/ **HydroMet**

User Manual

IoTa Irrigation

K KISTERS

Empowering decisions of tomorrow

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I   Disclaimer

The information provided in this manual was deemed accurate as of the publication date. However, updates to this information may have occurred.

This manual does not include all of the details of design, production, or variation of the equipment nor does it cover every possible situation which may arise during installation, operation or maintenance. KISTERS shall not be liable for any incidental, indirect, special or consequential damages whatsoever arising out of or related to this documentation and the information contained in it, even if KISTERS has been advised of the possibility of such damages.

Any errors found in any KISTERS product should be reported to KISTERS where every effort will be made to quickly resolve the problem.

This document is public.

II   Glossary + Abbreviations

Term	Explanation
LoRa	from "Long Range", a proprietary low-power wide-area network modulation technique
LoRaWAN	LoRa Wide Area Network, networking protocol built on top of the LoRa radio modulation technique
LTE-M	Long Term Evolution for Machines, a type of low power wide area network (LPWAN) radio technology standard
LPWAN	Low Power Wide Area Network, both LoRa/LoRAWAN and LTE-M are LPWAN technologies
SDI-12	Serial Digital Interface at 1200 baud, an asynchronous serial communications protocol for smart sensors, SDI-12 sensors reply to commands send by the data logger, the standard also specifies supply voltage and current and including modes for low-power operation
USB	Universal Serial Bus, an asynchronous serial communication protocol for peripheral devices

III   Scope of Delivery

- TB7/02 Rain Gauge with integrated IoTa LoRa Sensor Node
- Bird Spikes with mounting instructions
- Allen Key
- EnviroPro Soil Moisture Probe (M12-8 pin, SDI-12)

IV   Safety Instructions

- Read the user manual including all operating instructions prior to installing, connecting and powering up the KISTERS IoTa Irrigation. The manual provides information on how to operate the product. The manual is intended to be used by qualified personnel, i.e. personnel that have been adequately trained, are sufficiently familiar with installation, mounting, wiring, powering up and operation of the product.
- Keep the user manual on hand for later reference!
- If you encounter problems understanding the information in the manual (or part thereof), please consult the manufacturer or its appointed reseller for further support.
- KISTERS IoTa Irrigation is intended to be used in hydrometeorological or environmental monitoring applications.
- Before starting to work, you have to check the functioning and integrity of the system.
  - Check for visible defects on the IoTa Irrigation, this may or may not include any or all of the following mounting facilities, connectors and connections, mechanical parts, internal or external communication devices, power supplies or power supply lines, etc.
  - If defects are found that jeopardize the operational safety, work must be stopped. This is true for defects found before starting to work as well as for defects found while working.
- Do not use the KISTERS IoTa Irrigation in areas where there is a danger of explosion.
- The present user manual specifies environmental/climatic operating conditions as well as mechanical and electrical conditions. Installation, wiring, powering up and operating the KISTERS IoTa Irrigation must strictly comply with these specifications.
- Perform maintenance only when tools or machinery are not in operation.
- If guards are removed to perform maintenance, replace them immediately after servicing.
- Never make any electrical or mechanical diagnostics, inspections or repairs under any circumstances. Return the product to the manufacturer's named repair centre. You can find information on how to return items for repair in the relevant section of the KISTERS website.
- Disposal instructions: After taking the KISTERS IoTa Irrigation out of service, it must be disposed of in compliance with local waste and environmental regulations. The KISTERS IoTa Irrigation is never to be disposed in household waste!
- Inputs and outputs of the device are protected against electric discharges and surges (so-called ESD). Do not touch any part of the electronic components! If you need to touch any part, please discharge yourself, i.e. by touching grounded metal parts.

V   Specific Safety Instructions

⚠️ **Warning**! The lithium-ion battery may only be used under the conditions specified in this user manual. Using the lithium-ion battery under conditions outside the limits specified in this user manual may result in personal injuries and damage to the battery.

The lithium-ion battery must always be kept in a well ventilated, dry, clean and dust-free environment. Never expose the battery to fire, water or solvents.

The lithium-ion battery is installed and used in an enclosed housing. The housing is equipped with a pressure-compensation gland. Make sure that nothing prevents the pressure compensation gland from operating. Especially do not clog or block the gland, remove the gland and replace it with a closed cap or similar.

⚠️ Overvoltage, wrong wiring, reverse polarity of the terminals or short circuits between the terminals may damage the lithium-ion battery which can be extremely dangerous.

The hazard symbols and safety instructions on the battery label must be observed and must never be removed from the battery.

⚠️ In case of exceptional heat development during operation, the lithium-ion battery must be disconnected and removed.

⚠️ In case of battery leakage, the leaking electrolyte must never come into contact with skin or eyes. In case of skin contact, the affected area has to be cleaned with water and soap immediately. In case of eye contamination, the affected eye must be thoroughly rinsed with clean water immediately. In both cases, a doctor must be consulted without delay.

⚠️ In case of swallowing of leaking electrolyte, a doctor must be consulted immediately.

Please note the markings of the polarities on battery terminals and connection terminals

Dirty battery terminals must be cleaned with a dry and clean cloth.

At the end of its service life, the lithium-ion battery must be disposed of according to legal provisions.

⚠️ **Warning**! The lithium battery must not be mechanically damaged. A damaged lithium-ion battery must never be installed or used.

⚠️ **Warning**! The battery terminals must not come into contact with electroconductive objects.

1 Introduction

IoTa Rain Gauge consists of a TB7 rain gauge with an integrated IoTa LTE-M or LoRa sensor node. IoTa turns the Rain Gauge into a self/reporting rain monitor. With an integrated lithium battery, the system will reliably report rain rates independently over a long period of time.

The integrated IoTa sendor node interconnects the TB7 (and optionally an SDI-12 sensor) with data management software by means of adding modern wireless connectivity.

IoTa Rain Gauges are available in two variants: one for LTE-M and one for LoRaWAN communication.

2 Installation

The AgriMet Irrigation station consists of two main units:

- A TB7/0.2 rain gauge with a TB334 2" Pole Mount Bracket pre-mounted
- An EnviroPro Soil Moisture Probe, 40 cm with 4 sensors spaced out by 10 cm for soil moisture and soil temperature, complete with 5 m of signal cable

2.1 Site Selection

Rainfall measurements are intended to be representative of the actual rain falling on a given area. Some of the more important factors which influence the representativeness of a gauge are as follows:

- Place the gauge on level ground where possible. Avoid sloping sites.
- Site should have adequate protection from strong winds.
- Site should be free of large obstructions such as buildings and trees.
- Provide suitable ground surface to avoid splashing into the gauge.

Soil moisture measurements are intended to be representative of the actual moisture retention capacity of the paddock. The pursued goal is to build a thorough picture of soil moisture. The collected data then helps in finetuning irrigation timings to ensure maximum water-use efficiency and crop production.

- Locate probes in an area of the paddock that represents the most uniform soil type
- Locate probes in an area known to produce consistently average yields
- The probe should be placed radius of the crop intended to be monitored
- Keep the probe and the entire monitoring installation out of the pathways of tractors

2.2 Installing the TB7

The kit is prepared for pole mount installation of the central unit consisting of the TB7/0.2 rain gauge with integrated IoTa LoRa sensor Node. The Pole Mount Bracket for the Rain Gauge unit is designed to suit 2-inch poles with external BSP thread.

Note: Make sure the pole is machined with an external 2" BSP thread!

