Table of Contents

1   Introduction

This is a quick starting guide on how to operate with a LoRaWAN TBSL1 with following configuration (can be used as a reference for other set up):

- 1 SDI-12 soil moisture and temperature probe with 7 cells (Probe 0)
  - SDI-12 addresses from '1' to '7'
  - SDI-12 command: M1!
- 1 SDI-12 wind vane sensor (TBSWV1; Probe 1)
  - SDI-12 address: '8'
  - SDI-12 commands: M!, M1!
- 1 SDI-12 wind speed sensor (TBSWS1; Probe 2)
  - SDI-12 address: '9'
  - SDI-12 command: M!
- 1 SDI-12 air temperature sensor (TBSHT02; Probe 3)
  - SDI-12 address: 'b'
  - SDI-12 command: M1!
- 2 analog sensors inputs
- 1 pulse sensor input

For this example LoRaWAN AS923 plan will be used with 8 frequencies ranging from 923MHz to 924.4MHz with an increment of 200kHz.
It is therefore assumed that:

- Antenna fitted for 915MHz is used
- Gateway operating on 915MHz band is used
- Gateway is correctly configured and attached to a LoRaWAN server operating on above plan and frequencies
- TBSL1 must be configured accordingly to match the LoRaWAN server configuration. In this example this means:
  - Class A
  - ADR off
  - ABP
  - AS923 plan as described above
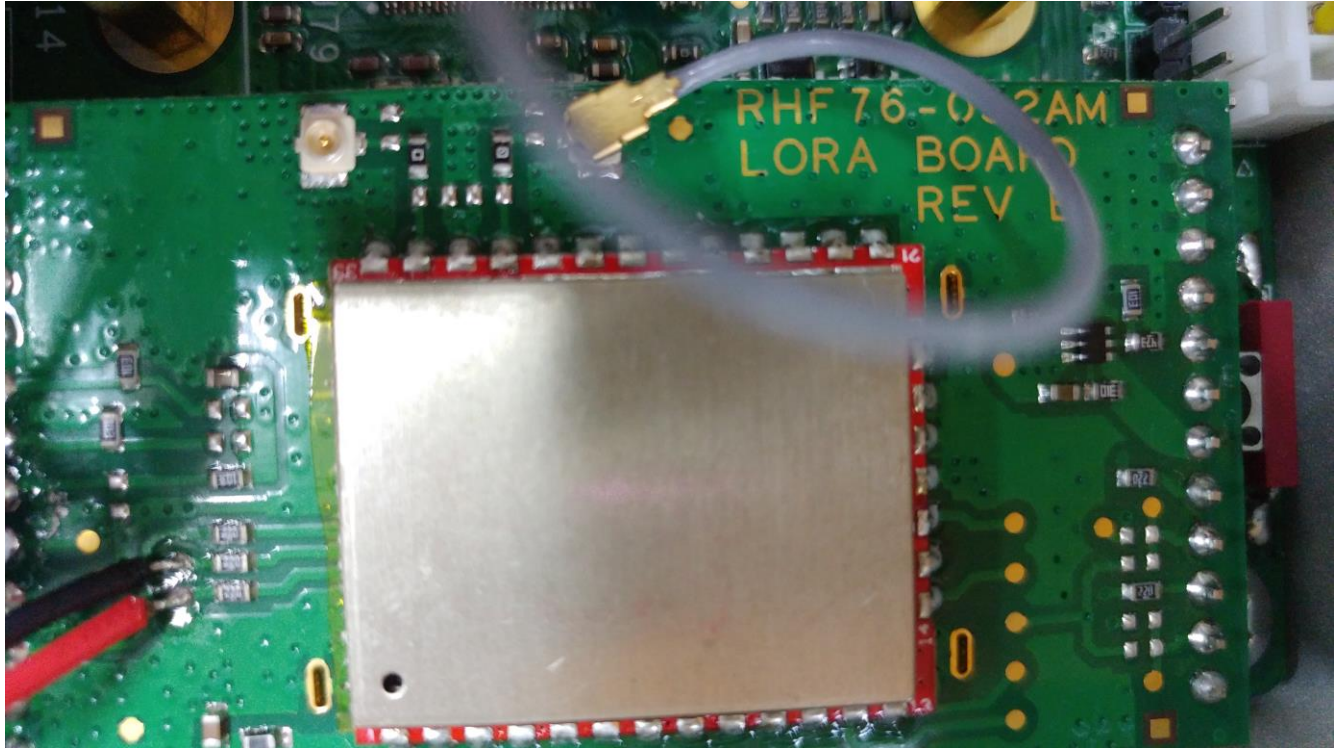 - EUI and ciphering keys as provided by LoRaWAN server

2   Prerequisites

2.1 Antenna

Connect antenna internally and externally, ensure the right connector is used on LoRaWAN modem board depending on the frequency used.

