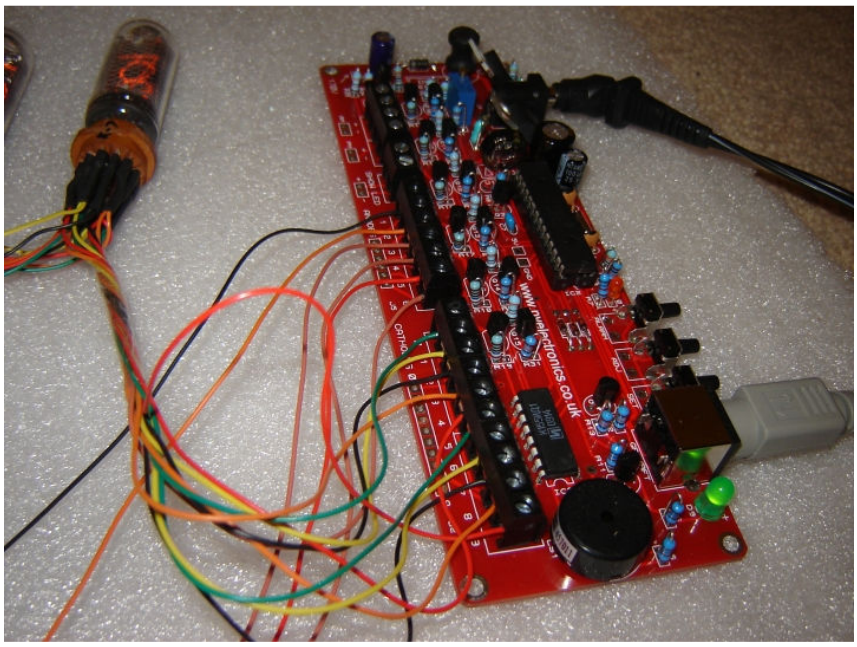
Assembly Instructions
And
User Guide

Nixie Clock Type 'Dink'



REVISION HISTORY

Issue Number	Date	Reason for Issue
9	10 November 2017	Modification to 5V Power Circuit
8	17 November 2013	WWVB no longer supported
7	19 June 2012	Different Inductor type added
6	30 May 2012	New Board revision 18 May 12
5	5 Feb 2012	Errors corrected
4	28 Jan 2012	Errors corrected, new C4 value
3	24 Jan 2012	Revised for new PCB dated 1 Jan 12
2	08 July 2011	Errors in schematic corrected
1	29 May 2011	New document

1. INTRODUCTION

1.1 About the clock

Nixie clock type 'Dink' is a Nixie Clock Driver PCB, specially designed for driving remotely-placed tubes. Connections are provided for simple wiring of tubes using a multiplex configuration. Connections may be made at the board by either screw terminals (supplied), direct solder connections or 0.1" pin headers/ sockets.

1.2 Clock Features

Nixie clock type 'Dink' has the following features:

- Tubes connected remotely via screw terminals or pin headers
- 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
- Output for 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 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. It is more efficient for the user to buy a suitable adapter locally. This saves shipping a heavy adapter with the kit, and also the extra costs of managing stocks of many varied power adapters. If you are using a WWVB, DCF or MSF receiver, it is recommended to avoid switching regulators as they can cause a lot of interference issues.
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 250 mA.
Output plug: 2.1mm pin, centre positive.

A suitable adapter is shown below:

3. LIST OF COMPONENTS

3.1 Table of components

Circuit Designation	Part Description
Resistors	
R1	390K, ¼ Watt
R2	4.3K, ¼ Watt
R3	10K, ¼ Watt
R4	390K, ¼ Watt
R5 – R7	560R, ¼ Watt
R8 - R10	10K, ¼ Watt
R11	560R, ¼ Watt
R12, R13	10K, ¼ Watt
R14 - R19	2K7, ¼ Watt
R20 – R25	390K, ¼ Watt
R26 – R33	10K, ¼ Watt
R34, R35	390K, ¼ Watt
Capacitors	
C1, C2	100nF Ceramic
C3	1uF, 250V, Electrolytic
C4, C5	33pF Ceramic
C6	0.22F
C7	100nF Ceramic
C8	470uF 16V Electrolytic low ESR
C9	100nF Ceramic
Transistors	
Q1	IRFD220 MOSFET
Q2, Q3	MPSA42 NPN
Q4 – Q9	MPSA92 PNP
Q10 – Q17	MPSA42 NPN
Diodes	
D1, D3	1N5817 or 1N5819
D4	UF4004
D5 – D8	1N4148
D9	5mm Green LED
D10	5mm Yellow LED
Integrated Circuits	
IC1	7805 5V voltage regulator
IC2	PIC16F1936 8-bit microcontroller
IC3	K155ID1 Nixie driver
Miscellaneous	
L1	100uH inductor
SW1, SW2, SW3	Miniature push button
VR1	1K Potentiometer
IC Socket	28 Way IC socket for IC2
J1	2.1mm PCB power socket
GPS / RFT	3.5mm Jack socket connector
LS1	Piezo sounder
FUSE	500mA resettable Fuse
Tube Connectors	2.5mm pitch screw terminals
X1	32.768KHz watch crystal

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.

Note that there is no D2 or D5.

The fuse is a resettable type, and looks similar to the picture below, so don't confuse it with a capacitor.

