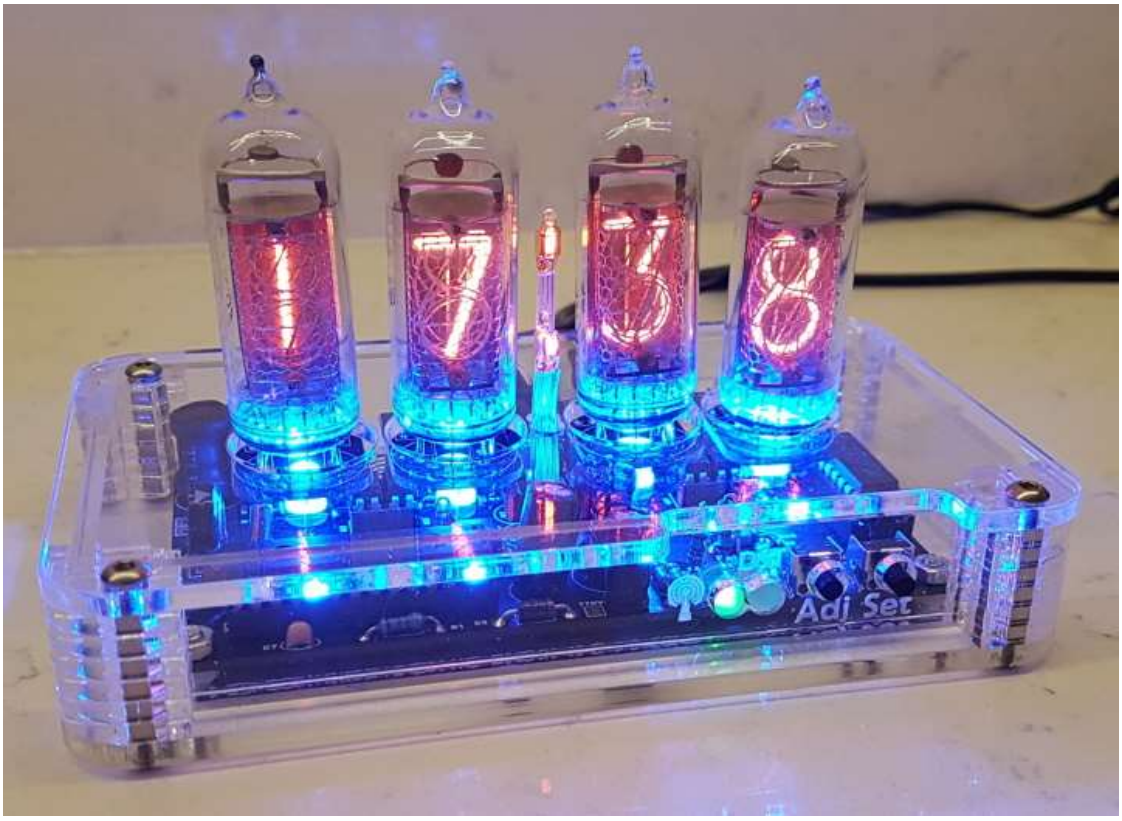
Assembly Instructions
And
User Guide

Nixie Clock Type
'Nixie QTC-Four'

For Parts Bag Serial Numbers from 100 onwards



REVISION HISTORY

Issue Number	Date	Reason for Issue
Issue 1	01 December 2019	New document

1. INTRODUCTION

1.1 Nixie QTC-FOUR - Features

- Hours, Minutes and Seconds display
- Drives a wide range of medium sized solder-in tubes
- Uses a Quartz Crystal Oscillator as the timebase
- 12 or 24 hour modes
- Programmable leading zero blanking
- Optional GPS / WiFi synchronisation with status indicator LED
- 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
- 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
- Front Indicator LEDs dim at night to prevent sleep disturbance
- 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
- 20 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

1.2 Tubes Supported

Each tube is soldered to a mini PCB 'Cell', making tubes easily changeable. Through the use of 2 different cell PCB types, it is possible for the kit to drive a wide range of solder-in tubes as detailed in the table below. There are detailed and specific instructions for mounting each type of tube, in sections 5.1 to 5.6 of this manual.

Tube types	**Section**
IN-14	5.1
IN-8-2, ZM1177	5.2
Z570M, Z5700M, Z573M, Z5730M, Z574M, Z5740M, GN-9A, B570M, TAF1317A, TAU7030, F9080B, F9080BA, TAF1093A, ZM1080, ZM1082, ZM1134, ZM1135, ZM1136, ZM1136A, ZM1136L, ZM1136R, ZM1138A, ZM1138L, ZM1138R	5.3
GNP-17A	5.4
GNP-7A, GNP-7AH	5.5
CD66, ZM1240, ZM1242, XN11, XN12	5.6

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.

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	4.7 KΩ, ¼ Watt
R3	390 KΩ, ¼ Watt
R4	4.7 KΩ, ¼ Watt
R5 – R10	1 KΩ, ¼ Watt
R7 - R10	1 KΩ, ¼ Watt
R11 – R14	2.7 KΩ, ¼ Watt
R15, R16	4.7 KΩ, ¼ Watt
R17, R18	390 KΩ, ¼ Watt
Capacitors	
C1, C2	220uF, 16-25V, Electrolytic
C3	1uF, 250V,
C4	220uF, 16-25V, Electrolytic
C5	15pF Ceramic
C6	33pF Ceramic
C7	100nF Ceramic
C8	0.1F or 0.22F
Transistors	
Q1	IRFD220 MOSFET
Q2 – Q5	EL817 Optocoupler
Q6, Q7	MPSA42
Diodes	
D1 – D3	1N5819
D4	1N4148
D5	UF4004
DST	5mm Yellow LED
SYNC	5mm Green LED
RGB1 – RGB4	APA106 RGB LED
Integrated Circuits	
IC1	LM2576 SMD 5V voltage regulator
IC2	PIC16F1936 8-bit microcontroller
IC3	K155ID1 Nixie Driver
Miscellaneous	
L1, L2	100uH inductor
AM, PM	4mm wire ended neon lamp
SET, ADJ	Miniature horizontal push button
IC2 Socket	28 Way narrow IC socket for IC2
IC3 Socket	16 Way narrow IC socket for IC2
Sockets for Q2 – Q5	8 Way narrow IC sockets
J1	2.1mm PCB power socket
GPS	Surface mount 3.5mm jack socket
FUSE	500mA fuse
Insulation	15 cm Clear insulation for neons
NX1 – NX4	2X6 way 0.1” header plug
DEKA	3 way Right Angle Male header
X1	32.768KHz watch crystal

3.2 Parts list / Packing Sheet - Component Bag

Part Description	Quantity
Resistors	
1 KΩ, ¼ Watt	6
4.7 KΩ, ¼ Watt	5
2.7KΩ, ¼ Watt	4
390 KΩ, ¼ Watt	3
Capacitors	
15pF, Ceramic	1
33pF, Ceramic	1
100nF, Ceramic	1
1uF, 250V, Electrolytic	1
220uF, 16-25V, Electrolytic	3
0.1F or 0.22F	1
Transistors	
IRFD220 MOSFET	1
MPSA42	2
EL817 Optocoupler	4
Diodes	
1N5819	3
UF4004 fast recovery diode	1
1N4148	1
5mm Green LED	1
5mm Yellow LED	1
APA106 RGB LED	4
Integrated Circuits	
LM25876 SMD	1
PIC16F1936 8-bit microcontroller	1
K155ID1	1
Miscellaneous	
100uH inductor	2
4mm wire ended neon lamp	2
Miniature horizontal push button	2
28 way narrow IC Socket for IC2	1
16 way narrow IC Socket for IC2	1
8 Way IC Socket	2
2.1mm PCB power socket	1
Surface mount 3.5mm jack socket	1
500mA fuse	1
15cm Clear insulation for neons	1
2X6 way 0.1” header plug	4
2X6 way 0.1” header socket	4
32.768KHz watch crystal	1
3 way Right Angle plug	1

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

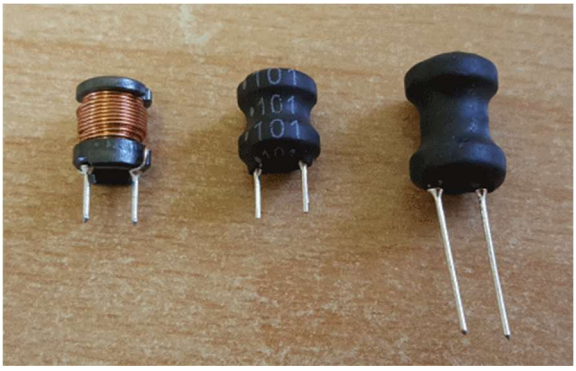
The resistors used in the kit are 1% tolerance metal film. They are marked with 4 coloured bands to identify the value. However it is sometimes unclear in which direction the bands should be read. Therefore, we recommend that the resistors be identified with a multimeter.

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 10pF and 33pF capacitors will be marked 10 and 33 respectively. The 100nF capacitors will be marked 104.

Q1 (IRFD220) is in a very similar package to Q2 – Q5 (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:

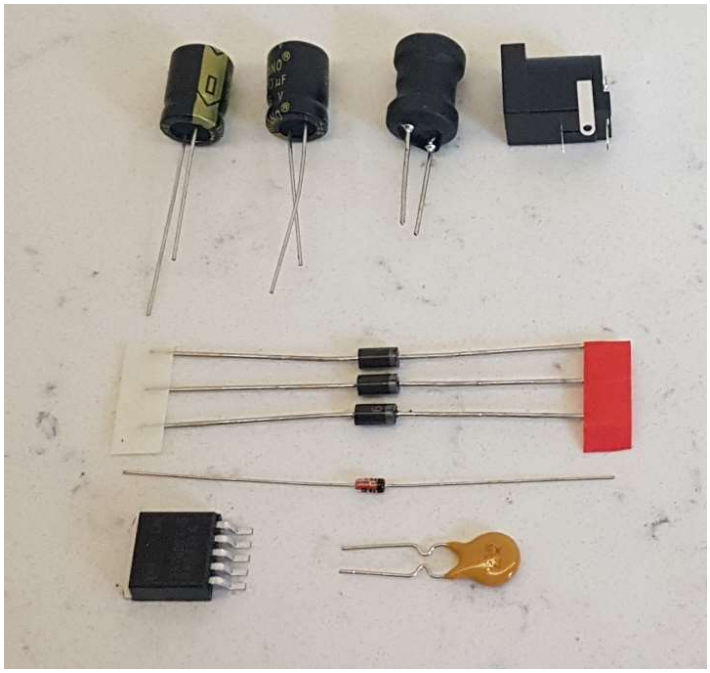


4. ASSEMBLY OF THE PCB

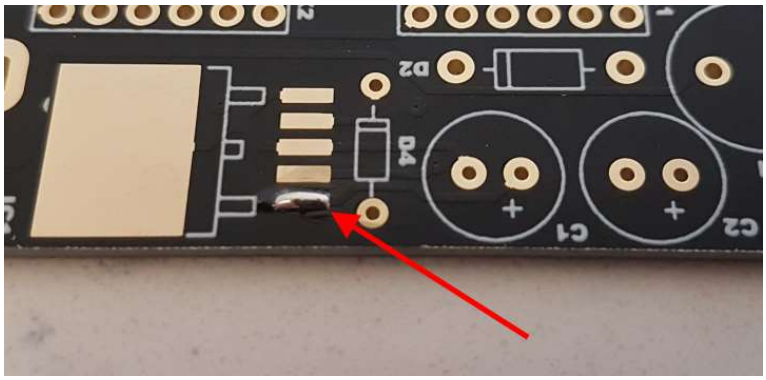
DUE TO PRODUCT DEVELOPMENT AND IMPROVEMENTS, YOUR PCB MAY NOT LOOK EXACTLY LIKE THE ONE PICTURED.

