AUTOMATED ENVIRONMENTAL MONITORING NETWORKS

User Manual

# Temperature String

*Digital temperature profiling · bus system · up to 48 nodes*

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# Table of Contents

# I Disclaimer

The information contained in this manual reflected the state of the art at the time of publication. Subsequent updates remain possible. This manual does not cover every detail of construction, production or product variants and does not address every situation that can arise during installation, operation or maintenance.

TerraTransfer GmbH shall not be liable for incidental, indirect, special or consequential damages arising from or connected with this documentation and the information contained herein — even if TerraTransfer has been advised of the possibility of such damages.

# II General safety notes

Read this user manual including all operating instructions in full before installing, connecting or commissioning the Temperature String. The manual describes the intended operation of the product and is addressed to qualified specialist personnel familiar with installation, mounting, wiring, commissioning and operation, and trained accordingly.

Inspect all components for external integrity (cable, nodes, connectors) before each deployment. The product must not be used if visible damage is present.

> **Note:** The Temperature String is part of a measurement system consisting of logger, sensors and software. Read the manual of the connected Aquatos data logger as well.

# III Specific safety notes

## III.1 Working on or over water

> **Warning:** Deploying the string in basins, boreholes, lakes or reservoirs entails a risk of falling and drowning. Wear a life jacket or fall-arrest harness and never work alone.

Secure the upper end of the cable against slipping. Use weights or a suitable shaft fixture so the string cannot drop into the structure.

## III.2 Mechanical cable loads

The string can carry a tensile load of up to 30 kg. Lift and hold the string only by the upper, cable-side end — never lift it by an individual node.

> **Warning:** Routing the string over sharp edges or through tight conduits can damage the PUR jacket. Use cable conduits or edge protection at transitions.

## III.3 Aggressive media

The PUR jacket and the stainless-steel nodes are resistant to most water types found in environmental monitoring (fresh water, brackish water, mildly aggressive seepage and waste water). For strongly acidic, alkaline or solvent-bearing media, clarify suitability with TerraTransfer before continuous deployment.

## III.4 Bus connection at the logger

Wire the string to the Aquatos data logger only when the logger is de-energised. Disconnect the logger's power supply (remove battery or switch off) and check the polarity of the three conductors before connecting.

# 1 Scope of delivery

The Temperature String is custom-built. The delivery includes:

- Temperature string in the ordered configuration (number of nodes, node spacing, total length)
- Logger-side termination: M8 plug or factory-fitted bare conductors, depending on order
- Factory test report listing node addresses and node positions

## 1.1 Optional accessories

- Floats and weights for free deployment in basins and standing water
- Mast and borehole adapters for fixing in stilling wells
- Cable conduits for transitions and riser sections
- Extension cables to the logger (3-conductor, factory-fitted)

# 2 Introduction

## 2.1 Intended use

The TerraTransfer Temperature String is designed for continuous temperature profile measurement in water, soil, ice and structures. It is engineered as sensor peripheral for an Aquatos data logger and provides digital readings via a 2-wire bus. Application areas include lakes, reservoirs, treatment basins, soil and substrate measurements, and structural monitoring.

## 2.2 String construction

The string consists of a PUR bus cable with over-moulded stainless-steel sensor nodes (TNode). Each node contains a digital semiconductor temperature sensor and communicates with the logger via a 2-wire bus. Calibration data is stored in the node itself.

