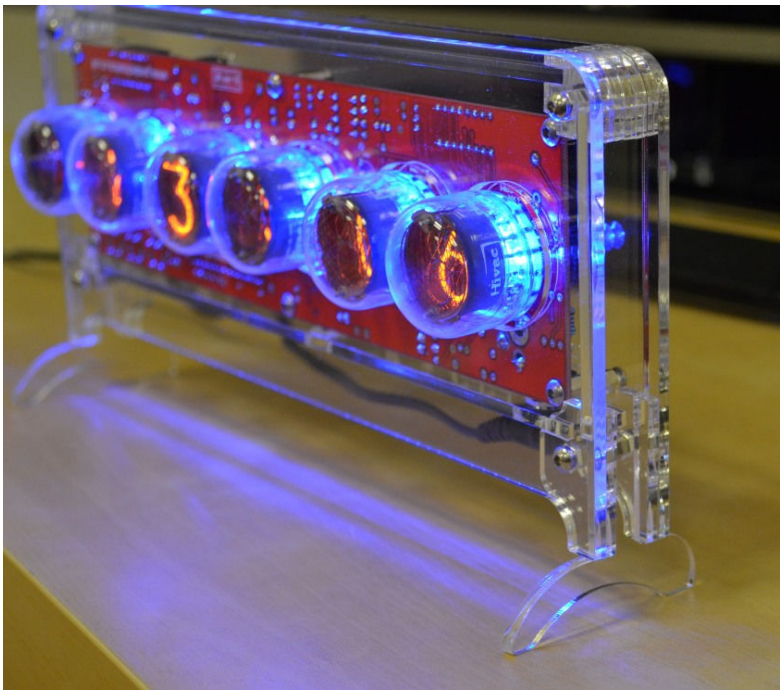
Assembly Instructions
And
User Guide

Nixie Clock Type
'Halo Clock'

For Z560M, Z5600M,
ZM1020, ZM1022,
GN-4, IN-4 Type Tubes

Parts Bags Serial No. 500 onwards



REVISION HISTORY

Issue Number	Date	Reason for Issue
3	01 Nov 2018	New code with DST changing (parameter 17)
2	15 March 2013	Added IN-4 board
1	01 March 2013	New document

1. INTRODUCTION

1.1 About the clock

Nixie clock type 'Halo' is a compact design with all components and tubes mounted on a single PCB. The efficient use of board space is achieved by using a multiplex design to drive the display tubes. Two high-voltage binary-to-decimal decoder ICs (K155ID1) are required, driving the six tubes in groups of three.

Compatibe tube types are Z560M, Z5600M, ZM1020, ZM1022, GN-4 and equivalant tubes. These are front view Nixie tubes with a digit height of typically 15.5mm. A separate PCB is used for IN 4 tubes with a digit height of 18mm.

1.2 Clock Features

Nixie clock type 'Halo' has the following features:

- Hours, Minutes and Seconds display
- 12 or 24 hour modes
- Date display in either DD.MM.YY or MM.DD.YY format
- Alarm, with programmable snooze period
- Programmable date display each minute
- Attractive LED tube lighting
- Uses a Quartz Crystal Oscillator as the timebase
- Optional DCF / MSF / GPS synchronisation with status indicator LED
- Supercapacitor backup. Keeps time during short power outages
- Simple time setting using two buttons
- Programmable leading zero blanking
- Five programmable neon colon settings (Flashing AM/PM indication, illuminated AM/PM indication, both flashing, both on, both off)
- Maintains time during setup mode, eg. When changing between Standard Time and Daylight Savings Time
- Seconds can be reset to zero to precisely the set time
- Programmable night mode - blanked or dimmed display to save tubes or prevent sleep disturbance
- Separate modes for colon neons during night mode
- Standard or cross-fading change of digits
- 'Slot Machine' cathode poisoning prevention routine
- All user preferences stored to non-volatile memory

1.3 SAFETY

DANGER: The clock pcb includes a switched-mode voltage booster circuit. This generates nominally 170 Volts DC, but is capable of generating up to 300 Volts before adjustment. Assembly may only be undertaken by individuals who are suitably qualified and experienced in electronics assembly, and are familiar with safe procedures for working with high voltages. If in doubt, refer to a suitably qualified engineer before proceeding.

The voltages generated by this circuit can give a potentially LETHAL ELECTRIC SHOCK.

DISCLAIMER: This product is supplied as a kit of parts, intended only for suitably qualified electronic engineers, who are suitably qualified and experienced in electronics assembly, and are familiar with safe procedures for working with high voltages. The supplier, his agents or associates accept no liability for any damage, injury or death arising from the use of this kit of parts.

This is not a finished product, and the person assembling the kit is responsible for ensuring that the finished product complies with any applicable local regulations governing electrical equipment, eg. UL, CE, VDE.

2. TOOLS AND EQUIPMENT REQUIRED

2.1 Tools required to assemble the PCB.

The following tools will be required to assemble the PCB:

- Soldering iron with a small tip (1-2 mm)
- Wire cutters (TIP: A small pair of nail clippers works very well for this function)
- Wire strippers (TIP: A small pair of scissors is quite suitable)
- Multimeter for voltage tests and for identifying the resistors.
- Small flat screwdriver for adjusting the high voltage supply

2.2 Materials you will need.

Solder. Lead - tin solder is preferred. Lead free solder, as now required to be used in commercial products in Europe, has a much higher melting point and can be very hard to work with.
Desoldering wick (braid) can be useful if you accidentally create solder bridges between adjacent solder joints.

2.3 Other items you will need.

The clock kit does not include a power adapter. This is because the kit is sold to many countries around the world, each with very different household mains outlet socket types. If you are using a DCF or MSF receiver avoid switching power type supplies, as they can cause interference problems.
The type of power adapter can be obtained at very low cost. The following type of adapter should be obtained and used with the kit:

Output 12V DC
Minimum power output capability of 500 mA
Output plug: 2.1mm pin, centre positive. A 90 degree plug is preferred if you will use our Plexiglass case.

A suitable adapter is shown below:

3. LIST OF COMPONENTS

3.1 Table of components

Circuit Designation	Part Description
Resistors	
R1, R2	560Ω, ¼ Watt
R3	4.3KΩ, ¼ Watt
R4	620KΩ, ¼ Watt
R5	4.3KΩ, ¼ Watt
R6, R7	560Ω, ¼ Watt
R8, R9	4.3KΩ, ¼ Watt
R10, R11	Not Installed
R12 – R14	4.3KΩ, ¼ Watt
R15 – R17	390KΩ, ¼ Watt
R18 – R20	Not Installed
R21 – R26	2.7KΩ, ¼ Watt
R27, R28	4.3KΩ, ¼ Watt
R29, R30	390KΩ, ¼ Watt
R31 – R36	See below
R37	Not Installed
R38, R39	560Ω, ¼ Watt
Capacitors	
C1, C2	100 nF Ceramic
C3	330pF Ceramic
C4	100nF Ceramic
C5	470 µF, 16-25V, Low ESR
C6	33pF Ceramic
C7	100nF Ceramic
C8	1 µF, 250V, Electrolytic
C9	0.1F
C10	100nF Ceramic
C11	33pF Ceramic
C12	15pF, Ceramic
C13	100nF Ceramic
Transistors	
Q1	BC639
Q2	BC640
Q3	IRFD220 MOSFET
Q4	Not installed
Q5– Q7	MPSA42
Q8 – Q10	MPSA92
Q11- Q13	MPSA42
Diodes	
D1, D2	1N5819
D3	UF4004
D4	5mm Green LED
D5	5mm Yellow LED
Integrated Circuits	
IC1	7805 5V Voltage regulator

IC2	MC34063A
IC3	PIC16F1936 8-bit Microcontroller
IC4, IC5	74141 / K155ID1 Nixie driver
Miscellaneous	
L1	100 µH Axial or radial inductor
AM / PM	6mm Wire ended neon lamp
SW1, SW2, SW3	Miniature push button
VR1	1K Potentiometer
IC Sockets	8 Way DIP IC socket for IC2 28 Way DIP IC socket for IC3 2 X 16 Way DIP IC sockets for IC4, IC5
J1	2.1mm PCB Power socket
GPS / RFT	SMD 3.5mm Jack socket
LS1	Piezo sounder
FUSE	500mA Resettable fuse
Insulation	Clear insulation for neons
X1	32.768KHz Watch crystal
Socket receptacles	66 X 1mm Socket receptacles

Lighting Pack:
The optional pack contains the extra components needed for the tube underlighting:

Circuit Designation	Part Description
R31 – R36	270Ω, ¼ Watt
D6a – D11c	1206 SMD LEDs (18 total + 2 spare) Blue, Yellow, Green or Pink
Q14	2N7000 MOSFET

The resistors used in the kit are 1% tolerance metal film. They are marked with 4 coloured bands to identify the value. However it is sometimes unclear in which direction the bands should be read. Therefore, we recommend that the resistors be identified with a multimeter.

