

TEO-X APRS

General

The APRS tracker assembly kit was developed by DK1TEO and DJ4XSN.

Target was to develop a tracker that's completely configurable.

We assume no liability for damage.

IMPORTANT: For operation the TEO-X-APRS a valid license for amateur radio is necessary.

In addition, laws and regulations have to be regarded.

The assembly kit is determined only for private use and not for commercial sales or operations.

For purchasing of components everyone is responsible by himself.

The assembly kit is only after soldering of components an electronic device. The person who solders the components takes the role of a manufacturer of electronic devices and is responsible for use and safety also for proper recycling conformable with national laws and regulations.

Necessary components

- 1x board: TEO-X APRS B1
- 1x board: TEO-X APRS B3
- 1x Mega2560-CORE

- 3x 1 k Ω
- 6x 2,2 k Ω
- 6x 5,6 k Ω
- 1x 10 k Ω
- 1x 22 k Ω
- 2x 100 k Ω
- 1x 1 M Ω
- 1x 100nF
- 3x 10nF
- 1x 10 μ H

- 1x 10 k Ω potentiometer (B10K)
- 1x knob for B10K
- 1x transistor (BC547A)
- 1x IC socket
- 1x IC HCF4011BE/MOS4011 (IC1)
- 1x OLED display
- 1x GPS module

- 6x micro-button
- 2x panel jack (5.5mm, 2.1mm)
- 1x toggle switch (on)-off-(on)
- 1x DC-DC converter

- 1x 2x10 pin-male-socket
- 1x 1x30 pin-male-socket
- 1x 2x10 pin-female-socket
- 2x 2x20 pin-female-socket
- 1x 1x6 pin-female-socket
- 1x 1x4 pin-female-socket

- 30 connector cable male-female (jumper)

Optional

- Housing
- 1x 2.5mm plug socket
- 1x 3.5mm plug socket

Component Relation

Resistors

Resistor	Number	Quantity
1 k Ω	R5, R6, R7	3
2,2 k Ω	R1, R2, R3, R4, R11, R13	6
5,6 k Ω	R14, R15, R16, R17, R18, R19	6
10 k Ω	R9	1
22 k Ω	R20	1
100 k Ω	R8, R21	2
1 M Ω	R12	1

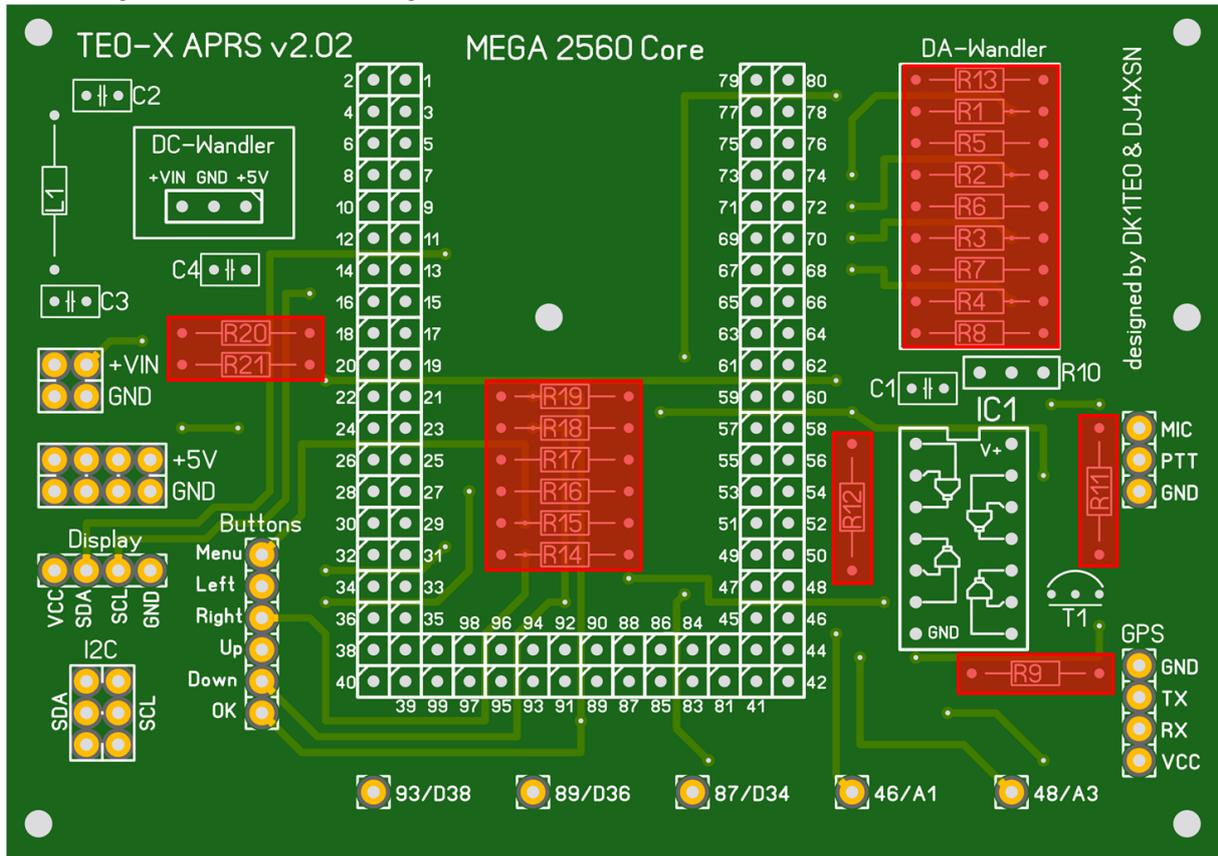
Other components

Identification	Number
B10K	R10
BC547A	T1
100 nF	C1
10 nF	C2, C3, C4
10 μ H	L1
IC socket	IC1
IC HCF4011BE	- will be put on IC socket -
Mega2560	- will be put on board -

