OCP is Ornament and Crime PLUS
Updated trough hole version of Ornament and Crime

Ornament and Crime - Polymorphic cv generator is one of the most versatile cv generator / processor module for Eurorack.
Ornament and Crime can load dozens of different apps for many uses, If this is your first Ornament and Crime - you will going to love this module and you will always find creative ways to use it in any of your following patches.

Official Firmware or Alternative Firmware:
There are two firmware versions available: Official firmware and Hemisphere suite, OCP kits comes pre loaded with the official firmware but it is an easy task to switch between firmware versions if you wish, more details here.

PLUS?

OCP is slightly different from other Ornament and Crime versions, few improvements are added to OCP:

VOR – Variable **O**utputs **R**ange make it easy to select different offsets for the outputs (Bi-Polar, Uni-Polar and Asymmetric), with the official firmware the module automatically choose the best offset for each application and you can always change it with the dedicated VOR button.

Extended Range – OCP outputs can deliver 10v peak to peak.

Front USB Input – Can be used for accessing easily to MIDI to CV / CV to MIDI functions of the Hemisphere firmware (Captain MIDI).

Atenuverters – With the 4 knobs you can scale and invert any modulation source you plugged to the CV inputs, when nothing plugged in, those knobs connected to internal voltage source and can control many parameters of each application.

Trough Hole Design – OCP uses mostly through hole component (kits are with pre soldered SMD DAC and Supervisor chips).

OCP Full DIY Kit:

Inside the kit you will find all the needed parts to complete your OCP.
Use this instruction guide step-by-step and check your work in each step.
OCP contain 175 components with total of 679 solder points, take your time, do it patiently, and take breaks when you feel tired or not focused.
I filmed the build process and the videos are integrated within this document, you can also access the full playlist here.
For any questions that arise, feel free to seek help from our community, here

There are several steps in the assembly process:

1. Main Board assembling
2. UI Board assembling
3. Connecting boards together
4. Interface parts and panel assembling
5. Calibration

You will need those tools for the assembling process:

1. Soldering Iron and high quality soldering wire
2. DMM - Multimeter
3. Cutter
4. Plier
5. Paper masking tape
6. Computer or mobile device with web browser and internet connection to access iBom.

*** Tip about soldering iron tips:**

There are many soldering iron tips (heads) that used for different kinds of soldering jobs, In fact, you can do all types of soldering with one conical (cone) tip and get to beautiful solder points, but I definitely recommend using the types of tips that are appropriate for the soldering nature.
This is to make the solder faster and get better solder points.

For this project I'll recommend to use 2 types of soldering iron tips :

	**conical tip** (at 360º-430ºc) for most of the parts in this project, The sharper the edge, the higher the temperature.
	**Knife tip** (at 300º-360ºc) for pin headers and IC sockets, with this tip you can hit up 2-3 pins simultaneity and solder long row of pins in one continuous drag (my favorite tip!)

BOM (Bill of Materials):

For your convenience, all component values are printed on the boards, use iBom to easily find the component locations on the boards, you can access iBom with any browser on your computer or your mobile device.

