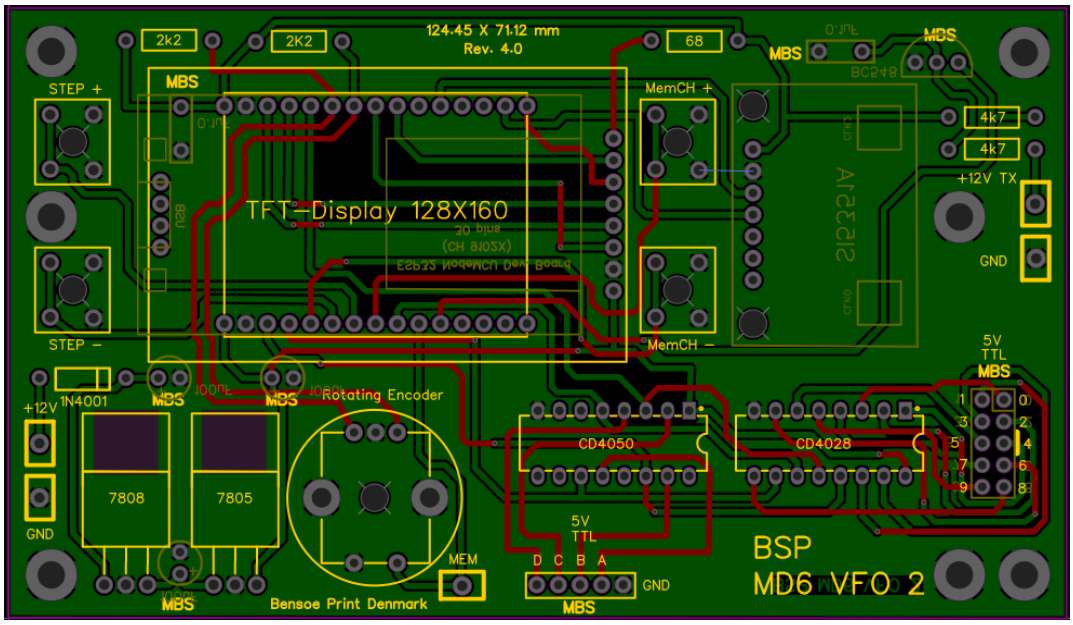
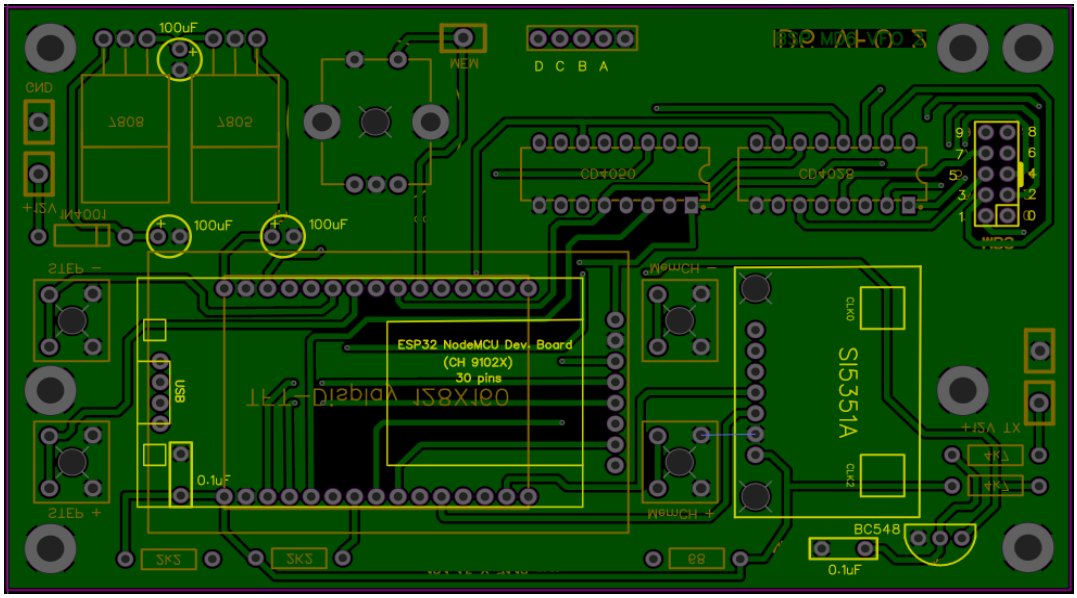
Instructions for mounting of the BSP module MD6 VFO 2

Bensø Print Denmark.



