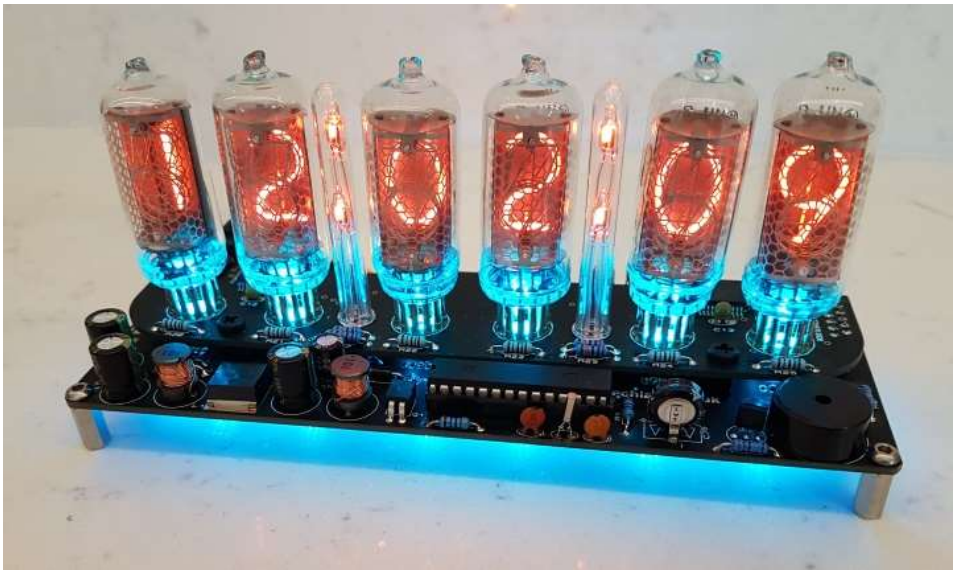
Assembly Instructions
And
User Guide

‘Elite Nixie’
For Parts Bag Serial Numbers from 1000 onwards



REVISION HISTORY

Issue Number	Date	Reason for Issue
5	05 March 2023	Changed values for C5, C6
4	13 June 2019	Added Dekatron Sync Pulse support from V2.2 code and parameter 23 to control it.
3	25 July 2018	Improved NL840 neon details ZM1000 Tube details added
2	07 June 2018	Added more NL840 details
1	04 May 2018	New document

1. INTRODUCTION

Here are the key features of the ELITE Nixie:

- Hours, Minutes and Seconds display
- Direct drive to six medium size Plug-in Nixie Tubes
- Supports IN-8, ZM1000, NL840, NL841, NL842, NL844, NL845, NL846, NL900, NL901 and CK8754
- Noiseless, Direct Drive giving optimum digit clarity
- Uses a Quartz Crystal Oscillator as the timebase
- 12 or 24 hour modes
- Programmable leading zero blanking
- Date display in either DD.MM.YY or MM.DD.YY or YY.MM.DD format
- Programmable date display each minute
- Scrolling display of date or standard display
- Alarm, with programmable snooze period
- Optional GPS / XTERNA synchronisation with status indicator LED
- Dedicated DST button to switch between DST and standard time
- Supercapacitor backup. Keeps time during short power outages
- PIR Motion Sensor input and accessory available. Configurable timeout period
- Simple time setting using two buttons
- Configurable for leading zero blanking
- Double dot colon neon lamps
- 11 colon neon modes including AM / PM indication (top / bottom or left / right), railroad (slow or fast) etc.
- 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
- Rear Indicator LEDs dim at night to prevent sleep disturbance
- Weekday aware 'Master Blank' function to turn off HV/ tubes and LEDs on weekends or during working hours
- Separate modes for colon neons during night mode
- Standard, fading, or crossfading with scrollback display modes
- 'Slot Machine' Cathode poisoning prevention routine
- Programmable RGB tube lighting – select YOUR favourite colour palette
- 729 colours possible. Have a different colour or your choosing every hour, or autochanging colours
- Not AC frequency dependent – works in all countries
  Supports output Sync Pulse for our DekaDuo Dekatron Driver Board
- All user preferences stored to non-volatile memory
- Additional wireless functions if XTERNA module used:
  - Display of outdoor temperature in Celsius or Fahrenheit.
  - Min / Max temperature in last 24 hours
  - Wireless, Auto Sync of time from GPS with auxilliary TCXO
  - GPS Sync time, and time since last GPS Fix
  - Voltage of XTERNA module battery

1.4 SAFETY

DANGER: The clock pcb includes a switched-mode voltage booster circuit. This generates nominally 170 Volts DC. 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 to trim the excess component leads after soldering. (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.
- A small hot air gun will be needed to shrink the heat shrink tubing over the neon lamp wires.

2.2 Materials you will need.

Solder – lead / tin solder is highly recommended.

USE LEAD/ TIN SOLDER!

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.

The following type of adapter should be obtained and used with the kit:

Output 12V DC regulated, minimum power output capability of 500mA
Output plug: 2.1mm pin, centre positive.

A suitable adapter is shown below:

3. LIST OF COMPONENTS

3.1 Table of Components – Driver Board

Circuit Designation	Part Description
Resistors	
R1	4.7 KΩ, ¼ Watt
R2	390 KΩ, ¼ Watt
R3	4.7 KΩ, ¼ Watt
R4, R5, R6	270 Ω, ¼ Watt
R7	4.7 KΩ, ¼ Watt
R8, R9, R10	270 Ω, ¼ Watt
Capacitors	
C1, C2	220uF 16-25V Electrolytic
C3	1uF, 250V Electrolytic
C4	220uF 16-25V Electrolytic
C5	22pF Ceramic
C6	47pF Ceramic
C7	0.22F Supercapacitor
C8, C9	100nF
Transistors	
Q1	IRFD220
Q2	MPSA42
Diodes	
D1, D2	1N5819
D3	1N4148
D4	1N5819
D5	UF4004
D6, D7, D8	3mm Yellow LED
RGB1 – RGB6	APA106 RGB LED
Integrated Circuits	
IC1	LM2576 5V voltage regulator
IC2	PIC16F1938 in socket
Miscellaneous	
L1, L2	100uH inductor
ALARM, SET, ADJ, DST	Miniature push button
IC2 Socket	28 Way narrow IC socket for IC2
PWR (12V IN Socket)	2.1mm PCB power socket
GPS, PIR	Surface mount 3.5mm jack socket
LS1	Piezo sounder
FUSE	500mA fuse
X1	32.768KHz watch crystal
J1	12 way MicroMatch Connector (Female)
CY18 Module	Rx Module with 2 X 2 way connectors

3.2 Packing Sheet – Driver Board

Part Description	Quantity
Resistors	
270 Ω, ¼ Watt	6
4.7 KΩ, ¼ Watt	3
390 KΩ, ¼ Watt	1
Capacitors	
22pF, Ceramic	1
47pF, Ceramic	1
100nF, Ceramic	2
220uF, 16-25V, Electrolytic	3
1uF, 250V, Electrolytic	1
0.22F	1
Transistors	
IRFD220	1
MPSA42	1
Diodes	
1N5819	3
1N4148	1
UF4004	1
3mm Yellow LED	3
APA106 RGB LED	6
Integrated Circuits	
LM2576 5V voltage regulator	1
PIC16F1938 8-bit microcontroller	1
Miscellaneous	
100uH inductor	2
Miniature push button	4
28 way narrow IC Socket for IC2	1
2.1mm PCB power socket	1
Surface mount 3.5mm jack socket	2
Piezo sounder	1
500mA fuse	1
12 way MicroMatch connector (Female)	1
CY18 Rx Module	1
2 way Right angle connector	2
32.768KHz watch crystal	1

3.3 Packing Sheet - Additional parts – Driver Board

- Printed Circuit Board 159mm X 55mm
- 20cm insulated wire for the whip antenna
- 2 X M3 X 5mm plastic screws
- 2 X M3 X 4mm plastic screws
- 2 X M3 X 6mm threaded hex spacer (plastic)
- Laser-cut Jig for forming and mounting the LEDs

3.4 Packing Sheet - IN-8 Tube PCB

- Printed Circuit Board with pre-soldered HV5622 ICs
- 12 Way Micromatch connector (Male)
- 4 X 4mm neon lamps
- 30cm clear heat shrink
- 66 gold socket receptacles
- 2 X 100nF ceramic capacitors
- 6 X 10 KΩ, ¼ Watt resistors
- 4 X 390 KΩ, ¼ Watt resistors
- 2 X 50mm tall glass cover tubes

3.5 Packing Sheet - NL840 Tube PCB

- Printed Circuit Board with pre-soldered HV5622 ICs
- 12 Way Micromatch connector (Male)
- 4 X 4mm neon lamps
- 30cm clear heat shrink
- 66 gold socket receptacles
- 2 X 100nF ceramic capacitors
- 6 X 10 KΩ, ¼ Watt resistors
- 4 X 390 KΩ, ¼ Watt resistors
- 2 X 50mm tall glass cover tubes

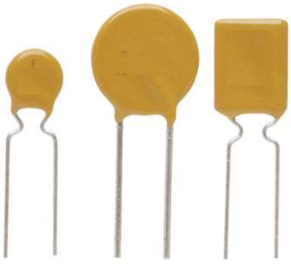
3.6 Packing Sheet - ZM1000 Tube PCB

- Printed Circuit Board with pre-soldered HV5622 ICs
- 12 Way Micromatch connector (Male)
- 4 X 4mm neon lamps
- 30cm clear heat shrink
- 3 X 20 Way socket strip
- 6 X Single socket receptcle
- 2 X 100nF ceramic capacitors
- 6 X 10 KΩ, ¼ Watt resistors
- 4 X 390 KΩ, ¼ Watt resistors
- 2 X 50mm tall glass cover tubes

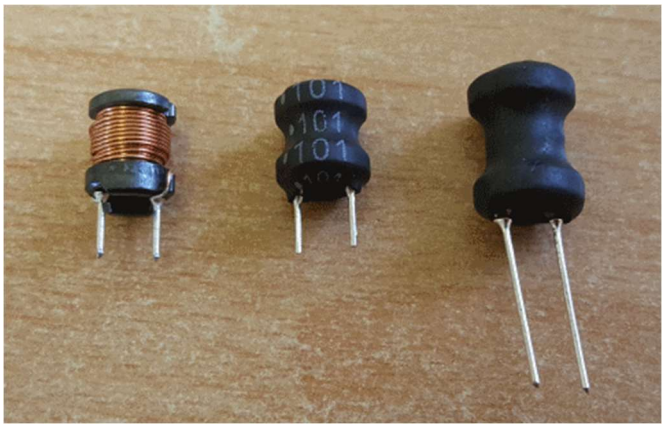
3.7 Parts Identification

The resistors used in the kit are 1% tolerance metal film. They are marked with four 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.