Antenna connected externally

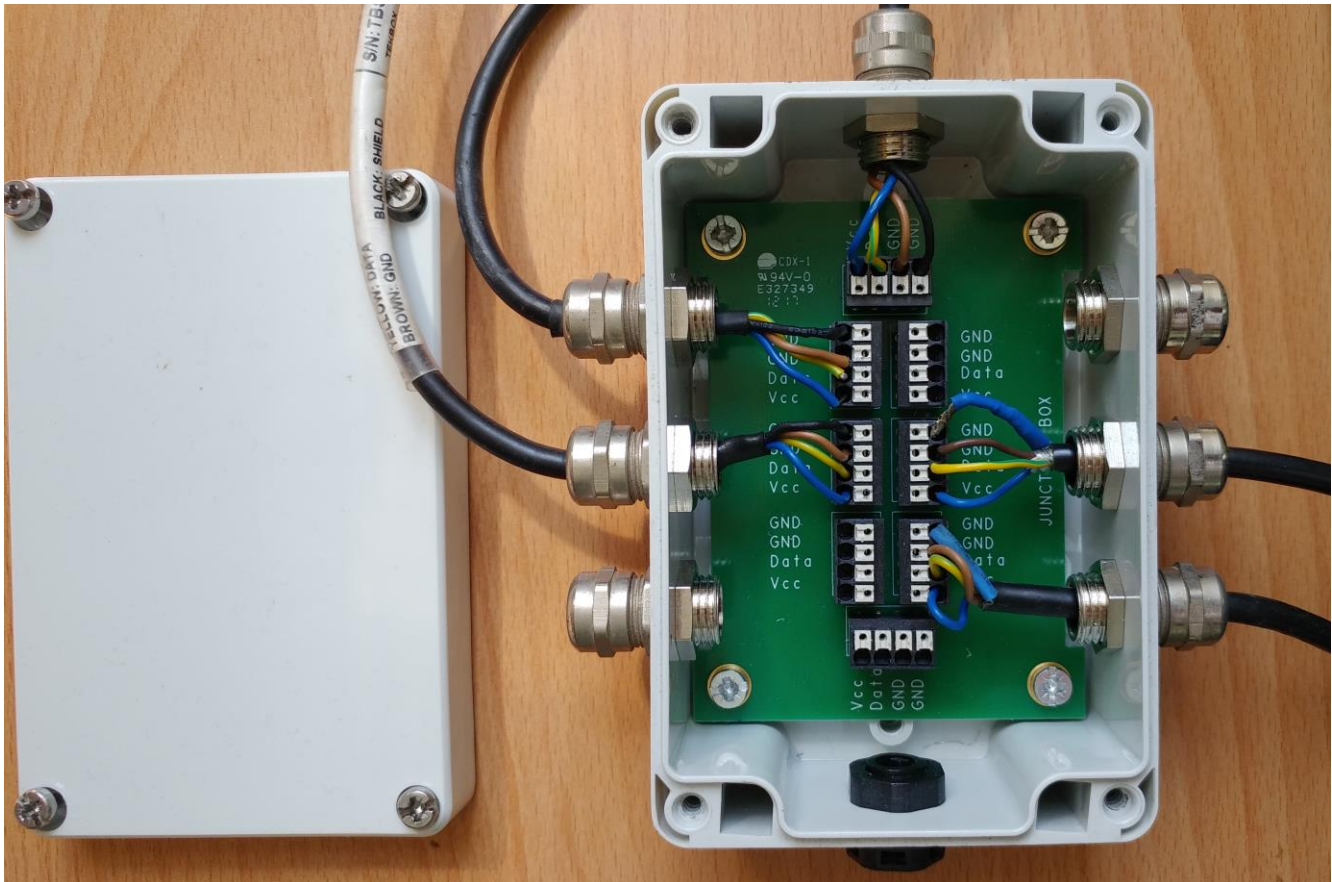*Antenna connected to LoRa modem high band connector*

2.2 Sensors

Connect the sensors cable(s): one or both TBSL1 sensors connectors can be used depending on user's set up.

