TMP235 Analog Temperature Sensor

DEVLAB FACTOR

Mfr. Part #: UE0101

Product Reference Manual (V1.0)

Description

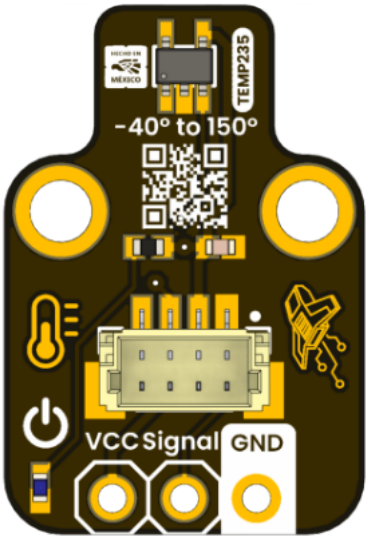
The **TMP235 Analog Temperature Sensor Module** is part of a precision CMOS linear temperature sensor family that provides an analog voltage directly proportional to temperature. Designed for simplicity and precision, this module offers a **typical accuracy of ±0.5°C** between 0°C and +70°C — surpassing most pin-compatible alternatives.

The TMP235 delivers a **positive slope output of 10 mV/°C** across its full operating range from **–40°C to +150°C**, with a supply voltage range of **2.3 V to 5.5 V**. Its low **9 µA quiescent current** and **800 µs power-on time** make it ideal for low-power and battery-operated systems. The **class-AB output driver** supports up to **500 µA** output current and can directly interface with ADC inputs or capacitive loads up to **1000 pF**.

With excellent linearity, low power use, and high reliability, the TMP235 is a **cost-effective alternative to thermistors** for analog temperature-sensing applications such as power management, motor control, and environmental monitoring.

DevLab format compatibility.

Simplicity and interoperability define the **DevLab form factor**. The module follows a **compact, communication-optimized PCB layout**, ensuring consistent electrical alignment and straightforward integration across the DevLab ecosystem. Its clearly labeled **JST 4-pin connector** allows easy connection to any controller with an analog input, supporting modular sensor expansion without additional wiring complexity.



Key Features

- **Wide Temperature Range:** –40°C to +150°C (TMP235)
- **High Accuracy:** ±0.5°C typical (0°C to +70°C)
- **Linear Analog Output:** 10 mV/°C scale factor
- **Low Power Consumption:** 9 µA typical quiescent current
- **Fast Response:** 800 µs typical power-on time
- **Wide Supply Range:** Operates from 2.3 V to 5.5 V
- **Direct ADC Interface:** Class-AB output driver up to 500 µA
- **High Capacitive Load Drive:** Supports up to 1000 pF
- **Compact and Reliable:** Fully solid-state CMOS design
- **Easy Integration:** JST 4-pin connector in DevLab format

Software Support

- **Arduino IDE**
- **Micro Python**

Applications

- Battery-powered temperature monitors
- Environmental and ambient temperature sensing
- Power supply and motor temperature supervision
- Analog control loops and compensation circuits
- Smart home and IoT sensor modules
- Consumer electronics and portable devices
- Educational and experimental analog systems

CONTENTS

Description 1
DevLab format compatibility. 1
Key Features 1
Software Support 2
Applications 2
1 The Board 3
1.1 Accessories 4
2 Ratings 4
2.1 Recommended Operating Conditions 4
3 Functional Overview 4
3.2 Board Topology 5
4 Connectors & Pinouts 7
4.1 General Pinout 7
4.2 Pinout General Description 8
5 Board Operation 9
6 Mechanical Information 10
7 Company Information 10
8 Reference Documentation 11

1 The Board

1.1 Accessories

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2 Ratings

2.1 Recommended Operating Conditions

Parameter	Description	Min	Typ	Max	Unit
Vcc	Input voltage to power on the module	**2.3**	**-**	**5.5**	**V**
Idd	Operating current	**-**	**9(Ta=25°C)**	**17 (Ta=150°C)**	**uA**
Tacy*	Temperature accuracy	**-2**	**±0.5**	**+2**	**°C**
V0℃	Output voltage offset at 0°C	**-**	**500**	**-**	**mV**
Tc	Temperature coefficient (sensor gain)	**-**	**10**	**-**	**mv/°C**
Iout	Output current	**-**	**-**	**500**	**uA**

3 Functional Overview

The TEMP235 Temperature Sensor Module provides a simple and reliable method for measuring ambient or surface temperature through a linear analog voltage output. The module is based on the TMP235 precision temperature sensor, which converts temperature directly into a proportional voltage signal, eliminating the need for digital communication protocols or complex configuration.

