Document No.KRH1901003
Hokuriku Electric Industry CO.,LTD

Humidity Sensor (Resistive Type) Application Manual

Part Number : HIS-06 Series
HIS-08 Series

HOKURIKU ELECTRIC INDUSTRY CO.,LTD

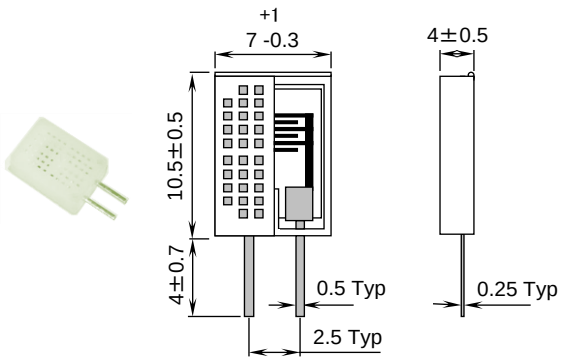
1. Outline

Since 1986, our resistive humidity sensors have been used for environmental control of household electrical appliances such as room air conditioners, refrigerators, dehumidifiers/humidifiers, the image quality control of OA equipment such as printers/copiers, and the control of air conditioners for automotive use. We have achieved the top share in the domestic market.

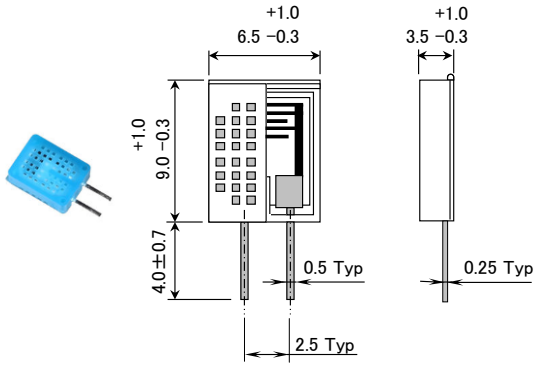
In this document, we explain how to use the resistive humidity sensor element and the precautions and so on. Therefore, please refer to it.

2. Specifications of Resistive Humidity Sensor Element

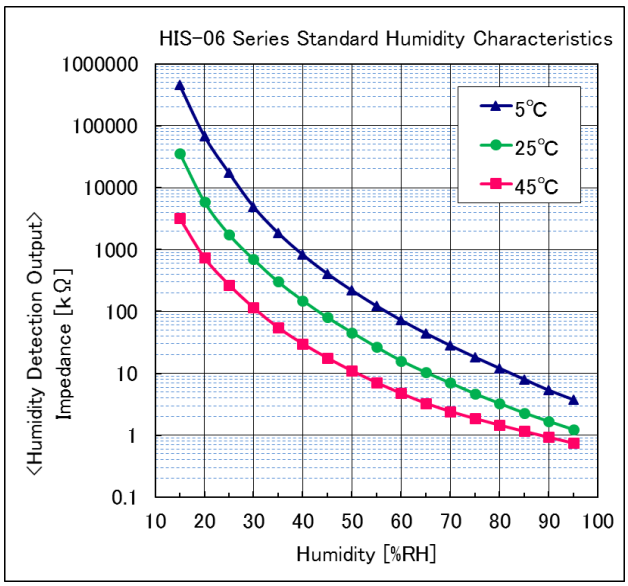
<HIS-06 Series>



<HIS-08 Series>



Item		HIS-06 Series	HIS-08 Series
Absolute Maximum Ratings	Rated Voltage	AC 5.5V Max.	
	Rated Power	1.0mW	
	Storage Temperature	−25℃～70℃	
Operating Range	Operating Temperature	−20℃～60℃	
	Operating Humidity	0%RH～90%RH	
Electrical characteristics	Humidity Detection Output	45.8kΩ (at. 25℃/50%RH)	57.0kΩ (at. 25℃/50%RH)
	Humidity Detection Accuracy	±5%RH (at. 25℃/50%RH)	
	Hysteresis	±1%RH (at. 30～90%RH)	
	Humidity Response Characteristics	3.5min (at. 30%RH⇔90%RH, 90% reached, 1.2cm/sec)	



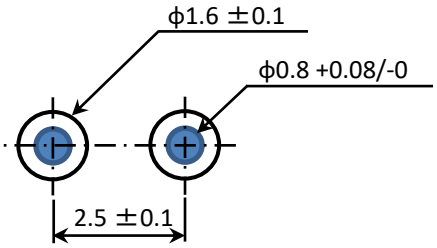
■Characteristics of
Resistive Humidity SensorEelement

The higher the humidity,
the lower the impedance.