The PCB 'front page + Tracks' (124.45 X 71.12 mm).



The PCB 'back side'.

Description:

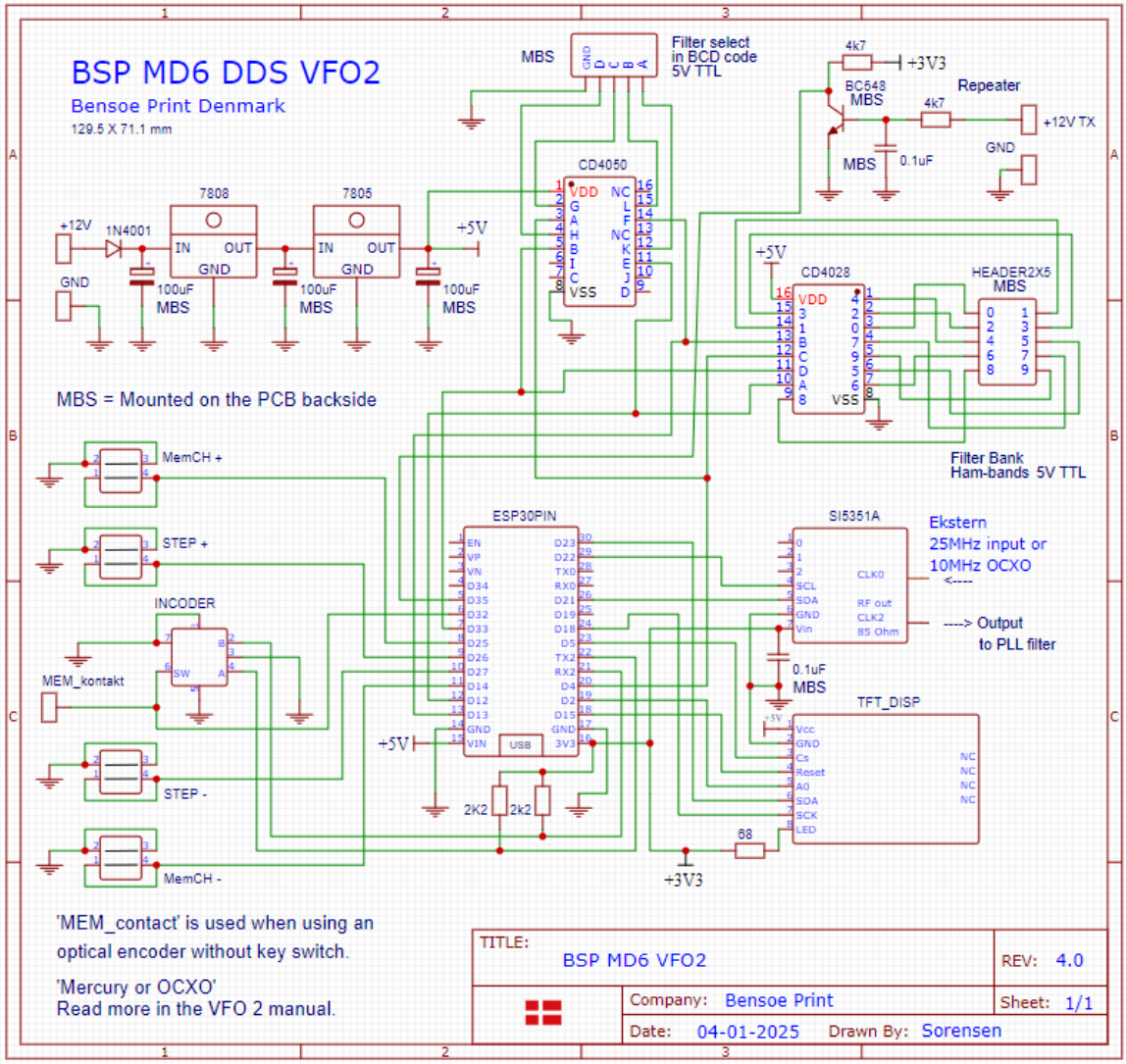
Our MD6 VFO2 is a so-called 'DDS VFO' (Direct Digital Synthesis), which in our case means the frequency generating unit 'SI 5351(A)' (PLL), which is controlled by a small computer (CPU) 'ESP 32 DEV', which also controls a small 1.8” TFT display 'ST 7735' (128*160).

