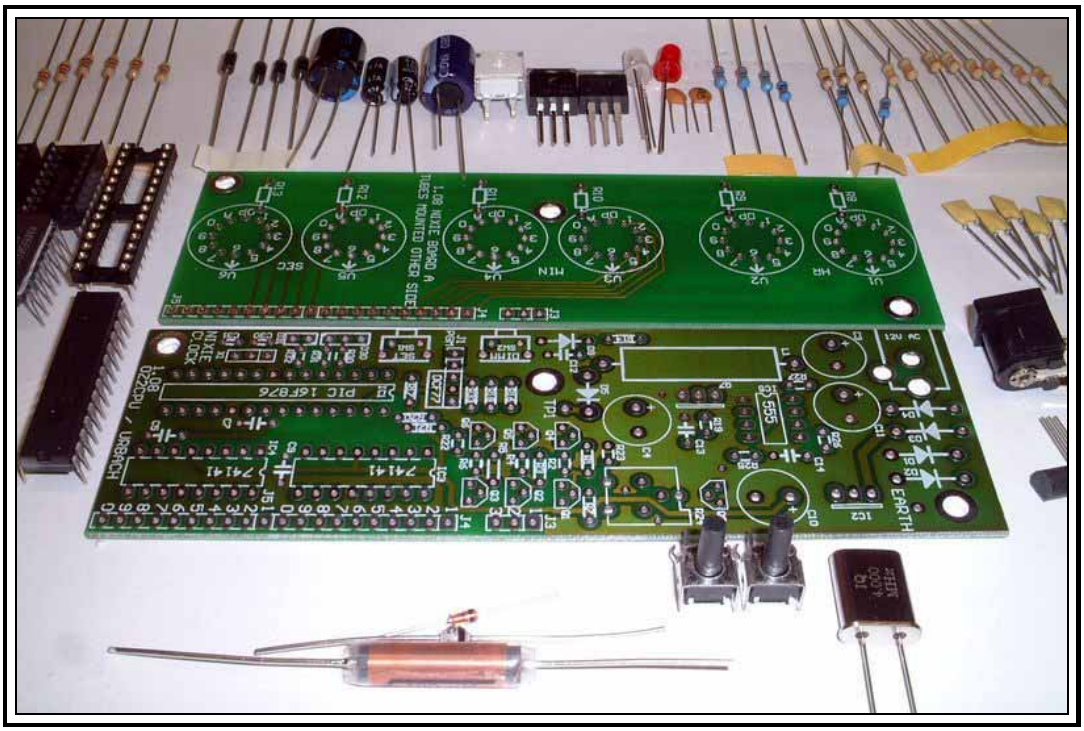
Nixie Clock Kit V1.08
Assembly and Operation

Hardware Revision 14.05.2005

Software Version 6.0
Revision 19.04.2006

WWW.NIXIECLOCKS.DE



CONTENTS

1 Introduction

The **Nixie Clock Kit v1.08** consists of two separate PCB (printed circuit board) assemblies.

The **clock PCB v1.08** contains all the clock circuitry. It is a multiplexed design which minimizes the parts count and PCB size, allowing the kit to be mounted in a wide variety of enclosures.

The **tube PCB** holds the Nixie tubes. Tube PCB version **1.08b** is specifically designed for six large IN-18 Nixie tubes. Tube PCB version **V1.08a** can be used with a wide variety of other Nixie tubes, such as the IN-14 and CD66. A list of compatible tubes can be found at **http://www.nixieclocks.de**.

This manual documents how to:

- Assemble and adjust the Clock PCB
- Connect different types of Nixie tubes to the Tube PCB
- Connect the Clock PCB and Tube PCB together
- Implement the following options:
  - DCF77 time receiver module
  - LDR auto-dimmer
  - Neon AM/PM indicator and flashing colons
- Operate the completed clock

This manual does not cover mounting the competed kit in a specific enclosure. That is left up to you, and is part of the fun of building your own Nixie clock. There are also several housings commercially available that are designed specifically for the 1.08 kit (see Section 9.4 on page 22 for suggested suppliers).

Please take your time while building the clock – it will be worth it.

Have fun with your new Nixie clock!

Figure 1 - The completed clock PCB, with the major components highlighted

1.1 Safety and Legal Warnings

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.

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.

2 What You Need

2.1 Tools

- Soldering iron
- Tin-solder
- Wire cutter
- Multimeter

2.2 Parts

See Section 9.4 (Appendix) on page 22 for suggested suppliers.

Required:

- **Nixie tubes**
- **Wall wart power supply**, 9-12V AC or DC, 500mA minimum.
  If you want to derive the clock timing from the 50Hz/60Hz mains frequency, you must use a 9-12V AC wall wart. If you use the DCF77 module (or any 1pps input) for clock timing, you can use a 9-12V AC or DC wall wart.
- **Nixie tube solder pins** (qty 66) if using Tube PCB v1.08b.

Optional:

- **DCF77 module.** See Section 0 on page 16 for details.
- **LDR.** See Section 9.1 (Appendix) on page 21 for details.

Any tools and parts needed for mounting the kit in a specific enclosure are not listed here.

3 Parts Lists

3.1 Clock PCB V1.08

Part	Part Number	Installed
Capacitors		
Capacitor 470uF/16-25V	C3, C11	❑
Capacitor 1 uF – 4,7 uF /450V	C4	❑
Capacitor 10uF – 100uF /16-63V	C10	❑
Capacitor 2,2 nF (222)	C14	❑
Capacitor 47 pF	C13	❑
Capacitor 22 nF (223)	C5, C7, C9, C12	❑
Capacitor 22pF – 33pF	C30, C31	❑
Resistors		
Resistor 100 KΩ	R1, R3, R5	❑
Resistor 470 Ω	R23, R30, R31, R32	❑
Resistor 1 KΩ	R19, R27	❑
Resistor 470 KΩ	R2, R4, R6	❑
Resistor 220 KΩ	R7	❑
Resistor 10 KΩ	R26	❑
Resistor 33 KΩ	R14, R16, R17, R18*, R20, R21, R22, R25, R33	❑
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 BYV 95C or FR 205 DC	D5	❑
LED dual color	D30	❑
LED (any color)	D31	❑
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 (KM 15588..)	IC3, IC4	❑
Timing circuit NE 555 DIP	IC5	❑
Other parts		
Xtal 4 MHZ or resonator	X1	❑
Coil 100µH	L1	❑
Switch to set the clock	S1, S2	❑
HEBW 21 Pin diameter 2,1mm	Power Supply socket	❑
PCB connectors 20 + 3 pins	only if a tube board is ordered	❑
PCB version 1.08	Clock Circuit board	❑

3.2 Tube PCB V1.08a And V1.08b

The value of the anode resistors on the tube PCB depends on the type of tubes used. 10 kΩ resistors work fine with almost all tubes, and those are included in the kit.

