IR Thermometry Module

BMH06203

Revision: V1.00 Date: July 06, 2023

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Table of Contents

Features

- Operating voltage: 2.6V~5.5V
- Operating current: 1.5mA @ 3.3V
- Standby current: <3μA
- Measurement parameters:
  - Resolution: 0.1°C
  - Measurement range: 0~100°C
  - Accuracy: ±0.2 (32~43°C); ±0.3 (30~45°C); ±1 (0~100°C)
- Field of View – FOV: 108°
- Operating modes: I²C Mode (default), PWM Mode, I/O Mode
- Factory-calibrated, saving the cost of calibration equipment
- Module size: 18.3mm×10mm×8.8mm

General Description

The BMH06203 is an IR thermometry module. The module uses a 24-bit Delta Sigma A/D converter chip and an infrared thermopile sensor to implement the temperature reading function. The temperature measurement range is 0~100°C, which has been calibrated before delivery. The module can implement the mode operating setting, ambient temperature reading and other functions using the I²C communication mode or the PWM mode. It can also output a high or low level via the IO pin by setting a threshold. The module is suitable for use in infrared thermometers (ear thermometers and forehead thermometers), industrial thermometers, electric ovens, induction cookers and other products.

Applications

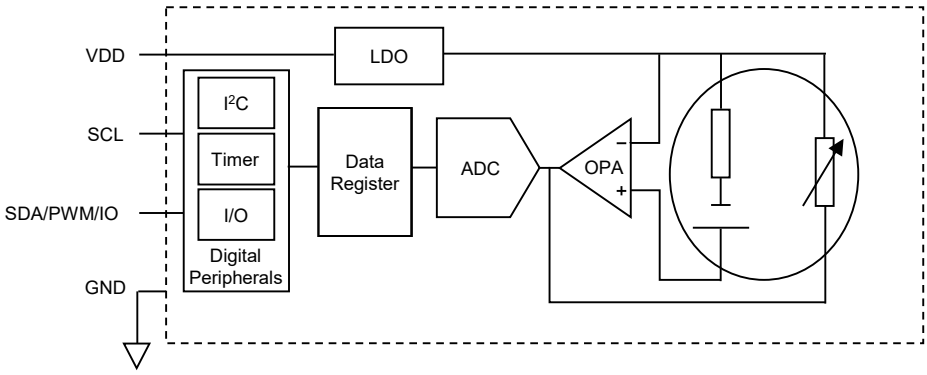
- Home appliances
- HVAC/R products such as for heating, ventilation and air conditioning/refrigeration
- Environmental sensing products
- IoT devices
- Industrial equipment

Selection Table

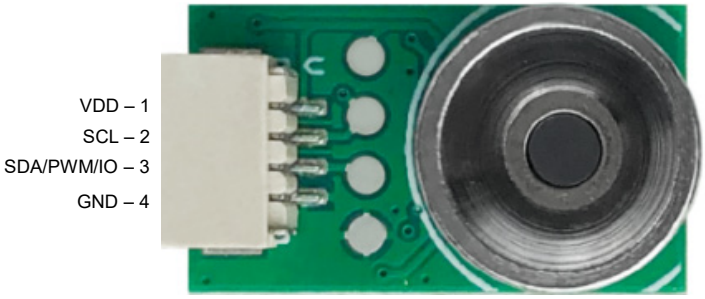
Part No.	Performance				Interface
	Range	FOV	Resolution	Accuracy	
BMH06203-11	0~100°C	36°	0.1°C	Blackbody temperature 32~43°C: measurement error=±0.2°C Blackbody temperature 30~45°C: measurement error=±0.3°C Blackbody temperature 0~100°C: measurement error=±1°C	I²C PWM_OUTPUT IO_OUTPUT
BMH06203-31		36°			
BMH06203-21		108°			
BMH06203-41		108°			
BMH06203-12	-40~300°C	36°		Blackbody temperature -40~300°C: ±1 or ±1%	
BMH06203-32		36°			
BMH06203-22		108°			
BMH06203-42		108°			

* Products are available from Best Modules

Block Diagram



Pin Assignment



Pin Description

Pin	Function	Operating Mode	Type	Description
1	VDD	I²C, PWM, I/O	PWR	Positive power supply
2	SCL	I²C	I	I²C clock line
3	SDA	I²C	I/O	I²C data line
	PWM	PWM	O	PWM output pin
	IO	IO	O	IO output pin
4	GND	I²C, PWM, I/O	PWR	Negative power supply, ground