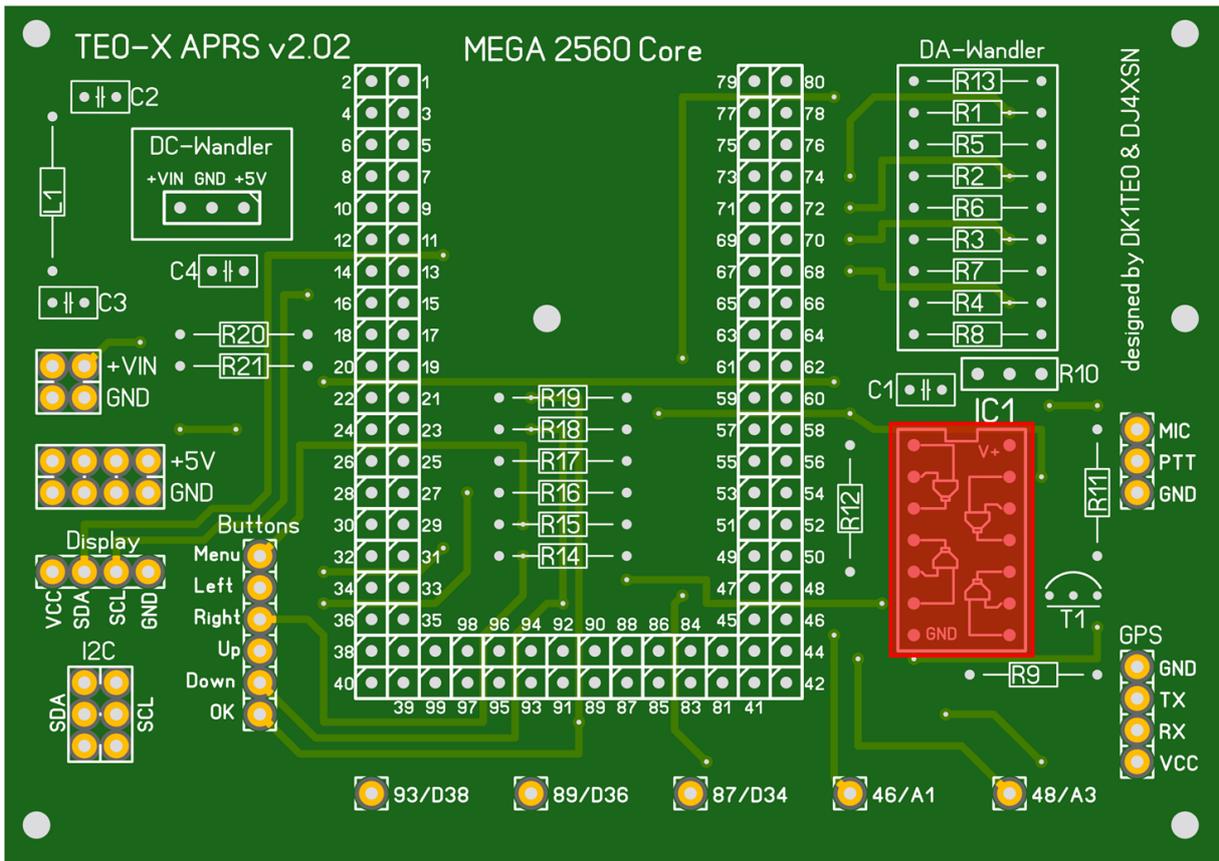
Assembly

Componets are placed on the top side and soldered on the underside.

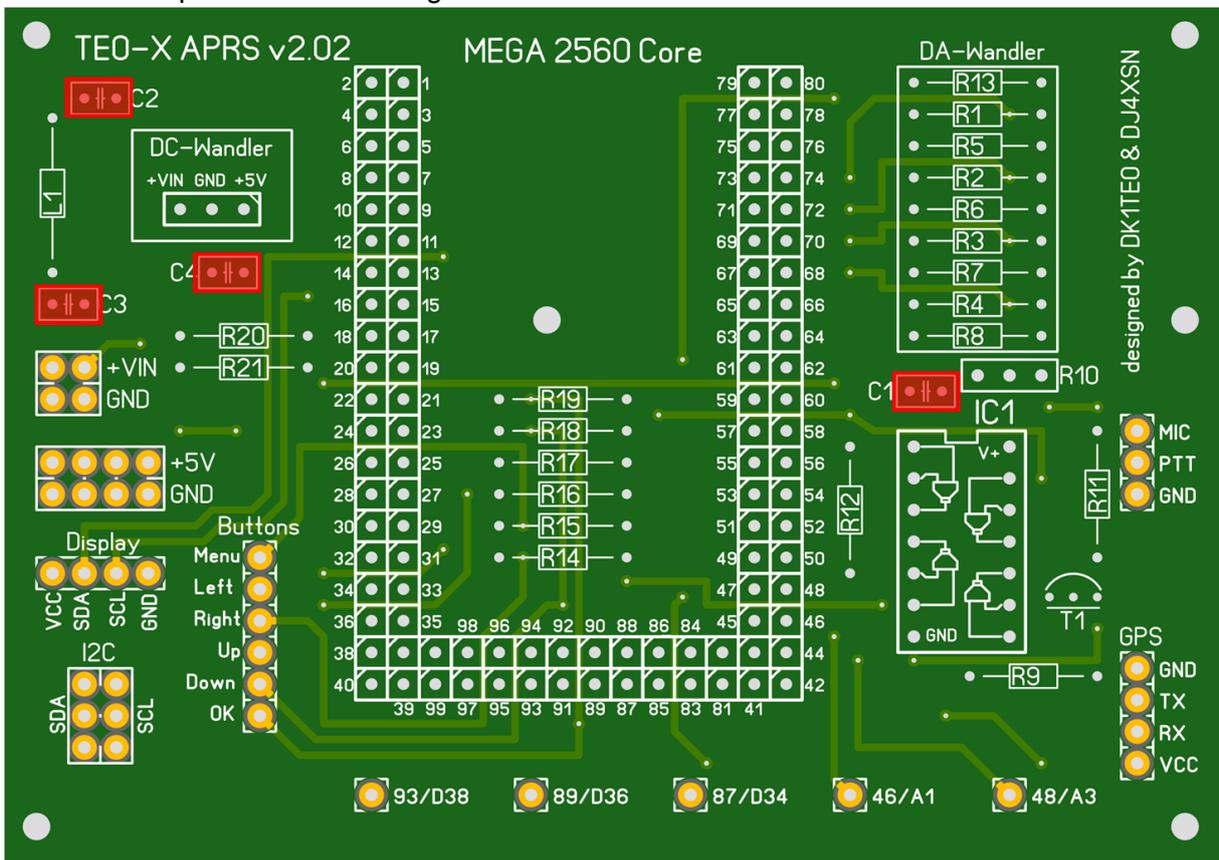
1. Soldering of resistors according list.



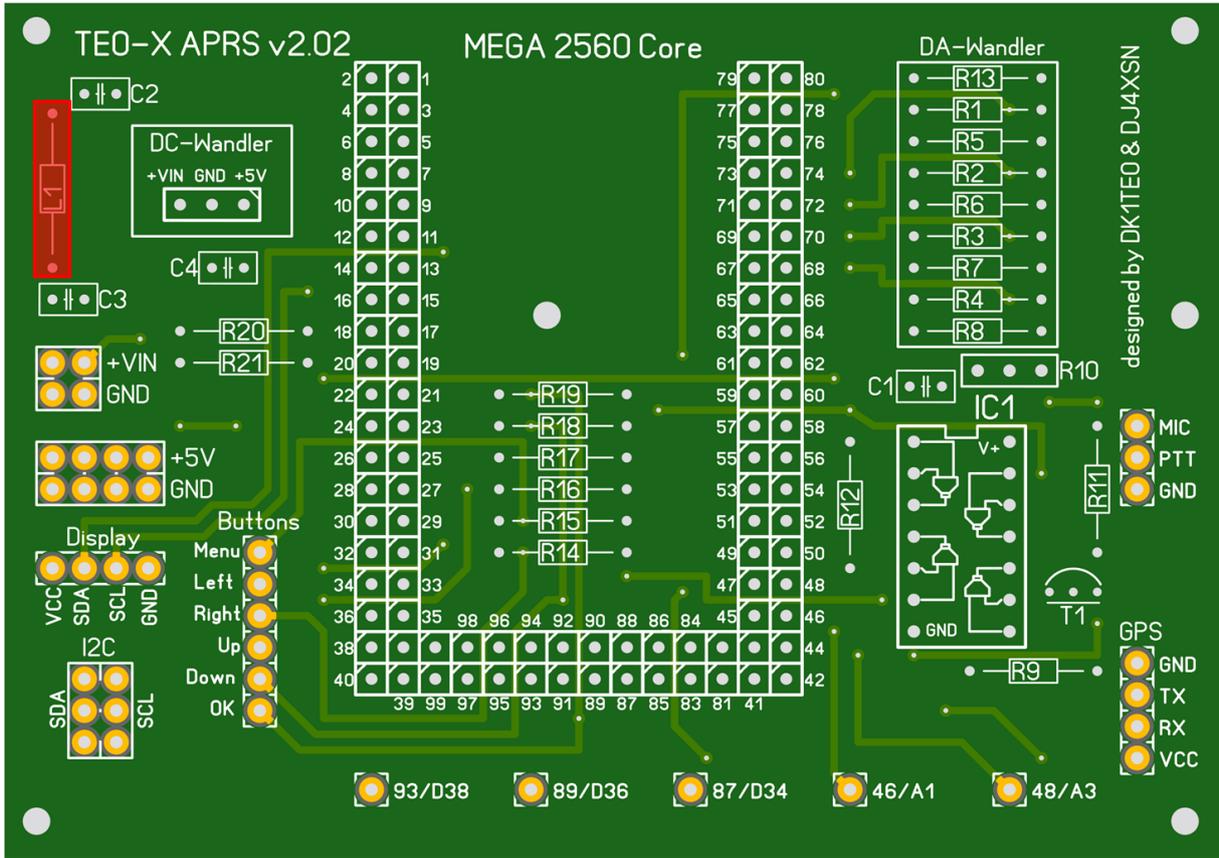
- 2. Solder first the IC socket for GPS connection then put the IC according to markings on the board into the IC socket.