Sensors connectors

To deploy multiple SDI-12 sensors, Tekbox SDI-12 junction boxes can be used:

SDI-12 Junction box: upper connector plugged to TBSL1, others to SDI-12 sensors

CAUTION: both TBSL1 sensors connectors share the same electrical signals therefore

- **SDI-12 sensors can be freely connected to either connectors or both and also by using a junction box if required.**
- **TBSL1 supports only ONE pulse input: a pulse sensor can then be plugged to either connector, having one pulse input connected and the other left unused.**
- **TBSL1 supports 2 analog channels: each channel has an input on each connector. Therefore when a channel is connected to an analog sensor, the second one must be left unused.**

2.3   Battery

Connect a suitable battery inside the unit: 3.7V Li-Ion cell with at least 1500mAh capacity (refer to TBSL1 user manual), 10k NTC and protection circuit.

Li-Ion battery plugged

2.4   Solar panel

Refer to TBSL1 user manual for information related to solar panel required features.

Solar panel 5 pins connector must be modified as follows to allow for the unit to be supplied:

Then connect the solar panel on the TBSL1 5 pins connector.

TBSL1 is then fully fitted and starts operating as soon as the solar panel is connected.
Taking out the solar panel will switch off the platform.

2.5   TBSL1 configuration

The very first time TBSL1 is used, it starts up in console mode and is then ready to be configured.

Ensure that the PC used for configuration has ST virtual COM port driver installed (refer to www.st.com to download the driver).

A USB cable and TBSL1 configuration tool installed on the PC are required to proceed with the platform set up.

The final set up should look like this:

Then proceed with following steps:

- Open the PC application in Administrator mode

- Connect the USB cable between the PC and the TBSL1 USB connector.
- Wait about 10s until a USB serial COM port is enumerated on Windows Device Manager.
- The PC application will then:
   - Either autoconnect to the virtual serial COM port
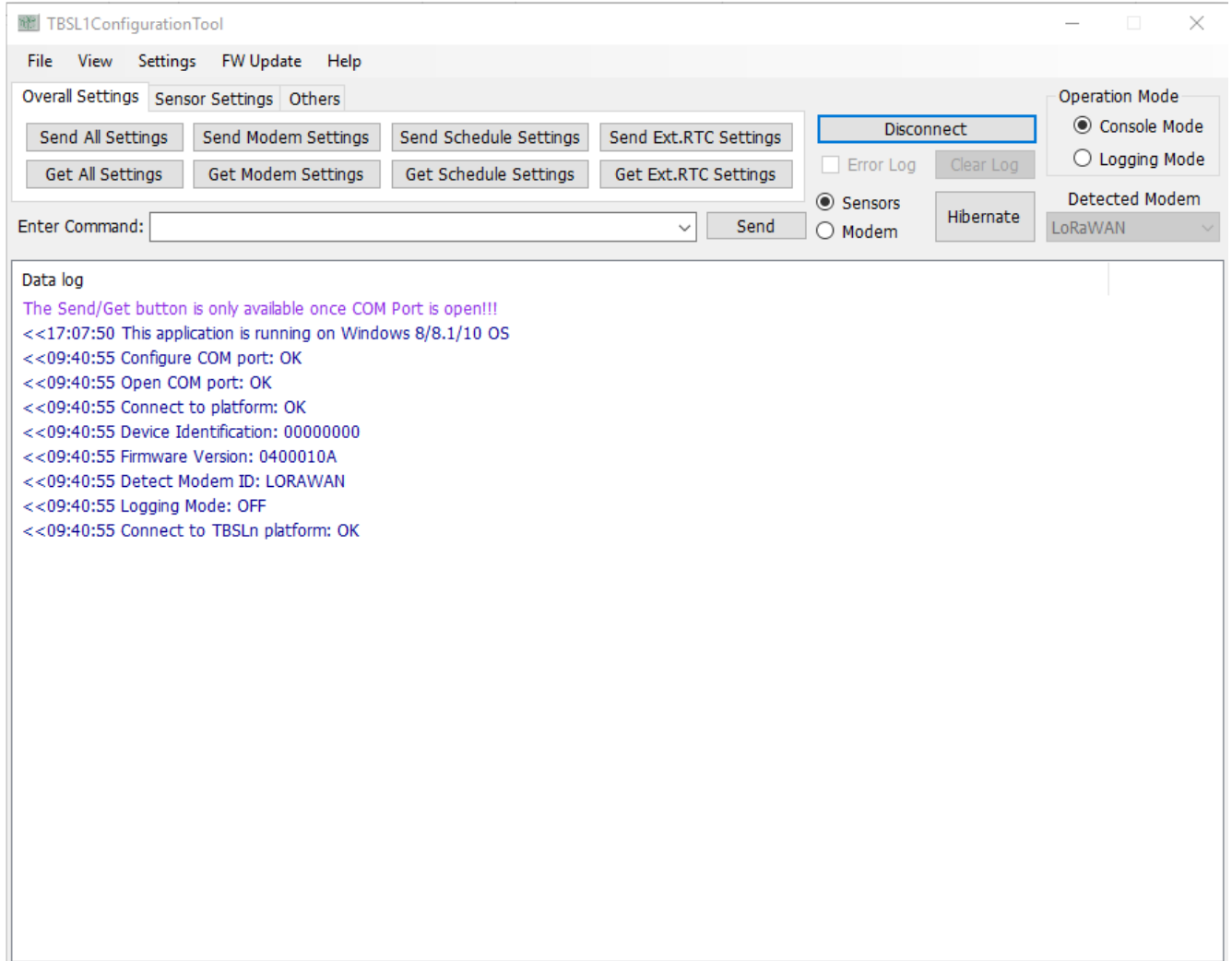
o Or will require manual connection by configuring the COM port from "Settings>COM port Configuration" PC application menu and clicking then on "Connection" button.