Please note the fuse will look like one of the pictures below. It can easily be confused for a capacitor. It is a self-resetting fuse.



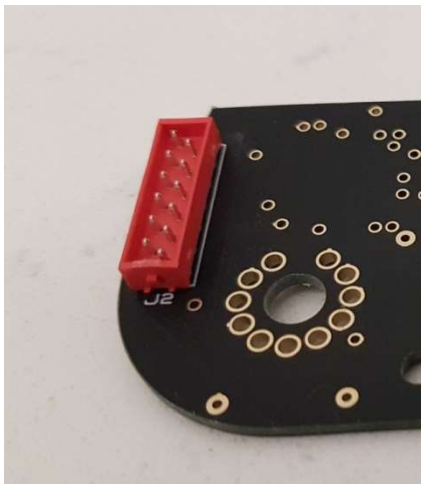
Inductors L1 and L2 may take different apperances:

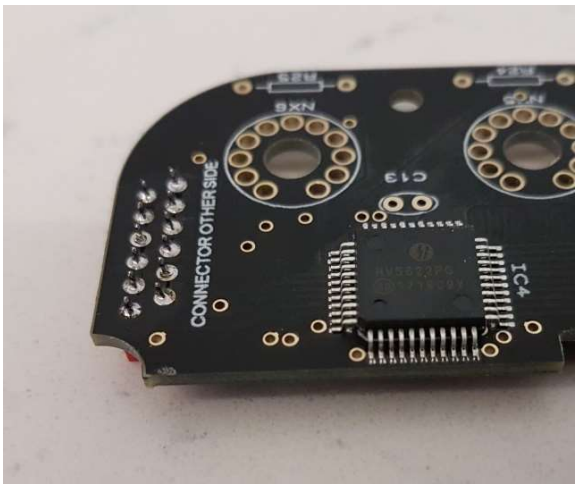


4. ASSEMBLY OF THE TUBE PCB

4.1 J2 (12 Way Micromatch connector (male))

Clip off the polarization tab from the connector as it is not needed. Then solder the connector into the tube PCB on the opposite side to the pre-soldered ICs.





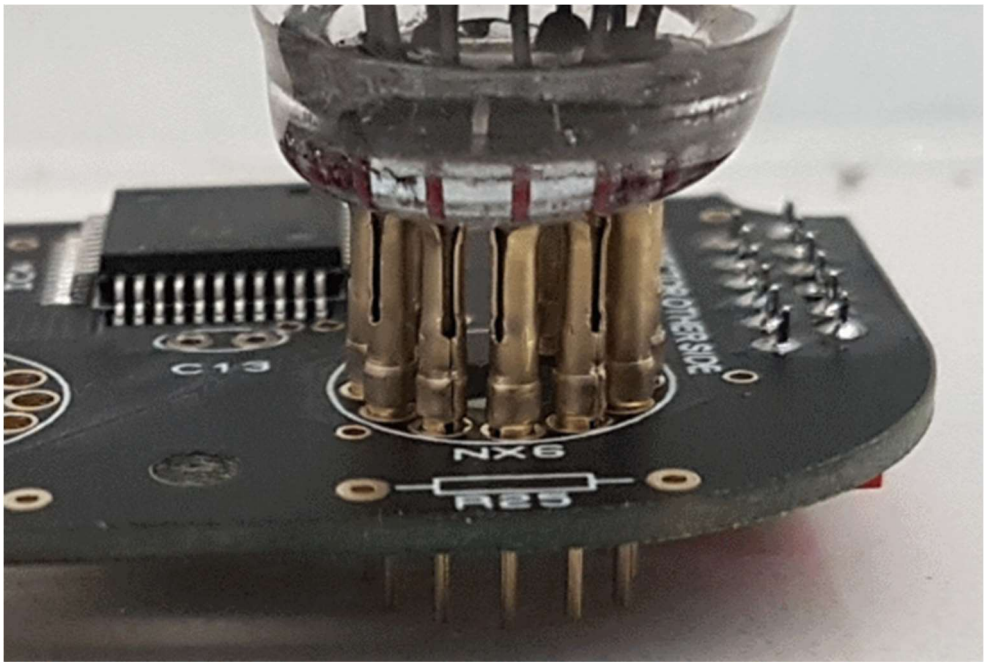
Now, proceed according to the tube type you are using.

4.2 IN-8 and NL84x Nixie Tubes

There are 66 individual sockets that need to be soldered in. The best method is a follows.

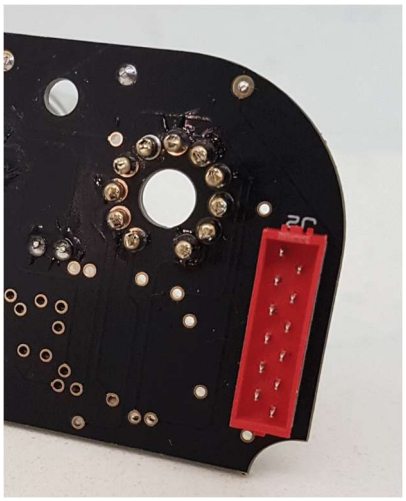
IN-8: Slide 11 sockets onto the 11 pins of the tube.
NL84x: Slide 10 sockets onto the 10 outer pins on the tube. With reference to the PCB check which one of the inner pins is needed (the corresponding hole on the PCB is plated), and slide a socket over this pin too.

Insert the tube with sockets into the PCB from the side with the pre-soldered ICs. Push firmly in. You may need to wiggle a little from side to side, to get all the sockets to fully go into the holes, to the level as shown below.



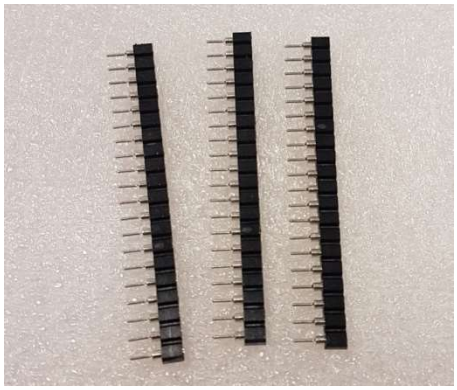
Flip over the PCB and solder the pins, ensuring the tube stays vertical. Solder sparingly – as soon as you see solder flow around the annulus, withdraw the solder and soldering iron.

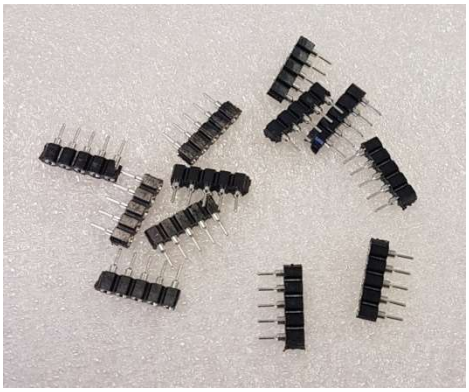
Remove the tube, then solder the next tube locations in turn. Finally clip off the long tails of the sockets.



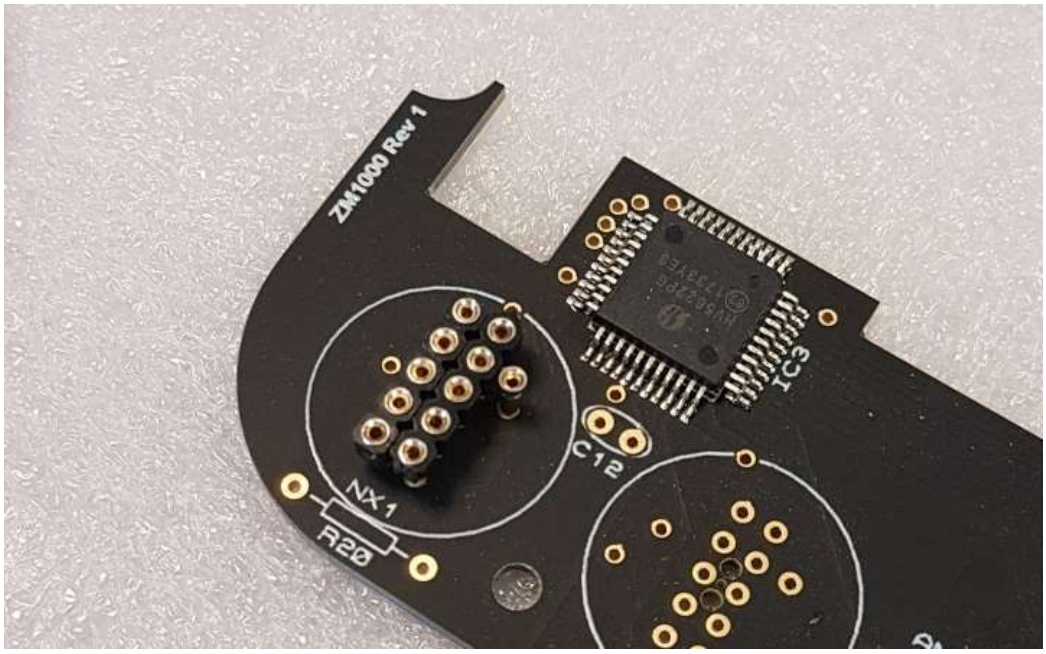
4.3 ZM1000 Nixie Tubes

Break the three 20 Way socket strips into lengths of 5. Nail clippers are very effective for this.





