# AM1011A Technical Manual

## Temperature and Humidity Sensor

- •Completely interchangeable
- •Analog voltage output
- •Excellent long-term stability
- •Low power consumption, small size, high cost performance

## Product overview

AM1011A analog temperature and humidity module is a temperature and humidity sensor with calibrated analog signal output.This module has high precision, high reliability, good consistency, and with temperature compensation, to ensure good long-term stability, easy to use and high cost performance characteristics, especially suitable for the quality, cost requirements of more demanding enterprises.

## Application scope

HVAC system, dehumidifier,test and inspection equipment,consumer goods,automobiles,automatic control, data recorder,weather station,household appliances,humidity regulation,medical and other related temperature and humidity detection and control.

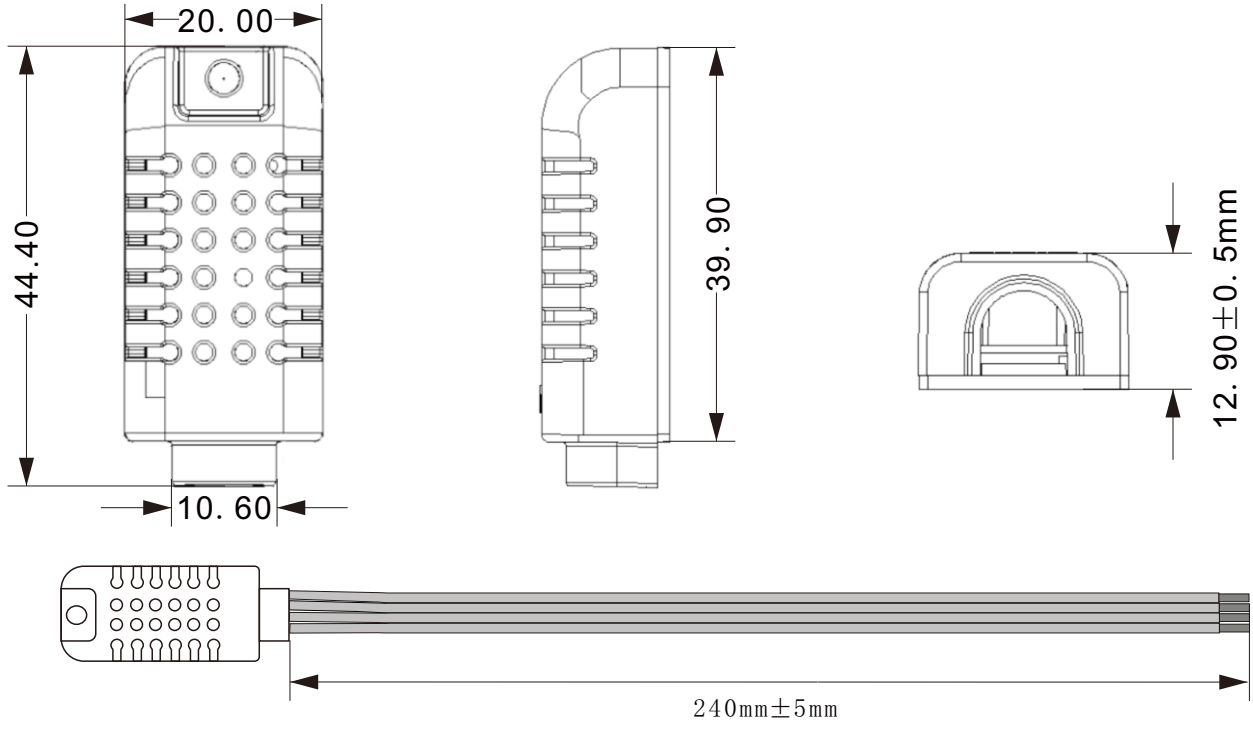



Figure 1: AM1011A Sensor Package Diagram (Unit: mm  Unmarked tolerance: 0.2 mm)

# Sensor performance

## Relative humidity

| Parameter | Condition | Min | Typical | Max | Unit |
|---|---|---|---|---|---|
| Resolution ratio | | | 0.1 | | %RH |
| Measuring range | extended[1] | 0 | | 99.9 | %RH |
| Accuracy[2] | | | ± 3 | See Figure 2 | %RH |
| Repeatability | | | ± 1 | | %RH |
| Interchangeability | | completely interchangeable | | | |
| Response time[3] | 1/e(63%) | | <6 | | S |
| Hysteresis | | | ± 0.3 | | %RH |
| Drift[4] | | | <0.5 | | %RH/yr |

