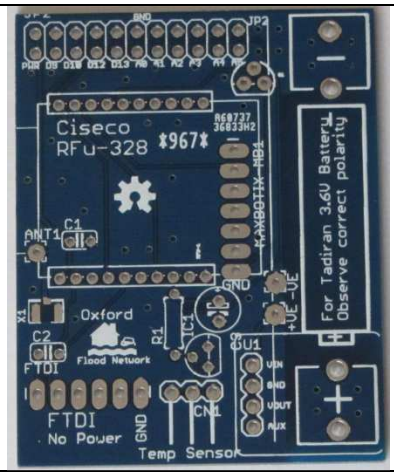
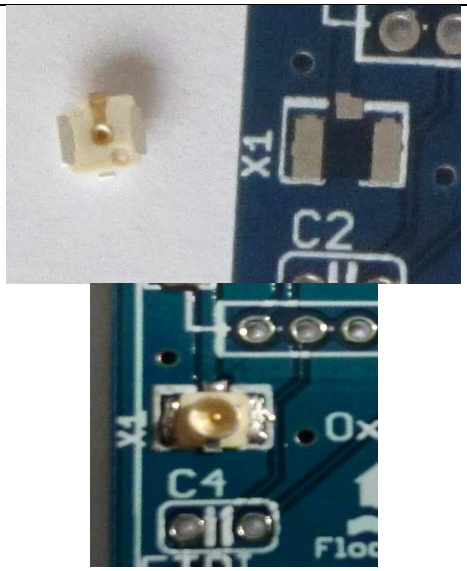
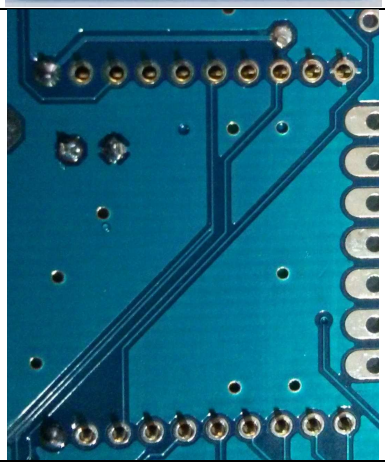
Oxford Flood Network Sensor Build Guide

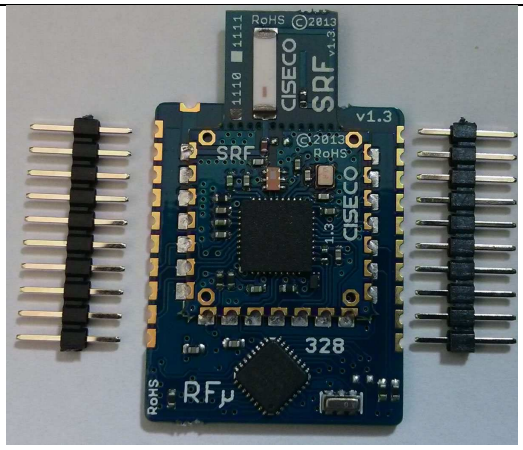
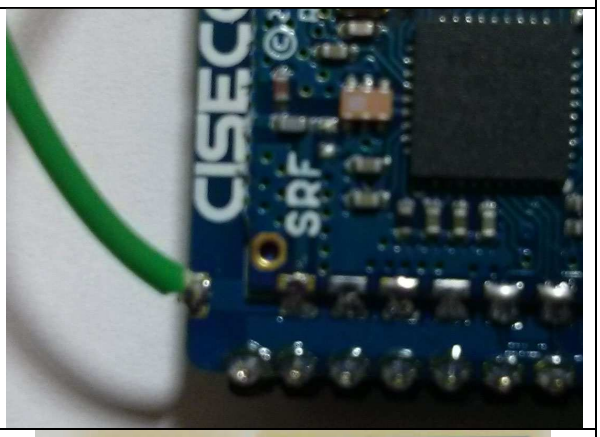
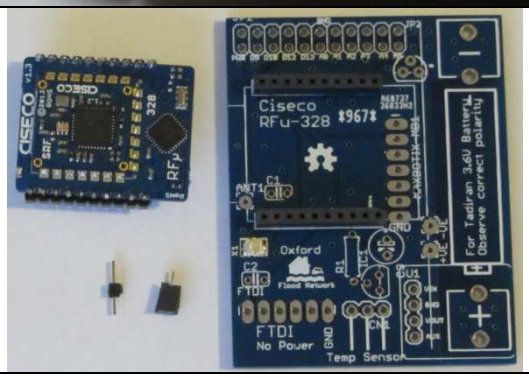
Sensor build instructions v3.1