The sensor outputs a voltage with a fixed offset of 500 mV at 0 °C and a linear gain of 10 mV/°C, enabling straightforward temperature calculation using standard ADC inputs on microcontrollers. This linear behavior allows the module to be easily integrated into a wide range of systems, from low-power embedded devices to industrial monitoring platforms.

Analog Temperature Conversion Principle

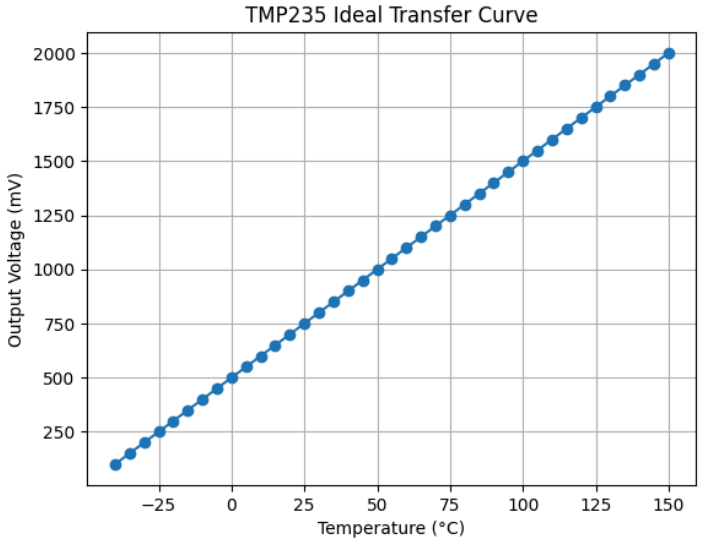
The TEMP235 operates by translating temperature changes into a continuous analog voltage:

- At 0 °C, the output voltage is approximately 500 mV
- For every 1 °C increase, the output rises by 10 mV
- The output range spans approximately 100 mV to 2000 mV, corresponding to –40 °C to +150 °C

This predictable transfer characteristic allows direct temperature calculation using the following relationship:

$$T(°C) = \frac{V_{OUT}(mV) - 500}{10}$$

Because the output is purely analog, the module can be connected to any ADC-capable input without protocol overhead, making it suitable for real-time monitoring and low-latency applications.



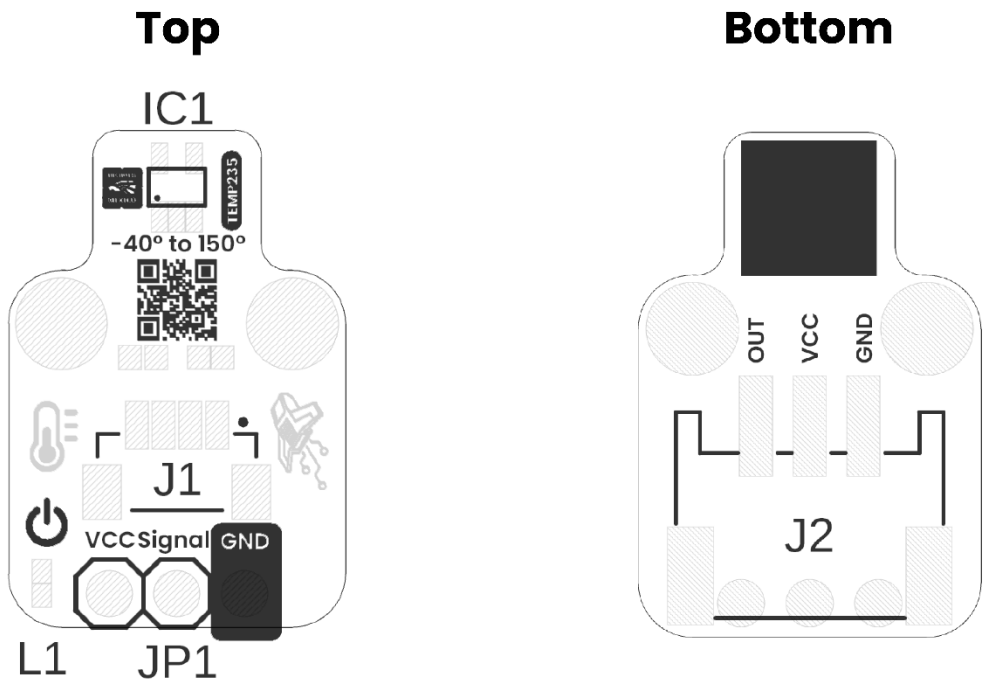
The figure illustrates the ideal transfer characteristic of the TMP235 temperature sensor. The output voltage increases linearly with temperature, featuring a 500 mV offset at 0 °C and a constant slope of 10 mV per degree Celsius across the full operating range.