Table 1 Humidity Characteristic

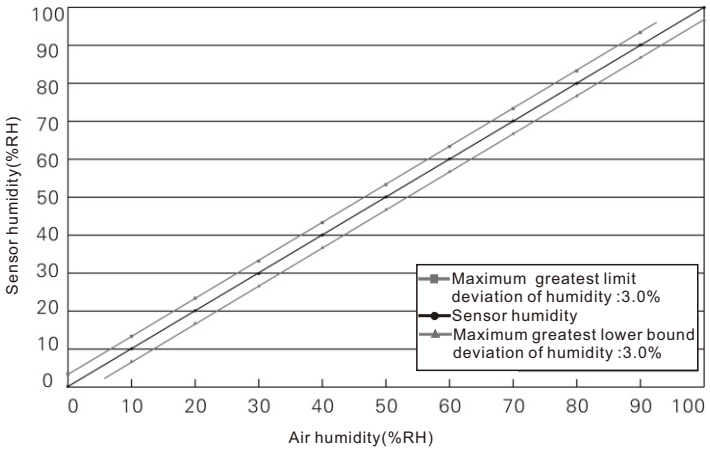



Figure2 the maximum error of relative humidity at 25℃

## Temperature

The humidity sensor is NTC10k thermistor temperature, and the sensor parameters are shown in table 2.

| Specifications | Rated zero power resistance (R25) | B (K) | Coefficient of heat transfer (mw/℃) | Thermal time constant(S) | Rated power (mw) | Operating temperature range(℃) |
|---|---|---|---|---|---|---|
| CN0603R103B3435FT | 10KΩ | 3435 | ≥ 2.5 | ≤ 18 | 150 | -40~80 |

Table2 Technical parameters of 10K NTC B3.3435

# Electric specification

| Parameter | Condition | Min | Typical | Max | Unit |
|---|---|---|---|---|---|
| Voltage | | 4.75 | 5.0 | 5.25 | V |
| Humidity voltage output range | | 0 | | 3 | V |
| Power consumption[5] | Measure | | 1.5 | | mA |
| Humidity sampling period | | 2 | 2.5 | | S |
| Temperature range | NTC 10K | -40 | | 80 | ℃ |
| Temperature output | NTC 10K | - | - | - | - |

Table3 Electric specification

1 Normal working scope: 0 - 80% RH. Sensor reading will be deviated if beyond this range, (drift < 3% RH after 200 hours at 90% RH humidity). The working scope is further limited to - 40– 80℃.

2 This precision is the test precision of the sensor with 5V voltage at 25℃ excluding hysteresis and nonlinearity, and only suitable for non-condensation conditions.

3 The time required to reach 63% of the first-order response under the conditions of 25℃ and 1 m/s air flow.

4 If the sensor is surrounded by volatile solvents, irritating tapes, adhesives and packaging materials, the reading may be higher. For more information, please refer to the relevant documents.

5 The minimum and maximum of power consumption are based on the conditions of VDD = 5 V and T < 60 ℃. The average value is value measured every two seconds.

# AM1011A User Guide

## 1 Expansion of performance

### 1.1 Working conditions

The sensor performance is stable in the suggested working scope, as shown in Figure 3.Long-term exposure to abnormal scope,especially when humidity > 80%,may lead to temporary signal drift (drift + 3% RH after 60 hours).When the sensor is restored to normal working conditions,it will slowly restore itself to the correct state.Refer to Recovery Processing in Section 2.2 to speed up the recovery process.Long-term use under abnormal conditions will accelerate the aging of products.

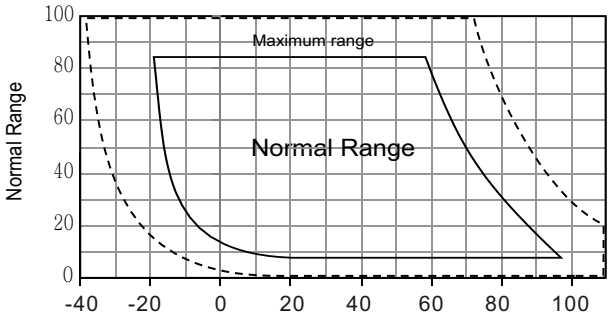



Figure 3 Working Conditions

### 1.2 RH accuracy at different temperatures

The RH accuracy at 25℃ is defined in Figure. 2, and the typical humidity error at other temperatures is shown in Fig. 4.

