MARK 2

FLOCCA.

User Manual

MARK 2

Version Record

Version No	Date of Issue	Reason for Update
0.1	05/03/2020	Draft - Partially Complete
1.0	08/03/2020	Initial Release
1.1	19/06/2020	Final Release

Table of Contents

Nomenclature

Controlled device	A piece of equipment that is actively controlled by the system (pump, valve, etc.)
Device	Any piece of equipment connected to the system (pump, valve, sensor, etc.)
Control Unit	The little box inside the Flocca Controller that does all the work behind the scenes.
Data Logs	Data logs on the Flocca Controller Mk2 are records of daily accumulated rainfall and chemical dosed. This information is recorded every minute. This is stored on internal flash memory and can be downloaded to SD card for review.
Event Logs	Event logs on the Flocca Controller Mk2 are records of events on the controller like door opening, solenoid activating, HMI interaction, etc. This is stored on internal flash memory and can be downloaded to SD card for review.
Operator	Person operating the control panel.
HMI	**H**uman **M**achine **I**nterface. This is usually an interactive touch screen graphical interface.
PPL	**P**ulses **P**er **L**itre. This is the calibration factor for the flow meter. The flow meter is a paddle wheel type flow meter and gives out a defined amount of pulses for every litre of chemical dosed.
PPM	**P**arts **P**er **M**illion. This is a measure of concentration of a chemical in a solution, like flocculent in water. It is also sometimes called µL/L or mL/M3.
Rain Event	A rain event is considered true when a minimum amount of rain has fallen within the last 12 hrs to cause the controller to potentially dose chemical.
RTC	Real Time Clock. This is a device within the Control Unit that maintains a very accurate time and date record. This is maintained even when the power is turned off.
Solenoid Activation	The dosing solenoid is energised and open, allowing chemical to flow.

1. General Overview

1.1. DESCRIPTION

The Flocca Controller Mk2 dosing system is a portable automated dosing system designed to provide an easy yet reliable solution to run-off water management. The system monitors rainfall or drain flow to determine the optimal volume of chemical to dose into the run-off stream. The controller is very easy to deploy, as it does not need mains water or power, just hook it up to the solar panel and turn it on. This makes it ideal for temporary sites where rapid solutions are required, or where mains power is just not available. The system is designed to only turn on parts of itself that are required, enabling the controller to run for extended periods on battery power.

1.2. FEATURES

Automatic dosing based on:
- » Rainfall measurement
- » Drain flow measurement

Manual dosing
- » Fixed volume dosing - deliver a desired volume of chemical in Litres
- » Constant rate dosing - deliver chemical at a fixed rate in Litres/Hour

Real Time Clock

Data logger
- » Log rain fall or drain flow readings
- » Log volume of chemical dosed
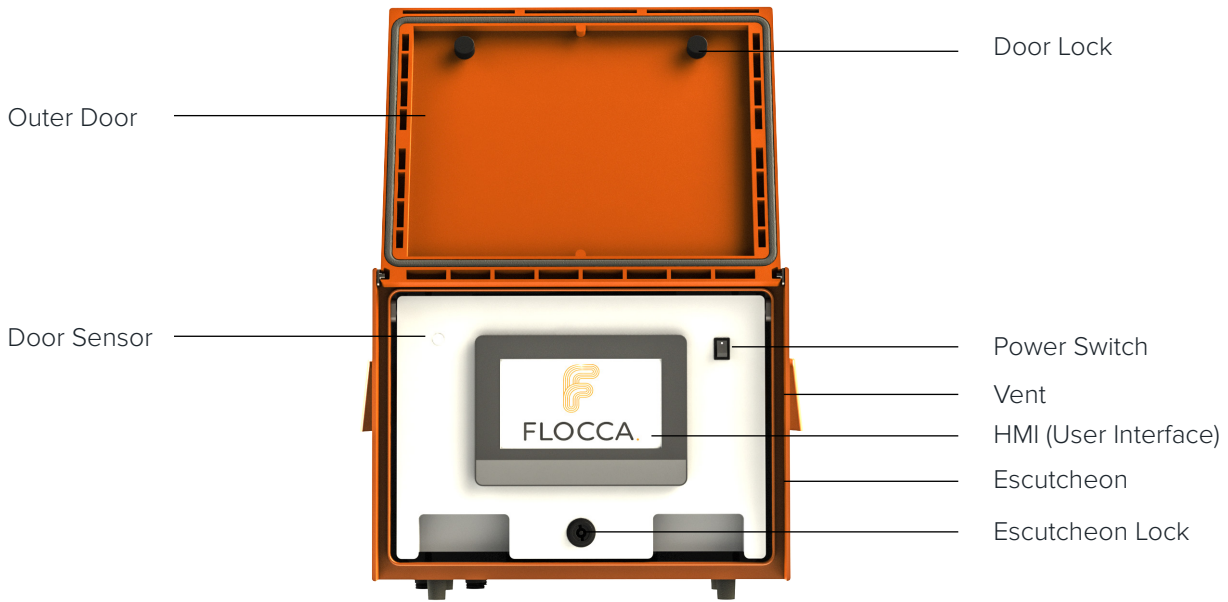- » Log user interaction (audit record)
- » Download to SD card

