Internal Product Specification

EDTracker Pro Wireless

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)

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Table of Contents

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).

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) *active, charging* *active, non-charging (battery full)* *sleep, non-charging (battery full)*		180 38 <1		mA
DC Supply Voltage (Internal Battery)	2.75	3.7	4.1	v
Supply Current (Internal Battery) *active* *sleep*	 - -	 28 <1	 - -	mA
Battery Technology	Lithium-Ion Polymer, Rechargeable			
Battery Capacity	-	300	-	mAh
Battery Charge current			165	mA
Battery Protection	Short-circuit protection 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 *(-6)*	-	mW *(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) 0x0C41 (main firmware)			

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

2.2 Product Images
(NB: Grid in photos is 50x50mm)
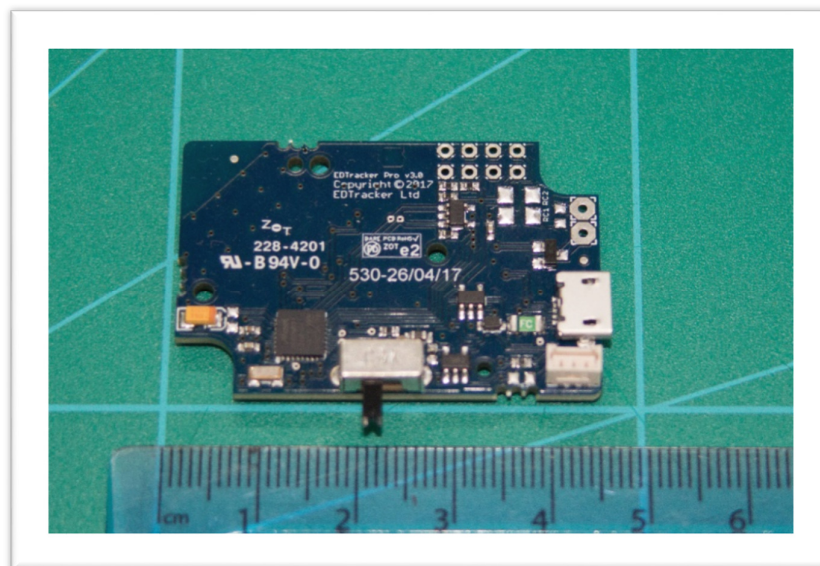

Figure 1 - EDTracker Pro Wireless
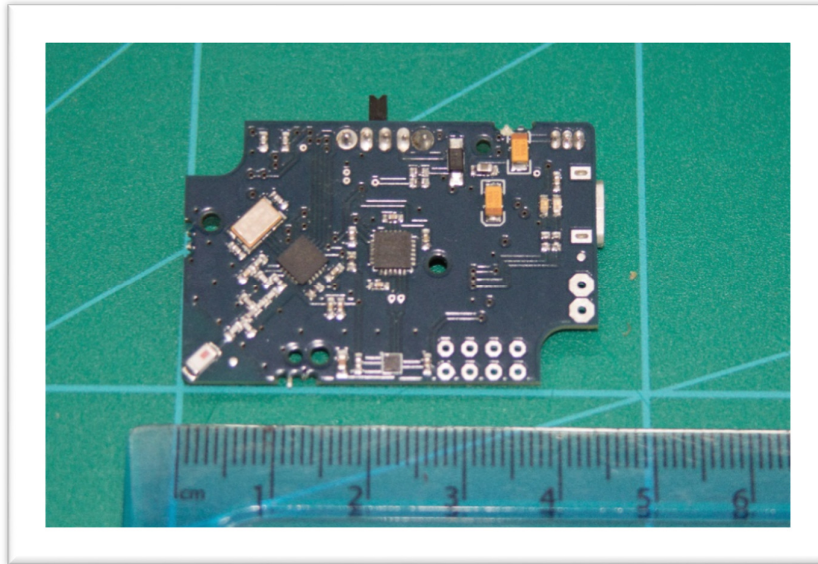

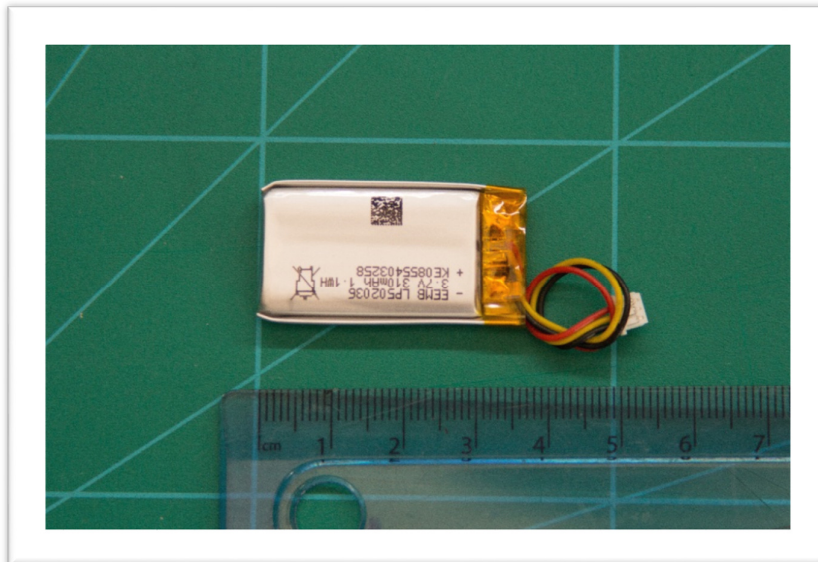*Figure 2 - PCB (underside)*

Figure 3 - PCB (topside)

Figure 4 - Internal Battery (removed)

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.
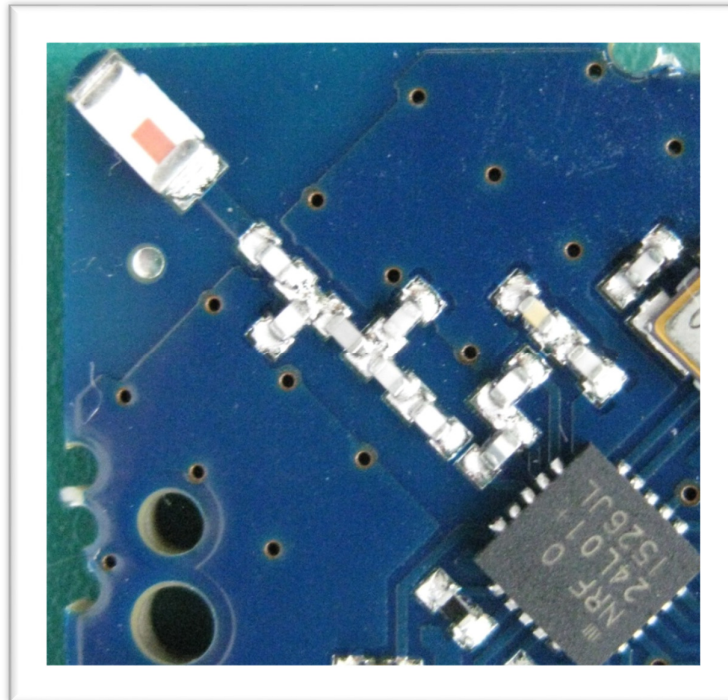