3.2 Parts list / Packing sheet

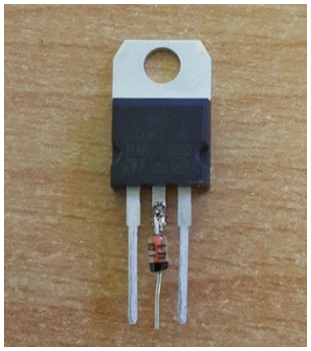
Part Description	Quantity
Resistors	
560R, ¼ Watt	4
2.7K, ¼ Watt	6
4.3K, ¼ Watt	1
10K, ¼ Watt	12
390K, ¼ Watt	10
Capacitors	
470uF, 16V, Electrolytic, low ESR	1
1uF, 250V, Electrolytic	1
100nF, Ceramic	4
33pF, Ceramic	2
0.22F	1
Transistors	
IRFD220 MOSFET	1
MPSA92 PNP	6
MPSA42 NPN	10
Diodes	
1N5817 or 1N5819	2
UF4004 fast recovery diode	1
1N4148	4
5mm Green LED	1
5mm Yellow LED	1
Integrated Circuits	
7805 5V voltage regulator	1
PIC16Fxxxx 8-bit microcontroller	1
K155ID1 Nixie driver	1
Miscellaneous	
100uH inductor	1
Miniature push button	3
1K Potentiometer	1
28 way IC Socket for IC2	1
2.1mm PCB power socket	1
3.5mm Jack socket connector	1
Piezo sounder	1
500mA resettable fuse	1
2-Way terminal connector	5
3-Way terminal connector	4
32.768KHz watch crystal	1

It is recommended that the kit is checked against the list 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.

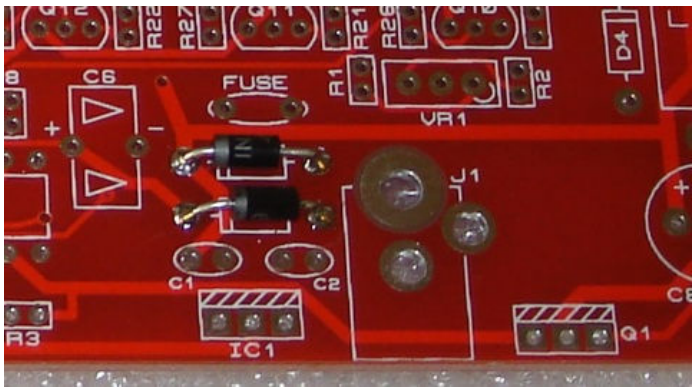
4. ASSEMBLY OF THE PCB

4.1 Low Voltage Power Components:
D1 and D3 (1N581x)
D5 (1N4148)
IC1 (7805)
C1 and C2 (100nF)
J1 (DC Connector), FUSE

Parts bags from serial 0691 onwards require a 1N4148 diode to be inserted into the middle leg of the 7805 voltage regulator. First, clip the middle lead so it is 4-5mm long, then solder the diode as shown. It can be then used as per the remaining instructions. But please note, the photos in the rest of the instructions show the 7805 without this addition.

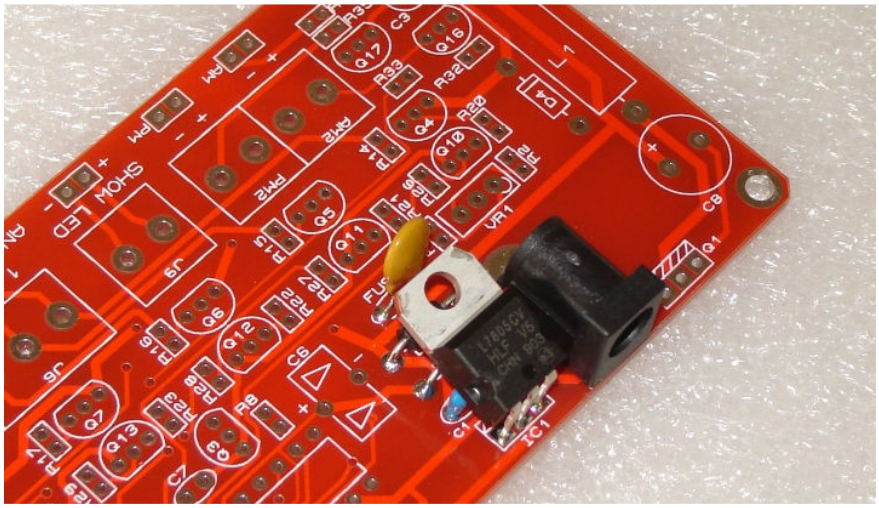


Start assembly of the PCB by installing D1 and D3. Align the white band on the components with the band marked on the PCB. Then mount C1 and C2.



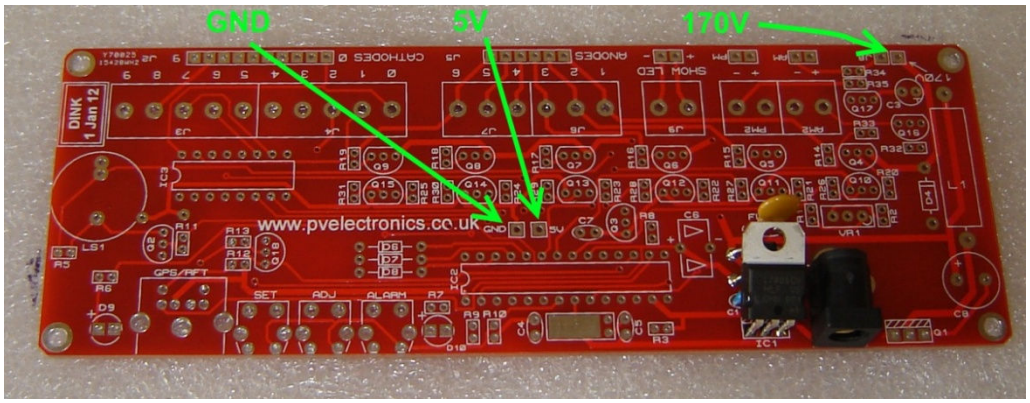
4.2 Continue to mount IC1 with D5 attached. After placement, IC1 can be placed and bent over to reduce the height of the assembled PCB. The fuse and J1 may now be placed in position.

