femtoino.

Ver.0.10.3.

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1. Document conventions.

1.1. Abbreviations.

ADC – analog to digital converter

CNC – computer numerical control

DAC – digital to analog converter

GPIO – general purpose input output

GHz – giga hertz

GND – ground

IMU – inertial measuring unit

I/O – input/output

ISP – in system programming

LED – light emission diode

PCB – printed circuit board

PWR – power

PMIC – power management integrated circuit

RGB – red, green, blue

SPI – serial peripheral interface

TBD – to be discussed

TWI – two wire interface

USB – universal serial bus

UART – universal asynchronous receiver transmitter

1.2. Text formatting.

The font name used – ISOCPEUR.

The font size – 14.

The font format – italic.

The font color – black.

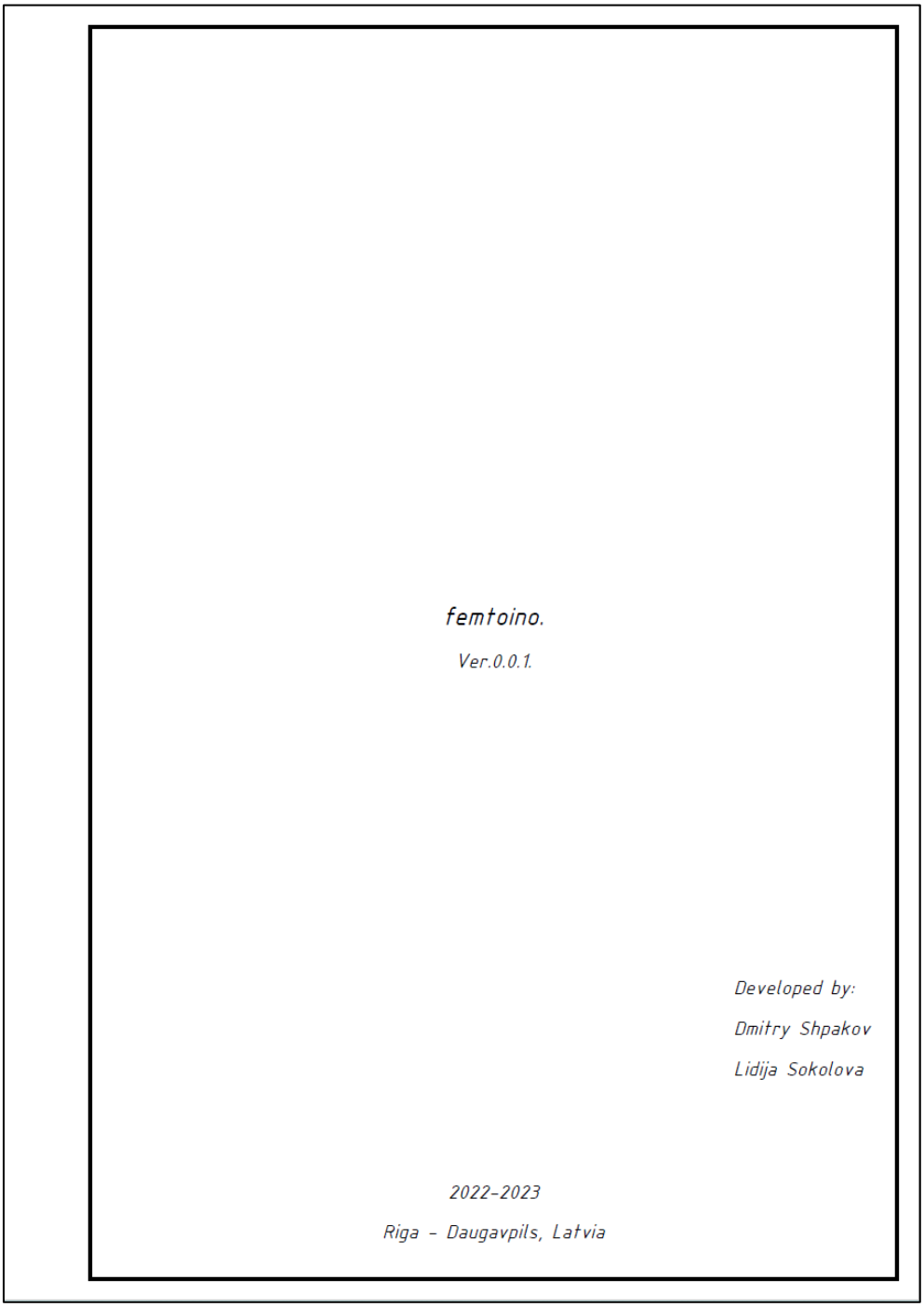
Try not to use different text colors. If possible, stick to only black color of text. Exception may be images, there may be different colors, but, if possible, use black text color everywhere. And yeah, if source code is added then there is no limitation on source code highlighting.

