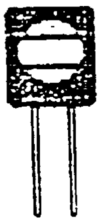
Humidity Sensor

Data

and

Application notes

Ver.2



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Introduction

In general, it has been considered difficult to make a high-Performance hygrometer or humidity Controller with a humidity sensor-

Chichibu Cement's humidity sensor CGS-H14 has changed this concept. Its easy to use features and high reliability allow anyone to apply this sensor to other equipment.

With this manual, we hope to promote the development of high-quality .humidity equipment which incorporates our humidity Sensors.

You can rely on our long and extensive experience with humidity Sensors.

If you have any questions,pertaining to the data included here, please contact us. We will be happy to assist you in every way.

NOTICE

#182630

1. SPECIFICATIONS

1-1 General Specifications

1. Part Name : Humidity Sensor
2. Type Name : CGS-H14
3. Storage Temperature Range : 0 ∿ 50°C
4. Storage Humidity Range : 10 ∿ 90% RH, w/o condensation
5. Storage/Operating Environment : avoid condensation, freeze-up, dust, mist, oil, alcohol, corrosive gases or any other dirty/anomalous environment.
6. Operating Humidity Range : 30 ∿ 90% RH
7. Operating Temperature Range: 0 ∿ 50°C
8. Rated Working Voltage : AC 1 V (50 Hz - 1 kHz)
9. Rated Power : 0.3 mW
10. Nominal Impedance Value : 60 kΩ (at 25°C, 50% RH)
11. Impedance Value Tolerance : +30 kΩ (nominal value ±3 σ)
12. Typical Characteristics : Shown in Fig. 1.
13. Typical Humidity Response Characteristics : Shown in Fig. 2.
14. Reliability (Impedance value change with relative humidity at 25°C, 50% RH)
    - 14-1 Dry Heat Test : <+5% RH (85°C, 1000 hrs)
    - 14-2 Cold Test : <+5% RH (-40°C, 1000 hrs)
    - 14-3 Damp Heat Test : <±5% RH (65°C, 90% RH, 1000 hrs)
    - 14-4 Low Humidity Test : <±5% RH (<20% RH, 1000 hrs)
    - 14-5 Change of Temperature Test : <±5% RH (-40°C ∿ +85°C, 100 cs)
    - 14-6 Dewing Cycle Test : <±5% RH (200 cs)
15. Dimensions : Shown in Fig 3.

1-2 Typical **Humidity** Sensor Characteristics

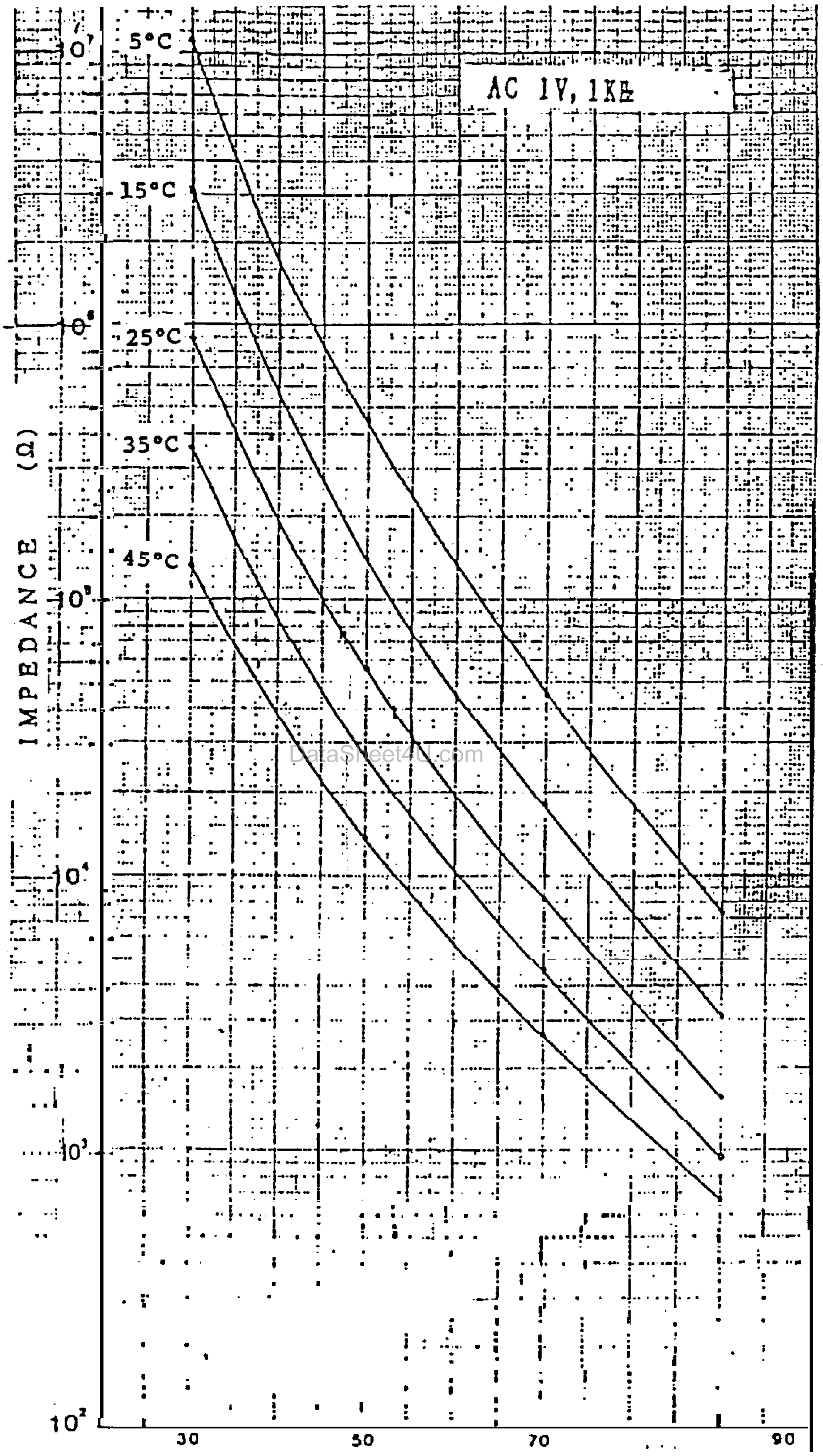


Fig. 1 Typical Characteristics

1-3 Temperature and Humidity Chzracteristics of CGS-H14

Table 1. Typical Humidity Sensor Characteristics
AC 1 V, 1 kHz unit: kΩ

	0 °C	5 °C	10 °C	15 °C	20 °C	25 °C	30 °C	35 °C	40 °C
15 %RH	-	-	-	-	-	-	18500	9800	4900
20 %RH	-	-	-	-	14000	7800	4300	2500	1300
25 %RH	-		16000	8200	4200	2300	1350	790	460
30 %RH	-	11000	5900	3100	1600	890	560	360	215
35 %RH	7600	4200	2300	1250	710	410	265	165	105
40 %RH	3000	1700	980	560	330	190	128	85	56
45 %RH	1450	820	480	270	165	100	68	46	32
50 %RH	760	440	245	135	88	55	38	27	19
55 %RH	420	235	135	77	49	32	23	16.5	12
60 %RH	225	130	77	46	29	19.5	15	10.5	7.6
65 %RH	128	77	46	28	18.5	12.3	9	6.7	5.1
70 %RH	73	45	28	18	12	8	6	4.5	3.4
75 %RH	45	28	18	11.5	7.8	5.4	4	3	2.4
80 %RH	28	18	11.5	7.3	5.1	3.6	2.7	2.1	1.6