First check that the virtual COM port is mounted by Windows, then select it in the tool:
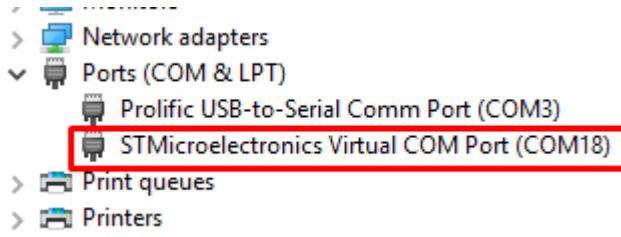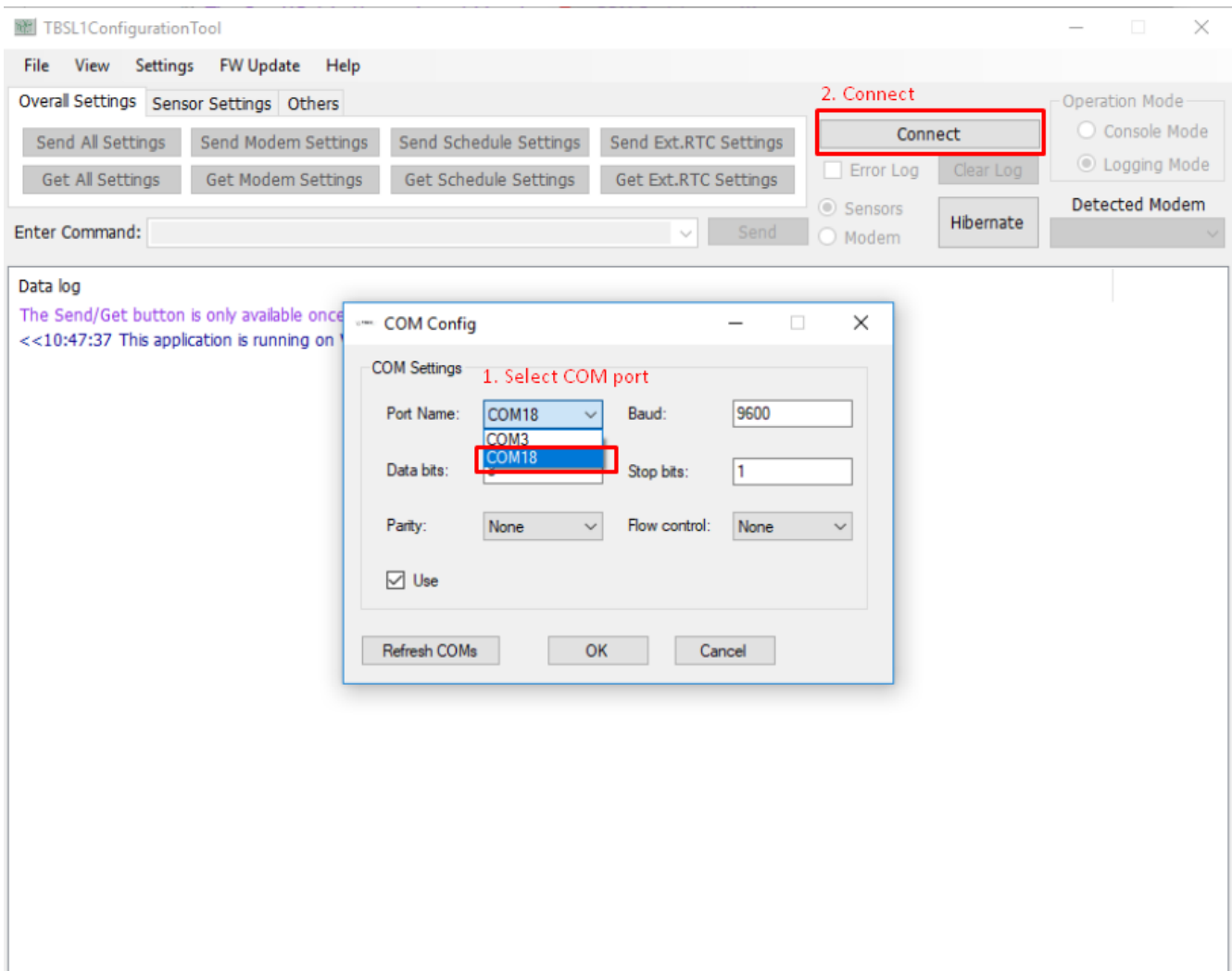
- TBSL1 is then switched to console mode (indicated by the comment "Logging Mode: OFF" and is therefore ready to be configured.
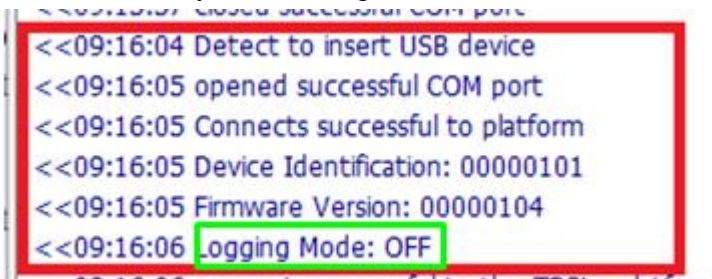
3   Configure TBSL1

