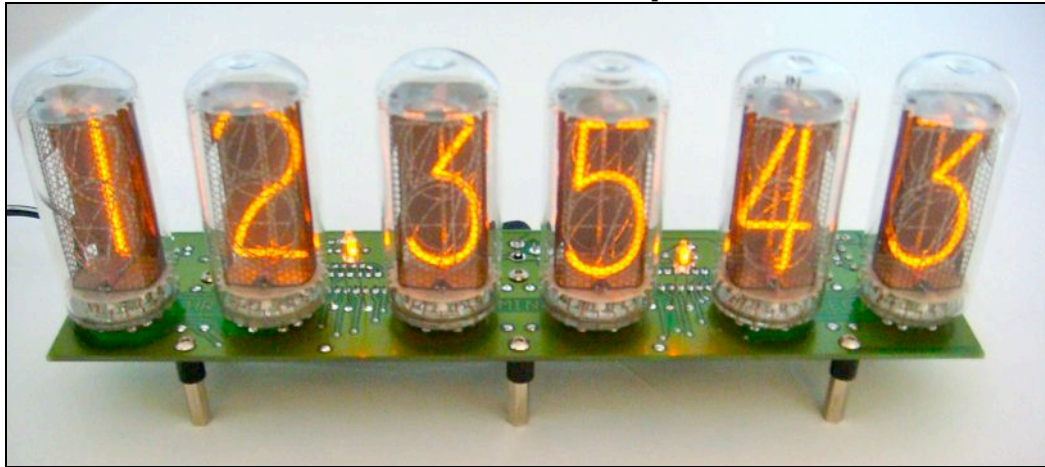# Building Instruction Nixie clock kit V1.06-IN-18

Software Version 6.3 – Revision September 2015

DANGER: This circuit design includes a switching-mode voltage converter, which generates 180 VDC. Therefore assembly should be attempted only by competent qualified personnel experienced in electronics assembly and high voltage safety. Safe assembly and operation of this kit is completely the reader's responsibility.

Read instructions: All the safety and operating instructions should be read carefully and completely before the clock is operated. Heed warnings: All warnings on the appliance and in the operating instructions should be adhered to.

Retain Instructions: The safety and operating instructions should be retained for future reference.

• If one of the tubes is broken or damaged, immediately pull the power plug out of the clock and contact the customer support.

• The tubes are made of glass and are consequently very easy to break. Because of their fragility, it is important that you keep the clock in a safe place free from the possibility of being struck inadvertently.

• No part of the clock may be swallowed or inserted into body openings.

• The power supply may not be swallowed or inserted into body openings.

• No part of the clock or the power supply may be used for other purpose other than described in this user manual.

• Water and moisture: The clock should be kept in a dry room free from humidity and dust. The clock should not be used near water – for example, near a bath tub, washbowl, kitchen sink, laundry tub, in a wet basement, near a swimming pool, in a sauna, etc. In addition the clock should be kept out of direct sunlight and high temperatures.

• Object and liquid entry: Care should be taken so that the clock does not fall into liquids or have them spilled over the clock.

• Do not use this appliance for anything other than the intended use as described in the manual.

• Immediately pull the power plug out of the clock and contact the customer support if the appliance does not appear to operate normally or exhibits a marked change in performance. In this case do not run the clock again!

• This clock is not a toy! Keep this clock out of the reach of children.

• Pay attention that this clock shall only be touched by people who have completely read and understood the user manual.

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, www.nixieclocks.de takes 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 www.nixieclocks.de 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. Commercial use of the kit, circuit designs, software or any parts thereof requires express written permission.

No responsibility is accepted for any damage, injury (however serious) or death.

Tools

▪ Soldering iron, tin-solder, wire cutter, Multimeter

Required:

▪ **Nixie tubes 6 x IN-18**

▪ **Wall wart power supply**, 9-12V AC or DC
If you want to derive the clock timing from the 50Hz/60Hz mains frequency, you must use a 9-12V AC wall wart.

▪ **Nixie tube solder pins** (qty 66)

Attention:
If you use the cool nixie converter, the parts are as follows:
IC2=cool nixie converter, C10 = tantal capacitor 1-10uF /16-35V!