At each location, solder two of the strips and a single socket as shown. Note carefully the location of the single socket.



Solder sparingly – as soon as you see solder flow around the annulus, withdraw the solder and soldering iron.

4.4 R20 – R25 (10KΩ)
R26 – R29 (390 KΩ)
C12, C13 (100nF)

You can solder the top pads if its easier – the holes are plated through, so it does not matter if you solder the top pads or the bottom pads. Don't solder top AND bottom, there is no need. As with all the components, after soldering clip the excess leads off.

4.5 AM1, AM2, PM1, PM2 (4 mm neon lamp)

Each neon is separately addressable, and many flashing and indication modes are implemented – see the configuration setup later in the manual.

Cut the clear heat shrink tubing into 8 lengths acording to the tube type.

Tube Type	Long Pieces	Short Pieces
IN-8	35mm	20mm
NL84x	30mm	15mm
ZM1000	30mm	15mm

Slip the insulation over the neon lamp leads and with a hot air gun, shrink the tubing:

NOTE: If you will be using our Oak, Walnut or Plexi Case, to allow clearance for the neon cover tubes, only use one piece of insulation on the taller neons – leave the other lead without insulation

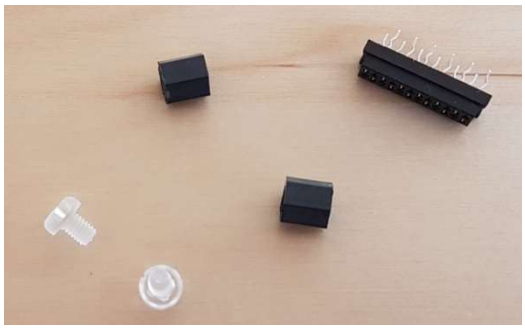
Finally, solder the neons in place on the PCB, with the taller neons at the back. The glass cover tubes can be placed over later.

The tube PCB is now complete.

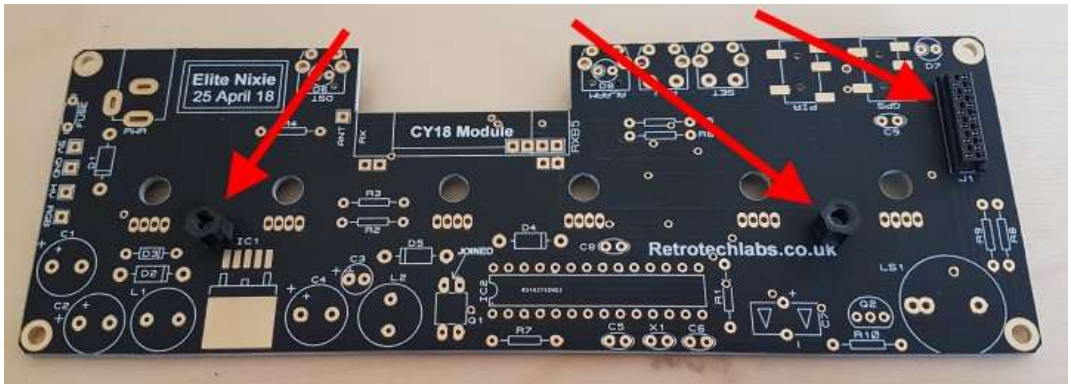
5. ASSEMBLY OF THE DRIVER PCB

5.1 J1 (12 Way Micromatch connector (Female))

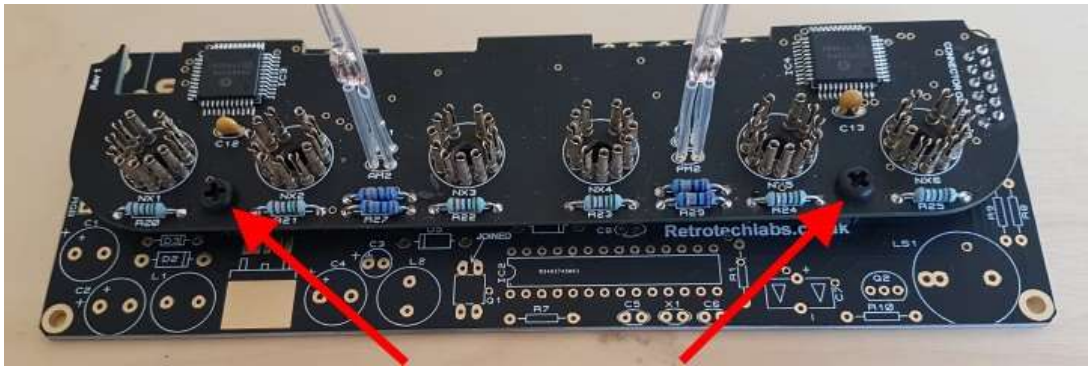
To solder this perfectly, it is best to fit the tube board temporarily so you can be sure everthing is in perfect alignment. Gather together the components below. The screws are the shorter, 4mm ones.



Then screw the hex spacers in position as shown below and also loosely place the 12 way connector.



Then place the tube PCB in position, and engage the 12 way connectors and screw together with the longer 5mm screws.



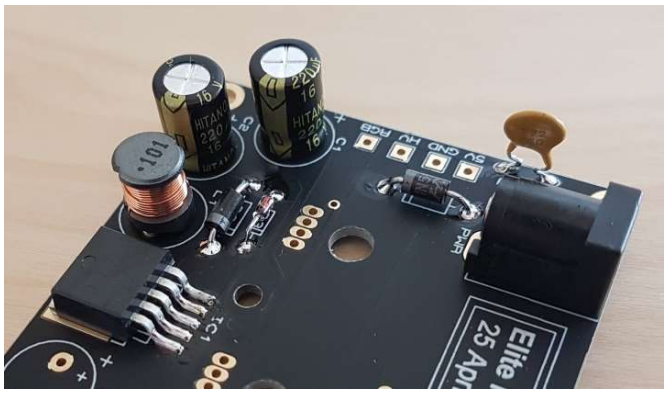
You can now solder the 12 way connector, on the bottom of the driver PCB. Then remove the tube PCB and all the screws and spacers.

5.2 Low Voltage Generator components.

Fuse
D1, D2 (1N5819)
D3 (1N4148)
C1, C2 (220uF)
PWR (DC Socket)
L1(100uH Inductor)
IC1 (LM2576)

IC1 is a Surface Mount part, but it is large and easy to solder. Start by wetting one pad with solder. Then place the part in position and heat the lead so the solder below it melts and anchors the part. The four other leads can then be soldered. Do not solder the heatsink tab.

C1 and C2 are polarized. The Positive lead is the longest, and goes in the pad marked '+'. The diodes are also polarized – the band on the part must match the band marked on the white PCB marking.



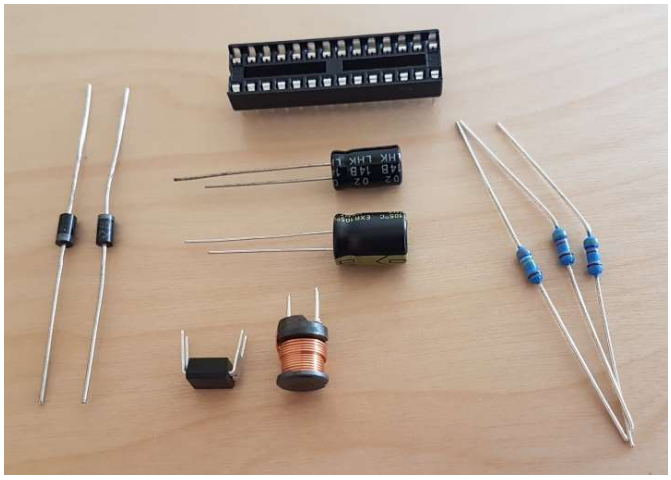
5.3 Testing Low Voltage Power Supply.

Identify the test GND, 5V and HV test points at the side of the PCB.

Plug in the 12V DC 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 5.6 and 5.9 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.

5.4 High Voltage Generator components.

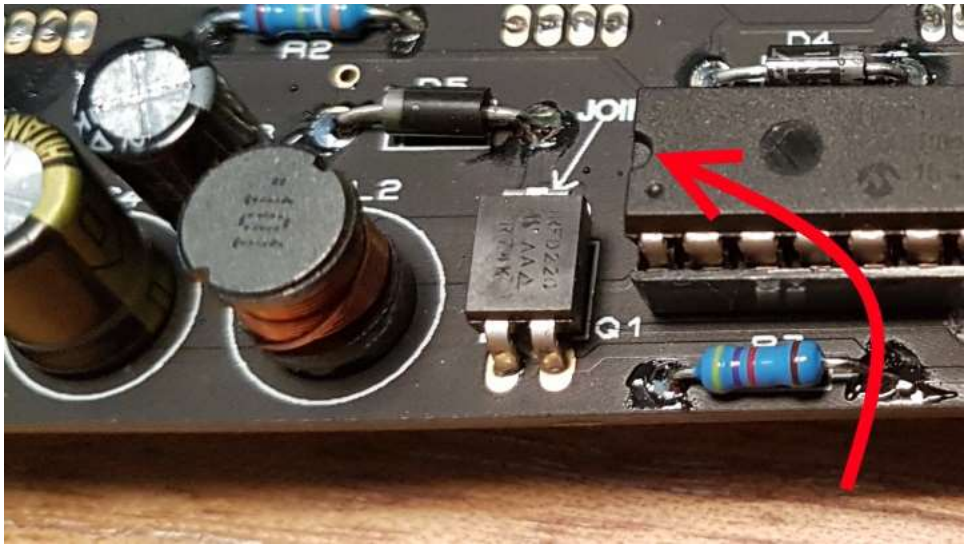
Socket for IC2
R1, R3 (4.7 KΩ)
R2 (390 KΩ)
C3 (1uF)
C4 (220uF)
D4 (1N5819)
D5 (UF4004)
Q1 (IRFD220)
L2 (100uH Inductor)



Take care that the notched end of the IC socket is at the end shown. However if after you solder the part you realise the notch is at the wrong end, DON'T try to desolder it! Actually, so long as the IC has the correct orientation, the socket does not really matter. Also the MOSFET needs to be placed with the two joined pins as marked on the PCB.

