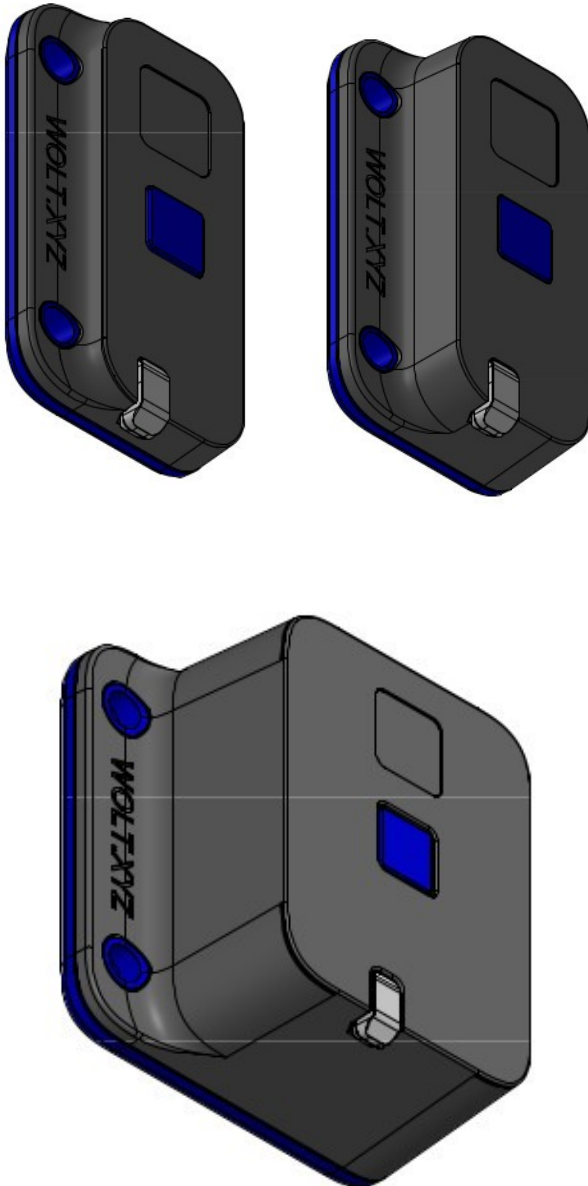


**Ultra low power
D7A / LoRaWAN / UWB
Interactive location Tag**



Description

Combined UWB/D7A-FSK/D7A-LoRa & LoRaWAN battery powered interactive location tag with years-long lifetime.

Communication over long-range LoRaWAN, mid-range D7A-FSK / D7A-LoRa, short range UWB.

RBG LED and button human interface.

Firmware Update Over the Air (FOTA) over D7A.

Low-latency low-power UWB two-way ranging for RTLS systems with up to 10 cm accuracy

Motion sensor: 3-axis accelerometer

NFC Passive Tag. Identification & configuration over NFC

Beaconing & configuration over BTLE

Tap-to-connect protocol

Operating temperature: -40 °C to 85 °C

Current consumption optimized for low power sleep mode: <10µA

IP65 casing

FCC, CE / RED certification

Applications

Indoor assets location with sub-meter precision

Security systems

Industrial monitor and control

Internet of things (IoT)

WizziLab product line at
www.wizzilab.com/products



Sub-GHz modem

Murata CMWX1ZZABZ hardware with WizziLab proprietary firmware

FCC, CE / RED and UKCA certification

Operates in the 868-915 MHz ISM bands

Embedded chip antenna.

Bi-directional DASH7-FSK/LoRa v1.2 Industrial IoT connectivity with 1s latency (www.dash7-alliance.org)

Bi-directional LoRaWAN connectivity (uplink driven).

IoT modulation schemes FSK (1.8bpsk/55kbps) or LoRa(125kHz/SF6 to 10)

Output power up to +13.2 dBm (FSK)+13.1dBm(Lora)

UWB/BLE/NFC Modem

Qorvo DWM1001 hardware with WizziLab proprietary firmware

FCC, CE / RED certification

Low-latency low-power two-way ranging for RTLS systems with up to 10 cm accuracy.

110 / 850 kbps data rate IEEE 802.15.4-2011.

UWB compliant, on channels 3/5.

Embedded PCB UWB antenna.

DASH7 over UWB communication @ 110 / 850 kbps on channels 3/5.

BLE & NFC-A listening device. Tap-to-connect protocol and secured BLE connectivity

Motion sensor: 3-axis accelerometer

Bluetooth® connectivity & chip antenna

Tap-to-connect

Table of Contents

1 Variants.....	5
1.1 WOLT-UWB-S.....	5
1.2 WOLT-UWB-M.....	6
1.3 WOLT-UWB-XL.....	7
2 Functional Description.....	8
2.1 Block Diagram.....	8
2.2 Sub-GHz Modem.....	9
2.3 UM-1 combo UWB/BLE/NFC.....	9
UWB transceiver.....	9
Bluetooth® Microprocessor Nordic nRF52832.....	9
NFC Passive Tag.....	10
Three Axis Motion Detector.....	10
Temperature.....	10
Battery Measure.....	10
2.4 LED.....	10
2.5 Button.....	10
2.6 Power Management.....	10
2.7 Battery.....	10
3 Hardware specification.....	11
3.1 Recommended operating conditions.....	11
3.2 Absolute maximum ratings(1).....	11
3.3 Battery Capacity.....	11
3.4 Lifetime.....	12
4 Wireless Specification.....	13
4.1 Sub-GHz radio.....	13
4.2 UWB radio.....	14
4.3 BLE radio.....	15
4.4 Antennas Performance.....	15
4.5 Certifications.....	15
ECC/RED.....	15
FCC.....	15
5 Application.....	16
5.1 Assets location Tracker.....	16
5.2 Ready to deploy.....	16
5.3 Firmware.....	17
6 Installation.....	19
6.1 Mounting.....	19
Direct Mounting.....	19
Magnets.....	19
Colson Support.....	19
6.2 Activation.....	21
7 The WOLT Family.....	22
8 FCC Caution.....	23
9 Ordering information.....	24
10 Revision history.....	25
11 References.....	26

