EDTRACKER®

# Internal Product Specification

EDTracker Pro Wireless

EDTracker and the EDTracker logo are registered trademarks of EDTracker Ltd. © 2017. All rights reserved.

# Revision History

| Version No. | Issue Date | Author(s) | Summary of revisions |
|---|---|---|---|
| 0.1 | 7 Dec 2016 | D. Howell | Initial draft for review |
| 0.2 | 9 Jan 2017 | D. Howell | Final draft |
| 0.3 | 30 Jan 2017 | D. Howell | Added some technical details to specification table |
| 0.4 | 14 Feb 2017 | D. Howell | Updated LED states to reflect final firmware |
| 0.5 | 27 Feb 2017 | D. Howell | Updated to reflect new (lower) power setting |
| 1.0 | 20 May 2017 | D. Howell | Baselined to final version |

# References

| Document | Version | Author(s) | Link (where applicable) |
|---|---|---|---|
| | | | |

The contents of this document may not be transmitted or reproduced in any form or by any means without the written permission of EDTracker Ltd. The EDTracker logo is a registered trademark of EDTracker Ltd.


©2017 EDTracker Ltd

# Table of Contents

**1 Introduction** ..... **4**

**2 Specifications** ..... **5**

2.1 Wireless Channel List ..... 6

2.2 Product Images ..... 7

2.3 Antenna ..... 9

**3 Circuit Functions** ..... **10**

3.1 Power Supply & Protection ..... 10

3.2 Battery Charge Control ..... 10

3.3 Atmel SmartARM MCU ..... 11

3.4 Nordic transceiver ..... 11

3.5 Antenna ..... 11

3.6 Sensors ..... 11

3.7 Memory ..... 11

**4 Guidelines for Use** ..... **12**

4.1 Turning On ..... 12

4.2 Wireless Operation ..... 13

4.3 Wired Operation ..... 14

4.4 Charging ..... 14

4.5 Storage & Shipping ..... 14

©2017 EDTracker Ltd

# 1 Introduction

The *EDTracker Pro Wireless* is a head tracking device for capturing head motion in 3 DOF (Degrees of Freedom), transmitting the positional information wirelessly to a USB dongle inserted into a PC. The user's head movements are represented to the PC as 3-axis joystick positions, the intention being that the movements are then reflected within 3rd party games to allow the user to reflect their real-world head movement as virtual head movement in-game.

The product specification relates to the *EDTracker Pro Wireless* device only; a separate specification details the *EDTracker Pro Dongle* device.

While conceptually the EDTracker Pro Wireless might be considered the "transmitter" for the solution, there is 2-way traffic between the devices for the purposes of configuration and it therefore also acts as a receiver in some situations.

The device transmits and receives within the 2.4GHz ISM RF band, using GFSK digital modulation. The device does not perform any frequency hopping.

The device is battery powered by an internal Lithium Polymer battery.

This document is **NOT** intended to be an End User Guide – it is a technical document for internal use and for the purposes of 3rd party testing, certification and/or accreditation ("Operating Description" document for the purposes of FCC and IC certification).


