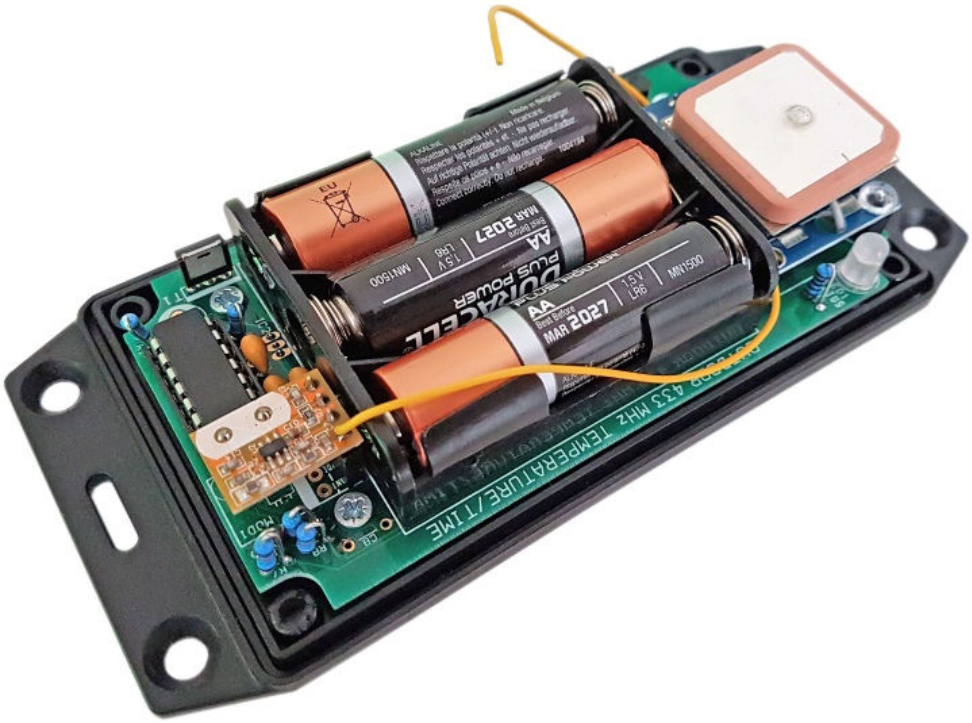
Assembly Instructions
And
User Guide

XTERNA
Module



REVISION HISTORY

Issue Number	Date	Reason for Issue
1	20 April 2018	New document

1. INTRODUCTION

1.1 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 24 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. Avoid direct sunlight and shelter from rain as far as possible.

1.2 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).

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 identifying the resistors.
- Screwdrivers.

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.

Decorator's masking tape.

2.3 Other items you will need.

The XTERNA module is powered by 3 X AA Batteries. We recommend high quality branded batteries for the longest service life between battery changes.

3. LIST OF COMPONENTS

3.1 Table of Electronic Components

PCB Designation	Part Description
Resistors	
R1, R2	10 KΩ, ¼ Watt
R4	1 KΩ, ¼ Watt
R5	390 KΩ, ¼ Watt
R7 – R9	10 KΩ, ¼ Watt
Capacitors	
C1	Not Installed
C2, C3	1uF Ceramic
R3	1uF Ceramic
Transistors	
T1	FQU13N10L
T2	2N7000
Diodes	
D1	1N4148
LED1	RGB LED 5mm Common Cathode
Integrated Circuits	
IC1	PIC16F1825
IC2	DS18B20
IC5	PCF2129AT (Pre-soldered)
Miscellaneous	
MOD1	4 way 0.1" female header
MOD3	4 X Turned Pin Sockets
IC1 Socket	14 Way narrow IC socket for IC1
BH-331P	3 X AA Battery Holder