3. Mounting Method of Resistive Humidity Sensor Element

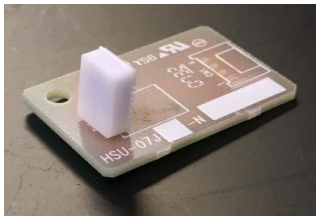
3-1. Land Design Example for Printed Circuit Board

An example of the land design of the printed circuit board is shown in the right figure.
There is no terminal polarity.
We recommend that the board thickness be 1.6 mm.
(Section 3-3, Depending on iron soldering conditions)

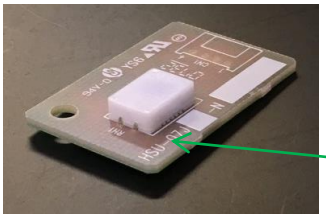


3-2. Mounting Method

The mounting method for the vertical and horizontal attachment is shown in the figure below.
When bending the lead terminal, please bend it while holding the case firmly so that it will not open.
Also, please do not bend and extend it more than 2 times. (There is a danger of lead breaking.)



<Vertical Placement>



<Horizontal Placement>

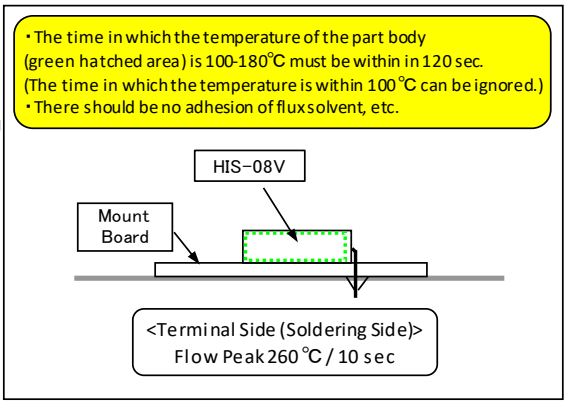
3-3. Soldering Method

■In the case of soldering with the iron (Standard Products)

Please solder the terminal at 1.6 mm or more away from the end of the case,
with the iron tip temperature of 350 ± 10 ℃, within 5 sec.
(There is a risk that the case melts when the temperature of the case becomes 120 ℃ or higher.)

■In the case of flow mounting (good only for custom products)

Products with "V" such as HIS-06KV-N, HIS-08V, etc. can be mounted by flow soldering. (A heat-resistant case is used.) Please use the flow soldering condition as shown in the right figure.



■Reflow mounting

Reflow mounting is impossible.

Reflow mounting is impossible.

3-4. Others (Product with Harness)

In addition, we have products with the harness.
(HIS-06L series)
Please contact our office in charge.

4. Driving Method Resistive Humidity Sensor Element

The resistive humidity sensor element is a resistance change type humidity sensor using a humidity sensitive polymer, and in order to operate it, it must be driven with AC voltage due to its operation principle. Please note that Applying DC voltage will affect sensor characteristics and lead to failure.

Prohibition of DC voltage application

The humidity sensor element is driven by a microcomputer in general. We explain how to use it in the order from 4-1 to 4-4.

<Outline of Each Section>

4-1. Connection with microcomputer, driving method and data fetching method
Drive with two output ports and take in the voltage value with one AD input port. Data is acquired in synchronization with the drive waveform.

