V1.9

Datasheet TBS12PC

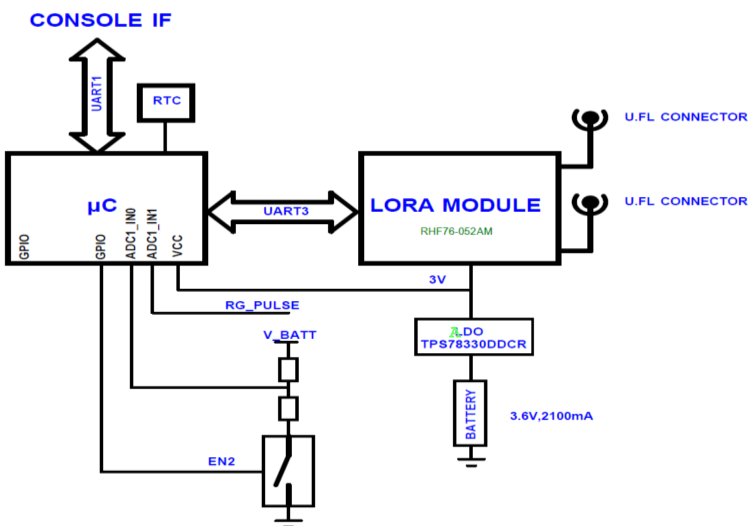
LoRaWAN Pulse Counter

The TBS12PC LoRaWAN pulse counter module brings LoRa wireless connectivity to pulse sensors. The module embeds a low power LoRaWAN 1.02 certified modem, with dual antennas connectors to operate on low (434MHz/470MHz) and high (868MHz/915MHz) ISM bands.

TBS12PC offers low current consumption, small footprint and easy integration with available rain gauges and float switches on the market: the module is available in 2 different versions, TBS12PC-RG for rain gauge/flow meter monitoring (reporting of rainfall and totalizer values) and TBS12PC-FS for float switches monitoring (configurable alarm).

The module empowers the long range capability of LoRa, along with flexible configuration.

The TBS12PC has been engineered specifically for applications where cost, performance, time to market and ease of integration are prime considerations.



Features

- LoRaWAN 1.02 Class A
- Selectable frequency schemes: EU, US, AU, AS, CN, Custom
- Easy configuration with PC tool through TBS12PC's UART port
- 2 pulse inputs
- Return number of pulses and totalizer values per logging period
- Configurable measurements and transmission intervals.
- Configurable transmission delay to allow to stagger multiple units and limit collisions.
- Low quiescent current
- 2*1.5V AA batteries powered
- Support for external power supply
- More than 15km range with clear line of sight
- Operating Temperature Range: -40°C - +85°C

Target Applications

- Rainfall monitoring.
- Flow meter
- Float switch

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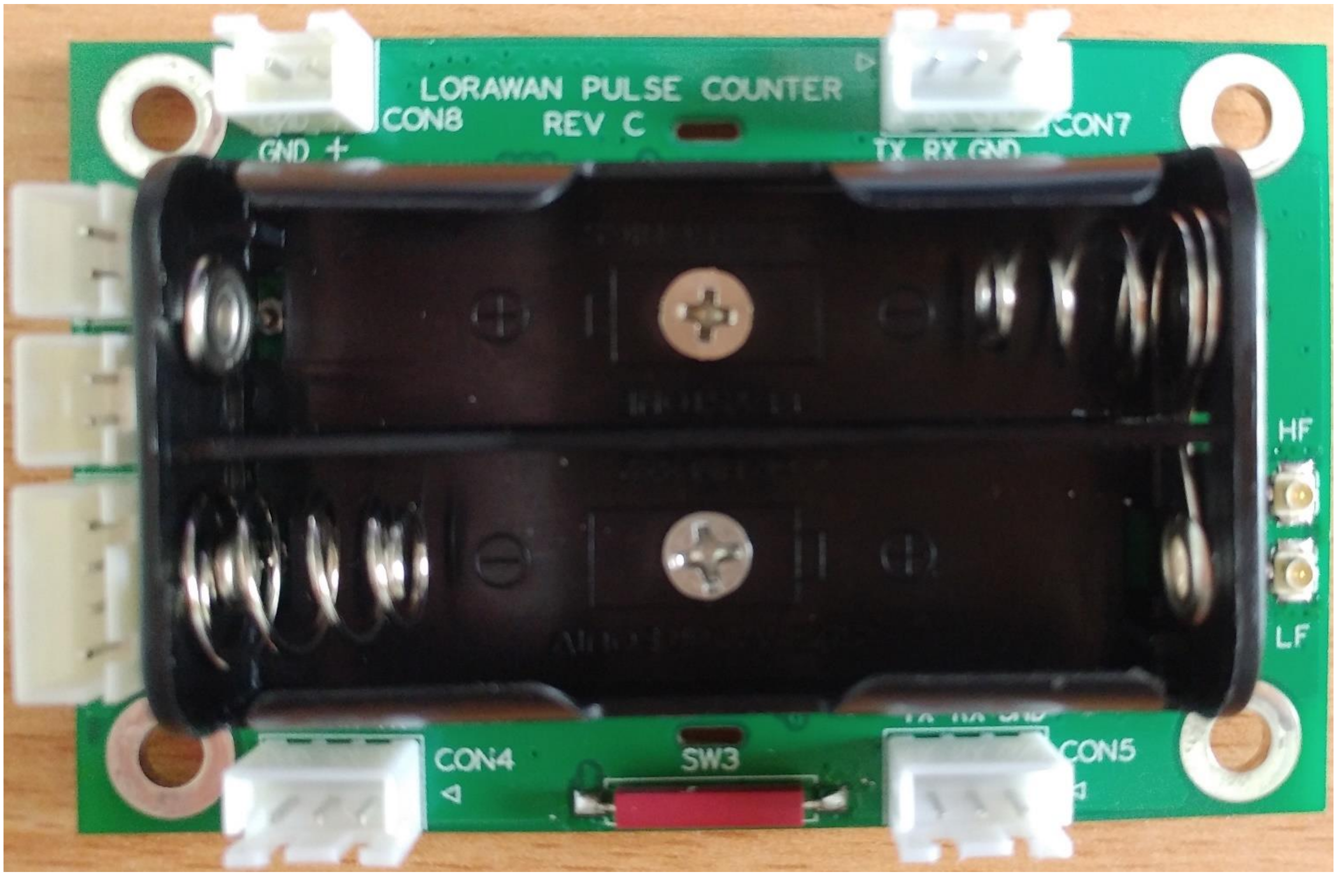
1 Introduction