1-4 Typical Hunidity **Response** Characteristics

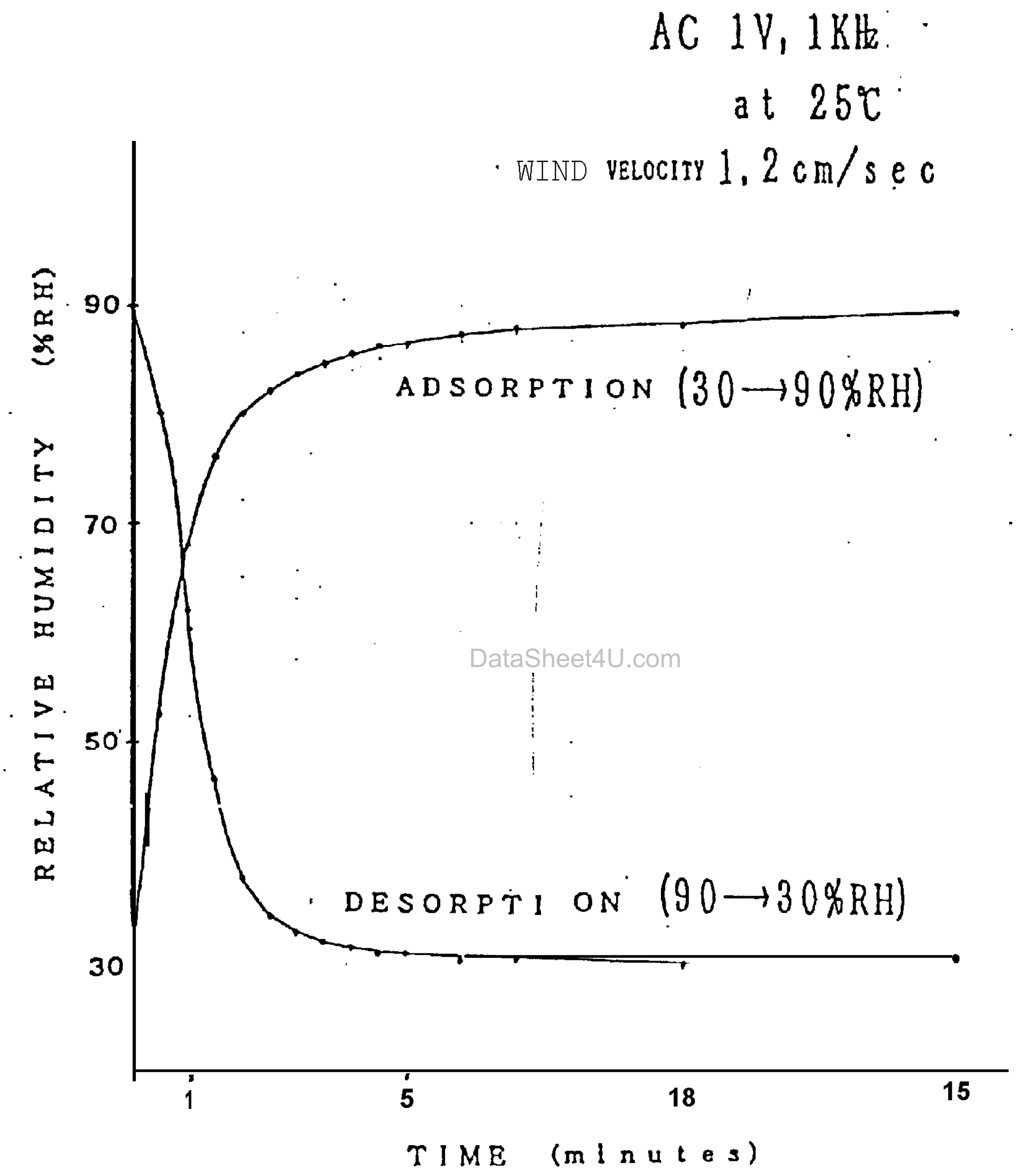


Fig. 2 Typical Humidity **Response** Characteristics

1-5 Configuration Outline

(a) CGS-H14

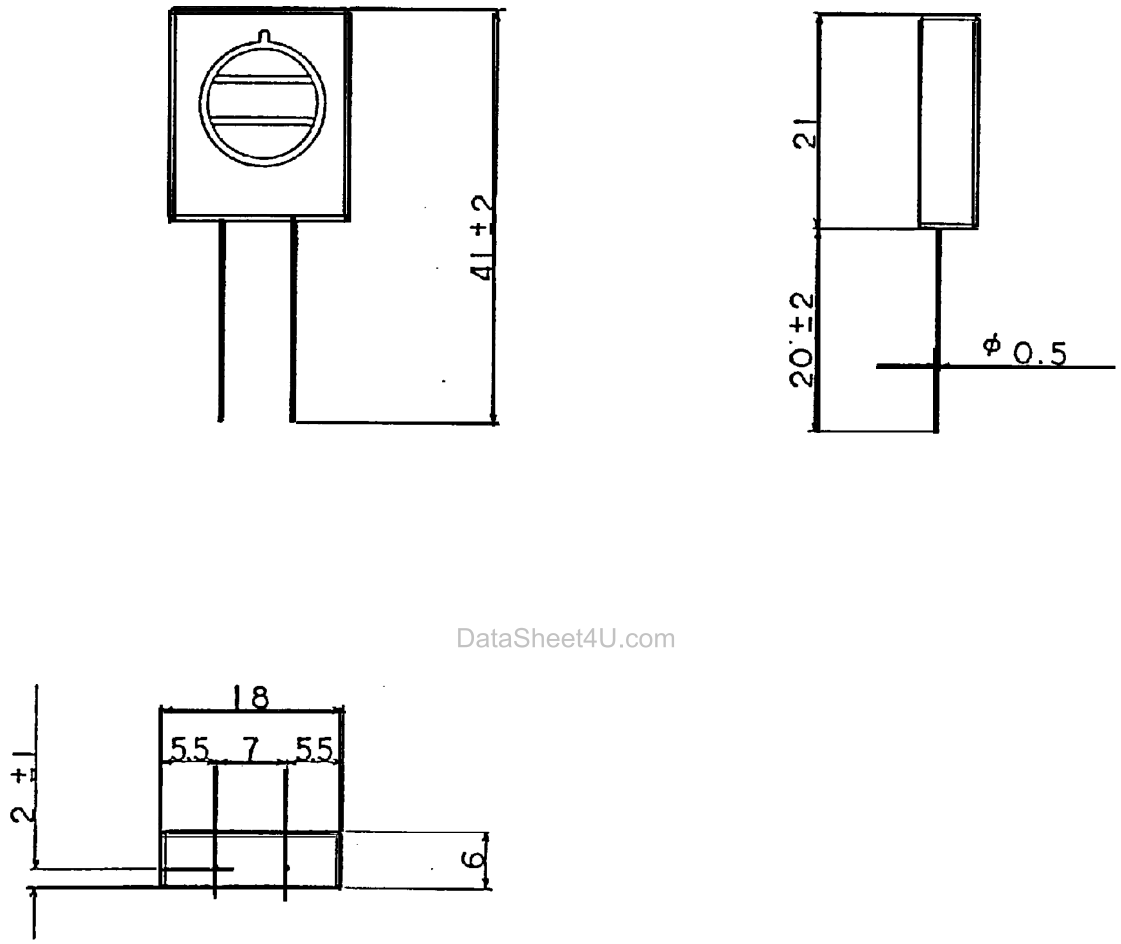


Fig. 3 Configuration Outline **(CGS-H14)**

(b) CGS-G14DL

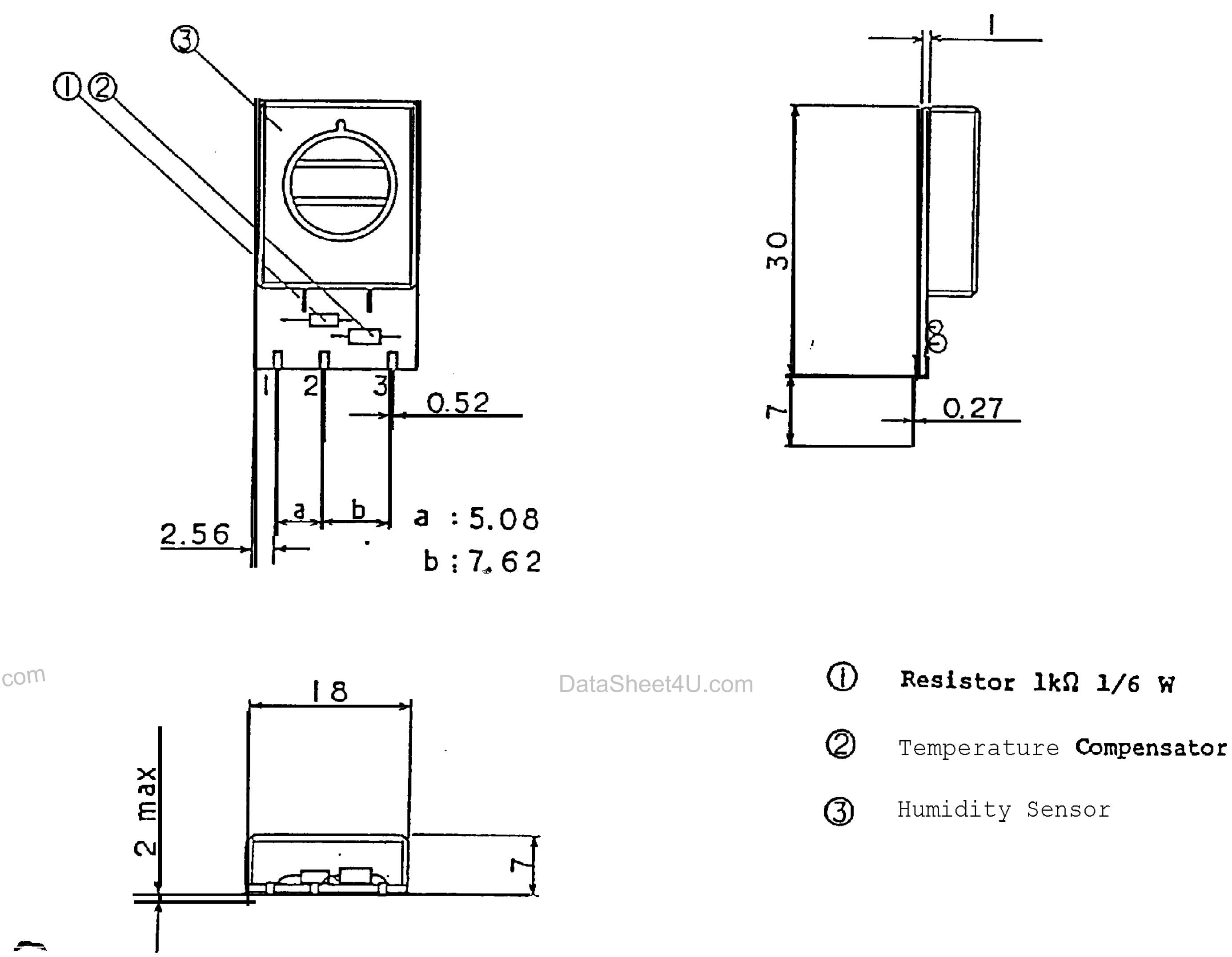


Fig. 4 Configuration **Outline (CGS-H14DL)**

1-6 CGS-E14/DL Reliability Test Results

[1] Durability Tests

(1)	High temperature	≤ +1% RH (85°C, 1000 hrs)
(2)	Low temperature	≤ +1% RH (-40°C, 1000 hrs)
(3)	High humidity	≤ ±1% RH (40°C, 93% RH, 1000 hrs)
(4)	Low humidity	≤ ±1% RH (20% RH, 1000 hrs)
(5)	Dewing cycle	≤ +2% RH (10 min dewing, 20 min drying, 200 cs)
(6)	Rapid change of temperature	≤ ±1% RH (-40°C ↔ 85°C, 100 cs)
(7)	High humidity and load	≤ ±2% RH (AC 0.5 V, 1 kHz, 1000 hrs)
(8)	High temperature and load	≤ ±2% RH (AC 1 V, 1 kHz, 1000 hrs)
(9)	Load Life	≤ ±1% RH (AC 1 V, 1 kHz, 1000 hrs)
(10)	Damp heat	≤ ±3% RH (60°C, 90% RH, 1000 hrs)

[2] Environment Tests

(1)	Methanol	≤ ±1% RH (10,000 ppm, 200 hrs)
(2)	Ethanol	≤ ±1% RH (10,000 ppm, 200 hrs)
(3)	Ammonia	≤ ±3% RH (10,000 ppm, 200 hrs)
(4)	Acetic acid	≤ ±2% RH (10,000 ppm, 200 hrs)
(5)	Cigarette smoke	≤ +3% RH (1 cigarette/liter)
(6)	CO_2	≤ ±2% RH (2,000 ppm, 200 hrs)
(7)	H_2S	≤ ±1% RH (50 ppm, 200 hrs)
(8)	Ultra Violet ray	≤ ±2% RH (1000 hrs)
(9)	Oil mist	≤ ±2% RH (180°C, 20 cm above, 1000 hrs)

[3] Mechanical Tests

(1)	Drop test	No visible darnage
(2)	Lead tensile strength	No visible damage
(3)	Lead bending strength	No visible darnage
(4)	Vibration test	No visible darnage

[4] Others

(1)	Room environment	≤ ±1% RH (1000 hrs)
(2)	Low temperature load	≤ ±1% RH (-40°C, AC 1 V, 1 kHz)
(3)	Temperature cycle	≤ ±1% RH (-30°C ∿ 60°C, 100 cs)
(4)	Overload	≤ ±1% RH (AC 2.5 V, 1 kHz, 1000 hrs)
(5)	Insecticide	≤ ±1% RH (30 sec. spray 1 m away from the sensor face)
(6)	Hair spray	≤ ±1% RH (30 sec. spray 1 m away from the sensor face)
(7)	Freon	≤ ±1% RH (10,000 ppm, 200 hrs)
(8)	Organic soiution	≤ ±3% RH (B:T:X=3:3:4, saturated atmosphere, 1000 hrs)
(9)	Light oil	≤ ±2% RH (1000 hrs)
(10)	Kerosene	≤ ±1% RH (1000 hrs)
(11)	Mosquito repellent	≤ ±2% RH (burns 1 coil in 5-l Container)

2. MEASUREMENT OPERATION AND ACCEPTANCE TEST OF HUMIDITY SENSOR

2-1 Measurement Precautions

Make sure to apply A/C for measurement'with the sensor.

If measured by ohm-meter, it causes darnage to the sensor. Our test is conducted pursuant to the procedures on page 11 (Fig. 5).

Since impedance analyzers are not widely used, when you want to measure only sensor data, follow the procedures on page 12 (Fig. 6). With this method the reliability of the data is lost in a high impedance environment, e.g., low humidity. With careful measurement, however, reliable data can be obtained up to the level of minimum humidity of 30% RH using this method.

Thus., it is sufficient for such acceptance test of materials (products) conducted by users.