4.1 Low Voltage Power components:

J1, FUSE
D1-D3 (1N5819)
D4 (1N4148)
IC1 (LM2576)
L1 (100uH Inductor)
C1, C2 (220uF)

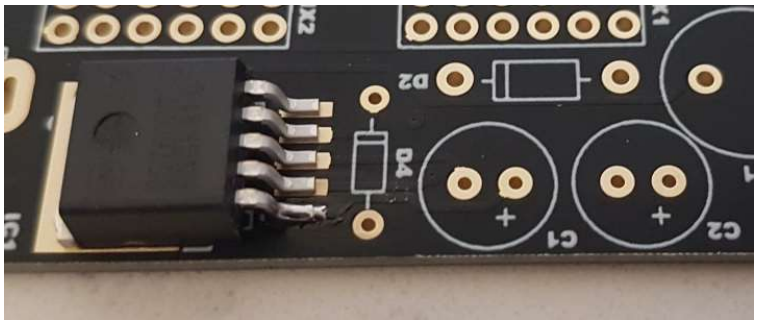


Start by installing IC1. Wet one end pad with solder as shown below:

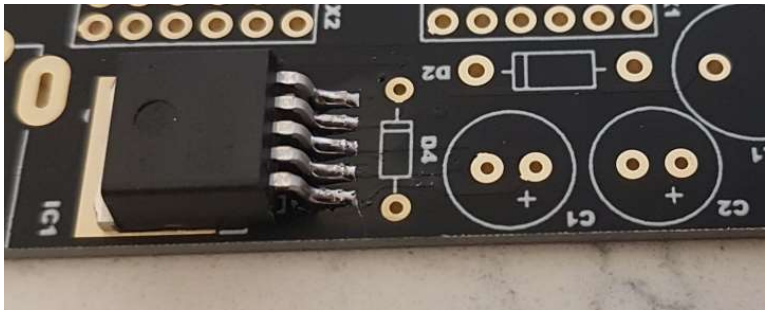


Now place the part IC2 over the soldered pad. Ensure the part is

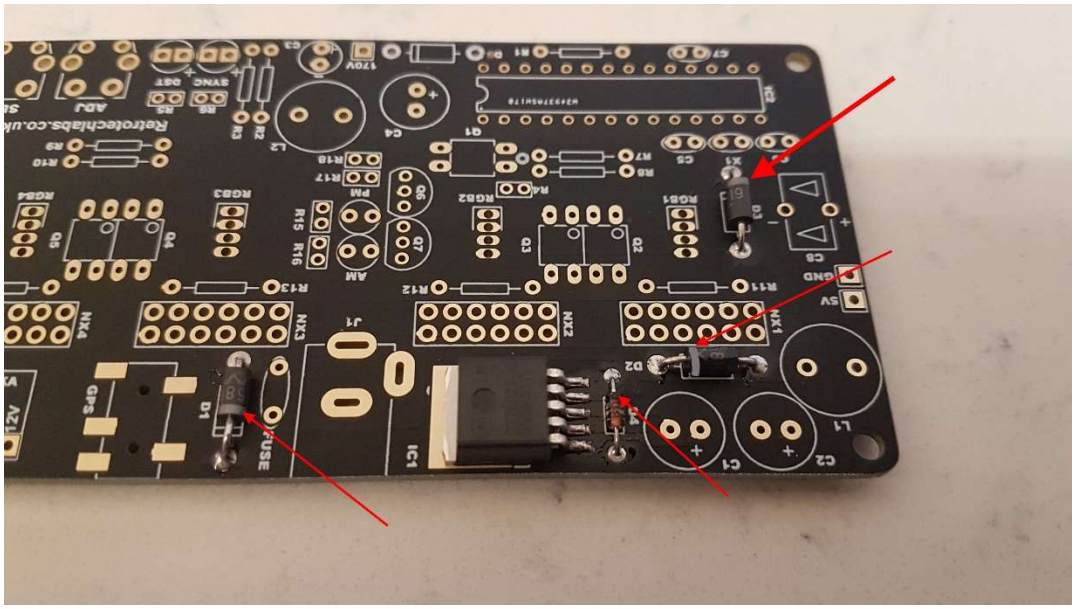
well-aligned over the other pads and then re-heat the solder to anchor the part to the PCB:



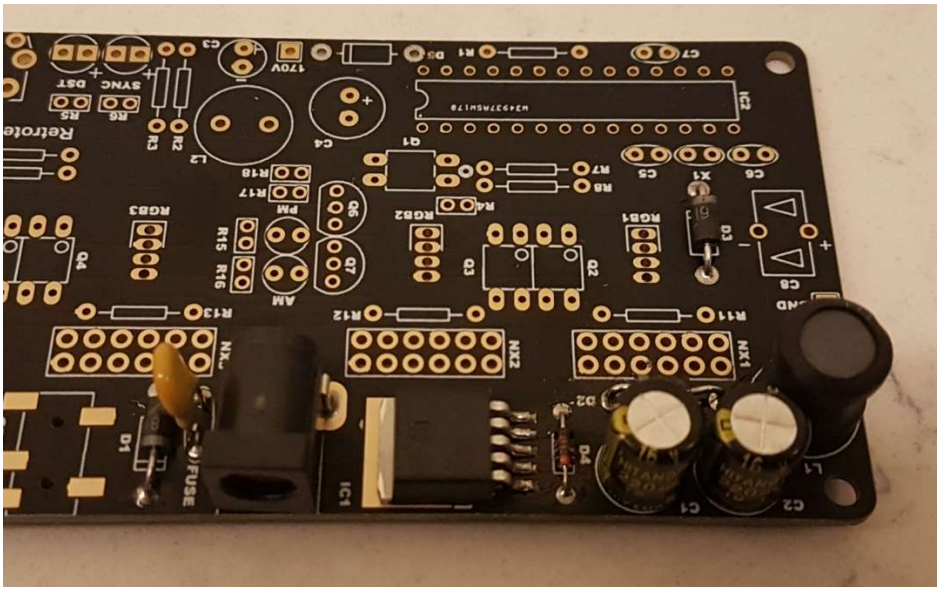
Now you can solder the remaining 4 pads of the IC. Do not solder the tab of the PCB.



Now solder the four diodes, taking care that the band on the diode matches the band marked on the PCB as shown below.

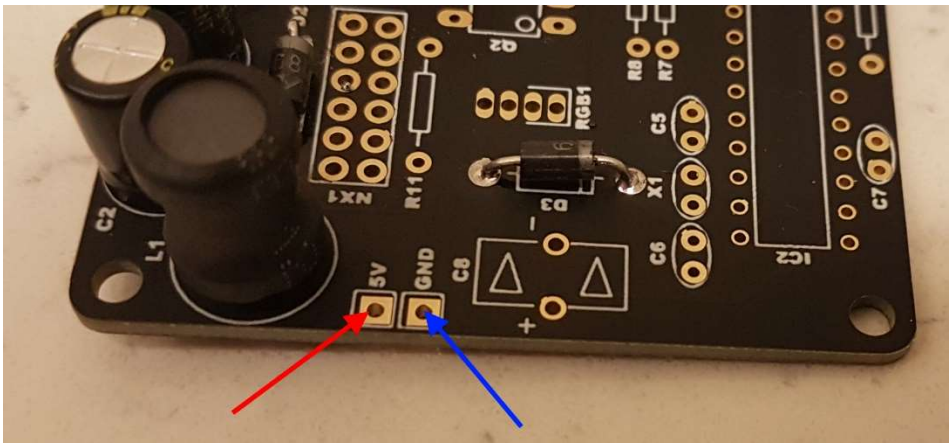


Continue to mount C1, C2, L1, J1 and FUSE. C1 and C2 are polarized. The longer lead goes in the hole marked '+'.



4.2 Testing Low Voltage Power Supply.

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

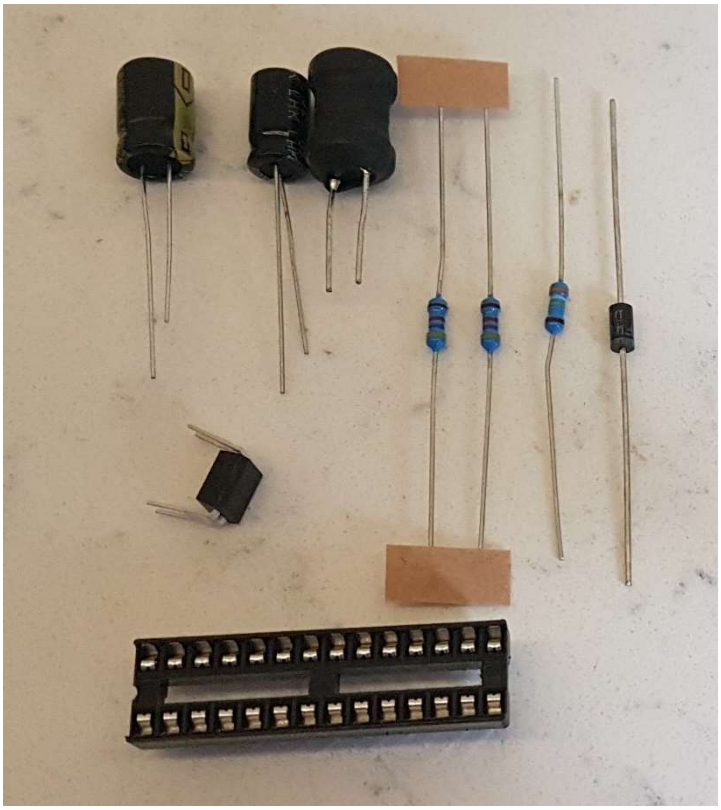


Plug in the power supply, and then test using a DC voltmeter: Touch the black probe on the GND test point and the red probe on the 5V test point. The voltage should measure between 5.4 and 5.8 Volts. If not, disconnect power and check your work. Do not proceed with the assembly until the error is corrected. 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 (4.7 KΩ)
R3 (390 KΩ)
C3 (1uF)
C4 (220uF)
Q1 (IRFD220)
L2 (100uH Inductor)
D5 (UF4004)