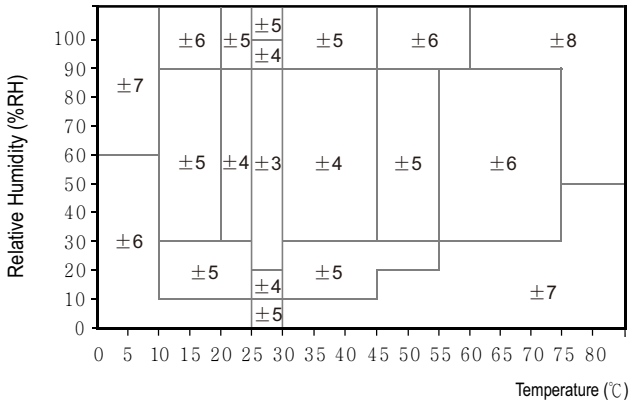



Figure 4 Typical humidity error between 0~80 °C, unit: (% RH)

Note: Above errors are the tested typical errors (excluding hysteresis) with the high precision dew-point instrument as reference instrument.

## 2 Application information

### 2.1 Storage conditions and instructions

The humidity sensitivity level (MSL) is 1, according to IPC/JEDEC J-STD-020 standard. Therefore, it is recommended to use it within one year after delivery.

Humidity sensor is not an ordinary electronic component, and it needs careful protection, which users must pay attention to. Long-term exposure to high concentration of chemical vapor will cause the sensor reading to drift.Therefore, it is recommended that the sensor be stored in the original package including sealed ESD bag, and meet the following conditions: temperature range 10℃ - 50℃ (0 - 85℃ in a limited time), humidity 20 - 60% RH (no ESD packaged sensor). For sensors that have been removed from the original package, we recommend that they be stored in antistatic bags made of metal PET / AL / CPE.

During production and transportation, sensors should avoid exposure to high concentration of chemical solvents and prolonged exposure. Avoid exposure to volatile glue, adhesive tape, stickers or volatile packaging materials, such as foamed foil, foam material, etc. The production area should be well ventilated.

### 2.2 Recovery processing

As mentioned above, if the sensor is exposed to extreme working conditions or chemical vapor, the reading will drift. It can be restored to the calibration state by processing as follows.
Drying: Keep for 10 hours at 80 - 85℃ and less than 5% RH humidity.
Rehydration: Keep for 12 hours[6] at 20 - 30℃ with the humidity of more than 75 % RH.

### 2.3 Temperature influence

The relative humidity of gases depends largely on temperature. Therefore, when measuring humidity, all sensors measuring the same humidity should work at the same temperature as possible. When testing, it is necessary to ensure that the tested sensors and reference sensors are at the same temperature, and then compare the humidity readings.
Moreover, when the measurement frequency is too high, the temperature of the sensor itself will rise, which will affect the measurement accuracy. In order to make its temperature rise below 0.1℃, the activation time of AM1011A should not exceed 10% of the measurement time - it is recommended to measure data every 2 seconds.

6 75%RH can be easily generated from saturated NaCl.

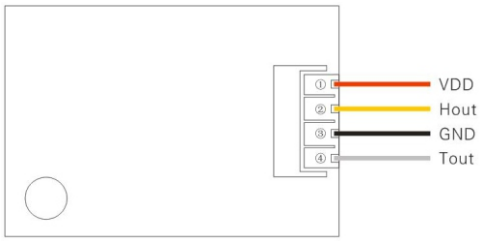
## 2.4 Material used for sealing and encapsulation

Many materials absorb moisture and act as buffer, which will increase response time and hysteresis. Therefore, the material around the sensor should be carefully selected. Recommended materials are: metal materials, LCP, POM (Delrin), PTFE (Teflon), PE, PEEK, PP, PB, PPS, PSU, PVDF, and PVF. Material for sealing and bonding (conservative recommendation): It is recommended to use method of filling epoxy resin or silicone resin for packaging electronic components. Gases released from these materials may also contaminate AM1011A (see 2.1). Therefore, the sensor should be finally assembled and placed in a well-ventilated place, or dried for 24 hours in an environment of > 50℃, in order to release the contaminated gas before packaging.

