## Assembly Gateway Tracker - Sheep variant

The housing parts are produced by 3D printing. ASA filament must be used for the hard plastic parts in order to obtain the strength and weather resistance required. PLA is definitely not suitable!

The gaskets are produced from permanent-elastic filament, e.g. SainSmart Flexible TPU.

Both types of filament mentioned are not entirely easy in processing and require some experience.

Housing individual parts - bottom cover for solar panel (DblSolarPltBottomCover) is missing
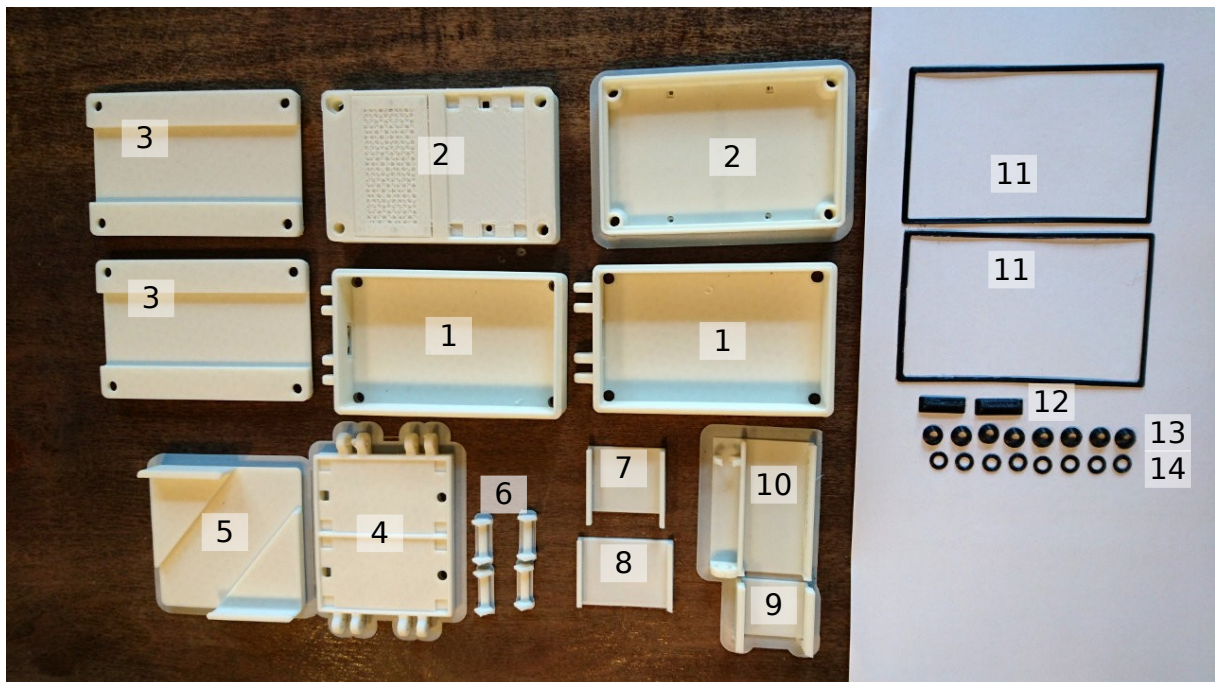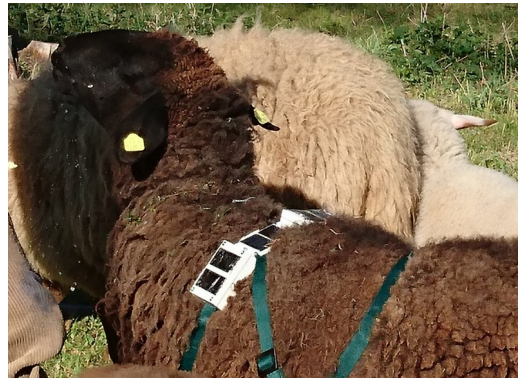
(1) Box bottom (*BoxBottomGateway*)
(2) Box top (*BoxTopGateway*)
(3) Box longitudinal belt guide (*BoxBeltClipGateway*)
(4) Double solar panel (*DoubleSolarPlate*)
(5) Solar panel cross belt guide (*DoubleSolarPlateBeltClip*)
(6) Cable guide (*CableClip*)
(7) GPS antenna holder (*GPSAntennaClip*)
(8) GPS board mount (*GPSBoardClip*)
(9) GSM board holder (*GSMBoardClip*)
(10) Arduino board mount (*ArduionoClip*)
(11) Box gasket (*BoxGasket*)