©2017 EDTracker Ltd

# 2 Specifications

| **Product Details** | | | | |
|---|---|---|---|---|
| Model Number | EDTPWL001 | | | |
| Model Name | EDTracker Pro Wireless | | | |
| **Physical Characteristics** | **Min** | **Value** | **Max** | **Unit** |
| Width | - | 50 | - | mm |
| Length | - | 35 | - | mm |
| Height | - | 19 | - | mm |
| Weight | - | 26 | - | g |
| Operating Temperature | -20 | - | 60 | deg C |
| **Electrical Characteristics** | **Min** | **Typical** | **Max** | **Unit** |
| DC Supply Voltage (USB) | 2.5 | 5.0 | 5.5 | v |
| Supply Current (USB)<br>*active, charging*<br>*active, non-charging (battery full)*<br>*sleep, non-charging (battery full)* | | <br>180<br>38<br><1 | | mA |
| DC Supply Voltage (Internal Battery) | 2.75 | 3.7 | 4.1 | v |
| Supply Current (Internal Battery)<br>*active*<br>*sleep* | <br>-<br>- | <br>28<br><1 | <br>-<br>- | mA |
| Battery Technology | Lithium-Ion Polymer, Rechargeable | | | |
| Battery Capacity | - | 300 | - | mAh |
| Battery Charge current | | | 165 | mA |
| Battery Protection | Short-circuit protection<br>Over-charging and over-discharging protection | | | |
| **RF Characteristics** | **Min** | **Typical** | **Max** | **Unit** |
| Operating Frequency | 2.4GHz ISM | | | |
| Modulation | GFSK | | | |
| Channel Access protocol (carrier type) | IC Vendor Proprietary (Nordic Semiconductor) | | | |
| Transceiver Operation | Simplex | | | |
| Duty Cycle | | 20 | | % |
| Antenna Type | SMD ceramic chip | | | |
| Antenna Gain | - | -0.5 | - | dBi |
| Transmit Power | - | 0.25<br>*(-6)* | - | mW<br>*(dBm)* |
| Signal Range (indoor) | 0 | - | 20 | m |
| Data Rate | 250kbps | | | |
| Frequency Range | 2403 | - | 2481 | MHz |
| No. of Channels | - | 27 | - | |
| Channel Bandwidth | - | 1 | - | MHz |
| Channel Spacing | - | 3 | - | MHz |
| **USB Characteristics** | **Value** | | | |
| USB Class | USB 2.0 | | | |
| Device Class | HID (Human Interaction Device) – Joystick | | | |
| USB Vendor ID | 0x16D0 | | | |
| USB Product ID | 0x0C40 (bootloader)<br>0x0C41 (main firmware) | | | |

©2017 EDTracker Ltd

## 2.1 Wireless Channel List

The following table shows the centre frequency for each software-selected channel available on the device

| Channel No. | Frequency (MHz) |
|---|---|
| 1 | 2403 |
| 2 | 2406 |
| 3 | 2409 |
| 4 | 2412 |
| 5 | 2415 |
| 6 | 2418 |
| 7 | 2421 |
| 8 | 2424 |
| 9 | 2427 |
| 10 | 2430 |
| 11 | 2433 |
| 12 | 2436 |
| 13 | 2439 |
| 14 | 2442 |
| 15 | 2445 |
| 16 | 2448 |
| 17 | 2451 |
| 18 | 2454 |
| 19 | 2457 |
| 20 | 2460 |
| 21 | 2463 |
| 22 | 2466 |
| 23 | 2469 |
| 24 | 2472 |
| 25 | 2475 |
| 26 | 2478 |
| 27 | 2481 |


©2017 EDTracker Ltd

## 2.2 Product Images

(NB: Grid in photos is 50x50mm)

