Assembly Instructions
And
User Guide

Nixie Clock Type
'Nixie 5750

For Parts Bag Serial
Numbers from 2000 onwards
Lower PCB Date 11 March 20
Upper PCB Date 11 April 20

REVISION HISTORY

Issue Number	Date	Reason for Issue
Issue 3	10 March 2022	Instructions for alternative lower PCB
Issue 2	10 May 2021	New resistors added to minimise ghosting
Issue 1	5 July 2020	New document

1. INTRODUCTION

1.1 Nixie 5750 - Features

- Hours, Minutes and Seconds display
- Drives a wide range of small sized solder-in tubes
- 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 / WiFi / XTERNA synchronisation with status indicator LED
- Dedicated DST button to switch between DST and standard time
- Supercapacitor backup. Keeps time during short power outages
- 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 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. Configurable.
  - 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

1.2 Tubes Supported

There are many types of tube this kit will drive – all have the same pinout. The commonest types are as follows:

B-5750
B-5870
GR-116D
ZM1330
ZM1332

Digit height is generally 13mm for all these tubes. A typical tube is shown below:

1.3 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.

Black nail varnish to obscure the majority of the RGB LEDs

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, R2, R4	4.7 KΩ, ¼ Watt
R3	390 KΩ, ¼ Watt
R6 - R11	270 Ω, ¼ Watt
R12 (Lower Board	4.7 KΩ, ¼ Watt
R12 (Upper Board)– R14	1 KΩ, ¼ Watt
R15 – R20	4.7 KΩ, ¼ Watt
R21	390 KΩ, ¼ Watt
R22 (Upper Board)	300 KΩ, ¼ Watt
R22 (Lower Board)- R25	15KΩ ¼ Watt
R27 – R29	300 KΩ, ¼ Watt
Capacitors	
C1, C2	220uF Electrolytic
C3	1uF, 250V,
C4	220uF, 16-25V, Electrolytic
C5	15pF Ceramic
C6	33pF Ceramic
C7	100nF Ceramic
C8	0.1F or 0.22F
C9	100nF Ceramic
Transistors	
Q1	IRFD220 MOSFET
Q2 – Q4	EL817 Optocoupler
Q5, Q11 – Q14	MPSA42
Diodes	
D1 – D3	1N5819
D4	1N4148
D5	UF4004
D6	5mm Yellow LED
D7	5mm Green LED
D8	5mm Yellow LED
RGB1 – RGB6	APA106 RGB LED
Integrated Circuits	
IC1	LM2576 5V voltage regulator
IC2	PIC16F1938 8-bit microcontroller
IC3	HV5812 (pre-soldered)
Miscellaneous	
L1, L2	100uH inductor
AM1, AM2, PM1, PM2	4mm wire ended neon lamp
ALARM, SET, ADJ, DST	Miniature push button
IC2 Socket	28 Way narrow IC socket for IC2
J1	2.1mm PCB power socket
GPS / RFT	Surface mount 3.5mm jack socket
LS1	Piezo sounder

FUSE	500mA fuse
Insulation	25 cm Clear insulation for neons
X1	32.768KHz watch crystal
Tube test Socket	
30cm Tube Test Cable	
J2	10 Way 0.1” Female socket strip
J3	10 Way 0.1” Male strip

3.2 Parts list / Packing Sheet - Component Bag

Part Description	Quantity
Resistors	
270 Ω, ¼ Watt	6
1 KΩ, ¼ Watt	3
4.7 KΩ, ¼ Watt	10
15 KΩ, ¼ Watt	4
300 KΩ, ¼ Watt	4
390 KΩ, ¼ Watt	2
Capacitors	
15pF, Ceramic	1
33pF, Ceramic	1
100nF, Ceramic	2
1uF, 250V, Electrolytic	1
220uF, 16-25V, Electrolytic	3
0.1F or 0.22F	1
Transistors	
IRFD220 MOSFET	1
MPSA42	5
EL817 Optocoupler	3
Diodes	
1N5819	3
UF4004 fast recovery diode	1
1N4148	1
5mm Green LED	1
5mm Yellow LED	2
APA106 RGB LED	6
Integrated Circuits	
LM2576 5V voltage regulator	1
PIC16F1938 8-bit microcontroller	1
HV5812 (pre soldered)	1
Miscellaneous	
100uH inductor	2
4mm wire ended neon lamp	4
Miniature push button	4
28 way narrow IC Socket for IC2	1
2.1mm PCB power socket	1
Surface mount 3.5mm jack socket	1
Piezo sounder	1
500mA fuse	1
25cm Clear insulation for neons	1
32.768KHz watch crystal	1
Tube test Socket	1
30cm Tube test cable	1
10 Way 0.1” Male strip	1
10 Way 0.1” Female socket strip	1

Additional Hardware

M3 X 6mm screw	4
11mm Female / Female hex spacer	4
8mm Male / Female hex spacer	4

We recommend to check against the list above, to ensure all parts are present before commencing assembly.

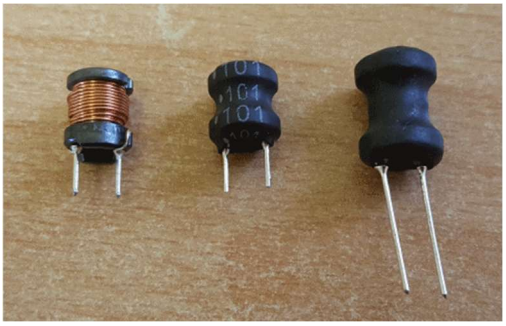
The resistors used in the kit are 1% tolerance metal film. They are marked with 4 coloured bands to identify the value. However it is sometimes unclear in which direction the bands should be read. Therefore, we recommend that the resistors be identified with a multimeter.

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

The 15pF and 33pF capacitors will be marked 15 and 33 respectively. The 100nF capacitors will be marked 104.

Q1 (IRFD220) is in a very similar package to Q2 – Q4 (EL817). You can tell the difference, in addition to the part marking by looking at the pins. Q1 has two pins that are actually joined at the resin body. Q2 – Q4 have 4 separate pins.

Inductors L1 and L2 may be one of three types:



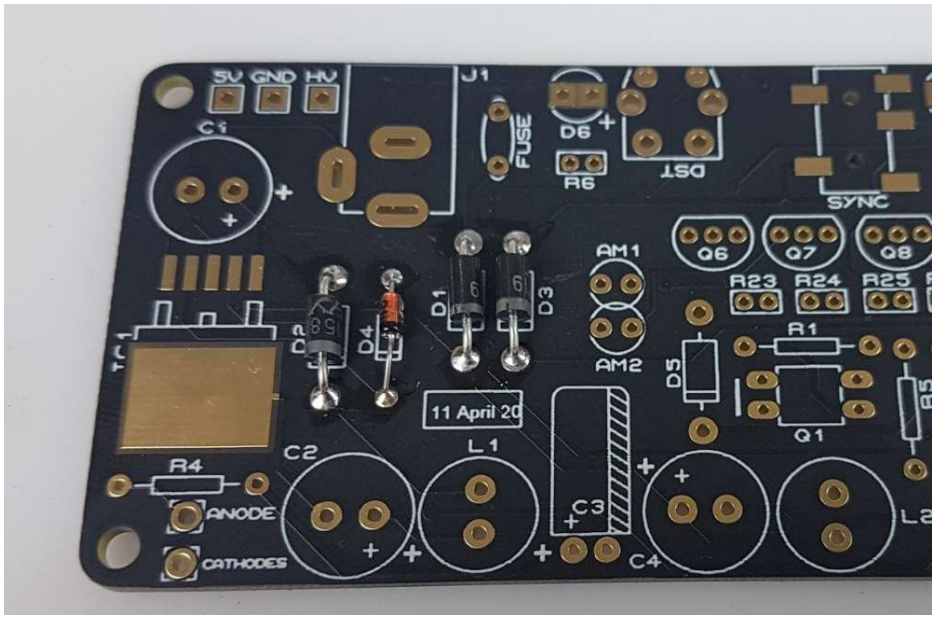
4. ASSEMBLY OF THE PCB

DUE TO PRODUCT DEVELOPMENT AND IMPROVEMENTS, YOUR PCB MAY NOT LOOK EXACTLY LIKE THE ONE PICTURED.

