

PlantControl CX LoRa

Irrigation Controller

Manual

Version 4.42



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1. Introduction

Please read these instructions carefully before configuring your PlantControl CX central unit and the soil moisture sensors.

Scope of delivery

- PlantControl CX central unit incl. 8-Station 24V AC module and GPRS modem
- Wireless soil moisture sensors (quantity and version acc. to order)



Solar cell to be used only with 9V DC impulse valve

External antenna for enhanced signal reception. PlantControl central unit or GPRS Modem

Basics

PlantControl CX is the world's first self-learning irrigation computer that intelligently determines the measurements from up to 99 wireless-linked soil moisture sensors. The totally maintenance-free sensors measure soil moisture content and soil temperature at regular intervals and transmits these measurements wirelessly to the PlantControl CX central unit. The central unit not only calculates the correct time to water but also the plants' actual water requirements and automatically adjusts run times according to their growth stages and seasonal temperature fluctuations. Irrigation starts automatically as soon as the measured dryness level exceeds the pre-set threshold value and the irrigation time window has been reached. After irrigation, the PlantControl CX determines whether the pre-set target soil moisture level has been reached or not. If necessary, the run time is increased or reduced in order to hit the target moisture in the next irrigation run (DRA-Technology, Dynamic Run-Time Adjustment). This worldwide unique technology ensures optimum water supply for the plants, prevents under- or overwatering and protects precious water resources.

Remote monitoring and remote control of the irrigation system as well as SMS-Alarm functions are also available. A special software (PlantCare DataViewer) allows quick analysis of irrigation data. Corrective actions can be carried out from a distance without extensive analysis on the spot.

The worldwide patented PlantCare sensor technology is based on a micro-thermal method of measuring soil moisture. A specially designed felt material, which is in moisture equilibrium with the soil serves as a standardized interface between the soil and the sensor. For the measurement of soil moisture, the sensor is heated for a short time and the cooling time is then determined, which varies depending on the soil moisture level. The cooling time of the sensor thus provides a reliable indication of the water content in the soil. The sensors require no maintenance and have no corrosion-prone parts.

In developing the Plant Control CX, performance, the ease of use and reliability were given the greatest priority.



Functions:

General characteristics

- Up to 99 wireless sensors
 - Depending on the type of terrain and the visual contact between the sensor and the PlantControl, the range of the radio connection can be up to 20 km. With optional repeaters, this range can be extended by another 20 kilometers.
 - Frequency band royalty free: 868 MHz
 - Measurement of soil moisture and soil temperature in freely selectable measuring cycles.
 - Soil moisture measurement in relative% or hPa (for hPa, 6 standard soils are available)
 - Fast reaction time of the sensor for moisture changes.
 - Reliable measurements even at shallow depths.
 - The measured value is not affected by the salt or fertilizer content.
 - Exact temporal assignment of measured values by built-in quartz clock in PlantControl central unit.

Connection of up to 40 solenoid valves

- Optionally 24VAC, 9VDC pulse, 24VDC valves possible
- Assignment of up to 5 fertilizer injectors per valve
- Automatic bypass valve control
- Control by cable or by radio. (8 valves per radio receiver)
- Adjustable rinsing times
- Adjustable pre-cut-off of the main valve to avoid pressure blows
- Several control modes can be selected per valve
 - timer
 - semiautomatic
 - full automatic
 - Clone
 - monitoring

Service

- Simple, menu-driven data input on the device
- Data retrieval via smartphone
- Remote control by smartphone
- SMS alarm function. All functions are electronically monitored and in case of a malfunction, up to 4 phone numbers can be alerted
- The measured data can be sent automatically at regular intervals to an e-mail address or by SMS. With the aid of the DataViewer software, the data can be immediately graphically displayed and analyzed
- More functions
 - Minimum and maximum Temperature alarm with SMS message
 - Start and shutdown of more distant pumps by SMS commands
 - Connection to existing fertilizer mixers possible

2. Commissioning

PlantControl Front Panel



- 1: ON/OFF key
- 2: Restore-Settings: not yet activated
- 3: Main Menu
- 4: DEL = Deletes last entry
- 5: BACK = Goes back one menu level
- 6: OK = Confirm selection or entry
- 7: Cursor keys
- 8: Display Alarm: Displays active alarms
- 9: Reset Alarm: Resets alarms
- 10: USB Imp/Exp: Button to call the import-export functions via USB interface
- 11: Alarm-LED
- 12: GPRS-Terminal-LED: Flashes every 3 seconds when network connection is established
- 13: Busy-LED: Lights up when the central unit is busy (operating panel is blocked)
- 14: USB-Interface
- 15: Service Interface
- 16: Service Interface
- 17: Special characters like @ # ? can be found under the key "1"
- Key Lock: By simultaneously pressing the keys "2nd" and "MENU" on or off.

Menu Structure



Go to the required menu item by using the cursor keys. Selectable menu items as well as data entry fields are shaded in grey. Enter in selected menu or data field by pressing the OK key.

Electrical Power Connections

Do not connect the mains cable until you have finished wiring!





An external antenna (optional exuipment) will extend the radio range

Please connect the external antenna here.

Repeaters can also be used to extend the radio range in case the line-of-sight is blocked..

Mains 115 or 230 VAC

The picture above shows the connection terminals for the mains. Besides the phase (P) and the neutral line (N) a ground wire has to be used. The power cable is fed through one of the cable entries and connected to the screw terminal.

Caution: Check first under the menu Settings> Controllers> AC Input, whether 115 or 230 volt is displayed. If you would like to change the AC input, please contact your supplier.

Solar cell for 9V DC impulse valves: The solar cell is connected to the 16V DC screw terminals. For this, the cable is pulled through one of the cable entries. Connect the black wire to GND and the red wire to 16 VDC.

After finishing the cabling, the cover has to be placed and screwed again. Please make sure that the rubber seal on the lid as well as the opposite side is not dirty.

PlantControl valve cable connection

A maximum number of 40 valves connections max. 0.7 Amps are available. 1-8 are always cable connections and 32-40 always radio controlled valves. Number 9-31 can either be used (in blocks of 8) for cable or radio connections or multifunctional outputs modules for fertigation control, KNX connection etc.

Removable plugs for valve connections Master (M) and 1- 31

Connections master valve



Master-Valve

The first 2 terminals (1, 2) are reserved for the master valve. The master valve is open as long as one other valve is open. This is an additional measure to prevent leakage.

To avoid shock waves in the pipes, generated by fast -closing valves, the closing of the master valves can be done prior to the closing of a normal valve. (See *Menu* > *Settings*> *Special*)

Multi-functional switching module

You have the following options, if you have purchased the optional multi-functional switching module (always installed in the last free module place, which may correspond to Module 2, 3 or 4):

- Fertigation control

- Initiation of an temperature alarm (frost).

- Interface to other electronic system s in case of any other alarm (i.e. general alarms to facility management systems).

Under *Menu* > *Status* > *Backplane Module* > *OK* one can see on which cable-terminal which function is available.

The multi-functional switching modules are available in the following versions:

- Floating contacts: This function must not be de-locked
 - \rightarrow As long the function is active, the contacts is closed.
- 9VDC impuls: (Has to be de-locked)
 - \rightarrow When the function is activated a positive 9V impulse is send to the terminals
 - \rightarrow When the function is de-activated a negative 9V impulse is activated

 \rightarrow 24VAC: (Has to be de-locked). As long as the function is activated 24VAC is put on the terminals.

De-locking procedure:

-Go to *Menu* > *Settings* > *Special* > *OK* "Module x as Fertil." select YES. The CX automatically is switched off and on again.

Fertilizer dosage valve control

You can control five fertilizer dosing valves per valve. The 5 cable connections that must be wired for the fertilizer dosing valves are automatically displayed on the PlantControl Display under *MENU> Status> Backplane Module> OK* button after installing the multi-function switch module.

Operation: As soon as a watering valve to which one or several fertilizer dosing valves is assigned is opened, the fertilizer dosing valves are also opened. The "fertilizer dosing valve" is closed as soon as the irrigation valve is closed. Exception: If you enter a rinse time in the same menu item, the fertilizer pump is switched off earlier and irrigation continues as long as the user specifies or as it is calculated by the system.



The Bypass valve is open whenever irrigation takes place without fertigation.

Connecting alarm relay to facility management system

The multi-functional switching module allows the wired transmission of an alarm message to the home automation system. In case of an alarm, a floating contact is closed (max. 800 mA current load). Which cable connection must be wired for this function can be seen, after mounting the module, on the central unit display:

MENU > Status > Backplane Module > OK (under item "Alarm Relay")

The home automation system will only display, that there is an alarm message from the PlantControl CX irrigation controller. The type of alarm can then be viewed on the PlantControl CX central unit display by pressing the "Display Alarm" button.