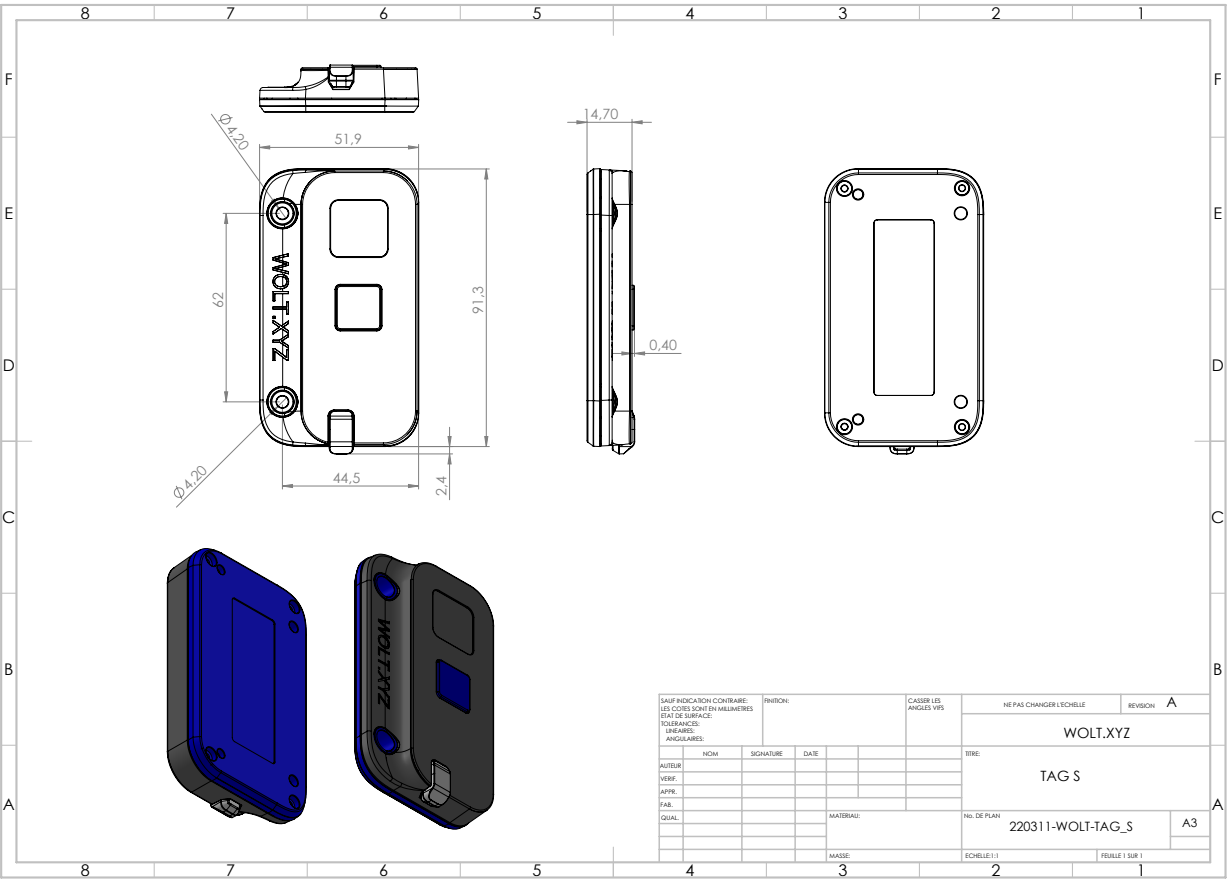
List of tables

Table 1. Recommended operating conditions.....	11
Table 2. Absolute maximum ratings.....	11
Table 3. Battery Capacity.....	11
Table 4. Lifetime (years).....	12
Table 5. Lifetime (locations).....	12
Table 6. DASH7 sub-GHz data rates.....	13
Table 7. DASH7 sub-GHz transmission power.....	13
Table 8. DASH7 sub-GHz reception sensitivity.....	13
Table 9. Ranging error.....	13
Table 10. UWB transceiver operating conditions.....	14
Table 11. UWB data rates.....	14
Table 12. UWB transmission power.....	14
Table 13. UWB ranging error.....	14
Table 14. BLE transceiver operating conditions.....	15
Table 15. Document revision history.....	25