➔ Main Board iBom

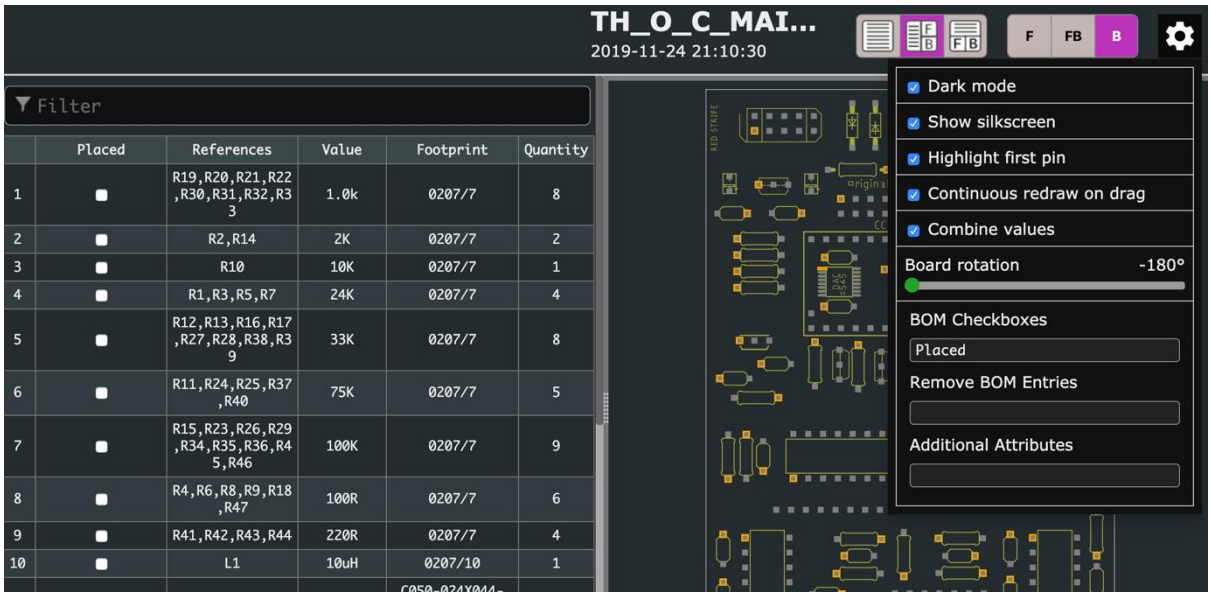
➔ UI Board iBom

*** How to use iBom:**

iBom is abbreviation for **I**nteractive **B**ill **O**f **M**aterials, an online system that is used as a live map of the board and components.
Use iBom table to look for components on the board, you just need to hover a mouse on one of the table lines to highlight the elements on the board live map.
When you're done solder each line, mark this line as "Placed" so you will see your progress anytime.

When you first open the iBom, I recommend changing the settings a bit (view picture below).
For Main Board set the view for the back of the board (B)
and board rotation to -180º
For UI Board set the view for the front of the board (F)
and board rotation to -180º
For higher contrast it's probably better to use Dark mode.

These settings will be automatically saved at your browser cookies so that the next time you open the page, it will display exactly how you left it.



***About my favorite soldering technique:**

After many years of soldering electronic circuits I have found that I prefer to solder most of the through hole components from the side where the components are (when possible, especially resistors) with a sharp conical tip.
In this method I can see the component at the moment of soldering, I can work on flat surface without helping hands and I succeed to get beautiful soldering points that works 100% of the time.
If you have already adopted a preferred soldering method use it, you are of course welcome to watch my method in the attached videos and try it.

STEP 1 – MAIN BOARD ASSEMBLING:

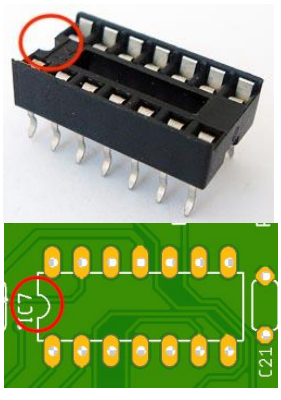
The most efficient way is to assemble the components according to their height on the board, so it is advisable to start with the lowest components and move to the higher components.
Solder components at this order:
Watch Video

1. **Resistors and Inductor**:
   Inside the components bag you will find 3 bags with all the resistors needed for the Main board:
   Bag 1: 100R, 100K, 10K and 10uH Inductor
   Bag 2: 220R, 1K, 2K
   Bag 3: 24K, 33K, 75K

* **How to identify resistor value?**

The resistors inside the kit are arranged in strips, you just have to count the number of resistors in each strip and cross with the number written on the bag label to know what the value is. But it's always a good idea to make sure the value is right, for that you can use your DMM to measure the resistors in each strip or use the color coding of the resistors, you can use this color code calculator.

2. **Diodes** – Polarity is mandatory, the line on the diode should match with the line that printed on board
   1N5819 to D1, D2



3. **IC's sockets** for IC6, IC7, IC8, IC9, IC10
   The orientations of the sockets are not really matter but IC's orientation is mandatory!
   I'll recommend to solder the sockets at the same orientation that printed on the board In order to avoid confusion when assembling the IC's, In general – in both OCP boards horizontal IC's are facing left and verticals IC's are facing up.
   do not connect the IC's to the sockets at this stage.
   * Paper masking tape can help you to hold the sockets in their places before you flip the board to solder them on the bottom side.

4. **MLCC (Multilayer ceramic capacitors)** - Inside the components bag you will find one bag with all the main board MLCC, polarity doesn't matter:
   22pF, 560pF, 100nF, 470nF, 1uF

   * **How to identify MLCC value?**
   The 3 digits that is printed on the capacitor is the value code in pF, the 2 first digits are the significant figures of the value and the third digit indicates how many zeros the multiplier has (0 = multiplier is 1 without zeros, 1=10, 2=100, 3=1000 and so on…).
   it's mean that:
   on **22pf** the printed code is **220** (22pF X 1),
   on **560pF** the code is **561** (56pF X 10),
   on **100nF** the code is **104** (10pF X 10,000),
   on **470nF** the code is **474** (47pF X 10,000)
   and on **1uF** the code is **105** (10pF X 100,000).