*To highlight some part of text use **bold** text or <u>underlined</u> text.*

1.3. Appearance of pages.

All pages follow the following format.

Cover page:



Nothing special just usual cover page. Version numbering should be changed according to section **1.4.** of this document.

The end date at bottom should be changed according to last modification date.

1.3. Appearance of pages. (continuation)

Table of contents page:

Chg. | Page | Doc № | Signature | Date | Table of contents. | Page 2

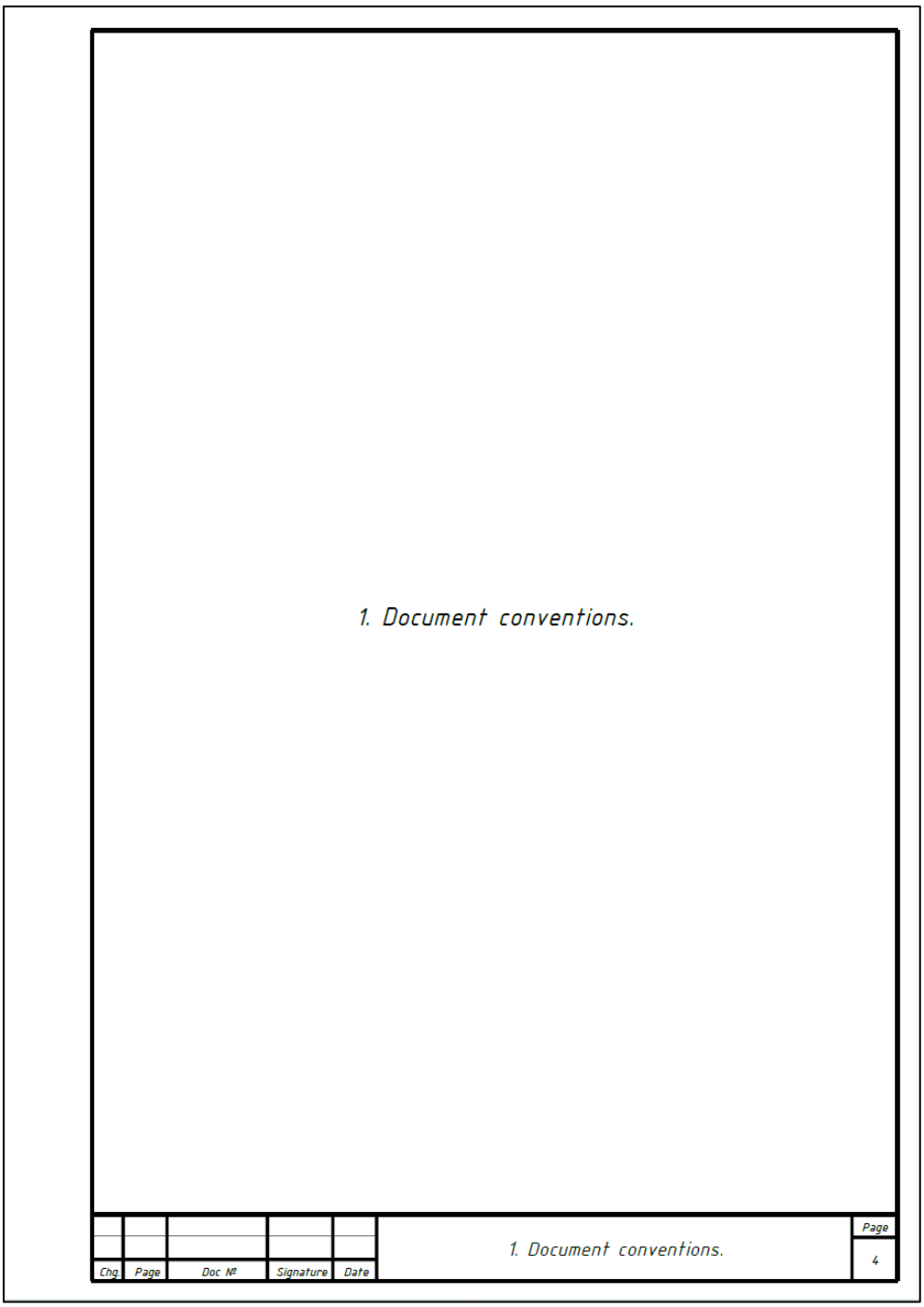
Sections and sub-sections have status in `Note` column.