The PCB should now look like the picture below, but with the addition of the diode D5 to the middle lead of IC1:



4.3 4.2 Testing Low Voltage 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 5.3 and 5.7 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:

R1 (390K), R2 (4.3K) and R3 (10K)
Q1 (IRFD220)
D4 (UF4004)
C3 (1uF 250V)
C8 (470uF, 16V)
VR1 (1K)
L1 (100uH inductor)
Socket for IC2

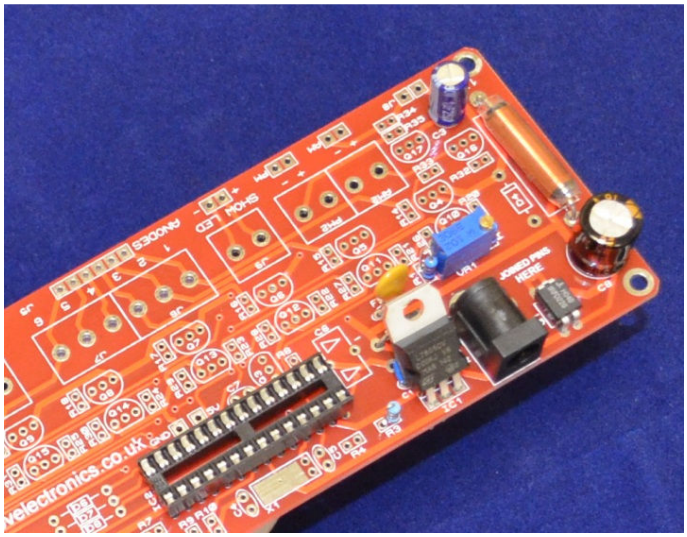
Note that due to part availability, one of two types of inductor may be supplied. An Axial inductor will fit the PCB marking easier. If you have the radial part, refer to the photograph on the next page for mounting instructions.

Pay attention to mount D4 with the white band aligned with the PCB marking. Insert the 28 way IC socket into the PCB at the IC2 position, ensuring that the notch at one end is aligned with the corresponding marking on the PCB.

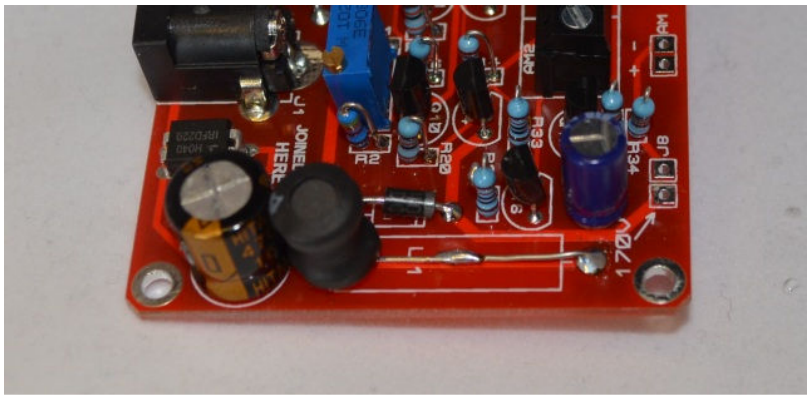
Q1 has two pins that are joined together. The orientation of the joined pins is marked on the PCB.

Resistors R1-R3, indeed all the resistors on the board need to be mounted upright to save space. The leads need to be formed as shown below. Bend the leads of each resistor as shown and solder in to the correct postion, making sure the component body is as close to the board as possible.

After installation of step 4.3 components, this is how the PCB should look:



If your kit contains the radial inductor, use a short piece of wire to extend one lead of the inductor as shown below:



4.4 High Voltage Generator Test.

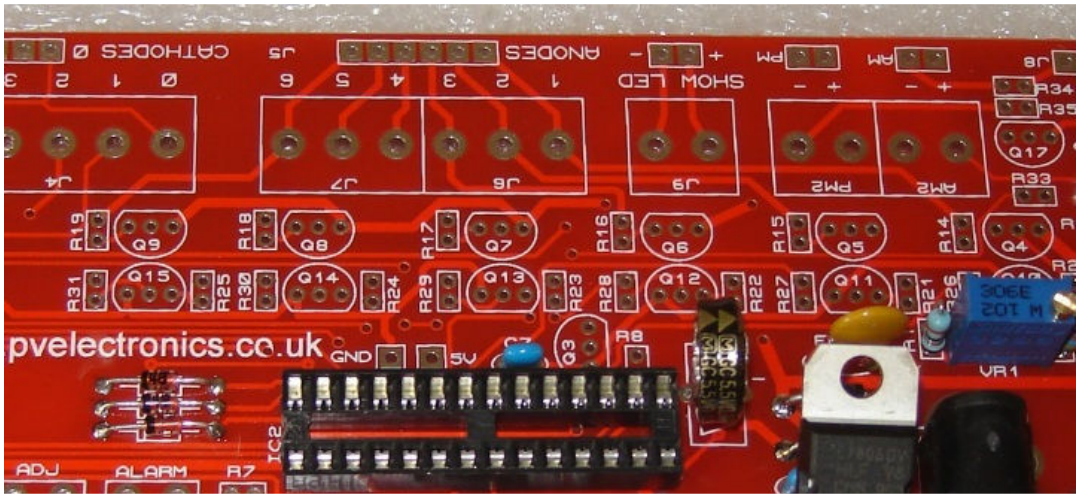
- Refer to the warnings on page 4
- Insert IC2 into its socket. Orient the notch on the IC with the notch on the IC socket and the PCB marking.