(12) Cable tunnel gasket (*CableGasket*)
(13) Countersunk head gasket (*ScrewHoleGasket*)
(14) Screw gasket (*ScrewGasket*)
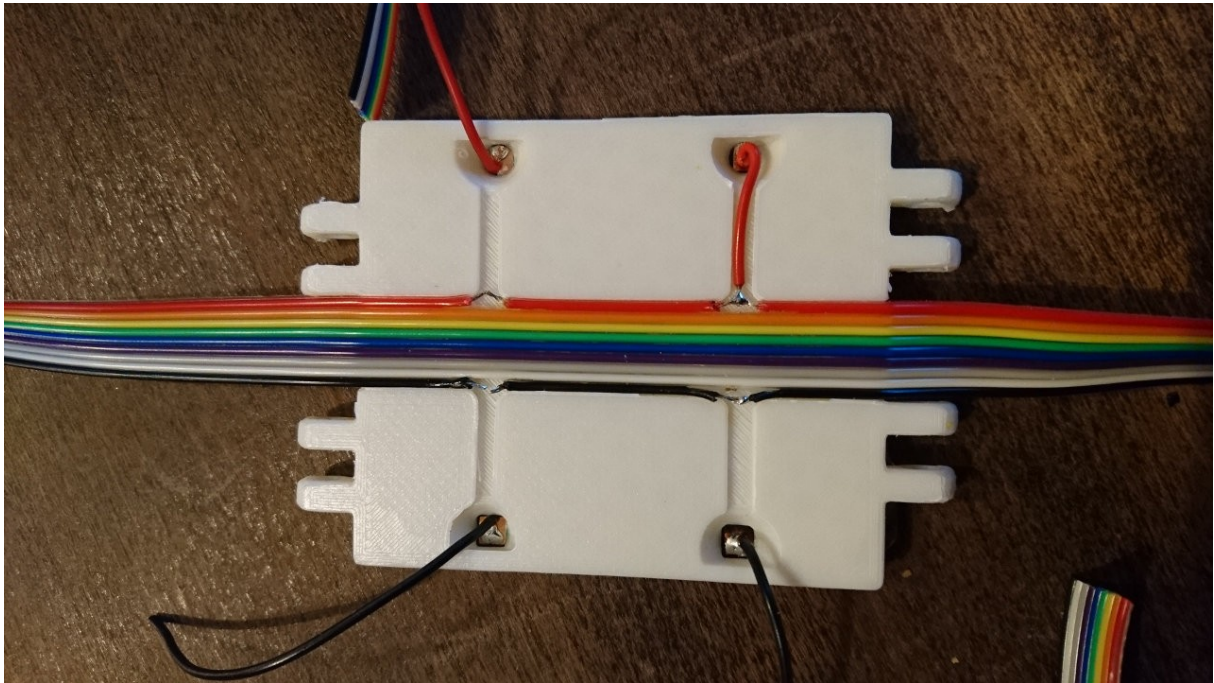(15) bottom cover for solar panel (*DblSolarPltBottomCover*)
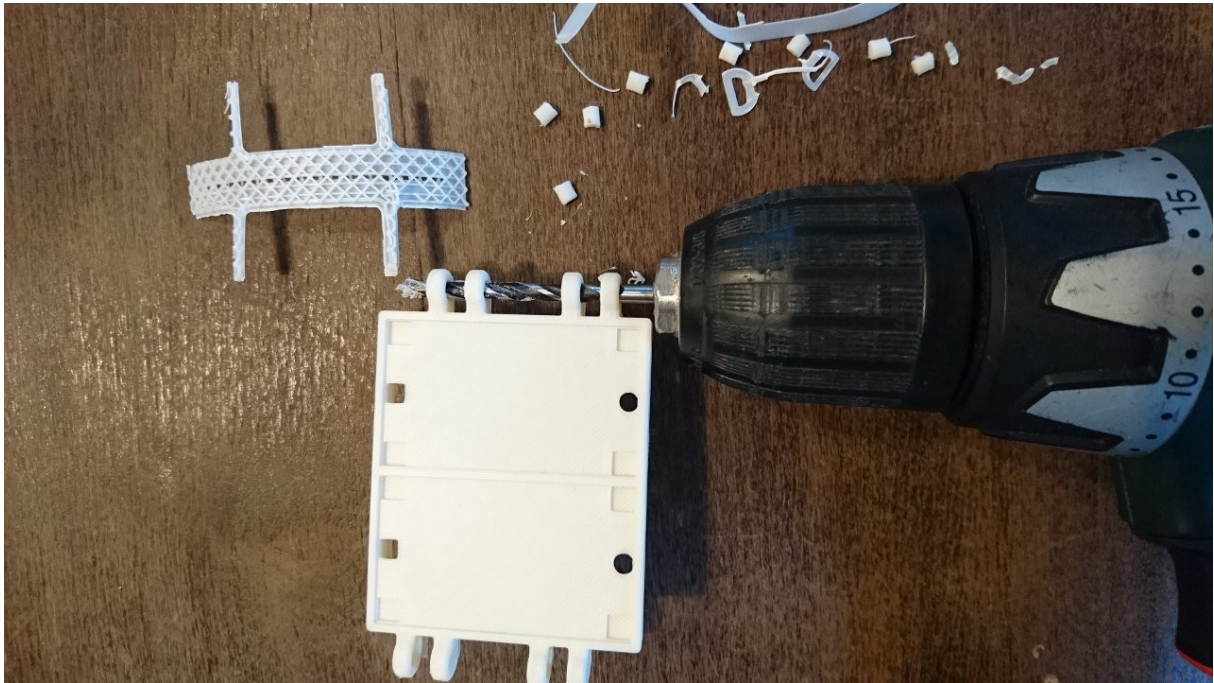
Remove support structures from 3D printing,
Remove burrs in screw eyes with 4.2mm drill (important!)
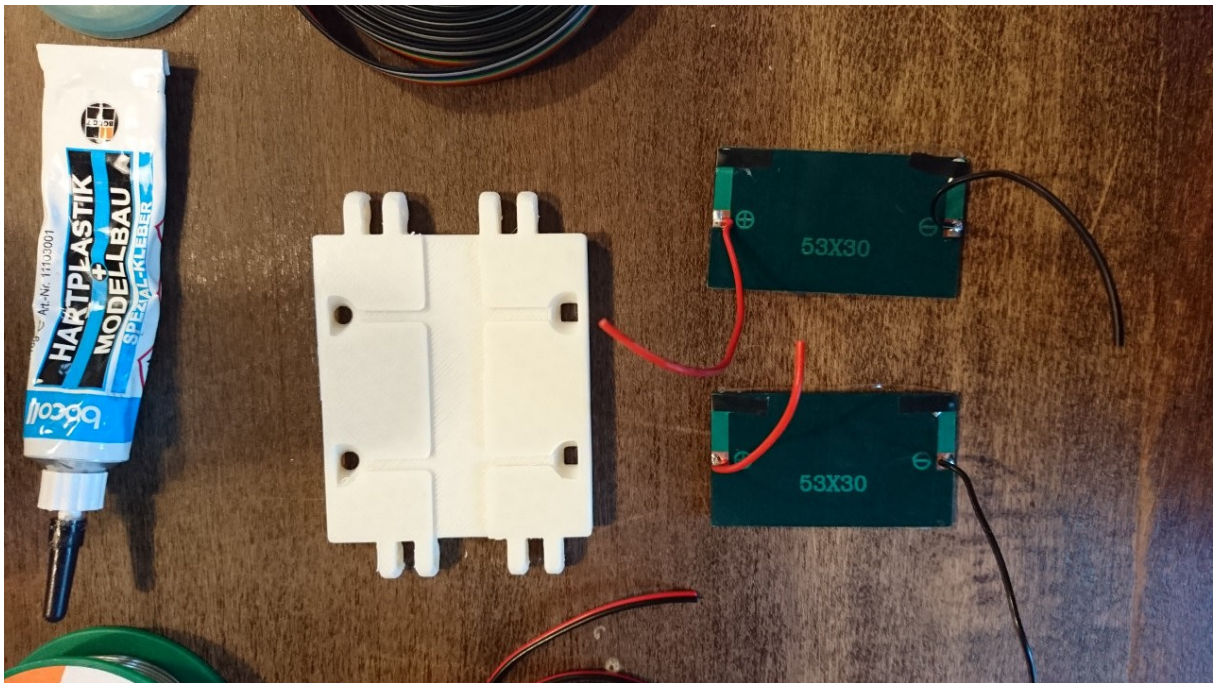
Check the solar cells (as well as all installed parts) before mounting. They must supply at least 4.9V with daylight or a bright LED lamp.