System Integration

- The module is designed for plug-and-play integration in embedded systems:
- Wide supply range (2.3 V to 5.5 V) allows operation with both 3.3 V and 5 V logic systems.
- Low operating current makes it ideal for battery-powered and always-on applications.
- Multiple connector formats (JST 1 mm, JST 2 mm pads, and 2.54 mm header) provide flexible mechanical and electrical integration.

The output signal can be sampled by microcontrollers, data acquisition systems, or analog comparators, enabling both digital processing and analog threshold detection use cases.

3.2 Board Topology



Views of Board Topology

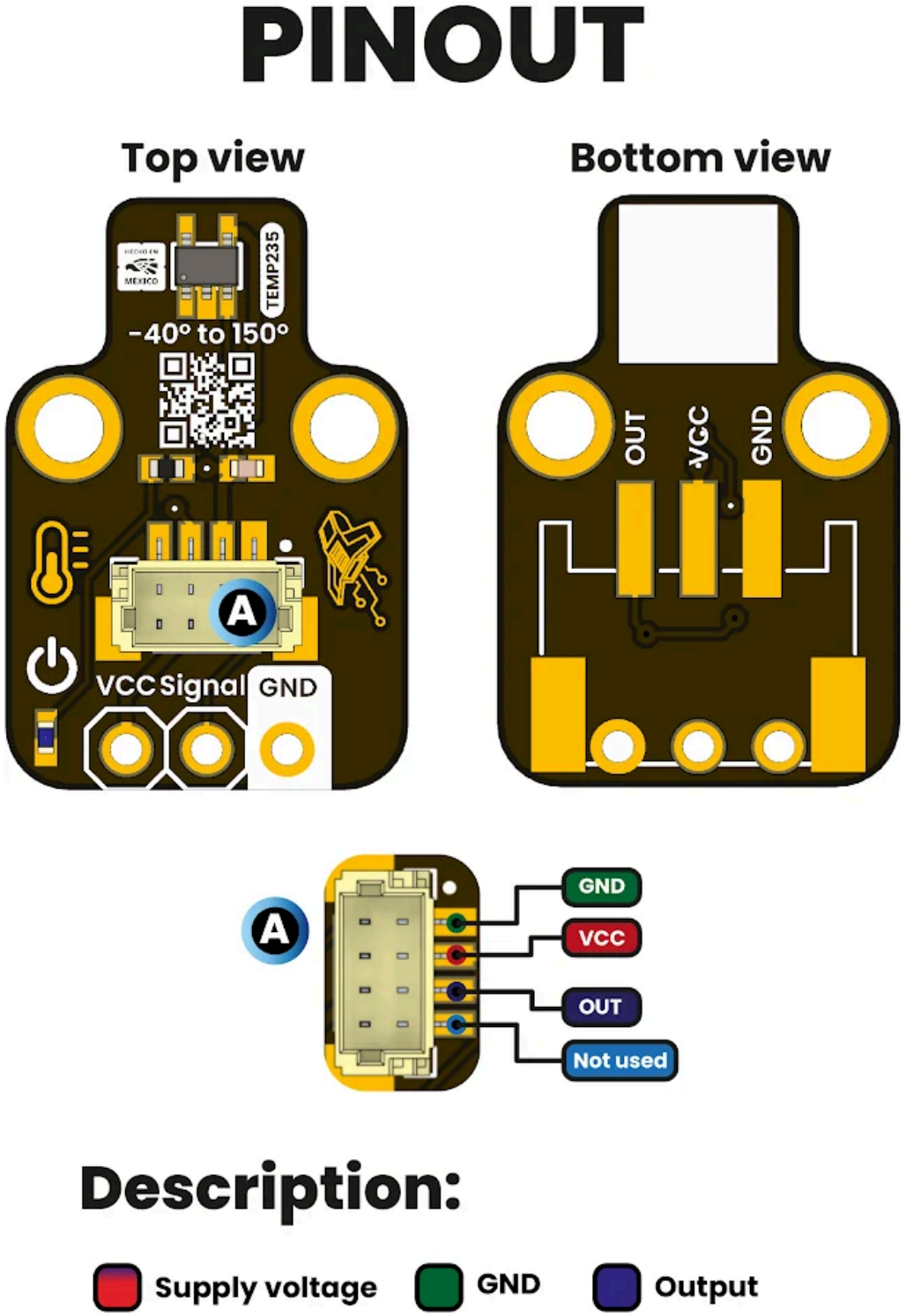
Views of Topology

Table 3.2.1 - Components Overview

Ref.	Description
IC1	TEMP235 Temperature Sensor
L1	Power On LED
JP1	2.54 mm Header
J1	JST 1 mm pitch for Input Signals
J2	JST 2 mm pitch (Pads) for Input Signals, Compatible with Gravity Connector