3.1   LoRaWAN configuration

In this example and as described in the introduction, following LoRaWAN configuration is used:

- Class A
- ABP
- AS923
- ADR off
- No ACK

Ensure that right frequencies are defined by clicking on "Set CH":
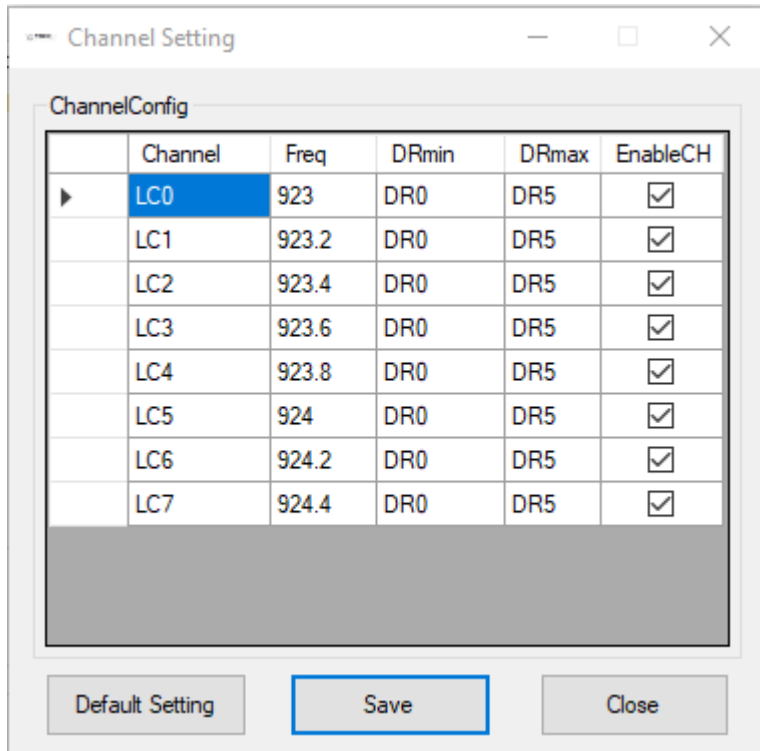
3.2 SDI-12 sensors configuration