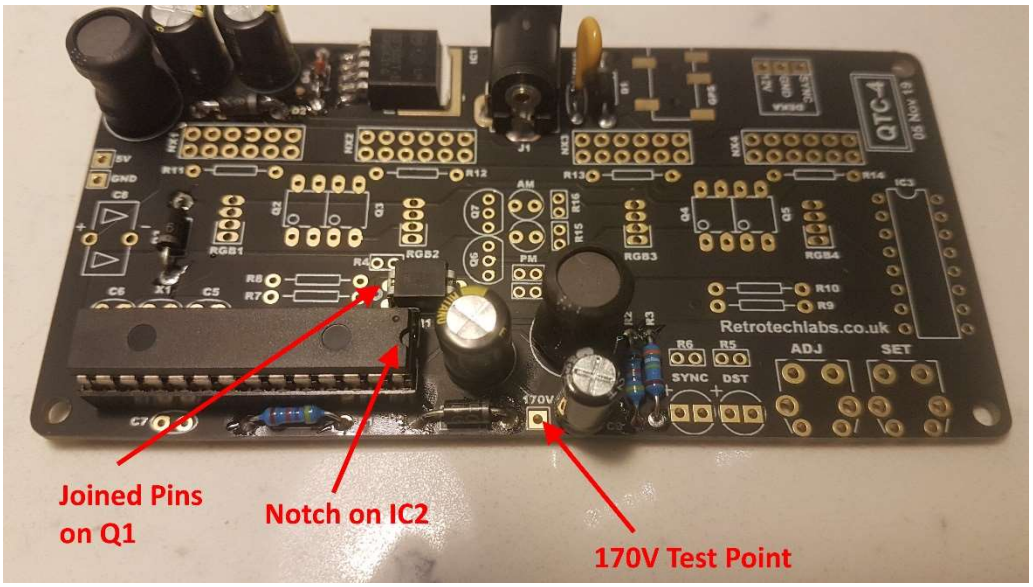


Take care that the notched end of the IC socket is at the end shown. However, if you find you soldered it with the wrong orientation, do not try to remove it. It is perfectly fine with the notch at the wrong end, just be sure to place the IC in the socket with the IC's notch in the correct position.

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

C3 and C4 are polarised – the longer lead goes in the hole marked +

Q1 has two pins joined together. It is important to position this side of the part by the white circle marking on the PCB.
You should now insert IC2 into its socket, paying attention to the image below showing the orientation of the notch.



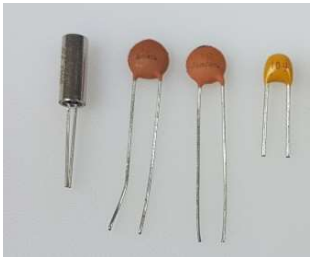
4.4 High Voltage Generator Test.

- Refer to the warnings on page 5
- Power up the PCB, and using the GND and 170 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.

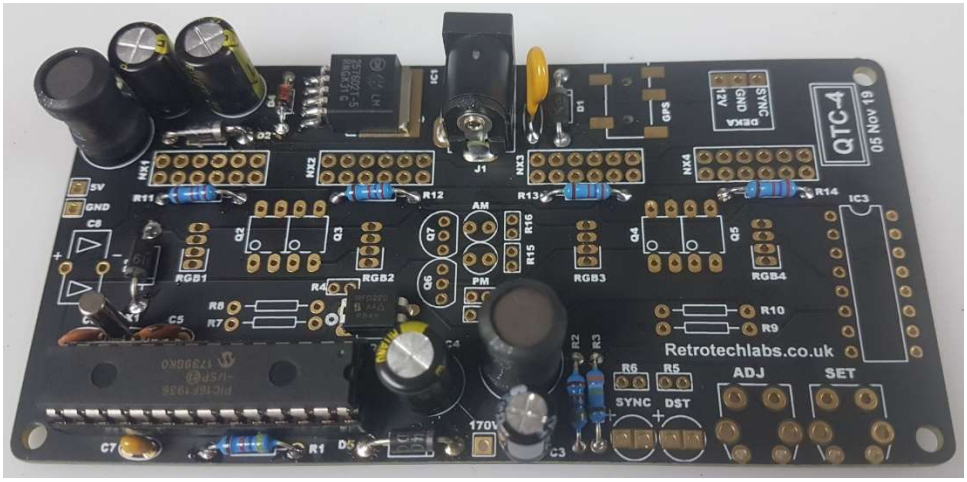
IF YOU CHOOSE TO PROCEED BEYOND THIS POINT WITHOUT GETTING THE CORRECT VOLTAGE, WE WILL NOT BE ABLE TO OFFER SUPPORT

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

(C7 may be a different colour)

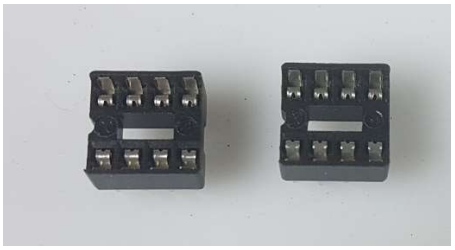


4.6 R11, R12, R13, R14 (2.7 KΩ)

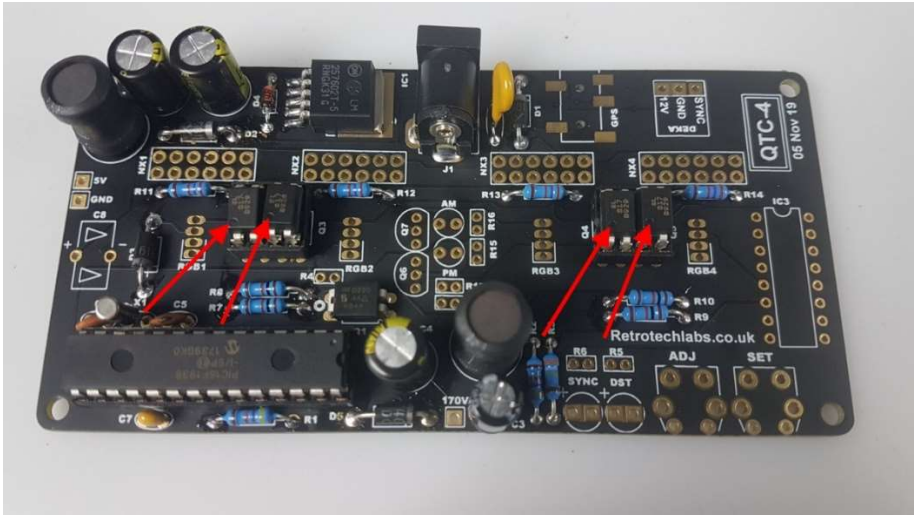


4.7 R7, R8, R9, R10 (1 KΩ)

4.8 Sockets for Q2 – Q5



Note: Earlier versions of the kit may not have the sockets – its perfectly safe to solder Q2 to Q5 directly to the PCB.
Once you have soldered the 2 sockets, insert Q2 to Q5 noting the orientation of the dot on each part:

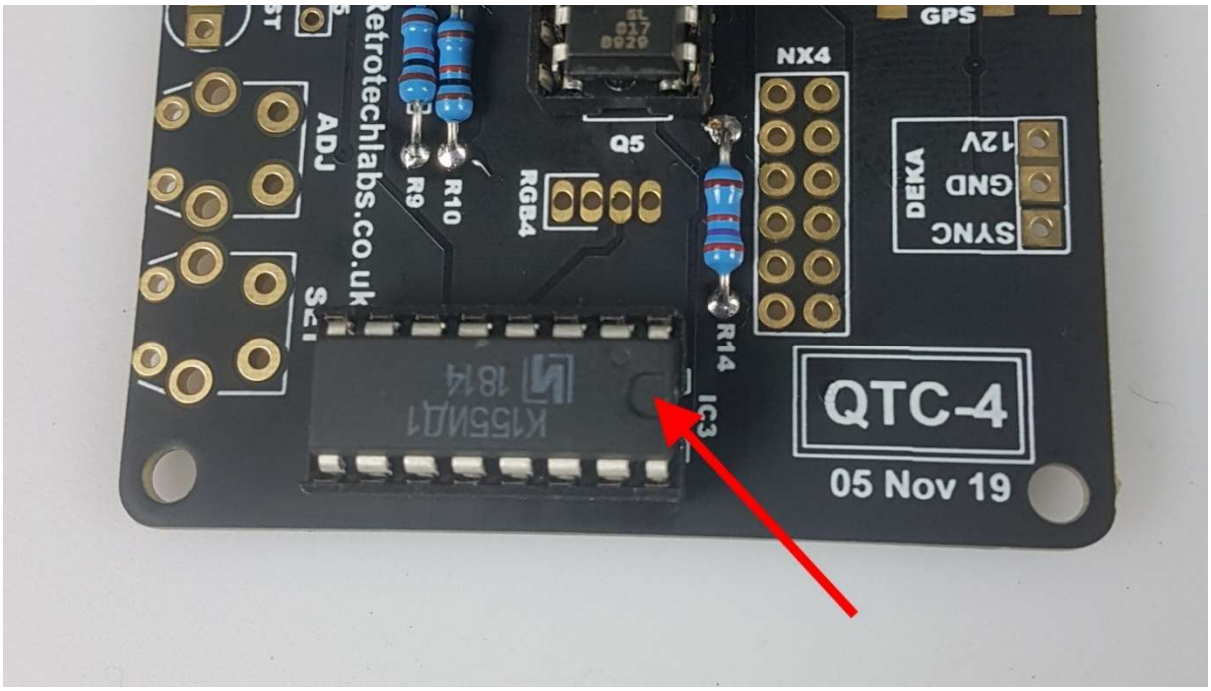


4.9 Socket for IC3

IC3

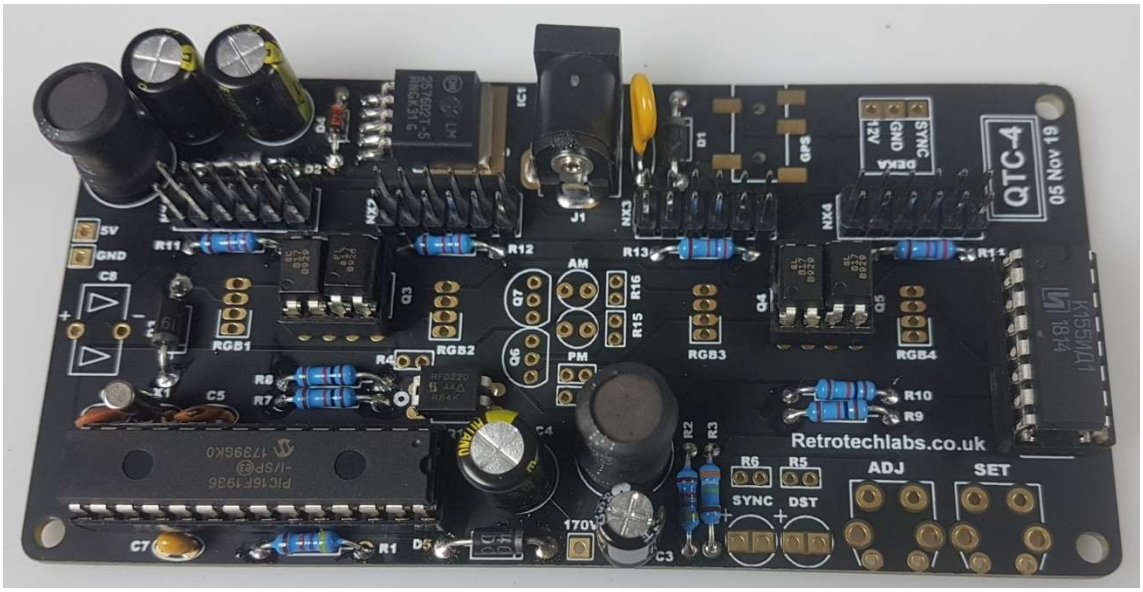
Align the notch on one end of the socket with the marking on the PCB. If you find you soldered it in the wrong orientation, don't try to remove it. See the troubleshooting section.

Now you can insert IC3 into the socket, noting the orientation as shown below.



4.10 NX1 – NX4 (6X2 way male pin header)

This is how the PCB should now look:


QTC-4
05 Nov 19
Retrotechlabs.co.uk
ADJ
SET
SYNC
DST
AM
PM
RGB1
RGB2
RGB3
RGB4
GPS
SYNC
GND
12V
DEKA
5V
GND
170V

5. ASSEMBLING THE NIXIE TUBE CELLS

PLEASE REFER TO THE APPROPRIATE SECTION FOR YOUR NIXIE TUBE TYPE.

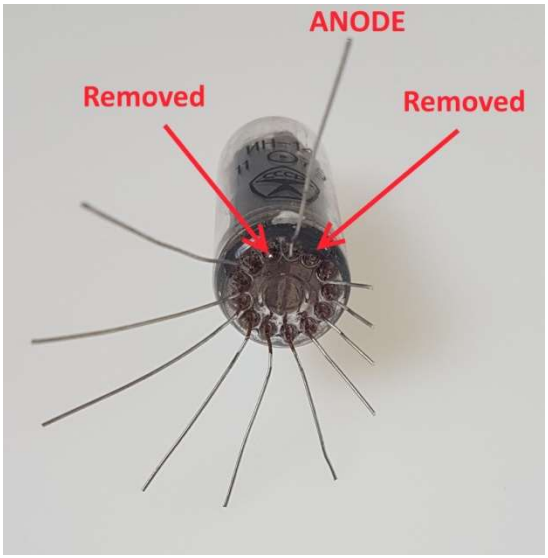
5.1 IN-14 Nixie Tubes.

Cell PCB Type:

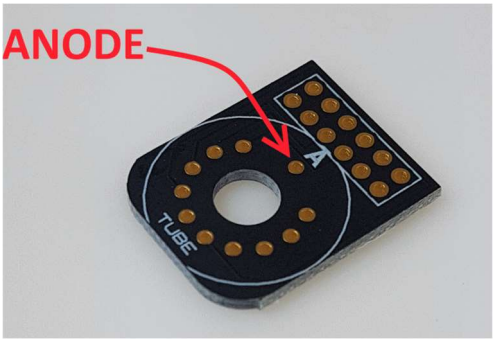
Start by identifying the anode lead at the back of the tube. It has a white coating where it enters the glass. Then remove the wires each side of the anode.

To facilitate easy insertion of the flying leads into the small holes, it helps enormously to trim the flying leads with a pair of scissors as shown below.

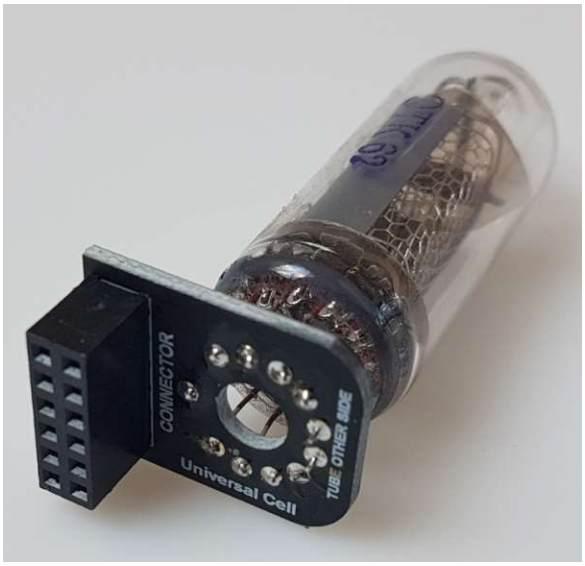
Start at the anode lead, then, working around the tube, cut each sucessive lead approx 2mm shorter than the previous one. This will allow you to feed each lead in turn.

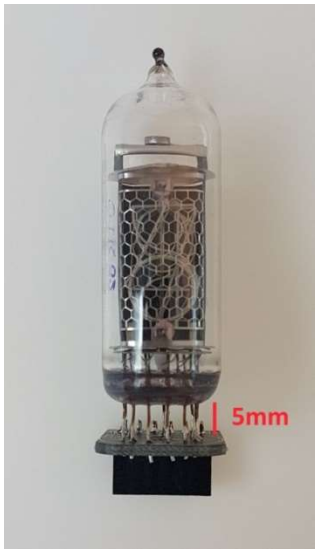


Referring to the picture below, identify the anode pad on the tube cell PCB.



Now you can insert and solder in the tube. Pay attention that the tube sits squarely on the PCB. Then solder on the connector.
Keep the tube 5mm (0.2”) from the PCB. Failure to keep this separation will invalidate any tube warranty claim.





The tube cell is now complete. Repeat for the other 3 tubes. Then move on to step 6.

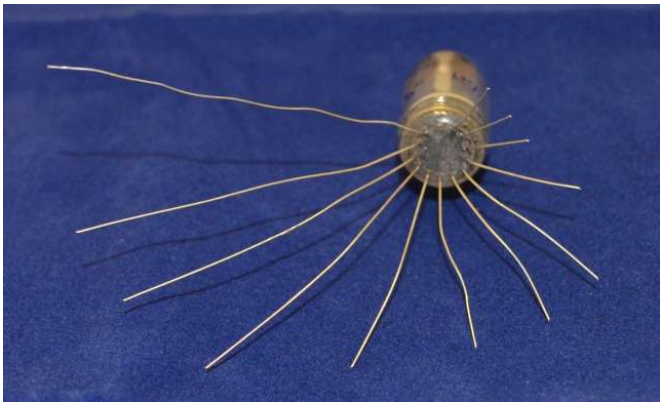
5.2 IN-8-2 and ZM1177 Nixie Tubes.

Cell PCB Type:

These tubes have a gap between leads at the back of the tube. The ZM1177 in fact has a small stub of a lead that is trimmed at manufacture. This helps identify the back of the tube, as well as being opposite to the viewing face of the tube.

The ZM1177 also has a gap between tubes near the front. Disregard this gap - the wires at either side will fit into adjacent holes on the PCB. Remember: 12 wires into 12 holes.

To facilitate easy insertion of the flying leads into the small holes, it helps enormously to trim the flying leads with a pair of scissors as shown below. Start at one of the leads at the back of the tube. Then, working around the tube, cut each sucessive lead approx 2mm shorter than the previous one. This will allow you to feed each lead in in turn.



Now you can insert and solder in the tube. Insert the 12 leads into the 12 holes. Pay attention that the tube sits squarely on the PCB. **Keep the tube 5mm (0.2”) from the PCB. Failure to keep this separation will invalidate any tube warranty claim.**

Note that there is one hole without a pad, that is unused - simply trim off this lead without soldering.

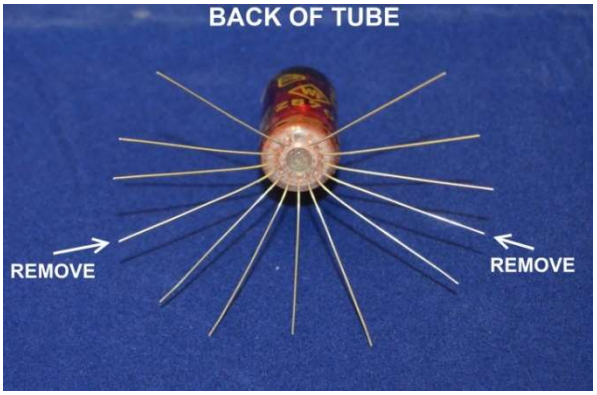
Then solder on the connector.

The tube cell is now complete. Repeat for the other 3 tubes. Then move on to step 6.

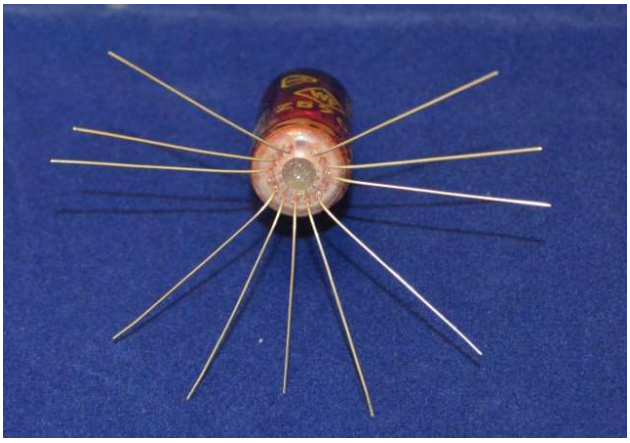
5.3 Z570M, Z5700M, Z573M, ZM1080, ZM1082, GN9A, ZM1136 Nixie Tubes.

