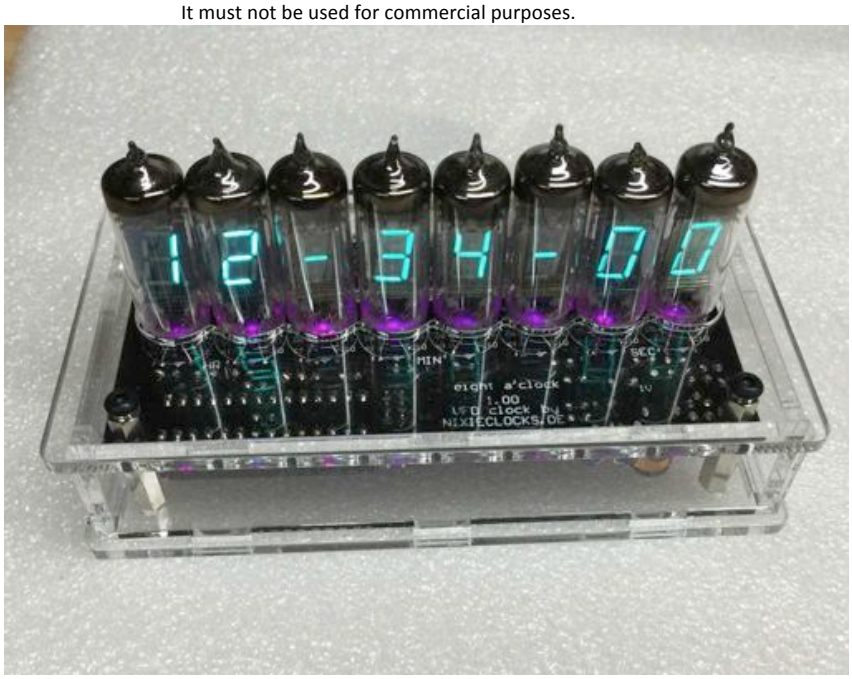
Documentation VFD clock “8 – a clock”



Congratulations on your purchase of your VFD clock. To guarantee success in the construction of the clock, it is essential to have good tools on hand, such as a special side cutter for electronics boards, a small flat pliers, tweezers, scissors, screwdrivers and a multimeter.

Technical specifications:
Operating voltage 9-12 volts AC or DC - 50 Hz or 60 Hz
Tubes used: IV6 - 8 pieces
12 / 24 hr format
US and European date format
Current consumption: 120 mA at 12 V
Board dimensions: approx 109 x 50 mm
Optional connection to a DCF77 or GPS receiver
DCF77 or GPS display the date in the 50th second for 5 seconds

1. Safety and Legal Notes

DANGER: This circuit design includes a switching-mode voltage-converter which generates 4**0 V DC**. Therefore only competent and qualified personnel experienced in electronics assembly should attempt assembly. Safe assembly and operation of this kit is completely the reader’s responsibility.

IMPORTANT: Please follow the assembly steps with extreme care. Please operate the clock only in an enclosed housing, which prevents contact with the dangerous voltages present on both printed circuit boards (PCB).

DISCLAIMER: The information in this document is provided strictly 'as is'. It is hereby stated that this kit is to be assembled only by experienced electronics engineers. No troubleshooting information is provided. Readers should not attempt to build this kit and/or design unless they are competent at electronics assembly and understand the dangers of mains voltages. Further, we take no responsibility for any possible personal or property damage. No responsibility is accepted for any damage, injury (however serious) or death. In no event shall we be held liable to you or any third parties for any special, punitive, incidental, indirect, consequential, or any other damages resulting from the assembly or use of this kit and/or design. The assembled unit should be properly encased to prevent contact with high voltages.

All applicable UL, CCE, VDE and local regulations must be considered.