Possible statuses: `Not started`, `In progress`, `Done`.

Every sub-section is indented by two `spaces` relative to its parent section.

1.3. Appearance of pages. (continuation)

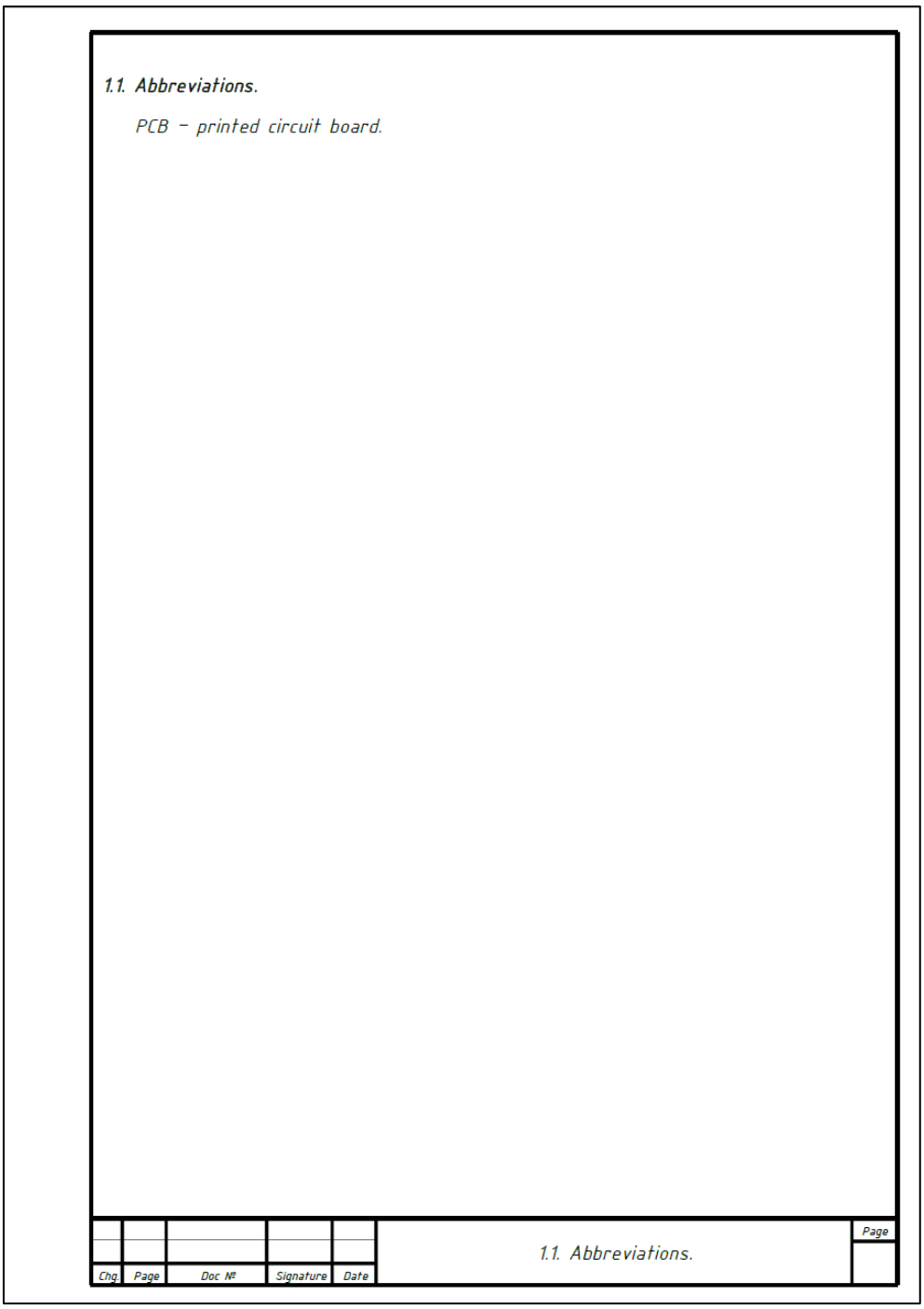
Section main page:



Simple as it is.

1.3. Appearance of pages. (continuation)

Section/subsection content page:



Simple as it is.

Note. All those page templates may be obtained by simply copy and paste from already existing pages and then modifying them.

1.4. Versioning.

The document versioning scheme is the following:

Ver.major.minor.patch.