Cell PCB Type:

It is necessary to clip off two of the Z570M and equivalent tube leads: Clip off the two leads as shown below:

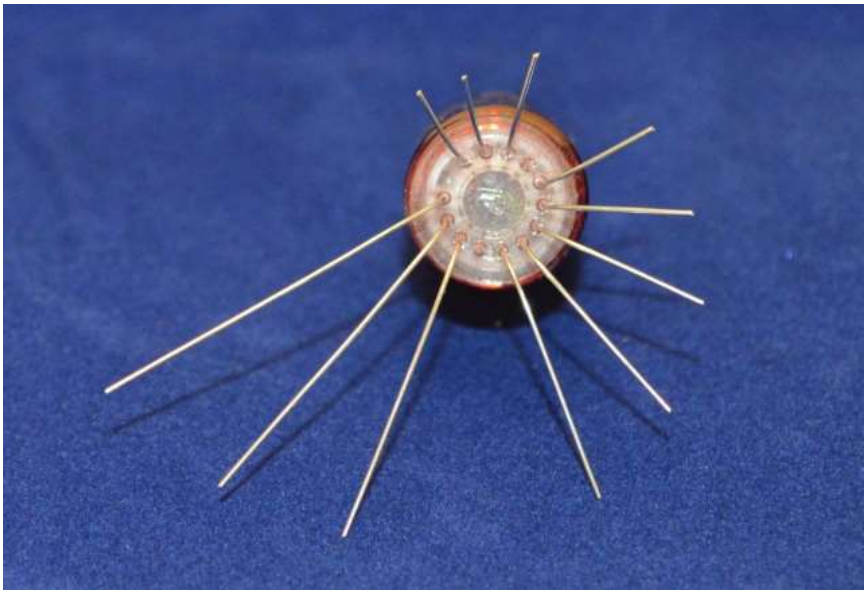


This is how the tube will look after removing the leads:

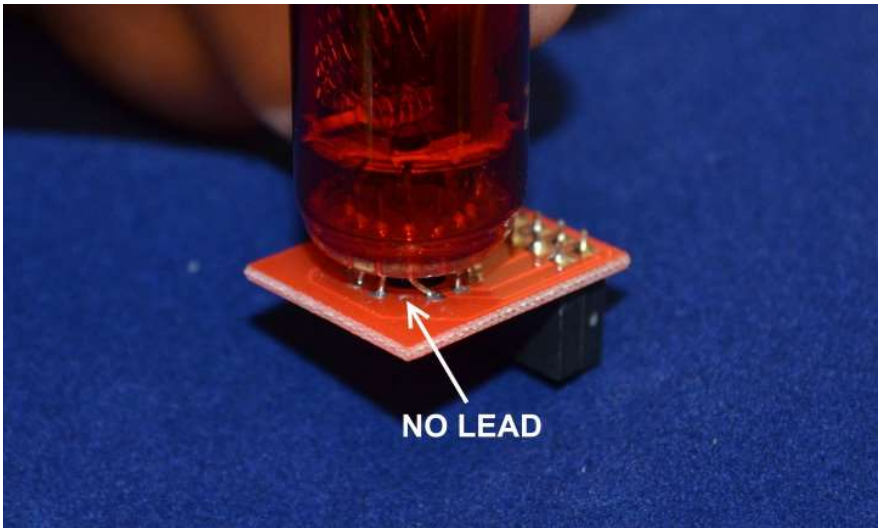


To facilitate easy insertion of the flying leads into the PCB holes, it helps enormously to trim the remaining flying leads with a pair of scissors as shown below. Start at one of the leads at the back of the tube.

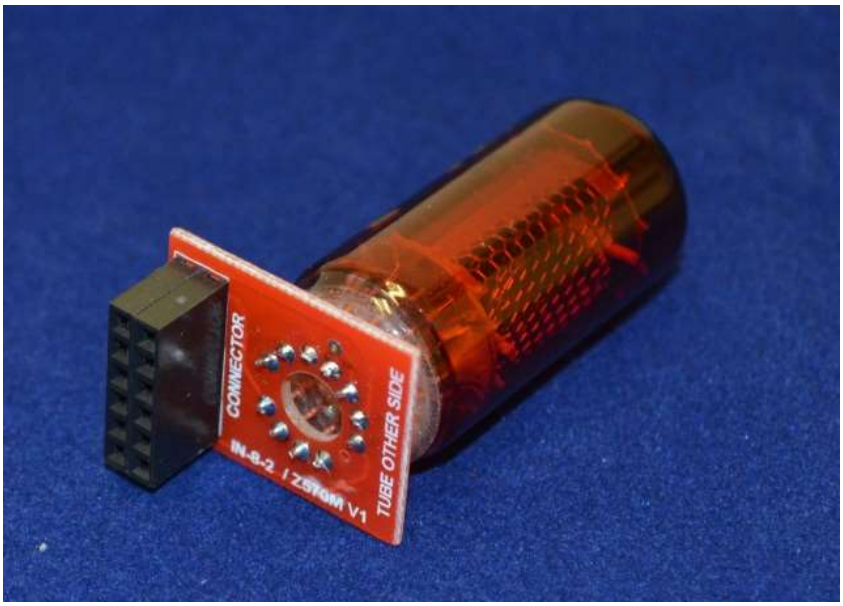
Then, working around the tube, cut each sucessive lead approx 2mm shorter than the previous one. This will allow you to feed each lead in in turn.



Now you can insert and solder in the tube.
There are 11 leads on the trimmed tube and 12 pads on the PCB. One of the pads on the PCB is unconnected. DO NOT INSERT A LEAD INTO THIS HOLE:



Insert from the side of the PCB with no markings.
Pay attention that the tube sits squarely on the PCB.
Then solder on the connector.

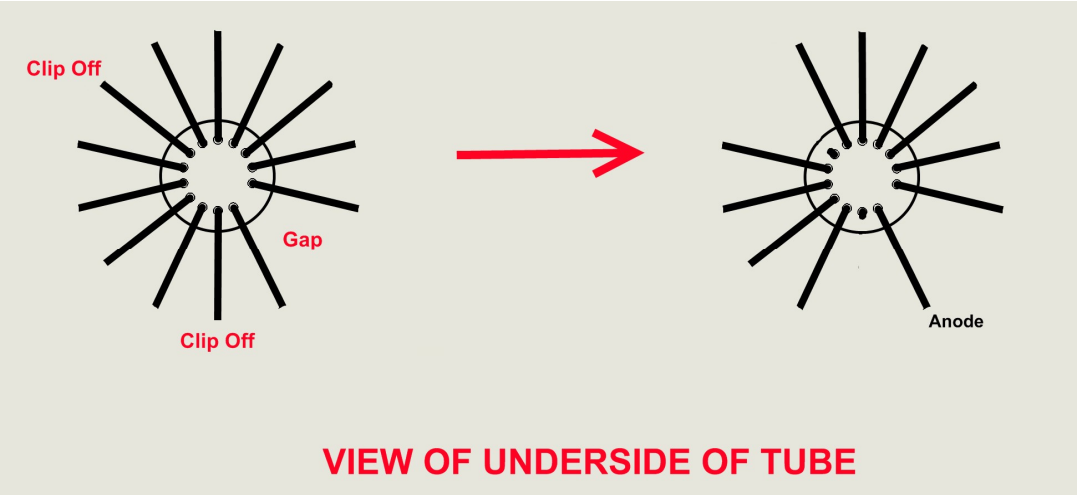


The tube cell is now complete. Repeat for the other 3 tubes. Then move on to step 6.

5.4 GNP-17A Nixie Tubes.

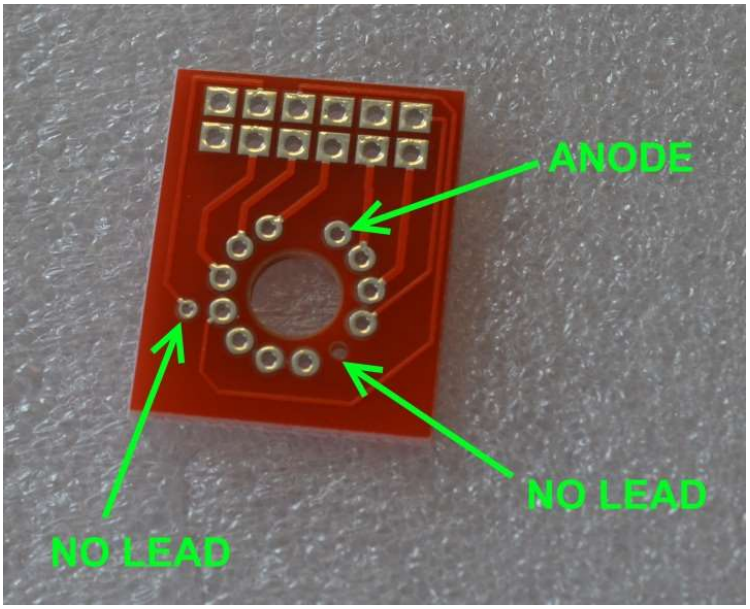
Cell PCB Type:

These tubes have 2 leads that need to be removed as shown below. Use the gap to correctly orient the tube:



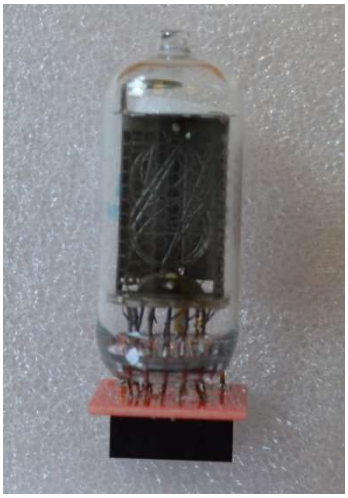
To facilitate easy insertion of the flying leads into the small holes, it helps enormously to trim the flying leads with a pair of scissors. Start at one of the leads at the back of the tube. Then, working around the tube, cut each sucessive lead approx 2mm shorter than the previous one. This will allow you to feed each lead in in turn.

Now you can insert and solder in the tube. Insert the 11 leads into the 11 holes with pads as shown below. Insert from the side of the PCB with no markings.



Pay attention that the tube sits squarely on the PCB. Ensure the tube is facing perfectly forwards before soldering - you may need to twist it a little.

Then solder on the connector .