Temperature alarm relay / Trigger an action in case of temperature alarm

If temperature drops below a lower limit or when exceeding an upper limit, the multi-functional switching module closes a floating contact (max. 800 mA current load).With an additional relay, this allows the automatic opening/switching of a valve, pump or optical and acoustic alarms, etc. Which cable connection must be wired for this function can be seen, after mounting the module, on the central unit display:

MENU > Status > Backplane Module > OK (under item "Temper. Alarm Rel")

Sensor operation

General

- The sensor is equipped with LEDs and a beeper, which give the user notes. This allows to switch on and off the sensor even when it is closed
- The following terms are used in the following:
 - Short beep = the LED flashes 1x briefly and the beeper beeps simultaneously 1x briefly
 - Long beep = the LED flashes 1x long and the beeper beeps at the same time 1x long
 - Beep-Beep = short double-blink or double-beep
 - Beep-Beep-Beep = 3 short signals in succession
- If necessary, the red cover can be removed with light pressure
- Pressing in the correct position, the on / off buttons can also be operated with the red cover on.



Mark

Matt surface area

Switching on/ switching off/ testing reception

- **Switching on**: Briefly press the ON/OFF button. The LED will flash for a moment.
- **Switching off**: Press and hold the ON / OFF button until the beep stops. Then release the button.
- Check whether the sensor is ON or OFF: Press the button briefly. If you hear a short beep the sensor was off and is now turned on. With a long beep the sensor was switched on already and now sends a telegram which is soon confirmed with a beep beep.
- Testing reception

This is only possible if the sensor has been switched on and initialized already and if a moisture measuring is not taking place:

Briefly press the ON/OFF button. The LED will flash for a moment and a test telegram is sent to the PlantControl. After a few seconds, the reception strength and other data can be seen on the PlantControl display in *Status* > *Sensors*.

On completion of a successful transmission, the LED will briefly flash twice. Otherwise the LED will light up for 1 second. Use this function, for example, when repositioning a sensor.

Special peeping modes

- Beep-Beep-Beep. The sensor is currently performig a measurement. Wait 10 seconds and try again
- Ongoing Beep-Beep-Beep-.....The sensor is not initilaized vet



Inserting/replacing the batteries

- 1. Pull off the red cover (A)
- 2. Remove the old batteries
- 3. Insert 2 AA 1,5 V DC batteries and take care about the right polarity. If old batteries have to be replaced, dispose the old one correctly.
- 4. Switch on the sensor. Providing the sensor has already been initialized the settings will remain unchanged and the sensor ready for use.
- 5. Push the red cover on again





Attention:

The sensors are calibrated prior to delivery with the felt type ordered.

In case the felt has to be replaced by a different type, the calibration values have to be adjusted. The manual for readjustment is available on request.





3. Configuration

Step 1. Switching on your PlantControl

- 1. If available, withdraw the safety film to activate the factory-installed and charged 8 AA batteries.
- 2. Press the ON button
- 3. Press the MENU button
- 4. Check, if the battery status symbol on the display shows at least one bar. Otherwise charge up the batteries either with a mains cable or with the solar cell.

Step 2. Configuring your PlantControl central unit

Settings > Controller > OK button:

Press the \blacktriangle - ∇ cursor keys in a sub-menu to scroll up or down and then select with the **OK button**. Use the alphanumeric keypad for your input.

Device name:	The controller can be allocated a specific name or location. The unit name will also appear in data files exported.
Measurement cycle	Your entry specifies the time between two measurements (minimum: 5 minutes maximum: 360 minutes). It is recommended that you set the longest possible measuring cycle time in order to conserve battery power.
Time:	Enter hours, minutes and seconds
Date:	Enter day, month, year
Network number:	Automatically allocated. The network number is determined by the system with a random generator and also transmitted to all sensors linked to the PlantControl unit. This prevents any mutual interference from neighboring networks. Recommendation: Do not change the network numbers allocated by the system.
Radio channel:	The factory setting for the radio channel is 5. Channels 2,3,4 and 5 can be selected. The channel number should only be changed if there is radio-frequency interference from a neighboring installation. If you change the channel number, the corresponding sensors must be initialized again.
Frequency band:	The factory setting for the frequency band is 868 MHz.
Language:	Choose between German and English.
LCD contrast:	The contrast of the LCD display can be optimized by entering a higher or lower number.
LCD light on:	Here, you can select how many seconds the background illumination will stay on. Recommendation: Set as short a period as possible to conserve battery power.
AC Input:	AC Input display

Step 3. Initializing the sensors

Wireless systems must first "recognize" each other if they are to communicate. Initialization of the PlantControl unit with the sensors must therefore be carried out first. In the normal case, the sensors are already initialized before delivery and thus this step is omitted. If, however, sensors have been deactivated and one would like to reactivated them later, or new ones are added, they must be reinitialized.



Initializing the sensors

Initialize > Sensors > OK button:

- 1. If the sensor has previously been deactivated and must now be initialized again, select the corresponding sensor number. (Otherwise the next free one is used).
- 2. Enter the repeater number (if any) with which the sensor is to be connected
- 3. The sensor must now be switched on. If the sensor sends short beeps after switching on, this means that it has never been initialized before.
- 4. Press shortly the button for initialization. If the initialization is successful, a beep-beep is acknowledged. Without the beep-beep the initialization failed. In this case, "Failed" appears on the screen. In such a case, the procedure from point 1 must be repeated.
- 5. As soon as the controller has initiated the sensor, label it with a number assigned by the system to ensure a clear assignment between the sensor and the data set. You can then initialize the next sensor.
- 6. Once all sensors are initialized, you can return to the menu with the BACK button.
- 7. Ensure that the number of initialized sensors is correct using Settings > Sensors > OK button.
- 8. Check reception strength: Using the menu item Status > Sensors, the reception strength will be shown in % for all sensors (Signal). Use the ▼ cursor key to move to the desired sensor as necessary. Do not stand in the transmission path between sensors and Data Logger when checking reception strength. If a sensor has a reception strength below 10%, briefly press the ON/OFF button of the corresponding sensor which will trigger radio contact and the reception strength will be displayed again after approx. 2 seconds. If it is still below 10%, the sensor should be repositioned as necessary. Briefly pressing the sensor's ON/OFF button will show reception strength again.

Commissioning of already initialized sensors:

If the PlantControl unit and sensors have been initialized already at the factory (would be labeled on PlantControl central unit), then proceed as follows:

- 1. Switch on the PlantControl
- 2. Switch on the repeaters and the sensor (s)
- If a reception test is to be carried out immediately, press the sensor control button briefly. Otherwise, depending on the number of sensors, check the PlantControl menu item *Status> Sensors* Receiving Strength after approximately 60 minutes.

Identification of sensors

With this function you can find out under which number a sensor is registered and whether it sends data correctly or not.

Status> Identify> OK

Press the On / Off button on the sensor and the pre-set data are displayed on the screen.

Note: The same function can also be used to identify repeaters and radio valve controls.

Step 4. Sensor settings

Settings > Sensors > OK button

This submenu contains all setting parameters for the sensors.

Number of sensors:	This is automatically assigned based on the number of initialized sensors. For this reason, the figure should not be changed.
Highest sensor no.:	This states the total number of sensors initialized in the controller. This figure cannot be overwritten.
* Moisture in:	Pressing the OK button allows you to choose between 3 readout units:
	rel %: Data readout is in relative moisture percentages (factory setting).
	sec: Sensor cool-down time in seconds
	hPa: Suction pressure (see also chapter 4)
	Note: The stored measurements, for example in rel%, can be read at any time for the same measurement period in hPa and vice versa.
* Sensor No.:	Press the OK button to enter a supplementary designation for the sensor in addition to the sensor no.
* Suction pressure:	If you have selected hPa under "Moisture in", then push the OK key and select one of the soil types, which matches best with your soil (see also chapter 4).
Repeater:	Indicates to which repeater number the sensor is assigned.
Deactivate:	Proceed as follows if you wish to deactivate a previously initialized sensor:
	Deactivate > OK button. Use the \blacktriangleleft - \blacktriangleright cursor keys to move to the next or previous sensor and to deactivate another sensor.

Attention:

After deactivation, the sensor is no longer visible in the status list and also no longer sends alarms and is removed from the valve assignment. There is a gap (e.g., sensor 3 missing).

To reactivate the sensor, it must be initialized again. When initializing, the first free gap is filled by default. If they do not want it, they must manually select the desired free sensor number.

*ONLY THESE ADJUSTMENTS MAY BE MADE!

Step 5. Initializing the valves/zones

There are max. 39 valve connections. 1-8 are always wired and 32-39 radio controlled. Numbers 9-31 can be used in steps of 8 as wired valve connections or radio valve connections (valve remote control) or for multifunctional purposes (e.g., fertilizer).

The definition takes place in menu 52 (Setting > Initialize > Valves>OK).

