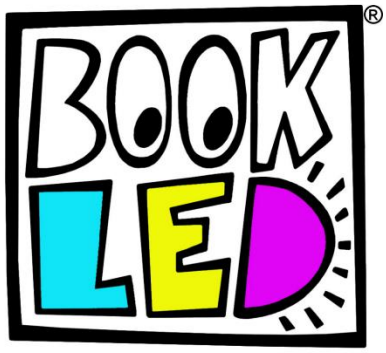


BOOKLED TECHNICAL MANUAL

Description

The BookLed is an HW electronic enhanced card board book.

In appearance, BookLed is a normal book with thick card pages.
At the top of the book, there is a small **USB port** and switch: BookLed is a book made of paper, card and electronics.
The technological core of the BookLed is a **page identification sensor**: using a system of magnets (not visible to the user), the book is able to recognize which page the user is reading and detect the turning from one page to the next.
The information from the page is then used:

- to activate light effects which follow what is going on in the story (for example, light of a fire-fly that flickers or the flashing of the back light of a motor scooter);
- to activate sound effects related to what is happening on the page (for example, the sound of a motorbike passing when there is a motorbike on that particular page).

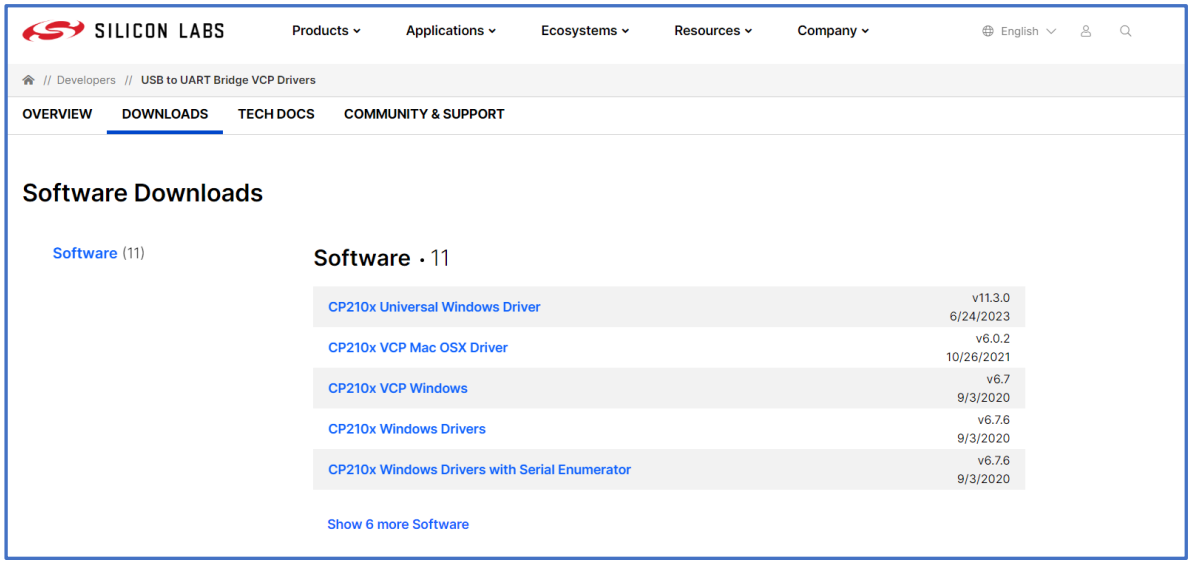
Using the mini-USB port, the BookLed can be connected to a normal PC in order to recharge its built-in LiPo (lithium polymer) battery.
This mini-USB port also allows the book to interface with Python codes, enhancing the story through the use of **generative AI**.
To access the USB port of the BookLed is necessary to install some drivers.

Silabs Drivers Installation

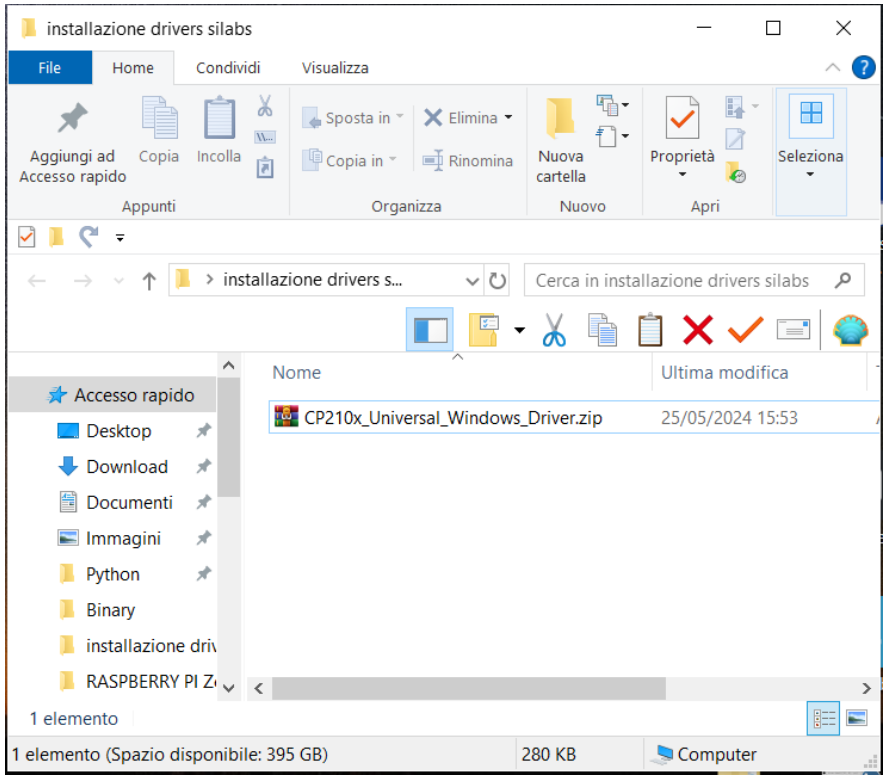
BookLed uses CP2102 Silicon Labs UART to USB chip.
In general Silabs drivers are automatically installed when you insert the USB device for the first time.
If the automatic installation fails, you will need to proceed with a manual installation.
Updated drivers are available on the site https://www.silabs.com/

Perform the following steps:

1) connect to the page https://www.silabs.com/developers/usb-to-uart-bridge-vcp-drivers?tab=downloads