# 3 Interface definition

| Pin | Color | Name | Descripition |
|---|---|---|---|
| 1 | Red | VDD | Power (4.75V-5.25VDC) |
| 2 | Yellow | Hout | Humidity output (0-3VDC) |
| 3 | Black | GND | Ground |
| 4 | White | Tout | The temperature is NTC10k thermistor |

Table 4 Interface definition description




## 3. 1 The power supply pins（VDD GND）

The power supply voltage of this module is 4.75v ~ 5.25v, and the recommended power supply voltage is 5.0v

## 3. 2 Voltage output signal line（Hout）

Humidity signal is output from the signal line in the form of voltage, and the voltage output range is 0-3V. For the specific relationship between humidity and voltage, please refer to the voltage and humidity characteristic table (table 5).

## 3. 3 Temperature output signal line（Tout）

The temperature sensor is 10k NTC b.3435 thermistor rather than the analog signal output, the user needs to add read circuit, temperature measurement range is - 40 ~ 80 ℃.

## 3.4 Schematic diagram of connection mode of temperature sensor

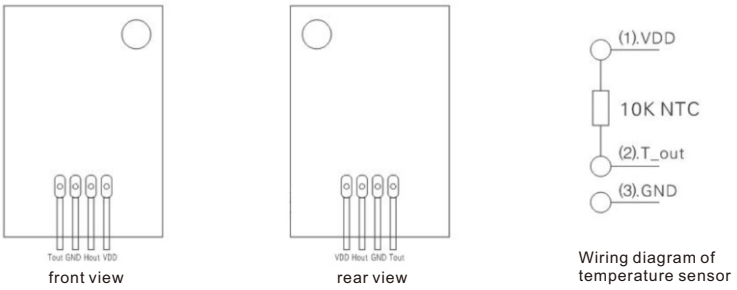



Figure 5 Schematic diagram of temperature connection mode

# 4Electrical characteristics

Electric specifications include power consumption, high and low voltage of input and output, voltage of power supply. In order to make the sensor communication smooth, it is important to ensure that the signal design is strictly limited to the range given in Tables 3.

## 4.1 Standard humidity output voltage (debugging free)

(Conditions：at25℃, Vin=5.0V)Unit：V

Table5 AM1011A Standard humidity output voltage corresponding table

| Relative humidity (%RH) | 0 | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Output voltage (V) | 0 | 0.3 | 0.6 | 0.9 | 1.2 | 1.5 | 1.8 | 2.1 | 2.4 | 2.7 | 3.0 |

Full range of temperature compensation, full range microcontroller calibration output, output impedance, below 5kΩ

## 4.2 Relationship between humidity and output voltage

Humidity conversion formula:

Humidity =Voltage /0.03(%RH)

### 4.3 Linear curve of voltage output and humidity

The humidity measurement range of the sensor is 0-100%RH, and the voltage output is 0-3.0V.The linear relationship between voltage and humidity is shown in figure 6:

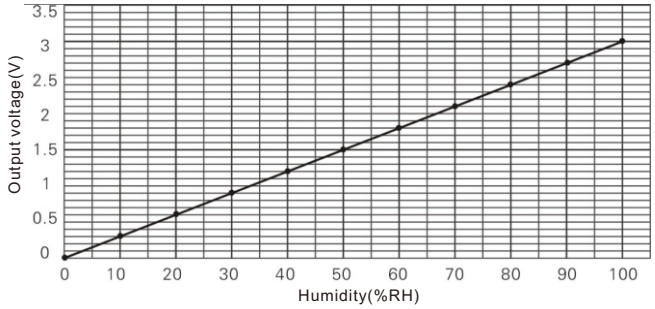



Figure6 Linear curve of voltage output and humidity

### 4. 4 NTC 10K thermistor temperature corresponding resistance value table

Resistance value of standard temperature output (free from debugging) :

Table6:10K NTC B.3435 temperature and resistance corresponding table

| Temperature (℃) | 0 | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 |
|---|---|---|---|---|---|---|---|---|---|
| Resistance (kΩ) | 27.90 | 18.22 | 12.12 | 8.31 | 5.80 | 4.12 | 3.00 | 2.21 | 1.66 |

