



Application Note for Dew Sensors (DPS 0603/1206)

The new DPS SMD dew sensors protect electronic equipment like VCRs, camcorders, cameras, and hard disk drives from moisture failure by fast detection of dew. Their sensitivity to relative humidity above 65 % makes them highly suitable for climate control systems. DPS sensors change their capacity as well as their resistance in response to water adsorption.



Figure 1. DPS 1206 dew sensor

Sensor Characteristics

The sensor elements (Figure 1) are specifically designed for direct dew detection in electronic equipment. Their well-defined sensor characteristics ensure reliable and temperature independent dew detection over the 0 °C to 85 °C temperature range.

In addition to its specific sensitivity to dew, the capacity and resistance response of the sensor element allows the detection of relative humidity when this exceeds 65 %. This allows the DPS to be used to sense the relative humidity of the air flow in climate control electronics well before the occurrence of dew.

To minimize the response time to humidity, the DPS sensors are made of a robust metal oxide film and are designed as an open sensor element. Compared to sensors based on organic materials, the DPS dew sensor is extremely resistant to mechanical stress and solvents. However, care must be taken during handling and processing to avoid contamination, which could influence device sensitivity. Contaminants like dust can be removed by compressed air, and fingerprints can be removed by isopropyl alcohol and subsequent rinsing with de-ionized water.

The DPS sensors are designed for SMD assembly technology and reflow soldering. Flux material residues on the sensor surface have to be removed carefully to maintain top sensor performance.

Test Equipment

For the functionality tests, the DPS sensors were located inside a humidity generator on top of a cooling plate. The equipment allows test cycles within the humidity range from R.H. 10 % up to R.H. 98 % at a temperature between 0 °C and 70 °C. The cooling plate allows the relative humidity of the sensor surface to be controlled up to 100 %.

Application Circuits

The DPS dew sensors are designed for direct dew detection. Depending on specific requirements, physical read-out parameters, or limiting factors (like supply voltage or available space), electronic circuit designers can choose between several different application circuits.

The following sections describe two such examples. One is based on the capacity response of the sensor to changes in relative humidity; the other is based on changes in resistance.

I. Capacitive read out electronics

Simple read out electronics for a variable capacitor are based on charge/discharge-cycles. For this purpose the Vishay application test circuit comprises a well-known 555 timer module. The functional block diagram of the test circuit is shown in Figure 2 and the wiring diagram in Figure 3.

The 555 timer module delivers a frequency signal (pin 3) which depends on the capacity of the dew sensor and therefore on the relative humidity value. Up to approximately 98 % R.H. this output signal has an almost constant frequency of about 80 kHz with a voltage amplitude of 5 V. If the relative humidity exceeds 98 % the frequency changes significantly and reaches a value below 10 Hz at 100 % R.H. allowing a precise detection of the occurrence of dew.

Application Note for Dew Sensors (DPS 0603/1206)

The AC signal is converted to a DC voltage by an active rectifier. For an R.H. below 98 % the voltage level is approximately 2 V and 3.3 V at 100 % R.H.

By choosing an adequate threshold, a comparator element discriminates between the two states "dew" and "no dew" on the sensor's surface, displayed in the test circuit by "LED 1" and "LED 2" (Figure 3). A typical application is to protect hard disk drives, camcorders, or other sensitive electronic components from moisture failure.

Test results

The characteristic feature of the Vishay DPS series is a significant variation of the sensor's impedance between 98 % R.H. and 100 % R.H. This allows reliable and especially temperature-independent detection of the states "dew" or "non dew."

In Figure 4, the frequency output of the 555 timer module is displayed versus relative humidity at different ambient temperatures. Below 98 % R.H. the frequency level is about 80 kHz. As soon as the sensor's surface is dewed, the frequency signal drops to a level below 10 Hz. This well-defined frequency signal is independent from temperature within a range from 0 °C up to 85 °C.

