Dampfe V2

1. Preface

This battery carrier was designed to improve functionality and flexibility compared to industrial manufactured ones. Push buttons were replaced by MOSFET sensors because they get defect after a couple of key presses. Because of the low current ripple a step down converter is being used to power the heating resistor and the batteries. A powerful battery charger was implemented so replacing the batteries is not necessary. Also a dry operation of the coil is detected and for security reasons the steamer output is shutdown.

The micro-controller hardware and software is fully compatible to the Arduino ® Micro.

2. Technical data[1]

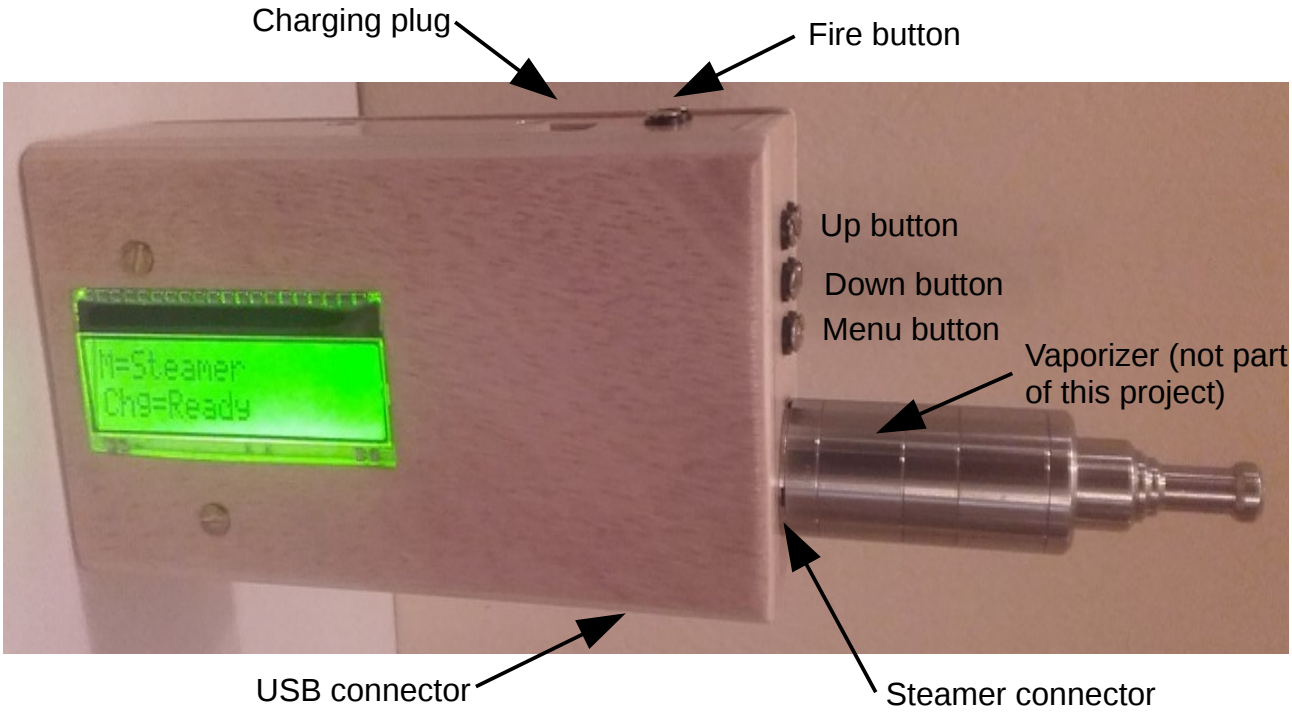
Parameter	Value
Short circuit protection	True
Power controller	True
Integrated charger	True
Power controller charger mode	True
Charger input voltage failure detection	True

1 Specified at 23°C ambient temperature

Parameter	Value
Charger mode	CC/CV
Charger balancer	True
Temperature battery monitoring	True
Temperature monitoring power electronics	False
Sleep mode	True
Continuous current[2]	3,2 A
Continuous current charging	3 A
Max. peak current	6,8 A
Minimal tested steamer resistance	0,33 Ω
Current measurement resolution	13,67 mA
Current measurement tolerance	+4,9 %, -0,5 %
Fuse current	F8 A
Battery cells	2
Maximum input voltage	14 V
Voltage measurement resolution	13,69 mV
Current measurement tolerance	+2,6 %, -0,7%
Mechanical dimensions (h/w/d)	125/75/40 mm
Steamer connector	510/22 mm
Housing material	Wood / compound plate 6 mm
Weight (without vaporizer and with batteries)	300 g

2 Used heat sink: Rth=63K/W

3. Interfaces, connectors and buttons



3.1. Charging plug

The charging plug is needed for powering the charger. A 6,3/2,1 mm DC plug is build-in and the outside polarity is minus.