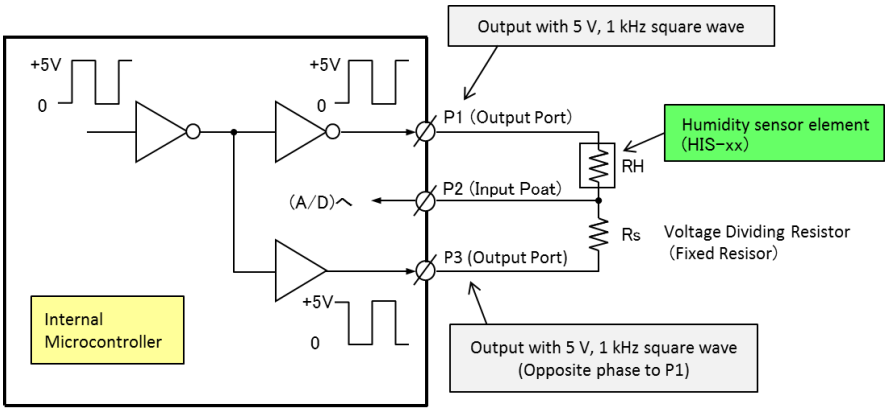
4-2. Conversion from captured voltage value to humidity
Convert the captured voltage value to the humidity based on the 1℃, 1% RH step conversion table.
Temperature data is required and one AD input port is required to measure the temperature with a thermistor or the like.

4-3. Selection of voltage dividing resistors
How to select the voltage dividing resistors is explained.

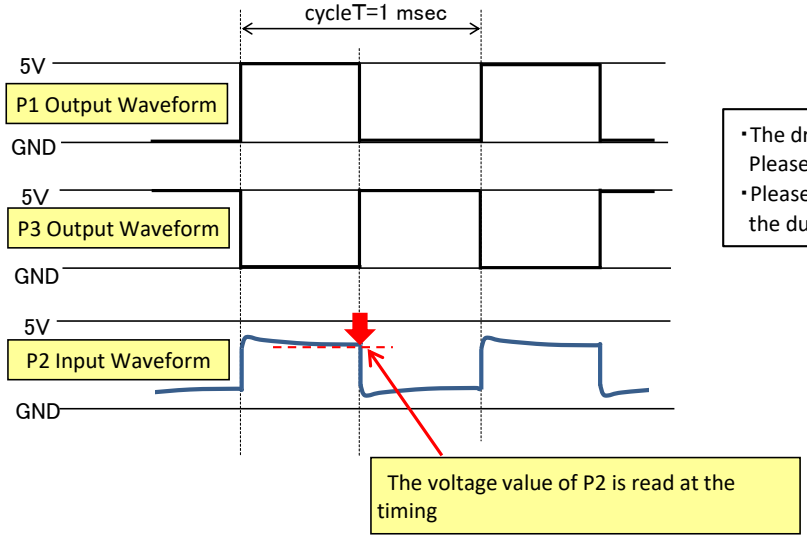
4-4. Example of waveform driven by microcomputer
An example of drive waveform and data acquisition waveform is explained.

<Number of required ports of microcomputer>
■Humidity measurement
Output port : 2 ports
AD input port : 1 port
■Temperature measurement
AD input port : 1 port

4-1. Connection with a Microcomputer, Driving Method and Data Fetching Method



①Connect the output port (P1, P3) and the A/D input (P2) of the microcomputer to the humidity sensor element and the voltage dividing resistor as shown in the above diagram above.
②Square wave of 5 V, 1 kHz is output from P1 and P3 depending on the internal setting of the microcomputer. Also, reverse the phase of P1 and P3. (When P1 is 5 V, P 3 is 0 V. Also, when P1 is 0 V, P 3 is 5 V.) By this setting, AC whose voltage is equivalent to ± 5 V, 1 kHz is applied between P1 and P3.
③The reading of the A/D input is done at the timing when the waveform of P2 is stable at the phase of P1 being High (5V). This timing differs depending on the microcomputer and external noise, but it is common to read the value of P2 just before the P1 switches from High to Low. (See the figure below)



・The driving voltage of P1 and P3 is not limited to 5V. Please choose arbitrarily in the range of 1 - 5.5V.
・Please set the frequency at 1 kHz ± 50 Hz and the duty ratio at 50%±5%.