Part	Part Number	Installed
Anode Resistors, 4.7 KΩ - 15 KΩ	R8, R9, R10, R11, R12, R13	❑

4 Assembling the Clock PCB

4.1 Solder the Components

TIP: Solder the flattest parts first (diodes, IC sockets) and the tallest parts last (voltage regulator, crystal).

TIP: Check off each component on the parts list (Section 3) as you install it.

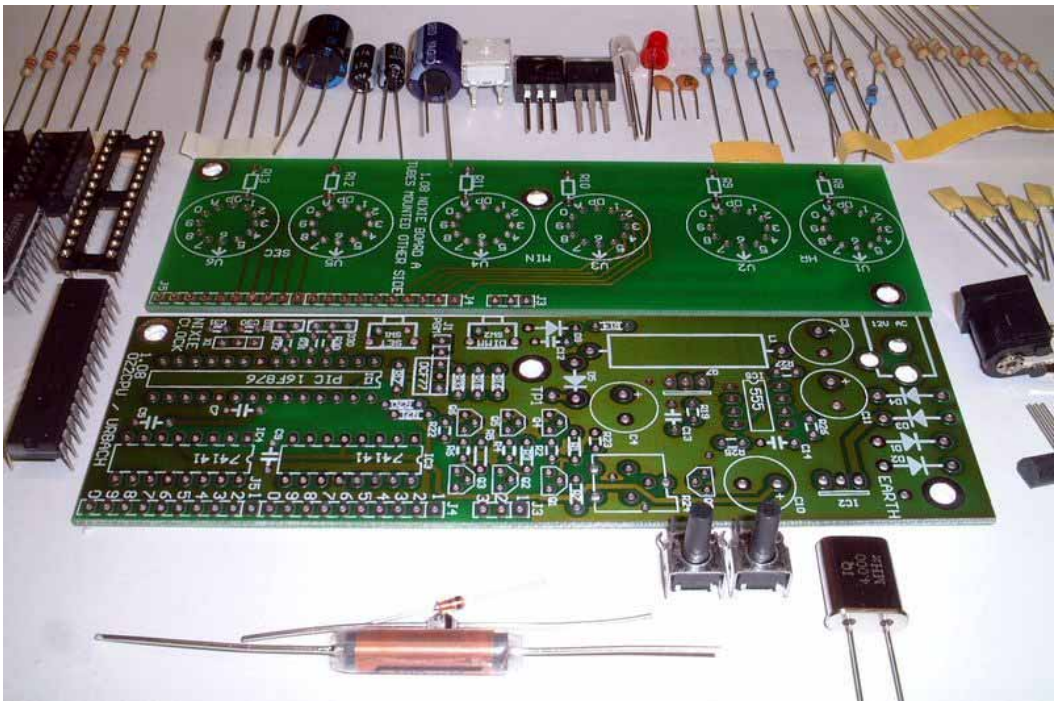
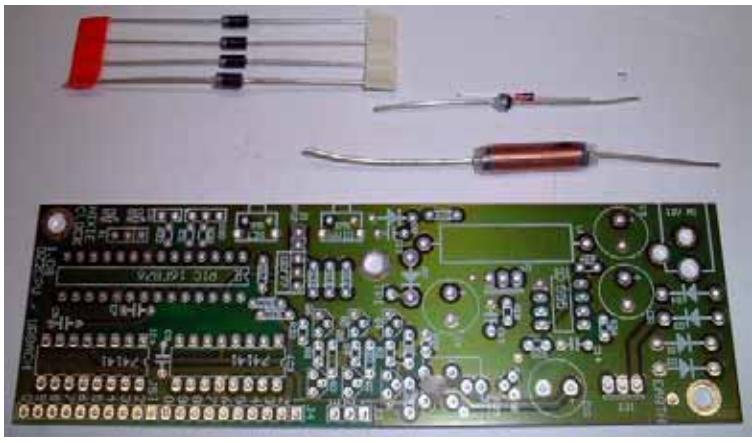


Figure 2 - The complete kit with 1.08 and 1.08a PCBs, without tubes and wall wart power supply

4.1.1 Diodes and Coil

Solder the diodes D1, D2, D3, D4, D5 und D9 and the Coil L1. All diodes are directional, and have a band marking on one end. Match the band on each diode with the band on the PCB. See Figure 4 for correct placement. The coil can be soldered in either direction.



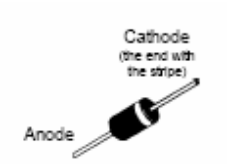


Figure 3 - The clock PCB V1.08 with the diodes and coil – watch out for the ring

Figure 4 - Diodes and Coil L1 soldered into the PCB

4.1.2 IC Sockets and IC5

Solder the 3 sockets for the ICs. Be very careful to mount the sockets in the correct orientation. There is a notch on one end of each socket, and the PCB is printed with matching notches. No socket is provided for IC5 (555). It is more effective without a socket, and should be soldered directly to the PCB. It has a notch on one end, or a dot which marks pin 1. The end with the pin 1 dot goes on the same side as the notch printed on the PCB, near the coil.