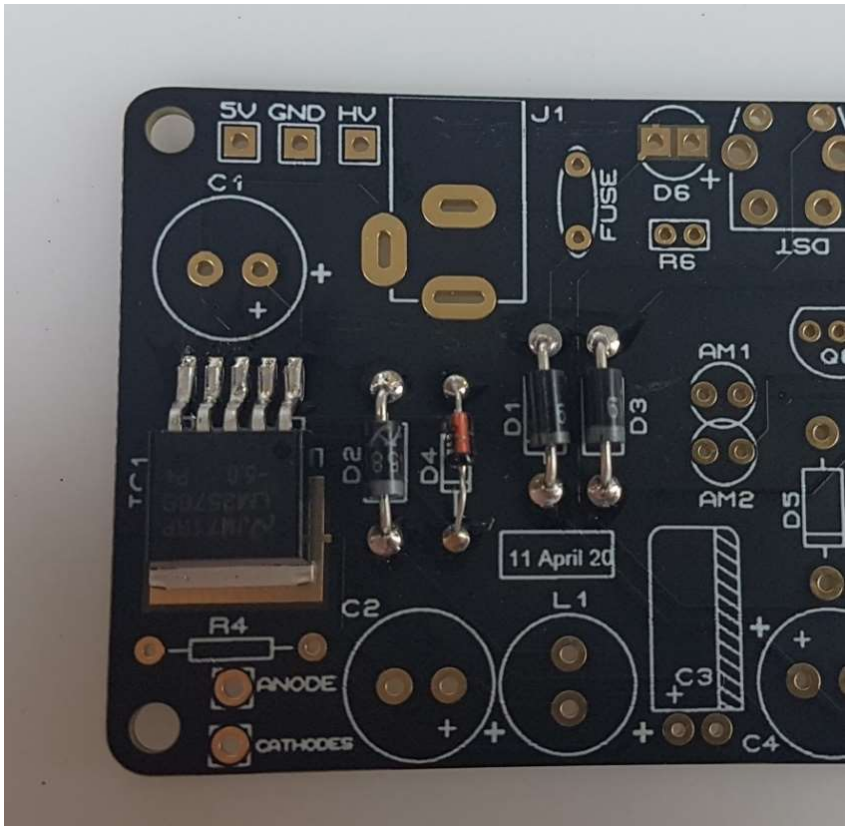
4.1

Low Voltage Power components:
J1, FUSE
D1-D3 (1N5819)
D4 (1N4148)
IC1 (LM2576)
L2 (100uH Inductor)
C1, C2 (220uF)

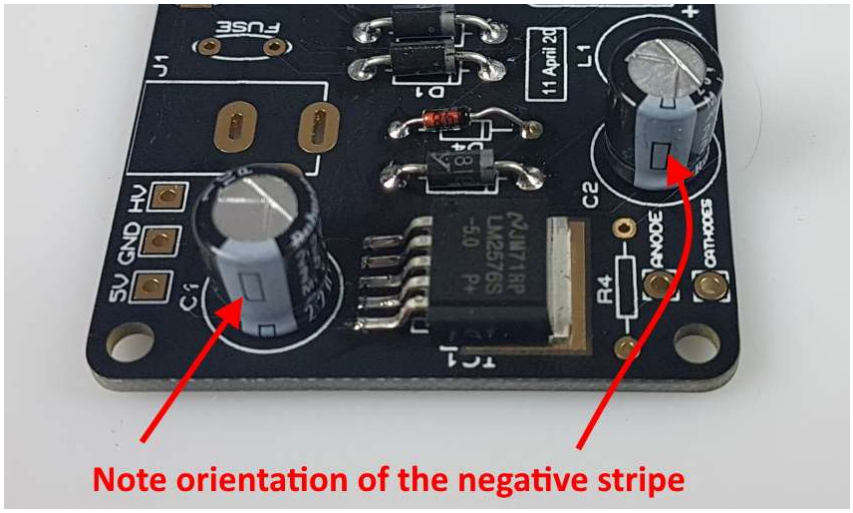
Start by installing D1-D4. The diodes are also polarized – the band on the part must match the band marked on the white PCB marking.



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.



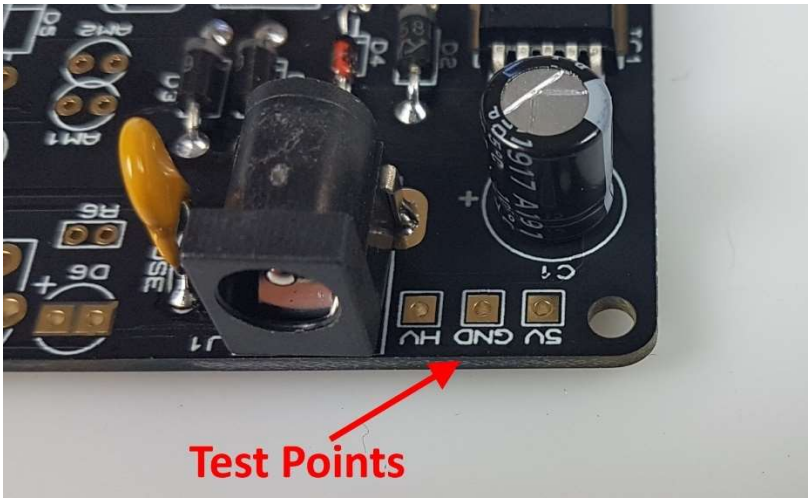
C1 and C2 are polarized. The Positive lead is the longest, and goes in the pad marked '+'.



Finally solder the fuse, connector J1 and Inductor L1. L1 is a tight fit, so push it in hard so that it is as close to the PCB as possible, preventing fouling the top PCB.

4.2 Testing Low Voltage Power Supply.

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

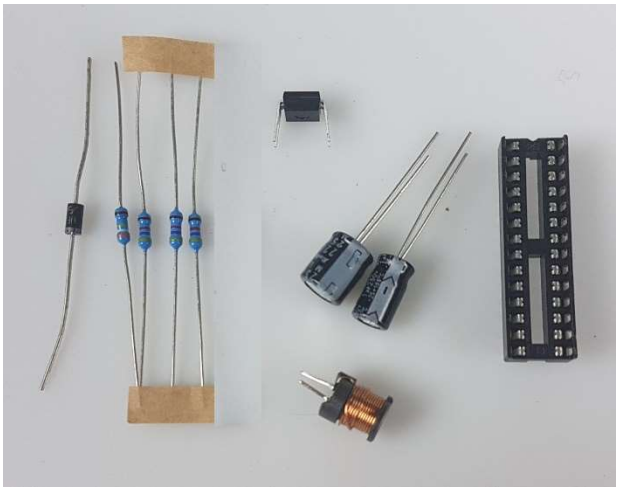


Plug in the power supply, and then test using a DC voltmeter: Touch the black probe on the GND test point and the red probe on the 5V test point. The voltage should measure between 5.6 and 5.9 Volts. If not, disconnect power and check your work. Do not proceed with the assembly until the error is corrected. Once the test is completed, disconnect the power.

IF YOU CHOOSE TO PROCEED BEYOND THIS POINT WITHOUT GETTING THE CORRECT VOLTAGE, WE WILL NOT BE ABLE TO OFFER SUPPORT

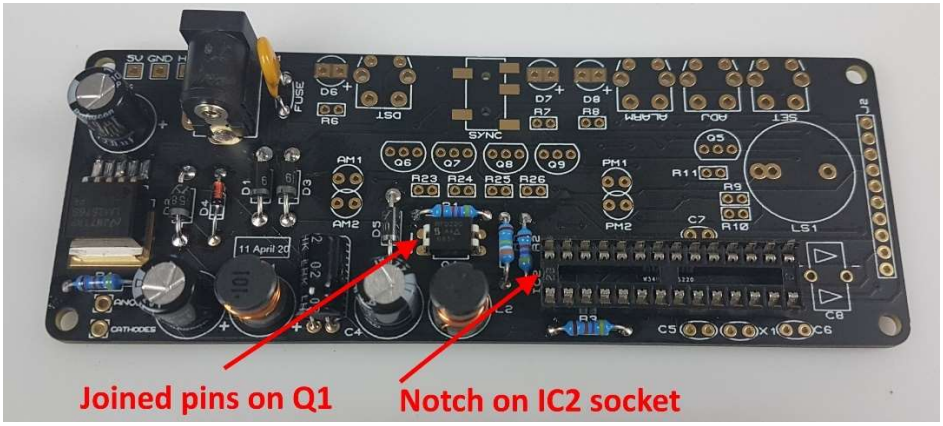
4.3 High Voltage Generator components.

Socket for IC2
R1, R2, R4 (4.7 KΩ)
R3 (390 KΩ)
C3 (1uF)
C4 (220uF)
Q1 (IRFD220)
L2 (100uH Inductor)
D5 (UF4004)



Solder the 4 resistors and the diode first as they are lower profile – its easier to solder the top pad rather than the bottom pad. This prevents the component falling out as you try to solder an inverted PCB! L2 is a tight fit, so push it in hard so that it is as close to the PCB as possible, preventing fouling the top PCB.

Also the MOSFET needs to be placed with the two joined pins at the position shown below.



Take care that the notched end of the IC socket is at the end shown. However, if you find you soldered it with the wrong orientation, do not try to remove it. It is perfectly fine with the notch at the wrong end, just be sure to place the IC in the socket with the IC's notch in the correct position.

C3 and C4 are polarized. The Positive lead is the longest, and goes in the pad marked '+'.

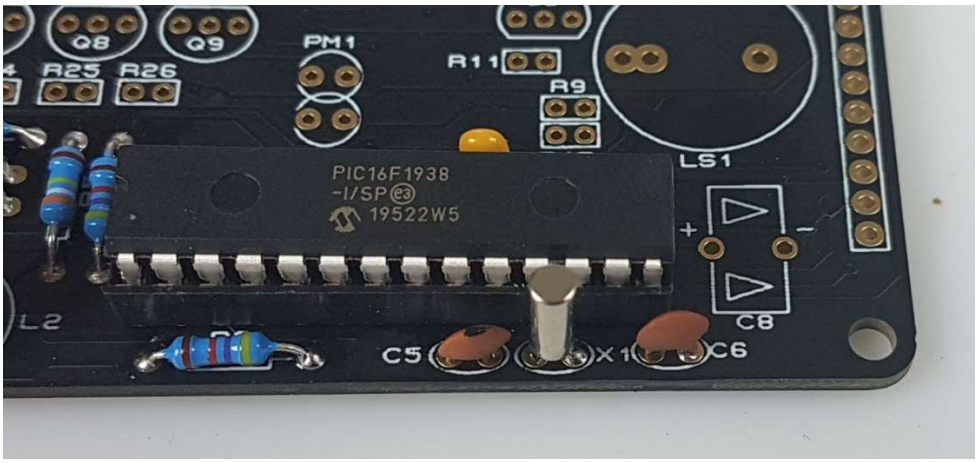
4.4 High Voltage Generator Test.