4 SDI-12 probes are defined in this example with the configuration described in the introduction. Measurement intervals are set to 15 minutes for each probe.

Probe 0:

| LoRaWAN | EHS6 | SDI-12 | Pulse | Analog | Alarm | Info |

SDI Settings

Number of Probes: 4

SDI-12 Probes ID: ProbeID_0

Number of Command: 7   in probe ProbeID_0

Measure Interval: 15   minutes

☐ Warm Up Delay   0   second ranges: 0 - > 30

SDI Sensor Setting

	Ordinal	Description	Measurement Command
▶	0	S1	1M1!
	1	S2	2M1!
	2	S3	3M1!
	3	S4	4M1!
	4	S5	5M1!
	5	S6	6M1!
	6	S7	7M1!

Probe 1:

| LoRaWAN | EHS6 | SDI-12 | Pulse | Analog | Alarm | Info |

SDI Settings

Number of Probes: 4

SDI-12 Probes ID: ProbeID_1

Number of Command: 2   in probe ProbeID_1

Measure Interval: 15   minutes

☑ Warm Up Delay   10   second ranges: 0 - > 30

SDI Sensor Setting

	Ordinal	Description	Measurement Command
▶	0	WD	8M!
	1	WT	8M1!

Probe 2:

Probe 3:

3.3   Analog sensors configuration

2 analog channels are configured with 10 and 15 minutes measurement intervals:

Channel 0:

Channel 1:

3.4 Pulse sensor

1 pulse sensor for rain gauge application:

3.5 Reporting intervals

Following intervals need then to be configured:
- Transmission
- Battery level reporting
- Transmission delay

3.6 Save configuration

From whatever tab, click on the 'Save' button to save the configuration:

TEKBOX
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Board Configuration   — □ ✕

LoRaWAN | EHS6 | **SDI-12** | Pulse | Analog | Alarm | Info

SDI Settings

Number of Probes: `4`

SDI-12 Probes ID: `ProbeID_3`

Number of Command: `1`   in probe `ProbeID_3`

Measure Interval: `15`   minutes

☐ Warm Up Delay   `0`   second ranges: 0 - > 30

SDI Sensor Setting

	Ordinal	Description	Measurement Command
▶	0	Air HT	bM1!

LoRaWAN RHF Version

Select Version `_____`

LoggingMode Schedule

Transmission Interval (minutes) `15`

Watchdog Interval (seconds) `10`

Battery Interval (minutes) `15`

Transmission Delay (seconds) `5`   (In Transmission Interval)

Power Management

Alarm when battery under `10` (1-99)%   ☑ LED   ☑ Buzzer

RTC Settings

Time Zone Selection:
`(UTC+07:00) Bangkok, Hanoi, Jakarta`

UTC Time `07/03/2018 06:05:47`

Modifiable Time `07/03/2018 13:05:47`   `07:00:00`

External RTC `07/03/2018 13:05:47`

[Set time for external RTC]   [Get User PC Timezone]

[Load from JSON file]   [**Save**]   [Close]

