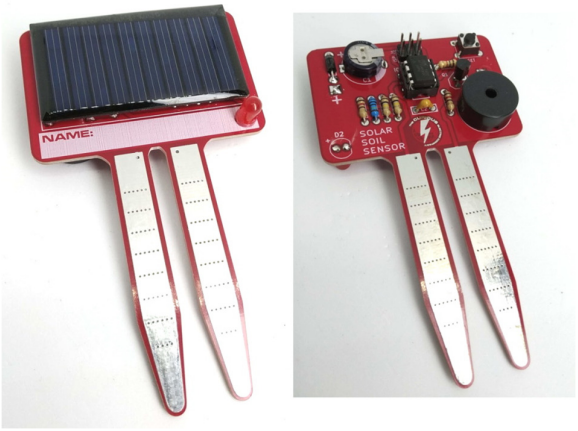
THE CURIOUS ELECTRIC CO.

Solar Soil Sensor Instructions

Date:	09/07/2020	Version:	1.0	By:	Matt Little



Add this soil moisture sensor to your pot plants to let you know when to water them. This checks the moisture level and either blinks an LED or 'chirps' to remind you to water the plant.

It is solar powered, so will never need batteries! It uses an ultra-capacitor to store the solar energy, so will work even if left uncharged for a long time. But it will need to be left in sun to recharge – on a sunny windowsill will work perfectly!

It was designed as a fun and interactive way introduce solar power and improve soldering skills.

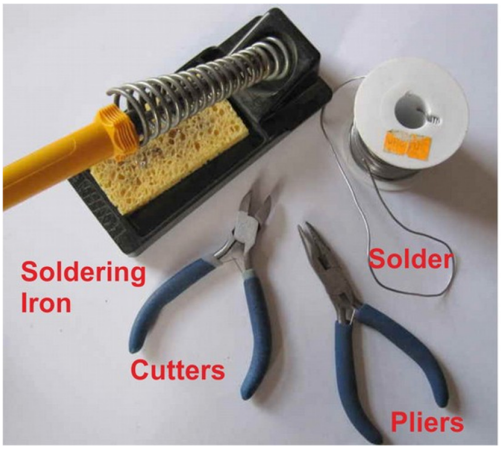
Parts included:

Piezo		ISP Header	Printed Circuit Board			6 x resistors: 2 x 120 Ω 1 x 1 kΩ 2 x 100 kΩ 1 x 1 MΩ
100 nf Capacitor						
Switch						
						Transistor BC547
						Ultra-Capacitor
Solar Photovoltaic Panel (5V, 30mA)						ATTiny85 Programmed Microcontroller (& holder)
		Diode - 1N5819		LED		Sticky Pad (not shown)

Parts list:

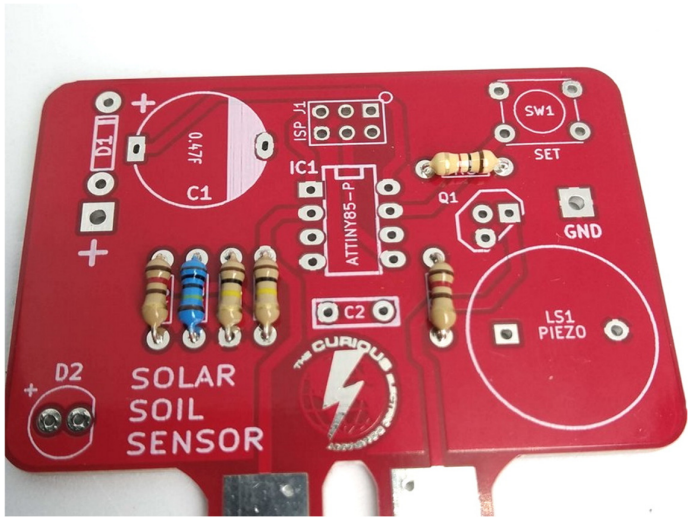
Item	Ref	Item	Ref
0.47F Ultra Capacitor	C1	1 MΩ Resistor	R1
100nF Decoupling Capacitor	C2	100 kΩ Resistor	R2
5mm Red LED	D2	100 kΩ Resistor	R3
1N5819 Shottky Diode	D1	120 Ω Resistor	R4
ATTiny85 Microcontroller (programmed) Plus IC Holder	IC1	1 kΩ Resistor	R5
ISP Header	J1	120 Ω Resistor	R6
Piezo buzzer	LS1	Solar Photovoltaic Panel (5V, 30mA)	SC1
2x3 ISP Header	P2	Switch	SW1
Printed Circuit Board	PCB	Sticky Pad	
BC 547C Transistor	Q1		