The original, but gradually heavily modified control software, basically originates from the Japanese radio amateur 'JF3HZB'.

The CPU gets its controlling input from 4 pcs. 'momentary switches', as well as a 'rotary encoder' for frequency setting. On the 4 switches you can select frequency steps **10 Hz. to 10 MHz. and 12.5 kHz.** for 2 meter channel use. In addition to this 20 fixed frequencies can be selected (see table further on), plus by pressing the encoder button, a start up frequency, which is saved and remembered at start up.

The CPU supplied by us is pre-programmed as a 'VFO' to a 10.7 MHz. intermediate frequency, which means that its output frequency is 10.7 MHz. higher than shown on the display.
Since the 'PLL unit' output is 'squares/not sine', it must be followed by a 'PLL filter', see more details in our BSP catalogue.
The VFO can also be supplied for other intermediate frequencies, e.g. 21.4 MHz, 9 MHz. and 455 kHz. or as a **'Signal generator'** directly on the frequency.

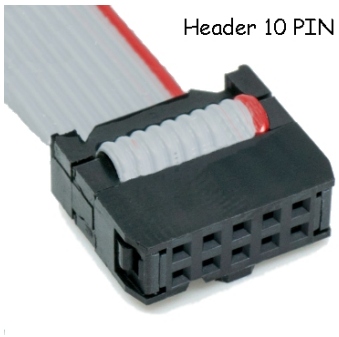
The VFO can also be supplied prepared for an external '10 or 25 MHz-clock module' to be connected to the 5351 PLL circuit. See more about our external 'clock solutions' in our catalogue. Be prepared for these questions when ordering the VFO.....



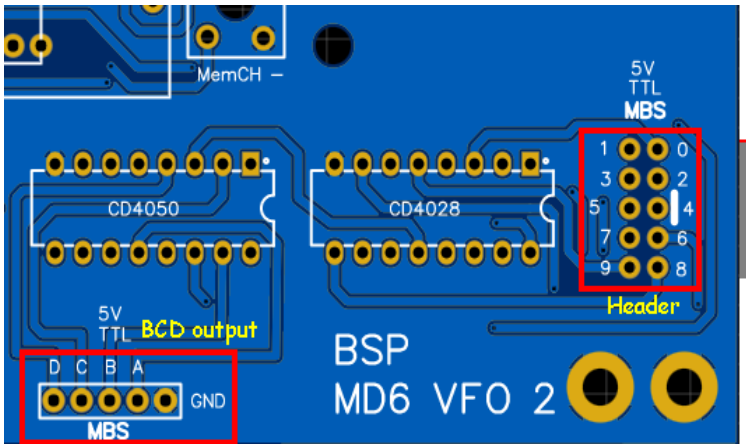
As you can probably see in the diagram, VFO 2 is equipped with some facilities that are not found in our 'VFO (1)'.

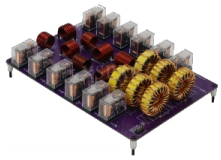
Control of external TX filter bank:
VFO 2 has a complete automatic control of a possible connected 'external TX filter bank'. This is done via the 'Header connector' outputs (0 – 9), where everyone of them is made to output +5V (TTL high) controlled by where the VFO is set in frequency, in this way a filter section in the 'bank' can be automatically selected based on the selected VFO frequency.

Filter bank table:



Output Header Connector:	BCD Output 'D-C-B-A':
LSB Region1 USB	
Pin '0'	160 Meter 1.8000 - 2.0000 MHz BCD: '0000'
Pin '1'	80 Meter 3.5000 - 3.8000 MHz BCD: '0001'
Pin '2'	60 Meter 5.2500 - 5.4500 MHz BCD: '0010'
Pin '3'	40 Meter 7.0000 - 7.2000 MHz BCD: '0011'
Pin '4'	30 Meter 10.100 - 10.150 MHz BCD: '0100'
Pin '5'	20 Meter 14.100 - 14.350 MHz BCD: '0101'
Pin '6'	17 Meter 18.068 - 18.168 MHz BCD: '0110'
Pin '7'	15 Meter 21.000 - 21.450 MHz BCD: '0111'
Pin '8'	12 Meter 24.890 - 24.990 MHz BCD: '1000'
Pin '9'	10 Meter 28.000 - 30.000 MHz BCD: '1001'