3.2 Parts list / Packing sheet

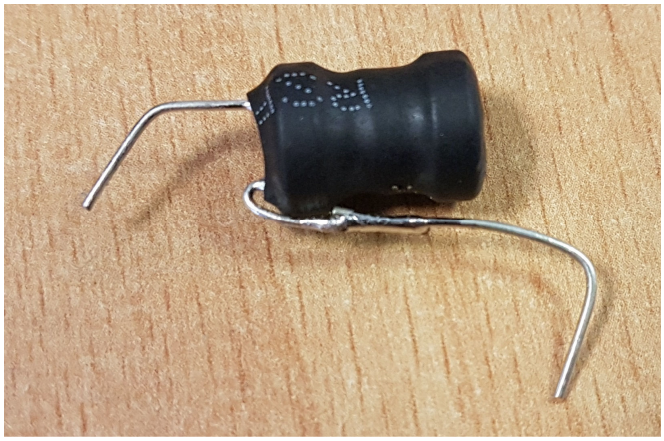
Part Description	Quantity
Resistors	
560Ω, ¼ Watt	6
4.3KΩ, ¼ Watt	9
2.7KΩ, ¼ Watt	6
390KΩ, ¼ Watt	5
620KΩ, ¼ Watt	1
Capacitors	
470µF, 16-25V, Electrolytic	1
1µF, 250V, Electrolytic	1
100nF, Ceramic	6
33pF, Ceramic	2
15pF, Ceramic	1
0.1F	1
330pF, Ceramic	1
Transistors	
IRFD220 MOSFET	1
BC639	1
BC640	1
MPSA42	6
MPSA92	3
Diodes	
1N5819	2
UF4004 Fast recovery diode	1
5mm Green LED	1
5mm Yellow LED	1
Integrated Circuits	
7805 5V Voltage regulator	1
MC34063A	1
PIC16F1936 8-bit Microcontroller	1
74141 / K155ID1 Nixie driver	2
Miscellaneous	
100 µH Axial or radial inductor	1
6mm Wire ended neon lamp	2
Miniature push button	3
1K Potentiometer	1
8 Way DIP IC Socket	1
28 Way DIP IC Socket	1
16 Way DIP IC Socket	2
2.1mm PCB Power socket	1
SMD 3.5mm jack socket	1
Piezo sounder	1
500mA Resettable fuse	1
6 cm Clear insulation	1
32.768KHz watch crystal	1
1mm Socket receptacles	66

Lighting Pack:
The optional pack contains the extra components needed for the tube underlighting:

270Ω, ¼ Watt resistor	6
1206 SMD Resistors Blue, Yellow, Green or Pink	20
2N7000 MOSFET	1

It is recommended that the kit is checked against the lists above, to ensure all parts are present before commencing assembly. Don't be alarmed if there are some extra components, as some component bags are shared between different kit types. Also check our kit updates document on our website downloads page. This details any changes to components, or substitutions that have been made due to part availability.

Note about Inductor L1:
If you received a radial inductor, extend one of the wires and shape the leads as shown below:

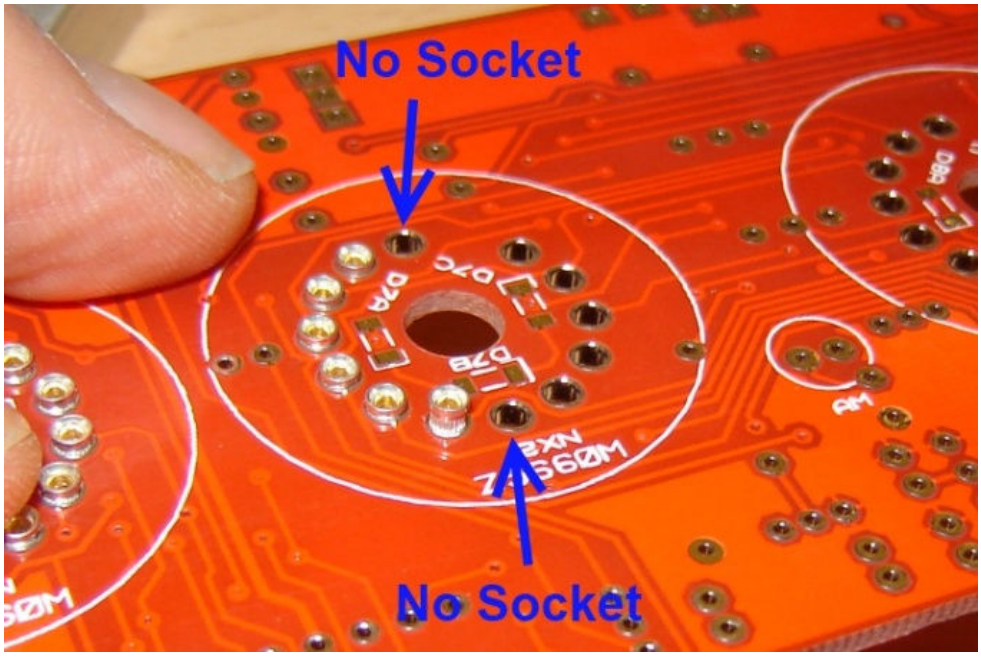


4. ASSEMBLY OF THE PCB

NOTE THAT THESE INSTRUCTIONS ARE SHARED BETWEEN SEVERAL VERY SIMILAR CLOCK TYPES. YOUR PCB MAY NOT LOOK EXACTLY LIKE THE ONE PICTURED.

4.1 1mm Sockets For Nixie Tubes (ZM1020 / Z560M / GN-4 PCB)

There are 66 individual sockets that need to be placed. Note that there are 2 holes per tube with NO SOCKET.
Place each socket loosely as shown below:

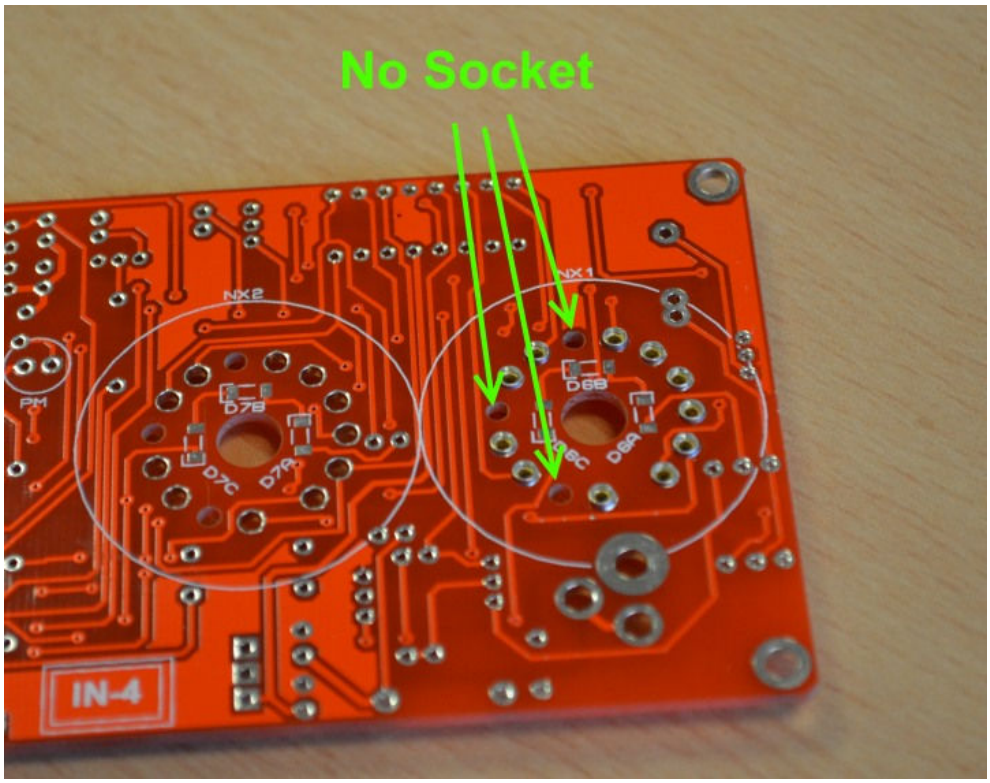


Be sure to insert the sockets FROM the tube side of the PCB – the side with the tube markings.

