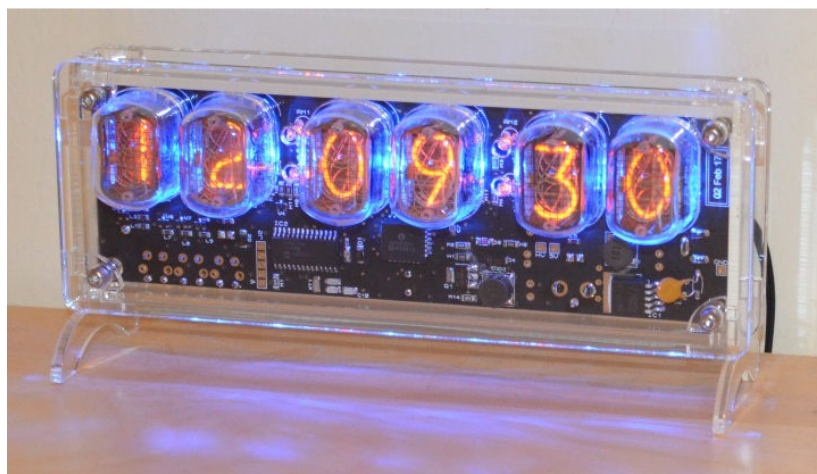


# Assembly Instructions and User Guide

## Nixie Clock Type 'Nixie Maestro'



## REVISION HISTORY

<b>Issue Number</b>	<b>Date</b>	<b>Reason for Issue</b>
4	01 April 2017	New version with neons for AM / PM
3	10 December 2014	Typing errors corrected. Updated photos. Added MSF and DCF support
2	27 December 2012	GPS Indicator LED function clarified
1	06 December 2012	New document



## 1. INTRODUCTION

### 1.1 Nixie Maestro - Features

Nixie clock type 'Nixie Maestro' 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 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 HV/ tubes on weekends or during working hours
- Separate modes for colon neons during night mode
- Standard or fading change of digits
- Standard, fading, or fading with scrollbar 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. Your choice
- Not AC frequency dependent - works in all countries
- All user preferences stored to non-volatile memory



## 1.2 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.



### 3. LIST OF COMPONENTS

Part Description	Circuit Designation	QTY
Piezo Sounder	LS1	1
220uF capacitor	C1, C3	2
Vertical 3.5mm jack socket	SYNC CONN	1
Vertical 2.1mm power socket	J1	1
0.1F Capacitor	C5	1
Vertical push switch	SET, ADJ, ALARM, DST	4
5mm Yellow LED	DST LED, ALM	2
5mm Green LED	SYNC	1
4mm neon lamp	AM1, AM2, PM1, PM2	4
500mA Fuse	F	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.

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

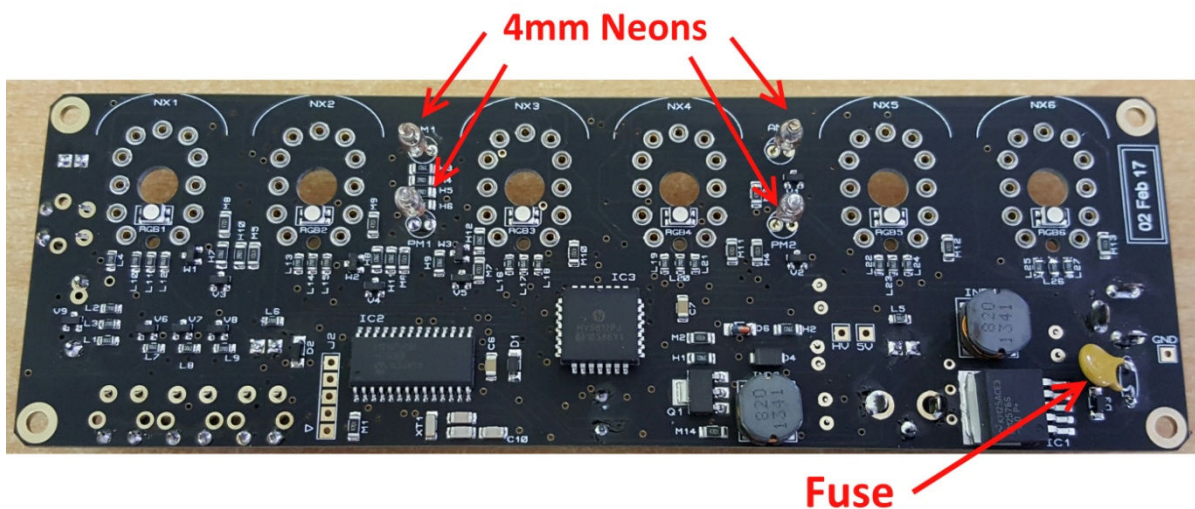




#### 4. ASSEMBLY OF THE PCB

Assemble the components onto the front and rear of the PCB as shown in the images below. Please note:

1. The longer lead of the LEDs is the '+' lead. this goes into the hole marked '+' or the hole with the white circle around it.
2. The electrolytic capacitors are polarised. The side of the capacitor with the lighter band marked '-' goes next to the cross-hatched marking on the PCB.
3. C5: The arrows on the PCB must match the arrows on the part.
4. The neon lamps are not polarised. Solder them 10-15mm from the PCB. Use a small piece of insulation on one lead of each neon.