Power up the PCB, and using the GND and 170V test points, measure the high voltage generated. It should be initially 150-190V. Using the VR1 brass screw, slowly adjust the screw until the voltage is between 168 and 172V. Disconnect the power supply.

Finally, remove IC2 from its socket and replace on its static-protective foam. It is best kept safe until later.

4.5 D6 - D8 (1N4148)
C6 (0.22F)
C7 (100nF)

C6 is a high capacity 'Super Capacitor', intended to keep the processor powered for short periods in the event of a main power failure. It is vital that it is placed in the correct orientation. See below. There are arrows on the component that need to be pointing the same way as the arrows on the PCB.

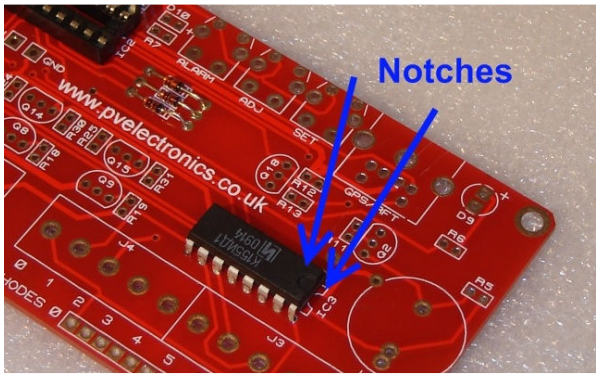


4.6 C4 and C5 (33pF)
X1 (32.768 Khz Crystal)

These are the timekeeping components: 32.768KHz crystal and two load capacitors.

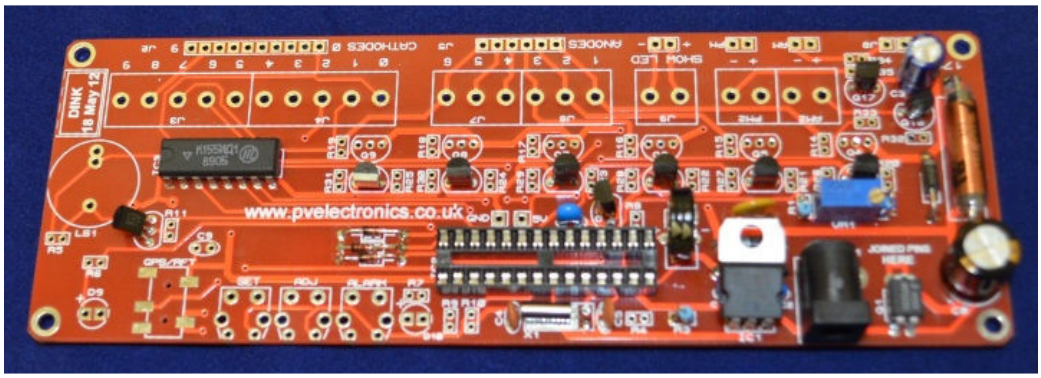
4.7 IC3 (K155ID1 Nixie Driver IC)

Align the notch on the IC body with the corresponding PCB mark. See below:



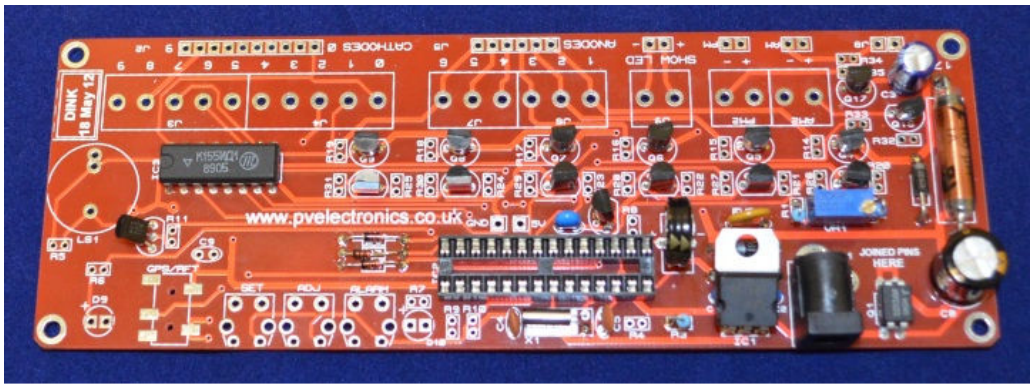
4.8 Q2, Q3, Q10 – Q17 (All MPSA42)

After placement of these 10 transistors, the board should look like this:



4.9 Q4 – Q9 (All MPSA92)

After placement of these 6 transistors, the board should look like this:



4.10 R20 – R25 (390K)
R26 – R31 (10K)

R14 – R19

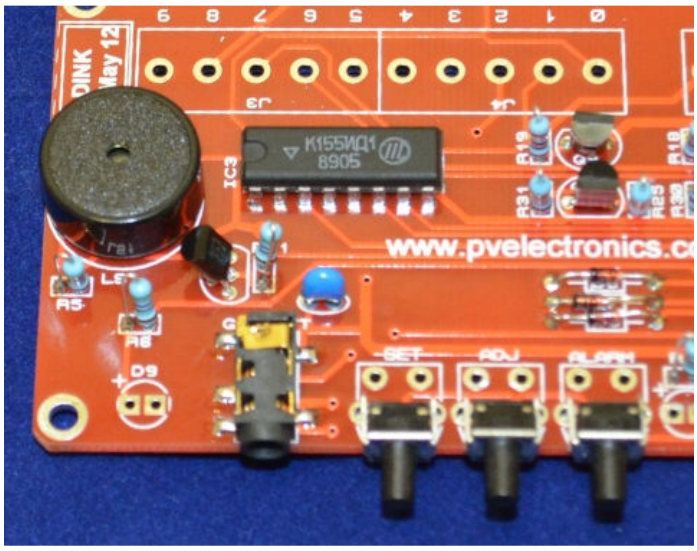
These are the current limiting resistors for the Nixie Tubes. For medium sized tubes with a current requirement of 2-3mA per digit, 2.7K are recommended and these are the value supplied. If your tubes differ from this requirement, you will need to calculate and supply an alternative value.