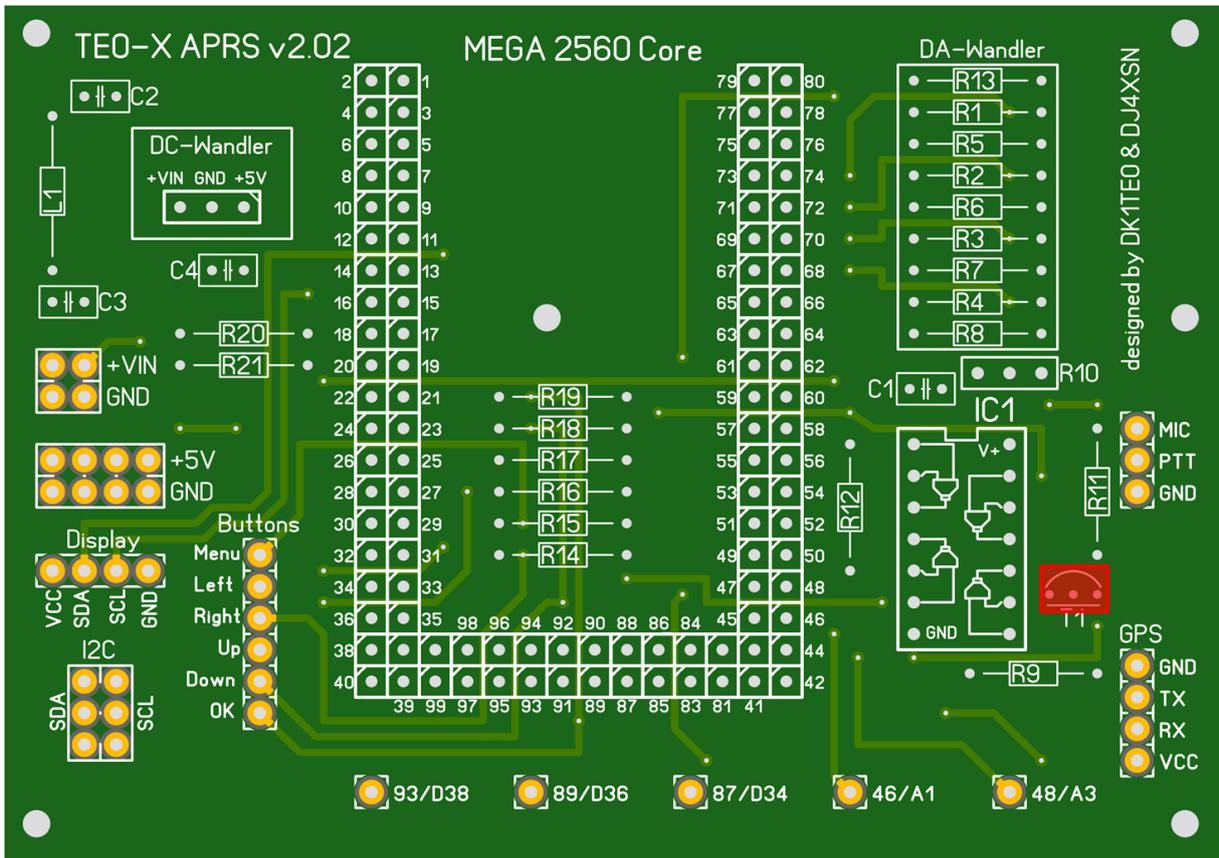
- 3. Solder the capacitors according list.



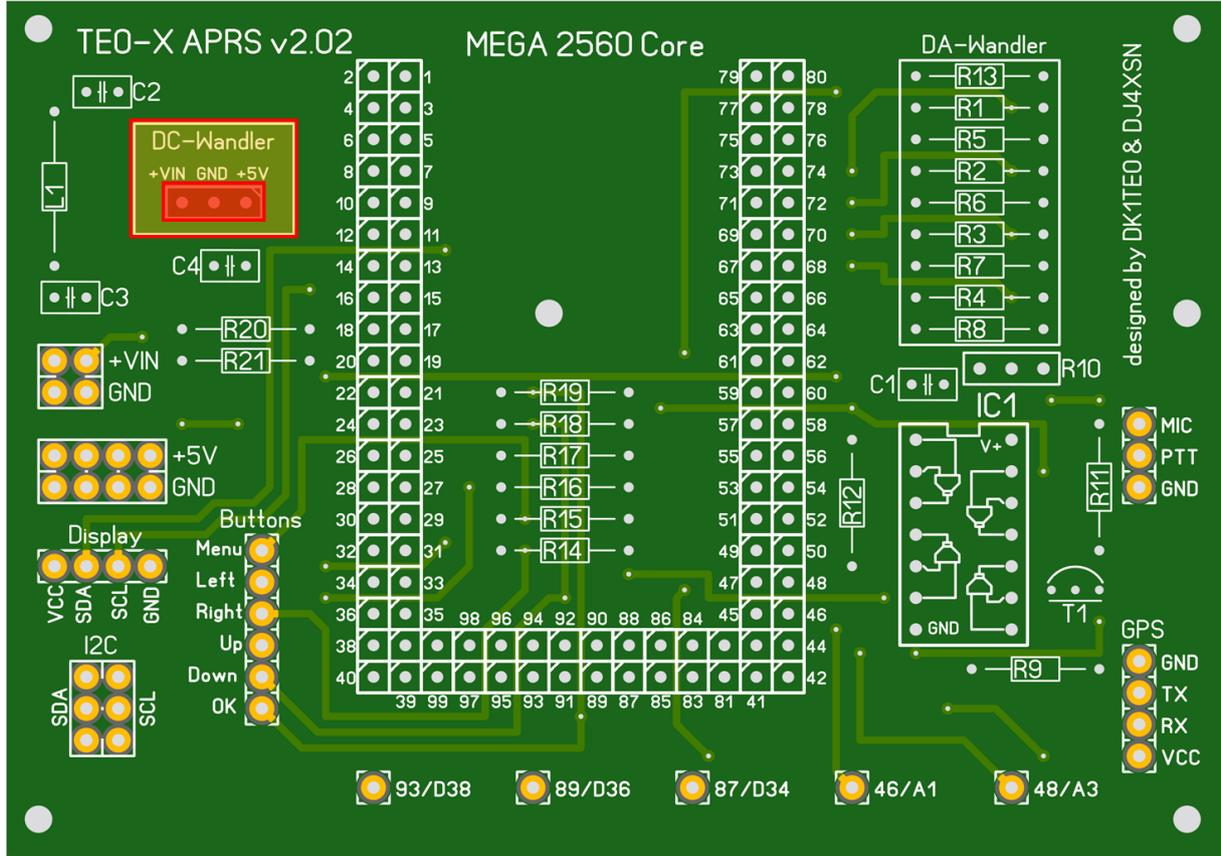
4. Solder the inductor.