10kΩ NTC See attached table for details: resistance - temperature characteristic table

## 5 Environmental stability

If the sensor is used in equipment or machinery, please make sure that it is the same temperature and humidity that the sensor used for measurement and the sensor used for reference that have sensed. If the sensor is placed in the equipment, the reaction time will be prolonged, so it is necessary to ensure that sufficient measurement time is reserved in the programming. The AM1011A sensor is tested according to the enterprise standard of Aosong temperature and humidity sensor. The performance of sensors under other test conditions is not guaranteed and cannot be regarded as a part of sensor performance. Especially for the specific occasions required by users, we do not make any commitments.

## 6 Package

### 6. 1 Tracking information

All AM1011A sensors have laser identification on the back as shown in figure 7

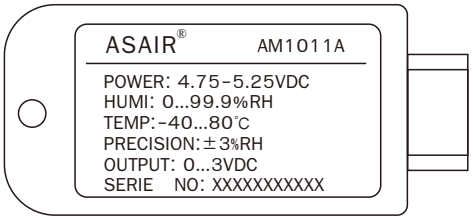



Figure 7 sensor laser identification

The back of the box is also tagged, as shown in figure 8, and provides additional tracking information.

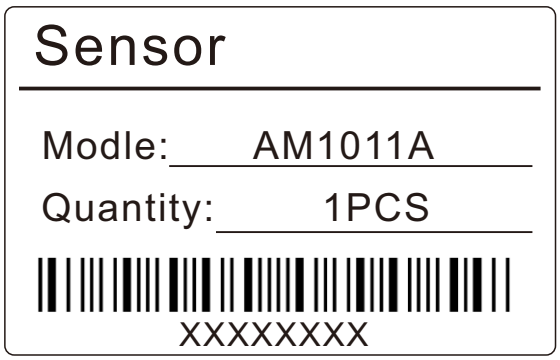
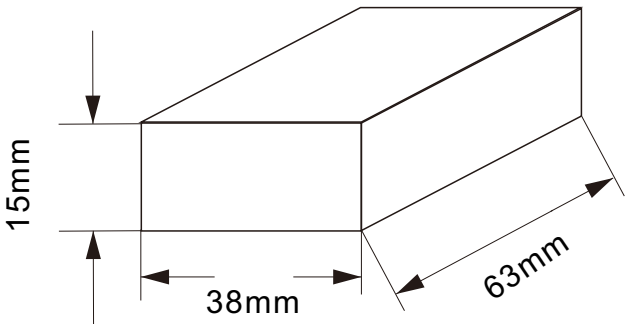


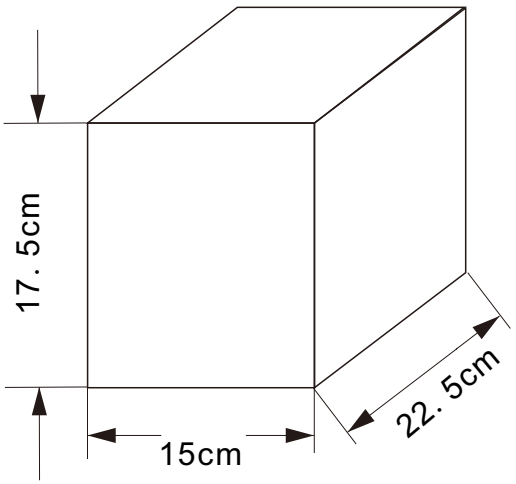

Figure8 The label on the color box

### 6.2 Transport packaging

AM1011A is independently packaged in a color box, each color box is packaged with a sensor, each 100 color boxes are placed in a carton, a total of 100 sensors.The dimensions of color boxes and cartons are shown in figure 9.




Color box size drawing: tolerance ±2mm




Outer carton dimension drawing: tolerance ±5mm

Figure 9 Color box and carton size drawing

## Version

| Date | Version | Page | Alteration |
|---|---|---|---|
| 2019/03 | V1.0 | 1-8 | Initial Version |

This manual is likely to change sometime without prior notice.