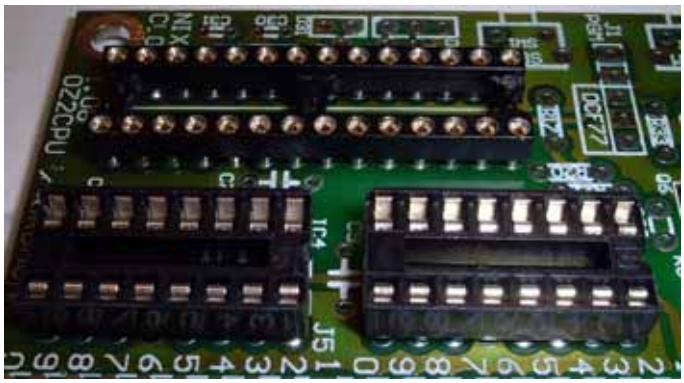


Figure 5 - The IC Sockets

4.1.3 Transistors

Solder the transistors Q1, Q2, Q3, Q4, Q5, Q6 and Q8. Watch out for the orientation on the PCB, and match the flat side of each transistor with the flat side printed on the PCB.

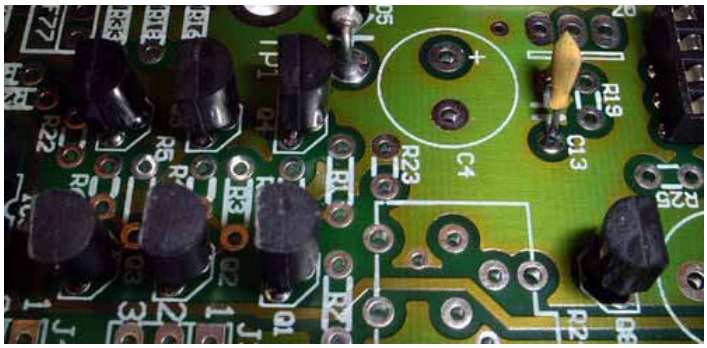


Figure 6 - Proper transistor mounting

4.1.4 Resistors

Solder all the resistors. See Section 9.2 (Appendix) for help identifying each resistor. This is one of the most time-consuming portions of the kit. Take your time, be patient, and make very certain you have the correct resistor value for each location. The resistors should be mounted standing up.

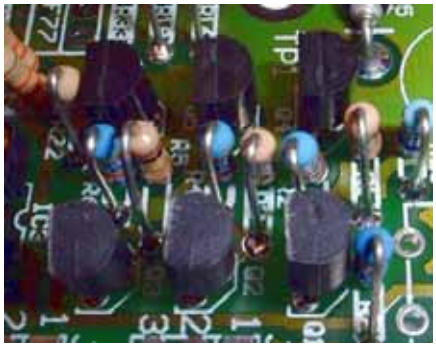


Figure 7 – Detail view of some resistors

TIP: For easier identification of the resistors after the kit is completed, consistently mount all resistors with the multiplier band at the bottom.

4.1.5 Trimmer Resistor R24

Solder the trimmer resistor and adjust it to mid position. The trimmer will be used later on to adjust the tube voltage to 170V-180V DC.

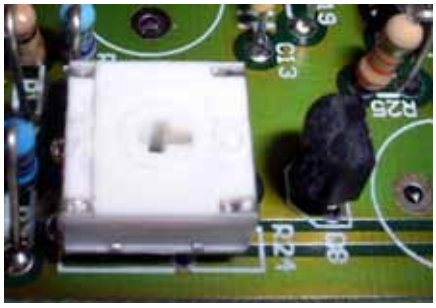


Figure 8 - Trimmer Resistor R24

4.1.6 Small Capacitors

Solder the capacitors C13, C14, C5, C7, C9, C12, C30 and C31. See Section 9.3 (Appendix) on page 22 for help identifying the capacitors.

Small capacitor

Figure 9 - Solder the 22p capacitors as shown – see more about the identification

TIP: These capacitors are not polarized and can be mounted either way, but for easier identification after the kit is completed, mount them with the markings visible whenever possible.

4.1.7 Switches

Solder the switches firmly against the PCB. If you plan to mount these (or other) switches elsewhere in your housing, you can connect them to the PCB with wires soldered into the holes meant for the switches.

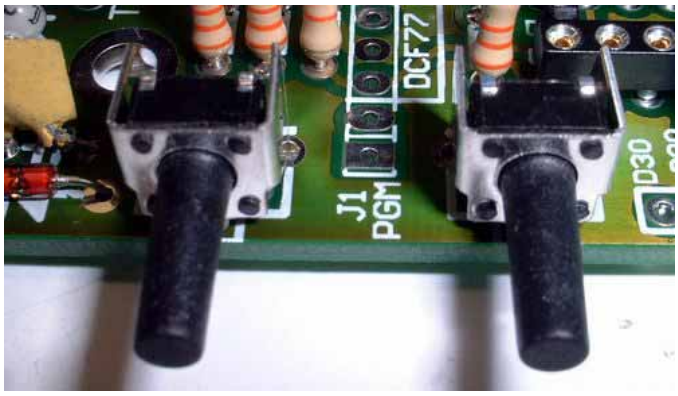


Figure 10 - Switches for setting the time, dimming and other functions

4.1.8 Large (electrolytic) Capacitors

These capacitors are polarized and must be mounted in the correct orientation. If they are mounted in reverse, they will overheat and eventually pop, causing damage to the clock PCB. Please be very careful when mounting these capacitors! The longer wire lead is plus/positive and the shorter lead is minus/negative. The grey stripe on the side of the capacitor indicates the minus/negative lead. The positive hole is marked on the PCB with a “+” symbol, and that is where the longer lead should go. Some of the supplied capacitors might be smaller than the corresponding marking on the PCB. That is normal, and the leads can be bent to fit.

Figure 11 - Proper mounting of the large capacitors

4.1.9 Power Supply Jack

Mount the jack flat against the PCB, and use plenty of tin-solder.

Figure 12 - The power supply jack

4.1.10 LEDs

When the clock is in DCF77 mode (See Section 0), the LED's indicate DCF77 signal quality and status. Otherwise, they function as AM/PM indicator and blinking colons. **If you will not use a DCF77 module (i.e. you are outside Europe) and you also do not want colons or an AM/PM indicator on your clock, they you do not need to install the LEDs at all.**

The LEDs are polarized and must be mounted in the correct orientation. This is especially important with the dual-color LED D30. If it is mounted backwards, the DFF77 signal indicator will show the wrong color, confusing the user. See Figure 13 and Figure 14 for correct mounting.