- 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 164 and 176 Volts. If this is in order, disconnect the power supply. If you do not get this voltage, do not proceed. Refer to the troubleshooting section on page 46.

IF YOU CHOOSE TO PROCEED BEYOND THIS POINT WITHOUT GETTING THE CORRECT VOLTAGE, WE WILL NOT BE ABLE TO OFFER SUPPORT

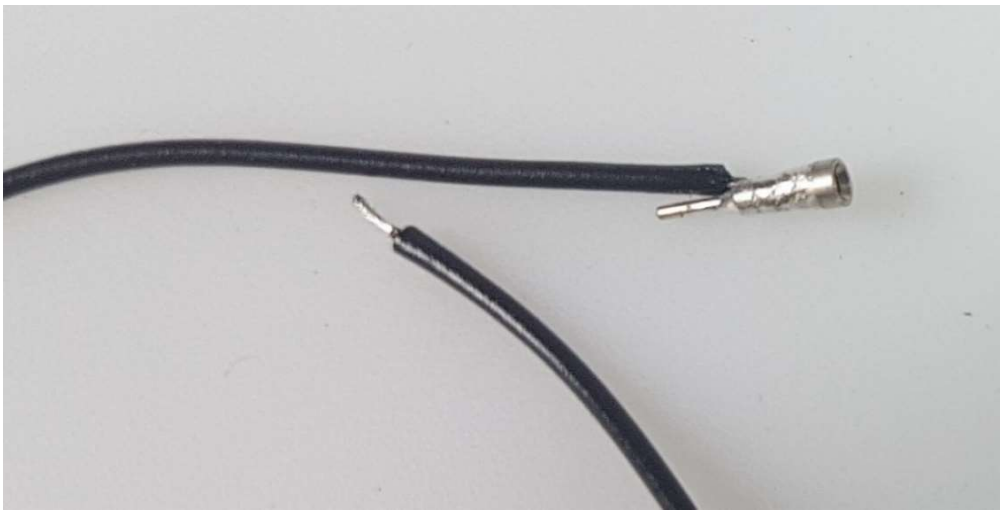
4.5 C5 (15pF)
C6 (33pF)
X1 (32.768KHz Crystal)
C7 (100nF but marked '104')

(C7 may be a different colour)

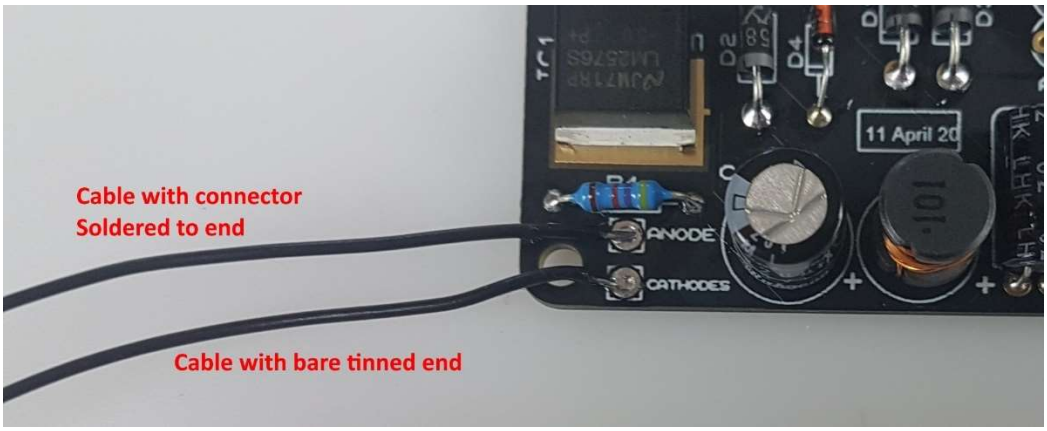


4.6 Preparing The Tube Test Cables

Take the 30cm of cable and cut it in half, then strip 2mm insulation from each end and tin the exposed strands. To one end of one cable, solder the very small socket receptacle:



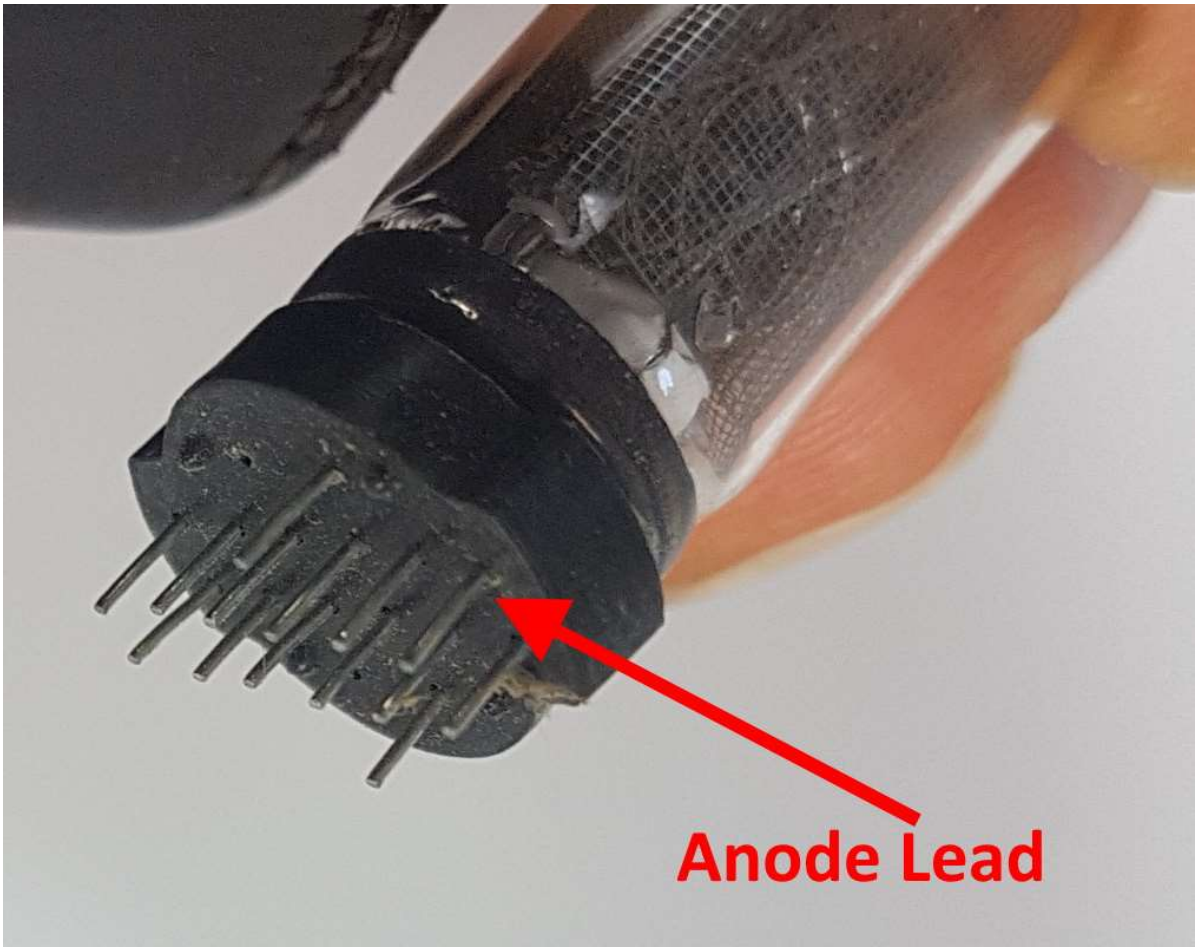
Solder the other end of this lead to the 'ANODE' pad as shown below. And solder one end of the other lead to the 'CATHODES' pad.



4.7 Testing The Tubes

Prior to soldering the tubes to the PCB, it makes sense to test all digits on all tubes – removing a bad tube is a fiddly job. First of all, we suggest to clip off the outer two leads as they are just for decimal points, which are not used in this kit.

First, identify the anode on the tube. We are showing GR116D tubes, but all tubes compatible with this kit have the same anode location. It is quite simple – the anode is the front left pin of the tube.



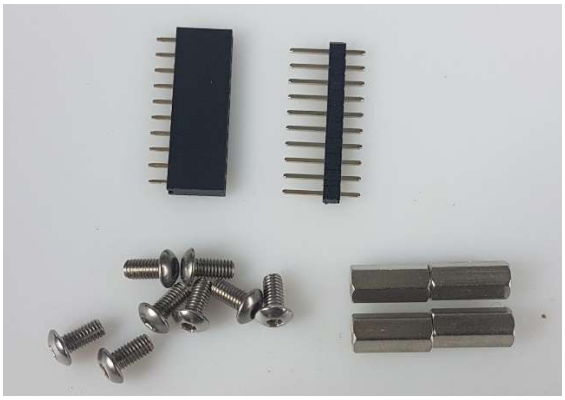
Then, push the anode test lead, with the socket on, onto the anode lead.

Now, remembering that the board generates 170V, power up the PCB and use the bare end of the cathode wire to touch up against each of the cathode wires in turn, and check that all digits light.