Note: The pole must be fastened on/in a solid foundation!

To install the TB7 on the pole, first undo the pole mount bracket. A 2" BSP thread has been machined into the central aperture of the pole mount bracket. Screw the pole mount bracket on the 2-inch pole.

The pole mount bracket has three legs equipped with nuts, bolts and washers. Remove the top nut and washer from the bolts. The bolts are positioned as to fit into the mounting lugs of the TB7. Use a washer (first) and a nut (on top of the washer) to fix the TB7 on the pole mount bracket.

2.3 Installing the Soil Moisture Probe

- Mix roughly 900 g of fine sand with 100 g of Bentonite (if Bentonite is not available, use a slurry made of local soil – caution: rocks and organic matter must be sieved out first)
- Add 1000 ml of clean water.
- Mix Bentonite and sand in a bucket.
- Ensure they are dry mixed together before adding any water.
- Pour the dry mix through a funnel into an appropriately sized plastic bottle (or similar).
- Add the water.
- Put the lid on and shake until thoroughly mixed.
- Allow 30 minutes for the Bentonite to swell.
- The resulting mix should be a 'creamy' consistency.

Installation Video: https://vimeo.com/132938575

Note: Always shake the mixture before pouring the slurry as the sand may have settled if not used immediately.

Drill a hole with a diameter of 36 mm and a depth of 50 cm into the ground. ensure that part of the hole wall has not collapsed and that other material has not fallen into the hole.

Pour slurry into the hole until it is half full.

Push the probe into the hole until the top is 35 mm (3.5 cm) below the soil surface. Do not apply too much pressure (15 kg max) and avoid causing sharp bends in the cable where it enters the probe.
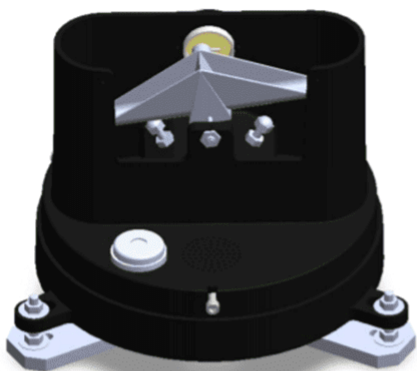
The slurry should ooze up around the probe and slightly overflow the hole. If you do not see any slurry, carefully extract the probe, mix up some more slurry and add to the hole.

Using the removed soil backfill the hole to cover the probe.

Connect the sensor to the piggy tail connector protruding out of the base of the TB7 rain gauge.
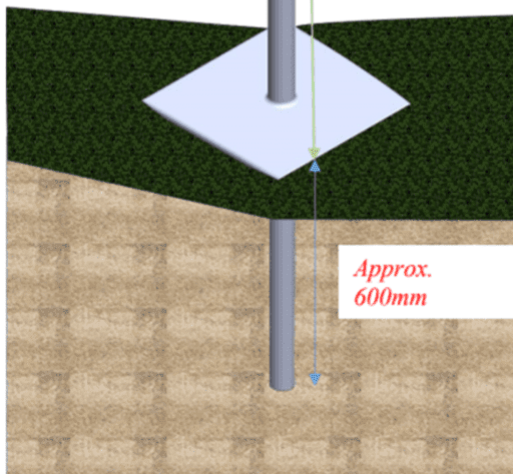
Pole Mount:

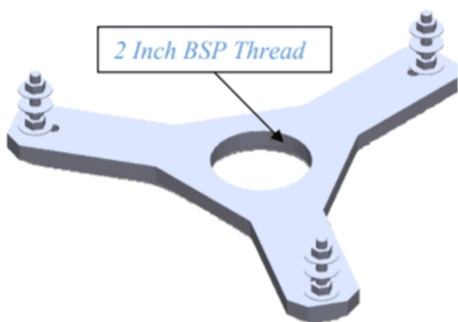*In Built Bird Guard*
Part No. TB777-04

2 Inch BSP threaded
end Galvanised Pipe
(Not Supplied)

Approx.
1200mm

2 Inch BSP Thread

Optional Pole Mount Bracket
Part No. TB334

Approx.
600mm

3   Configuration

The IoTa Stand-Alone can be configured locally or remotely using KISTERS' HyComm Windows software (free of charge).

- HyComm – General Description ⌐13⌐
- HyComm for IoTa SensorNode ⌐13⌐

3.1   HyComm – General Description

HyComm provides a framework for implementing on-site device (data logger/sensor) configuration. The software is available for the following deployment platforms:

- Windows (x64)
- Web (Chrome, Opera, Edge)
- Mobile Web (Chrome, Opera, Edge, Samsung Internet)

Note: supported configurable devices for each may vary.

3.2   HyComm for IoTa SensorNode

HyComm is a desktop application that can be used to configure the IoTa LTE-M or LoRa devices through their USB-ports.

Simply run the provided Windows installer and connect the IoTa LTE-M or LoRa through a USB cable to the computer running HyComm.

Connected devices are automatically recognised. In case that your device is not showing up, click on the (?) button in the connection screen, this will open up a guide on how to ensure a device connection.

While the USB cable is connected, the device will be in configuration mode and will not transmit any data. Upon disconnecting, the device will resume data transmission.

- Downloading Configuration Software ⌐13⌐
- Connecting to the Device ⌐14⌐
- Device Selection Screen (start-up) ⌐14⌐
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- Device Measurement Testing and Visualisation ⌐16⌐
- Device Integrations ⌐17⌐
- Device Configuration ⌐17⌐

3.2.1   Downloading Configuration Software

In order to configure the device, download the HyComm device configuration client.

You will need a USB Micro-B cable in order to connect the device with the computer on which the configuration client is installed.

Operating System	Download Link
Windows 7, 8, 10, 11 (x64)	https://hyconnect.kisters.de/config/download/HyComm.exe