Radio valve controller name D	Settings Cable valves available	7	Cable valves effectively used
	Number of cable valves Radio Valve B 815 R Radio valve C 16 23 P	3 initiat	Available, not used yet. Ready to be initialized
Connected through Repeater 3	Radio valve E 2431 RØ Radio valve E 3239 R3	deactivate deactivate	Already in use. Can be deactivated again

Initializing cable valves

Initialize > Valves/Zones > OK

Valves available: The number of available valve connections and/or monitored zones will be automatically displayed (in the example above = 7).

Number of valves: Enter the number of valves/zones effectively used (in the example shown = 3).

Initializing radio valves

Initialize > Valves/Zones > OK

- 1. Choose a group of valves for initializing e.g. $32...39 \rightarrow OK$
- 2. If the valve radio control is connected through a repeater enter the repeater number
- 3. Press the button at the remote valve control box for 5 sec or until the screen on the CX confirms the initialization



Radio Valves Interfaces

Note 1: Please note that a monitored zone also consumes a valve channel, even no valve is connected .

Step 6. Valve/Zone settings

Settings > Valves/Zones > OK

Under this menu item, setting parameters for the valves are grouped together. Depending on the chosen type of irrigation control mode, not all of the following submenus are displayed.

Menu				
			1	
1	Status	\rightarrow		
3	History	\rightarrow		_
4	Settings	\rightarrow	41 Controller	
5	Initializ.	\rightarrow	42 Sensors	
			43 Valves/Zones	
			44 GSM/GRPS	
			45 Repeater	
			46 Alarms	
			49 Special	

Valve/Zone 1:		
Valve manually	off	
Irrig. control mode	deactivated	

Valve/Zone No: Press the OK-button to enter a supplementary designation for the valve/zone after the valve/zone no. Use the ◀ - ► cursor keys to move to the next or previous valve.

Valve manually: If you would like to manually and immediately start the valve selected under "Valve No.", press the OK-button and enter how long the valve shall be open (1 - 240 minutes). If you want to close the valve immediately, enter "0". This function allows also to check, whether the connected valve responds properly. If other valves are cloned with this valve, they will also be opened (in sequence).

You can also switch off a valve for a certain amount of time (irrigation lock, max. 240 hours). After this period, the irrigation is automatically switched on again.

Settings		Valve manually
Valve/Zone 1: Valve manually Irrig. control mode	off deactivated	ON/OFF OFF for hours 0 = off Minutes ?
Irrigation control Irrig.control mode all-automatic semiautomatic Timer Valve to clone Monitoring/man deactivated	mode	Important: If you switch from one control mode to another, previous control mode settings will be los Select between different irrigation control modes per valve by pressing the OK-button.
Settings Valve/Zone 1: Valve manually Irr. control mode Fertilizer Relay Week days Time of irrigation Remeasurem. After Sensor numbers Irrigation start Irrigation start Irrigation stop Duration of irrig. min / max irri. Durat.	off all automatic (0 min) Su MoTu We Th Fr Sa always 60 minutes none 35% 95% 10 min 0 sec 3/240 minutes	All-automatic: Irrigation starts only, when the sensor assigned to the corresponding valve measures a soil moisture level below the dry threshold level. If several sensors are assigned to this valve, then the system calculates the average moisture value. In addition, the run time will be adjusted automatically and dynamically (Dynamic Run-Time Adjustment), so that an over- or under-watering can be prevented.

-	
Settings	
Valve/Zone 1:	
Valve manually	off
Irr. control mode	semiautomatic
Fertilizer Relay	(0 min)
Week days	Su MoTu We Th Fr Sa
Time of irrigation	always
Remeasurem. After	60 minutes
Sensor numbers	none
Irrigation start	35%
Irrigation stop	95%
Duration of irrig.	10 min 0 sec
-	
attings.	
settings	
Valve/Zone 1:	
Valve manually	off
Irr. control mode	Timer
Fertilizer Relay	(0 min)
Week days	Su MoTu We Th Fr Sa
Time of irrigation	never

off

Valve to clone

_ _ _ _ (0 min)

delayed

none

Settings Valve/Zone 1:

Valve manually

Irr. control mode

Time of irrigation

Fertilizer relay

Valve to clone

Semi-automatic: Irrigation starts only, when the sensor assigned to the corresponding valve measures a soil moisture level below the dry threshold level. If several sensors are assigned to this valve, then the system calculates the average moisture value. The run time however must be entered by the user

Timer: This control mode is used when a valve has to open at a predetermined time and for a fixed run-time.

Valve to clone: Cloning has the advantage that zones with identical water needs do not all have to be equipped with sensors. Instead, sensors are assigned to only one zone respectively valve and the other valves/zones are cloned. Thus, cloned valves/zones are watered indirectly sensor-controlled.

Enter here the number of valve/zone equipped with a sensor. In case you choose *delayed* the cloned valves will be opened one after the other. In case your controller is equipped with 9VDC latch or floating contacts modules, you could choose *simultaneous* to open the clones at the same time. In the same way, this function will transfer fertilizer, bypass and alarm information to the wireless valve control unit.

Important: Never place a sensor in the irrigation zone of a cloned valve. Sensor must be physically inserted always in that irrigation zone, where a valve is opened according to the measured values of a sensor. Otherwise, a sensor has no way to register the expelled water.

Settings			
Valve/Zone 1:			
Valve manually	off		
Irr. control mode	Monitoring manually		
Sensor number	none		
Irrigation start	35%		
Time between SMS	24 h		

Monitoring/Manual: This mode allows the monitoring of a zone. Once the moisture drops below a pre-set dry threshold, the system sends an SMS alert to a mobile phone (requires SMS-Alarm option). The time between two SMS messages can also be set.

The SMS message will indicate the moisture difference to the pre-set value for all monitored zones. The user can now activate the irrigation for that zone on the PlantControl manually (if a valve is connected) or irrigate the corresponding zone with a mobile irrigation unit.

Deactivated: Select this option, if you want to deactivate the current valve.

- **Fertilizer Relay:** If you have purchased a fertilizer control module, up to 5 fertilizer dosage valves can be actuated per irrigation valve (floating contacts with max. 800 mA current load).
- Week day: Select days of the week to water or not to water. In addition, you can specify here, which "irrigation window" shall apply within a day. By doing so, no irrigation will be started outside this window.
 NOTE: Your default under "irrigation window" has priority over your entries under "Time of irrigation". This means that irrigation times outside the irrigation window will not be considered.
- **Time of irrigation:** You can enter up to 12 start times per day or select "always" (only for control modes "all-automatic" and "semi-automatic"). If you select "always" an irrigation is started whenever the sensor has reached the entered dry level threshold regardless of time of day. **Exception**: If you have specified a irrigation window for watering under the menu "Week days", a "Time of irrigation" outside this window will be blocked by the system. If you want to delete a start time, go to the corresponding line and select the DEL-button.

NOTE: If you delete the first row, all other subsequent rows will be deleted too.

- **Re-measurement after**: If the irrigation control modes "all-automatic" or "semiautomatic" are selected, the system will conduct a moisture measurement after the irrigation end. With this, the system checks, whether sufficient water has been applied or not. Since the right moment of such a re-measurement after irrigation end depends on how deep the sensors are installed as well as how fast the water soaks to the sensor (different depending on soil type) the user must enter here, when a re-measurement after irrigation end shall take place. In general, the deeper the sensors are installed and the slower the water soaks through, the longer must be the measurement period. **IMPORTANT:** During the measurement period, no irrigation will take place.
- **Sensor numbers:** Enter here, which sensor(s) shall be assigned to the current valve. If several sensors are assigned to a valve (max. 6), the average moisture value of the sensors will determine the irrigation start respectively irrigation end.
- **Irrigation start:** Enter here at which dry threshold level an irrigation shall start. (only for control modes "all-automatic" or "semi-automatic"). The entered value is in relative moisture percentage.
- **Irrigation end:** If you have selected the control mode "all-automatic", enter here which target moisture shall be reached after irrigation. The entered value is in relative moisture percentage.
- **Duration of irrigation**: Enter here the run-time, if you have selected the control mode "semi-automatic". If you have selected the control mode "all-automatic", you can optionally enter the run-time according to your experience. Thereafter, the system automatically determines the optimal run-time in order to achieve the predetermined target moisture. If you enter "0", the system automatically determines the very first run-time. If you have selected the control mode "Timer" the run-time has to be defined in the menu "Time of irrigation".
- **min/max irrigation:** If you have selected the control mode "all-automatic", enter here a run-time duration which never may be undershot or exceeded by the system.

Introducing the Repeater (Range Extender)

If you don't use repeaters you can skip this section.

Repeater are used to extend the radio range in case the line-of-sight is blocked. Multiple repeaters can be used serial or in parallel.