Tools required:



PCB Instructions:

Step: 1	Solder resistors



Value	Ref	Colour
1 MΩ	R1	Brown – Black - Black– Yellow – Brown (5 band)
100 kΩ	R2	Brown – Black – Yellow - Gold
100 kΩ	R3	Brown – Black – Yellow - Gold
120 Ω	R4	Brown – Red – Brown – Gold
1 kΩ	R5	Brown – Black - Black– Brown – Brown (5 band)
120 Ω	R6	Brown – Red – Brown – Gold

Insert and solder the resistors to the locations marked on the PCB. Polarity does not matter for resistors. Ensure they are soldered flat & close to the PCB.

You can use a multi-meter or colour code chart to ensure correct resistor values.

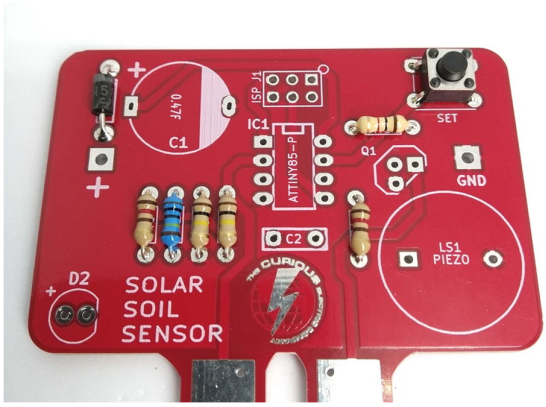
Step: 2	Solder diode D1 and Switch

Ensure correct orientation for D1, the 1N5819 diode.

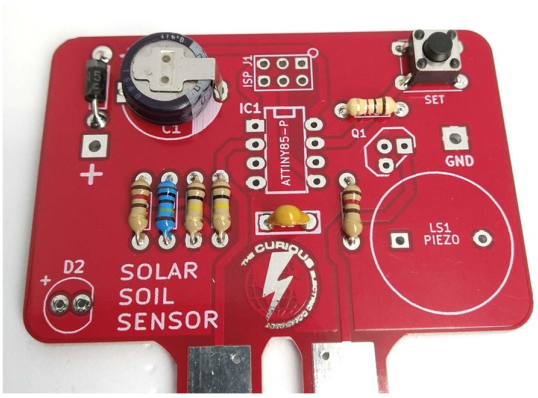
This has tiny markings saying “1N5819” and also a white band around one end to indicate polarity.

Ensure the white band on the diode aligns with the white band marked on the PCB.

Solder the switch into the four pads marked 'SET'.



Step: 3	Solder capacitors



First solder the non-polarised capacitor, C2. Orientation of this does not matter:

Value	Ref	Marking
100nf	C2	104

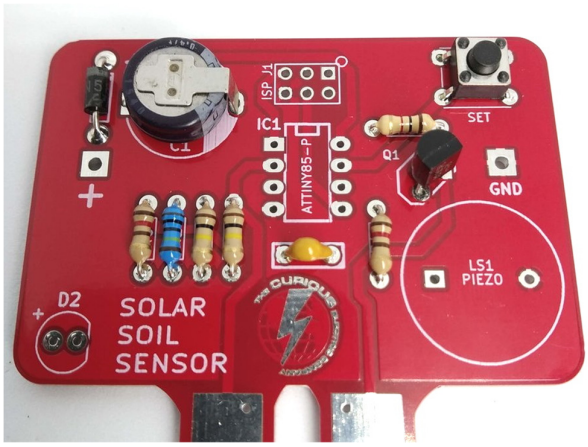
Next, solder the polarised ultra-capacitor. Ensure correct orientation of this component.
The negative lead is marked with a white bars. Align the positive lead with the + sign and the negative lead with the white PCB marking.