Functionality

- Device information overview
- Visualise stored measurement data
- Run integrations to automatically bind the device to Datasphere or other services.
- Easy SDI-12 configuration for supported sensors.
- Diagnose errors messages related to sensors / manually trigger measurements.
- Change the device's configuration:
  - Measured parameters
  - Measurement intervals
  - Etc.
- Save / load configuration files
- Perform firmware upgrades
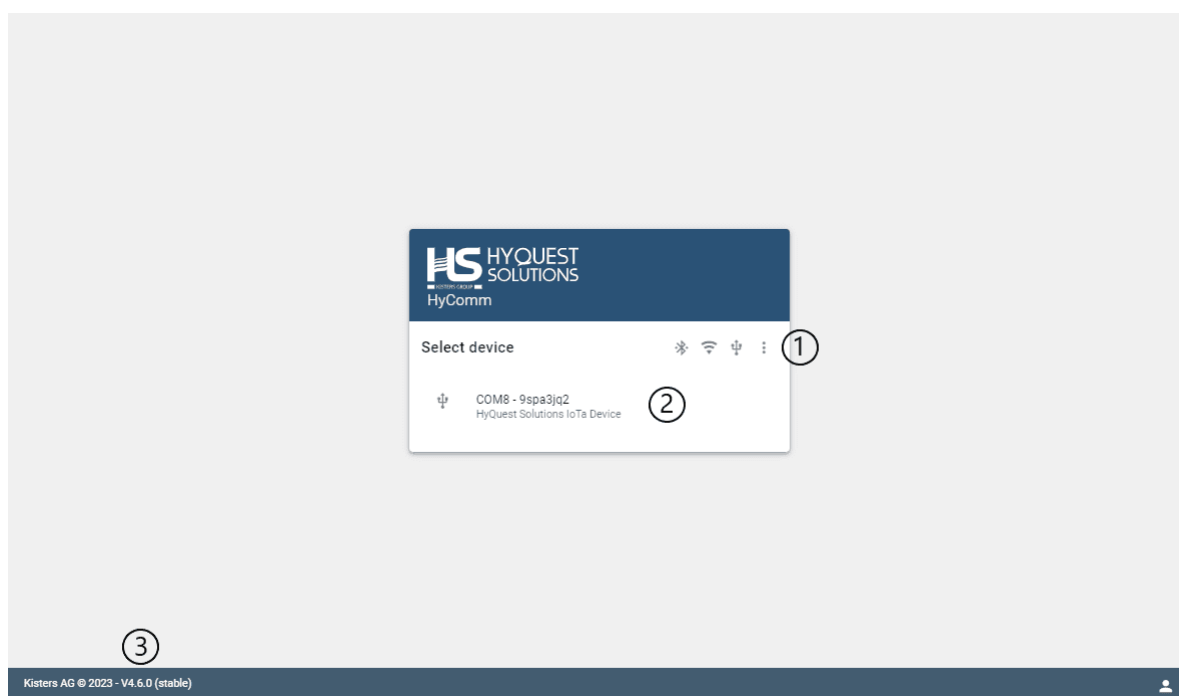
3.2.2   Connecting to the Device
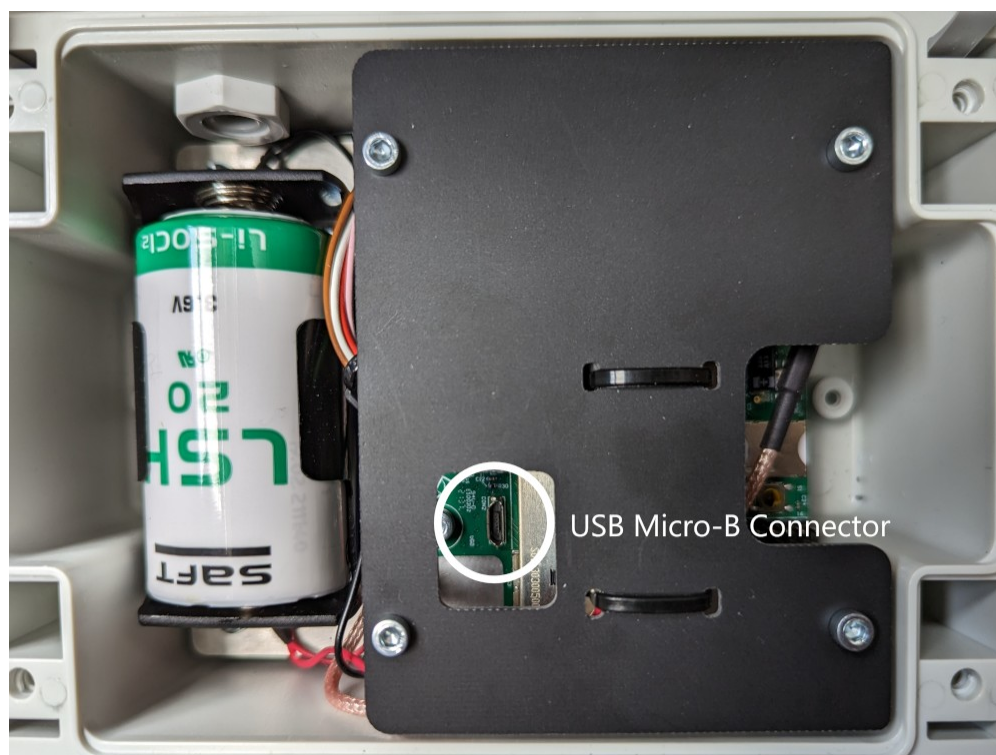
Simply run the provided Windows installer and connect the IoTa device through a USB Micro-B cable to the computer running HyComm.

Once connected, you might see a notification that your computer is updating its drivers. Once this automatic installation is complete you will be able to see the device in HyComm.

Note: While the USB cable is connected the device will be in configuration mode and will not transmit any data. Upon disconnecting the device will resume data transmission.

3.2.3   Device Selection Screen (start-up)

Note	Description
1	Buttons left to right: - Scan for Bluetooth devices - Scan for Wi-Fi devices - Scan for USB devices - Options - Device connection guide: Guide on things to check when a device is not found. - Offline configurations: Allows for the creation of configurations while not connected to any devices. - Settings: Menu to configure the automatic device configuration features of HyComm.
2	Found devices are displayed here, select one to connect to that device.
3	HyComm version info

3.2.4 Device Overview

Measurement and transmission intervals of both 30 minutes means that every 30 minutes the enabled interfaces are read out and this data is instantly transmitted.

Note	Description
1	Menu sidebar, click to access other pages.
2	Found devices are displayed here, select one to connect to that device.
3	What and when data is measured.

Note	Description
4	Info on the device's internal storage. Click on the bin to clear the internal device measurement data storage.
5	How and when data is transmitted.
6	If enabled, some upload servers can be contacted to retrieve information on the data transmissions of the device.

3.2.5   Device Measurement Testing and Visualisation
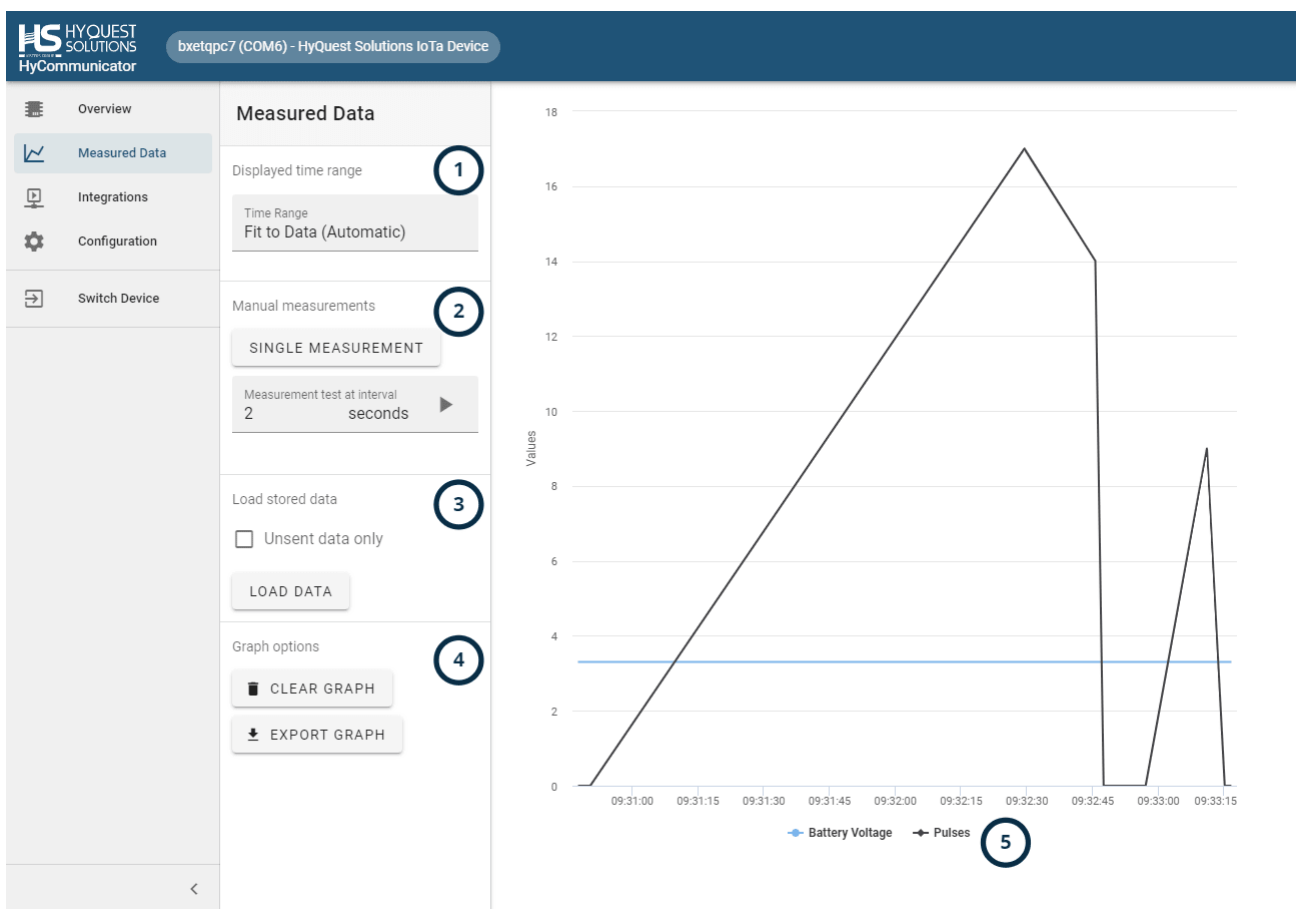
Note	Description
1	Adjust the time range displayed on the graph. Click to open a selection menu.
2	Trigger manual measurements: ▪ Single one-time measurement of all enabled interfaces. ▪ Series of measurements at specific intervals, note: this does not affect the normal measurement cycle as configured on the device.
3	Load stored data from the device. Enabling "unsent data only" will only display the values that were not transmitted yet when loading stored data.
4	Click to clear the graph. Internal data is not wiped.