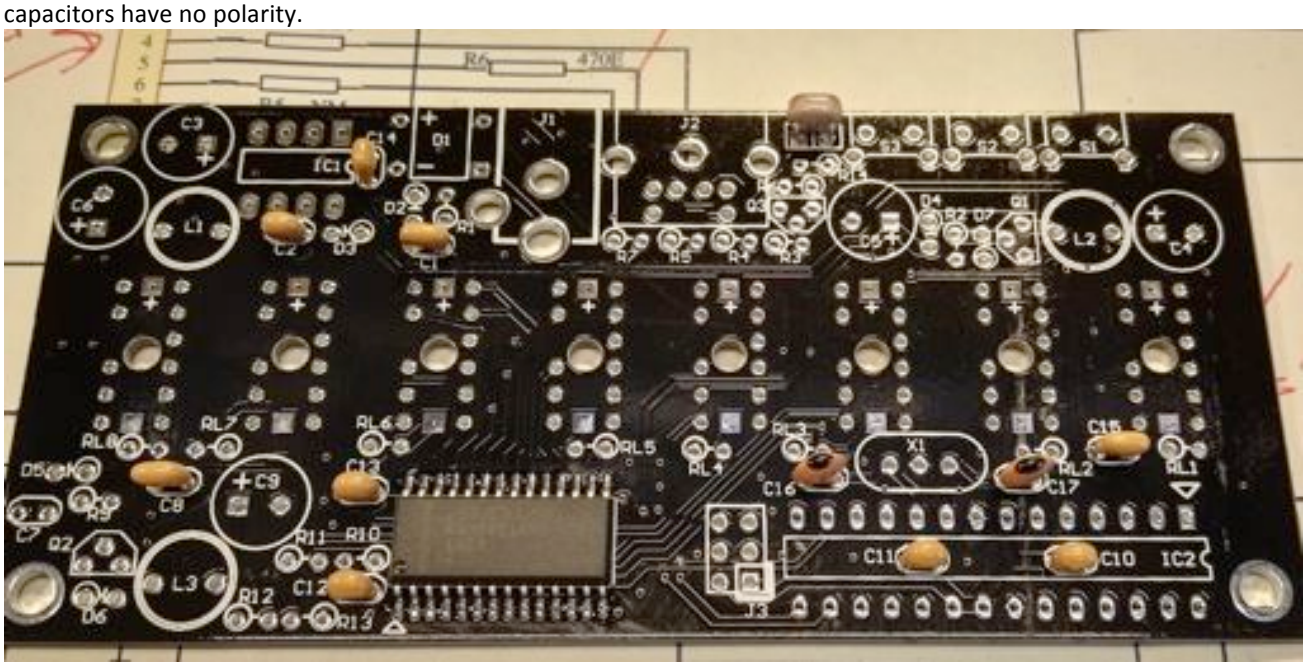
Part list

Part Type	Designator	Footprint	Parts
22NF	C1, C8, C15	Capacitor / 223	3
10NF	C14	Capacitor / 103	1
100NF	C2, C7, C10 - C13	Capacitor / 104	6
56p	C16, C17	Capacitor / 56	2
470uF 16V	C3, C4, C6, C9	Capacitor	4
68uF 63V	C5	Capacitor	1
BRIDGEDIL4	D1	Rectifier	1
BZX79C5V6	D2	Zener Diode	1
1N4002	D4	Diode	1
1N5818	D3, D6	Schottky Diode	2
BAT41	D5, D7	Schottky Diode	1
LM2671N-5.0	IC1	Switching regulator	1
ATMEGA88_DIP28	IC2	ATMEGA88_DIP28	1
MAX6921AWI	IC3	VFD Driver already mounted	1
CON3	J1	DC-connector	1
MINIDIN	J2	Mini DIN socket	1
100UH 500mA	L1 - L3	Inductor	3
LED3mm	LED1 - LED8	LED 3mm	8
ZVN4210A	Q1, Q3	TO-92FET	2
VP3203N3-G	Q2	TO-92FET	1
33k	R1	Resistor 1/8 Watt	1
470K	R3, R10	Resistor 1/8 Watt	2
1k	R6, R12, R13	Resistor 1/8 Watt	3
10K	R2, R9, R11, R14	Resistor 1/8 Watt	4
3,3 Ohm	R4	Resistor 1/8 Watt	1
2k2	RL1 - RL8	Resistor 1/8 Watt	8
LDR	R15	10k LDR resistor	1
SW-ANGLE-THM	S1 - S3	Push button	3
VFD	V1 - V8	VFD tube	8
20MHz	X1	Xtal 20 MHZ	1
IDC6 NM	J3	not mounted	0
Not mounted	R5, R7	Resistor not mounted	0
		Total number of parts	74

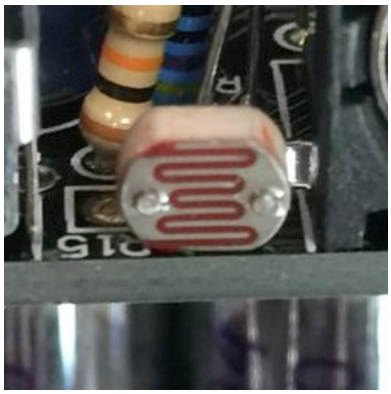
IDC6, R5 and R7 are not mounted!
IC2 sits in a socket.
Although the tubes are matched by date, it can happen that the do not have the same brightness.

2. Soldering the electronic components on the board

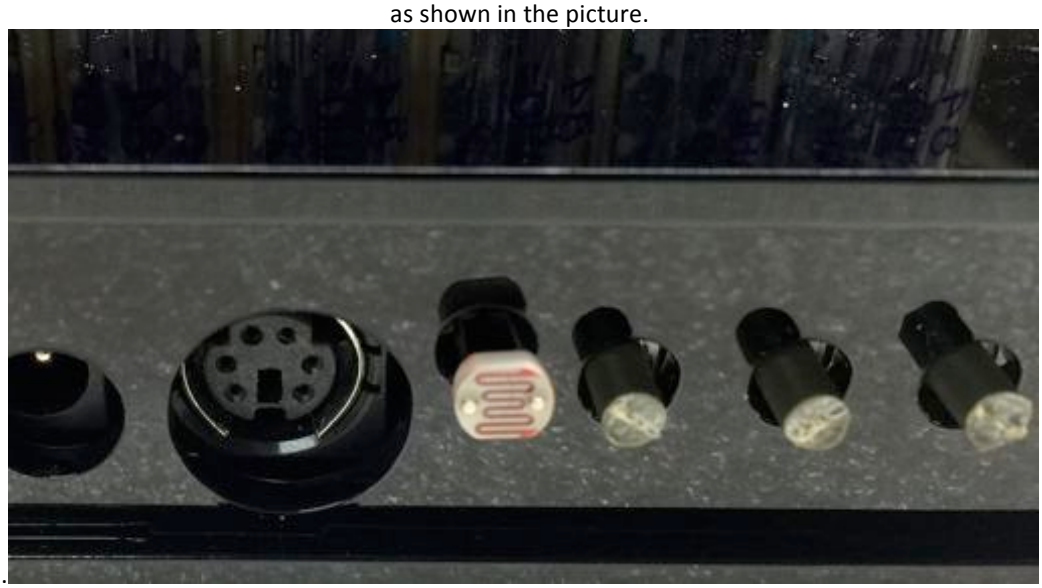
The VFD driver module is already soldered to the board as it is SMD. Solder all capacitors, as seen in the photo. These capacitors have no polarity.



If you use the **clear case**, solder the LDR resistor R15 at 90 degrees flush with the board edge. See Figure.