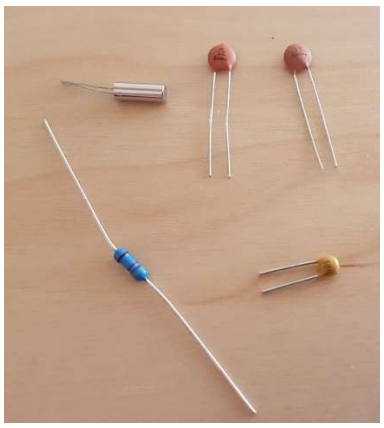
5.5 High Voltage Generator Test.

- Refer to the warnings on page 5
- Insert IC2 into its socket. Orient the notch on the IC with the notch on the IC socket and the PCB marking.

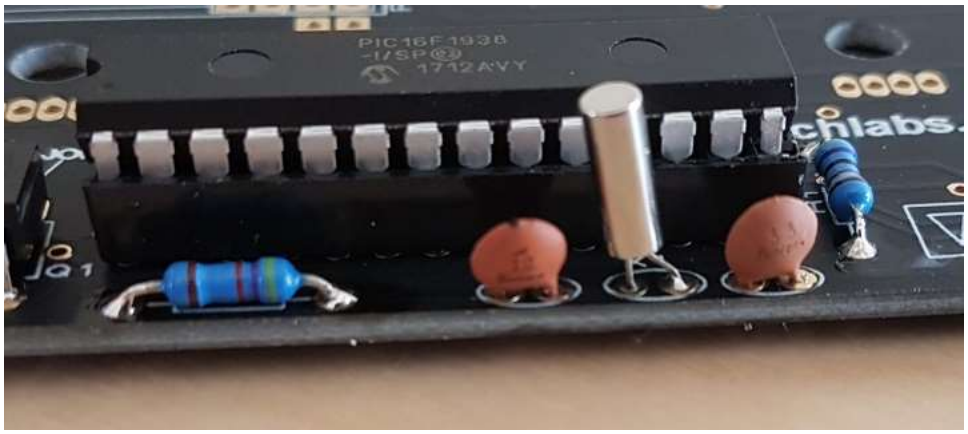


- Power up the PCB, and using the GND and HV test points, measure the high voltage generated using a voltmeter on DC setting. It should be between 165 and 176 Volts. If this is in order, disconnect the power supply.

5.6 R7 (4.7 KΩ)
C5 (22pF) – may be marked 22 or 220
C6 (47pF) – may be marked 47 or 470
X1 (Watch Crystal)
C8 (100nF) – may be marked 104



The capacitors may be different colours to those in the picture.

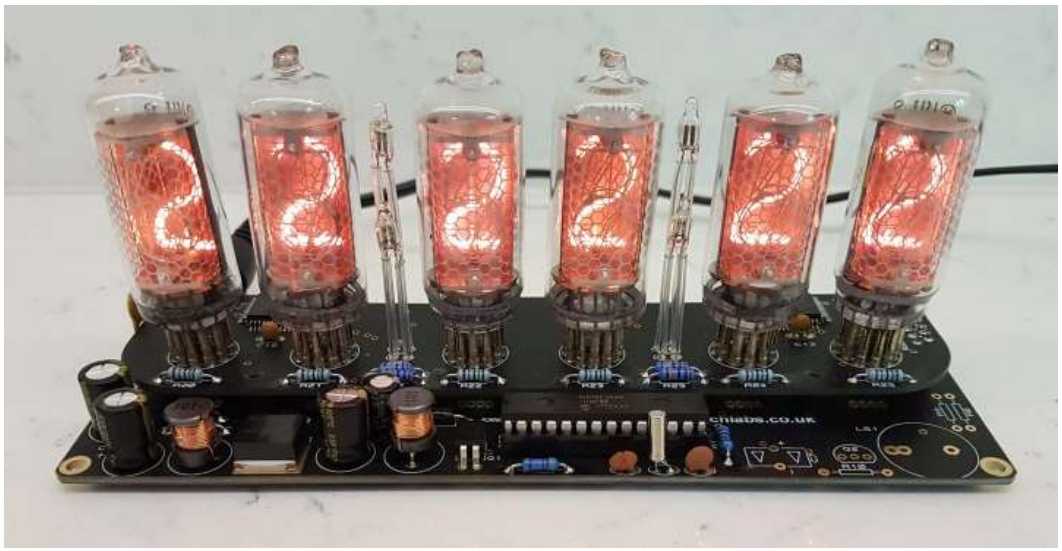


5.7 Tube Test

Now comes a very exciting part of the assembly – the first tube test. Replace the two small hex spacers that support the tube PCB. Remember to use the smaller 4mm screws underneath the driver board. Plug in the tube PCB, taking care the fuse is not trapped under it, but stands to the side of the tube PCB.

Take six Nixie Tubes corresponding to your tube PCB, and carefully insert into the sockets.

Now power up. After a short delay, the tubes should light and all start counting from zero to 9 and repeat. Please note this is a count UP, not a count DOWN. If you contact us with a support issue at this stage, please be clear about the count UP. If you refer to a count DOWN, it will be very confusing and slow down your support query!

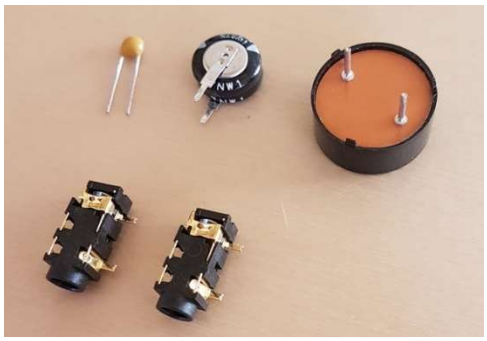


If you do not get this count UP, or have missing or overlapping digits, stop and check your work. Missing digits is usually rectified by pinching the tube contacts (when powered off!) so they make better contact with the tube. Also try swapping tubes around to see if the problem is with the tube, or the location. Please make these basic tests before contacting us for help and have the results to hand.

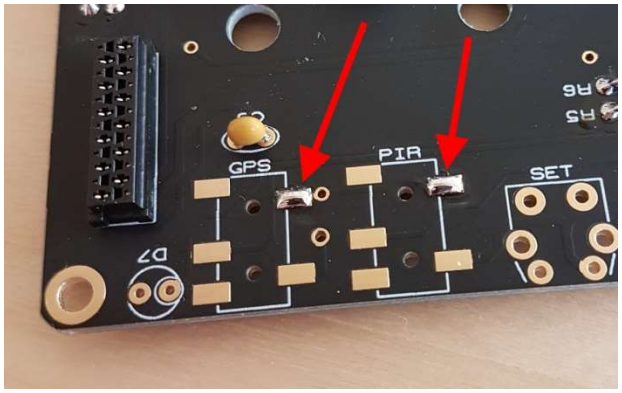
Once completed, remove the tube PCB and store it safely.

5.8 R4, R5, R6, R8, R9, R10 (270Ω)
Q2 (MPSA42)

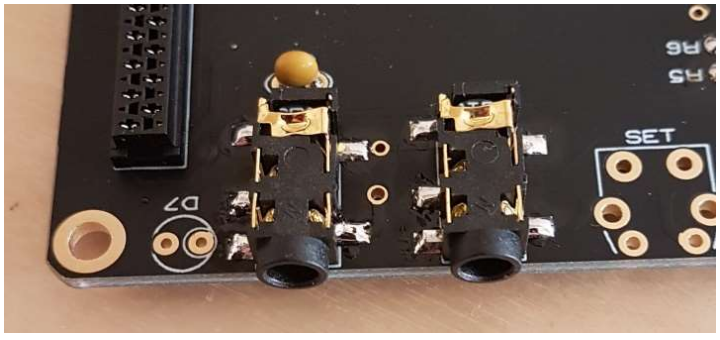
5.9 LS1(Piezo sounder)
C7 (0.22F)
C9 (100nF)
PIR, GPS (SMD Jack Sockets)



The 0.22F capacitor is polarised – note the arrows on the PCB, to correspond with the arrows on the part. To solder the SMD jack sockets, first tin one pad per jack socket:

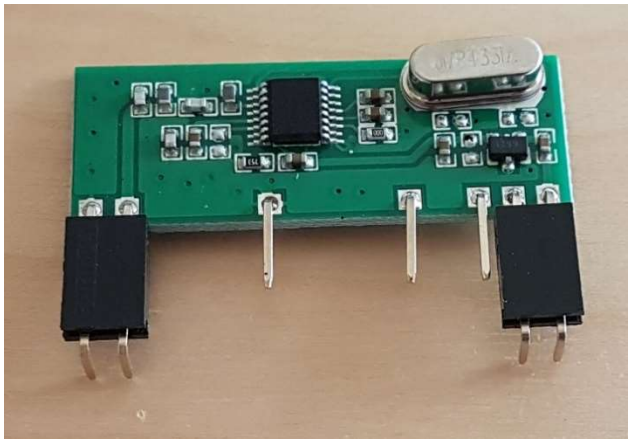


Then place the socket over the pad and re-heat the pad to wet the solder and anchor the part. The remaining pads can then be soldered.



5.10 CY18 Module and Connectors

Push the two connectors onto the end pins of the CY18 receiver Module.



Then position on the PCB. Press the black connectors level with the the PCB,and check alignment of the module before soldering the four pads. Then withdraw the CY18 module until later.