1.1 Module overview

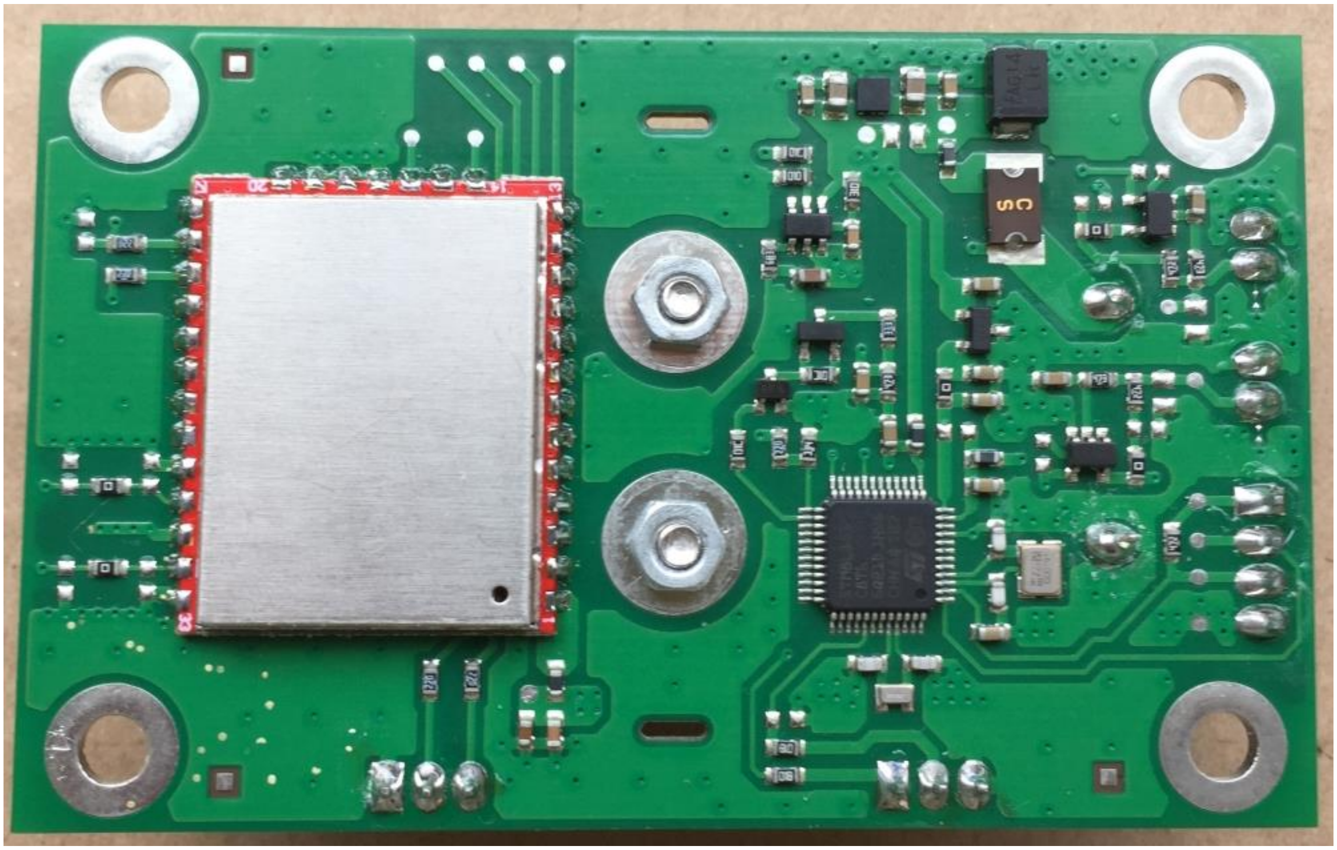
The TBS12PC is an interface module that provides LoRaWAN connectivity to pulse sensors.
Its primary target applications are rainfall monitoring, flow meters and float switch.

TBS12PC boasts 2 pulse inputs and a LoRaWAN 1.0.2 Class A compatible modem.

It is powered by 2*1.5V AA batteries.



TBS12PC LoRaWAN: battery rack and connectors.



TBS12PC LoRaWAN: LoRaWAN modem

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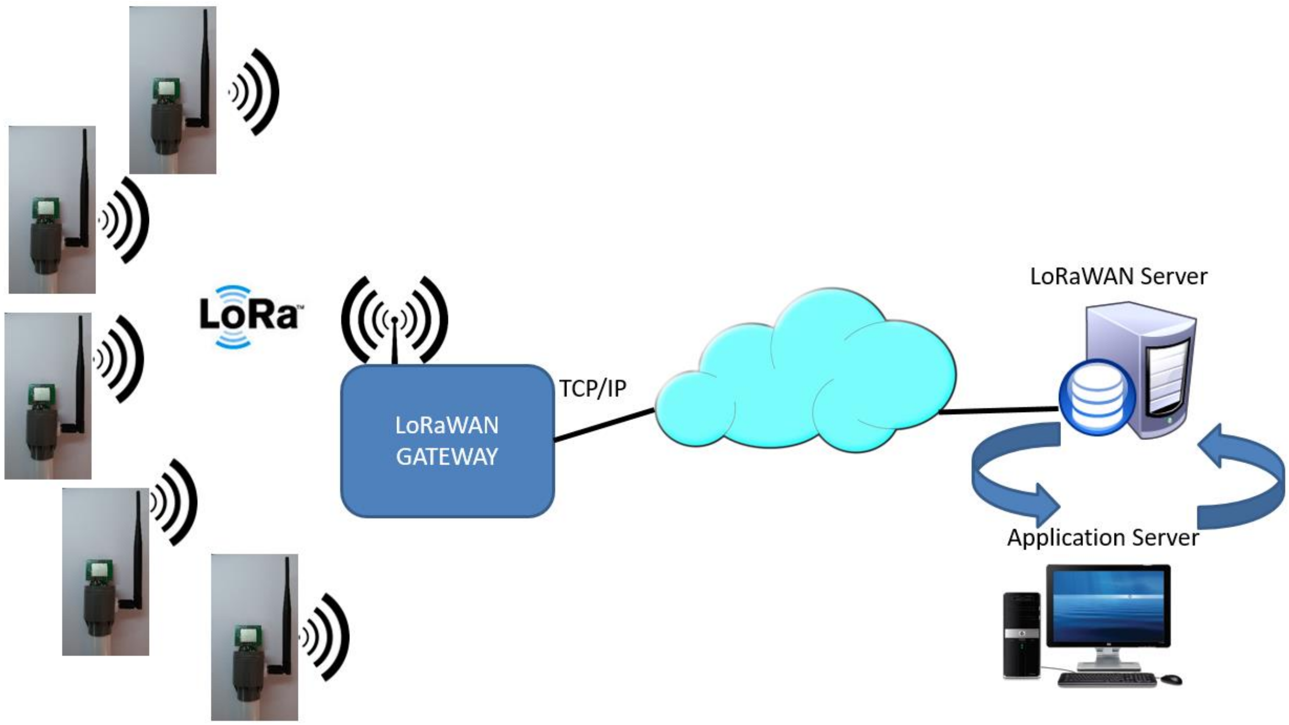
TBS12PC fitted with batteries

1.2 System overview

TBS12PC integrates within a typical LoRaWAN ecosystem: each TBS12PC is seen as a unique end node within a LoRaWAN private network (i.e. including at least one LoRaWAN gateway and a LoRaWAN server).

Following schematic shows a typical LoRaWAN deployment:



LoRaWAN nodes in a private LoRaWAN network

Before being used, TBS12PC must go through a configuration and provisioning phase to initialize system, pulse inputs and LoRaWAN parameters.

Device configuration is achieved by connecting TBS12PC to a PC and running the configuration tool provided along with this product. Further details pertaining to TBS12PC configuration are found in configuration chapter.

1.3 Product Features

The TBS12PC is based on a low power controller and a LoRaWAN 1.0.2 Class A modem.