The reception range can be extended by using multiple repeaters. Power is supplied by either an AC adapter, a solar cell or a car battery.



Control button / Connections

- A. Power connection (power supply or solar cell)
- B. LED
- C. Control button
- D. Interface for external antenna (optional)

Switching on/ switching off/ checking power supply

Please note that repeaters are usually delivered with built-in rechargeable batteries (8x AA).

- 1. Plug the AC adapter or solar cell to connector A. This automatically switches on the unit.
- 2. By pressing the button C you can check whether the repeater is receiving sufficient power. If the LED flashes, the repeater is operational. If the LED does not flash then either there is currently not enough power available (if a solar cell is used, the repeater enters in a sleep mode if the battery voltage is < 8.2V in and is only ready for operation again when the battery voltage rises again) or the repeater is defective.</p>

Operating (check also chapter "Initializing the repeater")

- By pressing the control button, the repeater sends a test message to the PlantControl. The test telegram can be used to identify the repeater (see also Plant Control menu Status > Sensor Identify.)
- To initialize a repeater, hold down the control button for 5 seconds (see also chapter "Initializing the repeater").





Step 7. Initializing a repeater (range extender)

Wireless systems must first "recognize" each other if they are to communicate. Initialization of the PlantControl unit with the repeater must therefore be carried out first.

Commissioning of already initialized repeaters:

If the PlantControl unit and repeaters have been initialized already at the factory (would be labeled on PlantControl central unit), no initialization must be performed.

Initializing a repeater

Initialize > Repeater > OK-button

Before initializing the repeater, you should draw a simple plan with the position of the individual components. The plan should show the assignment of repeaters to the PlantControl and how the repeaters are assigned between themselves.

For a better understanding, see the following example with a total of 5 repeaters. Repeater 1 is directly assigned to the PlantControl and repeaters 2 to 5 are connected to the PlantControl via repeater number 1.



The following display shows the settings (inputs) for the above example of repeater number 1.

Repeater	initial	ize	
Repeater Numb in direction in direction in direction in direction in direction	of Contr. of Sensor of Sensor of Sensor of Sensor of Sensor		Controll

- 1. Select Initialize > Repeater > OK-button.
- 2. Before initializing a repeater, you must first make the following settings:
 - **Repeater Number:** Here, number 1 is displayed as the first repeater.
 - **in direction of Controller:** Here you have to enter the other repeaters that connect a repeater to the PlantControl central unit. Since no further repeater is positioned in the direction of PlantControl in the example above, the number 0 must be entered (number 0 = controller). Otherwise, press the OK key and enter the repeater number, which is between Repeater 1 and the PlantControl.
 - **in direction Sensor:** You can assign up to five other repeaters to a certain repeater. Therefore, you have to enter here which other repeaters are connected to the repeater number 1. In this example, the repeater number 2, 3, 4 and then 5 were entered.
 - Place the repeater approximately at a distance of 1 meter from the controller and press the control button on the repeater for 5 seconds. Once the controller has detected and initialized a repeater, you should label it with the repeater number assigned by the system. You can then initialize the next repeater. When the repeater has not been detected, "failed" will be displayed. In such a case, the procedure from point 1 must be repeated.

The settings for the second repeater are as on the following display:



- Repeater Number: Here, number 2 is displayed as the first repeater.
- **in direction of Controller:** Enter here via which other repeater, repeater number 2 is connected to the PlantControl central unit. As in the example above, repeater number 1 is placed in direction to the PlantControl enter here number 1 (see also sketch on previous page).
- **in direction of Sensor:** As no other repeater is placed into the direction of sensors, no input is required (see also sketch on previous page).
- Initialize now the second repeater as described previously.

Further repeaters can be initialized as described with the above examples.

- 4. After having initialized all repeaters press the BACK-button to return to the main menu.
- 5. Check under the menu item *Settings* > *Repeater*> *OK*-button if the number of initialized repeaters is correct.

Further example:



Step 8. Commissioning the GPRS Modem

Settings > GSM/GPRS > OK

Disregard this step, if you have not purchased any of the optional functions such as remote data retrieval, remote control and SMS-Alarm function.

Working principles

The GPRS modem is used for the optional functions such as remote data retrieval, remote control and SMS-Alarm function. When transmission is set to automatic, the data is sent to the e-mail address entered in the corresponding menu field. In addition, the data required can be sent to any e-mail address by sending an SMS to the GPRS Modem.

Please note that for proper function of the modem minimum receiving power of 50% should be available. Check the current GSM receiving power on your PlantControl under the menu "Status> Controller".

SIM-Card

A GPRS-enabled SIM-Card is required for your GPRS Modem to be able to transmit data. We recommend purchasing a SIM-Card from a local supplier with excellent network coverage. A GPRSenabled, prepaid SIM-Card can also be used.

Deactivate PIN lock

Insert the SIM-Card in a mobile phone and follow the instructions in your mobile phone operating instructions .Settings \rightarrow Security \rightarrow PIN lock. The SIM-Card is correctly unlocked when no PIN code entry is requested after switching off and switching on your mobile phone.

Inserting the SIM-Card







Tilt the front panel 90° forward and slide into the slots



Remove the SIM-Card holder place the SIM-Card properly and push the holder back again (see details below).

Unscrew the 4 screws on the front panel.

Lift the front panel with the help of a small screwdriver

LED:

GPRS Modem

- Flashes every second when GPRS is searching the network
- Flashes every 3 seconds when network connection is established



Interface holder (not needed)



SIM-Card holder

SIM -Card

unlocking pin

holder



RS232 Interface

Antenna socket

Unlock the SIM-Card holder by pressing the small button to the right of the SIM -Card holder with the tip of a ballpoint pen or similar. Put the unlocked SIM-Card into the card holder and push it gently into the GPRS Modem. Reattach the front panel an tighten the 4 screws.

Switch on your PlantControl CX central unit and select

MENU > Settings > GSM/GPRS. Set now the following parameters:

1. Terminal operation

Activating/deactivating the GPRS Modem : select **Terminal operation** and then the **OK-**key. Note: If you have purchased the SMS-Alarm function, the modem will be, if deactivated, automatically activated for a short time for transmitting alerts.

2. Email Data output

Choose between sending *Monitoring SMS* to the phone number defined in alarm settings or sending *Data File /Status* to the Email Recipient. Select *Email Data output* and then the *OK*-key.

3. Email send

To test your settings or to manually initiate a transmission, select *Email send* followed by the *OK* key (only after entering all the parameters). The GPRS Modem will immediately transmit an e-mail to the e-mail address specified under "Recipient" or send an SMS to alarm#.

4. Power switch-on

For automatic data transmission or transmission in response to an SMS request, the GPRS Modem can be left permanently switched on (not recommended when used with a solar cell) or temporarily once a day at the specified time.

Select *Power switch-on* followed by the *OK* key. Now choose between the following options: **0** (permanently switched on) or, for example, **16** (= 4 p.m.), which is recommended when the system is used with a solar cell, and the GPRS Modem will be switched on every day at 4 p.m. for 30 minutes.

5. Send email every (transmitting interval)

Here, you must specify the interval at which the e-mail address entered under "Recipient" is to receive the data of the last couple of weeks automatically. If you do not require this option, the data can be also retrieved remotely by SMS.

Credit query:

If a prepaid SIM-Card is used, the data file transmitted will contain information on your residual credit. Select *Credit query* followed by the *OK* key. Then enter the code given to you by your SIM-Card provider (not all provider support this function).

- 7. APN (not required, if the modem is only used for sending and receiving SMS) To enter the APN (Access Point Name), select *APN* followed by the *OK* key. Now enter the APN given to you by your SIM-Card provider. Then enter the APN user name and password, if specified by your provider. In most cases this is not required. If no username and password is specified or you want to delete old entries, press the OK- button.
- 8. E-mail account settings (No need to change. you can leave plantcare default settings here) To ensure that your GPRS modem can send email messages, it requires an email account. You can use the existing Plant Care Account settings (recommended) or create a new account.
 - 8.1 Mail Server (Outgoing mail server)
 Select *Mail Server* followed by the *OK* key. Now enter the name of the outgoing mail server.
 → recommended setting = pop.plant-care.ch

8.2 User Name

Select **User Name** followed by the **OK** key. Now enter the user name of account above. \rightarrow recommended setting = gprs@plant-care.ch

8.3 Password

Select **Password** followed by the **OK** key. Now enter the password of account above. \rightarrow recommended setting = plantcare

9. Recipient (not required, if the modem is only used for sending and receiving SMS) Select *Recipient* followed by the *OK* key. Now enter the e-mail address to which the data is to be automatically transmitted in accordance with the interval defined (q.v. "Send e-mail every"). If you do not require this option, the data can also be remotely retrieved by SMS.

Prepaid SIM-Card information

If you are using a prepaid SIM card, we would like to draw your attention to the special terms and conditions for prepaid SIM card products.

