Assembly Instructions
And
User Guide

Nixie Clock Type
'Frank 3'
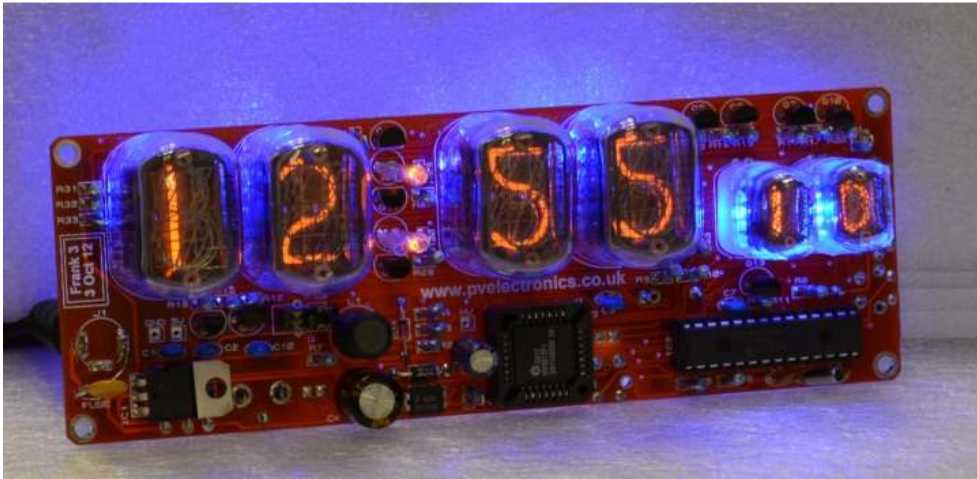
REVISION HISTORY

Issue Number	Date	Reason for Issue
3	12 November 2012	Improved first clock test routine
2	07 November 2012	Typo errors corrected
1	30 October 2012	New document

1. INTRODUCTION

1.1   About the clock

Nixie clock type 'Frank 3' is a compact design with all components and tubes mounted on a single PCB. The efficient use of board space is achieved by using a multiplex design to drive the display tubes.

The larger tubes for hours and minutes are type IN-12 with a digit height of 18mm. The smaller tubes for the seconds are type IN-17 with a digit height of 9mm. These tubes are Russian in origin and were produced during the 1980's, when the technology was at it's most advanced. It is expected that the tubes will last for very many years and should not need replacing.

Software

The main controller is the 8-bit PIC16F1936 running at 16Mhz. The code is programmed entirely in the 'C' programming language.

Drive Mode

The former K155ID1 / 74141 nixie driver IC is now replaced by a modern HV5812 High Voltage Driver IC by Supertex. With 20 outputs, it is able to drive the six Nixie Tubes in a very comfortable and low noise 3X2 multiplex.

GPS Time Synchronisation

A radical new clock design deserves a new and exciting GPS receiver module for those that demand the best timekeeping. And, with a groundbreaking price for a GPS receiver, a fully featured Nixie Clock with GPS synchronisation is now within the price range of most buyers.

1.2 Clock features

Nixie clock type 'Frank 3' has the following features:
- Hours, Minutes and Seconds display
- 12 or 24 hour modes
- Uses a Quartz Crystal Oscillator as the timebase
- 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 DCF / MSF / GPS 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
- Programmable leading zero blanking
- Five programmable neon colon settings (Flashing AM/PM indication, illuminated AM/PM indication, both flashing, both on, both off)
- 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, crossfading, or crossfading with scrollback display modes
- 'Slot Machine' Cathode poisoning prevention routine
- Programmable LED tube lighting – select from 10 brightness levels for each hour of the day.
- Not AC frequency dependent – works in all countries
- All user preferences stored to non-volatile memory

1.3 SAFETY

DANGER: The clock pcb includes a switched-mode voltage booster circuit. This generates nominally 170 Volts DC. 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.