1.3.1 HW features

- 2 pulses inputs with HW filtering and overvoltage protection
- PC UART interface: data rate 9600 baud, 8 bits data, no parity, 1 stop bit, no handshake
- 3.3V PC UART control interface (to be used along with TBS12PC Configuration Tool)
- Connectors for FW update through ST-Link/V2 (STM8 SWIM) and LoRaWAN modem FW update.
- Power supply: battery powered, refer to Power Supplies section for further information.
- Dual antenna connector: low (434MHz/470MHz) and high (868MHz/915MHz) bands
- Operating temperature range: -40 - +85°C

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1.3.2 LoRaWAN features

- LoRaWAN Class A
- Device activation: ABP / OTAA
- Frequency plans: EU868, EU433, US915, AU915, AU915OLD, AS923, CN470, CN779; configurable frequencies and data rates.
- Uplink communication – selectable confirmed or unconfirmed messages, repeat feature
- Reconfigurable LoRaWAN parameters: identifiers (DevAddr, DevEUI) and security keys (NwkSKey, AppSKey, AppKey)

1.3.3 System features

- Programmable measurement and transmission intervals (from 1 minute to 24 hours)
- Configurable battery information reporting interval
- Configurable transmission delay: allow to stagger the transmission of multiple TBS12PC units deployed in the same vicinity, contributing then to reduce the collision rate.
- 2 modes of operation while connected to TBS12PC PC application:
  - Logging mode: TBS12PC operates normally but outputs debug information to the PC tool
  - Console mode: TBS12PC is in configuration mode, its system and LoRaWAN parameters can be checked and updated. Moreover, it is possible to directly access LoRaWAN modem by sending any supported LoRaWAN modem AT command.

1.4 Technical references

1.4.1 LoRaWAN

LoRaWAN is a MAC layer radio protocol for LoRa (technology owned by Semtech, www.semtech.com) developed and maintained by LoRa Alliance:

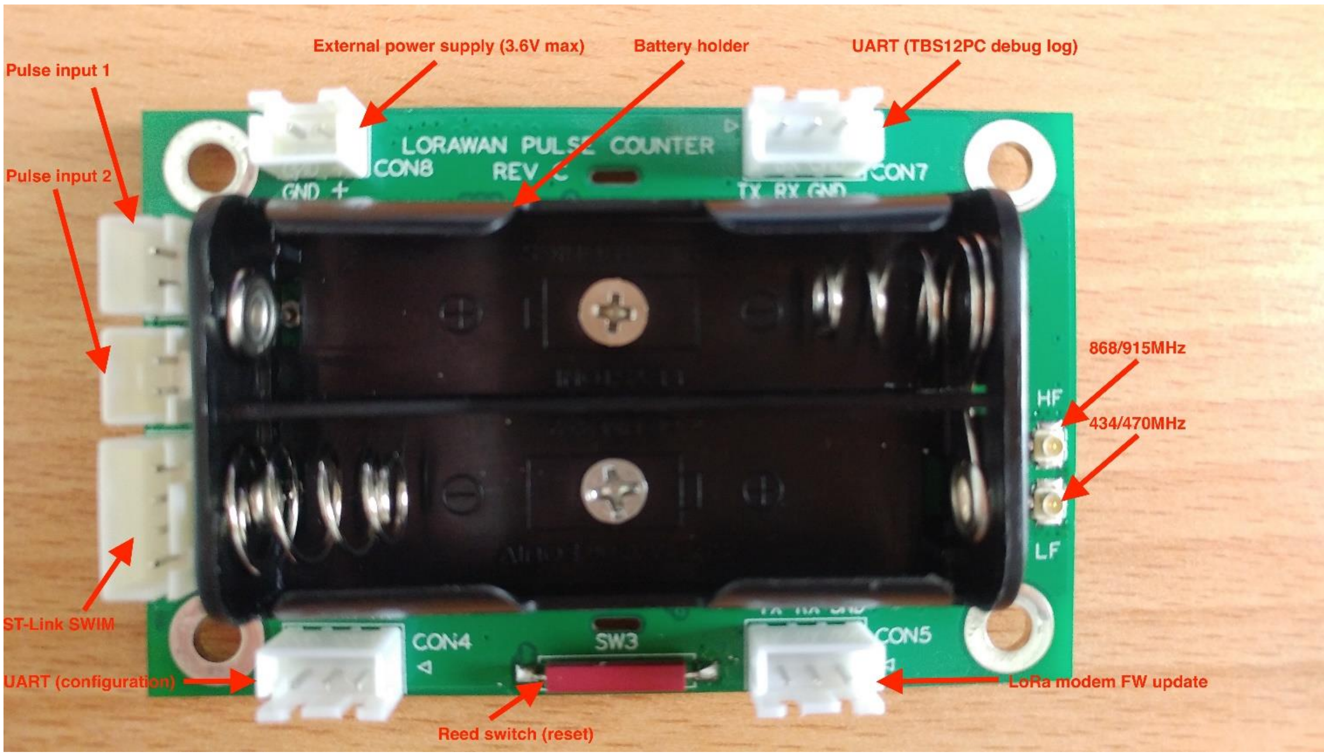
www.lora-alliance.org
LoRa™ Alliance
2400 Camino Ramon, #375
San Ramon, CA 94583
Phone: +1 925-275-6611
Fax: +1 925-275-6691

"**LoRaWAN™** is a Low Power Wide Area Network (LPWAN) specification intended for wireless battery operated Things in a regional, national or global network. LoRaWAN targets key requirements of Internet of Things such as secure bi-directional communication, mobility and localization services. The LoRaWAN specification provides seamless interoperability among smart Things without the need of complex local installations and gives back the freedom to the user, developer, businesses enabling the roll out of Internet of Things."

Further details available on LoRa Alliance website.

2 TBS12PC connectivity

2.1 Connectivity details



TBS12PC – Front view

Following connectivity is provided:

- 2 pulse inputs
- 1 FW programming connector (using ST-Link/V2 SWIM port)
- 1 port to update LoRa modem FW
- 2 UART ports for PC connection (module's configuration and debug log)
- 1 battery holder
- 1 connector for an external power supply (1.8V – 3.6V)
- 2 antenna connectors (for LoRaWAN 868/915MHz and 434/470MHz)

2.2 Pulse inputs, PC UART and SWIM port pins description

Port descriptions are directly available on the PCB:

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PC UART and LoRaWAN modem connectors – pins description

External power supply and debug UART connectors – pins description

Pulse inputs and SWIM connector – pins description

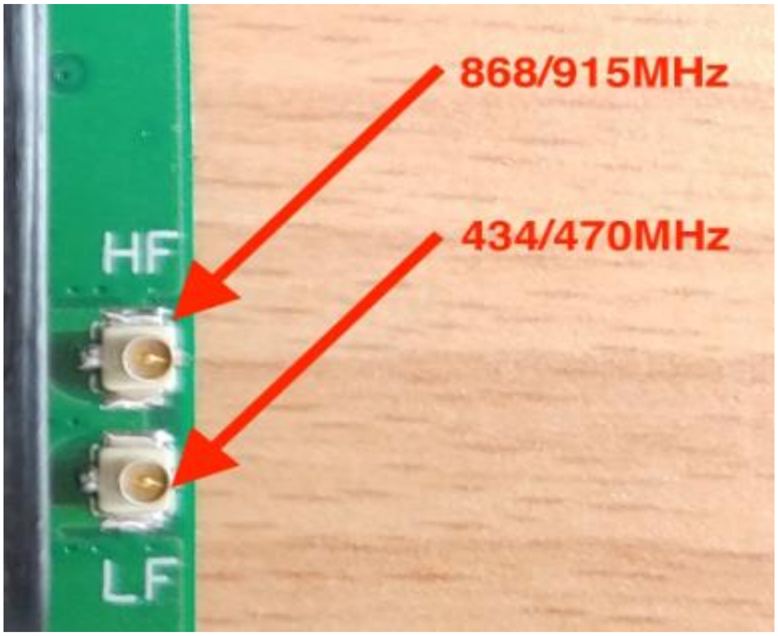
3 Functional Description

3.1 Interface function

3.1.1 LoRa modem and radio

TBS12PC embeds a LoRaWAN compatible modem and a dual band LoRa radio.