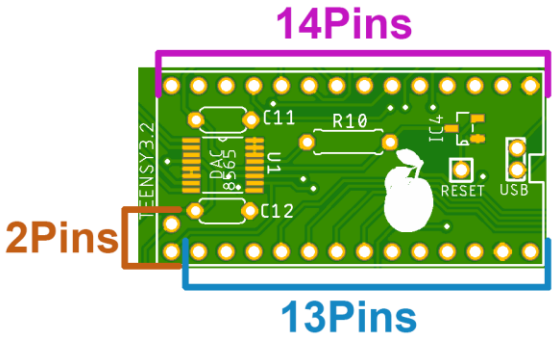
5. **Transistors –** Orientation is mandatory - the flat side should be directed as indicated on the board.
   2N3904 to Q1, Q2, Q3, Q4

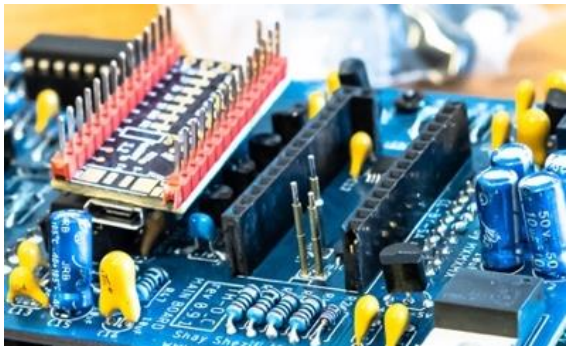
6. **Regulators –** Orientation is mandatory
   IC1, IC2, IC3, IC5

7. **Tantalum and Electrolytic Capacitors** - Polarity is mandatory, longer leg should go to the hole with the + sign.

8. **Power header** (IDC Connector) Polarity is mandatory, the cut-out of the socket should face down.

9. **Teensy board –** Inside the kit you will find the teensy board and rows of 14, 13 and 2 pin headers, the male headers is already attached to the female sockets, don't separate them.
The side of female sockets should soldered to the Main board and the pin headers to the teensy board.
Insert all sockets to the holes in the main board, place the teensy board on top of the pin headers and first solder the pins to the teensy.
then you can solder the female headers to the main board from the other side.
[Watch Video]





10. **POGO Pins –** or spring-loaded pins, used to connect 3 pads from the teensy board to the main board.
one pin is for reset and other two is to connect the USB data signals (D+ and D-).
first you need to remove the teensy from his socket. Insert the pins to the holes (spring end should face up) and solder them from the other side of the board.

Hurray!

You're done with the main board for now, it's time to start with the UI board.
If you feel you need a rest you should do it now and return to the assembly process when you feel refreshed.

STEP 2 – UI BOARD ASSEMBLING:

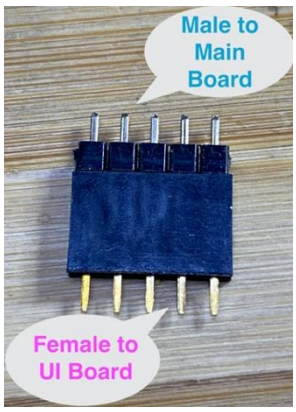
Take the UI board out from the antistatic bag and open the UI iBom, Solder the components at the following order.
Watch Video

1. **Resistors:**
   Inside the components bag you will find 2 bags with all the resistors needed for the UI board:
   Bag 1: 510R, 10K, 100K
   Bag 2: 100.0K
   Pay attention to 16 X 100.0K in the second bag, those are accurate resistors with tolerance of 0.1%, Don't mix them with the other 100K resistors otherwise the attenuverters zero point will be out of center.

2. **IC's sockets** for IC1, IC2

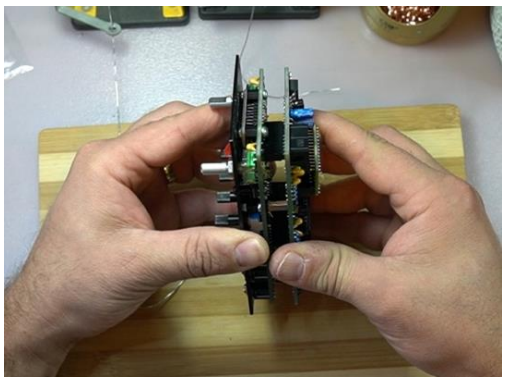
3. **MLCC –** 22pF, 100nF, 470nF

STEP 3 – CONNECTING BOARDS TOGOTHER:



Start with screwing the metal standoff to the UI board, insert the screw from components side to the hole in the board, then insert the plastic washer to the screw from the other side and tight the standoff on the screw.

Inside the kit you will find one rows of 19 pins, two rows of 6 pins and one row of 2X10 pins, the male headers is already attached to the female sockets, don't separate them.
Place the UI board on flat surface with the components side facing down, place all headers in place, the female sockets should be soldered to the UI board.
Place the the main board on top of the headers with components side facing up, make sure all headers in their places.
attach the second screw to the other side of the standoff to hold the boards together.
now you can solder all pins from both side.
Watch Video



STEP 4 – INTERFACE PARTS AND PANEL:

For the next steps, please separate the boards, we going to assembling all interface parts to the UI board.
Except the OLED Screen do not solder the interface parts before you attach the panel.