# Attention

## Warning of personal injury

Do not apply this product to safety protection devices or emergency stop equipment, as well as any other applications that may cause personal injury due to the failure of the product. This product cannot be used unless there is a special purpose or with an authorization to use it. Please refer to the product data sheet and Application guide before installing, processing, using or maintaining the product. Failure to comply with this recommendation may result in death and serious bodily injury.

If the Buyer intends to purchase or use the Aosong products without any application license and authorization, the buyer shall bear all compensation for personal injury and death resulting therefrom, and shall not claim for compensation including various costs, compensation fees, lawyers, etc. Expenses and so on with the managers and employees of Aosong Company, as well as subsidiaries, agents, distributors, etc.

## ESD protection

Due to the inherent component design, it is sensitive to static electricity. In order to prevent the damage and the reduction of the product's performance caused by static electricity, the necessary anti-static measures should be taken when applying this product.

## Quality assurance

Our company provides 12-month (1-year) quality assurance for buyers of its products (calculated from the date of delivery) based on the technical specifications in the data manual of the product published by Aosong. If the product is found to be defective under warranty, our company will provide free maintenance or replacement. Users need to satisfy the following conditions:

- Notify our company in writing within 14 days after the defect is found
- The defect of this product will help to find out the deficiency in design, material and technology of our product.
- The product should be sent back to our company at the buyer's expense.
- The product should be under warranty.

Our company is only responsible for the defective products which are used in the occasions that meet the technical requirements of the product. Our company makes no warranties or written representations regarding the use of its products in special application occasions.

At the same time, the company does not make any commitment to the reliability of the products applied to products or circuits.

**Attached table NTC 10k resistance-temperature characteristic table**

| T(℃) | RMin(KΩ) | RNor(KΩ) | RMax(KΩ) | T(℃) | RMin(KΩ) | RNor(KΩ) | RMax(KΩ) |
|---|---|---|---|---|---|---|---|
| -40 | 218.9971 | 228.2376 | 237.8441 | -1 | 28.9630 | 29.5745 | 30.1959 |
| -39 | 206.2948 | 214.8696 | 223.7783 | 0 | 27.6951 | 28.2671 | 28.8480 |