Depending on the frequency plan that is used (country specific), either low or high ISM band will be needed. It is therefore crucial to connect the antenna to the right connector:



As LoRaWAN uses free ISM bands, useable frequencies are subject to local regulation, and TBS12PC must be configured accordingly:

- To use supported LoRaWAN frequency plans for countries where this has been defined
- To use custom plans for other countries

Refer to latest LoRaWAN specification on www.lora-alliance.org

TBS12PC must be then used along with a LoRaWAN gateway that operates on the same frequency band: for example, if TBS12PC is deployed in Europe, both TBS12PC and gateway must be configured to use EU868 frequency plan.

3.2 Power Supplies

TBS12PC is powered with 2*1.5V AA batteries.

It can also be powered using an external power supply on CON8 (1.8V – 3.6V).

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3.3 Firmware

TBS12PC is available in a single HW version.

However two different firmware must be used depending on the targeted application:

- Rainfall and flow meter monitoring (TBSPC-RG)
- Float switch monitoring (TBSPC-FS)

Refer to ordering information for further details.

3.4 Rainfall and flow meter monitoring (TBS12PC-RG only)

3.4.1 Overview

TBS12PC acts like a mini-RTU (Remote Telemetry Unit): it is designed to detect pulses on both available inputs, accumulate the pulses that occurred during configured logging period and compute flow.

For each input, 2 metrics are computed:

- Totaliser:
  - It counts up indefinitely the number of pulses since the startup of the system.
  - Starting totalizer value must be set with PC configuration tool.
  - It's a 64 bits value that rolls over once the maximum value is reached.
- Flow/Rain:
  - It records how much flow (litre) or rain (mm) has been counted in the logging period.
  - This is the difference between the totalizer value at the end of the logging period and the start of the logging period.
  - It is recorded in real units, therefore for a rain gauge the capacity per tip must be configured with the PC tool.

These metrics are then stored in internal memory with corresponding logging period time stamp and transmitted over LoRa to application server on configured transmission interval.

Measurements are retained in TBS12PC internal memory until they're transmitted.

3.4.2 Time intervals

Pulses occur randomly and are therefore detected and counted by the system whenever they happen.

Besides the pulse detection, three different time intervals are defined in the system:

- Measurement interval
  - Period in minutes for totalizer and rain/flow computation. Metrics are time stamped and stored into internal memory.
- Transmission interval
  - Period in minutes to transmit metrics stored in TBS12PC internal memory over LoRa
- Monitoring interval
  - Period in minutes to transmit monitoring information (e.g. battery level) over LoRa to the application server. This must be a multiple of the Transmission Interval.

These parameters are configured with the TBS12PC Configuration Tool.

Intervals are set in minutes from 1min to 1440 minutes (i.e. 24 hours). As TBS12PC proceeds with time alignment, all intervals must comply with following constraint:

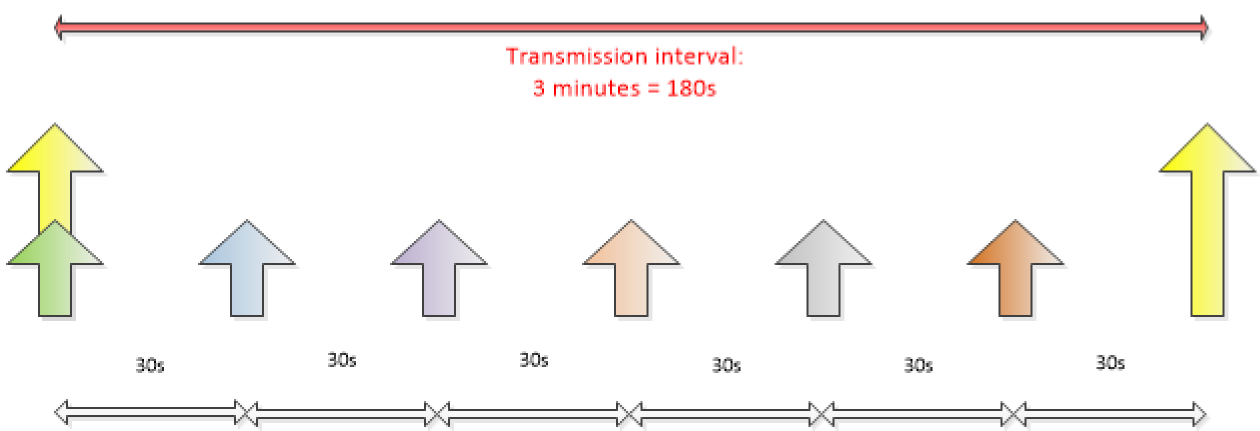
(1440) MODULO (INT_IN_MINUTES) = 0

TBS12PC Staggering

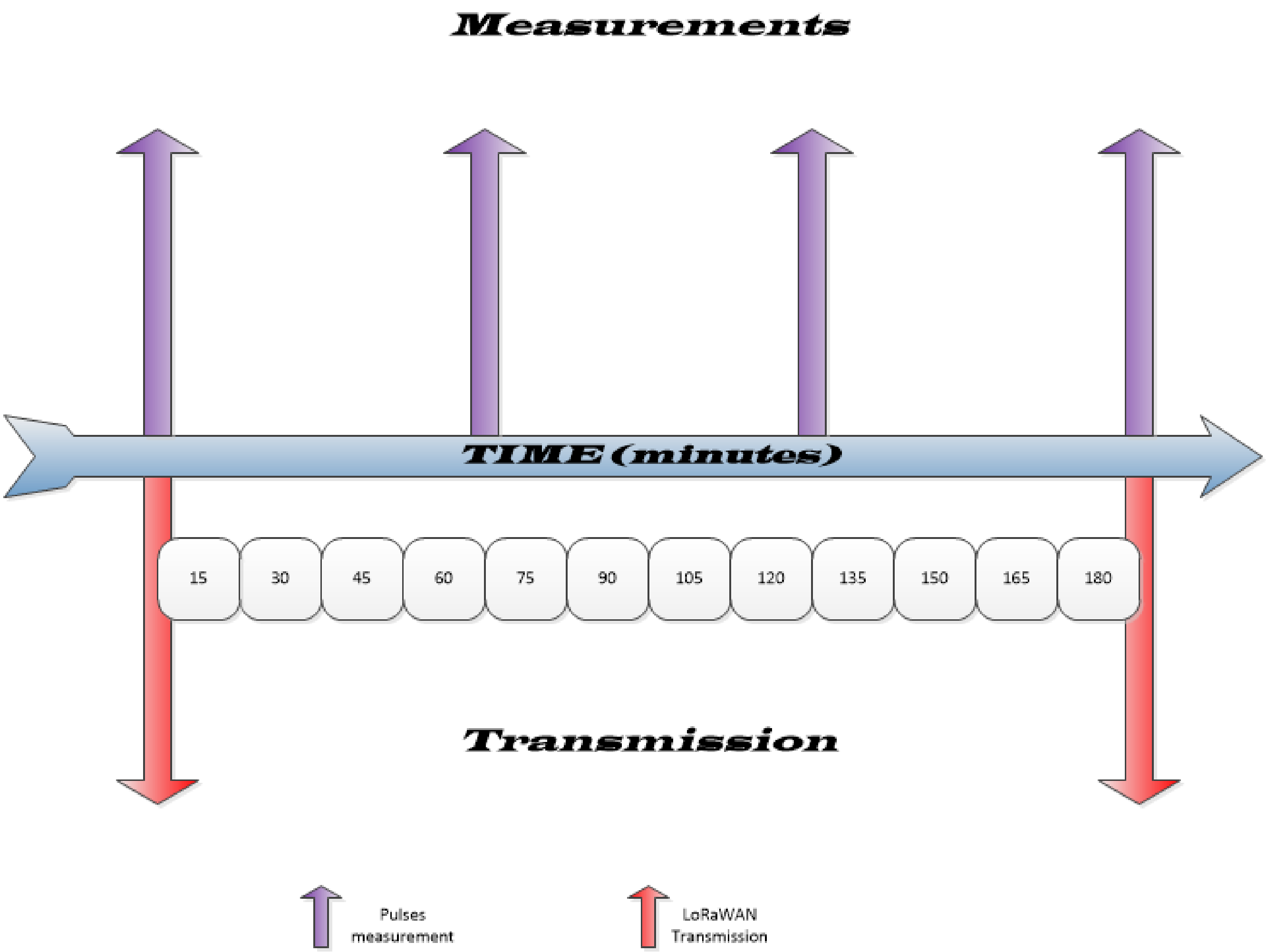
A transmission delay can be set in case multiple TBS12PC are deployed in the same area. Having several TBS12PC sending data at the same time will result in numerous packets collisions, therefore staggering the transmission of each units over the transmission interval will help reducing this effect.