Please note the following;

(1) NEVER apply D/C to the Sensor.

(2) Keep the effective value of A/C voltage below 1 Vrms for continuous use and 2.5 Vrms for short-time use of less than 10 min-

(3) Start the measurement only after the humidity of the generator becomes stabilized. (Refer to Section 6 for precautions in using a humidity generator-)

2-2 Measurement Operation

With an impedance analyzer, measurement is done simply by reading the displayed figures. Make sure to perform the Short/Open correction before reading. The measured f igure is the absolute value of impedance.

Obtain the impedance with the following formula when using A/C Voltmeter and A/C power supply unit (or Audio Freq. Oscillator).

$$Zs = R^{*} (Vs/Vo - 1) \quad (\Omega)$$

where Zs = impedance of humidity sensor
R = loaded resistance
VS = output voltage of generator
Vo = voltage generated at load ends

Please note that the upper limit is about 1 kHz. The higher the meaured frequency, the greater the error. (Especially the error due to frequency characteristics of Voltmeter and Circuits stray capacitance.)

(a) With impeärnce analyzer

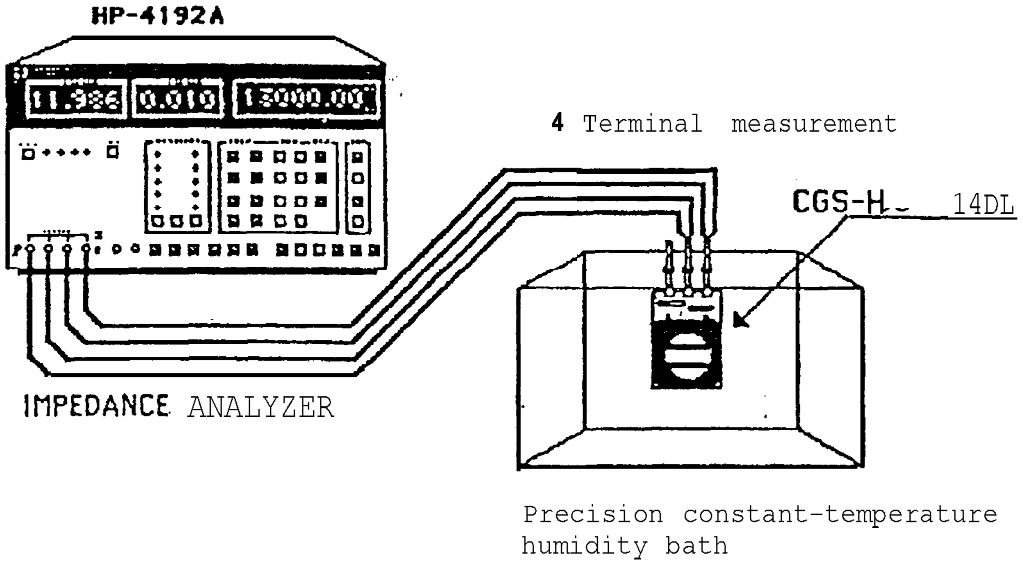
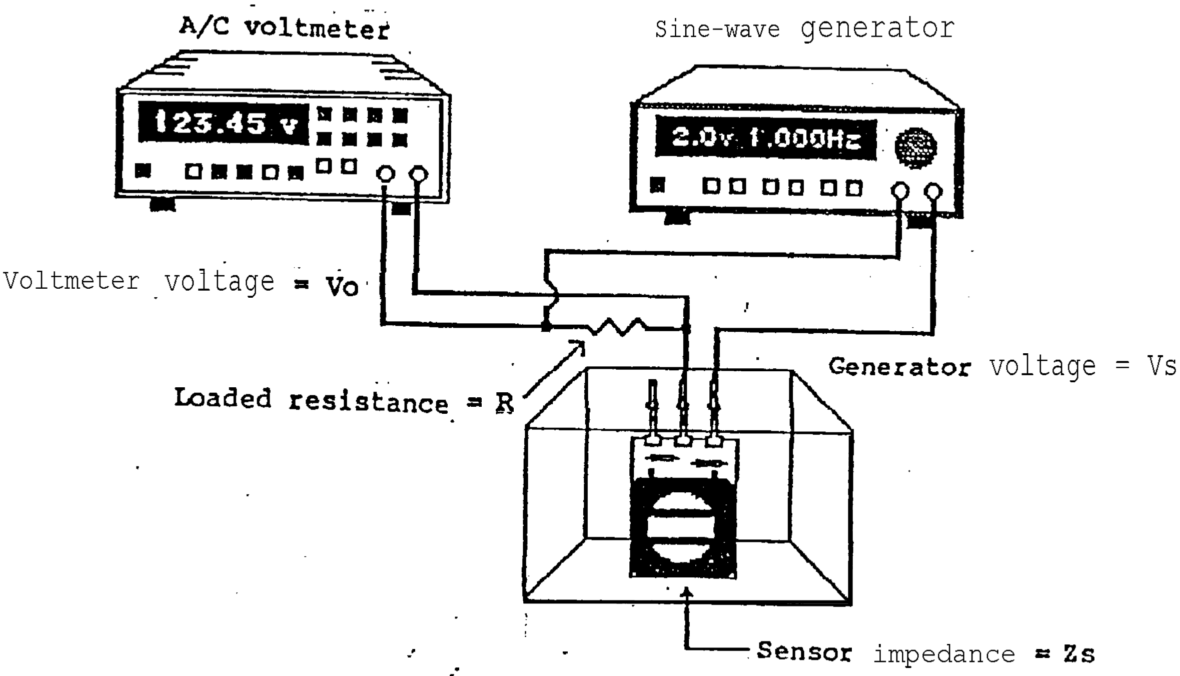


Fig. 5 Meaurement with CGS-H14DL (1)

(b) With A/C Voltmeter and AF oscillator



How to calculate impedance

$$ZS = R \left[\frac{VS}{Vo} - 1\right] \quad [\Omega]$$

Note: The input impedance of Voltmeter must sufficiently be greater than the loaded resistance.

Fig. 6 Measurement with CGS-H14DL (2)

3. COMPARISON WITH MECHANICAL HUMIDITY CONTROL

3-1 Advantages of Electronic Kumidity Control

Conventionally, hunidity controllers (mechanical controllers) which operate based on elasticity of nylon ribbon or hair have been.used.

Recently new electronic controllers which incorporate a humidity sensor have appeared.

Two types of the controllers are compared in this section to determine which is more advantageous in manufacturing current humidity-related equipment,

Owing to improved performance and decreased cost of humidity Sensors, the popularity of electronic humidity control is growing at present. However, since electronic humidity control requires some peripheral equipment other than sensor itself, it may not be affordable in practice in those cases where cost is the primary concern.

Users prefer high-quality products as a trend. Also it is important to satisfy users in the terms of cost by added product value. A comparison was made on next page between mechanical and electronic control of humidity. We hope that.it will assist the reader to make decisions. It is our belief that the data presented in the comparative table are sufficient to convince the reader that for high-quality, high-performance, high value-added products which will occupy the main stream in coming years, the utmost advantage will be gained by employing electronic control Systems with humidity sensors.

3-2 Comparative Table of Electronic and Mechanical Humidity Control

Table 2

Performance, function, etc.	Electronic humidity control (with humidity sensor)	Mechanical humidity control (Nylon ribbon)
1. Precision	With appropriate circuit design, an error level of ±2% of accuracy can be attained. Optimum circuit can be selected according to the required accuracy.	It is hard to achieve an accuracy level of ±5% error. Freedom of selection is limited.
2. Function	Othet than circuit control, display, alarm and other additional functions are available. The control method is not limited only to simple ON/OFF switching,	ON/OFF control only. Display is available only in simple readout scale. Cannot be applied to make high value-added products.
3. Life	Currently used humidity Sensors have sufficiently long life. If used properly, life lasts as long as other electronic parts.	The parts do not require high precision, thus they can be used for a long time if one does not care the wear.
4. Price, costs	Sensor cost is decreasing, yet, still more; expensive compared with mechanical control systems. Increase in sales price of finished prcducts possible.	Quite inexpensive, because no other device needed.
5. Response speed	Very fast. Also, circuit design allows desired response time. Humidity control and monitoring of environment where conditions arc always changing is possible.	It is impossible to develop fast-responding equipment. It cannot cope with fast-changing environment.
6. Hysteresis	Hysteresisparticularto Sensors isless than 1-2%RH. According to the control principle, a wide range of design is possible. Can remove instability of control loop.	Other than nylon ribbon hysteresis, major hysteresis is caused by mechanical play. Highly precise control isnot possible.

4. CIRCUIT EXAMPLES

4-1 CGS-H14DL Applications

(1) Circuit example

CGS-H14DL examples are given.

CGS-H14DL comprises the CGS-H14 Humidity Sensor and sensor incoporating temperature compensation and logarithmic compression.

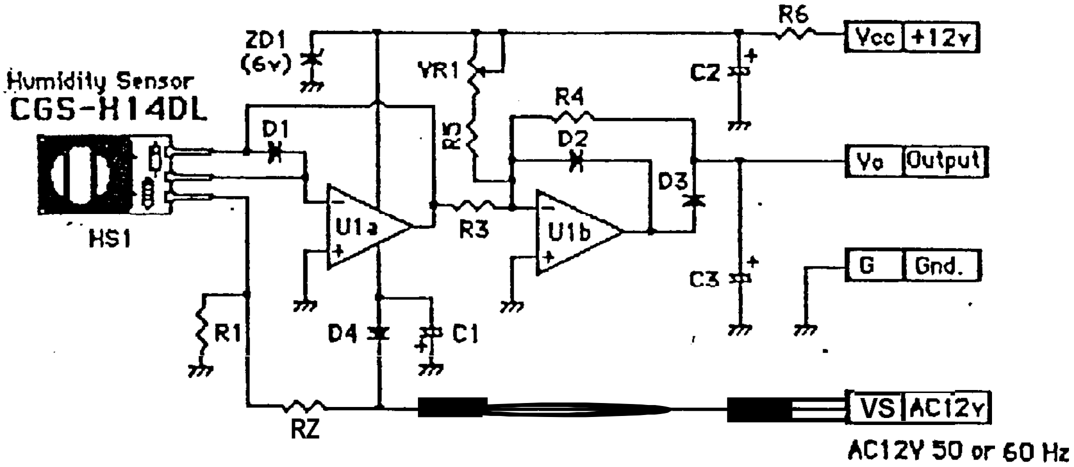
A circuit with the desired output regardless of degree of humidity can be designed by logarithmic compression of changing impedance characteristics of Sensor.

Actual application circuit and adjustment method are given in the following pages. On page 20 (Fig. 10), a circuit diagram for humidity indication/controller is given. This circuit has five LED indicators for humidity change and also the relay is activated when humidity reaches the fixed point set at the variable. resistor.

This can be used as humidity indicator and control circuit of humidifiers and air-conditio'riers.

Also on page 21 (Fig. 11), a circuit diagram of simplified humidity checker with a meter indicator is given. The change of humidity is indicated by an analog meter, which can be used as a simple humidity Checker.