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. This is because the kit is sold to many countries around the world, each with very different household mains outlet socket types. It is more efficient for the user to buy a suitable adapter locally. This saves shipping a heavy adapter with the kit, and also the extra costs of managing stocks of many varied power adapters. If you are using a DCF or MSF receiver avoid cheap Chinese switching power supplies, as they can cause interference problems.
The appropriate type of power adapter can be obtained at very low cost. The following type of adapter should be obtained and used with the kit:

Output 12V DC regulated, minimum power output capability of 500 mA
Output plug: 2.1mm pin, centre positive.
A suitable adapter is shown below:

3. LIST OF COMPONENTS

3.1   Table of Components

Circuit Designation	Part Description
Resistors	
R1	4.7 KΩ, ¼ Watt
R2	390 KΩ, ¼ Watt
R3	4.7 KΩ, ¼ Watt
R4	390 KΩ, ¼ Watt
R5	4.7 KΩ, ¼ Watt
R6 - R11	270 Ω, ¼ Watt
R12 – R14	4.7 KΩ, ¼ Watt
R15 – R17	390 KΩ, ¼ Watt
R18 – R24	10 KΩ, ¼ Watt
R25, R26	15 KΩ, ¼ Watt
R27, R28	4.7 KΩ, ¼ Watt
R29, R30	390 KΩ, ¼ Watt
R31, R32	270 Ω, ¼ Watt
R33	560 Ω, ¼ Watt
R34	4.7 KΩ, ¼ Watt
Capacitors	
C1, C2	100nF Ceramic
C3	1uF, 250V, Electrolytic
C4	470uF, 16-25V, Electrolytic
C5	33pF Ceramic
C6	15pF Ceramic
C7	100nF Ceramic
C8	0.1F
C9, C10	100nF
Transistors	
Q1	IRFD220 MOSFET
Q5 – Q7	MPSA42
Q8 – Q10	MPSA92
Q11 – Q14	MPSA42
Diodes	
D1 – D3	1N5819
D4	UF4004
D5	5mm Green LED
D6, D7	5mm Yellow LED
D8 – D13	3mm Blue LED
ZD1	62V Zener diode
Integrated Circuits	
IC1	7805 5V voltage regulator
IC2	PIC16F1936 8-bit microcontroller
IC3	HV5812
Miscellaneous	
L1	100uH inductor
AM, PM	4mm wire ended neon lamp
ALARM, SET, ADJ, DST	Miniature push button
IC2 Socket	28 Way narrow IC socket for IC2
IC3 Socket	PLCC28 IC socket for IC3

J1	2.1mm PCB power socket
GPS / RFT	Vertical 3.5mm jack socket
LS1	Piezo sounder
FUSE	500mA fuse
Insulation	Clear insulation for neons
X1	32.768KHz watch crystal

3.2 Parts list / Packing Sheet – Driver Board

Part Description	Quantity
Resistors	
270 Ω, ¼ Watt	8
560 Ω, ¼ Watt	1
4.7 KΩ, ¼ Watt	9
10 KΩ, ¼ Watt	7
15 KΩ, ¼ Watt	2
390 KΩ, ¼ Watt	7
Capacitors	
33pF, Ceramic	1
15pF, Ceramic	1
100nF, Ceramic	5
1uF, 250V, Electrolytic	1
470uF, 16-25V, Electrolytic	1
0.1F	1
Transistors	
IRFD220 MOSFET	1
MPSA42	7
MPSA92	3
Diodes	
1N5819	3
UF4004 fast recovery diode	1
5mm Green LED	1
5mm Yellow LED	2
3mm Blue LED	6
62V Zener diode	1
Integrated Circuits	
7805 5V voltage regulator	1
PIC16F1936 8-bit microcontroller	1
HV5812	1
Miscellaneous	
100uH inductor	1
4mm wire ended neon lamp	2
Miniature push button	4
28 way narrow IC Socket for IC2	1
PLCC28 IC Socket for IC3	1
2.1mm PCB power socket	1
Vertical 3.5mm jack socket	1
Piezo sounder	1
500mA fuse	1
Clear insulation for neons	1
1mm Socket Receptacle	44
32.768KHz watch crystal	1

It is recommended that the kit is checked against the list above, to ensure all parts are present before commencing assembly. Don't be alarmed if there are some extra components, as some component bags are shared between different kit types.