Solder wires and glue solar cells into the panel.

- Adhesive bocoll:
  https://toom.de/p/spezialkleber-hartplastik-modellbau-18-g/8150141 (3,99€)
- Solar cell: 53x30mm 5V 30mA:
 https://www.aliexpress.com/item/32640872912.html (13,70€ / 20 pcs.)

Remove the brown wire from the ribbon cable, cut off a sufficiently large piece and place it in the middle of the back of the solar panel. Cut open the outer cables and connect them to supply lines for solar cells. Then fix it with glue.

- Coloured ribbon cable: https://www.conrad.de/de/p/[..]-flachbandkabel[..].html (1,40€ / meter);
  or Amazon: UEETEK IDC-Flachbandkabel, 10 Pin, 5 m, IDC, Regenbogenfarben (8,99€)
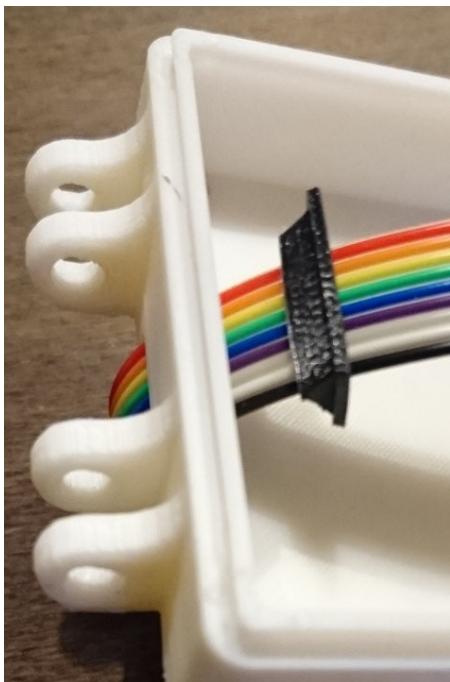
Pass the cable through cable tunnel gaskets and glue them in the cable tunnel. Allow the adhesive to cure for one day.