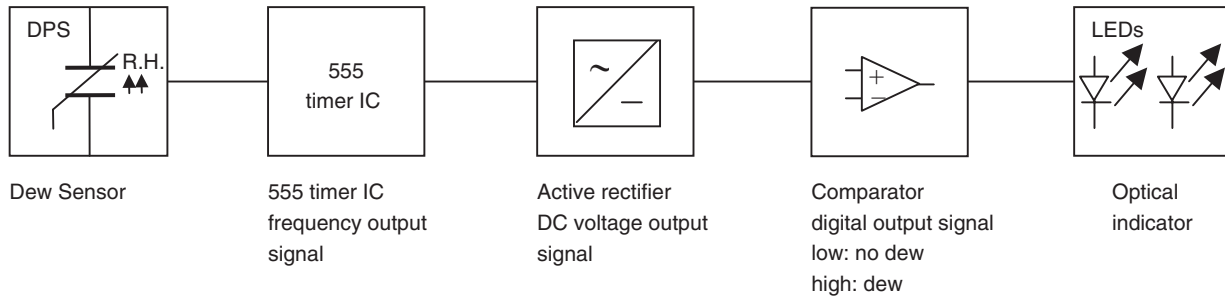


Figure 2. Functional block diagram of Vishay application test circuit

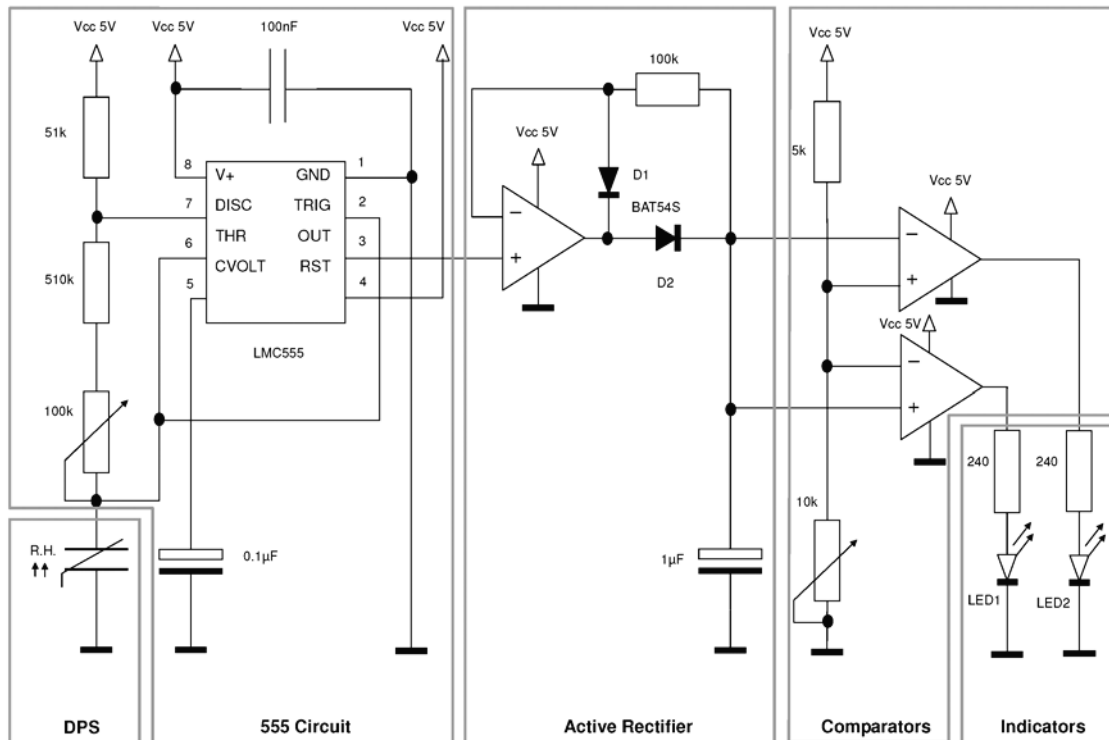


Figure 3. Diagram of Vishay application test circuit

APPLICATION NOTE

Application Note for Dew Sensors (DPS 0603/1206)