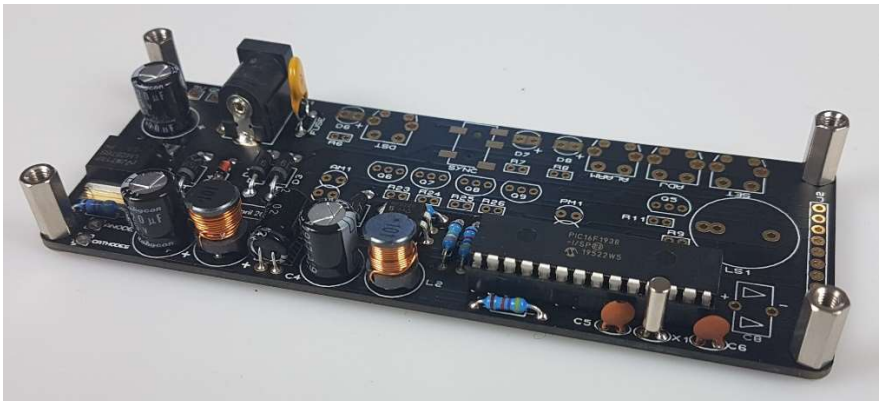
Once the tube tests have been completed, you can desolder the 2 test wires from the main PCB.

4.8 J2 (10 Way female socket strip)
J3 (10 Way male header)

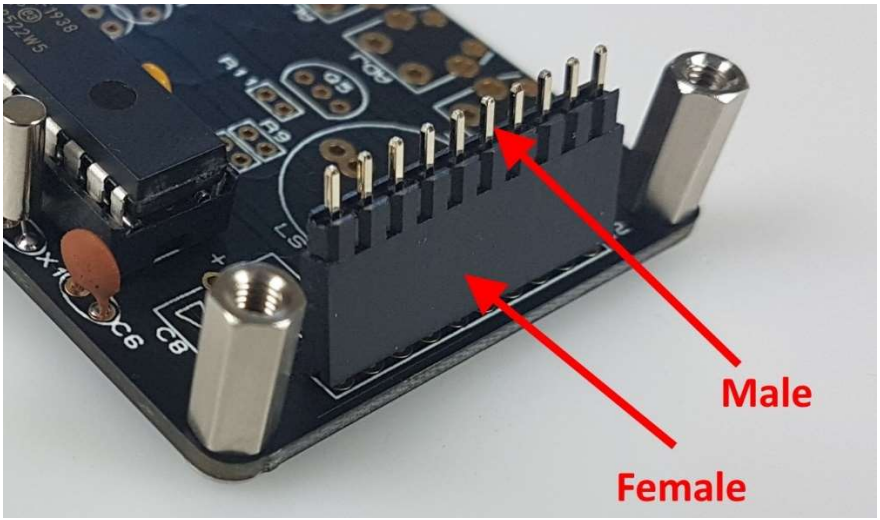
These are the parts you will need for this step:



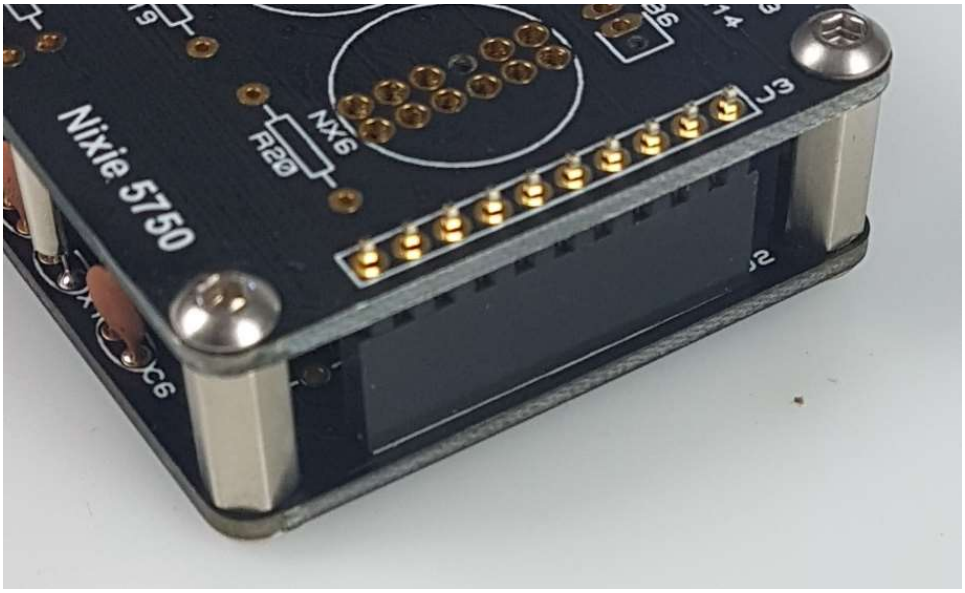
Start by screwing the 11mm hex spacers to each corner of the main PCB:



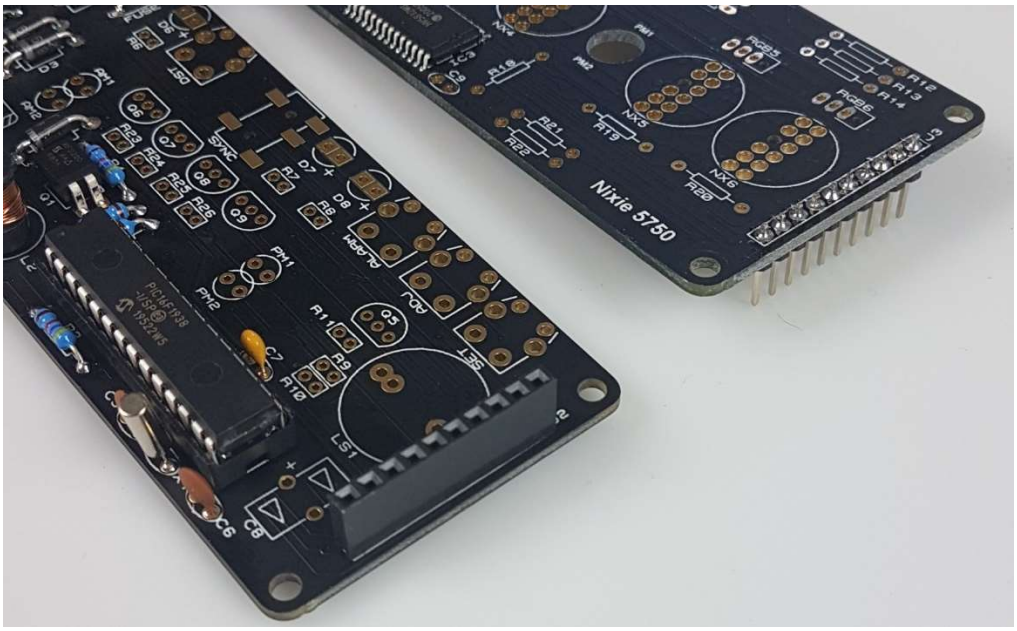
Now push the male and female connectors together and insert the FEMALE side into the J2 position on the main PCB.



Now lower the upper PCB into place with the pre-soldered IC facing upwards, ensuring the 10 pins are engaged in the 10 holes. Screw in place.



You can now solder all 20 pads, in the knowledge that everything is perfectly alighned. After soldering, remove all the screws and hex spacers and keep them safe for later. Now split the 2 PCBs – it is time to work on the upper tube PCB.



5 UPPER PCB COMPONENTS

For all the components on the top board, solder the TOP pad of each part, not the bottom. Then trim the lead from below very short. This ensures there is no contact between parts on the top of the PCB and bottom of the PCB

5.1 Q2, Q3, Q4 (EL817)

Be sure to place with the dot on the part at the same location as the white dot marking on the PCB.

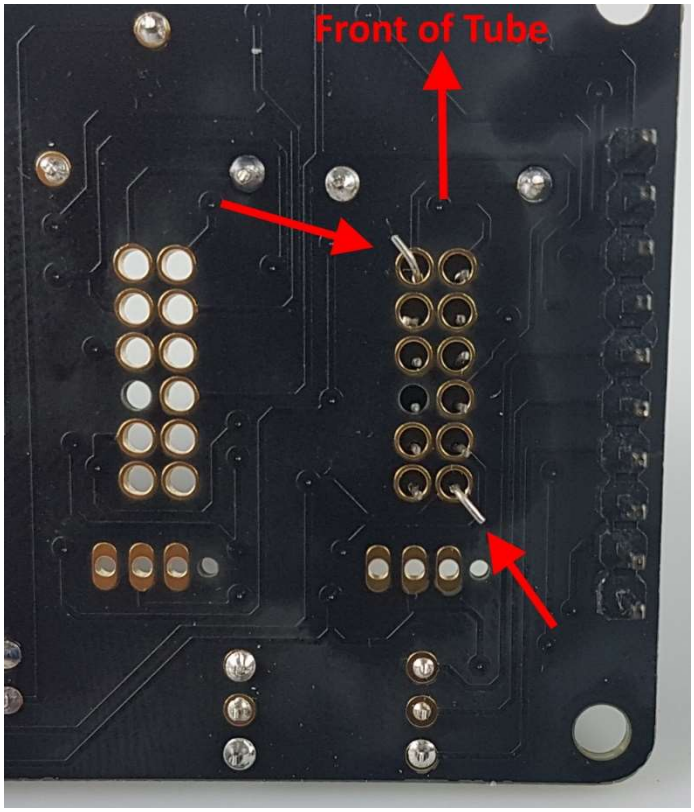
5.2 R12, R13, R14 (1 KΩ)

5.3 R15 - R20 (4.7 KΩ)
R21 (390 KΩ)
R22 (Upper Board) (300 KΩ)
C9 (100nF but marked 104)

6 SOLDERING THE NIXIE TUBES

PLEASE READ THIS CAREFULLY:
Solder each tube in turn, and after soldering each tube, test the tube by assembling the 2 boards and connecting power. Each tube should cycle 0 through to 9 and repeat. If you do not get this for a tube, stop and check your work. Do not proceed to mount the remaining tubes in the hope that the bad tube will magically fix itself at the end.