## 5. POWER SUPPLY

You will need to provide a suitable regulated power supply:

- 500mA or more current capability
- 12V DC
- 5.5mm plug, with 2.1mm inner, centre positive.

A suitable power supply for UK, USA, Canada, Japan and Australia is available in our web store:





## 6. HOW TO OPERATE THE CLOCK

The four buttons have the following functions:

SET: Exit tube test routine on cold power-up;

Show date;

Set time and date;

Enter configuration menu;

ADJ: Adjust: time, date, alarm time, configuration parameters;

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. 01:54:32	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 <sup>1</sup>	0 - 23
8	Master Blank end hour <sup>1</sup>	0 - 23
9	Master Blank days <sup>1</sup>	0 - Off (default) 1 - Weekdays 2 - Weekends 3 - All days
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 <sup>2</sup>	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) <sup>3</sup> 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) <sup>4</sup>
15	Radio time offset mins	0-45 (default 0) <sup>4</sup>
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	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 <sup>5</sup>	0 - Slots disabled 1 - Slots every minute 2 - Slots every 10 minutes (default) 3 - Slots every hour 4 - Slots at midnight
23	RFT Sync Mode <sup>6</sup>	0 - DCF / MSF Sync once per day only as per parameter 24 (default) 1 - DCF / MSF Sync every hour
24	RFT Daily Sync Hour	0 - 23 (default 2)
25	RFT Seek Blanking	0 - Keep tubes lit for DCF / MSF seek 1 - Blank tubes for DCF / MSF seek (default)
26	Display Mode	0 - standard change of digits 1 - fading digits 2 - fading digits with scrollbar effect (default)
27	Auto date display each minute	0 - Off 1 - Static display of date 2 - Scrolling display of date (default) <sup>7</sup>
28	Night Mode Override minutes	0 - 50 (default 0 gives 15 seconds override) <sup>8</sup>
29	Restore default settings	0 - Keep user settings 1 - Restore original default settings <sup>9</sup>

*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:***

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.

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).

### ***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 (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 beeps, 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.

### ***Calibration of Timekeeping Accuracy***

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

Set parameter 21 to 0 to slow down the clock and to 1 to speed up the clock.



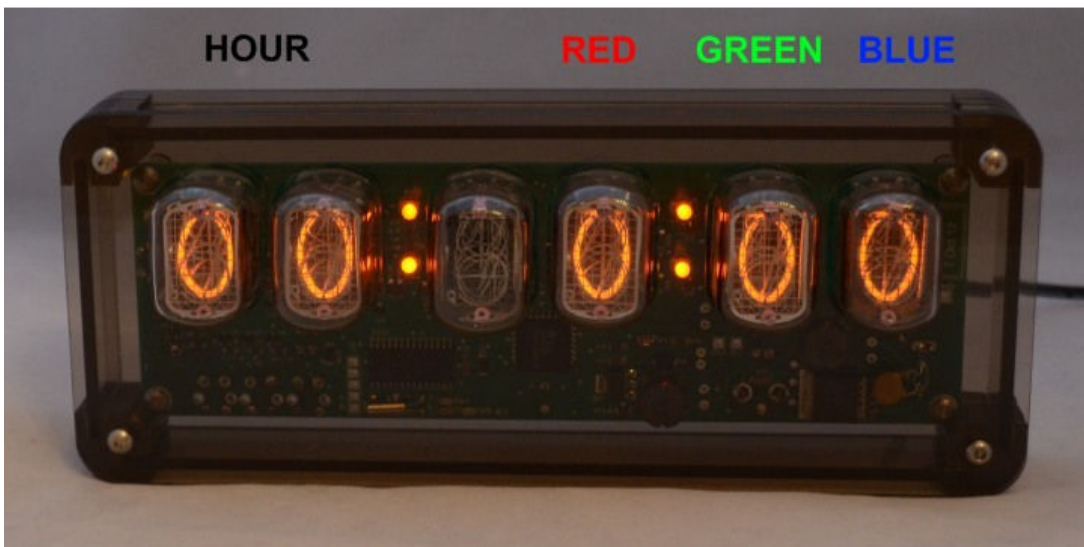
## 7. CONFIGURING THE RGB LED TUBE LIGHTS

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 a long power off.

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

### 7.1 Entering RGB LED menu

Press and hold the 'DST' button until the display shows: 00: 0:00. The first minutes tube 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 **SET**, **ADJ**, **ALARM** 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 8 and 9 hours, the LEDs will be purple (8 red, 0 green and 8 blue).
- In the example below, between 19 and 20 hours, the LEDs will be blue with a hint of green ( 0 red, 2 green and 8 blue).