Legend: PWR: Power; I: Digital input; O: Digital output

Technical Specifications

Absolute Maximum Ratings

Supply Voltage ..... 2.6V to 5.5V

Storage Temperature..... -30℃ to 80℃

Operating (Ambient) Temperature ..... 10℃ to 40℃

Operating (Ambient) Humidity..... 30% to 70% RH

Total Power Dissipation 12mW

Recommended Operating Conditions

- Operating (Ambient) Temperature: 10℃ to 40℃
- Measurement method: place the sensor probe close to the measured part
- Proximity distance: <5cm

D.C. Electrical Characteristics

Ta=25°C, V_{DD}=3.3V

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_{DD}	Operating Voltage	—	2.6	—	5.5	V
Ta	Operating Temperature	—	10	—	40	°C
I_{DD}	Operating Current	—	—	1.5	2.4	mA
	Sleep Current	—	—	1	3	μA

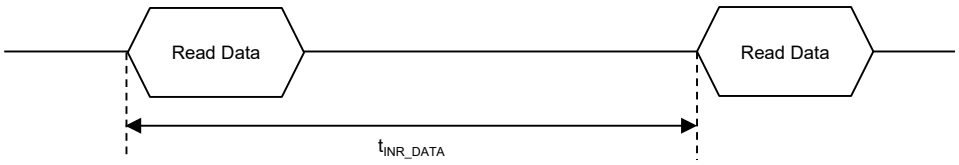
A.C. Electrical Characteristics

System Timing

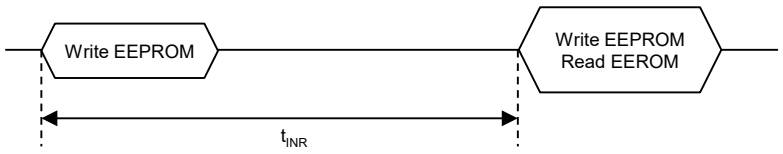
Ta=25°C, V_{DD}=3.3V

Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Unit
		V_{DD}	Conditions				
V_{IL}	Input Low Voltage	5V	—	0	—	1.0	V
		V_{DD}	—	0	—	$0.2V_{DD}$	
$_{VI}H$	Input High Voltage	5V	—	3.5	—	5.0	V
		V_{DD}	—	$0.7V_{DD}$	—	V_{DD}	
t_{PU}	Power-up Time	—	—	—	—	18	ms
$t_{INR-DATA}$	Interval Time between Two Data Reads	—	—	—	1.0	—	s
t_{INR}	Interval Time between Consecutive EEPROM Write Instructions	—	—	—	10	—	ms
	Interval Time between EEPROM Write and Read Instructions						

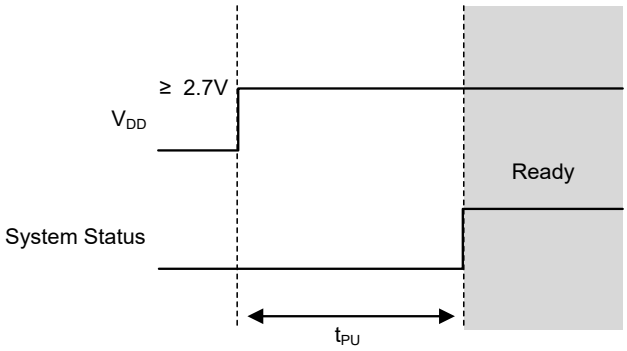
Interval time between temperature data reads:



Interval time between EEPROM operations:



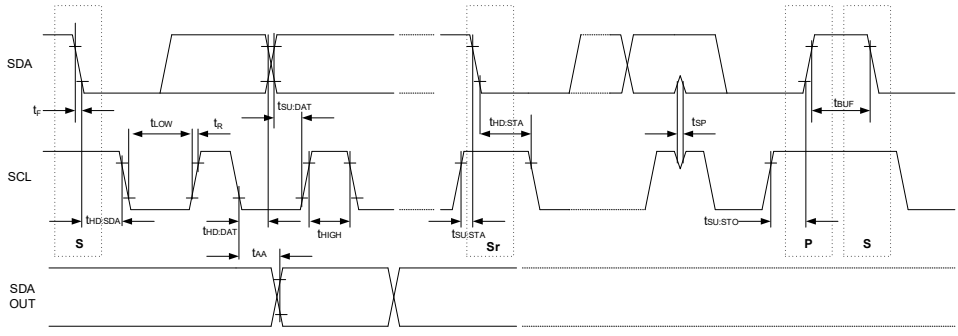
Power-up timg:



I²C Interface

Ta=25°C, V_{DD}=5V

Symbol	Parameter	Test Conditions	Standard Mode		Fast Mode		Unit
			Min.	Max.	Min.	Max.	
f_{SCL}	Clock frequency	—	—	100	—	400	kHz
t_{BUF}	Bus Free Time	Time in which the bus must be free before a new transmission can start	4.7	—	1.3	—	μs
$t_{HD:STA}$	START Condition Hold Time	After this period, the first clock pulse is generated	4.0	—	0.6	—	μs
t_{LOW}	SCL Low Time	—	4.7	—	1.3	—	μs
t_{HIGH}	SCL High Time	—	4.0	—	0.6	—	μs
$t_{SU:STA}$	START Condition Setup Time	Only relevant for repeated START condition	4.7	—	0.6	—	μs
$t_{HD:DAT}$	Data Hold Time	—	0	—	0	—	ns
$t_{SU:DAT}$	Data Setup Time	—	250	—	100	—	ns
t_R	SDA and SCL Rise Time	—	—	1.0	—	0.3	μs
t_F	SDA and SCL Fall Time	—	—	0.3	—	0.3	μs
$t_{SU:STO}$	STOP Condition Setup Time	—	4.0	—	0.6	—	μs
t_{AA}	Output Valid from SCL Low	—	—	3.5	—	0.9	μs
t_{SP}	Input Filter Time Constant (SDA and SCL Pins)	Noise suppression time	—	100	—	50	ns



I²C Timing

Sensor Characteristics

Ta=25°C, V_{DD}=5V

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
FOV	Field of View	—	—	—	108	°
	Resolution	—	—	0.1	—	°C
	Sensing range	—	0	°C	100	°C
	Accuracy	Blackbody temperature 32~43°C	—	±0.2°C	—	°C
		Blackbody temperature 32~43°C	—	±0.3°C	—	°C
		Blackbody temperature 0~100°C	—	±1°C	—	°C

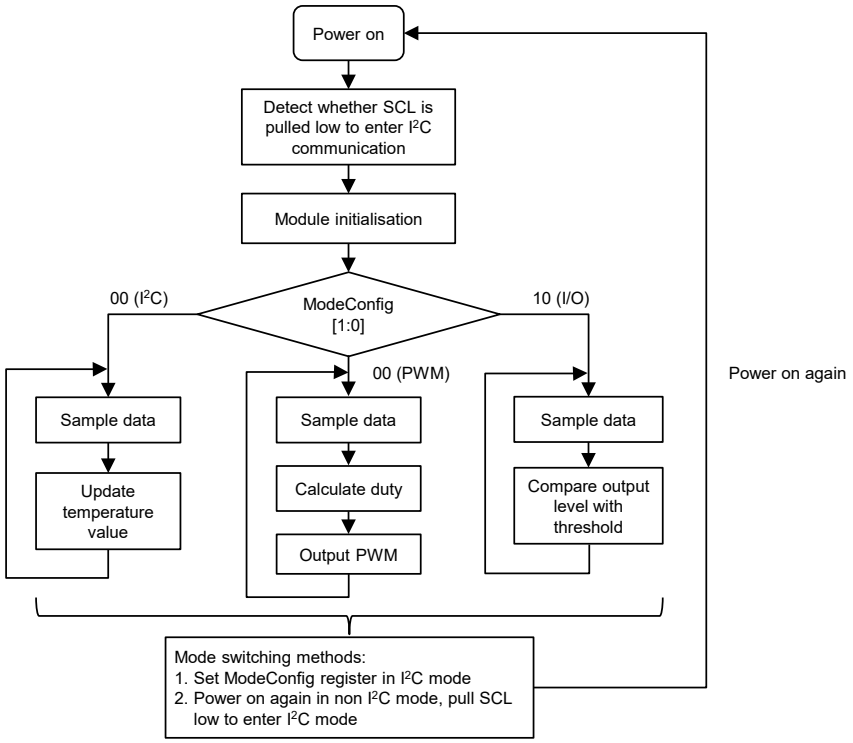
Functional Description

System Description

The BMH06203 is an infrared thermometry sensor. The main sensor is an infrared thermopile sensor. In having a Holtek 24-bit A/D converter chip which is specially designed for high accuracy infrared sensor applications, a measurement resolution of 0.01°C can be achieved.

