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ELSYS se ELT Series Multi Sensor Instruction Manual

Application Note
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ELT External Configuration Guide
Technical Manual – Radar Module

Contents

External Sensors

The ELT series of sensors can be connected to a wide array of external sensors, equipment, and modules. All connections to external gear are made available through the terminal block located on the top left of the circuit board inside the ELT. Available connections on the terminal block are power, ground and either one or two multi-purpose I/O-ports depending on the ELT variant.

Slot	Designator	Explanation	ELT Lite	ELT 2i	ELT 2
1	B+	Power output	x	x	X
2	IN	Multi-purpose I/O 1	x	x	x
3	GND	Ground	x	x	x
4	I/O2	Multi-purpose I/O 2		x	x

General External Sensor Parameters

All of the following settings can be set using NFC and our app Sensor Settings or via a LoRaWAN downlink to the device.

External Configuration (ExtCfg): Sets the external sensor type.

External Period (ExtPer): The external period sets how often the external sensor data is to be sampled as a multiple of the sensors time base. Ensure that the external sensor send period is set to a non-zero value for the sensor to send external sensor data, including non-periodic data, as the default value is 0.

External Startup Time (ExtPwrTime): The time in milliseconds between B+ power is applied to the external sensor and the external sensor is sampled. Set the External Startup Time to 1000000 or greater to make the B+ output always on.

The function of this parameter may change depending on the external sensor parameter, consult the following sections for details.

External Trigger Timeout (TriggTime): The amount of time in milliseconds from a trigger event to a new trigger being allowed. The External Trigger Timeout is used in the Pulse and switch modes.
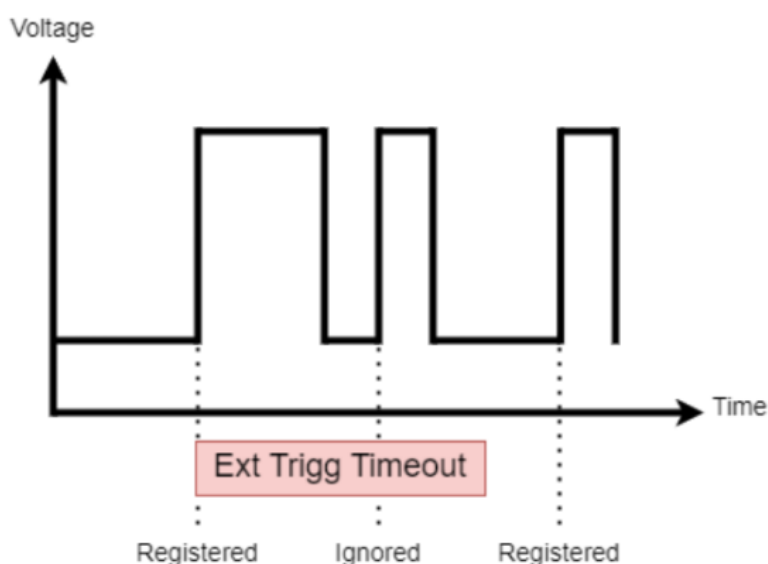
External IO manipulation (External): Sets the external IO to alternate functionality.

Power Output

The ELT sensors can power external sensors and modules using the B+ output on the terminal block.

The output is controlled by the External Startup Time parameter.

In some modes, a default startup time is applied by the ELT. In these modes, only External Startup Time values greater than the default startup time are applied. See section 4.2 for default startup times. The B+ output voltage is not regulated; it is directly tied to the + pole of the battery.

Module support

ELT series sensors with all four ports on the terminal block support ELSYS modules which expand the functionality of the ELT. Some modules are only operable with specific external configurations (see §5.1). Refer to module documentation for information and settings for module specific modes.

Module	Description	ExtCfg Specific
Step-up module	Increases output voltage of ELT	No
EXT-module	Allows the ELT to be externally power and to read and controll higher voltage equipment (10-50 V)	No
ADC-module	Adds high precision ADC with 2- and 4-wire connectivity support.	Yes
PT100-module	ADC-module tuned for PT100 temperature probes	Yes
Dual PT-1000 module	ADC-module tuned for up to two PT1000 temperature probes	Yes

External Configurations

The external configuration parameter (ExtCfg) sets the behavior of the multi-purpose I/O.
The external configuration parameter can be set via either NFC or LoRa downlink (see Downlink generator, app and downlink parameter documentation).

5.1 Extrernal Configurations table

ExtCfg (decimal)	External Configuration	ELT Lite	ELT2	ELT2i	Required module
1	Analog Input (0-10 V)	X	X	X	
2	Pulse Input, pull-down	X	X	X	
3	Pulse Input, pull-up	X	X	X	
4	Pulse input, absolute count, pull-down	X	X	X	
5	Pulse input, absolute count, pull-up	X	X	X	
6	1-Wire temperature probe (DS18B20)	X	X	X	
7	Switch, normally open (NO)	X	X	X	
8	Switch, normally closed (NC)	X	X	X	
9	Digital input	X	X	X	
11	Decagon		X	X	
12	Water leak	X	X	X	
13	Maxbotix MB738x		X	X	
15	DS18B20 + Switch		X	X	
16	Analog Input (0-3 V)	X	X	X	
17	PT1000		X	X	ADC-module

18	Decagon DDI		X	X	
19	Pulse input, no pull-up/down	X	X	X	
20	Pulse input, absolute count, no pull-up/down	X	X	X	
21	Switch, normally open, dual edge trigger	X	X	X	
22	Maxbotix MB736x		X	X	
23	0-180 Ohm sensor		X	X	
25	Load cell		X	X	ADC-module
26	Dual PT1000		X	X	Dual PT-1000 module
27	SLT5006		X	X	
28	Switch, door debounce	X	X	X	
29	Switch, level debounce	X	X	X	
30	PT100		X	X	PT100-module
31	SHT3x		X	X	
32	Radar		X	X	Radar
33	Meas pressure sensor M32Jx		X	X	
34	Pulse frequency + Analog 0-3 V	X*	X	X	

5.2 Default Startup Times

Some external configurations apply default startup times that have been tuned for their specific application. To keep power consumption at a minimum it is recommended to set the External Startup Time parameter to a time lower than- or equal to the default.