1 Variants

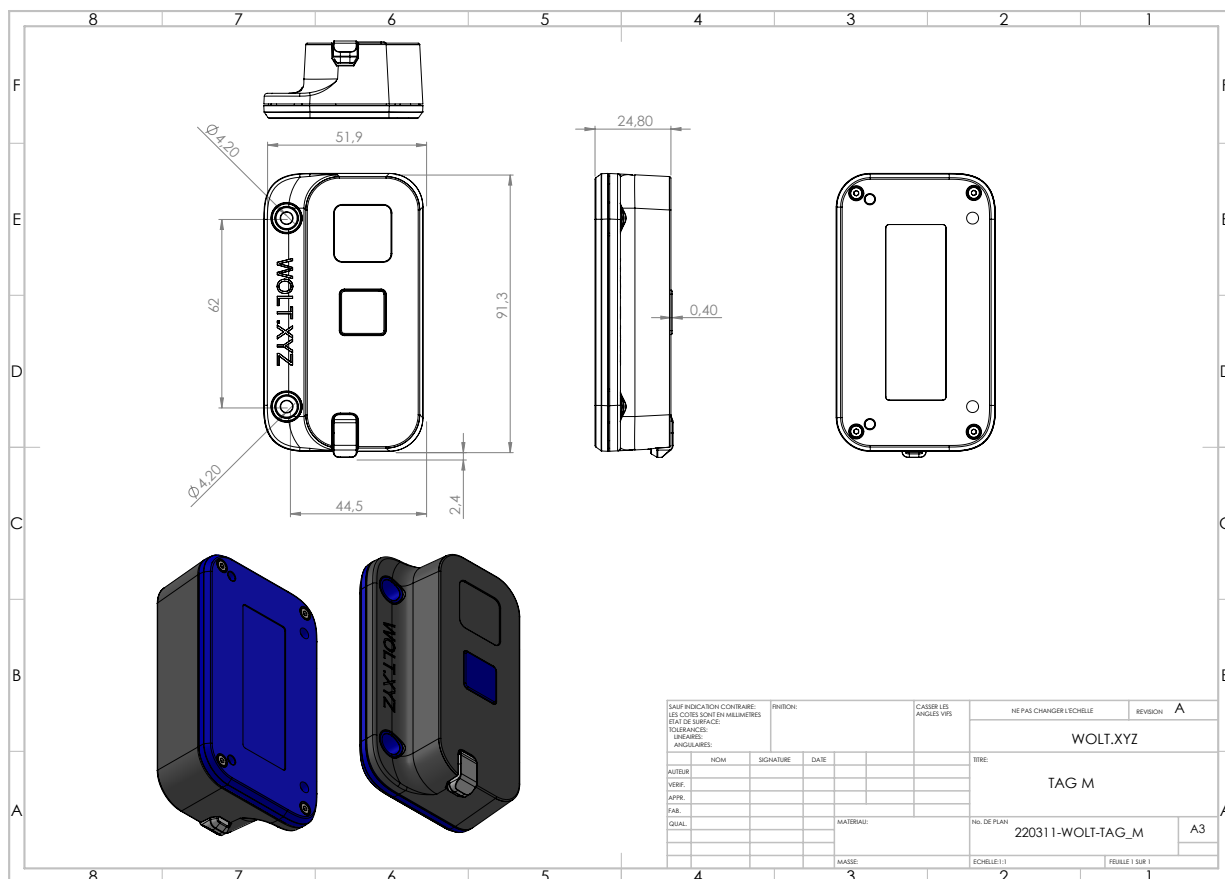
1.1 WOLT-UWB-S

The WOLT-UWB-S is proposed in a 91 x 52 x 5 mm casing respecting the IP65 specification of IEC 529 (Dust and Hose-proof) and powered with a flat LiMnO2 battery with 2300 mAh capacity @3.0V.