4 Connectors & Pinouts

4.1 General Pinout



General Pinout

4.2 Pinout General Description

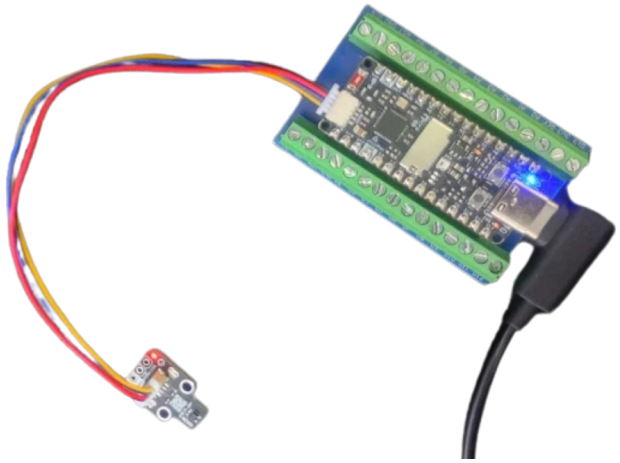
Pin Label	Description
VCC	Power supply (3.3V or 5V)
GND	Ground
OUT	Analog Output
-	No data

5 Board Operation

5.1 Getting Started with arduino IDE

The TMP235 Temperature Sensor Module can be easily evaluated using the **Arduino IDE** on the **Pulsar C6 (ESP32-C6)** platform. The provided Arduino example demonstrates how to acquire analog temperature data from the sensor and convert it into meaningful temperature values using the device's linear voltage output.

After installing the **ESP32 board support package** in the Arduino IDE and selecting the **Pulsar C6 / ESP32-C6** target, the example configures the ADC to operate at **12-bit resolution** with an attenuation suitable for the full 0–3.3 V range. This ensures accurate voltage sampling across the complete operating range of the TMP235.