Operaton Flow

The module has three operating modes, known as I²C Mode, PWM Mode and I/O Mode. After the system is powered on, it detects whether the SCL is pulled low for 50ms to enter the I²C mode. If the I²C mode is not entered, enter either the PWM, I/O or I²C mode according to the EEPROM configuration. In the I²C mode, the module temperature can be obtained, and the EEPROM parameters can also be configured. In the PWM mode, the output duty can be used to indicate the measured temperature. In the I/O mode, the module can output a high or low level which is determined by the measured temperature and temperature threshold. The module operation flow chart is shown below:



Sleep Mode

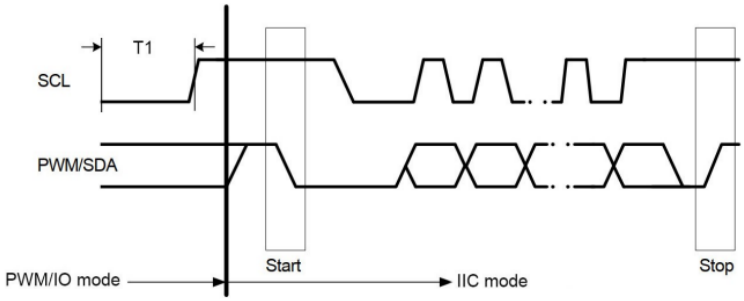
The Sleep function is available only in the I²C mode. To reduce the system power consumption, the system enters the Sleep mode immediately after receiving the I²C Sleep command and it is woken up when receiving any I²C communication instruction during Sleep.

Interface

The module uses the SH1.0-4P interface.

The module supports the I²C, PWM and I/O operating modes. After power-on, if the module SCL pin detects a low level for more than 50ms, it will enter the I²C mode. Otherwise enter the operating mode selected by the last configuration mode instruction. In the I²C mode, data write and read instructions can be executed.

The following diagram shows the I²C detection timing after power-on:



I²C Mode

Slave Addressing

- I²C address: 0x28

  I²C address format:

MSB LSB

A6	A5	A4	A3	A2	A1	A0	R/W
0	1	0	1	0	0	0	

Slave address (0x28)

Note: R/W=1: Read
=0: Write

Communication Protocol

There are two instruction frame formats, known as data write instruction frame and data read instruction frame.

Data write instruction frame format:

Start	Addr+W	CMD	Data	CheckSum	Stop
1-bit	1-byte	1-byte	N-byte	1-byte	1-bit

Frame content introduction:

- Start: Start bit signal
- Addr+W: I²C address write
- CMD: Command code, each command code corresponds to a different function

- Data: Data
- CheckSum: CheckSum=(CMD+Data) & 0xff
- Stop: Stop bit signal

Data read instruction frame format:

Start	Addr+W	CMD	Start	Addr+R	Data	CheckSum	Stop
1-bit	1-byte	1-byte	1-bit	1-byte	2-byte	1-byte	1-bit

Frame content introduction:

- Addr+R: I^2C address read

Data Write Instruction Set

No.	Functional Description	CMD	Data	Note
1	Mode configuration	0x28	D_2D_1: Mode configuration bit1~bit0: Set the operating mode 00: I^2C Mode 01: PWM Mode 10: IO_Mode 11: Reserved bit2: Set the IO output pin level status (for I/O mode) bit2=0: ≥temperature threshold, output low <temperature threshold, output high bit2=1: ≥temperature threshold, output high <temperature threshold, output low	
2	Set the emissivity	0x29	D_2D_1: Emissivity parameter Emissivity=Emissivity parameter÷100×100% (1%≤Emissivity≤100%)	
3	Set the minimum temperature for PWM mode	0x2A	D_2D_1: Minimum temperature parameter Minimum temperature=Minimum temperature parameter×0.1, unit: °C	
4	Set the maximum temperature for PWM mode	0x2B	D_2D_1: Maximum temperature parameter Maximum temperature=Maximum temperature parameter×0.1, unit: °C	
5	Set the temperature threshold for I/O mode	0x2C	D_2D_1: Temperature threshold parameter Temperature threshold=Temperature threshold parameter×0.1, unit: °C	
6	Set the module to enter the Sleep mode	0xff	D_1: 0x34 D_2: 0x12	

Note: #1~5 functions are implemented by writing EEPROM, which takes 10ms. During this time, the EEPROM read or write operation cannot be executed.