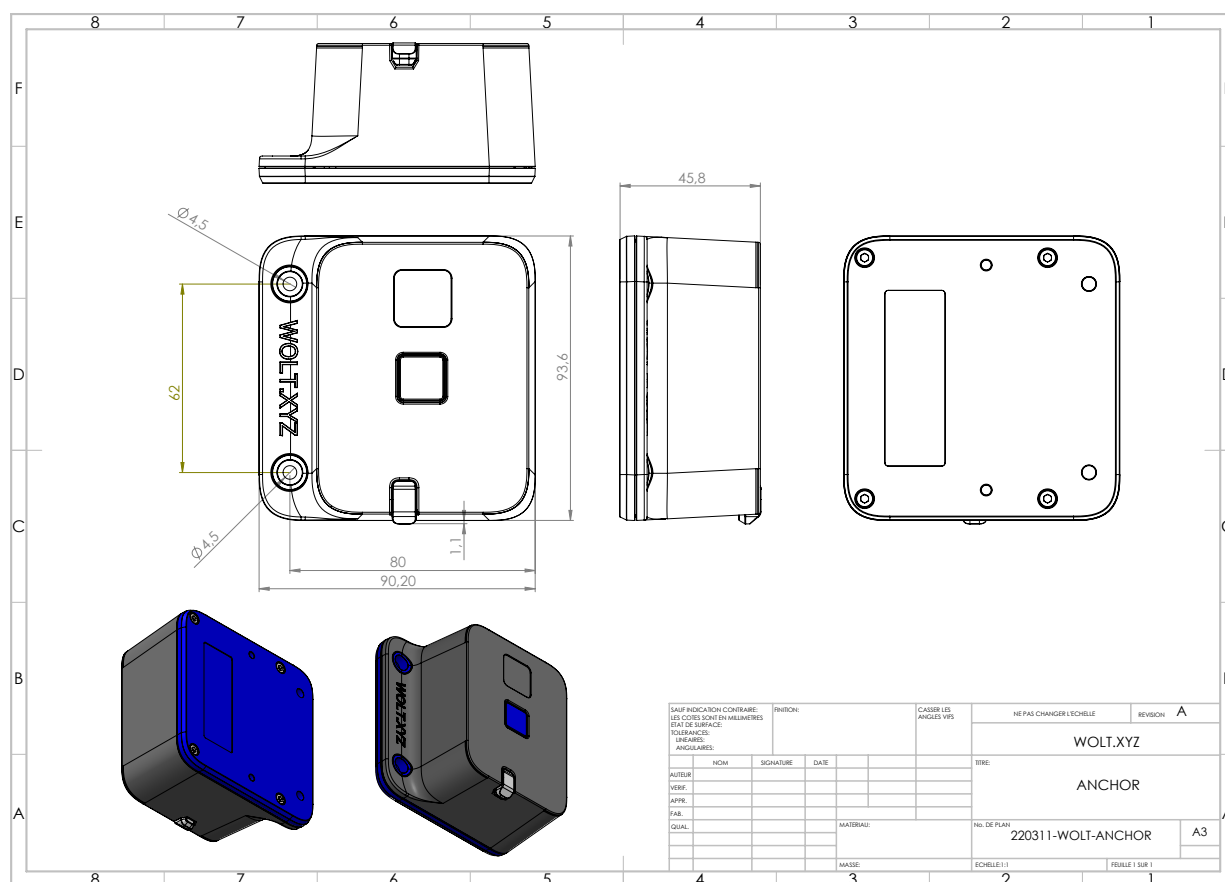
1.2 WOLT-UWB-M

The WOLT-UWB-M is proposed in a 91 x 52 x 25 mm casing respecting the IP65 specification of IEC 529 (Dust and Hose-proof) and powered with a LiSOC12 battery with 5400 mAh capacity @3.6V



1.3 WOLT-UWB-XL

The WOLT-UWB-XL (aka Anchor) is proposed in a 94 x 90 x 46 mm casing respecting the IP65 specification of IEC 529 (Dust and Hose-proof) and powered with a LiSOC12 battery with 38000 mAh capacity @3.6V



2 Functional Description

2.1 Sub-GHz Modem

The device features a combined DASH7-FSK/LoRa & LoRaWAN modem functioning @868 MHz in the RED/EU regulated areas and @915MHz in the FCC regulated areas. It both allows communication over long-range LoRaWAN and mid-range DASH7-FSK/LoRa, and over-the-air configuration and code update using the D7A protocol.

2.2 UM-1 combo UWB/BLE/NFC

The UM-1 Module is a full-function RTLS / wireless modem subsystem in a compact factor, composed of Qorvo DWM1001 hardware, and Wizzilab proprietary firmware. The UM-1 module enables customers to quickly get a RTLS system up-and-running, also provides additional over-the-air communication capabilities through the UWB, BLE and NFC interfaces. The UWB part of the system is designed to operate on 4.493 GHz (IEEE 802.15.4- 2011, Channel 3) and 6.490 GHz (IEEE 802.15.4- 2011, Channel 5) Nominal Centre Frequencies with a 500 MHz Bandwidth and data rates of 110 kbps and 850 kbps. It also features a BLE modem and a passive NFC-A listening device.

The UM-1 module comes loaded with embedded firmware which provides two-way ranging (TWR) and BLE (tap-to-connect, beaconing and sniffing in Eddystone and iBeacon format) functions. The firmware is available as a non-modifiable library, which provides a function API. This allows to execute the host firmware directly on the MCU of the UM-1.

UWB transceiver

The UM-1 module has a DW1000 UWB transceiver mounted on the PCB. The DW1000 uses a 38.4 MHz reference crystal. The crystal has been trimmed in production to reduce the initial frequency error to approximately 3 ppm, using the DW1000 IC's internal on-chip crystal trimming circuit. Always-On (AON) memory can be used to retain DW1000 configuration data during the lowest power operational states when the on-chip voltage regulators are disabled. This data is uploaded and downloaded automatically. Use of DW1000 AON memory is configurable.

The on-chip voltage and temperature monitors allow the host to read the voltage on the VDDAON pin and the internal die temperature information from the DW1000.

See the DW1000 Datasheet [2] for more detailed information on device functionality, electrical specifications and typical performance.

Bluetooth® Microprocessor Nordic nRF52832

The nRF52832 is an ultra-low power 2.4 GHz wireless system on chip (SoC) integrating the nRF52 Series 2.4 GHz transceiver and an ARM Cortex-M4 CPU with 512kB flash memory and 64kB RAM.

See the nRF52832 datasheet [1] for more detailed information on device functionality, electrical specifications and typical performance.

NFC Passive Tag

Allows identification & configuration over NFC

Three Axis Motion Detector

The LIS2DH12 is an ultra-low-power high performance three-axis linear accelerometer with digital I2C/SPI serial interface standard output. The LIS2DH12 has user selectable full scales of $\pm 2g/\pm 4g/\pm 8g/\pm 16g$ and is capable of measuring accelerations with output data rates from 1 Hz to 5.3 kHz. The self-test capability allows the user to check the functionality of the sensor in the final application. The device may be configured to generate interrupt signals by detecting two independent inertial wake-up/free-fall events as well as by the position of the device itself.