Typical SW
TX-filter bank

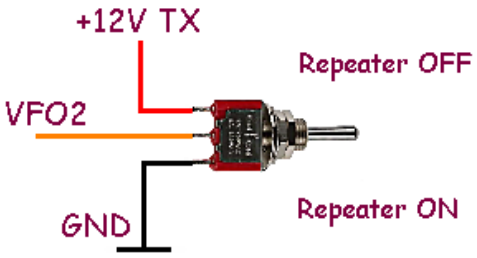
NB: Remember everything marked **'MBS'** must be mounted on the **back side of the board.**

TX filter banks can be controlled in different ways depending on how the 'bank author' has designed it. Therefore, the VFO 2 also allows for **'BCD control'** of the connected bank.

For 2 Meter repeater operation:

VFO 2 has another facility built in.
Automatic 'repeater space switching'.

If the '+12V TX' terminal is connected as shown, the VFO will automatically shift 600 kHz down in frequency when the transmitter is activated, but only when the VFO is in the 145 to 146 MHz range.
The facility is primarily intended for our upcoming 2 Meter transmitter.
If not used, connect the '+12V TX' terminal to **GND**.



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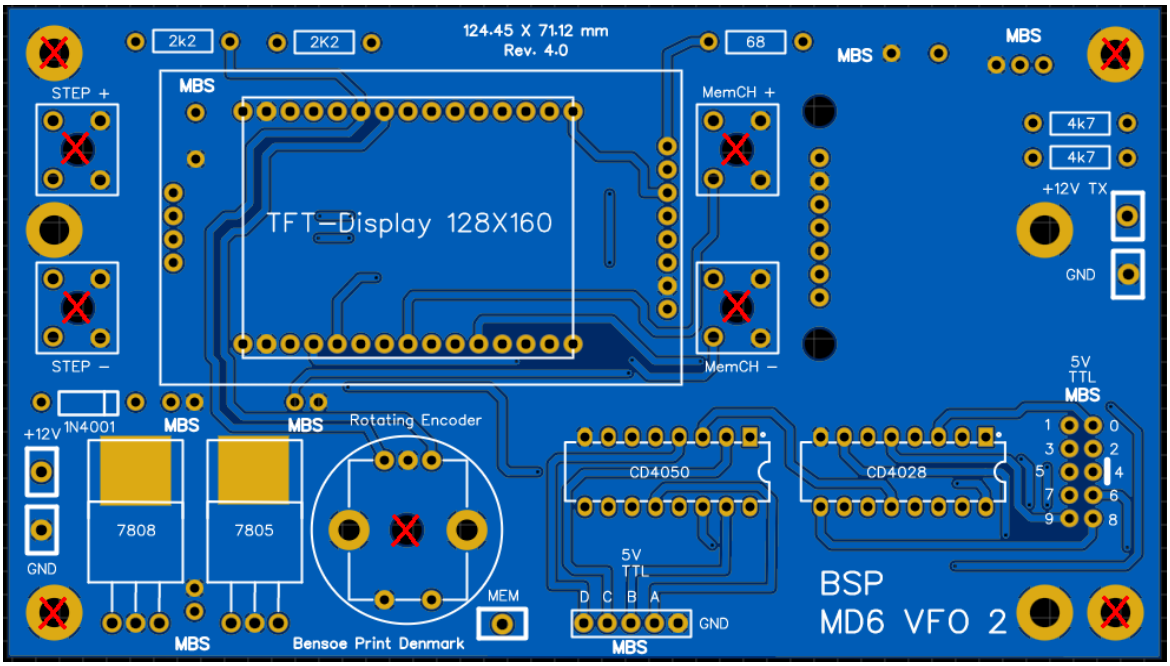
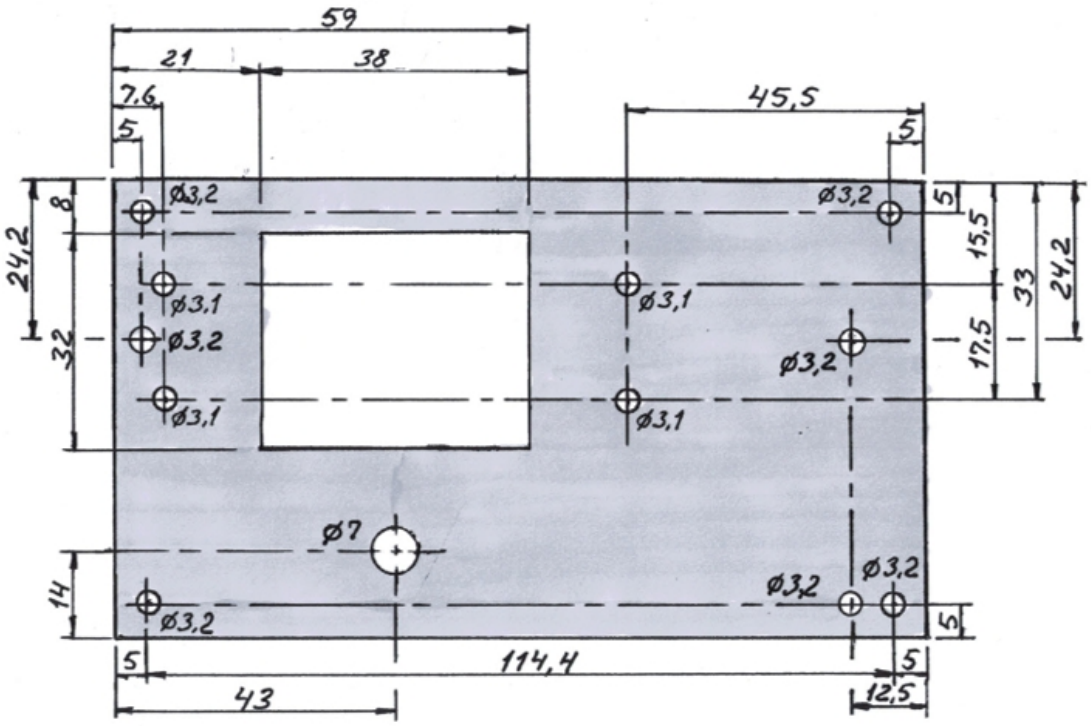
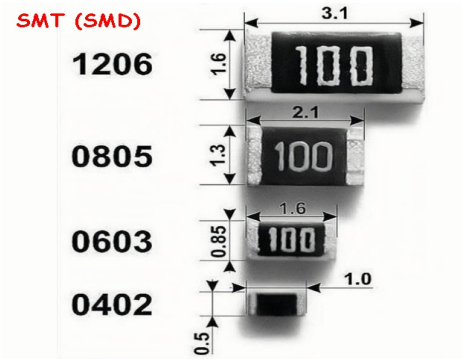
First step. Installation in the cabinet:



Why think about the cabinet as the first step?
Because before you start putting components into the PCB, you can use the PCB directly as a **'drilling template'**. Place the PCB on the front panel of your comming cabinet and mark the holes, which are marked with a red cross. Namely the four switches, the Encoder and the four mounting holes.



Here is the final assembly drawing for the front plate with hole for the display.

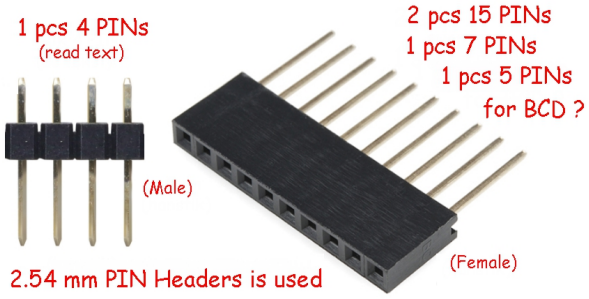


No, we do not use SMT here in the shop.

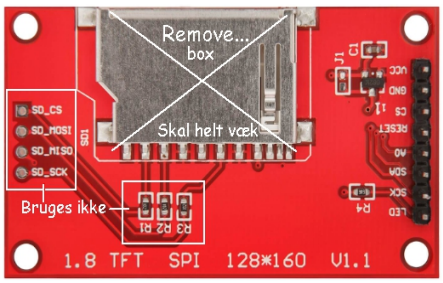
Assembling the PCB:

General: The components marked 'MBS' must be 'Mounted on the BackSide' of the PCB board.