1. **OLED Screen assembling:**
   Inside the kit you will find a small bag with the OLED, 3 standoffs and 1X7 pin header.
   First screw the 3 standoffs to the main board to support the screen, insert 1X7 pin headers to the holes in the UI board.
   Place the screen on top of the standoffs, make sure that the pin headers in their places from both sides and tight the top 2 screws.
   now you can solder the pin headers from both sides.
   Watch Video

2. **USB Input:**
   Prepare the USB board by soldering the USB jack to the small USB board and the pin headers to the bottom side of this board.
   Place the USB board in his place on the main board, don't solder it yet.
   Watch Video

3. **LEDs:**
   Inside the kit you will find a bag of bipolar LEDs.
   These LEDs should light green when the voltage is positive and red when the voltage is negative.

   Please note:
   Some OCP kits are provided with LEDs which need be mounted reversed from the printed on the board, so the supplied LEDs must first be checked.

   Use the black LED tubes provided in the kit, which will allow the installation of the LEDs at the right height and provide support and insulation for the LED legs.
   Place the LEDs in their holes and bend the legs in the other side, do not solder them yet.

   You can solder the LEDs only after you check if they light the correct colors (do it as the last assembly step):
   - Top row of LEDs should light Green when attenuators fully clockwise.
   - Outputs LEDs should light Red when the module is powered and the default app is activated (ASR app in official firmware).

4. **Push Buttons:**
   Inside the kit you will find 2 push buttons with a white caps.
   Although they will work even if you install them in reverse polarity for the sake of interface correctness you should install them in the correct polarity.
   the buttons have two modes: pressed and un-pressed, the un-pressed state should indicate bipolar operation of the attenuverters and the pressed state will indicate unipolar operation.

   At the bottom of the button there is a minus mark on one side, this mark should be directed to the left.
   Insert the buttons to the holes in the board but do not solder yet.

5. **Jacks, Encoders, Tall Trimmers, Tact switches:**
   There is no special instructions for the rest of the interface parts, attach them to the board but do not solder yet.

6. Install 2 IC's (TL074) on the IC's socket, make sure the polarity is correct (pin 1 mark should face left).

7. After all UI parts are in place attach the panel and tight all jack nuts and encoder nuts.

8. Use paper masking tape to hold buttons and LEDs in place and solder all parts except the USB board.

9. Before you solder the USB board, connect a micro USB cable to the jack (leave the other end unconnected), push the pin headers of the USB board against the cable and make sure the jack align with the panel.

10. Hurray, you're almost done!
    Do not forget to assemble all IC's to the sockets.

STEP 5 – CALIBRATION:

Before you can use your new OCP it is very important to calibrate it.
The calibration lets you fine-tune the CV outputs and inputs as well adjust some basic settings.
The calibration procedure of OCP is similar to any other Ornament and Crime version but there are few differences to be aware, in this document I will review the calibration of OCP in highlights, to read about the calibration procedure in depth please refer to Ornament and Crime manual here.
Watch Video

To enter to the calibration mode keep push down the left encoder during startup.

1. Encoder directions:
   With the encoders that supplied with the kit, the left encoder will be in reverse direction, to fix it – press twice on “up” button (the button bellow left encoder).

2. Use default values:
   Yes! It is new module that has never calibrated before…

3. Correct display offset:
   With the OLED provided there should be no offset problems, you can skip to the next step.

4. CV Outputs:
   In the following 40 steps you will calibrate the CV outputs from the most left out (A) to the most right out (D), 10 calibration points for each output - 0v to 10v.

5. VOR:
   The next 2 steps are used to calibrate the 2 extra offset modes of the cv outputs (VOR), first step is for the bi-polar mode and second for the asymmetrical mode.
   In both steps you need to calibrate to closest you can get to 0v.
   since VOR system is using the internal DAC of the Teensy (less accurate then the main DAC) precision of +/-0.0015v is fine.

6. CV Inputs:
   To calibrate the CV Inputs 0v first turn all attenuverters knobs fully clockwise and insert patch cable to each cv input you calibrate, leave the other end unconnected.
   to calibrate CV in 1 to 1v and 3v connect the other and to one of the outputs.

7. Screensaver timeout period:
   Here you can set. the timeout period before the screensaver is activated, the default value is 25 seconds, if you preferer longer or shorter time you can configure it now.

8. Save? Yes!!! ☺

You're done!

Check your new OCP and read Ornament and Crime firmware manual to understand how to operate it.
If you have problems, questions or if you found mistakes in this document visit PlumAudio DIY First Aid group at Facebook to get help or to contact me.

With Love,
Shay Shezifi,
Plum Audio