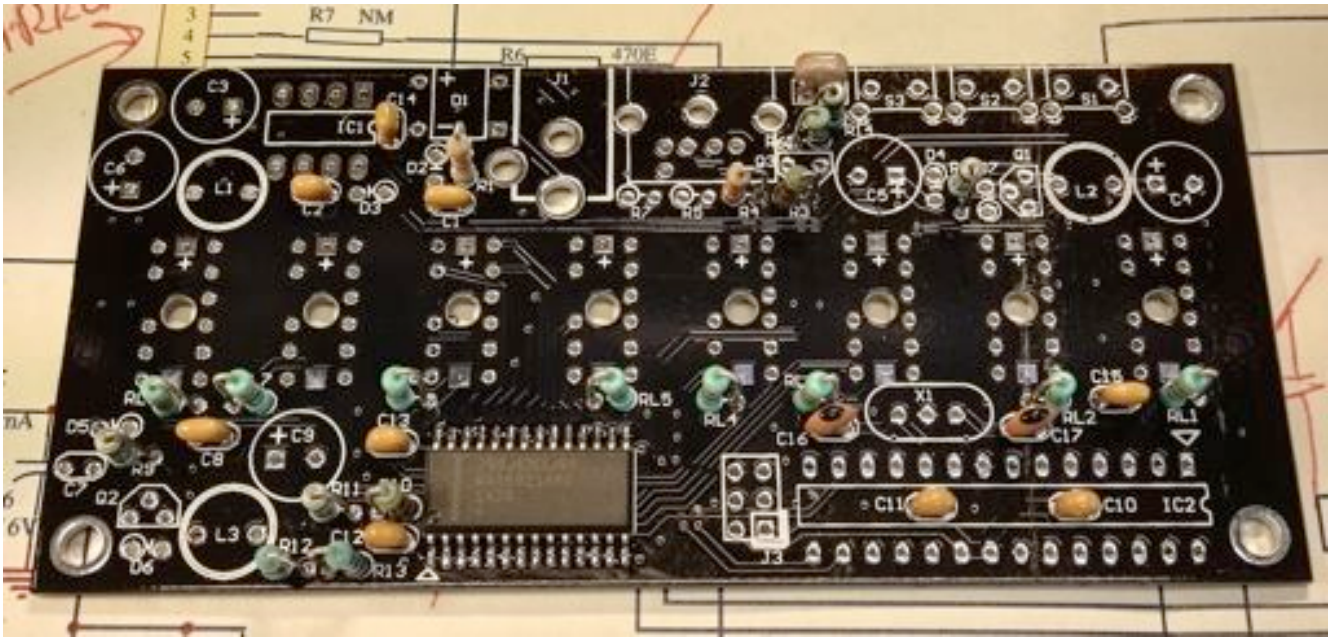


If you use the **black case**, solder the LDR resistor so that it later sticks out about 2-3 mm of the housing as shown in the picture.

