THE SMART FERTILIZER PUMP
USER GUIDE

GOLDTEC
CONTROL SYSTEMS

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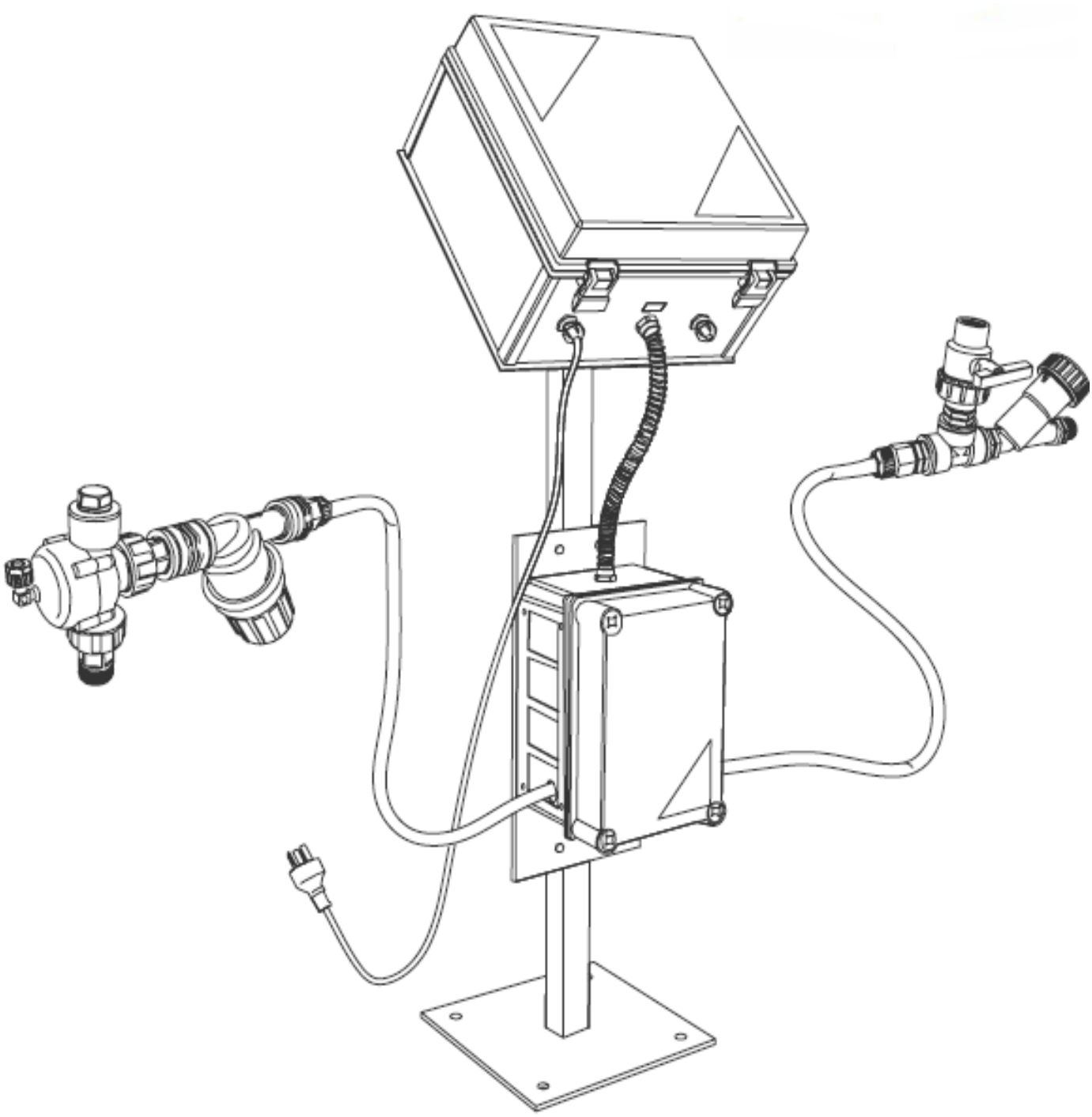
The Smart Fertilizer Pump



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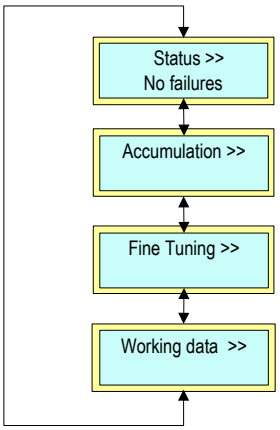
USER GUIDE

The fertilizer injection pump described within this guide can be set to work either as a stand-alone unit or under command of an irrigation controller. The setting is done by the installer during the configuration process. While in stand-alone mode, the pump works independently according to the user-defined parameters, in slave mode its operation is dictated by commands of the external controller.

The pump ensemble consists of a DC powered electric pump and a control unit that is programmed through an LCD display and a key board. The screens available to the user are divided into 4 subjects arranged in 4 rows; the desired row can be selected in the main menu that contains the names of the subjects:



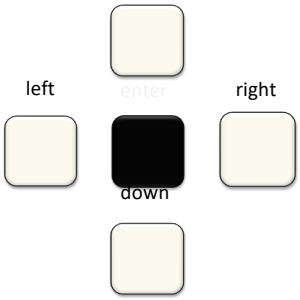
Master Toggle Switch

M (left) – Use only for priming pump. This function by-passes all pump control. Use for short periods only.

A (right) - In this position when starting by, control board, remote command in slave or stand-alone mode.

Off- (center) – This position sets pump control in idle mode to allow programming.

Navigation Buttons

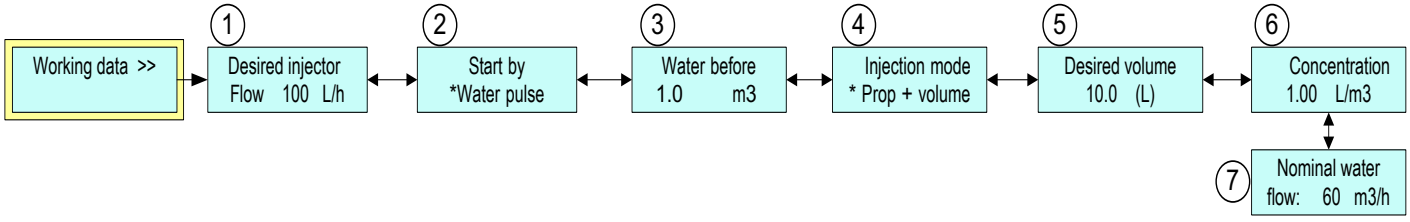


STAND ALONE MODE

In stand-alone mode, the operation of the pump depends completely on the user's definitions. The user may decide how will the injection start, how much water will be supplied before starting the injection, whether to inject continuously or proportionally to the water flow, whether or not to limit the injected fertilizer amount and when using the proportional mode, he may decide what will be the concentration of the fertilizer in the water. The use of a water meter in stand-alone mode is optional.

Stand-alone mode parameters

All the user definable parameters may be found in the row of the WORKING DATA of the menu:



1. **The desired injection flow** – indicates the flow that the pump will be adjusted to start with. However, depending on the injection method selected during configuration, the flow during the whole injection process may either remain unchanged (if the constant flow was selected) or vary according to the water flow (if the variable flow was selected).