Application Note | L1/a



UI a,b : FET Input OP Amp
(TL-062,072,082 etc)

HC-870410A	CGS-H14DL

Parts List

NO.		NO.	
U 1a,b	Dual OP Amp TL-062CP (FET input)	C 1	Elect. Cap. 47uF/25WV
D 1	Si SW Diode 1S1588 / Toshiba	C 2	Elect. Cap. 22uF/25WV
D 2	Si SW Diode 1S1588 / Toshiba	C 3	Elect. Cap. 47uf/16WV
D 3	Si SW Diode 1 S 1588 / Toshiba		
D 4	Si Rectifier 10D1 / IR	HS 1	Humidity Sensor CGS-H 14DL
ZD 1	Zenner Diode RD-6A / NEC (Vz=6v)		
R 1	Resistor 1 K ohm 1/4w J		
R 2	Resistor 1 1k ohm 1/4w J		
R 3	Resistor 20k ohm 1/4w F		
R 4	Resistor 100k ohm 1/4w F		
R 5	Resistor 330K ohm 1/4w J		
R 6	Resistor 470 ohm 1/4w J		
VR 1	Valiable Resistor 200k ohm B		

HC-870410A	CGS-H14DL

Fig. 7 Application Note Table 3 Parts List

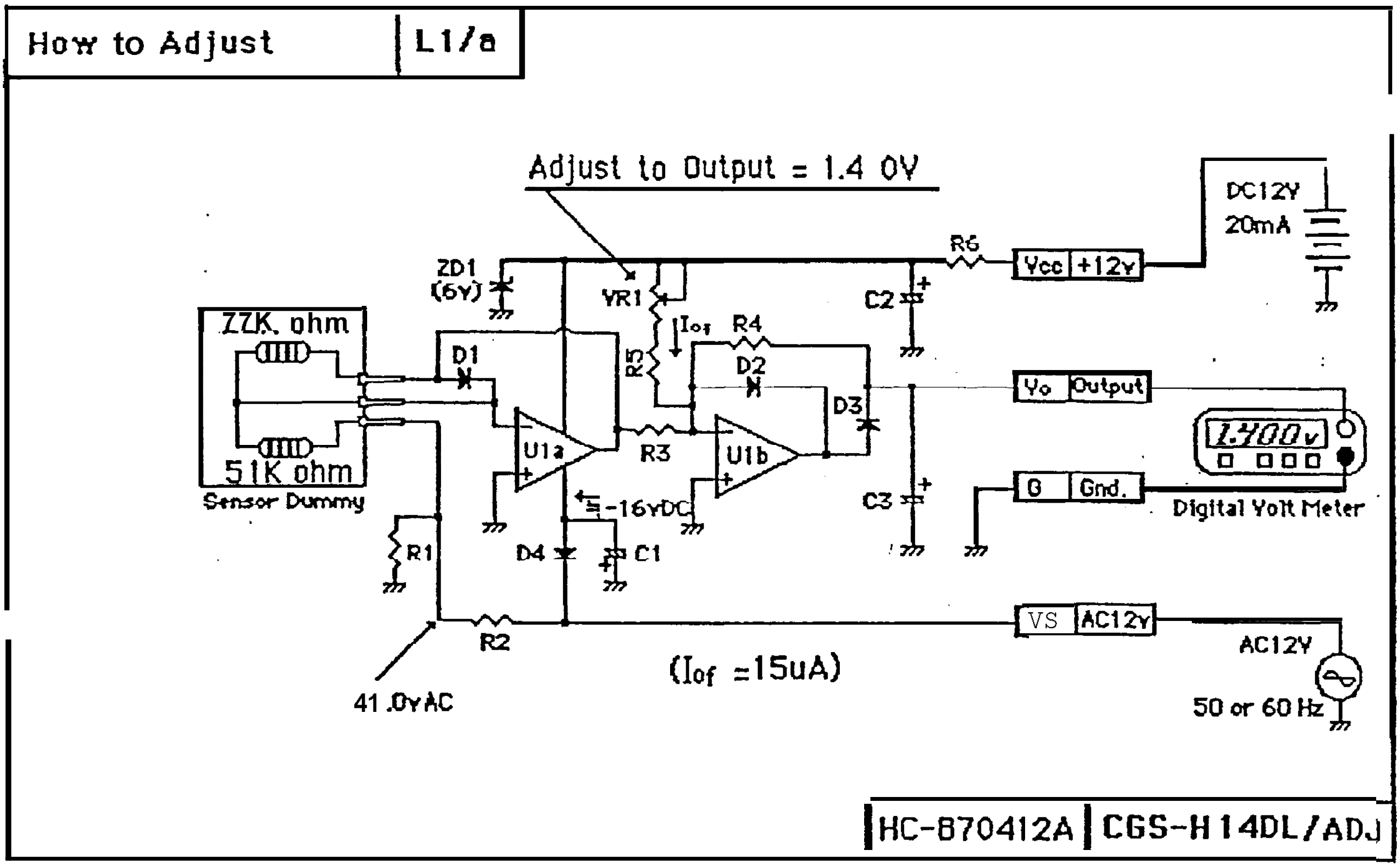


Fig. 8 How to Adjust

(2) Circuit adjustment

Connect 22 kΩ and 51 kΩ fixed resistors (error ≤ ±1%) as sensor dummy as shown above.

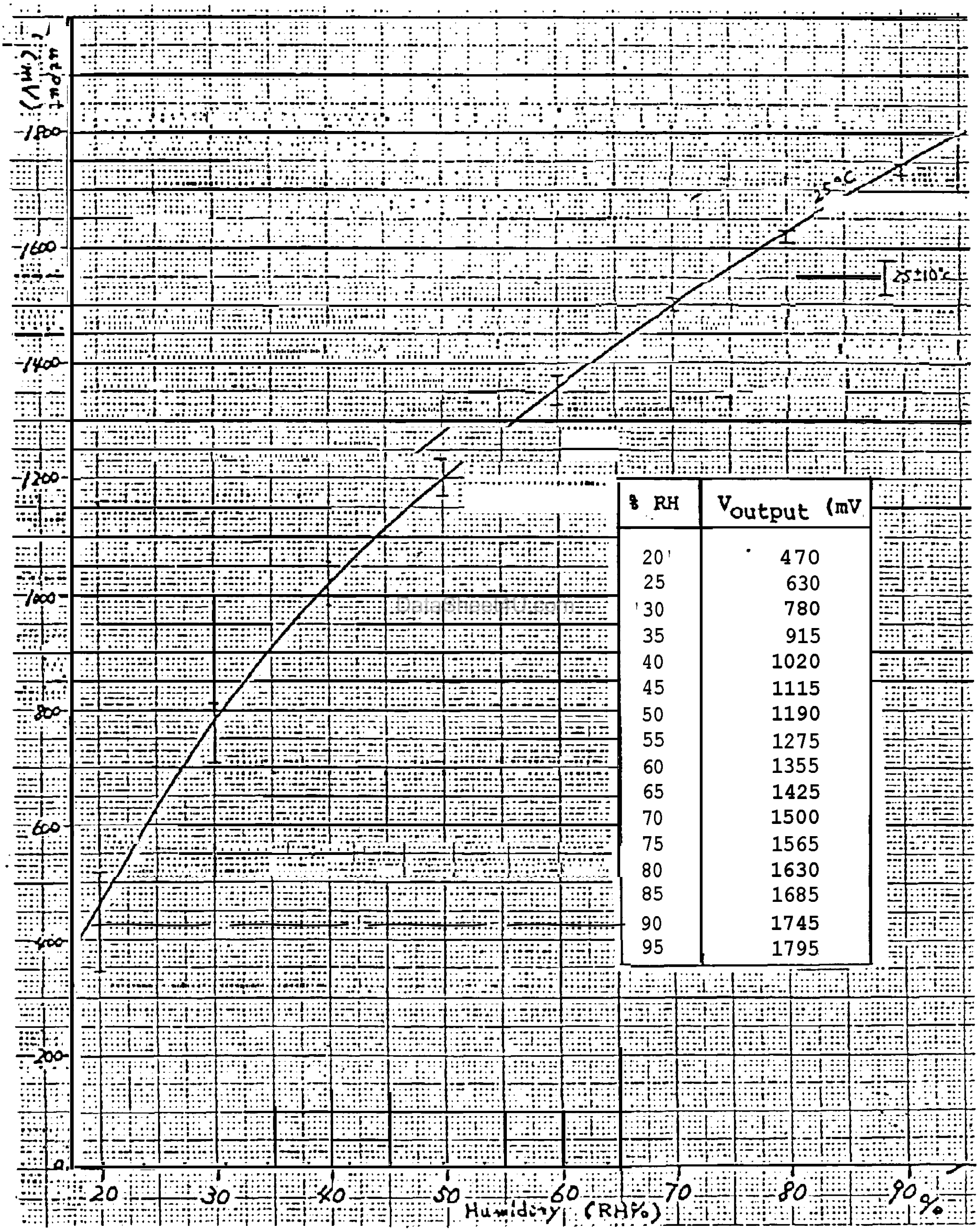
Next, adjust the variable resistor VR1 so that the output voltage (Vo) becomes 1.40 V.

Then, the output characteristics of a Standard sensor are shown on next page.

Since the CGS-14 has stable Performance, accuracy with ±5% RH error level can be attained with this adjustment,

If much higher accuracy is required, **adjustment** and **inspection** are required using a Standard humidity generation bath, etc.
For details on the Standard humidity generation bath, refer to **Section** 6, **which** explains the humidity generation method for Performance **test,** or make inquiry to us.

(3) Output **characteristics**



% RH	V_{output} (mV
20	470
25	630
30	780
35	915
40	1020
45	1115
50	1190
55	1275
60	1355
65	1425
70	1500
75	1565
80	1630
85	1685
90	1745
95	1795