Figure 5 - Close up of antenna configuration

3 Circuit Functions

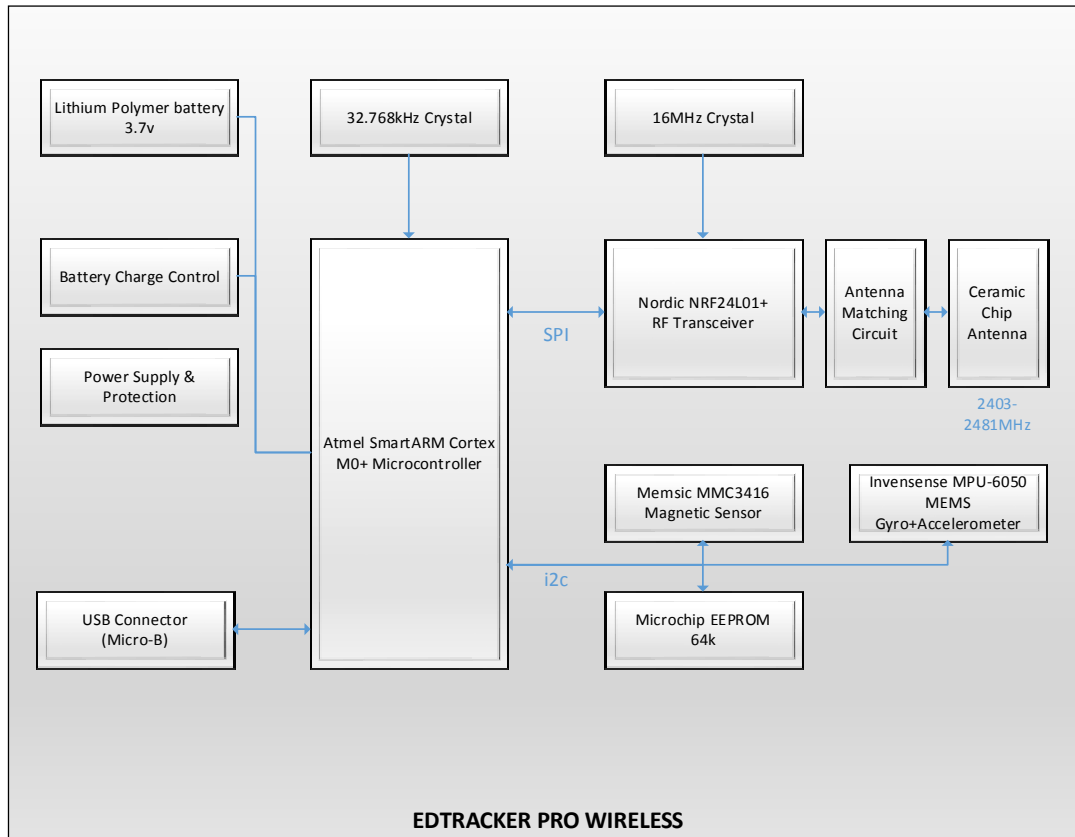The EDTracker Pro Wireless incorporates the following circuit functions :

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)

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- 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.

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.

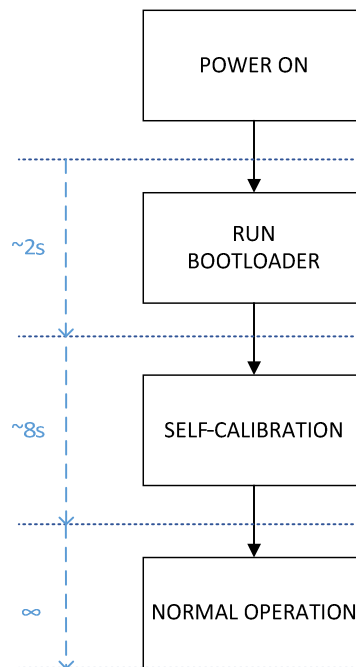Following initial power, the device will perform a number of tasks :

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.

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.
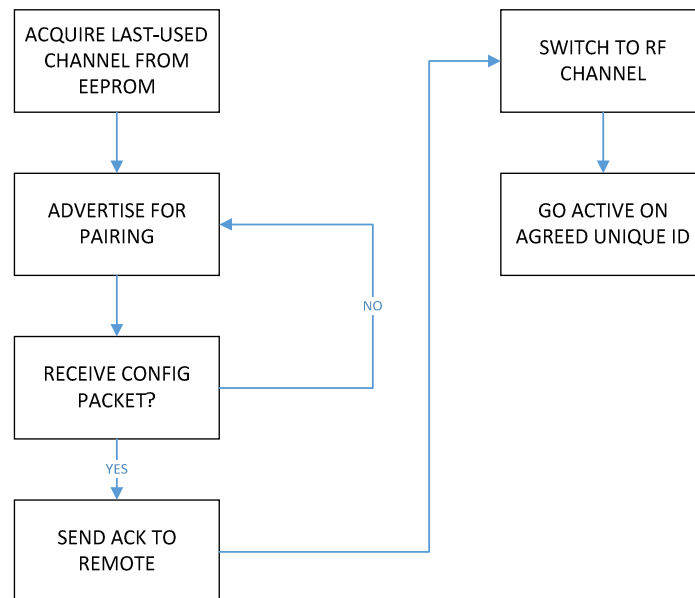

Figure 8 - Wireless negotiation logic (Pro)

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

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.