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.

5. ASSEMBLY OF THE PCB - PART 1

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

5.1 44 X 1mm Sockets For Nixie Tubes

There are 44 individual sockets that need to be soldered in. The best method is a follows. Place all sockets into the holes, noting that for each tube there is one hole that has no socket as shown below. When all sockets have been placed, place a flat and hard object over the top of the sockets, and turn the PCB over so you can solder from the underside. Be sure to insert the sockets FROM the component side of the PCB – the side with the white component markings. The photo below shows the component side of the PCB after all the sockets have been inserted and soldered in.
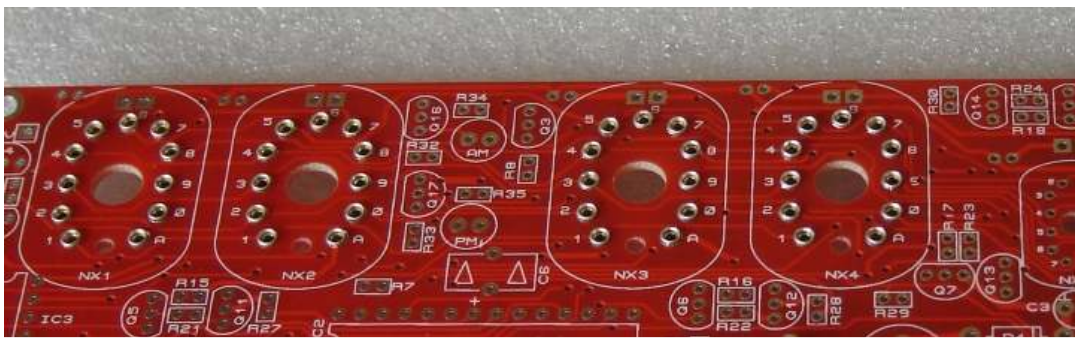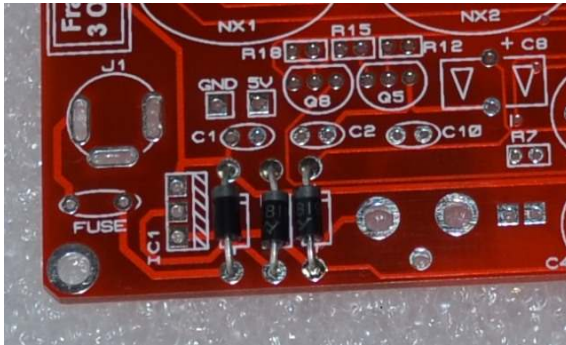
5.1   Low Voltage Power components:
J1, FUSE
D1-D3 (1N5819)
IC1 (7805)
C1, C2 (100nF)
Start by installing D1-D3. Align the white band on the components with the band marked on the PCB.
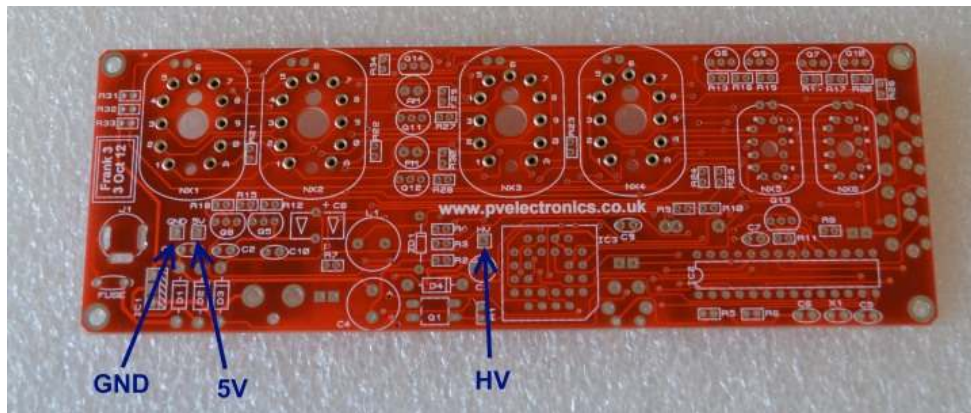

After placement, IC1 can be placed and bent over these diodes to reduce the height of the assembled PCB. Continue to mount C1, C2, J1 and FUSE.