3.2 Parts list / Packing Sheet

Part Description	Quantity
Resistors	
1 KΩ, ¼ Watt	1
10 KΩ, ¼ Watt	5
390 KΩ, ¼ Watt	1
Capacitors	
1 uF, Ceramic	3
Transistors	
2N7000	1
FQU13N10L	1
Diodes	
RGB LED 5mm Common Cathode	1
1N4148	1
Integrated Circuits	
PIC16F1825	1
DS18B20	1
Miscellaneous	
4 way 0.1” female header	1
Turned Pin Sockets	4
14 Way narrow IC socket for IC2	1
M3 X 4mm screw	2
M3 X 6mm Female / Female Spacer	1
433 MHz Tx Module	1
Self tapping screw	5
20cm cable for Antenna	1
4 X 0.1” turned pin header for GPS	1
Double sided foam square	1
Neo-6M GPS Module	1
3 X AA Battery Holder	1
Hammond Case with screws	1
PCB with pre-soldered IC5	1

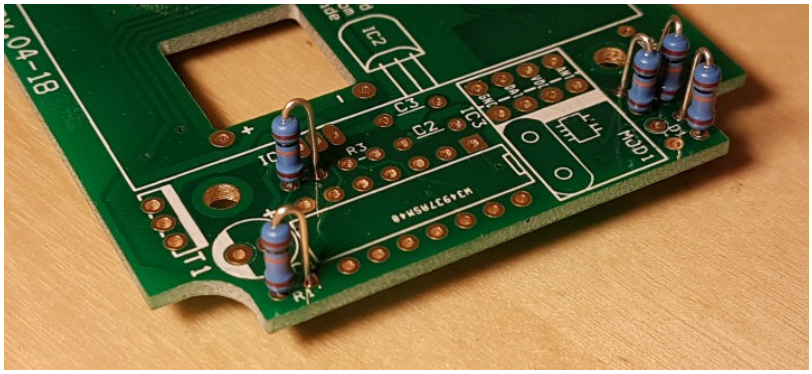
It is recommended that the kit is checked against the list above, to ensure all parts are present before commencing assembly. Don’t be alarmed if there are some extra components, as some component bags are shared between different kit types.

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.

4. ASSEMBLY OF THE PCB

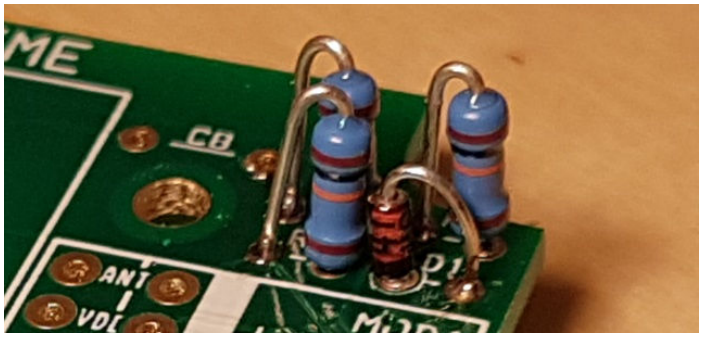
4.1 R1, R2, R7, R8, R9 (10 KΩ)

Bend one lead of each resistor sharply – no large curved bends which could touch other components – and solder the five resistors as shown.

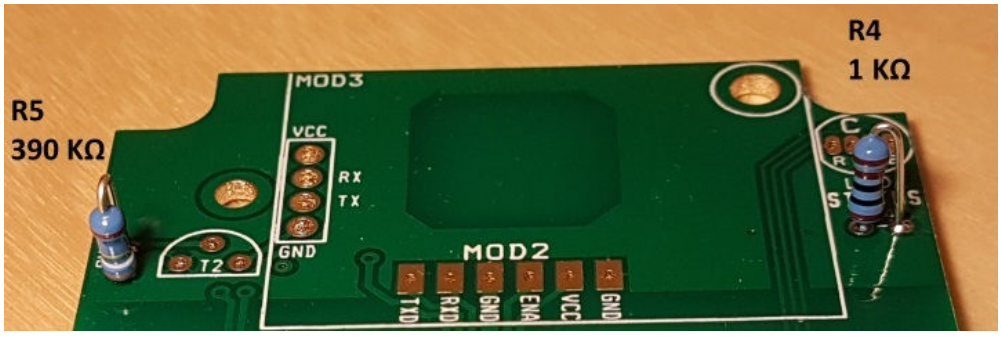


4.2 D1 (1N4148)

Bend and solder D1 with care that the black band is oriented as per the photo below.

