Water Safety Monitoring System

NERO

USER AND INSTALLATION GUIDE

Enabling businesses to meet all the HSE Compliance requirements needed to ensure a safe and healthy water supply.

Contents

> **“Alpha Micro’s NERO remote water safety monitor, enables businesses to meet all the HSE Compliance requirements needed to ensure a safe and healthy water supply.”**

1 Foreword

It is intended that qualified staff will fit these units.

It is the purchaser's responsibility to ensure that anyone engaged in this work is suitably qualified, equipped and has read the user manual.

2 Description

Nero is a remote battery powered temperature sensing and reporting device that is capable of monitoring up to 4 points simultaneously and is accurate to 1% +/- 5 degrees C.

It is capable of unattended operation for extended periods of time

The standard control box is supplied with 2 sensors and for ease of installation, is preconfigured at the factory to operate on either LoRa via Boston Networks, TTN or alternative or configured for SigFox.

It is important that the preferred network operator is specified at the time of ordering the Nero devices before they arrive to site so that devices can be correctly configured.

Nero is designed to work with the Neptune Legionella Application supplied by M2M Cloud Ltd. The device requires an account with Neptune in order for it record data and report correctly.

3 Basic Checklist

- Coverage for required wireless technology e.g. LoRa or Sigfox coverage
- The Nero unit is the correct wireless technology for your deployment. e.g. LoRa or Sigfox
- You have the correct size pipe clips and sensors

4 Nero Installation

A. VERIFY WIRELESS CONNECTION

Coverage for the wireless technology required for the particular installation should be considered and/or established before the installation. For Nero to send a signal a sensor must be connected.

Induce a Transmission

To verify coverage the following actions will cause an instant transmission. Note that Nero refreshes its inputs every 10 seconds so for any change to be detected this needs to be observed.

- Insert a sensor.
- Change the number of sensors connected.
- If there is a free connection swap a sensor to that connection.

Alternatively, if configured for LoRa and a sensor is detected wait for 24 hours (default) and Nero will verify gateway connection automatically if the wireless connection is to be LoRa.

The LED will flash green if Nero has successfully connected to a gateway and red if not, currently if the configuration is Sigfox then the LED will always flash green if a sensor is detected.

Refer to Table 2 LED Status for LED meaning.

Refer to Figure 4 Transmit Logic for a full overview of the transmit logic.

Reason	Description (Gateways and OTAR [Over The Air Register], OTAF [Over The Air Flash] and OTAP [Over The Air Programming] refer to LoRa)	ID
Normal/Sample counter	Normal packet that is transmitted every 15 minutes (default).	0
Start up	When power is first applied or when sensor is first detected in from having 0, instant transmit, Gateway verify, request OTAP OTAR OTAF.	1
Sensor Number Change	Sensor number has changed, instant transmit, Gateway verify, request OTAP OTAR OTAF.	2
All sensors removed	Sensors have all been unplugged, instant transmit, Gateway verify, request OTAP OTAR OTAF.	3
Keep alive	Routinely verify LoRa gateway when transmit threshold met, request OTAP OTAR OTAF.	4
Test	Test software will command this transmit type.	5
Supply voltage dropped /Battery removed	When the power supply is removed instant transmit when first detected.	6

Table 1 Transmission Table

Sensor input	LED operation LoRa	LED operation Sigfox
Sensors detected	Flash GREEN every 10 seconds	Flash GREEN every 10 seconds
Sensors detected but NOT Joined Network	Flash RED every 10 seconds	Flash GREEN every 10 seconds
No Sensors detected	No Flash	No Flash

Table 2 LED Status

B. ATTACH SENSORS TO PIPE

Attach sensors to the pipes that are to be monitored. Ensure pipes are clean, free from insulation tape or loose paint. Ensure the Temperature sensor clip is the correct size for the pipe to be monitored.

> **ATTENTION**
> Once clip attached to pipe **DO NOT** change its position by sliding on the pipe as this can damage the sensor and render inoperable.