BE SURE TO SOLDER J1 ON THE REAR OF THE PCB

5.2 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 5.1 and 5.3 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.

5.3 High Voltage generator components.
Socket for IC2
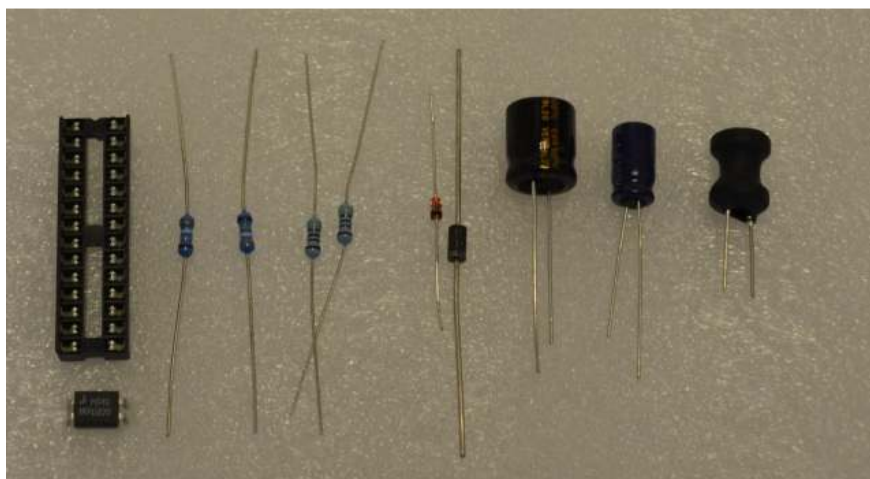**R1, R3 (4.7 KΩ)**
R2, R4 (390 KΩ)
C3 (1uF)
C4 (470uF)
Q1 (IRFD220)
L1 (100uH Inductor)
D4 (UF4004)
ZD1 (62V Zener diode)

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

Take care that the notched end of the IC socket is at the end shown. Also the MOSFET needs to be placed with the two joined pins at the position shown below.

The two capacitors C3 and C4 are polarised. The longer lead goes in the hole marked '+'.

5.4   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 167V and 173V. If this is in order, disconnect the power supply.
Finally, remove IC2 from its socket and replace on its static-protective foam. It is best kept safe until needed for the tube tests later in the assembly.
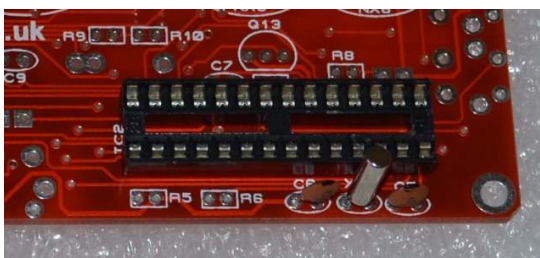

5.5   R12 - R14 (4.7 KΩ)
R15 - R17 (390 KΩ)
R18 - R24 (10 KΩ)
R25, R26 (15 KΩ)
R27, R28 (4.7 KΩ)

5.6 Q5, Q6, Q7 (MPSA42)
Q8, Q9, Q10 (MPSA92)

5.7 C5 (33pF)
## C6 (15pF)
X1 (32.768KHz Crystal)

5.8 Socket for IC3

Align the notch on one corner of the socket with the marking on the PCB. Be careful not to force in the socket if all pins are not aligned. Ensure all pins are fully pushed through the holes before soldering in place.