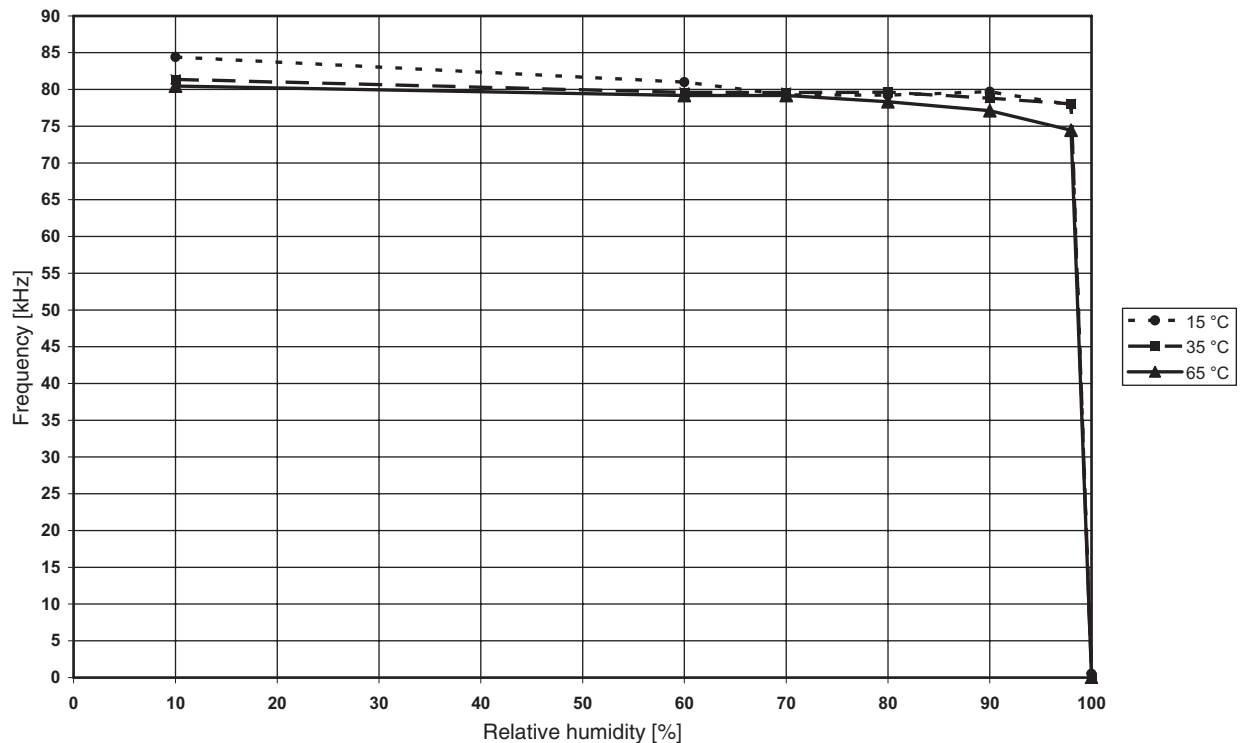


Figure 4. Frequency output of timer module in Vishay application test circuit versus relative humidity

II. Resistive read out electronics

In this circuit a sine-wave voltage is applied to the dew sensor with an additional resistor (Figure 5). In the case of a low relative humidity value, the DPS dew sensor acts as a capacitor. Hence, for a frequency of about 1 kHz only a negligible voltage drop occurs at the resistor, and the output-signal between the resistor and the dew-sensor equals the input signal. With increasing relative humidity, the resistance of the dew sensor decreases from several GΩ to some hundred kΩ at 90 % R.H. and further below 10 kΩ above 98 % R.H. Figure 6 shows an example of the sensor's typical behavior.

By choosing an appropriate value for the constant resistor, such as 1 MΩ, the resistance of the DPS dew sensor becomes negligible if the sensor surface is covered by a thin humidity layer. Thus, the output voltage equals 0 V and the appearance of dew can be detected very reliably.

Apart from the distinct detection of the “dry” state and the “dew” state, the output signal of this electronic circuit will also be affected by levels of relative humidity above 65 %, depending on the value of the constant resistor. Therefore, electronic regulators which have to distinguish between high levels of relative humidity, such as those in air conditioners, can be controlled by this circuit.

By using an active rectifier as described in the previous section, the output signal of the DPS dew sensor can be transformed into a DC voltage level which again can be used to regulate a dew protection circuit in a wide range of end products.