For example:

Ver. 4.2.1.

major – is incremented only if completely different document version is released or document changes its state from `beta` version to `first release` state. For example, from Ver.0.2.14 to Ver.1.0.0 or something similar.

minor – is incremented when new chapter is added or similar. Minor version number may be reset when major version number is incremented

patch – is incremented when chapter is edited, some cosmetics are made or similar. Patch number may be reset when minor or major version number is incremented.

Note. Try to increment versions constantly. For example, if section is added, increment the minor version and only then start to add the next section.

Note. This document version does not represent the version of hardware or software. Hardware and software have their own private version schemes and numbers.

2. General description.

2.1. Hardware.

The `femtoino` is Arduino like device, but in a small form factor with the following features:

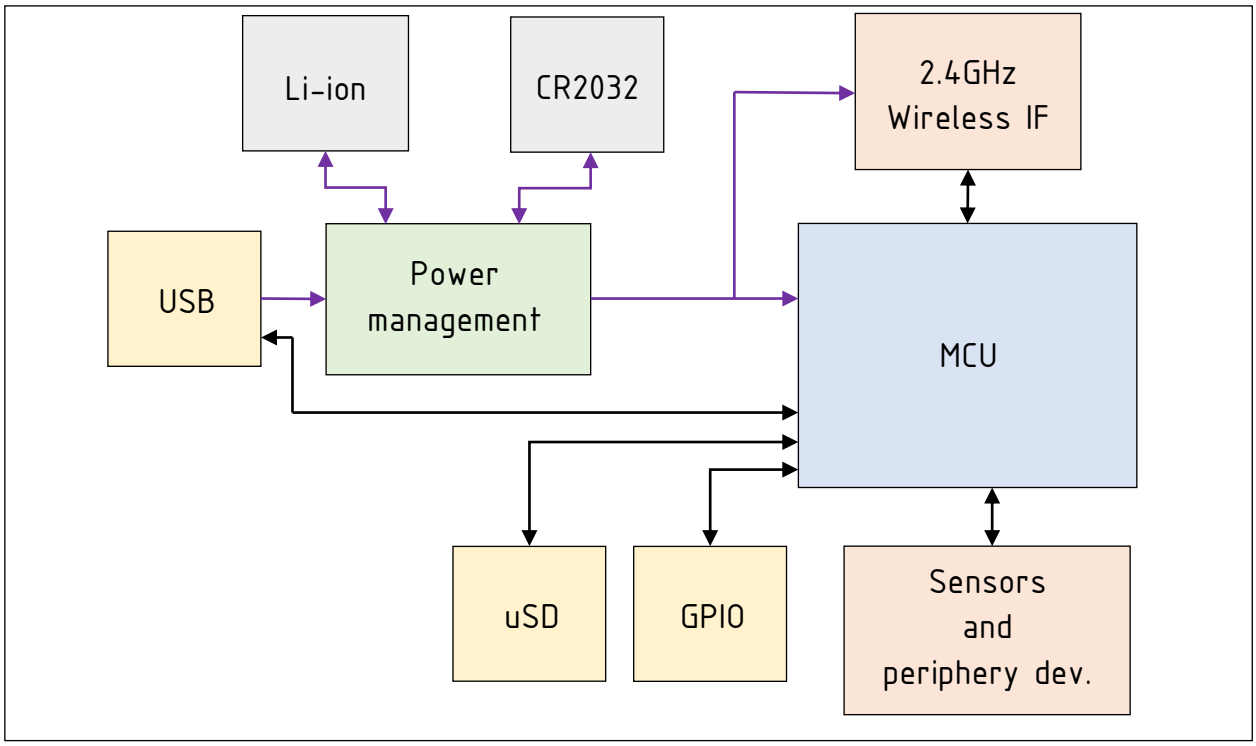
- USB Type-C power connector with data communication over it
- GPIO expansion pins including analog pins for ADC and DAC
- External Li-ion battery connector, for autonomous operation
- Some on-board sensors if enough space is available (TBD), for example the temperature, barometric pressure, humidity, IMU, light sensors, etc.
- 2.4GHz wireless interface for connectivity
- One or more onboard RGB LEDs
- CR2032 battery holder
- One or more micro buttons
- Micro SD card slot if possible
- Possibly some CNC milled case may be developed for this device in future, so consider to make usable GPIO expansion pins and wireless antenna connector

2.2. Software.

3. Hardware.

3.1. Technical specification.

*According to section **2.1** the following block diagram of the device may look like:*



Power management block should manage Li-ion battery recharge, provide power to the remaining system devices. All batteries are optional, so power management block should handle all possible powering schemes by its own. It's advised to choose PMIC for such purpose to save space on a PCB. Add two LEDs that indicate USB power-in and Li-ion battery charging status.