If your tubes have the extra outer 2 leads for decimal points, they must be snipped off, leaving 2 rows of 6 wires. Insert the tube facing forwards. From the underside, bend the 2 diagonally opposite wires outwards to hold the tube in place. See the picture below:

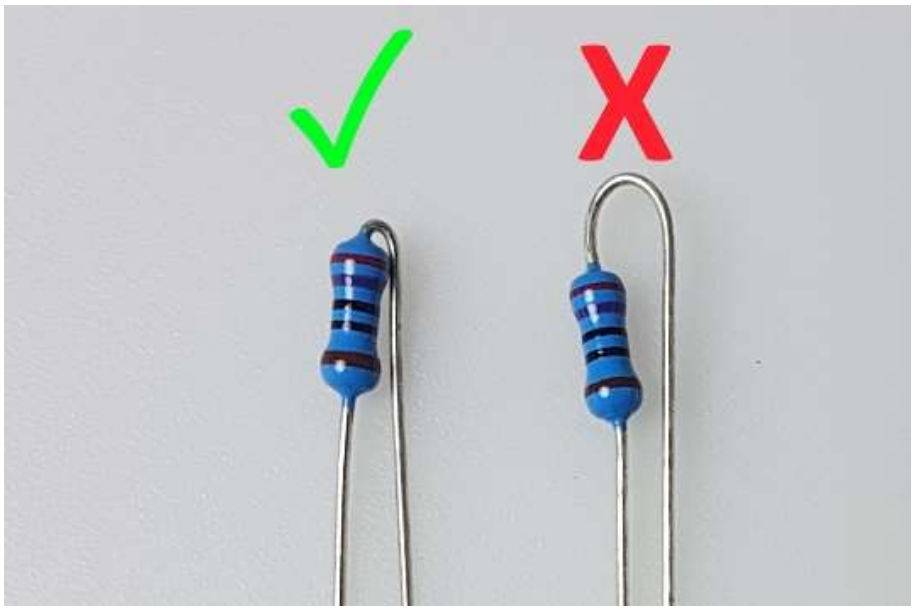


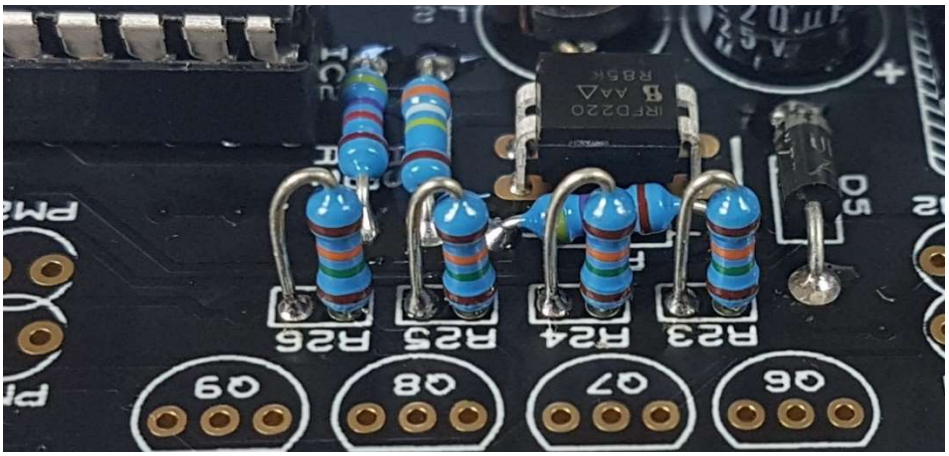
Now solder those 2 pins in place to secure the tube. From above, check the alighnment and orientation of the tube, and make adjustments as necessary by re-wetting the pads until the tube is perfectly front facing and vertical. Then you can solder the remaining 9 pins. Note that one pin is not soldered.

7 COMPLETION OF THE MAIN BOARD

7.1 R22 (Lower Board) – R25 (15 KΩ)

These 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. Mount them all in the same direction so that there is no possibility of contact between adjacent resistors.

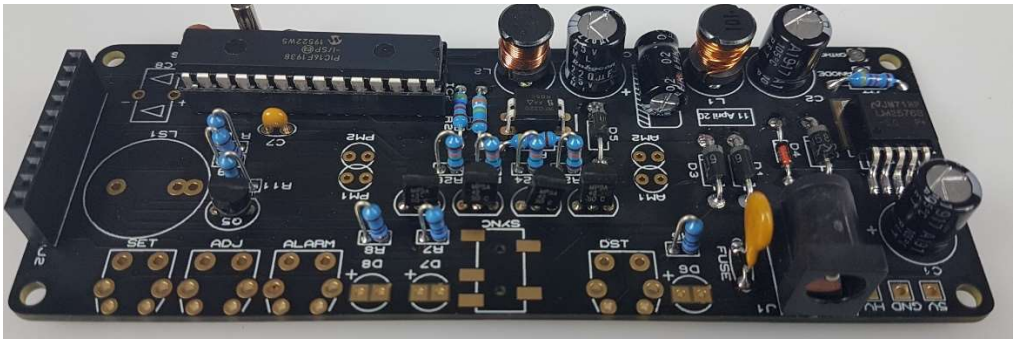




7.2 R6 – R11 (270 Ω)

As before, these need to be mounted vertically.

7.3 Q5, Q11- Q14 (MPSA42)



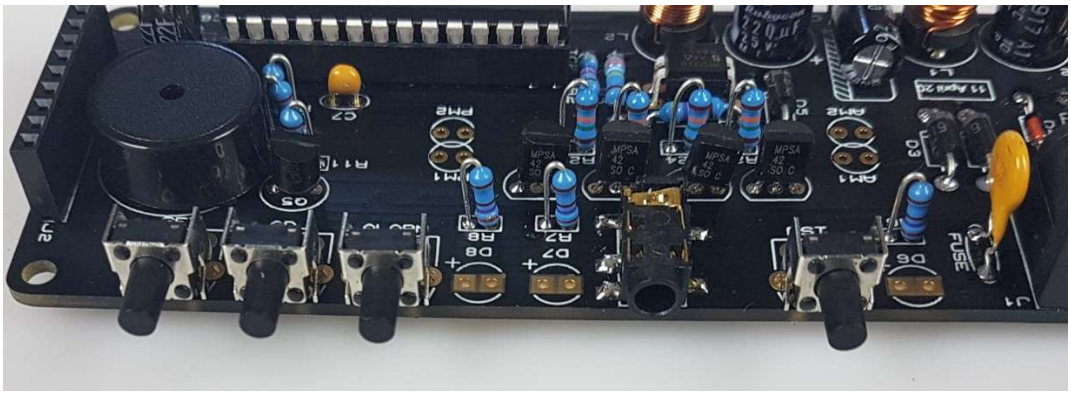
7.4 LS1 (Piezo Sounder)
C8 (0.22F Capacitor)
SYNC (3.5mm SMD Jack connector)

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 socket, first tin one pad, 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.

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

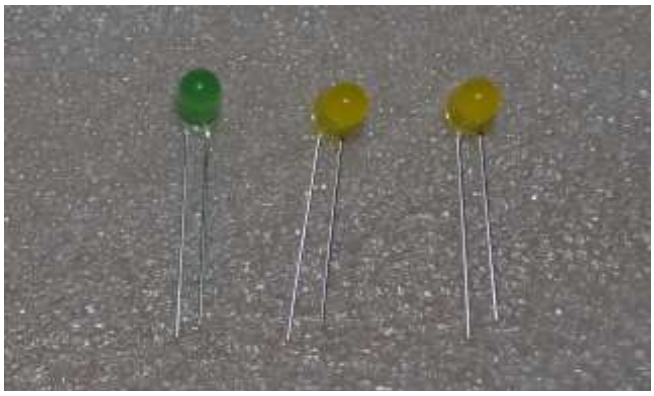
Only solder the two pins closest to the board edge. The other two pins are the frame and are not electrically connected. By only soldering the two active pads, if you make a mistake it is much easier to remove or re-position the switches!

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.



7.6 D6 (5mm yellow LED)
D7 (5mm green LED)
D8 (5mm yellow LED)

First, bend the leads of the LEDs as shown below, paying attention to the longer (+) lead being on the left hand side. Then solder in place with the body of the LED just touching the PCB.



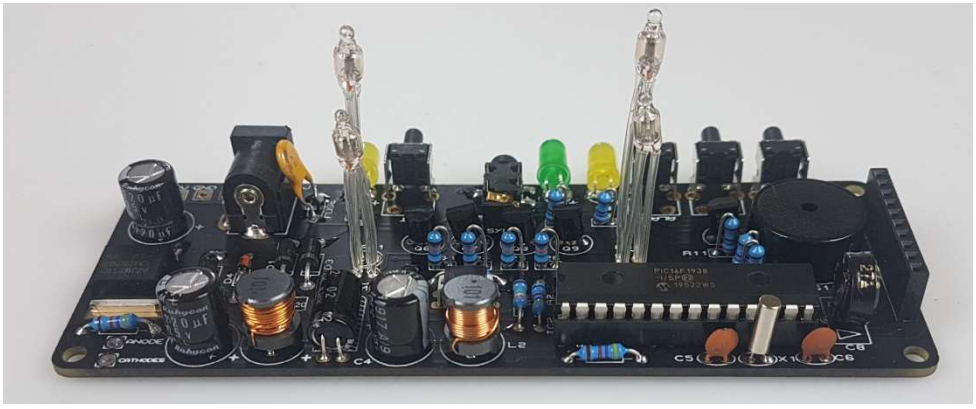
7.7 AM1, AM2, PM1, PM2 (4mm neon lamp)

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 - four of 30mm and four of 20mm, but make a test fit first as the lengths may be different dependiing on the tubes you have.

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

Finally, solder the neons in place on the PCB, with the taller neons at the back.