5.9   IN-17 Nixie tubes NX5, NX6

To facilitate easy insertion of the flying leads into the small holes, it helps enormously to trim the flying leads at an angle with a pair of scissors as shown below:
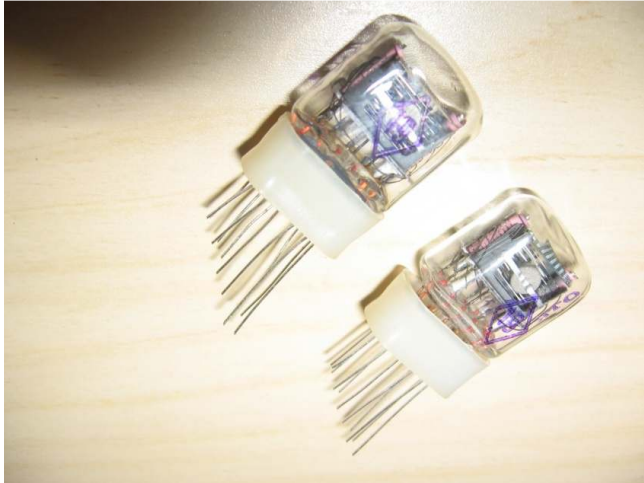
Be aware that each tube has one wire 'missing'. The tube is manufactured this way.

Feed all the wires in progressively. It is not as hard as it seems at first. Ensure the tubes are the correct way up. The part marking IN-17 should be to the RIGHT, but also check to see if you can tell that the 5 and 3, which are visible, are the correct way up. After soldering in, trim the flying leads.
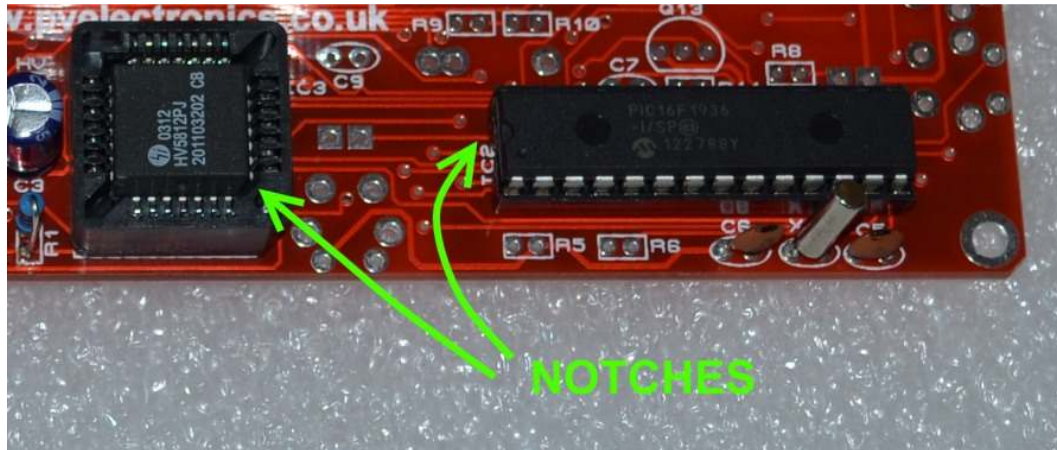
6.   FIRST CLOCK TEST

It is now time to check the basic clock functions and that all tubes are working correctly.

6.1   FIRST TEST
Insert IC2 and IC3 into their sockets, with the notches aligned as shown below:

Insert 4 X IN-12 tubes into the NX1 - NX4 positions.

Connect a 12V DC power supply (2.1mm central pin type, centre positive) and power up.

The clock should start counting 0-9 repeatedly on all tubes. If this does not happen, power off and check all tubes are connected correctly.

Power off and disconnect the power supply.