2. **The starting mode** – indicates the way the injection will be started. The following options exist:
    a. Start by water meter pulse (only if water meter was enabled)
    b. Start by closing a contact
    c. Start by opening a contact

    When a water-meter is connected to the pump control board, the injection may be triggered by a pulse of the water meter. In this case, the injection process ends either when the flow of the water drops to zero, or when the desired volume of fertilizer was fully supplied (if such a volume was defined).

    The other two starting modes depend of the existence of a starting switch whose contact is connected to the control board. When started by the contact the injection process ends when the contact state is inverted or when the desired volume is completed.

3. **Water before** – The user may optionally set the amount of water to be measured before starting the injection by the pump.

4. **Mode of injection** – defines the way the injection process will be executed. There are three options:
    a. Bulk
    b. Proportional
    c. Proportional+Volume

    In the **Bulk** mode, the injection is continuous and the user has to define the amount to be injected. In the **Proportional** mode, the injection is proportional to the water flow and it is not limited by a specified amount. In the **Proportional+volume** mode, the injection is proportional to the water flow and there is a defined volume that when completed, the injection ends.

5. **The desired volume** – defines the amount of fertilizer to be injected. It is used when the **Bulk** or the **Proportional+volume** modes were selected.
6. **The desired concentration** – defines the proportion between fertilizer and water to be kept during the proportional injection. If a water-meter exists, the injection will be proportional to the water flow measured by the water-meter, otherwise the nominal water flow (see below) will be assumed.

7. **The nominal water flow**- defines the average expected water flow to be assumed when there is no water meter in use or at the beginning of the injection process before having the flow measured.

Constant flow versus Variable flow under stand alone mode

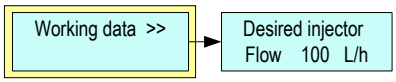
When selecting the proportional injection mode the purpose is to reach an even distribution of the fertilizer in the water. With the variable flow method, this requirement is fully met. In the constant flow method, the desired proportion is reached by injecting in pulses in such a way that the fertilizer flow during each pulse remains unchanged, but the rate of the pulses varies according to the variations of the water flow. In the variable flow method, the injection is continuous rather than pulsating and the desired proportion is reached by constantly adjusting the flow of the fertilizer to the flow of the water.

SLAVE MODE

In the slave mode of operation, the pump is commanded by an external controller. The command may arrive in various forms (see the Engineering guide). There is an exchange of signals between the external controller and the pump unit. The external controller will signal the pump when to start or stop injecting and in the opposite direction, the pump control signals the external controller of every predefined amount of fluid that was injected.

Slave mode parameters

The only parameter to be defined by the user in the slave mode is of the desired injection flow. For setting the desired injection flow, select the WORKING DATA row of the menu.



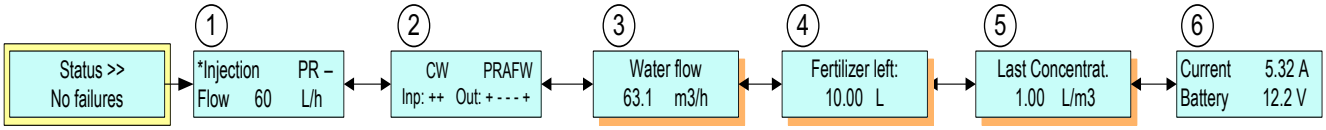
The desired injection flow – indicates the flow that the pump will be adjusted to start with. However, depending on the injection method selected during configuration, the flow during the whole injection process may either remain unchanged (if the constant flow was selected) or adjust itself according to the rate of commands arriving from the external controller in order to get an even distribution (if the variable flow was selected).

Constant flow versus Variable flow under slave mode

As explained above for the stand-alone mode, in the slave mode, when selecting the proportional injection mode the purpose is still the same - to reach an even distribution of the fertilizer in the water. In the constant flow method, the desired proportion is reached by injecting in pulses in such a way that the fertilizer flow during each pulse remains unchanged, but the external controller adjusts the rate of its commands sent to the pump unit according to the variations of the water flow. In the variable flow method, the pump control senses the variations of the command pulses rate arriving from the external controller and adjusts the flow of the fertilizer in order to distribute the injection along the specified percent of each pulse. Naturally, the desired percent should be close to 100%.

CHECKING THE STATUS

The status row of the menu supplies information about the general status of the system and about particular parameters that the user might be interested in. When there are failures detected, they will be listed on the left side of the status row.



The following list explains the information supplied within each screen of the status row. Notice that screens 3, 4 and 5 (with the light brown shadow) appear only in the STAND-ALONE mode.

1. **The general status and command screen**– indicates the status of the pump unit and allows execution of manual commands. The upper left corner describes the state of the machine which may be one of the followings:

   *READY

   *FROZEN

   *STOPPED

   *W. BEFORE

   *INJECTION

   *FROZEN

   *FINISHED

   *INCOMPLETE

   *FAILURE

Command mode - By pushing the ENTER key the unit goes into command mode allowing selection and execution of a command from the following list (depending on the current state) the selection is done by the upper arrow key:

*START – start injection (*available in stand-alone mode)*

*STOP – stop injection *(available during injection in stand-alone mod)e*

*FREEZE – freeze operation (*halting any activity)*

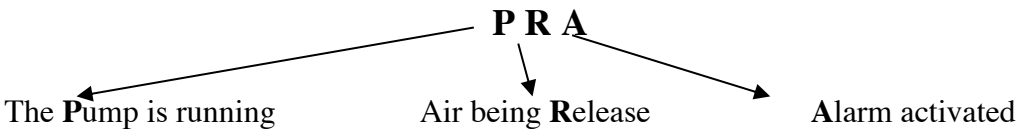
*UNFREEZE – resume operation (*available when being in FROZEN state)*

*CLEAR – clear an existing failure

*CONTINUE – continue execution of an incomplete process

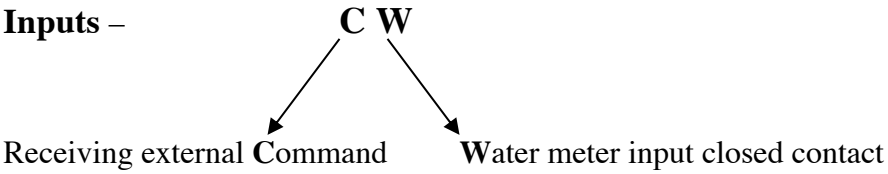
For execution of the selected command, push the **ENTER** key again.

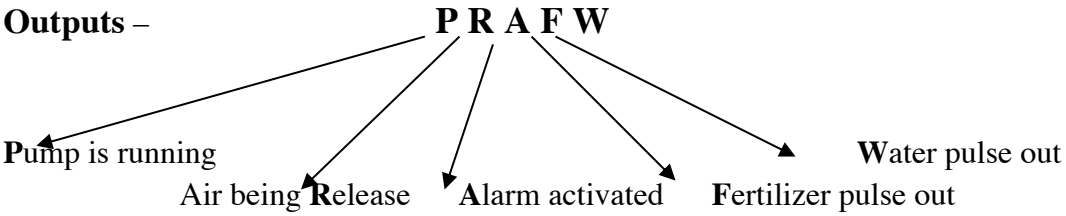
The upper right corner shows by three letters the status of three important outputs of the system:



At the bottom row of the screen, the actual flow or the last injection flow will be displayed.