*Figure 1 - EDTracker Pro Wireless*

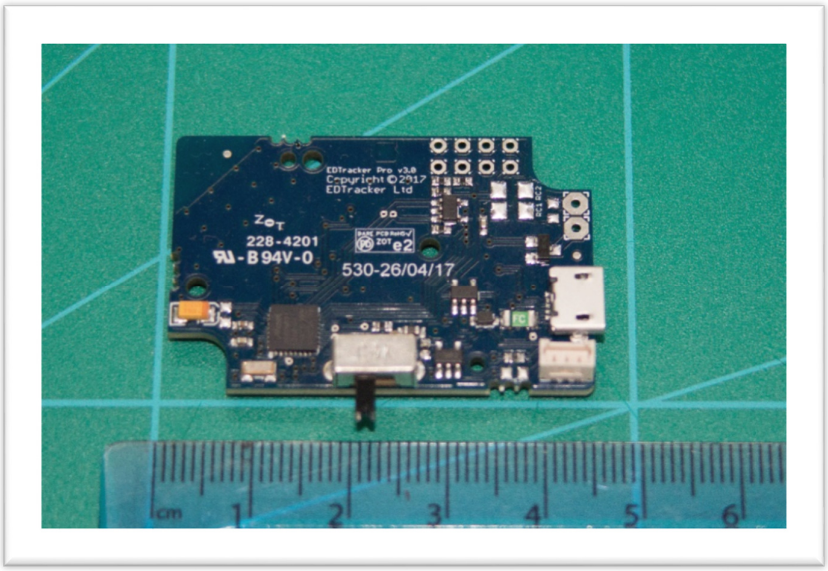


*Figure 2 - PCB (underside)*

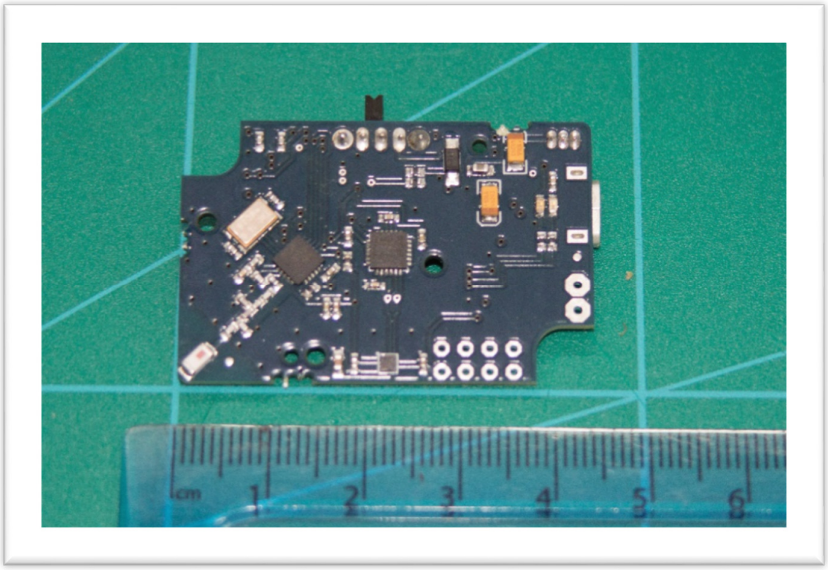

*Figure 3 - PCB (topside)*

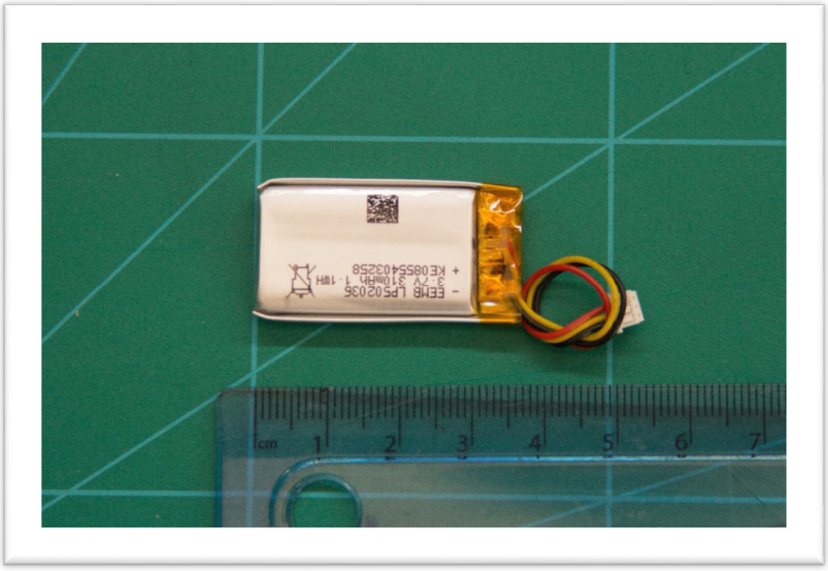


*Figure 4 - Internal Battery (removed)*


©2017 EDTracker Ltd

## 2.3 Antenna

The device makes use of a ceramic SMD chip antenna manufactured by Johanson Technologies (part # 2450AT18B100E). The PCB incorporates an antenna balancing and matching network between the Nordic NRF24 transceiver IC and the antenna. This design follows manufacturer recommendations from both Nordic and Johanson, and was reviewed by Nordic themselves during the design process.