If no AC source is available, an operational amplifier can be used to build up a Wien bridge oscillator, preferably with a 1 kHz frequency output and a peak power point voltage of 1 V.

A superimposed DC offset should not exceed 1 V and should preferably be filtered by an additional capacitor. Figure 7 shows an electronic circuit diagram with such an AC source, where the resistor voltage divider and DPS dew sensor are followed by a rectifier and comparator elements which allow an LED display of the humidity level. The output DC signal varies approximately between 0.5 V and 0 V. An additional amplifier can be used to increase this voltage difference.

Contact

Vishay welcomes your questions about the DPS sensor. Please contact us at ff3eresistors@vishay.com

Application Note for Dew Sensors (DPS 0603/1206)

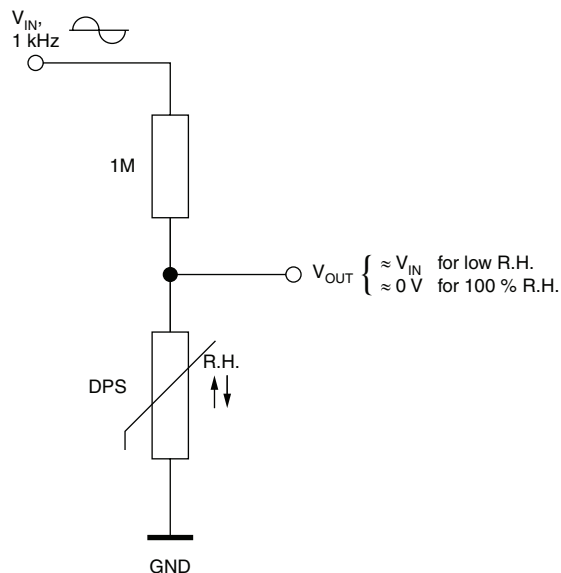


Figure 5. A.C.-response of the Vishay dew-sensor

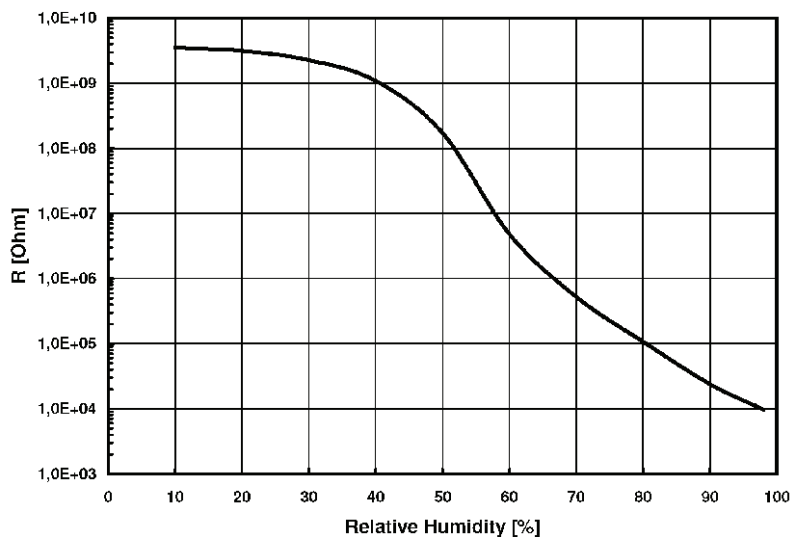


Figure 6. Typical dependency of the sensor-resistance on the ambient relative humidity (T = 25 °C, f = 1 kHz)

Application Note for Dew Sensors (DPS 0603/1206)