2. **The Inputs and Outputs status** – an activated output or a closed contact input will be indicated by the "+" sign.





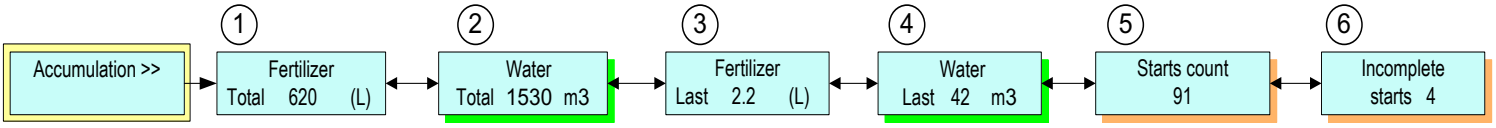
When pushing the ENTER key the screen turns into a manual test screen, enabling activation and deactivation of the outputs. The cursor ▓ can be moved by the horizontal arrows to the right, to the left, and by use of the upper arrow key, the selected output may be turned ON and OFF.

3. **The water flow** – indicates the water flow considered by the system as the current water flow. When a water meter exists, it is the flow measured by the water meter, otherwise it is the nominal water flow specified by the user in the WORKING DATA row.
   ** This screen appears only when working in STAND-ALONE mode.

4. **The Left fertilizer amount** – shows the amount of fertilizer still left to be supplied out of the desired volume.
   ** This screen appears only when working in STAND-ALONE mode
5. **The last concentration** – shows during operation the actual concentration of the fertilizer in the water. After termination, it shows the concentration that existed at the termination moment.
6. **The current consumption and battery voltage** – shows the current consumption of the pump and the voltage of the power source. When the pump is powered by solar energy and rechargeable battery the voltage shown is the battery voltage, otherwise it is the voltage of the power supply unit.

ACCUMULATIONS

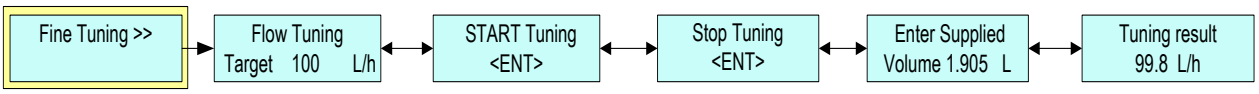
The accumulations row of the menu contains information about the quantities of injected fertilizer, quantities of measured water and the number of activations.



Notice that screens 2 and 4 (with the green shadow), appear only when water meter is connected and used by the system. Screens 5 and 6 (with the light brown shadow), appear only in the STAND-ALONE mode.

1. **Total fertilizer accumulation**- contains the accumulated amount of fertilizer injected by the pump starting from the moment this accumulation was cleared.
2. **The total water accumulation**- contains the accumulated amount of water measured by the water meter from the moment this accumulation was cleared. This screen appears only when water meter is in use.
3. **Last fertilizer accumulation**- contains the accumulated amount of fertilizer injected during the last injection process.
4. **Last water accumulation**- contains the accumulated amount of water measured during the last injection process. This screen appears only when water meter is in use.
5. **Counter of starts** – counts the number of injection processes executed by the pump unit. This screen appears only when working in stand-alone mode.
6. **Incomplete starts counter** – counts the number of processes that have been started and terminated without completing the desired amount to be injected. This screen appears only when working in stand-alone mode.

FINE TUNING



Since the pump is supplied calibrated it is usually unnecessary to do any calibration before starting to use it. However sometimes the local conditions resulting from the viscosity of the fertilizer and the structure of the injection line may influence the accuracy and the user may want to do some fine tuning of the flow. The fine tuning is executed as follows:

1. Prepare a measuring pot of 2 liters that enables accurate reading of the amount of liquid it contains; fill it with a known volume of the fertilizer you are using.

2. Insert the suction tube into the pot with the known volume, and the outlet remains connected to the usual injection point.

3. Activate an irrigation program in order to create the usual pressure condition in the line.

4. Select the screen of "Fine Tuning" and set the desired flow to which you want the pump to be accurately tuned.

5. When you are ready, start the tuning by pushing the ENTER key.

6. When the level of fluid in the pot drops to a low level, push the ENTER key again to stop the pump.

7. Calculate the "Supplied volume" by subtracting the remaining quantity from the original quantity and insert the result into the control unit.

8. The tuning result will be displayed in the next screen.

9. Repeat steps 1 to 8 until the resulting flow differs from the desired flow by no more than 0.5 %, this result is generally achieved within 1-3 repetitions.

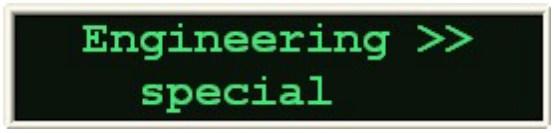
   Notice that the fine tuning may be repeated at other flow rates at which the user wants to improve the accuracy of the pump injection rate.

ENGINEERING

(For authorized technical person only)

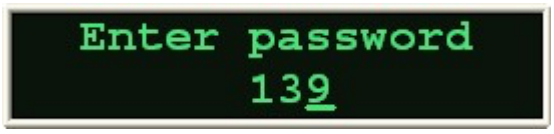
The procedures and parameters discussed in the following pages are meant to be dealt with by authorized technical persons; therefore, in order to reach the part of the menu dealing with these topics, a special procedure is needed:

1. Push and hold down the two horizontal arrow keys (white) and then push the ENTER key (black). As a result, a new subject can now be found in the list of subjects consisting in the menu. Use the vertical arrow keys to reach the following screen:

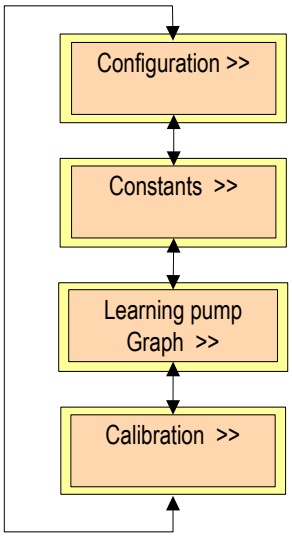


   Use the horizontal keys to move one screen to the right.

2. In the following screen, a password is requested. Without the password, the engineering information can be inspected but cannot be changed. The password that will permit full access for altering data is 139.