Use ATmega32 MCU with internal USB interface.

Choose low cost 2.4GHz wireless transceiver like nRF24L01+ or similar. Use PCB antenna and external antenna connector. Antennas may be switched mechanically or by on PCB RF switch controlled by MCU.

GPIO expansion header should include UART, SPI, TWI, ADC, DAC and I/O pins.

ISP pin header should be placed on PCB.

Use minimum 4-layer PCB stack-up for easier layout, where dedicate two internal layers for GND/GND or GND/PWR planes.

Use as many sensors as PCB size is capable to hold.

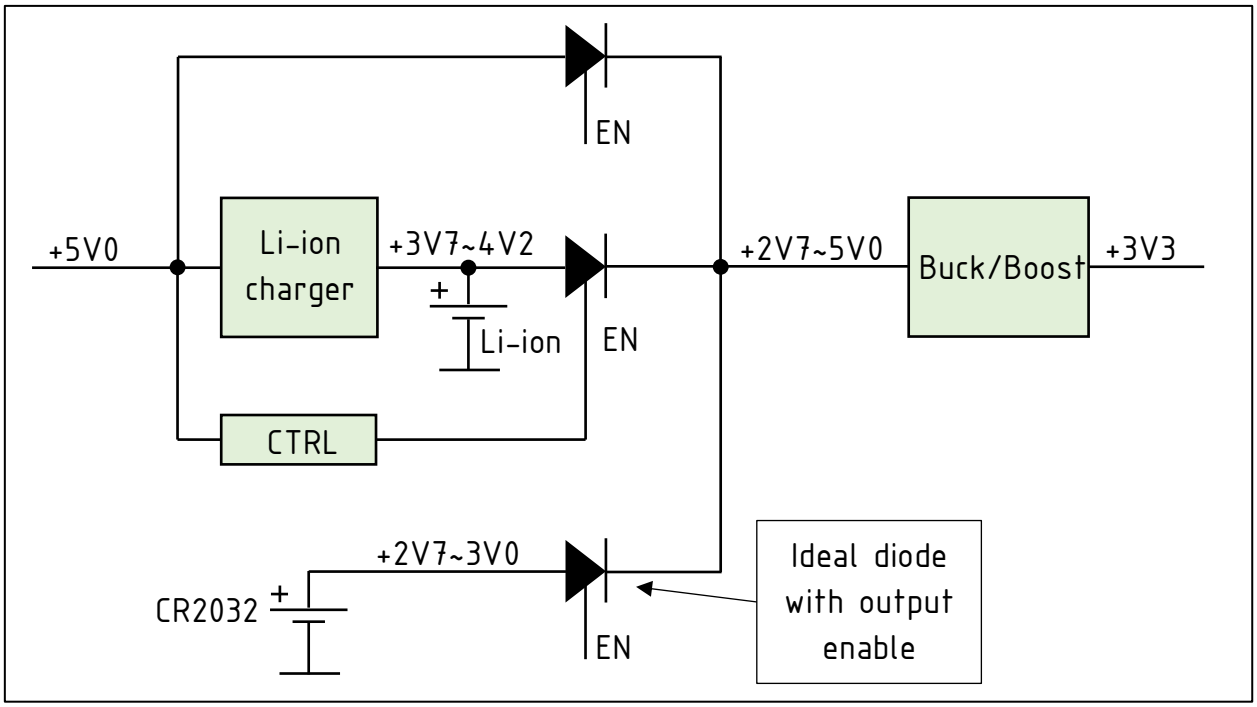
Use minimum two buttons. Hard reset and user button.

Use minimum on RGB LED for indications.

The size of PCB is TBD.

3.1. Technical specification. (continuation)

The power management block, showed above, may look the following:



This configuration allows to switch between three types of power sources automatically. For example, if all power sources are present, then the top circuit route is active, because the CTRL block disables Li-ion route and the +5V0 voltage is higher than CR2032 battery voltage, so bottom circuit route is closed (this is how diode ORing scheme works.).

When there are only batteries present, then due to Li-ion battery voltage is always higher than CR2032 battery voltage, only the middle route is active, and so only the Li-ion battery is discharged.

And, obviously, when the only CR2032 battery is left, then it is the only one which is discharged.

From this we get the following power source priorities:

1. *USB +5V0*
2. *Li-ion*
3. *CR2032*

Note. The lower number the higher priority.

Buck/Boost voltage converter is used to stabilize output voltage at +3V3 level based on non-constant input voltage.