SENSIRION
THE SENSOR COMPANY

SHTxx
Humidity & Temperature
Sensmitter

Application Note
Dew-point Calculation

1 Introduction

The dew-point temperature can easily be calculated from the relative humidity and temperature.

2 Theory

Definition of dew point:
The dew-point temperature is the temperature to which the air must be cooled to reach saturation (assuming air pressure remains the same). When the temperature cools to the dew point, fog or dew can occur, and the relative humidity becomes 100%.

Calculation of the dew point:
The Magnus formula [Sonntag90] relates the saturation vapour pressure and dew point. At a temperature T (in °C), the saturation vapour pressure EW (in hPa) over liquid water, is

$$EW = \alpha \cdot e^{\left(\frac{\beta \cdot T}{\lambda + T}\right)} \qquad (1)$$

For the range from –45°C to 60°C, Magnus parameters are given by α=6.112 hPa, β=17.62 and λ=243.12 °C. By re-stating equation (1), the dew-point temperature Dp (in °C) can be expressed from vapour pressure E

$$Dp = \frac{\lambda \cdot \ln\left(\frac{E}{\alpha}\right)}{\beta - \ln\left(\frac{E}{\alpha}\right)} \qquad (2)$$

Inserting the definition of relative humidity RH (in %), i.e. E=RH$*EW/100$, into equation (2) and using equation (1) leads to the calculation of the dew point Dp from temperature T and relative humidity RH

$$Dp(T, RH) = \frac{\lambda \cdot \left(\ln\left(\frac{RH}{100}\right) + \frac{\beta \cdot T}{\lambda + T}\right)}{\beta - \left(\ln\left(\frac{RH}{100}\right) + \frac{\beta \cdot T}{\lambda + T}\right)} \qquad (3)$$

The following simple program calculates the dew point Dp from the relative humidity RH and temperature T according to equation (3). All temperatures are in Celsius.

```
H     = (log10(RH)-2)/0.4343 + (17.62*T)/(243.12+T);
Dp    = 243.12*H/(17.62-H);        // this is the dew point in Celsius
```

Example: RH=10%, T=25°C -> Dew point = -8.77°C
RH=90%, T=50°C -> Dew point = 47.90°C

This formula is a commonly used approximation. See Figure 1 for the deviation to the more precise formula described in [Hardy98].

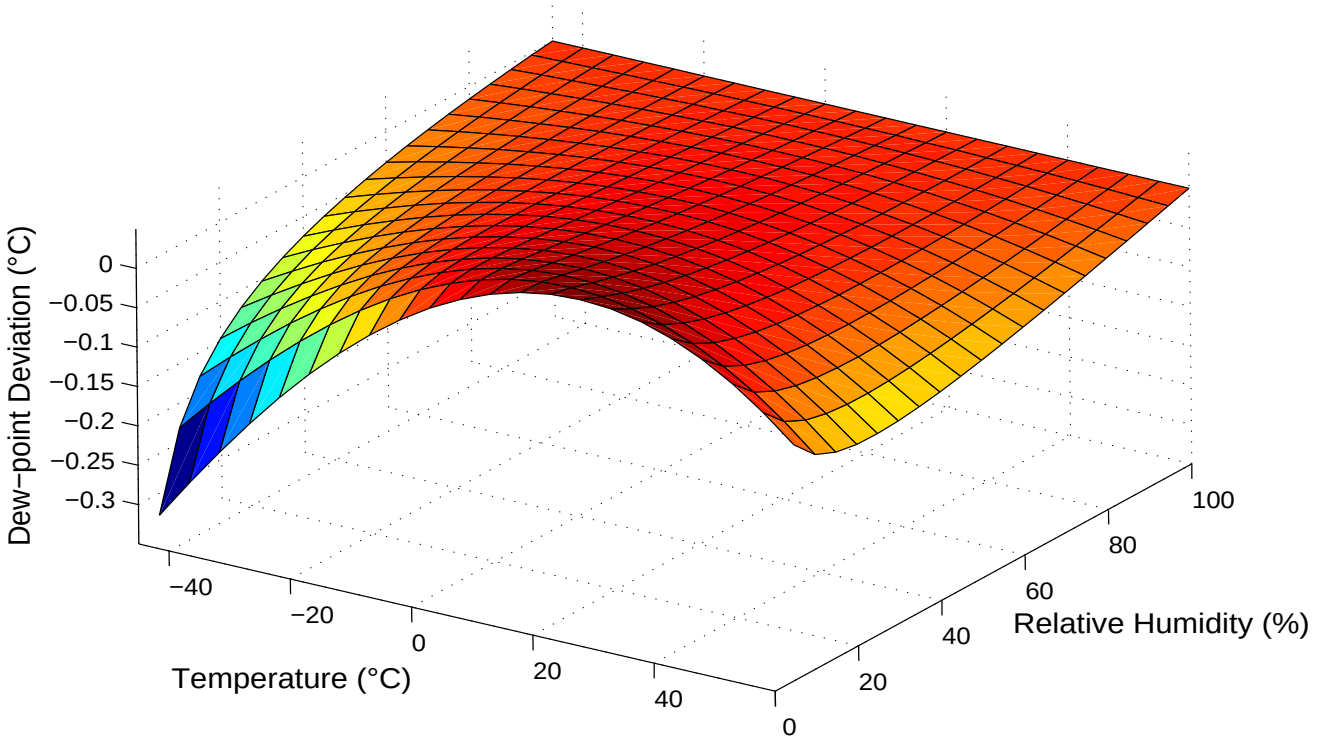

Figure 1: Deviation of simple Magnus formula compared to more complex and precise formula in [Hardy98]

3 References

[Sonntag90] Sonntag D.: Important New Values of the Physical Constants of 1986, Vapour Pressure Formulations based on the IST-90 and Psychrometer Formulae; *Z. Meteorol.*, 70 (5), pp. 340-344, 1990.

[Hardy98] Hardy B., Thunder Scientific Corporation, Albuquerque, NM, USA
The proceedings of the Third international Symposium on Humidity & Moisture, Teddington, London, England, April 1998.

4 Revision History

Date	Revision	Changes
Nov. 18, 2001	0.9 (Preliminary)	Initial revision
Oct. 17, 2003	1.0 (Preliminary)	Changed download link
Jan. 25, 2005	1.01	Corrected brackets in LogEW formula
May 25, 2005	1.02	Changed company address
January 4, 2005	1.1	Update of Magnus coefficients according to [Sonntag90]
Oct 3, 2006	1.2	Sensirion Inc. address added

The latest version of this document and all application notes can be found at:
www.sensirion.com/humidity

Headquarters and Sales Office

SENSIRION AG
Laubisrütistr. 50
CH-8712 Stäfa ZH
Switzerland

Phone: + 41 (0)44 306 40 00
Fax: + 41 (0)44 306 40 30
e-mail: info@sensirion.com
http://www.sensirion.com/

SENSIRION Inc
Westlake Pl. Ctr. I, suite 240
2801 Townsgate Road
Westlake Village, CA 91361
USA

Phone: 805-409 4900
Fax: 805-435 0467
e-mail: michael.karst@sensirion.com
http://www.sensirion.com/