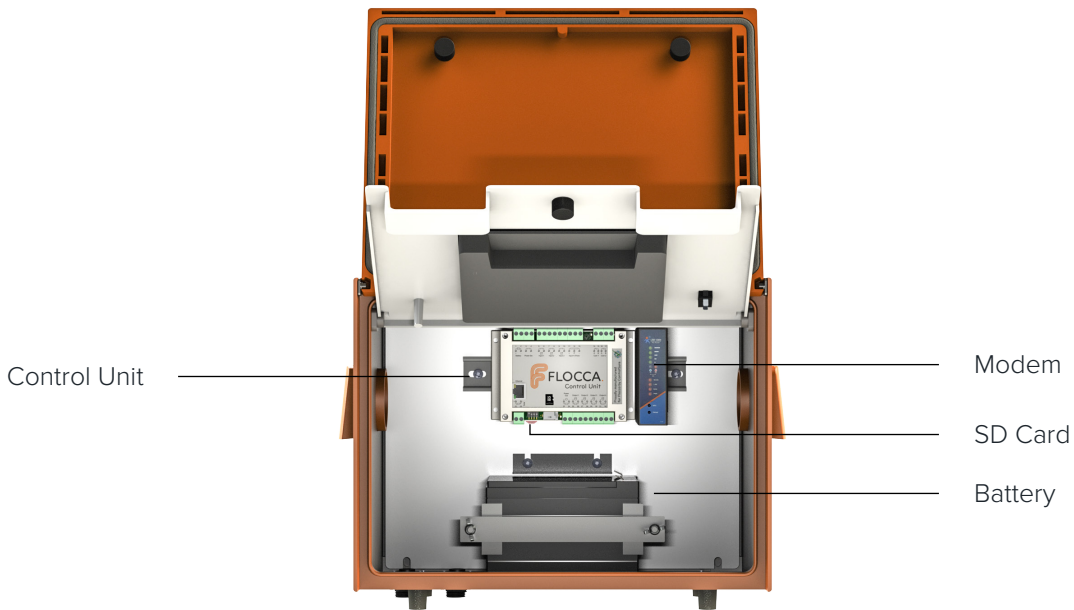Export and Import settings from SD card

Email generation
- » Alarms
- » Daily operation summary

Low voltage cut-out (battery protection)

1.3. GENERAL LAYOUT

Door Lock
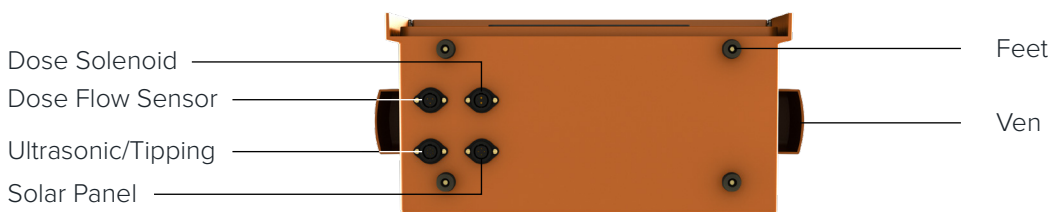
Outer Door

Door Sensor

Power Switch

Vent

HMI (User Interface)

Escutcheon

Escutcheon Lock

FRONT

Control Unit

Modem

SD Card

Battery

INSIDE

Dose Solenoid

Dose Flow Sensor

Ultrasonic/Tipping

Solar Panel

Feet

Ven

BOTTOM

Outer Door	The outer door provides weather protection for the controller.
Door Sensor	The door sensor detects when the outer door is closed. When the door is closed, the HMI will shut down to save power.
HMI	**H**uman **M**achine **I**nterface. This is the graphical user interface.
Escutcheon	The escutcheon is the inner door on the controller. Most of the equipment that the user or operator will need is mounted on the escutcheon.
Door Lock	These lock the outer door and maintain the IP rating of the controller.
Power Switch	This turns the controller on and off. If the controller is turned off, it will not measure or record rainfall, or dose chemical. The battery will still receive charge from the solar panels when the controller is turned off.
Vent	The controller is powered by a sealed lead-acid battery. Whist these batteries are sealed (mostly), they can still vent hydrogen gas when charging. The vents allow this gas to safely dissipate.
Escutcheon Lock	The escutcheon lock holds the escutcheon closed.
Dose Solenoid Socket	This is where the dose solenoid is plugged into. The plugs and sockets are matched, and the dose solenoid cannot physically plug into any other socket.
Dose Flow Sensor Socket	This is where the dose flow sensor is plugged into. The plugs and sockets are matched, and the dose flow sensor cannot physically plug into any other socket.
Ultrasonic / Tipping Bucket Socket	This is where the ultrasonic or tipping bucket sensor is plugged into. Only one of the two types of sensors can be used on the system at one time. The plugs and sockets are matched, and the ultrasonic or tipping bucket sensor cannot physically plug into any other socket.
Solar Panel Socket	This is where the solar panel is plugged into. The plugs and sockets are matched, and the solar panel cannot physically plug into any other socket.
Feet	The support the controller when it is placed on a bench.
Control Unit	This is the heart of the Flocca Controller Mk2.
Battery	This is a 12V, 12Ah Sealed Lead Acid Battery. This stores energy from the solar panels and powers the controller.
Modem	The 4G modem provides mobile internet connectivity for sending emails.
SD Card	The SD card provides a means to download logs from the controller unit, and upload and download system settings.

2. User Interface

The HMI will turn on when the outer door is opened, and correspondingly turn off shortly after the outer door is closed in order to save power. When powering up, the splash screen with be displayed for a few seconds, after which it will automatically switch to the home screen. Touching the splash screen will cause it to go straight to the home screen.