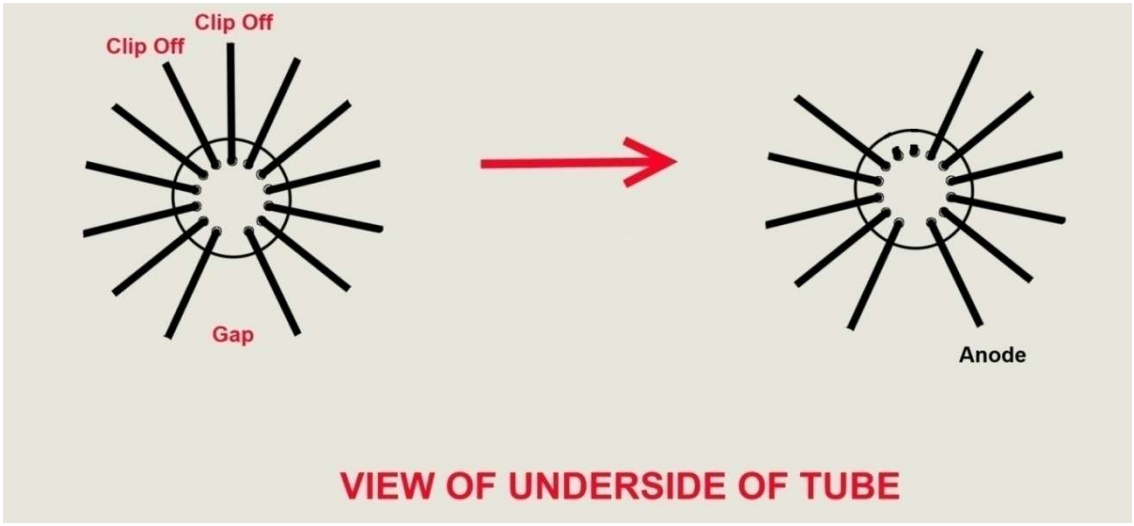


The tube cell is now complete. Repeat for the other 3 tubes.
Then move on to step 6.

5.5 GNP-7A and GNP-7AH Nixie Tubes.

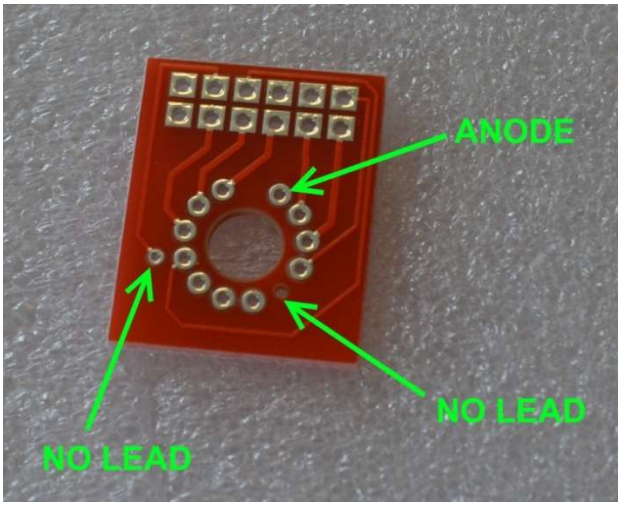
Cell PCB Type:

These tubes have 2 leads that need to be removed as shown below. Use the gap to correctly orient the tube:



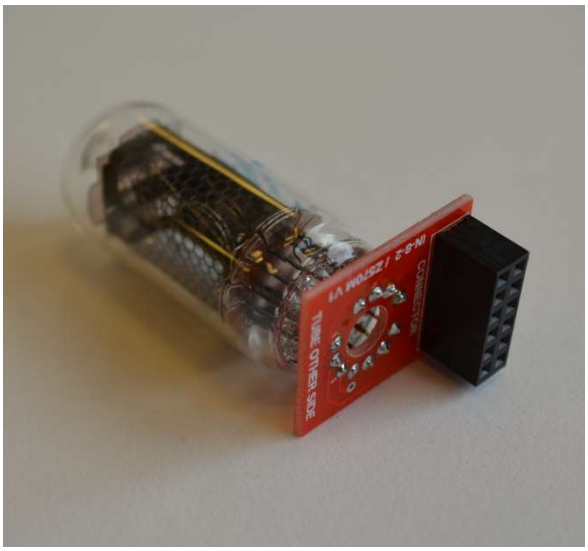
To facilitate easy insertion of the flying leads into the small holes, it helps enormously to trim the flying leads with a pair of scissors. Start at one of the leads at the back of the tube. Then, working around the tube, cut each sucessive lead approx 2mm shorter than the previous one. This will allow you to feed each lead in in turn.

Now you can insert and solder in the tube. Insert the 11 leads into the 11 holes with pads as shown below. Insert from the side of the PCB with no markings.



Pay attention that the tube sits squarely on the PCB. Ensure the tube is facing perfectly forwards before soldering - you may need to twist it a little.

Then solder on the connector.



The tube cell is now complete. Repeat for the other 3 tubes. Then move on to step 6.

5.6 CD66, ZM1242, ZM1240, XN11 and XN12 Nixie Tubes.

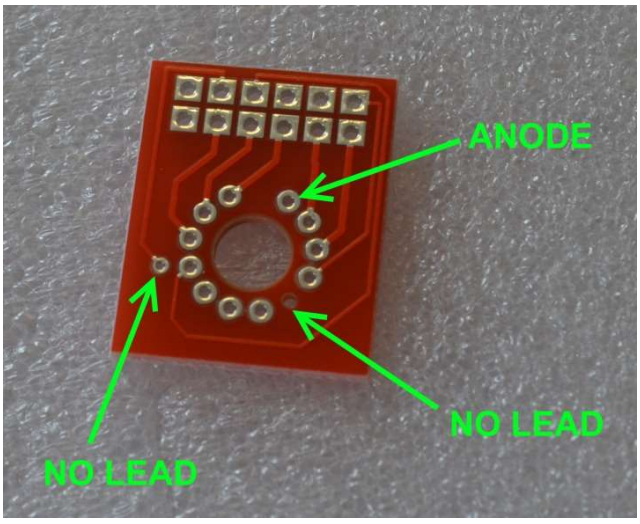
Cell PCB Type:

CD66, ZM1240 and ZM1242: These tubes have 1 lead at the very back of the tube that needs to be removed. Ensure you only clip the lead at the very back of the tube, this will leave you with 11 leads remaining and a gap at the back of the tube. Proceed as for XN11 and XN12 below.

XN11 and XN12: These tubes have 11 leads and a gap at the very back of the tube.

To facilitate easy insertion of the flying leads into the small holes, it helps enormously to trim the flying leads with a pair of scissors. Start at one of the leads at the back of the tube. Then, working around the tube, cut each sucessive lead approx 2mm shorter than the previous one. This will allow you to feed each lead in in turn.

Now you can insert and solder in the tube. Insert the 11 leads into the 11 holes with pads as shown below. Insert from the side of the PCB with no markings.



Pay attention that the tube sits squarely on the PCB. Ensure the tube is facing perfectly forwards before soldering - you may need to twist it a little.

Then solder on the connector.
The tube cell is now complete. Repeat for the other 3 tubes.
Then move on to step 6.

6. FIRST CLOCK TEST

It is now time to check that all tubes are working correctly.

6.1 Insert the Tubes

Carefully insert the tubes into the male headers on the main PCB. Ensure no components touch the tube cell assemblies.

6.2 First Tube Test

Now power up. After a short delay, the tubes should light and all start counting from 0 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!

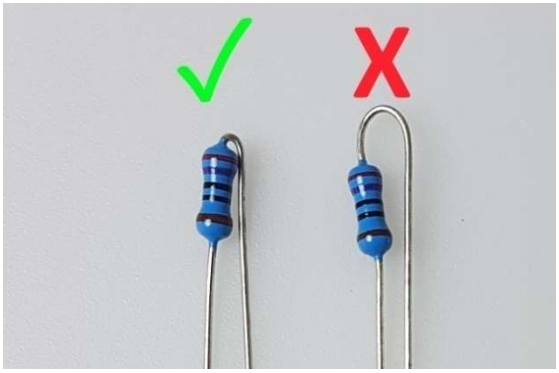
If you do not get this count up, or have missing or overlapping digits, stop and check your work. Try swapping tubes around to see if the problem is with the tube, or the location. Please make these basic tests before contacting us for help and have the results to hand.

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

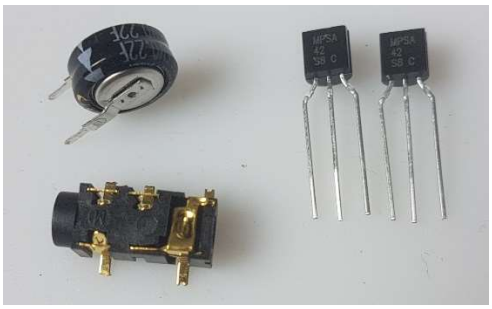
7. PCB ASSEMBLY CONTINUED

7.1 R5, R6 (1 KΩ)
R4, R15, R16 (4.7 KΩ)
R17, R18 (390 KΩ)

These resistors need to be soldered vertically. 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.



7.2 Q6, Q7 (MPSA42)
GPS (SMD Jack Connector)
C8 (0.22F)



To solder the GPS / RFT connector: First wet one pad on the PCB with solder. Then place the connector in position and re-touch the pad with the soldering iron. This will anchor the component and then you can solder the remaining pads.
Ensure the arrows on C8 are aligned with the corresponding arrows on the PCB

7.3 SYNC (5mm Green LED)
DST (5mm Yellow LED)
SET, ADJ (Push button switches)

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.