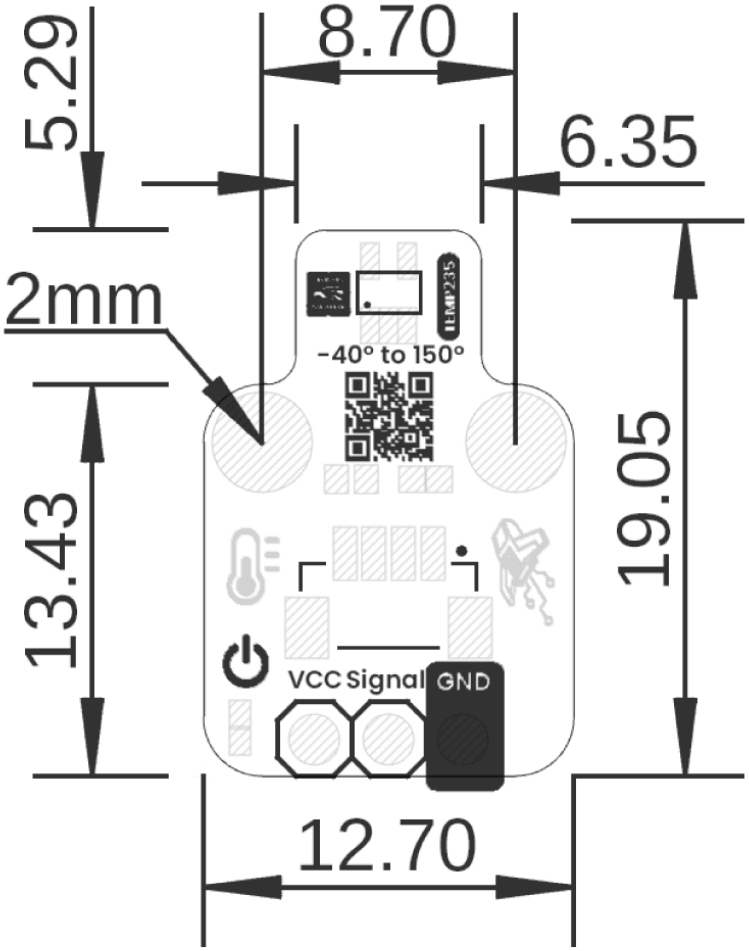


The example periodically reads the sensor output voltage from an ADC-capable GPIO, applies basic averaging to reduce noise, and converts the measured voltage into temperature using the sensor's defined transfer function (**500 mV offset at 0 °C and 10 mV/°C gain**). The resulting temperature values are displayed through the serial monitor, allowing real-time observation and validation of sensor behavior.

This reference implementation is intended as a **baseline example** that can be directly integrated into larger applications such as environmental monitoring, thermal supervision, or system health diagnostics, without requiring additional configuration or calibration steps.

```
#define TMP_PIN 6

float readTempC() {
 const int N = 20;
 long sum_mv = 0;

 for (int i = 0; i < N; i++) {
   sum_mv += analogReadMilliVolts(TMP_PIN);
   delay(5);
 }

 float v_mv = sum_mv / (float)N;

 // Tu curva: 0°C = 500mV, 10mV/°C
 float tempC = (v_mv - 500.0f) / 10.0f;
 return tempC;
}

void setup() {
 Serial.begin(115200);
 delay(500);

 analogReadResolution(12);
 analogSetAttenuation(ADC_11db);
}

void loop() {
 int raw = analogRead(TMP_PIN);
 int mv  = analogReadMilliVolts(TMP_PIN);
 float t = readTempC();

 Serial.print("Raw: "); Serial.print(raw);
 Serial.print(" | mV: "); Serial.print(mv);
 Serial.print(" | Temp: "); Serial.print(t, 2);
 Serial.println(" C");

 delay(1000);
}
```

6 Mechanical Information



Board Dimensions in Millimeters

Mechanical dimensions in millimeters

7 Company Information

Company name	UNIT Electronics
Company website	https://uelectronics.com/
Company Address	Salvador 19, Cuauhtémoc, 06000 Mexico City, CDMX

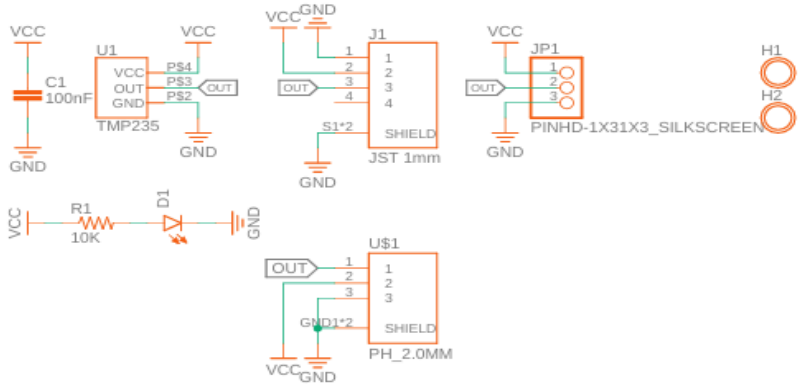
8 Reference Documentation

Ref	**Link**
Documentation	https://github.com/UNIT-Electronics-MX/unit_devlab_tmp235_analog_temperature_sensor
Wiki	https://wiki.uelectronics.com/wiki/devlab-tmp235-analog-temperature-sensor
Thonny IDE	https://thonny.org/
Arduino IDE	https://www.arduino.cc/en/software
Visual Studio Code	https://code.visualstudio.com/download
Uelectronics-ESP32 Arduino Package	https://github.com/UNIT-Electronics/Uelectronics-ESP32-Arduino-Package

9 Appendix

9.1 Schematic

(https://github.com/UNIT-Electronics-MX/unit_devlab_tmp235_analog_temperature_sensor/blob/main/hardware/unit_sch_v_1_0_0_ue0101_tmp235_temperature_sensor.pdf)



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	Author: Alberto Villanueva