The staggering delay should be carefully chosen so there's no overlap with the next transmission interval.

Following sequence shows 6 TBS12PC units transmitting their data on a 30s slot basis spread over a 3 minutes transmission interval:



Below diagram shows how TBS12PC operates with 30s measurement interval and 3 minutes transmission interval:



3.4.3 Communication outage

Communication outage situations can be mitigated by using LoRaWAN confirmed messages and setting the retry counter accordingly to minize the risk of not getting the ACK from the LoRaWAN server.

3.4.4 Data format

Each measurement stored in internal memory is time stamped.

TBS12PC returns 2 types of messages:

- Measurement message
- Battery reporting message

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Measurement message

This message is a string formatted as follows:

PPYY:MM:DD:HH:MM:SS<SensorID><SubSensorID><Nb of parameters> <PulsesNb> <RainQuantity>

Where:

- <PP>: packet header for TBS12PC measurements reporting (rain gauge or flow meter applications only)
- <YY:MM:DD> is the date with <YY> being the last 2 digits of the year, <MM> the month number and <DD> the date. For example, <18:06:01> is the 1rst of June 2018.
- <HH:MM:SS> is the time represented as hours/minutes/seconds, e.g. 16:25:00.
    - Note: time is 24h format (i.e. no AM/PM representation)
- <SensorID>: index of the pulse input, ‘0’ for P1 and ‘1’ for P2.
- <SubSensorID>: ‘0’ for rain monitoring application and ‘1’ for flow meter application
- <Nb of parameters>: set to ‘2’
- <PulsesNb>: number of pulses measured during the logging period (8 characters representing the hexadecimal value)
- <RainQuantity>:
    - For rain gauge application: amount of rain during the logging period
    - For flow meter application: value of the totalizer
    - Reported in exponential format

Example:

PP18:06:01:16:25:00102 0000000f 1.734000e+01

- Time stamp: 1rst of June 2018 (date) 16:25:00 (time)
- SensorID: 1 (pulse input 1)
- SubSensorID: 0, rain monitoring
- Number of parameters: 2
- Number of pulses: 0x0F = 15 pulses
- Depending on application:17.34
    - Amount of rain (mm)
    - Totalizer (l)

Battery measurement message

This message is a string formatted as follows:

PBYY:MM:DD:HH:MM:SS <Battery_voltage>Where:

- <PB>: packet header for battery voltage parameter
- <YY:MM:DD> is the date with <YY> being the last 2 digits of the year, <MM> the month number and <DD> the date. For example, <18:06:01> is the 1rst of June 2018.
- <HH:MM:SS> is the time represented as hours/minutes/seconds, e.g. 16:25:00.
    - Note: time is 24h format (i.e. no AM/PM representation)
- <0>: separator.
- <Battery_voltage>: battery voltage in V coded over 5 digit including the decimal separator.

Example:

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PB18:06:01:17:00:00 3.600

- Time stamp: 1rst of June 2018 (date) 17:00:00 (time)
- Battery voltage: 3.6V

3.5 Float switch monitoring (TBS12PC-FS only)

3.5.1 Overview

TBS12PC can be used to monitor the state of up to 2 float switches (1 per pulse input).

Default switch state is high level input on the pulse connector (open state).
When TBS12C detects the switch is closed (high to low transition) an alarm is triggered and cleared later when the switch is open again.

It will report when the alarm activates and when it is cleared at two different time through 2 LoRaWAN packets indicating respectively:

- Time when the alarm is activated
- Time when the alarm is cleared + duration of the alarm (i.e. how long the switch was closed)

A keep alive packet is also regularly sent by the device and contains the battery level information.

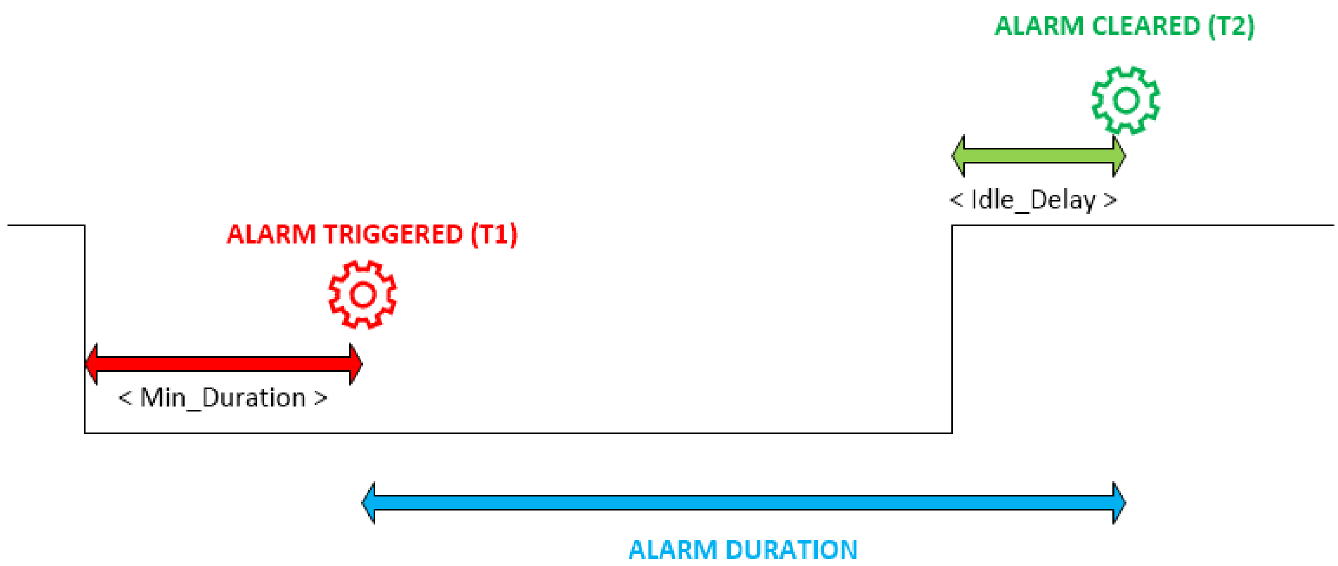
3.5.2 Time intervals

TBS12PC provides flexibility in terms of switch detection time as this depends on the situation:

- When used for monitoring flow in a drainage channel, the water flows very slowly. So the detection does not need to be fast to avoid false alarms. So a response of a few minutes is usual.
- For monitoring of water level in a water trough, a faster response time is usually required (5 to 10 seconds)
- When used for an alarm on a gate or a door, an immediate alarm is needed.
- …

Therefore 2 variable parameters are introduced to handle those situations:

- <Min_Duration>: used to avoid false alarm detection, the system will wait for this delay to expire to confirm the switch is closed and to trigger then the alarm.
- <Idle_Delay>: used to confirm the switch is open again and avoid false detection. After this time the alarm is cleared.