Then place a hard flat object on the sockets to keep them in place as you flip the PCB over and solder each socket in place.

4.2 1mm Sockets For Nixie Tubes (IN-4 PCB)

There are 66 individual sockets that need to be placed. Note that there are 3 holes per tube with NO SOCKET.
Place each socket loosely as shown below:



Be sure to insert the sockets FROM the tube side of the PCB – the side with the tube markings.

Then place a hard flat object on the sockets to keep them in place as you flip the PCB over and solder each socket in place.

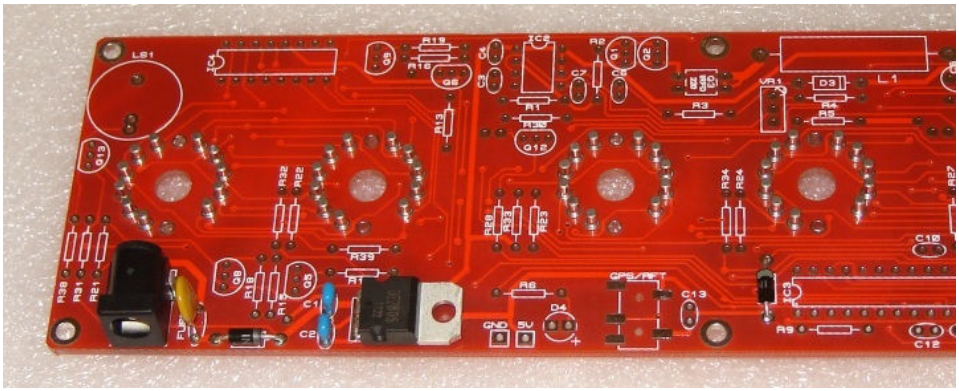
4.3 Low Voltage Power components:

J1, FUSE
D1, D2 - 1N5819
IC1 - 7805
C1, C2 - 100nF

Start by installing D1 and D2. Align the white band on the components with the band marked on the PCB.

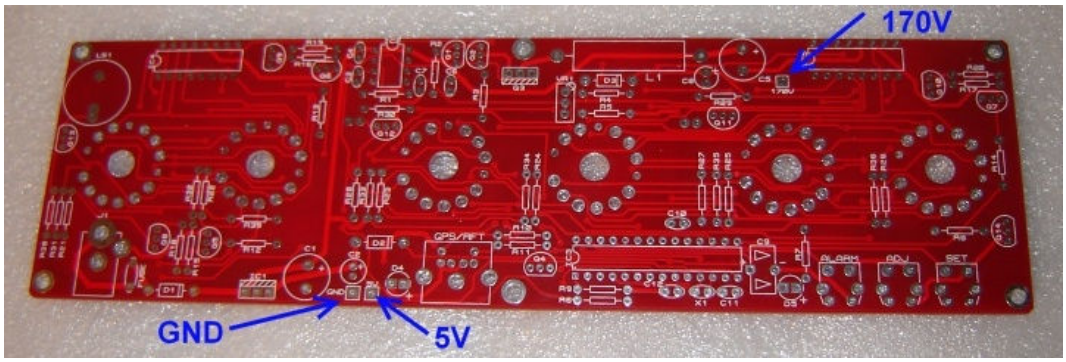
Proceed to mount the other components of this step. IC1 can be bent over to lower the profile of the board, but do not let it actually touch the PCB.

The PCB should now look like the picture below:



4.2 Testing Stage 1 Power Components.

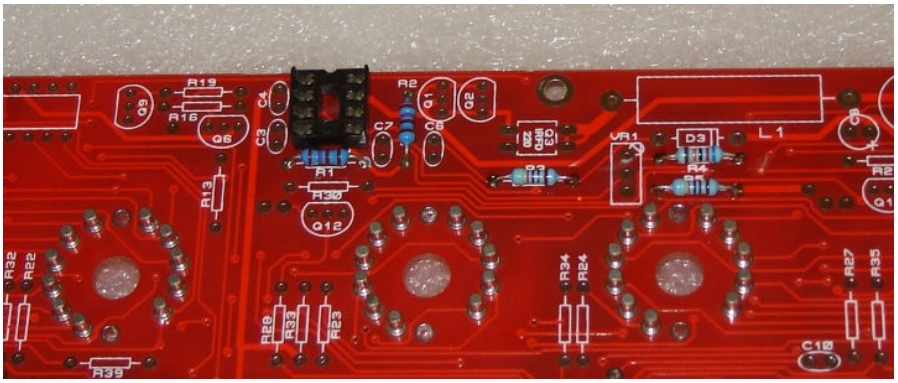
Identify the test GND, 5V and 170V test points as shown below.



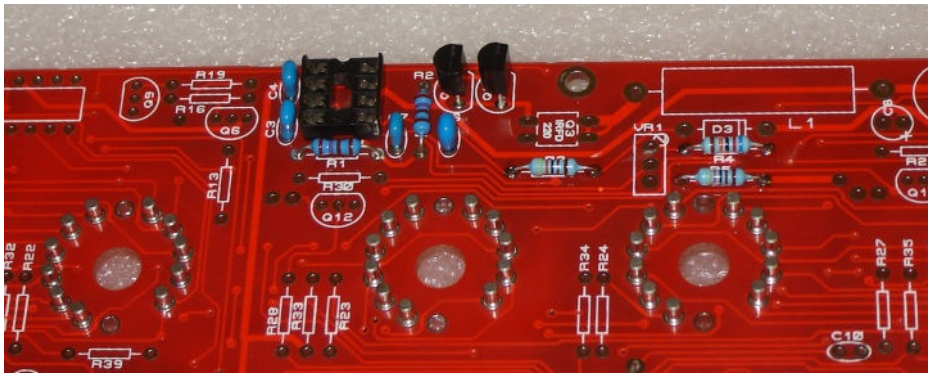
Plug in the power supply, and then test using a DC voltmeter: Touch the black probe on the GND test point and the red probe on the 5V test point. The voltage should measure between 4.9 and 5.1 Volts. If not, disconnect power and check your work. Do not proceed with the assembly until the error is corrected. Once the test is completed, disconnect the power.

4.3 High Voltage Generator components.

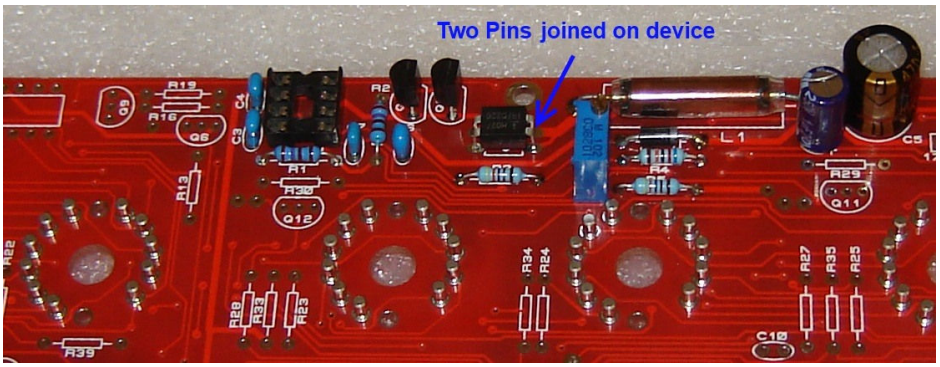
Socket for IC2
R1, R2 - 560Ω
R3 - 4.3KΩ
R4 - 620KΩ
R5 - 4.3KΩ



4.4 Q1 - BC639
Q2 - BC640
C3 - 330pF
C4 - 100nF
C6 - 33pF
C7 - 100nF



4.5 Q3 - IRFD220
D3 - UF4004
L1 - Inductor
C5 - 470µF
C8 - 1µF
VR1 - 1K Pot



Take care that the two pins that are joined go in the position marked. C5 and C8 are polarised. The longer lead goes in the '+' hole.