ExtCfg	External Configuration	Default Startup Time (ms)
6	1-Wire temperature probe (DS18B20)	1000
11	Decagon	0
12	Water leak	0
13	MB738x	280
15	1-Wire temperature probe (DS18B20) + Switch	1000
18	Decagon DDI	10
22	MB736x	800
25	Load Cell	200
26	PT1000	200
26	Dual PT1000	200
27	SLT5006	1000
30	PT100	200
31	SHT3x	0
33	Meas M32Jx	0
34	Pulse Frequency	12000

5.1 Digital Input

Connect the positive leads to IN and I/O2 and the negative lead to GND. The external IO are set to high-impedance inputs and a digital (GPIO) read of the IO are performed on every sample period of the sensor.
Voltage levels above 70 % of vdd are interpreted as '1' and voltage levels below 30 % of vdd are interpreted as '0'. Any voltage between the thresholds for '1' and '0' are uncertain and can be interpreted as either.
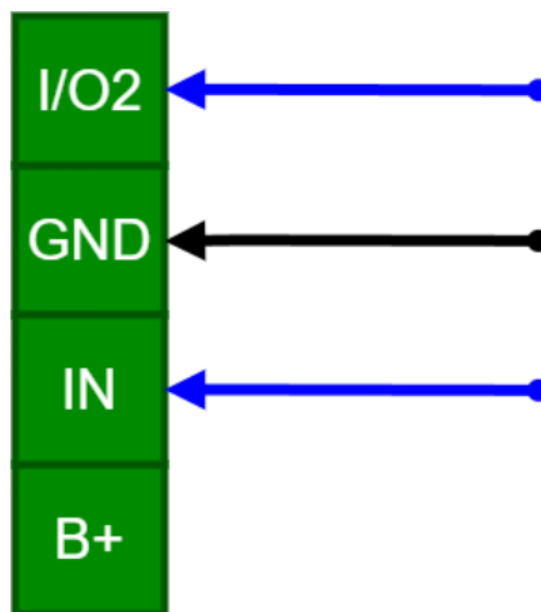
5.2 Analog Input

With the analog input modes set as external sensor type the sensor will wake up on main time base and measure the voltage at the input.
If the sensor has I/O2 the sensor will sample both inputs.

The reported value will be the voltage in mV. It can be set to measure two voltage ranges, 0-3 V or 0 – 10V, a mode where the ELT powers the source to be read is also available.

Note: Values for unconnected Analog inputs are undefined, meaning any number in the ADC may be reported for that channel. If a defined value is desired for unconnected inputs, connect a short jumper between the input and GND, which will result in the channel value being 0.
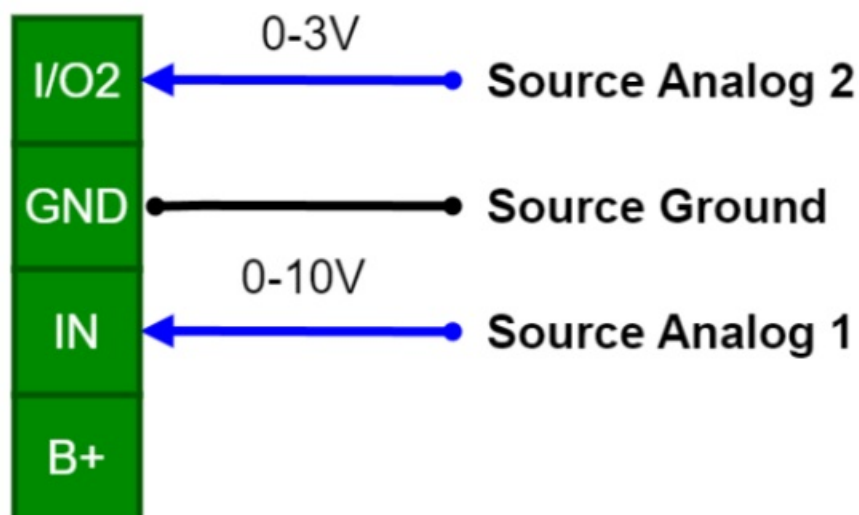
5.2.1 Analog Input 0-3 V

Connect positive lead to IN and negative lead to GND on the terminal of the ELT. If the sensor has I/O2, a second source may be connected with the positive lead connected to I/O2 and negative lead to GND. The input impedance is approximately 50 kΩ.
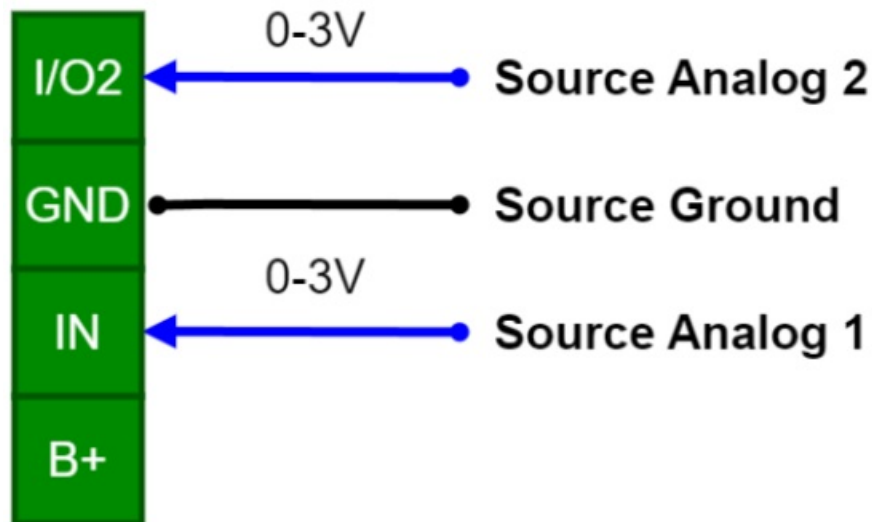
5.2.2 Analog Input 0-10 V

Connect positive lead to IN and negative lead to GND on the terminal of the ELT. The input impedance is approximately 6.5kΩ on the IN terminal.

If the sensor has I/O2, a second source may be connected with the positive lead connected to I/O2 and negative lead to GND. I/O2 is in 0-3 V range in this mode with an input impedance of approximately 50 kΩ.

5.2.3 Powered analog input 0-10 V

Connect positive lead to IN, negative lead to GND and the power to B+ on the terminal of the ELT.

The time between power is applied to B+ and the ELT samples the input can be set by the External startup time parameter.
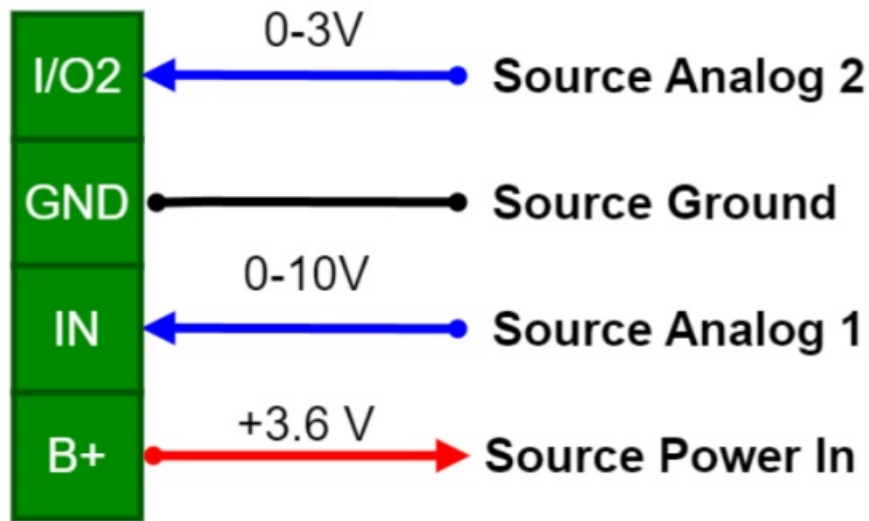
5.2.4 4-20mA Input