Data Read Instruction Set

No.	Functional Description	CMD	Response Data	Note
1	Read the version	0x3F	D_2D_1: Version For example, D_2=1, D_1=0, the version is V1.0	
2	Obtain the ambient temperature	0x08	D_2D_1: Ambient temperature parameter Ambient temperature=Ambient temperature parameter×0.1, unit: °C	
3	Obtain the object surface temperature	0x09	D_2D_1: Object surface temperature parameter Object surface temperature=Object surface temperature parameter×0.1, unit: °C	
4	Obtain the body temperature	0x0A	D_2D_1: Body temperature parameter Body temperature=Body temperature parameter×0.1, unit: °C	

PWM Mode

- Set to PWM mode using the I^2C, and then switch to PWM output mode after power-on again
- The PWM pin will output a square wave with a frequency of 60Hz and a duty that varies according to the minimum temperature parameter, maximum temperature parameter and measured temperature parameter. Users can calculate the measured temperature according to the duty
- Measured temperature:
  Measured temperature parameter=(output PWM duty×(maximum temperature parameter-minimum temperature parameter))+minimum temperature parameter
  Eg. Set the maximum temperature parameter to 1000 (100.0°C) and the minimum temperature parameter to 100 (10.0°C). When the measured output PWM duty is 28%, the measured temperature parameter=(0.28×(1000-100))+100=352 (35.2°C)

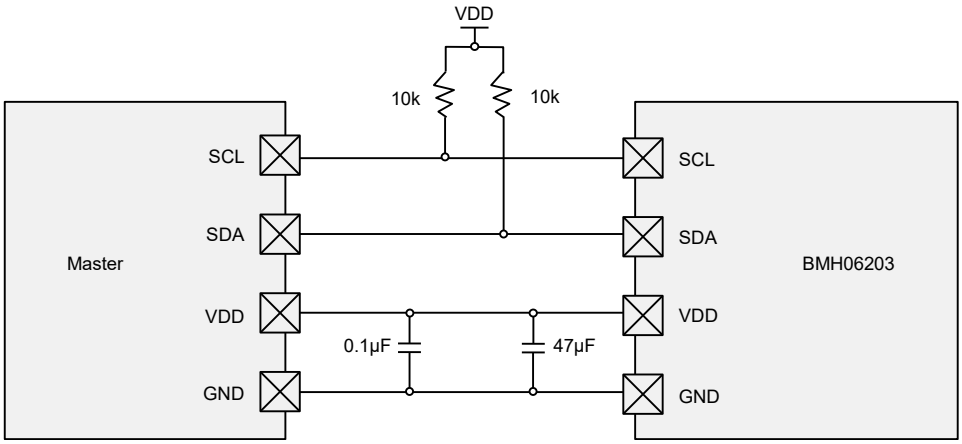
I/O Mode

- Set to I/O mode using the I^2C, and then enter the I/O mode after power-on again
- IO pin will output a high or low level determined by the result of comparing the measured temperature with the temperature threshold

Level Status Setting	IO Output Pin	
Measured Temperature	Bit2=0	Bit2=1
≥temperature threshold	Low	High
<temperature threshold	High	Low

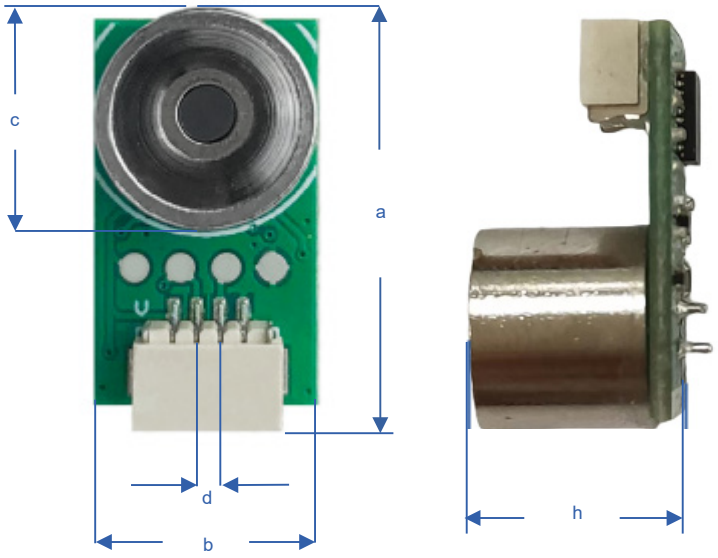
Note: Bit2 in the table is the bit2 parameter configured in the “Mode configuration” instruction (CMD=0x28). This parameter can set the I/O output pin level status. Refer to the Data Write Instruction Set for details.

Application Circuits



Note: If higher accuracy and anti-interference capability are required, it is recommended to keep 0.1μF and 47μF capacitors. If the cost is a main concern, the 47μF capacitor can be omitted.

Dimensions



Symbol \ Unit	mm	inch
a	18.3	0.72
b	10.0	0.39
c	9.00	0.35
d	1.0	0.04
h	8.8	0.35

Reference Information

Revision History

Data	Author	Issue	Modification Information
2023.03.30	—	V1.00	First Version

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