Figure 13 - LED D31
DCF77 status
or AM/PM

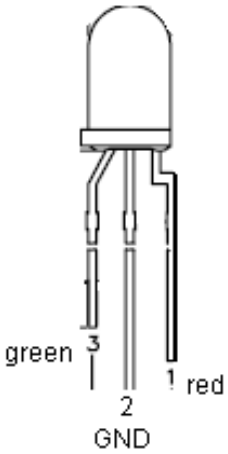


Figure 14 - Dual Color LED D30
DCF77 signal quality
or blinking colons and status LED

For DFC77 mode, be careful to mount the LEDs at the correct height from the PCB to be visible in the enclosure you plan to use.

For an AM/PM indicator and blinking colons, use wires to attach your enclosure-mounted LEDs to the PCB holes for D30 and D31. For the colons, use regular 2-wire LEDs (not the dual color LED supplied) and wire them to two of the three D30 PCB holes – connect to one side for a 1Hz blink rate, or the other side for a .5Hz blink rate. If you would like to use Neon bulbs instead of LEDs, to match the appearance of your Nixie tubes, use the drive circuit shown in Section 9.2 (Appendix).

4.1.11 Voltage Regulator IC2 and Power Transistor Q7

Be careful to mount IC2 and Q7 so that the metal heat sink tab matches the marking on the PCB.

During operation, Q7 will become extremely hot, so much that it cannot be touched. That is normal - the transistor is a power FET designed to handle over 100 degrees Celsius, the boiling point of water. However, if desired you can potentially extend the life of the transistor by attaching a heat sink. **The metal tab of the transistor is at 180 V, so it must not contact any other parts**. You can attach a free-standing isolated heat sink, if there is room for it in your housing. Or you can use the housing itself as the heat sink if it is metallic, but you must isolate the transistor tab with a thermally conductive insulator. Also, keep the wires to the PCB as short as possible, to avoid problems with RFI and oscillations.

Alternately, you can simply leave the transistor without a heat sink and it will be fine.

TIP: IC2 and Q7 are the two tallest components on the PCB. Therefore, depending on the size of your housing, you may want to leave some extra lead length when soldering them, to permit bending these parts over so they do not protrude too high.

Figure 15 - Proper mounting of IC2

4.1.12 Quartz Crystal or Resonator

Both the crystal and resonator have the same function, and either one may be supplied in the kit. Neither part is polarized, and may be mounted in either direction. Be sure to solder the crystal about 1-2mm above the PCB so that the metal case does not touch the PCB.

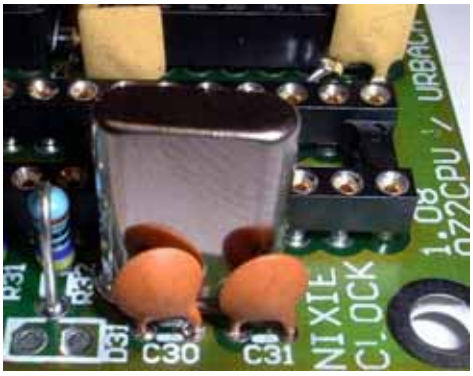


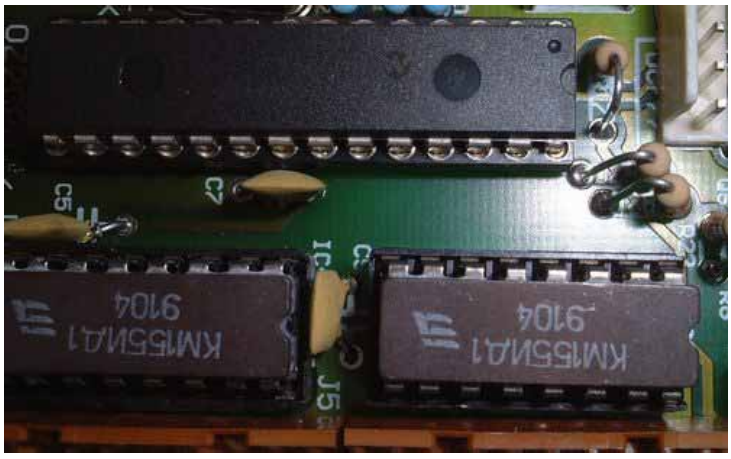
Figure 16 - Crystal

Figure 17 - 4 MHz Resonator

4.1.13 Insert the ICs

Be extremely careful to mount the ICs in the correct orientation! The ICs have notches on one end, which should match the notch on the socket. Some ICs may instead have a dot which marks pin 1. The end of the IC with the pin 1 dot goes on the same side as the notch on the socket.

TIP: When inserting the ICs into the sockets, be extremely careful to avoid bending any pins. IC pins can easily bend under the body of the IC, and this is difficult to spot. It can result in intermittent connections which are difficult to troubleshoot. So, inspect the ICs very closely after inserting them in their sockets, to make sure no pins are bent.



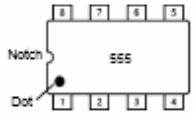


Figure 18 - Proper mounting and orientation of the ICs – see the notch or the dot on the IC

4.2 Check Your Work

Now that all components have been soldered to the PCB, it is time to methodically double-check your work until you are confident everything is correct. Your time and effort during this step will be rewarded with a clock which functions properly the very first time it is powered up.

Figure 19 below. Verify the correct orientation of all polarized components, such as diodes, LEDs, capacitors, ICs and transistors. Look for bent pins on the ICs. On the bottom of the PCB, look closely for solder bridges (shorts) across adjacent solder pads, especially around the ICs.

Figure 19 - The completed clock PCB

4.3 Voltage Adjustment

Warning: Do not touch the PCB once power is applied. There is high voltage present on some parts of the board!

