



## THERMO 16 CLICK

PID: MIKROE-3662

Weight: 17 g

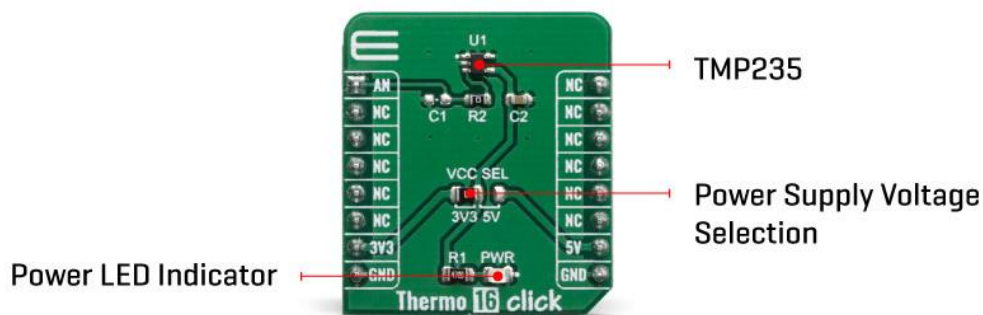
**Thermo 16 Click** is a Click board™ equipped with the sensor IC, which can measure temperature measurements between -40°C and +150°C so that the temperature measurement data can be processed by the host MCU. Thermo 16 click provides an accuracy of  $\pm 1^\circ\text{C}$  in the range from 0°C to 70°C. The sensor used on this Click board™ has a great combination of features that make it a perfect choice for any temperature measurement application: Analog signal output, low power consumption, compact sensor size, and more. The sensor itself requires almost no external components, which simplifies the design, reducing the cost and cutting the time to market.

Thermo 16 click click is supported by a mikroSDK compliant library, which includes functions that simplify software development. This Click board™ comes as a fully tested product, ready to be used on a system equipped with the mikroBUS™ socket

The Click board™ is specially designed so it retains the specified characteristics of the sensor IC. Equipped with this sophisticated, accurate and simple to use sensor IC, it can be used for measuring and monitoring the temperature in a whole range of applications, such as the PC case and other internal components temperature monitoring, office equipment, automotive infotainment and entertainment systems thermal monitoring, general purpose thermal measurement, and similar digital thermal measurement applications, that require a precise thermal measurement.

## HOW DOES IT WORK?

The active temperature sensing component on Thermo 16 click is the TMP235, a high accuracy temperature sensor IC Texas Instruments. The Click board™ itself has a reasonably small number of components because most of the measurement circuitry is already integrated on the TMP235 sensor. This sensor has many features that make it a perfect solution for small designs such as the Ambient 7 Click board™, and one of these features is certainly its high level of integration.



The TMP23X devices are a family of precision CMOS integrated-circuit linear analog temperature sensors with an output voltage proportional to temperature engineers can use in multiple analog temperature sensing applications. The TMP235 temperature sensor have an accuracy from 0°C to 70°C of  $\pm 1.25^\circ\text{C}$  and provides a positive slope output of 10 mV/°C over the full  $-40^\circ\text{C}$  to  $+150^\circ\text{C}$  temperature range.

It is worth to mention that the TMP235 has extremely low power consumption - 9  $\mu\text{A}$  (Typical). This makes Thermo 16 click a perfect solution for the development of the IoT, wearable and portable applications, logging devices, industrial and health-related time metering applications, and all the other applications that require an accurate temperature measurement for their operation.

An analog signal from the thermal sensor, from Vout pin is routed to the AN pin of the mikroBUS™ socket. On the path from the sensor to the mikroBUS™ socket, R2 and C1 are forming the RC filter. R2 is 0 ohm by default, but the user can increase the resistance in order to find a perfect match for desired purpose. Note that higher

resistance may help filter any noise in signal, but may also increase the sensor response time, so when tuning the RC filter, it is crucial to find the ideal balance between these two.


The TMP235 operates at power supply range from 2.3 V to 5.5 V. Thus, Thermo 16 click has the power supply selection jumper onboard, named VCC SEL. That way, the user can switch between 3.3V and 5V for sensor power supply.