Select one of the Analog Input modes (See 4.3.1 and 4.3.2), connect a resistor (R) in parallel to the input, between IN and GND. Convert the voltage to current using Ohm's law, U=R*I. For full range use a 150 Ω resistor in 3 V mode and a 536 Ω resistor in 10 V mode.
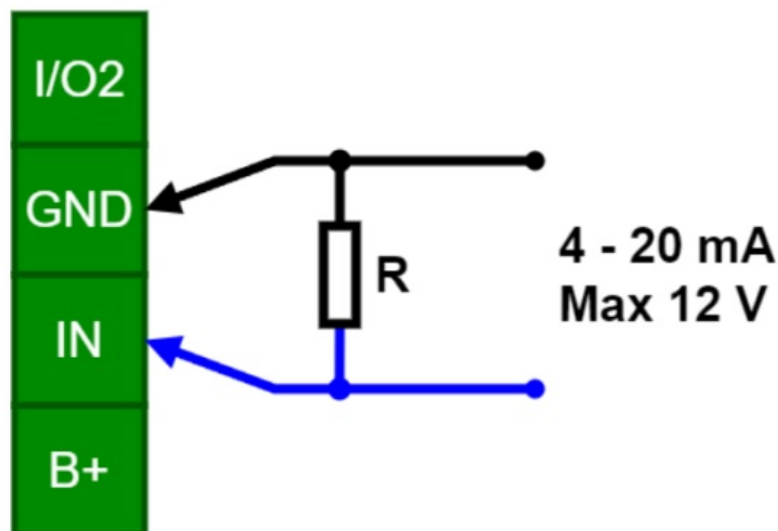

5.3 Pulse Count

With any of the pulse counting modes set as external sensor type, the sensor will be continuously sampling the input. The external trigger timeout is used in all pulse modes (see 6.1 for details).

The voltage needs to be as close as possible to the internal sensor voltage to register as a pulse. The pulse input modes will work with both passive switches and active outputs.

There are two ways of counting. In normal counting the sensor will report the number of pulses registered since the last uplink. In absolute count mode, the sensor will keep the number of pulses so the reported value will be the number of pulses registered since the device was started. The pulses will keep their count in absolute count mode even if the sensor resets and can only be reset by sending a "set pulse count"-downlink to the sensor or by changing the external configuration via NFC or downlink.

5.3.1 Pulse Input Pull-up & Pulse Input Pull-up Absolute Count

Connect positive lead to IN and negative lead to GND on the terminal of the ELT. If connected to an S0 output, connect the S0- lead to GND and S0+ lead to IN. The ELT will count all falling edges of the input signal. The ELT input is internally pulled up by approximately 50kΩ.
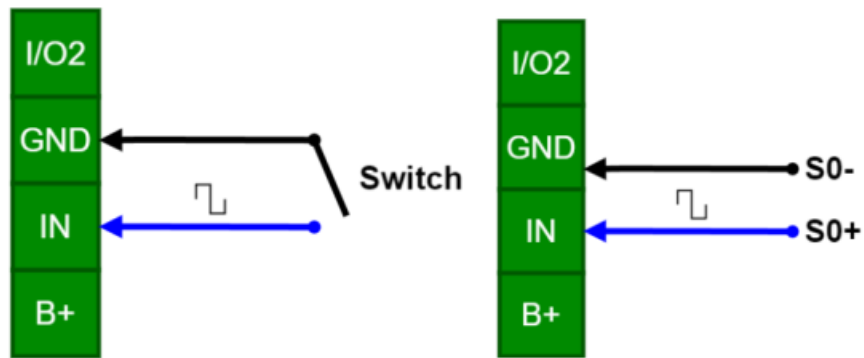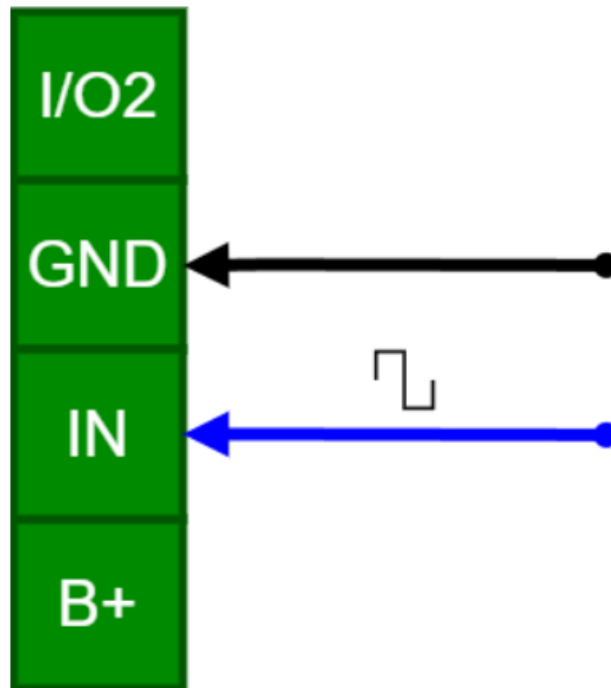
5.3.2 Pulse Input Pull-down & Pulse Input Pull-down Absolute Count

Connect positive lead to B+ and negative lead to IN on the terminal of the ELT. Set the ON-time parameter to 10 000 000 ms to make the B+ output always activated. The ELT will count all rising edges of the input signal. The ELT input is internally pulled down by approximately 50kΩ.
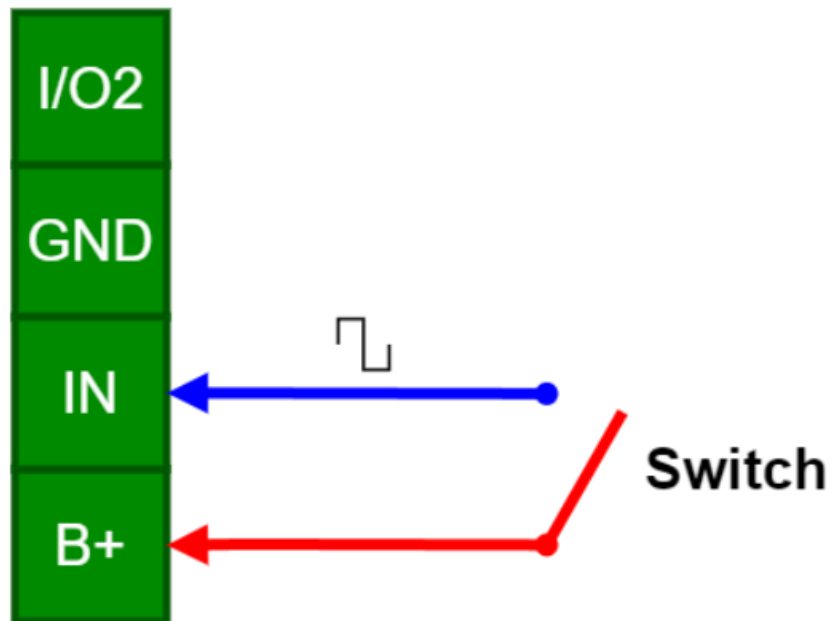

