

LinkTag20

Manual

Revision History

Date	Version	Description
Nov 14, 2025	V 1.0	Initial version
Nov 30, 2025	V 1.1	Updated with FW 1.0.3 specifications and hardware photos
Feb 3, 2026	V 1.2	Updated with FW 1.0.5 specifications
Mar 5, 2026	V 1.3	Updated with technical specifications and regulatory information for Mexico IFT certification compliance.
Mar 6, 2026	V 1.4	Added FCC compliance and RF exposure statement (Section 8).

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1. Product Introduction

1.1 Overview

The LinkTag20 is a fully autonomous GPS tracking device operating in the LoRaWAN US915 band. It is designed for the long-range wireless transmission of location and device status data with minimal user interaction.

The device periodically acquires GNSS coordinates, evaluates movement using an integrated IMU, and transmits the location, battery status, and operational metrics to the LoRaWAN network via unconfirmed uplink messages. It automatically determines its operational state (Standing or Moving) and adjusts its reporting interval accordingly to maximize power efficiency.

Once deployed, the device operates independently in outdoor environments without requiring additional configuration or control by the user. This makes the LinkTag20 suitable for asset tracking, equipment monitoring, infrastructure management, and other field applications.

The LinkTag20 is a high-performance, solar-assisted wireless tracking device designed for long-range asset monitoring and data logging. The product is intended to be used by end-users without requiring disassembly, modification, or access to the internal firmware interface.

1.2 Features

- **LoRaWAN US915 Compliance:** Supports LoRaWAN 1.0.3 in the US915 frequency band using the Quectel KG200Z module. All application data is transmitted via unconfirmed uplink messages.
- **High-Precision GNSS:** The integrated Quectel LC76G GNSS receiver provides accurate latitude and longitude data.
- **Autonomous Operating Cycle:** Upon activation, the device continuously performs GNSS acquisition, data transmission, and low-power standby mode in a fully automated manner.
- **Integrated Motion Detection:** Equipped with a TDK ICM-42670-P IMU that allows for reliable Standing/Moving state classification and motion-triggered activation.
- **Adaptive Reporting Logic:** Reporting intervals are automatically adjusted based on the device's movement state to optimize battery life.
- **Low Power Design:** Utilizes RTC-based wake-up scheduling and STOP2 low-power mode for an extended operational lifespan.
- **Outdoor Environmental Resistance:** Designed to withstand temperature variations, humidity, and dust exposure typical of long-term outdoor installations.
- **Reliable Data Retention:** The device stores uplink data in its internal Flash memory only when a connection attempt fails (e.g., gateway out of range). Stored data is buffered and retransmitted during the next successful cycle.
- **Optional Solar Charging:** Supports supplementary charging via an external photovoltaic module.

1.3 Regulatory and Safety Information

Regulatory Compliance

This device is designed to comply with international regulations applicable to radiocommunication equipment, including the requirements established by the IFT of Mexico and other regional authorities. The device must be operated in accordance with the instructions provided in this manual.

Any unauthorized modification, disassembly, software alteration, or replacement of parts may void the regulatory approval, certification status, and manufacturer's warranty. Users are prohibited from making changes that may affect radio performance, frequency operation, transmission characteristics, or the security functionality of the device. Only accessories, antennas, and components approved by the manufacturer should be used.

Safety Instructions

- Do not expose the device to excessive heat or fire for prolonged periods.
- Do not submerge the device in water unless it is specifically rated as waterproof.
- Do not operate the device in environments with explosive gases or flammable materials.
- Do not attempt to open, disassemble, puncture, repair, or modify the device or its internal battery.
- Avoid dropping or subjecting the device to strong physical shocks.
- Keep the device out of reach of children and pets.
- Dispose of the device and internal battery in accordance with local e-waste recycling regulations.
- If abnormal heat, smoke, swelling, noise, or odor is detected, contact authorized service personnel immediately.