7. ASSEMBLY OF THE PCB - PART 2

7.1 **Q11 - Q14 (MPSA42)**
R5, R34 (4.7 KΩ)
R6 - R11, R31, R32 (270 Ω)
R29, R30 (390 KΩ)
R33 (560 Ω)

7.2 **C7, C9, C10 (100nF)**
C8 (0.1F)
Ensure the arrows on C8 are aligned with the corresponding arrows on the PCB

7.3 **SET, ADJ, ALARM, DST (Switches)**
D5 (5mm Green LED)
D6, D7 (5mm Yellow LED)
LS1 (Piezo Buzzer)
GPS / RFT (3.5mm Vertical Jack Socket)
These components are all placed on the rear of the PCB:

7.4 **AM, PM Neon Indicators**
It is a good idea to install these components at the very end of the assembly, when you have a better idea of a suitable height that will look perfect with your design of case. So, do not install them now but remember to install them some time later! Use small pieces of the clear insulation supplied to prevent shorts on the leads.

## 8. MOUNTING THE TUBE LIGHTING LEDs (OPTIONAL)

8.1 LEDs D8 – D13.

You can substitute other colour 3mm LEDs if you wish.

Bend the leads of each LED as shown below. Note that the longer (+) lead is on the top. This is important as the leads will be trimmed to the same length, so you need to be sure that you have the correct (longer) lead in the (+) hole.

Now bend again, appropriate to the spacing between the pads for the LED and the hole for the LED. Cut the leads to the same length:

The six LEDs may now be installed, as shown below. Insert and solder on the solder side. Take care that the LED leads are well clear of the tube leads and sockets.
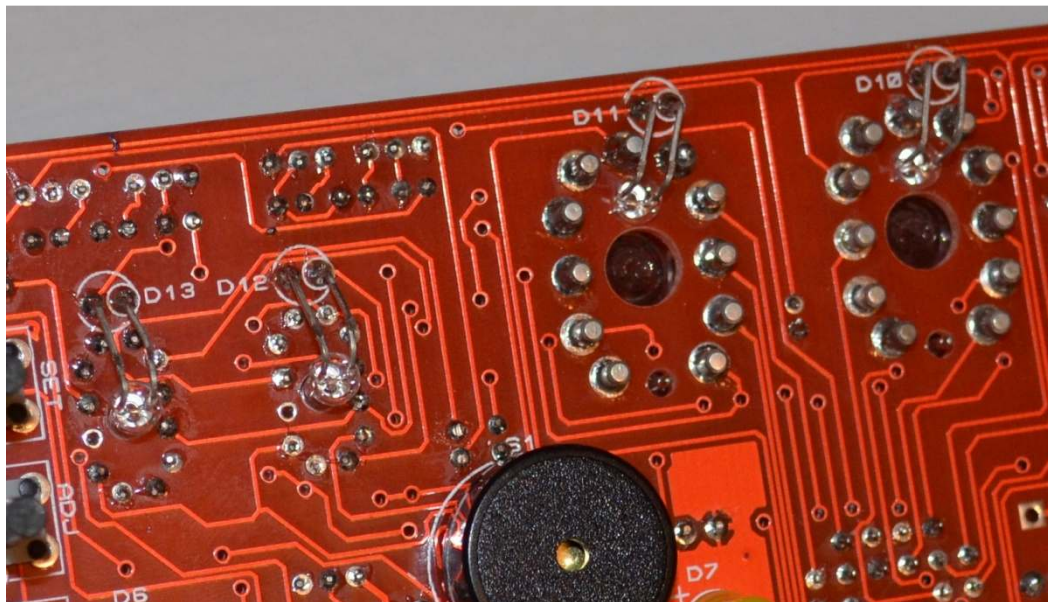
9.   HOW TO OPERATE THE CLOCK

The four buttons have the following functions:
SET: Exit tube test routine on cold power-up;
       Show date;
       Set time and date;
       Enter configuration menu;
ADJ: Adjust: time, date, alarm time, configuration parameters;
       Call DCF / MSF;
ALARM: Set alarm time; snooze; cancel snooze/alarm;
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 display the current parameter being adjusted, and the minutes digits display the current value stored against the parameter.
For each parameter, and referring to the table below, scroll through the range of possible values by pressing the 'ADJ' button. When the desired value has been reached, move on to the next parameter by pressing the 'SET' button. When the last parameter has been set, pressing 'SET' one more time will revert the clock back to time display mode. The first parameter (0) cannot be changed as it is the software revision number. It will show for several seconds and then move to parameter 1.