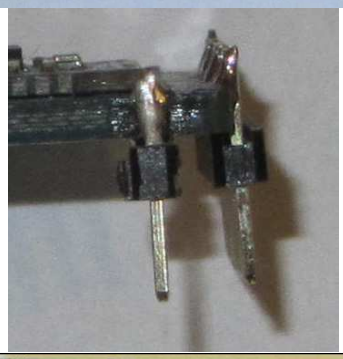
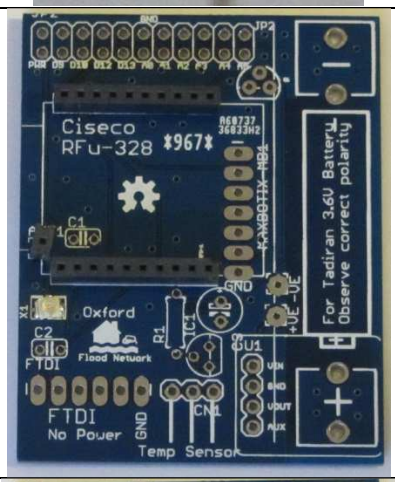
Main PCB

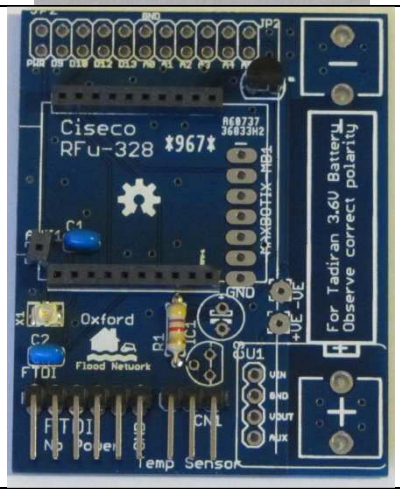
The build includes optional steps for the external antenna and the wire whip antenna options. These should be followed depending on which option you are building.

Step	Details	Photo
1	Start by examining the kit of parts and identify each part. The kit of parts without the case, connecting wire, battery and heat shrink tube are shown.	
2	Tools needed: • Soldering iron • Side Cutters • Wire strippers • Tweezers • Long nose pliers • Helping-hands or PCB holder to hold the PCB and components during soldering • Blu-tack • Heat gun for heat shrink tubing (Or disposable lighter). • Desoldering tool or braid (in case of mistakes!)	
3	The first part of the sensor build is to examine the printed circuit board (PCB) and familiarize yourself with the location of the components. Not all the pads are used as the board has a number of power and antenna options that are detailed in this guide.	

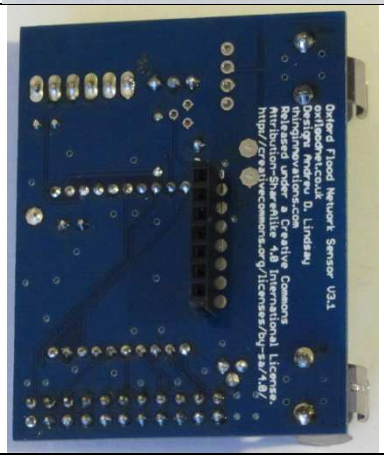
4	**NOTE:** *External Antenna option only. If using wire whip antenna then please ignore this step.* Start by soldering the lowest components first, this is the u.FL connector that is only needed if you are using the external antenna. It is important to get this round the correct way. Looking underneath the connector, you can see only one outer connector goes to the centre pin. This is gold in colour and is the side that must be soldered towards the centre pad at the top of the picture. Beware, these can be tricky to solder. Using a small blob of blu-tack (or similar) can help.	
5	The pair of 10 way header sockets should be soldered next. Start by soldering one end only then turn the board over to check that the connector is straight and level. If it's not straight then it can be moved from side to side to position it then just touch the soldering iron on the joint to re-align it.	
6	Solder the other end then check again. Once you're happy its straight then solder the remaining pins. Repeat for the other socket.	