5.3.3 Pulse Input no pull-up/down & Pulse Input no pull-up/down Absolute Count

Connect positive lead to IN and the negative lead to GND on the terminal of the ELT. The ELT will count all edges, positive and negative, of the input signal. The ELT input has no input pull-up/down resistance in this mode. This requires the input signal to be driven both high and low by the external sensor.

5.3.4 Pulse Input Pull-up, 2 channels

Connect positive lead 1 to IN and positive lead 2 to I/O2, and negative lead(s) to GND on the terminal of the ELT. The pulse count of the channels will be reported separately. The ELT input is internally pulled up by approximately 50k Ω.
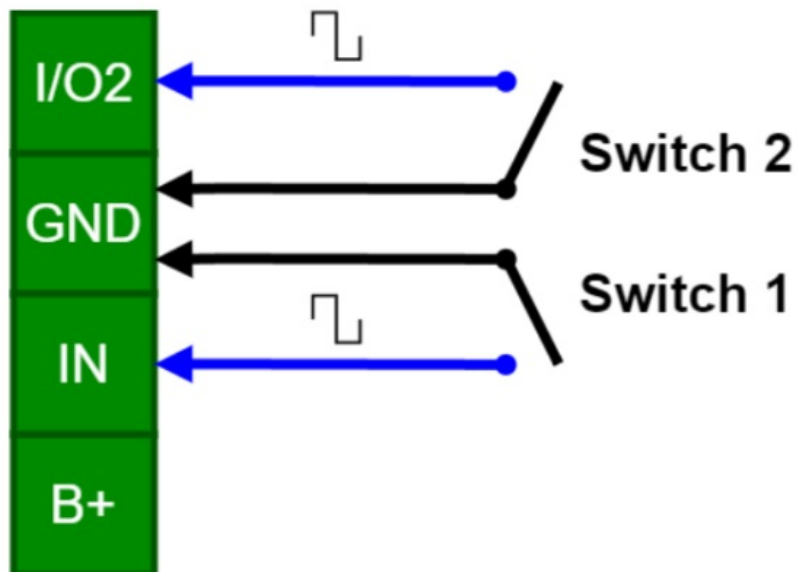

5.3.5 Pulse Input Pull-down, 2 channels

Connect positive lead 1 and 2 to B+, negative lead 1 to IN and negative lead lead 2 to I/O2. Set the ON-time parameter to 10 000 000 ms to make the B+ output always activated. The pulse count of the channels will be reported separately. The ELT input is internally pulled down by approximately 50k Ω.
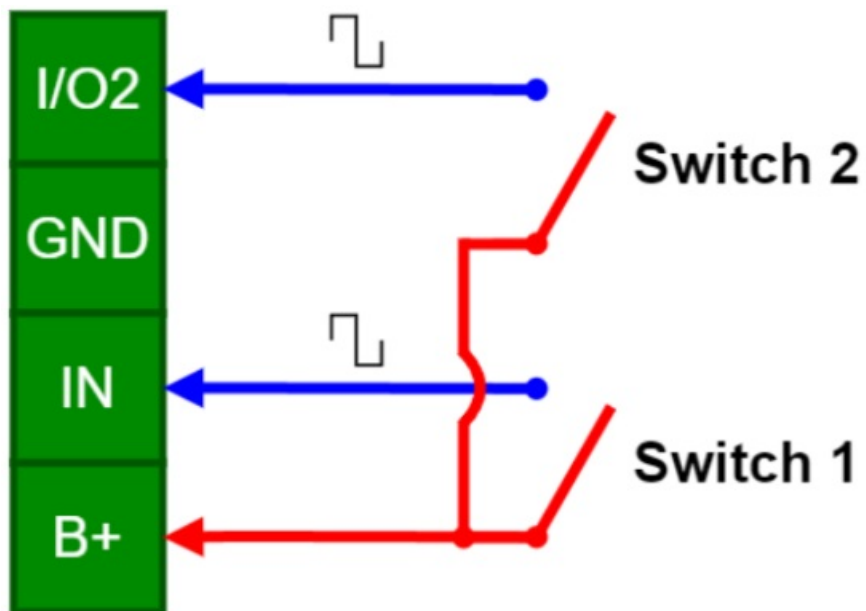
5.3.6 Pulse Input Pull-down – Frequency[1]

The pulse frequency mode can be used when a more exact measure of frequency is needed, and the exact pulse count isn't required.

The sensor will wake up and count the average time between 10 pulses once every sample period.

The reported pulse value is in 0.1 Hz.

Any frequency below 1 Hz will be interpreted as 0 Hz.