Start by mounting the two '15 PIN headers' and 5 PIN for BCD on the back of the PCB, if these 5 outputs are to be used. They are both soldered from the front of the PCB. (Save 7 PIN for a little while longer).
The length of the headers (PIN number), is adjusted with a 'good wire cutter'.
Mount the 0.1 uF shown. also on the back of the PCB, soldered from the front.



Preparation of TFT display:
In order to get a good and neat cabinet mounting of the VFO, the display and control buttons must 'flush' and therefore the height of the display must be reduced.



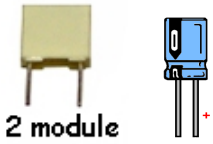
The small 'metal box' shown on the back must therefore be removed. This is done with a soldering iron and needle nose pliers. Heat and lift (one at a time) the four small 'feet' the box is fitted with.
The 'plastic gizmo' which sits hidden inside the box is 'wiggled free' and removed completely.
The mentioned '4 PINs header' is mounted with the short pin in the display PCB. has no electrical function, but is used to stabilize the display assembly mechanically.

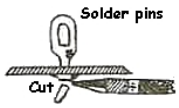
PS: Normally there are PIN-Headers included with the display and the PLL, if not, you must use your own purchased as shown in the picture (male connector).

Now mount the display, make sure it is 'all the way down' and solder to the back of the PCB.

Install now
The '7 PINs header' for the PLL module on the back of the PCB, soldered from the front.

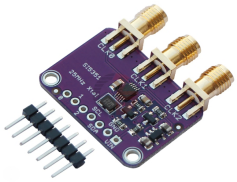
Now the rest of the components can be mounted:
Mount 7808 and 7805 on the front of the PCB. Bend the legs with a small flat-nose pliers from the 'thick point down', solder the legs from the back and solder the two regulators to the top of the PCB via the 'clamping hole'. Mount all the solder pins (**'MBS'** on the backside of the PCB).



Mount the 3 X 100uF el-lytes, transistor and the header connector for the flat cable (marked 'MBS') on the back of the PCB (solder from the front). Then mount the contacts, diode, resistors and the rotary encoder.

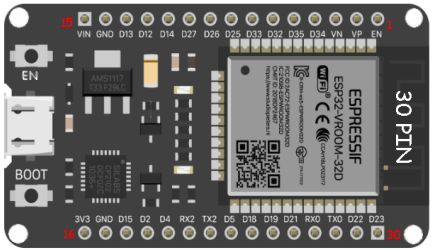
The PLL module 'SI 5351' is now ready to be mounted:
ATTENTION... An antistatic connected soldering iron is strongly recommended.



Start by drilling the 2 mounting holes with a 3.2 mm drill bit.
Now solder the supplied '7 PINs male header' (the short end) to the underside of the PLL board, solder from the top side. As shown, you can mount 'SMA plugs' on the outputs, but since we only use the CLK2 output, you only need to mount an 'SMA plug' there, or you can instead use e.g. RG178 and soldered directly on the PCB.

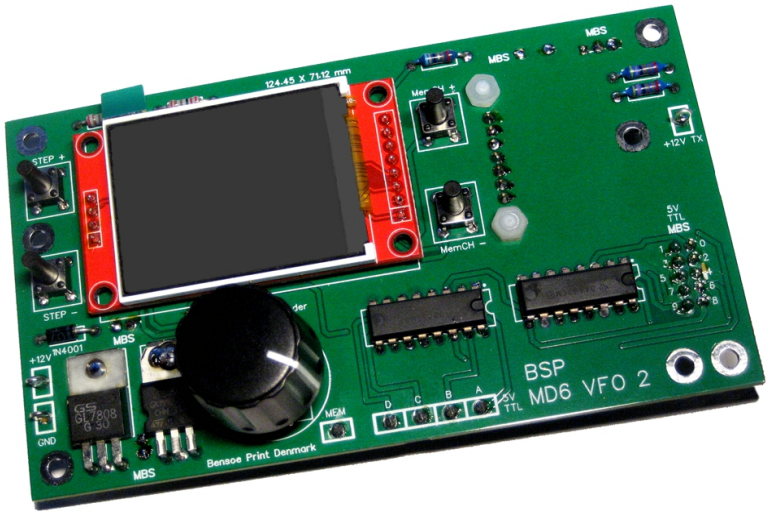
Carefully 'drill out' the plastic stays mentioned in the parts list with a 3.2 mm drill bit. Turn the PLL module as shown in the illustration on the back side of the PCB. Fit the plastic stay and the 2 plastic screws while pressing it into place in the header connector. Finish with the 2 plastic nuts.
Important: During this entire 'operation', for 'anti-static reasons' it is a good idea (almost a requirement) that at the start of the handling, you simultaneously hold on to both the Encoder (the GND of the VFO) and the GND of the PLL (the SMA connector), this method is use to carry out 'static diversion'.