Plug the wall wart power supply to the power jack. Attach a DC voltmeter to TP1 (Test point 1) and GND (Ground), and set the voltage on TP1 to 170-180 volt DC + - 10% by adjusting R24. The voltage may need to be re-adjusted slightly once the tubes are connected.

Figure 20 - Measuring and adjusting the correct voltage

5 Assembling the Tube PCB

5.1 PCB V1.08b for IN-18 Tubes

This PCB is designed specifically for six IN-18 tubes.

1. Solder the mouser pins as shown below.
2. Solder resistors R8-R13. For most tubes, an anode resistor value of 10kΩ works fine, and that is the resistor values included in the kit. However, some individual tubes are brighter than others, and in that case resistors with a value between 8K and 15K can be substituted to make all 6 tubes equal in brightness.

Figure 21 - Top of the PCB with 2 pins in place

Figure 22 - Bottom of the PCB, before soldering

Figure 23 - After soldering the pins

5.2 PCB V1.08a For All Other Tubes

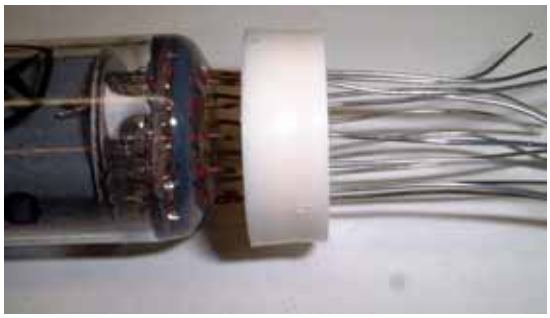


Figure 24 - IN-14 tubes come with long wires

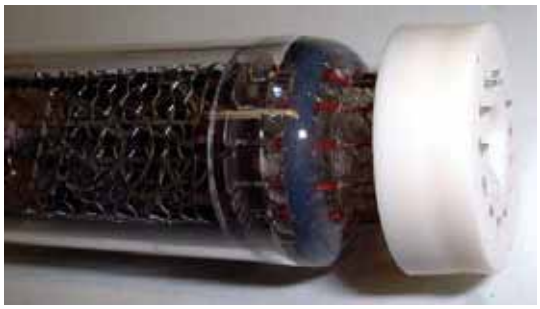
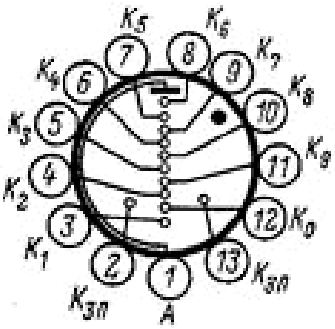


Figure 25 - Cut the wires short
to facilitate placement on the PCB



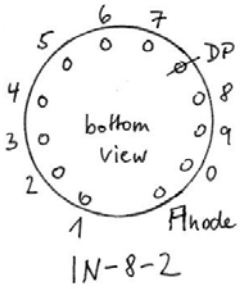


Figure 26 - Bottom view of IN-14 and IN-8-2
Bend the wires of the IN-14 left and right to the anode and cut them. Cut DP on IN-8-2 tube.

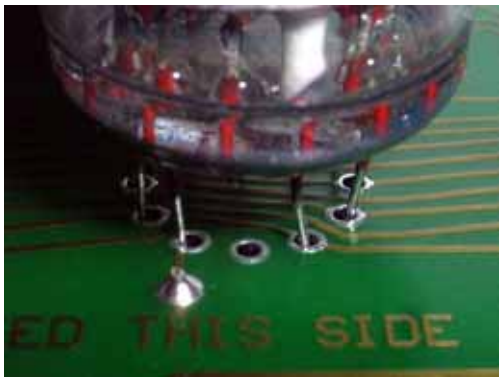


Figure 27 - Make sure the tube is straight.

Figure 28 - Bottom view of the tube PCB

Do not solder the tubes too close to the PCB. Be careful to leave enough lead length to permit bending the leads, if it's necessary to straighten the tubes, and to allow the tubes to protrude enough to be fully visible in whatever enclosure you choose.

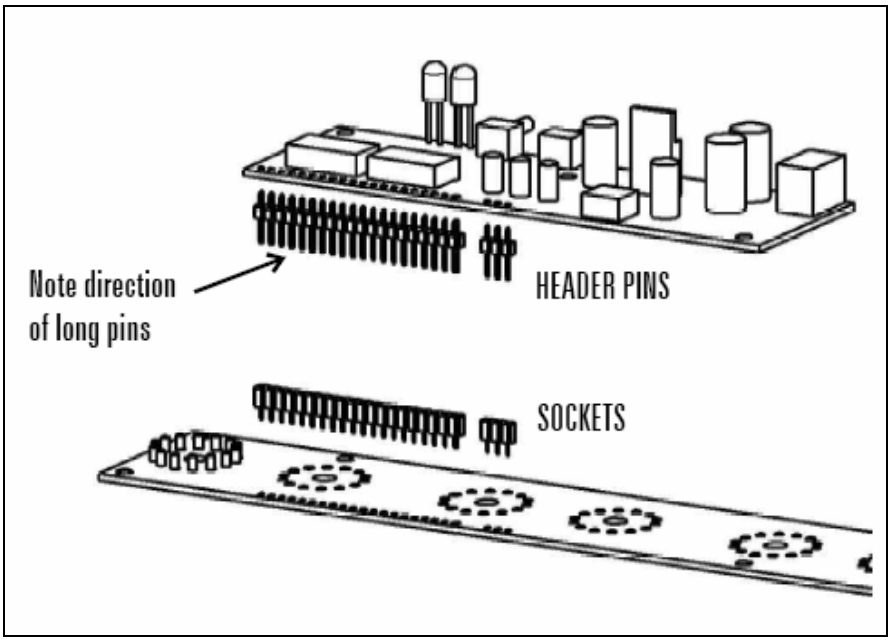
If you use other tubes via a cable connection, connect the cathodes according to the tube's pin layout. In this manner, it is possible to mount virtually all Nixie tubes to this clock board.

5.3 Connecting To the Clock PCB

Depending on the housing you will use, you can connect the tube PCB to the clock PCB in a “sandwich” configuration, or via cables. The necessary connectors belong to the kit if a tube board is ordered.