Range 1.0 – 400.0 Hz
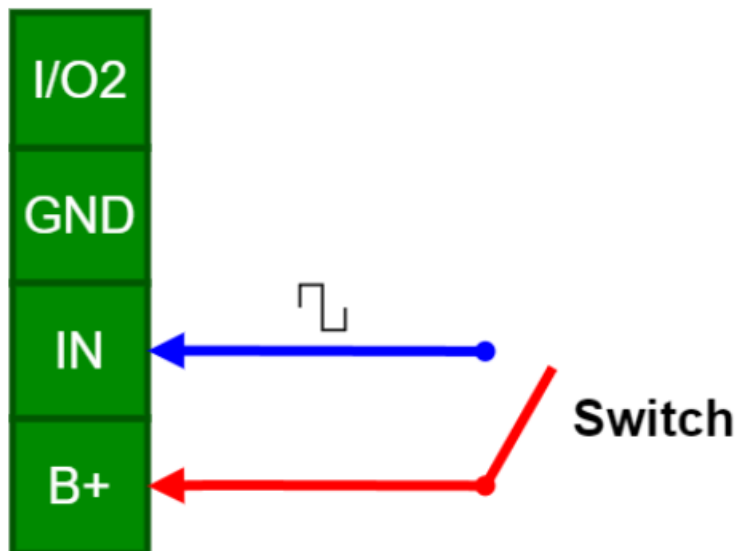
If the sensor has IO2, an analog read will be performed on I/O2 (see 4.2.1) after the pulse frequency is measured. The intended use is passive wind sensors, which commonly have a potentiometer-based wind direction meter.
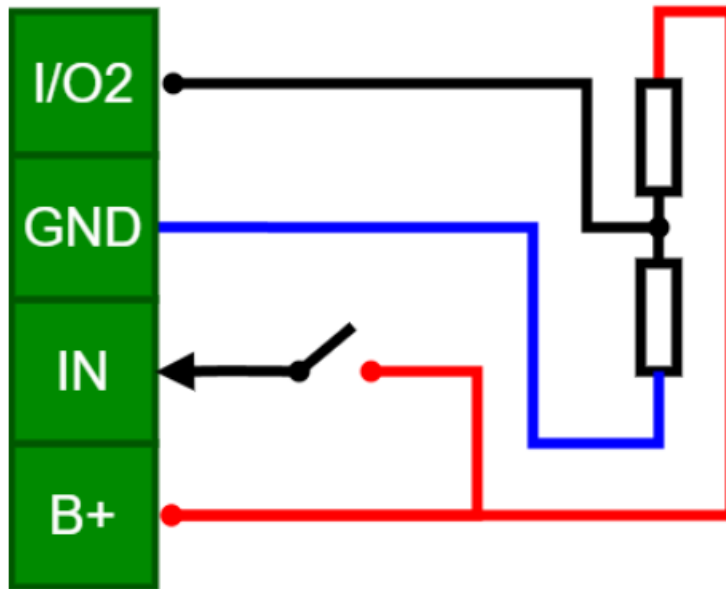
5.4 Switch input

When set to a switch input mode, the sensor will apply digital logic to the input(s), with 0 used for the normal switch state and 1 for the active switch state. The switch state will be read by the sensor applying a voltage to IN and (when applicable) I/O2 using a 50k Ω pull-up resistor. The inputs are debounced using the standard external trigger timout, except for the Level Switch mode (see. 7.4.3)

5.4.1 Switch input (Normally Open)

Connect the switch leads to IN and GND.
If the sensor has I/O2 two switches may be used, connect the second switch leads to I/O2 and GND.
The sensor will send triggered messages when the switch closes as well as periodically, containing the current state of the switches.
The reported values are 1 for closed and 0 for open.
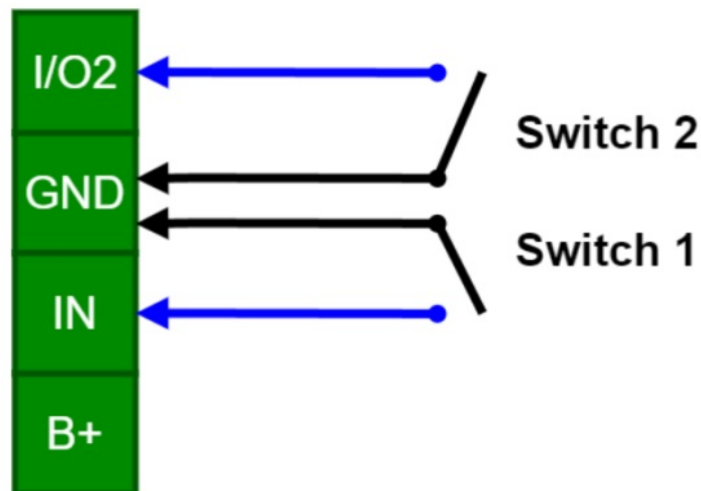
5.4.2 Switch input (Normally Open), Dual Edge Trigger

Connect the switch leads to IN and GND.
If the sensor has I/O2 two switches may be used, connect the second switch leads to I/O2 and GND.
The sensor will send triggered messages when the switch opens or closes as well as periodically, containing the current state of the switches.
The reported values are 1 for closed and 0 for open.
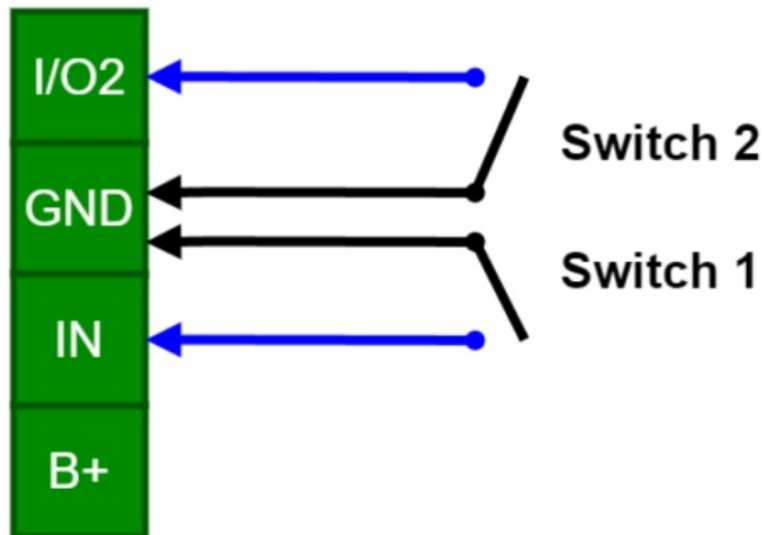
### 5.4.3 Switch input (Normally Closed)2

When set to switch NC the sensor will wake up every 10 seconds and apply voltage to the IN and (if applicable) I/O2 ports with pull-up resistors to test if the circuit is closed. An uplink will be sent if the switch opens or closes as well as periodically, containing the current state of the switches. If the sensor has I/O2 two switches may be used, connect the second switch leads to I/O2 and GND. The reported values are 0 for closed and 1 for open.
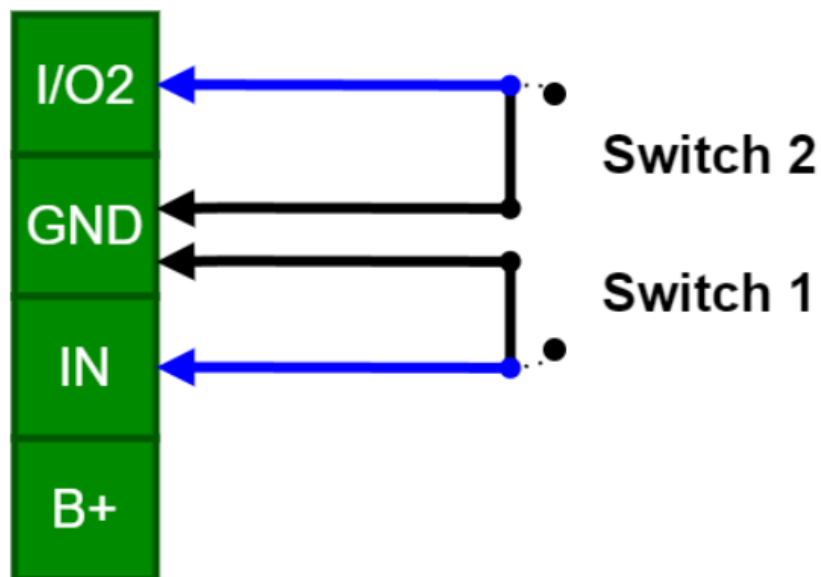
5.4.4 Switch input (Normally Open), Level

Connect the switch leads to IN and GND.