Note	Description
5	Legend with the measured interfaces listed, click on a time series name to hide/show that interface's data in the graph.

3.2.6   Device Integrations

Note	Description
1	Devices can be integrated with certain platforms. In order to access these, you must be registered with the platform and have a registration key.

Supported Platforms:

- datasphere:
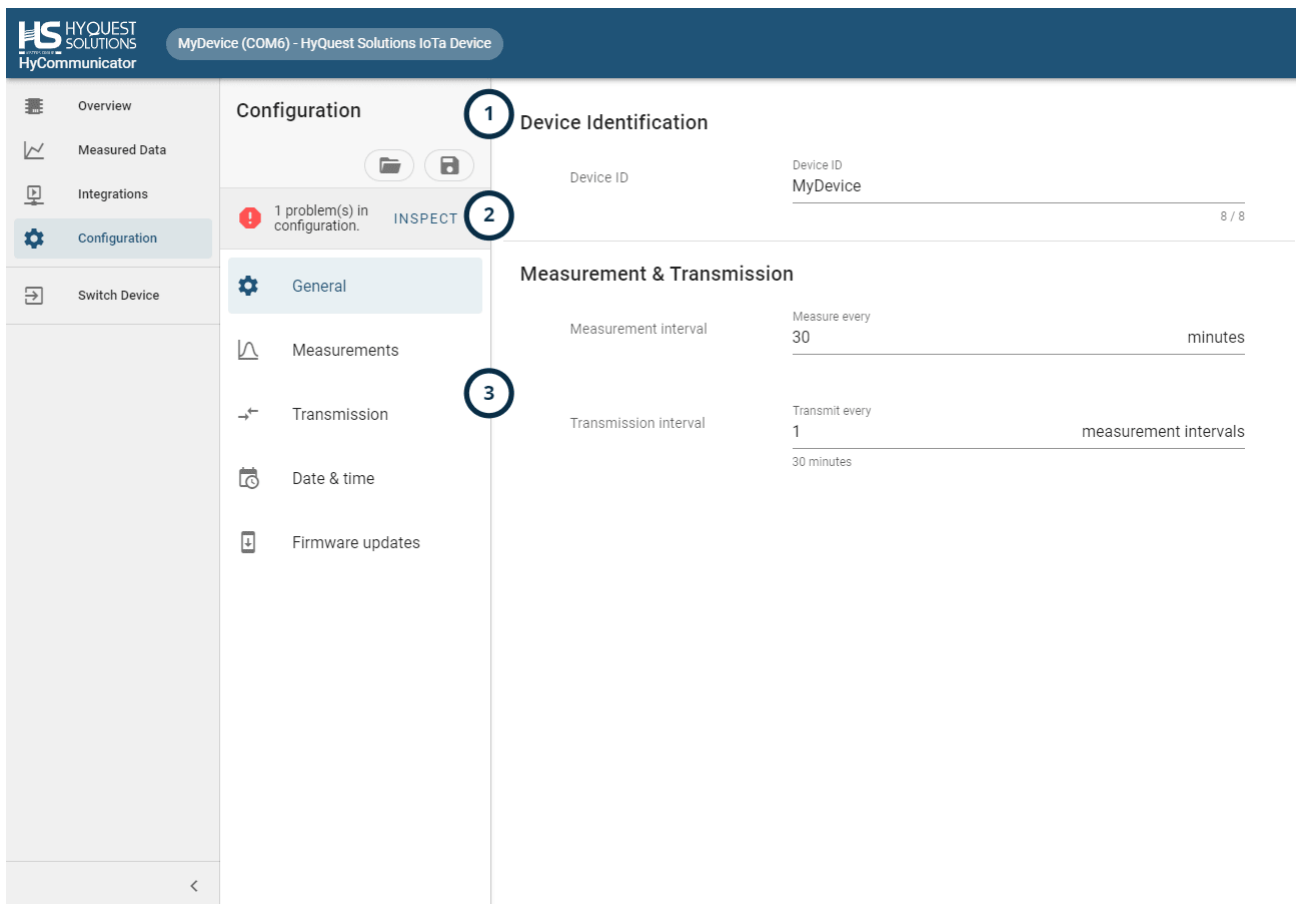 - data management system, cloud-based, operated by KISTERS. https://www.datasphere.online

3.2.7   Device Configuration

This chapter contains the following subsections:

3.2.7.1 Saving and Loading

Note	Description
1	Click on the folder button to **load** a configuration from either: ▪ The connected device ▪ A configuration file on your computer. ▪ The device type defaults (reset) Click on the **save** button to save the current configuration to either: ▪ The connected device ▪ A configuration file on your computer.
2	Inspect configuration issues automatically detected by HyComm with your configuration. See chapter Inspect Configuration Issues 19 for more information.
3	Click to access pages for various parts of the configuration.

3.2.7.2 Inspect Configuration Issues

Note	Description
1	When seeing this notification appear, the configuration you have open has one or more settings that can cause the device to not operate as you intended. Clicking on the **INSPECT** button will open a detailed dialog.
2	▪ Issues along with a brief explanation are shown here. ▪ Some issues will have a **FIX** button that can automatically edit your configuration to resolve the issue.