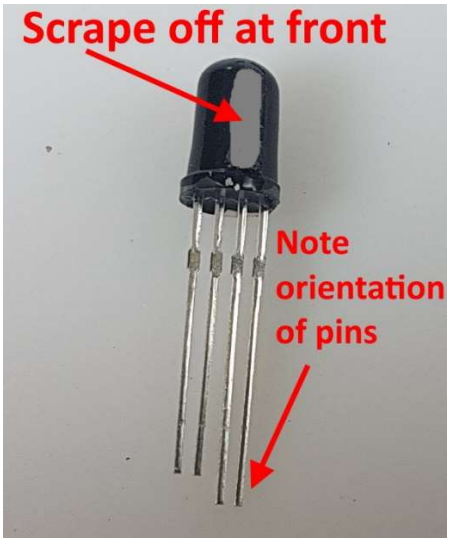
5.0 RGB LEDs

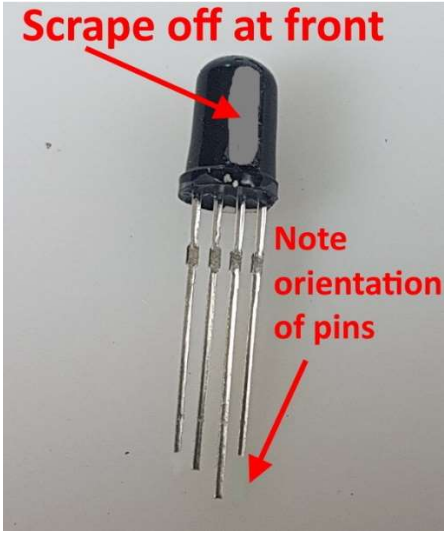
Due to the tube's opaque spacer, and also semi opaque base of many of the tubes that fit this kit, RGB lighting is problematic, in fact you may not wish to use RGB tube lighting at all, in which case simply don't solder the RGB LEDs. There are two possible lead lengths on the LEDs, as shown below.

If you wish to RGB backlight the tubes, this is the best method.

First, coat each LED with black nail varnish. Use a thick coating, but not so much that it drips. Leave each LED to dry for 24 hours. You can use the black foam square as a jig to hold the LEDs as you paint them.

Once dry, scrape a thin band off using a sharp knife. Note the position of the longer 2 pins.



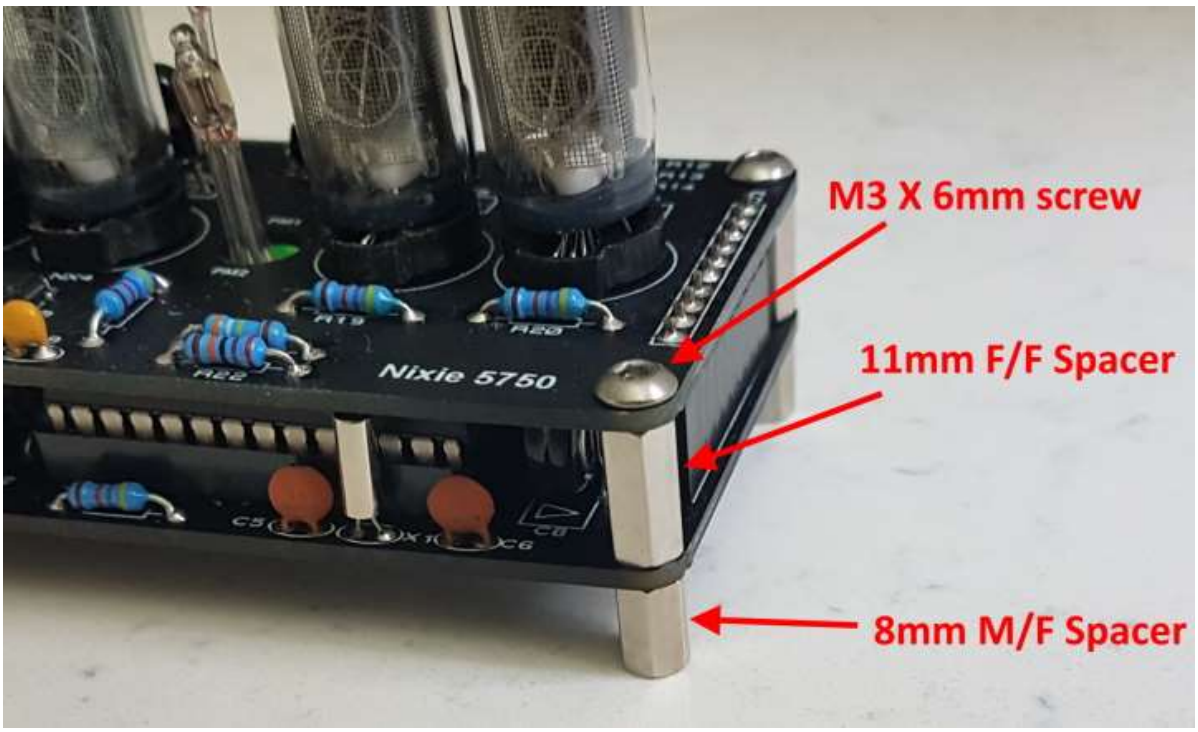


7.1 Solder each RGB LED in turn – the marking on the PCB indicates the flat on the LED body. Only 3 leads per LED are soldered.

As you did with the tubes, power up and test each LED at a time before progressing to the next one. Each LED should cycle through a variety of colours including off. If you don't get this cycling, stop and check for solder shorts between adjacent RGB solder pads.

8. FINAL ASSEMBLY

8.1 Using the hardware supplied, screw the 2 halves of the PCB together, ensuring the 10 way connectors are properly mated.

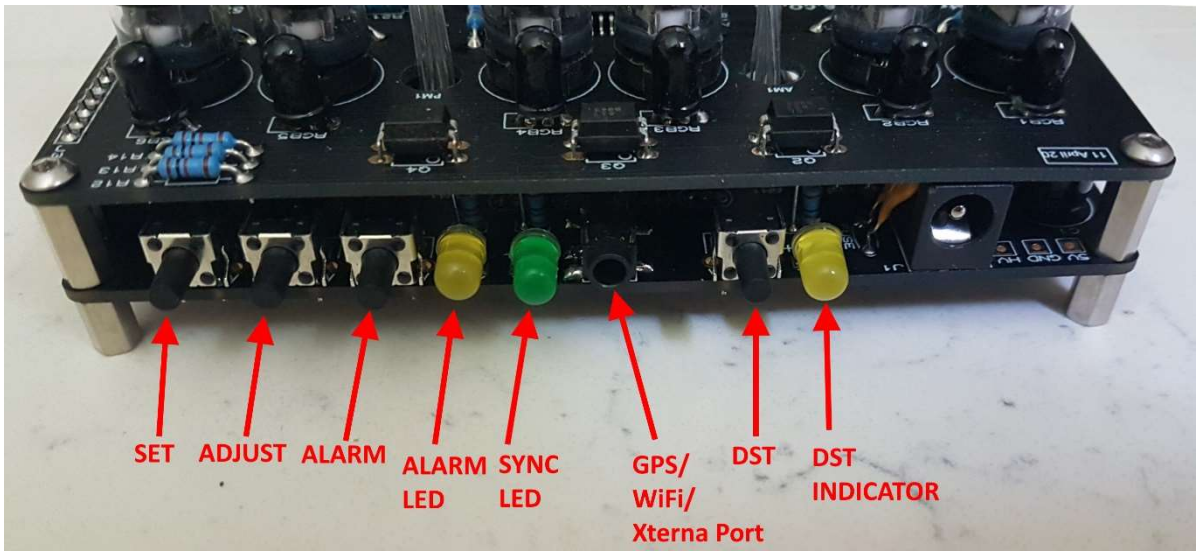


8.2 R27, R28, R29 (300 KΩ)

These three resistors are optional, if you find you are getting excessive ghosting of digits on tubes which should be blank. They are located just by the the EL817 optocouplers. If your PCB has white stencil marking, this shows where to place them.

If your PCB does not have stencil markings for them, solder them across the leads of each of the EL817s as shown below:

8. 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	1.0 = version 1.0, 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 - 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 (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	Reserved	
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)
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 C8 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 LED 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.

9. XTERNA FUNCTIONS

9.1 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 to 48 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.

9.2 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).

9.3 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.

9.4 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.

9.5 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.

9.6 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.

9.7 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	

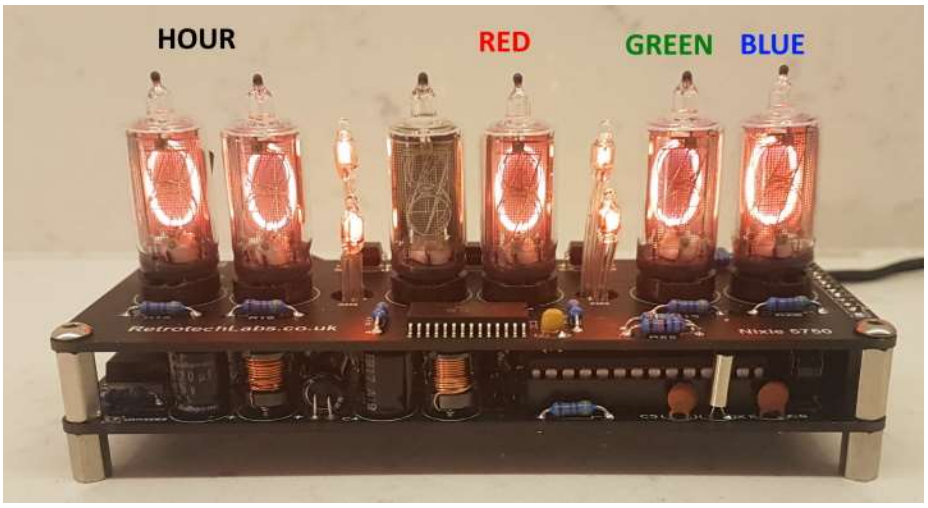
10. CONFIGURING THE RGB LED TUBE LIGHTS

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.

