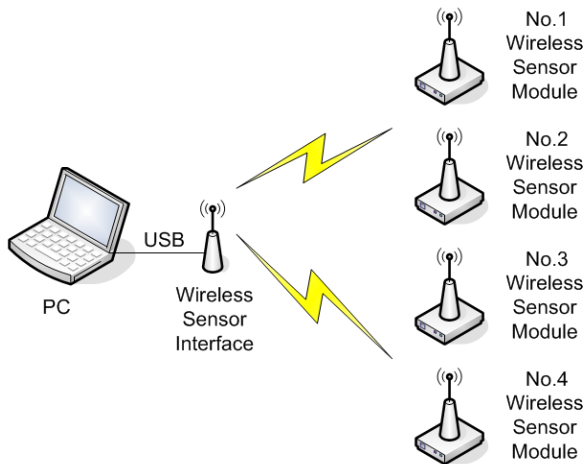


Introduction

The wireless sensor system consists of PC software, a PC interface and 1-4 wireless sensor modules.



To each wireless sensor module 3 analog signals can be connected. Also each board has 2 relay outputs and an onboard LM35 temperature sensor. The inputs are measured at a 1 Hz sample rate and the data is radio transmitted to the PC software. The software will show the live data in graphs and numbers.

All measurements can be traced to files. In this mode the system works like a datalogger and can store measurement data over long periods of time (days, weeks). A total of 4 x 3 analog signals can be logged this way.

Using the onboard relays and programmable logic rules (both relays can be switched on/off automatically based on the measured values of the input channels), simple "smart" controllers can be made.

Specifications

Wireless Sensor Interface

- Powered from USB
- 433 MHz frequency band
- Tx & Rx status LEDs
- FTDI USB interface chip & drivers
- USB Type B connector

Wireless Sensor Module (Type 2)

- 3x 10 bits analog inputs, 5 V range.
- 1x temperature sensor, -25 degC to +100 degC range.
- 2x digital relay outputs.
- 433 MHz frequency band.
- Selectable module ID.
- 7.5 V - 10 V supply voltage.
- 1 Hz input sample rate.
- Up to 4 modules can be used together.

PC Software

- Windows based. Supported versions: 2000, XP, Vista, Window 7
- Royalty free FTDI drivers <http://www.ftdichip.com/Drivers/D2XX.htm>

Wireless Sensor Interface (WSI)

The WSI is the PC interface for the wireless system.

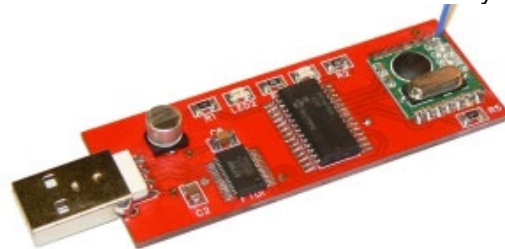


Figure 1, Wireless Sensor PC Interface

1.1 FTDI drivers

Download the correct FTDI drivers for your operating system from the FTDI site and install them. Do not connect the wireless sensor interface before you have installed the correct drivers.

1.2 Connect the PC interface

The PC interface has a "type A" USB connector. Connect the wireless sensor interface to a free USB port on the host computer. The PC will detect the new device and install the correct FTDI drivers. It is advised not to use an USB Hub.

Wireless Sensor Module (WSM)

Figure below shows the wireless sensor module.

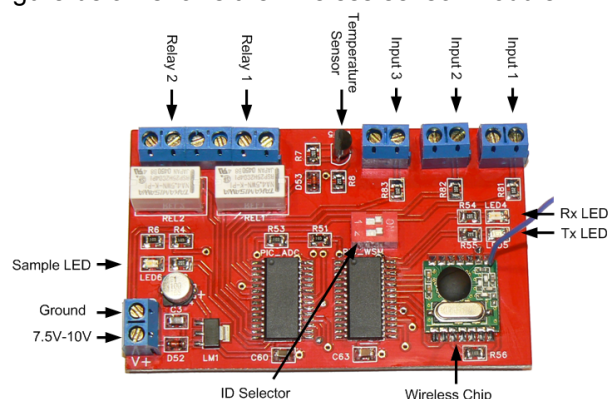


Figure 2, Wireless Sensor Module (Type 2)

2.1 Module ID

Use the DIP switches to set the module ID. Values 0, 1, 2 & 3 can be selected. Each module should have a unique ID in configurations where multiple modules are used. The ID is only read at power on of the module. Make sure to also restart the PC software after changing a module ID.

