

KY-013 Temperature Sensor Module – Detailed Explanation

The **KY-013** is a **temperature sensor module** commonly used in Arduino and other microcontroller projects. It detects **ambient temperature** and provides an **analog output** that corresponds to the detected temperature. This module is based on a **thermistor**, a type of resistor whose resistance changes with temperature.

KY-013 Module Components

The KY-013 consists of two main components:

1. NTC Thermistor (Negative Temperature Coefficient)

- The thermistor is a resistor whose resistance decreases as temperature increases.
- It is the **main sensing element** of the module.
- The **resistance variation** is **non-linear** and follows the **Steinhart-Hart equation**.

2. Pull-up Resistor (Fixed 10kΩ)

- The KY-013 module includes a **fixed resistor** (usually 10kΩ) that forms a **voltage divider circuit** with the thermistor.
- This resistor helps to **convert the resistance change into a voltage change** that can be measured by a microcontroller.

How Does KY-013 Work?

The thermistor in the KY-013 works on the principle of **resistance change with temperature**:

1. At lower temperatures, the thermistor's resistance is **higher**.
2. At higher temperatures, the thermistor's resistance is **lower**.
3. The **voltage across the thermistor changes** based on its resistance.
4. This voltage is read by a **microcontroller's Analog-to-Digital Converter (ADC)**.
5. The ADC converts the voltage to a **digital value**, which can be processed to calculate the **temperature**.

KY-013 Technical Specifications

Specification	Details
Operating Voltage	3.3V - 5V
Temperature Range	-55°C to +125°C
Accuracy	±0.5°C
Resistance at 25°C	10kΩ
Thermistor Type	NTC (Negative Temperature Coefficient)
Output Type	Analog

How to Use KY-013?

To use the KY-013 with a **microcontroller** (like an Arduino):

1. **Connect the VCC pin to 3.3V or 5V** power.
2. **Connect the GND pin to ground.**
3. **Connect the signal pin (S)** to an **analog input pin (A0-A5)** on the microcontroller.
4. Use the **Steinhart-Hart equation** to convert the analog reading into temperature.

KY-013 vs. Other Temperature Sensors

Sensor	Type	Accuracy	Output	Temperature Range
KY-013 (NTC Thermistor)	Analog	±0.5°C	Voltage	-55°C to 125°C
DHT11	Digital	±2°C	Digital Signal	0°C to 50°C
DHT22	Digital	±0.5°C	Digital Signal	-40°C to 80°C
LM35	Analog	±0.5°C	Voltage (10mV/°C)	-55°C to 150°C

Advantages of KY-013

Cheap and easy to use
Small size and lightweight
Wide temperature range (-55°C to 125°C)
Works with both 3.3V and 5V systems

Limitations of KY-013

Analog output requires calibration
Non-linear response (requires the Steinhart-Hart equation)
Not as accurate as digital sensors like DHT22

Applications of KY-013

Weather monitoring – Measures environmental temperature
Home automation – Temperature-based controls (fans, AC, heaters)
Industrial systems – Monitors overheating of devices
Medical devices – Body temperature measurement
Smart agriculture – Soil and air temperature monitoring

Summary

The **KY-013 Temperature Sensor Module** is a simple **analog sensor** that detects temperature using an **NTC thermistor**. It provides an **analog voltage** that changes with temperature, which can be measured using a **microcontroller ADC**. While it is **low-cost and widely used**, it requires **calibration** and a **conversion equation** to obtain accurate temperature readings.