7	The Ciseco RFμ-328 module needs the header pins soldering. These are in the package with the module. The easiest way to do with is to plug the two rows of pins into the socket with the longer pin into the socket and the shorter pin sticking up. Place the RFu module onto the pins so that they are in the semi-circular cutouts. Once you are happy with the fit, solder the pins carefully. If you are not fitting the external antenna then remove the module by carefully pulling upwards.	
8	**NOTE:** *Wire Whip antenna option only.* Strip 2mm of the sheath from one end of an 85mm piece of wire. Solder this to the pad at the top of the RFμ-328. The antenna can then be trimmed to 82mm above the PCB. The wire whip can then be curled loosely in the case when the PCB is mounted on the sensor.	
9	**NOTE:** *External Antenna option only.* The Ciseco RFμ-328 module shown here has the inbuilt antenna snapped off. The module requires an additional pin to link the antenna to the u.FL socket. The kit provides a small pin and header that may need to be trimmed to a single pin and header.	

10	**NOTE:** *External Antenna option only.* Plug the header pin and socket together, insert the socket into the PCB and line the pin up with the semi-circular cutout on the RFu module. Solder the pin end first then turn over to solder the header socket. The RFμ module can now be removed carefully by pulling gently upwards.	 
11	**NOTE:** *External Antenna option only.* The additional header socket should look like this.	
12	Carefully bend the legs of the 4K7 resistor close to the body so that they fit through the holes for R1. The two small capacitors, usually coloured blue or yellow are put into positions C1 and C2, the legs can be spread outwards to hold them while turning the board over. The resistor and capacitors should be soldered and the surplus leads trimmed closed to the board.	

13	The 6-way and 3-way right angle header pins are next. The black plastic strip should be next to the PCB. These should be soldered on one pin first. Check they are straight and square to the board before soldering the remaining pins. The 6-way header pins are for the FTDI programming cable, the 3-way header pins are for the temperature sensor.	
14	The 2N7000 Field Effect Transistor (FET) should be identified by the markings on its flat face. Do not mix this up with the temperature sensor DS18B20 which is in an identical TO-92 3 pin package. The centre leg should be bent backwards about 5mm down from the body, then a further 2mm down it should be bent downwards. The front is the flat face, the rear the curved side. This puts the centre leg behind the two outer legs forming a triangle that should match the holes towards the top of the PCB.	
15	The prepared FET should be pushed carefully into the holes as shown. The legs can be spread slightly from underneath to stop it falling out when turning the PCB over. Solder one leg, check the FET is straight, carefully re-position if it is not then solder the remaining legs. Trim the excess leads.	

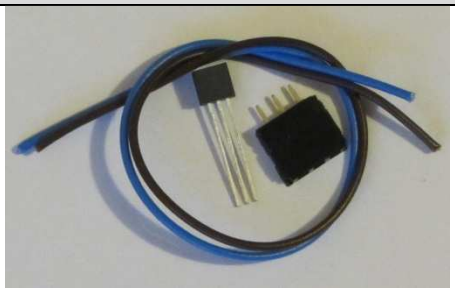
16	The double row of 11 pins should be soldered next. Again, follow the procedure of soldering a corner pin, checking position then soldering all the remaining pins.	
17	The electrolytic capacitor must be fitted correctly. The capacitor has the – lead identified, but the PCB has a + marked on it. The – lead goes into the lower hole, the + is the top hole closes to the RFμ-328 module socket. The silkscreen on the PCB isn't clear enough.	
18	Solder the electrolytic capacitor, observing the correct polarity. Trim the leads once done.	

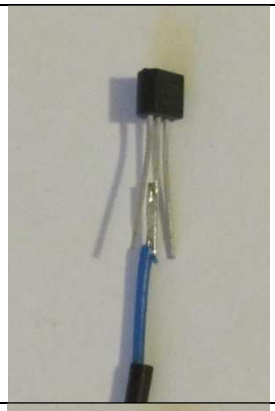
19	Push the two battery clips into the holes on the PCB. Make sure they are firmly down. Turn the PCB over and solder each of the 2 legs on each clip. These will require quite a lot of heat and solder but be careful not to overdo it and burn the PCB. **Warning:** *The battery clips will still be hot after soldering.*	
20	The ultrasonic transducer connector is fitted from the underside of the PCB. Follow the usual procedure of soldering one end. The soldering for this connector is done on the top of the board.	
21	The board is now complete, but before installing the RFμ-328 module and battery, visually check all solder joints for shorts, solder splashes and dry joints. [TESTS]	
22	The completed board with RFμ-328 module fitted. Take care to align the pins correctly before firmly pushing it into the socket.	

Ultrasonic Sensor

Step	Details	Photo
U1	The 7-way right angle header pins need to be soldered onto the Ultrasonic sensor. The black plastic strip should be next to the PCB. The pins should go in through the side with the model number sticker as this is the largest area for the pins. One point to note is that once the pins have been fitted it may be difficult to identify the correct way round for the sensor to fit onto the main PCB. Examine the connector and identify the end hole labeled GND. Using a black marker pen, make a mark on the grey plastic at the GND end as shown in the photo below.	
U2	Follow the same procedure as before by soldering one end, checking position then soldering the remaining pins. The sensor is now ready to fit into the case.	