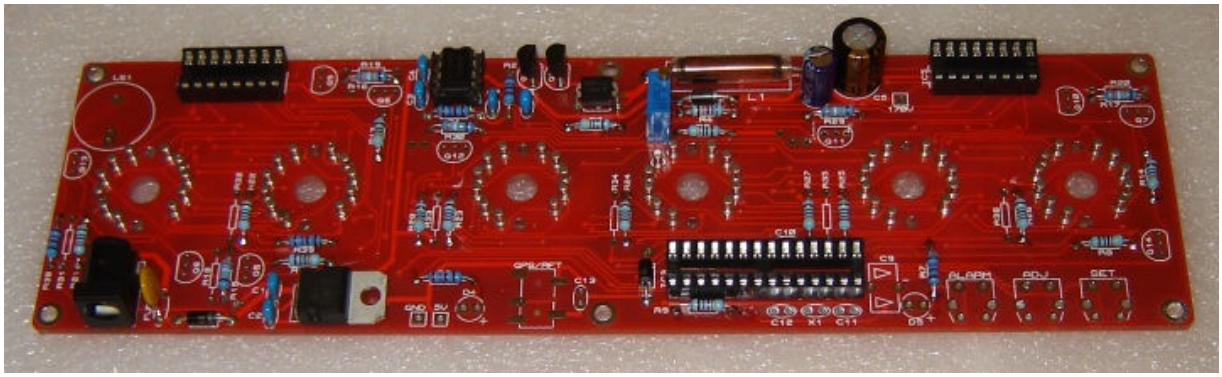
4.6 High Voltage Generator Test

- Refer to the warnings on page 4.
- Insert IC2 into the socket, making sure it is correctly oriented and firmly pressed into place.
- Power up the PCB, and using the GND and 170V test points, measure the high voltage generated. It should be initially between 150 and 190V. -
- Using the VR1 brass screw, slowly adjust the screw until the voltage is between 170 and 175V. Disconnect the power supply.

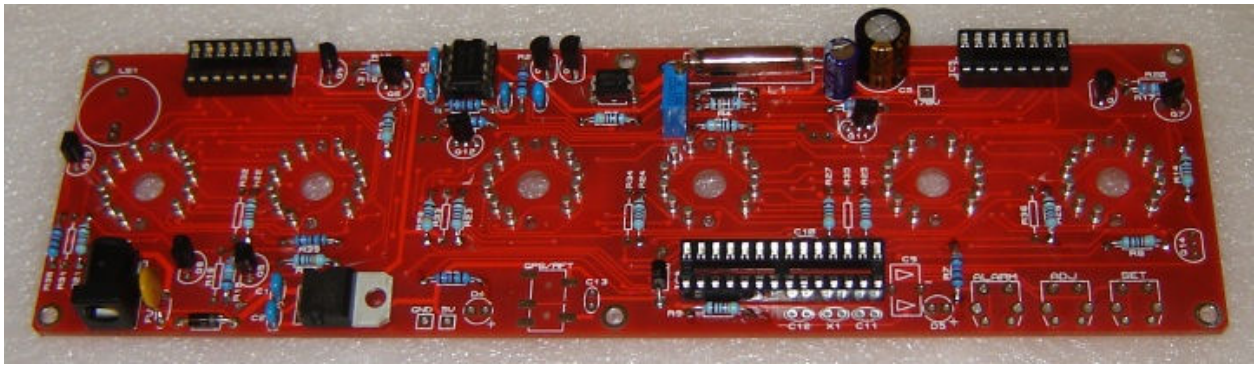
4.7 Sockets for IC3, IC4, IC5

Align the notch on the body of each socket with the corrsponding mark on the PCB

4.8 R6, R7, R38, R39 (all 560Ω)
R8, R9, R12, R13, R14, R27, R28 (all 4.3KΩ)
R21 - R26 (all 2.7KΩ)
R15, R16, R17, R29, R30 (all 390 KΩ)

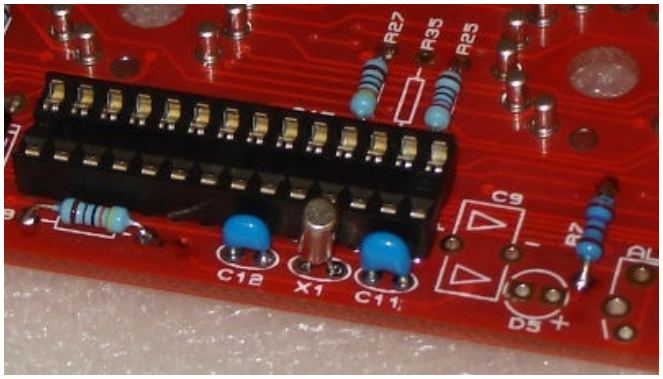


4.9 Q5, Q6, Q7, Q11, Q12, Q13 (all MPA42)
Q8, Q9, Q10 (all MPSA92)



4.10 X1 - 32.768 KHz Crystal
C11 (33 pF)
C12 (15 pF)

These are the timekeeping components: 32.768KHz crystal and two load capacitors. The capacitors in your kit may be blue, brown, or possibly another colour. Look at the part markings, not the colour.



4.11 Tube Test

At this stage, it is desirable and possible to test that the tube drivers and micro-controller are functioning correctly. Making the test at this point, before the remaining components are installed will make troubleshooting and diagnosis simpler if there is a problem.

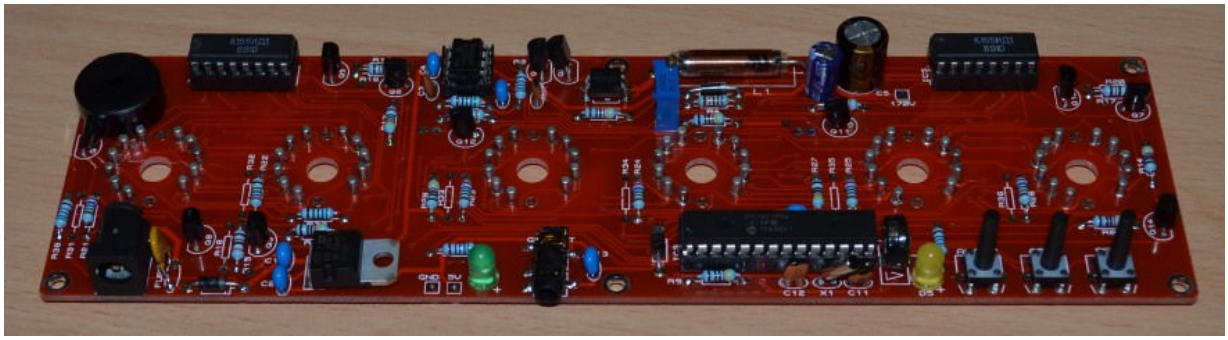
Insert IC3 (PIC16F1936) and IC4, IC5 (both K155ID1) into their sockets. Be very careful to align the notch on the IC body with corresponding PCB markings.

Then insert the Nixie Tubes into the sockets.

Now power up the PCB, and the tubes should proceed to all count in synchronisation from 0 to 9 repeatedly. If this does not happen, stop and check your work carefully before proceeding.