3.2.7.3 Configuration: General

Note	Description
1	The ID of the device, used for identifying transmissions from this device. Changing this value can cause transmission to be discarded on remote systems.
2	Configure how often the device measures and transmits data. Measurement Interval: ▪ Value given in minutes Transmission interval: ▪ Decides how many measurements are done before the device sends out its data. ▪ Value given in number of measurement intervals, below the calculated transmission interval is shown in minutes. ▪ IoTa LORA: This value must be set to 1 due to LoRa package length limits. ▪ IoTa LTE-M: This value can be increased to save power and transmit multiple stored measurements in one go.

3.2.7.4   Configuration: Measurements

Note	Description
1	Enable/Disable the SDI-12 interface.
	Having this disabled will make the device not record any SDI-12 data
2	Clicking on the magnifier will start an SDI-12 device scan. The device will automatically detect any connected SDI-12 sensors.
	▪ Once the device scan is started, and you have found all the devices you need, you can click FINISH to stop the scan and show your sensors.
	▪ Supported discovered SDI-12 sensors will allow you to perform a quick-setup. Clicking the button will open a dialog to configure the measurement:
3	Both manually and automatically (supported sensor) added SDI-12 measurements will be displayed here.
	Add SDI-12 measurements manually by clicking the + button.

Note	Description
4	Some SDI-12 sensors will require to be powered for some time before being able to perform a measurement, here the time in seconds between power-on and starting a measurement can be set.

Note	Description
1	Enable/Disable the battery interface. Having this disabled will make the device not record any battery data.
2	Enable/Disable the pulse counter interface. Having this disabled will make the device not record any pulse counter data. Every pulse on the pulse input will increase the value by 1*<factor>+<offset> Each time the device performs a measurement, the value is reset to 0.

3.2.7.5   Configuration: LoRa Transmissions

Note	Description
1	Device set to use LoRa transmission
2	LoRa device EUI, unique generated token used for registration.
3	Use OTAA (recommended) or ABP LoRa Modes.
4	App / Join EUI key for OTAA registration.
5	Application key for OTAA registration.
6	Which data rate to use, see LoRa Advanced for enabling adaptive data rates.

LoRa Advanced

LoRa port	Port: 1	1
Adaptive	☑	2
Confirmed	☐	3
Class	LoRa Class: A	4
Network Mode	Network mode: Public	5
Network ID	Network ID: 00000000	
Transmit power	Level 5	6
Retries on failure	Retry: 2 times	7
Delay window 1	RX1 Delay: 5000 milliseconds	8

Note	Description
1	LoRa port to use for uplinks. 1 is default.
2	Whether to enable adaptive data rates.
3	Whether LoRa Confirmed mode should be enabled, if set device will attempt failed transmissions up to 3 times.
4	LoRa Class, only A is supported
5	Whether device is connecting to a public network or private network. LoRa Network ID, must be 8 hex digits or empty.
6	Power level on transmissions, 5 is default.
7	How many times LoRa confirmed messages should be retried.
8	Delays for Transmission windows 1 (max. 10000 ms) and 2 (max. 12000 ms)

3.2.7.6 Configuration: LTE Transmissions

Note	Description
1	Device set to use LTE transmission.
2	Hostname/ IP and port used for data uploads.
3	How many times to attempt to retry a transmission on failing. Default: 3
4	Time out on connecting to the server, increase in case of low bandwidth due to bad network coverage.

3.2.7.7 Configuration: GSM

Note	Description
1	SIM Card APN
2	If required, username and password for SIM.
3	Restart the GSM module every set number of transmission intervals.
4	The maximum time the GSM module can be online / attempt to search for a network.

3.2.7.8   Configuration: Radio Access Technology

Note	Description
1	In this section, more advanced parts of the LTE/GSM network to use are set. Normally the preset can be left to "Automatic" to allow the device to use any network available. There are a number of presets available to quickly get started.
2	Allows setting whether LTE CAT M1 / NB IoT / GSM or both should be used.
3	Sequence in which networks are scanned. 00: Automatic 01: GSM 02: LTE Cat M1 03: NB-IoT Example: 020301 for a sequence.
4	Bands to use for LTE Cat M1/NB-IoT in hex format, examples: 15= Band 1 + Band 3 +Band 5 Any LTE-Cat M1 Band: 400A0E189F Europe LTE-Cat M1: 80084 Any LTE NB-IoT Band: A0E189F Europe NB-IoT: 80084

Note	Description
5	Allows specification of any or a specific GSM band.

3.2.7.9   Configuration: Time and Date

Note	Description
1	Current time on the device, can be changed by syncing this to the PC.
2	Enabled: Sync sends the current UTC time Disabled: Sync sends the local time.
3	IoTa LTE ONLY: Enabling this will sync the time on the device during transmissions.

3.2.7.10 Configuration: Firmware Updates

Note	Description
1	Current firmware version.
	Click the "select firmware file" button to open a dialog where you can select a new firmware file. The device will reboot once process is complete.

4 Operation

Operation of a IoTa Irrigation is straightforward.

It may help to have a basic understanding of the data communication technology used.

Note that the use of data transmission infrastructure – whether it is a provider-supplied network or a shared public network may be subject to both technical and regulatory restrictions. Please keep yourself about these rules to ensure proper operation of the devices.

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- Connecting the Rain Gauge 31
- Connecting an Antenna 31
- Data Transmission 32

4.1 Power Supply

The front lid must be opened to access the battery in the battery holder.

IoTa Irrigation is a battery-powered device.

The battery is help in a battery holder suitable for C-cell battery formats.

Inserting a sufficiently charged battery will start the device.

The batteries typically used in a IoTa Irrigation are not rechargeable. No provisions are made in the device to recharge batteries.

Warning:
- A power supply connected in reverse can destroy the device.
- A power supply with a voltage greater than 3.8V can destroy the device.

The device is designed to operate with a 3.6 V Lithium Thionyl Chloride (LiSOCL2) battery.

For proper operation in all conditions, the battery voltage should be > 3.25 V

- Below 3.25 V, GSM communication cannot operate reliably.
- Below 3.00 V, the device and USB communication cannot operate.

Access to the Battery Compartment

- Open the TB7/0.2 rain gauge housing with the allen key provided in the box.
  Inside you will see the IoTa LoRa, each corner of the front panel has a screw which has to be removed in order to access the internal components of the device (RED).
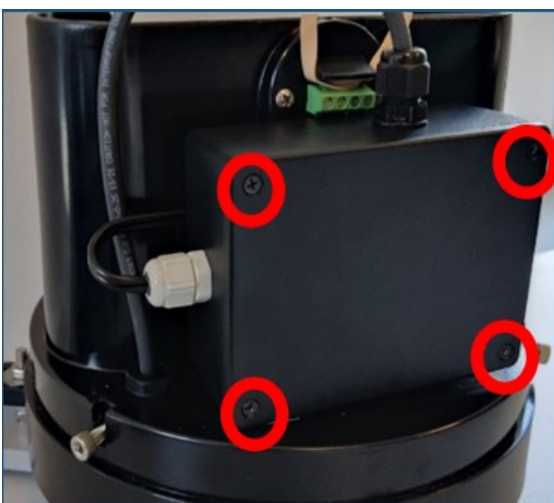
- Once the panel is removed, insert the battery connector into the appriopiate socket (RED).
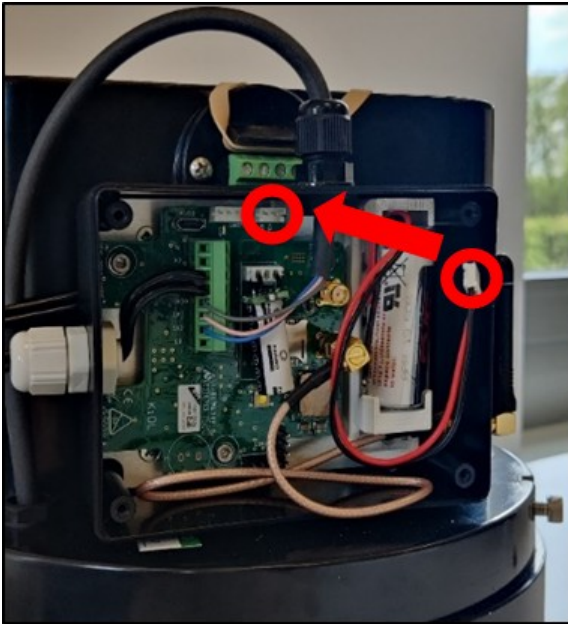
Depending on the power level of the device's internal capacitor, the device could take around 0 - 20 minutes to become fully operational. Having the USB-cable connected during this time will prolong / interrupt this process.
Once the initial charging is complete the device will automatically start.

