

Dicodes Flat Printed Circuit Board FL80_V2.1

(Preliminary, Subject to Change!)

The FL80 is an electronic circuit board for use in do it yourself electronic cigarettes, like box or tube mods.

1. Size, Dimensions and Positions

The drawing below shows the overall size of dicodes FL80.

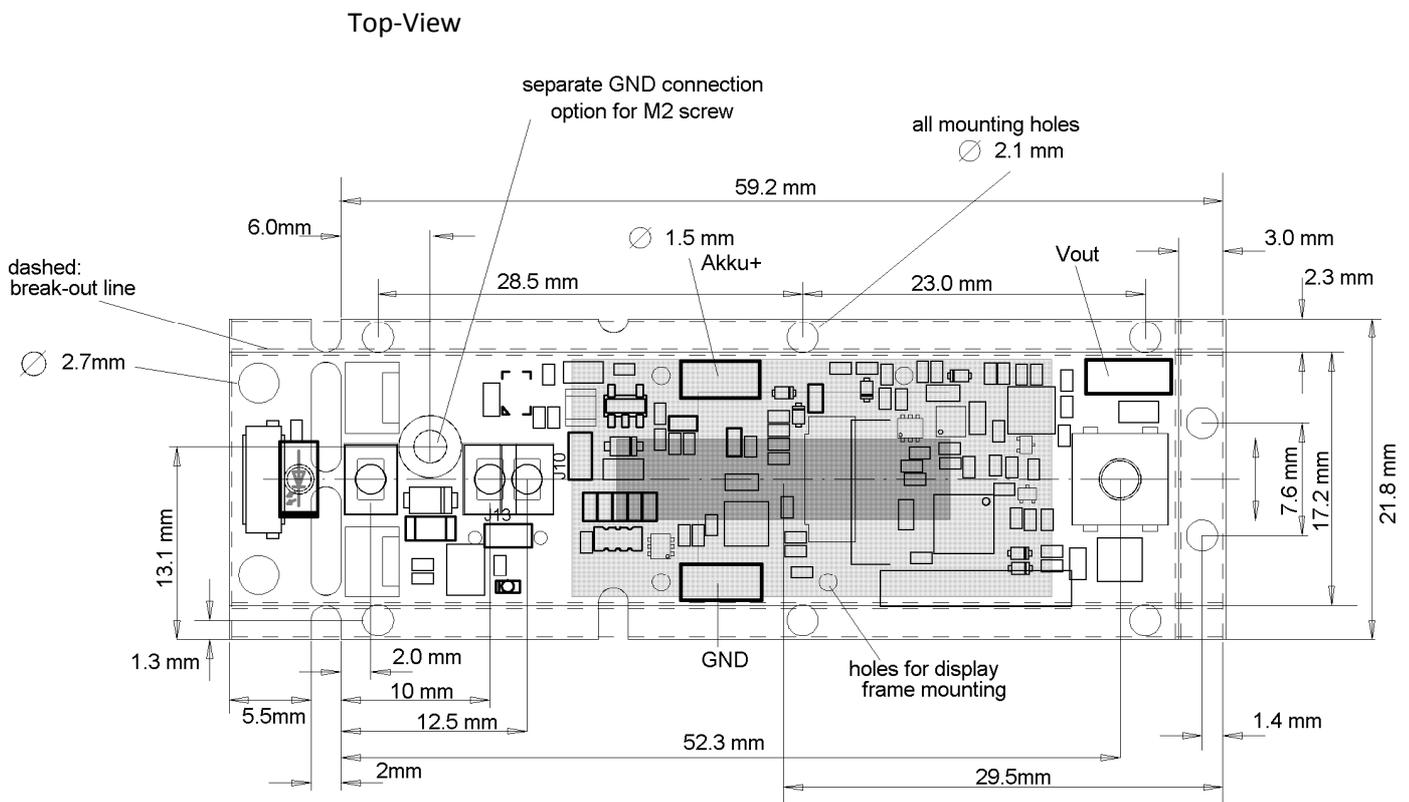
The board has several mounting options. When shipped, it has mounting strips on three sides, each with several 2.1mm holes to mount it inside a housing using M2 screws or equivalent. The mounting strips can be broken away individually. Without the strips the board has an outline dimension of 17.2mm x 56.2mm (+-0.4mm due to break lines), or 17.2x63.7mm respectively (with Micro-USB, see below).

There is also a separate metalized GND hole (battery minus), which gives the option to take the GND connection from the housing if housing is connected to battery minus.

There are two USB connector option. One Mini-USB is on the bottom side of the board and shows to the right, when you look at the board with the fire bottom in top position.

Note that the V2 boards default assembly is without the mini-USB plug populated (Beta Version is always with mini-USB mounted).