Assemble the housing base and solar panel with M4x50 screws.
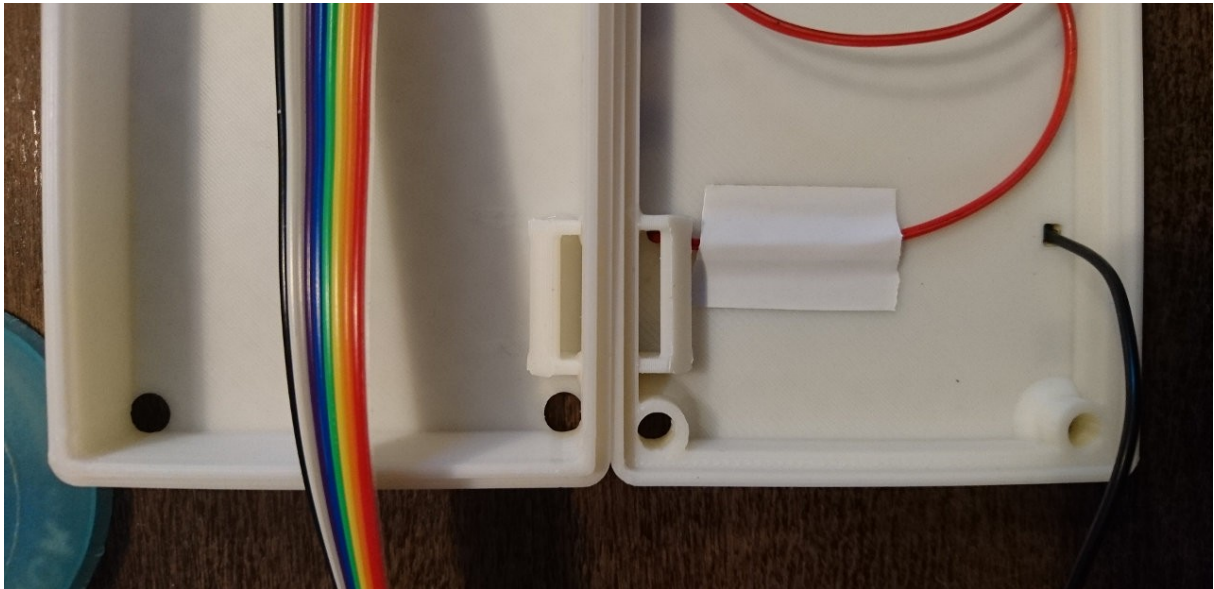
Glue the solar cells on the upper parts of the housing (similar as on the solar panel, but longer supply lines)

Glue in cable guides - on different positions for each box, see the fully equipped housing parts below. Allow the adhesive to cure for one day.


Check the contact of the supply line to the battery holder - sometimes it must be re-soldered because the riveted joint is weak - up to 3A should flow over it later without major voltage drops.

Remove the bottom of the battery holder (1.5mm space gain), roughen the rear side surface and glue in the battery holder with inserted battery and positioned housing screws.

Remove the outer end wall corners of the battery holder - they would overlap with the screw domes (small picture)