Mounting the 'ESP 32' CPU:
Flip the programmed 'ESP 32 Module' as shown in the illustration on the back of the PCB and press it into place in the 2 header connectors.



The test:

Connect 12 – 13.5V to the terminals 'GND and +12V'



The first time the VFO is switched on, the frequency will show 'something strange', this is because a 'custom' start-up frequency has not yet been loaded.
Try to display the fixed frequencies that are fixed in the system by pressing the switches '**MemCH** + and **-**'. '**STEP** + and **-**', which indicate how much the VFO 'step in frequency' when the Encoder knob is turned (10 Hz – 10 MHz and 12,5 kHz). Select a frequency and press the Encoder button, it is now saved and the VFO will start fixed on this frequency when it is switched on again.

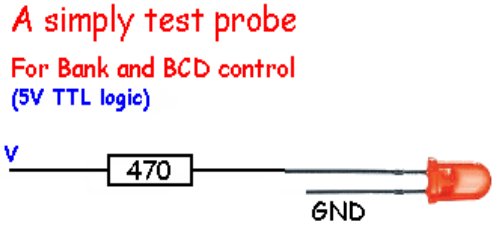
Embedded fixed frequencies:

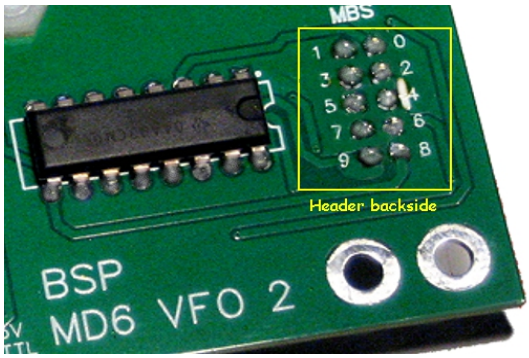
Ham band:		Frontend module:
137,0 kHz.	LW-band	'MD6 VLF-MB'
1,840 MHz.	160 Meter band	'MD6 VLF-MB'/'MD6 SW-KB'
3,600 MHz.	80 Meter band	'MD6 SW-KB'
5,300 MHz.	60 Meter band	'MD6 SW-KB'
7,040 MHz.	40 Meter band	'MD6 SW-KB'
10,130 MHz.	30 Meter band	'MD6 SW-KB'
14,100 MHz.	20 Meter band	'MD6 SW-KB'
18,120 MHz.	17 Meter band	'MD6 SW-KB'
21,100 MHz.	15 Meter band	'MD6 SW-KB'
24,940 MHz.	12 Meter band	'MD6 SW-KB'
28,500 MHz.	10 Meter band	'MD6 SW-KB'
50,100 MHz.	6 Meter band	'MD6 VHF6M'
70,100 MHz.	4 Meter band	'MD6 VHF'
144,000 MHz.	2 Meter band	'MD6 VHF'
Broadcast band:		
17,20 kHz.	Grimeton	'MD6 VLF-MB'
198,0 kHz.	BBC Radio 4	'MD6 VLF-MB'
648,0 kHz.	Radio Caroline	'MD6 VLF-MB'
1,440 MHz.	Radio 208	'MD6 VLF-MB'
6,055 MHz.	Radio OZ-Viola	'MD6 SW-KB'
27,025 MHz.	CB-band	'MD6 SW-KB'
Plus a user-selected start frequency.		

Testing the filter bank control:

The control of the filter bank can be tested in several ways. Mount a piece of flat cable on the 'header female connector' and split a small piece of the other end of the cable into 'single conductors' and strip the ends of them so that you can measure on them.

Or: Measure directly on the header connectors.





With this simple 'probe', you can easily check whether the selected port has gone 'TTL high'.