The second option is to use the vertically mounted micro-USB plug on the extended part of the PCB, which can be cut when not needed. The cut board has solder pads to reconnect it to the main board with single wires. Such, the micro-USB board can be mounted elsewhere in the housing.

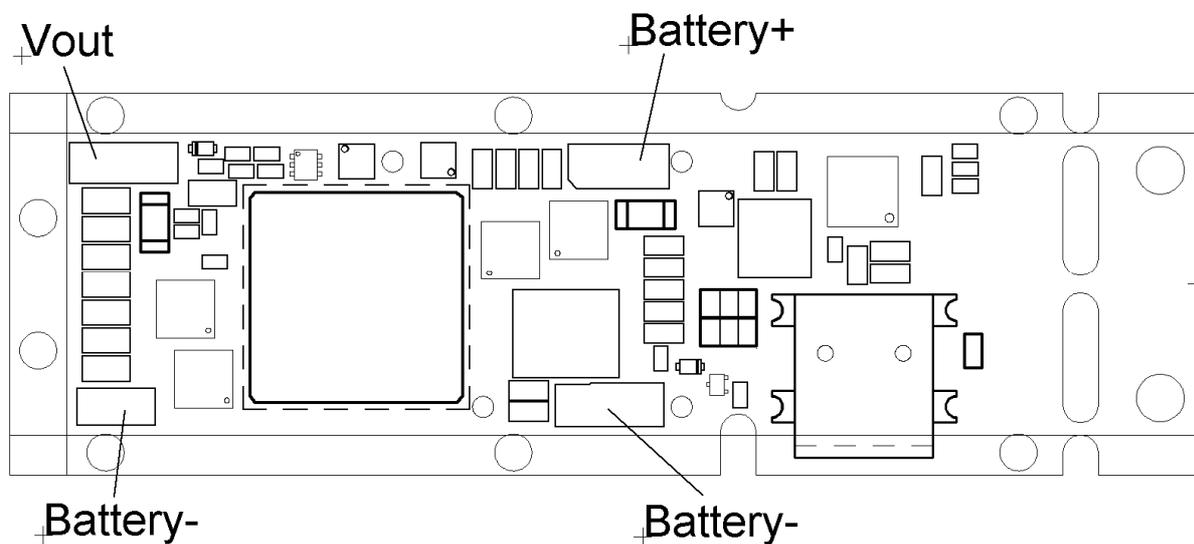


Drawing 1

On the FL80_V2 the Up-Button can have two different positions. One is the same as on the FL80_V1 (beta), option A, 3mm distance from the display frame. The second position is 2.5mm further away from the display frame, option B (total 5.5mm). This gives the option to use a rocker-button or larger up/down buttons.

Note that the different assembly options, i.e. whether the Mini-USB is needed and the up button position A or B, must be defined before any series orders. The standard assembly for single PCB orders will be Mini-USB NOT mounted and up-button in the original position (A).

Bottom View on Solder-Fields



Drawing 2

2. Battery and Charging

2.1. General Options

2.1.1. One Battery

The board can be run from a single Li-Ion battery, with the option to use the onboard active switch mode charging circuit, either supplied through the onboard Mini-USB plug or by the on-board vertical micro-USB, which can be separated (cut) from the main-board. If neither mini-USB nor vertical micro-USB is to be used, any separate USB-Plug carrier board can be connected through wiring cabling. Also, the USB-plug-board can be connected through a 6-pin 0.5mm pitch standard FPC cable connection, suppliers of which can be found at the end of this text (see ordering in formation).

2.1.2. Two (or more) Batteries in Parallel

With paralleled batteries it is also possible to use the onboard charger. The problem with paralleled batteries is the moment when they are paralleled: If the