The LIS2DH12 is guaranteed to operate over an extended temperature range from -40°C to $+85^{\circ}\text{C}$.

See the LIS2DH12TR Datasheet [4] for more detailed information on device functionality, electrical specifications and typical performance.

Temperature

On board temperature sensor.

Battery Measure

On board battery measure circuit.

2.3 LED

On board RGB LED with integrated controller.

2.4 Button

On board button for human-machine interaction.

2.5 Power Management

On board power management circuit with DC-DC converters down to 2.8V to optimize power consumption.

2.6 Battery

The WOLT-UWB comes in three different versions, S/M/XL, mounted with batteries with increasing capacity.

3 Hardware specification

3.1 Recommended operating conditions

Table 1. Recommended operating conditions

Symbol	Parameter	Min.	Typ.	Max.	Units
T _A	Operating ambient temperature range	-40	-	85	°C

3.2 Absolute maximum ratings⁽¹⁾

Table 2. Absolute maximum ratings

Symbol	Parameter	Min.	Typ.	Max.	Units
T _{STG}	Storage temperature range	-40	-	85	°C

(1) Stresses beyond those listed under absolute maximum ratings may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other conditions beyond those indicated under recommended operating conditions is not implied. Exposure to absolute–maximum–rated conditions for extended periods may affect device reliability.

3.3 Battery Capacity

The WOLT-UWB comes in three different versions, S/M/XL, with increasing battery capacity.

Table 3. Battery Capacity

Variant	Voltage	Capacity
WOLT-UWB-S	3.0V	2.3 Ah
WOLT-UWB-M	3.6V	5.4 Ah
WOLT-UWB-XL	3.6V	38 Ah

3.4 Lifetime

The power consumption is shared between a permanent routine (regular sub-GHz radio channel carrier sense, regular sensors measurements, regular keep-alive) and an event driven routine (location). The lifetime will vary depending on the actual usage.

Table 4. Lifetime (years)

Symbol	Operation Mode	Min.	Typ.	Max.	Units
$T_{LIFE,S}$	Static tag	-	3 ⁽¹⁾	-	years
$T_{LIFE,M}$	Static tag with pick-to-light	-	3 ⁽²⁾	-	years
$T_{LIFE,XL}$	Dynamic tag	-	3 ⁽³⁾	-	years
$T_{LIFE,XL,A}$	Anchor	-	5 ⁽⁴⁾	-	years

(1) one location every 5 minutes.

(2) one location every 90s, one pick-to-light per hour

(3) one location every 5s, with duty 33 %

(4) one two-way ranging every 5 s.

Table 5. Lifetime (locations)

Symbol	Operation Mode	Min.	Typ.	Max.	Units
$L_{LIFE,S}$	Static tag	-	0.1	-	Mlocs ⁽¹⁾
$L_{LIFE,M}$	Static tag with pick-to-light	-	1	-	Mlocs
$L_{LIFE,XL}$	Dynamic tag	-	10	-	Mlocs
$L_{LIFE,XL,A}$	Anchor	-	10	-	MTWR ⁽²⁾

(1) locations x 1 million. One location is composed of 1 D7A discovery (wake-up), typically 4 UWB distance two-way rangings and 1 report to the location server over the D7A LAN.

(2) UWB two-way rangings x 1 million.

4 Wireless Specification

4.1 Sub-GHz radio

The DASH7 modem has several data rates and modulation scheme available to better fit any kind of application.

Table 6. DASH7 sub-GHz transmission power

Condition	Max TX power	Units
ECC/RED regulations	+14	dBm
FCC regulations	+13.1(Lora) +13.2(FSK)	dBm

Table 7. Ranging error

Symbol	Parameter	Min.	Typ.	Max.	Units
E _{DIST-D7A}	Location error (1) based on power attenuation (link budget)	-	10	-	m
E _{DIST-LWAN}	Location error (1) based on power	-	1000	-	m

	attenuation (link budget)				
--	---------------------------	--	--	--	--

(1) Highly depends on anchor / gateway density, line-of-sight conditions, operator.

4.2 UWB radio

Table 8 . UWB transceiver operating conditions

Symbol	Parameter	Min.	Typ.	Max.	Units
B _{UWB}	RX/TX frequency range	4493		6490	MHz
P _{DSP}	Output power spectral density			-41.3	dBm/MHz
P _{TX}	Output Channel Power		-17		dBm/500MHz
P _V	Output power variation with temperature	-1		+1	dB
P _{RX}	Receiver power			0	dBm

Table 9 . UWB data rates

Modulation scheme	Parameter	802,154a channel	Data Rate	Units
UWB	ECC and FCC	#5 (6.4 GHz)	110000	bps
	ECC and FCC	#5 (6.4 GHz)	850000	bps

Table 10. UWB transmission power

Condition	Max TX power	Units
FCC/ECC/RED regulations, PRF16	0	dBm
FCC/ECC/RED regulations, PRF64	0	dBm

Table 11. UWB ranging error

Symbol	Parameter	Min.	Typ.	Max.	Units
E _{DIST-TWR}	Two-way ranging error (1)	-	30	-	cm
E _{DIST-TDOA}	Time difference of arrival ranging error (2)	-	30	-	cm

(1) two-way ranging by time of flight estimation without preliminary clock synchronization between the tag and the anchor, according to Decawave's application note APS013. (2) Depends on inter-anchors' synchronization accuracy

4.3 BLE radio

Table 12. BLE transceiver operating conditions

Symbol	Parameter	Min.	Typ.	Max.	Units
B _{BLE}	RX/TX frequency range	2402		2480	MHz
P _{TX}	Output Channel Power			2.41	dBm

4.4 Antennas Performance

Refer to the detailed description in the DWM1001 Datasheet [5].