TBS12PC Staggering
Refer to [TBS12PC staggering]

3.5.3 Data format

Each measurement stored in internal memory is time stamped.

TBS12PC returns 2 types of messages:
- Alarm message
- Battery reporting message (keep alive message)

Measurement message
This message is a string formatted as follows:
PPYY:MM:DD:HH:MM:SS<SensorID><SubSensorID><Nb of parameters> <Alarm State> <Duration>
Where:

- <PP>: packet header for TBS12PC measurements reporting (rain gauge or flow meter applications only)
- <YY:MM:DD> is the date with <YY> being the last 2 digits of the year, <MM> the month number and <DD> the date. For example, <18:06:01> is the 1rst of June 2018.
- <HH:MM:SS> is the time represented as hours/minutes/seconds, e.g. 16:25:00.
  - Note: time is 24h format (i.e. no AM/PM representation)
- <SensorID>: index of the pulse input, ‘0’ for P1 and ‘1’ for P2.
- <SubSensorID>: set to ‘2’
- <Nb of parameters>: set to ‘2’
- <Alarm State>: 0=OFF, 1=ON
- <Duration>:

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- Format: in seconds
- ‘0’ if <Alarm State>=’ON’, otherwise actual alarm duration.

Example:

PP18:06:01:16:25:00122 0 153

- Time stamp: 1rst of June 2018 (date) 16:25:00 (time)
- Sensor ID: 1, pulse input 1
- SubSensorID: 2 (float switch application)
- Number of parameters: 2
- Alarm state: OFF
- Duration: 153 seconds

Battery measurement message (keep alive message)

This message is a string formatted as follows:

PBYY:MM:DD:HH:MM:SS <Battery_voltage>

Where:

- <PB>: packet header for battery voltage parameter
- <YY:MM:DD> is the date with <YY> being the last 2 digits of the year, <MM> the month number and <DD> the date. For example, <18:06:01> is the 1rst of June 2018.
- <HH:MM:SS> is the time represented as hours/minutes/seconds, e.g. 16:25:00.
  - Note: time is 24h format (i.e. no AM/PM representation)
- <0>: separator.
- <Battery_voltage>: battery voltage in V coded over 5 digit including the decimal separator.

Example:

PB18:06:01:17:00:00 3.600

- Time stamp: 1rst of June 2018 (date) 17:00:00 (time)
- Battery voltage: 3.6V

3.6 Common report message

It is sent on each transmission interval and reports information related to the platform identification (Device ID and FW version) and the current RSSI.

Message for Common Data Report

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Report ID	Device ID	FW Version	RFU	Sensor Number	Board Status ID	Space character	RSSI
1 byte	*8 bytes*	*8 bytes*	*1 byte*	*1 byte*	*1 byte*	*1 byte*	*RSSI format*

Message's fields:

- Report ID
  - ✓ Description: character 'C' that is the first character of the common report message.
  - ✓ Field size: 1 byte
- Device ID or Node ID
  - ✓ Description: 8 characters identifier.
  - ✓ Field size: 8 bytes
  - ✓ Example: "abcd1234"
- FW Version
  - ✓ Description: firmware version coded over 8 characters.
  - ✓ Field size: 8 bytes
  - ✓ Example: version 04.00.01.0b is encoded as "0400010b".
- Power Supply ID
  - ✓ Description: set to '0'
  - ✓ Field size: 1 byte
  - ✓ **Reserved for future use (RFU).**
- Sensors Number
  - ✓ Description: one character that indicates the number of pulse inputs used (1 or 2)
  - ✓ Field size: 1 byte
  - ✓ Example: '2', pulse inputs 1 and 2 are used.
- Board Status ID
  - ✓ Description: this field indicates if the board has just startup or is running.
  - ✓ Field size: 1 byte
  - ✓ Example: value of this field that can is character 'S' or 'R' (Startup / Running)
- Space character
  - ✓ This field is space character that delimits parameters between the board status ID and RSSI.
  - ✓ Field size: 1 byte
- RSSI
  - ✓ Value format of the RSSI: pd
    - p – the polarity sign (+ or -)
    - d – numeric digits

    The maximum number of digits for a data value is 7, even without a decimal point. The minimum number of digits for a data value (excluding the decimal point) is 1.
  - ✓ Field size: changeable
  - ✓ For example: value of RSSI is -45 that is encoder as "-45".

Example of message for Common Data Report

- Fields:
  - ✓ Report ID: Message for common data reporting. Value of this field is character 'C'.
  - ✓ Device ID: Device ID is 00004AC1 and is encoded as "00004AC1"
  - ✓ FW Version: The firmware version is 04.00.01.0b and is encoded as "0400010b".
  - ✓ RFU: '0'
  - ✓ Sensor Number: number of used pulse inputs, '2'.
  - ✓ Board Status ID: 'R', running.
  - ✓ RSSI: value of RSSI is -53 and is encoded as "-53"
- So the message for common data report is as below:

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C00004AC10400010b02R -53

4 TBS12PC configuration

Before being used, TBS12PC must be configured:

- With ad hoc LoRaWAN ID and ciphering keys to operate on the selected LoRaWAN service provider.
- With LoRa frequencies and data rates corresponding to the area where the head is deployed (subject to loca regulation and as per LoRaWAN standard)
- With optional LoRaWAN parameters like ADR, confirmed/unconfirmed messages, …
- With measurement and transmission intervals

TBS12PC configuration is achieved through a PC application that accesses the device through its external UART port.

When TBS12PC is connected to PC application, its internal date and time are automatically updated. TBS12PC is designed so it can't operate until its date and time have been set through the PC application.

Refer to the TBS12PC PC configuration tool user guide for further information.

5 Electrical Characteristics

Current consumption in sleep mode: 20-25µA

Current consumption is dependant on the configured measurement and transmission transmission intervals and how often the pulse inputs are triggered.

Maximum pulse input voltage: 3V

6 Power Management strategy

When TBS12PC neither measures nor transmits, the MCU goes to sleep mode and LoRaWAN modem is shut down to minimize the power consumption.