Part list for clock kit V106-IN-18

| Parts	Part Number
Capacitors	
Capacitor 470uF/25V	C3, C11
Capacitor 4,7 uF /250V	C4
Capacitor 10-100uF/16-63V*	C10
Capacitor 2,2 nF (222)	C14
Capacitor 47 pF	C13
Capacitor 22 nF (223)	C5, C7, C8, C9, C12
Resistors	
Resistor 100 KΩ	RN1, RN2, R1, R3, R5
Resistor 470 Ω	R23
Resistor 1 KΩ	R16, R17, R19, R27
Resistor 470 KΩ	R2, R4, R6
Resistor 220 KΩ	R7
Resistor 6,8 KΩ - anode resistors	R8, R9, R10, R11, R12, R13
Resistor 10 KΩ	R18, R26
Resistor 33 KΩ	R14, R20, R21, R22, R25
Trimmer 1 KΩ	R24
Sockets	
16 pin socket for 74141 driver	Socket for IC3 and IC4
28 pin socket for PIC	Socket for IC1
Diodes	
Diode 1N 4001	D1, D2, D3, D4
Diode UF4004	D5
Diode Zener ZF 5,6	D9
Transistors	
Transistor MPSA 92	Q1, Q2, Q3
Transistor MPSA 42	Q4, Q5, Q6, Q8
Transistor FET IRF 730	Q7
Integrated circuits	
Voltage regulator μA 7805*	IC2
PIC processor 16F876	IC1
Driver IC 74141	IC3, IC4
Timing circuit NE 555 DIP	IC5
Other parts	
Xtal 4 MHZ	X1
Coil 100μH	L1
Switch to set the clock	S1, S2
HEBW 21	power supply socket
PCB version V1.06-IN-18	Circuit board for 6 x IN-18 tubes
Fuse 1 A picofuse	F1

The PCB
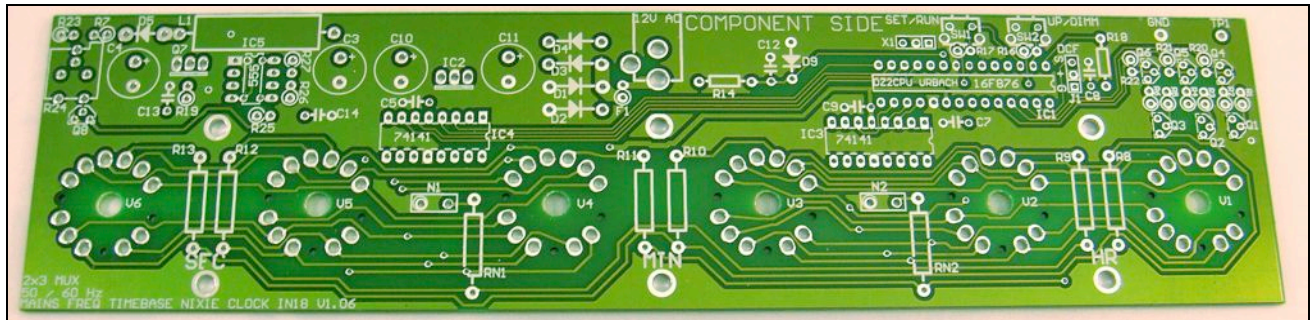
Figure 1: Component Side of the PCB
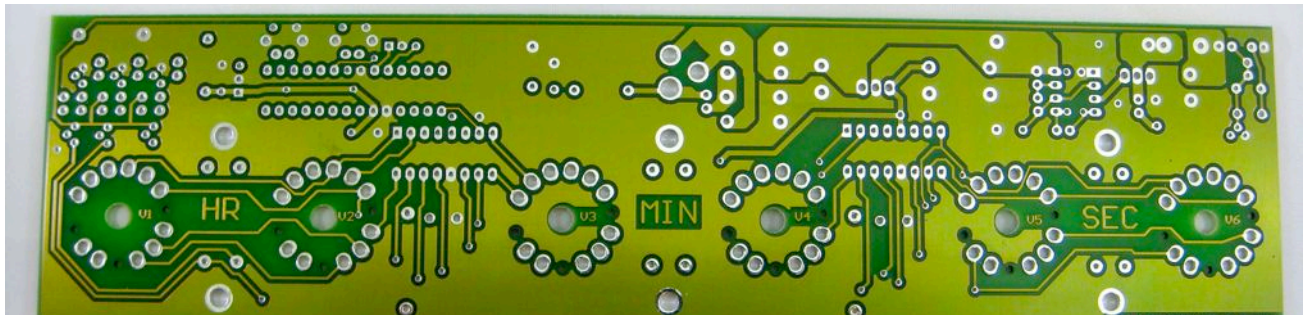
Figure 2: Solder Side

1. Mounting the Mouser Pins

Please place the pins from the solder side, turn the PCB without dropping the pins and solder the pins on the component side. All other parts are soldered from the solder side!