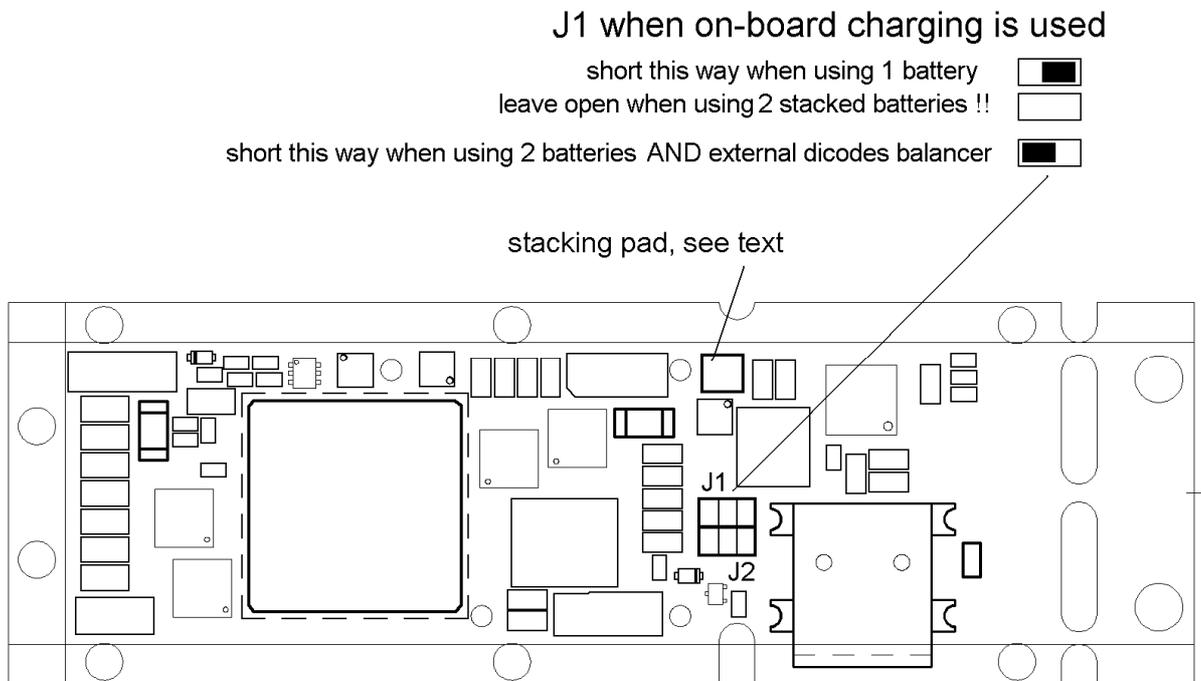
two (or more) batteries have different charge state when paralleling, dangerous high currents will flow between them, which might lead to overheating and destruction of the batteries.

2.1.3. Two Batteries in Series

It is also possible to use two Li-Ion batteries in series for higher wattage, especially in buck operation mode (output voltage < input voltage). In this case the charging circuit must not be connected to the batteries in series, because the charger circuit would immediately be destroyed, as it is designed to charge one battery only.

For use with two stacked batteries, the solder-jumper J1 MUST be removed or shorted to the left pad (when using the dicodes balancer).

(Don't change any other jumper settings on the top side of the board.)



Drawing 3

With two batteries, the electronic automatically activates battery supervision. The display will show an error message and further vaping is suppressed, when either of the batteries falls below the (programmable) minimum discharge level. When using two stacked batteries a cable needs to be connected to the center pin of the batteries and the "Stacking" Pad on the board (see picture above).

Nevertheless, by using the dicodes dual/triple high efficiency battery balancer board, the charging of two batteries with the onboard charging circuitry is possible. Please follow the wiring instructions of the balancer board for a correct setup.

2.2. The On-Board USB-Charger

The On-Board charging circuit is an active switch mode battery charger in contrast to the often used linear charger on other circuits. The active charger has the main advantage that it is much more efficient. This enables the circuit to charge with much higher currents compared to a linear charger, and thus charging the battery faster.

The charger is compatible with the battery charging specification 1.2 (BC1.2). The specification defines how a charging circuit should detect the supply strength of the source connected to it. Thus the charger can detect how much current it may draw from the source, i.e. 500mA from a PC or laptop up to 3A from a dedicated charging port.

On the board there is a vertical 5pin Micro-USB-B plug on an extension board, which can be cut off, if not used in that position. There is also the option to order the board with a mini-USB plug populated on the bottom side (see ordering information).

Beside this there is an option to populate a 6pin 0.5mm pitch FPC connector on the board and soldering pads on the bottom. The usage of this FPC connector has two options:

- When solder jumper J2 is closed, an external daughter board can be connected by the FPC connection, carrying an USB plug, which is mounted anywhere else in the design.
- When solder jumper J3 is closed AND J1 opened, the FPC plug is connected to the battery instead of the on-board charger.

This gives the opportunity to implement a different charger, or, when two batteries in series are used, to charge the batteries with a charger capable to charge 2 series batteries.