Value	Ref	Marking
0.47F	C1	0.47F 5.5V

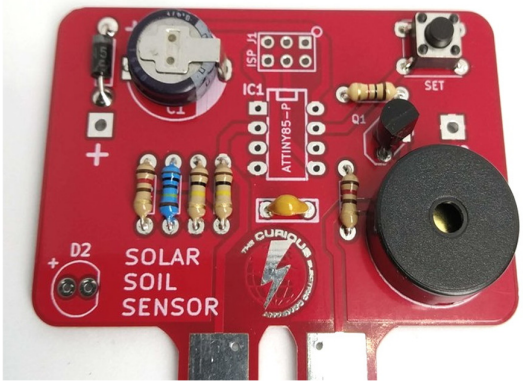
Step: 4	Solder Transistor

Solder the transistor into the part marked Q1. This is a BC547 NPN transistor.

Ensure the flat side of the transistor aligns with the long flat side of the silk screen markings.



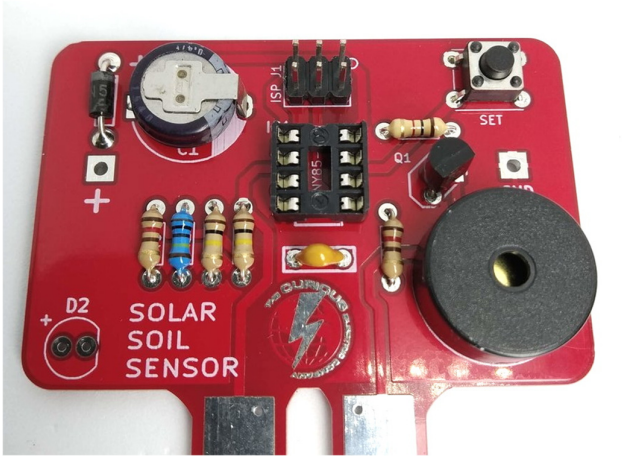
Step: 5	Solder Piezo

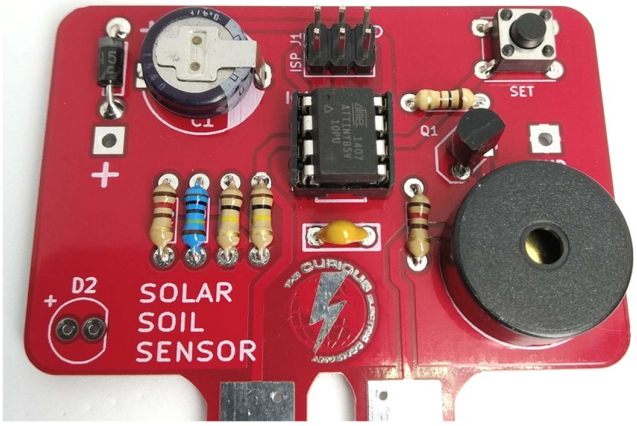


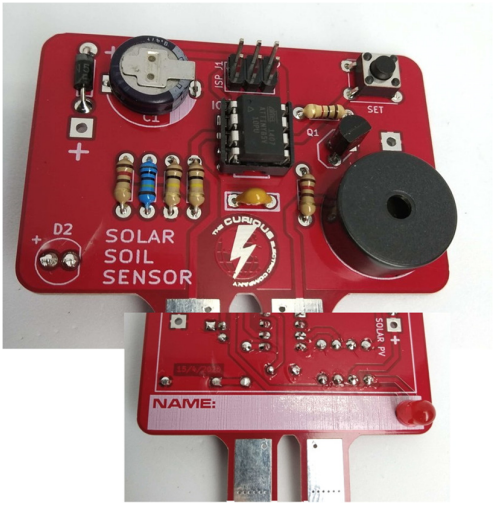
Solder the piezo into the section marked LS1.