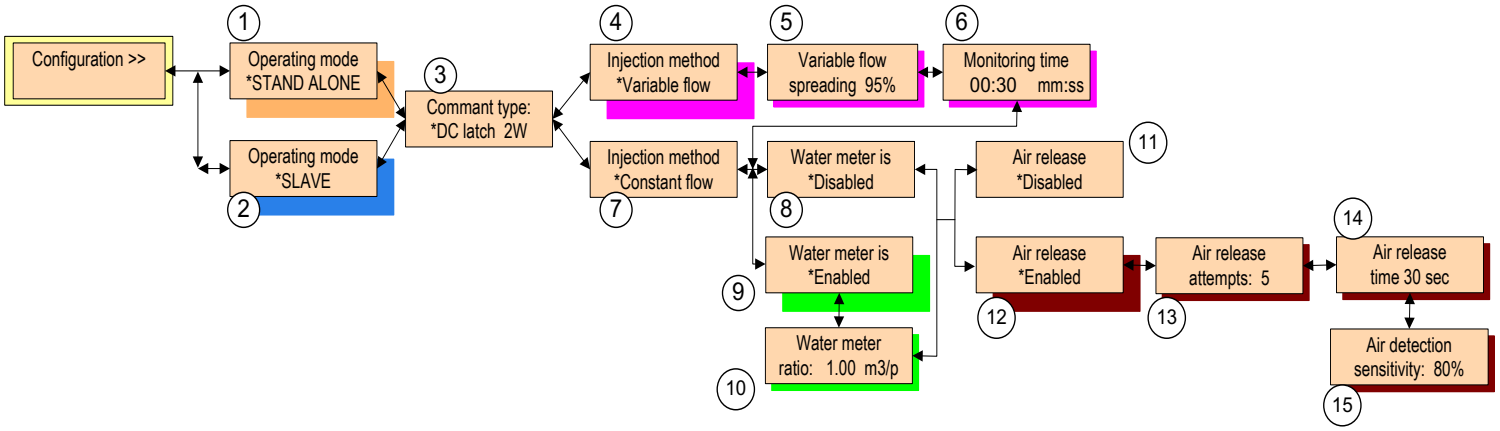
The engineering submenu contains the following subjects:



CONFIGURATION

Configuration is the procedure by which the pump is defined the way it is going to be used in the particular application.

Notice that screens 1,2,4,9 and 12 are marked with thick shadows, indicating that within these screens some selection is made that influences the appearance of other screens marked with thin shadows. Screens 5 and 6 (with thin pink shadow), appear only when "Variable flow" injection method was selected. Screen 10 (with thin green shadow), appears only When water meter is connected and used by the system. Screens 13,14 and 15 appear only when "Air release" was enabled.

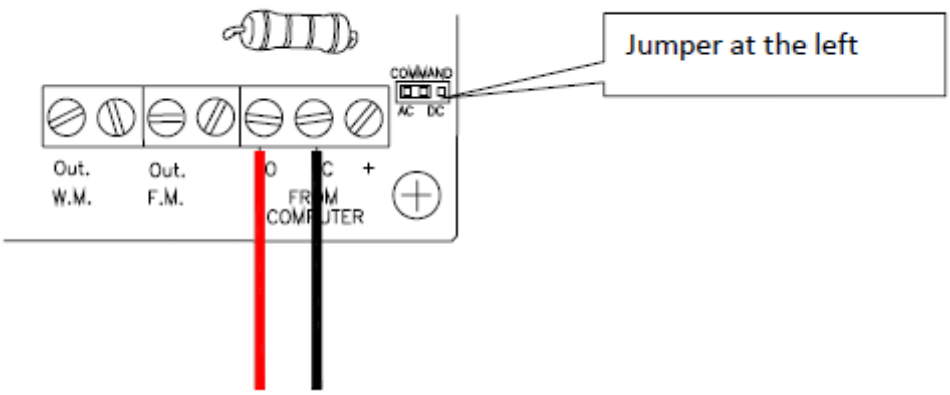


1. & 2. **Mode of operation -** Selecting the mode of operation to be either STAND ALONE or SLAVE mode. When in stand-alone mode, the pump works independently according to the user-defined parameters, in slave mode the pump works whenever a command is received from the external controller.

3. **Command type -** Selecting the command type. When in slave mode the command for the pump to be running arrives from the external controller, however even in stand-alone mode we may connect a command switch in order to manually command the pump to start running. The command arrives to the terminal board at the terminals designated as:

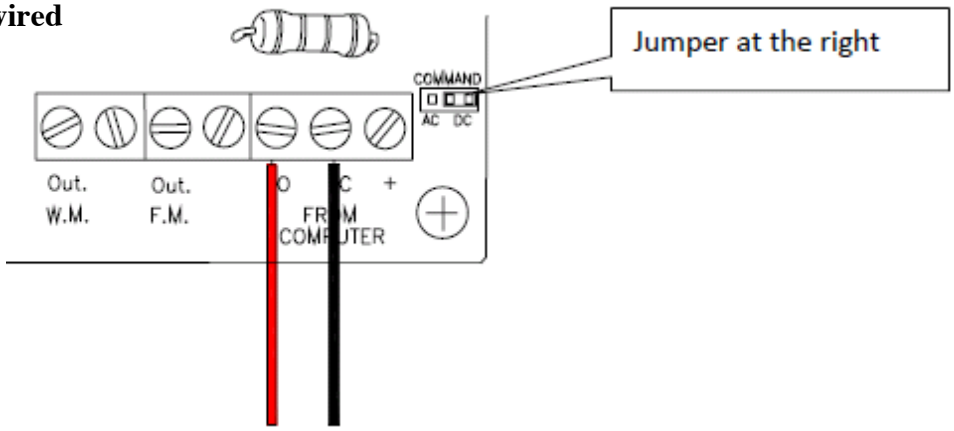
The types of commands recognized by the pump control are:

- **24v AC**

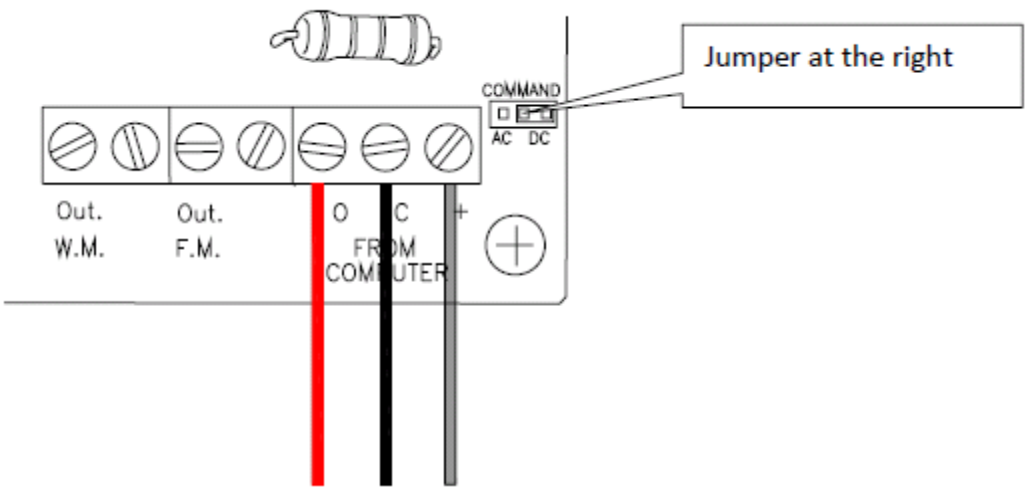


- **12-24 v DC continuous** – the connection of the DC continuous command is the same as that of the AC command just the jumper has to be moved to the right.