Considerations

The temperature sensor(s) must make good thermal contact to the target pipes. This may need changes to some existing thermal insulation.

After installation it is essential that all pipes are adequately insulated.

Temperature clips should be attached in a position that avoids external influences degrading measurements some examples are heating elements, areas with excessive drafts etc.

Cable runs should be arranged appropriately to avoid causing any problems such as trip hazards and health and safety issues.

Temperature Sensor Clip

Figure 1 Temperature Sensor Clip

Secure sensor to pipe

Push the clip around the pipe ensure the sensor holds its position and does not move when released. DO NOT slide the sensor on the pipe once it is attached. If the position needs to be adjusted unclip then re apply.

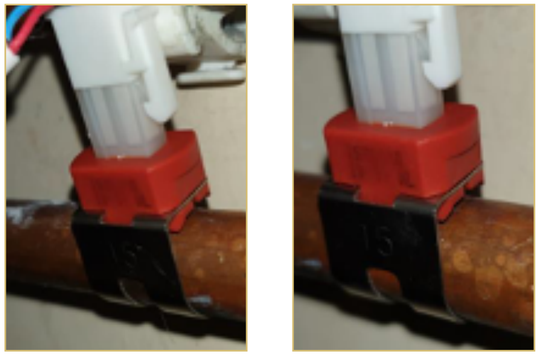


Figure 2 Temperature Sensor Pipe clip secured to pipe

> **ATTENTION**
> Ensure Pipe is clean and insulation/paint is removed

C. NERO BOX

Considerations

If possible place the Nero main unit in a position where it has adequate access for any required routine servicing while being inconspicuous and out of the way to minimise vandalism and unauthorised interference.

The antenna will need adequate signal so avoid placing the unit near large metal objects such as earth metal tanks which may affect the performance and reduce battery life. In extreme cases bad placement may render the device inoperable.

5 Powering up and commissioning

Nero will commence operation once a sensor has been inserted, given it has successfully connected to a LoRa gateway or Sigfox base station.

Installation checklist

Here are a few points to check over when installing and commissioning Nero.

- Temperature Clips should be placed in a position that avoids external influences degrading measurements such as heating elements or open windows.
- Cable runs should be arranged to avoid causing problems such as trip hazards and health and safety issues.
- If possible place Nero main unit in a position where it has adequate access for routine servicing while being inconspicuous and out of the way to minimise vandalism and unauthorised interference.
- The antenna will need adequate signal so avoid placing the unit near large metal objects such as earth metal tanks. This may affect the performance and reduce battery life, in extreme cases bad placement may render the device inoperable.
- LED is flashing every 10 seconds when sensors are connected.
- Message has been transmitted and relevant data populated on Neptune.

6 Status indicator LED

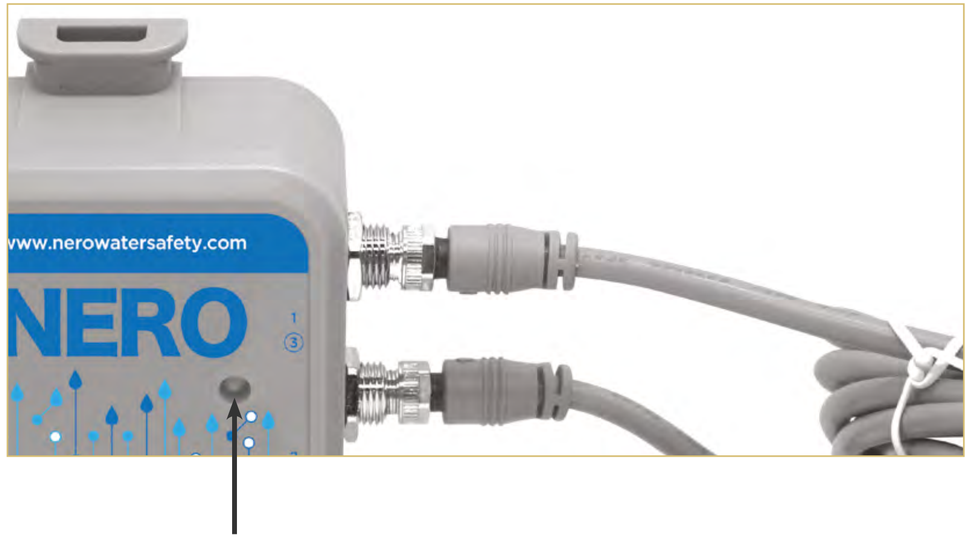
Once the sensors have been connected the main device will power up and the unit will display its status via the LED visible through its plastic enclosure as shown in Figure 3.