4-2. Conversion from Captured Voltage Value to Humidity

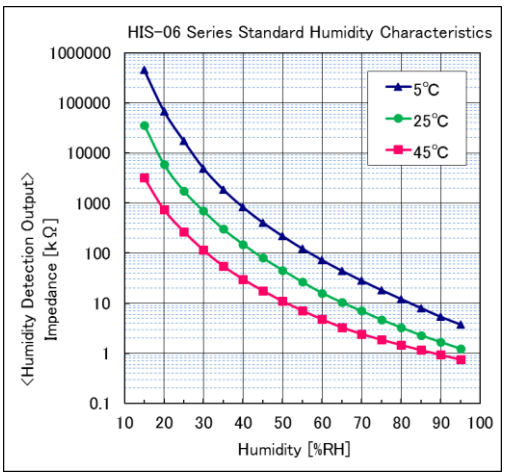
The P2 reading voltage is calculated from the sensor element impedance by the following formula.

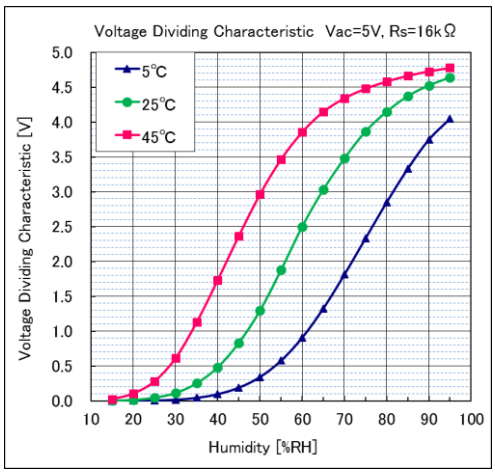
$$Vout = Vac \times Rs/(RH + Rs) \quad \cdots\cdot \text{Equation } ①$$

Vout : P2 Reading Voltage
(Voltage Dividing Characteristic)
Vac : Hi Voltage of P1, P3
Rs : Voltage Division Resistor
RH : Sensor Element Impedance

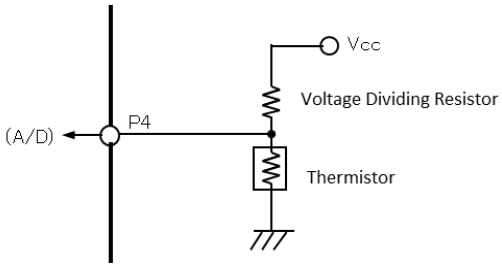
Since Vac and Rs are fixed in equation ①, Vout is a value corresponding to the sensor element impedance RH (= Humidity value).
The characteristic of this Vout is called "Voltage division characteristic".
The following graph shows the result of calculation of the voltage dividing characteristic when Vac = 5 V, Rs = 16 kΩ from equation ①.

<Sensor Element Impedance> → <Voltage Dividing Characteristic (Vac=5V, Rs=16kΩ)>



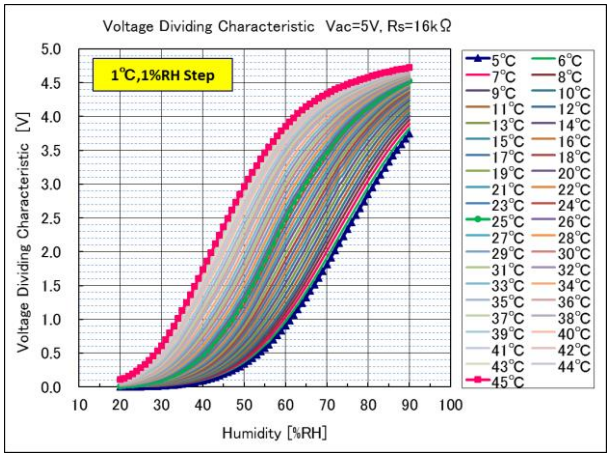


Temperature data is necessary to convert to the humidity because the voltage dividing characteristic varies with temperature.
Place the thermistor etc. as close as possible to the sensor element and measure the temperature.



<Example of Temperature Measurement by Thermistor>

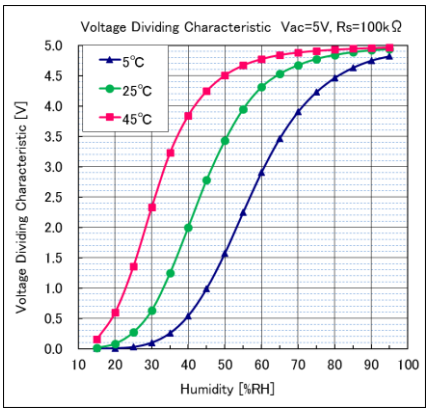
At our company, a voltage division characteristic table of 1℃, 1% RH step is presented.
Refer to this table and calculate the humidity value.