2.1. HOME SCREEN

The home screen shows an easy to read summary of the current status of the controller. The accumulated rainfall (or drain flow) and volume dosed over the last 1, 24 and 48 hour periods are displayed, as well as other basic information. The buttons at the bottom allow the operator to navigate through the various screens available. Pressing the Flocca symbol in the top right-hand corner of the screen will return to this page from anywhere in the HMI screen-set
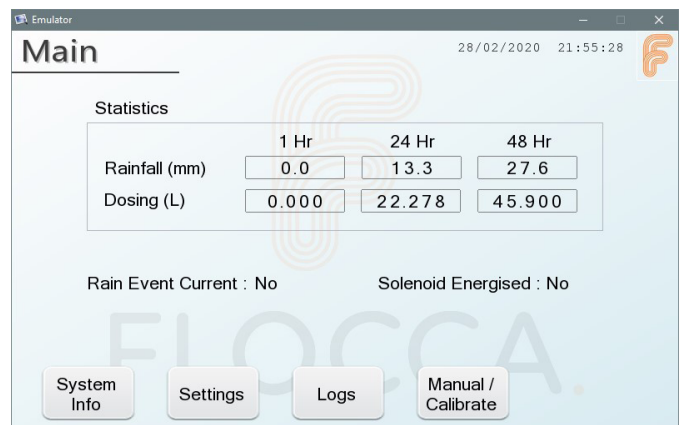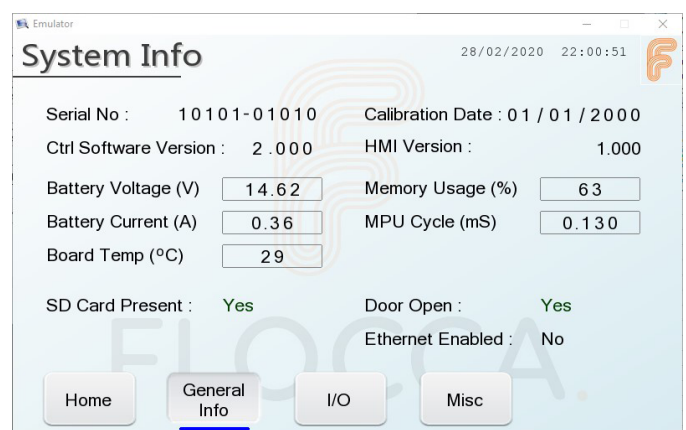

2.2 SYSTEM INFORMATION

The system information shows the current status of the system. It is broken up into 3 sections.

2.2.1. GENERAL INFORMATION

The first system information screen shows the current status of the control unit.

Serial Number	The serial number of the control unit at the heart of the Flocca Controller.
Calibration Date	The date the control unit was calibrated. This does not reflect the flow and ultrasonic sensor calibration.
Control Software Version	The software version in the control unit at the heart of the Flocca Controller.
HMI Version	The version of the HMI program.
Battery Voltage	The current voltage of the battery. When charging via the solar panels, this should be between 13V - 15V. When the solar panels are not providing charge, it should be between 12V and 13V. If this value falls below 12V, the battery is running low.
Battery Voltage	The current draw from the battery. A negative value indicates that the battery is charging.
Battery Voltage	The temperature of the control unit at the heart of the Flocca Controller.
Memory Usage	The percent memory used in the control unit.
MPU Cycle Time	The average cycle time, in milliseconds, of the control unit program.
SD Card Present	Indicates if the control unit detects an SD card. If an SD card is inserted, and is not detected, try removing and re-inserting the card.
Door Open	The current status of the door sensor.
Ethernet Enabled	Indicates if the Ethernet port is currently powered up and initialised. When not being used, the Ethernet port and the modem are turned off to conserve power.

2.2.2. I/O

The second system information screen shows the inputs and outputs of the control unit, as well as the battery power draw, and the status of the Ethernet port and the SD card.
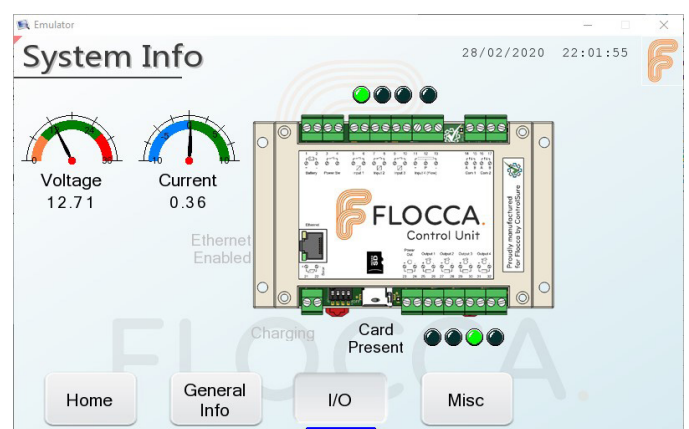
2.2.3. MISC

The third system information screen shows the IP address of the control unit.