Output Header Connector: **BCD Output 'D-C-B-A':**

LSB Region1 USB

Pin '0'	160 Meter 1.8000 - 2.0000 MHz	BCD: '0000'
Pin '1'	80 Meter 3.5000 - 3.8000 MHz	BCD: '0001'
Pin '2'	60 Meter 5.2500 - 5.4500 MHz	BCD: '0010'
Pin '3'	40 Meter 7.0000 - 7.2000 MHz	BCD: '0011'
Pin '4'	30 Meter 10.100 - 10.150 MHz	BCD: '0100'
Pin '5'	20 Meter 14.100 - 14.350 MHz	BCD: '0101'
Pin '6'	17 Meter 18.068 - 18.168 MHz	BCD: '0110'
Pin '7'	15 Meter 21.000 - 21.450 MHz	BCD: '0111'
Pin '8'	12 Meter 24.890 - 24.990 MHz	BCD: '1000'
Pin '9'	10 Meter 28.000 - 30.000 MHz	BCD: '1001'

Via this frequency table, you can see when the individual ports should be 'activated'. For example, try 'running through' the fixed pre-programmed amateur frequencies, here you should be able to follow the activation with the 'probe' from 0 to 9 as for example. shown via the 'back' of the header connector.

4028 BCD-DEC

TABLE I – TRUTH TABLE

D	C	B	A	0	1	2	3	4	5	6	7	8	9
0	0	0	0	1	0	0	0	0	0	0	0	0	0
0	0	0	1	0	1	0	0	0	0	0	0	0	0
0	0	1	0	0	0	1	0	0	0	0	0	0	0
0	0	1	1	0	0	0	1	0	0	0	0	0	0
0	1	0	0	0	0	0	0	1	0	0	0	0	0
0	1	0	1	0	0	0	0	0	1	0	0	0	0
0	1	1	0	0	0	0	0	0	0	1	0	0	0
0	1	1	1	0	0	0	0	0	0	0	1	0	0
1	0	0	0	0	0	0	0	0	0	0	0	1	0
1	0	0	1	0	0	0	0	0	0	0	0	0	1
1	0	1	0	0	0	0	0	0	0	0	0	0	0
1	0	1	1	0	0	0	0	0	0	0	0	0	0
1	1	0	0	0	0	0	0	0	0	0	0	0	0
1	1	0	1	0	0	0	0	0	0	0	0	0	0
1	1	1	0	0	0	0	0	0	0	0	0	0	0
1	1	1	1	0	0	0	0	0	0	0	0	0	0

1 = HIGH LEVEL 0 = LOW LEVEL

You can of course also test the BCD outputs with the same probe (see the tables).

*** Parts list ***

Resistors (1/4 W 7 mm):
68 1 pcs. 2,2k 2 pcs. 4,7k 2 pcs.

2 module:
100nF 2 pcs.

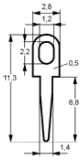
Electrolytes 1 module vertikal:
100uF (35V) 3 pcs.

Dioder:
1N4001 1 pcs.

Transistor:
BC 547 1 pcs.

ICs:
7808 1 pcs. 7805 1 pcs.
CD 4050 1 pcs. CD 4028 1 pcs.

PIN-Headers:
15pin (female) 2 pcs. 7pin (female) 1 pcs. 5pin (female) 1 pcs.
4pin (male) 1 pcs.



Solder pins:
For 1,2mm 5 pcs.

Assembly, nylon parts: (2 pcs. of all).
Machine screw nylon M3x18mm.
Nut nylon 3mm H2.4mm.
Threaded struts nylon M3x12

Push buttons
Moment 4 pin mini for PCB (high version) 4 pcs.

Encoder:
Rotary Encoder with Keyswitch (24 Impulse) 1 pcs.

TFT display:
1,8” ST 7735 (128*160) 1 pcs.

PLL module:
SI 5351 (A) 1 pcs.

Programmed CPU:
ESP-32 NodeMCU Dev. Board 30 pins (CH9102X) 1 pcs..

PCB:
BSP MD6 VFO2 1 pcs.

When ordering a fully assembled and tested VFO, please provide the following information:
1. As a VFO for intermediate frequency. 10.7 MHz, 9 MHz or 455 kHz.
2. As a Signal Generator (directly on the frequency).
3. Should the order be for an **'external clock module, 10 MHz OCXO or 25 MHz Mercury' ?**

Component purchase:

Bensø Print:
Project2024
Price List
and
Your local dealers in your country...

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