Watch out for good connection of pin and PCB. The component side with white text is actually the bottom side, when mounted in a clock case.

The solder side is the top side where the nixie tubes are mounted. Note: the sockets for the nixie tubes are also mounted from this side. One Pin can be left free. It is not connected in the tube so it might spare a lot of expensive pins.
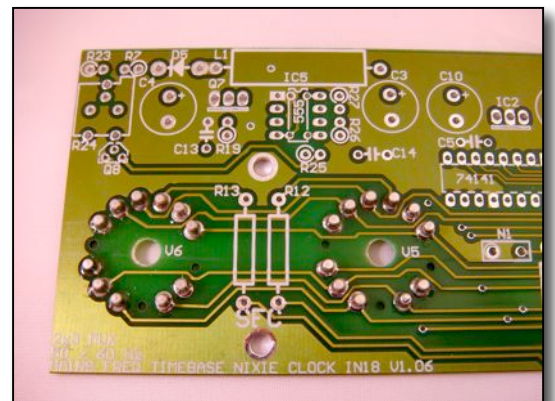
2. Solder the diodes

Now solder the diodes D1, D2, D3, D4, D5 and D9.
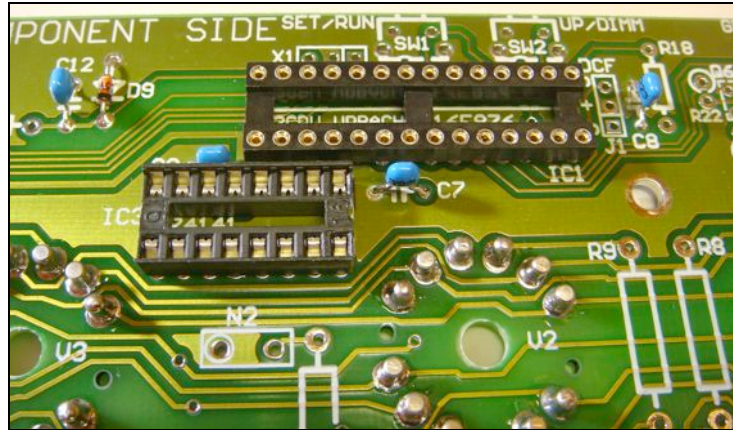Watch out for the position of the ring.
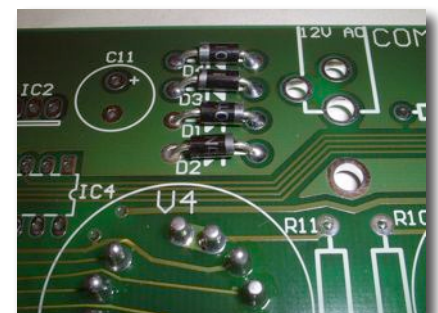
3. Mounting the resistors

To make soldering easier later, please solder in the resistors lying. All the other resistors are soldered vertically up.

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4. Soldering the sockets for ICs

Watch out for the marking of the sockets. They have to be soldered according to the marking on the PCB.
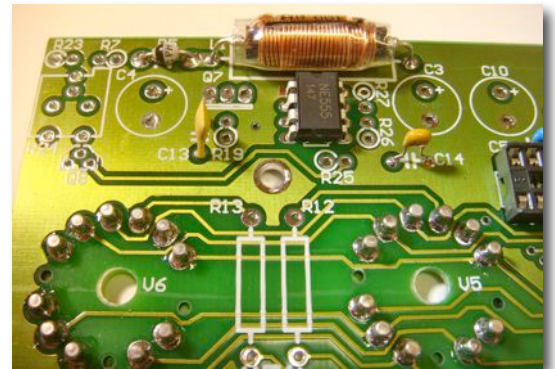