See picture below:

4.11 R8 - R10, R32, R33 (all 10K)
R5, R6, R7, R11 (560R)
R4, R34, R35 (390K)

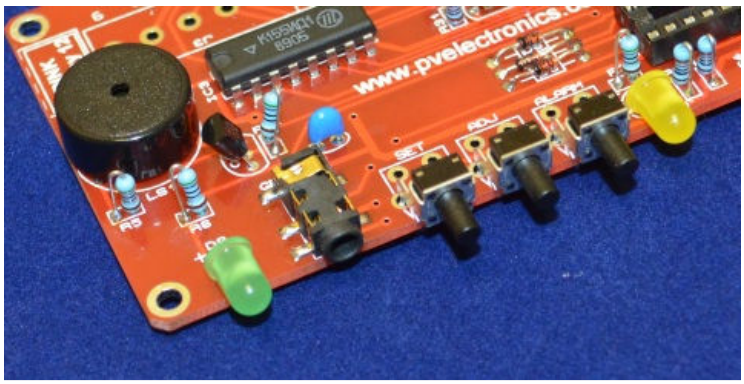
If you are going to use LEDs for the AM / PM colon indicators then do not install R34 and R35 at this stage. Refer to step 6.2

4.12 ALARM, ADJ, SET Switches
GPS / RFT Connector
C9 (100nF)
LS1 (Piezo buzzer)



4.13 D9 (5mm Green LED)
D10 (5mm Yellow LED)

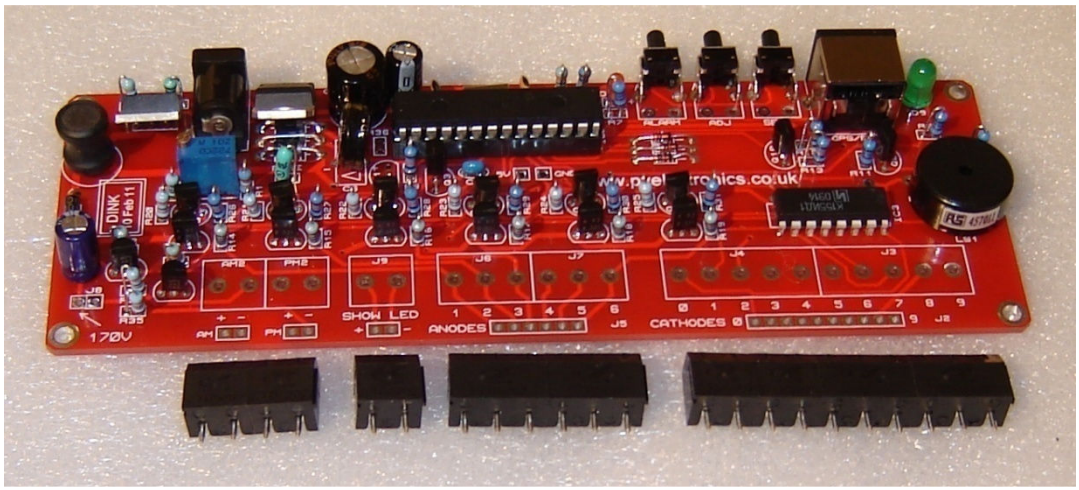
These two LEDs should be mounted with the longer lead in the hole marked +. You can choose to mount them facing sideways like the switches, or vertically.



4.14 Screw Terminal Connectors

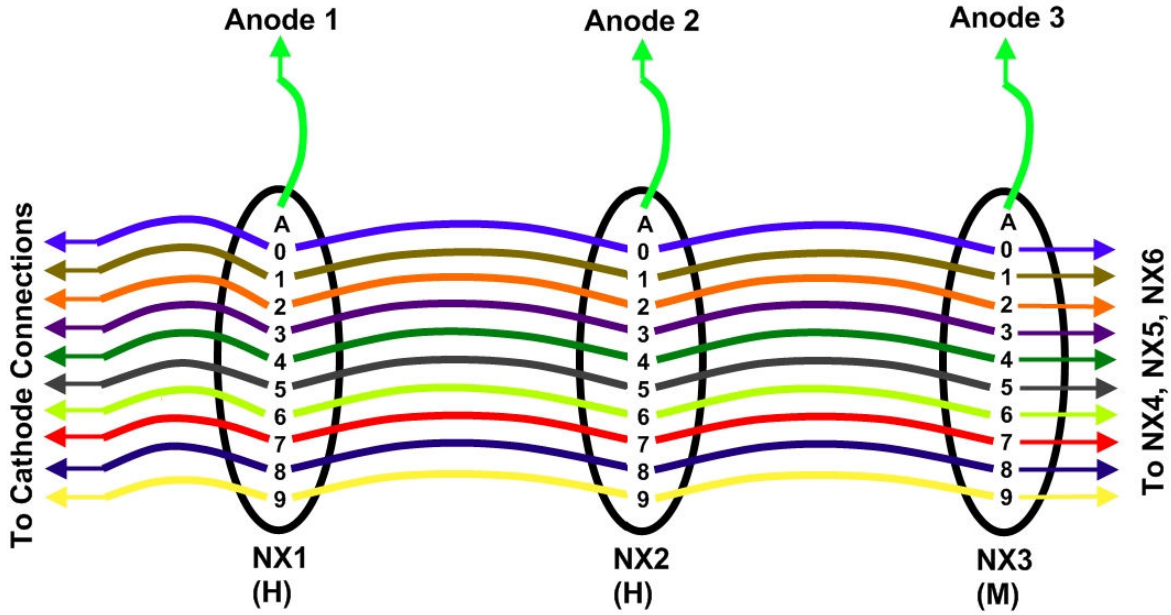
Note that the screw terminals may be omitted and the tube connections made either by direct solder connections or by using the subsidiary 0.1” spaced pin – terminal headers.