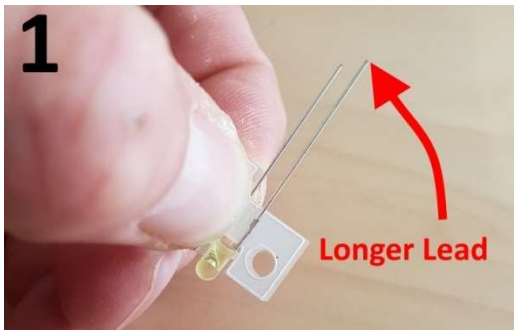
5.11 SET, ADJ, DST, ALARM (Push button switch)

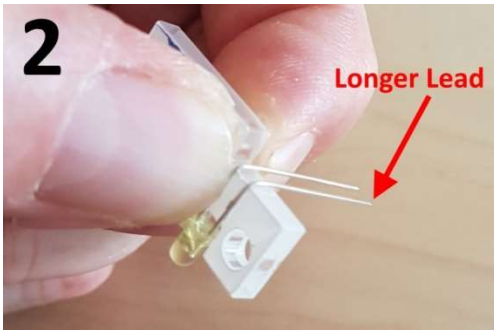
Only solder the two pins closest to the board edge. The other two pins are the frame and are not electrically connected. By only soldering the two active pads, if you make a mistake it is much easier to remove or re-position the switches!

It is easier to solder one pin per switch first, then re-position by rewetting the pad until the switch is fully pushed into position. Then solder the second pin.

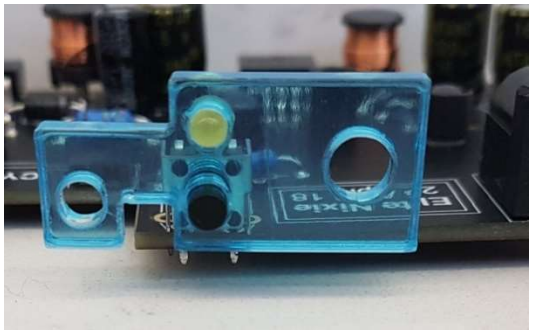
5.12 D6, D8 (3mm Yellow LED)

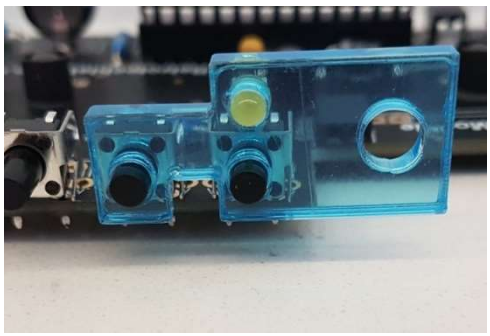
Using the LED bending jig, bend D6 and D8 as shown below.



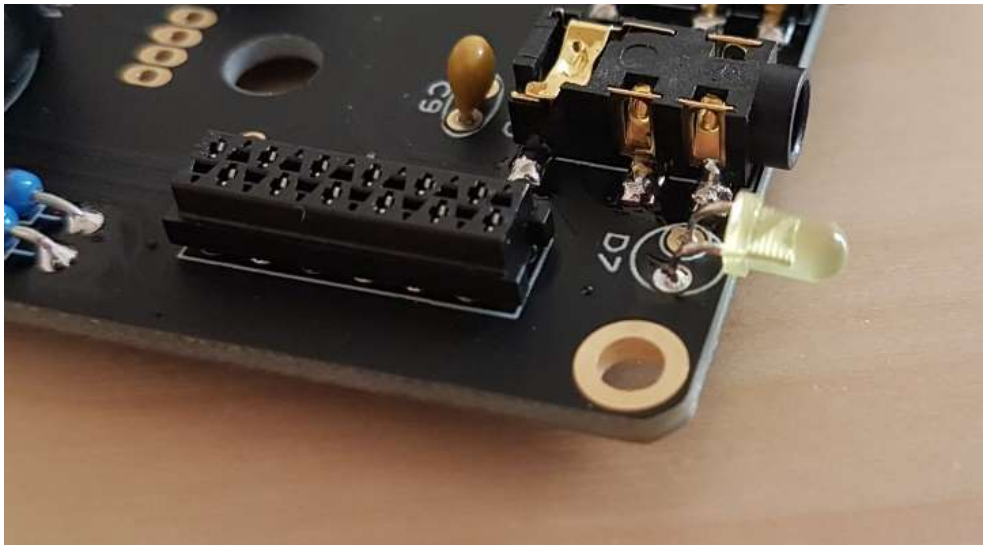


Now the anode leads of the LEDs will be in the correct orientation as you insert into the holes in the PCB behind the ALARM and DST switches. Use the jig again, to align the LEDs above the switches. This will give the correct spacing for if you want to use one of our cases.



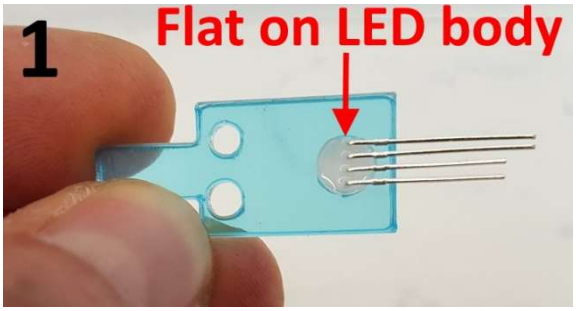


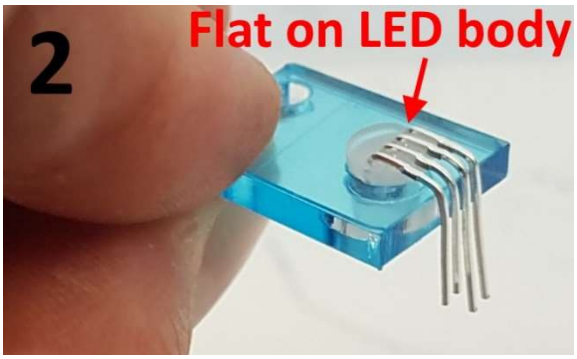
Now bend and solder D7. The longer lead goes in the pad with a circle around it. Think about the orientation before you bend the leads. D7 should be level with the GPS jack socket next to it, and protrude by its full body length from the rear of the PCB.

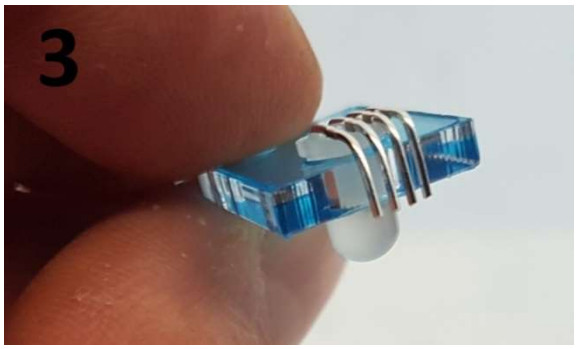


5.13 RGB1 – RGB6 (APA106 RGB LED)

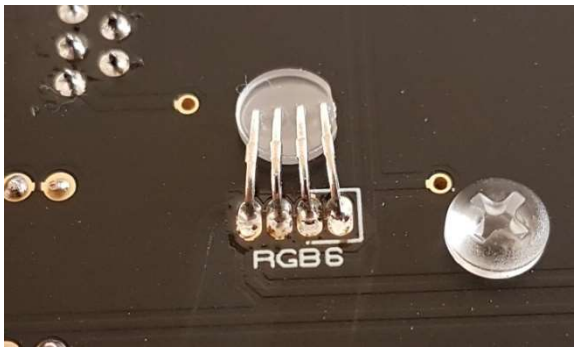
Using the large hole in the LED jig, bend the LED leads in three steps as shown below, noting the position of the flat on the LED body. The leads of the LED may have a different length configuration than shown below.





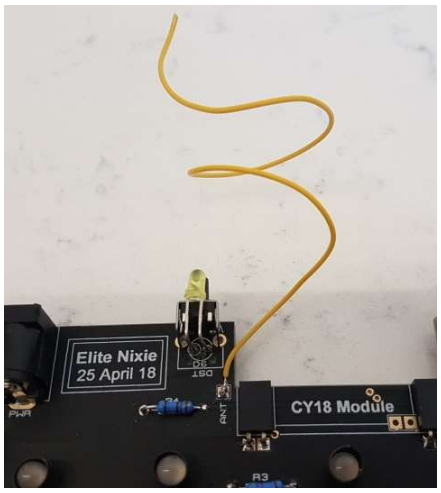


Then install the RGB LEDs from the base of the PCB.



5.14 Antenna wire

Strip 3mm insulation from the end of the wire supplied and cut the wire to 17cm length. Solder the wire to the ANT pad as shown below.



5.15 Final Assembly

Plug in the wireless receiver module. Then re-attach the tube board. You can now place the glass colon covers over the neons.

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;
Enter XTERNA Stats Menu;
ALARM: Set alarm time; snooze; cancel snooze/alarm;
DST: Toggle between DST and Standard Time (+/- 1 Hour)
Enter colour setup menu; scroll through colour / 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 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	20 = version 2.0, 12 = version 1.2 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
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 –5 Dimmed display (default 1)
7	Master Blank start hour[1]	0 - 23
8	Master Blank end hour[1]	0 - 23
9	Master Blank days[1]	0 – Off (default) 1 – Weekdays 2 - Weekends 3 – All days
10	Colon neons mode	0 – Both off 1 – AM/PM Indication, left / right 2 – AM/PM Indication, left / right flashing 3 – AM/PM Indication, top / bottom 4 – AM/PM Indication, top / bottom flashing 5 – All slow flashing 6 – Slow flashing left / right 7 – All flashing 8 – Both illuminated 9 – Railroad fast 10 – Railroad slow
11	Colon neons during night dimmed mode [2]	As per parameter 10
12	Radio time signal source[3]	0 to 3 reserved 4 – GPS 5 - XTERNA
13	GPS Baud rate	0 – 4.8 Kbps 1 – 9.6 Kbps (default)
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	PIR Motion Sensor Period	0 – No PIR installed (default) 1 – 15 seconds 2 – 30 seconds 3 – 1 minute 4 – 2 minutes 5 – 5 minutes 6 – 10 minutes 7 – 15 minutes 8 – 20 minutes 9 – 30 minutes

18	Snooze period	0 – 6 minutes (default) 1 – 9 minutes 2 – 12 minutes 3 – 15 minutes
19	Reserved	
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	Dekatron Sync Sleep Mode	0 – Dekatron always on 1 – Dekatron off when night dimmed Dekatron off when tubes master blanked 2 – Dekatron off in night blanked mode Dekatron off when tubes master blanked
24	Reserved	
25	Reserved	
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 - Static display of date 2– Scrolling display of date (default)[6]
28	Night Mode Override minutes	0 – 50 (default 0 gives 15 seconds override)[9]
29	Thermometer Settings	0 – Don't display temperature 1 – Fahrenheit display (default) 2 – Celsius display
30	Reserved	
31	Restore default settings	0 – Keep user settings 1 – Restore original default settings[8]

Notes:

1. Master Blanking Mode has priority over Night Mode. Use to disable the clock on weekends (eg clock 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 GPS / XTERNA 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.
6. Date will be displayed each minute between 50 and 55 seconds past the minute.
7. Press 'SET' briefly during Night Mode to show time for prescribed period.
8. Set this parameter to '1' to restore factory configuration settings. Internal operations will then load all the original settings and restore the value to '0'

Setting the Time and Date:
Before setting the time, press 'DST' briefly to toggle between DST and standard time modes. Set according to whether you are currently in DST time or not. The adjacent DST LED will light or extinguish accordingly.