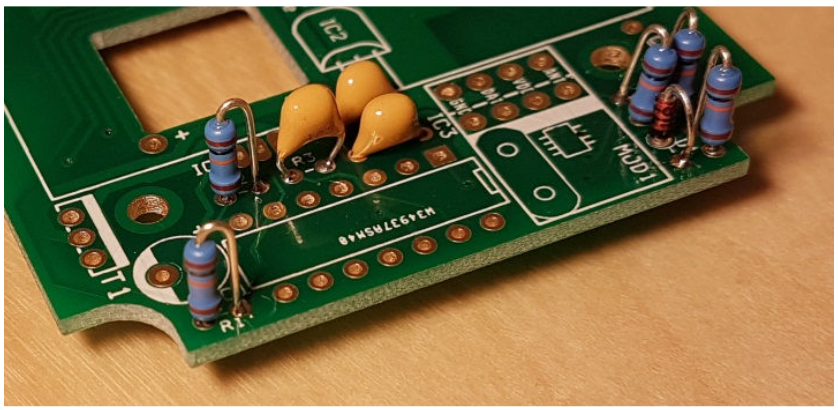


4.3 R5 (390 KΩ) , R4 (1 KΩ)



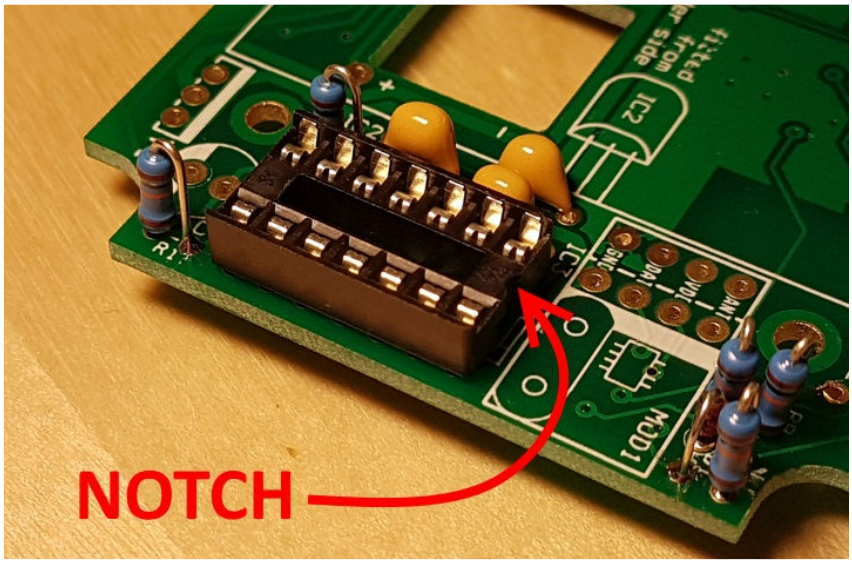
4.4 C2, C3, R3 (1uF)

Note that a capacitor is soldered at the R3 position. You will need to form the leads of this capacitor to better fit the pad spacing. These capacitors are not polarized, so the orientation does not matter.