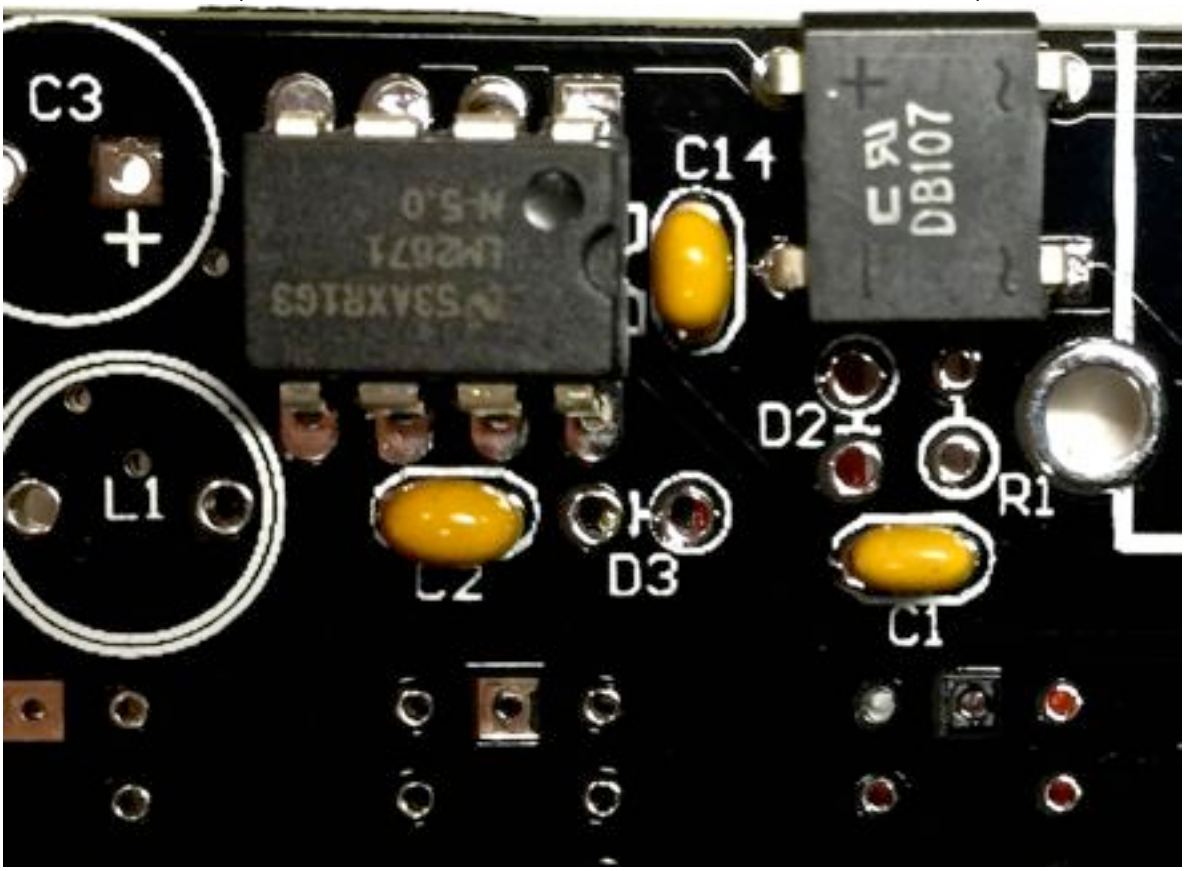


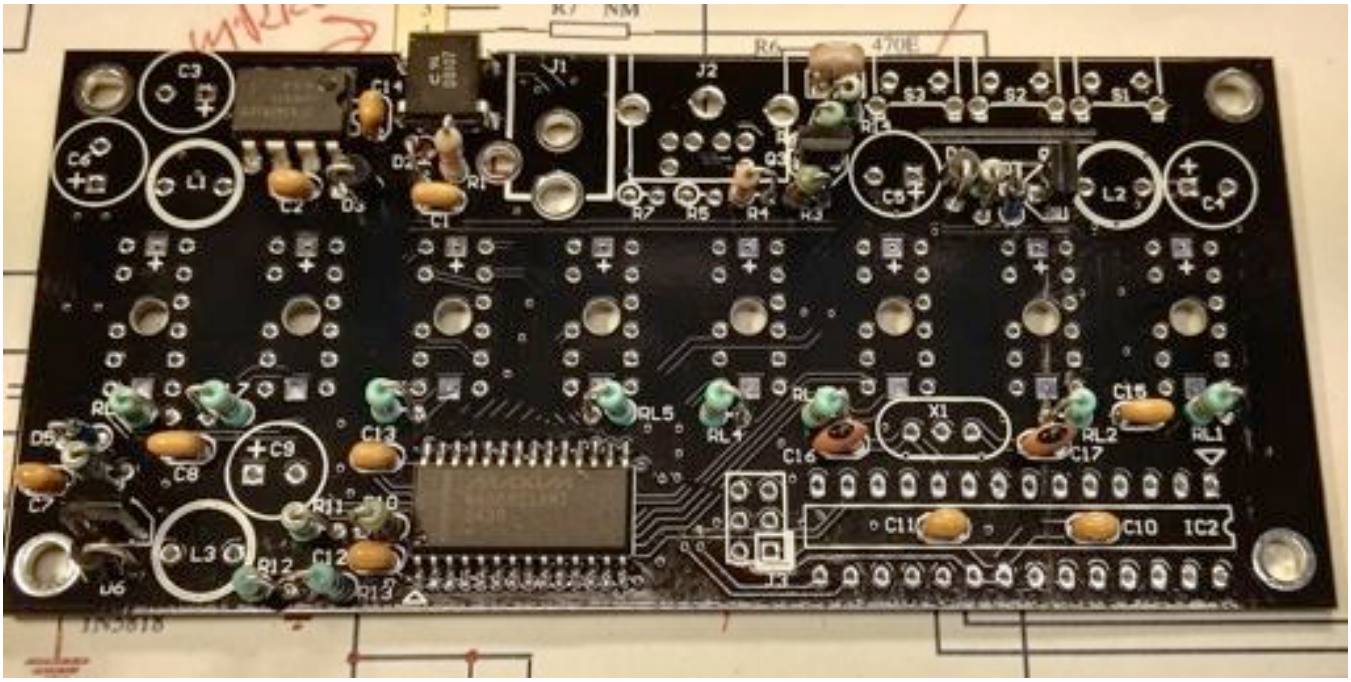
This is how the resistor should be placed. Check with the back of the case if it fits through the hole.

Next mount the resistors. They are all soldered **standing up**.



Now solder the diodes, the voltage regulator, IC1 and the transistor.
The next photo shows D1 and IC1. Make sure to solder them as shown in the photo.



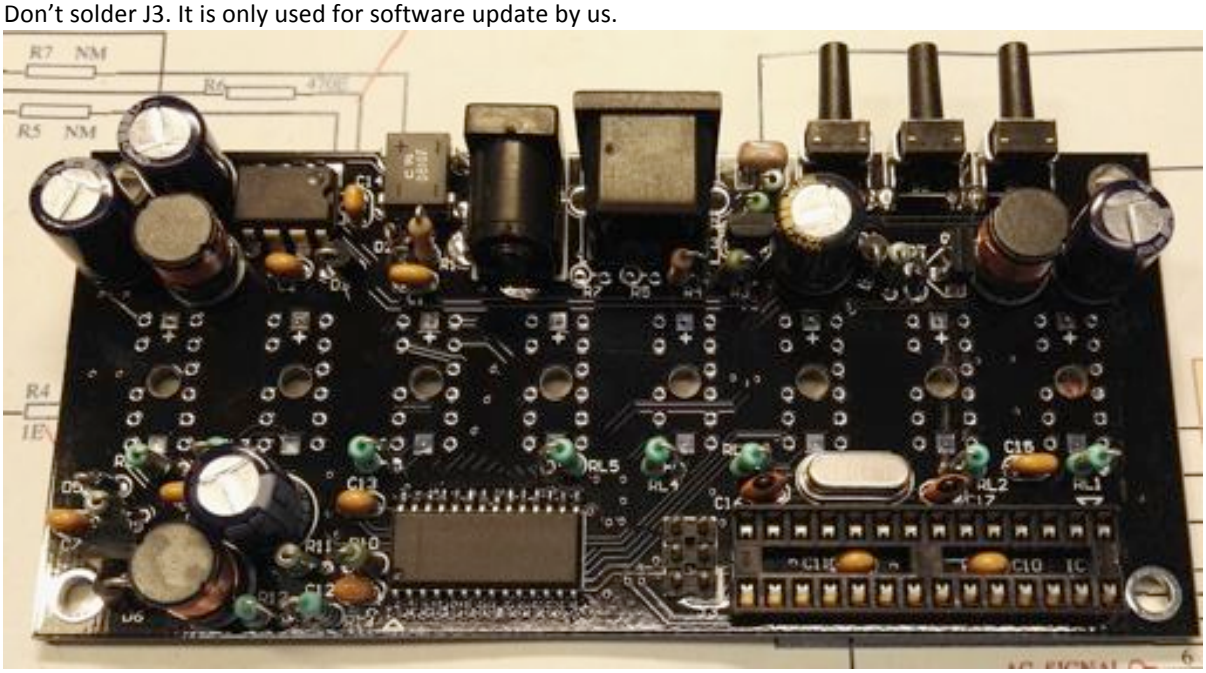


When soldering the diodes make sure ALL diodes are mounted with ring-marking pointing UP as pictured.

In the next step of construction, the remaining parts are soldered in.

When soldering the capacitors, make sure that they are soldered with the correct polarity. The long leg of the electrolytic capacitor is PLUS.

When soldering the crystal ensure that does not touch the board. Leave a gap of about 1mm to the board.
The coils L1-L3 have no polarity, but make sure to solder them parallel to the board.
When soldering the power jack and the push buttons, make sure that it is in right angle and is parlallel to the back of the pcb.
The same is true for the mini PS/2 socket for the optional connection of a DCF or GPS receiver. Thus, soldering on the component side is completed.
Don't solder J3. It is only used for software update by us.