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 27 to 1 or 2 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 28.

Setting Alarm:
Press the 'ALARM' Button. The seconds digits show the on / off status of the alarm: 00 (off) or 01 (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 subsequent days.

Rapid DST Adjustment
Press 'DST' briefly to toggle between DST and standard time. The indicator shows whether DST mode is active or not.

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.

Invoking Cold Start Tube Test
A cold start is when the Supercapacitor C7 is discharged. On a cold start, time and date are lost and the clock will perform the ascending tube test on power up. To force a Cold Start, do the following:

- Toggle the DST on by pressing the DST button if necessary
- From time display, press ALARM once.
- Press ADJ once to illuminate the ALARM LED
- Immediately disconnect power.

The Power sensing / sleep routine is not called from within the Alarm setup, so the clock will drain the supercapacitor via the DST and ALARM LEDs. Wait 2-3 minutes until the LEDs are fully off. On powering up again, you will get the cold start tube test.

Calibration of Timekeeping Accuracy
Over time you may observe the clock runs faster or slower than an accurate time standard. You can finely adjust the timekeeping by setting configuration parameters 20 and 21. We recommend to precisely set the clock against a known accurate clock, and then record the time drift in seconds after 5 full days (120 hours). Program this value into parameter 20.
Set parameter 21 to 0 to slow down the clock and to 1 to speed up the clock.

7. XTERNA FUNCTIONS

7.1 About the XTERNA Module

XTERNA is our new concept for synchronising time and capturing outdoor temperature for display on our clock and thermometer kits. Driven by a PIC microcontroller with advanced low power modes, the XTERNA captures time from GPS satellites every 6 hours, and stores in an on-board Temperature Controlled Crystal Oscillator (TCXO). Further, the device captures outdoor temperature every 10 minutes from an on-board DS18B20 digital temperature sensor. Every 10 minutes XTERNA transmits the time and temperature data, which can be received by our XTERNA compatible clocks.

Additional data is transmitted such as battery voltage and GPS fix time.

Supplied as a complete hobby kit of parts (For shipping reasons, batteries are not included), the kit takes approx 30-40 minutes to comfortably assemble. The TCXO IC is pre-soldered, so there is no fiddly SMD soldering to worry about.

Naturally, XTERNA is sealed against rain ingress. Battery life is estimated between 6 to 12 months. We recommend high quality branded batteries for the longest operation between battery changes.

The module should be placed outdoors. But as close as possible to the indoor clock or thermometer and away from direct sunlight.

7.2 Specification

Working Temperature Range: -40 °C to +60 °C. (-40 °F to +140 °F)
Typical Reception Range: 10 to 30 Metres (30 to 100 ft).

7.3 Configuring for XTERNA Reception

Elite Class Nixie Clocks are configured by default for XTERNA reception. If you have changed your configuration settings, you need to set parameter 12 to value 5. Also parameters 14, 15, 16 need to be set to specify your location's offset from UTC.

7.4 Time Synchronisation Function

XTERNA broadcasts every 10 minutes. After configuring your clock, please be patient in waiting for the first Synchronisation. Upon synchronisation the yellow LED D7 will illuminate. Remember to set DST ('Summer Time') with the DST button.

7.5 Temperature Display

The temperature is also transmitted with the time. Therefore, temperature will not be displayed until after the first synchronisation.
Set Celsius or Fahrenheit using parameter 29:
Fahrenheit: 1
Celsius : 2

Temperature is displayed between 30 and 35 seconds past each minute. Celsius is displayed with 0.5 °C resolution. Fahrenheit is displayed with 1 °F resolution.
Positive and negative temperature is indicated by the left hand neons: Neon indicator PM2 acts as a decimal point.

7.6 Temperature Validity

If no valid data is received on the next scheduled sync (every 10 minutes), the temperature will be deemed to be old and invalid. Temperature will not be shown until a new valid temperature is received.

7.7 XTERNA Stats menu

The Stats menu is accessible only if relevant XTERNA data has been received. From time display, press ADJ to enter the Stats Menu. Six items of data are displayed in sequence, stepped through by pressing the ADJ button sequentially, and finally exiting back to time display. Please see the table below.

Stats Menu Item	Description	Range of Values	Example
1	Minimum Temperature in last 24 hours	-40°C to +60°C 40°F to 140 °F	
2	Maximum Temperature in last 24 hours	-40°C to +60°C 40°F to 140 °F	
3	Voltage of XTERNA Battery	2.5V to 5.0V	
4	Time required for last GPS fix loaded into the TCXO	0 to 98 sec 99 = no fix at last attempt	
5	Hours and minutes since last GPS fix loaded into the TCXO	00:00 to 99:99	
6	XTERNA Firmware version	1.00 onwards	

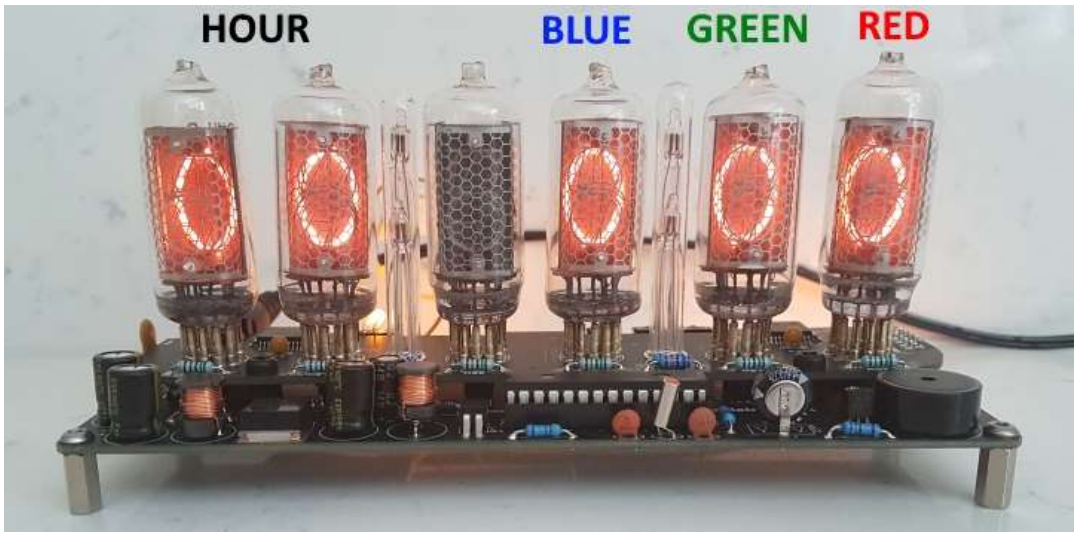
8. CONFIGURING THE RGB LED TUBE LIGHTS

The clock features a separate and dedicated setup menu for the RGB LED lights, accessed from the 'DST' button. All settings are stored to non-volatile memory, so your favourite colours will still be there after even after a long power off.

You can set fixed colours and intensities, or program an auto colour cycling effect at your choice of speed.

8.1 Entering RGB LED menu

Press and hold the 'DST' button until the display shows: 00: 0:00. NX3 will not be lit.



- For each hour (0-23), you can set a custom colour
- Each custom colour can have your choice of BLUE, GREEN and RED values from 0 (colour off) to 8 (maximum brightness)
- Mix the colours using the ALARM, ADJ, SET buttons.
- Use low values (1,2 and 3) for low brightness, eg. For night time
- Set the value to '0' for that colour to be off
- Once you are happy with the colour for that hour, press 'DST' to move to the next hour
- Have fun playing with your favourite colours and intensities!

- Colours are displayed live during RGB menu:

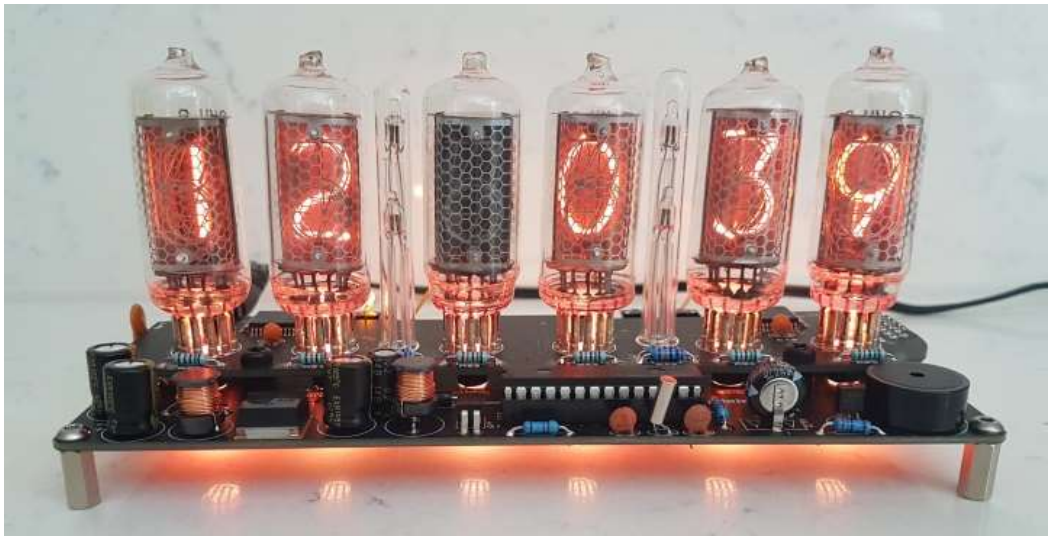
- In the example above, between 11 and 12 hours, the LEDs will be purple (8 blue, 0 green, 8 red)

- In the example below, between 19 and 20 hours, the LEDs will be blue with a hint of green (8 blue, 2 green and 0 red)

8.2 Setting auto colour cycling

Setting colour RED to value 9 has a special meaning:
This will enable auto colour cycling for the specified hour. The speed of the cycling will then be governed by the GREEN value:
0 = very slow change
9 = very fast change

This auto colour cycling mode is explained in the picture below:



Red = 9, therefore Auto Colour Cycling is enabled for 12-13 hours
Green = 3, so speed is 3.
Blue value has no effect.

