Helena

User Manual

1   Preface

Helena is an alternative driver for the popular Yinding or KD2 Headlight Cycling Lamp with following features:

- Two independent 3A Step-Down constant current sources, each capable of driving two white LEDs in series. The intended setup is one Cree XHP50 LED equipped with a flood optic and one Cree XM-L equipped with a spot optic.

- Integrated motion sensor to drive the LEDs in dependency of the head inclination, resulting a nearly constant brightness level, no matter if you're looking down or straight forward.

- Bluetooth interface for wireless remote control, lamp daisy-chaining and Smartphone based configuration.

- Integrated temperature regulation to prevent lamp from overheating.

- Smooth output power reduction when battery is low.

- Low standby current (less than 100µA).

- Works with input voltages between 6V and 8.5V

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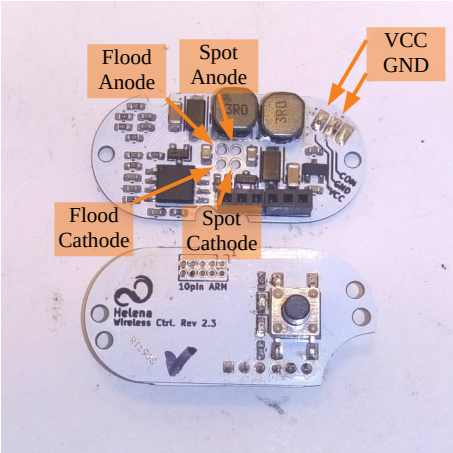
1 Installation

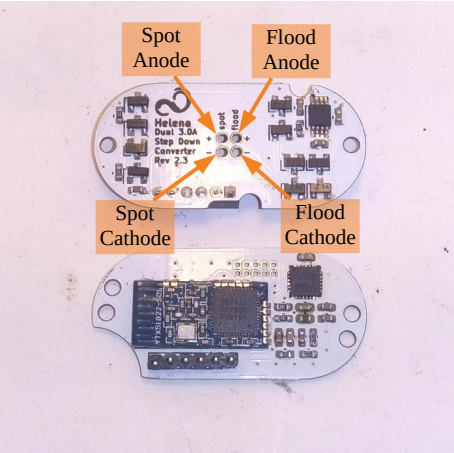## 1.1 Connections

Image 1: board connections

Image 2: board connections

1.2   Driver Swap for KD2

Step 1. Disassemble lamp and remove old driver. Mount LED board witch the notches facing to the top and route both cables through the left one. Then cut the cables to a length of 20-25mm and cover the screws with electric tape.

Image 3: LED board preparations

Step 2. Connect the LED cables to the spot driver output of the LED driver. Route the cables as shown in the image.

Image 4: LED connection

Step 3. Attach the power cable (and optionally the communication line). Route the cables along the board-to-board connector and use the notch next to it to lead it through the opening.
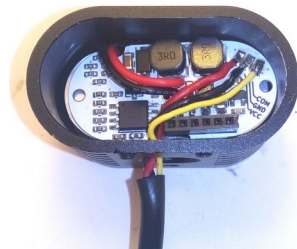

Image 5: power cable routing

Step 4. Mount the controller board to the lid.

Image 6: mounted
Controller board

Step 5. Put a pair of tweezers, zip ties,
toothpicks or a similar object between
the LED- and driver board to lift it a
couple of millimeters, then put the lid
on and.

Image 7: Lift driver board
for proper connection

Step 6. When the connector fits properly,
remove the tweezers, close the lid and
you are done.

Image 8: closed lid

1.3   Driver Swap for Yinding

Step 1. Disassemble lamp and remove old driver. Cut the cables to a length of 20-25mm.