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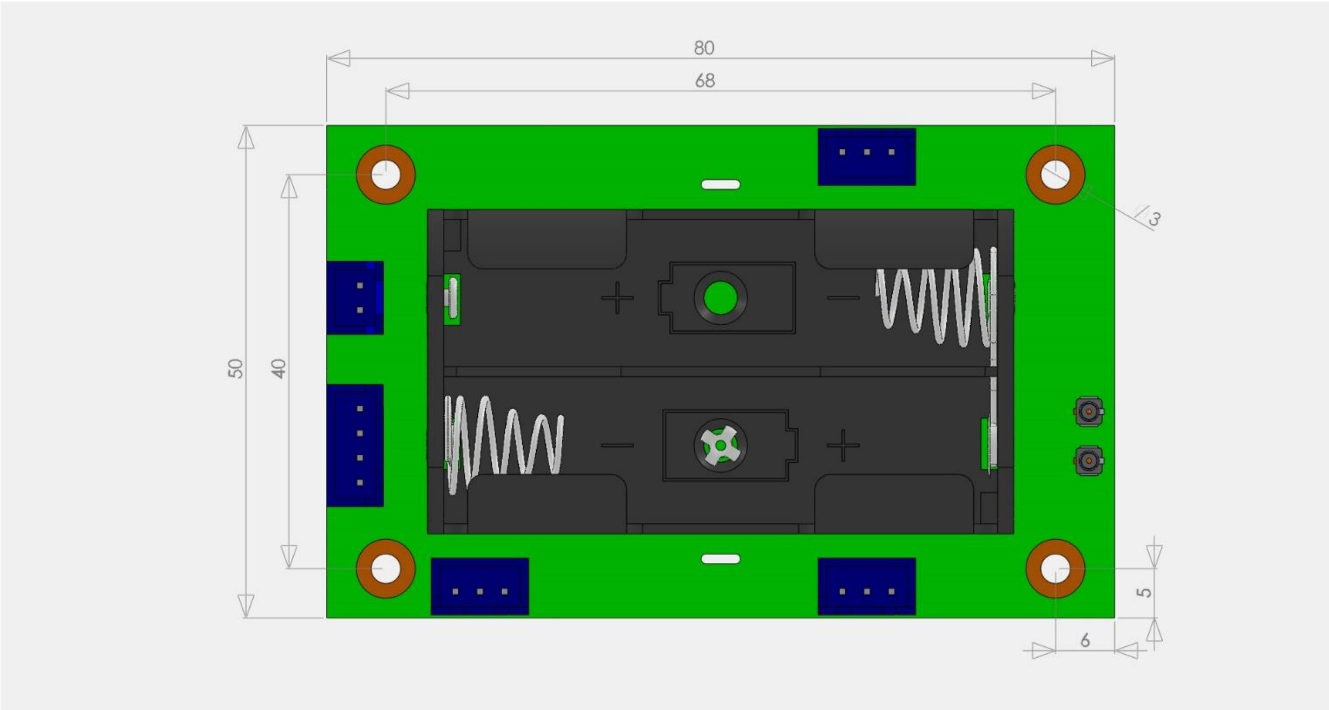
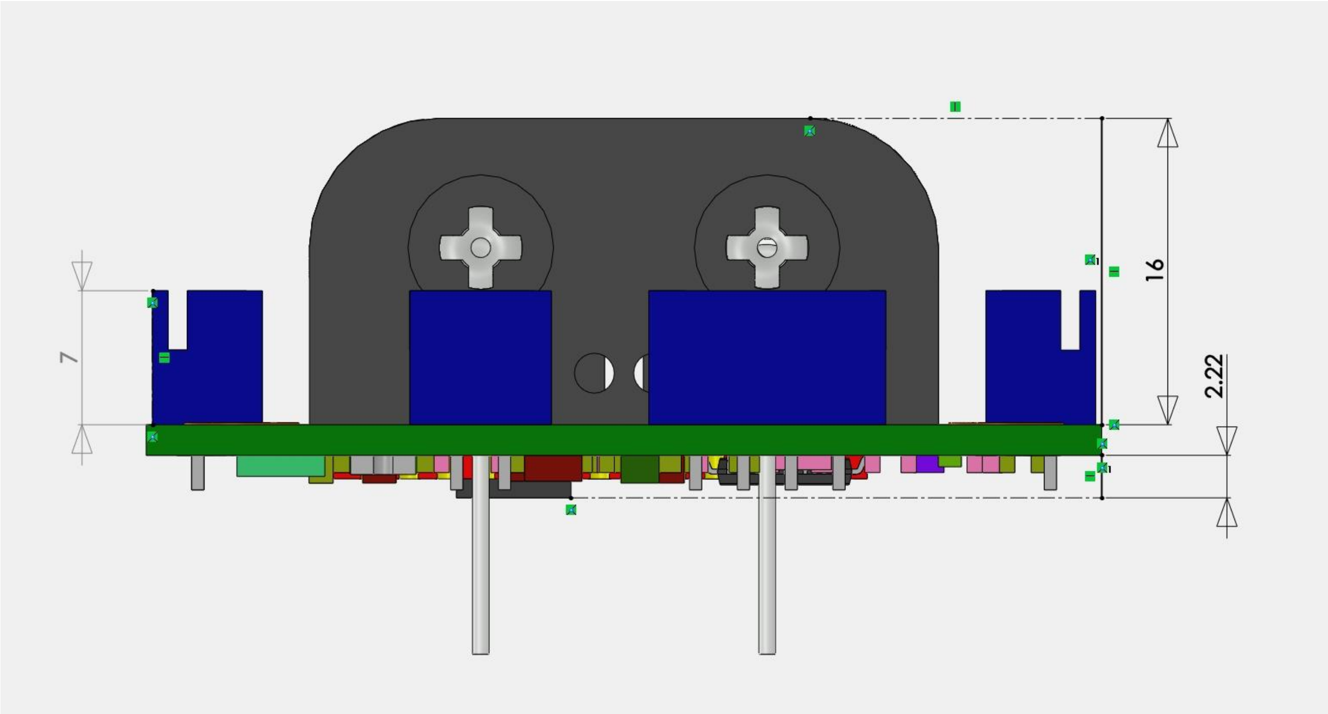
7 Mechanical Specifications





8 LoRaWAN network basics

8.1 Overview

This section provides the TBS12PC user a basic understanding of LoRaWAN key features, so TBS12PC can be integrated smoothly in such ecosystem.

LoRa Alliance describes a LoRaWAN network as follows:

"

LoRaWAN network architecture is typically laid out in a star-of-stars topology in which **gateways** is a transparent bridge relaying messages between **end-devices** and a central **network server** in the backend. Gateways are connected to the network server via standard IP connections while end-devices use single-hop wireless communication to one or many gateways. All end-point communication is generally bi-directional, but also supports operation such as multicast enabling software upgrade over the air or other mass distribution messages to reduce the on air communication time.

Communication between end-devices and gateways is spread out on different **frequency channels** and **data rates**. The selection of the data rate is a trade-off between communication range and message duration. Due to the spread spectrum technology, communications with different data rates do not interfere with each other and create a set of "virtual" channels increasing the capacity of the gateway. LoRaWAN data rates range from 0.3 kbps to 50 kbps. To maximize both battery life of the end-devices and overall network capacity, the LoRaWAN network server is managing the data rate and RF output for each end-device individually by means of an **adaptive data rate** (ADR) scheme.