| -38 | 194.4226 | 202.3826 | 210.6475 | 1 | 26.4908 | 27.0257 | 27.5687 |
| -37 | 183.3204 | 190.7126 | 198.3831 | 2 | 25.3463 | 25.8466 | 26.3542 |
| -36 | 172.9331 | 179.8005 | 186.9219 | 3 | 24.2585 | 24.7264 | 25.2008 |
| -35 | 163.2098 | 169.5919 | 176.2059 | 4 | 23.2242 | 23.6617 | 24.1051 |
| -34 | 154.1034 | 160.0366 | 166.1815 | 5 | 22.2404 | 22.6495 | 23.0638 |
| -33 | 145.5707 | 151.0884 | 156.7995 | 6 | 21.3044 | 21.6869 | 22.0739 |
| -32 | 137.5716 | 142.7046 | 148.0144 | 7 | 20.4136 | 20.7711 | 21.1327 |
| -31 | 130.0693 | 134.8459 | 139.7840 | 8 | 19.5655 | 19.8996 | 20.2373 |
| -30 | 123.0294 | 127.4759 | 132.0698 | 9 | 18.7578 | 19.0700 | 19.3854 |
| -29 | 116.4204 | 120.5608 | 124.8359 | 10 | 17.9884 | 18.2801 | 18.5746 |
| -28 | 110.2132 | 114.0696 | 118.0492 | 11 | 17.2553 | 17.5276 | 17.8025 |
| -27 | 104.3805 | 107.9735 | 111.6791 | 12 | 16.5564 | 16.8108 | 17.0673 |
| -26 | 98.8973 | 102.2459 | 105.6972 | 13 | 15.8901 | 16.1275 | 16.3668 |
| -25 | 93.7405 | 96.8620 | 100.0775 | 14 | 15.2547 | 15.4762 | 15.6994 |
| -24 | 88.8883 | 91.7990 | 94.7955 | 15 | 14.6484 | 14.8550 | 15.0631 |
| -23 | 84.3209 | 87.0357 | 89.8288 | 16 | 14.0699 | 14.2625 | 14.4564 |
| -22 | 80.0197 | 82.5523 | 85.1565 | 17 | 13.5176 | 13.6972 | 13.8778 |
| -21 | 75.9675 | 78.3306 | 80.7593 | 18 | 12.9903 | 13.1576 | 13.3257 |
| -20 | 72.1481 | 74.3538 | 76.6191 | 19 | 12.4867 | 12.6425 | 12.7989 |
| -19 | 68.5468 | 70.6058 | 72.7194 | 20 | 12.0056 | 12.1505 | 12.2960 |
| -18 | 65.1498 | 67.0723 | 69.0446 | 21 | 11.5459 | 11.6806 | 11.8158 |
| -17 | 61.9440 | 63.7394 | 65.5803 | 22 | 11.1064 | 11.2316 | 11.3571 |
| -16 | 58.9176 | 60.5946 | 62.3132 | 23 | 10.6862 | 10.8025 | 10.9190 |
| -15 | 56.0594 | 57.6261 | 59.2307 | 24 | 10.2844 | 10.3923 | 10.5002 |
| -14 | 53.3589 | 54.8228 | 56.3212 | 25 | 9.9000 | 10.0000 | 10.1000 |
| -13 | 50.8065 | 52.1745 | 53.5741 | 26 | 9.5249 | 9.6248 | 9.7248 |
| -12 | 48.3931 | 49.6717 | 50.9791 | 27 | 9.1662 | 9.2658 | 9.3656 |
| -11 | 46.1103 | 47.3056 | 48.5269 | 28 | 8.8230 | 8.9223 | 9.0218 |
| -10 | 43.9502 | 45.0676 | 46.2088 | 29 | 8.4946 | 8.5934 | 8.6925 |
| -9 | 41.9055 | 42.9503 | 44.0166 | 30 | 8.1803 | 8.2786 | 8.3772 |
| -8 | 39.9693 | 40.9462 | 41.9428 | 31 | 7.8794 | 7.9770 | 8.0750 |
| -7 | 38.1351 | 39.0487 | 39.9801 | 32 | 7.5913 | 7.6882 | 7.7855 |
| -6 | 36.3970 | 37.2514 | 38.1219 | 33 | 7.3153 | 7.4114 | 7.5080 |
| -5 | 34.7494 | 35.5484 | 36.3621 | 34 | 7.0509 | 7.1461 | 7.2419 |
| -4 | 33.1869 | 33.9342 | 34.6949 | 35 | 6.7976 | 6.8919 | 6.9867 |
| -3 | 31.7047 | 32.4037 | 33.1148 | 36 | 6.5547 | 6.6480 | 6.7420 |
| -2 | 30.2982 | 30.9520 | 31.6167 | 37 | 6.3219 | 6.4142 | 6.5072 |