Temperature Sensor

Step	Details	Photo
T1	The DS18B20 temperature sensor, not to be confused with the similar looking 2N7000 FET needs to be wired to the three way header so that it can attach to the main PCB. The sensor has 3 legs but we are using it in a parasitic power mode so only need two connections. The heat shrink tubing is also required here.	

T2	Separate the outer legs away from the centre leg to make soldering easier. Strip about 4mm of the insulation from the blue wire then twist and tin the exposed conductor. Solder this to the centre leg.	
T3	Slide a 15mm piece of narrow heat shrink tubing over this pin right up to the top. Using a heat gun, heat the tubing to shrink it.	
T4	The outer legs should be bent so that they meet in the middle, being careful not to bend too close to the black body of the temperature sensor.	
T5	The piece of brown wire can be stripped and tinned then soldered to the two outer legs as shown. A 15mm piece of narrow heat shrink can be pushed up as far as it can go then shrunk using a heat gun.	

T6	A larger piece of heat shrink tubing should be used to completely cover both the leads.	
T7	The other ends of the blue and brown wires should be stripped and tinned. Slide 10 – 15mm pieces of heat shrink tubing onto the wires then solder the blue wire to the centre of the 3-way header pins. Solder the brown to one of the outer pins. Slide the heat shrink tubing up and heat to shrink.	
T8	The finished temperature sensor should look like this.	
T9	The temperature sensor is plugged onto the 3-way header pins. The connector and temperature sensor has been designed so that it does not matter which way it is plugged in, it will work.	

Case

The case may arrive pre-machined with the kit; if this is the case then instructions can be ignored.

Step	Details	Photo
C1	The following build instructions refer to the IP55 rated junction box from Screwfix, as listed in the BoM. This is a 2-part case with rubber gasket between the base and the lid. Note when drilling and cutting plastic, the bit or saw will get hot causing the plastic to melt. Adjust the speed to help reduce overheating.	

C2	The hole for the ultrasonic sensor needs to be in the centre of the lid. Mark the centre by drawing lines from each diagonally opposite screw hole. A further mark is needed for the temperature sensor. This is approx. 15mm from the bottom edge and 10mm to the right of the centre line.	
C3	Using a 26mm (27mm maximum) hole saw mounted in a pillar drill is the easiest method to make the hole. If this is not available then the hole can be made using a smaller drill bit to produce a ring of holes, this is then cut out and the hole filed to the correct size.	
C4	The temperature sensor hole should be made with a 5mm drill bit.	
C5	The case used has a series of ribs inside the lid. These need to be removed around the hole so that the rubber O-ring can sit flush and the nut can be tightened. This can be done with a cutting disk in a rotary tool.	

C6	Fit the ultrasonic sensor. This should have the flat rubber washer on the outside and the rubber O-ring on the inside. Carefully tighten the large nut using either the proper spanner (!?) or a pair of long nose pliers, being careful not to damage the header pins.	
C7	**NOTE:** *External Antenna option only.* If the external antenna is to be used then a 6.5mm (or 6mm then run a file through hole to enlarge it).	
C8	**NOTE:** *External Antenna option only.* The SMA pig-tail should push through and be bolted in place. However, the plastic of the case may be too thick to let the antenna screw home fully.	
C9	**NOTE:** *External Antenna option only.* It is possible to produce a recess to thin the case where the connector is to be fitter. This can be done using a 12mm Forstner bit. These are special tools for cutting flat bottomed holes. In this case it was used to thin case. Ideally this should be done *before* the 6.5mm hole is made otherwise the tool may not centre correctly causing the tool to slip across the case.	

C10	**NOTE:** *External Antenna option only.* The SMA connector should be tightened up using a pair of 8mm spanners so that the connector doesn't turn when the antenna is fitted. For weather protection, the connector can be sealed with silicone sealant once the antenna has been fitted.	

The completed sensor:

All that remains is to decide how to attach the sensor to your chosen location. We have tried:

- Industrial strength Velcro
- Old hard disc magnets inside the case
- Bracket screwed onto case

You should also consider a safety line to attach the sensor to the bridge in case it gets knocked from its mounting. This is especially important if the magnetic option is used. Suitable safety line would be steel cable, such as bicycle brake cable inner, small gauge chain or cable.