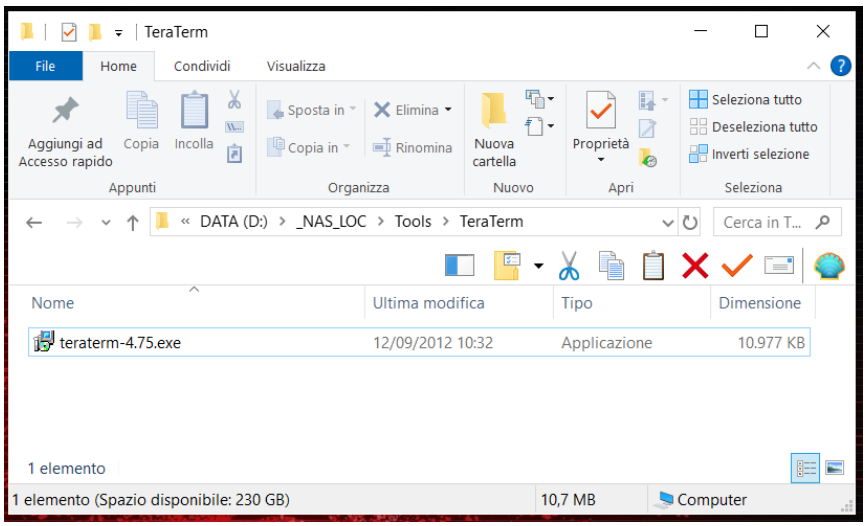
2) Download the driver compatible with your operating system (in the case of Windows 10/11 you can select “CP2110x Universal Windows Driver”).



3) Unzip the .zip file and you will have a directory containing the driver installer files.
4) Using Windows File Explorer, locate the driver folder (that you previously unzipped).
5) Right click on the **silabser.inf** file and select Install.
6) Follow the instructions.

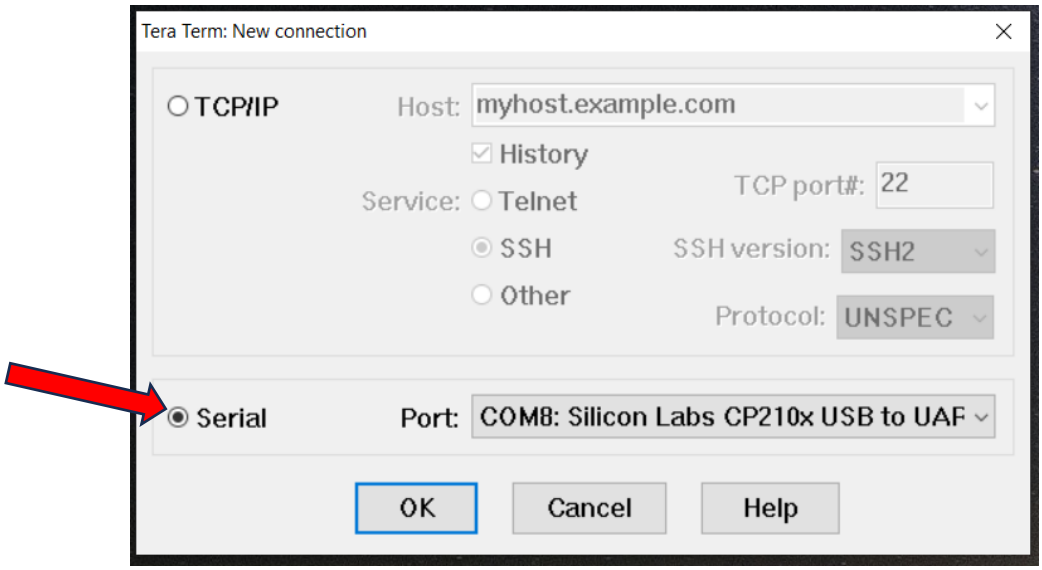
TeraTerm Installation

Before using the Python codes, it is advisable to practice with the BookLed using a terminal emulation program. Therefore, install TeraTerm, which can be downloaded from the following link: https://teratermproject.github.io/index-en.html

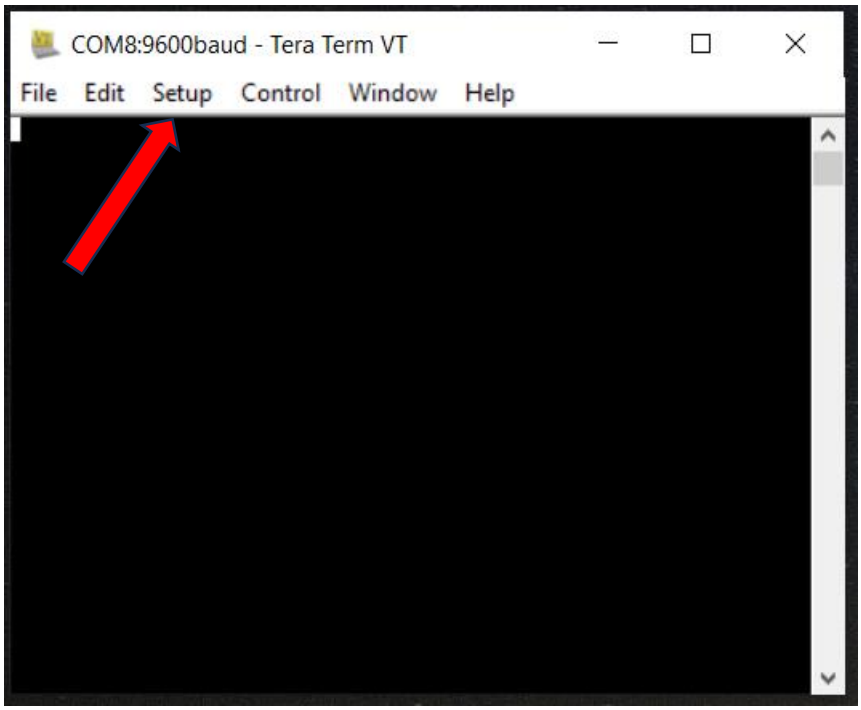


Then carry out the following steps:

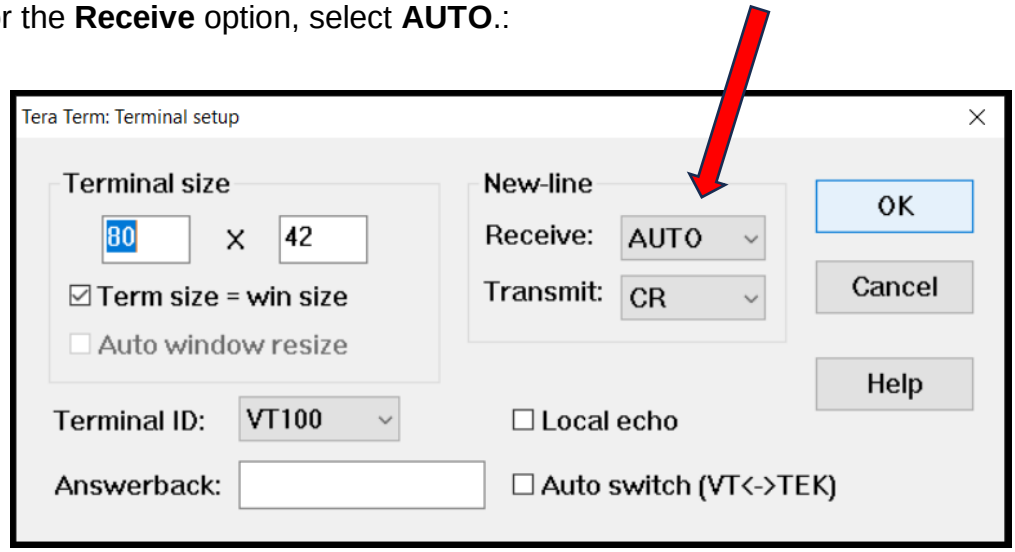
1) Connect the BookLed to the PC via the USB-mini cable.
2) Run TeraTerm.
3) Select **Serial** connection (in this case COM8)



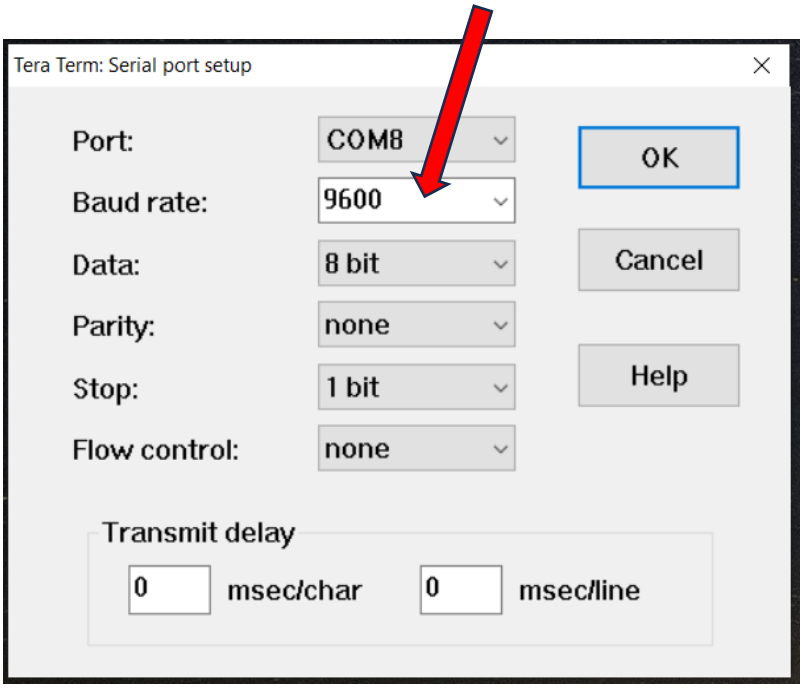
4) Select the **Setup** menu.



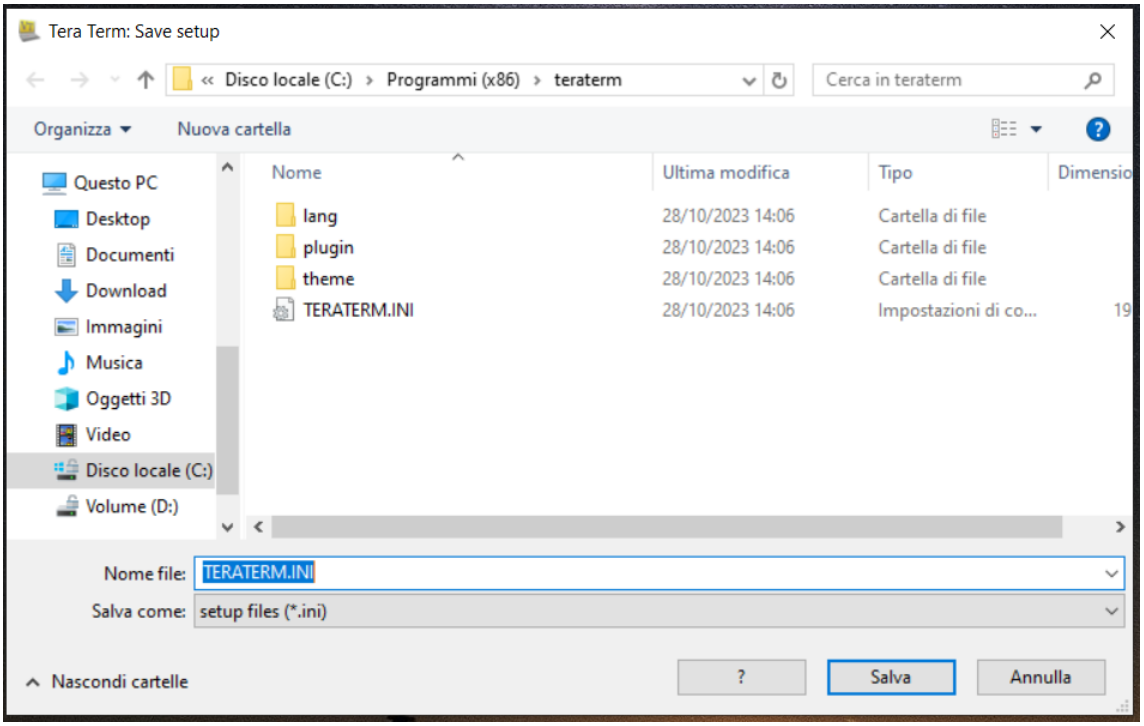
5) For the **Receive** option, select **AUTO**.:



6) Check that the Baud rate is set to **9600** (default):