This creates the sounds.

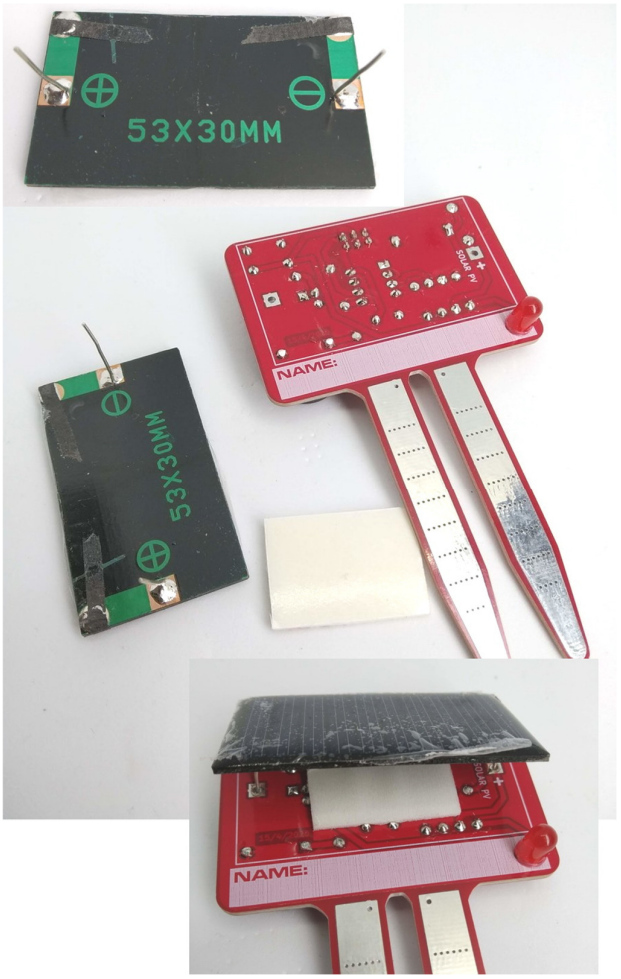
The orientation of this component does not matter.

Step: 6	Solder IC holders & ISP Port
Solder the 8 pin IC holder. These fit into the area marked IC1. Ensure correct orientation! Ensure the notch on the holder aligns with the notch shown on the PCB. Solder in the 2x3 ISP header pins into the location marked ISP P2 on the back of the board. This is only needed for reprogramming.	

Step: 7	Insert the IC
	Carefully push the microcontroller into the 8 pin IC holder. Ensure that the dot on the microcontroller aligns with the notch on the IC holder.

Step: 8	Solder the LED
The LED is soldered to the other side of the PCB in area D2. Please see photos. Ensure correct orientation! The longer lead on the LED is positive, so place that into the hole marked +. The negative side has a slightly flat edge on the body of the LED.	

Step: 9	Fit and solder the Solar PV Panel



Stop and double check that all the components are soldered correctly and in the correct locations. Once the solar PV panel has been soldered in place it will be difficult to fix any soldering issues!

Take two offcuts of component leads (I used the ones from the resistors).

Bend the end slightly and solder onto the two pads on the solar panel with the leads coming away from the panel vertically.

