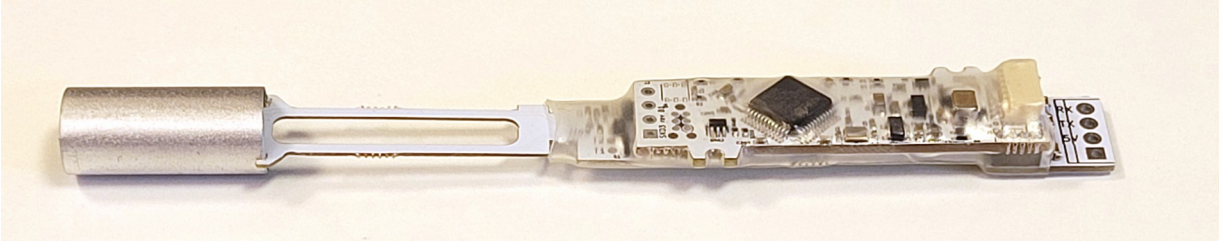
SKS21 Datasheet

Fast-response temperature and humidity sensor



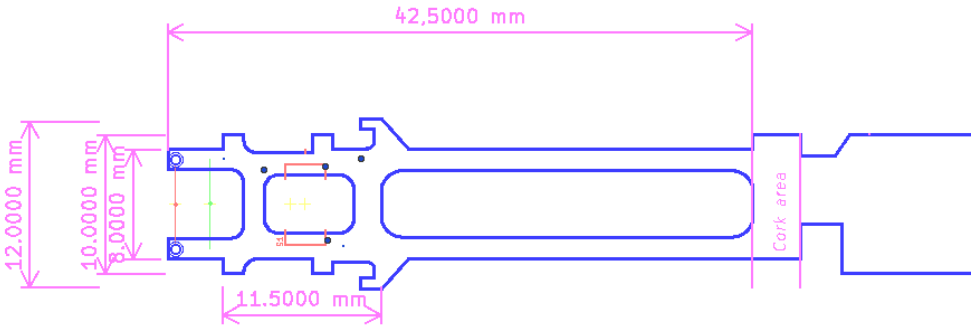
SKS21 is a temperature and relative humidity sensor module with very fast response time, designed for UAVs and miniature radiosondes. Special care has been taken to minimize the self-heating even in low air pressure.

Parameter	**Specification**
Sampling frequency	Configurable in range 1 - 50 Hz. Recommended 5 or 10 Hz.
Power	**Heating of the humidity element** **No heating**: 4.3 – 15 V DC, Average: 8 mA at 10 Hz sampling **With heating**: 4.5 – 7 V DC, Peak: 140 mA
Communication	Sparvio SSP (I2C) and a choice of UART, RS232 or USB
Mechanical attachment	Two hooks on the PCB for 2 mm diameter screws.
Size	110 x 16 x 6 mm
Weight	4 gram

Property	**Temperature**	**Relative Humidity**
Measurement Principle	Miniature thermistor	Capacitive polymer element
Measurement Range	-60 ~ +60 °C (*Preliminary; depends on the calibration*)	0 – 100 %RH, non-condensing conditions
Absolute accuracy	*TBD; the target is initial ±0.1 C* *Long-term drift: TBD*	*TBD; the target is initial ±2 %RH* *Long-term drift: TBD*
Resolution	Reported: 0.001 °C Noise-free: ca 0.002 °C 23 bit raw data is available	Reported: 0.01 %RH Actual with 1 Hz sampling: ca 0.01 %RH Actual with 10 Hz sampling: ca 0.1 %RH 16 bit raw data is available
Response Time T_{63}	Estimated to 0.32 sec	< 0.5 sec at 23 °C The response time is longer for lower temperatures.

Mechanical parts

SKS21 is composed of one digital PCB (”SKD3”) and one analog PCB (”H4”) with soldered sensor elements. The two PCBs can be detached if needed for calibration or replacement. The analog PCB is user-replacable as it stores the calibration itself. There are two thermistors and one humidity sensor element. The fragile sensor elements are protected by a small tube that can also act as solar radiation shield.



Communication

Multiple communication options are available for soldering to a 4-pin connector. An option can be specified when ordering.

UART

1.27mm pitch or 2.54mm pitch. Pinout: GND, 5V power, RX, TX. RX handles 3-5 V signal levels. TX uses 3.3V signal level. 115200 bps, no flow control, 8 bit data, no parity, 1 stop bits.

RS232

2.54mm pitch. Pinout: GND, 5V power, TX, RX. 115200 bps, no flow control, 8 bit data, no parity, 1 stop bits.

USB

Micro-USB, CDC profile. Powers SKS21 from the USB bus.

In parallel with the above, the white 6-pin “SSP” connector is available. This is an I2C interface that connects to the Sparvio SA1 USB adapter for firmware upgrading, settings and real-time data streaming to PC.

Data format

See the “sks21.py” Python file.

Settings

The firmware provides a large set of calibration values, settings and profiling data for the two thermistors, the humidity sensor, the heating element for the humidity sensor and the analog electronics.

Software
Windows software for calibration, settings and real-time data will be released in the future.

Heated humidity element
The humidity sensor element has an internal metal strip that can be used to heat the element itself and to measure the temperature of the element. SKS21 can be programmed for different heating policies with up to 100 mW. *(Not supported yet.)*

LED signals
On power-up, the LED cycles through red – green – blue.
Under normal operation, the LED will not blink. In case of hardware errors that prevents either T or RH from being measured, the LED will blink red for every attempted measurement. For example, this can be a broken sensor element.

In bootloader mode (used for firmware upgrade), the LED is purple.

Future features
The following features are supported by the hardware but not yet officially supported:

- An OLED screen showing sensor readings or status.
- The humidity sensor element has a built-in heater which can be used to reduce the RH response time in low temperatures and to avoid condensation (such as when exiting clouds).
- The twin temperature sensors could be used to reduce the temperature bias due to solar radiation.
- On-board temperature measurements could correct for temperature differences between the sensing elements and the electronics. An additional T/RH sensor measuring the PCB itself can be mounted.

Warnings
Certain chemicals can have a lasting impact on the humidity sensor accuracy. Since foams and plastics used in packaging material can release such chemicals in gas form, it's important to only store the sensor in safe packaging such as the original packaging. Also be careful when using glue, paint or tape nearby.

Prolonged exposure to humidity levels above ~70 %RH gives a positive RH bias for some time.
In one test storing a sensor in 85 %RH gave a bias of +5 %RH. After moving it to a 33 %RH chamber, the bias subsided over 24h.

Sparvio background
The Sparvio system provides a modular, plug-and-play solution for measuring various quantities for UAVs, other environmental studies, lab experiments and education. The system is designed to start immediate measurements without any further integration.

SKS21 is designed and manufactured in Sweden by Sparv Embedded AB.