If the sensor has I/O2, two switches may be used in parallel. Connect the second switch leads to I/O2 and GND.

The Switch Input Level mode uses a different debounce logic. The debounce timer will be reset on every edge of the switch input(s) and the input(s) will be read once the timer runs out. Triggered messages will be reported on both edges, and the input(s) will be reported periodically. The reported values are 1 for closed and 0 for open.
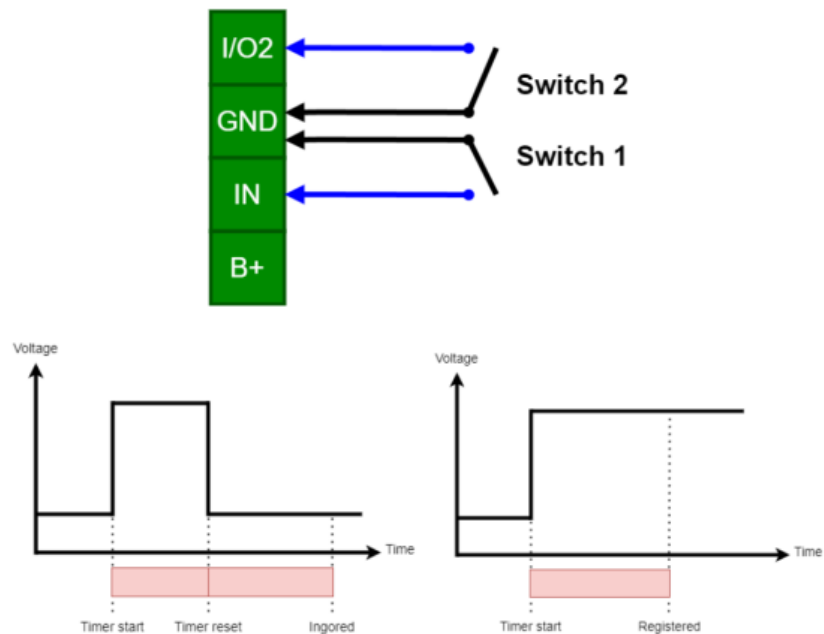
2 Firmware 2.4.6 or later required

5.4.5 Switch input, Door
Connect the switch leads to IN and GND, if applicable connect a second switch to I/O2 and GND.
When set to Switch Input Door, the sensor will send a triggered message containing the current state of the switch when the switch is opened or closed, then wait for a user-selectable amount time, then send a message containing the number of openings/closings that has occurred during the wait. In this mode, the "External Startup Time" parameter sets the wait time in milliseconds. Debounce may be used and is set using the "External Trigger Timeout" parameter. The reported values will be 1 for closed and 0 for open.
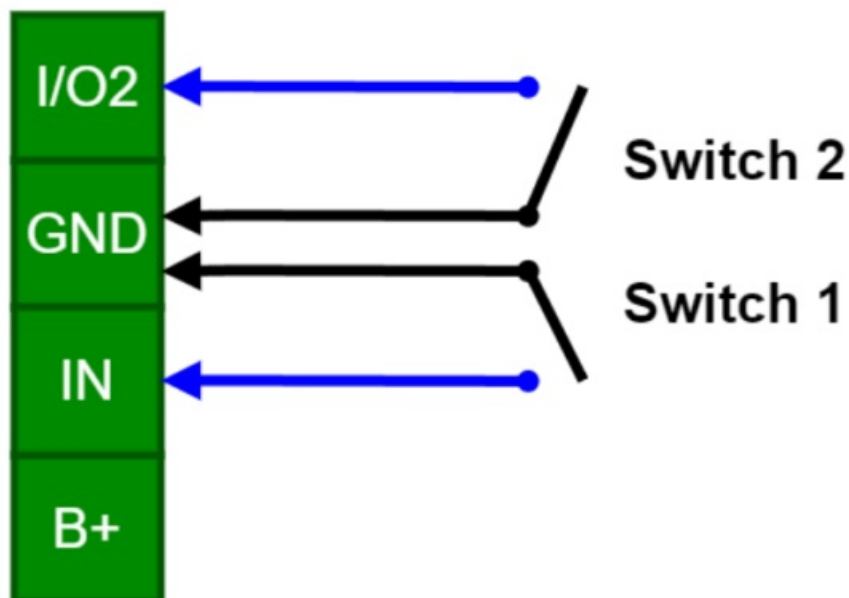
5.5 Temperature Probe DS18B20
The ELT is compatible with DS18B20 1-wire temperature probes. When connected to the ELT the probes will be set to 12-bit-mode. Six DS18B20 can be connected to the same ELT at once (ELT lite supports one DS18B20). If one DS18B20 temperature is connected the temperature will be reported as "External Temperature 1". If multiple DS18B20 are connected, one of the probes will be reported as External Temperature 1" and the rest as one or multiple External Temperature 2. The sequence of the External Temperature 2 will always be the same, so our recommended method of deciding which DS18B20 is reported as which External Temperature is to connect all probes that are to be connected and then dip the probe in a glass of hot or cold water while observing which reported temperature changes. Connect the black lead(s) to GND, the yellow lead(s) to IN and red lead(s) to B+.
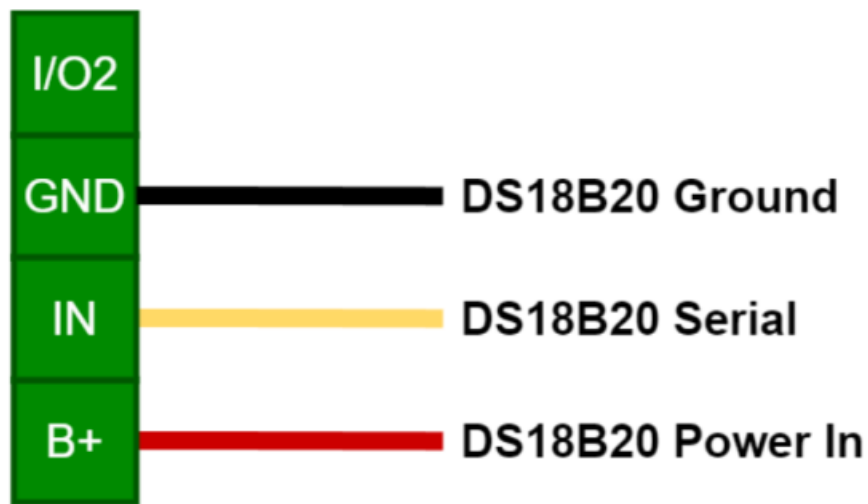
## 5.6 Temperature Probe Digital DS18B20 + Switch Normally Open