Make up the screw terminal connectors into blocks by sliding together to attach as shown below:



5. CONNECTING THE NIXIE TUBES

5.1 Referring to the diagram below, connect all the same cathodes from each tube together. This is because this is a multiplex design, so all the cathodes for each digit are connected, and each anode is energised in turn. Only the first 3 tubes are shown, however NX4, NX5 and NX6 are connected in exactly the same manner.



There will be just 16 wires from the tubes leading back to the PCB (10 for the cathodes and 6 for the anodes). Connect to either the screw terminals or the pin headers (via sockets / pins if you wish)

6. CONNECTING THE OTHER INDICATORS

6.1 About the colon indicators

Provision is made for two multifunction colon indicators – they can be set to flash the seconds, indicate AM /PM, or a combination of both. Each colon (AM or PM) has a + and a – terminal. The indicators can be either neon lamps or LEDs.
The indicators are fed from point J8. This needs to be connected to either 170V (for neons) or 5V (for LEDs)

6.2 Neon lamps for the colon indicators

Locate J8 – it is adjacent to the 170V test point. Solder a small connection between J8 and the 170V test point.
Now wire up small indicator neons to the AM and PM connection points. If the brightness needs to be adjusted, you can change the values of resistors R34 and R35 as appropriate

6.2 LEDs for the colon indicators

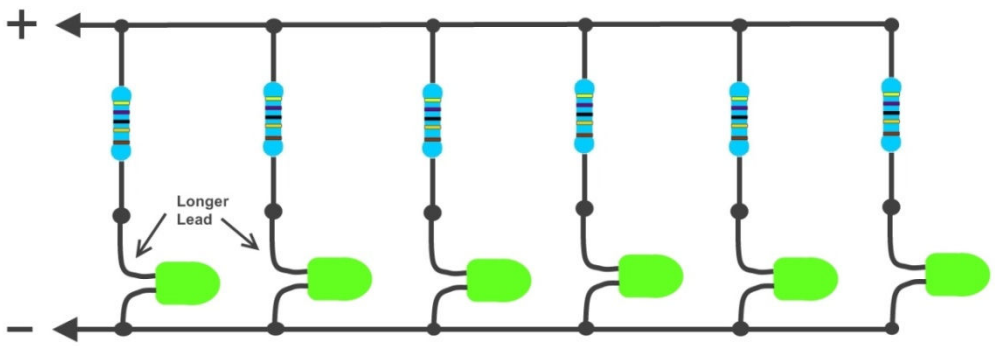
Locate J8 – it is adjacent to the 170V test point. Make a small wire connection between J8 and the 5V test point.
Install suitable current limiting resistors for R34 and R35. Do not draw more than 30mA per LED.

6.3 Show LEDs

Provision is made in hardware and software for a series of 'Show' LEDs that illuminate the tubes for added attraction. If you do not want this feature, you may omit these.

6.4 Connecting Show LEDs

Connect up the LEDs as shown below to the + and – Show Terminal Connections. Use appropriate current limiting resistors, calculated to draw no more than 20mA per LED.The LEDs are powered by 12V DC.



7. HOW TO OPERATE THE CLOCK

The three buttons have the following functions:
SET: Exit tube test routine on cold power-up;
Show date;
Set: time, date;
Enter configuration menu;
ADJ: Call DCF / MSF;
Adjust: time, date, alarm time, configuration parameters;
ALARM: Set alarm time; snooze; cancel snooze/alarm;

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 3 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 diplay 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	30 = version 3.0, 31 = version 3.1 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
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 (default) 1 – Dimmed display
7	Display mode	0 – standard change of digits(default) 1 – fading digits
8	Night mode override period (minutes)	0 – 50 (default 3) [1]
9	Snooze period	0 – 6 minutes (default) 1 – 9 minutes 2 – 12 minutes 3 – 15 minutes
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 - reserved 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	Disable /Set DST in GPS mode	0 – No DST offset 1 – 1 hour DST offset[5]
18	Auto date display each minute	0 – Off 1 – On (default)[6]
19	LED backlights	0 - Always off 1 - Always on 2 - On, and follows tube nightblanking (default)
20	Crystal calibration value	0 - 99[7] Each increment equals 0.2 sec per day

21	Crystal calibration polarity	0 - Make clock run slower[7] 1 - Make clock run faster
22	Slots Mode[8]	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[9]	0 – DCF / MSF Sync once per day only as per parameter(24) 1 – DCF / MSF Sync every hour (default)
24	RFT Daily Sync Hour	0 – 23 (default 2)
25	RFT Seek Blanking	0 – Keep tubes lit for DCF / MSF seek (default) 1 – Blank tubes for DCF / MSF seek
26	Reserved – leave as 0	0
27	Reserved – leave as 0	0
28	Restore default settings	0 – Keep user settings 1 – Restore original default settings[10]