10.1 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 RED GREEN and BLUE 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 red, 0 green, 8 blue)

- In the example below, between 19 and 20 hours, the LEDs will be Orange green (8 red, 5 green and 0 blue)

10.2 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.

11. USING A GPS OR WiFi RECEIVER

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

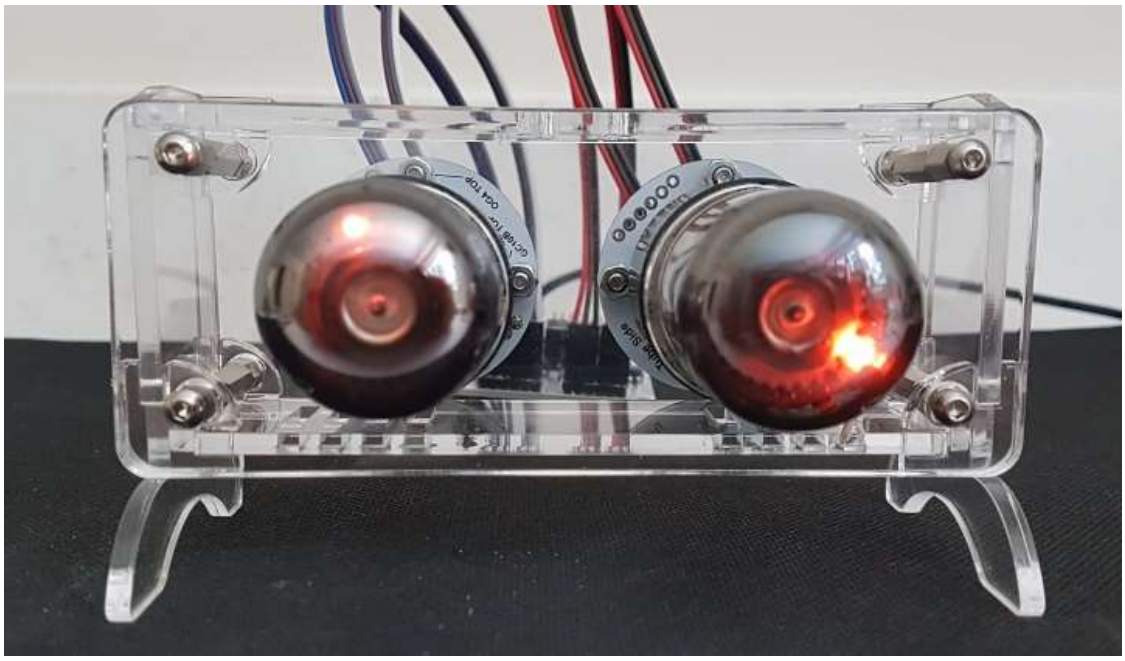
11.1 Configuring for GPS Synchronisation.

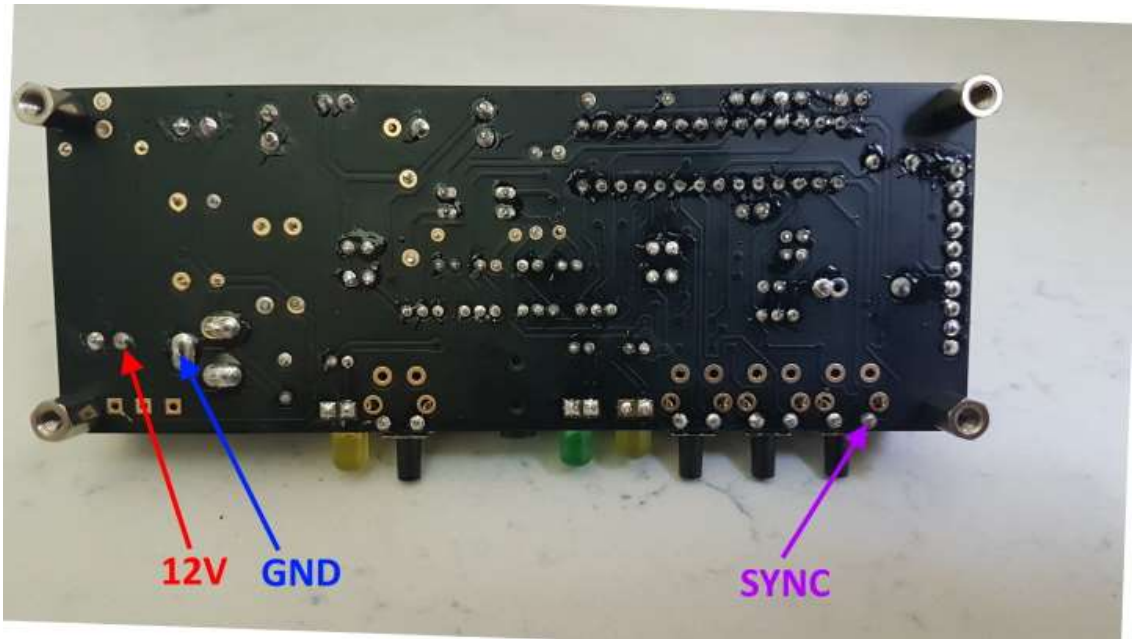
- Set parameter 12 to value 4.
- Set the baud rate in parameter 13.
- Set parameters 14 and 15 for the hours and minutes your time zone is offset from UTC Time. This is usually only whole hours.
- Set parameter (16) to identify whether the offset is minus (0) or positive (1) of the time source.

The Green 5mm LED will light when the clock has received a recent GPS, WiFi or XTERNA synchronisation data.

12. 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
L1
SYNC
GND
12V

13.3 Problems getting the correct High Voltage

This is the most common issue. Did you insert IC2? IC2 is needed to generate the HV. If IC2 is in its socket and you don't get HV, please record the following DC voltages with IC2 out of its socket.

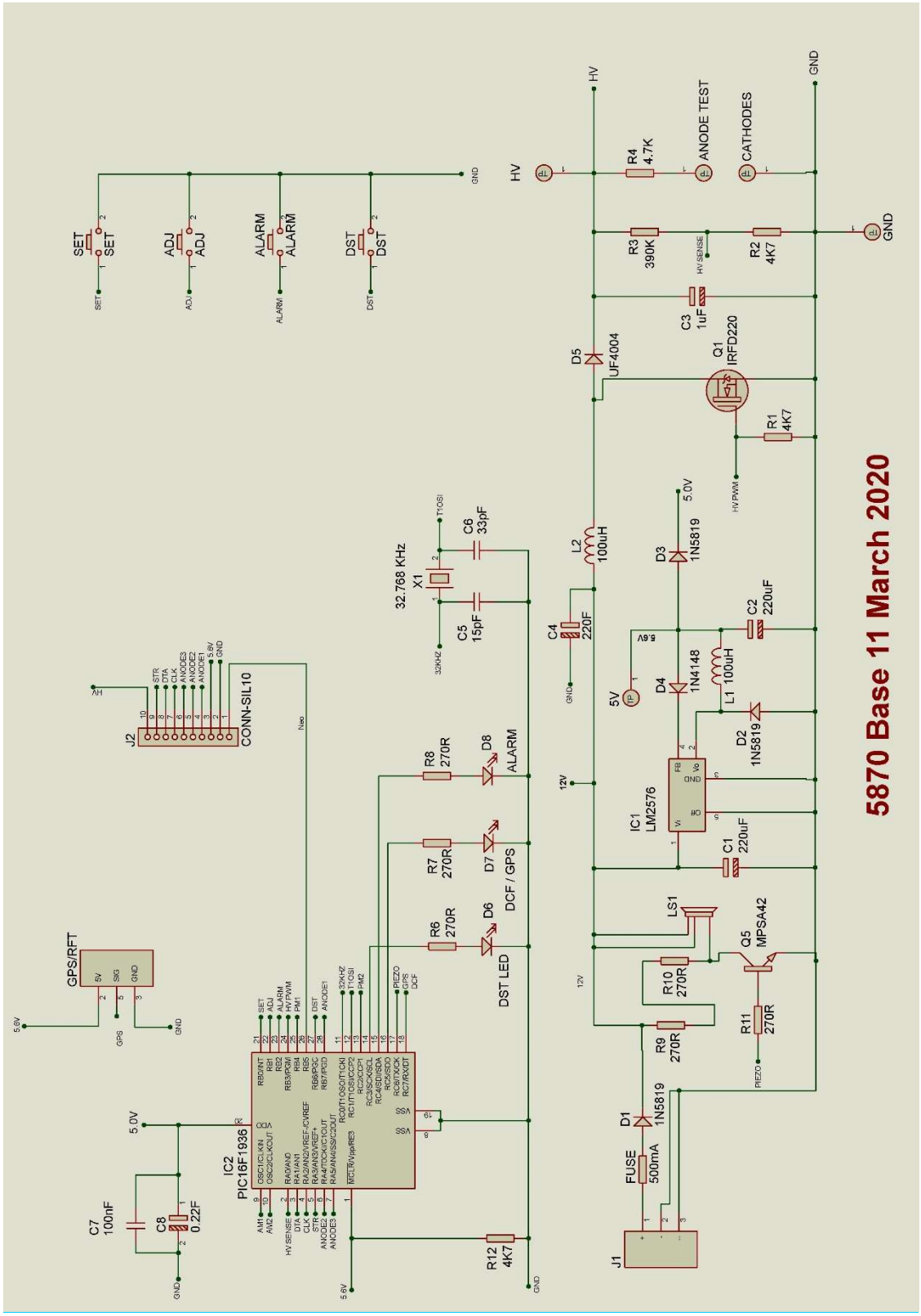
5V test Point	Should be 5.6V
HV test point	Should be approx 12V
IC2 Socket, Pin 1	Should be ~5.6V
IC2 Socket, Pin 2	Should be ~0.14V
IC2 Socket, Pin 24	Should be 0V
IC2 Socket, Pin 20	Should be ~5.2V