Fig. 9 Output Characteristics HA870410A

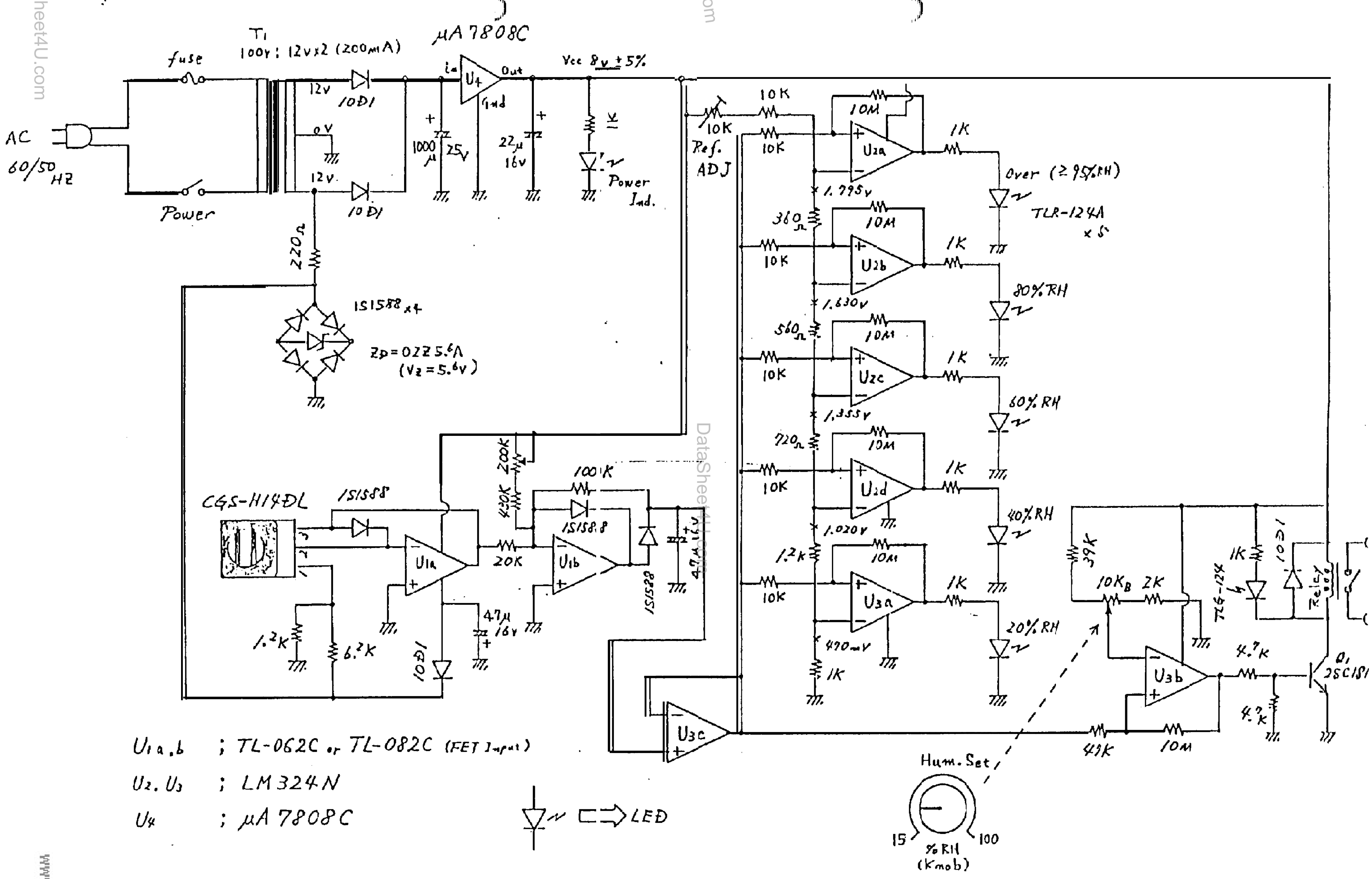
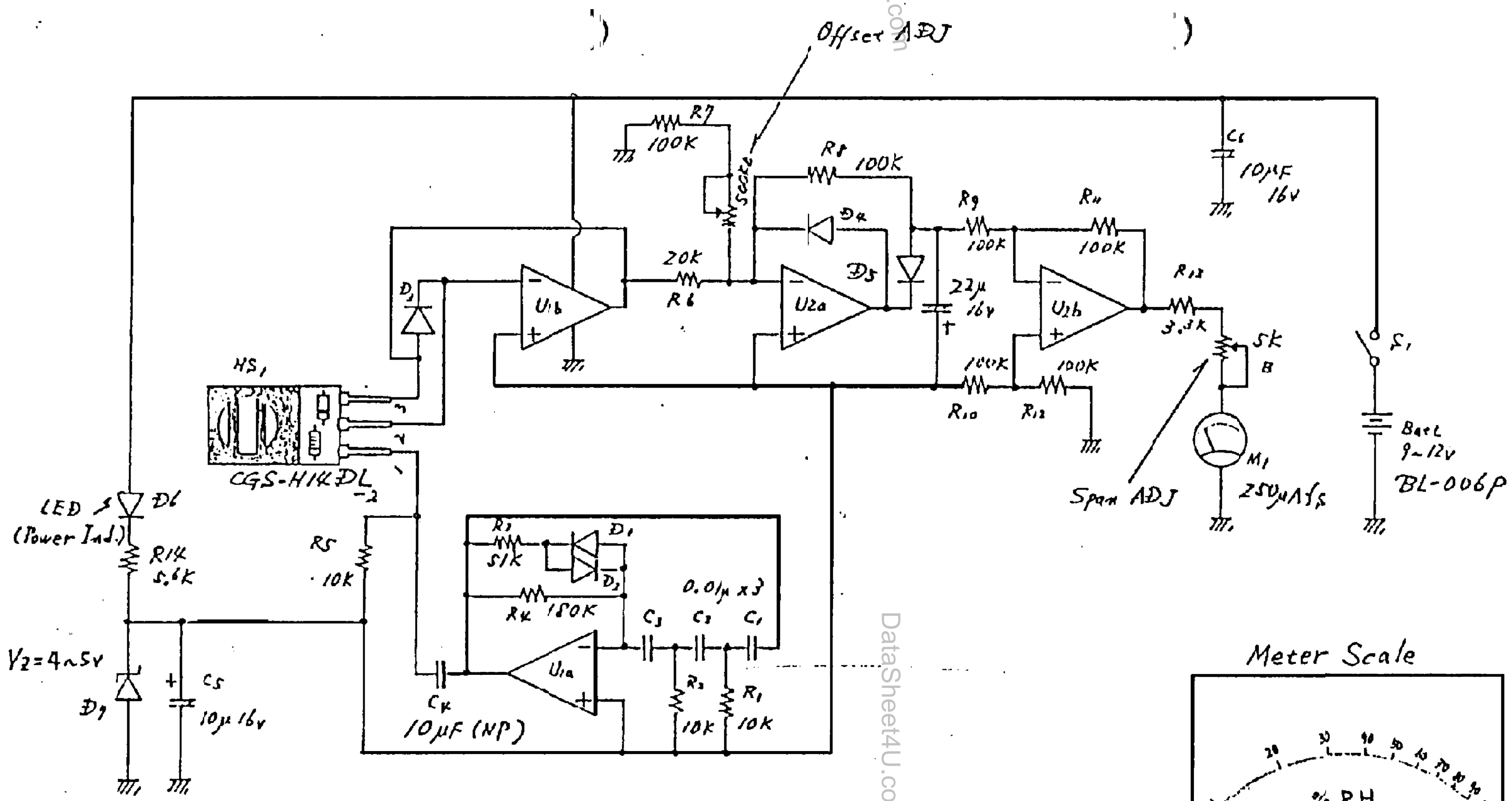


Fig. 10 Humidity Indicator (with relay control)



U1 ; TL-062CP (or TL-082CP)

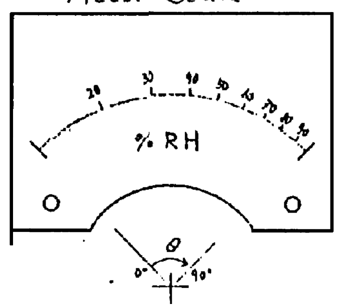
U2 ; LM358C

D1 ~ 5 ; 1N914 (or 1S1588)

D6 ; LED (Red)

D7 ; Zenner Diode $V_2 = 4 \sim 5V$

Meter Scale



% RH	θ (deg)
20	23°
30	38
40	50
50	58
60	66
70	73
80	79
90	85

(f.s = 90°)

Fig. 11 Humidity Checker (Analog Meter)

4-2 CGS-H14 Applications

(1) Circuit example

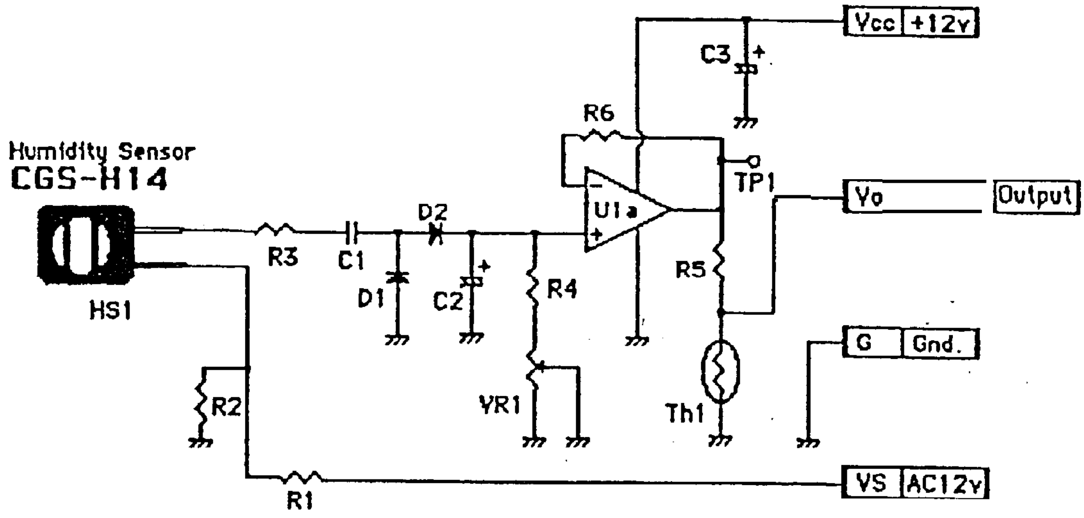
Example is given when CGS-H14 and a temperature compensation thermistor are used.

Output from the humidity sensor is rectified and temperature compensated with the thermistor, then output.

The thermistor cannot perfectly compensate the sensor temperature change against drastic change of ambient temperature. Make sure to use it in an appropriate condition.

It can be used for simple humidity checking and control.

Application Note	N1/a



HC-870412A	CGS-H14

Parts List /

NO.		NO.	
U 1a	OP Amp LM358N,LM324N etc	C 1	Elect. Cap. 0.047uF/50WV
D 1	Si SW Diode 1S1588 / Toshiba	C 2	Elect. Cap. 2.2uF/25WV
D 2	Si SW Diode 1S1588 / Toshiba	C 3	Elect. Cap. 22uf/16WV
Th 1	Thermistor R_{25}=50Kohm B=4100k	HS 1	Humidity Sensor CGS-H 14
R 1	Resistor 2K ohm 1/4w J		
R 2	Resistor 1 k ohm 1/4w J		
R 3	Resistor 22k ohm 1/4w J		
R 4	Resistor 82k ohm 1/4w J		
R 5	Resistor 62K ohm 1/4w J		
R 6	Resistor 10K ohm 1/4w J		
VR 1	Valiable Resistor 200k ohm B		