4.2   Connecting the Soil Moisture Sensor (SDI-12)

Piggy-tail M12 8-pin connector protruding out of the base of the TB7 rain gauge. Fitting female connector installed on the end of the cable of the soil moisture sensor.

On LoRa systems, due to the limited payload per message, it makes no sense to connect additional sensors to the SDI-12 bus.

For LTE-M systems, a Y-connector is optionally available, effectively enabling the user to add a second SDI-12 sensor.

- 8CON (SDI12; 2xAnalog)

Pin #	Colour		Signal
1	White		SDI-12 12V
2	Brown		N/A
3	Green		SDI-12 GND
4	Yellow		SDI-12 DATA
5	Grey		GND
6	Pink		Analog in 1
7	Blue		GND
8	Red		Analog in 2

Figure 1 – Pin-Out of the M12 8-pin Connector

4.3   Connecting the Rain Gauge

The reed switch of the tipping bucket mechanism of the rain gauge is wired to the proper input of the integrated IoTa sensor node.

4.4   Connecting an Antenna

A suitable internal stubby antenna is connected to the proper SMA port of the integrated IoTa sensor node.

4.5   Data Transmission

This chapter contains the following subsections:

- LoRa 32
- LTE-M 32

4.5.1   LoRa

Network Coverage: Check network coverage for LoRa/LoRaWAN at the monitoring site.

The maximum number of values transmitted per message is 8.

These 8 values can be obtained from a single multi-parameter SDI-12 sensor. They may also be the sum of up to 7 SDI-12 values plus the counter value. In any case, the total number may never exceed 8.

4.5.2   LTE-M

Network Coverage: Check network coverage for LTE-M at the monitoring site.

5 Maintenance

Overall maintenance consists of periodically checking the integrity of the system. The better the state of the instruments, the more reliable their operation and the better the measured data.

- Sensor Node [33]
- Rain Gauge TB7 [33]
- Soil Moisture Sensor [35]

5.1 Sensor Node

- Clean the IoTa Sensor Node by wiping with light cleaning solution and a soft cloth.
- Replace battery as needed.

5.2 Rain Gauge TB7

The only routine maintenance required is cleaning. The following items should be checked regularly for cleanliness:

- Catch filter
- Straight through Nozzle (refer diagram 5)
- Interior of bucket
- Top surface of adjusting screws
- Enclosure locking screws - lightly lubricate after cleaning
- All insect screens

For more information see the following chapters:

- Dismantle Details [33]
- Assembly Details [35]

5.2.1 Dismantle Details

(a) Push filter in and pull straight through Nozzle out

(b) Clean filter

(c) Clean straight through nozzle

To dismantle the Filter & Nozzle assembly. Push filter and pull nozzle at the same time. Do not twist.

Do not twist while pushing & pulling
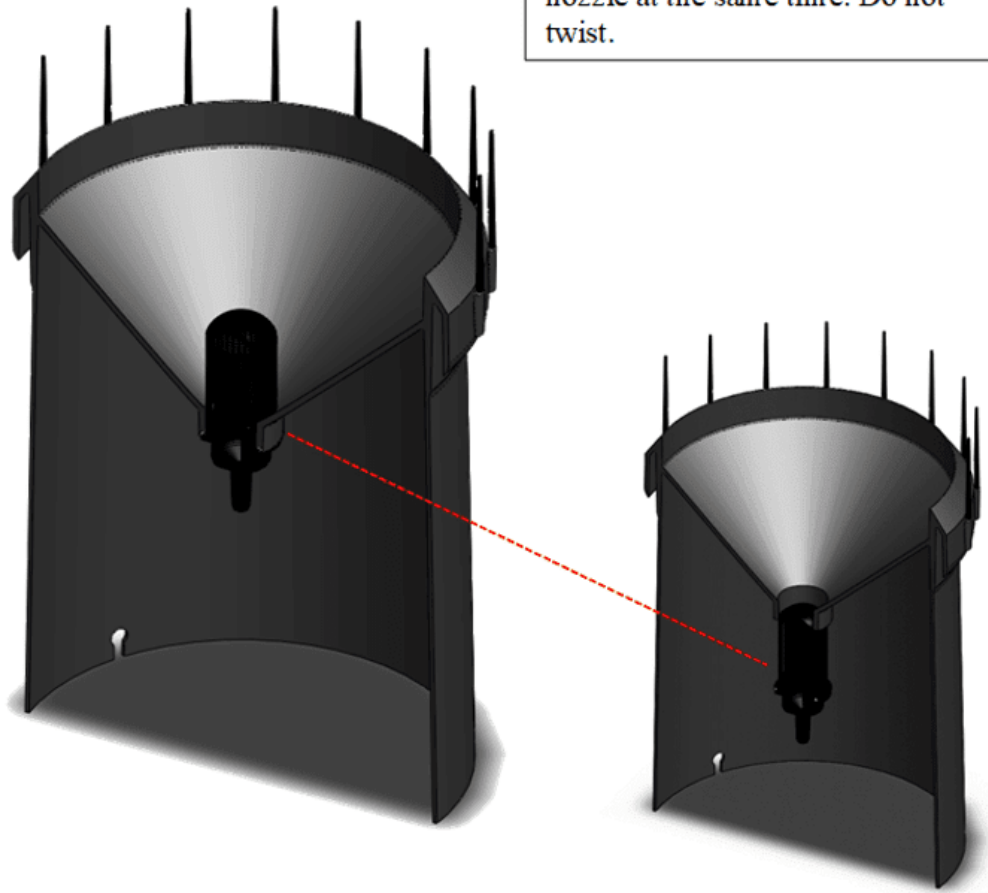
5.2.2   Assembly Details