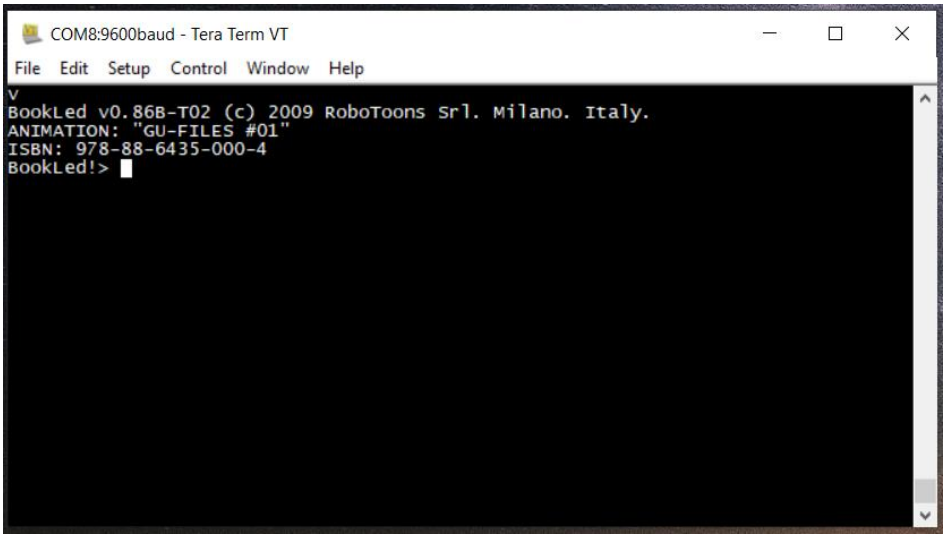


7) Save the connection parameters by selecting the **Setup** menu and then clicking on **Save Setup**:



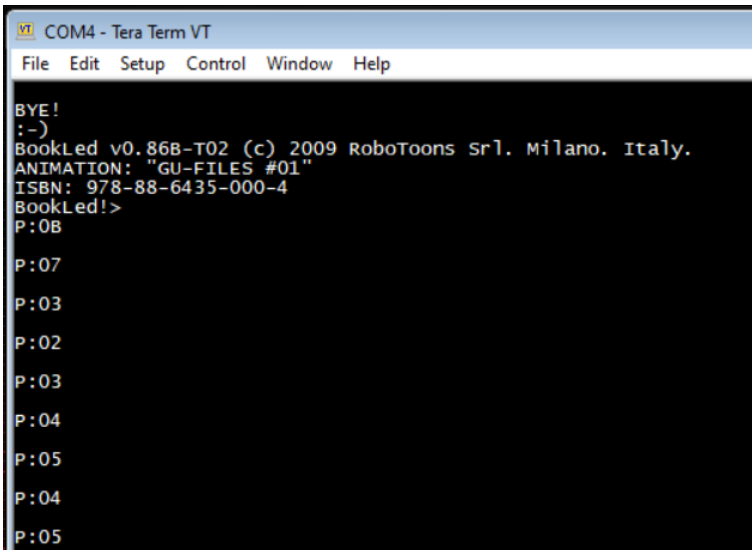
Connecting the BookLed to the PC

At this point the BookLed is connected. If you press the **v** key followed by **ENTER** you should see the FW version and then the interactive console:



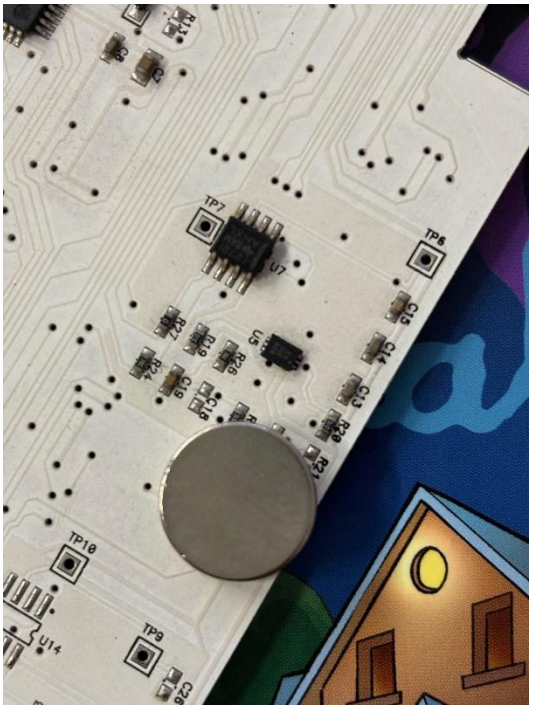
IMPORTANT: all commands given in the interactive console must be terminated by pressing the ENTER key.

ATTENTION: If you turn the pages of the BookLed you will see the page numbers appear in the window:



The BookLed Page Sensor

The technological core of the BookLed is a page identification sensor: using a system of NdFeB (Neodymium Iron Boron) magnets (not visible to the user), the book is able to recognize which page the user is reading and detect the turning from one page to the next.



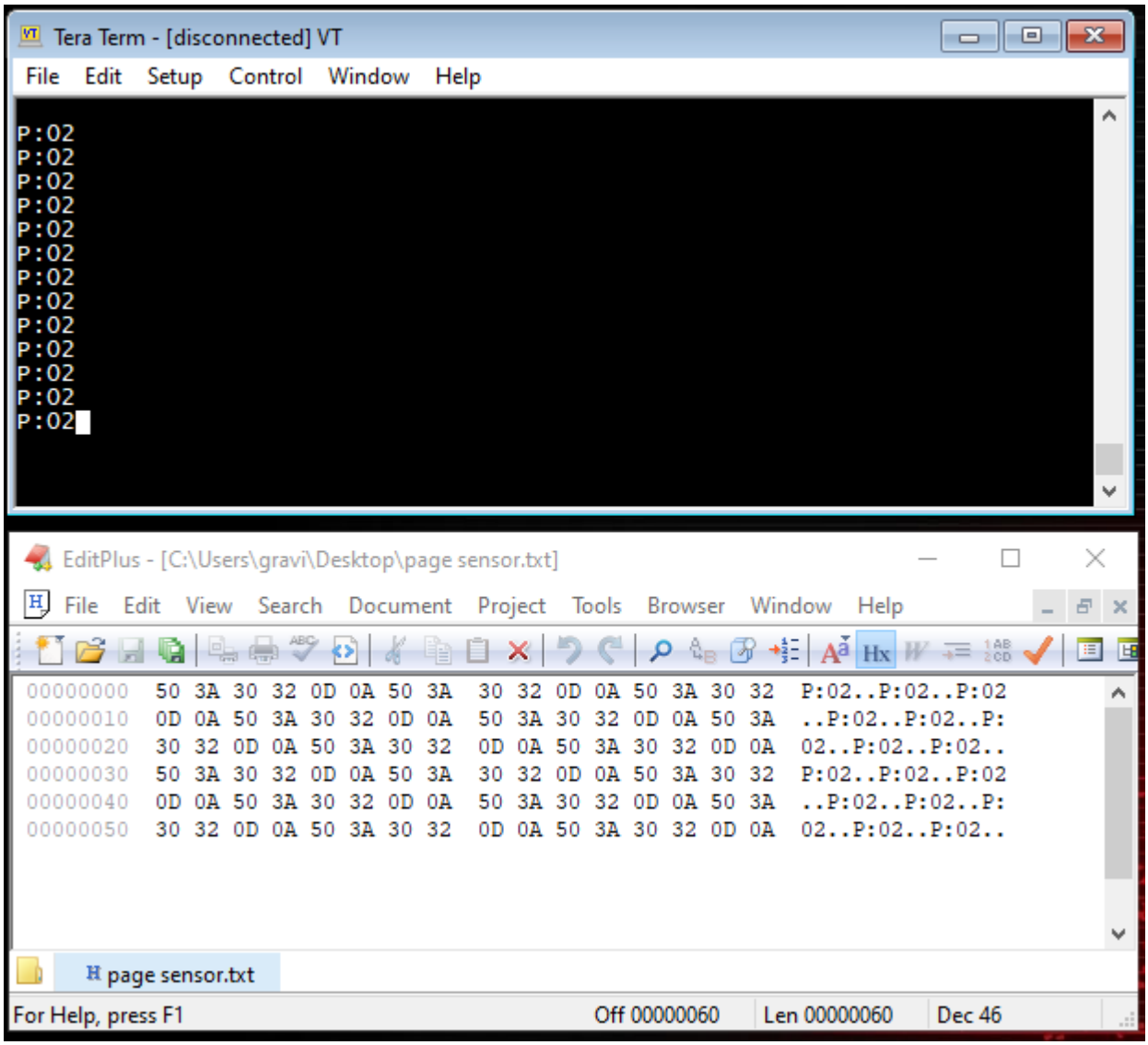
The information from the page is then used:

- to activate light effects which follow what is going on in the story.
- to activate sound effects related to what is happening on the page.
- to send the page code to the PC through an USB connection.

The bookled outputs the **page code** through the USB using the following format:

P: xx
00 ≤ xx ≤ 0C (hexadecimal value)

The identified page number can range from 1 to 12 (0C hexadecimal):

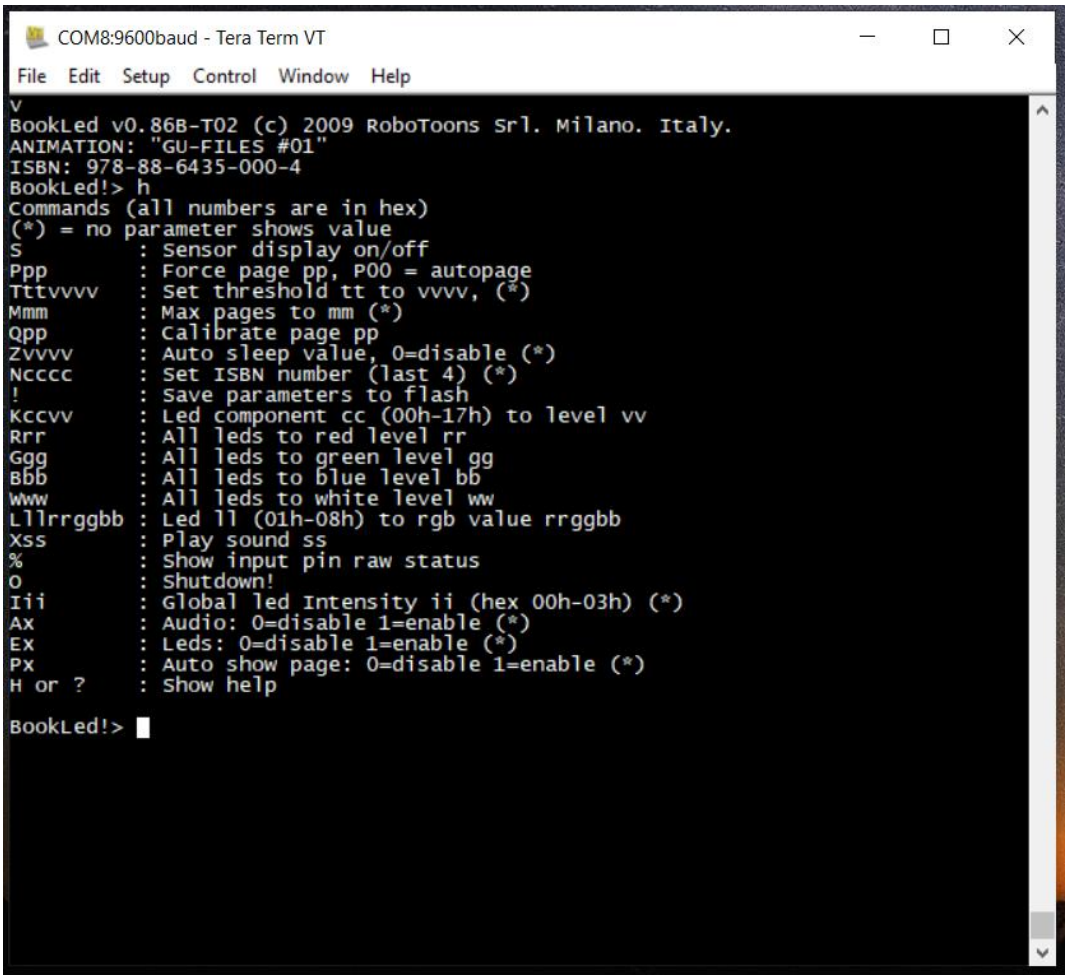


The page code is terminated with CRLF (0D 0A).
The page code can be output on:

- the page transition or
- approximately every 2 seconds (see AUTO SHOW PAGE command)

BookLed Console Commands

Pressing the **h** key followed by **ENTER** will display a list of commands that you can execute in the interactive console:



SET SENSOR DISPLAY ON/OFF

S : Sensor display on/off

Console command: S

Press S to show magnetic sensor real time values.
Press S again to stop

Executing this command will show real-time data from the magnetic sensor:

```
BookLed!> s
P02 | 0B 14 | 0416 02B9 015D
P02 | 0B 14 | 0415 02B9 015C
P02 | 0B 14 | 0415 02B9 015C
P02 | 0B 14 | 0415 02B9 015D

column 1 = current_page
column 2 = sensor_band
column 3 = sensor.filtered_value
column 4 = sensor.raw_value_x2
column 5 = sensor.raw_value_x4
```

FORCE PAGE EXECUTION

Ppp : Force page pp, P00 = Autopage

Console command: Ppp
1 ≤ pp ≤ Max Pages

Press Ppp to force the execution of led animation ad audio of page pp.
Press P00 to restore automatic page execution

SET THRESHOLD

Tttvvvv : Set threshold tt to vvvv, (*)

Console command: Tttvvvv
1 ≤ tt ≤ Max Pages
0 ≤ vvvv ≤ FFFF

This command sets a magnetic page sensor threshold.