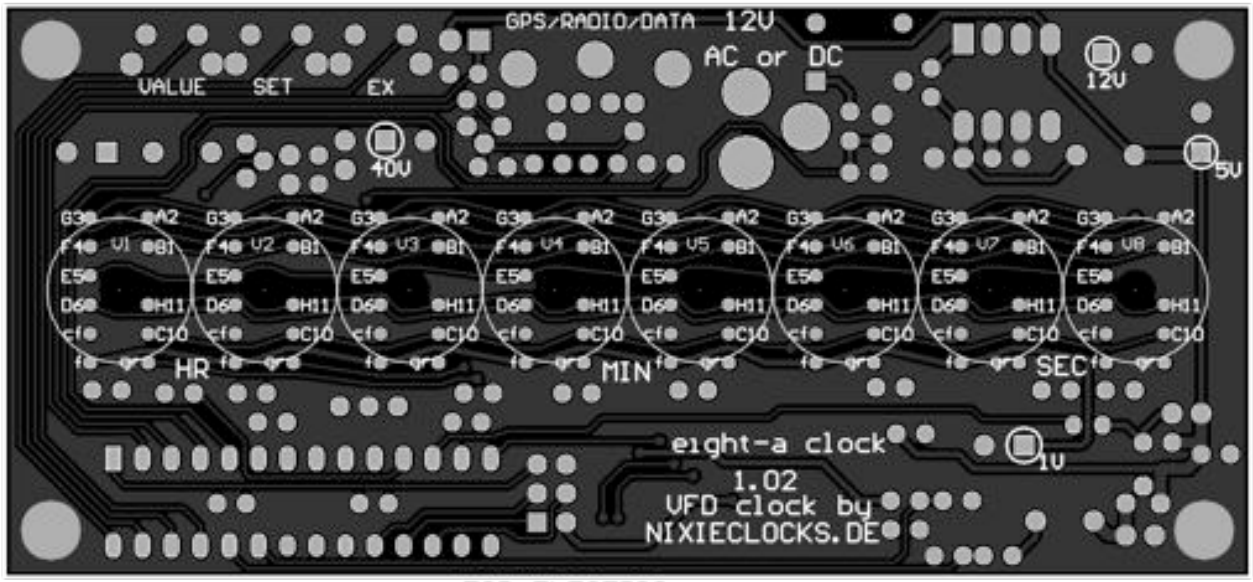
3 Measuring the correct voltages on the board

You have now soldered ALL parts into the board, except the tubes and the LEDs. Now power up the board and measure the voltages 1V, 5V, 12V and 40V on test points of the pcb to GND.

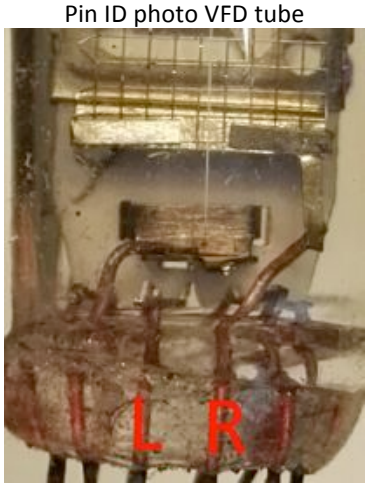
Check they are all within the specifications (see schematics) before any tubes are mounted.

The 1V is VERY important. If it is over 1.3V, then fix the error. Don't mount the tubes!

The 40V supply is 70-80 V unloaded, when no tubes are mounted, this is normal and ok.



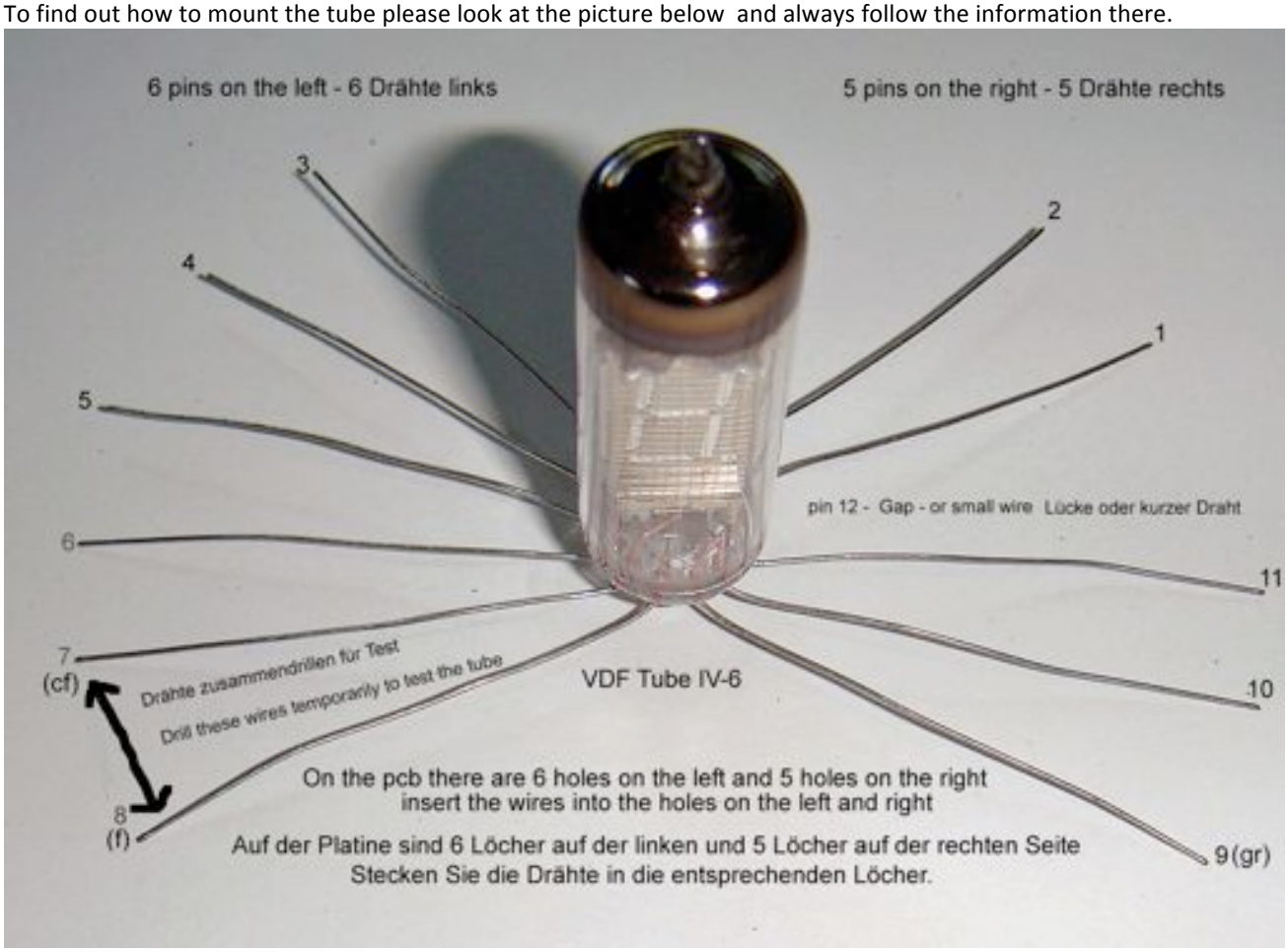
Pin ID photo VFD tube



This photo helps you to identify the left and the right side of the tube.