HC-870412A	CGS-H14

Fig. 12 Application Note   Tabl'e. 4 Parts List

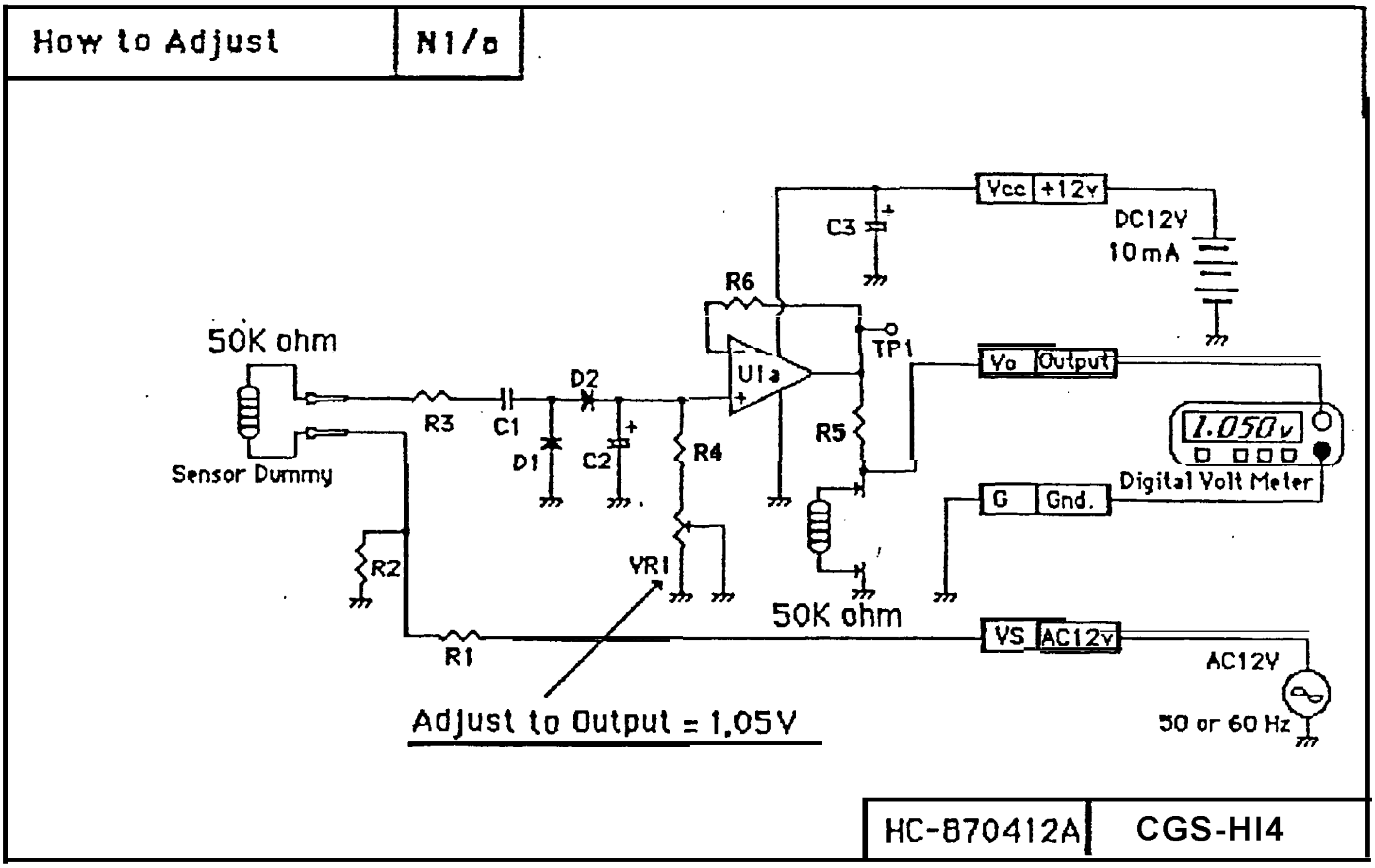


Fig.13 How to Adjust

(2) Circuit adjustment

Connect a 50 **kΩ (≤ +1%)** resistor as **sensor** dummy and a 50 **kΩ (≤ +1%)** resistor for thermistor dummy as shown above.

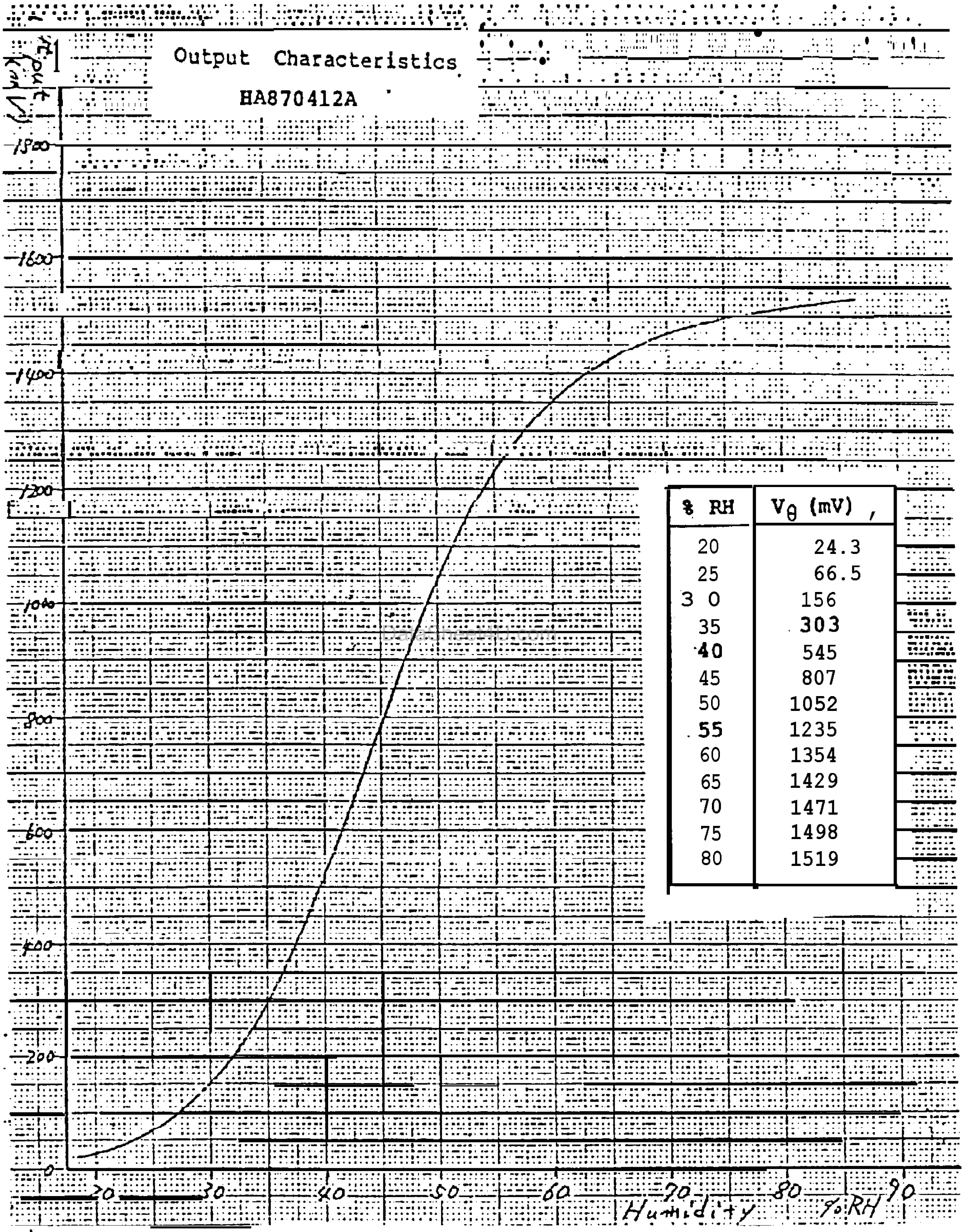
Next, **adjust** the variable resistor **VR1** so that the output voltage (Vo) **becomes** 1.05 V.

Then, with a Standard Sensor, the output characteristics shown on next page are obtained.

As CGS-14 has stable Performance, accuracy of +5% RH error **level can** be attained with this adjustment (provided that the **ambient** temperature is 24 +5°C).

If much higher accuracy is required, a circuit using CGS-H14DL (refer to page 15) is recommended.
For details , please make inquiry to us.

(3) Output characteristics



% RH	V_θ (mV)
20	24.3
25	66.5
30	156
35	303
40	545
45	807
50	1052
55	1235
60	1354
65	1429
70	1471
75	1498
80	1519

Fig. 14

5. CGS-H14DL MOUNTING EXAMPLE

The where and how of mounting a humidity sensor not only affects its Performance but also greatly influences sensor life. Thus, mounting circumstances are crucial to the reliability of the control unit itself. In this section, the mounting of Sensors is described.

5-1 Mounting in Air-conditioner

There are two possible ways of mounting a humidity sensor in an air-conditioner. One is to mount the sensor in the incoming air flow. The advantages of this mounting dre as follows:

a) Fast response

The humidity sensor responds faster when the surrounding air is flowing.

b) Higher accuracy

Higher accuracy can be expected by this direct measurement of incoming air.

The disadvantages of this mounting are as follows:

a) The sensor deteriorates faster due to direct exposure to unclean air.

b) The humidity of the incoming air is controlled, which may not coincide with the humidity condition of a particular room.

Fig. 15 on the next page shows an example of mounting a sensor in the incoming air flow. In this case, the humidity sensor is placed so that its back faces the incoming air. This way prevents dust and smoke particles in the air from sticking to the surface of the humidity sensor, improving sensor life. The response time and accuracy are scarcely affected by mounting the sensor backwards. Therefore, we recommend the sensor be mounted so that the sensor surface does not directly face the air flow.

(See the Fig. 15 on the next page.)

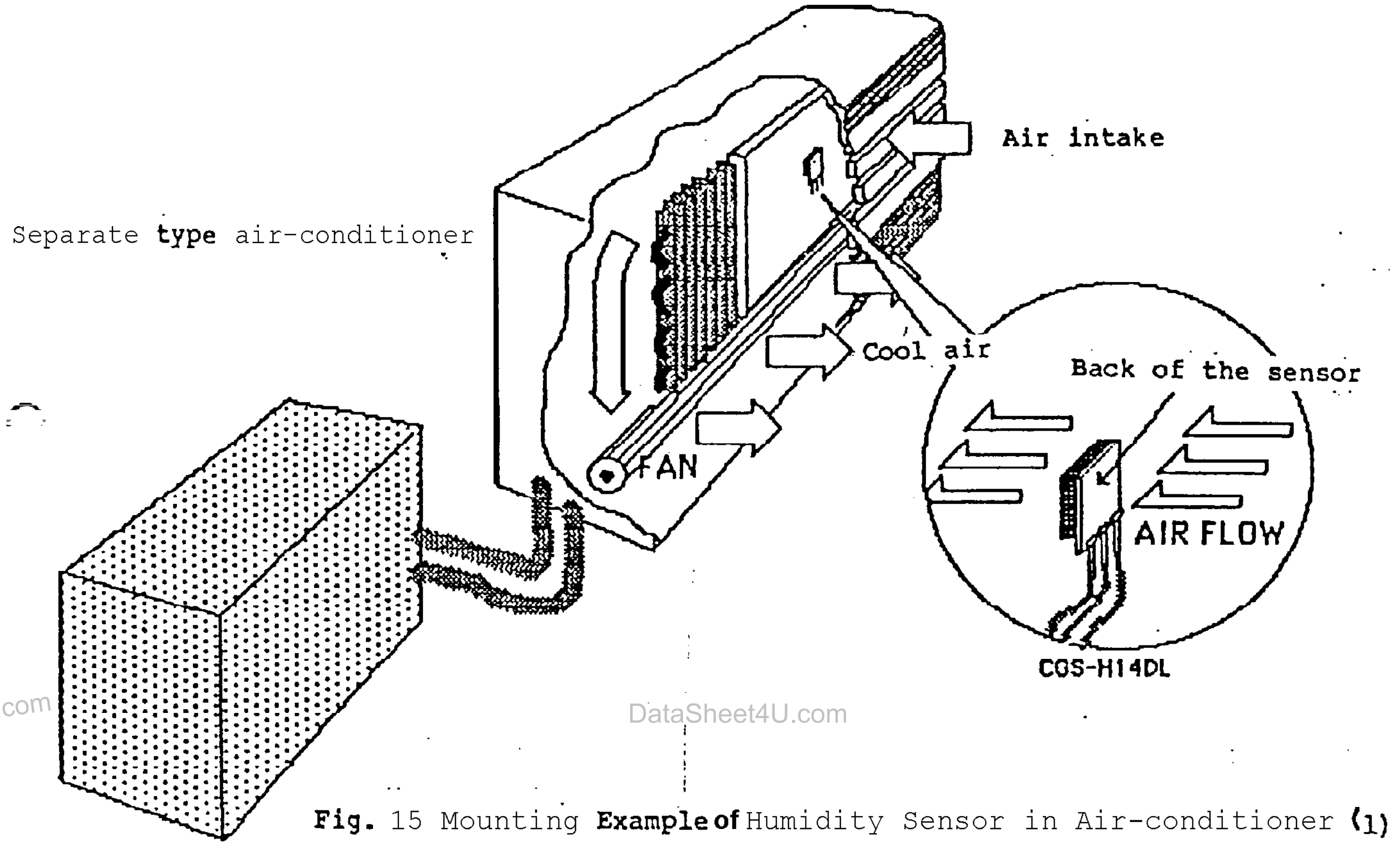


Fig. 15 Mounting Example of Humidity Sensor in Air-conditioner (1)

Another way of mounting is to place the sensor outside the incoming air flow.