Your prepaid SIM card provider may be subject to legal requirements and therefore, when you are not using the SIM card (inactivity), you must turn off your number for a certain period of time. In such a case, the GPRS modem could not send a data transfer. Depending on the provider of the SIM card and country, the legal provisions may differ. We recommend that you contact your SIM card provider in order to know the exact details.

For example, some providers require that the SIM card number be used within one year for incoming or outgoing calls. In such a case, you may need to periodically remove the SIM card from the GPRS modem, insert it into a mobile phone, and make a call. Some providers also accept a message outgoing from your GPRS modem as a usage. If this is the case with your provider, you could periodically send an SMS short message to the SIM card number of your GPRS modem for data fetching (see "Data request by SMS short message")

Alternatively, you can purchase a SIM card in subscription instead of a prepaid SIM card. In such a case, however, depending on the provider and subscription, monthly costs arise.

Troubleshooting

The system fails to send data after configuration:

- Make sure the GPRS modem has been activated (see also "Terminal operation")
- Make sure the SIM card has been unlocked and inserted correctly
- -Make sure the system is connected to the GPRS network (The terminal LED on the PlantControl front panel must flash every 3 seconds when network connection is established).

Further PlantControl menu items description

Menu > Status.

"Status" provides an overview of the system's operating condition. Press the \blacktriangle - ∇ cursor keys to scroll up and down.

Status > Controller > OK:

This displays the following parameters:

Time until next moisture measurement / Free data storage capacity / Battery current / Power supply via adapter / Date-time / Firmware version / Hardware version / Serial number / GSM reception strength / Residual credit if prepaid SIM-Card is used for the GPRS Modem

Status > Sensors > OK :

This displays the most recently measured sensor parameters in tabular form and critical deviations can quickly be localized:

Sensor number / Soil moisture / Soil temperature / Radio signal strength / Battery status

Status > Sensor Identify (also applies to range extenders)

If a sensor or repeater is used and can no longer be allocated to a sensor number or repeater number, this function can be used to clearly identify a sensor or a repeater. Proceed as follows:

Status > Sensor Identify > OK : Hold the sensor at least 1 meter from the controller and briefly press the sensor's On/Off button. After a few seconds, the PlantControl display will show the full identification of the corresponding sensor. The same procedure also applies to repeaters.

Status > Valves/Zones > OK :

This displays for all valves/zones in tabular form, if a valve is currently open, the status of all connected valves as well as time until next status change.

Status > Monitoring > OK :

This displays for all monitored zones the moisture difference to the pre-set dry treshold in percentage (minus or plus).

Status > Backplane Module > OK:

Find under this menu which additional modules such as valve modules or multi-functional switching module are installed and which cable connections are provided for various functions (e.g. valve connections, fertilizer relay, temperature alarm relay, alarm relay for home automation system, etc).

Further PlantControl menu items description (continuation)

Menu > History

Under this menu item, you can view historical information (logbook) about sensors, valves and irrigation. Press the \blacksquare cursor key in a sub-menu to scroll down. The \blacktriangleleft - \blacktriangleright cursor keys are used to move to the next or previous sensor.

Menu > Settings > Alarms > OK

Activate/deactivate alarms

Here you can define for each alarm type, the display formats to be used. (Alarm-LED, SMS, relay for home automation) and the time intervals in which it is to be displayed (never, always, interval). Regardless of the settings made, all alarms can be viewed on the display by pressing the "Display Alarm" key. Some alarms, such as "no water", are always displayed and cannot be parameterized or turned off, as this could damage the plants.

AI-LED	\rightarrow	Alarm is displayed by blinking alarm LED.
SMS	\rightarrow	Alarm is sent via SMS message (requires the optional SMS-Alarm function).
Relay	→	Alarm is transmitted to the home automation system (requires the optional Multi- functional switching module).
always	\rightarrow	Once it is determined by the system, the alarm is displayed immediately or sent via SMS.
never	\rightarrow	Alarm is never displayed and is not transmitted via SMS.
alarm interval	\rightarrow	After initial display, alarm is displayed in a configurable interval or transmitted via SMS.

Among other cases, an alarm is displayed in the following situations or transmitted by SMS (SMS alarm texts may be shorter). S=Sensor / V=Valve / x=Number:

Alarm text	Description	Trouble-Shooting
Sensor "x" temperature alarm	When ambient temperature falls below or exceeds a predefined value.	n/a
Valve "x" no water	When after irrigation end no moisture increase is registered by the sensors.	Check sensor position, valve cabling, water filter clogging. Check also if measurement period needs to be increased (see chapter Valve/Zone settings → Measurement period).
Valve "x" no measurement value	When a sensor does not provide moisture measurement and therefore no irrigation can take place .	Check reception strength of corresponding sensor. If necessary, reposition the sensor for a improved reception. Also check if sensor is defective.
Low battery	When PlantControl central unit battery voltage is too low.	Check mains connection. If a solar cell is used, optimize its position.
Low credit	When prepaid SIM card credit is very low (< 5).	Top up credit.
Check Sensor "x"	When an unnatural leap into the dry is determined by a sensor.	Check correct sensor placement.
Sensor "x" no radio connection	When a wireless sensor fails to transmit.	Check reception strength of corresponding sensor. If necessary, reposition the sensor for a improved reception (high position). Eventually, purchase the optional external antenna for your PlantControl unit.
Sensor "x" low battery	When sensor batteries must be replaced.	Change sensor batteries.
Sensor "x" defect	When a sensor is defective.	Replace the sensor (contact your supplier).
Sensor "x" no sensor connected	When the sensor tip is not connected to the sensors main electronics .	Replace the sensor (contact your supplier).

Further PlantControl menu items description (continuation)

SMS number 1 – 4 (If the option SMS-Alarm function has been acquired)

This feature allows alarm messages via SMS to up to 4 SMS-enabled phones.

Alarm upper temperature

Enter a temperature at which a temperature alarm should be triggered. If this feature is not used, be sure to enter the maximum temperature value (60), to avoid unwanted alarms.

Alarm lower temperature

Enter a temperature at which a temperature alarm should be triggered.

Irrigation lock

Select "lower temperature" or "off". If "lower temperature" is set, the irrigation will be blocked as soon as the temperature falls below the lower temperature setting. When the temperature rises again above the lower limit, a irrigation can take place again.

Menu > Special

This menu item allows the transmission of a freely definable SMS text message when the master valve is switched on or off. A physical cable connection to a master valve is not a precondition. This option can be used in many aspects:

The first 3 menu points allow the transmission of a freely definable SMS command in case the master valve is switched on or off. A master valve must not be connected for this function.

Spezial		
Message Master on	pumpon	
Message Master off	off	
SMS-Number: Master Val.	xxxxxxxxxxxxxx	
Modul 2 as Fertil.	NO	
Master Valve OFF	- 10 sec	

Sending a SMS Message to a mobile phone

Type your freely selectable text message which will be sent to the mobile phone number entered under the menu item "SMS Number ..." as soon as the master valve switches on or off.

Activate or deactivate a GPRS-enabled third party device

As an example, you can switch on or off a pump. If your pump is equipped with a GPRS modem, type in the command predefined by the third-party modem supplier under "Message Master on" respectively "Message Master off". Under "SMS Number" enter the phone number of the third party GPRS modem. Once the master valve opens the pump will be started via an SMS message to the pump's modem. If the master valve closes, the pump is switched off via an SMS message.

Exchanging a valve module by a multi-functional switching module.

If instead of a floating contact a 9VDC impulse or a 24VAC output is required, the module with the floating contacts can be replaced by an ordinary 9VDC impulse or a 24VAC valve module. It has be de-locked by going to **Settings> Special>Module X as Fertil>YES>OK.** The controller is automatically switched off and on again. After that the module is de-locked.

Pre-closing of the Master valve

To prevent mechanical shock in the piping, the master valve can be closed a few seconds prior to the closing of the irrigation valves.

Menu > Initialize

Initialize > Erase logbook > OK

This function is used to delete the memory. Your settings will remain.

Initialize > System reset > OK

This function restores the default settings, including the deletion of the network number. If you have previously initialized the sensors, make a note of the network number before carrying out a system reset (Settings > Controller > Network number) and re-enter it after the system reset so that the sensors will not require initializing again.

Initialize > Code Input > OK

Enter here the code obtained from the manufacturer for the activation of additional functions.

4. Installation

- Before installing the entire system in the field, you should have carried out the commissioning according to chapter 2.
- Depending on the type of terrain and the visual contact between the sensor and the controller, the range of the radio connection is up to 20 km.
- If a solar cell is used, position the solar-cell so that it is optimally aligned to the sun.
- If an external antenna is used for improved signal reception for PlantControl CX or the GPRS modem, it is recommended to place it at the highest possible location to obtain the best reception power.
- Switch on the sensors before placing them into the ground at the plug-in location and check the reception strength: *Menu Status> Sensors*: If the displayed reception strength is less than 10%, the sensor electronics should be placed either higher or closer to the central unit.