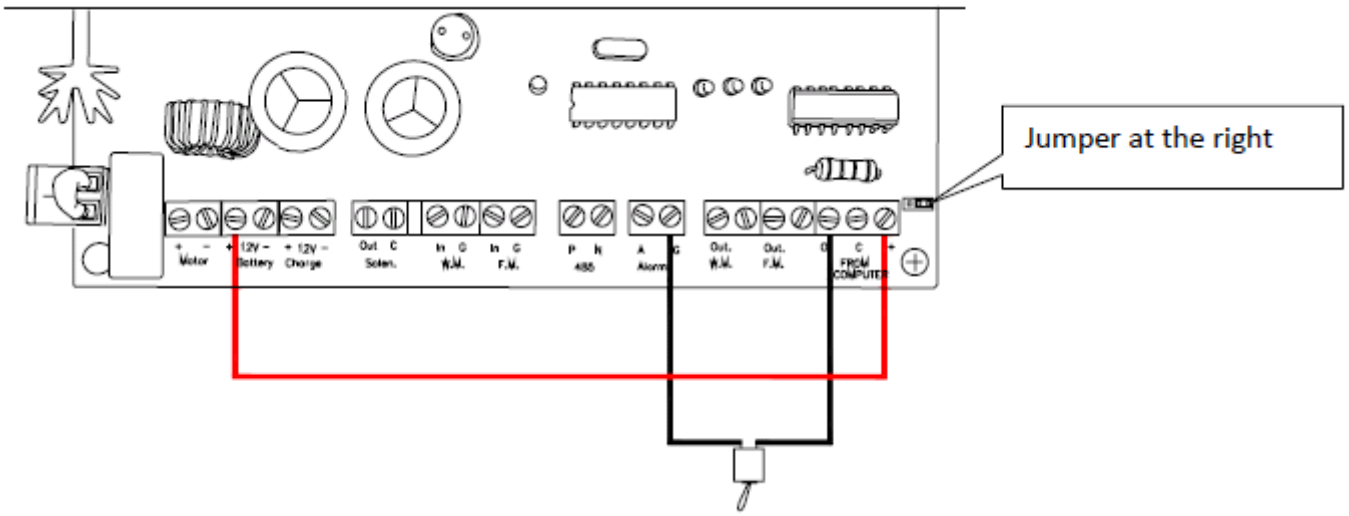
- **12v DC latching 2 wired**



- **12v DC latching 3 wired**



- **Dry contact**



4. **Variable flow -** Selecting of the "variable flow" as the injection method means that after starting with the selected flow, the pump will keep adjusting its injection flow according to the varying demands.

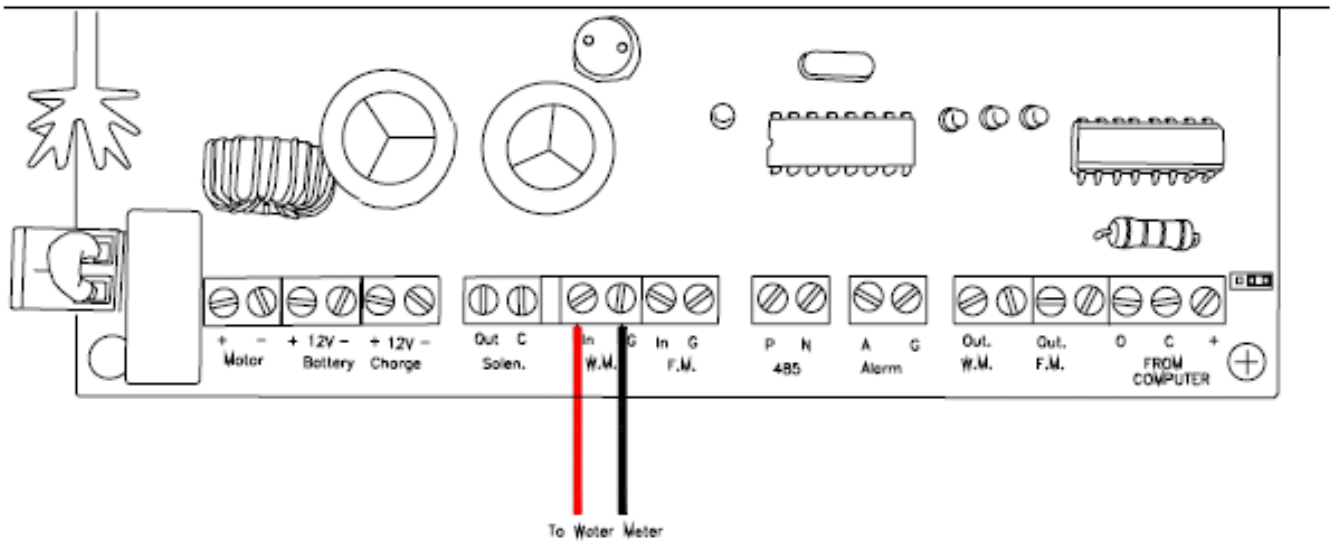
5. **Spreading percentage -** Screen no 5 defines the desired percentage of spreading the fertilizer in the water. For example if we select 80%, the pump will vary it's injection flow in such a way that the fertilizer will be injected during 80% of the water flow.

6. **Monitoring time -** The monitoring time defined in screen 6, indicates how long will the pump keep running at the preset injection flow, before starting to vary it's flow in order to adjust it to the water flow (in stand alone mode) or to the commands arriving from the external controller (in slave mode) in order to reach the desired spreading percentage.

7. **Constant Flow -** Selecting the constant flow method, means that the pump control will try to maintain the preset injection flow all along the injection process.

8. **Water meter disabled -** In case no water meter is in use we should select "Water meter is disabled" in this case the pump control system will assume the water flow to be equal to the nominal water flow as defined by the user.

9. & 10. **Water-meter enabled -** When a water meter is in use the amount of water represented by each pulse of the meter should be defined in terms of m3/pulse, this value is known as the water-meter's ratio and it is defined in screen no 10. The connection to the terminal board should be as below.



11. **Air release disabled -** In case there is no air release required, this screen terminates the configuration definitions.

12. **Air release enabled -** In case of air release enabled, the system will detect that there is air in the pipeline and will execute the steps that will release the air from the system. Principally the system will activate a solenoid by which a path from the injection line back into the feeding tank is opened. The necessary parameters are defined in the following screens.

13. **Air release attempts -** In screen 13 we define the number of attempts of releasing the air from the pipeline that should be executed before declaring an alarm situation.

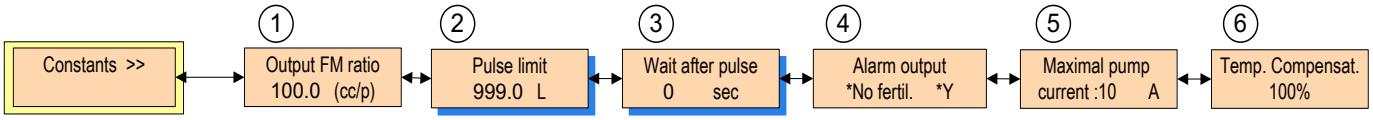
14. **Air release duration -** Screen 14 is where we define how many seconds will each attempt of air releasing take during the air release process.

15. **Air detection sensitivity -** Screen 15 defines the sensitivity of the air detection system. The sensitivity is expressed in percents therefore higher percent represents high sensitivity.