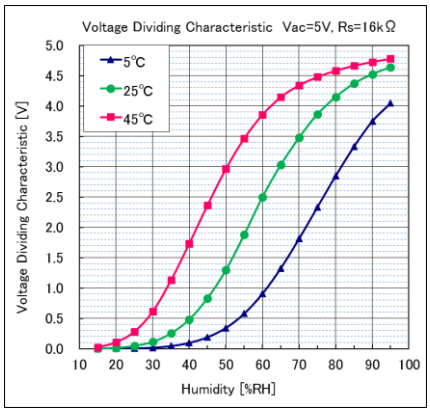
4-3. Selection of Voltage Division Resistor

As the curve becomes blunt at both ends (low humidity side, high humidity side) of the graph, the resolution performance is worse. Measurement that emphasizes low humidity side or high humidity side can be performed by voltage dividing resistance (Rs), so select an appropriate resistance value.

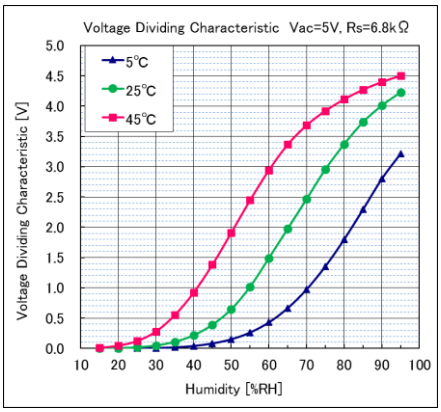
<Emphasis on Low Humidity Side> Rs=100kΩ



<Emphasis on Medium Humidity Side> Rs=16kΩ

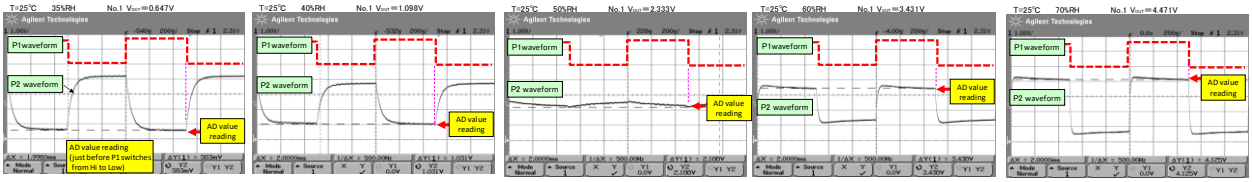


<Emphasis on High Humidity Side> Rs=6.8kΩ



4-4. Example of Waveform Driven by Microcomputer

Refer to Appendix 1 for an actual waveform example driven by a microcomputer.
With low humidity → high humidity, the P2 reading waveform changes as shown below, and as the humidity increases, the reading voltage increases.
Also, due to the sensor element capacity etc., the waveform does not become a clean square wave, and it causes dullness.



35%RH　40%RH　50%RH　60%RH　70%RH

4-5. Important Points

①The duty ratio of the output pulse (P1, P3) should be 50% and the error should be within ± 5%.
Application of DC component exceeding ± 5% affects element characteristics.
②When the output pulse is stopped, set P1 and P3 at the same potential (0 V is recommended)
If DC voltage is applied for a long time, element characteristics will be affected.
③The output current (Is) from P1 and P3 is required to be equal to or greater than Is = Vac/Rs.
(Vac = 5 V, Rs = 16 kΩ: 0.32 mA or more, Rs = 100 kΩ: 0.05 mA or more)
④Taking the rated power (max.1mW) of the element into consideration, the voltage division resistor should be 6.8 kΩ or more. (10 kΩ or more recommended)
⑤Please use the input impedance of the microcomputer which is high and stable.
(10 MΩ or more is recommended) If the input impedance is low, it will cause a voltage drop, and an accurate voltage dividing characteristic will not be entered as a result.