Inserting the sensor into the soil - quick guide (see also next pages)

- 1. Select a right location for the soil moisture sensor
 - The sensor must be placed at a point in the irrigation area where it is subjected to the same climatic conditions (sun, wind, rain, etc.) as the plants.
 - Never place the sensor(s) in the irrigation zone of a cloned valve. The sensor(s) must always be physically placed in that irrigation zone, where a valve is opened according to the measured values of a sensor. Otherwise, a sensor does not have any chance to detect the water that s being discharged.
 - To avoid erroneous measuring results caused by water logging, the sensor should not be positioned in dips in the ground.
 - In case of a sprinkler system it must be ensured that the sensor can "feel" the water supplied. For drip systems, a dripper must be installed directly above the sensor.
 - The higher the electronics housing of the sensor is installed from the ground surface, the higher the radio quality. Avoid locations, where the radio communication between sensor and PlantControl is disturbed by obstacles.
- 2. Dip the sensor tip with felt for approx. 30 seconds in water (the felt must be wet).Place the sensor tip at a position where the sensor is to measure the soil moisture. As a rule, this is in the root area. The sensor tip should touch the ground on all sides.
- 3. Insert the sensor tip in the root zoon. It is recommended to predrill a appropriate hole into the soil, in which the sensor with the protection cap can be pushed down. The sensor tip must be in full contact with the soil on all sides.
- 4. Avoid or prevent the formation of a preferential water path along the sensor channel.

















Guide for the correct placement of the soil moisture sensors

The Plant Control CX irrigation controller determines the starting point of an irrigation as well as the irrigation runtime completely automatically based on soil moisture. The measured soil moisture data are transferred wirelessly to the Plant Control CX, which then triggers the irrigation and stops the irrigation after a pre-calculated time.

In order to work properly, the sensors must be able to determine the soil moisture as precisely as possible. This is only possible if the sensors are placed in the correct place and in the correct depth. The following comments are designed to help you to avoid errors and achieve optimal results.

Number of Sensors per irrigation zone

Up to six soil moisture sensors can be assigned to an irrigation zone (a zone = a solenoid valve). The PlantControl CX calculates the average soil moisture per irrigation zone and uses this value for all calculations.

The optimal number of sensors per irrigation zone is dependent on the type of culture to be irrigated and on the value of the plants. As an example, one sensor would be sufficient for a lawn, which is evenly exposed to the sun. Are there many different plants to be irrigated, then the sensor should always be placed at the root zone of the plant, which must be irrigated most frequently. For expensive plants separate zones should be defined, so that they can be watered very specifically.

For agriculture applications, it is advisable to use at least one to two sensors per irrigation zone. In case a sensor fails to deliver the moisture data - due to inappropriate handling through harvest staff or a temporary loss of radio contact - at least one sensor transmits the moisture values.

For greenhouse applications or plantings in very homogeneous substrates , tonesensors per irrigation zone is sufficient.

Placing at the right depth

The sensors are to measure where the plants take up the water, namely in the root area (Fig.1a, b). In the case of drip irrigation, care must also be taken that the sensors are placed in the humidified soil area (Fig.1c). If the size of the root ball changes greatly during the course of the growth, the sensors can be positioned deeper after the first growth phase.





Sensors in stick version

- 1. For longer sensors in stick version, drilling of a hole is reasonable. Use an auger or a drilling machine with a bore diameter of 16 mm.
- 2. If the soil is dry, moisten.
- 3. Immerse entire sensor tip (yellow part) in water (felt must be wet).
- 4. Insert the sensor cautiously. Never rotate the sensor when inserting or pulling out as this may unscrew the yellow sensor tip.
- 5. Water the area around the sensor with sufficient water.

Sensors in cable version

Depending on the placement depth, the installation of sensors in cable version requires a different approach.

If the sensor is placed in turf, it is virtually impossible to accommodate the electronics within the lawn, as this would disrupt the use of the lawn. In this case, sensors with extension cable are available. This allows to embed just the sensor tip in the lawn. The electronics on the other hand is placed on the edge of the lawn (Fig. 2).

If the sensor has to be buried deeper in the soil, it is inevitable to excavate soil first.





Placing the sensor in drip irrigation applications

The sensors must be placed in a way that it can register the water. This is more or less critical, depending on the type of irrigation. If sprinklers are used, the distribution uniformity is usually homogeneous enough, unless the root zone and thus the sensor is not shielded by leafs.

If a drip irrigation is used, the water is supplied very locally and it will diffuse more or less evenly and quickly within the soil over a certain volume range. Therefore, especially in drip irrigation it is important to pay attention to the following points:

Depending on the permeability of the soil or substrate, differently shaped moisture zones are formed (Fig. 3).



Porous, permeable soil

Humus rich garden soil

Clayey soil

Fig. 3

If the soil is porous and permeable, it is advisable to use several dripper with a correspondingly lower water outlet per plant, in order to achieve a better distribution of water. Plants are very adaptive and the roots will grow into those areas, where water is available. However, the yield respectively the health of a plant is improving, the bigger a water saturated soil volume is available for the roots. Using this type of soil - especially in pot cultures - may result in the formation of so-called preferential water paths. This will always occur, whenever a dripper with a high water output is used. Since the water in the substrate runs off quite rapidly downward, fine particles are washed out, resulting in a preferred water path. In such a case, the water barely has time to spread horizontally, and this inevitably leads to an insufficient water supply to the plants. Once such a water path is formed, an initially correct placed sensor may not be able to register the applied water.

To avoid this problem, you can use drippers with a lower water output rate. However, such drippers may clog faster or calcify. The best remedy against the formation of preferred water paths is to use a piece of felt which is laid onto the substrate, so that the water drops first onto the felt and is distributed horizontally.

Proper placement of the sensor electronics

When using a wireless sensor, the radio link between the sensor and Plant Control D / CX or FA central unit should not be disturbed. Since the radio transmission can be disturbed by the water in the leaves or any other obstruction, the electronics should be placed as high as possible (preferably higher than the plant). Placement of electronics at ground level is only advisable if there is just a short distances to the central unit Wireless sensors are available with extension cables in various lengths, making it possible to mount the electronics on a pole at a height of 1-2 m (Fig. 4).

Proper placement of the repeater (range extender)

The same recommendations apply as described in "Proper placement of the sensor electronics."



Fig. 4

Placement of slalom poles

Use the tool shown in fig 5 to screw the anchor into the soil.



Fig. 5

Check

To verify the correct placement of the sensors, it is advisable to check the soil moisture readings after an irrigation cycle.

Status> Sensors> OK:

A table of the last measured sensor parameters is displayed and critical deviations can be quickly located: Sensor number / soil moisture / soil temperature / signal strength of the radio / battery status.

If a sensor does not show the expected moisture increase, the position should be checked.

5. Moisture output in hPa suction pressure

Note: Only applicable for sensors with a hard felt or part-number endings "H".

The PlantCare moisture sensor technology is based on a micro-thermal measuring principle. A cooling time is measured, which allows a statement about the water content of the soil.

To permit a conversion to a suction pressure (hPa), a calibration must therefore be made. This can be achieved by parallel measurements with a tensiometer. Here, a soil sample at different moisture levels is measured with both sensors, the PlantCare sensor as well as with a tensiometer and the measured values are set into a relation according to the accepted van Genuchten equation. However, such a calibration is valid for the used soil type only.

As there can also occur quite large variations in moisture measurements between two tensiometers, a tensiometer-independent calibration was performed by the Zurich University of Applied Sciences (ZHAW) in Wädenswil. For the calibration, a pF-pressure chamber was used.

To cover the most important soil types, 6 standard soils were obtained from the "Agricultural Research Institute (LUFA) Speyer" in Germany. The data from these standard soils can be seen on the table below.