- 18650 battery holder: https://www.aliexpress.com/item/4000445340785.html (0,30€ / pcs.)
- 18650 Battery, Panasonic NCR18650B: many suppliers - do not buy too cheap (from 4,00€ upwards / pcs.)
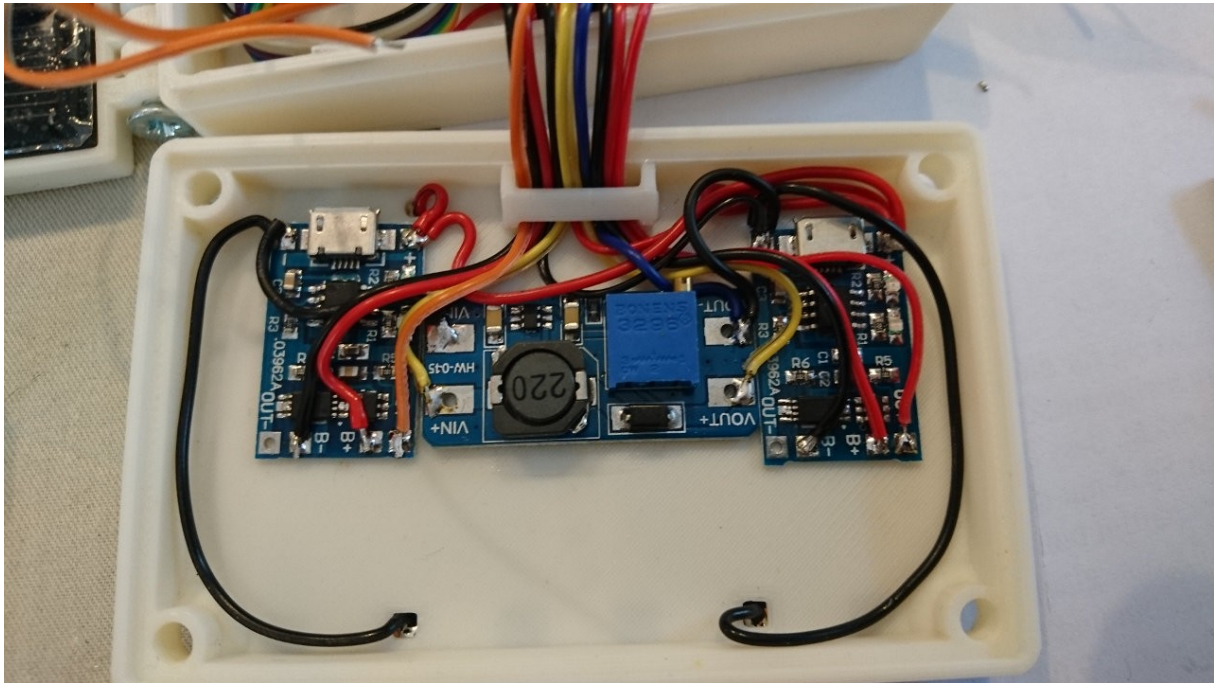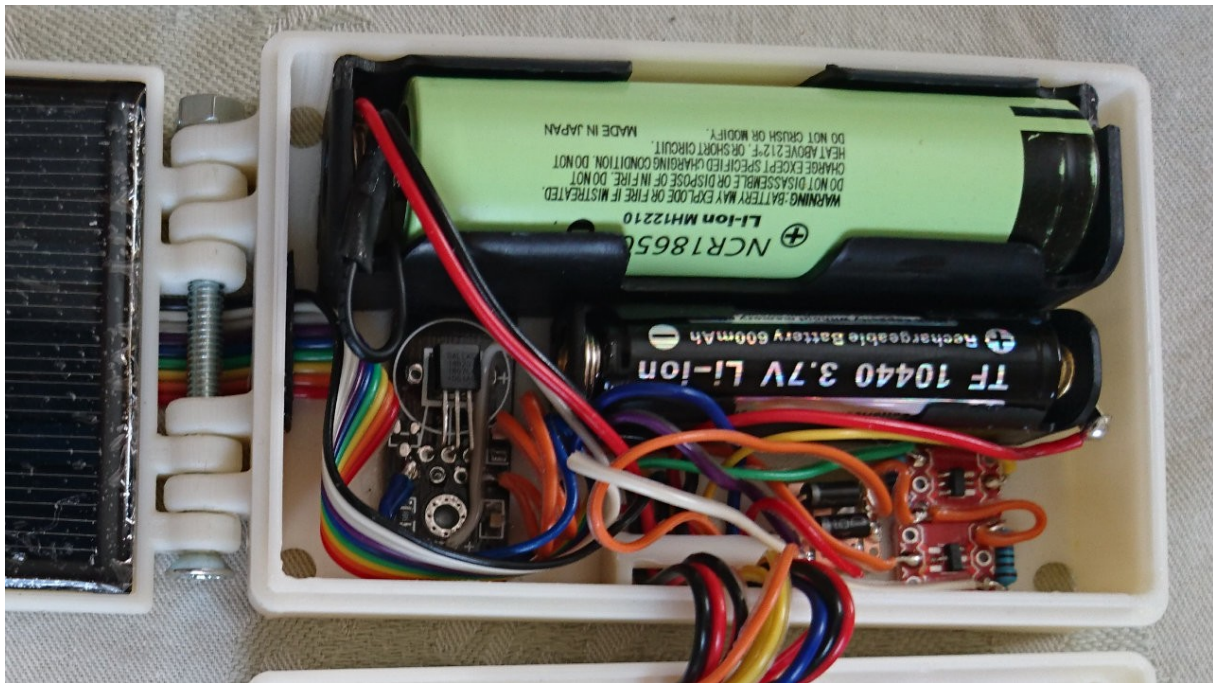
Glue the charging modules and the DC-DC converter into the upper part of the housing and wire them according to the wiring diagram.