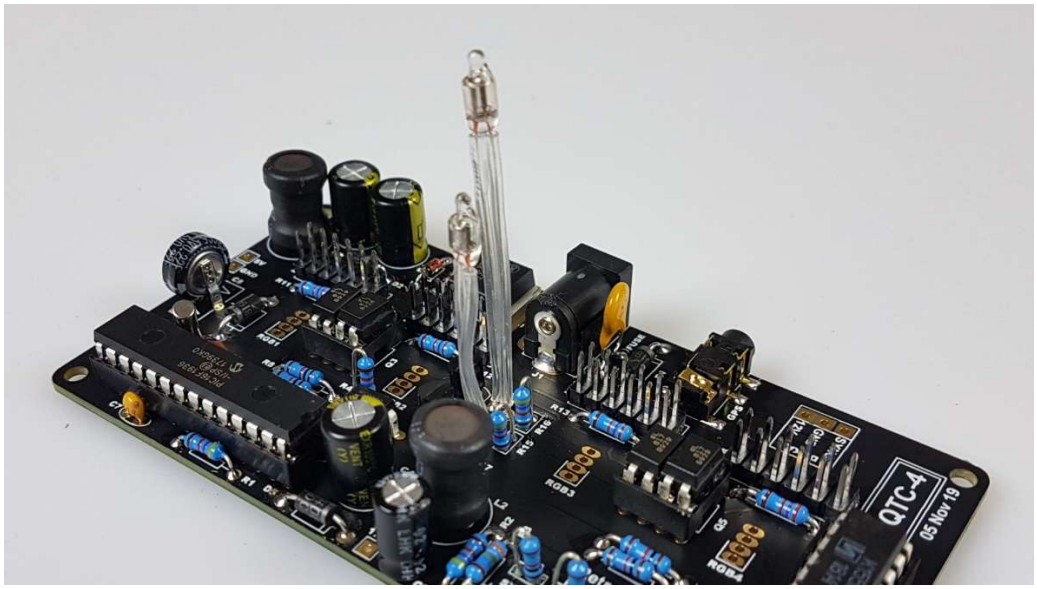
Then place and solder the 2 push button switches:

7.4 AM, PM (4mm neon lamp)

From experience, we have found it is best to leave the height of the neons to the customer's preference. The AM neon should be taller than the PM neon. Use lengths of insulation and insert a tube into the clock to estimate the best height of each neon for your final case design. Our suggestion is 35mm for the taller AM insulation and 25mm for the shorter PM insulation

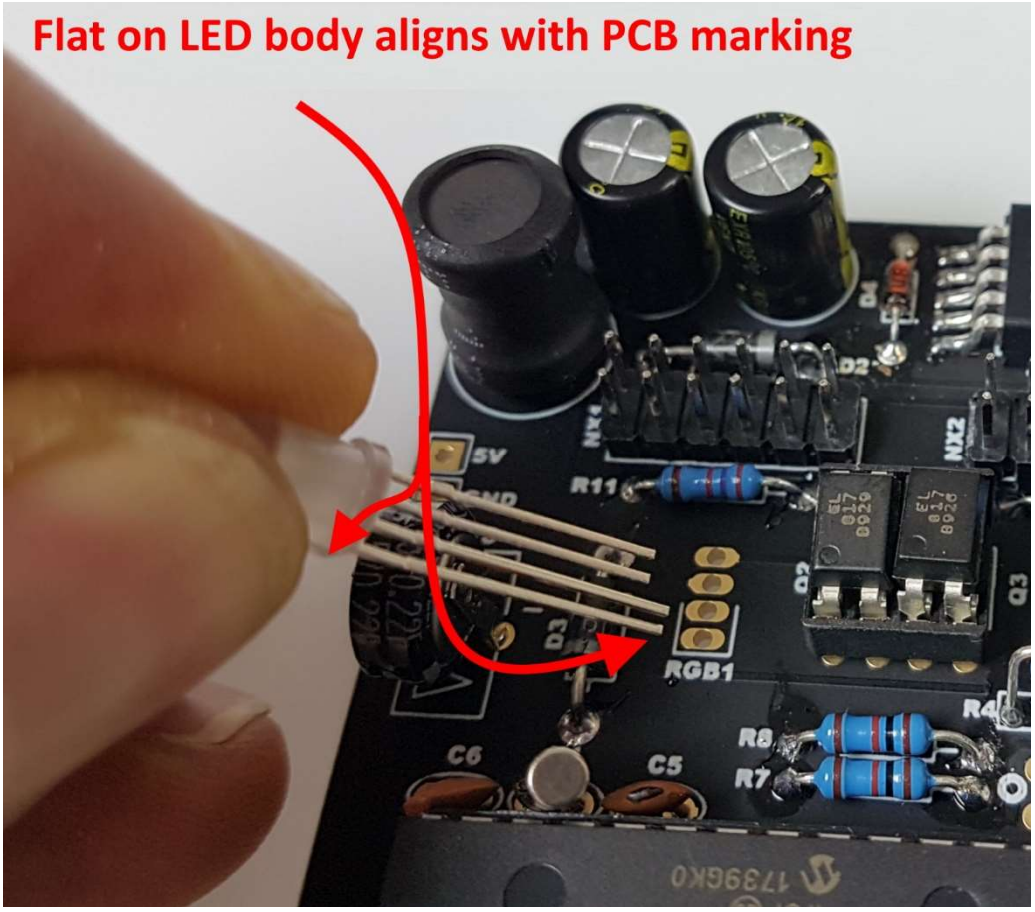
Slip the insulation over the neon lamp leads and with a hot air gun, shrink the tubing:

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



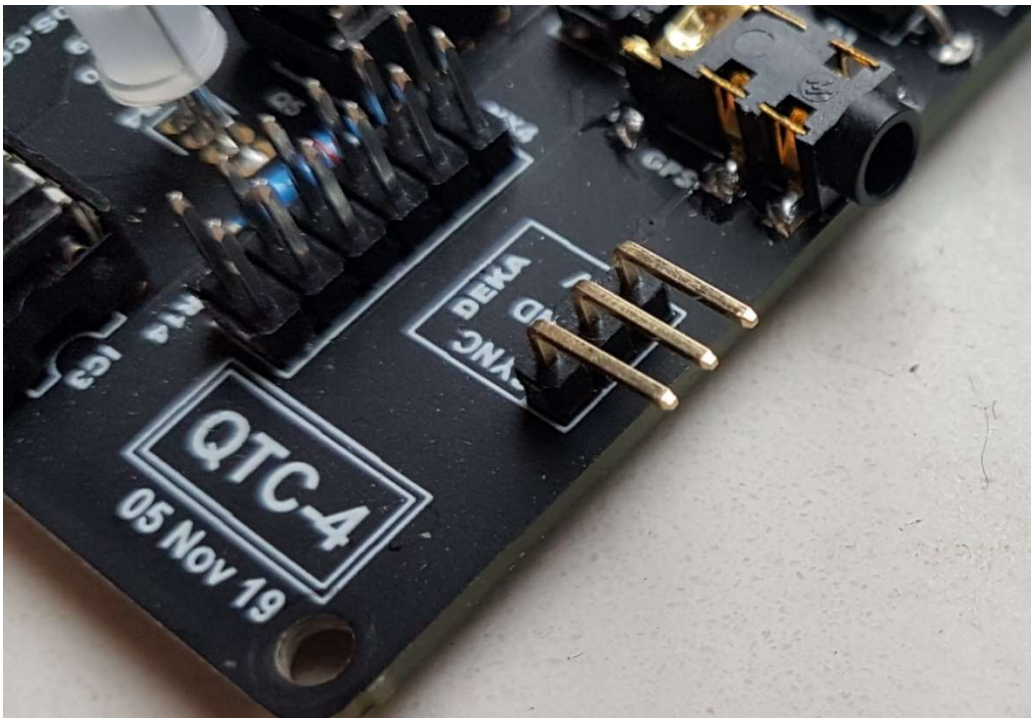
7.5 RGB1 – RGB4 (APA106 RGB LED).

To install the RGB LEDs, Align the flat on the LED body as shown. The leads of the LED may have a different length configuration than shown below.



7.6 DEKA – 3 way right angle Dekatron connection header

Soldering this part will allow you to connect the clock to our dual dekatron driver 'Dekaduo'. It provides power, ground and a sync pulse, so the DekaDuo does not even need its own power supply.



8. HOW TO OPERATE THE CLOCK

The two buttons have the following functions:
SET: Exit tube test routine on cold power-up;
Set time;
Enter configuration menu;
ADJ: Adjust: time, configuration parameters;
Toggle between standard time and DST time
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.

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

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

Parameter	Description	Values
0	Software revision	20 = version 2.0, 12 = version 2.1 etc
1	12 / 24 Hr mode	0 – 12 Hr (default) 1 – 24 Hr
2	Leading zero blanking eg. *0*1:54:32	0 – leading zero blanked (default) 1 – leading zero displayed
3	Night Mode start hour	0 - 23
4	Night Mode end hour	0 - 23
5	Night Mode	0 – Tubes off 1 - Dimmed display (default)
6	AM / PM neon mode	0 – AM/PM Indication, flashing 1 – AM/PM Indication, illuminated 2 – Flashing (default) 3 – Illuminated 4 – Off
7	AM / PM neon during night dimmed mode	0 – AM/PM Indication, flashing 1 – AM/PM Indication, illuminated 2 – Flashing 3 – Illuminated (default) 4 – Off
8	Reserved	
9	GPS / WiFi Sync Baud rate	0 – 4,800 bps 1 – 9,600 bps (default)
10	Time Calibration Factor	0 - 99 (each unit adjusts by 0.2s per day)
11	Time Calibration Polarity	0 - Make clock slower 1 - Make clock faster
12	Slots Mode	0 – Slots disabled 1 – Slots every minute 2 - Slots every 10 minutes (default) 3 - Slots every hour 4 – Slots at midnight
13	Display Mode	0 – Standard change of digits 1 – Cross-fading digits with scrollback effect (default)
14	Seconds display each minute	0 – Off 1 – On (default)
15	Night Mode Override Period	0 – 50 (default 0 gives 15 seconds override)
16	Radio time offset hours	0-13 (default 0)
17	Radio time offset mins	0-45 (default 0)
18	Radio time offset polarity	0 - Minus time (default) 1 – Plus time
19	Dekatron Sync Sleep Mode	0 – Dekatron always on 1 – Dekatron off when night dimmed 2 – Dekatron off in night blanked mode
20	RGB LED Colour	0 - 21
21	RGB LED Colour (Night mode)	0 - 20
22	Restore default settings	0 – Keep user settings 1 – Restore original default settings

Setting the Time:
Before setting the time, set DST according to whether you are currently in DST time or not by toggling the ADJ button. 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.

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

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 15.

Rapid DST Adjustment:
Press 'ADJ' briefly to toggle between DST and standard time. The yellow LED 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.

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 10 and 11. 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 10.
Set parameter 11 to 0 to slow down the clock and to 1 to speed up the clock.

9. USING A GPS or WiFi TIME RECEIVER

The clock can receive time from a GPS receiver that transmits information using NMEA-0183 protocol, using the $GPRMC sentence. Signals should be at TTL Levels, NOT RS232.
We also have a compatible WiFi Device which obtains time from a NTP time server, through your home internet.