Note: The colours do not cycle live during Auto Colour Cycling setup. The cycling starts only during normal time and date display.

9. USING A GPS RECEIVER

The clock can receive time from a GPS receiver that transmits information using NMEA-0183 protocol, using the $GPRMC sentence.

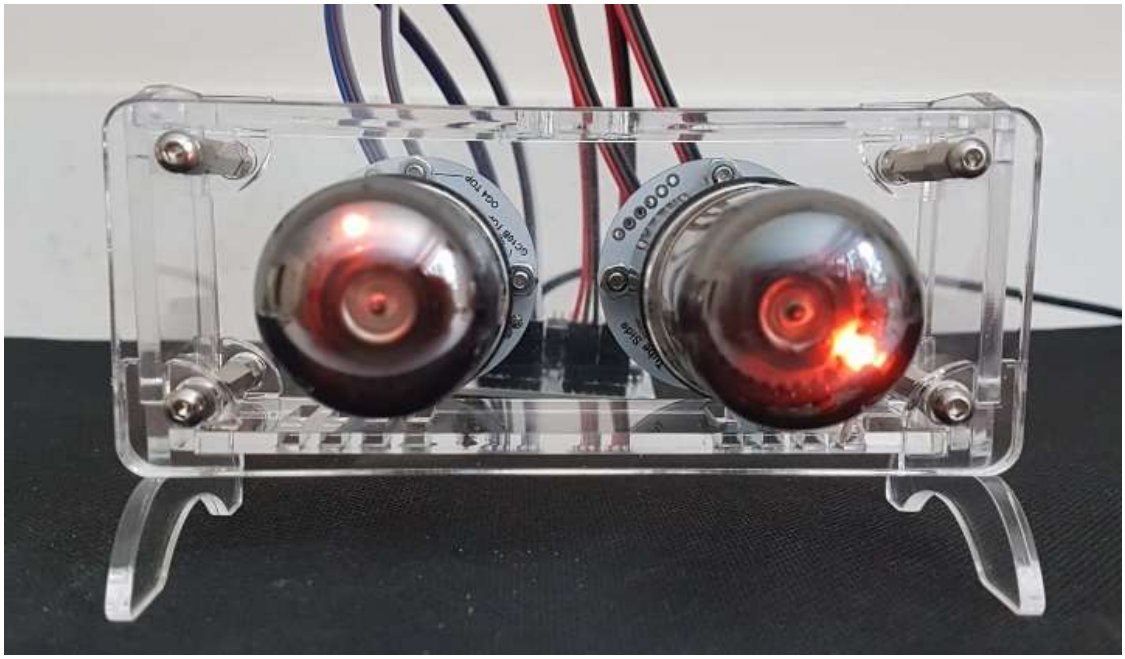
9.1 Configuring for GPS Synchronisation.

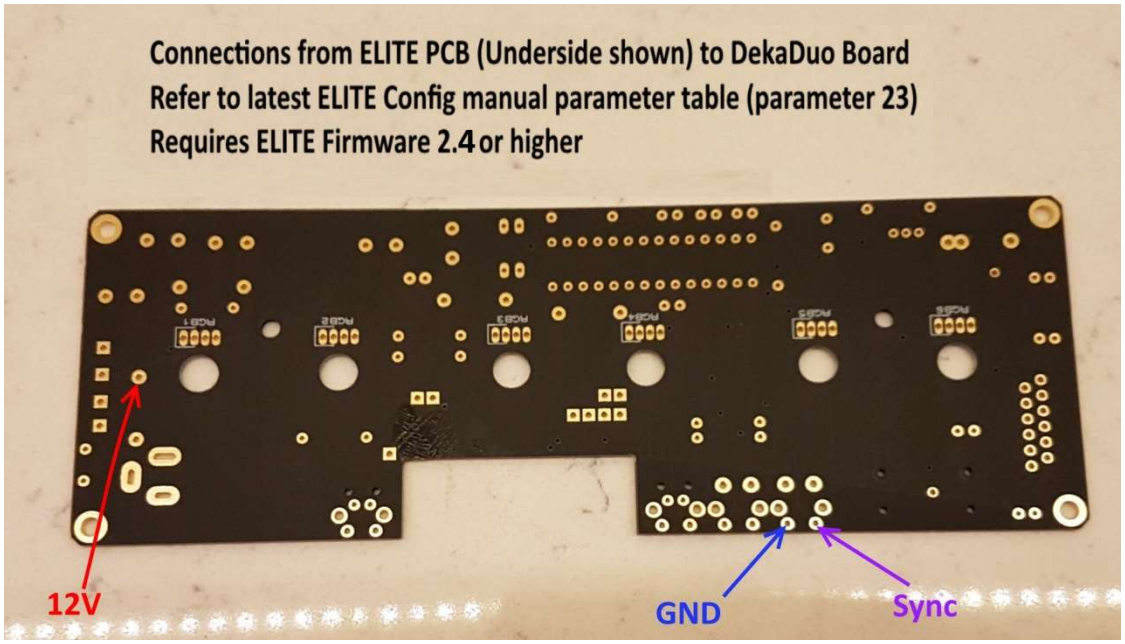
- Set parameter 12 to value 4.
- Set the baud rate in parameter 13.
- Set parameters 14 and 15 for the hours and minutes your time zone is offset from UTC Time. This is usually only whole hours.
- Set parameter (16) to identify whether the offset is minus (0) or positive (1) of the time source.

D7 will light when the clock has received a recent GPS or XTERNA synchronisation data.

10. CONNECTING OUR DEKATRON DRIVER

The clock can be connected by just 3 wires to our DekaDuo Dual OG4 Dekatron Driver. Please refer to the separate DekaDuo instructions for full details on how to do this. Control of the Dekatron in night modes is possible using parameter 23.






DANGER!!
HIGH VOLTAGE
Retrotechlabs.co.uk
HV
VHV
GND
SYNC
GND
12V
L1

11. PIR MOTION SENSOR

The clock has a 3.5mm Jack Plug socket for connection of our PIR Motion Sensor Accessory, available separately as a quick – build kit. This useful accessory helps save tube life and power by powering down the clock when it senses the room is empty. The sensing range is typically up to 12 ft (3.5 metres)

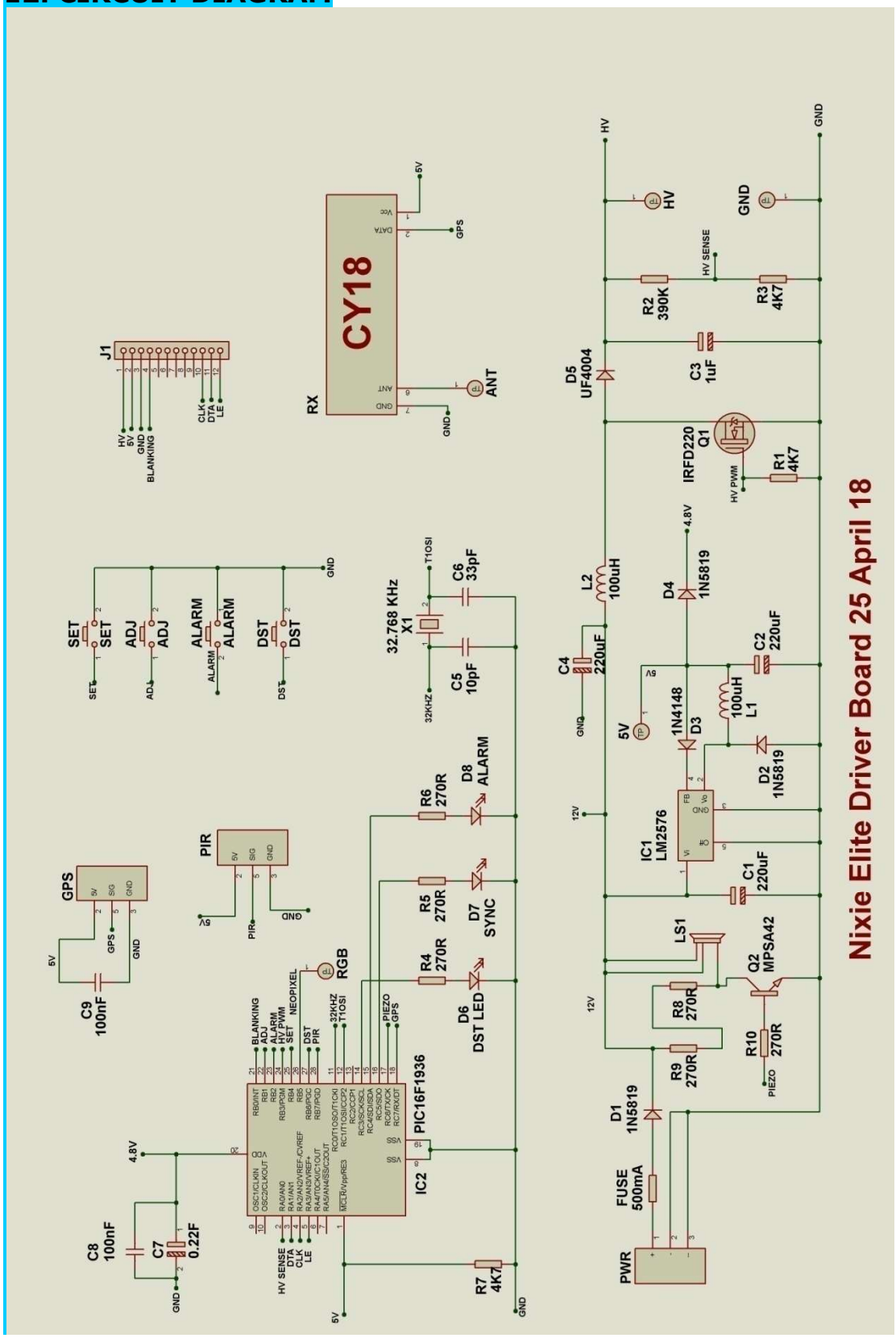
When installed and configured (configuration parameter 17), the sensor will sense motion in the room, and switch off the High Voltage generator, tubes and RGB LEDs when the PIR time period has expired.