The DC-DC converter should be set to Uo=4 V before gluing in. Sometimes, the variable resistor must be turned through 1x completely.

In some cases, the contact wires of the push-through elements need to be sanded down on the underside of the circuit boards. Take care for the space needed for the large battery. Connect ground wires (blue/black) together.

- 2 x Micro USB 5V 1A 18650 TP4056 Lithium Battery Charger Module Charging Board With Protection: https://www.aliexpress.com/item/32984862014.html (1,80€ / 10 pcs.)
- MT3608 DC-DC Step Up Converter Booster Power Supply Module Boost Step-up Board
  https://www.aliexpress.com/item/32948417810.html (1,70€ / 5 pcs.)

Roughen the AAA battery compartment and glue it in place with the battery inserted. The TrustFire batteries are a bit too long due to the built-in protection circuit, but still fit and last. Batteries without protection would also be possible, as the charging module offers sufficient protection, e.g. AAA ICR 10440 at amazon.

From bottom right to left: the MOSFETs on SOT23 circuit boards, the Schottky diodes on a grid circuit board and the thermal sensor - wired according to the circuit diagram.

- BestPlug battery holder for Micro AAA Battery, amazon: (2,16€ / pcs.)
- TrustFire Li-Ion Battery 3,7V AAA, amazon: (7,99€ / pcs.)
- thermal sensor DS18B20 single-wire-bus digital temperature sensor module: https://www.aliexpress.com/item/32242626689.html (0,80€ / pcs.)
- 2 x Schottky Diode 1N5817 Amazon: (4,99€ / 20 pcs.) - pay attention to low forward voltage for alternative types
- MOSFETs - IRLML6402 SOT-23 Ultra Low On-Resistance P-Channel MOSFET, conrad: (0,20€ / pcs.)
- SOT23 circuit boards, - MagiDeal 50 pcs. 6 pin SOT23 TO DIP Adapter pcb: amazon (3,99€ / 50 pcs.)
- grid circuit board and resistors 4k7 0,25W: Conrad (2,89 € / 75 cm² and 0,07€ / pcs.)
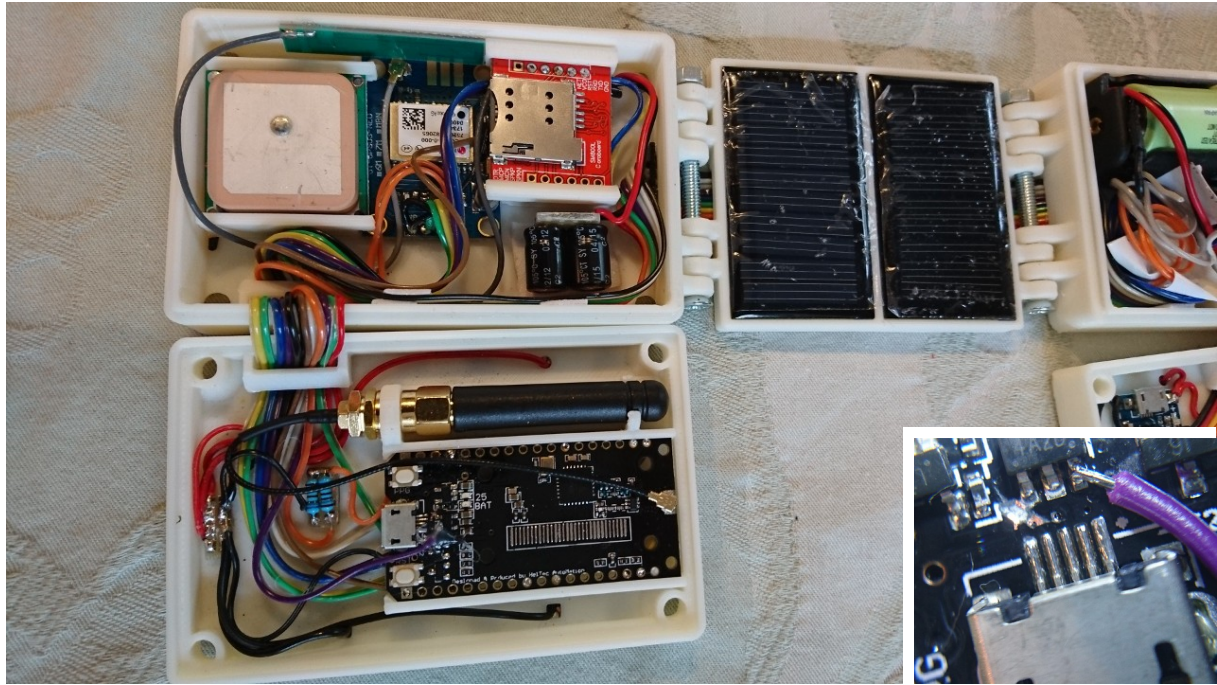
Install all electronic modules in the provided brackets and wire them according to the wiring diagram. On the picture, the GPS module (top middle) is not glued in its holder, but directly to the case - this is probably not a good idea due to the electrical characteristic of the glue and was changed later.