4.5 Certifications

ECC/RED

If deployed in Europe, the WOLT-UWB is provided with ECC/RED certified network profiles for all active radios.

FCC

If deployed in countries regulated by FCC, the WOLT-UWB is provided with FCC certified network profiles for all active radios.

5 Application

5.1 Assets location Tracker

The WOLT-UWB can be used for efficient medium-to-high precision tracking due to the combination of long / mid / short range connectivity. It is also useful for identification due to its NFC & BTLE connectivity. The UWB ranging provides high location accuracy up to 30 cm.

Depending on battery capacity, the application is configured in one of the following operation modes :

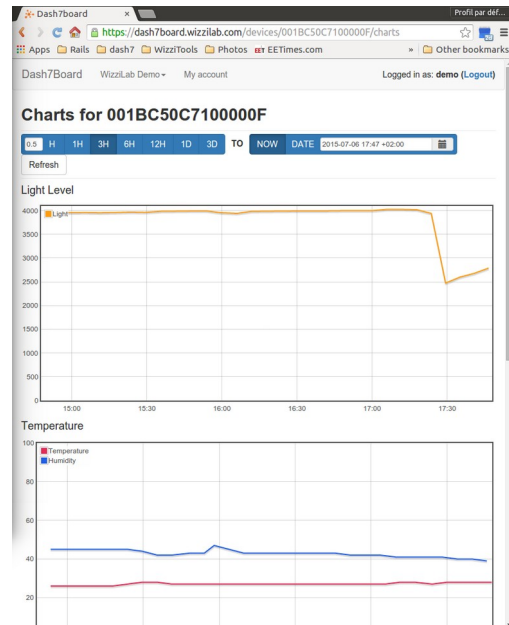
- **Static tag** – performs location on transition from motion to stable.
- **Static tag with pick-to-light** – performs location on transition from motion to stable. Turn on LED pattern up to 12 times a day.
- **Dynamic tag** – performs location continuously during motion.
- **Anchor** - location reference

Refer to the lifetime limitations in the Hardware Section.

5.2 Ready to deploy

The WOLT-UWB is suited for proof of concept, pilot and volume applications. By default, it is provisioned with LoRaWAN credentials for TTN (www.thethingsnetwork.org). For DASH7 communication, Wizzilab provides infrastructure for easy D7A network deployment. The WOLT-UWB seamlessly connects to the Wizzilab's DASH7 Industrial IoT platform.

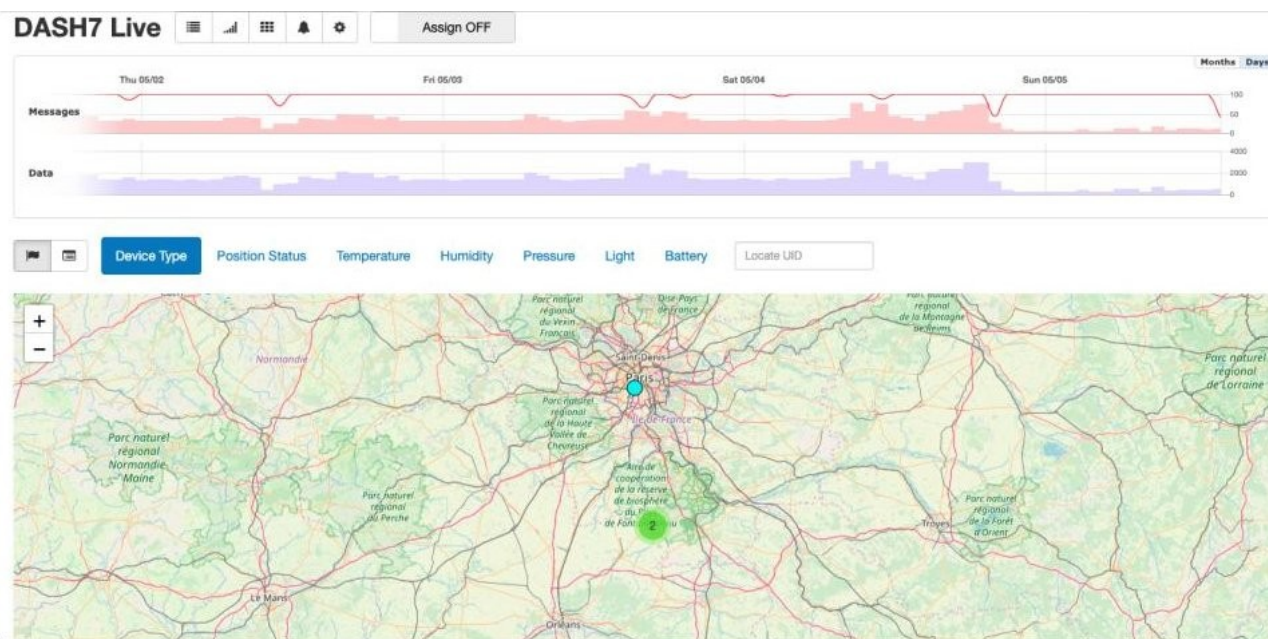
For details visit our website : www.wizzilab.com/products



DASH7 Access Point (gateway) and Network Management Platform
(<https://dash7board.wizzilab.com>)

5.3 Firmware

The WOLT-UWB is provided with configurable firmware, allowing to select beacon rates, beacon conditions (motion detection, ...) and beacon networks (LoRaWAN and/or D7A). Downlink access over D7A and LoRaWAN is available for static / dynamic configuration, FOTA and actuation (LED blinking). Identification over NFC is available as well.