The sockets for the integrated circuits IC1 and IC3

First solder the 4 outer pins of the socket. Make sure that the socket is firm on the PCB. Then solder the rest.
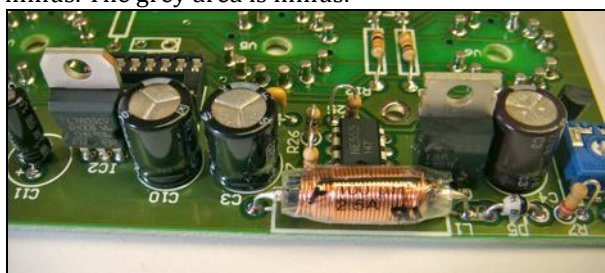
5. Mounting the coil L1

You can mount the coil either way.

6. Mounting the capacitors

Please mount all the capacitors. Please watch out for the correct plus and minus pins! The long wire is plus the short one is minus. The grey area is minus.
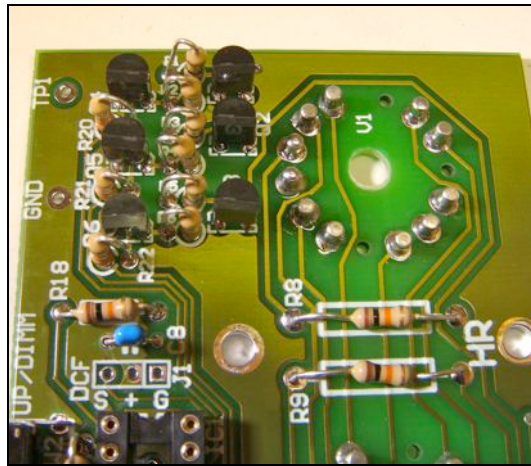

7. Mounting the Xtal

The Xtal fits into the 2 outer holes. Please make sure not to solder the Xtal too close to the pcb. Leave a space of 1 mm.
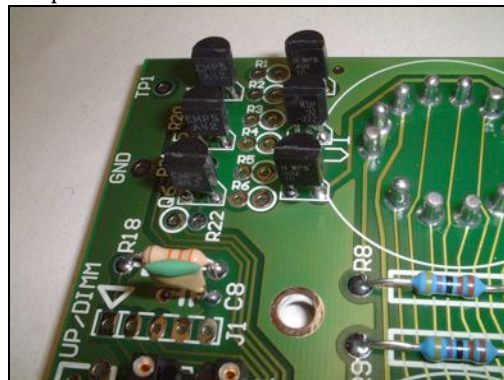
8. Mounting the transistors

Please note, that the types on the left are MPSA 42 the ones on the right are MPSA92. Never mix them up. Be careful when placing them into the PCB.
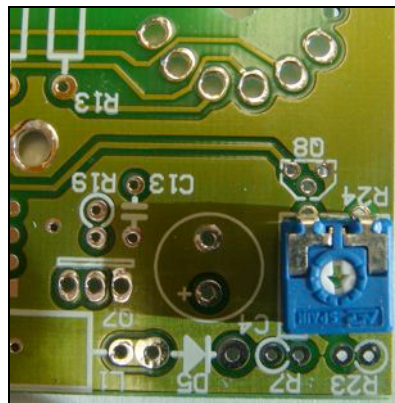

Q1, 2, 3 and Q4, 5, 6 and Q8

Watch out for the position of the transistors. See the marking on the PCB.

Transistors mounted on PCB

9. Mounting the trimmer R24

This trimmer is used to adjust the voltage to 180V DC later.

10. Mounting resistors (standing)

See the marking on the PCB for the position of the resistors.

Resistors (standing) mounted on the PCB
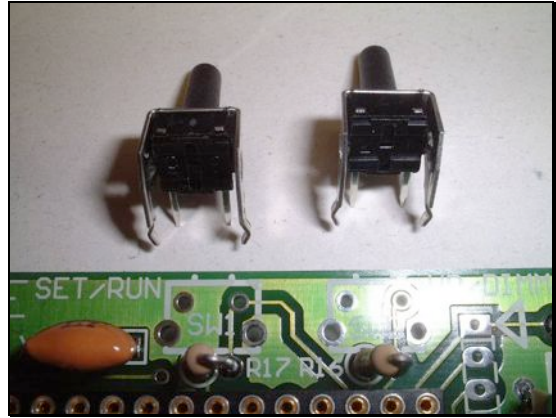
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11. Mounting the power supply socket and the push buttons

Place the connector and the switches into the PCB. Solder the connector with a lot of solder – the holes are big.

connector for the power supply

The switches – SET and DIMM

### 12. Mounting transistor FET 730 and the TS7805 (IC2)

Watch out for the metal tap, when soldering the parts.