5.3.1 Sandwich Connection

This method is very compact and allows a small housing.

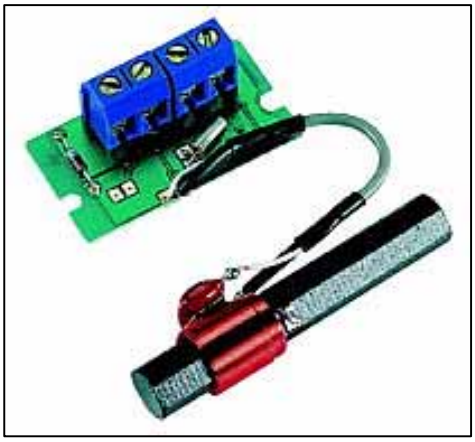


5.3.2 Cable Connection

The cable connection method permits mounting the two PCBs away from each other. You can use different connectors than the ones shown here.

Figure 29 - Connectors J5, J4 and J3

6 Connecting a DCF77 Receiver



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 or more meters away from the clock circuit.
This is another possibility to get the distortion as low as possible: The fix is to block "noise" from getting to the PIC-IC1 RB6-pin27. Solder a 100nF ceramic capacitor directly under the J1-PGN socket between RB6/DCF-pin3 and GND-pin4. In addition (not always necessary) also "decouple" the rectifier diodes D1,D2,D3,D4 and the 5V-stabilizer by soldering 100nF ceramic capacitors in parallel to each diode and IC2-7805 IN-pin1 to GND-pin2 and OUT-pin3 to GND-pin2.
To avoid the dissipation of "rf-noise" (multiplexing and 180V generation) use a ferrite-ring-core 20mm diameter and pass 5 windings of the cable (to the DCF receiver) through (at the clock end).

If the clock detects the presence of a DCF77 signal during power-up, it will use it automatically to set the time. You can adjust the DCF77 displayed time plus or minus 1 hour, to compensate for your local time zone in Europe. The range of DCF77 is about 2000km around Frankfurt/Main. DCF77 does not function in other parts of the world.

Connect the Conrad DCF77 receiver module to J1 on the clock PCB as follows.

Conrad Module Pin 1 (GND) .....Connector J1on clock pcb pin 4
Conrad Module Pin 2 (+5 Volt).....Connector J1 on clock pcb pin 5
Conrad Module Pin 4 (DCF Signal).....Connector J1 on clock pcb pin 3

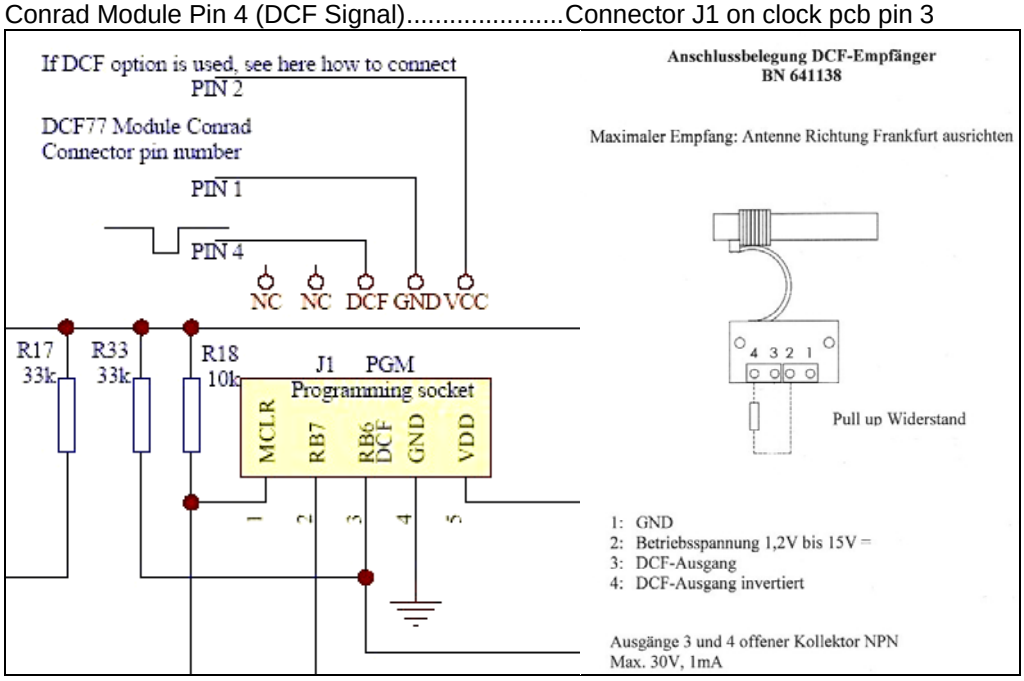


Figure 30 - Connecting the Conrad DCF77 module

7 Software Operation

7.1 Clock Features - What is new in version 6.0

We have implemented a **tube saving routine** in the clock's software.
See more at chapter 7.8 for this.
The DCF77 mode is now showing DATE and MONTH and YEAR, if in 6 digit mode. If in 4 digit mode the DATE and MONTH are shown, not the year. Every minute when the seconds go from 50 to 55, the date is shown. If no valid DCF77 string has been received after a 23:59 to 00:00 change, the date will not been shown, until new valid string has been received.
In the two digits modes, no date will be shown no matter what, sorry. But DCF77 mode is still useful /possible to set the clock.

If you don't want the date to be shown in DCF77 mode, please connect a short circuit in the DCF/programming connector J1 from pin 2 and 4 - that is RB7 from PIC - to ground.

- Auto Detection of DCF77 module
- Auto Detection of 1Hz, 50Hz or 60Hz clock pulse input mode
- Digit fade effect
- LED or neon bulb indicators for AM/PM and flashing colons (optional)
- Automatic dimming (optional)
- Manual dimming via push button with 4 levels
- Tube life routine, displays total days tubes have been in use
- Displaying the date (only in 4 and in 6 digit mode)
- 12 / 24 hr mode
- Able to drive any available Nixie tubes, in 2, 4 or 6 tube configurations

7.2 Power Up Sequence

❶ At power up the software version "60 -- --" 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 detected:

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 "60 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

DCF77 Module detected:

❸The blinking '60' 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.