The LED should flash every 10 seconds this indicates it has taken a temperature reading. The colour and status of the LED depends on what network it has been configured for outlined below.

A. LED

Sensor input	LED operation LoRa	LED operation Sigfox
Sensors detected	Flash GREEN every 10 seconds	Flash GREEN every 10 seconds
Sensors detected but NOT Joined Network	Flash RED every 10 seconds	Flash GREEN every 10 seconds
No Sensors detected	No Flash	No Flash

Table 3 LED Status



Status Indictor LED

Figure 3 LED Indicator

7 OTAR OTAF OTAP

Nero offers the ability to change certain registers, reprogram itself with firmware stored in external flash and to update with new firmware all over USB and LoRa Comms. This section details LoRa comms.

OTAR = Over The Air Register.

OTAF = Over The Air Flash.

OTAP = Over The Air Programming.

Nero periodically requests an update from the server, **refer to Error! Reference source not found.** which outlines when OTAR, OTAF and OTAP are requested.

Nero will request 3 times if there is any update or request required. If there is, then the counter will re-set and Nero will ask again. After the 3 requests depending on what was commanded by the server Nero will continue operation with the updated values (if any) or reprogram itself by resetting and allowing the bootloader to perform any reprogramming logic.

OTAR

The following registers can be changed OTA (Over The Air).

Register	Info	Value range
Positive Flow Threshold	Temperature change in the 10 second sample window registers a flow in the positive direction.	0.5°C - 7°C
Negative Flow Threshold	Temperature change in the 10 second sample window registers a flow in the negative direction.	0.5°C - 7°C
Sample Counter Threshold	How many 10 second samples before a transmit.	1-255
Keep Alive Threshold	How many transmits before a keep alive message	1-65534

OTAP

When the OTAP sequence begins Nero will first check if the incoming version is stored in flash if it is then the OTAF procedure begins and the server is notified that the firmware is already present in external flash.

If however the firmware version is not present in flash then the OTAP sequence begins. Nero can start a new OTAP sequence or continue from a previous session.

The program bytes are stored in flash after a successful OTAP and Cyclic Redundancy Check (CRC) pass the flash location and reprogram bit is set. Alternatively, if CRC fails then the program in that section of flash is erased.

OTAP takes around 45 minutes via LoRa.

OTAF

After every OTAP or reprogram via USB the program is stored in the external flash if it has passed CRC. Once the OTAF request is made Nero will inform the server if it has been found or not. If it has then the reprogram will begin after the server has stopped issuing commands to Nero.

> **“Installing the Nero Water Safety unit to your hot and cold water feeds, will reduce the incidence of infections.”**

8 Servicing

Servicing is limited to replacement of the batteries as required.

The unit regularly updates the Neptune web portal with the status of the battery and Neptune will alert the registered user of low battery allowing advance planning for swap out. Nominal 5 years battery life.

9 Fitting practice

There are no hazardous voltages or materials used in the equipment, however it must be installed with due regard to the points below to achieve its intended purpose.

The sensor(s) must make good thermal contact to the target pipes. This may need changes to some existing thermal insulation, At the end of fitting all pipes must be left adequately insulated. As noted above the placement of sensors is extremely important and they must be correctly orientated on the pipe.