CONSTANTS

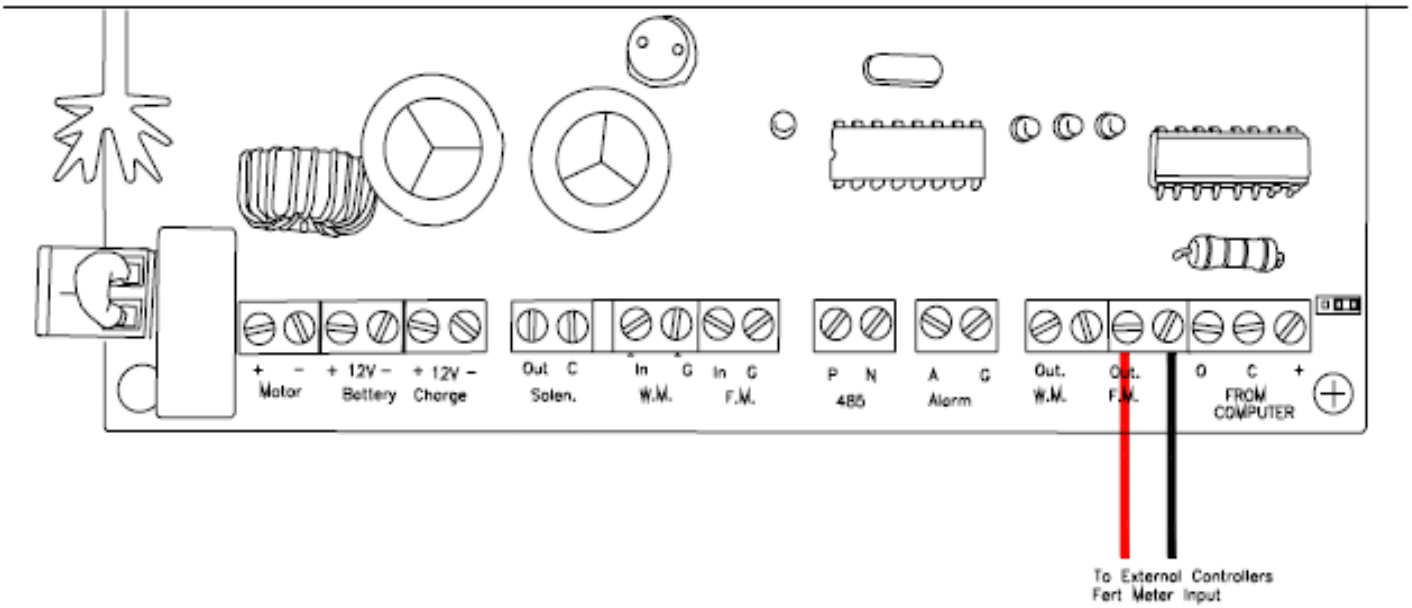
The following list of screens is used for defining the constant parameters of the pump.

Notice that screens 2 and 3 (with thin blue shadow), appear only when "SLAVE" operation mode was selected.



1. **Fertilizer Meter's output signal ratio –** the pump control board generates a dry contact output signal per each specified volume injected by the pump. This signal replaces the pulse of a fertilizer meter assuming such a meter was used for measuring the injected volume. The ratio defined in the current screen defines the amount of liquid in terms of c.c. indicated by each pulse generated.

The dry contact output signal is available at the terminal board as shown in the following drawing



2. **Pulse limit –** when working in the SLAVE MODE at a proportional injection way, the command of the external controller goes ON / OFF in a rate dictated by the external controller. However, if the command remains ON for a too long period, it may indicate a problem. The pulse limit defined herewith, indicates the maximal volume permitted for injection per each pulse.

REMARK: when the external controller is injecting continuously rather than proportionally, the pulse limit should be set to a value higher than the maximal injected volume expected.

3. **After pulse delay –** defines the minimal delay expected between the commands arriving from the external controller when working in the SLAVE MODE at a proportional injection way. Commands arriving during the delay will be ignored.

4. **Alarm output –** defines in which cases the alarm output will be activated. The options are:

   - **No Fertilizer –** after executing the air release procedure the system keeps detecting air in the pipe line.
   - **Line Jam –** the pump current reached the highest permitted value which indicates that the line is blocked.
   - **No control –** the control unit senses that the pump does not respond as it should.
   - **Low Battery –** the battery voltage is too low.
   - **Stuck Contact –** the external command (in slave mode) keeps arriving after injecting the maximal volume permitted per pulse.
   - **Shorted –** the pump consumption is much too high, indicating a short circuit.
   - **High Flow –** the current flow is too high, the pump is unable to reach the desired flow.
   - **Low Flow –** the current flow is too low, the pump is unable to reach the desired flow.

5. **Maximal pump current –** the amperage which indicates that the pump is working against a blocked line.

6. **Temperature Compensation –** not in use. Should remain 100%

LEARNING THE PUMP GRAPH

Learning the pump graph is a procedure that has to be executed prior to calibration. The purpose is to make the control board familiar with the behavior curve of the pump.

It should be pointed out that the pumps are supplied calibrated and there is no need for additional calibration unless there is a reason to suspect that the pump has lost its accuracy.

Both the graph learning and the calibration procedures are executed in open flow conditions. During the graph learning procedure the inlet and the outlet pipes of the pump should be placed into a tank containing water or fertilizer. The pump will accelerate from zero to maximum speed pumping the liquid from the tank and back into the tank with no pressure working against it.

At the end of the procedure the control board knows the curve of the pump and the maximal speed it can reach. In order for the control board to be able to use the obtained graph for generating the desired flow a calibration process must be executed.

NOTICE: For best results, learning the pump graph and the flow calibration procedures should be executed while the pump is hot. The pump should be running for 30 minutes in order to make it hot.

CALIBRATION

After knowing the behavior of the pump when accelerated from zero to maximal speed, we need to relate the obtained pump graph, with the flow that we would get at each point. That's the purpose of the flow calibration.

The calibration is done at two points of the graph - at the maximal flow and at a second flow that depends on the specific pump in use, as indicated in the following table:

Pump type	Second Calibration point
280 l/h	100 l/h
180 l/h	50 l/h

The calibration process detects the exact speed that makes the pump generate the desired flow. The calibration is executed while the pump is working against atmospheric pressure (open flow). During calibration we are pumping a known volume of liquid (water or fertilizer) into a tank while the time it takes is measured by the system. The resulting flow is calculated and displayed.

