

SHTxx
Humidity & Temperature
Sensmitter

Application Note

Compensation of RH non-Linearity

1 Introduction

The SHTxx devices show a small non-linearity of the humidity sensor.
This application note describes various ways to compensate it in the attached microcontroller.

2 Revision History

October 20, 2001	C2	URO	Revision 0.9 (Preliminary)
February 10, 2002	C2	URO	Revision 1.0 modified to final coefficients

3 Implementation

If the formula on page 2 of the SHT1x datasheet is to complex and therefore too computation intense, the follow calculations may provide simplified alternatives.

The examples are based on a 8 bit humidity readout. 12 bit readouts can be converted with similar formulas but with a slightly more complex calculation.

Type of calculation	Inaccuracy due to non-linearity (10-90%RH)	Complexity of calculation
linear	$\pm 2.2\%$ RH	Simple (8bit subtract, right shift)
2 * linear	$\pm 0.8\%$ RH	Quite simple (8bit multi, 16bit add/subtract)
Polynomial 2 nd order	$\pm 0.1\%$ RH	Floating point multiplications

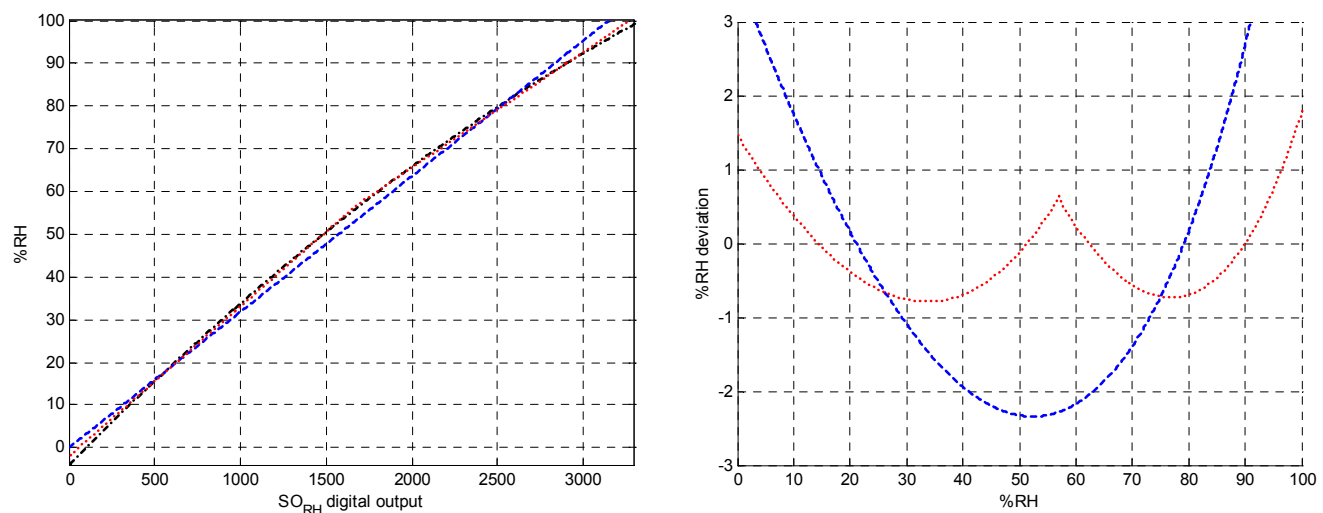


Figure 1 Inaccuracy due to non-linearity, original(from datasheet, black, dash-dotted), linear (blue, dashed) , 2* linear (red, dotted)

3.1 Linear

The most basic conversion formula from sensor output to %RH is:

$$RH_{\text{simple}} = c_1 + c_2 \cdot SO_{\text{RH}}$$

with $c_1 = 0.5$; $c_2 = 0.5$

3.2 2* linear

For improved accuracy with minimal calculation complexity the following calculation is recommended:

$$RH_{\text{real}} = (a \cdot SO + b) / 256$$

Where SO denotes the 8 bit humidity sensor output signal.

Validity	a	b
$0 \leq SO \leq 107$	143	-512
$108 \leq SO \leq 255$	111	2893

With the above values the calculation can be done with a single 8 bit multiplication followed by a 16bit addition / subtraction.

Sample Code:

```

u16 result;           // 16Bit unsigned for the result
u08 sensor_out;      // 8Bit unsigned for the sensoroutput

sensor_out = readSensor8(); // read 8 bit humidity value from SHTxx

If ( sensor_out <= 107 )
{
    result = mult8Bit( 143, sensor_out ); // result = a * sensor_out
    result < 512 ? result = 512;         // check for underflow
    result = result - 512                 // result = result + b
}
else
{
    result = mult8Bit( 111, sensor_out ); // result = a * sensor_out
    result = result + 2893                // result = result + b
    result > 25600 ? result = 25600;     // check for overflow (optional)
}

//8 MSB's are 0-100%RH integers, 8 LSB's are remainder
result = result >> 8 // result = result / 256

```

3.3 Polynomial 2nd order

Please consult the Datasheet for formula and coefficients.

Headquarters and Sales Office

SENSIRION AG Phone: + 41 (0)1 306 40 00
 Eggbühlstr. 14 Fax: + 41 (0)1 306 40 30
 P.O. Box e-mail: info@sensirion.com
 CH-8052 Zürich <http://www.sensirion.com/>
 Switzerland