)84 #2	
Gen. Sensor No. General sensor No.	The general sensor from the General sensors table to which this free output refers.	532(n)84 #3	

Free Output Programming:

Text in controller **Text in PC**	Description	Code
Start time Operate hour	Start hour	532(n)81 #1
End time Stop hour	End hour	532(n)81 #2
Tmp. To operate below Low tmp. To oper. -below	Enter a set point for devices that you want to turn ON when the temperature drops.	532(n)81 #3
Tmp. To operate above High tmp. To oper. -above	Enter a set point for devices that you want to turn ON when the temperature rises.	532(n)81 #4
Hum. To oper. below Low hum. To oper. -below	Enter a set point for devices that you want to turn ON when humidity drops.	532(n)81 #5
Hum. To oper. above High hum to oper. -above	Enter a set point for devices that you want to turn ON when humidity rises.	532(n)81 #6
Gen.sns.oper. below Low value (gen.sns) to oper. -below	Enter a set point for devices that you want to turn ON when the General sensor's (S.A. EC, pH, radiation, wind, or any other) value drops.	532(n)81 #7
Gen.sns.oper. above High value (gen.sns) to oper. -above	Enter a set point for devices that you want to turn ON when the General sensor's (S.A. EC, pH, radiation, wind, or any other) value rises.	532(n)81 #8
Oper. By sensors * Operation method	Use the Select button to define whether the output refers to sensors or is operated by hours.	532(n)81 #9
Oper. Time -sec. Oper. Time –sec.	An option for intermittent operation: Operation time must be non-zero to have the device work. The wait time can remain zero (if you want constant operation) or be any other number in seconds, for intermittent operation.	532(n)81 #10
Wait time –sec. Wait time -sec		532(n)81 #11

Activation by other processes or components

Most components in the greenhouse can enforce activation or inactivation of free outputs. All you have to do is to set the proper link in the proper place and avoid conflicts. In case of a conflict –inactivation is the dominant.

Enforcing the free outputs due to occasions.

Text in controller **Text in PC**	Description	Code
At fan oper. No. During fan operation No. 0-1234	An operation link between fans group and free output. For example: writing '14' here, will make the free output operate whenever fan groups no. 1 or/and 4 are on.	532(n)82 #1
At heat oper. No. During Heat oper No. 0-1234	An operation link between the heating process and free output. For example: writing '14' here, will make the free output operate whenever heating process no. 1 or/and 4 are active.	532(n)82 #2
At spray proc.No. During spray oper. No. 0-1234	An operation link between the spray process and free output. For example: writing '24' here, will make the free output operate when spray process 2 or/and 4 are on.	532(n)82 #3
At CO2 proc.No. During CO2 proc. No. 0-1234	An operation link between the CO2 process and free output. For example: writing '24' here, will make the free output operate when CO2 process 2 or/and 4 are on.	532(n)82 #4
At cool proc.No. During cool oper. No. 0-1234	An operation link between the cooling process and free output. For example: writing '24' here, will make the free output operate when cooling process 2 or/and 4 are on.	532(n)82 #5
At vent process * You can enter the same parameter from 2 places in the controller.	Use the Select button to set the dependency between free output and ventilation processes. The options are: <No change>, <Operate> and <Stop>. "No change" leaves the free output as it was when the ventilation process is activated; "Operate" causes operation of a stopped process and "Stop" stops an operated output.	532(n)82 #6 532(n)83 #6

Avoiding the free outputs due to occasions.

Text in controller **Text in PC**	Description	Code
At fan oper. No. During fan operation No. 0-1234	A stop link between fans group and free output. For example: writing '14' here, will make the free output stop whenever fan groups No. 1 or/and 4 are on.	532(n)83 #1
At heat oper. No. During Heat oper No. 0-1234	A stop link between heating process and free output. For example: writing '14' here, will make the free output stop whenever heating process No. 1 or/and 4 are active.	532(n)83 #2
At spray proc.No. During spray oper. No. 0-1234	A stop link between spray process and free output. For example: writing '24' here, will make the free output stop when spray process 2 or/and 4 are on.	532(n)83 #3
At CO2 proc.No. During CO2 proc. No. 0-1234	A stop link between CO2 process and free output. For example: writing '24' here, will make the free output stop when CO2 process 2 or/and 4 are on.	532(n)83 #4
At cool proc.No. During cool oper. No. 0-1234	A stop link between cooling process and free output. For example: writing '24' here, will make the free output stop when cooling process 2 or/and 4 are on.	532(n)83 #5
At vent process * Oper. During vent. Proc.	Use the Select button to set the dependency between free output and ventilation processes. The options are: <No change>, <Operate> and <Stop>. "No change" leaves the free output as it was when the ventilation process activates, "Operate" option makes a stopped one operates and the "Stop" option stop an operated output.	532(n)83 #6 532(n)82 #6