The advantages of this mounting are as follows:

a) Longer sensor life

There is less chance of deleterious substances sticking to the surface of the sensor, and therefore a lower degree of dirt can be expected.

b) More comfortable ambient conditions can be expected when the sensor is installed on a wireless Controller, etc.

The disadvantages of this mounting are as follows:

a) Possible delay of response time

As the sensor is not placed in the active air flow, the 'control speed 'may be slower when the surrounding air does not sufficiently circulate.

Fig. 16 on the next page gives examples of mounting a sensor outside the air flow. When mounting the sensor on the main body of the air-conditionor, it is most common to put it near the air inlet for better response speed. It is also possible to mount the sensor on the wireless Controller, and then transmit the humidity data to the main Controller.

(See Fig. 16 on the next page.)

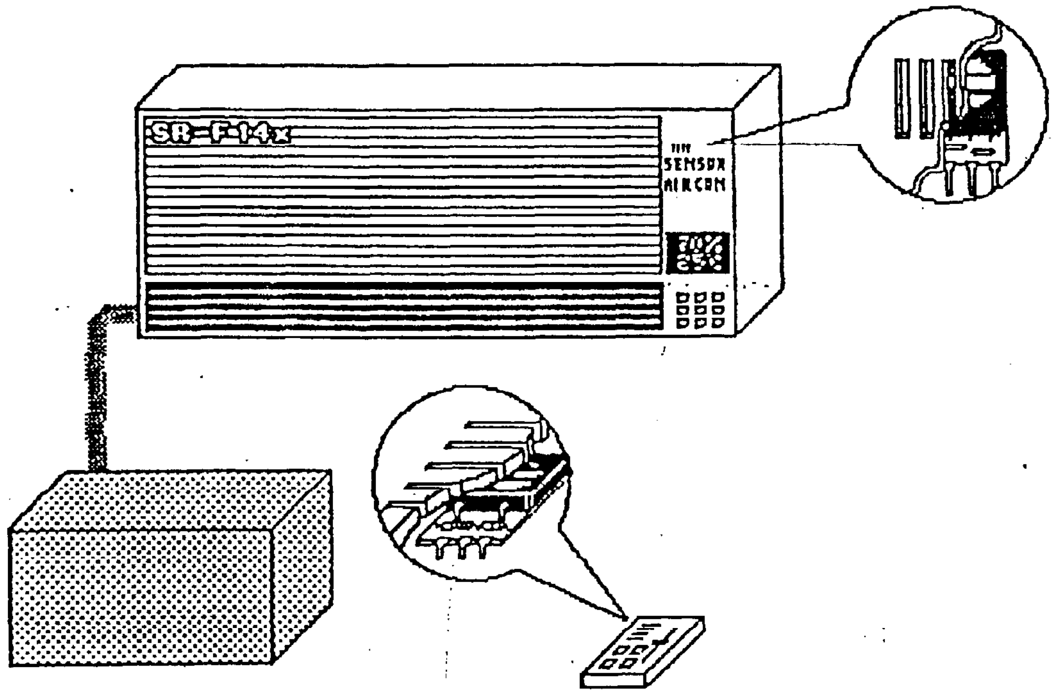


Fig. 16 Mounting Example of Humidity Sensor in Air-conditioner (2)

5-2 **Mounting of Sensor in Dehumidifier**

The humidity **sensor can** be mounted in a dehumidifier in **almost** the same **manner** as in air-conditioners, that is, in the air flow **or** outside the **air** flow.

The **advantages** and disadvantages are the same as with an air-conditioner. Please select the best way **to** suit your requirements.

(An example is illustrated below.)

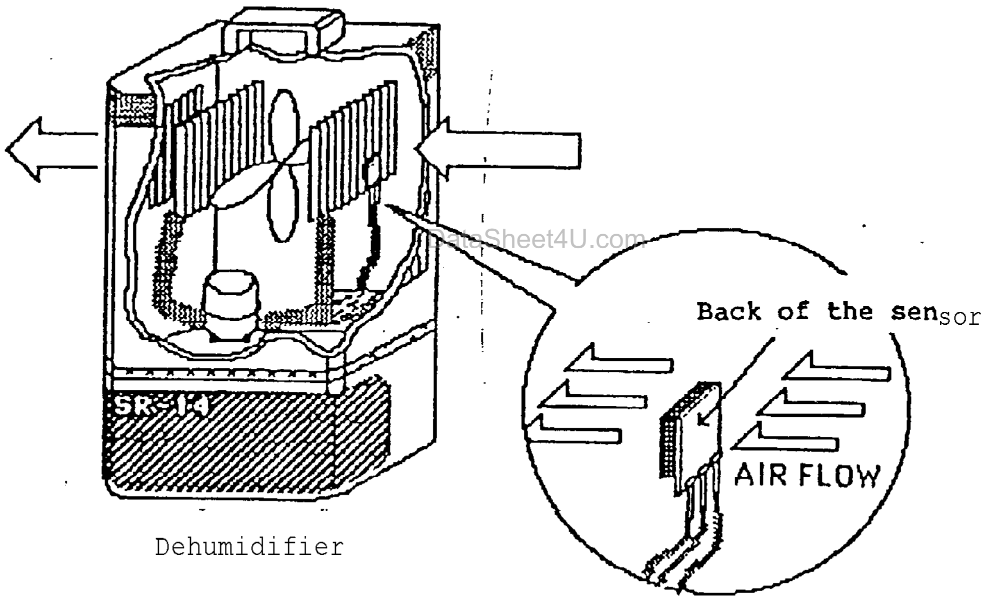


Fig. 17 **Mounting** Example of Humidity Sensor in Dehumidifier

5-3 Mounting of Sensor in Humidifier

In the case of a humidifier, it is most econmical to mount the sensor on the control board. It can also be placed on the outside surface, which does not improve the Performance but appeals to consumers in that the humidifier is controlled by a sensor.

For general use satisfactory Performance is achieved if the sensor is mounted in the air flow created by a fan. In this case, the same precautions should be taken as in the case for air-conditioners concerning dirt on the' sensor. It is effective to put a filter at the air inlet. (An example is given below.)

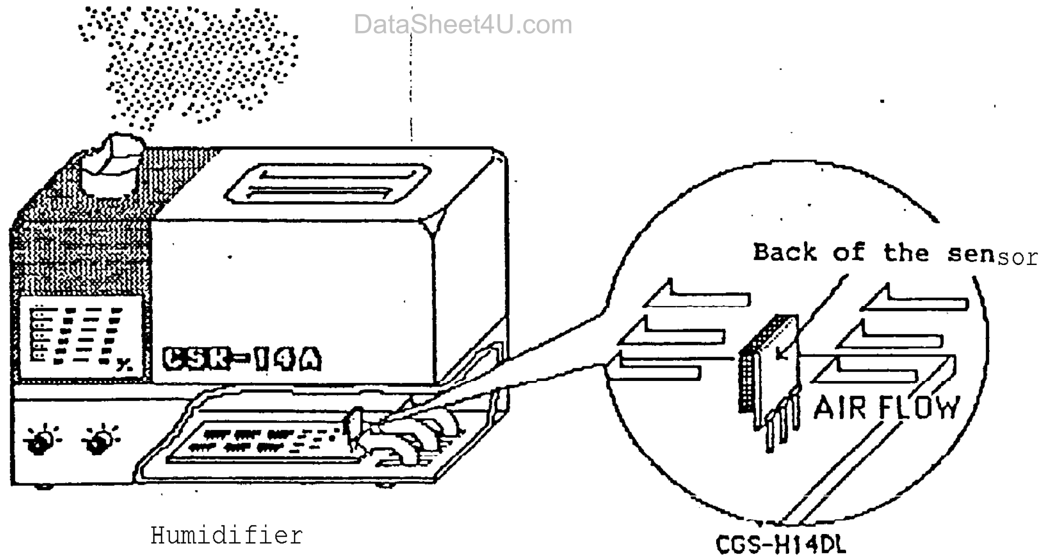


Fig. 18 Mounting Example of Humidity Sensor in Humidifier

5-4 Extension of Sensor Wiring

With some equipment, a sensor cannot be mounted directly on the printed circuit board. In such cases, it is necessary to extend the wiring from the sensor. When extending the wiring from the sensor, one should note the following items:

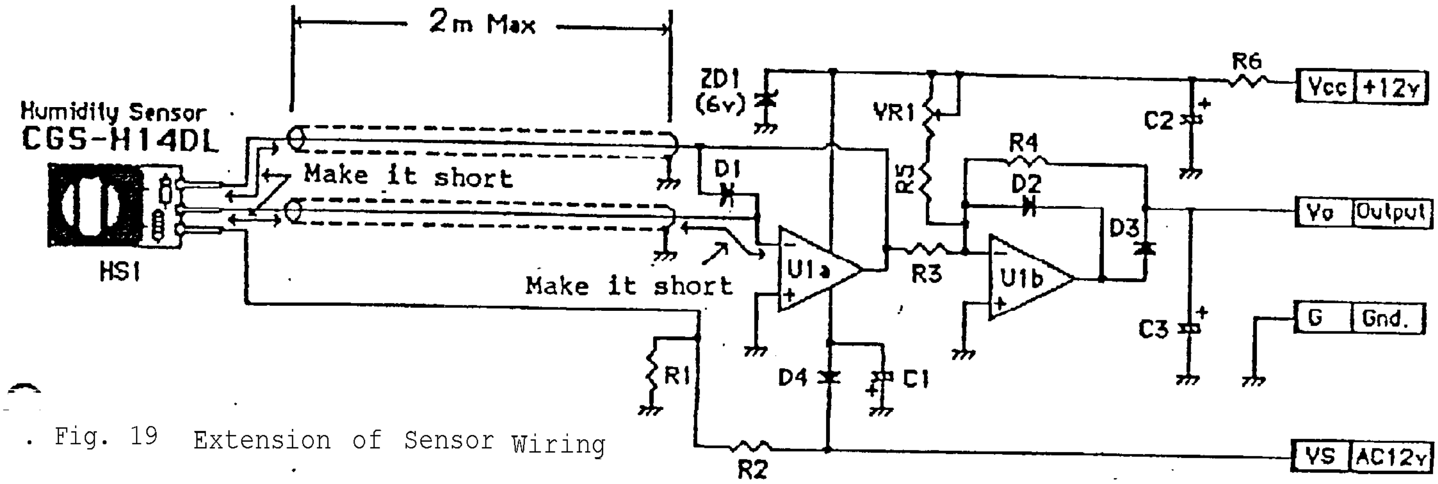
(1) Use shieled cables for extension.