2. Hardware Introduction

2.1 Development Specifications

NO.	Descriptions	SPEC	NOTE
1	LoRa RF Frequency	902.3MHz ~ 927.5MHz (200kHz)	
2	Spreading Factor	SF 7	
3	Total Channels	127 Channels	FCC certified range
4	LoRa Bandwidth	125kHz	
5	LoRa RF TX Power	20dBm	
6	BATTERY	Li-Polymer (3.7V/4000mAh)	
7	Solar Charging	Vmp 6V / Imp 167mA	
8	GNSS	L1	
9	LoRa Communication Range	Up to 10km	Open area
10	LoRa Antenna	PCB Antenna	
11	GNSS Antenna	Patch Antenna	
12	Flash Memory	32MB	Configurable storage up to 15 days. FIFO structure.

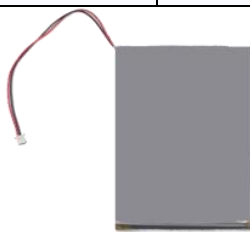
The RF hardware supports configurable channel allocation; however, the regulatory operating configuration is defined in Section 5.2.

2.2 Hardware Components

Component	Indicator	Function	Description
LED	GNSS	GNSS Indicator	Indicates GNSS function status and satellite positioning.
LED	LORA	LoRa Indicator	Indicates LoRaWAN communication and data transmission status.
LED	PWR	Charge Indicator	Shows the current battery charge and power status.
Solar CELL		Solar Module	High-efficiency solar panel for supplementary charging.
Battery		Rechargeable Battery	Internal battery (3.7V/4,000mAh) that powers the device.



Solar CELL



Battery



LinkTag20

3. Device Installation

3.1 Power Activation and Network Preparation

- **Simple Activation:** The device does not require special manual procedures. Upon applying battery power, it automatically begins to operate according to the flow described in Section 4.
- **Mandatory Network Configuration:** To comply with IFT regulations, the device must be registered on the authorized LoRaWAN gateway server prior to deployment.
- **Boot Signal:** Confirm the status by observing that the GNSS and LoRa LEDs blink once simultaneously immediately after power is applied.

3.2 Physical Mounting and Orientation

- **Upward Orientation:** The device must be installed with the Solar Cell facing upwards (directly towards the sky).
- **Optimal Performance:** This orientation is essential for the internal GNSS antenna to maintain a line of sight with satellites and for the Solar Cell to charge the battery.
- **Secure Fixation:** Firmly attach the device to a flat surface using high-strength adhesives or screws.

3.3 Firmware Management

The firmware comes pre-installed from the factory. Any maintenance is performed exclusively by authorized personnel. Debugging or ST-LINK instructions are omitted from this manual.

4. Operation and Working Principle

4.1 Summary of Operating Modes

Mode	State	Function
Install	-	Verification mode for GNSS/LoRa via LEDs during deployment.
General	Standing	Low-power mode activated when no movement is detected.
General	Moving	Active tracking mode triggered by movement.

4.2 Automatic Operation Flow

Upon field deployment, LinkTag20 operates autonomously based on its embedded algorithms without requiring manual user intervention. The operational phases are divided into Install Mode for initial verification and General Mode for real-time operation.

4.2.1 Install Mode (Installation and Field Verification)

Designed for installers to verify data acquisition and communication immediately upon deploying the device.

[Detailed Operational Flow]

1. **Power Application (ON):** The system initiates booting. Upon completion, the GNSS and LoRa LEDs blink once.
2. **GNSS Positioning:** Performs positioning for a maximum of 2 seconds.
 - In progress: GNSS LED blinks (1/sec).
 - Success: GNSS LED solid ON.
 - Failure: GNSS LED blinks rapidly.
3. **LoRa Communication:** Communicates with the LoRaWAN server.
 - In progress: LoRa LED blinks (1/sec).
 - Success: LoRa LED solid ON.
 - Failure: LoRa LED blinks rapidly.
4. **State Maintenance:** LEDs maintain their state for installer verification.
5. **Cycle and Transition:** The sequence repeats for five (5) cycles, then automatically transitions to the Standing state.