4.12 GPS / RFT Connector
LS1 - Piezo sounder
Set, Adj, Alarm Buttons
C9 - 0.1F Supercapacitor
C10, C13 - 100nF
D4 - Green GPS / RFT LED
D5 - Yellow Alarm LED

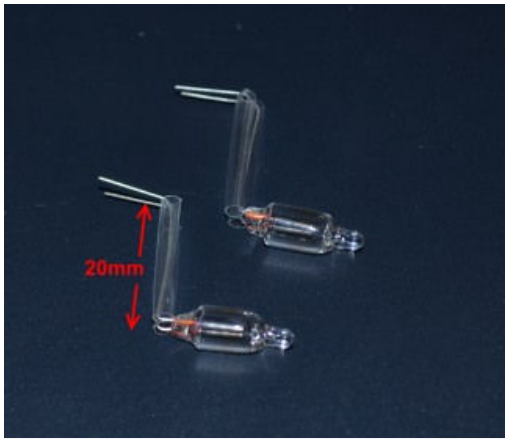
Note that if you won't be using a Radio Time Receiver Module, then you can omit the GPS / RFT Connector, D4 and C13.
C9 is a polarised component. The arrows on the component body should match the arrows on the PCB marking.

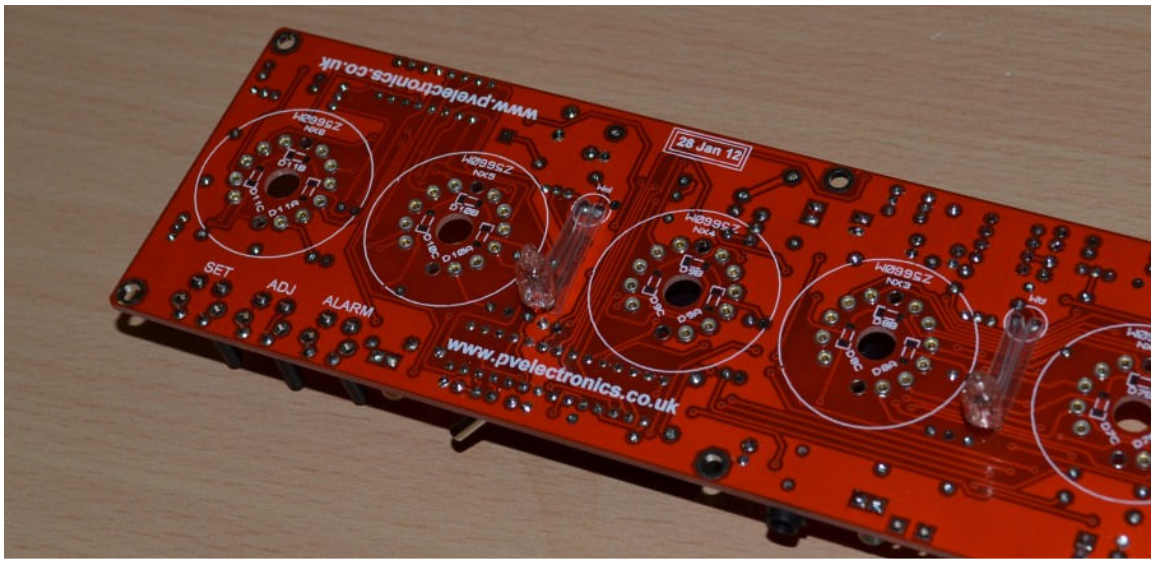


The longer lead of each LED goes in the hole marked '+'.

4.13 AM, PM Colon Neon Lamps

The 2 neons' leads need to be bent as shown below. Use small lengths of the clear insulation supplied on the leads to prevent shorts.





Note that the neons are mounted nearer to the bottom edge of the PCB, which is the edge where the switches and power socket are.

4.14 Microcontroller Tube Selection

The Microcontroller IC3 needs to be setup for your PCB type as the tube connections differ for the 2 types of PCB (ZM1020 / Z560M or IN-4). The controller is by default set to the ZM1020/ Z560M configuration. If you are using this PCB then omit this following step.

For IN-4 boards, proceed as follows. disconnect the power, remove and re-insert IC3 into its socket. Now, press and hold the 'ADJ' button and whilst it is held, re-connect the power supply. IC3 will now be re-configured for IN-4 PCB, and the setting will be retained in flash memory.

If for some reason you need to reverse this, you can do so by repeating the above procedure, which will re-configure the IC for the ZM1020 / Z560M PCB. Each time you follow this procedure, the IC will toggle between the two configurations.

5. OPTIONAL COMPONENTS

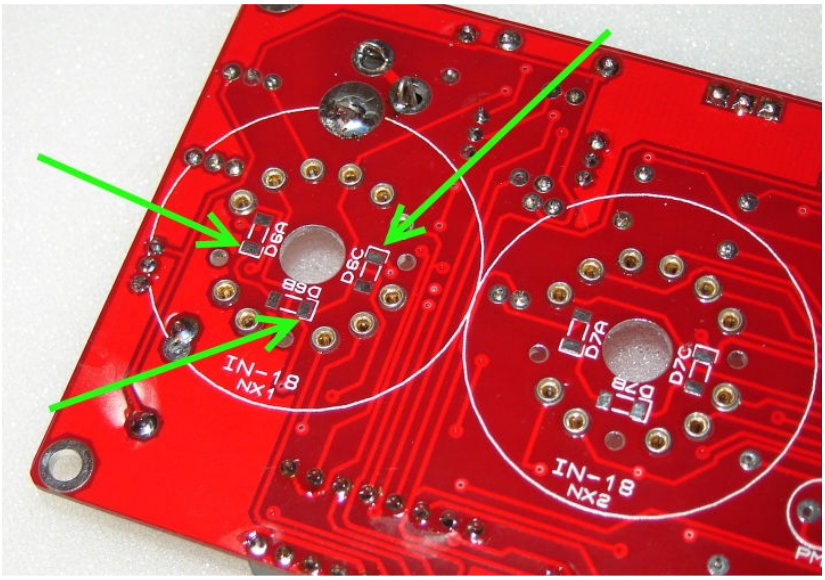
5.1 GPS Input Components

If you will be using a GPS time receiver module, install the following components:
GPS / RFT Connector (if you didn't already install it in step 4.12)
C13 (100nF)
D4 (Green LED)

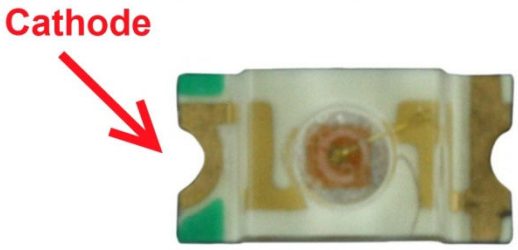
5.2 Tube Underlighting Pack

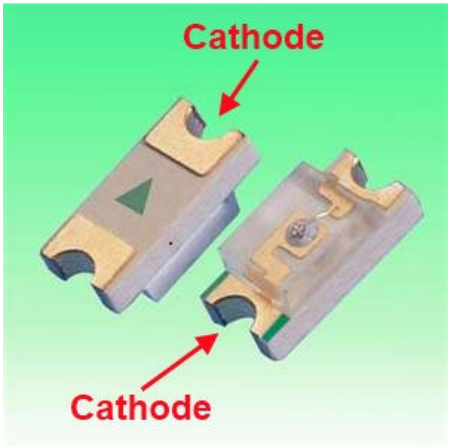
Q14 - 2N7000
R31 – R36 (all 270Ω)
D6A - D11C (18 X 1206 size SMD LEDs)
Three 1206 LEDs per tube provide attractive tube underlighting. Start by installing Q14 and the six 270R resistors.

The procedure for installing the LEDs is the same for all six tube locations. First, identify the white cathode marks on the PCB as shown below:

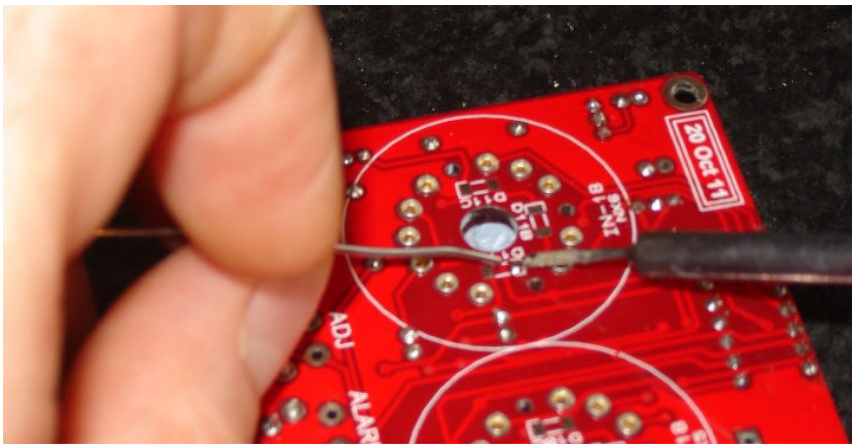


Now identify the cathode mark on the LEDs. This is usually a green marking at one end of the LED, though it may be under the LED lens and harder to see, It may also be an arrow or a line pointing in one direction on the underside of the LED:





With a fine soldering iron tip, melt a small amount of solder onto the three cathode pads of the PCB at a single tube location:



Using tweezers, place the LED over its pads and re-apply the soldering iron briefly to the pad with the solder on. This will re-melt the solder and anchor the LED. Now solder the other pad of the LED.