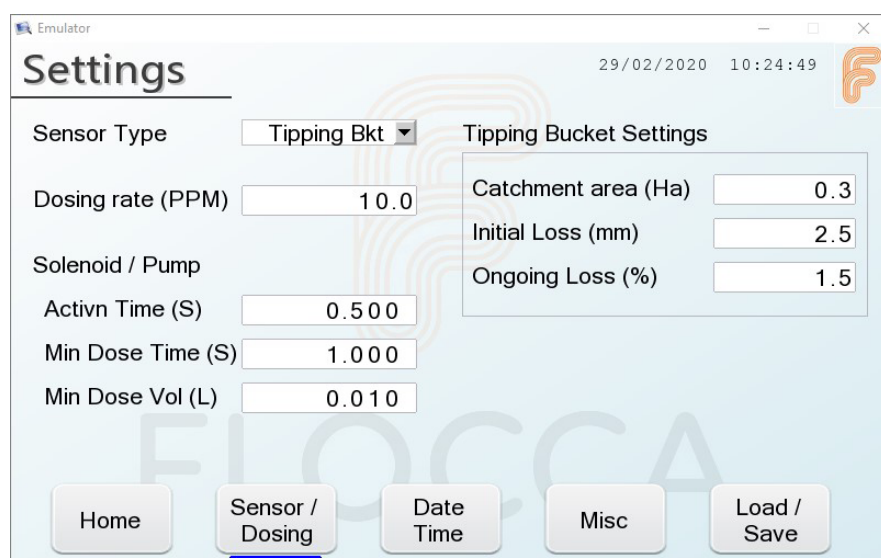# 2.3. SETTINGS

2.3.1. SENSOR AND DOSING SETTINGS

The sensor and dosing settings allow the operator to set what kind of sensor is fitted to the controller and set its associated parameters, as well as tune parameters associated with the dosing system.
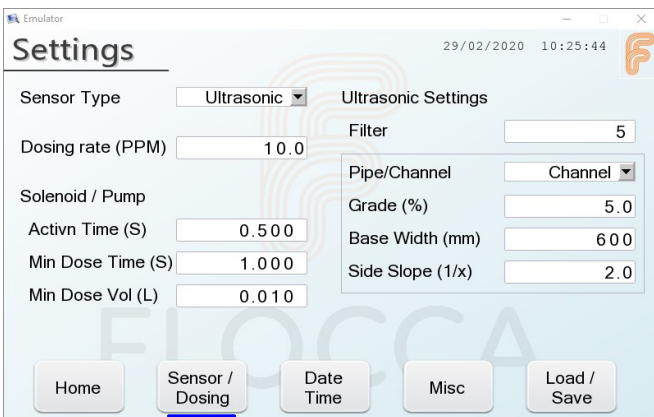
THE SENSORS AVAILABLE ARE:

Tipping Bucket   The tipping bucket sensor measures the rainfall, in mm, and calculates the volume of water that needs to be treated based on a nominated collection area.

Ultrasonic Sensor   The ultrasonic sensor measures the depth of water flowing in a drain channel or pipe and calculates the volume of water that needs to be treated based on Manning's equations and the dimensions of the pipe or channel.

Doppler Sensor   *The Doppler sensor measures the velocity of water flowing in a drain channel or pipe and calculates the volume of water that needs to be treated based on the dimensions of the pipe or channel (potential future addition).*

Sensor Type	The type of rain/flow sensor fitted to the controller - "Tipping Bucket", "Ultrasonic" or "Doppler".
	Different settings will become available depending on this selection.
	Note that the "Doppler" sensor option is not available at the time of writing this manual.
Dosing Rate	The amount of chemical to be dosed relative to the amount of rain or flow. The units are parts/million (PPM), also known as µL/L.
Solenoid Activation Time	The control unit will provide a high-power pulse to the solenoid in order to open it correctly, and then drop the power to a lower value to maintain it while it is open. This helps to reduce power consumption. The activation time is the duration of the high power pulse.
Solenoid Min Dose Time	The minimum time the solenoid must remain open for. This helps to avoid chattering and potential damage of the solenoid if one of the other settings like "Minimum Dose Volume" are set incorrectly.
Solenoid Min Dose Volume	The minimum amount of chemical to be dosed at one time. This helps to avoid chattering and potential damage of the solenoid if one of the other settings like "Minimum Dose Volume" are set incorrectly. This can be left at 0.01 for Flocca Rain. For Flocca Flow (with ultrasonic) we recommend using 0.1 L/s.
Tipping Bucket Catchment Area	This is the catchment area for the rain detected by the tipping bucket sensor. A larger area means more water collected per mm of rain, and hence more chemical dosed.
Tipping Bucket Initial Loss	This represents the amount of rain, in mm, that would be considered lost due to ground absorption at the start of a rain event.
Tipping Bucket Ongoing Loss	This represents the percentage of rain detected that is considered lost due to ground absorption throughout a rain event.

Ultrasonic Sensor Filter	This value filters or smooths out the signal from the sensor, helping to remove any noise or aberrant readings. A larger value provides a more stable reading, but with slower response time.
Ultrasonic Pipe / Channel	This tells the controller if the ultrasonic sensor is fitted into a pipe or suspended above a channel. Different settings will become available depending on this selection.
Ultrasonic Pipe Grade	This is the grade or slope of the pipe. This is the amount of fall in the pipe over a given length. A fall of "1 in 20" would be equivalent to 5%.
Ultrasonic Pipe Diameter	The inner diameter of the pipe the ultrasonic is fitted into.
Ultrasonic Channel Grade	This is the grade or slope of the channel. This is the amount of fall in the channel over a given length. A fall of "1 in 20" would be equivalent to 5%.
Ultrasonic Channel Base Width	The width of the flat section at the bottom of the channel.
Ultrasonic Channel Side Slope	The slope of the sides of the channel. A value of 0 here indicates a channel with vertical sides.

** Settings in this section will need to be saved to flash to be made permanent. See section 2.3.5*

2.3.2. DATE / TIME

The Date/Time settings screen allows the operator to update the Real Time Clock (RTC) in the control unit.

**Pre-Load** — Pressing Pre-Load will populate the new Date-Time values with the current Date-Time.

Set — Pressing Set will set the current Date-Time with the new Date-Time values.

The date and time will be updated in the systems RTC as soon as "Set" is pressed and does not need to be saved to flash.
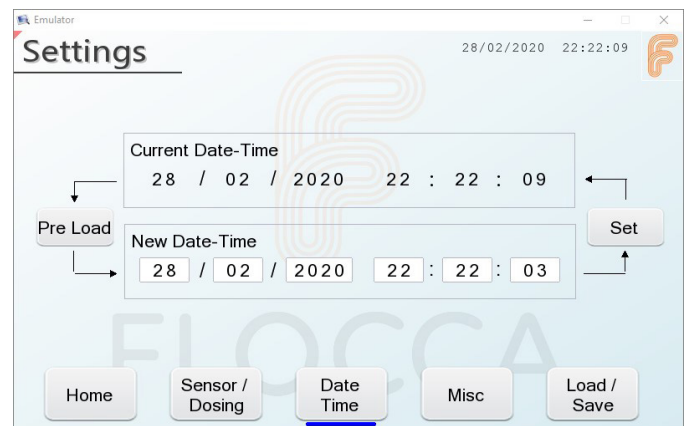
2.3.3. MISC