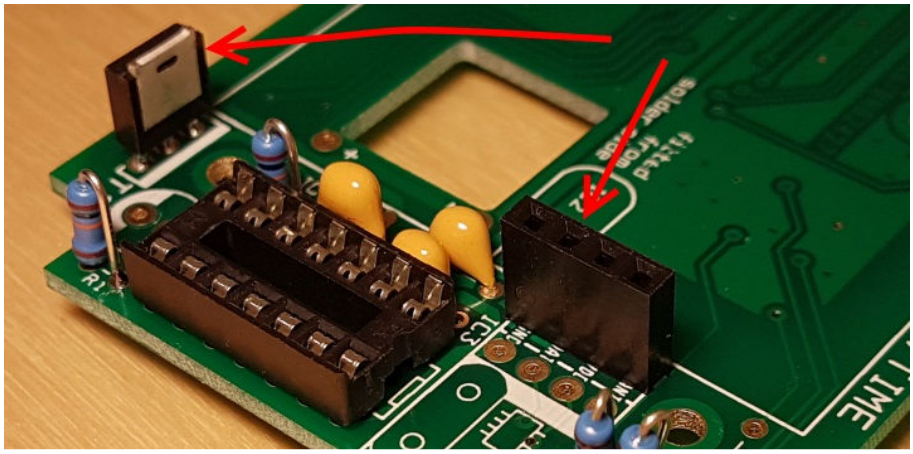
4.5 Socket for IC1

Ensure the small notch is oriented as shown. However if after you solder the part you realise the notch is at the wrong end, DON'T try to desolder it! Actually, so long as the IC has the correct orientation, the socket does not really matter.



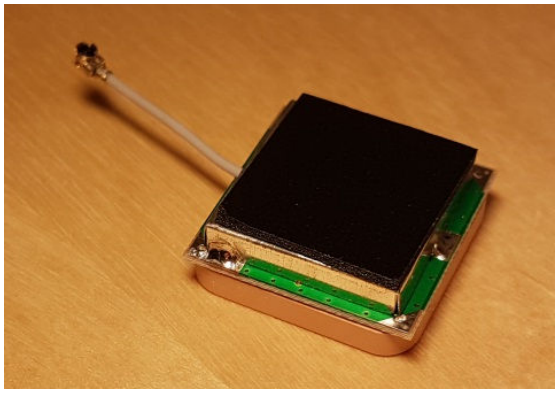
4.6 MOD1 (4 X 0.1” Female Header) and T1 (FQU13N10L)

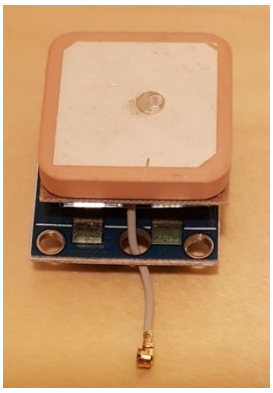
These parts are arrowed below. Don’t solder T1 too close to the PCB. Keep it 3-5mm from the PCB.



4.7 Prepare the GPS Module

First, apply the self adhesive foam pad to the back of the antenna, then stick onto the plain PCB side of the GPS, oriented so that the antenna cable can pass through the hole intended for it.

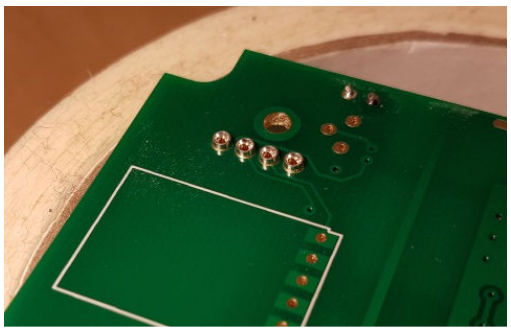




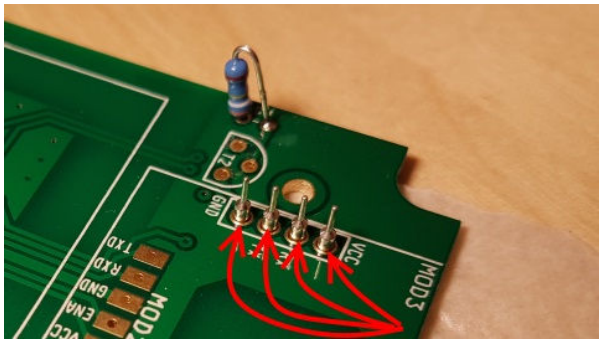
Now clip the antenna connector into the small matching connector on the component side of the GPS module. It helps to press with a hard surface, such as a small block of metal.