2.2 Power supply

Use a DC power supply or a battery to power the module. 7.5 V – 10 V supply voltage is allowed. Typical power consumption is 50mA - 75mA. Below 7.5 V the module will not operate correctly.

Do NOT connect 12V to the sensor module.

2.3 Antenna

The antenna should be a straight piece of wire of approx. 165 mm +/- 5 mm. For optimal performance keep the antenna straight and at a 90 degree angle to the module board.

2.4 Transmission range

Open field range (transmitter and receiver can “see” each other directly without any obstacles between them) is > 300 m. Actual values might even be better depending on outdoor conditions.

Indoor range in general is enough to have the modules around the house with good reception at any location. However, actual values depend on wall and floor types (wood versus concrete) and other sources of interference. Change orientation and/or location of a module when the data link is not stable.

2.5 Frequency band

The radio frequency used is 433 MHz. This frequency band can be used freely in almost all countries around the world, but check local regulations when in doubt.

2.6 Data recovery & bad samples

The used transmission protocol makes it possible to recover from a missed data packet. A single bad packet will be “repaired” by the next packets and therefore not lead to data loss in the trace file. However, multiple bad samples in a row, will lead to unreparable data loss.

Install & configure software

3.1 Install the windows software

Download the latest version of the wireless sensor software from http://www.usbscope.eu/wss_index.html, unzip and run setup.exe. This will install the software to the PC.

3.2 Detect modules

Start the WSS software using the desktop icon. Use the “scan” button to detect the wireless module(s).



Wireless Sensor System			
Wireless Sensor Interface	Connected		
Wireless Sensor Module	0x22C621		
Battery Voltage	13.71	Volt	
Temperature_C	20.02	°C	
Temperature_F	68.04	°F	
Analog Input 1	1.089	Volt	
Analog Input 2	1.172	Volt	
Analog Input 3	2.212	Volt	
Relay Output 1	0	On/Off	
Relay Output 2	0	On/Off	

Figure 3, Wireless Sensor Module

Of each detected module following is shown:

- Module identifier : 0x22C621
 - Module type : 2
 - Firmware version : 2
 - Serial number : C621
- Battery voltage (name, value, unit)
- Temperature (Celcius & Fahrenheit)
- Analog inputs (names, values, units)
- Relay outputs(names, values, units)

3.3 Modify settings

Select the module of which the settings should be displayed, and press the “configuration button”.



Trace	In/Output	Name	Gain	Offset	Unit	Digits
<input checked="" type="checkbox"/>	Battery Voltage	Battery Voltage	3.00	0.00	Volt	2
<input checked="" type="checkbox"/>	Temperature_C	Temperature_C	100.00	0.00	°C	2
<input type="checkbox"/>	Temperature_F	Temperature_F	180.00	32.00	°F	2
<input type="checkbox"/>	Analog Input 1	Analog Input 1	1.00	0.00	Volt	3
<input type="checkbox"/>	Analog Input 2	Analog Input 2	1.00	0.00	Volt	3
<input type="checkbox"/>	Analog Input 3	Analog Input 3	1.00	0.00	Volt	3
<input type="checkbox"/>	Relay Output 1	Relay Output 1	1.00	0.00	On/Off	0
<input type="checkbox"/>	Relay Output 2	Relay Output 2	1.00	0.00	On/Off	0

Figure 4, Settings for IO

Settings are stored on the Windows computer and will be reloaded each time this module is detected.

3.4 Tracing to file

Select the option “Trace all signals to file” to use the module as data logger. ALL signals of the selected module will be logged into the data file every second. The file name is auto generated by the software and contains the module ID + date + time at which the logging was started.



File format = ASCII text. Data can be imported in to e.g. Excel or Matlab easily. An example of a data file can be downloaded from the website.

3.5 Scaling

The analog to digital converters have a range of 0V – 5V. To display the real measured values in the software, the correct gain & offset have to be set. Calculation of the gains & offsets is simple: calculate what the measured range is when the output to the

ADC equals 5V. Then divide this value by 5V to get the gain.