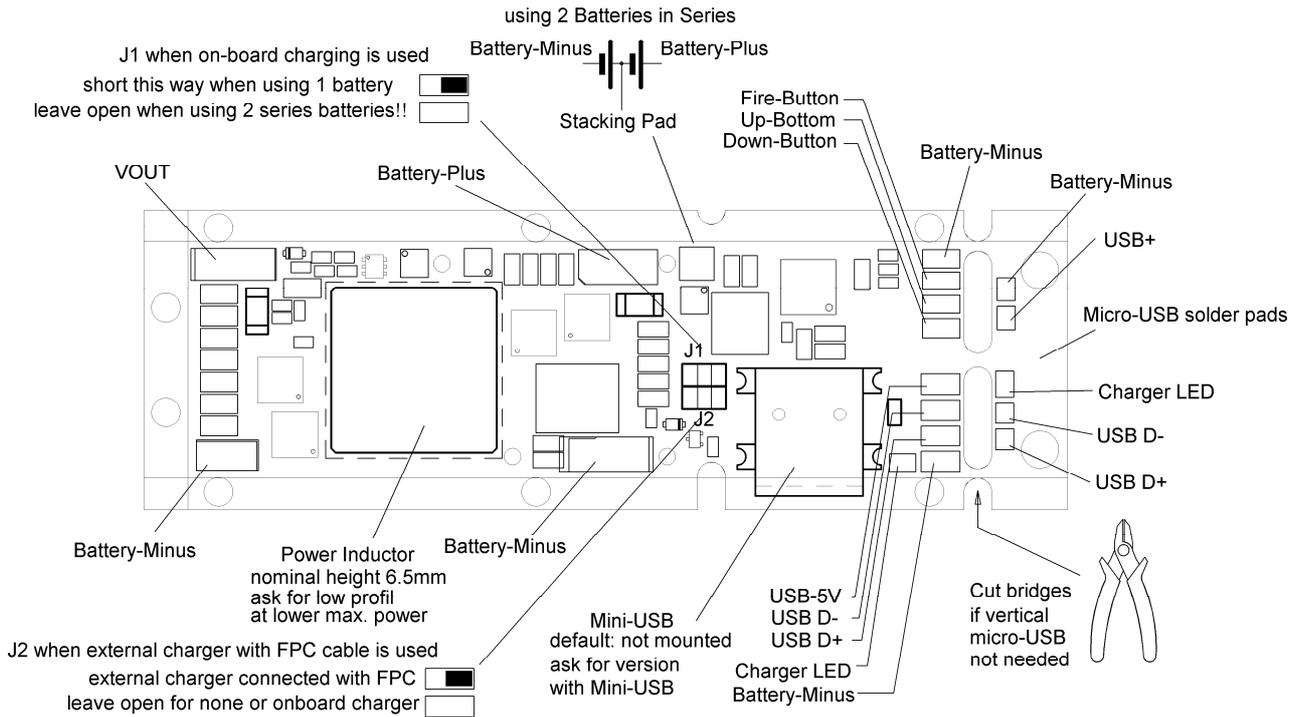
When the on-board charger circuitry is used note the following behavior: As soon as the USB-Plug is connected (with a battery connected to the board), the red LED lamp is on to show the charging is in progress. When the battery is almost completely charged, the LED starts blinking slowly and is off, when battery is fully charged.

By plugging in the USB-cable, the processor is switched on as well. Note that the processor will not react to any buttons, if it was actively switched off before the USB-cable was attached or when it was actively switched off while the USB cable is attached.

It can only be switched on again by removing the USB-connection and pressing the fire button five times in this case.

If it was NOT switched off actively by the user, but because of auto-power-off, the buttons will react normal.

It is also possible to vape during the charging, although this is not recommended because the charging circuit performs the charging in different steps, which depend on the battery voltage. By vaping during charging, the voltage drop in the battery can let the charger switch between phases and reset certain safety timers. Normally this is not critical, but with defective or bad batteries, the safety timers will not work properly in this case.