Current configuration can be saved into a JSON file and reloaded later through the 'File' menu:
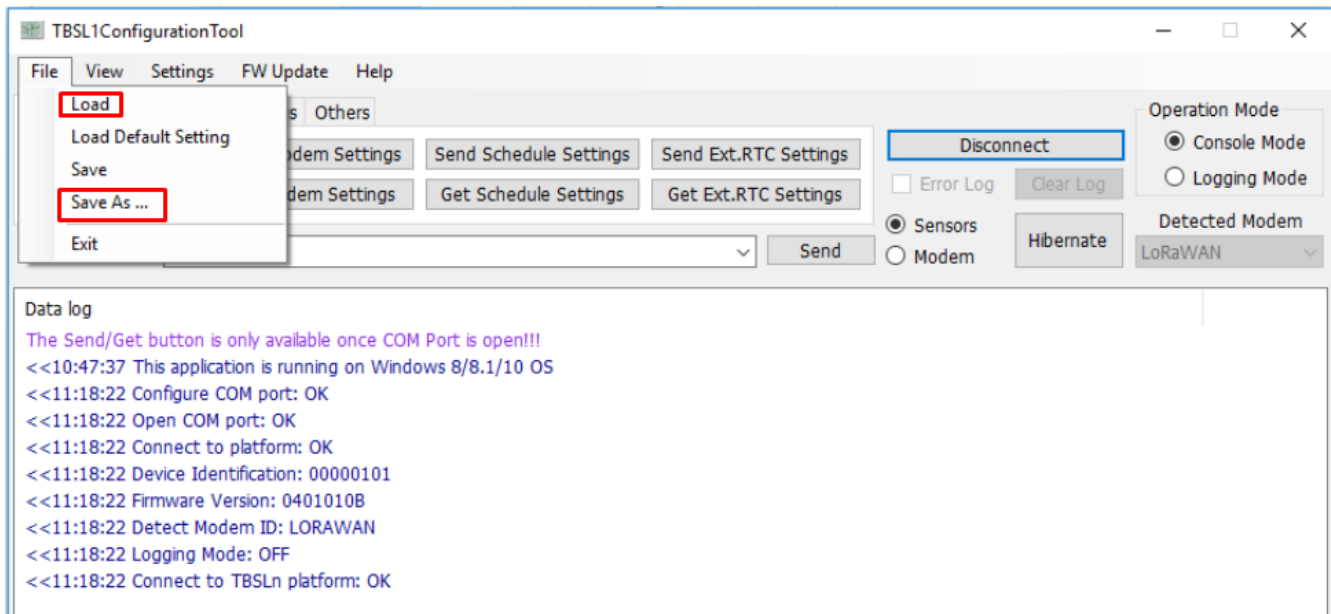
4   Platform activation

If platform default configuration has been modified, it is required to click on "Send All Settings" button (OR sub-category settings button depending on what has been changed): this will update the internal TBSL1 configuration.
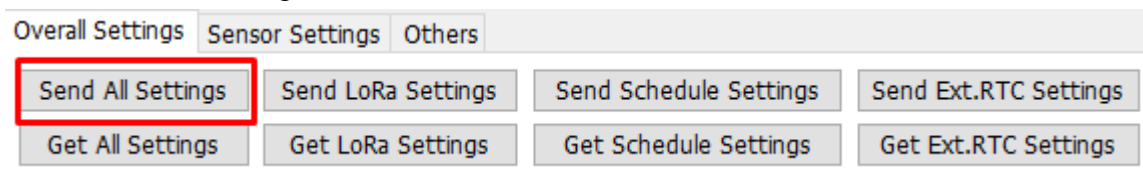
Configuration can be checked likewise through the 'Get All Settings' button or any sub-category get settings button.

Set and get parameters for specific sensors categories

To turn the platform to operating mode, it just requires to click on "Logging Mode" button and wait for the confirmation.

From this point, the PC application can be closed or left open, and the USB cable is no longer required. TBSL1 starts logging measurements and transmitting them based on various programmed intervals.