The Miscellaneous settings are where you will find all those settings that simply do not fit nicely into any category of their own.
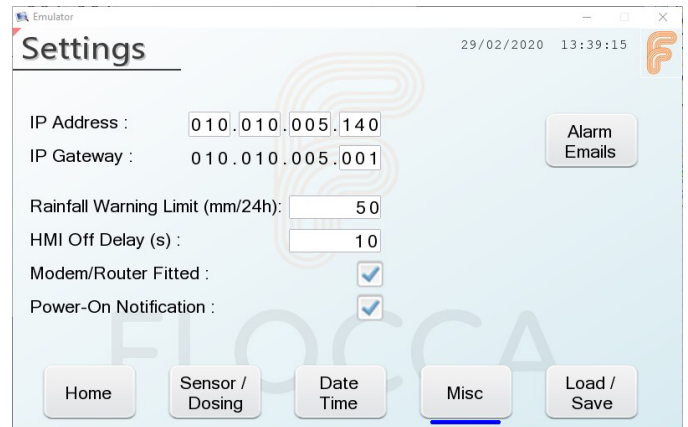
IP Address	Sets the IP address of the Ethernet port.
IP Gateway	Sets the IP gateway of the Ethernet port. The first 3 octets of the IP gateway must be the same as the IP address. This is usually set to the address of the modem or router.
Rainfall Warning Limit	A warning will be raised if an abnormally large amount of rain is detected, as set by this value. This could be due to an abnormal weather event, a faulty rain sensor, or incorrect use of the equipment. **This value must not be 0.** Default value is 200.
Modem/Router Fitted	This setting tells the controller that a router is fitted, facilitating email alarms and reports.
Power On Notification	This option causes the controller to send an email every time it powers up. This is useful if there are problems maintain charge in the battery and the controller is turning itself off. (Only valid if a router is fitted).
Alarm Emails	Pressing this button opens a window that lets the operator enter up to 6 email addresses that will receive alarm and status emails. (Only valid if a router is fitted).

* Settings on this page will need to be saved to flash to be made permanent. See section 2.3.5

2.3.4. ALARM EMAILS

The system will email notifications of events and alarms, as well as daily summary reports. Up to 6 addresses can be stored.

Press on an address box to enter a new address. Up to 6 addresses can be stored. The email addresses are directly read from and written to flash memory, and do not need to be saved to flash separately.

2.3.5. LOAD/SAVE

Any settings that have been updated are only stored in local memory. These settings will be lost when the controller is turned off unless they are saved to internal flash memory.

Whenever settings have been changed and the operator is happy with the operation of the controller, she/he should save the setting to flash. If a mistake has been made when changing the setting and the controller is not behaving as expected, the latest saved settings can be restored by loading from flash. The settings can also be exported to and imported from an SD card. This allows the settings in the controller to be backed up and stored elsewhere, as well as facilitating the transfer of settings from one controller to another.
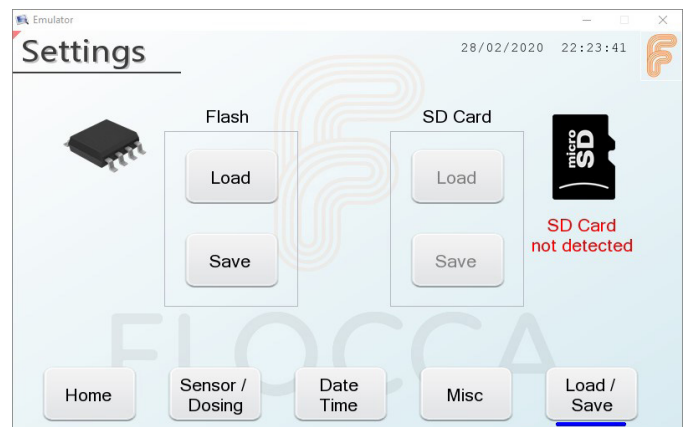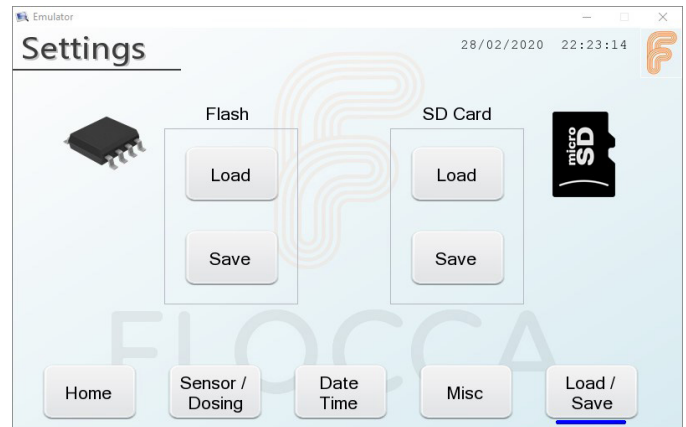
2.4. MANUAL MODE

The Flocca Controller Mk2 can operate in manual mode to either deliver a fixed volume of chemical, or constantly dose chemical at a fixed rate.
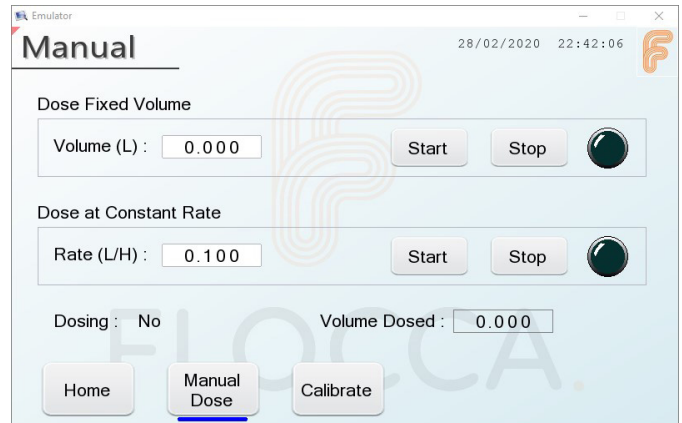
Fixed Volume	Enter an amount, in litres, of chemical to be dosed. When the associated "Start" button is pressed, the controller will start dosing chemical and will automatically stop once the required amount has been delivered. The actual volume dosed is shown in "Volume Dosed" at the bottom of the screen.
Constant Rate	Enter a dosing rate, in litres/hour, of chemical to be dosed. When the associated "Start" button is pressed, the controller will start calculating the amount of chemical required given the time that has passed. Dosing will only occur once the minimum dose volume has been reached. Constant rate dosing will continue until it is stopped by the operator. Refer the 'Dosing Volume Calculation' document on our website for more information
Dosing	Indicates if the system is currently dosing. This reflects the status of the solenoid or pump.
Volume Dosed	This value shows the volume of chemical that has been dosed during the current manual operation.