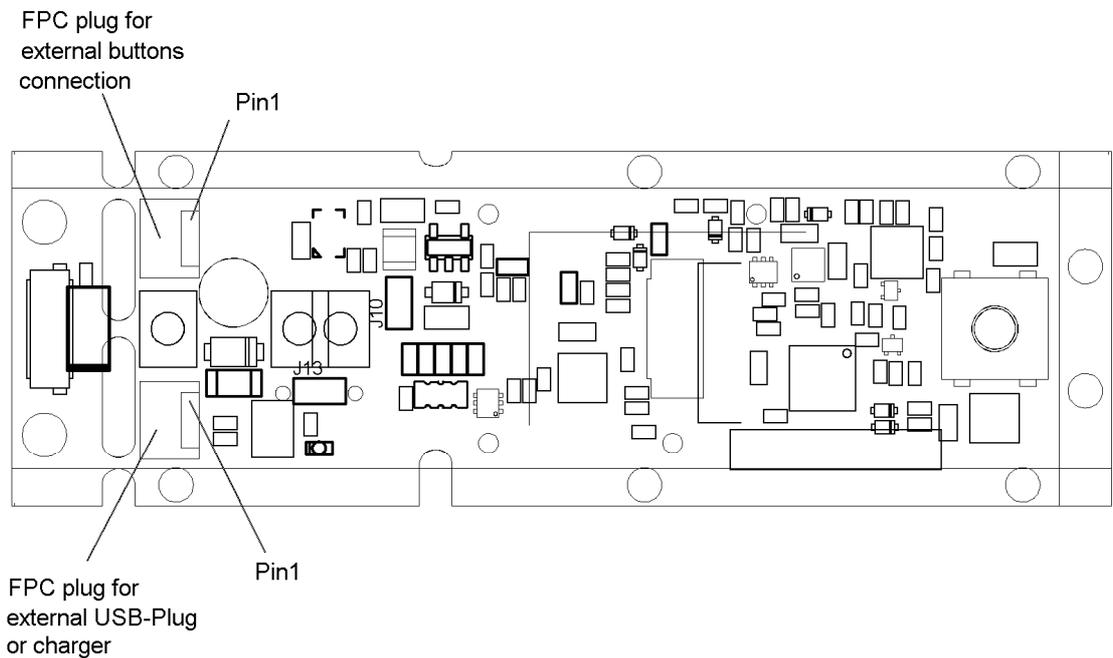


Drawing 4

The Jumper pads are on the bottom side of the board as shown in the picture above.

To connect an external USB plug or an external charger either use the 6-pin FPC connection (default: not populated) on the top side of the board or connect cables to the solder pads on the bottom.

Note to leave J1 open when using an external charging circuitry! Otherwise the on-board charger will be paralleled to the external one which might damage either parts.



Drawing 5

The Pinning of the FPC connector is as follows:

Pin 1	Vbus USB (+5V)	Charger Supply
Pin 2	Vbus USB (+5V)	Charger Supply
Pin 3	D-	Used for Source Strength Detect
Pin 4	D+	Used for Source Strength Detect
Pin 5	GND	
Pin 6	GND	

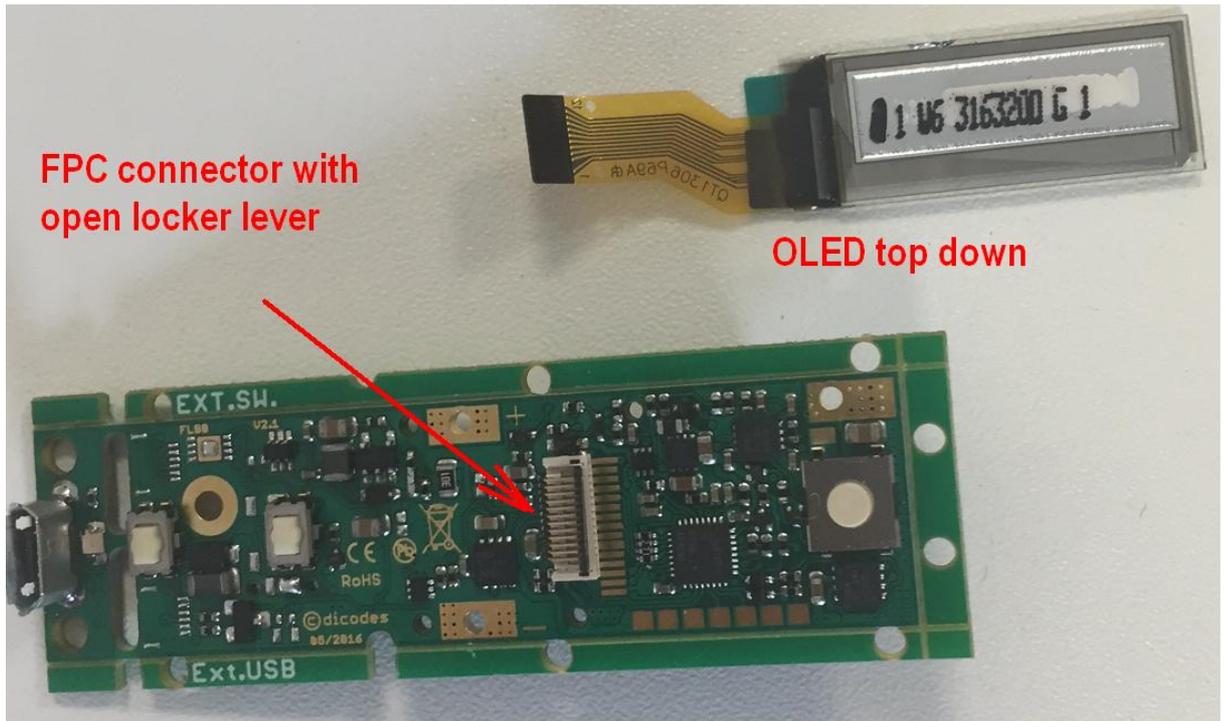
[Remark: Accidentally connecting a USB-source with a FFC cable to the Button FPC (External Buttons) does not harm the board.]