Image 9: prepared LED cables

Step 2. Attach the power cable (and optionally the communication line) Don't forget to run the cable through the opening in the lamp body.
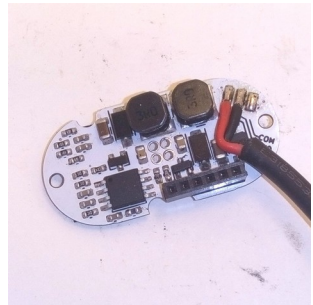

Image 10: attached power cable

Step 3. Now attach the cables from the LED board to the spot output. Connect them from the bottom side.
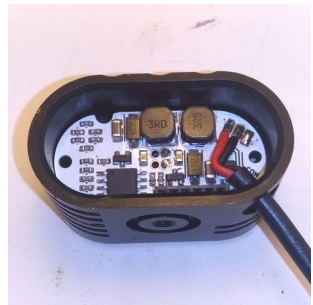

Image 11: attached LED cables

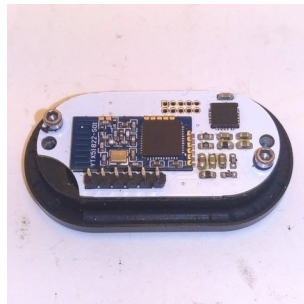**Step 4.** Mount the controller board to the lid.

Image 12: mounted
Controller board

Step 5. Close the lid and reassemble the lamp.

1.4   LED, lens and driver swap for Yinding

Step 1. Prepare LED boards by attaching cables and cutting them to a length of 25-30mm.
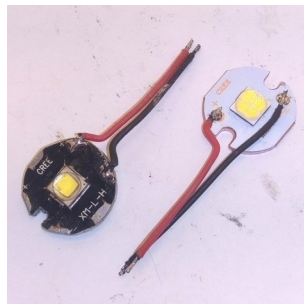

Image 13: prepard LED boards

Step 2. Attach the power cable (and optionally the communication line) Don't forget to run the cable through the opening in the lamp body.

Image 14: attached power cable
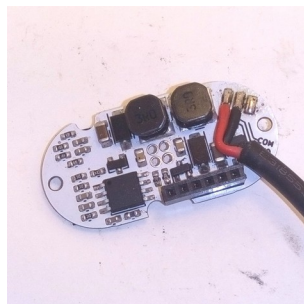
Step 3. Route the LED boards cables through the inner hole.

Image 15: cable routing

Step 4. Now attach the cables from the bottom side. Solder the cables of the XHP50 to the flood output and the cables of the XM-L to the spot output.
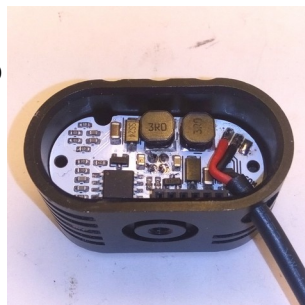

Image 16: attached LED boards cables

Step 5. Mount the controller board to the lid and close the lid.
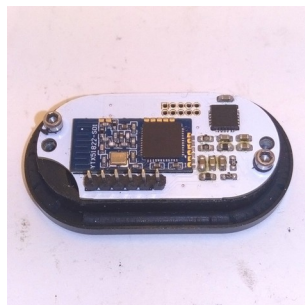
Image 17: mounted Controller board

Step 6. Flip the lamp around and tighten the screws to secure the lid and LED boards. Position the XHP50 board a bit to the top and the XM-L board a bit to the bottom.

Image 18: LED boards allingment

Step 7. Insert the lenses and use some spacers to tilt the spot lens upwards and the flood lens downwards. The spacers should have a height of 0.7-1.0mm, a quartered O-Ring works fine.

Image 19: tilted lenses

Step 8. Finally mount the lens cover.

Image 20: reassembled

2 Usage

2.1 Modes

Helena has 8 free configurable modes. Each mode is define by a setup and a intensity field. The following table gives an overview of the available setups.

ID	cloned[1]	Active pitch compensation[2]	spot	flood
0x00				
0x01				●
0x02			●	
0x03			●	●
0x05		●		●
0x06		●	●	
0x07		●	●	●
0x09	●			●
0x0A	●		●	
0x0D	●	●		●
0x0E	●	●		●

The meaning if the intensity field depends on the setting of the pitch compensation. If pitch compensation is activated it represents the

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1 If cloned is activated the desired output current of the selected driver is also applied to the other driver

2 If active pith compensation is activated the output current is regulated in dependency of the pitch angle to produce a constant illumination.

desired maximum illumination in lux, otherwise it represents the desired output power in %.