The digital temperature probe (§4.5) can be combined with switch normally open (§4.3.3) in parallel.
Connect the DS18B20 according to §8.4, the switch negative lead to GND and positive lead to I/O2.
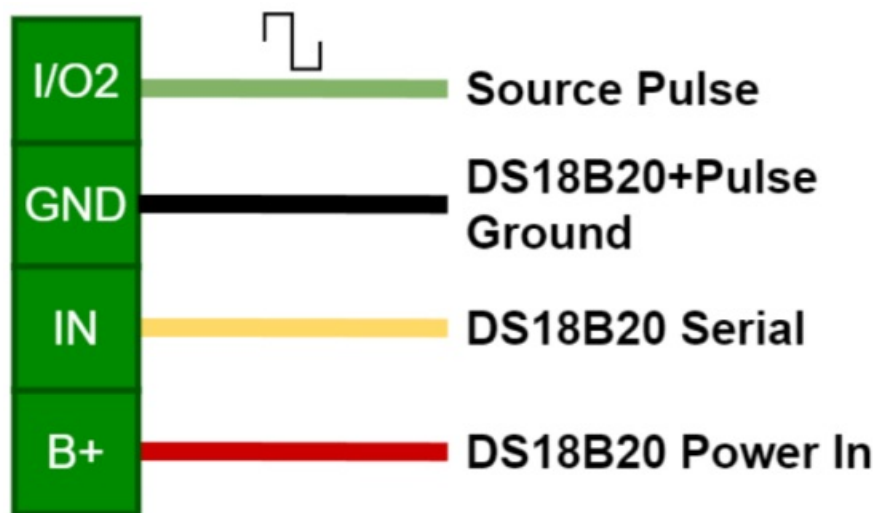
5.7 Sensirion SHT3x – External Temperature and Humidity Sensor[3]

The Sensirion SHT3x series are high accuracy temperature and relative humidity sensor. The external SHT probe is sampled using single shot high repeatability measurements.

The temperature of the SHT85 will be reported as External Temperature 1 and the humidity will be reported as Pulse 1.
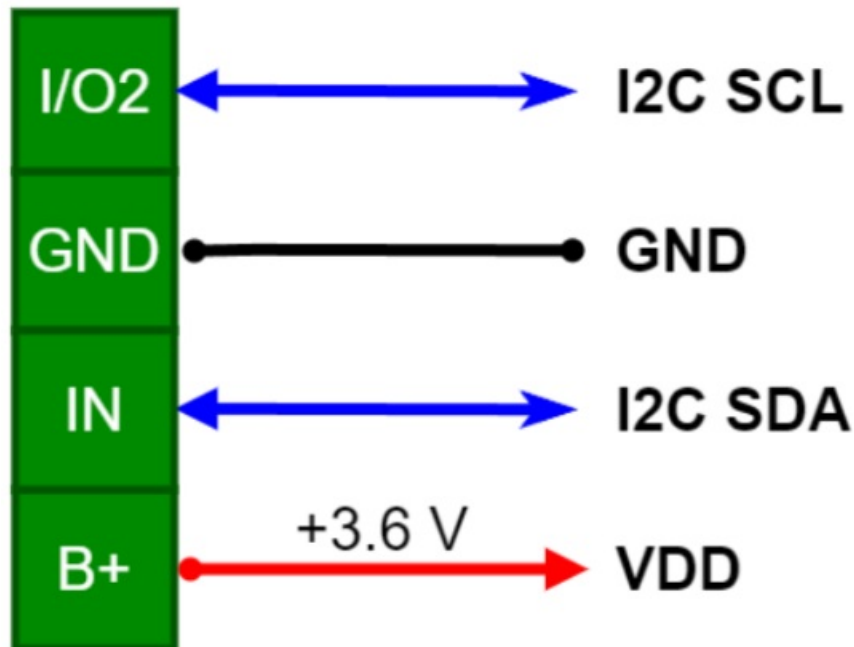
5.8 Water leak

The water leak mode measures conductivity between two wires which can be used to detect water and moisture. The reported values are 0-255 where higher values means higher conductivity.

Note that longer water leak cables have a higher base conductivity, this needs to be measured after the cables have been installed and an appropriate alarm level will need to be set in the backend system.

Connect the unshielded wires to IN and I/O2, make sure they aren't touching each other as that will result in the sensor always measuring maximum conductance.
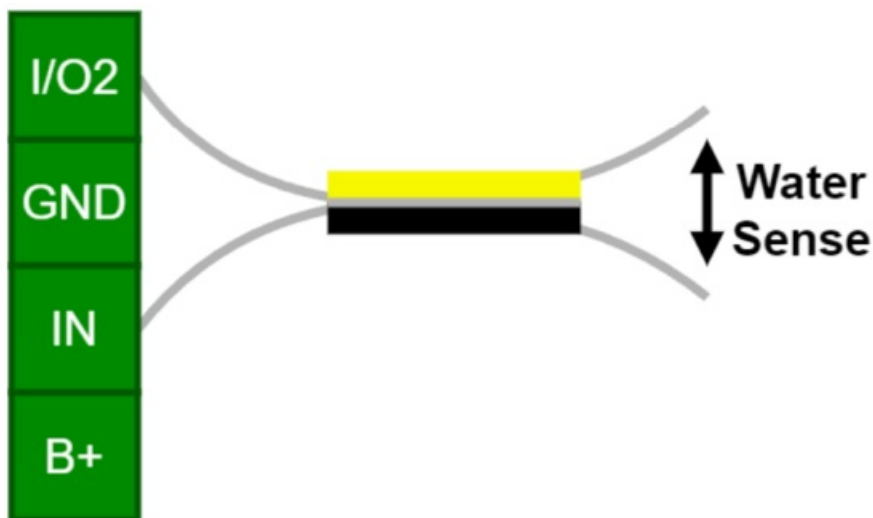
Note: The above picture is for illustrative purposes only. The water sense leads do not need to extend the black and yellow wires.