When dosing in manual mode, the screen will indicate that manual mode is active by turning on a lamp associated with the mode of dosing. The system will also display "Manual Dose Mode" at the top of the screen - this will be visible on every screen whilst manual dosing is active.
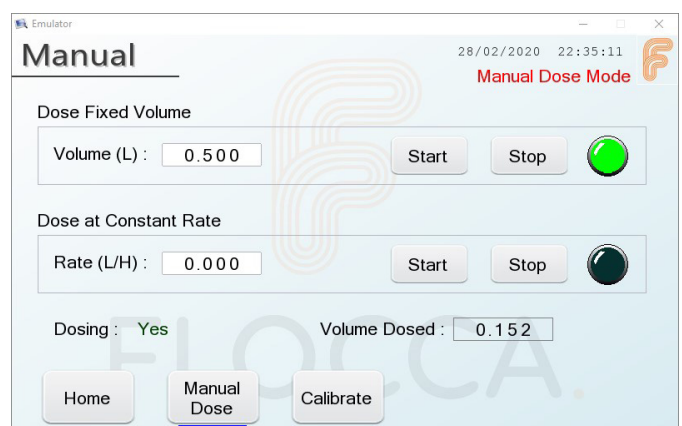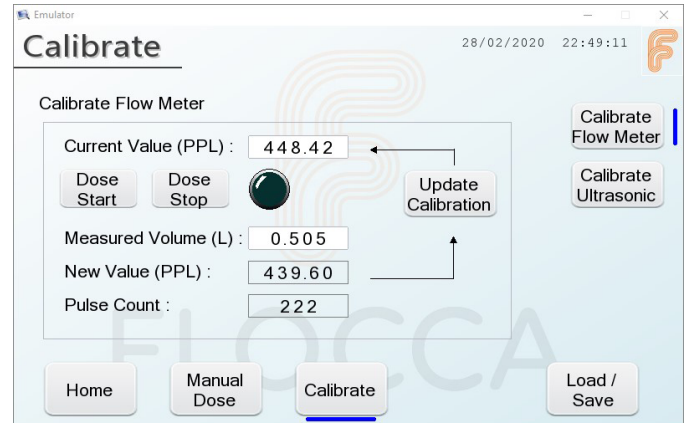
2.5 CALIBRATION

The flow sensor and ultrasonic sensor can be calibrated before use. The calibration pages provide an easy method for updating the sensor calibration.

2.5.1. FLOW SENSOR

Most flow sensors have been calibrated and will come with a certificate in the box. The value of the certificate can be used as Current Value (PPL). The flow sensor is calibrated by dosing a fixed amount of chemical, and then comparing be actual volume against the expected volume. An accurate measuring container or an accurate set of scales are required for this process.


Dose Start	This button starts the calibration process and opens the dosing solenoid to start dosing chemical.
Dose Stop	This button closes the dosing solenoid to stop dosing chemical.
Current Value (PPL)	This is the current calibration value of the flow meter. This can be updated manually by pressing on the value and entering a new value directly.
Measured Volume	This is the amount of chemical dosed during the calibration process. This value will show what the controller believes the volume should be and must be updated with the actual measured volume.
New Value (PPL)	This shows the new calibration value based on the amount of chemical dosed and the volume entered into "Measured Volume".
Pulse Count	The number of pulses returned from the flow sensor during the calibration process.
Update Calibration	This button updates the "Current Value" with the "New Value".

When using the system for the first time, perform Manual Dose of 0.6L to fill any voids and sags in the outlet assembly (refer 2.4).

To start the calibration process, put the measuring jug under the chemical outlet, then press the "Dose Start" button. Once a suitable amount of chemical has been dosed, press the "Dose Stop" button. A volume between 0.5L and 1L is recommended, with the larger volume preferred. Once the chemical has completely stopped flowing, check the exact amount of chemical dosed and then update the "Measured Volume" with the actual value. Press the "Update Calibration" button to complete the calibration process.

2.5.2. ULTRASONIC SENSOR

The ultrasonic sensor is calibrated by telling the controller where the 0 depth position is. The ultrasonic sensor is sensitive (and expensive) equipment and must be handled carefully.
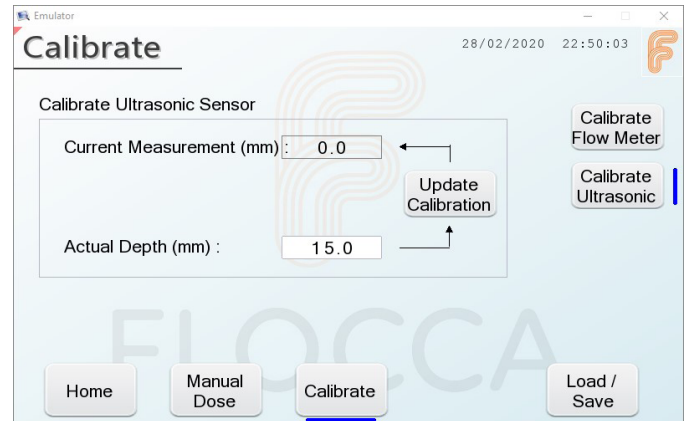
Current Measurement	This value shows what the controller believes is the current depth of water in the pipe of channel.
Actual Depth	Enter the actual depth of water (if any) in the pipe of channel to update the calibration of the sensor. In most cases, "Actual Depth" needs to be 0 to reflect a dry pipe/channel.
Update Calibration	This button updates the ultrasonic sensor based on the value in "Actual Depth"

Calibration is achieved by simply telling the system the current depth of water in the pipe or channel and pressing "Update Calibration". In most cases the pipe is dry, so type in 0 and click "Update calibration". The "Current measurement" will now change to a value of 0 (plus or minus 0.2mm). The controller will automatically calculate the required values from the information provided and update the ultrasonic sensor. The only time a different value in "Actual Depth" would be entered is when the system is being installed during a rain event, with actual flow through the pipe.