5. Solder transistor for PTT

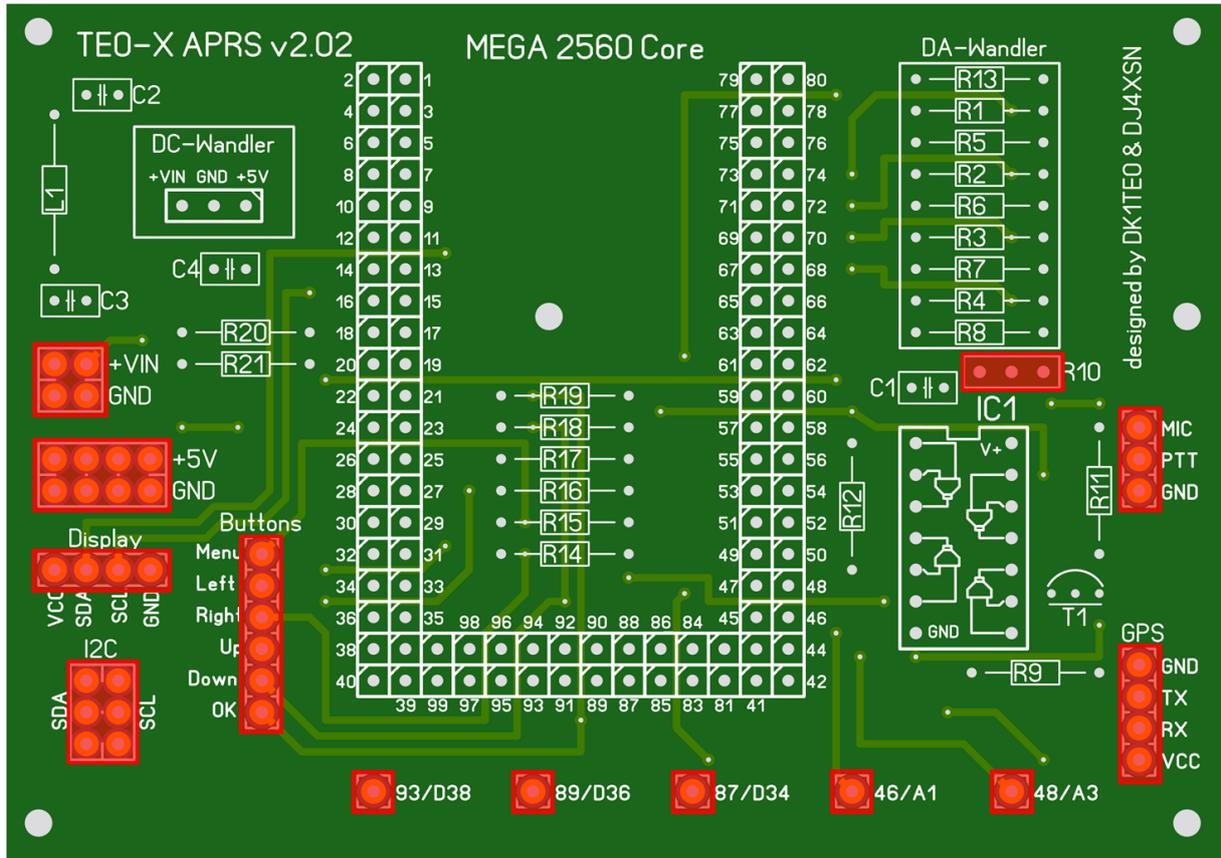


6. Solder DC-DC converter

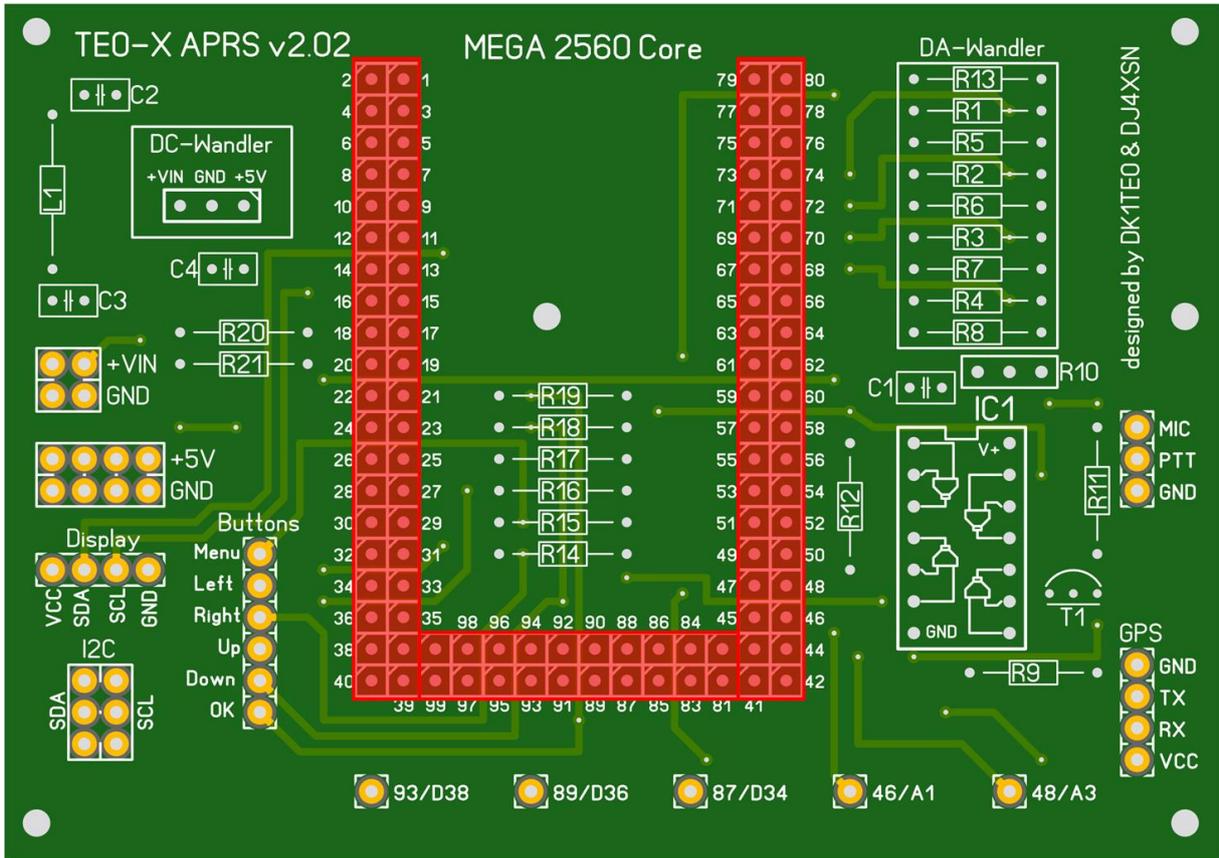




7. Place and solder the 2-row und 1-row pin-header on the front side.

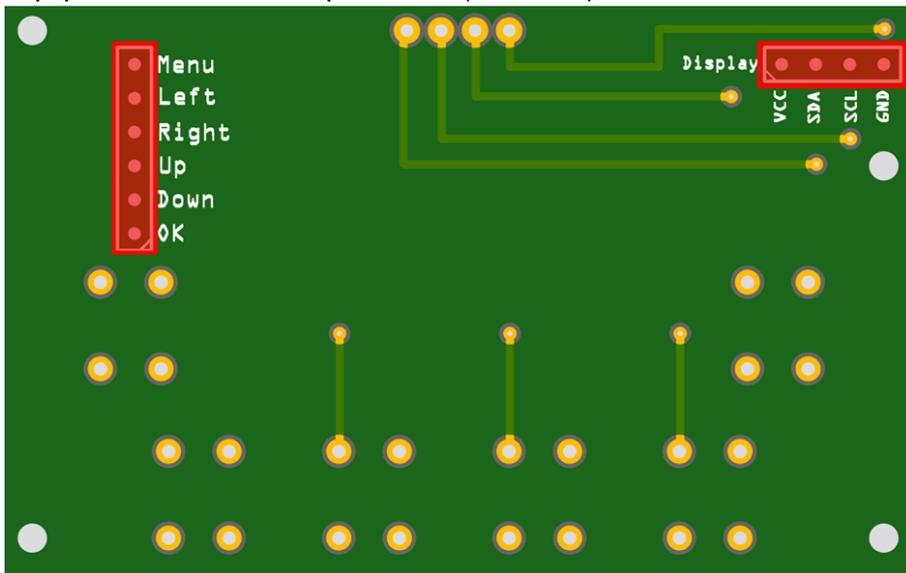


8. Place and solder the pin sockets

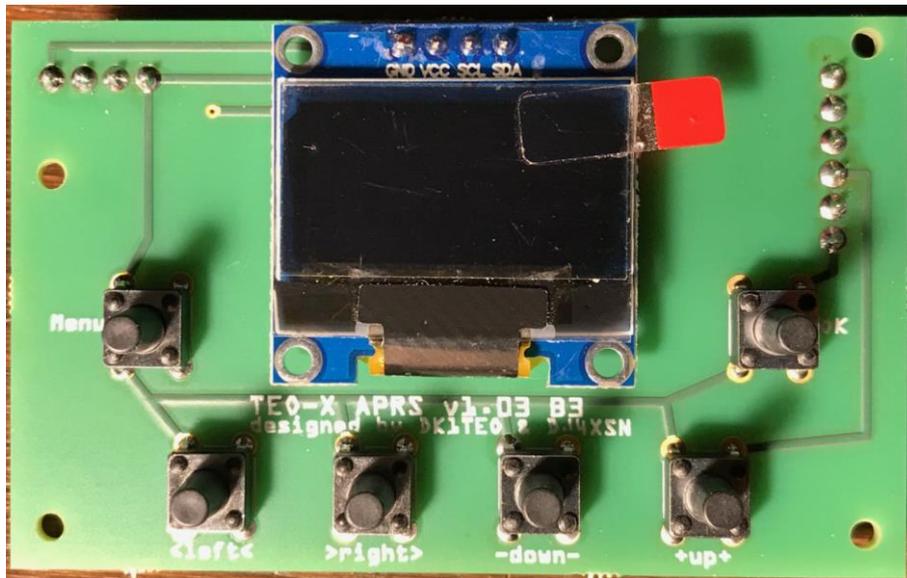
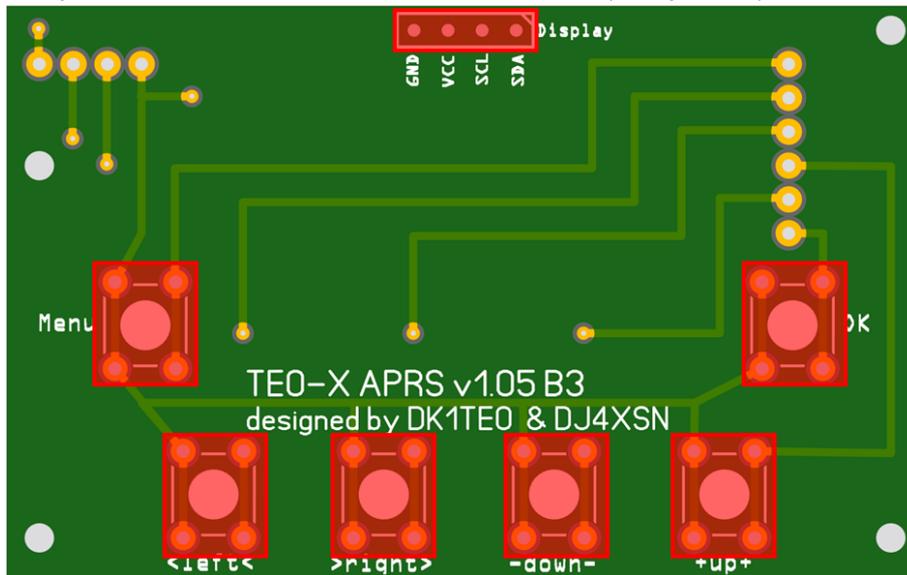


Tip: If you put the Arduino before soldering on the pin sockets the banks have a better fit. Important: Protect the Arduino from heat.

9. Equip the board B3 with pin banks (backside)

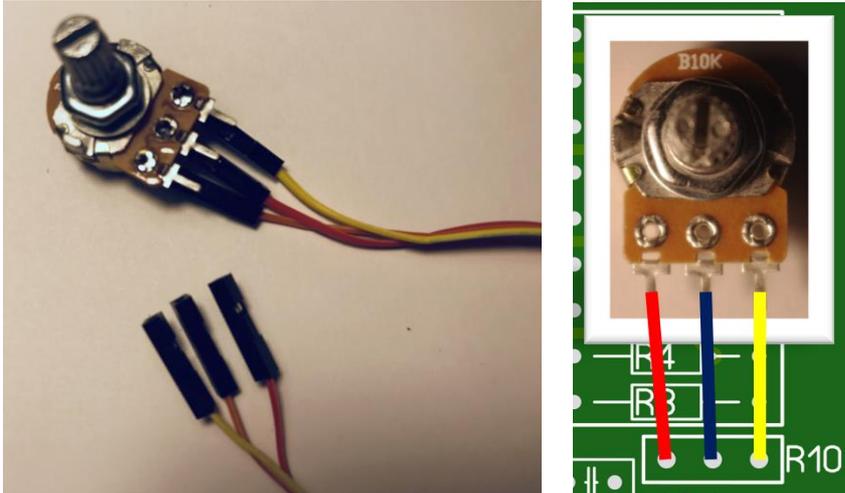


- 10. On the front side of board B3 the display is implemented and soldered directly with the still assembled pin headers. In addition the buttons are soldered. Respect the correct orientation of the buttons (see photos)



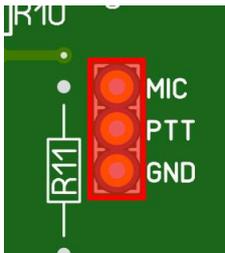
Wiring

11. B10K connect the variable resistor. It's used to modulate the microphone output.



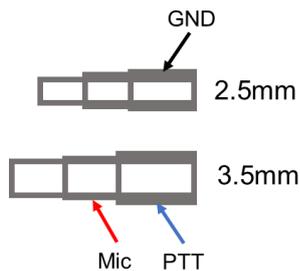
In the connection sequence in the photo you see the highest modulation when turning the variable resistor in a clockwise direction as far as it will go. For my device a 75 percent modulation fits best.

12. Connection of GND, Mic, PTT.



Depending on the radio pin the configuration varies.

In case the TEO-X-APRS is sending the APRS signal PTT is connected to GND via a transistor. The PIN configuration for my radio is as follows:



The wires connecting the jack plug could leave the casing via a drill hole.