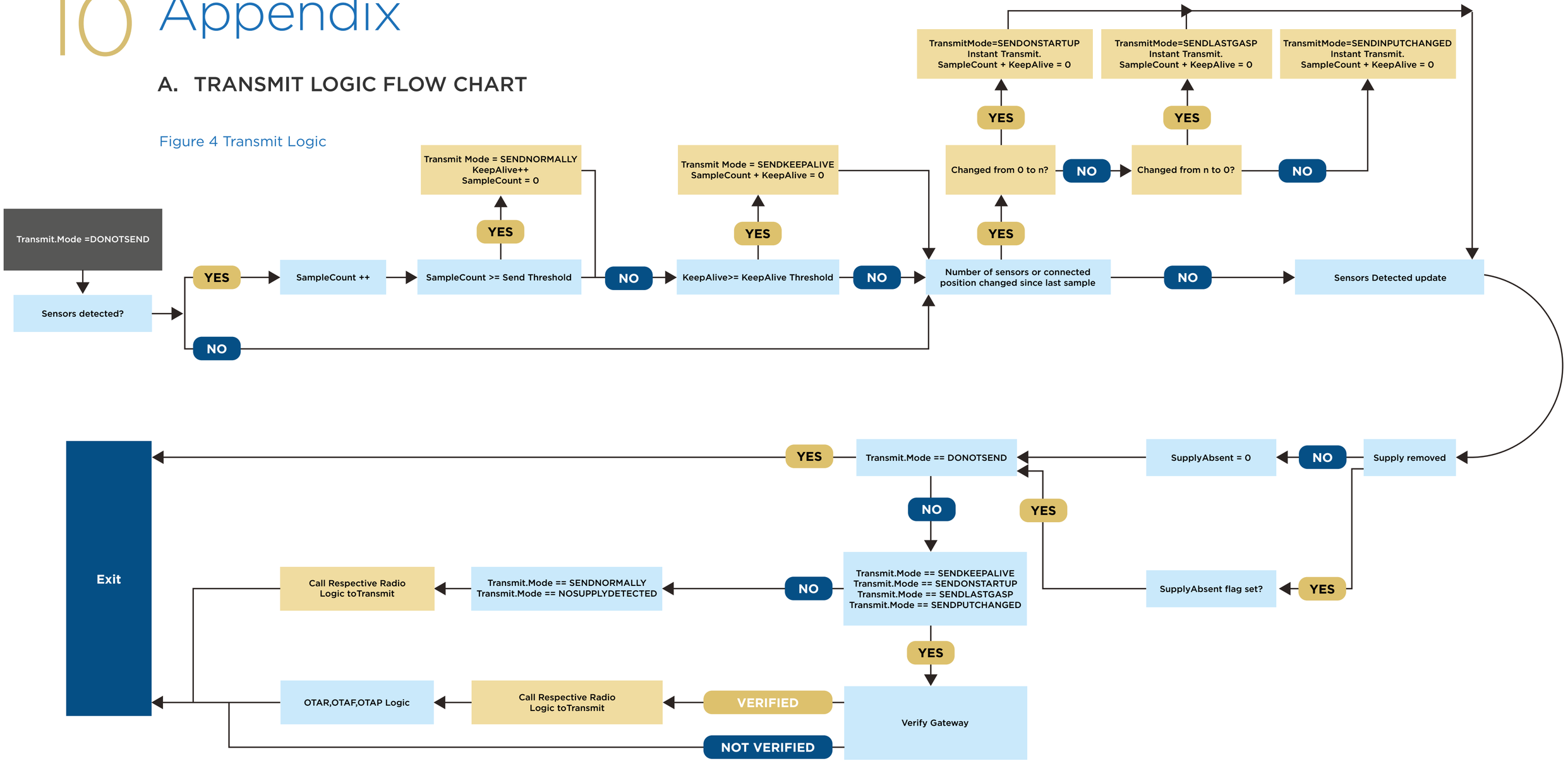
The main unit is designed to allow easy fitting to any size of pipe, larger diameters will not fit inside the trough on the back, however it will still provide good location.

When deciding on the placement of the system it will help to review the existing pipe layout and plan fitting to achieve the following as far as possible.

10 Appendix

A. TRANSMIT LOGIC FLOW CHART

Figure 4 Transmit Logic



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