| T(℃) | RMin(KΩ) | RNor(KΩ) | RMax(KΩ) | T(℃) | RMin(KΩ) | RNor(KΩ) | RMax(KΩ) |
|---|---|---|---|---|---|---|---|
| 38 | 6.0986 | 6.1899 | 6.2818 | 82 | 1.5032 | 1.5469 | 1.5918 |
| 39 | 5.8845 | 5.9746 | 6.0655 | 83 | 1.4613 | 1.5043 | 1.5484 |
| 40 | 5.6790 | 5.7680 | 5.8578 | 84 | 1.4208 | 1.4630 | 1.5063 |
| 41 | 5.4818 | 5.5697 | 5.6584 | 85 | 1.3816 | 1.4231 | 1.4656 |
| 42 | 5.2926 | 5.3793 | 5.4669 | 86 | 1.3437 | 1.3844 | 1.4262 |
| 43 | 5.1109 | 5.1964 | 5.2829 | 87 | 1.3070 | 1.3470 | 1.3880 |
| 44 | 4.9364 | 5.0208 | 5.1060 | 88 | 1.2715 | 1.3107 | 1.3510 |
| 45 | 4.7688 | 4.8520 | 4.9361 | 89 | 1.2371 | 1.2756 | 1.3152 |
| 46 | 4.6079 | 4.6898 | 4.7727 | 90 | 1.2038 | 1.2416 | 1.2805 |
| 47 | 4.4532 | 4.5339 | 4.6156 | 91 | 1.1716 | 1.2087 | 1.2469 |
| 48 | 4.3045 | 4.3840 | 4.4645 | 92 | 1.1404 | 1.1768 | 1.2143 |
| 49 | 4.1616 | 4.2398 | 4.3191 | 93 | 1.1101 | 1.1459 | 1.1827 |
| 50 | 4.0242 | 4.1012 | 4.1793 | 94 | 1.0808 | 1.1159 | 1.1520 |
| 51 | 3.8920 | 3.9678 | 4.0447 | 95 | 1.0524 | 1.0868 | 1.1223 |
| 52 | 3.7649 | 3.8395 | 3.9152 | 96 | 1.0248 | 1.0587 | 1.0936 |
| 53 | 3.6426 | 3.7160 | 3.7905 | 97 | 0.9981 | 1.0314 | 1.0656 |
| 54 | 3.5249 | 3.5971 | 3.6704 | 98 | 0.9723 | 1.0049 | 1.0385 |
| 55 | 3.4116 | 3.4826 | 3.5547 | 99 | 0.9472 | 0.9792 | 1.0123 |
| 56 | 3.3025 | 3.3724 | 3.4433 | 100 | 0.9228 | 0.9543 | 0.9868 |
| 57 | 3.1975 | 3.2662 | 3.3360 | 101 | 0.8992 | 0.9302 | 0.9620 |
| 58 | 3.0964 | 3.1639 | 3.2325 | 102 | 0.8764 | 0.9067 | 0.9380 |
| 59 | 2.9990 | 3.0654 | 3.1328 | 103 | 0.8542 | 0.8840 | 0.9147 |
| 60 | 2.9052 | 2.9704 | 3.0367 | 104 | 0.8326 | 0.8619 | 0.8921 |
| 61 | 2.8148 | 2.8788 | 2.9440 | 105 | 0.8117 | 0.8405 | 0.8702 |
| 62 | 2.7276 | 2.7905 | 2.8547 | 106 | 0.7914 | 0.8197 | 0.8488 |
| 63 | 2.6436 | 2.7054 | 2.7684 | 107 | 0.7717 | 0.7995 | 0.8281 |
| 64 | 2.5626 | 2.6233 | 2.6853 | 108 | 0.7526 | 0.7799 | 0.8080 |
| 65 | 2.4845 | 2.5442 | 2.6050 | 109 | 0.7341 | 0.7608 | 0.7885 |
| 66 | 2.4091 | 2.4678 | 2.5276 | 110 | 0.7161 | 0.7423 | 0.7695 |
| 67 | 2.3365 | 2.3940 | 2.4528 | 111 | 0.6986 | 0.7244 | 0.7511 |
| 68 | 2.2663 | 2.3229 | 2.3806 | 112 | 0.6816 | 0.7069 | 0.7332 |
| 69 | 2.1987 | 2.2542 | 2.3109 | 113 | 0.6650 | 0.6900 | 0.7158 |
| 70 | 2.1334 | 2.1879 | 2.2436 | 114 | 0.6490 | 0.6735 | 0.6988 |
| 71 | 2.0703 | 2.1239 | 2.1786 | 115 | 0.6334 | 0.6575 | 0.6824 |
| 72 | 2.0094 | 2.0620 | 2.1158 | 116 | 0.6183 | 0.6419 | 0.6664 |
| 73 | 1.9506 | 2.0023 | 2.0551 | 117 | 0.6036 | 0.6268 | 0.6508 |
| 74 | 1.8938 | 1.9446 | 1.9964 | 118 | 0.5893 | 0.6121 | 0.6357 |
| 75 | 1.8390 | 1.8888 | 1.9397 | 119 | 0.5754 | 0.5978 | 0.6210 |
| 76 | 1.7860 | 1.8349 | 1.8849 | 120 | 0.5618 | 0.5839 | 0.6067 |
| 77 | 1.7348 | 1.7828 | 1.8319 | 121 | 0.5487 | 0.5703 | 0.5928 |
| 78 | 1.6853 | 1.7324 | 1.7807 | 122 | 0.5359 | 0.5572 | 0.5793 |
| 79 | 1.6374 | 1.6837 | 1.7311 | 123 | 0.5235 | 0.5444 | 0.5661 |
| 80 | 1.5912 | 1.6366 | 1.6831 | 124 | 0.5114 | 0.5319 | 0.5533 |
| 81 | 1.5464 | 1.5910 | 1.6367 | 125 | 0.4996 | 0.5198 | 0.5408 |