The used Arduiono module (below) is a TTGO ESP32 SX1276 LoRa 868 MHz without OLED display in version 1.7. Some remarks on this:

There are newer versions which do not need the hardware hack (see next paragraph) or which may have GPS onboard. Nevertheless the "old" module was selected because it is much cheaper and compact. Furthermore the position of the USB socket, the mounting of the LoRa antenna and if necessary the mounting of the GPS antenna have to be considered - all in all the chosen configuration is the most reasonable one at the moment (06/2020).

The hardware hack (small picture) is necessary because in this version of the board the USB serial converter cannot be switched off and thus the quiescent current consumption is much too high. Therefore, the power supply of this IC has been disconnected from the board voltage (cutted track - from the left connector of the IC in the upper middle of the picture leading diagonally left down between the USB connectors and the SMD resistor) and the power supply has been soldered behind the disconnection (violet wire on the mentioned IC) - with connected USB cable, the USB serial converter still works.

A LoRa board is only needed if a local network with client trackers is to be used in the herd for single animal monitoring. Otherwise any ESP32 Arduino board with similar features is suitable (e.g. WEMOS ESP-32 Lite V1.0.0 Development Board, aliexpress: 3,50€).

When positioning the modules, pay attention to the cable routing, metallic connectors and the buttons on the Arduino board - especially check from time to time that there are no crushes, short circuits or unintentional button presses when the box is closed and screwed down.

Connect the ground wires (blue/black) together.

- Arduino board - TTGO ESP32 SX1276 LoRa 868 MHz without OLED-display: https://www.aliexpress.com/item/4000025676352.html (<10,00€ / pcs.)
- GPS-modul NEO-6M: https://www.aliexpress.com/item/1872389528.html (3,55€ / pcs.)
- GSM-modul SIM800L with flat antenna: https://www.aliexpress.com/item/32285159276.html (2,75€ / pcs.)

- 2x 500µF 6,3V capacitors: Conrad (0,51€ / pcs.)
- resistors 470R 0,25W: Conrad (0,07€ / pcs.)