5.8 Sender Unit (0-180 Ohm)

Connect the sender unit leads to GND and I/O2. The ELT will internally pull up an 180 ohm resistor and measure the voltage divided by the internal pull-up and the external sender resistance using the ADC. The reported value will be the ADC read in mV (VADC). To get the resistance of the sender (R), use the following formula:
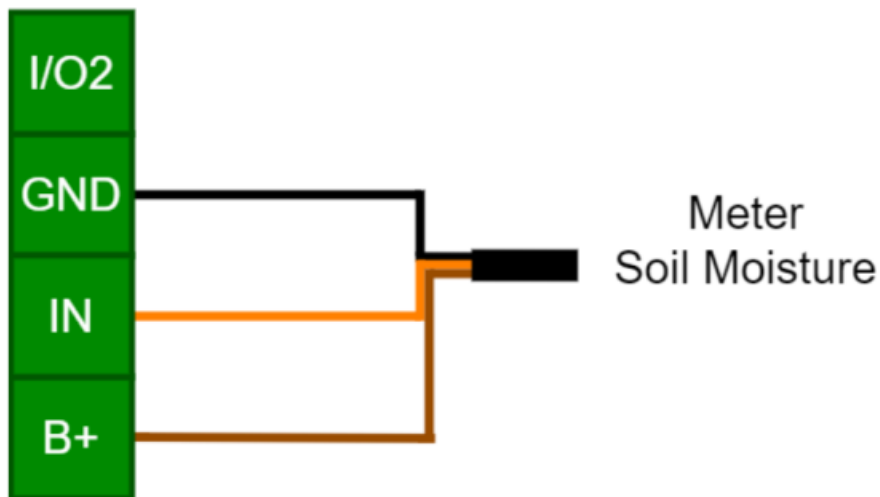
$$R = \frac{V_{ADC} * 180}{(V_{DD} - V_{ADc})}$$
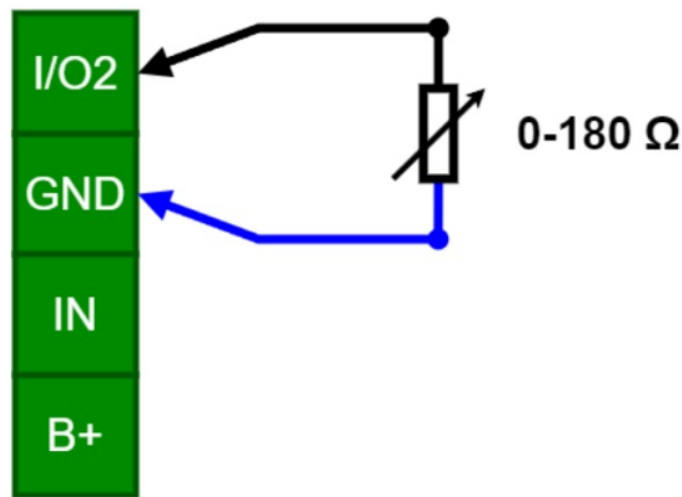
5.9 Soil Moisture Meter Teros12
Connect the black lead to GND, orange lead to IN and brown lead to B+.
In the application "Sensor settings", please follow these instructions:
For Teros 10, ECH2O 10HS, and ECH2O EC-5 – select "Meter Soil sensor (analog)". For Teros 11, Teros 12, and ECH2O 5TE – select "Meter Soil sensor (digital)".

5.10 Soil Moisture MuRata SLT5006[4]
The SLT5006 is a digital soil moisture sensor that measures electrical conductivity, moisture water content and temperature.
Connect yellow lead to I/O2, black lead to GND, blue lead to IN, and red and white leads to B+, leave green and orange leads disconnected.
Values are reported as
Volumetric water content: Pulse 1
Electrical conductivity (pore): Pulse 2
Electrical conductivity (bulk): Pulse 2 abs
To get actual electrical conductivity, multiply the reported value by 0.001
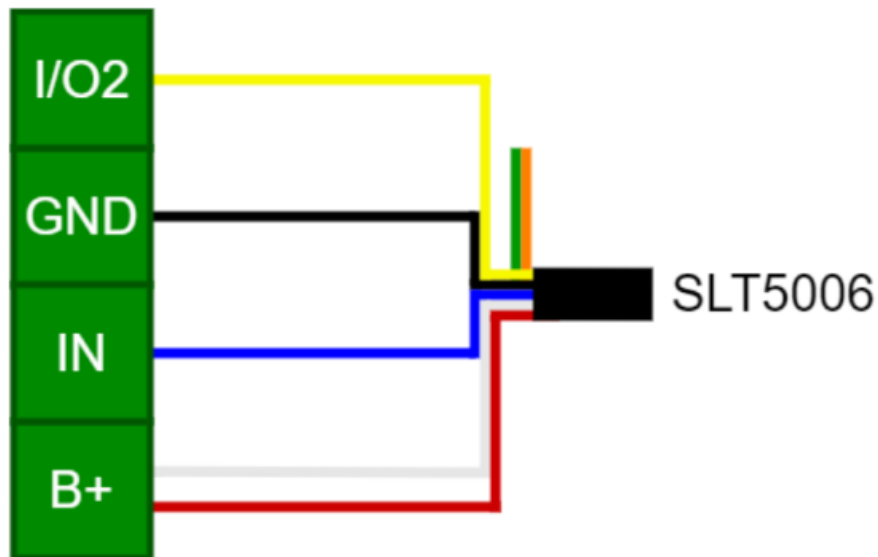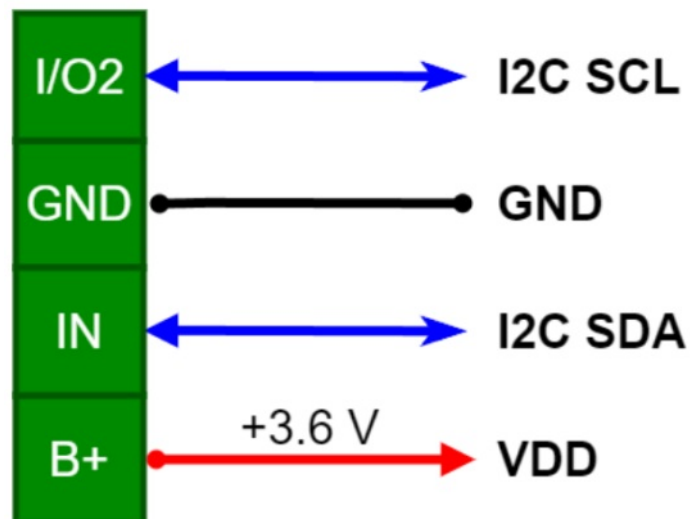
5.12 Meas M32Jx and M300Jx Digital Pressure sensors[5]

The Meas M32Jx and M300Jx are digital pressure sensors that connects to the ELT via I2C.

The ELT will automatically detect the I2C address of the connected device.

External temperature is reported as External Temperature 1 and pressure as Pulse 1. The pressure is reported as digital counts, consult the manual of your Meas I2C pressure sensor for counts to pressure conversion.
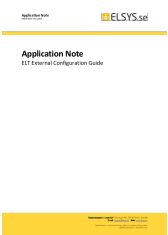

Document version history

Version	Comment
1.0	First version

Documents / Resources

ELSYS se ELT Series Multi Sensor [pdf] Instruction Manual
ELT Lite, ELT 2i, ELT 2, ELT Series Multi Sensor, ELT Series, Multi Sensor, Sensor

References

- **User Manual**