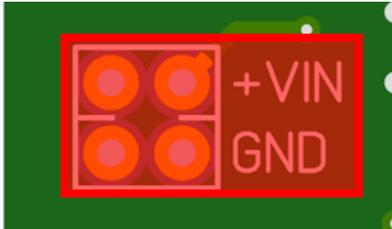
13. Now you could assemble the board in the casing and the Arduino on the board.

Power Supply

15. Connect the power supply.

IMPORTANT: The board is not protected against polarity reversal and overvoltage. Polarity reversal and overvoltage destroy the TEO-X-APRS.

The TEO-X-APRS is powered via the mainboard via VIN.
The minimum voltage is 7V. The maximum voltage is 25V.



16. Assemble the power supply socket in the casing.
Insert the fuse in the casing.

17. Insert fuse.

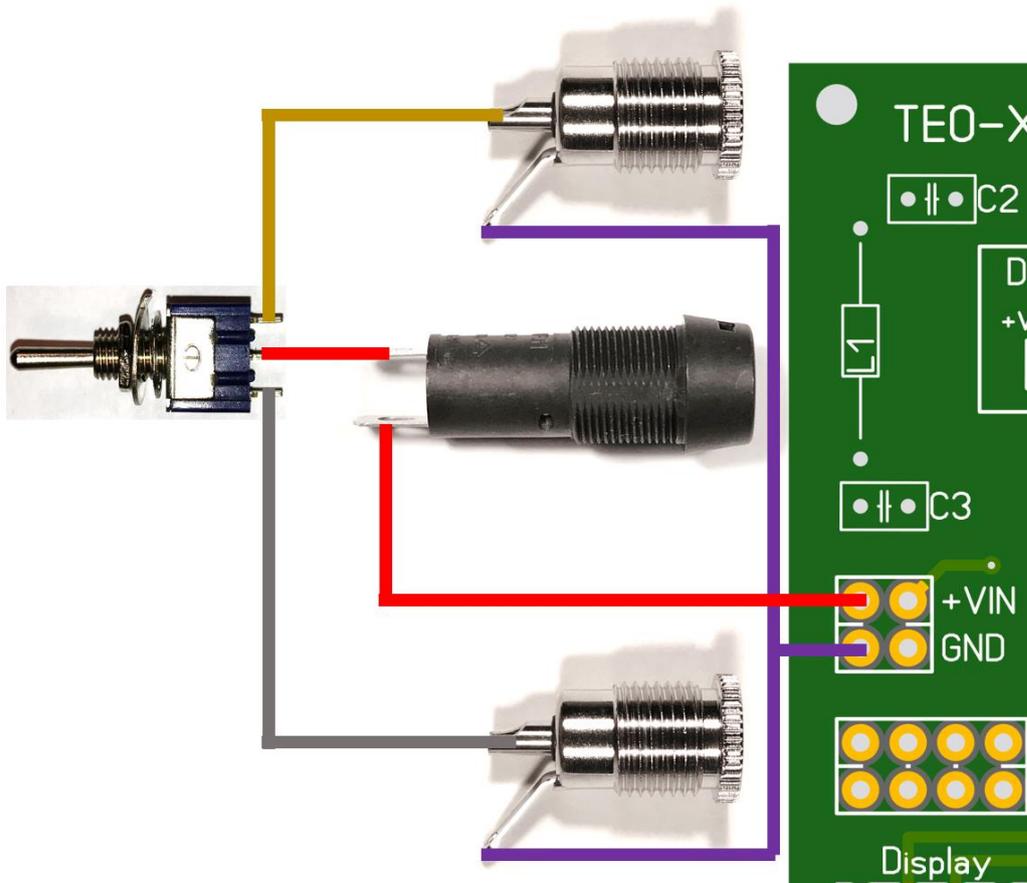


18. The TEO-X-APRS is designed for external power supply.

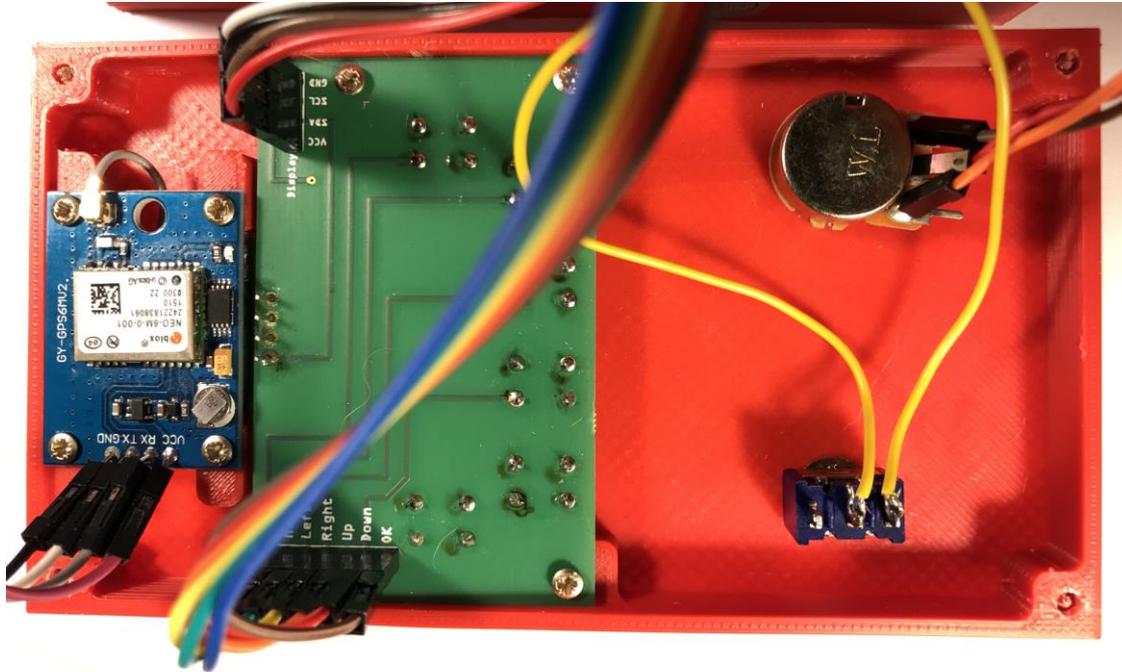
In own responsibility it's possible to integrate an accumulator battery. Therefor a second electrical connection exists. If an electronic charging device is used the second power connection could be used for charging.

For assembly and operation of an accumulator with or without electronic controller no liability is assumed! This is carried out on personal responsibility despite the casing offers enough space for an accumulator!