(a) Assemble filter to straight through Nozzle body

(b) Push assembly into funnel

To re-assemble push the filter/Nozzle assembly back in place. **Do not twist**
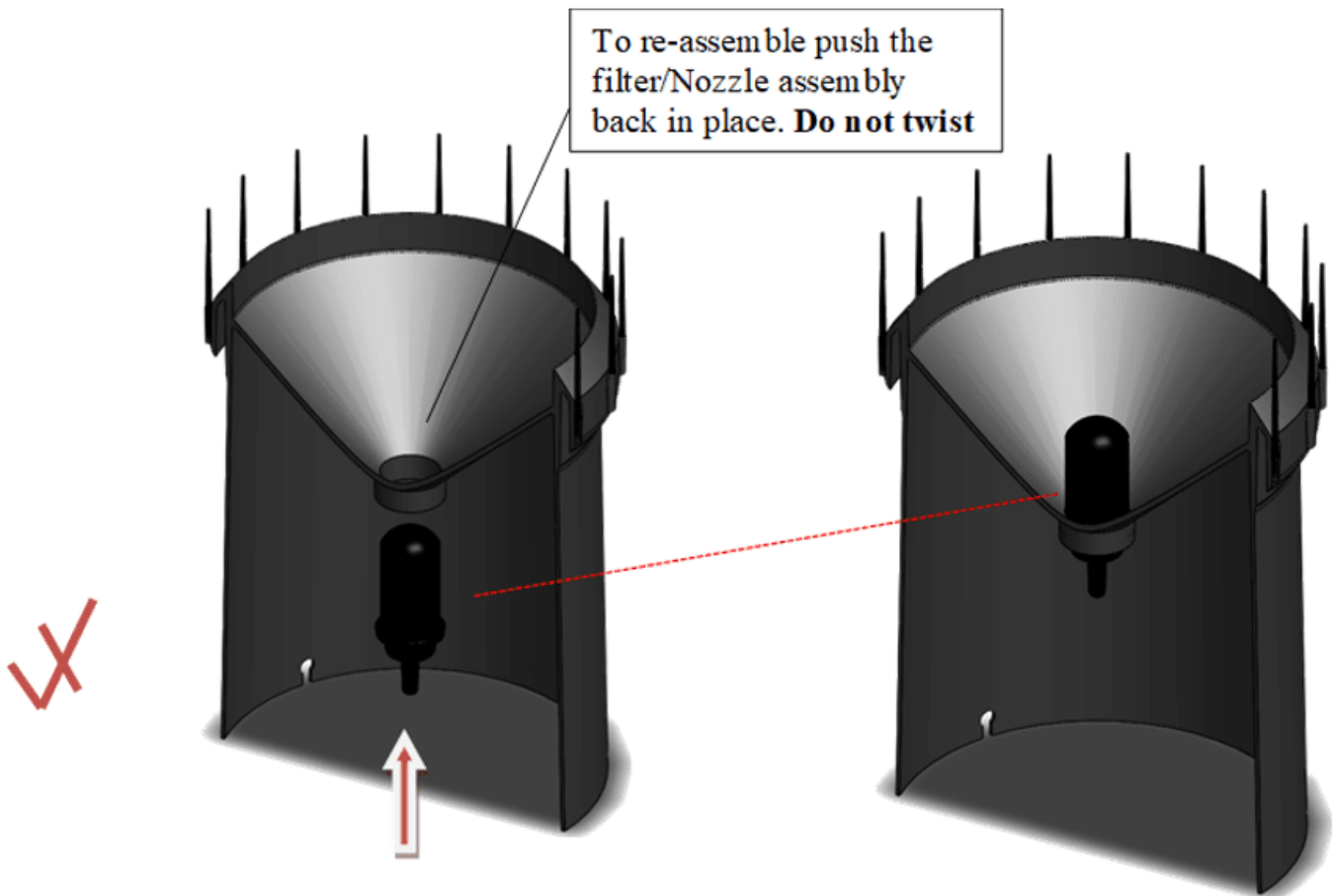
5.3   Soil Moisture Sensor

The soil moisture sensor once installed does not require any maintenance as long as it remains in the soil. It recommended to proceed to cleaning right away when extracting sensors and prior to either storing them or installing them at a new site.

6 Troubleshooting

This chapter contains the following subsections:

- No Rain Recorded 36
- IoTa - Device Stops Operating 36
- IoTa - Device Stops Transmitting Data 36

6.1 No Rain Recorded

Check and clean the TB7 rain gauge. Typical issues are:

- Collected debris in the funnel lead to clogging.
- Filter holes clogged (accumulation of dust and moisture for instance)

If the device exteriors are clean, open the lid and inspect the mechanical parts of the tipping bucket.

- Tip the bucket with your fingers: does it move freely? Does the movement require excessive force?
- Clean the bucket.
- Listen to the click of the reed switch.

6.2 IoTa – Device Stops Operating

Test the voltage of the inserted battery. A simple method for checking your battery's voltage involves using a voltmeter, which measures the electrical potential difference between two points in an electric circuit, i.e. the voltage. We recommend you opt for a digital voltmeter as they are much easier to use.

1. Extract the battery from the battery holder.
2. Check the terminals on both ends for corrosion and clean it off if necessary.
3. Put the positive lead on the batteries positive pole and the negative lead on the negative pole. Positive (+) and negative (-) poles are indicated on the battery.
4. Check the voltmeter readings: make sure the voltage ranges specified in Power Supply 30 are respected.
5. Insert a new battery if the voltage is outside the specified range.
6. Caution: the battery voltage may drop once a load is put on the battery. Only qualified technicians should make a battery voltage test when the battery is under load.

6.3 IoTa – Device Stops Transmitting Data

Main causes are loss of connectivity to the transmission network either due to a change made by the provider in its infrastructure, a faulty or defective or missing antenna, an obstacle acting as a shield to the electromagnetic signals, false or changed communication settings in the device. Proceed by checking the simple things first: antenna condition, shielding, etc. Try a system restart: extract and re-insert the battery (wait approximately 15 - 20 seconds before re-inserting the battery). For LTE-M systems, it may be worthwhile to have the data SIM checked – typically these SIMs have limited capacity and stop working once the limit has been exceeded. a Next check the communication settings. Finally get in touch with the network infrastructure provider.

7 Repair

KISTERS precision instruments and data loggers are produced in quality-controlled processes. All KISTERS production and assembly sites in Australia, New Zealand and Europe are ISO 90001 certified. All equipment is factory tested and/or factory calibrated before it is shipped to the client. This ensures that KISTERS products perform to their fullest capacity when delivered.

Despite KISTERS most rigorous quality assurance (QA), malfunction may occur within or outside of the warranty period. In rare cases, a product may not be delivered in accordance with your order.

In such cases KISTERS' return and repair policy applies. For you as a customer, this means the following:

- Contact KISTERS using the Repair Request Form and the Declaration of Contamination made available online:

Region (Language)	Download Link
Asia–Pacific (English)	Repair Request Form (APAC) Declaration of Contamination (APAC)
Europe, the Middle East and Africa (English)	Repair Request Form (EMEA) Declaration of Contamination (EMEA)
Germany (German)	Repair Request Form (DE) Declaration of Contamination (DE)

In response you will receive a reference number that must be referenced on all further correspondence and on the freight documents accompanying your return shipment.
- Please provide as much information and/or clear instructions within the return paperwork. This will assist our test engineers with their diagnosis.
- Please do not ship the goods prior to obtaining the reference number. KISTERS will not reject any equipment that arrives without reference number; however, it may take us longer to process.

Custom requirements for items sent to KISTERS for warranty or non-warranty repairs: Check with your national customs/tax authorities for details, processes and paperwork regarding tax exempt return of products. Typically, special custom tariff codes are available (such as HS Code = 9802.00) that verify the item is being returned for repair and has no commercial value. Please note that the customs invoice / dispatch documents should also clearly state: "Goods being returned to manufacturer for repair – No Commercial value". It is mandatory to have any returned goods accompanied by a commercial invoice on headed paper. KISTERS reserves the right to charge the customer for time spent rectifying incorrect customs documents.