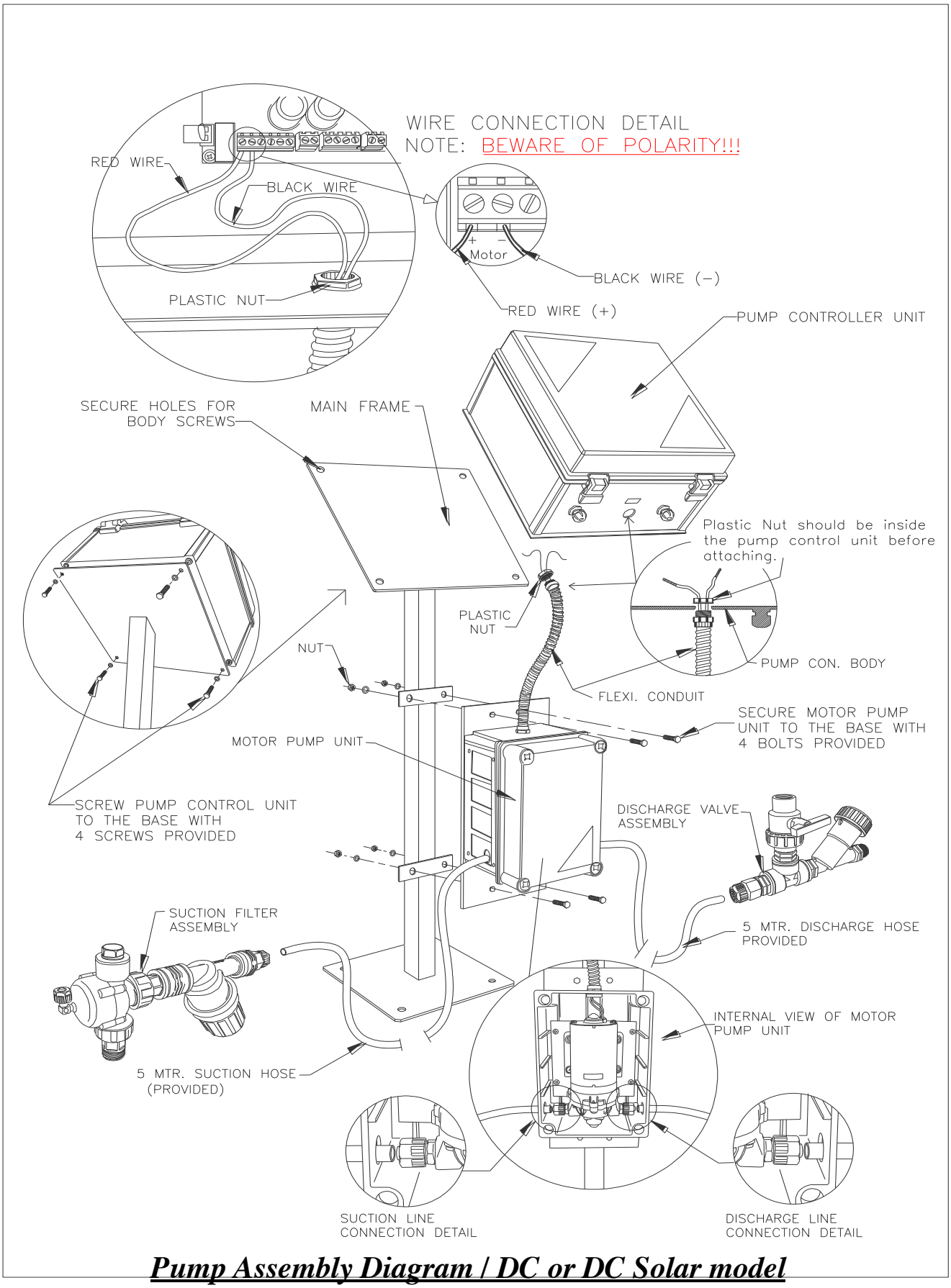
STEPS OF HIGH FLOW CALIBRATION

1. Prepare a measuring pot of 2 liters that enables accurate reading of the amount of liquid it contains; fill it with a known volume of liquid.
2. Inset the suction tube into the pot with the known volume, and the outlet tube into the tank that will receive the pumped liquid.
3. Select the screen of "MAX FLOW EVALUATION" and push the ENTER key. The pump will start running at the maximum speed which is 90% of the maximal point of the pump graph.
4. When the level of the liquid in the pot drops to a low level, push the ENTER key again to stop the pump.
5. Calculate the "Supplied volume" by subtracting the remaining quantity from the original quantity and use the next screen to insert the result into the control unit.
6. The resulting maximal flow will be displayed in the next screen.

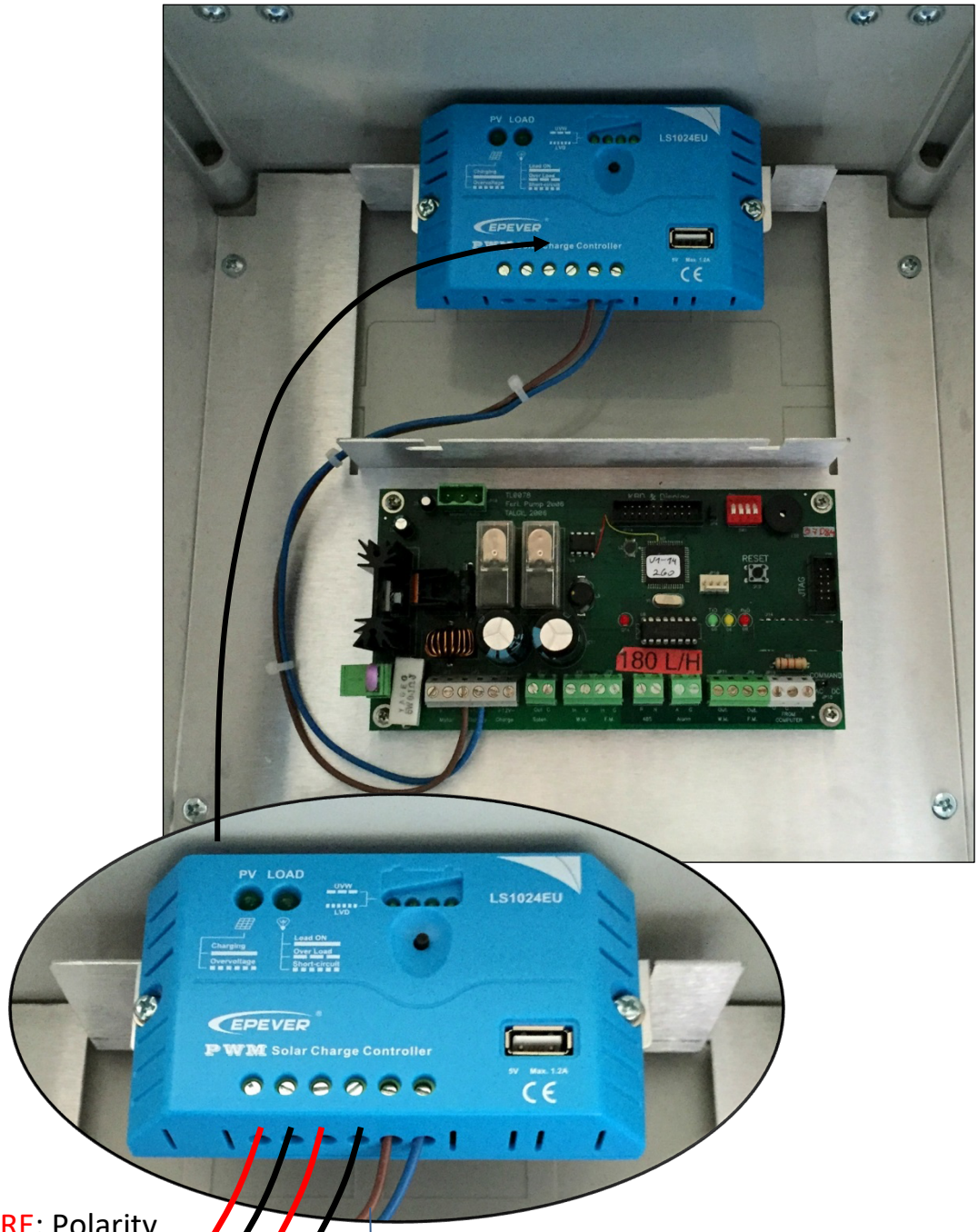
STEPS OF SECOND FLOW POINT CALIBRATION

10. Prepare a measuring pot of 2 liters that enables accurate reading of the amount of liquid it contains; fill it with a known volume of liquid.
11. Inset the suction tube into the pot with the known volume, and the outlet tube into the tank that will receive the pumped liquid.
12. Select the screen of "CALIBRATION FLOW TARGET" and set the second calibration flow point to the value indicated in the table above for the type of pump being calibrated. The process will be started by pushing the ENTER key.
13. When the level of the liquid in the pot drops to a low level, push the ENTER key again to stop the pump.
14. Calculate the "Supplied volume" by subtracting the remaining quantity from the original quantity and use the next screen to insert the result into the control unit.
15. The resulting flow will be displayed in the next screen.
16. Repeat steps 1 to 6 until the resulting flow differs from the desired flow by no more than 0.5 %, this result is generally achieved within 2-3 repetitions.