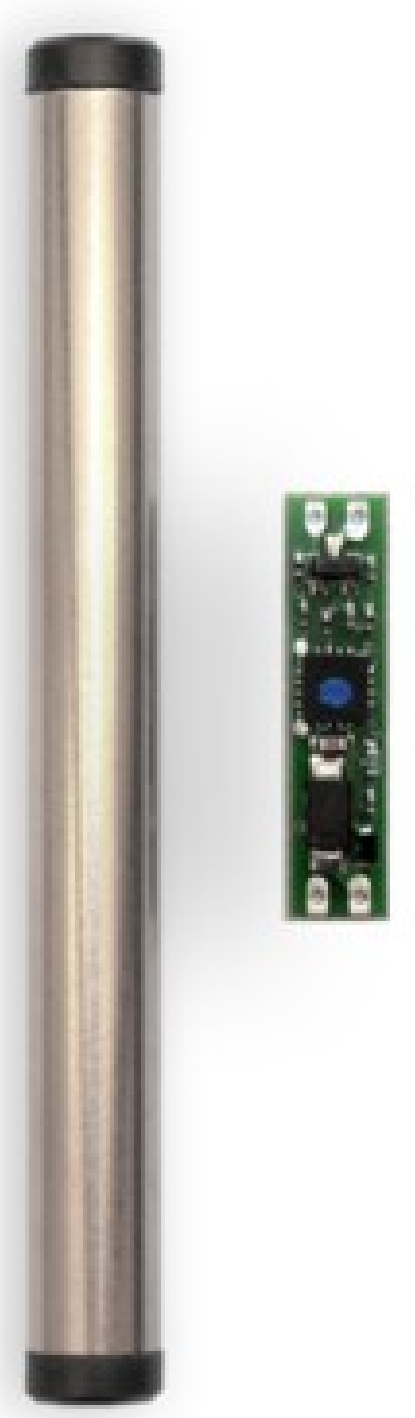

*Figure 1: Construction of a sensor node — stainless-steel housing and integrated sensor electronics.*

The nodes have a cylindrical stainless-steel housing (Ø 8 mm, length 80 mm) and are integrated into the PUR cable jacket (fully potted, IP69). Minimum spacing between nodes is 15 cm; the first two nodes at the logger side may be placed as close as 10 cm apart.

# 3 Installation

## 3.1 Pre-deployment check

Before each deployment, verify:

1. Completeness of delivery against the test report.
2. PUR jacket for nicks, cracks or pinching.
3. Nodes for mechanical damage to the stainless-steel housing.
4. Logger-side termination (M8 or bare conductors) for cleanliness.

## 3.2 Mechanical deployment

The string can be deployed in different ways:

- Free hanging in basins or wells — fixed at the top, weighted at the bottom
- Guided in a stilling well — centred via a borehole adapter
- Mounted on a mast or rope — fastened with cable ties or clamps
- Embedded in soil or concrete — as a static profile

> **Warning:** Nodes must not be loaded directly by cable ties or clamps. Fasten the string only to the cable jacket between nodes.

## 3.3 Wiring to the Aquatos logger

The string is wired to the SDI-12 input of the Aquatos Web LTX. The three conductors follow the TerraTransfer colour code:

> **Note:** The Aquatos logger powers the bus nodes directly with 3.3 V. The SDI-12 terminal on the logger is used as the wiring point only; the actual on-cable bus protocol is a TerraTransfer-specific 2-wire bus. An external SDI-12 supply voltage is not required and must not be applied.

| Conductor | Function |
|---|---|
| **White** | VCC (supply) |
| **Green** | Data (SDI-12 / bus) |
| **Yellow** | GND (reference) |

> **Warning:** Connect the string only when the logger is de-energised. Reversed polarity can destroy the bus driver inside a node.

If the string is delivered with an M8 plug, plug it directly into the SDI-12 socket on the logger. With bare conductors, insert them into the Wago terminals on the logger.

## 3.4 First commissioning

1. Power up the logger or insert batteries.
2. Connect the logger via Bluetooth using the Bluetooth app (Chrome or Edge, Web Bluetooth).
3. Scan the SDI-12 bus — the nodes of the string are detected with their factory addresses.
4. Set the measuring interval and channel labels.
5. Trigger a test measurement and check the profile curve for plausibility.

> **Note:** Node addresses and positions are documented in the supplied test report. Keep the report for future maintenance work.

# 4 Configuration

## 4.1 Register nodes in the Bluetooth app

Configuration is done via the Bluetooth app of the Aquatos logger. The app is a browser-based Web Bluetooth application; no installation is required. Chrome and Edge on desktop and Android are supported, as is the Bluefy browser on iOS.

After connecting to the logger, the SDI-12 scan is available. The string reports all nodes with their factory-assigned addresses — typically running consecutively from address 0.

## 4.2 Order and labelling

Each node can be assigned a logical label — typically the depth or height (for example "T-0.5 m", "T-1.0 m"). The order follows the physical layout of the string and is documented in the supplied test report.

## 4.3 Measuring interval and channels

The measuring interval is configured in the logger and applies to all connected nodes jointly. Typical values:

- Standing-water profile: 15 or 30 minutes
- Reservoir and climate context: 60 minutes
- Permafrost and soil: 1, 4 or 12 hours

> **Note:** Shorter intervals increase the energy consumption of the logger. The nodes themselves are very low-power (standby 0.75 µA); the combined bus pulses of all nodes dominate the power budget.

# 5 Operation

## 5.1 Readings in the Sensormanager portal

The data path is two-tier: the Bluetooth app (chapter 4) is used solely for on-site configuration and diagnostics, while the Sensormanager web portal is the central data platform for readings, profile analysis and alarming.