Note: Please ensure that your goods are packed carefully and securely. Damage that occurs during transit is not covered by our warranty and may be chargeable.

8 Technical Data

This chapter contains the following subsections:

8.1 TB7 Rain Gauge

Resolution	0.2 mm	
Range	700 mm per hour	
Accuracy	Flow rate 0 - 200 mm/hr	±5 %
Enclosure and Base	UV-resistant ASA	
Pivots	Ground sapphire pivots	
Bucket	Teflon impregnated injection moulded	
Dimensions	Height: 310 mm	
	Catch: 200 mm diameter	
Mass	2.1 kg	

8.2 Soil Moisture Sensor

LoRa + LTE-M				
Model	Moisture	Temp	Sensing	Length (cm)
EP100GL-04	●	●	4	46.5
EP100GL-08	●	●	8	86.5

Diameter:	33.5 mm ±0.2 mm
Field of Influence:	55 mm from wall of probe
Moisture resolution:	0.01 %
Temperature resolution:	0.01 °C
Moisture accuracy:	±2 % @ 0 % VWC to 50 % VWC (*with respect to dielectric)

8.3 IoTa

Inputs	SDI-12: max. 8 devices or parameters; max. power drain: 50 mA@12 VDC via external M12 8-pin connector Counter/Pulse: pull to GND; max.: 200 Hz; pulse width > 1 ms via external M12 4-pin connector
Data Transmission	IoTa LTE-M: 4G LTE-M – requires Nano SIM (frequency plans available on demand) IoTa LoRa: LoRaWAN External SMA antenna connector
Local Communication	USB accessible via internal Micro-B port for data downloads, configuration and firmware upgrades
Memory	8 MB data flash
Real-Time Clock	Precision: 3 ppm
Housing	ASA LURAN UV IP 66/EN 60529 / IP 67/EN 60529 Dimension (L × W × H): 160 × 110 × 70 mm
Supply Power	3.6 … 3.7 VDC, 1 × D-size LiSOCL2 Lithium Battery (non-rechargeable), ~17000 mAh capacity
Operating Temperature	-10 °C … +50 °C
Ingress Protection	IP67
Compliance	CE, RoHS, WEEE pending

9 Obligations of the Operator and Disposal

This chapter contains the following subsections:

9.1 Obligations of the Operator

European Union

In the Single European Market it is the responsibility of the operator to ensure that the following legal regulations are observed and complied with: national implementation of the framework directive (89/391/EEC) and the associated individual directives, in particular 2009/104/EC, on minimum safety and health requirements for the use of work equipment by employees at work.

Worldwide

Regulations: If and where required, operating licences must be obtained by the operator. In addition, national or regional environmental protection requirements must be complied with, regardless of local legal provisions regarding the following topics:

- Occupational safety
- Product disposal

Connections: Local regulations for electrical installation and connections must be observed.

9.2 Dismantling / Disposal

When disposing of the units and their accessories, the applicable local regulations regarding environment, disposal and occupational safety must be observed.

Before dismantling

- Electrical Devices:
  - Switch off the units.
  - Disconnect electrical appliances from the power supply, regardless of whether the appliances are connected to the mains or to another power source.
- Mechanical devices:
  - Fix all loose components. Prevent the device from moving independently or unintentionally.
  - Loosen mechanical fastenings: Please note that appliances can be heavy and that loosening the fastenings may cause them to become mechanically unstable.

Disposal

Operators of old appliances must recycle them separately from unsorted municipal waste. This applies in particular to electrical waste and old electronic equipment.

Electrical waste and electronic equipment must not be disposed of as household waste!

Instead, these old appliances must be collected separately and disposed of via the local collection and return systems.

Integrated or provided batteries and accumulators must be separated from the appliances and disposed of at the designated

collection point. At the end of its service life, the lithium-ion battery must be disposed of according to legal provisions.

EU WEEE Directive

As players in the environmental market, KISTERS AG is committed to supporting efforts to avoid and recycle waste. Please consider:

- Avoidance before recycling!

- Recycling before disposal!

This symbol ▰ indicates that the scrapping of the unit must be carried out in accordance with Directive 2012/19/EU. Please observe the local implementation of the directive and any accompanying or supplementary laws and regulations.

10 Appendices

This chapter contains the following subsections:

10.1 Precipitation Gauge Site Selection

Rainfall measurements are intended to be representative of the actual rain falling on a given area. Some of the more important factors which influence the representativeness of a gauge are as follows:

- Place the gauge on level ground where possible. Avoid sloping sites.
- Site should have adequate protection from strong winds.
- Site should be free of large obstructions such as buildings and trees.
- Provide suitable ground surface to avoid splashing into the gauge.

Soil moisture measurements are intended to be representative of the actual moisture retention capacity of the paddock. The pursued goal is to build a thorough picture of soil moisture. The collected data then helps in finetuning irrigation timings to ensure maximum water-use efficiency and crop production.

- Locate probes in an area of the paddock that represents the most uniform soil type
- Locate probes in an area known to produce consistently average yields
- The probe should be placed radius of the crop intended to be monitored
- Keep the probe and the entire monitoring installation out of the pathways of tractors.

10.2 Soil Moisture Probes – Background Info

This chapter contains the following subsections:

10.2.1 Do EnviroPro® Probes Work in All Soil Types?

Yes. However, for maximum accuracy (eg. for scientists or researchers) soil probes should be calibrated to soil type on site at the time of installation. Soil type calibration is different to our factory calibration which is to ensure life-time sensor-to-sensor and probe-to-probe repeatability, which is of highest importance in all applications. Ultimately, the daily water usage of the crop is a clear indicator to assist farmers in making optimal irrigation decisions, even without additional soil type calibration.

10.2.2 How Many Soil Probes Do I Need?

This depends on a large variety of factors, so there is no single answer for all cases. The purpose of your soil monitoring system and therefore your accuracy requirements, as well as site-specific characteristics such as soil types, topography and weather factors, all influence the number of soil probes required. The best way to know how many sensors you require is to consult your agronomist or telemetry provider.

10.2.3 What Is the Expected Life of an EnviroPro® Soil Probe?

EnviroPro® soil probes are fully encapsulated, providing long term stability and immunity to environmental damage and aging. They are manufactured to the highest standards and are designed with accuracy, repeatability and long-term durability being paramount. They carry an un-paralleled 5-year warranty against defect or failure and should be expected to last many, many years beyond that.

10.2.4   What Is the Field of Influence?

The field of influence refers to the size of the electric field emitted by a sensor, and ultimately determines the volume of soil that it can measure. EnviroPro® boasts a larger FOI than competitor probes of similar diameter due to its unique sensor design. A larger FOI means a greater sample size, minimizing the effect that slurry, objects, roots and air pockets have on readings and producing more meaningful measurements of the local soil.
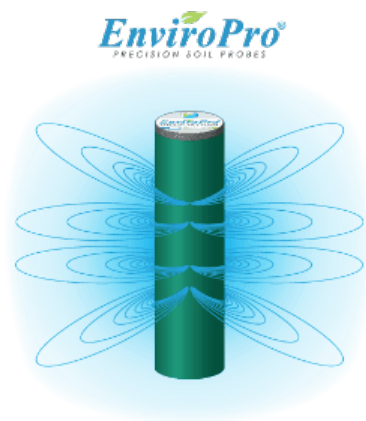
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