2.6 LOGS

The Logging feature in the Flocca Controller Mk2 records information about rainfall and the volume of chemical dosed (data logs), as well as event that occur on the controller (event logs). The process data is sampled every minute, and the event data is stored at the time it occurs. The data is stored on the control unit's internal flash memory. When the available memory buffer is full, the system will simply override the oldest values. There is enough memory on the control unit to store over 2 years' worth of process data, and over 25,000 events.

2.6.1. CHART

The recorded process data can be viewed on the screen as a chart.


The following selection of time ranges are available from the dropdown selection box at the top of the chart:

- » 12 Hours
- » 24 Hours
- » 48 Hours
- » 7 Days
- » 14 Days
- » 28 Days

The option to view the rainfall or the volume of chemical dosed can be selected by pressing on the label "Rainfall (mm)" or "Volume Dosed (L)" at the bottom of the chart.

2.6.2. DOWNLOAD

The logged data records can be downloaded to SD card for further review.
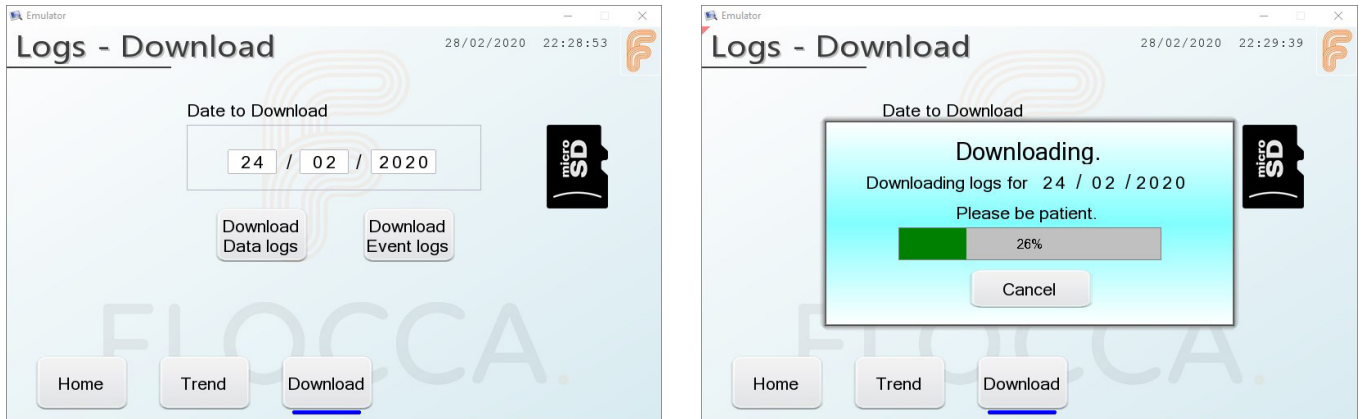
Data is downloaded 1 day at a time. Simply enter the required date (DD/MM/YYYY), and either press the "Download Data Logs" or "Download Event Logs". The logs can take up to a minute to copy to SD card, and a popup window will display the progress. If an SD card is not detected, then the buttons will be unavailable.

2.7 ALARMS

Any alarms that are active on the system will be displayed in a red bar at the top of the screen. This will be visible on all screens.

The alarm message will continuously scroll from right to left. If more than one alarm is active, they will each be scrolled across the rad bar. If a new alarm is activated while the door is open and the HMI is turned on, and popup box will alert the operator to the new situation.

Pressing on the message will remove it from the screen. If a modem is fitted to the controller, then an email will also be send when an alarm event occurs. Refer to section 2.3.4 for information on setting recipient addresses.

To clear an active alarm, go to "System Info"- "Alarms" and untick the relevant box to clear the alarm. Alarms will not clear themselves and the system will need to be checked after each rainfall event to ensure no alarms are active. The system will not activate dosing unless alarms have been cleared. A common alarm is after an IBC has been emptied and no flow was registered for some time. The system will shut the solenoid if no flow is registered for approximately 3 minutes, to prevent unwanted emptying of the IBC.
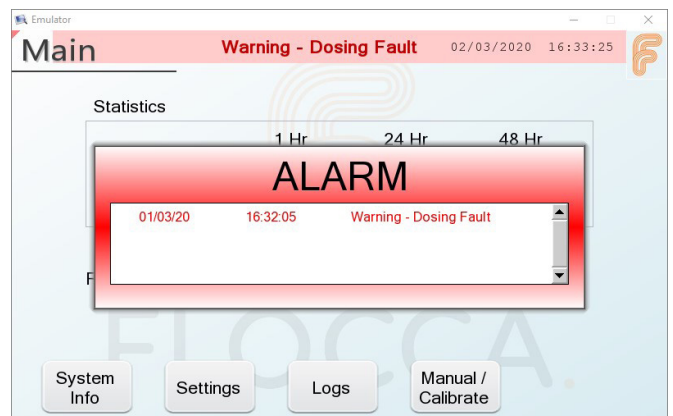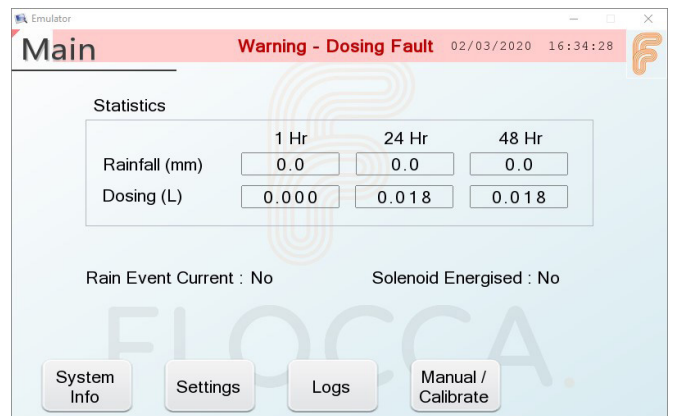
2.8 LOW POWER WARNING