4 The VFD “IV6” tubes

To find out how to mount the tube please look at the picture below and always follow the information there.

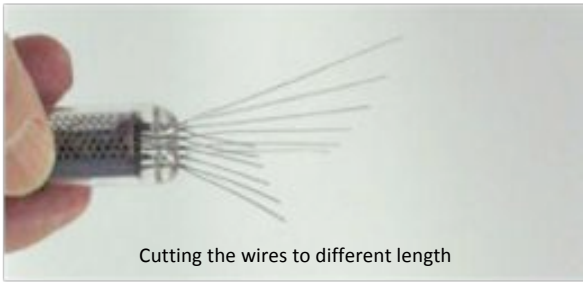


You need not bend the wires as shown in the picture. This photo is only for your information.There are 6 wires to the left (3, 4, 5, 6, 7, and 8) and there are 5 wires to the right (2, 1, 11, 10 and 9). If you have a short wire on the tube, you can cut it. It is number “12” on the picture. You don’t need that wire. Some tubes don’t have that wire, so there is just a gap.

The tubes are new old stock, so they are at least 20 years old. It might be important to test the tubes before you mount them. Unsoldering a tube is a bit difficult but possible. Again look at the picture.
Connect wire 8 and 7 temporarily and connect them to one lead your multimeter. We want to measure OHM. Now test the rest of the wires with the second lead of your mutlimeter and be sure there is now connection.

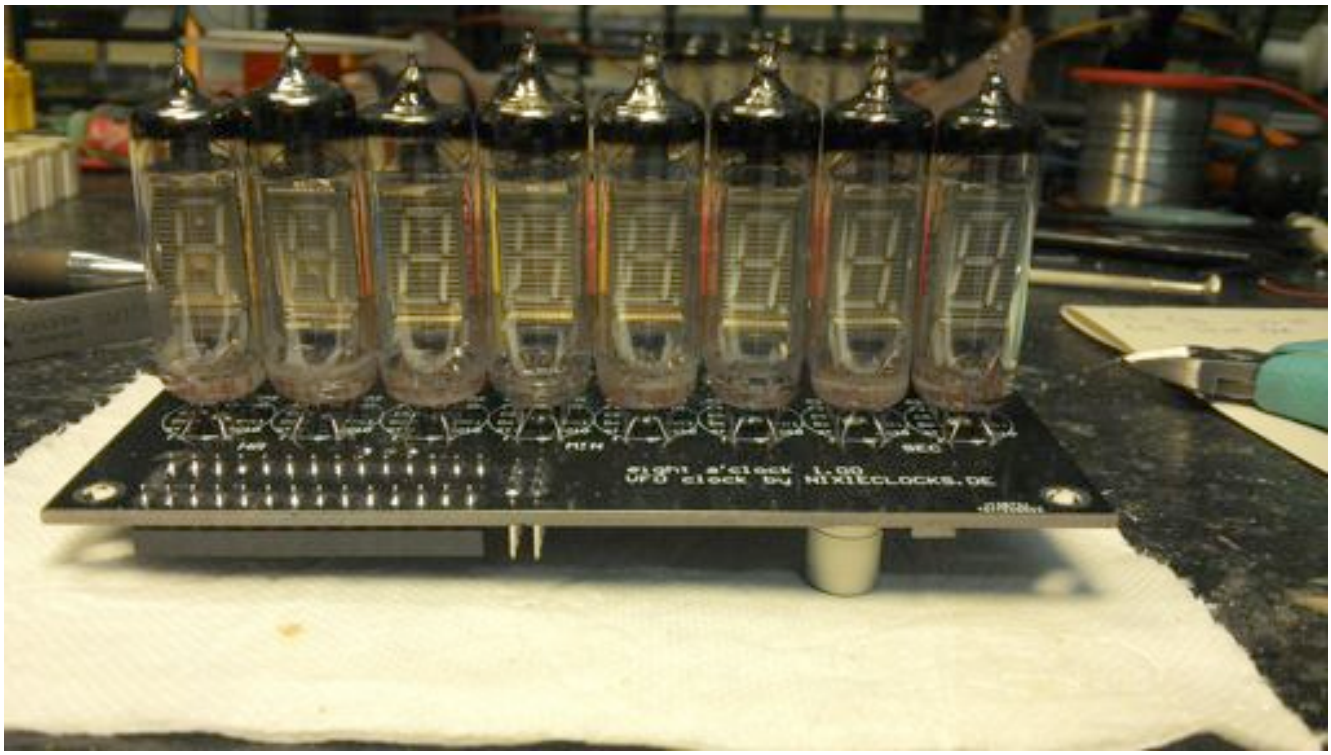
After having successfully tested the tube disconnect the wires 7 and 8. If the tube seems to be defective, get into contact with us. We have spare tubes in the shop. We can of course not guarantee the function of the tubes (NOS).

To make mounting of the tube easier cut the wires to different length.
See the picture on the right for more details. Having cut the wires like this it is much easier to mount the tubes to the pcb.


Cutting the wires to different length

Now insert the wires into the holes on the pcb. Remember, on the pcb there are 5 holes on the right and 6 holes on the left. Please adjust the tube so that it is in right angle from the front and from the side.