3. Display and buttons

3.1. Display

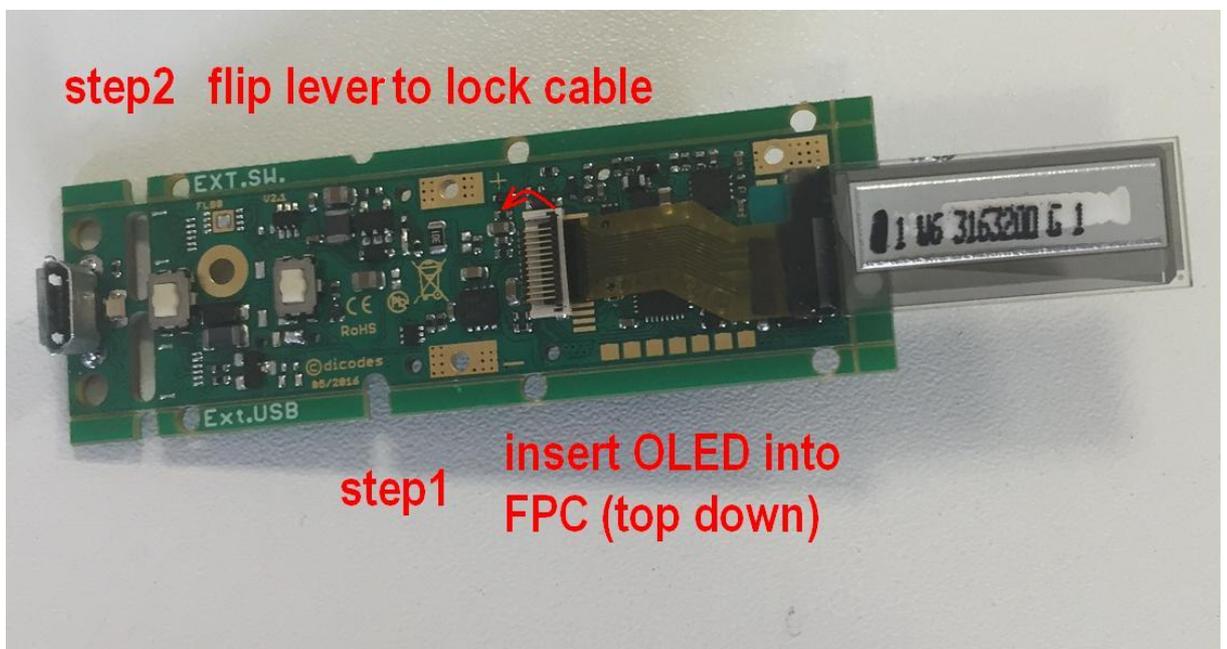
There is a 128x32 display attached to a 12pin FPC connector on the board. The software is prepared to drive this format.

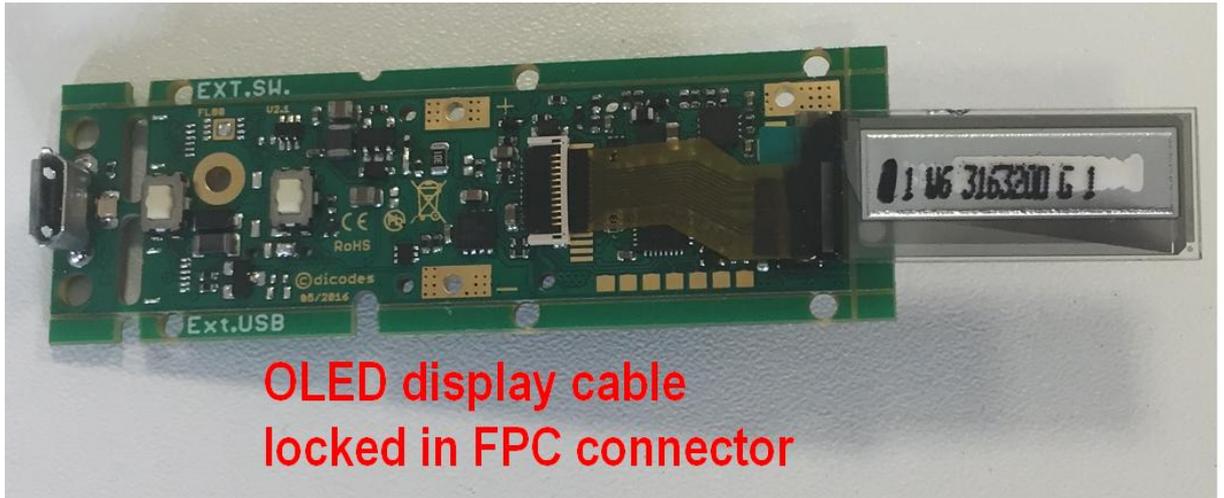
The display has to be attached to the on-board FPC connector with the active area down as shown in the following pictures:



Open the black lever of the FPC connector....