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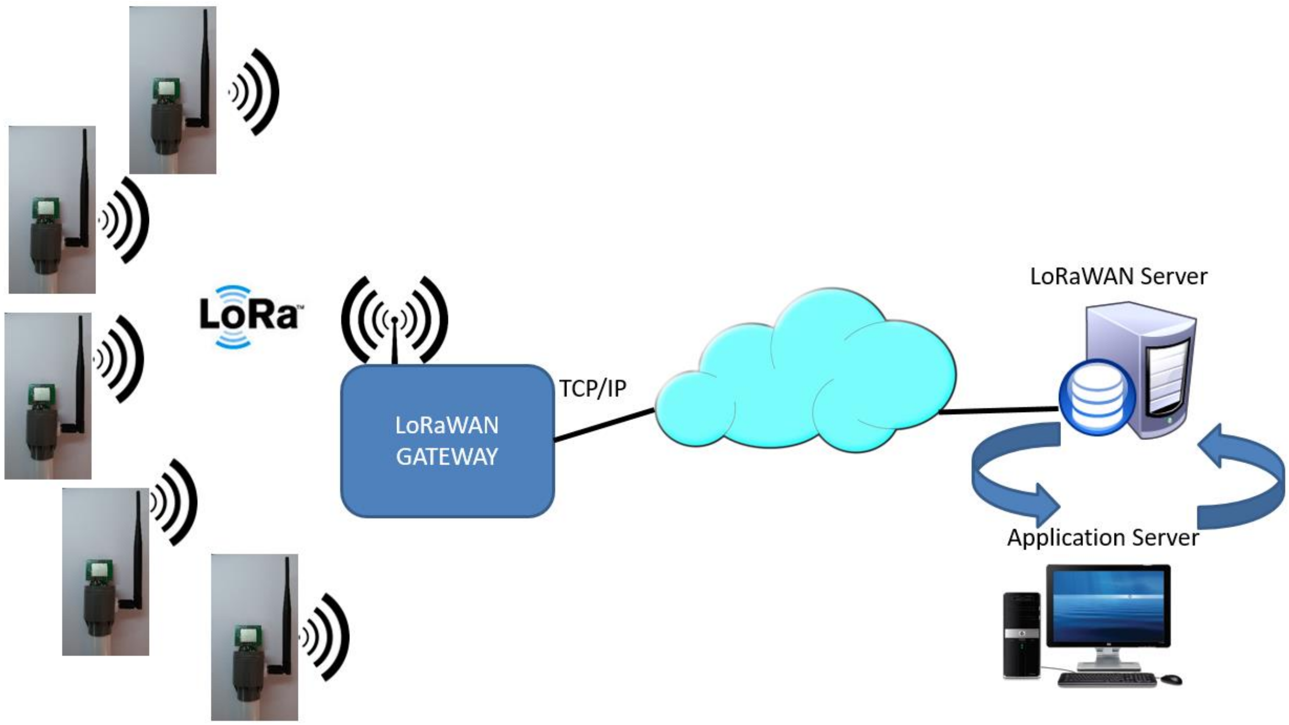
This leads then to a network where each TBS12PC is a unique end node communicating with a gateway as highlighted in below schematics:



Several components are involved in the LoRaWAN network:

- End nodes: this is any end-user device integrating a LoRaWAN modem and communicating with a LoRaWAN gateway. With respect to this, TBS12PC is a end node.
- Gateway: it acts as a packet forwarder between end nodes and LoRaWAN server. It communicates through LoRa radio with end nodes, and through a TCP/IP connection with LoRaWAN server (depending on the gateway capability, this can be achieved with an Ethernet, wifi or cellular connection). One gateway can accommodate thousands of end nodes, and typical range is 2km in urban areas and around 15km in rural areas with clear line of sight.
- LoRaWAN server: this is a service provided by a 3rd party company (hence the user needs to subscribe to such service). As LoRaWAN packets are encrypted, the LoRaWAN server proceeds with deciphering of LoRaWAN packets and make them available to user's application server through various communication protocols (this is totally dependant on the LoRaWAN service provider, but HTTPS, WebSocket and REST are widely used protocols besides direct integration with IoT platforms like Microsoft Azure or AWS IoT). An API is then provided to access deciphered data, device EUI and other radio parameters (usually in JSON or XML format).

8.2 Integrating TBS12PC in a LoRaWAN ecosystem

To build a private network of TBS12PC sensors, it is first required to choose a LoRaWAN gateway (e.g. www.kerlink.com, www.multitech.com, …) and a LoRaWAN services provider (e.g. www.loriot.io, …).

TBS12PC is compatible with any LoRaWAN 1.0.2 certified gateway and network service provider.

This choice is dependant on several criteria:

- Geographic area where the sensors will be deployed: this determines the LoRaWAN frequency plan to be used. The gateway must then have required HW to support these frequencies (e.g. 868MHz, 915MHz, etc…)
- Gateway connectivity: depending on where the gateway will be installed, next options need to be considered,
  - Indoor / outdoor model
  - Connectivity: Ethernet, cellular, wifi
- The LoRaWAN service provider:
  - Needs to support the chosen gateway (because it will be programmed to access the selected LoRaWAN service provider)
  - Must support the frequency plans required by the user
  - Must support the LoRaWAN features required by the user (e.g. LoRaWAN downlink, Class C, OTAA, etc…)
  - Provides a suitable interface for the user so the application server can collect deciphered data (e.g. JSON/XML API reachable through Websocket, REST, etc…)
  - Must be ideally located in the same region where end nodes are deployed, to avoid latenties (e.g. end nodes in Vietnam, LoRaWAN server in Singapore but not in Germany)
  - Support of multiple applications/accounts, scalability of the server, …
  - Pricing model: subscription based, billing per gateway and end nodes, etc…

The next step is to activate each end node so they are identified and can communicate with the LoRaWAN network.

LoRaWAN standard defines 2 ways of activating end nodes:

- Activation By Personalization (ABP): with this configuration, the end node is bound to a specific LoRaWAN network. This mode is supported by default in TBS12PC, and can be compared to a smartphone that is SIM-locked to a specific cellular network.
- Over the Air Activation (OTAA): this configuration is optional on TBS12PC. It gives the end node the “roaming” capability, i.e. the end node is not bound to a specific network, and can be re-activated on different LoRaWAN network through OTAA procedure.

Both activation modes require following identifiers & keys configuration:

Mode	ID/EUI	Key
ABP	DevAddr	NwkSKey, AppSKey
OTAA	AppEUI, DevEUI	AppKey

Note: the generation of DevAddr in ABP mode is dependant on the LoRaWAN service provider. It can be any random value generated by the user, or can be generated from EUI (or other mean) by the LoRaWAN service provider.

Good practice is to define an EUI for an end node, whether it is activated by ABP or OTAA.

8.3 Deploying TBS12PC on the field

It is key having the gateway installed as high as possible to get increased communication range with TBS12PC.

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As TBS12PC is meant to be used in static situations, ADR should not be used and the data rate should be carefully chosen to accommodate with 2 constraints:

- The maximum expected payload size ➔refer to LoRaWAN specification to find the data rate and maximum payload size matching vs used frequency plan.
- The reliability of the transmission depending on the gateway-node range.

9 Environmental Specifications

Symbol	Parameter	Conditions	Min	Max	Unit
T_A	Operating Ambient Temperature Range		-40	+85	°C
T_{STG}	Storage Temperature Range		-40	+85	°C
	Humidity level	Ta=60°C; no condensation	-	95	% R.H

Table 1 – Environmental Specifications

10 ESD Safety

The TBS12PC is a static-sensitive electronic device. Do not operate or store near strong electrostatic fields. Follow guidelines as per EIA/JESD22-A115-A.

11 RoHS Compliance

TBS12PC modules are compliant with the European Union Directive 2002/95/EC Restriction on the Use of Hazardous Substances (RoHS). All designated products have Pb-free terminals.

12 Ordering Information

Part Number	Description
TBS12PC-RG	LoRaWAN Pulse Counter for rain gauge or flow meter monitoring
TBS12PC-FS	LoRaWAN Pulse Counter for float switches monitoring

Contact: sales@tekbox.com

13 History

Version	Date	Author	Changes
V1.0	13.06.2018	Philippe Hervieu	Creation of the document

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V1.1	13.07.2018	Philippe Hervieu	Update pictures
V1.2	18.09.2018	Philippe Hervieu	Update mechanical specifications and system's features
V1.3	24.09.2018	Philippe Hervieu	Float switch feature / Update data format
V1.4	19.12.2018	Philippe Hervieu	Update for TBS12PC revC HW
V1.5	07.01.2019	Philippe Hervieu	Add SensorID/SubSensorID in PP messages
V1.6	09.11.2020	Philippe Hervieu	Update Communication Outage chapter
V1.7	03.03.2021	Philippe Hervieu	Update ordering information (Rain gauge or float switch FW)
V1.8	09.03.2021	Philippe Hervieu	Clarifies TBS12Pc variants (TBS12Pc-RG and TBS12PC-FS)
V1.9	09.05.2023	Philippe Hervieu	Update dead links

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