The results are primarily two parameters, alpha and n, which have to be inserted into the van Genuchten equation, in order to convert from the measured time to hPa. Moreover, a scaling factor K can be entered.

van Genuchten equation:

$$\psi_m = K \frac{1}{\alpha} \left[(1 - t_n)^{-1/m} - 1 \right]^{\gamma_n} \qquad m = 1 - 1/n$$

Standard soils from the "Agricultural Research Institute (LUFA) Speyer":

Standard Soils - Analyses Data Sheet (9/11)						
Mean values of different batch analyses +- standard deviation. All values refer to dry matter						
Standard soil type no.	1	2	3	4	5	6
organic carbon	0.621.0.07	1 97 . 0 20	0.041 0.10	242 . 05	1.05 . 0.20	164 . 0.12
Nitrogen in % N	0.05 +- 0.01	0.17 +- 0.02	0.08 +- 0.02	0.20 +- 0.04	0.12 +- 0.03	0.20 +- 0.02
pH-value				-,, -, -, -, -, -, -, -, -, -, -, -, -, -		
(0.01 M CaCl ₂)	5,1+- 0,4	5,5 +- 0,2	6,8 +- 0,2	7,1 +- 0,2	7,3 +- 0,1	7,1 +- 0,1
(meg / 100g)	40+-07	101+-05	10 3 +- 1 3	30 8 +- 6 2	153+-29	245+-70
(1104 / 1009)	.,,.	10,1 10,0	10,0 1 1,0	00,0 1 0,2	10,0 1 2,0	21,0 11,0
Particle size (mm) distribution according to German DIN (%):						
<0.002	2,4 +- 0,4	6,5 +- 0,8	8,7 +- 1,6	27,0 +- 1,9	10,4 +- 1,1	42,1 +- 1,2
0.002 - 0.006	2,0 +- 0,9	3,3 +- 0,7	4,2 +- 0,9	8,7 +- 0,7	5,1 +- 0,5	10,4 +- 1,0
0.006 - 0.02	3,1 +- 0,8	4,1 +- 0,7	8,8 +- 0,8	14,7 +- 1,3	9,1 +- 1,0	12,3 +- 1,4
0.02 - 0.063	6,9 +- 0,5	6,9 +- 0,9	17,6 +- 2,8	23,0 +- 1,3	21,2 +- 1,0	14,3 +- 2,0
0.063 - 0.2	27,4 +- 2,2	34,5 +- 1,9	30,1 +- 4,0	19,1 +- 0,3	38,1 +- 1,2	8,6 +- 0,4
0.2 - 0.63	55,8 +- 3,1	43,9 +- 1,6	27,9 +- 2,1	5,8 +- 0.3	14,7 +- 1,5	8,9 +- 0,5
0.63 - 2.0	2,4 +- 0,6	0,8 +- 0,3	2,7 +- 0,7	1,7 +- 0,3	1,4 +- 0,2	3,4 +- 0,7
soil type	silty sand (uS)	loamy sand (IS)	silty sand (uS)	clayey loam (tL)	loamy sand (IS)	clayey loam (tL)
Particle size (mm) distribution according to USDA (%)						
<0.002	2,7 +- 1,1	6,8 +- 1,3	8,7 +- 1,7	26,9 +- 0,3	11,2 +- 1,0	41,0 +- 1,9
0.002 - 0.05	10,0 +- 1,6	12,6 +- 1,7	27,6 +- 3,8	40,3 +- 1,1	28,5 +- 3,3	36,8 +-2,0
0.05 - 2.0	87,3 +- 1,2	80,6 +- 2,6	63,7 +- 4,4	32,8 +- 1,1	60,3 +- 4,1	22,2 +- 1,6
soil type	sand	loamy sand	sandy loam	loam	sandy loam	clay
(g/100g)	31,2 +- 2,0	44,4 +- 6,0	35,6 +- 3,0	44,1 +- 1,5	40,4 +- 2,7	38,9 +- 4,6
weight per volume (g/1000ml)	1462 +- 39	1257 +- 43	1295 +- 30	1305 +- 12	1280 +- 89	1372 +- 60

Swiss soil texture pyramid classification with positioning of the LUFA Speyer standard soils



European Union soil texture pyramid classification











6. Data readout and firmware update

The PlantControl CX offers a USB interface for easy data readout (if PlantCare DataViewer software is purchased) as well as firmware update.

- Insert either a USB stick for data readout or a USB stick, which contains a new firmware from PlantCare, into the corresponding USB interface of your PlantControl CX central unit.
- Press the key USB Imp/Exp and a new menu will appear on the display. Go to your selection with the cursor key and confirm with the "OK" button.
 - Data output

To read out data, select "Data output" and confirm with the "OK" button. The data is automatically loaded onto the USB stick.

Logbook output, last part

The logbook is the complete record of all incidents including alarms, setting changes, when the system was switched on and off, etc. The Logbook may be very helpful for troubleshooting. Since a logbook can be quite extensive, reading out just the last 3-4 weeks is recommended. The read out may last for several minutes.

Logbook output

With this command, the entire log is read out. This is only necessary, if analysing a long time span is important. The read out may take up to 30 minutes.

Firmware Update (USB)

If a new firmware from PlantCare is available, it may be sent to the user by email. The new software can be loaded on a USB stick and inserted into the USB port of the PlantControl central unit. By selecting the command "Firmware update" the firmware is automatically installed. This can take up to 10 minutes.

Firmware Update (GPRS)

If a new firmware version is available, it can be directly downloaded from the PlantCare server and installed by selecting the command "Firmware Update (GPRS)". Alternatively, this process can also be remotely triggered by sending the SMS message **pc exe fwupdate** to the SIM card number of your GPRS Modem. This can take up to 20 minutes.

If you have read out data, insert the USB stick into your computer and open the automatically generated Folder PC-DATA. Select the exported file and open it with a double-click. Providing you have installed the PlantCare DataViewer, the data will be displayed immediately.

Important: Disconnect the USB stick only at the end of the process and do not switch off the system during a read out or firmware update.

Data analyses with PlantCare DataViewer (optional)

The measured data are recorded from the central unit with date and time and stored. The data can be easily read on a USB stick and displayed and analyzed using the PlantCare DataViewer software (only possible if you have purchased the optional "PlantCare DataViewer Irrigation Analysis Software").

PlantCare DataViewer analysis software can be downloaded using the following link: www.plantcare.ch/en \rightarrow Support



7. Remote Control

If you have purchased the "Remote control function", you have the option of changing virtually all settings of your PlantControl CX via SMS command. A prerequisite for the remote control function via SMS is that the built-in GPRS modem is equipped with a SIM card. Send the commands as a message to the number of this SIM card.

By using examples, the following shows which settings can be changed with an SMS command. Please note that the spelling of an SMS text, especially entering a space where indicated, is important for the correct transmission. A SMS text must not exceed 140 characters.

For a better readableness, the variables in an SMS command are marked bold and underlined.

Example: changing the name of the device via SMS text to "Meier"

Send SMS text to the number of the SIM card in the device: pc set cname Meier

If 140 characters are not exceeded, even multiple commands can be sent in an SMS text, whereby a space must be set between two different commands:

Example: Customize the name of the device and manually turn on valve number 8 for 60 minutes: *pc set cname<u>Meier</u> vm<u>60</u>z<u>8</u>*

Retrieve moisture values (Examples)

Send moisture values to 079 123 45 67: pc set smsmoni-0791234567 Send data to email address: pc email d muster@muster.ch



General Commands

Description	Remark	Example(s)	SMS command
Location or controller name		Meier	pc set cname <u>Meier</u>
Time setting	hh:mm:ss	14:22:33	pc set ctime <u>142233</u>
Date setting	dd:mm:jj	20.10.12	pc set cdate <u>201012</u>
Language setting	German or English	- 0 for German - 1 for English	pc set clang <u>0</u> pc set clang <u>1</u>
Cycle time	Moisture measurement all 5 to 360 minutes	60 minutes	pc set mct <u>60</u>
Measurement unit	Seconds for cool down time, relative moisture percentage or hPa	- 0 for seconds - 1 for rel % - 2 for hPa	pc set smoi 0 pc set smoi <u>1</u> pc set smoi <u>2</u>
Sensor name	Define sensor name	"Apple" for sensor 1	pc set sname Apple - <u>1</u>
Deactivate sensor	1	Deactivate sensor 3	pc set sda <u>3</u>
Number of sensors	Define number of active sensors	5 sensors are active	pc set sno <u>5</u>
Deactivate valve		Deactivate valve 8	pc set vicm <u>5</u> z <u>8</u>
Number of valves	Define number of active valves	3 valves are active	pc set vno <u>3</u>
SMS number	Enter or delete SMS number 1	- 0791234567 on number 1 - 0 for deleting number 1	pc set smsn <u>1</u> - <u>0791234567</u> pc set smsn <u>1</u> - <u>0</u>