Hz mode.

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

-- 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. See Section 7.7 for information on the DCF77 status LED indicators.

7.3 Manual 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.

7.4 Manual Brightness Control

While in normal mode, press the UP/DIM button repeatedly to rotate through the 4 brightness levels. 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. Remember that manual brightness setting is deactivated if the LDR feature has been installed (see Section 9.1).

7.5 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 3 seconds until all the digits blink momentarily. If there is no 12/14 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.

7.6 Tube Running Time

The clock keeps track of how many days the tubes have been running, up to a maximum of 65535 days. The counter is incremented at 23:59:59 every day.

To display the tube hours count: While in regular mode, press and hold the UP/DIM button for 5 seconds. After 3 seconds all the digits will blink to indicate the 12/24 hour mode has been changed, but keep pressing the button 2 more seconds, and the days count will appear. The first digit is a 9 to indicate the tube running time is being displayed. For example, 365 days of use will appear as “90 03 65”. To exit the tube running time mode, turn off the clock. After turning the clock back on, you may want to switch the 12/24 hour mode back to its previous setting.

To reset the tube hours count back to zero: Turn off the clock, press and hold both the UP/DIM button and the SET button, power up the clock, then release both buttons. The tube running time counter has been set to zero. This procedure should only be performed if the tubes are replaced.

7.7 DCF77 Indicator LEDs

During normal operation:

- If the dual color LED is blinking green, and the red LED switches on/off once every minute, your clock is successfully receiving a DCF77 signal and is super accurate. Due to these LEDs, it has never been so easy and fun to receive correct DCF77 signals.
- The dual color LED is a signal quality meter, indicating how close the DCF77 pulses are to the correct pulse width. It is very fast reacting and updates every second. A correct pulse width is 100ms or 200ms. The LED blinks green if the pulses are within +/-10ms of the correct pulse, orange if the pulses are within +/-20ms, and red if the pulses are within +- 30ms. If the pulses are more than 40ms away from correct time, the signal will be marked as bad. That means it is actually possible (in theory) to set the clock to the correct time if only red blinks.

If a good DCF signal **has not been received** for at least 24 hours:

- The red warning LED switches on/off at a faster rate of once a second. This is to warn the user that the clock time might be off a few sec or maybe more depending of how many days / weeks this has been going on. The clock continues to look for a good DCF signal, and turns off the warning once a good DCF is received.
- The Nixie tubes will be turned off at 4:00 in the morning and back again at 5:00. This is in case there is electrical noise which is blocking DCF reception.

7.8 Tube saving mode – switch off the tubes to increase their lifetime

The software version 6.0 can now switch off the tubes at a selected time to increase their lifetime and save power. You can decide what time you want to switch the tubes off by connecting different pins from the pic processor to GND.

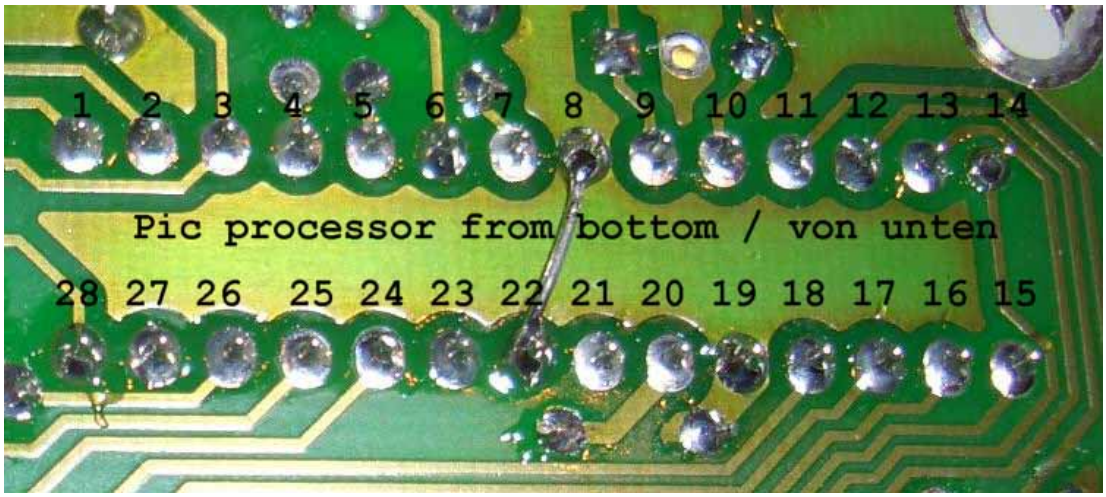
Here is an overview of the possible switch-off times:

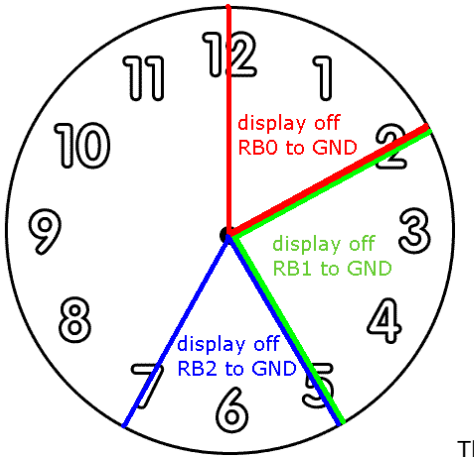
1. no pins connected	- default mode – tubes on all time
2. tubes off from 00:00 to 01:59	- Pin 21 (RB0) of pic processor to GND (Pin 8)
3. tubes off from 02:00 to 04:59	- Pin 22 (RB1) of pic processor to GND (Pin 8)
4. tubes off from 05:00 to 06:59	- Pin 23 (RB2) of pic processor to GND (Pin 8)

Example 1: If you want to switch off the tubes from 00:00 to 06:59 then connect pin 21 and pin 22 and pin 23 to GND (pin 8 of the pic processor). **Example 2**: If you want to switch off the tubes from 02:00 to 06:59 then connect Pin 22 and Pin 23 to GND and you are done.