3.2. Fire button

The fire button is used for:

- Activating the steamer's output
- Starting the charger
- Waking / going a sleep with five key presses

3.3. Up button

The up button is needed for:

- Incrementing the setpoint power of the steamer
- Increasing the contrast of the display

3.4. Down button

The down button is needed for:

- Decrementing the setpoint power of the steamer
- Reducing the contrast of the display

3.5. Menu button

The menu button is used for:

- Switching through the menu on the display

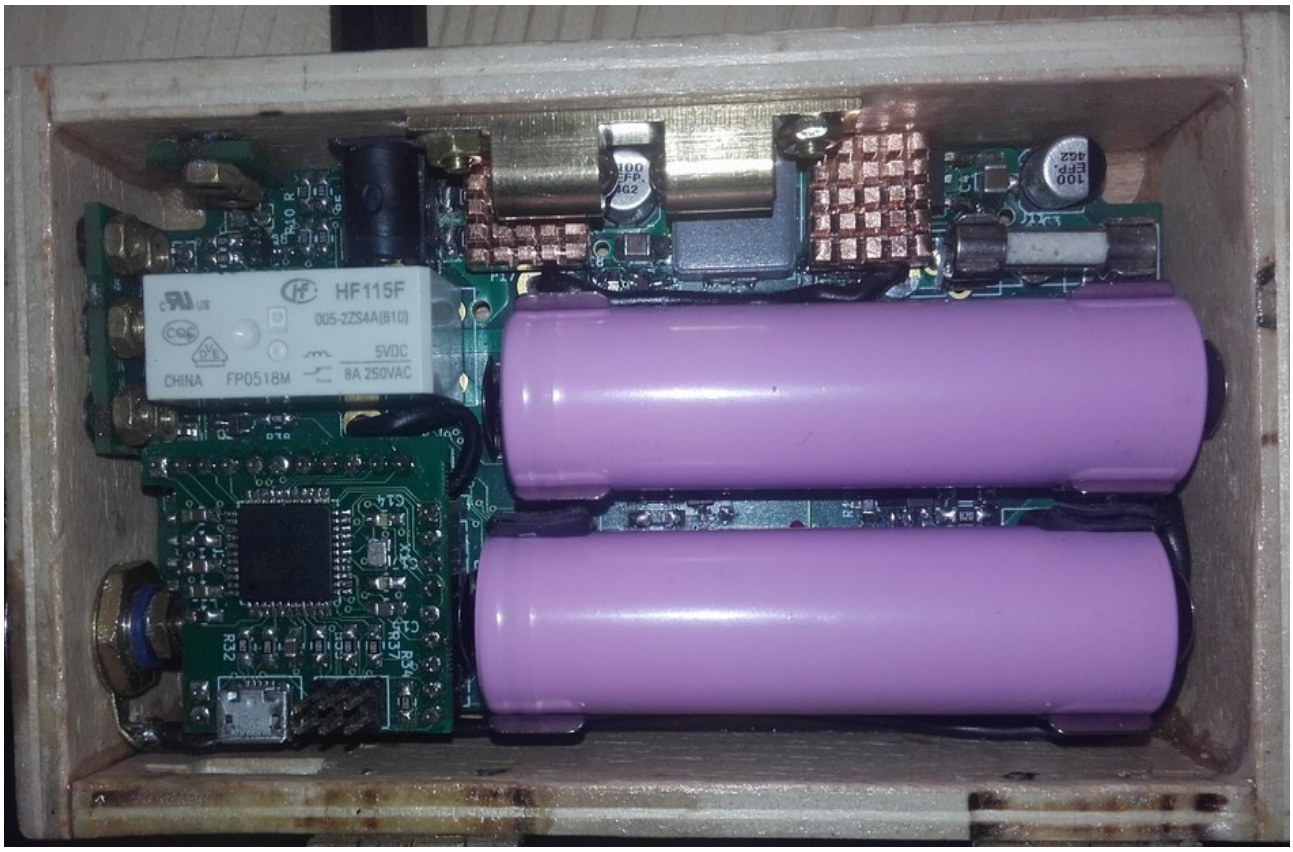
3.6. Steamer connector

Connect here your steamer/vaporizer.