See the marking for the metal tap. (white rectangle)

13. Place the ICs into their sockets

Watch out for the semicircular notch. Bend the legs together a bit and then press the ICs into the sockets. Be careful not to bend a leg. Make sure that all the legs are in the socket. **The NE 555 is not socketed.** The efficiency is better without a socket.
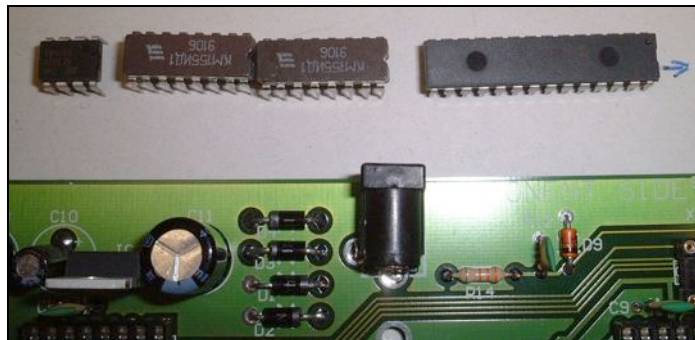
14. Check everything with a lot of care.

After you have assembled the kit and checked all parts placements and are confident that everything is correct, connect the power supply plug into the socket.
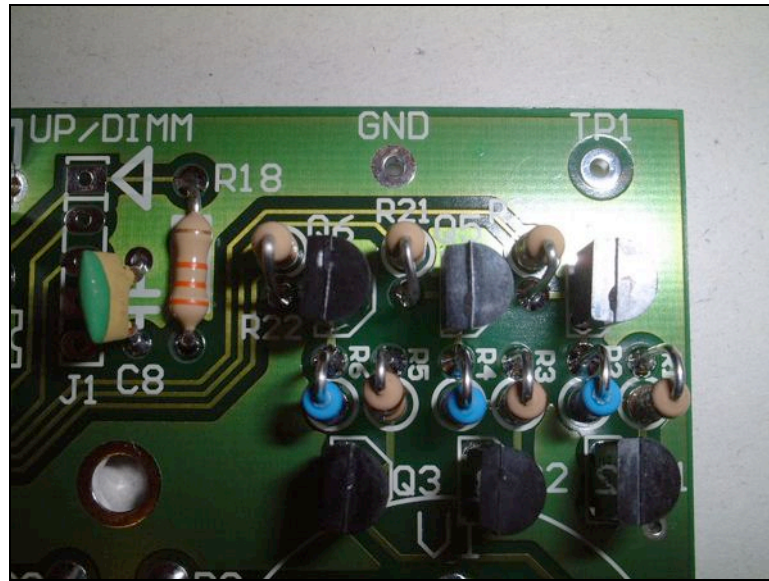
15. Connection of power supply plug.

Attention - Do not touch the PCB.
There is high voltage on some parts of the board now. Do not mount the tubes yet.

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16. Adjusting the correct voltage

Now measure with a help of a measuring device between TP1 (Test point 1) und GND (Ground). The voltage has to be 180 volt DC + - 10%. Adjust the voltage with R24.