4.2.2 Standing State (Stationary State - General Mode)

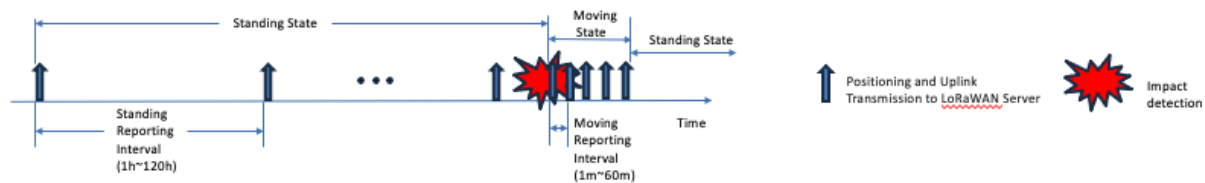
Minimizes power consumption while the asset is stationary.

[Detailed Operational Flow]

1. **RTC Wake-up:** The system wakes up based on the internal Real-Time Clock.
2. **GNSS and Data:** Performs positioning for a maximum of 5 minutes.
3. **LoRa Connectivity:** Checks session status. If not connected, attempts to connect (Default: 2 retries, range: 1 to 12).
4. **LoRa Transmission:** Sends current data and any data stored in Flash.
5. **Verification:** If successful, prepares for the next cycle. If it fails, stores the data in Flash for retransmission.
6. **Configurable Interval:** Default 24 hours (range 1 to 120 hours).
7. **Deep Sleep:** Enters ultra-low power mode immediately after transmission.

[State Transition]

- **To Moving State:** Transitions immediately if the IMU detects acceleration exceeding the threshold (Default: Level 1 / 80mg).



4.2.3 Moving State (Motion State - General Mode)

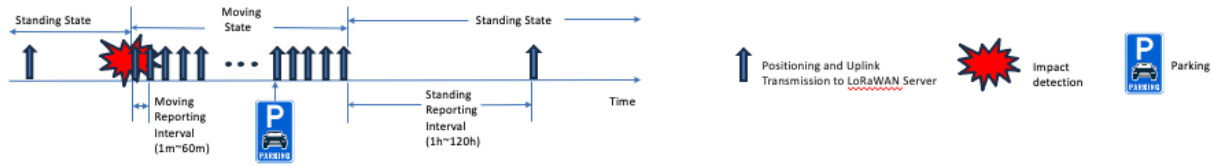
Activated upon detecting movement and focuses on high-frequency tracking.

[Detailed Operational Flow]

1. **RTC Wake-up:** Wakes up based on the internal RTC.
2. **GNSS and Data:** Performs positioning and data collection for 2 seconds.
3. **LoRa Connectivity:** Checks session status. If not connected, attempts to connect (Default: 2 retries, range: 1 to 12).
4. **LoRa Transmission:** Sends current data and any data stored in Flash.
5. **Verification:** If successful, prepares for the next cycle. If it fails, stores the data in Flash for retransmission.
6. **Reporting Loop:** Repeats according to the Moving Reporting Interval (Default: 1 min).

[State Transition]

- **To Standing State:** Returns if no movement is detected for 5 times the reporting interval AND the GNSS speed (SOG) is ≤ 1 knot.



4.2.4 Model-Specific Behavior

Model	Battery Format	Low Battery Warning
Solar Charging Model	0–100% (1% resolution)	Below 5%

5. Device Specifications

5.1 Configuration

The following are the default configuration values stored in the device.
All items can be modified through the communication protocol.

Item	Default Value	Description
LoRa Retries	2	Join attempts (range 1–12)
Moving Interval	1 min	Interval in moving state (range 1–60)
Standing Interval	24 h	Interval in stationary state (range 1–120)
Flash Retention	7 days	Days of storage in Flash (range 1–15)
IMU Threshold	3	Sensitivity: 0=50mg, 1=80mg, 2=100mg, 3=200mg, 4=400mg, 5=600mg, 6=800mg, 7=1000mg.
IMU Mode	0	0=OR Logic / 1=AND Logic
IMU Duration	1	0=1st event, 1=2nd, 2=3rd, 3=4th
Battery Mode	0	0 = solar charging model

5.2 LoRaWAN Configuration

The following configuration represents the operational configuration evaluated for regulatory compliance.