3.7. USB connector

The USB connector is used for programming and monitoring the device. The Dampfe V2's software and hardware is fully Arduino ® compatible (Arduino Micro).

Picture 1 shows an inside view of Dampfe V2.



Picture 1

4. Modes of operation

4.1. Enabling/disabling the device

To enable simply press the fire button once. A screen on the display like picture 2 is shown. After 5 key presses within 2 seconds, a “cold” resistance measurement is performed and the Dampfe V2 is online.

Picture 2

To switch off the device press fire 5 times and the device is going into sleep mode. Dampfe V2 will also go automatically into the sleep mode, if no key is being pressed the last 5 minutes.

4.2. Steamer

By pressing the fire button the steamer power controller is activated and it controls the output power of the heating resistor (coil) to ensure a constant temperature. If a dry operation is detected the output is set to zero and an error is shown on the display. If the battery voltage reaches the minimum of 3 V the output is also set to zero.

The setpoint power is adjustable using the up or down key if screen 1 to 3 is selected. This value is remanent. If the main screen is chosen the mode of operation is to be toggled with the up button. The contrast is adjustable at screen 4 with the up and down key and it's value is stored to the EEPROM.

Main screen

Picture 3

1st screen

Picture 4

Ps … Setpoint power / W

P … Current power / W

C … Relative resuming battery capacity / %[3]

O … Relative duty cycle of the step down converter / %

2nd screen

Picture 5

V … Output voltage / V

V1 … Battery voltage 1 / V

I … Output current / A

R … Resistance of the heating resistor / Ω

3 Given by the discharge voltage curve of the battery, 9 points, linear interpolation, INR18650-30Q

3rd screen

Picture 6

Tb1 … Battery temperature 1 / °C

Tb2 … Battery temperature 2 / °C[4]

4th screen

Picture 7

Contrast … Contrast setting of the display (26...63)

4.3. Charger

The charger mode is designed to fast-charge the batteries with a current up to 3 A in CC/CV mode. If unbalanced batteries are used they are charged up to 4,20 V per cell and if one or both cells reach a voltage of 4,22 V the balancer for the specific cell is activated and discharges the cell with a current of about 100 mA until a cell voltage of 4,20 V is reached. If the total voltage exceeds 4,3 V per cell the charge current is being reduced to protect your batteries.
While charging the capacity and energy is being logged and the maximum power of the power supply will not be overloaded. Be careful changing this value! You may damage your power supply.
The cell's temperature is monitored and the output is set to zero if one is reaching a temperature outside of -20 °C to 50 °C.

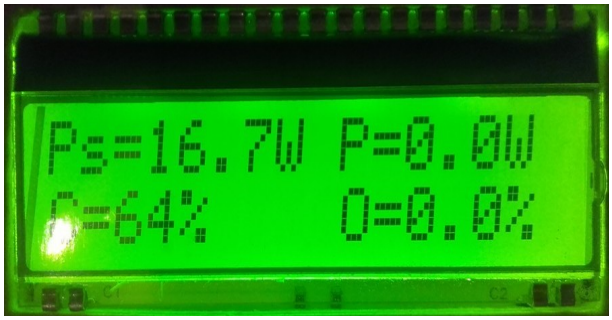
Note: To ensure better cooling of the Dampfe V2 and the batteries it is recommended to open the cover while charging.

4 This temperature is slightly higher than the first because of heat from the adjacent step down converter

Main screen

Picture 8

1st screen



Picture 9

Ps … Setpoint power / W

P … Current power / W

C … Relative resuming battery capacity / %[5]

O … Relative duty cycle of the step down converter / %

2nd screen

Picture 10

V … Battery voltage / V

V1 … Battery voltage 1 / V

5 Given by the discharge voltage curve of the battery, 9 points, linear interpolation, INR18650-30Q

I … Charging current / A

V2 … Battery voltage 2 / V

3rd screen

Picture 11

Tb1 … Battery temperature 1 / °C

Tb2 … Battery temperature 2 / °C[6]

4th screen

Picture 12

Cb … Battery capacity / Ah

Eb ... Battery energy / Wh

5. Software

Please contact the author for a binary version for uploading.

6. Hardware schematics/layout

Please contact the author for a copy.

6 This temperature is slightly higher than the first because of heat from the adjacent step down converter

7. Future work

- Build into a metal case
- Develop a single cell battery carrier