In the following picture the tubes are switched off from 02:00 to 04:59 (see wire from Pin 8 (GND) to Pin 22 (RB1). You can also use switches so it can be changed if you wish. The maximum switch off time goes from 00:00 to 06:59.

The tube save mode works in all display modes (2 tubes / 4 tubes / 6 tubes), in DCF77 mode and in 12 / 24 hr mode! The picture shows the pcb from the bottom with the pic processor in the centre.





This is the off-times only at night.

7.9 Setting the Number of Installed Tubes

The clock software can drive 2, 4 or 6 digit clocks.

To change tube operating mode: Press and hold the SET button, then power up the clock. Continue pressing the SET button, and press the UP/DIM button repeatedly to cycle through the 5 display modes. When you have selected the correct mode, release the SET button and this mode will be saved until you choose a different one.

The 5 different tubes modes are as follows:

- Mode 1: is six tubes 2x3 multiplexed mode normal Nixie tubes (default mode)
- Mode 2: is four tubes 2x2 multiplexed mode using normal Nixie tubes

- Mode 3: is four tubes using dual anode tubes 1x4 multiplexed mode
- Mode 4: is two tube non multiplexed mode using normal Nixie tubes
- Mode 5: for two B7971 or ZM1350 special alphanumeric tubes multiplex 1x32

When the correct mode is chosen, the tubes will show “12” or “12 34” or “12 34 56” depending on how many tubes you have used in your clock.

8 Frequently Asked Questions

Please visit http://www.nixieclocks.de/english/faqs.html for the latest updated faqs.

9 Appendix

9.1 Auto-Dimming LDR Option

The clock can auto-dim the tubes in relation to the light in the room, using an LDR and a resistor. This is an optional feature, and the necessary parts are not included in the kit.

The life time of a Nixie tube is determined by its light output multiplied by the hours it is lit. Since this kit uses a multiplexed design, Nixie tube brightness is in general lower compared to non-multiplexed Nixie clocks, therefore the lifetime is in general 2-3 times longer in this kit. By adding the auto-dimming feature, this can be made 10-15 times longer.

If the LDR feature is in use, the push button dim function is disabled.

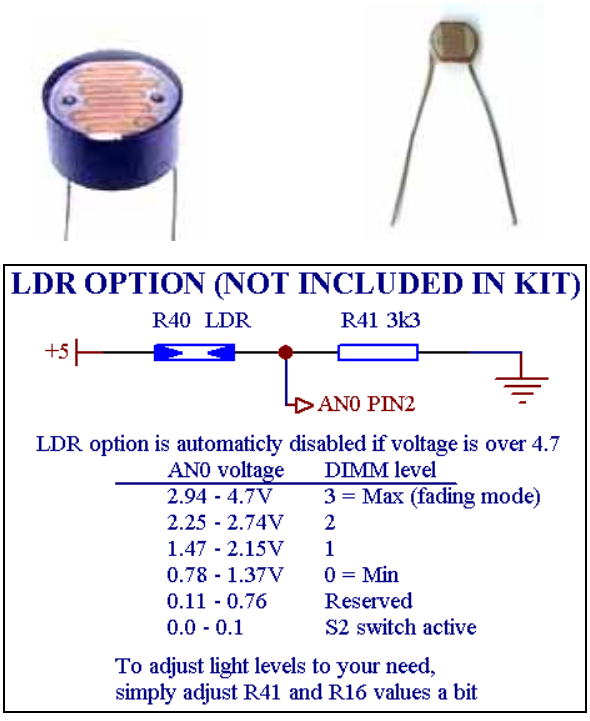


Figure 31 - Auto-dimming LDR schematic

9.2 Neon Bulb Drive Circuit

As explained in Section 4.1.10, the two LEDs can be used as an AM/PM indicator and blinking colons. If you would rather use neon bulbs to match the appearance of the Nixie tubes, the following circuit can be used to drive neon bulbs from the LED outputs. These parts are not supplied with the kit.

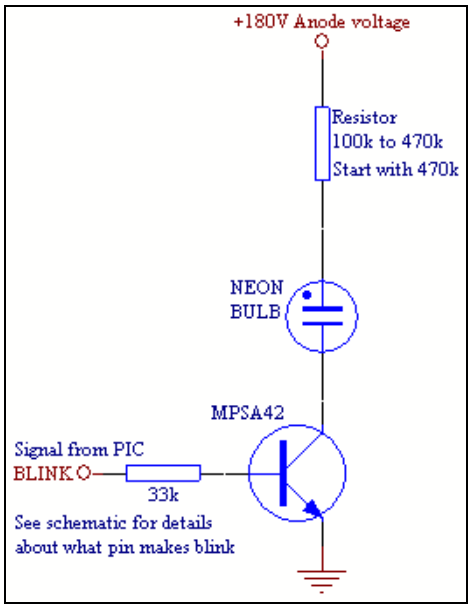


Figure 32 - Neon Bulb drive circuit

9.3 Parts Identification

Some of the supplied parts may have alternate markings, as shown here:

Diode	BYV 95 = FR205 DC		
Transistor	MPSA 92	=	KSP 92-044
	MPSA 42	=	CMPS A42
Driver ICs	74141	=	KM155
Capacitors	22 nF	=	223
	2.2 nF	=	222

9.4 Suppliers

Nixie Tubes – J. Wuesten at http://www.die-wuestens.de is a reputable supplier of Nixies.
Mouser solder pins - http://www.clausurbach.de/catalog
Neon Bulbs – http://www.clausurbach.de/catalog
DCF77 module (optional) – www.conrad.de - item number 641138.
Housing – The Klok housing from http://www.klokworks.com is highly recommended.

Wall Wart power supply – A variety of wall warts from various vendors will work, but Radio Shack catalog number 273-1631 is ideal for the Nixie clock.
It is available in their USA retail stores and at www.radioshack.com.
It has the correct plug attached, with a thin 6-foot cord and an attractive white color.
Set the voltage switch to 9V.