The commercial firmware configuration evaluated for regulatory compliance is as follows:

- **Join Method:** OTAA
- **Class:** A
- **Region:** US915
- **TX Power:** +20 dBm
- **DR:** 3 (SF7 / 125kHz)

5.3 LED Behavior

The PWR LED indicates the battery charging state.

The LoRa and GNSS LEDs (BLUE) are active only during:

- Install Mode

Low-battery thresholds differ by model (see Section 4.2.4).

Function	Action	General	Install Mode
Battery	Charging	LED PWR ON	LED PWR ON
	Not charging	LED PWR OFF	LED PWR OFF
Boot	Startup ready	LORA/GNSS OFF	1 BLINK
Sleep	Low power	LORA/GNSS OFF	LORA/GNSS OFF
GPS	Fix attempt	GNSS OFF	SLOW BLINK

	Success	GNSS OFF	LED ON
	Failure	GNSS OFF	FAST BLINK
LoRa	Connecting	LORA OFF	SLOW BLINK
	Success	LORA OFF	LED ON
	Failure	LORA OFF	FAST BLINK

5.4 Button Behavior

The device includes two physical buttons: a Reset Button and a Test Button, each providing distinct hardware-level and firmware-level functionality. The operational behavior of these buttons is described below.

Button	Duration	Action	Description
Reset	Short click	Hardware Reset	Immediate reset. Does not erase data.
Test	1–3 sec	Config Reset	Restores factory defaults and reboots.
Test	> 3 sec	Test Mode	Factory functional test mode.

6. Communication Overview

The LinkTag20 supports two communication interfaces during normal operation: **UART** for basic maintenance tasks and **LoRaWAN** for long-range wireless communication.

This section provides a high-level description of each interface required for standard device usage. Developer-level protocol details, payload definitions, and internal command structures are intentionally omitted from this manual.

6.1 STM UART Communication

The UART interface is intended for authorized maintenance and diagnostics, allowing users to interact with the device to check or update configuration settings.

UART Settings

- Baudrate: 115200
- Data Bits: 8
- Stop Bit: 1
- Parity: None
- Flow Control: None

The UART interface is available only when the MCU is awake. When the device enters low-power mode, the UART interface is automatically disabled. The UART interface is not required for normal user operation and is used solely for service or technical support purposes.

6.2 LoRaWAN Communication

The LinkTag20 communicates with the network server using LoRaWAN unconfirmed uplink messages without requiring acknowledgment.

Operating Parameters

- LoRaWAN Version: 1.0.3
- Region: US915
- Join Method: OTAA

During normal operation, the device automatically performs the following tasks:

- Joining the LoRaWAN network
- Transmitting GNSS and sensor data via uplink

All LoRaWAN-related processes are handled internally by the firmware. No user configuration or manual intervention is required.

6.3 Notice

Detailed payload formats are internal and are provided only to technical personnel upon request.

7. Warranty Information

7.1 Warranty Period

The LinkTag20 is covered by a limited warranty of **one (1) year** from the original date of purchase.

7.2 Coverage

This warranty covers defects in manufacturing and workmanship under normal use and in accordance with the instructions in this manual. If a hardware defect arises during the warranty period, the manufacturer will, at its sole discretion, repair or replace the product free of charge.

7.3 Warranty Exclusions

This warranty does not cover the following:

- Damage caused by misuse, abuse, negligence, or accidents (e.g., severe drops).
- Unauthorized modifications, repairs, or disassembly performed by non-certified personnel.
- Damage resulting from exposure to liquids beyond the environmental protection rating of the device.
- Use of accessories, batteries, or power supplies not approved by the manufacturer.
- Damage caused by acts of God (e.g., lightning, floods, fires, earthquakes).

7.4 Claim Procedure

To request warranty service, please contact your local authorized distributor or the technical support team. A valid proof of purchase and the device's serial number (DevEUI) will be required to process the claim.

8. Regulatory Information

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, including interference that may cause undesired operation of the device.

The user manual for an intentional or unintentional radiator shall caution the user that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

RF 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.

WARNING: This equipment may generate or use radio frequency energy. Changes or modifications to this equipment may cause harmful interference unless the modifications are expressly approved in the instruction manual. The user could lose the authority to operate this equipment if an unauthorized change or modification is made.