Repeat this for all LEDs at each tube location, before moving to the next tube location.

6. HOW TO OPERATE THE CLOCK

The four buttons have the following functions:

SET: Exit tube test routine on cold power-up;
Show date;
Set time and date;
Enter configuration menu;

ADJ: Adjust: time, date, alarm time, configuration parameters;
Call DCF / MSF;

ALARM: Set alarm time; snooze; cancel snooze/alarm;
Toggle between DST and Standard Time (+/- 1 Hour)
Enter tube LED setup menu; scroll through LED / time options

Entering configuration mode:
The principal settings of the clock are stored in flash memory – your preferred configuration is stored even after powering off the clock for extended periods. To access the configuration mode press and hold the 'SET' button. After 2 seconds the seconds will become highlighted. Continue holding the button a further 2 seconds until the clock displays in this format:
00-XX-99. The '99' in the seconds digits tells you that you are in the configuration menu.

In configuration mode the hours digits display the current parameter being adjusted, and the minutes digits display the current value stored against the parameter.
For each parameter, and referring to the table below, scroll through the range of possible values by pressing the 'ADJ' button. When the desired value has been reached, move on to the next parameter by pressing the 'SET' button. When the last parameter has been set, pressing 'SET' one more time will revert the clock back to time display mode. The first parameter (0) cannot be changed as it is the software revision number. It will show for several seconds and then move to parameter 1.

In all correspondence on support issues, please quote the board type, revision date and software version.

Parameter	Description	Values
0	Software revision	10 = version 1.0, 11 = version 1.1 etc
1	12 / 24 Hr mode	0 – 12 Hr (default) 1 – 24 Hr
2	Date format	0 = MM.DD.YY (default) 1 = DD.MM.YY 2 = YY.MM.DD (from V1.1 onwards)
3	Leading zero blanking eg. *0*1:54:32	0 – leading zero blanked (default) 1 – leading zero displayed
4	Night Mode start hour	0 - 23
5	Night Mode end hour	0 - 23
6	Night Mode	0 – Tubes off 1 – Dimmed display (default)
7	Master Blank start hour[1]	0 - 23
8	Master Blank end hour[1]	0 - 23
9	Master Blank days[1]	0 – Off 1 – Weekdays 2 - Weekends 3 – All days (default)
10	Colon neons mode	0 – AM/PM Indication, flashing 1 – AM/PM Indication, illuminated 2 – Both flash (default) 3 – Both illuminated 4 – Both off
11	Colon neons during night dimmed mode [2]	0 – AM/PM Indication, flashing 1 – AM/PM Indication, illuminated 2 – Both flash 3 – Both illuminated (default) 4 – Both off
12	Radio time signal source	0 – No Radio Time source (default)[3] 1 – DCF 2 – not used 3 – MSF 4 - GPS
13	GPS Baud rate	0 – 4.8 Kbps (default) 1 – 9.6 Kbps 2 – 19.2 Kbps 3 – 38.4 Kbps
14	Radio time offset hours	0-13 (default 0)[4]
15	Radio time offset mins	0-45 (default 0)[4]
16	Radio time offset polarity	0 - Minus time (default) 1 – Plus time
17	Alarm or DST function on ALARM Button	0 – ALARM Button is DST enable / disable 1 – ALARM Button is for Alarm
18	Snooze period	0 – 6 minutes (default) 1 – 9 minutes 2 – 12 minutes 3 – 15 minutes
19	Reserved – leave as 0	0
20	Time Calibration Factor	0 - 99 (each unit adjusts by 0.2s per day)
21	Time Calibration Polarity	0 - Make clock slower

		1 - Make clock faster
22	Slots Mode[5]	0 – Slots disabled 1 – Slots every minute 2 - Slots every 10 minutes (default) 3 - Slots every hour 4 – Slots at midnight
23	RFT Sync Mode[6]	0 – DCF / MSF Sync once per day only as per parameter 24 (default) 1 – DCF / MSF Sync every hour
24	RFT Daily Sync Hour	0 – 23 (default 2)
25	RFT Seek Blanking	0 – Keep tubes lit for DCF / MSF seek 1 – Blank tubes for DCF / MSF seek (default)
26	Display Mode	0 – standard change of digits 1 – fading digits 2 – fading digits with scrollback effect (default)
27	Auto date display each minute	0 – Off 1 – On (default)[7]
28	Night Mode Override Period	0 – 50 (default 0 gives 15 seconds override)[8]
29	Restore default settings	0 – Keep user settings 1 – Restore original default settings[9]

Notes:

1. Master Blanking Mode has priority over Night Mode. Use to disable the clock on lock is in office), or during office hours (eg clock is at home). Complete HV shutdown to save power and tube life.
2. Night time neons mode is active when night mode is set to dim. During night time blanking the tubes AND neons are disabled.
3. Clock is fully functional without DCF / MSF / GPS synchronisation. Set time manually.
4. Enter your time zone offset from the synchronisation source. Note that GPS transmits UTC.
5. Visual effect / cathode poisoning prevention – all digits on all tubes are cycled for 10 seconds. This setting overrides night blanking or dimming for the duration of the effect (10 seconds).
6. DCF /MSF synchronisation takes place on the hour. If no valid frame is received in 6 minutes, the clock reverts to normal operation.
7. Date will be displayed each minute between 50 and 55 seconds past the minute.
8. Press 'SET' briefly during Night Mode to show time for prescribed period.
9. Set this parameter to '1' to restore original default settings. Internal operations will then load all the original settings and restore the value to '0'

Time and Date:
From time display mode, press and hold 'SET' button for 2 seconds until the seconds digits are highlighted.
Press the 'ADJ' button to reset seconds to zero.

Briefly Press 'SET' again and the hours will be highlighted
Press the 'ADJ' button to set the minutes.

Briefly Press 'SET' again and the hours will be highlighted.
Press the 'ADJ' button to set the hours.

Proceed in this fashion to set the calendar: Year, Month and Day.

Finally, briefly Press 'SET' again to revert to normal clock operation.

Showing Date:
From time display mode, briefly press 'SET' button. Date will be shown for 5 seconds, then revert to time display.

Auto Date Display:
Setting parameter (18) to '1' will enable auto display of date between 50 and 55 seconds past each minute.

Night Blanking Override:
During programmed night blanking, the blanking may be overridden to see the time by briefly pressing the 'SET' button. Tubes will remain lit for the period defined in parameter (8).

Manual RFT Call:
In DCF / MSF modes, pressing 'ADJ' briefly during time display will initiate a manual time seek for maximum 6 minutes, or until a valid time frame is received.

Setting Alarm (if Config 17 = 1)
Press the 'ALARM' Button. The seconds digits show the on / off status of the alarm: 00 or 01 (off or on).

Set on / off status, then minutes followed by hours by using the 'ALARM' and 'ADJ' buttons. When set, the alarm LED will also light.

***Cancelling Alarm*:**
Press 'ALARM' briefly to cancel alarm and enter snooze mode, or a longer press until the clock bleeps, to cancel snooze. Alarm remains set for the next day.

Rapid DST Adjustment (if Config 17 = 0)
Press 'ALARM' briefly to toggle between DST and standard time. The Indicator LED shows whether DST mode is active or not. If time has been synchronised from DCF or MSF sources, this light will be set or cleared automatically. It can still be manually overridden, however the system will re-set the DST status again at the next valid time sync.