4.8 Attaching the GPS.

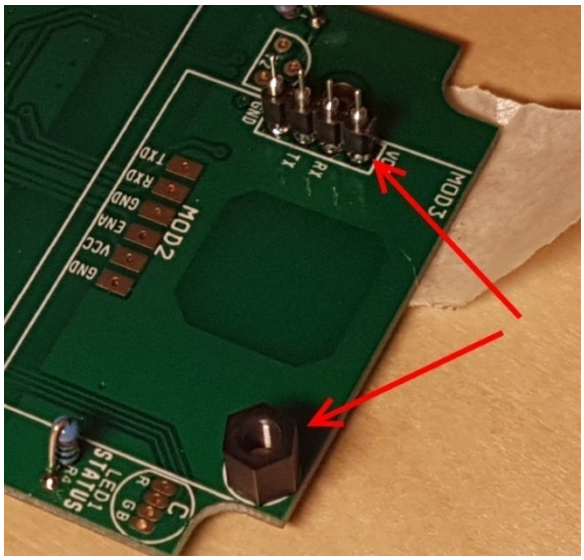
From the SOLDER side of the PCB, insert the four socket receptacles and secure with decorator's masking tape.



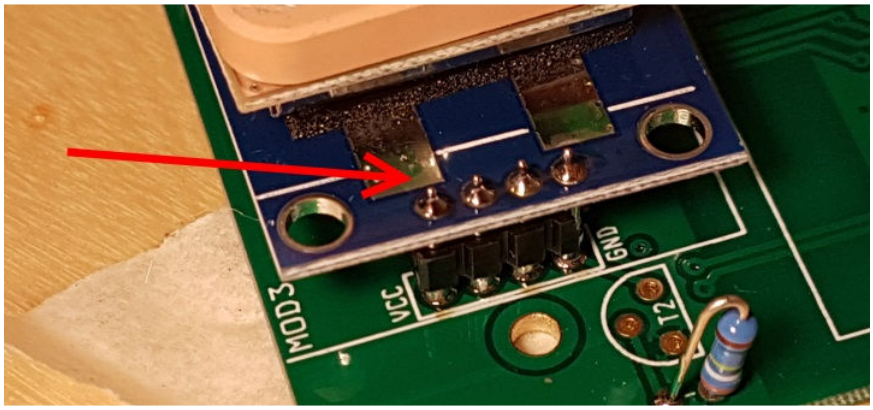
Flip over the PCB and solder the four sockets with minimal solder, as shown below. As soon as you see the solder flow around the annulus, you can withdraw the solder and iron.



Now plug the four way header strip over the pins and also screw on the 6mm spacer as shown below, using a M3 X 4mm plastic screw.

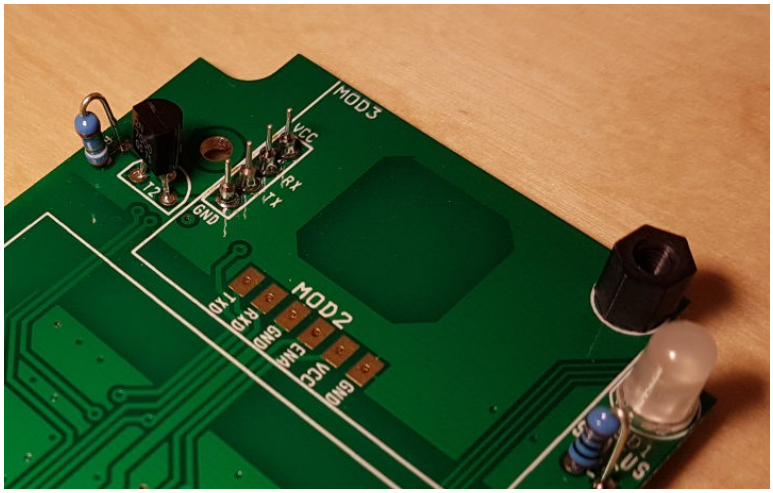


Now place on the GPS assembly, over the four connector pins and screw in place with the other M3 X 4mm plastic screw, then solder the four pins to the GPS. Keep the GPS level and pushed down as you solder.



Once the pins have been soldered, unscrew the top plastic screw and withdraw the GPS. Don't forget to put it back again later!