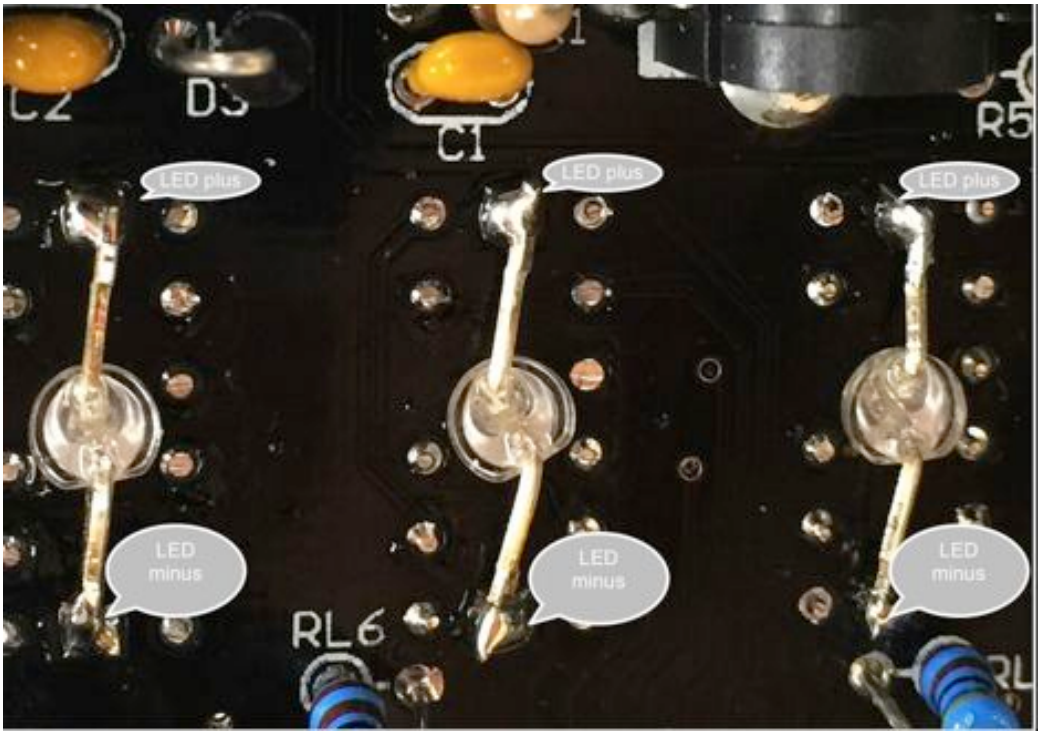
The distance from the tube to the pcb should be 4 -5 mm. Solder one or two wires from the top and then test again if the tube sits correctly. Now solder the rest of the pins from the bottom and cut all the wires from the bottom of the pcb and check for shortages and rests of solder.
You can use the top plate of the housing as a stencil to check whether the tubes are straight! Check every tube!



The last parts to solder are the LEDs. The LEDs have 2 different wires.
The longer one is PLUS, the shorter one MINUS. Shorten the legs and **remember the PLUS wire**.

Solder the LDEs as shown in the picture. The long wires (PLUS) point to the back of the board where the voltage connector is. Insert the LEDs into the hole so that it reaches out about 3-4mm on the other side of the board and almost touch the tube.

Align the LED and solder them in carefully.



5 Connect the clock to power

The clock can be operated with an AC or a DC power supply. The software automatically recognizes the connected power supply, the mains frequency and DCF77 or GPS operation. After plugging in the power supply, the clock shows “12345678”.

Then the software version number is shown followed by the measured frequency if an AC power supply is connected. If a DCF 77 receiver is connected, the dot in the last tube flashes after having received a correct DCF signal. If a GPS receiver is connected, it may take a few minutes until GPS time is received.

6 Setting the clock

Use the buttons VALUE, SET or EX to set the clock.

12-24 hour format (time and date format)

This change applies to all modes. Press the VALUE button for more than 2 seconds. The hour display shows "12" or "24", depending on pre-set format. It also changes the date format. In the 12 hours version displays the date as follows: MM: DD: YYYY. In 24 hour format it shows DD: MM: YYYY.

Setting the clock in AC or DC operation:

Press the SET button (middle button). The hours’ tubes shine brighter. With the VALUE buttons set the hours. Press the SET button again. Now the minutes shine brighter. Set the minutes to the next correct minute of your reference clock. Press the SET button with the next minute change. The clock starts running.

Setting the clock in GPS mode:

Plug the GPS module into the PS/2 connector at the back of the clock and after that the power supply. The clock now displays 00-00-00, until a correct GPS signal has been received. After that the clock displays the time the GPS receiver transmits. In GPS mode the date is shown at the 50th second for 5 seconds.

You now need to adjust the GPS offset for your time zone. Press the SET button. The minutes shine brighter. With the EX or the VALUE button you can now set the offset in 30 minutes steps. With the EX button offset will be deducted by 30 minutes and with the VALUE button 30 minutes will be added. Then press the SET button again.

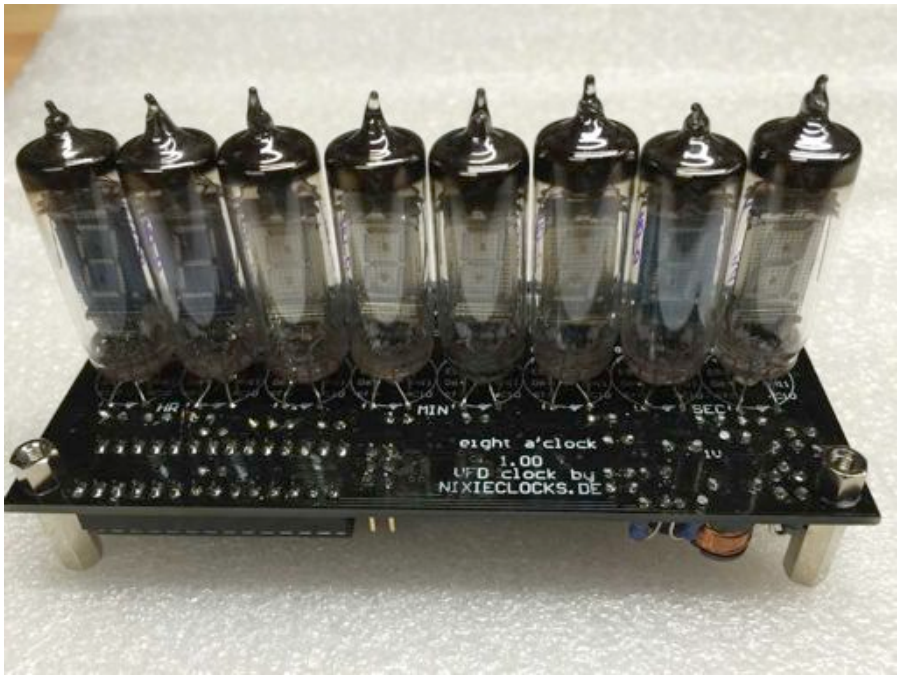
Setting the clock in the DCF77 mode:

Plug the DCF77 module in the PS/2 socket and after that the power supply and wait until the clock is set. This may take several minutes. To check whether the receiver is properly aligned, the dot of the last tube blinks in 1 Hz steps. Also in this mode, the date is displayed in the 50th second for 5 seconds. **In DCF 77 mode, the clock cannot be set in any way.**

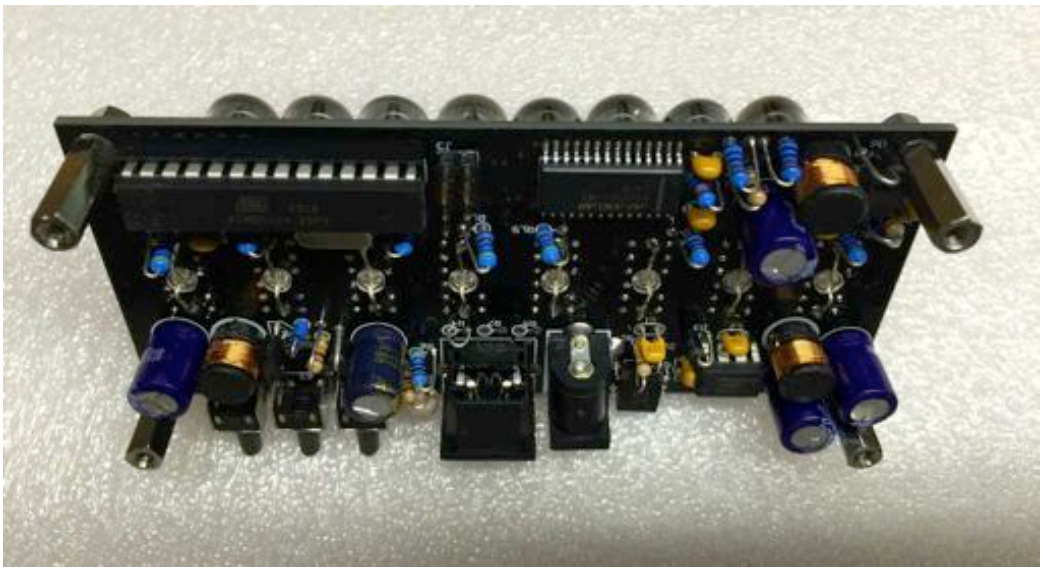
7 The Case

Remove the protective foil from all parts and apply please use the cotton gloves during assembly.

Insert the 5mm spacers from the top through the holes of the pcb and screw them to the 15mm spacers.

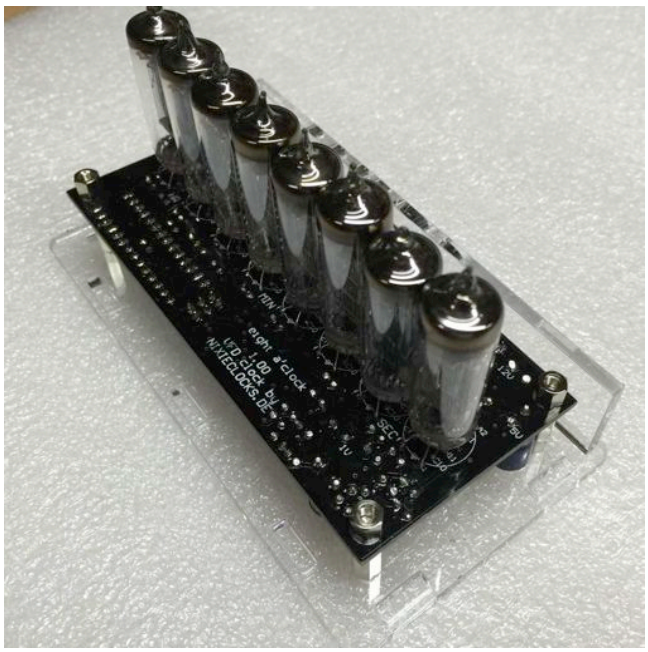


It should look like this.

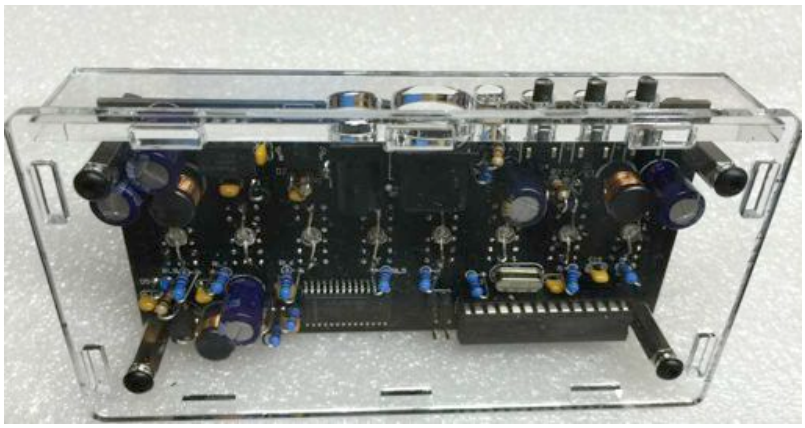


Now put the back plate to the ground plate and be careful not to break anything.

Set the pcb onto the ground plate and check whether the 3 push button go through the 3 holes at the back easily.
Fix the pcb to the bottom plate using the 3mm screws. Do not tighten too much!



It should like this.



Now mount the 2 sides and the front and put the top plate to the case. Fix the top plate with the 3mm screw. Do not tighten them too much!

The last step is to fix the 4 transparent rubber feet to the corners of the case on the bottom. This will prevent scratches and the clock will stand tight.

We wish you a lot of fun with your new clock!