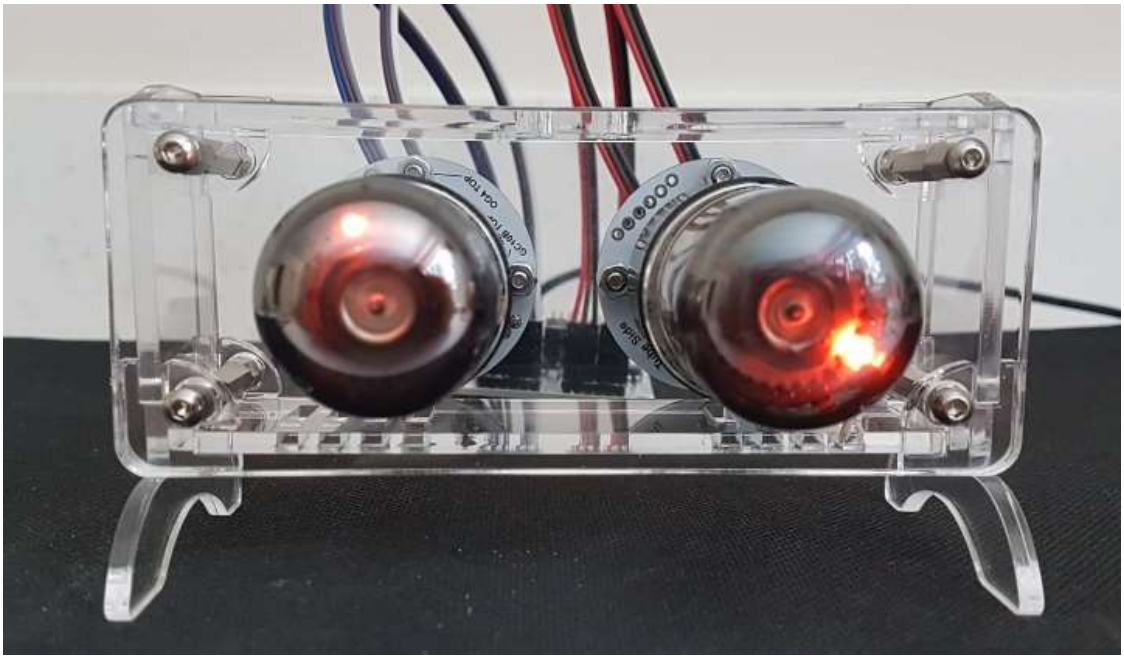
9.1 Configuring for GPS or WiFi Synchronisation.

- Default baud rate is 9,600 bps
- Set parameter 9 to value 0 for 4,800 bps
- Set parameters 16 and 17 for the hours and minutes your time zone is offset from UTC Time. This is usually only whole hours.
- Set parameter 18 to identify whether the offset is minus (0) or positive (1) of the time source.

The green SYNC LED will light when the clock has received recent 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 19.



11. TROUBLESHOOTING

11.1 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 13	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.

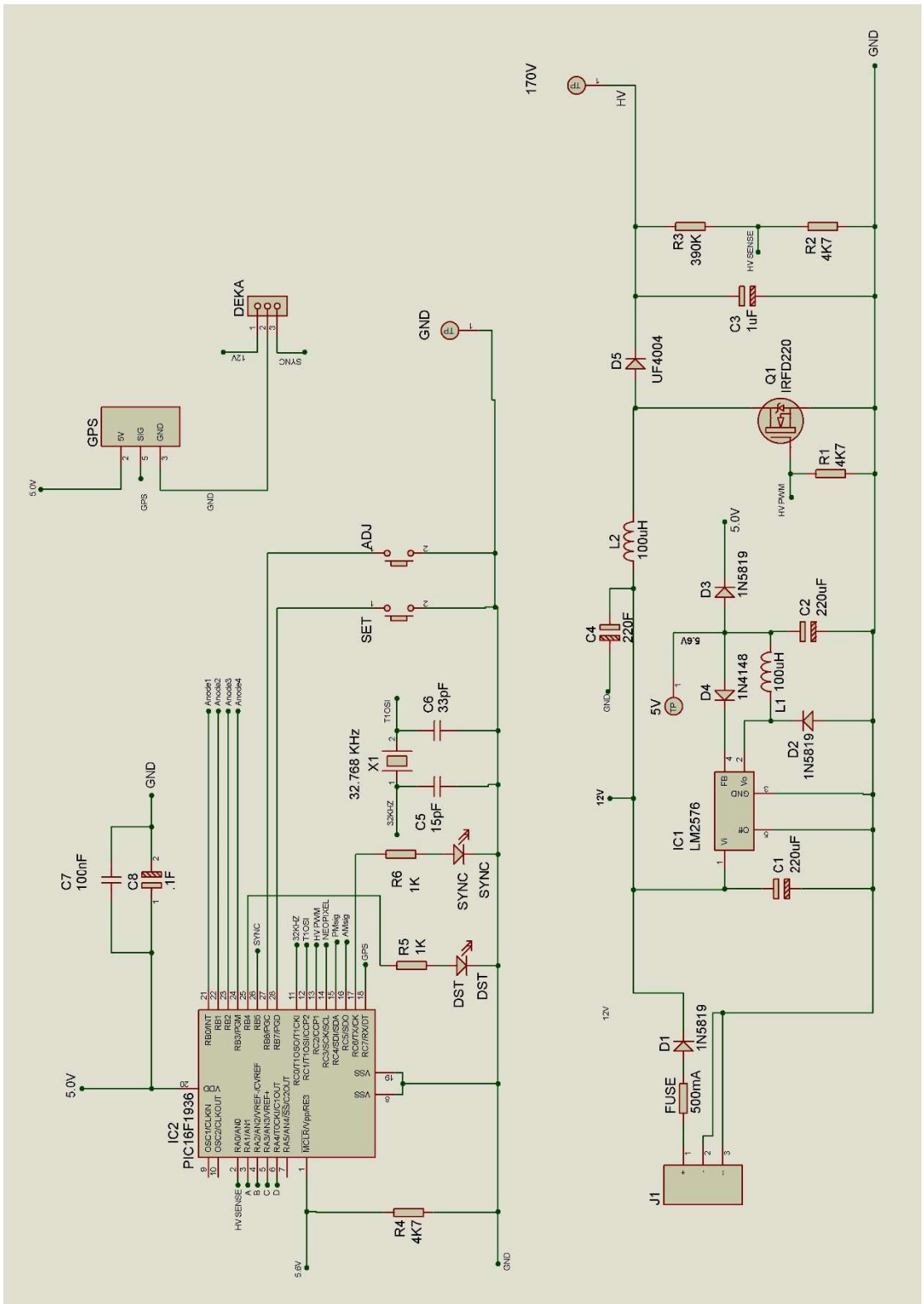
If pin 20 is not to spec, check why the PIC is not getting power via D3 (Orientation?)

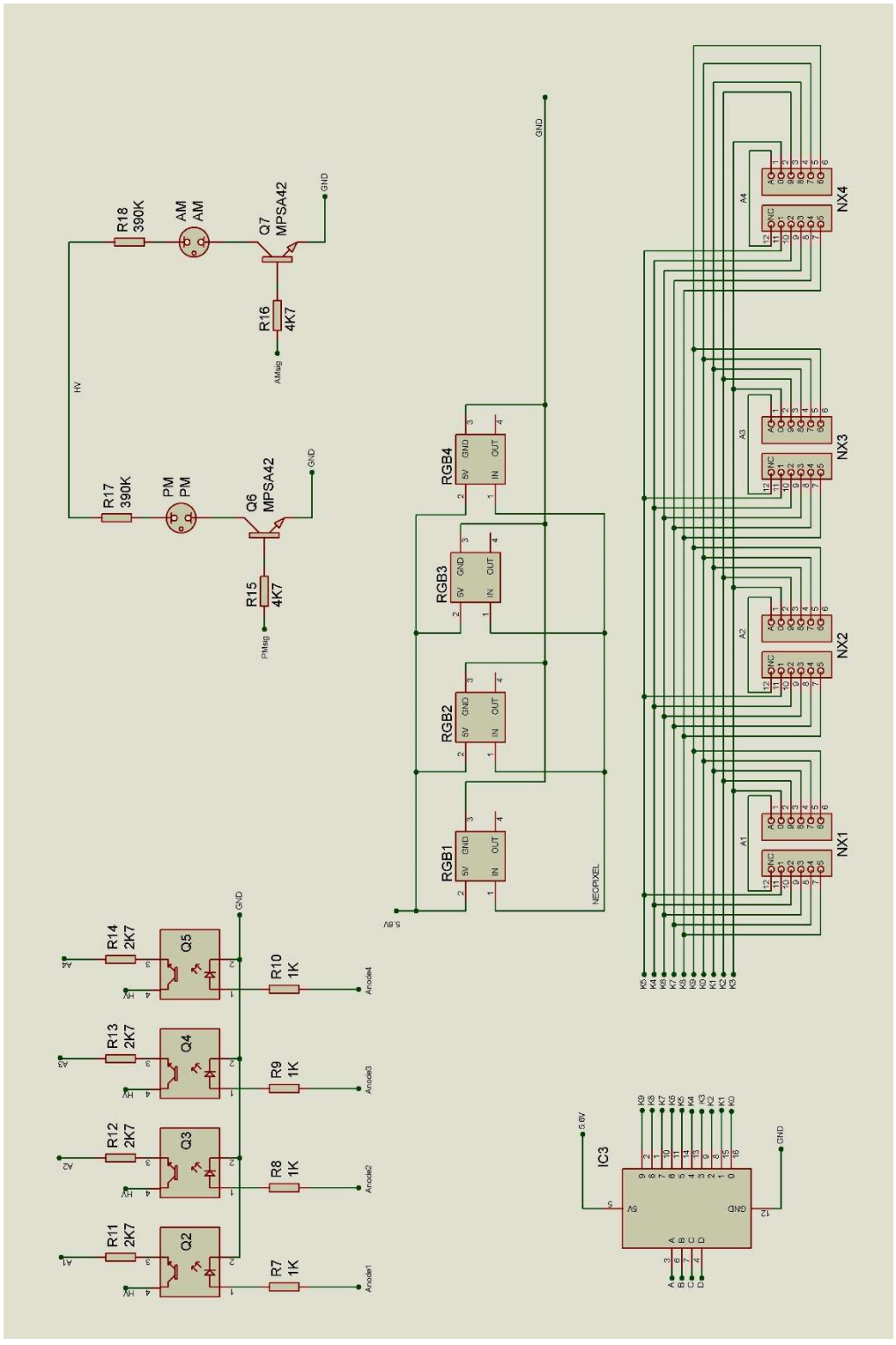
Then, put IC2 back into its socket and test the voltages again.

5V test Point	Should be 5.6V
HV test point	Should be approx. 170V
IC2 Socket, Pin 1	Should be ~5.6V
IC2 Socket, Pin 2	Should be 2V
IC2 Socket, Pin 13	Should be more than 0V
IC2 Socket, Pin 20	Should be ~5.2V

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

12. CIRCUIT DIAGRAM




R18 390K
AM
AM
Q7 MPSA42
GND
R16 4K7
AMsig
HV
R17 390K
PM
PM
Q6 MPSA42
GND
R15 4K7
PMsig
GND
RGB4
RGB3
RGB2
RGB1
5V
NEOPIXEL
NX4
NX3
NX2
NX1
R14 2K7
Q5
R10 1K
Anode4
R13 2K7
Q4
R9 1K
Anode3
R12 2K7
Q3
R8 1K
Anode2
R11 2K7
Q2
R7 1K
Anode1
IC3
5.6V
GND