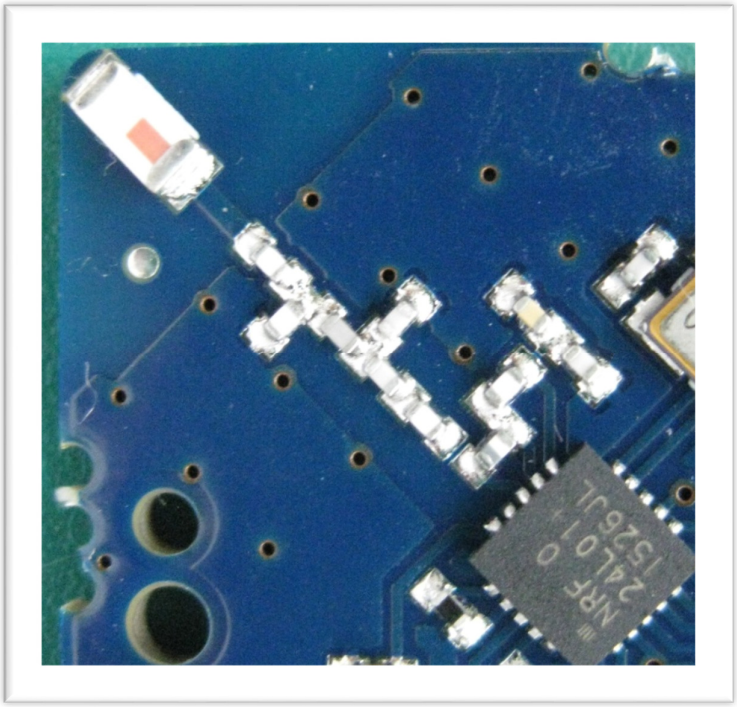


*Figure 5 - Close up of antenna configuration*

# 3 Circuit Functions

The EDTracker Pro Wireless incorporates the following circuit functions :

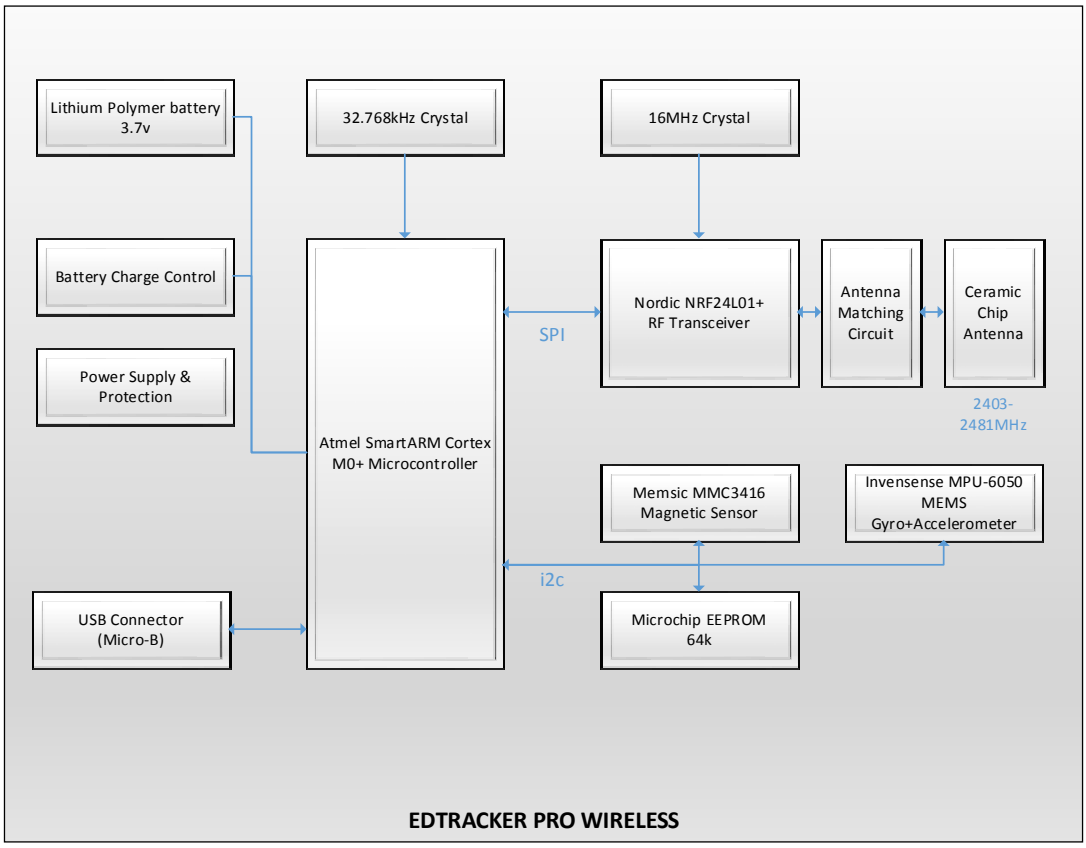


*Figure 6 - Circuit Block Diagram*

## 3.1 Power Supply & Protection

The power supply for the device is either internally from the 3.7v Lipo battery within the unit or, when the device is plugged in, an external 5v supply provided by the USB connector (PTC protected). These feed through a LDO voltage regulator to supply the board with a common 3.3v supply used by all logic components, output rated to 300mA. The LDO incorporates thermal as well as current-limit protection.