SET MAX PAGES

Mmm : Max pages to mm

Console command: Mmm
1 ≤ mm ≤ FF (exadecimal number)

This command sets the maximum number of book pages.
For the book “LittelOwl and the phone call” mm=0C

CALIBRATE PAGE

Qpp : Calibrate page pp

Console command: Qpp
1 ≤ pp ≤ FF (exadecimal number)

This command calibrates the magnetic sensor for a specific page.
See the BookLed calibration chapter for the complete calibration procedure.

AUTO SLEEP

Zvvvv : Auto sleep value, 0=disable (*)

Console command: Zvvvv
1 ≤ vvvv ≤ 9999 (decimal number)

This command sets the autosleep timer of the book.
The default value of autosleep is 7530

SET ISBN NUMBER

Ncccc : Set ISBN number (last 4)

Console command:Ncccc
1 ≤ cccc ≤ 9999 (decimal number)

This command sets the last 4 digits of the ISBN number of the book.

SAVE PARAMETERS TO FLASH

! : Save parameters to flash

Console command: !

This command stores all the parameters on non-volatile (FLASH) memory.

SET LED COMPONENT

Kccvv : Led component cc (00h-17h) to level vv

Console command: Kccvv
1 ≤ cc ≤ 17 (hexadecimal number)
0 ≤ vv ≤ FF (hexadecimal number)

This is a command to control the luminosity of a single component of a single RGB LED.

For example, sending the k0fff command will light up component number 15 (hexadecimal F) - red LED - at the maximum value (FF).

SET ALL LEDS TO RED

Rrr : All leds to red level rr

Console command: Rrr
0 ≤ rr ≤ FF (hexadecimal number)

This is a command to control the luminosity of all the RED LEDs.

SET ALL LEDS TO GREEN

Ggg : All leds to green level gg

Console command: Ggg
0 ≤ gg ≤ FF (hexadecimal number)

This is a command to control the luminosity of all the GREEN LEDs.

SET ALL LEDS TO BLUE

Bbb : All leds to blue level bb

Console command: Ggg
0 ≤ bb ≤ FF (hexadecimal number)

This is a command to control the luminosity of all the BLUE LEDs.

SET ALL LEDS TO WHITE

Www : All leds to white level ww

Console command: Www
0 ≤ ww ≤ FF (hexadecimal number)

This is a command to control the luminosity of all the WHITE LEDs.

SET ONE LED TO RGB VALUE

Lllrrggbb : Led ll (01h-08h) to rgb value rrggbb

Console command: Lllrrggbb

1 ≤ ll ≤ 8 (decimal led number)
0 ≤ rr ≤ FF (hexadecimal number: red component)
0 ≤ gg ≤ FF (hexadecimal number: green component)
0 ≤ bb ≤ FF (hexadecimal number: blue component)

This is a command to set the color of one RGB LED.

PLAY SOUND

Xss : Play sound ss

Console command: Xss

00 ≤ ss ≤ 14 (hexadecimal sound number)

This is a command to play internal sound.

SHOW INPUT PIN STATUS

% : Show input pin raw status

Console command: %

This command shows the status of the iput pins connected to the switch.
Press % (ENTER) again to stop execution.

```
BookLed!> %
BookLed!>
C1L1R1C00
C1L1R1C00
C1L1R1C00
C1L1R1C00
C1L0R1C00
C1L0R1C00
C1L0R1C00
C1L1R0C00
C1L1R0C00
C1L1R0C00
```

Cx (first column) is the status of the Central switch.
Lx is the status of the Left switch.
Rx is the status of the Right switch.
The last column C00 is fixed.

x = 1 → switch not pressed
x = o → switch is pressed

SHUTDOWN

O : Shutdown!

Console command: O

This command shut down the BookLed.
Press the Central switch to power ON the BookLed again.

SET GLOBAL LED INTENSITY

Iii : Global led Intensity ii (hex 00h-03h)

Console command: Ggg
0 ≤ ii ≤ 03 (decimal number)

This command set the global intensity of all the LEDS.
The default value is 03.

AUDIO ENABLE/DISABLE

Ax : Audio: 0=disable 1=enable

Console command: Ax
0 ≤ x ≤ 1 (decimal number)

This command enables or disables the audio of the BookLed.

LED ENABLE/DISABLE

Ex : Leds: 0=disable 1=enable (*)

Console command: Ex
0 ≤ x ≤ 1 (decimal number)

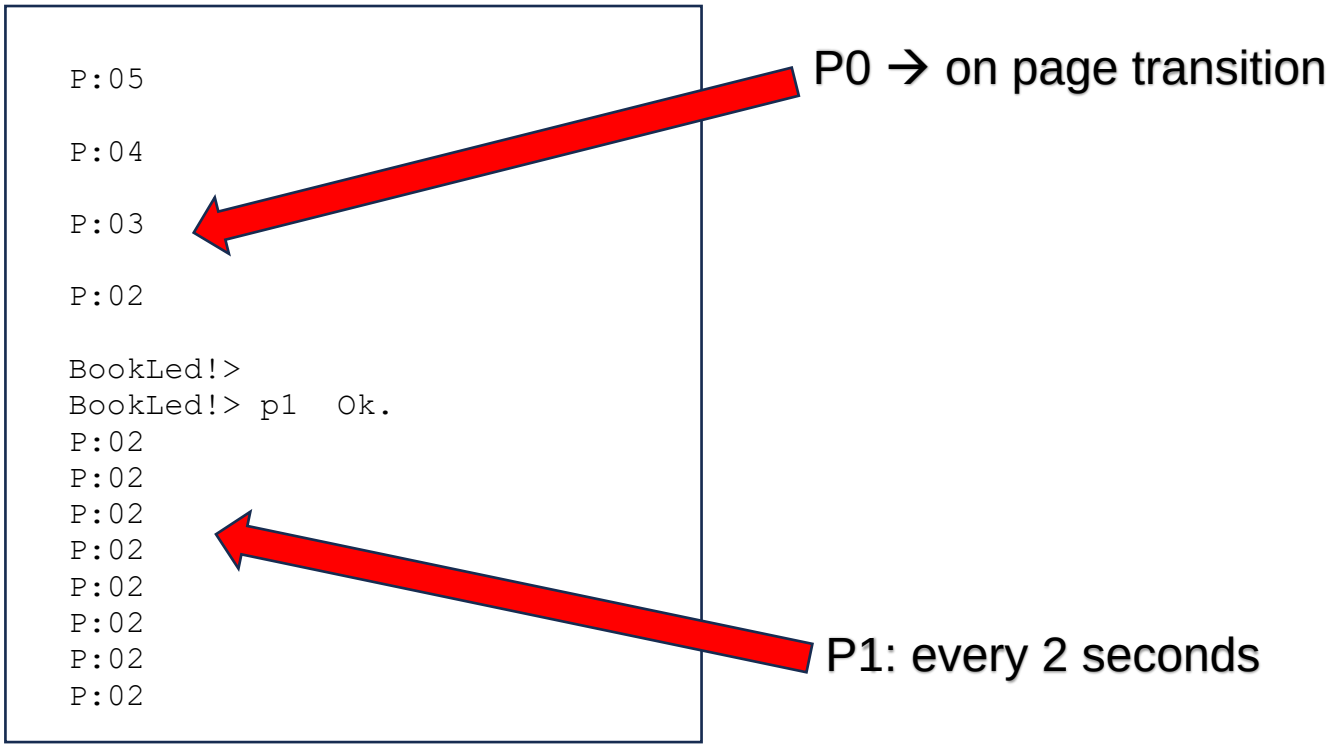
This command enables or disables all the LEDs of the BookLed.