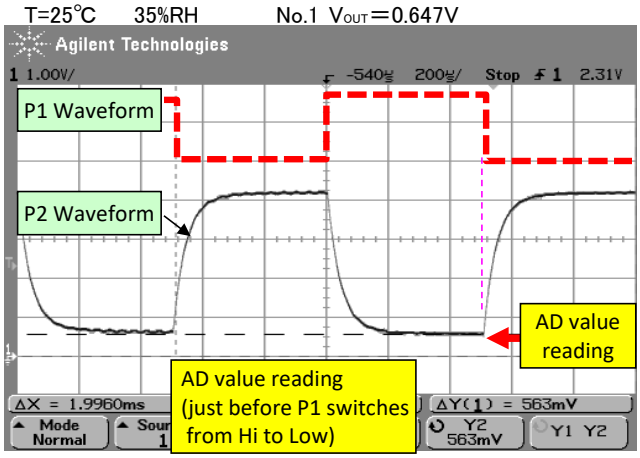
5. Precautions for Use

(1)This product has been processed to have water-resistant coating and even if a small amount of water sticks to the part, the humidity sensing membrane will not melt away. However please do not use this part under an environment where water adhesion or dew condensation occurs for a long period of time or frequently.
(2)Do not make foreign materials such as a solvent, oil and fat stick to the humidity sensor.
It may stop functioning normally. Cleaning is strictly prohibited.
(3)The following storage conditions are recommended.
Recommended storage temperature and humidity：15～35℃、70%RH less than.
Storage life : The above temperature and humidity, 1 year in an unopened state. However, within 6 months after the packing is opened.

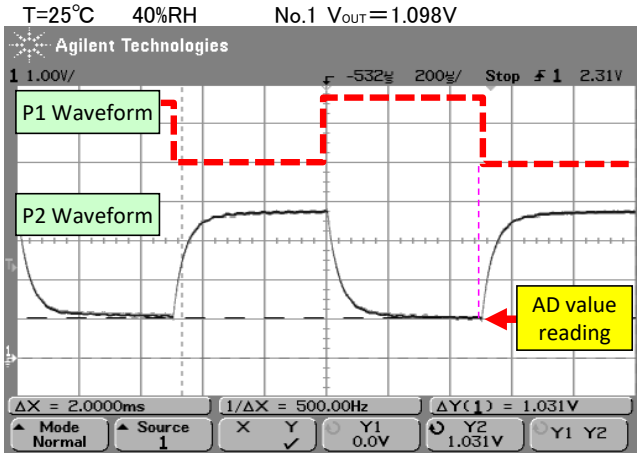
■Example of Microcomputer Driving Waveform of Humidity Sensor Element (HIS-xx).