Valve settings

Description	Remark	Example(s)	SMS command
Valve name	Define valve name	"Lawn" for valve 8	pc set vname Lawn - <u>8</u>
Change control mode	All-automatic=8, semi-automatic=2, Timer=3, Clone=4, Deactivate= 5, Monitoring=6 NOTE: If the control mode is changed all settigns for this valve will be reset to factory seetings. You have to set it again. E.g. Sensor#	Change valve 8 to all-automatic	pc set vicm <u>1</u> z <u>8</u>
Switching on a valve manually	1-240 minutes Shutoff with 0	- Open valve 8 for 60 minutes - Shutoff valve 8	pc set vm <u>60</u> z <u>8</u> pc set vm <u>0</u> z <u>8</u>
Activating fertilizer relay	Add avlues Fertilizer A = 1/ Fertilzer B = 2 Fertilizer C = 4/ Fertilzer D = 8 Fertilzer E = 16	Activate fertlizer B+C at valve 8 (B + C end up with the value 6)	pc set vfr <u>6</u> z <u>8</u>
Flushing time when fertilizer is used	Command does not exist yet		
Week days (allowed watering days)	Add values Sunday = Value 64 Monday = Value 32 Tuesday = Value 16 Wednesday = Value 8 Thursday = Value 4 Friday = Value 2 Saturday = Value 1	Valve 8 on Wednesdays and Saturdays (8+1 end up with the value 9)	pc set vwd <u>9</u> z <u>8</u>
Irrigation window	Command does not exist yet		
Irrigation time	If old irrigation times should be deleted, send first the relevant SMS command for deleting irrigation times (see below).	Valve 8, at 14:45 (Since exactly 9 digits must be entered, complete 4-digit time with five zeros at the end!)	pc set vtoi <u>144500000</u> z <u>8</u>
Deleting irrigation times	All previously set irrigation times will be deleted.	Delete all irrigation times for valve 8 with 0	pc set vtoi 0 z <u>8</u>
Measurement period	Control measurement after irrigation	60 min after irrigation a control measurement is performed in zone 5	pc set vmp60z5
Assign sensor		Sensor 2 to valve 8	pc set vsn <u>2</u> z <u>8</u>
Remove sensor from valve	All previously assigned sensors will be removed. Sensors continue to transmit readings, but the values are not considered for irrigation.	Remove all sensors from valve 8	pc set vsn 0 z <u>8</u>
Irrigation start and monitoring limit	1-80% (dry threshold)	30% for valve 8	pc set vista <u>30</u> z <u>8</u>
Irrigation stop	20-100% (target moisture after irrigation)	90% for valve 8	pc set visto <u>90</u> z <u>8</u>
Duration of irrigation (in minutes)	1-240 minutes (see also detailed explanation in this manual under valve/zone settings)	15 minutes for valve 8	pc set vdoi <u>15</u> z <u>8</u>
Duration of irrigation (in seconds)	60-14'400 seconds (see also detailed explanation in this manual under valve/zone settings)	180 seconds for valve 8	pc set vdois <u>180</u> z <u>8</u>
Minimum irrigation duration	This duration is never undershot by the system.	Minimum 3 minutes for valve 8	pc set vitm <u>3</u> z <u>8</u>
Maximum irrigation duration	This duration is never exceeded by the system.	Maximum 60 minutes for valve 8	pc set vitl <u>60</u> z <u>8</u>
Clone valve		Valve 8 is a clone of valve 1	pc set vtc <u>1</u> z <u>8</u>

Further SMS Commands

Description	Remark	Example(s)	SMS command
Retrieve moisture values	Retrieve moisture values from Zones/Valves and send it to alarm numbers	Alarm numbers defined in menue settings alarm	pc set smsmoni
	Retrieve moisture values from Zones/Valves and send it to a certain number	Send to 079 123 45 67	pc set smsmoni- 0791234567
Irrigation lock	Switch off valve fro a predefined duration (1-240 hours)	72 hours for valve 8	pc set vmo <u>72</u> z <u>8</u>
Alarm upper temperature limit	Command does not exist yet		
Alarm lower temperature limit	Command does not exist yet		
Erase logbook		Fix text	pc set eraselb
System reset		Fix text	pc set sysreset
Software update	Downloads latest software from PlantCare server	Fix text	pc exe fwupdate
GSM/GPRS	Deactivate modem	0 for deactivating modem	pc set gto <u>0</u>
GSM/GPRS	Modem power switch-on always activated or at a certain time (for 30 minutes)	 activate at 16 o'clock 0 = always activated 	pc set gpso <u>16</u> pc set gpso <u>0</u>
GSM/GPRS	Receive automatically e-mail with file attachment. 1-10 days or 0=never	- send e-mail each 5 days - 0 for never	pc set gsee <u>5</u> pc set gsee <u>0</u>
GSM/GPRS	Prepaid credit query with the code of provider	*130#	pc set gcq <u>*130#</u>
GSM/GPRS	APN (Access Point Name)	gprs.swisscom.ch	pc set gapn gprs.swisscom.ch
GSM/GPRS	User name for APN	example	pc set gapu <u>example</u>
GSM/GPRS	Password for APN	хуz	pc set gapp <u>xyz</u>
GSM/GPRS	Mail Server	pop.plant-care.ch	pc set gmsa pop.plant-care.ch
GSM/GPRS	User name for server account	gprs@plant-care-ch	pc set gsun gprs@plant-care.ch
GSM/GPRS	Set password	ххху	pc set gspw <u>xxxy</u>
GSM/GPRS	Define e-mail recipient	example@example.ch	pc set grad example@example.ch
GSM/GPRS	Send selected data to specific e-mail	-d for entire data -dl for short data - s for status - I for entire logbook - Il for short logbook - v for valve logbook	pc email <u>d</u> <u>example@example.ch</u> pc email <u>dl</u> <u>example@example.ch</u> pc email <u>s</u> <u>example@example.ch</u> pc email <u>l</u> <u>example@example.ch</u> pc email <u>ll example@example.ch</u> pc email <u>v</u> <u>example@example.ch</u>
GSM/GPRS	Receive a confirmation e-mail. System sends current status file, where the change can be verified.	At the end of a command line after space email:example@example.ch	email:example@example.ch

8. Deactivation / Re-Activation

Entire system:

- 1. Switch off the PlantControl unit.
- 2. Switch off the sensors.

Initialization is not required when re-commissioning. Simply switch-on the PlantControl unit and the sensors. For an immediate test of the reception strength, briefly press the ON/OFF button of the sensor. Otherwise, depending on the number of sensors, check after approx. 60 minutes the reception strength on the PlantControl display (Status > Sensors).

Individual sensors

- 1. Deactivate first the sensor as in **Settings > Sensors > Deactivate**.
- 2. Switch off the sensor

Initialization is necessary for re-commissioning (Initialize > Sensors). The PlantControl unit will assign the lowest available sensor number to the first newly initialized sensor. Please make sure that the sensor number assigned matches the number on the sensor cover.

9. Warranty

Your dealer will issue a two year warranty for this product (from date of purchase). This warranty covers all substantial defects of the unit that are demonstrably attributable to material or manufacturing faults. It will be implemented either by replacement with a unit in perfect condition or by repair (free of charge) of the returned unit at our discretion if the following conditions are met:

- The unit was treated properly and in accordance with the recommendations in the operating instructions.
- Neither the buyer nor any third party has attempted to repair the unit themselves.

10. Disclaimer

No liability is accepted for damage resulting from incorrect handling or a product malfunction.

11. Support

If you have any questions, please contact us by e-mail:

support@plant-care.ch

12. Technical Specification

Technical specifications sensors

- Can be used in all soil types
- Signal range 20km
- Power supply: 6 AA 1.5 V batteries
- Battery life span approx. 1 year depending on measuring cycle
- Dimensions: 5x 45x 40 cm (shortest version)
- Available length: Various Stick and cable versions see page 3

Technical specifications repeater (range extender)

- Weatherproof IP67 housing
- Signal range central unit to repeater 1 up to 200 meters and repeater1 to sensor or other repeater up to 20km (lineof-sight and dependent on the type of terrain).
- Power supply: 8 AA rechargeable batteries (inclusive), in combination with mains (230V AC) or solar cell
- Dimensions: 5.5 x 13 x 17 cm

Technical specifications remote valve control

- Weatherproof IP67 housing
- Signal range up to 200 meters or 20 km via repeater
- Power supply: 8 AA rechargeable batteries (inclusive), in combination with mains (230V AC) or solar cell
- Dimensions: 5.5 x 13 x 17 cm
- Use latching valves 9V DC
 - Netafim Aquanet, 12-40 volt DC latch or Hunter DC latching solenoid

Sensor measurement data

- Moisture display:
 - In relative %-units or
 - hPa suction pressure for 6 standard soils
- Measuring range soil moisture (at a soil temperature between 2° C to +37° C*):
 - Relative %-units: 0 100%
 - hPa: 0 1600 hPa
 - The range of highest sensitivity can be set from very wet to very dry
- Measuring range soil temperature: -20°C to +50° C
- Measuring accuracy:
 - Soil moisture: +/- 3%
 - Soil temperature: +/- 0.3° C
- Reading accuracy:
 - Soil moisture in relative %: 1%
 - Soil moisture in hPa: 1hPa
 - Soil temperature: 0.1 °C
- Sensors for soil moisture measurements at soil temperature range between 2° C to +50° C on request

Valves

- Cable valves
 - 24 Volt AC max. 0,7A
 - 9 Volt DC latch
 - Radio controlled valves
 - 9 Volt DC latch