Notes:

1. Press 'SET' briefly during blanking to show time for prescribed period.
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 WWVB transmits UTC.
5. In GPS Sync mode, this parameter is used to set DST. Set to '1' during DST.
6. Date will be displayed each minute between 50 and 55 seconds past the minute.
7. Use parameters 26 and 27 to tune the crystal timebase. Each increment of parameter 26 makes an adjustment of approx 0.2 sec per day.
Set the clock against a known time standard. Note the time drift after 5 full days (120 hours). This is the value to program into parameter 20. Program parameter 21 with 0 or 1 to make the clock slower or faster.
8. 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).
9. DCF /MSF synchronisation takes place on the hour. If no valid frame is received in 6 minutes, the clock reverts to normal operation.
10. Set this parameter to '1' to restore original default settings. Internal operations will then load the original factory settings and restore the value to '0'

Setting the 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:
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.

***Canceling 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.

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
  - 2: unused
  - 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.
- 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.

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.

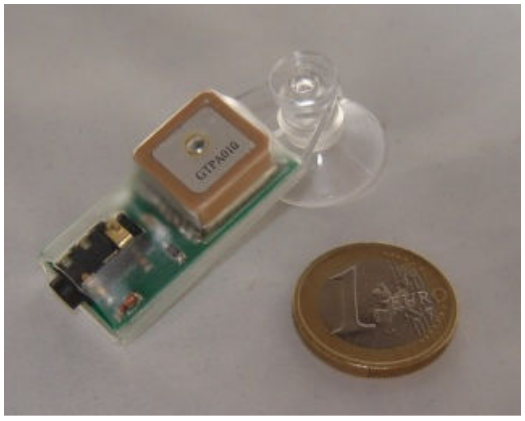
8. After 60 seconds of gathering data, the clock will illuminate the green LED, set the time and switch the tubes back on.

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 has been designed for, and tested with our Micro GPS Receiver (available separately from PV Electronics)



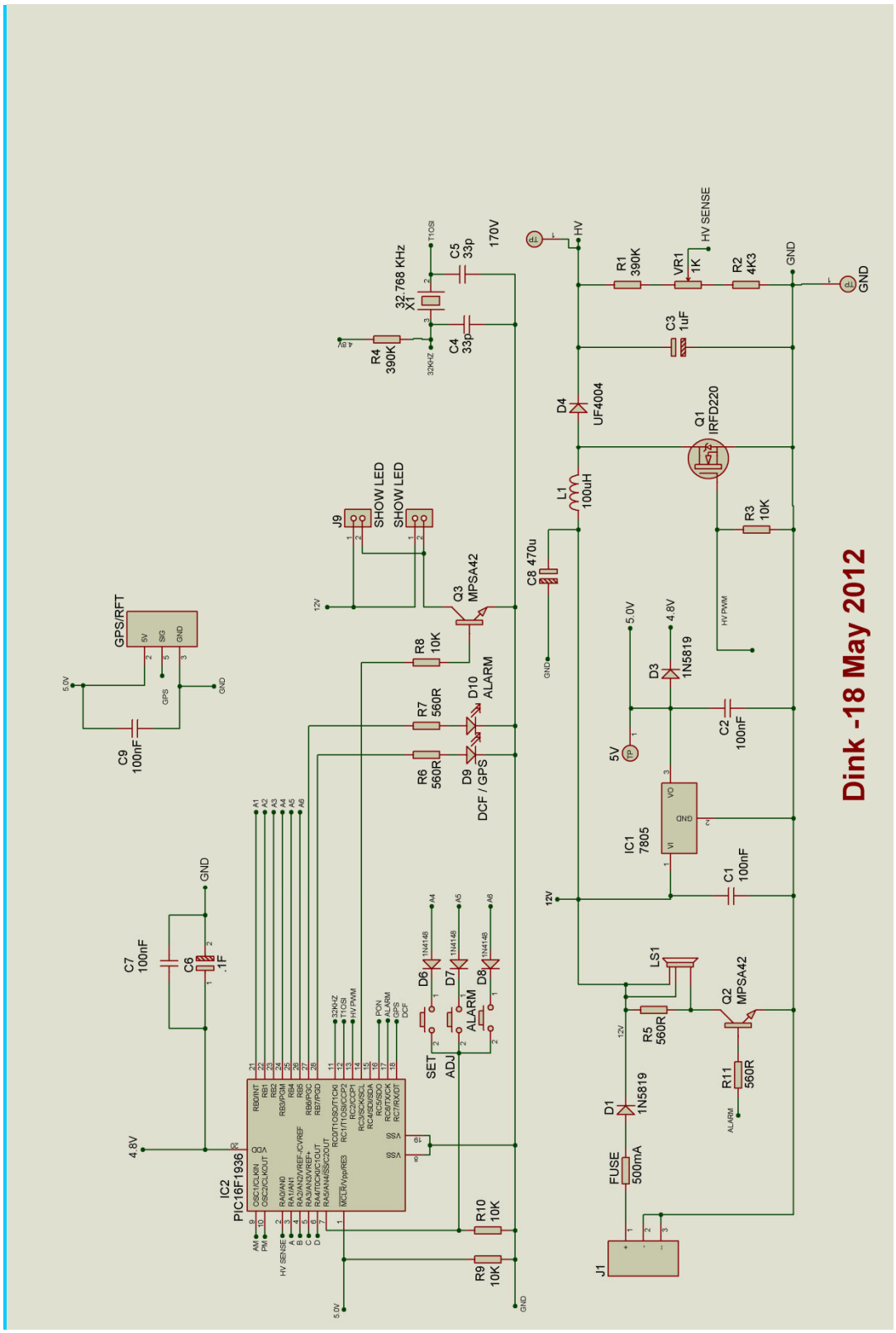
8.5 Function of the GPS / RFT indicator LED (D9):