The Aquatos Web LTX uploads readings automatically to the Sensormanager web portal, where they are available as profile views, time-series plots and CSV export. Thresholds and alarms can be defined per node or as a gradient between nodes.

## 5.2 Plausibility and profile diagnostics

In every cycle all nodes of the string are queried in one pass. Plausibility hints:

- Outliers on individual nodes usually indicate a local bus contact issue (corrosion at the cable end, loose terminal).
- A sharp temperature step in the profile may stem from real water-column stratification — physically correct.
- A uniform offset across all nodes points to a supply voltage problem — check the logger's battery.

# 6 Maintenance

## 6.1 Cleaning the nodes

Permanent deployment in water leads to algae, biofilm or sediment build-up on the nodes. This slows the temperature response but does not invalidate the measurement.

The string has no delicate sensing membrane and can be cleaned with common household tools. Cleaning:

1. Lift the string and rinse with clean water — a normal water jet or high-pressure washer is also safe.
2. Remove deposits with a brush or sponge; for heavier crusts a wire brush may also be used.
3. Loosen stubborn crusts with a household cleaner, then rinse with clean water.

> **Note:** Solvent-based cleaners (acetone, thinners) should be avoided as they may attack the PUR jacket over time. The stainless-steel housing and the cable itself are mechanically robust.

## 6.2 Cable and connector check

At every maintenance visit, inspect:

- Logger-side connector for cleanliness and firm seating
- Riser section of the cable for chafing
- Fixings for corrosion or loosening

> **Note:** Field calibration of nodes is not foreseen. The individually stored factory calibration remains valid for the entire service life.

# 7 Troubleshooting

| Symptom | Possible cause · remedy |
|---|---|
| **Bus scan finds no nodes** | Check wiring (white/green/yellow), restart logger, verify M8 plug seating |
| **Bus order does not match test report** | Repeat the bus scan in the Bluetooth app; compare the factory address list with the physical node arrangement |
| **All nodes report −127 °C** | No bus data — cable break, reversed polarity (white/yellow) or interrupted supply. Reversed polarity may also lead to total failure depending on the logger's protection circuit |
| **Single node value frozen** | Node no longer contacted; deactivate node in the Bluetooth app and arrange repair |
| **Large offset on all nodes** | Logger supply voltage too low — check and replace logger batteries |
| **Very slow response** | Deposits on nodes — clean per chapter 6.1 |

# 8 Repair and return

Repair of the string is only possible at the manufacturer. The fully potted construction does not allow individual node replacement in the field.

In case of repair:

1. Contact TerraTransfer and request an RMA number.
2. Clean the string and ship it dry in its original packaging.
3. Enclose the test report and a brief fault description.

# 9 Technical data

## 9.1 Mechanics

| | |
|---|---|
| **Node dimensions** | Ø 8 mm · length 80 mm |
| **Node material** | Stainless steel 1.4571 · 0.1 mm wall |
| **Cable** | PUR · Ø 4.2 mm · UV-resistant |
| **Tensile load** | up to 30 kg |
| **Min. spacing** | ≥ 15 cm between nodes · first two nodes from 10 cm |
| **Termination** | M8 plug (IP67) or factory-fitted conductors |

## 9.2 Electrical and bus

| | |
|---|---|
| **Bus** | 2-wire bus · digital data transfer |
| **Nodes per string** | up to 48 |
| **Cable length** | up to 250 m |
| **Supply voltage** | 3.0 V – 3.8 V (powered by the logger) |
| **Standby current** | 0.75 µA per node |
| **Measurement current** | 2.5 mA per node for approx. 500 ms |

## 9.3 Measurement performance

| | |
|---|---|
| **Sensing principle** | Digital semiconductor temperature sensor · individually calibrated |
| **Range** | −40 °C to +85 °C |
| **Resolution** | 0.01 °C |
| **Accuracy** | ±0.1 °C from −5 °C to +50 °C · ±0.5 °C across full range |

## 9.4 Environmental conditions

| | |
|---|---|
| **Ingress protection** | IP69 · fully potted · permanently submersible |
| **Operating temperature** | −40 °C to +85 °C |
| **Conformity** | CE · RoHS-compliant |

# 10 Operator obligations and disposal

The operator ensures that the string is installed, operated and maintained only by qualified specialists. Damaged components must be replaced or returned for repair without delay.

Under the EU WEEE Directive (2012/19/EU), used equipment must be disposed of separately from household waste. Return used equipment to municipal collection points or to TerraTransfer for proper disposal.

# Contact and imprint

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