## 7.2 Setting auto colour cycling

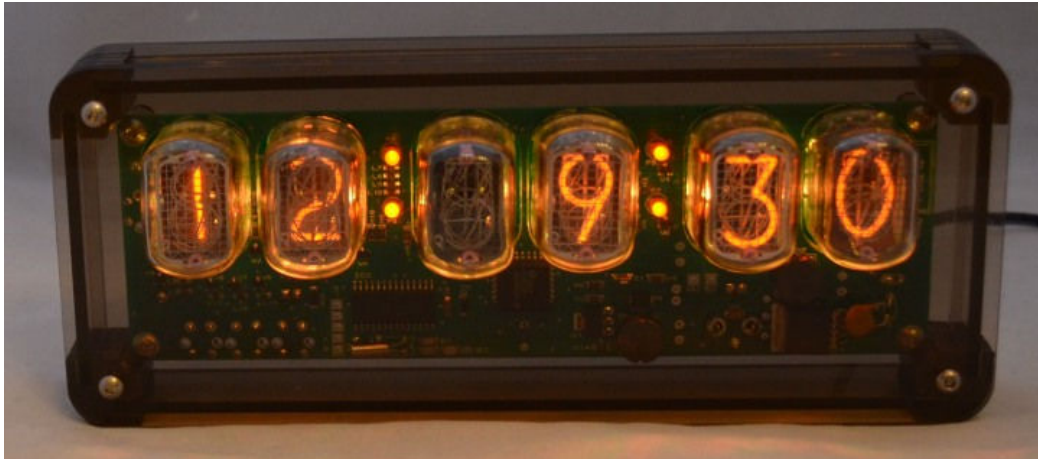
Setting colour **RED** to value 9 has a special meaning:

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.



## 8. USING A RADIO FREQUENCY TIME RECEIVER OR GPS RECEIVER

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

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

### 8.1 Configuring for RFT or GPS Synchronisation.

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



## 8.2 Connecting a Radio Time receiver

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



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

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

*Please note:*

1. The long wave signals propagate further at night, so the clock is configured by default to synchronize at 2am.
2. Suitable Power Supplies: If using a switching power supply, it must have an earth connection. Cheap Chinese switching adapters cause too much interference and will not work. Alternatively use an old-fashioned transformer type AC to DC adapter.
3. The time signals are intended that a receiving clock may collect time data intermittently. The signal strength and fidelity is not like a 'TV Signal', where one can get a perfect signal any time at will.



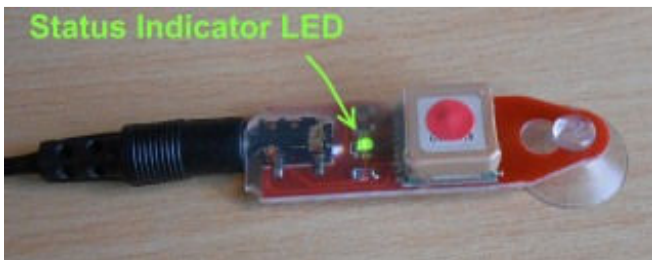
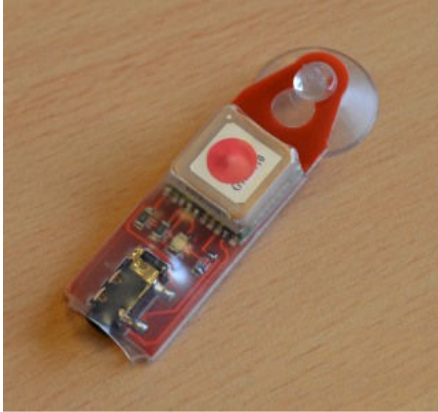
### 8.3 Setting Up for First Reception.

1. Ensure the correct setting has been applied to Config 12:
  - 1 = DCF
  - 3 = MSF
2. For the first tests, ensure Config 25 is set to value 1, to make the HV converter switch off for synchronisation. This stops any noise created by the HV converter.
3. Set Config 14 - 17 for your location's time zone offset from the transmitter.
4. Connect the receiver, and place horizontally by a window, broadside on to the transmitter as far as is possible.
5. Wait until after dark, and preferable the early hours.
6. Command a manual seek, by pressing the middle 'Adj' button. The tubes should switch off. The LED on the receiver module will now not be affected by the HV converter, and after 15-30 seconds start to flash regularly, showing the one pulse per second data from the transmitter.  
If your Module's red LED does not start to flash regularly, go back and check 1-6. of this section. If the red LED does not flash regularly, you will not get synchronisation!
7. At the start of the minute, the clock should start collecting data, and if so it will start flashing the RFT 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 RFT 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 appliances such as TVs and mobile phones reception when in close proximity. Metal objects cause reception problems too Place and design your case so the antenna is as far away from the PCB as possible.



## 8.4 Connecting a GPS receiver

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



### 8.5 Function of the GPS / RFT indicator LED (P2):

- *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:

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