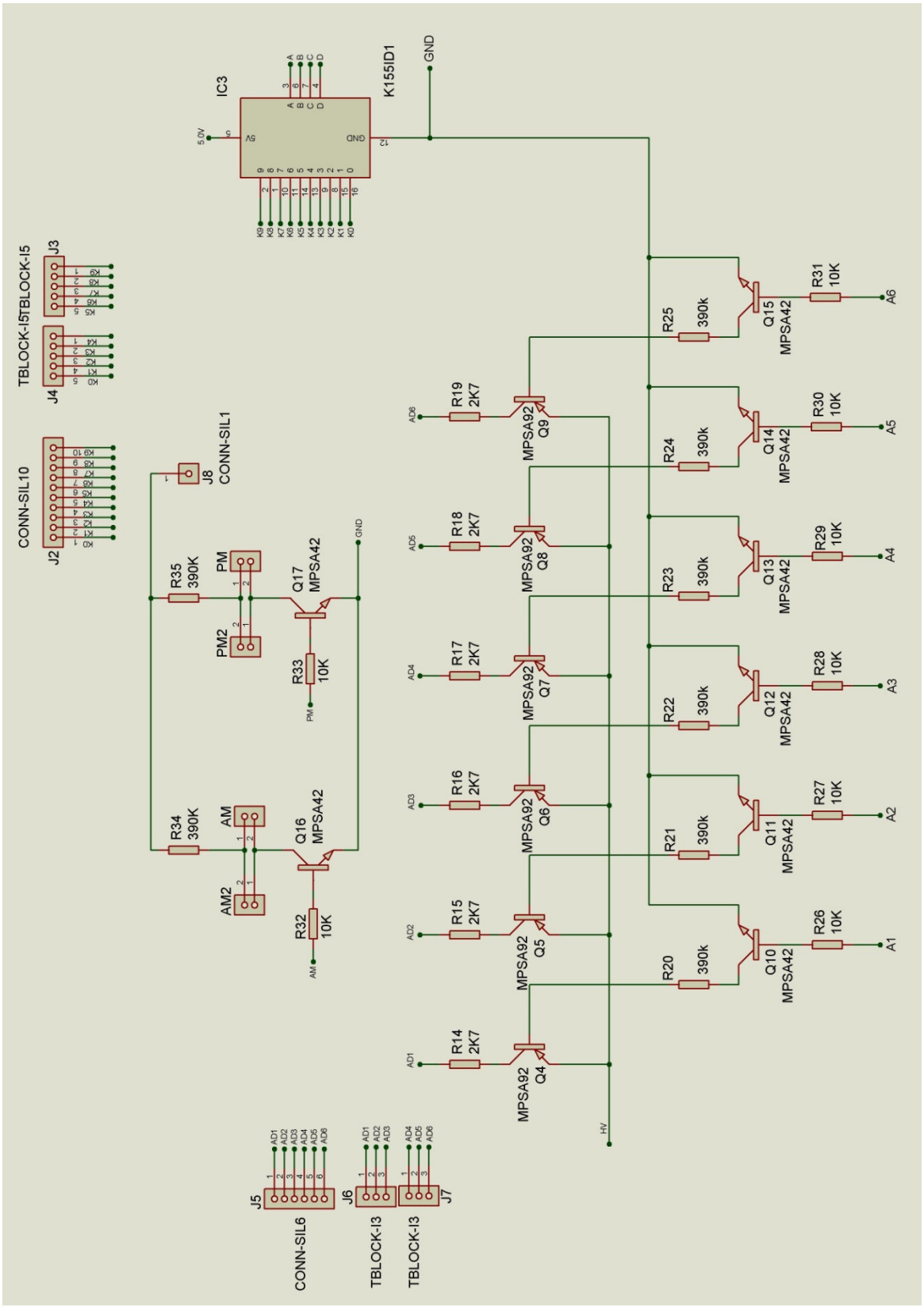
- *No Radio Synchronisation source installed (parameter (12) = 0)*
  LED is permanently off
- *RFT or GPS Synchronisation enabled (parameter (12) = 1-4)*
  The LED will be ON if the clock has synchronised in the last two hours; slowly flashing if the last synchronisation was between 2 hours and 24 hours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

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

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

9. CIRCUIT DIAGRAM




IC3
K155ID1
GND
5.0V
TBLOCK-I5
J3
J4
CONN-SIL10
J2
J8
CONN-SIL1
PM
PM2
AM
AM2
R35 390K
R34 390K
R33 10K
R32 10K
Q17 MPSA42
Q16 MPSA42
R19 2K7
R18 2K7
R17 2K7
R16 2K7
R15 2K7
R14 2K7
MPSA92 Q9
MPSA92 Q8
MPSA92 Q7
MPSA92 Q6
MPSA92 Q5
MPSA92 Q4
R25 390k
R24 390k
R23 390k
R22 390k
R21 390k
R20 390k
Q15 MPSA42
Q14 MPSA42
Q13 MPSA42
Q12 MPSA42
Q11 MPSA42
Q10 MPSA42
R31 10K
R30 10K
R29 10K
R28 10K
R27 10K
R26 10K
A6
A5
A4
A3
A2
A1
HV
J5
CONN-SIL6
J6
TBLOCK-I3
J7
TBLOCK-I3