## 3.2 Battery Charge Control

The LiPo battery charging is handled via a Microchip MCP73831 charge controller IC. This provides constant-current/constant-voltage charging with configurable cut-off and battery pre-conditioning. It automatically stops charging when the battery meets the required levels, and can also resume charging when the device is left plugged in for extended periods of time.

In addition to this, the battery itself incorporates over-charge and over-discharge protection.

The MCU monitors several aspects of the power supply and charge control to monitor the status of the battery and advise users of current capacity and state :

- NTC output on the battery to monitor battery temperature
- Charge controller STAT pin for current charging status (charging/non-charging)


©2017 EDTracker Ltd

- LDO voltage regulator input voltage
- LDO voltage regulator output voltage

## 3.3 Atmel SmartARM MCU

The core of the EDTracker Pro Wireless is the Atmel SmartARM microcontroller, based on an ARM Cortex M0 processor. All of the processing logic is performed within this component. It sources power from the common 3.3v board supply. The MCU is clocked from an external 32.768kHz crystal. It includes USB interface drivers and so connects directly to the USB port data lines.

## 3.4 Nordic transceiver

The Nordic NRF24L01+ provides a proprietary Nordic 2.4GHz wireless transceiver to handle RF functions (see section 2 – "Specifications" for RF details). It is coupled to the MCU via an SPI data bus. It sources power from the common 3.3v board supply. The IC makes use of an external 16MHz reference clock for all its functions.

## 3.5 Antenna

EDTracker Pro Wireless makes us of a ceramic chip antenna. This is wired directly in to the Nordic transceiver via a matching network. Please refer to section 2.3 above ("Antenna") for details.

## 3.6 Sensors

Core to EDTracker Pro Wireless is its ability to measure physical movement. This is achieved by a pair of sensor ICs – an Invensense MPU-6050 combined MEMS gyro and accelerometer and a separate Memsic Incorporated MMC3416 3-axis magnetic sensor. The sensors are accessed by the MCU via an i2c (2-wire) bus. They are powered from the common 3.3v board supply.

## 3.7 Memory

In order to retain user configuration settings during periods of no power, the device employs a 64kbit serial EEPROM from Microchip. This is accessed by the MCU using the i2c bus and sources its power from the common 3.3v board supply.

©2017 EDTracker Ltd

# 4 Guidelines for Use

The EDTracker Pro Wireless device is intended to be mounted upon a headset/headphones, typically on the top of the head band. The USB connector is used to charge the device or apply firmware updates in the future, if required. The device provides approximately 10 hours of continuous active use on a single charge (although power saving techniques are used to increase this during periods of inactivity).

A User Guide is available that provides detailed instructions on using the software necessary to operate the device.

## 4.1 Turning On

Slide the switch to the ON position (towards the USB connector) to enable the device.

When the device is plugged in to a power source, it will *always* power up – the switch has no effect. The switch isolates the internal battery power supply only.

Following initial power, the device will perform a number of tasks :

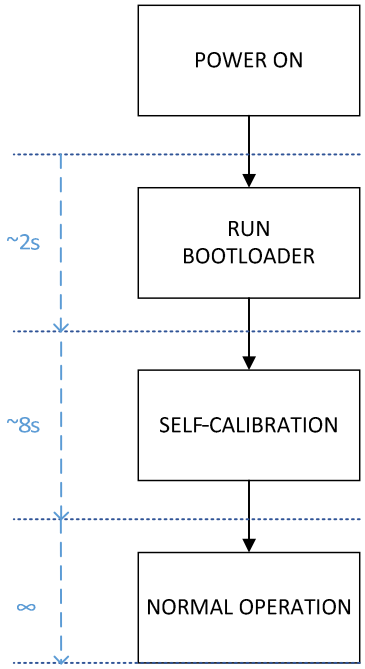


*Figure 7 - Steps following power-on*

- Run bootloader for 2 seconds (allows for future firmware updates via cable connection to PC)
- Perform self-calibration of internal MEMS gyro sensor
- Resume normal operation (transmit positional information to paired dongle)

The EDTracker software can be used to pair the device with an *EDTracker Wireless Dongle* and then change various settings, including enabling the wireless transmission test feature of the EDTracker for the purposes of regulatory testing.