T=25℃

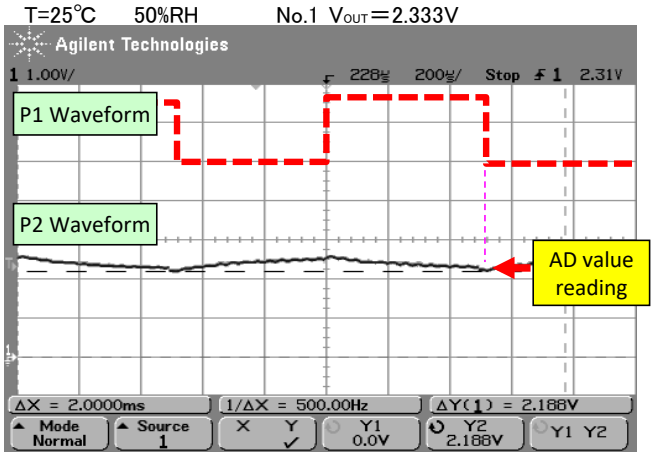
T=25℃ 35%RH No.1 V_{OUT}=0.647V



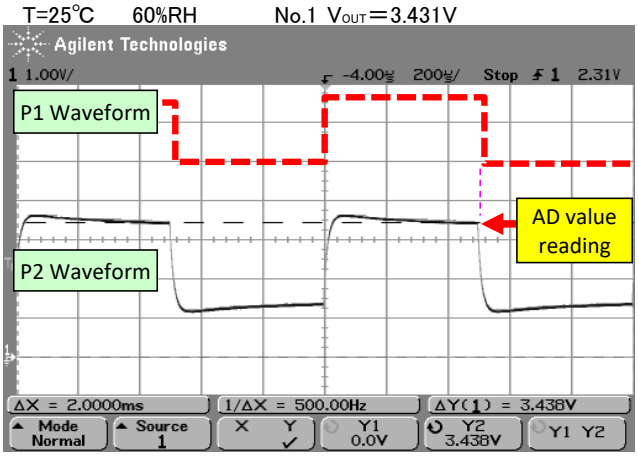
T=25℃ 40%RH No.1 V_{OUT}=1.098V



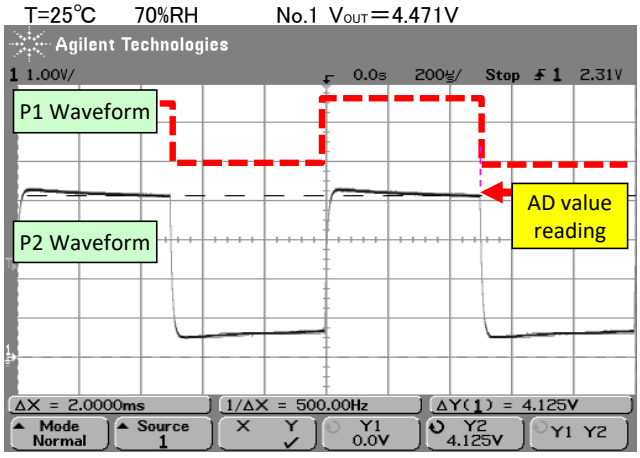
T=25℃ 50%RH No.1 V_{OUT}=2.333V



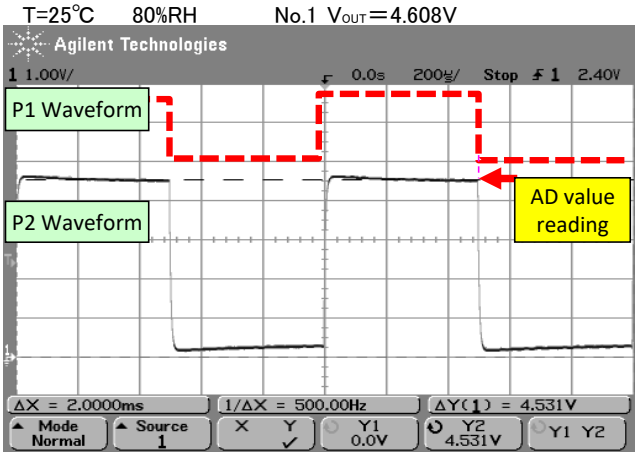
T=25℃ 60%RH No.1 V_{OUT}=3.431V



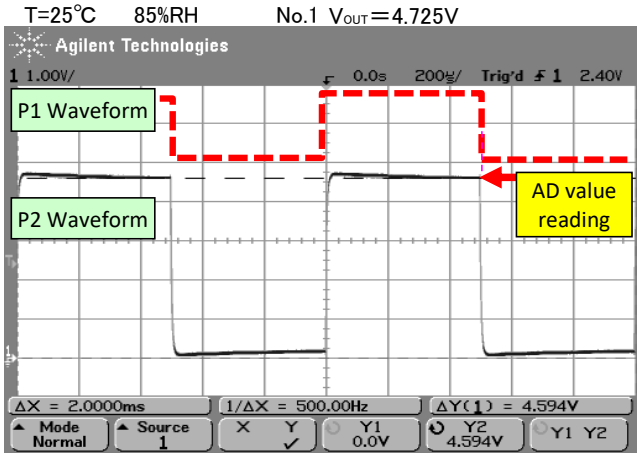
T=25℃ 70%RH No.1 V_{OUT}=4.471V



T=25℃ 80%RH No.1 V_{OUT}=4.608V



T=25℃ 85%RH No.1 V_{OUT}=4.725V



: The value of P2 is read at the timing just before P1 switches from High to Low.
: The P2 read waveform looks like the following.
Low humidity : Because RH > RS ,it reads on the Low side.
Middle humidity : When RH ≒ RS, the waveform appears to be collapsed.
High humidity : Because RH < RS, it read on the Hi side.

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