Pump Assembly Diagram / AC model



Pump Assembly Diagram / DC or DC Solar model



BEWARE: Polarity

To - fertilizer pump Main Board ("battery" terminal)

To - 75a/hr Battery

To – 50w solar cell

When connecting to Solar Charge Controller:

- First connect battery
- Second connect solar panel

TECHNICAL DATA

Pressure- 0-5 bar

Flow rate- 80-280 L/hour
50-180 L/hour

Voltage- 12v DC

Maximal Current- 10 A

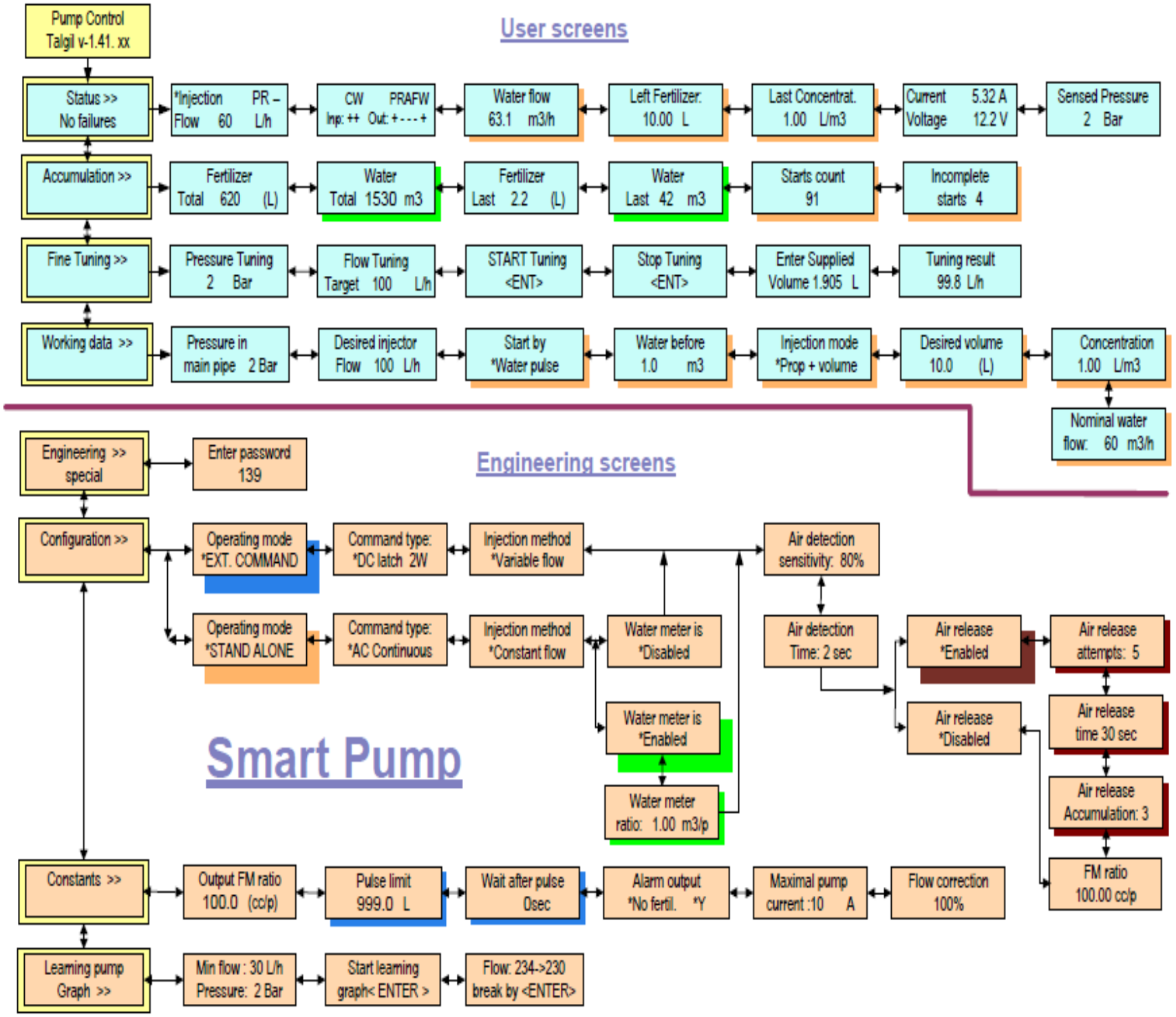
Charging – Solar energy or from the mains

Input Command- 24v AC
12v DC continuous
12v DC latching 2W
12v DC latching 3w
Dry contact

Output signal- dry contact

Air release solenoid- 12v DC latch 2w

Ambient temperature- 0 - 60°C°


User screens
Pump Control
Talgil v-1.41. xx
Status >>
No failures
*Injection PR –
Flow 60 L/h
CW PRAFW
Inp: ++ Out: + - - - +
Water flow
63.1 m3/h
Left Fertilizer:
10.00 L
Last Concentrat.
1.00 L/m3
Current 5.32 A
Voltage 12.2 V
Sensed Pressure
2 Bar
Accumulation >>
Fertilizer
Total 620 (L)
Water
Total 1530 m3
Fertilizer
Last 2.2 (L)
Water
Last 42 m3
Starts count
91
Incomplete
starts 4
Fine Tuning >>
Pressure Tuning
2 Bar
Flow Tuning
Target 100 L/h
START Tuning
<ENT>
Stop Tuning
<ENT>
Enter Supplied
Volume 1.905 L
Tuning result
99.8 L/h
Working data >>
Pressure in
main pipe 2 Bar
Desired injector
Flow 100 L/h
Start by
*Water pulse
Water before
1.0 m3
Injection mode
*Prop + volume
Desired volume
10.0 (L)
Concentration
1.00 L/m3
Nominal water
flow: 60 m3/h
Engineering screens
Engineering >>
special
Enter password
139
Configuration >>
Operating mode
*EXT. COMMAND
Command type:
*DC latch 2W
Injection method
*Variable flow
Air detection
sensitivity: 80%
Operating mode
*STAND ALONE
Command type:
*AC Continuous
Injection method
*Constant flow
Water meter is
*Disabled
Air detection
Time: 2 sec
Air release
*Enabled
Air release
attempts: 5
Water meter is
*Enabled
Air release
*Disabled
Air release
time 30 sec
Water meter
ratio: 1.00 m3/p
Air release
Accumulation: 3
Smart Pump
Constants >>
Output FM ratio
100.0 (cc/p)
Pulse limit
999.0 L
Wait after pulse
0sec
Alarm output
*No fertil. *Y
Maximal pump
current :10 A
Flow correction
100%
FM ratio
100.00 cc/p
Learning pump
Graph >>
Min flow : 30 L/h
Pressure: 2 Bar
Start learning
graph< ENTER >
Flow: 234->230
break by <ENTER>

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CONTROL SYSTEMS

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