DASH7 Logistics Management Platform (<https://dash7board.wizzilab.com>)

6 Installation

6.1 Mounting

Direct Mounting

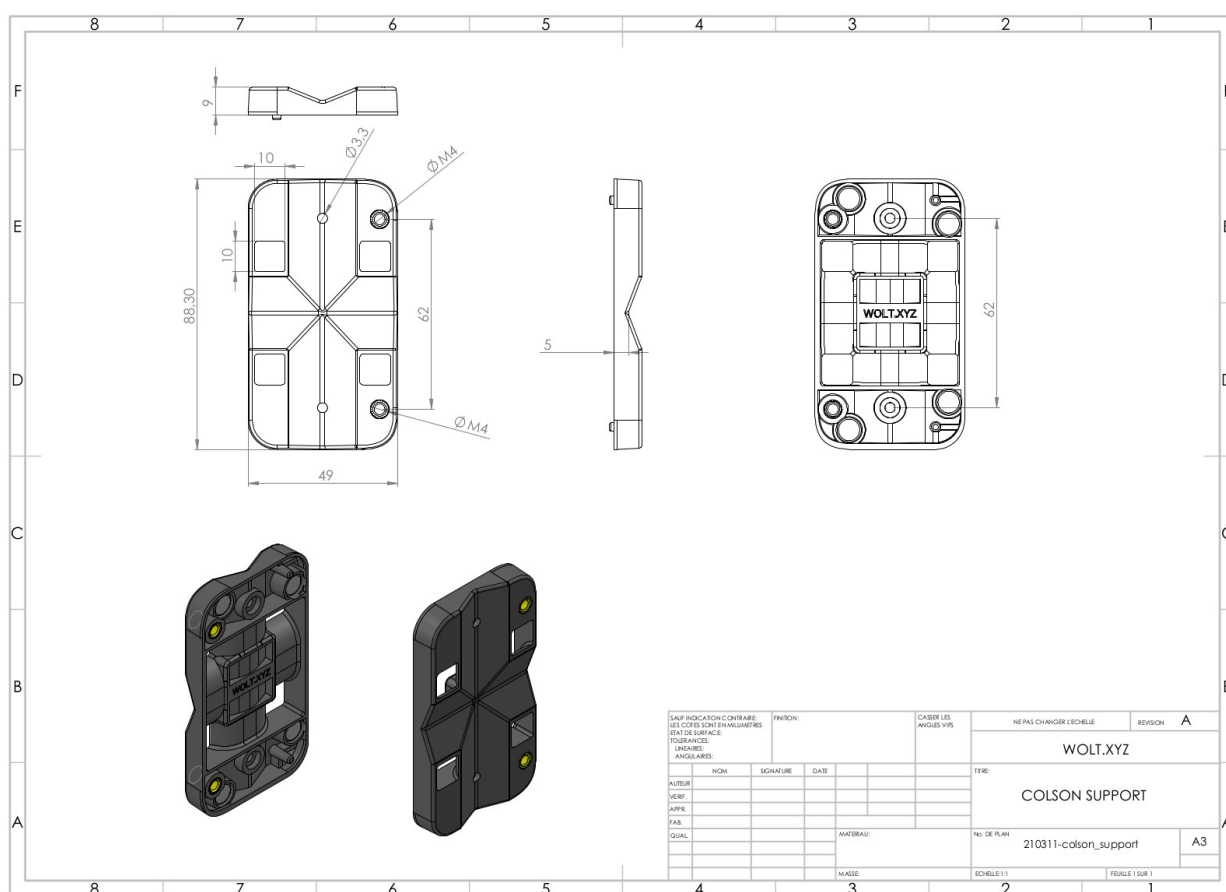
Device can be fixed directly to a mount by screwing through the available M4 holes.

Magnets

The bottom side of any casing can be optionally equipped with magnets, allowing to stick to metallic plates.