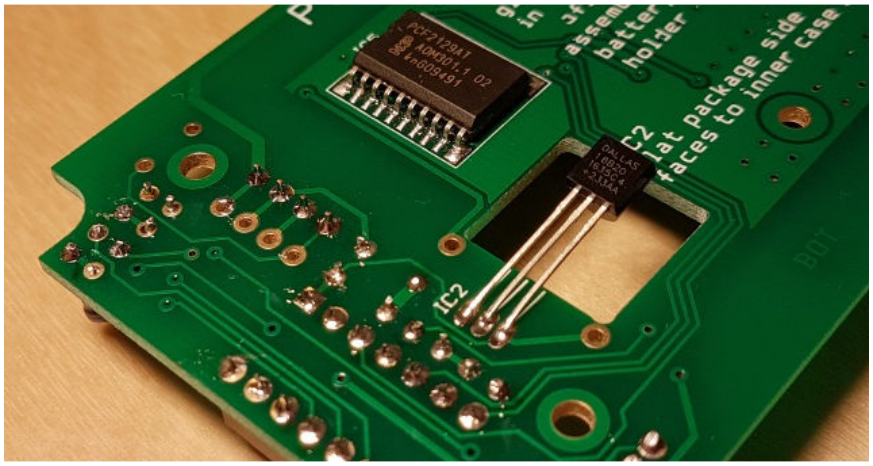
4.9 LED1 (5mm RGB LED) and T2 (2N7000)



The longest lead of the LED goes in the marked hole. Take care you orient correctly.

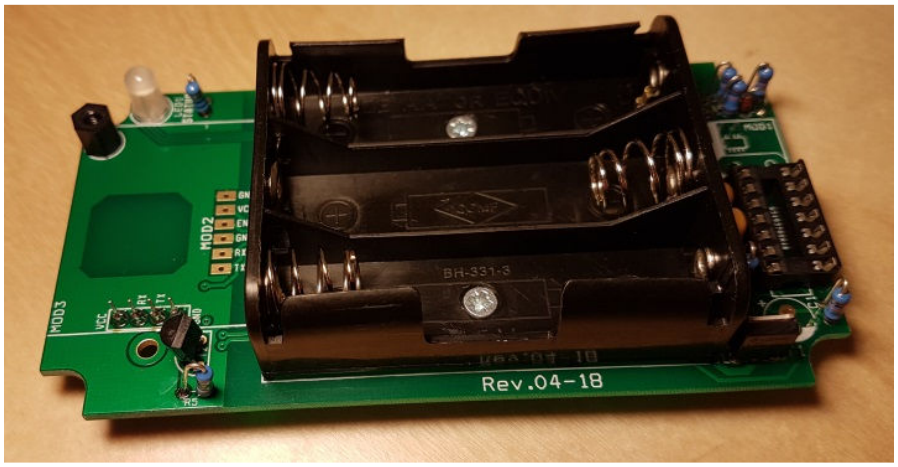
4.10 IC2 (DS18B20)

Insert just a few millimetres, then bend over as shown and solder. The flat, engraved front surface should be showing.



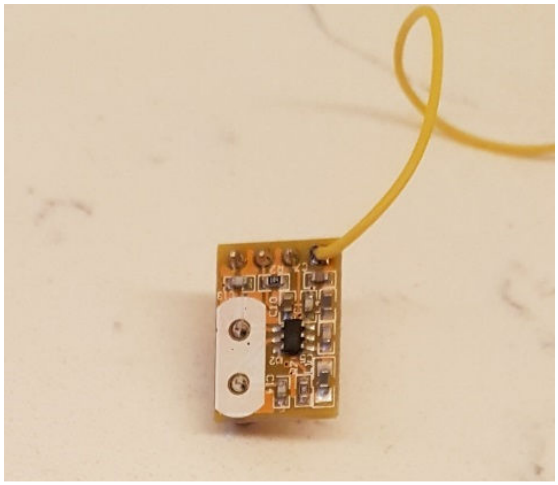
4.11 AA Battery Holder

Insert the battery holder, and first screw it to the PCB with two self-tapping screws. Then solder the two wires.