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

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

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

Notes:

1. Master Blanking Mode has priority over Night Mode. Use to disable the clock on 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 DCF / MSF / GPS synchronisation. Set time manually.
4. Enter your time zone offset from the synchronisation source. Note that GPS transmits UTC.
5. Visual effect / cathode poisoning prevention – all digits on all tubes are cycled for 10 seconds. This setting overrides night blanking or dimming for the duration of the effect (10 seconds).
6. DCF /MSF synchronisation takes place on the hour. If no valid frame is received in 6 minutes, the clock reverts to normal operation.
7. Date will be displayed each minute between 50 and 55 seconds past the minute.
8. Press 'SET' briefly during Night Mode to show time for prescribed period.
9. Set this parameter to '1' to restore original default settings. Internal operations will then load all the original settings and restore the value to '0'

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

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

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

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

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

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

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

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

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

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

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

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

Rapid DST Adjustment

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

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

10. CONFIGURING THE LED TUBE LIGHTS

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

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

10.1 Entering LED menu
Press and hold the 'DST' button until the display shows:
00:_ _:_ 0.
NX3, NX4, NX5 will not be lit.

- For each hour (0-23), you can set a custom brightness.
- NX1 and NX2 show the hour of the day for which you are setting the LED brightness. NX6 shows the selected brightness.
- Press 'ADJ' to adjust the brightness, as displayed on NX6.
- Once you are happy with the brightness for that hour, press 'DST' to move to the next hour.
- After setting up the brightness for hour 23, press DST once more to return to time display.

11. USING A RADIO FREQUENCY TIME RECEIVER OR GPS RECEIVER

The clock can automatically synchronise time from DCF (Europe), and MSF (UK) long wave time transmitters.

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

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

11.2 Connecting a Radio Time receiver

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

DCF Module: For receiving time signals from transmitter at Frankfurt, Germany. Reception is possible within a 2000Km radius of Frankfurt.

MSF Module: For receiving time signals from the transmitter at Anthorn, UK. Reception is possible within the UK, Eire, Northern France, and Norway.

Please note:

1. The long wave signals propagate further at night, so the clock is configured by default to synchronize at 2am.

2. Suitable Power Supplies: If using a switching power supply, it must have an earth connection. Cheap Chinese switching adapters cause too much interference and will not work. Alternatively use an old-fashioned transformer type AC to DC adapter.

3. The time signals are intended that a receiving clock may collect time data intermittently. The signal strength and fidelity is not like a 'TV Signal', where one can get a perfect signal any time at will.

11.3 Setting Up for First Reception.

1. Ensure the correct setting has been applied to Config 12:

      1 = DCF

      3 = MSF

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

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

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

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

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

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

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

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

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

11.4 Connecting a GPS receiver

The clock has been designed for, and tested with our Micro GPS Receiver (available separately from PV Electronics)
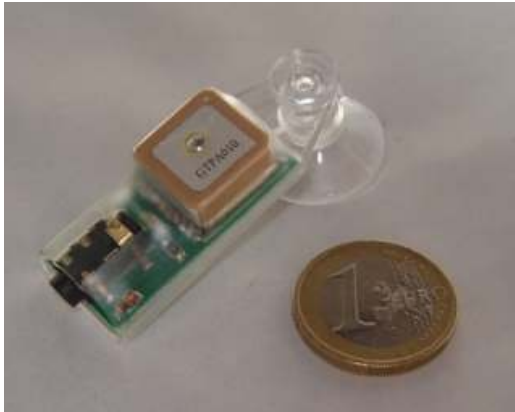
11.5 Function of the GPS / RFT indicator LED (D5):

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

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

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

12. CIRCUIT DIAGRAM

Frank 3 - 17 October 2012