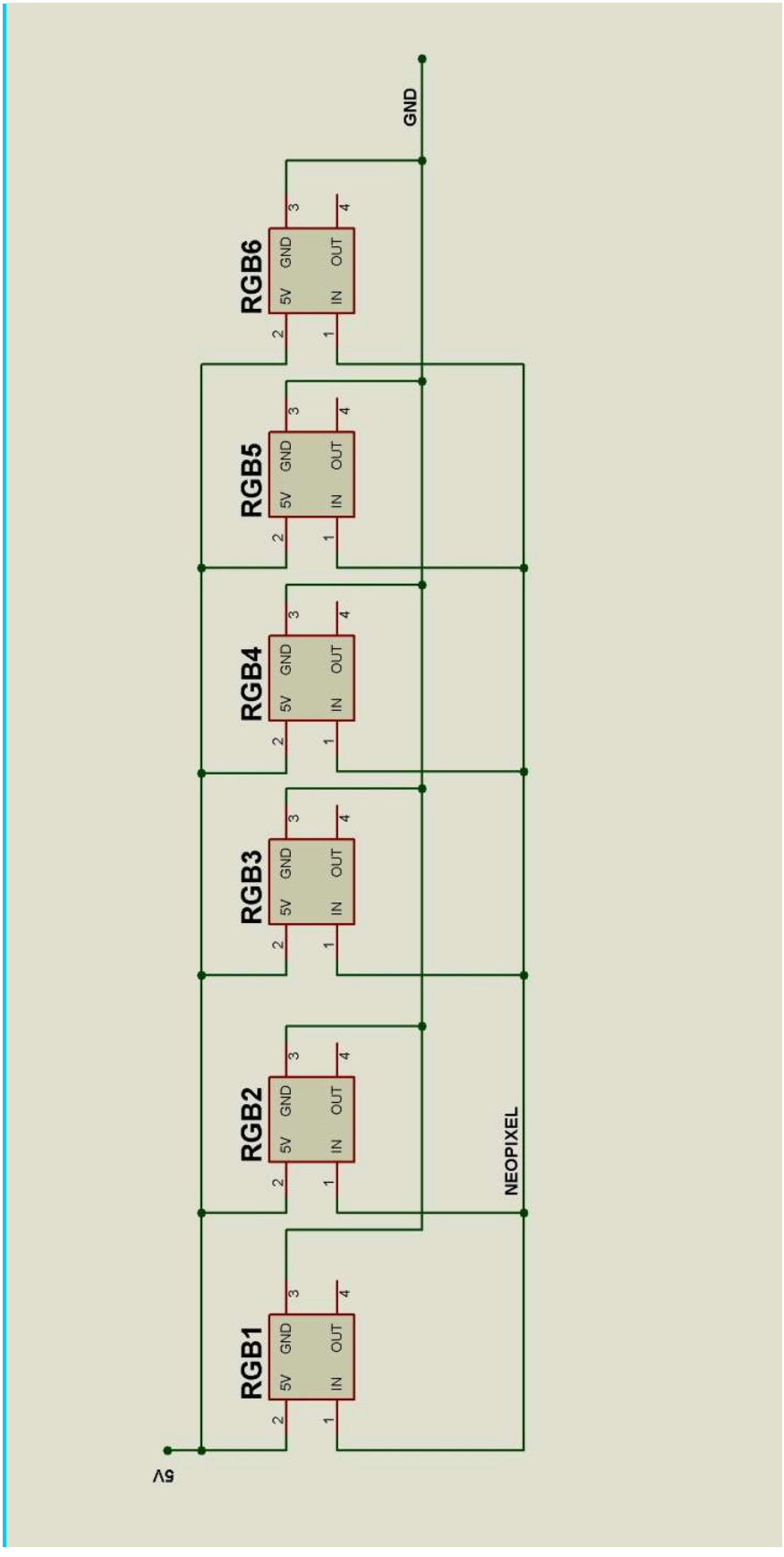
Configuration Parameter 17:
0 – No PIR installed (default)
1 – 15 seconds
2 – 30 seconds
3 – 1 minute
4 – 2 minutes
5 – 5 minutes
6 – 10 minutes
7 – 15 minutes
8 – 20 minutes
9 – 30 minutes

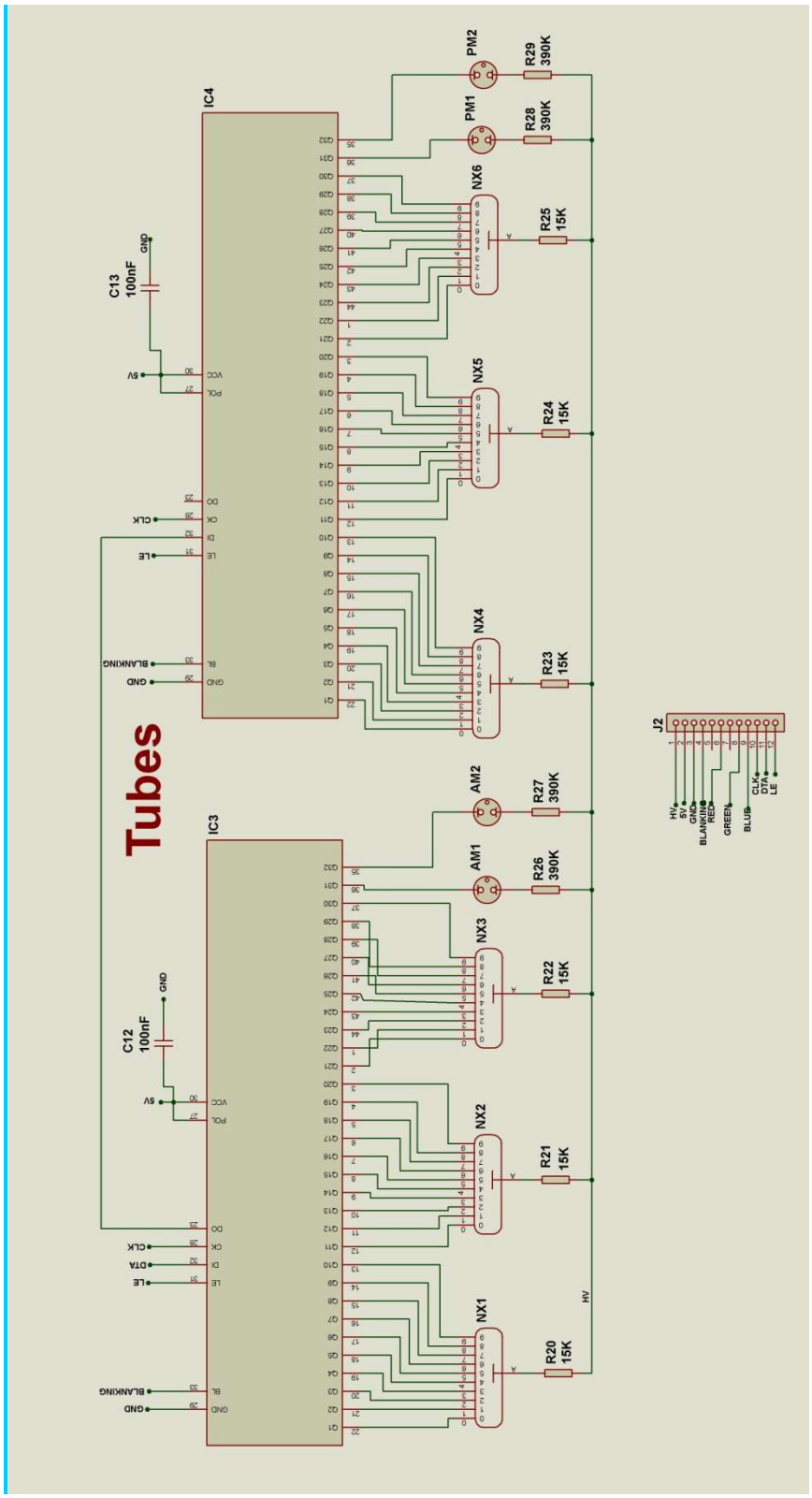
It is important to remember that the function does not override Night Blanking and Master Blanking, so when the clock is in Night Blanking or Master Blanking, no amount of jumping around in front of the sensor will light the tubes! If you are using the PIR motion sensor, the Night Blanking and Master Blanking periods are rather redundant, so it is recommended to not use these if you have the PIR installed.

The suggested initial PIR period is 10 minutes (Config 17 = 6).

12. CIRCUIT DIAGRAM




GND
RGB6
RGB5
RGB4
RGB3
RGB2
RGB1
5V
GND
OUT
IN
NEOPIXEL
5V


Tubes
IC4
IC3
PM2
PM1
AM2
AM1
R29 390K
R28 390K
R27 390K
R26 390K
R25 15K
R24 15K
R23 15K
R22 15K
R21 15K
R20 15K
NX6
NX5
NX4
NX3
NX2
NX1
C13 100nF
C12 100nF
GND
5V
CLK
LE
DTA
BLANKING
HV
J2
BLUE
GREEN
RED