2.2   Groups

The 8 modes can be grouped in either

- 1 group with 8 modes,

- 2 groups with 4 modes each,

- 4 groups with 2 modes each and

- 8 groups with 1 mode each

2.3   Control with lamp switch

If the lamp is off a short click will enable it by selecting the first mode. If the lamp is already on a short click will select the next mode. At the end of a group it will roll over to the first mode of this group.

A long click ($\geq$ 0.5s) will switch to the next group.

To turn off the lamp keep the button pressed until the lamp turns off ($\approx$2s).

Modes with a setup of `0x00` or an intensity field set to `0` will be skipped.

2.4   Remote Connection

Helena can establish a remote connection to either a remote control of a Xiaomi Yi or to another Helena.

To initiate the pairing process you have to

- turn of the lamp,

- wake up the remote device (by pressing a button on the remote control, or make sure the second Helena is powered on)

- press and hold the lamp button for at least 2 seconds.

After a successful pairing the lamp with automatically search for this remote device and establish a connection as soon as it is in range.

2.4.1   Remote Control

The control via the Xiaomi Yi remote is similar to the internal button.

- A short click on the big button will switch to the next mode.

- A long click on the big button will switch to the next grtoup.

- A click on the small button will turn off the lamp immediately.

Modes with a setup of `0x00` or an intensity field set to `0` will be skipped.

2.4.2   Remote with another Helena

A remote connection with another lamp works differently. Every time when a mode is changed, this new mode is relayed to the remote lamp.

The remote lamp with change into this mode even if this is an "empty" mode (a mode with a setup of `0x00` or an intensity field set to `0`). Furthermore this communication works bidirectional.

2.5   Status LED

Helena is equipped with a red and blue status LED, which is visible through the transparent button cap. The blue on indicates if a remote control is connected. The red on turns on whenever the temperature or input voltage limiter is active.

Appendix A   Configuration with nrf Connect

This section is only valid for Firmware revisions ≥ 1.0.0

The Configuration of states and group can be done with the App "nrf Connect" from Nordic Semiconductors.

Step 1. Plug in battery to Helena and open the App. Select SCANNER and then start scanning. Helena will then appear in the device list and you can press the CONNECT button.
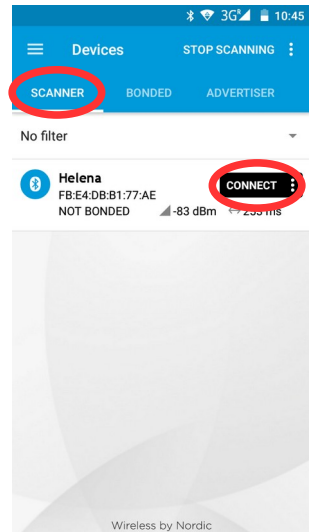

Image 21: Scanning

Step 2. After you connected to Helena, you will see a list of available services. Select the `Light Control Service`. Compare the UUIDs if the service is named `Unknown Service`.
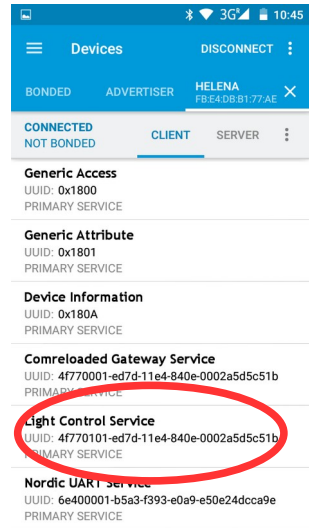