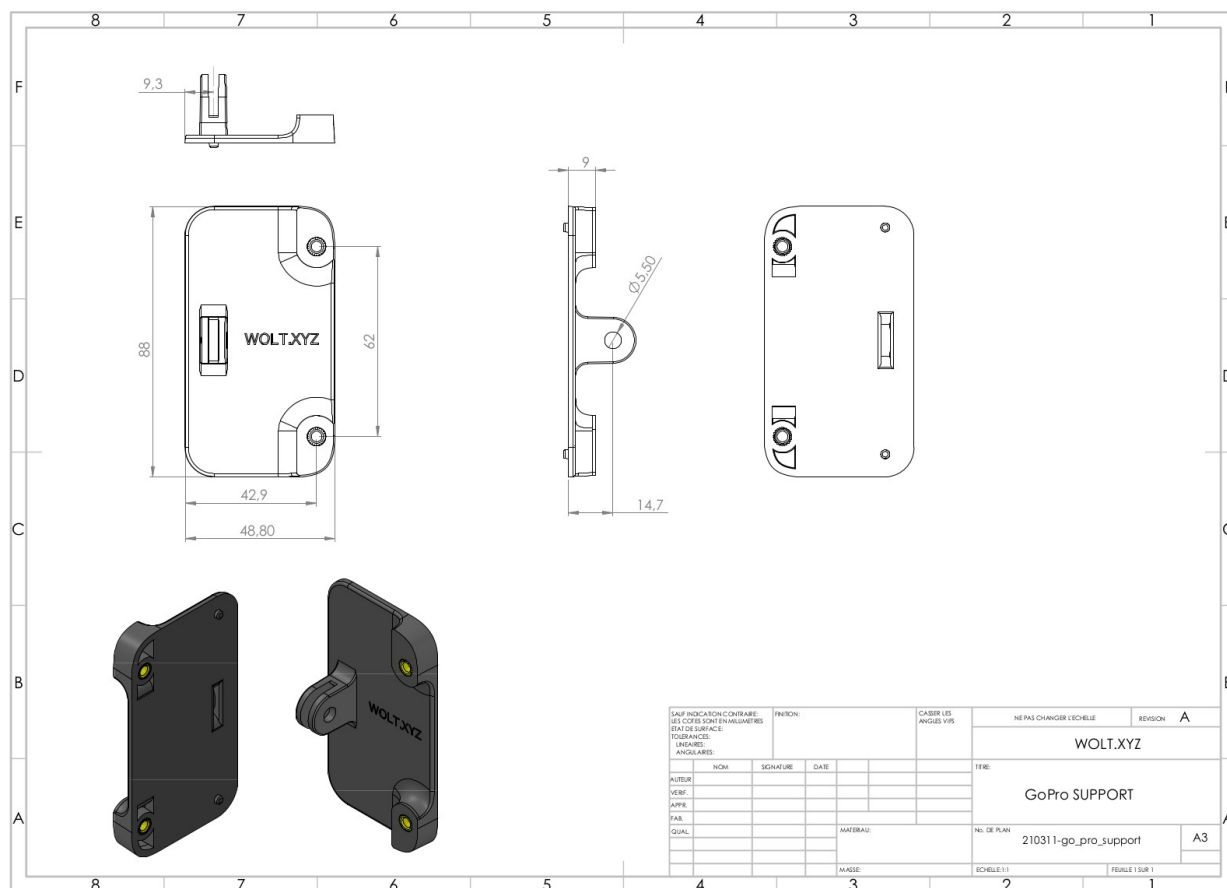
Colson Support

A Colson accessory can be affixed to the device, compatible with all casing versions.



Go-Pro Support

A Go-Pro accessory can be affixed to the device, compatible with all casing versions.



6.2 Activation

By default devices are produced and shipped in shelf mode. They need to be activated on the dash7board.

Configuration
☐ Flush Enabled
Read All

MODE ⓘ
ACTIVE
Read
Write

LED Duration ⓘ
Nat 30
Read
Write

Sleep Duration ⓘ
Nat 0
Read
Write

Wakeup threshold ⓘ
Nat 4
Read
Write

Beacon Status

Beacon Configuration
☐ Flush Enabled
Read All

Period stable ⓘ
Nat 1800
Read
Write

Period motion ⓘ
Nat 120
Read
Write

Beacon ITF enable ⓘ
☒ ☒ ☒ ☒ ☒
Read
Write

Beacon force ⓘ
☐ ☐ ☐ ☐ ☐
Read
Write

Scan Enable ⓘ
BOTH
Read
Write

Scan cells ⓘ
Nat 3
Read
Write

ITF 0 ⓘ
ITF A
Read
Write

ITF 1 ⓘ
ITF B
Read
Write

ITF 2 ⓘ
ITF C
Read
Write

ITF 3 ⓘ
ITF D
Read
Write

ITF 4 ⓘ
ITF E
Read
Write

For details, follow the instruction at : <https://wizzilab.com/wiki/#!hardware/wolt-uwb.md>

7 The WOLT Family

The WOLT trackers family also includes the WOLT-D7A dual mode FSK/LORA tracker with precision up to 3m.

For details visit our website : www.wizzilab.com/products

8 FCC Caution

Any Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

This equipment may only be operated indoors. Operation outdoors is in violation of 47 U.S.C. 301 and could subject the operator to serious legal penalties.

IMPORTANT NOTE:

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

FCC Radiation Exposure Statement:

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator & your body.

9 Ordering information

Contact us at : contact@wizzilab.com

Or visit our website: <http://www.wizzilab.com/products>

10 Revision history

Table 15. Document revision history

Date	Revision	Changes
2022-05-13	0.1	Document creation based on WOLT-D7A and UM-1 datasheets
2022-06-21	0.2	Feedback from certification process
2022-06-28	0.3	Feedback from certification process
2022-11-01	0.4	Specific FCC additions
2022-12-28	0.5	Fix typos
2023-01-13	0.6	Fix FCC power level

11 References

- [1] nRF52832 Product Specification v1.3 www.nordicsemi.com
- [2] Decawave DW1000 Datasheet www.decawave.com
- [3] Decawave DW1000 User Manual www.decawave.com
- [4] STMicroelectronics LIS2DH12TR www.st.com
- [5] Decawave DWM1001 Datasheet www.decawave.com
- [6] ALP specification v1.2 www.dash7-alliance.org
- [7] D7A specification v1.2 www.dash7-alliance.org