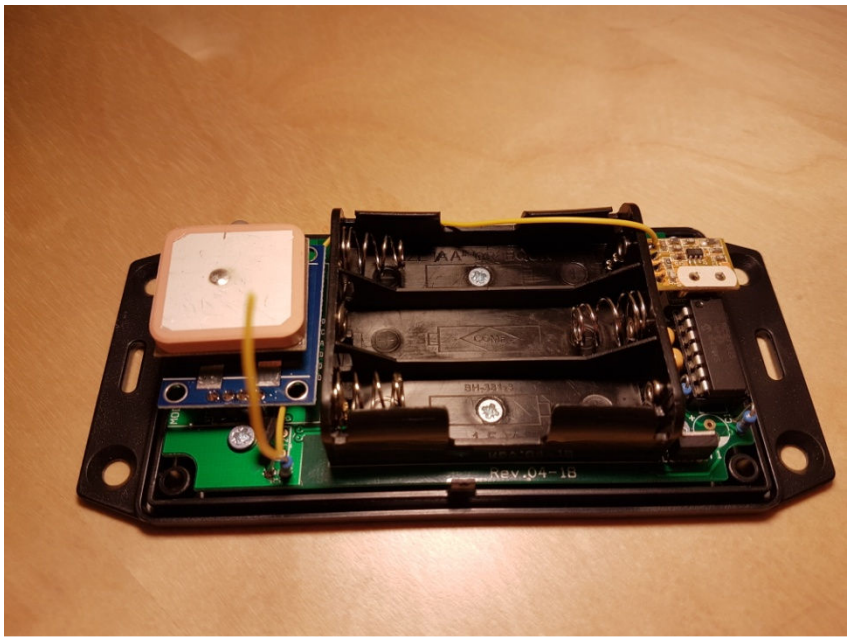
4.12 Transmitter Module

Cut 17cm of the cable supplied, strip off 3mm of the insulation from one end and tin the wires. Then attach to the end pad of the Transmitter module as shown.



4.13 Final Assembly

Re-attach the GPS module, not forgetting the M3 X 4mm screw. Orient the notch on the IC with the corresponding marking on the socket and push into the socket. Push in the Transmitter module, with the three pins in the three holes closest to IC1. Feed the antenna wire around the battery holder. Finally screw the PCB to the base of the case with the remaining three self-tapping screws.



5. USING XTERNA

5.1 CONFIGURING YOUR CLOCK OR THERMOMETER

Usually, the clock or thermometer will be pre-configured to receive the 433MHz broadcasts. All you need to do is set the time zone of any clock for your offset from UTC. (Usually parameters 14,15,16)