The test point TP 1 and GND
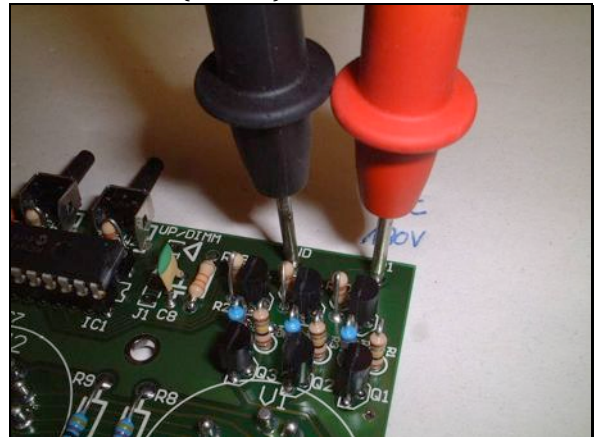
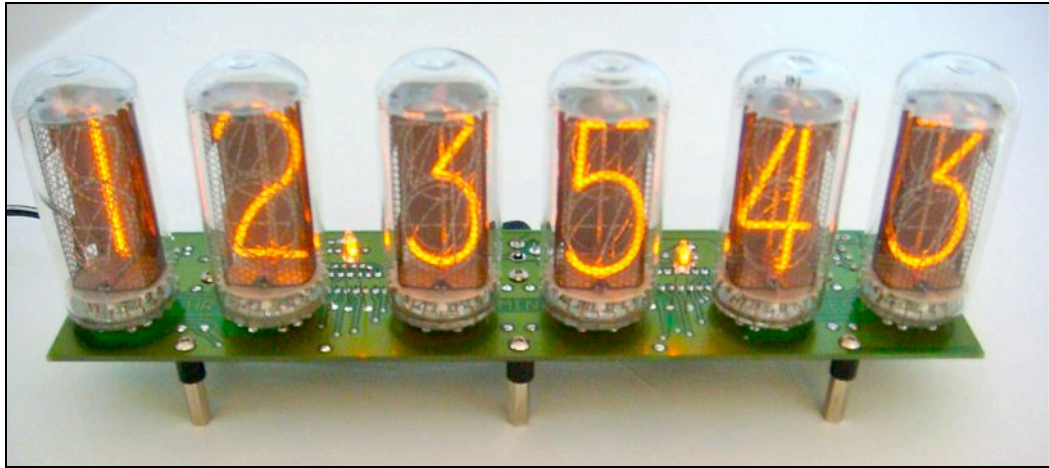Adjust the voltage with R24 to 180V DC (+- 10%)

Trimmer R 24

Test point

Voltage adjustment

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17. Placing the tubes

Disconnect the power supply and wait at least 30 seconds. Then take the tubes and press them into the mouser pins. Be very careful not to break a tube! Move them gently in by circling pressure.

Tubes mounted – clock running

The neons are mounted to NE1 and NE2" on the pcb. The resistor value is 100K-470K depending on the brightness you prefer. The kit comes with 100k resistors (RN1, and RN2)
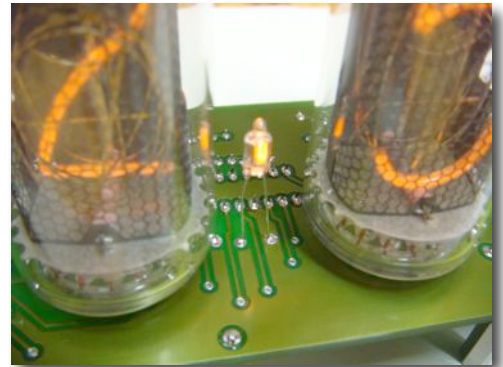

18. DCF77

If you use a DCF77 master time signal receiver module, you should ground (earth) the clock!

There is no guarantee of correct signal reception, but as long as you receive a good signal and ground (earth) the clock, it will set the time automatically using the DCF77 signal.
It is up to you to place the receiver and antenna in an appropriate housing. The receiver should be placed 1 meter or more meters away from the clock circuit.
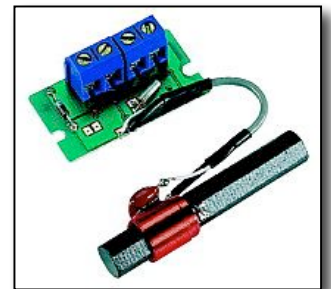
If the clock detects the presence of a DCF77 signal during power-up, it will use it automatically to set the time.
The range of DCF77 is about 1500km around Frankfurt/Main.
DCF77 does not function in other parts of the world! See more details to connect the DCF module in an extra document that comes with all the documentations.

19. Software Operation
Clock Features - Version 6.3
- Auto Detection of DCF77 module
- Slot machine effect every 10 minutes
- Auto Detection of 1Hz, 50Hz or 60Hz clock pulse input mode
- Digit cross fade effect
- Neon bulb indicators (optional)
- Manual dimming via push button with 4 levels plus 1 OFF-level
- Displaying the date only if in DCF77 mode
- 12 / 24 hr mode
- Changing the date format from EU standard to US standard if in DCF77 mode

20. Power Up Sequence

❶ At power up the software version "63 -- --" flashes on the HOURS tubes 20 times. The other tubes remain blank. During this time, the clock is looking for a DCF77 signal pulse. This delay has been implemented because DCF77 modules typically take 8-10 seconds to wake up. If there is no DCF77 module attached, this delay can by skipped by pressing the SET button.