Attache the display cable top down into the FPC connector. Make sure the cable is straight and in end position. The flip the lever down as indicated by the arrow....





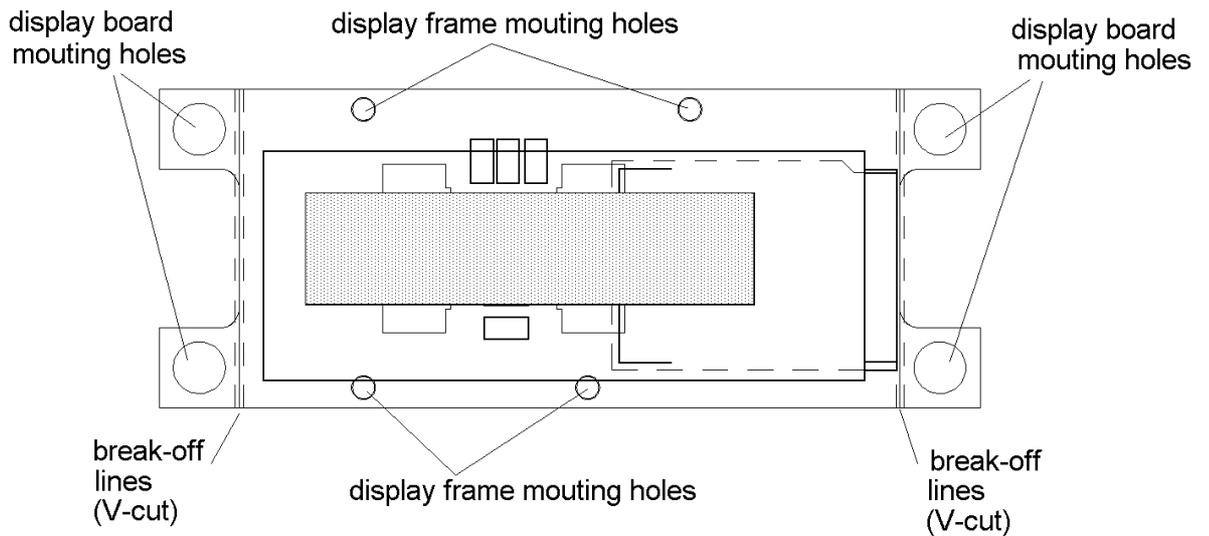
Now the cable is clamped and contacted.

The last step is to turn the display 180° so that the display orientation is up.



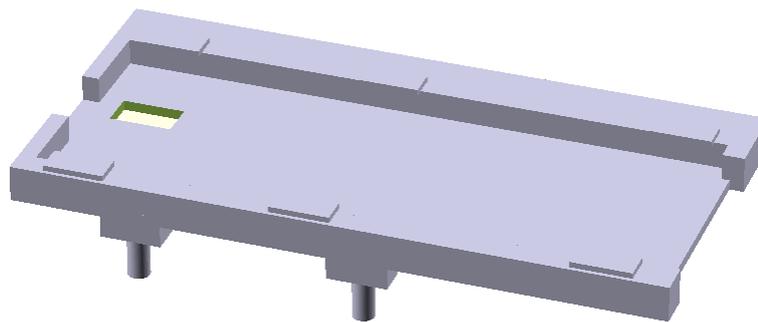
When the user wants to place the display somewhere else in the box/application, instead of plugging the OLED directly to the onboard FPC, a standard 12pin 0.5mm pitch FFC cable can be connected to the board which is then connected to a display carrier board at the other end.

Here is a picture of the display carrier board, dicodes offers:



Drawing 6

The display is normally mounted in a black frame:



Drawing 7

3.2. Buttons

There are three buttons on the board: One bigger fire button “right” to the display, and two up/down buttons “left” to it. The up-button has two possible assembly positions. The default position is next to the OLED display, and the center of the button has a distance of 3mm to the plastic frame of the display, which is the default position. The second option for assembly is 5.5mm distance from the frame. Please define during your order which position you prefer.

On one side of the board there is a FPC connector, again 6pin 0.5mm pitch like the external USB-connector (default: not populated), where buttons can be connected, which are mounted somewhere else in the design.

Beside the use of the FPC, external buttons can also be wired by cables using the solder pads on the bottom. See picture above to identify the solder pads in drawing 4.

External buttons will be in parallel with the onboard buttons, so they can be mixed when on-board or off-board buttons are used.