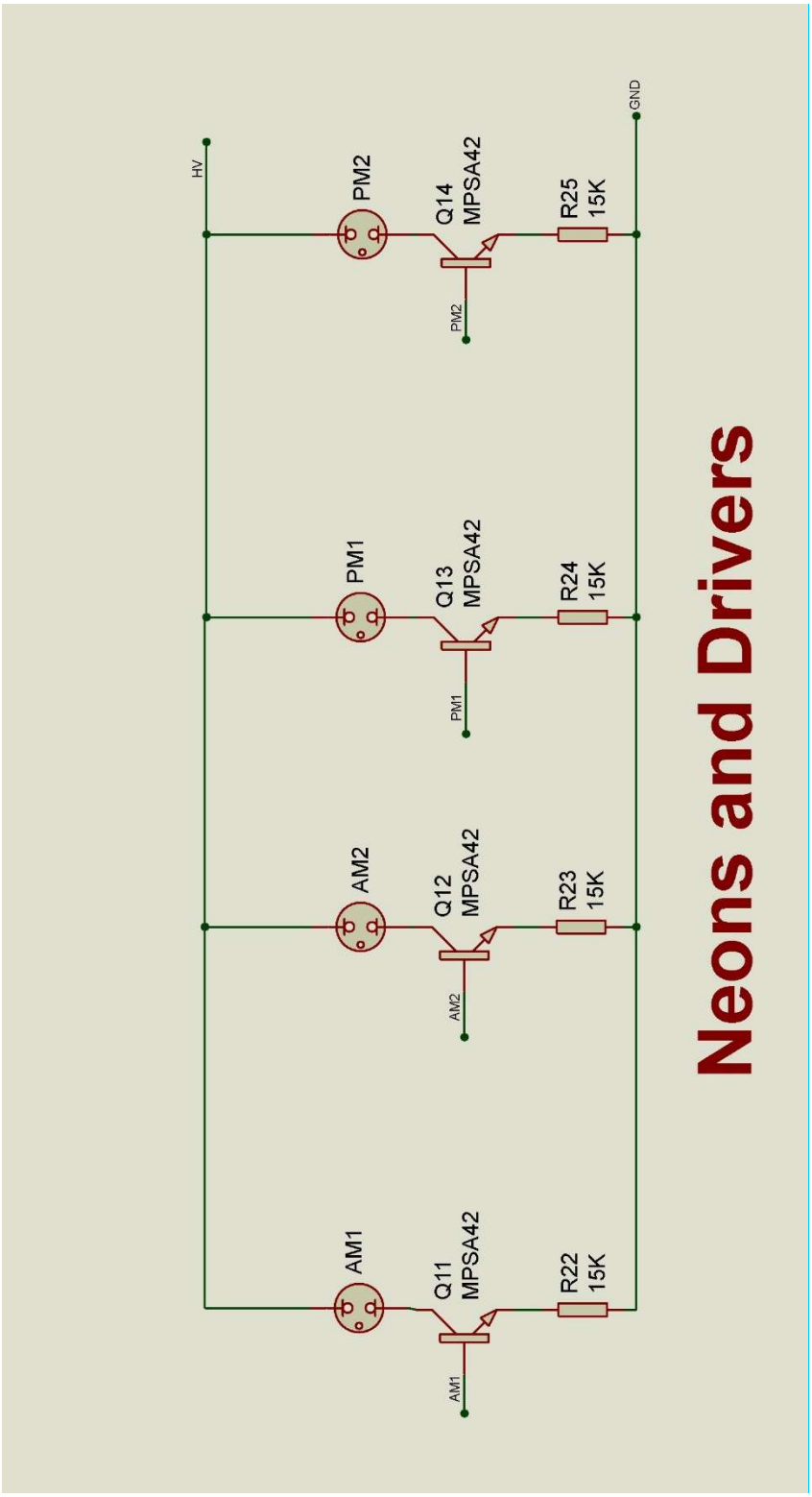
If pin 2 is not to spec, check the feedback resistors R2 and R3 are correct and correctly soldered.

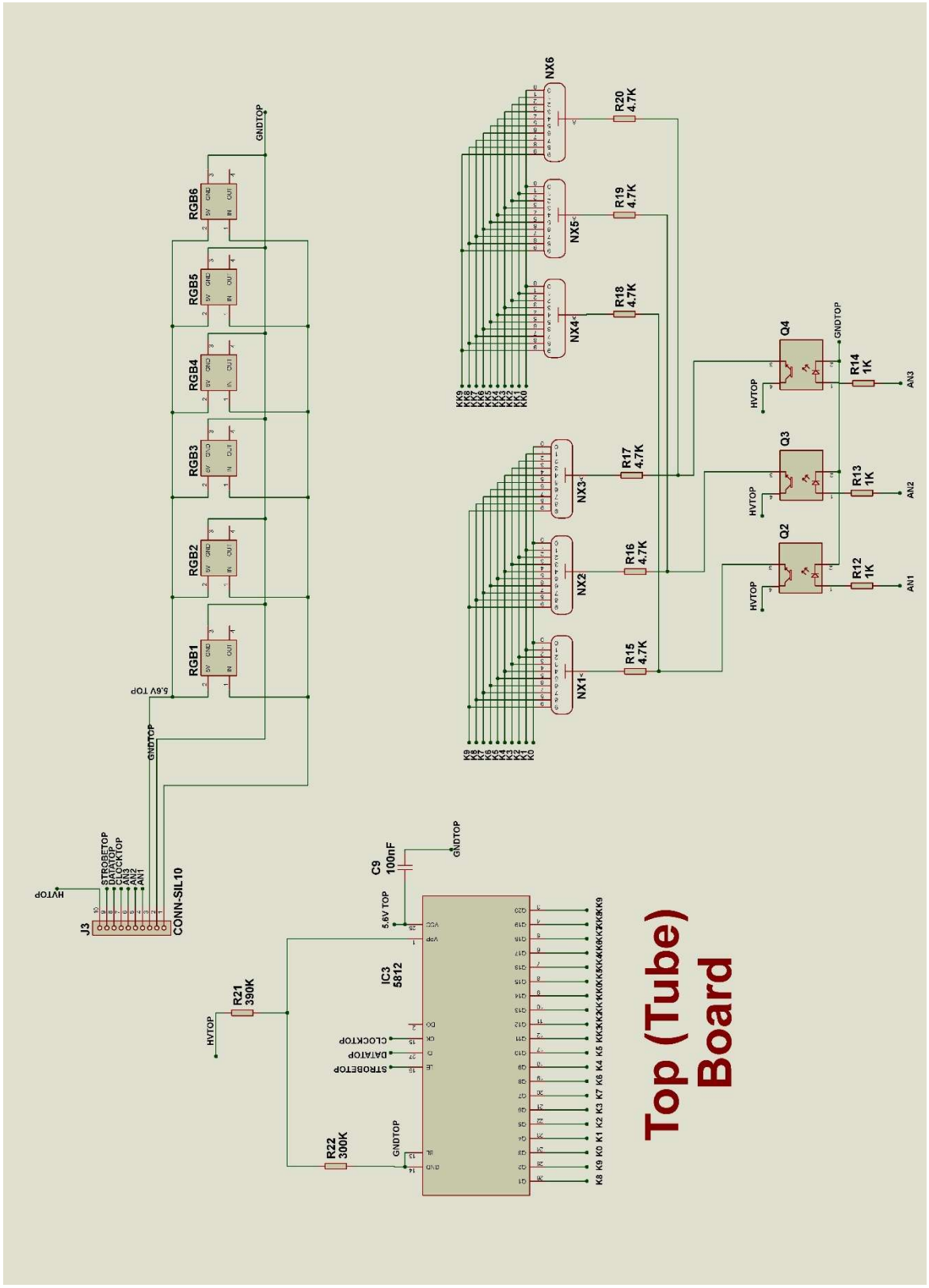
If pin 20 is not to spec, check why the PIC is not getting power via D3 (Orientation?)

If contacting us about an HV issue, please measure and give us these voltages in your email.

14. CIRCUIT DIAGRAM




Neons and Drivers
HV
GND
PM2
Q14
MPSA42
R25
15K
PM2
PM1
Q13
MPSA42
R24
15K
PM1
AM2
Q12
MPSA42
R23
15K
AM2
AM1
Q11
MPSA42
R22
15K
AM1


Top (Tube)
Board
NX6
NX5
NX4
NX3
NX2
NX1
R20 4.7K
R19 4.7K
R18 4.7K
R17 4.7K
R16 4.7K
R15 4.7K
Q4
Q3
Q2
R14 1K
R13 1K
R12 1K
HVTOP
AN3
AN2
AN1
GNDTOP
RGB6
RGB5
RGB4
RGB3
RGB2
RGB1
5.6V TOP
J3
CONN-SIL10
STROBETOP
DATATOP
CLOCKTOP
C9 100nF
IC3 5812
R21 390K
R22 300K
K8 K9 K0 K1 K2 K3 K7 K6 K5 K4