If the battery voltage drops below a hardware set low voltage cut-out, the controller will shut down until the battery is charged up again. The hardware cut-out is set between 9V-10V during factory calibration. When the battery voltage drops below a factory-set software limit, the controller will raise a warning, record the occurrence in the event logs, and if a modem is fitted, send an email. The pre-set limit is set to 10.25V in the factory settings of the controller.

2.9 DOSING WARNING

If the solenoid is opened, but no chemical is detected by the dose flow sensor, the controller will raise a warning, record the occurrence in the event logs, and if a modem is fitted, send an email. The system will attempt to correct the problem by chattering the solenoid on and off 10 times very quickly. This will help if the solenoid has jammed due to chemical build up or crystallisation within the valve. This will not help if the chemical has simply run out. The system will try four times using the chatter approach at 30 second intervals and if there is still no chemical detected flowing, then a Solenoid Fault Alarm will be raised.

2.10 SOLENOID CLOSE WARNING

If dosing has completed and the solenoid is closed, but chemical is still detected flowing by the dose flow sensor, the controller will raise a warning, record the occurrence in the event logs, and if a modem is fitted, send an email. The system will attempt to correct the problem by chattering the solenoid on and off 10 times very quickly. This will help if the solenoid jammed due to chemical build up or crystallisation within the valve. The system will try a couple of times using the chatter approach, and if there is still no chemical detected flowing, then a Solenoid Fault Alarm will be raised.

2.11 SOLENOID FAULT ALARM

If a non-recoverable fault occurs with the dosing solenoid, the controller will raise an alarm, record the occurrence in the event logs, and if a modem is fitted, send an alarm email. If a solenoid fault alarm is raised, the solenoid will be disabled until the controller is power cycled.

2.12 ULTRASONIC SENSOR COMMS WARNING

The Flocca Controller Mk2 gets readings from the ultrasonic sensor via Modbus communication. If communication is lost for an unacceptable amount of time, the controller will raise a warning, record the occurrence in the event logs, and if a modem is fitted, send an email.

2.13 HIGH RAINFALL DETECTED

If the accumulated rainfall total within the last 24Hr is more than the limit set in the settings (200 mm) of the Flocca Controller Mk2 (see section 2.3.3), the controller will raise a warning, record the occurrence in the event logs, and if a modem is fitted, send an email.

2.14 SD CARD FAULT

If an SD card is detected, but cannot be communicated with, the controller will raise a warning, record the occurrence in the event logs, and if a modem is fitted, send an email.

3. Related Equipment

The Flocca controller interfaces to a set of equipment to help it fulfil its function.

3.1. SOLAR PANEL

The solar panel provide ongoing power for the controller. The energy collected from the solar panels is stored in the controller's internal battery. The solar panels should be mounted in unsheltered area, clear of shade and possible debris from surrounding trees. The solar panels should be set to an angle of approximately 30o from horizontal and should be oriented in a generally northerly direction.

3.2. DOSING SOLENOID

The dosing solenoid controls the flow of chemical being dosed. The solenoid is mounted onto the bottom outlet of a chemical IBC and allows chemical to gravity feed out of the IBC when dosing is required. The solenoid is associated with a flow sensor that monitors the amount of chemical dosed and allows the controller to accurately control the dosing.The solenoid is directional so should be installed as per the arrow markings on the body of the solenoid.


3.3. DOSING FLOW SENSOR

The dosing flow sensor measures the chemical as it is dosed. The controller keeps track of expected vs actual dosed volumes and compensates for any over-run due to small time lags closing the solenoid (shown as negative).

The flow sensor is directional, so should be installed as per the markings on the body of the solenoid. The flow sensor should be mounted such that the ports are above the main body of the flow sensor, avoiding air traps within the sensor.

3.4. TIPPING BUCKET RAIN SENSOR

The tipping bucket rain sensor measures accumulated rainfall in real time. The tipping bucket collects rain in the opening at the top, which then flows through the body of the device where the volume of water is mechanically measured using a tipping bucket gauge. The sensor should be mounted on an uncovered **LEVEL (!!)** surface.
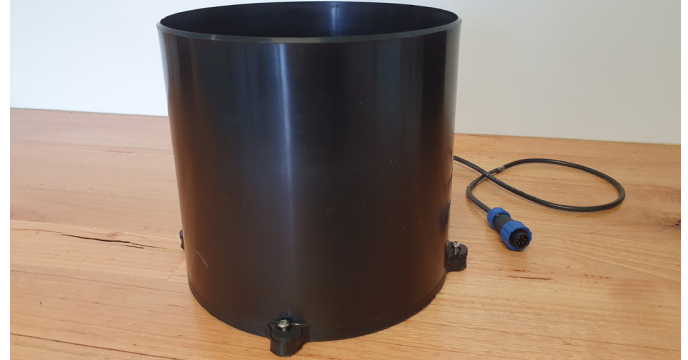
3.5. ULTRASONIC FLOW SENSOR

The ultrasonic sensor measure water depth in a drain channel or pipe, allowing for a more direct and accurate measurement of effluent that needs to be dosed. The ultrasonic is mounted in the top of a pipe or above a drain channel and measures the depth of water flowing through the drain. From this, the controller calculates the volume of water flowing per second and doses chemical accordingly.

4. Wiring Diagram