For the LM35 temperature sensor (10 mV/°C) the gain is 100. Offset = 0.

3.6 Relay outputs

Press the “digital output” button to set the digital outputs. Each module has 2 relay outputs with NO & NC connection.

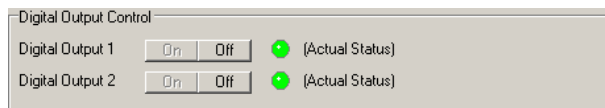


Figure 5, Digital output control with feedback

The 2 relay outputs of each module can be switch on / off either manually of based on **logic rules**.

These rules are programmed into the modules and updated at a 1 Hz update rate. If the Windows software is stopped, the rules will **continue** to run in the sensor modules.

Examples:

- In figure below Output 1 will switch on when the Temperature_C comes above 25 DegC.
- In figure below Output 2 will switch on when the Analog Input#1 comes above 3.55 Volt.

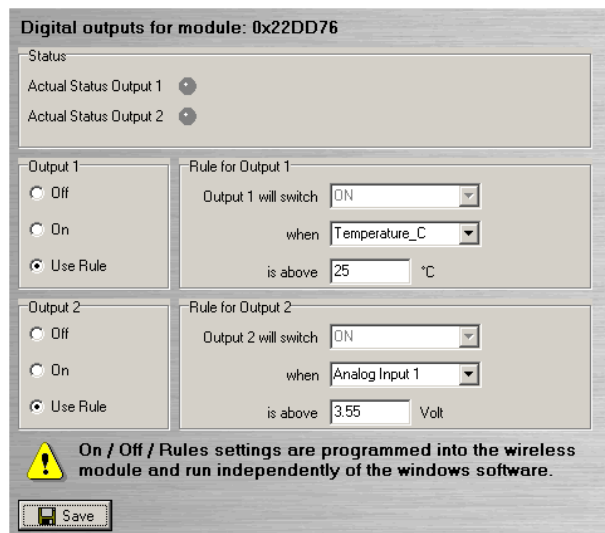


Figure 6, Logic rules to control two relays

The rules are stored in the EEPROM of the sensor module and reloaded after power-up of the module.

3.7 Trace window

To trace signals, open the “settings’ panel, and select the IO that should be traced. A maximum of 6 signals can be traced simultaneously.

Trace	In/Output	Name	Gain	Offset	Unit	Digits
<input checked="" type="checkbox"/>	Battery Voltage	Battery Voltage	3.00	0.00	Volt	2
<input checked="" type="checkbox"/>	Temperature_C	Temperature_C	100.00	0.00	°C	2
<input type="checkbox"/>	Temperature_F	Temperature_F	180.00	32.00	°F	2
<input type="checkbox"/>	Analog Input 1	Analog Input 1	1.00	0.00	Volt	3
<input type="checkbox"/>	Analog Input 2	Analog Input 2	1.00	0.00	Volt	3
<input type="checkbox"/>	Analog Input 3	Analog Input 3	1.00	0.00	Volt	3
<input type="checkbox"/>	Relay Output 1	Relay Output 1	1.00	0.00	On/Off	0
<input type="checkbox"/>	Relay Output 2	Relay Output 2	1.00	0.00	On/Off	0

Figure 7, Select signals to trace

Press the “trace” button to open the trace window. The traces are update with 1 Hz.



Measure various signals

4.1 Analog inputs

The analog inputs have a range of 0 V – 5 V. Applying a higher voltage to one of the inputs can permanently damage the input and/or the complete wireless sensor module. In case of noisy signals, an RC filter (10 kOhm & 10 uF) should be added to improve measurement accuracy.

4.2 Adjusted analog input range

Figure below shows how to adjust the analog input range to 0 V – 15 V. It is advised not to exceed the 15 V. The gain in the software then is “3”.