Image 22: Services list

Step 3. Go to the `Light Control Point Characteristic` (it may be named `Unknown Characteristic`, in this case compare the UUIDs again) and enable the indications by touching the arrow-up and arrow-down symbol.
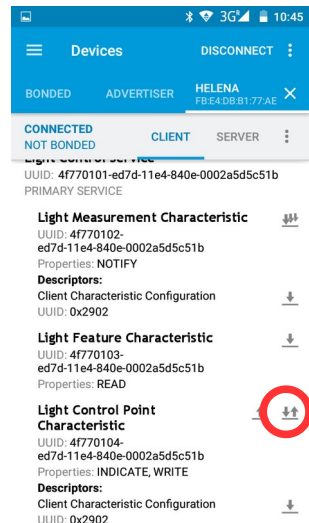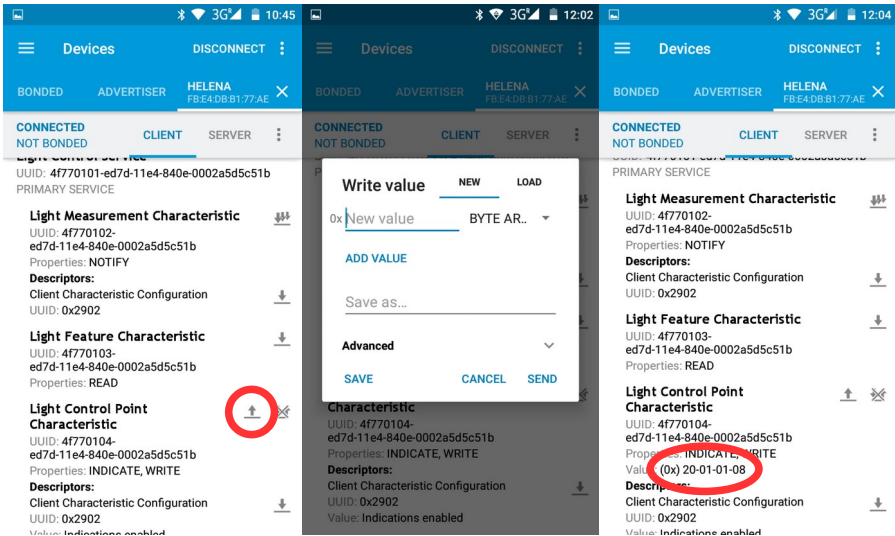

Image 23: Light Control Service

Image 24: Send commands Image 25: Send commands Image 26: Command reply

Step 4. After you have enabled the indications for the Light Control
Point you are ready to send commands to read out the actual
configuration and to change it, too. To send a command you
have to click the arrow-up symbol, then you can enter the
desired command. The Control will reply with at least 3 bytes:
The first byte is always $0x20$.
The second byte is the command this reply belongs to.
The third byte is a status byte.

Status Byte Value	Description
$0x01$	Success
$0x02$	Not supported
$0x03$	Invalid paramter
$0x04$	Operation failed

Depending on the command there my be additional data bytes.

A.1. Read Group Configuration

The command for reading the current group configuration is `0x03`.

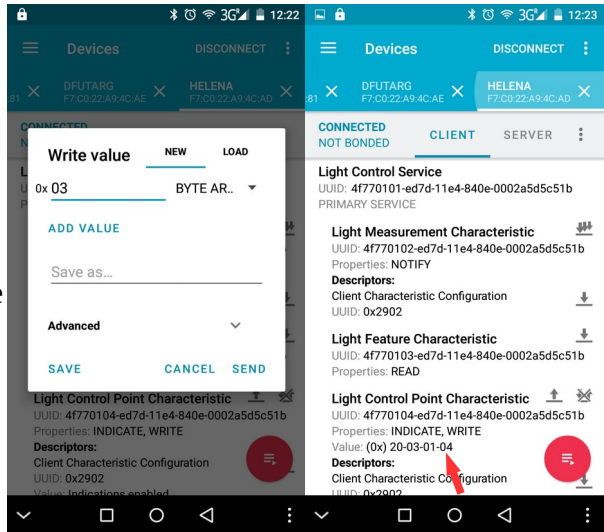The Control Point will reply with the actual number of groups in the fourth byte.

Image 27: Read group configuration command

Image 28: Group configuration reply

A.2.   Read Mode Configuration

The command for reading the current mode configuration is `0x05`. Followed by the mode number to start reading[3].