The pinning of the FPC plug is as follows:

Pin 1 Fire Button
Pin 2 Up Button
Pin 3 Down Button
Pin 4 Reserved, do not connect
Pin 5 Reserved, do not connect
Pin 6 GND

Accidentally connecting a FFC cable from an external button to the USB-FPC plug does not harm the board, but be careful: if J2 is closed and an external USB source is connected to the Mini-USB, although this should not be the configuration when J2 is closed, then, when pressing the Fire or the Up-button, the external source is shorted.

4. Power

The board is programmed to output a power of up to 60W. In normal vaping conditions, i.e. taking a puff, having a pause and then again vape, the board will work reliable at all time. With high wattage output it is possible to force the electronic to go to an overheating condition, by vaping without interruptions over a longer period (with short stops before the max vape time exceeds).

Nevertheless we recommend using two stacked batteries for power settings above 40W in VW mode. Note that quality 18650 batteries have an inner resistance, depending on type and capacity, between 20.. 80m Ohms. At 40W output power and 3.1V battery voltage (at the outer contacts!!), the power loss inside the battery is already between $[(40/3.1)^2 * 0.02 \dots 0.08]W = 3.3 \dots 13.3W$. Also note that the current of 12.9A in this case leads to a voltage drop inside the battery of between 0.26V .. 1.03V. For this topic see also application note "Power and Battery in Electronic Cigarettes".

With two batteries in series, the currents are half as the voltage doubles, looking at the same power. The power losses depend on the square of the current only and not on the voltage.

5. Mounting and Wring

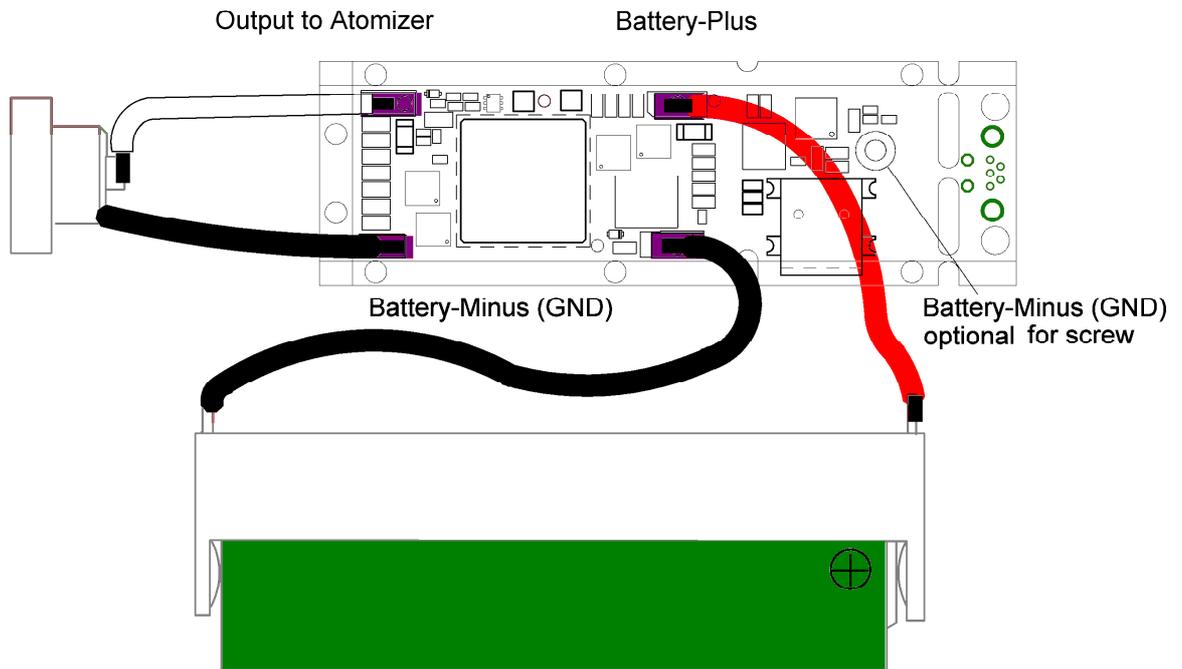
For the wiring of the power supply and atomizer/center pin connection the boards provides big solder pads for direct flat wire soldering. Although the pads are big, the soldering must be done carefully in order not to short adjacent components.

On request and for series production >9 pieces, the board can be shipped with highly flexible power cables already soldered to the board with 1.5mm². Ask for pricing.

The GND (battery minus) connection can also be established with a M2 screw connected to the housing, if housing is at the same potential as the battery minus.

The following picture illustrates the wiring scheme.

View from Bottom-Side



6pin FFC Cable suppliers (examples):

- Würth electronic, order number 687 606xxx002 (type 1, xxx=050,100,152,200 length in mm)
- Würth electronic, order number 687 706xxx002 (type 2, xxx=050,100,152,200 length in mm)
- digikey WM10510, WM11318 (50,08mm), WM11377 (76,2mm) and others