AUTO SHOW PAGE

Px : Auto show page: 0=disable 1=enable

Console command: Ex
0 ≤ x ≤ 1 (decimal number)

This command enables or disables the auto show page function.



P0 → the page number is only shown when there is a page transition.
P1 → the page number is shown once every two seconds.

HELP

H or ? : Show help

Console command: H

This command shows the console help.

BookLed Re-Calibration

Paper and cardboard are "living" materials. Therefore, sometimes, humidity, excessive heat, and other environmental factors can cause small deformations of the cardboard and the electronic sensor (which is not alive) can struggle and read a wrong page. But don't worry: the sensor can be easily recalibrated.
There are two re-calibration procedure: the manual procedure that works with all the FW codes and the automatic procedure that works with FW versions higher than v0.86B-T02.

MANUAL RE-CALIBRATION PROCEDURE

1. Turn off the BookLed with the button.
2. Place it on a plane surface, a table (not metal) with the cover facing up and closed.
The page on the right must be supported with the following pages.

Open this page:

Issue the command:
q01 <enter > <enter>

Open this page:

Issue the command:
q02 <enter > <enter>

Open this page:

Issue the command:
q03 <enter > <enter>

Open this page:

Issue the command:
q04 <enter > <enter>

Open this page:

Issue the command:
q05 <enter > <enter>

Open this page:

Issue the command:
q06 <enter > <enter>

Open this page:

Issue the command:
q07 <enter > <enter>

Open this page:

Issue the command:
q08 <enter > <enter>

Open this page:

Issue the command:
q09 <enter > <enter>

Open this page:

Issue the command:
q0A <enter > <enter>

Open this page:

Issue the command:
q0B <enter > <enter>

Open this page:

Issue the command:
q0C <enter > <enter>

Issue the command
! <enter>

If all was made well, the BookLed replies with "Calibration done".

AUTOMATIC RE-CALIBRATION PROCEDURE

This calibration procedure is applicable only in the case of FW greater than v0.86B-T02

1) Turn off the BookLed pressing the central button.
2) Place it on the table (not metal) with the cover facing up and closed.
3) Press and hold the button until you hear seven beeps in a row. If more than ten seconds pass and it doesn't ring, it's probably not turned off or the battery is flat (in this case connect it to the computer with a mini USB cable).
4) Open the BookLed on the second page, the one with the drawings where the story begins.
5) Briefly press the button, you will hear a beep and after about two seconds a double beep.

6) After the double beep, turn the page and repeat the previous point. Pages with holes will light up blue between single beeps and double beeps.
7) After calibrating the last page, if everything went well you will hear a happy sound and the LEDs will light up green; if something has gone wrong you will hear a sad sound and the LEDs will light up red.
8) In any case the BookLed will turn off automatically at the end of the calibration.
9) If something went wrong, repeat everything from point 1.
10) If you want to interrupt the calibration, wait thirty seconds without pressing the button and the BookLed will turn off on its own.

FAQS

HOW IT WORKS

To fully enjoy the BookLed, place it on a table and press the button at the top.
To turn it on, you have to press it in the central part (be careful because the button can have three directions).
As you turn the pages, the light animations and sounds will change depending on the page you are reading. If the brightness seems too strong you can adjust it by pressing the button to the left several times.
If you want to read the book without the sound effects being played, just press the button to the right.
To turn off the BookLed just press the button towards the center a second time.
When the lights tend towards reddish it means that the BookLed is running out of battery.

HOW DO I RECHARGE IT?

Luckily you don't have to replace or buy any new batteries.
To recharge, simply connect the BookLed mini USB socket to a normal PC or MAC (the cable is supplied).
A green light next to the mini USB socket will indicate that charging is in progress (when the light goes out the charging is finished).
Be careful: when you connect a BookLed to a PC with a Windows operating system for the first time you will be asked to install some drivers.