(2) Wiring extension affects the Performance especially in a low humidity environment. Pay special attention when a humidity range of 10 - 20% RH is involved in measurement and control.

(3) Watch out for noise. Sensor impedance can reach 10 MΩ in low humidity.

(4) When the lowest limit of measured (controlled) humidity is 40% RH and the extension distance is less than 50 cm, it is not necessary to use shielded cables. In that case, take special note of noise.

*** For the use of shielded cables, refer to the following diagram.



. Fig. 19 Extension of Sensor Wiring

6. METHOD OF KNOWN HUMIDITY GENERATION FOR PERFORMANCE TEST OF SENSOR

To test the circuit design and Performance of the equipment incorporating a humidity sensor, stable and accurate known humidity generation is necessary.

Humidity generation is also needed for acceptance test of the Sensor.

Here, a simple, economical and also accurate way of making . fixed humidity points without elaborate' equipment will be discussed.

6-l Methods of Known Humidity Generation

The following methods have been used for this purpose.

1) Saturated salt Solution
2) Method of changing both temperature and pressure

The latter method needs special equipment and it is not easy to acquire the required experimental apparatus. Thus, the former method using saturated salt solufion will be discussed here. However, when efficient inspection for large quantities of products (inspection of mass production) is needed, the second method is recommended.

*** We do not recommend the use of a constant temperature bath with a humidity generation function because it cannot provide a stable humidity. Therefore we cannot reply to inquiries concerning data obtained using such apparatus.

6-2 Saturated Salt Solution

Dissolve a specific salt solute into demineralized water and put the Solution into a air-tight Container. Then, the air confined in the Container with the Solution will attain a specific relative humidity depending on the kind of salt used. This equilibrium is used to make humidity fixed points. The only materials needed for this method are the followings:

1) Salt solutes (for the number of fixed points needed)
2) Demineralized water
3) Plastic Containers (for the the number of fixed points needed)
4) Small fan for air agitation
5) Others (adhesives for sealing, etc.)
6) Constant temperature bath when higher accuracy is required.

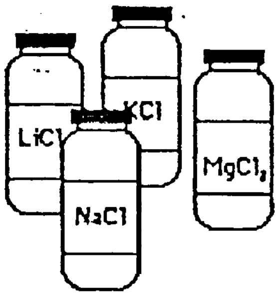
For the kinds of "salt," refer to the table on next page.

(1) Humidity fixed point table

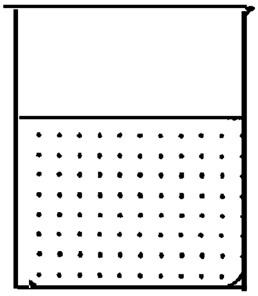
Table 5 Humidity Fixed Points by Kind of Salt

	Lithium chloride	Magnesium chloride	Magnesium nitrate	Sodium chloride	Potassium chloride
Temp. (°C)	LiCl (%RH)	$MgCl_2$ (%RH)	$Mg(NO_3)_2$ (%RH)	NaCl (%RH)	Kcl (%RH)
0	11.23±0.54	33.66±0.33	60.35±0.55	75.51±0.34	88.61±0.53
5	11.26±0.47	33.60±0.28	58.86±0.43	75.65±0.27	87.67±0.45
10	11.29±0.41	33.47±0.24	57.36±0.33	75.67±0.22	86.77±0.39
15	11.30±0.35	33.30±0.21	55.87±0.27	75.61±0.18	85.92±0.33
20	11.315r0.311	33.07±0.18	54.38±0.33	75.47±0.14	85.11±0.29
25	11.30±0.27	32.78fp.16	52.89±0.22	75.29±0.12	84.34±0.26
30	11.28±0.24	32.44±0.14	51.40±0.24	75.09±0.11	83.62±0.25
35	11.25±0.22	32.05±0.13	49.91±0.29	74.87±0.12	82.95±0.25
40	11.21±0.21	31.60±0.13	48.42±0.37	74.68±0.13	82.32±0.25
45	11.16f0.21	31.10±0.13	46.930.40	74.52±0.16	81.74±0.28
50	11.10±0.22	30.54±0.14	45.44±0.66	74.43±0.19	81.20±0.31
55	11.03±0.23	29.93±0.14		74.41±0.24	80.70±0.35
60	10.95±0.26	29.26±0.18		74.50±0.30	80.25±0.41
65	10.86±0.29	28.54±0.21		74.71±0.37	79.85±0.48
70	10.75±0.33	27.77±0.25		75.06±0.45	79.49±0.57
75	10.64±0.38	26.94±0.29		75.58±0.55	79.17±0.66
80	10.51±0.44	26.05±0.34		76.29±0.65	78.90±0.77

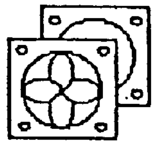
(2) Necessary materials



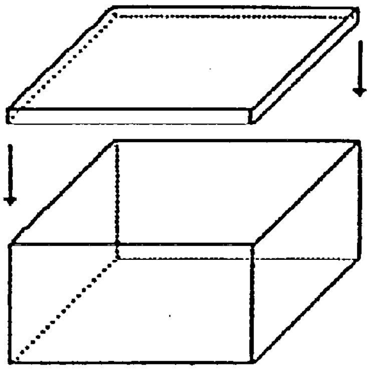
(1) Salt



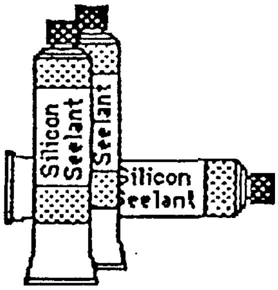
(2) , Demineralized water



(3) Small fan



(4) Air-tight Containers (plastic)



(5) Sealing adhesive (Silicone Sealant, etc)

Note: Use plastic containers only.
Some salts erode metals.

Fig. 20 Necessary Materials

(3) How to make saturated salt Solution

1) Prepare demineralized water of 40 - 60°C (500 cc for each salt, though minor adjustment may be necessasry depending on the Container).

2) Put the salt in a Container and gradually add the water. "Saturated" state means that salt is not dissolved completely, thus you should observe a little salt still remainining. Take care not to add too much water.

3) Cover the Container with a lid and seal. Let it stand at least for 6 h for the Solution adjust to room temperature. It is recommended, therefore, to prepare a large'quantity of saturated water at one time when many humidity fixed points are needed.

Fixed points.can be made with the above method.

When using the solution, please note the following:

1) If the container is opened and shut, wait 20 min. before measuring.

2) Agitate the air constantly with the fan. Keep the fan just strong enough to agitate the air thoroughly in the Container. If the solution's surface is rippled, it is too strong. If the agitation is too strong, tiny Solution particles will be released and such particles cause the sensor to deteriorate when they adhere to the sensor surface.

3) If the temperature of the solution has changed, let the Solution stand for 2 - 4 h before measurement.

Keeping the above precautions and correctly controlling the temperature, allows the saturated salt Solution method to be effective with a reproductivity of ±1% RH.

The method of making saturated salt solution is illustrated below.

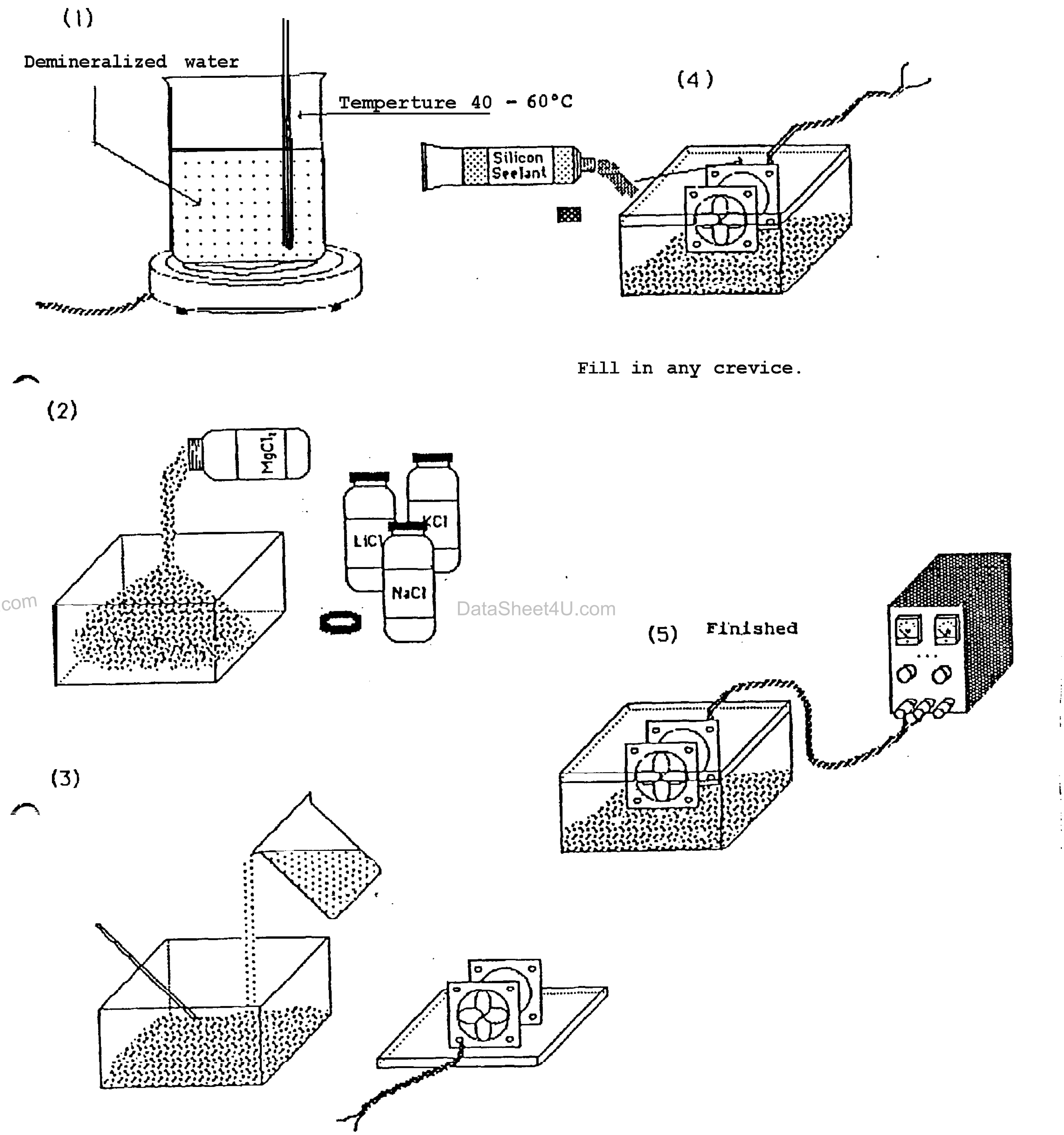

(1)
Demineralized water
Temperture 40 - 60°C
(4)
Silicon Seelant
Fill in any crevice.
(2)
MgCl$_2$
LiCl
KCl
NaCl
(5) Finished
(3)

Fig. 21