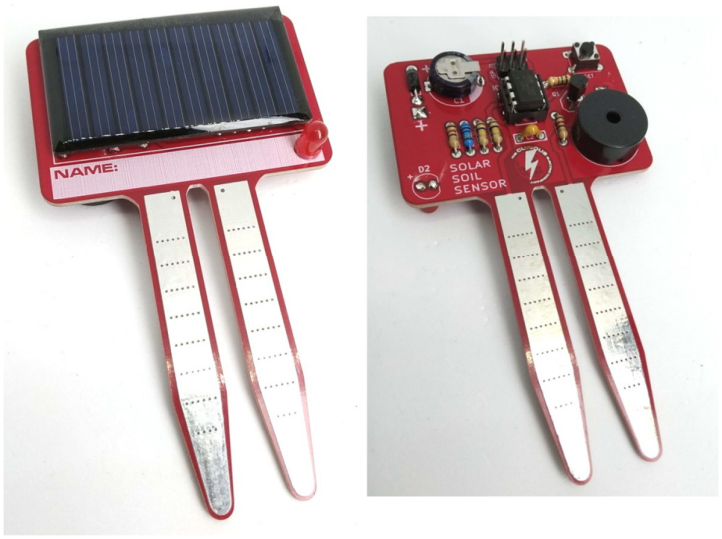
Add the sticky pad to the centre of the PCB on the solder side. Take off the backing of the sticky pad.

Align the two leads from the solar panel with the two holes for the solar PV panel, ensuring that the + of the solar panel goes through the hole with the + next to the solder pad.

Stick the solar panel down and then solder on the other side.

Check the photos for more details.

Step: 9	PCB is finished! Let's test...



Place the finished unit in bright sunlight.

It should charge up enough to work quite quickly (1-5 mins).

To get a full charge it will need to be left in the sun for a while. It can be left on a windowsill and will work very well there.

Please note: *This unit is NOT waterproof.*

Do NOT leave outside if it will get wet.

Step: 10: Operation

This unit has a few different functions, all controlled through the 'SET' button on the PCB. The unit will only work when it is charged, so this is best performed outside on a sunny day.

Set the 'I'm OK' moisture level
Pressing the 'SET' button for a short press (less than 1 second) will read the moisture value of the probes. It will use this value to make decisions on what is under-watered. This value is stored in memory, even if the unit it fully discharged.

Pressing and holding the 'SET' button (for more than 1 second) will cause the unit to cycle through the three modes. Each time the next mode is entered then there will be a beep(s). The number of beeps indicates the mode the unit is in. Release the 'SET' button when you are in the correct mode.

Mode 1: Flash and 'Chirp' on under-water
The unit will wake up every 8 seconds and check the moisture level.
If the moisture level is a bit below the set level (set as explained above), then the unit will 'Chirp' with a rising tone. This means 'water me!'. The LED will also flash.
The 'Chirp' will *only* happen when there is sunlight available (to stop it beeping through the night!).

Mode 2: Flash ONLY
This is the *quiet* mode. It will never 'chirp' but just flash if under-watered.

Mode 3: Flash and 'Chirp' on under-watered AND over-watered
This mode is similar to Mode 1 and does the same operation as Mode 1. It *also* checks for over-watering. If the plant is over-watered then the unit will do a falling 'Chirp'.

Note: *Even in normal operation this unit will probably discharge overnight (as the capacitor does not hold a huge amount of energy). This is normal and the unit will start again when there is solar power available.*

Step: 11 Re-programming Notes

Note: No programming is needed – the microcontrollers are already programmed! Here are some notes for people wanting to take things a step further…

The circuit board has a standard ISP (In-System Programming) port for the ATTiny85 microcontroller and full access to the code which can be programmed via the Arduino IDE, if that's your thing.
You will need an Arduino Uno with wiring set up for programming an ATTiny85 (please search internet).
You will need to include the ATTiny85 programming board manager into your version of the Arduino IDE (please search internet).
You upload code by using the "Arduino as an ISP" option.
The Arduino code for this unit (and all other design files) is available at the repository:
https://github.com/curiouselectric/solarSoilSensor