5.2 POWERING UP FOR THE FIRST TIME

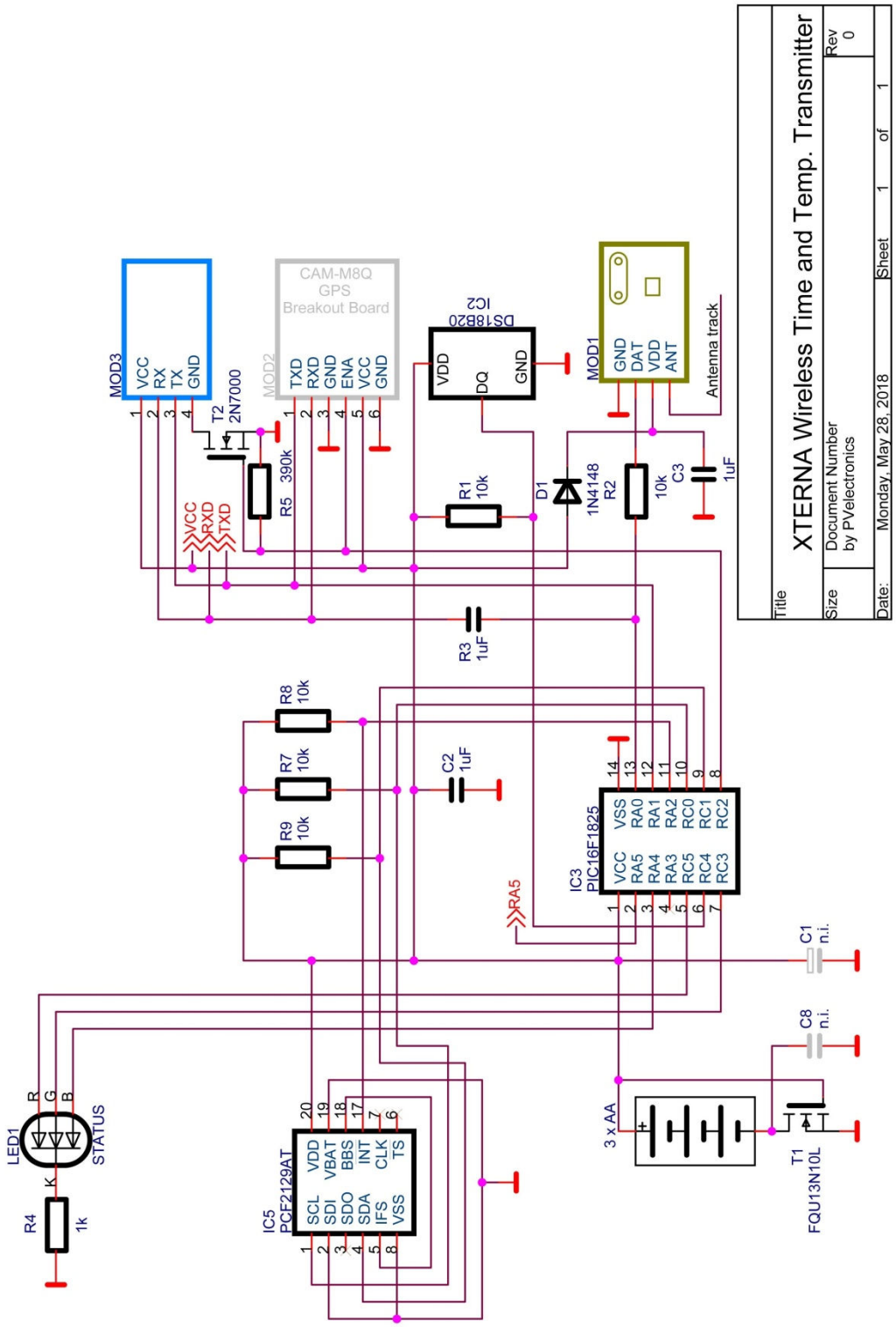
For the first use, configure your clock, and then position the XTERNA module as close as possible to the clock, but with a good view of the sky. Insert three NEW, top quality AA batteries. Keep the top cover open, so you can follow the progress on the RGB LED, in case of issues.

After inserting the batteries, the module will follow a pattern of calibration and GPS seek, which can be followed on the RGB LED. In case of issues, it will be helpful to follow the sequences, and make notes of the timings. Initially, just follow the LED. Only make timing notes if you have issues.

5.3 RGB LED SEQUENCE

1. Power up
2. LED off for 5 seconds
3. Start initial GPS seek. Red/Green flashing for up to 120 seconds
4. Hold on Green for 5 seconds = GPS module found
5. LED Off for 5 seconds
6. First GPS calibration. Red/Green flashing for up to 120 seconds
7. LED off for 5 seconds
8. GPS calibration. Red/Green flashing for up to 20 minutes
9. LED off, followed by burst of green flashes (data transmission)

6. CIRCUIT


XTERNA Wireless Time and Temp. Transmitter
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Rev
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Date:
Monday, May 28, 2018
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MOD3
VCC
RX
TX
GND
MOD2
CAM-M8Q
GPS
Breakout Board
TXD
RXD
GND
ENA
VCC
GND
IC2
DS18B20
VDD
DQ
GND
MOD1
GND
DAT
VDD
ANT
Antenna track
T2
2N7000
R5
390k
R1
10k
D1
1N4148
R2
10k
C3
1uF
R3
1uF
R8
10k
R7
10k
R9
10k
C2
1uF
IC3
PIC16F1825
VCC
RA5
RA4
RA3
VSS
RA0
RA1
RA2
RC0
RC1
RC2
RC5
RC4
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