©2017 EDTracker Ltd

An LED can be used to provide basic state information for the device :

| LED Activity | LED Colour | Description |
|---|---|---|
| Off | - | Device is unpowered or is in power-saving sleep mode |
| Fading In-Out | Green | Running bootloader |
| 4 flashes every second | Red | Device is unpaired and is performing self-calibration |
| | Green | Device is paired and is performing self-calibration |
| 2 flashes every second | Red | Device is unpaired and running normally on battery |
| | Green | Device is paired and running normally on battery |
| 1 flash every 2 seconds | Orange | Device is unpaired and is charging |
| | Green | Device is paired and is charging |
| On | Orange | Device is unpaired and is fully charged |
| | Green | Device is paired and is fully charged |

## 4.2 Wireless Operation

When powered by the internal battery, the device will attempt communication with an *EDTracker Wireless Dongle*. The device can be configured to one of 27 channels (see section 2.1, “Wireless Channel List” on page 6) each of which relates to a specific RF frequency.

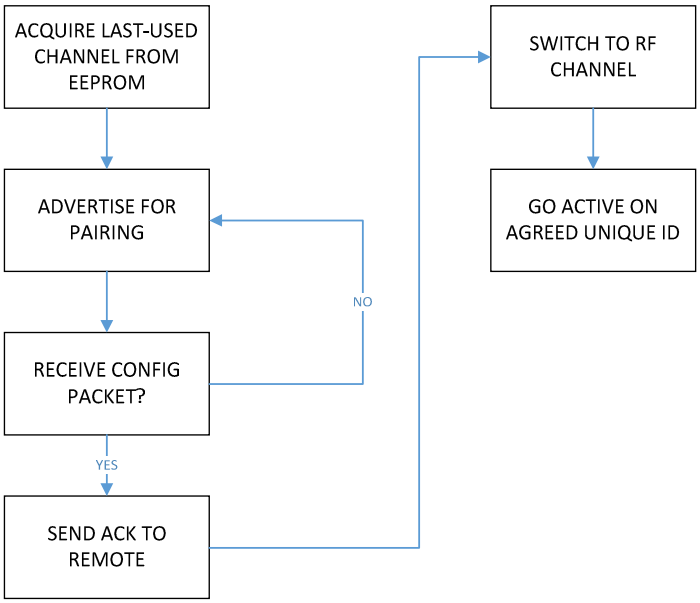


*Figure 8 - Wireless negotiation logic (Pro)*

The device will start broadcasting on the last configured channel upon which is was used (the default channel for new devices is channel 1). The device will not channel switch by itself (ie. without user intervention). The device then starts broadcasting “binding” packets on that channel. These packets can be identified by an *EDTracker Wireless Dongle* as an un-paired device looking for pairing, and acted upon accordingly. The packets are repeatedly broadcast until the device is discovered by an unpaired *EDTracker Wireless Dongle.*

After discovery, the device can expect to receive a command packet from the remote *EDTracker Wireless Dongle* that instructs the device to use a unique identifier code between the two devices for all subsequent communication. Optionally, the command packet may instruct the device to switch to an alternative RF

©2017 EDTracker Ltd

channel. At this point, the two devices are said to be *paired* and data communication begins between them on the newly-negotiated channel, using the unique identifier code to ensure the traffic is only processed by the correspondingly-paired devices.

This will continue until either of the devices is powered down, at which point the pairing is lost and must be re-established.

## 4.3 Wired Operation

When powered by a 5v USB power source, the device will behave identically. The internal battery will be charged during operation.

## 4.4 Charging

The device charges its internal battery automatically whenever it is plugged in to a 5v source via the Micro-B USB connector. The device uses smart management to regulate battery charging, therefore it is safe to leave the device plugged in for extended periods of time. It is not possible to “over-charge” the device.

EDTracker Ltd does not provide a charger with the device.

EDTracker Ltd recommends charging the device from a USB port on the user’s PC.

## 4.5 Storage & Shipping

Whenever shipping the device, ensure it is turned off. Slide the switch to the OFF position (away from the USB connector).

For extended periods of non-use, it is advisable to switch the device off using the slide switch. This will help preserve charge within the battery.


©2017 EDTracker Ltd