❷ The clock performs a display test by flashing a sequence of digits on all the tubes for about one second.

DCF77 Module not connected:

❸ The clock measures the mains frequency for 1 second, then displays it on the MINUTES tubes, along with the software version on the HOURS tubes (such as "63 50 --"). The mains frequency changes slightly throughout the day (slower during the day, faster at night), but always averages exactly 50 or 60 Hz long-term. Therefore the measured frequency is typically 49/50/51 Hz or 59/60/61 Hz. However, as long as the frequency is within +/- 5 Hz of 50 or 60 Hz, the clock will go into either 50 or 60 Hz mode and it will be very accurate over a long period of time. If the clock detects a 1 Hz signal instead, such as from a GPS module, it will go into 1 Hz mode.

❹ The clock enters normal mode and begins counting the time, starting at "12 34 56"

If DCF77 Module connected:

❸The blinking '63' in the start up shows the version. It will take up to 20 blinks while searching for a DCF77 input. If a DCF input signal is found, the blink sequence is dropped and DCF77 mode is entered directly without further delays! If no DCF module is found, the 20 pulses are shown, so that even slow DCF77 receiver units can be used also.
If still no DCF module found after all 20 pulses, the input frequency counter is started and the result is shown in the minutes' field. The clock enters normal mode and displays the received time. This might look like 00:00:00. It continues receiving the DCF77 signal and updating the display.

  -- or --

❹ If the DCF77 signal is of poor quality, all the tubes are turned off after 3 minutes and the clock continues looking for a good DCF77 signal. As soon as it receives a good signal, the tubes are turned on and the received time is displayed. If the tubes remain off for a long time, you can manually set the time as described in section 7.3 below. The clock will continue looking for a good DCF77 signal and as soon as it receives one it will replace the manually set time with the exact time as received from DCF77.

21. Time Setting

From normal mode:

❶ **Press the SET button to enter HOURS set mode.**
While in set mode, the SECONDS are reset to 00 and are blanked. The HOURS light up bright, since they are being set, and the MINUTES are dimmed.

❷ **Press the UP/DIM button repeatedly until the correct HOURS are shown.**
TIP: To switch between 12 hour and 24 hour mode while setting the HOURS, press and hold the UP/DIM button for 3 seconds until all the digits blink momentarily.

❸ **Press the SET button again to switch to MINUTES set mode**.
Now the HOURS are dimmed, and the MINUTES are bright.

❹ **Press the UP/DIM button repeatedly until the correct MINUTES are shown.**

❺ **Press the SET button again to exit set mode**.
   The SECONDS re-appear and begin incrementing from 00.

22. Manual Brightness Control

While in normal mode, press the UP/DIM button repeatedly to rotate through the 4 brightness levels. **The OFF Level switches the tubes off but the clock still works.**

Maximum brightness is the default level at power-up. Note that the eye-catching fade effect during digit transitions is only on the highest brightness level. In the 3 lower brightness levels, the digits change instantly.

23. 12/24 Hour Mode Selection

To switch between 12 hour and 24 hour mode, while in regular mode, press and hold the UP/DIM button for 2 seconds until all the digits blink twice for a short time. If there is no 12/24 hour indicator LED installed, there may not be any immediate change in the displayed time. The clock will remember the 12/24 hour mode setting even if the clock is turned off. The red LED will show whether you are in clock shows AM or PM.

24. Changing the date format – if in DCF77 mode

Hold down the DIMM button for 6 seconds and the date format DD:MM:YY will be changed to MM:DD:YY or vice versa. The nixies will blink slowly twice. The clock will remember the date format setting even if the clock is turned off. To switch back to the previous format just repeat the procedure.

26. Parts Identification

Some of the supplied parts may have alternate markings, as shown here:
Driver ICs   74141 =   KM155
Capacitors   22 nF = 223   2.2 nF = 222

27. Suppliers

You will get the mouser pins and the power supply in our web shop.

Nixie Tubes at www.nocortec.com is a reputable seller for nixie tubes.

We hope, you like your new clock!