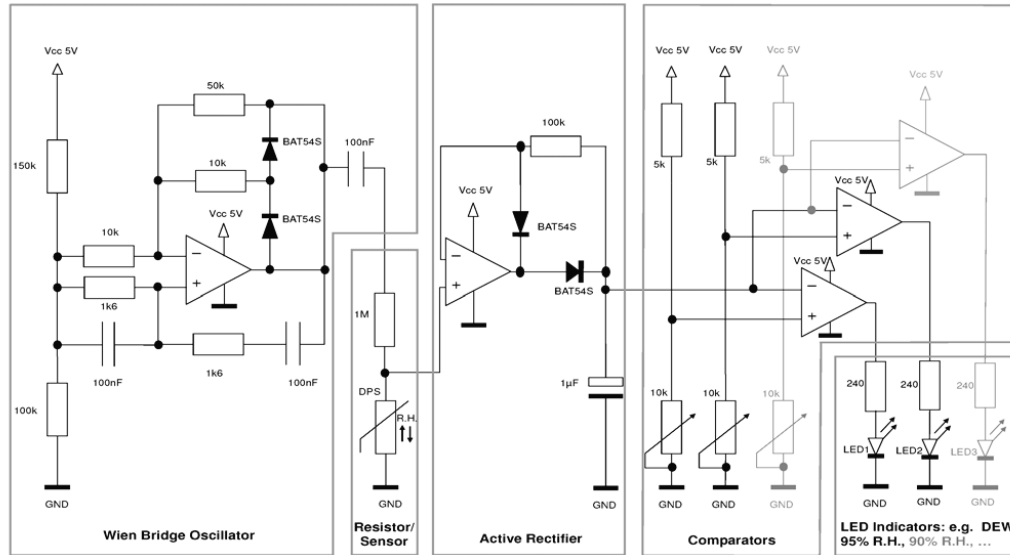


Figure 7. Circuit diagram for Vishay dew sensors based on their resistance response

NOTICE Specifications of the products displayed herein are subject to change without notice. Vishay Intertechnology, Inc., or anyone on its behalf, assumes no responsibility or liability for any errors or inaccuracies. Information contained herein is intended to provide a product description only. No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted by this document. Except as provided in Vishay's terms and conditions of sale for such products, Vishay assumes no liability whatsoever, and disclaims any express or implied warranty, relating to sale and/or use of Vishay products including liability or warranties relating to fitness for a particular purpose, merchantability, or infringement of any patent, copyright, or other intellectual property right. The products shown herein are not designed for use in medical, life-saving, or life-sustaining applications. Customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify Vishay for any damages resulting from such improper use or sale.

WORLDWIDE SALES AND TECHNICAL SUPPORT

THE AMERICAS

UNITED STATES

VISHAY INTERTECHNOLOGY, INC.
63 LANCASTER AVE.
MALVERN, PA 19355
UNITED STATES
PH: +1-610-407-4800
FAX: +1-610-640-9081

ASIA

SINGAPORE

VISHAY INTERTECHNOLOGY
ASIA PTE LTD.
25 TAMPINES STREET 92
KEPPEL BUILDING #02-00
SINGAPORE 528877
PH: +65-6788-6668
FAX: +65-6788-0988

P.R.C.

VISHAY INTERTECHNOLOGY
ASIA PTE LTD.
(SHANGHAI REPRESENTATIVE OFFICE)
ROOM D, 15F, SUN TONG INFOPORT PLAZA
55 HUAI HAI WEST ROAD
200030 SHANGHAI
P.R.C.
PH: +86-21-6283-1036
FAX: +86-21-6283-1039

JAPAN

VISHAY JAPAN CO., LTD.
GE EDISON BUILDING, SHIBUYA 3F
3-5-16 SHIBUYA
SHIBUYA-KU
TOKYO 150-0002
JAPAN
PH: +81-3-5464-6411
FAX: +81-3-5464-6433

EUROPE

GERMANY

VISHAY EUROPE SALES GMBH
GEHEIMRAT-ROSENTHAL-STR. 100
95100 SELB
GERMANY
PH: +49-9287-71-0
FAX: +49-9287-70435

FRANCE

VISHAY S.A.
199, BLVD DE LA MADELEINE
06003 NICE, CEDEX 1
FRANCE
PH: +33-4-9337-2920
FAX: +33-4-9337-2997

NETHERLANDS

VISHAY BCCOMPONENTS B.V.
HURKESTRAAT 31
P.O. BOX 8766
5652 AH EINDHOVEN
NETHERLANDS
PH: +31-40-2590-700
FAX: +31-40-2590-777

One of the World's Largest
Manufacturers
of Discrete Semiconductors and Passive Components

APPLICATION NOTE