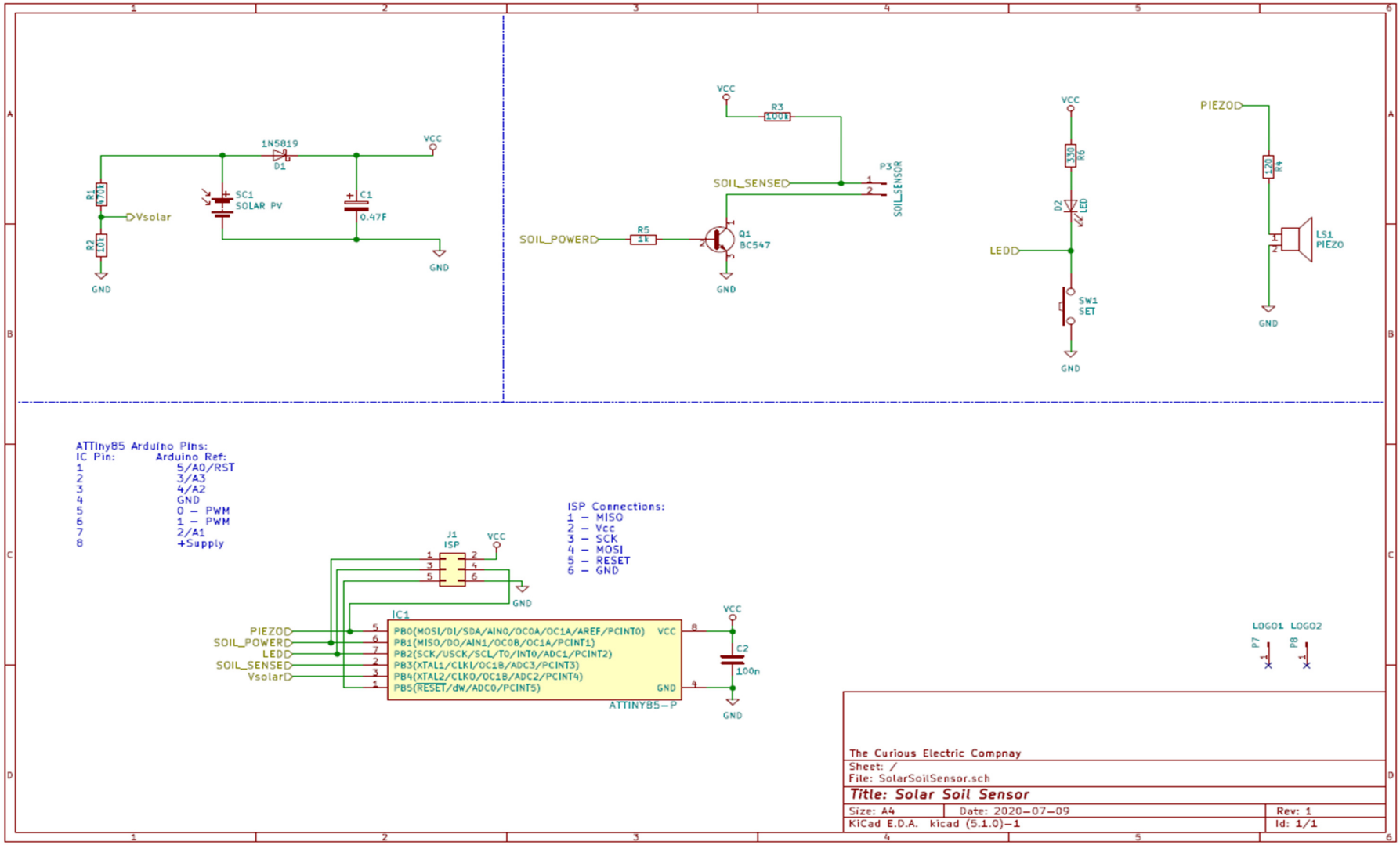
Contact details:

We would like you to be happy with this kit. If you are not happy for any reason, then please contact us and we will help to sort it out.
Please email **hello@curiouselectric.co.uk** with any questions or comments.
Please tweet us at **@curiouselectric**
If any parts are missing from your kit then please email **hello@curiouselectric.co.uk** with details and, if possible, where the kit was purchased.
More technical information can be found via **www.curiouselectric.co.uk**

This kit has been designed and produced by:

The Curious Electric Company
hello@curiouselectric.co.uk
www.curiouselectric.co.uk
Unit 23, Block D, Hartley Business Centre, Haydn Rd, Nottingham, NG5 1DG, UK

Circuit Schematic



Resistor Colour Codes