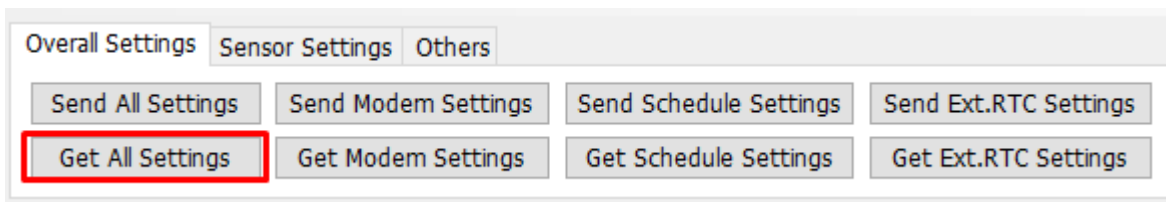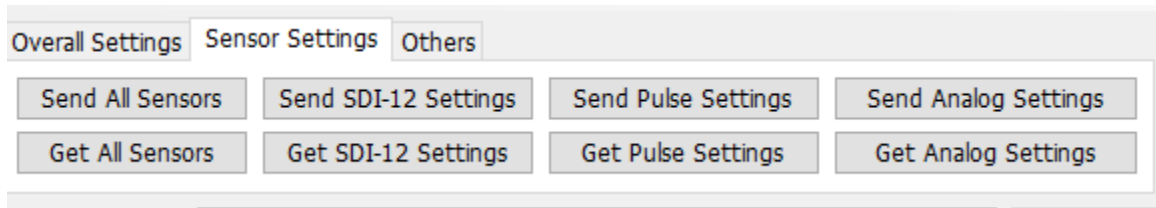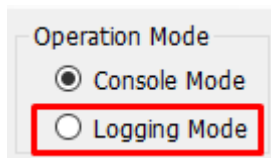Any further change to TBSL1 configuration requires to switch back to console mode by clicking to "Console Mode" button (note: the switch will only happen when the platform is not in sleep mode or at power up).

Alternatively if the unit has to be stored on shelves or left unattended for a while until it is deployed on the field, the following steps should be followed in order to save the battery:

- Click on 'Send All Settings'
- Click on 'Hibernate' ➔ this makes TBSL1 enter into hibernation mode
- Then 2 options to restart the platform in active mode (logging):
  - If TBSL1 is left hibernating, then swipe a magnet over the reed switch and it will automatically restart in logging mode
  - Unplug the solar panel and the platform will be shutdown. When plugging back the solar panel, TBSL1 will automatically restart in logging mode.

5 Data format

Several reporting messages are transmitted by TBSL1:

- Common data message
  - Ex: **C4AC112310265.030-53**
  - Fields:
    - **C:** common data message
    - **4AC1:** device ID to be read as "4AC1"

- **1231:** FW version to be read as "12.31"
- **0:** power supply ID, solar panel or USB charging a LiPo
- **26:** total number of connected sensors, to be read as "26"
- **5.030:** battery voltage, to be read as "5.030"
- **-53:** RSSI, to be read as "-53"

- Pulses report message
  - Ex: *PP16:10:27:02:45:000 12004*
  - Fields:
    - **P:** parameters report message
    - **P:** pulse sensor
    - **16:10:27:02:45:00** time stamp, 2016 October 27th 02:45:00AM (HH:MM:SS)
    - **0:** pulse sensor ID
    - **<space>**
    - **12004:** pulse count

- Analog report message
  - Ex: *PA16:10:29:14:30:001 0.235532 3.454323 5.454323*
  - Fields:
    - **P:** parameters report message
    - **A:** analog sensor
    - **16:10:29:14:30:00** time stamp, 2016 October 29th 14:30:00 (ie 2:30:00 PM, HH:MM:SS)
    - **<space>**
    - **0.235532:** minimum measured analog value
    - **<space>**
    - **3.454323:** average of analog measured values
    - **<space>**
    - **5.454323:** maximum measured value

- SDI-12 report message
  - Ex: *PS0216:10:29:02:30:003 -12.20003 +2.322432 -4.433332 -9.110423*
  - Fields:
    - **P:** parameters report message
    - **S:** SDI-12 sensor
    - **0:** SDI-12 sensor virtual ID
    - **2:** SDI-12 sensor address
    - **16:10:29:02:30:00** time stamp, 2016 October 29th 02:30:00AM (HH:MM:SS)
    - **3:** 4 measurements returned by the sensor

- ▪ **\<space\>**
- ▪ *-12.20003 +2.322432 -4.433332 -9.110423:* 4 measurements values returned by SDI-12 sensor and separated by a \<space\> delimiter.

Refer to TBSL1-N datasheet for further description of each message format.

6   History

Version	Date	Author	Changes
V1.0	15/09/2017	Philippe Hervieu	Creation
V1.1	03/07/2018	Philippe Hervieu	Update vs FW/GUI 04.00.01.0B