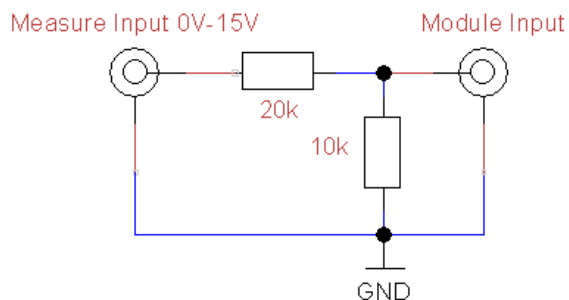


Figure 8, adjusted analog input range

4.4 Connecting LM35 temperature sensors

The LM35 temperature sensors (10 mV/°C) can be directly connected to the ADC inputs as shown in figure below. The filter (10 k & 1 uF) is used to reduce the measurement noise. In the software set:

- Gain = 100 & Offset = 0

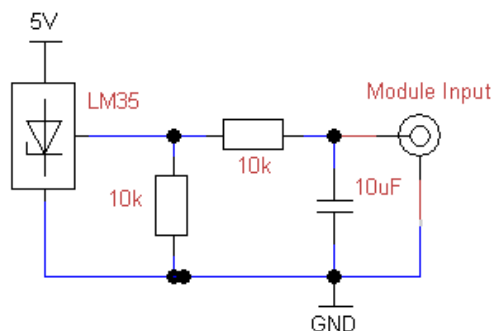


Figure 9, LM35 connection diagram

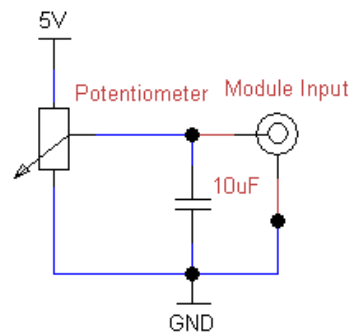


Figure 12, potentiometer connection

2) To be able to measure negative temperatures (below freezing), the LM35 output can be shifted with circuit diagram shown below.

- Gain = 100 & Offset = -250

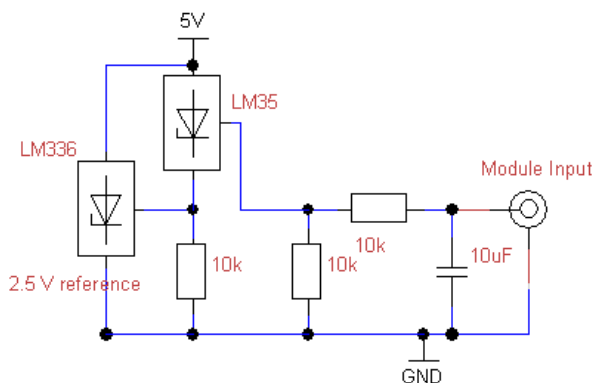


Figure 10, LM35 with offset

5. Connecting and LDR to measure light

Figure below shows how to connect an LDR (light dependent resistor) to measure light intensity or to measure if a light is on/off.

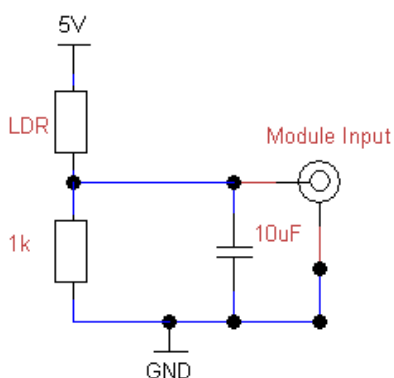


Figure 11, LDR connection diagram

7. Measure wind direction / position sensor

With a 360 degree potentiometer a simple wind vane or generic position sensor can be made.

Frequently Asked Questions

Below there is a list of frequently asked questions and their answers.

Question: Is it possible to use more than 4 modules? For example with 2 PC interface boards?

Answer: No, that is not possible. Only 4 frequencies are available for this system, limiting the number of wireless sensor modules to 4.

Question: Is there a Linux version of the software?

Answer: No there is not. I am not a experienced Linux programmer. If you are, let me know.

Question: Can the wireless modules sample and store data when the PC software is not running? Like a real data logger?

Answer: No, samples which are not transmitted to the PC immediately are lost.

Question: Will the logic rules to control the 2 relay outputs run without the Windows software?

Answer: Yes, this is a new feature for **Type 2** boards.

Question: Does the software still run with Type 1 boards?

Answer: Yes, the Windows software supports both versions, Type 1 & Type 2.