The reply is a list of all modes, where the first byte of each state represent the setup and the second the intensity[4].
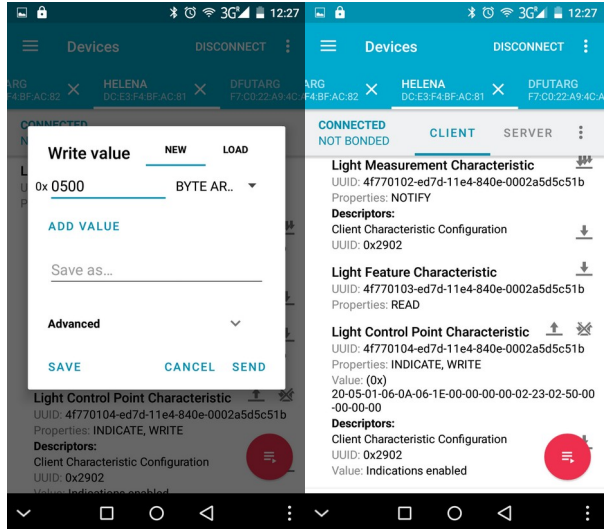

Image 29: Read state configuration command

Image 30: State configuration reply

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3   Internally the mode counter begins with 0, so to change mode 1 you have to select 0x00, for Mode 2 0x01, for Mode 3 0x02, ...

4   These are hexadecimal numbers, please use one of the plenty available online HEX to DEC converters.

The reply in Image 30 represents the following setting:

Mode 1	Spot Pitch compensated with 10lux
Mode 2	Spot Pitch compensated with 35lux
Mode 3	Not used
Mode 4	Not used
Mode 5	Spot constant with 35%
Mode 6	Spot constant with 80%
Mode 7	Not used
Mode 8	Not used

A.3.   Change Group Configuration

The command for changing the number of groups is 0x04. The new number of groups is followed as second byte (the complete command in Image 31 changes the configuration to two groups).
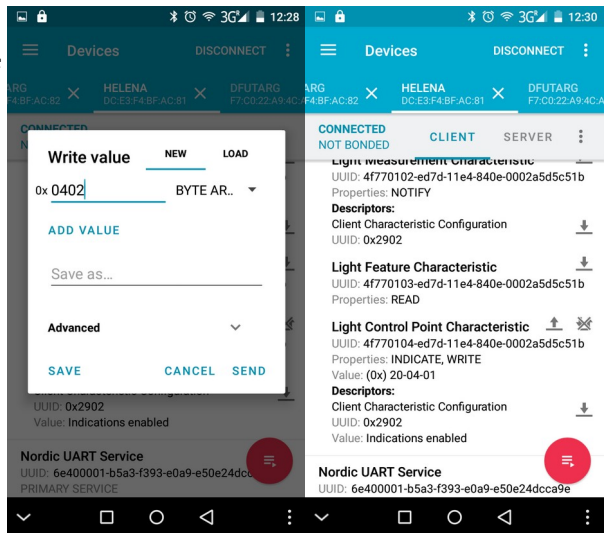

Image 31: Group change command

Image 32: Group change reply

A.4.   Change Mode Configuration

The command for changing the mode configuration is 0x06. Followed by the mode number to start[5] and a list of new mode. It is not necessary to change all modes, it is possible to change only a few, too. The command in Image 33 will start with Mode 3 and has only a list of two modes. So this command will
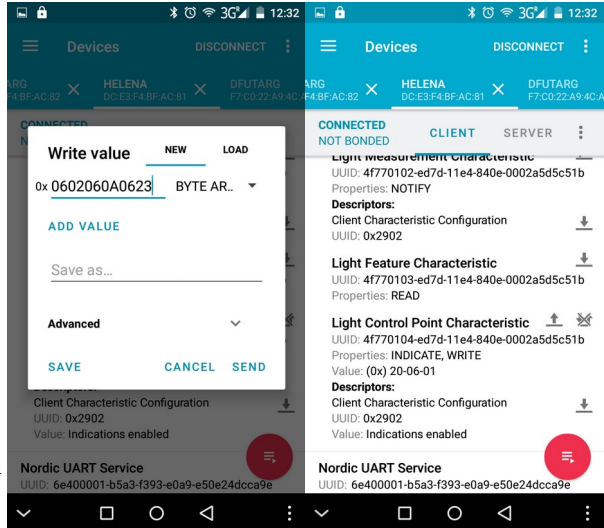

Image 33: State change command

Image 34: State change reply

result in changing mode 3 to Spot pitch compensated with 10lux and Mode 4 to Spot pitch compensated with 35lux. The other states will keep their prior setting.