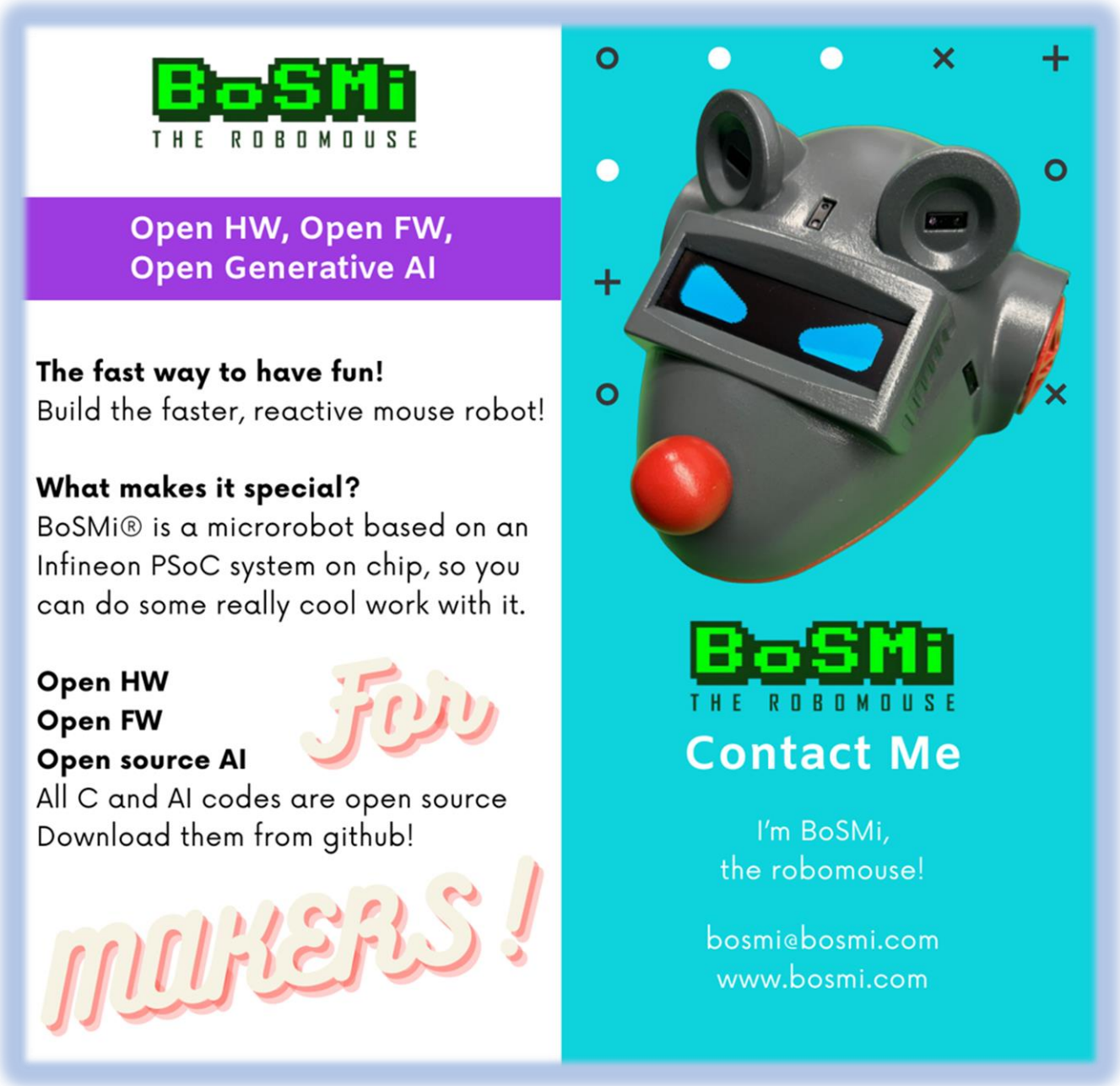
SOUND AND LIGHT NOT SYNCHRONIZED WITH PAGES!

"Damn! I turn to page 3 but the book doesn't move forward like yesterday, the sounds and lights no longer appear well synchronized with the pages: why???"

Paper and cardboard are "living" materials. Therefore, sometimes, humidity, excessive heat, and other environmental factors can cause small deformations of the cardboard and the electronic sensor (which is not alive) struggles and reads a wrong page. But don't worry: the sensor can be recalibrated as many times as you want (see Re-Calibration chapter of this manual at page 24). However, remember not to keep the BookLed too hot or humid otherwise the sensor could still lose calibration!

BoSMi, the Robomouse: available soon

Do you want to experiment with a microrobot
that you can control and act using **Generative AI**?
Then the **BoSMi** robot is the one for you: available soon!

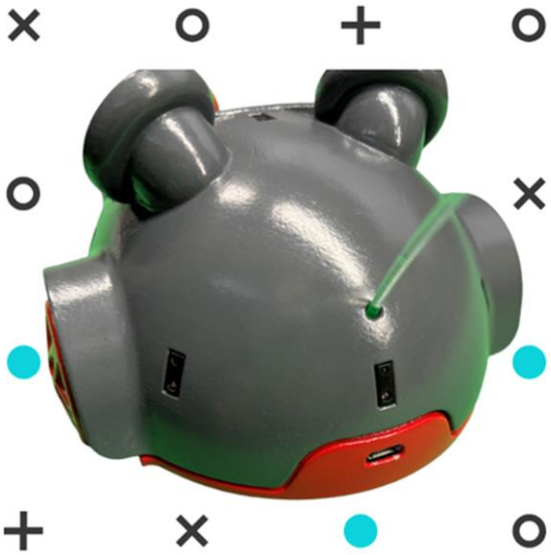


BoSMi
THE ROBOMOUSE

OLED LIBRARY
EXPRESSIVE ENGINE
GENERATIVE AI INTERFACE

Low level behaviors

- Go-to-Goal
- Obstacle-Avoidance
- Obstacle-bumping
- Wall-following
- Behavior Switching Controller



Generative AI Interface

- BT Audio to kinematic function
- BT commands to OLED expressivity

BOSMI@BOSMI.COM
WWW.BOSMI.COM

Hardware Specifications

Processor and memory

- **32 bit ARM Cortex-M3 PSoC** Infineon CY8C5888AXI-LP096 80MHz
- 256kB FLASH, 64kB RAM, 2kB EEPROM
- **64Mbit external FLASH** S25FL064 for expressive contents
- Configurable Analog, DSP and Digital Blocks

Sensors

- Up to 8 Vishay VCNL4200 proximity sensors (16 bit; 1.5m)
- **BNO055 IMU** (3x 16bit gyro + 3x 14 bit accelerometer + 3x geomagnetic sensor)
- 2x 12cpr optical encoders
- 2x Motor current sensing circuit
- Audio Input for beat detection (Analog LPF+PGA or DSP)
- Joystick Nose

Motors & Power

- 2x DC micro geared motors
- PWM 16 bit PID motor control
- 2000mAh LiPo battery
- USB recharging circuit

Expressivity

- OLED Display 128x32 pixel
- RGB Led Tail
- MP3 player with up to 32GB SD card (FAT16, FAT32)
- BT Audio

I/O Ports

- **I2C Ports** (Qwiic, Stemma QT, Grove, gravity, DFrobot HuskyLens compatible)
- Debug I/O port for motors analog calibration
- 4x Analog Input port for Reflectance Sensors Array (Pololu QTR compatible)
- USB Port for Console Interface (parameters, debug, control, bootload)
- **Audio Bluetooth input port for Generative AI interfacing**
- Audio Mixer port (mixes BT Audio with internally generated MP3)
- **UART Bluetooth bidirectional data port for Generative AI interfacing**