## SPECIFICATIONS

<b>Type</b>	Temperature & humidity
<b>Applications</b>	PC case and other internal components temperature monitoring, office equipment, automotive infotainment and entertainment systems thermal monitoring, general purpose thermal measurement, and similar
<b>On-board modules</b>	TMP235, High-Accuracy Analog Output Temperature Sensors
<b>Key Features</b>	Analog signal output, low power consumption, compact sensor size
<b>Interface</b>	Analog
<b>Click board size</b>	S (28.6 x 25.4 mm)
<b>Input Voltage</b>	3.3V or 5V

## PINOUT DIAGRAM

This table shows how the pinout on Thermo 16 click corresponds to the pinout on the mikroBUS™ socket (the latter shown in the two middle columns).

Notes	Pin		Pin	Notes

Analog signal output	<b>AN</b>	1	AN	PWM	16	NC	
	NC	2	RST	INT	15	NC	
	NC	3	CS	RX	14	NC	
	NC	4	SCK	TX	13	NC	
	NC	5	MISO	SCL	12	NC	
	NC	6	MOSI	SDA	11	NC	
Power Supply	<b>3.3V</b>	7	3.3V	5V	10	<b>5V</b>	Power Supply
Ground	<b>GND</b>	8	GND	GND	9	<b>GND</b>	Ground

## ONBOARD SETTINGS AND INDICATORS

Label	Name	Default	Description
JP1	VCC SEL	Left	Power supply voltage selection: left position 3V3, right position 5V
LD1	PWR	-	Power LED indicator

## THERMO 16 CLICK MAXIMUM RATINGS

Description	Min	Typ	Max	Unit
Temperature Range (accuracy $\pm 1^{\circ}\text{C}$ )	0	-	70	$^{\circ}\text{C}$

Temperature Range (accuracy $\pm 2^{\circ}\text{C}$ )	-40	-	+150	$^{\circ}\text{C}$
Supply voltage	2.3	-	5.5	V
Operating current	-	-	17	$\mu\text{A}$

## SOFTWARE SUPPORT

We provide a library for the Thermo 16 Click on our LibStock page, as well as a demo application (example), developed using MikroElektronika compilers. The demo can run on all the main MikroElektronika development boards.

### Library Description

The library includes function for read Temperature data and function for system(board) configuration. The user also has the function for ADC init and read ADC data.

Key functions:

- `float thermo16_getTemperature(uint32_t adcValue, uint8_t tempIn)` - Get Temperature data.
- `void thermo16_systemConfig(T_THERMO16_SYS_CONFIG *config)` - System (board) config.
- `uint32_t thermo16_adcRead()` - Get ADC data.

### Examples description

The application is composed of three sections :

- System Initialization - Sets AN pin as INPUT.
- Application Initialization - Initializes GPIO driver init, system configuration and ADC init.
- Application Task - Reads the ADC value and converts ADC data to the Temperature data. This temp data logs on the USBUART every 1500ms.

```
void applicationTask()
{
    uint32_t ADC_value;
    float Temperature;
    char demoText[ 50 ];

    ADC_value = thermo16_adcRead();
```

```
Temperature = thermo16_getTemperature(ADC_value, _THERMO16_TEMP_IN_CELSIUS);

FloatToStr(Temperature, demoText);
mikrobus_logWrite(" Temperature: ", _LOG_TEXT);
mikrobus_logWrite(demoText, _LOG_LINE);

mikrobus_logWrite( " ----- ", _LOG_LINE);
Delay_ms( 1500 );
}
```

The full application code, and ready to use projects can be found on our LibStock page.

Other mikroE Libraries used in the example:

- ADC
- UART
- Conversions

### **Additional notes and informations**

Depending on the development board you are using, you may need USB UART click, USB UART 2 click or RS232 click to connect to your PC, for development systems with no UART to USB interface available on the board. The terminal available in all MikroElektronika compilers, or any other terminal application of your choice, can be used to read the message.

## **MIKROSDK**

This Click board™ is supported with mikroSDK - MikroElektronika Software Development Kit. To ensure proper operation of mikroSDK compliant Click board™ demo applications, mikroSDK should be downloaded from the LibStock and installed for the compiler you are using.

For more information about mikroSDK, visit the official page.

## RESOURCES

mikroBUS™ Standard specification

LibStock: mikroSDK

Click board catalog

## DOWNLOAD

Thermo 16 click example on Libstock

Thermo 16 click schematic

Thermo 16 click 2D and 3D files

TMP235 datasheet

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<https://www.mikroe.com/thermo-16-click/7-29-19>