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5   Internally the mode counter begins with 0, so to change Mode 1 you have to select 0x00, for Mode 2 0x01, for Mode 3 0x02, ...

A.5.   Firmware Update

First download the new firmware archive (normaly named `Helena_app.zip`) from the Github repository in the folder `Firmware/Helena_NRF_SDK10/bin/debug`. To initiate the Firmware Update Process you have to plug in the lamp while keeping the button pressed. The Helena will activate the bootloader (indicated with the red LED).

Now open the App and start scanning. Connect to the "DfuTarg" and start the update by tapping on the smal DFU icon in the top. Then select the previously downloaded firmware archive.
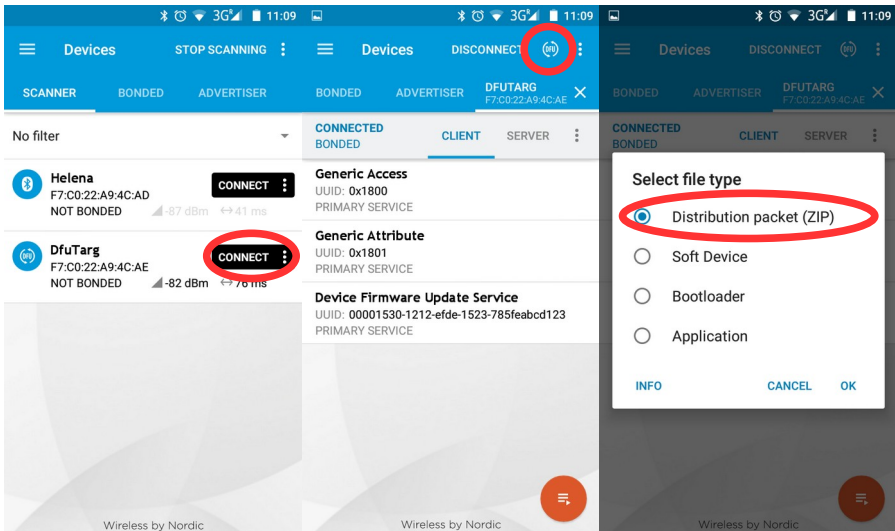
Image 35: scan and connect to DfuTarg

Image 36: start update

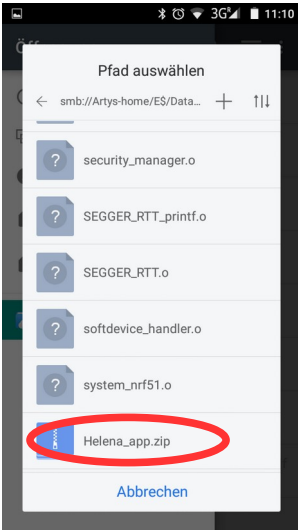Image 37: select Distribution packet (ZIP)

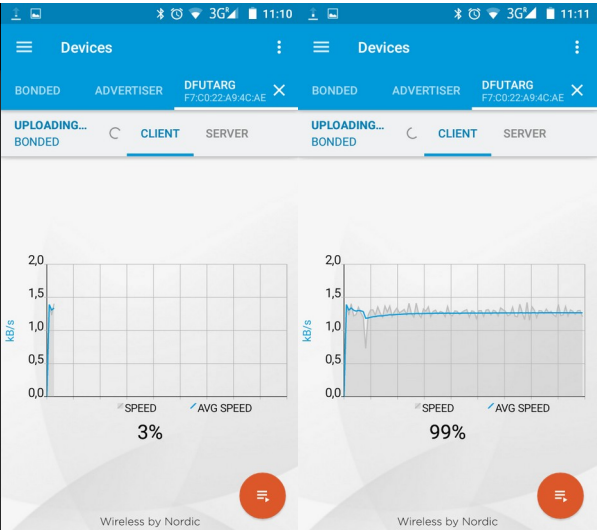# ∽ Helena User Manual

Image 38: select firmware archive   Image 39: update starting   Image 40: update finished