19. Connect power supply in a way that a change between both power connections is possible.
The contact in the middle represents the plus terminal.
The circuit diagram:

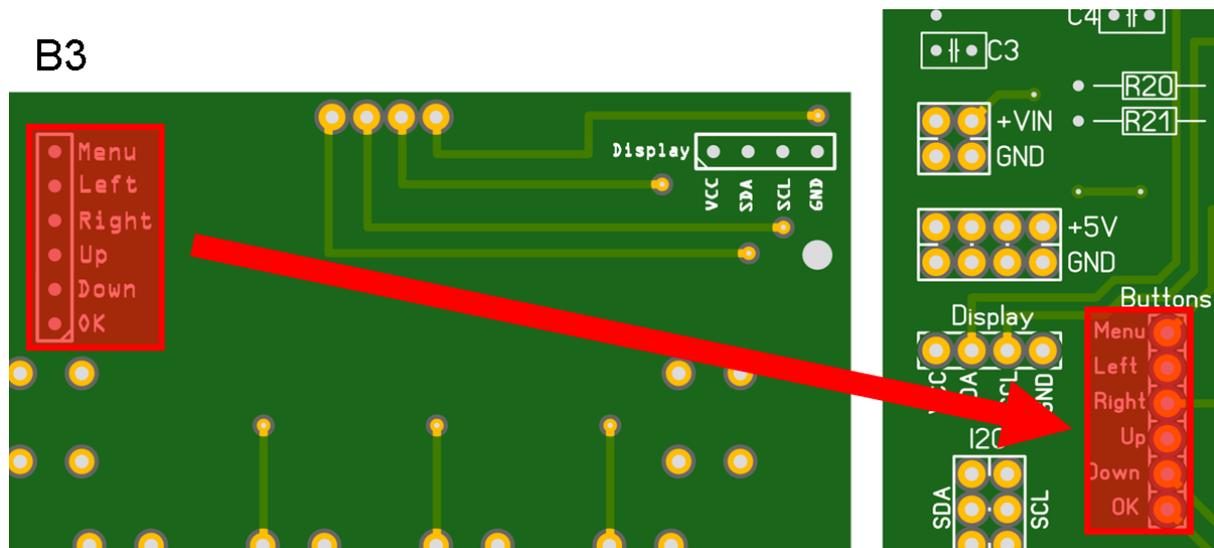


20. Remove the protective sheet of the display.
 21. Insertion and screw on the board B3 into the cap of the casing.
 22. Insertion of the on-off-on switch and B10K into the cap of the casing.
 23. Insertion and screw on of the GPS module. On the GPS module the connection cables must be soldered.
- Be careful, that antenna on the backside does not short-circuit the contacts on the backside.

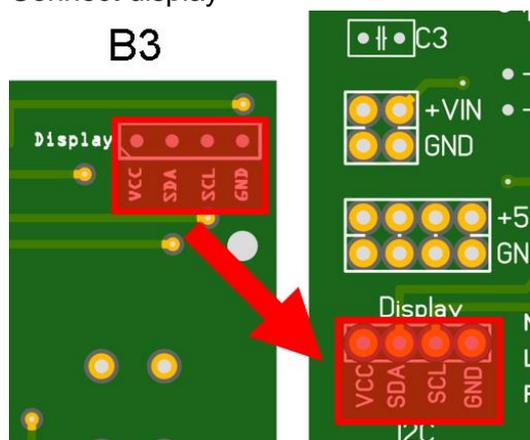


Connect Housing Cover and Housing Base

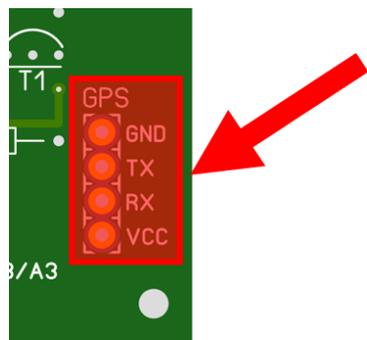
24. Connect switches



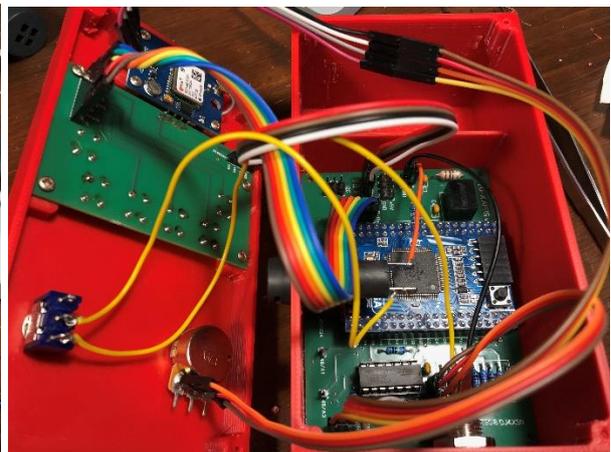
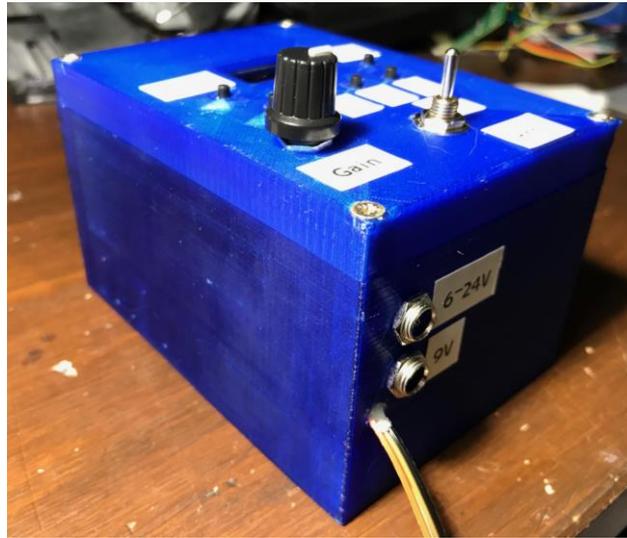
25. Connect display



26. Connect GPS module with main board



27. The mounting in a casing is an option. Important is to provide enough cooling of the MEGA 2560 CORE. Following an example of a casing manufactured with a 3D printer.



Software

Pressing the menu button, you could switch between menu positions. Before connecting with a radio the call sign should be inserted correctly.

Main page:

Remaining time in seconds until next transmission

Measured voltage

GPS time UTC

GPS location data

```

TEO-X 1 S 7.82 U
03.10.2018 - 21:18:26
Latit: 47.7 Deg
Longi: 9.2 Deg
Speed: 5.06 km/h
Altit: 439.10 m
  
```

Adjustment Menu:

Locator calculated out of the GPS data

Call sign with APRS number (SSID)

Interval of transmission in seconds

Table of Symbols (according APRS symbole table)

Symbol (according APRS symbole table)

```

TEO-X 24 S 7.80 U
03.10.2018 - 21:19:03
Locat: JN47PS
Rufze: DK1TEO-01
Sendi: 030 Sec
Symbo: 0/
  
```

Information Menu:

Software Version

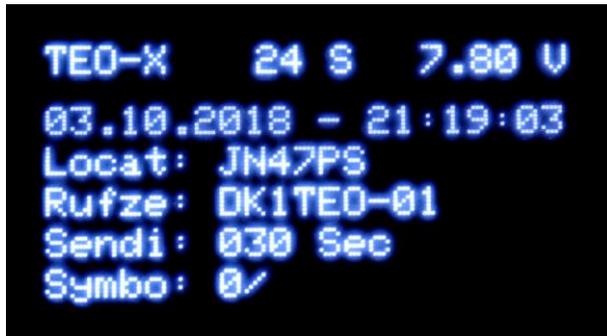
Developer of TEO-X APRS

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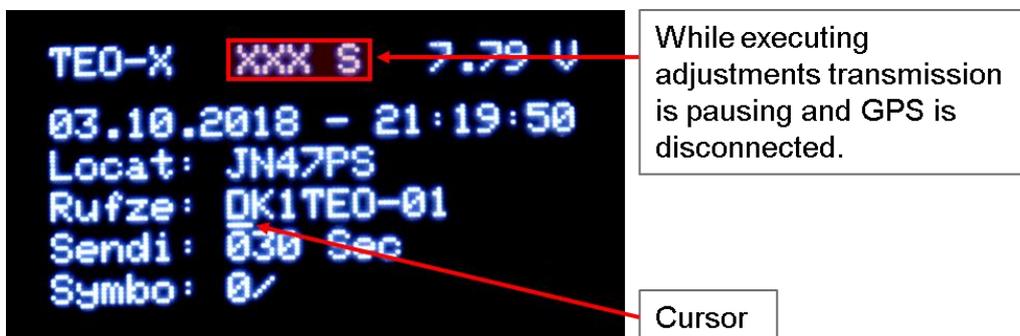
TEO-X 17 S 7.79 U
Versi: 01.00
Creat: DK1TEO
      DJ4XSN
  
```

Adjust settings

Start by pushing the menu button. This will display the menu for adjustments.



By pressing the OK button an underscore is visible (here under the call sign).



Using up and down buttons the characters above the cursor could be changed. With the right and left buttons, the cursor could be moved.

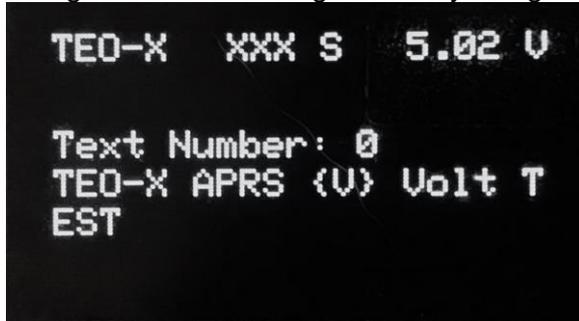
It's possible to change call sign, transmission interval and the symbol.

By pressing the OK button again the adjustment of settings is finished, and changes are saved.

Set APRS-Text

The APRS-Text can be set as follows:

Navigate to the following screen by using the menu key



Just as with the other settings, the EditMode can be started by pressing the OK button.

There are four (text number 0-3) different texts available which can be stored on the device. Each text can have a maximum of 20 characters per line or a total of 60 characters.

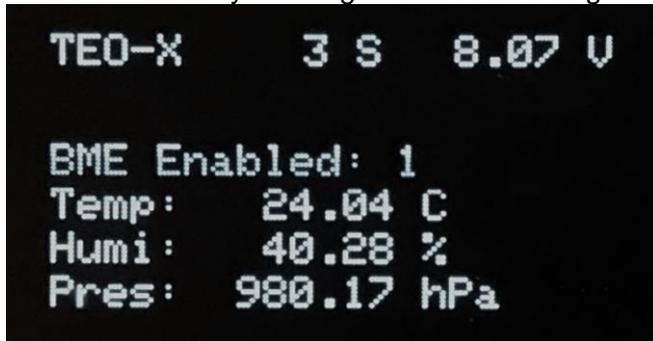
The following variables are available, each of which must be written in curly brackets { }. When sending, the variables in the text are replaced by the respective current values. The variables are each without units:

LOC	Locator
V	Supply voltage of the TEO-X APRS (Volt)
A1V	Voltage applied to A1 [max. 5V!] (Volt)
A1N	Depending on voltage applied to A1 Value from 0-1023 [max. 5V!]
A3V	Voltage applied to A3 [max. 5V!] (Volt)
A3N	Depending on voltage applied to A3 Value from 0-1023 [max. 5V!]
BT	BME280 sensor temperature (Celsius)
BH	BME280 sensor humidity (Percent)
BP	BME280 sensor air pressure (hPa)

Enable BME280 sensor

If a BME280 sensor is connected to the I²C connection, it can be read out.

Use the Menu key to navigate to the following screen



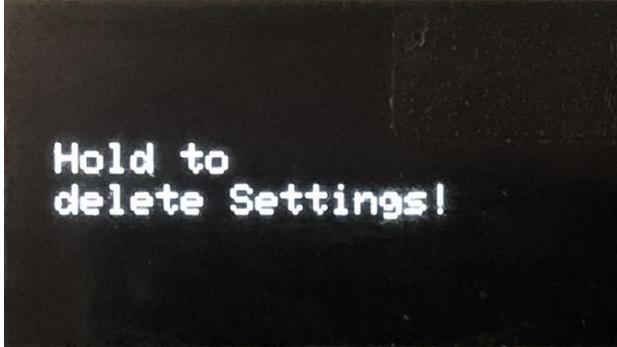
Just as with the other settings, the EditMode can be started by pressing the OK button.

When the sensor is correctly connected and activated, the temperature, humidity and pressure are displayed on the screen. The values can be used as variables in the APRS-Text.

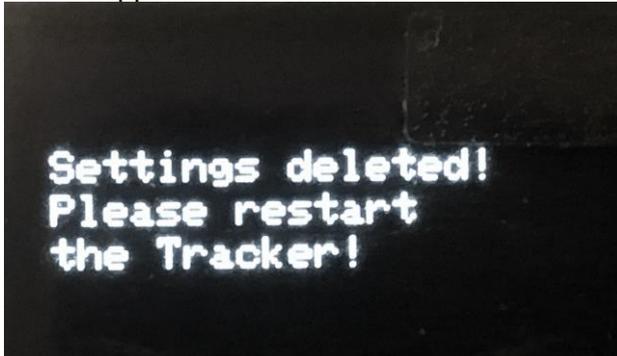
Reset APRS-Tracker

To reset the APRS-Tracker to factory settings, the buttons: +up+ and -down- keys must be pressed simultaneously and held for at least 5 seconds.
WARNING: ALL settings will be lost!

1. After holding both keys for about one second, a warning message is displayed:



2. If you continue to hold both keys, the settings are deleted and the following note appears:



3. After that the tracker must then be switched off and on again!

Note: The internal EEPROM-Memory on which the settings are stored has only a limited lifetime by technical reasons (approx. 100,000 write operations), in addition, errors may occur when saving or reading the settings. Resetting too often can lead to memory failure!

EEPROM-Memory Test

This test exists only to find out if the EEPROM-Memory is the source of errors, only use this test when errors occur.

WARNING: ALL settings will be lost!

1. Reset APRS-Tracker (see previous page)
2. After the message disappears, press and hold <-left<- and +up+ for at least one second, a warning message will appear and after another four seconds the test step 1 will start
3. After the message disappears, press and hold >right-> and -down- for at least one second, a warning message will appear and after another four seconds the test step 2 will start

Note: The internal EEPROM-Memory on which the settings are stored has only a limited lifetime by technical reasons (approx. 100,000 write operations), in addition, errors may occur when saving or reading the settings. Resetting too often can lead to memory failure!

Software Update

For updating the software the console application „avrdude“ (out of the Internet) and a data cable (not included) is necessary.
A software update is at your own risk...

The latest software build can be downloaded here:
<https://dk1teo.com/TEOXAPRS>

The console application is used as follows:

```
avrdude.exe
-p m2560
-b 115200
-P <COMPort>
-c avrispmkII
-U flash:w:C:\<Path>\TEO-X-APRS_001_v-<Version>.ino.mega.hex:i
```

Parameter -P is the respective COM-Port the Arduino is connected, in example COM1.

Within the parameter -U the path to the downloaded firmware file has to be specified. The ZIP file has to be extracted before. - The path should contain no blanks.

Software License

The software of the TEO-X APRS was developed by DK1TEO.

The following software libraries have been used:

- <https://github.com/williamhemmingsen/LibAPRS> (GPL)
- <https://github.com/mikalhart/TinyGPSPlus> (LGPL)
- <https://github.com/adafruit/Adafruit-GFX-Library> (BSD)
- https://github.com/adafruit/Adafruit_SSD1306 (BSD)
- https://github.com/adafruit/Adafruit_BME280_Library (other)
- https://github.com/adafruit/Adafruit_Sensor (Apache)

The source code could be downloaded from the following link:

<https://dk1teo.com/TEOXAPRS>

The TEO-X APRS software license is GPL v3.

All changes are made on own responsibility.

Support

Via Mail to: kai.pautsch@dk1teo.com