Note, that GPS time data does not contain DST information, so the DST status will need to be set manually in GPS sync mode as well as manual time-set mode.

7. CONFIGURING THE LED TUBE LIGHTS

The clock features a separate and dedicated setup menu for the LED tube lights, accessed from the 'ALARM' button. All settings are stored to non-volatile memory.

You can set a brightness of 0 to 9 for each hour of the day.

7.1 Entering LED menu

Press and hold the 'ALARM' button until the display shows:
00:_ X:0 0.
NX4 will not be lit.

- For each hour (0-23), you can set a custom brightness.
- NX1 and NX2 show the hour of the day for which you are setting the LED brightness. NX4 shows the selected brightness.
- Press 'ADJ' to adjust the brightness, as displayed on NX4.
- Once you are happy with the brightness for that hour, press 'ALARM' to move to the next hour.
  After setting up the brightness for hour 23, press ALARM once more to return to time display.

8. USING A RADIO FREQUENCY TIME RECEIVER OR GPS RECEIVER

The clock can automatically synchronise time from DCF (Europe) and MSF (UK) long wave time transmitters.
The clock can also receive time from a GPS receiver that transmits information using NMEA-0183 protocol, using the $GPRMC sentence.

8.1 Configuring for RFT or GPS Synchronisation.

- Set parameter 12:
  - 1: DCF
  - 3: MSF
  - 4: GPS
- If using GPS, set the baud rate in parameter (13)
- Set parameters 14 and 15 for the hours and minutes your time zone is offset from the synchronisation source. This is usually only whole hours. Examples:
  - UK is 1 hour offset from the time transmitted by the DCF transmitter
  - France has no offset from the time transmitted by the DCF transmitter
- Set parameter (16) to identify whether the offset is minus (0) or positive (1) of the time source.
- If using GPS, parameter (17) acts as a DST bit. Set to 1 during DST period, and 0 during standard time period.
- Set parameter (23) to select between hourly seek and daily seek in DCF / MSF modes.
- If you have selected daily seek, use parameter (24) to set the time of the daily seek in DCF / MSF modes.
- If you intend to place the RFT receiver module closer to the clock PCB than 6 ft / 2 metres, the clock will need to disable HV and switch off the tubes for time seek, otherwise the switch-mode power supply will prevent reception. Select blanking during time seek by setting parameter (25) to 1. Leave as 0 to keep tubes lit during time seek.

8.2 Connecting a Radio Time receiver

The clock has been designed for, and tested with our Radio Frequency Time (RFT) Receiver Modules. (available separately from PV Electronics).

DCF Module: For receiving time signals from transmitter at Frankfurt, Germany. Reception is possible within a 2000Km radius of Frankfurt.
MSF Module: For receiving time signals from the transmitter at Anthorn, UK. Reception is possible within the UK, Eire, Northern France, and Norway.

Please note:
1. The long wave signals propagate further at night, so the clock is configured by default to synchronize at 2am.
2. Suitable Power Supplies: If using a switching power supply, it must have an earth connection. Cheap Chinese switching adapters cause too much interference and will not work. Alternatively use an old-fashioned transformer type AC to DC adapter.
3. The time signals are intended that a receiving clock may collect time data intermittently. The signal strength and fidelity is not like a 'TV Signal', where one can get a perfect signal any time at will.

8.3 Setting Up for First Reception.

1. Ensure the correct setting has been applied to Config 12:
   1 = DCF
   3 = MSF

2. For the first tests, ensure Config 25 is set to value 1, to make the HV converter switch off for synchronisation. This stops any noise created by the HV converter.

3. Set Config 14 - 17 for your location's time zone offset from the transmitter.

4. Connect the receiver, and place horizontally by a window, broadside on to the transmitter as far as is possible.

5. Wait until after dark, and preferable the early hours.

6. Command a manual seek, by pressing the middle 'Adj' button. The tubes should switch off. The LED on the receiver module will now not be affected by the HV converter, and after 15-30 seconds start to flash regularly, showing the one pulse per second data from the transmitter. If your Module's red LED does not start to flash regularly, go back and check 1-6. of this section. If the red LED does not flash regularly, you will not get synchronisation!

7. At the start of the minute, the clock should start collecting data, and if so it will start flashing the green LED rapidly. Look for any LED activity at the start of the minute, using a known time source as the reference.

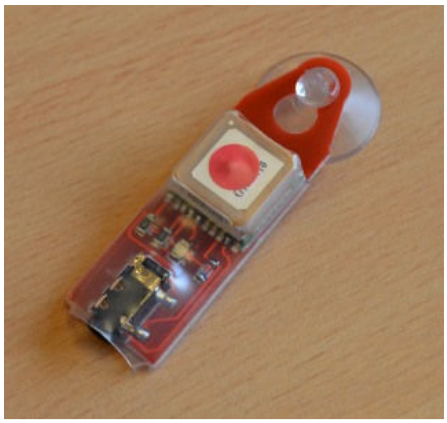
8. After 60 seconds of gathering data, the clock will illuminate the green LED, set the time and switch the tubes back on.

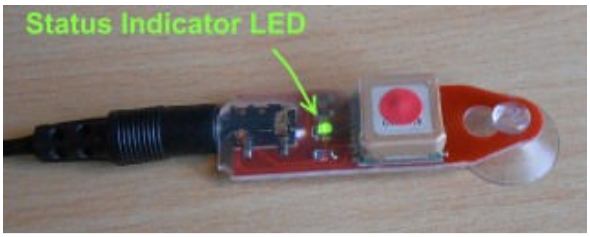
9. Once the system has been seen to work correctly, you can experiment with the antenna in different locations, and it may be possible to have the tubes stay on for time synchonisation.

10. Many other electrical applicances such as TVs and mobile phones reception when in close proximity. Metal objects cause reception problems too Place and design your case so the antenna is as far away from the PCB as possible.

8.4 Connecting a GPS receiver

The clock accepts input directly from our GPS Sync Time Receiver Module:

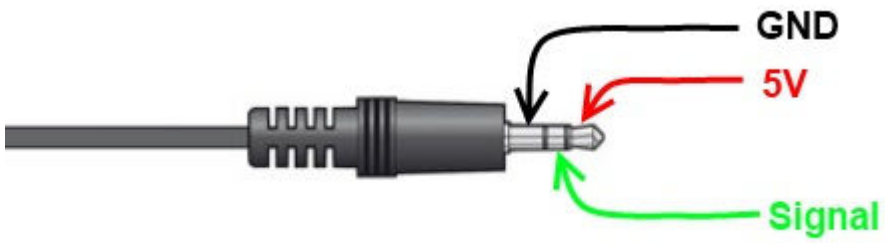




Please see the separate data sheet for the GPS receiver to find out the baud rate of your module, as different baud rates are used depending upon the version number.

Connection to the clock is made with a 3.5mm male / male cable of 3m / 10ft length.

Connections at the jack socket / plug are as follows:



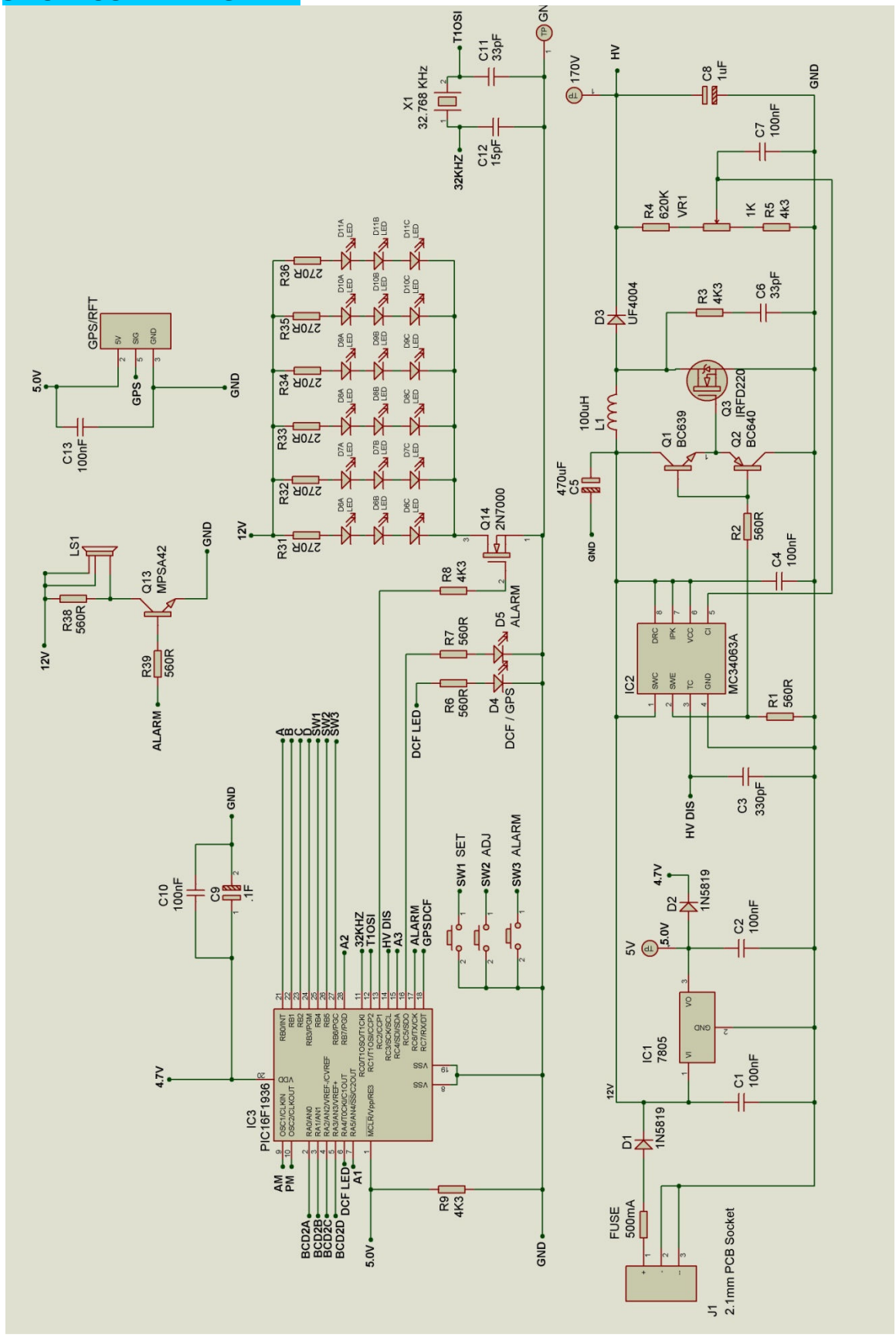
8.5 Function of the GPS / RFT indicator LED (D4):

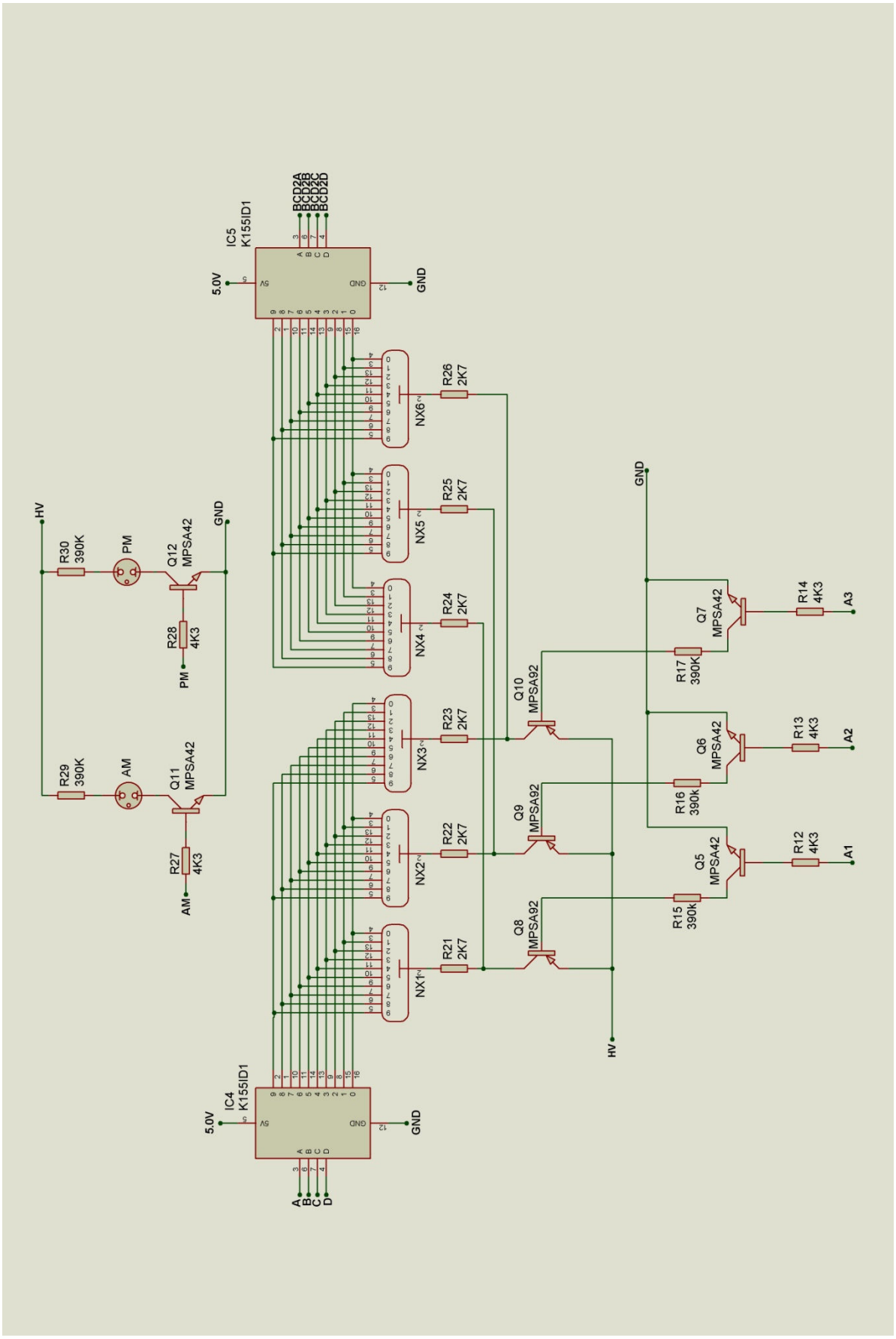
- *No Radio Synchronisation source installed (parameter (12) = 0)*
  LED is permanently off
- *RFT or GPS Synchronisation enabled (parameter (12) = 1-4)*
  The LED will be ON if the clock has synchronised in the last two hours; slowly flashing if the last synchronisation was between 2 hours and 24 hours ago; and off if the last synchronisation is older than 24 hours.
- Whilst seeking DCF or MSF the LED will flash very briefly once per second. Additionally, the indicator will flash rapidly whilst the clock is actually receiving and processing a valid time frame.

  The function of the RFT indicator LED may be summarised in the table below:

Radio Time Source	**Seeking DCF / MSF Frame**	**Aquiring DCF / MSF Frame**	**Sync < 2 Hrs**	**Sync >2 Hrs Sync < 24 Hrs**	**Sync > 24 Hrs**
None	-	-	Off	Off	Off
DCF / MSF	Brief flash each second	Fast Flash	On	Slow Flash	Off
GPS	-	-	On	Slow Flash	Off

9. CIRCUIT DIAGRAM




BCD2A
BCD2B
BCD2C
BCD2D
IC5
K155ID1
5.0V
GND
HV
R30
390K
PM
Q12
MPSA42
R28
4K3
R29
390K
AM
Q11
MPSA42
R27
4K3
NX6
NX5
NX4
NX3
NX2
NX1
R26
2K7
R25
2K7
R24
2K7
R23
2K7
R22
2K7
R21
2K7
Q10
MPSA92
Q9
MPSA92
Q8
MPSA92
Q7
MPSA42
Q6
MPSA42
Q5
MPSA42
R17
390K
R16
390k
R15
390k
R14
4K3
R13
4K3
R12
4K3
A3
A2
A1
IC4
K155ID1
A
B
C
D